SIMATIC S7-1500: The Most Advanced Controller in the World!

Jim Wilmot, Siemens Digital Factory
## Table of Contents

- Positioning within SIMATIC portfolio
- Hardware Overview
- Typical applications
- Innovative Features/Benefits
- Option – smaller form factor
- Summary
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SIMATIC Controllers Overview

The innovative solution for all automation tasks

SIMATIC Modular Controllers
- Long term available
- Ready to use
- Modular
- Expandable
- Scalable

SIMATIC PC-based Automation
- Latest/greatest PC tech.
- Integrates to C++ control
- Integrates to Excel, etc…

One Engineering Software: SIMATIC STEP 7
- Reusability of existing programs, higher flexibility, with or without safety functionality

- Minimize engineering time with a common engineering environment across controllers
- Minimize downtime with simplified, fully integrated communications & system diagnostics
- Lower initial & operating costs using one common system for standard & safety related automation
SIMATIC New Controller Generation
Always the appropriate Controller performance with comprehensive functionalities!

Advanced Controller
SIMATIC S7-1500

Distributed Controller
SIMATIC ET 200SP CPU

Basic Controller
SIMATIC S7-1200

CPU 1214 FC
CPU 1215 FC

CPU 1510SP F
CPU 1512SP F

CPU 1511F
CPU 1513F
CPU 1515F
CPU 1516F
CPU 1517F
CPU 1518F

STEP 7 Safety
Engineered with TIA Portal

and Safety Integrated!
Table of content

- Positioning within SIMATIC portfolio
- **Hardware Overview**
  - Typical applications
  - Innovative Features/Benefits
  - Option – smaller form factor
- Summary
## SIMATIC S7-1500 CPU - Standard / Failsafe Portfolio

<table>
<thead>
<tr>
<th></th>
<th>CPU 1511</th>
<th>CPU 1513</th>
<th>CPU 1515</th>
<th>CPU 1516</th>
<th>CPU 1517</th>
<th>CPU 1518</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prog. Memory</strong></td>
<td>150 kB</td>
<td>300 kB</td>
<td>500 kB</td>
<td>1 MB</td>
<td>2 MB</td>
<td>3 MB</td>
</tr>
<tr>
<td>(*) Safety CPU</td>
<td>(225 kB)</td>
<td>(450 kB)</td>
<td>(750 kB)</td>
<td>(1.5 MB)</td>
<td>(3 MB)</td>
<td>(4.5 MB)</td>
</tr>
<tr>
<td><strong>Data Memory</strong></td>
<td>1 MB</td>
<td>1.5 MB</td>
<td>3 MB</td>
<td>5 MB</td>
<td>8 MB</td>
<td>10 MB</td>
</tr>
<tr>
<td><strong>Bit perf.</strong></td>
<td>60 ns</td>
<td>40 ns</td>
<td>30 ns</td>
<td>10 ns</td>
<td>2 ns</td>
<td>1 ns</td>
</tr>
</tbody>
</table>

**CPU1511C**

**CPU1512C**
SIMATIC S7-1500 Compact Controllers
Firmware V1.8 – Advanced Controller now in compact design

Features

1. Compact design
2. Integrated I/Os (digital / analog) and Technology, 100Hz - 6x HSC & 4x PTO/PWM
3. Front connectors included
4. Same expansion options as the modular CPUs

Customer benefits

- Space savings of up to 25% compared to S7-00 CPUs
- Cost benefits of up to 70% compared to modular design
- Reduced spare parts inventory
Interface modules

<table>
<thead>
<tr>
<th>Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>ET 200MP</td>
</tr>
<tr>
<td>PROFINET</td>
</tr>
<tr>
<td>IM 155-5 PN ST</td>
</tr>
<tr>
<td>IM 155-5 PN HF</td>
</tr>
<tr>
<td>PROFIBUS</td>
</tr>
<tr>
<td>IM 155-5 DP ST</td>
</tr>
</tbody>
</table>

TOP connect wiring system (optional)
- Flexible type
- Modular type

### IO modules

<table>
<thead>
<tr>
<th>Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>35-mm wide modules (without front connector)</td>
</tr>
<tr>
<td>DI 16x 24 V DC HF</td>
</tr>
<tr>
<td>DI 32x 24 V DC HF</td>
</tr>
<tr>
<td>DI 16x 24 V DC SRC BA</td>
</tr>
<tr>
<td>DO 16x 24 V DC/0.5 A ST</td>
</tr>
<tr>
<td>DO 32x 24 V DC/0.5 A ST</td>
</tr>
<tr>
<td>DO 8x 24 V DC/2 A HF</td>
</tr>
<tr>
<td>DO 8x 230 V AC/2 A ST</td>
</tr>
<tr>
<td>DO 8x 230 V AC/5 A ST</td>
</tr>
<tr>
<td>DO 16x 230 V AC/1 A ST (Triac)</td>
</tr>
<tr>
<td>DO 16x 230 V AC/2 A ST (Relay)</td>
</tr>
<tr>
<td>AI 8x U/I/RTD/TC ST *</td>
</tr>
<tr>
<td>AI 8x U/I HS</td>
</tr>
<tr>
<td>AO 4x U/I ST</td>
</tr>
<tr>
<td>AO 8x U/I HS</td>
</tr>
<tr>
<td>F-DI 16x 24 V DC PROFlsafe</td>
</tr>
<tr>
<td>F-DQ 8x 24 V DC / 2 A PPM PROFlsafe</td>
</tr>
<tr>
<td>25-mm wide modules (incl. front connector)</td>
</tr>
<tr>
<td>DI 16x 24 V DC BA</td>
</tr>
<tr>
<td>DI 32x 24 V DC BA</td>
</tr>
<tr>
<td>DO 16x 24 V DC/0.5 A ST</td>
</tr>
<tr>
<td>DO 32x 24 V DC/0.5 A ST</td>
</tr>
<tr>
<td>DI 16x 24 V DC/DO 16x 24 V DC/0.5 A BA</td>
</tr>
<tr>
<td>AI 4x U/I/RTD/TC ST *</td>
</tr>
<tr>
<td>AO 2x U/I ST</td>
</tr>
<tr>
<td>AI/AO 4x U/I/RTD/TC / 2x U/I ST *</td>
</tr>
</tbody>
</table>

* Half of channels for RTD
### Communication Modules

- Point to Point
- PROFIBUS
- PROFINET
- Security Module
- *Modbus TCP/IP
- *OPC UA (August)

<table>
<thead>
<tr>
<th>Communication</th>
<th>PtP</th>
<th>PROFIBUS</th>
<th>PROFINET</th>
<th>Security Module</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PROFIBUS</strong></td>
<td>CM 1542-5 PROFIBUS communication module</td>
<td>CP 1542-5 PROFIBUS communications processor</td>
<td>CM 1542-1, PROFINET communications processor</td>
<td></td>
</tr>
<tr>
<td><strong>PROFINET</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Communication modules for point-to-point or multipoint communication with the protocols Freeport, 3964(R), Modbus RTU or USS. Transfer rates up to 115.2 kbit/s are supported.*

*Communication modules for PROFIBUS with DP master or DP slave function (CP/CM) and larger quantity structure, as well as dataset routing (CM).*

*Communication modules for Industrial Ethernet with Security Integrated by means of VPN and firewall (CP), or for additional PROFINET interfaces (CM).*
SIMATIC S7-1500
Communication Options

Identical PROFINET function on every CPU
- PROFINET as standard interface
- PROFINET IO IRT (incl. isochronous mode)
- iDevice, Shared Device / Shared iDevice
- Multiple IP address’s available
- Web server with user-programmable websites

Optimum integration of PROFIBUS and PROFINET communication modules
- Direct transfer of I/O data to the CPU process image
- Uniform SEND /RECEIVE function blocks for CPU local interfaces and communication module interfaces

MODBUS TCP for CPU and communication modules
- For communication with devices as Modbus master or slave
SIMATIC S7-1500
Shared I-Device – Functionality

Shared I-Device
- Access as I-Device by up to 4 controllers
- Rapid data exchange in realtime between CPUs
- Integration under PROFINET 3rd-party controllers

Example: Logical assignment of one station to two controllers
Technology Modules

- High speed encoder inputs

Power Modules

- PM – for module load power
- PS – for S7-1500 rack extension

Technology modules

<table>
<thead>
<tr>
<th>Technology modules</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMs</td>
</tr>
<tr>
<td>TM Count 2x24V</td>
</tr>
<tr>
<td>TM Poinput 2</td>
</tr>
<tr>
<td>TM Timer DIDQ 16x24V</td>
</tr>
</tbody>
</table>

Modules for counter functions up to 200 kHz or 1 MHz, with measuring functions for frequency, period duration or speed, for position detection with incremental or absolute encoders as well as for implementing cam controllers and especially precise response times.

Power supply and system wiring

<table>
<thead>
<tr>
<th>PM load current supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM 70 W, 120/230 V AC</td>
</tr>
<tr>
<td>PM 190 W, 120/230 V AC</td>
</tr>
</tbody>
</table>

The load current supply (PM) provides 24 V power for SIMATIC S7-1500 modules such as CPU, system power supplies, IO circuits of the peripheral modules and, where required, sensors and actuators.

<table>
<thead>
<tr>
<th>PS system power supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>System power supply 25 W, 24 V DC</td>
</tr>
<tr>
<td>System power supply 60 W, 24/48/60 V DC</td>
</tr>
<tr>
<td>System power supply 60 W, 120/230 V AC/DC</td>
</tr>
</tbody>
</table>

The system power supply (PS) provides the power for the S7-1500 modules via the backplane bus.
## Advanced Controller - SIMATIC S7-1500 T-CPU
Scalable Motion Control within Advanced Controller

<table>
<thead>
<tr>
<th>Feature / Function</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enhanced Motion Control functions like gearing and camming</td>
<td>Sophisticated Motion Control functions within the well-known SIMATIC environment for high machine flexibility</td>
</tr>
<tr>
<td>Integrated Cam Editor for a easy definition</td>
<td>High engineering efficiency within the TIA Portal trough graphical or tabular definition and optimization of camming axis</td>
</tr>
<tr>
<td>Consistent functionality and programming from S7-1500 up to S7-1500 T-CPU</td>
<td>Seamless enhancement of Standard PLC Motion Control functionalities</td>
</tr>
<tr>
<td>S7-1500 TF-CPU also with Safety-PLC</td>
<td>Motion Control and Safety Functions on one controller</td>
</tr>
</tbody>
</table>

### CPUs
- CPU 1511T-1 PN
- CPU 1515T-2 PN
- CPU 1517T-3 PN/DP
- CPU 1517TF-3 PN/DP
SIMATIC STEP 7 in TIA Portal
Controller Motion Improvements - S7-1500T

**Goal of S7-1500 T**
- Leverage additional **mid range** business and capture share in price sensitive markets
- Close the gap between SIMOTION and S7-1500 Motion Control performance
- Close the gap to midrange competitors with scalable systems
- Well known usability for OEM's used to SIMATIC

**S7-1500 Controller Family**
- High-end applications
- Distributed Motion
- Interpolation/Handling
- Camming
- Gearing (absolute)
- Gearing (relative)
- Output cams
- Measuring input
- Positioning
- Speed control

**S7-15xxT with V14**
- S7-1511 T-CPU
- S7-1517 T-CPU
- S7-1515 T-CPU
- V14 +1 and up

**Performance**
- Mid-range PLC
- High end PLC
## Feature

- S7-1500 Controller
- 2 PROFINET Interfaces with 4 Ports
- Programming interface RJ45
- Safety Integrated version available

## Benefit

- Use the advantages of the S7-1500 directly in IP65
- Network separation for an easy integration into the plant network
- Direct possibility to download the PLC project
- Controller and IO can cover Safety applications up to performance Level e
SIMATIC S7-1500
SIMATIC S7-1500 “SR” engineered solution, U.S.

Further Details…

- Available now! (True S7-1500H product solution ~2018)
- Engineered solution, support by Siemens App group
- 2 customers currently working with this concept in O&G!
  - BOP application – using SIPLUS CPUs
  - PID control for hydraulic valve – using standard CPUs

- Pros:
  - Works in TIA Portal
  - Works with various CPUs in S7-1500 family

- Cons:
  - Not “bumpless” like S7-400H
  - Engineered solution – not a standard “product”
  - Cannot do “safety rated” applications
SIPLUS extreme
Additional protections for Harsh Environments!

Recent Updates w/ SIPLUS

- Expanding SIPLUS product line in general
- Additional Ratings – IECeX, railway certifications – S7-1500(F), S7-1200, ET200SP, etc...*Marine – “certificate of declaration”
- More competitive pricing
## SIPLUS Extreme
- For harsh environments

<table>
<thead>
<tr>
<th>Ambient conditions</th>
<th>SIMATIC</th>
<th>SIPLUS extreme</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Climatic</strong></td>
<td>0 °C to 60 °C $^{1)}$</td>
<td>-40/-25 °C to +60/+70 °C $^{1)}$</td>
</tr>
<tr>
<td><strong>Relative humidity</strong></td>
<td>from 10 to 95 % with out condensation</td>
<td>100 % Condensation and Icing allowed</td>
</tr>
<tr>
<td><strong>Chemically active substances</strong></td>
<td>ISA S71.04 G3</td>
<td>EN60721-3-3 3C4 and ISA S71.04 G1, G2, G3, GX continuous load limit $^{2)}$</td>
</tr>
<tr>
<td></td>
<td>SO2 0.5 ppm</td>
<td>SO2 4.8 ppm</td>
</tr>
<tr>
<td></td>
<td>H2S 0.1 ppm</td>
<td>H2S 9.9 ppm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cl 0.2 ppm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HCl 0.66 ppm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HF 0.12 ppm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NH3 49 ppm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>O2 0.1 ppm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NOX 5.2 ppm</td>
</tr>
<tr>
<td><strong>Salt mist</strong></td>
<td>Not allowed</td>
<td>Salt mist test (EN 60068-2-52), severity level 3</td>
</tr>
<tr>
<td><strong>Mechanically active substances</strong></td>
<td>EN60721-3-3 3S2</td>
<td>EN60721-3-3 3S4</td>
</tr>
<tr>
<td></td>
<td>0.2 mg/m$^3$</td>
<td>4.0 mg/m$^3$</td>
</tr>
<tr>
<td></td>
<td>1.5 mg/m$^3$</td>
<td>40 mg/m$^3$</td>
</tr>
<tr>
<td></td>
<td>Without sand</td>
<td>Sand included</td>
</tr>
<tr>
<td><strong>Biologically active substances</strong></td>
<td>Not tested</td>
<td>EN60721-3-3 3B2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Growth of mold, sponge except fauna</td>
</tr>
</tbody>
</table>

$^{1)}$ For certain product ranges  
$^{2)}$ 30 min/day
A plus for extreme requirements

System- / multi-value topics

**Energy Efficiency**
Due to the robustness of the devices no additional cooling / heating is required, this reduces energy costs and protects the environment.

**Engineering Efficiency**
A seamless integration of SIPLUS products in TIA Portal offers all the advantages of an innovative framework in engineering.

**Usability**
The use of proven standard tools guarantees comprehensive project design and commissioning of automation. This saves time and enables a fast and error-free engineering and guarantees long-term use of the system under changing environmental conditions.
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- Hardware Overview
- **Typical applications**
- Innovative Features/Benefits
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SIMATIC New Controller Generation
Controller scalability that meets all requirements

**S7-1500: Advanced Control**
- Balance of control for machines or plants
- Complex automation architectures that require Many HMI’s, Drives and other field devices
- Customized mass production control
- Perfect for when machine to machine controls are required for an entire production process

**S7-1200: Basic Control**
- Perfect for stand-alone simple machine control
- *Waste Water treatment, car wash, elevators/escalators, pump control, compressor control systems, material handling and packaging, etc…*

- *O&G, automotive, aerospace, railway, amusement park rides, printing, etc…*
**SIMATIC S7-1500 Reference Applications**

*Industries across the board!*

- **O&G**, Blow Out Preventer (BOP) control
- **Aluminum Man. Ind.**, assembly machine
- **Appliance Ind.**, Tub Production – Washing Machines
- **Printing Ind.**, Cooling Water Re-circulation System
- **Rubber Ind.**, Automation of Rubber Mixing Room
- **Gas/Steam Ind.**, Automation of Natural Gas Compressor
- **Waste Water Ind.**, Plant Automation
- **HVAC Ind.**, Fin Press Machine
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SIMATIC S7-1500 Hands-On
Overview – Customer Value

- Display, optimized components, integrated DIN rail, jumpers, etc...
  - Simple assembly saves time & costs
  - Easy to maintain due to flexible wiring

- Integrated drives/HMI/controller, libraries, scalable HW, etc...
  - Efficient implementation & service saves time and costs

- Block, copy, access, & manipulation protection
  - Protects intellectual property and investment
  - Protects against unauthorized project changes

- Standard motion control & drives integrated
  - TRACE function running on CPU
  - Integration saves money, time, and panel space

- 400MB backplane, CPUs down to 1µs bit scan!
  - Increased productivity by shortened cycle times

- Built in, plain text diagnostic messages
  - No programming required!
  - Local and remote stations, drives, etc...
  - Available even in CPU-STOP Mode!
SIMATIC S7-1500 Hands-On

Consistent display of diagnostics

- Minimize Downtime!
- Simplify Troubleshooting!
SIMATIC S7-1500 Hands-On
Security Integrated

+ Security Integrated
  + Block protection
  + Copy protection
  + Access protection
  + Manipulation protection
**Design and handling**

- Display: Information and adjustment
- Integrated DIN rail
- Scalability
- Uniform front connector
- Prewiring position
- Integrated shielding
- Integrated potential bridges, coding elements

Max 32 I/O modules

Unrestricted © Siemens 2016
Page 32
SIMATIC S7-1500
Onboard Display

**Start screen**

**Status**

**Diagnostics**

**Fail-safe**
Simatic S7-1500
Onboard Display

Main Advantages of Display:

- **Reduced downtimes** through diagnostics alarms in plain text
- Changing of the interface settings on site, without programming device
- Simple access to CPU information, no tools required

---

**Memory Usage**

- **Card type:** Program card
- **Available memory:** 24.91 MB
- **Used memory:** 3.0% (742.60 KB)
- **Free memory:** 97.0% (23.28 MB)
- **Serial number:** 642255204344

---

**Setting IP Address**

- **Overview**
  - Slot 1: CP 1543-1_1
  - Slot 2: DI 16x24VD C, HF 1
  - Slot 3: DI 16x24VD C, HF 1
  - Slot 4: DI 16x24VD C, HF 1

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**Watch tables at the display**

- **Watchtable Area**
- **Watchtable DB**
- **Watchtable_DB_D**
SIMATIC Webserver
Built in... on board all CPUs as standard!

- General info on CPU, Actions - Run/Stop, LED flash, update FW
- Diagnostic Buffer, alarm messages, module information
- Tags - monitor / modify, watch tables, custom web pages
- File Browser, print function

Allows customers to do this.....
Remote access to your PLC using standard web browser! Over intranet or internet...
TIA Portal
Integrated within the TIA Portal

- Save projects > saving incomplete software is also possible
- Project tree > conveniently organized project structure with all objects
- Diverse wizards > adding CPUs, HMI panels, drives, and technology objects quickly and in structured fashion
- Devices and networks > graphic network overview of all hardware components based on PROFINET, PROFINET, and AS-i
- Safety Administration Editor > for central visualization, configuration, and change of safety parameters
- Structured program setup > conveniently organized program structure
- Tag definitions > immediately available in all editors once defined
- Consistent symbols > program with symbolic names within the whole project as object
- PLC Data Types > conveniently arranged display of user-defined types
- Drives integration > consistently configurable
- Drag & Drop > easy data handling from one editor to another
- Detail window > displays all details from selected object of the project tree
- Window switcher > to switch between opened editors
- Centralized data management > validation of all engineering data
- Simulation > integrated as a standard feature
- Online/offline comparison > quickly visualize differences
- Cross-references > project-wide overview using tags and objects
- IntelliSense > easy object selection
- Intuitive tab pages > follows the selected editor
- Global Library concept > reusing of project parts
- Property window > displays all relevant parameters of the selected object
- Information window > displays detailed information of the selected object in the tab accordingly
Trace editor – easy troubleshooting for sporadic faults on machine

Trace downloaded to PLC with trigger points for beginning of data

Trace 64 values… leave and let record without PC “Black Box”…
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SIMATIC ET 200SP CPU

The Controller for Distributed Automation

Engineering with TIA Portal
SIMATIC New Controller Generation
Controller scalability that meets all requirements

S7-1500: Advanced Control
- Applications requiring higher memory, high speed, large number of communication connections
- Complex automation architectures that require many HMI's, Drives and other field devices

ET 200 SP CPUs
Distributed Controller

- Price point / Power / Flexibility / Scalability / Compact size
- Perfect for modular machines
- Perfect for space constraints
- Optimized for machine-level distributed architectures

O&G, automotive, aerospace, railway, amusement park rides, printing, etc…
SIMATIC ET 200 SP CPUs
ET200SP CPUs - Operator controls and indicators

- PN Port 3 (RJ45)
- BusAdapter (BA)
- PN Port 1 and PN Port 2 (RJ45, FC, SCRJ)
- LEDs: LINK 1 and LINK 2
- LED: LINK 3
- DIN rail unlocking without tools
- Cable fixing 90° FC plug
- DC 24V plug
- Status and error indicators:
  - STOP/RUN: grin/yellow
  - ERROR: red
  - MAINT: yellow
- Label
- Mode selector:
  - RUN/STOP/MRES
- SIMATIC MC card (SD)
- Mounting dimensions B x H x T (mm): 100 mm x 117 mm x 75 mm
- IM151-7, 60mm wide
- IM151-8, 120mm wide
## SIMATIC S7-1500 CPU - Standard / Failsafe Portfolio

<table>
<thead>
<tr>
<th></th>
<th>CPU 1510</th>
<th>CPU 1512</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prog. Memory</td>
<td>100 kB</td>
<td>200 kB</td>
</tr>
<tr>
<td>(*Safety CPU)</td>
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</tr>
<tr>
<td>Data Memory</td>
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<td>Bit perf.</td>
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Summary

SIMATIC S7-1500 Controllers –

- S7-1500 is our flagship controller line for mid to advanced control applications
- Scalable with our other controllers – TIA!
- Pre-wired connectors available, complete line of accessory modules
- Multi-industry applications
- Expanding / improving our SIPLUS line for “Harsh Environments”
- S7-1500H on roadmap
- Feature rich product line – HW, SW, innovations
  - Diagnostics, Performance, Security, “Black box” TRACE, Design and Handling innovations, built in color display
- ET200SP form factor available
S7-1500: The most advanced controller in the world!

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