Instruction Manual
PN25007 Rev.1

Electro-Magnetic Flowmeters
Mini-Mag® with Integral XE Converter

10D1475W/Y
Sizes 1/10 through 4 Inches

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WARNING notices as used in this manual apply to hazards or unsafe practices which could result in personal injury or death.

CAUTION notices apply to hazards or unsafe practices which could result in property damage.

NOTES highlight procedures and contain information which assist the operator in understanding the information contained in this manual.

WARNING

POSSIBLE PROCESS UPSETS

Maintenance must be performed only by qualified personnel and only after securing equipment controlled by this product. Adjusting or removing this product while it is in the system may upset the process being controlled. Some process upsets may cause injury or damage.

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Safety Summary

GENERAL WARNINGS

POSSIBLE PROCESS UPSETS
Maintenance must be performed only by qualified personnel and only after securing equipment controlled by this product. Adjusting or removing this product while it is in the system may upset the process being controlled. Some process upsets may cause injury or damage.

RETURN OF EQUIPMENT
All Flowmeters and/or Signal Converters being returned to ABB Inc. for repair must be free of any hazardous materials (acids, alkalis, solvents, etc.). A Material Safety Data Sheet (MSDS) for all process liquids must accompany returned equipment. Contact ABB Inc. for authorization prior to returning equipment.

INSTRUCTION MANUALS
Do not install, maintain or operate this equipment without reading, understanding and following the proper ABB Inc. instructions and manuals, otherwise injury or damage may result.

ELECTRICAL SHOCK HAZARD
Equipment powered by AC line voltage presents a potential electric shock hazard to the user. Make certain that the system power is disconnected from the operating branch circuit before attempting electrical interconnections or service.

SPECIFIC WARNINGS

All flowmeters and/or signal converters being returned to ABB Inc. for repair must be free of any hazardous materials (acids, alkalis, solvents, etc). A Material Safety Data Sheet (MSDS) for all process liquids must accompany returned equipment. Contact ABB Inc. for authorization prior to returning equipment. (pg.V, 8-1)

ELECTRICAL SHOCK HAZARD.
Equipment powered by AC line voltage presents a potential electric shock hazard to the user. Make certain that the system power input leads are disconnected from the operating branch circuit before attempting electrical interconnections. (pg. 3-8)

ELECTRICAL SHOCK HAZARD.
Equipment powered by an AC line voltage presents a potential electric shock hazard. Servicing of the Magnetic Flowmeter or Signal Converter should only be attempted by a qualified electronics technician. (pg. 4-1, 8-2)

ELECTRICAL SHOCK HAZARD.
Equipment that operates from ac line voltage constitutes a potential electric shock hazard to the user. Make certain that the system power is disconnected before making the following ohmmeter checks. (pg. 8-2)

Inside edges of the Converter housing casting may be sharp! Use recommended tools, not fingers to disconnect plugs from the connectors, otherwise injury may result! (pg. 8-3, 8-4)

SPECIFIC CAUTIONS

Do not use graphite gaskets. Under certain conditions they may cause an electrically conductive layer to form on the inside wall of the meter, causing meter operation to degrade. (pg. 3-4)

The "magnetic programming stick" is a very strong magnet. Avoid getting the magnet near any magnetic media (such as floppy disks) since inad vertant data loss may result. (pg. 5-2)

Some of the IC devices used in the signal converter are static sensitive and may be damaged by improper handling. When adjusting or servicing the signal converter, use of a grounded wrist strap is recommended to prevent inadvertant damage to the integral solid state circuitry. (pg. 8-1)

Use care when reconnecting the Converter coil and electrode interface connections to insure that the plugs are in proper alignment with the pins of the headers. If these connectors do not mate correctly, the Signal Converter will be inoperable and could be damaged when power is applied. (pg. 8-4)

GÉNÉRAUX AVERTISSEMENTS

PROBLÈMES POTENTIELS. La maintenance doit être réalisée par du personnel qualifié et seulement après avoir sécurisé les équipements contrôlés par ce produit. L'ajustement ou le démontage de ce produit lorsqu'il est lié au système peut entraîner des dysfonctionnements dans le procédé qu'il contrôle. Ces dysfonctionnements peuvent entraîner des blessures ou des dommages.

RETOUR D'ÉQUIPEMENT. Tout débitmètre et(ou) convertisseur retourné à ABB Inc. pour réparation doit être exempt de toute trace de produit dangereux (acide, base, solvant, …). Un certificat de sécurité matériel doit être joint pour tous les liquides utilisés dans le procédé. Contacter ABB Inc. pour autorisation avant renvoi du matériel.

MANUEL DE MISE EN ROUTE. Ne pas installer, maintenir ou utiliser cet équipement sans avoir lu, compris et suivi les instructions et manuels de ABB Inc., dans le cas contraire il y a risque d'entraîner blessures ou dommages.

RISQUE DE CHOC ÉLECTRIQUE
Les équipements alimentés en courant alternatif constituent un risque de choc électrique potentiel pour l'utilisateur. Assurez-vous que les câbles d'alimentation amont sont déconnectés avant de procéder à des branchements, des essais ou tests.

SPÉCIFIQUES AVERTISSEMENTS

Tout débitmètre et(ou) convertisseur retourné à ABB Inc. pour réparation doit être exempt de toute trace de produit dangereux (acide, base, solvant, …). Un certificat de sécurité matériel doit être joint pour tous les liquides utilisés dans le procédé. Contacter ABB Inc. pour autorisation avant renvoi du matériel. (pg. V, 8-1)

RISQUE DE CHOC ÉLECTRIQUE
Les équipements alimentés en courant alternatif constituent un risque de choc électrique potentiel pour l'utilisateur. Assurez-vous que les câbles d'alimentation amont sont déconnectés avant de procéder à des branchements, des essais ou tests. (pg. 3-8)

RISQUE DE CHOC ÉLECTRIQUE
Les équipements alimentés en courant alternatif constituent un risque de choc électrique potentiel. La maintenance sur des équipements électromagnétiques ou des convertisseurs doit être effectuée par des techniciens qualifiés. (pg. 4-1, 8-2)

RISQUE DE CHOC ÉLECTRIQUE
Les équipements alimentés en courant alternatif constituent un risque de choc électrique potentiel. Assurez-vous que la puissance est déconnectée avant de procéder aux mesures de résistance suivantes. (pg 8-2)

Les bords des boîtiers des convertisseurs sont coupants! Utiliser les outils recommandés, pas les doigts, pour déconnecter les bornes des connecteurs, autrement vous pourriez vous blesser. (pg. 8-3, 8-4)

SPÉCIFIQUES ATTENTIONS

N’utilisez pas les garnitures de graphite. Dans certaines conditions elles peuvent causer une couche électriquement conductrice à la forme sur le mur intérieur du mètre, faisant dégrader l’exécution de mètre. (pg.3-4)

Le crayon magnétique contient un aimant très puissant. Eviter de le poser près d’un support d’informations magnétique (disquette, carte de crédit… par exemple) car il pourrait en résulter des pertes de données sur ces supports. (pg. 6-2)

Certains Circuits Intégrés utilisés dans le convertisseur sont sensibles à l’électricité statique et peuvent être endommagés par une mauvaise manipulation. Pendant l’ajustement ou la maintenance d’un convertisseur, l’utilisation d’un bracelet antistatique est recommandé pour éviter la destruction par inadvertance d’un circuit intégré. (pg. 8-1)

Prenez garde en remontant les connections des bobines et des électrodes à ce que les connecteurs soient bien alignés avec les broches des supports. Si ces connecteurs ne sont pas alignés correctement, le convertisseur ne fonctionnera pas et risque d’être endommagé à la mise sous tension. (pg. 8-4)

Read First

WARNING

INSTRUCTION MANUALS
Do not install, maintain, or operate this equipment without reading, understanding and following the proper factory-supplied instructions and manuals, otherwise injury or damage may result.

RETURN OF EQUIPMENT
All Flowmeters and/or Signal Converters being returned to the factory for repair must be free of any hazardous materials (acids, alkalis, solvents, etc). A Material Safety Data Sheet (MSDS) for all process liquids must accompany returned equipment. Contact the factory for authorization prior to returning equipment.

Read these instructions before starting installation;
save these instructions for future reference.

Contacting the Factory . . .

Should assistance be required with any of the company's products, contact the following:

Telephone:

24-Hour Call Center

1-800-HELP-365

E-Mail:

ins.techsupport@us.abb.com

The NEMA 4X rating applies to the meter body and electronics enclosure only. The following accessories (if supplied) may not meet NEMA 4X unless specifically ordered as NEMA 4X:

- meter flanges
- meter installation hardware: studs, nuts, bolts
- enclosure mounting hardware for pipe or wall mounting
- conduit hardware

This product is painted with a high performance epoxy paint. The corrosion protection provided by this finish is only effective if the finish is unbroken. It is the users' responsibility to "touch-up" any damage that has occurred to the finish during shipping or installation of the product. Special attention must be given to: meter flange bolting, pipe mounting of electronics, conduit entries and covers that are removed to facilitate installation or repair. For continued corrosion protection throughout the product life, it is the users' responsibility to maintain the product finish. Incidental scratches and other finish damage must be repaired and promptly re-painted with approved touch-up paint. Provide the model number and size of your product to the nearest ABB Inc. representative to obtain the correct touch-up paint.

1.0 Introduction

1.1 General

The Series 10D1475 MINI-MAG® magnetic flowmeters are electromagnetic liquid flow rate detectors. The meters use the characteristics of a conductive liquid to generate an induced voltage, directly proportional to flow rate, as the liquid passes internal electrodes (refer to Figure 1-2). The resultant voltage is applied to a solid state electronics package that conditions it to an output signal compatible with conventional receiving equipment.

The meter's design provides a compact, very low power, obstructionless primary metering element that bolts between flanges in a process pipeline. Pressure losses in this type of meter are reduced to levels occurring in equivalent lengths of equal diameter pipeline, thus reducing or conserving pressure source requirements as compared to other metering methods. The compact size of the meter results in a light-weight unit that requires no additional support other than that used normally on pipe runs.

This flowmeter may be used to measure many homogeneous liquids and is as independent of the tendency to plug or foul as the pipeline in which it is mounted. By design, only the liner and electrodes are wetted parts and will accommodate most acids, bases, water and aqueous solutions.

Viscosity and density of the metered liquid have no effect on the measurement accuracy of the meter and, therefore, signal compensation is not required. Metering limitations are confined to a minimum threshold of electrical conductivity inherent to the liquid being metered. The degree of liquid conductivity has no effect upon the metering accuracy (as long as it is greater than the minimum level). The liquid temperature and pressure are limited only to the meter material specification limit. ABB magmeters have been the preferred meters in the chemical, pharmaceutical, food, municipal water and waste water industries for many years .

The meter body is a sealed section that bolts between the customer's pipe line flanges. The body has a TEFZEL® (ETFE) liner which is turned out against the flange faces. The measuring electrodes that contact the process liquid have their ends flush with the inside of the liner. For accurate results, the meter bore diameter must be centered in the pipeline. For the larger size meters, spacer sleeves are slipped over the flange mounting bolts. The smaller size meters use a unique centering device (called a flange adaptor) to center the meter.

The associated integrally-mounted electronics package is called the signal converter. Typical integral 10D1475 magnetic flowmeters are shown in Figure 1-1 below.

The signal converter contains a magnet driver circuitry that is used to power the meter's magnet coils. The steady state magnetic field principle, referred to as the MAG-X® design concept, provides optimum zero point stability at an optimized frequency which is a submultiple of the power line frequency.

10D1475W

10D1475Y

FIGURE 1-1. TYPICAL 10D1475 FLOWMETERS

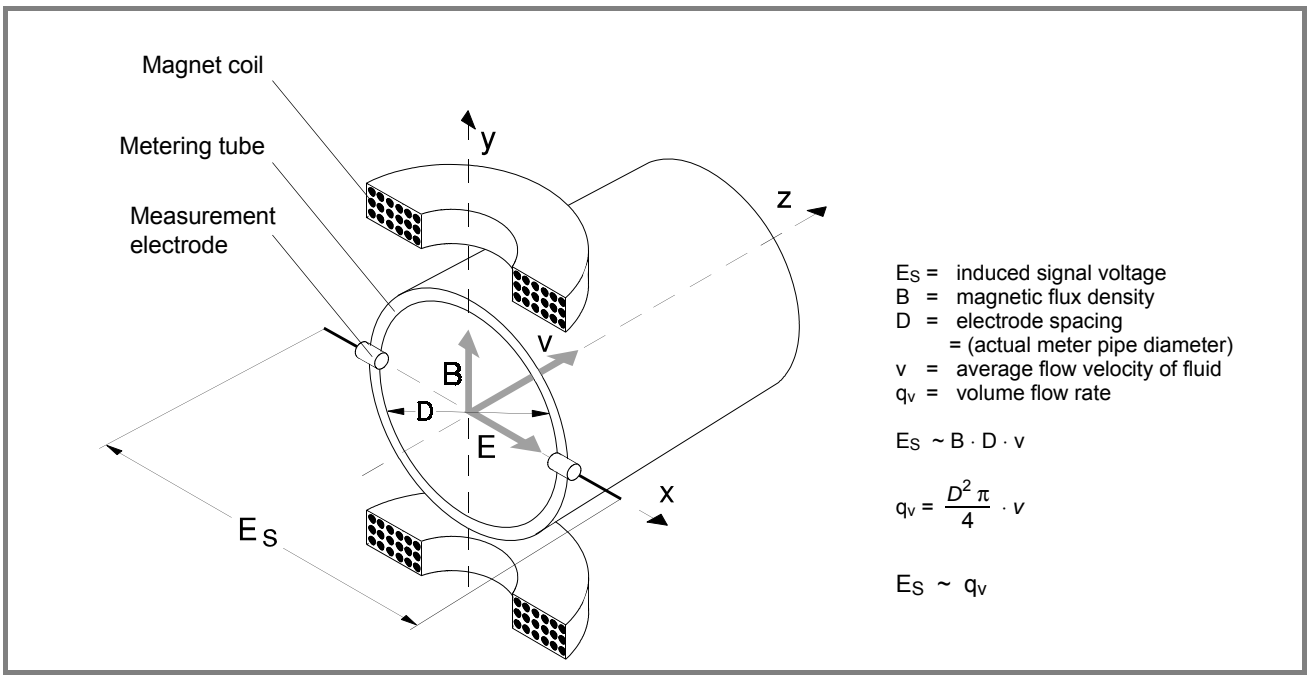


FIGURE 1-2. BASIC MAGMETER OPERATING PRINCIPLE

1.2 Operating Principle

The operating principle of the electromagnetic flowmeter is shown in Figure 1-2 and is based on Faraday's law of magnetic induction which states that the voltage induced across any conductor as it moves at right angles through a magnetic field is proportional to the velocity of that conductor.

The voltage induced within the fluid is picked up by two diametrically opposed mounted electrodes. The induced signal voltage (E_S) is proportional to the magnetic flux density (B), the distance between the electrodes (D) and the average flow velocity (V) of the fluid.

This may be expressed mathematically as:

(Equation #1)

$$E_S = \frac{1}{\alpha} BDV$$

where:

E_s = induced signal voltage
B = magnetic flux density
D = meter pipe diameter
α = dimensionless constant
V = velocity of the fluid

Thus, the metered liquid constitutes a continuous series of conductive liquid disks moving through a magnetic field. The more rapid the rate of liquid flow, the greater the instantaneous value of signal voltage as monitored at the meter electrodes.

1.2.1 Magnet Coil Drive Circuits

In many conventional magnetic flowmeters the integral magnet coils are driven directly by the customer's 50/60 Hz power service. The design of the Series 10D1475 magnetic flowmeter uses magnet drive circuits which are alternately energized bi-directionally at a low frequency rate controlled by the Converter/Driver assembly.

1.2.2 Volumetric Flow Rate Measurement

The magnetic flowmeter is a volumetric flow rate measuring instrument. This can be shown by substituting the physical equivalent of liquid velocity into equation #1 as follows:

(Equation #2)

$$V = \frac{Q}{A} = \frac{4Q}{\pi D^2}$$

Substituting for V in equation #1

$$Es = \frac{1}{\alpha} BD \frac{4Q}{\pi D^2}$$

and solving for Q:

$$\therefore \quad Q = \frac{\pi \alpha D^2}{4} \bullet \frac{E_s}{B}$$

Since $B = \beta E_r$

and since α, D and β are constant:

(Equation #3)

$$Q = \gamma \frac{E_s}{E_r}$$

where:

Q = volumetric flow rate
A = cross-sectional area
D = pipe section diameter
E_s = induced signal voltage
E_r = reference voltage
B = magnetic flux density
α = dimensionless constant
β & γ = dimensional constant
V = liquid velocity

Therefore, volumetric flow rate is directly proportional to the induced signal voltage as measured by the magnetic flowmeter.

1.3 Operating Characteristics

1.3.1 Liquid Variables

1.3.1.1 Liquid Conductivity

The magnetic flowmeter requires a liquid conductivity of 20 micro-Siemens per centimeter or higher for operation.

Since Primaries with integrally mounted signal converters use an encapsulated buffer preamplifier for each electrode, it is not possible to effectively measure the AC resistance of the electrodes to determine the fluid conductivity. The conductivity must be determined from actual process fluid sample measurements or from other known data. Factory Applications Engineers are qualified to determine the conductivities of special liquids, please contact the factory if assistance is required. Table 1-1 correlates 10D1475 electrode diameters to meter size.

TABLE 1-1. ELECTRODE DIAMETERS

Meter Size		Electrode Diameter	
inch	mm	inch	cm
1/10	3	0.048	0.122
5/32	4	0.048	0.122
1/4	6	0.048	0.122
3/8	10	0.048	0.122
1/2 - 1 1/2	15 - 40	0.250	0.635
2 - 4	50 - 100	0.312	0.792

Low conductivity liquids require special consideration when applying magnetic flowmeters. Applications Engineers will offer any assistance required for individual applications.

1.3.1.2 Liquid Temperature

Having established the minimum liquid conductivity requirements for a given application, any liquid which exhibits equal or higher conductivity may be metered without concern for any system compensating adjustments. However, the effect of the fluid's conductivity characteristics versus temperature should be taken into consideration.

Most liquids exhibit a positive temperature coefficient of conductivity. It is possible for certain marginal liquids to become sufficiently non-conductive at lower temperatures so as to hamper accurate metering. However, the same liquid at higher or normal environmental temperatures may be metered with optimum results. The possibility of an adverse temperature conductivity characteristic should be investigated before attempting to meter such a liquid. Process or ambient temperatures are also limited by the meter materials specification.

Other normal effects of temperature, such as influence upon liquid viscosity and density, the size of the metering area, and the flux density of the magnetic field, have negligible or no effect upon metering accuracy.

1.3.1.3 Other Liquid Variables

Other liquid variables such as viscosity, density and liquid pressure have no direct influence on metering accuracy. Liquid density has no effect on volumetric flow rate since only the area of the meter pipe and liquid velocity are required to determine the rate of flow. Viscosity and metering pressure are restricted to physical limitations alone, such as the leakage pressure of the meter pipe flange connections.

1.3.2 Metering Characteristics

The metering pipe must be completely filled at all times for accurate results. Where there is possibility of operation with a partially filled horizontal pipeline, it is recommended that the magnetic flowmeter be installed in a vertical section of that pipeline such that liquid flow moves upward. A vertical installation also offers the advantage of an even distribution of liner wear in the event that solid abrasives are being carried along in the liquid stream.

The magnetic flowmeter will measure the total amount of material passing in the liquid stream. The meter will not, however, differentiate between the amount of liquid and the amount of entrained gases. Also, in the case of a slurry, it will not differentiate the amount of liquid from solids. If the liquid to mixant ratio is important to process control, then separate measurements of the concentration of the desired medium must be made and appropriate correction factors must be applied to the magnetic flowmeter output.

In applications involving variable quantities of uniformly dispersed, non-conductive mixing agents, it must be determined that the higher concentrations of mixant will not drive the average conductivity of the liquid mixture below the minimum conductivity level for the given installation.

1.4 Model Number Breakdown

Refer to the data sheet or the data tag on the equipment for the model number of the instrument furnished. The details of a specific number are shown on the following two pages.

Order Number 10D1475	_	N	__	_	_	2	9	_	_
Design Level									
1/10 - 3/8 in. w/ 50XE µP Electronics	Y								
1/2 - 4 in. w/ 50XE µP Electronics	W								
Liner Material									
Tefzel (ETFE)		N							
Meter Size - inches (mm)									
1/10 (3)			01						
5/32 (4)			02						
1/4 (6)			04						
3/8 (10)			06						
1/2 (15)			07						
1 (25)			09						
1 1/2 (40)			11						
2 (50)			12						
3 (80)			14						
4 (100)			15						
Pressure Rating									
ANSI Class 150				P					
ANSI Class 300				Q					
Electrode Material									
Hastelloy-C					D				
Tantalum					F				
Platinum					M				
Electrode Type									
Flush						2			
Flange Material									
Wafer Design w/ English Tag							9		
Safety Classification									
w/o FM Approval (General Purpose)								A	
FM Approved - Nonincendive for Class I, Div 2, Gp A, B, C & D: Electrodes Intrinsically Safe for Class I, Div 1, Gp A, B, C & D: Outdoor Hazardous Locations, NEMA 4X. Integral signal converter enclosure additionally approved: Dust-Ignitionproof Class II & III, Div 1, Gp E, F & G: Accidental Submergence, 30 ft H_2O/48 hr (9 m H_2O/48 hr)								K	
FM Approved - Explosionproof for Class I, Div 1, Gp B, C & D; Dust-Ignitionproof Class II & III, Div 1, Gp E, F & G: Electrodes Intrinsically Safe for Class I, Div 1, Gp A, B, C & D - Outdoor Hazardous Location, NEMA 4X								L	
Power Requirements									
220/230/240 VAC, 50/60 Hz									A
110/115/120 VAC, 50/60 Hz									C
24 VDC									H

Order Number 10D1475	_	N	__	_	_	2	9	_	_	_	_	_	_	_	_	_	_
Enclosure Classification																	
IEC 529, IP65, NEMA 4X										1							
Accidental Submersion, IEC 529, IP67, 30 ft H_20/48 h (9 m H_2O/48 h) (NEMA 4X)										5							
Fluid Temperature Range																	
Refer to Figure 2-1											1						
Output Current																	
0-20 mA DC												B					
4-20 mA DC												C					
Output Options																	
Scaled Pulse, Passive													1				
Communication Mode																	
Not applicable														1			
HART Protocol														4			
Coil Drive Frequency																	
7-1/2 Hz (60 Hz line frequency)															1		
6-1/4 Hz (50 Hz line frequency)															4		
6-1/4 Hz (DC power, in vicinity of 50 Hz line)															6		
7-1/2 Hz (DC power, in vicinity of 60 Hz line)															8		
30 Hz (24 VDC)															T		
30 Hz (60 Hz Line Frequency															D		
Additional Options																	
Empty Pipe Detector																1	
None																2	
HART Protocol & Empty Pipe Detector																3	
HART Protocol																4	
FOUNDATION Fieldbus & Empty Pipe Detection (Disabled																F	
PROFIBUS PA &Empty Pipe Detection (Disabled)																P	
Mounting Hardware Kit																	
Standard Kit: Steel Bolts & Nuts, Centering Device, Klinger Sil C-4401 Gaskets																	C
Optional Kit: Steel Bolts & Nuts, Centering Device, Teflon Gaskets																	E
Standard Kit Not Required																	X
Converter																	
Required																	1
Not Required (Primary only)																	2

2.0 Specifications

2.1 Primary

2.1.1 Power Consumption

Refer to Converter Specifications, Section 2.2

2.1.2 Flowmeter Characteristics

2.1.2.1 Meter Size/Flow Capacity

See Table 2-1

2.1.2.2 Span

Set with the Converter. Refer to Sections 2.2.3 & 6.0 - Parameter Entry.

2.1.2.3 Rangeability

15:1

2.1.2.4 Minimum Liquid Conductivity

20 µSiemens/cm

2.1.2.5 RFI Protection

Class 3-abc-0.5% (30 V/m-27 to 446 MHz) Per SAMA Standard PMC 33.1-1978. Standard with integral Converters.

2.1.2.6 Enclosure Classification with or without Signal Converter

NEMA 4X, IEC 529 IP65

2.1.2.7 Accidental Submergence (Optional)

IEC 529 IP67, 30 feet H_2O/48 h (9 m H_2O /48 h)

2.1.2.8 Max. Process Pressure

Pressure		Temperature	
psi	MPa	°F	°C
740	5.11	100	40
720	4.96	150	65
650	4.50	250	120

2.1.2.9 Environmental & Process Temperature Limits

Ambient: -4 to 131°F (-20 to 55°C)
Fluid: 32 to 250°F (0 to 121°C)

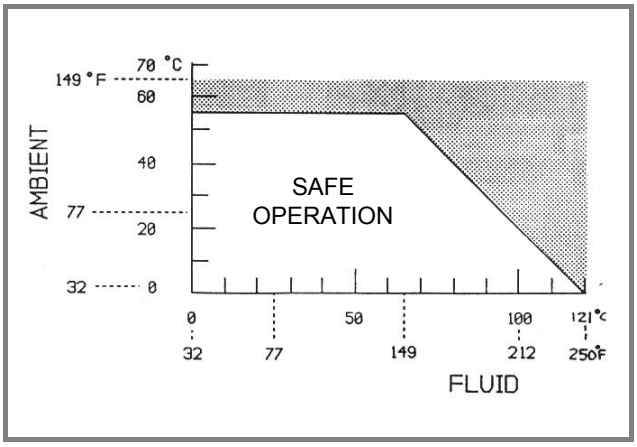


FIGURE 2-1. FLUID TEMPERATURE vs. AMBIENT TEMPERATURE

2.1.2.10 Vacuum

Full vacuum at 212° F (100° C) for 1/10 - 3 in. (3 - 80 mm) sizes.

Full vacuum at 176° F (80° C) for 4 in. (100 mm) size.

2.1.2.11 Meter Capacity

Specified on Flowmeter data tag (equal to maximum flow capacity in engineering units). This factor is equivalent to a flow velocity of 32.808 ft/s in the metering tube.

TABLE 2-1. METER CAPACITY

NOTE
Any maximum (range) between 0.05 x Meter Capacity & 1.0 x Meter Capacity is available with standard software.

			Flow Ranges 0 to value tabulated			
Meter Size		Meter Capacity*	Minimum		Maximum	
inch	mm	gpm	gpm	lpm	gpm	lpm (@ 10m/sec)
1/10	3	1.06	0.053	0.20	1.06	4.00
5/32	4	2.11	0.106	0.40	2.11	8.00
1/4	6	5.28	0.264	1.00	5.28	20.0
3/8	10	11.9	0.595	2.25	11.9	45.0
1/2	15	26.4	1.32	5.0	26.4	100.
1	25	52.8	2.64	10.0	52.8	200.
1 1/2	40	158.5	7.93	30.0	158.5	600.
				m^3/h		m^3/h
2	50	264.2	13.2	3.0	264.2	60.
3	80	792.5	39.6	9.0	792.5	180.
4	100	1056.7	52.8	12.0	1056.7	240.

* Flow Velocity (ft/s) = (Operating GPM x 32.81)/METER CAPACITY

2.1.3 Physical Characteristics

2.1.3.1 Outline Dimensions

Outline dimensions shown in Figure 2-5.

2.1.3.2 Conduit Connections

Two 1/2 inch NPT internally threaded entrances in Flowmeter junction box

2.1.3.3 Signal Converter Vibration Limit

5 to 14 Hz, 0.10 inch,
14 to 2000 Hz, 1 g

2.1.3.4 Meter Weight

Magnetic Flowmeter with integral Signal Converter - Refer to Table 2-2.

TABLE 2-2. METER WEIGHTS

Meter Size		Weight	
inch	mm	pounds	kilograms
1/10	3	7	3
5/32	4	7	3
1/4	6	7	3
3/8	10	7	3
1/2	15	7	3
1	25	7	3
1 1/2	40	8	3.6
2	50	10	4.5
3	80	13	6
4	100	19	8.6

2.1.4 Materials of Construction

2.1.4.1 Meter Liner

1/10 - 4 in. (3 - 100 mm) - TEFZEL (ETFE)

2.1.4.2 Electrode Assemblies

Hastelloy-C, Tantalum, Zirconium or Platinum materials as specified (ref: Application Guide PMI IV.C.10)

2.1.4.3 Meter Housing

Carbon steel, all welded construction, epoxy finish

2.1.4.4 Electronics Housing

Die cast aluminum, epoxy finish, 316 sst attachment screws, 1/2 in. NPT conduit connections; gasketed covers

2.1.4.5 Installation Kit

Includes 2 gaskets, mounting studs and nuts, flange adaptor device when required.

2.1.4.6 Safety Classification

See Section 1.4 - Model Number Breakdown.

2.2 Converter

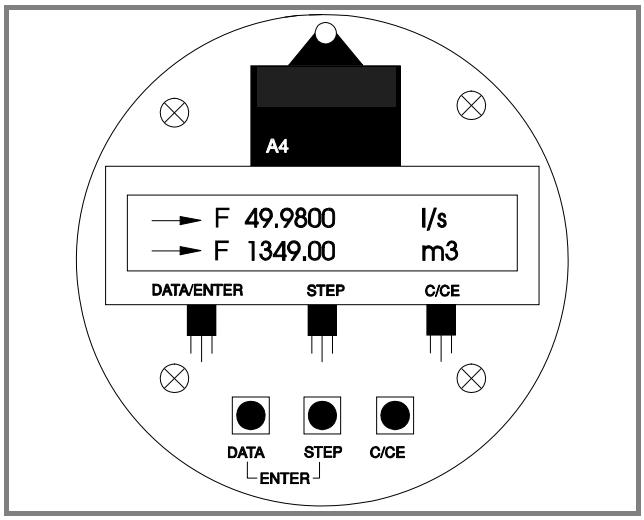


FIGURE 2-2. CONVERTER DISPLAY AND PUSHBUTTONS

2.2.1 Power Supply Requirements

See Section 1.4 - Model Number Breakdown

2.2.2 Power Consumption

≤ 10 VA (primary and converter)

2.2.3Flow Rate Range

Continually adjustable between 0.5 and 10 m/s

2.2.4 Accuracy

≤ 0.5 % of rate @ ≥ 7% of Meter Capacity

2.2.5 Reproducibility

≤ 0.15 % of rate @ ≥ 5% of Meter Capacity

2.2.6 Minimum Conductivity

20 μS/cm

2.2.7 Response Time

As a step function 0-99 % ≥ 1 s at 6 1/4, 7 1/2 Hz excitation

2.2.8 Magnet Coil Supply

6 1/4, 7 1/2 Hz (50/60 Hz supply)

2.2.9 Ambient Temperature

-20 to +60 °C (-4 to +140 °F) see temperature diagram page 2-1

2.2.10 Electrical Connections

- Cage-clamp terminals for wiring,
- ½ in. NPT internally threaded conduit fittings.

2.2.11 Parameter Entry

Parameters may be entered with the instrument either open or closed by using the data entry push-buttons or the "magnetic stick" respectively.

2.2.12 Forward/Reverse Flow Measurement

An arrow in the display indicates the flow direction, and an optocoupler contact provides an external indication of flow direction. Signaling takes place at forward flow.

2.2.13 Display

LCD dot matrix display, 2 lines x16 characters. The internal flow totalizer integrates in both forward and reverse flow directions and in 16 different units. Display of the flow volume may be in percent or any of 42 other units.

For better readability, the CL I DIV2 converter housing may be rotated 90° and the display can be placed in three different positions in 90° increments.

The units listed below are set by means of the arrow buttons. The unit refers to $Q_{max}DN$, Q_{max} forward and reverse flow and to the flow volume indication, if these are displayed in engineering units.

Unit Abbreviation / Description	Time Units *				with HART
	/S	/M	/H	/D	
l, liter	♦	♦	♦		♦
ml, milliliter, .001 liters	♦	♦	♦		
hl, hectoliter, 100 liters	♦	♦	♦		
Ml, megaliters, 1,000,000 l		♦	♦	♦	
m^3, cubic meters	♦	♦	♦	♦	♦
igal, imperial gallon	♦	♦	♦	♦	♦
gal, US gallon		♦	♦		♦
mgal, million US gallons				♦	
bbl, brewery barrel, 31 gal.	♦	♦	♦		♦
bls, petroleum barrel, 42 gal		♦	♦	♦	
gram	♦	♦	♦		♦
kg, kilogram, 1000 grams	♦	♦	♦		♦
t, metric ton, 2000 kg		♦	♦	♦	♦
lb, US pound	♦	♦	♦		♦
uton, US ton, 2000 pounds		♦	♦	♦	
configurable unit **	♦	♦	♦	♦	♦

Table 2-3 Flow Unit Settings

* Where:
/S = per second
/M = per minute
/H = per hour
/D = per day

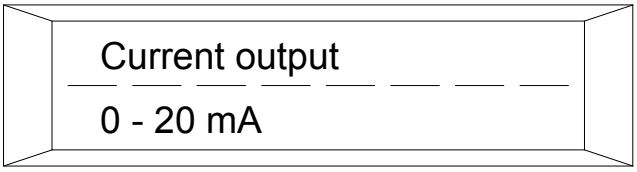
2.2.14 Data Security

If the power supply should fail, all data is stored in a NV-RAM for a period of more than 10 years without requiring external power. Additional data security is offered by an external serial EEPROM located in the converter for exchange or storage of process information.

2.2.15 Separation of Input / Output

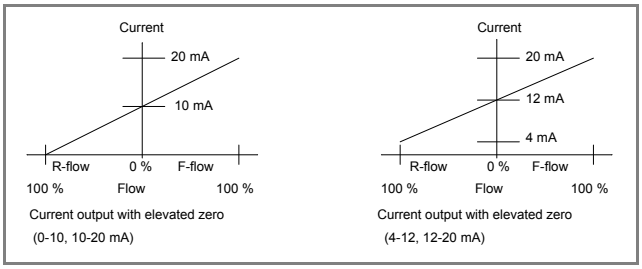
Current and pulse output are galvanically isolated from the input circuit and from one another.

2.2.16 Input / Output Signals

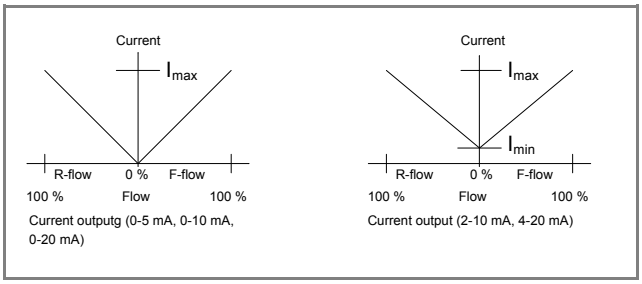


2.2.16.1 Current Output

Selectable:
0/4-20 mA, load ≤ 600 Ω;
0/2-10 mA, load ≤ 1200 Ω;
0-5 mA, load ≤ 2400 Ω



Terminals: +/-



2.2.16.2 Scaled Pulse Output

Maximum scaled pulse output frequency is 5 kHz. The pulse multiplication factor may be set between 0.001 and 1000. The pulse width is adjustable from 0.064 ms to 2000 ms.

Optocoupler **Terminals V8, V9**,
$0\ V \le U_{CEL} \le 2\ V$, $16\ V \le U_{CEH} \le 30\ V$
$0\ mA \le I_{CEH} \le 0{,}2\ mA$, $2\ mA \le I_{CEL} \le 250\ mA$

2.2.16.3 Contact Output

The following functions are selectable via the software:

- **System Supervision** opened or closed at alarm [1)]
- **Empty Pipe** opened or closed at alarm
- **Forward/Reverse Flow** - closed for forward flow
- **Limit Alarm** opened or closed at alarm
- **Optocoupler, terminals P7 & G2**
  $16V < V_{CEH} < 30V$, $0V < V_{CEL} < 2V$
  $0mA < I_{CEH} < 0.2mA$, $2mA < I_{CEL} < 15mA$

[1)] Contact functions (normally closed, normally open) are software selectable.

2.2.16.4 Contact Input

The following functions are software selectable:

- **External Output Cut-off** - All output signals are are forced to no-flow condition (Refer to Figure 3-13).
- **External Totalizer Reset** - The internal Totalizer value can be reset via an external contact closure (Refer to Figure 3-13).
- **Optocoupler, Terminals X1 & G2**
  $16V < V < 30V$, $Ri = 2k\Omega$

2.2.16.5 Empty Pipe Detection (option)

By using the optional "automatic empty pipe cut-off", an "Empty Pipe" condition is detected and signalled. Contact output opens for an alarm condition.

During this condition, the current output is forced to 0% or 130% of the limiting current value and the Totalizer will stop incrementing.

Only available for:

- Meter Size ≥ 10mm
- Conductivity ≥ 50 μSiemens/cm

2.2.16.6 HART-Protocol (Option)

Part Number CD699B143U01, Rev. X.17 is the optional **HART® PROTOCOL** firmware.

HART® Protocol provides a communication means between a process control system, a hand-held terminal and the magnetic flowmeter in the field. The digital communication occurs through use of an alternating voltage superimposed on the current output and which does not affect the instruments connected to this current output. This option is only available on "+/-" output terminals with a 4-20 mA output current.

The addition of HART capability affects availability of some flow units (Refer to Table 2-3).

The HART® protocol system, when supplied, permits simultaneous 4-20 mA and digital signal transmission on the same 2-wire cable. With this protocol, process parameters such as instantaneous flow rate and cumulative total flow, or operating conditions such as alarm values, can be monitored or altered by an external "smart " device, e.g., a host computer. This interface allows the Converter's data base to be uploaded into the host computer. Operating parameters which would only be changeable at the Converter can be scanned and remotely reconfigured.

Software and hardware are optionally available to implement a HART® Protocol information exchange between the converter and a HART® Protocol master device. This data link permits continuous monitoring of process variable and totalized flows and provides for configuration of the following:

- Values and units for range
- Pulse factor and units for totalizers as well as reset capability
- Damping, noise reduction, low flow cutoff value
- Empty pipe detector setup
- Alarm fail safe condition
- Converter tag name and record information
- Calibration of the analog (4 - 20 mA) output

The following parameters may be displayed but not configured:

- Meter size and calibration factor
- Instrument model type and manufacturer
- Totalizer overflow values

Refer to the HART® Model 275 Communicator Instruction Bulletin for detailed information regarding application of HART® Protocol.

When implementing the HART® protocol, the control computer is the master and the field transmitter the slave. In addition to this primary master a second master (such as the Model 275 Hand-Held Communicator) can become active. Data is transmitted at 1200 baud, with the serial information being encoded and detected as outlined in the Bell 202 standard.

NOTE

The "SERVICE" sub-menu developed for the 275 Communicator contains features intended to be used only by factory service personnel. Many of the functions shown are intentionally undocumented in the Instruction Bulletin. Modifying these functions without thoroughly understanding them can cause the flow measuring system to become inoperative or inaccurate.

It is also recommended that the "Meter Size" and "USL" (upper sensor limit/meter capacity) parameters not be changed using the Communicator. If changed, errors could develop later, especially after a power interruption.

Transmission mode

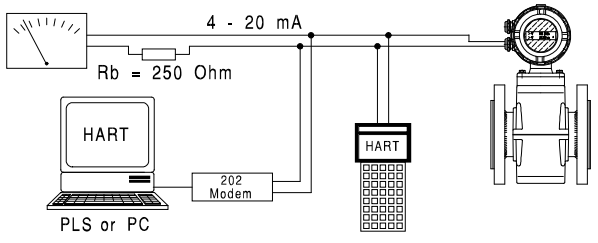
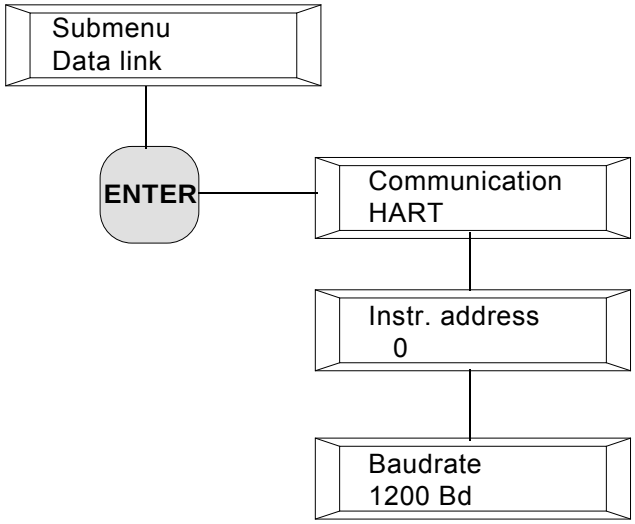


FIGURE 2-3. HART PROTOCOL COMMUNICATION

A submenu entitled **Submenu Data Link** has been added between the **Current Output** and **Function Test** submenus. Its contents are as follows:



Special HART® features are now available which were previously not available, these include:

- A function test for the modem which superimposes either 2200 Hz or 1200 Hz signals on the analog output
- A function test that displays the HART® command received from a master device

FSK current modulation is superimposed on the 4–20 mA current output in accordance with the Bell 202 standard. Maximum signal amplitude is 1.2 mA p-p.

2.2.16.6.1 Load, Current Output

Min.: >250 Ω, max. < 600 Ω

2.2.16.6.2 Cable

AWG 24 twisted

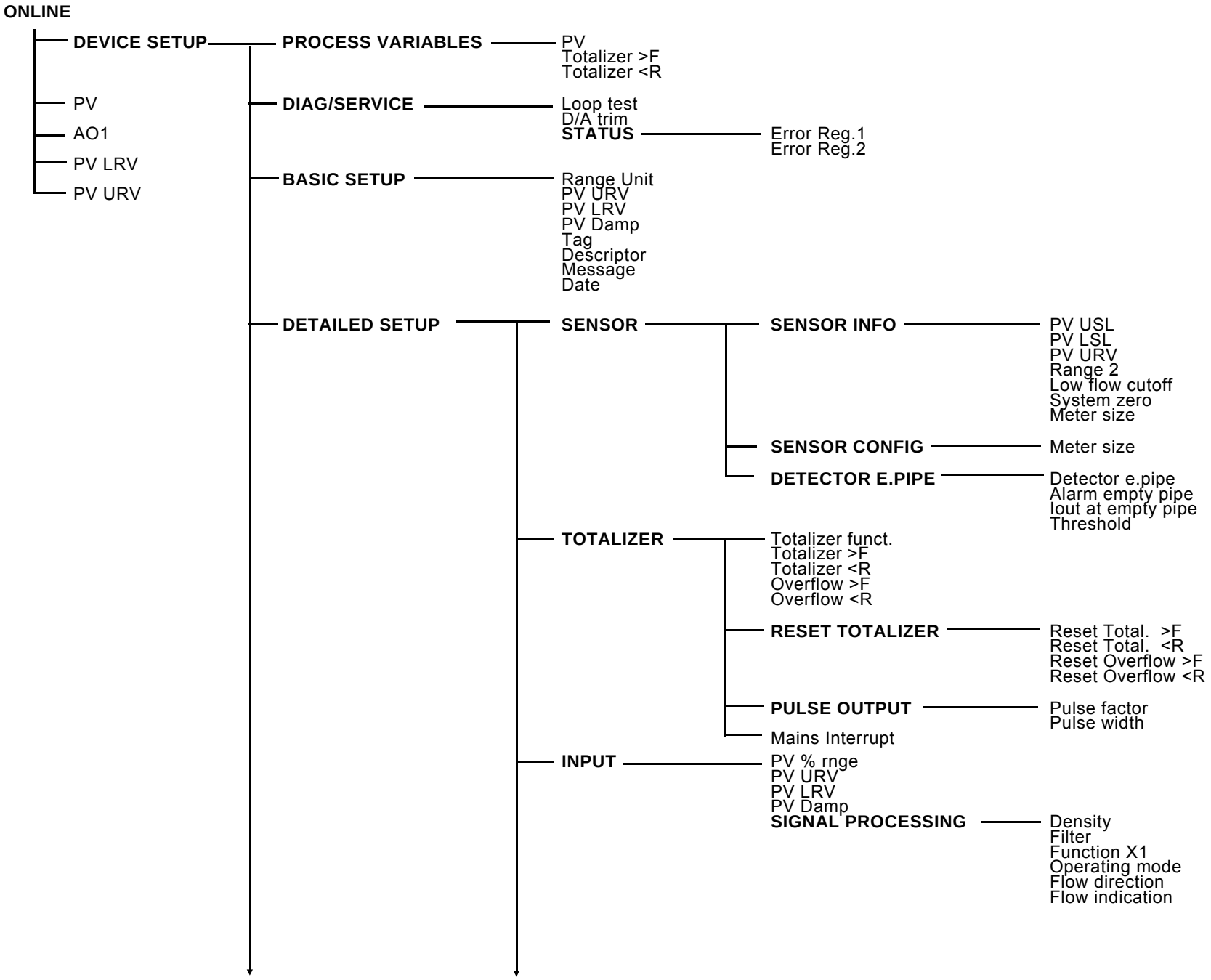
2.2.16.6.3 Maximum Cable Length

1500 meters (approx. 4900 feet)

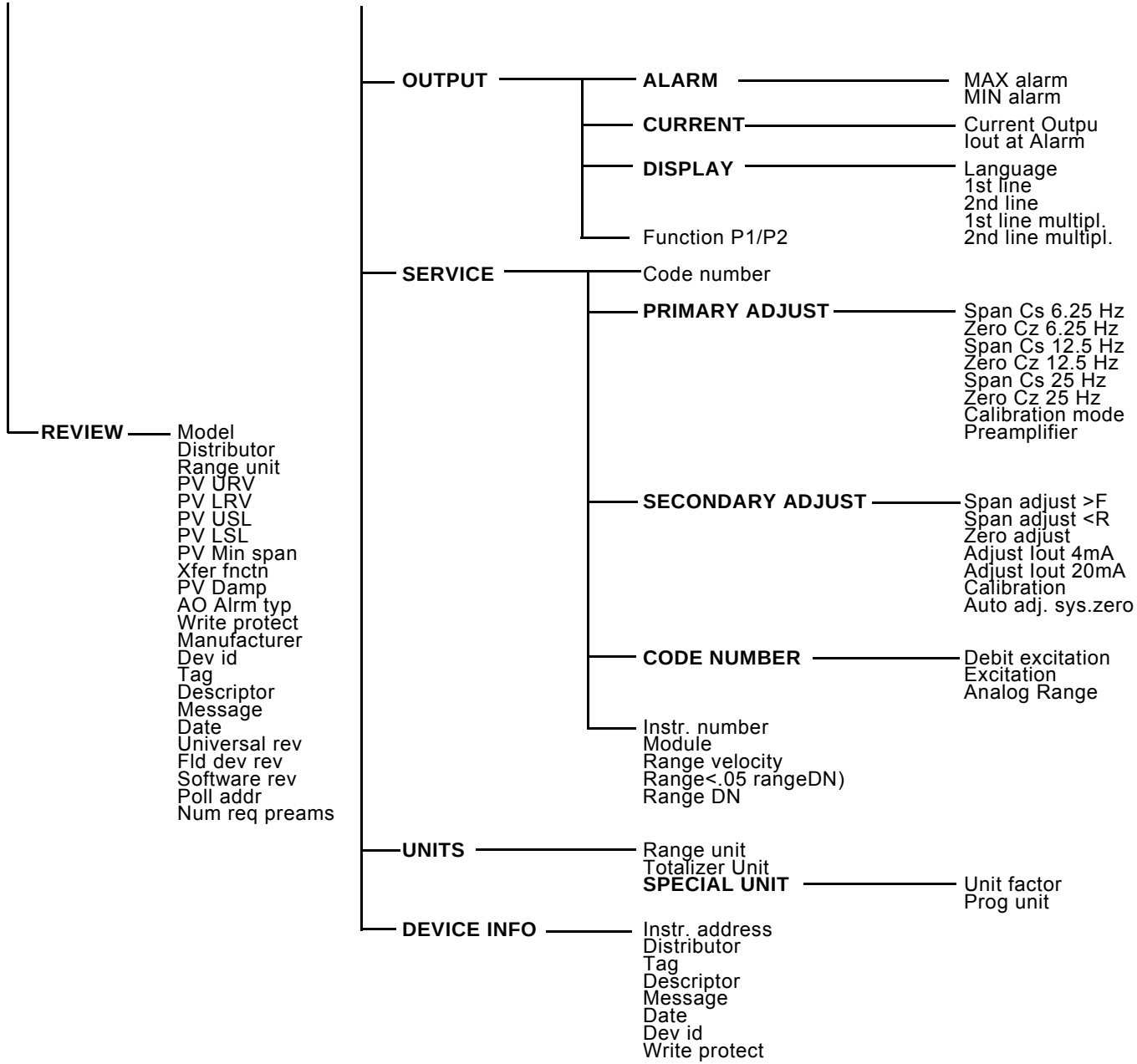
2.2.16.6.4 Baud Rate

1200 Baud
Logical 1: 1200 Hz
Logical 0: 2200 Hz

The Model 275 Hand-Held Communicator menu sequence is shown on the following pages for reference.


ONLINE
DEVICE SETUP
PV
AO1
PV LRV
PV URV
PROCESS VARIABLES
PV
Totalizer >F
Totalizer <R
DIAG/SERVICE
Loop test
D/A trim
STATUS
Error Reg.1
Error Reg.2
BASIC SETUP
Range Unit
PV URV
PV LRV
PV Damp
Tag
Descriptor
Message
Date
DETAILED SETUP
SENSOR
SENSOR INFO
PV USL
PV LSL
PV URV
Range 2
Low flow cutoff
System zero
Meter size
SENSOR CONFIG
Meter size
DETECTOR E.PIPE
Detector e.pipe
Alarm empty pipe
Iout at empty pipe
Threshold
TOTALIZER
Totalizer funct.
Totalizer >F
Totalizer <R
Overflow >F
Overflow <R
RESET TOTALIZER
Reset Total. >F
Reset Total. <R
Reset Overflow >F
Reset Overflow <R
PULSE OUTPUT
Pulse factor
Pulse width
Mains Interrupt
INPUT
PV % rnge
PV URV
PV LRV
PV Damp
SIGNAL PROCESSING
Density
Filter
Function X1
Operating mode
Flow direction
Flow indication

t


REVIEW
Model
Distributor
Range unit
PV URV
PV LRV
PV USL
PV LSL
PV Min span
Xfer fnctn
PV Damp
AO Alrm typ
Write protect
Manufacturer
Dev id
Tag
Descriptor
Message
Date
Universal rev
Fld dev rev
Software rev
Poll addr
Num req preams
OUTPUT
ALARM
MAX alarm
MIN alarm
CURRENT
Current Outpu
Iout at Alarm
DISPLAY
Language
1st line
2nd line
1st line multipl.
2nd line multipl.
Function P1/P2
SERVICE
Code number
PRIMARY ADJUST
Span Cs 6.25 Hz
Zero Cz 6.25 Hz
Span Cs 12.5 Hz
Zero Cz 12.5 Hz
Span Cs 25 Hz
Zero Cz 25 Hz
Calibration mode
Preamplifier
SECONDARY ADJUST
Span adjust >F
Span adjust <R
Zero adjust
Adjust Iout 4mA
Adjust Iout 20mA
Calibration
Auto adj. sys.zero
CODE NUMBER
Debit excitation
Excitation
Analog Range
Instr. number
Module
Range velocity
Range<.05 rangeDN)
Range DN
UNITS
Range unit
Totalizer Unit
SPECIAL UNIT
Unit factor
Prog unit
DEVICE INFO
Instr. address
Distributor
Tag
Descriptor
Message
Date
Dev id
Write protect

Selected Range and Totalizer units are **not available** with the HART® Protocol firmware version. Refer to Tables 1 & 2 for Range and Totalizer units available with the HART® Protocol firmware.

TABLE 2-4. RANGE UNITS

Unit Abbreviation / Description	Time Units *				with HART
	/S	/M	/H	/D	
l, liter	♦	♦	♦		♦
ml, milliliter, .001 liters	♦	♦	♦		
hl, hectoliter, 100 liters	♦	♦	♦		
Ml, megaliters, 1,000,000 l		♦	♦	♦	
m^3, cubic meters	♦	♦	♦	♦	♦
igal, imperial gallon	♦	♦	♦	♦	♦
gal, US gallon		♦	♦		♦
mgal, million US gallons				♦	
bbl, brewery barrel, 31 gal.	♦	♦	♦		♦
bls, petroleum barrel, 42 gal		♦	♦	♦	
gram	♦	♦	♦		♦
kg, kilogram, 1000 grams	♦	♦	♦		♦
t, metric ton, 2000 kg		♦	♦	♦	♦
lb, US pound	♦	♦	♦		♦
uton, US ton, 2000 pounds		♦	♦	♦	
configurable unit **	♦	♦	♦	♦	♦

* Where: /S = per second
/M = per minute
/H = per hour
/D = per day

TABLE 2-5. TOTALIZER UNITS

Unit Abbreviation / Description	with HART
l, liter	♦
ml, milliliter, .001 liters	
hl, hectoliter, 100 liters	
Ml, megaliters, 1,000,000 l	
m^3, cubic meters	♦
igal, imperial gallon	♦
gal, US gallon	♦
mgal, million US gallons	
bbl, brewery barrel, 31 gal.	♦
bls, petroleum barrel, 42 gal	
gram	♦
kg, kilogram, 1000 grams	♦
t, metric ton, 2000 kg	♦
lb, US pound	♦
uton, US ton, 2000 pounds	
configurable unit **	♦

** Name & volume may be configured by the user. Volume can be 0.001 to 4,999,999 liters. Default unit is "kgal", 1000 US gallons.

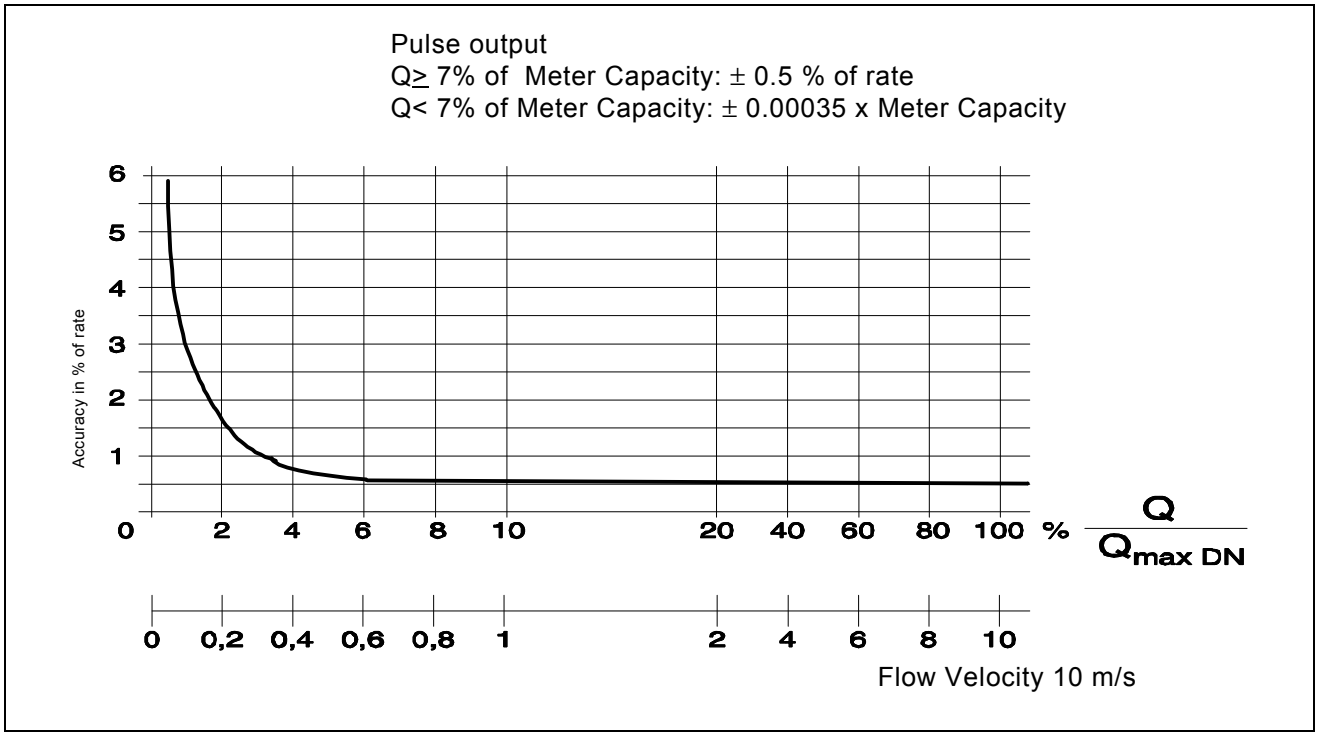


FIGURE 2-4. ACCURACY UNDER REFERENCE CONDITIONS

2.2.17 Reference Conditions in Accordance With EN29104

2.2.17.1 Fluid Temperature

20 °C ± 2 °C

2.2.17.2 Ambient Temperature

20 °C ± 2 °C

2.2.17.3 Power Supply

Rated voltage according to nameplate ± 1%

2.2.17.4 Installation Conditions of Straight Pipe Section

Upstream of primary > 10 x DN
Downstream of primary > 5 x DN

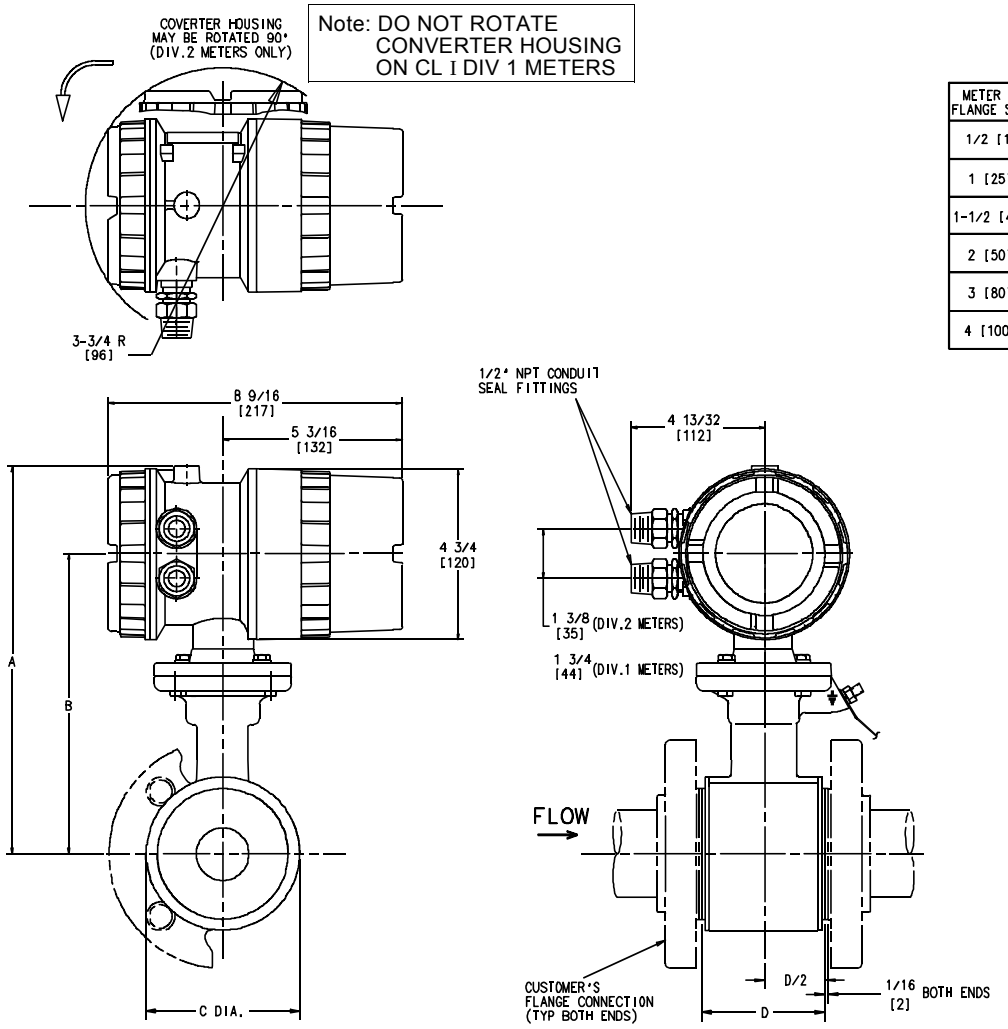
where DN = nominal meter size

2.2.17.5 Warm-Up Time

30 minutes

2.2.17.6 Analog Output Accuracy

Same as pulse output but with additional ± 0.1 % of span.



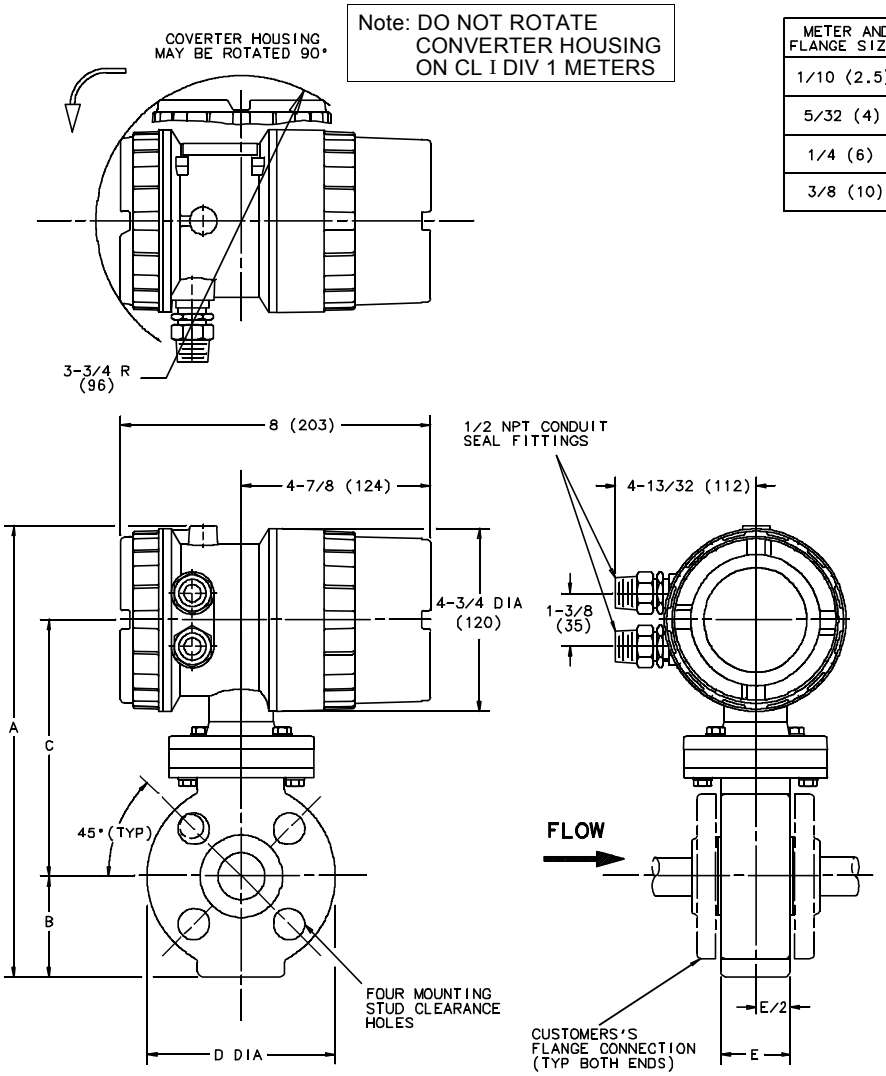
METER AND FLANGE SIZES	CUSTOMER FLANGE TYPE AND RATING	A	B	C DIA	D
1/2 [15]	ANSI CLASS 150 ANSI CLASS 300 BS 10 TBL D,E,F DIN PN 10, 16, 25 & 40	8-31/32 [228]	6-17/32 [166]	1-7/8 [48]	2-5/32 [55]
1 [25]		9-11/32 [237]	6-29/32 [175]	2-5/8 [67]	2-5/32 [55]
1-1/2 [40]		9-23/32 [247]	7-9/32 [185]	3-3/8 [86]	2-3/4 [70
2 [50]		10-1/32 [255]	7-19/32 [193]	4 [102]	3-11/32 [85]
3 [80]		10-21/32 [271]	8-7/32 [209]	5-1/4 [133]	4-23/32 [120]
4 [100]		11-5/16 [287]	8-7/8 [225]	6-1/2 [165]	5-29/32 [150]

NOTES:

1. DIMENSIONS ARE IN INCHES. DIMENSIONS IN BRACKETS [ ] ARE IN MILLIMETERS.
2. DIMENSIONS GUARANTEED ONLY IF THIS PRINT IS CERTIFIED.
3. ALL DIMENSIONS SUBJECT TO MANUFACTURING TOLERANCE OF ±1/8 INCH (3mm).
4. METER MUST BE COMPLETELY FILLED WITH LIQUID TO INSURE ACCURACY.
5. FLOW MUST BE IN SAME DIRECTION AS FLOW ARROW. 1/2 NPT CONDUIT CONNECTIONS IN HOUSING INDICATE "UPSTREAM" END OF METER.
6. METER MOUNTS BETWEEN CUSTOMER'S PIPELINE FLANGES. TYPES AND RATINGS LISTED IN TABLE OF DIMENSIONS.
7. THIS DRAWING IS THIRD ANGLE PROJECTION AS SHOWN

10d-4357r1

FIGURE 2-5 10D1475W OUTLINE DIMENSIONS, INTEGRAL 50XE CONVERTER



METER AND FLANGE SIZES	CUSTOMER FLANGE TYPE AND RATING	A	B	C	D DIA	E
1/10 (2.5)	ANSI CLASS 150 ANSI CLASS 300 BS 10 TBL D,E,F DIN PN 10, 16, 25 & 40	10-19/32 (269)	2-1/32 (52)	6-1/8 (156)	3-3/4 (95)	2-5/32 (55)
5/32 (4)		↓	↓	↓	↓	↓
1/4 (6)		↓	↓	↓	↓	↓
3/8 (10)		↓	↓	↓	↓	↓

NOTES:

1. DIMENSIONS ARE IN INCHES. DIMENSIONS IN PARENTHESES ( ) ARE IN MILLIMETERS.
2. DIMENSIONS GUARANTEED ONLY IF THIS PRINT IS CERTIFIED.
3. ALL DIMENSIONS SUBJECT TO MANUFACTURING TOLERANCE OF ±1/8 INCH (3mm).
4. METER MUST BE COMPLETELY FILLED WITH LIQUID TO INSURE ACCURACY.
5. FLOW MUST BE IN SAME DIRECTION AS FLOW ARROW. 1/2 NPT CONDUIT CONNECTIONS IN HOUSING INDICATE "UPSTREAM" END OF METER.
6. METER MOUNTS BETWEEN CUSTOMER'S PIPELINE FLANGES. TYPES AND RATINGS LISTED IN TABLE OF DIMENSIONS.
7. THIS DRAWING IS THIRD ANGLE PROJECTION AS SHOWN

10d4277r3

FIGURE 2-6 10D1475Y OUTLINE DIMENSIONS, INTEGRAL 50XE CONVERTER

3.0 Installation

3.1 Primary

3.1.1 Inspection

All Model 10D1475 magnetic flowmeters are shipped in heavy duty containers. An itemized list of all items included in the shipment is attached to the shipping container.

Depending upon the particular model specified, the shipment will generally consist of a magnetic flowmeter with integrally mounted signal converter and appropriate mounting hardware kit.

The mounting hardware kit for the flowmeter includes:

- 4 or 8 threaded studs and nuts
- 2 gaskets
- appropriate flange adaptor components, if specified.

> NOTE
> The centering device or adaptor sleeves (see Figure 3-5) required for the particular meter installation are supplied by the manufacturer with all U.S. orders.

Inspect all items included in the shipment immediately for indications of damage which may have occurred during shipment. All damage claims should be reported to the shipping agent involved before attempting to install or operate the equipment.

The proper use of the items included in the mounting hardware kit, as described subsequently, and the proper employment of them during installation is necessary to maintain a valid instrument warranty. An installation and warranty tag is furnished with the mounting hardware kit that provides the basic information essential for proper meter installation.

Following inspection of the shipment contents, it is suggested that all items be carefully replaced in the shipping container for transit to the installation site. The use of normal care in the handling and installation of this equipment will contribute substantially toward satisfactory performance.

3.1.2 Location

The flowmeter is suitable for either indoor or outdoor installation. When selecting the installation site, consider the ambient and process temperature limits, as stated in Section 2.0 - Specifications. Consideration should also be given to providing access to service the meter. The standard meter is rated NEMA 4X, watertight, and will withstand rain and hose down. If flooding is a problem, the optional "Accidental Submersible" flowmeter is suited for 30 feet (of water) depths for up to 48 hours.

The integrally mounted signal converter includes RFI filters that provide excellent protection against radiated RFI/EMI. Therefore, stray electromagnetic and electrostatic fields, low power radio transmissions, etc. will have no effect upon the operating characteristics of the electronic package of the magnetic flowmeter system. It is recommended, however, that the meter not be installed within the immediate proximity of heavy induction equipment.

Outline dimensions of the magnetic flowmeter are shown in Figure 2-5. When applicable, provide access for occasional servicing of the integrally mounted signal converter. The cover is removable from the front for servicing of the electronics.

The installation site must be provided with a source of power depending on the power supply specified at time of order. The power source must have an external disconnect and suitable fuse (or circuit breaker), as shown on the interconnection diagram.

3.1.3 Mounting

3.1.3.1 Meter Orientation

The Model 10D1475 MINI-MAG magnetic flowmeter may be installed in horizontal, vertical or sloping pipe runs. However, precautions must be taken to assure that the meter is filled at all times during measurement.

When installing the flowmeter in a horizontal pipeline, make sure that an imaginary line (center line) connecting the two electrodes is horizontal so that any trapped gases or air pockets cannot touch the electrodes and cause errors in the flow reading.

FIGURE 3-1 shows the desired position of the imaginary connecting line of the electrodes.

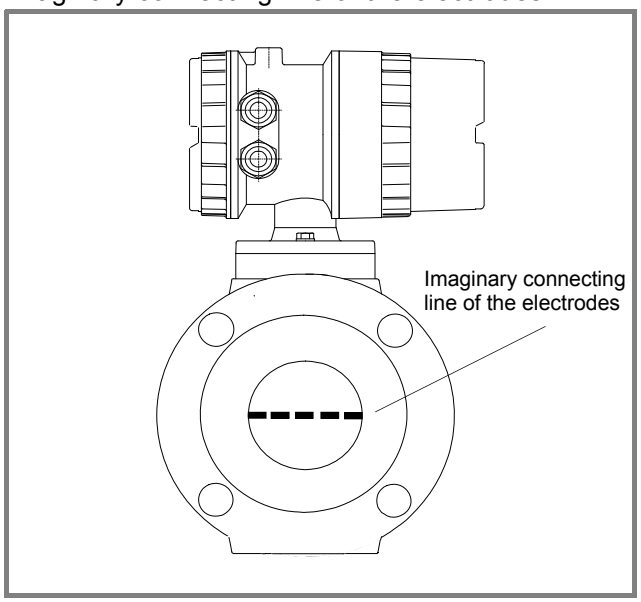


FIGURE 3-1. HORIZONTAL MOUNTING PRECAUTIONS

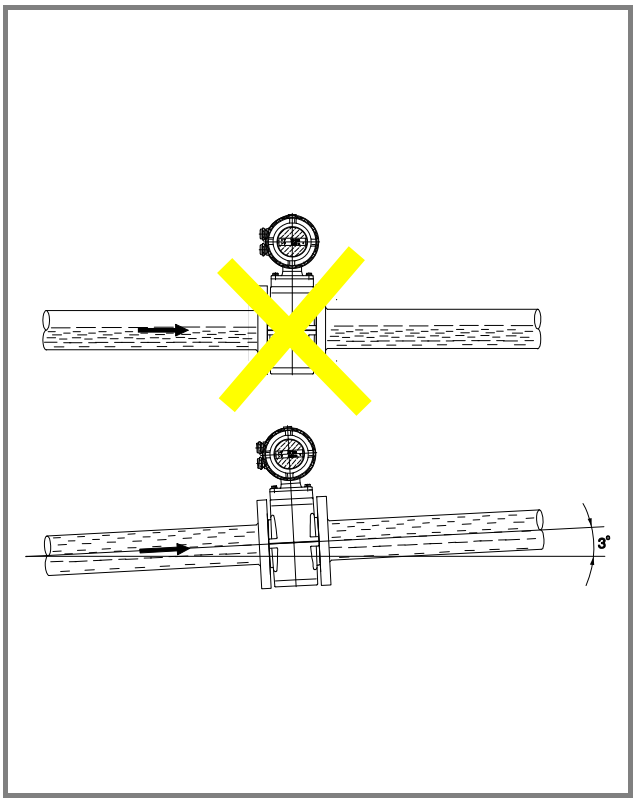


FIGURE 3-2. HORIZONTAL INSTALLATION

Horizontal installations should be made with the meter in the lower section of a pipeline to insure a filled meter condition.The flowmeter must be installed in such a way that the meter pipe is always totally filled with fluid and cannot run empty during the measuring procedure. A slight slope of approximately 3% is desirable for assuring this full-pipe condition (See FIGURE 3-2).

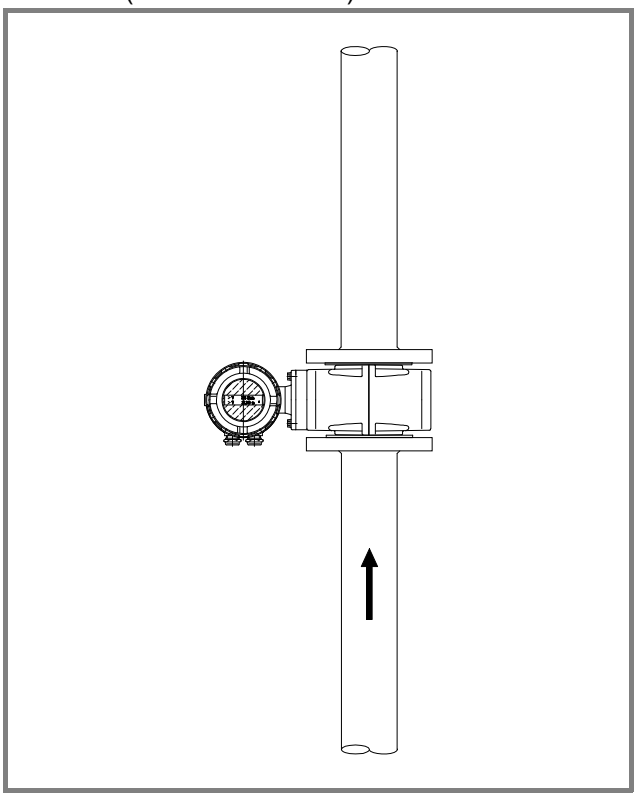


FIGURE 3-3. VERTICAL INSTALLATION

A vertical installation, with the pipe line carrying liquid upwards, insures a filled hydraulic line under low flow rate conditions and also minimizes wear on the meter lining by abrasive grit.

The electronic housing of the meter should be **top** oriented for horizontal or sloping installations. If the electronic housing must be **bottom** oriented, vibration must be limited to 1g, 14-2000 Hz. Orienting the electronic housing top or bottom aligns the meter electrodes in a lateral plane which eliminates the possibility of entrained air acting as an electrode insulator. An electrode must not be on "top" when the meter is horizontally mounted.

The magnetic flowmeter must be oriented in accordance with the direction of process flow, as indicated by the **FLOW** arrow on the meter data tag. Elbows should be located a minimum of three pipe diameters upstream from the meter. Control valves should be located on the downstream side of the meter. Control valves upstream of the meter can create turbulence that results in air pockets and may effect the meter's accuracy or cause its

output to be noisy. If for some reason the control valve cannot be located downstream from the meter, a minimum of ten pipe diameters upstream are required between the meter and the control valve. The requirements for control valves also applies to pumps. Pipe diameters are measured from the centerline of the meter to the nearest edge of the device. For higher accuracy requirements, use twice the number of pipe diameters referenced.

When the process liquid contains abrasive grit, avoid disturbance upstream of the meter so that the liquid passes smoothly through the meter; elbows and tees can distort the flow pattern causing uneven liner wear.

3.1.3.2 Head & Display Rotation

The CL I DIV 2 converter head can be swiveled 90° for better visibility of the instrument's controls and display by loosening the two screws on the converter base flange, rotating the head and retightening the screws.

For vertical installations, it may be desirable to rotate the display for improved readability. This may be done using the following procedure:

- Remove all power from the flowmeter.
- Unscrew the display housing cover to access the Display PCB Assembly.
- Remove the four Phillips-head PCB mounting screws whose locations are shown in Figure 2-2.
- Unplug the display PCB and rotate it to the desired position.
- Carefully re-insert the rotated display into its connector and re-install the four mounting screws.
- Re-install the display housing cover, after checking that the o-ring gaskets are properly seated.

3.1.3.3Meter Handling

The TEFZEL liner of the flowmeter must be protected at all times. The liner can be damaged by sharp objects or cut by undue pressure. Do not pass any rope or wire sling through the meter liner.

3.1.3.4 Pipe Connections

The Model 10D1475 magnetic flowmeter has a wafer type body designed for mounting between adjacent pipe flanges. Most commonly used ANSI, BS and DIN type flanges can be accommodated. Mounting hardware (studs, nuts, gaskets and the adaptor sleeves for the particular ANSI flange type and rating specified) is included with the meter. Line schedule 80 or lighter is recommended for system piping.

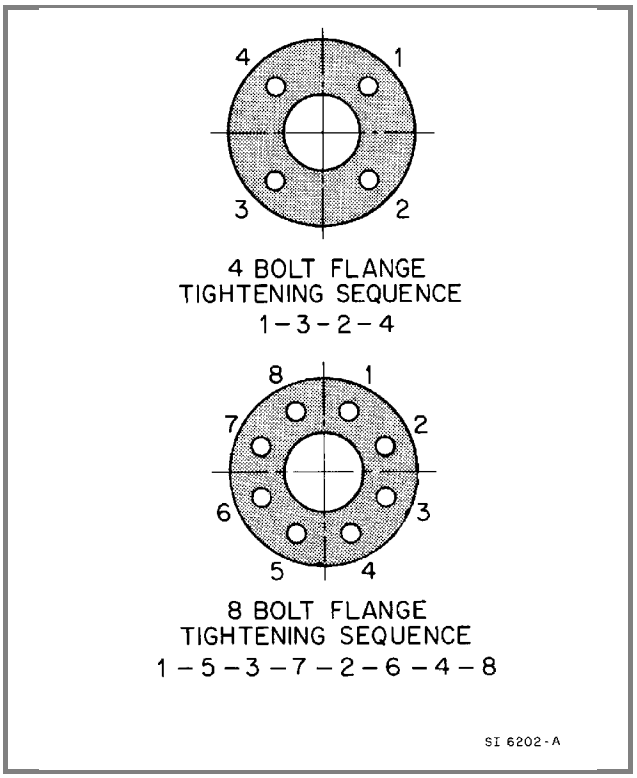
When the magnetic flowmeter is to be mounted in an electrically non-conductive pipeline such as totally plastic pipe, or a metal pipeline with an insulating liner, the user must obtain a pair of meter grounding rings (discussed in Section 3.4 Grounding Procedure) to facilitate grounding of the process. Good grounding is effected by bonding the meter body to the process liquid both upstream (inlet end) and downstream (outlet end) of the meter; thereby preventing any stray electrical currents that may be carried by the pipeline, or by the process fluid, from passing through the magnetic flowmeter. Improper grounding often results in unsatisfactory meter performance, therefore particular attention should be paid to the meter grounding procedure.

The threaded mounting studs and nuts supplied in the meter installation kit should be well lubricated before use. When the meter has been installed in the pipeline, tighten the nuts in even increments around the flange surface. It is recommended that the nuts be tightened using a torque wrench or an open end wrench with a handle length no greater than 8 inches. Recommended mounting-bolt torque values are shown in Table 3-1and should not be exceeded.

For 4-bolt and 8-bolt flanges, tighten the flange bolts in a "star" pattern as shown in FIGURE 3-4 to avoid localized stresses on the gaskets. The bolts and nuts should be tightened approximately 50% during the first pass, approximately 80% during the second pass and to full tightness during the third pass.

NOTE

All 1/10 - 1/2 inch (3 - 15 mm) size magnetic flowmeters are supplied for use with 1/2 inch (15 mm) pipe flange.



3-4. BOLT TIGHTENING SEQUENCE

TABLE 3-1. RECOMMENDED TORQUE VALUES

Meter Size	ANSI Class 150			ANSI Class 300		
	# of Holes	ft. lbs.	Nm	# of Holes	ft. lbs.	Nm
≤1/2	4	10	15	4	15	20
3/4	4	10	15	4	15	20
1	4	10	15	4	15	20
1 1/4	4	15	20	4	20	25
1 1/2	4	15	20	4	25	35
2	4	25	35	8	15	20
2 1/2	4	30	40	8	20	25
3	4	40	55	8	30	40
4	8	30	40	8	45	60

3.1.3.5 Gaskets

Use only the gaskets supplied with the instrument. The gaskets supplied with the meter are the proper size for the meter size and type specified. When installing the meter it is important that the correct size gaskets be utilized. Use of the wrong size gaskets could allow the inner diameter of the gasket to protrude into the flow stream, thereby altering the flow profile within the meter. This condition could affect meter accuracy significantly and must be avoided. Using the proper gaskets and installing them correctly will also avoid any possibility of leakage. Observe parts information given in Section 9.0 - Parts.

CAUTION
Do not use graphite gaskets. Under certain conditions they may cause an electrically conductive layer to form on the inside wall of the meter, causing meter operation to degrade.

3.1.3.6 Basic Mounting Procedure

Refer to FIGURE 3-5 to supplement the following procedure.

1. Insert two mounting studs through the lower two clearance holes in the pipe flange, so that approximately half the stud length extends past the flange face. (Start with either the upstream or downstream flange, as convenient.)

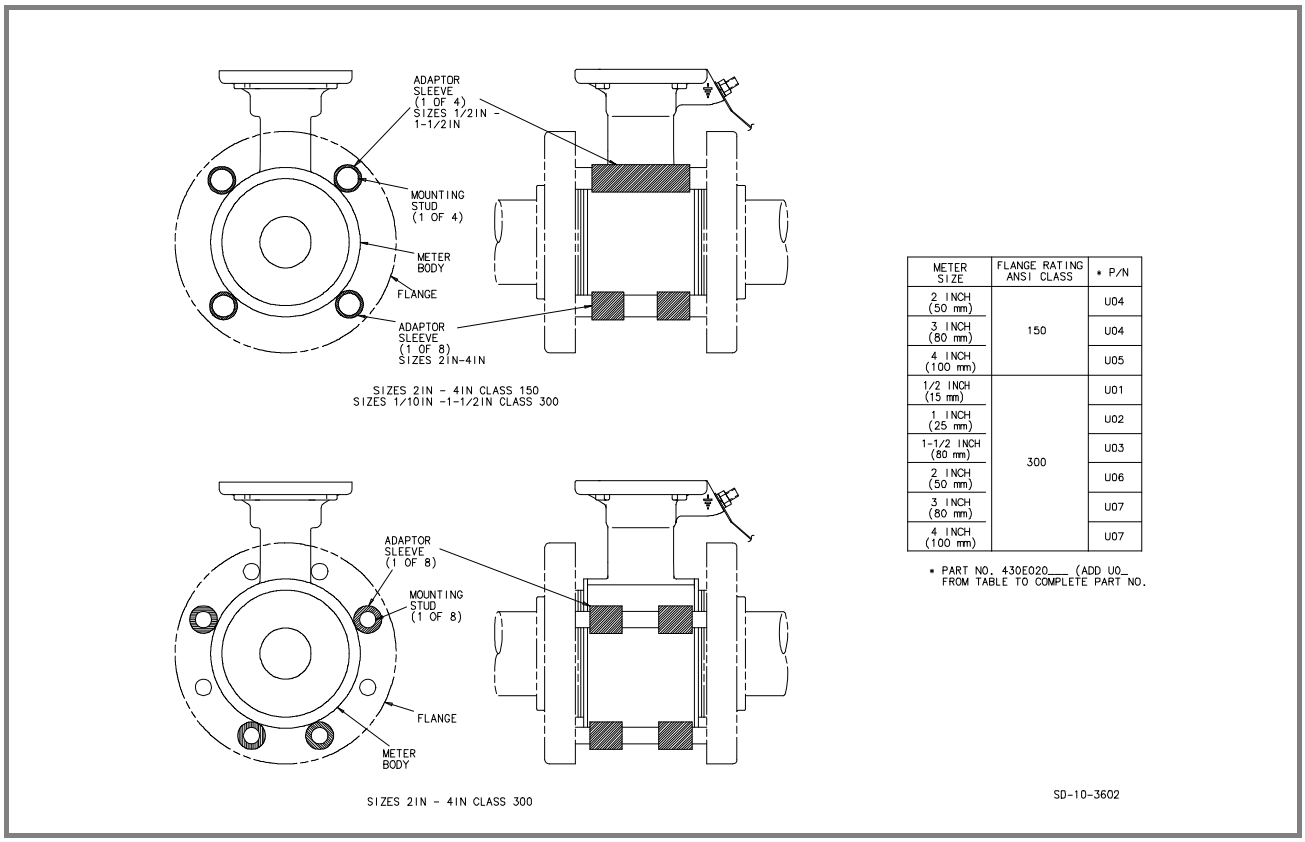
2. Install a gasket next to the flange face.

3. Slip an adapter sleeve* on both of the mounting studs, and then install the other gasket required. The two mounting studs can now be guided through the clearance holes in the downstream (typical) gasket and its associated flange.

*Exception: Adapter sleeves are not required for size 1/10 to 3/8 in. meters when installed between ANSI pipeline flanges.

4. Place the MINI-MAG magnetic flowmeter between the two flange gaskets, with the meter resting on the two adapter sleeves. **The meter must be oriented in accordance with the flow direction arrow.**

5. Install the two upper mounting studs and adapter sleeves as shown in Figure 3-5. Note that when the sleeves are properly located, only four adapter sleeves are needed for positioning the meter. In systems with an 8-bolt flange pattern, insert the four remaining mounting studs through the clearance holes in the upstream and downstream flanges.



METER SIZE	FLANGE RATING ANSI CLASS	* P/N
2 INCH (50 mm)	150	U04
3 INCH (80 mm)		U04
4 INCH (100 mm)		U05
1/2 INCH (15 mm)	300	U01
1 INCH (25 mm)		U02
1-1/2 INCH (80 mm)		U03
2 INCH (50 mm)		U06
3 INCH (80 mm)		U07
4 INCH (100 mm)		U07

* PART NO. 430E020___ (ADD U0_ FROM TABLE TO COMPLETE PART NO.

FIGURE 3-5. METER MOUNTING DIAGRAM

6. Thread nuts on both ends of the 4 (or 8) mounting studs, finger-tight.

7. As the meter body is positioned properly by the adapter sleeves, it is only necessary to tighten the stud nuts to complete the mounting procedure. Tighten the nuts in a "star" pattern as shown in FIGURE 3-4 and in even increments; to produce an even pressure distribution around the flange faces. It is recommended that the nuts be tightened using a torque wrench or an open end wrench with a handle length no greater than 8 inches. Recommended mounting-bolt torque values are shown in Table 3-1and should not be exceeded.

3.1.4 Grounding Procedure

3.1.4.1 General

Satisfactory operation of the magnetic flowmeter system requires that careful attention be paid to proper grounding techniques. Meter grounding requirements are a combination of standard grounding methods and grounding of the meter body to the process liquid. The grounding of the process liquid places an electrical short circuit through the meter body, thereby routing any stray current around the process liquid rather than through it.

There are two basic types of piping systems:

- One type is an electrically conductive pipeline where the process liquid comes in contact with the conductive pipe. This piping requires only that the grounding wires be attached to the adjacent pipe flanges.
- The other type is an electrically non-conductive where the pipeline may be plastic or lined with a non-conductive material. These pipelines require the use of metal grounding rings to ground the process liquid and the conductive exterior of the pipe/meter to ground.

A good ground is one that is in contact with the earth over a large conductive area. An excellent example of this is an iron cold water pipe that is buried in the earth for a considerable distance in its distribution system.

The water pipe laterals form a large conductive area of contact, that in turn provides a low resistance connection to earth. Plastic pipe does not provide an adequate ground system.

Select the grounding procedure applicable from Paragraphs 3.1.4.2 or 3.1.4.3 that follow.

Proper grounding of the magnetic flowmeter is required for optimum system performance.

3.1.4.2 Conductive Pipeline

If the flowmeter is included as part of a conductive pipeline that is not electrically insulated from the liquid to be metered, the following grounding procedure should be followed. Refer to Figure 3-6 for a schematic representation to supplement the text.

NOTE
The grounding illustrations are **schematic** representations only and are not meant to suggest physical locations of ground connections to the meter body. The grounding straps attached to the meter body should be used to electrically connect the meter body to the pipeline flanges for grounding purposes.

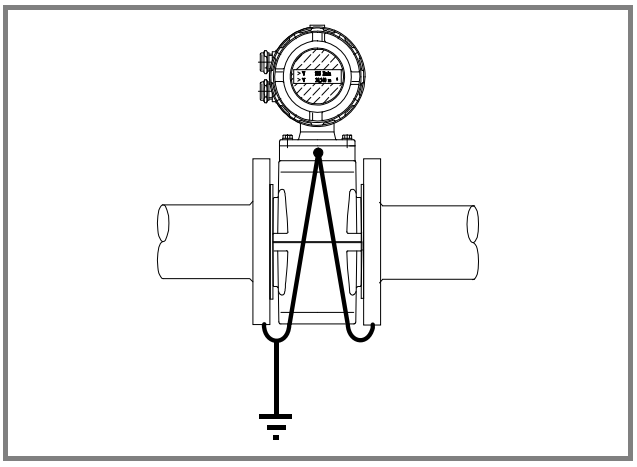


FIGURE 3-6. GROUNDING CONDUCTIVE PIPELINE

1. Drill and tap a blind hole on the peripheral surface of each of the two adjacent pipeline flanges. These tapped holes should be placed so that they are within easy reach of the bonding straps (2 supplied) attached to the ground lug on the meter housing.

2. Obtain a bright metal surface around the edges of both tapped holes with a file or emery cloth.

3. Clamp the end of each bonding strap to the adjacent pipe flange, using a pair of hex head bolts and external tooth lockwashers (supplied by user).

4. The user must supply a sufficient length of grounding wire for connecting the meter grounding post (ring lug supplied) to a good electrical ground. (Number 12 AWG, or heavier, copper wire may be used for this grounding wire.)

3.1.4.3 Non-Conductive or Insulated Pipeline

For the magnetic flowmeter mounted in a non-conductive or liquid insulated pipeline (such as totally plastic pipe, ceramic lined iron pipe, or cast pipe with internal bitumastic coating), perform the grounding procedure outlined below. Refer to FIGURE 3-7 for a schematic representation to supplement this discussion and FIGURE 3-8 for grounding ring dimensions.

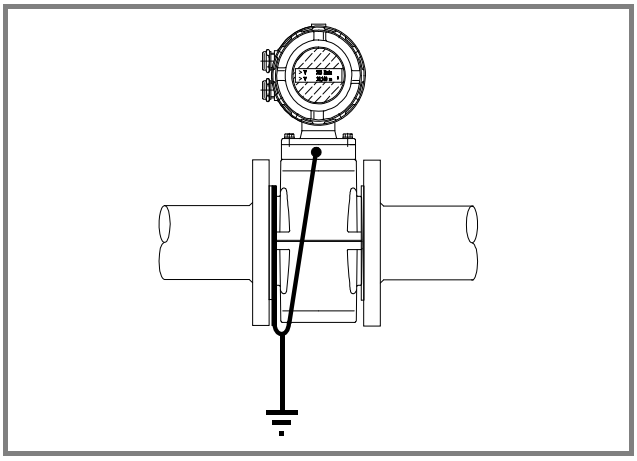
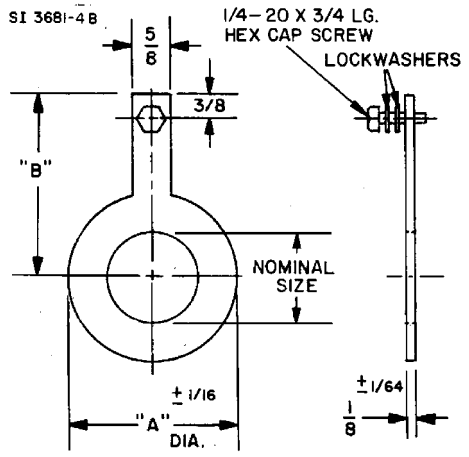


FIGURE 3-7. GROUNDING NON-CONDUCTIVE PIPELINE

1. Grounding rings are required if the meter is installed in non-conductive or insulated pipe. If grounding rings and gaskets were not specified at the time the meter was ordered, they can be ordered from Table 9-1. Grounding rings are available in various corrosion resistant materials and should be selected to be compatible with the process liquid. When installed, these rings are centered by the flange bolts and therefore must be selected according to the flange rating.

2. When installing the meter in the pipeline, place a grounding ring at both the inlet and outlet connections of the magnetic flowmeter. Provide standard gasketing between the face of the meter liner and the grounding ring and



NOMINAL SIZE		ANSI CLASS 150	
mm	(inch)	"A"	"B"
3-15	(1/2)	1-7/8	2-7/8
25	(1)	2-5/8	3-1/4
40	(1-1/2)	3-3/8	3-5/8
50	(2)	4-1/8	4
80	(3)	5-3/8	4-5/8
100	(4)	6-7/8	5-3/8

(Ref: OD-10D-3627R2)

NOTES:
1. ALL DIMENSIONS IN INCHES, EXCEPT AS NOTED.
2. GENERAL TOLERANCE = ±1/8.
3. GROUNDING RING CENTERED BY FLANGE BOLTS.

FIGURE 3-8. OUTLINE DIMENSIONS, GROUNDING RINGS*

the adjacent pipe flange; i.e., four gaskets required. Position the grounding rings in the pipeline so that the meter grounding straps (2) attached to the meter ground post will easily reach the ground strap connection bolt on the respective grounding ring.

* For applications other than ANSI Class 150, contact ABB.

3. Clamp the free end of the two bonding straps (shortest strap to downstream grounding ring) to the applicable grounding ring; using hex head bolt and external tooth lockwasher (supplied with the grounding rings when rings are ordered from ABB).

4. The user must supply a sufficient length of grounding wire for connecting the meter grounding post (ring nut supplied) to a good electrical ground. Number 12 AWG, or heavier, copper wire may be used for this grounding wire.

3.2 Converter

3.2.1 Inspection

The converter should be visually checked for any damage that may have occurred during shipping. All claims for damage must be made to the shipping agent immediately and before installation of the converter.

3.2.2 Installation Requirements

For installation requirements see Sections 3.1.2 and 3.1.3 of Primary Installation Section 3.1.

3.2.3 Electrical Connection

3.2.3.1 Grounding

Regardless of the interconnection procedure required, the grounding procedures given in Section 3.1.4 - page 3-5 must be followed.

3.2.3.2 Electrical Interconnections

The Series 10D1475 magnetic flowmeter is furnished with an integrally mounted signal converter.

The terminals for the input and output signals are located under the terminal housing cover opposite the electronics housing containing the digital display as shown in FIGURE 3-9. The electronic housing does not have to be opened in order to connect the leads. The 4-20mA current output is connected to the "+" & "-" terminals.

NOTE
In accordance with the National Electrical Code (NEC) and to preserve the NEMA-4X rating, all electrical wiring to the converter should be run in 1/2 in. NPT conduit. Conduit is **required** when equipment is used in hazardous locations.

Terminals P7/G2 are available for contact output while terminals X1/G2 are available for contact input. Refer to terminal diagram FIGURE 3-12 in Section 3.2.5.

NOTE
When installing the power cable, it is recommended that any connections to the primary be installed with a water trap as shown in FIGURE 3-10

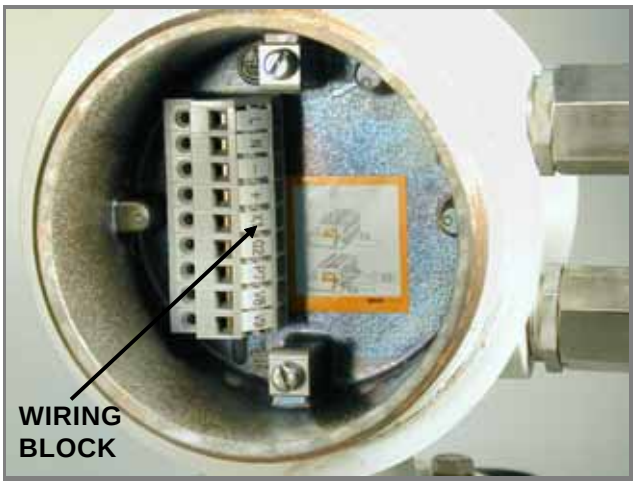


FIGURE 3-9. TERMINAL HOUSING

Make certain the power supply voltage is the correct value according to information on the nameplate of the primary. Power supply connection terminals are identified differently depending on the specific model number of the meter. Connect power supply (depending on model) to terminals:

- L and N
- L+ and L-
- 1L1 and 1L2

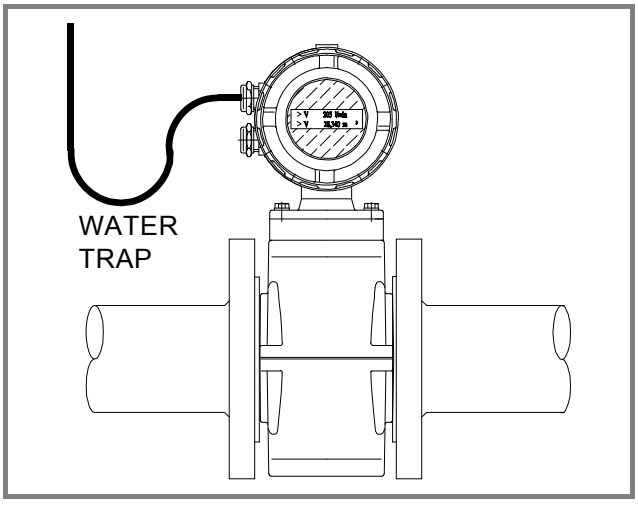


FIGURE 3-10. CABLE ENTRY WITH WATER TRAP

Refer to terminal connection diagram FIGURE 3-12 in Section 3.2.5. When making power connections from the AC line, always use a fuse or circuit breaker as well as an ON/OFF switch. The fuse or circuit breaker rating must be within the capacity of the AC wiring used. The maximum power consumption of flowmeter including signal converter is <10 VA. Refer to grounding information presented in Section 3.1.4.

WARNING
ELECTRICAL SHOCK HAZARD. Equipment powered by AC line voltage presents a potential electric shock hazard to the user. Make certain that the system power input leads are disconnected from the operating branch circuit before attempting electrical interconnections.

3.2.4 Conduit Entry Seal

In accordance with the National Electrical Code (NEC) ANSI/NFPA 70, Article 501-5(f)(3), the flowmeters include a **conduit entry seal** to prevent the process liquid from entering the electrical conduit system. This safety features considers the remote possibility of a primary seal failure between the meter and the electronic housing.

The **conduit entry seal is required** in order to prevent the process liquid from entering the electrical conduit system. This seal consists of a conduit entry cable seal on the meter junction box. The user must properly install the conduit entry cable seal fitting supplied with the signal converter interconnection cable. This will ensure proper performance of this safety feature. Refer to Figure 3-11. **Failure to install the conduit entry cable seal fitting may void the meter warranty.**

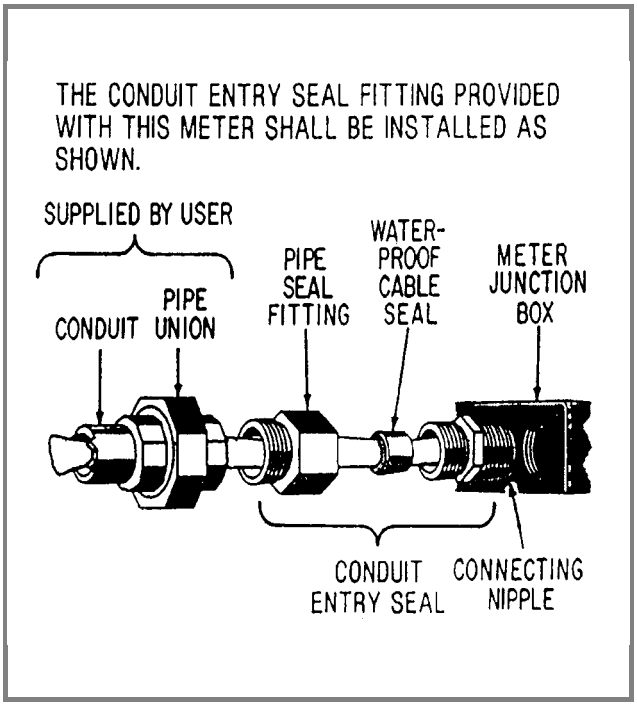
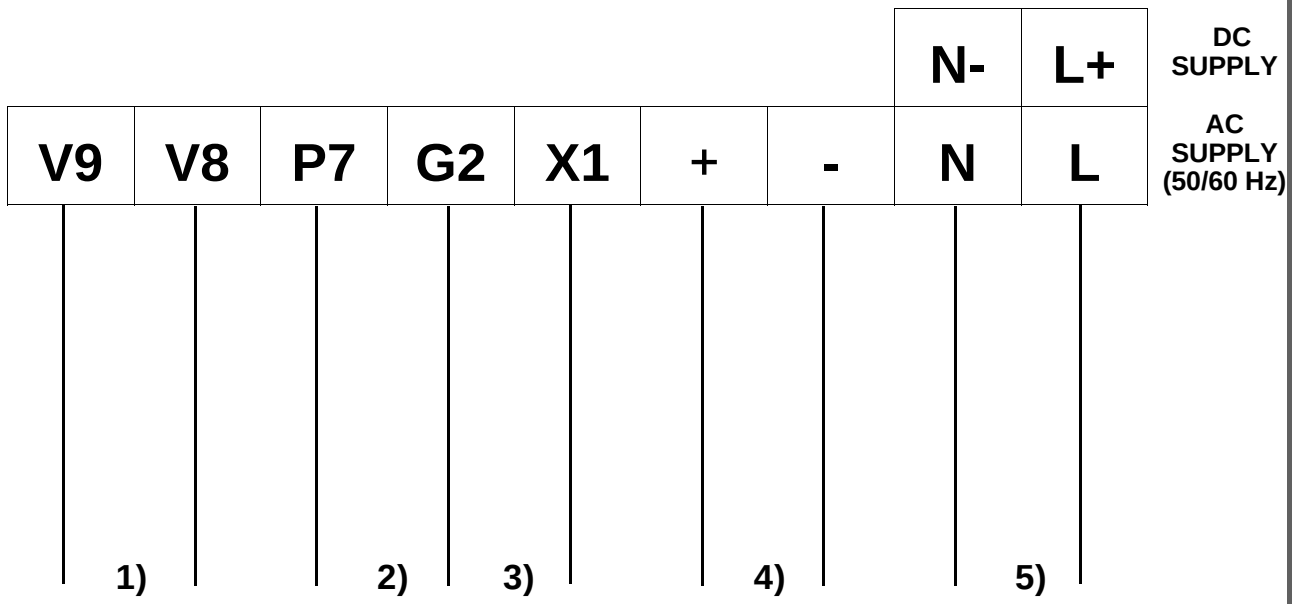


FIGURE 3-11. CONDUIT ENTRY SEAL INSTALLATION

3.2.5 Terminal Connection Diagram



1) Terminals: V8, V9
Scaled pulse output (passive), pulse width adjustable between 0.064 ms and 2000 ms,
Optocoupler, fmax = 5 kHz
$0\ V \le U_{CEL} \le 2\ V$, $16\ V \le U_{CEH} \le 30\ V$
$0\ mA \le I_{CEH} \le 0{,}2\ mA$, $2\ mA \le I_{CEL} \le 10\ mA$

2) Terminals: P7, G2
Contact output, function software selectable for system supervision, empty pipe detector, Max.-Min.-alarm or F/R signalling *, contact functions at alarm(NO, NC) are firmware-selectable.
Optocoupler, $16\ V < U_{CEH} < 30\ V$, $0\ V < U_{CEL} < 2\ V$
$0\ mA < I_{CEH} < 0{,}2\ mA$, $2\ mA < I_{CEL} < 15\ mA$

3) Terminals: X1, G2
Contact input, function software selectable for external output cut-off or external totalizer resetting, requires application of DC voltage across terminals.
Optocoupler, $16\ V \le U \le 30\ V$, $Ri = 2k\Omega$

4) Terminals: +/-
Current output, adjustable,, load $\le 600\ \Omega$ at 0/4 to 20 mA,
load $\le 1200\ \Omega$ at 0/2 to 10 mA
load $\le 2400\ \Omega$ at 0 to 5 mA,
Optional HART-Protocol, for specifications see Section 2.2.16.6.

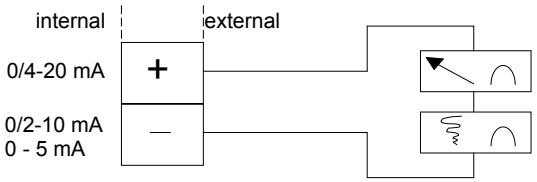
5) Power Supply, see Data Tag for rating

* The function "Forward Flow Signalling" is the factory default selection.

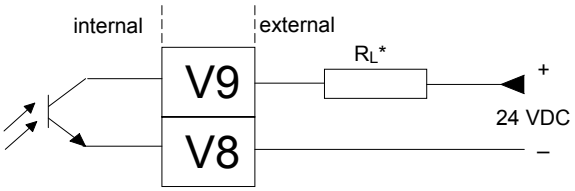
FIGURE 3-12. TERMINAL CONNECTION DIAGRAM

3.2.6 Connection Examples For Peripherals

Direct current output

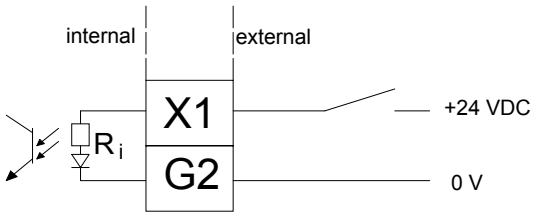


Pulse output optocoupler



$$* R_L \geq \frac{U_{CE}}{I_{CE}}$$

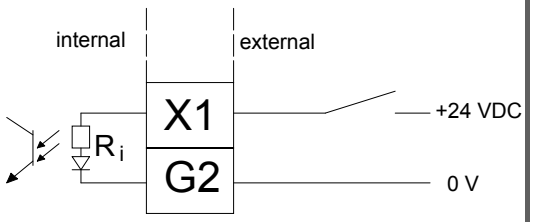
Contact input for
external output cut-off.
Function is software selectable



Contact position:
Output is turned off when
the contact is closed.

or

external totalizer reset



Contact position:
Internal Totalizer resets,
when the contact is closed.

Contact output for system supervision, Min / Max Alarm
Detector Empty Pipe or Forward / Reverse flow signalling.
Function is software selectable.

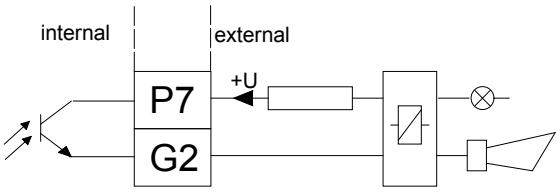


FIGURE 3-13. CONNECTION EXAMPLES FOR PERIPHERALS

4.0 Start Up

The Series 10D1475 MINI-MAG magnetic flowmeter is precision calibrated at the factory for the values stated on the instrument tag. If specific values were not specified, the meter is calibrated at the nominal maximum flow rate and for a 4-20 mA current output span. In either case, the calibration data is noted on the instrument data tag as shown below.

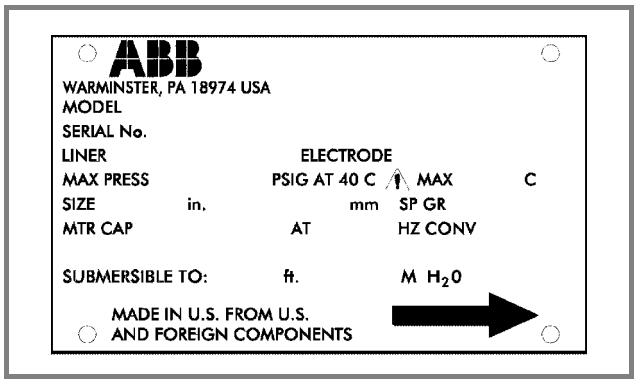


FIGURE 4-1. TYPICAL INSTRUMENT TAG

4.1 Preliminary Check List

Follow these start up instructions after completing the assembly and installation of the primary and converter and before applying power:

- Check that the flow direction of the fluid agrees with the flow-direction arrow on the primary housing.
- Check that the flowmeter is properly grounded. See Section 3.1.4. Improper grounding may result in unsatisfactory performance.
- Check that the interconnections agree with the interconnection diagram shown in Figure 3-12.
- Check that the power supply agrees with the specifications on the nameplate.
- Check that the ambient conditions meet the conditions specified in Section 2.0 - Specifications.

4.2 Start Process Flow

Start flow through the process piping system that includes the meter. Allow a nominal flow through the pipeline for several minutes to purge entrapped air. The pipeline must be full for accurate flow measurement. Flow measurement and concurrent output signal transmission will commence with flow through the meter and once power is applied.

4.3 Turn Power On

WARNING
Electrical Shock Hazard. Equipment powered by an AC line voltage presents a potential electric shock hazard. Servicing of the magnetic flowmeter or signal converter should only be attempted by a qualified electionics technician.

Apply system power to the 10D1475 magnetic flowmeter by closing the external switch or circuit breaker (not supplied with the meter); there are no master power switches inside of the equipment. Also energize any auxiliary equipment associated with the flow metering system such as remote analog recorders, controllers or rate indicators.

Once power is applied, the display should become active and show information similar to that shown in Section 5.1.

After the power is turned on, the flowmeter primary data stored in the external EEPROM are compared to the values stored internally. If the data sets are not identical, an automatic exchange of the data (upload) into the converter is initiated. The message “Primary data are loaded” is displayed on the converter. The flowmeter is now ready for operation.

If not already entered by the factory, some parameters must be entered for proper system operation (refer to Section 5.0 - Operation):

- Verify the meter size stamped on the nameplate in the "Size" parameter.
- The range may have been factory-set to 10 m/s. Enter the desired maximum forward and reverse flow values in the appropriate units.
- Hydraulically ideal range end values are approximately 5-10 ft/sec (or 2-3 m/s).
- Select the desired output current range in the "Submenu Current Output".
- Set the number of pulses per unit, the pulse width and the Totalizer Submenu for the Passive Pulse Output.

- To complete the start-up save the settings by selecting the “Store data in external EEPROM” submenu (refer to Sections 5.4 & 5.5), to save the settings which were changed during start-up. For a converter exchange the EEPROM is to be unplugged from the old converter and plugged into the new converter (see Section 4.6).

Check the system zero (Refer to Zero Check, Section 4.4).

4.4 Zero Check

The system zero must be set at the converter. For this parameter, all flow activity through the flowmeter must be totally stopped. Make certain that the meter pipe of the primary is totally full of fluid. The zero can be set either manually or automatically at the converter by accessing the parameter "System Zero". Select the menu parameter with the ENTER key and use the arrow keys to select either automatic or manual. Accept the selected parameter by pressing the ENTER key. During the automatic zero adjustment the 2nd line of the display on the converter counts from 255 to the actual zero value, after which the system zero adjustment cycle is ended. The automatic adjustment cycle takes approximately 20 seconds to complete. Refer toSection 5.5.

4.5 Empty Pipe Detector (option)

The empty pipe module, when installed, should be adjusted at start up under actual conditions. Refer to instructions in the menu-breakdown Section 5.5.

4.6 EEPROM

4.6.1General

All calibration parameter values are stored in the main EEPROM located on the display board assembly as shown in Figure 2-2 & 8-2. If replacing the electronics, remove the EEPROM from the original electronics and insert it into the replacement electronics.

On power-up, all data should be accepted and need not be entered again. To insure this, perform a data "upload" using the "**LOAD DATA FROM EXTERNAL EEPROM**" menu. Refer to Section 5.5, 6.21 & 6.22 for further information of the "**LOAD DATA**..." and "**STORE DATA**..." procedures.

If any menu parameter is ever changed from a previous value, it is always good practice to "download" the new data using the "**STORE DATA IN EXTERNAL EEPROM**" menu to insure that the new data is retained in the event of a power loss.

4.6.2 Converter EEPROM Module

The EEPROM provides a significant improvement in meter durability. Not only is it permanently located in the converter, but it also utilizes a technology which is not moisture sensitive thereby eliminating problems due to moisture.

The signal converter’s EEPROM module (read/write memory) is used to retain all fluid calibration and customer setup parameters of the flowmeter system. This data includes numeric constants required to properly span and zero the primary, a sum check, and customer information such as flow range, units for range and totalization, damping, etc. Data is programmed into the EEPROM with two commands, one accessed from "Submenu Primary" (Service Code entry required), and one accessible at the user level. Entry of new data at the user level only requires that program protection be turned off.

In order for the converter to operate properly (and to produce output signals), the contents of the EEPROM module must be valid. These devices are tagged with various pieces of information. Among them are the type of primary they are associated with and the software version of the converter. Incorrect combinations of this data will cause the flow system to be inoperative.

4.6.2.1 Benefits

The benefits of the new EEPROM calibration data storage procedure are:

- Increased environmental protection for all submergence classifications. The primary no longer contains the resistor network included in the CMF board. Even though these boards were conformal coated and tropicalized, moisture related failures have been known to occur in extreme situations when the accidental or continuous submergence options were not specified. The new EEPROM will allow an increased level of protection even if the IP67 or IP68 configurations are not utilized.
- Additional levels of data security are now employed. Currently, the CMF card provides the only storage location for the primary calibration data. With the use of the EEPROM, the data will now be stored in two

places. First the EEPROM provides a non-volatile memory for the primary data. Additionally, when the EEPROM is installed, a copy of the data will be transferred into an identical local device mounted in the converter module. Not only will the data be stored in an additional location, but the converters are typically not subjected to as hostile of an environment as the Primaries are, thus providing additional protection.

- Portability of primary data and user defined variables. The EEPROM contains information about the primary as well as all of the user defined configuration data (i.e. unit selection, analog output range, etc.). When a converter is replaced, the EEPROM can be transferred to the new converter and all of the configured parameters uploaded within seconds. The new unit will not require any programming to duplicate the original set-up. This feature will not only save time, but the user can be certain that the replacement unit is configured exactly the way that the original converter was.

NOTE

If the converter module is placed on another primary (or if the converter module is replaced), the EEPROM must remain associated with the primary. When a correctly configured device is placed into the converter, the converter's display will indicate "Primary Data are Loading" (assuming it is valid). The converter will then be able produce accurate results with its new primary and the proper memory module.

If an EEPROM requires replacement, a new one must be made from the same converter type and software version as those which were originally shipped with the primary.

4.6.2.2 Replacing the EEPROM

The EEPROM module is located on the display board assembly as shown in Figures 2-2 & 8-2.

If the EEPROM is lost or damaged, or if an entire converter must be replaced due to damage, then the factory must program a new EEPROM. The serial number of the flowmeter must be provided to the factory in order for the replacement to be made. Flowmeter serial numbers begin with the year of manufacture, followed by a letter and sequence number, such as 97W2815J002.

The old EEPROM may be removed by grasping it firmly, rocking it gently from side to side and pulling it straight away from the right-angle header on the connection board. Install the replacement EEPROM by laying it flat on the display board assembly and mating it with the right-angle header. When all new components are properly installed, the converter will power up and be ready for proper on-stream measurement without any required data entry.

4.6.2.3 Information Requiring Service Code Entry

Should the converter become inoperative to the extent that the information contained in this manual is insufficient to restore proper operation, factory service must be contacted. This in particular includes a need to access any information requiring entry of the Service Code number, referenced in some manual sections. The long term stability of system components is such that the flowmeter will remain within stated accuracy during its operating life time without need for routine and periodic calibration. Therefore, constants associated with converter and primary calibration need not be changed over the operating life of the converter.

4.6.2.4 Pulse Output Setting

The pulse output can be operated as active output (24 VDC pulse) or as passive output (optocoupler). Settings for the pulse output are shown in Figure 4-2.

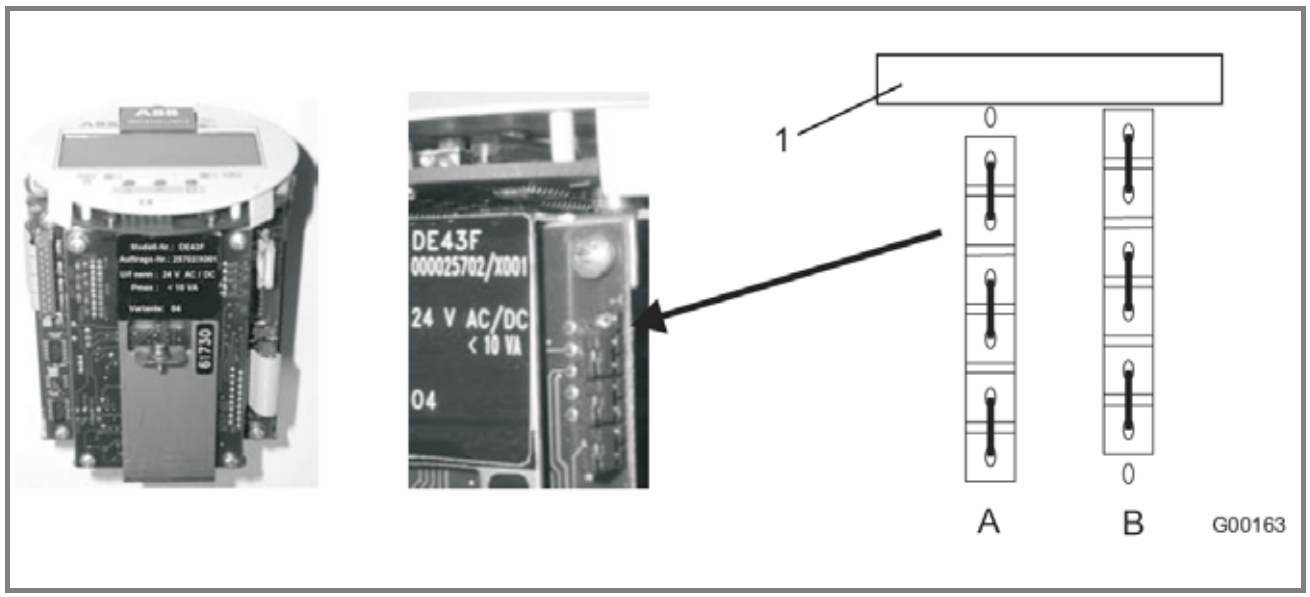


FIGURE 4-2. SETTING THE PULSE OUTPUT USING JUMPERS

A = Pulse, passive

B = Pulse, active

1 = Display Board

5.0 Operation: Data Entry and Configuration

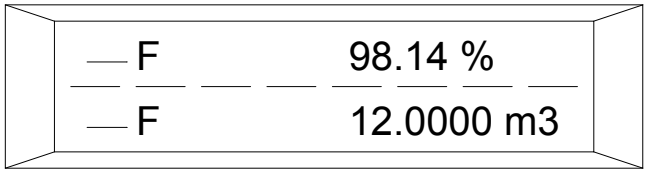
5.1 Display Indications

Initially, after the power is first turned on, the converter model number is shown in the first line of the display and the revision level in the second line. Subsequently the actual process information is displayed.

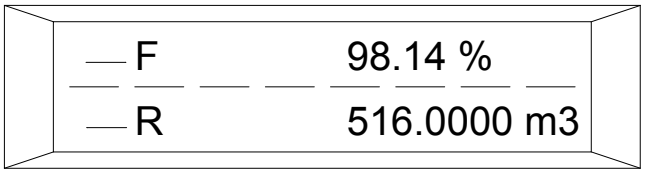
The instantaneous flow rate direction (→F for forward flow or ←R for reverse flow) is displayed on the first line together with the flow value in percent or in direct reading units. The totalizer value for the existing flow direction, up to 7 digits, is displayed in the second line with its corresponding units.

The totalizer values displayed are always those actually measured in their appropriate units, regardless of the pulse factor selected. This display is designated as process information throughout the remainder of this manual.

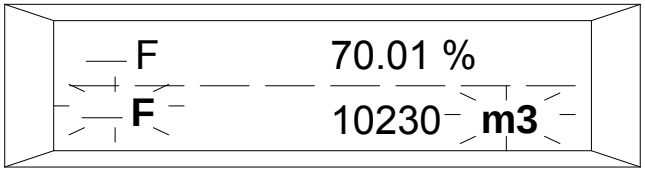
The totalizer value in the other flow direction can be displayed by pressing the STEP or DATA pushbuttons.



1st line Instantaneous forward flow rate
2nd line Reverse flow totalizer value

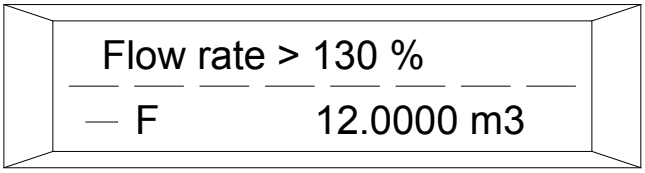


1st line Instantaneous forward flow rate
2nd line Reverse flow totalizer value (Multiplex operation)



1st line Instantaneous forward flow rate
2nd line Totalizer overflow. > F and m^3 are blinking.

A totalizer overflow occurs whenever the totalizer value exceeds 9,999,999. When a value in either of the flow directions exceeds 9,999,999, the flow direction symbol (→F oρ ←R) and the units displayed in the 2nd line (e.g. m^3) blink. The software can store up to 250 totalizer overflows. The overflow indication can be turned off by pressing ENTER independently for each flow direction (refer to section 6.17, page 6-11).



An error message will appear in the 1st line when an error condition is detected.

Display of the error message will alternate with the corresponding error code on the top line of the display. Only the error message with the highest priority is displayed in text, but codes of all encountered error conditions are displayed according to the table below).

TABLE 5-1. ERRORS vs. PRIORITY

Error code	Clear text / Cause
0 Empty pipe	Pipe not completely full
1 A/D over load	A/D-converter saturated
2 REF too low	Pos. or neg. excitation too low
3 Flow rate 130 %	Flow rate >130 %
4 External zero return	Ext. zero return contact actuated
5 EEPROM defect	Data in EEPROM corrupted
6 Totalizer	Totalizer value corrupted
7 REFp too high	Positive excitation too high
8 REFn too high	Negative excitation too high
9 Excitation Frequency	Supply power frequency or Driver/Digital board defective
A Max. Alarm	Max. alarm value exceeded
B Min. Alarm	Value below Min. alarm value
C Primary Data	Error in external EEPROM or it is not installed

Additionally during an error condition an output from the alarm relay or optocoupler is generated and the current and frequency outputs are driven to 0 or 130% (except for Error 6).

5.2 Data Entry

Data is entered either by pressing the STEP↑, DATA↓ and C/CE pushbuttons or by using a magnetic "programming stick" to activate magnetic sensors.

The cover must be removed from the housing to gain access to the STEP↑, DATA↓ and C/CE pushbuttons on the converter but need not be removed when programming using the "magnetic stick".

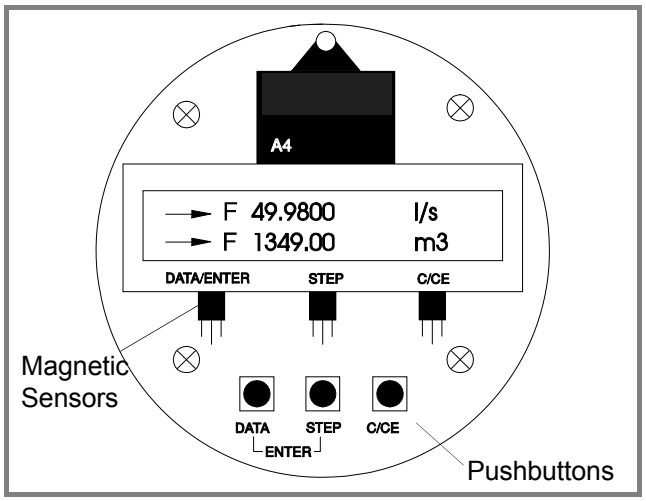


FIGURE 5-1. PUSHBUTTONS & CONVERTER DISPLAY

CAUTION
The "magnetic programming stick" is a very strong magnet. Avoid getting the magnet near any magnetic media (such as floppy disks) since inadvertant data loss may result.

The converter remains active during data entry, i. e. the current and pulse outputs are a function of the actual instantaneous flow values. The functions of the pushbuttons are described below:

C/CE — The C/CE pushbutton is used to toggle between the process mode and the menu.

STEP ↑ — The STEP pushbutton is one of two arrow buttons. **Pressing STEP pages through the menu in the forward direction.**

DATA ↓ — The DATA pushbutton is the other arrow button. **Pressing DATA pages through the menu in a reverse direction.**

ENTER — **Manual mode:** the ENTER function requires that both STEP and DATA pushbuttons be pressed simultaneously. The Program Protection can be turned on and off by pressing ENTER. **Magnetic mode:** When using the optional "magnetic stick" for operation, the ENTER function is performed by holding the magnetic stick over the DATA/ENTER sensor for longer than 3 seconds. Acknowledgement is indicated by the display flashing.

STEP↑ / DATA ↓ — Additionally, ENTER is used to gain access to the parameter to be changed and to store the new data selected or set in the parameter. The ENTER function is only in effect for 10 seconds. If no entry is made during this 10 second period, ENTER must be pressed again.

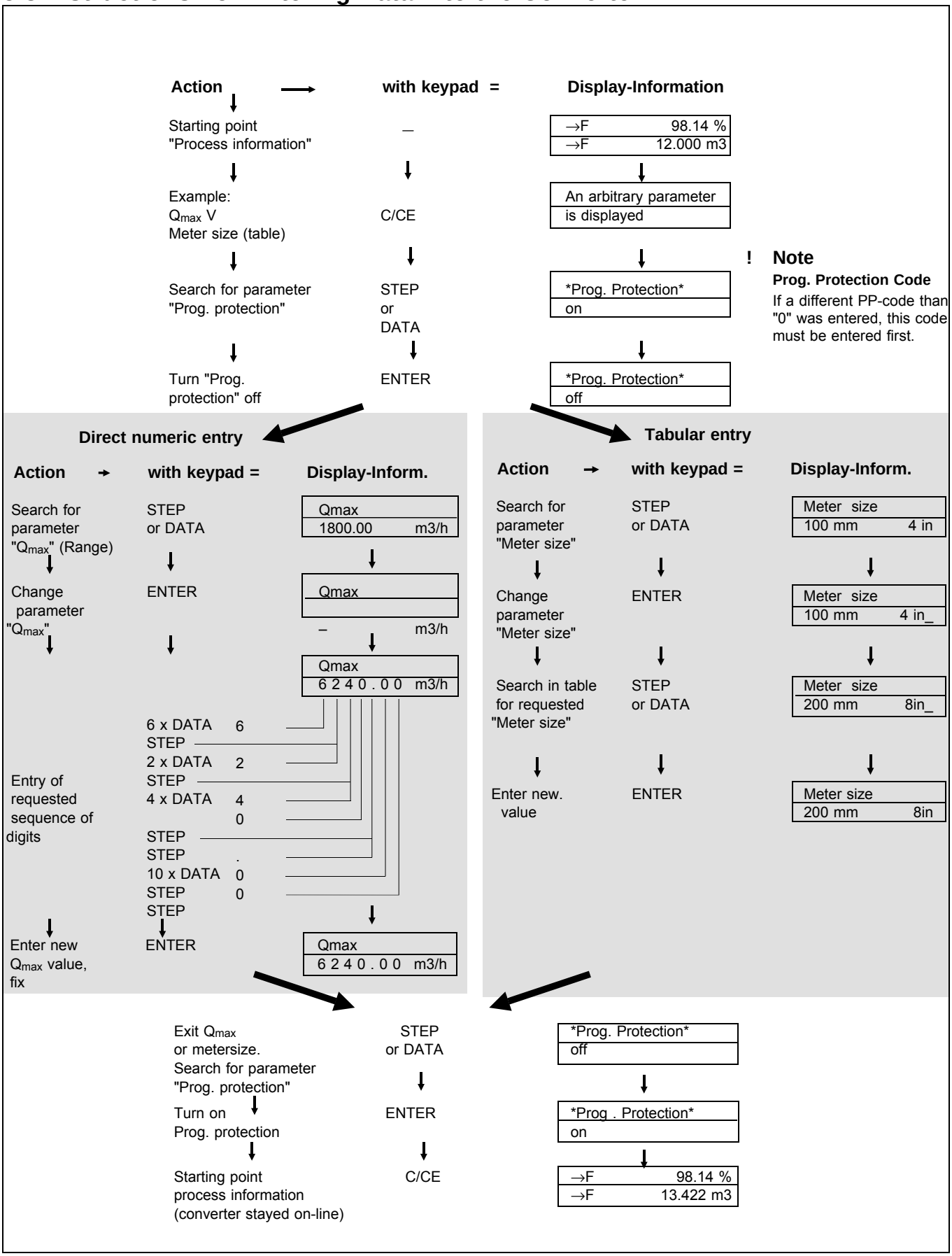
There are two methods of data entry:

- Direct number entry
- Input from a table menu.

The previous value will be displayed on the converter after 20 seconds if no data is entered. After an additional 10 second period delay, the display reverts to indicating the process information.

Note:
During data entry the input values are checked for acceptability. If data is not acceptable, it is rejected and a message is generated indicating that the new data has not been accepted.

5.3 Instructions For Entering Data Into the Converter

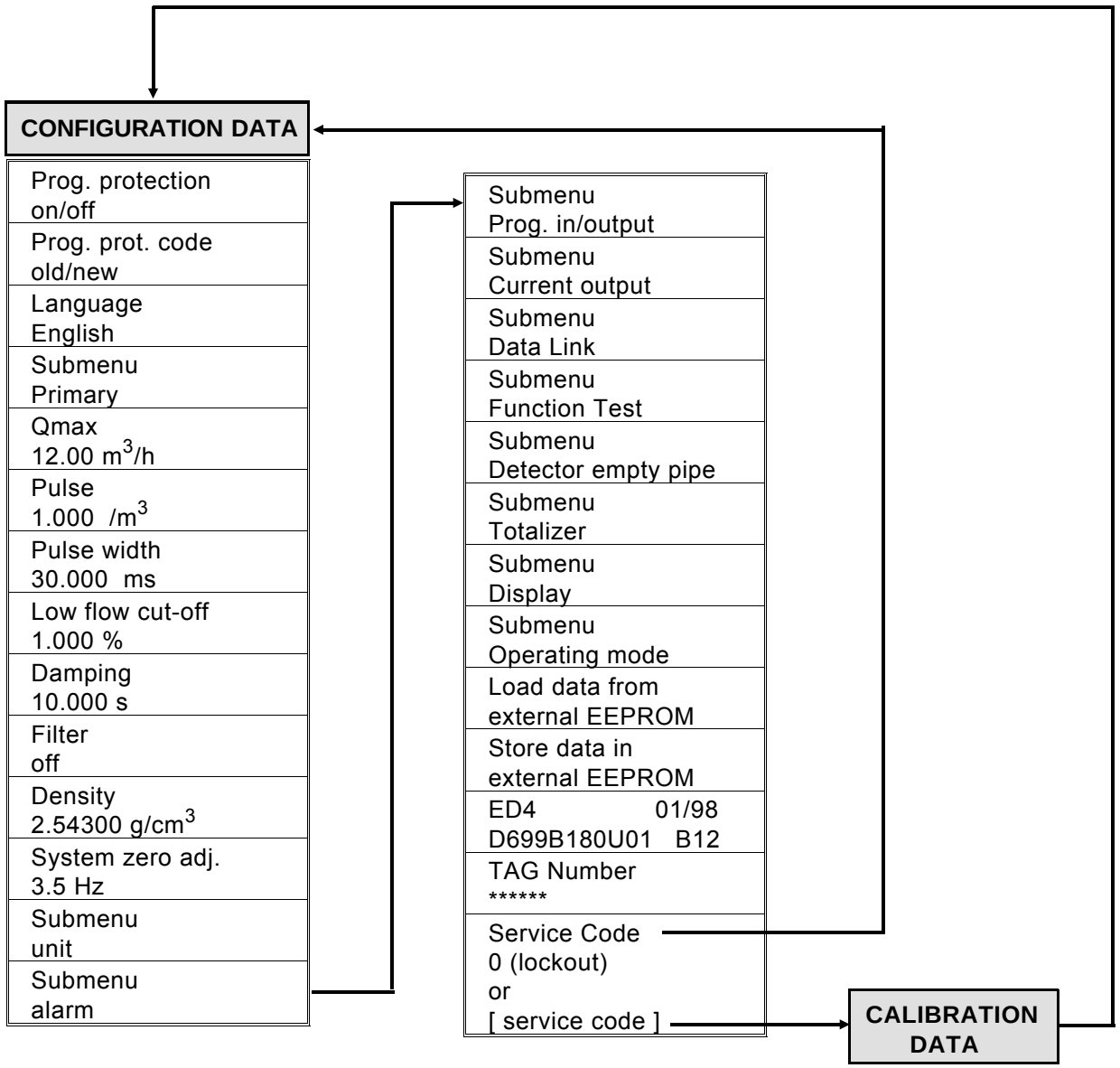


5.4 Menu Sequence

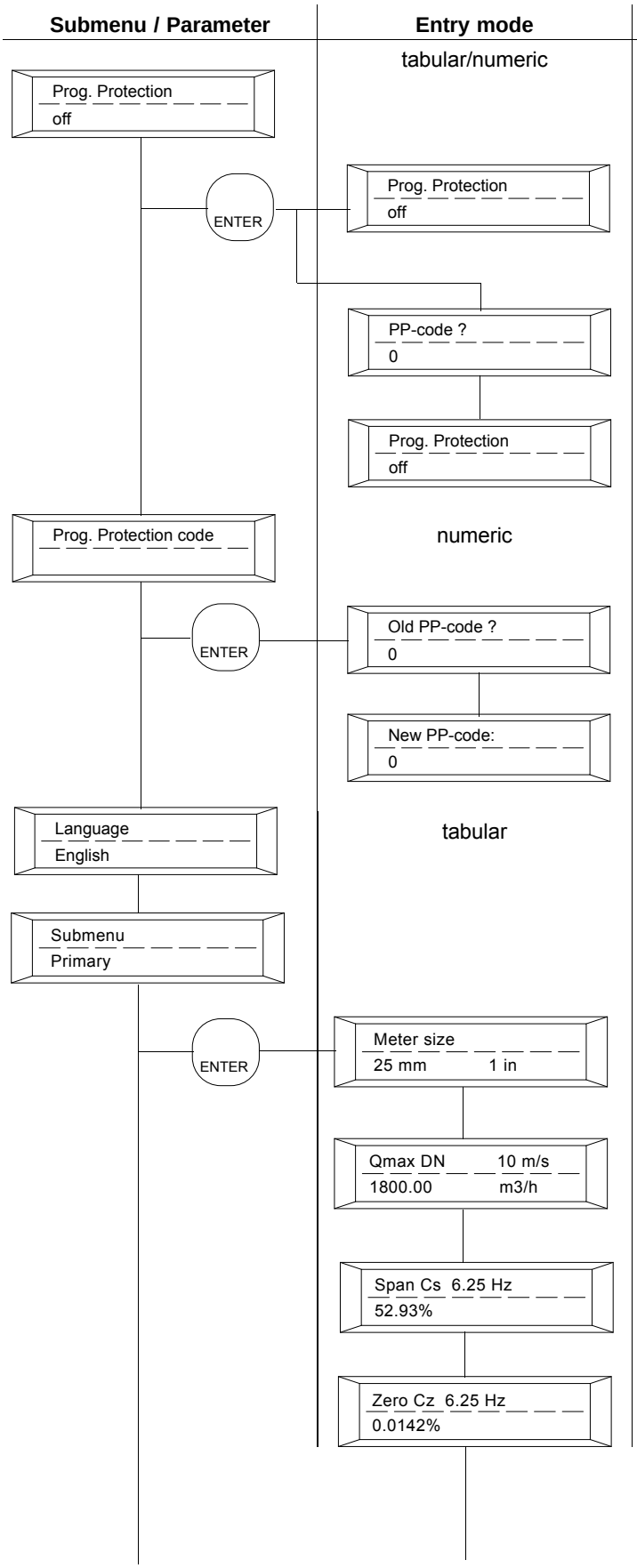
The listing below gives a general overview of the standard top-level display menu sequence when running firmware version B.12

The listing in Section 5.5 shows the standard display menu sequence and submenus using the ↑**Step** button to move through the menu items. The first message displayed the first time the **C/CE** button is pressed after the converter is powered up is "**Prog. Protection ON**". Thereafter, pressing the **C/CE** button while the converter is in monitoring mode will display the parameter that was last exited. Program Protection may be turned "**off**" by pressing the **ENTER** function when the Prog. Protection menu is displayed. When the last menu item is reached, the firmware "wraps around" and scrolls to the first item on the menu once again.

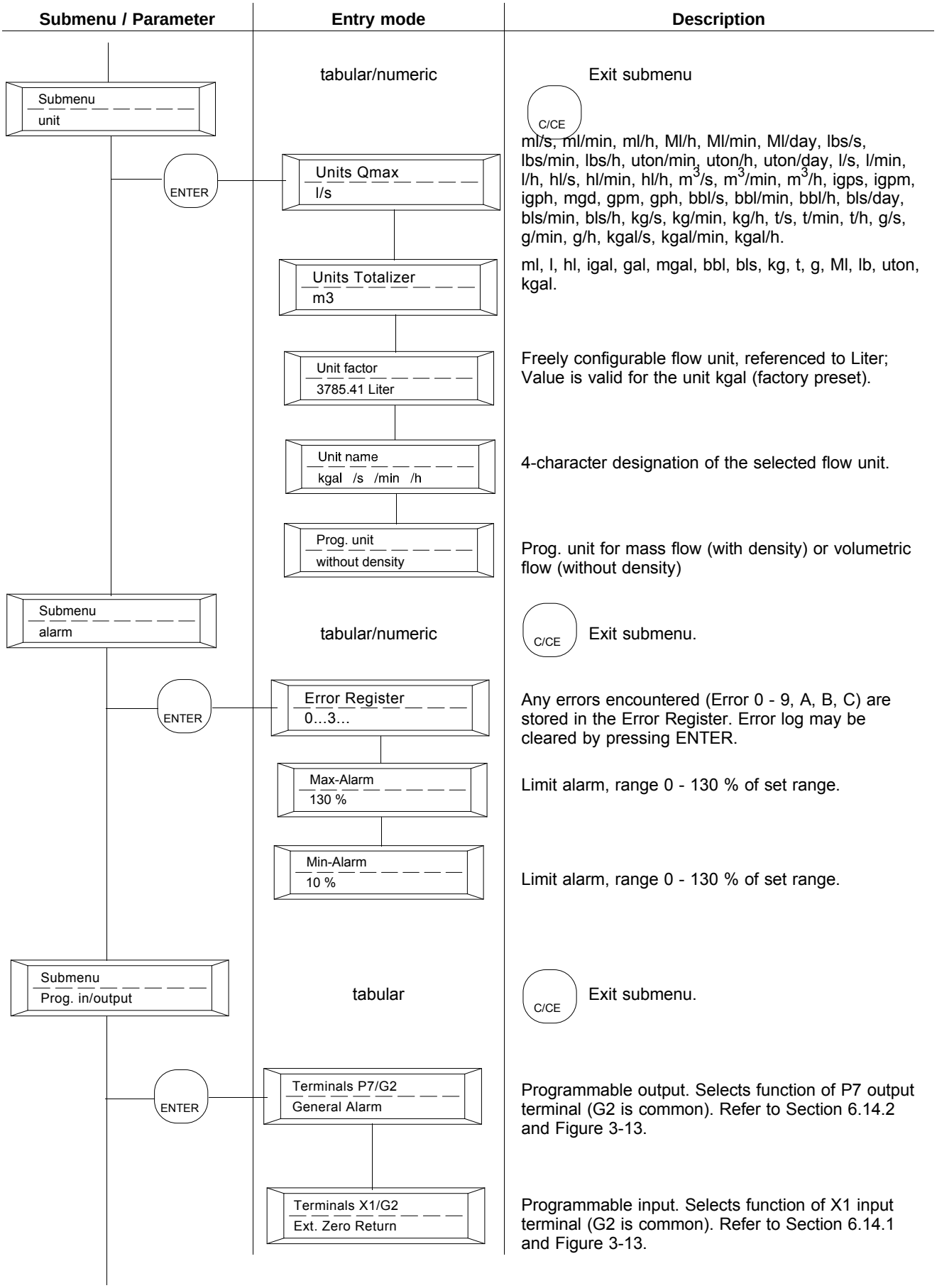
The menu items in the first column are upper-level configuration mode functions. Submenu selections (shown indented in the second column) only appear if the associated upper level is selected by pressing the **ENTER** function. The allowable selections of sub-menu items which are selected by tabular means are shown in detail in Section 6.0.

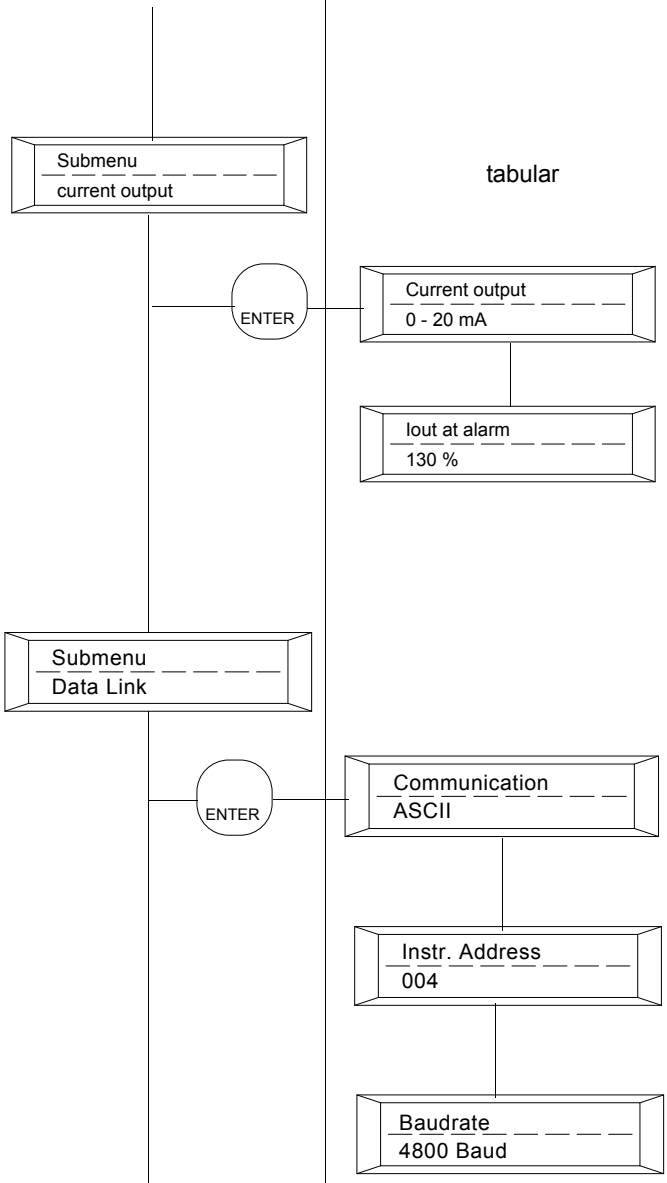


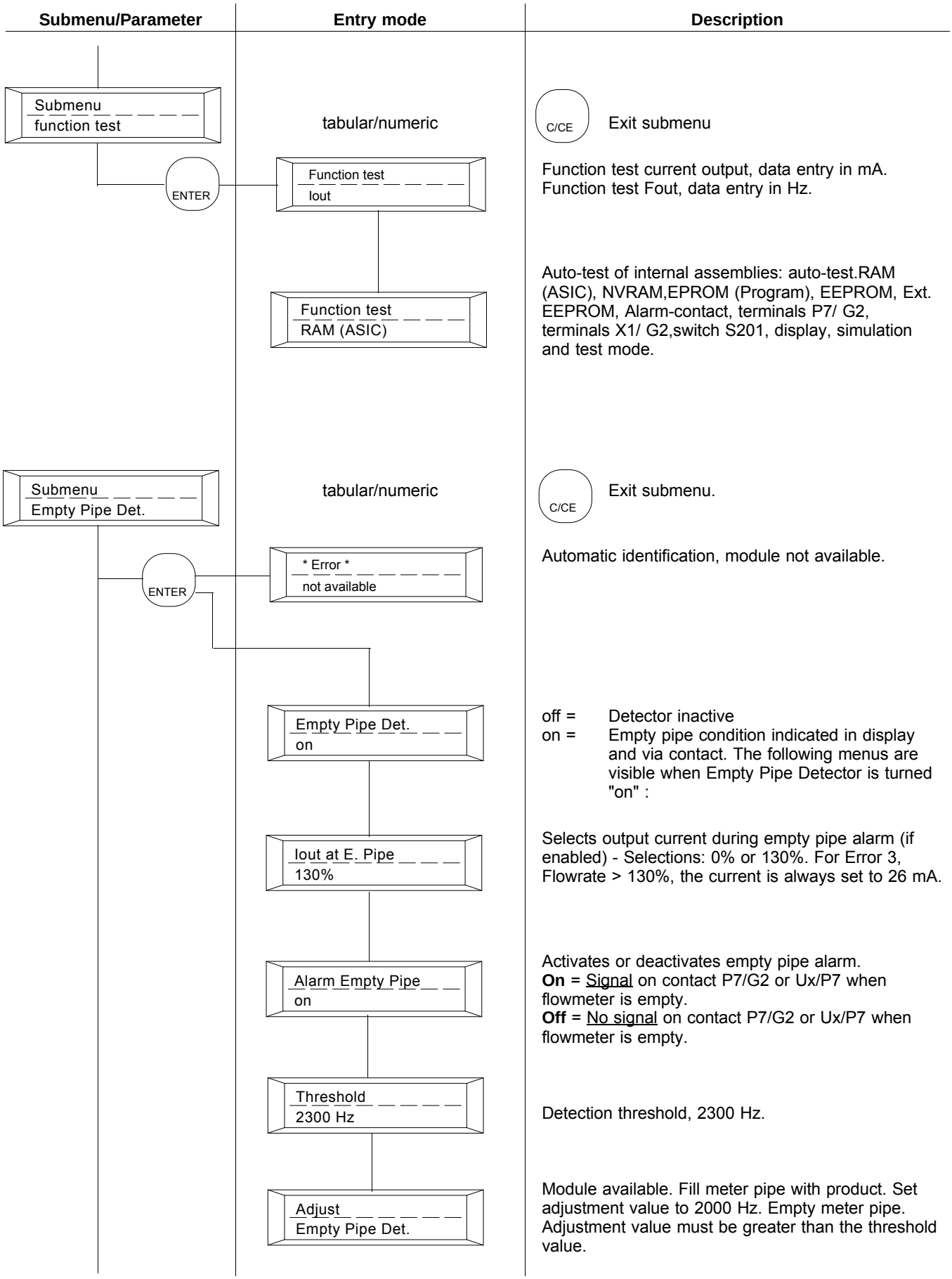
5.5 Parameter Summary and Data Entry

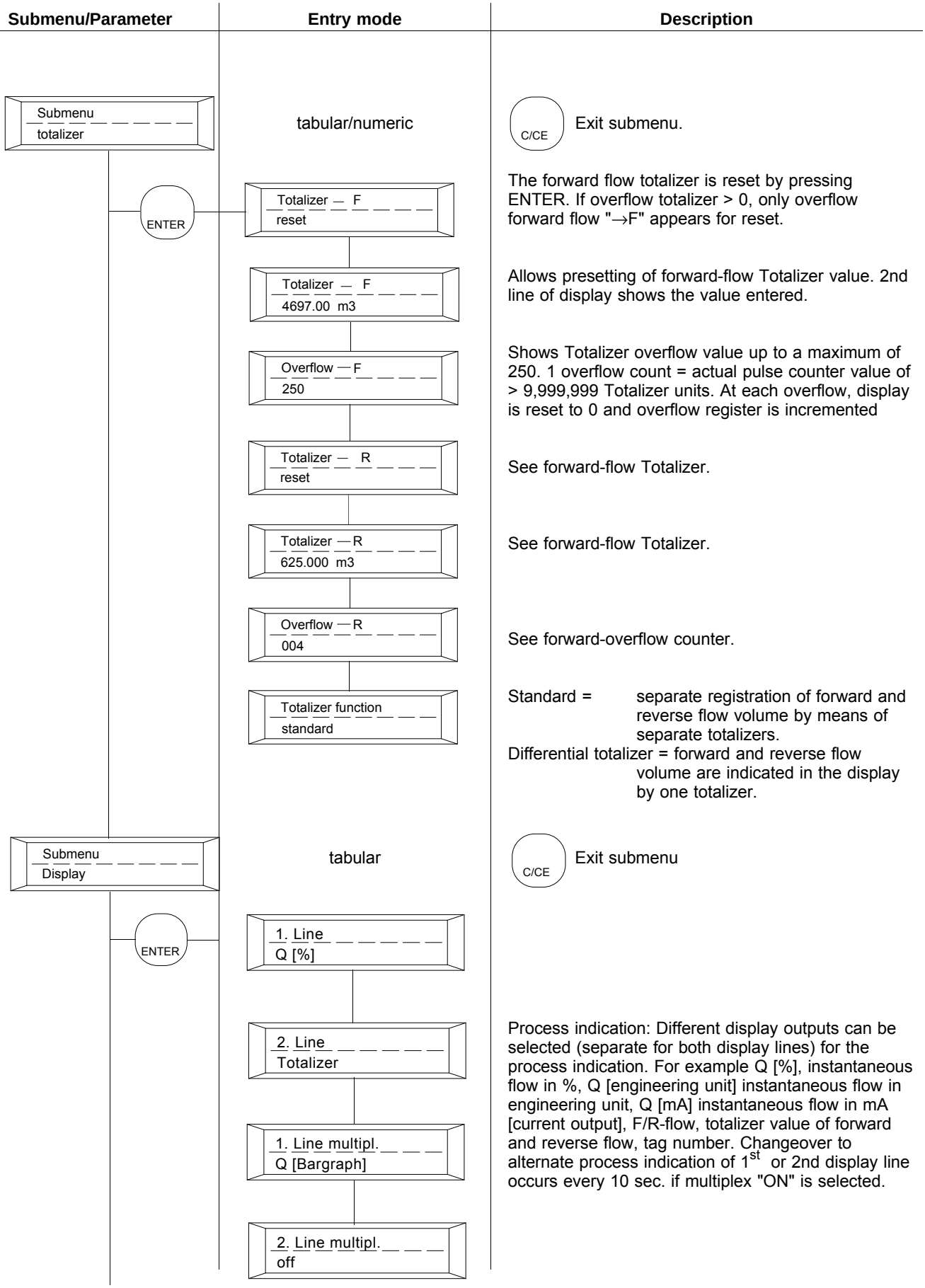


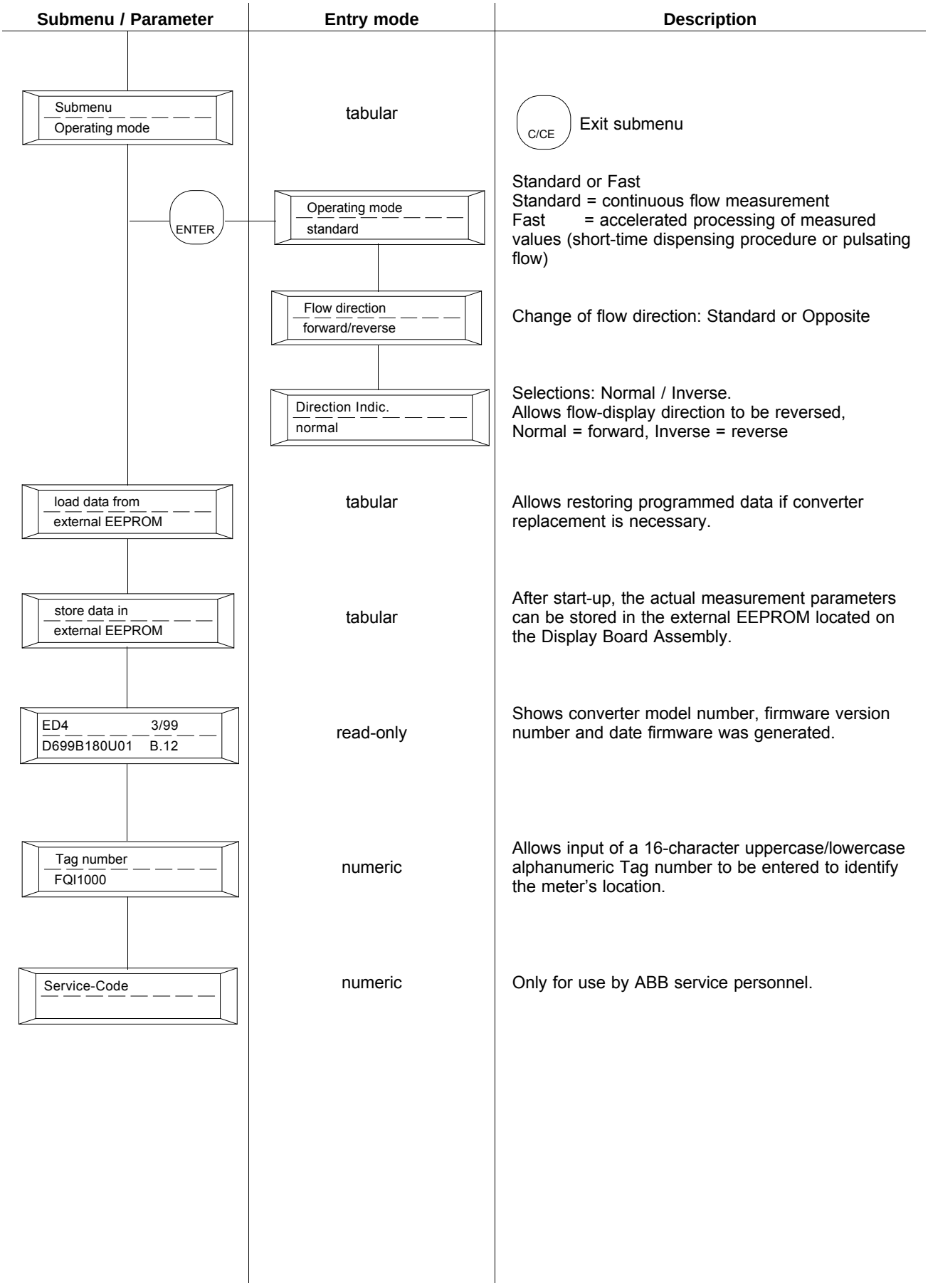
Submenu / Parameter	Entry mode	Description
Short model no. XE4		Descriptive short model number for the converter. Entered by the factory.
Order no. 97W87631		Flowmeter order number. This number should be identical to that on the Primary's Data Tag and on the sticker on the external EEPROM on the Display PCB.
Qmax 400.000 m3/h	numeric	Measuring range for forward- and reverse flow Minimum allowable range adjustable between 0 - 1.6 ft/s (0 - 0.5 m/s). Maximum allowable range adjustable between 0 - 33 ft/s (0 - 10 m/s). Upper range limit is adjustable between 1.6 and 33 ft/s (0.5 and 10 m/s).
Pulse 1.0000 /m3	numeric	For internal and external flow totalling, range 0.001-1000 pulses per selected unit, maximum counting frequency 5 kHz.
Pulse width 30.000 ms	numeric	For external pulse output, range 0.1 ms - 2000 ms.
Low flow cut-off 1.000 %	numeric	Range 0 - 10 %, sets display and all outputs
Damping 10.0000 s	numeric	Range 0.5 - 99.9999 s, response time for 0 - 99 % flow change.
Filter on	tabular	On/off. Defaults to "OFF". When noisy output signal is present turn noise reduction filter "ON" and select a damping time > 2.4 s.
Density 2.54300 g/cm3	numeric	Range 0.01 - 5 g/cm^3. Determines flow rate for display and totalizing in g, kg, t, ton or pound.
System-zero 3.5 Hz	tabular	Zero check (required for use with older primaries). C/CE Exit submenu.
ENTER → Adjust manual		Manual value entry.
Adjust automatic		Valve must be closed. There must be no fluid flow & meter must be full. Press ENTER to start auto adj.


Submenu / Parameter
Entry mode
Description
tabular/numeric
Exit submenu
C/CE
Submenu
unit
ENTER
Units Qmax
l/s
ml/s, ml/min, ml/h, Ml/h, Ml/min, Ml/day, lbs/s, lbs/min, lbs/h, uton/min, uton/h, uton/day, l/s, l/min, l/h, hl/s, hl/min, hl/h, m3/s, m3/min, m3/h, igps, igpm, igph, mgd, gpm, gph, bbl/s, bbl/min, bbl/h, bls/day, bls/min, bls/h, kg/s, kg/min, kg/h, t/s, t/min, t/h, g/s, g/min, g/h, kgal/s, kgal/min, kgal/h.
Units Totalizer
m3
ml, l, hl, igal, gal, mgal, bbl, bls, kg, t, g, Ml, lb, uton, kgal.
Unit factor
3785.41 Liter
Freely configurable flow unit, referenced to Liter; Value is valid for the unit kgal (factory preset).
Unit name
kgal /s /min /h
4-character designation of the selected flow unit.
Prog. unit
without density
Prog. unit for mass flow (with density) or volumetric flow (without density)
Submenu
alarm
tabular/numeric
C/CE
Exit submenu.
ENTER
Error Register
0...3...
Any errors encountered (Error 0 - 9, A, B, C) are stored in the Error Register. Error log may be cleared by pressing ENTER.
Max-Alarm
130 %
Limit alarm, range 0 - 130 % of set range.
Min-Alarm
10 %
Limit alarm, range 0 - 130 % of set range.
Submenu
Prog. in/output
tabular
C/CE
Exit submenu.
ENTER
Terminals P7/G2
General Alarm
Programmable output. Selects function of P7 output terminal (G2 is common). Refer to Section 6.14.2 and Figure 3-13.
Terminals X1/G2
Ext. Zero Return
Programmable input. Selects function of X1 input terminal (G2 is common). Refer to Section 6.14.1 and Figure 3-13.

Submenu/Parameter	Entry mode	Description
		This menu is not displayed for Profibus DP or ASCII Communication. For HART Protocol, the current output is fixed at 4-20 mA. For HART Protocol, if an Instrument Address >0 is set in the Submenu Data Link, the instrument operates in the Multidrop Mode. The current output is fixed at 4-20 mA. Select current output 0-20 mA / 4-20 mA, 0-10 mA / 2-10 mA, 0-5 mA / 0-10 mA, 10-20 mA / 4-12 mA, 12-20 mA Select current output for error condition, 0/4 mA or 0/26 mA. For Error Code 3 "flow rate > 130 %", current output is always 26 mA. C/CE Exit submenu. The Submenu Data Link only appears if that option has been ordered and has been recognized by the converter. The following information applies only if the respective option has been ordered. **HART Protocol:** Instrument address range is 0-15 (Multidrop mode for addresses >0). **Profibus PA:** Profibus PA has a default Instrument Address of 126 which may be changed by Profibus communication on the bus. **Profibus DP / ASCII:** Available menu selections are: Profibus DP ASCII ASCII2w Instrument addresses may be set by using the menu or by Profibus DP communication on the bus. The instrument address **must** be 3-digits (i.e. 065). Default instrument address is 126 and the instrument address range is 0-126. Selecting Profibus DP will display "Slave-Adr." & "Function" menu screens instead of the Instr. Address & Baudrate illustrated. If multiple instruments are connected to a single bus (i.e. ASCII-Protocol RS485), each instrument must have a unique address in the range of 000-099. Available Baud Rate selections are 110-28800 baud.


Submenu/Parameter
Entry mode
Description
Submenu
function test
tabular/numeric
C/CE
Exit submenu
ENTER
Function test
Iout
Function test current output, data entry in mA.
Function test Fout, data entry in Hz.
Function test
RAM (ASIC)
Auto-test of internal assemblies: auto-test.RAM (ASIC), NVRAM,EPROM (Program), EEPROM, Ext. EEPROM, Alarm-contact, terminals P7/ G2, terminals X1/ G2,switch S201, display, simulation and test mode.
Submenu
Empty Pipe Det.
tabular/numeric
C/CE
Exit submenu.
ENTER
* Error *
not available
Automatic identification, module not available.
Empty Pipe Det.
on
off = Detector inactive
on = Empty pipe condition indicated in display and via contact. The following menus are visible when Empty Pipe Detector is turned "on" :
Iout at E. Pipe
130%
Selects output current during empty pipe alarm (if enabled) - Selections: 0% or 130%. For Error 3, Flowrate > 130%, the current is always set to 26 mA.
Alarm Empty Pipe
on
Activates or deactivates empty pipe alarm.
On = Signal on contact P7/G2 or Ux/P7 when flowmeter is empty.
Off = No signal on contact P7/G2 or Ux/P7 when flowmeter is empty.
Threshold
2300 Hz
Detection threshold, 2300 Hz.
Adjust
Empty Pipe Det.
Module available. Fill meter pipe with product. Set adjustment value to 2000 Hz. Empty meter pipe. Adjustment value must be greater than the threshold value.


Submenu/Parameter
Entry mode
Description
Submenu
totalizer
tabular/numeric
C/CE
Exit submenu.
ENTER
Totalizer — F
reset
The forward flow totalizer is reset by pressing ENTER. If overflow totalizer > 0, only overflow forward flow "→F" appears for reset.
Totalizer — F
4697.00 m3
Allows presetting of forward-flow Totalizer value. 2nd line of display shows the value entered.
Overflow — F
250
Shows Totalizer overflow value up to a maximum of 250. 1 overflow count = actual pulse counter value of > 9,999,999 Totalizer units. At each overflow, display is reset to 0 and overflow register is incremented
Totalizer — R
reset
See forward-flow Totalizer.
Totalizer — R
625.000 m3
See forward-flow Totalizer.
Overflow — R
004
See forward-overflow counter.
Totalizer function
standard
Standard = separate registration of forward and reverse flow volume by means of separate totalizers.
Differential totalizer = forward and reverse flow volume are indicated in the display by one totalizer.
Submenu
Display
tabular
C/CE
Exit submenu
ENTER
1. Line
Q [%]
2. Line
Totalizer
Process indication: Different display outputs can be selected (separate for both display lines) for the process indication. For example Q [%], instantaneous flow in %, Q [engineering unit] instantaneous flow in engineering unit, Q [mA] instantaneous flow in mA [current output], F/R-flow, totalizer value of forward and reverse flow, tag number. Changeover to alternate process indication of 1st or 2nd display line occurs every 10 sec. if multiplex "ON" is selected.
1. Line multipl.
Q [Bargraph]
2. Line multipl.
off

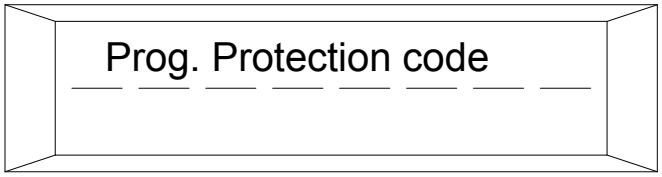

Submenu / Parameter
Entry mode
Description
Submenu
Operating mode
tabular
C/CE
Exit submenu
ENTER
Operating mode
standard
Standard or Fast
Standard = continuous flow measurement
Fast = accelerated processing of measured values (short-time dispensing procedure or pulsating flow)
Flow direction
forward/reverse
Change of flow direction: Standard or Opposite
Direction Indic.
normal
Selections: Normal / Inverse.
Allows flow-display direction to be reversed,
Normal = forward, Inverse = reverse
load data from
external EEPROM
tabular
Allows restoring programmed data if converter replacement is necessary.
store data in
external EEPROM
tabular
After start-up, the actual measurement parameters can be stored in the external EEPROM located on the Display Board Assembly.
ED4 3/99
D699B180U01 B.12
read-only
Shows converter model number, firmware version number and date firmware was generated.
Tag number
FQI1000
numeric
Allows input of a 16-character uppercase/lowercase alphanumeric Tag number to be entered to identify the meter's location.
Service-Code
numeric
Only for use by ABB service personnel.

6.0 Parameter Entry

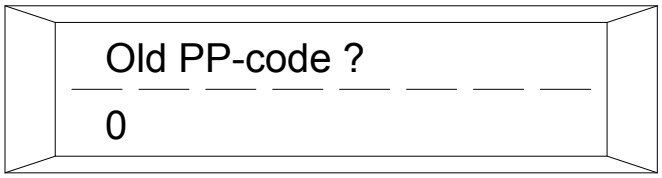
After power has been turned on, programming parameters may only be changed by turning program protection "OFF". There are two ways to turn off the program protection:

1. If program protection code (PP-code) is on "0" (factory default), the program protection is turned off by pressing ENTER key.
2. If a PP-code (1 to 255) other than "0" has been entered, this code must be entered in order to turn the program protection "OFF".

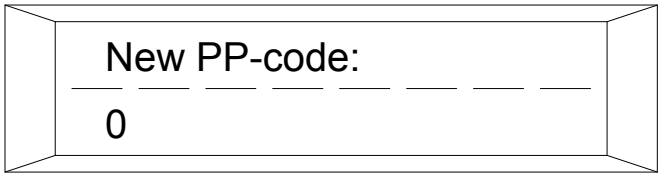
The PP-code can be changed after the program protection has been turned off.



In order to be on the safe side when changing the PP-code the old PP-code must be entered after ENTER has been actuated.



Press ENTER key after entry of old PP-code.



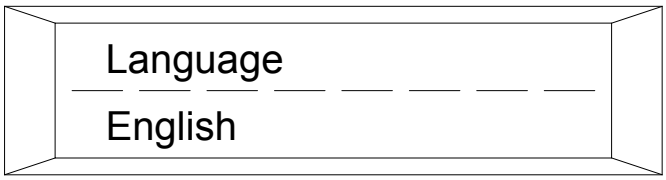
Now enter the new PP-code (0-255) and press ENTER key. The **new** PP-code is now valid to turn off the program protection.

If the PP-code is forgotten, entering the Service Code will reveal the Program Protection Code.

Note:
During data entry the input values are checked for acceptability. If data is not acceptable, it is rejected and a message is generated indicating that the new data has not been accepted.

6.1 Language Tabular Entry

The text in the display may be selected to read in nine different languages. The desired language can be selected with the arrow keys.



The following languages are available:

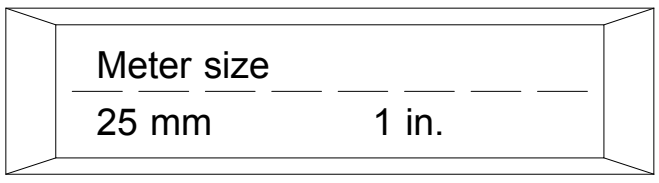
- German
- English
- French
- Italian
- Spanish
- Finnish
- Dutch
- Danish
- Swedish

6.2 Submenu Primary Read-only

This submenu contains information for the primary being used with the signal converter. These items are informational only and may not be changed (read-only). The indicated meter size determines the value shown in the **Cal -fact** display which follows the **Submenu Primary**.

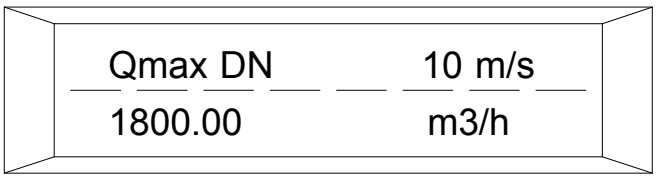
6.2.1 Meter Size

This display indicates the size of the meter's flowtube.



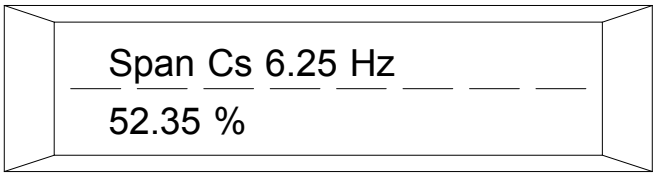
6.2.2 Q_{maxDN}

Q_{maxDN} is the maximum flowrate for the flowmeter size and is equivalent to a flow velocity of 10 m/s. Q_{maxDN} is set automatically, based on the flowmeter Primary size selected.



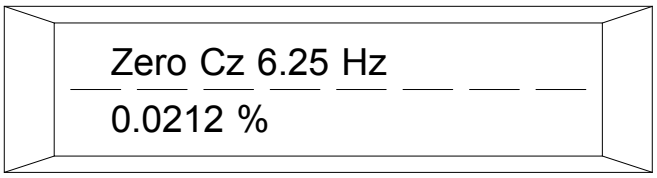
6.2.3 Span Cs 6.25 Hz

The Span Cs display shows the relative span signal produced by the Primary. Cs is shown as a percentage of the nominal value that would be expected based on the level of coil excitation current applied. A typical display is shown below.



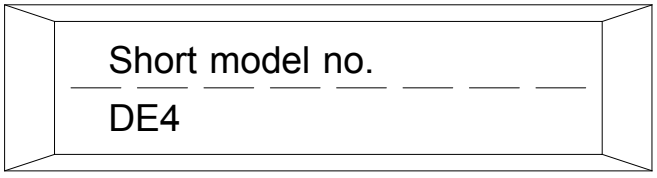
6.2.4 Zero Cz 6.25 Hz

The Zero Cz display is a measure of the zero offset produced by the Primary. A typical display is shown below. The Signal Converter uses both the Cs and Cz values to generate offset-free outputs normalized to the size of the Primary.



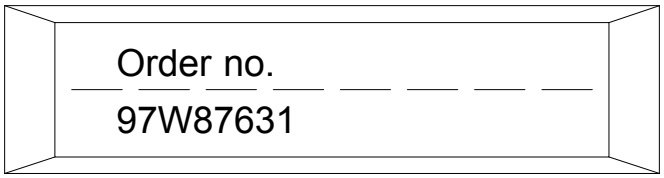
6.2.5 Short Model Number

The short model number display shows one of the generic Primary types intended for use with the M2 Signal Converter. This would also include the DM2 and DM3 series of meters.



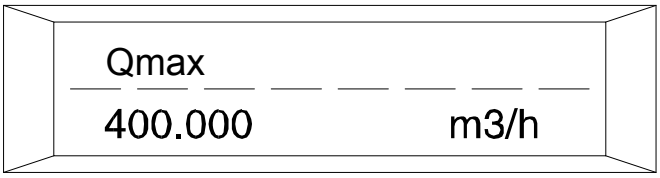
6.2.6 Order Number

The order number is the ABB serial number of the signal converter. This number is generated by the factory and is unique to the instrument.



6.3 Qmax

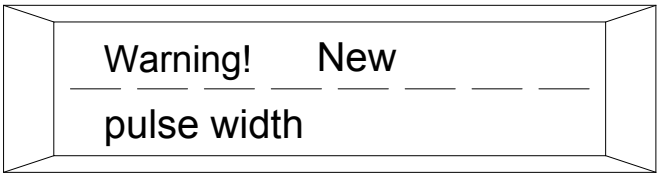
Numeric entry



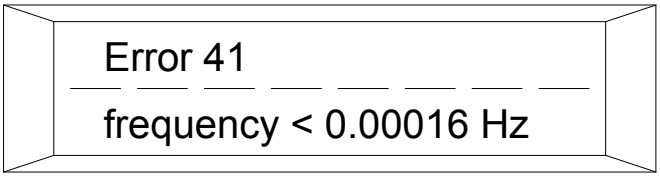
A maximum flow rate range value can be entered between the limits of 0.05 Q_{maxDN} and 1.0 Q_{maxDN}.

The selection is made with the STEP and DATA buttons. The unit is selected in Section 6.11.

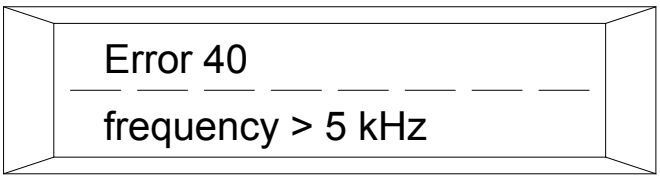
For Totalizer operation, the set measuring range is checked by the computer as a function of **the pulse factor** (between 0.01 and 1000 pulses/unit), **the pulse width** (between 0.1 and 2000 ms), **the totalizer unit** (e.g. ml, l, m^3) or **mass unit** (e.g. g, kg, t) with **the density correcting value**. If any of these parameters is changed, the resultant pulse width may not exceed 50% of the period of the output frequency at 100% flow rate (on/off ratio = 1:1). If the pulse width is greater, it is automatically reduced to 50% of the period and the following message is displayed:



If the output frequency is too low, the following message is displayed:

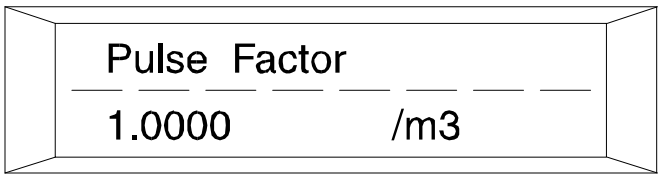


If the output frequency is too high, the following message is displayed:



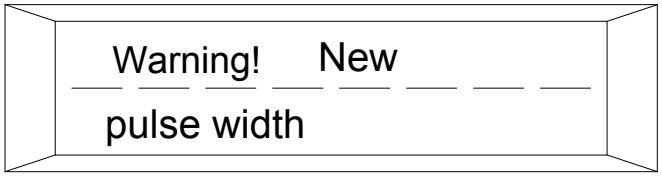
6.4 Pulse Factor, Forward & Reverse Numeric entry

The pulse factor is the number of pulses for one flow rate unit for the pulse output and the internal totalization and applies to forward as well as reverse flow.

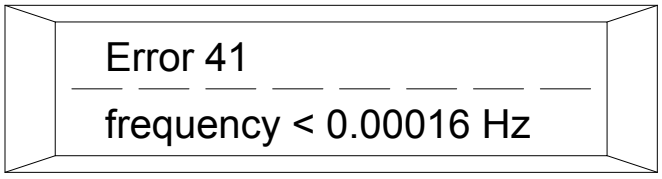


When the pulse factor is changed the totalizer value remains in the correct unit as selected per section 6.11.2 .

The pulse factor can be selected between 0.001 and 1000 pulses/unit. The selected pulse factor is checked by the computer as a function of **the pulse factor** (between 0.01 and 1000 pulses/unit), **the pulse width** (between 0.1 and 2000 ms), **the totalizer unit** (e.g. ml, l, m^3) or **mass unit** (e.g. g, kg, t) with **the density correcting value**. If one of these parameters is changed, the pulse width may be automatically recalculated to be a maximum of 50% of the period of the output frequency at 100 % flow rate (duty-cycle [on/off ratio] = 50%) and following message is displayed.



If theoutput frequency is too low, the following message is displayed:



6.5 Pulse Width Numeric entry

The pulse width (pulse duration) for the scaled pulse output can be selected between 0.1 and 2000 ms. For technical reasons the actual pulse width in the converter is always a multiple of 0.05 ms. The selected pulse width must be short enough to avoid pulses overlapping at the maximum output frequency (maximum flow 130 % = 6.5 kHz) but long enough to guarantee activation of the pulse counter being used.

Example:

Flow range = 100 l/min (Q_{max} = 100 % range end value)
Totalizer = 1 pulse/l

$$f = \frac{100\ pulses/\min}{60\ s} = 1.666\ Hz$$

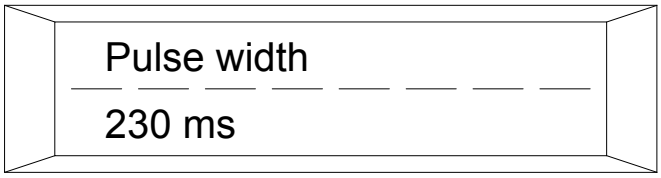
At 30% overrange:

$f = 1.666\ Hz \cdot 1.3 = 2.166\ Hz\ (^1/_s)$

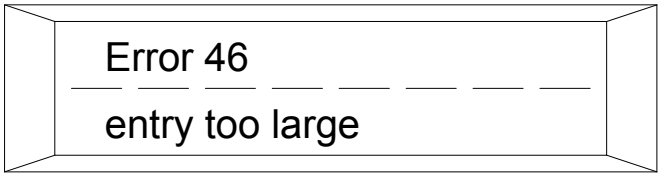
At 50% duty-cycle (on time = off time)

$$\text{Pulse width } tp = \frac{1}{2.166\ s^{-1}} \cdot 0.5 = 230\ ms$$

A value of < 230 ms can be set here. **Mechanical counters require a pulse width of ≥ 30 ms.**



The computer automatically checks the set pulse width. The pulse width may be 80% of the output frequency at 130% of flow rate. If this limit is exceeded, the new value will not be accepted and following error message is displayed:

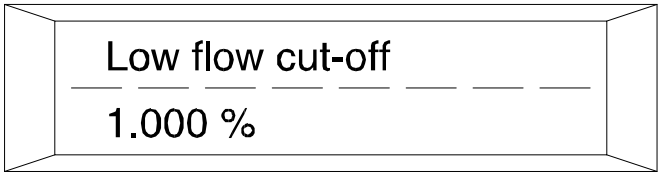


6.6 Low Flow Cut-Off Numeric Entry

The low flow cut-off can be selected between 0 and 10.0 % of the range end value.

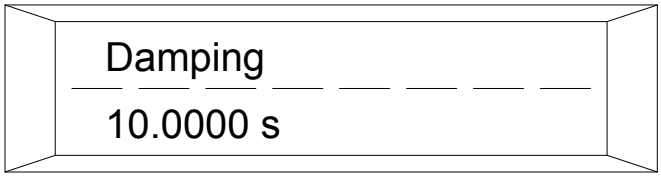
Flows less than the cut-off value are not totalized. The current and pulse outputs are set to zero.

The switching threshold for the low flow cut-off has 1% hysteresis.

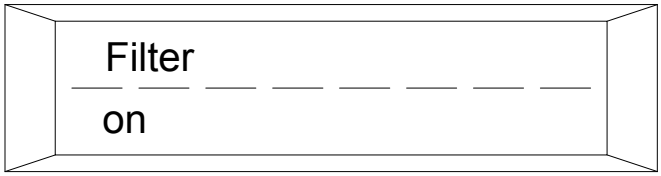


6.7 Damping
Numeric Entry

The damping value can be selected between 0.5 and 99.99 seconds. The value represents the response time for a 0 - 99 % step flow rate change.



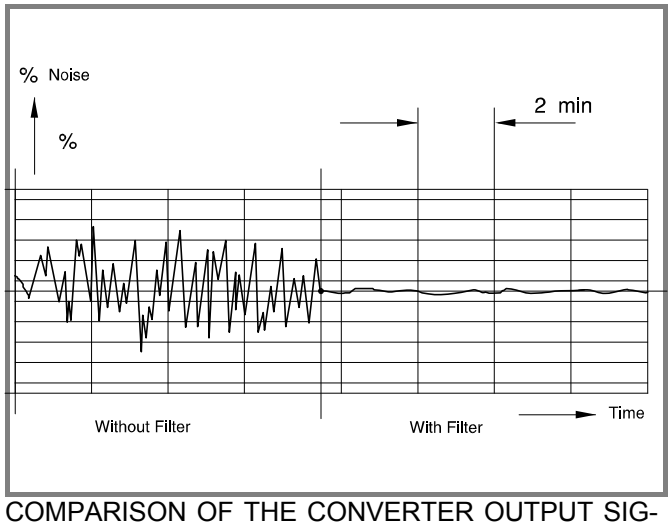
6.8 Filter (Noise Rejection)
Tabular Entry



A digital filter (noise reduction algorithm) is available in the converter when pulsating flow or especially noisy signals are encountered. The digital filter improves the displayed instantaneous flow values and provides a steady current output. With the filter turned on, the damping value may be reduced. The response time of the converter will not be influenced.

With one of the arrow keys the filter is turned on and is accepted by pressing the ENTER key. The filter is only active when the selected damping time is > 2.4 s.

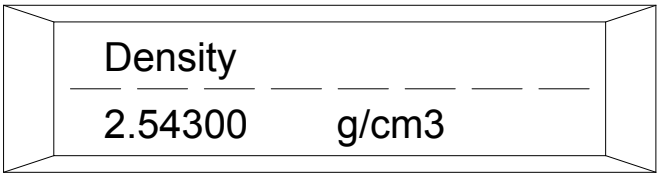
Noise Reduction Example



COMPARISON OF THE CONVERTER OUTPUT SIGNAL WITH AND WITHOUT NOISE REDUCTION FILTER.

6.9 Density
Numeric entry

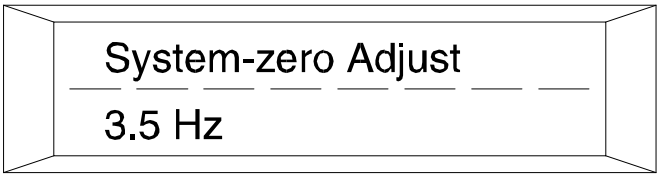
When the flow is totalized in gravimetric units g, kg, t, pound or UStон, a density value can be entered for the calculation. The translation conversion to mass flow is settable between 0.01 and 5.00000 g/cm^3. Changing the density value generates a recalculation of Range and Range DN values.



6.10 System Zero
Numeric Entry

A zero check should be made after start up. In order to do this properly, there must be **absolutely no flow** through the meter. The zero adjust procedure can be initiated at the converter. Automatic or manual setting modes are possible.

Select parameter "System-zero Adj." and press the ENTER key.



The STEP and DATA keys are used to toggle between the automatic and manual modes.

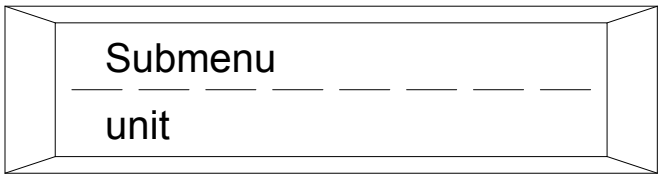
Pressing ENTER initiates the automatic zero adjustment. A countdown from 255 towards 0 on the display is repeated four times. The zero value determined by the converter must be within ± 500 Hz (+/- 5% of Range DN). If the zero value is not within these limits no adjustment takes place. The value determined by the converter is displayed in the 2nd line of the display. Pressing the C/CE key sets the zero value to 0 Hz.

6.11 Submenu Units

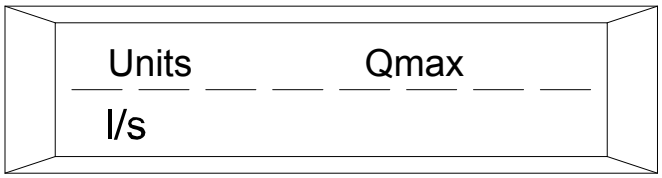
This submenu allows selection of units for the following parameters:

- Q_{max} Engineering unit
- Totalizer Engineering unit
- Engineering unit with unit factor freely configurable
- Unit identification freely configurable
- Prog. unit with/without correcting of density

The last three parameters refer to a freely configurable unit. This function replaces the previously available fixed "kgal" unit.



6.11.1 Units Qmax
Tabular Entry

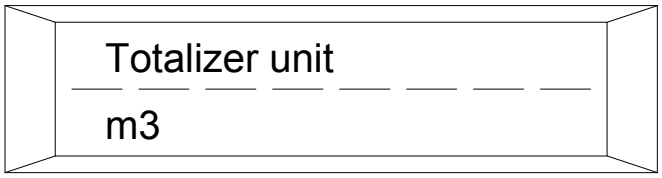


The listed units in the table to the right can be set with the STEP and DATA buttons and are accepted by pressing ENTER. Some units may not be available if the HART Protocol option is selected (Refer to Table 2-3)

The unit refers to $Q_{max\ DN}$, Q_{max} forward flow, Q_{max} reverse flow and the instantaneous value display if these are displayed with engineering unit.

6.11.2 Totalizer Unit
Tabular Entry

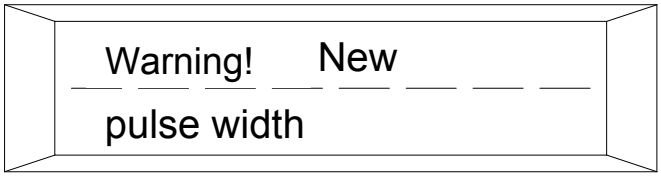
The units listed below are available for the flow Totalizer. They can be selected with the DATA and STEP buttons. The units can be different from those selected for the flow modes. The engineering unit is accepted by pressing ENTER.



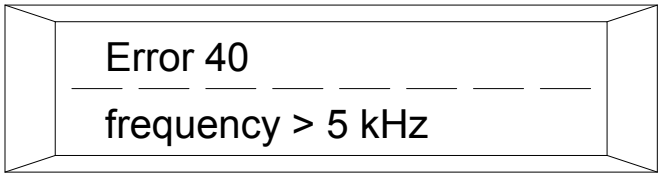
Units:ml, Ml, lb, uton, kgal, l, hl, m^3, igal, gal, mgal, bbl, bls, kg, t, g.

Unit	
Liter	l/s l/min l/h
Hectoliter	hl/s hl/min hl/h
Cubicmeter	m^3/s m^3/min m^3/h
Imperial-gallon per	igps igpm igph
U.S.-million-gallon per	mgd
U.S.gallon per	gpm gph
Barrel-Brewery [31 gallons]	bbl/s bbl/min bbl/h
Barrel- Petro chemistry [42 gallons]	bls/day bls/min bls/h
Kilogram	kg/s kg/min kg/h
Ton (metric)	t/s t/min t/h
Gram	g/s g/min g/h
Milliliter	ml/s ml/min ml/h
Megaliter	Ml/min Ml/h Ml/day
Pound (454 g)	lb/s lb/min lb/h
US-Ton	uton/min uton/h uton/day

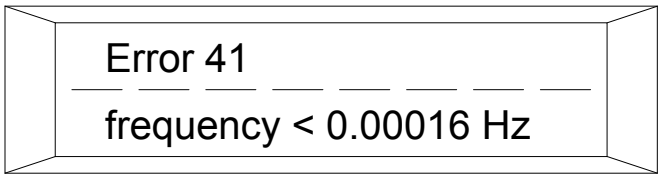
The selected engineering totalizer unit is checked by the computer as a function of **flow rate range, the pulse factor** (between 0.01 and 1000 pulses/unit), **the pulse width** (between 0.1 and 2000 ms) and with **the density correcting value** when a mass unit (e.g. g, kg, t) has been selected. If one of these parameters is changed, the pulse width may be automatically recalculated to be a maximum of 50% of the period of the output frequency at 100% flow rate (duty-cycle [on/off ratio] = 50%) and following message is displayed.



If the output frequency is too high, the following message is displayed:



If the output frequency is too low, the following message is displayed:



6.11.3 User Programmable Units

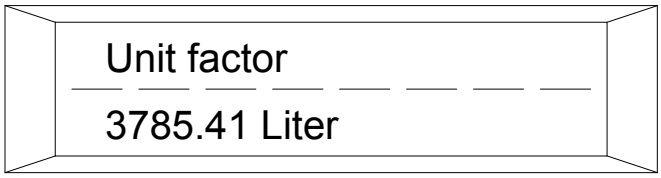
This function enables configuration of any engineering unit in the converter. The following three parameters are available for this function :

a) Units factor
b) Unit name
c) Prog. units with / without density

NOTE
The entry of the listed parameters a), b) and c) is only necessary in case the required engineering unit is not available in the table in Section 6.11.1 .

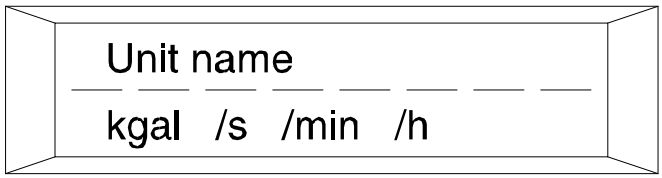
6.11.3.1 Units Factor
Numeric entry

This parameter indicates the factor of the new unit with respect to one liter. The default entry is kgal=3785.41 Liter.



6.11.3.2 Unit Name
Tabular entry

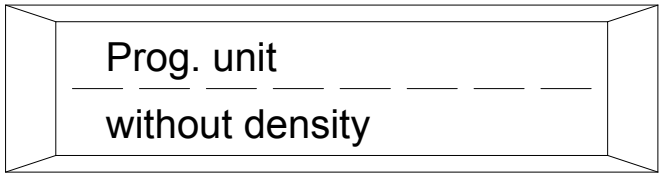
The selection is made with the STEP and DATA buttons. With DATA or the down-arrow key (↓) the alphabet is paged forward, first the lower-case letters appear and then the capital letters. The STEP or the up-arrow key (↑), controls the position and shifts the cursor to the next character position for entry. A maximum of four characters is available.



The units of time /s, /min and /h may be assigned to the engineering unit.

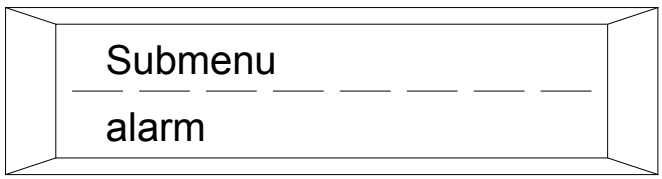
6.11.3.3 Programmable Unit
Tabular entry

This function determines whether the newly entered engineering unit is a mass unit (with density) or a volumetric unit (without density). If density was selected, also refer to section 6.9.



6.12 Submenu Alarm
Tabular entry

After pressing ENTER the functions listed in this submenu can be selected with the STEP and DATA buttons.



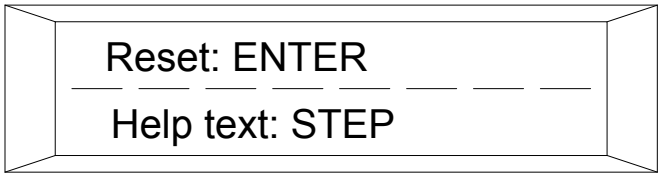
Error register (See Section 6.12.1)
MAX-Alarm (See Section 6.12.2)
MIN-Alarm (See Section 6.12.3)

6.12.1 Error Register

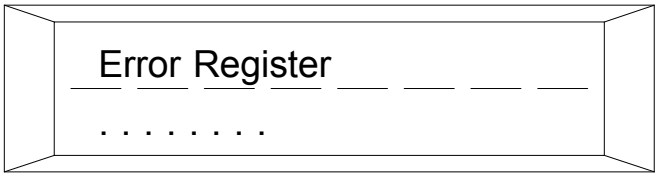
Any errors that may have occurred (Error 0 to Error 8) are stored in this register. All detected errors remain stored until the register is manually reset (by pressing ENTER or by way of data link).

In the example shown, error 0 (empty pipe) and error 3 (flow rate > 130 %) have occurred since the last reset.

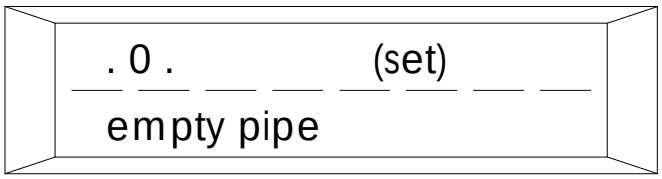
After pressing ENTER, the following is displayed:



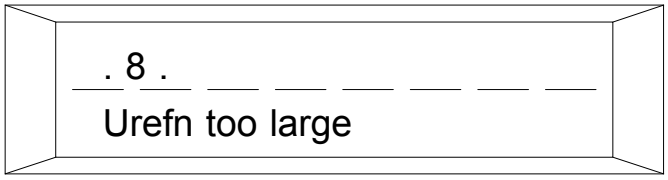
After pressing ENTER again the error register is deleted:



If ENTER is pressed again, the description for each error is displayed:



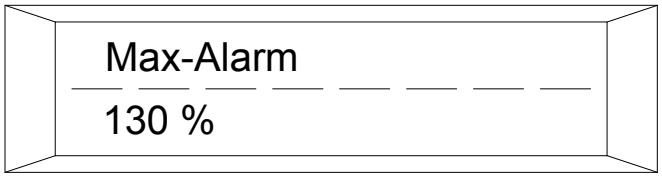
Error 0 = empty pipe.



Error 8 = negative reference voltage is too high

Pressing **C/CE** exits the help text information.

6.12.2 MAX-Alarm Numerical entry

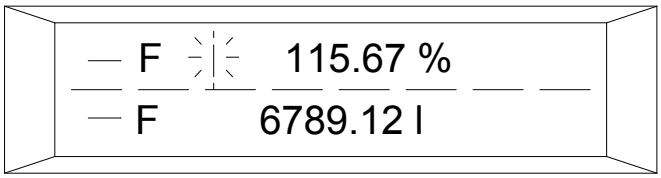


The limit of the MAX-Alarm value can be entered in 1% increments from 0% - 130%. This value is valid for both forward and reverse flow.

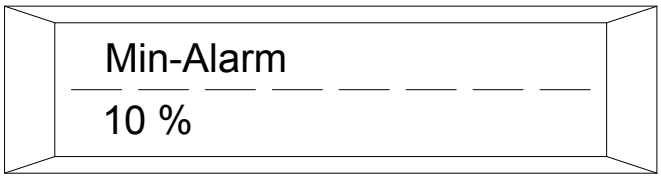
When the MAX-alarm value is exceeded, the alarm contacts will be actuated. This condition is also indicated on the display by means of a flashing upward-pointing arrow.

For example:

MAX-Alarm limit value = 110 %
At flow > 110 % a flashing arrow (pointing upward) appears in 1st line of the display in the position shown on the sample display.



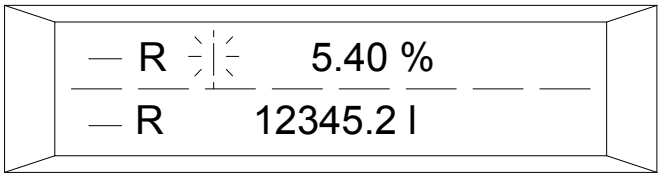
6.12.3 MIN-Alarm Numerical entry



The limit of required MIN-Alarm value can be entered in increments of 1% from 0% - 130% . This value is valid for forward and reverse flow.

> Note:
> Switching thresholds for the MAX- and MIN-Alarms are provided with 1% hysteresis.

If a MIN-alarm occurs, the alarm contacts will be activated when the flow is less than the MIN-Alarm value. The alarm condition is also indicated on the display by

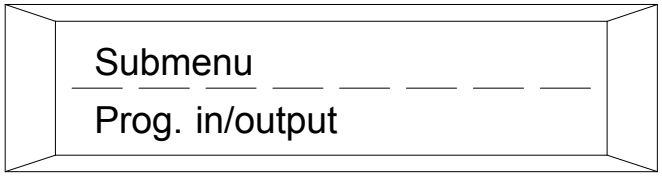


means of a downward pointing flashing arrow.

For example:
MIN-Alarm limit value = 10 %
At flow < 10 % a blinking arrow (pointing down) after flow direction indication appears in 1st line of the display.

6.13 Submenu Prog. In/Output Tabular Entry

This submenu permits configuration of the solid state contacts available at terminals X1 and P7 (circuit common is terminal G2 for both) to perform various selected functions. When configuration items have been selected as desired, they must be saved using the **Store Data in EXT EEPROM** menu selection, otherwise the configuration will be lost in the event of a power interruption.



6.13.1 Function of Input Terminals X1/G2

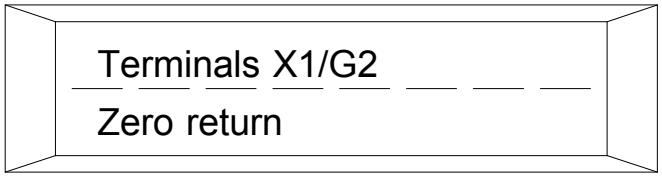
The available selections for programmable input terminals **X1/G2** are:

- Zero return
- Totalizer reset
- Totalizer stop
- No function

The following is a more detailed description of the function of the available selections. Refer to Figure 3-13 for typical X1/G2 terminal wiring.

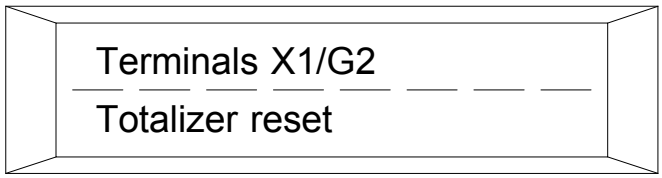
Press **ENTER** and the ↑**Step** button to toggle through the available parameters. Press **ENTER** to make a selection.

6.13.1.1 Zero Return



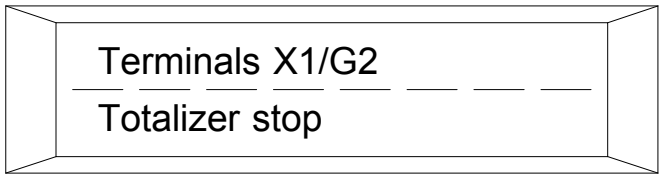
When a DC voltage is applied via a contact closure between terminals X1 & G2, all outputs will go to zero. This feature is useful when the liquid in the meter empties after the flow rate ceases.

6.13.1.2 Totalizer Reset



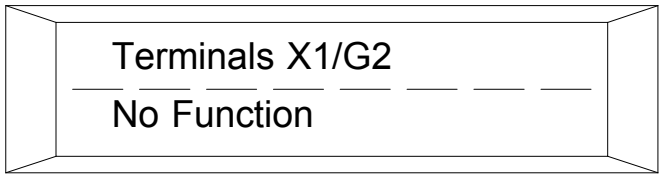
When a DC voltage is applied between terminals X1 & G2, the totalizer will reset to zero and a "Totalizer reset" message appears on the display as long as the voltage is maintained.

6.13.1.3 Totalizer Stop



When a DC voltage is applied between terminals X1 & G2, the totalizer stops counting as long as the voltage is maintained. If the display is configured to display the totalizer value, the totalizer's last value alternates with a "Totalizer stop" message as long as the totalizer is in the "stop" mode.

6.13.1.4 No Function



No function is assigned to terminal X1.

6.13.2 Function of Output Terminals P7/G2

The available selections for programmable output terminals **P7/G2** are:

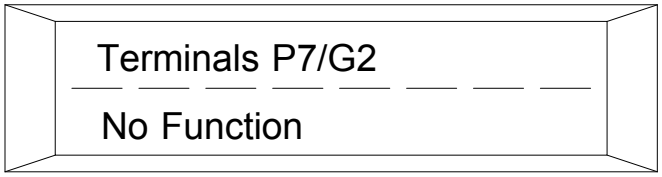
- No function
- F/R-Signal
- Empty pipe (normally open or closed)
- General alarm (normally open or closed)
- MAX/MIN alarm (normally open or closed)
- Min. alarm (normally open or closed)
- Max. alarm (normally open or closed)

Normally open or normally closed contact states are indicated on the display as follows:

NORMALLY CLOSED
(OPENS ON ALARM)

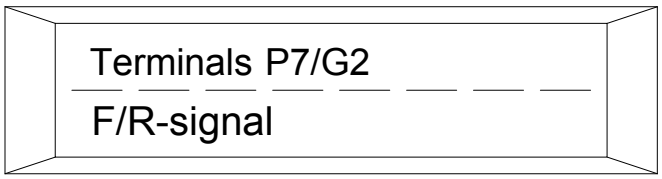
NORMALLY OPEN
(CLOSES ON ALARM)

6.13.2.1 No Function



If module "No function" has been selected there is no signalling via terminals P7 & G2.

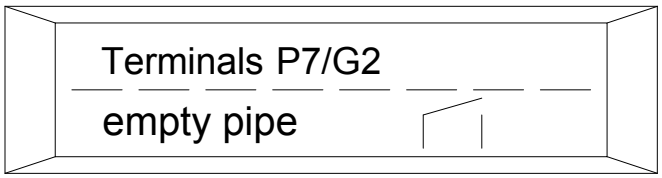
6.13.2.2 F/R-Signal
Tabular entry



Forward and reverse flow is indicated in the display by direction arrows and through contact output P7 & G2.

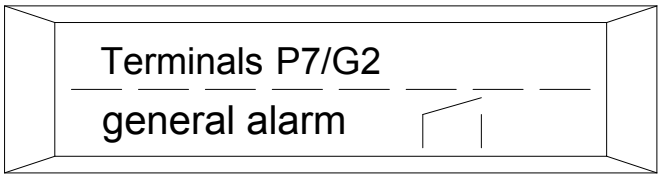
6.13.2.3 Empty Pipe
Tabular entry

With "Detector empty pipe" module installed, an empty pipe condition, with "Detector empty pipe" function enabled, will force the current output to the "no flow" condition and stop the Totalizer. The alarm output is activated and the message "Empty pipe" and "Error 0" appear on the display.



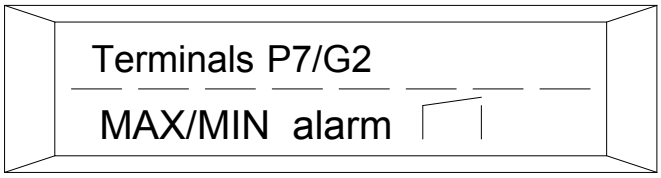
6.13.2.4 General Alarm (errors 0 - 9, A, B, C)
Tabular entry

Any error that occurs (Error 0 to 8) will activate terminals P7 & G2. If an error occurs, the contacts of terminals P7 & G2 open.

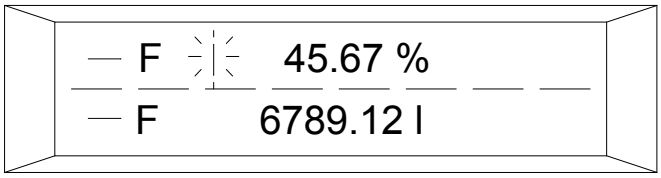


6.13.2.5 MAX/MIN-Alarm
Tabular entry

When the MAX/MIN-Alarm is desired at the P7 & G2 terminals, signalling occurs when the flow is above or below the MAX-Alarm and MIN-Alarm values respectively.

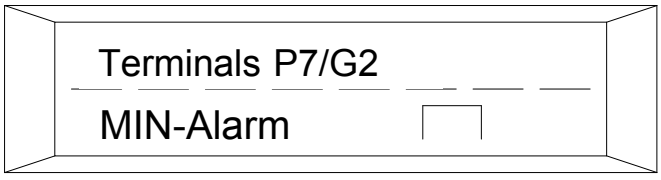


This alarm may also be configured to provide an indication of when the flow is between MIN and MAX alarm values. Setting the MIN-Alarm larger than the MAX-Alarm will provide a signal on the display as well as the P7 & G2 contacts as long as the flow is between the range settings. For example, setting the MIN-Alarm to 80% and the MAX-Alarm to 20% gives the action shown below:



MAX-Alarm = 20 %
MIN-Alarm = 80 %
Flashing double arrow indicates flow between 20% and 80 %.

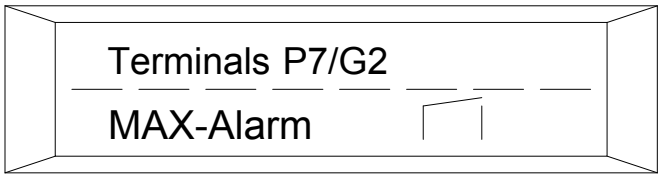
6.13.2.6 MIN. Alarm
Tabular entry



If it is desired for the terminals to signal a low-flow condition, select the MIN-alarm function must be selected for P7 & G2. The display shows the contacts **closing** for an alarm condition

For setting of the MIN alarm value, refer to Section 6.12.3.

6.13.2.7 MAX. Alarm
Tabular entry



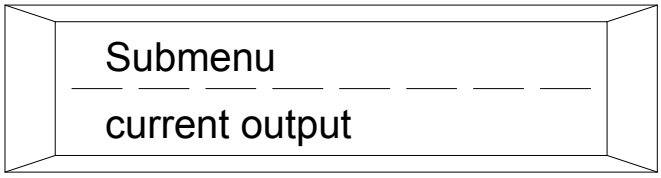
Selecting this mode will activate the output contacts if the MAX alarm value is exceeded. Contacts are shown **opening** for the alarm condition.

For setting of the MAX alarm value, refer to Section 6.12.2.

6.14 Submenu Current Output

The following parameters are set in the current output submenu:

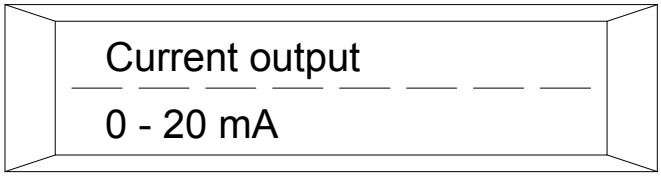
- Current output
- I_{out} at alarm.



6.14.1 Current output
Tabular entry

The following output ranges are available and can be selected with the STEP and DATA buttons.

Current output	
0–20 mA	0-5 mA
4–20 mA	0-10, 10-20 mA
0–10 mA	4-12, 12-20 mA
2–10 mA	

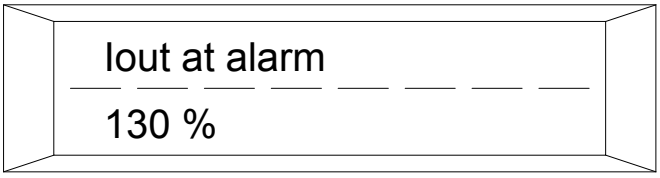


6.14.2 I_{out} at Alarm
Tabular entry

When an error condition is detected by the converter three things happen:

- an alarm contact output is activated
- an error message appears in the display
- the current output is set to a specified value

One of two values can be selected for the alarm current output, 0% and 130% of the Range Max. current value. For Error code 3 (flow rate > 130%), the current output is set to 130 % of the Range Max. current.

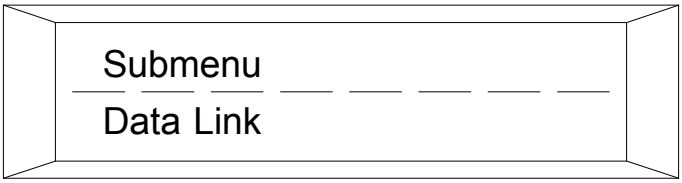


6.15 Submenu Data Link

This submenu allows the following communications parameters to be selected:

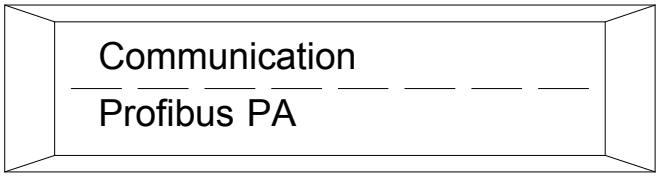
- Protocol
- Instrument Address
- Baud Rate

This menu will only be visible if the Data Link option was specified at time of order.



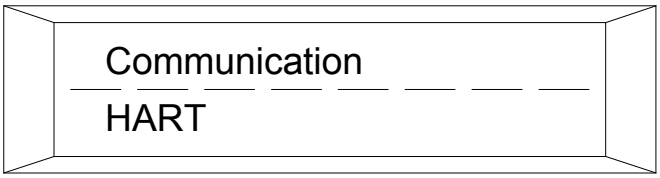
6.15.1 Profibus PA Communication

This protocol is available if a meter with this option has been ordered. The Profibus menu display is for information purposes only and no parameter settings are available. The Instrument Address defaults to 126. The address may be changed by Profibus communication on the bus.

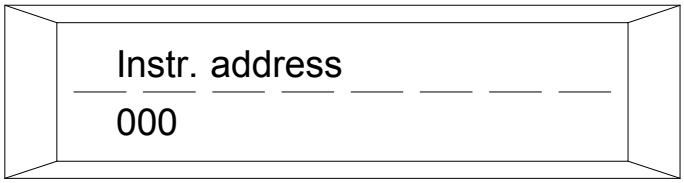


6.15.2 HART Protocol Communication

This protocol is available if a meter with this option has been ordered.



The previous display is for information purposes only and no additional selections may be made. A device Instrument Address may be selected using the following display:



Instrument addresses of 0 - 15 may be selected. If the address entered is >0, the instrument will be automatically placed in the multi-drop mode.

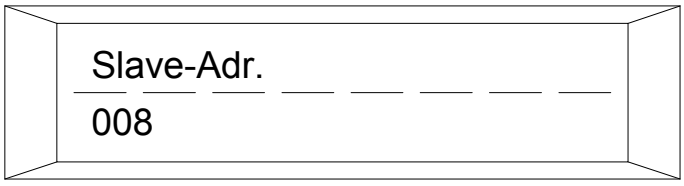
6.15.3 Profibus DP / ASCII Communication

6.15.3.1 Profibus DP

This protocol is available if a meter with this option has been ordered. With Profibus DP or ASCII protocol, the following selections are available:

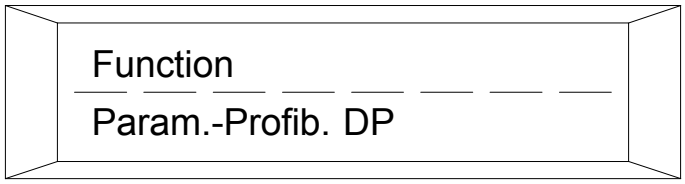
- Profibus DP
- ASCII
- ASCII2w

The Instrument Address using Profibus DP may be entered using the following display or by Profibus communication on the bus.



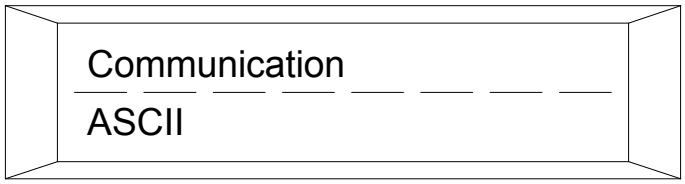
The Instrument Address must be entered using 3-digits (i.e. 005). Allowable address range is 0-126 and the default value is 126.

The following additional display is for information purposes only and no further parameter selections or settings are possible.

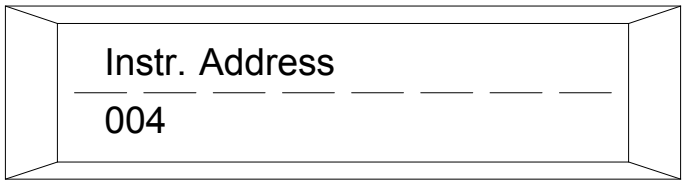


6.15.3.2 ASCII / ASCII2w

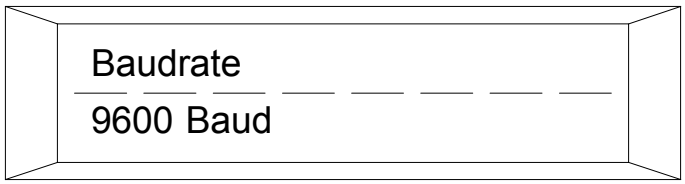
Selecting ASCII communications protocol will show the following display:



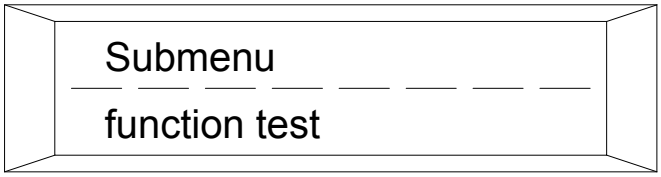
The Instrument Address is defined using the following display. If multiple instruments are connected to a single bus (i.e. ASCII-Protocol RS485), each instrument must have a unique address in the range of 0 - 99.



ASCII protocol also requires a baud-rate selection shown in the following display. Available Baud Rate selections are 110-28800 baud.



6.16 Submenu Function Test Numeric entry only I_{out} and F_{out}



The functional test submenu provides thirteen test functions which can be used to test the instrument independent of the instantaneous flow rate. These test functions are the following:

I_{Out}, RAM (ASIC), NVRAM, EPROM (Program), EEPROM, External EEPROM, Terminals P7/G2, switch S201, display, pulse output, Terminals X1/G2, Simulation and Test Mode.

During the functional test the converter is off-line (current and pulse output are no longer related to the flow). The individual test routines may be selected with STEP and DATA button.

The functional test is ended by pressing the C/CE button.

Select **I_{Out}**, press ENTER and enter the desired value in mA. Check entered value at terminals + and – with a digital voltmeter or with the process instruments connected to the output.

NOTE
The converter does not automatically return to data logging mode. To close the function press the C/CE button.

Select **RAM(ASIC)** and press ENTER. The converter automatically tests RAM and displays its diagnosis.

Select **NVRAM** and press ENTER. The converter automatically tests the NV-RAM and displays its diagnosis.

Select **EPROM(Program)** and press ENTER. The converter automatically tests its **EPROM** and displays its diagnosis.

Select **EEPROM** and press ENTER. The converter automatically tests its **EEPROM** and displays its diagnosis .

Select **Terminals P7/G2** and press ENTER. The contact can be toggled on and off with STEP or DATA buttons. Monitor continuity across terminals P7 & G2 with an ohmmeter.

Select **S201** and press ENTER. The on/off status of switch S201 and jumpers BR201 - BR205 is identified by an asterisk (*) on the display when the Code Number has been entered.

Select **Pulse Output** and press ENTER. A frequency of 1 Hz with a 500 ms pulse width is applied to the pulse output.

Select **Display** and press ENTER. The converter writes the numbers 0 - 9 and the letters A - F in the 1st and 2nd line of the display. This procedure checks the control of the display's dot matrix.

Terminal X1/G2: Select **External zero return** and press ENTER. Apply 24 VDC across terminals X1 and G2 (positive to X1), the converter indicates on/off.

Terminal X1/G2: Select **Totalizer reset** and press ENTER. Apply 24 VDC across terminals X1 and G2 (positive to X1), the converter indicates on/off.

NOTE
The converter does not automatically return to data logging mode. To close the function press the C/CE button.

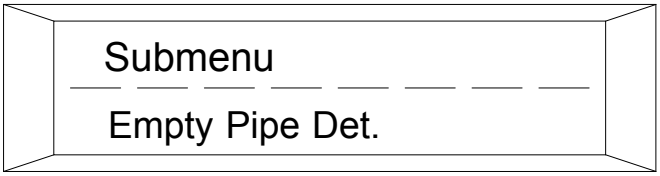
Select **Simulation** and press ENTER. Use the STEP or DATA buttons to turn simulation on or off. When the simulation is turned on, press C/CE to return to process metering. Any desired flowrate value in steps of 1% may be set using the STEP(+) and DATA (-) buttons. The output values correspond to the values entered. The message **Simulation** alternates with the totalizer value on the 2nd line of the display. Once the simulation test is finished, the **Simulation** mode should be turned off.

Selecting **Test Mode** and setting it to "on" enables the converter to be checked with a flow simulator.

NOTE
The following is for converters with the optional HART Protocol only.

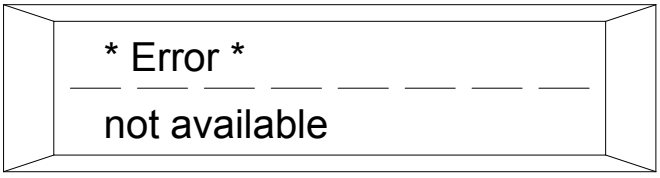
If the HART Protocol option for the converter has been specified, a test parameter is available to check for proper HART communication. Select **HART-Command** and press ENTER. Any HART command sent to the converter will then be shown on the display.

6.17 Submenu "Detector empty pipe"

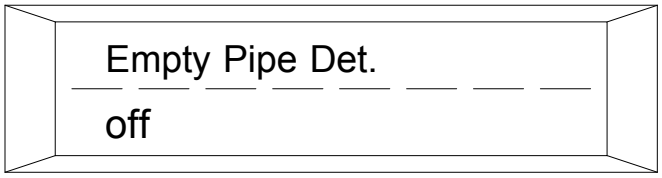


The submenu "Empty Pipe Det." contains all setting programs for this option.

If this option is not installed in the converter, the following message is displayed:



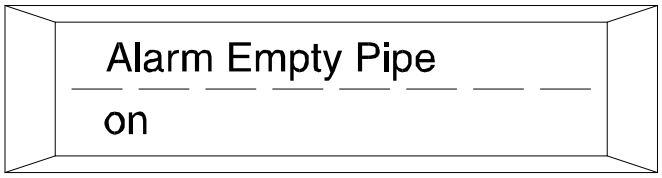
6.17.1 Detector on/off
Tabular entry



Use STEP and DATA buttons to select the on or off mode for the empty pipe detector.

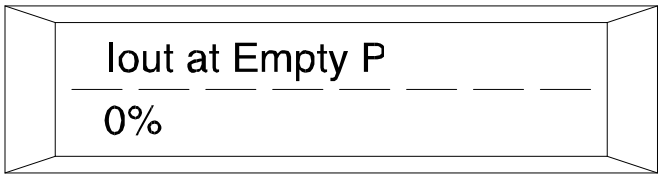
An empty pipe condition with the detector empty pipe "on", will cause the current output to be set to the value selected in the "Iout at Empty Pipe" menu and the will suspend the counting of the totalizer. If enabled in the "Alarm Empty Pipe " menu below, the alarm output is actuated and the message "Empty pipe" and "Error 0" appears in the display. When the detector is in the **on** mode and the alarm is disabled with an empty pipe condition, the detector must be adjusted to the prevailing conditions, i.e. must be adjusted at a full pipe condition. Select parameter "Adjustment detector empty pipe " in Section 6.17.5.

6.17.2 Alarm Empty Pipe
Tabular Entry



This menu parameter allows the empty pipe detector to be enabled or disabled by selecting **on** or **off** from the menu.

6.17.3 Iout at Empty Pipe
Tabular

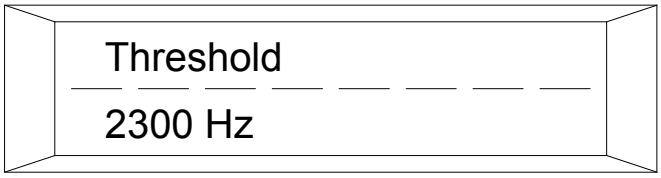


This menu selects the desired output current value if an empty pipe detector alarm condition is detected. Selection parameters are 0% of Range, 130% of Range or 3.8 mA.

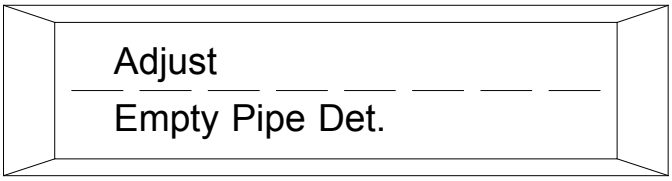
6.17.4 Threshold
Numeric entry

The sensitivity is set by changing the threshold.

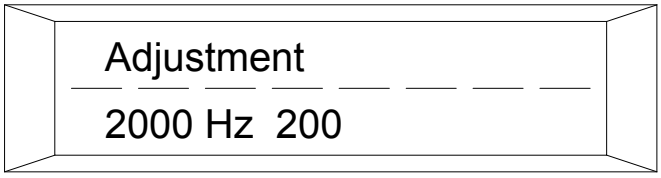
If with empty pipe condition the value 2300 Hz is not exceeded, the threshold can be reduced to 2200 Hz.



6.17.5 Empty Pipe Detector Adjustment
Numeric entry

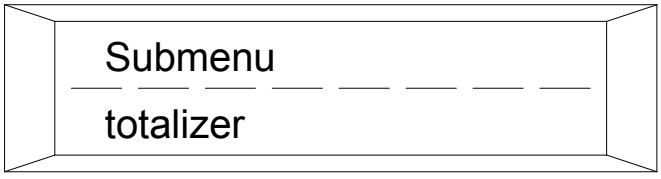


The adjustment value is displayed in the 2nd line. The pipe line must be full. With with the STEP or DATA button set adjustment value to +2000 Hz ± 25 Hz. Now drain the pipe and note the value. The value must be above the set 2300 Hz threshold.



NOTE
For proper function of "Detector empty pipe" the minimum conductivity of the fluid must be 20 µS/cm.

6.18 Submenu Totalizer

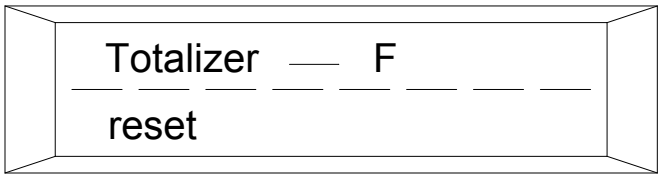


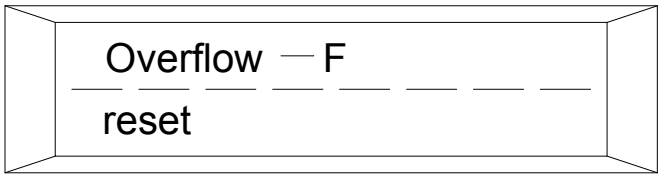
This submenu contains the following functions:

- Totalizer value forward or reverse flow and reset of overflows (Refer to Section 6.19.1)
- Totalizer functions (Refer to Section 6.19.2)
- Multiplex display (Refer to Section 6.19.3)

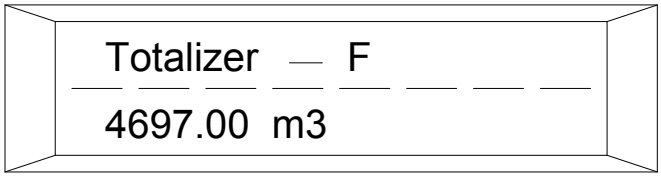
6.18.1 Totalizer Value Reset,Overflows, Presetting of Totalizer and Tabular/Numeric entry

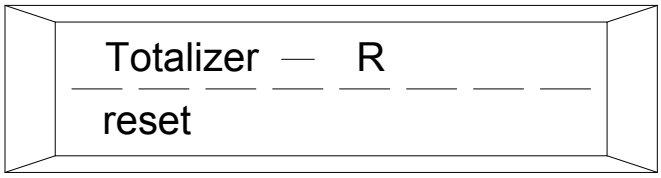
The Totalizers and overflow registers for each flow direction can be individually reset by pressing ENTER. First the overflow registers are reset (if available) and, after pressing ENTER again, the Totalizers are also reset. If the Totalizers have overflowed, the flow direction arrow and the units in the display will be flashing. The software allows up to 250 overflows of the internal Totalizer. At an overflow (Totalizer value > 10,000,000 units), the Totalizer will be reset and the overflow Totalizer will be incremented by one. If more than 250 overflows are counted, the message "Overflows > 250" appears in the display.

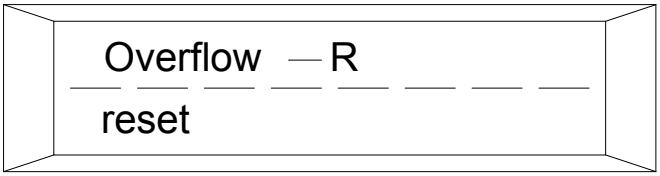




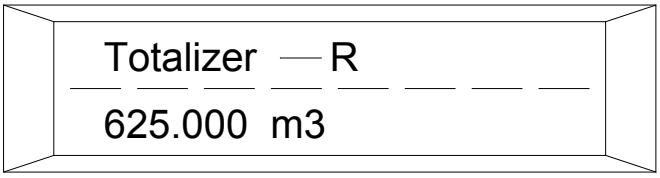
The Totalizer for "Forward flow" direction can be preset to an arbitrary value. If the converter is replaced, the new converter can be preset with the old converter's Totalizer value. Initiate the parameter (Totalizer >F/<R) with the arrow keys. The 2nd line of the display shows the present Totalizer value. After pressing ENTER, the previous Totalizer value may be entered and, by pressing ENTER again, will be accepted by the electronics.







The Totalizer for "Reverse flow" direction can also be preset, for entry see "Totalizer forward" flow direction.



Example calculation for overflow

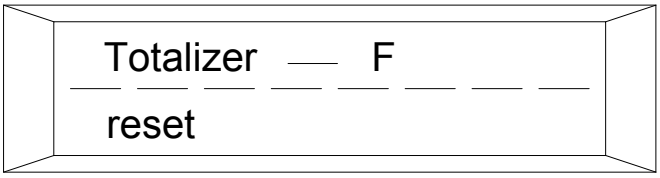
Overflow 012

12 x	10,000,000	units
=	120,000,000	units
+	23,455	actual totalizer value
	120,023,455	units

Max. Totalizer value

250 x	10,000,000	units
=	2,500,000,000	units

If the function "External totalizer reset" is selected, the totalizer and overflow values are reset via contacts X1 & G2. The following message is then displayed:

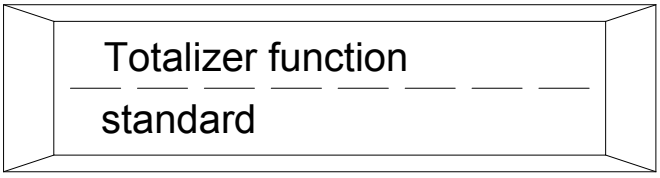


6.18.2 Totalizer Function Tabular Entry

Two operating modes are possible with the flow totalizer:

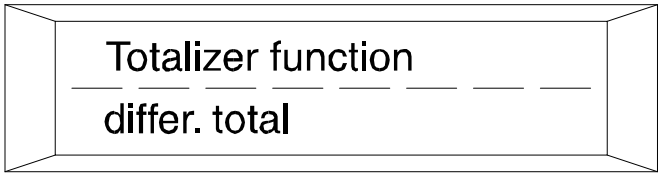
- Standard totalizer
- Differential totalizer.

6.18.2.1 Totalizer Function Standard



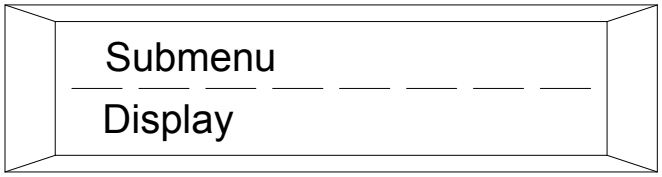
The "Totalizer Function Standard" integrates the flow rate pulse for forward or reverse flow in two different totalizers. If only the forward flow direction is selected, only the forward flow Totalizer counts. The selection is made with the STEP and DATA buttons and will be accepted with ENTER.

6.18.2.2 Totalizer Function Differential Totalizer

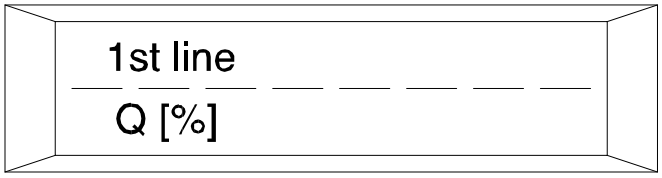


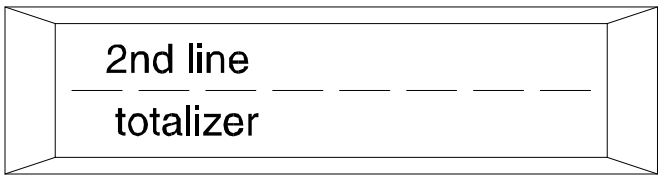
For differential totalization of both flow directions only one common internal totalizer is available. During forward flow, the Totalizer value is incremented. During reverse flow, the Totalizer value is decremented. The passive pulse output is not affected by this setting.

6.19 Submenu Display Tabular Entry



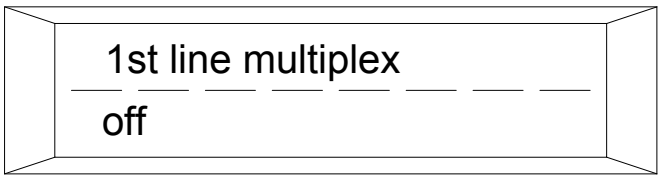
The Submenu Display parameters can be configured by selecting the appropriate parameters listed below and entering the desired information. The display may be configured so that any available information may be placed on either first or second line of the display.





In addition, a **multiplex feature** is available which can alternate any of two sets of parameters on either line of the display. This feature can be activated by turning ON the line(s) of the display desired for multiplexing and then selecting the desired parameter to be shown. The display will alternate between the display value and the multiplex value approximately every 7 seconds.

Press ENTER at the Submenu Display and press the STEP or DATA buttons until the following screen appears:



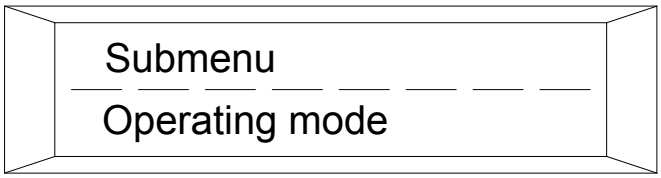
Press ENTER and the following parameters may be selected for the first line of the display by pressing the STEP or DATA buttons:

- **Q [%]** - flow rate as a percentage of range setting
- **Q [unit]** - flow rate in actual selected units
- **Bargraph** - left to right graphic representation of flow rate as a percentage of range, with numeric percentage to the right of the bar graph
- **Totalizer** - totalized flow for the direction currently indicated on the flow rate display or forward direction only
- **off**

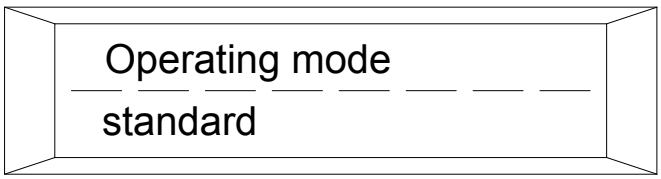
If desired, a multiplexed parameter for the second display line can also be chosen from the above list by selecting from the "2nd line multiplex" menu.

6.20 Submenu Operating Mode Tabular Entry

This submenu enables selection of several operating parameters



6.20.1 Operating Mode Tabular Entry



Selection of one of the two operating modes can be made using the arrow keys.

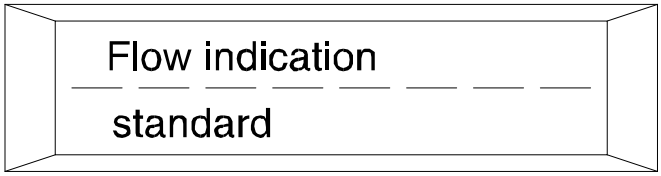
Select **"Standard"** operating mode for continuous flow measurment.

Select **"Fast"** operating mode for short-time dispensing < 3 sec. and for piston pump operations, when the converter is equipped with a higher excitation frequency .

In the **"Fast"** operating mode an improved reproducibilty during a shorter measuring time is achieved by more rapid data update.

Pressing the ENTER key accepts the entry.

6.20.2 Flow Indication Tabular entry

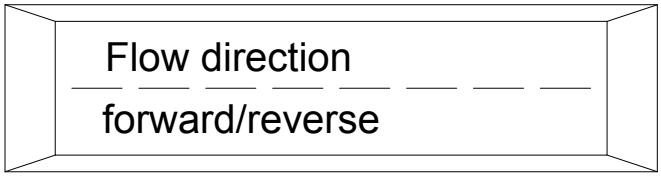


The arrow on the primary indicates the flow direction and defines the meter's forward-flow direction. If the forward direction is displayed when the flow is in the reverse direction, the direction may be interchanged using the Flow Indication selection (shown above) by selecting "Opposite".

With one of the arrow keys select the appropriate entry and press ENTER to accept.

6.20.3 Flow Direction Tabular Entry

This menu allows flow to be indicated in either forward and reverse directions or in the forward direction only.

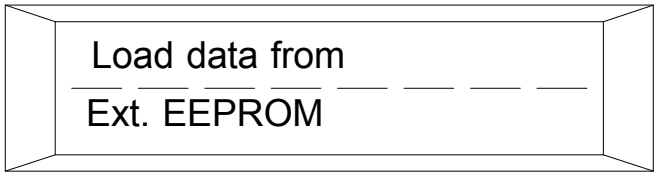


After pressing ENTER at the Submenu Operating Mode, scroll to the Flow Direction menu using either the STEP or DATA buttons.

Pressing ENTER allows changing of the "Flow Direction" setting by using the STEP or DATA buttons.

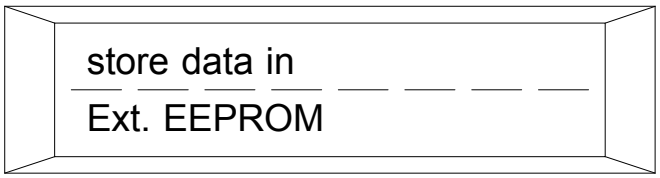
6.21 Load Data From External EEPROM

When a converter is replaced, the calibration data is automatically uploaded from the external EEPROM when the supply power is turned on. It is also possible to upload the data manually at any time by making this menu selection.



6.22 Store Data In External EEPROM

This menu selection must be made after the initial start-up at the installation site to copy the actual measurement parameters and meter location-specific data into the external EEPROM.

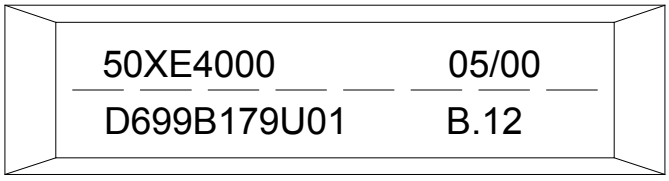


If any parameter is subsequently changed and should be saved, this procedure must be repeated in order to save the revised parameter in the EEPROM.

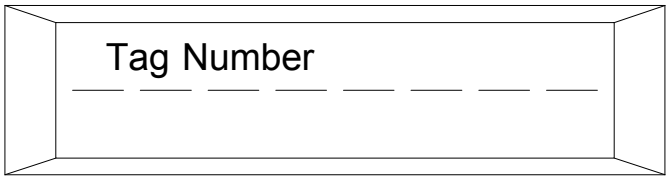
6.23 Software Version

The converter's model number is displayed on the first line of the display along with the release-date of the firmware. The second line of the display shows the firmware's part number and the firmware revision level.

This is a read-only parameter and cannot be changed. A typical display is shown below.



6.24 Tag Number Numeric Entry



Pressing ENTER allows the entry of an alphanumeric Tag Number for meter-location identification or the Instrument Address for Profibus Communication. The number may be up to 16 characters long and may consist of numbers and upper/lower case letters.

Once ENTER has been pressed, the characters are selected using the DATA button and scroll in the following order:

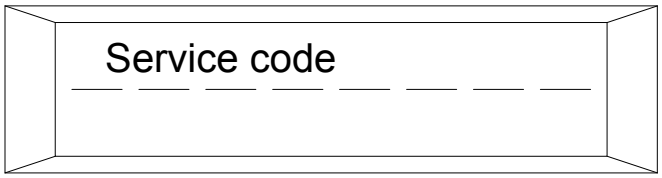
- lower-case letters
- numbers 0 through 9
- upper-case letters
- symbols - / : . * _

Once the desired character is reached, press the STEP button to shift to the next position and select the desired character for that position. If the desired character is inadvertantly passed, it is not possible to "back-up"; continue scrolling until the character appears again.

Once all the desired characters have been entered, press ENTER to accept the entries and exit the menu.

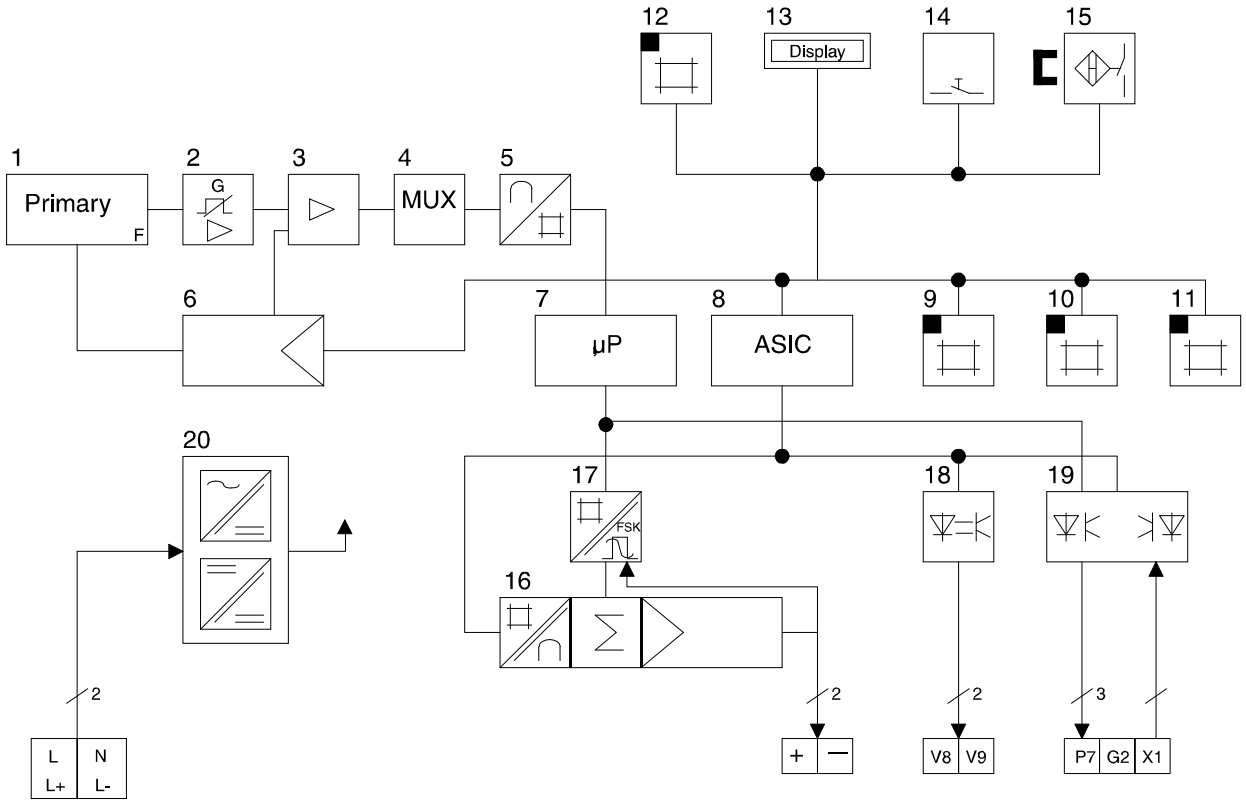
6.25 Service Code Number Numeric entry

The code number parameter provides a means to access the calibration parameters. Available for use only by ABB Service personnel.



In the event the Program Protection code is forgotten, entry of the Service Code will reveal the number.

7.0 Block Diagram



1. Primary
2. Input signal amplifier and empty pipe cut-off
3. Signal processing
4. Signal multiplexer
5. Analog/Digital converter
6. Driver/current regulator
7. Processor
8. Digital ASIC
9. Program memory
10. Parameter memory
11. Memory for totalizer values
12. Calibration data memory
13. 2x16-digit display
14. Operator buttons
15. Sensors for external operation
16. Current output
17. HART Interface
18. Scaled pulse output optocoupler
19. Configurable INPUT and OUTPUT OPTO
20. Power supply unit AC/DC or DC/DC

FIGURE 7-1. BLOCK DIAGRAM OF COPA-XE

8.0 Maintenance

8.1 General

Except for an occasional performance verification check, there is no required routine maintenance for the Model 10D1475. The flowmeter body is of all welded construction. In the event a malfunction occurs in the primary, the meter body must be replaced. The integrally mounted signal converter assembly is removable for maintenance or replacement purposes.

A Repair/Exchange Program to facilitate replacement of a defective meter or converter is available from the manufacturer. If the equipment is beyond the warranty limit, a fixed price will be charged under this program for replacement of defective equipment with appropriate credit issued when the repairable unit is received by the manufacturer (charges prepaid). The equipment available under this program is as follows:

- the complete flowmeter with integrally mounted signal converter and installation hardware
- the flowmeter, without the signal converter
- the signal converter assembly

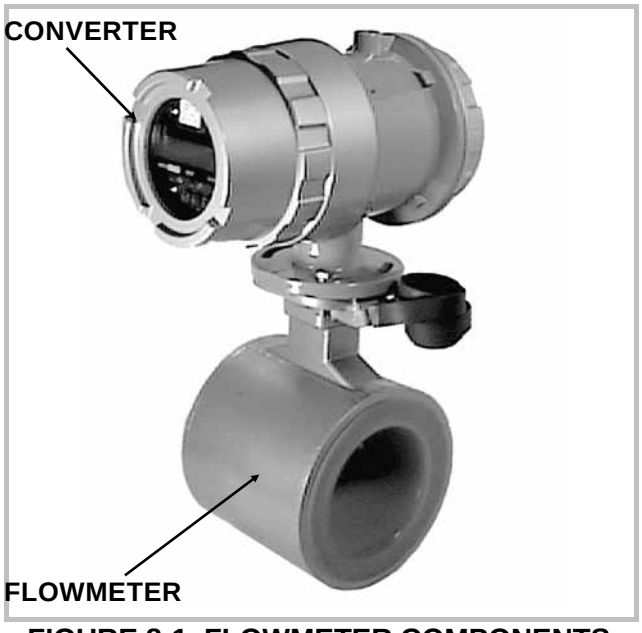


FIGURE 8-1. FLOWMETER COMPONENTS

The signal converter uses complex electronic circuit components. Generally, due to the complexity of troubleshooting integrated circuit devices, maintenance beyond the assembly level is not recommended. Also, caution must be used when connecting test probes, as even a momentary accidental short circuit may damage or destroy an integrated circuit device. Therefore, only trained electronic technicians who are familiar with CMOS technology and have a background in logic and gating circuitry should be permitted to service this equipment.

In the event of a malfunction in the signal converter assembly, a replacement electronics assembly can be easily substituted for the defective assembly, thereby minimizing system down-time (see Section 8-4). Servicing by substitution of spare assemblies is generally more economical than stocking a large variety of IC chips, transistors, diodes, etc. Also, test equipment requirements and the level of technical expertise necessary are minimized. Should any doubt arise regarding the proper procedure for solving an existing problem, it is suggested that the user contact the local factory service facility for technical assistance.

CAUTION

Some of the IC devices used in the signal converter are static sensitive and may be damaged by improper handling. When adjusting or servicing the signal converter, use of a grounded wrist strap is recommended to prevent inadvertant damage to the integral solid state circuitry.

WARNING

All flowmeters and/or signal converters being returned to the manufacturer for repair must be free of any hazardous materials (acids, alkalis, solvents, etc.). A Material Safety Data Sheet (MSDS) for <u>all process liquids</u> must accompany returned equipment. Contact the manufacturer for authorization prior to returning equipment.

When communicating with the manufacturer regarding the replacement of a complete meter (with integrally mounted Converter), the meter body, or the signal converter, it is important to refer to the complete instrument serial number to assure that the correct replacement will be supplied. The subject information is provided on the manufacturing specification sheet supplied with the magnetic flowmeter as well as on the instrument data tags.

8.2 Error Codes

Error Code	Detected Error Condition	Corrective Measures
0	Pipeline not full	Open shut-off devices; fill pipeline; adjust Empty Pipe Detector
1	A/D-Converter	Reduce flowrate, throttle shut off devices.
2	Positive or negative reference too	Check connection board and converter.
3	small Flowrate greater than 130%.	Reduce flowrate, change flow range
4	External zero return contact activated	Zero return activated by pump or field contact
5	RAM Defective 1. Error 5 appears on display 2. Error 5 appears only in Error Register	Program must be reinitiallized Contact FactoryService Information: Corrupted data in RAM, converter automatically executes a reset and uploads data from EEPROM.
7	Positive reference too large	Check signal cable and magnetic field excitation
8	Negative reference too large.	Check signal cable and magnetic field excitation
6	Error > F	Reset forward totalizer or preset new values in totalizer
	Error totalizer < R	Reset reverse totalizer or preset new values in totalizer
	Error totalizer	Forward, reverse or difference totalizer defective Reset forward/reverse totalizer
	Excitation frequency defective	Check line frequency for Supply Power 50/60 Hz or for AC/DC Supply Power Error in the Digital-Signal board
	MAX-Alarm limit value	Reduce flowrate
9	MIN-Alarm limit value	Increase flowrate
	Primary data invalid	The data for the primary in the external EEPROM are invalid. Compare data in submenu "Primary" with data listed on the Instrument Tag.
A B C		If the values agree, use "Store Primary" to reset the error message. If the data are not identical, then it is necessary to first reenter the primary data and then complete by using "Store Primary". Contact Factory Service.
10	Entry >1.00 QmaxDN >10 m/s	Reduce Qmax range
11	Entry <0.05 QmaxDN <0.5 m/s.	Increase Qmax range.
16	Entry >10 % Low Flow Cutoff	Reduce entry value
17	Entry < 0 % Low Flow Cutoff.	Increase entry value.
20	Entry >100 s Damping	Reduce entry value
21	Entry <0.5 s Damping	Increase entry value, (as a function of the excitation frequency)
22	Entry >99 Instrument Address.	Reduce entry value.
38	Entry >1000 Pulses/Unit	Reduce entry value
39	Entry < 0.001 Pulses/Unit	Increase entry value
40	Max. pulse frequency exceeded, scaled pulse output Pulse factor (5 kHz)	
41	Min. pulse frequency below limit <0.00016 Hz.	Reduce pulse factor Increase pulse factor
42	Entry >2000 ms Pulse Width	Reduce entry value
43	Entry <0.1 ms Pulse Width	Increase entry value
44	Entry >5.0 g/cm3 Density	Reduce entry value
45	Entry <0.01 g/cm3 Density	Increase entry value
46	Entry too large	Reduce pulse width entry value
54	Primary Zero > 50 Hz	Check ground and ground signals. Adjustment can be made if the flowmeter primary is filled with fluid and the flowrate is zero.
56	Entry >3000 Threshold Empty Pipe Detector.	Reduce entry value, check adjust "Empty Pipe Detector".
74/76	Entry > 130 % MAX - or MIN-Alarm	Reduce entry value
91	Data in EEPROM corrupted	Data in internal EEPROM invalid, for corrective measures see Error Code 5.
92	Data in ext. EEPROM corrupted	Data (e.g. Qmax, Damping) in external EEPROM invalid, access possible. Occurs when function "Store data in ext. EEPROM" was not called. The error message can be cleared using the function "Store data in ext. EEPROM"
93	Ext. EEPROM corrupted or not installed	No access possible, component defective. If the component is not installed, then it is necessary that the ext. EEPROM which belongs to the flowmeter primary be installed.
94	Ext. EEPROM version incorrect	The data base is not correct for the present software version. Calling the function "Load data from ext. EEPROM" initiates an automatic update of the external data. The function "Store data in ext. EEPROM" clears the error message.
95	External Primary Data incorrect	See Error Code C
96	EEPROM version incorrect	Data base in the EEPROM has a different version than the installed software. Clear the error by calling the function "Update".
97	Primary incorrect	The flowmeter primary data in the internal EEPROM are invalid. The error can be cleared by calling the function "Load Primary", (See Error Code C).
98	EEPROM corrupted or not installed	No access possible, component defective. If the component is not installed. then it is necessary that the ext. EEPROM which belongs to the flowmeter primary be installed.
99	Entry too large Entry too small	Reduce entry value Increase entry value

8.3 System Troubleshooting

NOTE
Due to normal product improvement cycles, illustrations shown in this section will be similar to but may not be identical to your equipment.

In the event faulty operation of the magnetic flowmeter is evident, the following procedure can be used as a guide to isolate the malfunctioning device to either the flowmeter or the signal converter. A standard multimeter and an oscilloscope are suitable for making the test measurements.

WARNING
ELECTRICAL SHOCK HAZARD. Equipment powered by an ac line voltage presents a potential electric shock hazard. Servicing of the magnetic flowmeter or signal converter should only be attempted by a qualified electronics technician.

1. If it appears that the meter is not operating properly, proceed as follows:

a) Remove front & rear access covers from the converter housing by turning them counter-clockwise until they separate from the housing.

b) Inspect for evidence of water entry in the connection box and converter electronics compartment.

If there is any evidence of water entry, de-energize system at power source. Inspect conduit seals and cover gaskets for possible source of water entry. Replace the seals and/or gaskets if evidence of water entry is indicated. Allow interior of converter housing to dry completely before restoring system power.

2. Possible causes of erroneous flow rate indication are:

- incorrect grounding
- excessive noise due to a heavy slurry process or a non-homogeneous process
- loose or intermittent wiring
- partially empty or empty meter pipe
- excess air entrained in process liquid

8.4 Static Test

If improper operation of the magnetic flowmeter is suspected, the following resistance measurements can be made to establish whether an electrical malfunction has occurred. A standard multimeter is suitable for making the resistance checks. These measurements can be made at the coil connector located on the top circuit board assembly of the converter electronics assembly.

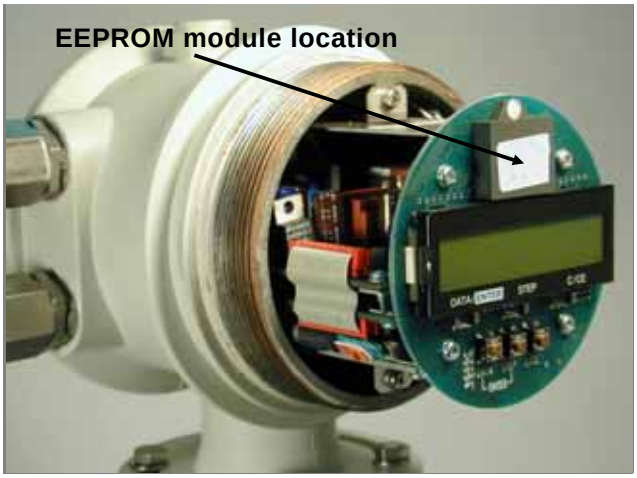


FIGURE 8-2. EEPROM MODULE LOCATION

WARNING
ELECTRICAL SHOCK HAZARD. Equipment that operates from ac line voltage constitutes a potential electric shock hazard to the user. Make certain that the system power is disconnected before making the following ohmmeter checks.

8.4.1 Magnet Coil Check

There are two magnet coils in the meter that are connected in a series arrangement. The coil leads are brought up to a 2-pin connector on the top printed circuit board assembly in the converter housing. To gain access to this board assembly, remove the Converter's front cover (display cover) by turning the cover counter-clockwise until it disengages from the housing. The coil-connection header is located on the right edge (when facing the display) of the top board assembly (refer to FIGURE 8-3).

Before making resistance measurements, verify that the system power service has been de-energized. Remove the electronics housing cover to obtain access to the Primary board.

WARNING
Inside edges of the converter housing casting may be sharp! Use recommended tools, not fingers, to disconnect plugs from the connectors, otherwise injury may result!

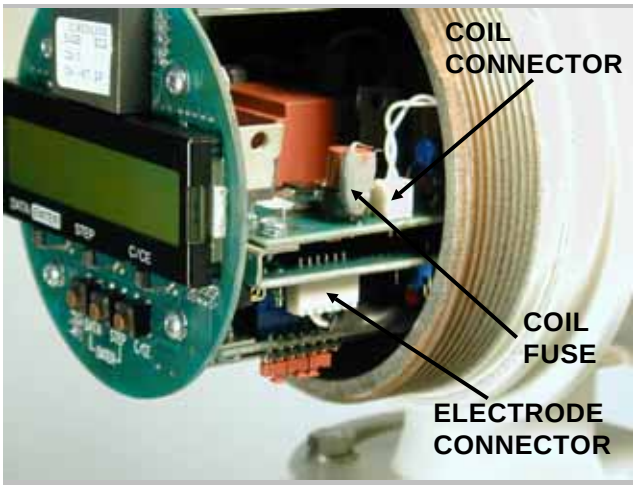


FIGURE 8-3. INTERFACE CONNECTORS

1) Set the ohmmeter to its lowest range; e.g., R x 1.

2) Carefully disconnect the 2-terminal coil connector from the printed circuit board by using needle-nose pliers to grasp the sides of the plug and pulling the plug upward, away from the printed circuit board, and out of the receptacle.

3) Connect the ohmmeter test leads to the plug terminals inside the plug housing (not the header terminals on the board assembly). It may be necessary to insert small wires into the plug holes to insure reliable contact of the ohmmeter leads to the terminals. The value displayed should correspond to the value (±20%) indicated in Table 8-1.

If proper coil resistance is measured, it can be assumed that the magnet coils are functional. If the measurement indicates that either or both coils are "open" (infinite resistance), or shorted (zero resistance), the magnetic flowmeter must be replaced.

4) Set the Ohmmeter to its highest range (R x 10,000) and measure from each coil-connection plug terminal to the converter body (case ground). The resistance reading should be infinite. If this measurement is less than 100K ohms, the meter is defective and must be replaced.

If all measurements appear normal, the coil connector may be reconnected (observe the proper plug orientation, the plug is mechanically "keyed" to the receptacle). After the coil connector is reconnected to the printed circuit board, replace the converter housing cover and return the meter to service.

TABLE 8-1. PRIMARY COIL RESISTANCE

Meter Size		Total Coil Resistance
inch	mm	Ohms (± 20%)
1/10	3	18
5/32	4	18
1/4	6	18
3/8	10	18
1/2	15	49
1	25	56
1 1/2	40	49
2	50	46
3	80	46
4	100	58

8.4.2 Electrode Check

The electrode check is essentially a resistance measurement that can be made to establish that a short (or high resistance leakage path) does not exist between one, or both, electrodes and the meter body.

Before proceeding, verify that system power has been de-energized. To perform this test, the meter must be removed from the pipeline and the meter liner "wiped" dry.

When the meter liner has been thoroughly dried, proceed as follows:

1) Remove cover from the converter housing electronics compartment.

2) Place ohmmeter on highest available range (for example, R x 10,000).

3) Locate the 6-terminal electrode connector on the underside of the bottom printed circuit board assembly in the converter electronics housing. FIGURE 8-3 shows the location of this connector. Carefully remove the connector from the printed circuit board by using needle-nose pliers to grasp the plug by its sides and pulling the plug out of the receptacle..

4) Connect the ohmmeter "minus" lead to an unpainted part of the converter housing (ground) and the "plus" lead to plug connector pin 1. Plug pin numbers can be found marked

on the circuit board next to the electrode connector receptacle as shown in FIGURE 8-4. The reading on the ohmmeter should be infinite. If any resistance is measured, the meter is defective and must be replaced.

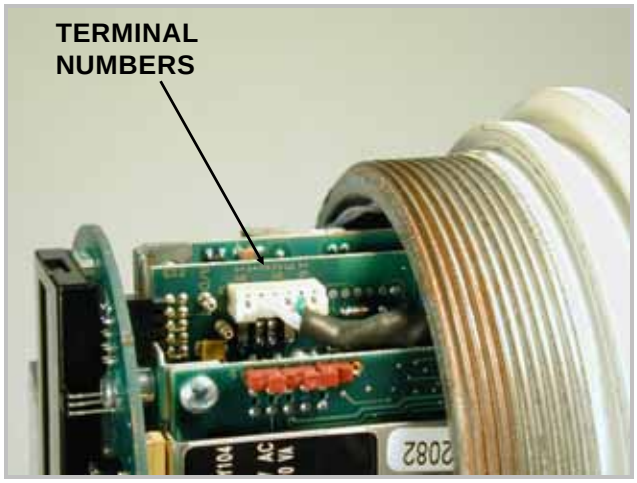


FIGURE 8-4. ELECTRODE PIN NUMBERS

5) Check the other electrode by connecting the ohmmeter "plus" lead to plug connector pin 2. This reading must also be infinite. If any resistance is measured, the meter is defective and must be replaced.

6) If measurement of both electrodes indicates an infinite resistance reading, the meter may then be returned to service. Reconnect the electrode connector (observe the proper plug orientation, the plug is mechanically "keyed" to the receptacle) and replace the signal converter cover. Return the meter to normal operation.

CAUTION

Use care when reconnecting the converter coil and electrode interface connections to insure that the plugs are in proper alignment with the pins of the headers. If these connectors do not mate correctly, the signal converter will be inoperable and could be damaged when power is applied.

8.5 Converter Electronics Replacement

All parameter values are stored in the main EEPROM located on the display board assembly (Refer to Figures 2-2 & 8-2). If a converter replacement is required, remove the EEPROM from the original electronics and insert it into the replacement electronics. Detailed instructions follow below. Follow "Load" or "Store" data menu procedures (whichever is applicable) detailed in Section 5-5, 6.21 & 6.22. On power-up, all data will be accepted and need not be entered again.

NOTE

After all parameters have been set and entered they should be saved in the external EEPROM, refer to the "Load" & "Store" menu commands at the end of Section 5.5 & Chapter 6.0 for more details.

WARNING

Inside edges of the converter housing casting may be sharp! Use recommended tools, not fingers, to disconnect plugs from the connectors, otherwise injury may result!

In the event it becomes necessary to replace the converter electronics assembly and/or fuses, the following procedure may be used:

1) Disconnect all power to the instrument.

2) Using needle-nose pliers, remove the coil and electrode connectors from the electronics assembly (see FIGURE 8-3).

3) Remove the I/O connector, shown in FIGURE 8-5, using needle-nose pliers.

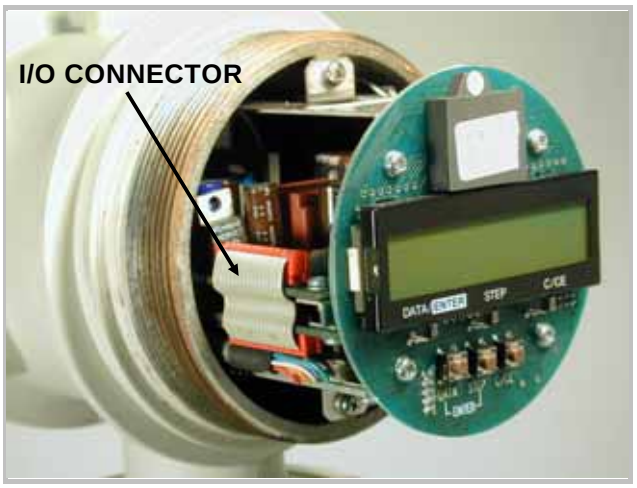


FIGURE 8-5. I/O CONNECTOR

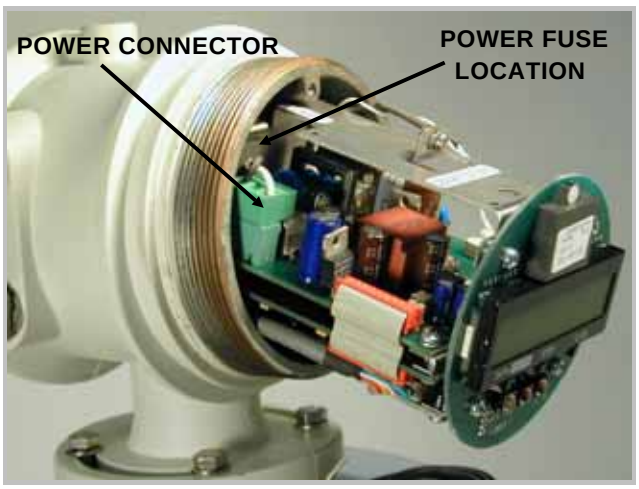


FIGURE 8-7. POWER CONNECTION

4) Remove the two electronics assembly mounting screws to disconnect the electronics assembly from the converter housing (refer to FIGURE 8-6). To protect against loss of the screws, the screws are "captured" and will remain in the mounting ears.

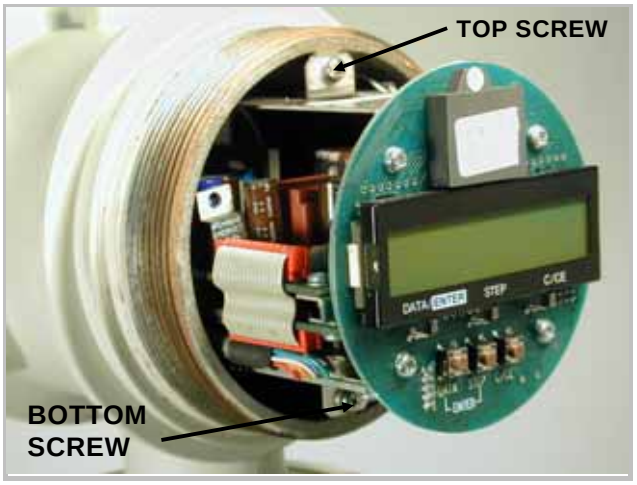


FIGURE 8-6. MOUNTING SCREWS

5) Carefully pull the electronics assembly forward until the power connector and fuses (shown in FIGURE 8-7) are visible.

6) Hold the electronics assembly and use needle-nose pliers to carefully pull the power connector out of its housing.

7) Remove the electronics assembly from the converter housing.

8) If replacing the electronics assembly, remove the EEPROM module (Refer to FIGURE 8-2) and reinstall it on the replacement electronics assembly. Go to the "Load data from external EEPROM" menu (refer to Section 6.21) and upload programmed data.

9) To install the replacement electronics assembly, reverse the above procedure.

9.0 Parts List

9.1 Grounding Rings

TABLE 9-1. ANSI CLASS 150 GROUNDING RINGS

Meter Size		F&P Part Number*	Part Number Suffix (Material)			
mm	inch		316 sst	Hast. "C"	Hast. "B"	Alloy 20
3 - 15	1/10 - 1/2	800D508	U01	U09	U34	U27
25	1	800D508	U02	U10	U18	U24
40	1½	800D508	U03	U11	U35	U28
50	2	800D508	U04	U12	U20	---
50	2	800D575	---	---	---	U07
80	3	800D508	U05	U13	U36	---
80	3	800D575	---	---	---	U08
100	4	800D508	U06	U14	U37	---
100	4	800D575	---	---	---	U09

* To complete the part number, add suffix from table; e.g., 800D508U02 for ordering one set (2) of 25 mm (1 in.) 316 sst grounding rings.

9.2 Gaskets

TABLE 9-2. GASKETS FOR ANSI CLASS 150 GROUNDING RINGS (2 Required)

KLINGER SIL C-4401--------Part Number 333J089___*
TEFLON----------Part Number 333J092___*

	Meter Size					
Flange Rating ANSI CL150	**1 - 15 mm**	**25 mm**	**40 mm**	**50 mm**	**80 mm**	**100mm**
	1/25 - 1/2inch	**1 inch**	**1½ inch**	**2 inch**	**3 inch**	**4 inch**
Suffix	U01	U10	U15	U19	U22	U29

* To complete the part number, add suffix from table; e.g., 333J089U10 for 25mm (1 inch) meter with KLINGER SIL gaskets.

For applications other than ANSI CLASS 150 Flanges contact the manufacturer.

TABLE 9-3. GASKETS FOR METER BODY (2 required)

KLINGER SIL C-4401--------Part Number 333J089___*
TEFLON----------Part Number 333J092___*

Flange Rating	Meter Size						
	3 - 10 mm	15 mm	25 mm	40 mm	50 mm	80 mm	100 mm
	1/10 - 3/8 in	1/2 inch	1 inch	1 1/2 inch	2 inch	3 inch	4 inch
ANSI CL 150	U01	U01	U10	U15	U19	U22	U29
ANSI CL 300	U02	U02	U11	U16	U25	U26	U30

* To complete the part number, add suffix from table; e.g., 333J089U10 for 25mm (1 inch) meter with KLINGER SIL gaskets.

9.3 Adapter Sleeves

TABLE 9-4. ADAPTER SLEEVE

Part Number 430E020___ *

Flange Rating	Meter Size						
	3 - 10 mm	15 mm	25 mm	40 mm	50 mm	80 mm	100 mm
	1/10 - 3/8 in	1/2 inch	1 inch	1 1/2 inch	2 inch	3 inch	4 inch
ANSI CL 150	N/R	N/R	N/R	N/R	U04	U04	U05
ANSI CL 300	U01	U02	U03	U03	U06	U07	U07

* To complete the part number, add suffix from table; e.g., 430E020U03 for 25mm (1 inch) meter with ANSI CL 300 pressure rating.

N/R = None Required

9.4 Studs & Nuts

TABLE 9-5. STUDS & NUTS (1 Required)

STEEL----------Part Number 614B650___ *

Flange Rating	Meter Size						
	3 - 10 mm	15 mm	25 mm	40 mm	50 mm	80 mm	100 mm
	1/10 - 3/8 in	1/2 inch	1 inch	1 1/2 inch	2 inch	3 inch	4 inch
ANSI CL 150	U01	U01	U01	U04	U07	U09	U14
ANSI CL 300	U01	U01	U03	U05	U08	U10	U15

* To complete the part number, add suffix from table; e.g., 614B650U01 for mounting hardware for 25mm (1 inch) meter with ANSI CL 150 pressure rating meter with KLINGER SIL gaskets.

9.5 Cable Entry Seals

9.5.1 Conduit Entry Seal

P/N 614B912U01 - ANSI Flanges, for use with 1/2 NPT conduit seals (Provides seals for one entry port only - 2 kits required)

9.5.2 Cable Entry Seal

P/N D150A004U01 - For wiring cable without conduit using Cable Seal fittings (Provides seals for one entry port only - 2 kits required)

P/N 1D150Z1053 - (Dust Cover - 2 required)

9.6 Magnetic Programming Stick

P/N D614K001U01

9.7 Fuses

9.7.1 Power

115/120 VAC Model, 1/4 Amp 5 x 20mm Slo-Blo - **P/N D151B001U03**
230/240 VAC Model, 1/8 Amp 5 x 20mm Slo-Blo - **P/N D151B001U08**
24VDC Model, 1/2 Amp 5 x 20mm Slo-Blo - **P/N D151B025U05**

9.7.2 Coil-Circuit Fuse

Type TR5, Slow-Blow, 160 mA **P/N 151B058U03**

Refer to Section 8.5 and Figures 8-3 & 8-7 for fuse access and location.

9.8 XE Converter Display

Display Replacement Kit with Instructions **P/N 614C216U01**

9.9 XE Signal Converter Assemblies

85 - 253 VAC, 50/60 Hz	698B270U03
85 - 253 VAC, 50/60 Hz with HART	698B270U04
24 VDC	698B270U05
24 VDC with HART	698B270U06

9.10 EEPROM

Blank EEPROM	D674A568U02

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Printed in USA (January, 2008)

PN25007_1

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