Overview
The G-901 motion controllers offer a fully integrated electronics solution with controller and driver in an industry-compatible 19" housing. The G-901 motion controller features the state-of-the-art ACS SPIiplusEC motion controller and EtherCAT master. Integrated drivers for 2, 3, or 4 axes. Upgradable via EtherCAT to up to 8 synchronized axes (additional driver modules necessary). EtherCAT cycle and generation rate of the motion profile 2 kHz. Ethernet velocity of up to 1 GbE. Servo algorithms for advanced gantry and dual-loop control. STO safety function for safely switching off the power supply for the axes.

Encoder
Supports incremental encoders (sine/cosine or RS-422) and absolute encoders (EnDat 2.2 & 2.1, Smart-Abs, Panasonic, BiSS-A/B/C (SSI)). Depending on the application, the encoders can be led to different interfaces.

I/O lines
The digital inputs and outputs can be flexibly configured. For the evaluation of reference switches, digital inputs can alternatively be led to the motor connectors. Depending on the application, the inputs for the limit and reference switches can be configured for 5 V or 24 V and also as PNP or NPN inputs. Position synchronous trigger signals with up to 10 MHz output frequency enable a precise process control at high travel velocities (position event generator – PEG).

Communication, software support
The motion controller works as master in an internal EtherCAT network. The open network architecture also enables the integration of components from other manufacturers. For communication with a PC, the motion controller is equipped with an Ethernet TCP/IP and a RS-232 interface. ACS SPIiplus MMI Application Studio, a modern user software with tools for control tuning and visualizing is included in the scope of delivery. Programming libraries are available for C/C++, COM, .NET, and MATLAB.

G-901
- ACS motion controller with integrated ACS driver and integrated module for safe torque off (STO)
- Directly compatible with positioners from PI
- For AC servo motors / brushless DC motors, brushed DC motors, voice coil motors, stepper motors
- Output power per axis to 1500 W
- Many options for trajectory planning
- Upgradable to up to 8 axes in an ACS EtherCAT network
**Configuration**
If the types of positioner are specified when ordering, all connectors of the G-901 are suitably preconfigured at delivery. The default factory configuration, without positioner-specific adjustments, is detailed in the specifications. For subsequent adjustments, please contact our service department.

**Specifications**

<table>
<thead>
<tr>
<th>Specification</th>
<th>G-901.Rx19</th>
<th>G-901.Rx197</th>
<th>G-901.Rx199</th>
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</thead>
<tbody>
<tr>
<td><strong>Function</strong></td>
<td>ACS SPIIPlusEC controller with up to two ACS UDMcb driver modules including ACS components for STO x codes the intermediate circuit voltage (48 V / 96 V), for details see &quot;Electrical properties&quot;</td>
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<tr>
<td><strong>Version</strong></td>
<td>19&quot; rack mount with connectors for positioners from PI</td>
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<tr>
<td><strong>Motor types</strong></td>
<td>2 and 3-phase AC servo motors / brushless DC motors, brushed DC motors, voice coil motors, stepper motors</td>
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<tr>
<td><strong>Number of drive axes</strong></td>
<td>2 / 3 / 4</td>
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</table>

**Motion and control**

<table>
<thead>
<tr>
<th>G-901.Rx19</th>
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<th>G-901.Rx199</th>
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</thead>
<tbody>
<tr>
<td><strong>Controller type</strong></td>
<td>Cascading PIV controller structure with velocity and acceleration feedforward control</td>
<td></td>
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<tr>
<td><strong>Sampling rate current control</strong></td>
<td>20 kHz</td>
<td></td>
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<tr>
<td><strong>Control algorithms</strong></td>
<td>Multiple Input Multiple Output (MIMO) gantry control, dual loop control</td>
<td></td>
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<tr>
<td><strong>Motion profiles/trajectory planning</strong></td>
<td>Multi-axis point-to-point, jog, tracking, and sequential multi-point motion Multi-axis segmented motion with look-ahead Arbitrary path with PVT cubic interpolation Third order profiles (S-Curve) Smooth on-the-fly change of target position or velocity Inverse/forward kinematics and coordinate transformations (at application level) Master-slave with position and velocity locking (electronic gear/cam)</td>
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<tr>
<td><strong>Encoder</strong></td>
<td>1 × per integrated axis, supported types: Incremental: 1Vss, RS-422 Absolute: EnDat 2.2 &amp; 2.1, Smart-Abs, Panasonic, BiSS-A/B/C (SSI)</td>
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<tr>
<td><strong>Limit switches</strong></td>
<td>2 × per integrated axis Default: 5 V sinking (NPN) Optional configuration: 24 V; sourcing (PNP)</td>
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<tr>
<td><strong>Reference switch</strong></td>
<td>Default: 1 × per integrated axis, 5 V sinking (NPN) Optional configuration: 24 V; sourcing (PNP); use as digital multipurpose inputs on digital I/O connector (HD D-sub 15 (f))</td>
<td></td>
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<tr>
<td><strong>Motor brake</strong></td>
<td>1 × per integrated axis Integrated PWM brake driver with current reduction for a reduced heating up of the brake</td>
<td></td>
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<tr>
<td><strong>Functional safety</strong></td>
<td>STO For safety applications including SIL-3 safety integrity level according to: EN/IEC 61800-5-2 Ed. 2 (Second Environment) EN/IEC 61800-5-1 IEC 61508 IEC 62061 PLe performance level and category 3 according to: EN ISO 13849-1/-2</td>
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**Electrical properties**

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<tbody>
<tr>
<td><strong>Output power intermediate circuit, continuous / peak</strong></td>
<td>1000 W / 1050 W (max. 5 s) Intermediate circuit 96 V: 2000 W / 2100 W (max. 5 s) Intermediate circuit 48 V: 480 W / 580 W (max. 10 s)</td>
<td>2000 W / 2100 W (max. 5 s)</td>
<td></td>
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<tr>
<td><strong>Output power per axis (effective value), continuous / peak (max. 1 s)</strong>*</td>
<td>250 W / 740 W (at 96 V intermediate circuit voltage) Axes 2, 3: 250 W / 580 W (at 48 V intermediate circuit voltage; axis 3 only with G-901.R4199)</td>
<td>500 W / 1500 W</td>
<td></td>
</tr>
<tr>
<td><strong>Current limitation per motor phase (amplitude of sine), continuous/peak (max. 1 s)</strong></td>
<td>6.6 A / 20 A</td>
<td>6.6 A / 20 A</td>
<td>6.6 A / 20 A</td>
</tr>
</tbody>
</table>
Interfaces and operation

Motor connectors per driver module with 48 V intermediate circuit voltage**

- 2 × HD D-sub 26 (f), maximum 3 A continuous current per pin
- 2 × D-sub 9W4 (f), maximum 20 A per motor phase
The lines for limit and reference switches are available on all connectors.
The lines for motor brakes are available on the HD D-sub 26 (f) connectors.

Motor connectors per driver module with 96 V intermediate circuit voltage**

- 2 × M15 9-pin (f)
The lines for limit switches are available for:
- 2 × HD D-sub 26 (f)
- 2 × M12 5-pin (f)
- 2 × D-sub 15 (m)
The lines for reference switches are available on the HD D-sub 26 (f) connectors.
The lines for motor brakes are available on the M15 9-pin (f) and HD D-sub 26 (f) connectors.

Sensor connectors, per driver module**

HD D-sub 15 (f):
- 2 × outputs PNP 24 V source; also control the drivers for the motor brakes
Default for inputs:
- 2 × PNP 24 V source on HD D-sub 15 (f); in addition 2 × NPN 5 V sinking for reference switches on the motor connectors
Optional configuration for inputs:
- 4 × PNP 24 V source on HD D-sub 15 (f)

Digital I/O lines, per driver module

HD D-sub 15 (m):
- 2 differential analog inputs: ±10 V, 12-bit
- 2 differential analog outputs: ±10 V, 10-bit

Outputs for position event trigger (PEG), per driver module

Parallel on HD D-sub 15 (m) and HD D-sub 15 (f):
- 2 differential outputs (RS-422) for pulses at programmable positions, pulse width 26 ns to 1.75 ms, max. 10 MHz; only possible with incremental encoder
D-sub 9 (f)
- 2 differential inputs (STO1, STO2): 24 V, < 50 mA per pin
If at least one signal assumes the “low” state, all drives are deactivated at the same time within 50 to 200 ms.

EtherCAT network

Up to 8 axes in an ACS EtherCAT network, also using EtherCAT third-party components.

Control rate and EtherCAT clock rate

2 kHz

Communication interfaces

EtherCAT IN and OUT: RJ-45
Ethernet (TCP/IP, Modbus/TCP, EtherNet/IP): RJ-45
RS-232: D-sub 9 (m)

User software

ACS SPIiPlus MMI Application Studio

Application programming interfaces

Programming libraries for C/C++, COM, .NET, MATLAB available

Programming

ACSPL+ real-time scripting language: Up to 10 simultaneously running programs (buffer)

Miscellaneous

Operating voltage***

- 2 × mains connector 100-250 V AC, 50-60 Hz
- IEC:
  - 12-16 A @ 250 V AC, 50 Hz
  - UL/CSA:
    - 12-20 A @ 125/250 V AC, 60 Hz
- 5 °C to 40 °C (temperature protection switches off at excessively high temperatures)
- Mass
  - 13 kg
- Dimensions
  - 482.6 mm × 539.5 mm × 184.2 mm (including handles)

Required protection per mains connector***

- 2 × mains connector 100-250 V AC, 50-60 Hz
- IEC:
  - 12-16 A @ 250 V AC, 50 Hz
  - UL/CSA:
    - 12-20 A @ 125/250 V AC, 60 Hz
- 5 °C to 40 °C (temperature protection switches off at excessively high temperatures)
- Mass
  - 17 kg
- Dimensions
  - 482.6 mm × 553.4 mm × 184.2 mm (including handles)

Operating temperature range

- 5 °C to 40 °C (temperature protection switches off at excessively high temperatures)
- 5 °C to 40 °C (temperature protection switches off at excessively high temperatures)

Mass

- 15.5 kg
- 13 kg

Dimensions

- 482.6 mm × 553.4 mm × 184.2 mm (including handles)
- 482.6 mm × 539.5 mm × 184.2 mm (including handles)

* Peak power cannot be made available for all axes at the same time.
** Driver modules for one drive axis have motor and sensor connectors for a second axis, these have, however, not been assigned
*** The supply must be delivered via two different current circuits. Both mains connectors must be connected and switched on.
Drawings / Images

G-901.R319[x], dimensions in mm
G-901.R419x and .R519, dimensions in mm
G-901.R5197 and .R5199, dimensions in mm
Rear panel of the G-901.R3199 with connectors

Rear panel of the G-901.R4199 with connectors
Ordering Information

G-901.R319
ACS controller with ACS driver module, 2 axes, intermediate circuit voltage 48 V / 1000 W, 19” housing, integrated ACS SP+EC-08080832NNNDNDNN motion controller + EtherCAT master, integrated ACS UDMcb2BA2U2CBAN driver module, integrated STO module (safe torque off), EtherCAT, Ethernet, and RS-232 interfaces

G-901.R3197
ACS controller with ACS driver module, 3 axes, intermediate circuit voltage 48 V / 1000 W, 19” housing, integrated ACS SP+EC-08080832NNNDNDNN motion controller + EtherCAT master, integrated ACS UDMcb2BA2U2CBAN and UDMcb1BA1U1CBAN driver modules, integrated STO module (safe torque off), EtherCAT, Ethernet, and RS-232 interfaces

G-901.R3199
ACS controller with ACS driver module, 3 axes, intermediate circuit voltage 48 V / 1000 W, 19” housing, integrated ACS SP+EC-08080832NNNDNDNN motion controller + EtherCAT master, two integrated ACS UDMcb2BA2U2CBAN driver modules, integrated STO module (safe torque off), EtherCAT, Ethernet, and RS-232 interfaces

G-901.R4197
ACS controller with ACS driver module, 3 axes, intermediate circuit voltage 96 V / 2000 W and 48 V / 480 W, 19” housing, integrated ACS SP+EC-08080832NNNDNDNN motion controller + EtherCAT master, integrated ACS UDMcb2BB2U2CBAN and UDMcb1BA1U1CBAN driver modules, integrated STO module (safe torque off), EtherCAT, Ethernet, and RS-232 interfaces

G-901.R4199
ACS controller with ACS driver module, 4 axes, intermediate circuit voltage 96 V / 2000 W, 19” housing, integrated ACS SP+EC-08080832NNNDNDNN motion controller + EtherCAT master, integrated ACS UDMcb2BB2U2CBAN and UDMcb2BA2U2CBAN driver modules, integrated STO module (safe torque off), EtherCAT, Ethernet, and RS-232 interfaces

G-901.R519
ACS controller with ACS driver module, 2 axes, intermediate circuit voltage 96 V / 2000 W, 19” housing, integrated ACS SP+EC-08080832NNNDNDNN motion controller + EtherCAT master, integrated ACS UDMcb2BB2U2CBAN driver module, integrated STO module (safe torque off), EtherCAT, Ethernet, and RS-232 interfaces

G-901.R5197
ACS controller with ACS driver module, 3 axes, intermediate circuit voltage 96 V / 2000 W, 19” housing, integrated ACS SP+EC-08080832NNNDNDNN motion controller + EtherCAT master, integrated ACS UDMcb2BB2U2CBAN and UDMcb1BB1U1CBAN driver modules, integrated STO module (safe torque off), EtherCAT, Ethernet, and RS-232 interfaces
G-901.R5199
ACS controller with ACS driver module, 4 axes, intermediate circuit voltage 96 V / 2000 W, 19” housing, integrated ACS
SP+EC-08080832NNNDNDNN motion controller + EtherCAT master, two integrated ACS UDMcb2BB2U2CBAN driver modules,
integrated STO module (safe torque off), EtherCAT, Ethernet, and RS-232 interfaces

Field Upgrades
G-900.F001
Field upgrade G-Code for programming ACS-based controllers