# Spirit[IT] Flow-X
## High accuracy flow computers

Mechanical installation, electrical installation and connection diagrams

**Measurement made easy**



—
**Flow-X/P with Flow-X/M module**

## Introduction

Welcome to the exciting world of Spirit[IT] Flow-X!

This manual is the installation manual for all Spirit[IT] 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 referencere

## For more information

All publications of Spirit[IT] Flow-X are available for free download from:



| | Search for: |
|---|---|
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| Spirit[IT] Flow-X liquid USC application manual | CM/FlowX/LU-EN |
| Spirit[IT] Flow-X function reference manual | CM/FlowX/RF-EN |

# Contents

# 1 Manual introduction

## Purpose of this manual

This Spirit$^{IT}$ 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 Spirit$^{IT}$ 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 Spirit $^{IT}$ 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 Spirit$^{IT}$ 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: 'Spirit$^{IT}$ Flow-X products' the user is presented with an overview of the Spirit $^{IT}$ 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 the operator panels.
Chapter 7 briefly describes software installation.
Chapter 8 lists the full technical specifications
Chapter 9 holds the detailed drawings including dimensions.
Chapter 10 describes a configuration sheet, which is downloadable from our website.
Chapter 11 describes how to diagnose and calibrate the flow computer IO.

## 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.

# Abbreviations

Throughout this document the following abbreviations are used:

| | |
|---|---|
| **ADC** | Analog to Digital converter |
| **AI** | Analog Input |
| **AO** | Analog Output |
| **API** | Application Programming Interface |
| | An interface that allows an application to interact with another application or operating system, in our case, Spirit$^{IT}$ Flow-X. Most of the Spirit$^{IT}$ Flow-X API is implemented through Excel worksheet functions. |
| **ASCII** | American Standard Code for Information Interchange. |
| | 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** | Central Processing Unit |
| **DAC** | Digital to Analog Converter |
| **DCS** | Distributed Control System |
| **DDE** | Dynamic Data Exchange |
| | A relatively old mechanism for exchanging simple data among processes in MS-Windows. |
| **DI** | Digital Input |
| **DO** | Digital Output |
| **EGU** | Engineering Units |
| **EIA** | Electrical Industries Association |
| **FET** | Field Effect Transistor |
| **GC** | Gas Chromatograph |
| **GUI** | Graphical User Interface |
| **HART** | Highway Addressable Remote Transducer. |
| | 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** | Human Machine Interface. |
| | 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** | Input/Output |
| **IEEE** | Institute for Electrical and Electronics Engineers |
| **ISO** | International Standards Organization |
| **MMI** | Man Machine Interface (see HMI) |
| **MIC** | Machine Identification Code. License code of Spirit$^{IT}$ Flow-X which uniquely identifies you computer. |
| **OEM** | Original Equipment Manufacturer |
| **P&ID** | Piping and Instrumentation Diagram |
| **PC** | Personal Computer |
| **PCB** | Printed Circuit Board |
| **PLC** | Programmable Logic Controller. |
| | 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** | Remote Terminal Unit |
| **SCADA** | Supervisory Control and Data Acquisition |
| **SQL** | Standard Query Language |
| **SVC** | Supervisory Computer |
| **TCP/IP** | Transmission Control Protocol/Internet Protocol. |
| | 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** | Transistor-Transistor Logic |
| **UART** | Universal Asynchronous Receiver & Transmitter |
| **URL** | Uniform Resource Locator. |
| | The global address for documents and resources on the World Wide Web. |
| **XML** | Extensible Markup Language. 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 Spirit<sup>IT</sup> 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 Spirit<sup>IT</sup> eXLerate, a 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. |

# 2    The Spirit<sup>IT</sup> Flow-X products

## Introduction

This chapter provides an overview of available models in the Spirit<sup>IT</sup> 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 2-1 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 Panel mounted internal single module flow computer, Flow-X/C
• A Rack frame, holding maximum 8 modules, Flow-X/R
• A single enclosure, Flow-X/S
• A single rack enclosure, Flow-X/K

These enclosures are described in more detail below.

A single module has the following I/O capabilities:

| Signal type | v1 Nr[3] | v2 Nr[3] | Description |
|---|---|---|---|
| Analog Input | 6[1] | 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] | 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 | 2 | High accuracy PT-100 inputs |
| Pulse inputs | 1[2] | 4[2] | High speed single or dual pulse input. Frequency range 0-5kHz (dual pulse) or 0-10kHz (single pulse) |
| Density | 4[2] | 4[2] | Periodic time input, 100µs - 5000µs. |
| Digital Inputs | 16[2] | 16[2] | Digital status inputs |
| Digital Outputs | 16[2] | 16[2] | Digital output, open collector |
| Pulse Outputs | 4[2] | 4[2] | Open collector, max. 100 Hz |
| Frequency Outputs | 4[2] | 4[2] | Open collector, max. 10 kHz (Only available for Flow-X/C device type) |
| Sphere | 4[2] | 4[2] | Supports 1, 2 and 4 detector configurations mode |

| Signal type | v1 Nr[3] | v2 Nr[3] | Description |
|---|---|---|---|
| detector inputs | | | 0.5ms detect update rate |
| Analog Outputs | 4 | 4 | Analog output for flow control, pressure control 4-20mA, outputs floating. |
| Prover Outputs | 1[2] | 1[2] | Pulse output for proving applications The output represents the corrected pulse signal |
| Serial | 2 | 2 | RS485/RS232 serial input for ultrasonic meter, printer or generic, 115kb |
| Ethernet | 2 | 2 | RJ45 Ethernet interface, TCP/IP |
| Power supply | 2 | 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
3 Flow X hardware version 1 or version 2.

Table 2-1 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 2-2 Flow-X/M nameplate

## Enclosures

### Flow-X/P
This is a Panel 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 2-3 Flow-X/P Panel version

**Flow-X/C**
This is a **C**ompact panel mounted flow computer with one integrated Flow-X/M module with a 7" multi-lingual color touch screen and one additional serial port 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 one 9-pin D-Sub type connector at the rear.



Figure 2-4 Flow-X/C Compact 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 7).



Figure 2-5 Flow-X/R Rack version

**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 2-6 Flow-X/S Single enclosure

**Flow-X/K**
This is a single stream, DIN rail enclosure with standard 37-pole D-Sub type connectors for field connection. Interfaces include dual Ethernet with built-in web-server via RJ45 connectors. It has graphical LCD display with 4 lines for local display of measured & calculated data. The Flow-X/K may be mounted in 2 ways: mounted on a DIN-rail and Wall mounted. In combination with a DIN-adapter it is possible to mount 7 Flow-X/K enclosures next to each other in a 19" cabinet.



Figure 2-7 Flow-X/K 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**

The Flow-X/C flow computer as well as each Flow-X/M module have a mechanical tamper switch to prevent changing of the application and vital parameters within that application.



Figure 2-8 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.

## Break-out board

**Flow-X/B**

The Flow-X/B break-out board allows for convenient connection to the measurement and control signals and protects the flow computer from harmful field signals.
For fully wired I/O, two Flow-X/Bs are required per module.



Figure 2-9 Flow-X/B break-out board

## Advantages

The Spirit<sup>IT</sup> 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  Spirit<sup>IT</sup> Flow-Xpress Basic configuration software guarantees easy configuration, and the Spirit<sup>IT</sup> 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  SpiritIT 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 SpiritIT 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 2-10 Flow-X/R label

# Recycling information in accordance with the WEEE

The product is marked with the wheelie bin symbol. It indicates that at the end of life the product should enter the recycling system. The figure below shows the wheelie bin symbol indicating separate collection for electrical and electronic equipment (EEE).



For disposal in the European Union
You should dispose of it separately at an appropriate collection point and not place it in the normal waste stream.
If you wish to discard electrical and electronic equipment (EEE), please contact your dealer or supplier for further information. Disposing of this product correctly will help save valuable resources and prevent any potential negative effects on human health and the environment, which could otherwise arise from inappropriate waste handling.

For disposal in countries outside of the European Union
The crossed –out wheeled bin symbol is only valid in the European Union (EU) and means that used electrical and electronic equipment (WEEE) should not be mixed with general household waste.
If you wish to discard this product please contact your local authorities or dealer and ask for the correct method of disposal. Disposing of this product correctly will help save valuable resources and prevent any potential negative effects on human health and the environment, which could otherwise arise from inappropriate waste handling.

# 3    Getting started

This chapter provides a short overview of considerations to be made in selecting the appropriate Spirit$^{IT}$ Flow-X products.

## Location

The Spirit$^{IT}$ 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 Spirit$^{IT}$ 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 Spirit$^{IT}$ Flow-X flow computer. Refer to the device documentation for adequate information.

## Capabilities

The Spirit$^{IT}$ 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
- GERG 2008

## 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).

The Flow-X/C is a compact version and similar to a Flow-X/P with one module. This module is integrated in the enclosure of the Flow-X/C.
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 Spirit$^{IT}$ 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) and Flow-X/C (Compact) flow computers have 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 Spirit$^{IT}$ 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 Spirit$^{IT}$ Flow-X solutions bring the best quality for the best price.

# 4      Mechanical installation

## Introduction

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

## Forced ventilation

(!) For Flow-X/P and Flow-X/R models, forced ventilation in the cabinet is always recommended.

For a Flow-X/R in a 19" rack, please ensure air flow at the front is not blocked by Ethernet switches or other devices mounted below or above the Flow-X/R.

For a Flow-X/R in a 19" rack with 3 or more modules adjacent to each other it is recommended to install a 19" rackmount ventilator unit, as shown in Figure 4-1 directly underneath the X/R enclosure.
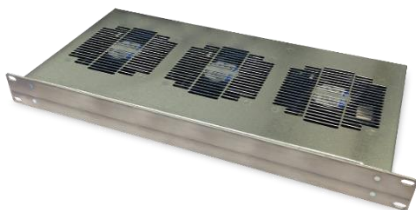


Figure 4-1 19" ventilator unit

## 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.
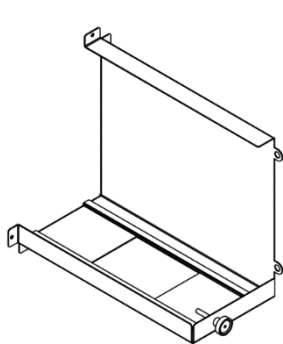


Figure 4-2 Flow-X/P Mounting bracket
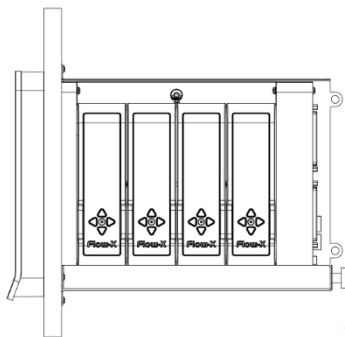
Figure 4-3 Flow-X/P mounted (side view)

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 16 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.
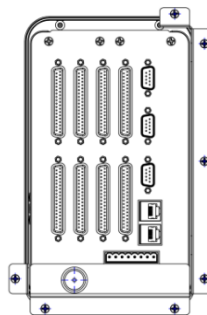


Figure 4-4 Flow-X/P version 1 rear view (mounted)
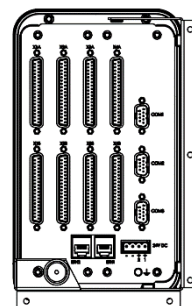
Figure 4-5  Flow-X/P version 2 rear view (mounted)

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

## Flow-X/C

The panel mounted Flow-X/C requires a mounting bracket, which is part of the delivery. After mounting the bracket to your cabinet/construction the Flow-X/C can then be slidden into the bracket and fasten with a knurled screw. The Flow-X/C can be installed horizontally and vertically.
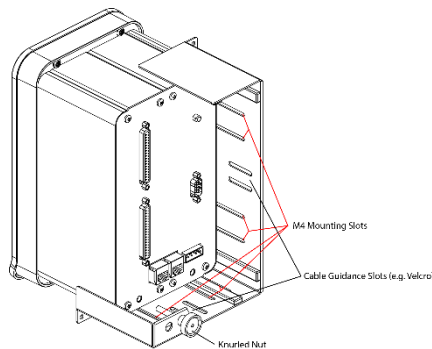


Figure 4-6  Flow-X/C Mounting bracket
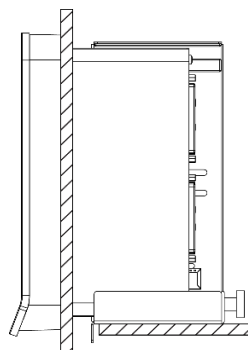


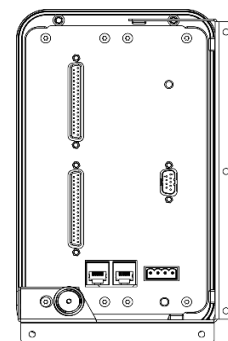Figure 4-7  Flow-X/C mounted (side view)

Figure 4-8.  Flow-X/C rear view (mounted)

The Flow-X/C Bracket can be fixed to any construction, but for an easy installation three installation cases will be described later in this chapter. The installation of the Flow-X/C is very similar to the Flow-X/P.

**Front mount**
The Bracket can be mounted in two different ways. The first method is by using the holes in the front of the bracket to mount the bracket to a front plate. In this case you need flat head screws (M4) and (flange) nuts. For more information, read chapter Bracket to blanking plate (front mounting) on page 13.

**Bottom mount**
The second method is to use the slots on the bottom side of the bracket. You need for this construction screws (M4) with a low head (maximum of 3 mm), washers and nuts. For more information, read chapter Bracket to Rittal Component Shelf (bottom mounting) on page 14.
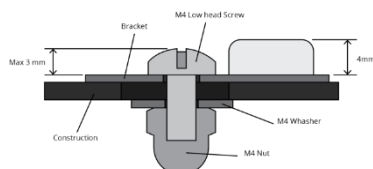


Figure 4-9  Mounting instructions M4 screw with low head

**Minimal Distance**
Due to heat control, we advice you to add free space around the Flow X/C.
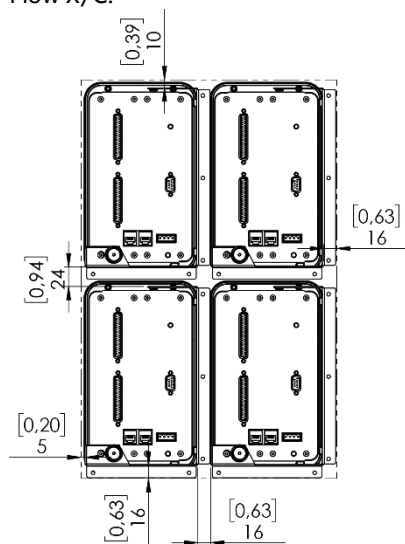


Figure 4-10  Minimal Distance around Flow-X/C (Brackets) (in mm)

**Blanking Plate**
The installtion of the Flow-X/C can be finished with an blanking plate. The measurements for the cut-out of the blanking plate can be found on page 42.
The maximum distance the Flow-X/C can come out of the bracket is 23 mm:
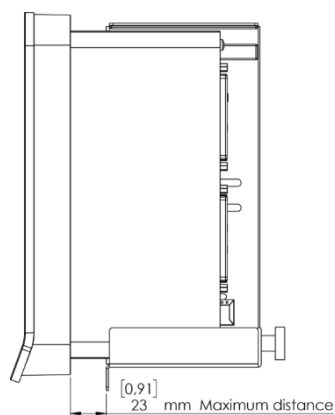


Figure 4-11  Maximum distance of the Flow-X/C out of the Bracket

# Flow-X/C installation example instructions

The installation with the Flow-X/C Bracket can be used for any custom installation solution. For convenience, there are also standard solutions available; one front mounting construction and two based on standard components of Rittal.
The cabinet installation examples we provide are based on an installation in a 19 inch (swing) frame and in the door of the cabinet.

**Bracket to blanking plate (front mounting)**
At the front of the bracket there are 5 M4 holes to mount the bracket directly to a plate. For this construction we advise you to use an 8 mm (anodized) aluminium plate. This plate can be mounted to a 19" inch (swing) frame or to the at the back of the door.
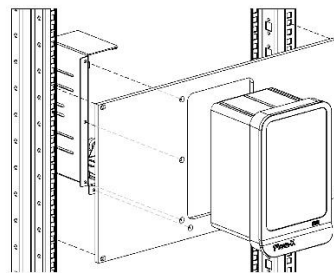


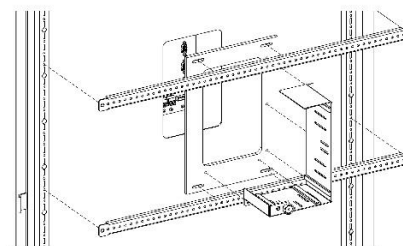Figure 4-12  Example of front mounting in a 19" frame



Figure 4-13  Example of front mounting in a door

On pages 42 & 44 you can find the measurements for a front installation.

**Bracket to Rittal Component Shelf (bottom mounting)**
The other two solutions, we provide, are based on the Rittal Component Shelf (7119.140).
The Bracket will be mounted to the shelf using the slots on the bracket and the slots on the Component Shelf.

- M4x8 Screw with a flat head (maximum of 3 mm)
- M4 Nut
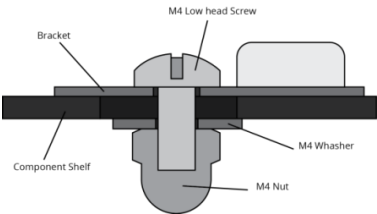- M4 Washer with a large outer diameter (minimum of 10 mm)



Figure 4-14  Mounting Bracket to Rittal Component Shelf

**Shelf - 19 inch Frame Installation**
By using the Rittal Component Shelf it is possible to easily install the Flow-X/Cs into a 19"inch (swing) frame.
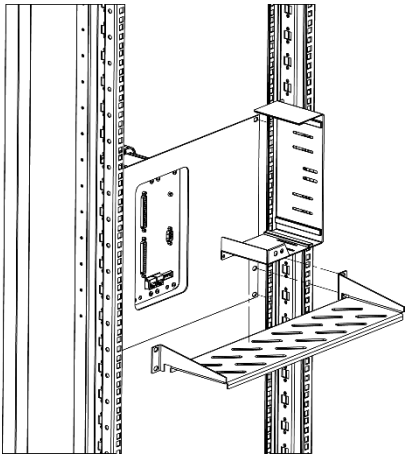


Figure 4-15 Installation of Flow-X/C Bracket on to a 19 inch (swing) frame

**Position**
The height that is needed for the installation is (in U):

Vertical Flow-X/Cs
1U + (6U * Flow-X/P rows)
(e.g. 1 Flow-X/C; 1U+6U=7U)

Horizontal Flow-X/Cs
1U + (4U * Flow-X/P rows)
(e.g. 2 Flow-X/C; 1U+8U=9U)

It is possible to place three vertical Flow-X/Cs next to each other and only one horizontal Flow-X/C on a shelf.

The precise dimensions can be found on page 42.

**Shelf - Door Installation**
Flow-X/Cs can be installed into the door of the standard cabinets of Rittal (TS, CM and AE). The only width of the cabinet door that is usable is 800 mm.
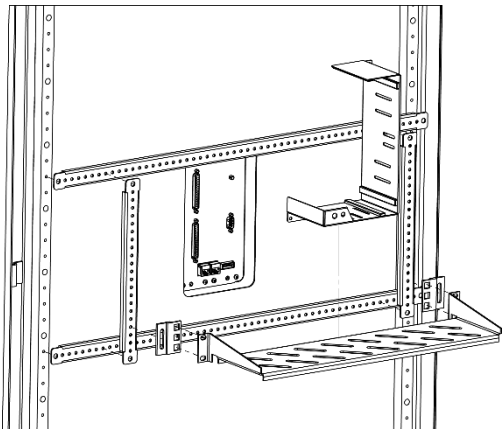


Figure 4-16 Installation of Flow-X/C Bracket on to a cabinet door

The door should have the 25 mm mounting profiles on which the Rittal Door Profiles can be mounted. To attach the Rittal Shelf to these profiles you also need two Rittal Adapters (7246.010).
Rittal Door Profiles:

| | | Amount of shelfs with Vertical Flow-X/Cs | Amount of shelfs with Horizontal Flow-X/Cs |
|---|---|---|---|
| 400 mm | 4594.000 | 1 | 1 |
| 500 mm | 4309.000 | 1 | 2 |
| 600 mm | 4596.000 | 1 | 3 |
| 800 mm | 4598.000 | 2 | 4 |
| 900 mm | 4579.000 | 3 | 5 |
| 1000 mm | 4599.000 | 3 | 5 |

Table 4-1 Amount of shelfs with Flow-X/Cs able to fit on the Rittal Door Profiles

It is possible to fit three vertical Flow-X/Cs next to each other and only one horizontal Flow-X/C on a shelf.
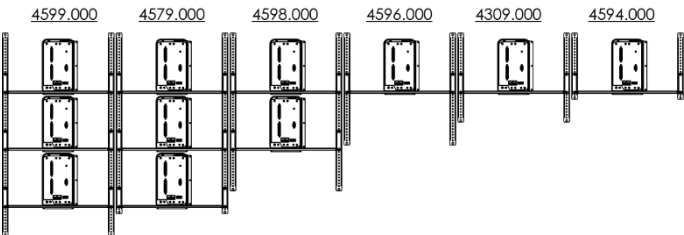


**Figure 4-17  Flow-X/Cs mounted to the Rittal Door Profiles**

## 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.
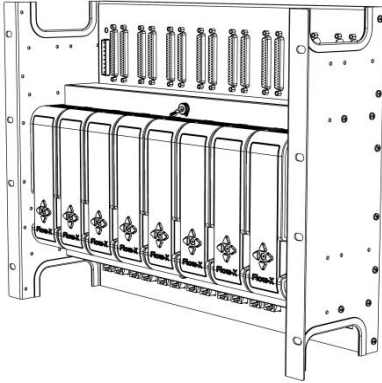


Figure 4-18 Flow-X/R Rack enclosure

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 18.
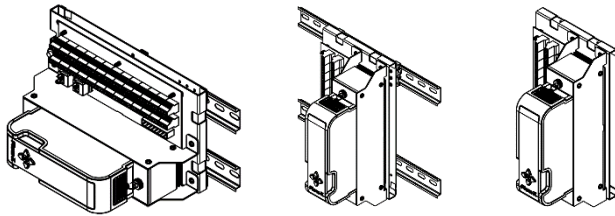


Figure 4-19 Mounting options for Flow-X/S
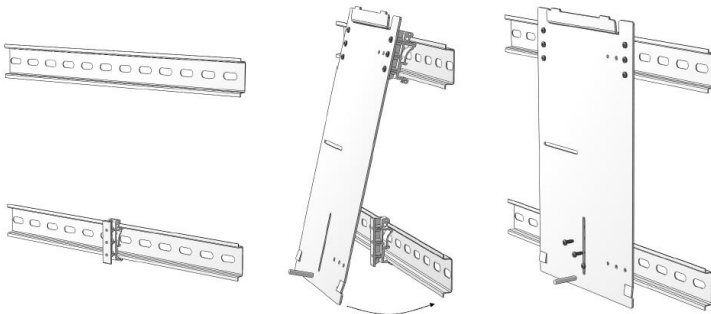


Figure 4-20 Flow-X/S mounting sequence (DIN-rail, vertical position)

## Flow-X/K

The single module Flow-X/K may be mounted on Din-rail or directly on a backplane/wall. The connections are made through 2 sub-D connectors. There is one power connector and 2 Ethernet RJ-45 connections below the module. See page 16 for connector details.

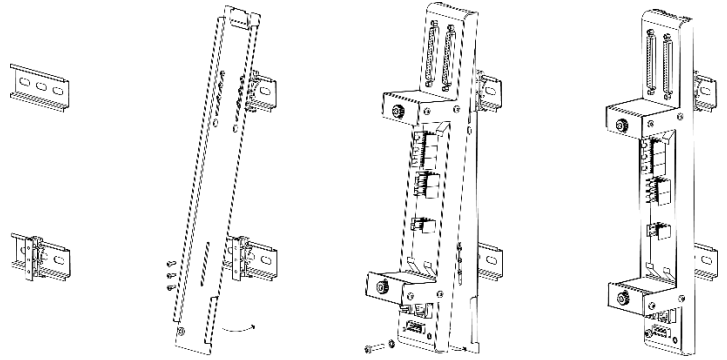Note: the 37-pin D-sub connectors are **female**



Figure 4-21 Flow-X/K mounting sequence (DIN-rail)

## Flow-X/B

The break-out board Flow-X/B may be mounted directly on a backplane/wall, either horizontally or vertically. The connections to the Spirit<sup>IT</sup> Flow-X enclosures are made through a sub-D connector. The connections to the field equipment are made through screw terminals. See page 19 for connector details.
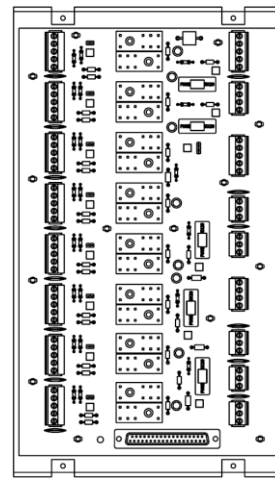
Note: the 37-pin D-sub connector is **female**



Figure 4-22 Flow-X/B

# 5    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 Spirit<sup>IT</sup> 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 Spirit<sup>IT</sup> Flow-X flow computer. Refer to the device documentation for adequate information.

The Spirit<sup>IT</sup> 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 supported serial interfaces are

| Port | Flow-X/P version 1 | Flow-X/P version 2 |
|------|--------------------|--------------------|
| COM 1 | RS232 | RS232/RS485 |
| COM 2 | RS232/RS485 | RS232/RS485 |
| COM 3 | RS232/RS485 | RS232 |

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 17.
For the power connection, see page 17.

The 39-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. In Flow-X/P version 1, Com 1 is RS-232 only, Com 2 and Com 3 may be individually configured for RS-232 or RS-485. In Flow-X/P version 2, Com 3 is RS-232 only and Com 1 and Com 2 are configurable. For connector details, see page 18.
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 17.
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/C
The Flow-X/C flow computer is the panel-mounted version that has a touch-screen and an integral Flow-X/M flow module.
The power, I/O and communication terminals are on the back of the flow computer. There are two 37-pin D-sub female connectors for the I/O and two serial ports, supporting RS232 and RS485.  Furthermore it has two RJ45 connectors (for Ethernet) and one 9-pin D-sub male connector, providing a third serial port that supports RS232 only.
The port connectors are described on page 17.
For the power connection, see page 17.
The 9-pin D-sub connector can be used as a generic serial port to communicate to devices such as a flow meter, gas chromatograph or a DCS. The port supports RS-232 only. For connector details, see page 18.
LAN1 and LAN2 are Ethernet connectors, to connect your Flow-X/C to your network.
One USB port can be found at the front, which is reserved for future usage.

### 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 18.
In addition, the Flow-X/S enclosure has a 24V power connector and 2 Ethernet connectors (ETH 1 and ETH 2). For the power connector see page 17.
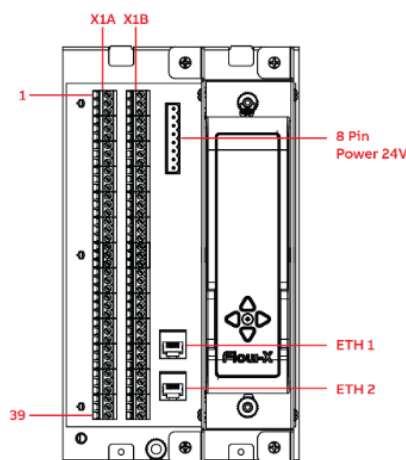
Figure 5-1 Flow-X/S connectors and terminals

## Flow-X/K

The Flow-X/K has room for 1 module. The module is connected through two D-sub 37 connectors (Port A and Port B). For the pin-out see page 17.

In addition, the Flow-X/K enclosure has a 24V power connector and 2 Ethernet connectors (LAN A and LAN B). For the power connector see page 17.

## Flow-X/B

The Flow-X/B board connects through a D-sub 37 connector to a Flow-X/R, Flow-X/K, Flow-X/P or Flow-X/C enclosure. A fully wired Flow-X/M module or Flow-X/C requires two Flow-X/B boards. The D sub 37 connector is electrically connected to the earth connection of the Flow-X/B. For the pin-out see chapter D-sub 37 connectors on page 17.

Flow-X/B contains different types of inputs and outputs to connect field signals. The protection depends on the type of input/output.

All field signal connectors on the Flow-X/B have connectors with screw terminals in the contra part of the connector.

- All signals related to one input or output are combined in one connector.
- Each connector has per pin a short descriptive name at the side the wires leaving the connector.
- Each connector has the input/output name at the other side of the connector. This name is also affixed on the contra part of the connector
- All inputs/outputs have the type and number of the A connector affixed next to the connector. The input/output number of the B Connector is between parentheses.

For more elaborate information on the connectors of the Flow-X/B, see chapter Break-out board connection details on page 19.

## Enclosure connector details

### Power supply

The Spirit<sup>IT</sup> 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, /C and /K use 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.
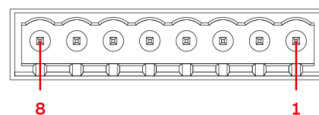


Figure 5-2: Flow-X/P version 1 & Flow-X/S power terminal block

| 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 5-1: Flow-X/P & Flow-X/S power supply connector pin layout
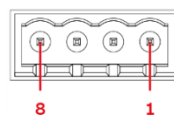


Figure 5-3: Flow-X/R, Flow-X/C, Flow-X/K & Flow-X/P version 2 power terminal block

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

Table 5-1: Flow-X/R, Flow-X/C & Flow-X/K power supply connector pin layout

### D-sub 37 connectors

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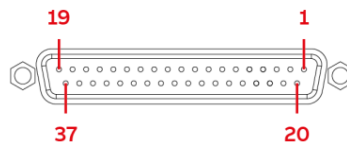


Figure 5-4: 37-pin D-sub female connector

**CONNECTOR A**

| 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 5-2 37-pin D-sub connector A pin-out Flow-X/P, Flow-X/C Flow-X/K and Flow-X/R

**CONNECTOR B**

| 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 |
| 19 | Analog input common | 37 | Analog input common |

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

Table 5-3 37-pin D-sub connector B pin-out Flow-X/P, Flow-X/C Flow-X/K and Flow-X/R

### D-sub 9 connectors (serial communication)

Three D-sub 9-pin connectors are available on the Flow-X/P and one on the Flow-X/C. The connectors are male, so the connecting cable must have a female connector.
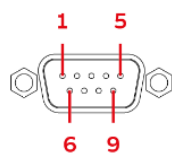The 9-pin D-sub male connectors have the following pin connections.



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

| Pin | X/P v1 COM 1 / X/P v2 COM 3 / X/C COM 3 (RS-232 only) | X/P v1 COM 2 / X/P v1 COM 3 / X/P v2 COM 1 / X/P v2 COM 2 232 \| 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 5-4 9-pin D-sub connector pin connections for Flow-X/P & Flow-X/C

### 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 5-5 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 5-6 Screw terminal B pin-out for Flow-X/S

**Ethernet**

The Flow-X/K, Flow-X/C, 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.

# Break-out board connection details

**Power supply**

The power supply of the Flow-X/B can be either from an external 24V DC power supply or a Flow-X/M module.

There are two separate connectors for both, both with a separate fuse and a red indicator LED (which will light up when the fuse is blown). The external power supply connection is protected by a 1.6 A (fast) fuse and the Flow-X/M power connection by a 500 mA (fast) fuse.

By setting a jumper you can select the power source for the board. A green indicator LED will light in case the selected power supply is not blown.

The available separated flow computer grounds are all available on one connector. These grounds are:

- DIG_GND:      Digital ground (two screw terminals)
- AO_GND:       Analog output ground
- AI_GND:       Analog input ground

**Serial communication**

Each Flow-X/B has one serial communication connection. The serial connection terminals are combined in one 5-pin connector. The signals on the connector pins depend on the communication protocol:

| Function |
|---|
| COM 1 - | Sig+| Tx+ * |
| COM 1 Tx | Sig- | Tx- * |
| COM 1 - | - | Rx- * |
| COM 1 Rx | - | Rx+ * |
| *  RS-232 | RS-485 2 wire | RS-485 4 wire |

The Flow-X/B does not contain protection serial communication signals.

**PRT inputs**

A Flow-X/B has one PRT connection. The signals are combined in one 4 pin connector. The available PRT connector pins are:

| Function |
|---|
| PRT_PWR - |
| PRT_SIG - |

| Function |
|---|
| PRT_SIG + |
| PRT_PWR + |

The Flow-X/B does not contain protection of the PRT input signals.

**Analog inputs**

Three analog input connections are available on a Flow-X/B. Every Analog input connection has a separate 3 pin connector:

| Function |
|---|
| AI_GND |
| AI_Sig_N (where N is the Analog output number) |
| AI_24_V_Out_N (where N is the Analog output number) |

All AI_24_V_Out_N (where N is the analog input number) are fuse (1.6 A) protected.

A red indicator led will light in case the AI_N fuse is blown.

The (leaking) current through the led does not influence the Analog Input value (is flow computer measurement).

All AI_24_V_Out_N (where N is the analog input number) provide power from the same source selected using the jumper described in section Power supply

Each Analog input has a high precision resistor of 250 Ω between the AI_SIG and AI_GND that can be enabled/disabled using a jumper. The precision of the resistor is that high that the accuracy of the Analog Input is equal to the Flow computer Analog input accuracy.

**Analog outputs**

Two analog output connections are available on a Flow-X/B. Every analog output has a separate three pin connector:

| Function |
|---|
| AO_GND |
| AO_Sig_N (Where N is the Analog output number) |
| 24_V_Out |

Analog output signals (AO_Sig_N) are not protected. They are directly connected to the Analog outputs of the D-Sub 37 connector from the flow computer.

The 24_V_Out pin of the Analog output connectors provides power from the same source as other 24_V_Out pins available in other connectors.

**Digital inputs / outputs Flow-X/B**

A Flow-X/B has 8 Digital IO connections. Each digital IO connection has a 5 pin connector:

| Function |
|---|
| 24_V_out |
| DIG_SIG_N (Where N is the Digital IO port number) |
| EXT_SIG_N (Where N is the Digital IO port number) |
| EXT_RET_N (Where N is the Digital IO port number) |
| DIG_GND |

**DIO Relays**
Each DIO has the option to split the field and flow computer signals using a relay.

Only mount 1 relay maximum for each DIOx channel, depending on signal-direction (see text and arrows on PCB, in front of each relay-socket).

The EXT_SIG and EXT_RET signals are connected to the coil of a relay if the DIO is used as Digital Input. The _SIG and _RET signals indicate the logical current flow.

The EXT_SIG and EXT_RET signals are connected to a relay contact in case the DIO is used as Digital Output. In this case the polarity of _DIG and _RET is not important.

The input relay and kickback diodes are protected against polarity swap up to 1000 VDC.

The relays can be replaced easily. They are 5 mm pitch SPNO or SPST (in which case the NS-contact is unconnected). Metal clip is meant for 26mm high relays. In case output- is used, relay coil must be rated 24VDC. Kickback-diodes for both input- and output-relay are present on PCB and always enabled.

Wrong mounting of the relay or wrong configuration of the DIO does not damage the Flow-X DIO.

Preferable use a single relay and switch configuration between input or output (ext signals connected to coil for Digital Input or relay contact for Digital Output)

**Direct connections**
Each Flow-X/M DIO can be directly connected using the DIG_SIG connection in combination with the 24_V_OUT and/or DIG_GND. These connections are not protected individually.

A pull-up resistor in combination with a green LED can be enabled or disabled with a jumper.

## Connection diagrams

### Ground wiring
The Spirit[IT] 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)
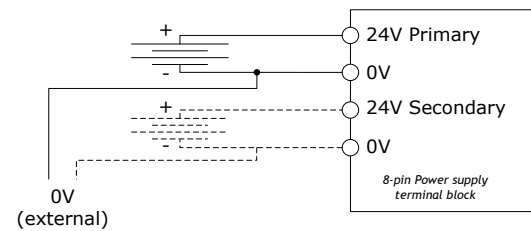


Figure 5-6 Spirit[IT] Flow-X power supply wiring

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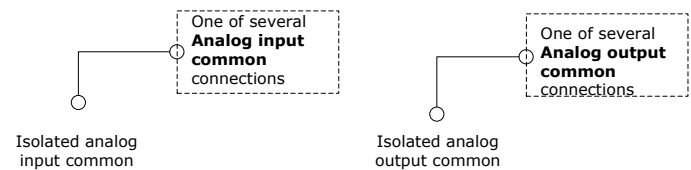


Figure 5-7 Isolated analog signal ground

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).
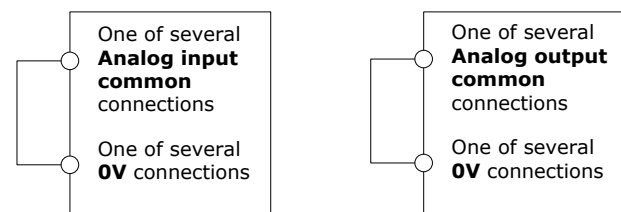


Figure 5-8 Common analog signal ground

### Fuses
Each 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.

⚠️ **Caution**

Analog inputs do not have overvoltage and overcurrent protection in order to meet the high accuracy specifications.

**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
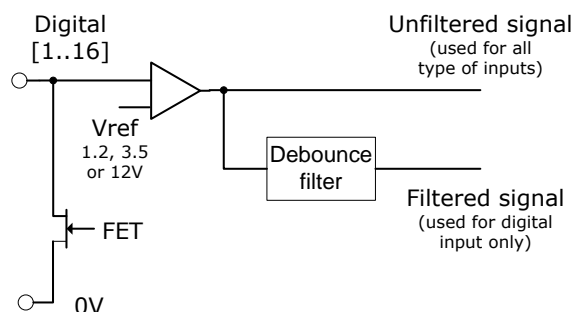


Figure 5-9 Digital channel circuit

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 3.6 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 Spirit IT 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.
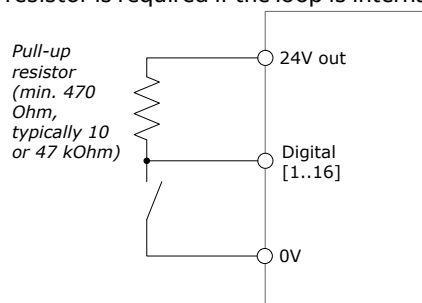


Figure 5-10 Internally powered digital input

When externally powered, the external source should have a connection to the common ground of the Spirit IT 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.
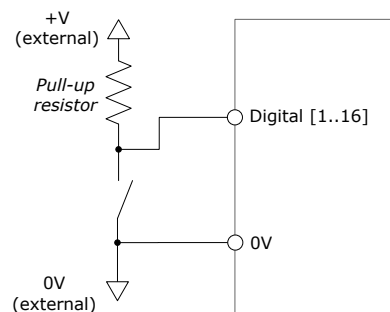


Figure 5-11 Externally powered digital input

**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 Spirit[IT] 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, depending on the hardware version, supports one or multiple 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 3.6V 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.
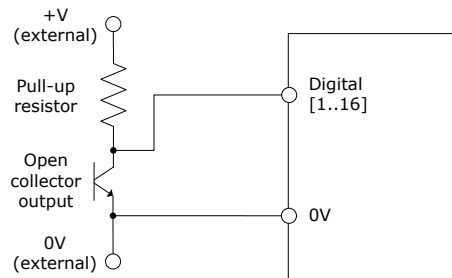


Figure 5-12 Pre-amplifier with open-collector output
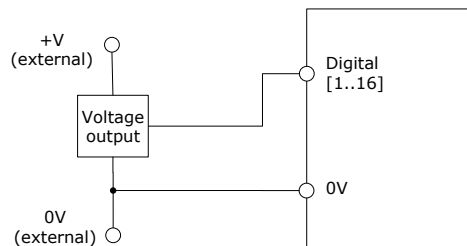


Figure 5-13 Pre-amplifier with voltage output

**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 Spirit[IT] 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 Spirit[IT] 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.
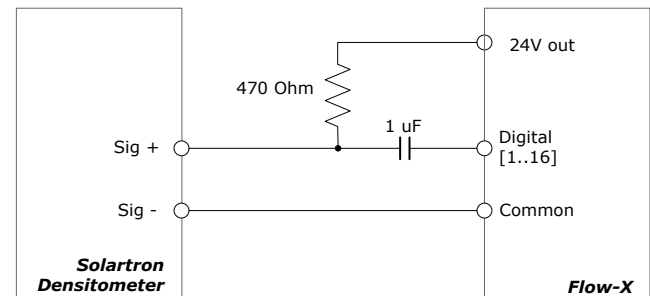


Figure 5-14 Solartron densitometer connection (loop powered by Flow-X)

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.

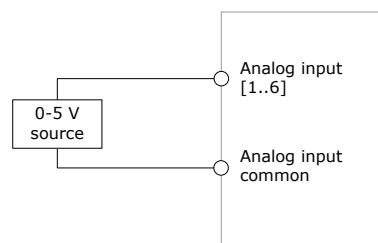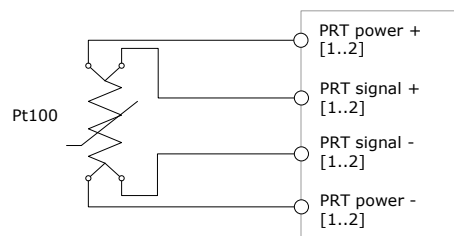**Digital outputs**

⚠️ 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 Spirit[IT] 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.
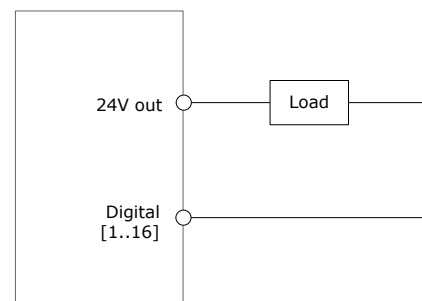


Figure 5-15 Internally powered digital output
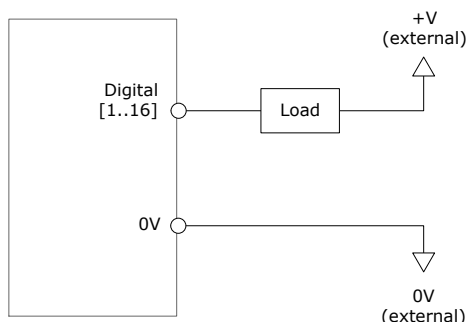
Figure 5-16 Externally powered digital output

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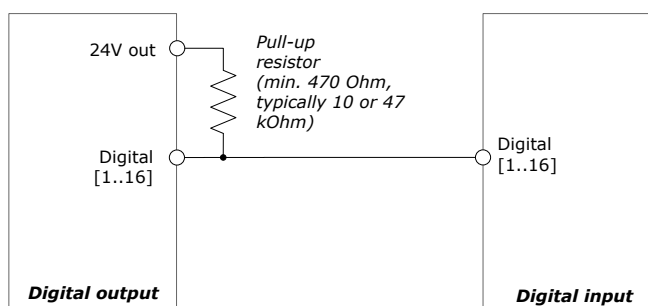


Figure 5-17 Connecting a digital output to a digital input

**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 Spirit IT 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 Spirit IT 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 Spirit IT 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 Spirit IT 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 Spirit IT 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 Spirit IT Flow-X flow computer, the common analog input ground must be referenced to the same reference ground as the power supply as shown below.
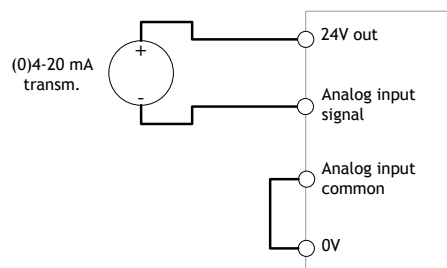


Figure 5-18 Internally powered mA input

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'.
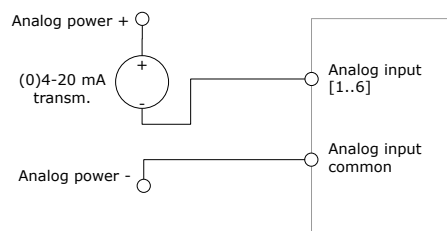


Figure 5-19 Externally powered mA input

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 5-20 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 Spirit $^{IT}$ Flow-X flow computer. Refer to the device documentation for adequate information.

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



Figure 5-21 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 Spirit $^{IT}$ 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 Spirit$^{IT}$ 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.
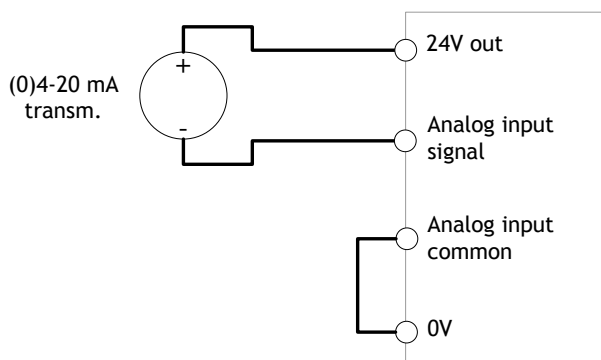


Figure 5-22 HART loop (single transmitter)
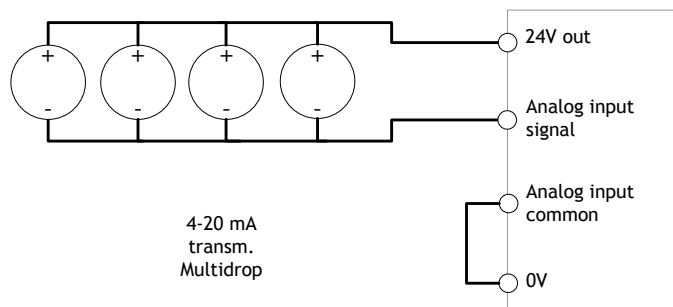


Figure 5-23 HART loop (multi-drop)

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 **47 μF bipolar 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.
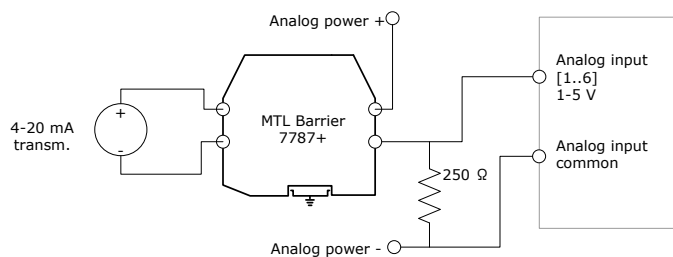


Figure 5-24 Analog 4-20 mA transmitter with barrier

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.
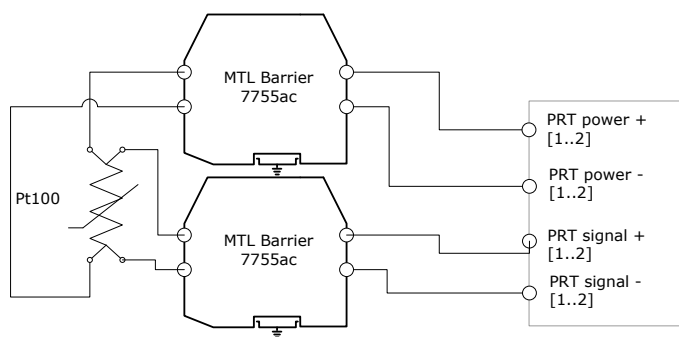
Figure 5-25 PT-100 with barrier

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 Spirit ᴵᵀ 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.
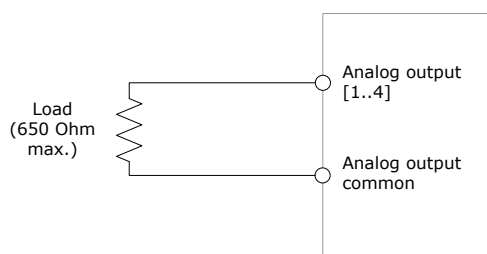


Figure 5-26 Analog output

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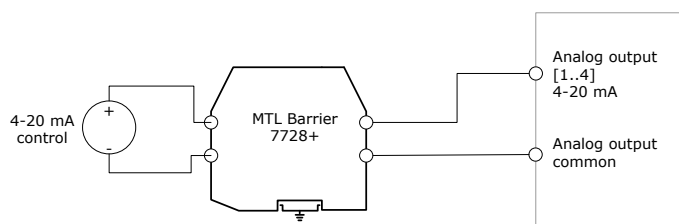


Figure 5-27 Analog 4-20 mA control with barrier

## Honeywell Enraf Calibron small volume prover

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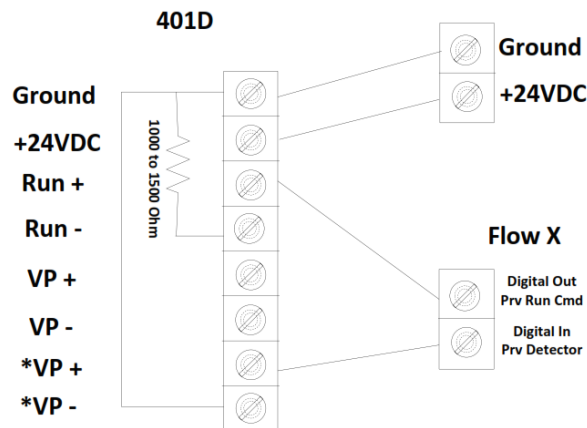


Figure 5-28 : Connection diagram for Honeywell Enraf Calibron prover

Note: on the Spiritᴵᵀ 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')

## Serial communication

Each Flow-X/M flow module provides 2 serial ports. Furthermore the Flow-X/P provides an additional 3 serial ports and the Flow-X/C one (COM3). Each serial port is capable of either RS-232 or RS-485 communications, with the exception of COM1 of the version 1 Flow-X/P, COM3 of the version 2 Flow-X/P or COM3 of the Flow-X/C, which are 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).
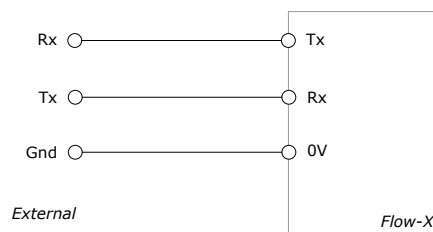


Figure 5-29 RS-232 connection

For RS-485 communications both half-duplex (2-wire) and full-duplex (4-wire) modes are supported.
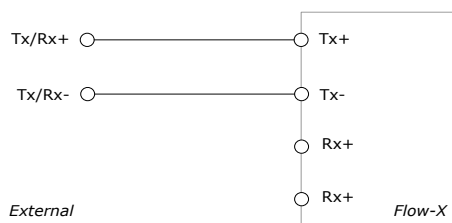
Figure 5-30 2-wire RS-485 connection

> ⓘ  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).
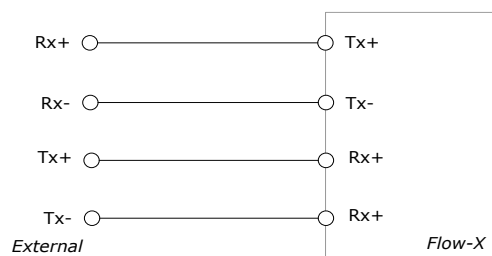


Figure 5-31 4-wire RS-485 connection

> ⓘ  **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 Spirit<sup>IT</sup> 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)
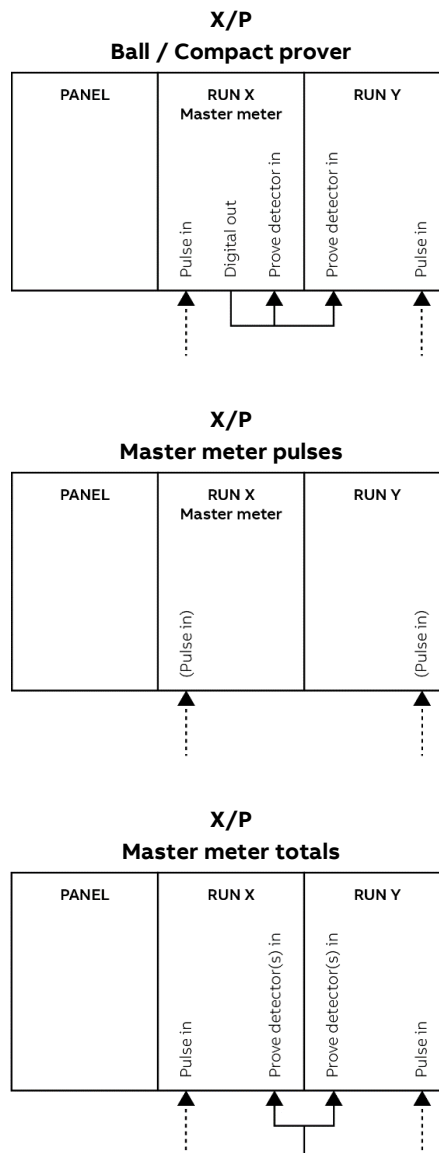


Figure 5-32 Proving signals connection on Flow-X/P

**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)
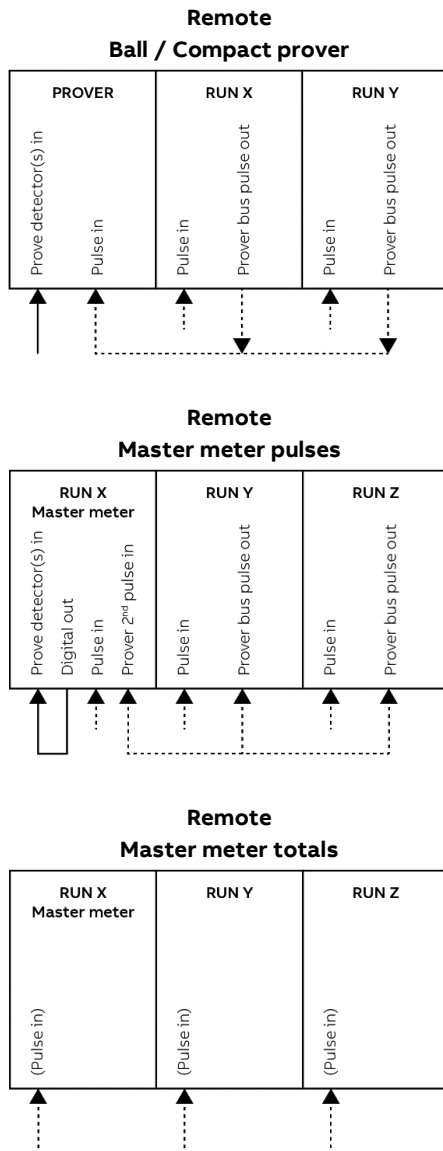


Figure 5-33 Proving signals connection on remote run / separate proving module

# Earth ground connection

The chassis must be connected to a good earth ground to prevent human contact with dangerous voltages and to minimize the effects of electrical transients.

⚠ For the correct operation of the device it is important to verify that there is no (significant) difference between the voltage levels of the signal ground (0 V of the power supply) and the earth ground.

The following pictures show the location of the threaded stud for the connection of the earth ground wire for the different Spirit^IT Flow-X enclosures.
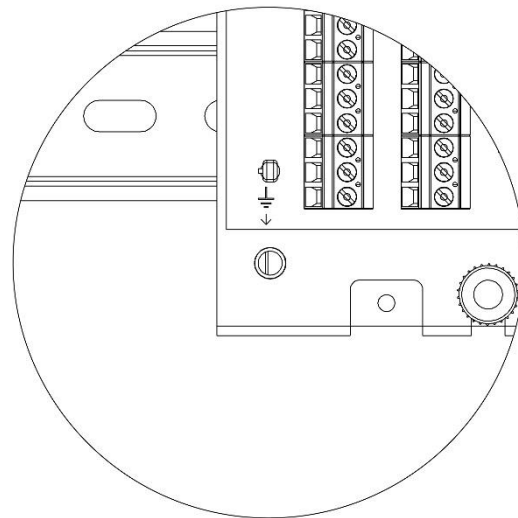


Figure 5-34 Flow-X/S earth ground connection
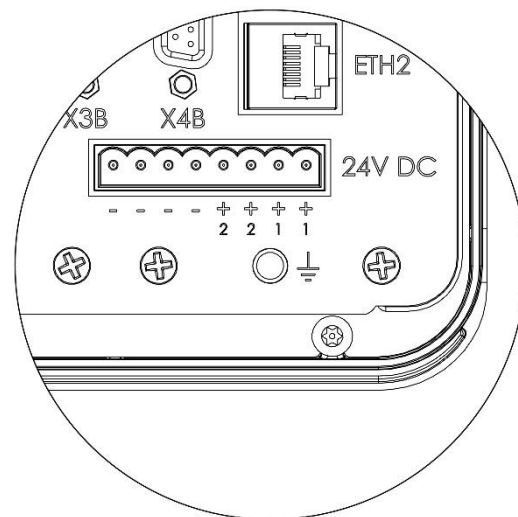


Figure 5-35 Flow-X/P earth ground connection
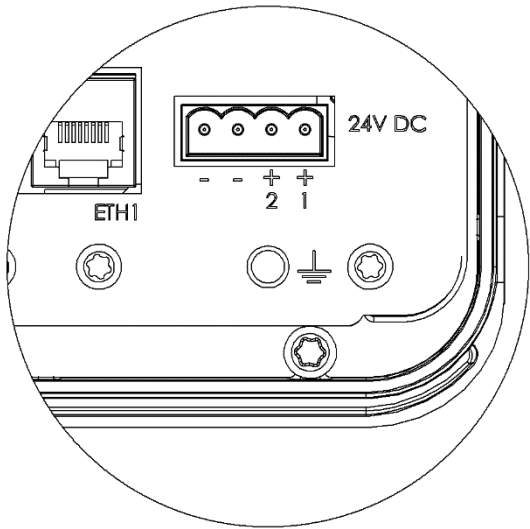
Figure 5-36 Flow-X/C earth ground connection
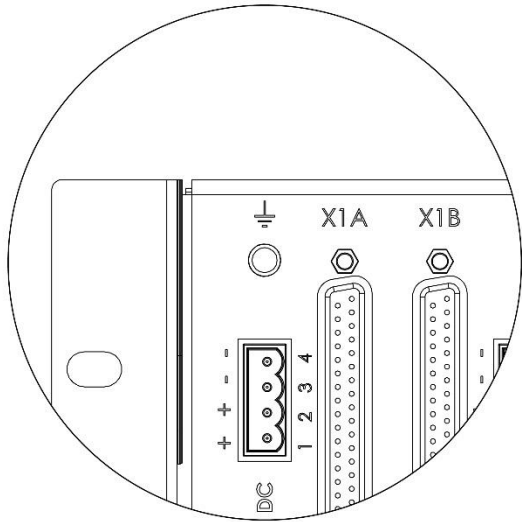


Figure 5-37 Flow-X/R earth ground connection
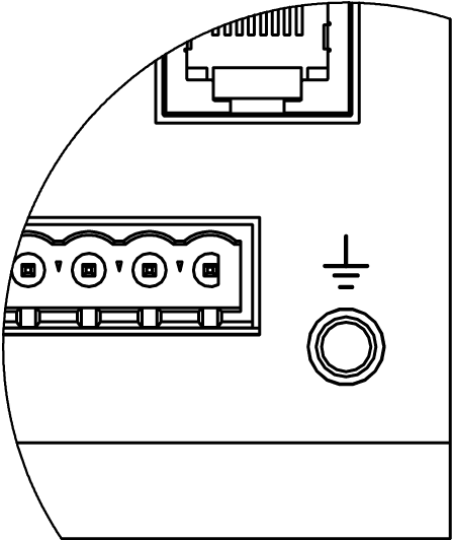


Figure 5-38 Flow-X/K earth ground connection

# 6    Operator Panels

## Introduction

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

## Flow-X/P & Flow-X/C touch screen

The Flow-X/P and Flow-X/C have 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 and X/C itself and to the up to 4 installed flow modules.



Figure 6-1 Flow-X/P touch screen

## Touchscreen panel PC

All Spirit<sup>IT</sup> 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<sup>IT</sup> 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.

ABB Spirit<sup>IT</sup> supplies a 7" or 10" touch panel PC version for installation in a cabinet.



Figure 6-2 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.
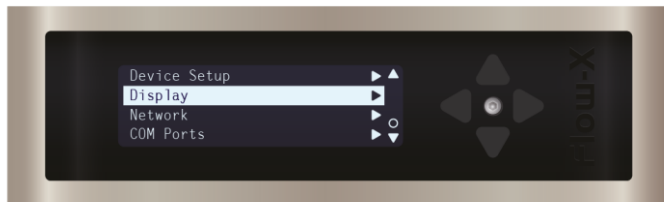


Figure 6-3 Flow-X/M LCD display

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.

## Spirit<sup>IT</sup> Flow-X web interface



All Spirit<sup>IT</sup> 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.

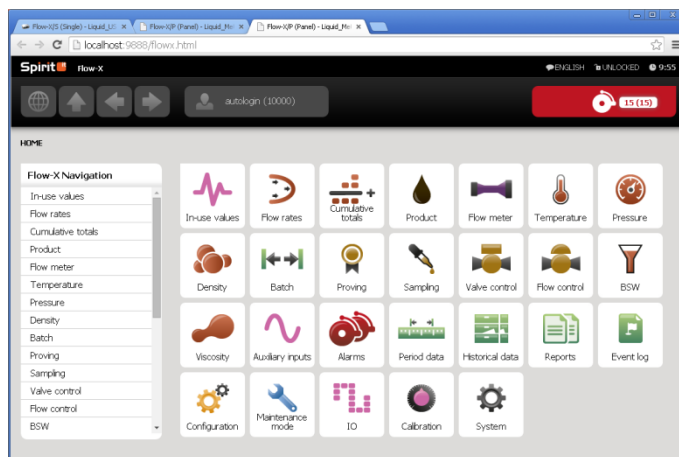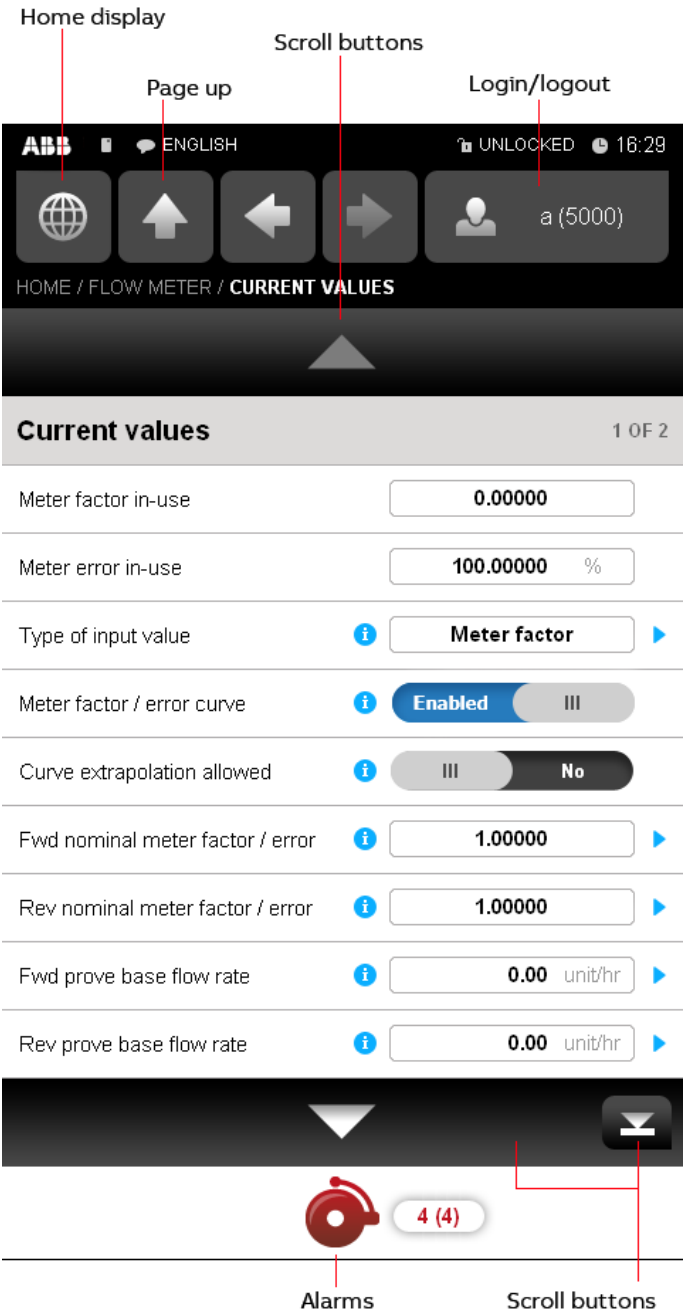It also provides the option to download reports and historical data.



Figure 6-4 Spirit<sup>IT</sup> Flow-X web interface

## Graphical User Interface Layout

All the Spirit<sup>IT</sup> Flow-X Graphical User Interfaces have the following layout and buttons.



Home display

Scroll buttons

Page up

Login/logout

Alarms          Scroll buttons

# 7    Software

## Introduction

Configuration of the Spirit<sup>IT</sup> 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 Spirit<sup>IT</sup> Flow-Xpress software. This software may be run in Basic mode, or, depending on your license, in Pro mode.

Requirements for the use of Spirit<sup>IT</sup> Flow-Xpress are:

| Aspect | Requirement |
|---|---|
| Operating system: | Windows 7 |
| | Windows Server 2008 R2 |
| | Windows 8 |
| | Windows Server 2012 |
| | Windows 8.1 |
| | Windows Server 2012 R2 |
| | Windows 10 |
| | Windows Server 2016 |
| Additional software | Microsoft Excel 2007 (minimum SP2), Excel 2010, Excel 2013, Excel 2016 or Excel 365 (up to and including the versions based on 2016). Microsoft .NET Framework 4.5.1 (or compatible). |
| 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 Spirit<sup>IT</sup> Flow-X model, (see Figure 7-1) 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 7-2.



Figure 7-1 Direct Ethernet connection without switch
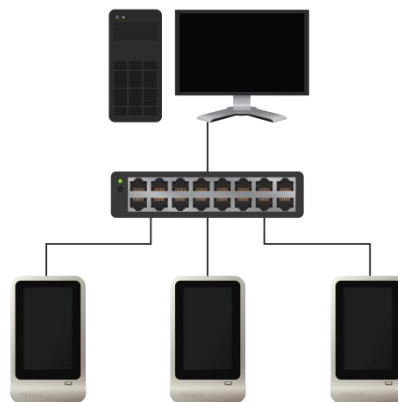


Figure 7-2 Ethernet connection with switch

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 7-1 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 7-2 Ethernet RJ-45 cross cable pin-out
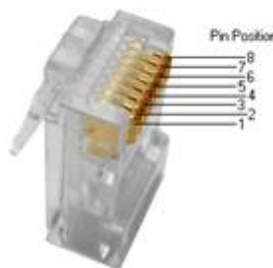
# Software installation

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.

( ! )    Note: Any existing version will automatically be replaced. If a version of 1.7.x or earlier was installed then the user will have to confirm this.

After installation, you will need to get a license from ABB 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 Spirit$^{IT}$ Flow-Xpress in Basic mode or also in Professional mode.

Refer to Volume II-A of this manual set for detailed installation instructions and for use of the Spirit$^{IT}$ Flow-Xpress software to configure your modules.

# 8    Technical specifications

## General

Version 1 Hardware

| Item | Type | Description | Quantity |
|------|------|-------------|----------|
| Temperature | Operating | Operating range temperature | 0 .. 60 °C |
| Temperature | Storage | Storage range temperature | -20 .. 70 °C |
| Processor | Freescale | i.MX processor with math coprocessor, and FPGA | 400 MHz |
| Memory | RAM | Program memory | 128 MB |
| Storage | SLC | Storage memory for data logging, OS and firmware | 1024 MB |
| Clock | RTC | Real time clock with internal lithium cell<br>Accuracy better than 1 s/day | |

Version 2 Hardware

| Item | Type | Description | Quantity |
|------|------|-------------|----------|
| Temperature | Operating | Operating range temperature | 0 .. 60 °C |
| Temperature | Storage | Storage range temperature | -20 .. 70 °C |
| Processor | Freescale | i.MX6 processor with math coprocessor, and FPGA | 800 MHz |
| Memory | RAM | Program memory | 512 MB |
| Storage | SLC | Storage memory for data logging, OS and firmware | 1024 MB |
| Clock | RTC | Real time clock with gold cap<br>Accuracy better than 1 s/day | |

Other specifications

| Item | Type |
|------|------|
| MTBF | 5 years minimum |
| EMC | EN 61326-1997 industrial locations |
| | EN 55011 |
| Casing | EN 60950 |

Table 8-1 General Specifications

## Flow-X/M I/O specifications

| Signal | V1 Nr | V2 Nr | Type | Description |
|--------|-------|-------|------|-------------|
| **Analog signals[1]** | | | | |
| Analog input | 6[1] | 6[1] | 4-20mA,<br>0-20mA,<br>0-5V<br>or 1-5V | Analog transmitter input<br>High accuracy (error <0.008% FS, resolution 24 bits)<br>For (for example) 3xdP, P, T.<br>Inputs are fully floating (optically isolated). |
| Temperature input | 2 | 2 | PRT | Analog PT100 input. -220 - 220 deg.C. for 100 ohms input.<br>Resolution 0.02 deg.C<br>Max. error Between 0-50 degC :0.05 deg.C,<br>Between -220 - +220 degC: 0.5 deg.C |
| Hart modems | 4[1] | 4[1] | HART | Loop inputs for HART transmitters, on top of the first 4 analog input signals. |
| Analog output | 4 | 4 | 4-20mA,<br>0-20mA,<br>or 1-5V. | Analog output for PID, pressure control valve. 12 bits ADC, 0.075% fs. Update rate 0.1s. |
| **Digital signals** | | | | |
| Dual pulse input | 1[2] | 4[2] | High impedance | High speed turbine/PD/USM meter input, pulse count. Trigger level 0.5V. Max. level 30 V.<br>Frequency range 0-5kHz (dual pulse), or 0-10kHz (single pulse).<br>Compliant with ISO6551, IP252, and API 5.5. True Level A implementation. |
| Density | 4[2] | 4[2] | High impedance | Periodic time input, 100us - 5000us.<br>Accuracy 30ns, resolution 2 ns |
| Digital input | 16[2] | 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] | 16[2] | Open collector | Digital output for relays etc. (0.5A DC). Rating 100mA @24V. Update rate at cycle time. |
| Prover output | 1[2] | 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] | 4[2] | Open collector | Max. 100Hz |

| Signal | V1 Nr | V2 Nr | Type | Description |
|---|---|---|---|---|
| Sphere detector inputs | 4[2] | 4[2] | High impedance | Supports 1, 2, 3 and 4 detector configurations mode<br>0.05 µs detect update rate. |
| **Communication** | | | | |
| Serial | 2 | 2 | RS485/422/232 | Multi-purpose serial communication interface<br>Minimum 300 baud, maximum 256000 baud |
| Ethernet | 2 | 2 | RJ45<br>100 Mbit/s | Ethernet interface - TCP/IP |

Table 8-2 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

| **Liquid calculations** |
|---|
| API 5, 6, 23, 24, 53, 54, 59 and 60 tables (A.B. D and E) |
| API 11.1 1980 (API 2540) and 2004/2007 |
| API 1952 historical tables |
| API 11.2.1, 11.2.2, 12.2, 21.1, 21.2 |
| API 11.3.2.1 Ethylene (API-2565) |
| GPA TP15, TP16, TP25, TP27 |
| Propylene (API 11.3.3.2) |
| Butadiene (ASTM D1550) |
| Asphalt (ASTM D4311) |
| Ethylene (IUPAC 1988, NIST 1045, API 2565) |
| Carbon dioxide (NIST) |
| OIML R22 |
| **Gas calculations** |
| AGA3, AGA5, AGA7, AGA8 (Part 1 and 2), AGA9, AGA10, AGA11 |
| AGA-NX19 |
| SGERG-88 and SGERG 2015 |
| GERG-2008 |
| GPA 2172 and GPA 2145 |
| IAPWS-IF97 (steam and water) |
| ISO 6976 (all editions) |
| Gas viscosity |
| GSSSD MR113 |
| **Flow calculations** |
| ISO 5167 (all editions) |
| ISO/TR15377 |
| ISO 6976 |
| AGA3 |
| GOST 8-586 |
| V-cone |

Table 8-3 Flow and fluid property calculations

| **Metering functions** |
|---|
| Retroactive meter factors, batch recalculations (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 functionality:<br>• Flow and pressure control<br>• Valve control<br>• Batching / liquid loading control<br>• Sampling control |
| API 21.1 and 21.2 compliant |
| All common spreadsheet functions to obtain maximum flexibility. |

Table 8-4 Metering functions

**Standard Supported Devices**

Ultrasonic Flow Meters
- Sick-Maihak,
- Daniel
- Cameron
- Elster-Instromet
- GE
- FMC
- Krohne
- Any Modbus-supporting Ultrasonic meter

Coriolis flow meters
- ABB CoriolisMaster
- MicroMotion
- Endress + Hauser

Any Modbus-supporting Coriolis meter

Gas chromatographs
- ABB
- Daniel
- Instromet
- Siemens
- Any Modbus-supporting Gas chromatograph
- Yamatake

Densitometers
- Solartron
- Sarasota
- UGC
- Densitrak
- Anton Paar

Table 8-5 Standard supported devices

## Power consumption

Values at 24 Vdc <u>excluding</u> supply of external transmitter loops.

|  | Nominal | Peak at start up |
|---|---|---|
| Flow-X/P0 | 0.3 A | 0.8 A |
| Flow-X/C | 0.5 A | 1.0 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

| Enclosure | Weight in kg | Weight in lbs |
|---|---|---|
| Flow-X/S (without flow module) | 1.7 | 3.7 |
| Flow-X/K (without flow module) | 0.9 | 2.0 |
| Flow-X/R (without flow modules) | 5.0 | 11.0 |
| Flow-X/B | 1.2 | 2.6 |

Version 1

| Enclosure | Weight in kg | Weight in lbs |
|---|---|---|
| Flow-X/M (single flow module) | 0.8 | 1.7 |
| Flow-X/P0 (without flow modules) | 3.7 | 8.2 |

Version 2

| Enclosure | Weight in kg | Weight in lbs |
|---|---|---|
| Flow-X/M (single flow module) | 0.9 | 1.9 |
| Flow-X/P0 (without flow modules) | 4.1 | 8.9 |
| Flow-X/C | 2.7 | 6.0 |

### Combined product

Version 1

| Enclosure | Weight in kg | Weight in lbs |
|---|---|---|
| Flow-X/S including flow module | 2.5 | 5.4 |
| Flow-X/K including flow module | 1.7 | 3.6 |
| Flow-X/P1 | 4.5 | 9.8 |
| Flow-X/P2 | 5.2 | 11.5 |
| Flow-X/P3 | 6.0 | 13.1 |
| Flow-X/P4 | 6.7 | 14.8 |
| Flow-X/R1 | 5.8 | 12.7 |
| Flow-X/R2 | 6.5 | 14.3 |
| Flow-X/R3 | 7.3 | 16.0 |
| Flow-X/R4 | 8.0 | 17.6 |
| Flow-X/R5 | 8.8 | 19.3 |
| Flow-X/R6 | 9.5 | 20.9 |
| Flow-X/R7 | 10.3 | 22.6 |
| Flow-X/R8 | 11.0 | 24.3 |

Version 2

| Enclosure | Weight in kg | Weight in lbs |
|---|---|---|
| Flow-X/S including flow module | 2.6 | 5.7 |
| Flow-X/K including flow module | 1.8 | 3.9 |
| Flow-X/P1 | 4.9 | 10.9 |
| Flow-X/P2 | 5.5 | 12.0 |
| Flow-X/P3 | 6.3 | 14.0 |
| Flow-X/P4 | 7.2 | 15.9 |

| Enclosure | Weight in kg | Weight in lbs |
|---|---|---|
| Flow-X/R1 | 5.9 | 13.0 |
| Flow-X/R2 | 6.8 | 14.9 |
| Flow-X/R3 | 7.6 | 16.8 |
| Flow-X/R4 | 8.5 | 18.8 |
| Flow-X/R5 | 9.4 | 20.7 |
| Flow-X/R6 | 10.3 | 22.7 |
| Flow-X/R7 | 11.2 | 24.6 |
| Flow-X/R8 | 12.0 | 26.5 |

# 9    Drawings

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

## Flow-X/P Panel version 1 mounted enclosure
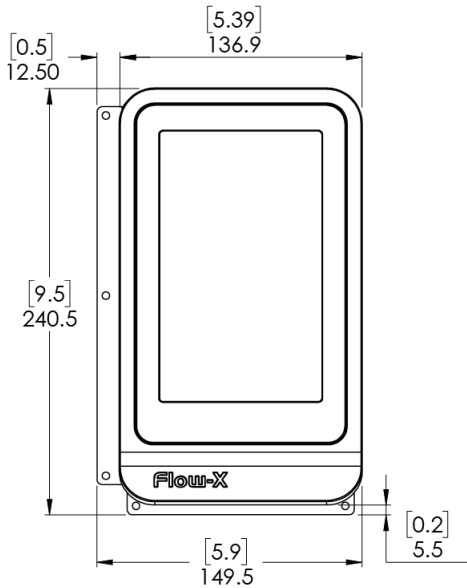


Figure 9-1 Flow-X/P Front view dimensions
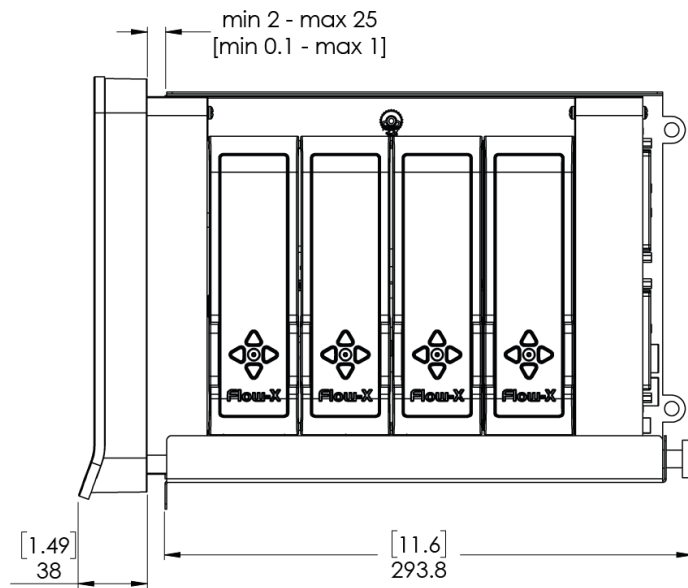


Figure 9-2 Flow-X/P Side view dimensions
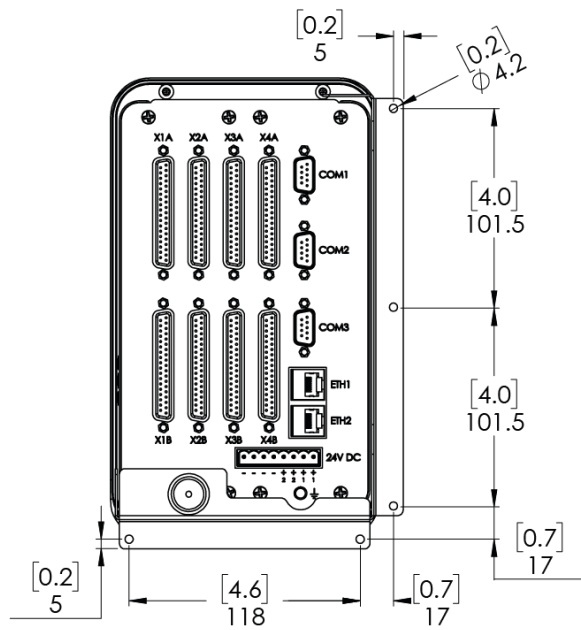


Figure 9-3 Flow-X/P rear view

# Flow-X/P Panel version 1 mounting bracket
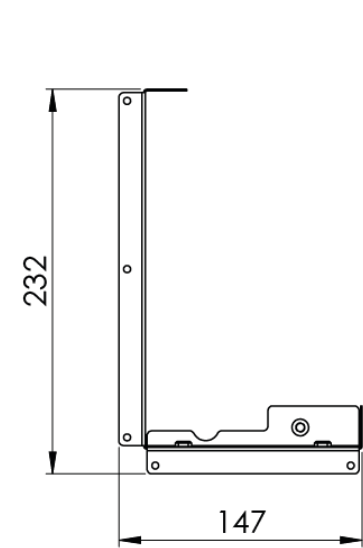


Figure 9-4 Flow-X/P Bracket Front side dimensions
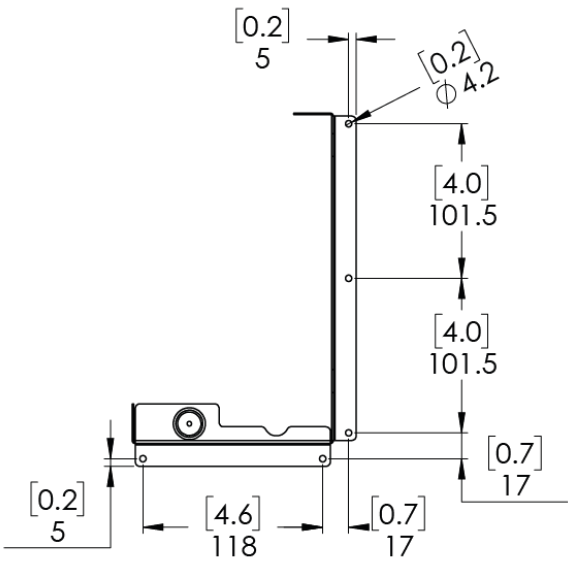


Figure 9-5 Flow-X/P Bracket Back view dimensions
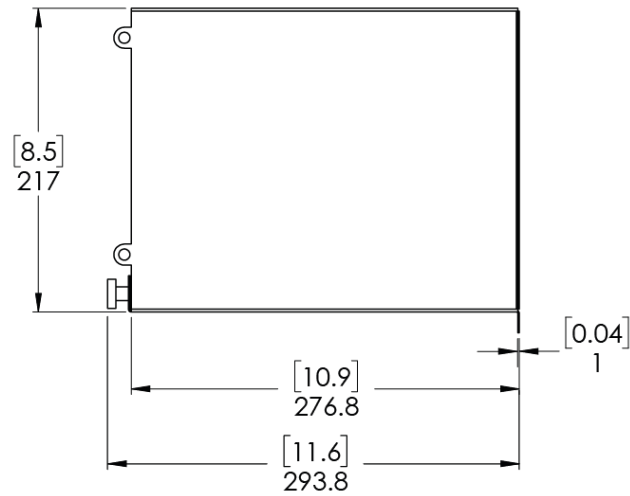
## Flow-X/P Panel version 2 mounted enclosure
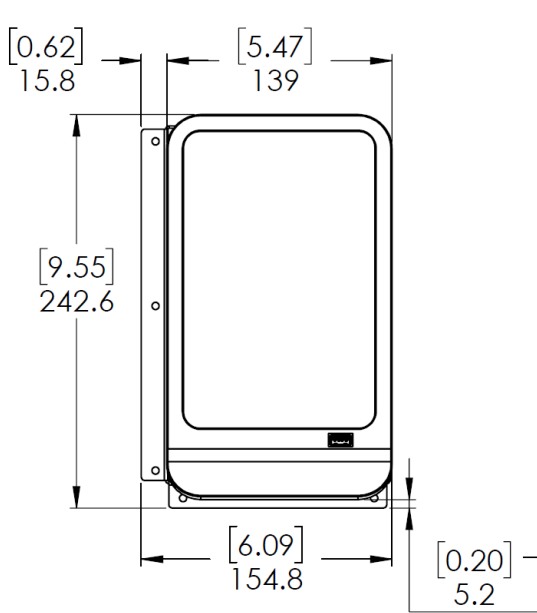


Figure 9-6 Flow-X/P version 2 Front view dimensions
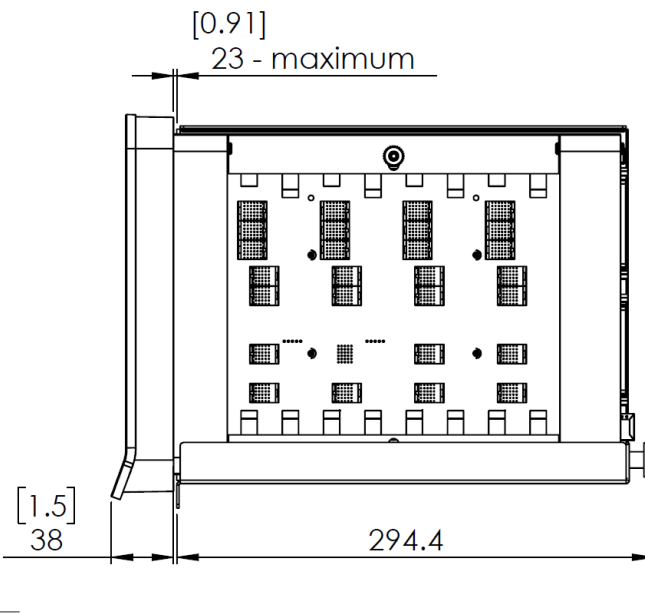


Figure 9-7 Flow-X/P version 2 right side view dimensions
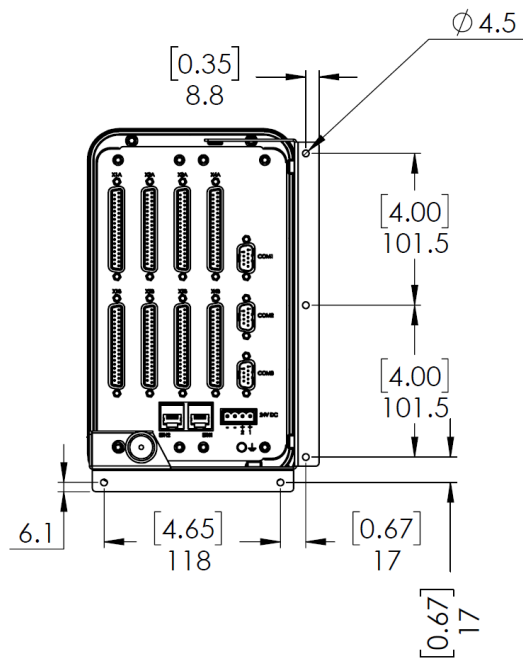


Figure 9-8 Flow-X/P version 2 rear view dimensions
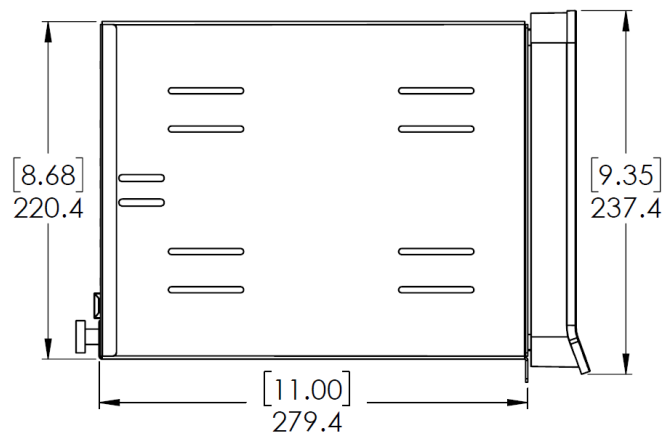


Figure 9-9 Flow-X/P version 2 left side view dimensions

## Flow-X/P Panel version 2 mounting bracket
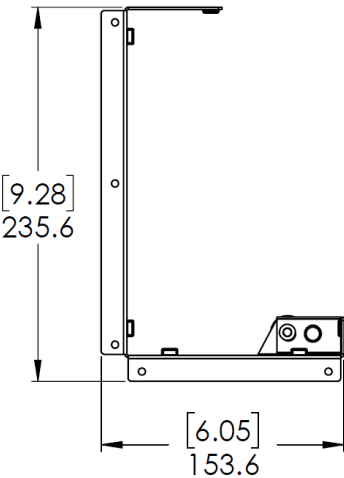


Figure 9-10 Flow-X/P version 2 bracket front view dimensions
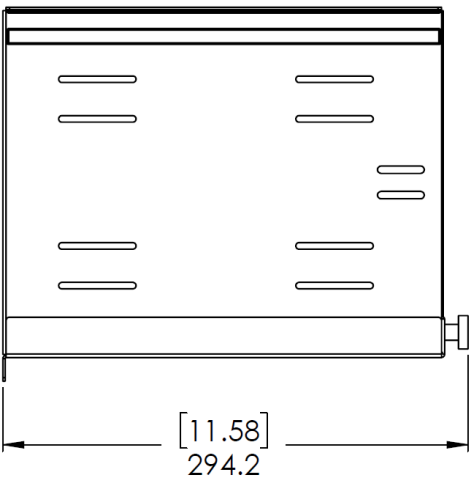


Figure 9-11 Flow-X/P version 2 bracket right side view dimensions
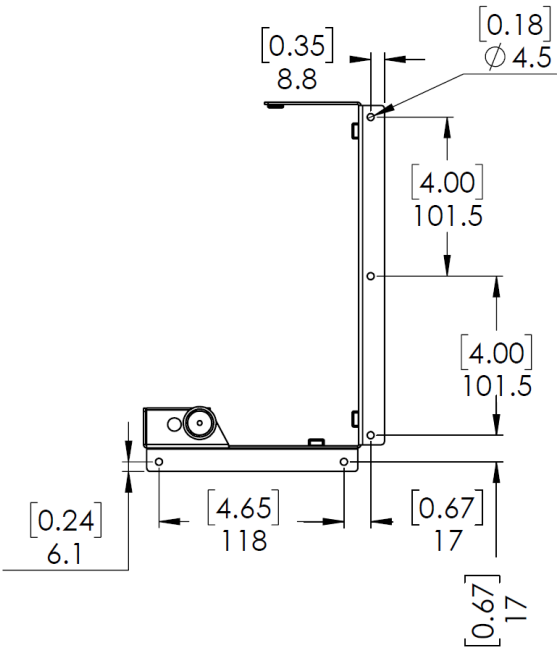


Figure 9-12 Flow-X/P version 2 bracket rear view dimensions

## Flow-X/C Compact panel mount enclosure
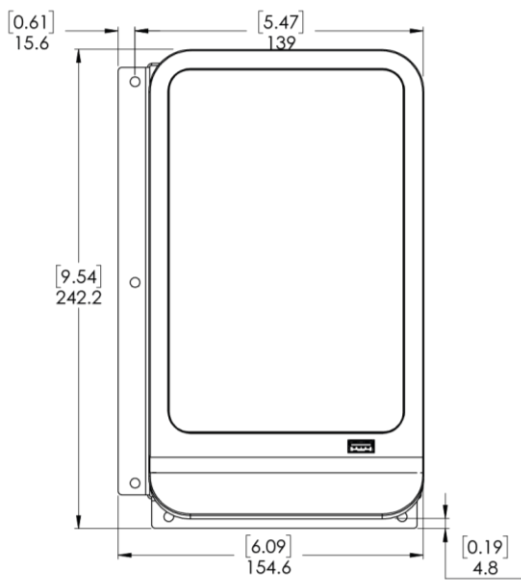


Figure 9-13 Flow-X/C Front view dimensions
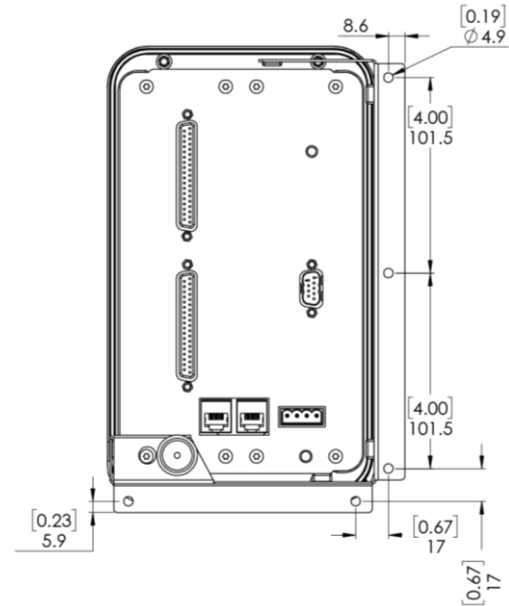


Figure 9-14 Flow-X/C rear view
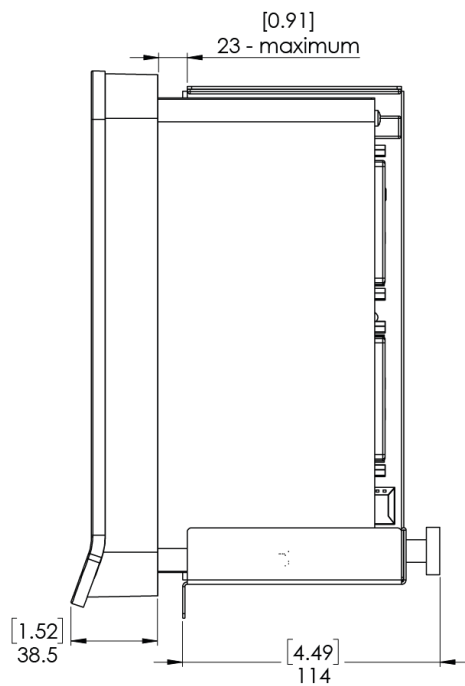


Figure 9-15  Flow-X/C Side view dimensions
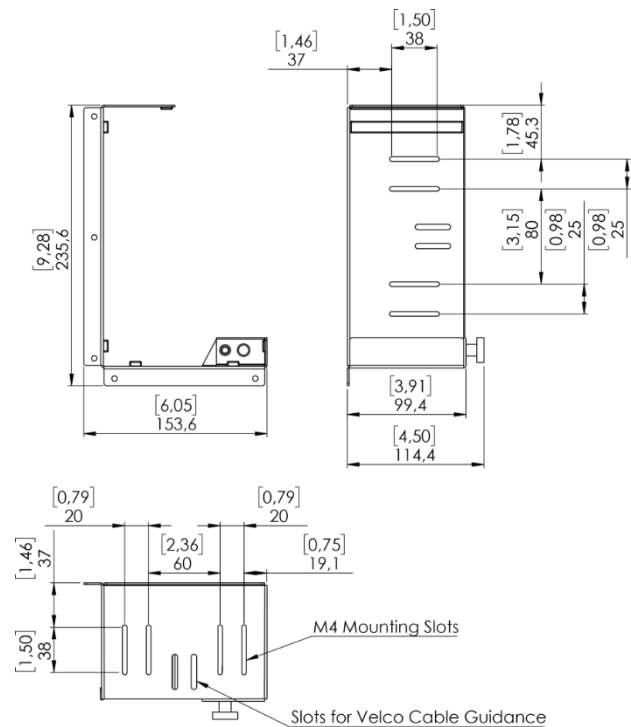


Figure 9-16  Flow-X/C Bracket dimensions
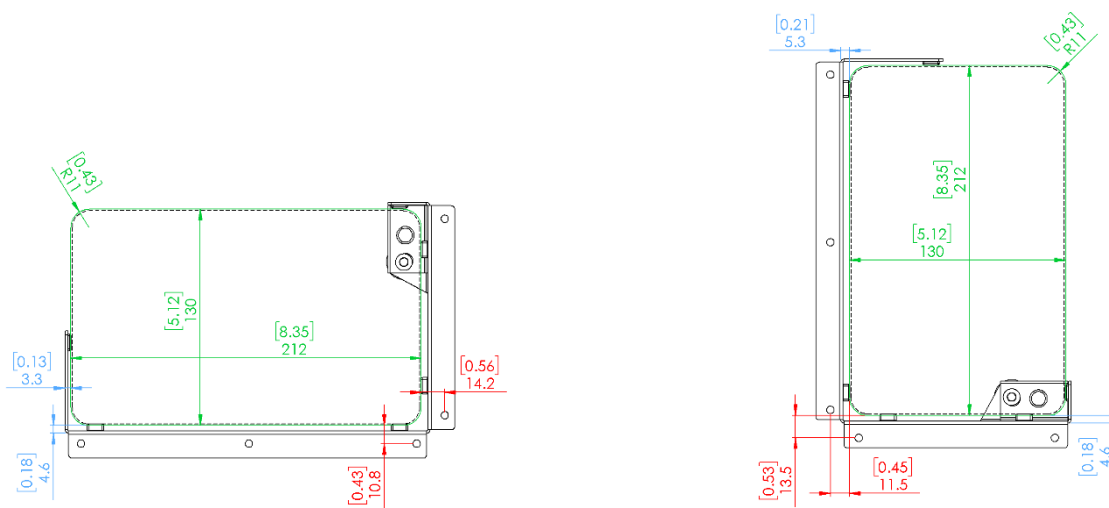
Figure 9-17  Flow-X/C position & cut out (vertical & horizontal position)

## Flow-X/C installation guides
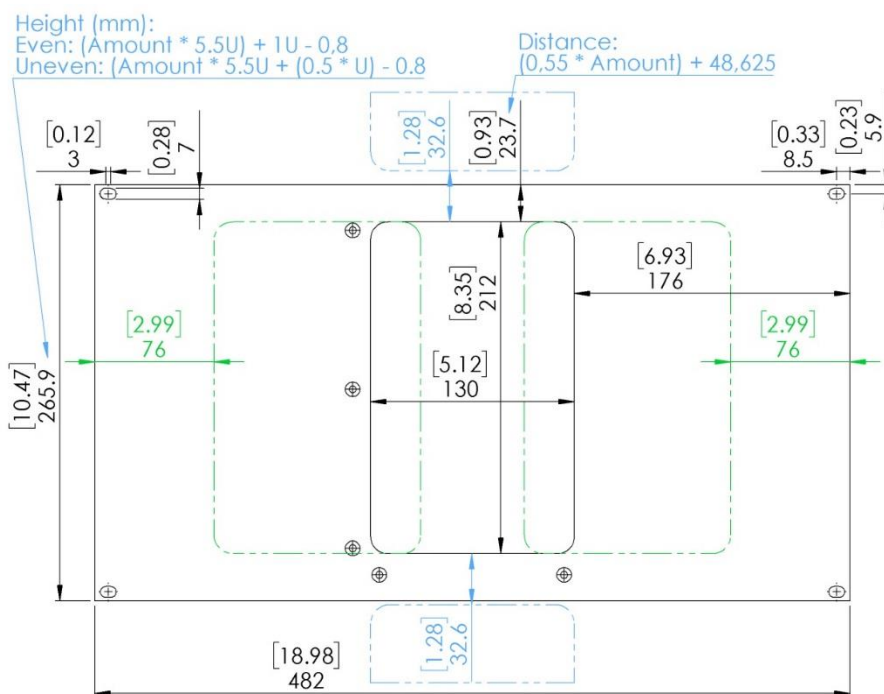


Figure 9-18 Blanking plate 19 inch installation, Front, vertical Flow-X/C
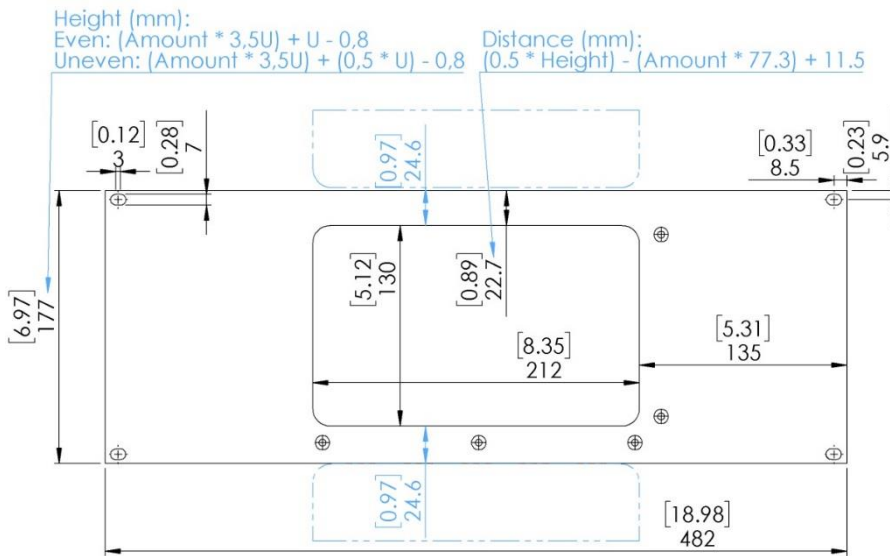
Figure 9-19 Blanking plate 19 inch installation, Front, horizontal Flow-X/C
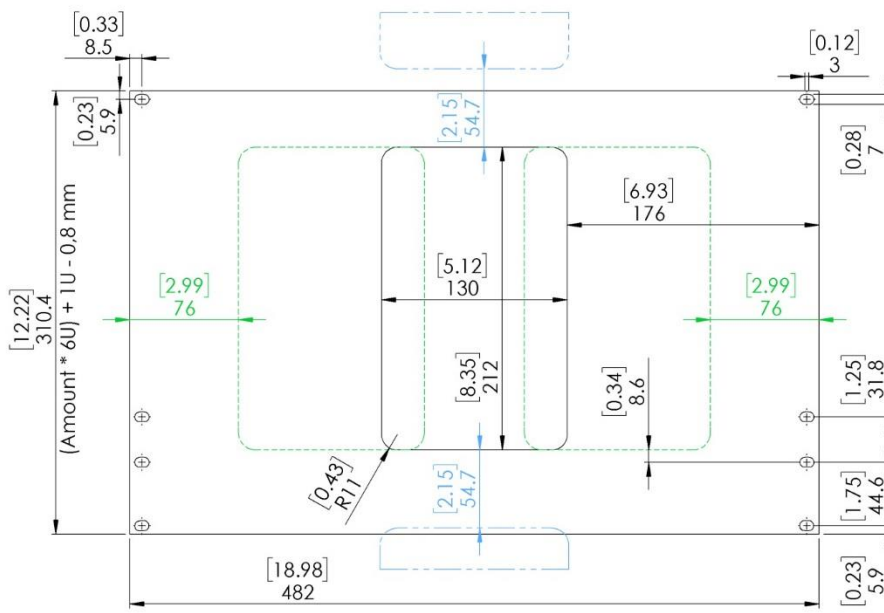


Figure 9-20 Blanking plate 19 inch installation with shelf, vertical Flow-X/C
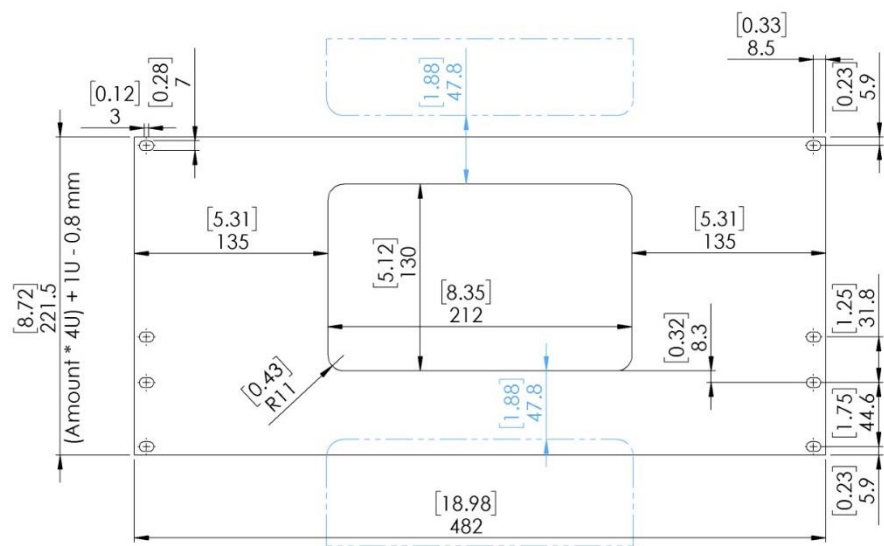
Figure 9-21 Blanking plate 19 inch installation with shelf, horizontal Flow-X/C
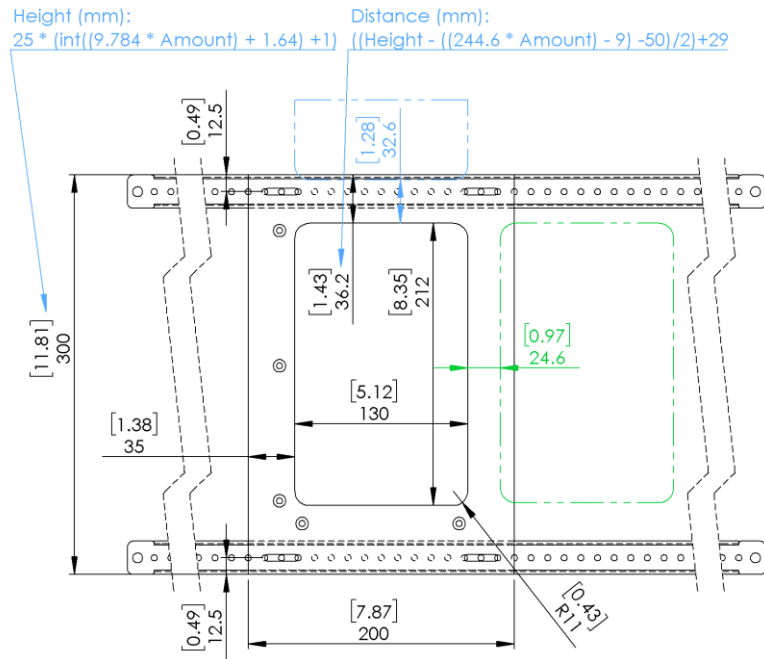


Figure 9-22  Cut out Door - Front installation, vertical Flow-X/C

Height (mm):
25 * (int((6.184 * Amount) + 1.96) +1)

Distance (mm):
((Height - ((154.6 * Amount) - 1) -50)/2)+29
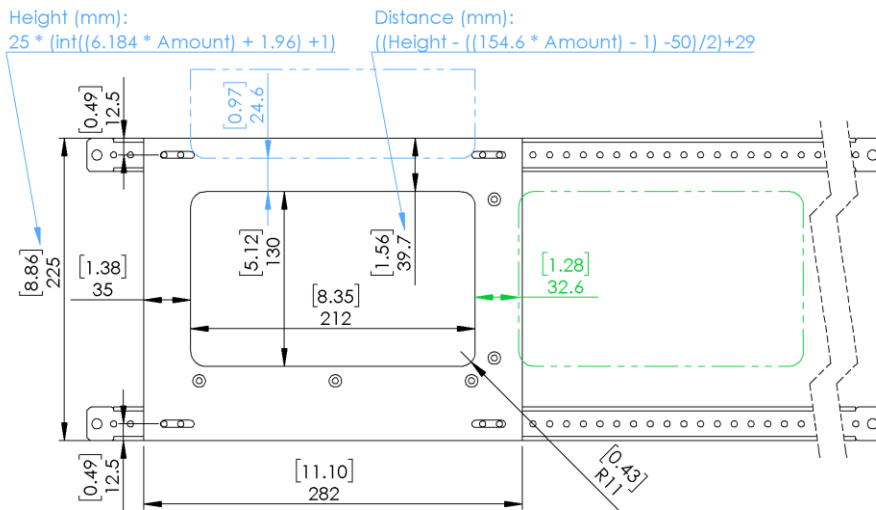
Figure 9-23  Cut out Door - Front installation, horizontal Flow-X/C

## Flow-X/R Rack mount enclosure
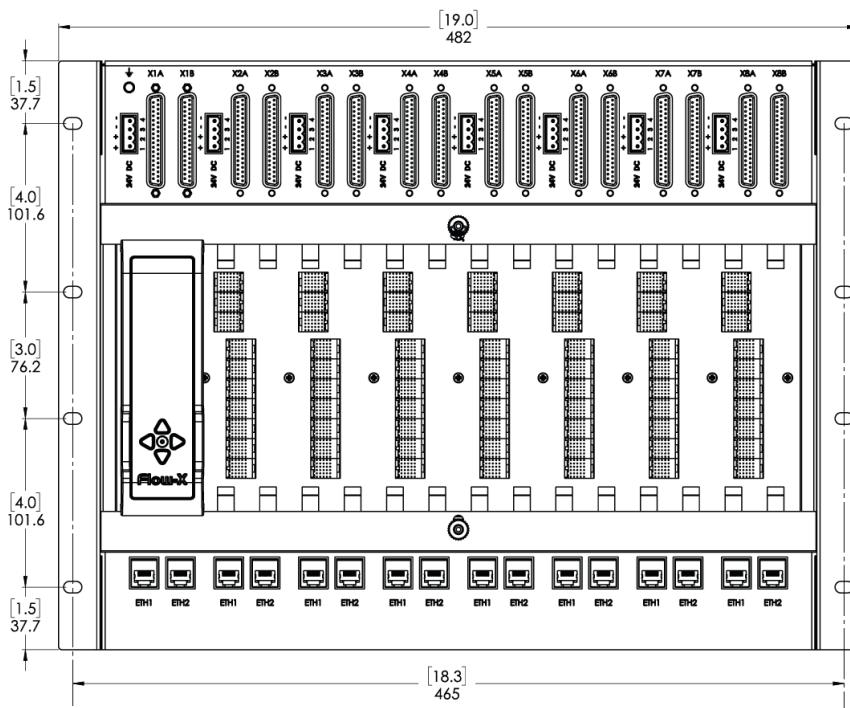
Figure 9-24 Flow-X/R Side view dimensions
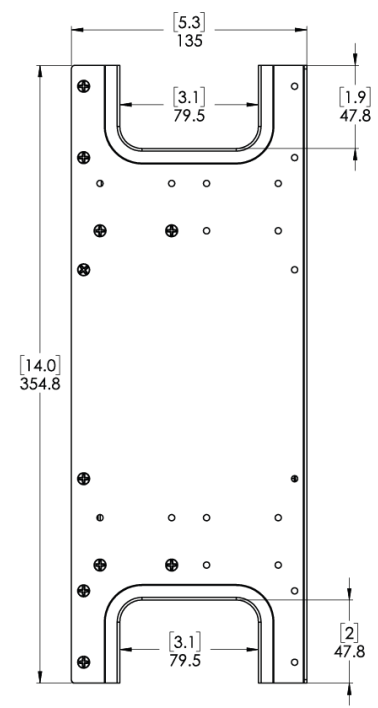
Figure 9-25 Flow-X/R Side view dimensions

## Flow-X/S Single module enclosure
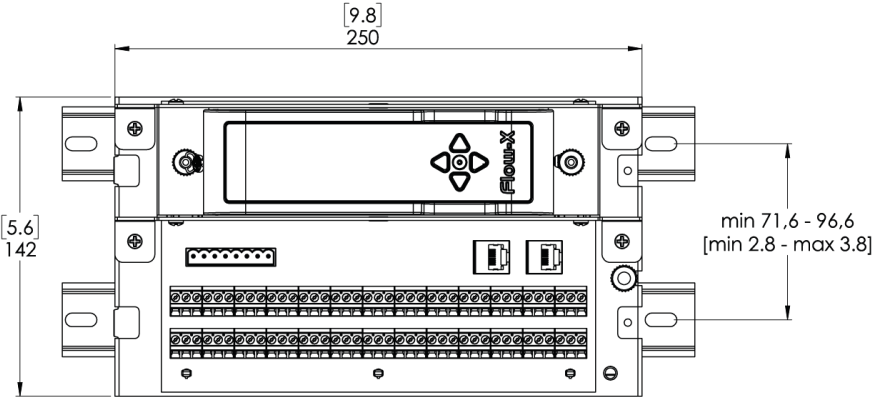


Figure 9-26 Flow-X/S horizontally dimensions
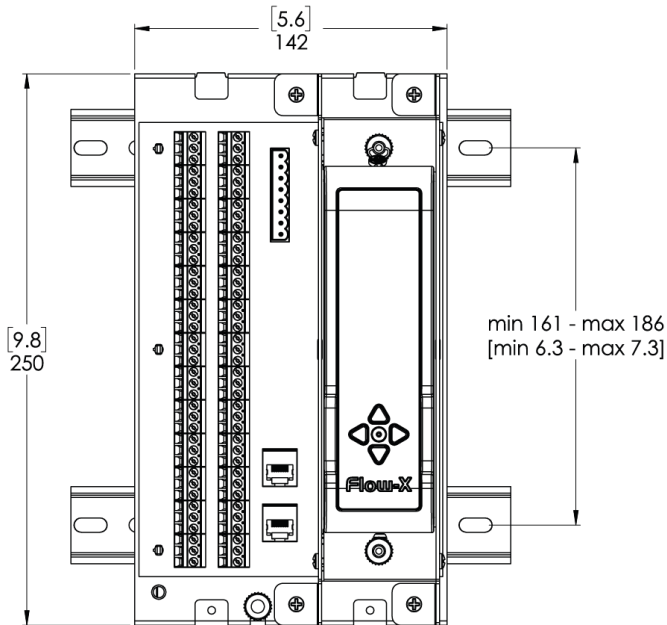


Figure 9-27 Flow-X/S vertically dimensions
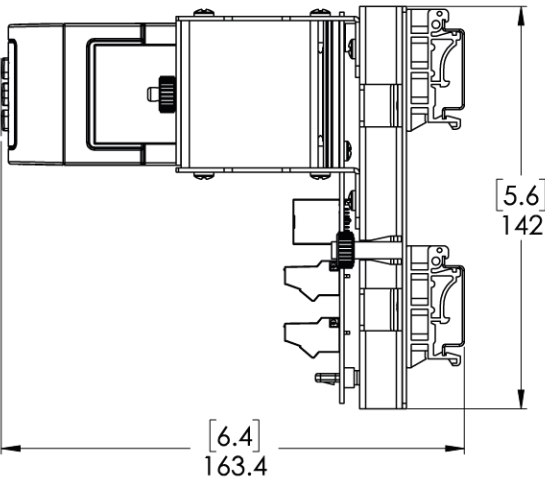


Figure 9-28 Flow-X/S DIN rail mount side view dimensions
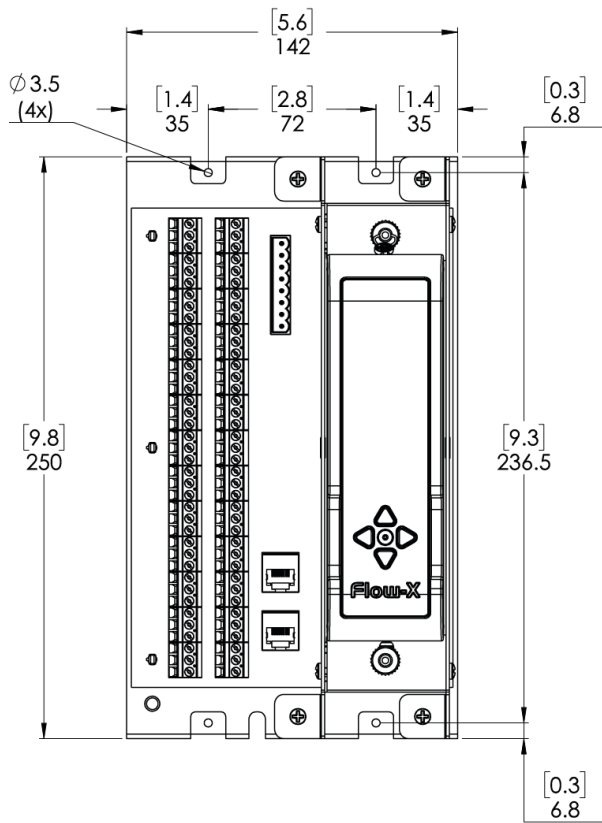
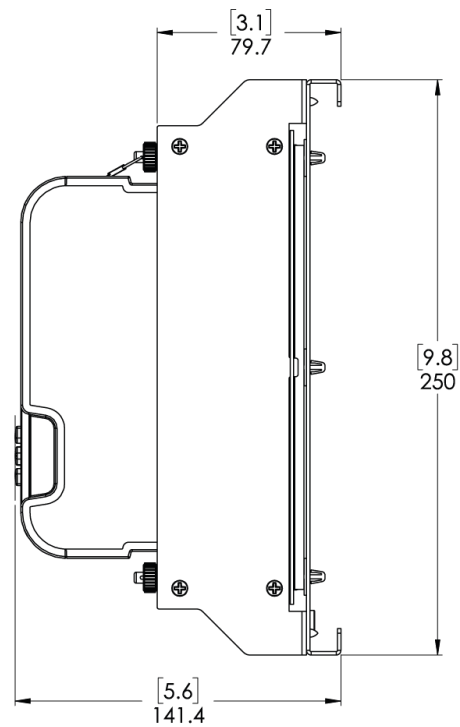Figure 9-29 Flow-X/S Wall mount dimensions



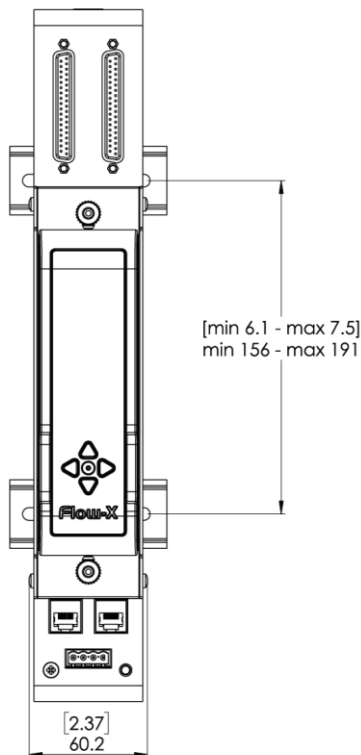Figure 9-30 Flow-X/S Wall mounted side view dimensions

## Flow-X/K enclosure



Figure 9-31 Flow-X/K Din rail mounted front view dimensions
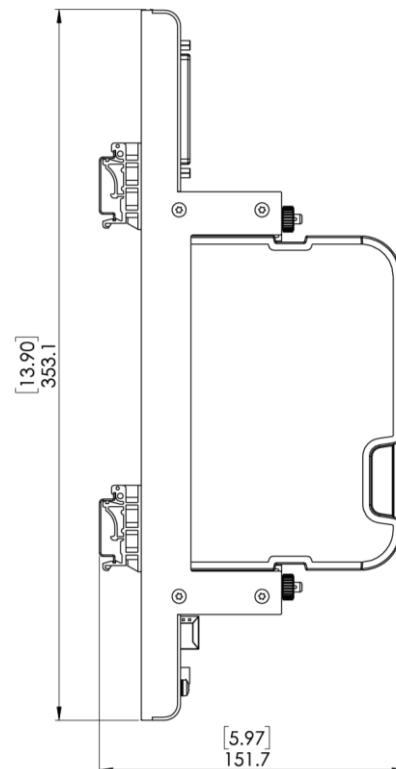


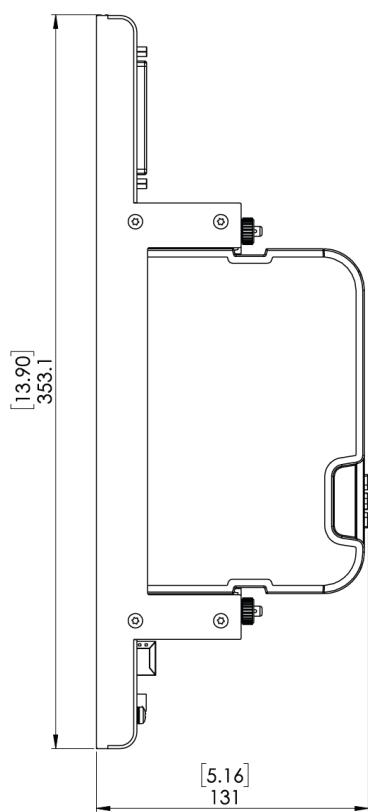Figure 9-32 Flow-X/K Din rail mounted side view dimensions

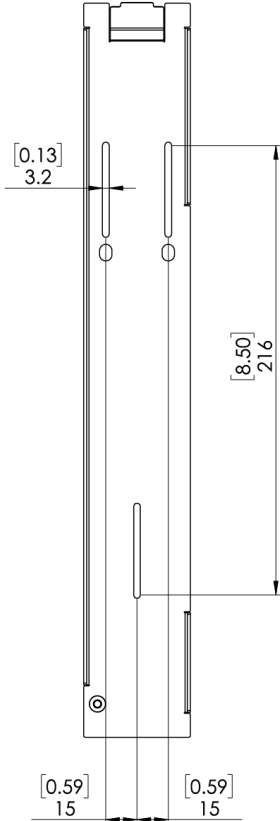Figure 9-33 Flow-X/K wall mounted side view dimensions



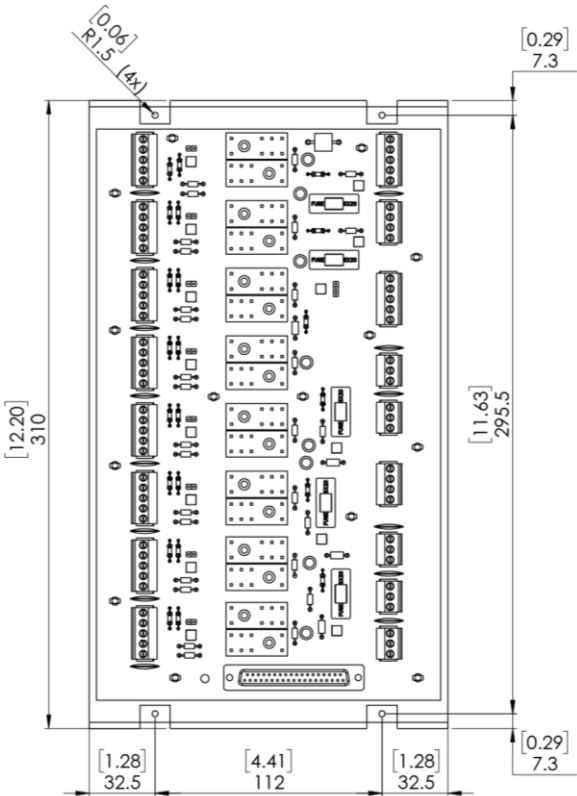Figure 9-34 Flow-X/K wall mounted dimensions

## Flow-X/B
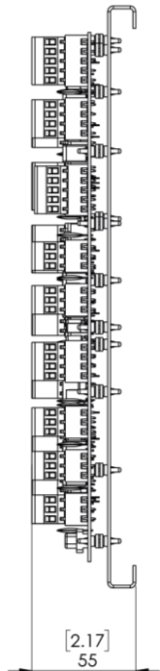


Figure 9-35 Flow-X/B front view dimensions



Figure 9-36 Flow-X/B side view dimensions
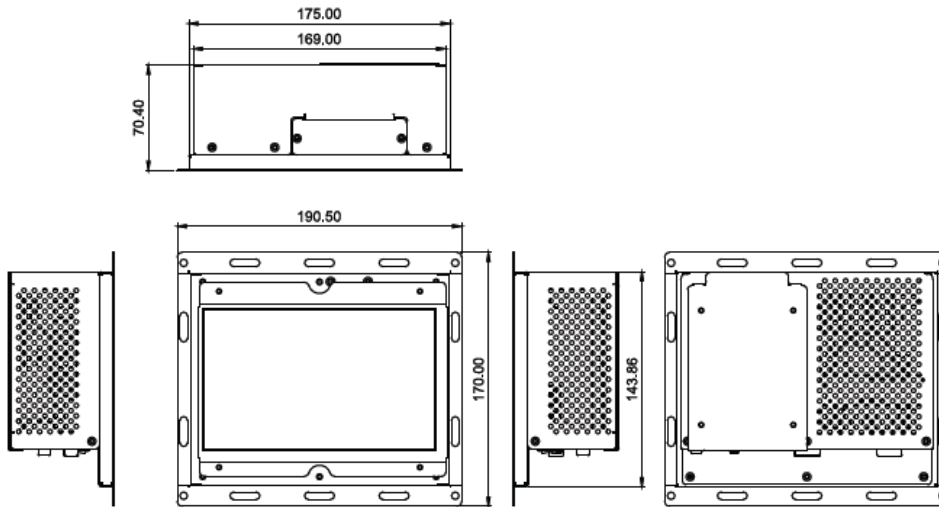
## 7" touch panel PC



Figure 9-37 7"touch panel PC dimensions

# 10   Configuration sheet

From our website 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.

# 11 I/O Diagnostics and calibration

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

## I/O diagnostics

A Spirit<sup>IT</sup> Flow-X flow computer with a standard Spirit<sup>IT</sup> 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 Spirit<sup>IT</sup> 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, PT100 inputs and analog outputs can be calibrated at up to 5 calibration points.

## Calibration points

For each type of I/O up to 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 ºC (metric applications) or ºF (metric applications). The number of calibration points may range from 1 through 5.

The reference values should be in an ascending order, e.g. 0, 50, 100 %. Non-used reference values shall be set to 0. If a reference value is smaller than or equal to the previous value, then this point and any further points are not 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

Display → IO, Module <x>, Calibration, Settings

Display → Calibration, Module <x>, Settings

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

| | | |
|---|---|---|
| **Analog input cal. point 1..5** | 750 | The calibration points for the calibration of the 6 analog inputs |
| **PT100 calibration point 1..5** | 750 | The calibration points for the calibration of the 2 PT100 inputs |
| **Analog output cal. point 1..5** | 750 | The calibration points for the calibration of the 4 analog outputs |
| **Inactivity timeout limit** | 750 | The input selected for calibration is automatically reset in case of inactivity longer than this limit. Enter 0 to disable the automatic reset function. |

If the calibration points are modified, the calibration of all applicable inputs initially remains unaltered. At the start of the next calibration of one of these inputs, any of the points that have been altered, added or removed since the last calibration are reset for this input only. E.g. when an analog input has been calibrated at 5 points (reference values at 0, 25, 50, 75 and 100 %) and the number of calibrations has been redefined to 3 points (e.g. 0, 50, 100, 0, 0 %), then at the start of the next calibration the 2nd and 3th calibration values will be reset to 50 and 100 % respectively and the 4th and 5th calibration values will be reset to zero (= not used).

## 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 follow the calibration value. So, before putting an input into calibration, please be sure that one of the following conditions is met:

- There's no flow
- The run has been set to maintenance mode
- The process value has been set to override mode
- The input has been frozen using the 'Freeze all analog and PT100 inputs' command

1  Go to the analog input calibration display.

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

Display → Calibration, Module <x>, 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 (1-6) to be calibrated.
   The calibration display shows the required reference value for the 1st calibration point.

3   Disconnect the transmitter signal and connect the loop calibrator
4   The calibration display shows the raw input value as it is read directly from the loop calibrator and the corrected input value based on the previous calibration.
5   Adjust the loop calibrator such that it outputs the required reference value
6   Wait for the signal to stabilize and issue the 'Recalibrate this point'.
    Note: recalibration is optional at every calibration point. If the corrected signal is close enough to the reference value you may decide to skip re-calibration of the calibration point.
7   Check that the corrected value corresponds with the reference value and issue the 'Go to next calibration point' command on the display.
8   Repeat steps 4 through 7 for the remaining calibration points
9   Disconnect the current loop calibrator and reconnect the transmitter.
10  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.

## PT100 input calibration

The procedure to calibrate a PT100 input is based on a decade box that is suitable for PT100 calibration

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(!)    During calibration the process input (temperature) that uses the PT100 input will follow the calibration value. So, before putting an input into calibration, please be sure that one of the following conditions is met:

• There's no flow
• The run has been set to maintenance mode
• The process value has been set to override mode
• The input has been frozen using the 'Freeze all analog and PT100 inputs' command

---

1   Go to the PT100 input calibration display.

Display → IO, <Module x>, Calibration, PT100 inputs

Display → Calibration, Module <x>, PT100 inputs

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

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2   Select the channel number (1-2) of the PT100 input to be calibrated.
    The calibration display shows the required reference value for the 1st calibration.
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   The calibration display shows the raw input value and the corrected input value based on the previous calibration.
6   Wait for the signal to stabilize and issue the 'Recalibrate this point'.
    Note: recalibration is optional at every calibration point. If the corrected signal is close enough to the reference value you may decide to skip re-calibration of the calibration point.
7   Check that the corrected value corresponds with the reference value and issue the 'Go to next calibration point' command on the display.
8   Repeat steps 4 through 6 for the remaining calibration points
9   Disconnect the decade box and reconnect the PT100 element.
10  Set the 'Selected PT100 input' to 'None' or alternatively select the next PT100 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 → IO, <Module x>, Calibration, Analog outputs

Display → Calibration, Module <x>, Analog outputs

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

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3   Select the channel number (1-4) of the analog output to be calibrated. This disables the setpoint that is controlled by the application and adjusts the analog output to the 1st calibration point.
4   If the actual output as measured by a reference meter is not correct, you can increase or decrease it by using the 'Increase output' and 'Decrease output' buttons until 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. If the output signal is close enough to the reference value you may decide to skip re-calibration of the calibration point.
6   Check on the mA meter that the output signal corresponds to 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.

# 12    Revisions

**Revision A**

Date      April 2017
- Initial release of the Flow-X Manual Volume I - Installation.
- D-sub 37 pinout corrected.
- RS-485 connections specified.
- Added schematic for analog output.
- Updated the XP bracket drawing.
- Added power consumption specifications.
- Updated Flow-X/R data.
- Added HART multi-drop schematic.
- Added MTL Barrier schematics for analog signals.
- Added connection diagram for Solartron densitometer.
- Added maintenance and cleaning instructions.
- Added chapter for description of operator panels and user interfaces.
- Added wiring diagram for Honeywell Enraf Calibron prover.
- Added paragraph on prover signals connection.
- Added earth ground connection paragraph and diagrams.
- Updated the software setup requirements and installation information.
- Added recommendation for forced ventilation.
- Added a caution notification for the fact that analog inputs don't have overvoltage and overcurrent protection for reason of accuracy.
- Added Flow-X/K specifications.
- Updated the supported Windows and Excel versions.

**Revision B**

Date      November 2017
- Flow X/C related changes.
- Supported baudrate range for Serial communication is updated.
- Update to new ABB lay-out.
- Document code: IM/FlowX-EN.
- Reintroduce revisions chapter.

**Revision C**

Date      March 2017
- Added Flow-X/B specifications.
- Updated drawings in Drawings chapter

**Revision D**

Date      June 2018
- Flow-X/P version 2 hardware specific information added.
- Supported Liquid and Gas calculations updated.
- Added WEEE guideline.
- Corrected Flow-X/C picture