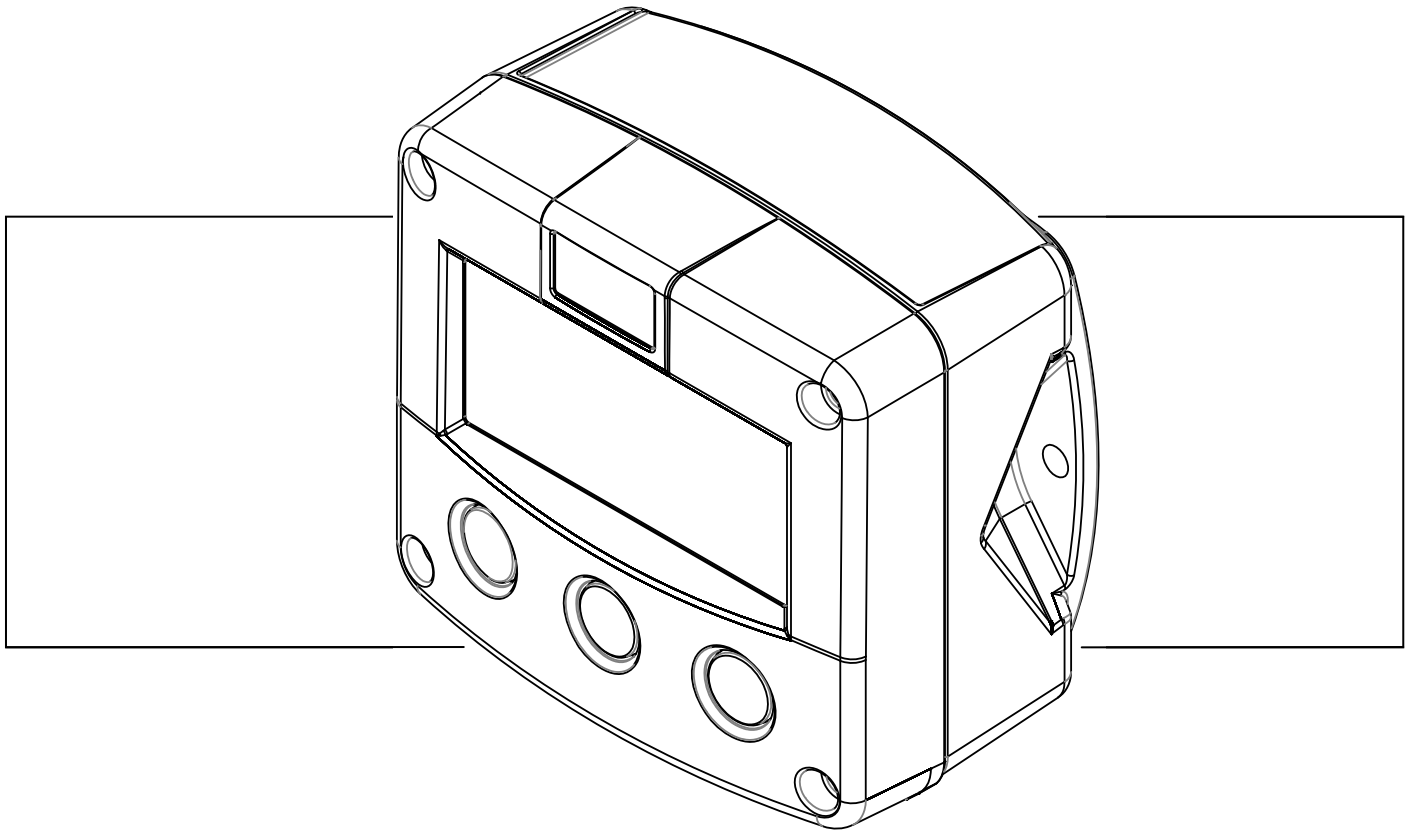
F116-A

WITH DIFFERENTIAL AND SUM FUNCTION



Signal input flowmeters: (0)4-20mA

Signal outputs: 4-20mA ref. flowrate, pulse ref. total and negative flow.

Options: Intrinsically Safe, Modbus communication.

SAFETY INSTRUCTIONS

- ***Any responsibility is lapsed if the instructions and procedures as described in this manual are not followed.***

- ***LIFE SUPPORT APPLICATIONS: The F116-A is not designed for use in life support appliances, devices, or systems where malfunction of the product can reasonably be expected to result in a personal injury. Customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify the manufacturer and supplier for any damages resulting from such improper use or sale.***

- ***Electro static discharge does inflict irreparable damage to electronics! Before installing or opening the unit, the installer has to discharge himself by touching a well-grounded object.***

- ***This unit must be installed in accordance with the EMC guidelines (Electro Magnetic Compatibility).***

- ***Do connect a proper grounding to the aluminum casing as indicated if the F116-A has been supplied with the 115-230V AC power-supply type PM. The green / yellow wire between the back-casing and removable terminal-block may never be removed.***

- ***Intrinsically Safe applications: follow the instructions as mentioned in Chapter 5 and consult "Fluidwell F1..-..-XI - Documentation for Intrinsic Safety".***

DISPOSAL

At the end of its life this product should be disposed of according to local regulations regarding waste electronic equipment. If a battery is present in this product it should be disposed of separately. The separate collection and recycling of your waste equipment will help to conserve natural resources and ensure that it is recycled in a manner that protects the environment.

SAFETY RULES AND PRECAUTIONARY MEASURES

- The manufacturer accepts no responsibility whatsoever if the following safety rules and precautions instructions and the procedures as described in this manual are not followed.
- Modifications of the F116-A implemented without preceding written consent from the manufacturer, will result in the immediate termination of product liability and warranty period.
- Installation, use, maintenance and servicing of this equipment must be carried out by authorized technicians.
- Check the mains voltage and information on the manufacturer's plate before installing the unit.
- Check all connections, settings and technical specifications of the various peripheral devices with the F116-A supplied.
- Open the casing only if all leads are free of potential.
- Never touch the electronic components (ESD sensitivity).
- Never expose the system to heavier conditions than allowed according to the casing classification (see manufacture's plate and chapter 4.2.).
- If the operator detects errors or dangers, or disagrees with the safety precautions taken, then inform the owner or principal responsible.
- The local labor and safety laws and regulations must be adhered to.

ABOUT THE OPERATION MANUAL

This operation manual is divided into two main sections:

- The daily use of the unit is described in chapter 2 "Operation". These instructions are meant for users.
- The following chapters and appendices are exclusively meant for electricians/technicians. These provide a detailed description of all software settings and hardware installation guidance.

This operation manual describes the standard unit as well as most of the options available. For additional information, please contact your supplier.

A hazardous situation may occur if the F116-A is not used for the purpose it was designed for or is used incorrectly. Please carefully note the information in this operating manual indicated by the pictograms:

A "**warning**" indicates actions or procedures which, if not performed correctly, may lead to personal injury, a safety hazard or damage of the F116-A or connected instructions.


Caution !

A "**caution**" indicates actions or procedures which, if not performed correctly, may lead to personal injury or incorrect functioning of the F116-A or connected instruments.


Note !

A "**note**" indicates actions or procedures which, if not performed correctly, may indirectly affect operation or may lead to an instrument response which is not planned.

Hardware version	:	02.01.xx
Software version	:	02.05.xx
Manual	:	HF116AEN_v0501_04
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CONTENTS MANUAL

1. INTRODUCTION

1.1. SYSTEM DESCRIPTION OF THE F116-A

Functions and features
The flowrate / totalizer model F116-A is a microprocessor driven instrument designed to display flowrate, total and accumulated total based on the calculated differential or count up value of two flows. Typical applications are found in the consumption calculation on board of ships and for power generators.
This product has been designed with a focus on:

- ultra-low power consumption to allow long-life battery powered applications (type PB / PC),
- intrinsic safety for use in hazardous applications (type XI),
- several mounting possibilities with aluminum or GRP enclosures for harsh industrial surroundings
- ability to process all types of flowmeter signals,
- transmitting possibilities with analog / pulse and communication (option) outputs.

Flowmeter input
This manual describes the unit with two analog (0)4-20mA inputs for the flowmeter "-A version". Other versions are available to process pulse or 0-10V flowmeter signals.
To power the sensor, several options are available.

Standard outputs

- Configurable pulse output: a scaled pulse mirroring a certain totalized differential or sum quantity. Maximum frequency 60Hz.; the pulse length can be set from 7,8msec up to 2 seconds.
- Configurable linear (0)4-20mA or 0-10V analog output with 10-bits resolution mirroring the actual differential / sum flowrate. Flowrate levels as well as the minimum and maximum signal output can be tuned.

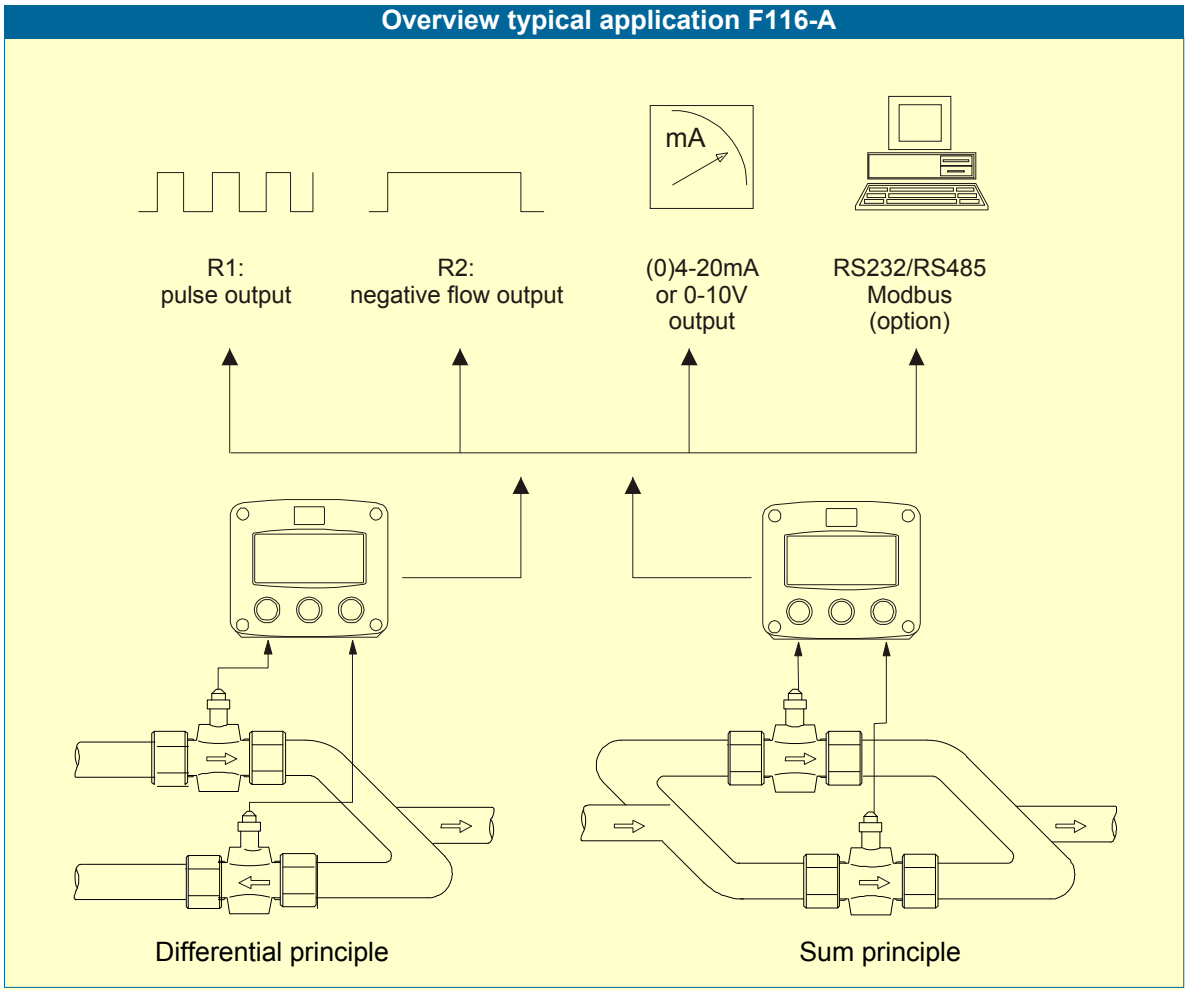


Fig. 1: Typical application for the F116-A.

Configuration of the unit
The F116-A was designed to be implemented in many types of applications. For that reason, a SETUP-level is available to configure your F116-A according to your specific requirements.
SETUP includes several important features, such as Span, measurement units, signal selection etc.
All setting as are stored in EEPROM memory and will not get lost in case of power break-down or empty battery.
To extend the battery-life time (option), please make use of the power-management functions as described in chapter 3.2.3.

Display information
The unit has a large transflective LCD with all kinds of symbols and digits to display measuring units, status information, trend-indication and key-word messages.
Flowrate and totals can be displayed either with the small 8mm digits or with the 17mm digits.
A backup of the total and accumulated total in EEPROM memory is made every minute.

Options
Following options are available: isolated or active 4-20mA / 0-10V / 0-20mA analog output, full Modbus communication RS232/485 (also battery powered), intrinsic safety, mechanic relay or active outputs, power- and sensor-supply options, panel-mount, wall-mount and weather-proof enclosures, flame proof enclosure.

2. OPERATIONAL

2.1. GENERAL

Caution !

- *The F116-A may only be operated by personnel who are authorized and trained by the operator of the facility. All instructions in this manual are to be observed.*
- *Take careful notice of the " Safety rules, instructions and precautionary measures " in the front of this manual.*

This chapter describes the daily use of the F116-A. This instruction is meant for users / operators.

2.2. CONTROL PANEL

The following keys are available:

Fig. 2: Control Panel.

Functions of the keys

This key is used to program and save new values or settings.
It is also used to get access to SETUP-level; please read chapter 3.

This key is used to SELECT accumulated total.
The arrow-key ▲ is used to configure the unit; please read chapter 3.

Press this key twice to CLEAR the value for total.
The arrow-key ▶ is used configure the unit; please read chapter 3.

2.3. OPERATOR INFORMATION AND FUNCTIONS

In general, the F116-A will always act at Operator level. The information displayed is dependant up on the SETUP-settings. The flowmeter signals will be measured by the F116-A in the background, whichever screen refresh rate setting is chosen. After pressing a key, the display will be updated very quickly during a 30 second period, after which it will slow-down again.

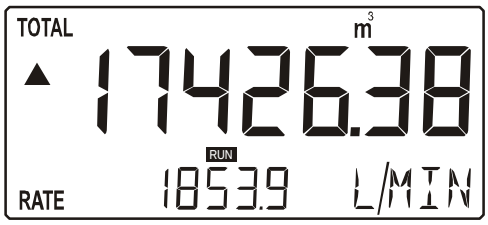


Fig. 3: Example of display information during process.

For the Operator, the following functions are available:

- **Display differential / sum flowrate and total or flowrate**
  This is the main display information of the F116-A. After selecting any other information, it will always return to this main display automatically.
  Differential (or sum) total is displayed at the upper-line of the display and the differential (or sum) flowrate and the bottom line.
  Possibly, only flowrate will be displayed with the large 17mm digits; do press the SELECT-key to read the total.
  When the flowrate of the output flow is more as the input flow, a negative flowrate might be displayed while total will count down.
  When "-------" is shown, then the flowrate value is too high to be displayed. The arrows ⬍ indicate the increase/decrease of the flowrate trend.

- **Clear differential / sum total**
  The value for total can be re-initialized. To do so, press CLEAR twice. After pressing CLEAR once, the flashing text "PUSH CLEAR" is displayed. To avoid re-initialization in this stage, press an other key as CLEAR or wait for 20 seconds.
  Re-initialization of total DOES NOT influence the accumulated total.

- **Display differential / sum accumulated total**
  When the SELECT-key is pressed, total and accumulated total are displayed. The accumulated total cannot be re-initialized. The value will count up to 99,999,999,999. The unit and number of decimals are displayed according to the configuration settings for total.

- **Low-battery alarm**
  When the battery voltage drops, it must be replaced. At first "low-battery" will flash, but as soon as it is displayed continuously, the battery MUST be replaced shortly after!
  Only official batteries may be used, or else the guarantee will be terminated. The remaining lifetime after the first moment of indication is generally several days up to some weeks.

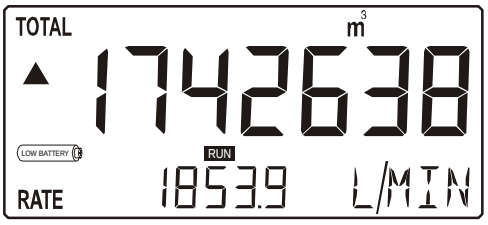


Fig. 4: Example of low-battery alarm.

- **Alarm 01-03**
  When "alarm" is displayed, please consult Appendix B: problem solving.

3. CONFIGURATION

3.1. INTRODUCTION

This and the following chapters are exclusively meant for electricians and non-operators. In these, an extensive description of all software settings and hardware connections are provided.

Caution !

- *Mounting, electrical installation, start-up and maintenance of the instrument may only be carried out by trained personnel authorized by the operator of the facility. Personnel must read and understand this Operating Manual before carrying out its instructions.*
- *The F116-A may only be operated by personnel who are authorized and trained by the operator of the facility. All instructions in this manual are to be observed.*
- *Ensure that the measuring system is correctly wired up according to the wiring diagrams. The housing may only be opened by trained personnel.*
- *Take careful notice of the " Safety rules, instructions and precautionary measures " in the front of this manual.*

3.2. PROGRAMMING SETUP-LEVEL

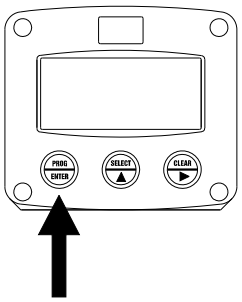
3.2.1. GENERAL

Configuration of the F116-A is done at SETUP-level. SETUP-level is reached by pressing the PROG/ENTER key for 7 seconds; at which time, both arrows ⬍ will be displayed. In order to return to the operator level, PROG will have to be pressed for three seconds. Alternatively, if no keys are pressed for 2 minutes, the unit will exit SETUP automatically.
SETUP can be reached at all times while the F116-A remains fully operational.

Note !

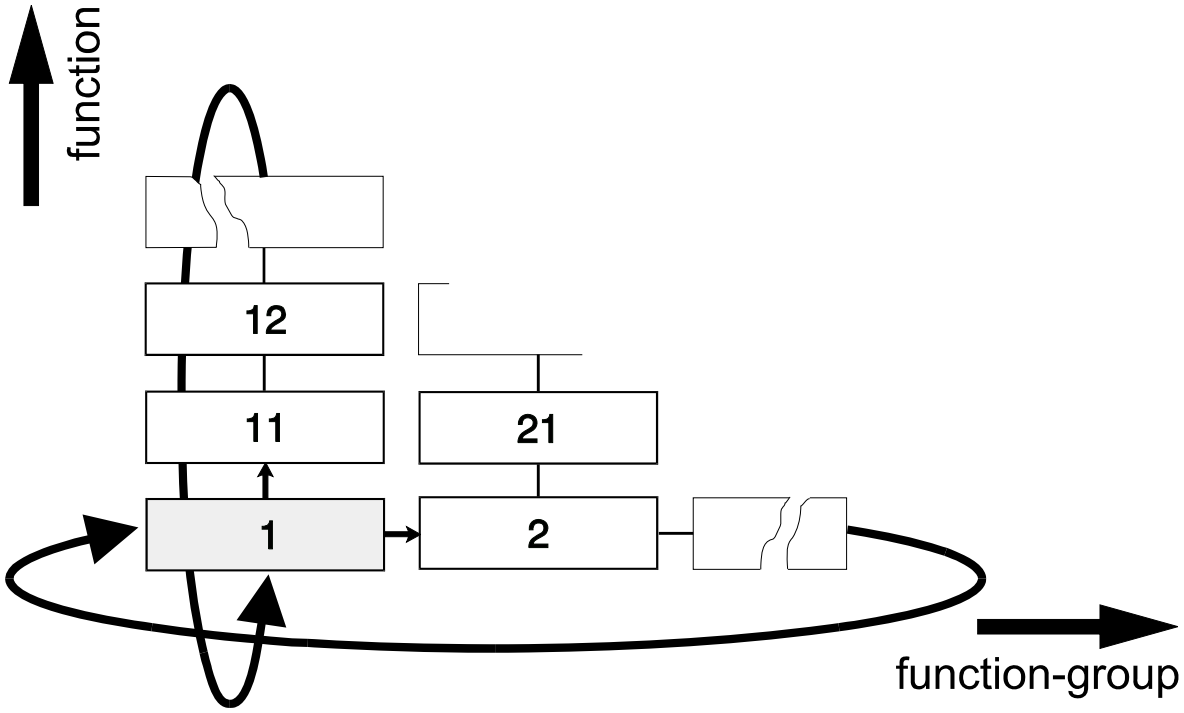
Note: *A password may be required to enter SETUP. Without this password access to SETUP is denied.*

To enter SETUP-level:



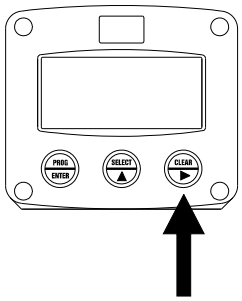
Press PROG/ENTER for 7 seconds

Matrix structure SETUP-level:

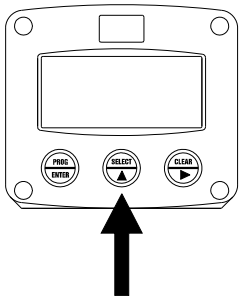


SCROLLING THROUGH SETUP-LEVEL

Selection function-group and function:
SETUP is divided into several function groups and functions.



Select function-group with CLEAR ▶

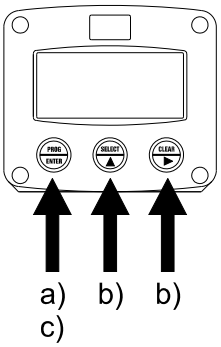


Select function with SELECT ▲

Each function has a unique number, which is displayed below the word "SETUP" at the bottom of the display. The number is a combination of two figures. The first figure indicates the function-group and the second figure the function. Additionally, each function is expressed with a keyword.

After selecting a sub-function, the next main function is selected after scrolling through all "active" sub-functions (e.g. 1▲, 11▲, 12▲, 13▲, 14▲, 1▶, 2▶, 3▲, 31 etc.).

To change or a select a value or value:



a) press PROG ENTER briefly; **PROGRAM** will start flash

b) select or enter value with SELECT ▲ and / or CLEAR ▶

c) press PROG ENTER to confirm the value / selection.

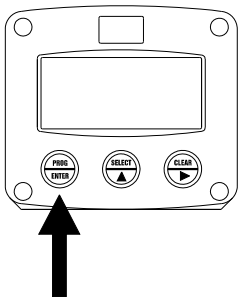
To change a value, use ▶ to select the digits and ▲ to increase that value.
To select a setting, both ▲ and ▶ can be used.
When the new value is not valid, the increase sign ▲ or decrease-sign ▼ will be displayed while you are programming.

When data is altered but ENTER is not pressed, then the alteration can still be cancelled by waiting for 20 seconds or by pressing ENTER for three seconds: the PROG-procedure will be left automatically and the former value reinstated.

Note !

Note: *alterations will only be set after ENTER has been pressed!*

To return to OPERATOR-level:



Press PROG ENTER for 3 seconds

In order to return to the operator level, PROG will have to be pressed for three seconds. Also, when no keys are pressed for 2 minutes, SETUP will be left automatically.

3.2.2. OVERVIEW FUNCTIONS SETUP LEVEL

SETUP FUNCTIONS AND VARIABLES			
1	**TOTAL A**		
	11	UNIT	L - m3 - kg - lb - GAL - USGAL - bbl - no unit
	12	DECIMALS	0 - 1 - 2 - 3 (Ref: displayed value)
	13	SPAN	0.000001 - 999,999 unit/second
	14	DECIMALS SPAN	0 - 6
2	**FLOWRATE A**		
	21	UNIT	mL - L - m3 - mg - g - kg - ton - GAL - bbl - lb - cf - REV - no unit - scf - Nm3 - NL - P
	22	TIME UNIT	sec - min - hour - day
	23	DECIMALS	0 - 1 - 2 - 3 (Ref: displayed value)
	24	SPAN	0.000001 - 999,999 unit/time-unit
	25	DECIMALS SPAN	0 - 6
3	**TOTAL B**		
	31	SPAN	0.000001 - 999,999 unit/second
	32	DECIMALS SPAN	0 - 6
4	**FLOWRATE B**		
	41	SPAN	0.000001 - 999,999 unit/time-unit
	42	DECIMALS SPAN	0 - 6
5	**DISPLAY**		
	51	FUNCTION	total - flowrate - all
	52	CALCULATE	differential - add
	53	NEGATIVE FLOWRATE	disable - enable
6	**POWER MANAGEMENT**		
	61	LCD UPDATE	fast - 1 sec - 3 sec - 15 sec - 30 sec - off
	62	BATTERY MODE	operational - shelf
7	**FLOWMETER A**		
	71	FORMULA	interpolation, square root
	72	FILTER	00 - 99
	73	CUT-OFF	0.0 - 99.9%
	74	CALIBRATE LOW	(0)4mA
	75	CALIBRATE HIGH	20mA
8	**FLOWMETER B**		
	81	FORMULA	interpolation, square root
	82	FILTER	00 - 99
	83	CUT-OFF	0.0 - 99.9%
	84	CALIBRATE LOW	(0)4mA
	85	CALIBRATE HIGH	20mA
9	**ANALOG**		
	91	OUTPUT	disable - enable
	92	4mA / 0V	0000.000 - 9,999,999
	93	20mA / 10V	0000.000 - 9,999,999
	94	CUT-OFF	0.0 - 9.9%
	95	TUNE MIN - 4mA / 0V	0 - 9,999
	96	TUNE MAX- 20mA / 10V	0 - 9,999
	97	FILTER	00 - 99
A	**IMPULSE**		
	A1	PERIOD TIME	0 - 250
	A2	IMPULSE PER	X,XXX,XXX quantity
B	**COMMUNICATION**		
	B1	SPEED / BAUDRATE	1200 - 2400 - 4800 - 9600
	B2	ADDRESS	1 - 255
	B3	MODE	RTU - off
C	**OTHERS**		
	C1	TYPE / MODEL	F116-A
	C2	SOFTWARE VERSION	__.__.__
	C3	SERIAL NO.	#########
	C4	PASSWORD	0000 - 9999
	C5	TAGNUMBER	0000000 - 9999999

3.2.3. EXPLANATION SETUP-FUNCTIONS

1 - TOTAL A	
With the exception of Span and decimal Span, all “Total settings” are valid for both flowmeters.	
MEASUREMENT UNIT **11**	SETUP - 11 determines the measurement unit for total, accumulated total and pulse output. The following units can be selected: L - m3 - kg - lb. - GAL - USGAL - bbl - _ (no unit). Alteration of the measurement unit will have consequences for operator and SETUP-level values. Please note that the Span has to be adapted as well; the calculation is not done automatically.
DECIMALS **12**	The decimal point determines for total, accumulated total and pulse output the number of digits following the decimal point. The following can be selected: 0000000 - 111111.1 - 22222.22 - 3333.333
SPAN **13**	With the span, the flowmeter signal is converted to a quantity. The **span for Total** is determined on the basis of the measurement unit (setting 11) and the **flowrate per second** at 20mA. Enter the span in whole numbers (decimals are set with SETUP 14). The more accurate the span, the more accurate the functioning of the system will be. **Example 1:** **Calculating the span for Total.** *Let us assume that the flowmeter generates 20mA at a flowrate of 2,481.3 Liters/minute and the selected unit is "cubic meters / m3".* *The rate per second is 2,481.3÷60 is 41.355 L/sec. This is 0.041355 m3/sec., which is the span.* *Enter for SETUP - 13: "041355" and for SETUP - 14 - decimals span "6".* **Example 2:** **Calculating the span for Total** *Let us assume that the flowmeter generates 20mA at a rate of 652.31 USGAL per hour, the selected unit is barrels.* *There are 42 gallons in one barrel; so the rate is 652.31/42 is 15.53119 barrels/hour. This is 0.0043142 barrels/second, which is the span.* *Enter for SETUP - 13: "004314" and for SETUP - 14 "6".*
DECIMALS SPAN **14**	This setting determines the number of decimals for the Span (SETUP 13). The following can be selected: 0 - 1 - 2 - 3 - 4 - 5 - 6 Please note that this function influences the accuracy of the Span indirectly. This setting has NO influence on the displayed number of digits for total (SETUP 12)!

2 - FLOWRATE A

The settings for total and flowrate are entirely separate. In this way, different units of measurement can be used for each e.g. cubic meters for total and liters for flowrate.
The display update time for flowrate is one second or more.
With the exception of Span and decimal Span, all “Flowrate settings” are valid for both flowmeters.
Note: *these settings also influence the analog output.*

MEASUREMENT UNIT **21**	SETUP - 21 determines the measurement unit for flowrate. The following units can be selected: mL - L - m3 - mg - g - kg - ton - GAL - bbl - lb - cf - REV - no unit - scf - Nm3 - NL - P. Alteration of the measurement unit will have consequences for operator and SETUP-level values. Please note that the Span has to be adapted as well; the calculation is not done automatically.
TIME UNIT **22**	The flowrate can be calculated per second (SEC), minute (MIN), hour (HR) or day (DAY).
DECIMALS **23**	This setting determines for flowrate the number of digits following the decimal point. The following can be selected: 00000 - 1111.1 - 2222.22 - 3333.333
SPAN **24**	With the span, the flowmeter signal is converted to a quantity. The **span for flowrate** is determined on the basis of the **selected measurement unit and time unit** at 20mA. Enter the span in whole numbers (decimals are set with SETUP 25). The more accurate the span, the more accurate the functioning of the system will be. **Example 1** **Calculating the span for flowrate** *Let us assume that the flowmeter generates 20mA at a flowrate of 2,481.3 Liters/minute, the selected unit is "Liters" and time unit "minute".* *The span is 2481.3* *Enter for* SETUP *- 24: "248130" and for* SETUP *- 25 - decimals span "2".* **Example 2** **Calculating the span for flowrate** *Let us assume that the flowmeter generates 20mA at a rate of 652.31 USGAL per hour, the selected unit is USG and the time unit is minute.* *The span is 652.31 / 60 minutes is 10.87183 (GPM).* *Enter for SETUP - 24: "108718" and for SETUP - 25 "4".*
DECIMALS SPAN **25**	This setting determines the number of decimals for Span (SETUP 24). The following can be selected: 0 - 1 - 2 - 3 - 4 - 5 - 6 Please note that this SETUP - influences the accuracy of the Span indirectly. This setting has NO influence on the displayed number of digits for "flowrate" (SETUP 23)!

3 - TOTAL B	
SPAN **31**	With the span, the flowmeter signal is converted to a quantity. The **span for Total** is determined on the basis of the measurement unit (setting 11) and the **flowrate per second** at 20mA. Enter the span in whole numbers (decimals are set with SETUP 14). The more accurate the span, the more accurate the functioning of the system will be. For examples: please read SETUP 13
DECIMALS SPAN **32**	This setting determines the number of decimals for the Span (SETUP 31). The following can be selected: 0 - 1 - 2 - 3 - 4 - 5 - 6 Please note that this function influences the accuracy of the Span indirectly. This setting has NO influence on the displayed number of digits for total (SETUP 12)!

4 - FLOWRATE B	
SPAN **41**	With the span, the flowmeter signal is converted to a quantity. The **span for flowrate** is determined on the basis of the **selected measurement unit and time unit** at 20mA (setup 21 and 22). Enter the span in whole numbers (decimals are set with SETUP 42). The more accurate the span, the more accurate the functioning of the system will be. For examples: please read SETUP 24.
DECIMALS SPAN **42**	This setting determines the number of decimals for the Span (SETUP 41). The following can be selected: 0 - 1 - 2 - 3 - 4 - 5 - 6 Please note that this SETUP - influences the accuracy of the Span indirectly.

5 - DISPLAY	
FUNCTION **51**	The large 17mm digits can be set to display total or flowrate. When "total" is selected, both total and flowrate are displayed simultaneously. When "flowrate" is selected, only flowrate will be displayed with it's measuring unit while total will be displayed first after pressing SELECT. When "all" is selected following will be displayed: flowrate, total, accumulated total of the A, B and differential / sum.
CALCULATE **52**	The unit can be set to calculate and display either the differential total / flowrate or to add (sum function) both flows.
NEGATIVE FLOWRATE **53**	It can be selected to display negative flowrate on the display or not.

6 - POWER MANAGEMENT

When used with the internal battery option (type PB / PC), the user may hold the concern of reliable measurement over a long period of time. The F116-A has several smart power management functions to extend the battery life time significantly. Two of these functions can be set:

LCD NEW **61**	The calculation of the display-information influences the power consumption significantly. When the application does not require a fast display update, it is **strongly advised** to select a slow refresh-rate. Please understand that NO information will be lost; every pulse will be counted and the output-signals will be generated in the normal way. The following can be selected: Fast - 1 sec - 3 sec - 15 sec - 30 sec - off. **Example 3:** **Battery life-time** *battery life-time with FAST update: about 2 years.* *battery life-time with 1 sec update: about 5 years.* ***Note:** after a button has been pressed by the operator - the display refresh-rate will always be FAST during 30 seconds. When "OFF" is selected, the display will be switched-off after 30 seconds and will be switched-on as soon as a button has been pressed.*
BATTERY-MODE **62**	The unit has two modes: operational or shelf. After "shelf" has been selected, the unit can be stored for several years; it will not count pulses, the display is switched-off but all settings and totals are stored. In this mode, power consumption is extremely low. To wake-up the unit again; press the SELECT-key twice.

7 - FLOWMETER A

SIGNAL
71

The F116-A can process the 4-20mA signal in two ways:

- Interpolation: the signal is processed linear

  R = S x I

- Square root: for differential pressure

  R = S $\sqrt{}$ I

where:
R = Rate: the calculated flowrate
S = Span: the maximum flowrate at 20mA. The span is programmed with setting 24 for flowrate and with setting 13 for total.
I = Input: the scaled analog value; in these formulas value 0 (zero) for (0)4mA and value 1 (one) for 20mA.

FILTER
72

Note !

The analog output signal of a flowmeter does mirror the actual flow. This signal is measured several times a second by the F116-A. The value measured is a "snap-shot" of the real flow as it will be fluctuating. With the help of this digital filter a stable and accurate reading can be obtained while the filter level can be set to a desired value.
The filter principal is based on three input values: the filter level (01-99), the last measured analog value and the last average value. The higher the filter level, the longer the response time on a value change will be.
Below, several filter levels with there response times are indicated:

FILTER VALUE	RESPONSE TIME ON STEP CHANGE OF ANALOG VALUE. TIME IN SECONDS			
	50% INFLUENCE	75% INFLUENCE	90% INFLUENCE	99% INFLUENCE
01	filter disabled	filter disabled	filter disabled	filter disabled
02	0.3 seconds	0.5 seconds	1.0 seconds	1.8 seconds
03	0.5 seconds	1.0 seconds	1.5 seconds	3 seconds
05	1.0 seconds	1.8 seconds	2.8 seconds	5.3 seconds
10	1.8 seconds	3.5 seconds	5.6 seconds	11 seconds
20	3.5 seconds	7.0 seconds	11 seconds	23 seconds
30	5.3 seconds	10 seconds	17 seconds	34 seconds
50	8.8 seconds	17 seconds	29 seconds	57 seconds
75	13 seconds	26 seconds	43 seconds	86 seconds
99	17 seconds	34 seconds	57 seconds	114 seconds

Continued next page >>>

7 - FLOWMETER A (CONTINUED)

CUT-OFF
73

To ignore e.g. leakage of the flow or vibration, a low-flow cut-off can be set as percentage over the full range of 16mA (or 20mA / 10V). When the analog value is less then required with this setting, the signal will be ignored.
The cut-off value can be programmed is the range 0.0 - 99.9%.

Examples:

FUNCTION (setup 71)	SPAN (setup 13/24)	REQUIRED CUT-OFF	CUT-OFF (setup 73)	REQUIRED OUTPUT
interpolation	450 L/min	25 L/min	25/450 x 100%=5.5%	16mA x 5.5% + 4mA = 4.88mA
square root	450 L/min	25 L/min	$(25/450)^2$ x 100%=0.3%	16mA x 0.3% + 4mA = 4.05mA

TUNE MIN / 4MA
74

With this setting it is possible to calibrate the input value for (0)4mA as the signal from the flowmeter might not be exact 4.0 mA (or 0.0 mA) at flowrate zero.
This function will measure the real output value at flow zero.

- *Warning: be very sure that the offered signal is correct before the calibration is executed as this function has major influences on the accuracy of the system!*

After pressing PROG, three settings can be selected:
- CALIBRATE: with this setting, the input will be calibrated with the actual "(0)4mA" value. After pressing enter, CAL SET will be displayed as soon as the calibration is completed. From that moment, the analog value must be more than the calibrated value before the signal will be processed.
- DEFAULT: with this setting, the manufactures value is re-installed.
- CAL SET: to select the last calibrated value.

TUNE MAX / 20MA
75

With this setting it is possible to calibrate the input value for 20mA as the signal from the flowmeter might not be exact 20.0 mA at maximum flowrate.
This function will measure the real output value at maximum flowrate.

- *Warning: be very sure that the offered signal is correct before the calibration is executed as this function has major influences on the accuracy of the system!*

After pressing PROG, three settings can be selected:
- CALIBRATE: with this setting, the input will be calibrated with the actual "20mA" value. After pressing enter, CAL SET will be displayed as soon as the calibration is completed. From that moment, the analog value must be less than the calibrated value for a reliable measurement.
- DEFAULT: with this setting, the manufactures value is re-installed.
- CAL SET: to select the last calibrated value.

8 - FLOWMETER B	
SIGNAL **81**	The F116-A can process the 4-20mA signal in two ways: ▪ Interpolation: the signal is processed linear ▪ Square root: for differential pressure For explanation of this function: please read “7 - Flowmeter A”
FILTER **82**	With the help of this digital filter a stable and accurate reading can be obtained while the filter level can be set to a desired value. For explanation of this function: please read “7 - Flowmeter A”
CUT-OFF **83**	To ignore e.g. leakage of the flow or vibration, a low-flow cut-off can be set as percentage over the full range of 16mA (or 20mA / 10V). When the analog value is less then required with this setting, the signal will be ignored. The cut-off value can be programmed is the range 0.0 - 99.9%. For explanation of this function: please read “7 - Flowmeter A”
TUNE MIN / 4MA **84**	With this setting it is possible to calibrate the input value for (0)4mA as the signal from the flowmeter might not be exact 4.0 mA (or 0.0 mA) at flowrate zero. This function will measure the real output value at flow zero. ▪ *Warning: be very sure that the offered signal is correct before the calibration is executed as this function has major influences on the accuracy of the system!* For explanation of this function: please read “7 - Flowmeter A”
TUNE MAX / 20MA **85**	With this setting it is possible to calibrate the input value for 20mA as the signal from the flowmeter might not be exact 20.0 mA at maximum flowrate. This function will measure the real output value at maximum flowrate. ▪ *Warning: be very sure that the offered signal is correct before the calibration is executed as this function has major influences on the accuracy of the system!* For explanation of this function: please read “7 - Flowmeter A”

9 - ANALOG OUTPUT

A linear analog (0)4-20mA or 0-10V signal is generated according to the flowrate with a 10 bits resolution. The settings for flowrate (SETUP - 2) influence the analog output directly.
The relationship between rate and analog output is set with the following functions:

DISABLE / ENABLE **91**	The analog output can be disabled. In case of a passive analog output type AP, 3.5mA will be generated if a power supply is available but the output is disabled.
MINIMUM FLOWRATE **92**	Enter here the flowrate at which the output should generate the minimum signal (0/4mA or 0V) - in most applications at flowrate "zero". The number of decimals displayed depend upon SETUP 23. The time and measuring units (L/min for example) are dependant upon SETUP 21 and 22 but are not displayed.
MAXIMUM FLOWRATE **93**	Enter here the flowrate at which the output should generate the maximum signal (20mA or 10V) - in most applications at maximum flow. The number of decimals displayed depend upon SETUP 23. The time and measuring units (L/min for example) are dependant upon SETUP 21 and 22 but can not be displayed.
CUT-OFF **94**	To ignore leakage of the flow for example, a low flow cut-off can be set as a percentage of the full range of 16mA, 20mA or 10V. When the flow is less than the required rate, the current will be the minimum signal (0/4mA or 10V). **Examples:**

4MA (SETUP 92)	20MA (SETUP 93)	CUT-OFF (SETUP 94)	REQUIRED RATE	OUTPUT
0 L/min	100 L/min	2%	(100-0)*2% = 2.0 L/min	4+(16*2%) = 4.32mA
20 L/min	800 L/min	3.5%	(800-20)*3.5%= 27.3 L/min	4+(16*3.5%)=4.56mA

TUNE MIN / 4MA **95**	The initial minimum analog output value is 0/4mA or 0V. However, this value might differ slightly due to external influences such as temperature for example. The 0/4mA or 0V value can be tuned precisely with this setting. ▪ *Before tuning the signal, be sure that the analog signal is not being used for any application!* After pressing PROG, the current will be about 4mA (or 0mA / 0V). The current can be increased / decreased with the arrow-keys and is directly active. Press ENTER to store the new value. Remark: the analog output value can be programmed “up-side-down” if desired, so 20mA at minimum flowrate for example!
TUNE MAX / 20MA **96**	The initial maximum analog output value is 20mA (or 10V). However, this value might differ slightly due to external influences such as temperature for example. The 20mA value (or 10V) can be tuned precisely with this setting. ▪ *Before tuning the signal, be sure that the analog signal is not being used for any application!* After pressing PROG, the current will be about 20mA. The current can be increased / decreased with the arrow-keys and is directly active. Press ENTER to store the new value. Remark: the analog output value can be programmed “up-side-down” if desired, so 4mA at maximum flowrate for example!

Continued next page >>>

9 - ANALOG OUTPUT (CONTINUED)

FILTER
97

This function is used to stabilize the analog output signal.
The output value is updated every 0.1 second. With the help of this digital filter a more stable but less precise reading can be obtained.
The filter principal is based on three input values: the filter level (01-99), the last analog output value and the last average value. The higher the filter level, the longer the response time on a value change will be.
Below, several filter levels with their response times are indicated:

FILTER VALUE	RESPONSE TIME ON STEP CHANGE OF ANALOG VALUE. TIME IN SECONDS			
	50% INFLUENCE	75% INFLUENCE	90% INFLUENCE	99% INFLUENCE
01	filter disabled	filter disabled	filter disabled	filter disabled
02	0.1 second	0.2 second	0.4 second	0.7 second
03	0.2 second	0.4 second	0.6 second	1.2 seconds
05	0.4 second	0.7 second	1.1 seconds	2.1 seconds
10	0.7 second	1.4 seconds	2.2 seconds	4.4 seconds
20	1.4 seconds	2.8 seconds	4.5 seconds	9.0 seconds
30	2.1 seconds	4 seconds	7 seconds	14 seconds
50	3.5 seconds	7 seconds	11 seconds	23 seconds
75	5.2 seconds	10 seconds	17 seconds	34 seconds
99	6.9 seconds	14 seconds	23 seconds	45 seconds

A - RELAY OUTPUT

Note !

One transistor or mechanic relay output is available as scaled pulse output according to the calculated differential or sum total.

PERIOD TIME PULSE OUTPUT
A1

Note !

The period time determines the time that the transistor or relay will be switched; in other words the pulse length. The minimum time between the pulses is as long as the period time.
One period is about 7,8 msec. With value “zero”, the pulse output is disabled. The maximum value is 255 periods.
Note: *when the frequency goes out of range - when the flowrate increases for example - an internal buffer will be used to "store the missed pulses": as soon as the flowrate goes down, the buffer will be "emptied". It might be that pulses will be missed due to a buffer-overflow, so it is advised to program this setting within it's range*

NUMBER OF PERIODS	PERIOD TIME	MAX. FREQUENCY
0	disabled	disabled
1	0,0078 seconds	64 Hz.
2	0,0156 seconds	32 Hz.
3	0,0234 seconds	21 Hz.
64	0,5000 seconds	1 Hz.
255	1,9922 seconds	0,25 Hz.

PULSE PER
A2

According to the measurement unit settings for total, a pulse will be generated every X-quantity. Enter here this quantity while taking the displayed decimal position and measuring unit into account.

B - COMMUNICATION (OPTIONAL)	
Functions as described below deal with hardware that are not part of the standard delivery. Programming of these functions does not have any effect if this hardware has not been installed. Consult Appendix C and the Modbus communication protocol description for a detailed explanation.	
BAUDRATE **B1**	For external control, following communication speeds can be selected: 1200 - 2400 - 4800 - 9600 baud
BUS ADDRESS **B2**	For communication purposes, a unique identity can be attributed to every F116-A. This address can vary from 1-255.
MODE **B3**	The communication is executed according Modbus protocol RTU mode. With OFF, the communication is disabled.

C - OTHERS	
TYPE OF MODEL **C1**	For support and maintenance it is important to have information about the characteristics of the F116-A. Your supplier will ask for this information in the case of a serious breakdown or to assess the suitability of your model for upgrade considerations.
VERSION SOFTWARE **C2**	For support and maintenance it is important to have information about the characteristics of the F116-A. Your supplier will ask for this information in the case of a serious breakdown or to assess the suitability of your model for upgrade considerations.
SERIAL NUMBER **C3**	For support and maintenance it is important to have information about the characteristics of the F116-A. Your supplier will ask for this information in the case of a serious breakdown or to assess the suitability of your model for upgrade considerations.
PASSWORD **C4**	All SETUP-values can be password protected. This protection is disabled with value 0000 (zero). Up to and including 4 digits can be programmed, for example 1234.
TAGNUMBER **C5**	For identification of the unit and communication purposes, a unique tagnumber of maximum 7 digits can be entered.

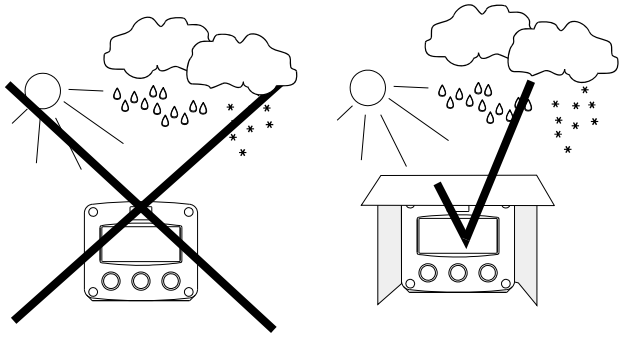
4. INSTALLATION

4.1. GENERAL DIRECTIONS

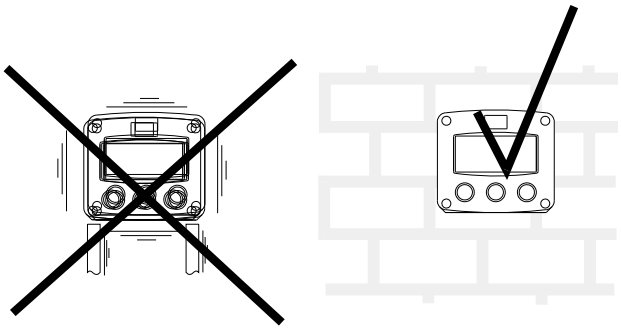
Caution !

- Mounting, electrical installation, start-up and maintenance of this instrument may only be carried out by trained personnel authorized by the operator of the facility. Personnel must read and understand this Operating Manual before carrying out its instructions.
- The F116-A may only be operated by personnel who are authorized and trained by the operator of the facility. All instructions in this manual are to be observed.
- Ensure that the measuring system is correctly wired up according to the wiring diagrams. Protection against accidental contact is no longer assured when the housing cover is removed or the panel cabinet has been opened (danger from electrical shock). The housing may only be opened by trained personnel.
- Take careful notice of the " Safety rules, instructions and precautionary measures " at the front of this manual.

4.2. INSTALLATION / SURROUNDING CONDITIONS



Take the relevant IP classification of the casing into account (see manufactures plate). Even an IP67 (NEMA 4X) casing should NEVER be exposed to strongly varying (weather) conditions.
When panel-mounted, the unit is IP65 (NEMA 4X)!
When used in very cold surroundings or varying climatic conditions, take the necessary precautions against moisture by placing a dry sachet of silica gel, for example, inside the instrument case.



Mount the F116-A on a solid structure to avoid vibrations.

4.3. DIMENSIONS- ENCLOSURE

Aluminum enclosures:

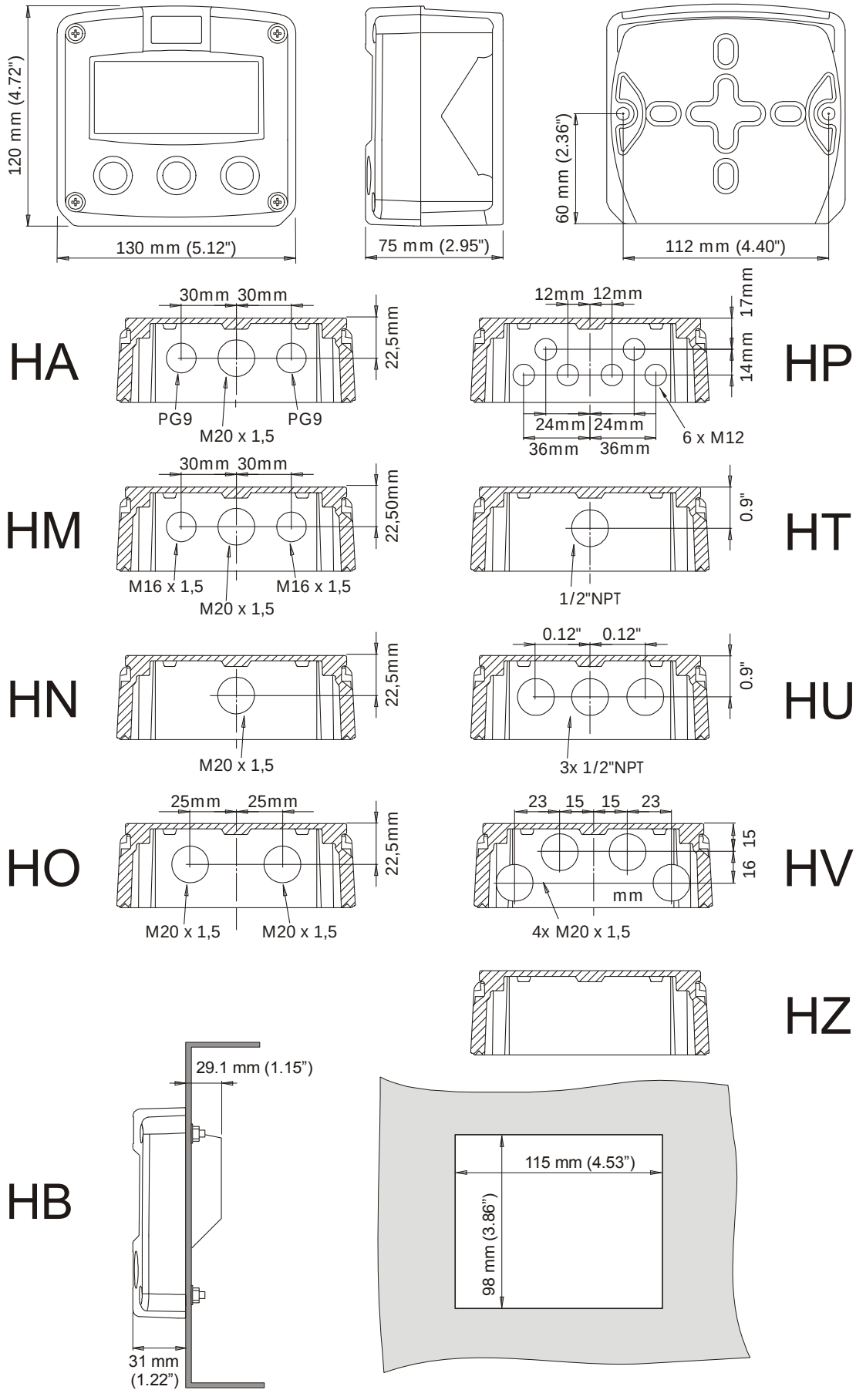


Fig. 5: Dimensions aluminum enclosures.

GRP enclosures:

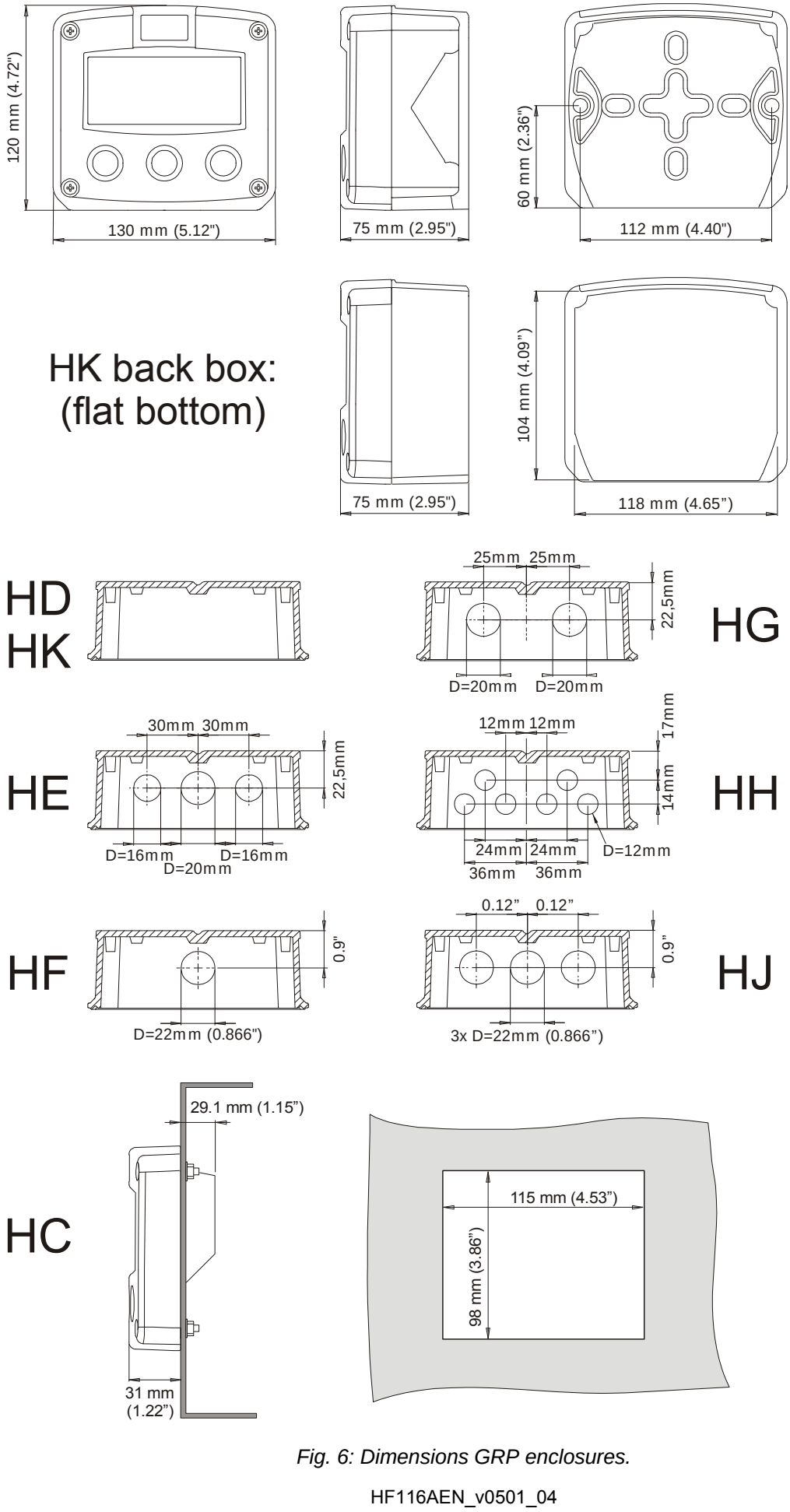


Fig. 6: Dimensions GRP enclosures.

4.4. INSTALLING THE HARDWARE

4.4.1. INTRODUCTION

WARNING

- Electro static discharge does inflict irreparable damage to electronics! Before installing or opening the unit, the installer has to discharge himself by touching a well-grounded object.

- This unit must be installed in accordance with the EMC guidelines (Electro Magnetic Compatibility).

WARNING

Aluminum enclosures

- When installed in an aluminum enclosure and a potentially explosive atmosphere requiring apparatus of equipment protection level Ga and Da, the unit must be installed such that, even in the event of rare incidents, an ignition source due to impact or friction sparks between the enclosure and iron/steel is excluded.

- Do ground the aluminum enclosure properly as indicated, if the F116-A has been supplied with the 115-230V AC power-supply type PM. The green / yellow wire between the back-casing and removable terminal-block may never be removed.

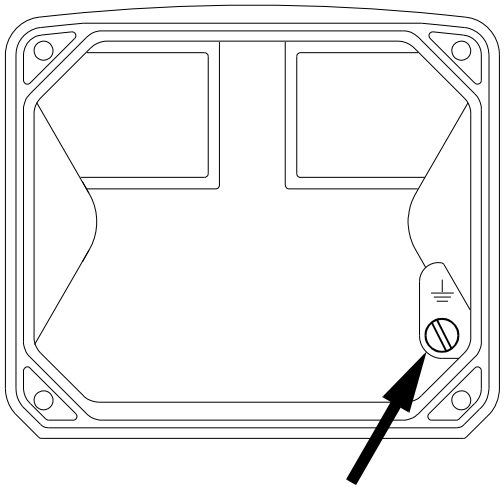


Fig. 7: Grounding aluminum enclosure with type PM 115-230V AC.

FOR INSTALLATION, PAY EMPHATIC ATTENTION TO:

- Separate cable glands with effective IP67 (NEMA4X) seals for all wires.
- Unused cable entries: ensure that you fit IP67 (NEMA4X) plugs to maintain rating.
- A reliable ground connection for both the sensor, and if applicable, for the metal casing.
- An effective screened cable for the input signal, and grounding of its screen to terminal 9 (GND) or at the sensor itself, whichever is appropriate to the application.

4.4.2. VOLTAGE SELECTION SENSOR SUPPLY

For Intrinsically Safe applications: read chapter 5.

Type PB / PC / PX (AP) - battery powered and output loop-powered applications:
Terminal 11 provides a limited supply voltage of 3.2 V DC for the signal output of the flowmeter. This is not suitable to power analog sensors.

Type PD / PF / PM: Sensor supply: 3.2V - 8.2V - 12V or 24 V DC:
With this option, a real power supply for the sensor is available. The flowmeter can be powered with 8.2 - 12 or 24 V DC.
Total power consumption PD: max. 50mA@24V and PF / PM: max. 400mA@24V.
The voltage is selected with the three switches inside the enclosure.

- *Warning: be sure that all the leads to the terminals are disconnected from the unit when the internal plastic protection cover has been removed !*
- *HIGH VOLTAGE 400V !! NEVER connect the mains power supply to the unit when the plastic protection cover has been removed !!!*

First, remove the terminal strip(s) after which the internal plastic cover can be removed. The switches are located in the top left corner (type PD) or on the right hand (type PF / PM) as indicated:

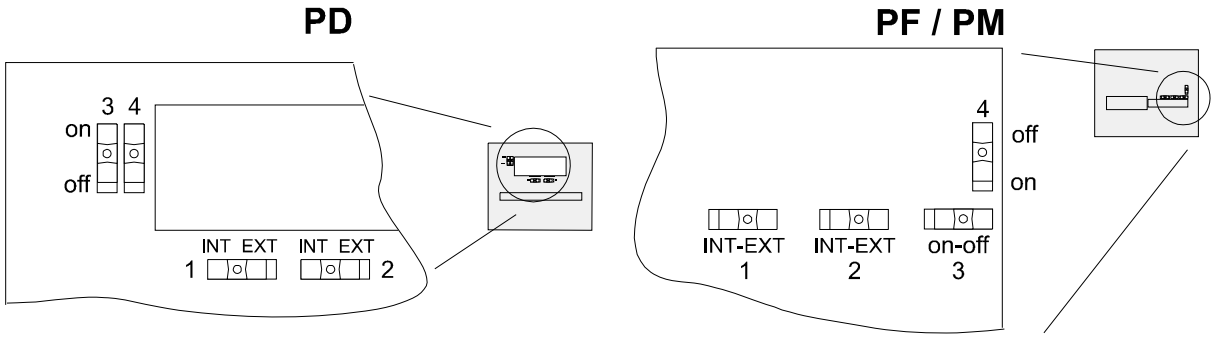


Fig. 8: Switch setting sensor supply voltage.

Switch positions

SENSOR A	
SWITCH 1	VOLTAGE
internal	3.2 V DC
external	switch 3+4

SENSOR B	
SWITCH 2	VOLTAGE
internal	3.2 V DC
external	switch 3+4

VOLTAGE SELECTION		
SWITCH 3	SWITCH 4	VOLTAGE
on	on	8.2 V DC
on	off	12 V DC
off	off	23 V DC

Function switch 1: voltage selection sensor A - terminal 11.
Function switch 2: voltage selection sensor B - terminal 14.
Function switch 3+4: the combination of these switches determine the voltage as indicated. Do move switch 1 and / or switch 2 to the OFF position to enable the selected voltage with switch 3+4.

4.4.3. TERMINAL CONNECTORS

For Intrinsically Safe applications: read chapter 5.

The following terminal connectors are available:

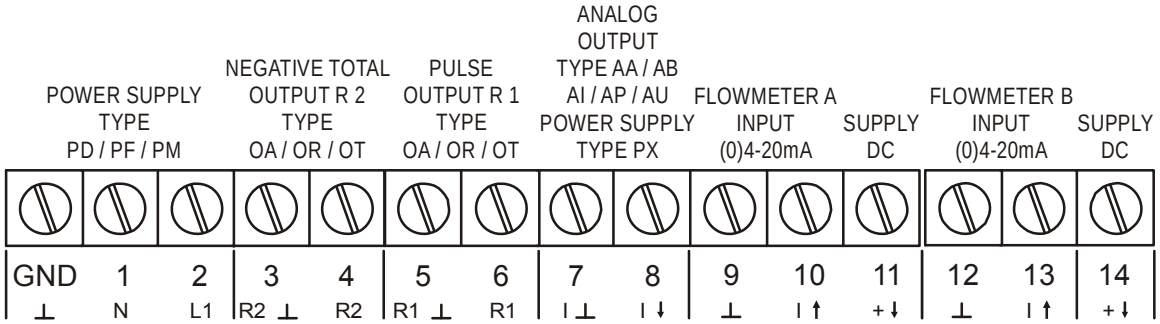


Fig. 9: Overview terminal connectors standard configuration F116-A and options.

REMARKS TERMINAL CONNECTORS:

Terminal GND- 01- 02: Power Supply - only available with type PD / PF or PM:

TYPE	SENSOR SUPPLY	Terminal			backlight	TYPE AA	TYPE AU	Type OA	Type OR
		GND	01	02					
PD 8-24V AC	8,2-12-24V max. 50mA		AC	AC	◊	◊	◊	◊	
PD 8-30V DC	8,2-12-24V max. 50mA	L-	L+		◊	◊	◊	◊	
PF 24V AC ± 15%	8,2-12-24V max. 400mA		AC	AC	◊	◊	◊		◊
PF 24V DC ± 15%	8,2-12-24V max. 400mA	L-	L+		◊	◊	◊		◊
PM 115-230V AC ± 15%	8,2-12-24V max. 400mA	EARTH	AC	AC	◊	◊	◊	◊	◊
Note PD	do not use a AC autotransformer (Spartrafo) without a galvanic isolation.								
Note PF / PM	The total consumption of the sensors and outputs may not exceed 400mA@24V								

◊=option

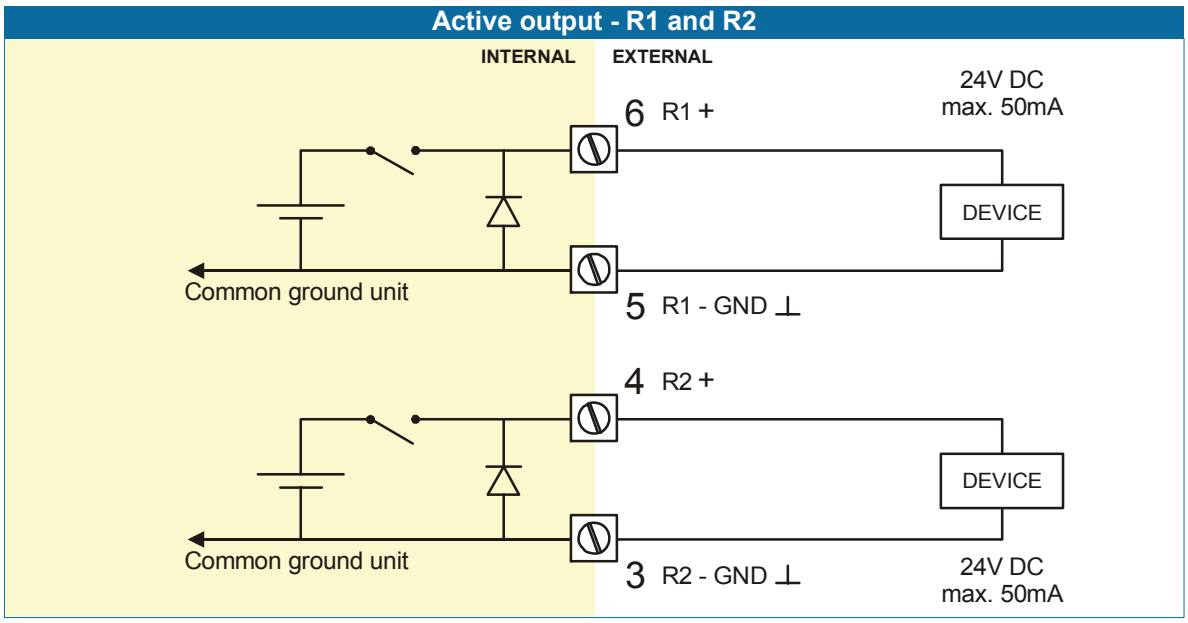
Note !

Note: for power supply type PX: please read Terminal 07-08 !

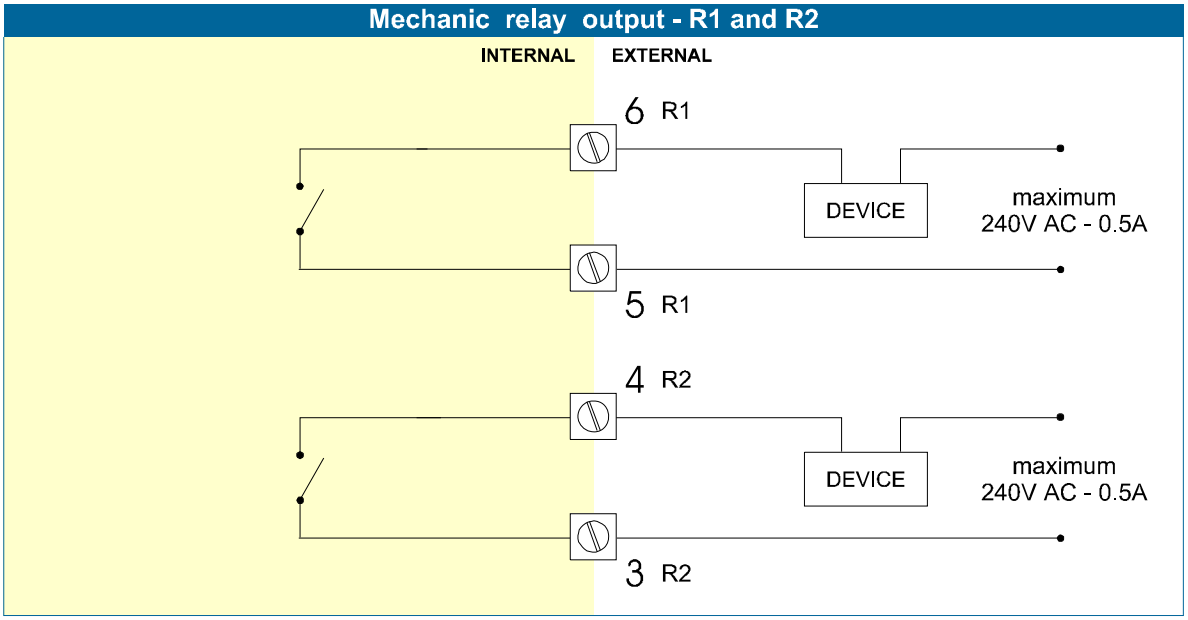
Terminal 03-04; negative total - output R2:
This output is switched in case the calculated accumulated total counts down. This is the case as soon as the measured flow B is more as flow A.

Terminal 05-06; scaled pulse - output R1:
This output is a pulse output. With SETUP A, the function of this output is set.
The maximum pulse frequency of this output is 60Hz.
If a relay output (option OR) has been supplied: be sure that the output frequency does not exceed 5Hz else the life-time of the relay is influenced significantly.

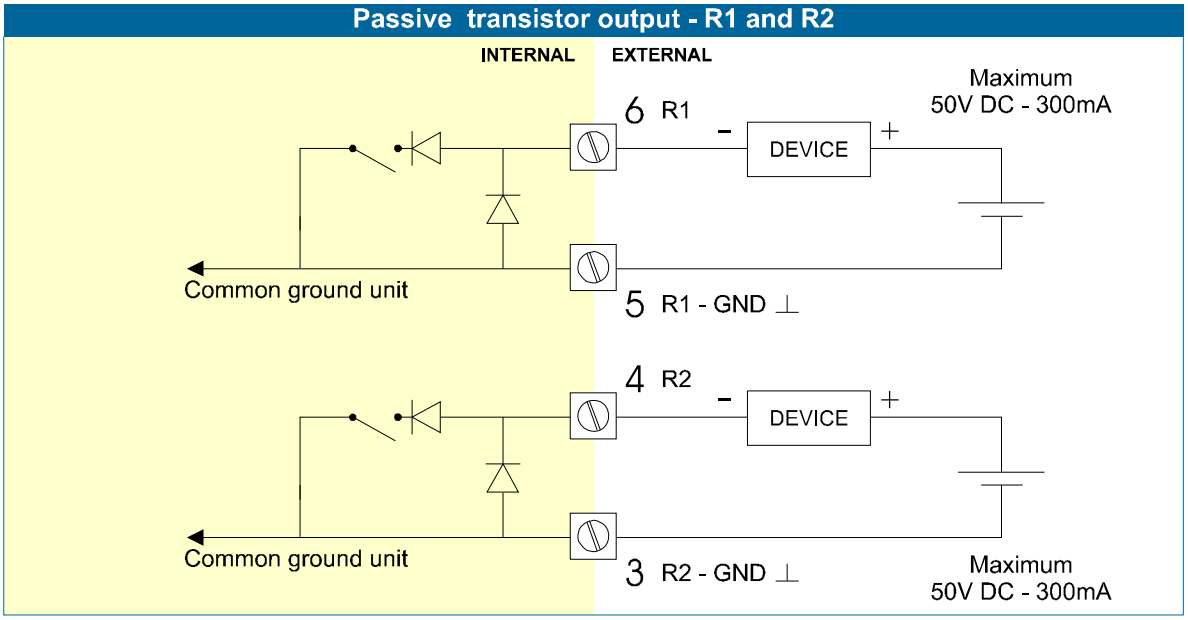
Type OA:
An active 24V DC signal according the alarm settings is available with this option.
Max. driving capacity 50mA@24V per output. (Requires power supply type PD / PF / PM).



Type OR:
A mechanical relay output is available with this option.
Max. switch power 240V-0.5A per output. (Requires power supply type PF / PM).
If this option has been supplied: be sure that the output frequency does not exceed 5Hz else the life-time of the relay is influenced significantly.



Type OT:
A passive transistor output is available with this option. Max. driving capacity 300mA@50V DC.

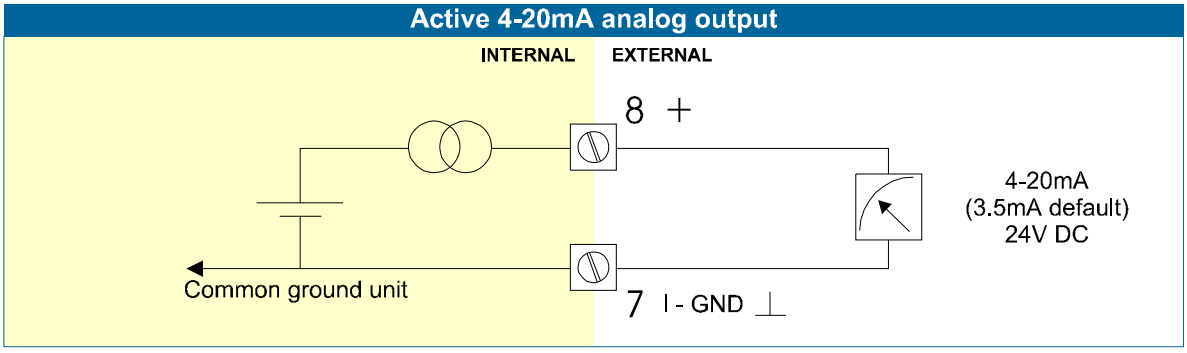


Terminal 07-08; basic POWER SUPPLY - type PX - output loop powered:
Connect an external power supply of 8-30VDC to these terminals or a 4-20mA loop.
Do connect the "-" to terminal 7 and the "+" to terminal 8. When power is applied to these terminals, the (optional) internal battery will be disabled / enabled automatically to extend the battery life time.

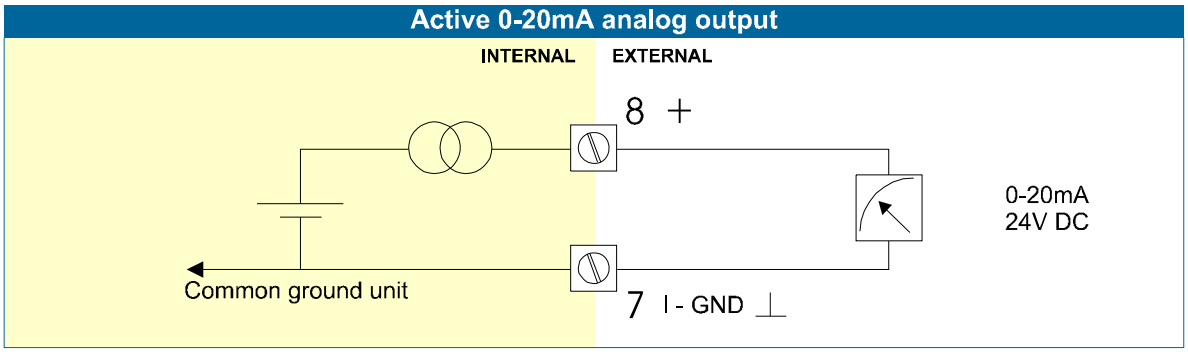
Caution ! *Only valid for standard passive output type AP!*

Terminal 07-08 analog output (SETUP 9) :
An analog output signal proportional to the differential / sum flowrate is available as standard.

Type AA:
An active 4-20mA signal proportional to the flowrate is available with this option.
When the output is disabled, a 3.5mA signal will be generated on these terminals.
Max. driving capacity 1000 Ohm @ 24VDC. (Requires power supply type PD / PF / PM).

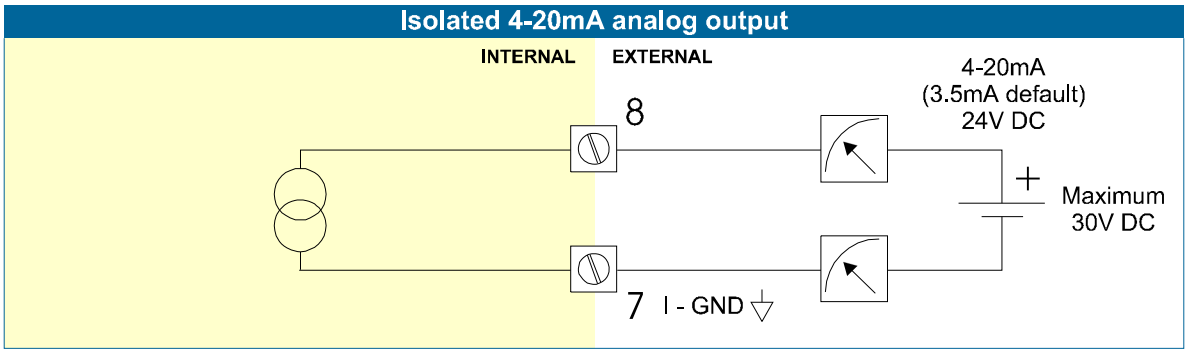


Type AB:
An active 0-20mA signal proportional to the flowrate is available with this option.
Max. driving capacity 1000 Ohm @ 24VDC. (Requires power supply type PD / PF / PM).

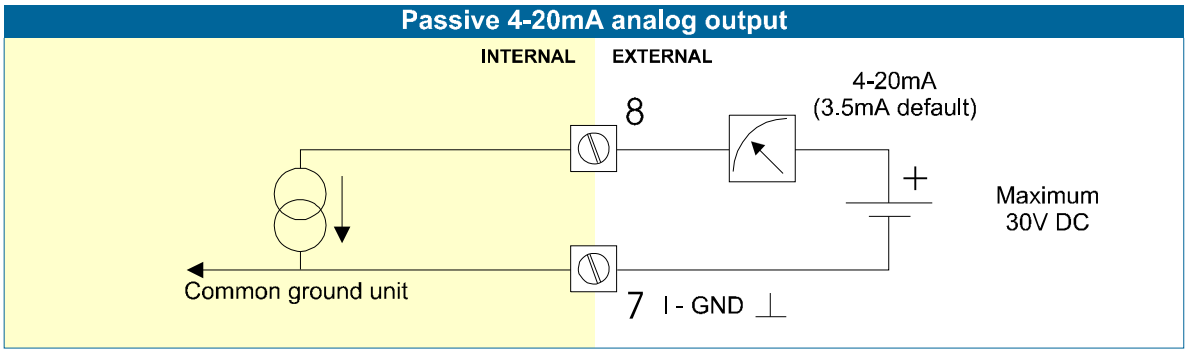


Type AF:
For the Intrinsically Safe floating 4-20mA signal: please read Chapter 5.

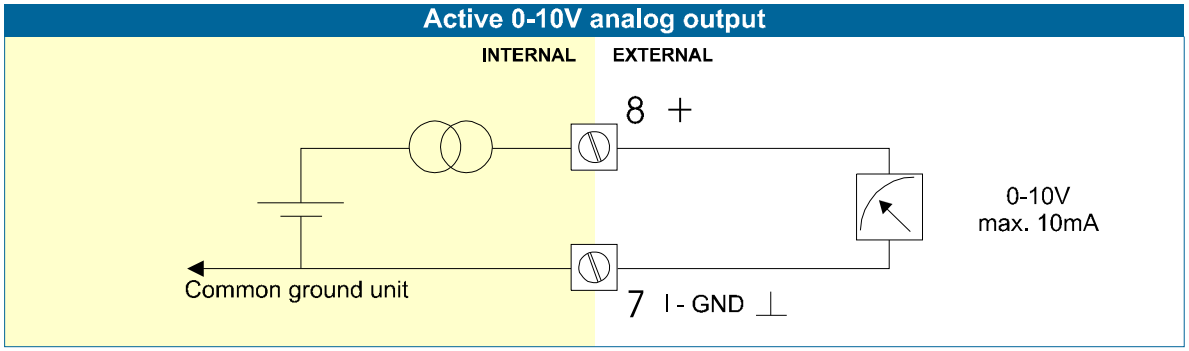
Type AI:
An isolated 4-20mA signal proportional to the flowrate is available with this option.
When the output is disabled, a 3.5mA signal will be generated on these terminals.
Max. driving capacity 1000 Ohm @ 30VDC.
This option can be used with a battery powered unit but the life time of the battery is about 2 -3 years.



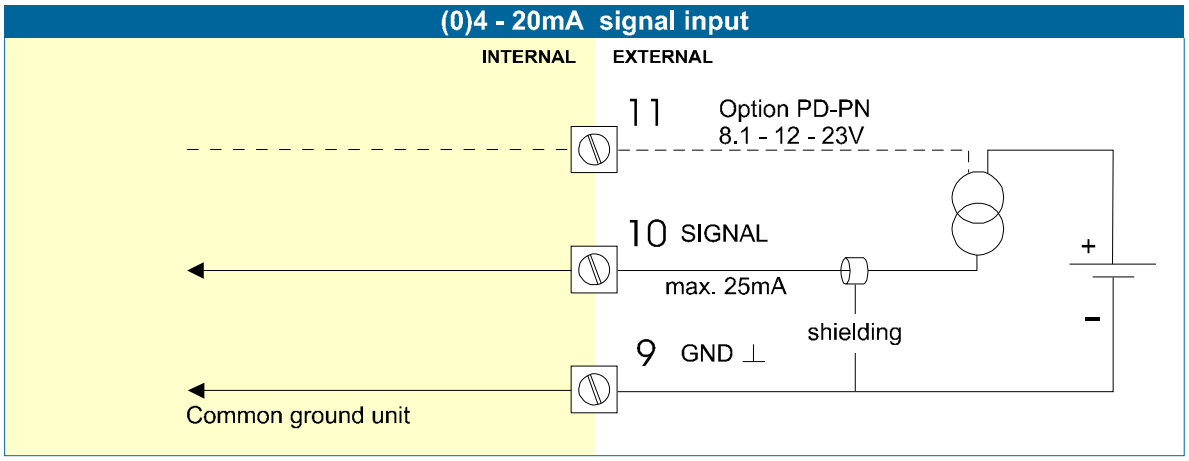
Type AP:
A passive 4-20mA signal proportional to the flowrate is available with this option. When a power supply is connected but the output is disabled, a 3.5mA signal will be generated.
Max. driving capacity 1000 Ohm. This output does loop power the unit as well (type PX).



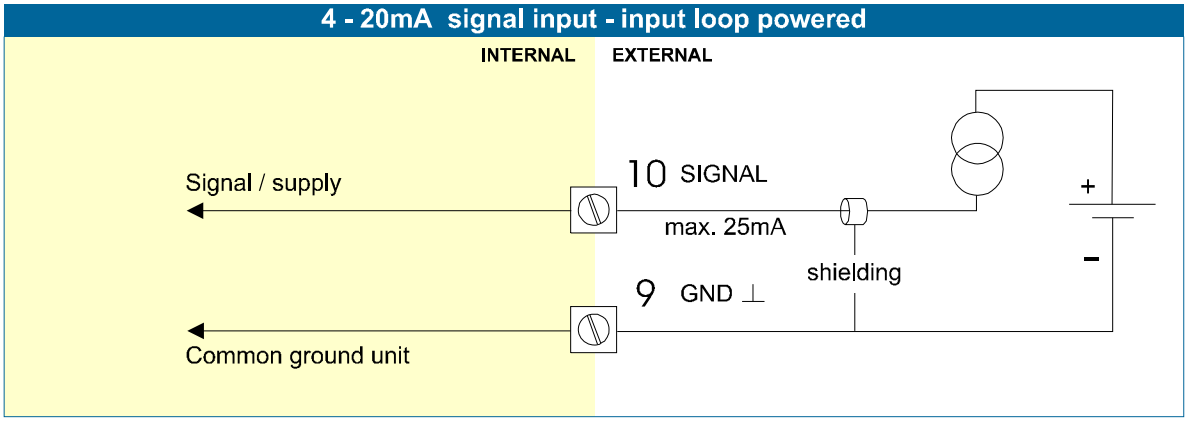
Type AU:
A 0-10VDC signal proportional to the flowrate is available with this option.
Max. load 10mA @ 10VDC. (Requires power supply type PD / PF / PM).



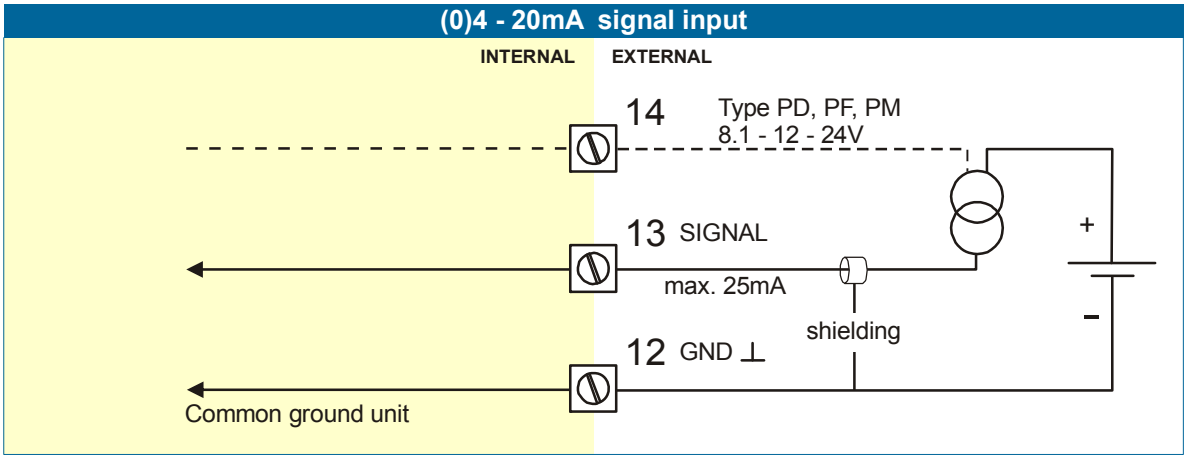
Terminal 09-11: Type A – Flowmeter input A (general)
The F116-A requires a (0)4-20mA flowmeter signal which will be processed 4 times a second with a 14 bits accuracy. The input is not isolated.
For Intrinsically safe applications (without input loop power): please read chapter 5.



Terminal 09-10: Type A-PL – Flowmeter input A / power supply:
The F116-A-PL requires a 4-20mA flowmeter signal which has a double function:
The signal will be processed 4 times a second with a 14 bits accuracy and the unit will be powered from the sensor signal (input loop powered). The input is not isolated and not intrinsically safe.



Terminal 12-14; Flowmeter input B:
The F116-A requires a (0)4-20mA flowmeter signal which will be processed 4 times a second with a 14 bits accuracy. The input is not isolated.
For Intrinsically safe applications: please read chapter 5.



Terminal 26-31: type CB / CH / CI / CT - communication RS232 / RS485 / TTL (option)

- Full serial communications and computer control in accordance with RS232 (length of cable max. 15 meters) or RS485 (length of cable max. 1200 meters) is possible.
- Read the Modbus communication protocol and Appendix C.

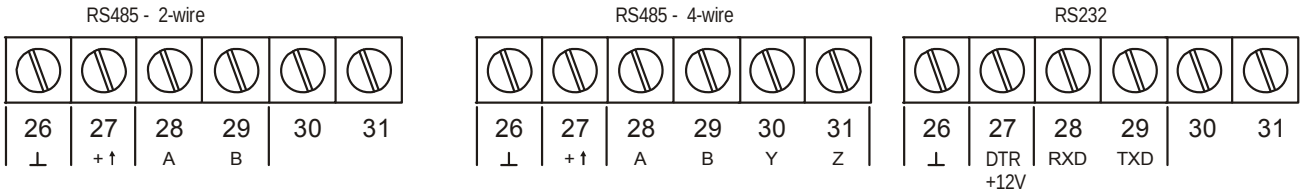


Fig. 10: Overview terminal connectors communication option.

When using the RS232 communication option, terminal 27 is used for supplying the interface. Please connect the DTR (or the RTS) signal of the interface to this terminal and set it active (+12V). If no active signal is available it is possible to connect a separate supply between terminals 26 and 27 with a voltage between 8V and 24V.

Terminal 26-31: backlight - type ZB (option):

Note !

Note: if the unit is supplied with a power supply type PD, PF or PM, the backlight supply is integrated, so the text following is not applicable.

To power the backlight, provide a 12-24V DC to terminal 26 (-) and 27 (+). An external trimmer 1kOhm trimmer can be used to tune the brightness of the backlight, or if not desired, a short-cut between these terminals have to be made which will result in the maximum brightness.

Note !

Note: Intrinsically Safe as well as 4-wire RS485 communication is not possible in combination with type ZB.

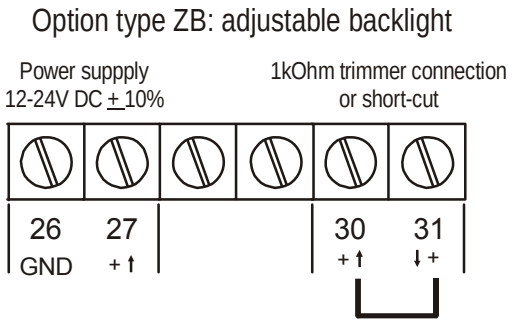


Fig. 11: Overview terminal connectors backlight option.

5. INTRINSICALLY SAFE APPLICATIONS

5.1. GENERAL INFORMATION AND INSTRUCTIONS


Caution !

Cautions

- Mounting, electrical installation, start-up and maintenance of this device may only be carried out by trained personnel authorized by the operator of the facility. Personnel must read and understand this Operating Manual before carrying out its instructions.
- This device may only be operated by personnel who are authorized and trained by the operator of the facility. All instructions in this manual are to be observed.
- Ensure that the measuring system is correctly wired up according to the wiring diagrams. Protection against accidental contact is no longer assured when the housing cover is removed or the cabinet has been opened (danger of electric shock). The housing may only be opened by trained personnel.
- To maintain the degree of protection of at least IP65 in accordance with IEC 60529, certified cable entries in accordance with IEC 61241-0 must be used and correctly installed. Unused openings must be closed with suitable blanking elements.
- When the enclosure of the Indicator is made of aluminum alloy, when used in a potentially explosive atmosphere requiring apparatus of equipment protection level Ga and Da, the unit must be installed such that, even in the event of rare incidents, an ignition source due to impact or friction sparks between the enclosure and iron/steel is excluded.
- Take careful notice of the " Safety rules, instructions and precautionary measures " in the front of this manual.

Safety Instructions

- When two or more active intrinsically safe circuits are connected to the indicator, in order to prevent voltage and/or current addition, applicable to the external circuits, precautions must be taken to separate the intrinsically safe circuits in accordance with IEC 60079-11.
- For the combined connection of the different supply, input and output circuits, the instructions in this manual must be observed.
- From the safety point of view the circuits shall be considered to be connected to earth.
- For installation under ATEX directive: this intrinsically safe device must be installed in accordance with the Atex directive 94/9/EC and the product certificate KEMA 03ATEX1074 X.
- For installation under IECEx scheme: this intrinsically safe device must be installed in accordance the product certificate IECEx DEK 11.0042X.
- Exchange of Intrinsically Safe battery FWLiBAT-0xx with certificate number KEMA 03ATEX1071 U or IECEx KEM 08.0005U is allowed in Hazardous Area. See paragraph 5.4. for detailed battery replacement instructions.

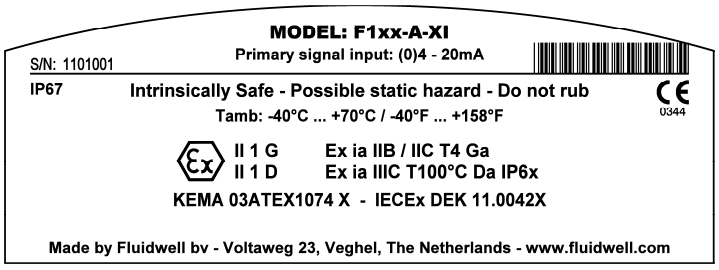

Note !

Please Note

- Certificates, safety values and declaration of compliance can be found in the document named: “Fluidwell F1..-..-XI - Documentation for Intrinsic Safety”.
- Special conditions for safe use mentioned in both the certificate and the installation instructions must be observed for the connection of power to both input and / or output circuits.
- When installing this device in hazardous areas, the wiring and installation must comply with the appropriate installation standards for your industry.
- Study the following pages with wiring diagrams per classification.

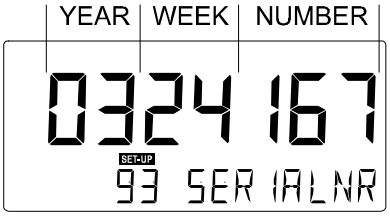
Label information (inside and outside the enclosure)

Indicated labels on the back cover (below) and on the inside cover (right) show the type labels for intrinsically safe certified units.
For details on usage see the separate “Fluidwell F1..-..-XI Documentation for Intrinsic Safety”.



Serial number and year of production

This information can be looked-up on the display:
See setup function (par. 3.2.2.) for details.



5.2. TERMINAL CONNECTORS INTRINSICALLY SAFE APPLICATIONS

Note !

The unit is classified as group IIB/IIIC by default.

Classification of the unit as group IIC is only possible under the following conditions:

- The indicator is either supplied by
  - the internal supply (option -PC); or
  - the external supply connected to terminals 0 and 1 (option -PD); or
  - the circuit supply connected to terminals 7 and 8 (option -AP);

  The maximum values for any of those circuits are those as defined for group IIB/IIIC;
- No other active external intrinsically safe circuits may be connected to the indicator, with exception of circuits connected to terminals 3 and 4 and/or terminals 5 and 6; the maximum values for any of those circuits are those as defined for group IIB/IIIC

Terminal connectors F116-A-XI:

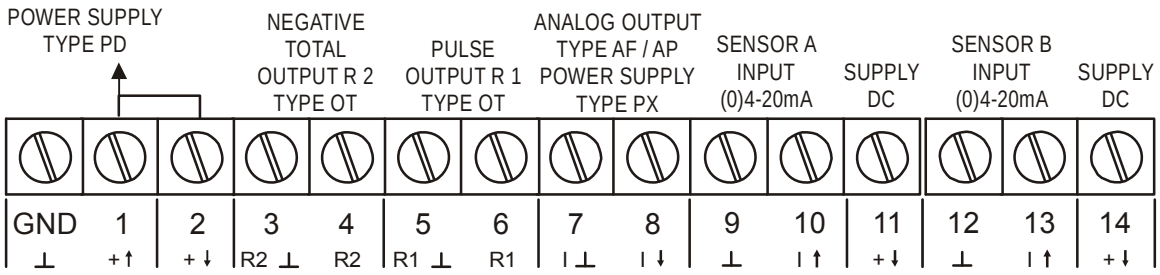


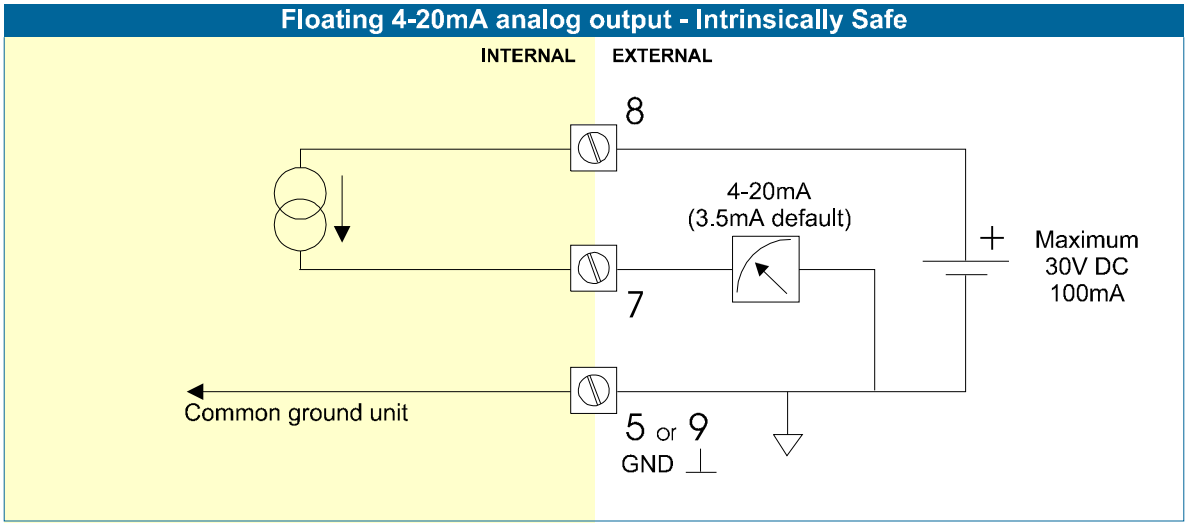
Fig. 12: Overview terminal connectors Intrinsically Safe.

Explanation Intrinsically Safe options:

Type AF - Intrinsically Safe floating 4-20mA analog output - Terminal 7-8:
A floating 4-20mA signal proportional to the flowrate is available with this option.
When the output is disabled, a 3.5mA signal will be generated.
Max. driving capacity 1000 Ohm @ 30V DC.

Note !

Note! It is required to link the minus from the analog output - terminal 7 - with a ground terminal of the unit; terminal: GND, 3, 5, 9, 12 or 15.



Type PD-XI
Intrinsically Safe power supply and sensor supply - Terminal GND- 01, 11 and 14.

TYPE		SENSOR SUPPLY (TERMINAL 11 AND 14)	Terminal		
			GND	01	02
PD-XI	Input voltage: 8-30V DC	= input voltage	L-	L+	output voltage is according the input voltage; internally linked with terminal 01.

Terminal 02, 11 and 14: these terminals offer the same voltage as connected to terminal 01.

5.3 CONFIGURATION EXAMPLES

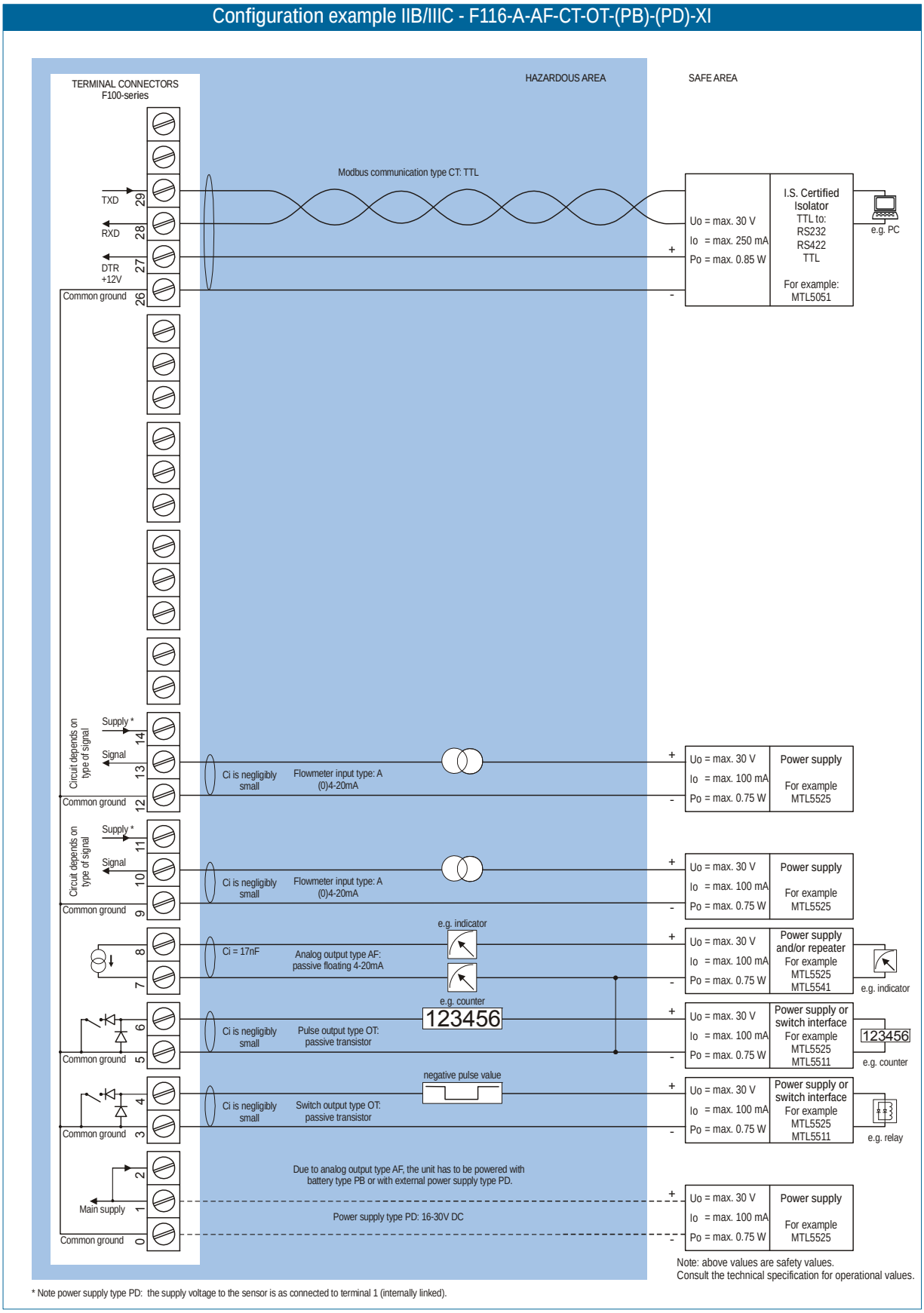


Fig. 13: Configuration example 1 Intrinsically

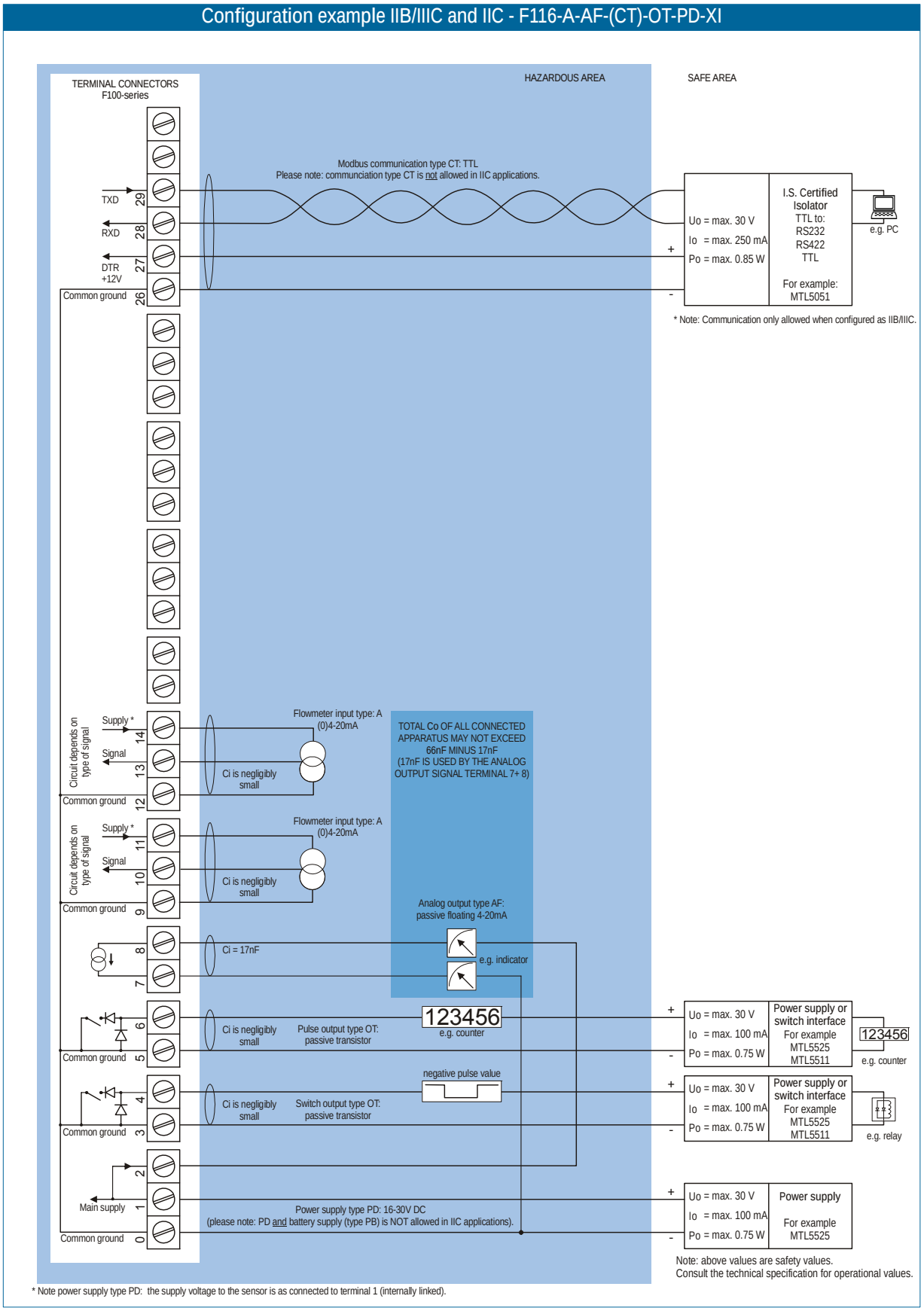


Fig. 14: Configuration example 2 Intrinsically Safe

5.4 BATTERY REPLACEMENT INSTRUCTIONS

WARNING

Safety Instructions

- **Fire, explosion or severe burns may result if mistreated.** Do not recharge, crush, disassemble, incinerate, heat above 100°C (212°F) or expose contents to water.
- Mounting, electrical installation, start-up and maintenance of this device may only be carried out by trained personnel authorized by the plant operator. Personnel must read and understand this instruction before carrying out the replacement procedure.
- Always follow the instructions listed in the supplied Battery Replacement Instruction Sheet.
- Batteries pose an environmental hazard. Return used batteries to a recycling point.

Caution !

Safety instructions for hazardous areas

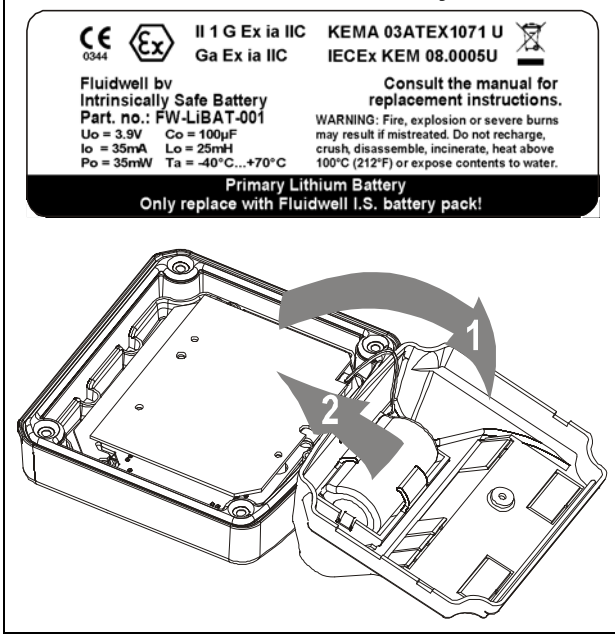
- Verify the correct battery is supplied: **Only batteries with indicated Ex label are certified for replacement and use in hazardous areas**. Batteries for use in safe areas have no Ex label. **DO NOT EXCHANGE**: Using the wrong type of battery can pose a SERIOUS RISK.
- **For use in hazardous areas Fluidwell recommends FW-LiBAT batteries (manufactured by Fluidwell bv) only**.

Battery replacement procedure

Note !

Depending on the production batch, one of two visualized Intrinsically Safe certified battery types may have been installed in the unit. They are interchangeable.

FW-LiBAT-001 battery



FW-LiBAT-021 battery

1. To replace the battery, open the unit to gain access to the back inside cover of the unit.
2. Unplug the field connectors from the back inside of the unit.
3. Remove the screw that holds the plastic inside cover.
4. Open the cover and unplug the battery connector.
5. Remove the battery from the inside of the plastic cover. *Do not remove the battery clip!*
6. Install the new battery and re-assemble the unit in reverse order.
7. Start-up the unit

6. MAINTENANCE

6.1. GENERAL DIRECTIONS


Caution !

- Mounting, electrical installation, start-up and maintenance of the instrument may only be carried out by trained personnel authorized by the operator of the facility. Personnel must read and understand this Operating Manual before carrying out its instructions.
- The F116-A may only be operated by personnel who are authorized and trained by the operator of the facility. All instructions in this manual are to be observed.
- Ensure that the measuring system is correctly wired up according to the wiring diagrams. Protection against accidental contact is no longer assured when the housing cover is removed or the panel cabinet has been opened (danger from electrical shock). The housing may only be opened by trained personnel.
- Take careful notice of the " Safety rules, instructions and precautionary measures " in the front of this manual.

The F116-A does not require special maintenance unless it is used in low-temperature applications or surroundings with high humidity (above 90% annual mean). It is customers responsibility to take all precautions to dehumidify the internal atmosphere of the F116-A in such a way that no condensation will occur, for example by placing dry silica-gel in the casing just before closing the enclosure.
Furthermore, is required to replace or dry the silica gel from time to time as advised by the silica gel supplier.

Battery life-time:
It is influenced by several issues as:
- Display update: fast display update has major influence; SETUP 61.
- Pulse output and communication.
- Low temperatures; the available power will be less due to battery chemistry.


Note !

Note: *It is strongly advised to disable unused functions.*

Check periodically:
- The condition of the casing, cable glands and front panel.
- The input/output wiring for reliability and aging symptoms.
- The process accuracy. As a result of wear and tear, re-calibration of the flowmeter might be necessary. Do re-enter any subsequent Span alterations.
- The indication for low-battery.
- Clean the casing with soapy-water; don't use any aggressive solvents as these might damage the polyester coating.

APPENDIX A: TECHNICAL SPECIFICATION

GENERAL

Display	
Type	High intensity reflective numeric and alphanumeric LCD, UV-resistant.
Digits	Seven 17mm (0.67") and eleven 8mm (0.31"). Various symbols and measuring units.
Refresh rate	User definable: 8 times/sec - 30 secs.
Type ZB	Transflective LCD with green LED backlight. Good readings in full sunlight and darkness. Note: only available for safe area applications. Power requirements: 12-24V DC + 10% or type PF, PM. Power consumption max. 1 Watt.

Enclosures	
General	Die-cast aluminum or GRP (Glassfibre Reinforced Polyamide) enclosure with Polycarbonate window, silicone and EPDM gaskets. UV stabilized and flame retardant material.
Control Keys	Three industrial micro-switch keys. UV-stabilized silicone keypad.
Painting	Aluminum enclosure only: UV-resistant 2-component industrial painting.
Panel-mount enclosures	Dimensions: 130 x 120 x 60mm (5.10" x 4.72" x 2.38") – LxHxD.
Classification	IP65 / NEMA4X
Panel cut-out	115 x 98mm (4.53" x 3.86") LxH.
Type HC	GRP panel-mount enclosure
Type HB	Aluminum panel-mount enclosure
Field/wall-mount enclosures	Dimensions: 130 x 120 x 75mm (5.10" x 4.72" x 2.95") – LxHxD.
Classification	IP67 / NEMA4X
Aluminum enclosures	
Type HA	Drilling: 2x PG9 – 1x M20.
Type HM	Drilling: 2x M16 – 1x M20.
Type HN	Drilling: 1x M20.
Type HO	Drilling: 2x M20.
Type HP	Drilling: 6x M12.
Type HT	Drilling: 1x ½"NPT.
Type HU	Drilling: 3x ½"NPT.
Type HZ	No drilling.
GRP enclosures	
Type HD	No drilling.
Type HE	Drilling: 2x 16mm (0.63") – 1x 20mm (0.78").
Type HF	Drilling: 1x 22mm (0.87").
Type HG	Drilling: 2x 20mm (0.78").
Type HH	Drilling: 6x 12mm (0.47").
Option ZS	Silicone free ABS enclosure with EPDM and PE gaskets. UV-resistant polyester keypad. Note: this option comes with type HD only.

Operating temperature	
Operational	-40°C to +80°C (-40°F to +176°F)
Intrinsically Safe	-40°C to +70°C (-40°F to +158°F)

Power supply	
Type PB	Lithium battery - life-time depends upon settings - up to 5 years.
Type PC	Intrinsically Safe lithium battery - life-time depends upon settings - up to 5 years.
Type PD	8-24V AC / DC ± 10%. Power consumption max. 10 Watt. Intrinsically safe: 16-30V DC; power consumption max. 0.75 Watt.
Type PF	24V AC / DC ± 10%. Power consumption max. 15 Watt.
Type PL	Input loop powered from sensor signal 4-20mA (type A, non IS).
Type PM	115-230V AC ± 10%. Power consumption max. 15 Watt.
Type PX	Output loop powered: 8-30V DC. Power consumption max. 0.5 Watt.
Note PF / PM	The total consumption of the sensors`, backlight and outputs may not exceed 400mA@24V.
Note I.S. applications	For intrinsically safe applications, consult the safety values in the certificate.

Sensor excitation	
Type PB / PC / PX	3.2V DC for pulse signals and 1.2V DC for coil pick-up. Note: This is not a real sensor supply. Only suitable for pulse sensors with a very low power consumption like coils (sine wave) and reed-switches.
Type PD	1.2 - 3.2 - 8.2 - 12 and 24V DC - max. 50mA@24V DC
Type PD-XI	Intrinsically safe: Pulse signals: 1.2 - 3.2 - 8.2 - max. 7mA@8.2V DC. Analog signals: the sensor supply voltage is according to the power supply voltage connected to terminal 1. Also terminal 2 offers the same voltage.
Type PF / PM	1.2 - 3.2 - 8.2 - 12 and 24V DC - max. 400mA@24V DC.

Terminal connections	
Type:	Removable plug-in terminal strip. Wire max. 1.5mm2 and 2.5mm2 (Type PM / PF)

Data protection	
Type	EEPROM backup of all setting. Backup of running totals every minute. Data retention at least 10 years.
Pass code	Configuration settings can be pass code protected.

Hazardous area (option)	
Intrinsically safe Type XI	ATEX approval: II 1 G Ex ia IIB/IIC T4 Ga II 1 D Ex ia IIIC T100°C Da IP6x IECEx approval: Ex ia IIB/IIC T4 Ga Ex ia IIIC T100°C Da IP6x
Explosion proof Type XD/XF	ATEX approval ref.: <EX> II 2 GD EEx d IIB T5. Weight appr. 15kg. Dimensions of enclosure: 350 x 250 x 200mm (13.7" x 9.9" x 7.9") LxHxD.

Environment	
Electromagnetic compatibility	Compliant ref: EN 61326 (1997), EN 61010-1 (1993).

INPUTS

Flowmeter	
Type P	Coil/sine wave (minimum 20mVp-p or 80mVp-p - sensitivity selectable), NPN/PNP, open collector, reed-switch, Namur, active pulse signals 8 - 12 and 24V.
Frequency	Minimum 0 Hz - maximum 7 kHz for total and flowrate. Maximum frequency depends on signal type and internal low-pass filter. E.g. Reed switch with low-pass filter: max. frequency 120 Hz.
K-Factor	0.000010 - 9,999,999 with variable decimal position.
Low-pass filter	Available for all pulse signals.
Type A	(0)4-20mA - with signal calibration feature at any current within the range.
Type U	0-10 V - with signal calibration feature at any voltage within the range.
Accuracy	Resolution: 14 bit. Error < 0.025mA / ±0.125% FS. Low level cut-off programmable.
Span	0.000010 - 9,999,999 with variable decimal position.
Update time	Four times a second.
Voltage drop	2.5 Volt.
Load impedance	3kOhm
Relationship	Linear and square root calculation.
Note	For signal type A and U: external power to sensor is required; e.g. Type PD.

OUTPUTS

Analog output	
Function	transmitting differential / sum flowrate.
Accuracy	10 bit. Error < 0.05% - update 10 times a second. Software function to calibrate the 4.00mA and 20.00mA levels precisely within set-up.
Load	max. 1 kOhm
Type AA	Active 4-20mA output (requires type OA + PD, PF or PM).
Type AB	Active 0-20mA output (requires type OA + PD, PF or PM).
Type AF	Passive floating 4-20mA output for Intrinsically Safe applications (requires PC, PD or PL).
Type AI	Passive galvanically isolated output (requires PB, PD, PF, PL or PM).
Type AP	Passive 4-20mA output - output loop powered (type PX).
Type AU	Active 0-10V output (requires type OA + PD, PF or PM).

Transistor output(s)	
Function	One pulse output - transmitting differential / sum accumulated total. One positive / negative output related to the negative accumulated total.
Pulse output	Max. frequency 60Hz. Pulse length user definable between 7,8msec up to 2 seconds.
Type OA	Active 24V DC transistor output; max. 50mA per output (requires type AA + PD, PF or PM).
Type OR	Isolated mechanic relay output; max. switch power 230V AC - 0,5A (requires type PF or PM).
Type OT	Passive transistor output - not isolated. Load max. 50V DC - 300mA.

Communication option	
Functions	reading display information, reading / writing all settings.
Protocol	Modbus ASCII or RTU
Speed	1200 - 2400 - 4800 - 9600 baud
Addressing	maximum 255 addresses.
Type CB	RS232
Type CH	RS485 2-wire
Type CI	RS485 4-wire
Type CT	TTL Intrinsically Safe communication.
Type CX	no communication.

OPERATIONAL

Operator functions	
Displayed functions	• calculated differential or sum total and/or flowrate. • calculated differential or sum accumulated total. • flowrate / total flow A • flowrate / total flow B • all totals can be reset to zero by pressing the CLEAR-key twice.

Total	
Digits	7 digits.
Units	L, m3, GAL, USGAL, KG, lb, bbl, no unit.
Decimals	0 - 1 - 2 or 3.
Note	total can be reset to zero.

Accumulated total	
Digits	11 digits.
Units / decimals	according selection for total.

Flowrate	
Digits	7 digits.
Units	mL, L, m3, Gallons, KG, Ton, lb, bl, cf, RND, ft3, scf, Nm3, NL, P, no units.
Decimals	0 - 1 - 2 or 3.
Time units	/sec - /min - /hr - /day.

APPENDIX B: PROBLEM SOLVING

In this appendix, several problems are included that can occur when the F116-A is going to be installed or while it is in operation.

Analog output does not function properly:
Check:
- SETUP 91 - is the function enabled?
- SETUP 92 / 93: are the flow-levels programmed correctly?
- connection of the external power-supply according specification.

Pulse output does not function:
Check:
- SETUP A1 - pulse per X-quantity; is the value programmed reasonable and will the maximum output be under 20Hz?
- SETUP A2 - impulse width; is the external device able to recognize the selected pulse width and frequency?

Flowrate displays "0 / zero" while there is flow (total is counting):
Check:
- SETUP 22 / 24 and 41 / 42: are the Span and time unit correct?

The password is unknown:
If the password is not 1234, there is only one possibility left: call your supplier.

ALARM
When the alarm flag starts to blink an internal alarm condition has occurred. Press the "select button" several times to display the 5-digit error code. The codes are:

0001: irrecoverable display-data error: data on the display might be corrupted.
0002: irrecoverable data-storage error: the programming cycle might have gone wrong: check programmed values.
0003: error 1 and error 2 occurred simultaneously

If the alarm occurs more often or stays active for a longer time, please contact your supplier.

APPENDIX C: COMMUNICATION VARIABLES

Remarks:

- Below, an overview of the F116-U specific variables; other common variables are described in the standard table.
- All numbers are decimal numbers, unless otherwise noted.
- Following variables of the standard table (var00-var30) are not valid for this product and will be responded with value 1: var00, 03-05, 07,08, 16-22, 24, 26-29.

CONFIGURATION VARIABLES F116-U - SETUP-LEVEL:				
VAR	**DESCRIPTION**	**BYTES**	**VALUE**	**REMARKS**
TOTAL A				
32 (20h)	unit	1	0=L 1=m3 2=kg 3=lb 4=gal 5=usgal 6=bbl 7=none	
33 (21h)	decimals	1	0…3	
34 (22h)	span	3	1....9.999.999	S 0000001 up to S 0000009 is allowed when decs < 6! (VAR37)
37 (25h)	decimals Span	1	0…6	
FLOWRATE A				
48 (30h)	unit	1	0=mL 1=L 2=m3 3=mg 4=g 5=kg 6=ton 7=gal 8=bbl 9=lb 10=cf 11=rev (revolutions for RPM) 12=none 13=scf 14=NM3 15=NL 16=p	
49 (31h)	time unit	1	0=sec 1=min 2=hour 3=day	
50 (32h)	decimals	1	0…1	
51 (33h)	span	3	1....9.999.999	S 0000001 up to S 0000009 is allowed when decs < 6! (VAR54)
54 (36h)	decimals span	1	0…6	

TOTAL B				
40 (28h)	span	3	1....9.999.999	S 0000001 up to S 0000009 is allowed when decs < 6! (VAR37)
43 (2Bh)	decimals Span	1	0…6	
FLOWRATE B				
227 (E3h)	span	3	1....9.999.999	S 0000001 up to S 0000009 is allowed when decs < 6! (VAR54)
230 (E6h)	decimals span	1	0…6	
DISPLAY				
64 (40h)	function	1	0=decrease 1=increase	
67 (43h)	calculate	1	0=differential 1=sum	
73 (49h)	Negative flow	1	0=disable 1=enable	
POWERMANAGEMENT				
80 (50h)	LCD update time	1	0=fast 1=1sec 2=3sec 3=15sec 4=30sec 5=off	
81 (51h)	power-mode battery	1	0=operational 1=shelf	
FLOWMETER A				
98 (62h)	formula	1	0=linear 1=square root	
99 (63h)	filter	1	0….99	
100 (64h)	cut-off	2	0….999	steps of 0.1%
102 (66h)	calibration low (0)4mA	1	0=default 1=calibrate 2=cal set	
103 (67h)	calibration high 20mA	1	0=default 1=calibrate 2=cal set	
FLOWMETER B				
182 (B6h)	formula	1	0=linear 1=square root	
183 (B7h)	Filter	1	0….99	
184 (B8h)	cut-off	2	0….999	steps of 0.1%
186 (BAh)	Calibration low (0)4mA	1	0=default 1=calibrate 2=cal set	
187 (BBh)	calibration high 20mA	1	0=default 1=calibrate 2=cal set	

ANALOG OUTPUT				
112 (70h)	analog output	1	0=disable 1=enable	
113 (71h)	minimum rate	3	0..9999999	unit, time, decimals acc. var48-50
116 (74h)	maximum rate	3	0..9999999	unit, time, decimals acc. var48-50
119 (77h)	cut off percentage	1	0..99	steps of 0.1%
120 (78h)	tune minimum rate	2	0..9999	
122 (7Ah)	tune maximum rate	2	0..9999	
99 (63h)	filter	1	0….99	
VAR	**DESCRIPTION**	**BYTES**	**VALUE**	**REMARKS**
PULSE OUTPUT				
128 (80h)	impulse width	1	0=off 1=short 2=long	
129 (81h)	pulse per X quantity	3	1..9999999	unit, decimals acc. var32 -33
OTHERS				
168 (A8h)	password	2	xxxx	read only!
170 AAh	tagnumber	3	0..9999999	Other vars: see standard table

OTHER F116-U VARIABLES FOR COMMUNICATION

DIFFERENTIAL TOTAL - variable number 566 (236h) – 6 bytes

READ TOTAL: The value of total read using communication might differ from the value that appears on the display. This is due to the fact that the display can only display up to seven digits (e.g. when two decimals are selected for total and total has a value of 123456,78 the display will show 23456,78 while communication will read a “total” of 12345678 and a “total decimals” of 2).

WRITE TOTAL: Total can only be cleared. This means writing a value different from 0 will result in the reply of an error message. Only writing 6 bytes of zero’s to total will be accepted.

DIFFERENTIAL ACCUMULATED TOTAL - variable number 560 (230h) – 6 bytes

READ ACC. TOTAL: A difference between the read value and the display value, as explained for “Read total”, might appear here too.

WRITE ACC. TOTAL: Impossible.

When reading or writing total or accumulated total it should be noted that the used values are given including the decimals. This means a read/write to one of these variables should be accompanied with a read/write to the variable that holds the number of decimals for this variable:

Example: read var. 566 for differential total:
Read var. 33 for total decimals and calculate the real value of total by multiplying total with 10^{-} *(total decimals)*

FLOWRATE no. 1 - variable number 572 (23Ch) – 4 bytes
FLOWRATE no. 2 - variable number 588 (24Ch) – 4 bytes
DIFFERENTIAL FLOWRATE - variable number 58 (3Ah) – 4 bytes

READ FLOWRATE: The value difference as mentioned with total/acc. total might appear here too.

WRITE FLOWRATE: Impossible.

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LIST OF FIGURES IN THIS MANUAL

NOTES

LIST OF CONFIGURATION SETTINGS

SETTING	DEFAULT	DATE :	DATE :
1 - TOTAL A			
11 unit	L		
12 decimals	0000000		
13 span	000001 /sec	/sec	/sec
14 decimals span	0		
2 - FLOWRATE A			
21 unit	L		
22 time unit	/min		
23 decimals	0000000		
24 span	000001 /min		
25 decimals span	0		
3 - TOTAL B			
31 span	000001 /sec	/sec	/sec
32 decimals span	0		
4 - FLOWRATE B			
41 span	000001 /min		
42 decimals span	0		
5 - DISPLAY			
51 function	total		
52 calculate	differential		
53 negative flow	enable		
6 - POWER MANAGEMENT			
61 LCD-new	1 sec.		
62 mode	operational		

SETTING	DEFAULT	DATE :	DATE :
7 - FLOWMETER - A			
71 formula	interpolation		
72 filter	01 (off)		
73 cut-off %	00.0%		
74 calibrat. low-(0)4mA	default		
75 calibrat. high-20mA	default		
8 - FLOWMETER - B			
81 formula	interpolation		
82 filter	01 (off)		
83 cut-off %	00.0%		
84 calibrat. low-(0)4mA	default		
85 calibrat. high-20mA	default		
9 - ANALOG OUTPUT			
91 output	disabled		
92 min. flowrate 4-mA	0000000		
93 max. flowrate 20mA	9999999		
94 cut off percentage	0.0%		
95 tune min - 4mA	0208		
96 tune max - 20mA	6656		
97 filter	01 (off)		
A - PULSE OUTPUT			
A1 impulse width	010 periods		
A2 pulse per	0001000		
B - COMMUNICATION			
B1 baud-rate	2400		
B2 address	1		
B3 mode	BUS-ASC		
C - OTHERS			
C1 model	F116-A	F116-A	F116-A
C2 software version			
C3 serial number			
C4 password	0000		
C5 tagnumber	0000000		

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