


# DIFFERENTIAL / SUM FLOWCOMPUTER

## WITH ANALOG AND PULSE SIGNAL OUTPUTS



### Features

- Calculates differential flow rate (consumption) total and accumulated total of flow A and B or the sum .
- Precautions for pulsating flows and very low consumption readings.
- 7 digit resettable total.
- 11 digit accumulated total.
- Large 17mm (0.67") digit selection for flow rate or total.
- Analog and pulse signal outputs.
- Very compact design for panel mount, wall mount or field mount applications.
- Operational temperature -40°C up to +80°C (-40°F up to 176°F).
- Rugged aluminum field mount enclosure IP67/NEMA4X.
- Intrinsically Safe - ATEX and IECEx approval for gas and dust applications.
- Explosion/ flame proof  II 2 GD EEx d IIB T5.
- Full Modbus communication RS232/485/TTL.
- Loop or battery powered, 8 - 24V AC/DC or 115 - 230V AC power supply.
- Sensor supply 3.2 / 8.2 / 12 / 24V DC.

### Signal output

- (0)4 - 20mA / 0 - 10V DC according to differential / sum flow rate.
- Scaled pulse output according to differential / sum accumulated total.
- Negative pulse value indication.

### Signal input

#### Flow

- Reed-switch.
- NAMUR.
- NPN/ PNP pulse.
- Sine wave (coil).
- Active pulse signals.
- (0)4 - 20mA.
- 0 - 10V DC.

### Applications

- Fuel consumption calculation for diesel engines on board of ships or locomotives. Sum function: where flows are split-up in two pipe-lines and total flow has to be calculated. More advanced model: F127.

## General information

### Introduction

The flowcomputer Model F116 has been developed to calculate differential or total volume. Typical applications are the measurement of fuel consumption or the calculation of total flow (sum) if - for costs reasons - two low cost flowmeters can be used instead of one expensive flowmeter. The usual difficulties encountered in such applications include: pulsating flows, very low consumption readings, vibration and high ambient temperatures. These are all well catered for in the design and operation of the F116.

### Display

The display has large 17mm (0.67") and 8mm (0.31") digits which can be set to show flow rate and total. On-screen engineering units are easily configured from a comprehensive menu. The accumulated total can register up to 11 digits and is backed-up in EEPROM memory every minute.

### Configuration

All configuration settings are accessed via a simple operator menu which can be pass-code protected. Each setting is clearly indicated with an alphanumerical description, which avoids confusing abbreviations. Once familiar with one F-series product, you will be able to program all models in the series without a manual. All settings are safely stored in EEPROM memory in the event of sudden power loss.

### Analog output signal

The calculated flow rate is re-transmitted with the (0)4 - 20mA or 0 - 10V DC output signal. The output signal is updated ten times per second with a filter function being available to smoothen out the signal if desired. The output value is user defined in relation to the flow rate, e.g. 4mA equals to 15L/Hr and 20mA equals to 2000L/Hr. The output signal can be passive, active or isolated where the passive output type will loop power the F116 as well.

### Pulse output

The scaleable pulse output, reflects the count on the accumulated display. The pulse length is user defined and the maximum output frequency is 64Hz. The second output will be

switched in case the total is counting down (negative consumption). The output signal can be a passive NPN, active PNP or an isolated electro-mechanical relay.

### Signal input

The F116 accepts most pulse and analog input signals for volumetric flow or mass flow measurement. The input signal type can be selected by the user in the configuration menu without having to adjust any sensitive mechanical dip-switches or jumpers.

### Communication

All process data and settings can be read and modified manually or through the Modbus communication link (RS232 / RS485). Full Modbus functionality remains available for the Intrinsically Safe version (TTL).

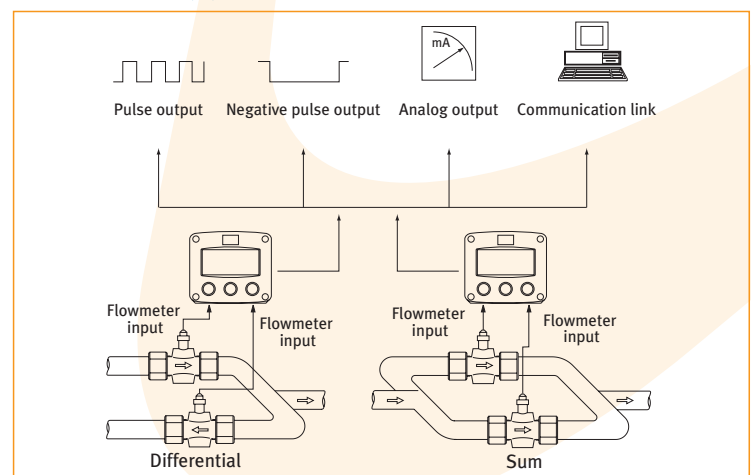
### Hazardous areas

This model has been ATEX and IECEx certified Intrinsically Safe for gas and dust applications, with an allowed operational temperature of -40°C to +70°C (-40°F to +158°F). A flame proof enclosure with ATEX certification offers the rating  $\text{Ex}$  II 2 GD EEx d IIB T5.

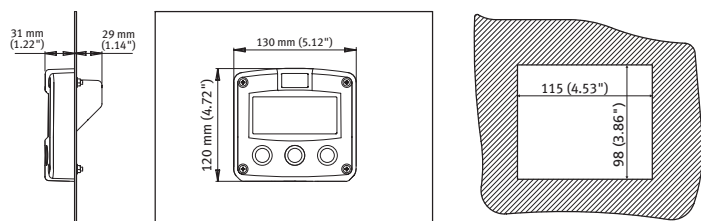
### Enclosures

Various types of enclosures can be selected, all ATEX and IECEx approved. As standard the F116 is supplied in an GRP panel mount enclosure. Most popular is our rugged aluminum field mount enclosure with IP67 / NEMA 4X rating. Both European or U.S. cable gland entry threads are available.

## Overview application F116

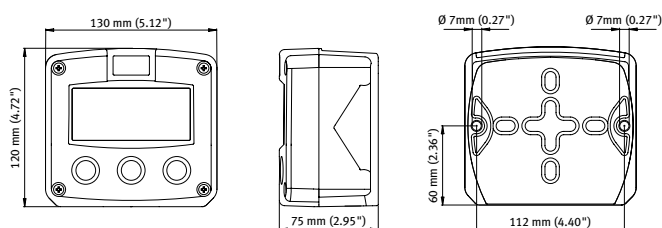


### Aluminum & GRP panel mount enclosure

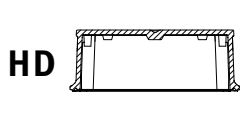


**panel cut-out**

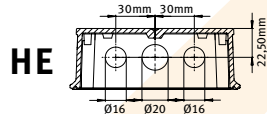
### Aluminum & GRP field / wall mount enclosures



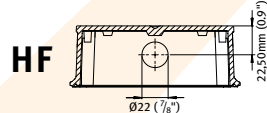
**GRP**



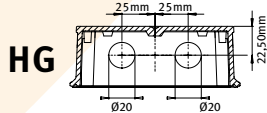
## HD



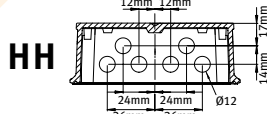
## HE



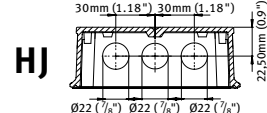
HF



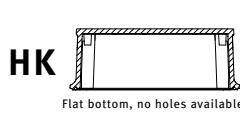
HG



HH



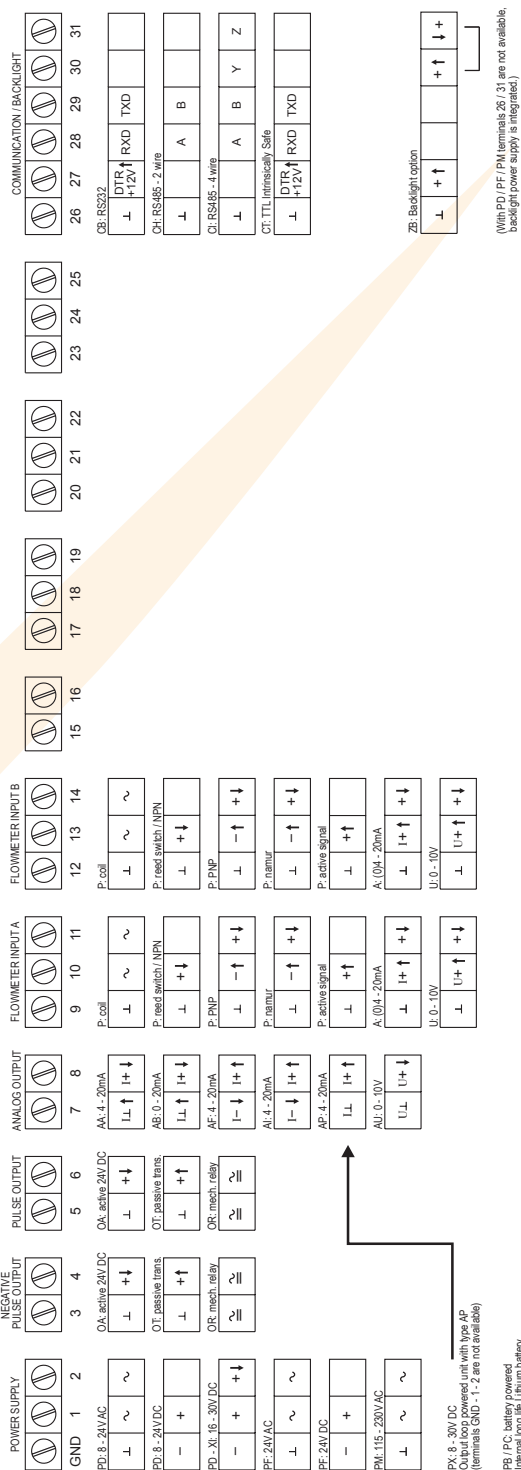
HJ



HK

## H7

## Terminal connections

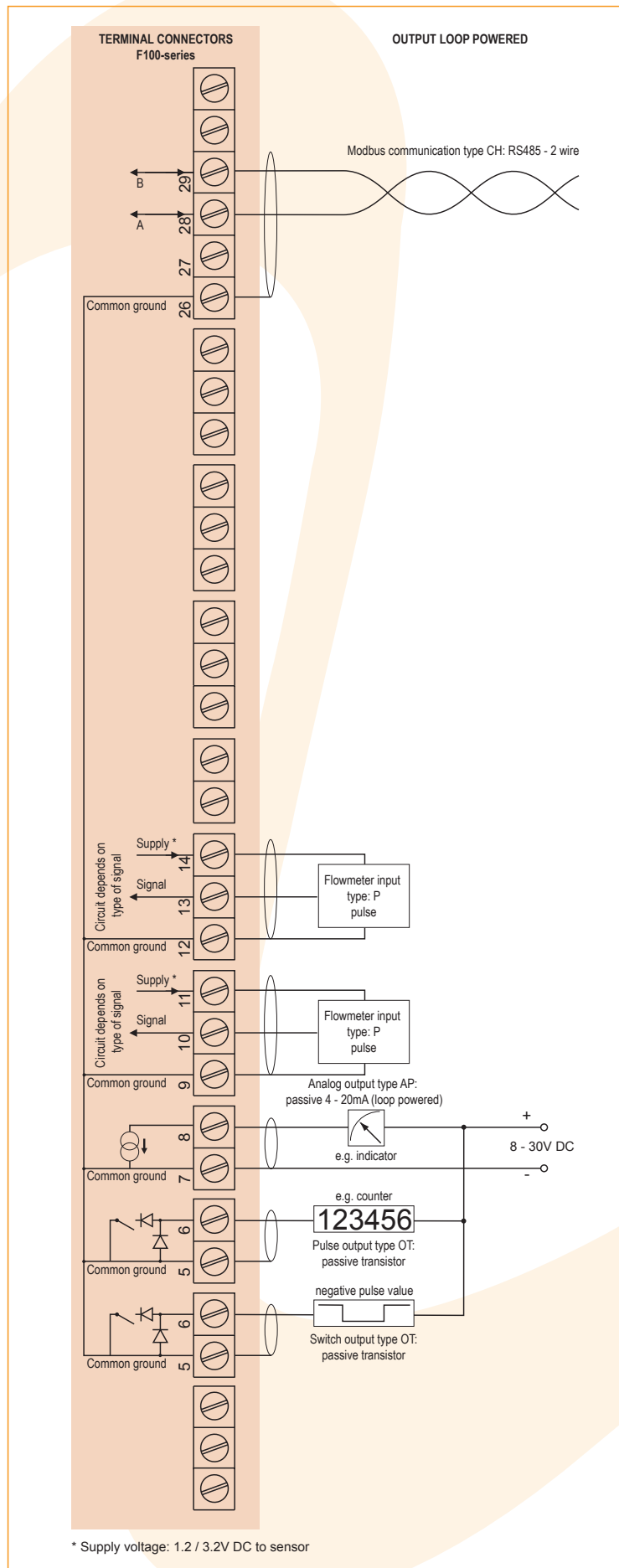
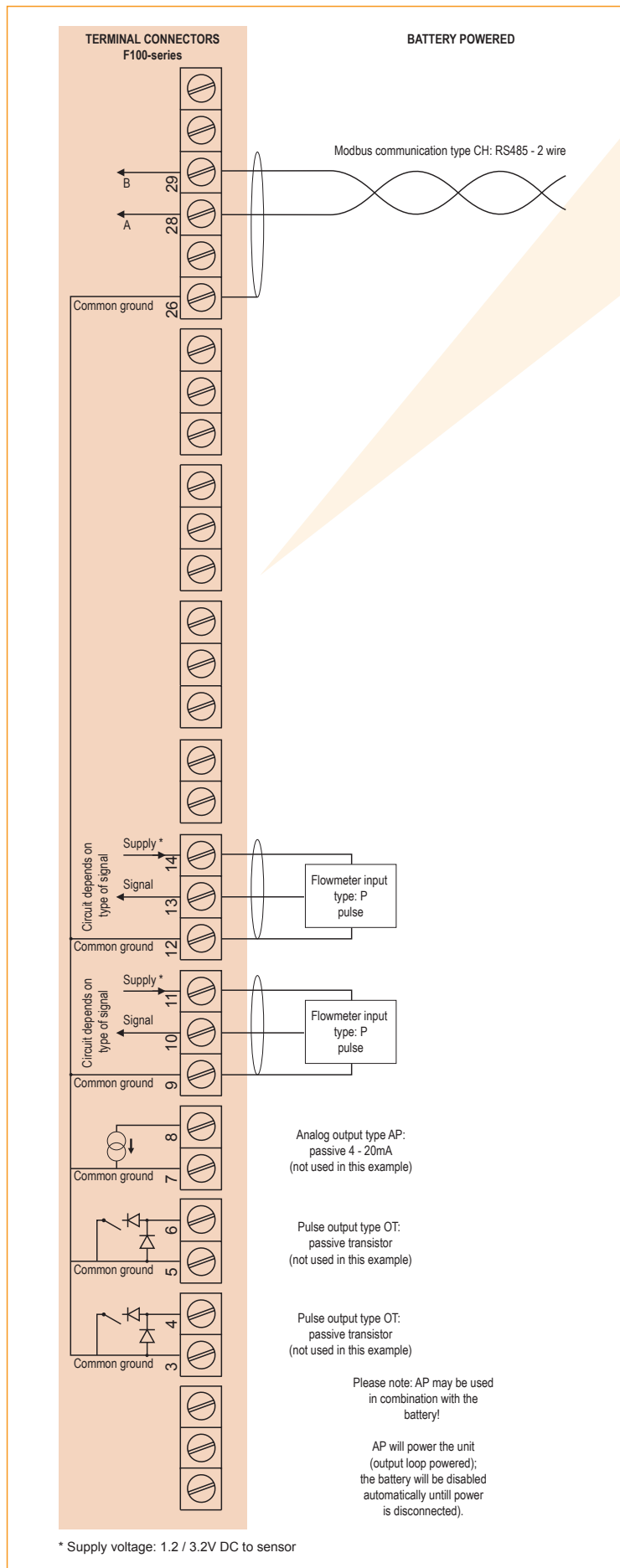


**Display example - 90 x 40mm (3.5" x 1.6")**

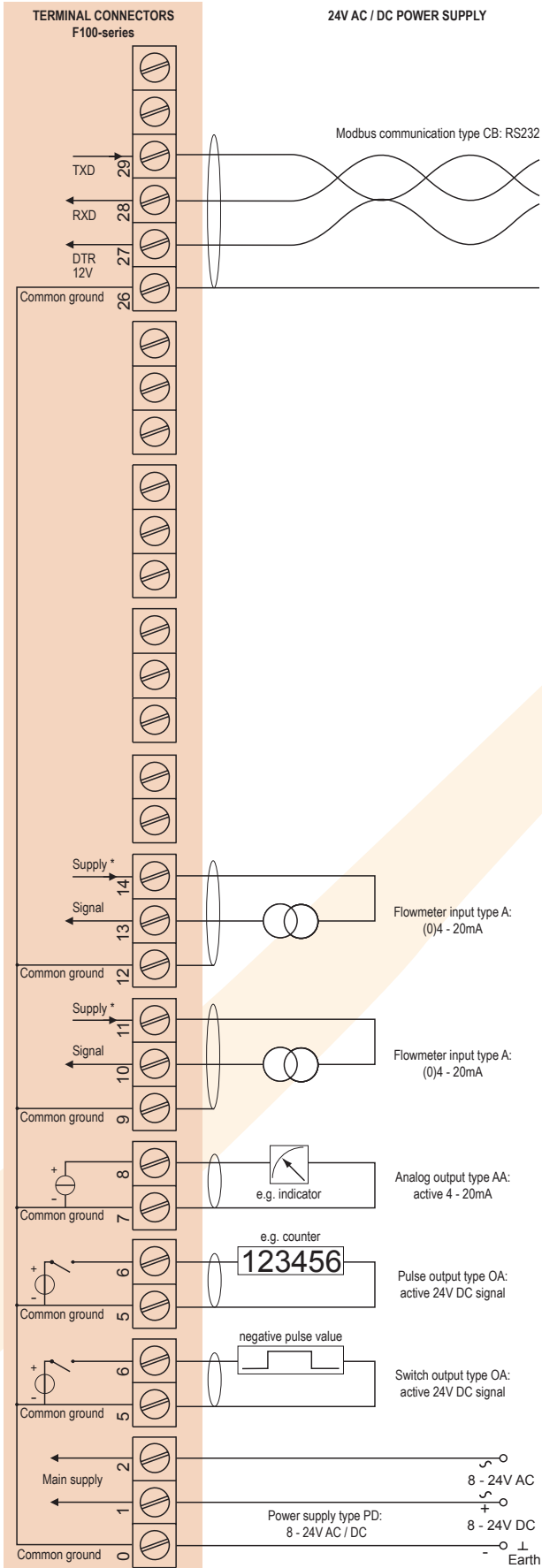


Typical wiring diagram F116-P-(AP)-CH-(OT)-PB

Typical wiring diagram F116-P-AP-CH-OT-PX

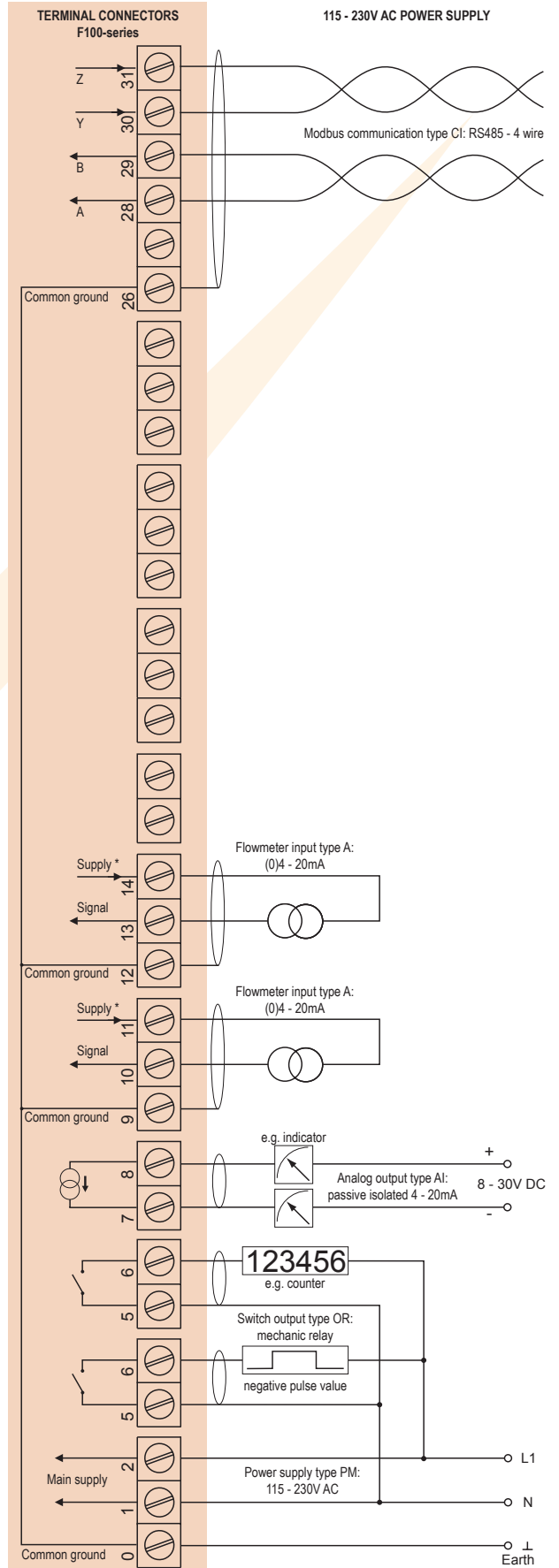


Typical wiring diagram F116-A-AA-CB-OA-PD



\* Supply voltage: 3.2 / 8.2 / 12 / 24V DC to sensor

Typical wiring diagram F116-A-AI-CI-OR-PM



\* Supply voltage: 3.2 / 8.2 / 12 / 24V DC to sensor



## Hazardous area applications

The F116-XI has been certified according ATEX and IECEx by DEKRA for use in Intrinsically Safe applications with an ambient temperature of -40°C to +70°C (-40°F to +158°F).

- The ATEX markings for gas and dust applications are:

**II 1 G Ex ia IIB/IIC T4 Ga**  
**II 1 D Ex ia IIIC T100 C Da IP6X.**

- The IECEx markings for gas and dust applications are: **Ex ia IIC/IIB T4 Ga** and **Ex ia IIIC T100 C Da IP6X.**

Besides the two I.S. power supplies for the pulse outputs, it is allowed to connect up to four I.S. power supplies in IIB/IIIC applications or one in IIC applications. Consult the certificate for the maximum input and output values of the circuits. Full functionality of the F116 remains available, including 4 - 20mA output, pulse output and Modbus communication (type CT). Power supply type PD-XI offers a 8.2V sensor supply e.g. for two Namur sensors. A flame proof enclosure with rating ATEX **II 2 GD EEx d IIB T5** is available as well. Please contact your supplier for further details.

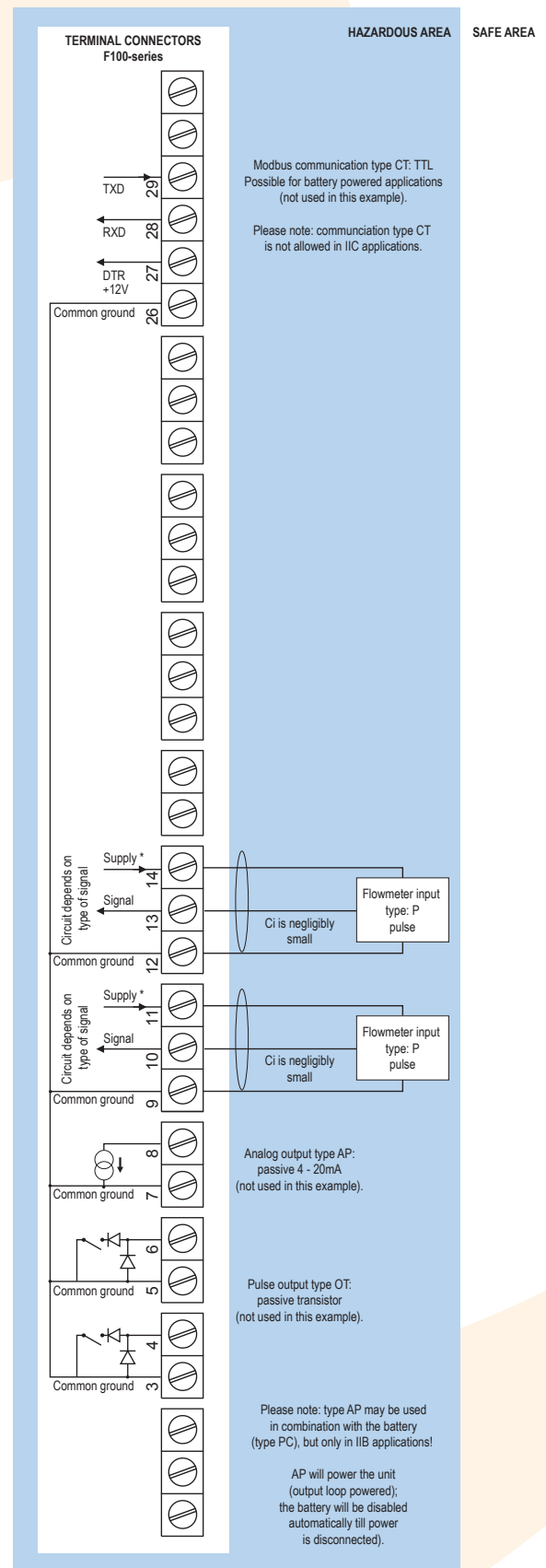
### Certificate of conformity KEMA 03ATEX1074 X

- IECEx DEK 11.0042X



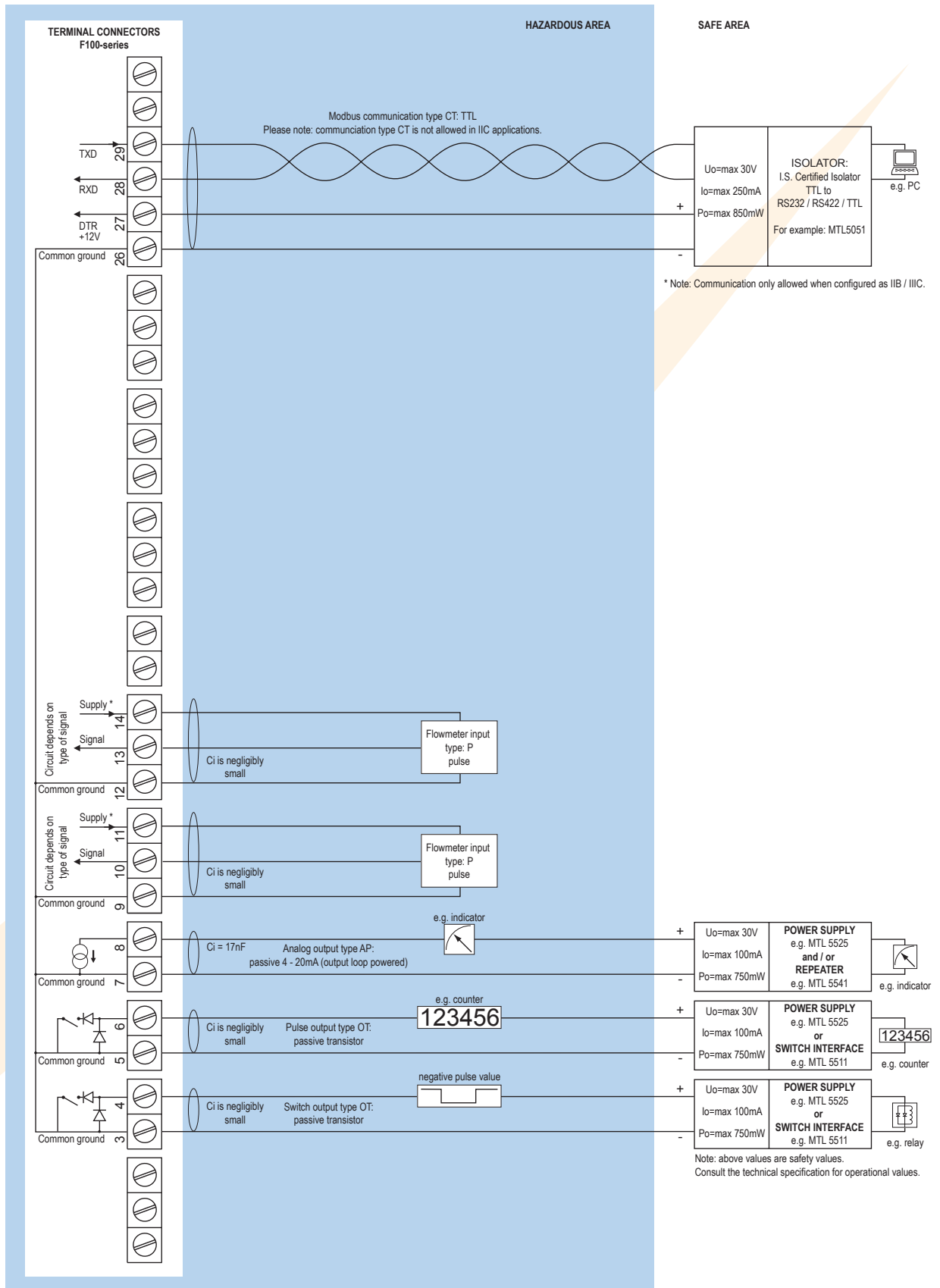
### Configuration example IIB / IIIC and IIC

#### F116-P-(AP)-(CT)-(OT)-PC-XI - Battery powered unit



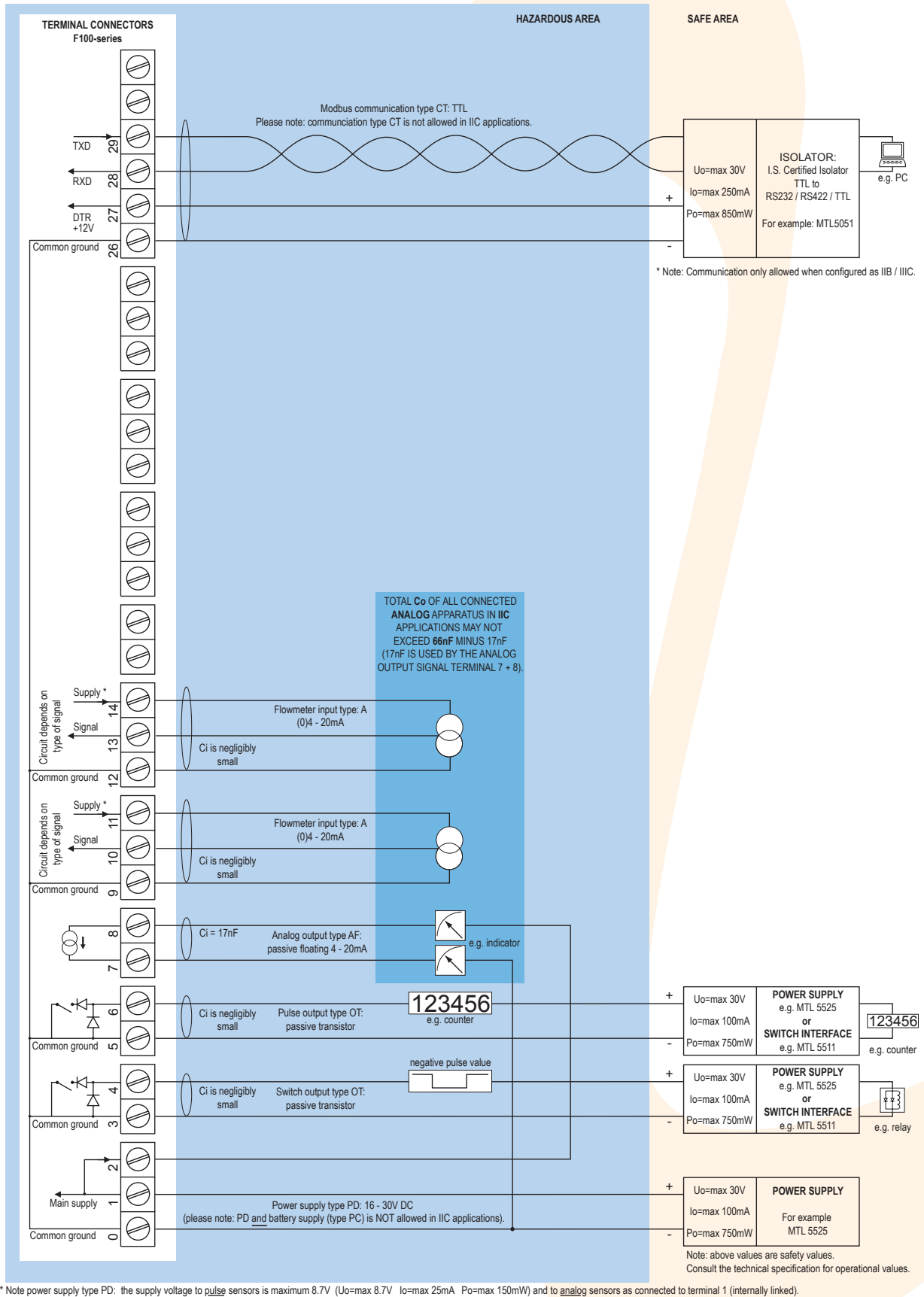
\* Note sensor supply voltage: 1.2V DC for coil sensors or 3.2V DC for other pulse sensors.

## Configuration example IIB / IIIC and IIC - F116-P-AP-(CT)-OT-PX-XI - Output loop powered



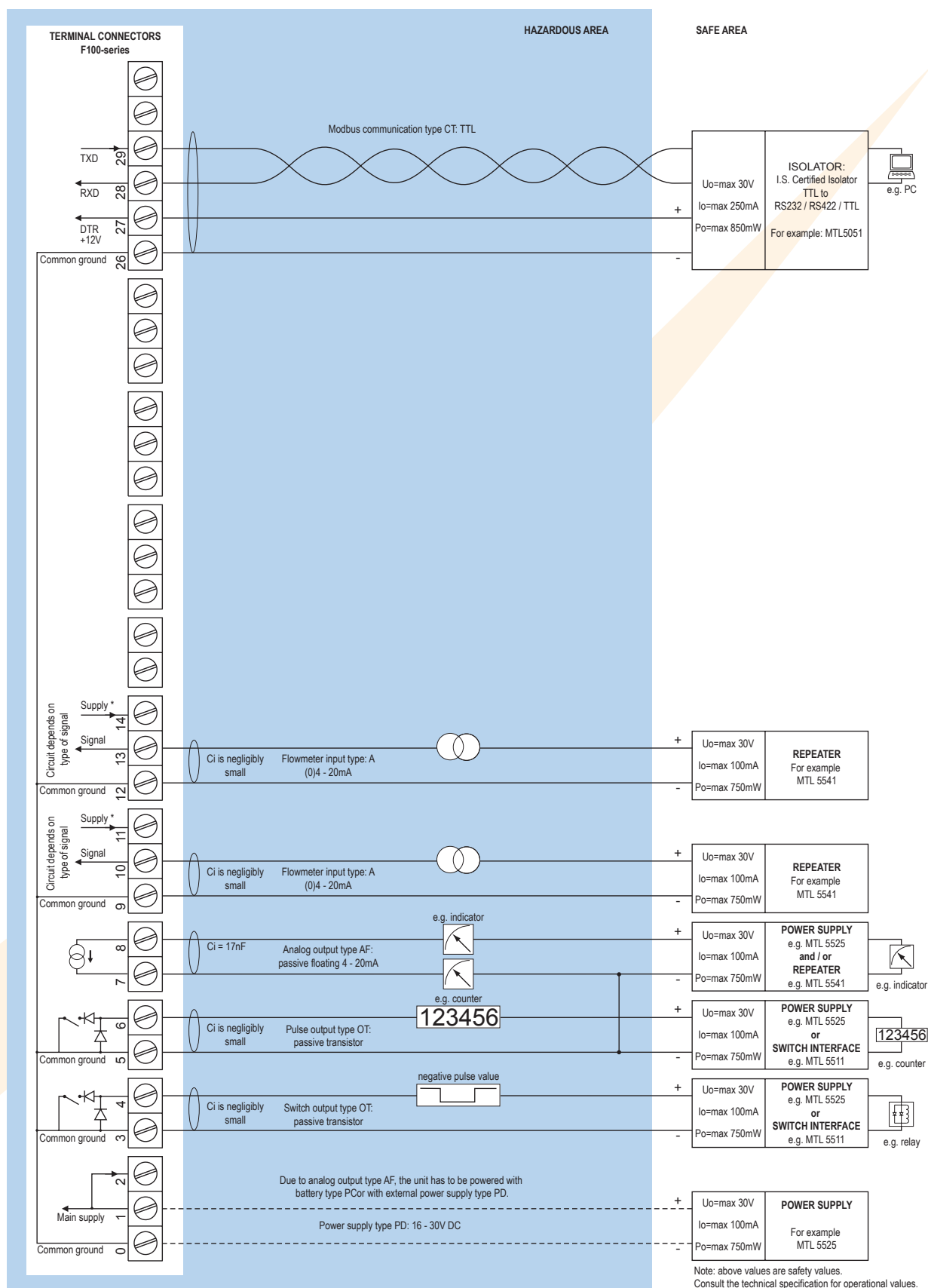
\* Note sensor supply voltage: 1.2V DC for coil sensors or 3.2V DC for other pulse sensors.

## Configuration example IIB / IIIC and IIC - F116-A-AF-(CT)-OT-PD-XI - Power supply 16 - 30V DC





**Configuration example IIB / IIIC - F116-A-AF-CT-OT-(PC)-(PD)-XI - Power supply 16 - 30V DC or battery powered**



\* Note power supply type PD: the supply voltage to pulse sensors is maximum 8.7V ( $U_0 = \max 8.7V$   $I_0 = \max 25mA$   $P_0 = \max 150mW$ ) and to analog sensors as connected to terminal 1 (internally linked).

## Technical specification

### General

Display	
Type	High intensity reflective numeric and alphanumeric LCD, UV-resistant.
Dimensions	90 x 40mm (3.5" x 1.6").
Digits	Seven 17mm (0.67") and eleven 8mm (0.31") digits. Various symbols and measuring units.
Refresh rate	User definable: 8 times/sec. - 1 time/30 secs.
Option ZB	Transflective LCD with green LED backlight. Good readings in full sunlight and darkness.
Note ZB	Only available for safe area applications.

### Operating temperature

Standard unit	-40°C to +80°C (-40°F to +176°F).
Intrinsically Safe	-40°C to +70°C (-40°F to +158°F).

### Power requirements

Type PB	Long life Lithium battery - life-time depends upon settings and configuration - up to 5 years.
Type PC	Intrinsically Safe long life lithium battery - life-time depends upon settings and configuration - up to 5 years.
Type PD	8 - 24V AC / DC $\pm$ 10%. Power consumption max. 10 Watt. Intrinsically Safe: 16 - 30V DC; power consumption max. 0.75 Watt.
Type PF	24V AC / DC $\pm$ 10%. Power consumption max. 15 Watt.
Type PL	Input loop powered from sensor signal 4 - 20mA (type "A") - requires types AI or AF and OT (not Xi).
Type PM	115 - 230V AC $\pm$ 10%. Power consumption max. 15 Watt.
Type PX	8 - 30V DC. Power consumption max. 0.5 Watt.
Type ZB	12 - 24V DC $\pm$ 10% or internally powered with type PD / PF / PM. Power consumption max. 1 Watt.
Note PB/PF/PM	Not available Intrinsically Safe.
Note PF/PM	The total consumption of the sensors and outputs may not exceed 400mA @ 24V.
Note	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 sensors with a very low power consumption like coils (sine wave) and reed-switches.
Type PD	1.2 / 3.2 / 8.2 / 12 / 24V DC - max. 50mA @ 24V DC.
Type PD-XI	1.2 / 3.2 / 8.2V DC - max. 7mA @ 8.2V DC and mains power supply voltage (as connected to terminal 1).
Note	In case PD-XI and signal A or U: 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 / 24V DC - max. 400mA @ 24V DC.

### Terminal connections

Type	Removable plug-in terminal strip. Wire max. 1.5mm <sup>2</sup> and 2.5mm <sup>2</sup> .
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### Data protection

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

### Casing

#### General

Window	Polycarbonate window.
Sealing	Silicone.
Control keys	Three industrial micro-switch keys. UV-resistant silicone keypad.

#### Aluminum wall / field mount enclosures

General	Die-cast aluminum wall/field mount enclosure IP67 / NEMA 4X with 2-component UV-resistant coating.
Dimensions	130 x 120 x 75mm (5.12" x 4.72" x 2.95") - W x H x D.
Weight	1100 gr.
Type HA	Cable entry: 2 x PG9 and 1 x M20.
Type HM	Cable entry: 2 x M16 and 1 x M20.
Type HN	Cable entry: 1 x M20.
Type HO	Cable entry: 2 x M20.
Type HP	Cable entry: 6 x M12.
Type HT	Cable entry: 1 x 1/2" NPT.
Type HU	Cable entry: 3 x 1/2" NPT.
Type HV	Cable entry: 4 x M20.
Type HZ	Cable entry: no holes.

#### GRP wall / field mount enclosures

General	GRP wall/field mount enclosure IP67 / NEMA 4X, UV-resistant and flame retardant.
Dimensions	130 x 120 x 75mm (5.12" x 4.72" x 2.95") - W x H x D.
Weight	600 gr.
Type HD	Cable entry: no holes.
Type HE	Cable entry: 2 x Ø 16mm and 1 x Ø 20mm.
Type HF	Cable entry: 1 x Ø 22mm (7/8").
Type HG	Cable entry: 2 x Ø 20mm.
Type HH	Cable entry: 6 x Ø 12mm.
Type HJ	Cable entry: 3 x Ø 22mm (7/8").
Type HK	Flat bottom, cable entry: no holes.

#### Panel mount enclosures



Dimensions	130 x 120 x 60mm (5.12" x 4.72" x 2.36") - W x H x D.
Panel cut-out	115 x 98mm (4.53" x 3.86") L x H.
Type HB	Die-cast aluminum panel mount enclosure IP65 / NEMA 4X.
Weight	600 gr.
Type HC	GRP panel mount enclosure IP65 / NEMA 4X, UV-resistant and flame retardant.
Weight	450 gr.

#### ABS wall / field mount enclosures


General	Silicone free ABS wall/field mount enclosure IP65 with EPDM and PE sealings. UV-resistant polyester keypad (old HD enclosure).
Dimensions	130 x 114 x 71mm (5.1" x 4.5" x 2.8") - W x H x D.
Weight	450 gr.
Type HS	Cable entry: no holes.

### Hazardous area

#### Intrinsically Safe (Type XI)

ATEX certification	 II 1 G Ex ia IIB/IIC T4 Ga. II 1 D Ex ia IIIC T100 °C Da IP6X.
IECEX certification	 Ex ia IIC/IIB T4 Ga. Ex ia IIIC T100 °C Da IP6X.
Ambient Ta	-40°C to +70°C (-40°F to +158°F).

#### Explosion proof (Type XF)

ATEX certification	 II 2 GD EEx d IIB T5.
Dimensions	300 x 250 x 200mm (11.8" x 9.9" x 7.9") L x H x D.
Weight	Appr. 15kg.

#### Environment

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

#### Flowmeter

Type P	Coil / sine wave (minimum 20mVpp or 80mVpp - sensitivity selectable), NPN/PNP, open collector, reed-switch, Namur, active pulse signals 8 - 12 and 24V DC.
Frequency	Minimum 0Hz - maximum 7kHz for total and flow rate. Maximum frequency depends on signal type and internal low-pass filter. E.g. reed switch with low-pass filter: max. frequency 120Hz.
K-Factor	0.000010 - 9,999,999 with variable decimal position.
Low-pass filter	Available for all pulse signals.
Option ZF	coil sensitivity 10mVpp.
Type A	(0)4 - 20mA. Analog input signal can be scaled to any desired range within 0 - 20mA.
Type U	0 - 10V DC. Analog input signal can be scaled to any desired range within 0 - 10V DC.
Accuracy	Resolution: 14 bit. Error < 0.025mA / $\pm 0.125\%$ FS. Low level cut-off programmable.
Span	0.000010 - 9,999,999 with variable decimal position.
Update time	Four times per second.
Voltage drop	Type A: 2.5V @ 20mA.
Load impedance	Type U: 3k $\Omega$ .
Relationship	Linear and square root calculation.
Note	For signal type A and U: external power to sensor is required; e.g. type PD.

### Signal outputs

#### Analog output

Function	Transmitting differential / sum flow rate.
Accuracy	10 bit. Error < 0.05%. Analog output signal can be scaled to any desired range.
Update time	Ten times per second.
Type AA	Active 4 - 20mA output (requires PD, PF or PM).
Type AB	Active 0 - 20mA output (requires PD, PF or PM).
Type AF	Passive floating 4 - 20mA output for Intrinsically Safe applications (requires XI + PC or PD).
Type AI	Passive galvanically isolated 4 - 20mA output - also available for battery powered models (requires PB, PD, PF, PL or PM).
Type AP	Passive 4 - 20mA output - not isolated. Unit will be loop powered.
Type AU	Active 0 - 10V DC output (requires PD, PF or PM).

#### Pulse output

Function	Pulse output according to differential or sum accumulated total and indication negative pulse output.
Frequency	Max. 64Hz. Pulse length user definable between 7.8 msec up to 2 seconds.
Type OA	Two active 24V DC transistor outputs (PNP); max. 50mA per output (requires PD, PF or PM).
Type OR	Two electro-mechanical relay outputs (N.O.) - isolated; max. switch power 230V AC - 0.5A per relay (requires PF or PM).
Type OT	Two passive transistor outputs (NPN) - not isolated. Max. 50V DC - 300mA per output.

#### Communication option

Function	Reading display information, reading / writing all configuration settings.
Protocol	Modbus 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.

### Operational

#### Operator functions

Displayed functions	<ul style="list-style-type: none"> <li>Differential flow rate (consumption) or the sum of both flow rates.</li> <li>Differential / sum total and accumulated total.</li> <li>Total can be reset to zero by pressing the CLEAR-key twice.</li> </ul>
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#### Total

Digits	7 digits.
Units	L, m <sup>3</sup> , 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 to selection for total.
Note	Can not be reset to zero.

#### Flow rate

Digits	7 digits.
Units	mL, L, m <sup>3</sup> , Gallons, kg, Ton, lb, bl, cf, RND, ft <sup>3</sup> , scf, Nm <sup>3</sup> , NL, igal - no units.
Decimals	0 - 1 - 2 or 3.
Time units	/sec - /min - /hr - /day.

### Accessories

#### Mounting accessories

ACFo2	Stainless steel wall mounting kit.
ACFo5	Stainless steel pipe mounting kit (worm gear clamps not included).
ACFo6	Two stainless steel worm gear clamps $\varnothing$ 44 - 56mm.
ACFo7	Two stainless steel worm gear clamps $\varnothing$ 58 - 75mm.
ACFo8	Two stainless steel worm gear clamps $\varnothing$ 77 - 95mm.
ACFo9	Two stainless steel worm gear clamps $\varnothing$ 106 - 138mm.
ACF10	Customized Grevopal tagplates for ACFo2 and ACFo5, including stainless steel screws. Dimension: 95mm x 12.5mm (3.75" x 0.50").

## Ordering information

Standard configuration: F116-P-AP-CX-EX-HC-IX-OT-PX-TX-XX-ZX.

Ordering information:	F116	-	-A	-C	-EX	-H	-IX	-O	-P	-TX	-X	-Z
<b>Flowmeter input signal</b>												
A	⊗											
P	⊗											
U	⊗											
<b>Analog output signal</b>												
AA												
AB												
AF	⊗											
AI												
AP	⊗											
AU												
<b>Communication</b>												
CB												
CH												
CI												
CT	⊗											
CX	⊗											
<b>Flow equations</b>												
EX	⊗											
<b>Panel mount enclosures - IP65 / NEMA4X</b>												
HB	⊗											
HC	⊗											
<b>GRP field / wall mount enclosures - IP67 / NEMA4X</b>												
HD	⊗											
HE	⊗											
HF	⊗											
HG	⊗											
HH	⊗											
HJ	⊗											
HK	⊗											
<b>Aluminum field / wall mount enclosures - IP67 / NEMA4X</b>												
HA	⊗											
HM	⊗											
HN	⊗											
HO	⊗											
HP	⊗											
HT	⊗											
HU	⊗											
HV	⊗											
HZ	⊗											
<b>ABS field / wall mount enclosures - IP65</b>												
HS	⊗											
<b>Additional inputs</b>												
IX	⊗											
<b>Outputs</b>												
OA												
OR												
OT	⊗											
<b>Power supply</b>												
PB												
PC	⊗											
PD	⊗											
PF												
PL												
PM												
PX	⊗											
<b>Temperature input signal</b>												
TX	⊗											
<b>Hazardous area</b>												
XI	⊗											
XF												
XX												
<b>Other options</b>												
ZB												
ZF	⊗											
ZX	⊗											

The bold marked text contains the standard configuration.

⊗ Available Intrinsically Safe.



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