The SIMATIC Controllers Portfolio
Always the right controller – Plus integrated added value!
Advanced Controller – SIMATIC S7-1500 CPU
Increase productivity with the ultimate power

Security Integrated
- Integrated copy and know-how protection function protect intellectual property
- Improved access protection (authentication)

Safety Integrated
- A controller for standard and fail-safe tasks
- The high-density channel can be directly addressed during the engineering

High Performance
- Higher productivity and product quality thanks to the backplane bus and shortest reaction times
- PROFINET with deterministic time response ensure reproducibility and precision within µs

Efficient Engineering
- Support of all IEC 61131-3 programming languages (LAD/FBD, STL, SCL and Graph)
- and of high-level languages such as C/C++ (only for CPU 1518(F)-4 PN/DP MFP and CPU 1515SP PC2 (F/T/TF) through SIMATIC ODK 1500S)

Reliable diagnostics
- The automatic generation of system and user diagnostics enables quick error detection
- Any errors can be quickly localized on-site thanks to 1:1 LED channel assignment for peripheral systems

Technology Integrated
- Motion Control task can be programmed directly in the controller, e.g.
  - Speed-controlled axes, positioning axes, gearing, camming
  - Control of kinematics
  - Cross-PLC synchronous operation
- Implement various technology functions directly with I/O modules (e.g. PWM)
Advanced Controller – SIMATIC S7-1500 T-CPU
Extended motion control functions with TIA Portal V16 and firmware V2.8 ¹)

Additional motion control functions
- Kinematic functions
- Control of kinematics with up to 4 interpolating axes
- Gearing and camming
  - Synchronization with specifying the synchronous pos. of the leading and following axes
  - Setpoint value coupling
  - Actual value coupling with extrapolation
- Cross-PLC synchronous operation ²)
  - Synchronization between axes on different CPUs
- SIMATIC Safe Kinematics V1.0
  - Optional fee-based system library for safe motion monitoring in the cartesian space

Hardware innovations
- SIMATIC S7-1500 T-CPUs
  - CPU 1511T, CPU 1511TF
  - CPU 1515T, CPU 1515TF
  - CPU 1516T, CPU 1516TF
  - CPU 1517T, CPU 1517TF
  - CPU 1515SP PC2 T/TF
  - CPU 1504D TF, CPU 1507D TF
  - Standard-, safety-plc and motion control on one controller

Integrated editors and viewers
- Cam editor
- Kinematics configuration
- Kinematics trace
- Coordination of traces in different CPUs

Programming
Consistent and seamless extension of S7-1500 by S7-1500 T-CPU

Web server
Diagnostic pages for motion control

¹) Compared to the standard CPU
²) New
Ultra-compact Design
- S7-1500 TF-CPU and SINAMICS S120 drive control in one device
- No additional space required for the PLC

Powerful
- Powerful TF-CPU with integrated SINAMICS S120 drive control
- Well equipped with memory, interfaces and technology I/Os

Easy scalable
- Uniform interfaces across all performance classes (CPU 1504D TF / CPU 1507D TF)
- Additional drive systems (e.g. SINAMICS S120, S210) can be connected via PROFINET.

Easy to use
- Comfortable project planning in the TIA portal with SIMATIC STEP 7 and SINAMICS Startdrive
- Low cabling and installation expense
- Central data storage on “one” SIMATIC Memory Card
## Advanced Controller – SIMATIC S7-1500

**Enlargement of the CPU Portfolio with Technology CPUs**

### Technology CPU

<table>
<thead>
<tr>
<th>CPU types</th>
<th>1511TF-1 PN</th>
<th>1515TF-2 PN</th>
<th>1516TF-3 PN/DP</th>
<th>1517TF-3 PN/DP</th>
<th>1518TF-4 PN/DP (MFP)</th>
<th>1515SP PC2 TF PN</th>
<th>1504D TF</th>
<th>1507D TF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interfaces</td>
<td>1</td>
<td>1</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Program memory</td>
<td>225/225 KB</td>
<td>750/750 KB</td>
<td>1.5/1.5 MB</td>
<td>3/3 MB</td>
<td>4/6 MB</td>
<td>1/1.5 MB</td>
<td>2 MB</td>
<td>6 MB</td>
</tr>
<tr>
<td>Data memory</td>
<td>1 MB</td>
<td>3 MB</td>
<td>5 MB</td>
<td>8 MB</td>
<td>20 MB</td>
<td>5 MB</td>
<td>4 MB</td>
<td>20 MB</td>
</tr>
</tbody>
</table>

### Standard CPU

| Bit performance | 60 ns | 30 ns | 10 ns | 2 ns | 1 ns | 10 ns | Scale with motion control performance |

### Open Controller

<table>
<thead>
<tr>
<th>Positioning axes</th>
<th>5</th>
<th>7</th>
<th>55</th>
<th>70</th>
<th>128</th>
<th>30</th>
<th>10</th>
<th>55</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical²</td>
<td>10</td>
<td>30</td>
<td>80</td>
<td>128</td>
<td>128</td>
<td>30</td>
<td>10</td>
<td>160</td>
</tr>
<tr>
<td>Maximum³</td>
<td>800</td>
<td>2,400</td>
<td>6,400</td>
<td>10,240</td>
<td>10,240</td>
<td>2,400</td>
<td>2,400</td>
<td>12,800</td>
</tr>
</tbody>
</table>

### Drive Controller CPU

| Extended Motion Control Resources⁴ | 40 | 120 | 192 | 256 | – | 120 | 120 | 420 |

### Motion Control

- Speed axis = 40  
- Positioning axis = 80  
- Synchr. Axis = 160  
- Output cam track = 160  
- Measuring input= 40  
- Cams = 2  
- Kinematic objects= 30  
- Leading axis proxy = 3

1 50 MB add. for C/C++ (PLC-RT)+500 MB for C/C++ appl. (RT/appl.)
2 At 4 ms Servo/IPO cycle time and 35 % CPU load due to Motion Control
3 No further TO’s applicable
4 Resources for Motion Control technology objects:
5 Resources for Extended Motion Control technology objects:

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December 2019
## Overview

**Motion control functions and typical applications**

### Cross project synchronous operation
- 2nd Servo / IPO
- 2nd PROFINET Interface

### Kinematics functions with conveyor tracking

### Coordination (synchronous operation, cams)

### Positioning Speed setpoint

<table>
<thead>
<tr>
<th>Functions</th>
<th>Typical Applications</th>
</tr>
</thead>
</table>
| Cross project synchronous operation | - Machines with a very high number of axes  
- High dynamic machines  
- Modular machines |
| Kinematics functions with conveyor tracking | - Cartesian gantries  
- Roll pickers  
- Articulated arm  
- Delta pickers  
- SCARA robots, ... |
| Coordination (synchronous operation, cams) | - Synchronized axes  
(also cross-PLC)  
- Cross cutters  
- Flying shears, ... |
| Positioning Speed setpoint | - Palletizers, ...  
- Hoisting + vertical conveyors  
- Feeder + door control systems  
- Conveyor belts  
- Auxiliary drives, ... |

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1) planned for FW-Update V2.8.x (V16)
Overview motion control functionalities (extract)

- Kinematics with conveyor tracking
- Kinematics with up to 4 interpolating axes
- Cross-PLC synchronous operation
- Offset of the leading value at the following axis
- Camming
- Coupling onto actual values
- Gearing - With synchronous position
- Gearing - Without synchronous position
- Encoder switch over to 2nd – 4th encoder
- Specification of motion vector from application
- Superimposed positioning during active motion
- Move axis to relative/absolute position
- Cyclic interface for torque data
- Moving an axis with torque limiting
- Homing absolute and on the fly, Setting a position
- Traversing an axis with speed setpoint
- Enabling/disabling an axis
- Activating output cams and cam tracks and measuring inputs
- …
TIA Portal V16
The scalable Motion Control System Portfolio

2nd PROFINET IRT interface
High-performance Motion Control 4)
Cross-PLC synchronous operation 3)
Kinematic functions with conveyor tracking 5)
Camming & Gearing 2)
Gearing 1)
Output cams
Measuring input
Positioning
Speed control

V90-PN and 1FL6
Basic Controller
Basic
Standard CPU

Midrange
Advanced Controller
Advanced
Standard CPU

High-End
SimOTION
Motion Controller

S120 and 1FK2
S120 and 1Fx7, 1PH8...

1) Synchronization without specification of the synchronous position
2) Synchronization with specification of the synchronous position
3) In one project
4) Cross-project synchronization; cams with dynamic size; 2 servo for axis groups
5) planned for FW-Update V2.8.x (V16)
The SINAMICS Drives Portfolio for “Cyclic Motion”
Always the right drive – Plus integrated added value!

Basic Drives
- SINAMICS V90 + SIMOTICS S-1FL6

Advanced Drives
- SINAMICS S210 + SIMOTICS S-1FK2
- SINAMICS S120 + SIMOTICS

Engineered with TIA Portal

Consistent drive and automation solutions
Seamless interaction of all drive components
Optimum maintenance and service
Safety Integrated
Technology Integrated
Questions and Answers

Q

A

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