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Innovative Technologies

Flow-X

Installation Manual

Mechanical

Electrical

Connection diagrams

Product	Flow-X Installation manual
Reference number	01-0110-1
Revision	A.11
Date	September 2013
Authors	Han van Dal, M.J.R. Payens, L.A.J. Joosten

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Special note

Printed in the Netherlands.

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Chapter 1 - Document Control

Revision Coding

Our documents are supplied with a revision code. This code has the following format:
<major revision letter>.<minor revision number>. Initially, the document has revision code A.0. When in the next release of the document minor changes were implemented, the minor revision number increases. When major changes have been implemented, the major revision number increments.

Example document:

A.0 First revision
A.1 Second revision with minor changes implemented
A.2 Third revision, with other minor changes
B.0 Fourth revision, with (a) major change(s).

The revision coding will be modified for each new release of a document.

Revision History

Revision A.0

Author : M.J.R. Payens
Date : January 2009

Initial release of the Flow-X Manual Volume I - Installation.

Revision A.01

Author : M.J.R. Payens
Date : February 2009

D-sub 37 pinout corrected.
RS-485 connections specified

Revision A.02

Author : Han van Dal
Date : July 2009

Added schematic for analog output
Updated the XP bracket drawing

Revision A.03

Author : Han van Dal
Date : October 2009

Added power consumption specifications

Revision A.04

Author : Marcel Payens
Date : June 2010

Updated Flow-X/R data

Revision A.05

Author : Han van Dal
Date : October 2010

Added HART multi-drop schematic.

Revision A.06

Author : Marcel Payens
Date : November 2010

Added MTL Barrier schematics for analog signals.

Revision A.07

Author : Han van dal
Date : March 2011

Added connection diagram for Solartron densitometer

Revision A.08

Author : Louis Joosten
Date : July 2011

Added maintenance and cleaning instructions

Revision A.09

Author : Han van Dal
Date : March 2012

Added chapter for description of operator panels and user in*terfaces*

Revision A.10

Author : Han van Dal
Date : June 2013

Added wiring diagram for Honeywell Enraf Calibron prover

Revision A.11

Author : Louis Joosten
Date : September 2013

Added paragraph on prover signals connection

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Chapter 2 - Introduction

Manual set

Welcome to the exciting world of Flow-X!

Using one of our Flow-X products, you are able to create your own flow-measurement solution, fully adapted to your specific needs.

This manual is the Installation manual for all Flow-X models.
There are three reference manuals:

- *Volume I – This Installation manual, with the installation instructions.*
- *Volume II- The Operation and Configuration manual. This manual consists of a general part and one of the following application-specific parts:*
  - IIA - Operation and configuration
  - IIB - Gas Metric application
  - IIC - Liquid Metric application
  - IID - Gas US customary units application
  - IIE - Liquid US customary units application
- Volume III - The manuals for solutions that exceed our standard applications. This volume consists of 1 part:
  - IIIB - Function reference

In the first chapter of this manual, the Flow-X product suite is introduced to a novice user.

Purpose of this manual

This Flow-X reference manual is written for a variety of readers:

- The **application developer**, who is interested in all details required to develop a complete flow measurement solution with a Flow-X product.
- The **Instrumentation engineer,** who selects the appropriate flow computer model, assigns inputs and outputs and designs transmitter loops and flow computer functionality
- A more generally **interested reader**, who investigates whether the capabilities and features of **Flow-X** will satisfy his/her project requirements.

This manual expects the reader to be commonly acquainted with flow measurement principles, such as turbine, orifice and ultrasonic measurements. This manual is not an introduction to these techniques.

Overview

This installation manual concerns the hardware related aspects of the Flow-X product suite, as they are required for design and installation of flow metering solutions.

In this first chapter, an introduction is given to this manual. Various terms and definitions as used throughout this book are given.

In chapter 2: '*Flow-X products*' the user is presented with an overview of the Flow-X module and models.

In chapter 3: '*Getting started*', an overview of design considerations is presented to assist in enclosure selection.

In the next chapters, fully detailed information is given on all installation aspects.

In chapter 4: '*Mechanical installation*', the mechanical details are given for all models.

In chapter 5: '*Electrical installation,'* electrical details are provided: typical loop diagrams, communication, power supply, earthing.

Chapter 6 briefly describes software installation.

Chapter 7 lists the full technical specifications

Chapter 8 holds the detailed drawings including dimensions.

Chapter 9 provides a configuration sheet.. These sheets are also available as an Excel sheet, downloadable from our website.

Abbreviations

Throughout this document the following abbreviations are used:

ADC	**A**nalog to **D**igital converter
AI	**A**nalog **I**nput
AO	**A**nalog **O**utput
API	**A**pplication **P**rogramming **I**nterface An interface that allows an application to interact with another application or operating system, in our case, **Flow-X**. Most of the **Flow-X** API is implemented through Excel worksheet functions.

ASCII	**A**merican **S**tandard **C**ode for **I**nformation **I**nterchange. A set of standard numerical values for printable, control, and special characters used by PCs and most other computers. Other commonly used codes for character sets are ANSI (used by Windows 3.1+), Unicode (used by Windows 95 and Windows NT), and EBCDIC (Extended Binary-Coded Decimal Interchange Code, used by IBM for mainframe computers).
CPU	**C**entral **P**rocessing **U**nit
DAC	**D**igital to **A**nalog **C**onverter
DCS	**D**istributed **C**ontrol **S**ystem
DDE	**D**ynamic **D**ata **E**xchange A relatively old mechanism for exchanging simple data among processes in MS-Windows.
DI	**D**igital **I**nput
DO	**D**igital **O**utput
EGU	**E**n**g**ineering **U**nits
EIA	**E**lectrical **I**ndustries **A**ssociation
FET	**F**ield **E**ffect **T**ransistor
GC	G**as** C**hromatograph**
GUI	**G**raphical **U**ser **I**nterface
HART	**H**ighway **A**ddressable **R**emote **T**ransducer. A protocol defined by the HART Communication Foundation to exchange information between process control devices such as transmitters and computers using a two-wire 4-20mA signal on which a digital signal is superimposed using Frequency Shift Keying at 1200 bps.
HMI	**H**uman **M**achine **I**nterface. Also referred to as a GUI or MMI. This is a process that displays graphics and allows people to interface with the control system in graphic form. It may contain trends, alarm summaries, pictures, and animations.
I/O	**I**nput/**O**utput
IEEE	**I**nstitute for **E**lectrical and **E**lectronics **E**ngineers
ISO	**I**nternational **S**tandards **O**rganization
MMI	**M**an **M**achine **I**nterface (see HMI)

MIC	**M**achine **I**dentification **C**ode. License code of **Flow-X** which uniquely identifies you computer.
OEM	**O**riginal **E**quipment **M**anufacturer
P&ID	**P**iping and **I**nstrumentation **D**iagram
PC	**P**ersonal **C**omputer
PCB	**P**rinted **C**ircuit **B**oard
PLC	**P**rogrammable **L**ogic **C**ontroller. A specialized device used to provide high-speed, low-level control of a process. It is programmed using Ladder Logic, or some form of structured language, so that engineers can program it. PLC hardware may have good redundancy and fail-over capabilities.
RS232	EIA standard for point to point serial communications in computer equipment
RS422	EIA standard for two- and four-wire differential unidirectional multi-drop serial
RS485	EIA standard for two-wire differential bidirectional multi-drop serial communications in computer equipment
RTU	**R**emote **T**erminal **U**nit
SCADA	**S**upervisory **C**ontrol **a**nd **D**ata **A**cquisition
SQL	**S**tandard **Q**uery **L**anguage
SVC	**S**uper**v**isory **C**omputer
TCP/IP	**T**ransmission **C**ontrol **P**rotocol/**I**nternet **P**rotocol. Transmission Control Protocol/Internet Protocol. The control mechanism used by programs that want to speak over the Internet. It was established in 1968 to help remote tasks communicate over the original ARPANET.
TTL	**T**ransistor-**T**ransistor **L**ogic
UART	**U**niversal **A**synchronous **R**eceiver & **T**ransmitter
URL	**U**niform **R**esource **L**ocator. The global address for documents and resources on the World Wide Web.

XML	**E**xtensible **M**arkup **L**anguage. A specification for Web documents that allows developers to create custom tags that enable the definition, transmission, validation and interpretation of data contained therein.

Terms and definitions

Throughout this manual the following additional terms and definitions are used:

Asynchronous	A type of message passing where the sending task does not wait for a reply before continuing processing. If the receiving task cannot take the message immediately, the message often waits on a queue until it can be received.
Client/server	A network architecture in which each computer or process on the network is either a client or a server. Clients rely on servers for resources, such as files, devices, and even processing power. Another type of network architecture is known as a peer-to-peer architecture. Both client/server and peer-to-peer architectures are widely used, and each has unique advantages and disadvantages. Client/server architectures are sometimes called two-tier architectures
Device driver	A program that sends and receives data to and from the outside world. Typically a device driver will communicate with a hardware interface card that receives field device messages and maps their content into a region of memory on the card. The device driver then reads this memory and delivers the contents to the spreadsheet.
Engineering units	Engineering units as used throughout this manual refers in general to the units of a tag, for example 'bar', or 'ºC', and not to a type of unit, as with 'metric' units, or 'imperial' units.
Ethernet	A LAN protocol developed by Xerox in cooperation with DEC and Intel in 1976. Standard Ethernet supports data transfer rates of 10 Mbps. The Ethernet specification served as the basis for the IEEE 802.3 standard, which specifies physical and lower software layers. A newer version, called 100-Base-T or Fast Ethernet supports data transfer rates of 100 Mbps, while the newest version, Gigabit Ethernet supports rates of 1 gigabit (1000 megabits) per second.
Event	Anything that happens that is significant to a program, such as a mouse click, a change in a data point value, or a command from a user.
Exception	Any condition, such as a hardware interrupt or software error-handler, that changes a program's flow of control.
Fieldbus	A set of communication protocols that various hardware manufacturers use to make their field devices talk to other field devices. Fieldbus protocols are often supported by manufacturers of sensor hardware. There are debates as to which of the different fieldbus protocols is the best. Popular types of fieldbus protocol include Modbus, Hart, Profibus, Devicenet, InterBus, and CANopen.

Kernel	The core of **Flow-X** that handles basic functions, such as hardware and/or software interfaces, or resource allocation.
Peer-to-peer	A type of network in which each workstation has equivalent capabilities and responsibilities. This differs from client/server architectures, in which some computers are dedicated to serving the others. Peer-to-peer networks are generally simpler, but they usually do not offer the same performance under heavy loads. Peer-to-peer is sometimes shortened to the term P2P.
Polling	A method of updating data in a system, where one task sends a message to a second task on a regular basis, to check if a data point has changed. If so, the change in data is sent to the first task. This method is most effective when there are few data points in the system. Otherwise, exception handling is generally faster.
Process visualization software	A system for monitoring and controlling for production processes, and managing related data. Typically such a system is connected to external devices, which are in turn connected to sensors and production machinery. The term 'process visualization software' in this document is generally used for software with which SCADA software, HMI software, or supervisory computer software applications can be built. In this document, although strictly not correct, the terms 'SCADA, 'HMI, 'supervisory', and 'process visualization' are alternately used, and refer to the computer software applications that can be realized with ***eXLerate***, Spirit IT's PC-based supervisory software.
Protocol	An agreed-up format for transmitting data between two devices. In this context, a protocol mostly references to the Data Link Layer in the OSI 7-Layer Communication Model.
Query	In SCADA/HMI terms a message from a computer to a client in a master/client configuration utilizing the message protocol with the purpose to request for information. Usually, more than 1 data-point is transmitted in a single query.
Real-time	The characteristic of determinism applied to computer hardware and/or software. A real-time process must perform a task in a determined length of time. The phrase "real-time" does not directly relate to how fast the program responds, even though many people believe that real-time means real-fast.
Resource	Any component of a computing machine that can be utilized by software. Examples include: RAM, disk space, CPU time, real-world time, serial devices, network devices, and other hardware, as well as O/S objects such as semaphores, timers, file descriptors, files, etc.

Synchronous	A type of message passing where the sending task waits for a reply before continuing processing.
Tag	A 'tag' as used within this document refers to a data point existing in the tag database, with a number of properties, such as its assigned I/O address, current value, engineering units, description, alias name, and many others.
Web Server	A computer that has server software installed on it and is used to deliver web pages to an intranet/Internet.

Document conventions

When the book symbol as displayed at the left appears in the text in this manual, a reference is made to another section of the manual. At the referred section, more detailed, or other relevant information is given.

When in this manual a symbol as displayed at the left appears in the text, certain specific operating instructions are given to the user. In such as case, the user is assumed to perform some action, such as the selection of a certain object, worksheet, or typing on the keyboard.

A symbol as displayed at the left indicates that the user may read further on the subject in one of the sample workbooks as installed on your machine.

When an important remark is made in the manual requiring special attention, the symbol as displayed to the left appears in the text

This symbol is shown when a safety-related warning is raised.

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Chapter 3 - The Flow-*X* products

Introduction

*This chapter provides an overview of available models in the **Flow-X** product suite.*

Flow modules

All products are based on the same flow module (Flow-X/M). A module usually represents one stream in your metering system. The module has its own 4-line display and 4 navigation buttons to allow inspection of values and changing of parameters if required.

Figure 3-1 Flow-X/M Module

Flow modules are to be mounted in one of the following enclosures:

- A Panel mounted flow computer (maximum 4 modules), Flow-X/P
- A Rack frame, holding maximum 8 modules, Flow-X/R
- A single enclosure, Flow-X/S

These enclosures are described in more detail below.

A single module has the following I/O capabilities:

Signal type	Nr	Description
Analog Input	6[1)]	Analog transmitter input, high accuracy 4-20mA, 0-20mA, 0-5V, 1-5V Inputs are fully floating (optically isolated)
HART input	4[1)]	Independent HART loop inputs, on top of the 4-20mA signals (Analog inputs) Support includes multi-drop for each transmitter loop
4-wire PRT inputs	2	High accuracy PT-100 inputs
Pulse inputs	1[2)]	High speed single or dual pulse input. Frequency range 0-5kHz (dual pulse) or 0-10kHz (single pulse)
Density	4[2)]	Periodic time input, 100µs - 5000µs.
Digital Inputs	16[2)]	Digital status inputs
Digital Outputs	16[2)]	Digital output, open collector
Pulse Outputs	4[2)]	Open collector, max. 100 Hz

Signal type	Nr	Description
Sphere detector inputs	4[2)]	Supports 1, 2 and 4 detector configurations mode 0.5ms detect update rate
Analog Outputs	4	Analog output for flow control, pressure control 4-20mA, outputs floating.
Prover Outputs	1[2)]	Pulse output for proving applications The output represents the corrected pulse signal
Serial	2	RS485/RS232 serial input for ultrasonic meter, printer or generic, 115kb
Ethernet	2	RJ45 Ethernet interface, TCP/IP
Power supply	2	External, 20 - 32 VDC, nominal 24 VDC, with redundant connections

1) The maximum number of Analog inputs plus Hart inputs is 6

2) There are in total 16 in- and outputs available for these functions

Table 3-1: Summary of Flow-X/M inputs and outputs

A full description of all specifications, including accuracies and acceptable signal levels, is to be found in Chapter 7 – Technical Specifications.

Nameplate

The Flow-X/M nameplate contains the following information: CE marking, MID approval number, notified body, serial number, year of build, operating temperature according to MID approval (actual operating temperature is 0 to 60 °C) and test certificate number.

Figure 3-2 Flow-X/M nameplate

Enclosures

Flow-X/P

This is a **P**anel mounted flow computer with up to four streams and an additional station module with a 7" multi-lingual color touch-screen and additional serial (3x) and Ethernet interfaces (2x). This flow computer can be used in both horizontal and vertical position. Field connections are available in standard 37-pin and 9-pin D-Sub type connectors at the rear.

Figure 3-3 Flow-X/P Panel version

Flow-X/R

The Flow-X/R is a **R**ack model with up to 8 streams for dense flow metering systems in 19” cabinets. Stream modules can be used as 8-stream application, as separate streams, or combinations. Field connections are available in standard 37-pole D-Sub type connectors; Ethernet connections are either individually used per stream module via dual RJ45 connectors, or to only one module when the modules operate in Multi-Module Mode (See paragraph on Multi-module mode on page 3-26).

Figure 3-4 Flow-X/R Rack enclosure

Flow-X/S

This is a **S**ingle stream, DIN rail enclosure with direct screw terminals for field connections. Interfaces include dual Ethernet with built-in web-server via RJ45 connectors. Graphical LCD display with 4 lines for local display of measured & calculated data. The Flow-X/S may be mounted in 3 ways: Horizontally on Din-rail, vertically on Din-rail, and Wall mounted.

Figure 3-5 Flow-X/S Single enclosure

Multi-module mode

The Flow-X/P and Flow-X/R enclosures usually accommodate more than one module. These modules may be used in standalone mode, where each module is acting as an independent flow computer. The other option is to use modules in Multi-Module mode, where they exchange data over the Ethernet. In this setup, the modules act together as one flow computer.

Security

Metrological seal

All enclosures have the option of locking the flow computer with a lead seal by an authorized body, to prevent access to the tamper switch of the individual modules (see below). In a Flow-X/P (Panel) and a Flow-X/R, one bar is used to seal all installed modules with one lead seal.

Tamper switch

Each flow module has a mechanical tamper switch to prevent changing of the application and vital parameters within that application.

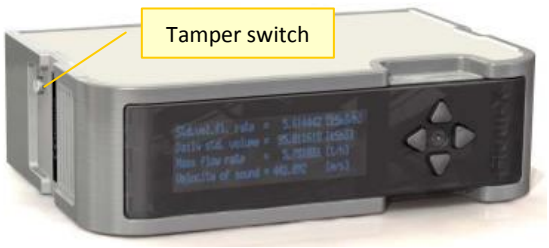

Figure 3-6 Flow-X/M module with tamper switch

Passwords

Access to the parameters and functions from the front panel or through a PC-connection is protected by passwords. For a full description of password protection, user groups and access rights see Volume II, Operation and configuration manual.

Advantages

The Flow-X product suite provides a flexible, scalable platform to create your flow metering solutions. Where in other systems, flexibility also implies extensive configuration for even the simplest application, our Flow-Xpress Basic configuration software guarantees easy configuration, and the Flow-Xpress Professional configuration software allows detailed configuration with unparalleled freedom.

Maintenance and cleaning instructions

Important - please read the following notes:

Safe operation of this product can only be guaranteed if it is properly installed, commissioned, used and maintained by qualified personnel in compliance with the operating instructions. General installation and safety instructions for pipeline and plant construction, as well as the proper use of tools and safety equipment must also be complied with.

Every effort has been made during the design of the flow computer to ensure the safety of the user but the following precautions must be followed:

1. Ensure correct installation. Safety may be compromised if the installation of the product is not carried out as specified in this manual.

2. The flow computer is designed as an installation category I product (24V max). The flow computer may not be used for measurements within measurement categories II, III and IV.

3. A disconnecting device (switch or circuit breaker) must be included in the installation. It must:
- Have a rating with sufficient breaking capacity.
- Be in close proximity to the equipment, within easy reach of the operator but not cause difficulty in operating.
- Be marked as the disconnecting device for the flow computer.
- Not interrupt a protective earth conductor.
- Not be incorporated into a mains supply cord.

4. This product is designed and constructed to withstand the forces encountered during normal use. Use of the product other than as a flow computer, or failure to install the product in accordance with these Instructions, product modifications or repair could:
- Cause damage to the product / property.
- Cause injury or fatality to personnel.
- Invalidate the marking.

5. Flow-X products are not intended to withstand external stresses that may be induced by any system to which they are fitted. It is the responsibility of the installer to consider these stresses and take adequate precautions to minimize them.

6. Environmental protection of the Flow-X enclosures is in accordance with IEC 60529 IP50. The flow computer should be installed in a dry and clean room.

7. Dust the flow computer by wiping the screen and the body with a soft, clean antistatic cloth. For more difficult cleaning situations, use a 50/50 mix of water and Isopropyl alcohol.

CAUTION: Spray the cleaner onto a cloth and use the damp cloth to gently wipe the surface. Never spray the cleaner directly on the screen surface. It may run behind the bezel and may result in fire, electric shock or damage to the electronics.

CAUTION: Do not use cleaners that contain any petroleum based materials such as benzene, thinner, or any volatile substance to clean the screen or body. These chemicals may damage the flow computer.

These instructions must be stored in a safe place near the installation of the flow computer at all times.

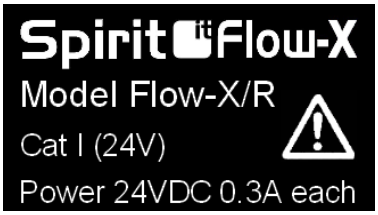

Figure 3-7 Flow-X/R label

Chapter 4 - Getting started

This chapter provides a short overview of considerations to be made in selecting the appropriate Flow-X products.

Decisions to make:

Location

The Flow-X modules are designed to operate in a temperature range of 0-60 °C (32-140°F) humidity may be up to 90%, non-condensating. In practice, the modules are usually mounted in racks in a controlled environment such as a control room, rack room or auxiliary room, or an analyzer house.

Caution
The Flow-X is neither intrinsically safe nor explosion-proof and can therefore only be used in a designated non-hazardous (safe) area.
For other devices always refer to documentation supplied by the manufacturer for details of installation in a hazardous area.
If connected to a device that resides in a hazardous area, it may be required to interpose safety barriers or galvanic isolators between the device and the Flow-X flow computer. Refer to the device documentation for adequate information.

Capabilities

The Flow-X supports an extensive list of International standard calculations for Natural gas, hydrocarbon liquids, and other applications: For example:

- AGA3, AGA5, AGA7, AGA8, AGA10
- API chapters 11.1, 11.2, and 21.1, API 2540, API 1952 tables
- ISO 5167 (all editions), ISO 6976 (all editions)
- NX19, SGERG, PTZ calculations
- GPA 2172 / TP15 / TP16 / TP25 / TP27
- ASME 1967 (IFC-1967) steam tables, IAPWS-IF97 steam density

See our website www.spiritit.com for the latest information on implemented methods.

Number of modules

Basically one module is needed for each flow meter. Additional modules may be needed for station and /or proving functionality.

A Flow-X/P contains an extra module (Module 0) that controls the touch screen and handles station and /or proving functionality (if applicable).

An overview of the available I/O per module may be found in Chapter 7 – Technical Specifications.

Station functionality (calculating station totals and / or handling station densitometers, gas chromatographs, BS&W analyzers etc.) and / or proving functionality may also be calculated in any module in the same enclosure, including the Flow-X/P Panel display module.

Special consideration applies to serial ports. Every module has 2 serial ports. If more ports are required, the Flow-X/P may be considered as it has 3 extra serial ports. Alternatively, a second module may be added in a Flow-X/R (rack) enclosure to provide more serial communication ports.

Redundancy

If, for increased availability, a redundant solution is required, 2 modules per stream may be used.
To obtain maximum availability, two identical Flow-X enclosures can be used that operate in redundancy mode.

All modules have integrated support for dual 24V power supply.

Fast Data exchange

Modules placed in a Flow-X/P (Panel) or Flow-X/R (Rack) enclosure are capable of fast data exchange with the modules next to it, over the Ethernet. This is the so-called Multi-Module Mode. Examples are one module communicating to a Gas Chromatograph and making this data available to 4 other modules, and additionally serving as a Modbus Slave to one central DCS connection. Each Module is capable of using the data from other modules as if it exists in its own data space. For this purpose the Flow-X/P includes two dedicated Ethernet switches. As an alternative it is possible to set up a Modbus TCP/IP link using Ethernet for data exchange between modules.

Display requirements

Obviously the Flow-X/P (Panel) flow computer has the best display features. The touch screen has the largest display area available on the flow computer market and allows for effective and user-friendly data display and navigation through pages. Its multi-language-support is unique and includes non-western fonts.
This display feature is not always required. Each individual module is equipped with a local black and white graphical display, allowing for data display and parameter setting at the module itself. The display supports 4 to 8 lines for data and/or parameters. This feature enables the stand-alone use of the flow modules, including in fiscal applications.
Apart from these physical displays, each module incorporates a web server, allowing display pages to be accessed through a standard web browser over Ethernet.

Power supply

All models require 24 VDC and support redundant power supply.

Cabinet space

Cabinet space may be at a premium, especially offshore. The Flow-X/R is the most efficient enclosure to use when every square inch counts.

Cost

Probably the most obvious design consideration is cost. We understand very well that you are looking for the best metering solution for the best price - in the long term. We are a company too, and cost matters to us too.
So if you are designing an architecture and feel that it is possibly less than optimum, please contact our local vendor or our headquarters to discuss your ideas.

One of the design goals of the Flow-X product suite was scalability – customers do not want to pay for hardware they don't use. Our modular concept and the available enclosures ensure that your hardware investment is tailored to your specific needs to the maximum extent.
We are not aiming at selling to you the largest number of flow modules in a single project, but, we do aim at selling many modules to you over the years. And you will only consider this when you are assured that Flow-X solutions bring the best quality for the best price.

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Chapter 5 - Mechanical installation

Introduction

This chapter describes the mechanical aspects of all enclosures. Chapter 10 -Drawings contains full drawings with sizes.

Flow-X/P

The panel mounted Flow-X/P requires a mounting bracket., which is part of the delivery. The bracket is designed to allow full access to the mounted flow modules. This rack is fixed to the back of the panel in which the Flow-X/P is to be mounted. The flow computer slides in at the front of the panel, and the screw fixes the two together.

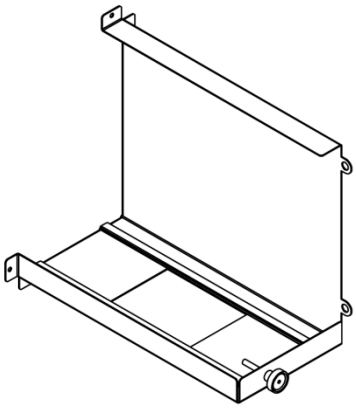

Figure 5-1 Flow-X/P Mounting bracket

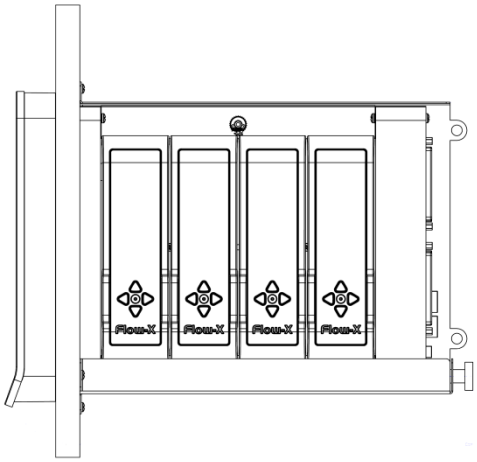

Figure 5-2 Flow-X/P mounted (side view)

All connectors for power, field wiring and communication are located at the back of the Flow-X/P. For each module, 2 sub-D connectors (37-pin) contain all field signals. Additional connectors exist for 3 the serial ports of the display module, and 2 Ethernet RJ-45 connections. A 24VDC Power connector completes the lot. See page 6-37 for connector details.
The modules that are inserted into the Flow-X/P are locked in place with a bar with the possibility to seal to prevent any unnoticed unauthorized access.

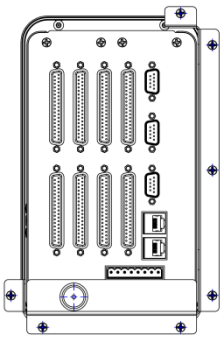

Figure 5-3 Flow-X/P rear view (mounted)

Note : 3 (three) 9-pins D-sub connectors are **male** and the 8 (eight) 37-pin D-sub connectors **female**

Flow-X/R

The rack version Flow-X/R requires 8 height units in a 19" rack. The connections are made through 2 sub-D connectors for each module. There is one power connector for each module (supporting redundant 24V power supply, as all other models). The 2 Ethernet RJ-45 connections for each module are located below the modules.

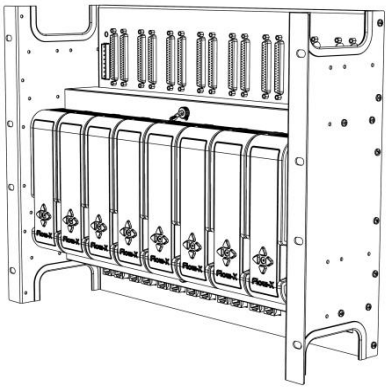

Figure 5-4 Flow-X/R Rack enclosure

Note : the 37-pin D-sub connectors are **female**

Flow-X/S

The single module Flow-X/S may be mounted on Din-rail, both horizontally and vertically, or directly on a backplane. Connections are made through screw terminals. For screw terminal assignments see page 6-41.

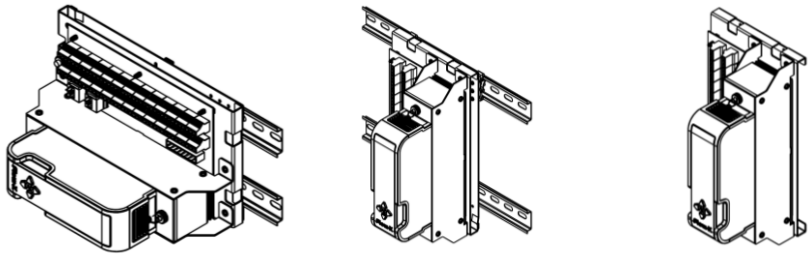

Figure 5-5 Mounting options for Flow-X/S

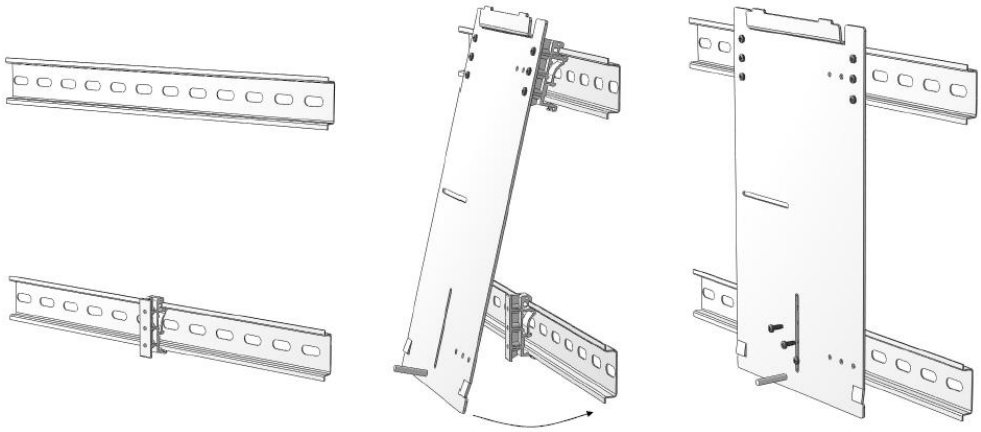

Figure 5-6 Flow-X/S mounting sequence (DIN-rail, vertical position)

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Chapter 6 - Electrical installation

Introduction

This chapter provides details on all aspects of the electrical installation, including field wiring, communication, power supply and earthing. Since all models use the same Flow-X/M module, the connection diagrams this chapter apply to all models.

Caution
The Flow-X is neither intrinsically safe nor explosion-proof and can therefore only be used in a designated non-hazardous (safe) area.
For other devices always refer to documentation supplied by the manufacturer for details of installation in a hazardous area.
When connected to a device that resides in a hazardous area, safety barriers or galvanic isolators may be required to be interposed between the device and the Flow-X flow computer. Refer to the device documentation for adequate information.

The Flow-X modules are fully configurable through software. No dipswitches or jumpers need to be set inside. There are no user-replaceable fuses or other components inside. Opening a module will void any warranty.

For easy reference, the connector details are presented first. Loop diagrams and additional connection drawings are to be found below.

Location of connectors

Flow-X/P

The Flow-X/P flow computer is the panel-mounted version that has a touch-screen and can contain up to 4 Flow-X/M flow modules.
The power, I/O and communication terminals are on the back of the flow computer. The touch-screen module processes the two RJ45 connectors (for Ethernet) and three 9-pin D-sub male connectors (for serial communications). These connections are functional even with no flow module installed. The 1st serial communications port only supports RS232, the other both RS232 and RS485.
Furthermore there are eight 37-pin D-sub female connectors for the I/O and serial communication ports of the 4 flow modules. Only the connections for the actual installed flow modules can be used.

The port connectors are described on page 6-39.
For the power connection, see page 6-39.
The 3 9-pin D-sub connectors are the serial ports of the Display module. These ports may be used to communicate to devices such as a gas chromatograph, or a DCS. Com 1 is RS-232 only, Com 2 and Com 3 may be individually configured for RS-232 or RS-485. For connector details, see page 6-41.
LAN1 and LAN2 are Ethernet connectors, to connect your Flow-X/P to your network. The modules are used in Multi-module mode. The individual Ethernet connections of each module are not used in a Flow-X/P.

Flow-X/R

The rack-mount Flow-X/R supports up to 8 modules. Each module has its own set of D-sub 37 connectors (Port A and Port B). For the pin-out see page 6-39.
Each module has its own power supply connector, from which it receives power. At the bottom, 2 Ethernet connections (LAN A and LAN B) are available for each module. When the modules are in Multi-Module Mode, only one pair of Ethernet connections will be used. When the modules are in individual mode, the Ethernet connections of each individual module are used.

Flow-X/S

The Flow-X/S has room for 1 module. The module is connected through 2 terminal strips with 39 terminals each. The connection details for the terminals are listed on page 6-41.
In addition, the Flow-X/S enclosure has a 24V power connector and 2 Ethernet connectors (LAN A and LAN B). For the power connector see page 6-39.

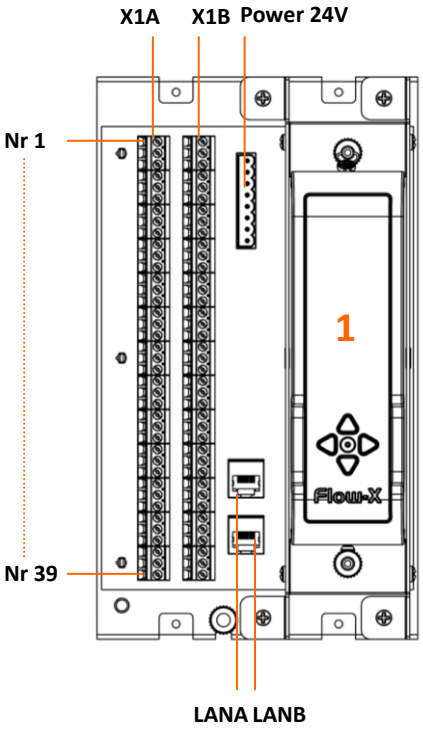


Figure 6-1 Flow-X/S connectors and terminals

Connector details

Power supply

The Flow-X flow computer provides redundant power connections that may be connected to two power supplies. The two power supplies may operate independently and there is no need for a redundant power supply. When the in-use power supply fails, the flow computer will automatically switch to the other power supply without any loss of power.
The Flow-X/P and /S flow computers use an 8-pin terminal block for connecting one or two external 24 Vdc power supplies, while the Flow-X/R uses a 4-pin terminal block. The primary connection must always be used, the secondary is optional.
The primary power supply must be connected to a (the) '24 Vdc - Primary' terminal and one of the '0 - Vdc' terminals. The optional secondary power supply must be connected to a (the) '24 Vdc - Secondary' terminals and one of the '0 V' terminals.

Figure 6-2: Flow-X/P & Flow-X/S power terminal block

Pin	Description	Indication on Flow-X
1	24 V – Primary	+ 1
2	24 V – Primary	+ 1
3	24 V – Secondary	+ 2
4	24 V – Secondary	+ 2
5	0 V	-
6	0 V	-
7	0 V	-
8	0 V	-

Table 6-1: Flow-X/P & Flow-X/S power supply connector pin layout

Figure 6-3: Flow-X/R power terminal block

Pin	Description	Indication on Flow-X
1	24 V – Primary	+ 1
2	24 V – Secondary	+ 2
3	0 V	-
4	0 V	-

Table 6-2: Flow-X/R power supply connector pin layout

D-sub 37 connectors

These connectors are used with the Flow-X/P (Panel) and Flow-X/R (Rack) models. The mounted connectors are female, so a connecting cable must have male connectors.

A-connector			
Pin	Function	Pin	Function
1	Com 1 - | Sig+| Tx+ *		
2	Com 1 Tx| Sig- | Tx- *	20	Digital 4
3	Com 1 - | - | Rx- *	21	0 V (Common)
4	Com 1 Rx| - | Rx+ *	22	Digital 5
5	24V out	23	0 V (Common)
6	Digital 1	24	Digital 6
7	0 V (Common) (Common)	25	0 V (Common)
8	Digital 2	26	Digital 7
9	0 V (Common)	27	0 V (Common)
10	Digital 3	28	Digital 8
11	0 V (Common)	29	0 V (Common)
12	Analog output 1	30	Analog output 2
13	Analog output common	31	Analog output common
14	Analog input common	32	Analog input 1
15	PRT 1 power +	33	Analog input common
16	PRT 1 signal +	34	Analog input 2
17	PRT 1 signal -	35	Analog input common
18	PRT 1 power -	36	Analog input 3
19	Analog input common	37	Analog input common

* RS-232 | RS-485 2 wire | RS-485 4 wire

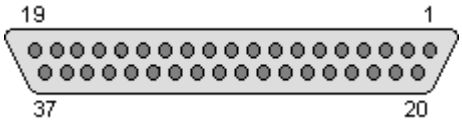
Table 6-3: 37-pin D-sub connector A pin-out Flow-X/P and Flow-X/R

B-connector			
Pin	Function	Pin	Function
1	Com 2 - | Sig+| Tx+ *		
2	Com 2 Tx| Sig- | Tx- *	20	Digital 12
3	Com 2 - | - | Rx- *	21	0 V (Common)
4	Com 2 Rx| - | Rx+ *	22	Digital 13
5	24V out	23	0 V (Common)
6	Digital 9	24	Digital 14
7	0 V (Common)	25	0 V (Common)
8	Digital 10	26	Digital 15
9	0 V (Common)	27	0 V (Common)
10	Digital 11	28	Digital 16
11	0 V (Common)	29	0 V (Common)
12	Analog output 3	30	Analog output 4
13	Analog output common	31	Analog output common
14	Analog input common	32	Analog input 4
15	PRT 2 power +	33	Analog input common
16	PRT 2 signal +	34	Analog input 5
17	PRT 2 signal -	35	Analog input common
18	PRT 2 power -	36	Analog input 6

B-connector			
Pin	Function	Pin	Function
19	Analog input common	37	Analog input common

* RS-232 | RS-485 2 wire | RS-485 4 wire

Table 6-4: 37-pin D-sub connector B pin-out Flow-X/P and Flow-X/R



D-sub 9 connectors (serial communication)

These connectors are only available on the Flow-X/P model. They connect to the 3 serial Com ports of the Display module. The connectors on the Flow-X/P are male. A connecting cable must have a female connector.

The 9-pin D-sub male connectors have the following pin connections.

Pin	COM 1 (RS-232 only)	COM 2 / COM 3 232 | 485(2wire) | 485 (4 wire)
1		- | - | Rx-
2	Rx	Rx | - | Rx+
3	Tx	Tx | Sig- | Tx-
4		- | Sig+| Tx+
5	0 V	0 V
6		
7	RTS	
8	CTS	
9		

Table 6-5: 9-pin D-sub connector pin connections for Flow-X/P

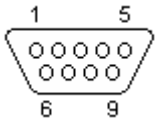


Figure 6-5: 9-pin D-sub connector pin numbering

Screw terminals

These connectors are used with the Flow-X/S (Single) model.

X1A / X2A terminal strip

Pin	Function	Pin	Function
1	24VDC out	21	Digital 9
2	0 V (Common)	22	0 V (Common)
3	Digital 1	23	Digital 10
4	0 V (Common)	24	0 V (Common)
5	Digital 2	25	Digital 11
6	0 V (Common)	26	0 V (Common)
7	Digital 3	27	Digital 12
8	0 V (Common)	28	0 V (Common)
9	Digital 4	29	Digital 13
10	0 V (Common)	30	0 V (Common)
11	Digital 5	31	Digital 14
12	0 V (Common)	32	0 V (Common)
13	Digital 6	33	Digital 15
14	0 V (Common)	34	0 V (Common)
15	Digital 7	35	Digital 16
16	0 V (Common)	36	0 V (Common)
17	Digital 8	37	24VDC out
18	0 V (Common)	38	0 V (Common)
19	24VDC out	39	24VDC out
20	0 V (Common)		

Table 6-6: Screw terminal A pin-out for Flow-X/S

X1B / X2B terminal strip			
Pin	Function	Pin	Function
1	PRT 1 power +	21	Analog input 6
2	PRT 1 signal +	22	Analog input common
3	PRT 1 signal -	23	Analog output 1
4	PRT 1 power -	24	Analog output common
5	Analog input common	25	Analog output 2
6	PRT 2 power +	26	Analog output common
7	PRT 2 signal +	27	Analog output 3
8	PRT 2 signal -	28	Analog output common
9	PRT 2 power -	29	Analog output 4
10	Analog input common	30	Analog output common
11	Analog input 1	31	0 V (Common)
12	Analog input common	32	COM 1 - | Sig+| Tx+ *
13	Analog input 2	33	COM 1 Tx| Sig- | Tx- *
14	Analog input common	34	COM 1 - | - | Rx- *
15	Analog input 3	35	COM 1 Rx| - | Rx+ *
16	Analog input common	36	COM 2 - | Sig+| Tx+ *
17	Analog input 4	37	COM 2 Tx| Sig- | Tx- *
18	Analog input common	38	COM 2 - | - | Rx- *
19	Analog input 5	39	COM 2 Rx| - | Rx+ *
20	Analog input common		

* RS-232 | RS-485 2 wire | RS-485 4 wire

Table 6-7: Screw terminal B pin-out for Flow-X/S

Ethernet

The Flow-X/S and Flow-X/P flow computers provide two standard RJ-45 Ethernet connections.
The Flow-X/R rack provides 16 Ethernet connections, 2 for each flow module in the corresponding slot. Whether or not these Ethernet plugs can be used for communication depends on the software configuration. When the corresponding flow module operates autonomously, so not in a multi-module configuration, the two Ethernet connections can be used to communicate with the flow module. This is also true when the flow module is the 'first' flow computer in a multi-module configuration. 'First' means first in the software application, which does not necessarily correspond with the physical position within the rack.

Connection diagrams

Ground wiring

The Flow-X flow computer uses the following separate ground connections:

- one common ground for the power supply and the digital signals ('**0 V**')
- one isolated common ground for the analog inputs ('**Analog input common**')
- one isolated common ground for the analog outputs ('**Analog output common**')
- chassis ground (through the chassis grounding screw)

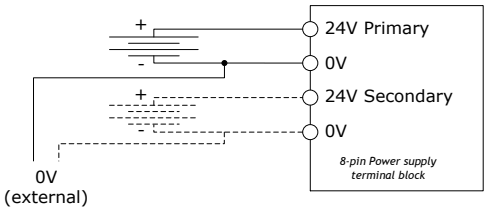


Figure 6-6: Flow-X power supply wiring

The separate common ground for analog inputs and analog outputs accommodate for applications with isolated (floating) analog signals.

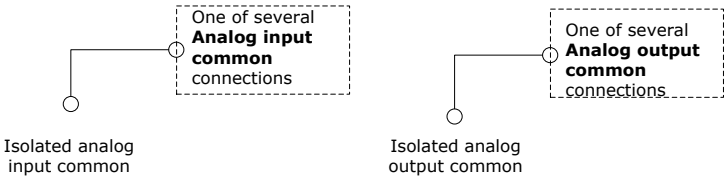


Figure 6-7: Isolated analog signal ground

If no isolated analog signal ground is available, then the analog input and/or output common ground must be connected to the common ground (0 V).

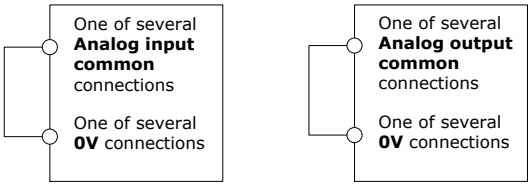


Figure 6-8: Common analog signal ground

Fuses

Each analog and digital I/O channel is protected for over-voltage and over-current by a **polyfuse** that resets automatically a few seconds after the fault situation has cleared.

The 24 VDC power supply is protected by a polyfuse as well, which is rated Imax 2.2 Ampere and Vmax 30 Vdc.

Digital signals

Each Flow-X/M module provides 16 general-purpose digital channels that are all sampled and processed at 10 MHz.
Each channel can be individually and independently configured as one of the following type of digital I/O:

- Digital input
- Digital output
- Pulse input
- Time period input (typically used for densitometers)
- Pulse output (for driving electro-mechanical counters)
- Detector input (for meter proving)
- Prover bus output (to support separate prover flow computers)

The following schematic illustrates the electrical circuit as used for each digital signal

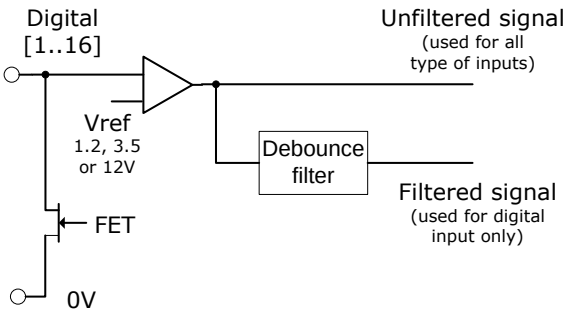


Figure 6-9: Digital channel circuit

Each digital channel has two field terminals, one terminal for the signal itself and one ground terminal. The ground terminal is only to be used when required by the application. All ground terminals are internally connected to the main power return terminal.
Each digital input channel supports two threshold levels for signal activation. For digital channels 1 through 8 the threshold level is selectable between 1.25 V and 12 V and for channels 9 through 16 between 3.5 V and 12 V. The default is 12 V for all 16 channels.
An 8 ms debounce filter is used to filter on digital status input signals, such as valve positions. Both the unfiltered and filtered signals are available in the software.
The FET is used for output signals and connects the input signal to the common ground. When the channel is configured as an input, the FET will be left in the open state permanently.

Digital inputs

When connected to a device that resides in a hazardous area, safety barriers or galvanic isolators may be required to be interposed between the device and the Flow-X flow computer. Refer to the device documentation for adequate information.

Each of the 16 digital channels of a Flow-X/M flow module can be configured to operate as a digital input.
Digital inputs are sampled at 20 MHz, so all 16 channels can be used for fast signals such as prover detector switches.
The digital input signal is sampled both unfiltered and with an 8 ms debounce period, which effectively ignores any state changes shorter than 8 ms.
The digital input circuit can be either externally or internally powered.
Because the digital inputs are floating, an external pull-up resistor is required if the loop is internally powered.

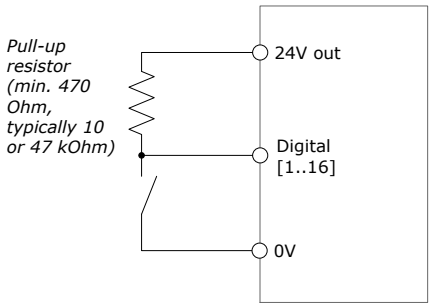


Figure 6-10: Internally powered digital input

When externally powered, the external source should have a connection to the common ground of the Flow-X flow computer ("0 V"). Only when this is not already arranged externally, an additional connection is required as shown in the following figure. Also a pull-up resistor may be required depending on the application.

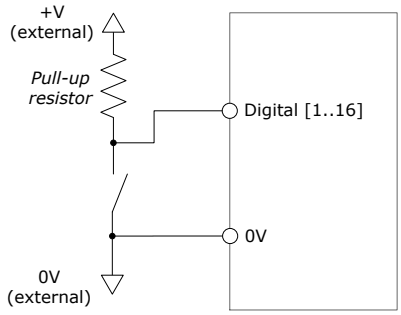


Figure 6-11: Externally powered digital input

Pulse inputs

When connected to a device that resides in a hazardous area, safety barriers or galvanic isolators may be required to be interposed between the device and the Flow-X flow computer. Refer to the device documentation for adequate information.

Each digital channel can be configured as a pulse input. Depending on the type of pulse signal a single- or dual pulse input will be allowed for each flow module. Each flow module supports one pulse input.(single or dual).
To accommodate for different type of pre-amplifiers each pulse input channel supports two threshold levels for signal activation. For channels 1 through 8 the threshold level is selectable between 1.25 V and 12 V and for channels 9 through 16 between 3.5V and 12 V. The default is 12 V for all 16 channels.
Both single and dual pulse inputs are supported. In dual pulse mode, ISO 6651 pulse integrity checking at level B is always enabled. Level A support (correction) may optionally also be enabled.
It is common practice to use pre-amplifiers to condition signal level from the meter pickup-coils. The following figures illustrate typical wiring when using pre-amplifiers.

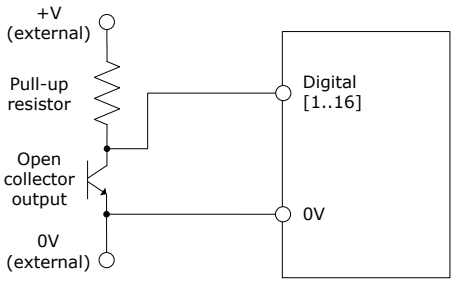


Figure 6-12: Pre-amplifier with open-collector output

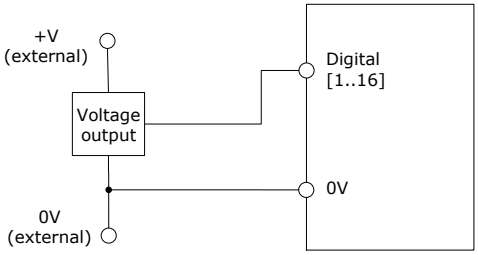


Figure 6-13: Pre-amplifier with voltage output

Time period inputs

When connected to a device that resides in a hazardous area, safety barriers or galvanic isolators may be required to be interposed between the device and the Flow-X flow computer. Refer to the device documentation for adequate information.

Each digital channel can be configured as a time period input, typically used to connect densitometers (also called density transducers or density meters) and specific gravity transducers. Each Flow-X/M module supports 4 time period inputs.

Time period inputs have to be connected to one of 16 digital channels provided by each flow module. Make sure that the used digital channel number has been set up properly in the Flow-X configuration.

For Solartron densitometers a 1 micro-Farad capacitor is required between the pull-up resistor and the digital channel as shown in the following figure.

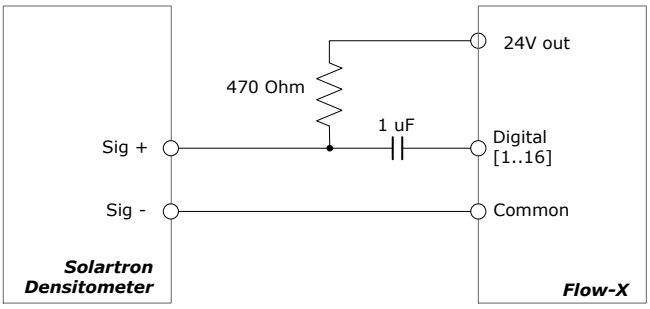


Figure 6-14: Solartron densitometer connection (loop powered by Flow-X)

Note : When the loop is externally powered a second 1 uF capacitor needs to be installed between the Solartron 'SIG-' and the Flow-X 'Common'. The capacitor should not have a polarity (+/-), electrolytical capacitors should not be used.

Digital outputs

When connected to a device that resides in a hazardous area, safety barriers or galvanic isolators may be required to be interposed between the device and the Flow-X flow computer. Refer to the device documentation for adequate information.

Each digital channel can be configured to operate as a digital output in which case it acts as an open collector. When the digital output is activated, the digital signal is connected to the flow computer common ground.

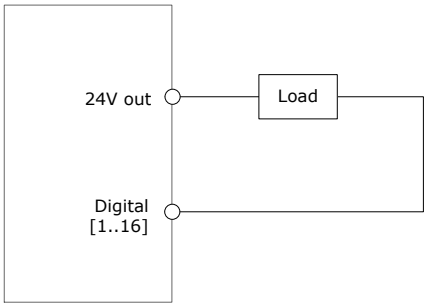


Figure 6-15: Internally powered digital output

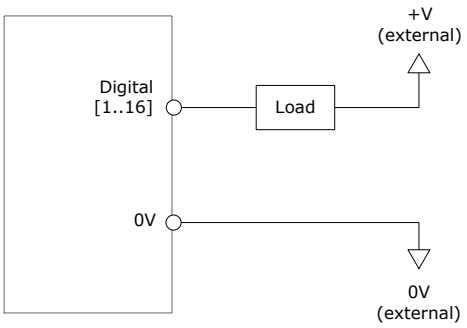


Figure 6-16: Externally powered digital output

To connect a digital output of one Flow-X flow computer to a digital input of another Flow-X flow computer an external resistor is required.

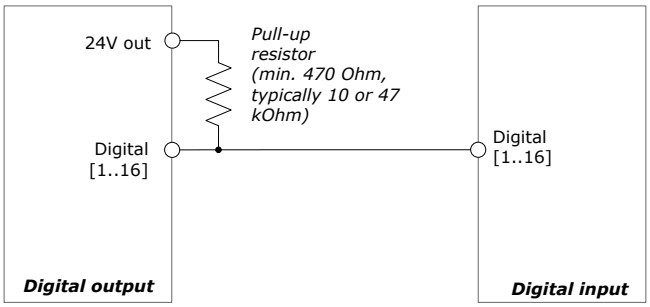


Figure 6-17: Connecting a digital output to a digital input

Pulse outputs

When connected to a device that resides in a hazardous area, safety barriers or galvanic isolators may be required to be interposed between the device and the Flow-X flow computer. Refer to the device documentation for adequate information.

Each flow module has pulse outputs available. These outputs can be used to increase external flow counters. The complete definition can be done by the Flow-Xpress configuration software.

Prover bus output

When connected to a device that resides in a hazardous area, safety barriers or galvanic isolators may be required to be interposed between the device and the Flow-X flow computer. Refer to the device documentation for adequate information.

Each flow module has a prover bus output. The prover bus output can be configured using the Flow-Xpress configuration software.

Analog signals

Analog inputs

When connected to a device that resides in a hazardous area, safety barriers or galvanic isolators may be required to be interposed between the device and the Flow-X flow computer. Below paragraph contains application examples with barriers. Always refer to the device documentation for adequate information.

Each flow module provides 6 analog inputs. Each analog input is software configurable as 4-20 mA, 0-20 mA, 1-5 Volt or 0-5 Volt input.

For each flow module the first 4 analog inputs can also be used as **HART** inputs.

The analog input circuits are floating in relation to the other type of I/O, with a single common ground shared between the analog inputs of the same flow module.
When the analog input channel is used as a mA input, the internal resistor of 250 Ω is activated.
When the loop is internally powered through one of the several '24 Vdc out' terminals of the Flow-X flow computer, the common analog input ground must be referenced to the same reference ground as the power supply as shown below.

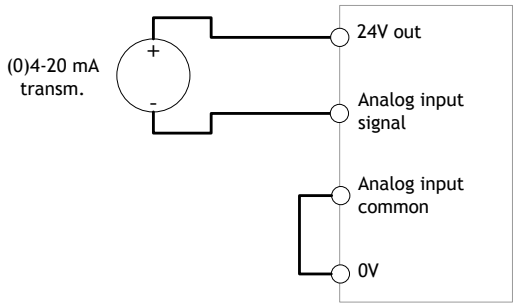


Figure 6-18: Internally powered mA input

When the mA loop is externally powered then the grounding method depends on whether the application uses an isolated power supply and isolated grounding for analog inputs, refer to section 'Ground wiring'.

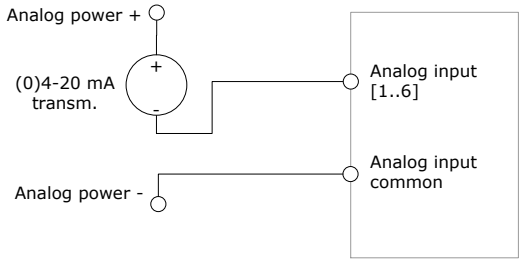


Figure 6-19: Externally powered mA input

When the analog input is configured for measuring 0 to 5 Vdc or 1 to 5 Vdc the internal resistor is disconnected and the voltage differential between the analog input terminal and common analog input ground is measured.

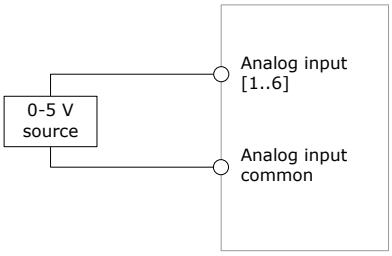


Figure 6-20: Vdc input

Pt100 input

When connected to a device that resides in a hazardous area, safety barriers or galvanic isolators may be required to be interposed between the device and the Flow-X flow computer. Refer to the device documentation for adequate information.

Each Flow-X/M flow module provides two PT100 inputs.

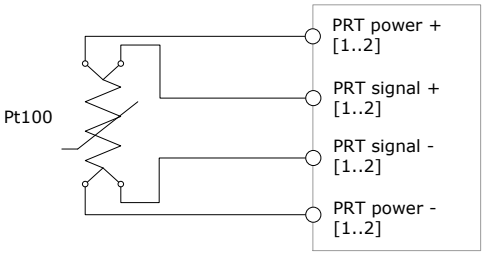


Figure 6-21: PT100 input

HART inputs

When connected to a device that resides in a hazardous area, safety barriers or galvanic isolators may be required to be interposed between the device and the Flow-X flow computer. Refer to the device documentation for adequate information.

The first 4 analog input circuits of each Flow-X/M flow module have an on-board HART modem to facilitate HART communication.
The Flow-X flow computer uses an internal 250 Ω resistor for its analog inputs, which is adequate for HART communication.
The flow computer supports both a single HART transmitter and multiple HART transmitter per loop.

If of a single HART device in the loop, the 4-20 mA signal is measured in parallel and available in the software.

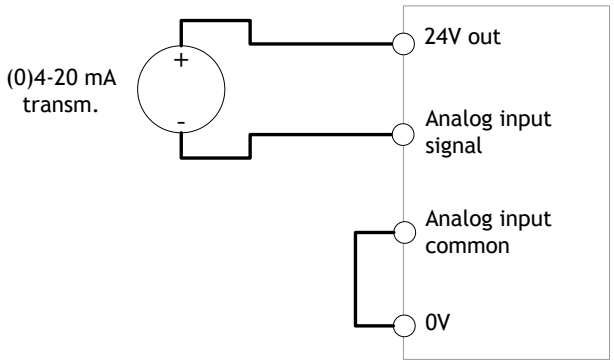


Figure 6-22: HART loop (single transmitter)

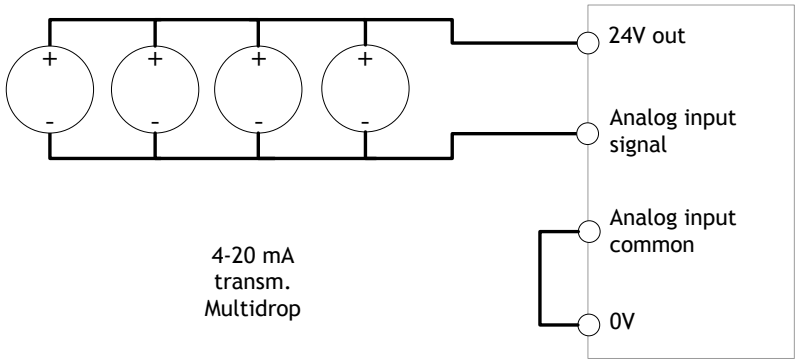


Figure 6-23: HART loop (multi-drop)

In systems with HART inputs where a separate external analog input common is used, it is required to connect the analog input common and the 0 V with a **50 µF capacitor** in-between.

Barriers

When devices are located in a hazardous area, safety barriers are required. For analog inputs, selected MTL Barriers have been tested with Flow-X/M. Other brands may work as well, but a test is recommended. Below schematics provide application examples that have been proved to function.
In all cases, refer to the barrier and device documentation to ensure proper application of barrier and field wiring.

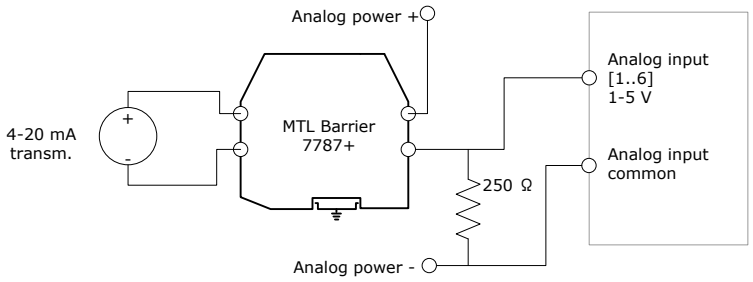


Figure 6-24: Analog 4-20 mA transmitter with barrier

Above figure shows a 4-20 mA transmitter, externally powered. The barrier is MTL, type 7787+. The Flow-X/M is configured as 1-5V input, requiring an external precision resistor of 250 Ohm to convert the 4-20 mA into 1-5 V. If the flow computer is configured as 4-20 mA, the resistor must be omitted.

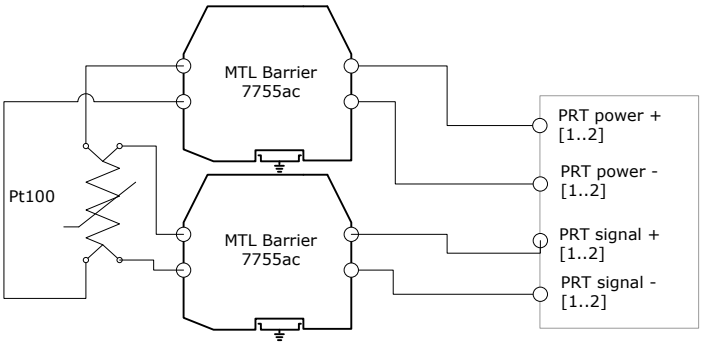


Figure 6-25: PT-100 with barrier

The above figure shows a 4-wire PRT-application with 2 MTL 7755ac barriers.

Analog outputs

When connected to a device that resides in a hazardous area, safety barriers or galvanic isolators may be required to be interposed between the device and the Flow-X flow computer. Below paragraph contains application examples with barriers. Always refer to the device documentation for adequate information.

The 4-20 mA analog output circuits are floating in relation to the other type of I/O, with a single common ground shared between the analog outputs of the same flow module.

Each analog output can drive a load up to 650 Ohm.

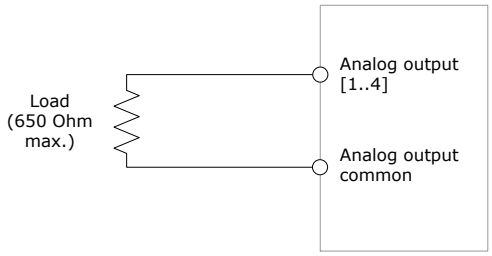


Figure 6-26: Analog output

Below figure shows a 4-20 mA control in a hazardous area, separated from the safe area by an MTL barrier type 7728+.

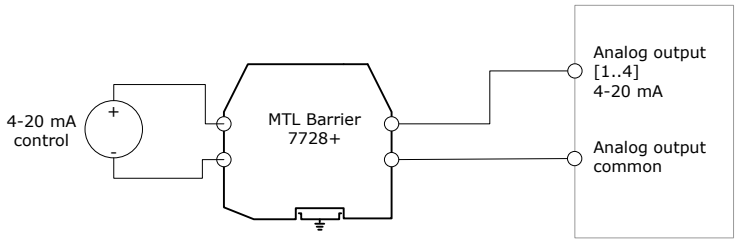
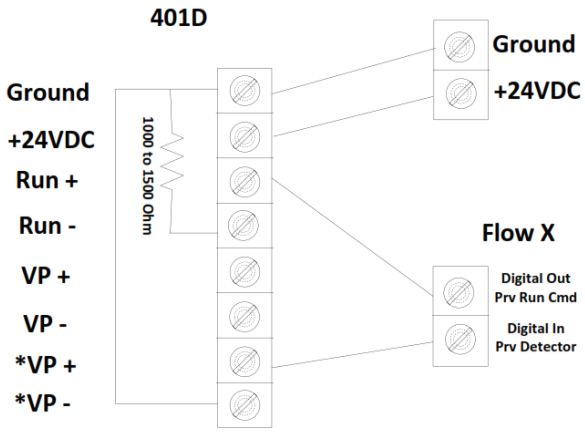


Figure 6-27: Analog 4-20 mA control with barrier

Honeywell Enraf Calibron small volume prover

The following diagram applies for the connection of the Flow-X to the 401D board of a Honeywell Enraf Calibron small volume prover.



*Note: on the Flow-X the polarity of the digital channel used for the Prover Run Command digital output must be set to '**Inverted**' (refer to display 'IO\Module <x>\Configuration\Digital IO settings')*

Figure 6-28 : Connection diagram for Honeywell Enraf Calibron prover

Serial communication

Each Flow-X/M flow module provides 2 serial ports. Furthermore the Flow-X/P provides an additional 3 serial ports. Each serial port is capable of either RS-232 or RS-485 communications, with the exception of COM1 of the Flow-X/P display module which is RS-232 only.

For RS-232 communications 3 terminals are used: Tx, Rx and 0 V. Hardware Flow control is not supported (except for COM1 of the Flow-X/P display module which does support flow control).

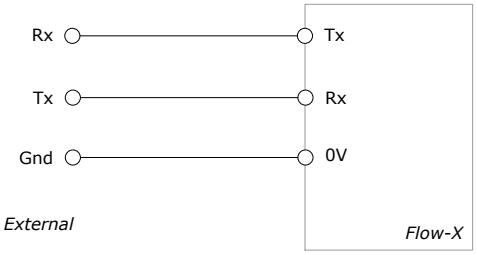


Figure 6-29: RS-232 connection

For RS-485 communications both half-duplex (2-wire) and full-duplex (4-wire) modes are supported.

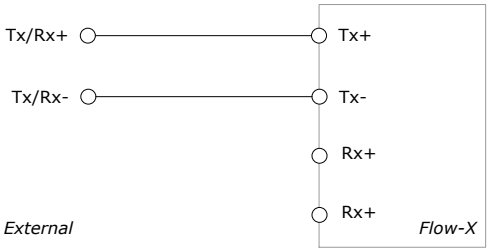


Figure 6-30: 2-wire RS-485 connection

For a **2-wire RS-485** connection the Tx+ and Tx- terminals must be connected, while the Rx+ and Rx- terminals may remain unconnected (no need for jumpers).

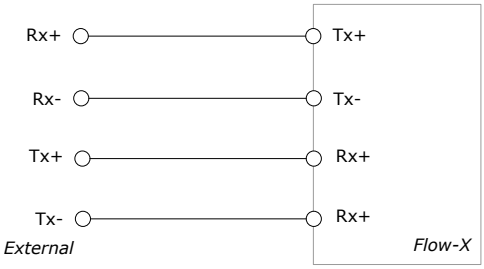


Figure 6-31: 4-wire RS-485 connection

RS-485 connections need terminating resistors to reduce voltage reflections that can cause the receiver to misread the logic level.

Proving signals

The connection of the prover signals depends on the Flow-X type and the prover set-up.

Flow-X/P

Ball prover / Compact prover

- Connect the flow pulse signals to the corresponding modules
- Connect all detector signals to **all** run modules

Master meter proving based on pulses

- Connect the flow pulse signals to the corresponding run module(s) and master meter module
- Connect a digital output of the "Master Meter" module to a digital input (prove detector in) of itself and **all** run modules

Master meter proving based on totals

- No connections to be made (except from the pulse inputs in case of pulse meters)

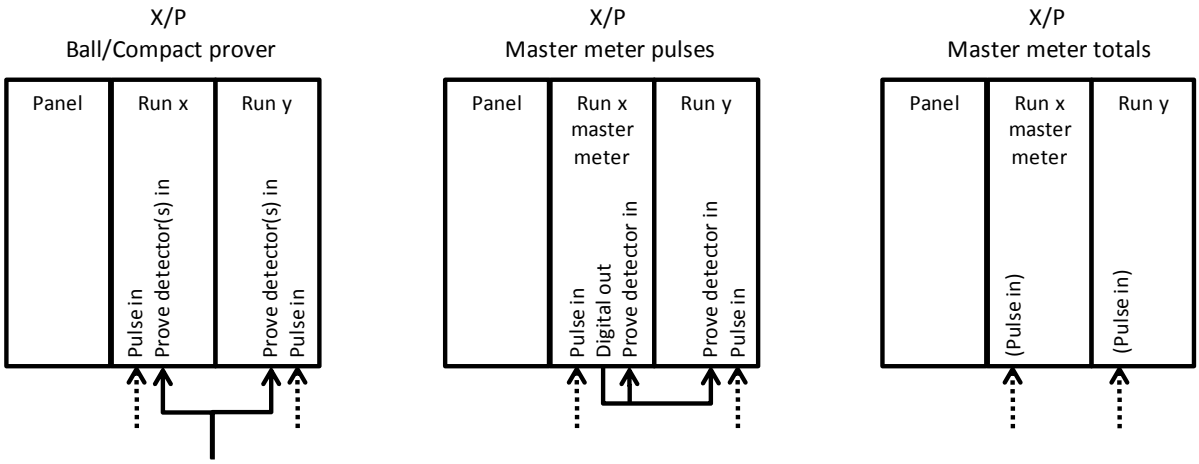


Figure 6-32: Proving signals connection on Flow-X/P

Remote run / separate prover module

Ball prover / Compact prover

- Connect the flow pulse signals to the corresponding run modules
- Connect the prover bus pulse output of the run modules to the pulse input of the prover module
- Connect all detector signals to the prover module

Master meter proving based on pulses

- Connect the flow pulse signals to the corresponding run module(s) and master meter module
- Connect the prover bus pulse output of the run modules to the 'prove 2nd pulse input' of the prover module
- Connect a digital output of the "Master Meter" module to a digital input (prove detector in) of itself

Master meter proving based on totals

- No connections to be made (except from the pulse inputs in case of pulse meters)

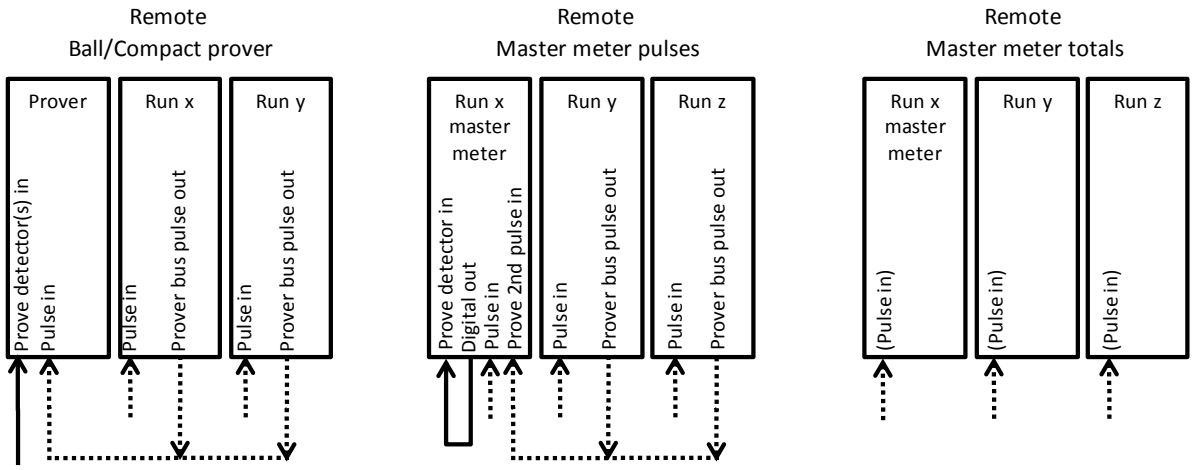


Figure 6-33: Proving signals connection on remote run / separate proving module

Chapter 7 - Operator Panels

Introduction

This chapter describes the different operator panels and user interfaces of the Flow-X flow computer. Please refer to Flow-X manuals II for instructions on how to use the different user interfaces.

Flow-X/P touch screen

The Flow-X/P has an integral 7" touch screen graphical interface that provides access to and allows for entry of all data. The touch screen is an integral part of the Flow-X/P and can't be detached or replaced. The interface provides access to the station module that is an integral part of the X/P itself and to the up to 4 installed flow modules.

Figure 7-1: Flow-X/P touch screen

Touchscreen panel PC

All Flow-X flow computers can be operated with several type of touchscreen panel PCs that run the WinCE or Windows 32 operating system. For this purpose Spirit IT provides the 'StandaloneGUI.exe' program that supports the following platforms:

- Windows 32 bit / x86

- WinCE5 / ARM
- WinCE6 / x86

A single touch panel can be used for multiple flow computers providing a cost-effective user interface.

Spirit IT supplies a 7" touch panel PC version for installation in a cabinet.

Figure 7-2: 7" Touch Panel PC

Flow-X/M LCD display

A Flow-X/M flow module has its own local textual display that has the same capabilities as the main user interface except for the entry of alpha-numeric characters.

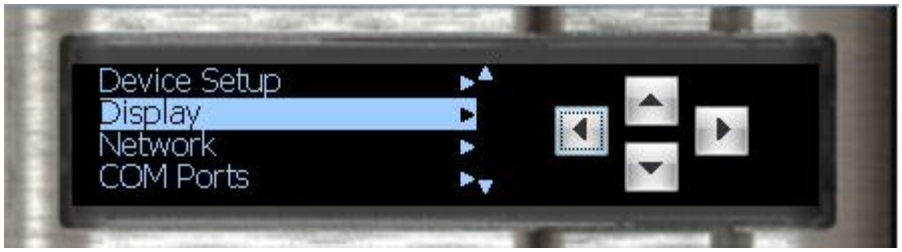


Figure 7-3: Flow-X/M LCD display

The display provides access to the data of the local module and when the module is installed in a Flow-X/P also to the station module and the other modules that are installed in the same flow-X/P.

Flow-X web interface

All Flow-X flow computers have an embedded web server that allows for remote operation through the common web browser programs, such as Windows Internet Explorer, Mozilla Firefox, Google Chrome, Opera, etc.

The web browser provides the same capabilities as the main user interface plus an explorer tree for easy navigation.

It also provides the option to download reports and historical data.

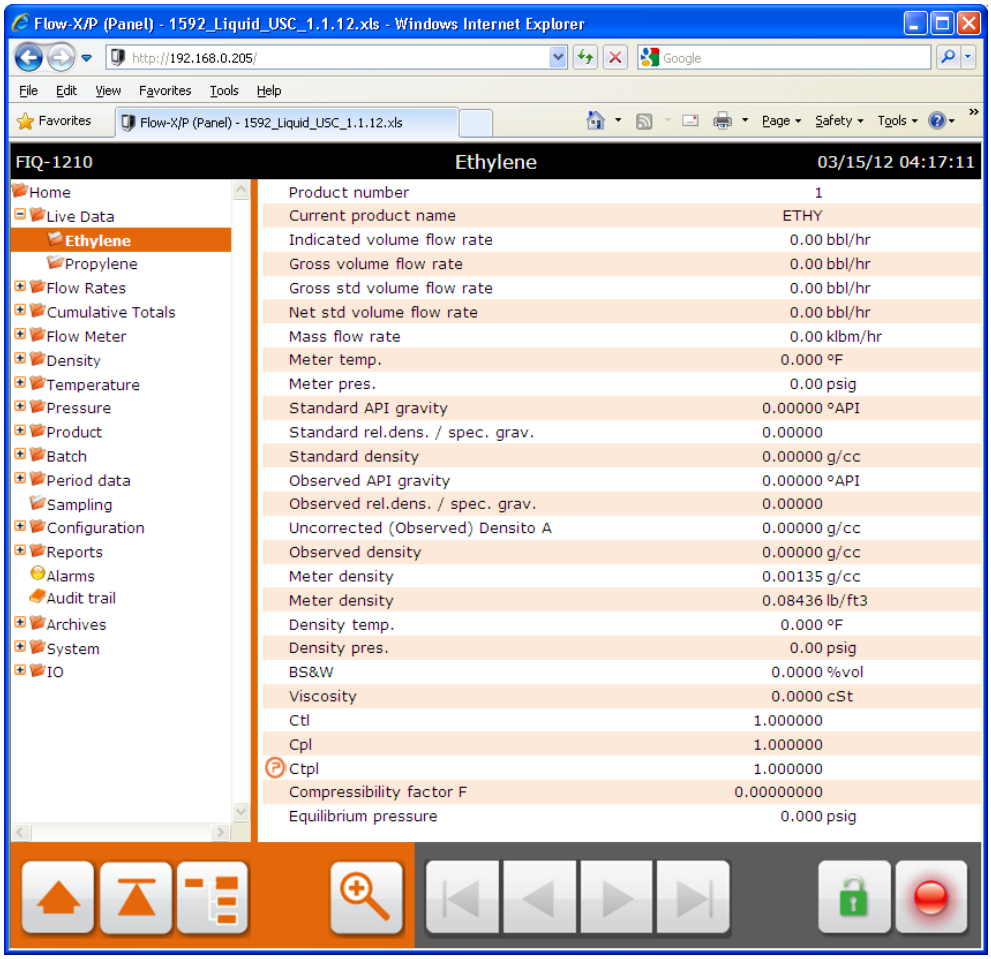
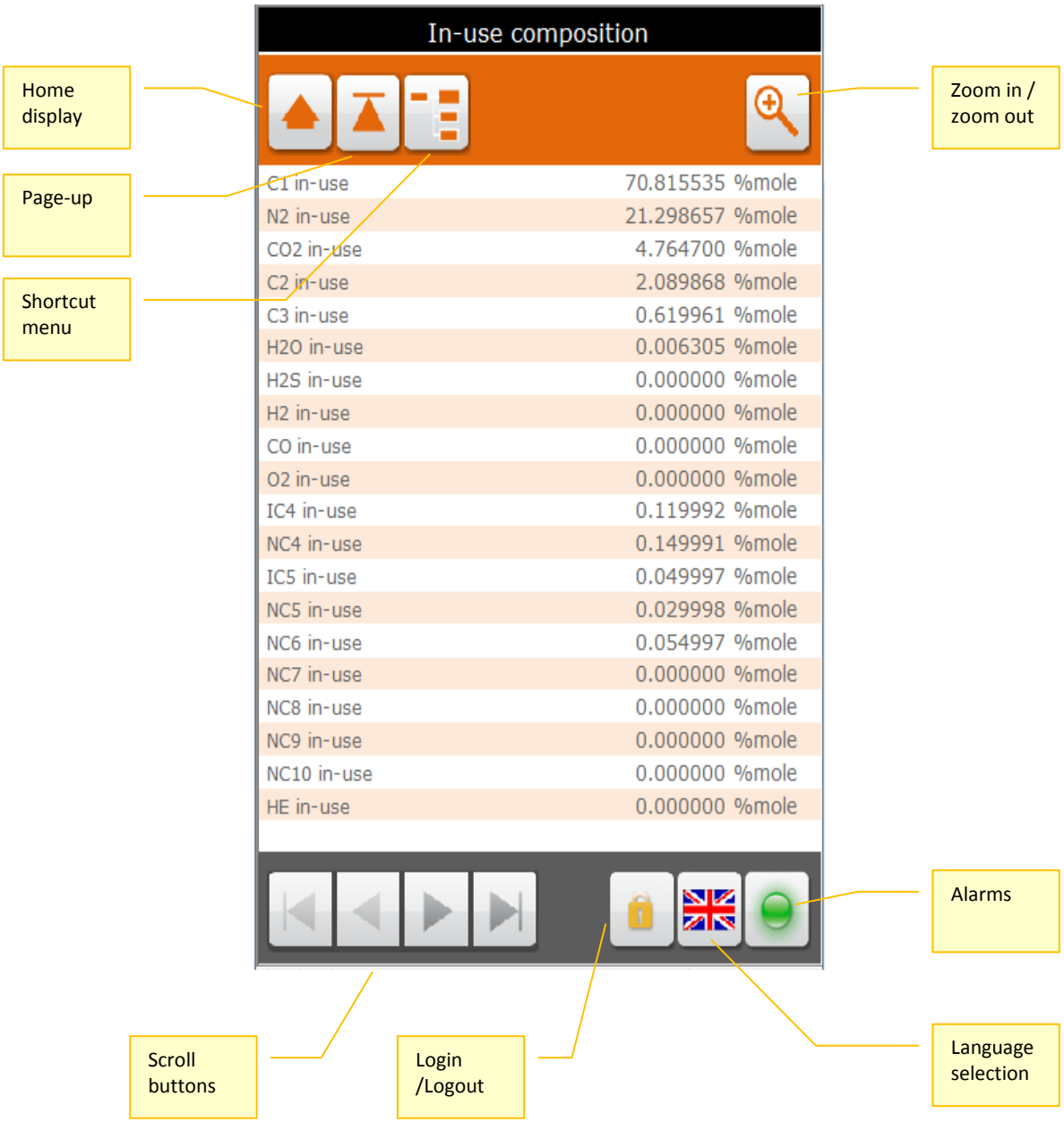


Figure 7-4: Flow-X web interface

Graphical User Interface Layout

All the Flow-X Graphical User Interfaces have the following layout and buttons



Chapter 8 - Software

Introduction

Configuration of the Flow-X is described in manual II-A, Operation and configuration. This chapter only describes the requirements and set up for configuration.

Set up

The flow modules are configured through our Flow-Express software. This software may be run in Basic mode, or, depending on your license, in Pro mode.

Requirements for the use of Flow-Express are:

Aspect	Requirement
Operating system:	Windows XP (Home or Pro) Windows 2003 (All versions) Windows Vista Windows 7
Additional software	Excel 2003 or Excel 2007
Connection	Standard Ethernet connection with RJ-45 connector, capable of 100baseT (100Mbit)
Hardware	CD-player for software installation only (local or shared from another computer)

If you want to connect a laptop or desktop PC directly to your Flow-X model, (see Figure 8-1) you will need an ethernet cross cable (CAT 5), available from any computer store. If you use a network hub or switch, you may use standard Ethernet cables (CAT 5). See figure Figure 8-2.

Figure 8-1 Direct Ethernet connection without switch

Figure 8-2 Ethernet connection with switch

If you want to fabricate your cables yourself, please use the following information:

ETHERNET STANDARD CABLE (EIQ/TIA-568B)			
Connector A		Connector B	
Pin	Color	Pin	Color
1	White/Orange	1	White/Orange
2	Orange	2	Orange
3	White/Green	3	White/Green
4	Blue	4	Blue
5	White/Blue	5	White/Blue
6	Green	6	Green
7	White/Brown	7	White/Brown
8	Brown	8	Brown

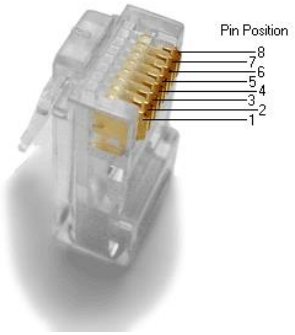


Table 8-1: Ethernet RJ-45 straight cable pin-out

ETHERNET CROSS CABLE EIQ/TIA-568A and B)			
Connector A		Connector B	
Pin	Color	Pin	Color
1	White/Orange	1	White/Green
2	Orange	2	Green
3	White/Green	3	White/Orange
4	Blue	4	Blue
5	White/Blue	5	White/Blue
6	Green	6	Orange
7	White/Brown	7	White/Brown
8	Brown	8	Brown

Table 8-2: Ethernet RJ-45 cross cable pin-out

Software installation

Software installation is quite straightforward.
You will need administrator rights in order to install. Refer to your system administrator if you are not sure you have these rights on the account you use.

Insert the CD in your CD-drive while your computer is running. The CD will normally autostart and present the installation Start-up display. Follow the instructions from there.
If autostart is disabled on your system, use Explorer to navigate to your CD-drive and start *setup.exe*.

After installation, you will need to get a license from Spirit IT based on the unique Machine ID that your computer will provide, in order to use the configuration software. Depending on your license you may be able to run Flow-Xpress in Basic mode or also in Professional mode.

Refer to Volume II of this manual set for detailed installation instructions and for use of the Flow-Express software to configure your modules.

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Chapter 9 - Technical specifications

General

Item	Type	Description	Quantity
Temperature	Operating	Operating range temperature, in deg C	0 .. 60
Temperature	Storage	Storage range temperature, in deg C	-20 .. 70
Processor	Freescale	i.MX processor with math coprocessor, and FPGA.	400 MHz
Memory	RAM	Program memory	50MB
Flash	FRAM	Permanent storage / data logging storage	32MB
Data Storage Memory	MMC	Storage memory for data logging	512 MB
Clock	RTC	Real time clock with internal lithium cell Accuracy better than 1 s/day	
Other specifications			
MTBF	5 years minimum		
EMC	EN 61326-1997 industrial locations		
	EN 55011		
Casing	EN 60950		

Table 9-1: General Specifications

Flow-X/M I/O specifications

Signal	Nr	Type	Description
Analog signals[1]			
Analog input	6[1]	4-20mA, 0-20mA, 0-5V or 1-5V	Analog transmitter input High accuracy (error <0.008% FS, resolution 24 bits) For (for example) 3xdP, P, T. Inputs are fully floating (optically isolated).
Temperature input	2	PRT	Analog PT100 input. -220 - 220 deg.C. for 100 ohms input. Resolution 0.02 deg.C Max. error Between 0-50 degC :0.05 deg.C, Between -220 - +220 degC: 0.5 deg.C
Hart modems	4[1]	HART	Loop inputs for HART transmitters, on top of the first 4 analog input signals.
Analog output	4	4-20mA, 0-20mA, or 1-5V.	Analog output for PID, pressure control valve. 12 bits ADC, 0.075% fs. Update rate 0.1s.

Signal	Nr	Type	Description
Digital signals			
Dual pulse input	1[2]	High impedance	High speed turbine/PD/USM meter input, pulse count. Trigger level 0.5V. Max. level 30 V. Frequency range 0-5kHz (dual pulse), or 0-10kHz (single pulse). Compliant with ISO6551, IP252, and API 5.5. True Level A implementation.
Density	4[2]	High impedance	Periodic time input, 100us - 5000us. Accuracy 30ns, resolution 2 ns
Digital input	16[2]	High impedance	Digital status input, or prover inputs. 0.5ms detect update rate for 2 inputs, others 250ms max.
Digital output	16[2]	Open collector	Digital output for relays etc. (0.5A DC). Rating 100mA @24V. Update rate at cycle time.
Prover output	1[2]	Open collector	Two related pulse outputs, for proving applications. One output is the highest value of the dual pulse inputs, and the other output the difference between the dual input pulses. The outputs are On-Off-HighZ.
Pulse output	4[2]	Open collector	Max. 100Hz
Sphere detector inputs	4[2]	High impedance	Supports 1, 2, 3 and 4 detector configurations mode 0.05 µs detect update rate.
Communication			
Serial	2	RS485/422/232	Multi-purpose serial communication interface Minimum 110 baud, maximum 256000 baud
Ethernet	2	RJ45 100 Mbit/s	Ethernet interface - TCP/IP

Table 9-2: Flow-module I/O Specifications

NOTES: (1) Total number of analog inputs + HART inputs = 6
(2) Total number of digital inputs + digital outputs + pulse outputs + density inputs + sphere detector inputs = 16

For the latest of certified flow calculations please see our website at www.spiritit.com.

Library of certified flow calculations
AGA3, AGA5, AGA7, AGA8, AGA10. Supports AGA9
API chapters 11.1, 11.2, and 21.1 API 2540, API 1952 tables

Library of certified flow calculations
ISO 5167 (all editions), ISO 6976 (all editions)
NX19 SGERG PTZ Costald Peng-Robinson calculations
GPA 2172 TP15 / TP16 / TP25 / TP27
ASME 1967 (IFC-1967) steam tables, IAPWS-IF97 steam density

Table 9-3: Certified flow calculations

Standard flow Calculations
Batch and period recalculation (meter factor, BS&W, density, etc.)
Unlimited number of period and batch totals and flow and time weighted averages. Periods can be of any type. Maintenance totalizers are supported
Calibration curve up to unlimited number of points (linear and polynomial).
Prover support: uni-directional, bi-directional (2 / 4 detector inputs), compact prover, master meter, dual chronometry, pulse interpolation.
Control: ▪ PID control ▪ valve control ▪ prove control ▪ batch control ▪ sampler control
ASTM D3588, McCrometer V-Cone, Density of Moist Air, CUSUM transmitter drift detection, and more.
All common spreadsheet functions to obtain maximum flexibility.

Table 9-4: Standard flow calculations

Standard Supported Devices
All major Ultrasonic Flow Meters ▪ Sick-Maihak, ▪ Daniel ▪ Cameron ▪ Elster-Instromet ▪ GE ▪ FMC ▪ Krohne ▪ Any Modbus-supporting Ultrasonic meter All major Coriolis meters ▪ MicroMotion

Standard Supported Devices
▪ Endress + Hauser ▪ Any Modbus-supporting Coriolis meter
All major gas chromatographs ▪ ABB ▪ Daniel ▪ Instromet ▪ Siemens ▪ Any Modbus-supporting Gas chromatograph ▪ Yamatake
Densitometers and specific gravity transducers ▪ Solartron ▪ Sarasota ▪ UGC ▪ Anton Paar

Table 9-5: Standard supported devices

Power consumption

Values at 24 Vdc excluding supply of external transmitter loops.

	nominal	peak at startup
▪ Flow X/P0	0.3 A	0.8 A
▪ Flow X/M (flow module)	0.3 A	0.8 A

The power supply input circuits of the Flow-X/P0 and the Flow-X/M flow modules are equipped with an auto-fuse rated at 30 Vdc and 1.1 A each.

E.g. a Flow-X/P4, which is a Flow-X/P with 4 Flow-X/M flow modules has a nominal power consumption of 1.5 A (0.3A of Flow-X/P0 + 4 * 0.3 A for each flow module) and a peak consumption of 4.0 A at startup.

Weight

Individual component

▪ Flow-X/M (single flow module)	0.8 kg / 1.8 lbs
▪ Flow-X/S (without flow module)	1.6 kg / 3.6 lbs
▪ Flow-X/P0 (without flow modules)	3.6 kg / 8.0 lbs
▪ Flow-X/R (without flow modules)	*To be defined*

Combined product

▪ Flow X/S including flow module	2.4 kg / 5.4 lbs
▪ Flow X/P1	4.4 kg / 9.8 lbs
▪ Flow X/P2	5.2 kg / 11.6 lbs
▪ Flow X/P3	6.0 kg / 13.4 lbs

- Flow X/P4 — 6.8 kg / 15.2 lbs
- Flow-X/R1 — *To be defined*
- Flow-X/R2 — *To be defined*
- Flow-X/R3 — *To be defined*
- Flow-X/R4 — *To be defined*
- Flow-X/R5 — *To be defined*
- Flow-X/R6 — *To be defined*
- Flow-X/R7 — *To be defined*
- Flow-X/R8 — *To be defined*

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Chapter 10 - Drawings

All sizes are in mm. Sizes in square brackets e.g. [5] are inches.

Flow-X/P Panel mounted enclosure

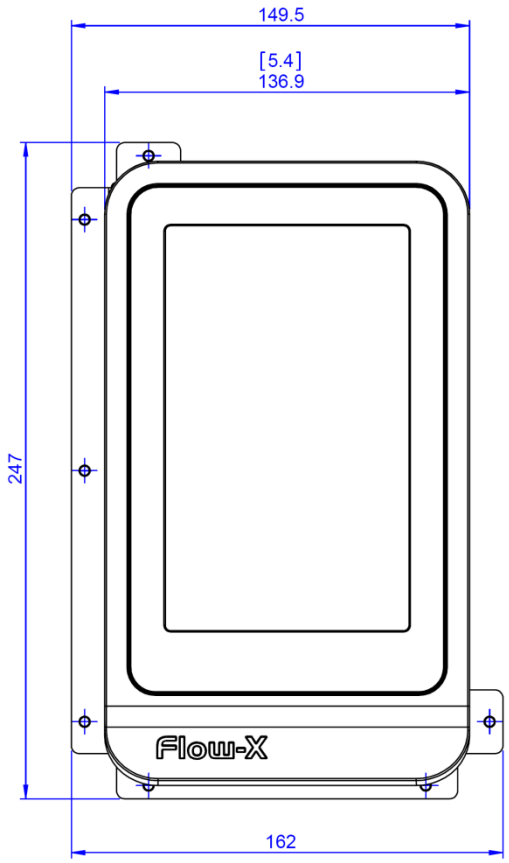

Figure 10-1 Flow-X/P Front view dimensions

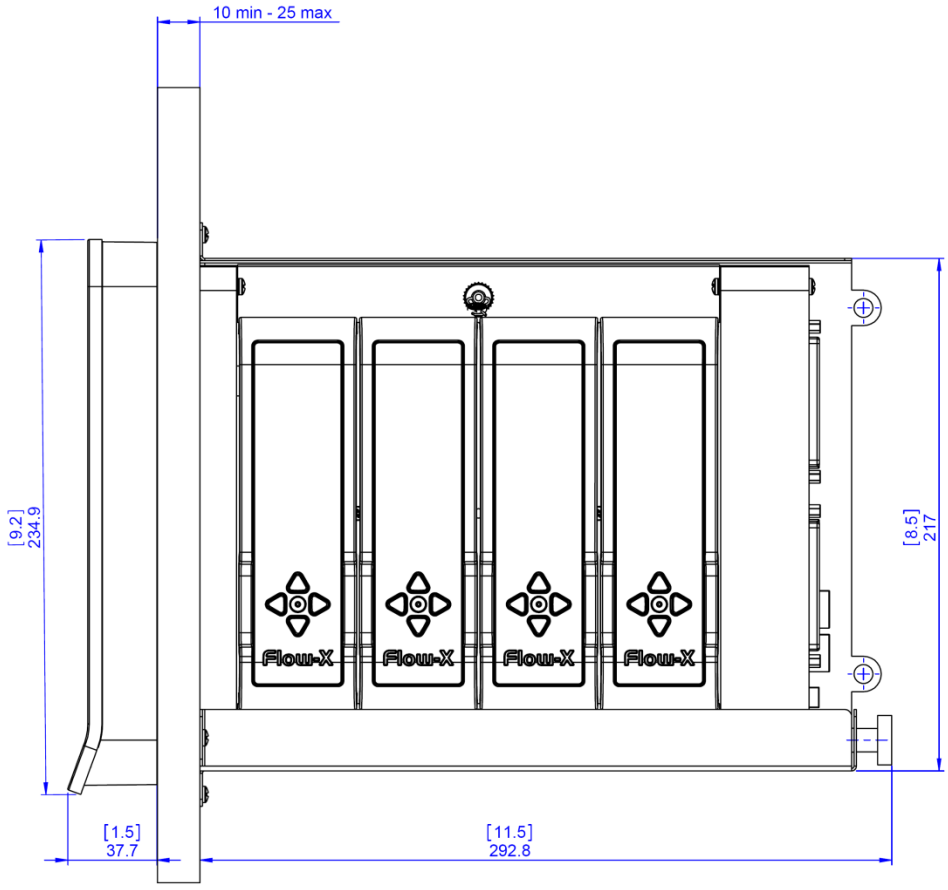

Figure 10-2 Flow-X/P Side view dimensions

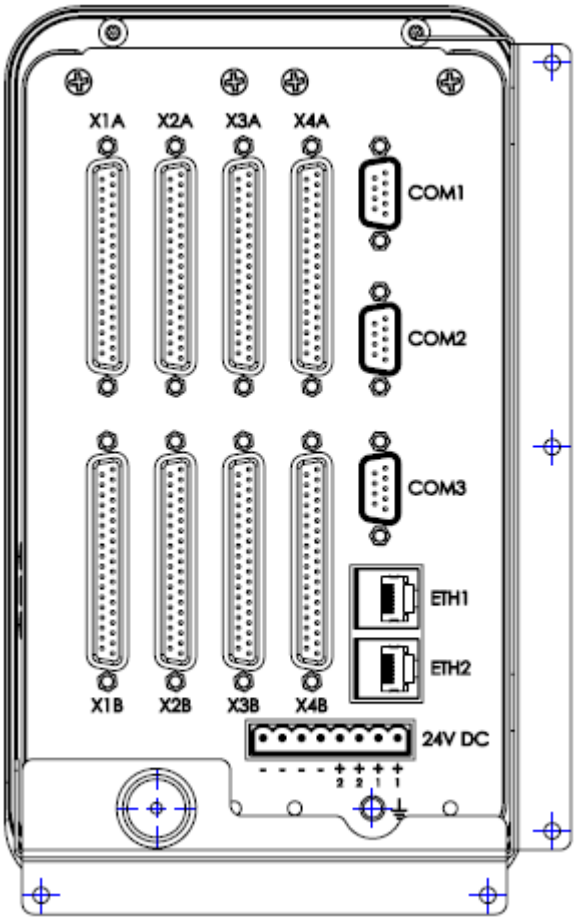

Figure 10-3 Flow-X/P rear view

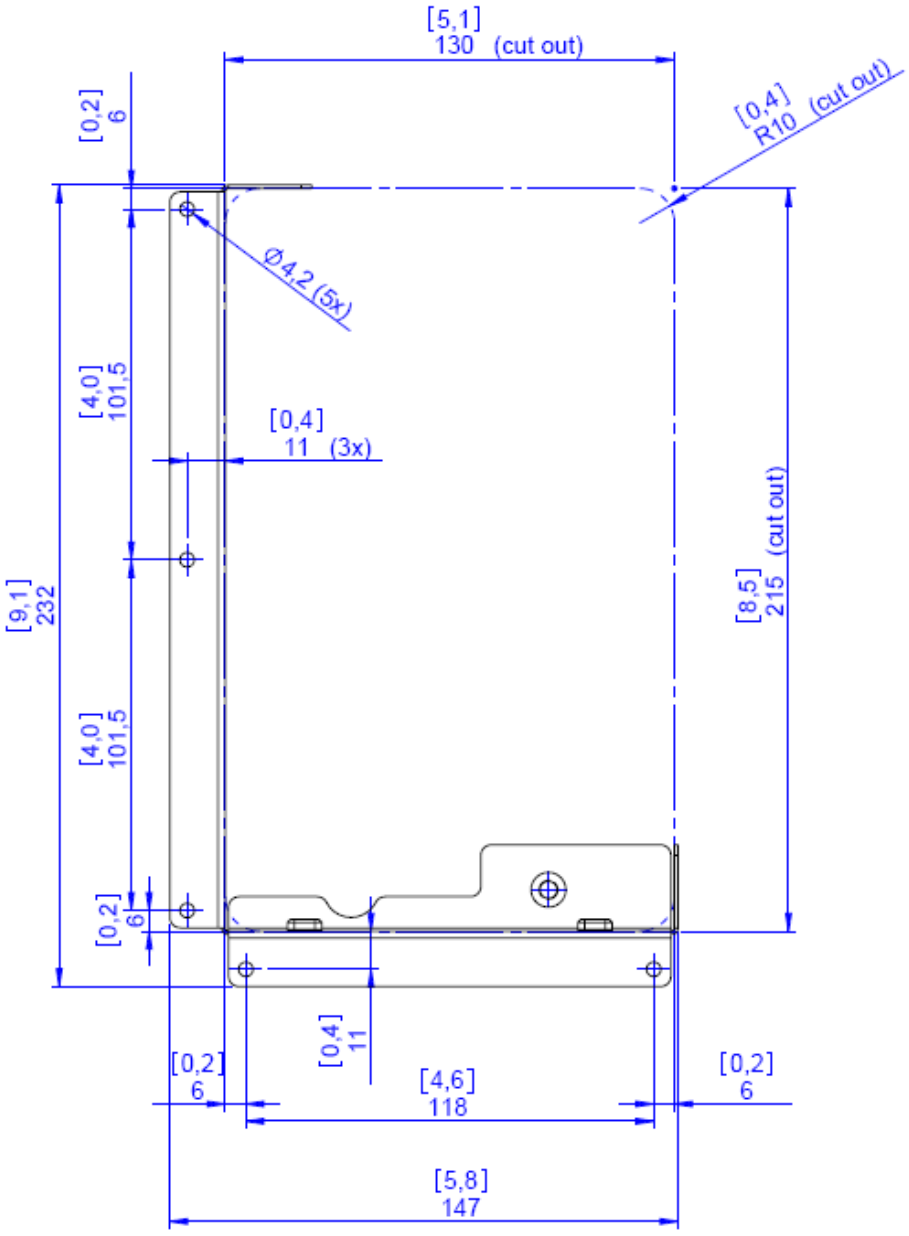

Figure 10-4 Flow-X/P Bracket dimensions

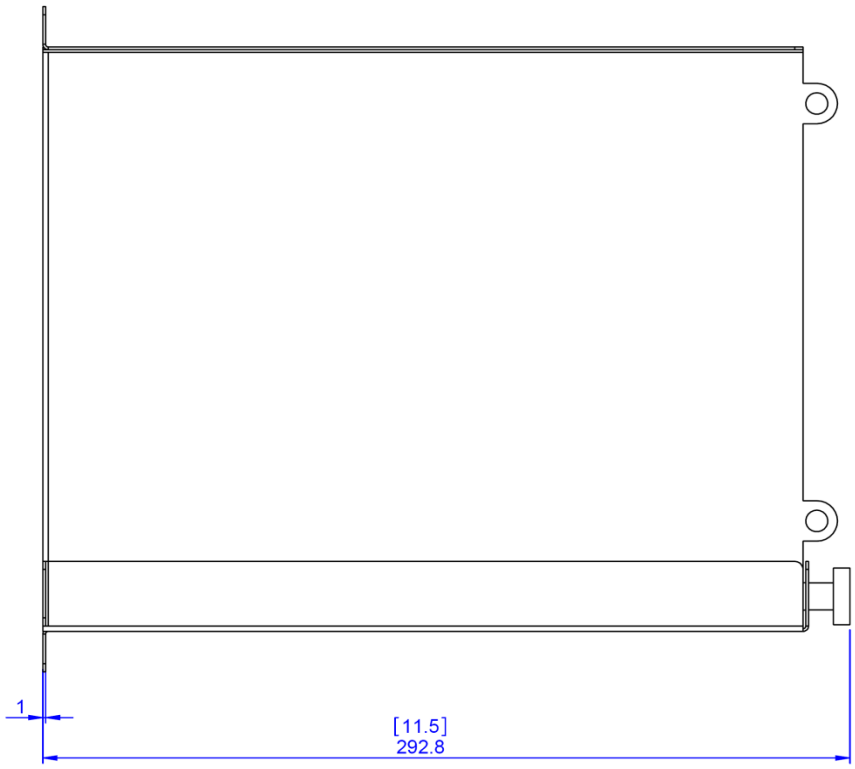

Figure 10-5 Flow-X/P Bracket Side view dimensions

Flow-X/R Rack mount enclosure

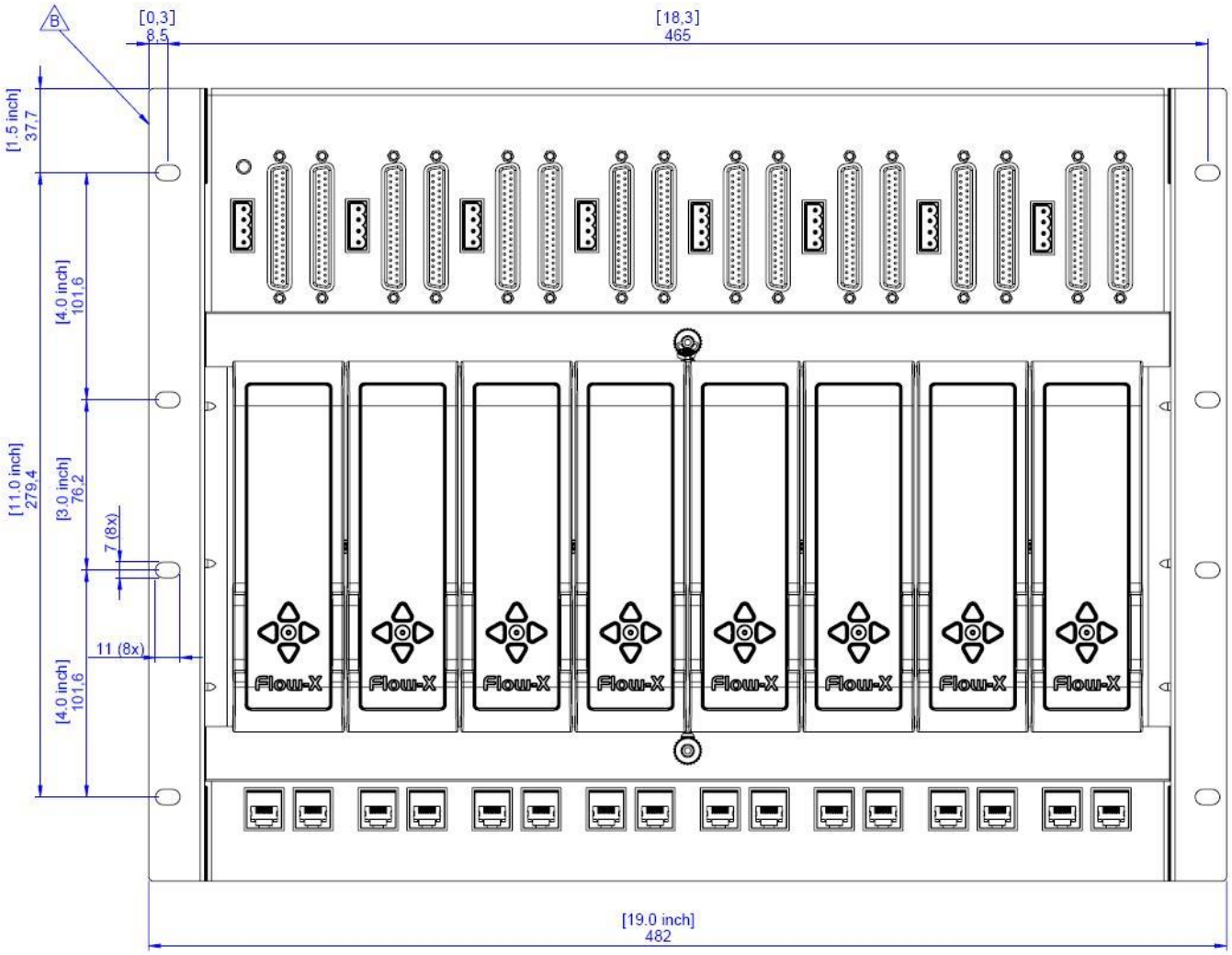

Figure 10-6 Flow-X/R Side view dimensions

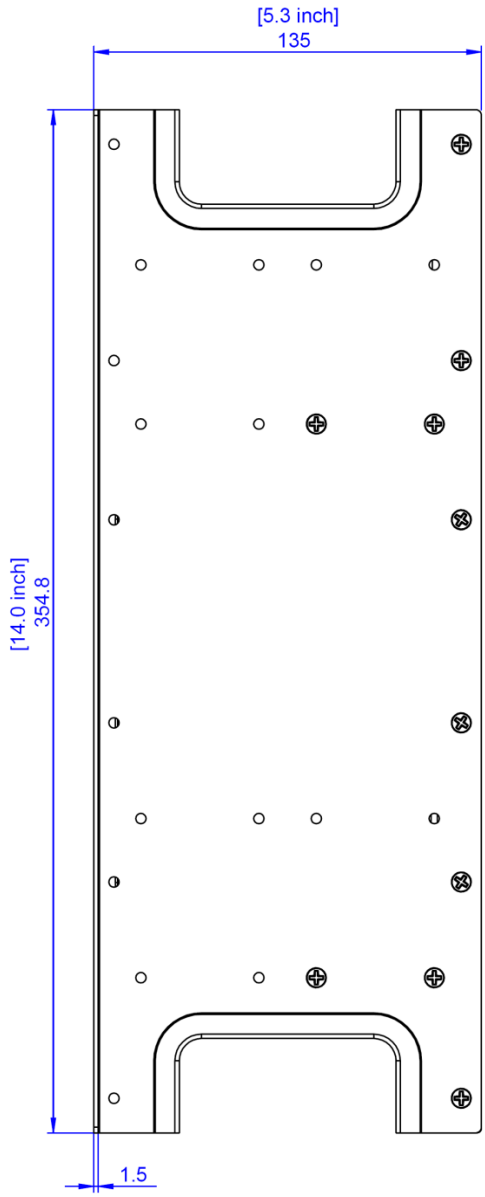

Figure 10-7 Flow-X/R Side view dimensions

Flow-X/S Single module enclosure

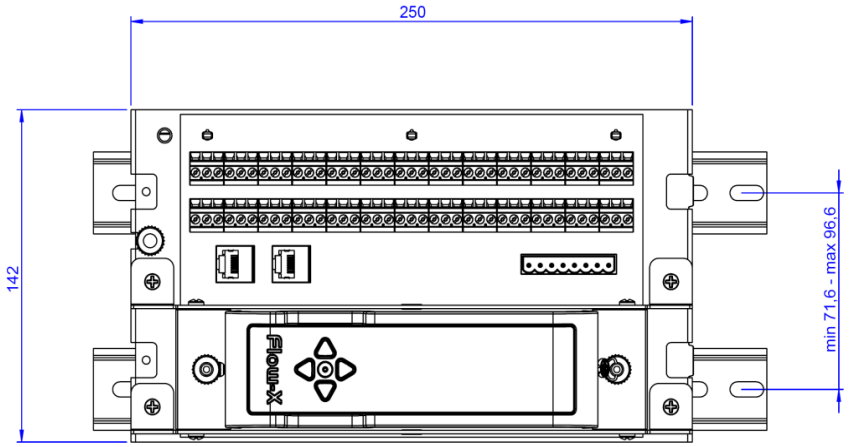

Figure 10-8 Flow-X/S horizontally dimensions

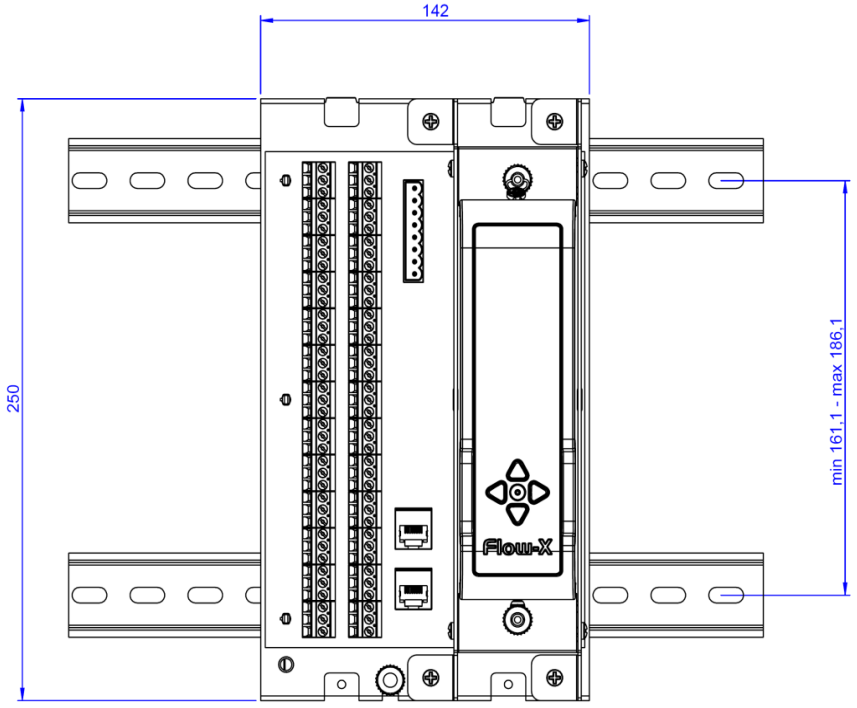

Figure 10-9 Flow-X/S vertically dimensions

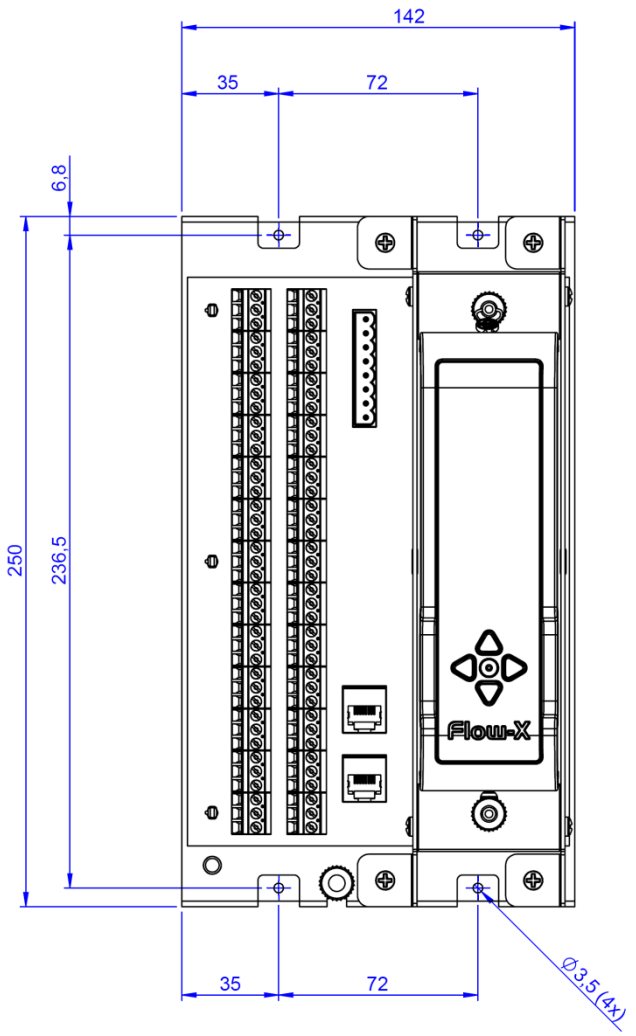

Figure 10-10 Flow-X/S Wall mount dimensions

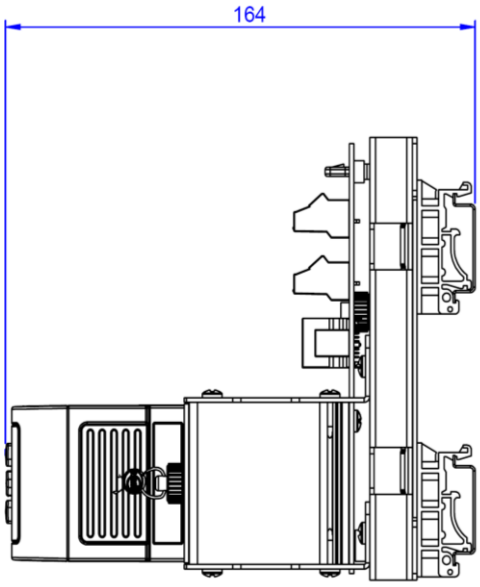

Figure 10-11 Flow-X/S Wall mount side view dimensions

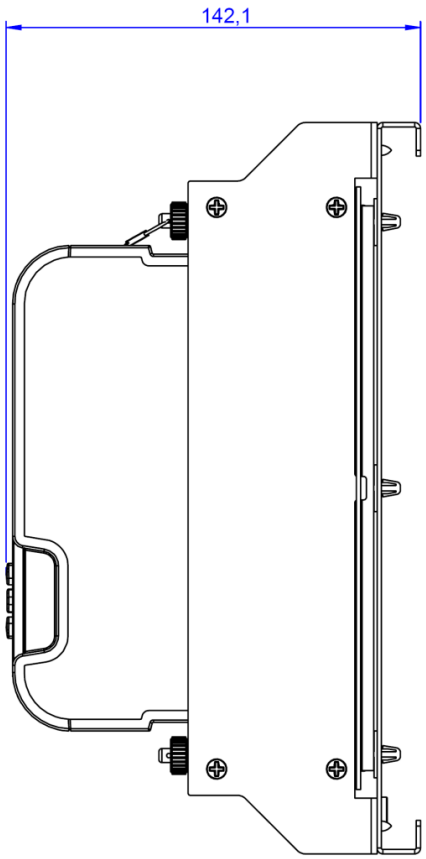

Figure 10-12 Flow-X/S Din rail mounted side view dimensions

7” touch panel PC

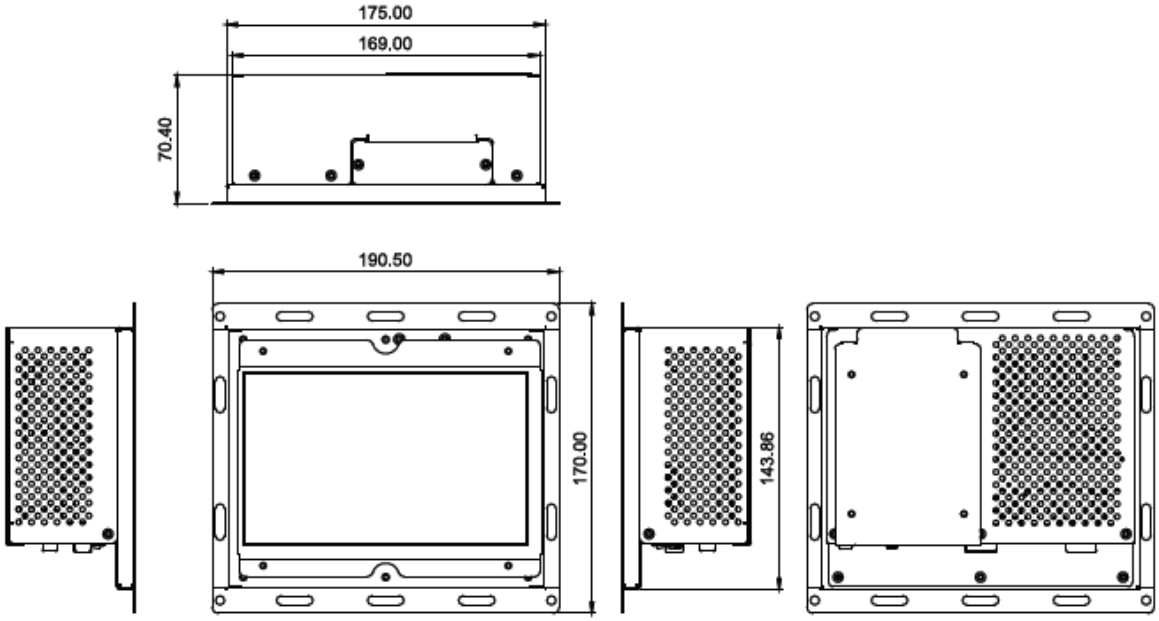

Figure 10-13 7“touch panel PC dimensions

Chapter 11 - Configuration sheet

From our web site you can download an Excel workbook that helps you to configure your flow computer. The sheet automatically provides connection details (sub-D 37 pin-outs, screw terminal pin-outs) with tag names.

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Chapter 12 - I/O Diagnostics and calibration

This chapter describes the diagnostics and calibration features for the digital and analog I/O.

I/O diagnostics

A Flow-X flow computer with a standard Spirit IT application provides a set of displays with diagnostic information on the digital and analog I/O of the flow modules that are part of the Flow-X flow computer

To access the diagnostics displays:

- On the LCD or web display select **Diagnostics, IO** from the main menu.
- Select the applicable flow module (only in case of a flow computer with more than one flow module)
- Select the type of I/O

I/O calibration

The analog inputs, PRT inputs and analog outputs can be calibrated at up to 5 calibration points.

Calibration points

For each type of I/O the 5 calibration points can be defined. For analog inputs and analog outputs the calibration points are defined as percentage of span, while for PT100 inputs the calibration points are defined in Ohm.

The number of calibration points may range from 1 through 5. The actual number of calibration points is determined by 5 reference values which are expressed as percentage of span.

The calibration points should be defined in ascending order, e.g. 0, 50, 100 %. Non-used reference values shall be set to 0. If a calibration point is smaller than or equal to the previous point, then it is not taken into account and also the following points will not be taken into account..

Typical calibration points for analog inputs and outputs are:

- 0, 0, 0, 0, 0 A single offset value is applied over the entire range
- 0, 100, 0, 0, 0 Calibration at 2 points, low and high range
- 0, 50, 100, 0, 0 Calibration at 3 points, low, mid and high range
- 0, 25, 50, 75, 100 Calibration at 5 points, low and high range and 3 mid ranges

For PRT inputs typical calibration points are:

- 0, 0, 0, 0, 0 A single offset value is applied over the entire range
- 50, 150, 0, 0, 0 Calibration at 2 points, low and high range
- 50, 100, 150, 0, 0 Calibration at 3 points, low, mid and high range

- 50, 75, 100, 125, 150 Calibration at 5 points, low and high range and 3 mid ranges

Display → Diagnostics, IO, Calibration

Analog input cal. point 1..5	1500	The calibration points for the calibration of the 6 analog inputs
PRT calibration point 1..5	1500	The calibration points for the calibration of the 2 PRT inputs
Analog output cal. point 1..5	1500	The calibration points for the calibration of the 4 analog outputs

Analog input calibration

The procedure to calibrate an analog input is based on a loop calibrator that, depending on the type of input, can provide a 4-20 mA, 0-20 mA, 1-5 Vdc, or 0-5 Vdc signal.

During calibration the process input (e.g. pressure, temperature) that uses the analog input will fall back to the keypad, last good or fallback value, depending on setting 'Fallback type' that has been defined for this process input.

1. Go to the analog input calibration display.

Display → Diagnostics, IO, <Module x>, Calibration, Analog inputs

With x the applicable module number, i.e. the flow module to which the signal is physically connected..

2. Select the analog input to be calibrated.

   The process value used for the flow calculations will now fall back to the last good, keypad or fallback value (depending on the fall back type). The calibration display shows the required reference value for the 1st calibration point and the actual corrected value based on the current calibration values.

3. Disconnect the transmitter signal and connect the loop calibrator

4. Adjust the loop calibrator such that it outputs the required reference value as indicated on the calibration display)

5. Wait for the signal to stabilize and issue the 'Recalibrate this point'.

   Note: recalibration is optional at every calibration point. When the corrected signal is close enough to the reference value you may decide to skip re-calibration.

6. Check that the corrected value corresponds with the reference value and issue the 'Go to next calibration point' command on the display.

7. Repeat steps 4 through 7 for the remaining calibration points

8. Disconnect the current loop calibrator and reconnect the transmitter.

9. Set the "Selected analog input" to 'None' or alternatively select the next analog input to be calibrated. The live input signal will now be used again.

PRT input calibration

The procedure to calibrate a PRT input is based on a decade box that is suitable for Pt100 calibration

During calibration the process input that uses the analog input will fall back to the keypad, last good or fallback value, depending on setting 'Fallback type' that has been defined for this process input.

1. Go to the PRT input calibration display.

Display → Diagnostics, IO, <Module x>, Calibration, PRT inputs

With x the applicable module number, i.e. the flow module to which the signal is physically connected..

2. Select the channel number of the PRT input to be calibrated on the display.

   The process value used for the flow calculations will now fall back to the last good, keypad or fallback value (depending on the fall back type). The calibration display shows the required reference value for the 1st calibration point and the actual corrected value based on the current calibration values.

3. Disconnect the PT100 element and connect decade box.

4. Adjust the decade box such that it outputs the required reference value as indicated on the calibration display)

5. Wait for the signal to stabilize and issue the 'Recalibrate this point'.

   Note: recalibration is optional at every calibration point. When the corrected signal is close

enough to the reference value you may decide to skip re-calibration.

6. Check that the corrected value corresponds with the reference value and issue the 'Go to next calibration point' command on the display.

7. Repeat steps 4 through 6 for the remaining calibration points

8. Disconnect the decade box and reconnect the PT100 element.

9. Set the 'Selected PRT input' to 'None' or alternatively select the next analog input to be calibrated. The live input signal will now be used again.

Analog output calibration

The procedure to calibrate an analog output is based on a 4-20 mA meter.

1. Connect the mA meter in series with the load.

2. Go to the analog output calibration display.

Display → Diagnostics, IO, <Module x>, Calibration, Analog outputs

With x the applicable module number, i.e. the flow module to which the signal is physically connected..

3. Select the channel number of the analog output to be calibrated on the display. This will adjust the analog output to the 1st calibration point.

4. Increase or decrease the output until it the indication on the mA meter matches the reference value.

5. Issue the 'Recalibrate this point' command.

   Note: recalibration is optional at every calibration point. When the output signal is close enough to the reference value you may decide to skip re-calibration.

6. Check on the current meter that the output signal corresponds with the reference value and issue the 'Go to next calibration point' command on the display.

7. Repeat steps 4 through 6 for the remaining calibration points

8. Set the 'Selected analog output' to 'None' or alternatively select the next analog output to be calibrated. The analog output will now be controlled by the application software again.

9. Disconnect the mA meter.

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