LONWORKS™ MODULE
8-CHANNEL DC DISCRETE INPUT

This Instruction contains installation and servicing procedures for the LonWorks module(s) listed in the table below. Acromag, Inc. manufactures the module(s). The table provides the module description, the Moore part number, and the equivalent Acromag model number.

<table>
<thead>
<tr>
<th>MODULE DESCRIPTION</th>
<th>MOORE P/N</th>
<th>ACROMAG MODEL NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>8-Channel DC Discrete Input Module</td>
<td>27005-12</td>
<td>540L3-410-8DI-10-NCR</td>
</tr>
</tbody>
</table>

Two major sections are found in this Instruction. General information on a LonWorks module ordered from Moore is located in this section. The Acromag User’s Manual for the module is the second section.

Go to the Acromag section of this Instruction to install or calibrate a module. For product support or repair, read the following paragraphs. These statements supersede or amend similar information in the Acromag section.

PRODUCT SUPPORT

Product support can be obtained from a Technical Information Center (TIC). Each regional TIC is a customer service center that provides direct telephone support on technical issues related to the functionality, application, and integration of all products supplied by Moore. Regional TIC contact information is provided in the following table. Your regional TIC is the first place you should 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 you call for support for the first time, a personal caller number is assigned. Having the number available when calling for support will allow the TIC 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 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 our Web site (www.mooreproducts.com/techservices). This area contains product support information. To log on, you will be prompted to enter your username and password.
TIC North America also offers a free faxback service called FaxRequest. You can dial-in to this service to access documents such as press releases, product information sheets, and training schedules. The service is completely automated and available 24 hours a day. To access this service, call the FaxRequest number listed in the tables below. The first document you should request is the directory (document number 9999). This document is updated as new documents are added. Each document has a number code assigned to it that you enter along with your fax number (area code entry is always required). Upon completing your entry, the FaxRequest computer automatically calls your fax machine and sends the requested documents.

<table>
<thead>
<tr>
<th><strong>TIC NORTH AMERICA</strong></th>
<th><strong>Tel:</strong> +1 215 646 7400, extension 4842, option 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fax:</strong> +1 215 283 6343</td>
<td></td>
</tr>
<tr>
<td><strong>E-mail:</strong> <a href="mailto:ticgroup@mpco.com">ticgroup@mpco.com</a></td>
<td></td>
</tr>
<tr>
<td><strong>FaxRequest:</strong> +1 215 646 7400, extension 4842, option 2</td>
<td></td>
</tr>
<tr>
<td><strong>Bulletin Board Service:</strong> +1 215 283 4968</td>
<td></td>
</tr>
<tr>
<td><strong>Hours of Operation:</strong> 8 a.m. to 6 p.m. eastern time</td>
<td></td>
</tr>
<tr>
<td><strong>Secure Web Site:</strong> <a href="http://www.mooreproducts.com/techservices">www.mooreproducts.com/techservices</a></td>
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<th><strong>TIC ASIA</strong></th>
<th><strong>Tel:</strong> +65 299 6454</th>
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<tr>
<td><strong>Fax:</strong> +65 299 6053</td>
<td></td>
</tr>
<tr>
<td><strong>E-mail:</strong> <a href="mailto:lohho@mpco.com">lohho@mpco.com</a></td>
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<tr>
<td><strong>Hours of Operation:</strong> 9 a.m. to 6 p.m. Singapore time</td>
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<tr>
<th><strong>TIC EUROPE</strong></th>
<th><strong>Tel:</strong> +44 1935 470172</th>
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<tr>
<td><strong>Fax:</strong> +44 1935 706969</td>
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<tr>
<td><strong>E-mail:</strong> <a href="mailto:uktic@mpco.com">uktic@mpco.com</a></td>
<td></td>
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<tr>
<td><strong>Hours of Operation:</strong> 8:30 a.m. to 5:15 p.m. GMT/BST</td>
<td></td>
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<td><strong>Secure Web Site:</strong> <a href="http://www.mooreproducts.com/techservices">www.mooreproducts.com/techservices</a></td>
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</tbody>
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RETURN FOR REPAIR
This section modifies the General Maintenance section in the Acromag User’s Manual.

During the warranty period, remove a failed instrument from service and proceed as follows to return it to Moore for repair. For out of warranty repair, return the module to either Moore or Acromag.

TO RETURN EQUIPMENT

- Call Moore Products Co. at (215) 646-7400, ext. 4RMA (4762) weekdays between 8:00 a.m. and 4:45 p.m. Eastern Time. If outside of North America go, to www.mooreproducts.com for the address and telephone and FAX numbers of your nearest Moore Products Co. subsidiary. Ask for an RMA (Return Material Authorization) number and be sure to mark the RMA number prominently on the outside of the shipment.

When calling for an RMA number, provide the reason for the return. If returning equipment for repair, failure information (e.g., error code, failure symptom, installation environment) will be requested. A purchase order number will also be needed.

MATERIAL SAFETY DATA SHEET

- A Material Safety Data Sheet (MSDS) must be included with each item being returned that was stored or used anywhere hazardous materials were present.

PACKAGING

- Package assembly in original shipping materials. Otherwise, package it for safe shipment or contact the factory for shipping recommendations.

An electronic module must be placed inside a static shielding bag to protect it from electrostatic discharge.

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*Procedures in this document have been reviewed for compliance with applicable approval agency requirements and are considered sound practice. Neither Moore Products Co. nor these agencies are responsible for repairs made by the user.*
INTRODUCTION:

These instructions cover the model types listed in Table 1 below. Supplementary sheets are attached for units with special options or features.

Table 1:
A. Model Number Format: 540L1-Function-Input-Power-Certification
B. Typical Model Number: 540L1-410-8DI-10-NCR

<table>
<thead>
<tr>
<th>Series/Network</th>
<th>-Function</th>
<th>-Inputs</th>
<th>-Power</th>
<th>-Cert.</th>
</tr>
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<tbody>
<tr>
<td>540L1</td>
<td>-4101</td>
<td>-8DI</td>
<td>-10</td>
<td>-NCR</td>
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<tr>
<td>540L3</td>
<td>-410</td>
<td>-8DI</td>
<td>-10</td>
<td>-NCR</td>
</tr>
</tbody>
</table>

Notes (Table 1):
1. Consult the factory for current information on agency (e.g. Canadian Standards Association, etc.) approvals.

DESCRIPTION:

The Series 550L is a member of the Acromag SmartPack family. It converts eight 0-to-42V DC inputs, into eight corresponding network variables. The eight inputs share a common, and as a group are isolated from power and the network. Each input includes basic configuration network variables for configuring debounce and update interval.

All SmartPack modules are designed for harsh industrial environments. They feature RFI and EMI protection, a wide operating temperature range, and isolation between power, network and I/O. They are DC powered, DIN-rail mountable, and available with either a twisted pair (TP/XF-76) or free topology (TP/FT-10) transceiver. Up to 64 modules can be connected on a single network segment. Multiple segments may be connected using repeaters to increase the number of modules and distance.

SmartPacks are interoperable with LONWORKS products from other manufacturers that use standard network variable types (SNVFs). Module calibration, configuration and network management are performed using a Windows configuration program on a PC.
SPECIFICATIONS:

DEFINITION: This DC-powered, SmartPack, LONWORKS module accepts eight DC input voltage signals (which share a common return), and converts the ON/OFF state of these signals to network variables using standard network variable types (SNVT). Each input has configuration network variables for debounce and update time. Three-way isolation is provided between the inputs, the network, and the power circuit. This module is DIN-rail mounted.

MODEL/SERIES: 540 (Color coded with a White label)

NETWORK (Designated by ‘LX’ of 540 LX Model prefix):

Protocol: LonTalk®

L1: TP/XF-78, Twisted Pair
   Speed: 78.1kb per second.
   Media: Unshielded twisted pair, UL Level IV, No. 22 gauge wire.
   Distance: Up to 6500 feet (2000 meters).
   Nodes per Network Segment: 64 (0 to +70°C), 44 (-25 to +85°C). A LONWORKS router configured as a repeater is required for more than 64 nodes.

L3: TP/FT-10, Free Topology
   Speed: 78.1kb per second.
   Media: See Cable Type in Table 2 below.
   Distance: See Table 2 below.

Table 2: Free Topology Specifications

<table>
<thead>
<tr>
<th>Cable Type</th>
<th>Maximum module-to-module distance</th>
<th>Maximum total wire length for SmartPack Modules</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belden 85102</td>
<td>1640 ft (500 m)</td>
<td>1640 ft (500 m)</td>
</tr>
<tr>
<td>Belden 8471</td>
<td>1312 ft (400 m)</td>
<td>1640 ft (500 m)</td>
</tr>
<tr>
<td>Level IV, 22 AWG</td>
<td>1312 ft (400 m)</td>
<td>1640 ft (500 m)</td>
</tr>
<tr>
<td>JY (Si) Y 2x2x0.8</td>
<td>1050 ft (320 m)</td>
<td>1640 ft (500 m)</td>
</tr>
</tbody>
</table>

Nodes per Network Segment: 64. A LONWORKS router configured as a repeater is required for more than 64 nodes.

FUNCTION: Code number used to represent the module’s firmware functionality.

-410: See the network variables section for a description of the module's standard network variable types and operation.

INPUT: This module has eight, 0 to 42 VDC, TTL threshold inputs.

-8DI: Eight DC inputs, 0 - 3V to 42V DC, 45V DC max. (all share a common).
   Input Threshold (L to H): 2.2V DC nominal.
   Input Threshold (H to L): 1.0V DC nominal.
   Input Hysteresis: 1.2V DC typical.
   Input Resistance: 82KΩ, typical
   Input Current: (pull-up resistors removed), 100µA max. at 42V DC
   Network Response Time: less than 20mS, typical (to Network Message), less than 30mS, typical (to Network Acknowledge).

Excitation: Four volts DC nominal, current limited (24mA nominal). Used, with an externally mounted switch to interface to switch contacts, one resistor per input. Minimum pull-up resistor 1000 ohms.

Isolation: Three-way isolation is provided between the inputs, DC power, and the network as follows:

Inputs-to-Power and Network-to-Power: Inputs, as a group, can operate at up to 250V AC, or 35V DC off ground, on a continuous basis (will withstand 1500V AC dielectric strength test for one minute without breakdown). This complies with test requirements outlined in ANSI/ISA-S82.01-1988 for the voltage rating specified.

Network-to-Input: The network can operate at up to 277V AC off DC power ground, on a continuous basis (will withstand 1000V AC dielectric strength test for one minute without breakdown).

POWER: Connect an external DC power supply to the Power (P) and (-) terminals. Currents specified are maximum values with all inputs at 42V and the module transmitting on the network. An internal diode provides reverse polarity protection.

-10: +10 to 36V DC, current draw is a function of supply voltage and excitation (refer to Table 3 below).

Table 3: Supply Current

<table>
<thead>
<tr>
<th>Supply Voltage</th>
<th>L1 without excitation</th>
<th>L1 with excitation</th>
<th>L3 without excitation</th>
<th>L3 with excitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>10V</td>
<td>45mA</td>
<td>60mA</td>
<td>35mA</td>
<td>50mA</td>
</tr>
<tr>
<td>12V</td>
<td>40mA</td>
<td>50mA</td>
<td>32mA</td>
<td>42mA</td>
</tr>
<tr>
<td>15V</td>
<td>35mA</td>
<td>40mA</td>
<td>30mA</td>
<td>36mA</td>
</tr>
<tr>
<td>24V</td>
<td>25mA</td>
<td>30mA</td>
<td>22mA</td>
<td>26mA</td>
</tr>
<tr>
<td>36V</td>
<td>20mA</td>
<td>25mA</td>
<td>18mA</td>
<td>22mA</td>
</tr>
</tbody>
</table>

CAUTION: Do not exceed 36V DC peak, to avoid damage to the module.

Power Supply Effect: None.
Reset/Service Toggle Switch:
- **Reset Position**: Allows the module to be reset to power-up conditions (toggle right).
- **Service Position**: Causes the Neuron® chip inside the node to transmit its unique 48-bit ID and 8-byte program ID string (toggle left).

**LED Indicators:**
- **Power LED (Green)**: Indicates power applied to unit.
- **Service LED (Red)**: LED blinks at a 1/2 Hz rate for an unconfigured node. LED OFF for a properly functioning node. LED ON for failed node.
- **Status LED (Yellow)**: (See Figure 1) LED remains ON indefinitely upon receiving an “offline” network management command. LED remains OFF upon receiving an “online” network management command (normal operation). LED blinks at a 2.5Hz rate for 10 seconds upon receiving a “wink” network command.

**Figure 1: Status LED Behavior**

1. **Offline/Online Commands**:
   - **ON**
   - **OFF**
   - **Indefinite**
   - **Offline Command**
   - **Online Command**

2. **Wink Command**:
   - **ON**
   - **OFF**
   - **200 mS**
   - **10 Seconds**
   - **200 mS**

**Reference Test Conditions**: Input: 0 to 42VDC; Network (78kB/S); 77°F (25°C); +15V DC supply.

**Ambient Temperature Range**: L1 (44 nodes): -13°F to +185°F (-25°C to +85°C), L1 (64 nodes): +32°F to +158°F (0°C to 70°C), L3 (64 nodes): -13°F to +185°F (-25°C to +85°C).

**Ambient Temperature Effect**: None.

**Response Time**: For an input change in state, an output message will be transmitted on the network within 20mS, typical, plus Debounce time (user configured 0 to 8mS).

**RFI Resistance**: Unit performs under the influence of RFI for field strengths up to 10V/meter at frequencies of 27mhz, 151mhz, and 467mHz.

**EMI Resistance**: Unit operates without error under the influence of EMI from switching solenoids or commutator motors.

**Surge Withstand Capability (SWC)**: Input/Output: power and network terminations are rated per ANSI/IEEE C37.90-1978. The unit is tested to a standardized test waveform that is representative of surges (high frequency transient electrical interference) observed in actual installations.

**Mounting**: General Purpose Housing with integrated DIN-Rail Mount. Supports “G” & “T” rails: “G” Rail (32mm), Type EN50035; “T” Rail (35mm), Type EN50022. Refer to Drawing 4501-471 for outline and clearance dimensions. Shipping Weight: 1 pound (0.45 Kg) packed.

**Construction**:
- Circuit Boards: Military grade FR-4 epoxy glass circuit board.
- Terminals: Compression type, wire size 14 AWG maximum.
- Case: Self-extinguishing NYLON Type 6.6 polyamide thermoplastic UL94 V-2, color black. General Purpose, NEMA Type 1 enclosure.

**CERTIFICATION**: Consult the factory for current information on the availability of agency (e.g. Canadian Standards Association, Factory Mutual, etc.) approvals.

- **NCR**: No Certification Required.

**INSTALLATION**:

The module is packaged in a general purpose type of enclosure. Use an auxiliary enclosure to protect against unfavorable environments and locations. Maximum operating ambient temperatures should be within -13 to 185°F (-25 to +85°C) for satisfactory performance. Connect as shown in Connection Drawing 4501-470.

**Mounting**: Mount module assembly - refer to Drawing 4501-471 for mounting and clearance dimensions.

**DIN Rail Mounting**: Use suitable fastening hardware to secure the DIN rail to the designated mounting surface. A module can be mounted to a “T” or “G” Rail. Installation of the module to the rail depends on the type of DIN rail used (See Drawing 4501-471). Units can be mounted side-by-side on 1.6 inch centers, if required.

**Electrical Connections**:

The wire size used to connect the unit to the control system is not critical. All terminal strips can accommodate wire from 14-25 AWG. Strip back wire insulation 1/4-inch on each lead before installing into the terminal block. Input wiring may be shielded or unshielded twisted pair. Network wires should be twisted pair. Since common mode voltages can exist on signal wiring, adequate wire insulation should be used and proper wiring practices followed. It is recommended that network and power wiring be separated from the signal wiring for safety, as well as for low noise pickup.

1. **Power**: Connect DC power supply per Connection Drawing 4501-470. These modules operate from DC power supplies only. Power supply voltage is not critical and normally should be from 10.0V to 36V DC. The supply voltage must not exceed 36 Volts, even momentarily. Variations in power supply voltage, above the minimum required have negligible effect on module accuracy. Refer to “POWER” in the preceding SPECIFICATIONS section for current requirements. This device includes reverse polarity protection.
2. **Network**: Connect network per Connection Drawing 4501-470. Note: Network circuit is isolated from output and power circuits. See NETWORK specifications for the maximum number of nodes per network segment.

3. **Grounding**: The module housing is plastic and does not require an earth ground connection.

4. **Input**: Connect input per connection diagram, observe proper polarity, see label for input type. If unit is factory calibrated, the calibration label indicates range of input. **NOTE**: The input circuits, as a group, are electrically isolated from the network/power circuits, allowing the input, as a group, to operate up to 250V AC, or 354V DC, off ground on a continuous basis.

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**NETWORK VARIABLES:**

To provide interoperability, standard network variable types are used for all external interface and configuration variables. Figure 2 below illustrates the 540L's network variable types.

**Figure 2: Series 540LX-410-8DI-10 SNVT Diagram**

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**HARDWARE INPUT**

All network variables are eight-element arrays. Discrete input 1's network variables are referenced with an array subscript of 0; 1 for discrete input 2, and so on. Network variables within the Configuration Section are intended to be accessed by a network management tool to configure the module. These variables are maintained in EEPROM and are limited to 10,000 write cycles. In addition, values written into configuration network variables do not take effect until the module is reset. Reset can occur as the result of powering-up, toggling the RESET switch, or issuing a "reset" network management command to the module. Network variables within the External Interface Section are intended to be bound, polled, or written by other nodes on the network. These variables are maintained in RAM.

**nvo_outstate[ x ]**: Discrete Output Variable

**Declaration**

```c
network output SNVT_lev_disc nvo_outstate[ 8 ];
```

**Description**

This output network variable contains the latest value of the corresponding digital input in units of SNVT_lev_disc. A value of ST_ON indicates the input is active. A value of ST_OFF indicates the input is inactive. The update rate for this variable is controlled by nci_debounce[ x ] and/or nci_pvtime[ x ].

**Power-up/Reset Value**

Per input.
nci_debounce[ x ]: Input Debounce Configuration Variable

**Declaration**
eeprom network input SNVT_elapsed_tm nci_debounce[ 8 ];

**Description**
This configuration input network variable specifies the amount of delay between updates (0 to 8 milliseconds) before the input ON or OFF state will be accepted as a correct input. This is used to eliminate false state transfers due to spikes or glitches on the input signal. Glitches are frequently caused by contact bounce in mechanical relays and switches. Only the millisecond (LL) member of this network variable structure determines the debounce time (0 to 8 ms). The hour, minute and second members are ignored and should be set to 0. To disable the debounce delay function, set the day (DD) member to 65535, or the millisecond member to 0. This variable is maintained in eeprom, and does not take effect until the module is reset.

**Initial Factory Value**
DD=65535, HH=0, MM=0, SS=0, LL=0: Debounce delay disabled.

nci_pvttime[ x ]: Output Update Time Configuration Variable

**Declaration**
eeprom network input SNVT_elapsed_tm nci_pvttime[ 8 ];

**Description**
This configuration input network variable specifies the period of time between updates of nvo_outstate[ x ]. Internal resolution is 0.1 seconds. The maximum allowable time expressed in DD:HH:MM:SS:LL format is 00:01:49:13:500 (65535.5 s). Anything greater will be clipped at 01:49:13:500. To disable periodic updates, set the day (DD) member to 65535, or all members to 0. This variable is maintained in EEPROM and does not take effect until the module is reset. Note that any change in state at the input automatically causes nvo_outstate[ x ] to be updated, independent of this delay.

**Initial Factory Value**
DD=65535, HH=0, MM=0, SS=0, LL=0: Periodic updates disabled.

**GENERAL MAINTENANCE:**
This module contains solid-state components and requires no maintenance, except for periodic cleaning and verification. When a failure is suspected, a convenient method for identifying a faulty module is to exchange it with a known good unit. It is highly recommended that a non-functioning module be returned to Acromag for repair, since Acromag makes use of tested and burned-in parts, and in some cases, parts that have been selected for characteristics beyond that specified by the manufacturer. Further, Acromag has automated test equipment that thoroughly checks the performance of each module.
SERIES 540L (-8DI) SIMPLIFIED SCHEMATIC

SERIES 540L (-8DI) INPUT MODULE

FIGURE A: DC POWER CONNECTIONS

FIGURE B: CONNECTION TO OPTIONAL 35PS POWER SUPPLY

INPUT CONNECTIONS

SERIES 540L1 (-8DI) ELECTRICAL CONNECTIONS

NOTE 1. EXTERNAL PULL-UP RESISTOR (USER SUPPLIES) MUST BE ADDED WHEN USING THE MODULE'S EXCITATION SUPPLY.
ENCLOSURE DIMENSIONS
FOR DIN RAIL MOUNTING

NOTE: ALL DIMENSIONS ARE IN INCHES (MILLIMETERS).