

## Motion Controller for High Power Requirement

Integrated Driver for up to 4 Drive Axes with AC Servo Motor, DC Motor, Voice Coil Motor, Stepper Motor



### 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

#### 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.

## 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

	G-901.Rx19 / G-901.Rx197 / G-901.Rx199
Function	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 "Electrical properties"
Version	19" rack mount with connectors for positioners from PI
Motor types	2 and 3-phase AC servo motors / brushless DC motors, brushed DC motors, voice coil motors, stepper motors
Number of drive axes	2 / 3 / 4 Upgradable via EtherCAT with additional driver modules to up to 8 synchronized axes.

Motion and control	G-901.Rx19 / G-901.Rx197 / G-901.Rx199
Controller type	Cascading PIV controller structure with velocity and acceleration feedforward control
Sampling rate current control	20 kHz
Control algorithms	Multiple Input Multiple Output (MIMO) gantry control, dual loop control
Motion profiles/trajectory planning	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)
Encoder	1 × per integrated axis, supported types: Incremental: 1V <sub>ss</sub> , RS-422 Absolute: EnDat 2.2 & 2.1, Smart-Abs, Panasonic, BiSS-A/B/C (SSI)
Limit switches	2 × per integrated axis Default: 5 V sinking (NPN) Optional configuration: 24 V; sourcing (PNP)
Reference switch	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))
Motor brake	1 × per integrated axis Integrated PWM brake driver with current reduction for a reduced heating up of the brake STO
Functional safety	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

Electrical properties	G-901.R319[x]	G-901.R4197, G-901.R4199	G-901.R519[x]
Intermediate circuit voltage	All axes: 48 V	Axes 0, 1: 96 V Axes 2, 3: 48 V (Axis 3 only with G-901.R4199)	All axes: 96 V
Output power intermediate circuit, continuous / peak	1000 W / 1050 W (max. 5 s)	Intermediate circuit 96 V: 2000 W / 2100 W Intermediate circuit 48 V: 480 W / 580 W (max. 10 s)	2000 W / 2100 W (max. 5 s)
Output power per axis (effective value), continuous / peak (max. 1 s)*	250 W / 740 W	Axes 0, 1: 500 W / 1500 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)	500 W / 1500 W
Current limitation per motor phase (amplitude of sine), continuous/peak (max. 1 s)	6.6 A / 20 A	6.6 A / 20 A	6.6 A / 20 A

Interfaces and operation	G-901.Rx19[x]
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 Alternative use is possible, depending on maximum phase current. 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**	2 × D-sub 15 (m) 2 × HD D-sub 26 (f) Alternative use depending on encoder type. Default factory configuration at delivery: Digital incremental encoder (RS-422) or absolute encoder on HD D-sub 26 (f) Incremental encoder 1 V <sub>ss</sub> on D-sub 15 (m) Possible modified factory configuration at delivery: Digital incremental encoder (RS-422) or absolute encoder on D-sub 15 (m)
Digital I/O lines, 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)
Analog 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
Inputs for STO safety function	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)

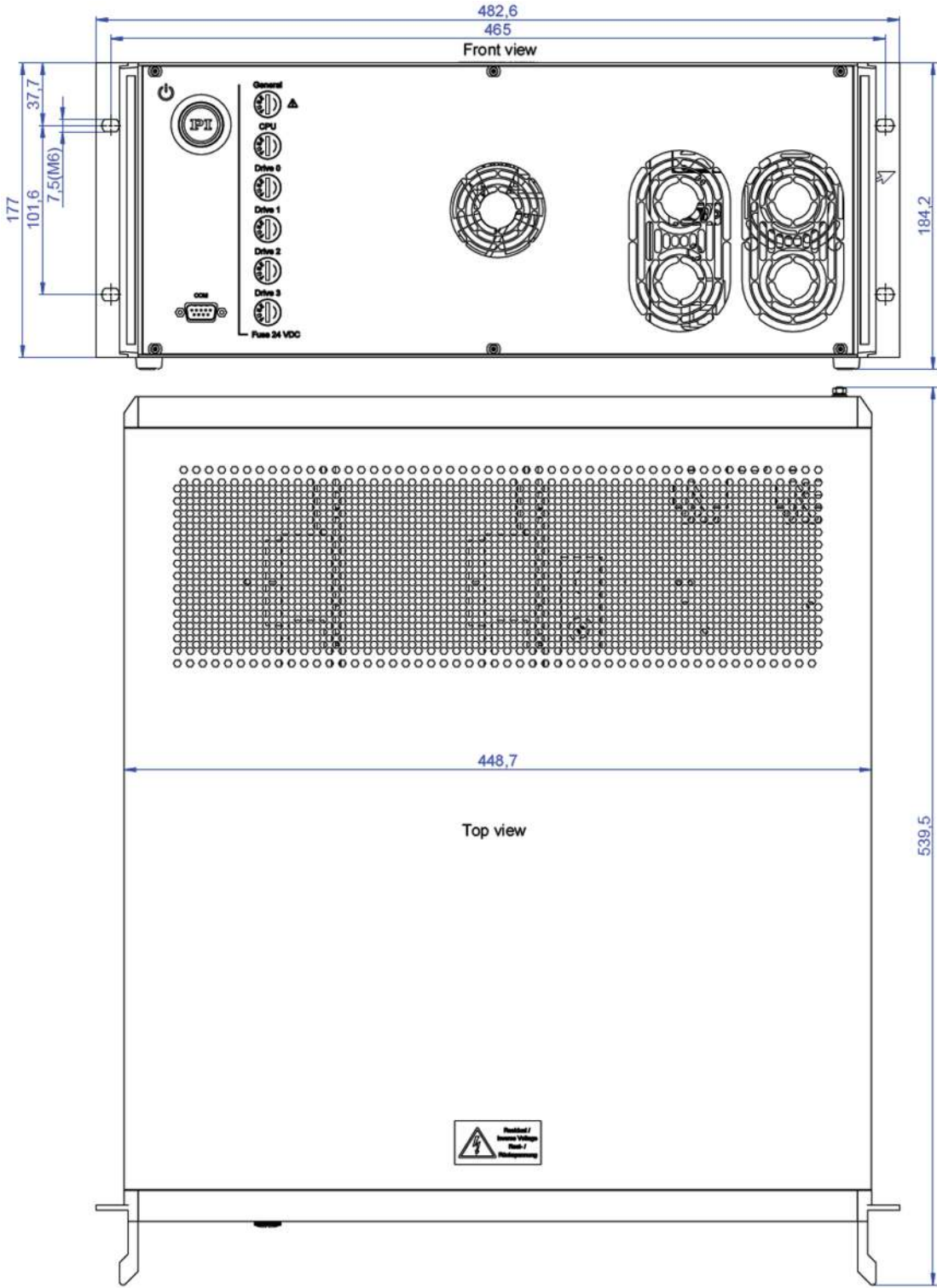
Miscellaneous	G-901.R319[x]	G-901.R419x	G-901.R519[x]
Operating voltage***	2 × mains connector 100-250 V AC, 50-60 Hz	2 × mains connector 100-250 V AC, 50-60 Hz	2 × mains connector 100-250 V AC, 50-60 Hz
Required protection per mains connector***	IEC: 12-16 A @ 250 V AC; 50 Hz UL/CSA: 12-20 A @ 125/250 V AC; 60 Hz	IEC: 12-16 A @ 250 V AC; 50 Hz UL/CSA: 12-20 A @ 125/250 V AC; 60 Hz	IEC: 12-16 A @ 250 V AC; 50 Hz UL/CSA: 12-20 A @ 125/250 V AC; 60 Hz
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)	5 °C to 40 °C (temperature protection switches off at excessively high temperatures)
Mass	13 kg	17 kg	15.5 kg
Dimensions	482.6 mm × 539.5 mm × 184.2 mm (including handles)	482.6 mm × 553.4 mm × 184.2 mm (including handles)	482.6 mm × 553.4 mm × 184.2 mm (including handles)

\* Peak power cannot be made available for all axes at the same time.

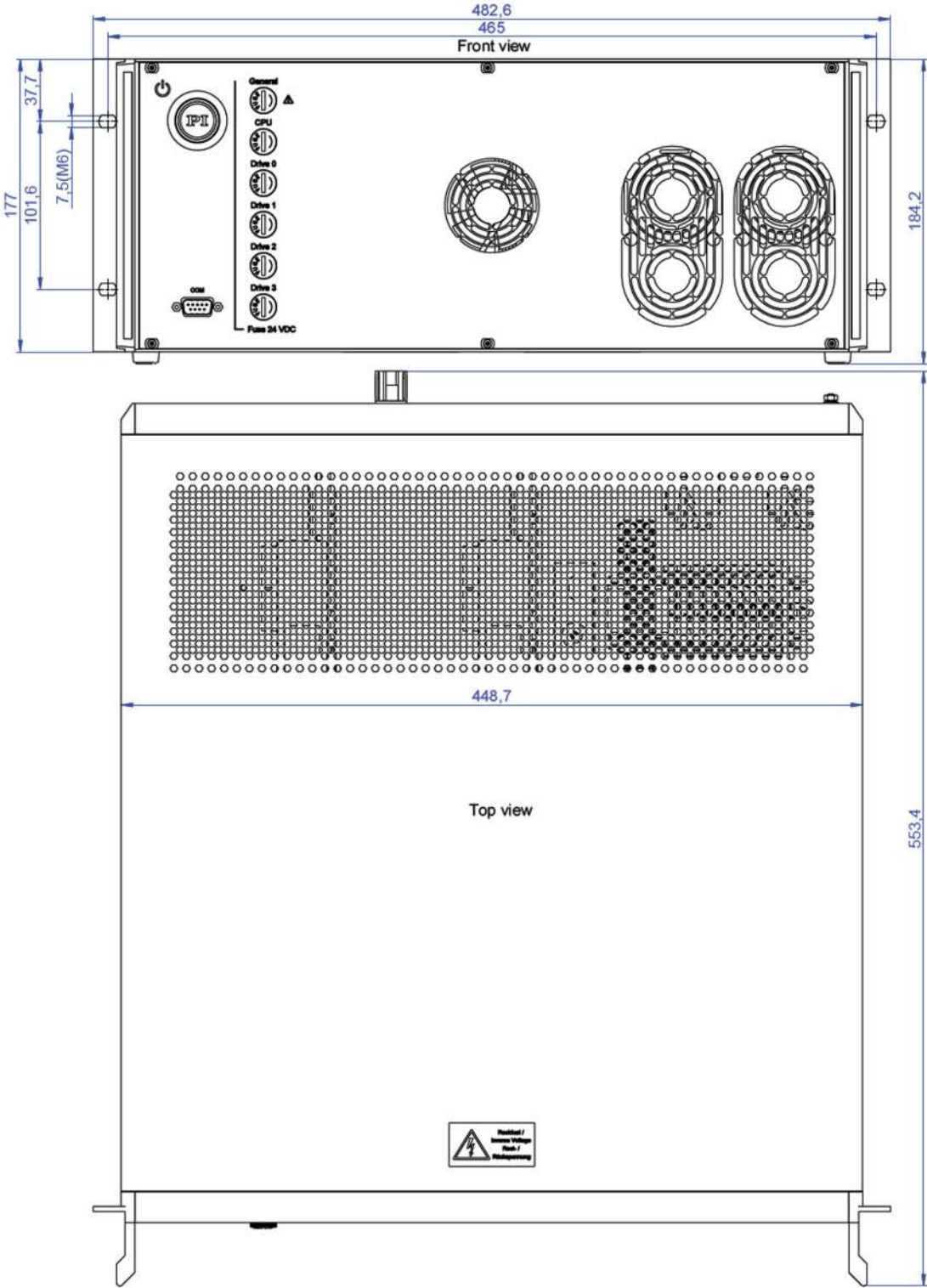
\*\* Driver modules for one drive axis have motor and sensor connectors for a second axis, these have, however, not been assigned

\*\*\* The supply must be delivered via two different current circuits. Both mains connectors must be connected and switched on.

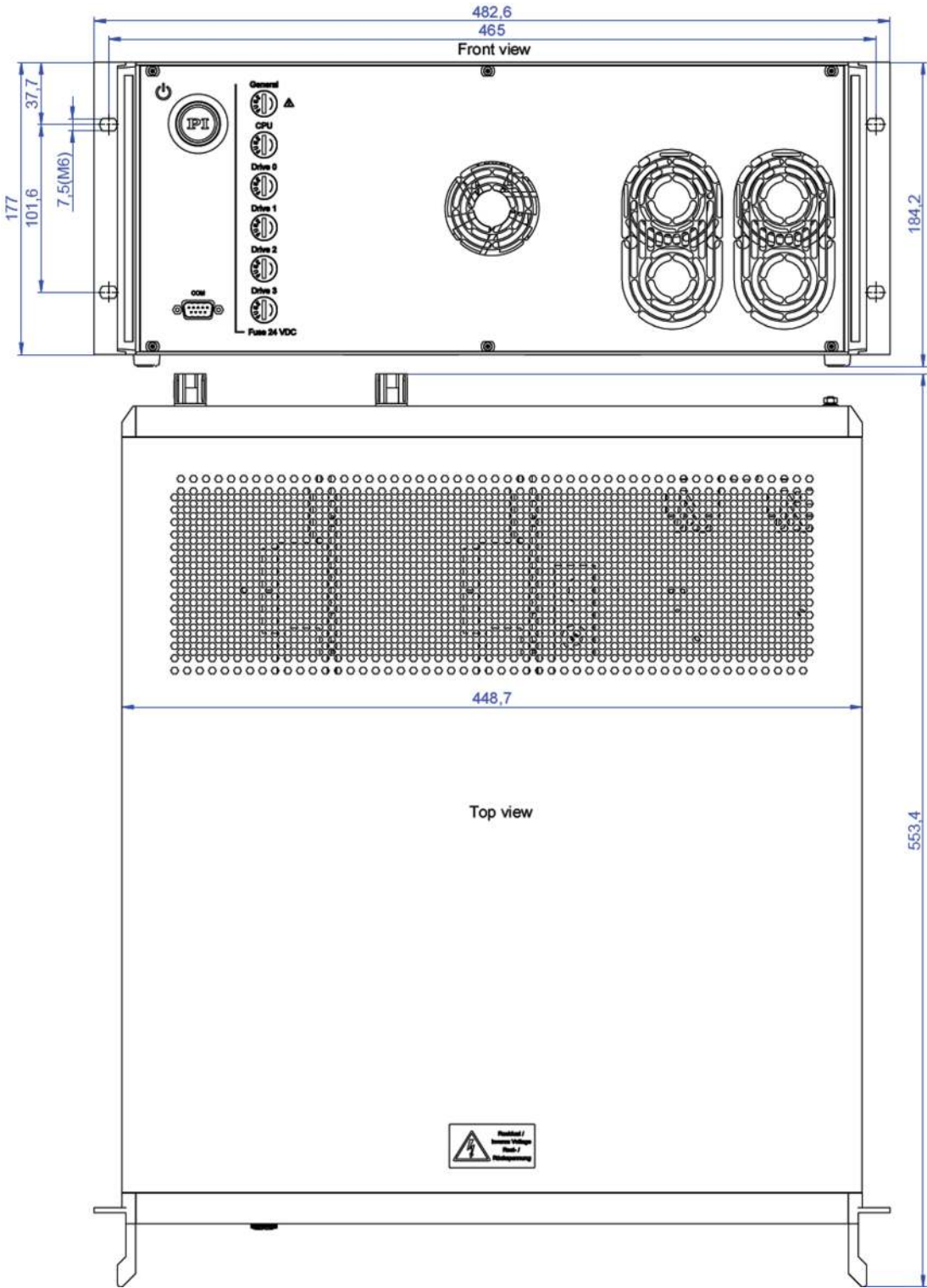
## Drawings / Images



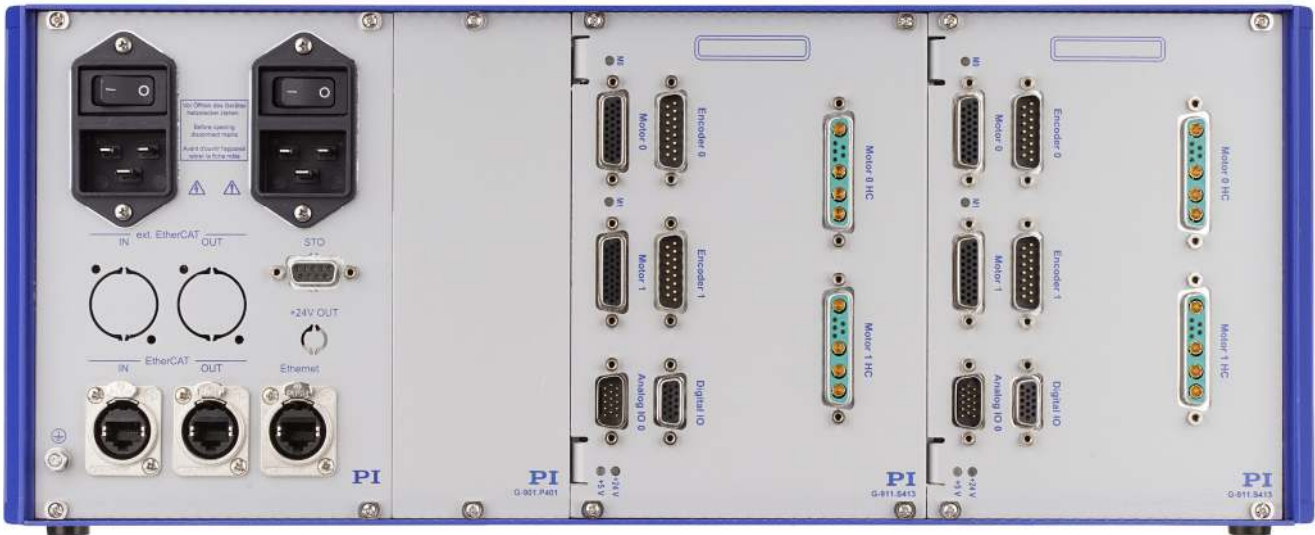
G-901.R319[x], dimensions in mm



G-901.R419x and .R519, dimensions in mm



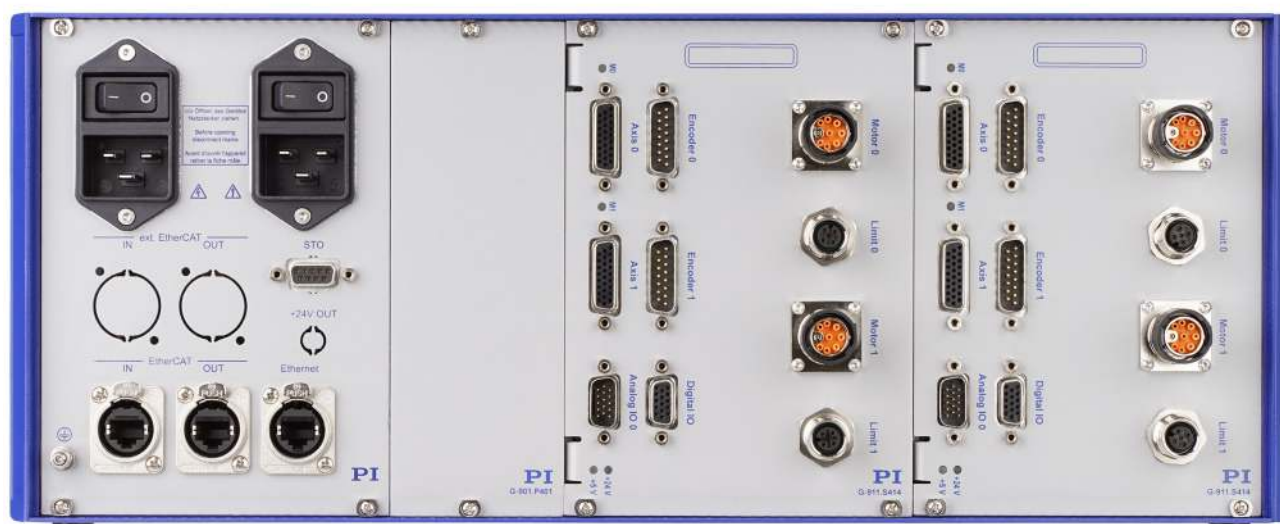
G-901.R5197 and .R5199, dimensions in mm



Rear panel of the G-901.R3199 with connectors



Rear panel of the G-901.R4199 with connectors



Rear panel of the G-901.R5199 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