Handbook

MAGFLO®

Electromagnetic flowmeters
Sensor types MAG 1100, MAG 3100, MAG 5100 W
Signal converter types MAG 5000, MAG 6000

SAP No. 521H0879

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FLOW DIVISION – SIMPLY BETTER

Danfoss range of electro-magnetic flowmeters

	MAG 1100	MAG 1100 FOOD	MAG 3100	MAG 3100 W	MAG 5100 W
					
Size [inch]	$^1/_4$" - 4"	$^3/_8$" - 4"	$^1/_2$" - 78"	1" - 48"	1" - 48"
Connection	Flangeless (Wafer)	Weld-in adapter, clamp adapter, thread adapter	Flange	Flange	Flange
Pressure [psi]	600	600	1500	600	600
Temperature [°F]	0 to 400	–20 to 300	–40 to 350	–20 to 200	–20 to 200
Liner	Ceramic (Al_2O_3) PFA	Ceramic (Al_2O_3) PFA	Neoprene, EPDM, Teflon (PTFE), Ebonite, Linatex®	Neoprene and EPDM	1" - 1½" & 14" - 48" hard elastomer 2" - 12" composite elastomer
Electrodes	Platinum Hastelloy C276	Platinum Hastelloy C276	AISI 316 Ti, Hastelloy C, Platinum/Iridium, Titanium, Tantalum Grounding electrode	AISI 316 Ti Grounding electrode	AISI 316 Ti, Grounding electrode
Enclosure	NEMA 4X & NEMA 6				
Ex-version Houzandous area	EEx ia/ib IIB T4-T6 intrinsically safe		EEx ia/ib IIB T4-T6 intrinsically safe		
Approvals			FM Class 1, division 2, WRc, NSF		WRc, NSF

	MAG 5000	MAG 6000
		
Outputs	1 current output 1digital output 1 relay output	1 current output 1digital output 1 relay output
Flow direction	Uni/bidirectional	Uni/bidirectional
Communication	Optional HART®	Add-on modules HART®, DeviceNet, Profibus DP, Profibus PA, CANopen
Display	3 lines 20 characters (optional without display)	3 lines 20 characters (optional without display)
Meter uncertainty	±0.5% of rate	±0.25% of rate
Enclosure	NEMA 2, NEMA 4X, NEMA 6	NEMA 2, NEMA 4X, NEMA 6
Custody transfer approval	PTB (cold water)	PTB OIML R75 OIML R117
Ex-version Safety barrier		[EEx ia/ib] IIB intrinsically safe
Power supply	12-24 V a.c./d.c. 115-230 V a.c.	12-24 V a.c./d.c. 115-230 V a.c.
Batch	No	Yes
Approvals	ULc general purpose FM Class 1, division 2	ULc general purpose FM Class 1, division 2

MAGFLO® **Contents**

1.1 Product introduction

MAGFLO® electromagnetic flowmeters offer reliable, precise and inexpensive flow measurement on all electrically conductive liquids. Typical applications are found in all industries. E.g.:

- Water sector: Potable water, treatment of chemicals, waste water and sludge.
- Food sector: Dairy products, beer, wine, soft-drinks and fruit juices.
- Chemical sector: Detergents, pharmaceuticals, acids and alkalies.
- Other sectors: HVAC, paper pulp and mining slurries.

MAGFLO® electromagnetic flowmeters are characterised by simplicity:

⇒ Simple to install
⇒ Simple to commission
⇒ Simple to operate
⇒ Simple to maintain

MAGFLO® electromagnetic flowmeters are manufactured by Danfoss A/S, Flow Division - one of the worlds leading makers of flowmeters.

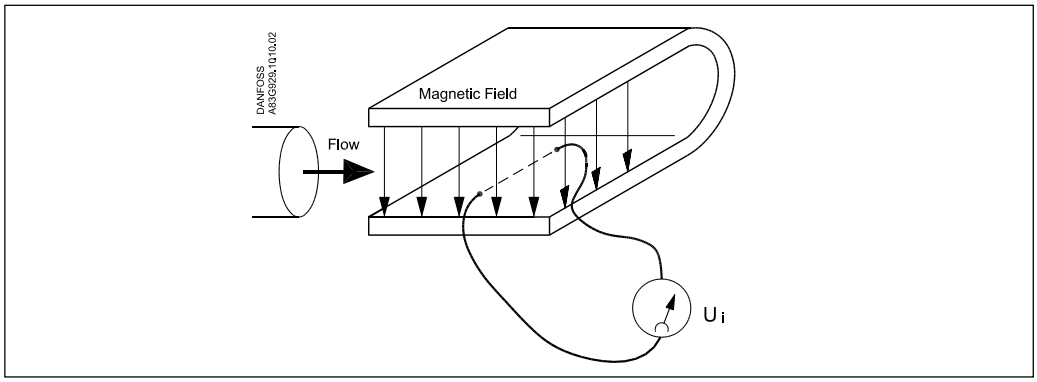
All MAGFLO® electromagnetic flowmeters feature a unique SENSORPROM® memory unit which stores sensor calibration data and signal converter settings for the lifetime of the product.
At commissioning the flowmeter commences measurement without any initial programming.

The factory settings matching the sensor are stored in the SENSORPROM® unit. Also customer specified settings are downloaded to the SENSORPROM® unit. Should the signal converter be replaced, the new converter will upload all previous settings and resume measurement without any need for re-programming.
Furthermore, the "fingerprint" used in connection with the Danfoss Verificator is stored during the sensor calibration.
The Danfoss Verificator can verify the accuracy of the flowmeter while still installed years after the initial calibration.

USM II "Plug & Play" add-on communication modules.
USM II - the **U**niversal **S**ignal **M**odule with "Plug & Play" simplicity makes it easy to access and integrate the flow measurement with almost any system. It ensures the flowmeter will be easy to upgrade to new communication platforms in the future, too.

1.2 Mode of operation

The flow measuring principle is based on Faraday's law of electromagnetic induction. The flowmeter consists of a sensor type MAG 1100, 3100 or 5100 W and a signal converter type MAG 5000 or 6000.



U_i = When an electrical conductor of length L is moved at velocity v, perpendicular to the lines of flux through a magnetic field of strength B, the voltage U_i is induced at the ends of the conductor

$U_i = L \times B \times v$

- U_i = Induced voltage
- L = Conductor length = Inner pipe diameter = k_1
- B = Magnetic field strength = k_2
- v = Velocity of conductor (media)
- k = $k_1 \times k_2$

$U_i = k \times v$, the electrode signal is directly proportional to the fluid velocity

SENSOR (Flow tube)
The sensor converts the flow into an electrical voltage (U_i) proportional to the velocity of the flow. The sensor is built up of a stainless steel pipe, 2 coils, electrodes, an isolating liner, housing and where applicable, connecting flanges.

SIGNAL CONVERTER
The signal converter consists of a number of function blocks which convert the sensor voltage into flow readings.

Power supply
2 different types of power supply are available. A 12 - 24 V a.c./d.c. and a 115 - 230 V a.c. switch mode type.

Coil current module generates a pulsating magnetizing current that drives the coils in the sensor. The current is permanently monitored and corrected. Errors or cable faults are registered by the self-monitoring circuit.

Input circuit amplifies the flow proportional signal from the electrodes. The input impedance is extremely high: $>10^{14}\ \Omega$ which allows flow measurements on fluids with conductivities as low as 1 mS/cm. Measuring errors due to cable capacitance are eliminated due to active cable screening.

Digital signal processor converts the analog flow signal to a digital signal and suppresses electrode noise through a digital filter. Inaccuracies in the signal converter as a result of long-term drift and temperature drift are monitored and continuously compensated for via the self-monitoring circuit. The analog to digital conversion takes place in an ultra low noise ASIC with 23 bit signal resolution. This has eliminated the need for range switching. The dynamic range of the signal converter is therefore unsurpassed with a turn down ratio of minimum 3000:1.

CAN communication
The signal converter operates internal via an internal CAN communication bus. Signals are transferred to/from a signal conditioner to the display module, internal/external option modules and the dialog module.

Dialog module
The display unit consists of a 3-line display and a 6-key keypad. The display shows a flow rate or a totalizer value as a primary reading.

Output module converts flow data to an analog, a digital and a relay output. The outputs are galvanically isolated and can be individually set to suit a particular application.

2. Specifications
2.1 Sensor MAG 1100 and MAG 1100 Ex

	MAG 1100 Ceramic 	MAG 1100 PFA 	MAG 1100 Ex 
Type	Flangeless sensor (Wafer)		
Nominal size	$^1/_4$", $^3/_8$", $^1/_2$", 1", 1$^1/_2$", 2", 3", 4"	$^3/_8$", $^1/_2$", 1", 1$^1/_2$", 2", 3", 4"	$^1/_4$", $^3/_8$", $^1/_2$", 1", 1$^1/_2$", 2", 3", 4"
Operating pressure	$^1/_4$"-2$^1/_2$": 600 psi, 3": 560 psi, 4": 450 psi	300 psi	$^1/_4$"-2$^1/_2$": 600 psi, 3": 560 psi, 4": 450 psi
Vacuum	1.5×10^{-5} psi	0.3 psi	1.5×10^{-5} psi
Temperature of medium *PFA*		–20°F to +265°F	
Ceramic	0°F to +300°F		–5°F to +250°F
High temperature version	0°F to +400°F	Suitable for steam sterilization at 300°F	
Temperature shock (Ceramic liner)	(Duration > 1 min.):	Max. ±210°F momentarily	(Duration > 1 min.):
	$^1/_4$", $^3/_8$", $^1/_2$", 1": Max. ΔT ≤ 60°F/min.		$^1/_4$", $^3/_8$", $^1/_2$", 1": Max. ΔT ≤ 60°F/min.
	1$^1/_2$", 2", 2$^1/_2$": Max. ΔT ≤ 50°F/min.		1$^1/_2$", 2", 2$^1/_2$" : Max. ΔT ≤ 50°F/min.
	3", 4" : Max. ΔT ≤ 40°F/min.		3", 4" : Max. ΔT ≤ 40°F/min.
	(Duration ≤ 1 min., followed by 10 min. rest):		(Duration ≤ 1 min., followed by 10 min. rest):
	$^1/_4$", $^3/_8$", $^1/_2$", 1": Max. ΔT ≤ 175°F		$^1/_4$", $^3/_8$", $^1/_2$", 1": Max. ΔT ≤ 175°F
	1$^1/_2$", 2", 2$^1/_2$": Max. ΔT ≤ 160°F		1$^1/_2$", 2", 2$^1/_2$": Max. ΔT ≤ 160°F
	3", 4": Max. ΔT ≤ 140°F		3", 4": Max. ΔT ≤ 140°F
Ambient temperature	Remote mount signal converter: –40°F to +210°F		
	Integral mount signal converter: –5°F to +120°F		
Liner	Aluminum oxide Al_2O_3 (ceramics)	Reinforced PFA (Teflon)	Aluminum oxide Al_2O_3 (ceramics)
Electrodes	Platinum with gold/titanium brazing alloy	Hastelloy C-276	Platinum with gold/titanium brazing alloy
Enclosure	Stainless steel AISI 316L (1.4404)	Stainless steel AISI 316 (1.4436)	Stainless steel AISI 316L (1.4404)
			Stainless steel AISI 316 (1.4436)
Terminal box *Standard*	Fiberglass-reinforced polyamide	Fiberglass-reinforced polyamide	Stainless steel AISI 316L (1.4404)
(Remote installation only) *High temp.*	Stainless steel AISI 316 (1.4436)	Stainless steel AISI 316L (1.4404)	
Studs & nuts	Stainless steel AISI 304 (1.4301)		Stainless steel AISI 304 (1.4301)
	Number and size to DIN 2501		Number and size to DIN 2501
Mating flanges	DIN 2501 (150-600 psi), ANSI B16.5, class 150 and 300 or equivalent		To DIN 2501 (150-600 psi), ANSI B16.5, class 150 and 300 or equivalent
Option	1/4'' & 3/8'': 1/2" NPT threaded adaptor		
Gaskets *Standard*	EPDM (max. 300°F, 600 psi)		EPDM (max. 300°F, 600 psi)
Option	Graphite (max. 390°F, 600 psi)		Graphite (max. 390°F, 600 psi)
Option	PTFE (max. 210°F, 300 psi)		PTFE (max. 265°F, 300 psi)
Cable entries	4 pcs. PG 13.5		
Enclosure rating *Standard*	NEMA 4X / 6 (3 ft. submersion for 30 min)		
Option	NEMA 6P (30 ft. continuous submersion)		
Mechanical load (vibration)	18-1000 Hz random, 3.17 G rms in all directions to EN 60068-2-36		18-1000 Hz random in all directions to EN 60068-2-36
			Sensor: 3.17 G/ Integral mount Ex-d: 1.14 G
Test pressure	1200 psi (2 × nominal)	600 psi (2 × nominal)	1200 psi (2 × nominal)
Ex approvals			EEx [ia/ib] IIB T4-T6/ DEMKO, No. 97D.121909X
Excitation frequency programmable	$^1/_4$" - 2$^1/_2$": 15 Hz	$^3/_8$" - 2$^1/_2$": 15 Hz	$^1/_4$" - 2$^1/_2$": 15 Hz
	3", 4": 7.5 Hz	3", 4": 7.5 Hz	3", 4": 7.5 Hz

2.2 Sensor MAG 1100 FOOD

	MAG 1100 FOOD 	MAG 1100 FOOD PFA 
Type	Hygienic sensor	
Nominal size	$^3/_8$", $^1/_2$", 1", 1$^1/_2$", 2", 3", 4"	
Process connection	Hygienic adapters available for: ♦ Direct welding in ♦ Clamp fitting ♦ Threaded fitting	
Operating pressure	$^3/_8$"-2$^1/_2$": 600 psi, 3": 560 psi, 4": 450 psi	300 psi
Vacuum	1.5×10^{-5} psi	0.3 psi
Temperature of medium	0°F to +300°F	–20°F to +270°F
	Suitable for steam sterilization	Suitable for steam sterilization at 300°F
Temperature shock	(Duration > 1 min.):	Max. ±212°F momentarily
	$^3/_8$", $^1/_2$", 1" Max. ΔT ≤ 60°F/min.	
	1$^1/_2$", 2", 2$^1/_2$" Max. ΔT ≤ 50°F/min.	
	3", 4" Max. ΔT ≤ 40°F/min.	
	(Duration ≤ 1 min., followed by 10 min. rest):	
	$^3/_8$", $^1/_2$", 1" Max. ΔT ≤ 175°F	
	1$^1/_2$", 2", 2$^1/_2$" Max. ΔT ≤ 160°F	
	3", 4" Max. ΔT ≤ 140°F	
Ambient temperature	Remote mount signal converter: –40°F to +210°F	Remote mount signal converter: –40°F to +210°F
	Integral mount signal converter: –5°F to +120°F	Integral mount signal converter: –5°F to +120°F
Liner	Aluminum oxide Al_2O_3 (ceramic)	Reinforced PFA (Teflon)
Electrodes	Platinum with gold/titanium brazing alloy	Hastelloy C-276
Enclosure	Stainless steel AISI 316L (1.4404)	Stainless steel AISI 316L (1.4404)
Terminal box *Standard*	Fiberglass-reinforced polyamide	Fiberglass-reinforced polyamide
(Remote installation only) *Option*	Stainless steel AISI 316 (1.4436)	Stainless steel AISI 316 (1.4436)
Cable entries	4 pcs. PG 13.5	4 pcs. PG 13.5
Enclosure rating *Standard*	NEMA 4X / 6 (3 ft. submersion for 30 min)	NEMA 4X / 6 (3 ft. submersion for 30 min)
Option	NEMA 6P (30 ft. continuous submersion)	NEMA 6P (30 ft. continuous submersion)
Mechanical load (vibration)	18-1000 Hz random, 3.17 G rms in all directions, to EN 60068-2-36	18-1000 Hz random, 3.17 G rms in all directions, to EN 60068-2-36
Test pressure	1200 psi (2 × nominal)	600 psi (2 × nominal)
Approvals	3A, EHEDG	3A
Excitation frequency programmable	$^3/_8$" - 2$^1/_2$": 15 Hz 3", 4": 7.5 Hz	$^3/_8$" - 2$^1/_2$": 15 Hz 3", 4": 7.5 Hz

Accessories MAG 1100 FOOD

Adapters	**Stainless steel AISI 316**		**Pressure**
Pipe connection/ Operating pressure	**Adapter for direct welding into pipe:**		
	Tri-Clover ISO 2037, DIN 11850, SMS 3008, BS 4825-1		
		$^3/_8$", $^1/_2$", 1", 1$^1/_2$", 2", 3"	600 psi
		4"	350 psi
	Clamp adapter:		
	Tri-Clamp ISO 2852, DIN 32676, SMS 3016, BS 4825-3		
		$^3/_8$", $^1/_2$", 1", 1$^1/_2$", 2"	200 psi
		2$^1/_2$", 3", 4"	150 psi
	Thread adapter:		
	DIN 11851:	$^3/_8$", $^1/_2$", 1", 1$^1/_2$"	600 psi
		2", 2$^1/_2$", 3", 4"	350 psi
	ISO 2853, SS 3351, BS 4825-4:	$^3/_8$", $^1/_2$", 1", 1$^1/_2$", 2", 3", 4"	200 psi
	SMS 1145:	1", 1$^1/_2$", 2", 2$^1/_2$", 3"	80 psi
Gasket *Standard*	EPDM (ethylene, propylene rubber) (–5 °F to 300 °F)		
Option	NBR (nitrile butadiene rubber) (–5 °F to 210 °F)		
Material	Stainless steel AISI 304, ISO 2852		

Note
It is always a system so please state system max. pressure and **not** MAG 1100 or adapter.

2.3 Sensor MAG 3100, MAG 3100 Ex and MAG 3100 W

	MAG 3100	MAG 3100 Ex			MAG 3100 W
					
Type	Sensor with flanges	Sensor with flanges			Sensor with flanges
Nominal size	1/2" - 78"	1/2" - 12"			1" - 48"
Temperature of medium		Temperature classification			
Liner:		T3 + T4	T5	T6	
Neoprene (standard)	30 to 160°F	30 to 160°F	30 to 160°F	30 to 160°F	30 to 160°F
EPDM[1])	–20 to 200°F	–20 to 200°F	–20 to 190°F	–20 to 170°F	–20 to 200°F
Linatex® rubber	–40 to 160°F[2])	0 to 160°F	0 to 160°F	0 to 160°F	
Ebonite[1])	30 to 200°F	30 to 200°F	30 to 190°F	30 to 170°F	
PTFE	0 to 210°F	0 to 210°F	0 to 190°F	0 to 170°F	
PTFE high temperature	0 to 350°F				
Ambient temperature					
Remote mount signal converter	–40°F to 210°F	0°F to 105°F			–40°F to 210°F
Integral mount signal converter	0°F to 120°F	0°F to 105°F			0°F to 120°F
Operating pressure[3]) [**abs.psi**]					
Liner:					
Neoprene	0.15 to 1500 psi	0.15 to 1500 psi			0.15 to 600 psi
EPDM	0.15 to 600 psi	0.15 to 600 psi			0.15 to 600 psi
Natural rubber & Linatex®	0.15 to 600 psi	0.15 to 600 psi			
Ebonite	0.15 to 1500 psi	0.15 to 1500 psi			
PTFE teflon:					
1/2" - 24"	Max. 210°F: 4.5 to 750 psi	4.5 to 600 psi			
1/2" - 12"	Max. 350°F: 9.0 to 750 psi				
Excitation frequency	1/2" - 2 1/2": 15 Hz	1/2" - 2 1/2": 7.5 Hz			All sizes: 3.75 Hz
	3" - 6": 7.5 Hz	3"/4": 3.75 Hz			
	8" - 48": 3.75 Hz	5" - 12": 1.875 Hz			
	54" - 78": 1.875 Hz	14" - 48": 3.75 Hz			
Enclosure rating *Standard*	NEMA 4X / 6 (3 ft. submersion for 30 min)				
Option	NEMA 6P (30 ft. continuous submersion)				
Cable entries	4 pcs. PG 13.5 - 2 others available				
Mechanical load	18-1000 Hz random, 3.17 G rms in all directions, to EN 60068-2-36				
Test pressure	1.5 × nominal pressure				
Approvals	FM Class 1, division 2				

1) With WRC and NSF (Water Research Council, UK) approval

2) For temperature below –5°F AISI 304 or 316 flanges must be used

3) Maximum operating pressure decreases with increasing operating temperature and with stainless steel flanges

2.3 Sensor MAG 3100, MAG 3100 Ex and MAG 3100 W *(continued)*

		MAG 3100 	MAG 3100 Ex 	MAG 3100 W 
Flanges EN 1092-1:2001[1]) Rased face	*Standard*	DN 15-50: 600 psi		DN 25-50: 600 psi
		DN 65-150: 200 psi		DN 65-150: 200 psi
		DN 200-1000: 150 psi		DN 200-1200: 150 psi
		DN 1100 -2000: 80 psi		
	Option	DN 65-1000: 80 psi		DN 200-600: 200 psi
		DN 1200-2000: 150 psi		
		DN 200-2000: 200 psi		
		DN 200-600: 350 psi		
		DN 65-600: 600 psi		
		DN 50-400 945 psi (DIN 2636)		
		DN 25-350 150 psi (DIN 2637)		
ANSI B 16.5 (~BS 1560)		3/4"-24": Class 150 (290 psi)		3/4"-24": Class 150 (290 psi)
		3/4"-24": Class 300 (725 psi)		
AS 2129		3/4"-48": Table D/E		
AS 4087		Class 14 (DN 50-1200, 200 psi)		
		Class 21 (DN 50-600, 300 psi)		
		Class 35 (DN 50-600, 500 psi)		
AWWA C-207		28"-78": Class D (145 psi)		28"-48": Class D (145 psi)
Electrodes	*Standard*	AISI 316 Ti (1.4571)		AISI 316 Ti (1.4571)
	Option	Hastelloy C-276, Platinum / Iridium, Titanium, AISI 316 Ti Ceramic Coated, Tantalum		
Grounding electrodes	*Standard*	As measuring electrodes (except PTFE)		AISI 316 Ti (1.4571)
Measuring pipe	*Standard*	AISI 304 (1.4301)		AISI 304 (1.4301)
	Option	AISI 316L (1.4404)		
Flange and housing material	*Standard*	Carbon steel Corrosion-resistant two-component coating (min. 150 µm)		Carbon steel Corrosion-resistant two-component coating (min. 150 µm)
	Option	AISI 304 (1.4301) flanges and carbon steel housing. Coating as above		
	Option	AISI 316 L (1.4404) flanges and housing		
Ex-approval	*Remote mount*		$^1/_2$" - 12" EEx [ia/ib] IIB T4-T6	
Approvals		FM Class 1, division 2		FM Class 1, division 2

[1]) EN 1092-1, DIN 2501 & BS 4504 have the same mating dimensions

2.4 Sensor MAG 5100 W

			
Type	Sensor with flanges		
Design	Straight	Coned down 1 pipe size	Straight
Nominal size *inch*	1" - 1½"	2" - 12"	14" - 48"
Liner	Hard elastomer (hard rubber)	Composite elastomer (hard & soft rubber)	Hard elastomer (hard rubber)
Liner approvals	WRc, NSF	WRc, NSF	WRc, NSF
Medium temperature	25 to 200°F		
Ambient temperature			
Remote signal converter	–40 to 200°F		
Compact signal converter	–5 to 125°F		
Operating pressure	0.15 to 580 psi	0.45 to 300 psi	0.15 to 200 psi
Excitation frequency	12.5 Hz	2-2½": 12.5 Hz	3.125 Hz
		3-6": 6.25 Hz	
		8-12": 3.125 Hz	
Enclosure rating *Standard*	NEMA 4X / 6 (3 ft. submersion for 30 min)		
Option	NEMA 6P (30 ft. continuous submersion)		
Cable entries	4 Pg 13.5		
Mechanical load	18-1000 Hz random, 3.17 G rms in all directions to EN 60068-2-36		
Test pressure	1.5 × nominal pressure		
Flanges			
EN 1092-1 *Standard*	600 psi	2-6": 200 psi	150 psi
		8-12": 150 psi	
Option		8-12": 200 psi	200 psi
ANSI B16.5 *Standard*	Class 150 lb	Class 150 lb	14"-24": Class 150 lb
AWWA C-207 Standard			28"-48": Class D
Pressure drop at 3 m/sec.	As straight pipe	Max. 0.35 psi	As straight pipe
Electrodes	AISI 316 Ti (1.4571)		
PE/grounding electrodes *Standard*	AISI 316 Ti (1.4571)		
Measuring pipe/meter body	AISI 304 (1.4301)	Composite elastomer	AISI 304 (1.4301)
Flanges	Carbon steel		
Housing	Carbon steel		
Surface finish	Two component epoxy min. 150 microns	Polyester powder coat min. 100 microns	Two component epoxy min. 150 microns
Color	RAL 7035 pale grey		
Approvals *Conforms to*	WRc, NSF		

1) For sizes greater than 24" PED conformity is available as a cost added option, the basic unit will only carry the LVD (Low Voltage Directive) and EMC approval.

2.5.1 Signal converter MAG 5000 ($^1/_4$" to 48")

	**Accuracy 0.5%**
Current output	
Active current	0-20 mA, 4-20 mA or 4-20 mA + alarm (Power supplied from flowmeter)
Load	< 800 ohm
Time constant	0.1-30 sec. adjustable
Digital output	
Frequency	0-10 kHz, 50% duty cycle
Time constant	0.1-30 sec. adjustable
Active pulse	24 V d.c., 30 mA, 1 KΩ ≤ R_{load} ≤ 10 KΩ, short-circuit-protected (Power supplied from flowmeter)
Passive pulse	3-30 V d.c., max. 110 mA, 200 Ω ≤ R_{load} ≤ 10 KΩ (Powered from connected equipment)
Relay Time constant	Changeover relay, time constant same as current time constant
Load	42 V a.c./2 A, 24 V d.c./1A
Digital input	11-30 V d.c., R_i = 4.4 KΩ
Activation time	50 msec.
Current	$I_{11\ V\ d.c.}$ = 2.5 mA, $I_{30\ V\ d.c.}$ = 7 mA
Functions	Flowrate, 2 totalizers, low flow cut-off, empty pipe cut-off, flow direction, error system, operating time, uni/bidirectional flow, limit switches, pulse output, control for cleaning unit
Galvanic isolation	All inputs and outputs are galvanically isolated
Cut-off Low flow	0-9.9% of maximum flow
Empty pipe	Detection of empty pipe **1)**
Totalizer	Two eight-digit counters for forward, net or reverse flow
Display	Background illumination with alphanumerical text, 3 × 20 characters to indicate flowrate, totalized values, settings and faults
	Reverse flow indicated by negative sign
Time constant	Time constant as current output time constant
Zero point adjustment	Automatic
Electrode input impedance	> 1 x 10^{14} Ω
Excitation frequency	Sensor size depending pulsating d.c. current (125 mA)
Ambient temperature	Display version during operation: –5 to 120°F
	Blind version during operation: –5 to 140°F
	During storage: –40 to 160°F (Relative humidity max 95%)
Custody transfer approval MAG 5000 CT	PTB (cold water) 6.221 99.19
Communication	
Standard	Without serial communication
Optional	HART®
Integral mount	
Enclosure material	Fiberglass-reinforced polyamide
Enclosure rating	NEMA 4X / 6 (3 ft. submersion for 30 min)
Mecanical load	18-1000 Hz random, 3.17 G rms in all directions to EN 60068-2-36
Rack mount	
Enclosure material	Standard rack mount of aluminum/steel (DIN 41494)
	Width: 4.75 inch
	Height: 5.25 inch
Enclosure rating	NEMA 2
Mechanical load	Version: 1 G, 1-800 Hz sinusoidal in all directions to EN 60068-2-36
EMC performance	Emission: EN 50081-1 (Light industry)
	Immunity: EN 50082-2 (Industry)
Power supply	115-230 V a.c. +10% to –15%, 50-60 Hz
	11-30 V d.c. or 11-24 V a.c.
Power consumption	230 V a.c.: 9 VA
	24 V d.c.: 9 W, I_N = 380 mA, start-up peak current = 8 A (30 msec.)
	12 V d.c.: 11 W, I_N = 920 mA start-up peak current = 4 A (250 msec.)
Approvals	FM Class 1, division 2, ULc general purpose

1) Special cable required in separate mounted installation

2.5.2 Signal converter MAG 6000 ($^1/_4$" to 78")

Accuracy 0.25% (0.5% for MAG 3100 W sensor)

Current output		
	Active current	0-20 mA, 4-20 mA or 4-20 mA + alarm (Power supplied from flowmeter)
	Load	< 800 ohm
	Time constant	0.1-30 sec. adjustable
Digital output		
	Frequency	0-10 kHz, 50% duty cycle
	Time constant	0.1-30 sec. adjustable
	Active pulse	24 V d.c., 30 mA, 1 KΩ ≤ R_{load} ≤ 10 KΩ, short-circuit-protected (Power supplied from flowmeter)
	Passive pulse	3-30 V d.c., max. 110 mA, 200 Ω ≤ R_{load} ≤ 10 KΩ (Powered from connected equipment)
Relay	Time constant	Changeover relay, time constant same as current time constant
	Load	42 V a.c./2 A, 24 V d.c./1A
Digital input		11-30 V d.c., R_i = 4.4 KΩ
	Activation time	50 msec.
	Current	$I_{11\ V\ d.c.}$ = 2.5 mA, $I_{30\ V\ d.c.}$ = 7 mA
Functions		Flowrate, 2 totalizers, low flow cut-off, empty pipe cut-off, flow direction, error system, operating time, uni/bidirectional flow, limit switches, pulse output, control for cleaning unit and batching
Galvanic isolation		All inputs and outputs are galvanically isolated
Cut-off	Low flow	0-9.9% of maximum flow
	Empty pipe	Detection of empty pipe **1)**
Totalizer		Two eight-digit counters for forward, net or reverse flow
Display		Background illumination with alphanumerical text, 3 × 20 characters to indicate flowrate, totalized values, settings and faults
		Reverse flow indicated by negative sign
	Time constant	Time constant as current output time constant
Zero point adjustment		Automatic
Electrode input impedance		> 1 x 10^{14} Ω
Excitation frequency		Sensor size depending pulsating d.c. current (125 mA)
Ambient temperature		Display version during operation: –5 to 120°F
		Blind version during operation: –5 to 140°F
		During storage: –40 to 160°F (Relative humidity max 95%)

Custody transfer approval MAG 6000 CT only	PTB (cold water) 6.221 99.19	DANAK OIML R75 (hot water)	DANAK OIML R117 (cold water/milk, beer etc.)

Communication		
	Standard	Prepared for client mounted add-on modules
	Optional	HART, Profibus PA, Profibus DP, CANopen, DeviceNet as add-on module
Integral mount		
	Enclosure material	Fiberglass-reinforced polyamide
	Enclosure rating	NEMA 4X / 6 (3 ft. submersion for 30 min)
	Mecanical load	18-1000 Hz random, 3.17 G rms in all directions to EN 60068-2-36
Rack mount		
	Enclosure material	Standard rack mount of aluminum/steel (DIN 41494)
		Width: 4.75 inch
		Height: 5.25 inch
	Enclosure rating	NEMA 2
	Mechanical load	Version: 1 G, 1-800 Hz sinusoidal in all directions to EN 60068-2-36
EMC performance		Emission: EN 50081-1 (Light industry)
		Immunity: EN 50082-2 (Industry)
Power supply		115-230 V a.c. +10% to –15%, 50-60 Hz
		11-30 V d.c. or 11-24 V a.c.
Power consumption		230 V a.c.: 9 VA
		24 V d.c.: 9 W, I_N = 380 mA, start-up peak current = 8A (30 msec.)
		12 V d.c.: 11 W, I_N = 920 mA, start-up peak current = 4A (250 msec.)
Approvals		FM Class 1, division 2, ULc general purpose

1) Special cable required in separate mounted installation

2.5.3 Safety barrier (ia/ib) for sizes up to 12''

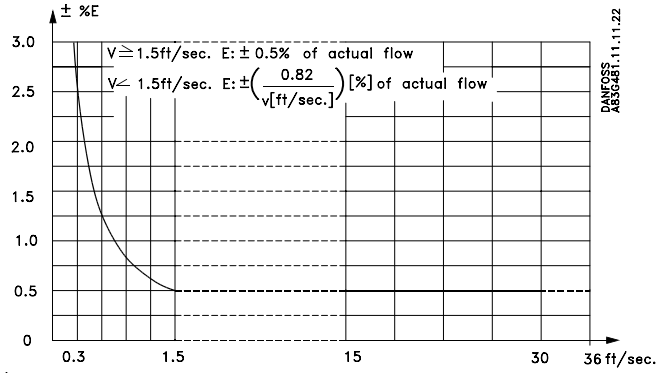
Application	As combined unit with MAG 6000 only and MAG 1100 Ex/3100 Ex in the size range $^1/_4$" - 12"		
Ex approval	[EEx ia/ib] IIB		
Cable parameter	Group	Capacity in μF	Inductance in mH
Electrode cable	IIB	≤ 31	≤ 80
Coil cable	IIB	≤ 0.5	≤ 8
Ambient temperature	During operation: –5 to 120°F		
	During storage: –5 to 160°F		
rack mount			
Enclosure material	Standard rack mount in aluminum/steel (DIN 41494)		
	Width: 4.75 inch		
	Height: 5.25 inch		
Enclosure rating	NEMA 2		
Mechanical load	1 G, 1-800 Hz sinusoidal in all directions to EN 60068-2-36		
EMC performance			
Emission	EN 50081-1 (Light industry)		
Immunity	EN 50082-2 (Industry)		

2.5.4 Cleaning unit

Application	For use together with MAG 5000 and 6000 rack mount to clean the electrodes on MAG 1100, MAG 3100 or MAG 5100 W. **NB** Must **not** be used with intrinsically safe systems
Cleaning voltage (unloaded)	
a.c. cleaning	60 V a.c.
d.c. cleaning	30 V d.c.
Cleaning period	60 sec. + 60 sec. pause period
Relay	Switch relay activated when cleaning is in progress
Load	42 V/2 A
Operation	
Automatic	Yes
Manual	No
Indicator lamps	LEDs: "ON" and "CLEANING"
Supply voltage and power consumption	115-230 V a.c. +10% to –15%, 50-60 Hz, 7 VA cleaning, 5 VA stand by
Ambient temperature	During operation: –5 to 120°F
	During storage: –5 to 160°F
Rack mount	
Enclosure material	Standard rack mount in aluminum/steel (DIN 41494)
	Width: 4.75 inch
	Height: 5.25 inch
Enclosure rating	NEMA 2
Mechanical load	1 G, 1-800 Hz sinusoidal in all directions to EN 60068-2-36

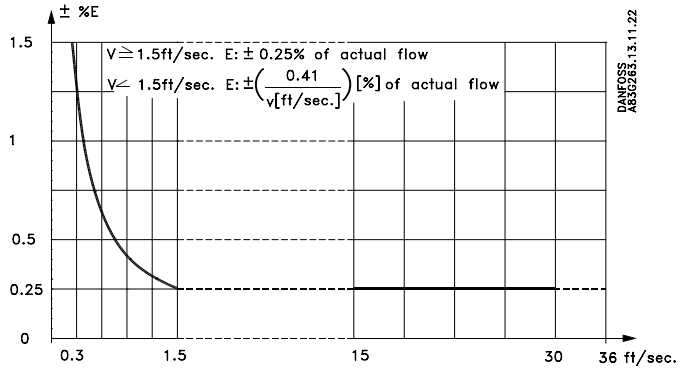
2.6 Meter uncertainty

MAG 5000 or MAG 6000 used with MAG 3100 W or MAG 1100 PFA



V: Actual flow velocity [ft./s]
E: Meter uncertainty as a percentage of actual flow

MAG 6000 used with MAG 3100, MAG 1100 Ceramic or MAG 5100 W



V: Actual flow velocity [ft./s]
E: Meter uncertainty as a percentage of actual flow

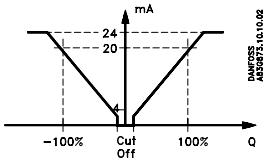
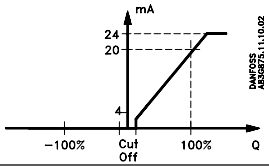
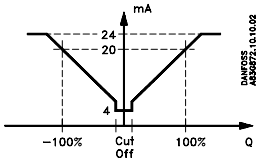
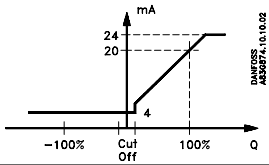
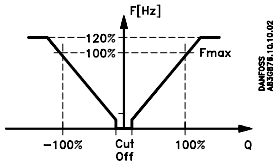
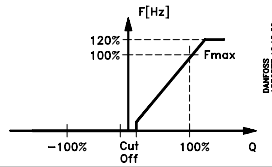
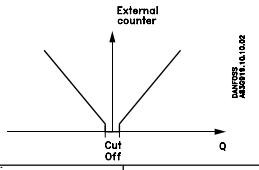
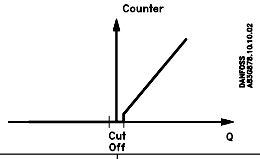
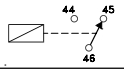
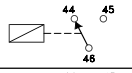
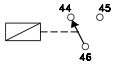
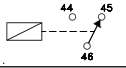
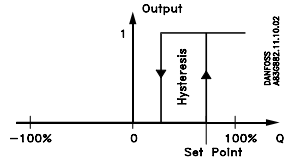
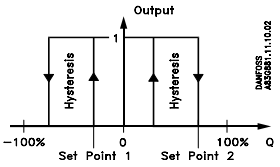
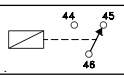
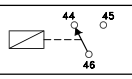
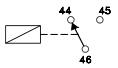
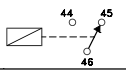
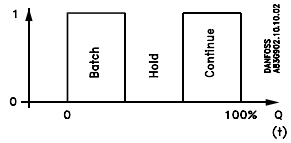
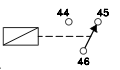
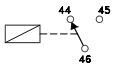
Reference conditions (ISO 9104 and DIN/EN 29104)

Temperature of medium	68°F ±9 F
Ambient temperature	68°F ±9 F
Supply voltage	Un ±1%
Warming-up time	30 min.
Incorporation in pipe section	Inlet section 10 * Nominal pipe size (sizes up to 48"), 5 * Nominal pipe size (sizes up to 48")
	Outlet section 5 * Nominal pipe size (sizes up to 48"), 3 * Nominal pipe size (sizes up to 48")
Flow conditions	Fully developed flow profile

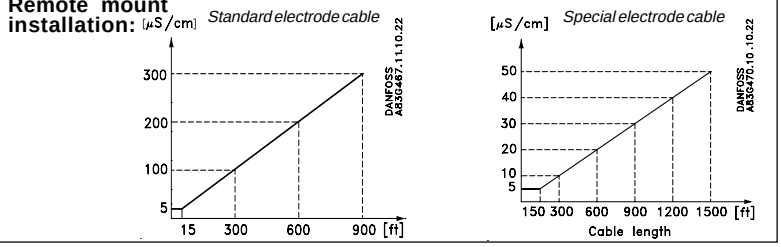
Additions in the event of deviations from reference conditions

Current output	As pulse output ±(0.1% of actual flow +0.05% FSO)
Effect of ambient temperature	Display/frequency/pulse output: < ±0.003% / < ±0.0017°F
	Current output: < ±0.005% / < ±0.0028°F
Effect of supply voltage	< 0.005% of measuring value on 1% change
Repeatability	±0.1% of actual flow for V ≥ 1.5 ft./sec.

2.7 Output characteristics MAG 5000 and MAG 6000

Output characteristics	Bidirectional mode		Unidirectional mode	
0-20 mA				
4-20 mA				
Frequency				
Pulse output				
Relay	Power down		Active	
Error relay	No error		Error	
Limit switch or direction switch	1 set point		2 set points	
				
	Low flow (Reverse flow)		Intermediate flow	
	High flow (Forward flow)		High flow/ Low flow	
Batch on digital output				
Batch on relay	Hold		Batch	

2.8.1 Sensor cables and conductivity of medium

Conductivity of medium	**Integral mount installation:** Liquids with an electrical conductivity ≥ 5 µS/cm. For a conductivity between 5 and 10 µS/cm, the repeatability may degrade to ±0.5% of actual flow.
	Remote mount installation: 

Note

- For detection of empty pipe the min. conductivity must always be ≥ 20 µS/cm. and the max. length of electrode cable when remote mounted is 150 ft. Special shielded cables must be used.
- For remote mounting in Ex applications special cable cannot be used, empty pipe cannot be detected and the electrical conductivity must be ≥ 30 µS/cm.
- For remote mounted CT installations the max. cable length is 600 ft.

2.8.2 Minimum accept data for cable

			Coil cable	***Electrode cable***
Basic data	No. of conductors		2	3
	Min. sqr. area		0.5 mm²/20 gage	0.2 mm²/22 gage
	Shield		Yes	Yes
	Max. capacitance		N.A.	107 pF/ft.
Max. cable loop resistance	Media temperature:	< 210°F	40 Ω	N.A.
		< 390°F	6 Ω	N.A.

2.9 HART® communication add-on module

Application	MAG 6000, MAG 6000 CT Optional available as factory mounted in MAG 5000
Communication standard	Bell 202 frequency shift keying (f.s.k.) standard
Communication modes	• Single loop mode
	• Multi-drop mode, 15 slave devices
Communicator	Rosemount Hand-held communicator, type 275

Cable specification

		Communication mode / *Single loop*
Q [mm²] CU		≥ 0.2 mm²/AWG 24
Shield		Yes (Overall shield)
Loop resistance	*Min.*	230 Ω
	Max.	800 Ω
Cable capacity		≤ 122 pF/ft.
Cable length		5000 ft.
Twisted pair		Yes

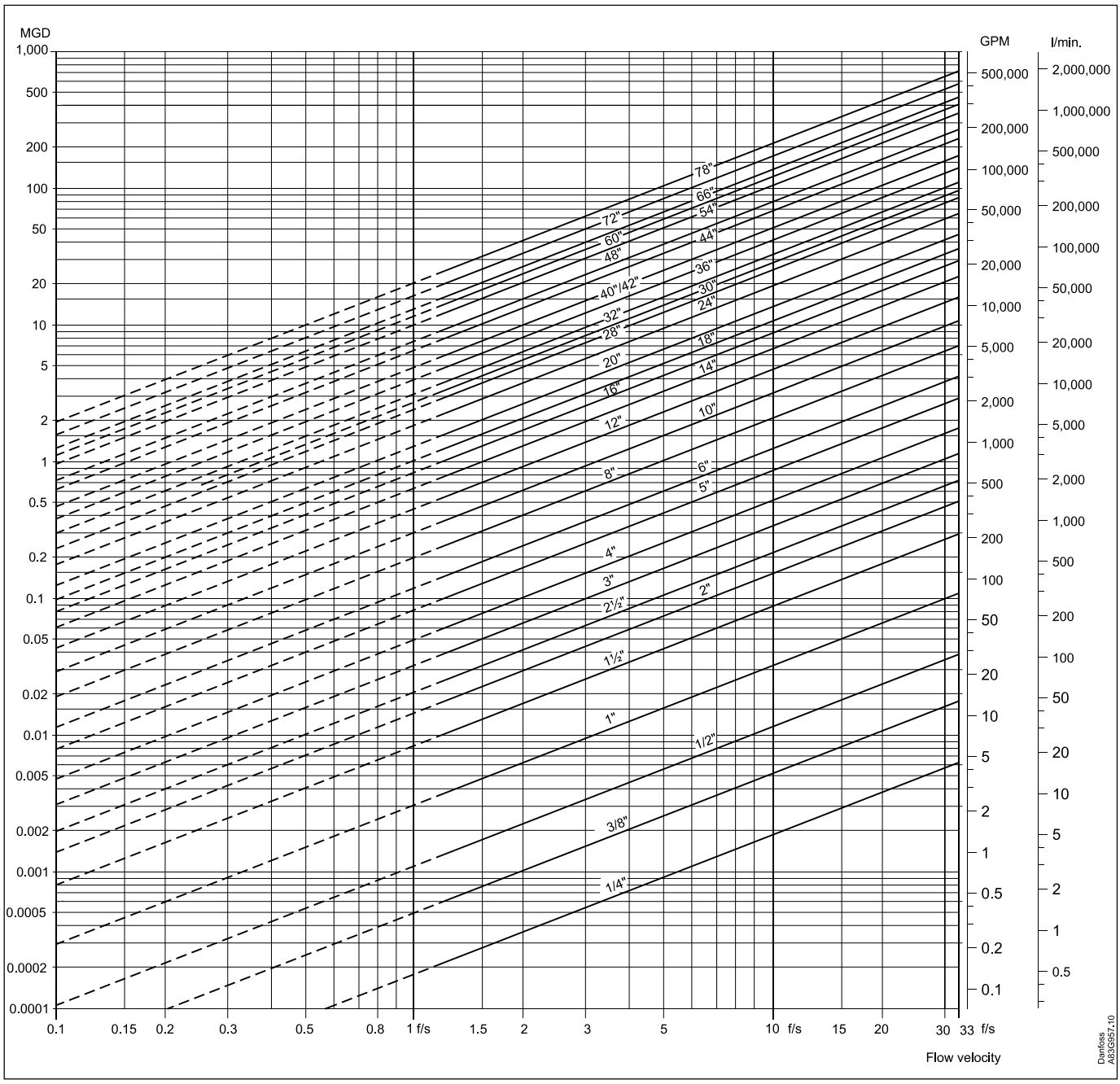
HART® is a registered trademark of the HART Communication Foundation.

2.9 Cable specification (Supplied by Danfoss)

		Standard cable (electrode/coil)	***Special cable (electrode)***
Basic data	No. of conductors	3	3
	Sqr. area	1.5 mm²/18 gage	0.25 mm²/22 gage
	Shield	Yes	Double
	Color code	Brown, blue, black	Brown, blue, black
	Outside color	Grey	Grey
	Ext. diameter	0.3"	0.32"
	Conductor	Flexible CU	Flexible CU
	Isolation material	PVC	PVC
Amb. temperature	• Flexible installation	–23 to 160°F	–23 to 160°F
	• Non flexible installation	–20 to 160°F	–20 to 160°F
Cable parameter	Capatance	49.24 pF/ft.	N.A.
	Inductance	0.178 µH/ft.	N.A.
	L/R	43.83 µH/Ω	N.A.

3. Product selection guidelines

3.1 Sizing table ($^1/_4$" to 78")



The table shows the relationship between flow velocity V, flow quantity Q and sensor dimension size.

Guidelines for selection of sensor
Min. measuring range: 0-0.8 ft./sec. Max. measuring range: 0-33 ft./sec.
Normally the sensor is selected so that the nominal flow velocity is within the measuring range 1-15 ft./sec.

Flow velocity calculation formula:
GPM = (Pipe I.D. inches)^2 x velocity (ft./sec.) x 2.448

$$V = \frac{\text{GPM} \times 0.408}{(\text{Pipe I.D. inches})^2} \quad \text{or } V = \frac{\text{MGD} \times 283.67}{(\text{Pipe I.D. inches})^2}$$

3.2.1 Minimum conductivity

Applications	Min. conductivity
Integral mounted	5 µS/cm
Remote mounted	5 µS/cm *(Please see 2.7.1 for further details)*
With empty pipe detection	20 µS/cm *(Please see 2.7.1 for further details)*
Ex-installations *(Remote mounted only)*	30 µS/cm *(Please see 2.7.1 for further details)*
District heating systems *(Without DC cleaning unit)*	250 µS/cm max. 150 ft.

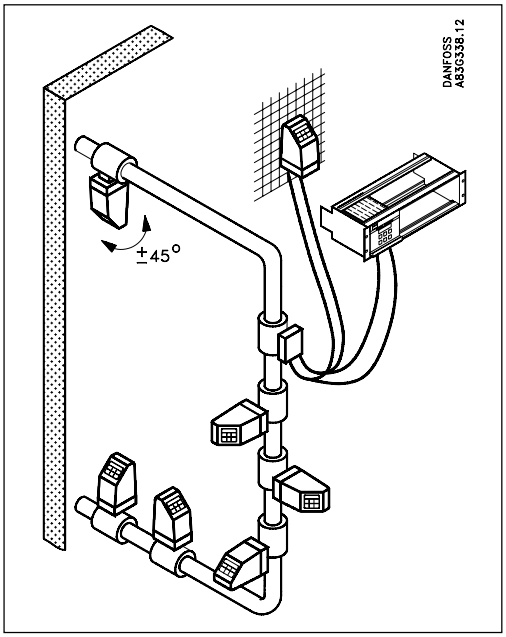
3.2.2 Liner selection guide

Liner	Applications
Ceramics Al_2O_3	General purpose, agressive chemicals
PFA	General purpose, dairy, food and beverage
Neoprene	General purpose, sewage
EPDM	Drinking water, sea water
PTFE	Agressive chemicals, paper and pulp, high temperature applications
Linatex®	Abrasive media and mining slurries
Ebonite	Drinking water

3.2.3 Electrode selection guide

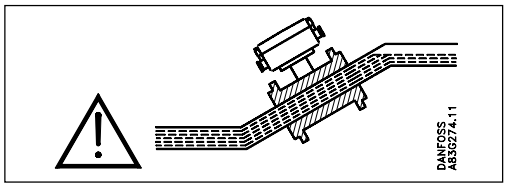
Electrodes	Applications
AISI 316 Ti	General purpose, water, sewage and district heating
AISI 316 Ti Ceramic coated	High content of fibres, paper pulp
Hastelloy C-276	Good chemical proporties, sea water
Titanium	Chlorine, chlorite, nitric and chromic acids
	Textile bleaching industry
Tantalum	Almost any acid solution
Platinum and platinum/irridium	The ultimate electrode material. Unaffected by most liquids

3.3 Installation conditions

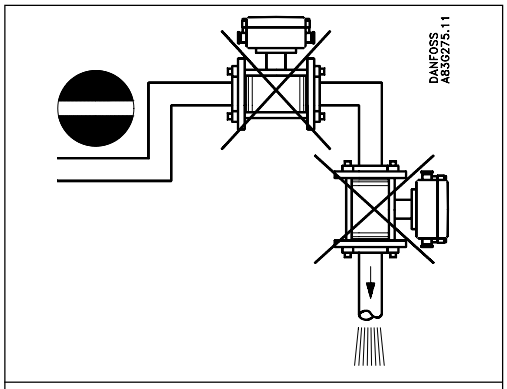


Reading and operating the flowmeter is possible under almost any installation conditions because the display can be oriented in relation to the sensor.

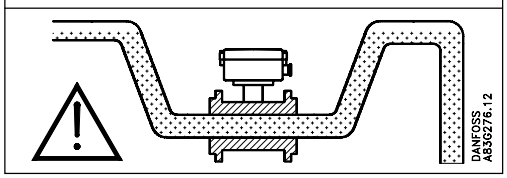
3.3
Installation conditions
(continued)



To ensure optimum flow measurement, attention should be paid to the following:
The sensor must always be completely full with liquid.

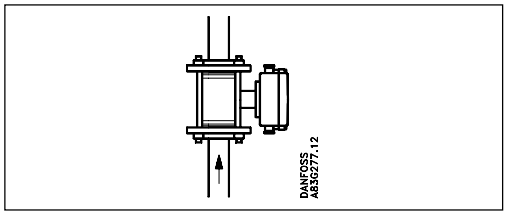


Avoid:
- Installation at the highest point in the pipe system
- Installation in vertical pipes with free outlet



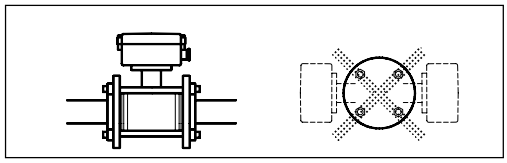
For partially filled pipes or pipes with downward flow and free outlet the flowmeter should be located in a U-tube.

Installation in vertical pipes



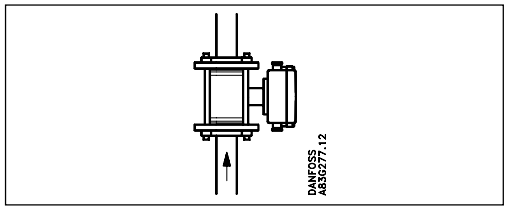
Recommended flow direction: upwards. This minimizes the effect on the measurement of any gas/air bubbles in the liquid.

Installation in horizontal pipes



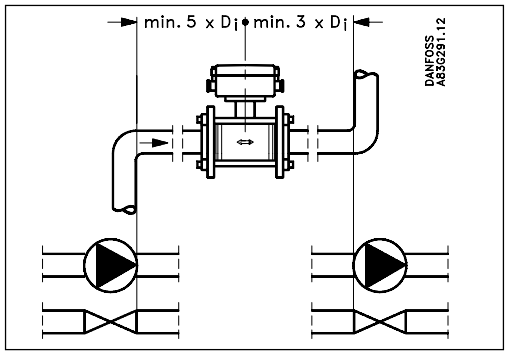
The sensor must be mounted as shown in the left figure. Do not mount the sensor as shown in the right figure. This will position the electrodes at the top where there is possibility for air bubbles and at the bottom where there is possibility for mud, sludge, sand etc.

Measuring abrasive liquids and liquids containing particles



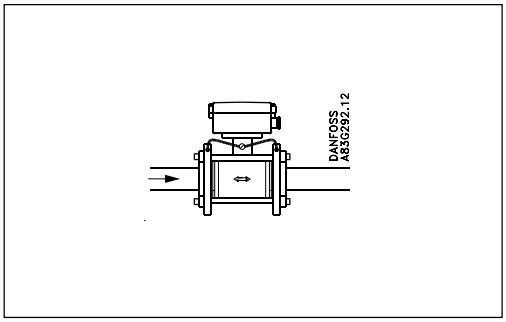
Recommended installation is in a vertical/inclined pipe to minimize the wear and deposits in the sensor.

Inlet and outlet conditions



To achieve accurate flow measurement it is essential to have straight lengths of inlet and outlet pipes and a certain distance between pumps and valves.
It is also important to center the flowmeter in relation to pipe flanges and gaskets.
For accurate flow measurement, the sensor must be installed in a section of straight pipe, free of valves, elbows, tees, etc.
- Min. 5 x I.D. upstream
- Min. 3 x I.D. downstream

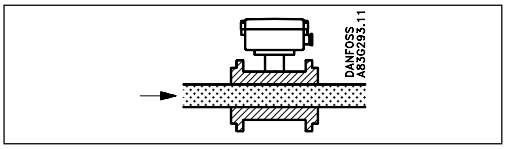
Potential equalization (Grounding)



The electrical potential of the liquid **must always** be equal to the electrical potential of the sensor. This can be achieved in different ways depending on the application:

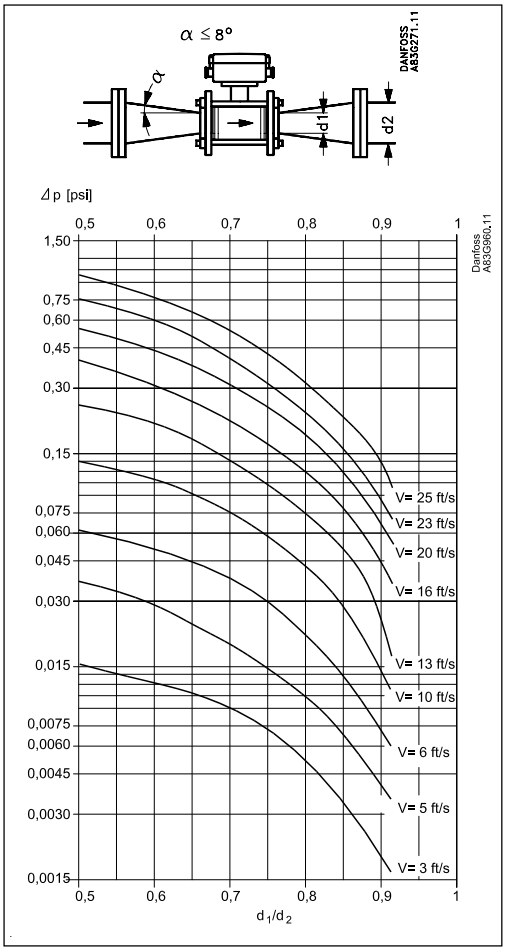
A. Built-in grounding electrodes. (MAG 3100 and MAG 3100 W).
B. Direct metallic contact between sensor and fittings. (MAG 1100 FOOD).
C. Wire jumper between sensor and adjacent flanges. (MAG 1100 and MAG 3100).
D. Optional graphite gaskets on MAG 1100. (Standard for MAG 1100 High temperature).

Vacuum



Avoid a vacuum in the measuring pipe, since this can damage certain liners.
See "Specifications", section 2.

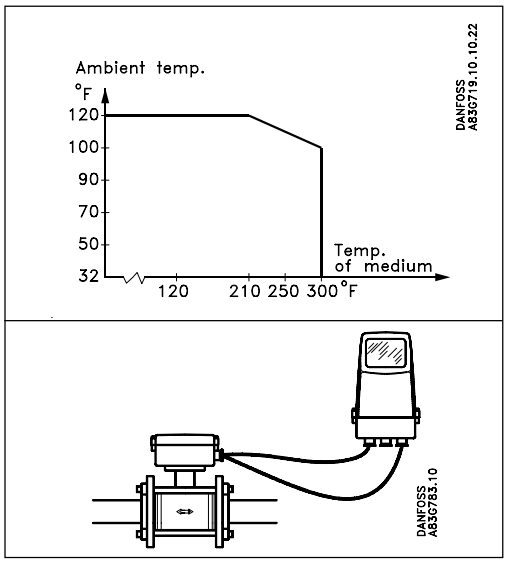
Installation in large pipes



The flowmeter can be installed between two reducers.
With an 8° reducer the following pressure drop curve applies. The curves are applicable to water.

Example:
A flow velocity of 10 ft./sec. (V) in a sensor with a diameter reduction from 4" to 3" (d_1/d_2 = 0.8) gives a pressure drop of 0.04 psi.

Integral mount/remote installation

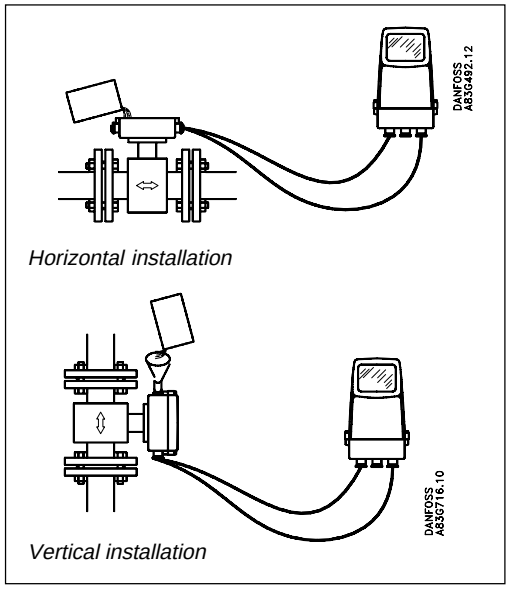


The sensor and signal converter can be installed either integral mount or remote.

With **integral mount** installation the temperature of medium must be according to the graph.

With **remote** installation, the cable length and type described under "Specifications", section 2 must be used.

NEMA 6 submersible kit (option)



If the sensor is going to be buried or permanently submerged, the terminal box must be encapsulated with silicon dielectric gel.
The optional kit has two components.
Mix the two components well (without inducing air) and pour the contents into the terminal box.
The material is a non-toxic, transparent, self-healing gel which cures in approx. 24 hours.
The gel can be penetrated with test instruments or be removed in case of cable replacement.

Suggestions for the direct burial of MAG 3100 & MAG 5100 W sensors

If MAGFLO 3100 or MAG 5100 W sensors are buried directly into the ground, we suggest the following precautions:

The SENSORPROM® unit should be removed from the terminal box on the sensor and relocated in the signal converter remote mounting prior to burying the sensor.

All the sensor data plate information and serial number should be recorded for each sensor prior to burying. This will ensure correct matching with the SENSORPROM® unit.

The sensor should be potted with the optional IP68 submersion kit and suitable coil and electrode cables should be used prior to burying.

The use of pea gravel, at least 12 inches all around the sensor, is recommended. This provides some drainage and prevents dirt from caking onto the sensor. It also helps locate the sensor should excavation be necessary.

Before covering the pea gravel with earth, we suggest the use of electrical cable identification tape laid above the gravel.

The sensor should not be subject to heavy vehicles applying excessive weight above the sensor or pipeline.

3.4 Cleaning unit

The Danfoss cleaning unit can be used with MAG 5000 or 6000 in rack mount versions.
The cleaning unit can be used in applications where the liner material and subsequently the electrodes may be coated with deposits. If the coating is electrically insulating, the electrode signal will be reduced. If the coating is electrically conductive, the electrode signal will be partly short-circuited. In both cases the accuracy of the meter will decrease (dependent on the type and thickness of the coating).

Note
The cleaning unit **cannot** be used for flammable or explosive media!
Empty pipe detection and cleaning facility **cannot** be used at the same time.

Theory of operation

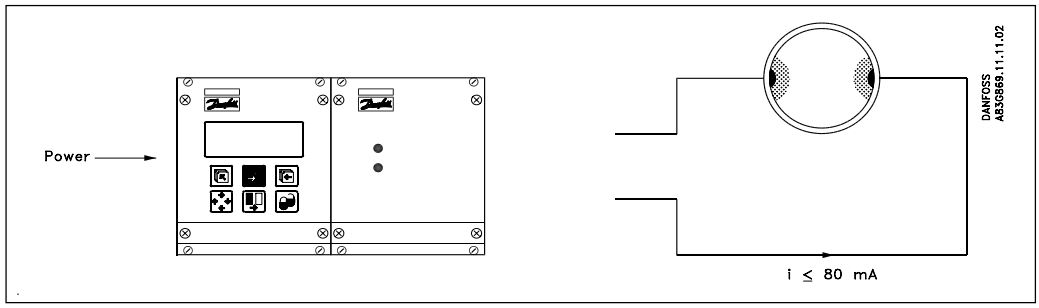
The cleaning unit cleans the electrodes electro-chemically by applying a voltage to the electrodes for approx. 60 sec. While cleaning, the signal converter stores and holds the latest measured flow reading on the display and also the signal outputs. After an additional pausing period of 60 sec. the flowmeter resumes normal measurement and the cleaning is now completed.

The relay in the signal converter activates the cleaning cycle. In the relay output menu (under cleaning) the cleaning interval can be set between 1 hour and 24 hours.

Cleaning should only take place with liquid in the pipe. This can be achieved via the empty pipe detection. It is therefore recommended to select “empty pipe detection” ON when using the cleaning unit.

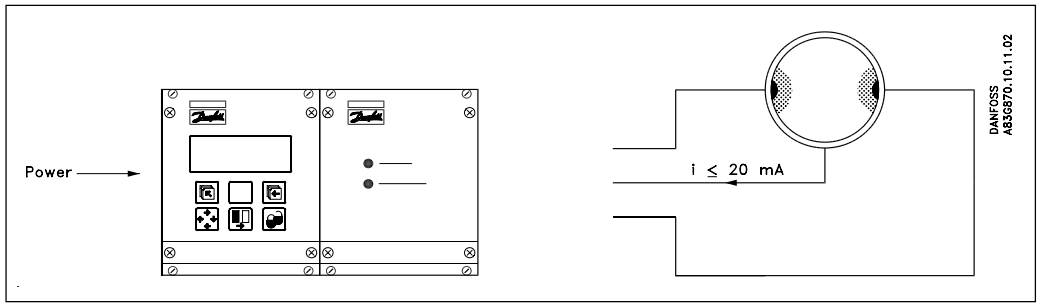
The cleaning sequence can also be controlled manually through the electrical input of the signal converter. Before this is done, ensure that the measuring pipe is full.

AC-cleaning
(For non-conductive coatings)



AC-cleaning is used to remove fatty deposits on the electrodes. Fatty deposits are seen from Slaughter houses and in rare instances from wastewater applications and water applications with oil residuals. During the cleaning process, the surface of the electrodes get warmer, which tends to soften grease particles and the gas bubbles generated mechanically lift deposits away from the surface of the electrodes.

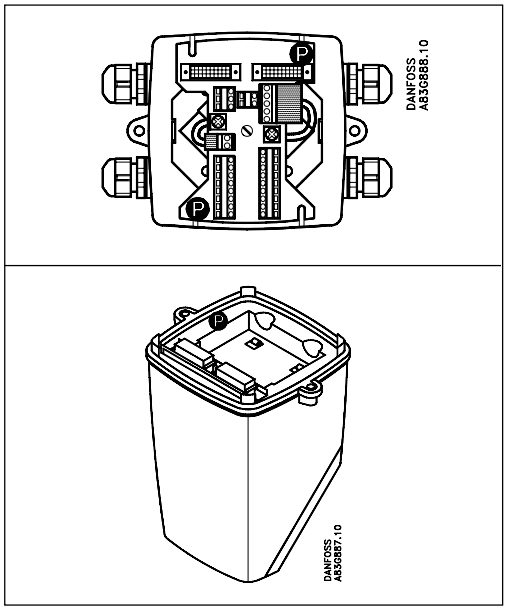
DC-cleaning
(For conductive coatings)



DC-cleaning is used to eliminate electrically conductive deposits in the measuring pipe influencing the measuring accuracy.
Particularly in district heating applications, an electrically conductive deposit (magnetite) may occur and short-circuit the electrode signal. In this case the accuracy of the meter decreases and the signal/noise conditions of the meter become inferior. The problem only arises if the conductivity of the water is less than approx. 250 μS/cm.

During DC-cleaning, electrolysis takes place where the flow of electrons removes the particle deposits from the electrode area.

3.5 Custody transfer approval



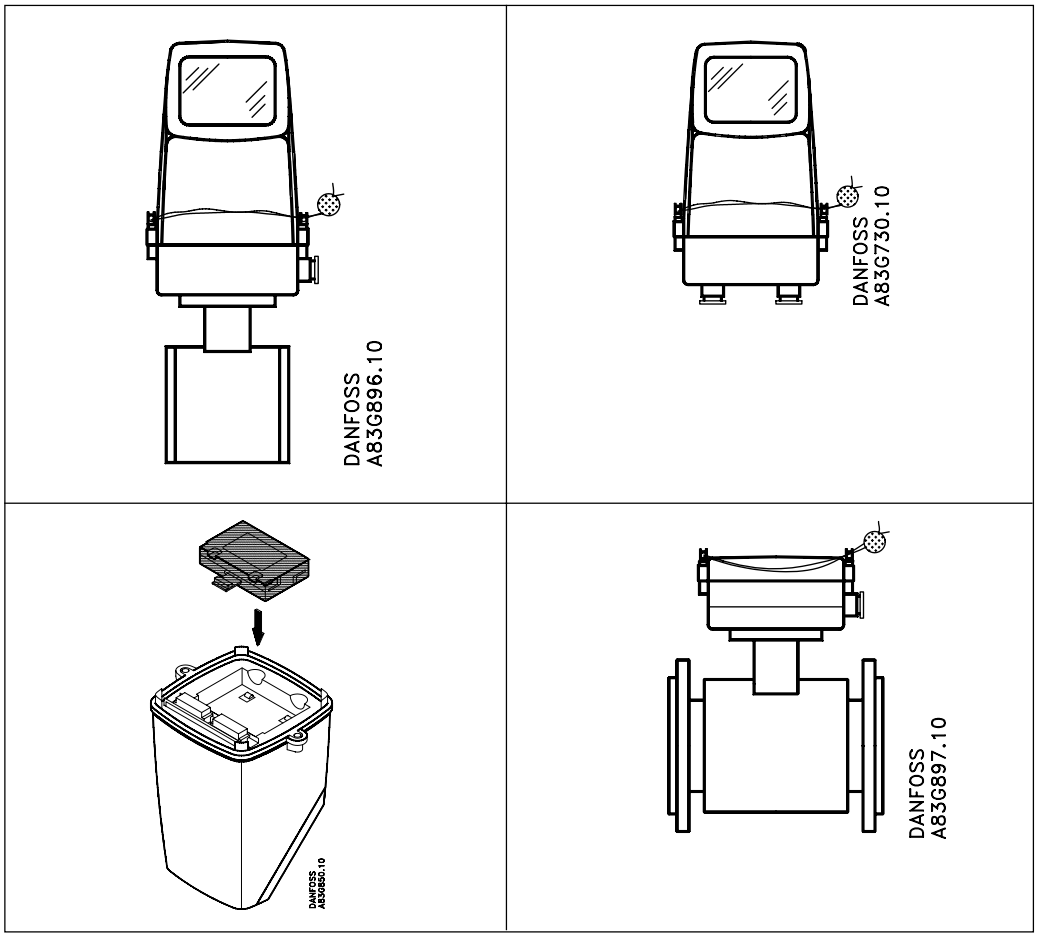
A signal converter can be supplied in a version tested and approved for custody transfer (CT). The internal counter can accordingly be used for billing.
This requires verification, sealing and setting of the signal converter together with the sensor for a specific flow range. After sealing, the data on the signal converter must not be changed.

The sealing of the signal converter is done by placing sealing marks on the signal converter and on the connection plate in the terminal box.

3.6 Signal converter MAG 5000 CT, 6000 CT

Sealing

The final (lead) sealing is carried out as shown:



MAG 6000 CT is installed like a standard MAG 6000 except for the final sealing.
Calibration sealing has been carried out at calibration.

3.7 Ex installations

MAG 6000 rack mount with integral safety barrier (ia/ib) for remote mounting in safe area
Approval [EEx ia/ib] llB. The safety barrier is to be used with sensors MAG 1100 Ex and MAG 3100 Ex, $^1/_4$" to 4". When this safety barrier is used, the coil circuit is intrinsic safety "ib" and the electrode circuit is intrinsic safety "ia".

Sensors
The sensors can be one of the following type.

MAG 1100 Ex for mounting in Ex areas
1/4" to 4" approval EEx [ia/ib] llB T4..T6. DEMKO no. 97D.121909X. DN 6 - 100.

MAG 3100 Ex for mounting in Ex areas
The sensor carries the approval:

$^1/_2$" to 1"	EEx [ia/ib] llB T4..T6, DEMKO no. 98E.123914X
$1^1/_2$" to 12"	EEx [ia/ib] llB T4..T6, DEMKO no. 98E.123915X

The electrode circuit in the sensors is manufactured to an intrinsically safe category "ia" and the coil circuit to an intrinsically safe category "ib", achieved by an integrated and patented protection circuit.

Marking
The marking has the following meaning according to European Norm EN 50014.

E: Certified to CENELEC standard.

Ex: Designates explosion proof material and indicates that the apparatus has been approved in accordance with a certificate issued.

i: **"Intrinsic safety"** is a protection ensuring that the energy in the electric circuit is too small to ignite the explosive atmosphere. There are two categories of intrinsic safety: "ia" and "ib".

- ia: In intrinsic safety category "ia", the circuit must remain safe, even in the event of two simultaneous errors occurring that are independent of one another.
- ib: In intrinsic safety category "ib" the circuit must remain safe if an error occurs.

ll: Designates that the apparatus may be used in all areas (Except mining).

B: Indicates the gas group in which the unit may be used.

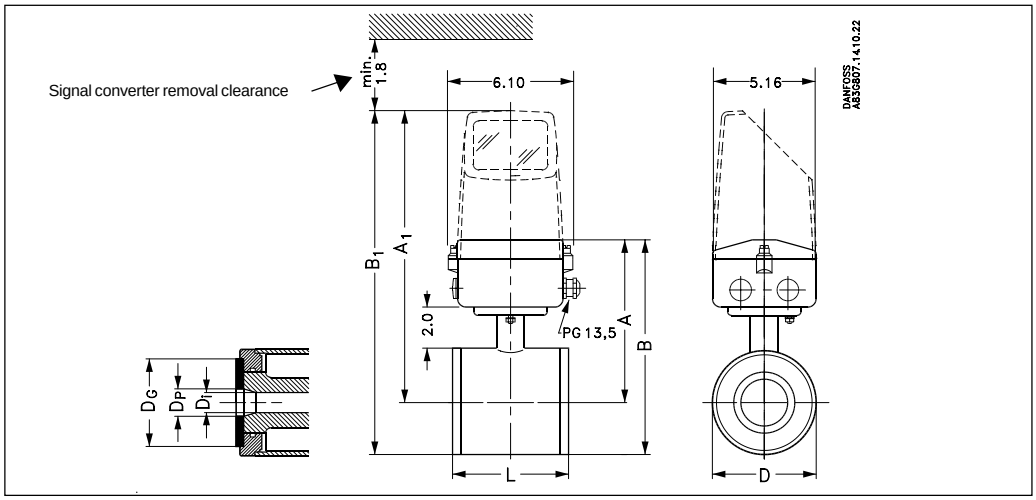
T4..T6 The temperature class describes the maximum temperature which any exposed surface of the equipment may reach. The sensor can have temperature class T3, T4, T5 or T6 depending on the temperature of the media. Please see technical data for the sensor.

T3: Max. surface temperature 390 °F => (Max. media temperature 355 °F)
T4: Max. surface temperature 275 °F => (Max. media temperature 250 °F)
T5: Max. surface temperature 210 °F => (Max. media temperature 195°F)
T6: Max. surface temperature 185 °F => (Max. media temperature 165 °F)

4. Dimensions and weight

4.1 Sensor MAG 1100

MAG 1100, integral/remote mount/separate

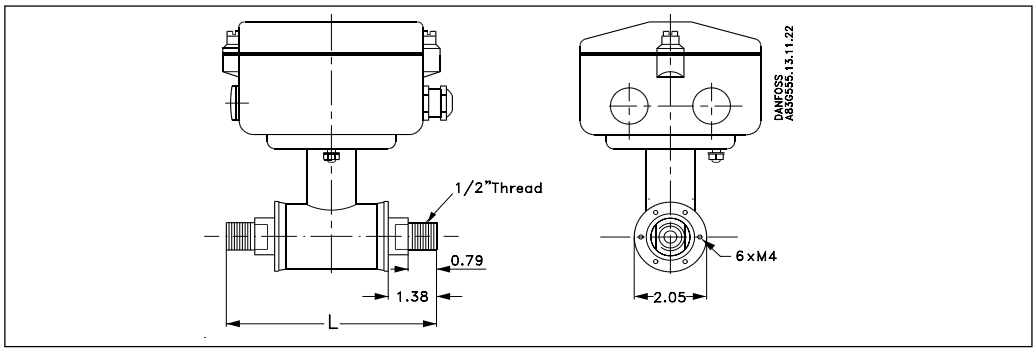


Size	A[1]) [inch]	B[1]) [inch]	A_1 [inch]	B_1 [inch]	D [inch]	D_i (Al_2O_3) [inch]	D_i (PFA) [inch]	D_p [inch]	D_G [inch]	Weight[2]) [lbs]
1/4"	6.14	7.13	12.16	13.15	1.90	0.24		0.68	1.34	10.6
3/8"	6.14	7.13	12.16	13.15	1.90	0.39	0.39	0.53	1.34	10.6
1/2"	6.14	7.13	12.16	13.15	1.90	0.59	0.63	0.68	1.57	10.6
1"	6.46	7.72	12.48	13.74	2.50	0.98	1.02	1.12	2.20	10.8
1 1/2"	6.93	8.58	12.95	14.61	3.31	1.57	1.50	1.71	2.95	16.5
2"	7.24	9.25	13.27	15.27	4.00	1.97	1.97	2.15	3.54	20.3
2 1/2"	7.64	10.00	13.66	16.02	4.72	2.56	2.60	2.68	4.41	26.5
3"	7.87	10.47	13.90	16.50	5.24	3.15	3.19	3.25	4.88	33.1
4"	8.39	11.50	14.41	17.52	6.26	3.94	3.94	4.22	5.91	48.5

1) 0.5" shorter when the AISI terminal box is used. (Ex and high temperature 390°F).
2) With signal converter MAG 5000 or MAG 6000 installed, weight is increased by approx. 1.8 lbs.

The total built-in length "L" [inch] before assembling depends on the gasket selected.

Size	EPDM	Graphite	PTFE(Teflon)	Without gasket	Grounding ring
1/4"	2.52	2.60	2.75	2.52	3.03
3/8"	2.52	2.60	2.75	2.52	3.03
1/2"	2.56	2.60	2.75	2.52	3.03
1"	3.15	3.19	3.35	3.10	3.62
1 1/2"	3.74	3.78	3.94	3.70	4.21
2"	4.13	4.17	4.33	4.05	4.61
2 1/2"	5.12	5.15	5.31	5.05	5.60
3"	6.10	6.14	6.30	6.00	6.57
4"	7.28	7.31	7.48	7.20	7.76



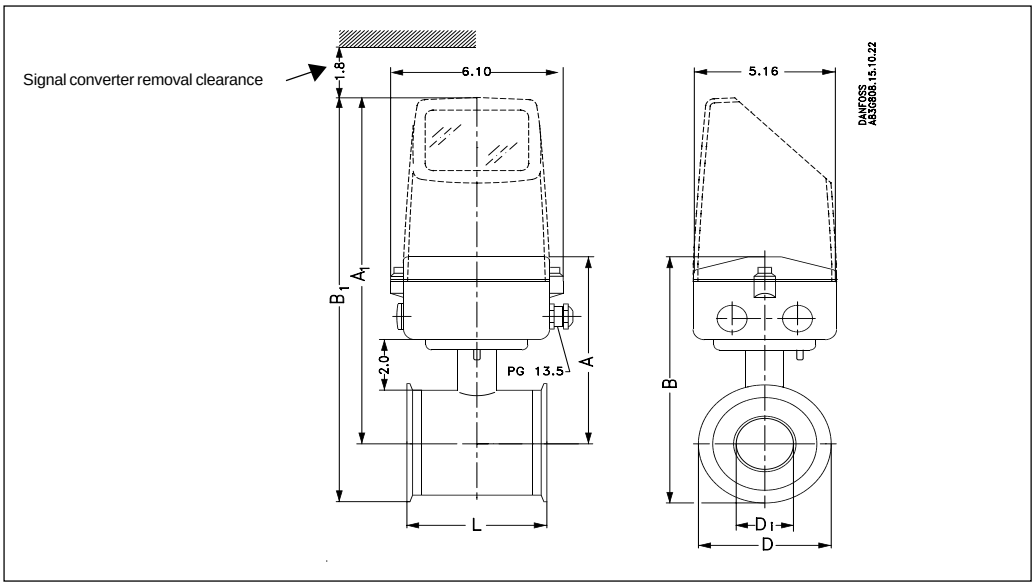
The MAG 1100 1/4" and 3/8" are prepared for assembly with the 1/2" pipe connection.

The built-in length "L" varies dependent on the gasket choice:

	Without gasket	EPDM	Graphite	Teflon
L [inch]	5.9	5.9	6.0	6.1

4.2 Sensor MAG 1100 FOOD

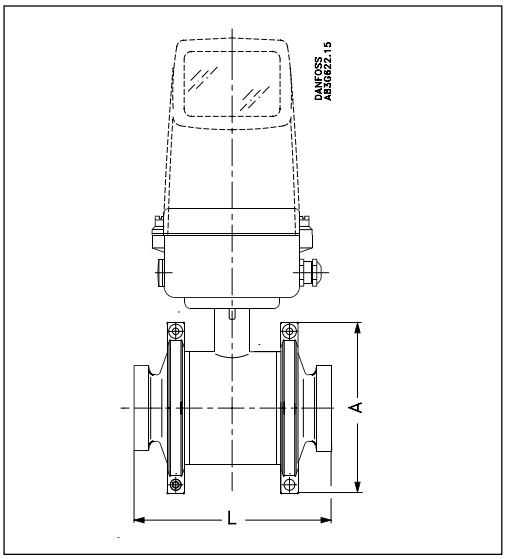
MAG 1100 FOOD, integral or remote mount and separate



Size	L [inch]	A [inch]	A_1 [inch]	B [inch]	B_1 [inch]	D [inch]	D_i (Al_2O_3) [inch]	D_i (PFA) [inch]	Weight 1) [lbs]
3/8"	2.52	6.14	12.16	7.40	13.43	2.52	0.39	0.39	4.8
1/2"	2.52	6.14	12.16	7.40	13.43	2.52	0.59	0.63	4.8
1"	3.11	6.46	12.48	7.98	14.01	3.05	0.98	1.02	4.9
1 1/2"	3.70	6.93	12.95	8.72	14.74	3.58	1.57	1.50	7.5
2"	4.09	7.24	13.27	9.59	15.61	4.68	1.97	1.97	9.2
2 1/2"	5.16	7.64	13.66	10.20	16.22	5.12	2.56	2.60	12.0
3"	6.14	7.87	13.90	10.93	16.95	6.10	3.15	3.19	15.0
4"	7.32	8.39	14.41	11.99	18.01	7.20	3.94	3.94	22.0

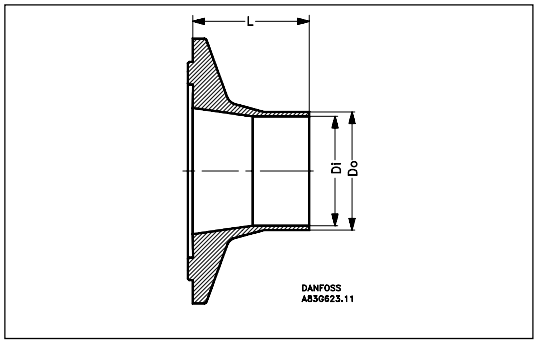
1) With signal converter MAG 5000 or MAG 6000 installed, weight is increased by approx. 1.8 lbs.

Built-in length

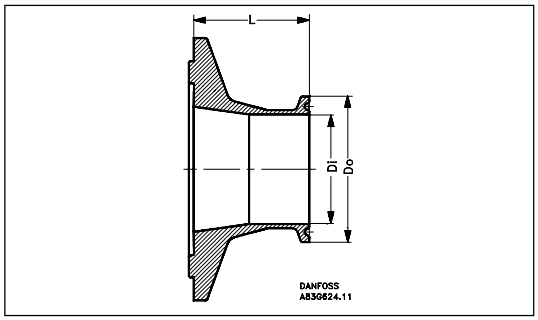


Size	A [inch]
3/8"	3.90
1/2"	3.90
1"	4.45
1 1/2"	4.96
2"	6.06
2 1/2"	6.50
3"	7.87
4"	8.86

Accessories
MAG 1100 FOOD



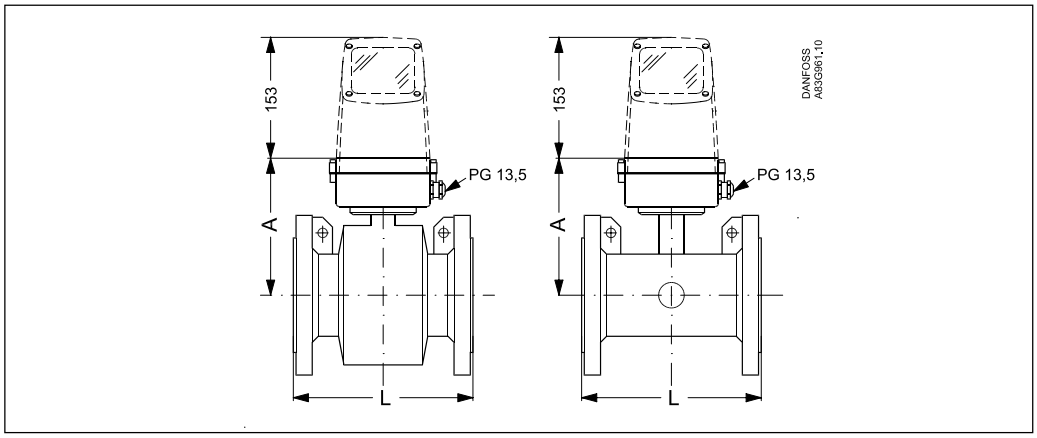
Adapter size [inch]	Sensor size [inch]	L [inch]	Weld-in type Tri-Clover® Di [inch]	Do [inch]
3/8	3/8	1 1/2	0.37	1/2
1/2	1/2	1 1/2	0.62	3/4
1	1	1 1/2	0.87	1
1 1/2	1 1/2	1 1/2	1.37	1 1/2
2	2	1 1/2	1.87	2
2 1/2	2 1/2	1 3/4	2.37	2 1/2
3	3	2	2.87	3
4	4	2	3.83	4



Adapter size [inch]	Sensor size [inch]	L [inch]	Clamp type Tri-Clamp® Di [inch]	Do [inch]
3/8	3/8	1 1/2	0.37	0.98
1/2	1/2	1 1/2	0.62	0.98
1	1	1 1/2	0.87	1.99
1 1/2	1 1/2	1 1/2	1.37	1.99
2	2	1 1/2	1.87	2.52
2 1/2	2 1/2	1 3/4	2.37	3.05
3	3	2	2.87	3.58
4	4	2	3.83	4.70

Tri-Clover® and Tri-Clamp® are registered trademarks for Ladish Co.

4.3
Sensor MAG 5100 W
Dimensions



Nominal size		A		L									
				PN 10		PN 16		PN 40		Class 150		AWWA	
mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch
25	1"	187	7.4	N/A	N/A	N/A	N/A	200	7.9	200	7.9	N/A	N/A
40	1½"	197	7.8	N/A	N/A	N/A	N/A	200	7.9	200	7.9	N/A	N/A
50	2"	188	7.4	N/A	N/A	200	7.9	N/A	N/A	200	7.9	N/A	N/A
65	2½"	194	7.6	N/A	N/A	200	7.9	N/A	N/A	200	7.9	N/A	N/A
80	3"	200	7.9	N/A	N/A	200	7.9	N/A	N/A	200	7.9	N/A	N/A
100	4"	207	8.1	N/A	N/A	250	9.8	N/A	N/A	250	9.8	N/A	N/A
125	5"	217	8.5	N/A	N/A	250	9.8	N/A	N/A	250	9.8	N/A	N/A
150	6"	232	9.1	N/A	N/A	300	11.8	N/A	N/A	300	11.8	N/A	N/A
200	8"	257	10.1	350	13.8	350	13.8	N/A	N/A	350	13.8	N/A	N/A
250	10"	284	11.2	450	17.7	450	17.7	N/A	N/A	450	17.7	N/A	N/A
300	12"	310	12.2	500	19.7	500	19.7	N/A	N/A	500	19.7	N/A	N/A
350	14"	362	14.3	550	21.7	550	21.7	N/A	N/A	550	21.7	N/A	N/A
400	16"	387	15.2	600	23.6	600	23.6	N/A	N/A	600	23.6	N/A	N/A
450	18"	418	16.5	600	23.6	600	23.6	N/A	N/A	600	23.6	N/A	N/A
500	20"	443	17.4	625	24.6	625	24.6	N/A	N/A	680	26.8	N/A	N/A
600	24"	494	19.4	750	29.5	750	29.5	N/A	N/A	820	32.3	N/A	N/A
700	28"	544	21.4	875	34.4	875	34.4	N/A	N/A	N/A	N/A	875	34.4
750	30"	571	22.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	937	36.9
800	32"	606	23.9	1000	39.4	1000	39.4	N/A	N/A	N/A	N/A	1000	39.4
900	36"	653	25.7	1125	44.3	1125	44.3	N/A	N/A	N/A	N/A	1125	44.3
1000	40"	704	27.7	1250	49.2	1250	49.2	N/A	N/A	N/A	N/A	1250	49.2
	42"	704	27.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1250	49.2
1100	44"	755	29.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1375	54.1
1200	48"	810	31.9	1500	59.1	1500	59.1	N/A	N/A	N/A	N/A	1500	59.1

MAG 5100 W weight

Nominal size		PN 10		PN 16		PN 40		Class 150		AWWA	
mm	inch	kgs	lbs	kgs	lbs	kgs	lbs	kgs	lbs	kgs	lbs
25	1"	N/A	N/A	N/A	N/A	4	9	4	9	N/A	N/A
40	1½"	N/A	N/A	N/A	N/A	7	15	6	13	N/A	N/A
50	2"	N/A	N/A	9	20	N/A	N/A	8	20	N/A	N/A
65	2½"	N/A	N/A	10.7	24	N/A	N/A	11	24	N/A	N/A
80	3"	N/A	N/A	11.6	26	N/A	N/A	13	28	N/A	N/A
100	4"	N/A	N/A	15.2	33	N/A	N/A	19	41	N/A	N/A
125	5"	N/A	N/A	20.4	45	N/A	N/A	24	52	N/A	N/A
150	6"	N/A	N/A	26	57	N/A	N/A	29	64	N/A	N/A
200	8"	48	106	48	106	N/A	N/A	56	124	N/A	N/A
250	10"	64	141	69	152	N/A	N/A	79	174	N/A	N/A
300	12"	76	167	86	189	N/A	N/A	110	243	N/A	N/A
350	14"	100	220	116	255	N/A	N/A	131	289	N/A	N/A
400	16"	127	280	144	317	N/A	N/A	165	364	N/A	N/A
450	18"	152	335	178	393	N/A	N/A	176	388	N/A	N/A
500	20"	184	405	232	512	N/A	N/A	235	518	N/A	N/A
600	24"	258	568	343	736	N/A	N/A	345	761	N/A	N/A
700	28"	315	693	350	772	N/A	N/A	N/A	N/A	309	681
750	30"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	480	1058
800	32"	410	904	442	975	N/A	N/A	N/A	N/A	421	928
900	36"	512	1129	550	1213	N/A	N/A	N/A	N/A	539	1188
1000	40"	650	1433	732	1614	N/A	N/A	N/A	N/A	670	1477
	42"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	700	1544
1100	44"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1100	2426
1200	48"	990	2183	1106	2439	N/A	N/A	N/A	N/A	1030	2271

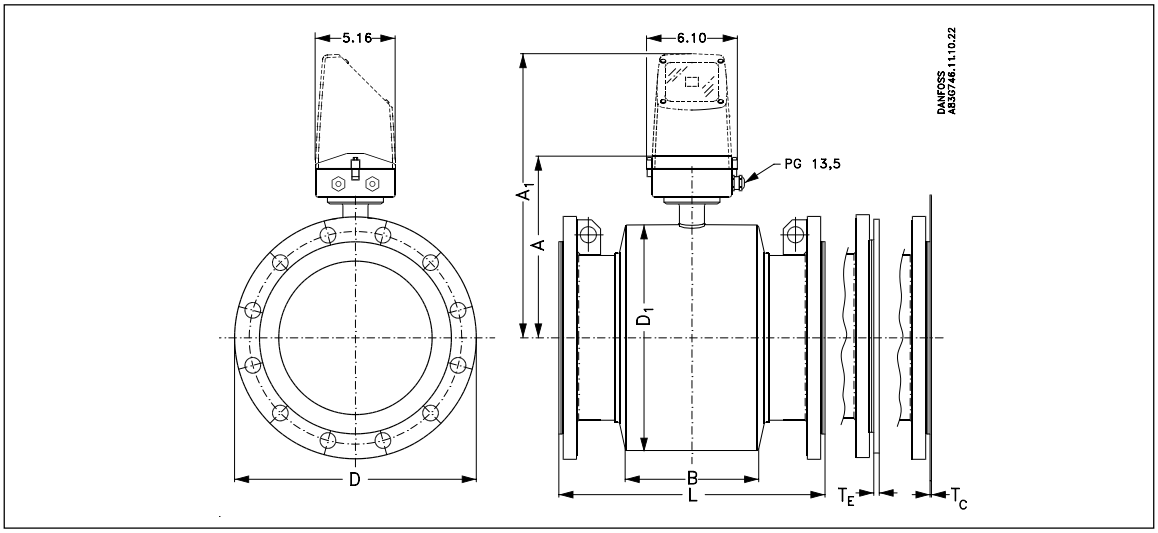
The effect of temperature on working pressure MAG 5100 W

Metric (Pressure in bar)					
Sizes 25 mm, 40 mm & > 600 mm					
Flange spec.	**Flange rating**	**Temperature °C**			
		–5	10	50	90
EN 1092-1	PN 10	10.0	10.0	9.7	9.4
	PN 16	16.0	16.0	15.5	15.1
	PN 40	40.0	40.0	38.7	37.7
ANSI B16.45	150 lb	19.7	19.7	19.3	18.0
AWWA C-207	Class D	10.3	10.3	10.3	10.3
Sizes 50 mm to 600 mm					
EN 1092-1	PN 10	10.0	10.0	10.0	8.2
	PN 16	10.0	16.0	16.0	13.2
	PN 40	10.0	40.0	40.0	32.9
ANSI B16.45	150 lb	10.0	19.7	19.7	16.2

Imperial (Pressure in Psi)					
Sizes 1", 1½", & > 24"					
Flange spec.	**Flange rating**	**Temperature °F**			
		25	50	125	200
EN 1092-1	PN 10	145	145	141	136
	PN 16	232	232	225	219
	PN 40	580	580	561	547
ANSI B16.45	150 lb	286	286	280	261
AWWA C-207	Class D	150	150	150	150
Sizes 2" to 24"					
EN 1092-1	PN 10	145	145	145	119
	PN 16	145	232	232	191
	PN 40	145	580	580	477
ANSI B16.45	150 lb	145	286	286	235

4.4 Sensor MAG 3100 and MAG 3100 W

MAG 3100 & MAG 3100 W, integral or remote mount and separate

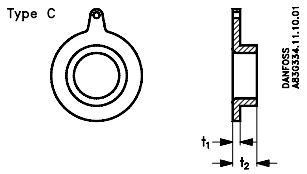


Size	A[1]	A_1	B	D_1	L[2]								T_C[3]	T_E[3]	Weight[4]
					EN 1092-1-2001					ANSI 16.5		AWWA C-207 Class D			
					PN 6, 10, 16	PN 25	PN 40	PN 2.52	PN 100	Class 150	Class 300				
[inch]	[inch]	[inch]	[inch]	[inch]	[inch]	[inch]	[inch]	[inch]	[inch]	[inch]	[inch]	[inch]	[inch]	[inch]	[lbs]
1/2"	7.36	13.31	2.32	4.09	7.87	7.87	7.87	-	-	7.87	7.87		-	0.24	11
1"	7.36	13.31	2.32	4.09	7.87	7.87	7.87	-	10.24	7.87	7.87		0.05	0.24	13
1 1/2"	7.76	13.70	3.23	4.88	7.87	7.87	7.87	-	11.02	7.87	7.87		0.05	0.24	17
2"	8.07	14.01	2.83	5.47	7.87	7.87	7.87	10.87	11.81	7.87	7.87		0.05	0.24	28
2 1/2"	8.35	14.29	2.83	6.06	7.87	7.87	7.87	12.60	13.78	7.87	10.71		0.05	0.24	30
3"	8.74	14.69	2.83	6.85	7.87	10.71	10.71	12.72	13.39	10.71	10.71		0.05	0.24	33
4"	9.53	15.47	3.35	8.43	9.84	9.84	9.84	14.96	15.75	9.84	12.20		0.05	0.24	44
5"	10.04	15.98	3.35	9.41	9.84	9.84	9.84	16.54	17.72	9.84	13.10		0.05	0.24	55
6"	10.87	16.81	5.39	11.10	11.81	11.81	11.81	16.34	17.72	11.81	11.81		0.05	0.24	66
8"	11.97	17.91	5.39	13.31	13.78	13.78	13.78	18.90	20.87	13.78	13.78		0.05	0.31	110
10"	13.07	19.02	5.39	15.47	17.72	17.72	17.72	21.65	24.41	17.72	17.72		0.05	0.31	155
12"	14.05	20.00	5.39	17.48	19.69	19.69	19.69	23.62	26.77	19.69	19.69		0.06	0.31	176
14"	14.25	20.20	10.63	17.76	21.65	21.65	21.65	27.56	31.50	21.65	21.65	-	0.06	0.31	242
16"	15.24	21.18	10.63	19.76	23.62	23.62	23.62	29.53	-	23.62	23.62	-	0.06	0.39	275
18"	16.45	22.40	12.20	22.16	23.62	23.62	23.62	-	-	23.62	25.20	-	0.06	0.39	385
20"	17.44	23.39	13.78	24.17	24.61	24.61	26.77	-	-	26.77	28.70	-	0.06	0.39	440
24"	19.45	25.39	16.93	28.15	29.53	29.53	29.53	-	-	32.28	33.80	-	0.06	0.39	660
28"	21.42	27.36	19.69	32.13	34.45	-	-	-	-	-	-	34.5	0.08	-	770
30"	22.48	28.43	21.89	34.21	-	-	-	-	-	-	-	36.9	0.08	-	880
32"	23.86	29.80	22.05	36.50	39.37	-	-	-	-	-	-	39.4	0.08	-	1045
36"	25.71	31.65	24.80	40.63	44.29	-	-	-	-	-	-	44.3	0.08	-	1233
40"	27.72	35.67	26.38	44.72	49.21	-	-	-	-	-	-	49.2	0.08	-	1541
42"	27.72	35.67	26.38	44.72	49.21	-	-	-	-	-	-	49.2	0.08	-	1541
44"	29.72	35.67	30.31	48.74	-	-	-	-	-	-	-	59.1	0.08	-	
48"	31.89	37.83	31.18	53.07	59.06	-	-	-	-	-	-	59.1	0.08	-	2751
54"	36.42	42.36	39.37	65.94	68.90	-	-	-	-	-	-	68.9	0.12	-	3211
60"	38.27	44.21	40.15	65.83	-	-	-	-	-	-	-	73.8	0.12	-	3731
66"	40.35	46.30	44.49	75.39	78.74	-	-	-	-	-	-	78.7	0.12	-	4257
72"	44.21	50.16	49.21	77.72	88.58	-	-	-	-	-	-	88.5	0.12	-	5291
78"	48.15	54.09	54.13	85.59	98.43	-	-	-	-	-	-	98.4	0.12	-	7492

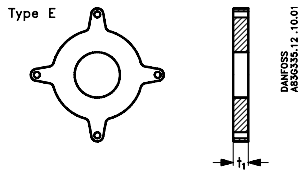
1) 1/2" shorter with AISI terminal box (Ex and is PTFE high temperature with ss terminal box)
2) When grounding rings are used, the thickness of the grounding ring must be added to the built-in length
3) T_C = Type C grounding ring, T_E = Type E grounding ring
4) Weights are for ANSI 150 without signal converter

D = Outside diameter of flange, see flange tables

Grounding/protection ring



Size	t_1 [inch]	t_2 [inch]	Weight [lbs]
1" to 10"	0.05	0.6	<1
12" to 24"	0.06	0.8	1-6
28" to 48"	0.08	1.0	6-11
54" to 78"	0.12	1.6	20-35



Size	t_1 [inch]	Weight [lbs]
$^1/_2$"	0.2	0.15
1" to 6"	0.2	1-3
8" to 14"	0.3	4-9
16 to 24"	0.4	14-28

Type C flanges for liners of neoprene, EPDM, Linatex® and ebonite.
Type E flanges for liners of PTFE.

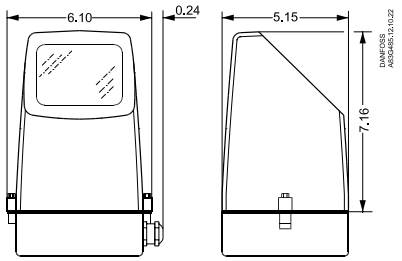
Note
MAG 3100 high temperature (PTFE) is always equipped with 2 pcs. type E grounding flanges.

D & W

4.5
Signal converter

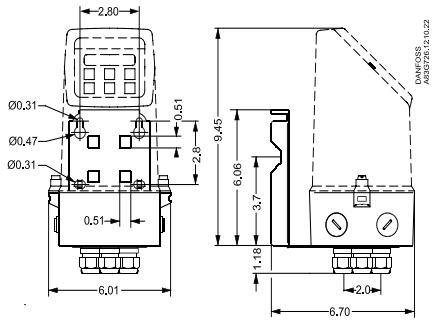
Integral or wall mount polyamide

Integral mount signal converter



Weight: MAG 6000 and MAG 5000: 2.0 lbs

Wall mount signal converter

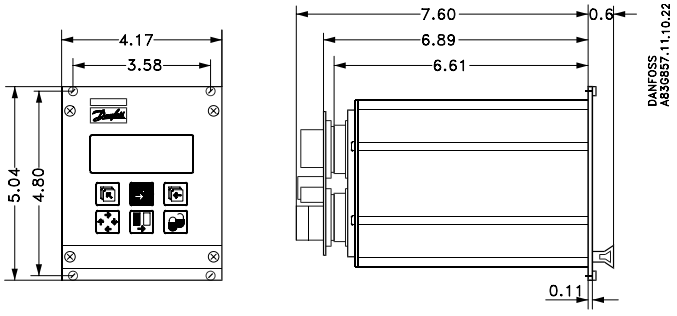


Weight: Wall bracket: 2.0 lbs

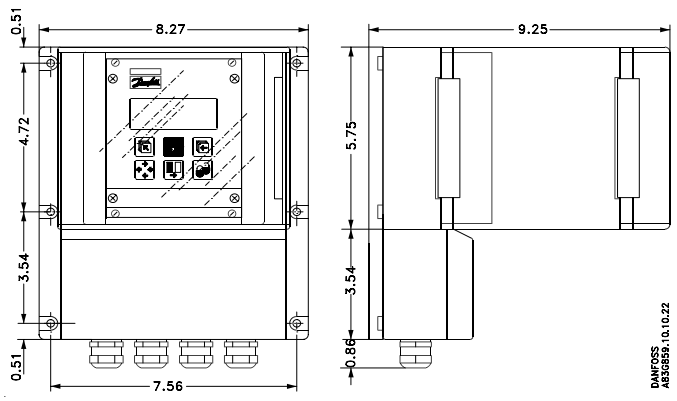
Rack mount, standard unit

Weight incl. back print:

MAG 5000:	1.8 lbs
MAG 6000:	1.8 lbs
Safety barrier (ia/ib):	2.2 lbs
Safety barrier (ia):	1.8 lbs
Cleaning unit:	2.0 lbs

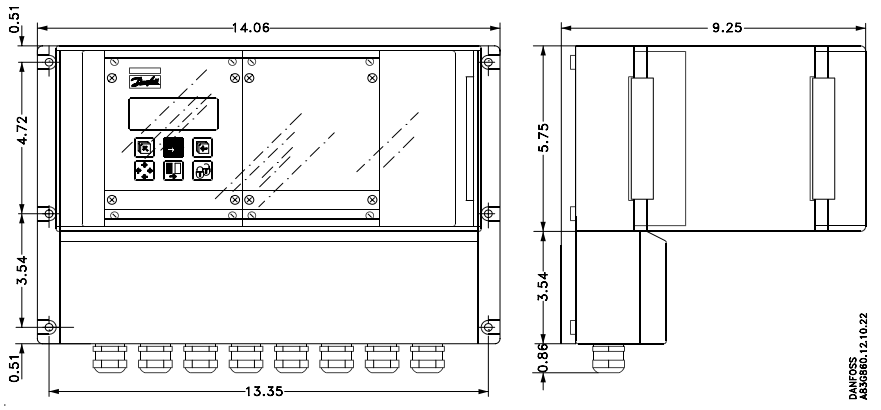


Wall mounting converter



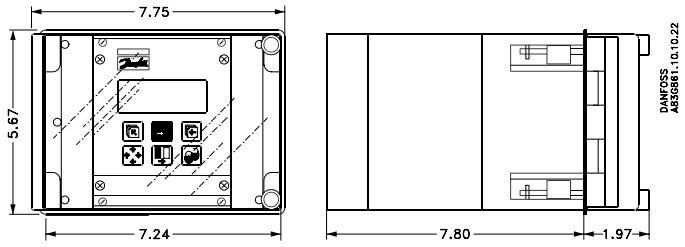
Weight excl. signal converter: 8.0 lbs

Wall mounting converter with cleaning unit or intrincically safe barrier



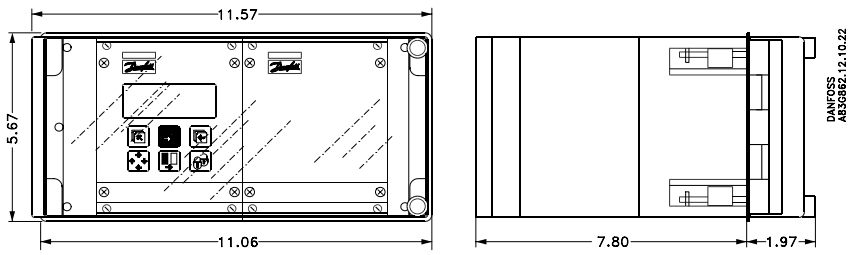
Weight excl. signal converter: 7.0 lbs

Front panel mounting kit



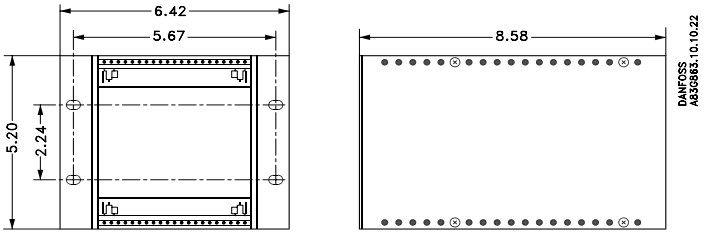
Weight excl. signal converter: 3.0 lbs

Front panel mounting kit for converter with intrinsically safe barrier or cleaning unit



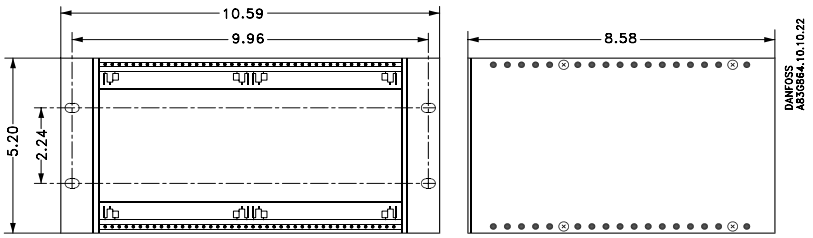
Weight excl. signal converter: 3.5 lbs

Back of panel mounting kit



Weight: 2.0 lbs

Back of panel mounting kit for converter with intrinsically safe barrier or cleaning unit



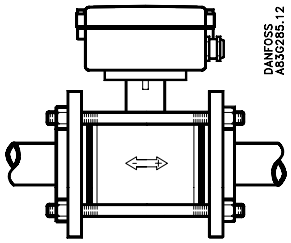
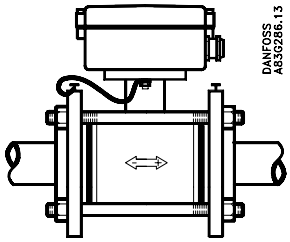
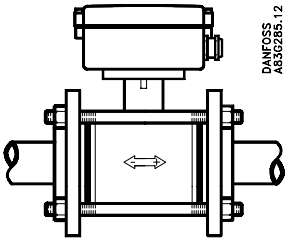
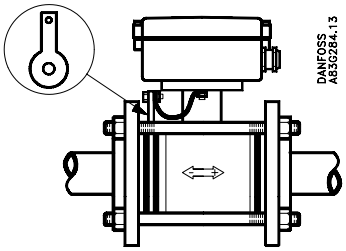
Weight: 2.0 lbs

D & W

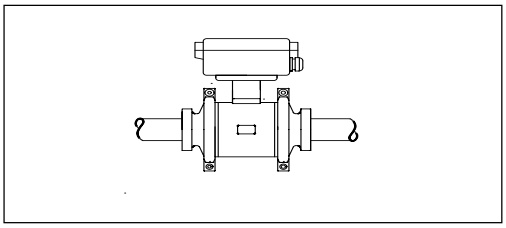
5.1 Potential equalization (Grounding)

To obtain optimum results from the measuring system, the chassis body of the sensor must have the same electrical potential as the liquid being measured.

MAG 1100

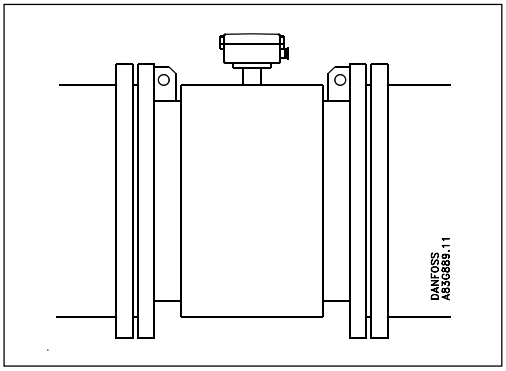
	Graphite gaskets	EPDM or PTFE gaskets
Electrically conductive piping	 **A**: Potential equalization with electrically conductive graphite gaskets	 **B**: Potential equalization using earth strap supplied.
Electrically non-conductive piping	 **C**: Potential equalization with electrically conductive graphite gaskets	 **D**: Potential equalization using separate potential equalization ring

MAG 1100 FOOD



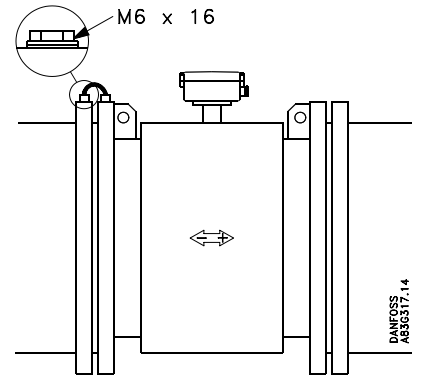
The sensor must be installed between two adapters. Potential equalization with the liquid occurs automatically via these adapters and through the adjacent pipe.

MAG 3100 W / MAG 3100 (except PTFE liner)



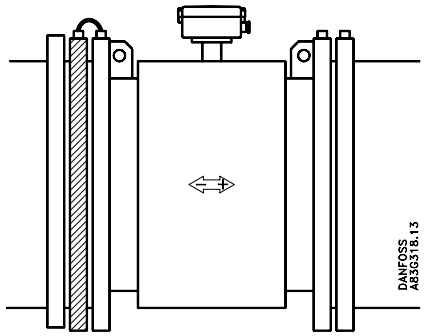
Potential equalization is carried out with the built-in grounding electrodes. No further action need to be taken.

MAG 3100
PTFE liner



Potential equalization, electrically conductive pipe

Electrically conductive piping
Use a grounding straps on one side.

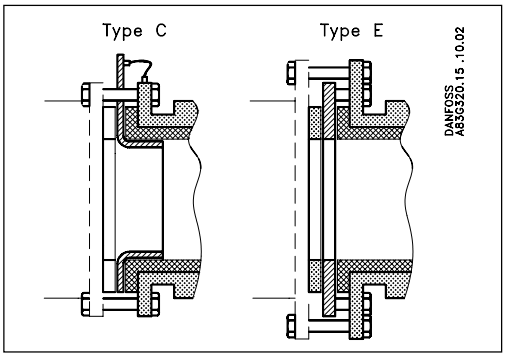


Type of grounding flange depending on liner material

Non-conductive piping
Use an grounding ringe. Place the ring between flowmeter and the adjacent pipe flange.
Selection of grounding ring depends on medium, liner material and application.

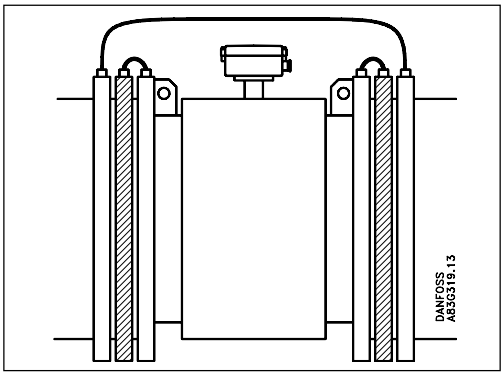
Liner material	Suitable grounding ring
PTFE	Type E

5.2
Inlet protection MAG 3100



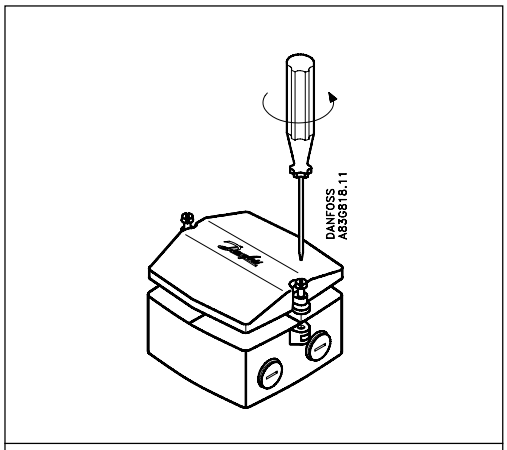
With abrasive liquids, flowmeter inlet protection may be necessary. Here type C and E grounding rings are used.
Type C (for all liners except PTFE) is inserted between the flanges.
Type E (for PTFE liner only) is fitted to the flange.
When using a grounding ring, gaskets must always be used between the adjacent pipe flange and the grounding flange.

5.3
Cathodic protected piping



Special attention must be given to systems with cathodic protection.
Integral installation:
The signal converter must be supplied through an isolation transformer. The terminal "PE" must never be connected.
Remote installation:
The shield must only be connected at the sensor end via a 1.5 µF capacitor. The shield must never be connected at both ends.
Isolated sensor:
If above mentioned connections are unacceptable, the sensor must be isolated from the pipe work.

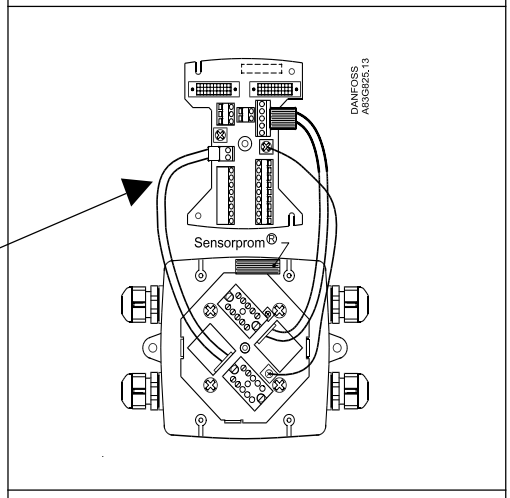
6.1 Integral installation MAG 5000 and MAG 6000



Step 1
Remove and discard the terminal box lid of the sensor.

Fit the PG 13.5 cable glands for the supply and output cables.

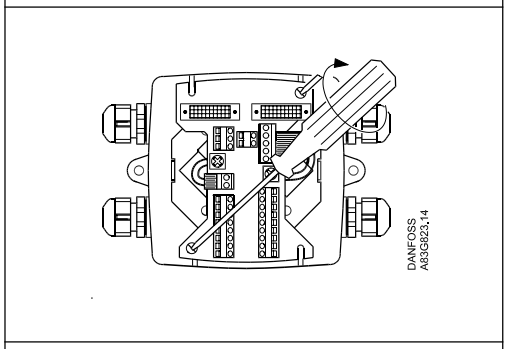
Step 2
Remove the two black plug assemblies for coil and electrode cables in the terminal box and connect them to their corresponding terminal numbers on the connection board.



Step 3
Connect an earth wire between PE on connection board and bottom of connection box.
Connect the 2 pin connector and 3 pin connector as shown.

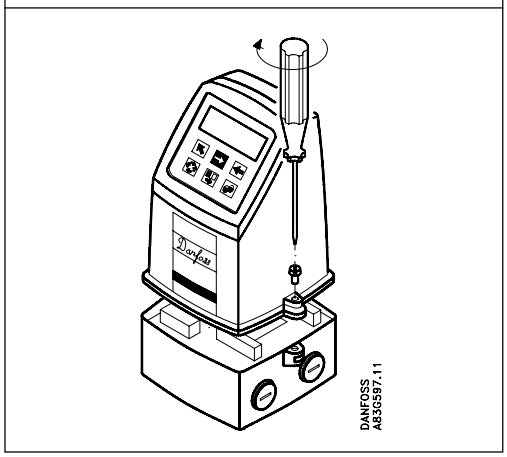
Note
In earlier version the 3 pin connector was a 5 pin connector.

Note
System will not register flow if black plugs are not connected to connection board



Step 4
Mount the connection plate in the terminal box. The SENSORPROM® unit connections will be established automatically when the connection plate is mounted in the terminal box.

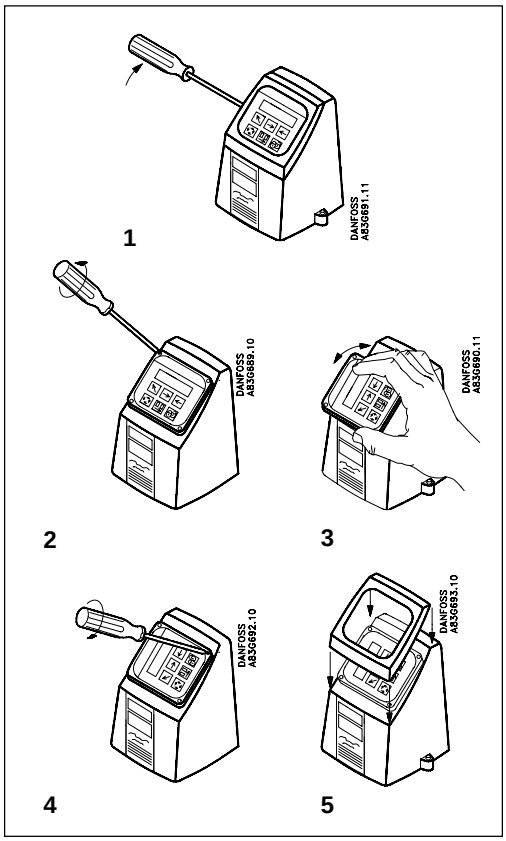
Note
Check that your connection board lines up with the SENSORPROM® unit, if not, move the SENSORPROM® unit to the other side of the terminal box.



Step 5
Fit the supply and output cables respectively and tighten the cable glands to obtain optimum sealing.
Please refer to the wiring diagram in section 7 for the electrical connections.

Mount the signal converter on the terminal box.

Turning the control pad



Step 1
Use a screw driver to remove the outer frame.

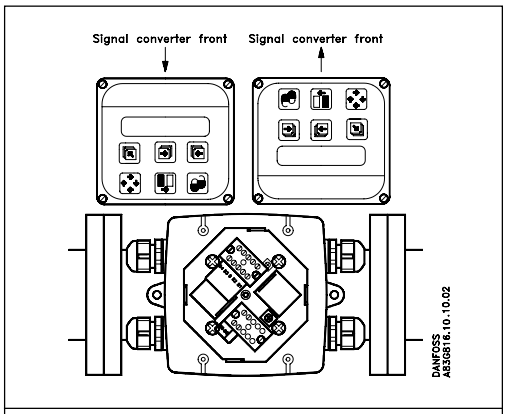
Step 2
Loosen the 4 screws retaining the control pad.

Step 3
Withdraw the control pad and turn it to the required orientation.

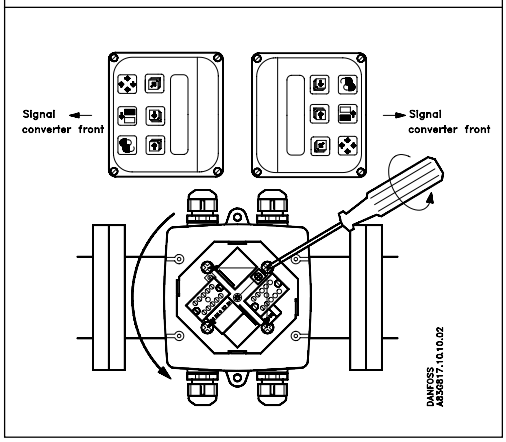
Step 4
Tighten the 4 screws until a mechanical stop is felt in order to obtain NEMA enclosure rating.

Step 5
Snap-lock the outer frame onto the control pad (click).

Turning the signal converter

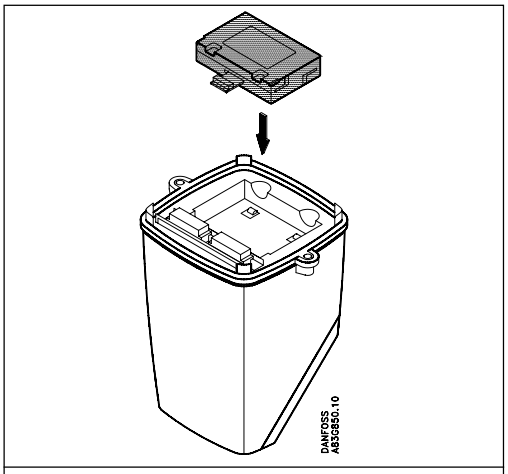


The signal converter can be mounted in either direction as the arrow indicates without turning the terminal box.

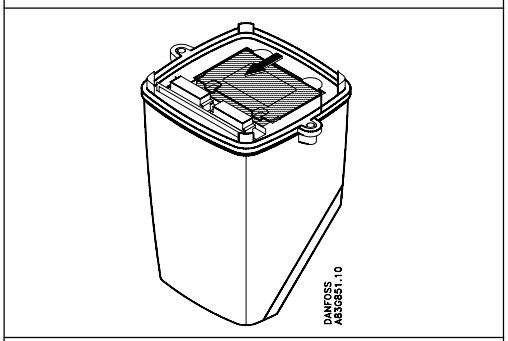


The terminal box can be rotated ±90° in order to optimize the viewing angle of the signal converter display/keypad:
Unscrew the four screws in the bottom of the terminal box. Turn the terminal box to the required position and retighten the screws firmly.

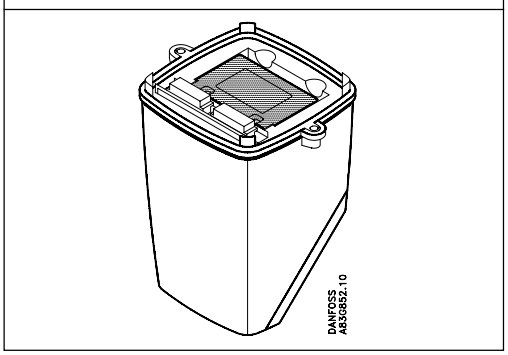
6.2.1 Add-on modules (MAG 6000 only)



Locate the add-on module in the bottom of the MAG 6000 signal converter.



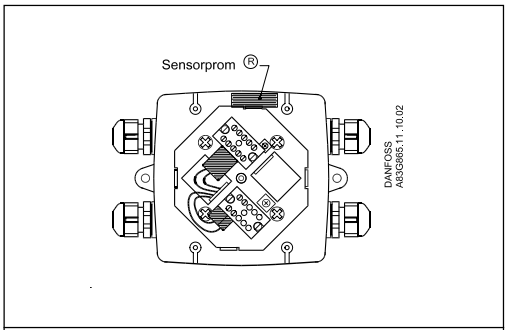
Press the add-on module forwards as far as possible.



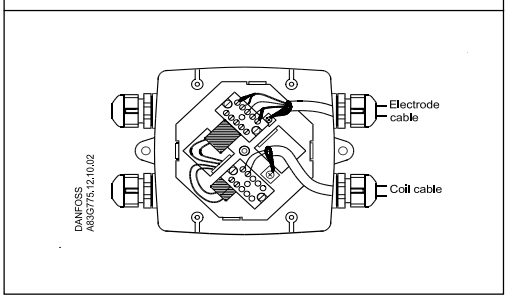
The add-on module has now been installed and the signal converter is ready to be installed on the terminal box.
Communication to the operator menu and electrically inputs and outputs is automatically established by power on.

6.2.2 Remote installation

Sensor end



Step 1 (All signal converter types)
Remove the SENSORPROM® unit from the sensor terminal box and mount it under the connection board for the signal converter (please refer to the following pages for specific mounting types).



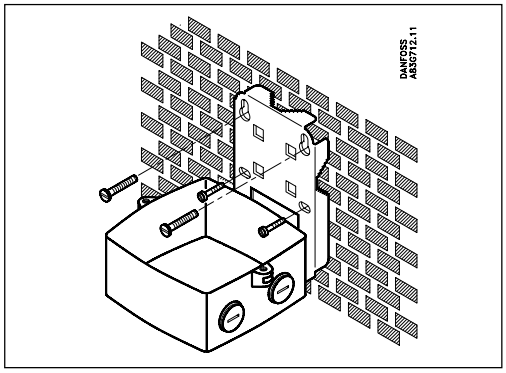
Step 2 (All signal converter types)
Fit and connect the electrode and coil cables as shown in section 7 “Electrical connections”.
The unshielded cable ends must be kept as short as possible.
The electrode cable and the coil cable must be two separate cables to prevent interference.
Tighten the cable glands well to obtain optimum sealing.

The two cables can run in the same conduit.

6.2.3 Remote installation

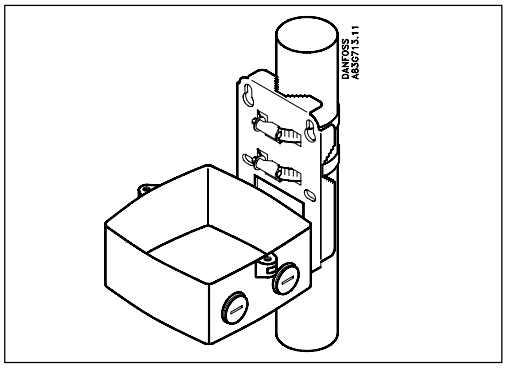
Wall mount

MAG 6000 & MAG 5000



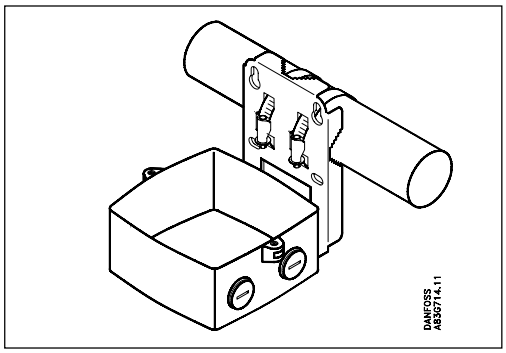
Step 3 (Wall mounting)
Mount wall bracket on a wall or in the back of a panel.

Vertical pipe mounting



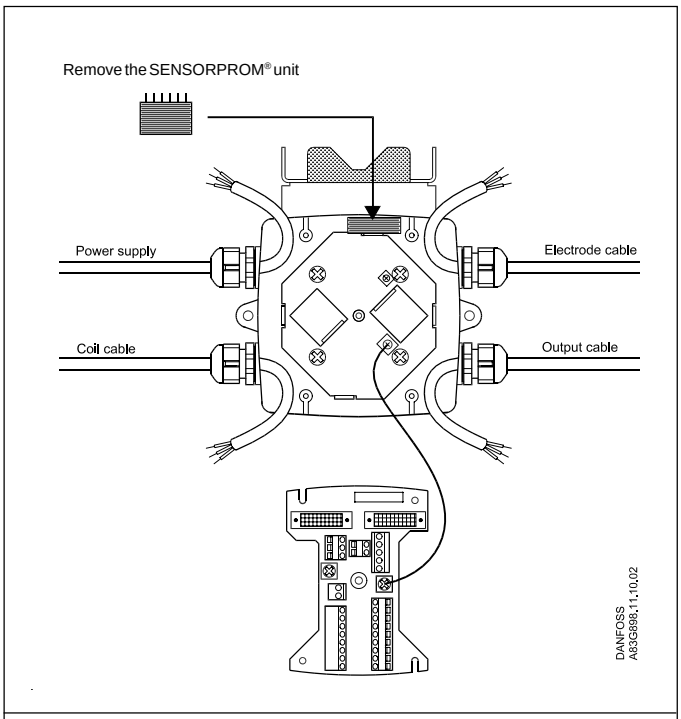
Mount the wall mounting on a vertical or horizontal pipe using an ordinary hose clamp or a duct strap.

Horizontal pipe mounting



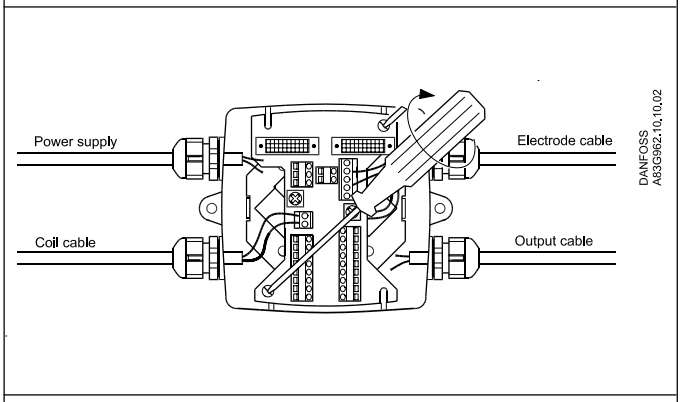
6.2.3 Remote installation

Wall mount
(continued)



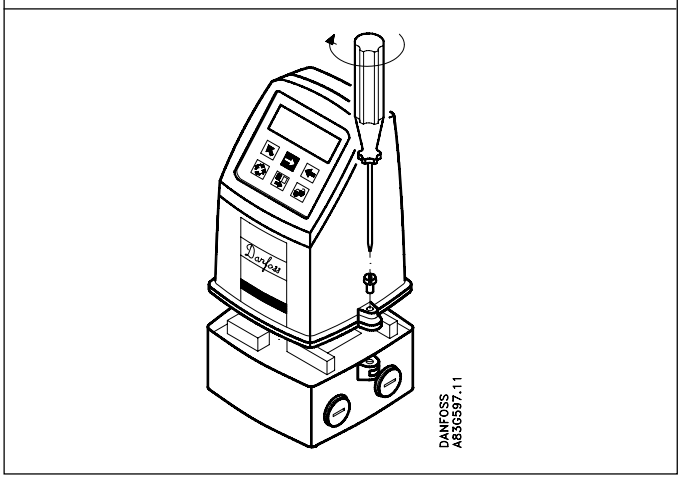
Step 4 (wall mounting)
Remove the SENSORPROM® unit from the sensor terminal box. Mount the SENSORPROM® unit in the wall mounting terminal box as shown. The text on the SENSORPROM® unit must face towards the wall bracket.

Mount an earth wire between PE on the connection board and bottom of connection box.



Step 5 (wall mounting)
Mount the connection board in the terminal box. Fix the connection board with the two diagonal opposite screws.

Fit the coil, electrode, supply and output cables respectively and tighten the cable glands to obtain optimum sealing.
Please see the wiring diagram in section 7 for the electrical connections.

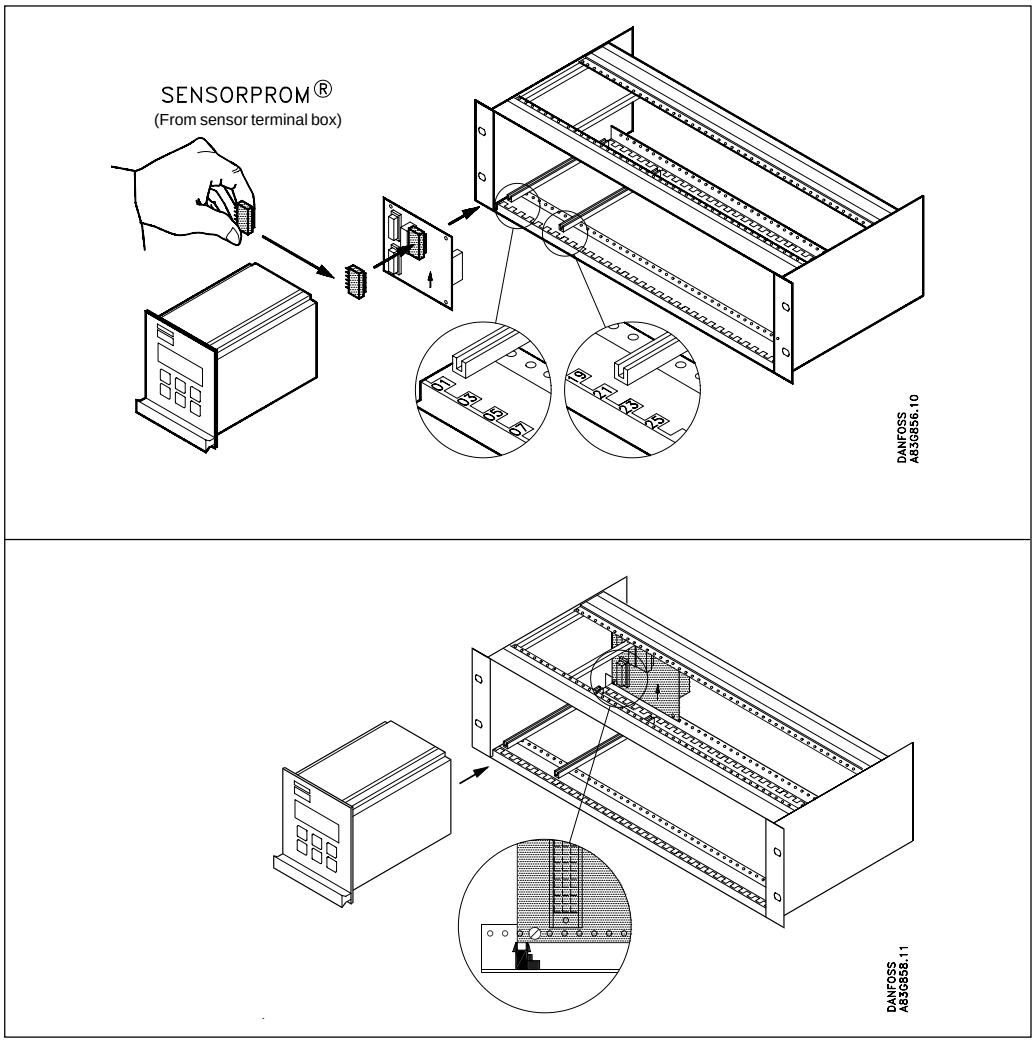


Step 6 (wall mounting)
Mount the signal converter on the terminal box.

6.2.4
Remote installation

Rack mount

(continued from page 38)



Step 1 + 2
Please refer to page 38.

Step 3 (Rack mount units)
Mount the SENSORPROM® memory unit on the connection board supplied with the signal converter as shown. **The SENSORPROM® unit is supplied with the sensor in the terminal box.**

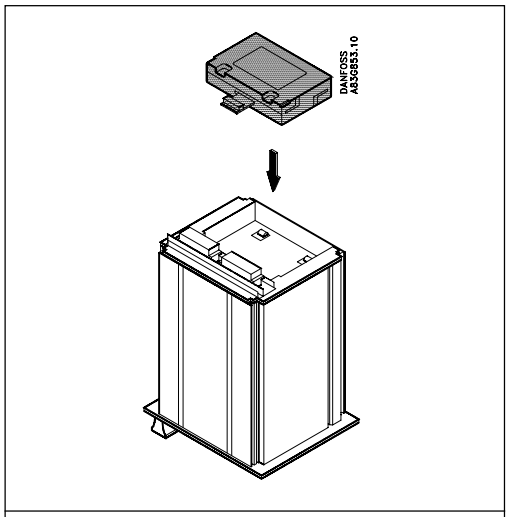
Step 4 (Rack mount units)
Mount the guide rails in the rack system as shown. Distance between guide rails is 4.52 inch. Guide rails are supplied with the rack system and not with the signal converter.

Step 5 (Rack mount units)
Mount the connection board as shown. Board to be mounted on the inside.

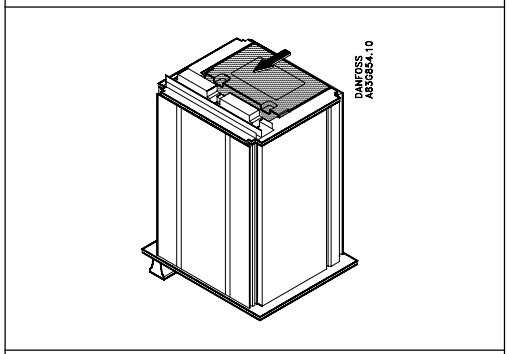
Step 6 (Rack mount units)
Connect the cables as shown under "Electrical connection", section 7.

Step 7 (Rack mount units)
Insert the signal converter into the rack system.

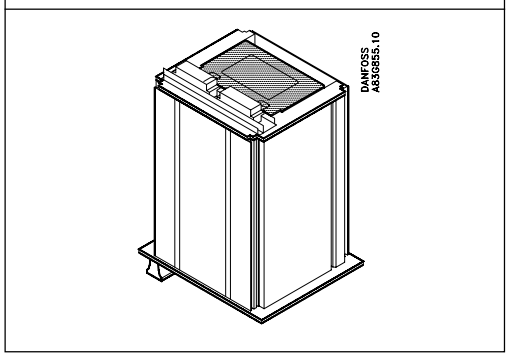
6.2.5 Add-on modules (MAG 6000 only)



Locate the add-on module in the bottom of the MAG 6000 signal converter.

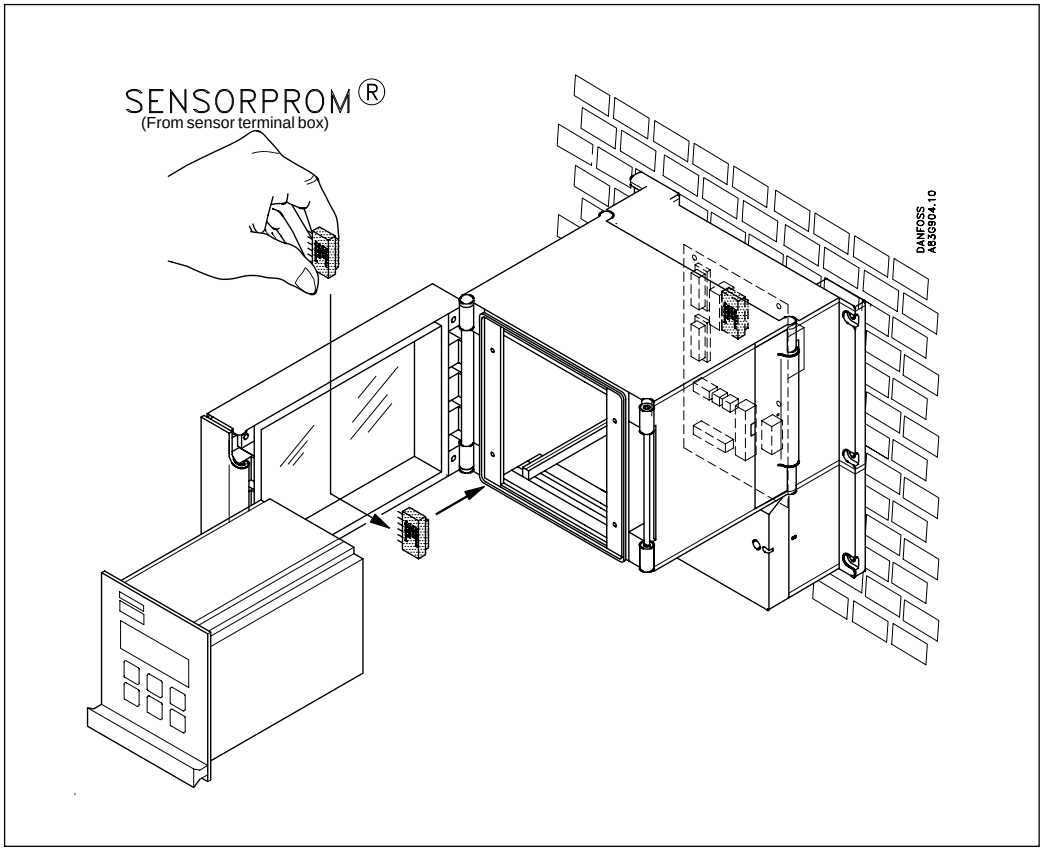


Press the add-on module forwards as far as possible.



The add-on module has now been installed and the signal converter is ready to be installed terminal box.

6.2.6
Installation using wall mounting kit
(continued from page 38)



Step 1 + 2
Please refer to page 38.

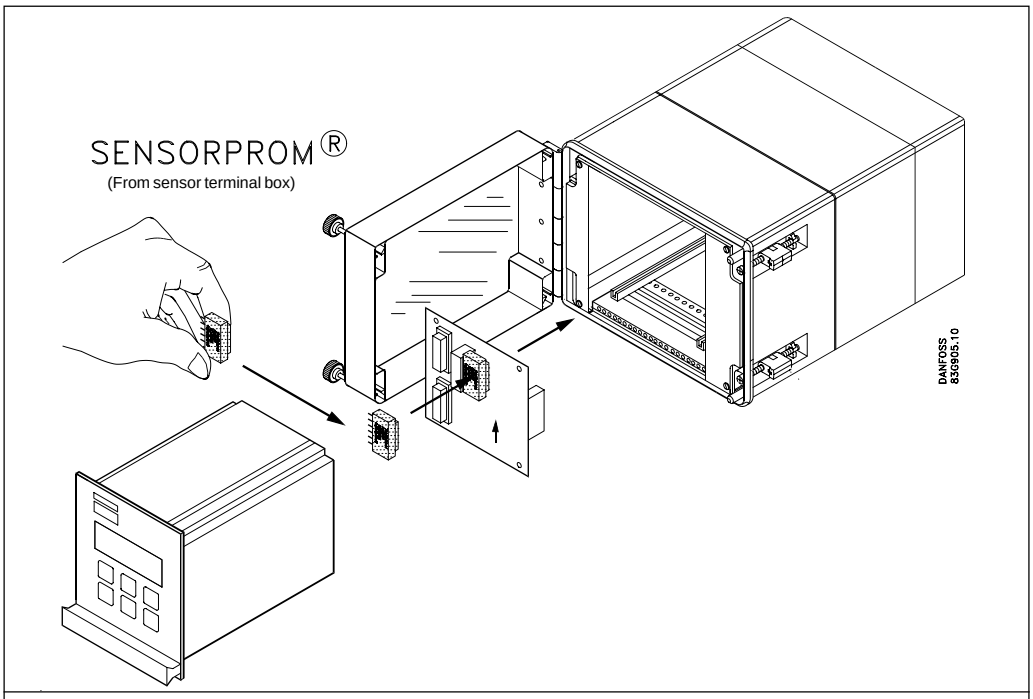
Step 3 (Rack mount units)
Mount the NEMA 4X enclosure on the wall with four screws.

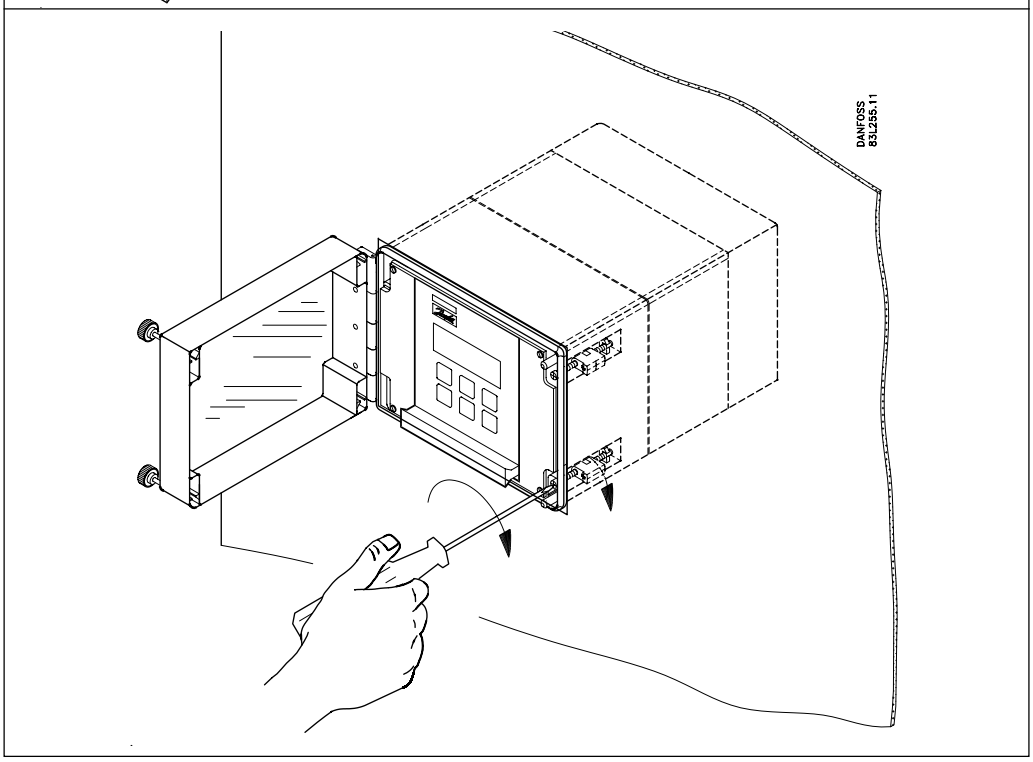
Step 4 (Rack mount units)
Mount the SENSORPROM® memory unit on the connection board as shown.
The SENSORPROM® unit is supplied with the sensor in the terminal box. The connection board for NEMA 4X wall mounting boxes must be used (only applicable if parts are bought separate and not as one unit).

Step 5 (Rack mount units)
Connect the cables to the terminals, see "Electrical connection", section 7.

Step 6 (Rack mount units)
Insert in the signal converter and close the cover.

6.2.7
Installation using front of panel mounting kit
(continued from page 38)





Step 1 + 2
Please refer to page 38.

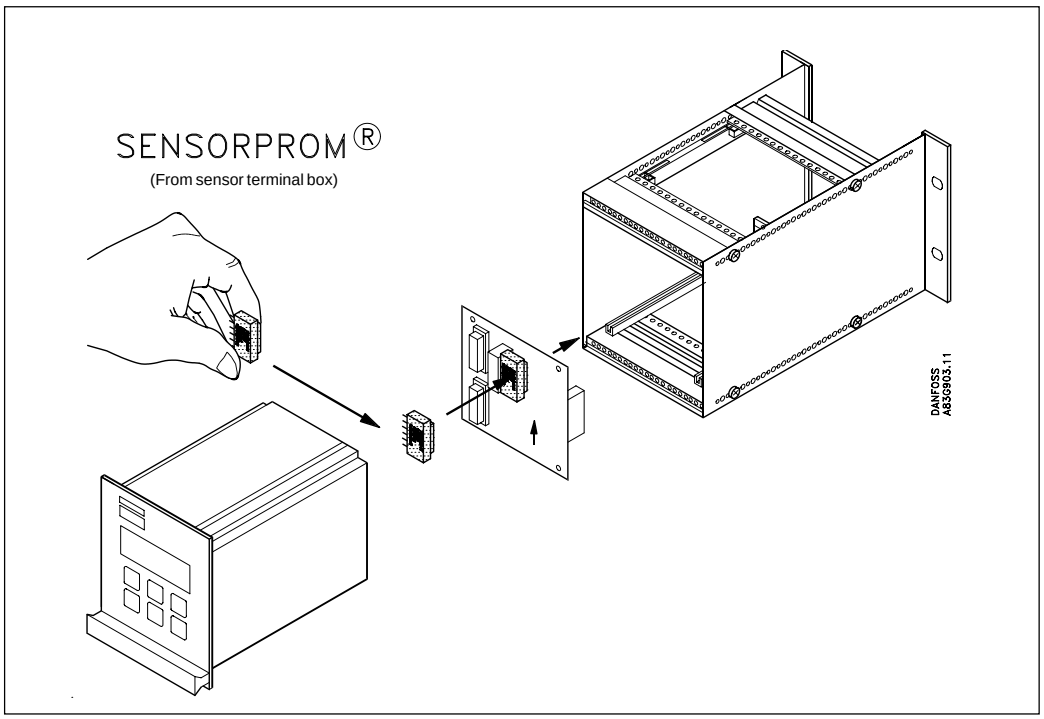
Step 3 (Rack mount units)
Mount the SENSORPROM® memory unit on the connection board as shown.
The SENSORPROM® unit is supplied with the sensor in the terminal box.

Step 4 (Rack mount units)
Fit the enclosure in a cut out at the front of a panel. Fasten the four screws accessible at the front.

Step 5 (Rack mount units)
Connect the cables as shown under "Electrical connection", section 7.

Step 6 (Rack mount units)
Insert in the signal converter and close the cover.

6.2.8
Installation using back of panel mounting kit
(continued from page 38)



Step 1 + 2
Please refer to page 38.

Step 3 (Rack mount units)
Mount the SENSORPROM® memory unit on the connection board as shown.
The SENSORPROM® unit is supplied with the sensor in the terminal box.

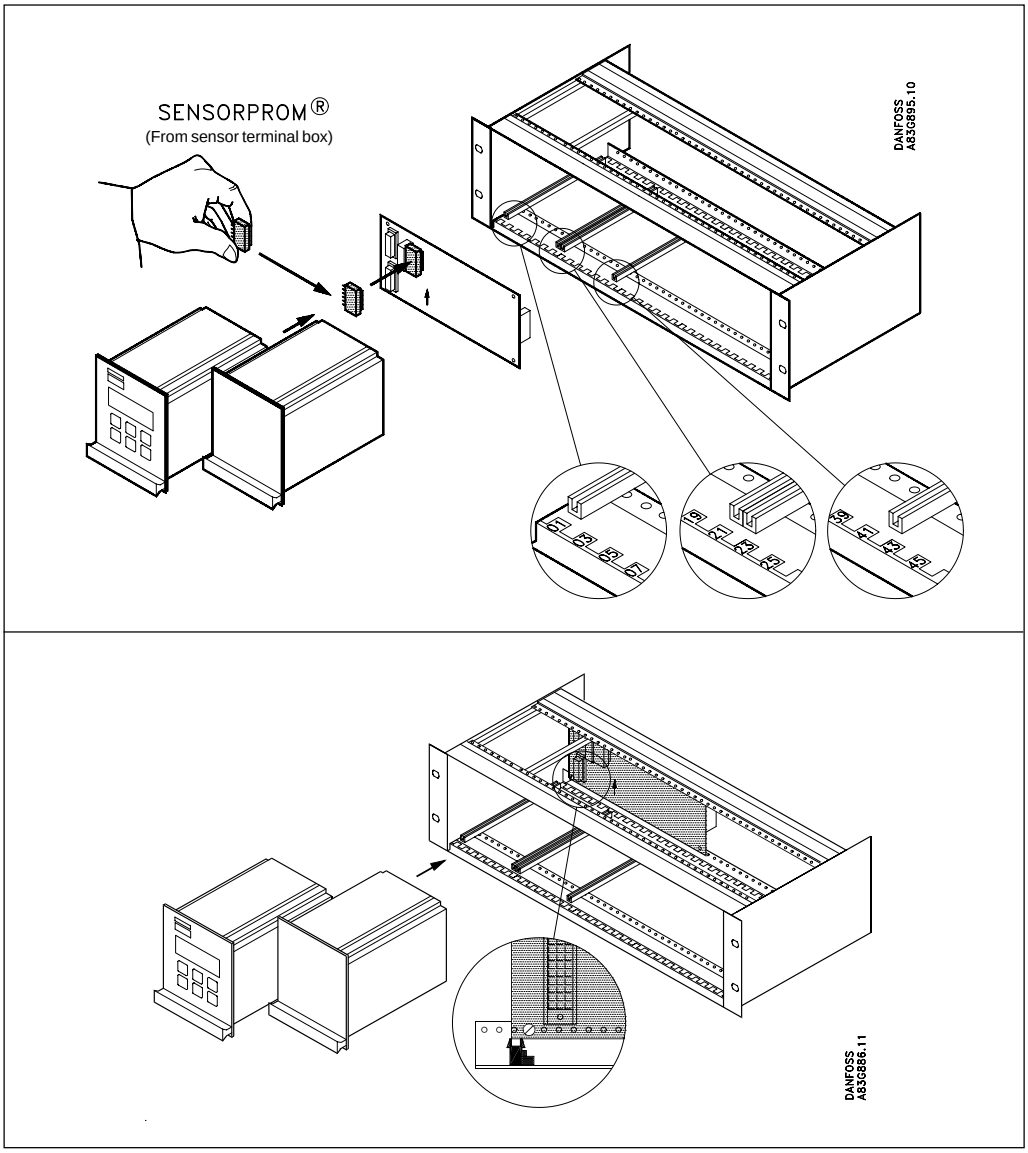
Step 4 (Rack mount units)
Mount the connection board in the back of the enclosure.

Step 5 (Rack mount units)
Connect the cables as shown under "Electrical connection", section 7.

Step 6 (Rack mount units)
Mount the enclosure in the back of a panel with four screws.

Step 7 (Rack mount units)
Insert in the signal converter.

6.3
Signal converter with safety barrier
(continued from page 38)



Step 1 + 2
Please refer to page 38.

Step 3 (Rack mount units)
Fit the SENSORPROM® memory unit on the connection board supplied with the safety barrier. **The SENSORPROM® unit is delivered mounted in the terminal box of the sensor**. The connection board supplied with the signal converter is not used.

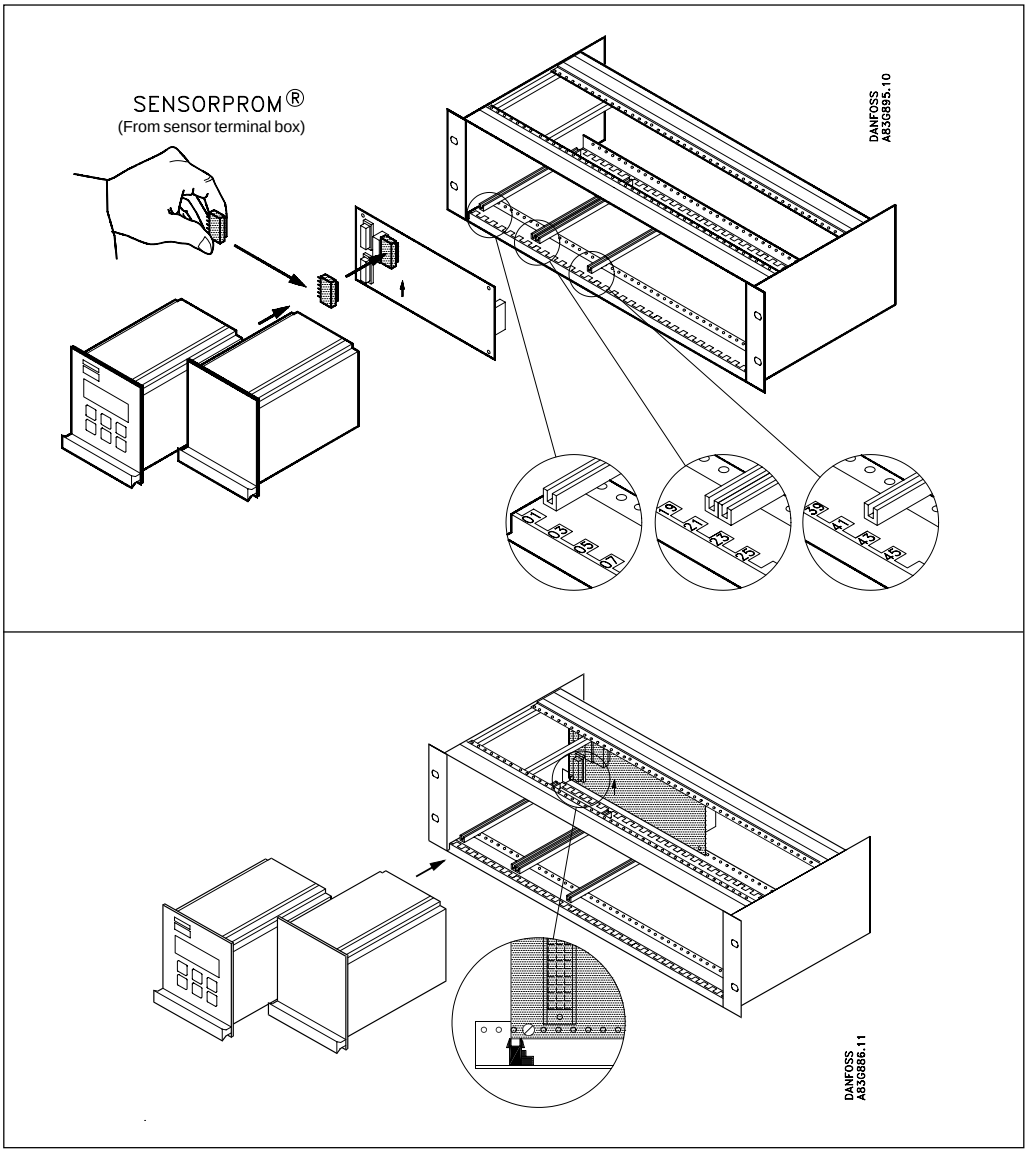
Step 4 (Rack mount units)
Mount the guide rails in the rack system as shown. Distance between guide rails is 4.52 inch. Guide rails are supplied with the rack system and not with the signal converter.

Step 5 (Rack mount units)
Mount the connection board as shown. The mounting screw must be installed just in line with the guide rails.

Step 6 (Rack mount units)
Connect the cables as shown under "Electrical connection", section 7.

Step 7 (Rack mount units)
Insert the signal converter and the safety barrier into the rack system.

6.4
Signal converter with cleaning unit
(continued from page 38)



Step 1 + 2
Please refer to page 38.

Step 3 (Rack mount units)
Fit the SENSORPROM® memory unit on the connection board supplied with the cleaning unit. **The SENSORPROM® unit is delivered mounted in the terminal box of the sensor.** The connection board supplied with the signal converter is not used.

Step 4 (Rack mount units)
Mount the guide rails in the rack system as shown. Distance between guide rails is 4.52 inch. Guide rails are supplied with the rack system and not with the signal converter.

Step 5 (Rack mount units)
Mount the connection board as shown. The mounting screw must be installed just in line with the guide rails.

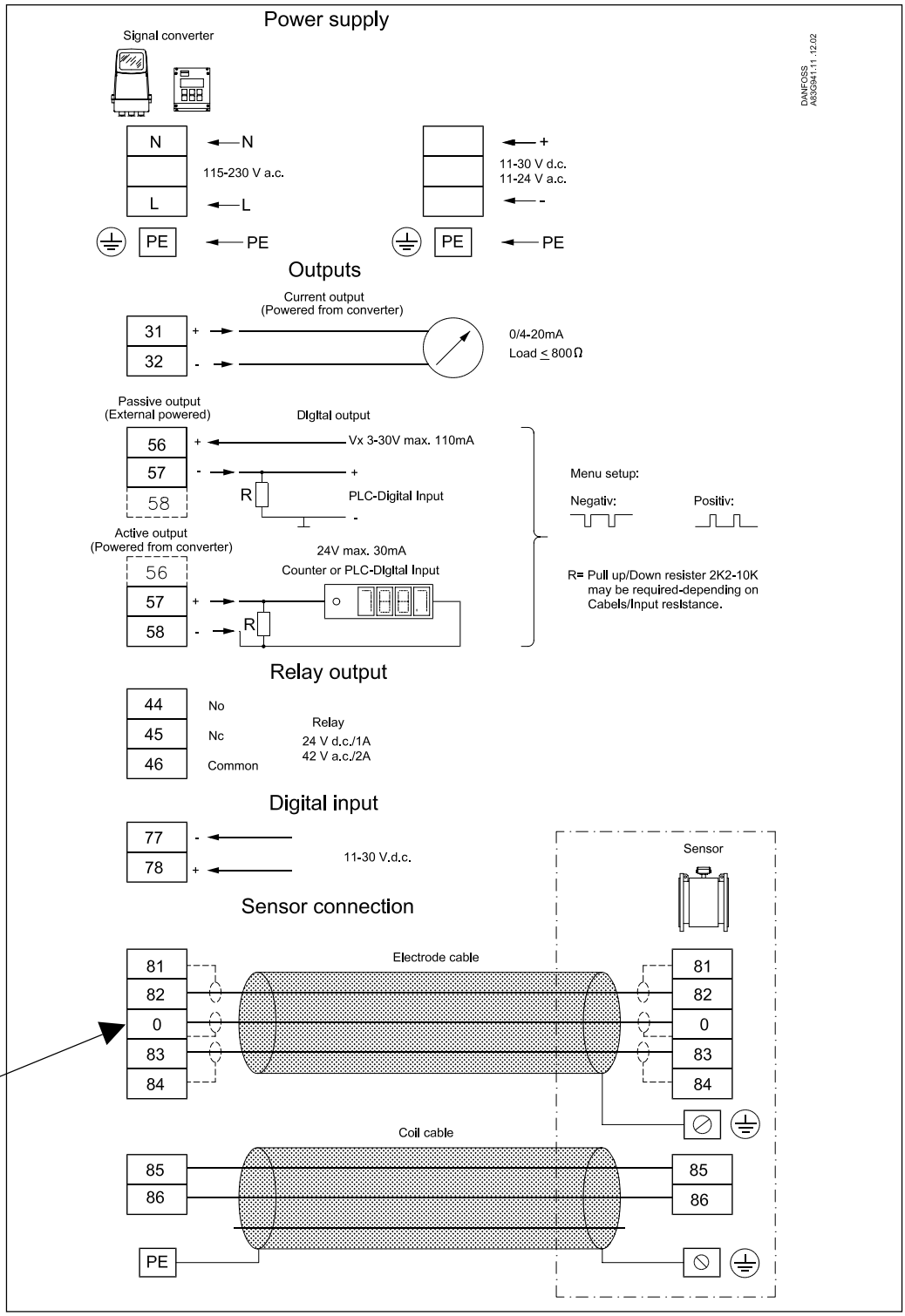
Step 6 (Rack mount units)
Connect the cables as shown under "Electrical connection", section 7.

Step 7 (Rack mount units)
Select AC-cleaning or DC-cleaning mode at the switch located on the base of the cleaning unit.

Step 8 (Rack mount units)
Insert the cleaning unit and the signal converter in the rack system.

7.1 Signal converter MAG 5000 and MAG 6000 connection diagram

Safety Note
Only qualified personnel should perform wiring or repairs, and only when the signal converter is not powered. Install signal converter in accordance with all relevant NEC and local codes.



Special cable with individual wire shields (shown with dashed lines) are only required when using empty pipe function with low conductivity process (see "Specifications, section 2)

Grounding
PE must be connected for safety reasons.

Mechanical counters
When connecting a mechanical counter to terminals 57 and 58 (active output), a 1000 µF capacitor must be connected to the terminals 56 and 58. Capacitor + is connected to terminal 56.

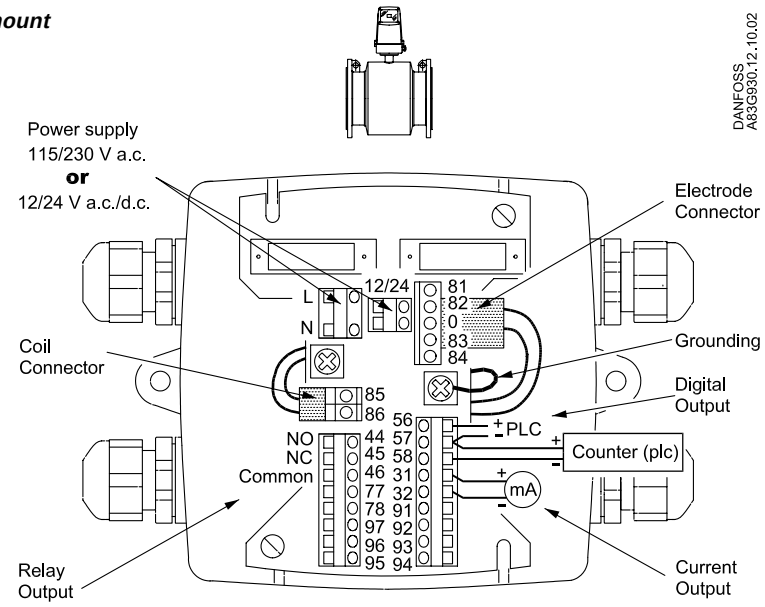
Output cables
When using long cables in an electrically noisy environment we recommend using shielded cable in metal conduit. See page 15 for max. cable lengths.

Electrode cables
Dotted connections only to be used when using speical cable.

7.2 Wiring diagram for signal converter and sensor

7.2.1 Integral installation

Integral mount



Note
Mount a grounding wire to the PE on the connnection board to ensure sufficient grounding.

Cathodic protected piping
Integral mount installation:
The signal converter must be supplied through an isolation transformer. The terminal "PE" must not be connected.

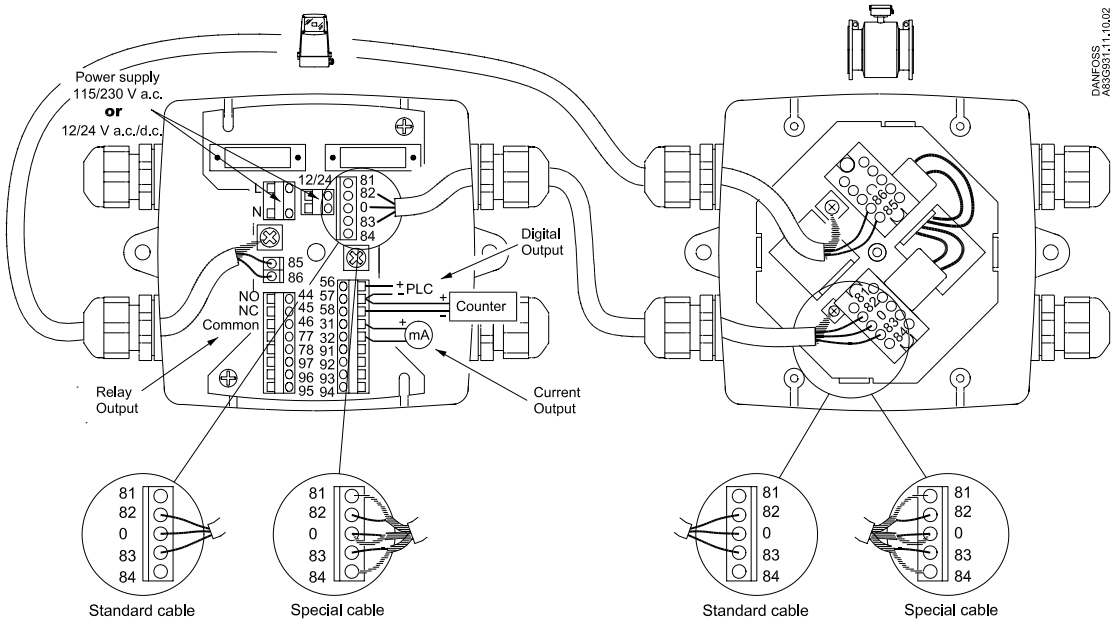
7.2.2 Remote installation wall mount NEMA 6 enclosure

Sensor cables

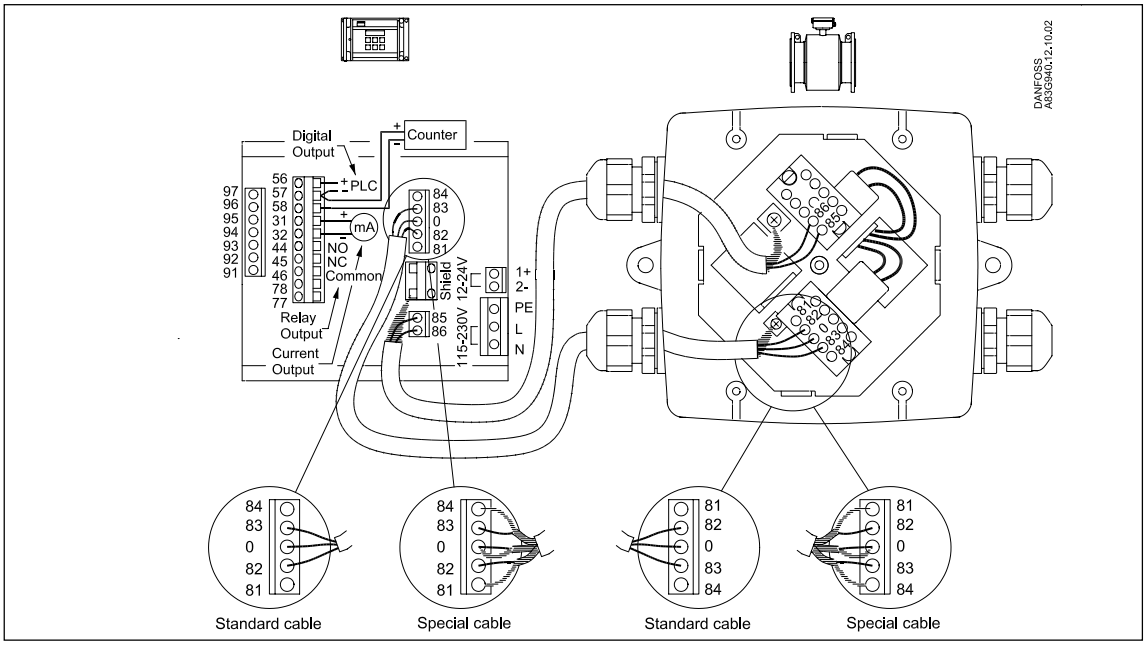
- Unshielded cable ends must be as short as possible and the two cables must be kept separate. Cables must not be spliced.
- Terminals 81 and 84 are only connected when double shielded is used. See 2.7.1.
- Coil cable shield must be connected at both ends. Electrode cable shields must be connected at sensor side only.

Note
See 5.3 when using cathodic protection.

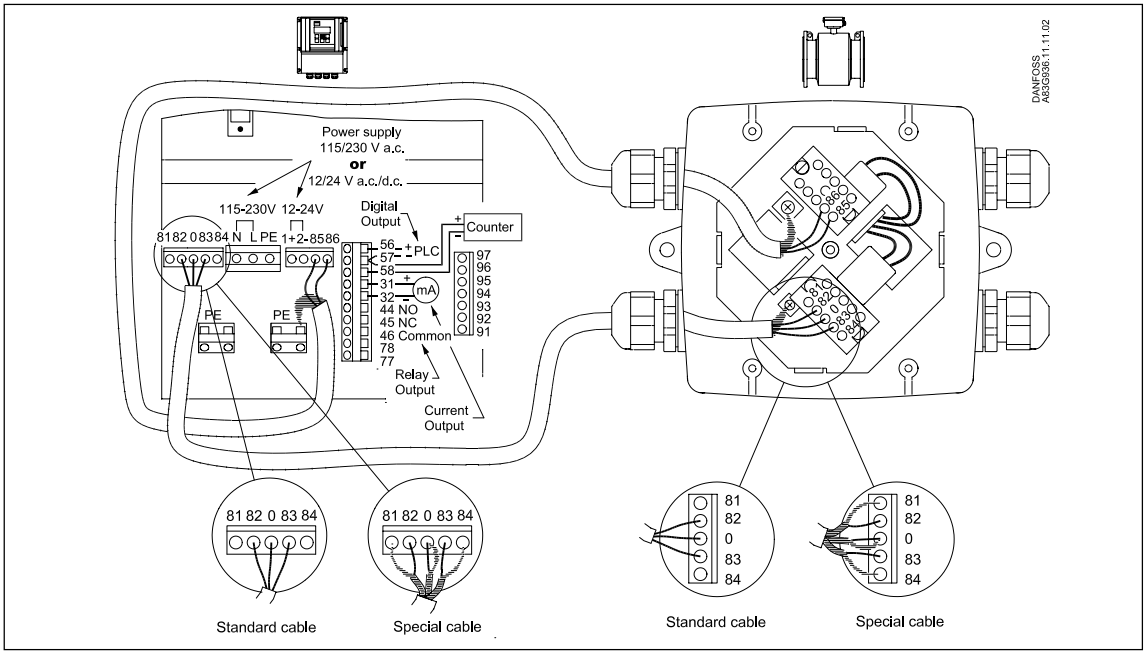
Remote wall mounting



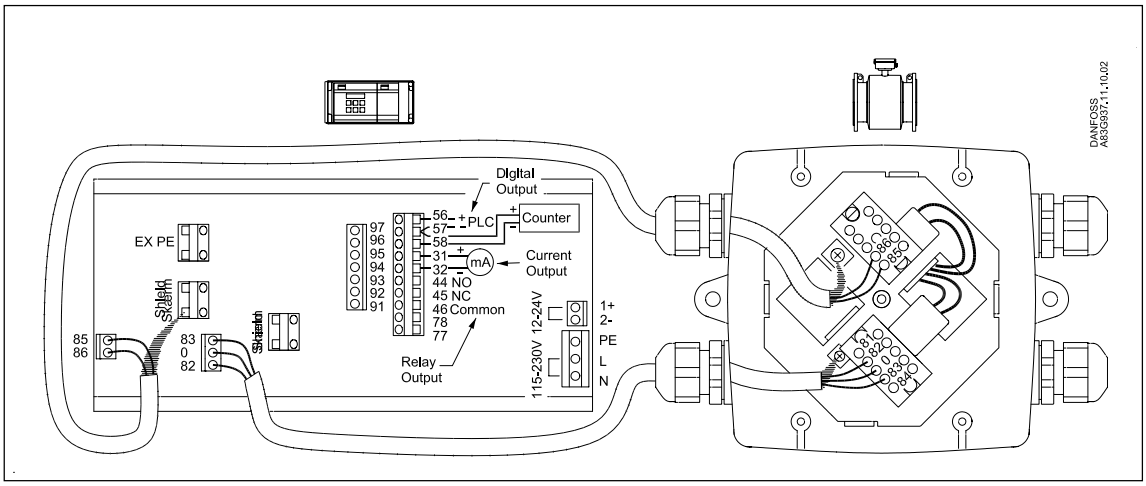
7.2.3 Rack mount NEMA 2 enclosure



7.2.4 Wall mount NEMA 4X enclosure

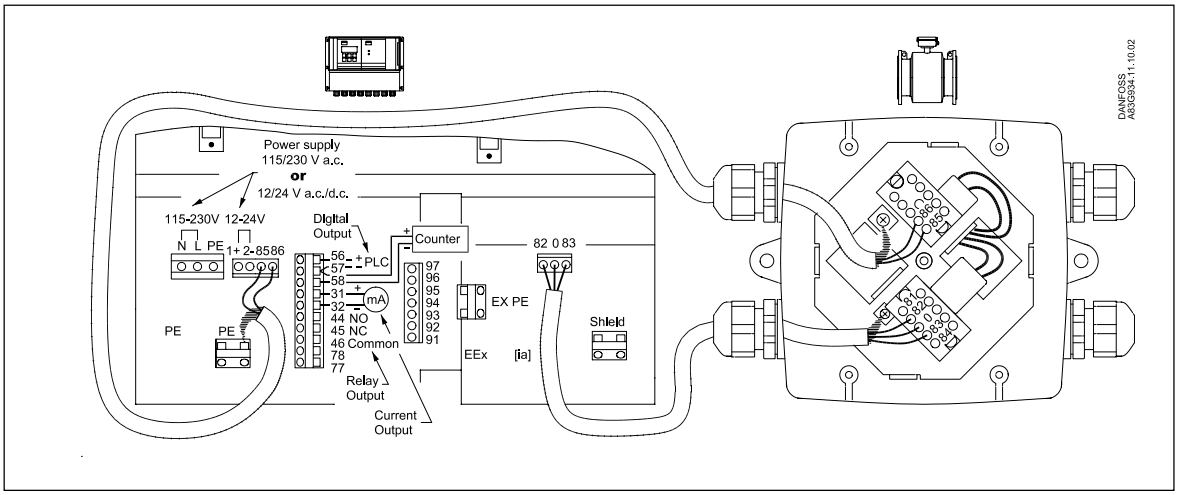


7.2.5 Rack mount with safety barrier NEMA 2 EEx (ia/ib) up to 12"

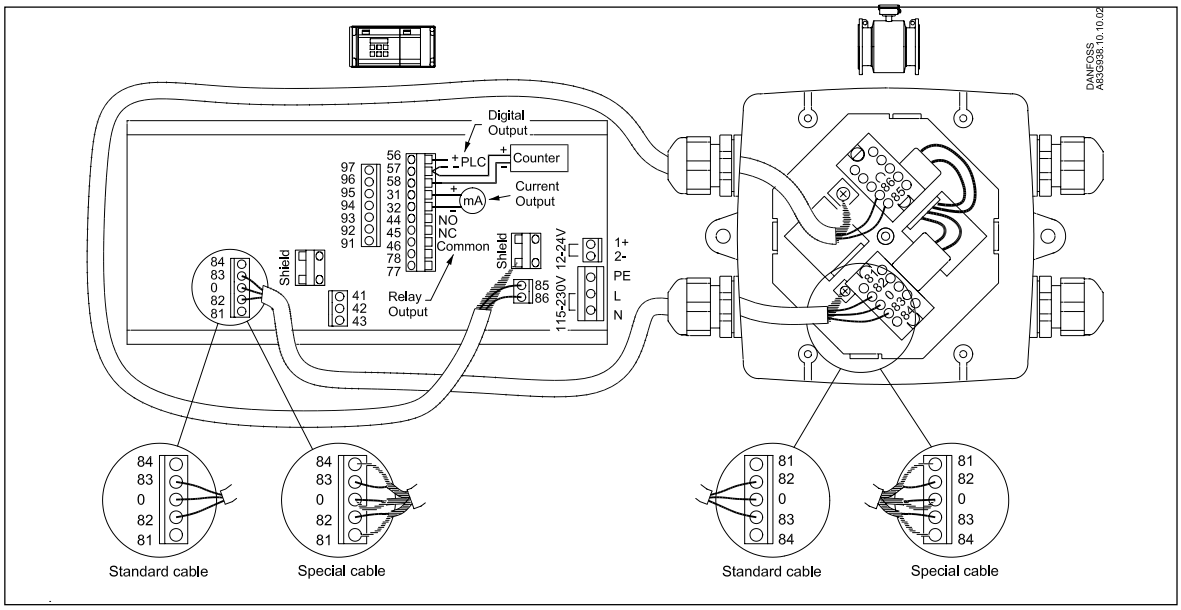


Elec.con.

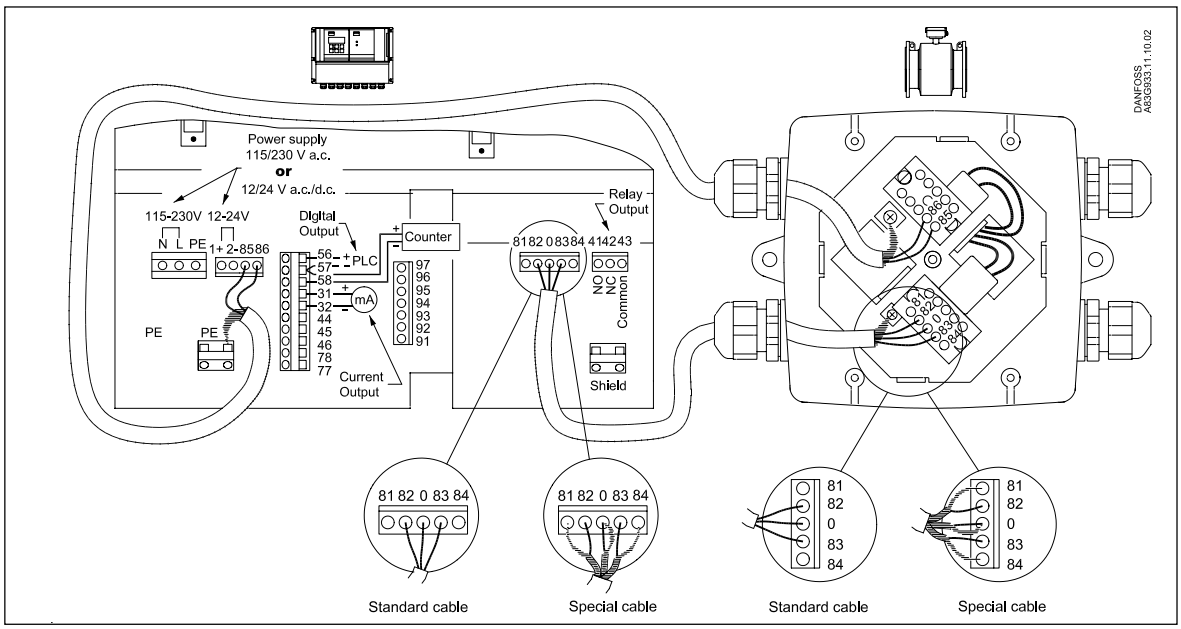
7.2.6 Wall mount with safety barrier NEMA 6 EEx (ia/ib) up to 12"



7.2.7 Rack mount NEMA 2 with cleaning unit



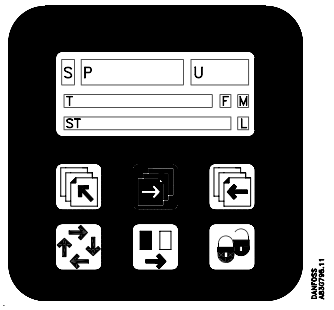
7.2.8 Wall mount NEMA 6 with cleaning unit



Elec.con.

8. Commissioning

8.1 Keypad and display layout



Keypad

The keypad is used to program the flowmeter. The function of the keys is as follows:

TOP UP KEY	This key (hold 2 sec.) is used to switch between operator menu and setup menu. In the converter setup menu, a short press will cause a return to the previous menu.
FORWARD KEY	This key is used to step forward through the menus. It is the only key normally used by the operator.
BACKWARD KEY	This key is used to step backward through the menus.
CHANGE KEY	This key changes the settings or numerical values.
SELECT KEY	This key selects the figures to be changed.
LOCK/UNLOCK KEY	This key allows the operator to change settings, save changes and gives access to submenus.

Display

The display is alphanumerical and indicates flow values, flowmeter settings and error messages.

The upper line is for primary flow readings and will always show either flow rate, totalizer 1 or totalizer 2. The line is divided into 3 fields.

S: Sign field
P: Primary field for numerical value
U: Unit field

The centre line is the title line (T) with individual information according to the selected operator or setup menu.

The lowest line is the subtitle line (ST) which either will add information to the title line or keep individual information independent of the title line.

F: The alarm field. Two flashing triangles will appear by a fault condition.

M: The mode field. The symbols indicate the following.

Communication mode	Basic settings	Operator active
Service mode	Output	Operator inactive
Operator menu	External input	
Product identity	Sensor characteristics	
Language mode	Reset mode	

L: The lock field. Indicates the function of the lock key.

Ready for change	Access to submenu
Value locked (saved)	RESET MODE: Zero setting of totalizers and initialization of setting

8.2 Menu build-up

The menu structure of a specific signal converter type is shown in a menu overview map. Details of how a specific parameter is set is shown in a menu detail map for the specific parameter. A detail map is valid for each type of signal converter if not indicated otherwise. The menu structure is valid for the title and subtitle line only. The upper line is for primary readings only and will always be active with either flowrate, totalizer 1 or totalizer 2.

The menu is built up in two parts. An **operator menu** and a **setup menu**.

Operator menu
The operator menu is for daily operation. The operator menu is customised in the operator menu setup. The signal converter always starts in operator menu No. 1. The page forward and page backward keys are used to step through the operator menus.

Setup menu
The setup menu is for start-up commissioning and service only.

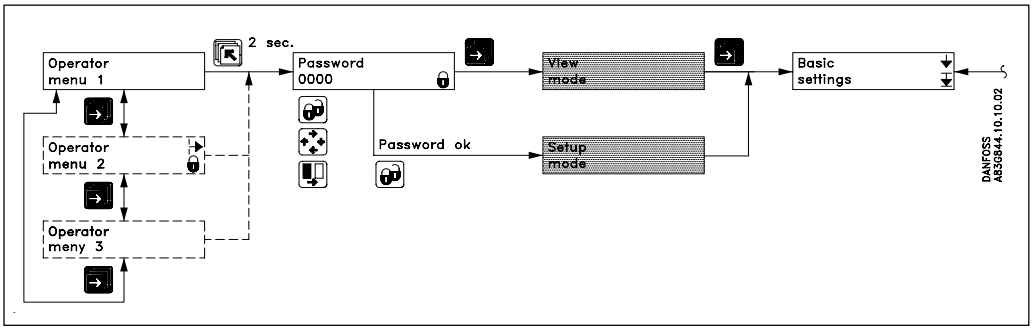
Access to the setup menu is gained by pressing the top up key for 2 seconds. The setup menu operates in two modes:
- View mode
- Setup mode

View mode is a read only mode. The pre-selected settings can only be viewed.

Setup mode is a read and write mode. The pre-selected settings can be scanned and changed. Access to the setup mode is password protected. **The factory set password is 1000 (see 8.6.1).**

Access to a submenu in the set up menu is gained by the lock key. A short press on a top up key will bring you back to the previous menu. A long press (2 sec.) on the top up key will exit the setup menu and bring you back to operator menu No. 1.

8.2.1 Password



The SETUP MENU can be operated in two different modes:

1. **VIEW MODE** (Read only)

2. **CHANGE MODE** (Read and write mode)

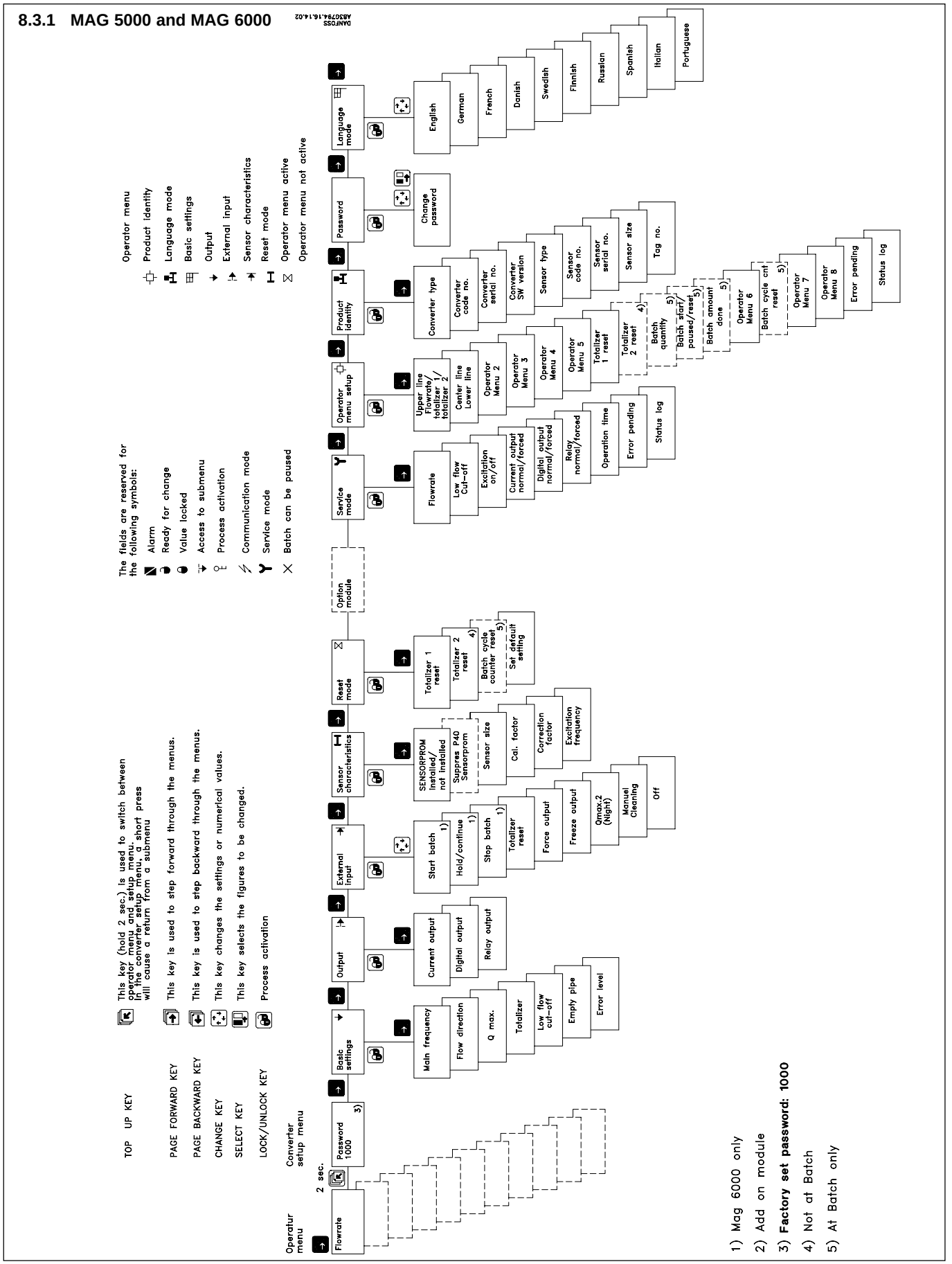
Access view mode is gained by pressing the forward key when in the password menu.

Access to change mode is password protected. The password is factory set to 1000, but can be changed to any value between 1000 and 9999 in the change password menu.

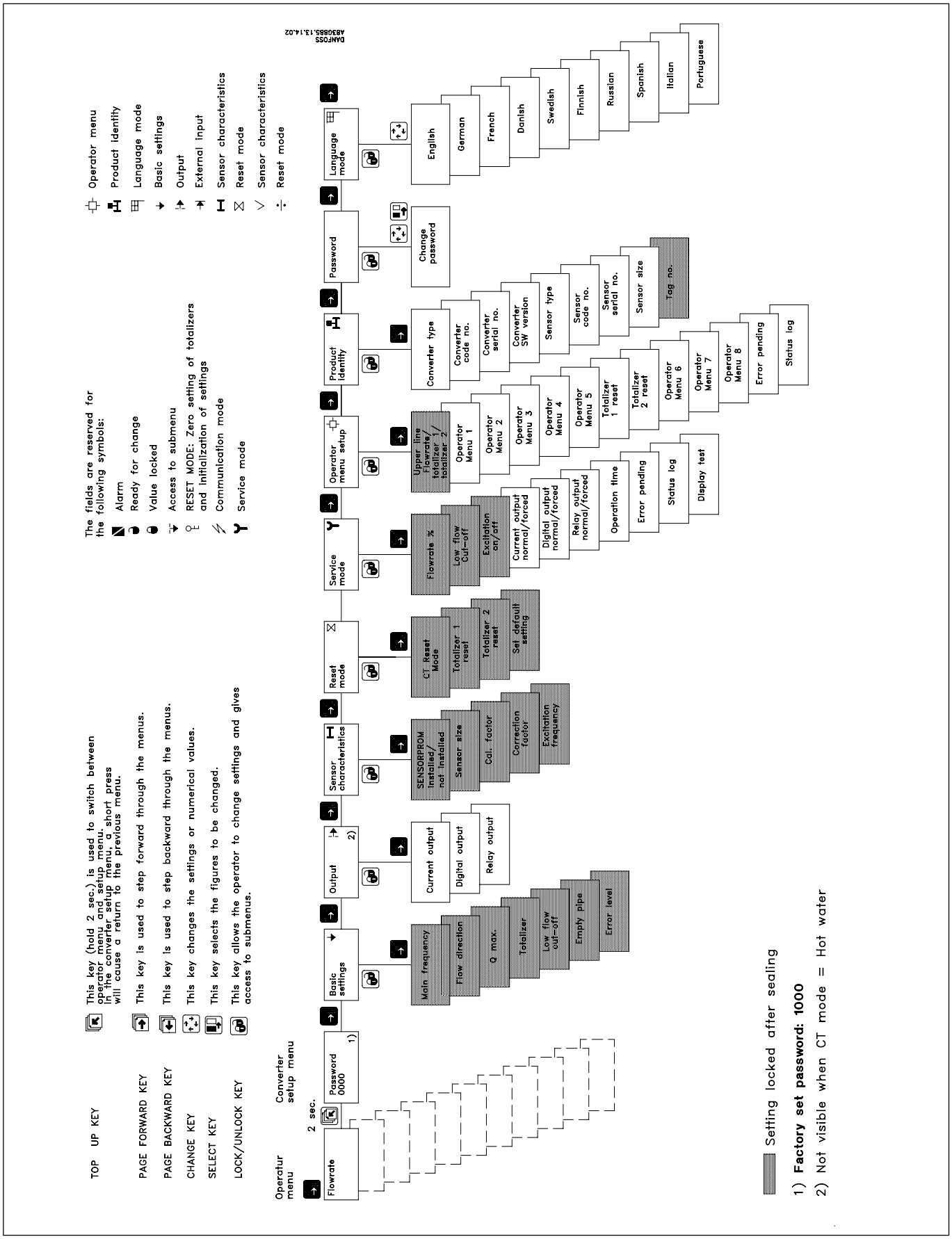
The factory setting of 1000 can be re-established as follows:
- Switch off power suppply
- Press the TOP UP key and switch on the power supply
- Release the key after ROM and RAM tests are completed

The password is now reset to 1000.

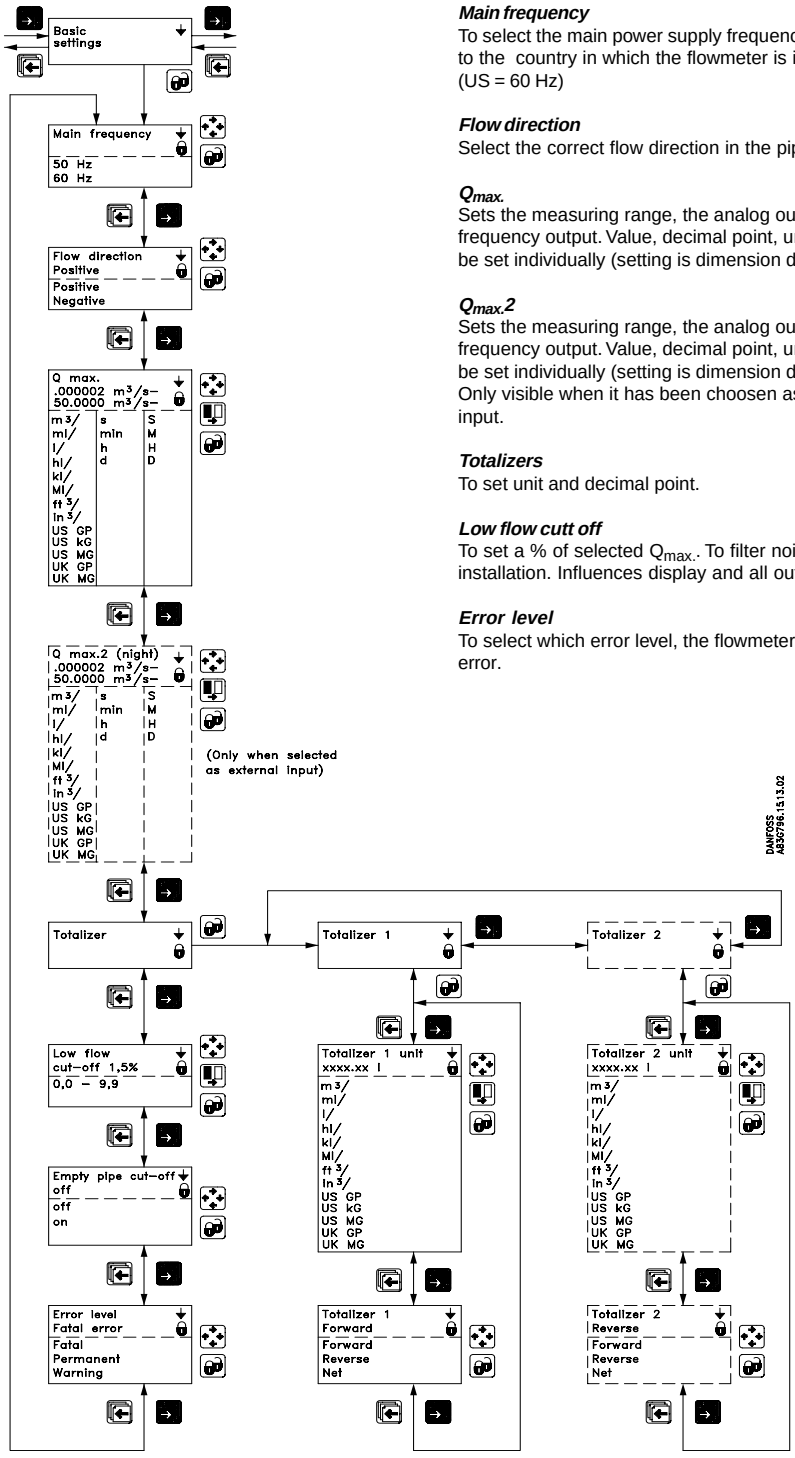
8.3.1 MAG 5000 and MAG 6000



8.3.2 MAG 6000 CT



8.4.1 Basic settings



Main frequency
To select the main power supply frequency corresponding to the country in which the flowmeter is installed. (US = 60 Hz)

Flow direction
Select the correct flow direction in the pipe

$Q_{max.}$
Sets the measuring range, the analog outputs and the frequency output. Value, decimal point, unit and time can be set individually (setting is dimension dependent).

$Q_{max.}2$
Sets the measuring range, the analog outputs and the frequency output. Value, decimal point, unit and time can be set individually (setting is dimension dependent). Only visible when it has been choosen as external digital input.

Totalizers
To set unit and decimal point.

Low flow cutt off
To set a % of selected $Q_{max.}$. To filter noise in the installation. Influences display and all outputs.

Error level
To select which error level, the flowmeter will detects an error.

Comma for flow rate, totalizer 1 and totalizer 2 can be individually positioned.

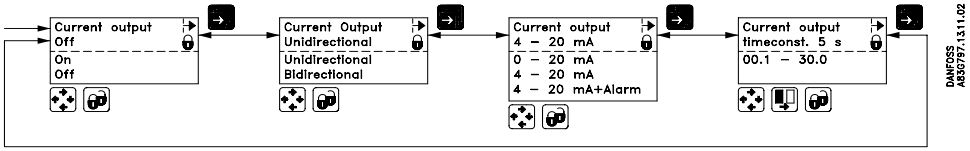
- open the respective window.
- ensure that the cursor is positioned below the comma. Use the SELECT KEY .
- move the comma to the requested position. Use the CHANGE KEY .

Units are changed by means of the CHANGE KEY with the cursor placed below the unit selected. Select units (cursor moved) by means of the SELECT KEY .

Totalizer 2 is not visible when batch is selected as digital output.

8.4.2 Outputs

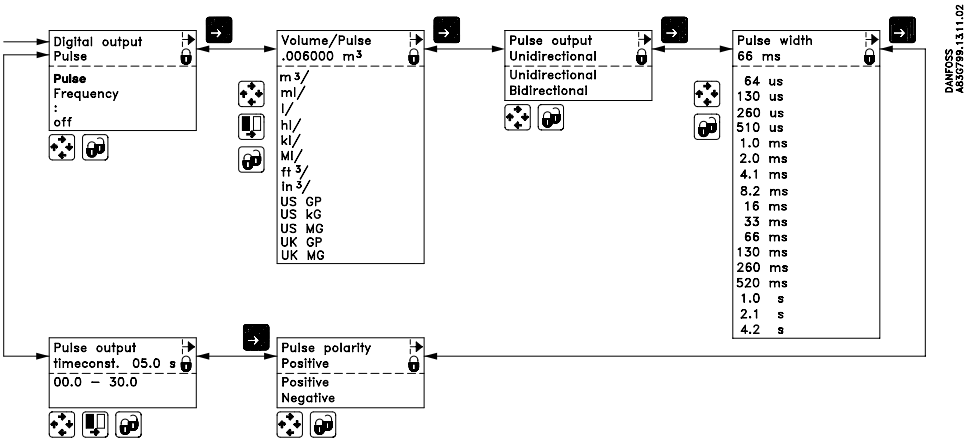
Current output Proportional to flowrate (Terminal 31 and 32)



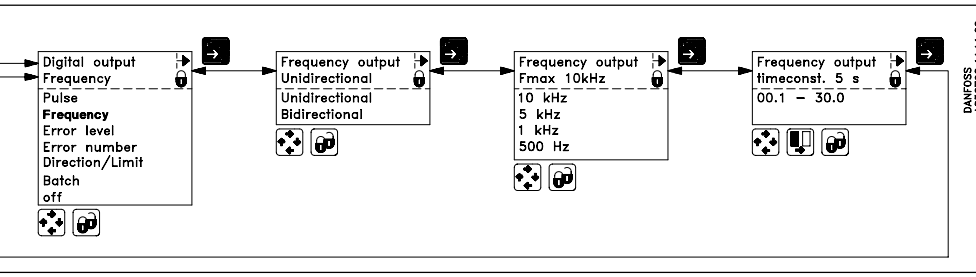
4 - 20 mA + alarm:
Current output gives the following mA, depending on what is selected as error level in basic settings.
Fatal: 1 mA, permanent: 2 mA, warning: 3 mA

The current output must be turned off when not used.

Digital output Pulse/volume (Terminal 56, 57, 58)

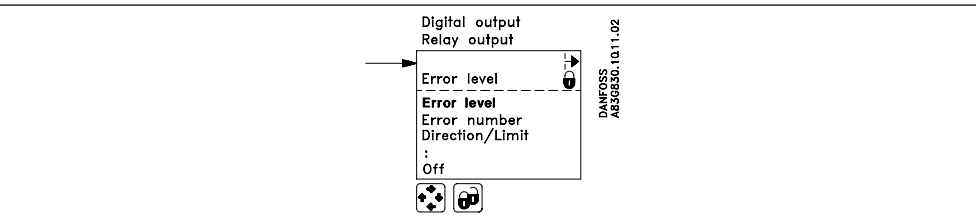


Digital output Frequency Proportional to flowrate (Terminal 56, 57, 58)

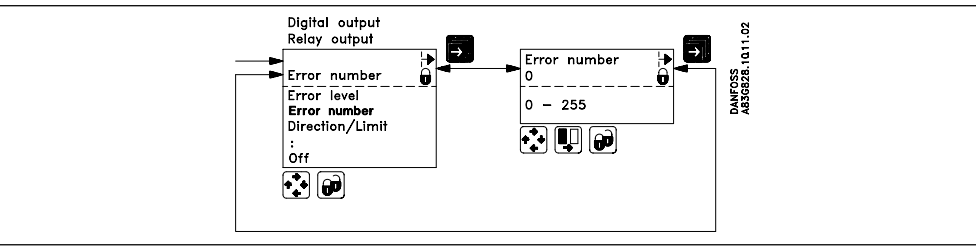


8.4.3 Digital and relay outputs

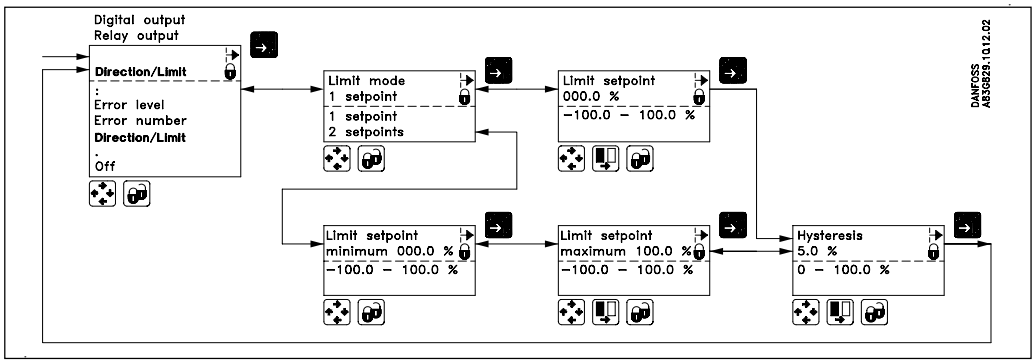
Error level



Error number



Limit/direction

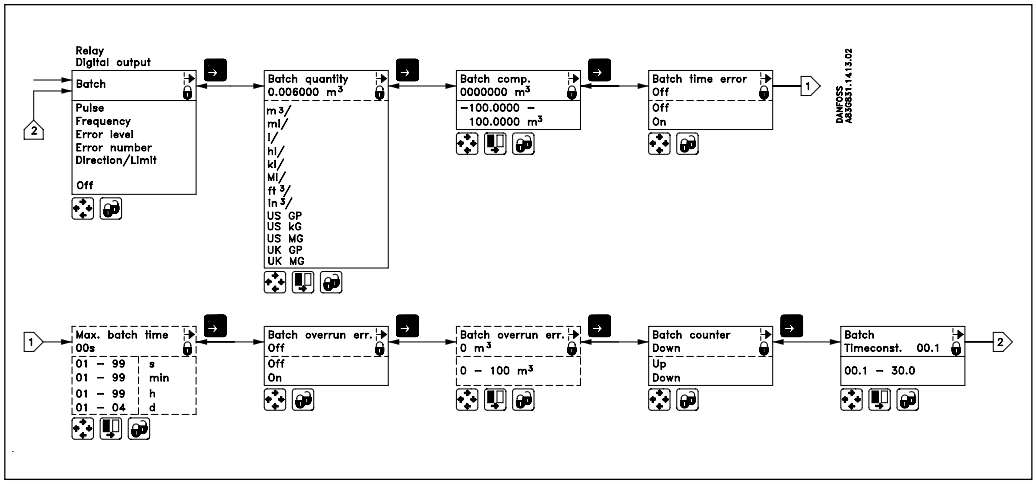


Limit switches are available for both digital as well as relay output.

Direction mode: 1 set point at 0% flow; hysteresis 5%.
If 2 set points must activate 2 separate outputs, a single set point has to be selected individually for digital as well as relay outputs.

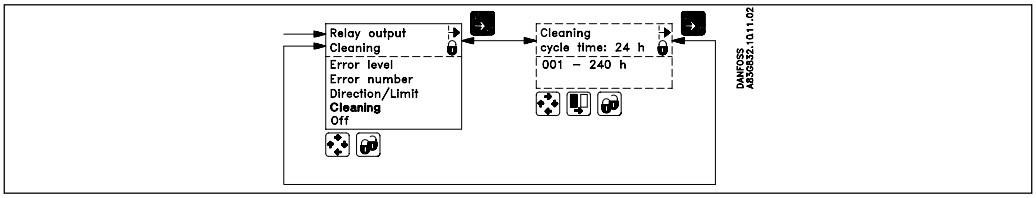
Batch

(MAG 6000 only)
(Possible through relay and digital output)



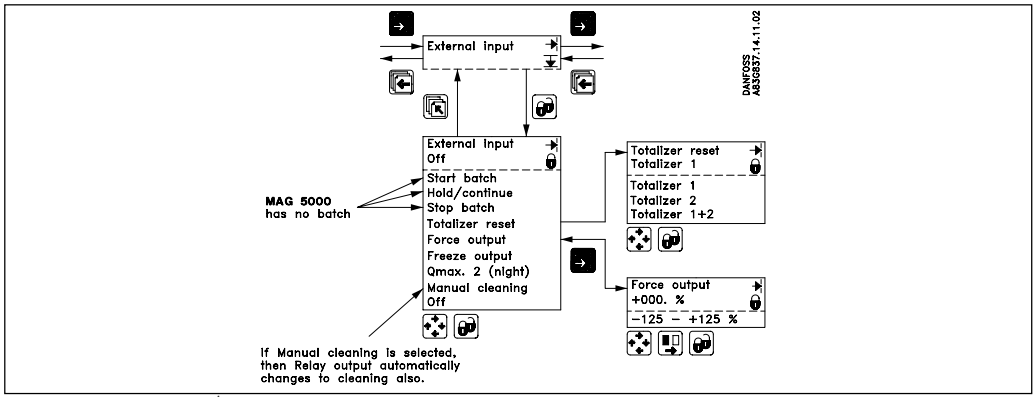
8.4.4 Relay output

Cleaning



The relay output must always be used to operate the cleaning unit when a cleaning unit has been installed together with the signal converter. The relay output cannot be used for other purposes.

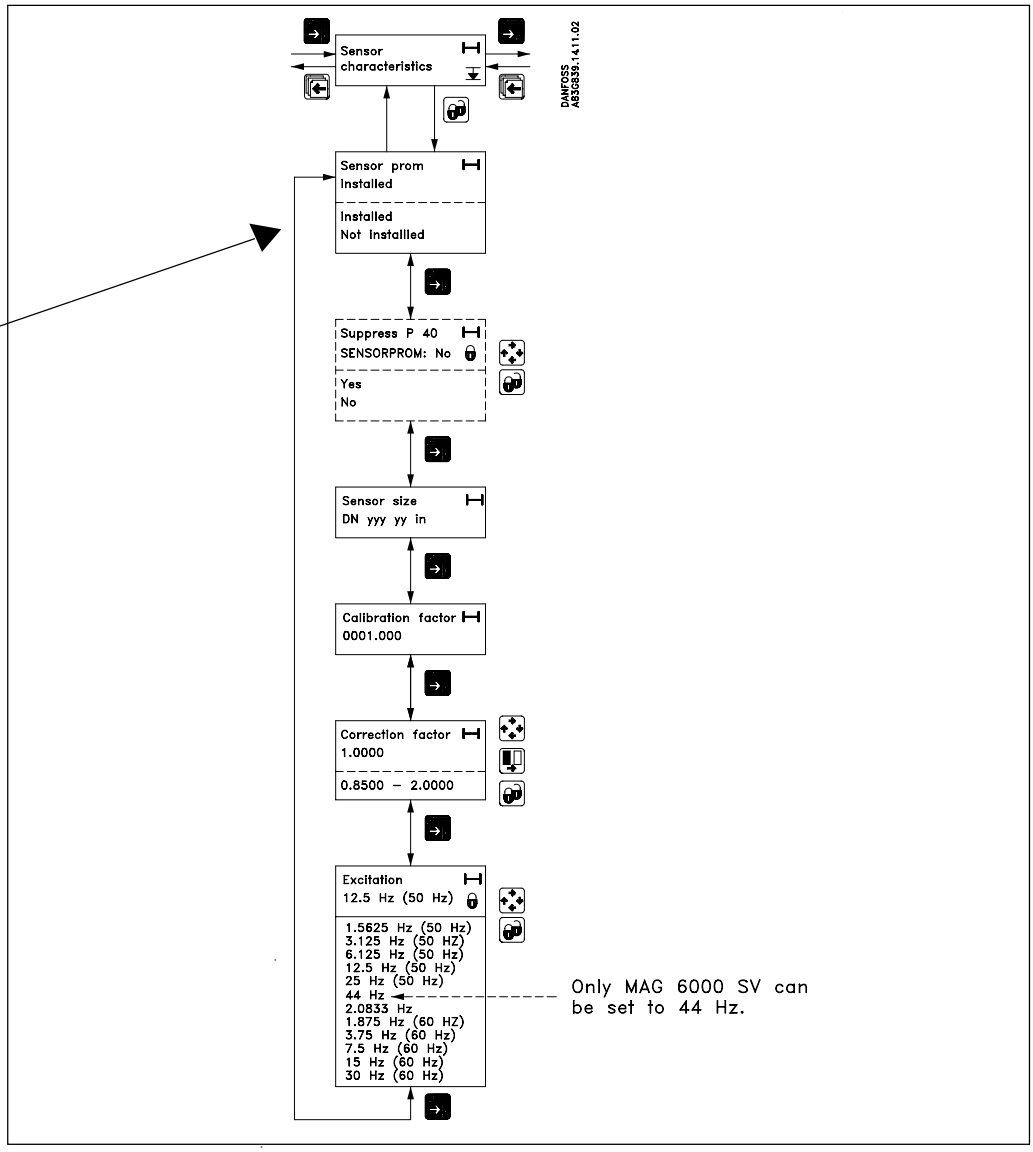
8.4.5 External input



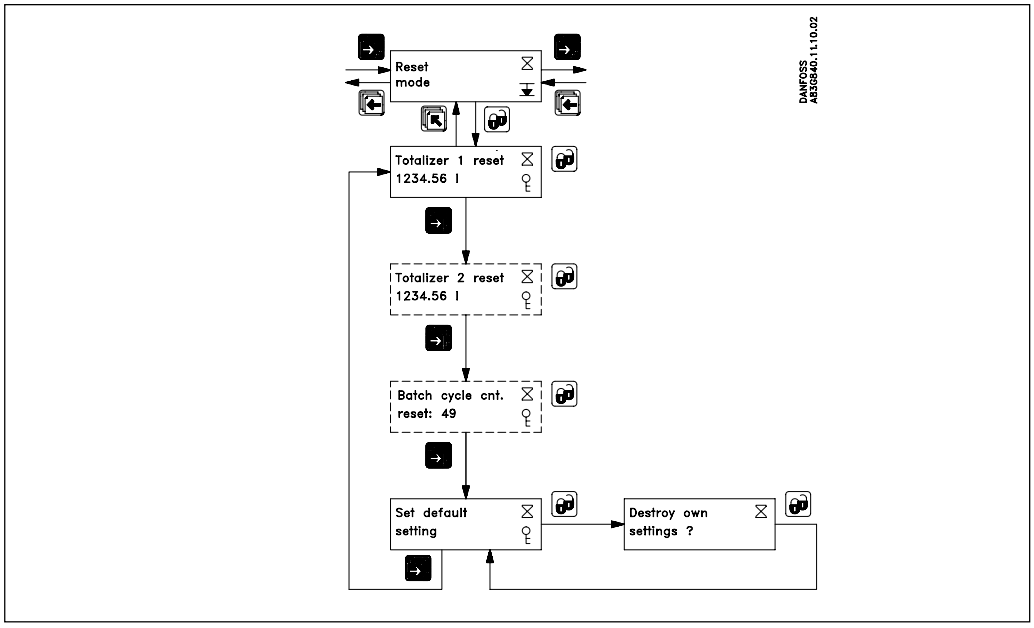
Batch control is available on MAG 6000 only.

8.4.6 Sensor characteristics

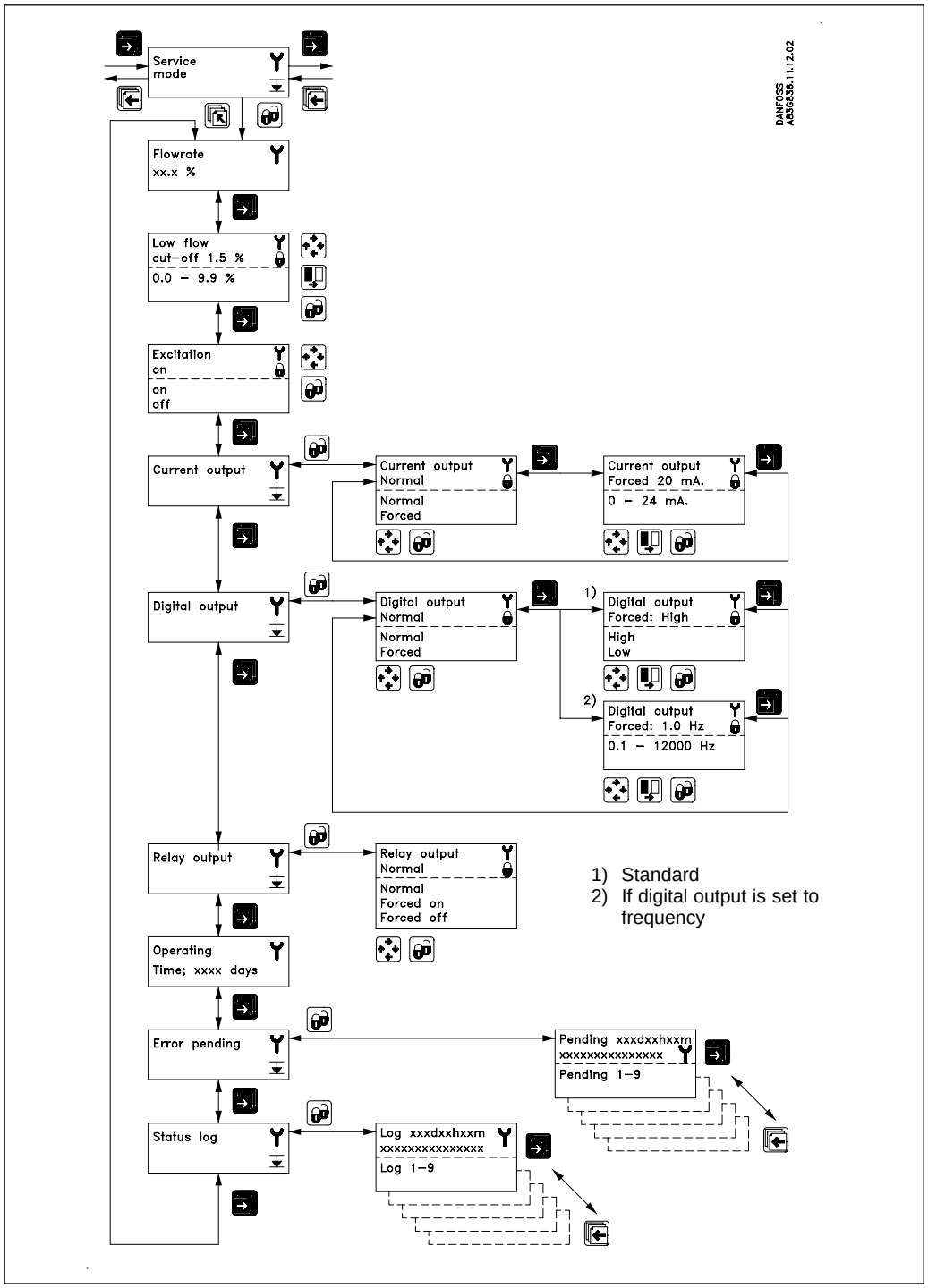
If “SENSORPROM not installed” is shown, refer to section 6 (depending on type of mounting configuration).



8.4.7 Reset mode



8.4.8 Service mode



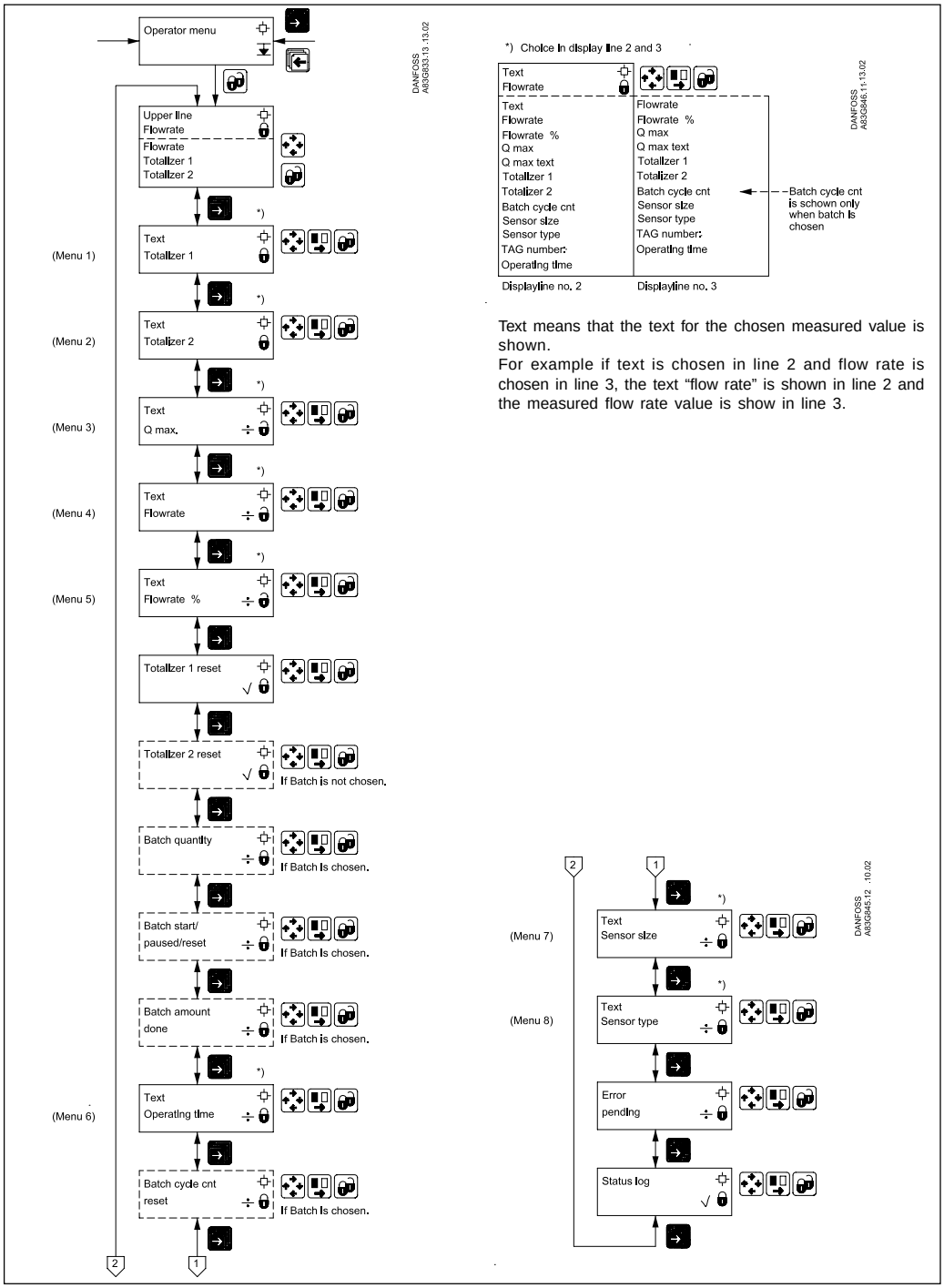
All previous settings are reinitialized when service mode is exited using the top up key .

The error system

The error system is divided into an error pending list and a status log list. Time is displayed as days, minutes and hours since the error has occurred. The first 9 standing errors are stored in error pending. When an error is removed it is removed from error pending. The latest 9 errors are stored in the status log. When an error is removed it is still kept in status log. Errors in status log is stored for 180 days.

Error pending and status log are accessible when enabled in the operator menu.

8.4.9 Operator menu setup



The upper line is always active and can never be deselected.

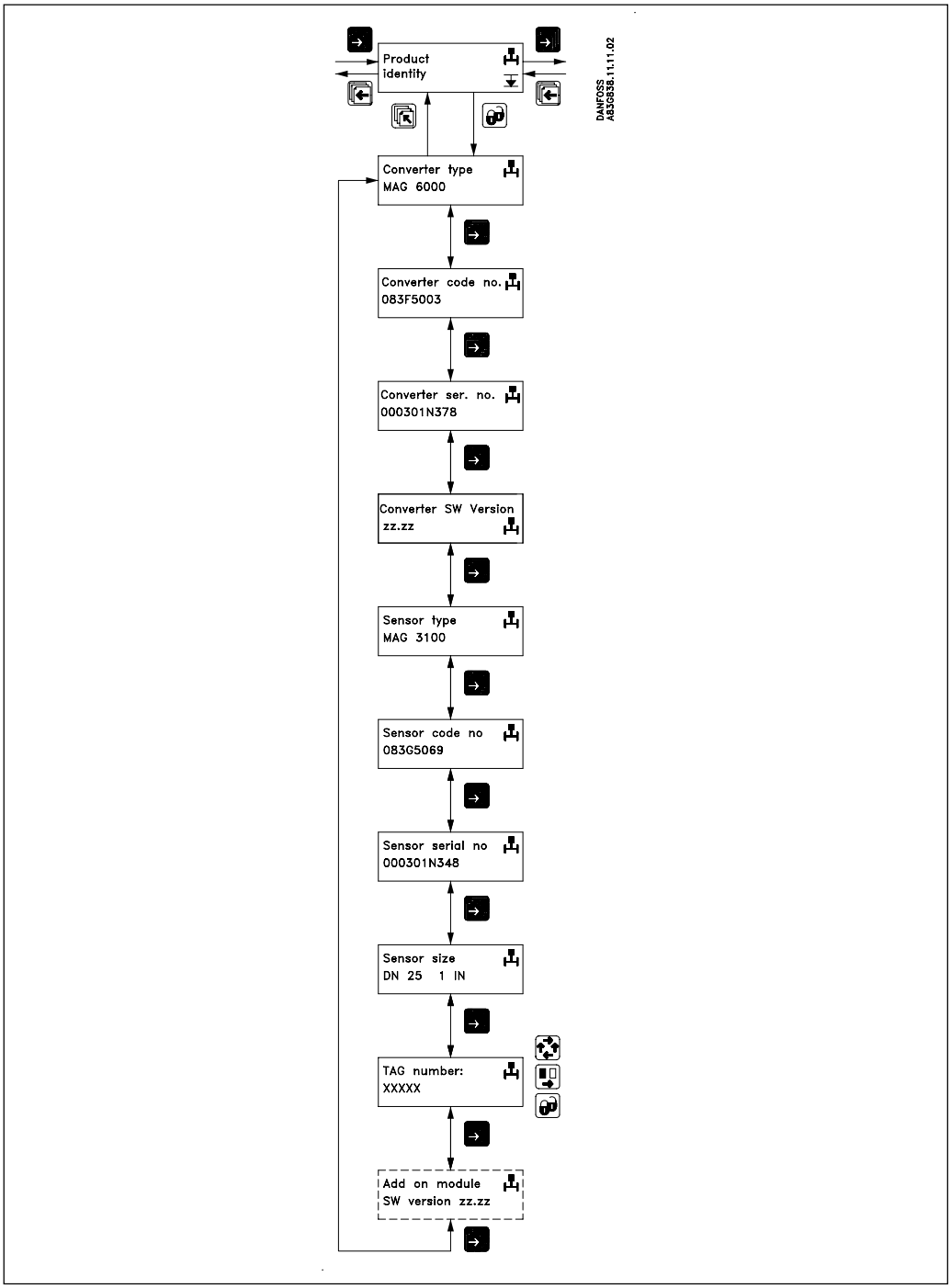
The two lower lines are for individual operator information. Information which the operator can scroll through with the forward key .

- A closed lock key in the operator menu setup, means that the menu is enabled when viewing the operator menu.
- An open lock key symbol , means that the menu is not available in the operator menu.

The middle line can either be used as a heading “Text line” for the lower line, or as a flow-reading. A flow reading can be individually selected for each menu.

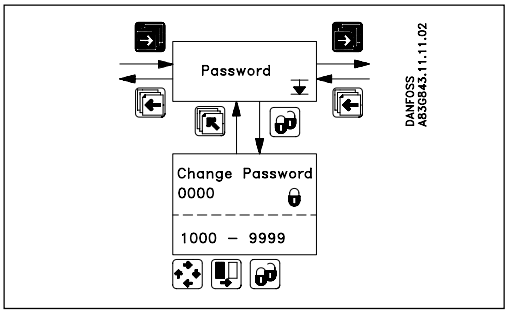
The lower line may be used for an additional flow reading to the reading already available in the upper line.

8.4.10 Product identity (Read only)



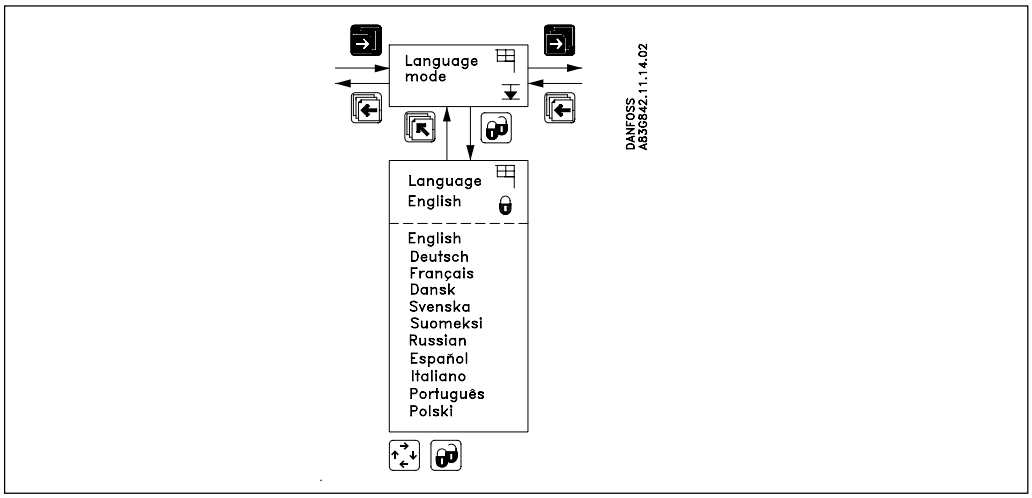
Software version of add-on module is only available if the add-on module has been installed.

8.4.11 Change password



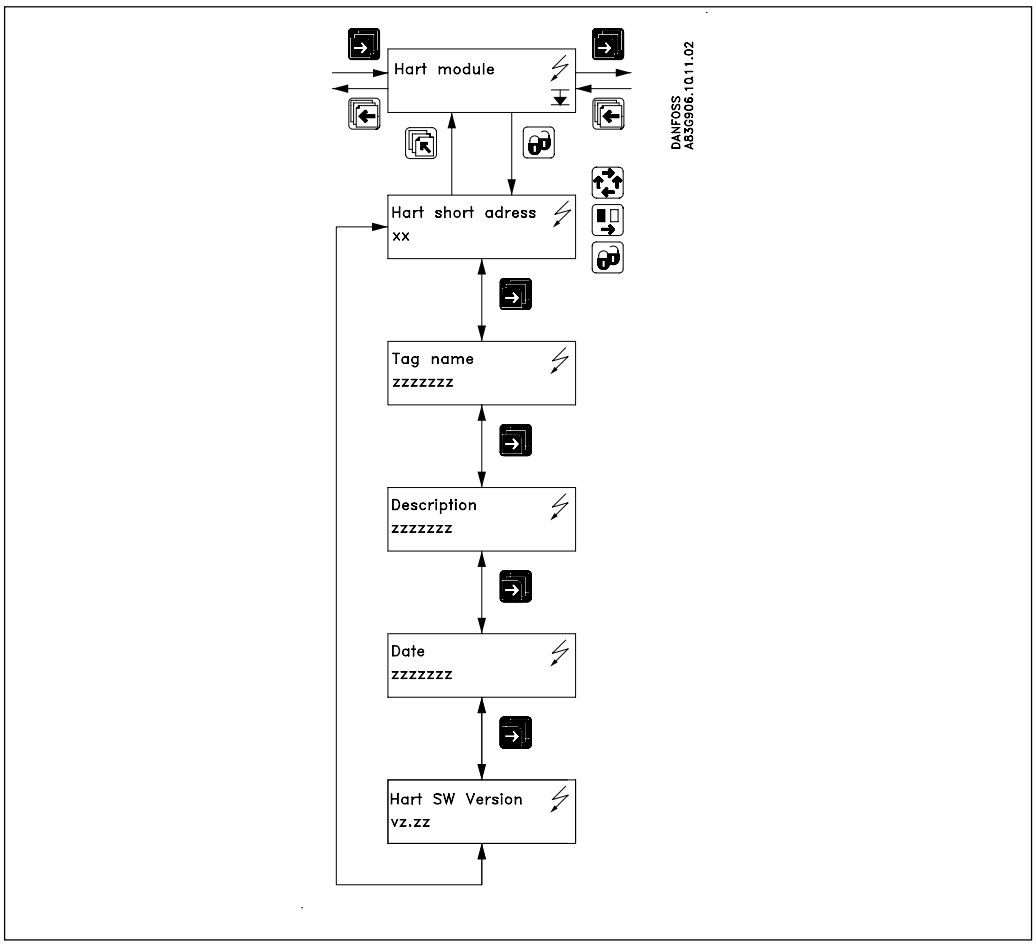
If you have forgotten your password please refer to 8.2.1 on how to reset your password back to factory setting, 1000.

8.4.12 Language mode

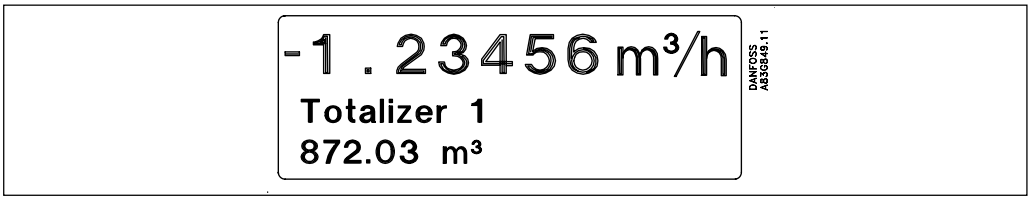


Used to select language.

8.4.13 HART® communication MAG 5000 HART or as add-on module



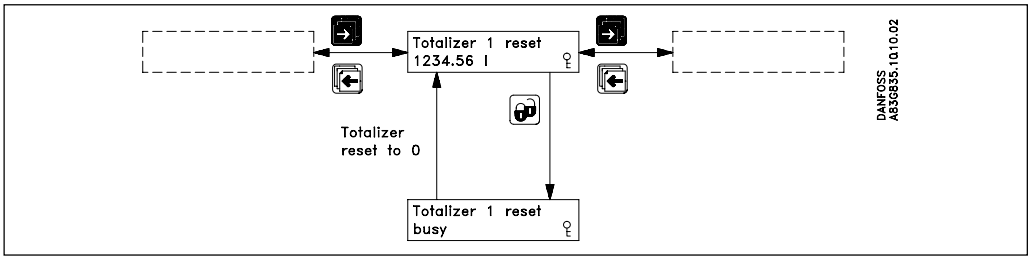
8.5.1
Operator menu
Flow rate



The 1st display line is always active and shows the value enabled in the operator menu setup.
- Flow rate
- Totalizer 1
- Totalizer 2

The 2nd and 3rd display lines are individually set in the operator menu. The page forward key steps through the enabled settings.
- Flow rate
- Totalizer
- Totalizer reset
- Batch control
- Batch cycle counter
- Batch cycle counter reset
- Pipe size
- Sensor type
- Pending errors
- Status log
- Tag No.

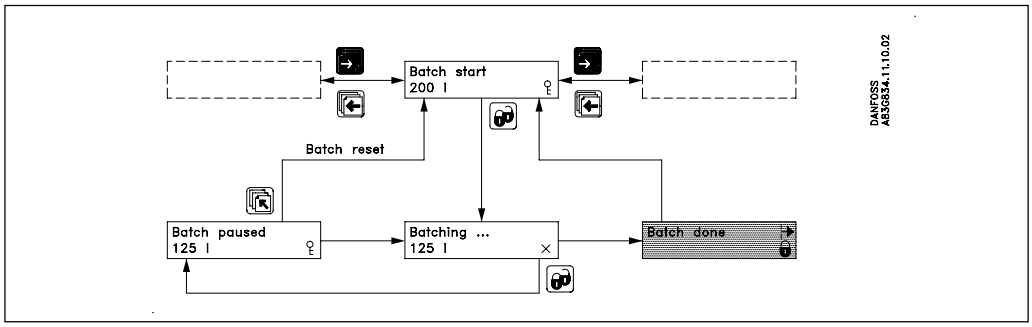
8.5.2
Totalizer reset
Totalizer



A totalizer is reset by pressing the lock key when the corresponding totalizer reset window is open.

8.5.3
Batch

(Only available on MAG 6000)



A batch can be started, paused or stopped from the operator menu, in addition to the externally operated batch control. The batch is controlled using the lock and the top up keys.
The lock key :
- Starts the batch
- Holds the batch (pause) when pressed during batching
- Restarts the batch to continue when pressed during a pause.

The top up key resets a batch completely during a pause.

Batch cycle counter The accumulated number of performed batches can be viewed when enabled in the operator menu setup, please refer to 8.4.9.

Batch cycle counter reset The batch cycle counter is reset by pressing the lock key in the “batch cycle counter reset” menu.

8.6.1 Factory settings/available settings

The signal converter is delivered with factory settings ready to measure the actual flow.

Parameter	Factory settings	Available settings
Password		
Default value	1000	
Password	1000	1000 - 9999
Basic settings		
Flow direction	Positive	Positive, negative
$Q_{max.}$ (1+2)		
- Volume units	Dim. dependent	m^3, ml, l, kl, hl, Ml, ft^3, in^3, US G, US kG, US MG, UK G, UK MG
- Time units	Dim. dependent	Sec., min., hour, day
Totalizer 1	Forward	Forward, reverse, net
- Totalizer 1 units	Dim. dependent	m^3, ml, l, kl, hl, Ml, ft^3, in^3, US G, US kG, US MG, UK G, UK MG
Totalizer 2	Reverse	Forward, reverse, net
- Totalizer 2 units	Dim. dependent	m^3, ml, l, kl, hl, Ml, ft^3, in^3, US G, US kG, US MG, UK G, UK MG
Low flow cut-off	1.5 %	0 - 9.9 %
Empty pipe	Off	Off, on
Error level	Warning	Fatal, permanent, warning
Output		
Current output	Off	On/off, uni-/bidirectional, 0/4 - 20 mA
- Direction	Uni-directional	Uni-/bidirectional
- Function	4-20 mA	0-20 mA, 4-20 mA, 4-20 mA + alarm
- Time constant	5 s	0.1 - 30 s
Digital output	Pulse	Error, direction/limit, batch[1)], frequency, pulse, error no., off
Relay output	Error	Error, direction/limit, cleaning, error No., off
Direction/limit switch	Off	1 set point/2 set points, - 100 - 100%
- Hysteresis	5%	0.0 - 100%
Batch[1)]	Off	
- Batch quantity	0	Dim. dependent
- Batch compensation	0	-100 - 100 m^3
- Batch counter	Down	Up/down
- Time constant	0.1 s	0.1 - 30 s
Frequency	Off	500 Hz, 1 kHz, 5 kHz, 10 kHz
- Time constant	5 s	0.1 - 30 s
Pulse	On	
- Pulse polarity	Positive	Positive/negative
- Pulse width	66 ms	64 µs, 130 µs, 260 µs, 510 µs, 1.0 ms, 2.0 ms, 4.1 ms, 8.2 ms, 16 ms, 33 ms, 66 ms, 130 ms, 260 ms, 520 ms, 1.0 s, 2.1 s, 4.2 s.
- Volume/pulse	Dim. dependent	Dim. dependent
- Time constant	0.1 s	0.1 - 30 s
Electrode cleaning	Off	Off/cleaning
- Cleaning cycle time	24 h	1 - 240 h
External input		
External input	Off	Batch, reset totalizer, freeze output, forced output, off
- Batch		Start, hold/continue, stop, $Q_{max.}$ 2
Sensor characteristics		
Correction factor	1	0.85 - 2.00
Language	English	English, German, French, Danish, Swedish, Finnish, Spanish, Russian, Italian, Portuguese
Operator menu		
Primary field	Flow rate	Flow rate, Totalizer 1, Totalizer 2
Title/subtitle line	Flow rate, Totalizer 1, totalizer 2, totalizer 1 reset, totalizer 2 reset, error pending	Flow rate, Flow rate %, $Q_{max.}$, Totalizer 1, Totalizer 2, Totalizer 1 reset, Totalizer 2 reset, Batch start/ paused/stop, Batch cycle counter, Batch cycle counter reset, Sensor size, Sensor type, Error pending, Status log, Tag No.

1) Batch is available on MAG 6000 only

8.6.2 Dimension dependent factory settings MAG 5000 and MAG 6000

MAG 1100

MAG 3100 (ANSI #150, ANSI#300 and AWWA flanges)

	$Q_{max.}$								
		MAG 5100 W		MAG 1100, 3100, 3100 W			Volume/	Pulse	Totalizer
[inches]	fac.set.	min.	max.	min.	max.	unit	pulse	unit	unit
1/4	**1.5**	-	-	0.11	4.4	US GPM	1	US G	US G
3/8	**4.0**	-	-	0.31	12.4	US GPM	1	US G	US G
1/2	**10**	-	-	0.7	28.0	US GPM	1	US G	US G
1	**25**	-	-	1.9	77.8	US GPM	1	US G	US G
1 1/2	**60**	-	-	5.3	198.1	US GPM	1	US G	US G
2	**100**	-	-	7.9	308.2	US GPM	1	US G	US G
2 1/2	**160**	-	-	13.2	523.9	US GPM	1	US G	US G
3	**250**	-	-	20.3	792.5	US GPM	1	US G	US G
4	**400**	-	-	31.3	1,241.6	US GPM	1	US G	US G
1/2	10	-	-	0.7	28.0	US GPM	1	US G	US G
1	25	1.9	77.8	1.9	77.8	US GPM	1	US G	US G
1 1/2	60	5.3	198.1	5.3	198.1	US GPM	1	US G	US G
2	100	7.0	277.4	7.9	308.2	US GPM	1	US G	US G
2 1/2	160	11.0	440.3	13.2	523.9	US GPM	1	US G	US G
3	250	17.6	704.5	20.3	792.5	US GPM	1	US G	US MG
4	400	27.7	1,100.7	31.3	1,241.6	US GPM	1	US G	US MG
5	600	44.0	1,761.1	48.9	1,941.6	US GPM	1	US G	US MG
6	900	70.4	2,773.8	70.4	2,800.2	US GPM	1	US G	US MG
8	1,500	110.1	4,402.8	124.6	4,975.2	US GPM	1	US G	US MG
10	2,500	176.1	7,044.5	194.6	7,779.8	US GPM	1	US G	US MG
12	3,500	277.4	11,007.1	280.5	11,200.8	US GPM	1	US G	US MG
14	4,500	381.3	15,247.0	381.3	15,247.0	US GPM	1	US G	US MG
16	6,000	498.0	19.914.0	498.0	19,914.0	US GPM	1	US G	US MG
18	7,500	630.5	25,206.2	630.5	25,206.2	US GPM	1	US G	US MG
20	9,500	778.4	31,119.2	778.4	31,119.2	US GPM	1	US G	US MG
24	13,500	1,120.5	44.812.0	1,120.5	44,812.0	US GPM	10	US G	US MG
28	18,500	1,525.1	60.996.9	1,525.1	60.996.9	US GPM	10	US G	US MG
30	21,000	1,751.0	70,022.7	1,751.0	70,022.7	US GPM	10	US G	US MG
32	24,000	1,991.8	79.669.3	1,991.8	79,669.3	US GPM	10	US G	US MG
36	30,000	2,522.8	100,833.7	2,522.8	100,833.7	US GPM	10	US G	US MG
40	37,000	3,112.8	124,485.7	3,112.8	124,485.7	US GPM	10	US G	US MG
42	37,000	3,112.8	124.485.7			US GPM	10	US G	US MG
44	45,000	3,765.7	150.625.3	3,765.7	150,625.3	US GPM	10	US G	US MG
48	53,000	4,482.1	179.261.4	4,482.1	179,261.4	US GPM	10	US G	US MG
54	73,000	-	-	6,100.1	243,991.8	US GPM	1000	US G	US MG
60	84,000	-	-	7,002.7	280,095.0	US GPM	1000	US G	US MG
66	95,000	-	-	7,967.4	318,685.9	US GPM	1000	US G	US MG
72	120,000	-	-	10,083.8	403,334.8	US GPM	1000	US G	US MG
78	140,000	-	-	12,449.0	497,947.2	US GPM	1000	US G	US MG

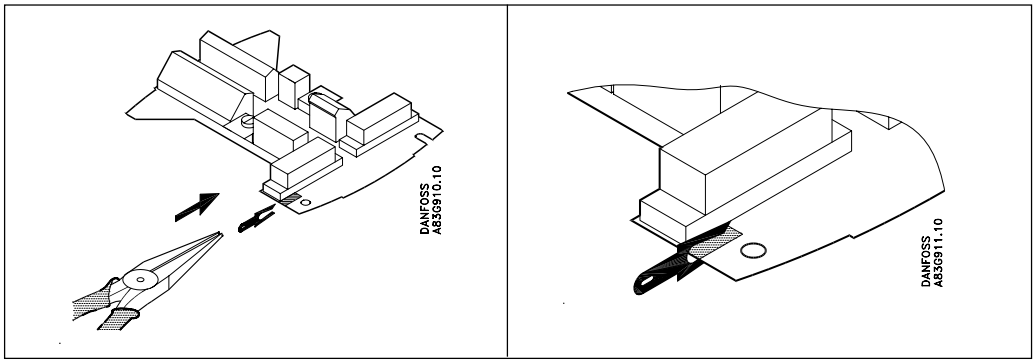
8.6.3 Dimension dependent batch and pulse output settings

	Volume/pulse or batch quantity	
	US G min.	US G max.
1/2	0.0000388	1,019
1	0.0000144	2,826
1 1/2	0.000277	7,264
2	0.000433	11,333
2 1/2	0.000732	19,152
3	0.00111	29,058
4	0.00173	47,022
5	0.0027	70,798
6	0.0039	101,970
8	0.0069	181,222
10	0.0011	283,192
12	0.016	407,881
14	0.021	555,289
16	0.028	725,152
18	0.035	917,733
20	0.043	1,133,034
24	0.062	1,631,791
28	0.085	2,220,894
32	0.110	2,900,873
36	0.140	3,671,199
40	0.173	4,532,400
48	0.249	6,526,635
78	0.692	181,129,860

8.6.4 MAG 6000 CT settings

Setting primary operating parameters such as $Q_{max.}$, low flow cut-off, units, approvals, etc. is blocked during normal operation. See menu setup.

These settings are made in connection with commissioning or calibration by mounting a hardware key on solder terminals of the connection plate of the signal converter. When the key is mounted, the terminals are shorted, providing access to all menu items. When the key is removed, the primary settings are blocked in accordance with the requirements in the authorisation.



Internal totalizers

Depending on type of approval it is possible to reset the internal totalizers. The type of approval is selected in the reset menu, with the hardware key mounted. It is possible to select between:

- Hot/cold water
- Other liquids

Resetting of totalizers by electrical input is not possible.

Hot/cold water

- Totalizer 1 is allocated to forward flow (cannot be reset).
- Totalizer 2 is allocated to reverse flow (cannot be reset).

Other liquids

Both totalizer 1 and totalizer 2 are allocated to measure the net forward flow, i.e. any reverse flow will make the totalizers count backwards.

- Totalizer 1 is consecutive and cannot be reset.
- Totalizer 2 can be reset if the flow velocity in the meter pipe is <0.75 ft./s. When the totalizer is reset, the pulse output register will also be reset.

Output

- When selecting hot water, the output settings are not allowed and menu will not be shown on display.
- When selecting cold water or other liquids, all output settings can be changed.

8.7.1 Error handling

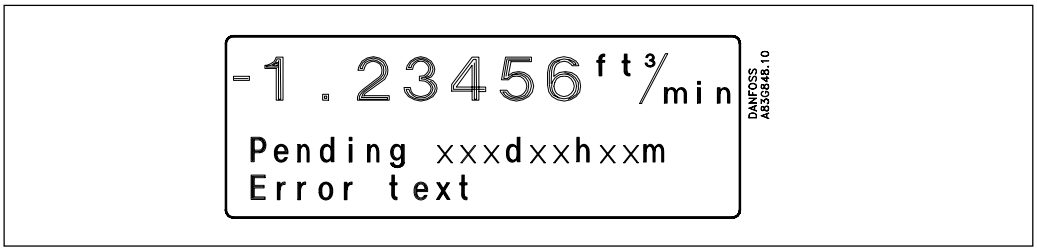
Error system
The converter system is equipped with an error and status log system with 4 groups of information.
- Information without a functional error involved
- Warnings which may cause malfunction in the application. The cause of the error may disappear on its own
- Permanent errors which may cause malfunction in the application. The error requires an operator
- Fatal error which is essential for the operation of the flowmeter

2 menus are available in service and operator menus for registration of information and errors
- Error pending
- Status log

Error pending
The first 9 standing errors are stored in “error pending”. When an error is removed it is removed from “error pending”.
The acceptance level for “error pending” can be individually configured to a particular application. The acceptance level is set in the “basic settings” in the converter setup menu.

Acceptance levels
- Fatal error: Fatal errors are registered as errors
- Permanent errors: Permanent and fatal errors are registered as errors
- Warning (Default value): Warnings, permanent and fatal errors are registered as errors

The error information is displayed in the title and subtitle line. The title line will show the time since occurrence of error. The subtitle line will flash between an error text and a remedy text. The error text will indicate type of error (I, W, P or F), error No. and error text. The remedy text will inform the operator of the action to take to remove the error.



Status Log
Like “error pending” except that information, warnings, permanent and fatal errors is always stored in the “status log”. The “status log” stores the latest 9 messages received/registered during the last 180 days.

Alarm field
The alarm field on the display will always flash with an error pending.

Error output
The digital and relay output can individually be activated error by error (error level). The relay output is default selected to error level. An output can also be selected to activate on a single error number. The alarm field, error output and error pending always operate together.
The analog output turns to a 1 mA level when in the 4-20 mA mode.

Operator menu
Error pending and status log are as default enabled in the operator menu.

8.7.2 List of error numbers

Error No.	Error text Remedy text	#Comment	Outputs status	Input status
1	I1 - *Power on* OK	Power on has happened	Active	Active
2	I2 - *Add-on module* Applied	A new module has been applied to the system	Active	Active
3	I3 - *Add-on module* Install	An add-on module is defect or has been removed. This can be an internal add-on module	Active	Active
4	I4 - *Param. corrected* OK	A less vital parameter in the converter has been replaced by its default value	Active	Active
20	W20 - *Totalizer 1* Reset manually	During initialisation the check of the saved totalizer value has failed. It is not possible to rely on the saved totalizer value anymore. The totalizer value must be reset manually in order to rely on future readings	Active	Active
20	W20 - *Totalizer 2* Reset manually	During initialisation the check of the saved totalizer value has failed. It is not possible to rely on the saved totalizer value anymore. The totalizer value must be reset manually in order to rely on future readings	Active	Active
21	W21 - *Pulse overflow* Adj. pulse settings	Actual flow is too big compared with pulse width and volume/pulse	Reduced pulse width	Active
22	W22 - *Batch timeout* Check installation	Duration of batching has exceeded a predefined max. time	Batch output on zero	Active
23	W23 - *Batch overrun* Check installation	Batch volume has exceeded a predefined maximum overrun volume	Batch output on zero	Active
24	*W24 - Batch neg. flow* Check flow direction	Negative flow direction during batch	Active	Active
30	W30 - *Overflow* Adj. $Q_{max.}$	Flow is above $Q_{max.}$ settings	Max. 120 %	Active
31	W31 - *Empty pipe*	Pipe is empty	Zero	Active
40	P40 - *SENSORPROM®* Insert/change	SENSORPROM® unit not installed	Active	Active
41	P41 - *Parameter range* Switch off and on	A parameter is out of range. The parameter could not be replaced by its default value. The error will disappear at the next power-on	Active	Active
42	P42 - *Current output* Check cables	Current loop is disconnected or the loop resistance is too big	Active	Active
43	P43 - *Internal error* Switch off and on	Too many errors occured at the same time Some errors are not detected correctly	Active	Active
44	P44 - *CT SENSORPROM®*	SENSORPROM® unit has been used as CT version	Active	Active
60	F60 - *CAN comm. error* Converter/AOM	CAN bus communication error. An add-on module, the display module or the converter is defect	Zero	Inactive
61	F61 - *SENSORPROM® error* Replace	It is not possible to rely on the data in SENSORPROM® unit anymore	Active	Active
62	F62 - *SENSORPROM® ID* Replace	The SENSORPROM® unit ID does not comply with the product ID. The SENSORPROM® unit is from another type of product MASSFLO®, SONOFLO® etc.	Zero	Inactive
63	F63 - *SENSORPROM®* Replace	It is not possible to read from the SENSORPROM® unit anymore.	Active	Active
70	F70 - *Coil current* Check cables	Coil excitation has failed	Active	Active
71	F71 - *Internal error* Replace converter	Internal convertion error in ASIC	Active	Active

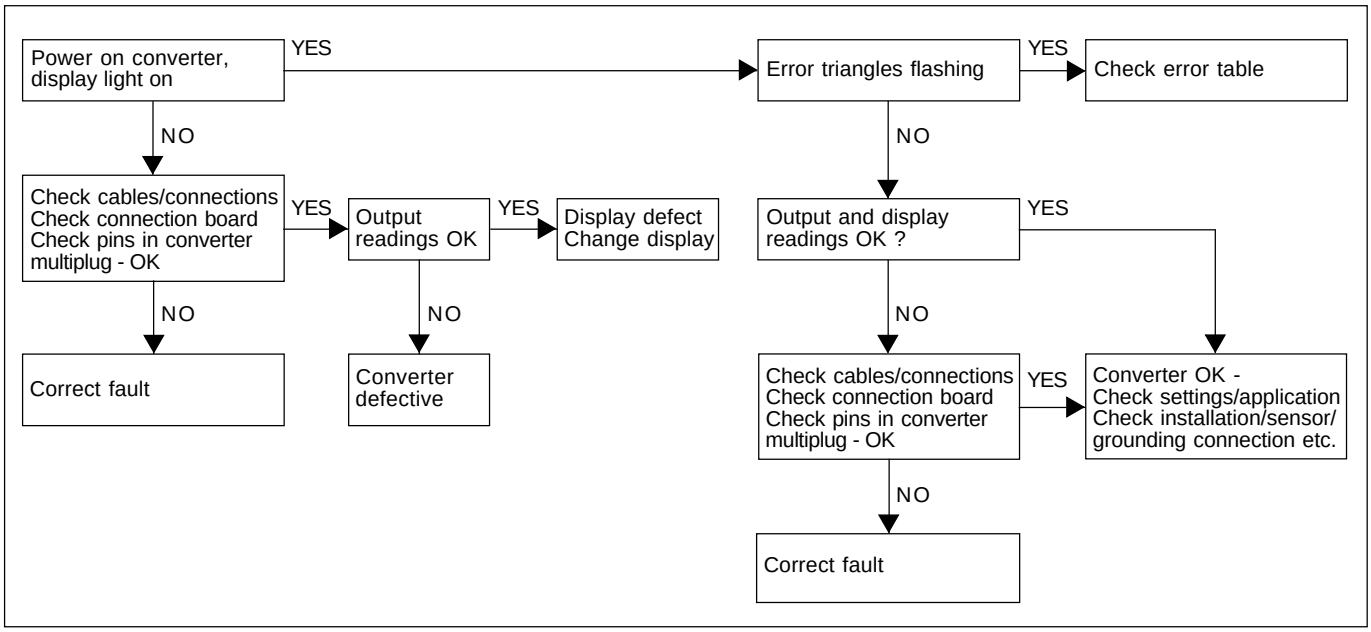
9. Service

Often problems with unstable/wrong measurements occur due to insufficient/wrong grounding or potential equalization. Please check connection. If OK, the MAGFLO® converter can be checked as described under 9.1 and sensor under 9.3.

9.1 Converter check list

When checking MAGFLO® installations for malfunction the easiest method to check the signal converter is to replace it with another MAG 5000/6000 converter with a similar power supply.
A replacement can easily be done as all settings are stored in and downloaded from the SENSORPROM® unit - no extra settings need to be made.

If no spare converter is available - then check converter according to check table.



9.2 Trouble shooting MAG 5000 and MAG 6000

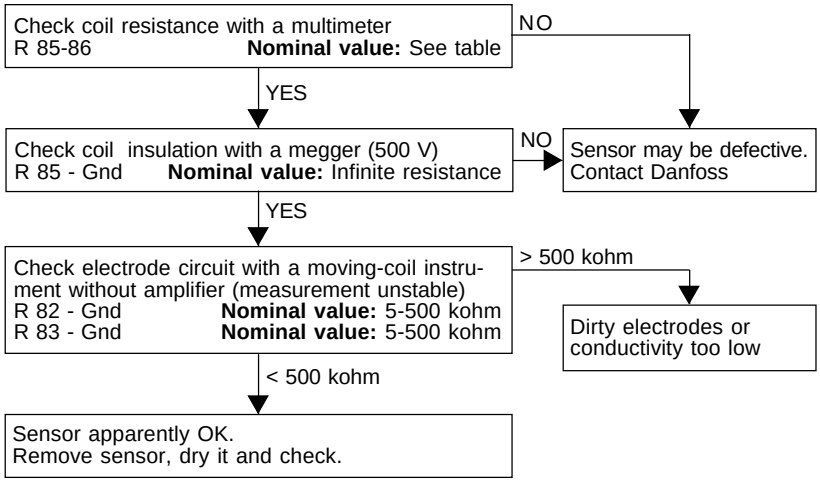
Symptom	Output signals	Error code	Cause	Remedy
Empty display	Minimum		1. No power supply	Power supply Check MAG 5000/6000 for bended pins on the connector
			2. MAG 5000/6000 defective	Replace MAG 5000/6000
No flow signal	Minimum		1. Current output disabled	Turn on current output
			2. Digital output disabled	Turn on digital output
			3. Reverse flow direction	Change direction
		F70	Incorrect or no coil current	Check cables/connections
		W31	Measuring pipe empty	Ensure that the measuring pipe is full
		F60	Internal error	Replace MAG 5000/6000
	Undefined	P42	1. No load on current output	Check cables/connections
			2. MAG 5000/6000 defective	Replace MAG 5000/6000
		P41	Initializing error	Switch off MAG 5000/6000, wait 5 s and switch on again
Indicates flow with no flow in pipe	Undefined		Measuring pipe empty	Select empty pipe cut-off
			Empty pipe cut-off is OFF	Ensure that the measuring pipe is full
			Electrode connection missing/ electrode cable is insuffi-ciently screened	Ensure that electrode cable is connected and sufficiently screened
Unstable flow signal	Unstable		1. Pulsating flow	Increase time constant
			2. Conductivity of medium too low	Use special electrode cable
			3. Electrical noise potential between medium and sensor	Ensure sufficient potential equalization
			4. Air bubbles in medium	Ensure medium does not contain air bubbles
			5. High concentration of par-ticles or fibres	Increase time constant
Measuring error	Undefined		Incorrect installation	Check installation
		P40	No SENSORPROM® unit	Install SENSORPROM® unit
		P44	CT SENSORPROM® unit	Replace SENSORPROM® unit or reset SENSORPROM® unit with MAG CT converter
		F61	Deficient SENSORPROM® unit	Replace SENSORPROM® unit
		F62	Wrong type of SENSOR-PROM® unit	Replace SENSORPROM® unit
		F63	Deficient SENSORPROM® unit	Replace SENSORPROM® unit
		F71	Loss of internal data	Replace MAG 5000/6000
	Maximum	W30	Flow exceeds 100% of $Q_{max.}$	Check $Q_{max.}$ (Basic Settings)
		W21	Pulse overflow • Volume/pulse too small • Pulse width too large	 Change volume/pulse Change pulse width
Measuring approx. 50%			Missing one electrode connection	Check cables
Loss of totalizer data	OK	W20	Initializing error	Reset totalizer manually
##### **Signs in display**	OK		Totalizer roll over	Reset totalizer or increase totalizer unit

9.3 Check list MAG sensor

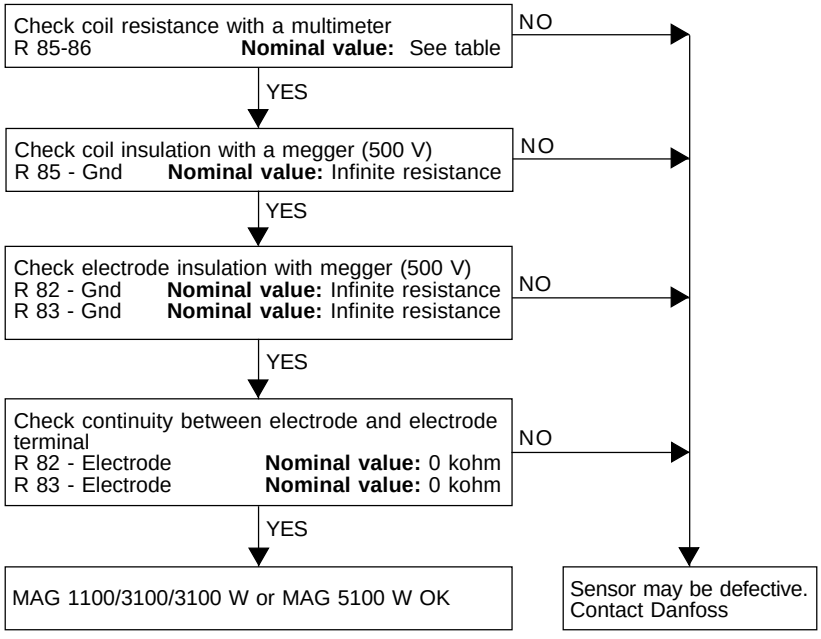
ATTENTION!
If there is leakage from MAG 1100/3100/3100 W or MAG 5100 W and the unit has been used to measure inflammable/explosive liquids, there might be a risk of explosion when checking with a megger.

Disconnect all leads to MAG 1100/3100/3100 W or MAG 5100 W

MAG 1100/3100/3100 W or MAG 5100 W installed and filled with the medium:



MAG 1100/3100/3100 W* or MAG 5100 W *removed from system – empty and dry:



9.4 Coil resistance table

Coil resistance for MAG 1100, MAG 1100 PFA = 98 ohms +/- 4 ohm

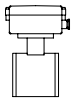
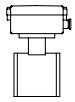
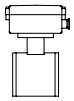
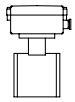
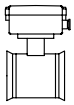
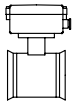
Note
On MAG 1100 ½" produced as from May 1999 the coil resistance must be 86 ohm, +8/-4 ohm.

	Coil resistance					
	MAG 3100	MAG 3100 W			MAG 5100 W	
Inches	Resistance	Size inches	Ohms	Tolerance	Ohms	Tolerance
1/2	104	15	104	+/– 2	104	+/– 2
1	104	1	104	+/– 2	104	+/– 2
1 1/2	92	1	92	+/– 2	92	+/– 2
2	92	2	92	+/– 2	124	+/– 4
2 1/2	100	2 1/2	100	+/– 2	127	+/– 4
3	94	3	94	+/– 2	126	+/– 4
4	92	4	92	+/– 2	125	+/– 4
5	92	5	92	+/– 2	126	+/– 4
6	94	6	94	+/– 2	116	+/– 4
8	90	8	90	+/– 2	109	+/– 4
10	92	10	92	+/– 2	104	+/– 4
12	100	12	100	+/– 2	108	+/– 4
14	112	14	112	+/– 2	112	+/– 2
16	100	16	100	+/– 4	100	+/– 4
18	108	18	108	+/– 4	108	+/– 4
20	122	20	122	+/– 4	122	+/– 4
24	115	24	114	+/– 4	114	+/– 4
28	128	28	112	+/– 4	112	+/– 4
30	133					
32	128	32	127	+/– 4	127	+/– 4
36	131	36	93	+/– 4	93	+/– 4
40	131	40	103	+/– 4	103	+/– 4
44	126					
48	130	48	124	+/– 4	124	+/– 4
54	130					
60	124					
66	133					
72	133					
78	147					

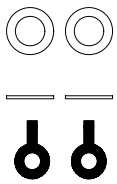
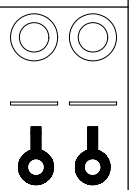
All resistance values are at 7 °F.
The resistance changes proportionally 0.22 %/°F.

10. Ordering

10.1 Sensor MAG 1100

Description	Size	Code No.	Symbol
MAG 1100 Ceramic Al_2O_3 Temperature of medium max. 300°F Included: 2 EPDM gaskets, studs and nuts	1/4" 3/8" 1/2" 1" 1 1/2" 2" 2 1/2" 3" 4" 1)	**083G4044** **083G4046** **083G4047** **083G4049** **083G4051** **083G4052** **083G4053** **083G4054** **083G4055**	
MAG 1100 PFA-liner Temperature of medium max. 300°F Included: 2 EPDM gaskets, studs and nuts	3/8" 1/2" 1" 1 1/2" 2" 2 1/2" 3" 4" 1)	**083G5046** **083G5047** **083G5049** **083G5051** **083G5052** **083G5053** **083G5054** **083G5055**	
MAG 1100 (High temperature) Ceramic Al_2O_3 Temperature of medium max. 390°F Included: 2 graphite gaskets, studs and nuts	1/2" 1" 1 1/2" 2" 3" 4" 1)	**083G4057** **083G4059** **083G4061** **083G4062** **083G4064** **083G4065**	
MAG 1100 Ex Ceramic Al_2O_3 Temperature of medium max. 250°F Included: 2 EPDM gaskets, studs and nuts	1/4 3/8" 1/2" 1" 1 1/2" 2" 2 1/2" 3" 4" 1)	**083G4024** **083G4026** **083G4027** **083G4029** **083G4031** **083G4032** **083G4033** **083G4034** **083G4035**	
MAG 1100 FOOD Ceramic Al_2O_3 Temperature of medium max. 300°F Enclosure NEMA 4X	3/8" 1/2" 1" 1 1/2" 2" 2 1/2" 3" 4"	**083G2016** **083G2017** **083G2019** **083G2021** **083G2022** **083G2023** **083G2024** **083G2025**	
MAG 1100 FOOD PFA Temperature of medium max. 265°F Enclosure NEMA 4X	3/8" 1/2" 1" 1 1/2" 2" 2 1/2" 3" 4"	**083G5066** **083G5067** **083G5069** **083G5071** **083G5072** **083G5073** **083G5074** **083G5075**	

Accessories

Description	Material	Size	Code No.	Symbol
Pipe connection 1/2" external thread 2 pipe connections 2 gaskets 12 M4 screws (12 mm)	AISI 316 (1.4436) EPDM	1/4", 3/8"	**083G0080**	
Grounding ring 1 potential equalizing ring 3 teflon gaskets 1 earth strap 1 M6 screw	AISI 316 (1.4436)	1/4", 3/8" 1/2" 1" 1 1/2" 2" 2 1/2" 3" 4"	**083G0686** **083G0687** **083G0689** **083G0691** **083G0692** **083G0693** **083G0694** **083G0695**	
Grounding ring 1 potential equalizing ring 3 teflon gaskets 1 earth strap 1 M6 screw	Hastelloy C22	1/4", 3/8" 1/2" 1" 1 1/2" 2" 2 1/2" 3" 4"	**083G3256** **083G3257** **083G3259** **083G3261** **083G3262** **083G3263** **083G3264** **083G3265**	

Gaskets for MAG 1100

Description	Material	Size	Code No.	Symbol
EPDM gaskets 2 gaskets 2 earth straps 3 M6 screws	EPDM	1/4", 3/8"	**083G3116**	
		1/2"	**083G3117**	
		1"	**083G3119**	
		1 1/2"	**083G3121**	
		2"	**083G3122**	
		2 1/2"	**083G3123**	
		3"	**083G3124**	
		4"	**083G3125**	
PTFE gaskets 2 PTFE gaskets 2 earth straps 3 M6 screws	PTFE	1/4", 3/8"	**083G0156**	
		1/2"	**083G0157**	
		1"	**083G0159**	
		1 1/2"	**083G0161**	
		2"	**083G0162**	
		2 1/2"	**083G0163**	
		3"	**083G0164**	
		4"	**083G0165**	
Graphite gaskets 2 gaskets	Graphite	1/4", 3/8"	**083G0116**	
		1/2"	**083G0117**	
		1"	**083G0119**	
		1 1/2"	**083G0121**	
		2"	**083G0122**	
		2 1/2"	**083G0123**	
		3"	**083G0124**	
		4"	**083G0125**	

Gaskets for MAG 1100 FOOD

Description	Material	Size	Code No.	Symbol
EPDM gaskets 2 gaskets	EPDM	3/8"	**083G2206**	
		1/2"	**083G2207**	
		1"	**083G2209**	
		1 1/2"	**083G2211**	
		2"	**083G2212**	
		2 1/2"	**083G2213**	
		3"	**083G2214**	
		4"	**083G2215**	
NBR gaskets 2 gaskets	NBR	3/8"	**083G2216**	
		1/2"	**083G2217**	
		1"	**083G2219**	
		1 1/2"	**083G2221**	
		2"	**083G2222**	
		2 1/2"	**083G2223**	
		3"	**083G2224**	
		4"	**083G2225**	

10.2 Adapter, MAG 1100 FOOD (contains 2 adapters, 2 clamp rings and 2 gaskets)

Adapter size [inch]	D_o [inch]	D_i [inch]	Sensor [inch]	**Weld-in type**: Matching standard **Tri-Clover®** **Code No.**	Symbol
3/8	1/2	0.37	3/8	**083G2276**	
1/2	3/4	0.62	1/2	083G2277	
1	1	0.87	1	**083G2279**	
1 1/2	1 1/2	1.37	1 1/2	**083G2281**	
2	2	1.87	2	**083G2282**	
2 1/2	2 1/2	2.37	2 1/2	**083G2283**	
3	3	2.87	3	**083G2284**	
4	4	3.93	4	**083G2285**	

Adapter size [inch]	D_o [inch]	D_i [inch]	Sensor [inch]	**Clamp type:** Matching standard **Tri-Clamp®** **Code No.**	Symbol
3/8	0.98	0.37	3/8	**083G2286**	
1/2	0.98	0.62	1/2	**083G2287**	
1	1.99	0.87	1	**083G2289**	
1 1/2	1.99	1.37	1 1/2	**083G2291**	
2	2.52	1.87	2	**083G2292**	
2 1/2	3.05	2.37	2 1/2	**083G2293**	
3	3.58	2.87	3	**083G2294**	
4	4.70	3.83	4	**083G2295**	

10.3 Sensor MAG 3100 and MAG 3100 Ex

Type No.: MAG 3100 – [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

1. Nominal size (inch)

½"	04
1"	06
1½"	08
2"	09
2½"	10
3"	11
4"	12
5"	13
6"	14
8"	15
10"	16
12"	17
14"	18
16"	19
18"	30
20"	20
24"	21
28"	22
30"	34
32"	23
36"	24
40"	25
42"	35
44"	26
48"	27
54"	28
60"	29
66"	31
72"	32
78"	33

2. Liner material

Neoprene	1
EPDM	2
PTFE (Size ≤ 12", max. 750 psi), (Size 14" to 24", max. 600 psi)	3
Ebonite	6
Linatex® (max. 600 psi)	7

3. Flanges

EN 1092-1, PN 6 (DN 65 - 2000)	A
EN 1092-1, PN 10 (DN 200 - 2000)	B
EN 1092-1, PN 16 (DN 65 - 2000) conform to PED 97/23/EC	C
EN 1092-1, PN 16 (DN 700 - 2000) not conform to PED 97/23/EC	W
EN 1092-1, PN 25 (DN 200 - 600)	D
EN 1092-1, PN 40 (DN 15 - 600)	E
EN 1092-1, PN 63 (DN 50 - 400) not with PTFE	Q
EN 1092-1, PN 100 (DN 25 - 350) not with PTFE	R
ANSI class 150 (½" - 24", 300 psi)	**F**
ANSI class 300 (½" - 24", 750 psi)	**G**
AS 2129, Table E (½" - 48", 210 psi)	N
AWWA C-207, class D (28" - 78", 150 psi)	**O**
AS 4087 Class 14 (2" - 48", 210 psi)	P
AS 4087 Class 21 (DN 50 - 600, 21 bar)	T
AS 4087 Class 35 (DN 50 - 600, 35 bar)	V

4. Electrode material/Grounding electrodes (not PTFE)

AISI 316 Ti, ceramic coated (Grounding electrodes not coated)	1
AISI 316 Ti (standard)	2
Hastelloy C-276	4
Platinum/iridium (80/20)	5
Titanium	6
Monel	7
Tantalum	8

5. Flange and housing material

Carbon steel flanges and housing (grey coating) (standard)	1
AISI 304 flanges/carbon steel housing (grey coating)	2
AISI 316 L flanges/housing (polished)	3

6. Temperature/Ex-version

Standard	1000
High temperature (PTFE only, size ≤ 12", max. 750 psi)	2100
EEx e ia IIC T4-T6 (14"- 78")	4000
EEx ia ib IIB T4-T6 (½"- 12")	4100

Grounding/protection flange type C (AISI 304) for all liners except PTFE for MAG 3100 and 3100 W only

Flange / Pressure stage / Size	EN 1092-1 PN 6 083N...	PN 10 083N...	PN 16 083N...	PN 25 083N...	PN 40 083N...	ANSI B 16.5 **150 lb 083N...**	**300 lb 083N...**	AWWA C207 **Class D 083N...**
1"					8361	**8361**	**8361**	
$1^1/_2$"					8362	**8362**	**8362**	
2"					8344	**8344**	**8344**	
$2^1/_2$"	8345		8345		8345	**8345**	**8345**	
3"	8347		8347		8347	**8347**	**8347**	
4"	8070		8025		8025	**8025**	**8025**	
5"	8071		8071		8071	**8071**	**8071**	
6"	8072		8008		8008	**8008**	**8073**	
8"	8074	8011	8011	8011	8075	**8011**	**8076**	
10"	8078	8013	8013	8013	8079	**8013**	**8079**	
12"	8080	8012	8012	8081	8082	**8012**	**8082**	
14"	8083	8039	8039	8084	8085	**8039**	**8085**	
16"	8099	8100	8100	8101	8102	**8100**	**8102**	
18"	8103	8103	8104	8104	8105	**8104**	**8106**	
20"	8107	8107	8108	8108	8109	**8107**	**8110**	
24"	8111	8111	8112	8112		**8113**	**8114**	
28"	8300	8294	8294			**8302**		**8302**
30"								**8366**
32"	8303	8304	8304			**8305**		**8305**
36"	8306	8307	8307			**8308**		**8308**
40"	8309	8310	8310			**8311**		**8311**
42"								**8394**
44"								**8395**
48"	8312	8313	8313			**8314**		**8314**
54"	8349	8353	8357					
66"	8350	8354	8358					
72"	8351	8355	8359					
78"	8352	8356	8360					

Grounding/protection flange type E (AISI 316) for PTFE liner only

Flange / Pressure stage / Size	EN 1092-1 PN 6 083N...	PN 10 083N...	PN 16 083N...	PN 25 083N...	PN 40 083N...	ANSI B 16.5 150 lb 083N...	300 lb 083N...
$^1/_2$"					8365	8365	8365
1"					8271	8272	8272
$1^1/_2$"					8278	8275	8275
2"					8282	8283	8283
$2^1/_2$"	8284		8285		8286	8287	8287
3"	8288		8289		8290	8291	8292
4"	8116		8117		8118	8118	8119
5"	8120		8121		8122	8122	8123
6"	8124		8125		8126	8126	8127
8"	8129	8130	8130	8131	8132	8370	8133
10"	8135	8136	8137	8138	8139	8140	8141
12"	8144	8144	8145	8146	8147	8148	8149
14"	8152	8153	8154	8155	8156	8157	8158
16"	8160	8161	8162	8163	8164	8165	8166
18"	8168	8169	8170	8171	8172	8173	8174
20"	8177	8178	8179	8180	8181	8182	8183
24"	8186	8187	8188	8189		8190	8191

Accessories

Description	**Code No.**	Symbol
Submersible kit, IP 68 ~ NEMA 4X / 6 (3 ft. for 30 min) For use with standard MAG 3100 when sensor is buried or permanently submerged.	**085U0220**	

10.4 Sensor MAG 3100 W

ANSI/AWWA flanges	Nominal size inch	Flange type	Code No. Neoprene liner	Code No. EDPM liner
Liner: Neoprene or EPDM Flange: Carbon steel (A 105/St. 37.2), ANSI Class 150 or AWWA C-207, Class D Electrodes: AISI 316 Ti Grounding electrode: AISI 316 Ti Enclosure: NEMA 6 (10 ft. of submersion for 72 hours)	**1"**	ANSI 150	**083Z8600**	**083Z8650**
	1½"	ANSI 150	**083Z8601**	**083Z8651**
	2"	ANSI 150	**083Z8602**	**083Z8652**
	2½"	ANSI 150	**083Z8603**	**083Z8653**
	3"	ANSI 150	**083Z8604**	**083Z8654**
	4"	ANSI 150	**083Z8051**	**083Z8052**
	5"	ANSI 150	**083Z8054**	**083Z8656**
	6"	ANSI 150	**083Z8056**	**083Z8057**
	8"	ANSI 150	**083Z8608**	**083Z8658**
	10"	ANSI 150	**083Z8609**	**083Z8659**
	12"	ANSI 150	**083Z8610**	**083Z8660**
	14"	ANSI 150	**083Z8611**	**083Z8661**
	16"	ANSI 150	**083Z8064**	**083Z8067**
	18"	ANSI 150	**083Z8613**	**083Z8663**
	20"	ANSI 150	**083Z8614**	**083Z8664**
	24"	ANSI 150	**083Z8615**	**083Z8665**
	28"	AWWA Cl.D	**083Z8616**	**083Z8666**
	30"	AWWA Cl.D	**083Z8622**	**083Z8672**
	32"	AWWA Cl.D	**083Z8617**	**083Z8667**
	36"	AWWA Cl.D	**083Z8618**	**083Z8668**
	40"	AWWA Cl.D	**083Z8619**	**083Z8669**
	42"	AWWA Cl.D	**083Z8620**	**083Z8670**
	44"	AWWA Cl.D		**083Z8673**
	48"	AWWA Cl.D	**083Z8621**	**083Z8671**

DIN flanges	Size	PN	Code No. Neoprene liner	Code No. EPDM liner
Liner: Neoprene or EPDM Flanges: Mild steel, DIN 2501 Electrodes: AISI 316 Ti Grounding electrodes: AISI 316 Ti Enclosure: NEMA 4X	1"	40	**083Z8000**	**083Z8100**
	$1^1/_2$"	40	**083Z8001**	**083Z8101**
	2"	40	**083Z8002**	**083Z8102**
	$2^1/_2$"	16	**083Z8003**	**083Z8103**
	3"	16	**083Z8004**	**083Z8104**
	4"	16	**083Z8005**	**083Z8105**
	5"	16	**083Z8053**	**083Z8055**
	6"	16	**083Z8007**	**083Z8107**
	8"	10	**083Z8008**	**083Z8108**
	8"	16	**083Z8208**	**083Z8308**
	10"	10	**083Z8009**	**083Z8109**
	10"	16	**083Z8209**	**083Z8309**
	12"	10	**083Z8010**	**083Z8110**
	12"	16	**083Z8210**	**083Z8310**
	14"	10	**083Z8058**	**083Z8060**
	14"	16	**083Z8059**	**083Z8061**
	16"	10	**083Z8012**	**083Z8065**
	16"	16	**083Z8063**	**083Z8066**
	18"	10	**083Z8068**	**083Z8070**
	18"	16	**083Z8213**	**083Z8071**
	20"	10	**083Z8014**	**083Z8114**
	20"	16	**083Z8214**	**083Z8314**
	24"	10	**083Z8015**	**083Z8115**
	24"	16	**083Z8215**	**083Z8315**
	26"	10	**083Z8016**	**083Z8116**
	32"	10	**083Z8017**	**083Z8117**
	36"	10	**083Z8018**	**083Z8118**
	40"	10	**083Z8019**	**083Z8119**
	48"	10	**083Z8021**	**083Z8121**

10.5 Sensor MAG 5100 W

Size inches	Factory set GPM	$Q_{max.}$ GPM		Flange type	Code No.
		Min.	Max.		
1	25	1.9	77.8	ANSI 150	**082Z8501**
1½	60	5.3	198.1	ANSI 150	**082Z8503**
2	100	7.0	277.4	ANSI 150	**082Z8505**
2½	160	11.0	440.3	ANSI 150	**082Z8507**
3	250	17.6	704.5	ANSI 150	**082Z8509**
4	400	27.7	1,100.7	ANSI 150	**082Z8511**
5	600	44.0	1,761.1	ANSI 150	**082Z8513**
6	900	70.4	2,773.8	ANSI 150	**082Z8515**
8	1,500	110.1	4,402.8	ANSI 150	**082Z8518**
10	2,500	176.1	7,044.5	ANSI 150	**082Z8521**
12	3,500	277.4	11,007.1	ANSI 150	**082Z8524**
14	4,500	381.3	15,247.0	ANSI 150	**082Z8527**
16	6,000	498.0	19.914.0	ANSI 150	**082Z8530**
18	7,500	630.5	25,206.2	ANSI 150	**082Z8533**
20	9,500	778.4	31,119.2	ANSI 150	**082Z8536**
24	13,500	1,120.5	44,812.0	ANSI 150	**082Z8539**
28	18,500	1,525.1	60.996.9	AWWA	**082Z8542**
30	21,000	1,751.0	70,022.7	AWWA	**082Z8543**
32	24,000	1,991.8	79.669.3	AWWA	**082Z8546**
36	30,000	2,522.8	100,833.7	AWWA	**082Z8549**
40	37,000	3,112.8	124,485.7	AWWA	**082Z8552**
42	37,000	3,112.8	124,485.7	AWWA	**082Z8553**
44	45,000	3,765.7	150,625.3	AWWA	**082Z8554**
48	53,000	4,482.1	179,261,4	AWWA	**082Z8557**

Stock item

10.6 Signal converter

Integral mount polyamide

Description	Version	Enclosure	Code No.	Symbol
Signal converter MAG 5000 Blind for integral mount and wall mounting	11-30 V d.c./ 11-24 V a.c.	NEMA 4X, fibre-glass reinforced polyamide	**083F5006**	
	115/230 V a.c. 50/60 Hz	NEMA 4X, fibre-glass reinforced polyamide	**083F5005**	
Signal converter MAG 5000 for integral mount and wall mounting	11-30 V d.c./ 11-24 V a.c.	NEMA 4X, fibre-glass reinforced polyamide	**083F5002**	
	115/230 V a.c. 50/60 Hz	NEMA 4X, fibre-glass reinforced polyamide	**083F5001**	
	115/230 V a.c. 50/60 Hz HART®	NEMA 4X, fibre-glass reinforced polyamide	**083F5011**	

Description	Version	Enclosure	Code No.	Symbol
Signal converter MAG 5000 CT for compact and wall mounting	11-30 V d.c./ 11-24 V a.c.	IP 67, fibre-glass reinforced polyamide	**083F5046**	
	115/230 V a.c. 50/60 Hz	IP 67, fibre-glass reinforced polyamide	**083F5044**	

Description	Version	Enclosure	Code No.	Symbol
Signal converter MAG 6000 Blind for integral mount and wall mounting	11-30 V d.c./ 11-24 V a.c.	NEMA 4X, fibre-glass reinforced polyamide	**083F5008**	
	115/230 V a.c. 50/60 Hz	NEMA 4X, fibre-glass reinforced polyamide	**083F5007**	
Signal converter MAG 6000 for integral mount and wall mounting	11-30 V d.c./ 11-24 V a.c.	NEMA 4X, fibre-glass reinforced polyamide	**083F5004**	
	115/230 V a.c. 50/60 Hz	NEMA 4X, fibre-glass reinforced polyamide	**083F5003**	

Description	Version	Enclosure	Code No.	Symbol
Signal converter MAG 6000 CT for integral mount and wall mounting	11-30 V d.c./ 11-24 V a.c.	NEMA 4X, fibre-glass reinforced polyamide	**083F5010**	
	115/230 V a.c. 50/60 Hz	NEMA 4X, fibre-glass reinforced polyamide	**083F5009**	

Accessories MAG 5000 and MAG 6000

Description	Code No.	Symbol
Wall mounting kit Wall bracket, 4 Pg 13.5 cable glands	**085U1001**	

Add-on module MAG 6000 only

Description	Code No.	Symbol
HART®	**085U0226**	
Profibus PA	**085U0227**	
CANopen	**085U0228**	
DeviceNet	**085U0229**	
Profibus DP	**085U0230**	

Spare parts

Description	Version	Code No.	Symbol
Connection plate	12-24 V	**083F4113**	
	115-230 V	**083F4112**	

10.7 Signal converter rack mount

Description	Version	Code No.	Symbol
Signal converter MAG 5000 for rack and panel mounting	11-30 V d.c./ 11-24 V a.c.	**083F5021**	
	115-230 V a.c. 50/60 Hz	**083F5020**	
Signal converter MAG 6000 for rack and panel mounting	11-30 V d.c./ 11-24 V a.c.	**083F5023**	
	115-230 V a.c. 50/60 Hz	**083F5022**	
Signal converter MAG 6000 *(" ≤ 12)* insert with safety barrier [EEx ia/ib] IIB	11-30 V d.c./ 11-24 V a.c.	**083F5041**	
Signal converter MAG 6000 *(" ≤ 12)* insert with safety barrier [EEx ia/ib] IIB	115-230 V a.c. 50/60 Hz	**083F5040**	

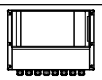
Accessories

Description	Version	Code No.	Symbol
Cleaning unit for electrode cleaning rack mount insert incl. back plate	115-230 V a.c. 50/60 Hz	**083F5036**	
Cleaning unit for electrode cleaning rack mount insert incl. back plate	11-30 V d.c. 11-24 V a.c.	**083F5039**	
Panel mounting kit for rack mount insert NEMA 4X enclosure in ABS plastic for panel-front mounting		**083F5030**	
Panel mounting kit for rack mount insert NEMA 4X enclosure in ABS plastic for panel-front mounting		**083F5031**	
Back of panel mounting kit for rack mount insert NEMA 2 enclosure in aluminium		**083F5032**	
Back of panel mounting kit for rack mount insert NEMA 2 enclosure in aluminium		**083F5033**	
Front cover		**083F4525**	

Wall mounting units complete

Description	Version	Code No.	Symbol
MAG 6000 with NEMA 4X enclosure	115/230 V a.c. 50/60 Hz	**083F5026**	
MAG 6000 rack mount insert and cleaning unit complete mounted with NEMA 4X wall mounting enclosure	115/230 V a.c. 50/60 Hz	**083F5029**	
MAG 6000 rack mount insert and cleaning unit complete mounted with NEMA 4X wall mounting enclosure	11-30 V d.c. 11-24 V a.c.	**083F5047**	
MAG 6000 rack mount insert and safety barrier complete mounted with NEMA 4X *(sizes: 1/4" to 12")* wall mounting enclosure, [EEx ia/ib] IIB	115/230 V a.c. 50/60 Hz	**083F5028**	

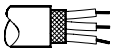
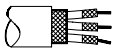
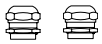
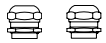
Wall boxes (Without back plates and without signal converter)

Description	Code No.	Symbol
NEMA 4X wall mounting enclosure for NEMA 2 rack mount inserts	**083F5037**	
NEMA 4X wall mounting enclosure for NEMA 2 rack mount inserts	**083F5038**	

Back plates

Description	Enclosure	Version	**Code No.**	Symbol
Signal converter	rack mount	12-24 V 115-230 V	**083F4117**	
Signal converter & ia, safety barrier	rack mount	12-24 V 115-230 V	**083F4118**	
Signal converter & ia/ib, safety barrier	rack mount	12-24 V 115-230 V	**083F4119**	
Signal converter & cleaning unit	rack mount	12-24 V 115-230 V	**083F4123**	
Signal converter	Wall unit	12-24 V 115-230 V	**083F4121**	
Signal converter & ia, safety barrier	Wall unit	12-24 V 115-230 V	**083F4122**	
Signal converter & ia/ib, safety barrier	Wall unit	12-24 V 115-230 V	**083F4120**	
Signal converter & cleaning unit	Wall unit	12-24 V 115-230 V	**083F4124**	

10.8 Accessories

Description	Length	**Code No.**	Symbol
Cable Standard electrode and coil cable, 3 x 18 gage PVC	33 ft.	**083F0121**	
	65 ft.	**083F0210**	
	130 ft.	**083F0211**	
	200 ft.	**083F0212**	
	330 ft.	**083F0213**	
	500 ft.	**083F3052**	
	650 ft.	**083F3053**	
	1650 ft.	**083F3054**	
Cable Special electrode cable, double screened, PVC	65 ft.	**083F3095**	
	130 ft.	**083F3094**	
	200 ft.	**083F3093**	
	330 ft.	**083F3092**	
	500 ft.	**083F3056**	
	650 ft.	**083F3057**	
	1650 ft.	**083F3058**	
Standard Pg 13.5 screwed cable entries for above cables (nickel-plated brass)	2-off	**083G3140**	
Standard Pg 13.5 screwed cable entries for above cables in black polyamide (100°C)	2-off	**083G0228**	
Sealing screws for sensor/signal converter	2-off	**085U0221**	
Stainless steel (AISI 316) terminal box with lid		**085U1000**	
Polyamide terminal box Complete incl. terminals incl. lid		**085U1002**	
Polyamide lid for terminal box		**085U1003**	
2 kB SENSORPROM® unit (Sensor serial No. must be specified when ordering)		**085U1005**	
Adapter for ½ NPT brass		**083N4394**	
Adapter for ½ NPT stainless steel		**083N4395**	
Adapter for ½ NPT polyamide		**083N4396**	

10.9 Calibration

Initial calibration

Description	
Standard calibration Each sensor calibrated twice at two calibration points Included in sensor scope of delivery	**Code No.: On application form to be filled in and sent to FD-GB**
Matched pair Sensor and signal converter calibrated together with standard calibration	
Customer specified matched pair Sensor with signal converter calibrated in max. 10 customer specified points	
Accredited Danfoss matched pairs Calibrations acc. to EN 45001 Sealing and labeling instruction must follow the order - PTB cold water - PTB other media than water - OIML R75 hot water - OIML R117 other media than water - OIML R117 cold water	
Accredited Delft matched pair Calibration acc. to EN 45001 Sealing and labeling instruction as above	
Add-on **Witness inspection** Any of above mentioned calibrations	

Re-calibration

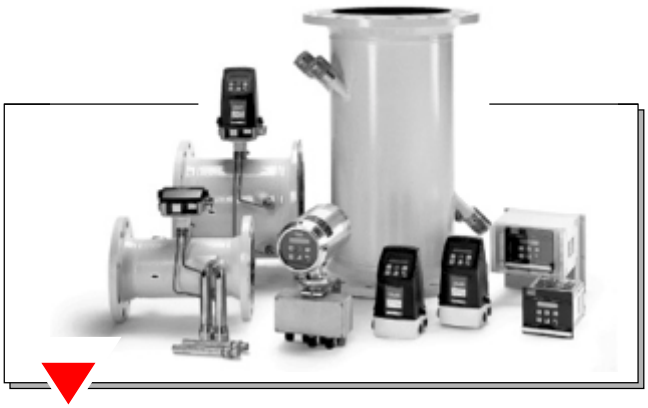
Description	**Code No.** $^1/_4$" - 2 $^1/_2$"	**Code No.** 3" - 6"	**Code No.** 8" - 20"	**Code No.** 24" - 48"
Matched pair Sensor and signal converter calibrated together with standard calibration	**085F7302**	**085F7303**	**085F7304**	**085F7305**
Customer specified matched pair Sensor with signal converter calibrated in max. 10 customer specified points	**085F7377**	**085F7378**	**085F7379**	**085F7380**
Accredited Danfoss matched pairs Calibrations acc. to EN 45001 Sealing and labeling instruction must follow the order - PTB cold water - PTB other media than water - OIML R75 hot water - OIML R117 other media than water - OIML R117 cold water	**085F7387**	**085F7388**	**085F7389**	**085F7390**
Accredited Delft matched pair Calibration acc. to EN 45001 Sealing and labeling instruction as above	**N/A**	**085F7393**	**085F7394**	**085F7395**

The Danfoss A/S, Flow Division range contains:

MAGFLO® electromagnetic flowmeters

MAGFLO® flowmeters are used for all electrically conductive liquids.
A wide range is offered for:

- The water treatment sector – enclosures are NEMA 4X/6 as standard.
- The chemical industry – Ex-approved and other versions available.
- The food industry – stainless steel and other versions available.



SONOFLO® ultrasonic flowmeters

SONOFLO® flowmeters measure flow in full pipes.
SONOFLO® flowmeters measure media in liquid form, irrespective of electrical conductivity.
The range includes a one- to four-track flowmeter, SONO 3000. The meter is also available in a integral mount Ex-version.
SONOFLO® flowmeters can also be installed on existing pipes, providing low cost installations, especially where large pipes are concerned.

MASSFLO® mass flowmeters

MASSFLO® flowmeters measure flow direct in kg/h. In addition, MASSFLO® flowmeters measure:

- Density
- Temperature
- Sugar concentration i.e. °Brix

MASSFLO® flowmeters are available in stainless steel, Hastelloy and with integrated heating.
MASSFLO® flowmeters can be obtained in an intrinsically safe version for explosive areas.

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