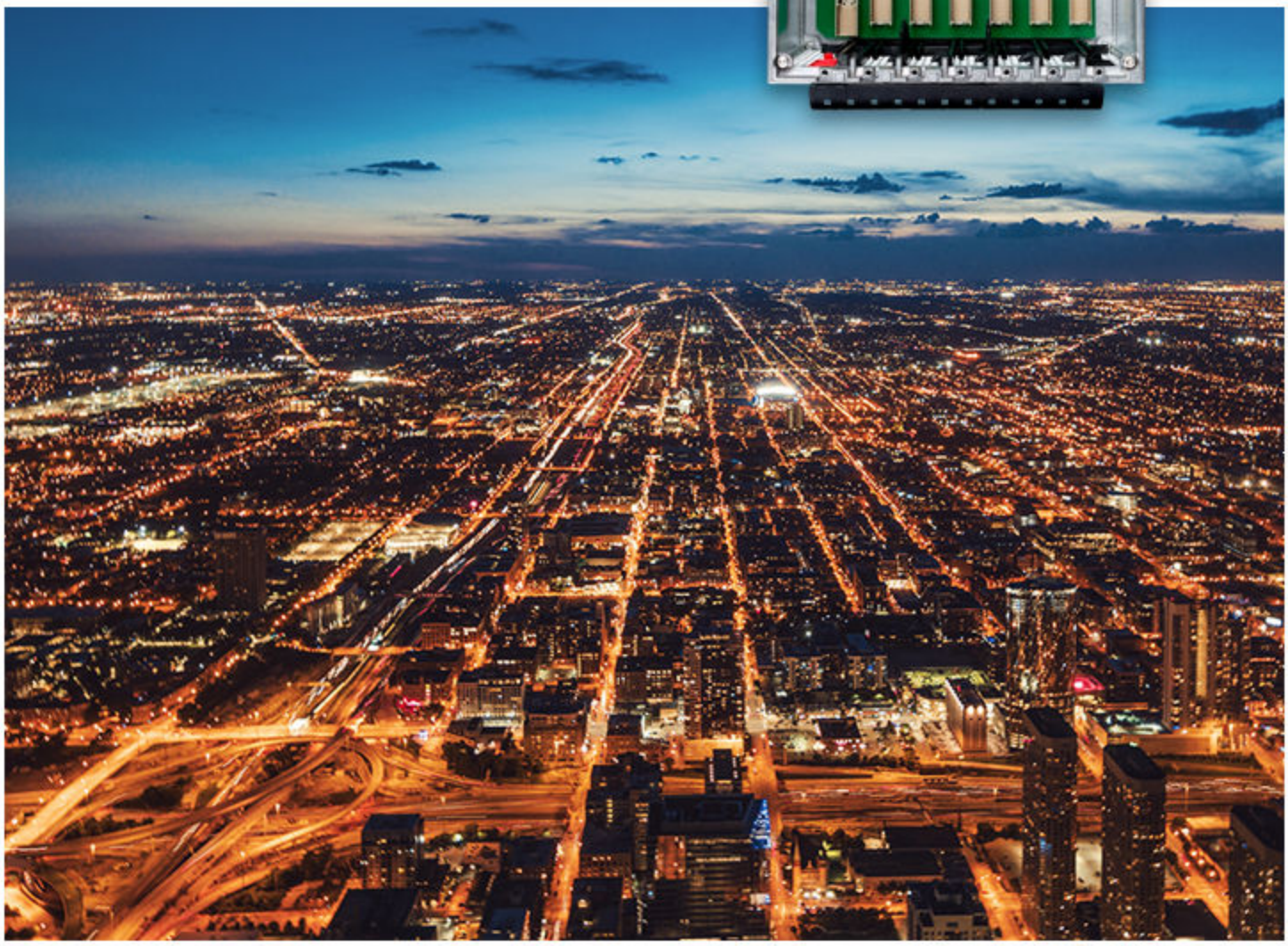
ML 300

4921240645B

Hardware modules

Data sheet

Improve Tomorrow

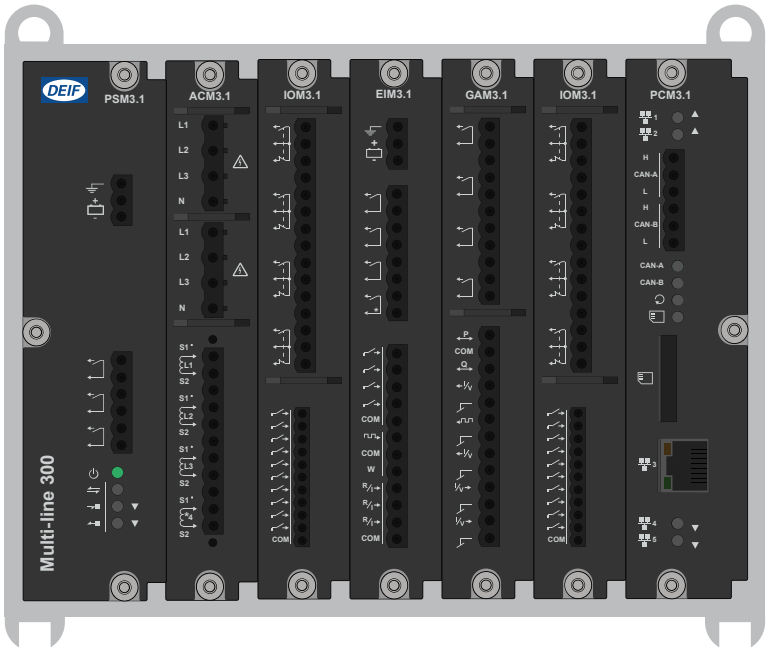


1. Multi-line 300

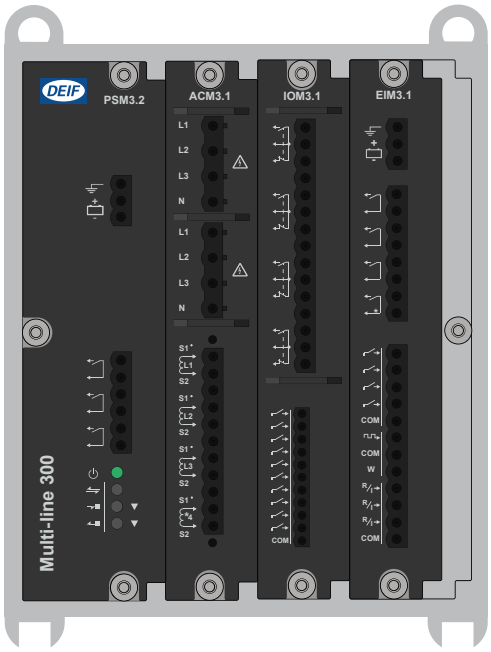
1.1 About the hardware modules

The Multi-line 300 (ML 300) hardware modules are printed circuit boards that slot in to either a rack R7.1 or rack R4.1. Depending on the type of module, they can provide measurement connections, inputs, and outputs.

Example rack R7.1



Example rack R4.1



The hardware modules feature:

- Placement flexibility in the rack.
- Remove, replace, or add on-site.
- Automatically recognised.
- Configurable input and output functions (digital and analogue):
  - Digital input functions: Commands from operators or 3rd party equipment, changing configuration, operating information.
  - Digital output functions: Alarm status, commands to 3rd party equipment, operating information.
  - Analogue input functions: External set points, operating information, supervised binary inputs.
  - Analogue output functions: Regulation *, operating information.

NOTE * Only available on certain types of controller.

All slots must be covered during operation and blind modules can be used to cover unused slots.

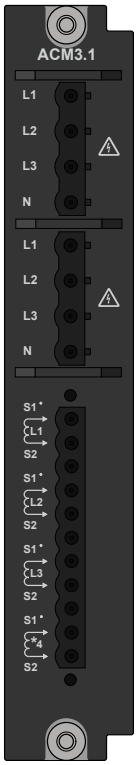
2. Technical specifications

2.1 Alternating current module ACM3.1

The alternating current module ACM3.1 measures the voltage and current on one side of a breaker, and the voltage on the other side. The hardware module responds when the measurements exceed the AC alarm parameters.

ACM3.1 provides robust frequency detection in environments with electrical noise. ACM3.1 allows extended measurement bandwidth up to 40 times the nominal frequency. ACM3.1 includes a configurable 4th current measurement.

ACM3.1 terminals

Module	Count	Symbol	Type	Name
	2 × (L1, L2, L3 and N)	L1/L2/L3/N	Voltage	3-phase voltage measurements
	1 × (L1, L2, L3 and 4th)		Current	3-phase current measurement 4th current measurement

ACM3.1 technical specifications

Category	Specification
Voltage measurements	Nominal value: 100 to 690 V AC phase-to-phase Measurement range: 2 to 897 V AC phase-to-phase Accuracy: Class 0.2 Phase angle accuracy: 0.1° (within nominal voltage range and nominal frequency range) Altitude derating from 2,000 to 4,000 m (6,562 to 13,123 ft): 100 to 480 V AC phase-to-phase UL/cUL Listed: 100 to 600 V AC phase-to-phase Load on external voltage transformer: Maximum 0.2 VA/phase Voltage withstand: 1.2 × Nominal voltage continuously; 1.3 × Nominal voltage for 10 s
Current measurements	Nominal value: 1 or 5 A AC from current transformer Measurement range: 0.02 to 17.5 A AC from current transformer; Truncation level: 11 mA Accuracy: Class 0.2 Earth current: 18 dB attenuation of third harmonic of the nominal frequency UL/cUL Listed: From listed or R/C (XODW2.8) current transformers 1 or 5 A Load on external current transformer: Maximum 0.3 VA/phase Current withstand: 10 A continuously; 17.5 A for 60 s; 100 A for 10 s; 250 A for 1 s

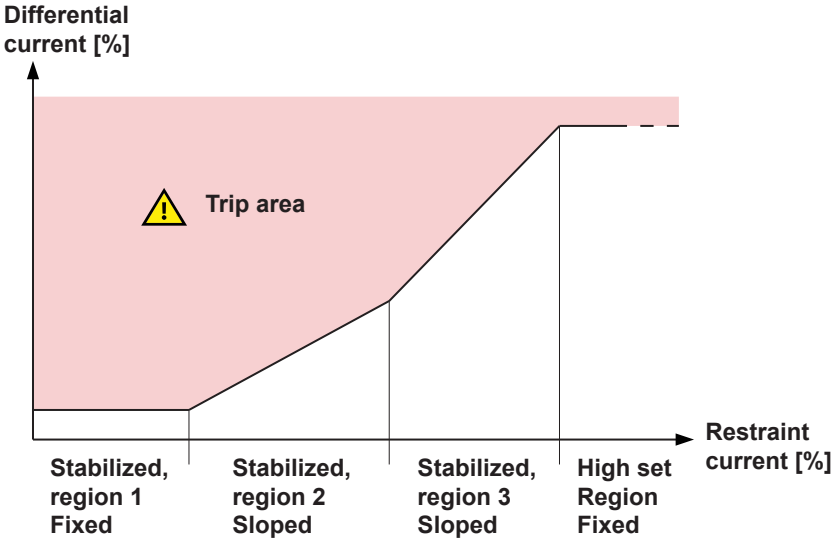
Category	Specification
Frequency measurements	Nominal value: 50 Hz or 60 Hz Measurement range: 35 to 78 Hz Accuracy: Class 0.1 of nominal value (35 to 78 Hz) (-40 to 70 °C) (-40 to 158 °F) Class 0.02 of nominal value (40 to 70 Hz) (15 to 30 °C) (59 to 86 °F)
Power measurements	Accuracy: Class 0.5
Accuracy and temperature	Unless otherwise specified for the above measurements: Nominal range: -40 to 70 °C (-40 to 158 °F) Reference range: 15 to 30 °C (59 to 86 °F) Accuracy: Measurement type specific within reference range Additional 0.2 % error of full scale per 10 °C (18 °F) outside reference range
Torques and terminals	Module faceplate screws: 0.5 N·m (4.4 lb-in) Secure the current measurement terminal block to the module faceplate: 0.25 N·m (2.2 lb-in) Connection of wiring to terminals: 0.5 N·m (4.4 lb-in) UL/cUL Listed: Wiring must be minimum 90 °C (194 °F) copper conductors only
Terminal connections	AC voltage and current terminals: Standard 45° plugs, 2.5 mm^2 Wiring: 2.5 mm^2 (13 AWG), multi-stranded
Galvanic isolation	Between AC voltage and other I/Os: 3310 V, 50 Hz for 60 s Between AC current and other I/Os: 2210 V, 50 Hz for 60 s
Ingress protection	Unmounted: No protection rating Mounted in rack: IP20 according to IEC/EN 60529
Dimensions	L×H×D: 28 × 162 × 150 mm (1.1 × 6.4 × 5.9 in)
Accessories (included)	• One roundel with 6 J-shaped voltage encoding pins (for the hardware module) • One roundel with 6 flat voltage encoding pins (for the voltage terminal blocks)
Weight	232 g (0.5 lb)

2.2 Differential current module ACM3.2

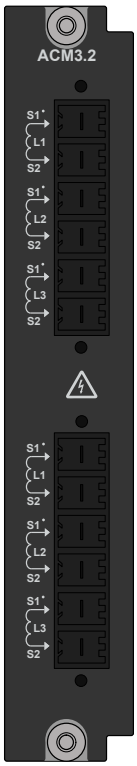
The differential current module ACM3.2 measures the generator outgoing 3-phase currents (consumer side) and star point 3-phase currents. The ACM3.2 uses the measurements to detect phase-to-phase faults or phase-to-earth faults (star point earthed generator stator only) in the generator stator, and dependent on the mounting of the CT's on the outgoing side, possibly also the cable between the generator and the main switchboard.

The protection consists of:

- A stabilised stage that uses a fixed + 2 × sloped operating characteristic. This current restraint approach is also known as biased differential protection.
- A high set fixed differential stage (non-stabilised).



ACM3.2 terminals

Module	Count	Symbol	Type	Name
	1 × (L1, L2 and L3)		Current	3-phase current measurement - Consumer side
	1 × (L1, L2 and L3)		Current	3-phase current measurement - Neutral side

ACM3.2 technical specifications

Category	Specification
Nominal, reference and operating values	Current: Nominal value: 1 or 5 A AC from current transformer Frequency: • Nominal value: 50 or 60 Hz • Reference range: 40 to 70 Hz • Operating range: 20 to 78 Hz Temperature: • Reference range: 15 to 30 °C (59 to 86 °F) • Operating range: -40 to 70 °C (-40 to 158 °F)
Current measurements	Measurement range: 0.025 to 250 A AC. Truncation level: 20 mA Accuracy: • 0.025 to 20 A: ±1 % or ±10 mA of measured current (whichever is greater) • 20 to 250 A: ±1.5 % of measured current UL/cUL Listed: From listed or R/C (XODW2.8) current transformers 1 or 5 A Load on external current transformer: < 4 mΩ, including the terminal block Current withstand: • 20 A continuously • 100 A for 10 s • 400 A for 1 s • 1250 A for 10 ms (half wave)
Frequency measurement	Accuracy (within operating range): > 0.1 A: ±0.1 % of actual frequency
Temperature	Current measurement accuracy temperature coefficient: ±0.25 %, or ±2.5 mA per 10 °C (18 °F) outside reference range (whichever is greater)
Torques and terminals	Module faceplate screws: 0.5 N·m (4.4 lb-in) Secure the current measurement terminal block to the module faceplate: 0.25 N·m (2.2 lb-in) Connection of wiring to terminals: • ≤ 4 mm^2: 0.5 N·m (4.4 lb-in) to 0.6 N·m (5.3 lb-in) • > 4 mm^2: 0.7 N·m (6.2 lb-in) to 0.8 N·m (7.1 lb-in) UL/cUL Listed: Wiring must be minimum 90 °C (194 °F) copper conductors only
Terminal connections	AC current terminals: Standard 0° plugs, 6 mm^2 with securing screws Wiring: 2.5 to 6 mm^2 (13 to 10 AWG), multi-stranded
Galvanic isolation	Between AC current and other I/Os: 2210 V, 50 Hz for 60 s
Ingress protection	Unmounted: No protection rating Mounted in rack: IP20 according to IEC/EN 60529
Dimensions	L×H×D: 28 × 162 mm × 152 mm (1.1 × 6.4 × 5.9 in)
Weight	230 g (0.5 lb) (including terminal blocks)
Accessories (included)	One roundel with 6 encoding pins (for the hardware module and terminal block)

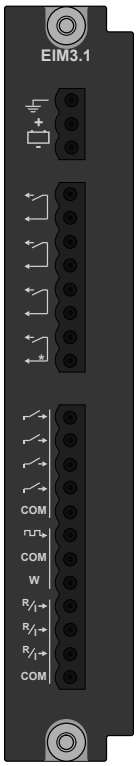
2.3 Engine interface module EIM3.1

The engine interface module has its own power supply and a tacho input to measure speed. It also has four relay outputs, four digital inputs, and three analogue inputs. These I/Os are configurable.

The power supply terminals include circuit protection against load dump transients and JEM177 surge transients (rugged design). These terminals also include battery voltage measurement.

EIM3.1 has its own microprocessor. If the rack power supply fails, or connection to the application is lost, the EIM3.1 can continue to operate independent of the application.

EIM3.1 terminals

Module	Count	Symbol	Type	Name
	1		Ground	Frame ground
	1		12 or 24 V DC	Power supply
	3		Relay output	Configurable
	1		Relay output (with wire break detection)	Configurable
	4		Digital input	Configurable
	1		MPU input (with wire break detection)*	Magnetic pickup
	1	W	W input (no wire break detection)*	Generator tacho output or NPN/PNP sensor
	3	R/I	Analogue current or resistance measurement input (RMI)	Configurable

NOTE *These inputs cannot both be used at the same time.

EIM3.1 technical specifications

Category	Specification
Frame ground	Voltage withstand: ±36 V DC to the power supply positive (terminal 1) and negative (terminal 2)
Auxiliary power supply	Input voltage: 12 or 24 V DC nominal (8 to 36 V DC continuously) UL/cUL Listed: 10 to 32.5 V DC 0 V DC for 50 ms when coming from at least 8 V DC (cranking dropout) Consumption: Typical 3 W, maximum 5 W Internal protection: by 12 A fuse (not replaceable) (fuse size determined by load dump requirements) Voltage withstand: ±36 V DC Load dump protected by TVS diodes **Start current** • Power supply current limiter ◦ 24 V: 0.6 A minimum

Category	Specification
	◦ 12 V: 1.2 A minimum • Battery: No limit
Relay outputs 	Relay type: Electromechanical Electrical rating and UL/cUL Listed: 30 V DC and 6 A, resistive Voltage withstand: ±36 V DC
Relay output with wire break detection 	Relay type: Electromechanical Electrical rating and UL/cUL Listed: 30 V DC and 6 A, resistive Includes wire break detection Voltage withstand: ±36 V DC
Magnetic pickup 	Voltage: 3 to 70 V AC peak Frequency: 2 to 20,000 Hz Accuracy: 2 to 99 Hz: 0.5 Hz; 100 to 20,000 Hz: ±0.5 % of measurement Cable supervision: Resistance maximum 100 kΩ Includes wire break detection Voltage withstand: 70 V AC
Generator tacho (W) W	Voltage: 8 to 36 V DC Frequency: 2 to 20,000 Hz Accuracy: 2 to 99 Hz: 0.5 Hz; 100 to 20,000 Hz: ±0.5 % of measurement No wire break detection Voltage withstand: ±36 V DC
NPN/PNP W	Voltage: 8 to 36 V DC Frequency: 2 to 20,000 Hz Accuracy: 2 to 99 Hz: 0.5 Hz; 100 to 20,000 Hz: ±0.5 % of measurement No wire break detection Voltage withstand: ±36 V DC
Digital inputs 	Bipolar inputs • ON: -36 to -8 V DC, and 8 to 36 V DC • OFF: -2 to 2 V DC Minimum pulse length: 50 ms Impedance: 4.7 kΩ Voltage withstand: ±36 V DC
Analogue multi-functional inputs 	**Current input** • From active transmitter: 0 to 20 mA, 4 to 20 mA, or any custom range between 0 and 25 mA • Accuracy: 1 % of selected range **Pt100/1000** • -40 to 250 °C (-40 to 482 °F) • Accuracy: 1 % of full scale (to IEC/EN60751) • Maximum sensor self-heating: 0.5 °C/mW (1 °F/mW) **Resistance measurement** • Any custom range between 0 and 2.5 kΩ • Accuracy: 1 % over ranges: 0 to 200 Ω, 0 to 300 Ω, 0 to 500 Ω, 0 to 1000 Ω, and 0 to 2500 Ω **Digital input** • Dry contact with cable supervision • Maximum circuit resistance: 330 Ω • Minimum current rating for the connected relay: 2.5 mA Voltage withstand: ±36 V DC All analogue multi-functional inputs for EIM3.1 have a common ground
Terminal connections	**Frame ground and power supply**

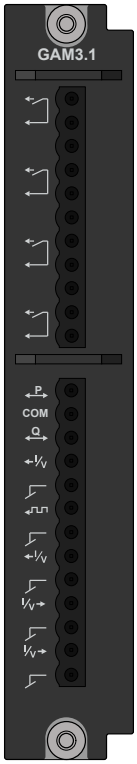
Category	Specification
	• Terminals: Standard 45° plug, 2.5 mm^2 • Wiring: 1.5 to 2.5 mm^2 (16 to 12 AWG), multi-stranded **Other connections** • Terminals: Standard 45° plug, 2.5 mm^2 • Wiring: 0.5 to 2.5 mm^2 (22 to 12 AWG), multi-stranded
Torques and terminals	Module faceplate screws: 0.5 N·m (4.4 lb-in) Connection of wiring to terminals: 0.5 N·m (4.4 lb-in) UL/cUL Listed: Wiring must be minimum 90 °C (194 °F) copper conductors only
Galvanic isolation	Between relay groups and other I/Os: 600 V, 50 Hz for 60 s Between digital input groups and other I/Os: 600 V, 50 Hz for 60 s Between MPU and W inputs and other I/Os: 600 V, 50 Hz for 60 s Between analogue inputs and other I/Os: 600 V, 50 Hz for 60 s
Ingress protection	Unmounted: No protection rating Mounted in rack: IP20 according to IEC/EN 60529
Dimensions	L×H×D: 28 × 162 × 150 mm (1.1 × 6.4 × 5.9 in)
Weight	250 g (0.5 lb)

2.4 Governor and AVR module GAM3.1

This governor and AVR module has four relay outputs, two analogue outputs and a pulse width modulation output, and two analogue inputs. These I/Os are configurable.

GAM3.1 also has terminals for analogue load sharing (future use).

GAM3.1 terminals

Module	Count	Symbol	Type	Name
	4		Relay output	Configurable
	1	P	Load sharing	Active power (P) (kW) load sharing (future use)
	1	Q	Load sharing	Reactive power (Q) (kvar) sharing (future use)
	2	I/V	Analogue current or voltage output	GOV/AVR/configurable
	1		Pulse width modulation (PWM) output	PWM output (with PWM ground)
	2	I/V	Analogue current or voltage input	Configurable

GAM3.1 technical specifications

Category	Specification
Relay outputs	Relay type: Electromechanical Electrical rating and UL/cUL Listed: 250 V AC or 30 V DC, and 6 A, resistive; B300, pilot duty (B300 is a power limit specification for inductive loads) Altitude derating from 2,000 to 4,000 m (6,562 to 13,123 ft): Maximum 150 V AC phase-to-phase Voltage withstand: 250 V AC
Load sharing (future use) P Q	Voltage input/output: -5 to 5 V DC Impedance: 23.5 kΩ Accuracy: 1 % of full scale, for both inputs and outputs Voltage withstand: ±36 V DC
Analogue multi-functional outputs I/V	**Current output** • -20 to 20 mA, or 0 to 20 mA, or 4 to 20 mA, or any custom range between -25 and 25 mA • Accuracy: 1 % of the selected range (minimum range: 5 mA) • 16-bit resolution over the range -25 to 25 mA • Active output (internal supply) • Maximum load: 400 Ω **Voltage output (DC)** • -10 to 10 V, 0 to 10 V, 0 to 5 V, -5 to 5 V, 0 to 3 V, -3 to 3 V, or 0 to 1 V, or any custom range between -10 and 10 V

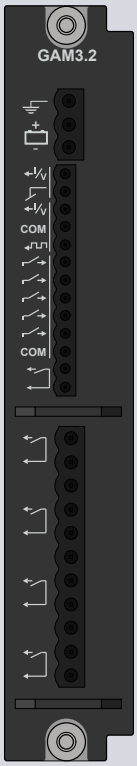
Category	Specification
	• Accuracy: 1 % of the selected range (minimum range: 1 V) • 16-bit resolution over the range -10 to 10 V • Minimum load: 600 Ω. Voltage output internal resistance: < 1 Ω Voltage withstand: ±36 V DC Controller power off: Internal resistance > 10 MΩ
Pulse width modulation (PWM) output	Frequency: 500 Hz ±50 Hz Resolution: 43,200 levels Voltage: • Low level: < 0.5 V • High level: > 5.5 V • Maximum: 6.85 V Output impedance: 100 Ω Nominal temperature range: -40 to 70 °C (-40 to 158 °F) Reference temperature range: 15 to 30 °C (59 to 86 °F) Duty cycle accuracy (5 to 95 %): 0.25 % within reference temperature range 0.2 % of full scale additional error per 10 °C (18 °F) outside the reference range Example: At 70 °C (158 °F) the accuracy of the PWM output is 0.25 % + 4 × 0.2 % = 1.05 % Voltage withstand: ±30 V DC
Analogue multi-functional inputs	**Current inputs** • From active transmitter: 0 to 20 mA, 4 to 20 mA, or any custom range between 0 and 24 mA • Accuracy: 1 % of selected range **Voltage inputs (DC)** • -10 to 10 V, 0 to 10 V, or any custom range between -10 and 10 V • Accuracy: 1 % of selected range Voltage withstand: ±36 V DC
Terminal connections	Terminals: Standard 45° plug, 2.5 mm^2 Wiring: 0.5 to 2.5 mm^2 (22 to 12 AWG), multi-stranded
Torques and terminals	Module faceplate screws: 0.5 N·m (4.4 lb-in) Connection of wiring to terminals: 0.5 N·m (4.4 lb-in) UL/cUL Listed: Wiring must be minimum 90 °C (194 °F) copper conductors only
Galvanic isolation	Between individual relays and other I/Os: 2210 V, 50 Hz for 60 s Between load sharing and other I/Os: 600 V, 50 Hz for 60 s Between terminals 12 to 15 (analogue output 1, PWM output), and other I/Os: 600 V, 50 Hz for 60 s • Analogue output 1 and the PWM output are galvanically connected Between terminals 16, 17 (analogue output 2) and other I/Os: 600 V, 50 Hz for 60 s Between terminals 18 to 21 (analogue inputs) and other I/Os: 600 V, 50 Hz for 60 s • Analogue inputs 1 and 2 are galvanically connected
Ingress protection	Unmounted: No protection rating Mounted in rack: IP20 according to IEC/EN 60529
Dimensions	L×H×D: 28 × 162 × 150 mm (1.1 × 6.4 × 5.9 in)
Weight	224 g (0.5 lb)

2.5 Governor and AVR module GAM3.2

This governor and AVR module has its own power supply, two analogue outputs and a pulse width modulation output, five digital inputs, a status relay output, and four relay outputs. Apart from the status relay, all these I/Os are configurable.

GAM3.2 has its own microprocessor. If the rack power supply fails, GAM3.2 can continue to be used for manual operation if it has its own, independent power supply. The power supply terminals include circuit protection against load dump transients and JEM177 surge transients (rugged design). These terminals also include battery voltage measurement.

GAM3.2 terminals

Module	Count	Symbol	Type	Name
	1		Ground	Frame ground
	1		12 or 24 V	Power supply
	2		Analogue current or voltage output	GOV/AVR/configurable
	1		Pulse width modulation (PWM) output	PWM output
	5		Digital input	Configurable
	1		Relay output	GAM3.2 status
	4		Relay output	Configurable

GAM3.2 technical specifications

Category	Specification

Auxiliary power supply	Input voltage: 12 or 24 V DC nominal (8 to 36 V DC continuously)
	UL/cUL Listed: 10 to 32.5 V DC
	0 V DC for 50 ms when coming from at least 8 V DC (cranking dropout)
	Consumption: Typical 3 W, maximum 5 W
	Voltage measurement accuracy: ±0.1 V (measurement range 8 to 36 V DC)
	Internally protection: 12 A fuse (not replaceable) (fuse size determined by load dump requirements)
	Voltage withstand: ±36 V DC
	Load dump protected by TVS diodes
	
	Start current
	• Power supply current limiter
	  ◦ 24 V: 0.6 A minimum
	  ◦ 12 V: 1.2 A minimum
	• Battery: No limit

Analogue multi-functional outputs	**Current output** • Any custom range between -25 and 25 mA • Accuracy: 1 % of the selected range (minimum range: 5 mA)

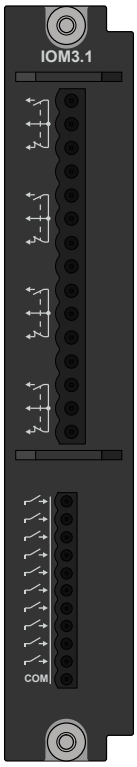
Category	Specification
	• 16-bit resolution • Active output (internal supply) • Maximum load: 400 Ω **Voltage output (DC)** • Any custom range between -10 and 10 V • Accuracy: 1 % of the selected range (minimum range: 1 V) • 16-bit resolution • Minimum load: 600 Ω. Voltage output internal resistance: < 1 Ω. Voltage withstand: ±36 V DC Controller power off: Internal resistance > 10 MΩ
Pulse width modulation (PWM) output	Frequency: 500 Hz ±50 Hz Resolution: 43,200 levels Voltage: • Low level: < 0.5 V • High level: > 5.5 V • Maximum: 6.85 V Output impedance: 100 Ω Nominal temperature range: -40 to 70 °C (-40 to 158 °F) Reference temperature range: 15 to 30 °C (59 to 86 °F) Duty cycle accuracy (5 to 95 %): 0.25 % within reference temperature range 0.2 % of full scale additional error per 10 °C (18 °F) outside the reference range Example: At 70 °C (158 °F) the accuracy of the PWM output is 0.25 % + 4 × 0.2 % = 1.05 % Voltage withstand: ±30 V DC
Digital inputs	Bipolar inputs • ON: -36 to -8 V DC, and 8 to 36 V DC • OFF: -2 to 2 V DC Minimum pulse length: 50 ms Impedance: 4.7 kΩ Voltage withstand: ±36 V DC
Relay output (GAM3.2 status)	Relay type: Solid state Electrical rating and UL/cUL Listed: 30 V DC and 1 A, resistive Voltage withstand: ±36 V DC
Relay outputs	Relay type: Electromechanical Electrical rating and UL/cUL Listed: 250 V AC or 30 V DC, and 6 A, resistive; B300, pilot duty (B300 is a power limit specification for inductive loads) Altitude derating from 2,000 to 4,000 m (6,562 to 13,123 ft): Maximum 150 V AC phase-to-phase Voltage withstand: 250 V AC
Terminal connections	**Frame ground and power supply** • Terminals: Standard 45° plug, 2.5 mm^2 • Wiring: 1.5 to 2.5 mm^2 (16 to 12 AWG), multi-stranded **Analogue inputs, PWM, digital inputs and the status relay** • Terminals: Standard 45° plug, 1.5 mm^2 • Wiring: 0.5 to 1.5 mm^2 (28 to 16 AWG), multi-stranded **Relay outputs** • Terminals: Standard 45° plug, 2.5 mm^2 • Wiring: 0.5 to 2.5 mm^2 (22 to 12 AWG), multi-stranded
Torques and terminals	Module faceplate screws: 0.5 N·m (4.4 lb-in) Connection of wiring to frame ground and power supply terminals: 0.5 N·m (4.4 lb-in) Connection of wiring to analogue inputs, PWM, digital inputs, and the status relay terminals: 0.25 N·m (2.2 lb-in)

Category	Specification
	Connection of wiring to relay output terminals: 0.5 N·m (4.4 lb-in) UL/cUL Listed: Wiring must be minimum 90 °C (194 °F) copper conductors only
Galvanic isolation	Between power supply and other I/Os: 600 V, 50 Hz for 60 s Between analogue inputs, PWM, digital inputs, and the status relay, and other I/Os: 600 V, 50 Hz for 60 s The analogue output on terminals 5 and 6 is galvanically connected to the PWM output (terminals 6 and 7) Between relay groups and other I/Os: 2210 V, 50 Hz for 60 s
Ingress protection	Unmounted: No protection rating Mounted in rack: IP20 according to IEC/EN 60529
Dimensions	L×H×D: 28 × 162 × 150 mm (1.1 × 6.4 × 5.9 in)
Weight	246 g (0.5 lb)

2.6 Input/output module IOM3.1

The input output module has 4 changeover relay outputs, and 10 digital inputs. These I/Os are all configurable.

IOM3.1 terminals

Module	Count	Symbol	Type	Name
	4		Relay output	Configurable
	10		Digital input	Configurable

IOM3.1 technical specifications

Category	Specification
Relay outputs 	Relay type: Electromechanical Electrical rating and UL/cUL Listed: 250 V AC or 30 V DC, and 6 A, resistive; B300, pilot duty (B300 is a power limit specification for inductive loads) Altitude derating from 3,000 to 4,000 m (9,842 to 13,123 ft): Maximum 150 V AC phase-to-phase Voltage withstand: 250 V AC
Digital inputs 	Bipolar inputs • ON: -36 to -8 V DC, and 8 to 36 V DC • OFF: -2 to 2 V DC Minimum pulse length: 50 ms Impedance: 4.7 kΩ Voltage withstand: ±36 V DC
Terminal connections	**Relay outputs**: Terminals: Standard 45° plug, 2.5 mm^2 Wiring: 0.5 to 2.5 mm^2 (22 to 12 AWG), multi-stranded **Digital inputs**: Terminals: Standard 45° plug, 1.5 mm^2 Wiring: 0.1 to 1.5 mm^2 (28 to 16 AWG), multi-stranded
Torques and terminals	Module faceplate screws: 0.5 N·m (4.4 lb-in) Connection of wiring to relay output terminals: 0.5 N·m (4.4 lb-in) Connection of wiring to digital input terminals: 0.25 N·m (2.2 lb-in) UL/cUL Listed: Wiring must be minimum 90 °C (194 °F) copper conductors only
Galvanic isolation	Between relay groups and other I/Os: 2210 V, 50 Hz for 60 s Between digital input groups and other I/Os: 600 V, 50 Hz for 60 s

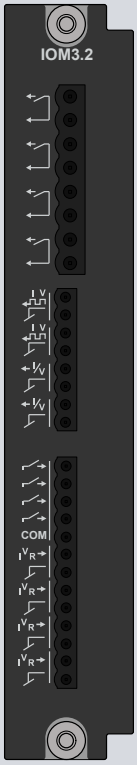
Category	Specification
Ingress protection	Unmounted: No protection rating Mounted in rack: IP20 according to IEC/EN 60529
Dimensions	L×H×D: 28 × 162 × 150 mm (1.1 × 6.4 × 5.9 in)
Weight	196 g (0.4 lb)

2.7 Input/output module IOM3.2

The input output module has 4 relay outputs, 4 analogue multifunctional outputs (including 2 pulse width modulation PWM outputs), 4 digital inputs, and 4 analogue multifunctional inputs. These I/Os are all configurable.

Internal cold junction compensation is not available on IOM3.2

IOM3.2 terminals

Module	Count	Symbol	Type	Name
	4		Relay output	Configurable
	2		Analogue multifunctional output (mA, V DC, PWM)	Configurable
	2		Analogue multifunctional output (mA, V DC)	Configurable
	4		Digital input	Configurable
	4		Analogue multifunctional input (mA, V DC, RMI)	Configurable

IOM3.2 technical specifications

Category	Specification
Relay outputs	Relay type: Solidestate relay Electrical rating and UL/cUL Listed: 30 V DC, and 6 A, resistive; B300, pilot duty (B300 is a power limit specification for inductive loads) Voltage withstand: ±36 V DC
Analogue multifunctional outputs	**Current output:** • Range: Any custom range between -25 to 25 mA DC • Accuracy: 1 % of range • Resolution: 16 bits (< 2 uA / bit) • Type: Active output (internal supply) • Load: Maximum ±25 mA → 400 Ω **Voltage output:** • Range: Any custom range between -10 to 10 V DC • Accuracy: 1 % of range • Resolution: 16 bits (< 0,7 mV / bit) • Load: Minimum ±10V -> 600 Ω • Internal resistance, power ON: < 1 Ω • Internal resistance, power OFF: > 10 MΩ **General information for all outputs:**

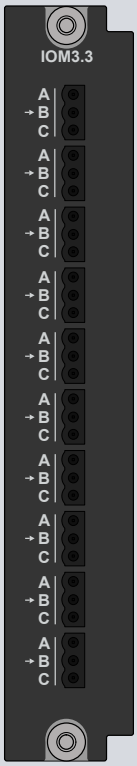
Category	Specification
	• Refresh rate (max): 50ms (input to output) • Voltage withstand: ±36 V DC
Analogue multifunctional PWM outputs	**PWM output:** • Frequency range: 1 to 2500 Hz ±5 Hz • Duty cycle accuracy (5 to 95 %): 0.5 % within reference temperature range • Resolution: 12 bits (4096 steps) • Voltage: Low level: < 0.5 V. High level: > adjustable 1 to 10 V. Maximum: 10.2 V • Output impedance: 25 Ω **General information for all outputs:** • Refresh rate (max): 50 ms (input to output) • Voltage withstand: ±36 V DC
Digital inputs	Bipolar inputs • ON: -36 to -8 V DC, and 8 to 36 V DC • OFF: -2 to 2 V DC Minimum pulse length: 50 ms Impedance: 3.9 kΩ Voltage withstand: ±36 V DC
Analogue multifunctional inputs	**Digital inputs with wire break detection:** • Dry contact inputs, 3 V DC internal supply • Wire-break detection with maximum resistance for ON detection: 100 Ω to 400 Ω **Current inputs:** • From active transmitter: 0 to 20 mA, or 4 to 20 mA • Accuracy: ±10 uA ±0.25 % of actual reading **Voltage inputs (DC):** • Range: ±10 V DC / 0 to 10 V DC • Accuracy: ±10 mV ±0.25 % of actual reading **Resistance measurement inputs, 2 wire (RMI):** • Resistance measurement: 0 to 4.5 kΩ • Accuracy: ±1 Ω ±0.25 % of actual reading **Resistance measurement inputs, 1 wire (RMI):** • Resistance measurement: 0 to 4.5 kΩ • Accuracy: ±2 Ω ±0.25 % of actual reading **Pt100:** • Range: -200 to 850 °C • Accuracy: ±1 °C ±0.25 % of actual reading **Pt1000:** • Range: -200 to 850 °C • Accuracy: ±0.5 °C ±0.25 % of actual reading **Thermocouple type, range and accuracy:** • E: -200 to 1000 °C (±2 °C ±0.25 % of actual reading) • J: -210 to 1200 °C (±2 °C ±0.25 % of actual reading) • K: -200 to 1372 °C (±2 °C ±0.25 % of actual reading) • N: -200 to 1300 °C (±2 °C ±0.25 % of actual reading) • R: -50 to 1768 °C (±2 °C ±0.25 % of actual reading) • S: -50 to 1768 °C (±2 °C ±0.25 % of actual reading) • T: -200 to 400 °C (±2 °C ±0.25 % of actual reading) **Note:** Twisted pair and shielded cable is recommended to achieve specification and optimisation of noise immunity.

Category	Specification
	General information for all outputs: • Refresh rate (max): 50 ms (input to output) • Voltage withstand: ±36 V DC • All analogue multi-functional inputs have a common ground
Terminal connections	**Relay outputs**: Terminals: Standard 45° plug, 2.5 mm^2 Wiring: 0.5 to 2.5 mm^2 (22 to 14 AWG), multi-stranded **Other inputs**: Terminals: Standard 45° plug, 1.5 mm^2 Wiring: 0.1 to 1.5 mm^2 (28 to 16 AWG), multi-stranded
Torques and terminals	Module faceplate screws: 0.5 N·m (4.4 lb-in) Connection of wiring to relay output terminals: 0.5 N·m (4.4 lb-in) Connection of wiring to digital input terminals: 0.25 N·m (2.2 lb-in) UL/cUL Listed: Wiring must be minimum 90 °C (194 °F) copper conductors only
Galvanic isolation	Between relay groups and other I/Os: 2210 V, 50 Hz for 60 s Between other input groups and other I/Os: 600 V, 50 Hz for 60 s
Ingress protection	Unmounted: No protection rating Mounted in rack: IP20 according to IEC/EN 60529
Dimensions	L×H×D: 28 × 162 × 150 mm (1.1 × 6.4 × 5.9 in)
Weight	188 g (0.4 lb)

2.8 Input/output module IOM3.3

The input output module has 10 analogue multifunctional inputs. These I/Os are all configurable.

IOM3.3 terminals

Module	Count	Symbol	Type	Name
	10	A → B C	Analogue multifunctional inputs (mA, V DC, RMI)	Configurable

IOM3.3 technical specifications

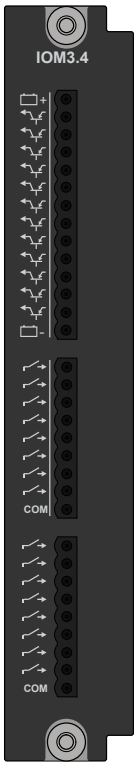
Category	Specification
Analogue multifunctional inputs **A** **→ B** **C**	**Digital inputs with wire break detection:** • Dry contact inputs, 3 V DC internal supply • Wire-break detection with maximum resistance for ON detection: 100 Ω to 400 Ω **Current inputs:** • From active transmitter: 0 to 20 mA, or 4 to 20 mA • Accuracy: ±10 uA ±0.25 % of actual reading **Voltage inputs (DC):** • Range: ±10 V DC / 0 to 10 V DC • Accuracy: ±10 mA ±0.25 % of actual reading **Resistance measurement inputs, 2 or 3 wire (RMI):** • Resistance measurement: 0 to 4.5 kΩ • Accuracy: ±1 Ω ±0.25 % of actual reading * **Resistance measurement inputs, 1 wire (RMI):** • Resistance measurement: 0 to 4.5 kΩ • Accuracy: ±2 Ω ±0.25 % of actual reading **Pt100:** • Range: -200 to 850 °C • Accuracy: ±1 °C ±0.25 % of actual reading **Pt1000:** • Range: -200 to 850 °C

Category	Specification
	• Accuracy: ±0.5 °C ±0.25 % of actual reading **Thermocouple type, range and accuracy:** • E: -200 to 1000 °C (±2 °C ±0.25 % of actual reading) • J: -210 to 1200 °C (±2 °C ±0.25 % of actual reading) • K: -200 to 1372 °C (±2 °C ±0.25 % of actual reading) • N: -200 to 1300 °C (±2 °C ±0.25 % of actual reading) • R: -50 to 1768 °C (±2 °C ±0.25 % of actual reading) • S: -50 to 1768 °C (±2 °C ±0.25 % of actual reading) • T: -200 to 400 °C (±2 °C ±0.25 % of actual reading) **Note:** Twisted pair and shielded cable is recommended to achieve specification and optimisation of noise immunity. **General information for all inputs:** • Voltage withstand: ±36 V DC
Internal cold junction compensation (CJC)	**Internal temperature sensor:** • Range: 0 to 70 °C ◦ Accuracy: ±1.0 °C • Range: -40 to 0 °C ◦ Accuracy: ±2.0 °C **Mathematical compensation:** • If non channels are configured as 4-20 mA ◦ Accuracy: ±1.0 °C • If any channels are configured as 4-20 mA ◦ Accuracy: ±1.5 °C If it is needed to have 4-20 mA channels on the same card, it is recommended to use the top channels for 4-20 mA and the lower channels for TC's **Internal cold junction accuracy:** • Heat dissipated by nearby heat sources can cause errors in thermocouple measurements by heating the IOM3.3 terminals to a different temperature than the cold-junction compensation sensor. Thermal gradient across the terminals can cause the terminals of different IOM3.3 channels to be at different temperatures, which creates accuracy errors and affects the relative accuracy between channels. • The temperature measurement accuracy specifications include errors caused by the thermal gradient across the IOM3.3 terminals for configurations with the IOM3.3 terminals facing forward or upward.
Terminal connections	Terminals: Standard 45° plug, 1.5 mm^2 Wiring: 0.1 to 1.5 mm^2 (28 to 16 AWG), multi-stranded
Torques and terminals	Module faceplate screws: 0.5 N·m (4.4 lb-in) Connection of wiring to relay output terminals: 0.5 N·m (4.4 lb-in) Connection of wiring to input terminals: 0.25 N·m (2.2 lb-in) UL/cUL Listed: Wiring must be minimum 90 °C (194 °F) copper conductors only
Galvanic isolation	All 10 multi inputs have a common ground Galvanic isolation from rack: 600 V, 50 Hz for 60 s
Dimensions	L×H×D: 28 × 162 × 150 mm (1.1 × 6.4 × 5.9 in)
Weight	164 g (0.4 lb)

2.9 Input/output module IOM3.4

The input output module has 12 digital outputs, and 16 digital inputs. These I/Os are all configurable.

IOM3.4 terminals

Module	Count	Symbol	Type	Name
	12		Digital output	Configurable
	16		Digital input	Configurable

IOM3.4 technical specifications

Category	Specification
Digital outputs	Transistor type: PNP Supply voltage: 12 or 24 V DC nominal, maximum 36 V DC (relative to common) Maximum current (per output): < 55 °C: 250 mA; > 55 °C: 200 mA Leak current: Typical 1 µA, maximum 100 µA (temperature-dependent) Saturation voltage: Maximum 0.5 V Non-replaceable 4 A fuse Voltage withstand: ±36 V DC Load dump protected by TVS diodes Short circuit protection Reverse polarity protection Internal freewheeling diode
Digital inputs	Bipolar inputs • ON: -36 to -8 V DC, and 8 to 36 V DC • OFF: -2 to 2 V DC Minimum pulse length: 50 ms Impedance: 4.7 kΩ Voltage withstand: ±36 V DC
Terminal connections	Terminals: Standard 45° plug, 1.5 mm^2 Wiring: 0.1 to 1.5 mm^2 (28 to 16 AWG), multi-stranded
Torques and terminals	Module faceplate screws: 0.5 N·m (4.4 lb-in) Connection of wiring to terminals: 0.25 N·m (2.2 lb-in) UL/cUL Listed: Wiring must be minimum 90 °C (194 °F) copper conductors only

Category	Specification
Galvanic isolation	Between groups: 600 V, 50 Hz for 60 s
Ingress protection	Unmounted: No protection rating Mounted in rack: IP20 according to IEC/EN 60529
Dimensions	L×H×D: 28 × 162 × 150 mm (1.1 × 6.4 × 5.9 in)
Weight	175 g (0.4 lb)

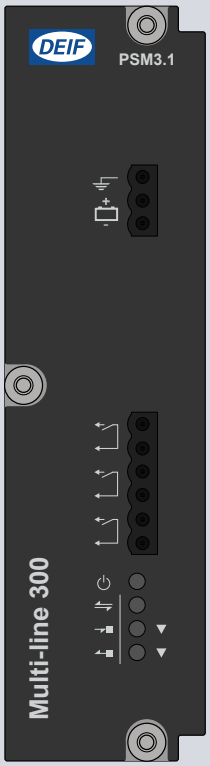
2.10 Power supply module PSM3.1 (Controller)

The power supply module provides power to all hardware modules in the rack. The rack status and alarms activate the three relay outputs. There are two ports for internal communication (EtherCAT) only with extension racks.

The PSM3.1 must to be powered by a power supply with Power Boost function.

The PSM3.1 manages the hardware module self-checks for the rack and includes a power LED. The power supply terminals include circuit protection against load dump transients and JEM177 surge transients (rugged design). These terminals also include battery voltage measurement.

PSM3.1 terminals

Module	Count	Symbol	Type/Info	Name
	1		Ground	Frame ground
	1		12 or 24 V	Power supply
	3		Relay output	1 × Status OK (fixed) 2 × configurable
	1		**Off** : No power supply **Red flash** : PSM is starting or module failure **Green** : Power supply **Green flash** : Controller identification	Power supply indication
	1		**Off** : No EtherCAT communication **Green** : EtherCAT Communication	EtherCAT communication connections (to connect to extension racks). LEDs are on the module front, connections are at the module bottom.
	1		EtherCAT communication (RJ45) input **Off** : No communication **Green** : Communication connected **Green flash** : Active communication	
	1		EtherCAT communication (RJ45) output **Off** : No communication **Green** : Communication connected **Green flash** : Active communication	

PSM3.1 technical specifications

Category	Specification
Frame ground	Voltage withstand: ±36 V DC to the power supply positive (terminal 1) and negative (terminal 2)
Controller power supply	Input voltage: 12 or 24 V DC nominal (8 to 36 V DC continuously) UL/cUL Listed: 10 to 32.5 V DC 0 V DC for 50 ms when coming from at least 8 V DC (cranking dropout) Consumption: Typical 20 W, maximum 35 W Voltage measurement accuracy: 0 to 30 V: ±1 V; 30 to 36 V: +1/-2 V Internal protection: 12 A fuse (not replaceable) (fuse size determined by load dump requirements) Voltage withstand: ±36 V DC Load dump protected by TVS diodes **Start current** • Power supply current limiter

Category	Specification
	◦ 24 V: 4 A minimum ◦ 12 V: 8 A minimum • Battery: No limit
Relay outputs 	Relay type: Solid state Electrical rating and UL/cUL Listed: 30 V DC and 1 A, resistive Voltage withstand: ±36 V DC
Terminal connections	**Frame ground and power supply**: • Terminals: Standard 45° plug, 2.5 mm^2 • Wiring: 1.5 to 2.5 mm^2 (16 to 12 AWG), multi-stranded **Other connections**: • Terminals: Standard 45° plug, 2.5 mm^2 • Wiring: 0.5 to 2.5 mm^2 (22 to 12 AWG), multi-stranded
Communication connections	EtherCAT communication: RJ45. Use an Ethernet cable that meets or exceeds the SF/UTP CAT5e specifications
Torques and terminals	Module faceplate screws: 0.5 N·m (4.4 lb-in) Connection of wiring to terminals: 0.5 N·m (4.4 lb-in) UL/cUL Listed: Wiring must be minimum 90 °C (194 °F) copper conductors only
Galvanic isolation	Between power supply and other I/Os: 600 V, 50 Hz for 60 s Between relay groups and other I/Os: 600 V, 50 Hz for 60 s Between internal communication ports and other I/Os: 600 V, 50 Hz for 60 s
Ingress protection	Unmounted: No protection rating Mounted in rack: IP20 according to IEC/EN 60529
Dimensions	L×H×D: 43.3 × 162 × 150 mm (1.5 × 6.4 × 5.9 in)
Weight	331 g (0.7 lb)

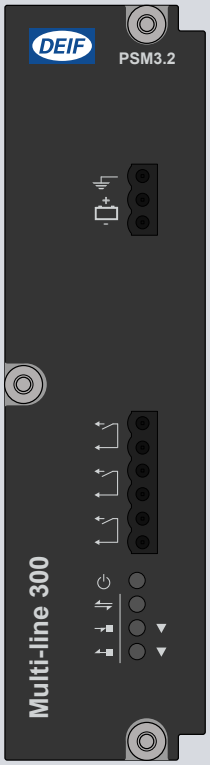
2.11 Power supply module PSM3.2 (Extension)

The power supply module provides power to all hardware modules in the extension rack. There are two ports for internal communication with the main controller. The internal communication (EtherCAT) connections are only used to communicate with the main controller. The rack status and alarms activate the three relay outputs.

The PSM3.2 must to be powered by a power supply with Power Boost function.

The PSM3.2 manages the hardware module self-checks for the rack and includes a power LED. The power supply terminals include circuit protection against load dump transients and JEM177 surge transients (rugged design). These terminals also include battery voltage measurement.

PSM3.2 terminals

Module	Count	Symbol	Type/Info	Name
	1		Ground	Frame ground
	1		12 or 24 V	Power supply
	3		Relay output	1 × Status OK (fixed) 2 × configurable
	1		**Off** : No power supply **Red flash** : PSM is starting or module failure **Green** : Power supply **Green flash** : Rack identification	Power supply indication
	1		**Off** : No EtherCAT communication **Green** : EtherCAT Communication	EtherCAT communication connections (to connect to the racks). LEDs are on the module front, connections are at the module bottom.
	1		EtherCAT communication (RJ45) input **Off** : No communication **Green** : Communication connected **Green flash** : Active communication	
	1		EtherCAT communication (RJ45) output **Off** : No communication **Green** : Communication connected **Green flash** : Active communication	

PSM3.2 technical specifications

Category	Specification
Frame ground	Voltage withstand: ±36 V DC to the power supply positive (terminal 1) and negative (terminal 2)
Controller power supply	Input voltage: 12 or 24 V DC nominal (8 to 36 V DC continuously) UL/cUL Listed: 10 to 32.5 V DC 0 V DC for 50 ms when coming from at least 8 V DC (cranking dropout) Consumption: Typical 20 W, maximum 35 W Voltage measurement accuracy: 0 to 30 V: ±1 V; 30 to 36 V: +1/-2 V Internal protection: 12 A fuse (not replaceable) (fuse size determined by load dump requirements) Voltage withstand: ±36 V DC Load dump protected by TVS diodes **Start current** • Power supply current limiter

Category	Specification
	◦ 24 V: 4 A minimum ◦ 12 V: 8 A minimum • Battery: No limit
Relay outputs 	Relay type: Solid state Electrical rating and UL/cUL Listed: 30 V DC and 1 A, resistive Voltage withstand: ±36 V DC
Terminal connections	**Frame ground and power supply**: • Terminals: Standard 45° plug, 2.5 mm^2 • Wiring: 1.5 to 2.5 mm^2 (16 to 12 AWG), multi-stranded **Other connections**: • Terminals: Standard 45° plug, 2.5 mm^2 • Wiring: 0.5 to 2.5 mm^2 (22 to 12 AWG), multi-stranded
Communication connections	EtherCAT communication: RJ45. Use an Ethernet cable that meets or exceeds the SF/UTP CAT5e specifications
Torques and terminals	Module faceplate screws: 0.5 N·m (4.4 lb-in) Connection of wiring to terminals: 0.5 N·m (4.4 lb-in) UL/cUL Listed: Wiring must be minimum 90 °C (194 °F) copper conductors only
Galvanic isolation	Between power supply and other I/Os: 600 V, 50 Hz for 60 s Between relay groups and other I/Os: 600 V, 50 Hz for 60 s Between internal communication ports and other I/Os: 600 V, 50 Hz for 60 s
Ingress protection	Unmounted: No protection rating Mounted in rack: IP20 according to IEC/EN 60529
Dimensions	L×H×D: 43.3 × 162 × 150 mm (1.5 × 6.4 × 5.9 in)
Weight	331 g (0.7 lb)

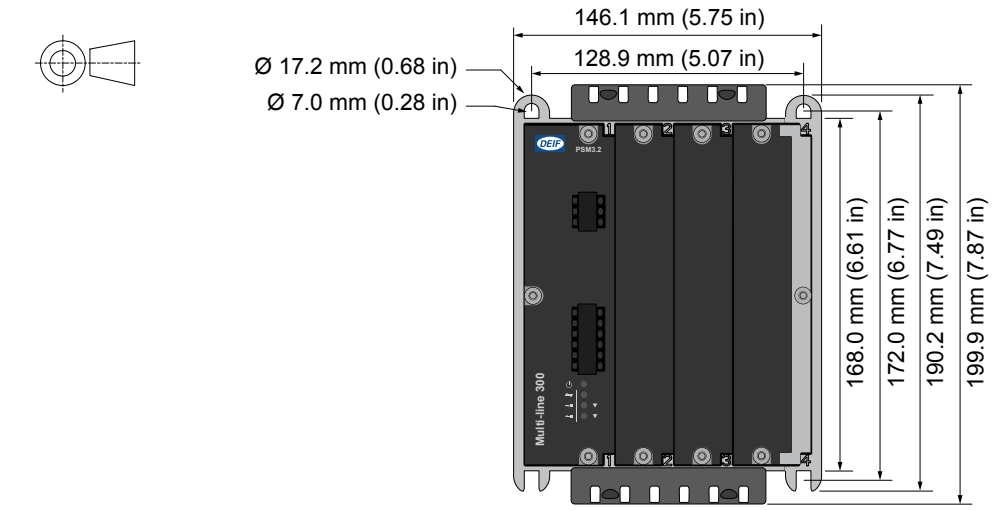
2.12 Rack R4.1

Rack R4.1 technical specifications

Category	Specification
Ingress protection	IP20 (all slots must have modules or blind modules mounted) according to IEC/EN 60529
UL/cUL Listed	Type Complete Device, Open Type 1
Material	Rack frame: Aluminium
Mounting	Base mount, using four M6 bolts with self-locking washers (or self-locking screws). The bolts and self-locking washers (or self-locking screws) are not included with the rack. UL/cUL Listed: For use on a flat surface of a type 1 enclosure UL/cUL Listed: To be installed in accordance with the NEC (US) or the CEC (Canada)
Tightening torque	Mounting bolts: 4 N·m (35 lb-in)

Rack 4.1 dimension and weight specifications

Category	Specification
Dimensions	L 146.1 mm x H 199.9 mm x D 157.5 mm (5.75 in x 7.87 in x 6.20 in) (outer frame, includes cable strain relief plates)
Weight	Without any hardware modules: 994 g (2.2 lb)



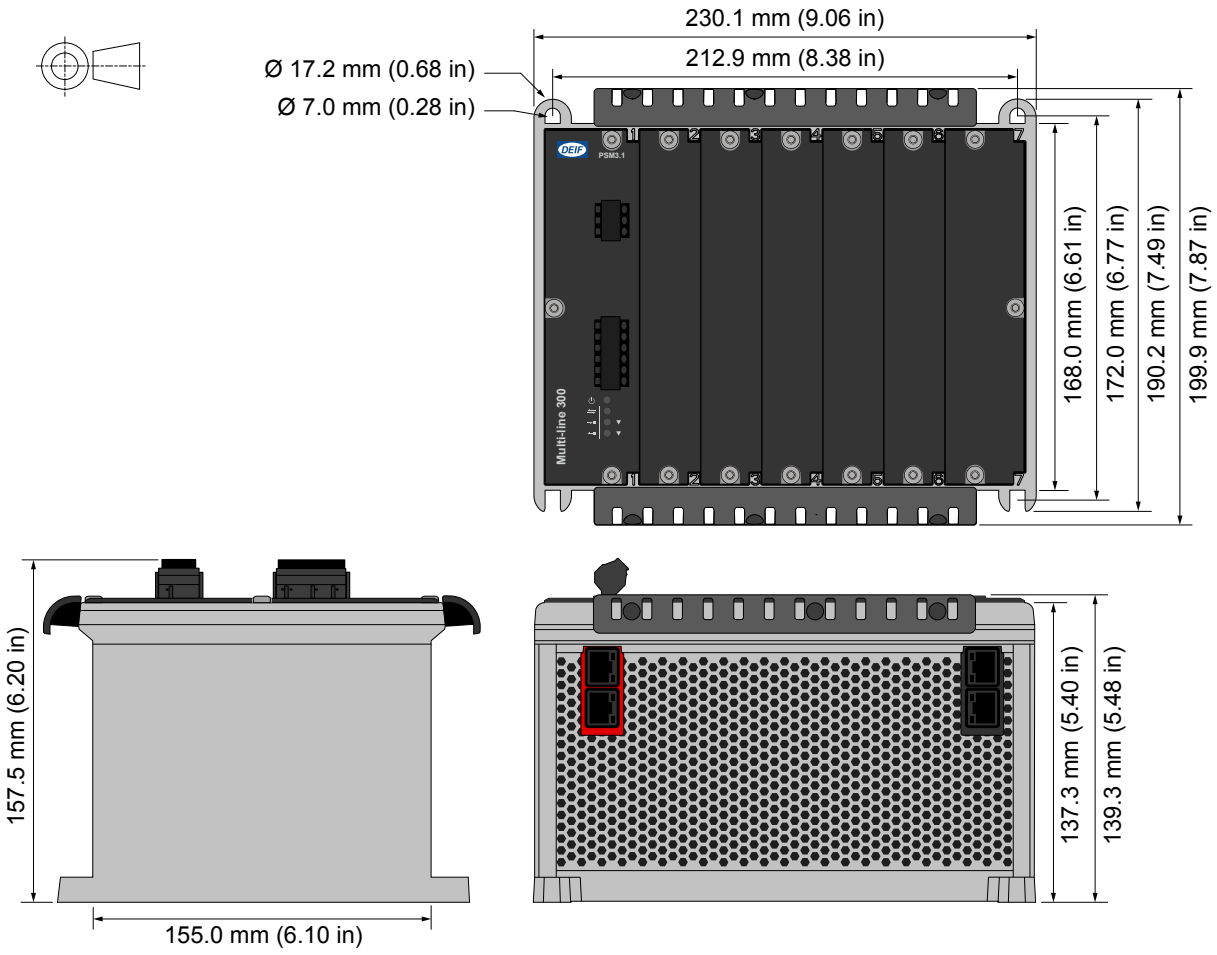
2.13 Rack R7.1

Rack 7.1 technical specifications

Category	Specification
Ingress protection	IP20 (all slots must have modules or blind modules mounted) according to IEC/EN 60529
UL/cUL Listed	Type Complete Device, Open Type 1
Material	Rack frame: Aluminium
Mounting	Base mount, using four M6 bolts with self-locking washers (or self-locking screws). The bolts and self-locking washers (or self-locking screws) are not included with the rack. UL/cUL Listed: For use on a flat surface of a type 1 enclosure UL/cUL Listed: To be installed in accordance with the NEC (US) or the CEC (Canada)
Tightening torque	Mounting bolts: 4 N·m (35 lb-in)

Rack 7.1 dimensions and weight specifications

Category	Specification
Dimensions	L 230.1 mm x H 199.9 mm x D 157.5 mm (9.06 in x 7.87 in x 6.20 in) (outer frame, includes cable strain relief plates)
Weight	Without any hardware modules: 1330 g (2.9 lb)



2.14 Blind module

A blind module must be used to close off each empty slot in the rack.

Blind module technical specifications

Category	Specification
Tightening torque	Module faceplate screws: 0.5 N·m (4.4 lb-in)
Dimensions	L×H×D: 28 × 162 × 18 mm (1.1 × 6.4 × 0.7 in)
Weight	44 g (0.1 lb)

2.15 Small blind module

A small blind module is required for extension racks.

Small blind module technical specifications

Category	Specification
Tightening torque	Module faceplate screws: 0.5 N·m (4.4 lb-in)
Size	L×H×D: 14 × 162 × 18 mm (0.5 × 6.4 × 0.7 in)
Weight	12 g (0.03 lb)

3. Legal information

3.1 Disclaimer and copyright

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