GPU-3 Hydro

4921240353K

Generator Protection Unit

Data sheet

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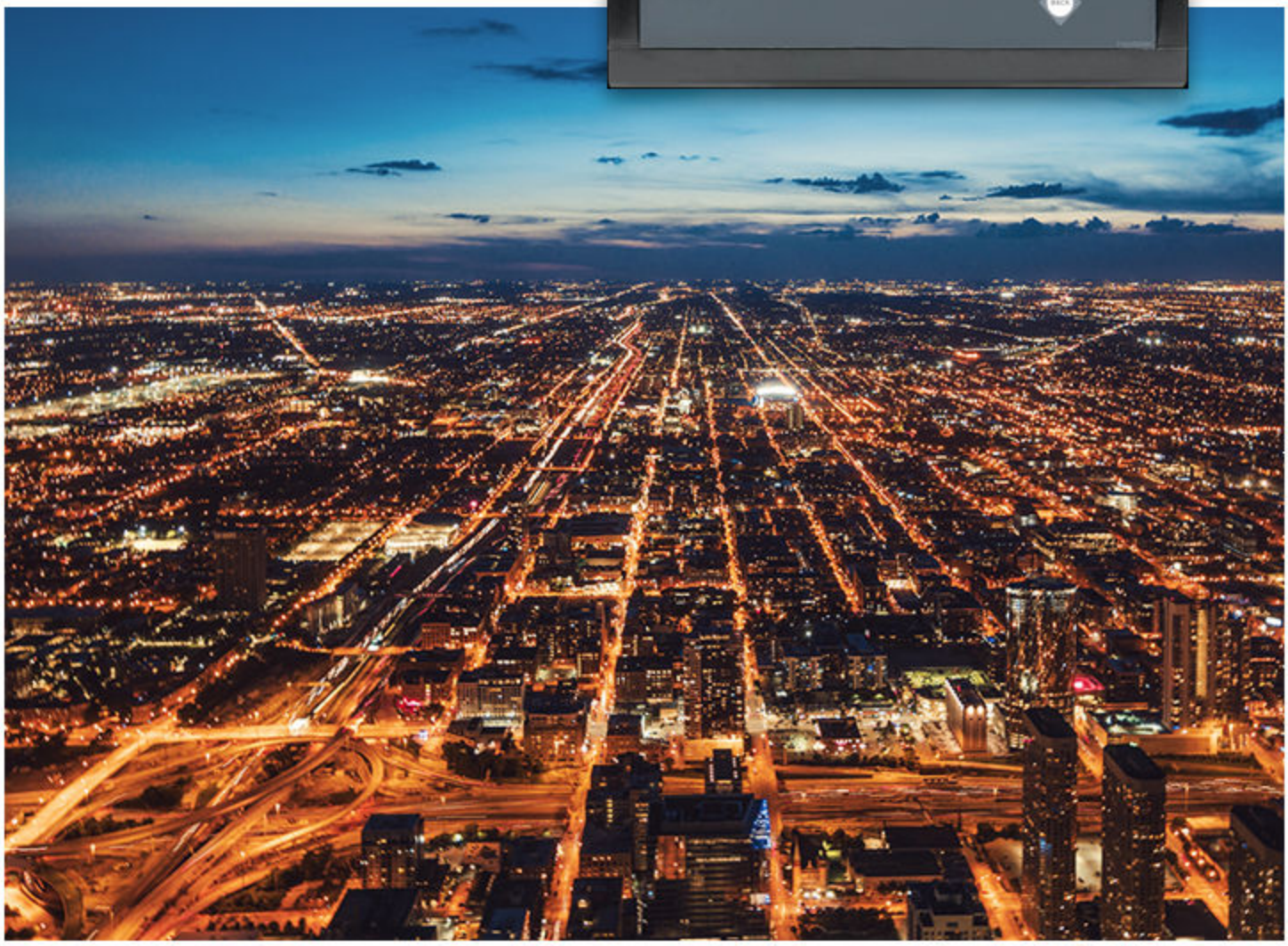


1. Contents

1. Contents

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

SW version: 3.0x.x or later

1.1 General information

1.1.1 Application

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

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

1.1.7 Options

In order to perfectly match the product solution to specific applications, the functionality of the GPU-3 Hydro can be equipped with a number of available options. The options selected by the customer will be integrated in the standard

GPU-3 Hydro, 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.

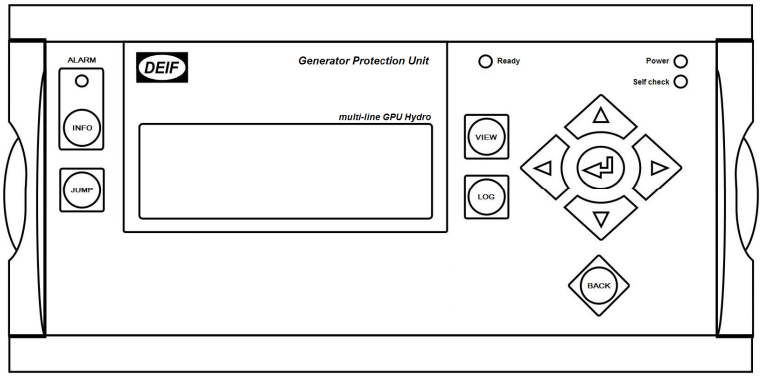
1.1.8 Approvals

The GPU-3 Hydro is UL/cUL listed.

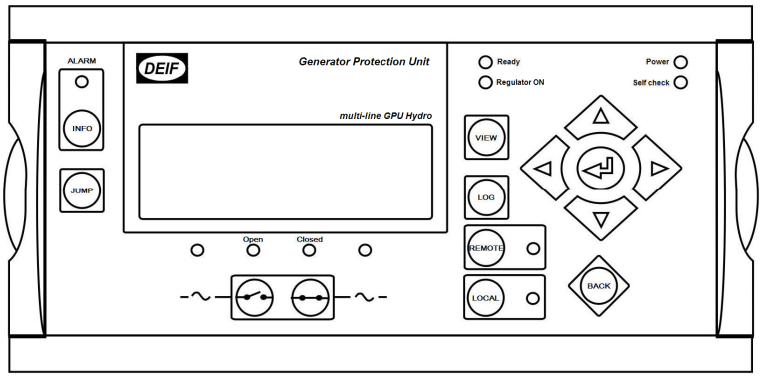
INFO
Refer to www.deif.com for details and certificates.

1.2 Display layouts

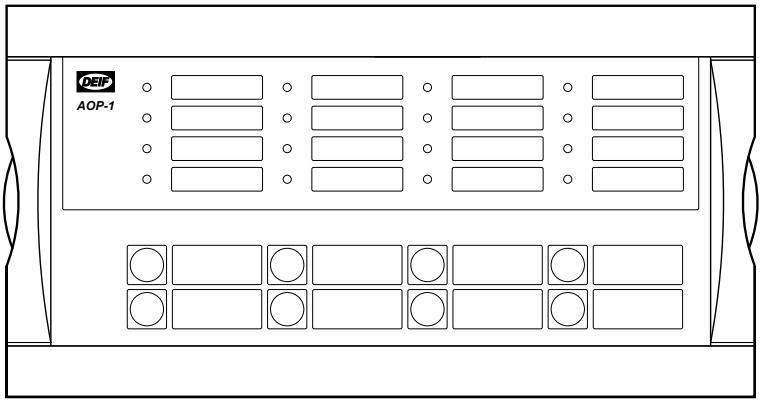
Standard delivery

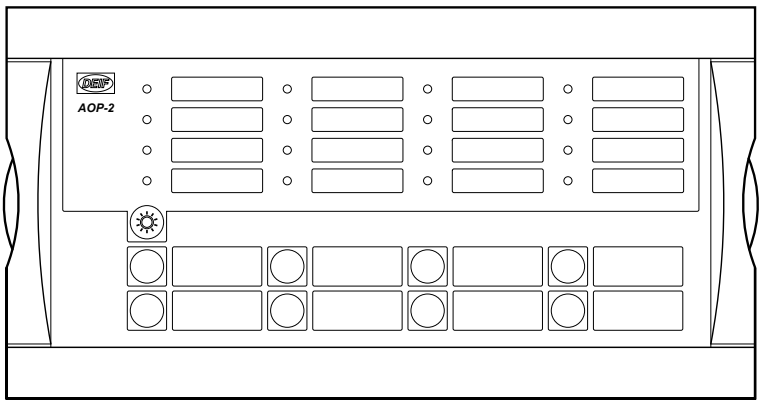


GB control (option Y5)



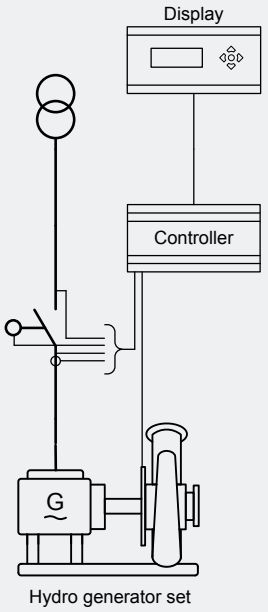
Additional operator panel - AOP-1 (option X3)



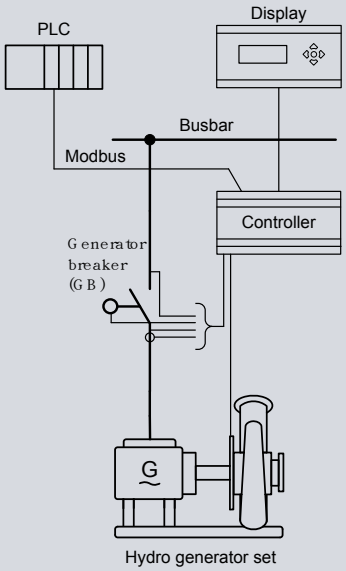


1.3 Application examples

Generator/mains protection

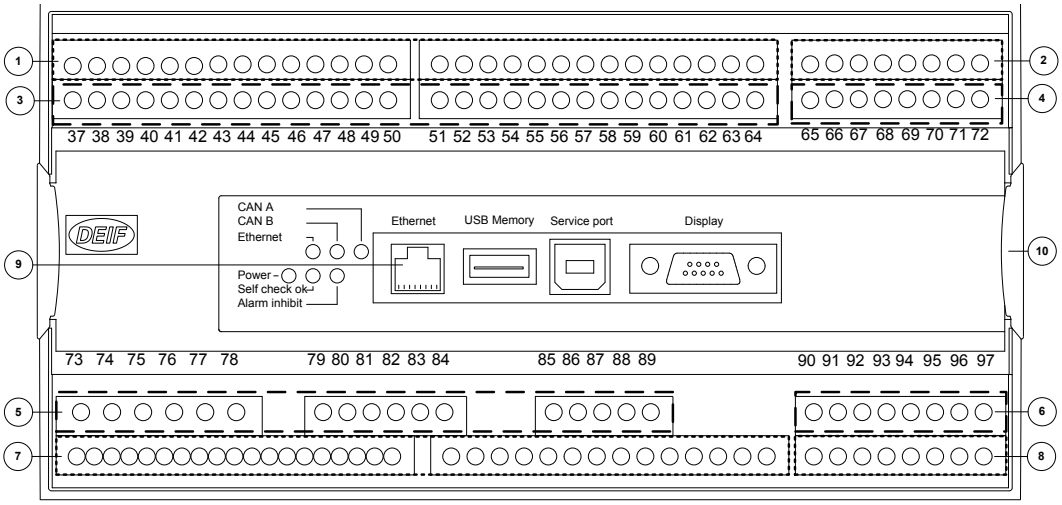


PLC-controlled system



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

1.4 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
	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
5		**Terminal 73-89, AC measuring**
	Standard	3 × generator voltage; 3 × generator current; 3 × busbar/mains voltage

Slot #	Option/standard	Description
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
8		**Terminal 126-133, engine communication, inputs/outputs**
	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

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

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

1.5 Technical information and dimensions

1.5.1 Technical specifications

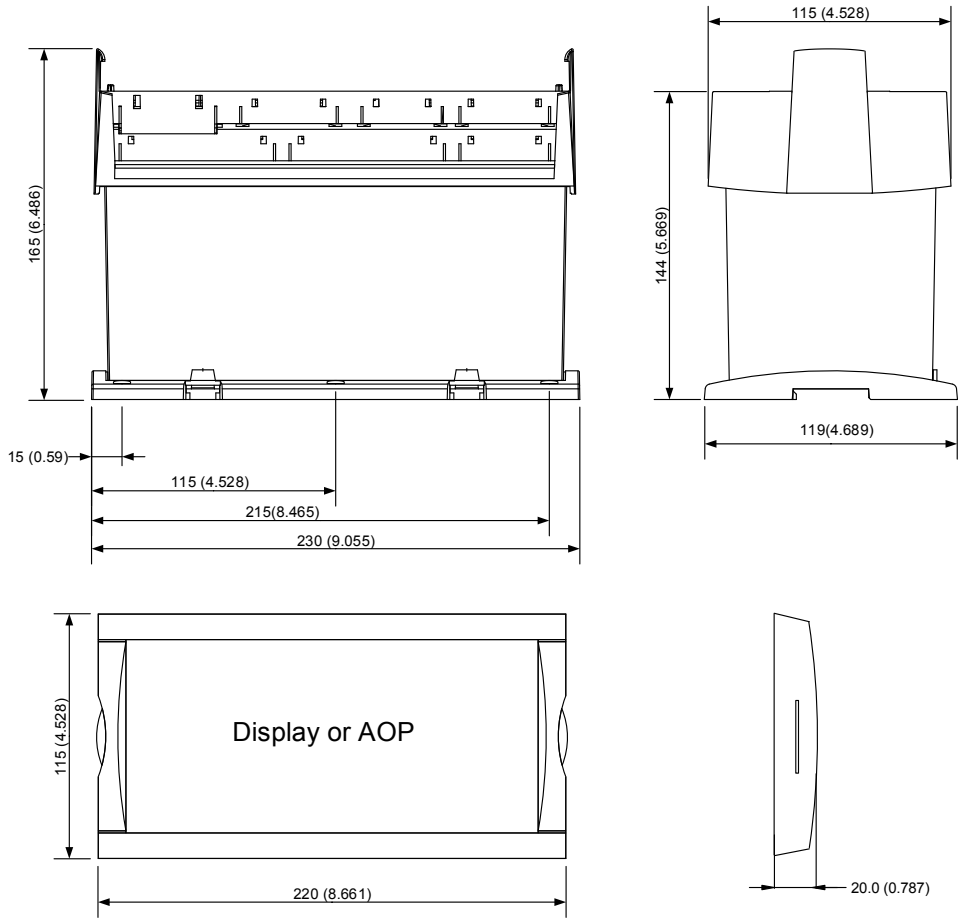
Accuracy	Class 1.0 -25 to 15 to 30 to 70 °C Temperature coefficient: +/-0.2 % of full scale per 10 °C Positive, negative and zero sequence alarms: class 1 within 5 % voltage unbalance Class 1.0 for negative sequence current Fast over-current: 3 % of 350 %*In Analogue outputs: class 1.0 according to total 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 1-5 A) Consumption: max. 0.3 VA/phase
Current overload	4 × I_n continuously 20 × I_n, 10 sec. (max. 75 A) 80 × I_n, 1 sec. (max. 300 A)
Measuring frequency	30 to 70 Hz
Aux. supply	Terminals 1 and 2: 12/24 V DC (8 to 36 V continuously, 6 V 1 sec.). 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 (8 to 36 V continuously, 6 V 1 sec.). Max. 5 W consumption 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 sec., t_{off} = 15 sec. (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.

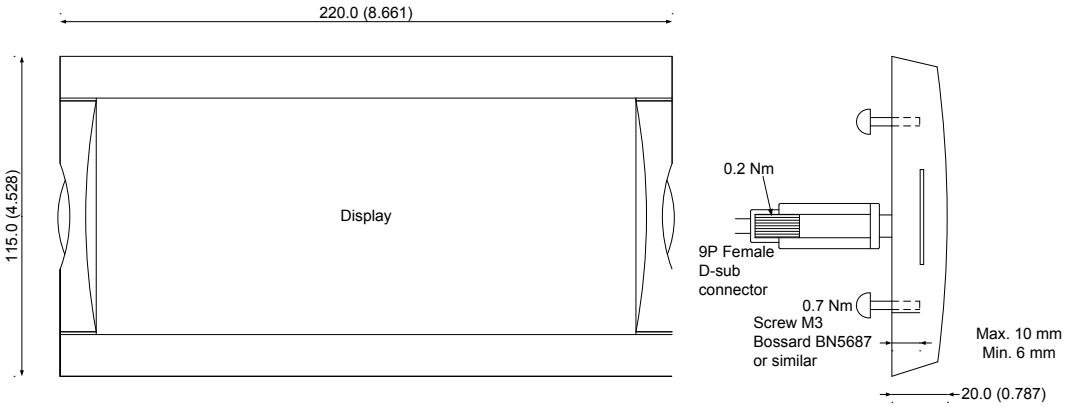
Response times (Delay set to min.)	**Busbar:**		
	Over-/under-voltage:	<50 ms	
	Over-/under-frequency:	<50 ms	
	Voltage unbalance:	<200 ms	
	Generator:		
	Reverse power:	<200 ms	
	Over-current:	<200 ms	
	Fast over-current:	<40 ms	
	Over-/under-voltage:	<200 ms	
	Over-/under-frequency:	<300 ms	
	Overload:	<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	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 98-116: 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
Protection	Unit: IP20. Display: IP40 (IP54 with gasket: option L). (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	UL/cUL Listed to UL508. UL/cUL Recognized to UL2200
UL markings	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:** Tightening torque: 0.5 Nm (4.4 lb-in) Wire size: AWG 22-14
Weight	Base unit: 1.6 kg (3.5 lbs.) Option J1/J3/J6: 0.2 kg (0.4 lbs.) Option J2: 0.4 kg (0.9 lbs.) Display: 0.4 kg (0.9 lbs.)

1.5.2 Unit dimensions in mm (inches)



Tightening torques



1.6 Available variants

Type	Variant no.	Description	Item no.	Note
GPU-3 Hydro	01	GPU-3 Hydro with display	2912120020-01 + A1	

1.7 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) **(27D)**		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)** Inverse time over-current **(51)**		Software	
D	**Voltage control**			
D1	Voltage control		Software	Requires G2
E and F	**Analogue controller and transducer outputs**			
E1	2 × +/-25 mA (GOV/AVR or transducer)	4	Hardware	Not with E2, EF2, EF4 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 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 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 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**			
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
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
L	**Display gasket for IP54**		Other	Standard is IP40
M	**Turbine control, digital and analogue I/Os**			
M4	Turbine control OR I/O extension	7	Hardware	
M12	13 digital inputs, configurable 4 relay outputs, configurable	3	Hardware	

Option	Description	Slot no.	Option type	Note
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
M14.X	4 relay outputs, configurable	4, 6, 8	Hardware	**M14.4:** Not with E1, E2, EF2 and EF4 **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**			
Y5	GB control		Other	Requires G2

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

INFO
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.

1.8 Available accessories

Type	Description	Item no.	Note
Accessory for GPU-3 Hydro	Additional standard display (X2) with CAN bus	2912890030	Max. 2
Accessory for GPU-3 Hydro	Operator panel AOP-1 (X3) 16 LEDs, eight buttons, one status relay, configurable	2912411070	One only
Accessory for GPU-3 Hydro	Operator panel AOP-2 (X4) 16 LEDs, eight buttons, one status relay, configurable. CAN bus	2912411060	Max. 5
Accessory for GPU-3 Hydro	3 m display cable (J1)	1022040076	1 pc. always included
Accessory for GPU-3 Hydro	6 m display cable (J2)	1022040057	
Accessory for GPU-3 Hydro	Crossed Ethernet cable for option N programming (J4)	1022040055	
Accessory for GPU-3 Hydro	1 m display cable (J6)	1022040064	
Accessory for GPU-3 Hydro	3 m USB programming cable (J7)	1022040065	

1.9 Order specifications and disclaimer

1.9.1 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
2912120020-01	GPU-3 Hydro	01	M4	Y1	H2		

Accessories

Mandatory information		
Item no.	Type	Accessory

Example:

Mandatory information		
Item no.	Type	Accessory
1022040076	Accessory for GPU-3 Hydro	3 m display cable (J1)

1.9.2 Disclaimer

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