FLUID HEATERS
Type RM 3/4

February 2008

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1 RM3/4 Wiring

Sig Nr.	Function	Cable colour Diameter [mm²/AWG Number]	RM3/4-Signal (IN/OUT/POWER)
1	Vehicle Ground	**Black** [0,518/20]	GND
2	Heater Enable	**Brown** [0,518/20]	HEATHER_EN (IN)
3	Fault Output	**Blue** [0,518/20]	FAULT_OUT (OUT)
	Plus Power	**Red** [6,63/9]	PLUS_POWER(+) (POWER)
	Minus Power	**Black** [6,63/9]	MINUS_POWER(-) (POWER)

2 Signals description:

2.1 GND

Vehicle Ground (minus pole of the onboard battery)

- Physically isolated from MINUS_POWER(-)
- Isolation Resistance > 2G Ω @ 1000V between PLUS_POWER or MINUS_POWER and any other Low Voltage Input or Output

2.2 HEATER_EN *(10 mA @ 12 V)*

To enable the heater:

- The Heater will be enabled with HEATER_EN input to 12 V (Min 8V , Max 18V)
- The Heater will be disabled with HEATER_EN input floating or to GND
- Available 24V version

2.3 FAULT_OUT

Fault output (Open Collector:MAX 10 mA, 50 V), in case of:

- Overvoltage
- Overtemperature, T >= 80℃
- Fluid flow interruption (Temperature Gradient based algorithm)
- Fluid absence detected (Temperature Gradient based algorithm)
- Intermittent when the temperature is in the right range after (2-3-4) fault condition: the normal operating will automatically reestablish

2.4 PLUS_POWER(+)

Plus pole from traction net

- Maximal current from the net: Imax = 40 Amp RMS with 100 V , 4000Watt Heater
- Isolation Resistance > 2G Ω @ 1000V between PLUS_POWER or MINUS_POWER and any other Low Voltage Input or Output

2.5 MINUS_POWER(-)

Minus pole from traction net

- Physically isolated from Vehicle Ground
- Isolation Resistance > 2G Ω @ 1000V between PLUS_POWER or MINUS_POWER and any other Low Voltage Input or Output

3 Block Diagram Description:

3.1 Semiconductor Fuse

The semiconductor fuse is responsible for Heater safety.
Its short clearing time (about 20 μs) , guarantees an high safety level during heater operation.
The semiconductor fuse is cleared by the heater control under the following conditions:

- Fluid temperature > 95℃
- Power Switching Module Hardware problems (short-circuit)

3.2 Secondary HV Power Supply (SPS)

In case of hardware fault the secondary HV Power Supply is charged to clear the fuse.

- The SPS module activate the Power Current Elevator in case of Tfluid > 95℃

3.3 Thermal Bimetallic Switch (TBSW)

The Thermal Bimetallic Switch is a component independent from the control circuit.
If the liquid temperature would rise above 95℃ , t he TBSW will activate the Power Current elevator to clear the fuse , disabling the heater.

3.4 Power Current Elevator (PCE)

The Power Current Elevator is an important part of the safety system, and is charged to clear the fuse under the following conditions:

- Fluid temperature > 95℃
- Power Switching Module Hardware problems (short-circuit)

The clearance of the fuse is obtained by increasing the current. This is the task of the PCE

3.5 HV Power Supply

The control circuit is supplied from the traction net.
The internal DC/DC need Ubat >= 40V in order to operate properly.

3.6 Microprocessor

The microprocessor is the arithmetic/logic unit of the control board. Beside, safety function which are independents , all the other function are implemented in the firmware.

3.7 Power Switching Module (PSM)

The PSM control the heating resistors current , as well as the constant heating power control.

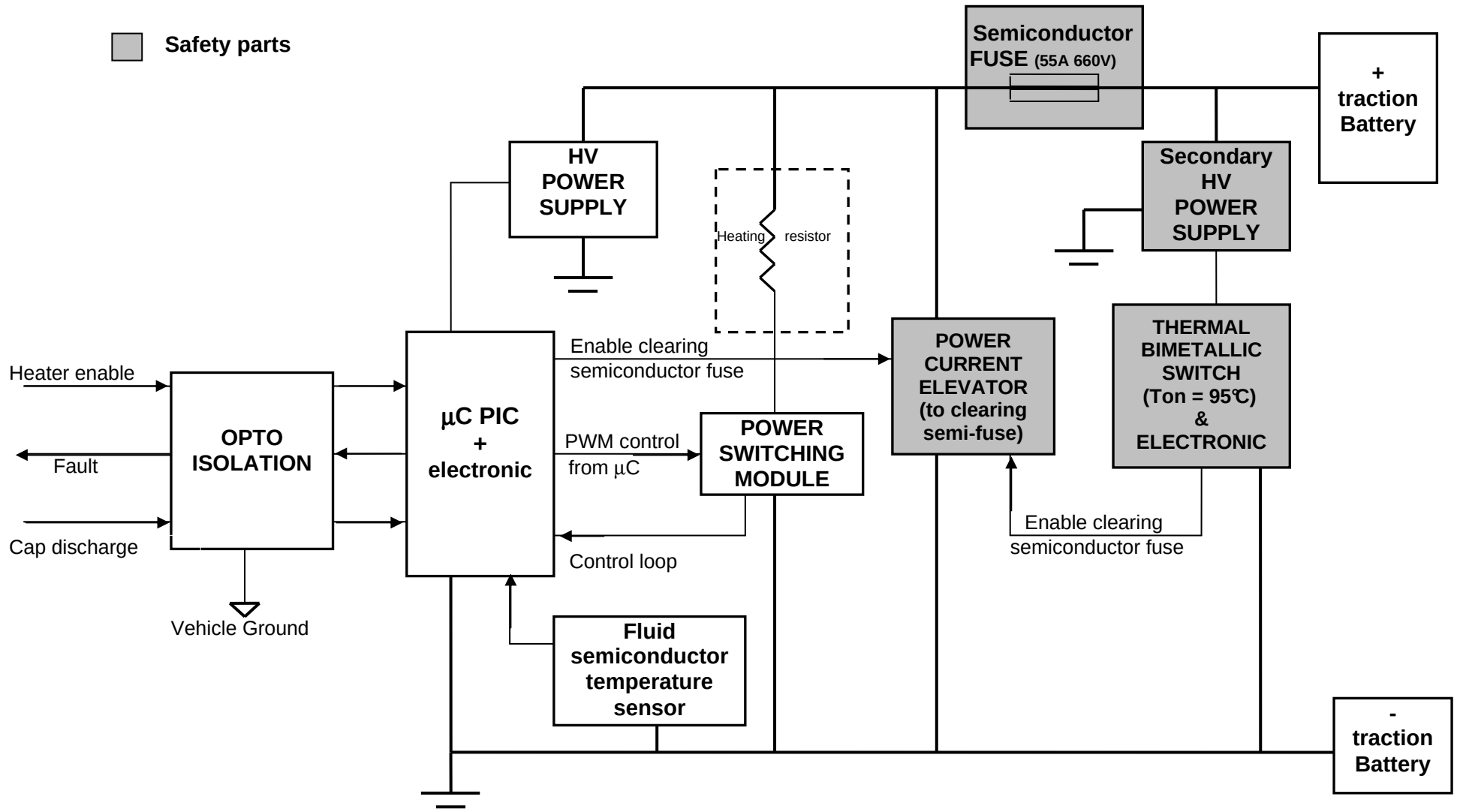
3.8 Fluid Semiconductor Temperature Sensor

The fluid sensor is dip in the fluid.
The measurement allows the controller to keep the fluid temperature at nominal value with an hysteresis of 4℃.

3.9 Opto Isolation

Heater signal inputs and outputs are galvanically insulated from HV potentials coming from traction net.
Isolation Resistance > 2G Ω @ 1000V between PLUS_POWER or MINUS_POWER and any other Low Voltage Input or Output

Block Diagram



4 Functional Description:

4.1 Mounting Considerations

The Heater must be mounted vertically ,with a maximal inclination of 20 degrees.
At 25 ℃ the fluid Level must be at least 6 cm bel ow the top of the heater (RM4).

4.2 Constant Power Control

The Heater is controlled by a PWM circuit which maintains the power constant over the voltage range.
The total Power control error is lower than ± 5% of the nominal power

4.3 Fluid Flow Interruption Control

The Heater can detect a fluid flow interruption (Temperature Gradient based algorithm), in this case FAULT_OUT is activated (set to GND), and the heater is disabled.
To reenabled the device , HEATER_EN must fall from HIGH to LOW state and then rise from LOW to HIGH again, or automatically after 1 min if the temperature return in the normal range.

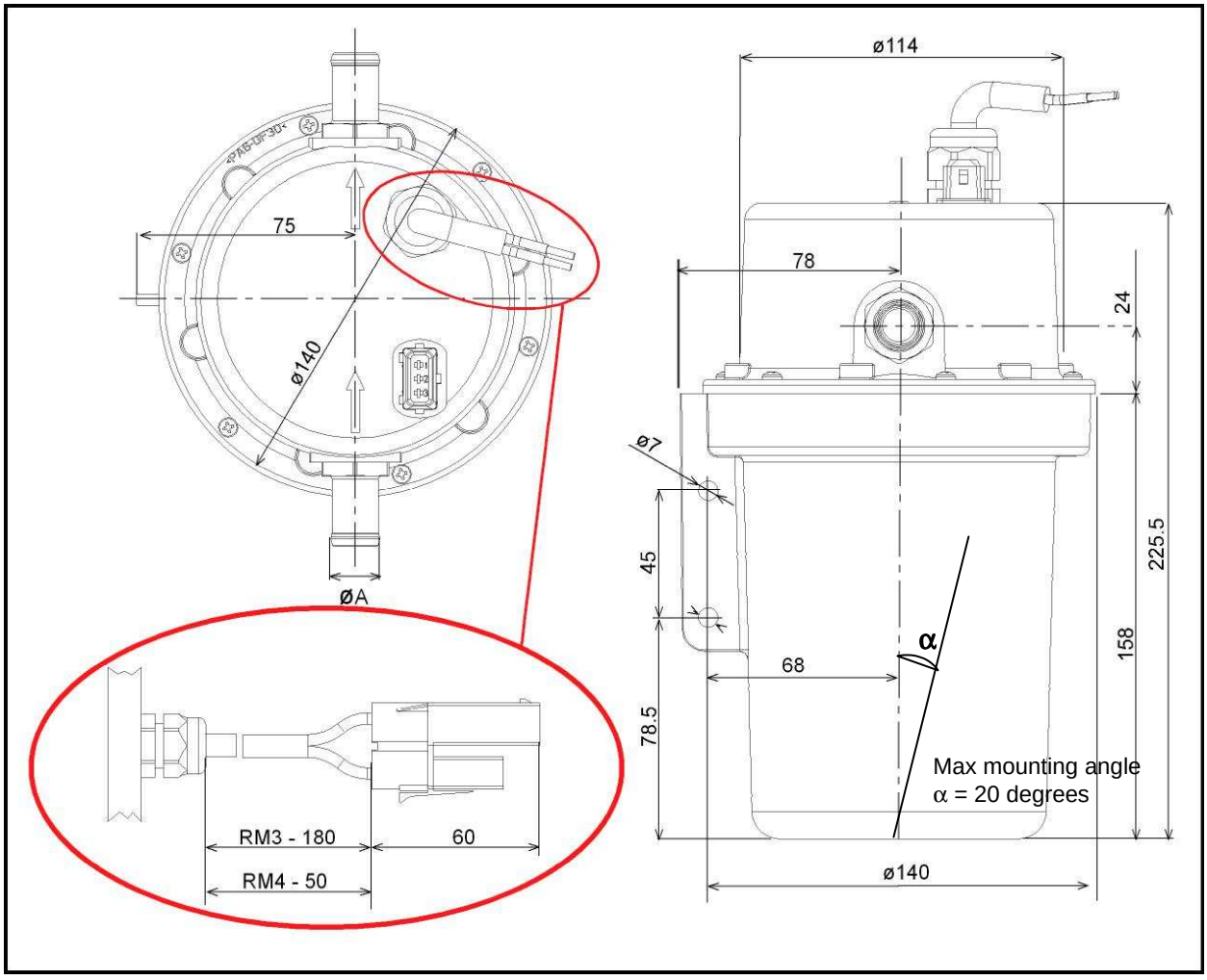
4.4 Liquid Absence Detection

The Heater can detect a fluid absence (Temperature Gradient based algorithm), in this case FAULT_OUT will be active (to GND), and the heater is disabled.
To reenabled the device , HEATER_EN must fall from HIGH to LOW state and then rise from LOW to HIGH again, or automatically after 1 min if the temperature return in the normal range.

4.5 General Considerations

The Heater does not accept reverse polarity (semiconductor fuse protected).
The FAULT_OUT signal is intended for Heater monitoring only , and can not be used as logical command for other devices of the vehicle. This restriction is due to the delayed activation of FAULT_OUT, in case of detection of a fluid interruption or fluid absence.

5 Mechanical Dimension RM3: (3D CAD on request)



Technical data RM3:

- **Temp regulation:** 70℃ +- 2℃
- **Version:** **(Umin,Umax)** **Power +-5%**

100/250V,	2000W
100/250V	3000W
100/250V	4000W
200/450V	2000W
200/450V	3000W
200/450V	4000W

- **Weight:** 1,7 Kg
- **Diameter A:** 16.5 – 18 – 20 mm
- **Max mounting angle:** 20 degrees
- Other versions on request

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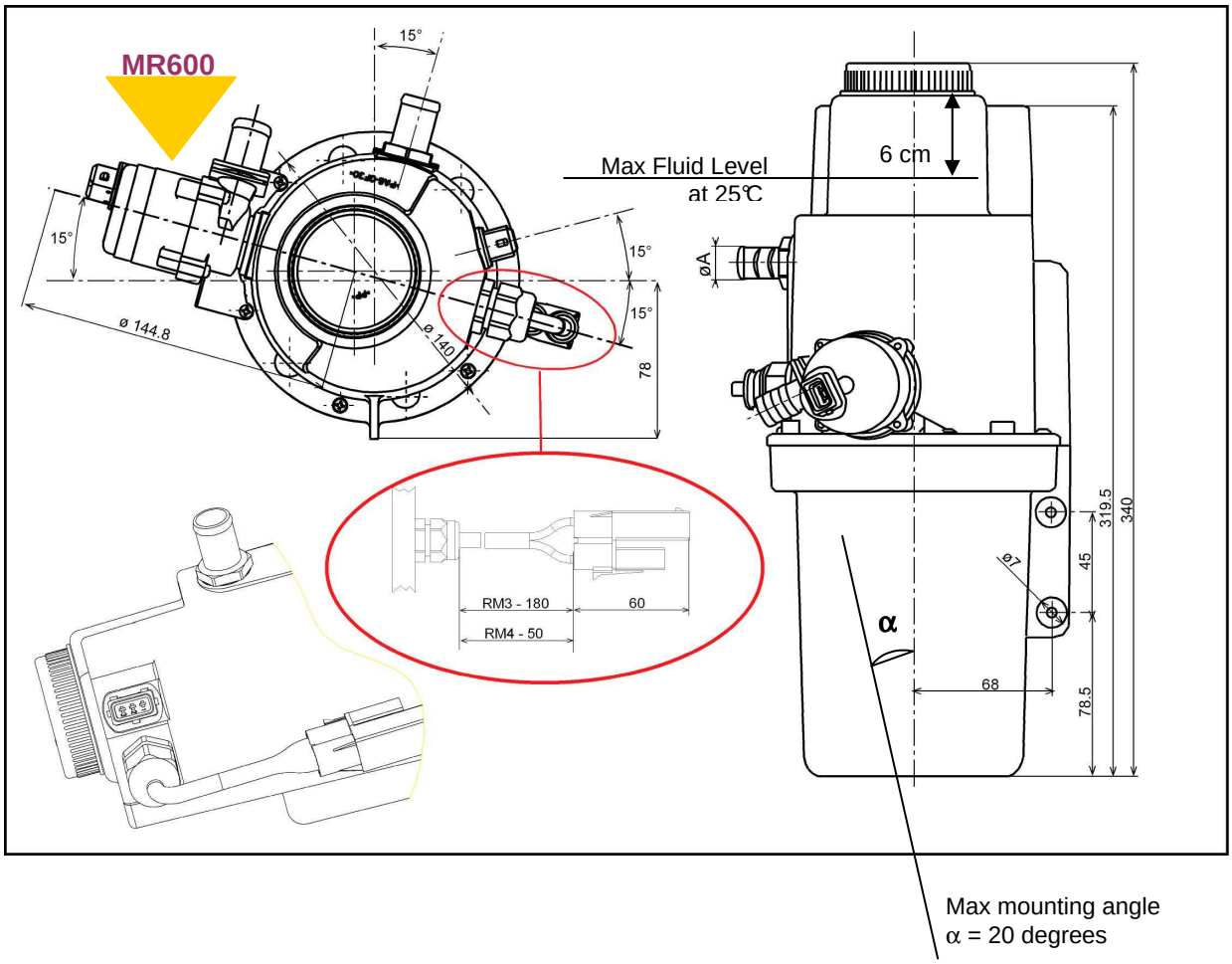
6 Mechanical Dimension RM4: (3D CAD on request)



Technical data RM4:

- **Temp regulation:** 70℃ +- 2℃
- **Version:** **(Umin,Umax)** **Power +-5%**

100/250V	2000W
100/250V	3000W
100/250V	4000W
200/450V	2000W
200/450V	3000W
200/450V	4000W

- **Weight::** 2.8 Kg
- **Diameter A :** 16.5 – 18 – 20 mm
- **Glycol thank:** 2 liters
- **Max mounting angle :** 20 degrees
- Other versions on request

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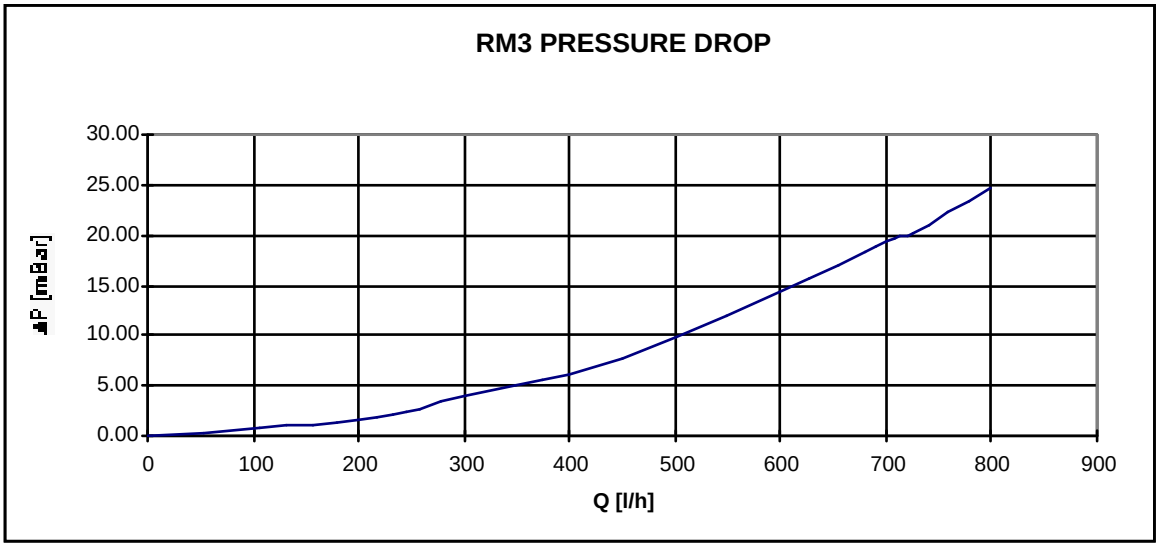
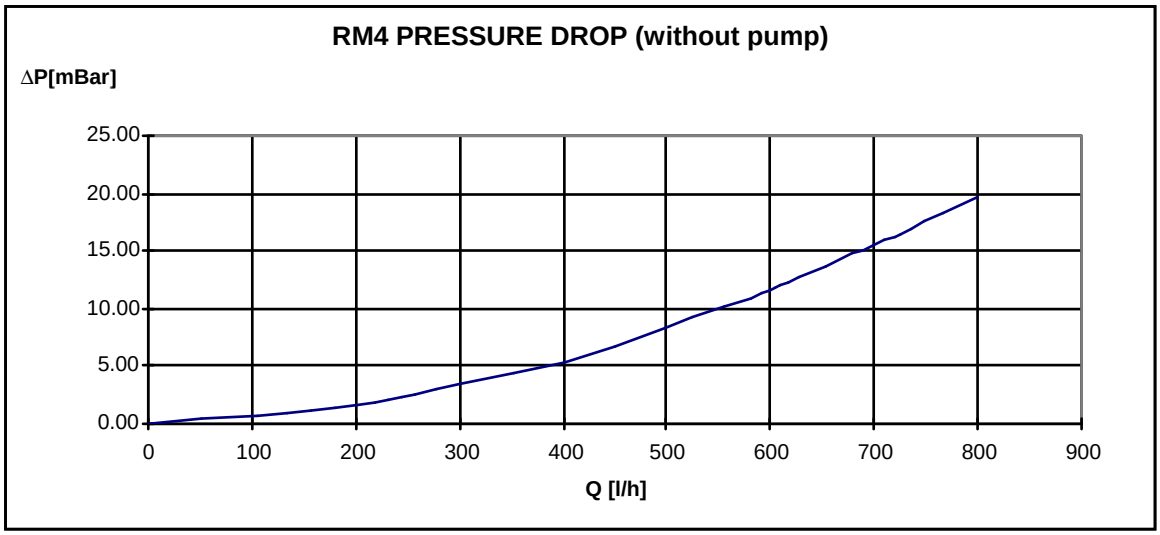
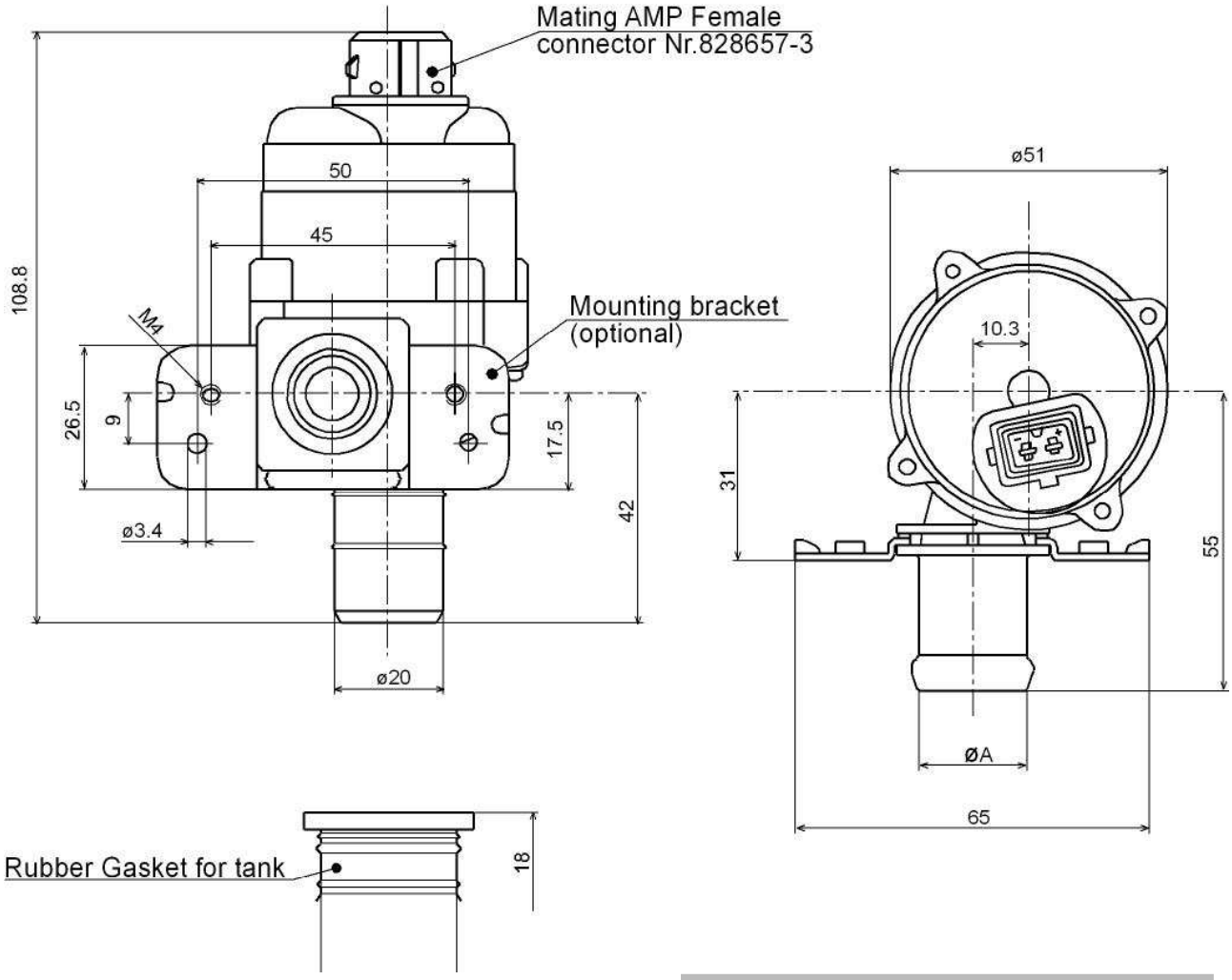
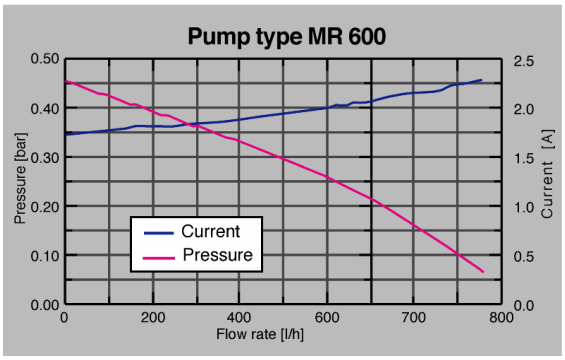
7 RM3/RM4 pressure drop





8 Circulation Pump MR600





Technical data MR600:

- **Nominal Voltage:** 13 VDC
- **Max. Pressure:** 0.45 bar
- **Max flow rate:** 750 l/h
- **Max. current:** < 2.5 A
- **Outlet diameter øA:** 16.5 – 18 mm
- **Type of service:** continuous, life >10'000 h
- **Note:** a 3A fuse as to be used

9 Maintenance and services

The fluid Heaters RM3/4 do not require regular maintenance.
In case of a fault it is highly recommended to send the faulty unit together with a description of the fault and operating condition to

MES-DEA S.A.
attn. ***U. Cassani***
Via Laveggio, 15
CH – 6855 Stabio
Switzerland

for repair or replacement to be paid after expiration of warranty.