DEIF

-power in control

CE

DATA SHEET

Automatic Fuel Controller, AFC
Plant Management

- Temperature-compensated inventory
- Safe fuel transfer
- Automated truck unloading
- Pump protection and supervision

DEIF A/S · Frisenborgvej 33 · DK-7800 Skive
Tel.: +45 9614 9614 · Fax: +45 9614 9615
info@deif.com · www.deif.com

Document no.: 4921240421D
SW version: 1.02.0 or later

1. Application information

1.1 General information

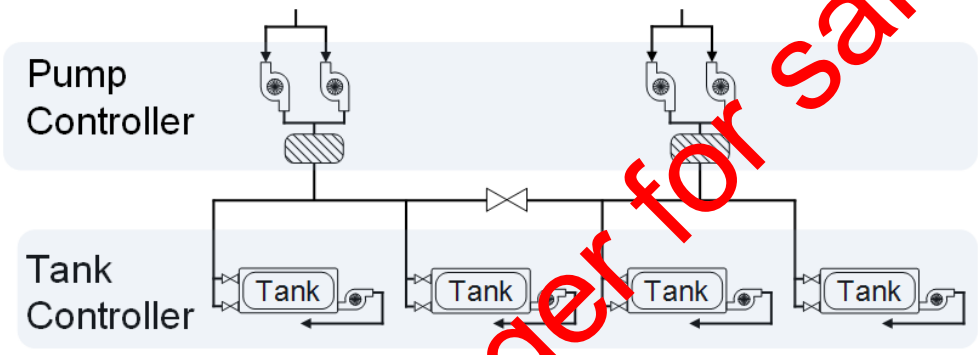
1.1.1 Automatic Fuel Controller, Plant Management

The Automatic Fuel Controller, Plant Management (AFC PM) is a series of controllers designed to control fuel logistics in liquid fuel-fired power plants.

1.1.2 System topology

The concept of AFC PM is to have several small decentralised fuel tanks instead of few large centralised fuel tanks. From designated pump station(s), the fuel is transferred to the fuel tanks.

Manually controlled valves can be inserted on the fuel pipe to separate pump station and fuel tanks.
The maximum capability of the system is 32 pump stations or fuel tanks in total, that is applications containing 1 pump station can have a maximum of 31 fuel tanks. Furthermore a maximum of eight separation valves is supported.



1.1.3 Pump controller

An AFC PM pump controller is used at each pump station.

The pump controller can start/stop a maximum of two pumps. In case the pump(s) is (are) driven by variable frequency drives (VFDs), it is able to control the fuel pressure delivered by the pump(s). Second priority pump can, if present, be started/stopped automatically according to demand for fuel supply and the requested delivery pressure. To obtain pressure control, the pump controller must be equipped with option E1 or E2.

The pump controller is able to interface to VFDs and in that way provide VFD-related measurements such as output power and load torque. The VFDs currently supported are listed below:

- **Vacon (option H2 required)**

By means of flow meters, the pump controller also provides monitoring of additional fuel-related measurements such as flow, temperature and density. The flow meters currently supported are listed below:

- **MicroMotion (option H2 required)**

Furthermore, fuel purity can be monitored by means of fuel contamination meters. The fuel contamination meters currently supported are listed below:

- **Parker iCount**

Fuel filter monitoring is supported as well, and filter status is directly indicated both on a designated LED on the display folio and on the SuperVision page provided by the free DEIF utility PC SW.

The AFC PM is able to operate in three different plant modes:

- Fuel transfer
- Fuel level
- Fuel feed

The system mode of operation is determined on the pump controller.

In fuel transfer mode, fuel is pumped from a customer pipeline or unloaded from a truck. Here the system can be pressurised in order to move fuel from the entry into the tanks. It is possible to divide the tanks into different fuel groups, which allows unloading of fuel to specific fuel tanks only. The system automatically monitors the tanks, so if all tanks are filled to their maximum capacity, the pump/valve is stopped. When the transfer of fuel is started, the pump(s) is (are) blocked till at least one of the tank's fuel valve is open. When the transfer is stopped, the last valve is kept open till after the pump(s) is (are) stopped in order to remove pressure from the transfer lines. It is possible to monitor the system's total unload capability directly on the display as well as on the SuperVision page provided by the free DEIF utility PC SW.

In fuel levelling mode, fuel is levelled between the tanks using gravity. As a system can involve different locations and heights inside the plant, the levelling mode can be separated into levelling blocks, so the tanks can level individually only with tanks that have the same height inside the plant. The levelling is driven by gravity alone.

In fuel feed mode, fuel is pumped without filling tank(s). This is applicable in applications where fuel is fed directly to the day tanks of the gensets.

1.1.4 Tank controller

An AFC PM tank controller is used on each fuel tank. The tank controller controls two valves:

- Fuel valve (FV)
- Level valve (LV)

The FV is used in fuel transfer mode when the tank takes in fuel that is being unloaded into the system at the pump station.

The LV is used in fuel level mode where the fuel is levelled among the tanks.

Furthermore, the tank controller controls a small pump that transfers fuel from the fuel tank into the day tank of the connected genset. Several gensets can be connected to the same tank. The transfer pump can be started by an external command generated by the genset controller(s) when the fuel level in the day tank drops below a specified threshold. If the gensets are equipped with AGC plant management control, the transfer of fuel to the generator is monitored and will be stopped if it is detected that the level in the day tank is not increasing.

The tank controller can handle different kinds of level inputs in the tanks:

- Resistive measurement
- Pressure-based measurement

The fuel temperature can be measured as well. Together with the knowledge of the density of the fuel, this enables the tank controller to provide inventory both in volume and mass. All inventory data can be seen and displayed in actual values both on the display and on the SuperVision page provided by the free DEIF utility PC SW.

The tank controller is able to maximise the inventory in the tank independent of the fuel temperature. When filling the tank, the tank controller uses the actual fuel temperature to determine the possible fuel expansion to expect and adjusts the maximum filling threshold accordingly. In this way, the maximum filling level is variable, dependent on the temperature. If the fuel is hot, the tank is filled to a higher level than if the fuel is cold.

The system offers the possibility of ventilating the fuel pipe to avoid pressure to be built up when fuel is not being pumped. The fuel pipe relief functionality will let the tank with most capacity keep its fuel valve open and use the free capacity in the tank as a fuel expansion void.

Any alarm related to the tank can be directly indicated both on a designated LED on the display folio and on the SuperVision page provided by the free DEIF utility PC SW.

1.2 Generated values

1.2.1 All controller variants

Values that are generated in the system and that can be monitored in the display.

Description	Presentation	Note	Value visible in
Total nominal volume of the tanks being ready to receive fuel.	TOrf 0000 000 0.00 [m3]		ALL
Actual fuel volume currently contained in the tanks being ready to receive fuel.	ACrf 0000 000 0.00 [m3]		ALL
Free fuel volume currently available in the tanks being ready to receive fuel.	FRrf 0000 000 0.00 [m3]	In respect to tank threshold limit and not nominal size of tank.	ALL
Actual fuel volume currently contained in the tanks being ready to receive fuel.	ACrf 000.0 [%]		ALL
Free fuel volume currently available in the tanks being ready to receive fuel.	FRrf 000.0 [%]	In respect to tank threshold limit and not nominal size of tank.	ALL
Minimum free fuel volume currently available in a tank being ready to level fuel.	FRrl min 000.0 [%]	In respect to tank threshold limit and not nominal size of tank. Only tanks belonging to the block selected for leveling included.	ALL
Maximum free fuel volume currently available in a tank being ready to level fuel.	FRrl max 000.0 [%]	In respect to tank threshold limit and not nominal size of tank. Only tanks belonging to the block selected for leveling included.	ALL
Total nominal volume of the tanks.	TO 0000 000 0.00 [m3]		ALL
Actual fuel volume currently contained in the tanks.	AC 0000 000 0.00 [m3]		ALL
Free fuel volume currently available in the tanks.	FR 0000 000 0.00 [m3]	In respect to tank threshold limit and not nominal size of tank.	ALL
Actual fuel volume currently contained in the tanks.	AC 000.0 [%]		ALL
Free fuel volume currently available in the tanks.	FR 000.0 [%]	In respect to tank threshold limit and not nominal size of tank.	ALL
Minimum free fuel volume currently available in a tank.	FR min 000.0 [%]	In respect to tank threshold limit and not nominal size of tank.	ALL
Maximum free fuel volume currently available in a tank.	FR max 000.0 [%]	In respect to tank threshold limit and not nominal size of tank.	ALL

1.2.2 Tank controller

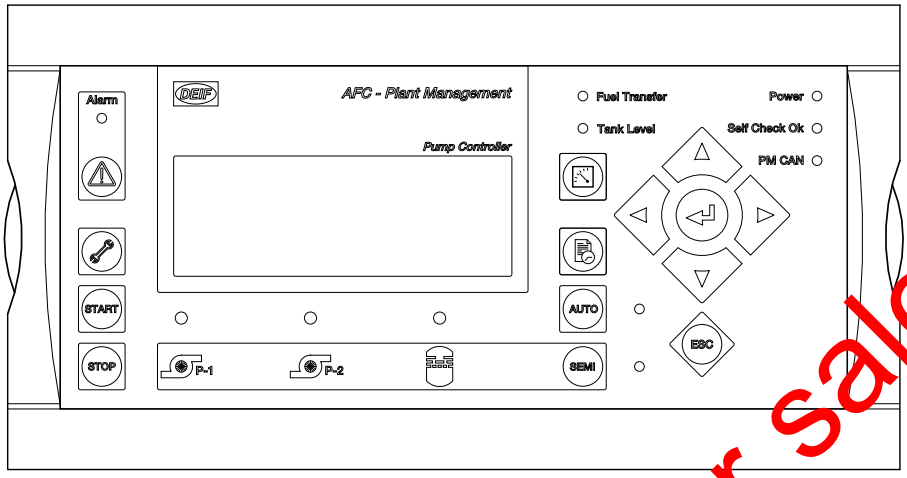
Values that are generated in the system and that can be monitored in the display.

Description	Presentation	Note	Value visible in
Total nominal volume of the tank.	TOt 0000 000 0.00 [m3]		AFC Tank
Actual fuel volume currently contained in the tank.	ACt 0000 000 0.00 [m3]		AFC Tank
Free fuel volume currently available in the tank.	FRt 0000 000 0.00 [m3]	In respect to tank threshold limit and not nominal size of tank.	AFC Tank
Actual fuel volume currently contained in the tank.	ACt 000.0 [%]		AFC Tank
Free fuel volume currently available in the tank.	FRt 000.0 [%]	In respect to tank threshold limit and not nominal size of tank.	AFC Tank
Fuel pressure generated by the fuel column.	Lvl. Pres. 0000 mbar/mpsi	Differential pressure between absolute pressure on tank bottom.	AFC Tank
Ambient pressure.	Amb. Pres. 0000 mbar/mpsi	Ambient pressure outside the fuel tank.	AFC Tank
Absolute pressure.	Abs. Pres. 0000 mbar/mpsi	Absolute pressure on the bottom of the fuel tank.	AFC Tank
Fuel temperature.	Temp. 000.0 C/F		AFC Tank
Fuel height.	Height 0.00 m	Height of fuel column in the tank.	AFC Tank
Threshold limit.	Threshold 000.0 %	The maximum allowed fill level of the tank.	AFC Tank
Density.	Density 0000 kg/m3		AFC Tank
Fuel weight.	Weight. 0000 000 000 kg	Weight of fuel in the tank.	AFC Tank
Capacity.	Cap. 0000 000 000 kWh	Production capacity in the tank.	AFC Tank

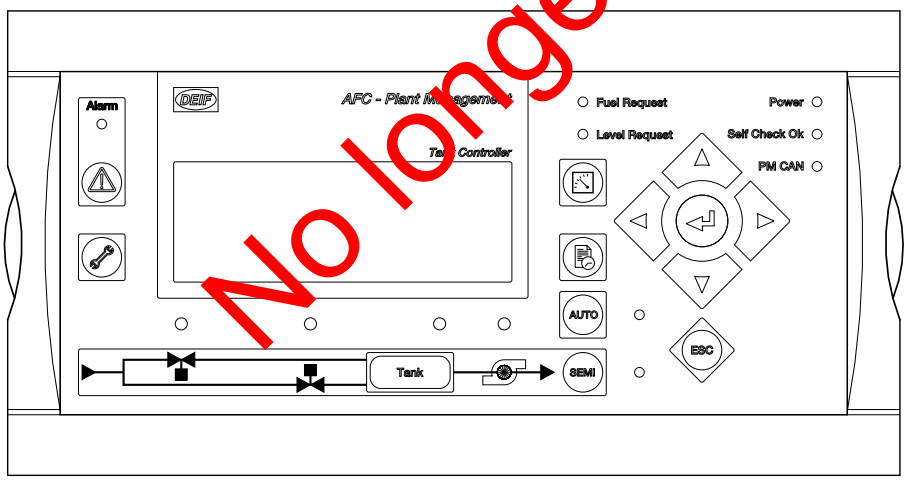
2. Display layout

2.1 Displays

2.1.1 Fuel pump controller



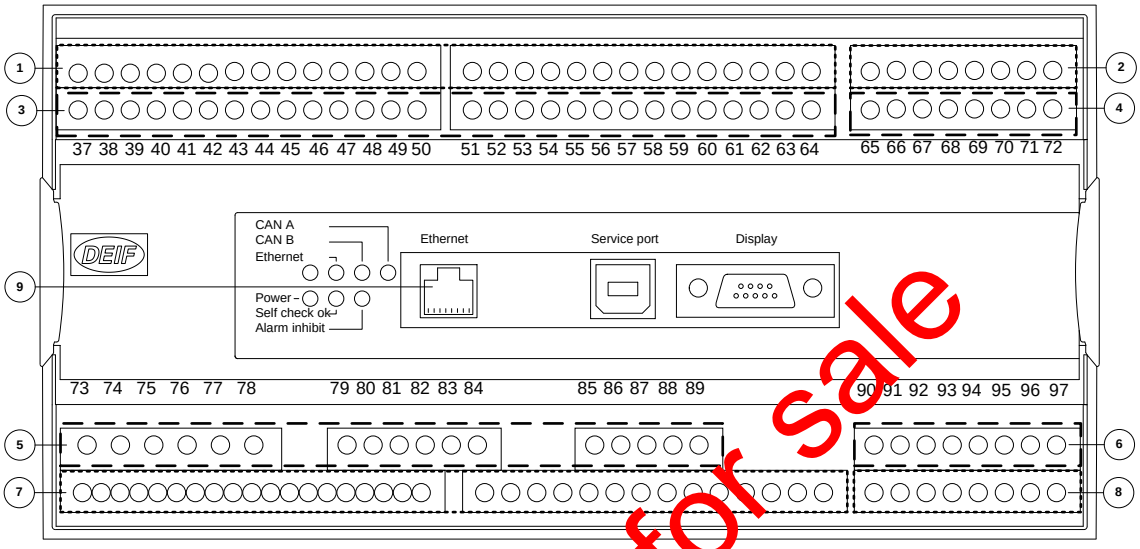
2.1.2 Fuel tank controller



3. Hardware, software and options

3.1 Hardware options and slot number locations

3.1.1 Slot number overview



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

3.1.2 Fuel pump controller

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 or configurable open collector outputs); 5 × digital inputs
2		**Terminal 29-36, communication, inputs/outputs**
	H2	Modbus RTU (RS-485)
	H5.2	CAN port C
	H12.2	CAN port C and D
	M13.2	7 × binary inputs
	M14.2	4 × relay outputs
3		**Terminal 37-64, inputs/outputs**
	M12	13 × digital inputs; 4 × relay outputs
4		**Terminal 65-72**
	E1	Pump pressure regulation, 2 × +/-25 mA outputs
	E2	Pump pressure regulation, 2 × 0(4) to 20 mA outputs
	M13.4	7 × binary inputs
	M14.4	4 × relay outputs
5		**Terminal 73-89, AC measuring**
	Standard	3 × pump voltage; 3 × pump current; 3 × mains voltage
6		**Terminal 90-97, inputs/outputs**
	F1	2 × 0(4) to 20 mA outputs, transducer
	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**
	Standard	8 to 36 V DC supply, 5 W; 1 × magnetic pickup (MPU); 3 × multi-inputs; 7 × digital inputs; 4 × relay outputs Power management communication, CAN port A and B
8		**Terminal 126-133, inputs/outputs**
	H5.8	CAN port E

Slot #	Option/standard	Description
	M13.8	7 × digital inputs
	M14.8	4 × relay outputs
	M15.8	4 × 4 to 20 mA inputs
9		**LED I/F**
	N	Modbus TCP/IP
Standard accessories		
		DU-2

There can only be one hardware option in each slot. For example, it is not possible to select option H2 and option M13.2 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".

3.1.3 Fuel tank controller

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 or configurable open collector outputs); 5 × digital inputs
2		**Terminal 29-36, communication, inputs/outputs**
	H2	Modbus RTU (RS-485)
	H5.2	CAN port C
	H12.2	CAN port C and D
	M13.2	7 × binary inputs
	M14.2	4 × relay outputs
3		**Terminal 37-64, inputs/outputs**
	M12	13 × digital inputs; 4 × relay outputs
4		**Terminal 65-72**
	E1	2 × +/-25 mA outputs
	E2	2 × 0(4) to 20 mA outputs
	M13.4	7 × binary inputs
	M14.4	4 × relay outputs
5		**Terminal 73-89, AC measuring**
	Standard	3 × pump voltage; 3 × pump current; 3 × mains voltage
6		**Terminal 90-97, inputs/outputs**
	F1	2 × 0(4) to 20 mA outputs, transducer
	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**
	Standard	8 to 36 V DC supply, 5 W; 1 × magnetic pickup (MPU); 3 × multi-inputs; 7 × digital inputs; 4 × relay outputs Power management communication, CAN port A and B
8		**Terminal 126-133, inputs/outputs**
	H5.8	CAN port E

Slot #	Option/standard	Description
	M13.8	7 × digital inputs
	M14.8	4 × relay outputs
	M15.8	4 × 4 to 20 mA inputs
9		**LED I/F**
	N	Modbus TCP/IP
Standard accessories		
		DU-2

There can only be one hardware option in each slot. For example, it is not possible to select option H2 and option M13.2 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".

4. Technical information

4.1 Specifications and dimensions

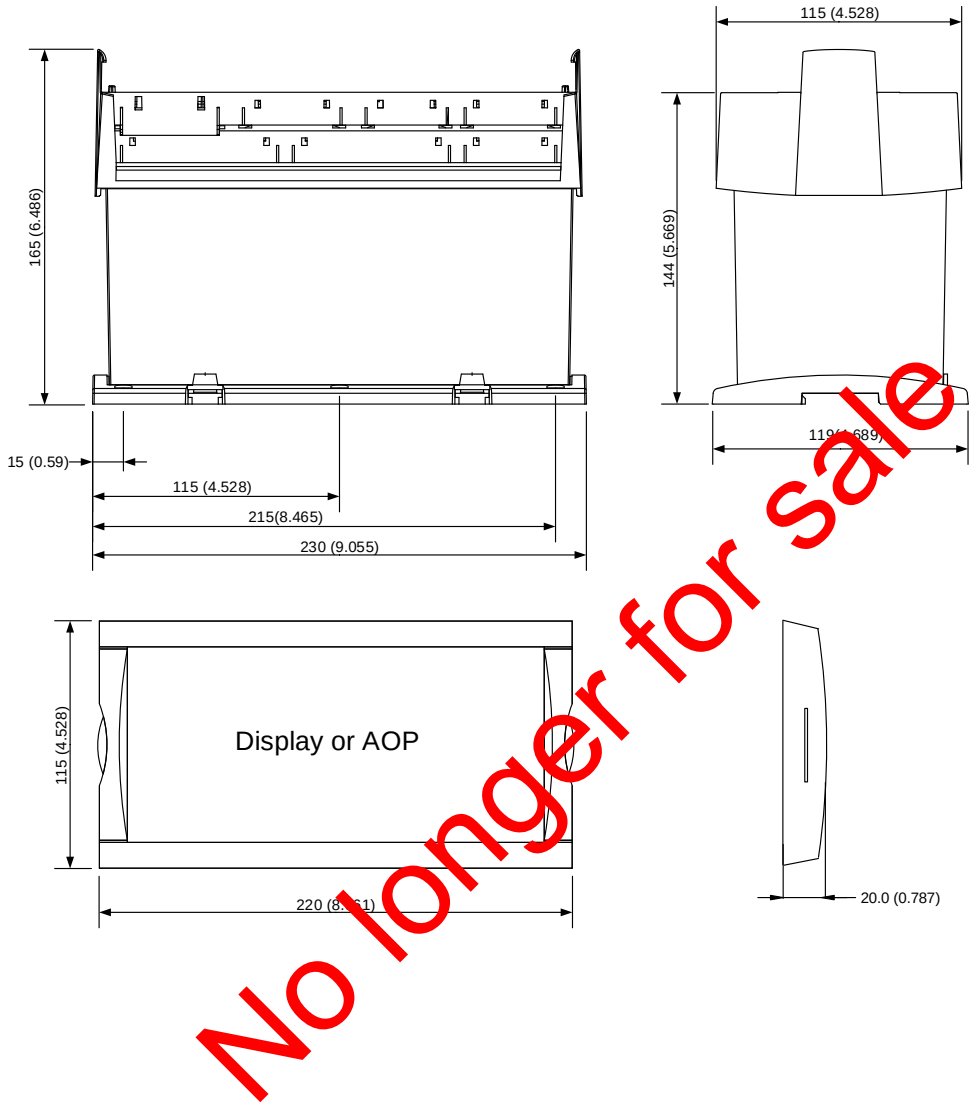
4.1.1 Technical specifications

Accuracy	Class 1.0 -25 to 15 to 30 to 60 °C Temperature coefficient: +/-0.2 % of full scale per 10 °C 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 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. 0.1 VA/phase
Current overload	4 x I_n continuously 20 x I_n, 10 sec. (max. 75 A) 80 x I_n, 1 sec. (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 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)
Binary inputs	Optocoupler, bi-directional OFF: <2 V DC, ON: 8 to 36 V DC Impedance: 4.7 kΩ
Analogue inputs	-10 to +10 V DC: not galvanically separated. Impedance: 100 kΩ 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/EN60751 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 (terminal 20, 21, 22 (com))
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.)	**BB:** Over-/under-voltage: <50 ms Over-/under-frequency: <50 ms Voltage unbalance: <250 ms **Pump:** Over-current: <250 ms Fast over-current: <40 ms Over-/under-voltage: <250 ms Over-/under-frequency: <350 ms Overload: <250 ms Current unbalance: <250 ms Voltage unbalance: <250 ms Reactive power import: <250 ms Reactive power export: <250 ms Overspeed: <500 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 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: 0.15mm_{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 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
Protection	Unit: IP20. Display: IP40 (IP54 with gasket: option L). (UL/cUL Listed: Type Complete Device, Open Type). To IEC/EN 60529
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)
Weight	Base unit: 1.6 kg (3.5 lbs.) Option J1/J4/J6/J7: 0.2 kg (0.4 lbs.) Option J2: 0.4 kg (0.9 lbs.) Option J8: 0.3 kg (0.58 lbs.) Display: 0.4 kg (0.9 lbs.)

4.1.2 Unit dimensions in mm (inches)



5. Ordering information

5.1 Order specifications and disclaimer

5.1.1 Order specifications

Variants

Type	Options specification				
Type	**Option**	**Option**	**Option**	**Option**	**Option**

Type: Pump controller/tank controller

Example:

Type	Options specification				
Type	**Option**	**Option**	**Option**	**Option**	**Option**
Pump controller	M14.8	J2			

Example:

Type	Options specification				
Type	**Option**	**Option**	**Option**	**Option**	**Option**
Tank controller	M14.8	M15.6			

5.1.2 Disclaimer

DEIF A/S reserves the right to change any of the contents of this document without prior notice.

The English version of this document always contains the most recent and up-to-date information about the product. DEIF does not take responsibility for the accuracy of translations, and translations might not be updated at the same time as the English document. If there is a discrepancy, the English version prevails.