MODEL 354N

UNIVERSAL LOOP CONTROLLER
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>SECTION AND TITLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREFACE</td>
<td>x</td>
</tr>
<tr>
<td><strong>1.0 INTRODUCTION</strong></td>
<td>1-1</td>
</tr>
<tr>
<td>1.1 PRODUCT DESCRIPTION</td>
<td>1-1</td>
</tr>
<tr>
<td>1.2 FUNCTION BLOCKS</td>
<td>1-3</td>
</tr>
<tr>
<td>1.2.1 LOOP Function Block Types</td>
<td>1-4</td>
</tr>
<tr>
<td>1.2.2 Power Up Initialization</td>
<td>1-5</td>
</tr>
<tr>
<td>1.2.3 Configuration</td>
<td>1-5</td>
</tr>
<tr>
<td>1.3 PRODUCT SUPPORT</td>
<td>1-5</td>
</tr>
<tr>
<td>1.4 EQUIPMENT DELIVERY AND HANDLING</td>
<td>1-7</td>
</tr>
<tr>
<td>1.4.1 Factory Shipment</td>
<td>1-7</td>
</tr>
<tr>
<td>1.4.2 Receipt of Shipment</td>
<td>1-7</td>
</tr>
<tr>
<td>1.4.3 Storage</td>
<td>1-7</td>
</tr>
<tr>
<td>1.4.4 Typical Shipment Contents</td>
<td>1-7</td>
</tr>
<tr>
<td><strong>2.0 CONFIGURATION OVERVIEW</strong></td>
<td>2-1</td>
</tr>
<tr>
<td>2.1 STATION FUNCTION BLOCKS</td>
<td>2-1</td>
</tr>
<tr>
<td>2.2 STATION HARDWARE I/O BLOCKS</td>
<td>2-1</td>
</tr>
<tr>
<td>2.3 LOOP FUNCTION BLOCKS</td>
<td>2-1</td>
</tr>
<tr>
<td>2.4 LIL GLOBAL DATA I/O FUNCTION BLOCKS</td>
<td>2-2</td>
</tr>
<tr>
<td>2.5 ETHERNET DATA I/O FUNCTION BLOCKS</td>
<td>2-3</td>
</tr>
<tr>
<td>2.6 LonWorks REMOTE I/O FUNCTION BLOCKS</td>
<td>2-3</td>
</tr>
<tr>
<td>2.7 CONFIGURATION PROCEDURE</td>
<td>2-3</td>
</tr>
<tr>
<td>2.8 OPERATION DURING LOCAL ON-LINE CONFIGURATION</td>
<td>2-5</td>
</tr>
<tr>
<td><strong>3.0 FUNCTION BLOCKS</strong></td>
<td>3-1</td>
</tr>
<tr>
<td>3.1 STATION FUNCTION BLOCKS</td>
<td>3-3</td>
</tr>
<tr>
<td>3.1.1 FCO LIB - Factory Configuration Library</td>
<td>3-3</td>
</tr>
<tr>
<td>3.1.2 SECUR - Security</td>
<td>3-3</td>
</tr>
<tr>
<td>3.1.3 STATN - Station Parameters</td>
<td>3-5</td>
</tr>
<tr>
<td>3.1.4 CLOCK - Real Time Clock (V2.0/2.2)</td>
<td>3-7</td>
</tr>
<tr>
<td>3.1.5 ETHERNET - Ethernet Communication Network (V2.4)</td>
<td>3-7</td>
</tr>
<tr>
<td>3.2 I/O AND LOOP FUNCTION BLOCKS</td>
<td>3-8</td>
</tr>
<tr>
<td>3.2.1 A/M - A/M Transfer</td>
<td>3-8</td>
</tr>
<tr>
<td>3.2.2 ACS - ARCCOSINE</td>
<td>3-10</td>
</tr>
<tr>
<td>3.2.3 ADD_ - Addition</td>
<td>3-10</td>
</tr>
<tr>
<td>3.2.4 AG3 - AGA 3 Orifice Metering of Natural Gas</td>
<td>3-11</td>
</tr>
<tr>
<td>3.2.5 AG7 - AGA 7 Measurement of Gas by Turbine Meters</td>
<td>3-13</td>
</tr>
<tr>
<td>3.2.6 AG8 - AGA 8 Compressibility Factors of Natural Gas</td>
<td>3-14</td>
</tr>
<tr>
<td>3.2.7 AIE_ - Analog Input - Ethernet (V2.4)</td>
<td>3-15</td>
</tr>
<tr>
<td>3.2.8 AIL_ - Analog Input - LIL</td>
<td>3-16</td>
</tr>
<tr>
<td>3.2.9 AIN_ - Analog Inputs</td>
<td>3-17</td>
</tr>
<tr>
<td>3.2.10 AINU_ - Analog Inputs, Universal</td>
<td>3-18</td>
</tr>
<tr>
<td>3.2.11 AIP_ - Analog Input lev_Percent</td>
<td>3-20</td>
</tr>
<tr>
<td>3.2.12 ALARM - Alarm</td>
<td>3-21</td>
</tr>
<tr>
<td>3.2.13 AND_ - AND Logic</td>
<td>3-23</td>
</tr>
<tr>
<td>3.2.14 AOE_ - Analog Output- Ethernet (V2.4)</td>
<td>3-24</td>
</tr>
<tr>
<td>3.2.15 AOL_ - Analog Output - LIL</td>
<td>3-24</td>
</tr>
<tr>
<td>3.2.16 AOP_ - Analog Output lev_Percent</td>
<td>3-25</td>
</tr>
<tr>
<td>Page</td>
<td>Description</td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
</tr>
<tr>
<td>3-26</td>
<td>AOUT_ - Analog Outputs</td>
</tr>
<tr>
<td>3-27</td>
<td>ASN_ - ARCSINE</td>
</tr>
<tr>
<td>3-27</td>
<td>ATD_ - Analog Trend Display</td>
</tr>
<tr>
<td>3-28</td>
<td>ATN_ - ARCTANGENT</td>
</tr>
<tr>
<td>3-29</td>
<td>BATOT - Batch Totalizer</td>
</tr>
<tr>
<td>3-31</td>
<td>BATSW - Batch Switch</td>
</tr>
<tr>
<td>3-32</td>
<td>BIAS - Bias</td>
</tr>
<tr>
<td>3-33</td>
<td>CIE_ - Coil Inputs - Ethernet (V2.4)</td>
</tr>
<tr>
<td>3-33</td>
<td>CHR_ - Characterizer</td>
</tr>
<tr>
<td>3-34</td>
<td>CMP_ - Comparator</td>
</tr>
<tr>
<td>3-34</td>
<td>COS_ - COSINE</td>
</tr>
<tr>
<td>3-35</td>
<td>DAM_ - Deviation Amplifier</td>
</tr>
<tr>
<td>3-36</td>
<td>DID_ - Digital Input lev _Discrete</td>
</tr>
<tr>
<td>3-37</td>
<td>DIE_ - Digital Input - Ethernet (V2.4)</td>
</tr>
<tr>
<td>3-37</td>
<td>DIL_ - Discrete Input _ LIL</td>
</tr>
<tr>
<td>3-37</td>
<td>DIN_ - Digital Inputs</td>
</tr>
<tr>
<td>3-39</td>
<td>DINU_ - Digital Inputs, Universal</td>
</tr>
<tr>
<td>3-40</td>
<td>DIS_ - Digital Input _ State</td>
</tr>
<tr>
<td>3-41</td>
<td>DIV_ - Division</td>
</tr>
<tr>
<td>3-41</td>
<td>DNC_ - Divide by N Counter</td>
</tr>
<tr>
<td>3-42</td>
<td>DOD_ - Digital Output lev _Discrete</td>
</tr>
<tr>
<td>3-43</td>
<td>DOE_ - Digital Output - Ethernet (V2.4)</td>
</tr>
<tr>
<td>3-43</td>
<td>DOL_ - Discrete Output - LIL</td>
</tr>
<tr>
<td>3-44</td>
<td>DOS__ - Digital Output State</td>
</tr>
<tr>
<td>3-45</td>
<td>DOUT_ - Digital Outputs</td>
</tr>
<tr>
<td>3-46</td>
<td>DTM_ - Dead Time Table</td>
</tr>
<tr>
<td>3-47</td>
<td>DYT_ - Delay Timer</td>
</tr>
<tr>
<td>3-48</td>
<td>E/I - External/Internal Transfer Switch</td>
</tr>
<tr>
<td>3-49</td>
<td>ESL - Events Sequence Logger</td>
</tr>
<tr>
<td>3-50</td>
<td>EXP_ - NATURAL EXPONENTIATION</td>
</tr>
<tr>
<td>3-50</td>
<td>EXT_ - EXPONENTIATION</td>
</tr>
<tr>
<td>3-51</td>
<td>FTG_ - Falling Edge Trigger</td>
</tr>
<tr>
<td>3-51</td>
<td>GB_ - Gain &amp; Bias</td>
</tr>
<tr>
<td>3-51</td>
<td>HLD_ - Hold</td>
</tr>
<tr>
<td>3-52</td>
<td>ID_ - ID Controller</td>
</tr>
<tr>
<td>3-53</td>
<td>LL_ - Lead/Lag</td>
</tr>
<tr>
<td>3-53</td>
<td>LMT_ - Limit</td>
</tr>
<tr>
<td>3-54</td>
<td>LN_ - NATURAL LOGARITHM</td>
</tr>
<tr>
<td>3-54</td>
<td>LOG_ - LOGARITHM BASE 10</td>
</tr>
<tr>
<td>3-55</td>
<td>MTH_ - Math</td>
</tr>
<tr>
<td>3-56</td>
<td>MUL_ - Multiplication</td>
</tr>
<tr>
<td>3-56</td>
<td>NND_ - NAND Logic</td>
</tr>
<tr>
<td>3-57</td>
<td>NOR_ - NOR Logic</td>
</tr>
<tr>
<td>3-57</td>
<td>NOT_ - NOT Logic</td>
</tr>
<tr>
<td>3-58</td>
<td>ODA - Operator Display for Analog indication &amp; alarming (V2.2)</td>
</tr>
<tr>
<td>3-60</td>
<td>ODC - Operator Display for Controllers</td>
</tr>
<tr>
<td>3-62</td>
<td>ODD - Operator Display for Discrete indication &amp; control (V2.2)</td>
</tr>
<tr>
<td>3-64</td>
<td>ODP - Operator Display for PushButtons (V2.2)</td>
</tr>
<tr>
<td>3-66</td>
<td>ODS - Operator Display for Sequencer</td>
</tr>
<tr>
<td>3-68</td>
<td>ON/OFF - On/Off Controller</td>
</tr>
<tr>
<td>3-69</td>
<td>OR_ - OR Logic</td>
</tr>
</tbody>
</table>
4.0 FACTORY CONFIGURED OPTIONS ................................................................. 4-1

4.1 FCO101 - Single Loop Controller w/ Tracking Setpoint ........................................ 4-2
4.2 FCO102 - Single Loop Controller w/ Fixed Setpoint ............................................ 4-3
4.3 FCO103 - External Set Controller with Tracking Local Setpoint ............................ 4-4
4.4 FCO104 - External Set Controller with Non-Tracking Local Setpoint ....................... 4-6
4.5 FCO105 - Ratio Set Control w/ Operator Setpoint Limits ...................................... 4-8
4.6 FCO106 - Single Loop Controller w/ Operator Setpoint Limits ............................... 4-10
4.7 FCO107 - Dual Loop Controller ............................................................................... 4-11
4.8 FCO121 - Cascade Control ...................................................................................... 4-13
4.9 FCO122 - Cascade Control w/ Operator Setpoint Limits ....................................... 4-15

5.0 LONWORKS COMMUNICATIONS ........................................................................ 5-1

6.0 NETWORK COMMUNICATIONS ............................................................................. 6-1

6.1 MODBUS DATA MAPPING .................................................................................... 6-1
6.2 LIL DATA MAPPING ............................................................................................... 6-3
6.2.1 Station Data ......................................................................................................... 6-3
6.2.2 Control Loop Data ............................................................................................... 6-5
6.2.3 Sequence Loop Data ............................................................................................ 6-6
6.2.4 Analog Indicator Loop Data ........................................................................................................ 6-9
6.2.5 Discrete Indicator Loop Data ........................................................................................................ 6-10
6.2.6 Pushbutton Loop Data ................................................................................................................... 6-11

7.0 DATA MAPPING .............................................................................................................................. 7-1

7.1 CONNECTING TO APACS 39ACM, MYCROADVANTAGE, ProcessSuite, i|ware PC .............. 7-1
7.1.1 APACS...................................................................................................................................... 7-1
7.1.2 MYCROADVANTAGE ............................................................................................................... 7-1
7.1.3 ProcessSuite .............................................................................................................................. 7-2
7.1.4 i|ware PC ................................................................................................................................ 7-2

7.2 STATION DATA .............................................................................................................................. 7-3
7.2.1 Integer Data (16-bit Integer) .................................................................................................... 7-3
7.2.2 Station String Data (8-bit ASCII Char - 2/Word) .................................................................. 7-5
7.2.3 Station Coil Data (1-bit) ........................................................................................................... 7-5
7.2.4 Station Status Word (SSW) .................................................................................................... 7-5

7.3 LOOP DATA .................................................................................................................................... 7-6
7.3.1 Dynamic Loop Integer Data ................................................................................................... 7-7
7.3.2 Variable Loop Integer Data....................................................................................................... 7-8
7.3.3 Static Loop Integer Data ........................................................................................................... 7-10
7.3.4 Dynamic Loop Floating Point Data (32-bit IEEE) ................................................................. 7-11
7.3.5 Variable Loop Floating Point Data (32-bit IEEE) ................................................................. 7-12
7.3.6 Static Loop Floating Point Data (32-bit IEEE) ........................................................................ 7-14
7.3.7 String Loop Data (8-bit ASCII Char - 2/Word) .................................................................... 7-16
7.3.8 Coil Loop Data (1-bit) .............................................................................................................. 7-19
7.3.9 PCOM Block Status ..................................................................................................................... 7-31
7.3.10 Sequencer Loop I/O Coil Data (1-bit) ....................................................................................... 7-33
7.3.11 LonWorks Remote I/O (Models 352P, 353, 354N) ............................................................... 7-35
7.3.12 Trend Data (Loop Defined by MLTP) ....................................................................................... 7-43
7.3.13 Configuration Data Sequencer Loop ...................................................................................... 7-46
7.3.14 LIL Alarm Type Word (ATW) ............................................................................................... 7-48

8.0 INSTALLATION ............................................................................................................................... 8-1

8.1 INSTALLATION CONSIDERATIONS ...................................................................................... 8-2
8.2 ENVIRONMENTAL CONSIDERATIONS ................................................................................ 8-2
8.3 MECHANICAL INSTALLATION .................................................................................................. 8-3
8.3.1 Controller Mounting, Model 354N......................................................................................... 8-3
8.3.2 Faceplate Display Remote Mounting, Model 354N_R ............................................................. 8-5
8.3.3 Faceplate Display Direct Mounting, Model 354N_ _ D .......................................................... 8-7

8.4 ELECTRICAL INSTALLATION ................................................................................................. 8-8
8.4.1 Wiring Guidelines ....................................................................................................................... 8-8
8.4.2 Analog Signal Input Wiring (4-20 mA, 1-5 Vdc, and mV) ..................................................... 8-12
8.4.3 Analog Output Wiring (4-20 mA, 1-5 Vdc) ........................................................................... 8-14
8.4.4 Digital Input and Output Wiring ............................................................................................... 8-15
8.4.5 Thermocouple Input Wiring ..................................................................................................... 8-17
8.4.6 RTD Input Wiring ....................................................................................................................... 8-18
8.4.7 Ohms and Slidewire Input Wiring .............................................................................................. 8-19
8.4.8 Relay Output Wiring .................................................................................................................. 8-19
8.4.9 Local Instrument Link Wiring ................................................................................................... 8-19
8.4.10 LonWorks Wiring .................................................................................................................... 8-21
8.4.11 Modbus Wiring ......................................................................................................................... 8-21
8.4.12 Wiring to a Model 363 VIEWPAC Recorder ........................................................................... 8-23
8.4.13 Power Wiring ............................................................................................................................ 8-23
9.0 LOCAL FACEPLATE OPERATION

9.1 NORMAL OPERATION MODE
9.2 CONFIGURATION MODE
9.3 AUTOTUNE PROCEDURE
9.4 REMOVABLE CONFIGURATION BOARD
9.5 REAL TIME CLOCK/CONFIGURATION BACKUP BOARD

10.0 CONTROLLER AND SYSTEM TEST

10.1 CONTROLLER CONFIGURATION AND TEST
  10.1.1 Connections and Power
  10.1.2 Configuration
  10.1.3 Input/Output
  10.1.4 Auto/Manual
  10.1.5 Modifying an FCO
  10.1.6 Alarms
  10.1.7 TAG
  10.1.8 QUICK
  10.1.9 TUNE
  10.1.10 View mode
10.2 SYSTEM CHECKOUT

11.0 MAINTENANCE

11.1 TOOLS AND TEST EQUIPMENT
11.2 UPGRADING A CONTROLLER
11.3 PREVENTIVE MAINTENANCE
  11.3.1 Environmental Considerations
  11.3.2 Visual Inspection
  11.3.3 Cleaning
  11.3.4 Circuit Board Handling
11.4 TROUBLESHOOTING
11.5 ERROR CODES
11.6 ASSEMBLY REPLACEMENT
  11.6.1 Removing the Controller Assembly
  11.6.2 Removing the I/O Expander Board
  11.6.3 Changing the Power Input Fuse
  11.6.4 Removing the MPU Controller Board
  11.6.5 Removing an Accessory Board
  11.6.6 Removing the Faceplate Display
    11.6.6.1 Replacing a Faceplate Display
    11.6.6.2 Replacing the Bezel or Circuit Board

12.0 CALIBRATION

12.1 ANALOG INPUT (AIN1-4)
12.2 ANALOG OUTPUT (AOUT1-3)

13.0 CIRCUIT DESCRIPTION

13.1 OVERVIEW
13.2 MPU CONTROLLER BOARD
13.3 I/O EXPANDER BOARD
13.4 LonWorks BOARD
13.5 LOCAL INSTRUMENT LINK (LIL) NETWORK BOARD ................................................................. 13-3

14.0 MODEL DESIGNATION AND SPECIFICATIONS .................................................................... 14-1
14.1 MODEL DESIGNATION .............................................................................................................. 14-1
14.2 ACCESSORIES ......................................................................................................................... 14-3
14.3 SERVICE PARTS KITS .............................................................................................................. 14-4
14.4 MECHANICAL SPECIFICATIONS ......................................................................................... 14-5
14.5 POWER INPUT REQUIREMENTS ............................................................................................ 14-5
14.6 MPU CONTROLLER BOARD SPECIFICATIONS ................................................................. 14-6
14.7 I/O EXPANDER BOARD SPECIFICATIONS ......................................................................... 14-6
14.8 COMMUNICATION BOARDS ................................................................................................. 14-9
  14.8.1 LonWorks Board ................................................................................................................. 14-9
  14.8.2 LIL Network Board (Local Instrument Link) ...................................................................... 14-10
14.9 ENVIRONMENTAL SPECIFICATIONS ................................................................................. 14-10
  14.9.1 Standard Mounting ............................................................................................................. 14-10
  14.9.2 Enclosure Mounting .......................................................................................................... 14-10
  14.9.3 Electromagnetic Compatibility (EMC) ............................................................................... 14-10
14.10 AGENCY APPROVALS .......................................................................................................... 14-10
  14.10.1 CSA Hazardous Locations Precautions ......................................................................... 14-11
  14.10.2 Special Conditions for Safe Use ..................................................................................... 14-12

15.0 ABBREVIATIONS AND ACRONYMS .................................................................................. 15-1

WARRANTY

SOFTWARE RELEASE MEMO
## LIST OF ILLUSTRATIONS

### FIGURE AND TITLE

<table>
<thead>
<tr>
<th>FIGURE AND TITLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1</td>
<td>Moore 354N, Exploded View</td>
</tr>
<tr>
<td>2-1</td>
<td>Configuration Road Map</td>
</tr>
<tr>
<td>3-1</td>
<td>PCOM Logic Diagram</td>
</tr>
<tr>
<td>8-1</td>
<td>Major Assemblies and Mounting Variations</td>
</tr>
<tr>
<td>8-2</td>
<td>Controller and Controller Mounting Tray Dimensions</td>
</tr>
<tr>
<td>8-3</td>
<td>Faceplate Display Dimensions</td>
</tr>
<tr>
<td>8-4</td>
<td>Faceplate Display Cutout Dimensions</td>
</tr>
<tr>
<td>8-5</td>
<td>Flange Mounting Clip, Local Faceplate Display</td>
</tr>
<tr>
<td>8-6</td>
<td>Terminal Blocks</td>
</tr>
<tr>
<td>8-7</td>
<td>Controller Terminal Layout and Terminal Assignments</td>
</tr>
<tr>
<td>8-8</td>
<td>Analog Input AIN1, 2-Wire Transmitter</td>
</tr>
<tr>
<td>8-9</td>
<td>Analog Inputs ANI1, 2, and 3; 4-Wire Transmitters</td>
</tr>
<tr>
<td>8-10</td>
<td>Universal Analog Input AINU1</td>
</tr>
<tr>
<td>8-11</td>
<td>Analog Output AOUT1, Current Output</td>
</tr>
<tr>
<td>8-12</td>
<td>Analog Output AOUT1, Voltage Output</td>
</tr>
<tr>
<td>8-13</td>
<td>Digital Inputs DIN and DINU</td>
</tr>
<tr>
<td>8-14</td>
<td>Digital Output DOUT1, Resistive and Inductive Loads</td>
</tr>
<tr>
<td>8-15</td>
<td>Universal Analog Input AINU1, Thermocouple Input</td>
</tr>
<tr>
<td>8-16</td>
<td>Reference Junction Locations and Connections</td>
</tr>
<tr>
<td>8-17</td>
<td>Universal Analog Input AINU1; 2, 3, and 4-Wire RTD Inputs</td>
</tr>
<tr>
<td>8-18</td>
<td>Universal Analog Input AINU1, Ohms Input</td>
</tr>
<tr>
<td>8-19</td>
<td>Universal Analog Input AINU1, Slidewire Input</td>
</tr>
<tr>
<td>8-20</td>
<td>Universal Relay Outputs ROUT1 and 2, Resistive Load</td>
</tr>
<tr>
<td>8-21</td>
<td>LIL Network Wiring</td>
</tr>
<tr>
<td>8-22</td>
<td>LonWorks Network Wiring</td>
</tr>
<tr>
<td>8-23</td>
<td>Modbus Communications, Personal Computer to Moore 353 or Moore 354</td>
</tr>
<tr>
<td>8-24</td>
<td>Moore 354N to Model 363 VIEWPAC Analog Input Wiring</td>
</tr>
<tr>
<td>8-25</td>
<td>Controller Power Wiring</td>
</tr>
<tr>
<td>8-26</td>
<td>Daisy Chained Power Wiring</td>
</tr>
<tr>
<td>8-27</td>
<td>Controller to Workstation and Faceplate Display Cabling</td>
</tr>
<tr>
<td>8-28</td>
<td>Cabling for Configuration and Application Development</td>
</tr>
<tr>
<td>11-1</td>
<td>Moore 354N Exploded View</td>
</tr>
<tr>
<td>11-2</td>
<td>MPU Controller Board with RTC Jumper W8</td>
</tr>
<tr>
<td>11-3</td>
<td>MPU Controller Board with RTC Jumper W7</td>
</tr>
<tr>
<td>11-4</td>
<td>I/O Expander Board</td>
</tr>
<tr>
<td>11-5</td>
<td>Accessory Board Installation and Replacement</td>
</tr>
<tr>
<td>11-6</td>
<td>LIL Network Board</td>
</tr>
<tr>
<td>11-7</td>
<td>LonWorks Board</td>
</tr>
<tr>
<td>11-8</td>
<td>Real Time Clock/Configuration Backup Board</td>
</tr>
<tr>
<td>13-1</td>
<td>Moore 354N Block Diagram</td>
</tr>
</tbody>
</table>
LIST OF TABLES

<table>
<thead>
<tr>
<th>TABLE AND TITLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Contact Information</td>
<td>1-7</td>
</tr>
<tr>
<td>3.1 Security Level vs. Accessible Operations</td>
<td>3-4</td>
</tr>
<tr>
<td>3.2 Modbus Port Baud Rate Parameters</td>
<td>3-6</td>
</tr>
<tr>
<td>3.3 Board Description and ID with Example Hardware and Software Revisions</td>
<td>3-6</td>
</tr>
<tr>
<td>3.4 Input Types</td>
<td>3-19</td>
</tr>
<tr>
<td>3.5 Calibration Input Values</td>
<td>3-19</td>
</tr>
<tr>
<td>3.6 Sen Min/Max &amp; Min/Max Scale Parameters</td>
<td>3-19</td>
</tr>
<tr>
<td>8.1 Rear Terminal Assignments</td>
<td>6-8</td>
</tr>
<tr>
<td>8.2 Factory Calibration</td>
<td>6-26</td>
</tr>
<tr>
<td>9.1 Autotune Errors</td>
<td>9-6</td>
</tr>
<tr>
<td>9.2 Autotune Warnings</td>
<td>9-6</td>
</tr>
<tr>
<td>11.1 RTC/CB and RCB Boards, Off-Line Error Codes</td>
<td>11-9</td>
</tr>
<tr>
<td>11.2 On-Line Error and Status Codes</td>
<td>11-10</td>
</tr>
<tr>
<td>14.1 Moore 354N Model Designation</td>
<td>12-2</td>
</tr>
</tbody>
</table>

Changes for Revision 2, May 2001

Significant changes for Rev 2 are indicated by change bars in the page margins. Some of these changes are listed below. The User’s Manual has been reorganized to move the FCO and Network Communications appendices into the body of the manual, as in the Procidia i|pac User’s Manual. The Function Block section is now followed by the FCO section and the Network Communications section is now followed by the Data Mapping section (previously Appendix A Network Communications).

<table>
<thead>
<tr>
<th>SECTION</th>
<th>CHANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cover</td>
<td>Banner revised to carry the Siemens Energy &amp; Automation name.</td>
</tr>
<tr>
<td>Contents</td>
<td>The User’s Manual has been reorganized. Preface section added to show conventions and symbols and state other important information.</td>
</tr>
<tr>
<td>1.0 Introduction</td>
<td>Section descriptions have been updated to reflect the reorganization of the manual. The Conventions and Usage Notes have been moved to the Preface. Product Support and Equipment Delivery and Handling sections updated. International Standard Organization Symbols section deleted and equivalent information added to Preface.</td>
</tr>
<tr>
<td>2.0 Configuration Overview</td>
<td>Function blocks for V2.2 and V2.4 added. Configuration Roadmap updated.</td>
</tr>
<tr>
<td>3.0 Function Blocks</td>
<td>Function blocks for V2.2 and V2.4 added. Corrections and additions made to other function block descriptions.</td>
</tr>
<tr>
<td>4.0 Factory Configured Options</td>
<td>This section was Appendix A. Corrections made to function block parameters.</td>
</tr>
<tr>
<td>5.0 LonWorks Communication</td>
<td>This section was titled Remote I/O Communications.</td>
</tr>
<tr>
<td>6.0 Network Communications</td>
<td>Updated.</td>
</tr>
<tr>
<td>7.0 Data Mapping</td>
<td>This section was Appendix A Network Communications. Updated.</td>
</tr>
<tr>
<td>11.0 Maintenance</td>
<td>Error messages updated and on-line error information updated. Display Assembly bezel replacement details added.</td>
</tr>
<tr>
<td>SECTION</td>
<td>CHANGE</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>14.0 Model Designation and Specifications</td>
<td>Equipment label drawings added. Model Designation table updated.</td>
</tr>
<tr>
<td>15.0 Abbreviations and Acronyms</td>
<td>This section was Appendix C Abbreviations and Acronyms.</td>
</tr>
<tr>
<td>Warranty</td>
<td>Updated to reflect Siemens Energy and Automation ownership.</td>
</tr>
<tr>
<td>Appendices A, B, and C</td>
<td>These appendices have been moved into the body of the manual, as described above.</td>
</tr>
<tr>
<td>Parts List</td>
<td>Discontinued as a separate section and publication. Service parts are now listed in the Model Designation and Specifications section, Service Parts Kits. Exploded views of the controller appear in Sections 1 and 11.</td>
</tr>
</tbody>
</table>

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Procedures in this document have been reviewed for compliance with applicable approval agency requirements and are considered sound practice. Neither Siemens Energy & Automation, Inc. nor these agencies are responsible for repairs made by the user.
PREFACE

Conventions and Symbols

The following symbols may be used in this manual and may appear on the equipment. The reader should become familiar with the symbols and their meaning. Symbols are provided to quickly alert the reader to safety related situations, issues, and text.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="DANGER" /></td>
<td>Indicates an immediate hazardous situation which, if not avoided, <em>will</em> result in death or serious injury.</td>
</tr>
<tr>
<td><img src="image" alt="WARNING" /></td>
<td>Indicates a potentially hazardous situation which, if not avoided, <em>could</em> result in death or serious injury.</td>
</tr>
<tr>
<td><img src="image" alt="CAUTION" /></td>
<td>Indicates a potentially hazardous situation which, if not avoided, <em>may</em> result in minor or moderate injury.</td>
</tr>
<tr>
<td><img src="image" alt="CAUTION" /></td>
<td>Indicates a potentially hazardous situation which, if not avoided, may result in property damage.</td>
</tr>
<tr>
<td><img src="image" alt="NOTICE" /></td>
<td>Indicates a potential situation which, if not avoided, may result in an undesirable result or state.</td>
</tr>
<tr>
<td><img src="image" alt="Important" /></td>
<td>Identifies an action that should be taken to avoid an undesirable result or state.</td>
</tr>
<tr>
<td><img src="image" alt="Note" /></td>
<td>Identifies additional information that should be read.</td>
</tr>
<tr>
<td><img src="image" alt="Electrical shock hazard" /></td>
<td>Electrical shock hazard. The included Warning text states that the danger of electrical shock is present.</td>
</tr>
<tr>
<td><img src="image" alt="Electrical shock hazard" /></td>
<td>Electrical shock hazard. Indicated that the danger of electrical shock is present.</td>
</tr>
<tr>
<td><img src="image" alt="Explosion hazard" /></td>
<td>Explosion hazard. Indicates that the danger of an explosion hazard exists.</td>
</tr>
<tr>
<td><img src="image" alt="Electrostatic discharge" /></td>
<td>Electrostatic discharge. The presence of this symbol indicates that electrostatic discharge can damage the electronic assembly.</td>
</tr>
</tbody>
</table>

Conventions and Usage Notes:

- In this User’s Manual, a Moore 354N can be referred to using the term Moore 354N, Model 354N, or simply 354N. The terms controller and station are also used to prevent repetition.
- Several chapters of this manual are also used in manuals for sister controllers and may contain references to those controllers.
- This manual describes the functionality provided by the current MPU Controller board firmware version. Where necessary a firmware version is identified by a phrase such as “in version x.x and higher” or simply 4.”
Part numbers are for items ordered from the Process Industries Division of Siemens Energy & Automation, except as noted.

Date format is Month-Day-Year, except as noted.

Time format is 12 hour (a.m./p.m.), except as noted.

Qualified Persons

The described equipment should be installed, configured, operated, and serviced only by qualified persons thoroughly familiar with this publication. A copy of this publication is shipped with the equipment. The current version, in Portable Document Format (PDF), is available at www.sea.siemens.com/ia/.

For the purpose of this publication and product labels, a qualified person is one who is familiar with the installation, construction, and operation of the equipment, and the involved hazardous. In addition, he or she has the following qualifications:

- Is trained and authorized to energize, de-energize, clear, ground and tag circuits and equipment in accordance with established safety practices.
- Is trained in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety practices.
- Is trained in rendering first aid.

Scope

This publication does not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser’s purposes, the matter should be referred to one of the support groups listed in the Product Support section of this manual.

The contents of this manual shall not become part of or modify any prior or existing agreement, commitment or relationship. The sales contract contains the entire obligation of Siemens. The warranty contained in the contract between the parties is the sole warranty of Siemens. Any statements continued herein do not create new warranties or modify the existing warranty.

General Warnings and Cautions

**WARNING**

This equipment contains hazardous voltages, and it has been certified for use in the hazardous locations specified on the product nameplate and in the Model Designation and Specifications section. Death, serious personal injury, or property damage can result if safety instructions are not followed. Only qualified personnel should work on or around this equipment after becoming thoroughly familiar with all warning, safety notices, and maintenance procedures contained herein. The successful and safe operation of this equipment is dependent upon proper handling, installation, operation, and maintenance.

The perfect and safe operation of the equipment is conditional upon proper transport, proper storage, installation and assembly, as well as, on careful operation and commissioning.

The equipment may be used only for the purposes specified in this publication.
Electrostatic discharge can damage or cause the failure of semiconductor devices such as integrated circuits and transistors. The symbol at right may appear on a circuit board or other electronic assembly to indicate that special handling precautions are needed.

- A properly grounded conductive wrist strap must be worn whenever an electronics module or circuit board is handled or touched. A service kit with a wrist strap and static dissipative mat is available from Siemens (PN15545-110). Equivalent kits are available from both mail order and local electronic supply companies.
- Electronic assemblies must be stored in anti-static protective bags when not installed in equipment.
1.0 INTRODUCTION

This User’s Manual contains configuration, installation and service information for the Moore 354N Universal Loop Controller. It is divided into fifteen sections.

• Section 1, Introduction, has general information about the organization of this manual, the controller, product support, and the contents of a typical shipment.

• Section 2, Configuration Overview, contains a list of the functions blocks available for use in configuring the controller and a procedure for configuration. Function block availability depends on controller model and MPU Controller board firmware version.

• Section 3, Function Blocks, contains a detailed description of each function block.

• Section 4, Factory Configured Options, provides a graphical presentation of the function blocks used in FCOs and a listing of changes made to default function block parameters.

• Section 5, LonWorks Communications, provides an overview of LonWorks® communication.

• Section 6, Network Communications, furnishes overviews of Modbus, LIL, and Ethernet communication data.

• Section 7, Data Mapping, contains network data details for Modbus, Local Instrument Link (LIL), and Ethernet.

• Section 8, Installation, contains drawings and steps detailing mechanical and electrical installation. Electrical connections to the controller are identified and numerous wiring diagrams are included.

• Section 9, Local Faceplate Operation, describes and illustrates the Display Assembly’s operator controls and displays. Use of these for on-line operation, for configurations and for autotuning is described.

• Section 10, Controller and System Test, has procedures for testing the controller and the installation.

• Section 11, Maintenance, lists the tools and test equipment to service a controller. It also has preventive maintenance and servicing procedures, including error codes. Assembly replacement steps are included as are detailed jumper selection criteria and jumper setting steps. Refer to this section when adding an assembly to an on-site controller.

• Section 12, Calibration, provides step-by-step procedures for calibration of analog input and output circuits.

• Section 13, Circuit Description, furnishes a block diagram level description of the controller’s circuits.

• Section 14, Model Designation and Specifications, shows controller model numbers; a list of accessories; mechanical, electrical, and environmental specifications; and a list of current agency approvals.

• Section 15, Abbreviations and Acronyms, is a convenient reference for new users that explains many abbreviations and acronyms appearing in this manual.

1.1 PRODUCT DESCRIPTION

The Moore 354N offers the control system designer the ultimate in flexibility and capability for the implementation of continuous solutions and batch solutions. An exploded view of the controller appears in Figure 1-1.

At the heart of the controller is a powerful MPU Controller board that uses the latest in microprocessor technology. It includes on-board I/O and reusable function blocks, and it is capable of solving a vast array of control implementations including single loop, cascade, and dual loop.

Modbus communication is standard and a port (RS485, half-duplex) at the rear terminals provides for network connection of up to 32 controllers (e.g. Models 352P, 353, 354, 354N, and Procidia™ i|pac™) to an operator workstation, Human/Machine Interface (HMI), or DCS, enabling integration of controllers into a plant-wide system. A popular HMI is the Procidia i|station™ running i|ware PC™ operator interface software. A DB9 communication port (RS232) on the underside of the controller is available for configuration and/or debugging when using i|config™, the optional PC-based Graphical Configuration Utility.
An optional I/O Expander Board can be added to the base controller. It includes direct thermocouple, RTD, and frequency inputs and additional I/O for direct process measurement of temperature and frequency variables, improving accuracy and control.

When even more I/O is needed for multiple-loop applications, advanced control, or batch sequencing, a remote I/O option board that uses the popular LonWorks protocol can be installed. This LonWorks board provides connectivity via a high-speed digital fieldbus to a large selection of standard I/O products: analog inputs and outputs and digital inputs and outputs using relay or solid state technology.

Although the controller can be connected to and operated entirely from a central operator workstation, such as i|station, a controller faceplate is included. This local operator interface is for applications where loops need individual attention during startup, troubleshooting, maintenance, or emergency conditions. The convenient faceplate layout and sophisticated software allow process and configuration changes to be made quickly and easily.

The controller can be completely configured from the operator faceplate or, as mentioned above, configured remotely using i|config™, the optional PC-based Graphical Configuration Utility. An optional Real Time Clock/Configuration Backup board (RTC/CB) is available to quickly transfer a configuration from one controller to another when downloading a configuration over a network is not available. The RTC/CB also provides a real time clock function.

Network communication options are listed in the following table.

<table>
<thead>
<tr>
<th>Protocol (Select One)</th>
<th>Available</th>
<th>Connection</th>
<th>Option Board Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modbus</td>
<td>Standard</td>
<td>Rear Terminals, NCA and NCB</td>
<td>None</td>
</tr>
<tr>
<td>Local Instrument Link</td>
<td>Optional</td>
<td>Rear Terminals, NCA and NCB</td>
<td>LIL Communication</td>
</tr>
</tbody>
</table>

Modbus communication is standard. An optional Local Instrument Link (LIL) network board is available in place of the Modbus communication to provide higher speed networking and peer-to-peer communication between controllers. This provides connectivity with an array of network-enabled products, including those listed below.

Current Controller Models
- Procidia i|pac Internet Control System
- Moore 352P Single-Loop Digital Controller
- Moore 354/354N Universal Controllers

Previous Controller Models
- Model 352 Single-Loop Digital Controller
- Model 351 Triple-Loop Digital Controller
- Model 382 Logic and Sequence Controller

Regardless of the selected communication option, the RS232 port on the underside of the controller will communicate using Modbus. Controller hardware architecture is designed to accommodate other emerging fieldbus technologies. This includes field communications that require lower power for intrinsic safety and higher speed for interplant networking.

For small retrofit applications, the Moore 354N with operator faceplate is a replacement for a simple stand-alone single-loop controller. It is easily upgraded with additional I/O and communication options for advanced control strategies and plant networking.
Often in this publication, reference is made to the labels on the controller to ensure that the controller being installed has the correct power input, I/O, communication options, and approvals. This is particularly important when non-incendive requirements are present or a critical process is involved where a custom configuration or calibration has been created. Label locations are shown in Figure 1-1 and typical labels are shown in Section 14 Model Designation and Specifications.

1.2 FUNCTION BLOCKS

Controller software is built on proven function block designs from previous LIL products and from Siemens APACS® products that support the IEC1131 standard. In many cases, the controller has been enhanced with features only now possible with state of the art technology.

Function blocks are selected for use within a LOOP. Multiple loops can be configured, and each loop can be associated with an operator faceplate. Certain blocks are used once within each loop (e.g. controller, setpoint, auto/manual), others can be used as many times as needed. Some notable features include Auto Tuning within the PID function blocks, an expandable Sequencer that allows configuration of up to 250 steps, and up to 256 discrete inputs and outputs. In addition, the Graphical Configuration Utility can be used to design the logic in a ladder diagram. Combining these features with continuous control loops within the same controller offers a well-integrated solution for small batch operations.

Several function blocks are available at the station level for configuration of STATION level parameters, such as the station address and station tag name. Function blocks include the CLOCK block (when the RTC/CB option board has been included and the controller contains firmware V2.4 or higher). All other function blocks are used for configuration within an individual LOOP. Control implementations are configured in the Moore 354N by first creating a loop, then entering a unique loop tag name and selecting function blocks for use within that loop. A number of loops can be configured in the controller and a number of function block types are available as described in the sections that follow.
1.2.1 LOOP Function Block Types

**Local I/O Function Blocks** are provided on both the MPU Controller Board and the I/O Expander Board. These blocks can be used in any LOOP, but as fixed resources are expendable. When used within a loop, the unique block name becomes `<loop>.<block>` (e.g. TC2053.AIN1 for Analog Input 1 used in loop TC2053).

**Fixed Loop Function Blocks** can be selected for use within each configured LOOP and include those blocks which define the major functions of a loop. The operator display function block (e.g. ODC Operator Display for Controllers) defines the loop type, the function of the local faceplate as well as the processing of commands coming from a remote workstation. A single controller function block can be selected from one of five available choices (ID, ON_OFF, PD, PIDAG, & PID) within each loop. When used within a loop the unique block name becomes `<loop>.<block>` (e.g. TC2053.PID for the PID controller used in loop TC2053).

**Arithmetic Function Blocks** are also designated as LOOP function blocks and can be used as many times as needed in each loop. Each use of a block is automatically assigned a unique name (i.e. MATH01, MATH02) within each loop so that the unique block name becomes `<loop>.<block>` (e.g. TC2053.MATH01).

**Logic Function Blocks** are also designated as LOOP function blocks and can be used as many times as needed in each loop. Each use of a block is automatically assigned a unique name (i.e. AND01, AND02) within each loop so that the unique block name becomes `<loop>.<block>` (e.g. TC2053.AND01).

**General Purpose Function Blocks** are also designated as LOOP function blocks and include blocks that do not fall into the arithmetic or logic categories. These can be used as many times as needed and each use will automatically be assigned a unique name (e.g. HLD01, HLD02) within each loop so that the unique block name becomes `<loop>.<block>` (e.g. TC2053.HLD01).

**Remote I/O Bus Function Blocks** can be used as needed in each LOOP to provide a method for sending and receiving both analog and discrete data to and from remote devices over the remote I/O digital bus. Each use will automatically be assigned a unique name (e.g. AIP01, AOP01) within the station so that the unique block name becomes `<loop>.<block>` (e.g. TC2053.AIP01 for Analog Input-lev_Percent used in loop TC2053). The second AIP block used within the station will be assigned AIP02 even if in a different loop so that the remote I/O blocks have unique names within the station. This will enable unique names for station variables on the LON network.

**LIL Global Function Blocks** are used as needed within a LOOP when the LIL option board is installed to enable global data communication over the LIL. They will automatically be assigned a unique name (e.g. AIL01, DIL01) within each loop when it is configured so that the unique block name becomes `<loop>.<block>` (e.g. TC2053.AIL01). Input and output data blocks are available as needed and will be assigned unique names as used (e.g. AIL01, AIL02 for Analog Input-LIL blocks).
**Ethernet Function Blocks** (V2.4) are used as needed within a LOOP when the Ethernet option board is installed. They will automatically be assigned a unique name (e.g. AIE01, DIE01) within each loop when it is configured so that the unique block name becomes `<loop>..<block>` (e.g. TC2053.AIE01). Available in Procidia i|pac and Moore 353 controllers; not available in Moore 352P and 354/354N controllers.

### 1.2.2 Power Up Initialization

The controller will retain, in the station NVRAM, calculated block values (e.g. outputs, elapsed time, last input/output logic states), including the time since power was lost. Three power up modes (hot, warm, and cold) are utilized in the controller that affect the initialization of function blocks. These modes are configured by two power up timers (warm and cold), included in STATION parameters. The station will initialize a hot start when power up occurs prior to the expiration of the warm timer. A cold start will occur when power up occurs after the expiration of the cold timer and a warm start will take place when the station powers up after the expiration of the warm timer but prior to the expiration of the cold timer.

**Hot Start**
- All function block execution continues from the last state prior to power fail.

**Warm Start**
- Function blocks that have a power up in a last state feature, either by design or by configuration selection, will power up as defined in the individual block descriptions. All other function blocks will initialize at cold start conditions.

**Cold Start**
- All function block outputs will initialize at 0 unless otherwise stated in individual block descriptions.

### 1.2.3 Configuration

The Moore 354N can be configured either locally or remotely. First, the local faceplate includes buttons located behind a flip-down door for complete configuration including the addition/deletion of loops and function blocks and the editing of function block parameters. Section 2 Configuration Overview includes a road map for stepping through configuration. Certain block parameters (e.g. gains, constants) can be edited while on-line but design changes (e.g. block interconnections, block additions) will put the station in “configuration hold” which will hold outputs at the current value until the Exit button is pressed. This will enable bumpless changes to be made while on-line.

The second method is to use the Graphical Configuration program. A configuration can be downloaded to the controller either via the DB9 port on the controller housing or over a network (either Modbus or LIL). During a download, all outputs will be held and the controller will retain all the intermediate calculations of all the blocks it had been running prior to the download. After the download, all function block parameters with the same tag name as those held will be used to initialize the downloaded function block parameters, thus providing a bumpless download under these conditions. If a loop tag name is changed, the tag names of all function blocks within that loop will change and will, therefore, require re-initialization of all of these blocks. However, the loop tag can be changed from the local faceplate without causing re-initialization, providing a bumpless tag change.

### 1.3 PRODUCT SUPPORT

Product support can be obtained from a customer service center (i.e. Technical Support Group in North America or a Technical Information Center (TIC) in Asia or Europe). Each region has a customer service center that provides direct telephone support on technical issues related to the functionality, application, and integration of all products supplied by the Process Industries Division of Siemens Energy & Automation. Regional contact information is

---

1 Set the Real Time Clock Jumper (W7 or W8) on the MPU Controller board. Refer to Section 11 Maintenance for details.
provided below. Your regional Technical Support Group or TIC is the first place to call when seeking product support information. When calling, it is helpful to have the following information ready:

- Caller ID number, or name and company name - When someone calls for support for the first time, a personal caller number is assigned. Having the number available when calling for support will allow the representative taking the call to use the central customer database to quickly identify the caller’s location and past support needs.
- Product part number or model number and version
- If there is a problem with product operation:
  - Whether or not the problem is intermittent
  - The steps performed before the problem occurred
  - Any status message, error messages, or LED indications displayed
  - Installation environment

Customers that have a service agreement (ServiceSuite or Field Service Agreement) are granted access to the secure area of the Siemens Internet site. This area contains a variety of product support information. When logging on, you will be prompted to enter your username and password. All customers have access to the public portion of the site.

### TABLE 1.1 Contact Information

<table>
<thead>
<tr>
<th>Region</th>
<th>Telephone</th>
<th>Fax</th>
<th>E-mail</th>
</tr>
</thead>
<tbody>
<tr>
<td>NORTH AMERICA</td>
<td>+1 215 646 7400, extension 4993</td>
<td>+1 215 283 6358</td>
<td><a href="mailto:MandCTechSupp@moore-solutions.com">MandCTechSupp@moore-solutions.com</a></td>
</tr>
<tr>
<td>ASIA</td>
<td>+011 65 299 6051</td>
<td>+011 65 299 6053</td>
<td><a href="mailto:TICGroupAP@moore-solutions.com">TICGroupAP@moore-solutions.com</a></td>
</tr>
<tr>
<td>EUROPE</td>
<td>+44 (0) 1935 470172</td>
<td>+44 (0) 1935 470137</td>
<td><a href="mailto:TICGroupEurope@moore-solutions.com">TICGroupEurope@moore-solutions.com</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Hours of Operation</th>
<th>Public Internet Site</th>
<th>Repair Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>NORTH AMERICA</td>
<td>8 a.m. to 6 p.m. eastern time</td>
<td><a href="http://www.sea.siemens.com/ia/">www.sea.siemens.com/ia/</a></td>
<td>+1 215 646 7400 extension 4993</td>
</tr>
<tr>
<td>ASIA</td>
<td>9 a.m. to 6 p.m. Singapore time</td>
<td><a href="http://www.sea.siemens.com/ia/">www.sea.siemens.com/ia/</a></td>
<td>+011 65 299 6051</td>
</tr>
<tr>
<td>EUROPE</td>
<td>8:30 a.m. to 4:30 p.m. GMT/BST</td>
<td><a href="http://www.sea.siemens.com/ia/">www.sea.siemens.com/ia/</a></td>
<td>+44 (0) 1935 470172</td>
</tr>
</tbody>
</table>
1.4 EQUIPMENT DELIVERY AND HANDLING

1.4.1 Factory Shipment
Prior to shipment, a controller is fully tested and inspected to ensure proper operation. It is then packaged for shipment. Most accessories are shipped separately.

Real Time Clock Jumper - As shipped, the MPU Controller board Real Time Clock Jumper (W7 or W8) is set to maximize battery life. If the jumper is to be set to enable Hot/Warm Start, or to confirm that the jumper is properly set, refer to Section 11 Maintenance.

1.4.2 Receipt of Shipment
Inspect each carton at the time of delivery for possible external damage. Any visible damage should be immediately recorded on the carrier’s copy of the delivery slip.

Carefully unpack each carton and check the contents against the enclosed packing list. Inspect each item for any hidden damage that may or may not have been accompanied by exterior carton damage.

If it is found that some items have been damaged or are missing, notify Siemens immediately and provide full details. In addition, damages must be reported to the carrier with a request for their on-site inspection of the damaged item and its shipping carton.

1.4.3 Storage
If a controller is to be stored for a period prior to installation, review the environmental specifications in Section 14 Model Designation and Specifications.

Refer to Section 11.6 Assembly Replacement to set the MPU Controller board Real Time Clock Jumper (W7 or W8) to the storage position to maximize battery life.

1.4.4 Typical Shipment Contents
The items listed below are those typically included in a shipment and are subject to change.

1. Moore 354N Universal Loop Controller, model number per order, qty. 1
2. Power Input and Range Resistor Kit, PN 16354-30, qty. 1

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistor, 250Ω, 0.1%, 3W, WW</td>
<td>3</td>
</tr>
<tr>
<td>Sleevng</td>
<td>3</td>
</tr>
<tr>
<td>Crimp-On Connector</td>
<td>6</td>
</tr>
<tr>
<td>Kit Installation Instruction</td>
<td>1</td>
</tr>
</tbody>
</table>

3. I/O Expander Board Kits

PN17354-40 I/O Expander Board Kit - The I/O Expander Board is factory installed when a Moore 354N with Expansion Board option 1 is ordered.

- For field installation of this kit, see the supplied Kit Installation Instruction (15900-390).

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>I/O Expander Board - Do not remove Board from static shielding bag until it is to be installed.</td>
<td>1</td>
</tr>
<tr>
<td>Range Resistor and Reference Junction Kit, see below</td>
<td>1</td>
</tr>
</tbody>
</table>
PN16353-49 Range Resistor and Reference Junction Kit - This kit is supplied with the above I/O Expander Board Kit and with a factory shipped Moore 354N with Expansion Board option 1.

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-20 mA to 1-5V Range Resistor, 250Ω, 0.1%, 3W, WW</td>
<td>1</td>
</tr>
<tr>
<td>4-20 mA to 15-75 mV Range Resistor, 3.75Ω, 0.1%, 3W, WW</td>
<td>2</td>
</tr>
<tr>
<td>Sleevings</td>
<td>5</td>
</tr>
<tr>
<td>Crimp-On Connector</td>
<td>6</td>
</tr>
<tr>
<td>TC Reference Junction, 100Ω</td>
<td>2</td>
</tr>
<tr>
<td>Kit Installation Instruction</td>
<td>1</td>
</tr>
</tbody>
</table>

5. UM354N-1, Moore 354N User’s Manual (this manual), qty. 1

6. Additional items as required by your order. Refer to the packing list accompanying a shipment.
2.0 CONFIGURATION OVERVIEW

Configuration enables a user to select function blocks, stored in the controller, from an available list and enter appropriate block parameters to implement a specific control strategy. Although configuration affects the entire station, the controller partitions related control implementations into LOOPS. A maximum of 99 loops can be configured and 25 can have operator displays that are mapped to network communications.

Each LOOP can contain the function blocks listed in the following paragraphs. Signals can be connected between function blocks within the LOOP as well as between loops. Also, there are several STATION function blocks that are fixed and available in the STATION menu for setting station related values.

Section 3 fully describes all available function blocks. For tuning guidelines refer to Section 9.3 Autotune Procedure or request AM-35 Digital Controller Tuning.

NOTE

This User’s Manual includes the functionality provided by MPU Controller Board firmware Versions 1.3 and 2.0 through 2.40. These enhancements appear mainly in Sections 2 and 3. They are identified by the phrase “in version 1.3 and higher” or simply “V2.4” in text.

2.1 STATION FUNCTION BLOCKS

Function blocks that are permanent and accessible at the STATION menu level:

FCO LIB .......... Factory Configured Options Library
STATN ............ Station Parameters
SECU R............ Security
CLOCK .......... real time CLOCK (requires firmware V2.2 or higher and RTC/CB board
ETHERNET .... Ethernet Communications (not available on Moore 352P or 354N controllers)

2.2 STATION HARDWARE I/O BLOCKS

Function blocks that are available during configuration depend on the hardware installed in the controller. These blocks can be selected within a LOOP but as fixed resources, once selected, are no longer available. The left column shows the minimum and maximum quantities of each block and the right column shows the quantity for each circuit board.

AIN1-4 ........ Analog Input............................ MPU Controller Board (3), I/O Expander Board (1)
AINU1-2 .... Analog Input, Universal............. I/O Expander Board (2)
AOUT1-3 .... Analog Output............................. MPU Controller Board (2), I/O Expander Board (1)
DIN1-4 ....... Digital Input............................ MPU Controller Board (3), I/O Expander Board (1)
DINU1-2 .... Digital Input, Universal............ I/O Expander Board (2)
DOUT1-2 .... Digital Output.......................... MPU Controller Board (2)
ROUT1-2 ....... Relay Output........................ I/O Expander Board (2)

2.3 LOOP FUNCTION BLOCKS

The following blocks are available as needed within each loop in the quantities indicated (the quantity is one if no number is shown). Some blocks (e.g. A/M, BIAS) can be used only once within each LOOP. Others (e.g. ADD) are reusable within a LOOP and can be used up to the maximum number indicated. Each time a reusable block is selected within a LOOP, a new instance number will automatically be assigned (i.e. ADD01, ADD02). Each LOOP can have one operator display block (i.e. ODC or ODS). The display block defines how the loop will be

---

2 Subject to available memory in the controller.
3 Model 352Plus only: Although these blocks can be selected in configuration, some may not have physical connections to the rear terminals depending upon the positioning of the Option 3 I/O Jumper.
displayed on the local faceplate when that loop is selected and also how loop data will be mapped on the Modbus or LIL network interface. Each LOOP can have one controller function block (i.e. ID, ONOFF, PD, PID, or PIDAG).

A/M…………… Auto/Manual
ACS01-99………ArcCosine (V1.3)
ADD01-99……… Addition
AG3 ……………AGA3 (V1.3)
AG7……………AGA7 (V1.3)
AG8……………AGA8 (V1.3)
ALARM………… Alarm
AND01-99……… AND Logic
ASN01-99……… Arcsine (V1.3)
ATN01-99……… Arctangent (V1.3)
ATD01-99……… Analog Trend Display (V1.3)
BATOT………… Batch Totalizer
BATSW………… Batch Switch
BIAS…………… Bias
CHR01-99……… Characterizer
CMP01-99……… Comparator
COS01-99……… Cosine (V1.3)
DAM01-99……… Deviation Amplifier
DIV01-99……… Division
DNC01-99……… Divide by N Counter
DTM01-99……… Dead Time Table
DYT01-99……… Delay Timer
E/I…………… External/Internal Transfer
ESL…………… Events Sequence Logger (V1.3)
EXP01-99……… Natural Exponentiation (V1.3)
EXT01-99……… Exponentiation (V1.3)
FTG01-99……… Falling Edge Trigger
GB01-99……… Gain & Bias
HLD01-99……… Hold
ID…………… ID Controller
LL01-99……… Lead/Lag
LM01-99……… Limit
LN_01-99……… Natural Logarithm (V1.3)
LOG01-99……… Logarithm Base 10 (V1.3)
MTH01-99……… Math
MUL01-99……… Multiplication
NND01-99……… Nand Logic
NOR01-99……… NOR Logic
NOT01-99……… NOT Logic

ODC…………… Operator Display for Controllers
ODS…………… Operator Display for Sequencers
ODA (V2.2)…… Op Disp for Analog Ind. & Alarm
ODD (V2.2)…… Op Disp for Discr Ind & Control
ODP (V2.2)…… Operator Display for Pushbuttons
ONOFF………… ON OFF Controller
OR01-99……… OR Logic
ORSL…………… Override Selector
OST01-99……… One Shot Timer
PB1SW……… PB1 Switch
PB2SW……… PB2 Switch
PB3SW……… PB3 Switch
PCOM………… Phase Communication (V1.3)
PD…………… PD Controller
PID…………… PID Controller
PIDAG……… PIDAG Controller
PRSEQ……… Program Sequencer
QHD01-99…… Quickset Hold
RATIO………… Ratio
RCT01-99……… Repeat Cycle Timer
RLM01-99……… Rate Limiter
ROT01-99……… Retentive On Timer
RSF01-99……… RS Flip-Flop
RTG01-99…… Rising Edge Trigger
RTT01-99…… Real Time Clock Trip (V2.0)
SCL01-99……… Scaler
SEL01-99……… Signal Selector
SETPT………… Setpoint
SIN01-99……… Sine (V1.3)
SPLIM………… Setpoint Limit
SRF01-99……… SR Flip-Flop
SRT01-99……… Square Root
SUB01-99……… Subtraction
TAN01-99……… Tangent (V1.3)
TH01-99……… Track & Hold
TST01-99……… Totalizer (V2.3)
TSW01-99……… Transfer Switch
XOR01-99……… Exclusive OR Logic

2.4 LIL GLOBAL DATA I/O FUNCTION BLOCKS

These function blocks are available in the quantities indicated within each loop when the optional LIL Network board is installed. The total number of global function blocks will be limited by the number of global channels available. A controller has 256 channels. Each global data block occupies one global channel. In addition, each configured Control LOOP occupies 5 channels, each configured Sequencer LOOP 6 channels, and the Station itself the first 7 channels. See Section 6 for more information on network communications.

AIL01-99……… Analog Input_LIL
AOL01-99……… Analog Output_LIL
DIL01-99……… Discrete Input_LIL
DOL01-99……… Discrete Output_LIL
2.5 ETHERNET DATA I/O FUNCTION BLOCKS

These function blocks are available in the quantities indicated within a controller when the optional Ethernet Network board is installed. These blocks can be selected for use within individual loops but block names are unique station wide.

AIE01-32 .......... Analog Input - Ethernet (V2.4)
AOE01-32......... Analog Output - Ethernet (V2.4)
CIE01-32 .......... Coil Input - Ethernet (V2.4)
DIE01-32......... Discrete Input - Ethernet (V2.4)
DOE01-32......... Digital Output - Ethernet (V2.4)

2.6 LonWorks REMOTE I/O FUNCTION BLOCKS

These function blocks are available in the quantities indicated within a controller when the optional LonWorks Remote I/O board is installed. LonWorks is available for use with Models 352P, 353 and 354 controllers. These blocks can be selected within individual loops, but block names will be unique station wide. This allows LonWorks network managers that identify variables using the block name within an individual node to be unique. For example, if LOOP01 uses AIP01 and AIP02 and an AIP block is selected in LOOP02 the name will be AIP03. Detailed information on the use of LonWorks can be found in Section 5. Model 352P only: Select LonWorks by setting the Option 3 I/O Jumper.

AIP01-25 .......... Analog Input lev_Percent
AOP01-25 .......... Analog Output lev_Percent
DID1-6............. Digital Input lev_Discrete, 16 Channels
DIS1-6............. Digital Input State (V1.3)
DOD1-6............. Digital Output lev_Discrete, 16 Channels
DOS1-6............. Digital Output State (V1.3)

2.7 CONFIGURATION PROCEDURE

Each controller must be configured to perform the desired control strategy. The arrangement of functions and the numerical data required for a particular control circuit are referred to as the controller configuration. Local and remote configurations are accommodated.

Local configuration involves the configuration pushbuttons and the pulser knob on the Display Assembly’s faceplate. Section 9.2 Configuration Mode shows the faceplate and provides brief descriptions of control functions.

Remote configuration requires a personal computer running the i|config™ Graphical Configuration Utility and either a configuration cable or a Modbus, LIL, or Ethernet network connection. The configuration can be created at and downloaded from the personal computer. A network connection is made at the controller’s terminals. The configuration cable plugs into the configuration port in the underside of a 352Plus or 353 Display Assembly or into a 354N DB9 connector. The other end of this cable connects to a personal computer’s serial port or to a modem.

**WARNING**

Explosion hazard

Explosion can cause death or serious injury.

In a potentially explosive atmosphere, remove power from the equipment before connecting or disconnecting power, signal or other circuits.

Comply with all pertinent regulations regarding installation in a hazardous area.
A configuration is designed by first arranging the needed function blocks in a fashion similar to that of a PI & D drawing. Parameter and calibration values are determined next and then entered on a Configuration Documentation Form or into the Graphical Configuration software. The controller may then be configured locally by entering the information on the form into the controller’s configuration memory or remotely by downloading directly from the personal computer.

Nine common controller configurations have been stored in a built-in library that can be entered from the FCO LIB function block at the STATION level. Simple changes can then be made to accommodate individual needs. As an example, FCO101 Single Loop Controller includes the setpoint tracking feature but by simply disconnecting the TC input to the SETPT function block, it becomes a fixed setpoint Single Loop Controller. These FCOs are fully documented in Section 4.

FCO101 - Single Loop Controller w/ Tracking Setpoint
FCO102 - Single Loop Controller with Fixed Setpoint
FCO103 - External Set Controller with Tracking Local Setpoint
FCO104 - External Set Controller with Non-Tracking Local Setpoint
FCO105 - Ratio Set Controller with Operator Setpoint Limits
FCO106 - Single Loop Controller w/Operator Setpoint Limits
FCO107 - Dual Loop Controller
FCO121 - Cascade Loop Controller
FCO122 - Cascade Loop Controller with Operator Setpoint Limits

Unless otherwise specified on the order, FCO101 is installed at the factory. Use the following procedure to change the factory configured option. Refer to Figure 2-1 Configuration Road Map to move to, and then through, the selected FCO and to enter or edit parameter values.

1. Press the ENTER/EXIT CONF button. LOOP will appear on the alphanumeric display.
2. Rotate the Pulser Knob until STATION appears on alphanumeric display.
3. Press the STEP DOWN button to display FCO LIB.
4. Press the STEP DOWN button to display FCO in the lower display.
5. Press the STEP DOWN button until the desired FCO number appears in numeric display.
6. Rotate the Pulser Knob to display the desired FCO number in the upper display.
7. Press the STORE button to load the new FCO.
8. Edit the FCO as needed. In addition to the material in this section, refer to:
   • Section 3 Function Blocks for details about configurable parameters
   • Section 4 Factory Configured Options for FCO diagrams and parameters
   • Sections 6 and 7 for Modbus, LIL, or Ethernet mapping
   • Section 9 Operation for operating controls and displays

Where an FCO is not suitable, a complete configuration can be designed to suit individual needs. Section 4 can be used as a guide for documenting a user-created or used-edited configuration. i|config, a PC-based Graphical Configuration Utility, can be used to design, document, and save configurations as well as download them to the controller, through either the configuration port or using a Modbus, LIL, or Ethernet network connection.

The above steps are illustrated in Figure 2-1 Configuration Road Map. The map also provides a broad overview of the configuration procedure.

• Press the ENTER CONF button to enter the configuration mode. Press the button again to exit configuration.
• After entering the configuration mode, LOOP or STATION can be selected.
• At the STATION level, a factory configured option can be loaded, station parameters can be configured, security passwords can be entered, the clock can be set, communication parameters can be configured, and inputs and outputs can be calibrated.

• Calibration can also be performed within individual loops containing the input or output function blocks used in the LOOP.

• At the LOOP level, new loops can be added, loops can be deleted, or an existing loop can be edited.

When a new loop is created, the controller will assign a default name (e.g. LOOP01). The loop name can be changed to any valid 12-character ASCII value. It is suggested that loop names be limited to six characters so that the complete tag name will appear in the alphanumeric display during normal operation.

A Loop can be edited by stepping down from the EDIT menu. If more than one loop has been configured, press the STEP DOWN button and turn the Pulser Knob to step through the list of configured loops. From the selected loop, stepping down will provide various options within the specific loop.

• The current value of all configured block outputs can be viewed.

• The current tag name of the loop and the ESN (Execution Sequence Number) can be changed. ESNs are automatically assigned by the controller in the order of creation, either a loop or individual block. An ESN should be changed when it is important that one loop be executed prior to another (e.g. cascade primary executes prior to the cascade secondary).

• Function blocks can be added to or deleted from the loop. Existing function blocks can be edited. Use the step up and step down buttons to move between the function block, parameter, and value levels within the EDIT FB menu.

If no configuration entries are made for about three minutes, the mode will time out and the controller will exit the configuration mode. The STATN function block has a CONFG TO (Configuration Timeout) parameter to enable or disable timeout.

Loading an Earlier Firmware Version

In rare instances, replacing the installed MPU Controller board firmware with an earlier version may be desired. Before loading the earlier firmware, refer to the sections on configuration and load FCO 101 as the active configuration. This will install a basic configuration and will reduce the number of error messages that appear during the firmware loading process.

2.8 OPERATION DURING LOCAL ON-LINE CONFIGURATION

Changing a controller’s configuration parameters while the station is on-line can affect its operation and output values. Configuration parameters are divided into four types: HARD, SOFT, READ, and CALIBRATION.

HARD - When a HARD parameter is STORED the controller will suspend execution of all function blocks and will hold all outputs until the EXIT button is pressed. A HARD parameter is identified with each ‘(H)’ notation in a function block parameter listing in Section 3. When a loop or function block is added or deleted, the station enters a HARD configuration mode.

SOFT - A SOFT function block parameter can be changed while the function blocks are executing. A SOFT parameter is identified with each ‘(S)’ notation in a function block parameter listing in Section 3. All QUICKSET changes also fall into this category.

READ - These parameters are not changeable and therefore can be read while the station function blocks are executing. A READ parameter is identified with each ‘(R)’ notation in a function block parameter listing in Section 3. The configuration VIEW mode also falls into this category.

CALIBRATION - When entering the CONFIGURATION mode, the station will suspend execution of all function blocks and will hold all outputs until the EXIT button is pressed. If an output block is being calibrated its output
will be adjusted during the calibration procedure. A CONFIGURATION parameter is identified with each ‘(C)’ notation in a function block parameter listing in Section 3. The calibration mode can be entered from the individual block or from the CAL mode at the station level.

**FIGURE 2-1  Configuration Road Map**
3.0 FUNCTION BLOCKS

This section contains a detailed description of each function block (FB) available for configuration. Each function block description is supplemented by: (1) a drawing of the block showing data inputs and outputs and control lines, (2) a block parameter table. Most blocks are further described by a block diagram that shows the block’s circuitry in a simplified or equivalent circuit form.

NOTE

This User’s Manual includes the additional functionality provided by MPU Controller Board firmware Versions 1.3, and 2.0 through 2.40. These enhancements appear mainly in Sections 2 and 3. They are identified by the phrase “in firmware 1.3 and higher” or the two-digit firmware version (e.g. “V1.3” or “V2.4” in text.

Ethernet function blocks described in this section are available in Procidia i|pac and Moore 353 controllers. They are not available in Moore 352P and 354/354N controllers.

Function blocks have three types of inputs/outputs: digital, analog, and special data structure.

1. Arrows with dark shading and white letters are digital (outputs are displayed as 0 and 1 in the VIEW mode when using the local faceplate). Digital outputs are typically used to designate function block status, logical outputs, and on/off function block outputs. Some examples are:
   - Function block status: E/I status (IS, ES, SI), A/M status (AS, NA, MS, ES, SS), and Quality Status (QS)
   - Logical Outputs: AND (01), OR (01), NOR (01), or NOT (01)
   - On/Off function blocks: One Shot Timer (01), Retentive On Timer (01), Rising Edge Trigger (01), Alarms (A1, A2, A3, and A4), and Comparator (01)

2. Arrows with medium shading and black letters are analog. Internally they are REAL floating point numbers and outputs of these types will be displayed in the VIEW mode when using the local faceplate with the decimal point located to allow greatest resolution between 0.00000 and 999999 or -0.0000 and -99999. Numbers outside this resolution will blink.

   Analog outputs are typically output (01) for analog I/O blocks and math functions. Analog outputs may also be specific to a particular function block such as the Analog Output (AO), Step Number (SN), Step Time (ST), Remaining Time (RT), and Current Recipe (CR) outputs of the Program Sequencer.

3. Arrows with medium shading and black letters but with a white tip are special data structures for range scaling information and will not be displayed in the VIEW mode. Range scaling information is used when there is a conversion of units within a function block, for example, the Alarm block scales the alarm limits into process engineering units when the range pointer is configured to the process analog input block. If unconfigured the units default to 0-100%. The output range (OR), typically used on analog output function blocks, includes MIN and MAX SCALE, the DPP (Decimal Point Position), and the ENGUNITS (Engineering Units). The analog output block is typically used for a 0-100% output to a valve where a minscale of 0 = 4 mA output and a max scale of 100 = 20 mA output.

   The output range is connected to the Range Pointer (input R) of functions blocks requiring scaling other than the default 0-100. For example, an Analog input block could be scaled 0-5000 psig with output (01) connected to the AOUT input (S) and the AIN (OR) connected to the AOUT input (R). The Analog output would then output 4 mA at a minscale of 0 psig and 20 mA at a maxscale of 5000 psig. In contrast, if AOUT input (R) were left unconfigured the output would equal 4 mA at a minscale of 0 psig, 20 mA at a maxscale of 100 psig and over ranged for any input over 100 psig.

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4 The LonWorks function blocks used in Models 352P, 353, and 354/354N are described in this manual. The Ubus function blocks used in Procidia (UAH, UAI, UAO, UDI, UDO, UEI, UER, UET, URI, USD, and UTI) are included in the firmware but are not described here since they will not operate in Models 352P, 353, and 354/354N.
Some users may prefer to use normalized 0-1 analog inputs for math calculations and scale outputs for display only; in this case, the Scaler function block may be used to provide an output range (OR) for the ODC (Operator display block).

Note how the range pointers are used in the following Factory Configured Options (FCOs). FCOs are described in detail in the Factory Configured Options section.

- **FCO101 Single Loop Controller** – The process output range AIN1 (OR) is connected to the range pointer of the SETPT block, the PID block, the ALARM block and the process variable range of the ODC block. As a result these blocks will be automatically rescaled when the minscale and the maxscale or the engineering units of the Process is changed. For example, if AIN1 is scaled 0-5000, the 0-100% bargraph on the display will represent 0-5000 when displaying the process. The A/M block, AOUT1 (Valve) output, and the Valve input of the ODC block are scaled based on the output of the PID block.

- **FCO104 External-Set PID controller** – The external setpoint is displayed as variable X in the ODC block. Therefore, the ODC (RX) input uses the range output of the external setpoint AIN2 (OR) for scaling. The 0-100% bargraph will represent the range of AIN1 when displaying the process variable and the range of AIN2 when displaying the X variable.

- **FCO105 Ratio Set Control** – AIN1 and AIN2 are scaled 0-100% of flow. The ratio of these flows is displayed on variable Y and the scaler function block is used to define the engineering units as a dimensionless ratio CF/WF scaled from 0.50 –1.50.

Connections between blocks are allowed only with similar data types.

To help you quickly locate a function block:

- In this section, function blocks are listed alphabetically by the block ID (e.g. AIN for Analog Input).
- In Section 2, function blocks are listed by broad function (e.g. station hardware I/O).
3.1 STATION FUNCTION BLOCKS

Station function blocks include factory configured options (FCOs), security, and station parameters. Each is described in the following subsections.

3.1.1 FCO LIB - Factory Configuration Library

The FCO LIB function block provides a selection of pre-configured applications. An FCO can be selected from the library and “STORED”. This loads a complete controller configuration, as defined by the FCO documentation, and erases any previously stored configuration. Station parameters and Calibration are retained when a new FCO is loaded. This enables a user to quickly configure the controller with an FCO without having to re-calibrate or re-enter the Station parameter values.

Upon stepping down to the FCO parameter, the last FCO that was loaded in the controller will be displayed. Turning the pulser knob will then display other FCOs that are available in the FCO library.

The configuration installed at the factory will be either FCO 101 or a custom configuration that was ordered and defined by the user. FCO 101 is a basic single loop PID controller.

An FCO can be loaded at any time in the field and used as is or modified (edited) to meet individual requirements. The FCO library file is not modified when the FCO selected for controller configuration is edited.

3.1.2 SECUR - Security

The SECUR function block enables a user to lock out portions or all of the faceplate configuration functions. Five levels of security are available; see Table 3.1. Each level is factory set to 000000 (no security), and can be changed by the user in the field to any number up to 999999.

A security combination should be assigned to each security level (1-highest, 5-lowest). A level that remains at the default 000000 combination will have no security for the involved function(s) regardless of the security assigned to the other levels. For example, assume that level 1 is assigned a security combination but level 4 remains at 000000. If a controller calibration is performed, the station will not prompt the user for the security combination and anyone will be able to store new calibration values.

If security is desired, it is recommended that all 5 levels of security be set with either the same value or different values when different individuals are granted access to only certain functions.

The functions that can be accessed at the various security levels are listed in Table 3.1. The security combination will be required when the user attempts to store a parameter or attempts to view a security combination. The
faceplate alphanumeric will display “ENTR COM” and allow the user to enter and store the combination. A combination is entered by selecting one digit at a time using the $<$ and $>$ keys and setting the number for that digit using the pulser. When all digits have been set, press STORE. If incorrect, the alphanumeric will display “ACCESS/DENIED” and then return to the parameter level. Once a combination has been entered correctly, access will be provided for all functions within that level until the user exits configuration. If a combination is lost, contact Siemens technical support to obtain a method to enter configuration and change the security codes. Refer to Section 1.3 for the contact information.

The PC-based Graphical Configuration Software may also have security options similar to the above. However, there is no security in the download procedure itself. At the controller there are parameters in function block STA_PARM that will lock out all downloads and all parameter writes from a PC.

**TABLE 3.1 Security Level vs. Accessible Operations**

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>LEVEL 1</th>
<th>LEVEL 2</th>
<th>LEVEL 3</th>
<th>LEVEL 4</th>
<th>LEVEL 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Station Function Block Edit</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loop/Function Block Add/Delete</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loop/Function Block Edit</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Security Configuration</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calibration of Input/Outputs</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quick Faceplate Access*</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Configuration of NEW FCO</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change CLOCK</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Security does not apply, in firmware versions 1.30 and higher, to continuously adjustable quickset parameters that include RATIO, BIAS, and QHLD.
3.1.3 STATN - Station Parameters

The STATN function block enables entry of station identification and other station related information. When the station is networked using Modbus or the LIL option board the address is used by higher level devices to obtain information from the station. LIL addresses range from 1-32 or 1-64 when a Model 321 Expansion Satellite is used. Modbus can range from 1-250 but normally 1-32 is used to correspond to the total number of devices that can be installed on a single network.

Once the address has been assigned and higher level devices have been configured to access information from the station, changing the address can require reconfiguration of the higher level device. There may also be higher level devices that will query and assign addressing information based on the station tag name. In this case a tag name change will also require reconfiguration of higher level devices. Therefore, it is important not to change the station identification without being aware of system consequences.

There are two timers used during power up initialization: WARM TIM and COLD TIM. The station takes approximately 8 seconds to perform power up initialization before the power up time is evaluated. A timer should be set to a value greater than 8 seconds to be effective. A timer setting of 0 will be considered as infinite (e.g. to always power up hot, set the warm timer to 0). When the station powers up after a loss of power but prior to the expiration of the warm timer, the station will execute a Hot Start. If the station powers up after the warm timer expiration but prior to the expiration of the cold timer, the station will execute a warm start. In all other cases, the station will execute a cold start. The adjustable range of these timers is 0-18000 seconds for firmware versions prior to than 1.30 and is 0-999999 seconds for versions 1.30 and higher. IMPORTANT: The Real Time Clock jumper must be set for the warm and hot timers to function. See the Maintenance section for details on this jumper.

When using Modbus Network communications, the WATCHDOG timer can be set to a value other than 0 to cause a high WD output from the loop operator display function block when the station does not receive a computer command within the timer period. A value of 0 disables the watchdog. A Modbus communications DELAY time can enter for both the Display Assembly configuration port and LIL/Modbus terminals NCA/NCB (front and rear ports respectively). This may be necessary when the station responds too quickly for the modem. Modbus masters may handle IEEE floating point numbers in a different word order. The IEEE REV parameter allows matching the station to the Modbus master in use.

The CONFIG LO (Configuration Lockout) parameter (V2.40) - renamed from DWNLD LO in earlier versions - and PARAM LO (Parameter Write Lockout) parameter provide a method for locking out configuration transfers and parameter read/writes from a PC over a Modbus or LIL network. The parameter lockout does not affect the global updates on the on the LIL.

The 8-digit SERIAL # of the station is stored in memory and can be viewed when this parameter is displayed. If only seven digits are seen, assume a leading zero.
BAUD rate parameters set the Modbus port characteristics; see Table 3.2. The network Modbus port at terminals NCA and NCB, the rear port, is RS485 and uses the assigned station address. The configuration port, the front port, at a Moore 352Plus or Moore 353 Display Assembly’s MMJ-11 connector, or a Moore 354 or 354N Controllers’ DB9 display/configuration port, is RS232 and uses an address of 1.

The Cycle Time of the station can be viewed as a parameter within the STATN block. In addition, a bias can be added to increase the total cycle time of the station. This may be necessary when significant communications activities are taking place, causing communication overrun errors. Adding bias will allow the processor more time during each scan cycle for completing the communication chores.

The station can be configured to time out of the configuration mode after 1 minute of no faceplate operations by setting the CONFG TO parameter to YES (default). This parameter is in firmware versions 1.30 and higher.

<table>
<thead>
<tr>
<th>TABLE 3.2 Modbus Port Baud Rate Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PARAMETERS</strong></td>
</tr>
<tr>
<td>Data Formatting</td>
</tr>
<tr>
<td>Baud Rate Selections</td>
</tr>
<tr>
<td></td>
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<td></td>
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<tr>
<td>Handshaking Selections</td>
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</tbody>
</table>

A list of the installed controller hardware and software can be viewed within the STATN block using the HW PRES read only parameter. As shown in Table 3.3, each board has an ID and a hardware revision, and most also have a software revision. The controller’s operating Kernel and operating code reside on the MPU Controller board and there is an entry in the table for each. The table lists the hardware and software revisions. For example, in Table 3.3, the MPU Controller board would be shown in the numeric display as ‘11 1.00’.

<table>
<thead>
<tr>
<th>TABLE 3.3 Board Description and ID with Example Hardware and Software Revisions</th>
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</thead>
<tbody>
<tr>
<td><strong>BOARD DESCRIPTION</strong></td>
</tr>
<tr>
<td>Kernel</td>
</tr>
<tr>
<td>MPU Controller - Models 352P, 353, and 354N</td>
</tr>
<tr>
<td>Display Assembly, Faceplate Display</td>
</tr>
<tr>
<td>I/O Expander</td>
</tr>
<tr>
<td>Ethernet Network</td>
</tr>
<tr>
<td>Local Instrument Link</td>
</tr>
<tr>
<td>LonWorks</td>
</tr>
<tr>
<td>RTC/CB or RCB - Models 352P, 353, and 354N</td>
</tr>
</tbody>
</table>

Check the NVRAM battery condition by reading the BAT OK parameter. The NVRAM, on the MPU Controller Board, uses a sealed lithium battery that has a life of up to 40 years. The battery powers a portion of memory that stores operating data when external power is removed from the controller. When external power is next applied, the controller will read this data and return to the stored operating conditions. Should the battery fail, the station

---

5 With the Real Time Clock jumper properly set, as described in Section 11, up to 40 years for an on-line controller or for a stored MPU Controller Board or controller.
Up to 4 years for a stored MPU Controller Board or controller with the Real Time Clock jumper improperly set (i.e. clock enabled).
Environmental conditions can affect battery life.
will power up in a Cold start using the controller configuration stored in permanent FLASH memory. Battery condition has no effect on normal operation while external power is applied. The SERV PIN is used when a LonWorks board is installed to identify this controller to the LonWorks network manager.

### 3.1.4 CLOCK - Real Time Clock (V2.0/2.2)

The CLOCK function block is available when the RTC/CB (Real Time Clock / Configuration Backup) option board is installed in the controller and the controller includes firmware version V2.0 or higher.

This function block enables the current time and date to be viewed when using the local faceplate. When the Step Down Button is pressed to view the parameter value, the current TIME or DATE at that instant is displayed. The value can be changed using the pulser and the <-- and -- > arrow buttons to enter a new value. The new value will initialize the clock when the STORE button is pressed. The time & date cannot be changed locally if the SRCE ADD parameter has been configured to a value other than 0 to have the time synchronized with a master station on the Local Instrument Link (LIL).

When the SRCE ADD parameter (version 2.2) has been configured to synchronize the time with a master controller on the LIL the controller will query the master controller at 12 midnight and synchronize its time with the master.

### 3.1.5 ETHERNET - Ethernet Communication Network (V2.4)

- Ethernet is available on Procidia i|pac and Moore 353 controllers; not available on Moore 352P and 354/354N.

The ETHERNET function block is available when the Ethernet Communication Network option board is installed in the controller and the controller includes firmware version V2.4 or higher.

Use this function block to configure Ethernet communication parameters. The default IP addresses shown are used for factory testing in a network environment and should be changed to meet individual system requirements. Consult your company’s network administrator for assistance in determining IP addresses. Also, consider any network security issues that can arise when networking plant areas.
3.2 I/O AND LOOP FUNCTION BLOCKS

This section provides a detailed description of each input/output and loop function block. Blocks are listed alphabetically.

3.2.1 A/M - A/M Transfer

One A/M function block can be used per loop and it is normally used on the output of controller blocks to enable auto/manual operation of the loop. It is separate from the controller block allowing the option of inserting other function blocks (e.g. override, feedforward) between the controller and the A/M Transfer. If function block PB3SW has been used the A/M block is not available.

AUTO allows the signal from the controller (input A) to become the output of the A/M Transfer unless EMER MAN or STANDBY is active. Auto ONLY forces the operator pushbutton to be locked in the AUTO position, but EMEG MAN and STANDBY will function normally.

MANual allows the operator to adjust the manual value unless STANDBY is active. The manual value tracks the block output when in AUTO or STANDBY. The manual value can be adjusted when in MAN, provided the displayed variable is the process or the valve (e.g. TC2053.P or TC2053.V). When a loop is switched to MANual the display will automatically show the valve (e.g. TC2053.V). The range pointer (input Range) lets the A/M function block know the range of the auto input signal and enables the A/M block to properly process pulser changes from the operator faceplate. The range pointer also defines the range of the manual function as -10% to 110%. This can be useful to prevent inadvertent changes from an operator workstation that might set the manual value well beyond the local operator’s changeable range. In most cases, the Range input (range pointer) will connect to the controller function block. An unconfigured range pointer will default the range to 0.00 - 100.00.
**EMER**gency **MAN**ual will be asserted when input EM is high (1). This causes the output to hold at the last position and permits the operator to adjust the manual value under the conditions listed for **MAN**ual. It will also assert an EM **MAN** status, at the configured priority, to the operator display.

**STANDBY** will be asserted when input TC is high (1). This causes the A/M block output to track input TV thus placing the loop in a standby condition. This feature can be used to enable one loop to track another for either redundancy applications or optional control schemes. It will also assert a STANDBY status, at the configured priority, to the operator display.

**STATUS OUTPUTS** - Output **AS** (Auto Status) goes high (1) when output O1 is the Auto input; output NA will go high when output O1 is not the Auto input, output MS goes high when the A/M switch is in the manual position; output ES goes high when the Emergency Manual switch is in the manual position; and SS goes high when the standby switch is in the Track Variable position. Two LEDs on the display identify the position of the A/M switch.

**POWER UP** - The A/M function block can be configured to power up under various conditions during a warm or cold start. If PU LAST has been configured as YES, during a warm start all outputs are initialized at previous values and the block will power up in the same condition (i.e. same A/M switch position). When powering up in auto, the A/M block will execute in the manual mode for the first two scan cycles, allowing a controller block to track the last value. When PU LAST is set to NO, the A/M block does not power up in last position during a warm start and will power up as configured by the POWER UP parameter, either AUTO or MAN. During a cold start, the A/M block will always power up as configured by the POWER UP parameter. When the POWER UP parameter is used and the block powers up in MAN, the manual value can be set using the PU MAN parameter.

Clock **Wise** **MAN**ual configured as YES, the default position, will cause the manual value to increase with clockwise rotation of the knob. This feature is useful when clockwise rotation is desired to always open a value whether the valve is direct or reverse acting.

**EM**ergency **MAN**ual, in firmware 1.30 and higher, allows the position of the A/M block Manual Switch (switch 1 in the block diagram) and the associated light to be configured. When the EM input goes high (1), the Emergency Manual Switch (switch 2) switches to manual. If EM **MAN** is configured as YES, the Manual Switch (switch 1) and the indicator light will switch to the manual position, assuming that switch 1 is in Auto, and will remain in the manual position until the operator presses the A/M button or a command is received from an HMI to switch to Auto. The EM Switch (switch 2) will remain in the manual position until the EM status clears regardless of the position of the Manual Switch (switch 1). If the EM **MAN** parameter is configured as NO, the Manual Switch (switch 1) and associated indicator light will not change position when the EM input goes high (1).

**LOCK MAN**, in V2.4, can be set to YES to lock the loop in manual when Emergency Manual has been activated. The operator can switch the loop to Auto only when the EM condition has cleared. This feature is available only when the EM **MAN** parameter is configured as YES.

The **MAN** ACCL parameter, in firmware 1.30 and higher, enables setting the acceleration rate applied to the pulser knob. It can be configured for Slow, Medium, or Fast. Slow is the default and is consistent with firmware versions less than 1.30.

**PRIORITIES** - The priority assigned to EM or SB PRIOR will affect the operation as follows (the outputs ES and SS will go high with all priority assignments, including 0, when event is active):

1. Bargraphs, event LEDs, and condition will flash. ACK button must be used to stop flashing.
2. Bargraphs, event LEDs, and condition will flash. Flashing will stop if ACK or if event clears.
3. Event LEDs and condition will flash. ACK button must be used to stop flashing.
4. Event LEDs and condition will flash. Flashing will stop if ACK or event clears.
5. Event LEDs and condition will turn on when event is active and off when the event clears.
6. No local display action occurs when event is active.
3.2.2 ACS - ARCCOSINE

ACS_ function blocks, in firmware 1.30 and higher, accept an input between -1.0 and 1.0. Each provides an output signal in radians of which the input is the cosine.

![ACS Block Diagram](image)

3.2.3 ADD_ - Addition

ADD_ function blocks perform arithmetic addition on three input signals. Any unused input will be set to 0.0 and will have no effect on the output.

All inputs should have the same engineering units. If units are not consistent, an SCL (Scaler) function block can be used or an alternative is to use a MATH function block that has built-in scaling functions.

![ADD Block Diagram](image)
3.2.4 AG3 - AGA 3 Orifice Metering of Natural Gas

AG3 function blocks, which can be used on a one per loop basis, are available in firmware 1.30 and higher. This block uses the AGA 3 (American Gas Association Report #3) calculation to accurately measure the flow of natural gas using an orifice meter with flanged taps. The basic equations calculated by this block, in accordance with AGA Report No. 3, Orifice Metering of Natural Gas, Part 3, August 1992 (AGA Catalog No. XQ9210), are:

\[ Q_b = C' \sqrt{P_{f1} h_w} \]

\[ C' = F_n (F_c + F_{sl}) Y_1 F_{pb} F_{tb} F_{tf} F_{gr} F_{pv} \]

where:
- \( Q_b \) = volume flow rate at base conditions
- \( C' \) = composite orifice flow factor
- \( P_{f1} \) = absolute flowing pressure (upstream tap)
- \( h_w \) = orifice differential pressure
- \( F_n \) = numeric conversion factor
- \( F_c \) = orifice calculation factor
- \( F_{sl} \) = orifice slope factor
- \( Y_1 \) = expansion factor (upstream tap)
- \( F_{pb} \) = base pressure factor
- \( F_{tb} \) = base temperature factor
- \( F_{tf} \) = flowing temperature factor
- \( F_{gr} \) = real gas relative density factor
- \( F_{pv} \) = supercompressibility factor

Output \( Q_b \) is updated every scan cycle. Output \( C' \) is updated continuously for temperature effects and periodically for other effects. The following conditions are considered in the calculations:

- **Standard Conditions**: \( P_s = 14.73 \) psia, \( T_s = 60\^\circ F \), \( Z_{sair} = 0.999590 \).
- Nominal pipe size is 2" or larger, Beta is 0.1 - 0.75, and Re (Reynolds Number) is 4000 or larger.
- \( Y \) (expansion factor) and absolute flowing pressure \( P_f \) are referenced to upstream tap (i.e. \( Y_1 \) & \( P_{f1} \)).
- \( h_w \) is in inches H₂O and \( P_f \) is in psia. \( 0 < \frac{h_w}{(27.707*P_f)} \leq 0.2 \).

The following parameters are configuration entries:

- \( d_r \) = orifice plate bore diameter in inches at a reference temperature of 68°F
- \( D_r \) = meter tube internal diameter in inches at a reference temperature of 68°F
- \( P_b \) = base pressure (psia)
- \( T_b \) = base temperature (°F)

The following are analog inputs to the AGA 3 function block:

- \( h_w \) = orifice differential pressure (in H₂O)
- \( P_f \) = flowing pressure at upstream tap - \( P_{f1} \) (psia)
The specific gravity factor ($G_r$) and the compressibility factors ($Z_s, Z_f, Z_b$) can be entered manually using HLD (Hold) function blocks, computed, and then downloaded from a host device, or calculated in the controller using the AG8 (AGA 8 Compressibility Factors of Natural Gas) function block.

The following are analog outputs of the AGA 3 function block:

- $Q_b = \text{volume flow rate at base conditions (SCFH - Standard Cubic Feet per Hour)}$
- $C' = \text{composite orifice flow factor [SCFH/\sqrt{(psia)(in H2O)}]}$

The specific gravity factor ($G_r$) and the compressibility factors ($Z_s, Z_f, Z_b$) can be entered manually using HLD (Hold) function blocks, computed, and then downloaded from a host device, or calculated in the controller using the AG8 (AGA 8 Compressibility Factors of Natural Gas) function block.

The following are analog outputs of the AGA 3 function block:

- $Q_b = \text{volume flow rate at base conditions (SCFH - Standard Cubic Feet per Hour)}$
- $C' = \text{composite orifice flow factor [SCFH/\sqrt{(psia)(in H2O)}]}$
3.2.5 AG7 - AGA 7 Measurement of Gas by Turbine Meters

AG7 function blocks, which can be used on a one per loop basis, are available in firmware 1.30 and higher. This block uses the AGA 7 (American Gas Association Report #7) calculation to accurately measure the volume flow of gas at base conditions using a turbine meter. The basic equations calculated by this block in accordance with AGA Turbine Meter Report No. 7, 1985 (AGA Catalog No. XQ0585) are:

\[ Q_b = Q_f \left( \frac{T_b}{T_f} \right) \left( \frac{P_f}{P_b} \right) \left( \frac{Z_f}{Z_b} \right) \]

where:
- \( Q_f \) = volume flow at standard conditions
- \( Q_b \) = volume flow rate at base conditions
- \( P_f \) = flowing pressure (psia)
- \( T_f \) = flowing temperature
- \( Z_f \) = compressibility at flowing conditions
- \( P_b \) = base pressure (psia)
- \( T_b \) = base temperature (°F)
- \( Z_b \) = compressibility at base conditions

Block output \( Q_b \) is updated continuously and is the volume flow rate at base conditions in the same units as input \( Q_f \). \( T_b \) and \( T_f \) are converted within the block from °F to °R (adds 459.67 to the °F input value) for the actual calculation. Compressibility factors (\( Z_f \), \( Z_b \)) can be entered manually using HLD (Hold) function blocks, computed and downloaded from a host device, or calculated in the controller using the AG8 (AGA 8 Compressibility Factors of Natural Gas) function block.
3.2.6 AG8 - AGA 8 Compressibility Factors of Natural Gas

AG8 function blocks, which can be used on a one per loop basis, are available in firmware 1.30 and higher. This block calculates the compressibility factors of natural gas in accordance with AGA 8 Report No. 8, July 1994 (AGA Catalog No. XQ9212). It computes various compressibility factors and the specific gravity (relative density) using the detailed characterization method described in the report. The mole percentage of the gas components and the base temperature and pressure are entered in the configuration and the flowing temperature and pressure are provided as block inputs. Parameter MOL% SUM provides a read only value that is the total of all the gas compounds that have been entered. The AGA8 computation is time consuming and is calculated over a total of 100 scan cycles so as not to have any significant effect on the controller cycle time.

Z_s (compressibility at standard conditions) is calculated after a power-up or after a configuration change is made. Z_b and Z_f are calculated on a periodic basis with the actual update time dependent on the number of gas components and the scan cycle of the controller.
3.2.7 AIE_ - Analog Input - Ethernet (V2.4)

- Ethernet is available on Procidia i|pac and Moore 353 controllers; not available on Moore 352P and 354/354N.

AIE_ function blocks are available when the optional Ethernet communication board is installed. It allows the controller to obtain analog data from other stations over the Ethernet network. Up to 32 AIE_ blocks are available and are assigned in sequence with each use, station wide. The data is received as a real floating-point number and is passed to the block output O1. Block output OR is the range scaling for this real number. The Output Range is a special data type that includes the MIN and MAX SCALE, the DPP, and the ENGUNITS and can be connected to other blocks having a Range (RG PTR) input. The range scaling information can be automatically obtained from the source of the data if the server has the scaling information packaged with the data as is provided by AOE function blocks from other Moore and Procidia controllers. AOE blocks are defined by using the Modbus Registers from the table below. If this feature is not available, the default setting of the RANGE parameter "MAN" can be used. In this case the range parameters are entered manually. When the auto range feature is used, the range in the AIE block may be out of sync for several seconds if on line changes are made to the AOE range.

Output QS indicates the quality of the received data and will go high (1) when the data is bad. This is normally associated with failure to receive data due to a communication failure or a misconfiguration of the source.

<table>
<thead>
<tr>
<th>FB Number</th>
<th>MB Register</th>
<th>FB Number</th>
<th>MB Register</th>
<th>FB Number</th>
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<tr>
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</tbody>
</table>
3.2.8 AIL_ - Analog Input - LIL

AIL_ function blocks are available when the optional LIL communication board is installed. They allow the controller to obtain global data from other stations on the LIL. AIL block numbers are assigned in sequence with each use, station wide. The data is received in the LIL format having a standard range of $80 to $F80. The block output is a real number and is scaled in engineering units using the MIN and MAX SCALE parameters. The Output Range is a special data type that includes the MIN and MAX SCALE, the DPP, and the ENGUNITS that can be connected to other blocks having a Range (RG PTR) input.

Output QS indicates the quality of the received data and will go high (1) when the data is bad. This is normally associated with failure to receive global data due to a LIL failure or a misconfiguration of the source.

The AIL function can be assigned to a single LIL channel. It will then have certain data that will be accessible over the LIL. Parameter 1 is the received data (RD) in the $80-$F80 format and will be re-transmitted by this station on the assigned channel. This LIL CHAN parameter can also be set to 0. The controller will still receive global data from the other station but the received data will not be re-transmitted and the other channel data (i.e. MINSCALE, ...) will not be accessible.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<tbody>
<tr>
<td>n</td>
<td>RD</td>
<td>SA/SC</td>
<td>MINSCALE</td>
<td>MAXSCALE</td>
<td>ENG UNITS</td>
<td>Output O1</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
3.2.9 AIN_ - Analog Inputs

**AIN_** function blocks convert a voltage input, having a range defined during calibration, into a block output signal that is scaled in engineering units. The output is then interconnected to other function blocks within the controller.

A 6-character ASCII value can be entered to identify the engineering units of the output signal. The scaled output range is configurable and has a factory default of 0.0 to 100.0 PRCT. Ranges such as 300.0 to 500.0, representing engineering units in degrees C, can also be configured. The Output Range is a special data type that includes the MIN and MAX SCALE, the DPP, and the ENGUNITS that can be connected to other blocks with a Range (RG PTR) input.

Analog Input blocks are available on the MPU Controller Board (CB) and on the I/O Expander Board (EB). Block names (IDs) are listed in Section 8.4 together with the case rear terminal numbers. Power for 2-wire transmitters is available at the rear terminals.

A digital filter (time constant) is available to dampen process noise. A square root extractor is also available to linearize a flow signal from a ΔP transmitter, allowing the block output to be configured for flow units. Output QS indicates the quality of the analog output signal O1, and will be high (1) when output O1 is bad, and low (0) when good. Bad quality signifies an A/D conversion failure or a 1-5Vdc input signal that falls below 0.6 Vdc indicating an open circuit or failure of a 2-wire transmitter.

A verify mode is available during calibration to view the analog input, in volts, over the full calibrated range. The input is factory calibrated for 1-5 Vdc and should not require field calibration. However, field calibration can be performed if another range is required or to match the exact transmitter calibration. Current inputs are accommodated using precision dropping resistors connected across the input terminals (250Ω resistors are supplied with the controller for conversion of 4-20mA inputs).

Power Up - During a hot, a warm or a cold start, the function block will temporarily by-pass the digital filter to enable the output to initialize at the actual hardware input signal.
3.2.10 AINU_ - Analog Inputs, Universal

AINU_ function blocks are available on the optional I/O Expander Board. These function blocks convert sensor inputs such as T/C (thermocouple), RTD (resistance temperature detector), millivolt, ohm, and slidewire sources into block outputs. Current inputs (i.e. 4-20 mA) are accommodated by using the WMV type and connecting a 3.75Ω resistor across the input. An output bias can be used to nullify any known offset in the sensor circuit and a digital filter (time constant) is included, to dampen process noise. Output QS indicates the quality status of the output signal O1 and will go high (1) when the output is of bad quality. Bad quality indicates an A/D conversion failure or an open circuit T/C, or an out of range process variable.

The scaling function is used to establish an output range, in engineering units, for the selected sensor range (e.g. 0-10 mv or 50.0-150.0 amperes). Direct Temperature Measurements (i.e. T/C and RTD) bypass sensor and range scaling and the block output units are selected from Table 3.4. When selected, the proper read only ASCII characters corresponding to the type units selected will automatically be placed in the ENG UNITS parameter. When OHMs or MVs are selected, the ENG UNITS parameter can be configured to correspond to the process engineering units. The default SEN MIN and MIN SCALE are set to the minimum operating value and the SEN MAX & MAX SCALE are set to the maximum operating value. SEN MIN & SEN MAX always indicate the sensor range limits in degrees C. However, it is important to enter the actual intended operating range in the MINScale, MAXSCALE, and DPP parameters so that other function blocks, such as the controller, operator faceplate, and workstation interface, can point to this block for range and display information. Block names (IDs). Input terminations (terminal numbers) are listed in Section 8.4.

All input types are factory calibrated and do not require field calibration. However, for those cases where outputs must be adjusted to meet a local standard, a field calibration feature is available to override the factory calibration for the input type selected. The factory calibration is retained so that the input can be returned to the factory calibration at any time by storing ‘FAC’ in the calibration selection. Table 3.5 provides the input values that are used to perform a field calibration. A verify mode is available during calibration to view the sensor input over the full range. The signal that is viewed, in the calibration verify mode, is in the basic units of measure (e.g. °C for temperature, mv for millivolts) and is not affected by the temperature units conversion, digital filter, scaling, or the output bias adjustment. The full block output with these parameters applied can be viewed in the VIEW mode within loop configuration. During a hot, a warm or a cold start, the function block will temporarily by-pass the digital filter to enable the output to initialize at the actual hardware input signal. Note that the field calibration is erased when the SENsor TYPE is changed.

![Block Diagram](image-url)
### TABLE 3.4  Input Types

<table>
<thead>
<tr>
<th>#</th>
<th>ENGineering UNITS</th>
<th>AVAILABLE ON INPUT TYPES</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>6 Char ASCII</td>
<td>OHM, SLW, NMV, WMV</td>
</tr>
</tbody>
</table>

### TABLE 3.5  Calibration Input Values

<table>
<thead>
<tr>
<th>#</th>
<th>TYPE</th>
<th>DESCRIPTION</th>
<th>OPERATING RANGE</th>
<th>FIELD CAL ‘FLD’ POINTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>JT/C</td>
<td>Type J Thermocouple</td>
<td>-185°C to 1100°C (-300°F to 2010°F)</td>
<td>0°C &amp; 800°C</td>
</tr>
<tr>
<td>2</td>
<td>KT/C</td>
<td>Type K Thermocouple</td>
<td>-185°C to 1370°C (-300°F to 2500°F)</td>
<td>0°C &amp; 1000°C</td>
</tr>
<tr>
<td>3</td>
<td>TT/C</td>
<td>Type T Thermocouple</td>
<td>-200°C to 370°C (-400°F to 698°F)</td>
<td>-100°C &amp; 300°C</td>
</tr>
<tr>
<td>4</td>
<td>ET/C</td>
<td>Type E Thermocouple</td>
<td>-18°C to 1000°C (-30°F to 1830°F)</td>
<td>0°C &amp; 800°C</td>
</tr>
<tr>
<td>5</td>
<td>ST/C</td>
<td>Type S Thermocouple</td>
<td>-18°C to 1650°C (0°F to 3000°F)</td>
<td>400°C &amp; 1400°C</td>
</tr>
<tr>
<td>6</td>
<td>RT/C</td>
<td>Type R Thermocouple</td>
<td>-18°C to 1610°C (0°F to 2930°F)</td>
<td>400°C &amp; 1400°C</td>
</tr>
<tr>
<td>7</td>
<td>BT/C</td>
<td>Type B Thermocouple</td>
<td>-18°C to 1815°C (0°F to 3300°F)</td>
<td>800°C &amp; 1600°C</td>
</tr>
<tr>
<td>8</td>
<td>NT/C</td>
<td>Type N Thermocouple</td>
<td>-185°C to 1300°C (-300°F to 2370°F)</td>
<td>0°C &amp; 1000°C</td>
</tr>
<tr>
<td>9</td>
<td>DRTD</td>
<td>DIN 43760/IEC 751 RTD alpha 0.003850</td>
<td>-185°C to 622°C (-300°F to 1152°F)</td>
<td>100Ω (0°C) &amp; 285Ω (512.380°C)</td>
</tr>
<tr>
<td>10</td>
<td>URTD</td>
<td>US (NBS 126) RTD alpha 0.003902</td>
<td>-185°C to 613°C (-300°F to 1135°F)</td>
<td>100Ω (0°C) &amp; 285Ω (504.84°C)</td>
</tr>
<tr>
<td>11</td>
<td>JRTD</td>
<td>JIS C-1604 RTD alpha 0.003916</td>
<td>-185°C to 610°C (-300°F to 1130°F)</td>
<td>100Ω (0°C) &amp; 285Ω (502.94°C)</td>
</tr>
<tr>
<td>12</td>
<td>OHM*</td>
<td>Resistance</td>
<td>0 ohms to 5000 ohms</td>
<td>0 ohms &amp; 5000 ohms</td>
</tr>
<tr>
<td>13</td>
<td>SLW*</td>
<td>Slidewire</td>
<td>500 ohms to 5000 ohms</td>
<td>0% &amp; 100%</td>
</tr>
<tr>
<td>14</td>
<td>NMV*</td>
<td>Narrow Millivolt</td>
<td>-19.0 mv to 19.0 mv</td>
<td>0 mv &amp; +15 mv</td>
</tr>
<tr>
<td>15</td>
<td>WMV*</td>
<td>Wide Millivolt</td>
<td>-30.0 mv to 77 mv</td>
<td>0 mv &amp; +75 mv</td>
</tr>
</tbody>
</table>

* Not available in Model 352Plus.

### TABLE 3.6 SEN MIN/MAX & MIN/MAX SCALE Parameters

<table>
<thead>
<tr>
<th>SEN TYPE</th>
<th>SEN MIN</th>
<th>SEN MAX</th>
<th>MIN SCALE</th>
<th>MAX SCALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-11</td>
<td>[min. operating value]</td>
<td>[max. operating value]</td>
<td>[min. operating value]</td>
<td>[max. operating value]</td>
</tr>
<tr>
<td>12</td>
<td>0 (ohms)</td>
<td>5000 (ohms)</td>
<td>0.0 PRCT</td>
<td>100.0 PRCT</td>
</tr>
<tr>
<td>13</td>
<td>0 (%)</td>
<td>100 (%)</td>
<td>0.0 PRCT</td>
<td>100.0 PRCT</td>
</tr>
<tr>
<td>14</td>
<td>-19 (mv)</td>
<td>19 (mv)</td>
<td>0.0 PRCT</td>
<td>100.0 PRCT</td>
</tr>
<tr>
<td>15</td>
<td>15 (mv)</td>
<td>75 (mv)</td>
<td>0.0 PRCT</td>
<td>100.0 PRCT</td>
</tr>
</tbody>
</table>
3.2.11 **AIP** - Analog Input lev_Percent

**AIP** function blocks convert an analog signal with a lev-percent type SNVT (Standard Network Variable Type) received from the LonWorks network into a block output, scaled in engineering units, for interconnection to other function blocks within the controller. A maximum of 25 **AIP** blocks can be used, up to the limit of nodes allowed on the Lon network or the memory limit of the controller. Each use of the block will be assigned a unique station wide ID (e.g. AIP06). These blocks are available when the LonWorks option board is installed in a 352P, 353, or 354N controller. The input connection is established by ‘binding’ a network variable from the remote analog node to the network variable of the **AIP** function block.

A 6-character ASCII value can be entered to identify the engineering units of the output signal. Output scaling (MINSCALE and MAXSCALE) is provided to establish an engineering range of choice. The number of the input network variable to the **AIP** block can be viewed in the configuration mode. This is useful when other devices need this for binding. The Output Range is a special data type that includes the MIN and MAX SCALE, the DPP, and the ENGUNITS that can be connected to other blocks with a Range (RG PTR) input.

The block output QS indicates the quality status of the output signal O1 and will go high when the output is of bad quality. Bad quality usually indicates a loss of communications within the LonWorks network.
3.2.12 ALARM - Alarm

ALARM function blocks can be used on a one per loop basis and contain four (4) alarms associated with Input P (normally the process input to the controller function block). Each alarm can be configured as NONE, HI, LO, HDEV, LDEV, DEV, and OR.

Deviation type alarms compare Input P with Input D, the deviation input, normally the loop setpoint (i.e. the setpoint to the controller function block), having the same range as Input P. An Out of Range (OR) alarm compares the process input with the range limits specified by the range pointer parameter (input R). This parameter must point to a function block that includes MINScale and MAXScale configuration parameters (e.g. Analog Input) for proper scaling. If not configured, 0.0-100.0 will be used as a default range.

Alarms have priorities 1 to 5, with 1 the highest and are reported to the operator faceplate in order of priority first and then in order of occurrence. Priority 1 causes the station bargraphs and condition (e.g. A1 HI) to flash and requires acknowledgment to stop flashing. Priority 2 also flashes the bargraphs and condition but stops flashing when the alarm clears (i.e. Self Clearing). Priority 3 causes the event LEDs (L and S) and condition to flash. Flashing stops only when the alarm is acknowledged. Priority 4 also causes the event LEDs and condition to flash but stops when the alarm clears. Priority 5 displays the alarm but does not require that it be acknowledged.

Alarm limits are in engineering units. A quickset ALARM feature is also available allowing alarm limits to be set quickly during operation. The settings are in engineering units but will also be displayed in % of range on the bargraph. Alarms are displayed as defined by the range pointer parameter. Alarms can be set to any engineering value within -10% to 110% of the range defined by the pointer. If a range is changed, the current alarm settings will be changed to the same % within the new range. For example, if a HI alarm is currently set at 100.0 with a range of 0.0 to 100.0 and the range is changed to 300.0 to 400.0, the HI alarm will be moved to 400.0.

Each alarm can be enabled or disabled when in the quickset ALARM mode. The configuration allows an alarm to be enabled or disabled on a cold start. When an alarm is disabled, it will not operate but will retain settings for return to the enabled mode. Complete operator faceplate functions, relating to alarms, are described in the sections describing the specific faceplate design. All alarms have the following features:

Deadband - requires that the signal either drop below or exceed the limit setting by the amount of the deadband before the alarm clears (goes low). The alarm deadband is set as a fixed % of the range pointer scale.

Delay-In Time - requires that the input remain above (or below) the limit setting for the delay time before the alarm trips (goes high). This can help prevent nuisance alarms that may be tripping due to process noise.

Delay-Out Time - requires that the input remain below (or above) the limit setting plus deadband for the delay time before the alarm will clear (goes low). This can help prevent inadvertent clearing of alarms due to process noise.
Ringback - causes a previously acknowledged alarm to require acknowledgment (priorities 1-4) when the alarm clears.

**Alarm Types**

**HI** compares the process input with the limit setting and it will trip the alarm status high (1) when the process is equal to or higher than the limit setting. The alarm status will clear (0) when the process is less than the limit setting minus the deadband.

**LO** compares the process input with the limit setting and it will trip the alarm status high (1) when the process is equal to or less than the limit setting. The alarm status will clear (0) when the process is greater than the limit setting plus the deadband.

**HI DEV** compares the difference between the process input and the deviation input (P-D) with the limit setting and it will trip the alarm status high (1) when (P-D) is equal to or greater than the limit setting. The alarm status will clear (0) when (P-D) is less than the limit setting minus the deadband.

**LO DEV** compares the difference between the deviation input and the process input (D-P) with the limit setting and it will trip the alarm status high (1) when (D-P) is equal to or greater than the limit setting. The alarm status will clear (0) when (D-P) is less than the limit setting minus the deadband.

**DEV** compares the absolute difference between the process input and the deviation input |P-D| with the limit setting and it will trip the alarm status high (1) when |P-D| is equal to or greater than the limit setting. The alarm status will clear (0) when |P-D| is less than the limit setting minus the deadband.

**OR** compares the process input with the range limits referenced by the range pointer parameter and will trip the alarm status high (1) when the process is equal to or greater than the high limit or equal to or less than the low limit. The alarm status will clear (0) when the process is less than the high limit minus the deadband or greater than the low limit plus the deadband.

POWER UP - During a warm start, all alarms will be handled the same as during a hot start: outputs are initialized at the last state, all previously acknowledged alarms are treated as acknowledged, and any new alarms will be processed on the first scan cycle. On a cold start, all alarm outputs are initialized at 0, all alarms are reset and any new alarms, based on the block inputs, will be processed during the first scan cycle. Also, during a cold start, alarms will be enabled or disabled as determined by the PU ENable parameters.

**Alarm Status**

Alarm status is available with Modbus communication or the Local Instrument Link option for alarm management at a remote location. The alarm status is available in coils with Modbus communication or the same information is packed into a single word (Alarm Status Word) with LIL communication. Detailed information can be found in the Network Communications section of this document.
An alarm status word is shown below.
\( A_\_\_1 \) when the alarm is active
\( N_\_\_1 \) when the alarm is Not acknowledged
\( E_\_\_1 \) when the alarm is enabled (when the alarm is disabled the E, N, and A bits are set to 0)
\( OS=1 \) indicates that all alarms are identified as Out of Service which means that all alarms function normally but the OS flag indicates to a higher level device that they can be ignored. OS cannot be set locally.
\( CC=1 \) indicates a configuration change has occurred. It can be reset by a write command.
\( AE=1 \) indicates an Active Event is present within the loop. It will clear when all the loop events clear.
\( NA \) will be set to 1 when events occur and at least one within the loop has not yet been acknowledged. It can be reset to 0 which will acknowledge all events within the loop or when 0 will indicate all active events have been acknowledged.

<table>
<thead>
<tr>
<th>BIT</th>
<th>15</th>
<th>14</th>
<th>13</th>
<th>12</th>
<th>11</th>
<th>10</th>
<th>9</th>
<th>8</th>
<th>7</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AE</td>
<td>NA</td>
<td>CC</td>
<td>OS</td>
<td>E4</td>
<td>N4</td>
<td>A4</td>
<td>E3</td>
<td>N3</td>
<td>A3</td>
<td>E2</td>
<td>N2</td>
<td>A2</td>
<td>E1</td>
<td>N1</td>
<td>A1</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

### 3.2.13 AND_ - AND Logic

**AND** function blocks perform a logical AND on the three inputs. Any unused input will be set high (1).
3.2.14 AOE_ - Analog Output - Ethernet (V2.4)

- Ethernet is available on Procidia ipac and Moore 353 controllers; not available on Moore 352P and 354/354N.

AOE_ function blocks are available when the optional Ethernet communication board is installed. Up to 32 AOE blocks are available and are assigned in sequence with each use, station wide.

The range pointer parameter (Input R) enables the block to pass the range scaling to AIE function blocks in other Moore and Procidia controllers connected over the Ethernet network.

3.2.15 AOL_ - Analog Output - LIL

AOL_ function blocks are available when the optional LIL communication board is installed. They enable the station to provide a LIL global output, received as an interconnection from another function block. AOL block numbers are assigned in sequence with each use, station wide. The configuration requires the entry of a LIL Channel number to which the data is to be assigned. The range pointer parameter (input R) enables the block to scale the LIL global output (GO), in the standard $80-$F80 range, for the range of input S. If the pointer is not configured the value will be scaled as 0.0 to 100.0.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>256</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>GO</td>
<td>MINSCALE</td>
<td>MAXSCALE</td>
<td>ENG UNITS</td>
<td>Input S</td>
<td>105</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3.2.16  **AOP_ - Analog Output lev_Percent**

**AOP_** function blocks convert a function block interconnection signal, input S, to a output which is bound to a network variable in a node on the LonWorks network having a SNVT (Standard Network Variable Type of lev_percent). A maximum of 25 AOP blocks can be used, up to the limit of nodes allowed on the Lon network or the memory limit of the controller. Each use of the block will be assigned a unique station wide ID (e.g. AOP13). These blocks will be available when the LonWorks option board is installed in a 352P, 353, or 354N controller.

The range pointer parameter (input R) tells the function block where to obtain the signal’s range scaling information. An unconfigured range pointer will use a default range of 0.00 to 100.00. The signal will be scaled and transmitted on the network as a SNVT_lev_percent (SNVT #81) data type. The NV NUM parameter enables viewing the output variable number. This may be needed when using a remote PC network manager to bind this output with the network variable in a remote node.

The block output QS indicates the quality status of the Lon output and will go high when the output is of bad quality. Bad quality usually indicates a loss of communications within the LonWorks network.
### 3.2.17 AOUT_ - Analog Outputs

**AOUT_** function blocks convert function block interconnection signals, connected to input S, to a block output having a range of 4-20 mA. Input D can be used to disconnect the output from the load when asserted high (1). This feature is useful when two or more controllers are connected to a common load. When one controller is connected to the load, others are disconnected using the disconnect feature. The function block includes scaling to range the 4-20 mA output with the block input signal. The range pointer parameter (input R) tells the block where to obtain scaling information. If this parameter is not configured the block will use a range of 0.0 to 100.0.

Two analog output function blocks are available on the Controller Board and one additional on the Expander Board. Function block names and terminal identifications are listed below. The output is factory calibrated for 4-20 mA and should not require field calibration. However, field calibration can be performed if desired. The output is calibrated by adjusting the pulser until the desired output (i.e. 4.0 mA for zero) is obtained and then pressing the store button. A verify mode is available during calibration that will show the mA value in the numeric display as the pulser adjusts the output over the full range.

Output QS is the Quality Status output. It will go high if the output driver detects a high impedance or an open circuit. The alphanumeric will flash AOUT_OC when an open circuit condition is detected. The QS output could also be used to switch to a second output circuit in a redundancy application.
### 3.2.18 ASN_ - ARCSINE

**ASN_** function blocks, in firmware 1.30 and higher, accept an input between -1.0 and 1.0 and provide an output signal in radians of which the input is the sine.

![BLOCK DIAGRAM](image)

**ARCSINE**

**Input**

- X

**Output**

- O1

\[ O1 = \text{ASIN}(X) \]

**Parameter**

- ASN ESN = 000

- Exec. Seq. No. = 000

- SNAP

- BLOCK DIAGRAM

---

### 3.2.19 ATD_ - Analog Trend Display

**ATD_** blocks, in firmware 1.30 and higher, can be used as needed in loops (up to a maximum of 5 per loop) to trend an analog variable connected to input A. The block can store up to 170 data points depending upon the use of the enable/disable function (see below). A trend can be displayed using Modbus commands. Data can be retrieved and displayed by a remote operator station that can retrieve, interpret, and display data packets from the station. A PC or Istation running Iware PC operator interface software can display trend data on a Loop Detail screen or Analog Detail screen.

Parameter TRND TYP allows data to be stored in one of two formats: the average over each sample time or the peak/peak values of the data over each sample time. All data is stored in a normalized form based on the value of the RG PTR (range pointer) input. The range information will be part of the data packet when retrieved over the network communications. When this input is unconfigured, a range of 0.0 - 100.0 will be used.

Several inputs can control the operation of the ATD function block. Input E (enable) can be used to enable the trend function when high (1) or unconfigured. Trend action can be disabled by setting E low (0). Each time the function block is enabled a new trend packet will be created.

The block also includes parameter OVERWRIT that, when set to YES, will cause the block to overwrite old data (i.e. circular file). When the parameter is set to NO, the block will stop trending when full and retain the data until reset. When the full state is reached, output TF (Trend Full) will go high (1). This function can be used to enable a second ATD block.
3.2.20 ATN_ - ARCTANGENT

ATN_ function blocks, in firmware 1.30 and higher, output a signal in radians of which the input is the tangent.
3.2.21 BATOT - Batch Totalizer

BATOT function blocks can be used on a one per loop basis and integrate an analog input. Each provides an output signal representing a total integrated value over the time base selected. For example, if the time base is minutes and input A is 5.0 for 60 minutes, output TL would equal 300.0. The total can be displayed on the faceplate as <loop tag>.T if the configuration parameter DISPTOT is set to YES. A 6-character maximum name (e.g. GAL) is entered in configuration under TOTUNIT to identify the totalizer units.

Input S asserted high (1) will stop the integrator action. Input R will cause the integrator function to reset to the initial value (INIT VAL). These inputs do not affect the PuLSe output. The integrator output is summed with the INITial VALue entered in configuration to provide the count total. The INIT VAL is used as the total when the BATOT is reset.

DIR ACT set to YES will cause the integrator to increase its output while NO will cause the integrator output to decrease. When INIT VAL is set to a predetermined batch amount, decreasing action will provide a count down counter. This is sometimes preferred since the count output then represents the amount remaining in a batch.

ZDO is used for setting a small positive value, insuring that the integrator will stop when the flow is shut off, which might not otherwise happen if a flowmeter zero is out of calibration.

The function block has two trip presets: PRESET 1 and PRESET 2. These can be set to cause a high output (1) from A1 or A2 when the count total equals or exceeds the preset values. The preset values, entered in configuration, can also be set using the QUICK button if the parameter QUICKSET has been set to YES. The QS parameter allows fixing the decimal point during quickset to speed up changes to these settings. A parameter value with no decimal point position, the default, is for applications dealing with the totalizer count as whole units. An external preset can be used by providing an input to T1 and/or T2 and when used, the internal preset will be ignored. If an external preset is used, the value can be viewed but not changed in QUICKSET.

The action of the presets is also determined by the action setting of the integrator. When DIR ACT is set to YES the presets will be direct acting and will cause outputs A1 or A2 to go high when the integrated total is equal to or higher than the preset. If set to NO the total will cause A1 or A2 to go high when the total is equal to or lower than the preset. The actual preset value is available on outputs T1 and T2.

The function block can also provide a pulse output to drive a remote counter. The pulse output function integrates the input signal using the same time base and output pulses at a rate determined by the PUL SCAL configuration parameter. This parameter determines the change to the integrator total that must occur to cause a new output pulse. In the above example, if PUL SCAL equals 10, a total of 30 pulses will have occurred in the same time period. The PUL SCAL value is also the multiplier that would be used to read the exact value of gallons to a remote counter. The pulse output function operates on the absolute value of the analog input. When both negative and positive values are to be totalized, a CoMParator block can be used to sense the polarity of the analog input and the CMP output can then indicate a direction to the counter.

May 2001
Be sure that the PUL SCAL setting does not require a pulse rate output greater than the scan cycle time of the controller under the maximum input conditions. Using the same example, if the maximum A input is 60.0 and the cycle time is 0.1 sec, the maximum required pulse rate is 0.1/sec. The condition is satisfied since the maximum output requirement is less than the maximum pulse rate of 5/sec available with a 0.1 sec cycle time. The requirement would also be satisfied if a PUL SCAL of 1 was selected which would have required a maximum pulse rate of 1/sec.

POWER UP - During a warm start, if the configuration parameter PU LAST was set to YES, the integrator function will initialize with the last value prior to power down and all outputs will be initialized to the last value prior to power down. If set to NO, or during a cold start, the integrator and all outputs will initialize to 0.

Input EC allows the batch totalizer block to be used with another function block, such as the DINU that provides a count signal. When input A is not configured it will be set to (0.0). The EC input is summed with the initial value for use as the total. This value will now be displayed as the total on the operator faceplate and the presets will act on this value to provide outputs A1 and A2.
3.2.22 BATSW - Batch Switch

**BATSW** function blocks can be used on a one per loop basis. Each is used with a PID function block to eliminate overshoot during startup conditions. When placed in the feedback path of the controller it causes the reset component of the controller to be reduced (if controller action is Rev). Without the use of a batch switch during startup, the controller output \((O1 = GE + R)\) will equal full output since the reset will wind up. This requires the process to overshoot the setpoint in order to bring the controller output back down. With a batch switch in the feedback path, a lower reset value will be present when crossover occurs, thus reducing or eliminating overshoot.

As input \(A\) equals or exceeds the HI or LO LIMIT setting, the output of the batch switch will be either decreased (HI LIMIT) or increased (LO LIMIT), changing the feedback signal and therefore the controller reset signal. This maintains controller output at the batch switch limit setting and eliminates reset windup.

If a controller has a large proportional gain setting, the reset can be modified too much, such that the process may under shoot the setpoint during a startup condition. The BPL (Batch Pre-Load) is adjusted to optimize the controller for startup conditions by limiting how much the batch switch can adjust the controller feedback signal.

When the controller output is within its normal operating output, the batch switch has no effect on the controller. This allows the controller to be tuned optimally for normal operating conditions and the batch switch to add additional compensation, very similar to derivative action, only during startup.
3.2.23 BIAS - Bias

BIAS function blocks can be used on a one per loop basis and provide a means to bias a signal, such as the setpoint in an external set application. Inputs A and E (external bias) are summed and then added to the operator adjustable bias B.

Track Command input TC, asserted high (1), will cause the block output to track input TV and BIAS to be recalculated as \( B = TV - (A+E) \). The value of B will be clamped at the HI and LO LIMIT settings. It is important to realize that the inputs and outputs are in engineering units and the limits must be adjusted accordingly with the expected minimum and maximum required range values. The default values have been set to -150.00 and +150.00, which might be the normal expected limits when using the default range of 0.0 to 100.0. These values can be set lower but have a maximum setting of +/-150% of the range pointer value.

The default range is 0.00 to 100.00 if the pointer is not configured.

If, for example, the BIAS block is used to bias a flow setpoint with a range pointer (input R) of 0-6.00 GPM, the maximum bias adjustments would be +/-9.00. If limit adjustments of +/-50% of this range are desired, then the BIAS block LO LIMIT should be set at -3.00 and the HI LIMIT at +3.00. If a range change is made the current LIMIT settings and the current BIAS value will be changed to be the same % value within the new range.

The BIAS can be adjusted using the QUICKSET feature if the parameter QUICKSET is set to YES. The BIAS value will continuously change as the knob is adjusted but the STORE button must be pressed when the final value is reached to insure that the new BIAS setting will be retained on a Cold power up condition.

Any unused inputs to the block will be set equal to 0.

The TO (Tracked Output) is normally used in applications where an external device is being used to set a bias in place of the BIAS parameter (B is then set to 0.0). When it is desired to have the output of the BIAS block track the TV variable, the external device is forced to track TO. Input E will then equal TV - [A+(0.0)] and, therefore, the BIAS block output O1 will equal TV.
### 3.2.24 CIE_ - Coil Inputs - Ethernet (V2.4)

- Ethernet is available on Procidia ipac and Moore 353 controllers; not available on Moore 352P and 354/354N.

CIE_ function blocks are available when the optional Ethernet communication board is installed. They allow the controller to obtain up to 16 discrete Modbus coil data from other stations over Ethernet. A configuration value of 0000 will turn off the channel. The configuration includes the IP address of the other device on the Ethernet network, the number of coils requested, and the starting coil address. Up to 32 CIE_ blocks are available and are assigned in sequence with each use, station wide. The data are received as boolean values that are dispersed to individual boolean outputs. C0 gets the value of the first start-coil and each subsequent output gets the next value. If there are less than 16 coils, the remaining values will be set to zero.

### 3.2.25 CHR_ - Characterizer

CHR_ function blocks provide 10 segments that can be used to characterize the X input signal. Individual segments are configured by entering the Xn, Yn and Xn+1, Yn+1 points for each segment. All Xn+1 points must be greater than the associated Xn points. Input X is in engineering units and the Y points should be in the engineering units desired for the characterizer output.
3.2.26 CMP_ - Comparator

CMP_ function blocks compare analog input A with an external or internal limit setting and provide a high (1) output when the limit is exceeded.

ACTION - the CMP block can be configured as direct or reverse action. Direct action will cause the output to go high when input A is equal to or greater than the limit. Reverse action will cause the output to go high when input A is equal to or less than the limit.

DEAD BAND - the output will return from a high (1) output to a low (0) output when input A is less than the limit - Dead BAND setting for direct action or greater than the limit + Dead BAND for reverse action.

EXTERNAL LIMIT - When input EL is configured, the LIMIT setting will be ignored and the value of input EL will be used as the limit value.

3.2.27 COS_ - COSINE

COS_ function blocks, in firmware 1.30 and higher, accept radian inputs and output the cosine of that angle.
### 3.2.28 DAM_ - Deviation Amplifier

**DAM_** function blocks compute the difference between inputs A and B, amplify the difference signal, and sum the resultant with an internal BIAS and an external signal at input C. Unused inputs are set to 0.0.

![Block Diagram of DAM_ - Deviation Amplifier](image)

**Formula:**

\[ O1 = \text{GAIN} \times (A - B) + \text{BIAS} + C \]
3.2.29 DID_ - Digital Input lev_Discrete

DID_ function blocks convert 16 on/off signals received from a single or multiple nodes on the LonWorks network into 16 block outputs for use by other function blocks within the controller. A maximum of 6 DID blocks can be used, up to the limit of nodes allowed on the Lon network or the memory limit of the controller. Each use of the block will be assigned a unique station wide ID (e.g. DID02). Input connections are established by ‘binding’ each output variable of type SNVT_lev_disc (SNVT #22) in the remote node devices to each network variable in the DID function block. These blocks will be available when the LonWorks option board is installed in a 352P, 353, or 354N controller.

The 0 NV NUM parameter enables the number that the station has assigned to input 0. All subsequent network variables are assigned consecutively.

Each function block output has a mode associated with it. The mode can be either NORMAL or FORCED. When using a PC capable of sending LIL or Modbus commands, the mode can be changed and the forced state can be assigned a high (1) or low (0) value. The values accessible over the network are the two switch inputs (N and F) and the position of the SPDT switch illustrated in the block diagram. A mode of ‘0’ is Normal and ‘1’ is Forced.

Each function block output also has a quality status associated with it. This status will go high (1) when the block determines it has lost communication with the Lon node. If any of the individual quality outputs are high the Quality Status block output will also be high.
3.2.30 DIE_ - Digital Input - Ethernet (V2.4)

- Ethernet is available on Procida i|pac and Moore 353 controllers; not available on Moore 352P and 354/354N.

**DIE_ function blocks** are available when the optional Ethernet communication board is installed. They allow the controller to obtain up to 16 digital points from another Moore or Procida controller over the Ethernet network. Up to 32 DIE_ blocks are available and they are assigned in sequence with each use, station wide. The data is received as an integer value and is fanned out to the block outputs D0 - DF.

Output QS indicates the quality of the received data and will go high (1) when the data is bad. This is normally associated with failure to receive data due to a communication failure or a misconfiguration of the source.

Modbus registers associated with DOE function blocks for digital inputs coming from other controllers are listed below.

<table>
<thead>
<tr>
<th>FB Number</th>
<th>MB Register</th>
<th>FB Number</th>
<th>MB Register</th>
<th>FB Number</th>
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<td>DOE24</td>
<td>31048</td>
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</tbody>
</table>

3.2.31 DIL_ - Discrete Input _ LIL

**DIL_ function blocks** are available when the optional LIL communication board is installed. DIL block numbers are assigned in sequence with each use, station wide. The block allows the station to obtain a global word (GW) from another station on the LIL.

The function block has 16 outputs, D0 through DF, which represent the values of bits 0-F in the global word. Output QS indicates the quality of the received data and will go high (1) when the data is bad. This is normally associated with failure to receive global data due to a LIL failure or a misconfiguration of the source.

The received global word will also be re-transmitted by this station as a parameter 1 value in the configured channel n.
3.2.32 DIN_ - Digital Inputs

DIN_ function blocks can be used to sense a discrete signal from an external source and provide a block output representing the state of this signal. Blocks are available on the Controller Board and on the Expander Board. Function block names (IDs) and terminal designators are listed in Section 8.4.

The block output is high (1) when the input is on and low (0) when off.

Output QS indicates the quality status of the output signal O1 and will be high (1) when the output is of bad quality. Bad quality indicates any hardware failure of the input converter.
3.2.33 DINU_- Digital Inputs, Universal

DINU_- blocks have multi-function capability:

- sensing a discrete input and providing a high (1) or low (0) output representing the state of the input
- totalizing and scaling the count of input pulses
- converting the rate of input pulses to a scaled analog frequency output

Two DINU_- blocks are available on the I/O expander board. The fixed names (IDs) of these blocks and their terminal designations are listed in Section 8.4.

Output CT represents the scaled (actual count x K) total of input pulses that occurred since the last reset. This output is a real number and can be used in a number of applications, such as a direct count input to the BAT batch totalizer function block or in math operations, such as computing the difference between counts in a ratio trim circuit.

Output IS is the current state of the input at the time the block is executed at the start of each controller scan cycle. It will be low (0) when the input is low and high (1) when the input is high.

Output SF is a scaled frequency (using the FREQ MIN and MAX parameters) that can represent flow rate, speed, etc. It will be low (0) when the input is low and high (1) when the input is high.

Input R resets output CT to 0.0. Input D controls the direction of the count. When direction input D is low (0), the count will move backwards, including negative values. The direction input feature enables the use of count down counters and it allows duplication of functions performed by previous computer pulse interfaces having a Pulse/Direction format. Input TC asserted high (1) will force the scaled count to track an external signal. This can be used in applications where the CT output is being used to set a value (e.g. setpoint) that can be changed from another source.

The quality status output QS indicates the quality of the block outputs and is high (1) when outputs CT, IS, or SF are of bad quality. Bad quality indicates a failure in the hardware conversion circuit.

POWER UP - With PU LAST set to YES, the CT output will power up at the last value during a hot or warm start. If set to NO, during a warm or a cold start it will be set to 0.0. The digital filter will be temporarily bypassed during a hot, a warm or a cold start.
3.2.34 DIS_ - Digital Input _ State

DIS_ function blocks, in firmware 1.30 and higher, convert a 16-bit word received from a single node on the LonWorks network into 16 block outputs for interconnection to other function blocks within the controller. A maximum of 6 DIS blocks can be used, up to the limit of nodes allowed on the Lon network or the memory limit of the controller. Each use of the block will be assigned a unique station wide ID (e.g. DIS02). Input connections are established by ‘binding’ the output variable of type SNVT_state (SNVT #83) in the remote node to the network variable in the DIS function block. These blocks will be available when the LonWorks option board is installed in a 352P, 353, or 354N controller.

The 0 NV NUM parameter enables viewing the number that the station has assigned to input 0.

Each function block output has a mode associated with it. The mode can be either NORMAL or FORCED. When using a PC capable of sending LIL or Modbus commands, the mode can be changed and the forced state can be assigned a high (1) or low (0) value. The values accessible over the network are the two switch inputs (N and F) and the position of the SPDT switch illustrated in the block diagram. A mode of ‘0’ is Normal and ‘1’ is Forced.

The function block also has a quality status output associated with it. This status will go high (1) when the block determines it has lost communication with the Lon node.
3.2.35 DIV_ - Division

DIV_ function blocks perform simple arithmetic division. The output will be the quotient of the two configured inputs N/D. The output will be limited to the maximum real number and, if the divisor is 0.0, the output will go to the maximum real number with the sign determined by the numerator. If the numerator is 0.0, the output will be 0.0.

Any unconfigured inputs will be set equal to 1.0.

3.2.36 DNC_ - Divide by N Counter

DNC_ function blocks provide a single output pulse for a pre-selected number of input pulses. The output will go high (1) with a positive transition of the input P and will return to a low (0) output on the succeeding positive transition.

POWER UP - During a hot or a warm start, with PU LAST set to YES, the block will retain the last count and continue at the last input/output states. If set to NO, during a warm or a cold start, the output and count will be initialized to 0.
3.2.37 DOD_ - Digital Output lev_Discree

DOD_ function blocks transmit up to 16 on/off signals received from a controller block interconnection to remote nodes on the LonWorks network. A maximum of 6 DOD blocks can be used, up to the limit of nodes allowed on the Lon network or the memory limit of the controller. Each use of the block will be assigned a unique station wide ID (e.g. DOD01). Each input transmitted is of type SNVT_lev_disc and can be bound to network variables in a single or multiple remote nodes that can receive network variables of this type. These blocks will be available when the LonWorks option board is installed in a 352P, 353, or 354N controller. The 0 NV NUM parameter enables the number that the station has assigned to input 0 to be viewed. All subsequent network variables are assigned consecutively.

Each function block input has a mode associated with it. The mode can be either NORMAL or FORCED. When using a PC capable of sending LIL or Modbus commands, the mode can be changed and the forced state can be assigned a high (1) or low (0) value. The values accessible over the network are the two inputs (F and N) and the position of the SPDT switch illustrated in the block diagram. A mode of ‘0’ is Normal and ‘1’ is Forced.

Each function block input also has a quality status associated with it. This status will go high (1) when the block determines it has lost communication with the Lon node bound to that input. If any of the individual quality inputs are high, the Quality Status block output will also be high.
3.2.38 DOE_ - Digital Output - Ethernet (V2.4)

- Ethernet is available on Procidia i|pac and Moore 353 controllers; not available on Moore 352P and 354/354N.

**DOE_** function blocks are available when the optional Ethernet communication board is installed. Up to 32 DOE blocks are available and are assigned in sequence with each use, station wide.

Up to 16 digital inputs can be configured. The block will pack inputs I0 - IF into a single integer word which can be accessed from another controller having Ethernet communication capability.

Each DOE block is automatically assigned Modbus registers that can be accessed from any device having the Modbus Ethernet capability.

![Digital Output Ethernet Diagram](image-url)

3.2.39 DOL_ - Discrete Output - LIL

**DOL_** function blocks are available when the optional LIL communication board is installed. They allow the station to output a global word GW with bits 0-F representing the state 1 or 0 of each of the Boolean inputs D0 - DF. Unconfigured inputs are set to 0. DOL block numbers are assigned in sequence with each use, station wide.

![Discrete Output LIL Diagram](image-url)

<table>
<thead>
<tr>
<th>i</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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</tr>
</thead>
<tbody>
<tr>
<td>n</td>
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<td></td>
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</tbody>
</table>

![Table](image-url)
**3.2.40 DOS__ - Digital Output State**

**DOS__** function blocks, in firmware 1.30 and higher, transmit up to 16 on/off signals received from a controller block interconnection to a remote node on the LonWorks network as a single 16-bit word value. A maximum of 6 DOS blocks can be used, up to the limit of nodes allowed on the Lon network or the memory limit of the controller. Each use of the block will be assigned a unique station wide ID (e.g. DOS01). The transmitted value is of type SNVT_state and can be bound to a network variable in a remote node that can receive a network variable of this type. These blocks will be available when the LonWorks option board is installed in a 352P, 353, or 354N controller.

Each function block input has a mode associated with it. The mode can be either NORMAL or FORCED. When using a PC capable of sending LIL or Modbus commands, the mode can be changed and the forced state can be assigned a high (1) or low (0) value. The values accessible over the network are the two switch inputs (N and F) and the position of the SPDT switch illustrated in the block diagram. A mode of ‘0’ is Normal and ‘1’ is Forced.

The function block also has a quality status associated with it. This status will go high (1) when the block determines it has lost output communication with the Lon node bound to that input.
3.2.41 DOUT_ - Digital Outputs

DOUT_ function blocks are used to turn on remote devices powered from an external source. The negative terminal of the external power source must be connected to station common. The transistor switch will turn on when the block input S is high (1) and will turn off when low (0). Two digital output function blocks are available on the Controller Board.

Terminal Connections:

**DOUT1** ----- DOUT1+ (8) -- DOUT1c (9)
**DOUT2** ----- DOUT2+ (10) -- DOUT2c (9)
3.2.42 DTM_ - Dead Time Table

DTM_ function blocks provide shift registers to hold the analog input signal A for a period of time and shift it from register to register to provide an overall delay between input and output as configured in parameter DEADTIME.

Input AT can be used to adapt the DEADTIME to an external signal. The actual shift register used as the block output will equal the whole value of input AT (e.g. 0.184 = register 0, 1.897 = register 1).

Output MA will provide the moving average of register 0 to the output register divided by the number of registers [e.g. output register = 50, MA = (R0+R1+R2+......+R50)/51].

Input E asserted high (1) will enable the operation of the DTM block. When this input is not configured, it will be set high. A low (0) input will cause all registers and the outputs to equal the input A.

POWER UP - During a warm or cold start, all outputs will be initialized at 0 and all registers will be initialized to the value of the input on the first scan.
3.2.43 DYT_ - Delay Timer

**DYT_** function blocks perform either an ON or OFF output delay as determined by the TYPE configuration parameter.

**ON Delay** - When input P is low (0), output O1 is low. If P goes high (1), the elapsed timer starts and sets O1 high upon reaching the DLY TIME, provided P is still high.

**OFF Delay** - When input P is high (1) the output is high. If P goes low (0), the elapsed timer starts and sets O1 low upon reaching the DLY TIME, provided P is still low.

In firmware 1.30 and higher, the DLY TIME is adjustable over the full range of the display, which is 0.00000 to 999999. In earlier versions, the minimum time setting is 0.1. If the delay time is set to less than the scan time of the station, the delay time will equal the scan time.

Output ET (elapsed time) will ramp from 0.0 to the value of DLY TIME and remain there until P resets the output. Output RT (remaining time) equals DLY TIME - ET.

**POWER UP** - During a warm or a hot start, with PU LAST set to YES, the block will initialize with the input/output states and elapsed time in effect at the instant power down occurred. A cold start, with PU LAST set to NO, will initialize the input/output states and elapsed time to 0.
3.2.44 E/I - External/Internal Transfer Switch

**E/I** function blocks can be used on a one per loop basis to select an analog signal, connected to input E (External) or input I (Internal), as a setpoint for the loop controller.

The position of the E/I switch can be changed on each positive transition of input ST and will normally be connected to the PS output of pushbutton block PB2SW, configured for momentary action. The SE output will normally be connected to the MD input of pushbutton block PB2SW. E/I switch position will be shown on the operator faceplate by a lighted LED: green for E, red for I.

The E/I switch position can also be changed by command over the Modbus or LIL network.

When PU LAST is set to YES, the E/I switch will power up in the last position during a hot or a warm start. During a cold start, it will power up in the position set by the POWER UP parameter. If PU LAST is set to NO, the E/I switch will power up in the last position during a hot start, but during a warm or cold start will power up in the position set by the POWER UP parameter.

The IO (Internal Override) input enables a HI (1) input to temporarily select the Internal Input as the function block output O1. This input does not affect the position of the E/I switch.

Outputs SE and SI indicate the actual position of the E/I switch. SE is HI (1) when in the E position and LO (0) when in the I position. SI is HI when in the I position and LO when in the E position. Outputs IS and ES indicate the actual source of the block output. IS is HI when O1 is the Internal input and is LO when O1 is the External input. ES is HI when O1 is the External input and is LO when O1 is the Internal input.
3.2.45 ESL - Events Sequence Logger

ESL function blocks, in firmware 1.30 and higher, can be used on a one per loop basis to log events within the loop. Each ESL input can be assigned a user tag (up to 8 ASCII characters) that will be displayed when viewing the logged events from the front panel. Events, once triggered by a positive transition 0>1 input, will remain in the logger until reset. Reset can be initiated either by setting input R high (this input is edge sensitive and will reset the events on the leading edge) or by entering configuration and setting the parameter RESET to YES.

Events logged to the ESL function block can be viewed at the operator faceplate by pressing the ACK pushbutton when displaying the loop containing an ESL function block having logged events. The alphanumeric display will first step through any active alarms, status conditions or errors and then all the logged events that occurred since the last reset. The configured 8-character name will be shown in the alphanumeric display and the order of occurrence (ESL-1, ESL-2...) will appear in the numeric display when stepping through the event log. Other events such as alarms, status conditions, or errors can be similarly viewed if logged to the ESL function block.
3.2.46 **EXP_ - NATURAL EXPONENTIATION**

**EXP_** function blocks, in firmware 1.30 and higher, perform the natural exponentiation function, base “e”. The output will be the value “e” raised to the power of input X.

![Block Diagram](image1)

3.2.47 **EXT_ - EXPONENTIATION**

**EXT_** function blocks, in firmware 1.30 and higher, will provide an output that equals the Y input raised to the power of X input. All negative values of input Y will be treated as 0.0. When input Y is 0.0 and X is negative, the output will be set to the maximum number (i.e. 1.17...e38).

![Block Diagram](image2)
3.2.48 FTG_ - Falling Edge Trigger

FTG_ function blocks provide a high (1) output for one scan cycle each time input P transitions from a high (1) input to a low (0) input.

![Falling Edge Trigger Block Diagram]

3.2.49 GB_ - Gain & Bias

GB_ function blocks provide action, gain, and bias adjustments to input signal A. Although this block can provide signal scaling, it should not be used if needed as a reference for a range pointer. The SCL function block should be used when scaling is required for this purpose.

![Gain & Bias Block Diagram]

3.2.50 HLD_ - Hold

HLD_ function blocks provide an output equal to the HOLD VAL set in configuration for interconnection to other function blocks.

![Hold Block Diagram]
3.2.51 ID - ID Controller

**ID** is an integral only controller and one of five controller types that can be used on a one per loop basis. It uses external feedback to provide integral action and, therefore, allows interaction with other function blocks or external devices, such as pneumatic controllers and shutoff switches while eliminating windup that can occur with other controller types. Derivative action is provided when the parameter TD is non-zero.

When input A is high (1) the controller will operate in the normal auto mode and when low (0) will cause the output of the lag function to track the feedback signal. This will cause the controller output to track the feedback within the limits. When the controller is switched back to auto, the value at the input of the lag (GE+FB), if the GE is non-zero, will cause the output to integrate to a new output at the TI time constant.

The process range pointer parameter points to a function block that has range scaling, such as the analog input that is providing the process variable signal. This enables the controller to normalize the tuning parameters for the range of the process input. If this parameter is not configured, the controller will use a range scaling of 0.00 - 100.00.

POWER UP - During a warm or cold start, the output will be initialized to the value of the MINScale parameter and all dynamic states will be initialized to their current input value on the first scan cycle.

![ID Controller Block Diagram](image_url)
3.2.52 LL_ - Lead/Lag

LL_ function blocks provide both lead and lag functions. The block can function as lag only by setting the TLEAD time to 0.0. The lag function is always active and has a minimum setting of 0.01 minutes.

Input E asserted high (1) will enable the Lead/Lag function. When asserted low (0), the Lead/Lag function will be bypassed and the output will be set equal to the input. If input E is not configured, the block will be enabled.

![Block Diagram]

POWER UP - During a warm or cold start, the dynamic elements and the output will be initialized to the value of the current input on the first scan.

3.2.53 LMT_ - Limit

LMT_ function blocks are used to limit a real signal. Input A will normally pass through the function block to the output O1. If the input exceeds one of the limits, the block will output the limit value.

If the HI LIMIT is set lower than the LO LIMIT, the block will output the high limit value. The output statuses will be high (1) when the block is in a limit condition.
3.2.54 LN_ - NATURAL LOGARITHM

LN_ function blocks, in firmware 1.30 and higher, will output the natural logarithm of input X. When the input is <= 0.0, the input will be treated as the smallest number greater than 0.0 (i.e. 1.17....e-38) and the LN will be computed accordingly.

3.2.55 LOG_ - LOGARITHM BASE 10

LOG_ function blocks, in firmware 1.30 and higher, will output the logarithm to the base 10 of input X. When the input is <= 0.0, the input will be treated as the smallest number greater than 0.0 (i.e. 1.17....e-38) and the LOG will be computed accordingly.
### 3.2.56 MTH_ - Math

MTH_ function blocks provide universal arithmetic capability. As shown in the block diagram, each input has gain and bias scaling. The resulting signals are then applied to configurable math operations (DIV, MUL, ADD and SUB). Operation A will be performed first on inputs A and B. Operation B will be performed next on the resultant and input C.

Unused inputs to a MUL or DIV operation will be set to 1.0 and those to an ADD or SUB operation will be set equal to 0.0. The operation of those inputs will function normally so it is important to insure that the bias and gain settings are set properly.

In a DIV operation, when a divisor is 0.0 the output will go to the maximum Real number with the sign determined by the numerator. If the numerator is 0 the output will be 0.
### 3.2.57 MUL_ - Multiplication

MUL_ function blocks perform arithmetic multiplication on the three input signals. Any unused input will be set to 1.0 and will therefore have no affect on the output.

**Block Diagram**

\[ O_1 = A \times B \times C \]

### 3.2.58 NND_ - NAND Logic

NND_ function blocks perform a logical NAND on the three inputs. Any unused input will be set high (1).

**Truth Table**

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>Output 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
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<tr>
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<td>1</td>
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</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

**Block Diagram**
3.2.59 NOR - NOR Logic

NOR function blocks perform a logical NOR on the three inputs. Any unused input will be set low (0).

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>Output 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
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<tr>
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<td>1</td>
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</tr>
<tr>
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<tr>
<td>1</td>
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</tr>
<tr>
<td>1</td>
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</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

3.2.60 NOT - NOT Logic

NOT function blocks perform a logical NOT on input A. Any unused input will be set low (0).
3.2.61 ODA - Operator Display for Analog indication & alarming (V2.2)

ODA blocks are one of five operator displays that are used on a one per loop basis to configure the local operator display functions and network parameters. See the i|ware PC faceplate on the next page.

The block will display up to four process variables P1 to P4 in both analog bargraph and digital form. There are two alarms associated with each process variable. They can be configured as HI or LO alarms. Each alarm function has associated block outputs that are high (1) when the alarm is active. Output LE is high (1) when a loop event is active. Output SE is high when a station error is active. LOOP # parameters are used to index reads and writes to Modbus and LIL network parameters. See Sections 6 and 7 for network parameters.

The VIEW OD parameter, when set to YES, enables the operator display to be viewed and accessed locally. In cases where it is desired to view display or operation parameters only from a network workstation, the parameter should be set to NO.

Range pointers (i.e. R1 to R4) for all four process inputs must be configured to define the range of each variable input (i.e. P1 to P4). If these parameters are not configured, the bargraphs will be scaled using the engineering range of 0.00 to 100.00. This information also defines the scaling of the loop information provided to a remote workstation over the network (i.e. Modbus or LIL).

Each process variable can be displayed on the local faceplate using the D button. When first stepping into a loop using the Loop button, the loop tag will be displayed (e.g. AnDisp1). However, if there is a point within the loop that has an unacknowledged alarm, that point will be displayed alternating between the point tag and the alarm condition (e.g. P693/3B LO). Press the D button to scroll through the analog points displaying the point tag (e.g. T712) in the alphanumeric and the value of the point in the digital display (e.g. 348.47). Press the UNITS button to display the units of the point. Press the Loop tag to return to displaying the loop tag.

Alarm Types

HI compares the process input with the limit setting and trips the alarm status high (1) when the process is equal to or higher than the limit setting. The alarm status will clear (0) when the process is less than the limit setting minus the deadband.

LO compares the process input with the limit setting and trips the alarm status high (1) when the process is equal to or less than the limit setting. The alarm status will clear (0) when the process is greater than the limit setting plus the deadband.

OR compares the process input with the range limits referenced by the range pointer parameter. It will trip the alarm status high (1) when the process is equal to or greater than the high limit, or equal to or less than the low limit. The alarm status will clear (0) when the process is less than the high limit minus the deadband or greater than the low limit plus the deadband.
Alarms have priorities 1 to 5, with 1 the highest. Alarms are reported to the operator faceplate in order of priority first and then in order of occurrence. Priority 1 causes the station bargraphs and condition (e.g. A1 HI) to flash and requires acknowledgment to stop flashing. Priority 2 also flashes the bargraphs and condition but stops flashing when the alarm clears (i.e. Self Clearing). Priority 3 causes the event LEDs (L and S) and condition to flash. Flashing stops only when the alarm is acknowledged. Priority 4 causes the event LEDs and condition to flash but flashing stops when the alarm clears. Priority 5 displays the alarm but does not require that it be acknowledged.

Alarm limits are in engineering units. A quickset ALARM feature is also available allowing alarm limits to be set quickly during operation. The settings are in engineering units but will also be displayed in % of range on the setpoint bargraph when viewing a point. Alarms are displayed as defined by the range pointer parameter. Alarms can be set to any engineering value within -10% to 110% of the range defined by the pointer. If a range is changed, the current alarm settings will be changed to be the same % within the new range. For example, if a HI alarm is currently set at 100.0 with a range of 0.0 to 100.0 and the range is changed to 300.0 to 400.0, the HI alarm will be moved to 400.0.

Each alarm can be enabled or disabled when in the quickset ALARM mode. The configuration allows an alarm to be enabled or disabled on a cold start. When an alarm is disabled, it will not operate but will retain settings for return to the enabled mode. Complete operator faceplate functions, relating to alarms, are described in the sections describing the specific faceplate design. All alarms have the following features:

- **Deadband** - requires that the signal either drop below or exceed the limit setting by the amount of the deadband before the alarm clears (goes low). The alarm deadband is set as a fixed % of the range pointer scale.

- **Delay-In Time** - requires that the input remain above (or below) the limit setting for the delay time before the alarm trips (goes high). This can help prevent nuisance alarms that may be tripping due to process noise.

- **Delay-Out Time** - requires that the input remain below (or above) the limit setting plus deadband for the delay time before the alarm will clear (goes low). This can help prevent inadvertent clearing of alarms due to process noise.

- **Ringback** - causes a previously acknowledged alarm to require acknowledgment (priorities 1-4) when the alarm clears.

![Aux Ind](image1)

![AnDisp1](image2)

![iware PC Faceplate Display](image3)

![BLOCK DIAGRAM](image4)
3.2.62 ODC - Operator Display for Controllers

ODC blocks are one of five operator displays that are used on a per loop basis to configure the local operator display functions and network parameters from a remote operator workstation associated with the loop. See the iware PC faceplate on the next page.

The following features are in firmware 1.30 and higher.

1. A new parameter, VIEW OD, when set to YES, the default setting, enables the operator display to be viewed and accessed locally using the LOOP button. In some cases, it may be desired to view only display or operation parameters with a network workstation and not allow operation or viewing of the control loop from the local display. Here the parameter should be set to NO.

2. Output LE is high (1) when a loop event is active. Output SE is high when a station error is active.

3. The LOOP # (this parameter was MB INDEX in version 1.21) is used to index reads and writes to Modbus parameters. The LIL has 25 parameters: C1S, C2S, C3S, C4S, C5S, C6S, C7S, C8S, C9S, C10S, C11S, C12S, C13S, C14S, C15S, C16S, C17S, C18S, C19S, C20S, C21S, C22S, C23S, C24S, C25S. When an ODC block has been selected and the LOOP # has been configured, the corresponding C#S LIL parameter will contain the LIL starting Chan (n) location. The LOOP# must be entered to enable either LIL or Modbus communications.

Range pointers for both the process/setpoint and valve bargraphs must be configured to define the range of the variable inputs to P, S, and V. If these parameters are not configured, the bargraphs will be scaled using the engineering range of 0.00 to 100.00. The range pointer for X and Y define the displayed decimal point position and the units code. This information also defines the scaling of the loop information provided to a remote workstation over the network (i.e. Modbus or LIL).

Input variables P, S, V, X, and Y are shown in the numeric display, using the engineering UNITS and the preferred DPP of the range pointer. The Total from the BATOT will also be displayed when configured within the BATOT block. If a value is greater than allowed by the DPP parameter, the decimal point will be shifted to allow the display to show the full number, until it exceeds the maximum available digits, at which time it will indicate over range.

When input U1 or U2 goes high (1), the 8-character user status (U_STATUS) will be displayed as configured by the status priority (U_PRIOR). A priority of 0 will disable that status function setting the bits in the status word to 0. See Section 9 Operation for a description of display actions using priorities 1 to 5.

The horizontal bargraph can be selected as direct or reverse acting. This feature allows it to always indicate an OPEN valve when fully lit. The labels on the basic faceplate are fixed, but paste on labels can be used to change the indications. The V NET AC parameter allows the LxVI network parameter to be set for direct or reverse action. This enables the valve on the HMI to operate similar to the valve bar on the faceplate. The left and right bar labels should be set accordingly (e.g. Left = “OPEN & Right = CLOSE”).
An operator display must be configured to map controller loop data to network data. Loop network data is mapped into registers or coils when the standard Modbus interface is used and to channels/parameters when the optional LIL interface has been added. Mappings for both Modbus and LIL are listed in the tables included in the ‘Network Communications’ section. The ‘LOOP #' and ‘LIL CHAN’ parameters enable configuration of a loop index number (x) for Modbus data or a starting channel (n) for LIL loop data.

Input CL controls local arbitration of changes to loop data from the network. When input CL is not configured, the three status outputs LO (in 1.21 firmware this output was named L), CN, and CM will be set high (1) and changes can be made from a network command or the local faceplate. When CL is configured, it can be changed locally from a pushbutton switch such as PB1SW output PS (configured as momentary) and will change from local to console or console/computer to local with each positive transition of the input. Also, when output LO goes high, output CN will also go high and CM will go low, indicating that the control source will change to Console whenever Local is disabled, either by a positive transition on input CL or from a network command. The Computer CM state can be set high using a network command. The NL output will normally be connected to the MD input of pushbutton block PB1SW to indicate the C/L switch position on the operator faceplate, a green LED for C and a red LED for LO.

Output WD will go high (1) when the controller fails to receive a Modbus network command within the watchdog time. The watchdog time is set in the STATN (Station Parameters) function block. Input A can be used to acknowledge all the alarms in all of the loops in a controller. Output PN (Pulse oN) will go high for 0.5 seconds (or one scan cycle whichever is longer) whenever the bargraph flashes. Bargraph flashing is controlled by the priority setting of alarms or events. Output PF (Pulse ofF) will go high for 0.5 sec when the flashing bargraph is stopped (e.g. pressing the ACK button).
3.2.63 ODD - Operator Display for Discrete indication & control (V2.2)

ODD function blocks are one of five operator displays that can be used on a one per loop basis to configure the local operator display functions as well as network parameters. See the icware PC faceplate example on the next page.

The ODD function block displays up to 16 discrete variables. Each input has a corresponding block output that is equal to the input when the variable mode is in Auto. Each input variable can be assigned a mode. The value of the output can be changed while in Man by using the pulser and pressing the ACK button. When a variable is switched to Manual it will always equal the input value until changed.

The LOOP # parameter is used to index reads and writes to Modbus and LIL network parameters. When using the LIL, the LIL CHAN parameter must also be configured. See Section 6 for more information on network parameters.

The VIEW OD parameter, when set to YES enables the operator display to be viewed and accessed locally. In cases where it is desired to view display or operation parameters only from a network workstation, the parameter should be set to NO.

During a cold or warm start, each input variable will power up in the auto mode. During a hot start, the mode and manual value will equal the value prior to power down.

Each discrete input variable can be displayed on the local faceplate using the D button. When first stepping into a loop using the Loop button, the loop tag will be displayed (e.g. DigDisp1). Pressing the D button will scroll through the discrete points displaying the point tag (e.g. SV-103) in the alphanumeric and the value of the input on the left 3 positions of the digital display (e.g. On) and the output in the right most 3 positions (e.g. OFF).

The A/M button will display the point mode and enable switching the point between auto & manual using the A/M button. The manual value can be changed by turning the pulser and pressing the ACK button. If the ACK button is not pressed within 4-5 seconds, the display will return to the actual output value.
DigDisp1

<table>
<thead>
<tr>
<th>#</th>
<th>TAG</th>
<th>IN</th>
<th>MODE</th>
<th>OUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>SV101</td>
<td>A</td>
<td>ON</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>SV102</td>
<td>A</td>
<td>OFF</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>SV103</td>
<td>A</td>
<td>ON</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>LS103</td>
<td>A</td>
<td>OFF</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>PS105</td>
<td>A</td>
<td>ON</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>MS105</td>
<td>A</td>
<td>ON</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>SV107</td>
<td>A</td>
<td>ON</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>LS109</td>
<td>A</td>
<td>OFF</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>SV110</td>
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<td></td>
</tr>
<tr>
<td>9</td>
<td>PS115</td>
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<td>ON</td>
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<td>SV117</td>
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<td>D</td>
<td>LS124</td>
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<td></td>
</tr>
<tr>
<td>E</td>
<td>MS123</td>
<td>A</td>
<td>ON</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>MS129</td>
<td>A</td>
<td>OFF</td>
<td></td>
</tr>
</tbody>
</table>

DigDisp1

Block Diagram

SV-103

SV-206

iware PC Faceplate Display
3.2.64 ODP - Operator Display for PushButtons (V2.2)

ODP function blocks are one of five operator displays that can be used on a one per loop basis to configure local operator display functions as well as network parameters. See the i ware PC faceplate example on the next page.

The ODP function block can provide up to 8 groups of two pushbuttons and one selector switch. Each group includes:

- One normally open pushbutton, identified as PB1, on the local faceplate. It can have a 6-character tag to identify the button function on a HMI display.
- One normally closed pushbutton, identified as PB2 on the local faceplate. It can have a 6-character tag for display on an HMI.
- One two-position selector switch identified as A/M on the local faceplate. It can have a 6-character tag for switch position identification on an HMI.

Each group also has a set of 6-character messages associated with the status of a feedback signal (1/0).

Each pushbutton has a configuration parameter that controls how long the button function will be held in the pressed position. The default value is 1 second but can be set from 0.1 (or scan time if greater than 0.1) to 10 seconds.

The LOOP # parameter is used to index reads and writes to Modbus and LIL network parameters. When using the LIL, the LIL CHAN parameter must also be configured. See Sections 6 and 7 for more information on network parameters.

The VIEW OD parameter, when set to YES enables the operator display to be viewed and accessed locally. In cases where it is desired to view display or operation parameters only from a network workstation, the parameter should be set to NO.

During a cold or warm start, the A/M switch will power up in the Auto position. During a hot start, the A/M switch will power up in the position prior to power down.

Each group can be displayed on the local faceplate using the D button. When first stepping into a loop using the Loop button, the loop tag will be displayed (e.g. PBDisp1). Pressing the D button will scroll through the groups displaying the group tag (e.g. MSI036) in the alphanumeric and the value of the feedback in the digital display (e.g. 1). The feedback message associated with this feedback value can be viewed on the local faceplate using the UNITS button. The A/M button will display the position of the group selector switch and enable switching the group selector switch between auto and manual.
i|ware PC Faceplate Display:

**Group 1 Message**

```
11  START  MS1036
```

```
12  STOP
```

```
1A  AUTO  MAN
```

```
1F  0  STOP
```

**Groups 2 to 7**

**Group 8 Message**

```
81  START  MS1036
```

```
82  STOP
```

```
8A  AUTO  MAN
```

```
8F  0  STOP
```

Note: Numbers shown on input lines indicate values of unconfigured inputs.
3.2.65 ODS - Operator Display for Sequencer

ODS function blocks are one of five operator displays available on a one per loop basis to configure the local operator display functions as well as the network commands from an operator workstation associated with the loop. See the iware PC faceplate example on the following page.

The following six enhancements are in firmware 1.30 and higher.

1. The VIEW OD parameter, when set to YES, the default value, enables the operator display to be viewed and accessed locally using the LOOP button. Set the parameter to NO to view the display or operation parameters only with a network workstation and not allow operation from the local display. This may be desired with a sequence/logic loop where local operation is not needed but a workstation needs access to force I/O or sequence parameters for recipe changes.

2. Messages will be available over Modbus or LIL. Refer to the Network Communication section for mapped data points.

3. The # of Recipe messages can now be set to 0 so that a Recipe Message does not appear in the message list.

4. Messages will now function as follows with the local faceplate display:

   When the local display first enters a loop, the convention loop tag and sequence step number will be displayed. When the D button is pressed, the Numeric display will show MSG and the alphanumeric display will show the first message it comes to in the order shown below.

   • Conditional messages will be displayed in the order in which they occurred.
   • The latest message will be displayed first.
   • A new message will override the current message.

   The ACK button can be used to scroll through active messages. It will stay on the last message until a new message overrides it or the ACK button is again pressed. When an active message clears, the message display will loop back and start at the top and display the first message it comes to. Events that require acknowledgment will return the display to the normal mode (i.e. \texttt{<loop tag>\.S}) and will flash the message. When events have been acknowledged they can be viewed using the ACK button. The display can be returned to the MSG mode using the D button and will then display the first message in the Queue.

5. Output LE is high (1) when a loop event is active. Output SE is high when a station error is active.

6. The LOOP # (in version 1.21 firmware this parameter was MB INDEX but they have the same function). It will be used to index reads and writes to Modbus parameters. The LIL has 25 parameters: C1S, C2S, C3S, ..., C25S. When an ODS block has been selected and the LOOP # has been configured, the corresponding C8S LIL parameter will contain the LIL starting Chan (n) location. The LOOP# must be entered to enable either LIL or Modbus communications.
An operator display must be configured in order to properly map station loop data to network data. Sequencer loop network data is mapped onto registers or coils when the standard Modbus interface is used and to channels/parameters when the optional LIL interface has been added. Mappings for both Modbus and LIL are listed in tables in the ‘Network Communications’ section.

Input CL controls local arbitration of changes to loop data from the network. When input CL is not configured, the three status outputs LO (in 1.21 firmware this output was named L), CN, and CM will be set high (1) and changes can be made from a network command or the local faceplate. When CL is configured, it can be toggled locally from a pushbutton switch, such as PB1SW (output PS), and will change from local to console or from console/computer to local each time the input is toggled. Also, when output LO goes high, output CN will also go high and CM will go low, indicating that the control source will change to Console whenever Local is disabled, either by toggling input CL or from a network command. The Computer CM state can be set high using a network command. The NL output will normally be connected to the MD input of the pushbutton block PB1SW to indicate the C/L switch position on the operator faceplate using the green LED for C and the red LED for LO.

Output WD will go high (1) when the station fails to receive a Modbus network command within the watchdog time period. The watchdog time is set in the STATN (Station Parameters) function block.
### 3.2.66 ON/OFF - On/Off Controller

**ON/OFF** is an on/off controller with deviation function. It is one of five controller types that can be used on a one per loop basis.

When P-S (Process - Setpoint) reaches the HDEV limit, the Boolean output HO will go high (1) and when S-P (Setpoint - Process) reaches the LDEV limit, the output LO will go high (1). When the deviation drops to less than the DEADBAND setting, the outputs will go low (0). Derivative action is added to the process variable when the TD parameter is other than 0.0.

When single ended action (gap action) is desired, set the DEADBAND equal to the gap and the HDEV parameter for half the gap. For example, if DEADBAND = 20.0, set HDEV to 10.0. If the setpoint S is 50.0, output HO will go high (1) when P equals 60.0 and HO will go low (0) when P equals 40.0.

Input E asserted high (1) will enable the block outputs; when low (0) all outputs will be set low (0).

The process range pointer parameter points to another function block that has range scaling, such as the analog input that is providing the process variable. This enables the controller to normalize the tuning parameters for the range of the process input. If this parameter is not configured, the controller will use a range scaling of 0.0 - 100.0.

**POWER UP** - During a warm start, outputs and comparator functions will be initialized at the state prior to power down and all dynamic elements will be initialized at the current input on the first scan. During a cold start all outputs and comparator states will be set to zero, to be activated by the block functions. All dynamic elements will be initialized at the current input on the first scan.
3.2.67 OR - OR Logic

OR_ function blocks perform a logical OR on the three inputs. Any unused input will be set low (0).

3.2.68 ORSL - Override Selector

ORSL function blocks are used on a one per loop basis and they enable a primary input signal, such as the output from a controller, to be overridden by other signals. For a selector configured as LO, the function block outputs the lower of the primary or override inputs. For a selector configured as HI, the function block will output the higher of the primary or override inputs. Override signals can be hard limits, coming from HOLD blocks, or signals coming from other controllers. Block override inputs 1 and 2 can be used as HI or LO selector functions. Additional override inputs can be accommodated by connecting these inputs to signal selector (SEL) blocks.

When the output of the ORSL block is not the primary input, the output OS will be high (1). In addition, the block can cause the operator faceplate to display ‘OVERRIDE’ status when a priority level higher than 0, the default, has been selected.

If an override input is not configured the individual selector will output the other input. When no inputs are configured, the block will output 0.0 and the OS status will be set low (0).
3.2.69 OST_ - One Shot Timer

**OST_** function blocks provide a high (1) output for a predetermined time, set by ON TIME, when input P goes high (1). If input P goes low (0), the output will remain high until the time expires. If input P goes high during the on time, the elapsed timer will be re-triggered if RETRIG is set to YES.

With firmware 1.30 and higher the ON TIME is adjustable over the full range of the display which is 0.00000 to 999999. In earlier versions, the minimum time setting was 0.1. If the delay time is set to less than the scan time of the station the delay time will equal the scan time.

Output ET (elapsed time) will ramp from 0.0 to the value of ON TIME and remain there until P goes low (0). Output RT (remaining time) equals ON TIME - ET.

POWER UP - During a warm start, when PU LAST is set to YES, the block will initialize at the input/output states and elapsed time in effect at the instant power down occurred. A cold start will initialize the input/output states and elapsed time to 0.
3.2.70 PB1SW - PB1 Switch

**PB1SW** is one of three general purpose switches available in each loop. It can be utilized for switching Boolean signals in such applications as: toggling Console/Local operation of the ODC or ODS function blocks, Start/Stop, controlling the position of a TSW (Transfer Switch) function block for switching analog signals, or other operator initiated actions.

PB1SW can be configured for momentary or sustained operation. As momentary, the switch will transfer to the NO position when the button is pressed and will return when released. Momentary action is used in toggle applications such as changing the function of the ODC or ODS function blocks. In the sustained mode, the switch will alternate positions each time the button is pressed. An unconfigured NC input defaults to 0 and an unconfigured NO input to 1. With firmware 1.30 and higher, the button can be remotely activated through a command over Modbus or LIL.

This block operates with an operator faceplate that includes green and red LEDs that are turned on using input MD. A HI (1) input will turn on the Green LED and a LO the Red LED. The default connection will be the PS output of the block but should be changed as required to display the correct status. The message parameters do not apply to the current product.

POWER UP - When the switch is configured for momentary action, it will always power up in the NC position. For sustained action, with the POWER UP parameter set to YES, the switch will power up in the last position during a hot or warm start, and during a cold start will power up in the NC position. When the POWER UP parameter is set to NO, the switch will power up in the last position during a hot start. During a warm or cold start, it will power up in the NC position.
3.2.71 PB2SW - PB2 Switch

PB2SW is one of three general purpose switches available in each loop. It can be utilized for switching Boolean signals in such applications as: toggling the EITS (External/Internal setpoint Transfer Switch) function block, Start/Stop, controlling the position of a TSW (Transfer Switch) function block for switching analog signals, or other operator initiated actions.

The switch can be configured for momentary or sustained operation. As momentary, the switch will transfer to the NO position when the button is pressed and will return when released. Momentary action is used in toggle applications such as changing the function of the EITS function block. In the sustained mode, the switch will alternate positions each time the button is pressed. An unconfigured NC input defaults to 0 and an unconfigured NO input to 1. With firmware 1.30 and higher, the button can be remotely activated through a command over Modbus or LIL.

This block operates with an operator faceplate that includes green and red LEDs that are turned on using input MD. A HI (1) input will turn on the Green LED and a LO the Red LED. The default connection will be the PS output of the block but should be changed as required to display the correct status. The message parameters do not apply to the current product.

POWER UP - When the switch is configured for momentary action, it will always power up in the NC position. For sustained action, with the POWER UP parameter set to YES, the switch will power up in the last position during a hot or warm start, and during a cold start will power up in the NC position. When the POWER UP parameter is set to NO, the switch will power up in the last position during a hot start. During a warm or cold start, it will power up in the NC position.
3.2.72 PB3SW - PB3 Switch

PB3SW is one of three general purpose switches, available in each loop. It can be utilized for switching Boolean signals in such applications as: Start/Stop, controlling the position of a TSW (Transfer Switch) function block for switching analog signals, or other operator initiated actions. PB3SW can only be operated from the front panel when the A/M function block has not be configured.

PB3SW can be configured for momentary or sustained operation. As momentary, the switch will transfer to the NO position when the button is pressed and it will return when released. In the sustained mode, the switch will alternate positions each time the button is pressed. An unconfigured NC input defaults to 0 and an unconfigured NO input to 1. With firmware 1.30 and higher, the button can be remotely activated through a command over Modbus or LIL.

This block operates with an operator faceplate that includes green and red LEDs that are turned on using input MD. A HI (1) input will turn on the Green LED and a LO the Red LED. The default connection will be the PS output of the block but should be changed as required to display the correct status. The message parameters do not apply to the current product.

POWER UP - When the switch is configured for momentary action, it will always power up in the NC position. For sustained action, with the POWER UP parameter set to YES, the switch will power up in the last position during a hot or warm start, and during a cold start it will power up in the NC position. When the POWER UP parameter is set to NO, the switch will power up in the last position during a hot start. During a warm or cold start will power up in the NC position.
3.2.73 PCOM - Phase COMmunication

The Phase Communication PCOM function block, in firmware 1.30 and higher, is available on a one per loop basis to enable communication with a higher level device, such as a PC running a batch management software program. When the controller configuration is structured such that logic operations are partitioned in small phase operations, the PCOM block facilitates the interface between the logic controlling the overall phase operations for the batch and the logic performing the control logic for each phase.

The logic performed by the PCOM block is detailed in Boolean form in Figure 3-1. Network communication can be either Modbus or LIL (Local Instrument Link). Details are listed in the Network Communications section. The LOOP # configured in the ODC or ODS function block for the loop determines the location of the status word and the status coils in the Modbus mapping. Communication states are represented in Figure 3-1, on the next page, using the symbols shown below. Modbus states are mapped in coils and LIL states mapped into two 16-bit status word as shown below. Three global channels are used to send out the two status words and an integer value from 1-7 that represents the status of the PCOM block: 1=ABORTED, 2=DONE, 3=HELD, 4=RUN, 5=INTRLK, 6=READY, 7=EMERG OR. The location of the first channel is configured using the LIL CHAN parameter, represented by channel z in the LIL mapping tables.

### Read/Write States

<table>
<thead>
<tr>
<th>NAME</th>
<th>ABORTED</th>
<th>DONE</th>
<th>HELD</th>
<th>READY</th>
<th>RESTART</th>
<th>PRIORITY</th>
<th>PCOMF</th>
<th>HOPE</th>
<th>鈥冓</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R/0</td>
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<td>R/W</td>
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<tr>
<td>0</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R/0</td>
<td>R</td>
<td>R</td>
<td>R/W</td>
</tr>
</tbody>
</table>

### Status Word 1

### Status Word 2

Each communication state is read as a 1 or 0. Using Modbus, a write of a 1 (W1) or a 0 (W0) will affect the communication state as defined by the associated logic in Figure 3-1. The W1 or W0 is equivalent to a Mask ON or a Mask OFF using LIL commands. All unconfigured inputs will be treated as low (0) except OK, RD, RN and HE which will be treated as high (1). Three of the output states, EO ("EMERG"), IK ("INTRLK"), and FD -5. This will affect the flashing, etc. as previously described for other controller status conditions. These states also have unacknowledged bits as detailed in status word 2. Conditions that require acknowledging can be acknowledged by either using the local faceplate ACK button or by writing to the individual not acknowledged bit or the Not Ack’d PCOM bit.
Figure 3-1
### 3.2.74 PD - PD Controller

**PD** is a proportional only controller with manual reset. It is one of five controller types that can be used on a one per loop basis.

Manual reset allows the output of the controller to be set for a normal operating value (i.e. the desired output when the process equals setpoint under a given load condition). Derivative action is provided when the parameter TD is non-zero. The controller includes an autotune feature that can be initiated from the operator faceplate using the quick TUNE feature.

When input A is high (1) the controller will operate in the normal auto mode and when low (0) causes the controller output to track the feedback signal to eliminate bumping the output when switching to auto. This is accomplished by forcing the reset component R to a value that will keep (GE+R) equal to the feedback value. When the controller is switched to auto the value of the reset component will change back to the manual reset MR value at a rate determined by the MR TLAG setting. When MRTRCK is set to YES the manual reset MR will also track the feedback signal when input A is low.

Input I, when changed from low (0) to high (1) or high to low, will cause the controller to initialize (i.e. eliminate any proportional gain action during that scan cycle). This can be used to prevent bumping the output when changes are made to the setpoint through a switch block.

The process range pointer parameter should point to another function block that contains range scaling, such as an analog input that is the source of the process variable. This enables the controller to normalize tuning parameters.
for the process range. If this parameter is not configured, the controller will use a range scaling of 0.00-100.00. During a warm or cold power up the output will be initialized to MINSCALE and all dynamic elements will be initialized at the current input on the first scan.

The controller output has MINSCALE and MAXSCALE parameters allowing the output signal to be scaled for engineering ranges other than the default of 0 - 100 PRCT. This may be necessary when the controller output is the setpoint to another controller.

The Autotune feature is accessible using the TUNE pushbutton when AUTOTUNE is set to YES. It can be initiated while the loop is in Auto or Manual. The autotuner, when initiated, replaces the PD controller with an on-off control function, places the A/M block in Auto (if in Man), and cycles the control loop through six on-off cycles while learning the process dynamics which it uses to provide tuning recommendations for the PD controller.

The % DEV parameter is the maximum amount in % that the process should deviate from the setpoint during the on-off cycles. This parameter can be set manually or can be configured as AUTO. When AUTO is configured, the autotuner will set the % DEV to 4 times the % HYS. This is the minimum value needed to provide good autotuning results.

The % HYS parameter is the amount that the process must deviate from setpoint before switching the output in the opposite direction. This value must be equal to or slightly greater than any process noise band. If the noise band can not be determined, the autotuner will compute it at the start of an autotuning exercise when the % HYS parameter has been configured as AUTO.

The % STEP parameter is the amount that the valve will change on the first 1.5 on-off cycles. After the first cycles the autotuner will adjust the step to keep the process within the value of the % DEV parameter. On subsequent autotune exercises, the step will use the value computed from the previous exercise unless the AT RESET parameter is set to YES or the controller has been power cycled. The dynamic response recommended by the autotuner can be configured as Fast, Medium, or Slow. The Medium setting will normally provide a response that has no or little overshoot to a setpoint step response.

When the POST AT parameter is set to YES, the control loop will be returned to Auto using the recommended tuning values unless a warning occurred during the test.

More details on autotuning can be found in the Operation section of this manual.
3.2.75 PID - PID Controller

**PID** is a proportional + integral controller and one of five controller types that can be used on a one per loop basis. It uses external feedback to provide integral action. The block allows interaction with other function blocks or external devices, such as pneumatic controllers and shutoff switches, to eliminate the windup that can occur with other controller types. Derivative action is provided when the parameter TD is non-zero. The controller includes an autotune feature that can be initiated from the operator faceplate using the QUICK access feature.

When input A is high (1) the controller operates in the normal auto mode and when low (0) causes reset R to track (F-GE). This will force the controller output to track the feedback within the controller limits and allow the controller to switch back to auto without bumping the output.

The process range pointer parameter points to another function block that has range scaling, such as an analog input that is the process variable. This enables the controller to normalize the tuning parameters for the process range. If this parameter is not configured, the controller will use a range scaling of 0.00-100.00.

Input I, when changed from low (0) to high (1) or from high to low, will cause the controller to initialize (i.e. eliminate any proportional gain action during that cycle). This can be used to prevent bumping the output when changes are made to the setpoint using a switch block.

**POWER UP** - During a warm or cold power up, the output will be initialized to MINSCALE and all dynamic elements will be initialized at the current input on the first scan.
The controller output has MINSCALE and MAXSCALE parameters allowing the output signal to be scaled for engineering ranges other than the default of 0-100 PRCT. This may be necessary when the controller output is the setpoint to another controller.

The Autotune feature is accessible using the TUNE pushbutton when AUTOTUNE is set to YES and can be initiated while the loop is in Auto or Manual. The autotuner, when initiated, replaces the PID with an on-off control function, places the A/M block in Auto (if in Man) and cycles the control loop through six on-off cycles while learning the process dynamics which it uses to provide tuning recommendations for the PID controller.

The % DEV parameter is the maximum amount in % that the process should deviate from the setpoint during the on-off cycles. This parameter can be set manually or can be configured as AUTO. When AUTO is configured, the autotuner will set the % DEV to 4 times the % HYS. This is the minimum value needed to provide good autotuning results.

The % HYS parameter is the amount that the process must deviate from setpoint before switching the output in the opposite direction. This value must be at least equal to or slightly greater than any process noise band. If the noise band cannot be determined, the autotuner will compute it at the start of an autotuning exercise when the % HYS parameter has been configured as AUTO.

The % STEP parameter is the amount that the valve will change on the first on-off cycle. After the first cycle, the autotuner will adjust the step to keep the process within the value of the % DEV parameter. On subsequent autotune exercises, the step will use the value computed from the previous exercise unless the AT RESET parameter is set to YES or the controller has been power cycled. The dynamic response recommended by the autotuner can be configured as Fast, Medium, or Slow. The Medium setting will normally provide a response that has no or little overshoot to a setpoint step response.

When the POST AT parameter is set to YES, the control loop will be returned to Auto using the recommended tuning values unless a warning occurred during the test.

More details on autotuning can be found in the Operation section.
3.2.76 PIDAG - PIDAG Controller

**PIDAG** is an adaptive gain proportional + integral controller and is one of five controller types that can be used on a one per loop basis. It uses external feedback to provide integral action that allows interaction with other function blocks or external devices, such as pneumatic controllers, shutoff switches. PIDAG eliminates windup that can occur with other controller types. Derivative action is provided when the parameter TD is non-zero. The controller includes an autotune feature that can be initiated from the operator faceplate using the quick TUNE feature.

When input A is high (1) the controller will operate in the normal auto mode and when low (0) causes reset R to track (F-GE). This forces the controller output to track the feedback within controller limits and allow the controller to be switched back to auto without bumping the output.

The process range pointer parameter (input R) points to a function block that has range scaling, such as the analog input that is providing the process variable. This enables the controller to normalize the tuning parameters for the process range. If this parameter is not configured, the controller will use a range scaling of 0.00-100.00.

Input I, when changed from low (0) to high (1) or from high to low, will cause the controller to initialize (i.e. eliminate any proportional gain action during that scan cycle. This can be used to prevent bumping the output when changes are made to the setpoint using a switch block.

![PID Adaptive Gain Controller Diagram](image-url)
POWER UP - During a warm or cold power up, the output will be initialized to MINScale and all dynamic elements will be initialized at the current input on the first scan.

Input AG is multiplied by the gain error (GE). In version 1.30 of the controller firmware, an unconnected AG input will be set to 1.0. In earlier versions, it was set to 0.0 which required that the input always be connected to a source (e.g. Hold block) in order for the PIDAG block to function.

The controller output has MINScale and MAXScale parameters allowing the output signal to be scaled for engineering ranges other than the default of 0 - 100 PRCT. This may be necessary when the controller output is the setpoint to another controller.

The Autotune feature is accessible using the TUNE pushbutton when AUTOTUNE is set to YES and can be initiated while the loop is in Auto or Manual. The autotuner, when initiated, replaces the PIDAG with an on-off control function, places the A/M block in Auto (if in Man) and cycles the control loop through six on-off cycles while learning the process dynamics which it uses to provide tuning recommendations for the PIDAG controller.

The % DEV parameter is the maximum amount in % that the process should deviate from the setpoint during the on-off cycles. This parameter can be set manually or can be configured as AUTO. When AUTO is configured, the autotuner will set the % DEV to 4 times the % HYS. This is the minimum value needed to provide good autotuning results.

The % HYS parameter is the amount that the process must deviate from setpoint before switching the output in the opposite direction. This value must be at least equal to or slightly greater than any process noise band. If the noise band can not be determined, the autotuner will compute it at the start of an autotuning exercise when the % HYS parameter has been configured as AUTO.

The % STEP parameter is the amount that the valve will change on the first on-off cycle. After the first cycle, the autotuner will adjust the step to keep the process within the value of the % DEV parameter. On subsequent autotune exercises, the step will use the value computed from the previous exercise unless the AT RESET parameter is set to YES or the controller has been power cycled. The dynamic response recommended by the autotuner can be configured as Fast, Medium, or Slow. The Medium setting will normally provide a response that has no or little overshoot to a setpoint step response.

When the POST AT parameter is set to YES, the control loop will be returned to Auto using the recommended tuning values unless a warning occurred during the test.

More details on autotuning can be found in the Operation section.
3.2.77 PRSEQ - Program Sequencer

PRSEQ function blocks are available on a one per loop basis. They can be used to generate a simple setpoint profile or a complex batch sequence involving multiple discrete input and output logic operations as well as setpoint profiles.

The number of steps is configurable using the STEPS parameter and the number of discrete inputs/outputs using the GROUPS parameter. Sixteen (16) discrete inputs/outputs are provided for each group. If these parameters are increased after the function block is initially configured, the values of all previously entered step parameters will be retained. If however, a configuration is downloaded from the PC-based Graphical Configuration Software, the parameter values are determined by the download which includes the entire block configuration. The PRSEQ can store from 1 to 9 recipes. Each recipe will have the same number of steps and groups but all of the parameters can be configured differently.

Two new inputs have been added in firmware 1.30: RN (Recipe Number) and LR (Load Recipe). Input RN will accept a recipe number and input LR on a positive transition will select the recipe number which is the RN input. The RN input will round the number to the nearest integer value. A recipe number that is out of range will have no effect and the current recipe will remain. The recipe number set by the RN and LR inputs will be retained during HOT and WARM starts. During a COLD start, the recipe will revert to the recipe set by the configuration parameter “Recipe.”

Input SN will accept a step number and input GS, on a positive transition, will select the step number, which is the SN input. The SN input will round the number to the nearest integer value. A step number that is out of range will have no effect and the sequencer will remain at the current step.

Output AO (analog output) will track input TV when input TC is high (1). If input TC goes low (0), AO will remain at the tracked values unless either a timed step ramps AO to the AEP (analog end point) for the step or an event completes the step at which time AO will go to the AEP value for the completed step.

The current sequencer step can be changed by any of the following six events:

1. the Reset input R going high (1) moving it to step 1
2. Goto Step input GS going high (1) forcing the sequencer to the step indicated by the whole value of input SN
3. the Step Forward input SF going high (1) moving it to the next higher step unless on the last step
4. the Step Backward input SB going high (1) moving back to the previous step unless on the first step
5. a step time expiring advancing to the next step
6. all the discrete inputs nn are True (1) that match the input mask (a mask value of ‘0’ is a ‘don’t care’ condition) advancing to the next step

Input H will hold the remaining time of the current step and disable advancing of the sequencer by operations 5 and 6 but will allow operations 1, 2, 3, and 4 to move the sequencer to the starting position of a new step.
When the last sequencer step is completed, SC will be set high (1). The sequencer cannot be moved past the last step unless the reset input R goes high (1) forcing it to position 1. The sequencer can be moved forward only when in position 1. Network communications will allow the sequencer to be moved to a new step and the remaining time of the current step to be changed to a new value.

When discrete groups are used and a step is desired as ‘timed only’, one discrete input should be used to prevent the input mask from moving the sequencer to the next step. This can be accomplished by requiring a high (1) input and then not connecting that input, since unconnected inputs will be treated as 0.

When discrete groups are used and a step is desired as ‘event only’, the TIMe parameter for the step should be set to 0.0. The Analog Output will remain at the AEP value of the previous step or, if at step 1, the Analog value will be 0.0. When the sequencer advances to the next step, the Analog Output will go to the AEP value for the completed step.

POWER UP - During a warm start, if PU LAST is set to YES, all outputs, step number, track variable, and remaining step time will be initialized at the last values prior to power fail. During a cold start all outputs are initialized to 0 and the PRSEQ is in a reset condition.
3.2.78 QHD_ - Quickset Hold

QHD_ function blocks enable a real value to be changed on-line using the QUICKSET feature. The block is identified by an 8-character name that will be displayed in the QUICKSET mode. The block is configured with a range entered as MIN SCALE and MAX SCALE to set a usable range, and a Decimal Point Position parameter can set the allowed precision. The hold value cannot be changed beyond the -10% to 110% value of these limits. The hold value will change continuously as the pulser is turned. The MAX value must always be set greater than the MIN value. The block can also be forced to track input TV by asserting input TC high (1).

Firmware 1.30 added parameter QSCHANGE. It enables the block output to either update continuously in the Quickset mode as the pulser knob is turned or to only update the output with the value in the numeric display when the STORE button is pressed.

When configuring the DPP (Decimal Point Position) it is important to keep the resolution to the minimum necessary for operation changes. It will take the operator longer turning the pulser if the resolution is too high. For example, if only 0.1% changes are needed configure a 0-100 range as 0.0 – 100.0 and not 0.000 – 100.000.

During Hot or Warm start, the QHD will power-up in the last position during a Cold start at the -10% range value.
3.2.79 RATIO - Ratio

RATIO function blocks can be used on a one per loop basis. They provide a means of setting a ratio in an external setpoint application, for example, controlling a captive flow while maintaining the ratio between a wild flow and the captive flow at the desired value. Inputs A and E (external ratio) and the operator set ratio R value are multiplied and become the function block output O1.

Track Command input TC, asserted high (1), causes the ratio block to track the input variable TV. The ratio value to be recalculated is then \( R = \frac{TV}{A \times E} \). The value of R will be limited at the HI or LO LIMIT range settings. The factory default settings of the ratio limits are 0.00 - 30.00.

The RATIO can be adjusted using the QUICKSET feature if parameter QUICKSET is set to YES. The RATIO will continuously change as the knob is adjusted. Press the STORE button when the final value is reached to insure that the new RATIO setting will be retained on a Cold power up condition. The QS DPP parameter enables setting of the Ratio adjustment resolution when in the QUICKSET mode.

If input A or E is not configured, its value will be set to 1. When input TC or TV is not configured, its value will be set to 0.

The TO (Tracked Output) is normally used in applications where an external device is being used to set a ratio in place of the RATIO parameter (R is then set to 1.0). When it is desired to have the output of the RATIO block track the TV variable, the external device is forced to track TO. Input E will then equal \( TV / [A \times (1.0)] \) and, therefore, the RATIO block output O1 will equal TV.
3.2.80 RCT_ - Repeat Cycle Timer

RCT_ function blocks provide repeat time cycles that can be used in logic timing operations or with PID blocks to provide adaptive on times controlled by the PID block. Output ET will provide the time in minutes that has elapsed during the current cycle (ON + OFF). Output RT is the remaining time in the current cycle and will equal the total cycle time (ON + OFF) when the timer has not been started.

With firmware 1.30 and higher, the ON and OFF TIME is adjustable over the full range of the display which is 0.00000 to 999999. In earlier firmware, the minimum time setting was 0.1. If the delay time is set to less than the scan time of the station the delay time will equal the scan time.

Input S, asserted high (1), will cause the RCT block to start the timing cycle. Output O1 will first go high (1) for a time set by ON TIME and then it will go low (0) for a time set by OFF TIME. It will continue to repeat this cycle until input S is asserted low (0) which forces O1 low (0) and ends the timing cycle.

ADAPTIVE ON TIME - this feature is active only when input AT is configured. It has a valid range of 0.0 to 1.0 and there are two separate modes of adaptive on time depending on the configuration of the OFF TIME parameter.

- OFF TIME = 0.0 - The time cycle will remain fixed and equal to the value of ON TIME. The output will be high for a period equal to ON TIME x AT.
- OFF TIME > 0.0 - The output will be low (0) for a period equal to OFF TIME and will be high for a period equal to ON TIME x AT. The time cycle equals [(ON TIME x AT) + OFF TIME].

POWER UP - With the PU LAST parameter set to YES, during a hot or warm power up the block will initialize the input/output states and elapsed time at the last values. During a cold start, they will be set to 0. With PU LAST set to NO, during a hot start the block will initialize the input/output states and elapsed time at the last values. During a warm or cold start, they will be set to 0.
### 3.2.81 RLM_ - Rate Limiter

**RLM_** function blocks limit the rate of change of analog input A. Separate up and down rates are entered in configuration, in engineering units per minute. Output RL will be high (1) if the block is limiting a rising input signal and output FL will be high when the block is limiting a falling input signal.

![Rate Limiter Block Diagram](image)

Input E asserted high (1) will enable the limit action of the block. When input E is low (0), the output will track the analog input. If input E is not configured, the limit action of the block will be enabled.

### 3.2.82 ROT_ - Retentive On Timer

**ROT_** function blocks perform an on-delay timing function with output states determined by inputs ON and EN.

When input EN is low (0) outputs D and ND are low and when input EN is high (1), the outputs will be determined by the ON input and the elapsed time.

When ON goes high the elapsed time will start. Output D will go high after ET (elapsed time) equals or exceeds the DLY TIME. Output RT (remaining time) equals DLY TIME - ET. If ON goes low, the elapsed time will stop at the current value and will continue when ON returns to a high state. The elapsed time returns to 0.0 when input EN goes low. Output ND will be high (1) if input EN is high and output D is not high. With firmware 1.30 and higher, the DLY TIME is adjustable over the full range of the display which is 0.00000 to 999999. In earlier versions, the minimum time setting was 0.1. If the delay time is set to less than the scan time of the station the delay time will equal the scan time.

**POWER UP** - During a warm start, when PU LAST is set to YES, the block will initialize at the input/output states and elapsed time at the instant power down occurred. A cold start will initialize the input/output states and elapsed time to 0.
3.2.83 ROUT_ - Relay Outputs

ROUT_ function blocks provide SPDT contacts activated by function block input C. The relay will turn on when the block input is high (1) and will turn off when low (0). Two relay outputs are available on the Expander Board. Terminal Connections are listed in Section 8.4.

3.2.84 RSF_ - RS Flip-Flop

RSF_ function blocks perform a reset dominant flip-flop function as detailed in the truth table. An unused S input will be set high (1) and an unused R input will be set low (0).

POWER UP - During a warm start, when PU LAST is set to YES, the block will initialize at the input/output states at the instant power down occurred. A cold start will initialize the input/output states to 0.
3.2.85 RTG_ - Rising Edge Trigger

RTG_ function blocks provide a high (1) output for one scan cycle each time input P transitions from a low (0) to a high (1).

![RISING EDGE TRIGGER](image1)

3.2.86 RTT_ - Real Time clock Trip (V2.0)

RTT_ function blocks provide high (1) outputs when time from the CLOCK block coincides with the TIME, DATE, & DAYS of the Week TRIP settings. The block outputs will remain high while the CLOCK coincides with the settings.

![REAL TIME TRIP](image2)
3.2.87 SCL_ - Scaler

SCL_ function blocks provide a means to scale an analog signal. It will re-range a signal by using the range pointer to reference the function block with the original range. When the range pointer (input R) is not configured, the function block will not re-scale the input signal but will pass it directly to the output. The purpose, under this situation, would be to provide minimum and maximum scale, preferred decimal point position, and units for another block (e.g. operator display) to reference.

```
<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Input MIN SCALE</td>
</tr>
<tr>
<td>B</td>
<td>Input MIN SCALE</td>
</tr>
<tr>
<td>C</td>
<td>Input MIN SCALE</td>
</tr>
<tr>
<td></td>
<td>Input Range/PTR</td>
</tr>
<tr>
<td></td>
<td>Input Eng/Units</td>
</tr>
<tr>
<td></td>
<td>Output MIN SCALE</td>
</tr>
<tr>
<td></td>
<td>Output Eng/Units</td>
</tr>
</tbody>
</table>
```

3.2.88 SEL_ - Signal Selector

SEL_ function blocks can provide a high or low signal selection on the three input signals. Unused inputs will be set equivalent to the lowest real value when configured as a HI selector and to the highest real value when configured as a LO selector.

```
<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Input A</td>
</tr>
<tr>
<td>B</td>
<td>Input B</td>
</tr>
<tr>
<td>C</td>
<td>Input C</td>
</tr>
<tr>
<td></td>
<td>Output (HI/LO)</td>
</tr>
</tbody>
</table>
```
3.2.89 SETPT - Setpoint

SETPT function blocks can be used on a one per loop basis to permit operator adjustment of the controller setpoint within the loop. The on-line setpoint is adjustable, using the pulser knob, while <loop tag>.S is the displayed variable; unless the track command TC is high (1), at which time the setpoint will track the TV input.

A setpoint ramping feature allows the setpoint to ramp to a TARGET value. The start of a ramp can be initiated using a communication command asserting input SR high (the ramp starts on a positive transition of the SR input), or using the RAMP ON/OFF function in the QUICKSET mode. Both ramp RATE and ramp TIME can be set in configuration. Firmware 1.30 and higher sets the USE RATE default to NO; earlier versions are set at YES.

Setting configuration parameter USE RATE to YES will cause the setpoint to change at the rate setting and ignore a configured ramp time. The RTIME or RRATE, TARGET, and PU SETPT values can be set using the QUICKSET feature if the QUICKSET parameter is set to YES.

The RG PTR, range pointer, parameter determines the normal operating range of the function block. If the pointer is not configured the block will use 0.00 to 100.00. The range of the setpoint block will be limited to -10% to 110% of the range parameter. If a range change is made the current setpoint, ramp rate, target setpoint, and power up setpoint will be moved to be the same % values within the new range.

The setpoint block also has two inputs LU and LD that can be used to limit pulser changes in one direction. This can be used if another function block is limiting the setpoint and it is desired not to allow the operator to adjust the setpoint block to a value beyond the external limit.

POWER UP - The function block can be configured to power up in various conditions during a warm start. If the PU LAST parameter is set to YES, the block will power up with the last setpoint. When SETPT does not power up in last position or on a cold start, it will power up using the PU SETPT parameter.
3.2.90 SIN_ - SINE

SIN_ function blocks, included in firmware 1.30 and higher, accept a radian input and output the sine of that angle.
### 3.2.91 SPLIM - Setpoint Limit

**SPLIM** function blocks can be used on a one per loop basis to limit the setpoint of the loop controller. Input A will pass through the function block to output O1 unless it exceeds one of the limit settings at which time the block will output the limit value.

If the HI LIMIT is set lower than the LO LIMIT, the block will always output the high limit value.

Output status HS or LS will be high (1) if the block is in a limit condition. The status event ‘S HI LIM’ or ‘S LO LIM’ will be displayed in the alphanumeric if the SL PRIOR is greater than 0. A priority of 0 disables the reporting of the limit function and sets the bits in the status word to 0. See below for additional details regarding priorities.

The SPLIM function block has an RG PTR parameter (input R) that defines the normal operating range of the block. Limit settings can be made within -10% to 110% of the range pointer values. If the range pointer is not configured, a range of 0.0 to 100.0 will be used. If a range change is made the current limit value will be moved to be the same % value within the new range.

**PRIORITIES** - The priority assigned to SL PRIOR will affect the operation as follows (the outputs HS and LS will go high with all priority assignments, including 0, when event is active):

1. Bargraphs, event LEDs, and condition will flash. ACK button must be used to stop flashing.
2. Bargraphs, event LEDs, and condition will flash. Flasing will stop if ACK or if event clears.
3. Event LEDs and condition will flash. ACK button must be used to stop flashing.
4. Event LEDs and condition will flash. Flashing will stop if ACK or event clears.
5. Event LEDs and condition will turn on when event is active and off when the event clears.
6. No display action occurs when event is active. The HL and LL status bits are always set to 0.

![Block Diagram](image-url)
3.2.92 SRF_ - SR Flip-Flop

SRF_ function blocks perform a set dominant flip-flop function as detailed in the truth table. An unused R input will be set high (1) and an unused S input will be set low (0).

![SRF Block Diagram]

POWER UP - During a warm start, when PU LAST is set to YES, the block will initialize at the input/output states at the instant power down occurred. A cold start will initialize the input/output states to 0.

3.2.93 SRT_ - Square Root

SRT_ function blocks compute the square root of input signal A. The input has a built-in low limit that will limit the signal to the square root computation to 0.0.

![SRT Block Diagram]
### 3.2.94 SUB_ - Subtraction

SUB_ function blocks perform arithmetic subtraction on the two input signals. Any unused input will be set to 0.0.

All inputs should have the same engineering units. If units are not consistent, a SCL function block can be used or an alternative is to use a MTH function block that has built-in scaling functions.

![SUBTRACTION Block Diagram](image)

### 3.2.95 TAN_ - TANGENT

TAN_ function blocks, in firmware 1.30 and higher, accept a radian input and output the tangent of that angle.

![TANGENT Block Diagram](image)
3.2.96 TH_ - Track & Hold

TH_ function blocks can hold an initial value that will transfer to the block output O1 on power up and it can be used to track the TV input when input TC is high (1).

In 1.30 firmware or greater, the HOLD value can be changed on line, using the pulser, when the TH_O1 block output is directly connected to X or Y inputs in an ODC block. The range and resolution used by the pulser making on line changes will be determined by the X Range or Y Range inputs.

3.2.97 TOT_ - Totalizer (V2.3)

TOT_ function blocks accept a Boolean input and they will retain a running total of the input transitions as the block output as a real value for interconnection to other blocks in the controller. The running total can be reset when input R goes high (1). Input R is executed prior to reading input S on each scan cycle.

Unconfigured inputs will be set to 0. When the EDGETRIG parameter is set to 1, the total will increment on each 0 to 1 transition on input S. When the EDGETRIG parameter is set to 0, the total will increment on each 1 to 0 transition.

The total will be retained during a WARM & HOT start and will be initialized to 0.0 on a COLD start.
3.2.98 TSW_ - Transfer Switch

TSW_ function blocks select one of two analog input signals as the output signal. Input A becomes the output when input SC is low (0) and input B will be the output when input SC goes high (1).

Unconfigured inputs will default to SC=low(0), A=0.0, B=100.0.

---

3.2.99 XOR_ - Exclusive OR Logic

XOR_ function blocks perform a logical exclusive OR function on all three inputs. An unused input will cause the block to function as a two input XOR. The XOR output will be low (0) when all configured inputs are low (0) or when all configured inputs are high (1).

---

**XOR TRUTH TABLE**

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>Output 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
4.0 FACTORY CONFIGURED OPTIONS

Factory Configured Options provide an easy way to configure a Model 352Plus, Model 353, or Model 354. In most cases a Factory Configured Option (FCO) will provide a complete, functional loop controller, once the proper I/O connections are made. Changes can be made to an FCO to meet individual requirements. The FCO listings on the following pages document the parameters that are different than the default values listed in section 3. Some things to keep in mind when making changes are:

a) All analog signals have been configured for an engineering range of 0.00 to 100.00. In most cases converting to other engineering units will only require changing the range at the source (e.g. Analog Input function block). All other blocks (i.e. Controller, Operator Display, Alarm, and Setpoint) that require knowledge of the range have range pointers that point to the signal source (e.g. Analog Input block) for this information.

b) A number of function blocks have parameters that may be affected by range pointers. The range pointer limits the setting of parameter values to within -10% to 110% of the range. If a range is changed, the current parameter values will be changed to the same % within the new range. For example, if the range is 0.0-100.0 and the Alarm 1 Limit setting is 90.0 and the range is changed to 400.0-500.0 the alarm setting will be changed to 490.0.

c) All controller (ID, PID, PD, PIDAG) outputs have an engineering range of 0.0-100.0 which will be satisfactory in most cases since outputs normally convert to a 4-20 mA signal to drive a valve 0-100% Open or Closed. However, when a controller is used in a cascade configuration, the primary controller output must be configured for the same engineering range as the secondary controller process.

d) FCOs do not change Station parameters or calibration.

e) FCO 0 deletes all loops and set all parameters in the STATN & SECUR function blocks to default values. Calibration is not affected. As new loops and function blocks are added, parameters will appear at default values.
4.1 FCO101 - Single Loop Controller w/ Tracking Setpoint

Factory Configured Option FCO101 provides a single loop controller configured in Loop01. A block diagram of the loop configuration is shown below along with any changes to the default parameter values of the configured blocks. This configuration provides setpoint tracking which will cause the setpoint to track the process when the loop is not in Auto (NA). If the loop tag ‘Loop01’ is changed, all configured references within the station will automatically be changed to the new tag.

![Block Diagram]

**SETPT - Setpoint Function Block**
- RG PTR - Range Pointer: Loop01.AIN1.OR
- INPUT TV - Input TV: Loop01.AIN1.O1
- INPUT TC - Input TC: Loop01.A/M.NA
- ESN - Exec. Seq. No.: 5

**ALARM - Alarm Function Block**
- RG PTR - Range Pointer: Loop01.AIN1.OR
- INPUT P - Input P: Loop01.AIN1.O1
- INPUT D - Input D: Loop01.SETPT.O1
- ESN - Exec. Seq. No.: 10

**PID - PID Controller Function Block**
- RG PTR - Range Pointer: Loop01.AIN1.OR
- INPUT P - Input P: Loop01.AIN1.O1
- INPUT S - Input S: Loop01.SETPT.O1
- INPUT F - Input F: Loop01.A/M.O1
- INPUT A - Input A: Loop01.A/M.AS
- ESN - Exec. Seq. No.: 15

**A/M - Auto/Manual Function Block**
- RG PTR - Range Pointer: Loop01.PID.OR
- INPUT A - Input A: Loop01.PID.O1
- ESN - Exec. Seq. No.: 20

**AOUT1 - Analog Output 1 Function Block**
- RG PTR - Range Pointer: Loop01.PID.OR
- INPUT S - Input S: Loop01.A/M.O1

**ODC - Operator Display for Controllers**
- P RG PTR - P Range Pointer: Loop01.AIN1.OR
- V RG PTR - V Range Pointer: Loop01.PID.OR
- INPUT P - Input P (Process): Loop01.AIN1.O1
- INPUT S - Input S (Setpoint): Loop01.SETPT.O1
- INPUT V - Input V (Valve): Loop01.A/M.O1
- LOOP # - Loop #: 01
4.2 FCO102 - Single Loop Controller w/ Fixed Setpoint

Factory Configured Option FCO102 provides a single loop controller configured in Loop01. A block diagram of the loop configuration is shown below along with any changes to the default parameter values of the configured blocks. If the loop tag ‘Loop01’ is changed, all configured references within the station will automatically be changed to the new tag.

![Block Diagram of Loop01 Configuration](image-url)

**SETPT** - Setpoint Function Block  
RG PTR - Range Pointer ------- Loop01.AIN1.OR  
ESN - Exec. Seq. No.---------- 5

**ALARM** - Alarm Function Block  
RG PTR - Range Pointer ------- Loop01.AIN1.OR  
INPUT P - Input P ------------- Loop01.AIN1.O1  
INPUT D - Input D ------------ Loop01.SETPT.O1  
ESN - Exec. Seq. No.--------- 10

**PID** - PID Controller Function Block  
RG PTR - Range Pointer ------- Loop01.AIN1.OR  
INPUT P - Input P ------------- Loop01.AIN1.O1  
INPUT S - Input S ------------ Loop01.SETPT.O1  
INPUT F - Input F ------------ Loop01.A/M.O1  
INPUT A - Input A ----------- Loop01.A/M.AS  
ESN - Exec. Seq. No.-------- 15

**A/M** - Auto/Manual Function Block  
RG PTR - Range Pointer ------- Loop01.PID.OR  
INPUT A - Input A ------------- Loop01.PID.O1  
ESN - Exec. Seq. No.--------- 20

**AOUT1** - Analog Output 1 Function Block  
RG PTR - Range Pointer ------- Loop01.PID.OR  
INPUT S - Input S ------------- Loop01.A/M.O1

**ODC** - Operator Display for Controllers  
P RG PTR - P Range Pointer ----- Loop01.AIN1.OR  
V RG PTR - V Range Pointer ----- Loop01.PID.OR  
INPUT P - Input P (Process) ----- Loop01.AIN1.O1  
INPUT S - Input S (Setpoint) ----- Loop01.SETPT.O1  
INPUT V - Input V (Valve) ------ Loop01.A/M.O1  
LOOP # - Loop # ------- 01
4.3 FCO103 - External Set Controller with Tracking Local Setpoint

Factory Configured Option FCO103 provides a single loop controller with external setpoint configured in Loop01. A block diagram of the loop configuration is shown below along with any changes to the default parameter values of the configured blocks. This configuration provides setpoint tracking. If a fixed setpoint is desired, the TC input to the SETPT function block can be set to UNCONFIG. If the loop tag ‘LOOP01’ is changed, all configured references will automatically be changed to the new tag.

![Diagram of the loop configuration and parameter changes.](attachment:image.png)

**SETPT - Setpoint Function Block**  
- **RG PTR** - Range Pointer ------ Loop01.AIN1.OR  
- **INPUT TV** - Input TV ------- Loop01.AIN1.O1  
- **INPUT TC** - Input TC ------- Loop01.OR01.O1  
- **ESN** - Exec. Seq. No. ------- 10

**PB2SW - PB2 Switch Function Block**  
- **INPUT MD** - Input MD ------ Loop01.E/I.SE  
- **ESN** - Exec. Seq. No. ------- 5

**ALARM - Alarm Function Block**  
- **RG PTR** - Range Pointer ------ Loop01.AIN1.OR  
- **INPUT P** - Input P ----------- Loop01.AIN1.O1  
- **INPUT D** - Input D ----------- Loop01.E/I.O1  
- **ESN** - Exec. Seq. No. ------- 20

**PID - PID Controller Function Block**  
- **RG PTR** - Range Pointer ------- Loop01.AIN1.OR  
- **INPUT P** - Input P ------------- Loop01.AIN1.O1  
- **INPUT S** - Input S ------------ Loop01.E/I.O1  
- **INPUT F** - Input F ------------ Loop01.A/M.O1  
- **INPUT A** - Input A ----------- Loop01.A/M.AS  
- **INPUT I** - Input I ----------- Loop01.E/LES  
- **ESN** - Exec. Seq. No. -------- 25

**E/I - Ext/Int Transfer Switch Function Block**  
- **INPUT ST** - Input ST --------- Loop01.PB2SW.PS  
- **INPUT E** - Input E --------- Loop01.AIN2.O1  
- **INPUT I** - Input I --------- Loop01.SETPT.O1  
- **ESN** - Exec. Seq. No. ------- 15

**A/M - Auto/Manual Function Block**  
- **RG PTR** - Range Pointer ------ Loop01.PID.OR  
- **INPUT A** - Input A ---------- Loop01.PID.O1  
- **ESN** - Exec. Seq. No. ------- 30

**OR01 - OR Function Block**  
- **INPUT A** - Input A ----------- Loop01.E/I.ES  
- **INPUT B** - Input B ----------- Loop01.A/M.MS  
- **ESN** - Exec. Seq. No. ------- 35

**AOUT1 - Analog Output 1 Function Block**  
- **RG PTR** - Range Pointer ------- Loop01.PID.OR  
- **INPUT S** - Input S --------- Loop01.A/M.O1  
- **INPUT A** - Input A ----------- Loop01.A/M.AS  
- **INPUT I** - Input I --------- Loop01.E/LES  
- **ESN** - Exec. Seq. No. ------- 25
ODC - Operator Display for Controllers
P RG PTR - P Range Pointer ------- Loop01.AIN1.OR
V RG PTR - V Range Pointer ------- Loop01.PID.OR
X RG PTR - X Range Pointer ------- Loop01.AIN2.OR
INPUT P - Input P (Process) ------ Loop01.AIN1.O1
INPUT S - Input S (Setpoint) ------ Loop01.E/LO1
INPUT V - Input V (Valve) ------- Loop01.A/M.O1
INPUT X - Input X (X-Variable) - Loop01.A/M.O1
LOOP # - Loop # ----- 01

DOUT1 - Digital Output 1 Function Block
INPUT S - Input S ------------------- Loop01.ALARM.A1

DOUT2 - Digital Output 2 Function Block
INPUT S - Input S ------------------- Loop01.ALARM.A2
4.4 FCO104 - External Set Controller with Non-Tracking Local Setpoint

Factory Configured Option FCO104 provides a single loop controller with external setpoint configured in Loop01. A block diagram of the loop configuration is shown below along with any changes to the default parameter values of the configured blocks. If the loop tag ‘LOOP01’ is changed, all configured references will automatically be changed to the new tag.
**ODC - Operator Display for Controllers**

- P RG PTR - P Range Pointer ----- Loop01.AIN1.OR
- V RG PTR - V Range Pointer ----- Loop01.PID.OR
- X RG PTR - X Range Pointer ----- Loop01.AIN2.OR
- INPUT P - Input P (Process) ----- Loop01.AIN1.O1
- INPUT S - Input S (Setpoint) ----- Loop01.E/I.O1
- INPUT V - Input V (Valve) ------ Loop01.A/M.O1
- INPUT X - Input X (X-Variable) - Loop01.AIN2.O1
- LOOP # - Loop # ----- 01

**DOUT1 - Digital Output 1 Function Block**

- INPUT S - Input S ------------------- Loop01.ALARM.A1

**DOUT2 - Digital Output 2 Function Block**

- INPUT S - Input S ------------------- Loop01.ALARM.A2
4.5 FCO105 - Ratio Set Control w/ Operator Setpoint Limits

Factory Configured Option FCO105 provides a ratio set controller in Loop01. The setpoint to the Captive Flow controller can be maintained as a ratio of the Captive Flow to Wild Flow. The controller has complete setpoint tracking as well as ratio tracking. The local setpoint will track the Captive Flow signal when the loop is not in auto (NA) OR is in External (Ratio) Set (ES). The value of the RATIO will be computed as Captive Flow \( \text{setpoint} \) / Wild Flow while in the tracking mode which occurs whenever the loop is not in auto (NA) OR is in Internal Set (IS). The tracking features can be removed by setting the TC inputs to UNCONFIG. The Wild Flow signal will be displayed on Variable X and the actual Ratio CF/WF will be displayed on Variable Y.

![Diagram of FCO105 Function Blocks]

**SETPT - Setpoint Function Block**
- **RG PTR** - Range Pointer ------ Loop01.AIN2.OR
- **INPUT TV** - Input TV -------- Loop01.AIN2.OR
- **INPUT TC** - Input TC ------ Loop01.OR02.OR
- **INPUT LU** - Input LU ------ Loop01.SPLIM.HS
- **INPUT LD** - Input LD ------ Loop01.SPLIM.LS
- **ESN - Exec. Seq. No.** ------- 5

**PB2SW - PB2 Switch Function Block**
- **INPUT MD** - Input MD ------ Loop01.E/I.SE
- **ESN - Exec. Seq. No.** ------- 10

**ALARM - Alarm Function Block**
- **RG PTR** - Range Pointer ------ Loop01.AIN2.OR
- **INPUT P** - Input P -------- Loop01.AIN2.OR
- **INPUT D** - Input D -------- Loop01.SPLIM.LS
- **ESN - Exec. Seq. No.** ------- 15

**RATIO - Ratio Function Block**
- **HI LIMIT** - HI Range LIMIT ---- 1.50
- **LO LIMIT** - LO Range LIMIT ---- 0.50
- **INPUT A** - Input A -------- Loop01.AIN1.OR
- **INPUT TC** - Input TC ------ Loop01.OR02.OR
- **INPUT LU** - Input LU ------ Loop01.SPLIM.HS
- **INPUT LD** - Input LD ------ Loop01.SPLIM.LS
- **ESN - Exec. Seq. No.** ------- 20

**E/I - Ext/Int Transfer Switch Function Block**
- **INPUT ST** - Input ST ------ Loop01.PB2SW.PS
- **INPUT E** - Input E -------- Loop01.RATIO.OR
- **INPUT I** - Input I -------- Loop01.SETPT.OR
- **ESN - Exec. Seq. No.** ------- 25

**SPLIM - Setpoint Limit Function Block**
- **RG PTR** - Range Pointer ------ Loop01.AIN2.OR
- **INPUT P** - Input P -------- Loop01.AIN2.OR
- **INPUT D** - Input D -------- Loop01.E/I.OR
- **ESN - Exec. Seq. No.** ------- 30
**PID - PID Controller Function Block**
- RG PTR - Range Pointer -------- Loop01.AIN2.OR
- INPUT P - Input P --------------- Loop01.AIN2.O1
- INPUT S - Input S --------------- Loop01.SPLIM.O1
- INPUT F - Input F --------------- Loop01.A/M.O1
- INPUT A - Input A --------------- Loop01.A/M.AS
- INPUT I - Input I --------------- Loop01.E/I.ES
- ESN - Exec. Seq. No. ----------- 35

**A/M - Auto/Manual Function Block**
- RG PTR - Range Pointer -------- Loop01.PID.OR
- INPUT P - Input A --------------- Loop01.PID.O1
- ESN - Exec. Seq. No. ----------- 40

**AOUT1 - Analog Output 1 Function Block**
- RG PTR - Range Pointer -------- Loop01.PID.OR
- INPUT S - Input S --------------- Loop01.A/M.O1

**ODC - Operator Display for Controllers**
- P RG PTR - P Range Pointer ------ Loop01.AIN2.OR
- V RG PTR - V Range Pointer ------ Loop01.PID.OR
- X RG PTR - X Range Pointer ------ Loop01.AIN1.OR
- Y RG PTR - Y Range Pointer ------ Loop01.SCL01.OR
- INPUT P - Input P (Process) ------ Loop01.AIN2.O1
- INPUT S - Input S (Setpoint) ----- Loop01.SPLIM.O1
- INPUT V - Input V (Valve) ------ Loop01.A/M.O1
- INPUT X - Input X (X-Variable) - Loop01.AIN1.O1
- INPUT Y - Input Y (Y-Variable)-- Loop01.DIV01.O1
- LOOP # - Loop # ----- 01

**DIV01 - Division Function Block**
- INPUT N - Input N --------------- Loop01.AIN2.O1
- INPUT D - Input D --------------- Loop01.AIN1.O1
- ESN - Exec. Seq. No. ----------- 45

**SCL01 - Scaler Function Block**
- MINSCALE - Output MIN -------- 0.50
- MAXSCALE - Output MAX -------- 1.50
- ENGUNITS - ENGineering UNITS ---CF/WF
- ESN - Exec. Seq. No. ----------- 50

**OR01 - OR Function Block**
- INPUT A - Input A --------------- Loop01.A/M.NA
- INPUT B - Input B --------------- Loop01.E/LIS
- ESN - Exec. Seq. No. ----------- 55

**OR02 - OR Function Block**
- INPUT A - Input A --------------- Loop01.A/M.NA
- INPUT B - Input B --------------- Loop01.E/LIS
- ESN - Exec. Seq. No. ----------- 60
4.6 FCO106 - Single Loop Controller w/ Operator Setpoint Limits

Factory Configured Option FCO106 provides a single loop controller configured in Loop01. This is similar to FCO101 but with a SPLIM block added to the output of the SETPT block. A block diagram of the loop configuration is shown below along with any changes to the default parameter values of the configured blocks. This configuration provides setpoint tracking. If a fixed setpoint is desired, the TC input to the SETPT function block can be set to UNCONFIG. If the loop tag 'LOOP01' is changed, all configured references will automatically be changed to the new tag.

SETPT - Setpoint Function Block
RG PTR - Range Pointer --- Loop01.AIN1.OR
INPUT TV - Input TV ------- Loop01.AIN1.O1
INPUT TC - Input TC ------- Loop01.A/M.NA
INPUT LD - Input LD ------- Loop01.SPLIM.HS
INPUT LU - Input LU ------- Loop01.SPLIM.LS
ESN - Exec. Seq. No. ------- 5

SPLIM - Setpoint Limit Function Block
RG PTR - Range Pointer --- Loop01.AIN1.OR
INPUT A - Input A ------- Loop01.SETPT.O1
ESN - Exec. Seq. No. ------- 10

ALARM - Alarm Function Block
RG PTR - Range Pointer --- Loop01.AIN1.OR
INPUT P - Input P ------- Loop01.AIN1.O1
INPUT D - Input D ------- Loop01.SPLIM.O1
ESN - Exec. Seq. No. ------- 15

PID - PID Controller Function Block
RG PTR - Range Pointer -_--- Loop01.AIN1.OR
INPUT P - Input P ------- Loop01.AIN1.O1
INPUT S - Input S ------- Loop01.SPLIM.O1
INPUT F - Input F ------- Loop01.A/M.O1
INPUT A - Input A ------- Loop01.A/M.AS
ESN - Exec. Seq. No.------- 20

A/M - Auto/Manual Function Block
RG PTR - Range Pointer --- Loop01.PID.OR
INPUT A - Input A ------- Loop01.PID.O1
ESN - Exec. Seq. No. ------- 25

AOUT1 - Analog Output 1 Function Block
RG PTR - Range Pointer --- Loop01.PID.OR
INPUT S - Input S ------- Loop01.A/M.O1

ODC - Operator Display for Controllers
P RG PTR - P Range Pointer --- Loop01.AIN1.OR
V RG PTR - V Range Pointer --- Loop01.PID.OR
INPUT P - Input P (Process) --- Loop01.AIN1.O1
INPUT S - Input S (Setpoint) --- Loop01.SPLIM.O1
INPUT V - Input V (Valve) --- Loop01.A/M.O1
LOOP # - Loop # ------- 01
4.7 FCO107 - Dual Loop Controller

Factory Configured Option FCO107 provides two independent loops with tracking setpoints. The block diagram of the configuration of the two loops is shown below along with the changes made to the default parameter values of the configured blocks. This configuration provides setpoint tracking. If a fixed setpoint is desired, the TC input to the SETPT function block can be set to UNCONFIG. The process range of the first loop can be changed in Analog Input 1 and the range of the Second loop in Analog Input 2.

**Loop 01**

**SETPT - Setpoint Function Block**
- RG PTR - Range Pointer  LOOP01.AIN1.OR
- INPUT TV - Input TV  LOOP01.AIN1.O1
- INPUT TC - Input TC  LOOP01.A/M.NA
- ESN - Exec. Seq. No.  5

**ALARM - Alarm Function Block**
- RG PTR - Range Pointer  LOOP01.AIN1.OR
- INPUT P - Input P  LOOP01.AIN1.O1
- INPUT D - Input D  LOOP01.SETPT.O1
- ESN - Exec. Seq. No.  10

**PID - PID Controller Function Block**
- RG PTR - Range Pointer  LOOP01..AIN1.OR
- INPUT P - Input P  LOOP01..AIN1.O1
- INPUT S - Input S  LOOP01..SETPT.O1
- INPUT F - Input F  LOOP01..A/M.O1
- INPUT A - Input A  LOOP01..A/M.AS
- ESN - Exec. Seq. No.  15

**A/M - Auto/Manual Function Block**
- RG PTR - Range Pointer  LOOP01..PID.OR
- INPUT A - Input A  LOOP01..PID.O1
- ESN - Exec. Seq. No.  20

**Loop 02**

**SETPT - Setpoint Function Block**
- RG PTR - Range Pointer  LOOP01.AIN1.OR
- INPUT TV - Input TV  LOOP01.AIN1.O1
- INPUT TC - Input TC  LOOP01.A/M.NA
- ESN - Exec. Seq. No.  5

**ALARM - Alarm Function Block**
- RG PTR - Range Pointer  LOOP01.AIN1.OR
- INPUT P - Input P  LOOP01.AIN1.O1
- INPUT D - Input D  LOOP01.SETPT.O1
- ESN - Exec. Seq. No.  10
Loop 01 (cont)

ODC - Operator Display for Controllers
P RG PTR - P Range Pointer ----- LOOP01.AIN1.OR
V RG PTR - V Range Pointer ---- LOOP01.PID.OR
INPUT P - Input P (Process) ----- LOOP01.AIN1.O1
INPUT S - Input S (Setpoint) ---- LOOP01.SETPT.O1
INPUT V - Input V (Valve) ------ LOOP01.A/M.O1
LOOP # - Loop# ----- 01

AOUT1 - Analog Output 1 Function Block
RG PTR - Range Pointer ----------- LOOP01.PID.OR
INPUT S - Input S ---------------- LOOP01.A/M.O1

Loop 02

SETPT - Setpoint Function Block
RG PTR - Range Pointer ------- LOOP02.AIN2.OR
INPUT TV - Input TV --------- LOOP02.AIN2.O1
INPUT TC - Input TC -------- LOOP02.A/M.O1
ESN - Exec. Seq. No.---------- 5

ALARM - Alarm Function Block
RG PTR - Range Pointer ----- LOOP02.AIN2.OR
INPUT P - Input P ----------- LOOP02.AIN2.O1
INPUT D - Input D ---------- LOOP02.SETPT.O1
ESN - Exec. Seq. No. -------- 10

PID - PID Controller Function Block
RG PTR - Range Pointer ------- LOOP02.AIN2.OR
INPUT P - Input P ----------- LOOP02.AIN2.O1
INPUT S - Input S ------------ LOOP02.SETPT.O1
INPUT F - Input F ----------- LOOP02.A/M.O1
INPUT A - Input A --------- LOOP02.A/M.AS
ESN - Exec. Seq. No.-------- 15

A/M - Auto/Manual Function Block
RG PTR - Range Pointer ------- LOOP02.PID.OR
INPUT A - Input A ----------- LOOP02.PID.O1
ESN - Exec. Seq. No.-------- 20

ODC - Operator Display for Controllers
P RG PTR - P Range Pointer ----- LOOP02.AIN2.OR
V RG PTR - V Range Pointer ---- LOOP02.PID.OR
INPUT P - Input P (Process) ----- LOOP02.AIN2.O1
INPUT S - Input S (Setpoint) ---- LOOP02.SETPT.O1
INPUT V - Input V (Valve) ------ LOOP02.A/M.O1
LOOP # - Loop# ----- 02

AOUT2 - Analog Output 2 Function Block
RG PTR - Range Pointer ---------- LOOP02.PID.OR
INPUT S - Input S ---------------- LOOP02.A/M.O1
4.8 FCO121 - Cascade Control

Factory Configured Option FCO121 provides two loops configured for Cascade control. The block diagram of the configuration of the two loops is shown below along with the changes made to the default parameter values of the configured blocks. The process range of the Primary loop can be changed in Analog Input 1 and the range of the Secondary loop in Analog Input 2. Also, the output range of the primary PID controller must be changed to match any new range in the secondary loop. If the loop tag ‘PRIM’ or ‘SEC’ is changed, all configured references will automatically be changed to the new tag.

**Primary Loop**

**SETPT - Setpoint Function Block**
- RG PTR - Range Pointer ------- PRIM.AIN1.OR
- INPUT TV - Input TV ---------- PRIM.AIN1.O1
- INPUT TC - Input TC ----------- PRIM.A/M.NA
- ESN - Exec. Seq. No. ----------- 5

**ALARM - Alarm Function Block**
- RG PTR - Range Pointer ------- PRIM.AIN1.OR
- INPUT P - Input P ----------- PRIM.AIN1.O1
- INPUT D - Input D --------- PRIM.SETPT.O1
- ESN - Exec. Seq. No. ---------- 10

**Secondary Process**

**Alarm**

**Primary Process**
### Primary Loop (cont)

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<tr>
<th>Block Name</th>
<th>Description</th>
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<th>INPUT P</th>
<th>INPUT S</th>
<th>INPUT F</th>
<th>INPUT A</th>
<th>ESN</th>
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<tr>
<td>PID - PID Controller Function Block</td>
<td>RG PTR - Range Pointer</td>
<td>PRIM.AIN1.OR</td>
<td>PRIM.AIN1.OR</td>
<td>PRIM.SETPT.01</td>
<td>PRIM.A/M.AS</td>
<td>Prim.A/M.AS</td>
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<td>INPUT P - Input P</td>
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<td>PRIM.AIN1.OR</td>
<td>PRIM.AIN1.OR</td>
<td>PRIM.SETPT.01</td>
<td>PRIM.A/M.AS</td>
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<tr>
<td>INPUT S - Input S</td>
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<td>PRIM.SETPT.01</td>
<td>PRIM.SETPT.01</td>
<td>PRIM.A/M.O1</td>
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<td>INPUT F - Input F</td>
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<td>SEC.AIN2.OR</td>
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<th>Description</th>
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<th>INPUT S</th>
<th>INPUT F</th>
<th>INPUT A</th>
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<td>A/M - Auto/Manual Function Block</td>
<td>RG PTR - Range Pointer</td>
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<td>PRIM.PID.OR</td>
<td>PRIM.PID.OR</td>
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<td>PRIM.PID.OR</td>
<td>PRIM.PID.OR</td>
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<td>INPUT TV - Input TV</td>
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<td>SEC.AIN2.OR</td>
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<th>Description</th>
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<th>INPUT S</th>
<th>INPUT F</th>
<th>INPUT A</th>
<th>ESN</th>
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<tr>
<td>ODC - Operator Display for Controllers</td>
<td>P RG PTR - Range Pointer</td>
<td>PRIM.AIN1.OR</td>
<td>PRIM.AIN1.OR</td>
<td>PRIM.AIN1.OR</td>
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<td>INPUT P - Input P (Process)</td>
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<td>INPUT S - Input S (Setpoint)</td>
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<td>INPUT V - Input V (Valve)</td>
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<td>RG PTR - Range Pointer</td>
<td>SEC.AIN2.OR</td>
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<td>INPUT TC - Input TC</td>
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<td>SEC.OR02.O1</td>
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<th>INPUT F</th>
<th>INPUT A</th>
<th>ESN</th>
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<tbody>
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<td>ALARM - Alarm Function Block</td>
<td>RG PTR - Range Pointer</td>
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<td>INPUT D - Input D</td>
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<td>SEC.E/I.O1</td>
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<th>INPUT F</th>
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<th>Description</th>
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<th>INPUT S</th>
<th>INPUT F</th>
<th>INPUT A</th>
<th>ESN</th>
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<td>SPLIM - Setpoint Limit Function Block</td>
<td>RG PTR - Range Pointer</td>
<td>SEC.AIN2.OR</td>
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<td>INPUT A - Input A</td>
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<td>PRIM.A/M.O1</td>
<td>PRIM.A/M.O1</td>
<td>PRIM.A/M.O1</td>
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<th>INPUT S</th>
<th>INPUT F</th>
<th>INPUT A</th>
<th>ESN</th>
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<tr>
<td>E/I - Ext/Int Transfer Switch Function Block</td>
<td>INPUT ST - Input ST</td>
<td>SEC.PB2SW.PS</td>
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<td>INPUT I - Input I</td>
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</table>
4.9 FCO122 - Cascade Control w/ Operator Setpoint Limits

Factory Configured Option FCO122 provides two loops configured for Cascade control. The block diagram of the configuration of the two loops is shown below along with the changes made to the default parameter values of the configured blocks. The process range of the Primary loop can be changed in Analog Input 1 and the range of the Secondary loop in Analog Input 2. Also, the output range of the primary PID controller must be changed to match any new range in the secondary loop. If the loop tag ‘PRIM’ or ‘SEC’ is changed, all configured references will automatically be changed to the new tag.

**Primary Loop**

**SETPT - Setpoint Function Block**
- RG PTR - Range Pointer ------- PRIM.AIN1.OR
- INPUT TV - Input TV --------- PRIM.AIN1.O1
- INPUT TC - Input TC --------- PRIM.A/M.NA
- INPUT LU - Input LU --------- PRIM.SPLIM.HS
- INPUT LD - Input LD --------- PRIM.SPLIM.LS
- ESN - Exec. Seq. No.--------- 5

**SPLIM - Setpoint Limit Function Block**
- RG PTR - Range Pointer ------- PRIM.AIN1.OR
- INPUT A - Input A ----------- PRIM.SETPT.O1
- ESN - Exec. Seq. No.--------- 10
Primary Loop (cont)

ALARM - Alarm Function Block
RG PTR - Range Pointer ------- PRIM.AIN1.OR
INPUT P - Input P -------- PRIM.AIN1.O1
INPUT S - Input S -------- PRIM.SPLIM.O1
INPUT A - Input A -------- PRIM.A/M.AS
ESN - Exec. Seq. No. ------- 25

PID - PID Controller Function Block
RG PTR - Range Pointer ------- PRIM.AIN1.OR
INPUT P - Input P -------- PRIM.AIN1.O1
INPUT S - Input S -------- PRIM.SPLIM.O1
INPUT F - Input F -------- SEC.AIN2.OR
INPUT A - Input A -------- SEC.E/I.O1
ESN - Exec. Seq. No. ------- 30

A/M - Auto/Manual Function Block
RG PTR - Range Pointer ------- PRIM.PID.OR
INPUT P - Input P -------- PRIM.PID.O1
INPUT TV - Input TV -------- SEC.AIN2.OR
INPUT TC - Input TC -------- SEC.OR01.O1
ESN - Exec. Seq. No. ------- 50

ODC - Operator Display for Controllers
P RG PTR - P Range Pointer ------- PRIM.AIN1.OR
V RG PTR - V Range Pointer ------- PRIM.PID.OR
INPUT P - Input P (Process) ------- PRIM.AIN1.O1
INPUT S - Input S (Setpoint) ------- PRIM.SPLIM.O1
INPUT V - Input V (Valve) ------- PRIM.A/M.O1
LOOP # - Loop # ------- 01

Secondary Loop

SETPT - Setpoint Function Block
RG PTR - Range Pointer ------- SEC.AIN2.OR
INPUT TV - Input TV -------- SEC.AIN2.O1
INPUT TC - Input TC -------- SEC.OR02.O1
INPUT LU - Input LU -------- SEC.SPLIM.HS
INPUT LD - Input LD -------- SEC.SPLIM.LS
ESN - Exec. Seq. No. ------- 5

ALARM - Alarm Function Block
RG PTR - Range Pointer ------- SEC.AIN2.OR
INPUT P - Input P -------- SEC.AIN2.O1
INPUT D - Input D -------- SEC.SPLIM.O1
ESN - Exec. Seq. No. ------- 10

PB2SW - PB2 Switch Function Block
INPUT MD - Input MD ------- SEC.E/LSE
ESN - Exec. Seq. No. ------- 15

E/I - Ext/Int Transfer Switch Function Block
INPUT ST - Input ST -------- SEC.PB2SW.PS
INPUT E - Input E -------- PRIM.A/M.O1
INPUT I - Input I -------- SEC.SETPT.O1
ESN - Exec. Seq. No. ------- 20

SPLIM - Setpoint Limit Function Block
RG PTR - Range Pointer ------- SEC.AIN2.OR
INPUT A - Input A -------- SEC.E/LO1
ESN - Exec. Seq. No. ------- 35

PID - PID Controller Function Block
RG PTR - Range Pointer ------- SEC.AIN2.OR
INPUT P - Input P -------- SEC.AIN2.O1
INPUT S - Input S -------- SEC.SPLIM.O1
INPUT F - Input F -------- SEC.A/M.O1
INPUT A - Input A -------- SEC.A/M.AS
INPUT I - Input I -------- SEC.E/LES
ESN - Exec. Seq. No. ------- 60

A/M - Auto/Manual Function Block
RG PTR - Range Pointer ------- SEC.PID.OR
INPUT A - Input A -------- SEC.PID.O1
ESN - Exec. Seq. No. ------- 35

OR01 - OR Function Block
INPUT A - Input A -------- SEC.A/M.NA
INPUT B - Input B -------- SEC.E/LIS
ESN - Exec. Seq. No. ------- 40

OR02 - OR Function Block
INPUT A - Input A -------- SEC.A/M.NA
INPUT B - Input B -------- SEC.E/LIS
ESN - Exec. Seq. No. ------- 45

AOUT1 - Analog Output 1 Function Block
RG PTR - Range Pointer ------- SEC.PID.OR
INPUT S - Input S -------- SEC.A/M.O1

ODC - Operator Display for Controllers
P RG PTR - P Range Pointer ------- SEC.AIN2.OR
V RG PTR - V Range Pointer ------- SEC.PID.OR
INPUT P - Input P (Process) ------- SEC.AIN2.O1
INPUT S - Input S (Setpoint) ------- SEC.SPLIM.O1
INPUT V - Input V (Valve) ------- SEC.A/M.O1
LOOP # - Loop# ------- 02


5.0 LONWORKS COMMUNICATIONS

The LonWorks option board A-1 is added to a controller to expand the I/O capacity. The board uses the LonWorks communication protocol to communicate with remote LonWorks devices over a single twisted pair network. The diagram shows the option board added to an MPU Controller board and remote mounted LonWorks nodes.

A LonWorks Remote I/O board uses a Free Topology transceiver communicating at 78.1 Kbps.

Up to fifteen (15) physical nodes can be connected to a controller.

Install a LonWorks network by first wiring all the nodes to the network. Next, temporarily connect a PC-based Network Manager to the network using a SLTA (Serial Link Talk Adapter) manufactured by Echelon Corp. The Network Manager (MetaVision 3.0) and the SLTA are included in the LonWorks Startup Kit.

Each individual node is then installed by the Network Manager and saved in a Project file. The Project file is a permanent record of the network installation and must be retained for any future network maintenance. When a node is first installed, the Network Manager reads the Program ID and the Neuron ID (every LonWorks device has a Neuron chip that contains a worldwide unique ID). If a node with the same Program ID had not been previously installed, it will read all of the self-documentation from the node. The Network Manager will now have a list of all the available parameters and I/O variables within that node. Some parameters may need to be configured, but for most applications, the default settings are acceptable. The Network Manager is then used to BIND network variables (i.e. connect I/O variables from one node to another).

Network variable connections from remote nodes to the controller are used within the controller by selecting LonWorks I/O function blocks within individual loop configurations6. These function blocks, which are detailed in the Function Blocks section of this manual, enable connections to network variables to be made to other block inputs within the controller. There are a number of different block types available. Block selection depends on the types of variables to be connected. Siemens supports LonWorks Standard Network Variable Types:

- SNVT_lev_percent for analog inputs and outputs
- SNVT_lev_disc for discrete inputs and outputs
- SNVT_state for use with the Moore 16-channel discrete input or output modules available with firmware 1.30 or higher

There is a 15 node per network limit. When large I/O counts are needed for a controller application, use physical nodes with higher I/O counts to minimize the number of physical nodes required. For example, 16-channel discrete input and output modules are available. Up to six of each can be used within a controller configuration. A 4-channel analog input module and a 2-channel analog output module are also available.

6 Model 352P only: the Option 3 I/O Jumper must also be used to select LonWorks.
SERVICING CONSIDERATIONS

The functioning of a LonWorks network can be affected by:

- Upgrading the MPU Controller board firmware
- Replacing a controller’s MPU Controller board with a board having a different firmware version
- Moving a LonWorks board to a controller with a different MPU Controller board firmware version

Background

A LonWorks option board contains a Program ID for the controller node. A Controller MPU board will store a Program ID in the EEPROM on the LonWorks board when the combination is first powered up. When the Network Manager software installs a controller node as part of a network, it reads the Program ID when a controller is installed for the first time. The Program ID of the controller, as with all other installed nodes, is then retained by the Network Manager.

The version 1.30 Program ID was changed since new function blocks DIS and DOS contained a new network variable type: SNVT_state. When controller firmware is upgraded to 1.30 or higher, the controller will store a new Program ID in the EEPROM on the LonWorks board so that a Network Manager will recognize it as a different type of node.

Considerations

1. When a controller in an installed network is upgraded to 1.30 or higher, the Network Manager will not recognize the network variables added by the new version. The Network Manager will be able to bind variables present in the earlier version.

2. A LonWorks board that has been used in a controller with 1.30 or higher firmware should not be used in a controller with firmware 1.21 or lower. The LonWorks board EEPROM will contain the Program ID stored in it by the 1.30 firmware.

- If the LonWorks board is mounted in a controller with 1.21 firmware and the controller is installed by a Network Manager that had **not previously installed** a controller with 1.30 firmware, a problem will occur. The Network Manager will read out the list of network variables available but the variables will be only those that were available in 1.21. In subsequent installations of controllers with 1.30 firmware, the Network Manager will not read, and therefore will not have access to, the new 1.30 variables.

- If the LonWorks board is mounted in a controller with 1.21 firmware and the controller is installed by a Network Manager that **had previously installed** a controller with 1.30 firmware, the Network Manager variable list will include the new 1.30 variables. The controller, however, will reject an attempt to bind them.
Suggested Actions

1. When upgrading MPU Controller firmware:
   1) Generate a report of all network bindings.
   2) Uninstall the controller node from a network.
   3) Upgrade the controller firmware
   4) Install the controller node.
   5) Refer to the above report and bind all network variables.

   Note
   If the controller has already been upgraded, it can still be uninstalled with the current version of the MetaVision 3.0x Network Manager but uninstalling prior to upgrading is recommended. Other Network Managers may not allow this.

2. Once a LonWorks option board is used in a 1.30 or higher controller and is uninstalled and removed from service, mark the board as “1.30 firmware only”.

■
6.0  NETWORK COMMUNICATIONS

This section provides an overview of the data that can be obtained from the station using Modbus, LIL, or Ethernet, which provides Modbus over Ethernet protocol. In the Modbus over Ethernet protocol all listed Modbus items are available but are embedded in the Modbus/Ethernet protocol frame. Refer to Section 7 for detailed list of the actual data.

**NOTE**

Ethernet is available on Procidia i|pac and Moore 353 controllers. It is not available on Moore 352P and 354/354N controllers.

6.1 MODBUS DATA MAPPING

Modbus is a master/slave protocol where a master device (e.g. PC-based operator workstation) sends commands to one slave (e.g. a controller) and waits for a response. Each station has a unique network address (1-32), configured as part of the station parameters, that identifies a specific controller.

Data is assigned to either a register (16-bit word) or a coil (1-bit). An IEEE floating point number (Real) is assigned to 2 consecutive registers with the first containing the most significant and the second the least significant portion of the floating point number.

The station supports Modbus function codes 01, 02, 03, 04, 05, 06, 08, and 16. Section 7 provides a listing of available data and specific locations within the Modbus map. The following is the overview for the Modbus data mapping.

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Address Range</th>
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</thead>
<tbody>
<tr>
<td>Station Coils</td>
<td>x0001 - x0071</td>
</tr>
<tr>
<td>Loop Coils</td>
<td>x0296 - x1495</td>
</tr>
<tr>
<td>Extended Loop Coils (ODD Pushbuttons V2.1)</td>
<td>x8701 - x9100</td>
</tr>
<tr>
<td>Sequencer Loop I/O Coils (ref. MSLCP pointer)</td>
<td>x1496 - x2263</td>
</tr>
<tr>
<td>LonWorks Remote I/O Coils (Moore 352P, 353, &amp; 354/354N)</td>
<td>x2401 - x3976</td>
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<tr>
<td>Ubus Discrete I/O States &amp; Forcing V2.1 (Procidia)</td>
<td>x4001 - x5500 (spares)</td>
</tr>
<tr>
<td>Loop PCOM Block Coils</td>
<td>x9101 - x9999</td>
</tr>
<tr>
<td>Station Data (16-bit integer)</td>
<td>x0001 - x0100</td>
</tr>
<tr>
<td>Station String Data (ASCII)</td>
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<tr>
<td>Loop Dynamic Data (16-bit integer)</td>
<td>x0201 - x0450</td>
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<tr>
<td>Loop Variable Data (16-bit integer)</td>
<td>x0451 - x1200</td>
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<tr>
<td>Loop Static Data (16-bit integer)</td>
<td>x1201 - x1950</td>
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<tr>
<td>Loop Dynamic Data (32-bit floating point)</td>
<td>x1951 - x2450</td>
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<tr>
<td>Loop Variable Data (32-bit floating point)</td>
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<td>Loop Static Data (32-bit floating point)</td>
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<tr>
<td>Loop String Data (ASCII)</td>
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<td>Ubus Module Types (Procidia)</td>
<td>x7951 - x8000</td>
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<tr>
<td>Loop Trend Data (ref. MLTP pointer)</td>
<td>x8001 - x9000 (spares)</td>
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<td>x9001 - x9999</td>
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EXTENDED MODBUS REGISTERS: The traditional addressing of Modbus Holding Registers has been limited to 9999. However, since the actual address is contained in a 16-bit word, addresses above 9999 are available. Many Modbus Masters support this extended addressing. Configuration data for a Sequencer & Timers contained in a single sequencer loop can be accessed in this space. The actual loop that can be accessed is contained in the Modbus parameter MSLCP Modbus Sequencer & Timers Configuration Pointer located in register 40041. This register contains the Modbus Index for the loop that can be configured with these extended parameters. A small number of these parameters have also been mapped in the areas listed within the actual loop area for those Masters that cannot access the extended area.

In addition, there are a number of registers reserved for the mappings of Modbus registers used in the peer-to-peer functionality of the Ethernet function blocks.

Sequencer Mask Configurations .............................................x10001 – x18000
Real Time Trip Block Configurations ..................................x19001 – x19021
Sequencer Time & Analog Configurations ............................x20001 – x20999
Timer Function Block Configurations .....................................x21001 – x21009
Reserved -- Modbus Ethernet Block Register .......................x29001 – x29019
Reserved – Modbus Ethernet Analog Inputs Static Data .........x30001 – x30352
Reserved – Modbus Ethernet Analog Outputs Static Data ......x30353 – x30608
Reserved – Modbus Ethernet Digital Inputs Static Data ..........x30609 – x30704
Reserved – Modbus Ethernet Coil Inputs Static Data .........x30705 – x30832
Reserved – Modbus Ethernet Analog Inputs Dynamic Data ......x30833 – x30896
Reserved – Modbus Ethernet Digital Inputs Dynamic Data ......x30897 – x30928
Reserved – Modbus Ethernet Coil Inputs Dynamic Data .........x30929 – x30960
Reserved – Modbus Ethernet Analog Outputs Dynamic Data.x30961 – x31024*

* Refer to the AIE function block in the Function Blocks section for details.
6.2 LIL DATA MAPPING

LIL data is assigned to one of two data types. The first is global data which occupies parameter 1 of each channel and is transmitted by the LIL interface every 0.5 seconds. The remaining data is non-global which occupies parameters 2 through 256 and is transmitted in response to a LIL READ command or can be changed by a LIL WRITE command.

Each parameter is a 16-bit word. An IEEE floating point number (Real) is assigned to 2 consecutive parameters with the first containing the most significant and the second the least significant portion of the floating point number. String data can occupy one or more consecutive parameters. The following tables provide an overview listing of available data with descriptions located in Section 7. The acronym in the table identifies the data in Section 7. Data can be accessed using the Model 320 Independent Computer Interface. Refer to AD320-10 Model 320 ICI User Manual and AD320-20 Guidelines for Writing Application Software Using the Model 320 ICI.

Guidelines:
All individual parameters (words) can be read using the random parameter data request (CMD 7). Parameters that span multiple words, such as floating point, ASCII tags, etc., can also be read using the multiple-byte parameter data request (CMD 23) but only one variable can be requested at a time. Writes are made using the parameter data send (CMD 9). In some cases such as loop and alarm status words, the MASK ON/OFF type codes are used to identify individual bits. Not all bit mapped words support this option. See Section 7 for specific information.

6.2.1 Station Data

Station data is fixed and occupies the first seven channels.

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Usbus Address xx - Discrete I/O States & Forcing (N=Normal, M=Mode, F=Forced (see Section 7 for details)

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LonWorks Remote Function Blocks I/O States N=Normal, M=Mode, F=Forced (see Section 7 for details)

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### 6.2.2 Control Loop Data

Control loop data occupies five LIL channels. The starting channel is entered during configuration of the ODC operator display function block for each loop, as LIL CHAN (n). The first channel for each loop can be viewed in station data starting at channel 5/parameter 2 for control loops and channel 6/parameter 2 for a sequencer loops. The station configuration entry (both local and graphical PC-based) will indicate the next available open space of five contiguous channels. Another starting channel can be entered but it is important to utilize the lowest total number of channels.

Channel locations n through n+4, in the table below, identify variables that will be available on the LIL for each control loop. All parameter 1 data (e.g. P-process) is global and is transmitted every 0.5 second. All other data is sent out on command.

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6.2.3 Sequence Loop Data

Sequence Loop data occupies six LIL channels. The starting channel is entered during configuration of the ODS operator display function block for each loop, as LIL CHAN (n). The configuration entry (both local and graphical PC-based) will indicate the next available open space of six contiguous channels. Another starting channel can be entered but it is important to utilize the lowest total number of channels.

Channel locations n through n+5, in the table below, identify variables that will be available on the LIL for each sequencer loop. All parameter 1 data (e.g. SSN Program Sequencer Step No.) is global and is transmitted every 0.5 seconds. All other data is sent out on command.

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Sequencer & Remote I/O State, Mode & Forcing

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### Sequencer and Timer Configuration Parameters:

- **SxxxTIM**: Step x Time Period .............................. Real
- **SxxxAEP**: Step x Analog End Point ........................ Real
- **SxxxGnIM**: Step x Group n Input Mask ................. 16 bit mask word
- **SxxxGnOM**: Step x Group n Output Mask ............... 16 bit mask word
- **DYTxxT**: Delay Timer x Time ................................. Real
- **OSTxxT**: One Shot Timer x Time ............................. Real
- **RCTxxNT**: Repeat Cycle Timer x-ON Time .......... Real
- **RCTxxFT**: Repeat Cycle Timer x-OFF Time .......... Real
- **ROTxxT**: Retentive On Timer Time .......................... Real

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6.2.4 Analog Indicator Loop Data

Analog Indicator loop data occupies six LIL channels. The starting channel is entered during configuration of the ODA operator display function block for each loop, as LIL CHAN (n). The first channel for each loop can be viewed in station data starting at channel 5/parameter 38. The station configuration entry (both local and graphical PC-based) will indicate the next available open space of six contiguous channels. Another starting channel can be entered but it is important to utilize the lowest total number of channels.

Channel locations n through n+5, in the table below, identify variables that will be available on the LIL for each analog indicator loop. All parameter 1 data (e.g. P-process) is global and is transmitted every 0.5 second. All other data is sent out on command.

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6.2.5 Discrete Indicator Loop Data

Discrete Indicator loop data occupies four LIL channels. The starting channel is entered during configuration of the ODD operator display function block for each loop, as LIL CHAN (n). The first channel for each loop can be viewed in station data starting at channel 6/parameter 38. The station configuration entry (both local and graphical PC-based) will indicate the next available open space of six contiguous channels. Another starting channel can be entered but it is important to utilize the lowest total number of channels.

Channel locations n through n+3, in the table below, identify variables that will be available on the LIL for each analog indicator loop. All parameter 1 data (e.g. discrete input states) is global and is transmitted every 0.5 second. All other data is sent out on command.

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6.2.6 Pushbutton Loop Data

Pushbutton loop data occupies two LIL channels. The starting channel is entered during configuration of the ODP operator display function block for each loop, as LIL CHAN (n). The first channel for each loop can be viewed in station data starting at channel 7/parameter 38. The station configuration entry (both local and graphical PC-based) will indicate the next available open space of six contiguous channels. Another starting channel can be entered but it is important to utilize the lowest total number of channels.

Channel locations n through n+1, in the table below, identify variables that will be available on the LIL for each analog indicator loop. All parameter 1 data (e.g. discrete input states) is global and is transmitted every 0.5 second. All other data is sent out on command.

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<thead>
<tr>
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<th>3</th>
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<td></td>
<td></td>
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<td>L#G8SMT</td>
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</table>
7.0  DATA MAPPING

This section provides loop and station data mapping for Modbus, Local Instrument Link, and Ethernet. Modbus is standard. LIL and Ethernet option boards are available and the correct board must be installed to enable either communication protocol. With the Ethernet option, data is accessed using Modbus commands embedded within the TCP protocol. This is becoming known within the industry as the Open Modbus/TCP Protocol.

The controller has an RS232 port that always communicates via Modbus. It is located on the underside of the operator faceplate.

Each controller also has a multi-drop network connection that is either Modbus, LIL (when the optional LIL board is installed), or Ethernet (when the optional Ethernet board is installed). The Ethernet connection is made using the standard RJ45 connector. The network can interconnect:

- Procida i|pac, Moore 352Plus, Moore 353 and Moore 354N Controllers and a computer running i|ware PC™, ProcessSuite™, MYCROADVANTAGE™ or other operator interface software that includes the communication driver (e.g. Modbus, LIL (320), or OPC Ethernet) in the controller.
- Procida i|pac, Moore 352Plus, Moore 353 and Moore 354N Controllers and an APACS® Model 39ACM Advanced Control Module via Modbus or LIL

The network permits data to be uploaded from the station to the computer or workstation. This data is typically used for process and alarm monitoring, additional processing of the data for inventory management and accounting, and process and equipment troubleshooting. Data can be downloaded to the station to change setpoint or valve value, change control mode, and acknowledge alarms.

Proprietary data transfers associated with configuration upload/download or on-line monitoring associated with the i|config Graphical Configuration Utility are not described. MPU Controller firmware versions are identified as explained in earlier sections.

7.1  CONNECTING TO APACS 39ACM, MYCROADVANTAGE, ProcessSuite, i|ware PC

7.1.1  APACS

A Model 39ACM (Advanced Control Module) supports both Modbus and LIL connections. Use the standard Modbus Master Function Block Library to communicate with a station. When requesting Modbus data, do not exceed 48 coils or 60 registers per request. A LIL function block library (P/N 15939-625V4.00 ACM Serial Communication FB Library LIL) that provides a method for connecting the ACM to standard LIL stations is available. The library includes a Moore 352P/353/354 Loop block. The current release of the library maps the 352P/353/354 as having 3-loops located at channels 8, 13, and 18. Therefore, it is necessary to configure ODC function blocks for these channels. It is expected that later releases of the library will allow multiple loops, up to maximum allowed. Also, data from additional loops can be obtained by using a combination of other library functions such as LIL_GBL, LIL_NGBL, and LIL_CMD.

7.1.2  MYCROADVANTAGE

Model 320 Driver

MYCROADVANTAGE provides a LIL(320) driver that will communicate with stations on a Local Instrument Link (LIL). Standard, predefined parameter tables for many LIL products (e.g. Models 351 and 352) are within MYCROADVANTAGE to simplify configuration. MYCROADVANTAGE release 3.32 does not include a Model 352P/353/354 predefined parameter table. However, when up to three control loops are to be configured in a Model 352P, 353 or 354, use the Model 351 predefined parameter table and configure the ODC blocks in the loops to channels 8, 13, and 18. This method will work since the loop data in the controller is the same as a 351 and is located at the same relative offsets as in a 351. Loops can also be configured individually. Details on the configuration can be found the MYCROADVANTAGE user manual.
Modbus Driver

MYCROADVANTAGE provides a Modbus driver for communicating with up to 32 stations through a single COM port. There are a few considerations when communicating with a Model 352P, 353 or 354 using the Modbus driver.

- Loop data is available as integer or floating point. When integer is used, more data is obtained with a single command, thus improving the communication throughput. When integer data is used, ranges can be scaled using 3:Linear function MX+B scaling.
- The MODBUS.DAT file must be modified. Under the section [Address Chunk Range], set “UseDefault=0”, under section [Address Size], set “itChunkSize=48” and “WordChunkSize=60”.

7.1.3 ProcessSuite

RealTime LIL I/O Server

An optional LIL RealTime I/O Server is available to communicate with the Model 320 ICI (Independent Computer Interface). The 320 communicates over the Local Instrument Link (LIL) with other stations that have the LIL option boards installed. Refer to the literature provided with the LIL RealTime I/O Server for proper operation. Optimize LIL performance by using Global Data, especially for data that is updated on each scan such as the process, setpoint, valve, loop status, and alarm I. Use individual parameter requests only to obtain data not required frequently (e.g. tuning parameters, range scaling).

Modbus I/O Server

A Modbus I/O Server comes with Process Suite and it can be used to communicate with the controller. Refer to the Modbus I/O Server instructions for operating details. Certain parameter settings are critical. In the Topic Definition, use the 584/984 slave type. Set the maximum coil reads to 48 and maximum register reads to 60. Maximum coil writes can be set to the minimum allowed value of 8 and register writes to 2.

7.1.4 i|ware PC

Modbus OPC Server

The i|ware PC Operator Interface software includes a Modbus OPC server that when connected to the controller can auto populate its database with the number and type of loops configured in the station. All tag names used in the OPC database will be the same as listed in this manual.

LIL OPC Server

The i|ware PC Operator Interface software includes an LIL OPC server that when connected to the controller can auto populate its database with the number and type of loops configured in the station. All tag names used in the LIL OPC database will be the same as listed in this manual.

Ethernet OPC Server

The i|ware PC Operator Interface software is an OPC Client and can be connected to an OPC server. An Ethernet OPC server using the Open Modbus/TCP Protocol is available to obtain data from single or multiple controllers and server the data to OPC clients.

Modbus Application Note: Refer to application document AD353-108 for information on using Modbus communications with controller products.
7.2 STATION DATA

A station contains some data that pertains to the entire station and some to individual loops. Station data, available over the network, is part of the station function block (STATN) configuration and is mapped to fixed locations in Modbus registers or coils and fixed channel/parameters when the optional LIL board is installed. Loop data (detailed in the next section) can be associated with a Controller “Control Loop” or a Sequencer “Sequencer Loop” as defined by the selection of the operator display: ODC “Operator Display for Controller” or ODS “Operator

Much of the analog data is available in two formats. The first is 16-bit values, scaled consistent with previous LIL products, enabling integration into existing LIL systems. This data type also provides Modbus masters, unable to handle 32-bit floating point, a method for obtaining data from the station.

The second is the standard 32-bit IEEE floating point format consistent with the actual data in the station. This data type is contained in two consecutive registers or parameters.

- When using Modbus, the LSW is first and the MSW second.
- When using LIL, the first parameter contains the MSW and the second parameter the LSW.
- Boolean values are packed into 16-bit words for LIL use and are available in coils when using Modbus.
- String data, formatted as 2 ASCII characters per word with the left-most character in the most significant byte, containing tag, units, and message information is available with Modbus and LIL.

Most Station data is ‘Read Only’ except for:

- SE (Station Error) parameter that allows a write of $0000 to reset the current error as an acknowledgment
- SSW (Station Status Word) parameter which allows writes to certain bits (coils)
- MLTP (Modbus Loop Trend Pointer, included in version 1.30 firmware) parameter
- AASEL (Active Acknowledged Station Error Log, included in version 1.30 firmware) parameter
- other items as noted below

7.2.1 Integer Data (16-bit Integer)

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<th>Code</th>
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<th>Description</th>
<th>Range</th>
<th>Register (MB)</th>
<th>C/P (LIL)</th>
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<td>SSW</td>
<td>R/W</td>
<td>Station Status Word</td>
<td>(see Station Status Word)</td>
<td>(see coils)</td>
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<td>R/W</td>
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Data Mapping UM354N-1

CWT R Computer Watchdog Timer (sec) 0-1000 ($0000-$03F8) 40020 3/2
KSR R Kernel Software Rev. # (see below) 40021 1/16
CT R Cycle Time (msec) 0-32767 ($00000-$7FFF) 40022 3/4
LxT R Loop - Type ($0000-$0005) 40023-40047 n/a

- (0-none, 1-controller, 2-sequencer, 3-analog ind. V2.2, 4-discrete ind. V2.2, 5-pushbuttons V2.2)

MSLCP R/W Modbus Seq. Loop Config. Pt 0-25 ($0000-$0019) 40048 n/a
LSLCP R/W LIL Seq. Loop Config. Pointer 0-25 ($0000-$0019) n/a 7/1
SA R/W Station Address 0-250 ($0000-$00FA) 40049 n/a
RTS R/W Front Port (Display Assembly) RTS 1-3 ($0001-$0003) 40050 3/5

reserved 40051-40057 1/17-23

MLTP R/W Modbus Loop Trend Pointer (V1.3) 0-25 ($0000-$0019) 40058 n/a
NLTB R Number of Loop Trend Blocks (V1.3) 0-5 ($0000-$0005) 40059 n/a
AASEL R/W Active Ack’d Station Error Log (V1.3) 0-33767 ($0000-$7FFF) 40060 4/6

STY R/W (1) Standard Time in Years 1997- 40061 3/6 (V2.0)
STM R/W (1) Standard Time in Months 1-12 40062 3/7 (V2.0)
STD R/W (1) Standard Time in Days 1-31 40063 3/8 (V2.0)
STH R/W (1) Standard Time in Hours 0-23 40064 3/9 (V2.0)
STMN R/W (1) Standard Time in Minutes 0-59 40065 3/10 (V2.0)
STSC R/W (1) Standard Time in Seconds 0-59 40066 3/11 (V2.0)

NAL R No of Analog Ind. Loops (ODA) 0-255 ($0000-$00FF) 40067 5/37 (V2.2)
NDL R No of Discrete Ind. Loops (ODD) 0-255 ($0000-$00FF) 40068 6/37 (V2.2)
NDP R No of Pushbutton Loops (ODP) 0-255 ($0000-$00FF) 40069 7/37 (V2.2)
IPA1 R IP Address (2) 1: 0-255, 2: 0-255 40070 n/a (V2.4)
IPA2 R IP Address (2) 3: 0-255, 4: 0-255 40071 n/a (V2.4)
IPG1 R IP Gateway Address (4) 1: 0-255, 2: 0-255 40072 n/a (V2.4)
IPG2 R IP Gateway Address (4) 3: 0-255, 4: 0-255 40073 n/a (V2.4)
IPM1 R IP Mask (3) 1: 0-255, 2: 0-255 40074 n/a (V2.4)
IPM2 R IP Mask (3) 3: 0-255, 4: 0-255 40075 n/a (V2.4)
EBS R Ethernet Board Speed 0-auto, 1-10M, 2-100M 40076 n/a (V2.4)
EBD R Ethernet Board Duplex 0-auto, 1-half duplex, 2-full duplex 40077 n/a (V2.4)
PPR R Ethernet Board Peer-to-Peer Rate 0.25, 0.5, 1, 2, 5, 10 sec 40078 n/a (V2.4)

Spare 40079-40100

C_S R Control Loop Starting Chan. LIL 8-250 ($0008-$00FA) n/a 5/2-5/26
S_S R Seq. Loop Starting Chan. LIL 8-250 ($0008-$00FA) n/a 6/2-6/26
A_S R Analog Indicator - Starting Chan. LIL 8-250 ($0008-$00FA) n/a 5/38-5/62 (V2.2)
D_S R Discrete Indication - Starting Chan LIL 8-250 ($0008-$00FA) n/a 6/38-6/62 (V2.2)
P_S R PB Indication - Starting Chan LIL 8-250 ($0008-$00FA) n/a 7/38-7/62 (V2.2)
SCR R Starting Configuration Record 0- ($0000-) 2/13
NCR R Number of Configuration Records 0- ($0000-0) 2/14
LxZ R Loop x Param. Z Staring Channel 8-250 ($0008-00FA) n/a 7/16-7/36. 6/36

Software Revisions:
Development Release MSB 128 to 255 ($80-$FF)
Major Rev. MSB 1 to 127 ($00-$7F) (5)
Minor Rev. LSB 0 to 255 ($00-$FF)

Hardware Type and Revisions:
Type MSB1 to 15 ($01-$0F) (5)
Rev. LSB 1 to 15 ($01-$0F)

(1) The controller time should be changed one parameter at a time and then verified before writing the next parameter (i.e. for Modbus use command 06 and not command 16 and LIL use a single parameter send). The change to each parameter will take approximately 1 to 2 seconds each.

(2) IP Address format (nnn.nnn.nnn.nnn) 1,2,3,4 (default 192.168.0.2)
(3) IP Mask format (nnn.nnn.nnn.nnn) 1,2,3,4 (default 255.255.255.0)
(4) IP Gateway format (nnn.nnn.nnn.nnn) 1,2,3,4 (default is 197.168.0.1)
(5) A major software Rev. of 0 = no software included and a hardware type of 0 = not installed.

7-4 May 2001
### 7.2.2 Station String Data (8-bit ASCII Char - 2/Word)

<table>
<thead>
<tr>
<th>Code</th>
<th>R/W</th>
<th>Description</th>
<th>Range</th>
<th>Register (MB)</th>
<th>C/P (LIL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAG</td>
<td>R</td>
<td>Station Tag</td>
<td>12 ASCII Char</td>
<td>40101-40106</td>
<td>2/7-7</td>
</tr>
<tr>
<td>CFNR</td>
<td>R</td>
<td>Configuration File Name Reduced</td>
<td>8 ASCII Char</td>
<td>n/a</td>
<td>2/9-12</td>
</tr>
<tr>
<td>CFN</td>
<td>R</td>
<td>Configuration File Name</td>
<td>20 ASCII Char</td>
<td>40107-40116</td>
<td>7/2-7/12</td>
</tr>
<tr>
<td>SN</td>
<td>R</td>
<td>Station Serial No.</td>
<td>8 ASCII (0-99999999)</td>
<td>40117-40120</td>
<td>4/2-4/5</td>
</tr>
</tbody>
</table>

### 7.2.3 Station Coil Data (1-bit)

<table>
<thead>
<tr>
<th>Code</th>
<th>R/W</th>
<th>Description</th>
<th>Range</th>
<th>Coil (MB)</th>
<th>C/P (LIL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASE</td>
<td>R</td>
<td>1-Active Station Event</td>
<td>1/0</td>
<td>00001</td>
<td>3/1(0)</td>
</tr>
<tr>
<td>SEN</td>
<td>R/W</td>
<td>1-Station Event Not Ackl’d</td>
<td>1/0</td>
<td>00002</td>
<td>3/1(1)</td>
</tr>
<tr>
<td>FSB</td>
<td>R</td>
<td>1- Flushing Station Bargraph</td>
<td>1/0</td>
<td>00003</td>
<td>3/1(2)</td>
</tr>
<tr>
<td>SDV</td>
<td>R</td>
<td>1- Station Database Valid</td>
<td>1/0</td>
<td>00004</td>
<td>3/1(3)</td>
</tr>
<tr>
<td>CCL</td>
<td>R</td>
<td>Config Change Counter LSB (bit)</td>
<td>1/0</td>
<td>n/a</td>
<td>3/1(4)</td>
</tr>
<tr>
<td>CCH</td>
<td>R</td>
<td>Config Change Counter MSB (bit)</td>
<td>1/0</td>
<td>n/a</td>
<td>3/1(5)</td>
</tr>
<tr>
<td>SCH</td>
<td>R</td>
<td>1-Station Configuration Hold</td>
<td>1/0</td>
<td>00007</td>
<td>3/1(6)</td>
</tr>
<tr>
<td>SRB</td>
<td>R/W</td>
<td>1-Station Run Bit</td>
<td>1/0</td>
<td>00008</td>
<td>3/1(7)</td>
</tr>
<tr>
<td>OOS</td>
<td>R/W</td>
<td>1-Station Alarms Out of Service</td>
<td>1/0</td>
<td>00009</td>
<td>3/1(8) V2.0</td>
</tr>
<tr>
<td>CC1</td>
<td>R/W</td>
<td>Config Change Bit #1</td>
<td>1/0</td>
<td>n/a</td>
<td>3/1(9-10)</td>
</tr>
<tr>
<td>CC2</td>
<td>R/W</td>
<td>Config Change Bit #2</td>
<td>1/0</td>
<td>n/a</td>
<td>3/1(11)</td>
</tr>
<tr>
<td>CC3</td>
<td>R/W</td>
<td>Config Change Bit #3</td>
<td>1/0</td>
<td>n/a</td>
<td>3/1(12)</td>
</tr>
<tr>
<td>SEB</td>
<td>R</td>
<td>1-Station Error Bit</td>
<td>1/0</td>
<td>00015</td>
<td>3/1(14)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(spare)</td>
<td></td>
<td>0</td>
<td>3/1(15)</td>
</tr>
</tbody>
</table>

### 7.2.4 Station Status Word (SSW)

[channel 3/parameter 1]

<table>
<thead>
<tr>
<th>BIT</th>
<th>Description</th>
<th>Value</th>
<th>Block</th>
<th>Read/Write</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Active Station Event (ASE)</td>
<td>1-Active Event</td>
<td>R</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Station Event Not Ackl’d (SEN)</td>
<td>1-Not Acknowledged</td>
<td>R/W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Flashing Bargraph (FSB)</td>
<td>1-Flashing Bargraph</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Database Valid (SDV)</td>
<td>1-Valid</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Config Change Counter LSB</td>
<td>1/0</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Config Change Counter MSB</td>
<td>1/0</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Configuration Hold (SCH)</td>
<td>1-Hold</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Station Run Bit (SRB)</td>
<td>1-Run</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Stations Alarms Out of Service</td>
<td>1-OOS</td>
<td>R/W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>(not used)</td>
<td>0</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>(not used)</td>
<td>0</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Configuration Change #1</td>
<td>1-Config. Changed</td>
<td>R/W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Configuration Change #2</td>
<td>1-Config. Changed</td>
<td>R/W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Configuration Change #3</td>
<td>1-Config. Changed</td>
<td>R/W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Station Error Bit (SEB)</td>
<td>1-Error</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>(not used)</td>
<td>0</td>
<td>R</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
7.3 LOOP DATA

Loop data is grouped into several categories. The groupings are not as significant when using the LIL option as all LIL data has been mapped consistent with previous LIL products using Global and Non-Global data. However, when using Modbus, the groupings enable single data requests (up to 60 Words/Registers or 48 Coils) to obtain similar data with a single command. The loop will have different data if assigned as a controller type (i.e. using the ODC block), a sequencer type (i.e. using the ODS block), an Analog Indicator Display (i.e. using the ODA block), or a Discrete Indicator Display (i.e. using the ODD block), or Pushbutton/Switch Operation (i.e. using the ODP block).

a) Dynamic data may change value on each controller scan and/or is not identified as being changed by the data base change bit (coil). This category of data usually needs to be updated by a workstation every few seconds.

b) Variable data changes periodically. It is usually associated with on-line operation at a workstation but may only need to be updated on a lower periodic basis or when a data base change is indicated.

c) Static data is similar to variable data but has a lower update requirement. The data may only need updating when a change is indicated or to verify a previous change made to a parameter.

d) String data contains tag names, units, and messages.
## 7.3.1 Dynamic Loop Integer Data

### Controller [ODC]

<table>
<thead>
<tr>
<th>Code</th>
<th>R/W</th>
<th>Description</th>
<th>Range</th>
<th>Register (MB)</th>
<th>C/P (LIL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L#PI</td>
<td>R</td>
<td>Process (%)</td>
<td>-3.3 to 103.3 ($0-$0FFF)</td>
<td>40201+10(#-1)</td>
<td>n/1</td>
</tr>
<tr>
<td>L#SI</td>
<td>R/W</td>
<td>Setpoint (%)</td>
<td>-3.3 to 103.3 ($0-$0FFF)</td>
<td>40202+10(#-1)</td>
<td>n+1/1</td>
</tr>
<tr>
<td>L#VI</td>
<td>R/W</td>
<td>Valve (%)</td>
<td>-3.3 to 103.3 ($0-$0FFF)</td>
<td>40203+10(#-1)</td>
<td>n+2/1</td>
</tr>
<tr>
<td>L#XI</td>
<td>R</td>
<td>X Variable (%)</td>
<td>-3.3 to 103.3 ($0-$0FFF)</td>
<td>40204+10(#-1)</td>
<td>n+3/24</td>
</tr>
<tr>
<td>L#YI</td>
<td>R</td>
<td>Y Variable (%)</td>
<td>-3.3 to 103.3 ($0-$0FFF)</td>
<td>40205+10(#-1)</td>
<td>n+4/24</td>
</tr>
<tr>
<td>L#RI</td>
<td>R/W</td>
<td>Ratio</td>
<td>0.00 to 38.40($80-$0F80)</td>
<td>40206+10(#-1)</td>
<td>n/7</td>
</tr>
<tr>
<td>L#BI</td>
<td>R/W</td>
<td>Bias</td>
<td>100-0-100 ($80-$0F80)</td>
<td>40207+10(#-1)</td>
<td>n/8</td>
</tr>
<tr>
<td>L#TlMI</td>
<td>R</td>
<td>Totalizer - 3 ms (whole) digits</td>
<td>0-999 ($0000-$03E7)</td>
<td>40208+10(#-1)</td>
<td>n+2/2</td>
</tr>
<tr>
<td>L#TIll</td>
<td>R</td>
<td>Totalizer - 3 ls (whole) digits</td>
<td>0-999 ($0000-$03E7)</td>
<td>40209+10(#-1)</td>
<td>n+3/3</td>
</tr>
<tr>
<td>CLS</td>
<td>R/W</td>
<td>Control Loop Status</td>
<td>(see CLS)</td>
<td>(see coils)</td>
<td>n+3/1</td>
</tr>
<tr>
<td>ASW</td>
<td>R/W</td>
<td>Alarm Status Word</td>
<td>(see ASW)</td>
<td>(see coils)</td>
<td>n+4/1</td>
</tr>
<tr>
<td>L#PCSW</td>
<td>R</td>
<td>PCOM Block Status Word (V1.3)</td>
<td>1-7 ($0001-$0007)</td>
<td>40210+10(#-1)</td>
<td>n+43/1</td>
</tr>
</tbody>
</table>

### Sequencer [ODS]

<table>
<thead>
<tr>
<th>Code</th>
<th>R/W</th>
<th>Description</th>
<th>Range</th>
<th>Register (MB)</th>
<th>C/P (LIL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L#SSNI</td>
<td>R</td>
<td>Sequencer Step No.</td>
<td>0-250 ($0000-$00FA)</td>
<td>40201+10(#-1)</td>
<td>n/1</td>
</tr>
<tr>
<td>L#SNII</td>
<td>R</td>
<td>Sequencer Number of Steps</td>
<td>0-250 ($0000-$00FA)</td>
<td>40202+10(#-1)</td>
<td>n/4</td>
</tr>
<tr>
<td>L#SNGI</td>
<td>R</td>
<td>Sequencer Number of Groups</td>
<td>0-16 ($0000-$0010)</td>
<td>40203+10(#-1)</td>
<td>n/5</td>
</tr>
<tr>
<td>L#SLS</td>
<td>R/W</td>
<td>Sequencer Loop Status</td>
<td>(see SLS)</td>
<td>(see coils)</td>
<td>n+5/1</td>
</tr>
<tr>
<td>L#SNRI</td>
<td>R</td>
<td>Sequencer Number of Recipes</td>
<td>0-9 ($0000-$0009)</td>
<td>40204+10(#-1)</td>
<td>n/11</td>
</tr>
<tr>
<td>L#CRNI</td>
<td>R/W</td>
<td>Current Recipe Number</td>
<td>0-9 ($0000-$0009)</td>
<td>40205+10(#-1)</td>
<td>n+3/1</td>
</tr>
<tr>
<td>L#PCSW</td>
<td>R</td>
<td>PCOM Block Status Word (V1.3)</td>
<td>1-7 ($0001-$0007)</td>
<td>40206+10(#-1)</td>
<td>n+2/1</td>
</tr>
<tr>
<td>L#TACM</td>
<td>R</td>
<td>Total Active Conditional Msgs (V1.3)</td>
<td>0-64 ($0000-$0040)</td>
<td>40207+10(#-1)</td>
<td>n+43/1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(spare)</td>
<td>0 ($0000)</td>
<td>40208+10(#-1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Analog Indicator [ODA] - (V2.2)

<table>
<thead>
<tr>
<th>Code</th>
<th>R/W</th>
<th>Description</th>
<th>Range</th>
<th>Register (MB)</th>
<th>C/P (LIL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L#P1I</td>
<td>R</td>
<td>Process 1 (%)</td>
<td>-3.3 to 103.3 ($0-$0FFF)</td>
<td>40201+10(#-1)</td>
<td>n/1</td>
</tr>
<tr>
<td>L#P2I</td>
<td>R</td>
<td>Process 2 (%)</td>
<td>-3.3 to 103.3 ($0-$0FFF)</td>
<td>40202+10(#-1)</td>
<td>n+1/1</td>
</tr>
<tr>
<td>L#P3I</td>
<td>R</td>
<td>Process 3 (%)</td>
<td>-3.3 to 103.3 ($0-$0FFF)</td>
<td>40203+10(#-1)</td>
<td>n+2/1</td>
</tr>
<tr>
<td>L#P4I</td>
<td>R</td>
<td>Process 4 (%)</td>
<td>-3.3 to 103.3 ($0-$0FFF)</td>
<td>40204+10(#-1)</td>
<td>n+3/1</td>
</tr>
<tr>
<td>L#SW1</td>
<td>R/W</td>
<td>Status Word 1</td>
<td>(see SW1)</td>
<td>(see coils)</td>
<td>n+4/1</td>
</tr>
<tr>
<td>L#SW2</td>
<td>R/W</td>
<td>Status Word 2</td>
<td>(see SW1)</td>
<td>(see coils)</td>
<td>n+5/1</td>
</tr>
</tbody>
</table>

### Discrete Indicator [ODD] - (V2.2)

<table>
<thead>
<tr>
<th>Code</th>
<th>R/W</th>
<th>Description</th>
<th>Range</th>
<th>Register (MB)</th>
<th>C/P (LIL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L#DISW</td>
<td>R/W</td>
<td>Discrete Input Status Word</td>
<td>(see L#DISW)</td>
<td>(see coils)</td>
<td>n/1</td>
</tr>
<tr>
<td>L#DSSW</td>
<td>R/W</td>
<td>Discrete State Status Word</td>
<td>(see L#DSSW)</td>
<td>(see coils)</td>
<td>n+1/1</td>
</tr>
<tr>
<td>L#DOSW</td>
<td>R/W</td>
<td>Discrete Output Status Word</td>
<td>(see L#DOSW)</td>
<td>(see coils)</td>
<td>n+2/1</td>
</tr>
<tr>
<td>L#SW</td>
<td>R/W</td>
<td>Status Word</td>
<td>(see L#SW)</td>
<td>(see coils)</td>
<td>n+3/1</td>
</tr>
</tbody>
</table>

### Discrete Indicator [ODP] - (V2.2)

<table>
<thead>
<tr>
<th>Code</th>
<th>R/W</th>
<th>Description</th>
<th>Range</th>
<th>Register (MB)</th>
<th>C/P (LIL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L#SW1</td>
<td>R/W</td>
<td>Status Word 1</td>
<td>(see L#SW1)</td>
<td>(see coils)</td>
<td>n/1</td>
</tr>
<tr>
<td>L#SW2</td>
<td>R/W</td>
<td>Status Word 2</td>
<td>(see L#SW2)</td>
<td>(see coils)</td>
<td>n+1/1</td>
</tr>
</tbody>
</table>
### 7.3.2 Variable Loop Integer Data

#### Controller [ODC]

<table>
<thead>
<tr>
<th>Code</th>
<th>R/W</th>
<th>Description</th>
<th>Range</th>
<th>Register (MB)</th>
<th>C/P (LIL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L#TSP1</td>
<td>R/W</td>
<td>Target Setpoint (%)</td>
<td>-3.3 to 103.3 ($0-0FFF)</td>
<td>40451+30(#-1)</td>
<td>n+1/2</td>
</tr>
<tr>
<td>L#SHLI</td>
<td>R/W</td>
<td>Setpoint High Limit (%)</td>
<td>-3.3 to 103.3 ($0-0FFF)</td>
<td>40452+30(#-1)</td>
<td>n+1/4</td>
</tr>
<tr>
<td>L#SLI</td>
<td>R/W</td>
<td>Setpoint Low Limit (%)</td>
<td>-3.3 to 103.3 ($0-0FFF)</td>
<td>40453+30(#-1)</td>
<td>n+1/5</td>
</tr>
<tr>
<td>L#RTI</td>
<td>R/W</td>
<td>Setpoint Ramp Time (min)</td>
<td>0-3840($0080-$0F80)</td>
<td>40454+30(#-1)</td>
<td>n+1/3</td>
</tr>
<tr>
<td>L#RAI</td>
<td>R/W</td>
<td>Setpoint Ramp Rate (%/min)</td>
<td>-3.3 to 103.3 ($0-0FFF)</td>
<td>40455+30(#-1)</td>
<td>n+1/6</td>
</tr>
<tr>
<td>L#A1LI</td>
<td>R/W</td>
<td>Alarm 1 Limit (%)</td>
<td>-3.3 to 103.3 ($0-0FFF)</td>
<td>40456+30(#-1)</td>
<td>n+4/2</td>
</tr>
<tr>
<td>L#A2LI</td>
<td>R/W</td>
<td>Alarm 2 Limit (%)</td>
<td>-3.3 to 103.3 ($0-0FFF)</td>
<td>40457+30(#-1)</td>
<td>n+4/3</td>
</tr>
<tr>
<td>L#A3LI</td>
<td>R/W</td>
<td>Alarm 3 Limit (%)</td>
<td>-3.3 to 103.3 ($0-0FFF)</td>
<td>40458+30(#-1)</td>
<td>n+4/4</td>
</tr>
<tr>
<td>L#A4LI</td>
<td>R/W</td>
<td>Alarm 4 Limit (%)</td>
<td>-3.3 to 103.3 ($0-0FFF)</td>
<td>40459+30(#-1)</td>
<td>n+4/5</td>
</tr>
<tr>
<td>L#T1mI</td>
<td>R/W</td>
<td>Tot. Preset 1 - 3 ms whole digits</td>
<td>0-999 ($0000-$03E7)</td>
<td>40460+30(#-1)</td>
<td>n+2/4</td>
</tr>
<tr>
<td>L#T1lI</td>
<td>R/W</td>
<td>Tot. Preset 1 - 3 ls whole digits</td>
<td>0-999 ($0000-$03E7)</td>
<td>40461+30(#-1)</td>
<td>n+2/5</td>
</tr>
<tr>
<td>L#T2mI</td>
<td>R/W</td>
<td>Tot. Preset 2 - 3 ms whole digits</td>
<td>0-999 ($0000-$03E7)</td>
<td>40462+30(#-1)</td>
<td>n+2/6</td>
</tr>
<tr>
<td>L#T2lI</td>
<td>R/W</td>
<td>Tot. Preset 2 - 3 ls whole digits</td>
<td>0-999 ($0000-$03E7)</td>
<td>40463+30(#-1)</td>
<td>n+2/7</td>
</tr>
<tr>
<td>L#A1TW</td>
<td>R/W</td>
<td>Alarm 1 Type Word</td>
<td>(bit mapped - see ATW)</td>
<td>n/a</td>
<td>n+4/6</td>
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<tr>
<td>L#A2TW</td>
<td>R/W</td>
<td>Alarm 2 Type Word</td>
<td>(bit mapped - see ATW)</td>
<td>n/a</td>
<td>n+4/7</td>
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<tr>
<td>L#A3TW</td>
<td>R/W</td>
<td>Alarm 3 Type Word</td>
<td>(bit mapped - see ATW)</td>
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<td>n+4/8</td>
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<td>L#A4TW</td>
<td>R/W</td>
<td>Alarm 4 Type Word</td>
<td>(bit mapped - see ATW)</td>
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<td>n+4/9</td>
</tr>
<tr>
<td>L#A1TI</td>
<td>R/W</td>
<td>Alarm 1 Type</td>
<td>0-6 ($0000-$0006)</td>
<td>40464+30(#-1)</td>
<td>n+4/37</td>
</tr>
<tr>
<td>L#A2TI</td>
<td>R/W</td>
<td>Alarm 2 Type</td>
<td>0-6 ($0000-$0006)</td>
<td>40465+30(#-1)</td>
<td>n+4/38</td>
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<tr>
<td>L#A3TI</td>
<td>R/W</td>
<td>Alarm 3 Type</td>
<td>0-6 ($0000-$0006)</td>
<td>40466+30(#-1)</td>
<td>n+4/39</td>
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<tr>
<td>L#A4TI</td>
<td>R/W</td>
<td>Alarm 4 Type</td>
<td>0-6 ($0000-$0006)</td>
<td>40467+30(#-1)</td>
<td>n+4/40</td>
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<tr>
<td>L#A1PI</td>
<td>R/W</td>
<td>Alarm 1 Priority</td>
<td>1-5 ($0001-$0005)</td>
<td>40468+30(#-1)</td>
<td>n+4/41</td>
</tr>
<tr>
<td>L#A2PI</td>
<td>R/W</td>
<td>Alarm 2 Priority</td>
<td>1-5 ($0001-$0005)</td>
<td>40469+30(#-1)</td>
<td>n+4/42</td>
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<tr>
<td>L#A3PI</td>
<td>R/W</td>
<td>Alarm 3 Priority</td>
<td>1-5 ($0001-$0005)</td>
<td>40470+30(#-1)</td>
<td>n+4/43</td>
</tr>
<tr>
<td>L#A4PI</td>
<td>R/W</td>
<td>Alarm 4 Priority</td>
<td>1-5 ($0001-$0005)</td>
<td>40471+30(#-1)</td>
<td>n+4/44</td>
</tr>
<tr>
<td>L#CAI</td>
<td>R/W</td>
<td>Controller Action</td>
<td>1-DIR, 0-REV</td>
<td>40472+30(#-1)</td>
<td>n+1/7</td>
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<tr>
<td></td>
<td></td>
<td>(spare)</td>
<td>0 ($0000)</td>
<td>40473+30(#-1)</td>
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<tr>
<td></td>
<td></td>
<td>(spare)</td>
<td>0 ($0000)</td>
<td>40480+30(#-1)</td>
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#### Sequencer [ODS] - (MASK Configurations)

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<tr>
<th>Code</th>
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<th>Description</th>
<th>Range</th>
<th>Register (MB)</th>
<th>C/P (LIL)</th>
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</thead>
<tbody>
<tr>
<td>L#S001G0I</td>
<td>R/W</td>
<td>Step 1 Group 0 Input Mask</td>
<td>$0000-$FFFF</td>
<td>40451+30(#-1)</td>
<td>1/154</td>
</tr>
<tr>
<td>L#S001G0O</td>
<td>R/W</td>
<td>Step 1 Group 0 Output Mask</td>
<td>$0000-$FFFF</td>
<td>40452+30(#-1)</td>
<td>1/170</td>
</tr>
<tr>
<td>L#S001G1I</td>
<td>R/W</td>
<td>Step 1 Group 1 Input Mask</td>
<td>$0000-$FFFF</td>
<td>40453+30(#-1)</td>
<td>1/155</td>
</tr>
<tr>
<td>L#S001G1O</td>
<td>R/W</td>
<td>Step 1 Group 1 Output Mask</td>
<td>$0000-$FFFF</td>
<td>40454+30(#-1)</td>
<td>1/171</td>
</tr>
<tr>
<td>L#S001G2I</td>
<td>R/W</td>
<td>Step 1 Group 2 Input Mask</td>
<td>$0000-$FFFF</td>
<td>40455+30(#-1)</td>
<td>1/156</td>
</tr>
<tr>
<td>L#S001G2O</td>
<td>R/W</td>
<td>Step 1 Group 2 Output Mask</td>
<td>$0000-$FFFF</td>
<td>40456+30(#-1)</td>
<td>1/172</td>
</tr>
<tr>
<td>L#S002G0I</td>
<td>R/W</td>
<td>Step 2 Group 0 Input Mask</td>
<td>$0000-$FFFF</td>
<td>40457+30(#-1)</td>
<td>2/154</td>
</tr>
<tr>
<td>L#S002G0O</td>
<td>R/W</td>
<td>Step 2 Group 0 Output Mask</td>
<td>$0000-$FFFF</td>
<td>40458+30(#-1)</td>
<td>2/170</td>
</tr>
<tr>
<td>L#S005G0I</td>
<td>R/W</td>
<td>Step 5 Group 0 Input Mask</td>
<td>$0000-$FFFF</td>
<td>40476+30(#-1)</td>
<td>5/170</td>
</tr>
<tr>
<td>L#S005G0O</td>
<td>R/W</td>
<td>Step 5 Group 0 Output Mask</td>
<td>$0000-$FFFF</td>
<td>40476+30(#-1)</td>
<td>5/170</td>
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<tr>
<td>L#S005G1I</td>
<td>R/W</td>
<td>Step 5 Group 1 Input Mask</td>
<td>$0000-$FFFF</td>
<td>40477+30(#-1)</td>
<td>5/155</td>
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<tr>
<td>L#S005G1O</td>
<td>R/W</td>
<td>Step 5 Group 1 Output Mask</td>
<td>$0000-$FFFF</td>
<td>40478+30(#-1)</td>
<td>5/171</td>
</tr>
<tr>
<td>L#S005G2I</td>
<td>R/W</td>
<td>Step 5 Group 2 Input Mask</td>
<td>$0000-$FFFF</td>
<td>40479+30(#-1)</td>
<td>5/156</td>
</tr>
<tr>
<td>L#S005G2O</td>
<td>R/W</td>
<td>Step 5 Group 2 Output Mask</td>
<td>$0000-$FFFF</td>
<td>40480+30(#-1)</td>
<td>5/172</td>
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### Analog Indicator [ODA] - (V2.2)

<table>
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<tr>
<th>Code</th>
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<th>Description</th>
<th>Range</th>
<th>Register (MB)</th>
<th>C/P (LIL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L#P1ALI</td>
<td>R/W</td>
<td>Process 1 Alarm A Limit (%)</td>
<td>-3.3 to 103.3 (00-FFFF)</td>
<td>40451+30(#-1)</td>
<td>n+1/13</td>
</tr>
<tr>
<td>L#P1BLI</td>
<td>R/W</td>
<td>Process 1 Alarm B Limit (%)</td>
<td>-3.3 to 103.3 (00-FFFF)</td>
<td>40452+30(#-1)</td>
<td>n+1/14</td>
</tr>
<tr>
<td>L#P2ALI</td>
<td>R/W</td>
<td>Process 2 Alarm A Limit (%)</td>
<td>-3.3 to 103.3 (00-FFFF)</td>
<td>40453+30(#-1)</td>
<td>n+1/15</td>
</tr>
<tr>
<td>L#P2BLI</td>
<td>R/W</td>
<td>Process 2 Alarm B Limit (%)</td>
<td>-3.3 to 103.3 (00-FFFF)</td>
<td>40454+30(#-1)</td>
<td>n+1/16</td>
</tr>
<tr>
<td>L#P3ALI</td>
<td>R/W</td>
<td>Process 3 Alarm A Limit (%)</td>
<td>-3.3 to 103.3 (00-FFFF)</td>
<td>40455+30(#-1)</td>
<td>n+1/17</td>
</tr>
<tr>
<td>L#P3BLI</td>
<td>R/W</td>
<td>Process 3 Alarm B Limit (%)</td>
<td>-3.3 to 103.3 (00-FFFF)</td>
<td>40456+30(#-1)</td>
<td>n+1/18</td>
</tr>
<tr>
<td>L#P4ALI</td>
<td>R/W</td>
<td>Process 4 Alarm A Limit (%)</td>
<td>-3.3 to 103.3 (00-FFFF)</td>
<td>40457+30(#-1)</td>
<td>n+1/19</td>
</tr>
<tr>
<td>L#P4BLI</td>
<td>R/W</td>
<td>Process 4 Alarm B Limit (%)</td>
<td>-3.3 to 103.3 (00-FFFF)</td>
<td>40458+30(#-1)</td>
<td>n+1/20</td>
</tr>
<tr>
<td>L#P1ATI</td>
<td>R/W</td>
<td>Process 1 Alarm A Type</td>
<td>0-3 (0000-0003)</td>
<td>40459+30(#-1)</td>
<td>n+2/13</td>
</tr>
<tr>
<td>L#P1BTI</td>
<td>R/W</td>
<td>Process 1 Alarm B Type</td>
<td>0-3 (0000-0003)</td>
<td>40460+30(#-1)</td>
<td>n+2/14</td>
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<tr>
<td>L#P2ATI</td>
<td>R/W</td>
<td>Process 2 Alarm A Type</td>
<td>0-3 (0000-0003)</td>
<td>40461+30(#-1)</td>
<td>n+2/15</td>
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<tr>
<td>L#P2BTI</td>
<td>R/W</td>
<td>Process 2 Alarm B Type</td>
<td>0-3 (0000-0003)</td>
<td>40462+30(#-1)</td>
<td>n+2/16</td>
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<tr>
<td>L#P3ATI</td>
<td>R/W</td>
<td>Process 3 Alarm A Type</td>
<td>0-3 (0000-0003)</td>
<td>40463+30(#-1)</td>
<td>n+2/17</td>
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<tr>
<td>L#P3BTI</td>
<td>R/W</td>
<td>Process 3 Alarm B Type</td>
<td>0-3 (0000-0003)</td>
<td>40464+30(#-1)</td>
<td>n+2/18</td>
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<tr>
<td>L#P4ATI</td>
<td>R/W</td>
<td>Process 4 Alarm A Type</td>
<td>0-3 (0000-0003)</td>
<td>40465+30(#-1)</td>
<td>n+2/19</td>
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<tr>
<td>L#P4BTI</td>
<td>R/W</td>
<td>Process 4 Alarm B Type</td>
<td>0-3 (0000-0003)</td>
<td>40466+30(#-1)</td>
<td>n+2/20</td>
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<tr>
<td>L#P1API</td>
<td>R/W</td>
<td>Process 1 Alarm A Priority</td>
<td>1-5 (0001-0005)</td>
<td>40467+30(#-1)</td>
<td>n+3/13</td>
</tr>
<tr>
<td>L#P1BPI</td>
<td>R/W</td>
<td>Process 1 Alarm B Priority</td>
<td>1-5 (0001-0005)</td>
<td>40468+30(#-1)</td>
<td>n+3/14</td>
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<tr>
<td>L#P2API</td>
<td>R/W</td>
<td>Process 2 Alarm A Priority</td>
<td>1-5 (0001-0005)</td>
<td>40469+30(#-1)</td>
<td>n+3/15</td>
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<td>L#P2BPI</td>
<td>R/W</td>
<td>Process 2 Alarm B Priority</td>
<td>1-5 (0001-0005)</td>
<td>40470+30(#-1)</td>
<td>n+3/16</td>
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<tr>
<td>L#P3API</td>
<td>R/W</td>
<td>Process 3 Alarm A Priority</td>
<td>1-5 (0001-0005)</td>
<td>40471+30(#-1)</td>
<td>n+3/17</td>
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<tr>
<td>L#P3BPI</td>
<td>R/W</td>
<td>Process 3 Alarm B Priority</td>
<td>1-5 (0001-0005)</td>
<td>40472+30(#-1)</td>
<td>n+3/18</td>
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<tr>
<td>L#P4API</td>
<td>R/W</td>
<td>Process 4 Alarm A Priority</td>
<td>1-5 (0001-0005)</td>
<td>40473+30(#-1)</td>
<td>n+3/19</td>
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<td>L#P4BPI</td>
<td>R/W</td>
<td>Process 4 Alarm B Priority</td>
<td>1-5 (0001-0005)</td>
<td>40474+30(#-1)</td>
<td>n+3/20</td>
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#### Discrete Indicator [ODD] - (V2.2)

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<th>Description</th>
<th>Range</th>
<th>Register (MB)</th>
<th>C/P (LIL)</th>
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#### Discrete Indicator [ODP] - (V2.2)

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<th>C/P (LIL)</th>
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**** NOTE: Registers (40451-40480) are reserved for ASCII Tags when the ODP display has been selected in configuration.
### 7.3.3 Static Loop Integer Data

#### Controller [ODC]

<table>
<thead>
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<th>Description</th>
<th>Range</th>
<th>Register (MB)</th>
<th>C/P (LIL)</th>
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<tbody>
<tr>
<td>L#PGI</td>
<td>R/W</td>
<td>Proportional Gain</td>
<td>-9.99 to -0.01 ($1419-$17FF)</td>
<td>41201+30(#-1)</td>
<td>n/2</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>0.01 to 9.99 ($1801$1BE7)</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>-100.0 to -10.0 ($2418-$279C)</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10.0 to 100.0 ($2864-$2BE8)</td>
<td></td>
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<tr>
<td>L#TII</td>
<td>R/W</td>
<td>Integral Time (min)</td>
<td>0.01 to 9.99 ($2081-$2467)</td>
<td>41202+30(#-1)</td>
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<td>10.0 to 99.9 ($10E4-$1BE7)</td>
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<tr>
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<td></td>
<td>-100.0 to -10.0 ($2418-$279C)</td>
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<tr>
<td>L#TDI</td>
<td>R/W</td>
<td>Derivative Time (min)</td>
<td>0.00 to 9.99 ($2080-$2467)</td>
<td>41203+30(#-1)</td>
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<td>10.0 to 100.0 ($2864-$2BE8)</td>
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<tr>
<td>L#DGI</td>
<td>R/W</td>
<td>Derivative Gain</td>
<td>1.00 to 39.67 ($20E4--$2FFF)</td>
<td>41204+30(#-1)</td>
<td>n/5</td>
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<tr>
<td>L#MRI</td>
<td>R/W</td>
<td>Manual Reset (%)</td>
<td>0.0 to 100.0 ($0080-$0F80)</td>
<td>41205+30(#-1)</td>
<td>n/6</td>
</tr>
<tr>
<td>L#RHI</td>
<td>R</td>
<td>Range High</td>
<td>-1 to -32768 ($FFFF-$8000)</td>
<td>41206+30(#-1)</td>
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<tr>
<td>L#RLI</td>
<td>R</td>
<td>Range Low</td>
<td>-1 to -32768 ($FFFF-$8000)</td>
<td>41207+30(#-1)</td>
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<tr>
<td>L#DPPI</td>
<td>R</td>
<td>Decimal Point Position</td>
<td>0 to 5 ($0000-$0005)</td>
<td>41208+30(#-1)</td>
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</tr>
<tr>
<td>L#PDPI</td>
<td>R</td>
<td>Process DPP</td>
<td>0 to 5 ($0000-$0005)</td>
<td>41209+30(#-1)</td>
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<tr>
<td>L#VDPI</td>
<td>R</td>
<td>Valve DPP</td>
<td>0 to 5 ($0000-$0005)</td>
<td>41210+30(#-1)</td>
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</tr>
<tr>
<td>L#XDPPI</td>
<td>R</td>
<td>Variable X DPP</td>
<td>0 to 5 ($0000-$0005)</td>
<td>41211+30(#-1)</td>
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</tr>
<tr>
<td>L#YDPPI</td>
<td>R</td>
<td>Variable Y DPP</td>
<td>0 to 5 ($0000-$0005)</td>
<td>41212+30(#-1)</td>
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<td>L#S006G0I</td>
<td>R/W</td>
<td>Step 6 Group 0 Input Mask</td>
<td>$0000-$FFFF</td>
<td>41201+30(#-1)</td>
<td>6/154</td>
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<tr>
<td>L#S006G0O</td>
<td>R/W</td>
<td>Step 6 Group 0 Output Mask</td>
<td>$0000-$FFFF</td>
<td>41202+30(#-1)</td>
<td>6/170</td>
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<tr>
<td>L#S006G1I</td>
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<td>L#S006G1O</td>
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<tr>
<td>L#S006G2O</td>
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#### Sequencer [ODS] - (MASK Configurations)

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<th>Range</th>
<th>Register (MB)</th>
<th>C/P (LIL)</th>
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<td>Step 6 Group 1 Output Mask</td>
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<td>41204+30(#-1)</td>
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<td>R/W</td>
<td>Step 6 Group 2 Input Mask</td>
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<tr>
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<td>R/W</td>
<td>Step 10 Group 0 Input Mask</td>
<td>$0000-$FFFF</td>
<td>41225+30(#-1)</td>
<td>10/154</td>
</tr>
<tr>
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<td>R/W</td>
<td>Step 10 Group 1 Input Mask</td>
<td>$0000-$FFFF</td>
<td>41226+30(#-1)</td>
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<td>R/W</td>
<td>Step 10 Group 1 Output Mask</td>
<td>$0000-$FFFF</td>
<td>41227+30(#-1)</td>
<td>10/155</td>
</tr>
<tr>
<td>L#S010G2I</td>
<td>R/W</td>
<td>Step 10 Group 2 Input Mask</td>
<td>$0000-$FFFF</td>
<td>41228+30(#-1)</td>
<td>10/171</td>
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<td>Step 10 Group 2 Output Mask</td>
<td>$0000-$FFFF</td>
<td>41229+30(#-1)</td>
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#### Analog, Discrete, & Pushbutton Indicators [ODA] [ODD] [ODP]- (V2.1)

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<th>Description</th>
<th>Range</th>
<th>Register (MB)</th>
<th>C/P (LIL)</th>
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* **NOTE:** Registers (40451-40480) are reserved for ASCII Tags when the ODP display has been selected in configuration
### 7.3.4 Dynamic Loop Floating Point Data (32-bit IEEE)

#### Controller [ODC]

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<th>C/P (LIL)</th>
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<tbody>
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<td>L#PF</td>
<td>R</td>
<td>Process</td>
<td>Real</td>
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<td>n/9-10</td>
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<tr>
<td>L#SF</td>
<td>R/W</td>
<td>Setpoint</td>
<td>Real</td>
<td>41953+20(#-1)</td>
<td>n+1/9-10</td>
</tr>
<tr>
<td>L#VF</td>
<td>R/W</td>
<td>Valve</td>
<td>Real</td>
<td>41955+20(#-1)</td>
<td>n+2/9-10</td>
</tr>
<tr>
<td>L#XF</td>
<td>R</td>
<td>X Variable</td>
<td>Real</td>
<td>41957+20(#-1)</td>
<td>n+3/25-26</td>
</tr>
<tr>
<td>L#YF</td>
<td>R</td>
<td>Y Variable</td>
<td>Real</td>
<td>41959+20(#-1)</td>
<td>n+4/25-26</td>
</tr>
<tr>
<td>L#RF</td>
<td>R/W</td>
<td>Ratio</td>
<td>Real</td>
<td>41961+20(#-1)</td>
<td>n/23-24</td>
</tr>
<tr>
<td>L#BF</td>
<td>R/W</td>
<td>Bias</td>
<td>Real</td>
<td>41963+20(#-1)</td>
<td>n/25-26</td>
</tr>
<tr>
<td>L#TLF</td>
<td>R</td>
<td>Totalizer</td>
<td>Real</td>
<td>41965+20(#-1)</td>
<td>n+3/13-14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(spare)</td>
<td>($00000000)</td>
<td>41967+20(#-1)</td>
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#### Sequencer [ODS]

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<th>Description</th>
<th>Range</th>
<th>Register (MB)</th>
<th>C/P (LIL)</th>
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<tbody>
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<td>R/W</td>
<td>Sequencer Step No.*</td>
<td>Real</td>
<td>41951+20(#-1)</td>
<td>n/2-3</td>
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<tr>
<td>L#SAOF</td>
<td>R</td>
<td>Sequencer Analog Output</td>
<td>Real</td>
<td>41953+20(#-1)</td>
<td>n+1/2-3</td>
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<tr>
<td>L#SAOnF</td>
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<td>Step Analog Out (most sig. word)#</td>
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<td>L#SAOff</td>
<td>R</td>
<td>Step Analog Out (least sig. word)#</td>
<td>Real</td>
<td>n/a</td>
<td>n+2/1</td>
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<td>Step Analog End Point</td>
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<td>R/W</td>
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<td>n+3/2-3</td>
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<td>R/W</td>
<td>Current Recipe Number @</td>
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#### Analog Indicator [ODA] - (V2.2)

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<th>Description</th>
<th>Range</th>
<th>Register (MB)</th>
<th>C/P (LIL)</th>
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<td>R</td>
<td>Process 1</td>
<td>Real</td>
<td>41951+20(#-1)</td>
<td>n/2-3</td>
</tr>
<tr>
<td>L#P2F</td>
<td>R</td>
<td>Process 2</td>
<td>Real</td>
<td>41953+20(#-1)</td>
<td>n+1/2-3</td>
</tr>
<tr>
<td>L#P3F</td>
<td>R</td>
<td>Process 3</td>
<td>Real</td>
<td>41955+20(#-1)</td>
<td>n+2/2-3</td>
</tr>
<tr>
<td>L#P4F</td>
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<td>Process 4</td>
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#### Discrete Indicator [ODD] & [ODP] - (V2.2)

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<th>C/P (LIL)</th>
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</table>

* A Write command will force the Step or Remaining Time to the write value.

@ The current recipe can be changed if the Sequencer is in the HOLD mode.
### 7.3.5 Variable Loop Floating Point Data (32-bit IEEE)

**Controller [ODC]**

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<th>Range</th>
<th>Register (MB)</th>
<th>C/P (LIL)</th>
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<tr>
<td>L#HLF</td>
<td>R/W</td>
<td>Setpoint High Limit</td>
<td>Real</td>
<td>42453+60(#-1)</td>
<td>n+1/17-18</td>
</tr>
<tr>
<td>L#LLF</td>
<td>R/W</td>
<td>Setpoint Low Limit</td>
<td>Real</td>
<td>42455+60(#-1)</td>
<td>n+1/19-20</td>
</tr>
<tr>
<td>L#RTF</td>
<td>R/W</td>
<td>Setpoint Ramp Time (min)</td>
<td>Real</td>
<td>42457+60(#-1)</td>
<td>n+1/15-16</td>
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<td>R/W</td>
<td>Setpoint Ramp Rate (units/min)</td>
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<tr>
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<td>R/W</td>
<td>Alarm 1 Limit</td>
<td>Real</td>
<td>42461+60(#-1)</td>
<td>n+4/13-14</td>
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<td>L#A2LF</td>
<td>R/W</td>
<td>Alarm 2 Limit</td>
<td>Real</td>
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<td>n+4/15-16</td>
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<td>n+4/17-18</td>
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<td>R/W</td>
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<td>Real</td>
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<td>R/W</td>
<td>Quickset Hold 2</td>
<td>Real</td>
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<td>Batch Switch High Limit</td>
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**Sequencer (Timers - Running Values) [ODS]**

<table>
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<th>Description</th>
<th>Range</th>
<th>Register (MB)</th>
<th>C/P (LIL)*</th>
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<td>R</td>
<td>DYT01 Elapsed Time</td>
<td>Real</td>
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<td>n/61-62</td>
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<tr>
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<td>R/W</td>
<td>DYT01 Remaining Time</td>
<td>Real</td>
<td>42453+60(#-1)</td>
<td>n/63-64</td>
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<tr>
<td>L#OST01ET</td>
<td>R</td>
<td>OST01 Elapsed Time</td>
<td>Real</td>
<td>42455+60(#-1)</td>
<td>n+1/61-62</td>
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<tr>
<td>L#OST01RT</td>
<td>R/W</td>
<td>OST01 Remaining Time</td>
<td>Real</td>
<td>42457+60(#-1)</td>
<td>n+1/63-64</td>
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<tr>
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<tr>
<td>L#OST02ET</td>
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* In addition to the timers listed here the LIL will map 1 through 21 (see LIL overview for exact locations).
**Analog Indicator [ODA] - (V2.2)**

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<tr>
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<th>Description</th>
<th>Range</th>
<th>Register (MB)</th>
<th>C/P (LIL)</th>
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<td>Process 1 Alarm A Limit</td>
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<td>42451+60(#-1)</td>
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<tr>
<td>L#P1BLF</td>
<td>R/W</td>
<td>Process 1 Alarm B Limit</td>
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<tr>
<td>L#P2ALF</td>
<td>R/W</td>
<td>Process 2 Alarm A Limit</td>
<td>Real</td>
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<tr>
<td>L#P2BLF</td>
<td>R/W</td>
<td>Process 2 Alarm B Limit</td>
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<td>42457+60(#-1)</td>
<td>n/19-20</td>
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<td>L#P3ALF</td>
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<td>Process 3 Alarm A Limit</td>
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<td>L#P4ALF</td>
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<td>L#Q1F</td>
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<td>Quickset Hold 1</td>
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<td>L#Q2F</td>
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<td>Quickset Hold 2</td>
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<td>Quickset Hold 3</td>
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<td>n+3/29-30</td>
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<tr>
<td>L#Q4F</td>
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<td>Quickset Hold 4</td>
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<td>42473+60(#-1)</td>
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**(spares) ($00000000) 42475-42509+60(#-1)**

**Discrete Indicator [ODD] - (V2.2)**

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**Pushbutton/Switch Indicator [ODP] - (V2.2)**

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**** NOTE: Registers (40451-40480) are reserved for ASCII Tags when the ODP display has been selected in configuration.
### 7.3.6 Static Loop Floating Point Data (32-bit IEEE)

**Controller [ODC]**

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<th>Range</th>
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<th>C/P (LIL)</th>
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<tbody>
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<td>R/W</td>
<td>Proportional Gain</td>
<td>0.001 - 100.0</td>
<td>43951+60(#-1)</td>
<td>n/13-14</td>
</tr>
<tr>
<td>L#TIF</td>
<td>R/W</td>
<td>Integral Time</td>
<td>0.001 - 4000.0 min</td>
<td>43953+60(#-1)</td>
<td>n/15-16</td>
</tr>
<tr>
<td>L#TDF</td>
<td>R/W</td>
<td>Derivative Time</td>
<td>0.00 - 100.0 min</td>
<td>43955+60(#-1)</td>
<td>n/17-18</td>
</tr>
<tr>
<td>L#MRF</td>
<td>R/W</td>
<td>Manual Reset</td>
<td>0.00 - 100.0</td>
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<td>n/21-22</td>
</tr>
<tr>
<td>L#ADF</td>
<td>R/W</td>
<td>Autotune Deviation</td>
<td>auto(0), 2.5-25%</td>
<td>43959+60(#-1)</td>
<td>n/37-38</td>
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<td>L#AUF</td>
<td>R/W</td>
<td>Autotune Hysteresis</td>
<td>auto(0), 0.5 - 10.0%</td>
<td>43961+60(#-1)</td>
<td>n/39-40</td>
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<td>R/W</td>
<td>Autotune Step (initial)</td>
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<td>R/W</td>
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<td>n/29-30</td>
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<td>n/27-28</td>
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**Sequencer [ODS]**

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**Controller [ODA] - (V2.2)**

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<th>Range</th>
<th>Register (MB)</th>
<th>C/P (LIL)</th>
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<td>R/W</td>
<td>Quickset 1 MIN SCALE</td>
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<tr>
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<td>R/W</td>
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<td>R/W</td>
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<td>Process 2 MIN SCALE</td>
<td>Real</td>
<td>43971+60(#-1)</td>
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<tr>
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<td>n+4/17-18</td>
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<tr>
<td>L#P3MXF</td>
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<td>Process 3 MAX SCALE</td>
<td>Real</td>
<td>43977+60(#-1)</td>
<td>n+5/17-18</td>
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<tr>
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<td>Real</td>
<td>43979+60(#-1)</td>
<td>n+4/19-20</td>
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<td>R</td>
<td>Process 4 MAX SCALE</td>
<td>Real</td>
<td>43981+60(#-1)</td>
<td>n+5/19-20</td>
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**Discrete Indicator [ODD] - (V2.2)**

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**Pushbutton/Switch Indicator [ODP] - (V2.2)**

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### 7.3.7 String Loop Data (8-bit ASCII Char - 2/Word)

**Controller [ODC]**

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<tr>
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<td>Process Units - Reduced</td>
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<td>45457+100(#-1)</td>
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<td>L#PU</td>
<td>R/W</td>
<td>Process Units</td>
<td>6 ASCII Char</td>
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<td>L#VU</td>
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<td>n+2/31-33</td>
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<td>Quickset Hold 2 Units</td>
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<td>R/W</td>
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<td>L#RHM</td>
<td>R/W</td>
<td>Right Horizontal Bar Message</td>
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**Sequencer [ODS]**

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<td>L#PMSG</td>
<td>R</td>
<td>Primary Message (V1.3)</td>
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<td>R</td>
<td>Secondary Message (V1.3)</td>
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<td>45461+100(#-1)</td>
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<td>L#CMSGa</td>
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<td>Conditional Message a *(V1.3)</td>
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<td>45467+100(#-1)</td>
<td>n+3/37-44</td>
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<tr>
<td>L#CMSGb</td>
<td>R</td>
<td>Conditional Message b * (V1.3)</td>
<td>16 ASCII Char</td>
<td>45473+100(#-1)</td>
<td>n+4/37-44</td>
</tr>
<tr>
<td>L#CMSGc</td>
<td>R</td>
<td>Conditional Message c * (V1.3)</td>
<td>16 ASCII Char</td>
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<td>n+5/37-44</td>
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<td>R</td>
<td>Conditional Message d * (V1.3)</td>
<td>16 ASCII Char</td>
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<tr>
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<td>R</td>
<td>Conditional Message e * (V1.3)</td>
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<td>45499+100(#-1)</td>
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<tr>
<td>L#CMSGf</td>
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<td>45515+100(#-1)</td>
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* Conditional messages are stacked in the order of occurrence. The 9 most recent active conditional messages can be viewed over LIL or Modbus.

** Version 1.3 included the Recipe Message at 45451. Version 2.2 moved the Recipe Message to a new location and placed the Loop Tag in place of the Recipe Message.
## Analog Indicator [ODA] - (V2.2)

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<td>Loop Tag</td>
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<td>6 ASCII Char</td>
<td>45457+100(#-1)</td>
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<td>n/7-9</td>
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<td>Process 2 Tag</td>
<td>6 ASCII Char</td>
<td>45463+100(#-1)</td>
<td>n+1/4-6</td>
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<td>n+1/7-9</td>
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<td>6 ASCII Char</td>
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<td>Process 3 Units</td>
<td>6 ASCII Char</td>
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## Discrete Indicator [OOD] - (V2.2)

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<tr>
<td>L#I2T</td>
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## Discrete Indicator [ODP] - (V2.2)

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<td>n/2-7</td>
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<tr>
<td>L#G1Tag</td>
<td>R</td>
<td>Group 1 Tag</td>
<td>6 ASCII Char</td>
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<td>6 ASCII Char</td>
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<td>Group 1 Feedback 1 Tag</td>
<td>6 ASCII Char</td>
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<td>45475+100(#-1)</td>
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<td>Group 2 Tag</td>
<td>6 ASCII Char</td>
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<td>6 ASCII Char</td>
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<tr>
<td>L#G2F0T</td>
<td>R</td>
<td>Group 2 Feedback 0 Tag</td>
<td>6 ASCII Char</td>
<td>45496+100(#-1)</td>
<td>n+1/28-30</td>
</tr>
<tr>
<td>L#G3Tag</td>
<td>R</td>
<td>Group 3 Tag</td>
<td>6 ASCII Char</td>
<td>45499+100(#-1)</td>
<td>n/37-39</td>
</tr>
<tr>
<td>L#G3P1T</td>
<td>R</td>
<td>Group 3 PB1 Tag</td>
<td>6 ASCII Char</td>
<td>45502+100(#-1)</td>
<td>n/40-42</td>
</tr>
<tr>
<td>L#G3P2T</td>
<td>R</td>
<td>Group 3 PB2 Tag</td>
<td>6 ASCII Char</td>
<td>45505+100(#-1)</td>
<td>n/43-45</td>
</tr>
<tr>
<td>L#G3SAT</td>
<td>R</td>
<td>Group 3 Switch Position A Tag</td>
<td>6 ASCII Char</td>
<td>45508+100(#-1)</td>
<td>n/46-48</td>
</tr>
<tr>
<td>L#G3SMT</td>
<td>R</td>
<td>Group 3 Switch Position M Tag</td>
<td>6 ASCII Char</td>
<td>45511+100(#-1)</td>
<td>n+1/46-48</td>
</tr>
<tr>
<td>L#G3F1T</td>
<td>R</td>
<td>Group 3 Feedback 1 Tag</td>
<td>6 ASCII Char</td>
<td>45514+100(#-1)</td>
<td>n+1/37-39</td>
</tr>
<tr>
<td>L#G3F0T</td>
<td>R</td>
<td>Group 3 Feedback 0 Tag</td>
<td>6 ASCII Char</td>
<td>45517+100(#-1)</td>
<td>n+1/40-42</td>
</tr>
<tr>
<td>L#G4Tag</td>
<td>R</td>
<td>Group 4 Tag</td>
<td>6 ASCII Char</td>
<td>45520+100(#-1)</td>
<td>n/49-51</td>
</tr>
<tr>
<td>L#G4P1T</td>
<td>R</td>
<td>Group 4 PB1 Tag</td>
<td>6 ASCII Char</td>
<td>45523+100(#-1)</td>
<td>n/52-54</td>
</tr>
<tr>
<td>L#G4P2T</td>
<td>R</td>
<td>Group 4 PB2 Tag</td>
<td>6 ASCII Char</td>
<td>45526+100(#-1)</td>
<td>n/55-57</td>
</tr>
<tr>
<td>L#G4SAT</td>
<td>R</td>
<td>Group 4 Switch Position A Tag</td>
<td>6 ASCII Char</td>
<td>45529+100(#-1)</td>
<td>n/58-60</td>
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<tr>
<td>L#G4SMT</td>
<td>R</td>
<td>Group 4 Switch Position M Tag</td>
<td>6 ASCII Char</td>
<td>45532+100(#-1)</td>
<td>n+1/58-60</td>
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<tr>
<td>L#G4F1T</td>
<td>R</td>
<td>Group 4 Feedback 1 Tag</td>
<td>6 ASCII Char</td>
<td>45535+100(#-1)</td>
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<tr>
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<td>R</td>
<td>Group 4 Feedback 0 Tag</td>
<td>6 ASCII Char</td>
<td>45538+100(#-1)</td>
<td>n+1/52-54</td>
</tr>
<tr>
<td>L#G5Tag</td>
<td>R</td>
<td>Group 5 Tag</td>
<td>6 ASCII Char</td>
<td>40451+30(#-1)</td>
<td>n/61-63</td>
</tr>
<tr>
<td>L#G5P1T</td>
<td>R</td>
<td>Group 5 PB1 Tag</td>
<td>6 ASCII Char</td>
<td>40454+30(#-1)</td>
<td>n/64-66</td>
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<tr>
<td>L#G5P2T</td>
<td>R</td>
<td>Group 5 PB2 Tag</td>
<td>6 ASCII Char</td>
<td>40457+30(#-1)</td>
<td>n/67-69</td>
</tr>
<tr>
<td>L#G5SAT</td>
<td>R</td>
<td>Group 5 Switch Position A Tag</td>
<td>6 ASCII Char</td>
<td>40460+30(#-1)</td>
<td>n/70-72</td>
</tr>
<tr>
<td>L#G5SMT</td>
<td>R</td>
<td>Group 5 Switch Position M Tag</td>
<td>6 ASCII Char</td>
<td>40463+30(#-1)</td>
<td>n+1/70-72</td>
</tr>
<tr>
<td>L#G5F1T</td>
<td>R</td>
<td>Group 5 Feedback 1 Tag</td>
<td>6 ASCII Char</td>
<td>40466+30(#-1)</td>
<td>n+1/61-63</td>
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<tr>
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<td>R</td>
<td>Group 5 Feedback 0 Tag</td>
<td>6 ASCII Char</td>
<td>40469+30(#-1)</td>
<td>n+1/64-66</td>
</tr>
</tbody>
</table>

Note: These Modbus groupings normally used for Variable Loop Integer Data with displays other than ODP

| L#G6Tag  | R | Group 6 Tag            | 6 ASCII Char | 41201+30(#-1)  | n/73-75   |
| L#G6P1T  | R | Group 6 PB1 Tag        | 6 ASCII Char | 41204+30(#-1)  | n/76-78   |
| L#G6P2T  | R | Group 6 PB2 Tag        | 6 ASCII Char | 41207+30(#-1)  | n/79-81   |
| L#G6SAT  | R | Group 6 Switch Position A Tag | 6 ASCII Char | 41210+30(#-1)  | n/82-84   |
| L#G6SMT  | R | Group 6 Switch Position M Tag | 6 ASCII Char | 41213+30(#-1)  | n+1/82-84 |
| L#G6F1T  | R | Group 6 Feedback 1 Tag | 6 ASCII Char | 41216+30(#-1)  | n+1/73-75 |
| L#G6F0T  | R | Group 6 Feedback 0 Tag | 6 ASCII Char | 41219+30(#-1)  | n+1/76-78 |
| L#G7Tag  | R | Group 7 Tag            | 6 ASCII Char | 42451+60(#-1)  | n/85-87   |
| L#G7P1T  | R | Group 7 PB1 Tag        | 6 ASCII Char | 42454+60(#-1)  | n/88-90   |
| L#G7P2T  | R | Group 7 PB2 Tag        | 6 ASCII Char | 42457+60(#-1)  | n/91-93   |
| L#G7SAT  | R | Group 7 Switch Position A Tag | 6 ASCII Char | 42460+60(#-1)  | n/94-96   |
| L#G7SMT  | R | Group 7 Switch Position M Tag | 6 ASCII Char | 42463+60(#-1)  | n+1/94-96 |
| L#G7F1T  | R | Group 7 Feedback 1 Tag | 6 ASCII Char | 42466+60(#-1)  | n+1/85-87 |
| L#G7F0T  | R | Group 7 Feedback 0 Tag | 6 ASCII Char | 42469+60(#-1)  | n+1/88-90 |
| L#G8Tag  | R | Group 8 Tag            | 6 ASCII Char | 42472+60(#-1)  | n/97-99   |
| L#G8P1T  | R | Group 8 PB1 Tag        | 6 ASCII Char | 42475+60(#-1)  | n/100-102 |
| L#G8P2T  | R | Group 8 PB2 Tag        | 6 ASCII Char | 42478+60(#-1)  | n/103-105 |
| L#G8SAT  | R | Group 8 Switch Position A Tag | 6 ASCII Char | 42481+60(#-1)  | n/106-108 |
| L#G8SMT  | R | Group 8 Switch Position M Tag | 6 ASCII Char | 42484+60(#-1)  | n+1/106-108 |
| L#G8F1T  | R | Group 8 Feedback 1 Tag | 6 ASCII Char | 42487+60(#-1)  | n+1/97-99 |
| L#G8F0T  | R | Group 8 Feedback 0 Tag | 6 ASCII Char | 42490+60(#-1)  | n+1/100-102 |
| L#G8F0T  | R | Group 8 Feedback 0 Tag | 6 ASCII Char | 42493+42509    |          |

Note: These Modbus groupings normally used for Variable Loop Floating Point Data with displays other than ODP
### 7.3.8 Coil Loop Data (1-bit)

**Controller [ODC]**

<table>
<thead>
<tr>
<th>Code</th>
<th>R/W</th>
<th>Description</th>
<th>Range</th>
<th>Coil(MB)</th>
<th>C/P (LIL)</th>
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<tbody>
<tr>
<td>L#A</td>
<td>R/W</td>
<td>1-Auto 0-Manual</td>
<td>1/0</td>
<td>00296+48(#-1)</td>
<td>n+3/1(0)</td>
</tr>
<tr>
<td>L#L</td>
<td>R/W</td>
<td>1-Local</td>
<td>1/0</td>
<td>00297+48(#-1)</td>
<td>n+3/1(1)</td>
</tr>
<tr>
<td>L#SS</td>
<td>R</td>
<td>1-AM block in STANDBY</td>
<td>1/0</td>
<td>00298+48(#-1)</td>
<td>n+3/1(2)</td>
</tr>
<tr>
<td>L#E</td>
<td>R/W</td>
<td>1-External Set</td>
<td>1/0</td>
<td>00299+48(#-1)</td>
<td>n+3/1(3)</td>
</tr>
<tr>
<td>L#CN</td>
<td>R/W</td>
<td>1-Console</td>
<td>1/0</td>
<td>00300+48(#-1)</td>
<td>n+3/1(4)</td>
</tr>
<tr>
<td>L#CM</td>
<td>R/W</td>
<td>1-Computer</td>
<td>1/0</td>
<td>00301+48(#-1)</td>
<td>n+3/1(5)</td>
</tr>
<tr>
<td>L#RS</td>
<td>R/W</td>
<td>1-Ramping Setpoint</td>
<td>1.0</td>
<td>00302+48(#-1)</td>
<td>n+3/1(6)</td>
</tr>
<tr>
<td>L#OR</td>
<td>R</td>
<td>1-Override</td>
<td></td>
<td>00303+48(#-1)</td>
<td>n+3/1(7)</td>
</tr>
<tr>
<td>L#EM</td>
<td>R</td>
<td>1-Emergency Manual</td>
<td></td>
<td>00304+48(#-1)</td>
<td>n+3/1(8)</td>
</tr>
<tr>
<td>L#CH</td>
<td>R</td>
<td>1-Configuration Hold</td>
<td>1/0</td>
<td>00305+48(#-1)</td>
<td>n+3/1(9)</td>
</tr>
<tr>
<td>L#HL</td>
<td>R</td>
<td>1-HI Setpoint Limit</td>
<td>1/0</td>
<td>00306+48(#-1)</td>
<td>n+3/1(10)</td>
</tr>
<tr>
<td>L#LL</td>
<td>R</td>
<td>1-LO Setpoint Limit</td>
<td>1/0</td>
<td>00307+48(#-1)</td>
<td>n+3/1(11)</td>
</tr>
<tr>
<td>L#OS</td>
<td>R/W</td>
<td>1-Alarms - Out of Service</td>
<td>1/0</td>
<td>00308+48(#-1)</td>
<td>n+3/1(12)</td>
</tr>
<tr>
<td>L#U1S</td>
<td>R</td>
<td>1-U1 Status Active</td>
<td></td>
<td>00309+48(#-1)</td>
<td>n+3/1(13)</td>
</tr>
<tr>
<td>L#U2S</td>
<td>R</td>
<td>1-U2 Status Active</td>
<td></td>
<td>00310+48(#-1)</td>
<td>n+3/1(14)</td>
</tr>
<tr>
<td>L#AT</td>
<td>R/W</td>
<td>1-Autotune</td>
<td>1/0</td>
<td>00311+48(#-1)</td>
<td>n+3/1(15)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L#A1</td>
<td>R</td>
<td>1-Alarm 1 is Active</td>
<td>1/0</td>
<td>00312+48(#-1)</td>
<td>n+4/1(0)</td>
</tr>
<tr>
<td>L#N1</td>
<td>R/W</td>
<td>1-Alarm 1 is Not Acknowledged</td>
<td>1/0</td>
<td>00313+48(#-1)</td>
<td>n+4/1(1)</td>
</tr>
<tr>
<td>L#E1</td>
<td>R/W</td>
<td>1-Alarm 1 is Enabled</td>
<td>1/0</td>
<td>00314+48(#-1)</td>
<td>n+4/1(2)</td>
</tr>
<tr>
<td>L#A2</td>
<td>R</td>
<td>1-Alarm 2 is Active</td>
<td>1/0</td>
<td>00315+48(#-1)</td>
<td>n+4/1(3)</td>
</tr>
<tr>
<td>L#N2</td>
<td>R/W</td>
<td>1-Alarm 2 is Not Acknowledged</td>
<td>1/0</td>
<td>00316+48(#-1)</td>
<td>n+4/1(4)</td>
</tr>
<tr>
<td>L#E2</td>
<td>R/W</td>
<td>1-Alarm 2 is Enabled</td>
<td>1/0</td>
<td>00317+48(#-1)</td>
<td>n+4/1(5)</td>
</tr>
<tr>
<td>L#A3</td>
<td>R</td>
<td>1-Alarm 3 is Active</td>
<td>1/0</td>
<td>0318+48(#-1)</td>
<td>n+4/1(6)</td>
</tr>
<tr>
<td>L#N3</td>
<td>R/W</td>
<td>1-Alarm 3 is Not Acknowledged</td>
<td>1/0</td>
<td>00319+48(#-1)</td>
<td>n+4/1(7)</td>
</tr>
<tr>
<td>L#E3</td>
<td>R</td>
<td>1-Alarm 3 is Enabled</td>
<td>1/0</td>
<td>00320+48(#-1)</td>
<td>n+4/1(8)</td>
</tr>
<tr>
<td>L#A4</td>
<td>R</td>
<td>1-Alarm 4 is Active</td>
<td>1/0</td>
<td>00321+48(#-1)</td>
<td>n+4/1(9)</td>
</tr>
<tr>
<td>L#N4</td>
<td>R/W</td>
<td>1-Alarm 4 is Not Acknowledged</td>
<td>1/0</td>
<td>00322+48(#-1)</td>
<td>n+4/1(10)</td>
</tr>
<tr>
<td>L#E4</td>
<td>R/W</td>
<td>1-Alarm 4 is Enabled</td>
<td>1/0</td>
<td>00323+48(#-1)</td>
<td>n+4/1(11)</td>
</tr>
<tr>
<td>L#OS2</td>
<td>R/W</td>
<td>1-Alarms - Out of Service</td>
<td>1/0</td>
<td>00324+48(#-1)</td>
<td>n+4/1(12)</td>
</tr>
<tr>
<td>L#CC</td>
<td>R</td>
<td>1-Configuration has Changed</td>
<td></td>
<td>00325+48(#-1)</td>
<td>n+4/1(13)</td>
</tr>
<tr>
<td>L#NK</td>
<td>R</td>
<td>1-Unacknowledged Loop Event</td>
<td></td>
<td>00326+48(#-1)</td>
<td>n+4/1(14)</td>
</tr>
<tr>
<td>L#AE</td>
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<td>1-Active Loop Event</td>
<td></td>
<td>00327+48(#-1)</td>
<td>n+4/1(15)</td>
</tr>
<tr>
<td>L#NSS</td>
<td>R/W</td>
<td>1-Not Ack’d STANDBY (V1.3)</td>
<td>1/0</td>
<td>00328+48(#-1)</td>
<td>n+4/1(0)</td>
</tr>
<tr>
<td>L#NOR</td>
<td>R/W</td>
<td>1-Not Ack’d Override (V1.3)</td>
<td>1/0</td>
<td>00329+48(#-1)</td>
<td>n+4/1(1)</td>
</tr>
<tr>
<td>L#NEM</td>
<td>R/W</td>
<td>1-Not Ack’d Emergency Man (V1.3)</td>
<td>1/0</td>
<td>00330+48(#-1)</td>
<td>n+4/1(2)</td>
</tr>
<tr>
<td>L#NHL</td>
<td>R/W</td>
<td>1-Not Ack’d HI Setpoint Limit (V1.3)</td>
<td>1/0</td>
<td>00331+48(#-1)</td>
<td>n+4/1(3)</td>
</tr>
<tr>
<td>L#NLL</td>
<td>R/W</td>
<td>1-Not Ack’d LO Setpoint Limit (V1.3)</td>
<td>1/0</td>
<td>00332+48(#-1)</td>
<td>n+4/1(4)</td>
</tr>
<tr>
<td>L#NU1</td>
<td>R/W</td>
<td>1-Not Ack’d U1 Status (V1.3)</td>
<td>1/0</td>
<td>00333+48(#-1)</td>
<td>n+4/1(5)</td>
</tr>
<tr>
<td>L#NU2</td>
<td>R/W</td>
<td>1-Not Ack’d U2 Status (V1.3)</td>
<td>1/0</td>
<td>00334+48(#-1)</td>
<td>n+4/1(6)</td>
</tr>
<tr>
<td>L#NW1</td>
<td>R/W</td>
<td>1-Not Ack’d W1 Status (V1.3)</td>
<td>1/0</td>
<td>00335+48(#-1)</td>
<td>n+4/1(7)</td>
</tr>
<tr>
<td>L#NW2</td>
<td>R/W</td>
<td>1-Not Ack’d W2 Status (V1.3)</td>
<td>1/0</td>
<td>00336+48(#-1)</td>
<td>n+4/1(8)</td>
</tr>
<tr>
<td>L#NW3</td>
<td>R/W</td>
<td>1-Not Ack’d W3 Status (V1.3)</td>
<td>1/0</td>
<td>00337+48(#-1)</td>
<td>n+4/1(9)</td>
</tr>
<tr>
<td>L#NE1</td>
<td>R/W</td>
<td>1-Not Ack’d E1 Status (V1.3)</td>
<td>1/0</td>
<td>00338+48(#-1)</td>
<td>n+4/1(10)</td>
</tr>
<tr>
<td>L#NE2</td>
<td>R/W</td>
<td>1-Not Ack’d E2 Status (V1.3)</td>
<td>1/0</td>
<td>00339+48(#-1)</td>
<td>n+4/1(11)</td>
</tr>
<tr>
<td>L#NE3</td>
<td>R/W</td>
<td>1-Not Ack’d E3 Status (V1.3)</td>
<td>1/0</td>
<td>00340+48(#-1)</td>
<td>n+4/1(12)</td>
</tr>
<tr>
<td>L#XAT</td>
<td>W</td>
<td>1-Transfer Autotune Parameters (V1.3)</td>
<td>1/0</td>
<td>00341+48(#-1)</td>
<td>n+4/1(13)</td>
</tr>
<tr>
<td>L#PB1C</td>
<td>R/W</td>
<td>PB1SW Input MD (*) (V1.3)</td>
<td>1/0</td>
<td>00342+48(#-1)</td>
<td>n+4/1(14)</td>
</tr>
<tr>
<td>L#PB2C</td>
<td>R/W</td>
<td>PB2SW Input MD (*) (V1.3)</td>
<td>1/0</td>
<td>00343+48(#-1)</td>
<td>n+4/1(15)</td>
</tr>
</tbody>
</table>

* These bits indicate the status of the switch input MD. A write of a “1” will have the same effect as pressing and releasing the button on the faceplate. If the action of the switch is sustained the switch will change position. If the action is momentary the switch will close for one scan cycle.
### Control Loop Status Word (L#CLS) - channel n+3/parameter 1

<table>
<thead>
<tr>
<th>BIT</th>
<th>Description</th>
<th>Value</th>
<th>Block</th>
<th>Read/Write</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Auto/Manual (A)</td>
<td>1-Auto</td>
<td>A/M</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0-Manual</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Local Loop (L)</td>
<td>1-Local</td>
<td>ODC</td>
<td>R/W</td>
<td>L</td>
</tr>
<tr>
<td>2</td>
<td>Standby Sync (SS)</td>
<td>1-Standby</td>
<td>A/M</td>
<td>R</td>
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<tr>
<td>3</td>
<td>External/Internal (E)</td>
<td>1-External</td>
<td>E/I</td>
<td>R/W</td>
<td>ES</td>
</tr>
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<td></td>
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<td>0-Internal</td>
<td></td>
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</tr>
<tr>
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<td>Console (CN)</td>
<td>1-Console</td>
<td>ODC</td>
<td>R/W</td>
<td>CN</td>
</tr>
<tr>
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<td>Computer (CM)</td>
<td>1-Computer</td>
<td>ODC</td>
<td>R/W</td>
<td>CM</td>
</tr>
<tr>
<td>6</td>
<td>Ramping Setpoint (RS)</td>
<td>1-Ramping Setpoint</td>
<td>SETPT</td>
<td>R/W</td>
<td>RS</td>
</tr>
<tr>
<td>7</td>
<td>Override (OR)</td>
<td>1-Override</td>
<td>ORSL</td>
<td>R</td>
<td>OS</td>
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<td>9</td>
<td>Configuration Hold (CH)</td>
<td>1-Configuration Hold</td>
<td></td>
<td>R</td>
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<tr>
<td>10</td>
<td>HI Setpoint Limit (HL)</td>
<td>1-HI Setpoint Limit</td>
<td>SPLIM</td>
<td>R</td>
<td>HS</td>
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<tr>
<td>11</td>
<td>LO Setpoint Limit (LL)</td>
<td>1-LO Setpoint Limit</td>
<td>SPLIM</td>
<td>R</td>
<td>LS</td>
</tr>
<tr>
<td>12</td>
<td>Alarms are Out of Service (OS)</td>
<td>1-Out of Service</td>
<td>ALARM</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>U1 Status Active (U1S)</td>
<td>1-U1 Active</td>
<td>ODC</td>
<td>R</td>
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<td>14</td>
<td>U2 Status Active (U2S)</td>
<td>1-U2 Active</td>
<td>ODC</td>
<td>R</td>
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<tr>
<td>15</td>
<td>Autotune is active (AT)</td>
<td>1-Autotune</td>
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<td>R/W</td>
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### Control Loop Alarm Status Word (L#ASW) - channel n+4/parameter 1

<table>
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<th>Output</th>
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<tbody>
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<td>0</td>
<td>Alarm 1 is Active (A1)</td>
<td>1-Active</td>
<td>ALARM</td>
<td>R</td>
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<td>1</td>
<td>Alarm 1 is Not Acknowledged (N1)</td>
<td>1-Not Acknowledged</td>
<td>ALARM</td>
<td>R/W</td>
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<tr>
<td>2</td>
<td>Alarm 1 is Enabled (E1)</td>
<td>1-Enabled</td>
<td>ALARM</td>
<td>R/W</td>
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</tr>
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<td>3</td>
<td>Alarm 2 is Active (A2)</td>
<td>1-Active</td>
<td>ALARM</td>
<td>R</td>
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<tr>
<td>4</td>
<td>Alarm 2 is Not Acknowledged (N2)</td>
<td>1-Not Acknowledged</td>
<td>ALARM</td>
<td>R/W</td>
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<tr>
<td>5</td>
<td>Alarm 2 is Enabled (E2)</td>
<td>1-Enabled</td>
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<td>R/W</td>
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<tr>
<td>6</td>
<td>Alarm 3 is Active (A3)</td>
<td>1-Active</td>
<td>ALARM</td>
<td>R</td>
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<tr>
<td>7</td>
<td>Alarm 3 is Not Acknowledged (N3)</td>
<td>1-Not Acknowledged</td>
<td>ALARM</td>
<td>R/W</td>
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<td>R/W</td>
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<tr>
<td>9</td>
<td>Alarm 4 is Active (A4)</td>
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<td>ALARM</td>
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</tr>
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<td>R/W</td>
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<td>ALARM</td>
<td>R/W</td>
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<td>R/W</td>
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<tr>
<td>13</td>
<td>Configuration has Changed (CC)</td>
<td>1-Loop Configured</td>
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<td>14</td>
<td>Unacknowledged Loop Event (NA)</td>
<td>1-Unacknowledged Event</td>
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<td>15</td>
<td>Active Loop Event (AE)</td>
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### Extended Control Loop Status Word (L#ECLS) - channel n+4/parameter 10

<table>
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<th>Output</th>
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<tbody>
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<td>Not Ack’d STANDBY</td>
<td>1-Not Acknowledged</td>
<td>A/M</td>
<td>R/W</td>
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</tr>
<tr>
<td>1</td>
<td>Not Ack’d Override</td>
<td>1-Not Acknowledged</td>
<td>A/M</td>
<td>R/W</td>
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<tr>
<td>2</td>
<td>Not Ack’d Emergency Manual</td>
<td>1-Not Acknowledged</td>
<td>A/M</td>
<td>R/W</td>
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<tr>
<td>3</td>
<td>Not Ack’d HI Setpoint Limit</td>
<td>1-Not Acknowledged</td>
<td>SPLIM</td>
<td>R/W</td>
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<tr>
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<td>Not Ack’d LO Setpoint Limit</td>
<td>1-Not Acknowledged</td>
<td>SPLIM</td>
<td>R/W</td>
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<tr>
<td>5</td>
<td>Not Ack’d User 1 Status</td>
<td>1-Not Acknowledged</td>
<td>ODC</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Not Ack’d User 2 Status</td>
<td>1-Not Acknowledged</td>
<td>ODC</td>
<td>R/W</td>
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<tr>
<td>7</td>
<td>Not Ack’d Autotune W1 Warning</td>
<td>1-Not Acknowledged</td>
<td>PID</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Not Ack’d Autotune W2 Warning</td>
<td>1-Not Acknowledged</td>
<td>PID</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Not Ack’d Autotune W3 Warning</td>
<td>1-Not Acknowledged</td>
<td>PID</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Not Ack’d Autotune E1 Warning</td>
<td>1-Not Acknowledged</td>
<td>PID</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Not Ack’d Autotune E2 Warning</td>
<td>1-Not Acknowledged</td>
<td>PID</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Not Ack’d Autotune E3 Warning</td>
<td>1-Not Acknowledged</td>
<td>PID</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Transfer Autotune Parameters</td>
<td>1-Transfer</td>
<td>PID</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>PB1SW Input MD (*)</td>
<td>1-High, 0-Low</td>
<td>PB1SW</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>PB2SW Input MD (*)</td>
<td>1-High, 0-Low</td>
<td>PB2SW</td>
<td>R/W</td>
<td></td>
</tr>
</tbody>
</table>

* These bits indicate the status of the switch input MD. A write of a “1” will have the same effect as pressing and releasing the button on the faceplate. If the action of the switch is sustained the switch will change position. If the action is momentary, the switch will close for one scan cycle.
Sequencer Loop [ODS]

<table>
<thead>
<tr>
<th>Code</th>
<th>R/W</th>
<th>Description</th>
<th>Range</th>
<th>Coil (MB)</th>
<th>C/P (LIL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L#HS</td>
<td>R</td>
<td>1-Hold Sequencer</td>
<td>1/0</td>
<td>00296+48(#-1)</td>
<td>n+4/1(0)</td>
</tr>
<tr>
<td>L#L</td>
<td>R/W</td>
<td>1-Loop Local</td>
<td>1/0</td>
<td>00297+48(#-1)</td>
<td>n+4/1(1)</td>
</tr>
<tr>
<td>L#RSQ</td>
<td>W</td>
<td>1-Reset Sequencer</td>
<td>1/0</td>
<td>00298+48(#-1)</td>
<td>n+4/1(2)</td>
</tr>
<tr>
<td>L#TC</td>
<td>R</td>
<td>1-Track</td>
<td>1/0</td>
<td>00299+48(#-1)</td>
<td>n+4/1(3)</td>
</tr>
<tr>
<td>L#CN</td>
<td>R/W</td>
<td>1-Console</td>
<td>1/0</td>
<td>00300+48(#-1)</td>
<td>n+4/1(4)</td>
</tr>
<tr>
<td>L#CM</td>
<td>R/W</td>
<td>1-Computer</td>
<td>1/0</td>
<td>00301+48(#-1)</td>
<td>n+4/1(5)</td>
</tr>
<tr>
<td>L#SSF</td>
<td>W</td>
<td>1-Step Forward (normal 0)</td>
<td>1/0</td>
<td>00302+48(#-1)</td>
<td>n+4/1(6)</td>
</tr>
<tr>
<td>L#SSB</td>
<td>W</td>
<td>1-Step Backward (normal 0) (spare)</td>
<td>1/0</td>
<td>00303+48(#-1)</td>
<td>n+4/1(7)</td>
</tr>
<tr>
<td>L#CH</td>
<td>R</td>
<td>1-Configuration Hold</td>
<td>1/0</td>
<td>00304+48(#-1)</td>
<td>n+4/1(8)</td>
</tr>
<tr>
<td>L#SSC</td>
<td>R</td>
<td>1-Steps Completed (spare)</td>
<td>0</td>
<td>00307+48(#-1)</td>
<td>n+4/1(11)</td>
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<tr>
<td></td>
<td></td>
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<td></td>
<td>00308+48(#-1)</td>
<td>n+4/1(12)</td>
</tr>
<tr>
<td>L#PB1</td>
<td>R</td>
<td>PB1SW Input MD (*) (V1.3)</td>
<td>1/0</td>
<td>00309+48(#-1)</td>
<td>n+4/1(13)</td>
</tr>
<tr>
<td>L#PB2</td>
<td>R</td>
<td>PB2SW Input MD (*) (V1.3)</td>
<td>1/0</td>
<td>00310+48(#-1)</td>
<td>n+4/1(14)</td>
</tr>
<tr>
<td>L#PB3</td>
<td>R</td>
<td>PB3SW Input MD (*) (V1.3)</td>
<td>1/0</td>
<td>00311+48(#-1)</td>
<td>n+4/1(15)</td>
</tr>
<tr>
<td>L#A1</td>
<td>R</td>
<td>1-Alarm 1 is Active</td>
<td>1/0</td>
<td>00312+48(#-1)</td>
<td>n+5/1(0)</td>
</tr>
<tr>
<td>L#N1</td>
<td>R/W</td>
<td>1-Alarm 1 is Not Acknowledged</td>
<td>1/0</td>
<td>00313+48(#-1)</td>
<td>n+5/1(1)</td>
</tr>
<tr>
<td>L#E1</td>
<td>R/W</td>
<td>1-Alarm 1 is Enabled</td>
<td>1/0</td>
<td>00314+48(#-1)</td>
<td>n+5/1(2)</td>
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<tr>
<td>L#A2</td>
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<td>1-Alarm 2 is Active</td>
<td>1/0</td>
<td>00315+48(#-1)</td>
<td>n+5/1(3)</td>
</tr>
<tr>
<td>L#N2</td>
<td>R/W</td>
<td>1-Alarm 2 is Not Acknowledged</td>
<td>1/0</td>
<td>00316+48(#-1)</td>
<td>n+5/1(4)</td>
</tr>
<tr>
<td>L#E2</td>
<td>R/W</td>
<td>1-Alarm 2 is Enabled</td>
<td>1/0</td>
<td>00317+48(#-1)</td>
<td>n+5/1(5)</td>
</tr>
<tr>
<td>L#A3</td>
<td>R</td>
<td>1-Alarm 3 is Active</td>
<td>1/0</td>
<td>00318+48(#-1)</td>
<td>n+5/1(6)</td>
</tr>
<tr>
<td>L#N3</td>
<td>R/W</td>
<td>1-Alarm 3 is Not Acknowledged</td>
<td>1/0</td>
<td>00319+48(#-1)</td>
<td>n+5/1(7)</td>
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<tr>
<td>L#E3</td>
<td>R/W</td>
<td>1-Alarm 3 is Enabled</td>
<td>1/0</td>
<td>00320+48(#-1)</td>
<td>n+5/1(8)</td>
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<tr>
<td>L#A4</td>
<td>R</td>
<td>1-Alarm 4 is Active</td>
<td>1/0</td>
<td>00321+48(#-1)</td>
<td>n+5/1(9)</td>
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<tr>
<td>L#N4</td>
<td>R/W</td>
<td>1-Alarm 4 is Not Acknowledged</td>
<td>1/0</td>
<td>00322+48(#-1)</td>
<td>n+5/1(10)</td>
</tr>
<tr>
<td>L#E4</td>
<td>R/W</td>
<td>1-Alarm 4 is Enabled</td>
<td>1/0</td>
<td>00323+48(#-1)</td>
<td>n+5/1(11)</td>
</tr>
<tr>
<td>L#OS2</td>
<td>R/W</td>
<td>1-Alarms - Out of Service</td>
<td>1/0</td>
<td>00324+48(#-1)</td>
<td>n+5/1(12)</td>
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<tr>
<td>L#CC</td>
<td>R</td>
<td>1-Configuration has Changed</td>
<td>1/0</td>
<td>00325+48(#-1)</td>
<td>n+5/1(13)</td>
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<tr>
<td>L#NA</td>
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<td>1/0</td>
<td>00326+48(#-1)</td>
<td>n+5/1(14)</td>
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<tr>
<td>L#AE</td>
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<td>1-Active Loop Event (spare)</td>
<td>0</td>
<td>00327+48(#-1)</td>
<td>n+5/1(15)</td>
</tr>
</tbody>
</table>

* These bits indicate the status of the switch input MD. A write of a “1” will have the same effect as pressing and releasing the button on the faceplate. If the action of the switch is sustained the switch will change position. If the action is momentary the switch will close for one scan cycle.
### Sequencer Loop Status Word (L#SLS) - channel n+4/parameter 1

<table>
<thead>
<tr>
<th>BIT</th>
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<th>Block</th>
<th>Read/Write</th>
<th>Output</th>
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<tbody>
<tr>
<td>0</td>
<td>Hold Sequencer (HS)</td>
<td>1-Hold</td>
<td>PRSEQ</td>
<td>R</td>
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<tr>
<td>1</td>
<td>Local (L)</td>
<td>1-Local</td>
<td>ODS</td>
<td>R/W</td>
<td>L</td>
</tr>
<tr>
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<td>Reset Sequencer (RSQ)</td>
<td>1-Reset</td>
<td>PRSEQ</td>
<td>W</td>
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</tr>
<tr>
<td>3</td>
<td>Track Command (TC)</td>
<td>1-Track</td>
<td>PRSEQ</td>
<td>R</td>
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</tr>
<tr>
<td>4</td>
<td>Console (CN)</td>
<td>1-Console</td>
<td>ODS</td>
<td>R/W</td>
<td>CN</td>
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<td>Computer CM)</td>
<td>1-Computer</td>
<td>ODS</td>
<td>R/W</td>
<td>CM</td>
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<tr>
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<td>Step Forward (SSF)</td>
<td>1-Step</td>
<td>PRSEQ</td>
<td>W</td>
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</tr>
<tr>
<td>7</td>
<td>Step Backward (SSB)</td>
<td>1-Step</td>
<td>PRSEQ</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Configuration Hold (CH)</td>
<td>1-Configuration Hold</td>
<td></td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Steps Completed (SSC)</td>
<td>1- Steps Complete</td>
<td>PRSEQ</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>PB1SW Input MD (PB1)</td>
<td>1/0 (write of 1 presses PB)</td>
<td>PB1SW</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>PB2SW Input MD (PB2)</td>
<td>1/0 (write of 1 presses PB)</td>
<td>PB2SW</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>PB3SW Input MD (PB3)</td>
<td>1/0 (write of 1 presses PB)</td>
<td>PB2SW</td>
<td>R/W</td>
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### Sequencer Loop Alarm Status Word (L#ASW) - channel n+5/parameter 1

<table>
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<th>Value</th>
<th>Block</th>
<th>Read/Write</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Alarm 1 is Active (A1)</td>
<td>1-Active</td>
<td>ALARM</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Alarm 1 is Not Acknowledged (N1)</td>
<td>1-Not Acknowledged</td>
<td>ALARM</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Alarm 1 is Enabled (E1)</td>
<td>1-Enabled</td>
<td>ALARM</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Alarm 2 is Active (A2)</td>
<td>1-Active</td>
<td>ALARM</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Alarm 2 is Not Acknowledged (N2)</td>
<td>1-Not Acknowledged</td>
<td>ALARM</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Alarm 2 is Enabled (E2)</td>
<td>1-Enabled</td>
<td>ALARM</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Alarm 3 is Active (A3)</td>
<td>1-Active</td>
<td>ALARM</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Alarm 3 is Not Acknowledged (N3)</td>
<td>1-Not Acknowledged</td>
<td>ALARM</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Alarm 3 is Enabled (E3)</td>
<td>1-Enabled</td>
<td>ALARM</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Alarm 4 is Active (A4)</td>
<td>1-Active</td>
<td>ALARM</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Alarm 4 is Not Acknowledged (N4)</td>
<td>1-Not Acknowledged</td>
<td>ALARM</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Alarm 4 is Enabled (E4)</td>
<td>1-Enabled</td>
<td>ALARM</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Alarms are Out of Service (OS)</td>
<td>1-Out of Service</td>
<td>ALARM</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Configuration has Changed (CC)</td>
<td>1-Loop Configured</td>
<td></td>
<td>R</td>
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</tr>
<tr>
<td>14</td>
<td>Unacknowledged Loop Event (NA)</td>
<td>1-Unacknowledged Event</td>
<td>R/W</td>
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<tr>
<td>15</td>
<td>Active Loop Event (AE)</td>
<td>1- Active Loop Event</td>
<td>R</td>
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### Analog Indicator [ODA] - (V2.2)

<table>
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<tr>
<th>Code</th>
<th>R/W</th>
<th>Description</th>
<th>Range</th>
<th>Coil(MB)</th>
<th>C/P (LIL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L#P1AA</td>
<td>R</td>
<td>1-Process 1 Alarm A is Active</td>
<td>1/0</td>
<td>00296+48(#-1)</td>
<td>n+4/1(0)</td>
</tr>
<tr>
<td>L#P1AN</td>
<td>R/W</td>
<td>1-Process 1 Alarm A is Not Acknowledged</td>
<td>1/0</td>
<td>00297+48(#-1)</td>
<td>n+4/1(1)</td>
</tr>
<tr>
<td>L#P1AE</td>
<td>R/W</td>
<td>1-Process 1 Alarm A is Enabled</td>
<td>1/0</td>
<td>00298+48(#-1)</td>
<td>n+4/1(2)</td>
</tr>
<tr>
<td>L#P1BA</td>
<td>R</td>
<td>1-Process 1 Alarm B is Active</td>
<td>1/0</td>
<td>00299+48(#-1)</td>
<td>n+4/1(3)</td>
</tr>
<tr>
<td>L#P1BN</td>
<td>R/W</td>
<td>1-Process 1 Alarm B is Not Acknowledged</td>
<td>1/0</td>
<td>00300+48(#-1)</td>
<td>n+4/1(4)</td>
</tr>
<tr>
<td>L#P1BE</td>
<td>R/W</td>
<td>1-Process 1 Alarm B is Enabled</td>
<td>1/0</td>
<td>00301+48(#-1)</td>
<td>n+4/1(5)</td>
</tr>
<tr>
<td>L#P2AA</td>
<td>R</td>
<td>1-Process 2 Alarm A is Active</td>
<td>1/0</td>
<td>00302+48(#-1)</td>
<td>n+4/1(6)</td>
</tr>
<tr>
<td>L#P2AN</td>
<td>R/W</td>
<td>1-Process 2 Alarm A is Not Acknowledged</td>
<td>1/0</td>
<td>00303+48(#-1)</td>
<td>n+4/1(7)</td>
</tr>
<tr>
<td>L#P2AE</td>
<td>R/W</td>
<td>1-Process 2 Alarm A is Enabled</td>
<td>1/0</td>
<td>00304+48(#-1)</td>
<td>n+4/1(8)</td>
</tr>
<tr>
<td>L#P2BA</td>
<td>R</td>
<td>1-Process 2 Alarm B is Active</td>
<td>1/0</td>
<td>00305+48(#-1)</td>
<td>n+4/1(9)</td>
</tr>
<tr>
<td>L#P2BN</td>
<td>R/W</td>
<td>1-Process 2 Alarm B is Not Acknowledged</td>
<td>1/0</td>
<td>00306+48(#-1)</td>
<td>n+4/1(10)</td>
</tr>
<tr>
<td>L#P2BE</td>
<td>R/W</td>
<td>1-Process 2 Alarm B is Enabled</td>
<td>1/0</td>
<td>00307+48(#-1)</td>
<td>n+4/1(11)</td>
</tr>
<tr>
<td>L#OS1</td>
<td>R/W</td>
<td>1-Alarms - Out of Service</td>
<td>1/0</td>
<td>00308+48(#-1)</td>
<td>n+4/1(12)</td>
</tr>
<tr>
<td>L#PB1</td>
<td>R/W</td>
<td>PB1SW Input MD (*) (V1.3)</td>
<td>1/0</td>
<td>00309+48(#-1)</td>
<td>n+4/1(13)</td>
</tr>
<tr>
<td>L#PB2</td>
<td>R/W</td>
<td>PB2SW Input MD (*) (V1.3)</td>
<td>1/0</td>
<td>00310+48(#-1)</td>
<td>n+4/1(14)</td>
</tr>
<tr>
<td>L#PB3</td>
<td>R/W</td>
<td>PB3SW Input MD (*) (V1.3)</td>
<td>1/0</td>
<td>00311+48(#-1)</td>
<td>n+4/1(15)</td>
</tr>
<tr>
<td>L#P3AA</td>
<td>R</td>
<td>1-Process 3 Alarm A is Active</td>
<td>1/0</td>
<td>00312+48(#-1)</td>
<td>n+5/1(0)</td>
</tr>
<tr>
<td>L#P3AN</td>
<td>R/W</td>
<td>1-Process 3 Alarm A is Not Acknowledged</td>
<td>1/0</td>
<td>00313+48(#-1)</td>
<td>n+5/1(1)</td>
</tr>
<tr>
<td>L#P3AE</td>
<td>R/W</td>
<td>1-Process 3 Alarm A is Enabled</td>
<td>1/0</td>
<td>00314+48(#-1)</td>
<td>n+5/1(2)</td>
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<tr>
<td>L#P3BA</td>
<td>R</td>
<td>1-Process 3 Alarm B is Active</td>
<td>1/0</td>
<td>00315+48(#-1)</td>
<td>n+5/1(3)</td>
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<tr>
<td>L#P3BN</td>
<td>R/W</td>
<td>1-Process 3 Alarm B is Not Acknowledged</td>
<td>1/0</td>
<td>00316+48(#-1)</td>
<td>n+5/1(4)</td>
</tr>
<tr>
<td>L#P3BE</td>
<td>R/W</td>
<td>1-Process 3 Alarm B is Enabled</td>
<td>1/0</td>
<td>00317+48(#-1)</td>
<td>n+5/1(5)</td>
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<tr>
<td>L#P4AA</td>
<td>R</td>
<td>1-Process 4 Alarm A is Active</td>
<td>1/0</td>
<td>00318+48(#-1)</td>
<td>n+1/1(6)</td>
</tr>
<tr>
<td>L#P4AN</td>
<td>R/W</td>
<td>1-Process 4 Alarm A is Not Acknowledged</td>
<td>1/0</td>
<td>00319+48(#-1)</td>
<td>n+5/1(7)</td>
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<tr>
<td>L#P4AE</td>
<td>R/W</td>
<td>1-Process 4 Alarm A is Enabled</td>
<td>1/0</td>
<td>00320+48(#-1)</td>
<td>n+5/1(8)</td>
</tr>
<tr>
<td>L#P4BA</td>
<td>R</td>
<td>1-Process 4 Alarm B is Active</td>
<td>1/0</td>
<td>00321+48(#-1)</td>
<td>n+5/1(9)</td>
</tr>
<tr>
<td>L#P4BN</td>
<td>R/W</td>
<td>1-Process 4 Alarm B is Not Acknowledged</td>
<td>1/0</td>
<td>00322+48(#-1)</td>
<td>n+5/1(10)</td>
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<tr>
<td>L#P4BE</td>
<td>R/W</td>
<td>1-Process 4 Alarm B is Enabled</td>
<td>1/0</td>
<td>00323+48(#-1)</td>
<td>n+5/1(11)</td>
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<tr>
<td>L#OS</td>
<td>R/W</td>
<td>1-Alarms - Out of Service</td>
<td>1/0</td>
<td>00324+48(#-1)</td>
<td>n+5/1(12)</td>
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<tr>
<td>L#CC</td>
<td>R</td>
<td>1-Configuration has Changed</td>
<td>1/0</td>
<td>00325+48(#-1)</td>
<td>n+5/1(13)</td>
</tr>
<tr>
<td>L#NA</td>
<td>R/W</td>
<td>1-Unacknowledged Loop Event</td>
<td>1/0</td>
<td>00326+48(#-1)</td>
<td>n+5/1(14)</td>
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<tr>
<td>L#AE</td>
<td>R</td>
<td>1-Active Loop Event</td>
<td>1/0</td>
<td>00327+48(#-1)</td>
<td>n+5/1(15)</td>
</tr>
</tbody>
</table>

* These bits indicate the status of the switch input MD. A write of a “1” will have the same effect as pressing and releasing the button on the faceplate. If the action of the switch is sustained the switch will change position. If the action is momentary the switch will close for one scan cycle.
### Analog Indicator Loop Status Word (L#W1) - channel n+4/parameter 1

<table>
<thead>
<tr>
<th>BIT</th>
<th>Description</th>
<th>Value</th>
<th>Block</th>
<th>Read/Write</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>P1 Alarm A is Active (A1)</td>
<td>1-Active</td>
<td>ALARM</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>P1 Alarm A is Not Ack’d (N1)</td>
<td>1-Not Acknowledged</td>
<td>ALARM</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>P1 Alarm A is Enabled (E1)</td>
<td>1-Enabled</td>
<td>ALARM</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>P1 Alarm B is Active (A1)</td>
<td>1-Active</td>
<td>ALARM</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>P1 Alarm B is Not Ack’d (N1)</td>
<td>1-Not Acknowledged</td>
<td>ALARM</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>P1 Alarm B is Enabled (E1)</td>
<td>1-Enabled</td>
<td>ALARM</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>P2 Alarm A is Active (A1)</td>
<td>1-Active</td>
<td>ALARM</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>P2 Alarm A is Not Ack’d (N1)</td>
<td>1-Not Acknowledged</td>
<td>ALARM</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>P2 Alarm A is Enabled (E1)</td>
<td>1-Enabled</td>
<td>ALARM</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>P2 Alarm B is Active (A1)</td>
<td>1-Active</td>
<td>ALARM</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>P2 Alarm B is Not Ack’d (N1)</td>
<td>1-Not Acknowledged</td>
<td>ALARM</td>
<td>R/W</td>
<td></td>
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<tr>
<td>11</td>
<td>P2 Alarm B is Enabled (E1)</td>
<td>1-Enabled</td>
<td>ALARM</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Alarms are Out of Service (OS)</td>
<td>1-Out of Service</td>
<td>ALARM</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>PB1SW Input MD (PB1)</td>
<td>1/0 (write of 1 presses PB)</td>
<td>PB1SW</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>PB2SW Input MD (PB2)</td>
<td>1/0 (write of 1 presses PB)</td>
<td>PB2SW</td>
<td>R/W</td>
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</tr>
<tr>
<td>15</td>
<td>PB3SW Input MD (PB3)</td>
<td>1/0 (write of 1 presses PB)</td>
<td>PB2SW</td>
<td>R/W</td>
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### Analog Indicator Loop Alarm Status Word (L#SW2) - channel n+5/parameter 1

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<th>BIT</th>
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<th>Value</th>
<th>Block</th>
<th>Read/Write</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>P3 Alarm A is Active (A1)</td>
<td>1-Active</td>
<td>ALARM</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>P3 Alarm A is Not Ack’d (N1)</td>
<td>1-Not Acknowledged</td>
<td>ALARM</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>P3 Alarm A is Enabled (E1)</td>
<td>1-Enabled</td>
<td>ALARM</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>P3 Alarm B is Active (A1)</td>
<td>1-Active</td>
<td>ALARM</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>P3 Alarm B is Not Ack’d (N1)</td>
<td>1-Not Acknowledged</td>
<td>ALARM</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>P3 Alarm B is Enabled (E1)</td>
<td>1-Enabled</td>
<td>ALARM</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>P4 Alarm A is Active (A1)</td>
<td>1-Active</td>
<td>ALARM</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>P4 Alarm A is Not Ack’d (N1)</td>
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<td>ALARM</td>
<td>R/W</td>
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<tr>
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<td>P4 Alarm A is Enabled (E1)</td>
<td>1-Enabled</td>
<td>ALARM</td>
<td>R/W</td>
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<tr>
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<td>P4 Alarm B is Active (A1)</td>
<td>1-Active</td>
<td>ALARM</td>
<td>R</td>
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</tr>
<tr>
<td>10</td>
<td>P4 Alarm B is Not Ack’d (N1)</td>
<td>1-Not Acknowledged</td>
<td>ALARM</td>
<td>R/W</td>
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<tr>
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<td>1-Enabled</td>
<td>ALARM</td>
<td>R/W</td>
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<tr>
<td>12</td>
<td>Alarms are Out of Service (OS)</td>
<td>1-Out of Service</td>
<td>ALARM</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Configuration has Changed (CC)</td>
<td>1-Loop Configured</td>
<td>ALARM</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Unacknowledged Loop Event (NA)</td>
<td>1-Unacknowledged Event</td>
<td>ALARM</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Active Loop Event (AE)</td>
<td>1- Active Loop Event</td>
<td>ALARM</td>
<td>R</td>
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**Digital Indicator [ODD] - (V2.2)**

<table>
<thead>
<tr>
<th>Code</th>
<th>R/W</th>
<th>Description</th>
<th>Range</th>
<th>Coil(MB)</th>
<th>C/P (LIL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L#D0</td>
<td>R</td>
<td>Discrete 0 Input 1-ON 0-OFF</td>
<td>1/0</td>
<td>00296+48(#-1)</td>
<td>n/1(0)</td>
</tr>
<tr>
<td>L#D1</td>
<td>R</td>
<td>Discrete 1 Input 1-ON 0-OFF</td>
<td>1/0</td>
<td>00297+48(#-1)</td>
<td>n/1(1)</td>
</tr>
<tr>
<td>L#D2</td>
<td>R</td>
<td>Discrete 2 Input 1-ON 0-OFF</td>
<td>1/0</td>
<td>00298+48(#-1)</td>
<td>n/1(2)</td>
</tr>
<tr>
<td>L#D3</td>
<td>R</td>
<td>Discrete 3 Input 1-ON 0-OFF</td>
<td>1/0</td>
<td>00299+48(#-1)</td>
<td>n/1(3)</td>
</tr>
<tr>
<td>L#D4</td>
<td>R</td>
<td>Discrete 4 Input 1-ON 0-OFF</td>
<td>1/0</td>
<td>00300+48(#-1)</td>
<td>n/1(4)</td>
</tr>
<tr>
<td>L#D5</td>
<td>R</td>
<td>Discrete 5 Input 1-ON 0-OFF</td>
<td>1/0</td>
<td>00301+48(#-1)</td>
<td>n/1(5)</td>
</tr>
<tr>
<td>L#D6</td>
<td>R</td>
<td>Discrete 6 Input 1-ON 0-OFF</td>
<td>1/0</td>
<td>00302+48(#-1)</td>
<td>n/1(6)</td>
</tr>
<tr>
<td>L#D7</td>
<td>R</td>
<td>Discrete 7 Input 1-ON 0-OFF</td>
<td>1/0</td>
<td>00303+48(#-1)</td>
<td>n/1(7)</td>
</tr>
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<td>L#D8</td>
<td>R</td>
<td>Discrete 8 Input 1-ON 0-OFF</td>
<td>1/0</td>
<td>00304+48(#-1)</td>
<td>n/1(8)</td>
</tr>
<tr>
<td>L#D9</td>
<td>R</td>
<td>Discrete 9 Input 1-ON 0-OFF</td>
<td>1/0</td>
<td>00305+48(#-1)</td>
<td>n/1(9)</td>
</tr>
<tr>
<td>L#DA</td>
<td>R</td>
<td>Discrete A Input 1-ON 0-OFF</td>
<td>1/0</td>
<td>00306+48(#-1)</td>
<td>n/1(10)</td>
</tr>
<tr>
<td>L#DB</td>
<td>R</td>
<td>Discrete B Input 1-ON 0-OFF</td>
<td>1/0</td>
<td>00307+48(#-1)</td>
<td>n/1(11)</td>
</tr>
<tr>
<td>L#DC</td>
<td>R</td>
<td>Discrete C Input 1-ON 0-OFF</td>
<td>1/0</td>
<td>00308+48(#-1)</td>
<td>n/1(12)</td>
</tr>
<tr>
<td>L#DD</td>
<td>R</td>
<td>Discrete D Input 1-ON 0-OFF</td>
<td>1/0</td>
<td>00309+48(#-1)</td>
<td>n/1(13)</td>
</tr>
<tr>
<td>L#DE</td>
<td>R</td>
<td>Discrete E Input 1-ON 0-OFF</td>
<td>1/0</td>
<td>00310+48(#-1)</td>
<td>n/1(14)</td>
</tr>
<tr>
<td>L#DF</td>
<td>R</td>
<td>Discrete F Input 1-ON 0-OFF</td>
<td>1/0</td>
<td>00311+48(#-1)</td>
<td>n/1(15)</td>
</tr>
<tr>
<td>L#D0S</td>
<td>R/W</td>
<td>Discrete 0 Status 1-Auto 0-Manual (*)</td>
<td>1/0</td>
<td>00312+48(#-1)</td>
<td>n+1/1(0)</td>
</tr>
<tr>
<td>L#D1S</td>
<td>R/W</td>
<td>Discrete 1 Status 1-Auto 0-Manual (*)</td>
<td>1/0</td>
<td>00313+48(#-1)</td>
<td>n+1/1(1)</td>
</tr>
<tr>
<td>L#D2S</td>
<td>R/W</td>
<td>Discrete 2 Status 1-Auto 0-Manual (*)</td>
<td>1/0</td>
<td>00314+48(#-1)</td>
<td>n+1/1(2)</td>
</tr>
<tr>
<td>L#D3S</td>
<td>R/W</td>
<td>Discrete 3 Status 1-Auto 0-Manual (*)</td>
<td>1/0</td>
<td>00315+48(#-1)</td>
<td>n+1/1(3)</td>
</tr>
<tr>
<td>L#D4S</td>
<td>R/W</td>
<td>Discrete 4 Status 1-Auto 0-Manual (*)</td>
<td>1/0</td>
<td>00316+48(#-1)</td>
<td>n+1/1(4)</td>
</tr>
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<td>L#D5S</td>
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<td>00317+48(#-1)</td>
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<td>00318+48(#-1)</td>
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<td>00319+48(#-1)</td>
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<td>L#D8S</td>
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<td>Discrete 8 Status 1-Auto 0-Manual (*)</td>
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<td>00320+48(#-1)</td>
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<td>L#D9S</td>
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<td>n+2/1(11)</td>
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<td>Discrete E Output 1-ON 0-OFF</td>
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<td>00342+48(#-1)</td>
<td>n+2/1(14)</td>
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<td>PB1SW Input MD (**)</td>
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<td>08701+16(#-1)</td>
<td>n+3/1(0)</td>
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<td>L#PB2</td>
<td>R/W</td>
<td>PB2SW Input MD (**)</td>
<td>1/0</td>
<td>08702+16(#-1)</td>
<td>n+3/1(1)</td>
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(*) L#DnS - writing a "1" toggles the switch. Reading "1" indicates Auto Status; reading "0" indicate Man status.
(**) L#PB1 & L#PB2 - writing a "1" to the controller will have the same affect as pushing the button on the faceplate of the controller. If the action of the switch is sustained the switch will change position. If the action is momentary, the switch will close for one scan cycle. Reading the bits indicates the status of the switch MD input.
### Digital Indicator Loop Status Word (L#DISW) - channel n/parameter 1

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<th>Output</th>
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<td>Discrete 2 Input Value</td>
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<td>1 - ON 0 - OFF</td>
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<td>Discrete 6 Input Value</td>
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<td>Discrete 8 Input Value</td>
<td>1 - ON 0 - OFF</td>
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<td>Discrete 9 Input Value</td>
<td>1 - ON 0 - OFF</td>
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<td>1 - ON 0 - OFF</td>
<td>ODD</td>
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<td>Discrete B Input Value</td>
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### Digital Indicator Loop Status Word (L#DSSW) - channel n+1/parameter 1

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<td>Discrete 0 Status (*)</td>
<td>1 - AUTO 0 - MANUAL</td>
<td>ODD</td>
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<td>Discrete 1 Status (*)</td>
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<td>R/W</td>
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<td>Discrete 2 Status (*)</td>
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<td>Discrete 3 Status (*)</td>
<td>1 - AUTO 0 - MANUAL</td>
<td>ODD</td>
<td>R/W</td>
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<td>Discrete 4 Status (*)</td>
<td>1 - AUTO 0 - MANUAL</td>
<td>ODD</td>
<td>R/W</td>
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<td>Discrete 5 Status (*)</td>
<td>1 - AUTO 0 - MANUAL</td>
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<td>R/W</td>
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<td>6</td>
<td>Discrete 6 Status (*)</td>
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<td>ODD</td>
<td>R/W</td>
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<td>Discrete 7 Status (*)</td>
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<td>ODD</td>
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<td>8</td>
<td>Discrete 8 Status (*)</td>
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<td>ODD</td>
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<td>Discrete A Status (*)</td>
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<td>ODD</td>
<td>R/W</td>
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<td>Discrete B Status (*)</td>
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<td>ODD</td>
<td>R/W</td>
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<td>12</td>
<td>Discrete C Status (*)</td>
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<td>R/W</td>
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<td>R/W</td>
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<td>R/W</td>
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<tr>
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<td>Discrete F Status (*)</td>
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- A mask on command will toggle the position of the Auto/Man switch
### Digital Indicator Loop Status Word (L#DOSW) - channel n+2/parameter 1

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<td>OF</td>
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### Digital Indicator Loop Status Word (L#SW) - channel n+3/parameter 1

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<th>Output</th>
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<td>PB1SW Input MD (PB1)</td>
<td>1/0 (write 1 presses PB)</td>
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<td>PB2SW Input MD (PB2)</td>
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<td>PB2SW</td>
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**Pushbutton/Switch Indicator [ODP] - (V2.2)**

<table>
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<tr>
<th>Code</th>
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<th>Description</th>
<th>Range</th>
<th>Coil(MB) C/P (LIL)</th>
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<tbody>
<tr>
<td>L#G1P1</td>
<td>W</td>
<td>Group 1 - Press PB1 (**)</td>
<td>1</td>
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<tr>
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<td>Group 1 - Press PB2 (**)</td>
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<td>00297+48(#-1) n/1(1)</td>
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<tr>
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<td>Group 1 - Auto/Man Switch (*)</td>
<td>l/0</td>
<td>00298+48(#-1) n/1(2)</td>
</tr>
<tr>
<td>L#G1FS</td>
<td>R</td>
<td>Group 1 Feedback Status</td>
<td>l/0</td>
<td>00299+48(#-1) n/1(3)</td>
</tr>
<tr>
<td>L#G2P1</td>
<td>W</td>
<td>Group 2 - Press PB1 (**)</td>
<td>1</td>
<td>00300+48(#-1) n/1(4)</td>
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<tr>
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<td>W</td>
<td>Group 2 - Press PB2 (**)</td>
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<td>00301+48(#-1) n/1(5)</td>
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<tr>
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<td>R/W</td>
<td>Group 2 - Auto/Man Switch (*)</td>
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<td>00302+48(#-1) n/1(6)</td>
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<tr>
<td>L#G2FS</td>
<td>R</td>
<td>Group 2 Feedback Status</td>
<td>l/0</td>
<td>00303+48(#-1) n/1(7)</td>
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<tr>
<td>L#G3P1</td>
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<td>Group 3 - Press PB1 (**)</td>
<td>1</td>
<td>00304+48(#-1) n/1(8)</td>
</tr>
<tr>
<td>L#G3P2</td>
<td>W</td>
<td>Group 3 - Press PB2 (**)</td>
<td>1</td>
<td>00305+48(#-1) n/1(9)</td>
</tr>
<tr>
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<td>R/W</td>
<td>Group 3 - Auto/Man Switch (*)</td>
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<td>00306+48(#-1) n/1(10)</td>
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<td>L#G3FS</td>
<td>R</td>
<td>Group 3 Feedback Status</td>
<td>l/0</td>
<td>00307+48(#-1) n/1(11)</td>
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<tr>
<td>L#G4P1</td>
<td>W</td>
<td>Group 4 - Press PB1 (**)</td>
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<td>00308+48(#-1) n/1(12)</td>
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<td>L#G4P2</td>
<td>W</td>
<td>Group 4 - Press PB2 (**)</td>
<td>1</td>
<td>00309+48(#-1) n/1(13)</td>
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<tr>
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<td>R/W</td>
<td>Group 4 - Auto/Man Switch (*)</td>
<td>l/0</td>
<td>00310+48(#-1) n/1(14)</td>
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<tr>
<td>L#G4FS</td>
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<td>Group 4 - Feedback Status</td>
<td>l/0</td>
<td>00311+48(#-1) n/1(15)</td>
</tr>
</tbody>
</table>

* L#GnS3 - reading a "1" indicates a switch position of Auto and reading a "0" indicates Man. Writing a "1" to the controller will toggle the state of the Auto/Man switch.

** L#GnP1 & L#GnP2 - writing a "1" to the controller will have the same affect as pushing the button on the faceplate of the controller. If the action of the switch is sustained the switch will change position. If the action is momentary the switch will close for one scan cycle.
**Digital Indicator Loop Status Word (L#SW1) - channel n/parameter 1**

<table>
<thead>
<tr>
<th>BIT</th>
<th>Description</th>
<th>Value</th>
<th>Block</th>
<th>Read/Write</th>
<th>Output</th>
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<tbody>
<tr>
<td>0</td>
<td>Group 1 - Press PB1</td>
<td>I/O (write of 1 presses PB)</td>
<td>ODP</td>
<td>W</td>
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<tr>
<td>1</td>
<td>Group 1 - Press PB2</td>
<td>I/O (write of 1 presses PB)</td>
<td>ODP</td>
<td>W</td>
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<tr>
<td>2</td>
<td>Group 1 - Auto/Man Switch</td>
<td>1 - Auto 0- Manual (*)</td>
<td>ODP</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Group 1 - Feedback Status</td>
<td>1 - True 0- False</td>
<td>ODP</td>
<td>R</td>
<td></td>
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<tr>
<td>4</td>
<td>Group 2 - Press PB1</td>
<td>I/O (write of 1 presses PB)</td>
<td>ODP</td>
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</tr>
<tr>
<td>5</td>
<td>Group 2 - Press PB2</td>
<td>I/O (write of 1 presses PB)</td>
<td>ODP</td>
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</tr>
<tr>
<td>6</td>
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<td>1 - Auto 0- Manual (*)</td>
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<td>R/W</td>
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<tr>
<td>7</td>
<td>Group 2 - Feedback Status</td>
<td>1 - True 0- False</td>
<td>ODP</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Group 3 - Press PB1</td>
<td>I/O (write of 1 presses PB)</td>
<td>ODP</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Group 3 - Press PB2</td>
<td>I/O (write of 1 presses PB)</td>
<td>ODP</td>
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<tr>
<td>10</td>
<td>Group 3 - Auto/Man Switch</td>
<td>1 - Auto 0- Manual (*)</td>
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<tr>
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<td>Group 3 - Feedback Status</td>
<td>1 - True 0- False</td>
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<td>R</td>
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<tr>
<td>12</td>
<td>Group 4 - Press PB1</td>
<td>I/O (write of 1 presses PB)</td>
<td>ODP</td>
<td>W</td>
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<tr>
<td>13</td>
<td>Group 4 - Press PB2</td>
<td>I/O (write of 1 presses PB)</td>
<td>ODP</td>
<td>W</td>
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<tr>
<td>14</td>
<td>Group 4 - Auto/Man Switch</td>
<td>1 - Auto 0- Manual (*)</td>
<td>ODP</td>
<td>R/W</td>
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<tr>
<td>15</td>
<td>Group 4 - Feedback Status</td>
<td>1 - True 0- False</td>
<td>ODP</td>
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* A mask on command will toggle the position of the Auto/Man switch

---

**Digital Indicator Loop Status Word (L#SW2) - channel n+1/parameter 1**

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<th>Output</th>
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<td>I/O (write of 1 presses PB)</td>
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<td>W</td>
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<tr>
<td>1</td>
<td>Group 5 - Press PB2</td>
<td>I/O (write of 1 presses PB)</td>
<td>ODP</td>
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<tr>
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<td>Group 5 - Auto/Man Switch</td>
<td>1 - Auto 0- Manual (*)</td>
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<td>R/W</td>
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</tr>
<tr>
<td>3</td>
<td>Group 5 - Feedback Status</td>
<td>1 - True 0- False</td>
<td>ODP</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Group 6 - Press PB1</td>
<td>I/O (write of 1 presses PB)</td>
<td>ODP</td>
<td>W</td>
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</tr>
<tr>
<td>5</td>
<td>Group 6 - Press PB2</td>
<td>I/O (write of 1 presses PB)</td>
<td>ODP</td>
<td>W</td>
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</tr>
<tr>
<td>6</td>
<td>Group 6 - Auto/Man Switch</td>
<td>1 - Auto 0- Manual (*)</td>
<td>ODP</td>
<td>R/W</td>
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<tr>
<td>7</td>
<td>Group 6 - Feedback Status</td>
<td>1 - True 0- False</td>
<td>ODP</td>
<td>R</td>
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</tr>
<tr>
<td>8</td>
<td>Group 7 - Press PB1</td>
<td>I/O (write of 1 presses PB)</td>
<td>ODP</td>
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<tr>
<td>9</td>
<td>Group 7 - Press PB2</td>
<td>I/O (write of 1 presses PB)</td>
<td>ODP</td>
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<tr>
<td>10</td>
<td>Group 7 - Auto/Man Switch</td>
<td>1 - Auto 0- Manual (*)</td>
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<td>R/W</td>
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<tr>
<td>11</td>
<td>Group 7 - Feedback Status</td>
<td>1 - True 0- False</td>
<td>ODP</td>
<td>R</td>
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<tr>
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<td>Group 8 - Press PB1</td>
<td>I/O (write of 1 presses PB)</td>
<td>ODP</td>
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<tr>
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<td>Group 8 - Press PB2</td>
<td>I/O (write of 1 presses PB)</td>
<td>ODP</td>
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<td>Group 8 - Feedback Status</td>
<td>1 - True 0- False</td>
<td>ODP</td>
<td>R</td>
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### 7.3.9 PCOM Block Status

Included in MPU Controller board firmware version 1.30 and higher.

#### Controller/Sequencer

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<th>Code</th>
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<td>L#INIT_OK</td>
<td>R/W</td>
<td>1-INIT_OK</td>
<td>1/0</td>
<td>09101+32(#-1)</td>
<td>z/1(0)</td>
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<tr>
<td>L#DFAIL</td>
<td>R/W</td>
<td>1-DFAIL</td>
<td>1/0</td>
<td>09102+32(#-1)</td>
<td>z/1(1)</td>
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<tr>
<td>L#RESET</td>
<td>W</td>
<td>1-RESET</td>
<td>1/0</td>
<td>09103+32(#-1)</td>
<td>z/1(2)</td>
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<tr>
<td>L#START</td>
<td>W</td>
<td>1-START</td>
<td>1/0</td>
<td>09104+32(#-1)</td>
<td>z/1(3)</td>
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<tr>
<td>L#RESTART</td>
<td>W</td>
<td>1-RESTART</td>
<td>1/0</td>
<td>09105+32(#-1)</td>
<td>z/1(4)</td>
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<tr>
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<td>W</td>
<td>1-HOLD</td>
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<td>09106+32(#-1)</td>
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<td>09107+32(#-1)</td>
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<tr>
<td>L#ABORT</td>
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<td>1-ABORT</td>
<td>1/0</td>
<td>09108+32(#-1)</td>
<td>z/1(7)</td>
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<tr>
<td>L#READY</td>
<td>R</td>
<td>1-READY</td>
<td>1/0</td>
<td>09109+32(#-1)</td>
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<td>L#RUN</td>
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<td>1-RUN</td>
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<td>09110+32(#-1)</td>
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<td>L#HELD</td>
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<td>09112+32(#-1)</td>
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<td>09113+32(#-1)</td>
<td>z/1(12)</td>
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<td>09114+32(#-1)</td>
<td>z/1(13)</td>
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<td>09115+32(#-1)</td>
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<td>L#EMERG (EO)</td>
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<td>R/W</td>
<td>1-EO Not Ack’d</td>
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<td>09118+32(#-1)</td>
<td>z+1/1(1)</td>
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<td>L#INTRLK (IK)</td>
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<td>1-INTRLK</td>
<td>1/0</td>
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<td>z+1/1(2)</td>
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<tr>
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<td>09123+32(#-1)</td>
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</tr>
<tr>
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<td>09128+32(#-1)</td>
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<td>spare</td>
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<td>z+1/1(12)</td>
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<tr>
<td>spare</td>
<td>R</td>
<td></td>
<td>1/0</td>
<td>09130+32(#-1)</td>
<td>z+1/1(13)</td>
</tr>
<tr>
<td>L#NotAck’dPCOM</td>
<td>R/W</td>
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<td>09131+32(#-1)</td>
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<td>z+1/1(14)</td>
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<td>L#ACTIVEPCOM</td>
<td>R</td>
<td>1-PCOM Event is Active</td>
<td>1/0</td>
<td>09132+32(#-1)</td>
<td>z+1/1(15)</td>
</tr>
</tbody>
</table>

z - LIL CHAN configured in the PCOM function block configuration.
### PCOM Function Block Status Word (L#PSW1) - channel z/parameter 1

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<tr>
<th>BIT</th>
<th>Description</th>
<th>Value</th>
<th>Block</th>
<th>Read/Write</th>
<th>Output</th>
</tr>
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<td>R/W</td>
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<td>PCOM</td>
<td>R/W</td>
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<td>RESET</td>
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<tr>
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<td>1-READY</td>
<td>PCOM</td>
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<td></td>
<td>PCOM</td>
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<td>14</td>
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<td></td>
<td>PCOM</td>
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### PCOM Function Block Status Word (L#PSW2) - channel z+1/parameter 1

<table>
<thead>
<tr>
<th>BIT</th>
<th>Description</th>
<th>Value</th>
<th>Block</th>
<th>Read/Write</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>EMERG (EO)</td>
<td>1-EO is Active</td>
<td>PCOM</td>
<td>R</td>
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</tr>
<tr>
<td>1</td>
<td>EO Not Acknowledged</td>
<td>1-EO is not acknowledged</td>
<td>PCOM</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>INTRLK (IK)</td>
<td>1-IK is Active</td>
<td>PCOM</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>IK Not Acknowledged</td>
<td>1-IK is not acknowledged</td>
<td>PCOM</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>FAILED (FD)</td>
<td>1-FD is Active</td>
<td>PCOM</td>
<td>R</td>
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<tr>
<td>5</td>
<td>FD Not Acknowledged</td>
<td>1-FD is not acknowledged</td>
<td>PCOM</td>
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<td></td>
<td>PCOM</td>
<td>R</td>
<td></td>
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<td>PCOM</td>
<td>R</td>
<td></td>
</tr>
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<td>R</td>
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<td>13</td>
<td>spare</td>
<td></td>
<td>PCOM</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>PCOM Not Acknowledged</td>
<td>1-PCOM is not ack’d</td>
<td>PCOM</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>ACTIVE PCOM Event (EO,IK,FD)</td>
<td>1-PCOM event is active</td>
<td>PCOM</td>
<td>R</td>
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</tr>
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</table>

z - LIL CHAN configured in the PCOM function block configuration.
7.3.10 Sequencer Loop I/O Coil Data (1-bit)

**Sequencer:**

<table>
<thead>
<tr>
<th>Code</th>
<th>R/W</th>
<th>Description</th>
<th>Range</th>
<th>Coil (MB)</th>
<th>C/P (LIL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SG0KI0</td>
<td>R</td>
<td>Seq. Group 0 (cur. step) masK for Input 0</td>
<td>I/O</td>
<td>01496</td>
<td>n/13(0)</td>
</tr>
<tr>
<td>SG0KIF</td>
<td>R</td>
<td>Seq. Group 0 (cur. step) masK for Input F</td>
<td>I/O</td>
<td>01511</td>
<td>n/13(15)</td>
</tr>
<tr>
<td>SG0SI0</td>
<td>R</td>
<td>Seq. Group 0 (cur. step) State of Input 0</td>
<td>I/O</td>
<td>01512</td>
<td>n/14(0)</td>
</tr>
<tr>
<td>SG0SIF</td>
<td>R</td>
<td>Seq. Group 0 (cur. step) State of Input F</td>
<td>I/O</td>
<td>01527</td>
<td>n/14(15)</td>
</tr>
<tr>
<td>SG0SO0</td>
<td>R</td>
<td>Seq. Group 0 (cur. step) State of Output 0</td>
<td>I/O</td>
<td>01528</td>
<td>n/15(0)</td>
</tr>
<tr>
<td>SG0SOF</td>
<td>R</td>
<td>Seq. Group 0 (cur. step) State of Output F</td>
<td>I/O</td>
<td>01543</td>
<td>n/15(15)</td>
</tr>
<tr>
<td>SGFKI0</td>
<td>R</td>
<td>Seq. Group F (cur. step) masK for Input 0</td>
<td>I/O</td>
<td>02216</td>
<td>n+3/22(0)</td>
</tr>
<tr>
<td>SGFKIF</td>
<td>R</td>
<td>Seq. Group F (cur. step) masK for Input F</td>
<td>I/O</td>
<td>02231</td>
<td>n+3/22(15)</td>
</tr>
<tr>
<td>SGFSI0</td>
<td>R</td>
<td>Seq. Group F (cur. step) State of Input 0</td>
<td>I/O</td>
<td>02232</td>
<td>n+3/23(0)</td>
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<tr>
<td>SGFSIF</td>
<td>R</td>
<td>Seq. Group F (cur. step) State of Input F</td>
<td>I/O</td>
<td>02247</td>
<td>n+3/23(15)</td>
</tr>
<tr>
<td>SGFSO0</td>
<td>R</td>
<td>Seq. Group F (cur. step) State of Output 0</td>
<td>I/O</td>
<td>02248</td>
<td>n+3/24(0)</td>
</tr>
</tbody>
</table>

**Sequencer Group n (current step) Mask Word for Inputs (SGnKI)**

<table>
<thead>
<tr>
<th>BIT</th>
<th>Description</th>
<th>Value</th>
<th>Block</th>
<th>Read/Write</th>
<th>Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Group n, Input 0, Mask Config.</td>
<td>1-high 0-don’t care</td>
<td>PRSEQ</td>
<td>R</td>
<td>n0</td>
</tr>
<tr>
<td>1</td>
<td>Group n, Input 1, Mask Config.</td>
<td>1-high 0-don’t care</td>
<td>PRSEQ</td>
<td>R</td>
<td>n1</td>
</tr>
<tr>
<td>2</td>
<td>Group n, Input 2, Mask Config.</td>
<td>1-high 0-don’t care</td>
<td>PRSEQ</td>
<td>R</td>
<td>n2</td>
</tr>
<tr>
<td>3</td>
<td>Group n, Input 3, Mask Config.</td>
<td>1-high 0-don’t care</td>
<td>PRSEQ</td>
<td>R</td>
<td>n3</td>
</tr>
<tr>
<td>4</td>
<td>Group n, Input 4, Mask Config.</td>
<td>1-high 0-don’t care</td>
<td>PRSEQ</td>
<td>R</td>
<td>n4</td>
</tr>
<tr>
<td>5</td>
<td>Group n, Input 5, Mask Config.</td>
<td>1-high 0-don’t care</td>
<td>PRSEQ</td>
<td>R</td>
<td>n5</td>
</tr>
<tr>
<td>6</td>
<td>Group n, Input 6, Mask Config.</td>
<td>1-high 0-don’t care</td>
<td>PRSEQ</td>
<td>R</td>
<td>n6</td>
</tr>
<tr>
<td>7</td>
<td>Group n, Input 7, Mask Config.</td>
<td>1-high 0-don’t care</td>
<td>PRSEQ</td>
<td>R</td>
<td>n7</td>
</tr>
<tr>
<td>8</td>
<td>Group n, Input 8, Mask Config.</td>
<td>1-high 0-don’t care</td>
<td>PRSEQ</td>
<td>R</td>
<td>n8</td>
</tr>
<tr>
<td>9</td>
<td>Group n, Input 9, Mask Config.</td>
<td>1-high 0-don’t care</td>
<td>PRSEQ</td>
<td>R</td>
<td>n9</td>
</tr>
<tr>
<td>10</td>
<td>Group n, Input A, Mask Config.</td>
<td>1-high 0-don’t care</td>
<td>PRSEQ</td>
<td>R</td>
<td>nA</td>
</tr>
<tr>
<td>11</td>
<td>Group n, Input B, Mask Config.</td>
<td>1-high 0-don’t care</td>
<td>PRSEQ</td>
<td>R</td>
<td>nB</td>
</tr>
<tr>
<td>12</td>
<td>Group n, Input C, Mask Config.</td>
<td>1-high 0-don’t care</td>
<td>PRSEQ</td>
<td>R</td>
<td>nC</td>
</tr>
<tr>
<td>13</td>
<td>Group n, Input D, Mask Config.</td>
<td>1-high 0-don’t care</td>
<td>PRSEQ</td>
<td>R</td>
<td>nD</td>
</tr>
<tr>
<td>14</td>
<td>Group n, Input E, Mask Config.</td>
<td>1-high 0-don’t care</td>
<td>PRSEQ</td>
<td>R</td>
<td>nE</td>
</tr>
<tr>
<td>15</td>
<td>Group n, Input F, Mask Config.</td>
<td>1-high 0-don’t care</td>
<td>PRSEQ</td>
<td>R</td>
<td>nF</td>
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### Sequencer Group n (current step) State Word of Inputs (SGnSI)

<table>
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<tr>
<th>BIT</th>
<th>Description</th>
<th>Value</th>
<th>Block</th>
<th>Read/Write</th>
<th>Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Group n, Input 0, State</td>
<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>n0</td>
</tr>
<tr>
<td>1</td>
<td>Group n, Input 1, State</td>
<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>n1</td>
</tr>
<tr>
<td>2</td>
<td>Group n, Input 2, State</td>
<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>n2</td>
</tr>
<tr>
<td>3</td>
<td>Group n, Input 3, State</td>
<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>n3</td>
</tr>
<tr>
<td>4</td>
<td>Group n, Input 4, State</td>
<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>n4</td>
</tr>
<tr>
<td>5</td>
<td>Group n, Input 5, State</td>
<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>n5</td>
</tr>
<tr>
<td>6</td>
<td>Group n, Input 6, State</td>
<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>n6</td>
</tr>
<tr>
<td>7</td>
<td>Group n, Input 7, State</td>
<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>n7</td>
</tr>
<tr>
<td>8</td>
<td>Group n, Input 8, State</td>
<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>n8</td>
</tr>
<tr>
<td>9</td>
<td>Group n, Input 9, State</td>
<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>n9</td>
</tr>
<tr>
<td>10</td>
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<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>nA</td>
</tr>
<tr>
<td>11</td>
<td>Group n, Input B, State</td>
<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>nB</td>
</tr>
<tr>
<td>12</td>
<td>Group n, Input C, State</td>
<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>nC</td>
</tr>
<tr>
<td>13</td>
<td>Group n, Input D, State</td>
<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>nD</td>
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<tr>
<td>14</td>
<td>Group n, Input E, State</td>
<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>nE</td>
</tr>
<tr>
<td>15</td>
<td>Group n, Input F, State</td>
<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>nF</td>
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</table>

(1) Writes are made using a parameter data send command (CMD 9) to the entire word

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### Sequencer Group n (current step) State Word of Outputs (SGnSO)

<table>
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<tr>
<th>BIT</th>
<th>Description</th>
<th>Value</th>
<th>Block</th>
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<th>Output</th>
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<td>PRSEQ</td>
<td>R/W(1)</td>
<td>n0</td>
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<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>n1</td>
</tr>
<tr>
<td>2</td>
<td>Group n, Output 2, State</td>
<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>n2</td>
</tr>
<tr>
<td>3</td>
<td>Group n, Output 3, State</td>
<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>n3</td>
</tr>
<tr>
<td>4</td>
<td>Group n, Output 4, State</td>
<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>n4</td>
</tr>
<tr>
<td>5</td>
<td>Group n, Output 5, State</td>
<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>n5</td>
</tr>
<tr>
<td>6</td>
<td>Group n, Output 6, State</td>
<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>n6</td>
</tr>
<tr>
<td>7</td>
<td>Group n, Output 7, State</td>
<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>n7</td>
</tr>
<tr>
<td>8</td>
<td>Group n, Output 8, State</td>
<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>n8</td>
</tr>
<tr>
<td>9</td>
<td>Group n, Output 9, State</td>
<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>n9</td>
</tr>
<tr>
<td>10</td>
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<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>nA</td>
</tr>
<tr>
<td>11</td>
<td>Group n, Output B, State</td>
<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>nB</td>
</tr>
<tr>
<td>12</td>
<td>Group n, Output C, State</td>
<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>nC</td>
</tr>
<tr>
<td>13</td>
<td>Group n, Output D, State</td>
<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>nD</td>
</tr>
<tr>
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<td>PRSEQ</td>
<td>R/W(1)</td>
<td>nE</td>
</tr>
<tr>
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<td>1-high 0-low</td>
<td>PRSEQ</td>
<td>R/W(1)</td>
<td>nF</td>
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### 7.3.11 LonWorks Remote I/O (Models 352P, 353, 354N)

<table>
<thead>
<tr>
<th>DID1N-0</th>
<th>R</th>
<th>DID01 - Normal state of LON Input 0</th>
<th>I/O</th>
<th>02401</th>
<th>1/202(0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DID1N-F</td>
<td>R</td>
<td>DID01 - Normal state of LON Input F</td>
<td>I/O</td>
<td>02416</td>
<td>1/202(15)</td>
</tr>
<tr>
<td>DID1M-0</td>
<td>R/W</td>
<td>DID01 - Mode of FB Output 0</td>
<td>I/O</td>
<td>02417</td>
<td>1/203(0)</td>
</tr>
<tr>
<td>DID1M-F</td>
<td>R/W</td>
<td>DID01 - Mode of FB Output F</td>
<td>I/O</td>
<td>02432</td>
<td>1/203(15)</td>
</tr>
<tr>
<td>DID1F-0</td>
<td>R/W</td>
<td>DID01 - Forced state 0</td>
<td>I/O</td>
<td>02433</td>
<td>1/204(0)</td>
</tr>
<tr>
<td>DID1F-F</td>
<td>R/W</td>
<td>DID01 - Forced state F</td>
<td>I/O</td>
<td>02448</td>
<td>1/204(15)</td>
</tr>
<tr>
<td>DOD01N0</td>
<td>R</td>
<td>DOD01 - Normal state of FB Input 0</td>
<td>I/O</td>
<td>02449</td>
<td>1/205(0)</td>
</tr>
<tr>
<td>DOD01NF</td>
<td>R</td>
<td>DOD01 - Normal state of FB Input F</td>
<td>I/O</td>
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<td>1/205(15)</td>
</tr>
<tr>
<td>DOD1M0</td>
<td>R/W</td>
<td>DOD01 - Mode of LON Output 0</td>
<td>I/O</td>
<td>02465</td>
<td>1/206(0)</td>
</tr>
<tr>
<td>DOD1MF</td>
<td>R/W</td>
<td>DOD01 - Mode of LON Output F</td>
<td>I/O</td>
<td>02480</td>
<td>1/206(15)</td>
</tr>
<tr>
<td>DOD1F0</td>
<td>R/W</td>
<td>DOD01 - Forced state 0</td>
<td>I/O</td>
<td>02481</td>
<td>1/207(0)</td>
</tr>
<tr>
<td>DOD1FF</td>
<td>R/W</td>
<td>DOD01 - Forced state F</td>
<td>I/O</td>
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<td>1/207(15)</td>
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The following DIS and DOS function blocks are included in MPU Controller board firmware versions 1.30 and higher.

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<th>DIS1N0</th>
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### Discrete Input Remote xx, Normal State Word of Function Block Outputs (DIDxxN)

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<th>Value</th>
<th>Block</th>
<th>Read/Write</th>
<th>Output</th>
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<td>0</td>
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<td>1-high 0-low</td>
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<td>R</td>
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<td>1</td>
<td>DIDxx, Output O1 Normal State</td>
<td>1-high 0-low</td>
<td>DIDxx</td>
<td>R</td>
<td>O1</td>
</tr>
<tr>
<td>2</td>
<td>DIDxx, Output O2 Normal State</td>
<td>1-high 0-low</td>
<td>DIDxx</td>
<td>R</td>
<td>O2</td>
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<tr>
<td>3</td>
<td>DIDxx, Output O3 Normal State</td>
<td>1-high 0-low</td>
<td>DIDxx</td>
<td>R</td>
<td>O3</td>
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<tr>
<td>4</td>
<td>DIDxx, Output O4 Normal State</td>
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<td>DIDxx</td>
<td>R</td>
<td>O4</td>
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<tr>
<td>5</td>
<td>DIDxx, Output O5 Normal State</td>
<td>1-high 0-low</td>
<td>DIDxx</td>
<td>R</td>
<td>O5</td>
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<tr>
<td>6</td>
<td>DIDxx, Output O6 Normal State</td>
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<td>DIDxx</td>
<td>R</td>
<td>O6</td>
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<tr>
<td>7</td>
<td>DIDxx, Output O7 Normal State</td>
<td>1-high 0-low</td>
<td>DIDxx</td>
<td>R</td>
<td>O7</td>
</tr>
<tr>
<td>8</td>
<td>DIDxx, Output O8 Normal State</td>
<td>1-high 0-low</td>
<td>DIDxx</td>
<td>R</td>
<td>O8</td>
</tr>
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<td>9</td>
<td>DIDxx, Output O9 Normal State</td>
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<td>DIDxx</td>
<td>R</td>
<td>O9</td>
</tr>
<tr>
<td>10</td>
<td>DIDxx, Output OA Normal State</td>
<td>1-high 0-low</td>
<td>DIDxx</td>
<td>R</td>
<td>OA</td>
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<tr>
<td>11</td>
<td>DIDxx, Output OB Normal State</td>
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<td>DIDxx</td>
<td>R</td>
<td>OB</td>
</tr>
<tr>
<td>12</td>
<td>DIDxx, Output OC Normal State</td>
<td>1-high 0-low</td>
<td>DIDxx</td>
<td>R</td>
<td>OC</td>
</tr>
<tr>
<td>13</td>
<td>DIDxx, Output OD Normal State</td>
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<td>DIDxx</td>
<td>R</td>
<td>OD</td>
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<tr>
<td>14</td>
<td>DIDxx, Output OE Normal State</td>
<td>1-high 0-low</td>
<td>DIDxx</td>
<td>R</td>
<td>OE</td>
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<td>15</td>
<td>DIDxx, Output OF Normal State</td>
<td>1-high 0-low</td>
<td>DIDxx</td>
<td>R</td>
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### Discrete Input Remote xx Mode Word of Function Block Outputs (DIDxxM)

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<th>Block</th>
<th>Read/Write</th>
<th>Output</th>
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<td>DIDxx</td>
<td>R/W (1)</td>
<td>O1</td>
</tr>
<tr>
<td>2</td>
<td>DIDxx, Mode of Output O2</td>
<td>1-forced 0-normal</td>
<td>DIDxx</td>
<td>R/W (1)</td>
<td>O2</td>
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<td>DIDxx, Mode of Output O3</td>
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<td>DIDxx</td>
<td>R/W (1)</td>
<td>O3</td>
</tr>
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<td>DIDxx, Mode of Output O4</td>
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<td>DIDxx</td>
<td>R/W (1)</td>
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<td>5</td>
<td>DIDxx, Mode of Output O5</td>
<td>1-forced 0-normal</td>
<td>DIDxx</td>
<td>R/W (1)</td>
<td>O5</td>
</tr>
<tr>
<td>6</td>
<td>DIDxx, Mode of Output O6</td>
<td>1-forced 0-normal</td>
<td>DIDxx</td>
<td>R/W (1)</td>
<td>O6</td>
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<tr>
<td>7</td>
<td>DIDxx, Mode of Output O7</td>
<td>1-forced 0-normal</td>
<td>DIDxx</td>
<td>R/W (1)</td>
<td>O7</td>
</tr>
<tr>
<td>8</td>
<td>DIDxx, Mode of Output O8</td>
<td>1-forced 0-normal</td>
<td>DIDxx</td>
<td>R/W (1)</td>
<td>O8</td>
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<tr>
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<td>DIDxx, Mode of Output O9</td>
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<td>DIDxx</td>
<td>R/W (1)</td>
<td>O9</td>
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<tr>
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<td>1-forced 0-normal</td>
<td>DIDxx</td>
<td>R/W (1)</td>
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<tr>
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<td>DIDxx, Mode of Output OB</td>
<td>1-forced 0-normal</td>
<td>DIDxx</td>
<td>R/W (1)</td>
<td>OB</td>
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<td>13</td>
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<td>DIDxx</td>
<td>R/W (1)</td>
<td>OD</td>
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<td>DIDxx, Mode of Output OE</td>
<td>1-forced 0-normal</td>
<td>DIDxx</td>
<td>R/W (1)</td>
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<td>15</td>
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<td>1-forced 0-normal</td>
<td>DIDxx</td>
<td>R/W (1)</td>
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(1) Writes are made using a parameter data send command (CMD 9) to the entire word.
### Discrete Input Remote xx, Forced State Word of Function Block Outputs (DIDxxF)

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<th>Read/Write</th>
<th>Output</th>
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<td>1-high 0-low</td>
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<td>R</td>
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</tr>
<tr>
<td>1</td>
<td>DIDxx, Output O1 Forced State</td>
<td>1-high 0-low</td>
<td>DIDxx</td>
<td>R</td>
<td>O1</td>
</tr>
<tr>
<td>2</td>
<td>DIDxx, Output O2 Forced State</td>
<td>1-high 0-low</td>
<td>DIDxx</td>
<td>R</td>
<td>O2</td>
</tr>
<tr>
<td>3</td>
<td>DIDxx, Output O3 Forced State</td>
<td>1-high 0-low</td>
<td>DIDxx</td>
<td>R</td>
<td>O3</td>
</tr>
<tr>
<td>4</td>
<td>DIDxx, Output O4 Forced State</td>
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<td>DIDxx</td>
<td>R</td>
<td>O4</td>
</tr>
<tr>
<td>5</td>
<td>DIDxx, Output O5 Forced State</td>
<td>1-high 0-low</td>
<td>DIDxx</td>
<td>R</td>
<td>O5</td>
</tr>
<tr>
<td>6</td>
<td>DIDxx, Output O6 Forced State</td>
<td>1-high 0-low</td>
<td>DIDxx</td>
<td>R</td>
<td>O6</td>
</tr>
<tr>
<td>7</td>
<td>DIDxx, Output O7 Forced State</td>
<td>1-high 0-low</td>
<td>DIDxx</td>
<td>R</td>
<td>O7</td>
</tr>
<tr>
<td>8</td>
<td>DIDxx, Output O8 Forced State</td>
<td>1-high 0-low</td>
<td>DIDxx</td>
<td>R</td>
<td>O8</td>
</tr>
<tr>
<td>9</td>
<td>DIDxx, Output O9 Forced State</td>
<td>1-high 0-low</td>
<td>DIDxx</td>
<td>R</td>
<td>O9</td>
</tr>
<tr>
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<td>1-high 0-low</td>
<td>DIDxx</td>
<td>R</td>
<td>OA</td>
</tr>
<tr>
<td>11</td>
<td>DIDxx, Output OB Forced State</td>
<td>1-high 0-low</td>
<td>DIDxx</td>
<td>R</td>
<td>OB</td>
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<tr>
<td>12</td>
<td>DIDxx, Output OC Forced State</td>
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<td>DIDxx</td>
<td>R</td>
<td>OC</td>
</tr>
<tr>
<td>13</td>
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<td>DIDxx</td>
<td>R</td>
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<td>OE</td>
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### Discrete Output Remote xx, Normal State Word of Function Block Inputs (DODxxN)

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<th>Value</th>
<th>Block</th>
<th>Read/Write</th>
<th>Input</th>
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<tr>
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<td>DODxx</td>
<td>R</td>
<td>1</td>
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<td>2</td>
<td>DODxx- Input 2 Normal State</td>
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<td>DODxx</td>
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<td>2</td>
</tr>
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<td>DODxx- Input 3 Normal State</td>
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<td>DODxx</td>
<td>R</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>DODxx- Input 4 Normal State</td>
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<td>DODxx</td>
<td>R</td>
<td>4</td>
</tr>
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<td>5</td>
<td>DODxx- Input 5 Normal State</td>
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<td>DODxx</td>
<td>R</td>
<td>5</td>
</tr>
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<td>DODxx- Input 6 Normal State</td>
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<td>6</td>
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<td>DODxx- Input 7 Normal State</td>
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<td>DODxx</td>
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<td>7</td>
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<tr>
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<td>DODxx</td>
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<td>8</td>
</tr>
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<td>9</td>
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<tr>
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<td>DODxx</td>
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<tr>
<td>11</td>
<td>DODxx- Input B Normal State</td>
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<td>R</td>
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</tr>
<tr>
<td>12</td>
<td>DODxx- Input C Normal State</td>
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<td>R</td>
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<td>R</td>
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<td>DODxx- Input E Normal State</td>
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<tr>
<td>15</td>
<td>DODxx- Input F Normal State</td>
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### Discrete Output Remote xx Mode Word of Function Block Inputs (DODxxM)

<table>
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<tr>
<th>BIT</th>
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<th>Value</th>
<th>Block</th>
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<th>Input</th>
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<td>R/W (1)</td>
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<td>11</td>
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<td>12</td>
<td>DODxx, Mode of Input C</td>
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<td>13</td>
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<td>14</td>
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<td>15</td>
<td>DODxx, Mode of Input F</td>
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<td>R/W (1)</td>
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(1) Writes are made using a parameter data send command (CMD 9) to the entire word.

### Discrete Output Remote xx, Forced State Word of Function Block Inputs (DODxxF)

<table>
<thead>
<tr>
<th>BIT</th>
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<th>Value</th>
<th>Block</th>
<th>Read/Write</th>
<th>Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>DODxx- Input 0 Forced State</td>
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<td>R/W (1)</td>
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</tr>
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<td>1</td>
<td>DODxx- Input 1 Forced State</td>
<td>1-high 0-low</td>
<td>DODxx</td>
<td>R/W (1)</td>
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</tr>
<tr>
<td>2</td>
<td>DODxx- Input 2 Forced State</td>
<td>1-high 0-low</td>
<td>DODxx</td>
<td>R/W (1)</td>
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<tr>
<td>3</td>
<td>DODxx- Input 3 Forced State</td>
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<td>DODxx</td>
<td>R/W (1)</td>
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<td>4</td>
<td>DODxx- Input 4 Forced State</td>
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<td>DODxx</td>
<td>R/W (1)</td>
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<td>5</td>
<td>DODxx- Input 5 Forced State</td>
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<td>R/W (1)</td>
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<td>6</td>
<td>DODxx- Input 6 Forced State</td>
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<td>DODxx- Input 7 Forced State</td>
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<td>DODxx</td>
<td>R/W (1)</td>
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<tr>
<td>8</td>
<td>DODxx- Input 8 Forced State</td>
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<td>DODxx</td>
<td>R/W (1)</td>
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<tr>
<td>9</td>
<td>DODxx- Input 9 Forced State</td>
<td>1-high 0-low</td>
<td>DODxx</td>
<td>R/W (1)</td>
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<tr>
<td>10</td>
<td>DODxx- Input A Forced State</td>
<td>1-high 0-low</td>
<td>DODxx</td>
<td>R/W (1)</td>
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<tr>
<td>11</td>
<td>DODxx- Input B Forced State</td>
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<td>DODxx</td>
<td>R/W (1)</td>
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</tr>
<tr>
<td>12</td>
<td>DODxx- Input C Forced State</td>
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<td>DODxx</td>
<td>R/W (1)</td>
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<td>13</td>
<td>DODxx- Input D Forced State</td>
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<td>DODxx</td>
<td>R/W (1)</td>
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<tr>
<td>14</td>
<td>DODxx- Input E Forced State</td>
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<td>DODxx</td>
<td>R/W (1)</td>
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<tr>
<td>15</td>
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### Discrete Input Remote xx, Normal State Word of Function Block Outputs (DISxxN)

<table>
<thead>
<tr>
<th>BIT</th>
<th>Description</th>
<th>Value</th>
<th>Block</th>
<th>Read/Write</th>
<th>Output</th>
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<tbody>
<tr>
<td>0</td>
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<td>R</td>
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<tr>
<td>1</td>
<td>DISxx, Output O1 Normal State</td>
<td>1-high 0-low</td>
<td>DISxx</td>
<td>R</td>
<td>O1</td>
</tr>
<tr>
<td>2</td>
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<td>DISxx</td>
<td>R</td>
<td>O2</td>
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<tr>
<td>3</td>
<td>DISxx, Output O3 Normal State</td>
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<td>R</td>
<td>O3</td>
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<tr>
<td>4</td>
<td>DISxx, Output O4 Normal State</td>
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<td>DISxx</td>
<td>R</td>
<td>O4</td>
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<td>5</td>
<td>DISxx, Output O5 Normal State</td>
<td>1-high 0-low</td>
<td>DISxx</td>
<td>R</td>
<td>O5</td>
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<td>6</td>
<td>DISxx, Output O6 Normal State</td>
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<td>DISxx</td>
<td>R</td>
<td>O6</td>
</tr>
<tr>
<td>7</td>
<td>DISxx, Output O7 Normal State</td>
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<td>DISxx</td>
<td>R</td>
<td>O7</td>
</tr>
<tr>
<td>8</td>
<td>DISxx, Output O8 Normal State</td>
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<td>R</td>
<td>O8</td>
</tr>
<tr>
<td>9</td>
<td>DISxx, Output O9 Normal State</td>
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<td>DISxx</td>
<td>R</td>
<td>O9</td>
</tr>
<tr>
<td>10</td>
<td>DISxx, Output OA Normal State</td>
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<td>DISxx</td>
<td>R</td>
<td>OA</td>
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<tr>
<td>11</td>
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<td>R</td>
<td>OB</td>
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<tr>
<td>12</td>
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<td>DISxx</td>
<td>R</td>
<td>OC</td>
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<tr>
<td>13</td>
<td>DISxx, Output OD Normal State</td>
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<td>DISxx</td>
<td>R</td>
<td>OD</td>
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<tr>
<td>14</td>
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<td>DISxx</td>
<td>R</td>
<td>OE</td>
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<tr>
<td>15</td>
<td>DISxx, Output OF Normal State</td>
<td>1-high 0-low</td>
<td>DISxx</td>
<td>R</td>
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### Discrete Input Remote xx Mode Word of Function Block Outputs (DISxxM)

<table>
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<th>Block</th>
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<th>Output</th>
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<td>DISxx</td>
<td>R/W (1)</td>
<td>O1</td>
</tr>
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<td>2</td>
<td>DISxx, Mode of Output O2</td>
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<td>DISxx</td>
<td>R/W (1)</td>
<td>O2</td>
</tr>
<tr>
<td>3</td>
<td>DISxx, Mode of Output O3</td>
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<td>DISxx</td>
<td>R/W (1)</td>
<td>O3</td>
</tr>
<tr>
<td>4</td>
<td>DISxx, Mode of Output O4</td>
<td>1-forced 0-normal</td>
<td>DISxx</td>
<td>R/W (1)</td>
<td>O4</td>
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<tr>
<td>5</td>
<td>DISxx, Mode of Output O5</td>
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<td>DISxx</td>
<td>R/W (1)</td>
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</tr>
<tr>
<td>6</td>
<td>DISxx, Mode of Output O6</td>
<td>1-forced 0-normal</td>
<td>DISxx</td>
<td>R/W (1)</td>
<td>O6</td>
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<tr>
<td>7</td>
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<td>DISxx</td>
<td>R/W (1)</td>
<td>O7</td>
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<td>DISxx</td>
<td>R/W (1)</td>
<td>O8</td>
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<td>R/W (1)</td>
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<td>DISxx</td>
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<td>DISxx</td>
<td>R/W (1)</td>
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<td>DISxx</td>
<td>R/W (1)</td>
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<td>DISxx</td>
<td>R/W (1)</td>
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<td>DISxx</td>
<td>R/W (1)</td>
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<td>OF</td>
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(1) Writes are made using a parameter data send command (CMD 9) to the entire word.
### Discrete Input Remote xx, Forced State Word of Function Block Outputs (DISxxF)

<table>
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<tr>
<th>BIT</th>
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<th>Value</th>
<th>Block</th>
<th>Read/Write</th>
<th>Output</th>
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<tbody>
<tr>
<td>0</td>
<td>DISxx, Output O0 Forced State</td>
<td>1-high 0-low</td>
<td>DISxx</td>
<td>R</td>
<td>O0</td>
</tr>
<tr>
<td>1</td>
<td>DISxx, Output O1 Forced State</td>
<td>1-high 0-low</td>
<td>DISxx</td>
<td>R</td>
<td>O1</td>
</tr>
<tr>
<td>2</td>
<td>DISxx, Output O2 Forced State</td>
<td>1-high 0-low</td>
<td>DISxx</td>
<td>R</td>
<td>O2</td>
</tr>
<tr>
<td>3</td>
<td>DISxx, Output O3 Forced State</td>
<td>1-high 0-low</td>
<td>DISxx</td>
<td>R</td>
<td>O3</td>
</tr>
<tr>
<td>4</td>
<td>DISxx, Output O4 Forced State</td>
<td>1-high 0-low</td>
<td>DISxx</td>
<td>R</td>
<td>O4</td>
</tr>
<tr>
<td>5</td>
<td>DISxx, Output O5 Forced State</td>
<td>1-high 0-low</td>
<td>DISxx</td>
<td>R</td>
<td>O5</td>
</tr>
<tr>
<td>6</td>
<td>DISxx, Output O6 Forced State</td>
<td>1-high 0-low</td>
<td>DISxx</td>
<td>R</td>
<td>O6</td>
</tr>
<tr>
<td>7</td>
<td>DISxx, Output O7 Forced State</td>
<td>1-high 0-low</td>
<td>DISxx</td>
<td>R</td>
<td>O7</td>
</tr>
<tr>
<td>8</td>
<td>DISxx, Output O8 Forced State</td>
<td>1-high 0-low</td>
<td>DISxx</td>
<td>R</td>
<td>O8</td>
</tr>
<tr>
<td>9</td>
<td>DISxx, Output O9 Forced State</td>
<td>1-high 0-low</td>
<td>DISxx</td>
<td>R</td>
<td>O9</td>
</tr>
<tr>
<td>10</td>
<td>DISxx, Output OA Forced State</td>
<td>1-high 0-low</td>
<td>DISxx</td>
<td>R</td>
<td>OA</td>
</tr>
<tr>
<td>11</td>
<td>DISxx, Output OB Forced State</td>
<td>1-high 0-low</td>
<td>DISxx</td>
<td>R</td>
<td>OB</td>
</tr>
<tr>
<td>12</td>
<td>DISxx, Output OC Forced State</td>
<td>1-high 0-low</td>
<td>DISxx</td>
<td>R</td>
<td>OC</td>
</tr>
<tr>
<td>13</td>
<td>DISxx, Output OD Forced State</td>
<td>1-high 0-low</td>
<td>DISxx</td>
<td>R</td>
<td>OD</td>
</tr>
<tr>
<td>14</td>
<td>DISxx, Output OE Forced State</td>
<td>1-high 0-low</td>
<td>DISxx</td>
<td>R</td>
<td>OE</td>
</tr>
<tr>
<td>15</td>
<td>DISxx, Output OF Forced State</td>
<td>1-high 0-low</td>
<td>DISxx</td>
<td>R</td>
<td>OF</td>
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</table>

### Discrete Output Remote xx, Normal State Word of Function Block Inputs (DOSxxN)

<table>
<thead>
<tr>
<th>BIT</th>
<th>Description</th>
<th>Value</th>
<th>Block</th>
<th>Read/Write</th>
<th>Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>DOSxx- Input 0 Normal State</td>
<td>1-high 0-low</td>
<td>DOSxx</td>
<td>R</td>
<td>0</td>
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<tr>
<td>1</td>
<td>DOSxx- Input 1 Normal State</td>
<td>1-high 0-low</td>
<td>DOSxx</td>
<td>R</td>
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</tr>
<tr>
<td>2</td>
<td>DOSxx- Input 2 Normal State</td>
<td>1-high 0-low</td>
<td>DOSxx</td>
<td>R</td>
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</tr>
<tr>
<td>3</td>
<td>DOSxx- Input 3 Normal State</td>
<td>1-high 0-low</td>
<td>DOSxx</td>
<td>R</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>DOSxx- Input 4 Normal State</td>
<td>1-high 0-low</td>
<td>DOSxx</td>
<td>R</td>
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</tr>
<tr>
<td>5</td>
<td>DOSxx- Input 5 Normal State</td>
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<td>DOSxx</td>
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### Discrete Output Remote xx Mode Word of Function Block Inputs (DOSxxM)

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<th>Input</th>
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<td>C</td>
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<td>R/W (1)</td>
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<td>DOSxx</td>
<td>R/W (1)</td>
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<td>R/W (1)</td>
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(1) Writes are made using a parameter data send command (CMD 9) to the entire word

### Discrete Output Remote xx, Forced State Word of Function Block Inputs (DOSxxF)

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<th>Input</th>
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<td>0</td>
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<td>R/W (1)</td>
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<td>DOSxx</td>
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<td>DOSxx</td>
<td>R/W (1)</td>
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<td>DOSxx</td>
<td>R/W (1)</td>
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<td>DOSxx</td>
<td>R/W (1)</td>
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<td>DOSxx</td>
<td>R/W (1)</td>
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<td>DOSxx</td>
<td>R/W (1)</td>
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<td>DOSxx</td>
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<td>DOSxx</td>
<td>R/W (1)</td>
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<td>DOSxx- Input C Forced State</td>
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<td>DOSxx</td>
<td>R/W (1)</td>
<td>C</td>
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<td>DOSxx</td>
<td>R/W (1)</td>
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<td>DOSxx- Input E Forced State</td>
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<td>DOSxx</td>
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<td>DOSxx- Input F Forced State</td>
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<td>DOSxx</td>
<td>R/W (1)</td>
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### 7.3.12 Trend Data (Loop Defined by MLTP)

Included in MPU Controller board firmware version 1.30 and higher.

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<tr>
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<th>Range</th>
<th>Register (MB)</th>
<th>C/P (LIL)</th>
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<td>48009</td>
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<td>128-3968</td>
<td>48018</td>
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<td>48019</td>
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* Writing to the sample time will reset all data points A1D1 through A1D170 to $0.$
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* Writing to the sample time will reset all data points A3D1 through A3D170 to $0.

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<td>A4D3</td>
<td>R</td>
<td>ATD04 Data 3 0-100%</td>
<td>128-3968</td>
<td>48619</td>
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</tr>
<tr>
<td>A4D168</td>
<td>R</td>
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<td>48784</td>
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</tr>
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<td>A4D169</td>
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<td>128-3968</td>
<td>48785</td>
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</tr>
<tr>
<td>A4D170</td>
<td>R</td>
<td>ATD04 Data 170 0-100%</td>
<td>128-3968</td>
<td>48786</td>
<td>n/a</td>
</tr>
</tbody>
</table>

* Writing to the sample time will reset all data points A4D1 through A4D170 to $0.
<table>
<thead>
<tr>
<th>Code</th>
<th>R/W</th>
<th>Description</th>
<th>Range</th>
<th>Register (MB)</th>
<th>C/P (LIL)</th>
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<tbody>
<tr>
<td>A5RMN</td>
<td>R</td>
<td>ATD05 MIN SCALE</td>
<td>Real</td>
<td>48801</td>
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<td>A5RMX</td>
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<td>A5DPP</td>
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<td>ATD05 Decimal Point Position</td>
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<tr>
<td>A5EU</td>
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<td>A5YR</td>
<td>R</td>
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<td>48809</td>
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<td>A5MT</td>
<td>R</td>
<td>ATD05 Month V2.0 (5)</td>
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<td>48810</td>
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<tr>
<td>A5DY</td>
<td>R</td>
<td>ATD05 Day V2.0 (5)</td>
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<td>48811</td>
<td>n/a</td>
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<tr>
<td>A5HR</td>
<td>R</td>
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<td>48812</td>
<td>n/a</td>
</tr>
<tr>
<td>A5MN</td>
<td>R</td>
<td>ATD05 Minute V2.0 (5)</td>
<td>0-59</td>
<td>48813</td>
<td>n/a</td>
</tr>
<tr>
<td>A5SC</td>
<td>R</td>
<td>ATD05 Second V2.0 (5)</td>
<td>0-59</td>
<td>48814</td>
<td>n/a</td>
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<tr>
<td>A5ST</td>
<td>R/W*</td>
<td>ATD05 Sample Time x0.01=min</td>
<td>1-48000</td>
<td>48815</td>
<td>n/a</td>
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<tr>
<td>A5STC</td>
<td>R</td>
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<td>0-1000 (x.1=%)</td>
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<td>128-3968</td>
<td>48817</td>
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</tr>
<tr>
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<td>128-3968</td>
<td>48818</td>
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</tr>
<tr>
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<td>R</td>
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</tr>
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<td>A5D168</td>
<td>R</td>
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<tr>
<td>A5D169</td>
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<td>48986</td>
<td>n/a</td>
</tr>
</tbody>
</table>

* Writing to the sample time will reset all data points A5D1 through A5D170 to $0.

**Notes:**

1. A read of any Time Stamp Data (i.e. Year, Month, Day, Hour, Minute, Second, or Sample Time) will update all Loop data registers. Additional data reads of Trend data within the same block should only request data so as to obtain a complete set of time synchronized data.

2. The Trend data is obtained from the loop referenced by the MLTP parameter (register 40058). This parameter can also be written to change the loop.

3. Parameter NTTB will indicate the number of ATD Analog Trend Display blocks that are available in the loop specified by the MLTP.

4. Undefined data (e.g. unconfigured inputs, period station was in HOLD or powered down) is represented by a value of $0.

5. Real time clock data requires the optional RTC/CB (Real Time Clock/Configuration Backup) board, shipped after July 1999 and Version 2.0 or higher MPU Controller firmware
### 7.3.13 Configuration Data Sequencer Loop

The Modbus registers or LIL parameters on this page refer to configuration parameters of function blocks within a specific loop previously defined by Modbus parameter MSLCP (40048) or LIL parameter LSLCP (7/1). For example, to read or write the Step 1 Group 0 Input Mask for the PRSEQ block that is in a loop with a Modbus Index of 3, write a 3 to 40048, then read or write to register 410001.

#### Sequencer (MASK Configurations)

<table>
<thead>
<tr>
<th>Code</th>
<th>R/W</th>
<th>Description</th>
<th>Range</th>
<th>Register (MB)</th>
<th>C/P (LIL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S001G0I</td>
<td>R/W</td>
<td>Step 1 Group 0 Input Mask</td>
<td>$0000-$FFFF</td>
<td>410001</td>
<td>1/154</td>
</tr>
<tr>
<td>S001G0O</td>
<td>R/W</td>
<td>Step 1 Group 0 Output Mask</td>
<td>$0000-$FFFF</td>
<td>410002</td>
<td>1/170</td>
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<tr>
<td>S001G1I</td>
<td>R/W</td>
<td>Step 1 Group 1 Input Mask</td>
<td>$0000-$FFFF</td>
<td>410003</td>
<td>1/155</td>
</tr>
<tr>
<td>S001G1O</td>
<td>R/W</td>
<td>Step 1 Group 1 Output Mask</td>
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<td>410004</td>
<td>1/171</td>
</tr>
<tr>
<td>S001G2I</td>
<td>R/W</td>
<td>Step 1 Group 2 Input Mask</td>
<td>$0000-$FFFF</td>
<td>410005</td>
<td>1/156</td>
</tr>
<tr>
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<td>Step 1 Group 2 Output Mask</td>
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<td>410006</td>
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<tr>
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<td>1/157</td>
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<tr>
<td>S250GEO</td>
<td>R/W</td>
<td>Step 250 Group E Input Mask</td>
<td>$0000-$FFFF</td>
<td>417997</td>
<td>250/168</td>
</tr>
<tr>
<td>S250GFI</td>
<td>R/W</td>
<td>Step 250 Group F Input Mask</td>
<td>$0000-$FFFF</td>
<td>417998</td>
<td>250/169</td>
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<tr>
<td>S250GFO</td>
<td>R/W</td>
<td>Step 250 Group F Output Mask</td>
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#### Real TimeTrip Block Configurations

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<th>Range</th>
<th>Register (MB)</th>
<th>C/P (LIL)</th>
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<tbody>
<tr>
<td>RTT01Y</td>
<td>R/W</td>
<td>Year</td>
<td>1999-</td>
<td>419001</td>
<td>1/100 V 2.0</td>
</tr>
<tr>
<td>RTT01M</td>
<td>R/W</td>
<td>Month</td>
<td>1-12</td>
<td>419002</td>
<td>1/101 V 2.0</td>
</tr>
<tr>
<td>RTT01D</td>
<td>R/W</td>
<td>Day</td>
<td>1-31</td>
<td>419003</td>
<td>1/102 V 2.0</td>
</tr>
<tr>
<td>RTT01HR</td>
<td>R/W</td>
<td>Hour</td>
<td>0-23</td>
<td>419004</td>
<td>1/103 V 2.0</td>
</tr>
<tr>
<td>RTT01MN</td>
<td>R/W</td>
<td>Minute</td>
<td>0-59</td>
<td>419005</td>
<td>1/104 V 2.0</td>
</tr>
<tr>
<td>RTT01SC</td>
<td>R/W</td>
<td>Second</td>
<td>0-59</td>
<td>419006</td>
<td>1/105 V 2.0</td>
</tr>
<tr>
<td>RTT01DA</td>
<td>R/W</td>
<td>Day</td>
<td>0000 0000 0SMT WTFS</td>
<td>419007</td>
<td>1/106 V 2.0</td>
</tr>
<tr>
<td>RTT02Y</td>
<td>R/W</td>
<td>Year</td>
<td>1999-</td>
<td>419008</td>
<td>2/100 V 2.0</td>
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<td>R/W</td>
<td>Month</td>
<td>1-12</td>
<td>419009</td>
<td>2/101 V 2.0</td>
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<td>0-59</td>
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<td>Year</td>
<td>1999-</td>
<td>419015</td>
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<td>419017</td>
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**Sequencer Time & Analog Configurations**

<table>
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<tr>
<th>Code</th>
<th>R/W</th>
<th>Description</th>
<th>Range</th>
<th>Register (MB)</th>
<th>C/P (LIL)</th>
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<tbody>
<tr>
<td>S001TIM</td>
<td>R/W</td>
<td>Step 1 Time Period (min)</td>
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<td>1/150-151</td>
</tr>
<tr>
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<td>R/W</td>
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<td>Real</td>
<td>420003</td>
<td>1/152-153</td>
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<td>R/W</td>
<td>Step 2 Time Period (min)</td>
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<td>Real</td>
<td>420007</td>
<td>2/152-153</td>
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<td>R/W</td>
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<td>420987</td>
<td>247/152-153</td>
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<td>Step 248 Time Period (min)</td>
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</table>

**Timer Function Block Configurations**

<table>
<thead>
<tr>
<th>Code</th>
<th>R/W</th>
<th>Description</th>
<th>Range</th>
<th>Register (MB)</th>
<th>C/P (LIL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DYT01T</td>
<td>R/W</td>
<td>Delay Timer 01 Time (min)</td>
<td>Real</td>
<td>421001</td>
<td>1/190-191</td>
</tr>
<tr>
<td>OST01T</td>
<td>R/W</td>
<td>One Shot Timer 01 Time (min)</td>
<td>Real</td>
<td>421003</td>
<td>1/192-193</td>
</tr>
<tr>
<td>RCT01NT</td>
<td>R/W</td>
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<td>Real</td>
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<td>1/194-195</td>
</tr>
<tr>
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<td>R/W</td>
<td>Rept Cy Timer 01 OFF Time (min)</td>
<td>Real</td>
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</tr>
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<td>Real</td>
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<td>1/198-199</td>
</tr>
<tr>
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<td>1/198-199</td>
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</tbody>
</table>
7.3.14 LIL Alarm Type Word (ATW)

BITS: 2 1 0
0 0 0 - no alarm action is required
0 0 1 - HIGH Alarm
0 1 0 - LOW Alarm
0 1 1 - HIGH DEVIATION Alarm
1 0 0 - LOW DEVIATION Alarm
1 0 1 - ABSOLUTE DEVIATION Alarm
1 1 0 - OUT OF RANGE Alarm
1 1 1 - no alarm action is required

BITS: 4 3
0 0 - 0.1 % alarm deadband
0 1 - 0.5 % alarm deadband
1 0 - 1.0 % alarm deadband
1 1 - 5.0 % alarm deadband

BITS: 7 6 5
0 0 0 - 0.0 seconds - delay time IN
0 0 1 - 0.4 seconds - delay time IN
0 1 0 - 1.0 seconds - delay time IN
0 1 1 - 2.0 seconds - delay time IN
1 0 0 - 5.0 seconds - delay time IN
1 0 1 - 15.0 seconds - delay time IN
1 1 0 - 30.0 seconds - delay time IN
1 1 1 - 60.0 seconds - delay time IN

BITS: 10 9 8
0 0 0 - 0.0 seconds - delay time OUT
0 0 1 - 0.4 seconds - delay time OUT
0 1 0 - 1.0 seconds - delay time OUT
0 1 1 - 2.0 seconds - delay time OUT
1 0 0 - 5.0 seconds - delay time OUT
1 0 1 - 15.0 seconds - delay time OUT
1 1 0 - 30.0 seconds - delay time OUT
1 1 1 - 60.0 seconds - delay time OUT

BIT: 11
0 - (ringback option is not required)
1 - RINGBACK

BITS: 12 through 15 - changes to these bits will be ignored.
8.0 INSTALLATION

This section describes installation of a Moore 354N Universal Loop Controller. Topics include: installation considerations and mechanical and electrical installation.

IMPORTANT

The installation must conform to the National Electrical Code and all other applicable construction and electrical codes.

Model 354N major assemblies and mounting variations are shown in Figure 8-1. Each controller will usually be connected to a PC running HMI operator interface software, such as iware PC. An optional Faceplate Display can be directly mounted on the controller or remote mounted on a panelboard. A remote mounting kit is available.

![Model 354N_D... Controller with Direct Mounted Faceplate Display](image1)

![Model 354N_R... Controller with Remote Mounted Faceplate Display](image2)

FIGURE 8-1 Major Assemblies and Mounting Variations

The major assemblies and options that comprise a given Model 354N are indicated by the model number printed on a controller nameplate. A model number breakdown is provided in Table 14.1. Compare the model number on a nameplate to the model number table before beginning an installation to be sure the correct assemblies, options, and electrical approvals are included. Assemblies and options added in the field will not be included in the model number on a factory installed nameplate.

Sections 8.1 through 8.4 provide installation procedures for the various Model 354N physical arrangements. Section 1.4.4 has a list of the items in a typical shipment, including installation kits. Section 8.5 shows the connections to a PC for controller configuration development and to an HMI operator interface for application development and on-line operation. Lastly, Section 8.6 lists the factory calibration values.

Agency approvals and related statements are located in Section 14. Use of the equipment in a manner not specified by the manufacturer may impair the protection provided by the equipment.
8.1 INSTALLATION CONSIDERATIONS

Mount a Moore 354N on a vibration free instrument panel or rack in an indoor or sheltered location.

The controller can be mounted in a user-supplied NEMA 4X enclosure located out-of-doors or in a location whose environmental parameters exceed controller operating specifications. A thin bead of silicon sealant is often applied between a remote mounted Faceplate Display and the mounting panel to prevent air or liquid leakage at this joint.

Do not mount the controller where direct sunlight can strike the faceplate or case. Direct sunlight can make the displays difficult to read and will interfere with heat dissipation.

Route electrical power to the controller through a clearly labeled circuit breaker, fuse, or on-off switch that is located near the controller and is accessible by the operator. The breaker or switch should be located in a non-explosive atmosphere unless suitable for use in an explosive atmosphere.

Thermocouple inputs are accommodated with an I/O Expander board and a Reference Junction temperature sensor. At the factory, two Reference Junctions are included in a Range Resistor and Reference Installation Kit.

I/O options can be expanded by adding a variety of LonWorks modules. Module installation instructions are provided with the modules.

Jumpers on the MPU Controller board are discussed in Sections 11.3 Troubleshooting and 11.6 Assembly Replacement. Refer to this material when installing or storing a controller or an MPU Controller board.

8.2 ENVIRONMENTAL CONSIDERATIONS

Operate a controller within its environmental specifications to help ensure reliable, trouble-free operation with minimum down-time. Refer to Section 14 Model Designation and Specifications for controller operating temperatures limits, operating humidity, and maximum moisture content.

TEMPERATURE

Keep the air surrounding an operating controller below 50°C (122°F). Check air temperature periodically to ensure that this specification is not being exceeded.

CAUTION

Exceeding the specified operating temperature limits can adversely affect performance and may cause damage to the controller.

Forced air ventilation is recommended when controllers are mounted in a partially or completely enclosed panel or cabinet (e.g. NEMA 1); as shown at right. When clean air is present, exhaust fans are often mounted across the top of a panel and louvers formed in the panel bottom. Air is then drawn upward between the station cases. When air contains particulate matter, fans and filters are generally located at the panel bottom and louvers at the top. Filtered air is now forced upward between the station cases. Filters must be serviced periodically.

Use high quality, quiet running fans that do not generate
electrical noise that could interfere with electronic instruments.

A sealed cabinet (e.g. NEMA 12 or 4X) containing equipment that does not generate significant heat should contain a recirculating fan for forcing air flow around equipment and throughout the cabinet preventing hot spots from developing. Forced air conditioning may be required in high heat, high-density panels or consoles. Periodically change or clean air filters.

CONTAMINANTS

The controller case is slotted to permit circulation of clean cooling air. Liquids and corrosive gases must not be allowed to enter the case. Whether the controller is in a control room or field mounted it must be protected from rain, air conditioning condensate, and plant and process related contaminants. Extended exposure to contaminants can result in malfunctions.

Industrial environments often contain airborne particulate contaminants. Particulate matter, usually dust and dirt, is abrasive and can cause intermittent connections. A layer of dust on circuit boards can interfere with component heat dissipation and can absorb other airborne contaminants. Extended exposure to these contaminants may result in malfunctions.

Although controller circuit boards have a protective coating, the following steps can reduce contaminant related equipment malfunctions:

1. Identify contaminants and implement methods to reduce their presence.
2. Install protective housing for field mounted controllers.
3. When cleaning equipment and surrounding area, especially the floor, either vacuum away all dust and dirt or use a dampened rag or mop. Sweeping or dry dusting recirculates dust and dirt.
4. Clean or replace all air conditioning filters, room air filters, and equipment filters regularly.
5. Inform all personnel with access to the equipment of the need for cleanliness.

8.3 MECHANICAL INSTALLATION

The following subsections provide guidelines and procedures for mounting controllers on a panel or rack. See Figure 8-1 for mounting variations. The installation should be structurally rigid and mounting surfaces should be reinforced as necessary to prevent bowing. Each major assembly is discussed and illustrated, with dimension and panel cutout drawings, in a separate subsection.

8.3.1 Controller Mounting, Model 354N...

This model provides for separate mounting of the Controller. Controller Mounting Tray hardware is not supplied since it is installation site dependent. See Figure 8-2 for Controller and Controller Mounting Tray dimensions.

1. Select a flat, easily accessible mounting location. The terminals must be easily reached for wiring, and the DB9 connector for display (HMI) and configuration connections must be accessible. If remote mounting the Faceplate Display, refer to the instruction supplied with the kit and note the maximum display cable length. Be sure it will interconnect display and controller.
2. Note the mounting surface characteristics and the hole pattern and hole size in Figure 8-2. Determine the needed mounting hardware.
3. Secure the Controller Mounting Tray to the surface.
4. Insert the Controller case mounting tabs into slots in the Tray. Hold the Controller in place and secure it to the Tray with the 4 screws and lockwashers supplied in the installation kit.
FIGURE 8-2 Controller and Controller Mounting Tray Dimensions
8.3.2 Faceplate Display Remote Mounting, Model 354N_R

The following procedure may be amended by the instructions supplied with a Remote Display Kit. See Figures 8-3 and 8-4 for assembly and panel cutout dimensions.

1. Locate the supplied Remote Display Kit. It contains a Remote Display (Ribbon) Cable, a Remote Display Flange, two mounting clips and two 8-32 x 1" fillister head screws. Thread the mounting screws into the mounting clips. See Figure 8-5.

2. Carefully prepare the panel cutout.

3. From the panel front, insert the Remote Display Flange into the panel cutout.

4. From the panel back, slightly rotate the top mounting clip to fit it into the Flange cutout. Then straighten the clip and partially tighten the mounting screw. Insert, straighten and partially tighten the bottom clip.

5. Square the Flange with the panel and alternately tighten top and bottom mounting clip screws until the Flange is secured to the panel. Do not over tighten and distort the Flange.

6. Pass the display cable from behind the panel to the front of the panel.

7. Check that the O-ring gasket is in place on the back of the Faceplate Display. Mate the display cable with the connector on the Faceplate Display and close the ejector levers. The connectors are keyed.

8. Place the Faceplate Display against the Flange and tighten the two faceplate screws to 6 in-lbs (0.7 N-m). Do not over tighten and distort or damage the Display.

FIGURE 8-3 Faceplate Display Dimensions
### Panel Cutout Dimensions: Tolerances +0.06/-0 [+1.5/-0]

<table>
<thead>
<tr>
<th>Height</th>
<th>Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.44 [138.2]</td>
<td>(2.84 X A) + (5.67 X B) - 0.16 inches</td>
</tr>
<tr>
<td></td>
<td>[(72.0 X A) + (144 X B) - 4.1] mm</td>
</tr>
</tbody>
</table>

Where:
- **A** = Number of Faceplate Displays and 353 Stations
- **B** = Number of 363 Recorders

### Alternate (DIN Standard) Cutout

For Individually Mounted 363 Recorders Only


Note: Alternate cutout does not allow for possible future substitution of 2 Faceplate Displays or Model 353 stations due to width limitations.

---

### FIGURE 8-4  Faceplate Display Cutout Dimensions

- **Side View**
- **Bottom View**

---

**Insert clip as shown and straighten**

---

### FIGURE 8-5  Flange Mounting Clip, Local Faceplate Display
8.3.3 Faceplate Display Direct Mounting, Model 354N_ _ D

Use the following steps to field install a Faceplate Display on a Controller cover. Refer to Figure 8-2 as needed.

1. Remove the small cover plate from the Controller cover.

2. Gently extract the connector and ribbon cable from inside the cover. If the connector cannot be extracted, go to Section 11.6 to disassemble the Controller; then return to this section, step 3.

3. At the back of the Faceplate Display, open the two ejector levers. Check that the O-ring gasket is in the groove at the back of the Display.

4. Open the Display’s flip-down door.

5. Press the cable-mounted connector into the Display mounted connector. The connectors are keyed. Close the ejector levers when the connectors are fully mated.

6. Hold the Display against the Controller cover and align the two captive screws with the holes in the cover. Be sure the ribbon cable is not pinched.

7. Tighten the screws to 6 in-lbs (0.7 N-m). Do not over tighten and distort or damage the faceplate.
8.4 ELECTRICAL INSTALLATION

This section describes electrical installation of the Model 354N Universal Loop Controller. Electrical installation consists of power, I/O, and communications wiring to be installed by the user. These connections are made to the four terminal blocks on the case. Installation of supplied cables between major assemblies, particularly when remote mounted assemblies are specified, is discussed in Sections 8.4.14 and 8.5.

Section 8.4.1 Wiring Guidelines contains specific information about terminal block removal, wire size, wire stripping and other details that will be needed while wiring. Read this entire section before beginning to wire a controller. Sections 8.4.2 through 8.4.11 contain wiring diagrams and, where needed, step-by-step installation procedures to describe I/O and network wiring. Section 8.4.12 provides power input wiring information. Single controller and daisy chained power wiring are illustrated.

**WARNING**

Electrical shock hazard

Hazardous voltage can cause death or serious injury.

Remove power from all wires and terminals before working on this equipment.

Do not insert an electrically conductive object into a case ventilation slot while the controller is powered.

8.4.1 Wiring Guidelines

**Electrical Connections** - Power, I/O, and Modbus network connections to a basic controller are completed through removable connectors with terminals H, N, and 3-26. When the controller includes an I/O Expander board, connectors with terminals 27-52 are also used. Connector locations are shown in Figure 8-6. Individual terminals functions are stated in Table 8.1.

**Terminal Blocks** - Power terminals are identified by a letter: Hot, Neutral, Ground (case/safety). Signal I/O and communication terminals are identified by a number: 3 through 52. A terminal will accept the following wire(s).

- one 14-22 AWG (2.1-0.38 mm$^2$)
- two 16 AWG (1.3 mm$^2$)
- three 18 AWG (0.96 mm$^2$)

**Wire Size Recommendations:**

- signal wiring - 18 AWG (0.96 mm$^2$)
- power wiring - 18 AWG (0.96 mm$^2$)

**Wire Stripping Recommendations:**

- terminal block wiring - 1/2" (13 mm) to 5/8" (16 mm)

Be careful not to nick the conductor or cut away strands.

**FIGURE 8-6  Terminal Blocks**
**Wire Selection** - Stranded wire is recommended for most connections, however, solid wire is typically used for thermocouple extension wire. Carefully select wire size, conductor material, and insulation. Some selection considerations are:

- current and voltage to be carried
- total length of each wire run
- whether wire will be bundled or run singly
- indoor or outdoor installation
- temperature extremes
- exposure to sunlight
- vibration
- types of contaminates

**Station Common, Terminal 6** - Within the controller, station common is connected to:

- the two-wire power supply common (COM, terminal 6)
- digital output common (DOUTC, terminal 9)
- all analog input and analog output commons (e.g., AIN1C, terminal 21)

Station common is isolated from case/safety ground (terminal G). Connect it to user’s instrument bus common at only one point. Digital input commons are isolated from the station common and case/safety ground.

**Terminal Block Removal and Insertion**

*Removal:*

1. As necessary, disconnect, unclamp, or unbundle the wire harness connected to the terminal block to be removed. Be sure there is sufficient slack in the wiring for terminal block removal.
2. The removable portion of each terminal block is secured with two small captive screws, one at each end of the block. Loosen the captive screws, then grasp the terminal block and pull straight out from the case. See Figure 8-6. Be careful not to over stress or damage connected wires or components.

*Insertion:*

1. Complete all wiring connections to the terminal block.
2. Using a straight blade screwdriver with a 1/8” blade width, turn each unused terminal screw clockwise until it is just tight - do not over tighten.
3. Read the letters/numbers on the terminal block to be inserted, then refer to Figure 8-6 for the block’s proper location. Terminal blocks are keyed.
4. Visually check that all pins in the Controller mounted receptacle are straight. If a pin is only slightly bent, very gentle straightening can be tried. Excessive straightening may cause the pin to break requiring replacement of the attached circuit board.
5. Align the terminal block with the Controller mounted socket and push the block straight in. See Figure 8-6. Tighten the screw at each end of the block.

**Terminal Torque Specifications:**

- terminals - 4.5 in. lbs (0.5 N m)

**Crimp-On (solderless) Connectors** - A pin-style crimp-on connector can be used when two or more wires or a combination of wires and component leads are to be inserted into a rear terminal. Wires and leads are crimped in the connector and the connector pin inserted in the selected terminal. The connector can provide a more secure connection when multiple leads are involved. An example of its use is shown at right. Several crimp-on connectors are provided in installation kits, and they are available from electrical supply sources.

**Wire Routing and Conduit** - DC wiring should be separated from AC wiring and away from AC powered pushbuttons, alarms, annunciators, motors, solenoids, and similar devices. Conduit and raceways are commonly used for routing panel wiring. Wiring not installed in conduit or raceway should be clamped or supported approximately every 12 inches (300 mm).

May 2001
### FIGURE 8-7 Controller Terminal Layout and Terminal Assignments

<table>
<thead>
<tr>
<th>Terminal Name</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power- AC Hot (ACH)</td>
<td>H</td>
</tr>
<tr>
<td>Power- AC Neutral (ACN)</td>
<td>N</td>
</tr>
<tr>
<td>Case/Safety Ground (GND)</td>
<td>G</td>
</tr>
<tr>
<td>Network Communication A (NCA)</td>
<td>3</td>
</tr>
<tr>
<td>Network Communication B (NCB)</td>
<td>4</td>
</tr>
<tr>
<td>Transmitter Power 26 Vdc+ (XMTR+)</td>
<td>5</td>
</tr>
<tr>
<td>Transmitter/Station Common (COM)</td>
<td>6</td>
</tr>
<tr>
<td>Transmitter Power 26 Vdc+ (XMTR+)</td>
<td>7</td>
</tr>
<tr>
<td>Digital Output 1+ (DOUT1+)</td>
<td>8</td>
</tr>
<tr>
<td>Digital Outputs 1/2 Common (DOUTC)</td>
<td>9</td>
</tr>
<tr>
<td>Digital Output 2+ (DOUT2+)</td>
<td>10</td>
</tr>
<tr>
<td>Digital Input 1+ (DIN1+)</td>
<td>11</td>
</tr>
<tr>
<td>Digital Input 1- (DIN1-)</td>
<td>12</td>
</tr>
<tr>
<td>Digital Input 2+ (DIN2+)</td>
<td>13</td>
</tr>
<tr>
<td>Digital Input 2- (DIN2-)</td>
<td>14</td>
</tr>
<tr>
<td>Digital Input 3+ (DIN3+)</td>
<td>15</td>
</tr>
<tr>
<td>Digital Input 3- (DIN3-)</td>
<td>16</td>
</tr>
<tr>
<td>Analog Output 1+ (AOUT1+)</td>
<td>17</td>
</tr>
<tr>
<td>Analog Output 1/2 Common (AOUTC)</td>
<td>18</td>
</tr>
<tr>
<td>Analog Output 2+ (AOUT2+)</td>
<td>19</td>
</tr>
<tr>
<td>Analog Input 1+ (AIN1+)</td>
<td>20</td>
</tr>
<tr>
<td>Analog Input 1/2 Common (AINC)</td>
<td>21</td>
</tr>
<tr>
<td>Analog Input 2+ (AIN2+)</td>
<td>22</td>
</tr>
<tr>
<td>Analog Input 3+ (AIN3+)</td>
<td>23</td>
</tr>
<tr>
<td>Analog Input 3 Common (AINC)</td>
<td>24</td>
</tr>
<tr>
<td>Digital Bus A (IOA)</td>
<td>25</td>
</tr>
<tr>
<td>Digital Bus B (IOB)</td>
<td>26</td>
</tr>
<tr>
<td>Relay Output 1 Normally Closed</td>
<td>ROUT1nc</td>
</tr>
<tr>
<td>Relay Output 1 Common</td>
<td>ROUT1c</td>
</tr>
<tr>
<td>Relay Output 1 Normally Open</td>
<td>ROUT1no</td>
</tr>
<tr>
<td>Relay Output 2 Normally Closed</td>
<td>ROUT2nc</td>
</tr>
<tr>
<td>Relay Output 2 Common</td>
<td>ROUT2c</td>
</tr>
<tr>
<td>Relay Output 2 Normally Open</td>
<td>ROUT2no</td>
</tr>
<tr>
<td>Analog Output 3+</td>
<td>AOUT3+</td>
</tr>
<tr>
<td>Analog Output 3 Common</td>
<td>AOUTC</td>
</tr>
<tr>
<td>Digital Input Universal 1+</td>
<td>DINU1+</td>
</tr>
<tr>
<td>Digital Input Universal 1-</td>
<td>DINU1-</td>
</tr>
<tr>
<td>Digital Input Universal 2+</td>
<td>DINU2+</td>
</tr>
<tr>
<td>Digital Input Universal 2-</td>
<td>DINU2-</td>
</tr>
<tr>
<td>Transmitter Power 26 Vdc+</td>
<td>XMTR+</td>
</tr>
<tr>
<td>Transmitter/Station Common</td>
<td>COM</td>
</tr>
<tr>
<td>Digital Input Universal 4+</td>
<td>DIN4+</td>
</tr>
<tr>
<td>Digital Input Universal 4-</td>
<td>DIN4-</td>
</tr>
<tr>
<td>Analog Input Universal 1a</td>
<td>AINU1a</td>
</tr>
<tr>
<td>Analog Input Universal 1b</td>
<td>AINU1b</td>
</tr>
<tr>
<td>Analog Input Universal 1c</td>
<td>AINU1c</td>
</tr>
<tr>
<td>Analog Input Universal 1d</td>
<td>AINU1d</td>
</tr>
<tr>
<td>Analog Input Universal 2a</td>
<td>AINU2a</td>
</tr>
<tr>
<td>Analog Input Universal 2b</td>
<td>AINU2b</td>
</tr>
<tr>
<td>Analog Input Universal 2c</td>
<td>AINU2c</td>
</tr>
<tr>
<td>Analog Input Universal 2d</td>
<td>AINU2d</td>
</tr>
</tbody>
</table>

### Notes:

1. Each terminal is identified by a letter or number printed on the terminal block. Case/safety ground indicated by G or a ground symbol. Either 2 or 4 terminal blocks are installed depending upon I/O Expander board option:
   - Model 354N_ _N, 2 blocks; Model 354N_ _1, 4 blocks.
2. Terminal G or ground symbol, Case/Safety Ground - Connect to earth ground.
3. NCA and NCB - Connect Modbus or LIL Twinaxial Cable or twisted pair wiring. Refer to Section 8.4.9 or 8.4.11 for additional information.
4. IOA and IOB - LonWorks bus connections. Twisted pair wiring is typical.
5. Ground Bus - An external, user-supplied ground bus can ease connection of multiple grounds, particularly when twinaxial cable shields are to be grounded.
6. NC terminal - Do not connect to this terminal.
## TABLE 8.1 Controller Terminal Assignments

<table>
<thead>
<tr>
<th>Description</th>
<th>ID</th>
<th>#</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power - AC Hot</td>
<td>ACH/DC+</td>
<td>H  27</td>
<td>ROUT1nc Relay Output 1 Normally Closed</td>
</tr>
<tr>
<td>Power - AC Neutral</td>
<td>ACN/DC-</td>
<td>N  28</td>
<td>ROUT1c Relay Output 1 Common</td>
</tr>
<tr>
<td>Case/Safety Ground</td>
<td>GND</td>
<td>G  29</td>
<td>ROUT1no Relay Output 1 Normally Open</td>
</tr>
<tr>
<td>Network Communication A</td>
<td>NCA</td>
<td>3  30</td>
<td>ROUT2nc Relay Output 2 Normally Closed</td>
</tr>
<tr>
<td>Network Communication B</td>
<td>NC</td>
<td>4  31</td>
<td>ROUT2c Relay Output 2 Common</td>
</tr>
<tr>
<td>Transmitter Power 26Vdc +</td>
<td>XMTR+</td>
<td>5  32</td>
<td>ROUT2no Relay Output 2 Normally Open</td>
</tr>
<tr>
<td>Transmitter/Station Common</td>
<td>COM</td>
<td>6  33</td>
<td>AOUT3+ Analog Output 3 +</td>
</tr>
<tr>
<td>Transmitter Power 26Vdc +</td>
<td>XMTR+</td>
<td>7  34</td>
<td>AOUTC Analog Output 3 Common</td>
</tr>
<tr>
<td>Digital Output 1 +</td>
<td>DOUT1+</td>
<td>8  35</td>
<td>DINU1+ Digital Input Universal 1 +</td>
</tr>
<tr>
<td>Digital Outputs 1/2 Common</td>
<td>DOUTC</td>
<td>9  36</td>
<td>DINU1- Digital Input Universal 1 -</td>
</tr>
<tr>
<td>Digital Output 2 +</td>
<td>DOUT2+</td>
<td>10</td>
<td>37 DINU2+ Digital Input Universal 2 +</td>
</tr>
<tr>
<td>Digital Input 1 -</td>
<td>DIN1-</td>
<td>11</td>
<td>38 DINU2- Digital Input Universal 2 -</td>
</tr>
<tr>
<td>Digital Input 3 +</td>
<td>DIN3+</td>
<td>15</td>
<td>42 DIN4+ Digital Input 4 +</td>
</tr>
<tr>
<td>Digital Input 3 -</td>
<td>DIN3-</td>
<td>16</td>
<td>43 DIN4- Digital Input 4 -</td>
</tr>
<tr>
<td>Analog Output 1 +</td>
<td>AOUT1+</td>
<td>17</td>
<td>44 DIN4- Digital Input 4 -</td>
</tr>
<tr>
<td>Analog Output 1/2 Common</td>
<td>AOUTC</td>
<td>18</td>
<td>... No Connection (Note 5)</td>
</tr>
<tr>
<td>Analog Output 2 +</td>
<td>AOUT2+</td>
<td>19</td>
<td>45 AINU1a Analog Input Universal 1 a</td>
</tr>
<tr>
<td>Analog Input 1 +</td>
<td>AIN1+</td>
<td>20</td>
<td>46 AINU1b Analog Input Universal 1 b</td>
</tr>
<tr>
<td>Analog Input 1/2 Common</td>
<td>AINC</td>
<td>21</td>
<td>47 AINU1c Analog Input Universal 1 c</td>
</tr>
<tr>
<td>Analog Input 2 +</td>
<td>AIN2+</td>
<td>22</td>
<td>48 AINU1d Analog Input Universal 1 d</td>
</tr>
<tr>
<td>Analog Input 3 +</td>
<td>AIN3+</td>
<td>23</td>
<td>49 AINU2a Analog Input Universal 2 a</td>
</tr>
<tr>
<td>Analog Input 3 Common</td>
<td>AINC</td>
<td>24</td>
<td>50 AINU2b Analog Input Universal 2 b</td>
</tr>
<tr>
<td>I/O Bus A</td>
<td>IOA</td>
<td>25</td>
<td>51 AINU2c Analog Input Universal 2 c</td>
</tr>
<tr>
<td>I/O Bus B</td>
<td>IOB</td>
<td>26</td>
<td>52 AINU2d Analog Input Universal 2 d</td>
</tr>
</tbody>
</table>

### Notes:
1. # - Each terminal is identified by a letter or number printed on the terminal block. Case/Safety Ground terminal identified by G or a ground symbol. Either 2 or 4 terminal blocks are installed depending upon I/O Expander board option: Model 354N_ _N, 2 blocks; Model 354N_ _1, 4 blocks.
2. Terminal G or ground symbol, Case/Safety Ground - Connect to earth ground.
3. NCA and NCB - Connect Modbus or LIL Twinaxial Cable or twisted pair wiring. Refer to Section 8.4.9 or 8.4.11 for additional information.
4. IOA and IOB - LonWorks bus connections. Twisted pair wiring is typical.
5. Ground Bus - An external, user-supplied ground bus can ease connection of multiple grounds, particularly when twinaxial cable shields are to be grounded.
6. NC terminal - Do not connect to this terminal.
8.4.2 Analog Signal Input Wiring (4-20 mA, 1-5 Vdc, and mV)

Analog signal input terminals are connected to software function blocks AIN and AINU within the controller. Table 8.1 correlates function blocks and input terminals. These terminals will accept several input signal types with the appropriate wiring and components. A current input signal to an AIN or AINU function block must be converted to 1-5 Vdc by a range resistor.

<table>
<thead>
<tr>
<th>INPUT TYPE</th>
<th>FUNCTION BLOCKS</th>
<th>RANGE RESISTOR</th>
<th>FIGURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-20 mA</td>
<td>AIN1-4</td>
<td>250Ω</td>
<td>8-8 and 8-9</td>
</tr>
<tr>
<td></td>
<td>AINU1 and 2</td>
<td>3.75Ω</td>
<td>8-10A</td>
</tr>
<tr>
<td>1-5 Vdc</td>
<td>AIN1-4</td>
<td>Not Required</td>
<td>8-8 and 8-9</td>
</tr>
<tr>
<td>Millivolt</td>
<td>AINU1 and 2</td>
<td>Not Required</td>
<td>8-10B</td>
</tr>
</tbody>
</table>

Notes:
(1) Function blocks AIN4, AINU1, and AINU2 are available only when an I/O Expander Board is installed.
(2) Range resistors listed are supplied in Installation Kits. For other current values, select a range resistor that will provide a 1-5 Vdc input. For example, for 10-50 mA, install a 100Ω range resistor.

Crimp-on connectors are provided for use when a range resistor and a signal input wire are to be inserted in the same connector terminal. A connector should also be used when two wires of significantly different gauges would otherwise be inserted in a single connector terminal.

Perform the following steps for each analog input.

1. Select an analog input terminal pair for connection of the input signal wiring. Refer to Table 8.1 and the following illustrations as necessary.

For a 4-20 mA input, go to step 2. For a 1-5 Vdc or millivolt input, go to step 4.
A. 4-20 mA Input

2. 4-20 mA Input Only - Select a 250Ω (for AIN#) or 3.75Ω (for AINU#) resistor from the installation kit and insulate the bent resistor lead with a piece of sleeving. At the lead end, approximately 1/4" (6 mm) to 5/16" (8 mm) of bare resistor lead should be exposed.

If a crimp-on connector is to be used, go to step 3. Otherwise, go to step 4.
3. Crimp-On Connector - Insert the resistor lead and any signal wiring into the connector until the wire ends are visible at the pin end of the connector. Use a standard electrical connector crimp tool to crimp the connection. Be certain that all resistor leads and signal input wires are inserted in the connector before crimping.

4. Loosen the two terminal screws using a straight blade screwdriver with a 1/8" (3 mm) blade width. Insert wires, resistor leads, or a crimp-on connector pin into the two openings in the side of the connector adjacent to the selected terminal numbers.

5. Check that all involved components and station wiring are fully inserted and carefully tighten the screws to 5 in. lbs. Do not over tighten.

6. Repeat steps 1-5 for each 4-20 mA, 1-5 Vdc and millivolt input.

7. Carefully dress resistors and wiring so that excessive stress is not placed on a component, wire, or connection.

8. Analog Output Wiring (4-20 mA, 1-5 Vdc)

Analog output functions blocks are AOUT1, AOUT2, and AOUT3. Figure 8-11 shows connections for an external device that accepts 4-20 mA. For an external device that needs 1-5 Vdc, see Figure 8-12. Refer to Section 8.4.2 for wiring guidelines.

![FIGURE 8-11 Analog Output AOUT 1, Current Output](image)

![FIGURE 8-12 Analog Output AOUT 1, Voltage Output](image)
8.4.4 Digital Input and Output Wiring

Connections to Digital Input and Digital Input Universal function blocks are shown in Figure 8-13. Wiring for internal and external power sources is shown. Semiconductor devices can replace the mechanical switches shown. Wiring guidelines are found in Section 8.4.2.

Digital input commons, e.g. DIN1 (-), are isolated from station common and from case/safety ground.

Digital output wiring is shown in Figure 8-14. Three diagrams are provided showing current and voltage outputs. Note the use of transient suppression diodes in Figure 8-14C. Always install a transient suppression component across a reactive component, such as a relay coil, to protect the semiconductor devices in the controller.

Digital output common, DOUTC, is connected to station common.

A. DIN1 and 2
B. DINU1 and 2

FIGURE 8-13 Digital Inputs DIN and DINU
A. Current Output, Isolated

B. Voltage Output, Non-Isolated

Notes:
1. Inductive load must be shunted with a transient suppression diode (1N4005 or equiv.) to prevent damage to station output circuit.
2. See Table 8.1 for DOUT2 terminal numbers.

Figure 8-14 Digital Output DOUT1, Resistive and Inductive Loads
8.4.5 Thermocouple Input Wiring

Function blocks AINU1 and AINU2 can be configured for thermocouple or RTD input.

Thermocouple input wiring is shown in Figures 8-15 and 8-16. Shown is a typical grounded tip thermocouple. If an ungrounded thermocouple is used, the thermocouple wire shield can be grounded at the controller. Thermocouple wire often has a solid conductor. Make connections as outlined in Section 8.4.2. Be sure that the solid conductor is satisfactorily clamped by the terminal screw and pressure plate. Two reference junctions (RJ) are supplied in the I/O Expander board installation kit. Install as outlined below.

**FIGURE 8-15 Universal Analog Input AINU1, Thermocouple Input**

Thermocouple reference junction (RJ) installation:

1. Slip a length of insulating sleeving over the portion of each reference junction lead that will remain exposed after installation. Carefully form the leads as shown.

2. Loosen the two terminal screws using a straight blade screwdriver with a 1/8” (3 mm) blade width. Insert the reference junction leads into the two openings in the connector adjacent to the selected terminal numbers. See Figure 6-16.

3. Check that all involved components and station wiring are fully inserted. Carefully tighten the terminal screws to 5 in. lbs (0.6 N-m).

4. Press the reference junction against the connector.

5. Repeat the above steps if the second thermocouple input is needed.
8.4.6 RTD Input Wiring

Wiring for 2-, 3-, and 4-wire RTDs is shown in Figure 8-17. Make connections as outlined in Section 8.4.2. Note the wire jumper between terminals 47 and 48 when a 2-wire RTD is installed.

FIGURE 8-17 Universal Analog Input AINU1; 2, 3, and 4-Wire RTD Inputs
8.4.7 Ohms and Slidewire Input Wiring

Function blocks AINU1 and AINU2 can be configured for ohm or slidewire inputs. Figures 8-18 and 8-19 show the needed connections.

![Diagram of Ohms and Slidewire Input Wiring](image)

**FIGURE 8-18 Universal Analog Input AINU1, Ohms Input**

**FIGURE 8-19 Universal Analog Input AINU1, Slidewire Input**

8.4.8 Relay Output Wiring

Function blocks ROUT1 and ROUT2 are located on the I/O Expander board. They provide two single-pole, double-throw relay outputs, as shown in Figure 8-20. Relay contact ratings are stated in Section 14.6.

The load connected to a closed contact should draw a current between the minimum and maximum contact ratings. A resistive load is recommended. An inductive or capacitive load can cause high peak currents or contact arcing which can pit or otherwise damage contacts. The arcing associated with an inductive load can be limited by connecting a voltage transient suppressor, such as a 1N4005 diode, across the load.

![Diagram of Relay Output Wiring](image)

**FIGURE 8-20 Universal Relay Outputs ROUT1 and 2, Resistive Load**

8.4.9 Local Instrument Link Wiring

The Local Instrument Link (LIL) is a high performance digital data link that carries commands and responses between user-selected stations. Each station must be identified by a unique link address. This address permits commands and responses to be sent from one station to another specific station. Lower link addresses are 1 through 32. A Model 321 Expansion Satellite is used to add an upper link with addresses 33 through 64. In the controller, the Station address is entered as the ADDRESS parameter in the STATN function block. Specific instructions for setting a link address in other models are available in the Installation And Service Instructions for that particular model. Refer to SD15492 for complete installation, wiring, and service instructions for the Local Instrument Link.
Figure 8-21 shows typical wiring for stations connected to the LIL. Link cabling and wiring involves twinaxial cable and twisted pair wiring. Twinaxial cable is a twisted pair, shielded cable that is used for runs of 2 feet (0.6m) or more. Unshielded twisted pair wiring is used mainly for interconnecting row mounted stations. Twisted pair wiring can also be used for runs up to 2 feet in length, for example, between rows of stations.

Two types of twinaxial cables are recommended: Belden 9182 for links up to 1500 feet (457 meters) and Belden 9860 for links up to 4000 feet (1220 meters). Either type of cable may be used on a single link. To prevent noise interference, electrically distribute stations as follows:
- no more than 8 stations may be connected within any 10 foot (3m) section of lower or upper link
- no more than 16 stations may be connected within any 100 foot (30m) section of lower or upper link
- insert 100 feet of coiled twinaxial cable between clusters of up to 8 stations

Tap boxes can be installed to serve as a connector interface between Link twinaxial cables and twisted pair wiring connected to screw terminals. Tap boxes provide over-voltage/lightening protection by including eight transient voltage suppressors and one 130V surge arrestor. Link termination is also provided by two 150Ω resistors.

Notes:
1. Drain wire of shield connects to terminal SG. A short jumper of 16 AWG insulated wire grounds shield to station earth ground.
2. Drain wire of shield is cut back and insulated.
3. Twisted pair wiring is used to interconnect stations separated by up to 2 ft (0.6 meters). Twinaxial cable is used for distances greater than 2 ft (0.6 meters). The maximum twisted pair length is 10 ft (3 meters).
4. When there is no tap box at the end of a link, connect a 150 ohm ±5%, resistor across the link conductors at the last station.
5. See Local Instrument Link Installation And Service Instruction SD15492 for details.

FIGURE 8-21 LIL Network Wiring
8.4.10 LonWorks Wiring

Figure 8-22 shows typical LonWorks network wiring to the controller. The network termination resistor is supplied in the installation kit. Connections to remote devices are described in each device User’s Manual, supplied with the devices. See Section 8.4.2 for wiring guidelines.

![LonWorks Network Wiring Diagram]

**FIGURE 8-22 LonWorks Network Wiring**

8.4.11 Modbus Wiring

This section describes the wiring needed to connect a host device to a controller’s Modbus network interface. When connected, the host can read data from and write data to a controller in a command/response format.

Most host devices communicate using RS232 while the Modbus network interface is RS485. As shown in Figure 8-23, a 2-wire RS485 to RS232 converter is installed to perform the protocol conversion and adapt the connection hardware. A shielded RS232 cable with either DB9 or DB25 connectors is installed between the host device and the converter. An RS485 shielded, twisted-pair cable connects the converter to a Moore 354N. Up to 32 Procidia i|pac and Moore 352P, 353, and 354N controllers can be connected since RS485 is a multi-drop network.

Shown below are the jumper locations and identifiers for the Entrelec® Isolated Converter shown in Figure 8-23.

![Converter Diagram]

Enterelec ILPH 084.233.11 Isolated Converter
Notes:

1. RS232 cable must be shielded and less than 50 feet (15 meters) in length. Recommended cable is Belden 9927, 24 AWG, or equivalent. For an assembled cable, order Siemens PN 16137-191.
2. RS485 recommended cable is Belden 9842, 24 AWG, 120 ohm or equivalent.
3. Up to 32 Moore 352Ps, Moore 353s, Moore 354s, and i|pac's can be connected.
4. A user-supplied 120 ohm network termination resistor should be installed on the last device on the network.
5. In ACM's SERIAL Function Block, set Flow Control to 1.
6. Assembled cable above has DB9 (plug) connector. Connection to computer serial port may require a DB9 (socket/receptacle) gender adapter.
7. Connection between F and J provided by Entrelec converter.

FIGURE 8-23 Modbus Communications, Moore 353 and 354/354N to APACS ACM and Personal Computer
8.4.12 Wiring to a Model 363 VIEWPAC Recorder

Figure 8-24 shows the wiring needed to connect a Model 363 analog input to a controller analog input. As shown, a 1-5 Vdc transmitter input to the controller is also routed to the recorder’s Analog Input 1.

**Figure 8-24 Moore 354/354N To Model 363 VIEWPAC Analog Input Wiring**

8.4.13 Power Wiring

Basic connections for AC and DC power input are shown in Figure 8-25. Wiring guidelines are given in Section 8.4.2.

**Figure 8-25 Controller Power Wiring**

Power input to the controller should be routed through a clearly labeled circuit breaker, fuse or on-off switch that is located near the controller and is accessible by the operator. The protective device should be located in a non-explosive atmosphere unless suitable for use in an explosive atmosphere. It will permit removal of controller power without affecting the on-line status of adjacent controllers.

Where separate wiring is not required, power input wiring can daisy chain together a series of controllers. Here, each controller, except for the last controller on the daisy chain, will have two wires (18 AWG recommended) inserted in terminal H and in terminal N. If a larger gauge is to be used, the two wires can be inserted in a crimp-
on connector and the connector inserted in the terminal, for a more secure installation. Daisy chained wiring is shown in Figure 8-26. Perform the following steps at H, N, and G terminals at each involved controller.

To fabricate the power cable:

1. Terminal Block Connections: Remove 1/2" (13 mm) to 5/8" (16 mm) from each Hot, Neutral, and Ground wire to be inserted in a terminal.

   Crimp-On Connector Connections: Remove 1/4" (6 mm) to 5/16" (8 mm) from each Hot, Neutral, and Ground wire to be inserted in a crimp-on connector.

2. Crimp-On Connector only - Insert the wires into the crimp-on connector until the wires are visible at the pin end of the connector. Use a standard electrical connector crimp tool to crimp the connection. Be certain that both power input wires are fully inserted in the connector before crimping.

3. Loosen the terminal screw using a straight blade screwdriver with a 1/8" (3 mm) blade width.

4. Insert the striped wire or crimp-on connector pin into the terminal and tighten the screw to 4.5 in. lbs (0.5 N-m).

**8.4.14 Display Cable Connections**

Figure 8-27 shows the display cabling needed to connect the Controller to an PC-based HMI and to a Faceplate Display. Refer to the Figure for maximum cable length and connections. All connectors are keyed.

**Local HMI Operator Interface, Model 354N**

A local operator interface should be connected to the controller with a serial communication cable. The connection on the 354N side is a DB9/M and requires a null modem cable (P/N 15720-353, length is 10-feet (3 meters). The communication is RS232 and the maximum length is 50 feet (per RS232). A shorter length cable is recommended in electrically noisy environments. See Figure 8-27A.

**Direct Mount Faceplate Display, Model 354N_D**

The Display will be factory installed on the Controller and the display cable connected when the direct mount option is specified on the order. See Figure 8-27B. If the Display is being installed in the field, refer to Section 8.3 Mechanical Installation.

**Remote Mount Faceplate Display, Model 354N_R**

The ribbon cable and needed hardware are contained in a Remote Display Kit. To install the kit, refer to the Instruction supplied with the kit and the following.

1. Remove the small cover plate from the Controller cover.

2. Gently extract the connector and ribbon cable from inside the cover. If the connector cannot be extracted, go to Section 11.6 to disassemble the Controller; then return to this section, step 3.

3. Locate the chassis mount connector on the remote cable assembly and fasten it to the Controller cover using the supplied hardware. Orient the cable assembly as shown in Figure 8-27C.

4. Open the two ejector levers and press the cable-mounted connector exiting the Controller cover into the cover-mounted connector. Close the ejector levers when the connectors are fully mated.
5. Mount the Faceplate Display as described in the Instruction supplied with the kit or as indicated in Section 8.3 Mechanical Installation.

6. Route the ribbon cable to the Faceplate Display.

7. At the back of the Display, open the two ejector levers and press the cable-mounted connector into the Display mounted connector. Close the ejector levers when the connectors are fully mated. The connectors are keyed.

FIGURE 8-27 Controller to Workstation and Faceplate Display Cabling
8.5 CONFIGURATION AND APPLICATION DEVELOPMENT CABLE CONNECTIONS

Figure 8-28 shows the cabling needed to connect a personal computer running the Graphical Configuration Utility to a Controller’s Modbus display serial port for controller configuration. Note that the MMJ11 port on the underside of a Faceplate Display bezel is disabled.

![Diagram of cabling connections]

Connect to COM1 or COM2 using MJ11 to 9-pin or 25-pin adapter.

Communications Cable, MJ11 to MJ11 with Adapters

For Controller configuration, connect to Controller 9-pin/M. Use MJ11 to 9-pin/F adapter.

Personal Computer running Configuration Utility Software

Note:
1. See Accessories in Section 14 for communications cable and adapter part numbers.

FIGURE 8-28 Cabling for Configuration and Application Development

8.6 FACTORY CALIBRATION

Unless a special calibration is ordered, the factory calibration is as follows:

**TABLE 8.2 Factory Calibration**

<table>
<thead>
<tr>
<th>ANALOG INPUT OR OUTPUT</th>
<th>FACTORY CALIBRATION, UP TO V1.21</th>
<th>FACTORY CALIBRATION, V1.30 AND ABOVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog input function blocks</td>
<td>1 to 5 Vdc</td>
<td>1 to 5 Vdc</td>
</tr>
<tr>
<td>Analog output function blocks</td>
<td>4 to 20 mA</td>
<td>4 to 20 mA</td>
</tr>
<tr>
<td>Thermocouple</td>
<td>Type J, Upscale Break</td>
<td>Type J, Upscale Break</td>
</tr>
<tr>
<td>RTD</td>
<td>CAL ZERO - 0°C</td>
<td>CAL ZERO - 0°C</td>
</tr>
<tr>
<td></td>
<td>CAL FULL - 500°C</td>
<td>CAL FULL - 500°C</td>
</tr>
<tr>
<td></td>
<td>CAL VIEW - -3.3 to 103.3%</td>
<td>CAL VIEW - -3.3 to 103.3%</td>
</tr>
<tr>
<td>Slidewire</td>
<td>CAL ZERO - 0%</td>
<td>CAL ZERO - 0%</td>
</tr>
<tr>
<td></td>
<td>CAL FULL - 100%</td>
<td>CAL FULL - 100%</td>
</tr>
<tr>
<td></td>
<td>CAL VIEW - Contact factory</td>
<td>CAL VIEW - Contact factory</td>
</tr>
<tr>
<td>Ohms</td>
<td>CAL ZERO - 0 ohms</td>
<td>CAL ZERO - 0 ohms</td>
</tr>
<tr>
<td></td>
<td>CAL FULL - 5000 ohms</td>
<td>CAL FULL - 5000 ohms</td>
</tr>
<tr>
<td></td>
<td>CAL VIEW - Contact factory</td>
<td>CAL VIEW - Contact factory</td>
</tr>
<tr>
<td>Millivolt</td>
<td>CAL ZERO - 0.0 mV</td>
<td>CAL ZERO - -19.0 mV</td>
</tr>
<tr>
<td></td>
<td>CAL FULL - 10 mV</td>
<td>CAL FULL - +19.0 mV</td>
</tr>
<tr>
<td></td>
<td>CAL VIEW - 0% TO 100%</td>
<td>CAL VIEW - 0% TO 100%</td>
</tr>
</tbody>
</table>

Section 12.0 provides calibration procedures that may be used to check or change factory calibration.
9.0 LOCAL FACEPLATE OPERATION

Controller operation is described in this section. Each faceplate display, pushbutton, and knob will be discussed first in normal operation mode and then in configuration mode. This section contains many references to function blocks. As necessary, refer to Section 3 for details about a function block.

Most operator controls are shown on the faceplate below. Several additional pushbuttons are located behind the flip-down door at the bottom of the faceplate. These will be discussed in the configuration mode portion of this section.

9.1 NORMAL OPERATION MODE

- **6-Digit Numeric Display** - displays the numeric value of the variable identified by the 8-character alphanumeric display. Numbers can be displayed from 0.00000 to 999999 or -0.0000 to -99999. Any input exceeding these limits will be shown as the maximum or minimum displayable value and cause the display to flash.

- **8-Character Alphanumeric Display** - normally displays the loop tag with the dot suffix of the variable currently showing in the 6-digit numeric display (e.g. TC2053.P is the Process variable for loop TC2053). A loop tag that is displayed is called the Active Loop and all operator controls (e.g. PB1, PB2, A/M, ACK, D, UNITS, ALARM, TUNE, TAG, QUICK) will affect the function blocks within the Active Loop.

- **PB1 Pushbutton** - controls the operation of the PB1SW (PB 1 transfer Switch) function block when the block has been configured for use within the Active Loop. See the function block details in Section 3 for more information on PB1SW.

- **PB2 Pushbutton** - controls the operation of the PB2SW (PB 2 transfer Switch) function block when the block has been configured for use within the Active Loop. See the function block details for more information on PB2SW.

- **A/M Pushbutton** - controls the operation of an A/M (Auto/Manual) function block when the block has been configured for use within the Active Loop. See the function block details for more information on A/M. When the A/M is switched to Auto the numeric display will show the Setpoint value, as indicated by .S in the alphanumeric display, and when switched to Manual, the Valve value and .V will be shown.

- **LOOP Pushbutton** - One or more loops can be configured. When more than one loop has been configured, the LOOP button will advance the operator display to the next Active Loop. All operator controls now affect the Active Loop that is currently shown in the alphanumeric display (e.g. FC2367). When a loop is first displayed, the loop tag will appear in the alphanumeric and the displayed variable will be the same as when the loop was last viewed.

- **ACK Pushbutton** - this button is used together with the L and S status LEDs to manage events (e.g. alarm, status, and error conditions) within the controller. Events have user assigned priorities 1-5 (with 1 the highest) and will be organized within the controller, first by priority and then by order of occurrence.

- **S Status LED** - Indicates that event is active in the Station. A flashing LED indicates that the event needs to be acknowledged.

- **L Status LED** - Indicates that event is active in the displayed Loop. A flashing LED indicates that the event needs to be acknowledged.
Priority:

- Priority 1 causes the station bargraphs and event LEDs to flash and requires acknowledgment to stop flashing. This is the highest priority.
- Priority 2 also flashes the bargraphs but stops flashing when the event clears (i.e. Self Clearing).
- Priority 3 causes the event LEDs L & S to flash and stops only when the event is acknowledged.
- Priority 4 also causes the event LEDs to flash but stops when the event clears.
- Priority 5 displays the event but does not require that it be acknowledged. This is the lowest priority.

If the event is in the active loop, the alphanumeric display will alternate between the loop tag and the unacknowledged condition (e.g. ‘TC2053.P’ $$\leftrightarrow$$ ‘A3 HI’). Press the ACK button to acknowledge this condition and stop the flashing.

The ACK button, after all events have been acknowledged, can then be used to scroll through any active alarm or status conditions within the Active Loop. Pressing the ACK button will scroll through the list of active events and wrap around to the start of the list when more than one event is active. This function will time out if the ACK button is not pressed for 3 seconds and return to the normal display mode.

If an unacknowledged event is not within the active loop, press the LOOP button to page through the loops.

- **D** Pushbutton - changes the variable currently displayed. Pressing this pushbutton steps the display one position in the sequence P, S, V, X and Y from any starting point within the display select group.
- **UNITS** Pushbutton - displays the units of the variable shown in the alphanumeric display. When the button is pressed the units that apply to the displayed variable will appear in the alphanumeric (e.g. ‘TC2053.P’ ‘deg F’, ‘nds, the alphanumeric display will return to the variable tag.
- **S** Bargraph - this vertical bargraph displays the scaled range of the controller setpoint in the Active Loop. Bargraph height shows the setpoint as the % of range value. The setpoint in engineering units can be viewed by pressing the **D** button to display the dot S parameter (e.g. TC2053.S).
- **P** Bargraph - this vertical bargraph displays the scaled range of the controller process in the Active Loop. Bargraph height shows the process as the % of range value. The process in engineering units can be viewed by pressing the **D** button to display the dot P parameter (e.g. TC2053.P).
- **Pulser Knob** - rotate the Pulser to change the value in the numeric display (e.g. Setpoint, Valve, or other variable configured for normal operator display changes such as Ratio, Bias). The Pulser knob is also used in configuration to change values in the alphanumeric display.

An accelerator is included. Turning the knob faster multiplies the rate of change of the displayed parameter. Large value changes then require fewer knob rotations.

- **V** Bargraph - this horizontal bargraph displays the scaled range of the controller output in the Active Loop. The output/valve signal is shown as the % of range value. The value in engineering units can be viewed by pressing the **D** button to display the dot V parameter (e.g. TC2053.V).
9.2 CONFIGURATION MODE

Configuration pushbuttons are located behind the flip-down door on the lower quarter of the faceplate. Note that many of these buttons are used in both the normal operation mode and configuration mode, as described below.

- **ENTER/EXIT CONF** - press to enter configuration when the station is in the normal operation mode or to exit configuration when in the configuration mode.

- **ALARM/STEP DOWN** - has a dual purpose. When in the normal operation mode, pressing the button will scroll through the alarm configuration parameters if the ALARM function block has been configured in the *Active Loop*. The alarm setting is displayed in engineering units and the % of range value will also be displayed on the setpoint bargraph by flashing a single segment equal to the % of range value. If security clearance is satisfied, the parameters can also be changed. See the ALARM function block description for details on the parameters. Press the ENTER/EXIT CONFIG button to return to the on-line displays.

When in the configuration mode, this button will step down to the next configuration level. See the Configuration Overview section of this manual for details on typical levels of the configuration mode.

- **TUNE/STEP UP** - has a dual purpose. When in the normal operation mode, pressing the button will scroll through the controller tuning parameters and allow activating the AUTOTUNE algorithm, if configured for the loop controller. If security clearance is satisfied, the parameters can also be changed. Press the ENTER/EXIT CONFIG button to return to the on-line displays.

When in the configuration mode, this button will step up to the next configuration level.

- **TAG/---** - has a dual purpose. When in the normal operation mode, pressing the button will scroll the complete tag name of the *Active Loop* in the alphanumeric display. The tag will scroll one character at a time starting on the right (e.g. ----T, -----TI, ----TIC).

When in the configuration mode, this button will provide a shift left function for configurable items (e.g. will shift the decimal point left).

- **QUICK/--->** - has a dual purpose. When in the normal mode this button will step through and access either previously selected configuration parameters in the quick hold blocks configured within the *Active Loop* (e.g. the HOLD value in QHOLD03 which was labeled to display TEMP_LIM having a range of 300.0 to 600.0) or parameters defined as QUICKSET in certain function blocks (e.g. RATIO). Press the ENTER/EXIT CONFIG button to return to the on-line displays.

When in the configuration mode, this button will provide a shift right function for configurable items (e.g. will shift the decimal point right).

- **STORE** - will store the configuration parameter to memory. All configuration changes, except for QUICK, ‘BIAS’, ‘RATIO’, and (quickset hold), require a store before the change is applied to the configuration. However, the QUICK functions will also require a store for the value to be placed in permanent memory, otherwise, it will only remain in battery RAM. Values in battery will be used on a hot or warm start. A cold start will use the value in permanent memory.

7 ALARM, TUNE, and QUICK are QUICKSET functions.
9.3 AUTOTUNE PROCEDURE

If the AUTOTUNE parameter in the controller function block is set to YES, the autotune procedure can be initiated using the TUNE pushbutton located behind the flip-down door. The Autotuner will substitute an ON_OFF controller for the PD or PID function. By making +/- step changes to the valve position, the controller will control the process at the current setpoint while it learns about the process dynamics. The controller then uses this knowledge to derive recommended P, I, and D settings.

Press the TUNE button to step through the following parameters and, if desired, initiate autotune:

- **PG** .................. Proportional Gain setting - (view or change)
- **TI** .................... Integral Time setting - PID/PIDAG controllers only (view or change)
- **MR** ............... Manual Reset setting - PD controller only (view or change)
- **TD** ..................... Derivative Time setting - (view or change)
- **% DEV** .......... The peak/peak % process deviation that the autotuner will maintain during test
- **% HYS** .......... The % process change needed before the valve output will switch

**AUTOTUNE ......** Set to YES and STORE to start autotune. Press EXIT CONF to return to normal operator faceplate operation.

**AT PG** .................. Proportional Gain setting recommended by the autotuner
**AT TI** .................. Integral Time setting recommended by the autotuner
**AT TD** .................. Derivative Time setting recommended by the autotuner

**STORE AT ......** Pressing STORE transfers autotuner recommended settings to controller

While autotuning, the controller will continue normal operation. Pressing the A/M button to switch the controller to Manual will terminate autotune. While in autotune, the alphanumeric display will alternate between ‘AUTOTUNE’ and the loop tag name and will stop alternating when the autotune program has been completed. Once completed, the controller will return to the mode prior to autotune initiation. When the POST AT (in the controller block) is set to auto transfer, the recommended tuning parameters will automatically be transferred to the controller and it will return to automatic control. To review the AT parameters before initiating autotune, press TUNE and then press STORE at the STORE AT prompt to transfer the recommended settings.

Chart 1 (0-100% range) illustrates a typical autotune exercise. Variable 1 is the Valve and 2 the Process. In this example, the process has noise with a standard deviation of less than 0.5%. The % HYS (% hysteresis band) is set to 0.75% and the % DEV (% deviation from setpoint which should be set to at least 4 times the % HYS value) is set to 3%.

The autotuner will use the initial valve step size (set as % STEP in the controller function block) during the first 1-1/2 cycles to learn the approximate gain of the process. It will then adjust the valve step size during the remainder of the autotuning exercise to maintain the % DEV setting. When this test concludes, the recommended settings are transferred to the controller and a 20% setpoint change is made to illustrate the controller tuning.

When the autotuner is started for the next autotune exercise, it will use the process gain learned during the previous exercise to determine the valve step size unless: the parameter AT RESET in the controller block has been stored as YES, warnings occurred during the first test, or the station has been power cycled.
Autotuning Considerations:

**Process Noise** - could have an effect where the autotuner will not produce periodic valve cycles. The autotuner will complete an exercise but results may not be satisfactory. This is illustrated in the first autotuning exercise in chart 2 which is the same process as chart 1 but the % HYS was set at 0.5%. If these results occur when the controller % HYS has been set to A (auto set hysteresis) the controller may be having difficulty deriving a good noise figure and manual entry of the % HYS parameter should be considered. The % HYS value should be increased to at least twice the standard deviation value of the noise. In cases where the noise amplitude is extremely large, the filter on the analog input should be increased to minimize the amplitude of the noise seen by the controller. The value of the % DEV parameter should be set to at least four time the % HYS value for best results.

**Steady State Conditions** - must be established for the process and controller prior to starting an autotune exercise. The autotuner can be initiated while in manual or auto. Steady state is reached when the present valve signal has brought the process to its present value, and the setpoint is equal to the process. When not at steady state, valve cycles will not be symmetrical as illustrated in the second tuning exercise in chart 2 or, as a worse case situation, the valve may not cycle at all. If the valve is does cycle, although not symmetrically, adequate tuning results will still be obtained.
Autotuner Errors - terminate the autotune exercise and returns the control loop to the point prior to the start of autotune. An Error message can be cleared by pressing the ACK button.

**TABLE 9.1  Autotune Errors**

<table>
<thead>
<tr>
<th>ERROR</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>A zero crossing did not occur within 120 minutes. Most likely caused by the control loop not being in a steady state condition when the autotuner was started.</td>
</tr>
<tr>
<td>E2</td>
<td>Process went out of range twice (&lt;0%, &gt;100%). The first time an out of range occurs, the autotuner will cut the valve step size in half and restart the exercise.</td>
</tr>
<tr>
<td>E3</td>
<td>When the autotune algorithm has been set to HYS = A and it calculates a required hysteresis value greater than 10%. Process filtering should be added to reduce the noise seen by the autotuner.</td>
</tr>
</tbody>
</table>

Autotuner Warnings - do not terminate the autotune exercise and are normally eliminated by increasing the % HYS and/or the % DEV settings. In some cases, they may have been caused by load changes that occurred during the autotune exercise. The autotuner will still derive recommended tuning values but they will not automatically be transferred to the controller, if that feature was requested. The warnings can be cleared by pressing the ACK button.

**TABLE 9.2  Autotune Warnings**

<table>
<thead>
<tr>
<th>WARNING</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>Indicates that the % DEV setting is not greater than 4 times the % HYS setting.</td>
</tr>
<tr>
<td>W2</td>
<td>Indicates that the process deviations during the first one and a half cycles, where the autotuner first learns about the process gain, were inconsistent.</td>
</tr>
<tr>
<td>W3</td>
<td>Indicates that the average % DEV values during the final phase of the autotuning exercise were not greater than 4 times the % HYS setting. If this warning occurs while the % DEV selection was set to A (auto selection of deviation setting), the use of manual entry should be considered.</td>
</tr>
</tbody>
</table>
9.4 REMOVABLE CONFIGURATION BOARD

The Removable Configuration Board (RCB) can be installed in this controller. It retains a complete copy of the configuration being used by the controller in which the RCB is installed. Should that controller fail, the RCB can be removed and installed in the replacement controller. The stored configuration can then be selected as the active configuration in the controller.

On power up, the controller will test the RCB and compare the configuration stored in the RCB to the controller’s configuration. If the RCB passes all tests and the configurations are identical, the controller will power up normally and use the configuration from the MPU board. If a problem is detected or the configurations are different, an ON-LINE STATUS or OFF-LINE ERROR message will be displayed. See the Maintenance section for messages.

9.5 REAL TIME CLOCK/CONFIGURATION BACKUP BOARD

The controller is available with an optional real time clock and configuration backup board. The configuration backup performs the same functions as the RCB described above. In addition, the board includes a real time clock. The time can be set using the built-in CLOCK function block in the STATN parameters. It can also be set over the Modbus, LIL, or Ethernet network.

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8 RCB requires MPU Controller board firmware version 1.31 or higher.
9 RTC/CB requires MPU Controller board firmware version 2.0 or higher.
10.0 CONTROLLER AND SYSTEM TEST

This section presents a series of steps to verify controller operation and to help a user become familiar with the functionality of the controller. A new controller is shipped factory configured with either Factory Configured Option FCO101 Single Loop Controller or a user-specified custom configuration. The following procedure is for FCO101 with factory set parameter values. If a custom configuration was installed, or if you have configured the controller, it may be necessary to modify the procedure to test all function blocks in that configuration.

To determine the current configuration of a controller, either:

- refer to your configuration documentation for that controller
- upload the configuration to a PC running the Graphical Configuration software where the configuration can be viewed
- enter the configuration mode and step through the configuration recording the configured function blocks and entered parameter values

In the following steps, ‘press’ indicates a faceplate button (key).

10.1 CONTROLLER CONFIGURATION AND TEST

The purpose of this section is to configure and test the controller and to familiarize the user with the controller’s faceplate pushbuttons, pulser, and displays. This section also introduces several configuration topics.

10.1.1 Connections and Power

1. Connect power to the controller. Refer to Controller nameplate for model number and then to Section 14 of this manual for power requirements. Refer to Section 8 Installation for connections.

   ![WARNING]
   
   Electrical shock hazard
   Explosion hazard
   
   Can cause death or injury

   - Remove power from all wires and terminals before working on equipment.
   - In potentially hazardous atmosphere, remove power from equipment before connecting or disconnecting power, signal, or other circuit.
   - Observe all pertinent regulation regarding installation in hazardous area.

2. Depending upon the configuration, connect test equipment to the I/O terminals.

   FCO101 - This FCO has one 1-5 Volt analog input (AIN1), and one 4-20 mA analog output (AOUT1) configured. To verify both of these outputs, and to simulate an analog input for subsequent steps, jumper the terminals shown below. Connect a 250 ohm range resistor across the terminals shown below to convert the 4-20 mA output to a 1-5 volt input. This will tie the valve output (horizontal bargraph) back in the loop as the process input (P bargraph). Refer to Section 8 as necessary.

<table>
<thead>
<tr>
<th>CONTROLLER</th>
<th>JUMPER TERMINAL</th>
<th>INSTALL 250Ω AT TERMINALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 352Plus</td>
<td>A4 to A7</td>
<td>From A4 to A5</td>
</tr>
<tr>
<td>Models 353 and 354/354N</td>
<td>17 to 20</td>
<td>From 20 to 21</td>
</tr>
</tbody>
</table>

   Custom Configuration - Refer to Section 8 as necessary for any additional connections.
3. Apply power to the controller. Upon power up a two step test is automatically performed on the alphanumeric
display to light all segments. ‘WAIT’ will then appear on the alphanumeric display while the controller
performs power-up diagnostics.

If a power-up diagnostic test fails, an error code will be displayed on the alphanumeric display. Refer to
Sections 11.3 and 11.4 for troubleshooting error codes.

If WAIT remains displayed for more than 1 minute, the controller is not powering up correctly and power
connections should be checked for loose wiring.

10.1.2 Configuration

1. Determine the current configuration; refer to Section 10.0 above. Then perform one of the following steps.

To load FCO101, go to step 2.

IMPORTANT

Loading FCO101 will overwrite the current configuration and any entries made
since shipment. Skip step 2 if the installed configuration is to be retained.

To proceed with the installed configuration, go to Section 10.1.3.

2. To load FCO101 locally or to download it from a PC running the Graphical Configuration Utility, refer to
Section 2.7 for a procedure and to Section 4 for the block diagram and parameter values.

3. Edit the configuration as desired. Refer to Section 10.1.5 Modifying an FCO.

10.1.3 Input/Output

Press the D button on the faceplate to scroll through Loop01.S (Setpoint), Loop01.V (Valve Output), and Loop01.P
(Process Input). Note from the FCO101 block diagram, that INPUT P is configured as the output from function
block AIN1, INPUT S is configured as the output of function block SETPT, and INPUT V is configured as the
output of function block A/M.

10.1.4 Auto/Manual

In FCO101, the A/M block is configured to switch Valve control from the PID controller in AUTO, to the Pulser
Knob in Manual. Press the A/M button to toggle the display between the (Loop01.S) setpoint parameter and the
(Loop01.V) valve parameter. Turn the pulser knob while displaying the valve parameter in manual to change the
value on the numeric display as well as the horizontal bargraph; turn the pulser knob while displaying the setpoint
parameter in Auto to change the numeric value and the vertical S bargraph.

10.1.5 Modifying an FCO

In addition to FCO101, Single Loop Control, there are several other factory configured options available, such as
Ratio Set Control (FCO105) and Cascade Control (FCO121). To download another FCO follow the steps in
Section 2.7.

Changes to an FCO may be made either by adding and deleting function blocks or by changing the default
parameter values. A Configuration Road Map is shown in Section 2. Note that an X represents pressing the STEP
DOWN or STEP UP button and a <> represents turning the pulser knob. For example, to add a function block you
would do the following steps:

1. Press ENTER/EXIT CONF.

2. Press STEP DOWN until VIEW is displayed.

3. Turn the pulser knob until ADD FB is displayed.

4. Press STEP DOWN for the function block menu.
5. Turn the pulser knob to scroll through the available function blocks and press STORE to add the function block to the configuration.

6. To make changes to a function block parameter turn the Pulser Knob to EDIT FB.

7. Press STEP DOWN for the function Block menu.

8. Turn the pulser knob to the desired Function Block and Press STEP DOWN.

9. The first function block parameter will be displayed. For example, RG PTR for the A/M Transfer Block or MINSCALE for the Analog Input Block. Press STEP DOWN to display current parameter value or use the pulser knob to select a different parameter. Press STORE to save any changes.

10. Press EXIT to return to normal operation mode.

Notice that the SETPT, ALARM, PID, and ODC function blocks in FCO101 all refer to AIN1 as the RG PTR (range pointer) to determine the operating range of the function block. Be aware that making changes to a configuration may require changing referenced RG PTRs. For example, in FCO105 (Ratio Set Control), the PID controller output range is determined by the range of AIN2.

Try changing the default 0-100% range of analog input #1 (AIN1) to 100.0-500.0°F using the Configuration Road Map in Section 2 or the following steps:

1. Press ENTER/EXIT CONF to display LOOP.
2. Press STEP DOWN twice to display VIEW.
3. Turn pulser knob or use arrow button to display EDIT FB.
4. Press STEP DOWN to display Function Block menu.
5. Turn the pulser knob or use right arrow button to display AIN1.
6. Press STEP DOWN to display MINSCALE.
7. Press STEP DOWN to display current 0% of range.
8. Turn the pulser knob to display 1 in the last digit. Display should read “0.00001”.
9. Now press the left arrow (TAG) button. Notice that the decimal place will move one place every time the button is pressed. Press the arrow button until the display reads “100.000” and press the STORE button.
10. Press STEP UP.
11. Turn the pulser knob or use the arrow button to display MAXSCALE.
12. Press STEP DOWN to display “100.000”.
13. Press the right arrow button until display reads “0.00001”.
14. Turn the pulser knob to change the last digit to 5. Display should read “0.00005”.
15. Press left arrow button until display reads “500.000” and press store.
16. Press STEP UP.
17. Turn the pulser knob or the use arrow button to display DPP.
18. Press STEP DOWN. Notice “0.00” or 2 decimal places is the default. Turn the pulser knob to set the number of decimal places to 0.0 or to show 1 decimal place on the display and press STORE button.
19. Press STEP UP and turn the pulser knob or use the arrow button to display ENGUNITS.
20. Press STEP DOWN. Notice that the default units are PRCT.
21. Use the arrow buttons to move the flashing cursor to the space before the P. Now turn the pulser knob to display “D”. Use the arrow button to move to the next position and turn the pulser knob to select “E”. Repeat until display reads DEG F and press the STORE button.
22. Press ENTER/EXIT CONF to return to normal operation.

Try displaying the process and setpoint. Notice that these are now displayed in engineering units scaled 100 to 500 DEG F, or 300 at 50%. Press the UNITS button to display the engineering units configured above.

10.1.6 Alarms

Upon power up, FCO101 has 4 alarms enabled:

- Hi alarm at 110% on AIN1
- Lo alarm at -10% on AIN1
- Deviation alarm of 110% between AIN1 and SETPT
- No alarm

1. Press the ALARM/STEP DOWN button to step through the Alarm limits and Enable/Disable Status. Notice all the alarms are enabled and the alarm limits are displayed in engineering units on the numeric display and as a percentage of range by a flashing LED on the S bargraph. If security clearance is satisfied, the alarm limits can be changed by rotating the pulser knob. Try changing the alarm limit A1 to 50% (300 DEG F) and press STORE to save the new value.

2. Press EXIT to return to normal operation mode.

3. Enter manual mode to display Loop01.V.

4. Turn the pulser knob until both the valve output and process input are greater than 50%. Note that the alphanumeric display will flash “A1 HI” and the L and S LEDs will flash. Press the ACK button to acknowledge the alarm.

Alarms have a default priority of 3 (see Alarm block in Section 3.2), meaning that the alarms must be acknowledged to clear the flashing. Alarms may also be configured as self clearing. Try changing the alarm priority to 4 using the Configuration Road Map in Section 2 or the following steps:

1. Press ENTER/EXIT CONF. LOOP should be displayed.

2. Press STEP DOWN twice until VIEW appears on the display.

3. Press the right arrow button 3 times or turn the pulser knob until EDIT FB appears on the display.

4. Press STEP DOWN. A/M will be displayed.

5. Press the right arrow button 3 times or the turn pulser knob until ALARM appears on the display.

6. Press STEP DOWN to display RG PTR

7. Press the right arrow button or turn the pulser knob until A1 PRIOR appears on the display.

8. Press STEP DOWN to display 3 on the numeric display.

9. To change the priority of alarm 1 from 3 to 4, rotate the pulser knob until 4 appears on the numeric display.

10. Press STORE to save the configuration change.

11. Press ENTER/EXIT CONF to return to normal operation.

Try adjusting the process above and below 50% (300 DEG F). Notice that the alarm will clear without pressing the ACK button if the process drops below the alarm limit - deadband. Use the ALARM QUICK button to return the Alarm Limit A1 to the default 110% (540 DEG F) and press STORE to save. Other alarm parameters referenced in the ALARM function block description may be changed in a similar manner.
10.1.7 TAG

Press the TAG button. Note that Loop01.* (*= P, S, V, X or Y) will scroll across the screen. To change the tag, refer to the Configuration Road Map in Section 2 or the following instructions:

Note that although 12 characters are available for the tag, it is suggested that loop names be limited to 6 characters so that the complete tag name will be displayed during normal operation. The additional 6 characters can be displayed by scrolling the tag. The last two digits of the alphanumeric displayed during normal operation will be used to identify the variable currently being displayed, P, S, V, X or Y.

1. Press ENTER/EXIT CONF. LOOP will be displayed.
2. Press STEP DOWN twice until VIEW appears on display.
3. Press the right arrow button or the turn pulser knob until EDIT TAG appears on the display.
4. Press STEP DOWN. LOOP01 will appear on the display with the 1 digit flashing. Use the pulser knob to change the value of the flashing character and press store to save the change. Use the arrow buttons to move to another character. Try changing the TAG to TC101.
5. Press ENTER/EXIT CONF to return to normal operation mode.
6. Press TAG to view tag names longer than 6 characters.

10.1.8 QUICK

When in normal operation mode the QUICK button can be used to step through the QUICK SET parameters of any function block which has this feature enabled. In FCO101, the SETPT function block has the QUICK SET feature enabled as a default. Press the QUICK button and note that you can scroll through the following Setpoint features: RAMP ON/OFF, Ramp RATE, TARGET setpoint, and POWER UP SETPOINT. The ramp feature can either use a ramp TIME or a ramp RATE. USE RATE is set to YES as the default (see SETPT function block details in Section 3.2).

To see how the Ramp rate works, make sure the controller is in AUTO mode and do the following steps.

1. Press QUICK to display RRATE.
2. Rotate the pulser knob to set the ramp RATE to 300 and press STORE. Since the SETPT range pointer is configured for AIN1 scaled 100 to 500 DEG F, 300 will represent a ramp rate of 300 DEG F/min.
3. Press QUICK to display TARGET. Set the target to 250% and press STORE.
4. Press QUICK to display R ON OFF. Turn the pulser knob to change the setting to ON and press STORE.
5. Press ENTER/EXIT to display the setpoint on the numeric display. The setpoint should ramp to 25% in 30 seconds.

To change from a Ramp RATE to a Ramp TIME do the following steps.

1. Press ENTER/EXIT CONF to display LOOP.
2. Press STEP DOWN twice to display VIEW.
3. Press the right arrow button or turn the pulser knob to display EDIT FB.
4. Press STEP DOWN to display A/M.
5. Turn the pulser knob to display SETPT.
6. Press STEP DOWN to display RG PTR.
7. Turn the pulser knob to display USE RATE.
8. Press STEP DOWN to display YES.
9. Turn the pulser knob to change to NO, and press STORE. Press STEP UP.
10. Turn pulser knob counterclockwise or use left arrow button to display RTIME.

11. Press STEP DOWN to display ramp TIME.

12. Turn the pulser knob to set the desired Ramp TIME, and press STORE.

13. Press EXIT to return to normal operation mode.

Now press the QUICK button. Note that the RTIME parameter will now be displayed instead of the RRATE parameter. Setting R ON OFF parameter to “ON” will now ramp the setpoint to the TARGET setpoint in the specified time rather than at a particular rate. See the SETPT description in Section 3.2 for more details on setpoint functions.

Quickset parameters for other function blocks such as RATIO and BIAS may be changed in a similar fashion. See specific function block descriptions in Section 3 for more details.

10.1.9 TUNE

When in normal operation mode, pressing the TUNE button will scroll through the controller tuning parameters and allow activating the AUTOTUNE algorithm. FCO101 is configured for PID control with the AUTOTUNE feature enabled. Press the TUNE button and note that the default values for Proportional Gain (PG), Time-Integral (TI), Time-Derivative (TD), and the Derivative Gain (DG) will be displayed. In addition, the AUTOTUNE parameters % Deviation, % Hysteresis, and Autotune YES/NO will be displayed.

It is difficult to simulate the autotune feature without simulating a process signal but increasing the digital filter parameter on the AIN1 will help make the process seem more realistic. To change the digital filter to a value around 10 follow the Configuration Road Map in Section 2 or do the following steps.

1. Press ENTER/EXIT CONF.
2. Press STEP DOWN twice to display VIEW.
3. Use the right arrow button or the pulser knob to display EDIT FB.
4. Press STEP DOWN for Function Block menu.
5. Use the right arrow button or the pulser knob to display AIN1.
6. Press STEP DOWN for parameter menu.
7. Use the right arrow button or the pulser knob to display DIG FILT and Press STEP DOWN.
8. Rotate the pulser knob to set the digital filter to 10 and press STORE.
9. Press ENTER/EXIT CONF to return to normal operation.

Before initiating AUTOTUNE bring the process to steady state. This can be done by placing the instrument in manual mode and bringing the valve to approximately mid-scale using the pulser knob. Display the process and wait a minute or two for the process to stabilize.

To activate the AUTOTUNE feature:

1. Press the TUNE Quick Button to display AUTOTUNE.
2. Set this parameter to YES, press STORE, then press EXIT. The controller is now set to AUTO and “AUTOTUNE” will flash until the AUTOTUNE is finished. Tuning warnings may occur; refer to Section 9.3. Since this is only a simulation, press ACK to clear any warnings.
3. Press the TUNE button to display the default controller parameters and the resulting AUTOTUNE (ATUNE) parameters. After viewing the parameters, STORE AT will be displayed. Press the STORE button to change the controller parameters to the new values or press the ENTER/EXIT CONF button to keep the defaults.

To cancel the AUTOTUNE before the tuning operation is complete, press the A/M button to enter MANUAL mode. Refer to Section 9.3 for more details on the AUTOTUNE feature.
10.1.10 View mode

When troubleshooting a configuration, it is often helpful to be able to view the intermediate outputs of function blocks that are not configured as display variables during normal operation. This can be accomplished via the VIEW mode. To enter VIEW mode:

1. Press ENTER/EXIT CONF to display LOOP.
2. Press STEP DOWN to display VIEW.
3. Press STEP DOWN to display the first output of the first configured function block.
4. Use the pulser knob or arrow buttons to scroll through the function block outputs. Note that analog outputs are in engineering units and discrete/status outputs (represented by the black shaded arrows in the Function Block diagrams) are either low (0) or high (1).
5. Press EXIT to return to normal operation mode.

10.2 SYSTEM CHECKOUT

1. Check that the correct circuit boards are installed and fully seated in the case as follows. The controller model number on the P&I drawing should match the model number on the controller’s case. Compare the model number to the Model Designation table in Section 14 to be sure the proper boards are installed.

   NOTE

   When power is applied to the controller, an installed hardware list can be viewed in the STATN function block. Refer to Section 3.1.2 for board description and ID.

2. Check all wiring between the controller and external equipment (e.g. transmitters, recorders, power supplies). Check for correct and secure connections, correct wire gauge and insulation, adequate support (ties, raceways, conduit), and protection from damage (sharp edges, moving equipment, chemicals, abrasion).

3. Test all equipment connected to the controller for proper operation. Refer to the equipment manufacturer’s literature as necessary.

4. Apply power to the controller and note the faceplate displays during power up. See Section 10.1.1 for a description of the faceplate displays during power up.

5. Based on the controller hardware present, the current configuration in the controller, and the external equipment, exercise the system in a systematic manner to ensure proper operation.
11.0 MAINTENANCE

Controller maintenance requirements are minimal. Activities such as cleaning and visual inspections should be performed at regular intervals. The severity of the controller’s operating environment will determine the frequency of maintenance. Additional topics including troubleshooting, assembly replacement, and software compatibility are also covered. Figure 11-1 shows an exploded view of the controller.

Before servicing or calibration the equipment, note the following statements.

- Maintenance should be performed only by qualified personnel. Failure to properly maintain the equipment can result in death, serious injury, or product failure. This manual should be carefully reviewed, understood, and followed.
- The steps in the Preventive Maintenance section should be performed regularly.
- The procedures in this section do not represent an exhaustive survey of maintenance steps necessary to ensure safe operation of the equipment. Particular applications may require further procedures. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser’s purposes, the matter should be referred to the local Siemens sales office.
- The use of unauthorized parts in the repair of the equipment or tampering by unqualified personnel will result in dangerous conditions that can cause death, serious injury, or equipment damage. Follow all safety instructions contained herein.

**WARNING**

Electrical shock hazard
Explosion hazard
Can cause death or injury

- Remove power from all wires and terminals before working on equipment.
- In potentially hazardous atmosphere, remove power from equipment before connecting or disconnecting power, signal, or other circuit.
- Observe all pertinent regulation regarding installation in hazardous area.

11.1 TOOLS AND TEST EQUIPMENT

The following tools and equipment are necessary for servicing:

A. Common hand tools for servicing electronic equipment
B. Digital Multimeter (DMM)
   Voltmeter Section:
   - Accuracy +/-0.01% of reading
   - Resolution 1.0 millivolt Input
   - Impedance 10 Megohms
   Ammeter section:
   - Accuracy +/- 0.1% of reading
   - Resolution 100 microamperes
C. Maintenance Kit, P/N 15545-110, containing wrist strap and conductive mat. This kit or an equivalent is required when a circuit board assembly is handled for any reason.
11.2 UPGRADING A CONTROLLER

A controller can be upgraded in the field to add I/O or a communication option, for example. Always confirm with the factory hardware and software compatibility before upgrading a controller. To install an upgrade, you may need to:

- Refer to the Function Blocks section and develop a configuration. Refer to the HMI documentation and develop an application.
- Refer to the Kit Installation Instruction or other publications supplied with the assembly being installed.
- Refer to the Assembly Replacement subsection in the Maintenance section of this User’s Manual for information about disassembling the controller, installing the assembly, and then reassembling.
- Refer to the Installation section of this manual for wiring details.
- Refer to the Controller and System Test section to ensure proper operation of the controller.

11.3 PREVENTIVE MAINTENANCE

The objective for establishing a preventive maintenance program is to provide maximum operating efficiency. Every preventive maintenance operation should assist in realizing this objective. Unless a preventive measure reduces a Station’s down time, it is unnecessary.

11.3.1 Environmental Considerations

The controller has been designed to operate within specified environmental parameters (temperature and humidity). These parameters are listed in the Model Designation and Specifications section of this User’s Manual. Additional information concerning environmental contaminants is covered in the Installation section.

11.3.2 Visual Inspection

As part of a periodic maintenance program, the controller should be visually inspected. When viewing the station, scan for abnormalities such as loose, broken or stressed ribbon cables. Look for damaged circuitry and heat stressed parts. Check for excessive dirt or dust build-up that may impede the flow of air and inhibit proper heat dissipation.

11.3.3 Cleaning

Circuit boards have a conformal coating for protection against contaminants. They should not be cleaned unless accumulated foreign material is causing a problem.

Protect the station’s electronic components from electrostatic discharge. Fasten a conductive wrist strap around your wrist and ground the strap to the station’s case, the panel, or a static dissipative workmat. See the next section for circuit board handling guidelines.

If cleaning is needed, go to Section 11.6 for a disassembly procedure. Remove any debris from the enclosure and circuit boards with either a soft brush or low velocity deionized air. Be careful not to dislodge the jumpers on the MPU Controller board.

Clean the Faceplate Display with a clean, soft, lint-free cloth - do not use a paper towel - dampened with a mild nonabrasive liquid cleaner. Avoid harsh solvents.
11.3.4 Circuit Board Handling

**ELECTROSTATIC DISCHARGE, ALL ELECTRONIC ASSEMBLIES**

Semiconductor devices must be protected from electrostatic discharge. A properly grounded conductive wrist strap must be worn whenever a circuit board assembly is handled or touched. A PN 15545-110 service kit with a wrist strap and static dissipative workmat is available from the Process Industries Division of Siemens Energy & Automation. Equivalent kits are available from both mail order and local electronic supply companies.

**LITHIUM BATTERY PRECAUTIONS**

Each MPU Controller board and Real Time Clock/Configuration Backup board has a lithium battery that is not field replaceable. Note the following when handling or disposing of either board.

- Properly dispose of an un-repairable circuit board with a lithium battery
- Do not burn the battery
- Do not place the circuit board on a metal surface or otherwise short circuit battery terminals
- Do not attempt to charge the battery
- If electrolyte is exposed, wear safety glasses and rubber gloves when handling the battery
- For details contact the battery manufacturer
11.4 TROUBLESHOOTING

Error codes provide primary troubleshooting information. These codes appear on the faceplate’s alphanumeric display in response to a failed power-up diagnostic test or to an on-line controller error. Section 11.5 provides a quick reference to the identification of these codes and discusses each code with respect to the type of test, controller response, problem confirmation, and corrective action.

In the event a malfunction within the controller is suspected, troubleshooting by assembly substitution is recommended to get the controller back on-line in the shortest possible time.

If a problem appears upon initial installation of the controller, check the installation wiring and the controller’s configuration parameters. Also, check the wiring of associated external process devices (e.g. process transmitter, LonWorks modules). Field servicing experience indicates that most initial service incidents are of this nature.

Additional troubleshooting avenues are also possible. For example, a series of test configurations may be created and implemented to ‘exercise’ different function blocks within the controller. Section 3 describes each function block. This type of troubleshooting analysis is implemented in an off-line test bench situation.

On-line checks of the controller input and output signals (both analog and digital) can be performed without affecting station operation. This type of signal tracing is usually carried out behind an instrument panel. Refer to the Installation section, Table 8.1, for rear terminal assignments and for wiring diagrams.

MPU CONTROLLER BOARD JUMPERS

There are two Controller board versions. Figure 11-3 shows an MPU Controller board with jumpers W2, W4 and W8. Figure 11-4 shows an MPU Controller board with jumpers W2, W4, and W7. These jumpers are factory set but may need to be changed in the field. W7 and W8 settings are described in the figures and in Section 11.6.3 MPU Controller Board. Two additional jumpers, W2 and W4, are discussed in Section 11.6.5 Accessory Boards.

11.5 ERROR CODES

This section describes off-line error codes, on-line error codes, and on-line status codes. Typically, a code will point to a failed internal assembly or a failed peripheral device. Note that a configuration error can also cause an error code or multiple error codes to be produced.

OFF-LINE ERROR CODES

Off-line error messages are displayed while the controller is powered but not running function block code and therefore not actively controlling a process. Depending on the message, user intervention will most likely be required.

Corrective action can be initiated via the LIL or Modbus ports if appropriate. LIL parameter “SE” located at channel 4, parameter 1 (Modbus register 40002) will contain the hexadecimal form of the error number currently displayed (e.g., ERR: 213 would be sent as $00D5). An Error message can be acknowledged over the network by writing a 0 to the Modbus register or LIL parameter. Messages will be displayed one at a time in the order they occur and they cannot be cleared until the error condition is corrected.
Display Format: ERR: x x x

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Error Type</th>
<th>Error Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAM Test</td>
<td>Fatal</td>
<td>The station cannot operate until the source of the error has been corrected.</td>
</tr>
<tr>
<td>Flash CRC Test</td>
<td>Non-Fatal</td>
<td>Correct error from faceplate or communication port.</td>
</tr>
<tr>
<td>Constant Data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calibration Data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Software</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Database</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Board Not</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hardware</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(QSPI) Test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RCB or RTC/CB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethernet Network</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Error Type:

1. Fatal
   The station cannot operate until the source of the error has been corrected.

2. Non-Fatal
   Correct error from faceplate or communication port.

Board Type:

0. MPU Controller
1. I/O Expander
2. LIL Network
3. LonWorks Remote I/O
8. RCB or RTC/CB
9. Ethernet Network

Test Type:

0. RAM Test
   - MPU Controller board - Fatal error, replace board. Press ENTER to repeat test.
   - Option Board - Station operation suspended. Pressing ENTER will cause all references to blocks relating to the option board to be removed from the configuration and removal of the board from the availability list.

1. Flash CRC Test
   - MPU Controller board - Station operation suspended until new code is downloaded. Press ENTER to repeat test.
   - Option Board - Station operation suspended until new code is downloaded. Pressing ENTER will cause all references to blocks relating to the option board to be removed from the configuration and removal of the board from the availability list.

2. Constant Data CRC Test
   Station operation suspended until new constant data is downloaded. Press ENTER to load board specific default constant data.

3. Calibration Data CRC Test
   Station operation suspended until ENTER is pressed to load default calibration data.

4. Software Compatibility Test
   Station operation suspended until new code is downloaded. Pressing ENTER will cause all references to blocks relating to the option board to be removed from the configuration and removal of the board from the availability list.

5. Database Compatibility Test
   Station operation suspended until new constant data is downloaded. Press ENTER to, if possible, convert the database or load board specific default constant data.

6. Board Not Present Error
   Station operation suspended. Install the missing board or press ENTER to remove from the configuration all references to the missing board.

7. Hardware Communication (QSPI) Test
   Fatal error. Repair or replace as necessary. Press ENTER to repeat test.

8. Board Compatibility Test
   Remove the board causing the error and install a compatible board.

Real Time Clock/Configuration Backup board and Removable Configuration Board (RCB) off-line error codes are listed in Table 11.1. RTC/CB and RCB on-line status codes are located in Table 11.2 and listed as “RCB” errors.
TABLE 11.1  RTC/CB and RCB Boards, Off-Line Error Codes

<table>
<thead>
<tr>
<th>ERROR CODE</th>
<th>DESCRIPTION</th>
<th>CORRECTIVE ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERR280</td>
<td>Board failed NVRAM test</td>
<td>1) Power down and replace Board. 2) Press ENTER to ACK error. Controller will go on-line using configuration in MPU memory.</td>
</tr>
<tr>
<td>ERR282</td>
<td>Configuration on Board failed checksum test and is corrupted.</td>
<td>1) Power down and install a Board containing a valid configuration. 2) Press ENTER to ACK error. Controller will go on-line using configuration in MPU memory that will also be loaded into the Board.</td>
</tr>
<tr>
<td>ERR284</td>
<td>Configuration on Board is not compatible with MPU Controller board firmware level. This will occur only when the Board comes from a controller with a different MPU Controller board firmware level than the current controller and some functions in the configuration database cannot be supported by the current firmware.</td>
<td>1) Install MPU firmware compatible with the Board configuration 2) Press ENTER to ACK error. Controller will go on-line using configuration in MPU memory. The configuration will remain intact until a parameter is STOREd, at which time the MPU configuration will be transferred to the Board.</td>
</tr>
<tr>
<td>ERR285</td>
<td>Configuration on Board is not compatible with MPU Controller board database. This will occur only when the Board comes from a controller with a higher MPU Controller firmware level than the current controller. Controller firmware can convert a database created with a lower firmware revision level but not a higher level.</td>
<td>1) Install MPU firmware compatible with the Board configuration 2) Press ENTER to ACK error. Controller will go on-line using configuration in MPU memory. The configuration will remain intact until a parameter is STOREd, at which time the MPU configuration will be transferred to the Board.</td>
</tr>
<tr>
<td>ERR286</td>
<td>The controller powered down with a Board installed but could not identify it on power up. The board may have been removed or the board ID may be corrupted.</td>
<td>1) Install a Board or new Board. 2) Press ENTER to ACK error. Controller will go on-line using configuration in MPU memory.</td>
</tr>
<tr>
<td>ERR288</td>
<td>The LonWorks circuit board currently installed is not compatible with the LonWorks configuration contained on the Board.</td>
<td>1) Power down and install the LonWorks board from the same controller that the Board came from. 2) Press ENTER to ACK error. Controller will go on-line. Any existing LonWorks network data will be used if it is valid, otherwise, it will be set to default values. In either case, the LonWorks network manager will be required to re-establish the network bindings.</td>
</tr>
</tbody>
</table>

ON-LINE ERROR CODES AND STATUS CODES

These codes can be produced while the controller is running function block and may be actively controlling a process. Depending on the message and its priority level, user intervention may be required or the message may simply be informational in nature. LIL parameter “SE” located at channel 4, parameter 1 (Modbus register $40002) will reflect unacknowledged error or status messages present in the controller. Messages are displayed according to priority until all active messages have been acknowledged. If no link code has been assigned to the active message, the “SE” code will remain at its last value.

Table 11.2 lists on-line error and status codes. For most error codes, replace the involved circuit board to repair the controller. For most status codes, acknowledge or otherwise respond to the situation.
### TABLE 11.2 On-Line Error and Status Codes

<table>
<thead>
<tr>
<th>DISPLAYED CODE</th>
<th>LINK/MODBUS CODE (Hex/Dec)</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPU A/D</td>
<td>$0001 1</td>
<td>MPU Controller board A/D Error</td>
</tr>
<tr>
<td>EXP A/D</td>
<td>$0002 2</td>
<td>I/O Expander Board A/D Error</td>
</tr>
<tr>
<td>AOUT1 OC</td>
<td>$0003 3</td>
<td>MPU Controller board D/A #1 Open Circuit</td>
</tr>
<tr>
<td>AOUT2 OC</td>
<td>$0004 4</td>
<td>MPU Controller board D/A #2 Open Circuit</td>
</tr>
<tr>
<td>AOUT3 OC</td>
<td>$0005 5</td>
<td>MPU Controller board D/A #3 Open Circuit</td>
</tr>
<tr>
<td>AINU1 AD</td>
<td>$0006 6</td>
<td>I/O Expander Board Universal Analog Input #1 A/D Error</td>
</tr>
<tr>
<td>AINU1 TC</td>
<td>$0007 7</td>
<td>I/O Expander Board Universal Analog Input #1 T/C Burnout</td>
</tr>
<tr>
<td>AINU1 RJ</td>
<td>$0008 8</td>
<td>I/O Expander Board Universal Analog Input #1 Reference Junction Error</td>
</tr>
<tr>
<td>AINU2 AD</td>
<td>$0009 9</td>
<td>I/O Expander Board Universal Analog Input #2 A/D Error</td>
</tr>
<tr>
<td>AINU2 TC</td>
<td>$000A 10</td>
<td>I/O Expander Board Universal Analog Input #2 T/C Burnout</td>
</tr>
<tr>
<td>AINU2 RJ</td>
<td>$000B 11</td>
<td>I/O Expander Board Universal Analog Input #1 Reference Junction Error</td>
</tr>
<tr>
<td>DINU1 E1</td>
<td>$000C 12</td>
<td>I/O Expander Board Universal Digital Input #1 Underflow Error</td>
</tr>
<tr>
<td>DINU2 E1</td>
<td>$000D 13</td>
<td>I/O Expander Board Universal Digital Input #2 Underflow Error</td>
</tr>
<tr>
<td>LIL ERR</td>
<td>$000E 14</td>
<td>LIL Port Error</td>
</tr>
<tr>
<td>LIL NUI</td>
<td>$000F 15</td>
<td>LIL Non Updating Input Error</td>
</tr>
<tr>
<td>MOD ERR</td>
<td>$0010 16</td>
<td>Modbus Port Error</td>
</tr>
<tr>
<td>LON ERR</td>
<td>$0011 17</td>
<td>LON Port Error</td>
</tr>
<tr>
<td>LON NUI</td>
<td>$0012 18</td>
<td>LON Non Updating Error</td>
</tr>
<tr>
<td>Watchdog</td>
<td>$0013 19</td>
<td>Watchdog Timeout</td>
</tr>
<tr>
<td>LOW BAT</td>
<td>$0014 20</td>
<td>Low NVRAM Battery Voltage</td>
</tr>
<tr>
<td>RCB→MEM</td>
<td>$0015 21</td>
<td>Press STORE to load RCB configuration into MPU memory</td>
</tr>
<tr>
<td>CYCLTIME</td>
<td>$0016 22</td>
<td>Cycle Time Overrun – see STATN block – add Cycle Time bias</td>
</tr>
<tr>
<td>BURNFAIL</td>
<td>$0017 23</td>
<td>Flash Memory burn failed</td>
</tr>
<tr>
<td>RCB FAIL</td>
<td>$0018 24</td>
<td>Press ENTER to ACK error and replace RCB</td>
</tr>
<tr>
<td>NO EXPBD</td>
<td>$0019 25</td>
<td>Expander board is not installed</td>
</tr>
<tr>
<td>PEB FAIL</td>
<td>$001A 26</td>
<td>Ethernet Board failure</td>
</tr>
<tr>
<td>IP OVRUN</td>
<td>$001B 27</td>
<td>Ethernet board TCP communication error</td>
</tr>
<tr>
<td>MB OVRUN</td>
<td>$001C 28</td>
<td>Modbus communication error</td>
</tr>
<tr>
<td>A1 HI</td>
<td>None</td>
<td>Alarm A1 High</td>
</tr>
<tr>
<td>A1 LO</td>
<td>None</td>
<td>Alarm A1 Low</td>
</tr>
<tr>
<td>A1 HI D</td>
<td>None</td>
<td>Alarm A1 High Deviation</td>
</tr>
<tr>
<td>A1 LO D</td>
<td>None</td>
<td>Alarm A1 Low Deviation</td>
</tr>
<tr>
<td>A1 DEV</td>
<td>None</td>
<td>Alarm A1 Deviation</td>
</tr>
<tr>
<td>A1 OR</td>
<td>None</td>
<td>Alarm A1 Overrange</td>
</tr>
<tr>
<td>A2 HI</td>
<td>None</td>
<td>Alarm A2 High</td>
</tr>
<tr>
<td>A2 LO</td>
<td>None</td>
<td>Alarm A2 Low</td>
</tr>
<tr>
<td>A2 HI D</td>
<td>None</td>
<td>Alarm A2 High Deviation</td>
</tr>
<tr>
<td>A2 LO D</td>
<td>None</td>
<td>Alarm A2 Low Deviation</td>
</tr>
<tr>
<td>A2 DEV</td>
<td>None</td>
<td>Alarm A2 Deviation</td>
</tr>
<tr>
<td>A2 OR</td>
<td>None</td>
<td>Alarm A2 Overrange</td>
</tr>
<tr>
<td>A3 HI</td>
<td>None</td>
<td>Alarm A3 High</td>
</tr>
<tr>
<td>A3 LO</td>
<td>None</td>
<td>Alarm A3 Low</td>
</tr>
<tr>
<td>A3 HI D</td>
<td>None</td>
<td>Alarm A3 High Deviation</td>
</tr>
<tr>
<td>A3 LO D</td>
<td>None</td>
<td>Alarm A3 Low Deviation</td>
</tr>
<tr>
<td>A3 DEV</td>
<td>None</td>
<td>Alarm A3 Deviation</td>
</tr>
<tr>
<td>A3 OR</td>
<td>None</td>
<td>Alarm A3 Overrange</td>
</tr>
<tr>
<td>A4 HI</td>
<td>None</td>
<td>Alarm A4 High</td>
</tr>
<tr>
<td>A4 LO</td>
<td>None</td>
<td>Alarm A4 Low</td>
</tr>
<tr>
<td>A4 HI D</td>
<td>None</td>
<td>Alarm A4 High Deviation</td>
</tr>
<tr>
<td>DISPLAYED CODE</td>
<td>LINK/MODBUS CODE (Hex/Dec)</td>
<td>DESCRIPTION</td>
</tr>
<tr>
<td>----------------</td>
<td>-----------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>A4 LO D</td>
<td>None</td>
<td>Alarm A4 Low Deviation</td>
</tr>
<tr>
<td>A4 DEV</td>
<td>None</td>
<td>Alarm A4 Deviation</td>
</tr>
<tr>
<td>A4 OR</td>
<td>None</td>
<td>Alarm A4 Overrange</td>
</tr>
<tr>
<td>B1 HI</td>
<td>None</td>
<td>Alarm B1 High</td>
</tr>
<tr>
<td>B1 LO</td>
<td>None</td>
<td>Alarm B1 Low</td>
</tr>
<tr>
<td>B1 OR</td>
<td>None</td>
<td>Alarm B1 Out of Range</td>
</tr>
<tr>
<td>B2 HI</td>
<td>None</td>
<td>Alarm B2 High</td>
</tr>
<tr>
<td>B2 LO</td>
<td>None</td>
<td>Alarm B2 Low</td>
</tr>
<tr>
<td>B2 OR</td>
<td>None</td>
<td>Alarm B2 Out of Range</td>
</tr>
<tr>
<td>B3 HI</td>
<td>None</td>
<td>Alarm B3 High</td>
</tr>
<tr>
<td>B3 LO</td>
<td>None</td>
<td>Alarm B3 Low</td>
</tr>
<tr>
<td>B3 OR</td>
<td>None</td>
<td>Alarm B3 Out of Range</td>
</tr>
<tr>
<td>B4 HI</td>
<td>None</td>
<td>Alarm B4 High</td>
</tr>
<tr>
<td>B4 LO</td>
<td>None</td>
<td>Alarm B4 Low</td>
</tr>
<tr>
<td>B4 OR</td>
<td>None</td>
<td>Alarm B4 Out of Range</td>
</tr>
<tr>
<td>Emeg Man</td>
<td>None</td>
<td>Emergency Manual</td>
</tr>
<tr>
<td>Em Local</td>
<td>None</td>
<td>Emergency Local</td>
</tr>
<tr>
<td>Standby</td>
<td>None</td>
<td>Standby Sync</td>
</tr>
<tr>
<td>Override</td>
<td>None</td>
<td>Override</td>
</tr>
<tr>
<td>EMERG OR</td>
<td>None</td>
<td>Emergency Override - PCOM block</td>
</tr>
<tr>
<td>INTRLK</td>
<td>None</td>
<td>Interlocked – PCOM block</td>
</tr>
<tr>
<td>DFAIL</td>
<td>None</td>
<td>Device Failed – PCOM block</td>
</tr>
<tr>
<td>MAX LOOP</td>
<td>None</td>
<td>Maximum Loop Size</td>
</tr>
<tr>
<td>S HI Lim</td>
<td>None</td>
<td>Setpoint HI Limit</td>
</tr>
<tr>
<td>S LO Lim</td>
<td>None</td>
<td>Setpoint LO Limit</td>
</tr>
<tr>
<td>U1 Status</td>
<td>None</td>
<td>User Status #1</td>
</tr>
<tr>
<td>U2 Status</td>
<td>None</td>
<td>User Status #2</td>
</tr>
<tr>
<td>ATUNE W1</td>
<td>None</td>
<td>Autotuner Warning: hys/desamp &gt;0.2; see Section 9.3 for ‘W#’ details</td>
</tr>
<tr>
<td>ATUNE W2</td>
<td>None</td>
<td>Autotuner Warning: Deviation Ratio is HI; see Autotune procedure</td>
</tr>
<tr>
<td>ATUNE W3</td>
<td>None</td>
<td>Autotuner Warning: Avg. Deviation is LO; see Autotune procedure</td>
</tr>
<tr>
<td>ATUNE E1</td>
<td>None</td>
<td>Autotuner Error: limit cycle timeout</td>
</tr>
<tr>
<td>ATUNE E2</td>
<td>None</td>
<td>Autotuner Error: process out of range</td>
</tr>
<tr>
<td>ATUNE E3</td>
<td>None</td>
<td>Autotuner Error: Only applies when % HYS set to A. Process too noisy.</td>
</tr>
<tr>
<td>E In RAM</td>
<td>None</td>
<td>Insufficient Volatile Memory Available</td>
</tr>
<tr>
<td>E In Con</td>
<td>None</td>
<td>Insufficient Constant Memory Available</td>
</tr>
<tr>
<td>E Db CRC</td>
<td>None</td>
<td>Database CRC/Checksum Error</td>
</tr>
<tr>
<td>E P Qual</td>
<td>None</td>
<td>Poor I/O quality</td>
</tr>
<tr>
<td>i0On NC</td>
<td>None</td>
<td>Ubus Module #n Not Communicating</td>
</tr>
<tr>
<td>AEEnn NU</td>
<td>None</td>
<td>AEEnn Function Block Not Updating</td>
</tr>
<tr>
<td>CIEnn NU</td>
<td>None</td>
<td>CIEnn Function Block Not Updating</td>
</tr>
<tr>
<td>DIEnn NU</td>
<td>None</td>
<td>DIEnn Function Block Not Updating</td>
</tr>
</tbody>
</table>


11.6 ASSEMBLY REPLACEMENT

The following describes removing and replacing controller assemblies. Common hand tools for electronic equipment servicing are needed and a torque screwdriver, calibrated in inch-pounds or Newton-meters, is recommended. Before handling an assembly, refer to Section 11.3.4 for electrostatic discharge prevention procedures. See Figure 11-1 for an exploded view of the controller that shows field replaceable assemblies and individual parts.

Disassembly Sequence

Optional Faceplate Display, Direct or Remote Mount - Section 11.6.6
Controller Assembly - Section 11.6.1
I/O Expander Board - Section 11.6.2
MPU Controller Board - Section 11.6.4
Accessory Boards - Section 11.6.5

Perform only the steps needed to access the target assembly in the controller model at hand. Go to Section 11.6.1 to remove the controller from its mounting tray.

Real Time Clock Jumper

To set the Real Time Clock jumper (W7 or W8) when installing or storing a controller, remove the controller from its mounting tray and disassemble to gain access to the MPU Controller board.

11.6.1 Removing the Controller Assembly

1. Following plant procedures, take the Controller off-line and remove electrical power from it.

WARNING

Electrical shock hazard

Hazardous voltage can cause death or serious injury.

Remove power from all wires and terminals before working on this equipment.

Assembly Notes

A replacement Controller (or MPU Controller Board) must have a configuration entered from a Faceplate Display or downloaded from a personal computer running the Graphical Configuration Utility.

2. Disconnect terminal blocks. At each Controller terminal block, free the wiring harness to allow the terminal block to be disconnected. Then, loosen a captive screw at each end of the block and gently pull the block from the circuit board mounted receptacle. See Figure 8-6. Be careful not to damage or stress components and wires. Alternatively, label and disconnect all components and wires.

3. Disconnect the Modbus display cable (9-pin ‘D’ connector) at the underside of the Controller. Loosen two captive screws, grasp the cable connector, and pull it from the circuit board mounted receptacle.

4. Model 354N_R - Disconnect the remote display cable to the remote mount Faceplate Display.
   1) On the Controller cover, open the two ribbon cable ejector levers.
2) Grasp the cable-mounted connector and pull the connector from the case mounted connector. Do not pull on the ribbon cable.

3) Remove two screws that secure the ribbon cable receptacle to the Controller cover.

5. Support the Controller and remove the four screws securing the Controller to the Mounting Tray. Remove the Controller from its mounting tray.

6. To Repair a Controller or Set W7 or W8 - Go to Section 11.6.2 Removing the I/O Expander Board to continue disassembly.

To Replace a Controller - Install a replacement or repaired Controller by performing the above steps in reverse order.

11.6.2 Removing the I/O Expander Board

1. Remove four screws securing the I/O Expander board to the MPU Controller board. See Figure 11-1 and 11-2.

2. Slightly lift the lower edge of the I/O Expander board (edge closest to the DB9 Modbus display cable connector). On the MPU Controller board, open the connector ejector levers on the ribbon cable connector. Grasp the cable-mounted connector and pull it from the board-mounted connector.

   **Assembly Note**

   If field installing an I/O Expander Board Kit, remove four screws securing the MPU Controller Board to the cover. Thread four hex standoffs from the kit into these locations.

3. Lift the board from the Controller cover and place it in an anti-static bag.

**IMPORTANT**

After replacing an I/O Expander board in a controller whose configuration includes an AINU function block: assemble the controller, apply power, ENTER configuration and STORE the SEN TYPE parameter. This must be done even if the SEN TYPE displays the desired type. This will ensure that the function block loads the calibration from the new Expander board. If desired, a FIELD CAL can then be performed.
FIGURE 11-2  I/O Expander Board, Simplified View

To MPU Controller Board

6-Pin Connector, Terminals 27 - 32

21-Pin Connector, Terminals 33 - 52
11.6.3 Changing the Power Input Fuse

If replacing the fuse go to step 1 below, otherwise, go to Section 11.6.4 Removing the MPU Controller Board to continue disassembling the Controller.

1. Refer to Figure 11-1 and 11-4 or 11-5 and carefully remove the fuse (F1) from the mounting clips.
2. Press the replacement fuse into the clips and reassemble the Controller.

Assembly Note

After re-assembly, apply power to the Controller and operate it off-line for several minutes to be sure that a condition does not exist that will cause the replacement fuse to fail.

11.6.4 Removing the MPU Controller Board

1. Disconnect an optional Faceplate Display.
   - If a direct mount Faceplate Display is installed, go to Section 11.6.6 and remove the Display. Then return here to step 2.
   - If a remote mount Faceplate Display is installed and it was not disconnected in an earlier step, disconnect the Faceplate Display’s display cable as follows. On the Controller cover, open the ribbon cable ejector levers. Grasp the cable-mounted connector and pull the connector from the case-mounted connector.
2. Remove either four screws or four hex standoffs securing the MPU board and lift the board (and any accompanying Accessory boards) from the Controller cover. Set W7 or W8 as described in Figure 11-3 or 11-4 and slip the board(s) into an anti-static bag.

Assembly Note

On the replacement MPU Controller board, set W7 or W8 as described in the appropriate figure. Set W2 and W4 as described in Section 11.6.5 Removing an Accessory Board.
Real Time Clock Jumper:
1. As shown, shunt installed on CLK pins to enable HOT/WARM Start.
2. Place shunt on N/C pins when storing Controller or MPU Controller board, and for COLD Start.

FIGURE 11-3 MPU Controller Board with Real Time Clock Jumper W8
W7 Real Time Clock Jumper:
1. Place shunt on both pins, as shown, to enable Hot/Warm Start.
2. Place shunt on one pin when storing a Controller or MPU Controller Board, and for Cold Start.
3. See detail below.

Jumpers are factory set for the circuit boards installed at time of shipment.

FIGURE 11-4 MPU Controller Board with Real Time Clock Jumper W7
11.6.5 Removing an Accessory Board

1. Remove screws and nuts holding the selected Accessory board(s) to the MPU Controller board. See Figure 11-5.
2. Carefully unplug the Accessory board(s) from the MPU Controller board.
3. Place board(s) in an anti-static bag.

Assembly Notes and Jumpers W2 and W4

When reassembling, carefully align the Accessory board connector with the MPU Controller board connector before mating.

These boards mechanically fasten and electrically connect to the MPU Controller board as shown in Figure 11-5 and listed below. Carefully align connectors before applying force to seat them.

- LIL Network board (Figure 11-6) plugs into J3
- LonWorks board (Figure 11-7) plugs into J6
- RCB or RTC/CB board (Figure 11-8) plugs into a Network board. When a Network board is not installed, plug the RCB or RTC/CB board into J3 on the MPU Controller board. See the RTC/CB procedure below.

Jumpers W2 and W4:

W2 LIL/Ethernet/Modbus Network Jumper, located on the MPU Controller board:
- Install shunt when network connections at rear terminals 3 and 4 are wired for Modbus.
- Remove and save the shunt when network connections at rear terminals 3 and 4 are wired for LIL and a LIL Network board is installed.

W4 LonWorks I/O Bus Jumper, located on the MPU Controller board:
- Install shunt when LonWorks Board is NOT installed.
- Remove and save the shunt when a LonWorks Board is installed.

If a controller is receiving one of these boards for the first time, ERR 232 may be displayed when power is applied. This should not be a concern and can be cleared by pressing the ENTER/EXIT configuration button. Edit the configuration to activate the board and connect I/O or network wiring as needed.
FIGURE 11-5 Accessory Board Installation and Replacement

| RTC/CB and RCB Boards |

Refer to Figure 11-5 for board location and assembly hardware; the RCB and RTC/CB board mount in the same location and use the same hardware. The board typically mounts on and electrically connects to either a LIL Network board or an Ethernet board. If either of these boards is not installed, the RTC/CB board will mount directly on and electrically connect to the MPU Controller.

**IMPORTANT**

Before powering the controller after installing an RTC/CB board, connect a local faceplate to the controller. The controller will power up in a hold state and the faceplate is needed to select the controller configuration as described in the following procedure.

**Board Installation**

1. To install a board, fasten a grounded wrist strap on your wrist.
2. The MPU Controller board may have several attached boards secured by spacers and screws. Refer to Figure 11-5 for board location and fasteners. Refer to the board comments above for jumpering and other information before attaching a board to the MPU Controller board.
3. Insert the board or board stack into the case card guides and carefully guide the connector end of the board until it mates with the connector(s) on the case. Only when the connectors are mated should additional force be applied to seat the board. Install board retaining hardware. (Refer to Section 11.6.3 as needed.)
4. Install the Display Assembly. Refer to Section 11.6.2.
5. Remove the wrist strap.
6. When power is applied, an RCB->MEM message will appear in the local faceplate’s alphanumeric display. This message is prompting you to select the controller’s operating configuration. Read the two bulleted items below and select the desired configuration.

- To copy the configuration stored on the RTC/CB or RCB board to the MPU Controller board: rotate the pulser to display YES and press the STORE pushbutton. This option is typically selected when a configuration is being transferred from one controller to another by moving the RTC/CB or RCB board from one controller to another.

- To retain the configuration stored on the MPU Controller board: rotate the pulser to display NO and press the STORE pushbutton. The configuration stored on the MPU Controller board will be the operating configuration and it will be copied to the RTC/CB or RCB board when a change is made to the configuration.

![Connector, This Side](image)

**FIGURE 11-6 LIL Network Board**

![Components on other side of circuit board](image)

**FIGURE 11-7 LonWorks Board**
11.6.6 Removing the Faceplate Display

To replace the Faceplate Display, see Section 11.6.6.1. To replace the bezel or the circuit board, perform the procedures in Sections 11.6.6.1 and 11.6.6.2.

11.6.6.1 Replacing a Faceplate Display

REMOVAL:

1. In a hazardous area, remove power from the Controller.
2. Protect the station’s electronic components from electrostatic discharge. Fasten a conductive wrist strap around your wrist and ground the strap to the ground screw on the Controller’s case, an unpainted area on the panel, or a grounded static dissipative workmat.
3. Loosen the Display assembly’s two faceplate screws. One is above the numeric display and one behind the flip-down door at the bottom of the faceplate.
4. Pull the assembly from the panel about 1.5” (38 mm).
5. Look behind the assembly and locate the display cable from the MPU Controller board. Open the connector locking levers on the assembly-mounted connector to eject the cable-mounted connector.
6. Either place the Display assembly in a static shielding bag and set it aside or go to Section 11.6.6.2 to replace the assembly’s bezel or circuit board.

INSTALLATION

1. Hold the Display assembly close to the open case and mate the display cable with the connector on the Display assembly circuit board. Check that the locking levers on the connector fully engaged the cable-mounted connector. The connector is keyed.
2. Align the Display assembly with the case. To ensure water tightness, use a torque screwdriver set to 6 inch-pounds to tighten the two faceplate screws. Alternatively, use a screwdriver to tighten the screws until a slight resistance is felt, then tighten an additional ½ turn. DO NOT OVERTIGHTEN.
3. Remove the wrist strap.

NOTE

When changing a Display assembly with the controller powered-up and an error code present, the displays will light in a random pattern except for the alphanumeric display which will show the error code. Clear the error to clear the displays.

11.6.6.2 Replacing the Bezel or Circuit Board

REMOVAL

1. Place a properly grounded wrist strap on your wrist and remove the Display assembly as described above.

FIGURE 11-8 Real Time Clock/Configuration Backup Board
2. Refer to the figure below. Notice that the circuit board is captured by a Fixed Retainer at the top of the bezel and a Flexible Retainer at the bottom. Grasp the body of the black connector at “A” and at the same time press the Flexible Retainer downward slightly. Pull gently on the connector to lift the bottom edge of the board above the Flexible Retainer.

**Note**

The board is a snug fit. Do not squeeze the bezel sides and make removal more difficult.

3. Remove the board from the bezel by carefully continuing to lift board while pulling the board out from under to Fixed Retainer at the top of the assembly.

4. If the bezel is being replaced:
   1) Remove the two Display assembly mounting screws. Turn the Assembly face up and lift each mounting screw upward until the threaded portion contacts the bezel. Turn each screw counterclockwise to unscrew it from the bezel. A screwdriver may be needed once a screw is started.
   2) Remove the flip-down door by pressing on the door near its pivot point to free the door from the bezel.

---

**INSTALLATION**

1. Place an anti-static wrist strap on your wrist and connect the ground lead.

2. Get the replacement bezel, or get the replacement circuit board and remove it from the anti-static bag.

3. If the bezel is being replaced, start threading each Faceplate mounting screw into the bezel. Use a screwdriver to complete screw installation. Install the flip-down door; see the figure.

4. Turn the bezel over.

5. Install the circuit board in the bezel by slightly inserting the top edge of board under the Fixed Retainer. The top edge is nearest the Numeric and Alphanumeric Displays.

6. Continue to ease the board under the Fixed Retainer while lowering the bottom edge of the board into the bezel. Be sure that the keypad connector mates with the connector on the keypad. The board is fully inserted when it snaps under the Flexible Retainer.

7. Install the Display assembly on the case as described above.
12.0 CALIBRATION

A controller is factory calibrated to either the standard values listed in Section 8.6 or to values specified by the purchaser at time of order. Field calibration should not be necessary.

For those cases where inputs or outputs must be adjusted either to meet a local standard or for a more critical application, a field calibration can be performed. The field calibration becomes the default calibration.

A CAL VIEW mode is available in calibration to view the sensor input over the full range. The signal that is viewed, in the calibration verify mode, is 0 to 100% of span in basic units of measure (e.g., °C for temperature, mv for millivolts) and is not affected by the temperature units conversion, digital filter, scaling, or the output bias adjustment. The full block output in engineering units with these parameters applied can be seen in the VIEW mode within loop configuration.

This section describes calibration and calibration verification of the following function blocks:

| AIN1-4 | - Analog Input | MPU board (3) and I/O Expander board (1) |
| AOUT1-3 | - Analog Output | MPU board (2) and I/O Expander board (1) |

Note

AINU1-2, Analog Input Universal, refer to the AINU description in Section 3 Function Blocks for calibration information.

When field calibrating a controller for a critical application, consider the following:

- If the input is a current signal (e.g., 4-20 mA), use a precision current source. The 250 ohm precision range resistor installed across the input terminals for calibration should remain with the station, connected across that set of terminals, to eliminate the voltage drop variation due to resistor tolerance.

- Allow the Station to warm-up for an hour prior to calibration. The ambient temperature should be close to normal operating conditions.

The controller must be off-line during calibration. Factory calibration values are listed in Section 8.5.

Refer to Table 8.1 and to the installation wiring figures in Section 8 for power input, signal input and signal output terminals.

Security, Calibration of Inputs/Outputs: If level 1 and level 4 security are enabled, the user-determined six-digit security combination (e.g. 000025) for either level 1 or level 4 must be entered before new calibration parameters can be stored. Once the security combination has been entered, access will be provided to all functions with that security level until the user exits configuration. For additional information, refer to function block SECUR - Security in Section 3.

Bargraphs: The bargraphs on the Display Assembly are not used during the calibration procedure. Ignore any bargraph indications during calibration.
Calibration and calibration verification are described in the following procedures.

**WARNING**

**Electrical shock hazard**

Hazardous voltage can cause death or serious injury.

Remove power from all wires and terminals before working on this equipment.

### 12.1 ANALOG INPUT (AIN1-4)

Analog input function blocks have been factory calibrated for 1 to 5 Vdc inputs. Recalibration should not be required unless calibration parameters are to be changed. Periodic recalibration should not be necessary. To calibrate an analog input, use the following procedure.

1. At the controller's rear terminals, connect an electronic calibrator or precision reference source capable of supplying a voltage between 0.000 and 5.000 Vdc to the selected analog input terminals (e.g. AIN1 or AIN2). Refer to Section 8 Installation for terminal numbers and wiring guidelines. Ensure that terminal screws are tight.

2. If security is enabled, a level 1 or level 4 security combination will be needed to store the results of a calibration. Refer to SECUR-Security in Section 3 for additional information.

3. Apply power to the station.

4. Press the ENTER CONF button to enter the configuration mode at the MENU level. Rotate the Pulser Knob to select ‘STATION’ on the alphanumeric (lower) display.

5. Press the STEP DOWN button to choose options at the station level and rotate the Pulser Knob to select ‘CAL’ on the alphanumeric display.

6. Press the STEP DOWN button to enter the FUNCTION BLOCK level. Rotate the Pulser Knob to select the desired input (e.g. AIN1 or AIN2).

7. Press the STEP DOWN button to enter the PARAMETER level.

8. Rotate the Pulser Knob to select the desired parameter, CAL ZERO, shown on the alphanumeric display.

9. Press the STEP DOWN button to enter the VALUE level ('CAL' appears on upper display).

10. Set the precision voltage source to the zero input value (0.000 to 1.000 Vdc).

11. Press STORE to lock-in the desired value. If ENTER COM appears in the alphanumeric display, security is enabled and steps 1) through 5) must be performed to store the calibration. Otherwise, go to step 14.

   1) The numeric display shows 000000 with the right-most digit flashing. Rotate the pulser knob to set the units digit to the correct number.

   2) Press the TAG/ key to select the next digit, the tens digit. Rotate the pulser knob to select a number for that digit.

   3) Move to and select the needed number for each remaining digit.

   4) Press ENTER. If the combination entered is incorrect, “ACCESS/DENIED” will be displayed and the controller will return to the parameter level. Otherwise, go to step 14.

14. Press the STEP UP button. Rotate the Pulser Knob to select the ‘CAL FULL’ parameter.

15. Press the STEP DOWN button to enter the VALUE level (‘CAL’ appears on upper display).
16. Set the voltage source to the full scale input value (4.000 to 5.000 Vdc).

17. Press STORE.

18. For verification perform the following steps:
   1) Press STEP UP button. Rotate Pulser Knob to select ‘CAL VIEW’ parameter.
   2) Press STEP DOWN button to enter VALUE level. Set precision voltage source to zero input voltage. The display should read 0%.
   3) Set source to full scale voltage. The display should read 100%.

20. If all points have been calibrated and verified, press EXIT button to leave the calibration mode and enter the operation mode. If additional function blocks are to be calibrated and verified, press the STEP UP button to enter the FUNCTION BLOCK level. Perform steps 2 -19 for each function block.

If security is enabled, exiting the configuration mode will lock out the calibration mode until the security combination is re-entered.

12.2 ANALOG OUTPUT (AOUT1-3)

Analog output function blocks have been factory calibrated to 4-20 mA dc outputs. If recalibration is necessary use the following procedure.

1. At the controller’s rear terminals, connect an electronic calibrator or digital multimeter capable of displaying 4.00 and 20.00 mA dc to the selected analog output terminals (AOUT1 or AOUT2). Refer to Section 8 Installation for terminal numbers and wiring guidelines. Ensure that terminal screws are tight.

2. If security is enabled, a level 1 or level 4 security combination will be needed to store the results of a calibration. Refer to SECUR-Security in Section 3 for additional information.

3. Apply power to the station.

4. Press the ENTER CONF button to enter the configuration mode at the MENU level.

5. Rotate the Pulser Knob to select ‘STATION’ on the alphanumeric (lower) display.

6. Press the STEP DOWN button to choose options at the station level and rotate the Pulser Knob to select ‘CAL’ on the alphanumeric display.

7. Press the STEP DOWN button to enter the FUNCTION BLOCK level. Rotate the Pulser Knob to select the desired output (e.g. AOUT1).

8. Press the STEP DOWN button to enter the PARAMETER level. Rotate the Pulser Knob to select the desired parameter, CAL ZERO, shown on the alphanumeric display.

9. Press the STEP DOWN button to enter the VALUE level (‘CAL’ appears on display).

10. Rotate the Pulser Knob to set the zero output to 4.00 mA on the digital multimeter or electronic calibrator.

11. Press the STORE button to lock-in the desired value. (If “ENTER COM” appears in the alphanumeric display, go to Section 12.1, step 13 for entering a level 1 or level 4 security combination.)

12. Press the STEP UP button. Rotate the Pulser Knob to select the ‘CAL FULL’ parameter.

13. Press the STEP DOWN button to enter the VALUE level (‘CAL’ appears on display).

14. Rotate the Pulser Knob to set the full scale output to 20.00 mA.

15. Press STORE.

16. For verification perform the following steps:
   1) Press STEP UP button and rotate Pulser Knob to select ‘CAL VIEW’ parameter.
   2) Press STEP DOWN button to enter VALUE level.
3) Rotate Pulser Knob to set display to 0.0%. Output current should be 4.00 mA.

4) Rotate Pulser Knob to set 100.0%. Output current should be 20.00 mA.

20. If all points have been calibrated and verified, press EXIT button to leave calibration mode and enter operation mode. If additional function blocks are to be calibrated and verified, press STEP UP button to enter FUNCTION BLOCK level. Perform steps 2-19 for each function block.

If security is enabled, the exiting the configuration mode will lock out the calibration mode until the security combination is re-entered.
13.0 CIRCUIT DESCRIPTION

This section provides a block diagram level circuit description of the Moore 354N.

13.1 OVERVIEW

Controller hardware architecture is shown in Figure 13-1. Notice that all major plug-in assemblies interact with the Controller Board.

The Display Assembly is used for operation and configuration. The MPU-based Controller Board performs many of the controller’s signal processing and process control functions in addition to overseeing internal operations. The Controller Board’s on-board power supply furnishes DC operating voltages to all plug-in assemblies and to external process transmitters connected to the rear terminals. The I/O Expander board provides additional I/O. Networking options include Modbus, Local Instrument Link and Ethernet (Procidia ii|pac and Moore 353 only).

FIGURE 13-1 Moore 354N Block Diagram
13.2 MPU CONTROLLER BOARD

The heart of the controller is the powerful, microprocessor-based MPU Controller Board. The flexible software supports reusable function blocks beneficial in solving a vast array of control strategies such as single loop, cascade and dual loop.

The Controller Board assembly contains both analog and digital circuits. The analog circuitry operates in real time while the microprocessor based digital circuitry operates at high speed under program control. The MPU (microprocessor unit) contains a CPU32 core, System Integration Module (SIM), a queued SPI module (QSPI), timer module and two general-purpose 8-bit ports. The MPU is capable of arithmetic, logical, and support circuit control functions and interacts with surrounding on-board and off-board circuitry to direct the internal operation of the controller. The MPU Board also contains 16-bit RAM, 16-bit ROM, a 2-wire RS485 connection, and an RS232 connection.

The CPU32 communicates with the RAM, ROM and external communications boards via the SIM. All communication between the MPU and the I/O, display and expander board is done via the QSPI. The QSPI is a full-duplex, synchronous serial interface with a queue for receive and transmit data. Communication consists of timing, control, data, and sequencing information.

The Controller Board has three analog inputs, 3 digital inputs, 2 analog outputs and 2 digital outputs. The configuration in use determines the active inputs and outputs. For example, Factory Configured Option FCO101 is configured to accept one analog input for the process signal and one analog output for the valve signal. The two analog outputs are 4 to 20 mA current sources with shutdown control for use in redundant control systems. The two digital outputs are open collector devices with over-voltage protection.

Two serial ports are available for bi-directional asynchronous communications. Terminals NCA and NCB provide an RS485 connection for LIL or Modbus network communications. A DB9 connector on the underside of the controller provides an RS232 connection for creating and editing configurations using the optional PC-Based Graphical Configuration Utility and for communication with a local HMI operator display. Since both ports are independent UARTs, communications with one serial port will not interfere with communications to the other. Parameters in the STATN function block allow setting of the Modbus baud rate and transmission characteristic for the DB9 configuration/HMI port and LIL/Modbus terminals NCA/NB. (See STATN-Station Parameters in Section 3.) Additional information on Modbus network communications and data mapping can be found in Section 6 and Section 7.

The RS-232 connection uses a DB9 connector with the following six connections:

- RTS - Handshaking output from MPU
- TXD - Data output from MPU
- Common
- Common
- RXD - Data input to MPU
- CTS - Handshaking input to MPU

The on-board Power Supply circuit provides the power sources necessary for system power, internal analog output power and transmitter power. Transmitter power is +26 Vdc at 0.125 amperes, to power up six process transmitters.

13.3 I/O EXPANDER BOARD

The I/O Expander Board communicates with the Controller Board and contains hardware that increases station capability. Additional direct connected I/O includes two isolated universal analog inputs with thermocouple, RTD, resistance, slidewire, mA and voltage conversions, two additional digital inputs that can be used as discrete or frequency inputs, an additional analog output and two relay outputs. All calibration data for the Expander Board is stored in the board’s nonvolatile EEPROM making recalibration unnecessary when interchanging Expander and Controller Boards.
Expander circuitry operates under the control of the MPU-based Controller Board, and like the Controller Board, it contains both analog and digital circuitry. The analog circuitry operates in real time while the digital circuitry operates at high speed under program control.

Relay 1 and Relay 2 are triggered by the off-board MPU to provide relay contact type outputs. Each SPDT relay output can be connected in a normally open or normally closed contact state.

### 13.4 LonWorks BOARD

The LonWorks Board provides additional I/O when needed for multiple-loop applications, advanced control, or batch sequencing. This board uses the popular LonWorks (LON stands for Local Operating Network) protocol for high connectivity via a high-speed digital fieldbus to a large selection of standard I/O products. LonWorks remote I/O products include many analog input and output options as well as digital inputs and outputs using relay or solid state technology. This board plugs into the Controller Board via two connectors. An 80 pin pass-through connector is also available for stacking additional option boards.

The LonWorks Board has an integrated circuit containing three processors, two timers, RAM, EEPROM, parallel and serial ports and a network communication port. The board communicates with the Controller Board via a parallel MIP interface. The MIP interface uses a token passing scheme so only the token holder can initiate a data transfer. The board also connects directly to a remote network using a free topology transceiver that operates at a rate of 78 kbps and connects up to 64 nodes over a twisted pair (see Section 5.0). The network wiring may be in a bus configuration or wired in any combination of bus, star or loop topologies.

### 13.5 LOCAL INSTRUMENT LINK (LIL) NETWORK BOARD

An optional Local Instrument Link (LIL) Network Board is available in place of the Modbus communication network to provide higher speed networking and peer-to-peer communication between controllers. The hardware architecture is designed to accommodate other emerging fieldbus technologies. This includes both field communications that may require lower power for intrinsic safety and also higher speed for interplant networking.

The LIL Board plugs into the controller board via two connectors. An 80-pin pass-through connector is also available for stacking additional option boards. The LIL Board communicates with the main Controller Board via a 32K, 8-bit Dual Port RAM. Two LED’s on the LIL Board indicate serial transmit and line activity.

Global LIL function blocks (AIL, AOL, DIL, DOL) can be configured to provide communication between controllers as well as connectivity to other LIL products, such as the Models 352, 351 and 382, over a twisted pair network. The total number of global function blocks will be limited by the number of global channels available. Information on LIL network communications and Data Mapping can be found in Sections 6 and 7.
14.0 MODEL DESIGNATION AND SPECIFICATIONS

This section provides model designation information, lists of controller accessories and service parts, detailed controller specifications and hazardous area installation information.

**IMPORTANT**

Before installing or servicing a controller, refer to the controller labels and the applicable specifications and hazardous area classifications in this section to ensure that the correct model with the needed certifications is at hand.

Every controller is identified by several labels. Labels are located on the case and inside the drop-down door on the Display Assembly, as shown in Figure 1-1. Typical labels are shown below.

---

**14.1 MODEL DESIGNATION**

Table 14.1 shows the controller’s model number sequence. The model designation is shown on a nameplate on the top of the case. The nameplate and other labels carry important information about the controller, such as Model Number, Bill of Material number (P/N No.), Serial Number, and Certifications.

**IMPORTANT**

Confirm a controller’s model number and hazardous area certifications before installing, applying power, or servicing.

When circuit boards are added to a controller in the field, nameplate information will not reflect the current physical configuration.
# TABLE 14.1 Moore 354N Model Designation*

**BASIC MODEL NUMBER**

<table>
<thead>
<tr>
<th>Model Designation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>354N</td>
<td>Universal Control Station</td>
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**Power Requirements**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>120/240 Vac (90-250 Vac), 47-63 Hz.</td>
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</table>

**Local Faceplate Display**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>N</td>
<td>Not Required</td>
</tr>
<tr>
<td>D</td>
<td>Fixed Analog &amp; Digital Displays - Direct Mounted</td>
</tr>
<tr>
<td>R</td>
<td>Fixed Analog &amp; Digital Displays - Remote Mounted</td>
</tr>
</tbody>
</table>

**Expander I/O Board**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>N</td>
<td>Not Required</td>
</tr>
<tr>
<td>L</td>
<td>Local I/O Expander (T/C, RTD, Frequency, Relay…)</td>
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</tbody>
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**Option Board A-1 (Remote I/O Communications)**

<table>
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<th>Requirement</th>
<th>Description</th>
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<tbody>
<tr>
<td>N</td>
<td>Not Required</td>
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<tr>
<td>L</td>
<td>LonWorks Protocol</td>
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**Option Board A-2**

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<td>N</td>
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**Option Board B-1 (Network Communications)**

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<th>Requirement</th>
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</thead>
<tbody>
<tr>
<td>N</td>
<td>Not Required</td>
</tr>
<tr>
<td>L</td>
<td>Local Instrument Link (LIL)</td>
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</tbody>
</table>

**Real Time Clock/Configuration Backup**

<table>
<thead>
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<th>Requirement</th>
<th>Description</th>
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<tbody>
<tr>
<td>N</td>
<td>Not Required</td>
</tr>
<tr>
<td>R</td>
<td>Removable Configuration Board (Discontinued)</td>
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<tr>
<td>T</td>
<td>Real Time Clock/Configuration Backup</td>
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**Modification Options**

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<tbody>
<tr>
<td>N</td>
<td>Not Required</td>
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<tr>
<td>X</td>
<td>Controller Modified as detailed in order bill of material</td>
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**Reserved for Future Use**

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<th>Requirement</th>
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<td>N</td>
<td>Reserved for Future Use</td>
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**Design Level**

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<tbody>
<tr>
<td>A</td>
<td>Design Level A</td>
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**Electrical Approval**

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<tbody>
<tr>
<td>N</td>
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</tr>
<tr>
<td>J</td>
<td>CSA (NRTL) Class 1, Div. 2, Groups A, B, C, &amp; D</td>
</tr>
<tr>
<td>E</td>
<td>CE + CSA (NRTL) Class 1, Div. 2, Groups A, B, C, &amp; D</td>
</tr>
</tbody>
</table>

**Sample Model No.**

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>354A</td>
<td>N N N N N N N A N</td>
</tr>
</tbody>
</table>

* Contact the Process Industries Division of Siemens Energy & Automation for the latest model designation information, availability of some options, and current electrical approvals. Always refer to the labels on the controller case for approvals and certifications.
### 14.2 ACCESSORIES

The following two tables list the accessories currently available.

<table>
<thead>
<tr>
<th>ACCESSORY</th>
<th>PART NUMBER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td>config Graphical Configuration Utility</td>
<td>iCONFIG-Vn.nn</td>
</tr>
<tr>
<td>Transmitter Power Supply</td>
<td>15124-1</td>
<td>Acopian Model B24G210M, 24 Vdc, 2.0A</td>
</tr>
<tr>
<td>Adapter Bezel</td>
<td>15738-123</td>
<td>A panel cutout adapter for mounting a controller in a 3&quot;x 6&quot; panel cutout.</td>
</tr>
<tr>
<td>Blank Filler Panel</td>
<td>15738-168</td>
<td>Enhances control room appearance by covering a panel cutout intended for future mounting of a controller.</td>
</tr>
<tr>
<td>Loop Identification Card</td>
<td>-----</td>
<td>Custom printed loop identification for flip-down access door. Specify up to 5 lines with 24 characters per line.</td>
</tr>
<tr>
<td>Permanent Instrument Tag</td>
<td>-----</td>
<td>Stainless steel tag permanently attached to the controller case. One line with up to 24 characters can be specified.</td>
</tr>
<tr>
<td>Display Assembly Remote Mounting Kit</td>
<td>16353-54</td>
<td>For remote panel mounting of a Display Assembly. Includes: Flange Assembly Mounting Clips and Screws Display (Ribbon) Cable, 45 inches (1143 mm) long Installation Instruction Does not include the Display Assembly.</td>
</tr>
<tr>
<td>Communications Cable, MMJ11 to MMJ11</td>
<td>16353-61</td>
<td>Connects MMJ11 on adapter (connected to a personal computer’s serial port) to MMJ11 on a Display Assembly. Select one of the following adapters.</td>
</tr>
<tr>
<td>Adapter, DB25 to MMJ11</td>
<td>16353-62</td>
<td>Adapts personal computer serial port to above Communications Cable.</td>
</tr>
<tr>
<td>Adapter, DB9 to MMJ11</td>
<td>16353-63</td>
<td>Peel and stick labels for customizing faceplate pushbuttons.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LONWORKS ACCESSORY</th>
<th>PART NUMBER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>LonWorks Protocol Startup Kit</td>
<td>16353-65</td>
<td>LonWorks Startup Kit; includes: 27005-1 Adapter - see description below 15939-70Vn.nn Driver - see description below 16353-66 Cable - see description below</td>
</tr>
<tr>
<td>Echelon 73000-1-600-6 SLTA/2</td>
<td>27005-1</td>
<td>Serial PC Interface Adapter</td>
</tr>
<tr>
<td>Echelon SLTA/2 Device Driver</td>
<td>15939-70Vn.nn</td>
<td>PC software (latest version will be supplied)</td>
</tr>
<tr>
<td>SLTA/2 to LonWorks Network Cable</td>
<td>16260-27</td>
<td>Cable assembly to connect DB9 on PC serial port to DB9 on SLTA Adapter</td>
</tr>
<tr>
<td>Configuration Software</td>
<td>27005-2</td>
<td>Acromag 50SW-CFS-M03-1.44MB</td>
</tr>
</tbody>
</table>
### 14.3 SERVICE PARTS KITS

Exploded view drawings of the Moore 354N appear in Section 1 Introduction and Section 11 Maintenance.

<table>
<thead>
<tr>
<th>SERVICE PART DESCRIPTION</th>
<th>PART NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>- FIRMWARE UPDATE KITS -</strong></td>
<td></td>
</tr>
<tr>
<td>MPU Controller Firmware V1.3# to V1.32</td>
<td>15939-71V1.32</td>
</tr>
<tr>
<td>MPU Controller Firmware V1.2# to V1.32</td>
<td>15939-77V1.32</td>
</tr>
<tr>
<td>MPU Controller Firmware V1.3# to V2.40</td>
<td>15939-77V2.40</td>
</tr>
<tr>
<td><strong>- ELECTRONIC ASSEMBLIES AND RELATED PARTS -</strong></td>
<td></td>
</tr>
<tr>
<td>Display Assembly Kit, for Model 354N D</td>
<td>16353-53*</td>
</tr>
<tr>
<td>Display Assembly Bezel Replacement Kit</td>
<td>16353-163</td>
</tr>
<tr>
<td>Contains gray bezel, keypad, pulsar knob, and Instruction. Does not contain black Display Board or Display Assembly mounting screws.</td>
<td></td>
</tr>
<tr>
<td>MPU Controller Board Kit for 120/240 Vac Power Input</td>
<td>17354-57*</td>
</tr>
<tr>
<td>I/O Expander Board Kit</td>
<td>17354-40*</td>
</tr>
<tr>
<td>Local Instrument Link Network Board Kit with mounting hardware, for Model 354N L</td>
<td>16297-22*</td>
</tr>
</tbody>
</table>

10 For 4-20 mA input module, order 72005-6 calibrated to 0.2 to 1V. (Replaces part 27005-3.)
<table>
<thead>
<tr>
<th>SERVICE PART DESCRIPTION</th>
<th>PART NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>LonWorks Board Kit with mounting hardware, for Model 354N_ _ _ L _ _ _ _ _ _ _</td>
<td>16353-69*</td>
</tr>
<tr>
<td>LonWorks Resistor Kit, includes: 2000 Ohm, 5%, 1/4W, qty 8 105 Ohm, 1%, 1/8W, qty 2 52 Ohm, 1%, 1/8W, qty 4 Diode, 1N4005G, 1A, 600V, qty 8</td>
<td>16353-141</td>
</tr>
<tr>
<td>Removable Configuration Board Kit with mounting hardware, for Model 354N _ _ _ _ _ _ R _ _ _ _ (for firmware V1.31 or V1.32)</td>
<td>16353-143</td>
</tr>
<tr>
<td>Spare Parts Kit, includes: Power Input and Range Resistor Kit, includes: 250 Ohm, 0.1%, 3W, WW resistor and insulating sleeving, qty 3 each Crimp-on connector, qty 6 Range Resistor and Reference Junction Kit, includes: 250 Ohm, 0.1%, 3W, WW resistor, qty 1 3.75 Ohm, 1%, 3W, WW resistor, qty 2 Insulating sleeving, qty 5 Crimp-on connector, qty 6 100 Ohm reference junction for TC inputs, qty 2 Crimp-on Connector, qty 18 O-Ring, Display Assembly, qty 1 Fuses, 0.5A (for 120/240 Vac MPU Controller board) and 2A (for 24 Vdc MPU Controller board), 250V, SloBlo, qty 1 each Case Mounting Clip and 8-32 x 1 Fillister Hd. Screw, qty 2 each Case Ground Screw (Green) and Rear Terminal Cover, qty 1 each</td>
<td>16353-131*</td>
</tr>
<tr>
<td>Real Time Clock/Configuration Backup Board Kit Model 354N_ _ _ _ _ _ T_ _ _ _ (for firmware V2.0/V2.20 or higher, see the CLOCK function block description)</td>
<td>16357-34*</td>
</tr>
</tbody>
</table>

Notes to Kits:
- Refer to User’s Manual UM354N-1 for accessory part numbers and for servicing a controller.
- See drawing(s) on previous page for disassembly and item reference numbers.
- * Identifies a recommended on-hand spare part for the indicated model. Include nameplate information when ordering.
- NS = Not Shown

### 14.4 MECHANICAL SPECIFICATIONS

#### Dimensions
Controller and Tray Dimensions .........................See Figure 8-2
Faceplate Display Dimensions .........................See Figure 8-3
Panel Cutout Dimensions, Faceplate Display ..........See Figure 8-4

#### Weight
Model 354N_ _ ................................................. 4.5 lbs (2.0 kg)
Faceplate Display ............................................. 0.3 lbs (0.14 kg)
All weights are approximate.

### 14.5 POWER INPUT REQUIREMENTS

#### Voltage Input
Model 354N ...................................................... 85-264 Vac, 47-63 Hz
AC power ride through time ...................... 25 msec. (minimum)
Power .......................................................... 25 Watts, 40 VA (maximum)

Wire Size, Recommended .................................... 18 AWG (0.96 mm²)

Terminals ...................................................... H - Hot; N - Neutral; G (or ground symbol) - Ground

Over-current Protection ..................................... 20A maximum fuse or circuit breaker

14.6 MPU CONTROLLER BOARD SPECIFICATIONS

Analog Inputs: (3)
  Input Range ................................................... 0-5 Vdc (standard calibration 1-5 Vdc)
    Zero .......................................................... 0-1 Vdc
    Span ........................................................... 4-5 Vdc
  Type ............................................................. Single ended
  Accuracy ...................................................... 0.10 %
  Resolution .................................................. 0.024 %
  Software Output Type .................................... Analog [configurable (default 0.0-100.0)]
  Normal Mode Rejection ................................. >50dB @ 60Hz.
  Input Impedance ............................................. >1 megohm
  Maximum Continuous Input
    Without Crosstalk .................................... +7, -30 Vdc
    Without Damage ........................................ ±30 Vdc

Analog Outputs: (2)
  Standard Calibration ..................................... 4-20 mA dc
    Zero .......................................................... 4 mA dc +/- trim
    Span ........................................................... 16 mA dc +/- trim
  Current Limits ............................................... 2.4 mA to 21.6 mA
  Accuracy .................................................... 0.1 %
  Resolution .................................................. 0.003 %
  Software Input Type ...................................... Analog [configurable (default 0.0-100.0)]
  Signal Reference ......................................... Neg. (-) output tied to station common
  Output Load ................................................ 800 Ohms
  Over-voltage Protection .................................. 30 Vdc

Digital Inputs: (3)
  Logic “1” Range ............................................. 15-30 Vdc
  Logic “0” Range ............................................. 0-1 Vdc
  Over-voltage ............................................... +/-30 Vdc
  Minimum Required ON time ................................ >Scan Time
  Software Output Type .................................... Digital
  Isolation .................................................... 100 Vdc

Digital Outputs: (2)
  Type ............................................................ Open Collector Transistor (emitter tied to station common)
  Load Voltage ............................................... +30Vdc maximum
  Load Current ............................................... 100 mA maximum
  Off State Leakage Current ............................... < 200 uA @ 30 Vdc

Transmitter Power ........................................ 25 Vdc +/-3V, 120 mA, short circuit protected

14.7 I/O EXPANDER BOARD SPECIFICATIONS

Analog Inputs, Universal: (2)
  Type ’J’ Thermocouple:
    Range Limits ............................................. -185°C to 1100°C (-300°F to 2010°F)
    Performance Range .................................... 0 to 1100°C
Accuracy ...................................... +/-0.5°C
Conformity .................................. <= 0.06°C
Software Output Type.................... Analog (configurable °C, °F, °R, °K)
Ambient Temperature Effect: .......... +/- 0.08°C/°C

Type ‘K’ Thermocouple:
Range Limits ................................ -185°C to 1370°C (-300°F to 2500°F)
Performance Range...................... 0 to 1370°C
Accuracy ...................................... +/-0.6°C
Conformity .................................. <= 0.06°C
Software Output Type.................... Analog (configurable °C, °F, °R, °K)
Ambient Temperature Effect: .......... +/- 0.10°C/°C

Type ‘T’ Thermocouple:
Range Limits ................................ -240°C to 370°C (-400°F to 698°F)
Performance Range...................... -100 to 370°C
Accuracy ...................................... +/-0.5°C
Conformity .................................. <= 0.06°C
Software Output Type.................... Analog (configurable °C, °F, °R, °K)
Ambient Temperature Effect: .......... +/- 0.07°C/°C

Type ‘E’ Thermocouple:
Range Limits ................................ -185°C to 1000°C (-300°F to 1830°F)
Performance Range...................... 0 to 1000°C
Accuracy ...................................... +/-0.5°C
Conformity .................................. <= 0.06°C
Software Output Type.................... Analog (configurable °C, °F, °R, °K)
Ambient Temperature Effect: .......... +/- 0.07°C/°C

Type ‘S’ Thermocouple:
Range Limits ................................ -18°C to 1650°C (0°F to 3000°F)
Performance Range...................... 200 to 1650°C
Accuracy ...................................... +/-0.7°C
Conformity .................................. <= 0.06°C
Software Output Type.................... Analog (configurable °C, °F, °R, °K)
Ambient Temperature Effect: .......... +/- 0.14°C/°C

Type ‘R’ Thermocouple:
Range Limits ................................ -18°C to 1610°C (0°F to 2930°F)
Performance Range...................... 200 to 1610°C
Accuracy ...................................... +/-0.7°C
Conformity .................................. <= 0.06°C
Software Output Type.................... Analog (configurable °C, °F, °R, °K)
Ambient Temperature Effect: .......... +/- 0.15°C/°C

Type ‘B’ Thermocouple:
Range Limits ................................ -18°C to 1815°C (0°F to 3300°F)
Performance Range...................... 800 to 1815°C
Accuracy ...................................... +/-0.7°C
Conformity .................................. <= 0.06°C
Software Output Type.................... Analog (configurable °C, °F, °R, °K)
Ambient Temperature Effect: .......... +/- 0.15°C/°C

Type ‘N’ Thermocouple:
Range Limits ................................ -200°C to 1300°C (-325°F to 2370°F)
Performance Range...................... 0 to 1300°C
Accuracy ........................................... +/-0.5°C
Conformity ........................................ <= 0.06°
Software Output Type ................. Analog (configurable °C, °F, °R, °K)
Ambient Temperature Effect: ....... +/- 0.10°C/°C

Type DIN 43760/ IEC 751 RTD (à = 0.003850):
Range Limits ........................................ -185°C to 622°C (-300°F to 1152°F)
Accuracy ............................................ +/-0.4°C
Software Output Type ................ Analog (configurable °C, °F, °R, °K)
Ambient Temperature Effect: ........ +/- 0.04°C/°C

Type US (NBS126) RTD (à = 0.003902):
Range Limits ........................................ 185°C to 613°C (-300°F to 1135°F)
Accuracy ............................................ +/-0.4°C
Software Output Type ................ Analog (configurable °C, °F, °R, °K)
Ambient Temperature Effect: ........ +/- 0.04°C/°C

Type JIS C-1604 RTD (à = 0.003916):
Range Limits ........................................ -185°C to 610°C (-300°F to 1130°F)
Accuracy ............................................ +/-0.4°C
Software Output Type ................ Analog (configurable °C, °F, °R, °K)
Ambient Temperature Effect: ........ +/- 0.04°C/°C

Slidewire
Resistance Rangepection.................. 500-5000 Ω
Software Output Type ................ Analog (% slidewire 0.0 to 100.0)
Accuracy: ............................................ +/- 0.1%
Ambient Temperature Effect: ........ +/- 0.01°C/°C

Ohms
Resistance Range .................. 0-5000 Ω
Software Output Type ................ Analog (ohms)
Accuracy: ............................................ +/- 0.1%
Ambient Temperature Effect: ........ +/- 0.01°C/°C

Millivolt
Narrow Range .................... -19.0 to 19.0 mVdc
Accuracy ............................................ +/-5.0 uV
Ambient Temperature Effect........ 1.0 uV/°C
Wide Range .............................. -30.0 to 77 mVdc
Accuracy ............................................ +/-8.0 uV
Ambient Temperature Effect........ 2.5 uV/°C
Software Output Type ................ Analog (millivolts)

Analog Input: (1)
Input Range ........................................ 0-5 Vdc (standard calibration 1-5 Vdc)
Zero .................................................. 0-1 Vdc
Span .................................................. 4-5 Vdc
Type .............................................. Single ended
Accuracy ............................................ 0.10 %
Resolution ........................................ 0.024 %
Software Output Type ............... Analog [configurable (default 0.0 - 100.0)]
Normal Mode Rejection .................. >50dB @ 60Hz.
Input Impedance ...................... >1 megohm
Maximum Continuous Input ........... +/-30 Vdc
Analog Output: (1)

- Standard Calibration ................................ 4-20 mA
- Zero .............................................. 4 mA +/- trim
- Span .............................................. 16 mA +/- trim
- Accuracy ........................................... 0.10 %
- Resolution ....................................... 0.003 %
- Software Input Type .............................. Analog [configurable (default 0.0 - 100.0)]
- Current Range Limits ............................ 2.4 to 21.6 mA dc
- Signal Reference ................................. Neg. (-) output tied to station common
- Output Load ...................................... 800 Ohms
- Overvoltage Protection .......................... 30 Vdc

Digital Input: (1)

- Logic “1” Range .................................. 15-30 Vdc
- Logic “0” Range .................................. 0-1 Vdc
- Overvoltage ...................................... +/-30 Vdc
- Minimum Required ON Time .................... >Scan Time
- Software Output Type ............................ Digital
- Isolation .......................................... 100 Vdc

Universal Digital Inputs: (2)

- Logic “1” Range .................................. 4-30 Vdc
- Input Current .................................... <7 mA @ 30 V
- Logic “0” Range .................................. 0-1 Vdc
- Overvoltage ...................................... +/-30 Vdc
- Frequency Range ................................. 0 to 25,000 Hz.
- Accuracy ......................................... 0.03 % of reading
- Minimum Operating Frequency ............... 0.05 Hz.
- Pulse Width ...................................... 20 µsec (minimum)
- Signal Types ...................................... Sine Square, Pulse, Triangle, or Contact Closure
- Software Output Types: (a) Scaled Frequency: Analog
- (b) Scaled Count: Analog
- (c) Current Input State: Digital
- Isolation .......................................... 100 Vdc

Relay Outputs: (2)

- Type .............................................. Sealed (meets requirements of Division 2 applications)
- Software Input Type .............................. Digital
- Contact Configuration ............................ SPDT
- Contact Rating ................................. 5A @ 115 Vac; 2.5A @ 230 Vac (resistive load)
- Minimum Current .............................. 100 mA @ 10 mVdc or 150 mA @ 50 mVac

14.8 COMMUNICATION BOARDS

Communication boards plug into the Controller Board and provide digital communication as required by the application. These boards provide digital communication for remote I/O and NETWORK communication for interstation/workstation/APACS networking. Two communication boards plug into the MPU controller board: a LonWorks board and a LIL Network board.

14.8.1 LonWorks Board

This board provides for additional I/O, remote from the controller. The communication method allows various configurations of analog and discrete signal types, both input and output, for use in control and/or sequencing applications within the station.
14.8.2 LIL Network Board (Local Instrument Link)

This board provides network communication, mapping station variables to the standard LIL channel/parameter communication map. When this board is used, neither Modbus nor Ethernet communication are available. The local configuration port under the faceplate is still available for configuration and diagnostic applications.

14.9 ENVIRONMENTAL SPECIFICATIONS

14.9.1 Standard Mounting

Mounting, Typical Location..........................Control room or other protected area

Temperature Limits:
- Operating...........................................0 to 50°C (32 to 122°F)
- Storage..............................................-40 to 85°C (-40 to 185°F)

Climatic Conditions...........................IEC654-1 (Class B3)
Corrosive Conditions............................IEC654-4 (Class 2)

14.9.2 Enclosure Mounting

Mounting:
- Typical Location..........................Out-of-doors or other area without environmental controls
- Enclosure............................................User supplied
- Controller......................................Installed inside enclosure
- Faceplate Display..........................Exposed through enclosure to external environment
- Installation Requirements..............Refer to Section 8 Installation

Temperature Limits:
- Enclosure Internal, Operating............0 to 50°C (32 to 122°F)
- Enclosure External, Operating..........-40 to 50°C (-40 to 122°F)
- Controller Storage.........................-40 to 85°C (-40 to 185°F)

Climatic Conditions:..................IEC654-1 (Class B3)
Corrosive Conditions:.......................IEC654-4 (Class 2)

14.9.3 Electromagnetic Compatibility (EMC)

Electromagnetic Compatibility (EMC)...........IEC801-2 (Electrostatic Discharge)
..................................................IEC801-3 (RFI)
..................................................IEC801-4 (Electrical Transients)

14.10 AGENCY APPROVALS

The Moore 354N has been designed to meet various agency approvals. Contact the factory or your local Siemens Energy & Automation, Process Industries Division representative for current approvals. Labels on each controller list the agency approvals that apply to that particular instrument.

CSA
- Class I, Division 2, Groups A, B, C, and D; temperature code T4A

CE - see Section 14.10.2
14.10.1 CSA Hazardous Locations Precautions

This section provides CSA hazardous location precautions that should be observed by the user when installing or servicing the equipment described in this Instruction. These statements supplement those given in the preceding section.

**WARNING**

Explosion Hazard

Explosion can cause death or serious injury.

In a potentially explosive atmosphere, remove power from the equipment before connecting or disconnecting power, signal or other wiring.

All pertinent regulations regarding installation in a hazardous area must be observed.

**Precautions - English**

For Class I, Division 1 and Class I, Division 2 hazardous locations,

- Use only factory-authorized replacement parts. Substitution of components can impair the suitability of this equipment for hazardous locations.

For Division 2 hazardous locations:

When the equipment described in this Instruction is installed without safety barriers, the following precautions should be observed. Switch off electrical power at its source (in non-hazardous location) before connecting or disconnecting power, signal, or other wiring.

**Précautions - Français**

Emplacements dangereux de classe I, division 1 et classe I, division 2:

- Les pièces de rechange doivent être autorisées par l'usine. Les substitutions peuvent rendre cet appareil impropre à l'utilisation dans les emplacements dangereux.

Emplacement dangereux de division 2:

Lorsque l'appareil décrit dans la notice ci-jointe est installé sans barrières de sécurité, on doit couper l'alimentation électrique à la source (hors de l'emplacement dangereux) avant d'effectuer les opérations suivantes branchement ou débranchement d'un circuit de puissance, de signalisation ou autre.
14.10.2 Special Conditions for Safe Use

Always refer to the labels on the controller case for approvals and certifications applicable to that instrument.

CE

- Use of the equipment in a manner not specified by the manufacturer may impair the protection provided by the equipment.
- Route electrical power to the station through a clearly labeled circuit breaker or on-off switch that is located near the station and is accessible by the operator. The breaker or switch should be located in a non-explosive atmosphere unless suitable for use in an explosive atmosphere.
- Local Instrument Link twinaxial cable must be shielded.
- The next page contains a Declaration of Conformance with the standards or other normative documents stated on the certificate.
- Environmental Conditions, Per IEC 664, Installation Category II, Pollution Degree 2
- A representative unit was tested in accordance with EN50082-2. Test results are available upon request.
- CSA electrical classification approval as non-incendive for Division 2 service applies to installations in North America and where recognized. Check local approval requirements.
DECLARATION OF CONFORMITY
according to EN 45014

Moore Products Co.
Sumneytown Pike
Spring House, PA 19477

Declare under our sole responsibility that the product,

Model 354 Universal Loop Controller when labeled with the CE mark

to which this declaration relates is in conformity with the following standards or other normative documents

- EN61010-1, with amendments 1 and 2, Safety Requirements for electrical equipment for measurement, control and laboratory use.
- EN50081-2, Electromagnetic compatibility: Generic emission standard Industrial environment
- EN50082-1, Electromagnetic compatibility: Generic immunity standard Residential, commercial and light industrial environment
- EN50082-2, Electromagnetic compatibility: Generic immunity standard Industrial environment

following the provisions of the:


Manufactured in Spring House, PA U. S. A.

Date: 4/4/01

John C. Grebe
Director
Embedded Product Development
### 15.0 ABBREVIATIONS AND ACRONYMS

This section contains definitions for many of the abbreviations and acronyms that frequently appear in this User’s Manual. Less frequently used terms are defined where they are appear. Where a term has more than one meaning, context will usually indicate the meaning. Terms that identify a function block are indicated by (FB).

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>A - ampere(s)</td>
<td>DISP - display</td>
</tr>
<tr>
<td>AC - action, alternating current</td>
<td>DIV - Division (FB)</td>
</tr>
<tr>
<td>ACS - Arccosine (FB)</td>
<td>DLY - delay</td>
</tr>
<tr>
<td>ACT - acting</td>
<td>DMM - digital multimeter</td>
</tr>
<tr>
<td>ADD - Addition (FB), address</td>
<td>DNC - Divide by N Counter (FB)</td>
</tr>
<tr>
<td>AIE - Analog Input - Ethernet (FB)</td>
<td>DOD - Digital Output Discrete (FB)</td>
</tr>
<tr>
<td>AIN - Analog Input (FB)</td>
<td>DOE - Digital Output -Ethernet (FB)</td>
</tr>
<tr>
<td>AINU - Analog Input Universal (FB)</td>
<td>DOL - Discrete Output - LIL (FB)</td>
</tr>
<tr>
<td>A/M - auto/manual</td>
<td>DOS - Digital Output_State (FB)</td>
</tr>
<tr>
<td>AOE - Analog Output - Ethernet (FB)</td>
<td>DOUT - Digital Output (FB)</td>
</tr>
<tr>
<td>APACS - Advanced Process Automation and Control System</td>
<td>DPP - decimal point position</td>
</tr>
<tr>
<td>ASCII - American Standard Code for Information Interchange</td>
<td>DWNLD - download</td>
</tr>
<tr>
<td>ASN - Arcsine (FB)</td>
<td>DYT - Delay Timer (FB)</td>
</tr>
<tr>
<td>AT - adaptive time, autotune transfer</td>
<td>E/I - External/Internal Transfer Switch (FB)</td>
</tr>
<tr>
<td>ATD - Analog Trend Display (FB)</td>
<td>EM - EMER MAN - emergency manual</td>
</tr>
<tr>
<td>ATN - Arctangent (FB)</td>
<td>EN - enable, enabled</td>
</tr>
<tr>
<td>AWG - American Wire Gauge</td>
<td>ENG - engineering (units)</td>
</tr>
<tr>
<td>BAT - battery</td>
<td>ERR - error</td>
</tr>
<tr>
<td>BATSW - Batch Switch (FB)</td>
<td>ESL - Events Sequence Logger (FB)</td>
</tr>
<tr>
<td>BATOT - Batch Totalizer (FB)</td>
<td>ESN - Execution Sequence Number</td>
</tr>
<tr>
<td>BPL - batch pre-load</td>
<td>ET - elapsed time</td>
</tr>
<tr>
<td>BOD - Basic Operator Display</td>
<td>EXP - Natural Exponent (FB)</td>
</tr>
<tr>
<td>C - centigrade</td>
<td>EXT - Exponentiation (FB)</td>
</tr>
<tr>
<td>CAL - calibrate, calibration</td>
<td>F - Fahrenheit</td>
</tr>
<tr>
<td>CHN - channel</td>
<td>FAC - factory</td>
</tr>
<tr>
<td>CHR - Characterizer (FB)</td>
<td>FB - function block</td>
</tr>
<tr>
<td>CHAN - channel</td>
<td>FCO - Factory Configured Option</td>
</tr>
<tr>
<td>CIE - Coil Input - Ethernet (FB)</td>
<td>FREQ - frequency</td>
</tr>
<tr>
<td>CL - console/local</td>
<td>ft. - feet</td>
</tr>
<tr>
<td>CMP - Comparator (FB)</td>
<td>FTG - Falling Edge Trigger (FB)</td>
</tr>
<tr>
<td>COS - Cosine (FB)</td>
<td>GB - Gain &amp; Bias (FB)</td>
</tr>
<tr>
<td>CRD - deviation, denominator</td>
<td>GS - go to step</td>
</tr>
<tr>
<td>DAM - Deviation Amplifier (FB)</td>
<td>GW - global word (LIL)</td>
</tr>
<tr>
<td>DC - direct current</td>
<td>H - hold</td>
</tr>
<tr>
<td>DEG - degrees</td>
<td>HART - Highway Addressable Remote Transducer</td>
</tr>
<tr>
<td>DEV - deviation</td>
<td>HI - high</td>
</tr>
<tr>
<td>DG - derivative gain</td>
<td>HLD - Hold (FB)</td>
</tr>
<tr>
<td>DIE - Digital Input -Ethernet (FB)</td>
<td>HYS - hysteresis</td>
</tr>
<tr>
<td>DID - Digital Input Discrete (FB)</td>
<td>Hz - Hertz</td>
</tr>
<tr>
<td>DIG - digital</td>
<td>IC - Independent Computer Interface (Model 320)</td>
</tr>
<tr>
<td>DIL - Discrete Input LIL (FB)</td>
<td>ID - ID Controller (FB), identity</td>
</tr>
<tr>
<td>DIN - Digital Input (FB)</td>
<td>in. - inch</td>
</tr>
<tr>
<td>DINU - Digital Input Universal (FB)</td>
<td>INIT - initial</td>
</tr>
<tr>
<td>DIR - direct</td>
<td>I/O - input/output</td>
</tr>
<tr>
<td>DIS - Digital Input_State</td>
<td></td>
</tr>
<tr>
<td>Abbreviations And Acronyms</td>
<td>UM354N-1</td>
</tr>
<tr>
<td>----------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>IO - internal override</td>
<td>PIDAG - PIDAG Controller (FB), proportional/integral/derivative/adaptive gain</td>
</tr>
<tr>
<td>k - kilo (prefix) $10^3$</td>
<td>PRSEQ - Program Sequencer (FB)</td>
</tr>
<tr>
<td>K - Kelvin</td>
<td>PTR - pointer</td>
</tr>
<tr>
<td>lb. - pound(s)</td>
<td>PU - Power Up</td>
</tr>
<tr>
<td>LED - Light Emitting Diode</td>
<td>PUL - pulse</td>
</tr>
<tr>
<td>LIB - library</td>
<td>Q - quality</td>
</tr>
<tr>
<td>LIL - Local Instrument Link</td>
<td>QHD - Quickset Hold (FB)</td>
</tr>
<tr>
<td>LL - Lead/Lag (FB)</td>
<td>QS - quick set, quality status</td>
</tr>
<tr>
<td>LMT - Limit (FB)</td>
<td>QSPI - Queued Serial Peripheral Interface</td>
</tr>
<tr>
<td>LN_ - Natural Logarithm (FB)</td>
<td>R - reset, Rankine</td>
</tr>
<tr>
<td>LO - low, lockout</td>
<td>RCB - Removable Configuration Board</td>
</tr>
<tr>
<td>LOG - Logarithm Base 10 (FB)</td>
<td>RCT - Repeat Cycle Timer (FB)</td>
</tr>
<tr>
<td>m - milli (prefix) $10^{-3}$, meter</td>
<td>RD - received data</td>
</tr>
<tr>
<td>M - mega (prefix) $10^6$</td>
<td>Rev - revision</td>
</tr>
<tr>
<td>MAX - maximum</td>
<td>RG - range</td>
</tr>
<tr>
<td>MB - Modbus</td>
<td>RLM - Rate Limiter (FB)</td>
</tr>
<tr>
<td>MD - Message Display</td>
<td>RN - recipe number</td>
</tr>
<tr>
<td>MIN - minimum</td>
<td>ROT - Retentive On Timer (FB)</td>
</tr>
<tr>
<td>MR - manual reset</td>
<td>ROUT - Relay Output (FB)</td>
</tr>
<tr>
<td>MSG - Message</td>
<td>RSF - RS Flip-Flop (FB)</td>
</tr>
<tr>
<td>MTH - Math (FB)</td>
<td>RT - remaining time</td>
</tr>
<tr>
<td>MUL - Multiplication (FB), multiply, multiplication</td>
<td>RTD - resistance temperature detector</td>
</tr>
<tr>
<td></td>
<td>RTG - Rising Edge Trigger (FB)</td>
</tr>
<tr>
<td>N - number, numerator</td>
<td>S - setpoint, set</td>
</tr>
<tr>
<td>NC - normally closed</td>
<td>SCL - Scaler (FB)</td>
</tr>
<tr>
<td>NND - NAND Logic (FB)</td>
<td>SEN - sensor</td>
</tr>
<tr>
<td>NO - normally open</td>
<td>SEL - Signal Selector (FB)</td>
</tr>
<tr>
<td>NOR - NOR Logic (FB)</td>
<td>SETPT - Setpoint (FB)</td>
</tr>
<tr>
<td>NOT - NOT Logic (FB)</td>
<td>SF - step forward</td>
</tr>
<tr>
<td>NUM - number</td>
<td>SIN_ - Sine (FB)</td>
</tr>
<tr>
<td>NV - network variable</td>
<td>SL - setpoint limit</td>
</tr>
<tr>
<td>NVRAM - non-volatile random access memory</td>
<td>SRF - SR Flip-Flop (FB)</td>
</tr>
<tr>
<td>ODC - Operator Display for Controllers (FB)</td>
<td>SRT - Square Root (FB)</td>
</tr>
<tr>
<td>ODS - Operator Display for Sequencer (FB)</td>
<td>SS - stainless steel, standby synchronization</td>
</tr>
<tr>
<td>ON/OFF - On/Off Controller (FB)</td>
<td>ST - status</td>
</tr>
<tr>
<td>OP - operation</td>
<td>STATN - station</td>
</tr>
<tr>
<td>OR - OR Logic (FB), override</td>
<td>SUB - Subtraction (FB), subtract</td>
</tr>
<tr>
<td>ORSL - Override Select (FB)</td>
<td>SW - switch</td>
</tr>
<tr>
<td>OST - One Shot Timer (FB)</td>
<td>TAN_ - Tangent (FB)</td>
</tr>
<tr>
<td>O - process</td>
<td>TC - thermocouple, track command</td>
</tr>
<tr>
<td>PAC - Process Automation Controller</td>
<td>TD - time derivative</td>
</tr>
<tr>
<td>PARM - parameter</td>
<td>TH - Track &amp; Hold (FB)</td>
</tr>
<tr>
<td>PB - Pushbutton</td>
<td>TI - time integral</td>
</tr>
<tr>
<td>PB#SW - Pushbutton # Switch (FB)</td>
<td>TIM - timer</td>
</tr>
<tr>
<td>PC - personal computer</td>
<td></td>
</tr>
<tr>
<td>PCOM - Phase Communication (FB)</td>
<td></td>
</tr>
<tr>
<td>PD - PD Controller (FB)</td>
<td></td>
</tr>
<tr>
<td>PG - proportional gain</td>
<td></td>
</tr>
<tr>
<td>PID - PID Controller (FB), proportional/integral/derivative</td>
<td></td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Definition</td>
</tr>
<tr>
<td>--------------</td>
<td>------------</td>
</tr>
<tr>
<td>TO</td>
<td>tracked output</td>
</tr>
<tr>
<td>TOT</td>
<td>totalizer</td>
</tr>
<tr>
<td>TSW</td>
<td>Transfer Switch (FB)</td>
</tr>
<tr>
<td>TV</td>
<td>track variable</td>
</tr>
<tr>
<td>V</td>
<td>valve, volt(s)</td>
</tr>
<tr>
<td>VAL</td>
<td>value</td>
</tr>
<tr>
<td>W</td>
<td>watts</td>
</tr>
<tr>
<td>WD</td>
<td>watchdog</td>
</tr>
<tr>
<td>XMTR</td>
<td>transmitter</td>
</tr>
<tr>
<td>XOR</td>
<td>Exclusive OR Logic (FB)</td>
</tr>
<tr>
<td>ZDO</td>
<td>zero drop out</td>
</tr>
</tbody>
</table>
WARRANTY

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Siemens Energy & Automation, Inc.
Process Industries Division
1201 Sumneytown Pike
Spring House, PA  19477   USA
Tel: +1 215 646 7400
Fax: +1 215 283-6340

Warranty will be null and void if repair is attempted without authorization by a member of the Service Department or Technical Support Group, Process Industries Division, Siemens Energy & Automation, Inc.
Controller Models 352P, 353, 354, and 354N
MPU Controller Board Firmware Version 2.40

PRODUCTS INVOLVED

A Model 352P, 353, 354 or 354N Controller with MPU Controller Board V2.40 firmware

INTRODUCTION

This Software Release memo discusses the enhancements and operational considerations for firmware version 2.40 MPU Controller board software (firmware).

ENHANCEMENTS

Model 353 only: V2.40 firmware adds Ethernet communication function blocks to the features provided by earlier firmware versions. The Ethernet Communication Network option board must be installed in a Model 353 controller for these blocks to be available. Note: Ethernet communications is not available in a Model 352P, 354, or 354N.

- **ETHERNET Function Block** – Use this function block to configure Ethernet communication parameters.
- **AIE Function Block** – The AIE (Analog Input Ethernet) function block allows the controller to obtain analog data from other stations over the Ethernet network. Up to 32 AIE blocks are available.
- **AOE Function Block** – The AOE (Analog Output Ethernet) function block allows the controller to send analog data to AIE blocks in other stations over the Ethernet network. Up to 32 AOE blocks are available.
- **CIE Function Block** – The CIE (Coil Input Ethernet) function block allows the controller to obtain up to 16 discrete Modbus coil data from other stations over the Ethernet network. Up to 32 CIE blocks are available.
- **DIE Function Block** – The DIE (Digital Input Ethernet) function block allows the controller to obtain up to 16 digital points from another Procidia controller over the Ethernet network. Up to 32 DIE blocks are available.
- **DOE Function Block** – The DOE (Digital Output Ethernet) function block allows the controller to send up to 16 digital inputs to DIE blocks in other stations over the Ethernet network. Up to 32 DOE blocks are available.

All listed controllers: V2.40 firmware adds a TOTalizer function block and enhancements to the A/M, ODC, and QHD blocks.

- **TOT Function Block** – The TOT (Totalizer) block can be created as required in any loop, up to the limit of 99 blocks per loop. The block counts input pulses and outputs the total count. A reset input is provided to zero the counter.
- **A/M Function block** – A new parameter, LOCK MANual, will override the EMergency MANual parameter, when configured to YES. If LOCK MAN is configured for YES, the Manual Switch and the LEDs will switch to Manual when the EM input goes high. The A/M switch will stay in Manual and the A/M button will not allow switching to AUTO until the EM input has cleared.
- **ODC Function block** – A new input, Input A, can be used to acknowledge all the alarms in all of the loops in a controller.

A new parameter, V NET AC (Valve Bar Network Action), allows the LxVI network parameter to be set for direct or reverse action. This enables the valve bar on the HMI to operate similar to the valve bar on the faceplate. The left and right valve labels should be set accordingly (e.g. Left = OPEN; Right = CLOSED).

- **QHD Function block** - the power up value can now be configured.

Version 2.40 firmware resolves the following operational consideration.

- **PRSEQ Function block** – Downloading a configuration containing the PRSEQ block to a controller with V2.40 firmware will no longer reset the PRSEQ block if no parameter changes have been made. Downloading a configuration to a controller having V2.31 or earlier firmware will cause the PRSEQ to reset to step 1.

- **LIL Configuration Download** - After downloading a large configuration, the transmitted LIL data goes to 0 at the end of the download for one scan.

**OPERATIONAL CONSIDERATIONS**

- Before installing MPU Controller board firmware that is a lower level than that presently installed in the controller, select and Store FCO-0 (zero) as the controller configuration.

- **AIE_ Function block** – When using the Analog Input Ethernet block, leave the RANGE parameter set to “Man”. Setting the parameter to “Auto” can cause communication problems with large configurations. This issue will be resolved in a future firmware release.

**UPGRADE CONSIDERATIONS AND MATERIALS**

1. Check the current MPU Controller Board firmware version before upgrading. To display the firmware version, refer to the STATN – Station Parameters section in the Function Blocks chapter of the controller’s User’s Manual.

2. A personal computer running Microsoft® Windows® 95, 98 or NT is needed.

3. Upgrading requires the following items:
   1) Communications Cable - P/N 16353-61
   2) Communications Cable Adapter; select one to mate with your computer’s COM port:
      - DB25 to MMJ11 - P/N 16353-62
      - DB9 to MMJ11 - P/N 16353-63
   3) Model 352P/353/354 Firmware Upgrade Utility P/N15939-77V2.40 (upgrades 1.xx to 2.40). Kit contains are:
      - a CD-ROM with the multiple versions of the controller firmware
      - a software license disk created for the station (by serial number) to be upgraded.
      - a software registration card

**INSTALLING VERSION 2.40**

1. Follow the instructions on the label of the supplied CD-ROM to install the utility.

2. Read the supplied HELP file for information about downloading firmware (kernel and code) to a controller.

3. Complete and mail the software registration card.
Technical Support

For technical support, contact the Technical Support Group at +1 215 646 7400 ext. 4993. For the address of the Siemens Energy & Automation, Process Industries Division office nearest you, visit either of the following Internet sites.

www.sea.siemens.com/ia/

www.procidia.com

Current revisions of User’s Manuals for the listed controllers can be found at the above sites. The manuals are in Portable Document Format (PDF).

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