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CE

DATA SHEET

Generator Protection Unit, GPU-3

- Generator protection (ANSI)
- Busbar protection (ANSI)
- M-Logic (Micro PLC)
- Display
- General

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1. Contents

1.1 General information

1.1.1 Application

The Generator Protection Unit, GPU-3, is a compact microprocessor-based protection unit containing all necessary functions for protection of a synchronous/asynchronous generator. It contains all necessary galvanically separated 3-phase measuring circuits.

The GPU-3 is intended for land- and marine-based applications. It is well-suited for PLC-controlled systems, and the interfacing can be done via digital and analogue I/Os or via serial communication.

1.1.2 Display unit

The display unit is separate and can be installed directly on the main unit or in the front of the switchboard door (3 m display cable included). Up to two additional displays can be installed within 200 m.

The display unit shows all measured and calculated values as well as alarms and data from the event log.

1.1.3 Self-test

The GPU-3 automatically carries out a cyclical self-test at start-up. If any errors are found, they will be displayed in clear text in the display and indicated with a relay output (status output).

1.1.4 M-Logic (Micro PLC)

This configuration tool is part of the PC utility software which is free of charge. With this tool, it is possible to customise the application to your needs. It is possible to dedicate specific functions or logical conditions to different inputs and outputs.

1.1.5 Setup

Setup is easily done via a menu structure in the display (password-protected) or via the USB PC connection and the Multi-line 2 Windows®-based PC utility software. The PC utility software can be downloaded free of charge from www.deif.com/Documentation & Software. The utility software offers additional features such as monitoring of all relevant information during commissioning, saving and downloading of settings and downloading of software updates.

1.1.6 Synchronisation

As an option, the GPU-3 can perform synchronisation of the generator. After closing of the breaker the regulation is switched OFF, and the GPU-3 will carry out all necessary protective functions.

1.1.7 Engine control and protection

With the engine control and protection option added, the GPU-3 will control the start and stop sequences of the engine and furthermore it can be used as engine protection unit providing full backup of engine shutdown channels in case the main processor fails.

The option includes an engine interface I/O card with separate power supply and processor. The card is equipped with the following I/Os:

In-/outputs		Available
Multi-inputs (with wire break)	4 to 20 mA Digital input Pt100 Pt1000 RMI 0 to 40 V DC	3 (3)
Digital inputs		7(6)
MPU input w/wire break		1
Start prepare relay		1
Starter relay		1
Run coil		1
Stop coil w/wire break		1
CAN bus comm.		2

The number in parenthesis indicates the number of user-configurable in-/outputs.

The CAN bus communication is for option H7 only.

1.1.8 Options

In order to perfectly match the product solution to specific applications, the functionality of the GPU-3 can be equipped with a number of available options. The options selected by the customer will be integrated in the standard GPU-3, hereby securing the same user interface unaffected by whether the application needs a highly complex or a more basic genset controller.

Refer to the paragraph "Available options" for the options available.

1.1.9 Approvals

The GPU-3 is marine-approved by all major classification societies and is UL/cUL Listed.

Refer to www.deif.com for details and certificates.

1.2 Protections

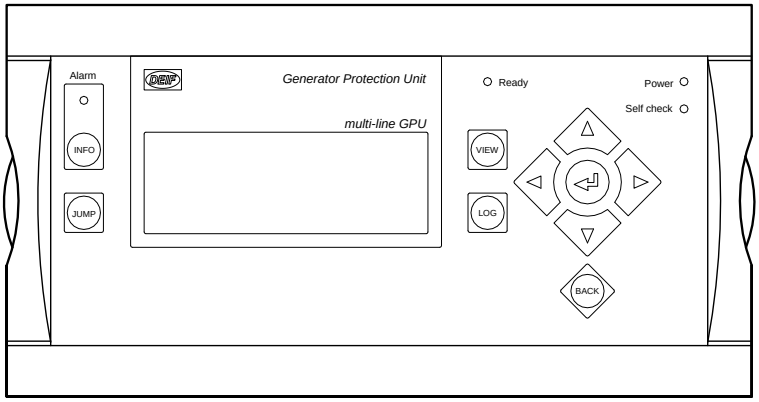
The following protection functions are included as standard functions

Protection function	ANSI no. *	Levels
Generator reverse power	(32)	2 steps
Generator over-current	(50/51)	6 steps
Voltage-dependent over-current	(51V)	1 step
Inverse time over-current	(51)	1 step
Generator over-voltage	(59)	2 steps
Generator under-voltage	(27)	3 steps
Generator over-frequency	(81)	3 steps
Generator under-frequency	(81)	3 steps
Busbar over-voltage	(59)	3 steps
Busbar under-voltage	(27)	4 steps
Busbar over-frequency	(81)	3 steps
Busbar under-frequency	(81)	4 steps
Busbar voltage unbalance	(60)	1 step
NEL group		3 steps
Generator overload	(32)	5 steps
Current unbalance	(60)	1 step
Voltage unbalance	(60)	1 step
Over-excitation	(40/32 RV)	1 step
Loss of excitation	(40/32 RV)	1 step

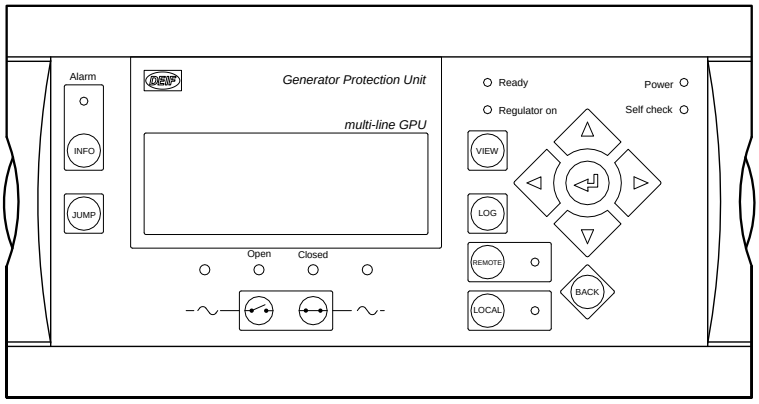
***** (ANSI# as per IEEE Std. C37.2-1996 (R2001) in parenthesis).

1.3 Display layouts

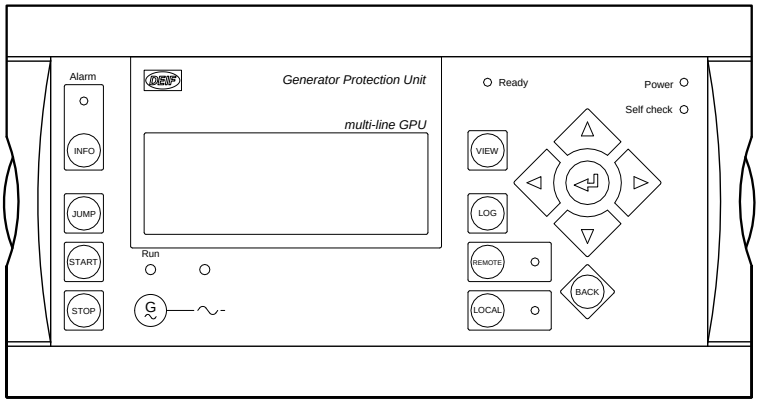
Standard delivery



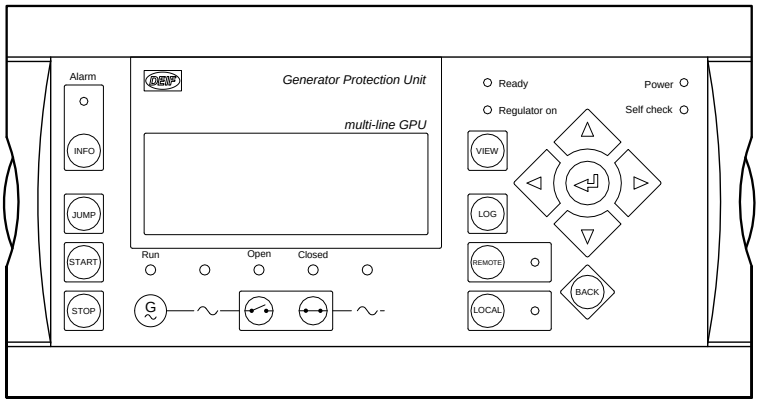
GB control (option Y5)



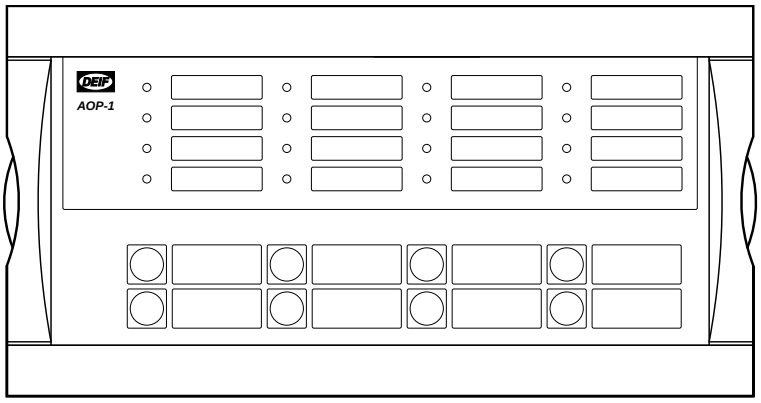
Engine control (option Y7)



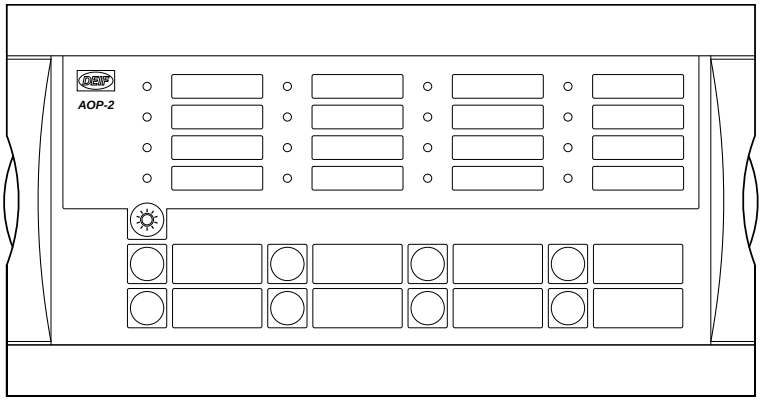
Engine and GB control (option Y1)



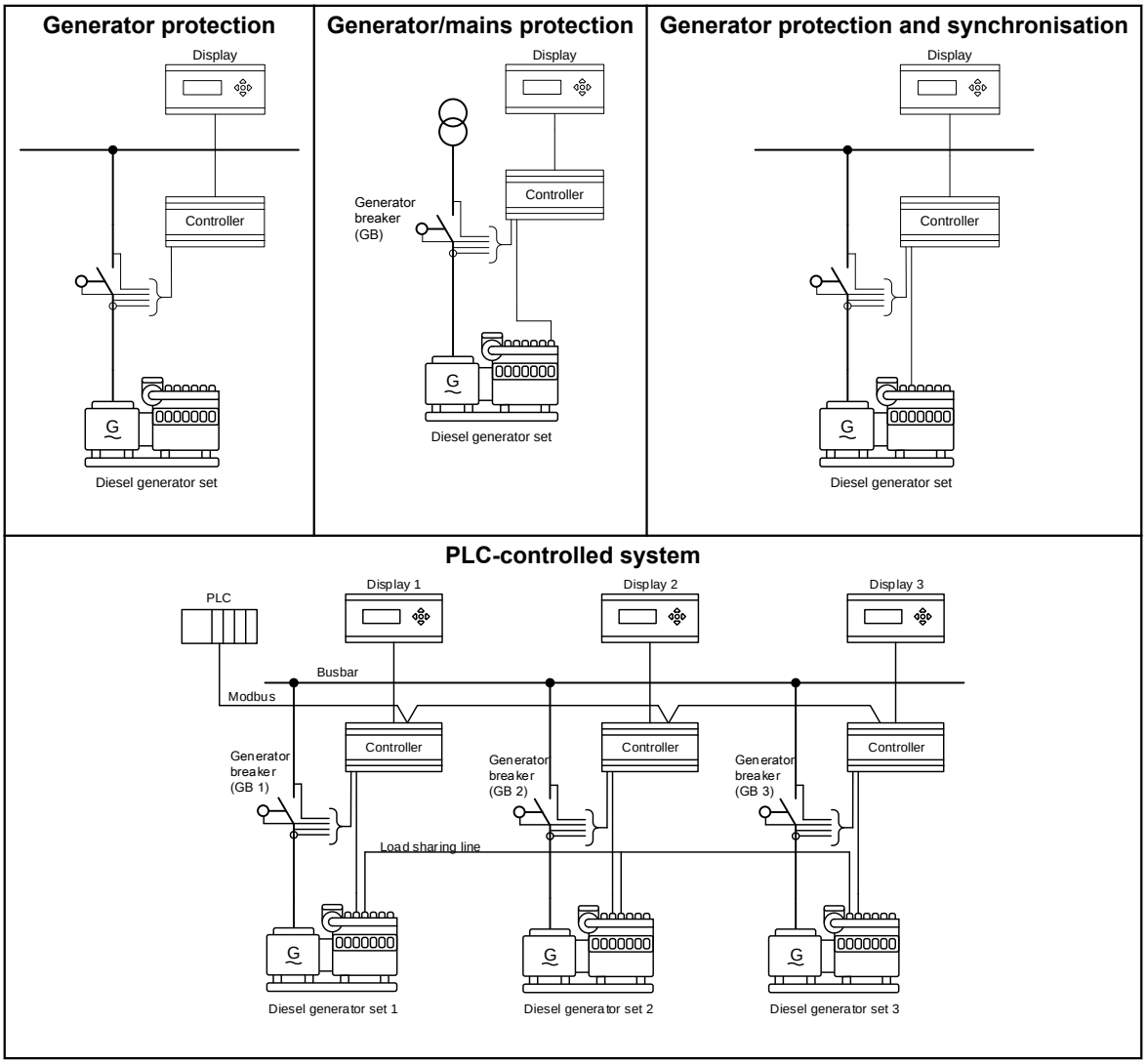
Additional operator's panel - AOP-1 (option X3)



Additional operator's panel - AOP-2 (option X4)



1.4 Application examples



The GPU-3 can be used in simple or complex applications. The above shows very simple applications only, but due to the flexibility, the GPU-3 can be used in all types of applications.

1.5 Available variants

Type	Variant no.	Description	Item no.	Note
GPU-3 Marine	01	GPU-3 with display	2912110030-01	One 3 m display cable is included as standard
GPU-3 Marine	02	GPU-3 without display	2912110030-02	
GPU-3 Marine	03	GPU-3 with display + F1	2912110030-03	One 3 m display cable is included as standard

1.6 Available options

Option	Description	Slot no.	Option type	Note
A	**Mains protection package**			
A1	Time-dependent under-voltage **(27t)** Under-voltage and reactive power low **(27Q)** Vector jump **(78**) df/dt (ROCOF) **(81)**		Software	
A4	Positive sequence (mains voltage low) **(27)**		Software	
A5	Directional over-current **(67)**		Software	
C	**Generator add-on protection package**			
C2	Negative sequence voltage high **(47)** Negative sequence current high **(46)** Zero sequence voltage high **(59)** Zero sequence current high **(50)** Power-dependent reactive power import/ export **(40)**		Software	
D	**Voltage control**			
D1	Voltage control		Software	Requires G2
E and F	**Analogue controller and transducer out-puts**			
E1	2 × +/-25 mA (GOV/AVR or transducer)	4	Hardware	Not with E2, EF2, EF4, EF5 or M14.4 AVR output requires D1
E2	2 × 0(4) to 20 mA (GOV/AVR or transducer)	4	Hardware	Not with E1, EF2, EF4, EF5 or M14.4 AVR output requires D1
EF2	1 × +/-25 mA (GOV/AVR or transducer) 1 × 0(4) to 20 mA (GOV/AVR or transducer)	4	Hardware	Not with E1, E2, EF4, EF5 or M14.4 AVR output requires D1
EF4	1 × +/-25 mA (GOV/AVR or transducer) 2 × relay outputs (GOV/AVR or configurable)	4	Hardware	Not with E1, E2, EF2, EF5 or M14.4 AVR output requires D1
EF5	1 × PWM (Pulse Width Modulated) output for CAT GOV 1 × +/-25 mA (GOV/AVR or transducer) 2 × relay outputs (GOV/AVR or configurable)	4	Hardware	Not with E1, E2, EF2, EF4 or M14.4 AVR output requires D1
F1	2 × 0(4) to 20 mA (transducer)	6	Hardware	Not with M13.6, M14.6 or M15.6
G	**Synchronisation**			

Option	Description	Slot no.	Option type	Note
G2	Synchronisation (GOV/AVR control)		Software	Outputs for regulation are not included AVR control requires D1
H	**Serial communication**			
H2	Modbus RTU/ASCII (RS-485)	2	Hardware	Not with H3, H8.2 or H9.2
H3	Profibus DP	2	Hardware	Not with H2, H8.2 or H9.2
H5	Engine comm.: MTU (ADEC/MDEC) and CAN bus J1939 (H7)	8	Hardware	Not with H7, H8.8, M13.8, M14.8 or M15.8
H6	Cummins GCS	8	Hardware	Not with H5, H7, H8.8, M13.8, M14.8 or M15.8
H7	CAN bus (J1939): Caterpillar Cummins CM850/570 Detroit Diesel (DDEC) Deutz (EMR) Iveco (NEF/CURSOR) John Deere (JDEC) Perkins Scania (EMS) Scania (EMS S6) Volvo Penta (EMS) Volvo (EMS2)	7	Software	Requires M4 Not with H5
H8.X	External I/O modules	2, 8	Hardware	**H8.2:** Not with H2, H3, H8.8 or H9.2 **H8.8:** Not with H5, H6, H8.2, M13.8, M14.8 or M15.8
H9.2	Modbus RTU/ASCII (RS-232) and GSM modem connection	2	Hardware	Not with H2, H3 or H8.2
M	**Engine control, digital and analogue I/Os**			
M4	Engine control and protection (safety system) OR I/O extension	7	Hardware	
M12	13 binary inputs, configurable 4 relay outputs, configurable	3	Hardware	
M13.X	7 digital inputs, configurable	6, 8	Hardware	**M13.6:** Not with F1, M14.6 or M15.6 **M13.8:** Not with H5, H6, H8.8, M14.8 or M15.8

Option	Description	Slot no.	Option type	Note
M14.X	4 relay outputs, configurable	4, 6, 8	Hardware	**M14.4:** Not with E1, E2, EF2, EF4 and EF5 **M14.6:** Not with F1, M13.6 or M15.6 **M14.8:** Not with H5, H6, H8.8, M13.8 or M15.8
M15.X	4 analogue inputs, configurable, 4 to 20 mA	6, 8	Hardware	**M15.6:** Not with F1, M13.6 or M14.6 **M15.8:** Not with H5, H6, H8.8, M13.8 or M14.8
N	**Ethernet TCP/IP communication**			
N	Modbus TCP/IP EtherNet/IP SMS/e-mail alarms		Hardware/ software	
Q	**Measurement accuracy**			
Q1	Verified class 0.5		Other	
Y	**Display layout**			
Y1	Engine and GB control		Other	Requires G2 and M4
Y5	GB control		Other	Requires G2
Y7	Engine control		Other	Requires M4

(ANSI# as per IEEE Std. C37.2-1996 (R2001) in parenthesis).

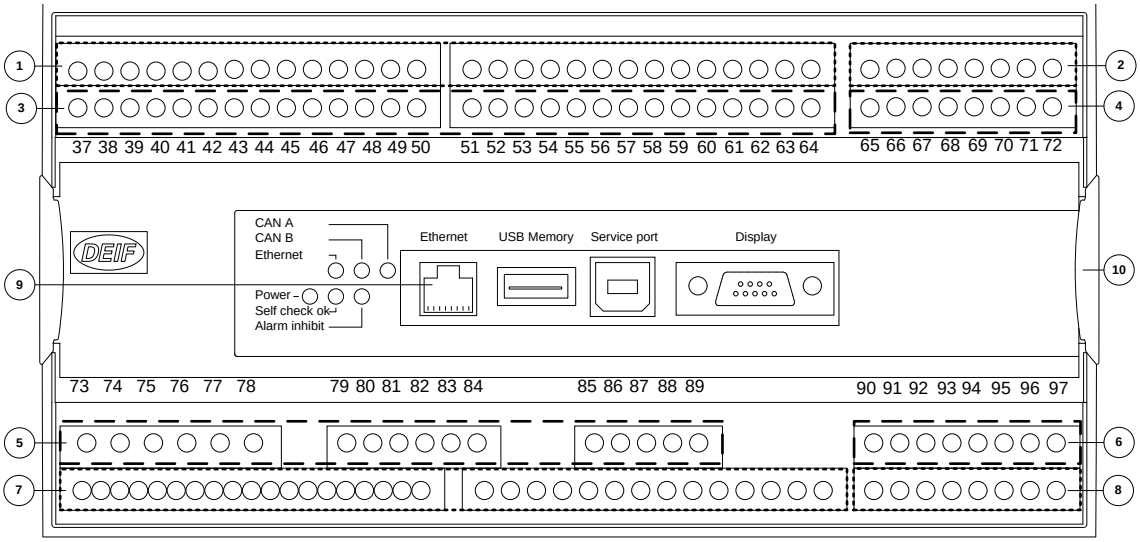
Notice that not all options can be selected for the same unit. Refer to the paragraph "Hardware overview" in this data sheet for further information about the location of the HW options in the unit.

1.7 Available accessories

Accessory	Description	Item no.	Note
Operator panels			
Standard Display Unit, DU-2	For connection directly to base unit with display cable	2912210050	Specify product and folio (refer to paragraph "Display layouts") Two additional displays can be used with each GPU unit
Additional Display Unit, DU-2 (X2)	For CAN bus connection to the standard display	2912890030	
Additional Operator Panel, AOP-1 (X3)	16 configurable LEDs and eight configurable push-buttons	2912890040	Max. one AOP-1 for each display unit
Additional Operator Panel, AOP-2 (X4)	16 configurable LEDs, eight configurable buttons and one status relay. CAN bus comm.	2912890050	Five AOP-2 units can be used with each GPU unit
Display gasket for IP54 (L)	Standard is IP40	1134510010	
Cables			
Display cable, 3 m		1022040076	
Display cable, 6 m (J2)		1022040057	
Display cable, 1 m (J6)		1022040064	
USB cable, 3 m (J7)	For PC utility software	1022040065	
Ethernet cable, crossed, 3 m (J4)	For option N	1022040055	
Documentation			
CD-ROM with complete documentation (K2)		2304230002	

Display gasket is required for RS-approved applications.

1.8 Hardware overview



(1) : The numbers in the drawing above refer to the slot numbers indicated in the table below.

Slot #	Option/standard	Description
1		**Terminal 1-28, power supply**
	Standard	8 to 36 V DC supply, 11 W; 1 × status output relay; 5 × relay outputs; 2 × pulse outputs (kWh, kvarh); 5 × digital inputs
2		**Terminal 29-36, communication**
	H2	Modbus RTU (RS-485)
	H3	Profibus DP
	H8.2	External I/O modules
	H9.2	Modbus RTU/ASCII (RS-232)
3		**Terminal 37-64, inputs/outputs**
	M12	13 × digital inputs; 4 × relay outputs
4		**Terminal 65-72, GOV/AVR/transducer outputs**
	M14.4	4 × relay outputs
	E1	2 × +/-20 mA outputs

Slot #	Option/standard	Description
	E2	2 × 0(4) to 20 mA outputs
	EF2	1 × +/-20 mA output; 1 × 0(4) to 20 mA output
	EF4	1 × +/-20 mA output; 2 × relays
	EF5	1 × PWM output; 1 × +/-20 mA output; 2 × relays
5		**Terminal 73-89, AC measuring**
	Standard	3 × generator voltage; 3 × generator current; 3 × busbar/mains voltage
6		**Terminal 90-97, inputs/outputs**
	F1	2 × 0(4) to 20 mA outputs
	M13.6	7 × digital inputs
	M14.6	4 × relay outputs
	M15.6	4 × 4 to 20 mA inputs
7		**Terminal 98-125, engine I/F**
	M4	8 to 36 V DC supply, 5 W; 1 × magnetic pickup (MPU); 3 × multi-inputs; 7 × digital inputs, configurable; 4 × relay outputs
	H7	CAN bus J1939 (requires M4)
8		**Terminal 126-133, engine communication, inputs/outputs**
	H5	MTU (MDEC) + J1939
	H6	Cummins GCS
	H8.8	External I/O modules
	M13.8	7 × digital inputs
	M14.8	4 × relay outputs
	M15.8	4 × 4 to 20 mA inputs
9		**LED I/F**
	Standard	Display connection; service port (USB); power LED; self check LED; alarm inhibit LED; EtherNet (option N) LED
10		**EtherNet**
	N	- Modbus TCP/IP - EtherNet/IP - SMS/e-mail alarms

There can only be one hardware option in each slot. It is for example not possible to select option H2 and option H3 at the same time, because both options require a PCB in slot #2.

Besides the hardware options shown above, it is possible to select the software options mentioned in the paragraph "Available options".

1.9 Technical information and dimensions

1.9.1 Technical specifications

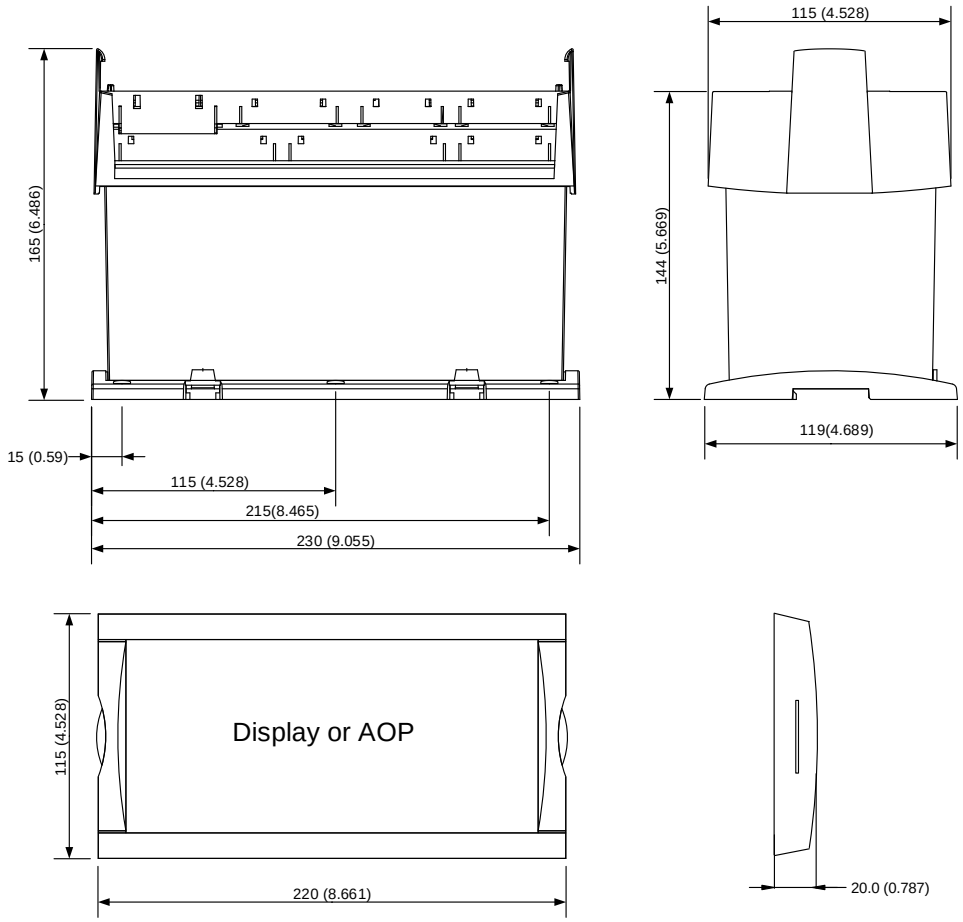
Accuracy	Class 1.0 -25 to 15 to 30 to 70 °C Temperature coefficient: +/-0.2 % of full scale per 10 °C Positive, negative and zero sequence alarms: class 1 within 5 % voltage unbalance Class 1.0 for negative sequence current Fast over-current: 3 % of 350 %*In Analogue outputs: class 1.0 according to total range Option EF4/EF5: class 4.0 according to total range To IEC/EN 60688
Operating temperature	-25 to 70 °C (-13 to 158 °F) With option N: -25 to 60 °C (-13 to 140 °F) (UL/cUL Listed: max. surrounding air temperature: 55 °C/131 °F)
Storage temperature	-40 to 70 °C (-40 to 158 °F)
Climate	97 % RH to IEC 60068-2-30
Operating altitude	0 to 4000 m above sea level Derating 2001 to 4000 m above sea level: Max. 480 V AC phase-phase 3W4 measuring voltage Max. 690 V AC phase-phase 3W3 measuring voltage
Measuring voltage	100 to 690 V AC +/-20 % (UL/cUL Listed: 600 V AC phase-phase) Consumption: max. 0.25 VA/phase
Measuring current	-/1 or -/5 A AC (UL/cUL Listed: from CTs 1 to 5 A) Consumption: max. 0.3 VA/phase
Current overload	4 × I_n continuously 20 × I_n, 10 s (max. 75 A) 80 × I_n, 1 s (max. 300 A)
Measuring frequency	30 to 70 Hz
Aux. supply	Terminals 1 and 2: 12/24 V DC nominal (8 to 36 V DC operational). Max. 11 W consumption Battery voltage measurement accuracy: ±0.8 V within 8 to 32 V DC, ±0.5 V within 8 to 32 V DC @ 20 °C Terminals 98 and 99: 12/24 V DC nominal (8 to 36 V DC operational). Max. 5 W consumption 0 V DC for 10 ms when coming from at least 24 V DC (cranking dropout) The aux. supply inputs are to be protected by a 2 A slow-blow fuse (UL/cUL Listed: AWG 24)

Digital inputs	Optocoupler, bi-directional ON: 8 to 36 V DC Impedance: 4.7 kΩ OFF: <2 V DC
Analogue inputs	0(4) to 20 mA Impedance: 50 Ω. Not galvanically separated RPM (MPU): 2 to 70 V AC, 10 to 10000 Hz, max. 50 kΩ
Multi-inputs	0(4) to 20 mA: 0 to 20 mA, +/-1 %. Not galvanically separated Binary: max. resistance for ON detection: 100 Ω. Not galvanically separated Pt100/1000: -40 to 250 °C, +/-1 %. Not galvanically separated. To IEC/EN 60751 RMI: 0 to 1700 Ω, +/-2 %. Not galvanically separated V DC: 0 to 40 V DC, +/-1 %. Not galvanically separated
Relay outputs	Electrical rating: 250 V AC/30 V DC, 5 A. (UL/cUL Listed: 250 V AC/24 V DC, 2 A resistive load) Thermal rating @ 50 °C: 2 A: continuously. 4 A: t_{on} = 5 s, t_{off} = 15 s (Unit status output: 1 A)
Open collector outputs	Supply: 8 to 36 V DC, max. 10 mA
Analogue outputs	0(4) to 20 mA and +/-25 mA. Galvanically separated. Active output (internal supply). Load max. 500 Ω. (UL/cUL Listed: max. 20 mA output) Update rate: transducer output: 250 ms. Regulator output: 100 ms
Galvanic separation	Between AC voltage and other I/Os: 3250 V, 50 Hz, 1 min. Between AC current and other I/Os: 2200 V, 50 Hz, 1 min. Between analogue outputs and other I/Os: 550 V, 50 Hz, 1 min. Between binary input groups and other I/Os: 550 V, 50 Hz, 1 min.

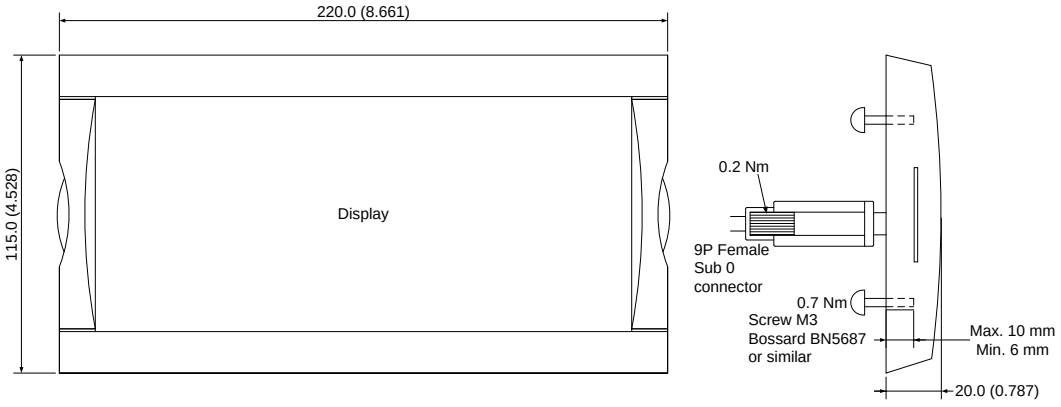
Response times (Delay set to min.)	**Busbar:** Over-/under-voltage: <50 ms Over-/under-frequency: <50 ms Voltage unbalance: <200 ms **Generator:** Reverse power: <200 ms Over-current: <200 ms Fast over-current: <40 ms Over-/under-voltage: <200 ms Over-/under-frequency: <300 ms Overload: <200 ms Current unbalance: <200 ms Voltage unbalance: <200 ms React. power import: <200 ms React. power export: <200 ms Overspeed: <400 ms Digital inputs: <250 ms Emergency stop: <200 ms Multi-inputs: <800 ms Wire failure: <600 ms **Mains:** df/dt (ROCOF): <130 ms (4 periods) Vector jump: <40 ms Positive sequence: <60 ms Time-dependent under-voltage, U_t< <50 ms Under-voltage and reactive power low, U_Q< <250 ms
Mounting	DIN-rail mount or base mount with six screws
Safety	To EN 61010-1, installation category (over-voltage category) III, 600 V, pollution degree 2 To UL 508 and CSA 22.2 no. 14-05, over-voltage category III, 600 V, pollution degree 2
EMC/CE	To EN 61000-6-2, EN 61000-6-4, IEC 60255-26
Vibration	3 to 13.2 Hz: 2 mm_{pp}. 13.2 to 100 Hz: 0.7 g. To IEC 60068-2-6 & IACS UR E10 10 to 60 Hz: 0.15 mm_{pp}. 60 to 150 Hz: 1 g. To IEC 60255-21-1 Response (class 2) 10 to 150 Hz: 2 g. To IEC 60255-21-1 Endurance (class 2)
Shock (base mount)	10 g, 11 ms, half sine. To IEC 60255-21-2 Response (class 2) 30 g, 11 ms, half sine. To IEC 60255-21-2 Endurance (class 2) 50 g, 11 ms, half sine. To IEC 60068-2-27
Bump	20 g, 16 ms, half sine. To IEC 60255-21-2 (class 2)
Material	All plastic materials are self-extinguishing according to UL94 (V1)

Plug connections Tightening torque	AC current: 0.2 to 4.0 mm^2 stranded wire. (UL/cUL Listed: AWG 18) AC voltage: 0.2 to 2.5 mm^2 stranded wire. (UL/cUL Listed: AWG 20) Relays: (UL/cUL Listed: AWG 22) Terminals 98 to 116: 0.2 to 1.5 mm^2 stranded wire. (UL/cUL Listed: AWG 24) Other: 0.2 to 2.5 mm^2 stranded wire. (UL/cUL Listed: AWG 24) Display: 9-pole Sub-D female Service port: USB A-B Refer to the "Installation Instructions"
Protection	Unit: IP20. Display: IP40 (IP54 with gasket: option L). Display: IP54 is required for RS-approved applications. (UL/cUL Listed: Type Complete Device, Open Type). To IEC/EN 60529
Governors	Multi-line 2 interfaces to all governors including GAC, Barber-Colman, Woodward and Cummins. See interfacing guide at www.deif.com
Approvals	Marine-approved by all major classification societies UL/cUL Listed to UL508. UL/cUL Recognized to UL2200
UL markings Tightening torque	Wiring: use 60/75 °C copper conductors only Mounting: for use on a flat surface of type 1 enclosure Installation: to be installed in accordance with the NEC (US) or the CEC (Canada) **AOP-2:** Maximum ambient temperature: 60 °C Wiring: use 60/75 °C copper conductors only Mounting: for use on a flat surface of type 3 (IP54) enclosure. Main disconnect must be provided by installer Installation: to be installed in accordance with the NEC (US) or the CEC (Canada) **DC/DC converter for AOP-2:** Wire size: AWG 22-14 Refer to the "Installation Instructions"
Weight	Base unit: 1.6 kg (3.5 lbs.) Cable, 3 m: 0.2 kg (0.4 lbs.) Cable, 6 m: 0.4 kg (0.9 lbs.) Display: 0.4 kg (0.9 lbs.)

1.9.2 Unit dimensions in mm (inches)



Tightening torques



1.10 Order specifications and disclaimer

1.10.1 Order specifications

Variants

Mandatory information			Additional options to the standard variant				
Item no.	**Type**	**Variant no.**	**Option**	**Option**	**Option**	**Option**	**Option**

Example:

Mandatory information			Additional options to the standard variant				
Item no.	**Type**	**Variant no.**	**Option**	**Option**	**Option**	**Option**	**Option**
2912110030-03	GPU-3 Marine	03	M4	Y1	H2		

Accessories

Mandatory information		
Item no.	**Type**	**Accessory**

Example:

Mandatory information		
Item no.	**Type**	**Accessory**
1022040065	Accessories for GPU-3	USB cable, 3 m (J7)

1.10.2 Disclaimer

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