



PPM Protection and Power Management DATA SHEET



Power Management

- Multiple master system
- Redundant internal communication
- Load-dependent start/stop
- Fuel optimisation logic
- Programmable start priority
- Heavy consumer control
- Blackout start sequence
- Trip of non-essential load groups

Protection (ANSI)

- 5 x Overload (32)
- 2 x Reverse power (32)
- 6 x Overcurrent (50/51)
- Voltage-dependent overcurrent (92)
- 3 x Over/undervoltage (27, 59)
- 3 x Over/underfrequency (81)
- Current/voltage unbalance (60)
- Loss of excitation/overexcitation (40)

M-logic (Micro PLC)

- Simple logic configuration tool
- Selectable input/output events

Display

- Push-buttons for start/stop and breaker
- Status texts
- Information messages
- Alarm indication
- One-touch sequences
- Prepared for additional remote displays

General

- USB interface to PC
- Free PC utility software for commissioning
- Mini SCADA in PC utility software
- Programmable parameter, timer and alarms
- User-configurable texts

Engine control and protection

- Run and stop coil
- GOV and AVR control
- 3 x alarm inputs with wire break supervision



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Application

The Protection and Power Management (PPM) is a standard system for marine applications with microprocessor-based control units containing all necessary functions for protection and control of diesel generators, shaft generators, shore connections and bus tie breakers. It contains all necessary 3-phase measuring circuits and all values and alarms are presented on the LCD display.

The PPM is a compact all-in-one unit designed for the following applications:

- Multiple gen-sets
- Split busbars with independent section control
- Ring bus connection
- Shaft generator and shore connection control
- Bus tie breaker control
- Emergency generator control

Operation modes:

- Load sharing between diesel generators
- Fixed power (diesel generator)
- Load transfer between shaft- and diesel generator
- Load transfer between shore connection and diesel generator
- Split busbar

The display is separate and can be installed directly on the main unit or in the front of the switchboard door (requires option J1 - display cable). Additional displays can be installed within 200m.

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

In-/outputs	Available
4-20mA	3 (3)
Digital inputs	
PT100	
PT1000	
VDO	
0-40V DC	
Digital inputs	7 (4)
RPM (MPU)	1
Relays	4
CANbus comm.	2



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



One of the two CAN communications (1) is used for internal communication. CAN 2 is for communication options or redundant internal CAN.

Plant operation

The plant operation depends on the plant configuration, i.e. if there are shaft generator(s), bus tie breaker(s), synchronisable shore connection(s) and/or an emergency diesel generator involved.

Switching between different operation modes is done with push-buttons on the display.

Unit control modes

AUTO: Auto control means that the plant is controlled automatically by PPM and gen-set starting and stopping is based on power demand (when in DG supply operation). Upon operator command, switching between different operation modes is done automatically.

SEMI: Semi-auto control is an operator dependent auto mode. This means that gen-set start/stop, synchronisation and opening of the breaker is carried out by PPM on operator command only. A diesel generator unit connected in semi-auto will not be a part of the load-dependent start/stop function.

SWBD: Switchboard control means that PPM is disabled totally with regards to start/stop/synchronising and load sharing. The protection functions remain active.

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.arith.com.tw](#).

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.

Options

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

Please refer to pages 7 and 8 for the options available.

Unit definitions

- PPM DG: Diesel generator controller.
- PPM SG: Shaft generator controller.
- PPM SC: Shore connection controller.
- PPM BTB: Bus tie breaker controller.
- PPM EDG: Emergency diesel generator controller.

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.



Power management

Description

The PPM is a power management system able to handle applications with up to

- 8 bus tie breakers (BTB)
- 16 diesel generators (DG)
- 1 emergency generator (EDG)
- 2 shaft generators (SHAFT)
- 2 shore connections (SHORE)

The basic functions are:

- All breakers can be synchronised by choice
- Load-dependent start/stop operation
- Priority selection of gen-sets
- Redundant communication between the controllers
- Plant divided into sections for individual functionality
- Load transfer
- Heavy consumer management
- Multi-master system

In a multi-master system, all vital data is broadcasted from all units to all units, giving all units knowledge of their own position in the application. This philosophy makes the application immune to a failing master controller.

Application

The plant operational modes supported by the power management options are:

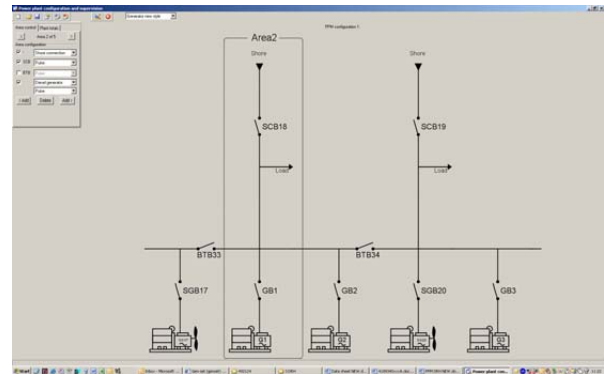
- Diesel generator operation
- Shaft generator operation
- Shore connection operation
- Split busbar(s) operation
- Emergency/harbour generator operation

The plant operational modes are configurable and it is possible to change them on the fly, dependent on the actual or desired situation.

The plant can be divided into sections by several bus tie breakers, making it possible to run different operation modes in each section.

Configuration

The setup of the application is easily configured using a computer and the DEIF PC utility software.



Your PC tool visualises it - the PPM realises it.

Heavy consumer management

The heavy consumer management functions are available to ensure sufficient power capacity to handle the load either in terms of number of gen-sets or by soft starting the load. Available power can be reserved for heavy consumers with variable load e.g. bow thrusters.

If a certain level of available power on the busbar is required to connect a heavy consumer, a function is available for starting additional generators. Furthermore, relays can be configured to activate when a specific level of available power is reached.

Load-dependent operation

The load-dependent starting and stopping of the gen-sets are based on a *power available* calculation. The next generator will start when the available power decreases below the adjustable setpoint. It will stop when too much power is available.

Priority selection

The start/stop priority of the diesel generators can be set in different ways:

- Manual selection with the 1st PRIOR push-button on each diesel generator unit.
- Running hours.
- Fuel optimising calculating the best combination of generator kW size and the plant load. Works with up to 16 gen-sets.

Redundant CANbus

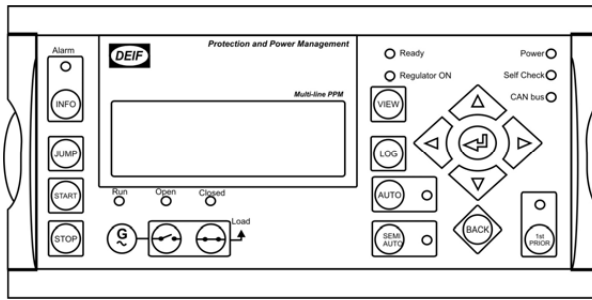
In systems requiring extra operation reliability, redundant CANbus communication lines can be used to provide back-up.



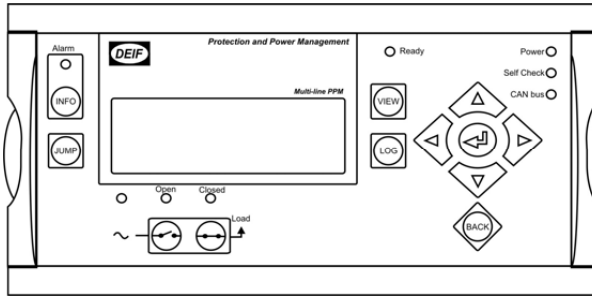
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Display layouts

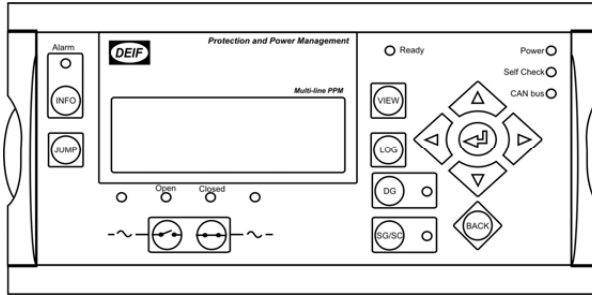
Diesel generator display



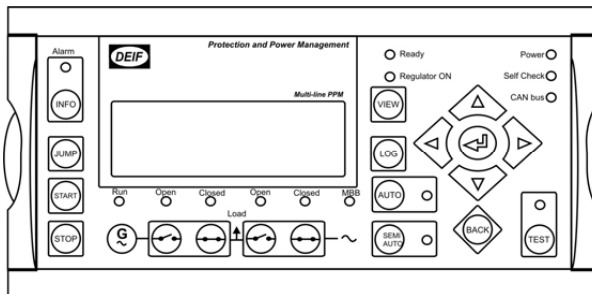
Shaft generator/Shore connection display



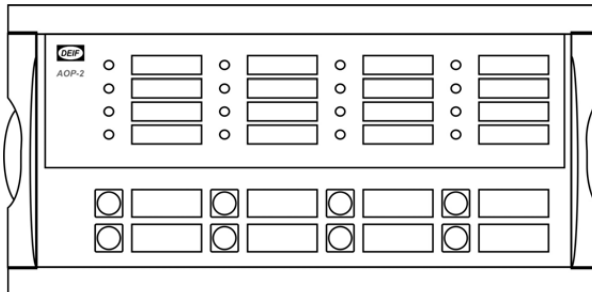
Bus tie breaker display



Emergency diesel generator display



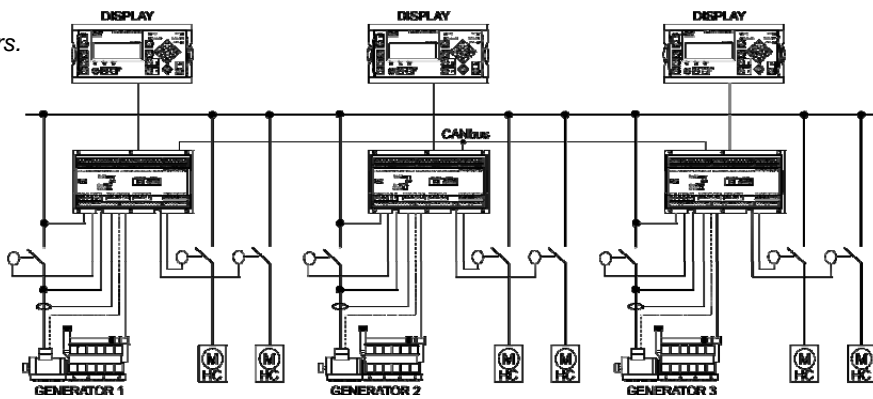
Additional operator panel display (AOP)



Power management applications

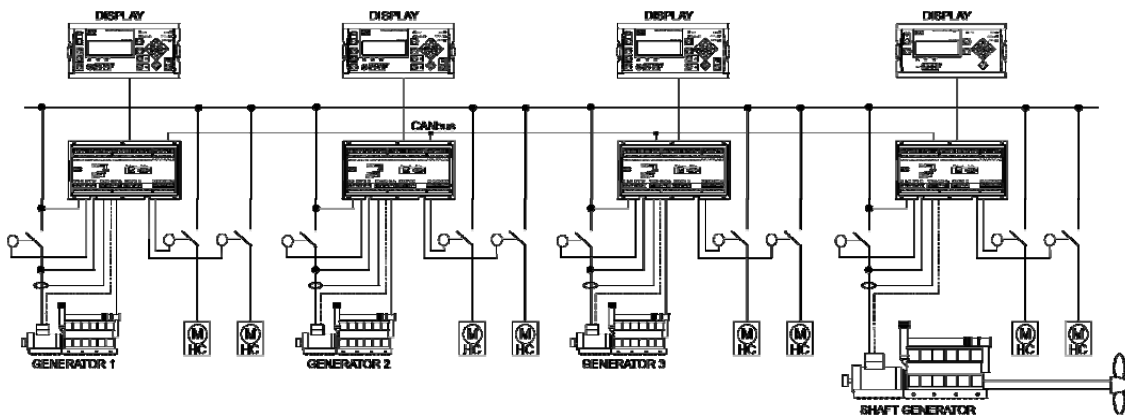
1. DG operation

Up to 16 generators.



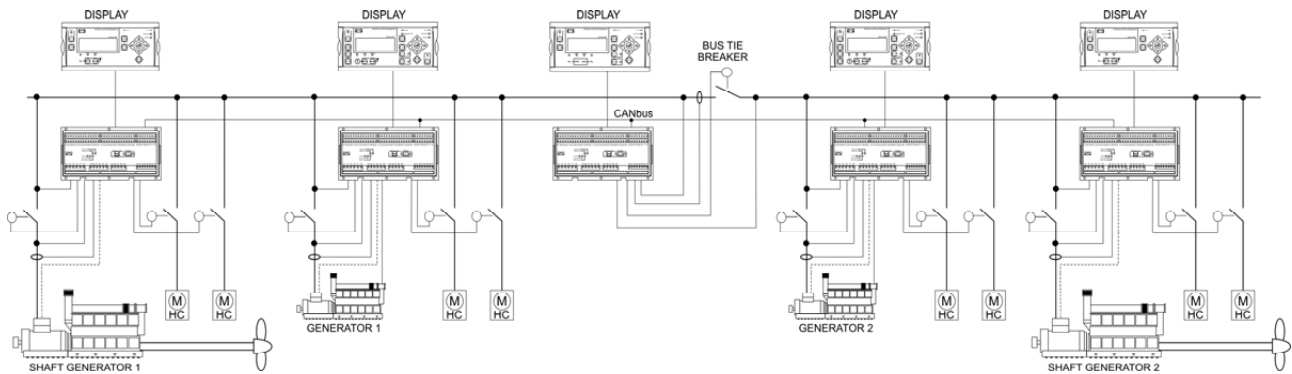
2. Shaft generator/Shore connection

For shore connection, the shaft generator position is used for the shore connection.



3. One or two shaft generators/shore connections with split busbars

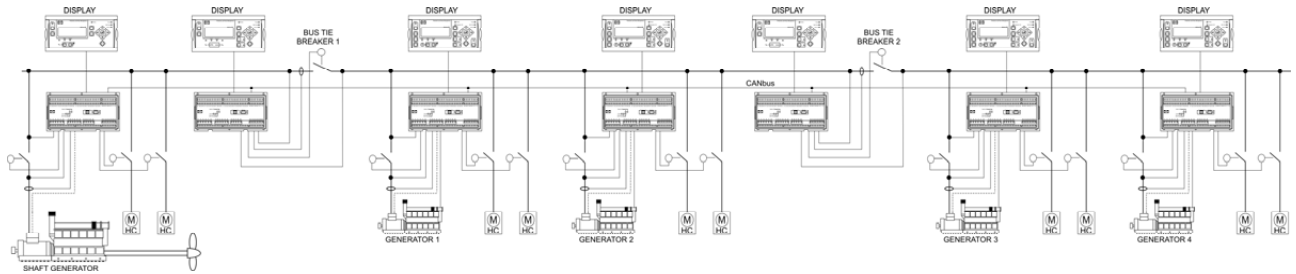
The bus tie breaker is selectable depending on applicational needs.



Power management applications

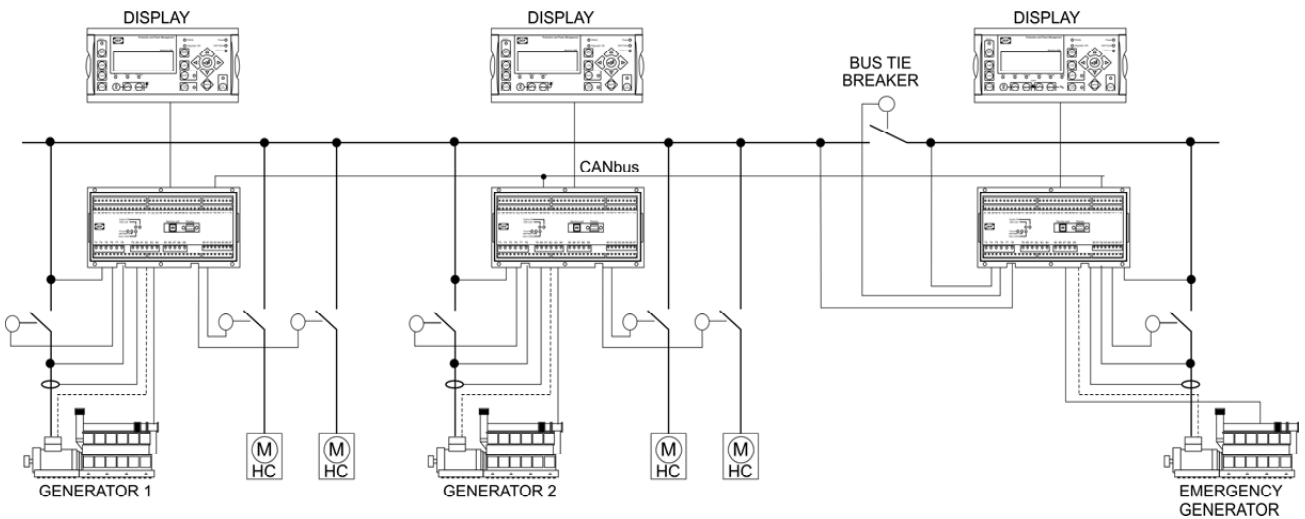
4. Multiple bus tie breakers

The bus tie breakers are selectable depending on applicational needs.



5. Emergency generator

The emergency generator can be combined with any other plant type.



Available options

Option	Description	Slot no.	Option type	Note
B	Generator/busbar protection package			
B1	Over- and undervoltage (generator and busbar) (27/59) Over- and underfrequency (generator and busbar) (81) Voltage unbalance (busbar) (60)		Software	Included as standard
C	Generator add-on protection package			
C1	Over- and undervoltage (27/59) Over- and underfrequency (81) Overload (32) Current unbalance (46) Voltage unbalance (60) Reactive power import (excitation loss) (40) Reactive power export (overexcitation) (40) Voltage dependent overcurrent (92)		Software	Included as standard
D	Voltage/VAr/PF control			Not available for PPM SG/SC and PPM BTB
D1	Constant voltage control (stand-alone) Constant reactive power control (parallel with mains) Constant power factor control (parallel with mains) Reactive load sharing (island paralleling with other generators)		Software	Not with EF2
E and F	Analogue controller and transducer outputs			
E1	2 x +/-25mA (GOV/AVR or transducer)	4	Hardware	Not with E2, EF2, EF4 or EF5 AVR output requires D1
E2	2 x 0(4)...20mA (GOV/AVR or transducer)	4	Hardware	Not with E1, EF2, EF4 or EF5 AVR output requires D1
EF2	1 x +/-25mA (GOV/AVR or transducer) 1 x 0(4)...20mA (GOV/AVR or transducer)	4	Hardware	Not with E1, E2, EF4 or EF5 AVR output requires D1
EF4	1 x +/-25mA (GOV/AVR or transducer) 2 x relay outputs (GOV/AVR or configurable)	4	Hardware	Not with E1, E2, EF2 or EF5 AVR output requires D1
EF5	1 x PWM (Puls Width Modulated) output for CAT GOV +/-20mA for AVR. 2 x relay outputs (GOV/AVR or configurable)	4	Hardware	Not with E1, E2, EF2 or EF4 AVR output requires D1
F1	2 x 0(4)...20mA (transducer)	6	Hardware	Not with M13.6, M14.6 or M15.6
G	Load sharing			
G3	Load sharing with analogue lines		Software	
G5	Power management, 16 gen-sets, 8 bus tie breakers, 2 shaft generators, 2 shore connections, 1 emergency-/harbour generator		Software	Included as standard
H	Serial communication			
H2	Modbus RTU (RS485)	2	Hardware	Not with H3, H8.2
H3	Profibus DP	2	Hardware	Not with H2, H8.2
H5	CANbus: MTU (ADEC and MDEC) and all J1939 engine comm. in option H7	8	Hardware	Not with H7, H8.8, M13.8, M14.8 or M15.8. Not available for PPM SG/SC and PPM BTB.
H7	CANbus (J1939): Caterpillar Cummins CM850/570 Detroit Diesel (DDEC) Deutz (EMR) Iveco (NEF/CURSORS) John Deere (JDEC) Perkins Scania (EMS) Scania (EMS S6) Volvo Penta (EMS) Volvo (EMS2)	7	Software	Not with H5 or redundant PMS CANbus. Not available for PPM SG/SC and PPM BTB.
H8.X	External I/O modules	2, 8	Hardware	H8.2: Not with H2, H3, H8.8 H8.8: Not with H5, H8.2, M13.8, M14.8 or M15.8

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



Options E1, E2, EF2, EF4 and EF5 are used for GOV/AVR control. 4 relays are used as standard in the PPM for GOV/AVR control. If selected, these options will replace the 4 relays.



Option	Description	Slot no.	Option type	Note
J	Cables			
J1	Display cable with plugs, 3 m. UL94 (V1) approved		Other	Included as standard
J2	Display cable with plugs, 6 m. UL94 (V1) approved		Other	
J4	PC cable for option N-programming UL94 (Ethernet cable crossed), 3 m. UL94 (V1) Listed.		Other	
J6	PC cable for utility software (USB) 1 m. UL94 (V1) approved		Other	
J7	PC cable for utility software (USB) 3 m. UL94 (V1) approved		Other	
K	Documentation			
K1	Designer's Reference Handbook (hard copy)		Other	
K2	CD-ROM with complete documentation		Other	
L	Display gasket for IP54		Other	Standard is IP52
M	Binary and analogue I/Os			
M12	13 binary inputs, 4 relay outputs, configurable	3	Hardware	Included as standard
M13.X	7 binary inputs, configurable	6, 8	Hardware	M13.6: Not with F1, M14.6 or M15.6 M13.8: Not with H5, H8.8, M14.8 or M15.8
M14.X	4 relay outputs, configurable	4, 6, 8	Hardware	M14.4: (standard) Not with E1, E2, EF2 or EF4 M14.6: Not with F1, M13.6 or M15.6 M14.8: Not with H5, H8.8, M13.8 or M15.8
M15.X	4 analogue inputs, configurable, 4...20mA	6, 8	Hardware	M15.6: Not with F1, M13.6, M14.6 or M15.8 M15.8: Not with H5, H8.8, M13.8, M14.8 or M15.6
N	Ethernet TCP/IP communication			
N	Ethernet TCP/IP Modbus comm. and alarms via SMS or e-mail		Hardware/ software	
Q	Measurement accuracy			
Q1	Verified class 0,5		Other	
X	Display			One Display per PPM unit is included as standard
X2	Additional standard display. CANbus comm.		Other	Two X2 options can be ordered for each PPM unit
X3	Additional operator panel (AOP-1): 16 configurable LEDs and 8 configurable push-buttons		Other	Max. one AOP-1 for each display unit
X4	Additional operator panel (AOP-2): 16 configurable LEDs, 8 configurable buttons and 1 status relay. CANbus comm.		Other	Five X4 options can be ordered for each PPM unit



Please notice that not all options can be selected for the same unit. Please refer to page 9 in this data sheet for further information about the location of the options in the unit.

Hardware overview

Slot #4, term. 65-72 Governor, AVR, in-/outputs
M14.4: 4 x relay (standard)
E1: 2 x +/-20mA out
E2: 2 x 0(4)...20mA out
EF2: 1 x +/-20mA out 1 x 0(4)...20mA out
EF4: 1 x +/-20mA out 2 x relay
EF5: 1 x PWM governor output 1 x +/-20mA out for AVR 2 x relay

Slot #2, term. 29-36 Communication
H2: Modbus RTU (RS485)
H3: Profibus DP
H8.2: Ext. I/O modules

Slot #1, term. 1-28 Power supply (standard)
8-36V DC supply, 11W 1 x status output relay 5 x relay outputs 2 x pulse outputs (kWh, kVArh) 5 x digital inputs

Slot #3, term. 37-64 In-/outputs/load sharing
13 x digital inputs 4 x relay outputs (standard)
G3: Active power load sharing Reactive power load sharing (requires option D1)

Ethernet
N: TCP/IP Modbus comm. and alarm via SMS or email

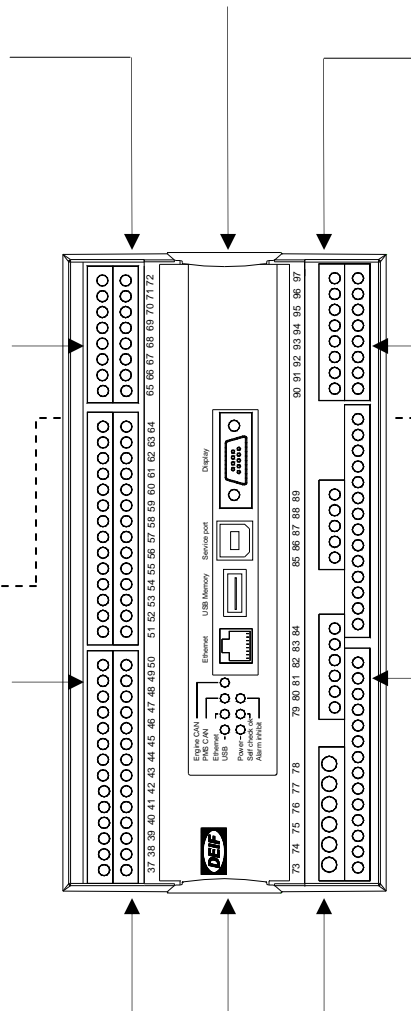
Slot #6, term. 90-97 In-/outputs
F1: 2 x 0(4)...20mA out, transducer
M13.6: 7 x digital inputs
M14.6: 4 x relay outputs
M15.6: 4 x 4...20mA inputs



Slot #8, term. 126-133 Engine comm., in-/outputs
H5: MTU (MDEC) + J1939 (option H7)
H8.8: Ext. I/O modules
M13.8: 7 x digital inputs
M14.8: 4 x relay outputs
M15.8: 4 x 4-20 mA input

Slot #7, term. 98-125 Engine I/F (std.)
8-36V DC supply, 5W 1 x magnetic pick-up (MPU) 3 x multi-inputs 7 x digital inputs 4 x relay outputs
G5: Power management (standard)
H7: J1939

Slot #5, term. 73-89 AC measuring (standard)
3 x generator voltage 3 x generator current 3 x busbar/mains voltage

LED I/F
Display connection PC programming connection



-  There can only be one hardware option in each slot. It is e.g. 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 on this page, it is possible to select the software options mentioned in the chapter 'Available options'.



Technical specifications

Accuracy:	<p>Class 1.0</p> <p>Positive, negative and zero sequence alarms: Class 1 within 5% voltage unbalance</p> <p>Class 1.0 for negative sequence current</p> <p>Fast overcurrent: 3% of 350%*I_n</p> <p>Analogue outputs: Class 1.0 according to total range</p> <p>Option EF4: Class 4.0 according to total range</p> <p>To EN60688/IEC 688</p>	Analogue inputs:	<p>0(4)...20mA:</p> <p>Impedance: 50Ω</p> <p>Not galvanically separated</p> <p>RPM (MPU): 2...70V AC, 10...10000Hz, 250...3000Ω</p>
Operating temp.:	<p>-25...70°C (-13...158°F)</p> <p>(UL/cUL Listed: Max. surrounding air temp.: 55°C/131°F)</p>	Multi-inputs:	<p>0(4)...20mA:</p> <p>0-20mA, +/-1%</p> <p>Not galvanically separated</p> <p>Binary:</p> <p>Max. resistance for ON detection: 100Ω</p> <p>Not galvanically separated</p> <p>PT100/1000:</p> <p>-40...250°C, +/-1%</p> <p>Not galvanically separated</p> <p>To IEC 751 and EN60751</p> <p>VDO:</p> <p>0...1700Ω, +/-2%</p> <p>Not galvanically separated</p> <p>V DC:</p> <p>0...40V DC, +/-1%</p> <p>Not galvanically separated</p>
Storage temp.:	-40...70°C (-40...158°F)	Relay outputs:	<p>Electrical rating:</p> <p>250V AC/30V DC, 5A</p> <p>(UL/cUL Listed: 250V AC/24V DC, 2A resistive load)</p> <p>Thermal rating @ 50°C:</p> <p>2A: Continuously</p> <p>4A: t_{ON} = 5 sec., t_{OFF} = 15 sec.</p> <p>(Unit status output: 1A)</p>
Climate:	Class HSE, to DIN 40040	Open collector outputs:	Supply: 8...36V DC, max. 10mA
Meas. voltage:	100-690V AC +/-20% (UL/cUL Listed: 480V AC phase-phase)	Analogue outputs:	<p>0(4)...20mA and +/-25mA</p> <p>Galvanically separated</p> <p>Active output (internal supply)</p> <p>Load max. 500Ω</p> <p>(UL/cUL Listed: Max. 20mA output)</p> <p>Update rate:</p> <p>Transducer output: 250 ms</p> <p>Regulator output: 100 ms</p>
Consumption:	Max. 0.25VA/phase	Analogue Load sharing lines:	-5...0...+5V DC, Impedance: 23.5 kΩ
Meas. current:	-/1 or -/5A AC (UL/cUL Listed: From CTs 1-5A)	Galv. separation:	<p>Between AC voltage, AC current and other I/Os:</p> <p>3250V AC, 50Hz, 1 min.</p> <p>Between analogue outputs and other I/Os:</p> <p>500V DC, 1 min.</p> <p>Between binary input groups and other I/Os:</p> <p>500V DC, 1 min.</p>
Consumption:	Max. 0.3VA/phase		
Current overload:	4 x I _n continuously 20 x I _n , 10 sec. (max. 75A) 80 x I _n , 1 sec. (max. 300A)		
Meas. frequency:	30...70Hz		
Aux. supply:	<p>Terminals 1 and 2:</p> <p>12/24V DC (8...36V continuously, 6V 1 sec.)</p> <p>Max. 11W consumption</p> <p>Terminals 98 and 99:</p> <p>12/24V DC (8...36V continuously, 6V 1 sec.)</p> <p>Max. 5W consumption</p> <p>The aux. supply inputs are to be protected by a 2A slow blow fuse</p> <p>(UL/cUL Listed: AWG 24)</p>		
Binary inputs:	<p>Optocoupler, bi-directional</p> <p>ON: 8...36V DC</p> <p>Impedance: 4.7kΩ</p> <p>OFF: <2V DC</p>		

Data sheet

Response times:

(Delay set to min.)

Busbar:

Over-/undervoltage: < 50 ms
Over-/underfrequency: < 50 ms
Voltage unbalance: <200 ms

Generator:

Reverse power: <200 ms
Overcurrent: <200 ms
Fast overcurrent: < 40 ms
Over-/undervoltage: <200 ms
Over-/underfrequency: <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

Mounting:

DIN-rail mount or base mount
with 6 screws

Safety:

To EN 61010-1, installation
category (overvoltage
category) III, 600V, pollution
degree 2
To UL 508 and CSA 22.2 no.
14-05, overvoltage category
III, 300V, pollution degree 2

EMC/CE:

To EN 61000-6-1/2/3/4
SS4631503 (PL4) and
IEC 255-3

Material:

All plastic materials are self-
extinguishing according to
UL94 (V1)

Plug connections:

AC current:
0.2-4.0 mm² stranded wire
(UL/cUL Listed: AWG 18)

AC voltage:
0.2-2.5 mm² stranded wire
(UL/cUL Listed: AWG 20)

Relays:
(UL/cUL Listed: AWG 22)

Terminals 98-116:

0.2-1.5 mm² stranded wire
(UL/cUL Listed: AWG 24)

Protection and Power Management

Other:

0.2-2.5 mm² stranded wire
(UL/cUL Listed: AWG 24)

Display:

9-pole Sub-D female

Service port:

USB A-B

Protection:

Unit: IP20
Display: IP52 (IP54 with gasket:
Option L)
(UL/cUL Listed: Type Complete
Device, Open Type)

To IEC 529 and EN 60529

Governors:

Multi-line 2 interfaces to all governors,
including GAC, Barber-Colman,
Woodward and Cummins

See interfacing guide at
[_____](#)

Approvals:

UL/cUL Listed

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: 0.5Nm (4.4lb-in)

Wire size:

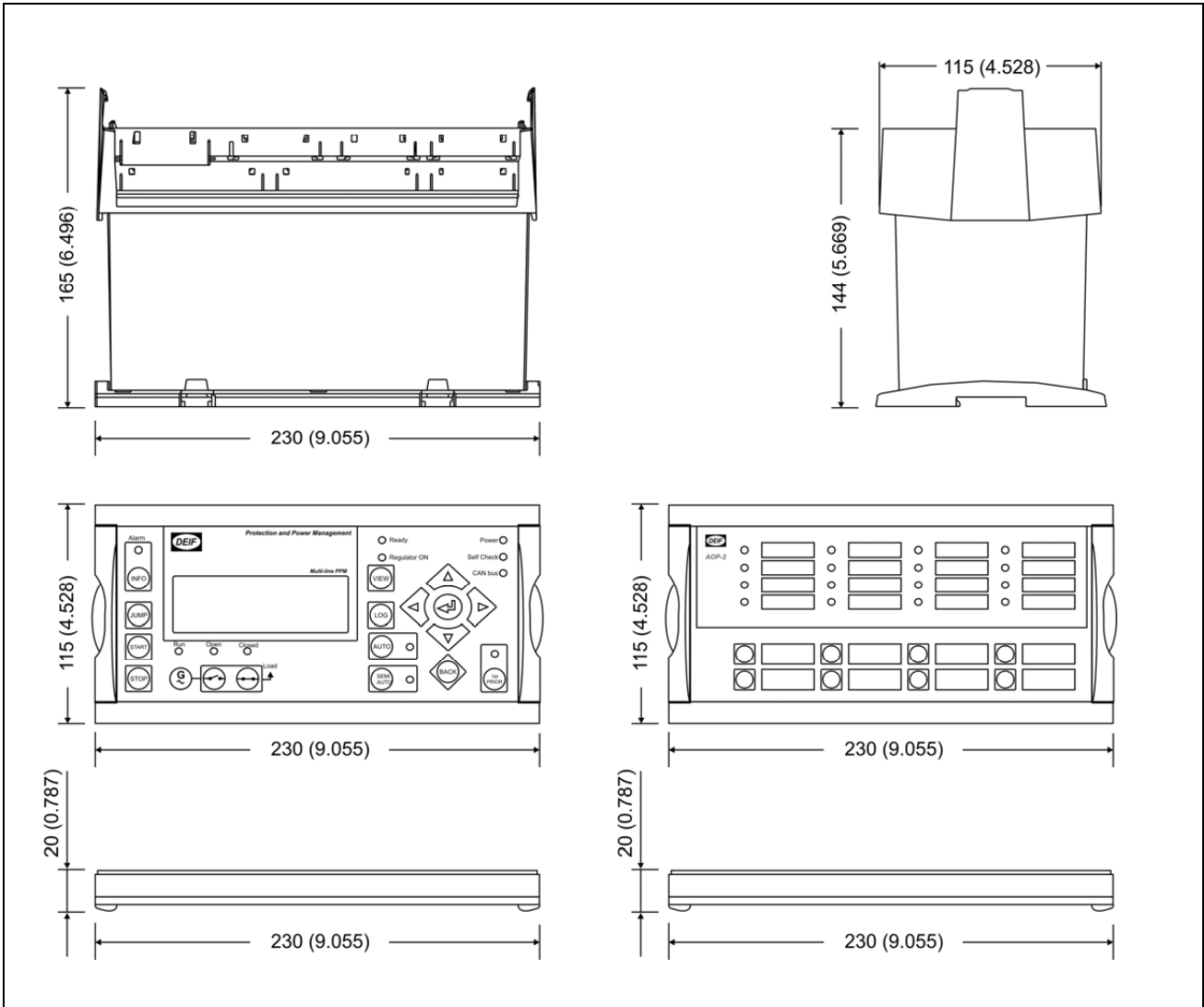
AWG 22-14

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.)



Unit dimensions in mm (inches)



Order specifications

Type Version Option Option Option Option Displays
 PPM type - [] - [] - [] - [] - [] - []

Example:
 Type Version Option Option Option Option Displays
 PPM EDG - 3.x - E1 - H2 - M13.6 - [] - 123

Specify the PPM type:

- DG (diesel generator)
- SG (shaft generator)
- SC (shore connection)
- BTB (bus tie breaker)
- EDG (emergency diesel generator)

Displays: 213

Total number of displays:
 1: 1 std. display (always included)
 2: 1 std. + 1 add. display (option X2)
 3: 1 std. + 2 add. displays (option X2)

Total number of AOP-1 (Option X3)

Total number of AOP-2 (Option X4)



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Due to our continuous development we reserve the right to supply equipment which may vary from the described.