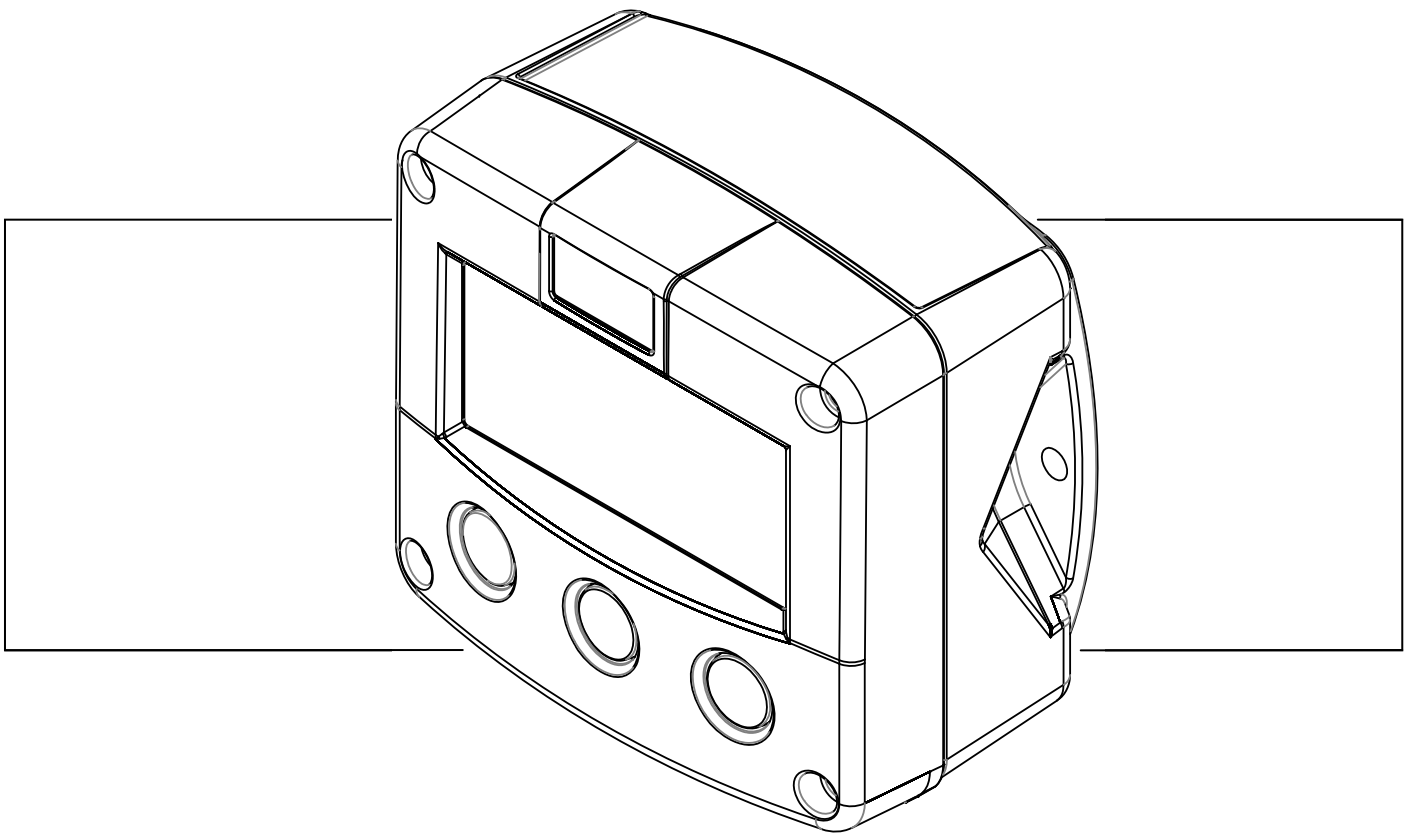# F124-A

Ratio Controller

Signal input flow meters: (0)4-20mA

Control output: (0)4-20mA/ 0-10V

Alarm outputs: high / low ratio alarm

Options: Intrinsically Safe, Modbus communication and backlight

⚠ SAFETY INSTRUCTIONS

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

- **LIFE SUPPORT APPLICATIONS: The F124-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 F124-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 F124-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 F124-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 F124-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 F124-A or connected instruments.

A "**caution**" indicates actions or procedures which, if not performed correctly, may lead to personal injury or incorrect functioning of the F124-A or connected instruments.

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.

CONTENTS MANUAL

1. INTRODUCTION

1.1. SYSTEM DESCRIPTION OF THE F124-A

Functions and features

The PI ratio controller model F124-A is a microprocessor driven instrument designed to control the ratio between two flows.

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 flow meter signals,
- transmitting possibilities with communication option,

Flow meter input

This manual describes the unit with two (0)4-20mA inputs from the flow meter "-A version". Other versions are available to process pulse or 0-10V flow meter signals.

Two flow sensors with a (0)4-20mA output can be connected to the F124-A. To power these sensors, several options are available.

Standard outputs

- Configurable linear (0)4-20mA or 0-10V analog output with 10-bits resolution to control a valve or pump.
- Two alarm outputs: high and low ratio alarm.
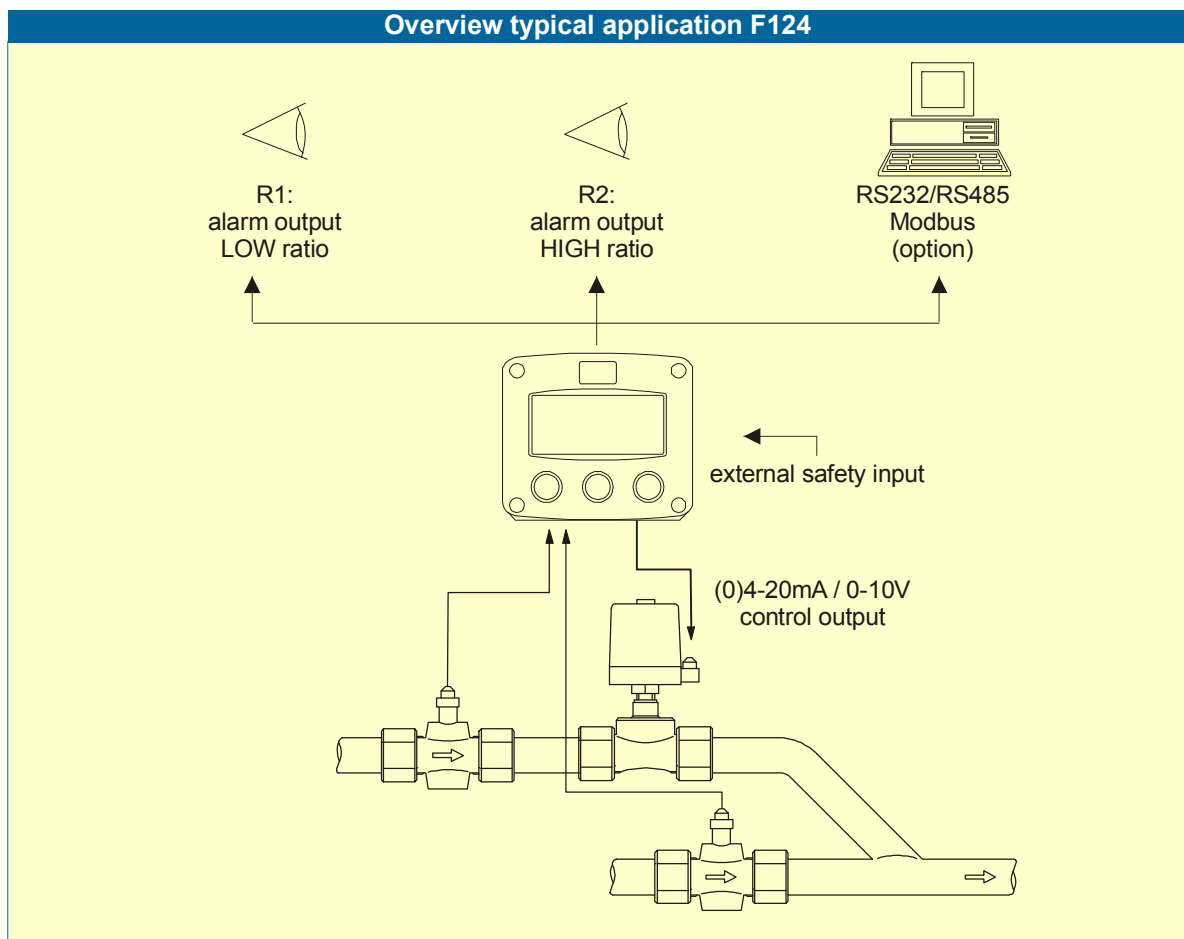
Fig. 1: Typical application for the F124-A.

Configuration of the unit
The F124-A was designed to be implemented in many types of applications. For that reason, a SETUP-level is available to configure your F124-A according to your specific requirements. SETUP includes several important features, such as Span, measurement units etc. All setting are stored in EEPROM memory and will not be lost in the event of power failure or a drained 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.

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

2. OPERATION

2.1. GENERAL

Caution !

- *The F124-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 F124-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 and to enter the operator mode menu.
It is also used to gain access to SETUP-level; please read chapter 3.

The arrow-key ▲ is used to increase a value after PROG has been pressed or to configure the unit; please read chapter 3.

The arrow-key ▼ is used is used to decrease a value after PROG has been pressed while > is used to select a digit or SETUP function.

2.3. OPERATOR INFORMATION AND FUNCTIONS

In general, the F124-A will always act at Operator level. The information displayed depends upon the SETUP-settings. All values of the connected flow meters are measured by the F124-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.
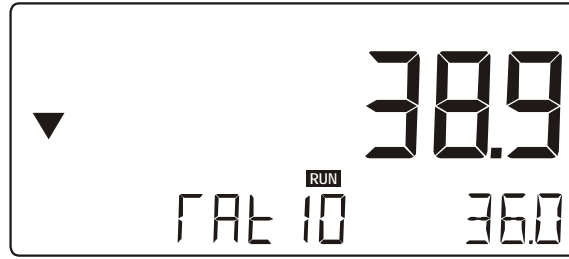
Fig. 3: Example of display information during process.

Operation:

The following IP algorithm is used by the F124-A :
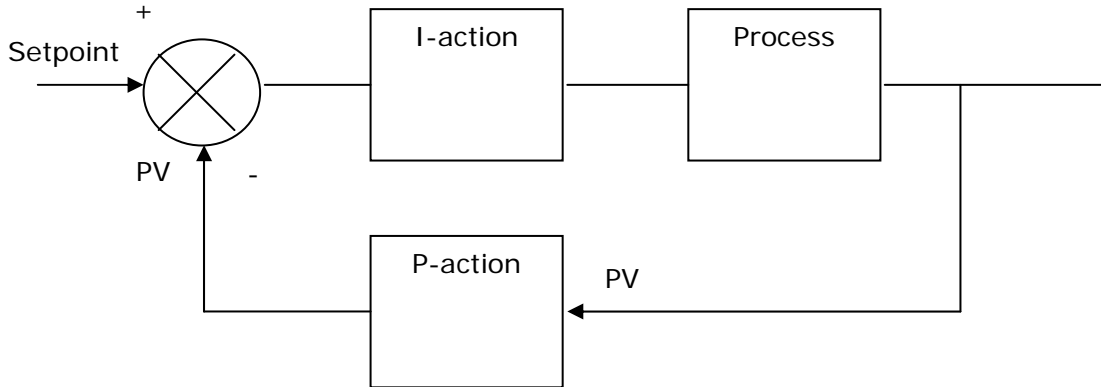
Only the Integral action works at a set-point change, so there is no aggressive change in the control output even when the set-point is changed in steps. In this way the control method produces stable control, but does not react as quick as a normal PI controller.

- **Selection and programming Operation mode:**
  By pressing the PROG-button, "Control" is displayed and the following operation modes can be selected: Hand, Local and Ratio.
  After selecting a mode, the control operation is displayed at the bottom line as well as the actual set-point.
  The value is changed directly from the keyboard by using the "▲" UP-button and the "▼" DOWN-button. The longer you press the button, the quicker the value change.

  - **"Hand" mode**
    In this mode the control output (CO) can be manipulated directly. In the "Hand" mode, there is no loop connection between flow A and B.
    In the "hand" mode, 0% correspondents with the minimum output signal (most applications 4mA) and 100% with the maximum output signal (20mA).
    The top line displays the calculated ratio between flow A and B (flow B / flow A).

- **"Local" mode**
  In this mode the local set-point B can be set, corresponding with the process value of flow transmitter B (additive). The set-point can be changed, using the "▲" button (UP) and the "▼" button (DOWN).
  Both set-point and process value are displayed as a percentage.
  Remark : In this mode the single loop of flow B can be controlled and is ideal to tune the ratio controller (PI values corresponding to the process).

- **"Ratio" mode**
  This mode is used during normal operation. Using the "▲" button (UP) and the "▼" button (DOWN) to set the desired ratio as percentage.
  The process value corresponds with flow B / flow A. Flow rate B will be controlled in relation to flow rate A. The top-line displays the actual ratio as a percentage.

- **Run / Safety mode**
  Via an external input closure the control output can be set to a predefined value.
  During this safety mode, the message "SAFETY" is displayed.

- **Selection actual flow rate A and flow rate B:**
  Press shortly the "PROG" and the "▼" button simultaneously to display the actual flow rate A. Flow rate B is selected by pressing the "SELECT" button.

- **Selection and programming the ratio alarm values**

Note: This function might not be accessible or visible due to a configuration settings.

Note !

Press shortly the "PROG" and the "▼" button simultaneously. Use the "SELECT" button to select the actual ratio alarm values. The ratio HI and ratio LO alarm values are displayed and set as a percentage (%).

To change the alarm value, the following procedure must be executed:

1) press PROG: the word "PROGRAM" will flash,
2) use ▶ to select the digits and ▲ to increase that value,
3) confirm the new alarm value by pressing ENTER.

Fig. 4: Example of display information during programming minimum ratio alarm.

When data is altered but ENTER has not been pressed yet, then the alteration can still be cancelled by waiting for 20 seconds or by pressing ENTER during three seconds: the former value will be reinstated.

- **Ratio alarm**
  When the actual ratio is outside the allowed range, an alarm message will be displayed indicating the type of alarm: "LO RATIO" or "HI RATIO".
  The alarm is terminated automatically as soon as the ratio is within its range again.

- **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 original batteries supplied by the manufacturer may be used, else the guarantee and liability will be terminated. The remaining lifetime after the first moment of indication is generally several days up to some weeks.

Fig. 5: 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 F124-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 F124-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 F124-A remains fully operational.

Note !

Note: A pass code may be required to enter SETUP. Without this pass code access to SETUP is denied.

To enter SETUP-level:
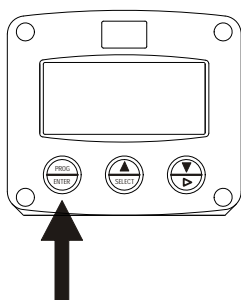
Press $\left(\begin{array}{c}\text{PROG}\\\text{ENTER}\end{array}\right)$ for 7 seconds

Matrix structure SETUP-level:
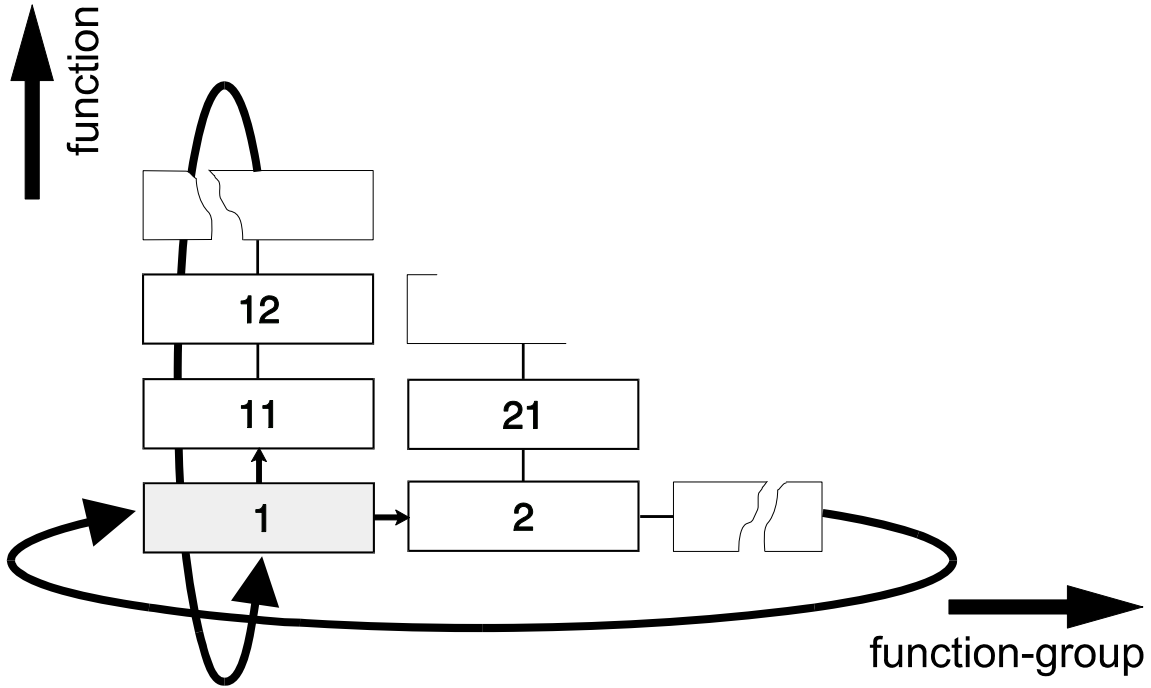
SCROLLING THROUGH SETUP-LEVEL

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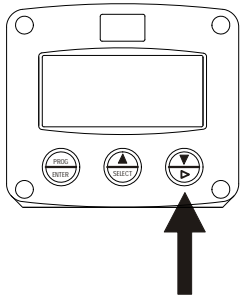
Select function-group with
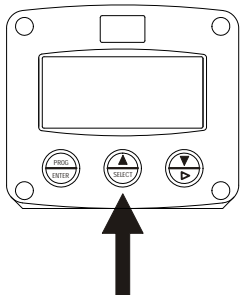
Select function with

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 sub-function. Additionally, each function is expressed with a keyword.

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

To change or select a value:
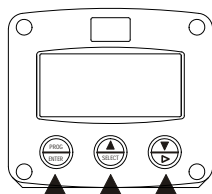
a) press $\begin{array}{c}\text{PROG}\\\text{ENTER}\end{array}$ briefly; **PROGRAM** will start flash

b) select or enter value with $\begin{array}{c}\blacktriangle\\\text{SELECT}\end{array}$ and / or $\begin{array}{c}\blacktriangledown\\\triangleright\end{array}$

c) press $\begin{array}{c}\text{PROG}\\\text{ENTER}\end{array}$ to confirm the value / selection.

a)   b)   b)
c)

To change a value, use ▸ to select the digits and ▲ to increase that value.
To select a setting, both ▲ and ▸ can be used.
If the new value is invalid, 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:
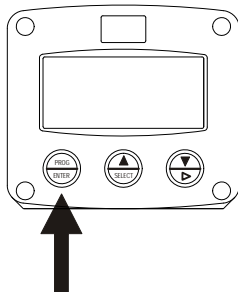
Press $\begin{array}{c}\text{PROG}\\\text{ENTER}\end{array}$ for 3 seconds

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	**FLOW RATE -A-**	
	11	UNIT	mL, L, m3, mg, g, kg, ton, GAL, bbl, lb, cf, rev, no unit, SCF, nm3, nL, P
	12	TIME UNIT	sec - min - hour - day
	13	DECIMALS	0 - 1 - 2 - 3 (Ref: displayed value)
	14	SPAN	0.000001 - 999,999 unit/time-unit
	15	DECIMALS SPAN	0 - 6
2	**FLOW RATE -B-**	
	21	SPAN	0.000001 - 999,999 unit/time-unit
	22	DECIMALS SPAN	0 - 6
3	**SETPOINT**	
	31	DECIMALS SV RATIO	0 - 1 - 2 (Ref: displayed value)
	32	SV MIN - RATIO LIMIT LO (set-point)	0.0 - 100.0 %
	33	SV MAX - RATIO LIMIT HI (set-point)	0.0 - 100.0 %
4	**CONTROL**	
	41	ACTION	Direct - reverse
	42	PB (Proportional band) PCT	0.0 - 999.9 %
	43	IT (Integration time) SEC	0.0 - 6000.0 seconds
	44	STARTUP	Continue – Hand – Safety
5	**ALARM**	
	51	ALARMSET	operate - setup - hidden - disable
	52	FLOWZERO	default - no relays - ignore
	53	RATIO ALARM LO (Measure)	0.0 - 100.0 %
	54	RATIO ALARM HI (Measure)	0.0 - 100.0 %
6	**POWER MANAGEMENT**	
	61	LCD UPDATE	fast - 1 sec - 3 sec - 15 sec - 30 sec - off
	62	BATTERY MODE	operational - shelf
7	**FLOW SENSOR -A-**	
	71	FORMULA	interpolation, square root
	72	FILTER	00 - 99
	73	CUT-OFF	0.0 - 99.9%
	74	CALIBRATE LOW	default - calibrate - calibrate set
	75	CALIBRATE HIGH	default - calibrate - calibrate set
8	**FLOW SENSOR -B-**	
	81	FORMULA	interpolation, square root
	82	FILTER	00 - 99
	83	CUT-OFF	0.0 - 99.9%
	84	CALIBRATE LOW	default - calibrate - calibrate set
	85	CALIBRATE HIGH	default - calibrate - calibrate set
9	**ANALOG OUTPUT**	
	91	CO MIN - Low limit	0.0 - 100.0 %
	92	CO MAX - High limit	0.0 - 100.0 %
	93	CO SAFE - safety value	0.0 - 100.0 %
	94	TUNE MIN - 4mA / 0V	0 - 9,999 (=0%)
	95	TUNE MAX- 20mA / 10V	0 - 9,999 (=100%)
A	**COMMUNICATION**	
	A1	SPEED / BAUDRATE	1200 - 2400 - 4800 - 9600
	A2	ADDRESS	1 - 255
	A3	MODE	RTU - off
B	**OTHERS**	
	B1	TYPE / MODEL	F124-A
	B2	SOFTWARE VERSION	xx.xx.xx
	B3	SERIAL NO.	xxxxxxx
	B4	PASSWORD	0000 – 9999
	B5	TAGNUMBER	0000000 – 9999999

3.2.3.   EXPLANATION OF SETUP-FUNCTIONS

1 – FLOW RATE -A-	
The settings for flow rate A (main flow) and flow rate B (additive) are common, with the exception of the Span settings.	
MEASUREMENT UNIT 11	SETUP - 11 determines the measurement unit for flow rate for flow A: 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 12	The flow rate can be calculated per second (SEC), minute (MIN), hour (HR) or day (DAY).
DECIMALS 13	This setting determines the displayed number of digits following the decimal point for flow A. The following can be selected: 00000 - 1111.1 - 2222.22 - 3333.333 *Note: This setting does not relate to the decimals span fraction as defined in SETUP 15.*
SPAN 14	With the span, the flow meter signal is converted to a quantity. The **span for flow rate** 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 15). The more accurate the span, the more accurate the functioning of the system will be. **Example 1** **Calculating the span for flow rate** *Let us assume that the flow meter generates 20mA at a flow rate of 2,481.3 Liters/minute, the selected unit is "Liters" and time unit "minute".* *The span is 2481.3* *Enter for SETUP - 14: "248130" and for SETUP - 15 - decimals span "2".* **Example 2** **Calculating the span for flow rate** *Let us assume that the flow meter 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 - 14: "108718" and for SETUP - 15 "4".*
DECIMALS SPAN 15	This setting determines the location of the decimal point of the span defined in SETUP 14. The following decimal point locations can be chosen from: 0 - 1 - 2 - 3 - 4 - 5 - 6 *Note: This SETUP influences the accuracy of the Span. This SETUP does not affect the decimal position on the display (SETUP 13)!* For examples see SETUP 14.

Note !

2 – FLOW RATE -B-	
SPAN **21**	With the span, the flow meter signal is converted to a quantity. The **span for flow rate** is determined on the basis of the **selected measurement unit and time unit** at 20mA (setup 11 and 12). Enter the span in whole numbers (decimals are set with SETUP 22). The more accurate the span, the more accurate the functioning of the system will be. For examples see SETUP 14.
DECIMALS SPAN **22**	This setting determines the decimal fraction of the span defined in SETUP 21. The following fractions can be chosen from: 0 - 1 - 2 - 3 - 4 - 5 - 6 *Note: This SETUP influences the accuracy of the Span indirectly. This SETUP does not affect the displayed number of digits (SETUP 13)!* For examples see SETUP 14.

Note !

3 - SETPOINT	
Below settings for the local and ratio mode.	
DECIMALS SV RATIO **31**	This setting determines for ratio setpoint (SV) the number of digits following the decimal point. The following can be selected: 00000 - 1111.1 - 2222.22
SV MIN **RATIO LIMIT LO** **(SETPOINT)** **32**	This setting determines lowest allowed set-point for the "ratio mode": 0.0 - 100.0 % (usually 0
SV MAX **RATIO LIMIT HI** **(SETPOINT)** **33**	This setting determines maximum allowed set-point for the "ratio mode": 0.0 - 100.0 %

4 - CONTROL	
Below settings for the PI algorithm used in the Fluidwell F124-A:	
CONTROL ACTION **(ACTION)** **41**	Enter here how the control action should be defined: Direct – Reverse Direct: if process value PV increases, the control output CO increases as well. Reverse: if process value PV increases, the control output CO decreases.
PROPORTIONAL BAND **(PB PCT)** **42**	The proportional band describes the process value variation span, which is expressed as a percentage (%) and is required to change the control output from 0 – 100%. Setting range: 0.1 to 999.9 %
INTEGRATION TIME **I-TIME** **(IT SEC)** **43**	An integral action continually increases and decreases the output in proportion to the integrated to the integrated deviation. Setting range : 0.0 – 6000.0 seconds (value 0.0 seconds disables this function)
STARTUP **44**	This function allows the F124-A to start-up after a power-shutdown in a safe mode. Three selections can be made: Safety: it continues with the safety value as programmed with SETUP 93. . Hand: it continues with the last value as entered in the Hand-mode. Continue: it remains with the last control mode at the moment of power shutdown.

5 - ALARM

With these settings, it is determined if and how the ratio will be monitored.

SET ALARM **51**	This function determines if and how the ratio alarm values can be set: Following can be selected: Operate: the values can be set at both Operator and SETUP-level. Setup: the values can be set at SETUP level only, but are visible for the operator. Hidden: the ratio alarm values are not visible for the operator, only the alarm warning. Disable: there is no ratio monitoring.
FLOW ZERO **52**	When the flow rate of both flows is zero, then it is possible to ignore or disable the ratio monitoring. The following settings can be selected: DEFAULT: in case of a low-ratio alarm and zero flow, it will switch the alarm output and indicate the alarm on the display. NO RELAY: in case of a low-ratio alarm and zero flow, it won't switch the alarm output but will indicate it on the display only. IGNORE: in case of a low-ratio alarm and zero flow the alarm will be ignored.
ALARM VALUE **RATIO LOW** **53**	The low alarm is set as a % with this setting. An alarm will be generated as long as the ratio lower as this value. With value 0.0 this function is disabled.
ALARM VALUE **RATIO HIGH** **54**	The high alarm is set as a % with this setting. An alarm will be generated as long as the ratio higher as this value. With value 0.0 this function is disabled.

6 - POWER MANAGEMENT

When used with the internal battery option, the user can expect reliable measurement over a long period of time. The F124-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 refresh rate 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; regardless the refresh rate all data will be processed and output-signals will be generated in the normal way.
	The following refresh rates 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 operate, 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.

Note !

7 - FLOW SENSOR -A-

FORMULA **71**	The F124-A can process the 4-20mA signal in two ways: ▪ Interpolation: the signal is processed linear $$R = S \times I$$ ▪ Square root: for differential pressure $$R = S \sqrt{I}$$ where: R = Rate: the calculated flow rate S = Span: the maximum flow rate at 20mA. The span is programmed with SETUP 14 and 21 for flow rate. I = Input: the scaled analog value; in these formulas value 0 (zero) for (0)4mA and value 1 (one) for 20mA.
FILTER **72**	The analog output signal of a flow meter does mirror the actual flow. This signal is measured several times a second by the F124-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 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	0.3 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

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 than 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 14/21)	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

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7 - FLOW SENSOR -A- (CONTINUED)	
CALIBRATE MIN / 4MA 74	With this setting it is possible to calibrate the input value for (0)4mA as the signal from the flow meter might not be exact 4.0 mA (or 0.0 mA) at flow rate 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.
CALIBRATE MAX / 20MA 75	With this setting it is possible to calibrate the input value for 20mA as the signal from the flow meter might not be exact 20.0 mA at maximum flow rate. This function will measure the real output value at maximum flow rate. ▪ *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 - FLOW SENSOR -B-	
FORMULA **81**	The F124-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 - Flow sensor -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 - Flow sensor -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 than 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 - Flow sensor -A-"
CALIBRATE **MIN / 4MA** **84**	With this setting it is possible to calibrate the input value for (0)4mA as the signal from the flow meter might not be exact 4.0 mA (or 0.0 mA) at flow rate 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 - Flow sensor -A-"
CALIBRATE **MAX / 20MA** **85**	With this setting it is possible to calibrate the input value for 20mA as the signal from the flow meter might not be exact 20.0 mA at maximum flow rate. This function will measure the real output value at maximum flow rate. ▪ *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 - Flow sensor -A-"

9 - ANALOG OUTPUT

A linear analog (0)4-20mA / 0-10V signal is generated to control the ratio between flow A and B.
The range of the analog output is set with the following functions:

CONTROL OUTPUT CO MIN - LOW LIMIT 91	With this function, the value for the minimum control output is set. The value has to be entered as a percentage of the maximum output value as tuned with SETUP 94 / 95. Example: 10% means that the output value will not come below be 5.6mA for example.
CONTROL OUTPUT CO MAX - HIGH LIMIT 92	With this function, the value for the maximum control output is set. The value has to be entered as a percentage of the maximum output value as tuned with SETUP 94 / 95. Example: 90% means that the output value will not come above be 18.4mA for example.
CONTROL OUTPUT CO SAFETY 93	With the external input (terminals 15-16), the safety mode can be enabled. With this setting the control output value is defined for the safety mode. As long as the contact is made, this value will be transmitted. After releasing, the former value and function will be reinstalled. The value has to be entered as a percentage of the maximum output value as tuned with SETUP 94 / 95. Example: 50% means that the safety output will be 12mA for example.
TUNE MIN / 4MA 94	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 <u>directly active</u>. Press ENTER to store the new value. Remark: the analog output value can be programmed "up-side-down" if desired, so 20mA at minimum flow rate for example!
TUNE MAX / 20MA 95	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 <u>directly active</u>. Press ENTER to store the new value. Remark: the analog output value can be programmed "up-side-down" if desired, so 4mA at maximum flow rate for example!

A - COMMUNICATION (OPTIONAL)	
The functions described below deal with hardware that is 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 **A1**	For external control, the following communication speeds can be selected: 1200 - 2400 - 4800 - 9600 baud
BUS ADDRESS **A2**	For communication purposes, a unique identity can be attributed to every F124-A-P. This address can vary from 1-255.
MODE **A3**	The communication protocol is Modbus RTU mode. Select OFF, to disable this communication function.

| B - OTHERS	
TYPE OF MODEL **B1**	For support and maintenance it is important to have information about the characteristics of the F124-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 **B2**	For support and maintenance it is important to have information about the characteristics of the F124-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 **B3**	For support and maintenance it is important to have information about the characteristics of the F124-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.
PASS CODE **B4**	All SETUP-values can be pass code protected. This protection is disabled with value 0000 (zero). Up to and including 4 digits can be programmed, for example 1234.
TAGNUMBER **B5**	For identification of the unit and communication purposes, a unique tag number 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 F124-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
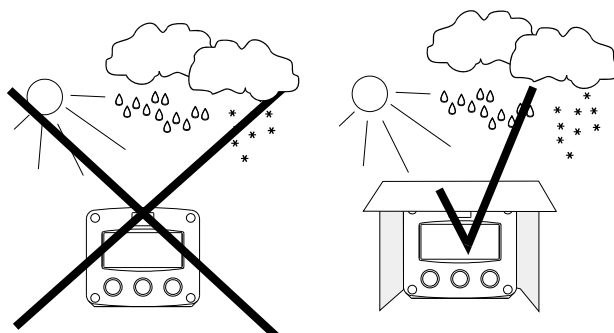
Take the relevant IP classification of the casing into account (see manufactures plate). Even an IP67 (NEMA 4X) casing should NEVER be exposed to strongly varying (weather) conditions.
When panel-mounted, the unit is IP65 (NEMA 4X)!
When used in very cold surroundings or varying climatic conditions, take the necessary precautions against moisture by placing a dry sachet of silica gel, for example, inside the instrument case.
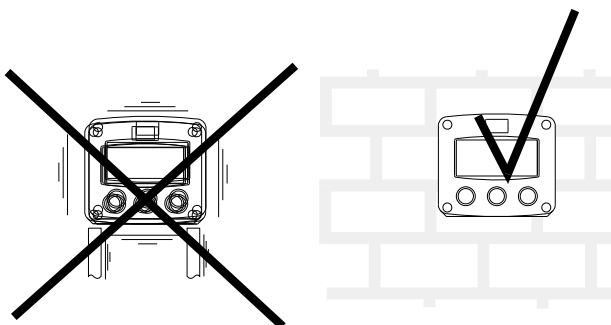
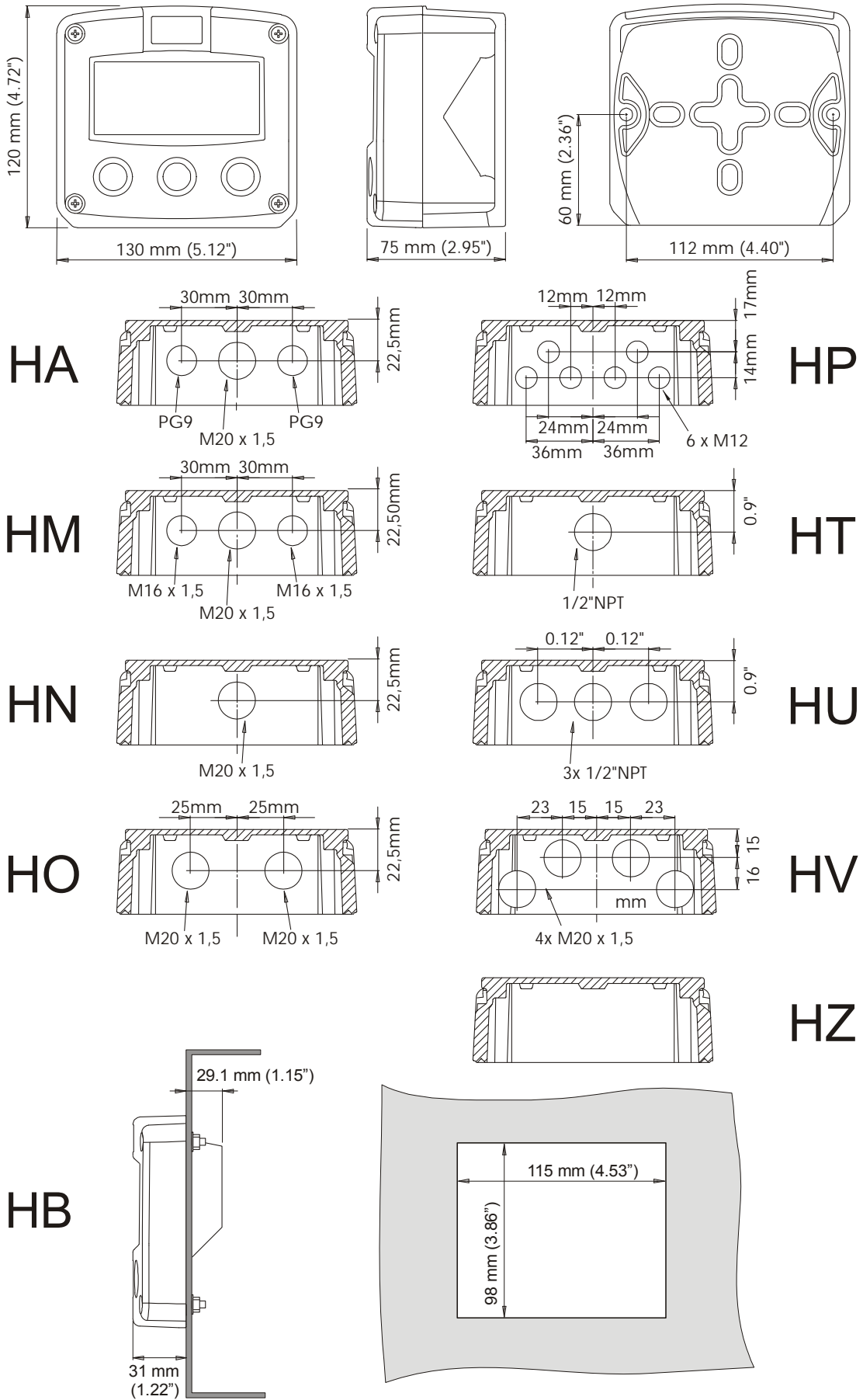Mount the F124-A on a solid structure to avoid vibrations.
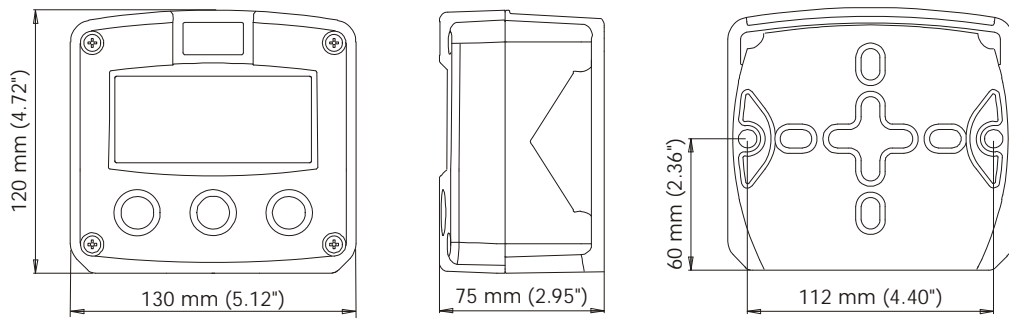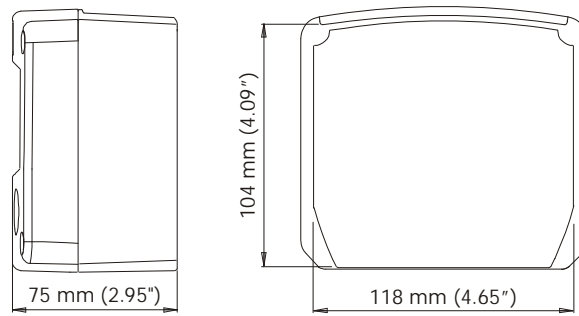
4.3. DIMENSIONS- ENCLOSURE
Aluminum enclosures:

Fig. 6: Dimensions aluminum enclosures.

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GRP enclosures:

HK back box:
(flat bottom)

HD
HK

HG

D=20mm   D=20mm

25mm   25mm
22,5mm

HE

30mm   30mm
22,5mm

D=16mm   D=16mm
D=20mm

HH

12mm 12mm
17mm
14mm

24mm   24mm
36mm   36mm
D=12mm

HF

D=22mm (0.866")
0.9"

HJ

0.12"   0.12"
0.9"

3x D=22mm (0.866")

HC

29.1 mm (1.15")

31 mm
(1.22")

115 mm (4.53")

98 mm (3.86")

120 mm (4.72")
130 mm (5.12")
75 mm (2.95")
60 mm (2.36")
112 mm (4.40")
104 mm (4.09")
75 mm (2.95")
118 mm (4.65")
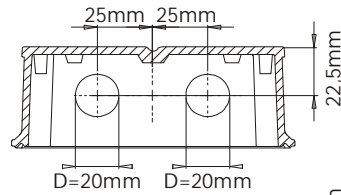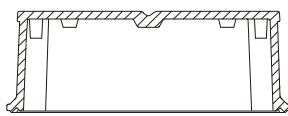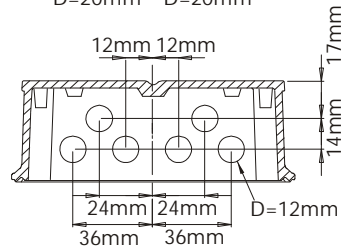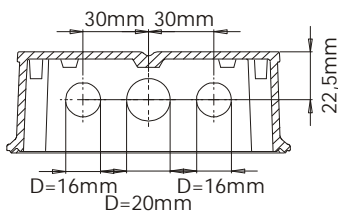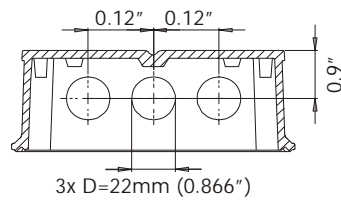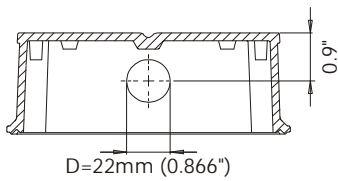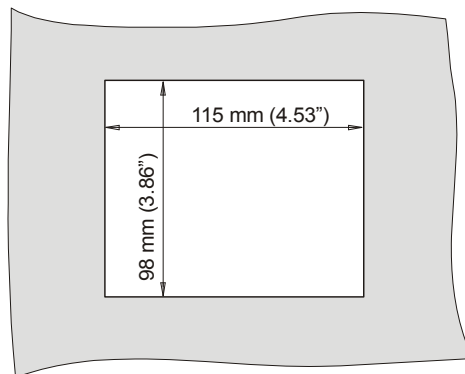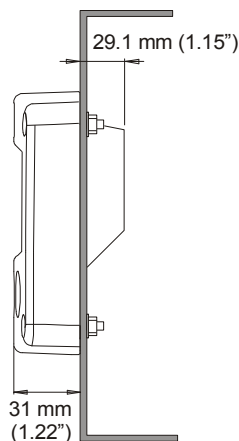
Fig. 7: Dimensions GRP enclosures.

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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 F124-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.
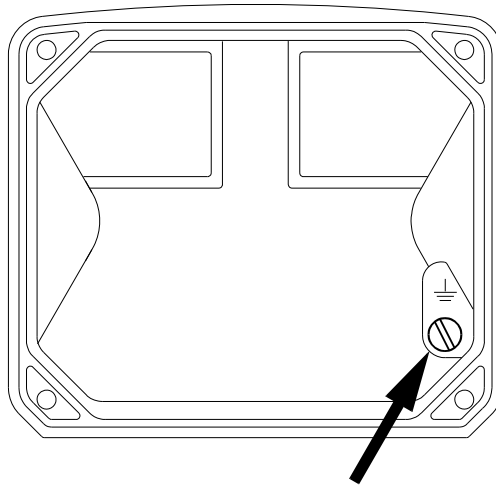
Fig. 8: Grounding aluminum enclosure with type PM 115-230V AC.

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 <u>Intrinsically Safe</u> applications: read chapter 5.

Type PB / PC / PX (AP) - battery powered and output loop-powered applications:
Terminals 11 and 14 provide a limited supply voltage of 3.2 V DC for the signal output of the flow meter. 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 flow meter can be powered with 8.2 - 12 or 24 V DC.
Total power consumption PD: max. 50mA at 24V and PF / PM: max. 400mA at 24V.
The voltage is selected with the three switches inside the enclosure.

⚠ **WARNING**

- *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:
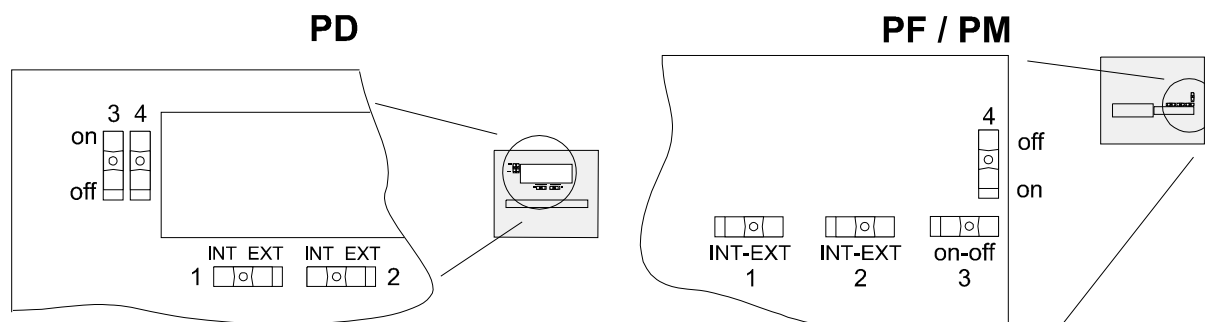
Fig. 9: Switch setting sensor supply voltage.

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

The following terminal connectors are available:
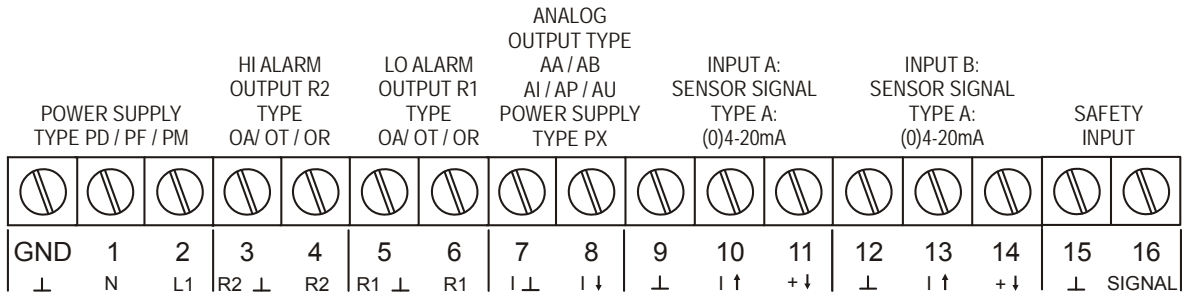
Fig. 10: Overview of terminal connectors standard configuration F124-A and options.

REMARKS: TERMINAL CONNECTORS:

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

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 at 24V								

◊=option

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

Note !

Terminal 05-06; transistor or relay output R1:
This output is high ratio alarm output. With SETUP 5, the function of this output is set.

Terminal 03-04; transistor or relay output R2:
This output is low ratio alarm output. With SETUP 5, the function of this output is set.

Type OA:
An active 24V DC signal output is available with this option.
Max. driving capacity 50mA at 24V per output. (Requires power supply type PD / PF / PM).
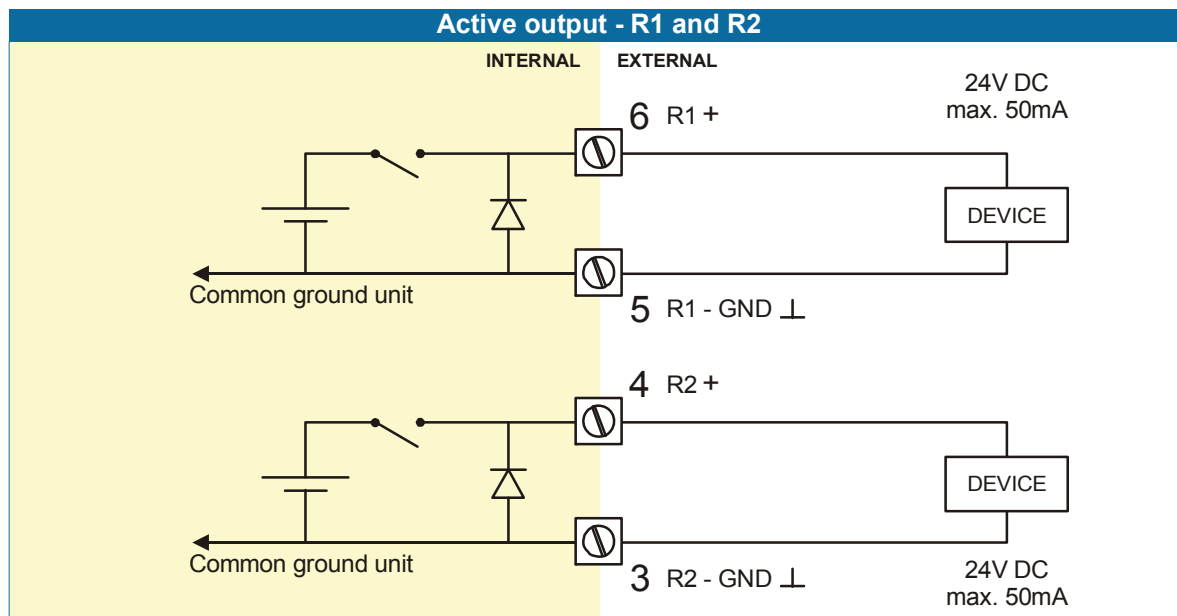
Type OR:
A mechanical relay output is available with this option.
Max. switch power 240V 0,5A per output. (Requires power supply type PF / PM).
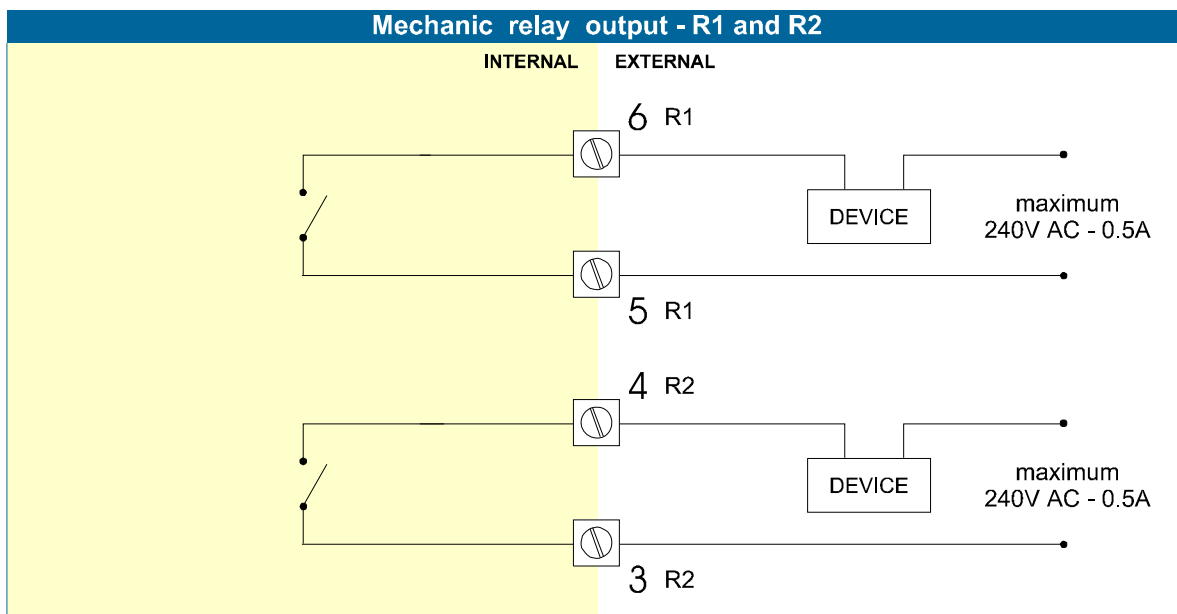
Type OT:
A <u>passive</u> transistor output is available with this option. Max. driving capacity 300mA at 50V DC.

Passive transistor output - R1 and R2
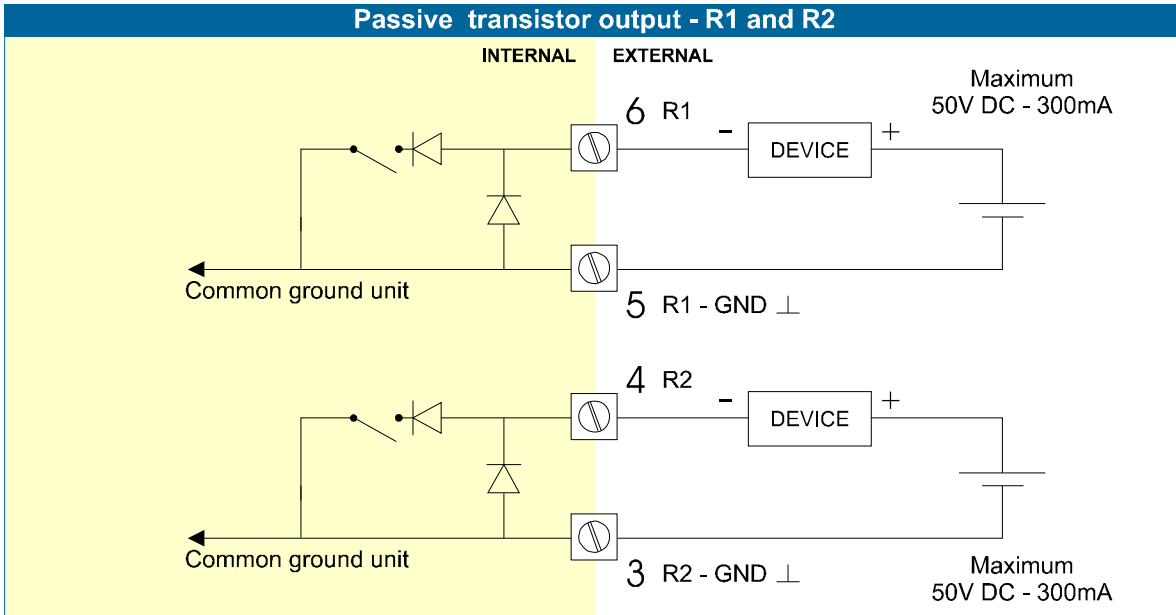
Terminal 07-08; basic <u>POWER SUPPLY</u> - type PX - output loop powered:
Connect an external power supply of 8-30VDC to these terminals or a 4-20mA loop.
Do connect the "-" to terminal 7 and the "+" to terminal 8. When power is applied to these terminals, the (optional) internal battery will be disabled / enabled automatically to extend the battery life time.

Only valid for standard passive output type AP!

Caution !

Terminal 07-08 analog output (SETUP 7) :
This is the IP control output.

Type AA:
An <u>active 4-20mA signal</u> control output is available with this option.
Max. driving capacity 1000 Ohm at 24VDC. (Requires power supply type PD / PF / PM).

Active 4-20mA analog output
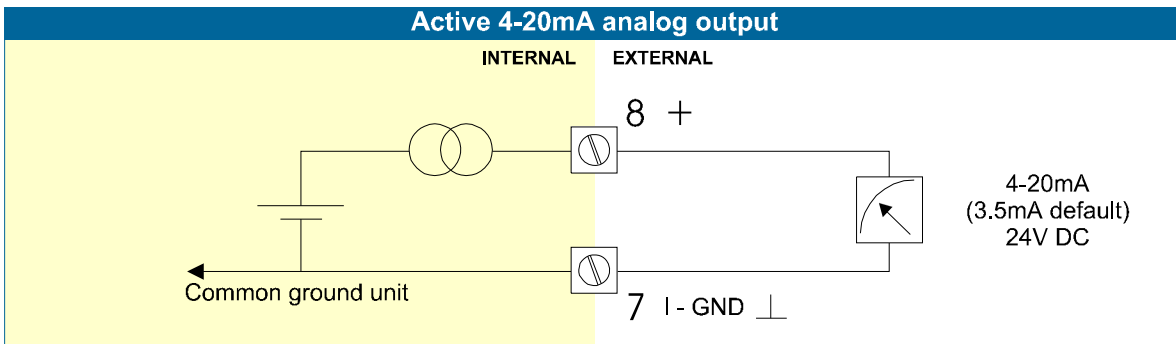
Type AB:
An active 0-20mA signal control output is available with this option.
Max. driving capacity 1000 Ohm at 24VDC. (Requires power supply type PD / PF / PM).

Active 0-20mA analog output
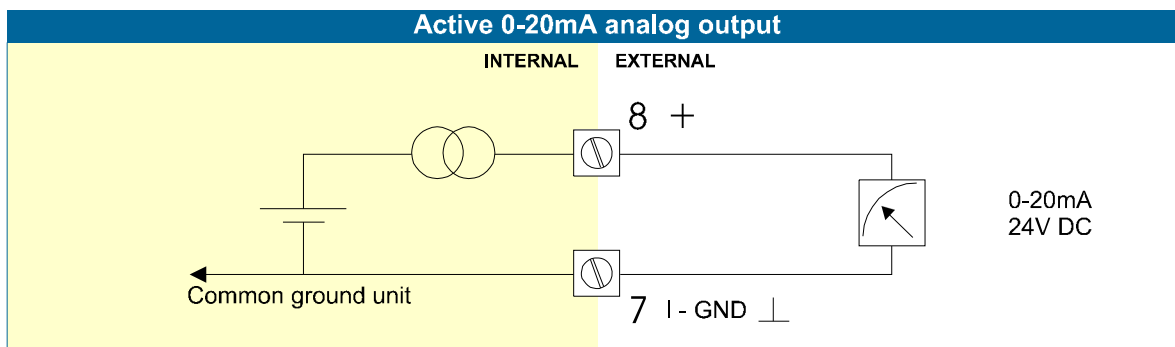
Type AI:
An isolated passive 4-20mA signal control output is available with this option.
Max. driving capacity 1000 Ohm at 30VDC.
This option can be used with a battery powered unit but the life time of the battery is about 2 -3 years.

Isolated 4-20mA analog output

Type AP:
A passive 4-20mA signal control output is available with this option.
 Max. driving capacity 1000 Ohm. This output does loop power the unit as well (type PX).

Passive 4-20mA analog output
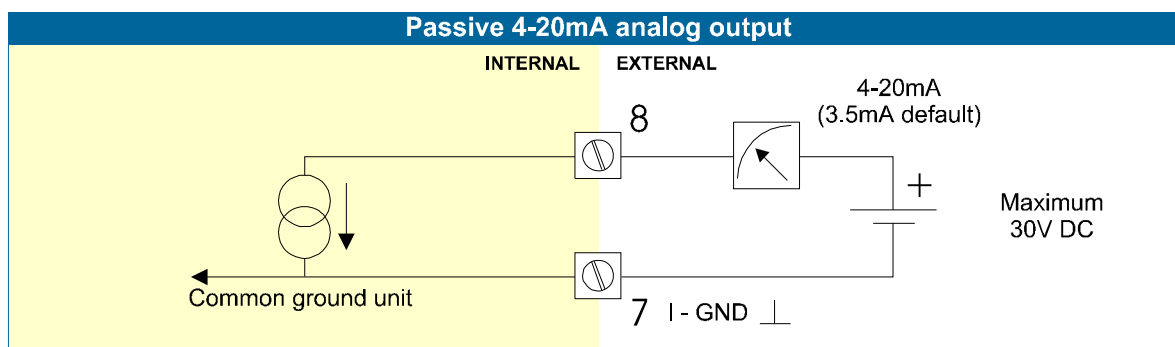
Type AU:
A 0-10VDC signal control output is available with this option.
Max. load 10mA at 10VDC. (Requires power supply type PD / PF / PM).

Active 0-10V analog output

INTERNAL   EXTERNAL

8 +

0-10V
max. 10mA

Common ground unit

7 I - GND ⊥
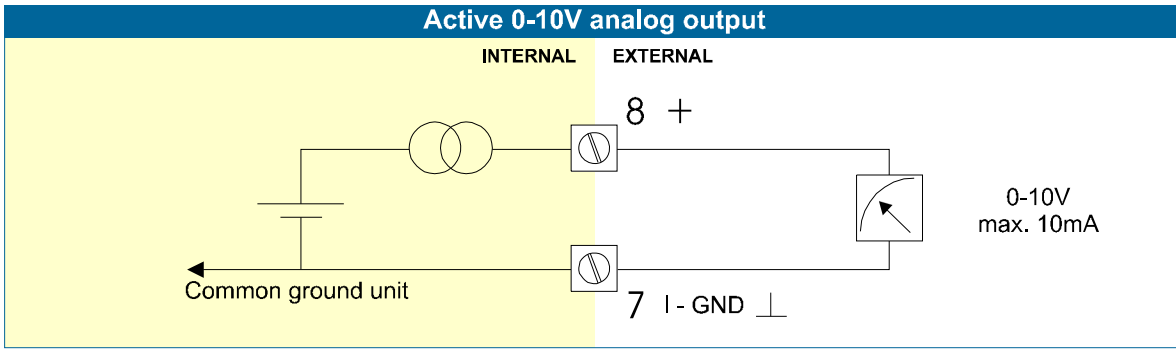
Terminal 09-11: Type A – Flowmeter input (general)
The F124-A requires a (0)4-20mA flowmeter signal which will be processed 4 times a second with a 14 bits accuracy. The input is not isolated.
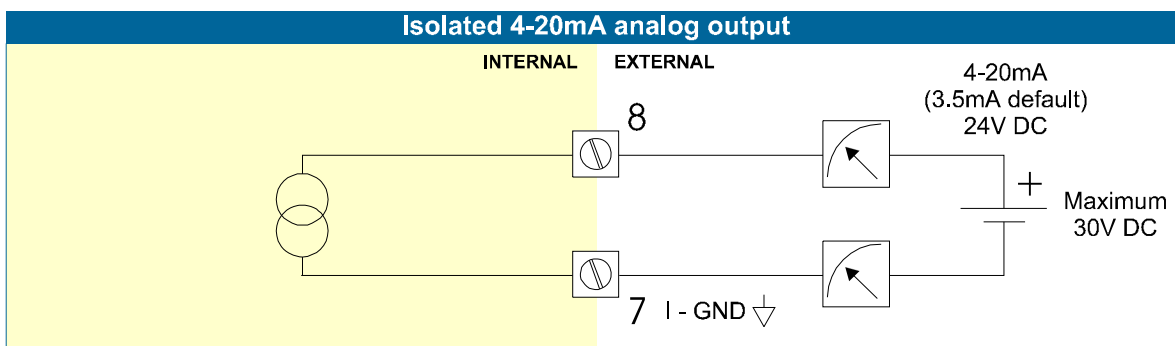**For Intrinsically safe applications (without input loop power): please read chapter 5.**

(0)4 - 20mA signal input

INTERNAL   EXTERNAL

11   Option PD-PN
        8.1 - 12 - 23V

10 SIGNAL   +
    max. 25mA

                    shielding   −

9   GND ⊥

Common ground unit
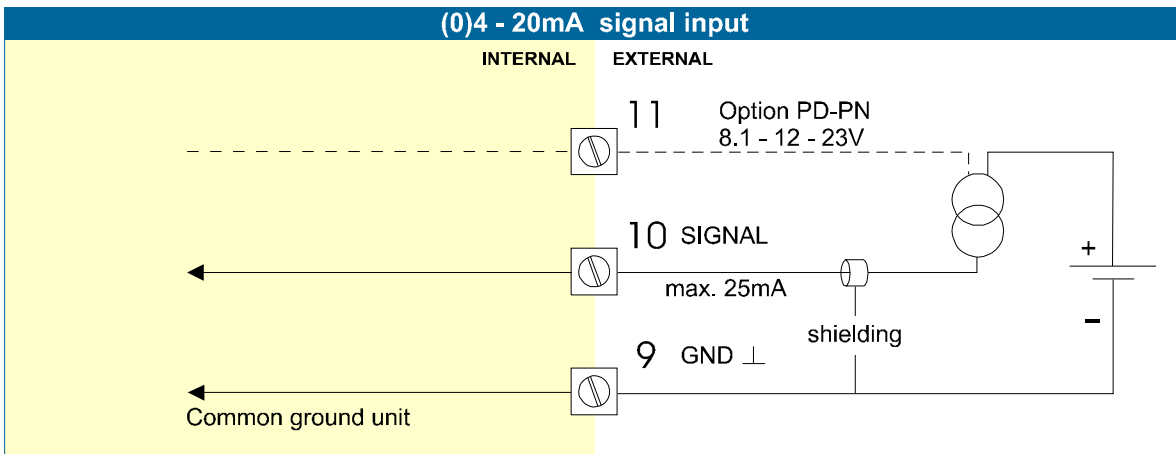
Terminal 09-10: Type A-PL – Flowmeter input / power supply:
The F124-A-PL requires a 4-20mA flowmeter signal which has a double function:
The signal will be processed 4 times a second with a 14 bits accuracy and the unit will be powered from the sensor signal (input loop powered). The input is not isolated and not intrinsically safe.

4 - 20mA signal input - input loop powered

INTERNAL   EXTERNAL

Signal / supply

10 SIGNAL   +
    max. 25mA

                    shielding   −

9   GND ⊥

Common ground unit
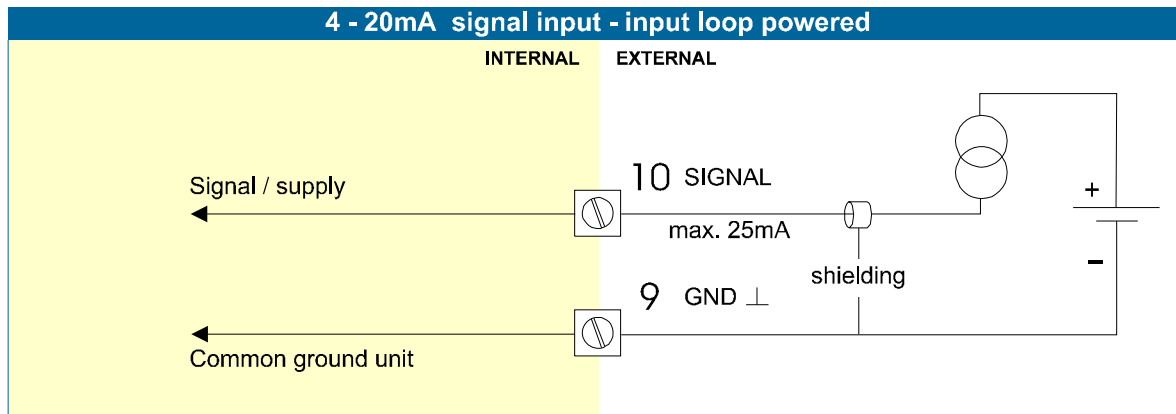
Terminal 12-14; Flow meter input B:
The F124-A requires a (0)4-20mA flow meter signal which will be processed 4 times a second with a 14 bits accuracy. The input is not isolated.
For Intrinsically safe applications: please read chapter 5.

(0)4 - 20mA signal input

INTERNAL   EXTERNAL

14   Type PD, PF, PM
      8.1 - 12 - 24V

13 SIGNAL

max. 25mA

shielding

+

−

12 GND ⊥

Common ground unit
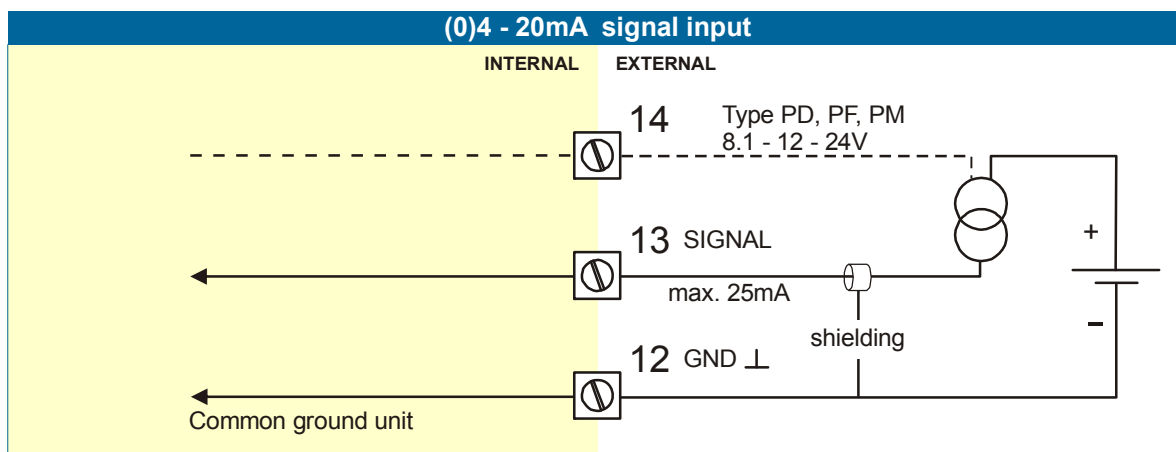
Terminal 15-16; safety mode:
With this function, the controller can be switched to a safety mode by making this contact. As long as this input is closed, the control output (terminal 7+8) will be according to SETUP 93.

External safety switch

INTERNAL   EXTERNAL

+ 3.2V DC

1M

low-pass filter

15 SIGNAL

shielding   SWITCH

Common ground unit

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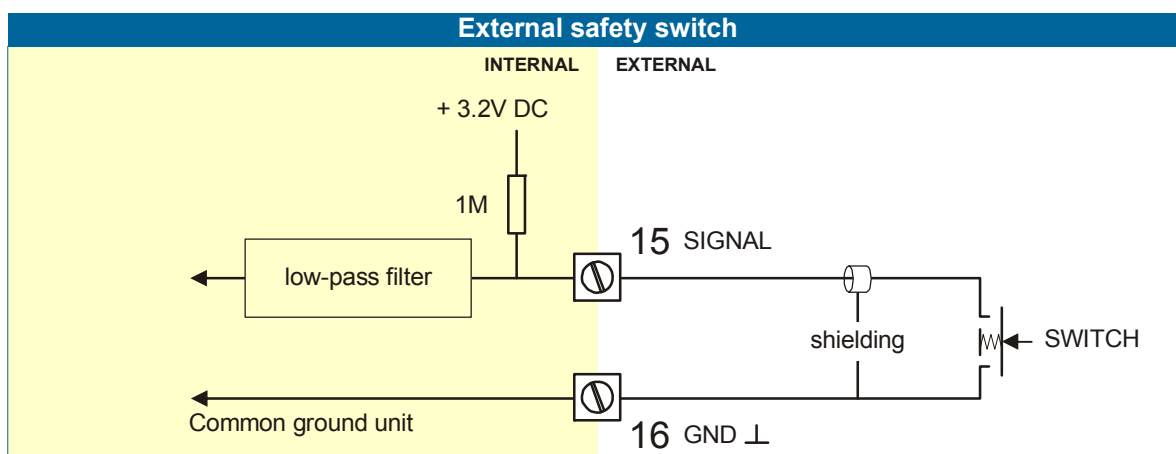
Terminal 26-31: type CB / CH / CI / CT - communication RS232 / RS485 / TTL (option)

- 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.
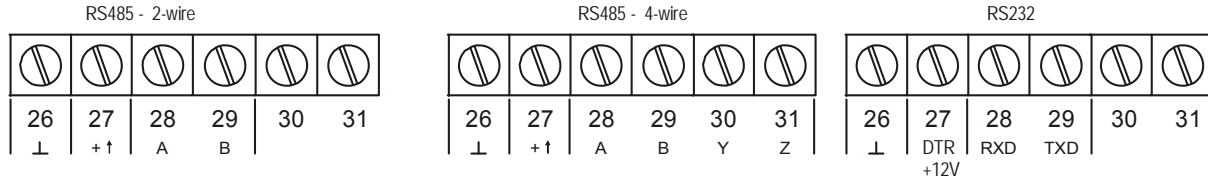
Fig. 11: Overview terminal connectors communication option.

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, except if a PD, PF or PM power supply is being used.

Fig. 12: 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.
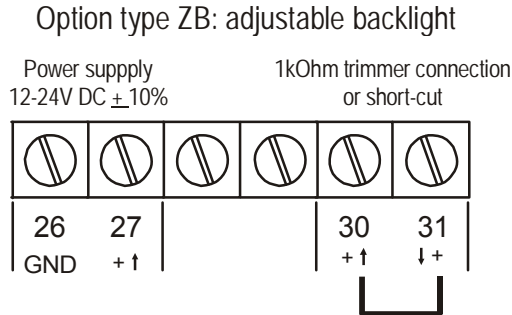- Ensure that the measuring system is correctly wired up according to the wiring diagrams. Protection against accidental contact is no longer assured when the housing cover is removed or the cabinet has been opened (danger of electric shock). The housing may only be opened by trained personnel.
- To 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.

WARNING

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".
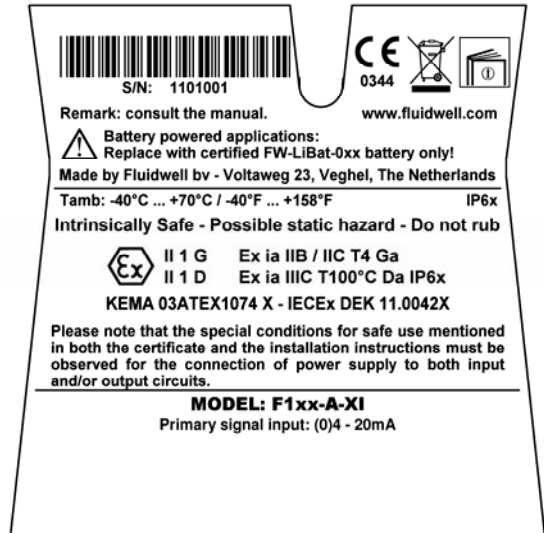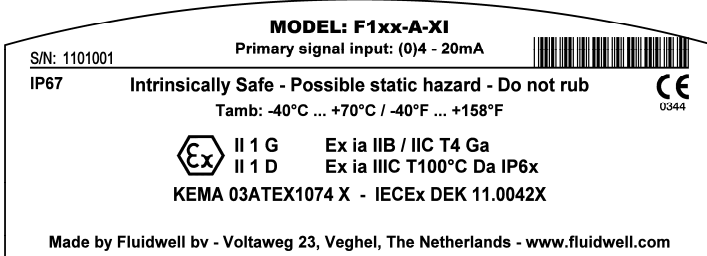
Serial number and year of production
This information can be looked-up on the display:
See setup function (par. 3.2.2.) for details.
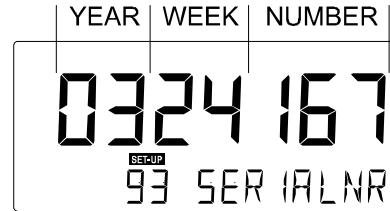
5.2.   TERMINAL CONNECTORS INTRINSICALLY SAFE APPLICATIONS

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 F124-A-XI:
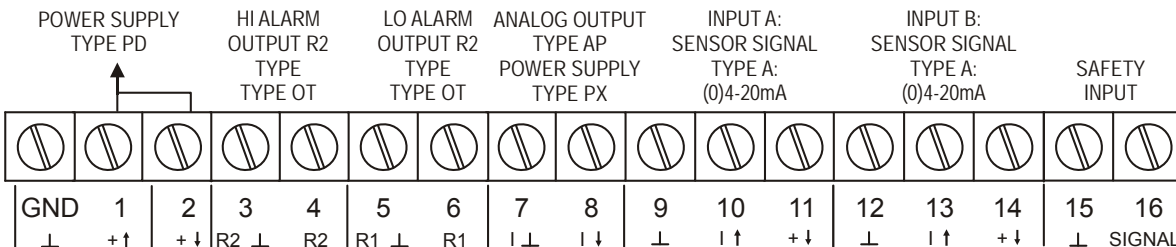
Fig. 13: Overview terminal connectors XI - Intrinsically Safe applications.

Explanation Intrinsically Safe options:

Type AF - Intrinsically Safe floating 4-20mA analog output - Terminal 7-8:
A <u>floating 4-20mA signal</u> control output is available with this option.
When the output is disabled, a 3.5mA signal will be generated.
.Max. driving capacity 1000 Ohm at 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.

Floating 4-20mA analog output - Intrinsically Safe
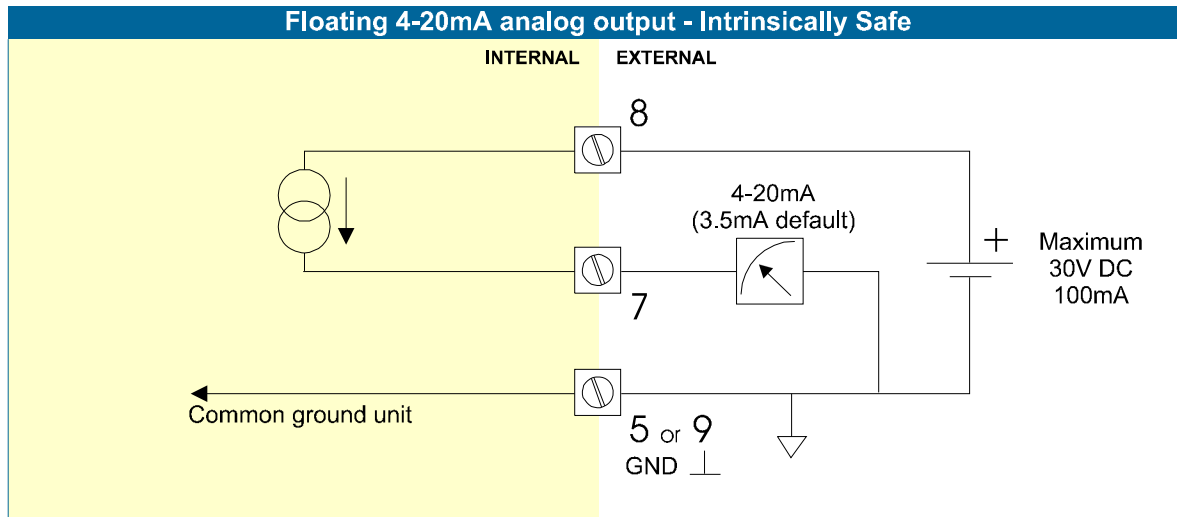
Type PD-XI
Intrinsically Safe power supply and sensor supply - Terminal GND- 01, 11 and 14. .

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 INTRINSICALLY SAFE APPLICATIONS

Fig. 14: Configuration example 1 Intrinsically Safe.

HF124AEN_v0501_04

Configuration example IIB/IIIC and IIC - F124-A-AP-(CT)-OT-PD-XI

TERMINAL CONNECTORS
F100-series

HAZARDOUS AREA

SAFE AREA

Modbus communication type CT: TTL
Please note: communciation type CT is not allowed in IIC applications.

TXD 29

RXD 28

DTR 27
+12V

Common ground 26

Uo = max. 30 V
Io = max. 250 mA
Po = max. 0.85 W

+

-

I.S. Certified
Isolator
TTL to:
RS232
RS422
TTL

For example:
MTL5051

e.g. PC

* Note: Communication only allowed when configured as IIB/IIIC.

TOTAL Co OF ALL CONNECTED
APPARATUS MAY NOT EXCEED
66nF MINUS 17nF
(17nF IS USED BY THE ANALOG
OUTPUT SIGNAL TERMINAL 7+ 8)

+ 3.2V — 1M
low-pass
filter

16

Common ground 15

Safety inputI

C_i is negligibly
small

Supply * 14

Signal 13

Circuit depends on
type of signal

Common ground 12

C_i is negligibly
small

Flowmeter input type: A
(0)4-20mA

Supply * 11

Signal 10

Circuit depends on
type of signal

Common ground 9

C_i is negligibly
small

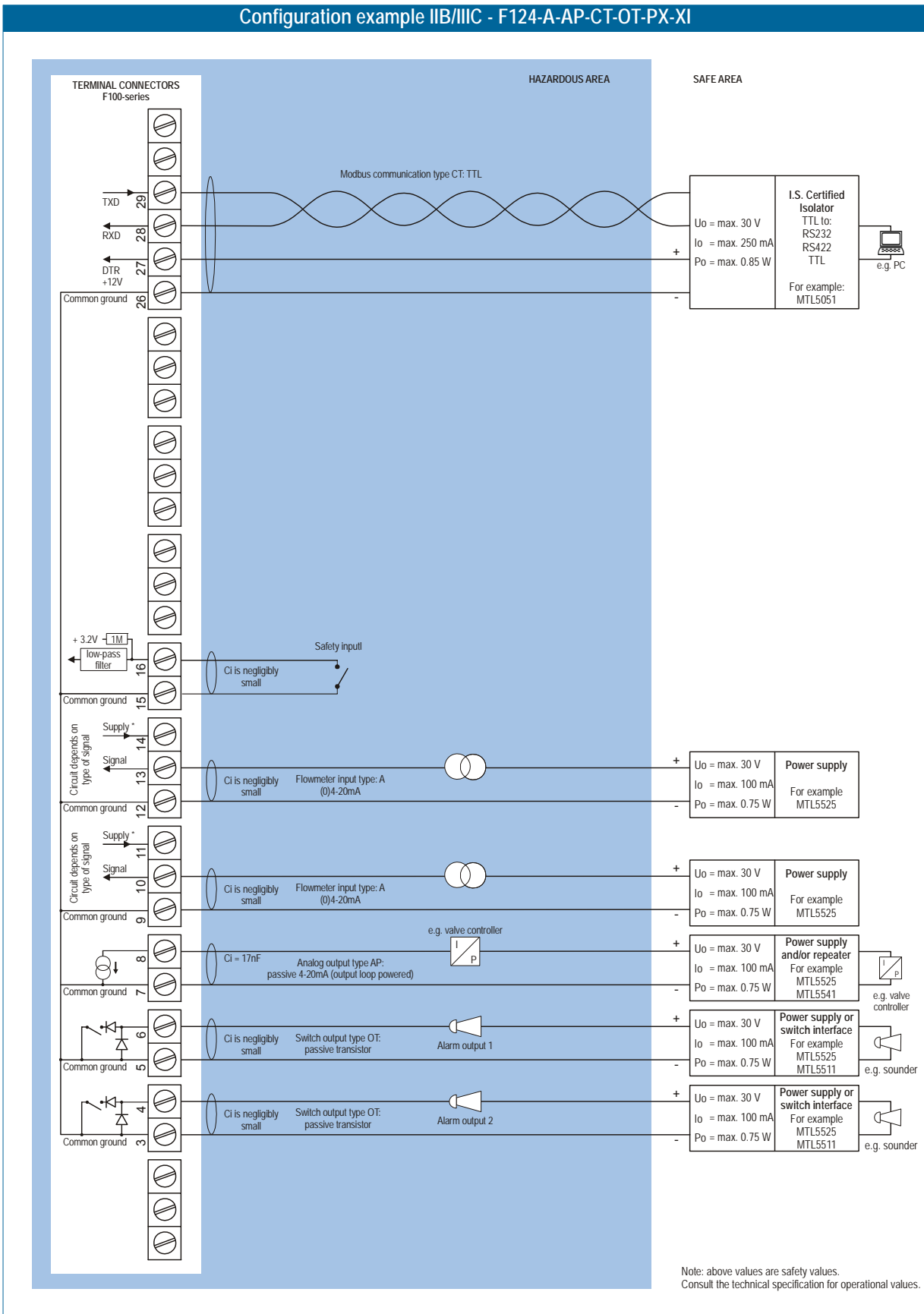Flowmeter input type: A
(0)4-20mA

8

Common ground 7

C_i = 17nF

e.g. valve controller
I
P
Analog output type AP:
passive 4-20mA

6

Common ground 5

C_i is negligibly
small

Switch output type OT:
passive transistor

Alarm output 1

+

-

Uo = max. 30 V
Io = max. 100 mA
Po = max. 0.75 W

Power supply or
switch interface
For example
MTL5525
MTL5511

e.g. sounder

4

Common ground 3

C_i is negligibly
small

Switch output type OT:
passive transistor

Alarm output 2

+

-

Uo = max. 30 V
Io = max. 100 mA
Po = max. 0.75 W

Power supply or
switch interface
For example
MTL5525
MTL5511

e.g. sounder

2

Main supply 1

Common ground 0

Power supply type PD: 16-30V DC
(please note: PD and battery supply (type PC) is NOT allowed in IIC applications).

+

-

Uo = max. 30 V
Io = max. 100 mA
Po = max. 0.75 W

Power supply

For example
MTL5525

Note: above values are safety values.
Consult the technical specification for operational values.

* Note power supply type PD: the supply voltage to the sensor is as connected to terminal 1 (internally linked).
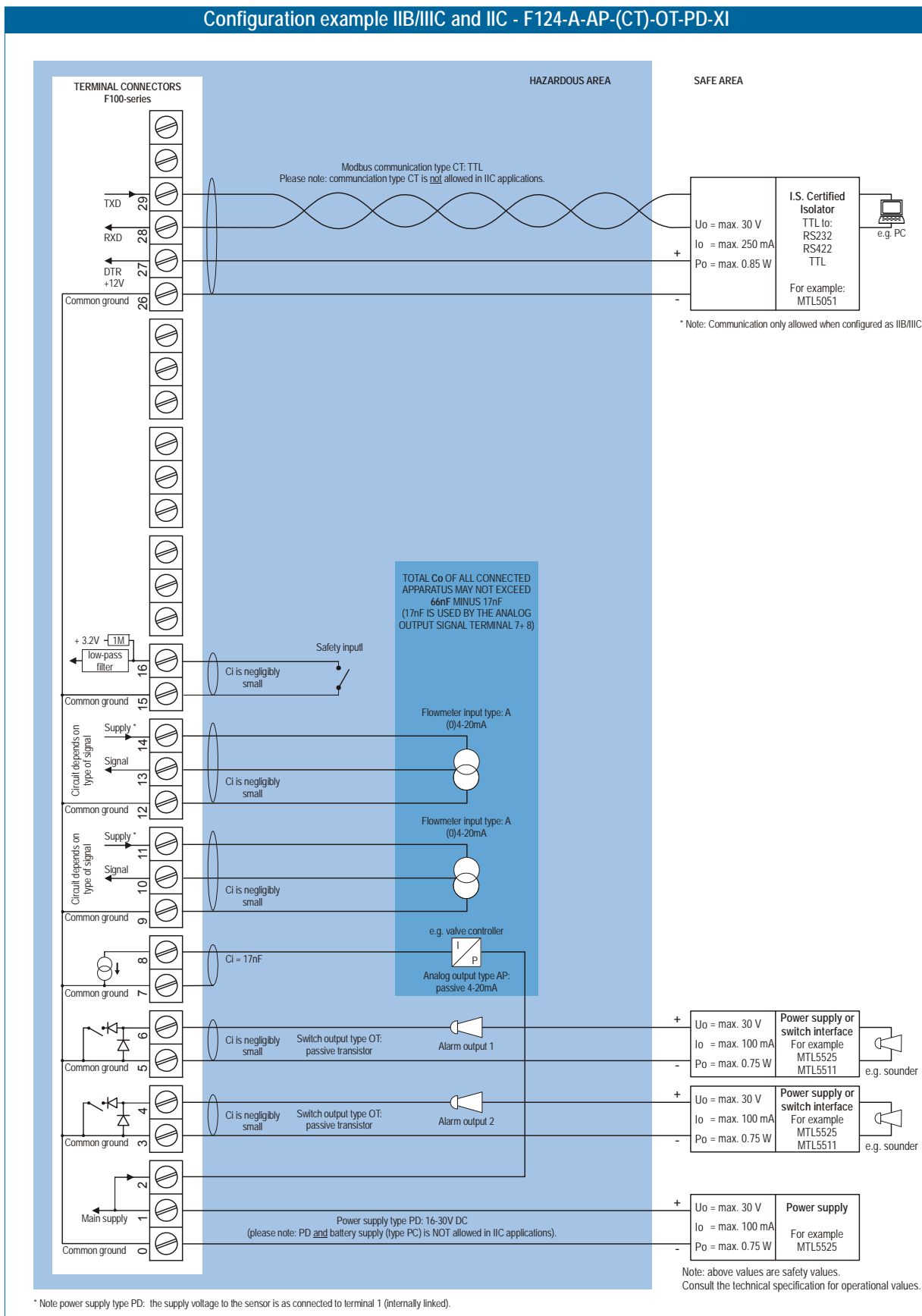
Fig. 15: Configuration example 2 Intrinsically Safe.

5.4   BATTERY REPLACEMENT INSTRUCTIONS

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.

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 type batteries (manufactured by Fluidwell bv) only**.

Battery replacement procedure

Depending on the production batch, one of two visualized Intrinsically Safe certified battery types may have been installed in the unit. They are interchangeable.
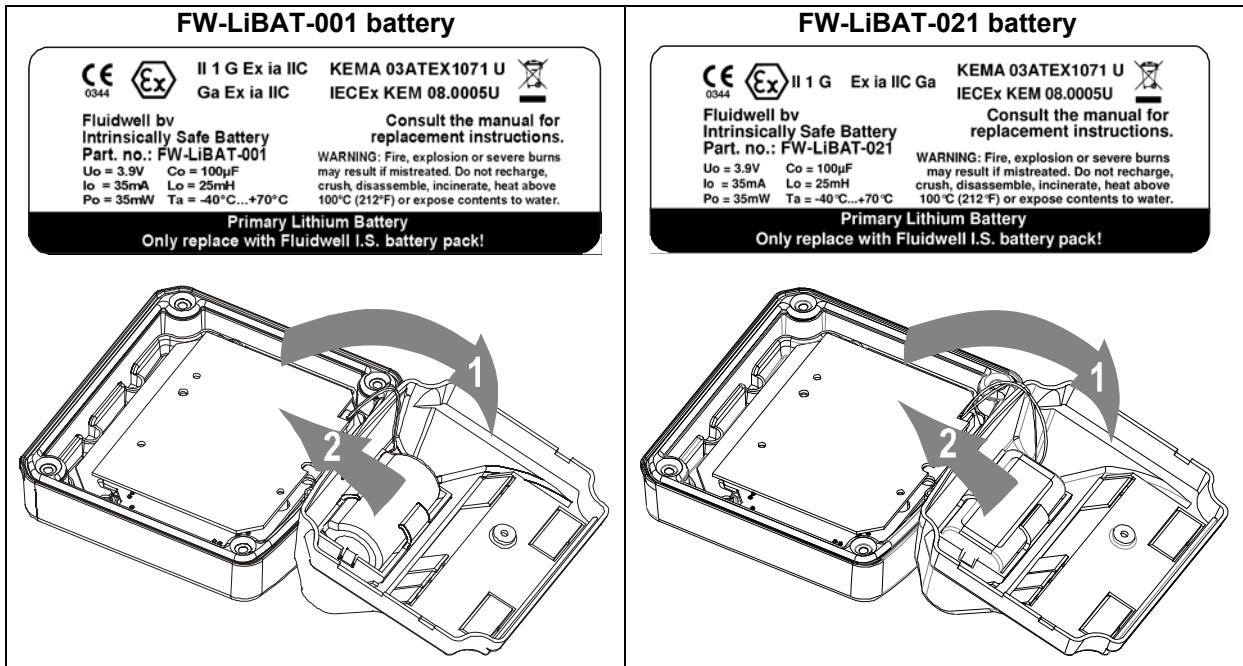
1. To replace the battery, open the unit to gain access to the back inside cover of the unit
2. Unplug the field connectors from the back inside of the unit.
3. Remove the screw that holds the plastic inside cover.
4. Open the cover and unplug the battery connector.
5. Remove the battery from the inside 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 F110-U 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 F124-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 the users responsibility to take all precautions to dehumidify the internal atmosphere of the F124-A in such a way that no condensation will occur, for example by placing dry silica-gel sachet in the casing just before closing it. Furthermore, it is required to replace or dry the silica gel periodically as advised by the silica gel supplier.

Battery life-time:
It is influenced by several issues :

- Display update: fast display update uses significantly more power; SETUP 61.
- Relay output and communications.
- 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 flow meter might be necessary. Do re-enter any subsequent Span alterations.
- The indication for low-battery.
- Clean the casing with soapy-water. Do not use any aggressive solvents as these might damage the coating.

6.2.   REPAIR

This product cannot be repaired by the user and must be replaced with an equivalent certified product. Repairs should only be carried out by the manufacturer or his authorized agent.

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 PD, 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:** ⟨Ex⟩ 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

Flow meter	
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 flow rate. 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.

Safety input	
Function	Sets the control output to predefined -safe- value (SETUP 83). Close the loop to activate.
Input type	Pull-down input with low-pass filter.

OUTPUTS

Analog output	
Function	IP Control output.
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)	
Pulse output	Max. frequency 60Hz. Pulse length user definable between 7,8msec up to 2 seconds.
Function	Two outputs: high and low ratio.
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 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	• Set-point • Process value • Control action (manual, local, ratio) • Flow rate A • Flow rate B • Alarm value low ratio • Alarm value high ratio

Flow rate	
Digits	7 digits.
Units	mL, L, m3, Gallons, KG, Ton, lb, bl, cf, RND, ft3, scf, Nm3, Nl, igal - 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 F124-A is going to be installed or while it is in operation.

The pass code is unknown:
If the pass code 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.

The alarm condition will almost certainly be handled internally and if all mentioned values still appear correct, no intervention by the operator is needed. If the alarm occurs more often or stays active for a longer time, please contact your supplier.

0004: internal setpoint out of range. Ratio setpoint x flow A is outside flow B range.
Example: ratio setpoint 50%, flow A 60.000 L/hour requires 30.000 L/hour for flow B. If this value is outside setting 32 or 33 the error is generated.

Above alarms can only be resolved by changing the configuration settings.

Note ! *Note: If several alarms are generated simultaneously, the alarm values are added together. (e.g. 0003 is error 0001 and error 0002).*

APPENDIX C: COMMUNICATION VARIABLES

The F124-A can be supplied with Modbus communication.

Available on request – please contact your supplier.

INDEX OF THIS MANUAL

LIST OF FIGURES IN THIS MANUAL

LIST OF CONFIGURATION SETTINGS			
SETTING	DEFAULT	DATE :	DATE :
1 - FLOW RATE -A-	Enter your settings here		
11 unit	L		
12 time unit	/min		
13 decimals	0000000		
14 span	0001600		
15 decimals span	0		
2 - FLOW RATE -B-			
21 Span	0001600		
22 decimals Span	0		
3 - SETPOINT			
31 SV decimals	111111.1		
32 SV minimum	0.0%.		
33 SV maximum	100.0%		
4 - CONTROL			
41 Action	reverse		
42 Proportional band PB	500.0%		
43 Integration time I-time	5.0 sec.		
44 Start up	safety		

SETTING	DEFAULT	DATE :	DATE :
5 - ALARM	Enter your settings here		
51 Set alarm	disable		
52 flow zero	ignore		
53 alarm low ratio	0.0%		
54 alarm high ratio	0.0%		
6 - POWER MANAGEMENT			
61 LCD-update	1 sec.		
62 mode	operational		
7 – FLOW SENSOR -A-			
71 formula	interpol		
72 filter	0		
73 cut-off	0.0%		
74 calibrate low	default		
75 calibrate high	default		
8 – FLOW SENSOR -B-			
81 formula	interpol		
82 filter	0		
83 cut-off	0.0%		
84 calibrate low	default		
85 calibrate high	default		
9 - ANALOG OUTPUT			
91 CO minimum (low limit_	0.0%		
92 CO maximum (high limit)	100.0%		
93 CO Safety mode	0.0%		
94 tune min - 0V	0160		
95 tune max - 10V	6656		
A - COMMUNICATION			
A1 baud-rate	2400		
A2 address	1		
A3 mode	RTU		
B - OTHERS			
B1 model	F124-A	F124-A	F124-A
B2 software version			
B3 serial number			
B4 pass code	0000		
B5 tagnumber	0000000		