

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

## High accuracy flow computers



—  
Flow-X/P with  
Flow-X/M module

### Introduction

Welcome to the exciting world of Spirit<sup>IT</sup> Flow-X!

This configuration manual describes the generic operation and configuration of all Spirit<sup>IT</sup> Flow-X models.

There are three reference manuals:

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

Software installation  
User interface & parameters  
Reports & communication  
Historical data

### Measurement made easy

### For more information

All publications of Spirit<sup>IT</sup> Flow-X are available for free download from:



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Spirit <sup>IT</sup> Flow-X function reference manual	CM/FlowX/FR-EN

## Contents

<b>1</b>	<b>Manual introduction</b> .....	<b>3</b>		
	Purpose of this manual.....	3		
	Document conventions .....	3		
	Abbreviations .....	4		
	Terms and definitions.....	5		
	Cyber security.....	5		
<b>2</b>	<b>Spirit<sup>IT</sup> Flow-Xpress software</b> .....	<b>7</b>		
	Spirit <sup>IT</sup> Flow-Xpress Basic mode .....	7		
	Spirit <sup>IT</sup> Flow-Xpress Online mode .....	8		
	Spirit <sup>IT</sup> Flow-Xpress Professional mode .....	8		
<b>3</b>	<b>Spirit<sup>IT</sup> Flow-X applications</b> .....	<b>10</b>		
	Introduction .....	10		
	Application templates .....	10		
	Communication devices.....	10		
	Creating applications .....	10		
	Updating applications .....	11		
	Spirit <sup>IT</sup> Master applications .....	12		
	Enable faster opening of applications.....	12		
<b>4</b>	<b>Software installation</b> .....	<b>13</b>		
	Prerequisites.....	13		
	Software installation.....	13		
	PC Security .....	14		
	Software uninstallation.....	14		
<b>5</b>	<b>Writing an application to a device</b> .....	<b>15</b>		
	Full reboot and Partial reboot.....	15		
<b>6</b>	<b>Reading an application from a device</b> .....	<b>17</b>		
	Favorite devices .....	17		
<b>7</b>	<b>Setting up the device</b> .....	<b>18</b>		
	Overall set-up procedure .....	18		
	Setting up Ethernet.....	18		
	Setting up the displays.....	19		
<b>8</b>	<b>Communication bus set-up</b> .....	<b>20</b>		
<b>9</b>	<b>Setting up the application</b> .....	<b>22</b>		
	Device Setup .....	22		
<b>10</b>	<b>Setting up HART communication</b> .....	<b>23</b>		
	Multi-drop HART.....	23		
<b>11</b>	<b>Setting up communication devices</b> .....	<b>24</b>		
	Setting up a COM port .....	24		
	Setting up communication with a host computer .....	24		
	Setting up communication with external devices .....	25		
	Modbus – Register sizes .....	26		
	Modbus – Modicon compatibility .....	27		
<b>12</b>	<b>Modifying the application parameters</b> .....	<b>28</b>		
	Parameter printing and exporting .....	28		
	Configuring parameters in Debug offline .....	28		
<b>13</b>	<b>Security and Data protection</b> .....	<b>29</b>		
	W & M switch .....	29		
	Metrological seal .....	29		
	Data protection .....	29		
	Users, passwords and security levels.....	29		
	Flow-X Network Ports .....	30		
<b>14</b>	<b>Reports &amp; printers</b> .....	<b>31</b>		
	Defining a serial text printer.....	31		
	Defining an Ethernet text printer .....	31		
	Reports .....	32		
	Report sections .....	33		
	Report properties.....	33		
	Check on report line width.....	34		
<b>15</b>	<b>Displays</b> .....	<b>35</b>		
	Overview.....	35		
<b>16</b>	<b>Calculations</b> .....	<b>36</b>		
	Overview.....	36		
<b>17</b>	<b>Time synchronization</b> .....	<b>37</b>		
	Overview.....	37		
<b>18</b>	<b>Data Archives</b> .....	<b>38</b>		
	Overview.....	38		
<b>19</b>	<b>Redundancy</b> .....	<b>40</b>		
	Data points to be synchronized.....	40		
<b>20</b>	<b>XML Interface</b> .....	<b>41</b>		
<b>21</b>	<b>Reading debugging information from a device.</b>	<b>42</b>		
<b>22</b>	<b>Revisions</b> .....	<b>43</b>		

# 1 Manual introduction

## Purpose of this manual

This Spirit<sup>IT</sup> 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<sup>IT</sup> 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<sup>IT</sup> 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.

## 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

## Abbreviations

Throughout this document the following abbreviations are used:

<b>ADC</b>	Analog to Digital converter
<b>AI</b>	Analog Input
<b>AO</b>	Analog Output
<b>API</b>	Application Programming Interface An interface that allows an application to interact with another application or operating system, in our case, Spirit <sup>IT</sup> Flow-X. Most of the Spirit <sup>IT</sup> Flow-X API is implemented through Excel worksheet functions.
<b>ASCII</b>	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).
<b>CPU</b>	Central Processing Unit
<b>DAC</b>	Digital to Analog Converter
<b>DCS</b>	Distributed Control System
<b>DDE</b>	Dynamic Data Exchange A relatively old mechanism for exchanging simple data among processes in MS-Windows.
<b>DI</b>	Digital Input
<b>DO</b>	Digital Output
<b>EGU</b>	Engineering Units
<b>EIA</b>	Electrical Industries Association
<b>FET</b>	Field Effect Transistor
<b>GC</b>	Gas Chromatograph
<b>GUI</b>	Graphical User Interface
<b>HART</b>	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.
<b>HMI</b>	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.
<b>I/O</b>	Input/Output
<b>IEEE</b>	Institute for Electrical and Electronics Engineers
<b>ISO</b>	International Standards Organization
<b>MMI</b>	Man Machine Interface (see HMI)
<b>MIC</b>	Machine Identification Code. License code of Spirit <sup>IT</sup> Flow-X which uniquely identifies you computer.
<b>NTP</b>	Network Time protocol
<b>OEM</b>	Original Equipment Manufacturer
<b>P&amp;ID</b>	Piping and Instrumentation Diagram
<b>PC</b>	Personal Computer
<b>PCB</b>	Printed Circuit Board
<b>PLC</b>	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.
<b>RS232</b>	EIA standard for point to point serial communications in computer equipment
<b>RS422</b>	EIA standard for two- and four-wire differential unidirectional multi-drop serial
<b>RS485</b>	EIA standard for two-wire differential bidirectional multi-drop serial communications in computer equipment
<b>RTU</b>	Remote Terminal Unit
<b>SCADA</b>	Supervisory Control and Data Acquisition
<b>SNTP</b>	Simple Network Time protocol
<b>SQL</b>	Standard Query Language
<b>SVC</b>	Supervisory Computer
<b>TCP/IP</b>	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.
<b>TTL</b>	Transistor-Transistor Logic
<b>UART</b>	Universal Asynchronous Receiver & Transmitter
<b>URL</b>	Uniform Resource Locator. The global address for documents and resources on the World Wide Web.
<b>XML</b>	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:

<b>Asynchronous</b>	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.
<b>Client/server</b>	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
<b>Device driver</b>	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.
<b>Engineering units</b>	Engineering units as used throughout this manual refers in general to the units of a tag, for example 'bar', or '°C', and not to a type of unit, as with 'metric' units, or 'imperial' units.
<b>Ethernet</b>	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.
<b>Event</b>	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.
<b>Exception</b>	Any condition, such as a hardware interrupt or software error-handler, that changes a program's flow of control.
<b>Fieldbus</b>	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.
<b>Kernel</b>	The core of Spirit <sup>IT</sup> Flow-X that handles basic functions, such as hardware and/or software interfaces, or resource allocation.
<b>Peer-to-peer</b>	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.
<b>Polling</b>	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.
<b>Process visualization software</b>	A system for monitoring and controlling for production processes, and managing related data. Typically such a system is connected to external devices, which are in turn connected to sensors and production machinery. The term 'process visualization software' in this document is generally used for software with which SCADA software, HMI software, or supervisory computer software applications can be built. In this document, although strictly not correct, the terms 'SCADA', 'HMI', 'supervisory', and 'process visualization' are alternately used, and refer to the computer software applications that can be realized with eXLerate, ABB's PC-based supervisory software.
<b>Protocol</b>	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.
<b>Query</b>	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.
<b>Real-time</b>	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.
<b>Resource</b>	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.
<b>Synchronous</b>	A type of message passing where the sending task waits for a reply before continuing processing.
<b>Tag</b>	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.
<b>Web Server</b>	A computer that has server software installed on it and is used to deliver web pages to an intranet/Internet.

## Cyber security

This product is designed to be connected to and to communicate information and data via a network interface. It is your sole responsibility to provide and continuously ensure a secure connection between the product and your network or any other network (as the case may be). You shall establish and maintain any appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of anti-virus programs, etc.) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information.

ABB B.V. and its affiliates are not liable for damages and/or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.

See sections Security and Data protection and XML Interface for more information.

### Flow-X Authentication

Please be aware that, when communicating to the Flow-X through a web browser, user credentials are transferred, and if HTTP protocol is used it may not be safe for man-in-the-middle or sniffing attacks. Therefore, it's recommended to use HTTPS, although

this may cause warnings on some web browsers due to the fact that the Flow-X uses self-signed certificates. The use of HTTP is not recommended.

## 2 Spirit<sup>IT</sup> Flow-Xpress software

Spirit<sup>IT</sup> Flow-Xpress is the software package to configure and engineer Spirit<sup>IT</sup> Flow-X software applications

There are two editions of Spirit<sup>IT</sup> Flow-Xpress: **Spirit<sup>IT</sup> Flow-Xpress**, the standard edition for flow computer configuration and engineering, and **Spirit<sup>IT</sup> Flow-Xpress Professional Edition** with which template applications can be fully developed using our advanced spreadsheet environment.

A Spirit<sup>IT</sup> Flow-X module or set of modules is configured from a laptop or computer via the Ethernet interface. Configurations can be uploaded or downloaded to or from the flow computer.

With the Spirit<sup>IT</sup> Flow-Xpress software step-by-step a flow computer configuration is made using an Explorer-like tree. At this user level simple checkboxes and straight-forward data entry fields are offered to the user.

After all applicable choices/selections have been made, the flow computer configuration can be written to the connected flow computer with a single mouse-click.

With each flow computer a DVD is shipped with various ready-to-run & metrology approved templates for oil and gas applications, from which the user selects the required application for his or her needs.

In addition to this standard level of configuration software operation we offer additionally a Professional Edition, Spirit<sup>IT</sup> Flow-Xpress Pro, containing a spreadsheet environment in which maximum flexibility is offered for demanding end-users or System Integrators.

The configuration of the flow computer can be directly edited in the spreadsheet environment of Spirit<sup>IT</sup> Flow-Xpress Pro so that fully-user definable applications can be developed.

A flow computer application can be checked and tested in a spreadsheet, compared directly with alternative flow calculation programs, tested off-line and even on-line.

A further advantage of Spirit<sup>IT</sup> Flow-Xpress Pro is that - even without a connected flow computer - the software offers a powerful and rich environment for flow calculations in a spreadsheet with more functionality than many commercially available flow calculation software packages.

Our standard edition of Spirit<sup>IT</sup> Flow-Xpress is shipped with each flow computer. Spirit<sup>IT</sup> Flow-Xpress Pro is only available for end-users and System Integrators who have successfully followed our dedicated training program.

Note: The spreadsheet based "templates" can be seen as the firmware of our flow computer. "Firmware" is the term used for the software of traditional flow computers. Since the user can freely modify the Spirit<sup>IT</sup> Flow-X templates for a fit-for-purpose approach, tailor-made "firmware" can be created

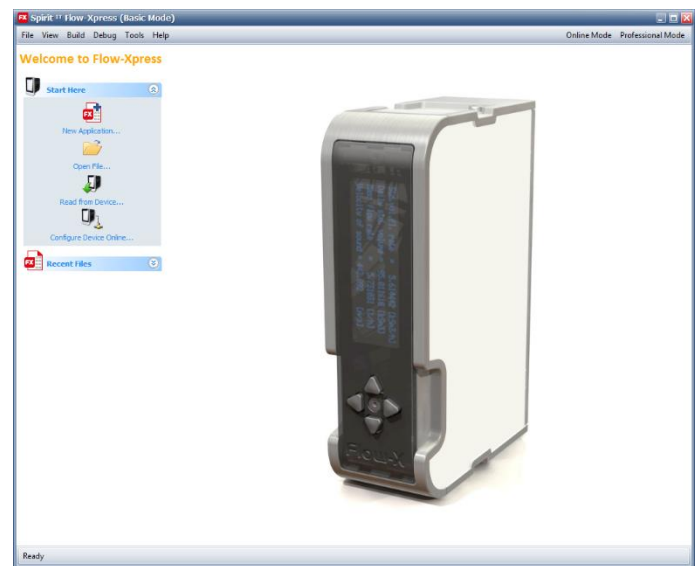






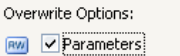


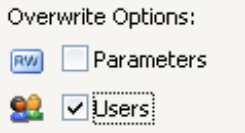







Figure 1: Spirit<sup>IT</sup> Flow-Xpress configuration software

### Spirit<sup>IT</sup> Flow-Xpress Basic mode

After an application file has been opened from file or read from a device the following options appear:

 Device Setup	Defines the type of flow computer and the number of modules. For custom-made applications, which contain more than one template, also the actual application running in each module can be defined.
 Ports & Devices	Defines the communication devices and printers that are connected to the flow computer serial, Ethernet and HART communication ports
 Settings	General date/time, display and security settings
 Displays	Shows all the operating displays including the menu structure. Existing displays may be modified and new displays may be added.
 Languages	Defines the actual translation tables. The native language of the standard applications is English. Additional languages may be added and can then be selected on the local flow computer and on the web display.

 Parameters	<p>Shows all the parameters (i.e. configuration settings or constants) that are part of the loaded application and that will be modifiable on the local flow computer display and web display. The actual values as stored in the loaded application are shown. These may be different from the actual values as used by each flow computer.</p> <p>To change a parameter value in the flow computer you can do any of the following:</p> <ul style="list-style-type: none"> <li>• Modify the parameter value directly on the flow computer display</li> <li>• Enter the Spirit<sup>IT</sup> Flow-Xpress Online mode and change the parameter accordingly</li> <li>• Change the value in the loaded application and write the application to the flow computer with the option to overwrite the parameters enabled. Note that this will <b>overwrite all</b> parameter values in the flow computer.</li> </ul>
	
 Reports	<p>Shows the actual reports that are part of the loaded application. Report editor that allows modifications to existing reports, addition of new reports, assignment of printers and definition of report retention (archiving) periods.</p>
 Security	<p>Editor for user names and passwords that are configured for the loaded application. Users may be added and deleted, provided that you have appropriate log-on level.</p> <p>The actual users as stored in the loaded application are shown. These may be different from the actual as known by each flow computer.</p> <p>To change security settings you can do any of the following:</p> <ul style="list-style-type: none"> <li>• Enter the Spirit<sup>IT</sup> Flow-Xpress Online mode and make the changes accordingly</li> <li>• Change the user(s) in the loaded application and write the application to the flow computer with the option to overwrite the security settings enabled. Note that this will <b>overwrite all</b> security settings in the flow computer.</li> </ul>
	
 Calculations	<p>Contains the user-defined calculations</p>
 Logging	<p>Event log options</p>
 Alarming	<p>Defines overall alarm settings including the colors used on the displays for the different alarm states.</p>
 Units & Formats	<p>Defines the units that are used for the displays and the conversions between units.</p>
 Versions	<p>Allows for version control of the applications and shows the revision history of the loaded application</p>

### Spirit<sup>IT</sup> Flow-Xpress Online mode

The Spirit<sup>IT</sup> Flow-Xpress Online mode allows for modification to the flow computer parameter values and security settings on-the-fly, so without the necessity to write an application or reboot the flow computer.

The Online mode also allows modification of the security settings for multiple devices simultaneously. To do this, select multiple flow computers in the “Read configuration from Flow Computer” screen.

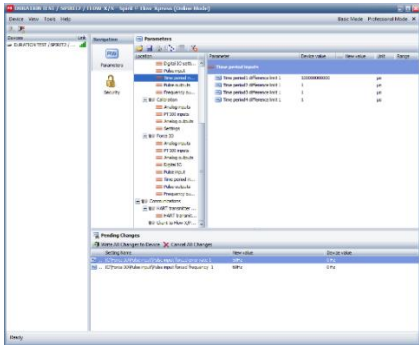



Figure 2: Spirit<sup>IT</sup> Flow-Xpress Online mode

### Spirit<sup>IT</sup> Flow-Xpress Professional mode





Spirit<sup>IT</sup> Flow-Xpress Professional mode provides full access to all the functions and features.

 Spirit<sup>IT</sup> Flow-Xpress Professional mode requires the 'Spirit<sup>IT</sup> Flow-Xpress Professional' license.

Spirit<sup>IT</sup> Flow-Xpress Professional mode provides additional capabilities and functions such as:

- define new applications consisting of one or more templates
- access to the worksheets that contain all the application-specific functionality
- modify, add and delete worksheets
- debug flow computers on-line, i.e. looking into all the details inside the flow computer
- define enumerations
- define historical data archives

The following functions are additional to the Spirit<sup>IT</sup> Flow-Xpress Basic mode:

 <b>Sheets &amp; Templates</b>	Structures the worksheets in templates
 <b>Historical Data</b>	Defines the historical data archives
 <b>Units</b>	
 <b>Enumerations</b>	Defines the enumerations E.g. consider the enumeration for the failure status: 0: OK 1: Fail for a tag that uses this enumeration and that has the value 1, the text 'Fail' will appear on the display and report.

### 3 Spirit<sup>IT</sup> Flow-X applications

#### Introduction

A Spirit<sup>IT</sup> Flow-X flow computer is loaded with a single software application that is loaded by all the flow modules and, in case of the Flow-X/P, also by the panel module. The software application consists of 1 or more application templates and optionally 1 or more communication drivers.

#### Application templates

An application template contains all the calculations, logic, displays and reports for a typical meter run.

Consider the following example: a flow metering skid consisting of 3 meter runs and an inlet header with common process equipment (e.g. a densitometer or a gas chromatograph).

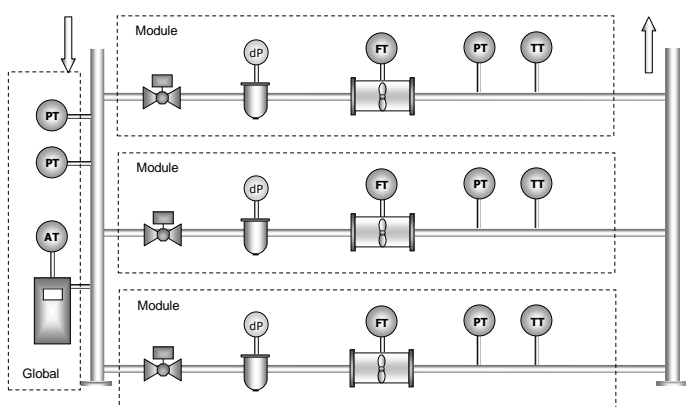


Figure 3: Typical gas metering station

The assignment the application template ("Gas\_Metric" in this example) would be as follows in case of a Flow-X/P3.

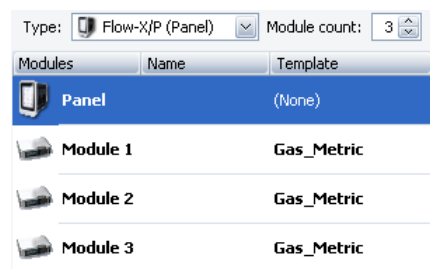


Figure 4: Flow-X/P template assignment

If no template is selected for a module, then still its IO can be used for the meter run(s) or station. This is a means to add more IO, without adding more meter runs.

#### Communication devices

Communication templates are used to set-up communication between the flow computer and external devices.

The Flow computer is able to communicate with any device that supports the HART and/or the Modbus protocol. Also, special communication protocols such as the Uniform protocol for Instromet ultrasonic flow meter are supported.

For each type of communication device (HART, Modbus and others) a separate communication template is used. A communication template contains the actual communication details such as data addresses, data block and register sizes etc. for the particular device.

A communication template may also contain additional calculations and logic. Furthermore, communication templates may provide additional displays and reports to the flow computer configuration that show any data from the device.

Using separate communication templates has the advantage that new communication devices can be added to the configuration without having to modify the application template itself.

For HART devices generic communication templates are provided that can be used for all HART devices.

#### Data hand-off

To provide flow computer data to external systems, e.g. a central SCADA system, a DCS or a supervisory computer, communication templates of type Modbus Slave and Modbus Server can be used.

The standard applications provide a Modbus communication sheet named 'Tag list' that contains all relevant data. It can be used both for Modbus Ethernet (TCP/IP) and serial communication.

This tag list can be modified and new custom tag lists can be created using the Spirit<sup>IT</sup> Flow-Xpress professional software.

#### Creating applications

Prior to version 1.5, Spirit<sup>IT</sup> Flow-Xpress stored Spirit<sup>IT</sup> Flow-X applications as Excel workbooks. From version 1.5 onwards, two new file formats are supported, namely "Flow-X Application" and "Flow-X Master". The old format is still supported, but it lacks support of new features such as updating to a newer Spirit<sup>IT</sup> Flow-X Master.

Spirit<sup>IT</sup> Flow-X Masters can only be created by Spirit<sup>IT</sup> Flow-Xpress Pro and can neither be changed nor written to a flow computer. The main purpose of a Master is to separate changes made by the supplier of Masters from changes made by end users, and to keep these user changes when a new Master is released.

A Spirit<sup>IT</sup> Flow-X application can be customized in Flow-Xpress Basic and written to a Flow-X flow computer.

In order to create a Spirit™ Flow-X Application from a Spirit™ Flow-X Master, use the command “Create from Master” from the File menu.

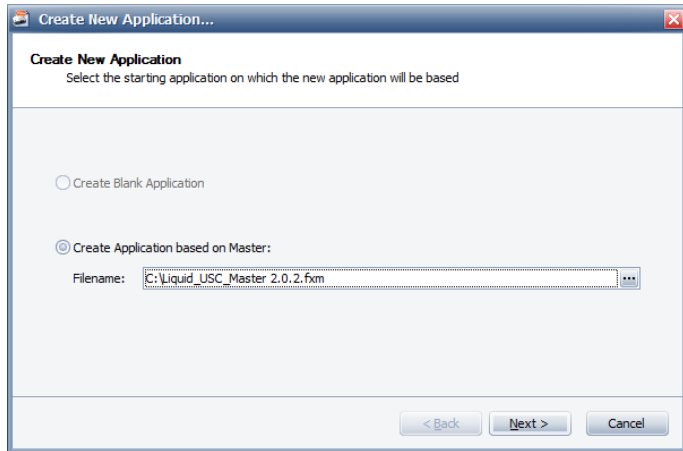


Figure 5: Creating an Application from the Master

Applications created by older versions of Flow-Xpress can be converted to the new format using the “Save as” command.

### Updating applications

Applications that were created from a Master can be updated to a newer version of that Master using the command “Update to Master” from the File menu. The update process consists of two steps. In the first step Spirit™ Flow-Xpress will detect what changes were made to the application, and in the second step these changes will be transferred to the new Master. Thus, the updated application will consist of the new Master, plus all the changes that you have made to the Application.

In order to perform an update of an Application, first select the Application that you wish to update, and then select the Master that you wish to update to (see Figure 6: Selecting an Application and Master).

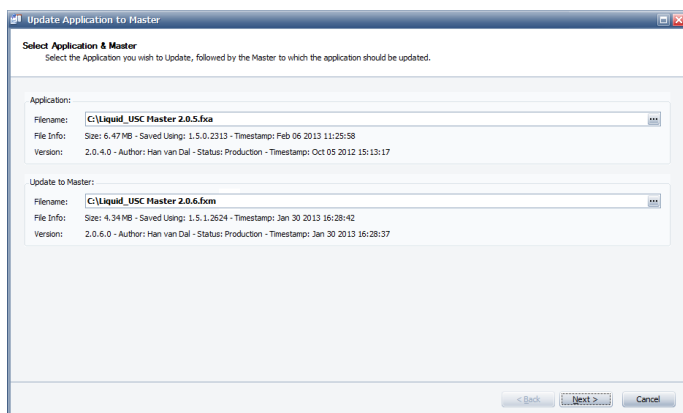


Figure 6: Selecting an Application and Master for updating

When you click next Spirit™ Flow-Xpress will take a moment to compute the changes that have been made to the Application. Once this is complete you are offered the choice to view/edit the changes that were found and which will be applied to the new

Master (see Figure 7: Changes have been found in the Application).

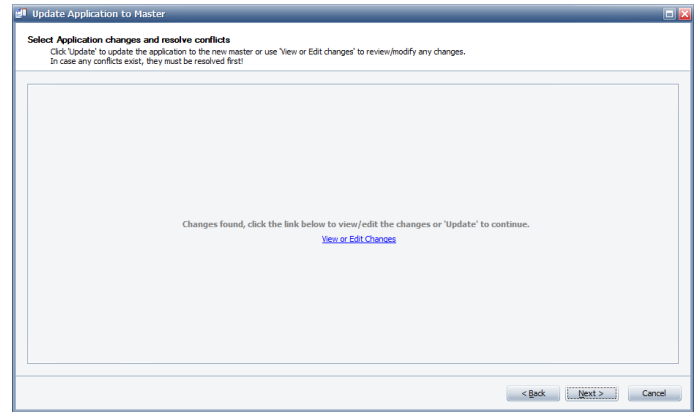


Figure 7: Changes have been found in the Application

If you choose to view or edit the changes you will be presented with a screen similar to Figure 8. In this screen you can select specific changes that you wish to either include or exclude from the update. The leftmost column shows in which categories changes have been found. The middle column shows a hierarchical view of the application, showing the displays, reports, etc. that were found to have been modified in the Application. A small indicator icon indicates the type of change (i.e. a small green “plus” symbol for additions that you have made, a red “cross” for items which you have deleted, or a “pencil” for items which have been modified). The rightmost column shows the changes to the properties of the selected item, e.g. when you have selected a Display in the middle column, the rightmost column will show you what changes you have made to that Display’s properties.

Including or excluding changes can be done by choosing either from either “Master” or “Application”. By choosing “Master” you indicate that Spirit™ Flow-Xpress should use the version of the item as it exists in the new Master. E.g. if you select “Master” for an item that you had previously deleted from the Application, the result will be that the item will be again present in the updated Application (unless of course that item was deleted in the Master as well).

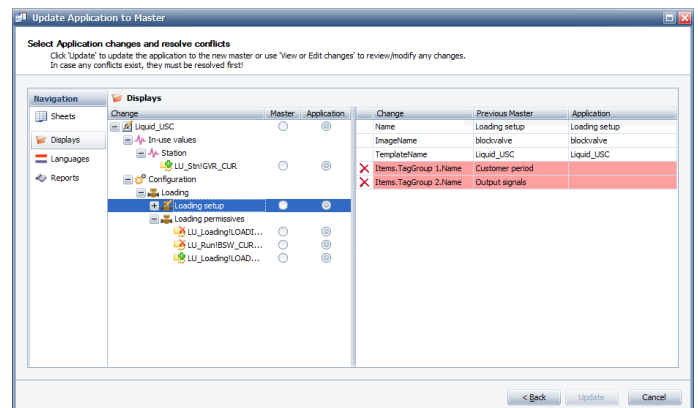


Figure 8: Selecting changes to keep during update

It can happen that changes in the Master conflict with changes in the Application, e.g. a report which has been deleted in the Master has been modified in the Application. In this case, a choice must be made during the update, to disambiguate which change is the more important one and thus should be kept. Figure 9 gives an example of a conflict on the “LACTicket” report. Conflicts are highlighted in red, and on the category list a red badge indicating the number of unresolved conflicts remaining in that category is shown. Further a toolbar will be shown to assist you in finding and resolving conflicts. Using this toolbar, you can quickly navigate between unresolved conflicts, as well as revisit conflicts you have already resolved. A “Quick Actions” menu allows you to easily select a common resolve action for all (unresolved) conflicts. To resolve the conflict, simply select either “Master” or “Application”.

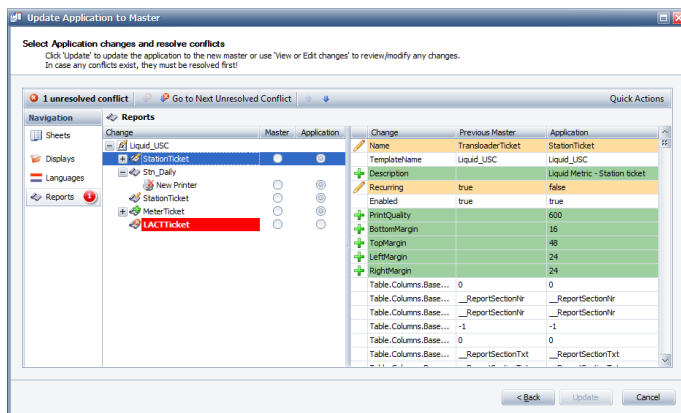


Figure 9: Resolving a conflict during the update process

## Spirit<sup>IT</sup> Master applications

Spirit<sup>IT</sup> provides several Master applications that are under revision and quality control of ABB. These Masters provide most if not all functionality required in the majority of all field installations. For a detailed description of the Master applications, refer to the Spirit<sup>IT</sup> Flow-X Application Manuals.



Besides of the master applications provided by ABB you can also set up and use your own application and communication templates, provided that you are authorized to use Spirit<sup>IT</sup> Flow-Xpress Pro.



Refer to the Spirit<sup>IT</sup> Flow-Xpress Pro manual for more information.

## Enable faster opening of applications

Flow-Xpress 3.2.5 introduced a new option that, when enabled, allows applications to be opened faster. This is especially useful for large applications. This option is enabled by default. When an application is saved while this option is enabled, it can no longer be opened in previous versions of Flow-Xpress.

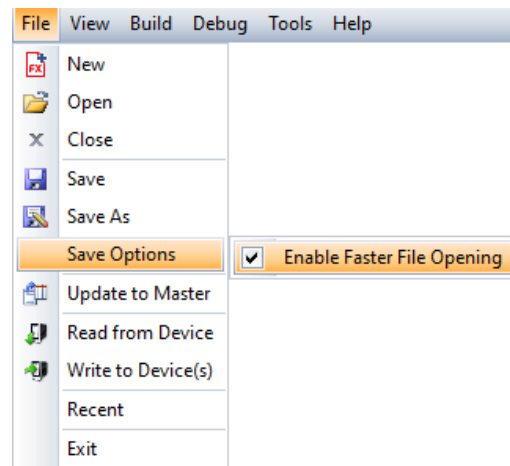


Figure 10: Enable faster file opening menu item

## 4 Software installation

This chapter describes how to install the Spirit<sup>IT</sup> Flow-Xpress configuration software to your computer.

### Prerequisites

Spirit<sup>IT</sup> Flow-Xpress requires the following software to be installed on your computer:

- One of the Following Windows versions:
    - Microsoft Windows 7
    - Microsoft Windows Server 2008 R2
    - Microsoft Windows Server 2012
    - Microsoft Windows 8.1
    - Microsoft Windows Server 2012 R2
    - Microsoft Windows 10
    - Microsoft Windows Server 2016
  - Microsoft .NET Framework 4.5.1 (or compatible)
  - One of the Following Excel versions:
    - Excel 2016
    - Excel 2019
    - Excel 365 (up to and including the versions based on 2019).
    - Excel 2021
- Including:
- .NET Programmability support (See Figure 10)
  - Visual Basic for applications (Office Shared Features) (See Figure 11)

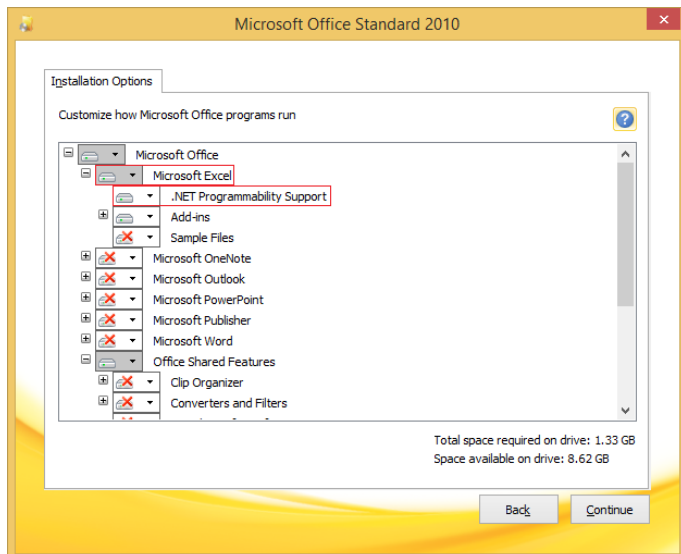


Figure 10: Excel .NET Programmability Support instructions in red.

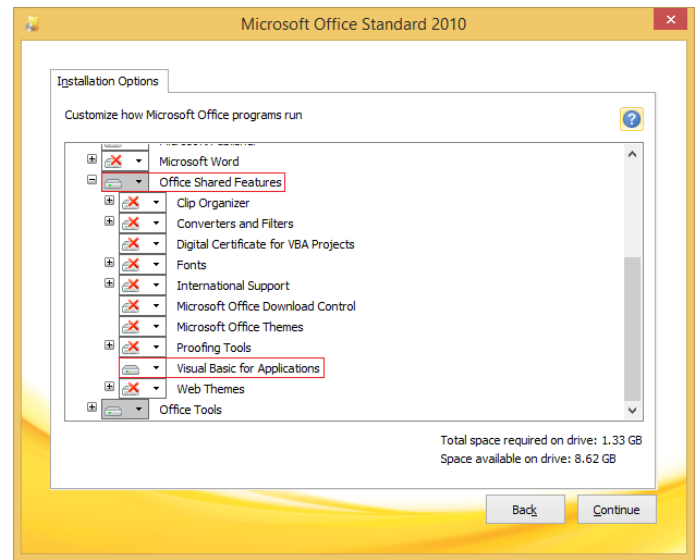


Figure 11: Excel VBA installation instructions in red.

### Software installation

The software installation is designed to allow end users to maintain and create flow-computer applications independently from the ABB Application Engineering Team. Such a concept allows total freedom of flow-computer software for a system integrator or OEM customer.

The software installation process is by means of a step-by-step software installer. In most cases, the user only has to choose the installer which matches their version of Microsoft Excel (either 32- or 64-bits) and accept the setup defaults. If an existing version of the software is present, it will (when possible) be automatically uninstalled. If the existing version cannot be uninstalled automatically, the user will be prompted to perform the uninstallation by hand.

This process will verify that the system requirements to be able to run Flow-Xpress are met. If there are any unmet requirements the installer will, if possible, remedy this. If it is not possible to correct an unmet requirement automatically, the user will be informed about the problem and which corrective action(s) to take, where possible with instructions.

Examples of requirements that cannot be automatically resolved by the installer:

- **Unsupported Windows version**

Solution:

Installing a supported version of the Windows Operating System. See the prerequisites section above for a list of supported versions.

- **Unsupported Excel version**

Solution:

Installing a supported version of Microsoft Office and Excel. See the prerequisites section above for a list of supported versions.

- **Unsupported .Net version**

Solution:

Installing a supported version of the Microsoft .NET Framework. See the prerequisites section above for a list of supported versions. A compatible version of the Microsoft .NET Framework is also available on the Flow-Xpress Installation CD, under the “Utilities” folder.

- **VBA (Visual Basic for Applications) missing or disabled**

Solution:

Modify the Microsoft Office installation. See Figure 11 for an example.

## PC Security

ABB B.V. recommends users to protect their PC's with industry recommended Malware protection and Virus scanner tools and firewalls. Flow-Xpress will require certain ports to be allowed in firewall. See Cyber Security section for more information.

## Software uninstallation

Software uninstallation is done through the Windows “Add or remove programs” dialog. Alternatively, it is also offered when the installer is started again (together with an option to Repair the installation).

## 5 Writing an application to a device

This chapter describes how to write an application to a Spirit™ Flow-X device

The procedure is as follows:

- 1 Connect an Ethernet cable between your computer and the Flow-X



Flow-Xpress → Open File...

- 2 Load parameter file (if available) in Flow-Xpress.  
If no parameter file is loaded the default parameter set will be used.



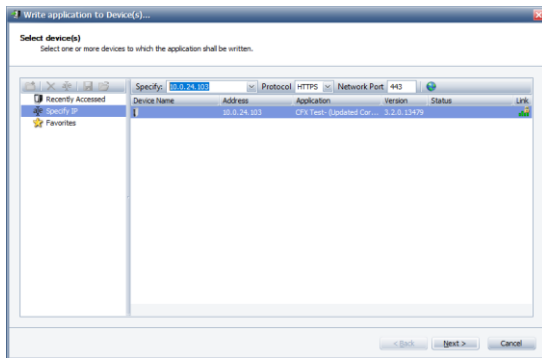
Flow-Xpress → Parameters, Load

- 3 Open the application file in Flow-Xpress.



Flow-Xpress → File, Write to device...

Flow-Xpress starts compiling the application. When this has been finished, Flow-Xpress will allow you to select a device.



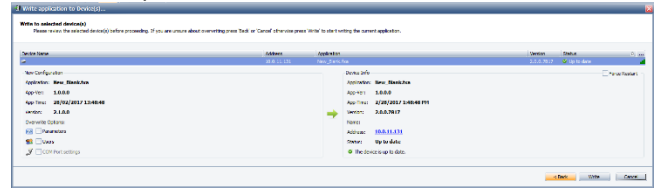
Set the network protocol and port used to connect to the devices, select the device you want write the application to and click Next >.



Be sure the application has been configured for the right device setup (Flow-X → Device Setup). An application can only be written to a device with the same device setup.

In case of a Flow-X/P the application should be written to the panel (X/P) itself, not to the individual modules. The panel will distribute the application to the modules.

- 6 Select write options and click 'Write'.



- **Parameters:** If selected, the configuration parameters from Flow-Xpress are written to the Flow-X as well, overwriting the parameters in the Flow-X.
- **Users:** If selected, the security settings (usernames, passwords, etc.) from Flow-Xpress are written to the Flow-X as well, overwriting the settings in the Flow-X.
- **COM port settings:** Deprecated; COM port settings (baud rate, data bits, etc.) have become part of "Parameters".



**WARNING:** If you select one of these options (Parameters / Users), the existing configuration parameters and settings in the Flow-X are overwritten with the parameters and settings of the application. Only use these options if you are sure you want to use the parameters and settings from the application instead of the existing parameters and settings in the Flow-X.

- 7 Enter administrator username and password.

The administrator username and password of the current application in the Flow-X must be entered, in order to allow the existing application to be overwritten by the new one.

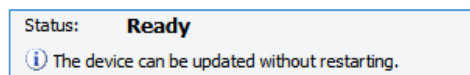
Now the application is written to the Flow-X. Depending on the type of modifications that have been made relative to the existing application and settings, the Flow-X reboots and starts the new application.

### Full reboot and Partial reboot

When writing an updated application to the device, the Flow-X determines whether a full reboot is required or a partial (soft) reboot suffices.

#### Partial reboot

In case of a partial reboot, calculation and totalizing remain running uninterrupted, while only some auxiliary processes are restarted.



Changes that normally only require a partial reboot of the flow computer are modifications to:

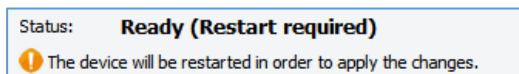
1. Displays (including display units)
2. Reports
3. Parameters

4. Historical data archives
5. Security (users definitions and other security settings)
6. Modbus client and Modbus slave communication drivers
7. Application file name

Although the main calculation and totalization remain running during a partial reboot, it's not advisable to write an updated application immediately before the end of a batch or a period, as batch ends / period ends might be missed and reports / archives might not be generated during the soft reboot.

### Full reboot

In case of a full (hard) reboot, the flow computer is completely restarted such that calculation and totalizing will be inactive for some time.



Modifications that require a full reboot of the flow computer:

1. Writing a different Flow-Xpress version
2. Writing a different application
3. Adding / removing / editing calculations in Flow-Xpress Professional
4. Adding / removing / editing user calculations in Flow-Xpress Basic
5. Modifications to Modbus client, Modbus master and HART communication drivers in Flow-Xpress Professional
6. Enabling / disabling communication devices and printers in 'Ports & Devices'
7. Adding / removing / editing units and enumerations
8. Languages (translations)

In order to avoid flow from being lost, please make sure only to apply updates that require a hard reboot when flow is inactive.

## 6 Reading an application from a device

This chapter describes how to read an application from a Spirit<sup>IT</sup> Flow-X device.

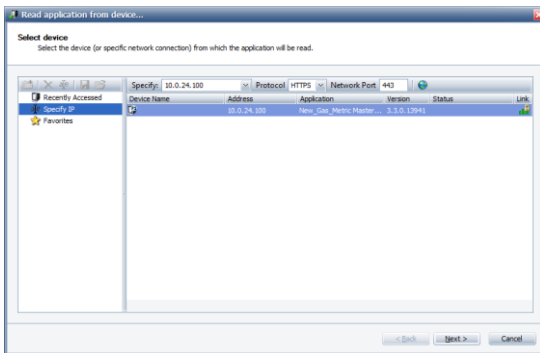
The procedure is as follows:

- 1 Connect an Ethernet cable between your computer and the Flow-X
- 2 Set up your computer's Ethernet port.  
Make sure the IP-address of your computer's Ethernet card is in the same range (but not equal to) the IP-address of the corresponding Ethernet port of the Flow-X.
- 3 Start Flow-Xpress and select 'Read from device...'



Flow-Xpress → File, Read from device...

Flow-Xpress will allow you to select a device.



- 4 Set the network protocol and port used to connect to the devices, select the device you want to read the application from and click Next >.  
Flow-Xpress reads the application from the selected device. It creates a folder in \My Documents\Flow-X\Received and saves a copy of the application and associated parameter and security files into that folder.
- 5 Load the application.  
By clicking the 'Load' button, the application is loaded into Flow-Xpress. The parameter and security files are loaded as well. After this you might save the application to a different location, or with a different file name. By doing this, the parameter and security files are included as default settings in the application file.

### Favorite devices

To ease administration of large numbers of flow computers, it is possible to create 'Favorites folders' (e.g. 'My desk' in the previous screenshot). Simply drag and drop devices from the 'Search Network' folder to the Favorites folder or click the 'New Favorite' button and enter its address manually.

It is also possible to further organize Favorites into sub-folders, and these folders can be exported to a file, for example to send a list of devices of a station to a colleague. Right-click a Favorites (sub-)folder and select 'Export' to export it, or select 'Import' to replace its content with that from an imported list.

Devices in the Favorites (sub-)folder can be assigned custom names. Note that a single device can be present in multiple folders; its Favorite Name can be different in each folder. The Favorite Name of a flow computer will initially be set to its Device Name, if it is known.

## 7 Setting up the device

This chapter describes how to set up a new flow computer configuration based on the ABB application templates.

### Overall set-up procedure

The overall set-up procedure for a Flow-X flow computer consists of the following steps:

#### 1 Setting up **Ethernet**

The Flow-Xpress configuration software uses Ethernet to communicate with the flow computer.

#### 2 Setting up the **display**

The brightness of the LCD display of each flow module can be changed if required. Also, the Flow-X/P & Flow-X/C touch screen can be re-calibrated if required.

#### 3 Setting up the **communication bus**

For the Flow-X/P the internal communication bus needs to be set up manually.

#### 4 Setting up the **flow computer application**

The Flow-X comes with a pre-installed application file. Optionally, by means of the Flow-Xpress software a modified or alternative application can be used. This may be one of the standard applications, e.g. Gas\_Metric or Liquid\_USC or a custom-made application. Application files can be read into the Flow-Xpress software on your laptop or PC from an application file on disc or directly from a flow computer.

#### 5 Setting up the flow computer device

Once the actual application is loaded on your laptop or PC, the actual Flow-X flow computer device needs to be defined in Flow-Xpress, e.g. a Flow-X/P3 will be of type Flow-X/P with 3 modules.

#### 6 Setting up **HART devices**

Each flow module provides 4 HART inputs, which are configured in Flow-Xpress.

#### 7 Setting up **communication devices**

Communication with host devices and field and control equipment need to be set up in Flow-Xpress. The available communication drivers may differ for each application.

#### 8 Setting the **application parameters**

Each application will have its own set of parameters (also called 'configuration settings' or 'constants'). For the standard applications all parameters are described in the corresponding application manual.

#### 9 Setting up **security**

By default, the flow computer uses 4 generic users called 'Operator', 'Tech', 'Engineer' and 'Administrator'. Other users may be added.

#### 10 Setting up **printers and reports**

The flow computer stores all its reports internally also when no printer has been defined.

#### 11 Add **user-defined displays**

The flow computer provides an extensive set of displays. You can add any number of displays to the set of standard displays.

#### 12 Add **user-defined calculations**

Additional data points, alarms and logic can be added through so-called 'Calculations'.

#### 13 **Writing the application to the flow computer**

After the initial set-up has been completed in Flow-Xpress the application can be stored and written to the flow computer.

## Setting up Ethernet

Flow-Xpress software uses Ethernet to communicate with the flow computer. Additionally, Ethernet can be used for communication with a host computer and other field and control equipment. It may also be used for network printing and remote web access. See Security and Data protection → 'Flow-X Network Ports' for the list of ports used by Flow-X.



The flow computer has 2 independent Ethernet ports. The flow computer is only able to access or communicate with devices that are in the same IP range / subnet mask of the applicable Ethernet port. See section 'Flow-X Network Ports' for details.

This device is able to communicate using inherently open protocols such as Modbus, HART and HTTP. Therefore, make sure to only connect it to a local, controlled network and/or provide proper protection mechanisms such as firewalls, VPNs etc. See section 'Flow-X Network Ports' for details.

The following Ethernet settings need to be defined for both Ethernet port 1 and 2:

<b>IP address</b>	Unique IP address
<b>Subnet Mask</b>	The subnet mask is applied to the destination IP address when matching it to the value in the network destination. When written in binary, a "1" must match and a "0" need not match. For example, a default route uses a 0.0.0.0 net mask that translates to the binary value 0.0.0.0, so bits need not match. A host route--a route that matches an IP address--uses a 255.255.255.255 net mask that translates to the binary value 11111111.11111111.11111111.11111111, so all of the bits must match
	Usually set to 255.255.255.0, causing the flow computer to be able to reach all IP addresses 'on the same subnet'.

<b>Default Gateway</b>	The gateway address is the IP address that the local host uses to forward IP messages to other IP networks. This is either the IP address of a local network adapter or the IP address of an IP router (such as a default gateway router) on the local network segment.
	For additional security, it is recommended to leave this at the default ("0.0.0.0"), unless access to/from another network (e.g. VPN) is required.

**Setting up Ethernet on a Flow-X/M flow module**

For each flow module the Ethernet settings are accessible through the local LCD display:

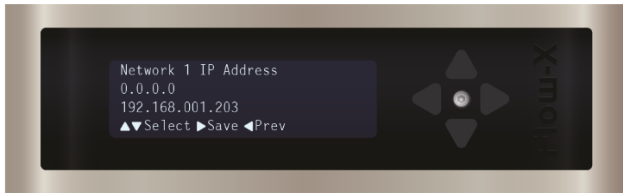




Figure 12: Ethernet settings on the LCD display

 Display → System, Network

**Setting up Ethernet on a Flow-X/P & Flow-X/C**

Ethernet settings are available on the local touch screen.

 Display → System, Network

**Setting up the displays**

**Setting up the display of the Flow-X/M**

For each flow module the following settings are available for the local LCD display

<b>Number of lines on LCD</b>	Sets the number of lines displayed on the LCD. Minimum number of lines is 4, maximum is 8.
<b>LCD backlight intensity</b>	Sets the brightness of the local LCD display between 30 (lowest brightness) and 100 (highest brightness). 100 is the default value.
<b>Caption on LCD</b>	Enables or disables the caption (the title of the display) on top of each page
<b>Test LCD flash</b>	Allows for a visual test of all display pixels. Alternates between black and white for 5 seconds
<b>Test LCD black</b>	Shows all display pixels in black color
<b>Test LCD white</b>	Shows all display pixels in white color

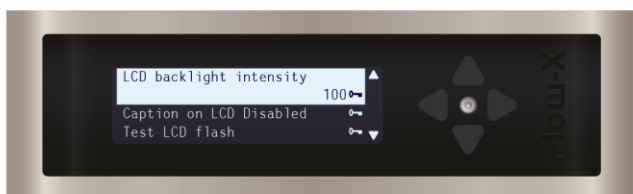


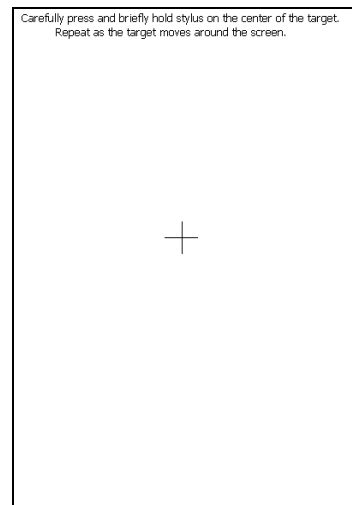
Figure 13: Ethernet settings on the LCD display

 Display → System, Display

**Setting up the display on a Flow-X/P & Flow-X/C**

The following settings are available for the touch screen of a Flow-X/P and Flow-X/C.

<b>Orientation</b>	Sets the display orientation to either 'Vertical' (the default) or 'Horizontal'.
<b>Re-calibrate</b>	Enables a 5-point recalibration of the Flow-X/P and Flow-X/C touch screen the next time the device is powered up.



<b>LCD backlight intensity</b>	Controls how bright the display of the Flow-X/P is during normal operation. This setting is specified as a percentage, with 100% corresponding to the maximal brightness that the particular unit is capable of. This can be used to e.g. calibrate the displays of multiple Flow-X/P flow computers such that they each have the same apparent brightness.
<b>Screensaver intensity</b>	Controls how bright the display of the Flow-X/P or Flow-X/C is when the screensaver is active. The screensaver will automatically dim the display after a configurable amount of time. This setting is specified as a percentage relative to the LCD backlight intensity setting.
<b>Screensaver timeout</b>	Controls how after much time the screensaver will active. This setting is specified in seconds. The value '0' can be used to disable the screensaver functionality; however, we recommended that users do <b>not</b> disable the screensaver functionality.

 Display → System, Display

## 8 Communication bus set-up

This chapter describes the procedure to set-up the internal communications bus for a Flow-X/P.

**!** The internal communication bus needs to be set-up as outlined in these procedures otherwise the flow computer will not operate correctly

**!** In case two or more modules installed in a **Flow-X/R** (rack-mounted) operate as a multi-stream flow computer, then the communication between the modules needs to be set up in a similar fashion.

**!** The procedure for the Flow-X/R is the same as for the Flow-X/P, except that there is no module 0 (the X/P touchscreen module). Any station or prove functionality will be automatically assigned to the first run module.

The procedure to set up a Flow-X/P that contains one or more flow modules is as follows:

- 1 Install the flow modules in the Flow-X/P chassis  
Module 1 must be inserted in slot 1 (slot closest to front panel), module 2 in slot 2, etc. as indicated in the picture below.

**!** Before installing a module into (or removing a module from) the Flow-X/P (or Flow-X/S or Flow-X/R) chassis be sure the chassis has been powered down.

- 2 Assign consecutive IP addresses  
Assign consecutive IP addresses to **Network 1** of the Flow-X/P and to all the flow modules as shown in the picture below. The Flow-X/P should have the lowest IP address (e.g. 192.168.1.5), module 1 (the one closest to the front panel) should have the same IP address plus 1 (e.g. 192.168.1.6) etc.

The network address of a module can be set on the display System, Device setup or System, Network of that module.

Note; if you change the network address through a web browser, or if you change the network address of a module through the panel touch screen (display 'System, Modules, Module <x>, Device setup') you will lose the connection to the flow computer or module.

Note: make sure that the last part of the subnet mask, which is typically set to xxx.xx.xxx.0, allows the modules to connect to each other'

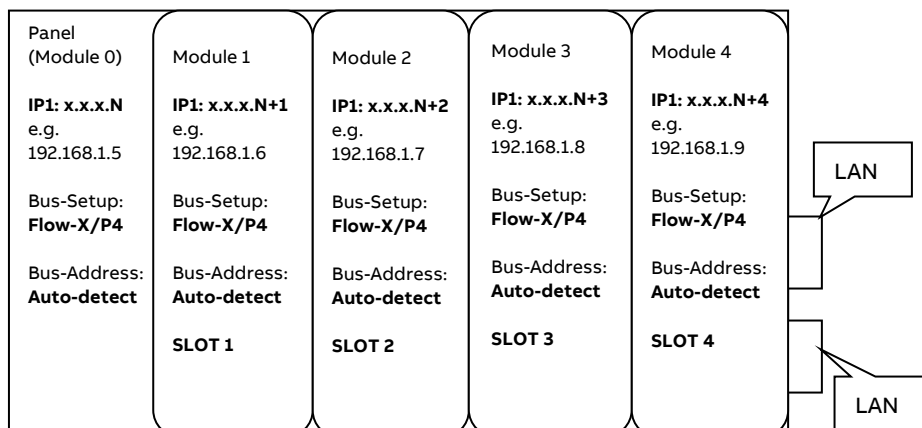
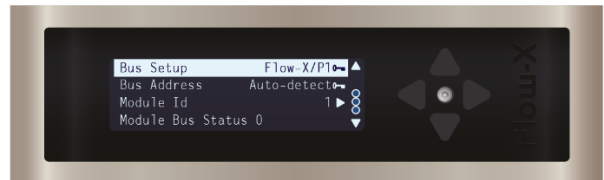
- 3 Set the 'Bus setup' setting on the Flow-X/P  
Set the 'Bus setup' setting to the applicable value on the front module (Flow-X/P)
- |           |                  |
|-----------|------------------|
| 1 module  | <b>Flow-X/P1</b> |
| 2 modules | <b>Flow-X/P2</b> |
| 3 modules | <b>Flow-X/P3</b> |
| 4 modules | <b>Flow-X/P4</b> |

The network address can be set on display 'System, Device setup' (or 'System, Modules, <Panel/Module <x>, Device setup)

### Setup

Device Name	
Bus Setup	Flow-X/P2
Network 1 IP Address	10.1.8.211
Current Time	18/05/2012 10:19:09

- 4 Set the 'Bus setup' setting on all modules.  
Perform the previous step on **all the flow modules** (through the LCD, touchscreen or web display). Use the **same bus setting** as on the Flow-X/P.



- 5 Power the flow computer off and on again
- 6 Write the application  
Write the required application to the flow computer. Make sure that the application is set up properly (refer to section Device setup in Flow-Xpress)
- 7 Final check  
Check that the communications bus is working properly on display on display 'System, Bus'  
Note that the picture below is applicable for a Flow-X/P1 (being a Flow-X/P with 1 flow module).

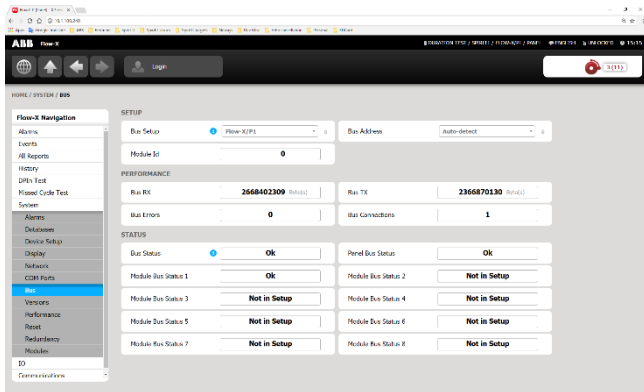


Figure 14: Checking the communication bus status

## 9 Setting up the application

Before the flow computer can be put in operation the appropriate application file has to be written to it from Spirit<sup>IT</sup> Flow-Xpress. ABB provides a number of standard applications that cover most of the oil and gas flow metering installations (downloadable from [www.spiritit.com](http://www.spiritit.com)).

### 1 Start Flow-Xpress

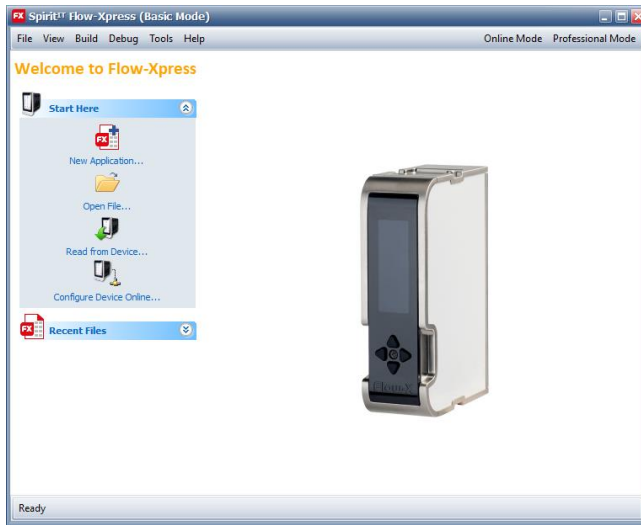


Figure 15: Flow-Xpress startup display

### 2 Select **Open file** under **Start Here** to open an application file from a local or network drive.

or alternatively:

Select **Read from Device** under **Start Here** to read an application file from a flow computer and use that as a string point for your modified configuration.

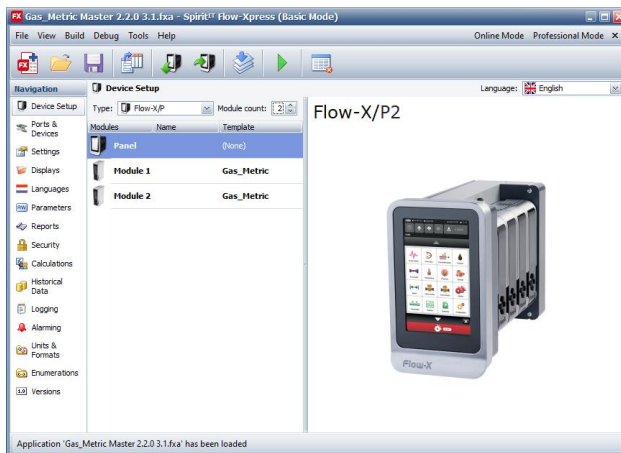
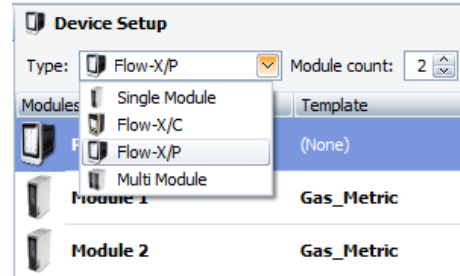


Figure 16: Flow-Xpress Basic mode main display

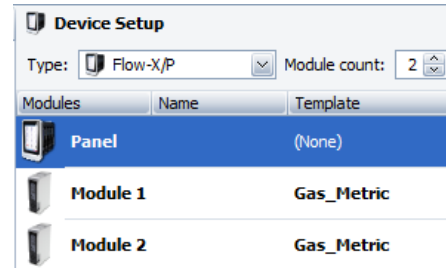
The next step is to set up the flow computer device.

## Device Setup

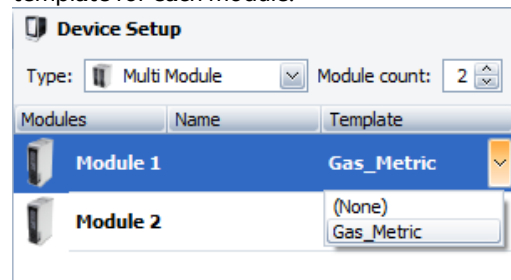
- 1 In Flow-Xpress select **Device Setup**
- 2 Select the **Type** of device



- 3 For the Flow-X/P (Panel) define the actual number of installed flow modules



- 4 For applications with multiple templates, select the applicable template for each module.



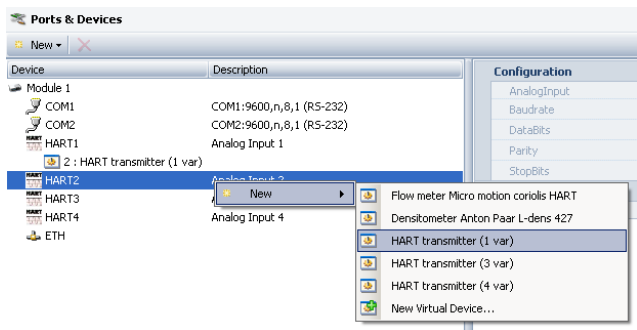
Note: this is not required for the standard applications, because these contain one template only.

## 10 Setting up HART communication

The following setup procedure applies when HART devices are connected to the flow computer.

Each flow module provides 4 HART inputs on analog inputs 1, 2 3 and 4.

- 1 In Flow-Xpress select **Ports & Devices**.
- 2 Select the Flow-X/M flow module to which the HART loop is / will be connected.
- 3 Select the HART / analog input channel to which the HART device is / will be connected. Either select **New** or right-click the port and select **New**.

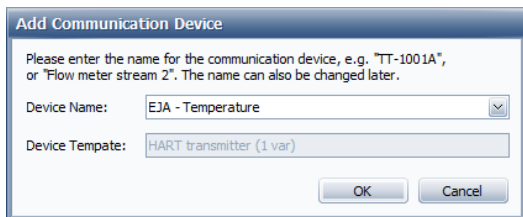


- 4 Select the HART device from the pop-up list.

Select **HART transmitter (1 var)** for generic HART communication with any HART device. This will have the flow computer read the primary variable only.

If the flow computer should read the 2<sup>nd</sup>, 3<sup>th</sup> or 4<sup>th</sup> variable, then **HART transmitter (3 var)** or **HART transmitter (4 var)** should be selected, depending on the number of variables that is supported by the transmitter.

- 5 Define a unique name for device. This name will be shown on the flow computer display.

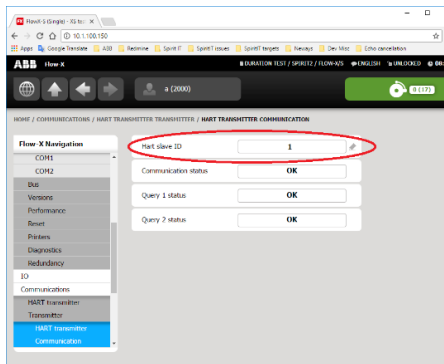


- 6 Note the DeviceNr that has been assigned to the device. This deviceNr you will need later in the configuration process, to define which process value (temperature, pressure, density, ...) will be read through this HART port.

Device	
Description	
DeviceNr	2
Location	Module 1, HART1

You may modify the DeviceNr.

- 7 The **HART ID** is the **HART slave address**. This defaults to 0 and can't be modified in Flow-Xpress, but must be configured on the flow computer once the application has been written to it (display Communications, <Device> communication):



For single HART transmitters (no multi-drop) the HART slave address is usually 0.

### Multi-drop HART

Multiple transmitters can be connected to the same HART loop (i.e. analog input channel). For this purpose the HART transmitters need to have a unique slave address that is in the range 1..15 (so >0).

Note: In multi-drop mode the HART transmitter sets its output at a constant 4 mA and only communicates digitally.

- 1 To enable multi-drop mode, assign multiple HART transmitters to the same HART port.

Module 1		
COM1		COM1:9600,n,8,1 (RS-232)
COM2		COM2:9600,n,8,1 (RS-232)
HART1		Analog Input 1
	2 : EJA - Temperature	
	3 : KJN - Pressure	
HART2		Analog Input 2
HART3		Analog Input 3


- 2 Write the application to the Flow-X device
- 3 For each transmitter set the HART slave ID (poll address) on the flow computer display Communications, <HART device> Communication.

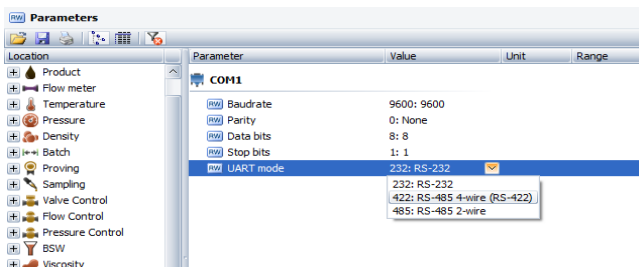
Note: in multi-drop mode the slave ID must be unique for transmitter connected to the same HART port. The ID must be a number between 1 and 15 (so > 0).

## 11 Setting up communication devices

The chapter applies when the flow computer has to communicate with one or more host computers and/or devices over one of its serial COM ports or via Ethernet.

### Setting up a COM port

- 1 Flow-Xpress select **Parameters**.
- 2 Select System / COM Ports.  
When the COM Ports parameters are not visible, select 
- 3 Select the COM port and make sure all settings match with the connected device.



<b>Baud rate</b>	Baud rate (300 to 256000)
<b>Data Bits</b>	Number of data bits (5, 6, 7 or 8).
<b>Mode</b>	Type of electrical connection: <b>RS232</b> , <b>RS485 (2-wire)</b> or <b>RS485 (4-wire)</b> .

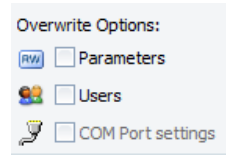
RS 485 2-wire is also known as **half-duplex** and RS-485 4-wire is also known as **full duplex** and as RS-422.

Refer to Flow-X Volume Installation manual for details about electrical connection and supported modes.

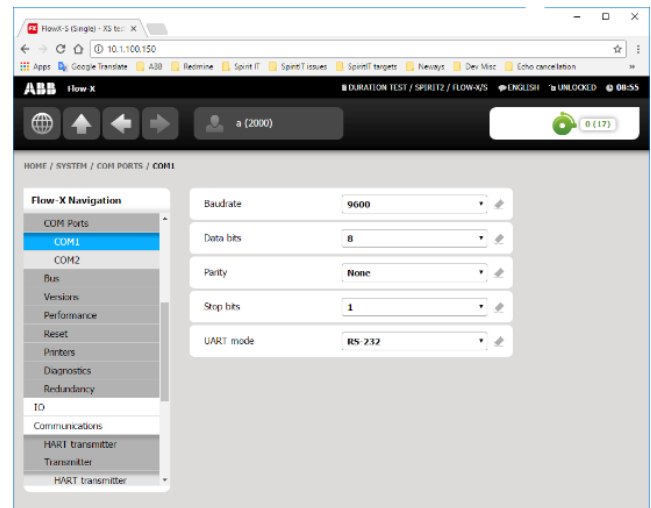
<b>Parity</b>	Type of data parity bit: None, Odd, Even, Mark or Space. If the parity bit is present but not used, it may be referred to as <u>mark</u> parity (when the parity bit is always 1) or <u>space</u> parity (the bit is always 0).
<b>Stop bits</b>	Number of stop bits (1, 2 or 1.5)

Note: When writing the application to the flow computer the COM port settings will be written to the Flow computer when the “Parameters” checkbox is checked.

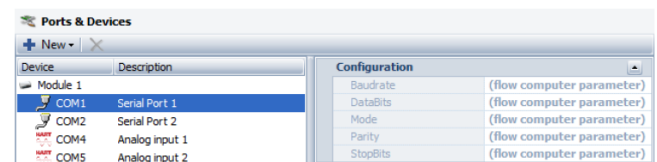
The “COM Port settings” was previously used for this purpose, but this is now deprecated.



Note: After having written the application to the flow computer, the COM port settings can be modified on the flow computer display System, COM Ports, COM-<x> or System, Modules, Module <x>, COM Ports, COM Port <y>.



The Ports & Devices section can no longer be used to change the communication configuration, the communication fields are greyed out like:

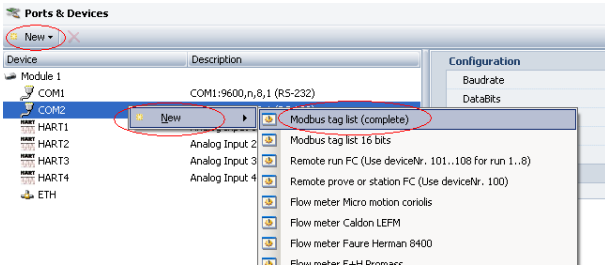


### Setting up communication with a host computer

If the host device is connected to one of the COM-ports, then first set up the COM port as described in section 'Setting up a COM port'.

If the host device is connected to Ethernet, then make sure that the IP address and subnet mask of the external device correspond with the flow computer settings (as described in section 'Communication bus setup').

- 1 Select the COM port to which the device will be connected, then either select **New** or right-click the port and select **New**.

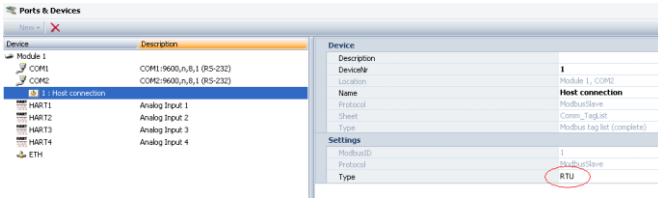


To set up Modbus communication with a host use the appropriate Modbus list, e.g. **Modbus tag list complete** or **Modbus tag list 16 bits**. See the application manual for more details.

- 2 Define a name for this connection 'e.g.' Host connection' or 'DCS'.



- 3 In case of communication through a COM port, define the **Modbus type**.

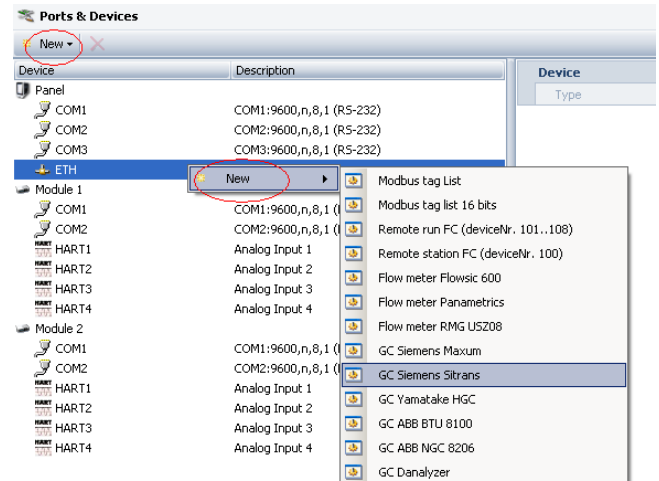


<b>RTU</b>	Modbus RTU.  This is the preferred setting for Modbus RTU communication. It uses the addresses and register sizes as defined on the communication sheet in the application file.
<b>RTU16</b>	Modbus RTU, 16-bit register based. Refer to section 'Modbus – Register sizes' for further details.
<b>ASCII</b>	Modbus ASCII (uses the same type of register addressing as Modbus RTU)

## Setting up communication with external devices

Follow this procedure to set up the communication with external (Modbus) devices like ultrasonic flow meters and gas chromatographs:

- 1 Select the COM or Ethernet port to which the device is / will be connected, then either select **New** or right-click the port or select **New**.



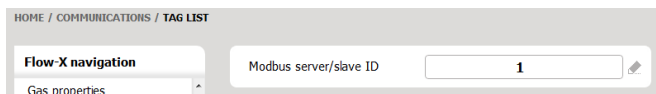
Select the device from the list of the available devices.


- 2 Define a name for the device. This name will be used on the displays.
- 3 In case of communication through a COM port, define the **Modbus type**.



<b>RTU</b>	Modbus RTU.  This is the preferred setting for Modbus RTU communication. It uses the addresses and register sizes as defined on the communication sheet in the application file.
<b>RTU16</b>	Modbus RTU, 16-bit register based. Refer to section 'Modbus – Register sizes' for further details.
<b>ASCII</b>	Modbus ASCII (uses the same type of register addressing as Modbus RTU)

- 4 In case of Ethernet communication, fill in the **IP-address** of the device and the **port number** to be used. For details about Flow-X port numbers used for Modbus communication see section 'Flow-X Network Ports'. Modbus Client supports two



 The actual Modbus addresses can be inspected by opening the application file in Flow-Xpress professional.

types, Modbus/TCP and RTU over TCP. The RTU (remote terminal Unit) is a message format that has a cyclic redundancy checksum following the commands/data. This ensures reliability of data. The Modbus type setting defines the Frame Format of Modbus messages.

ModbusIP	10.0.1.100
Options	0
Port	502
Protocol	ModbusClient
Type	RTU over TCP
	Modbus/TCP (MBAP)
	RTU over TCP

**Modbus/TCP** Modbus TCP is different than RTU over TCP in that, it relies on the TCP stack to provide checksums and retransmissions. So, the Modbus does not provide cyclic redundancy checksum, since TCP provides checksum protection.

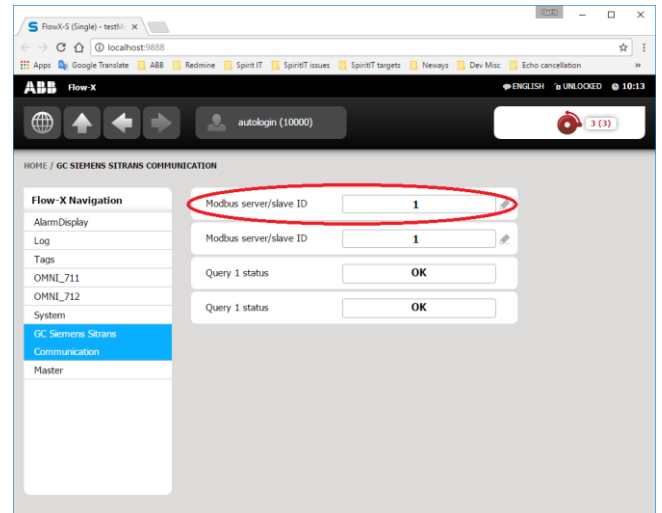
**RTU over TCP** RTU over TCP means that the client uses TCP as the communication layer while messages are formatted in the same way as Modbus RTU, meaning serial links are emulated over Ethernet. So, a checksum is included in the Modbus payload.

- 5 **Step 5:** Note the **DeviceNr** that has been assigned to the device. This DeviceNr you will need later in the configuration process, to define for which purpose this communication device will be used (e.g. GC A of meter run 3).

You may modify the DeviceNr.

Device	
Description	
DeviceNr	1
Location	Module 1, COM2
Name	GC Siemens Sitrans
Protocol	ModbusMaster
Sheet	Comm_GC_Sitrans
Type	GC Siemens Sitrans

- 6 The **Modbus ID** is the **Modbus Slave address** for serial ports and the **Modbus Server address** in case of Ethernet communication. This defaults to 1 and can't be modified in Flow-Xpress, but must be configured on the flow computer once the application has been written to it (display Communications, <Device> communication):



The actual Modbus addresses can be inspected by opening the application file in Flow-Xpress Professional.

## Modbus – Register sizes

The Flow-X not only supports a register size of 16 bits, but also register sizes of a multiple of 16 bits, such as 32-bits (long integers, single precision floats), 64-bits (double precision floats, 8 character strings) and 128 bits (16 character strings).

In Flow-Xpress Professional, Modbus tag lists can be created based on 16 bits registers only or using the larger register sizes as well. Because long integers, single and double precision floats and strings use more than 16 bits, Modbus lists based on 16 bits registers will show address lists with gaps. When using 16 bits registers for single precision floats (32 bits), addresses go up by 2 (e.g. 1000, 1002, 1004 etc.). If larger register sizes are used, then the addresses just go up by 1 (e.g. 1000, 1001, 1002 etc.).

The standard applications contain examples of both types of Modbus lists. The main tag list **Modbus tag list (complete)** uses the larger register sizes, whereas the **Modbus list (16 bits)** only uses 16 bits registers.

**Modbus taglist (complete)** is primarily meant for use with devices that support the larger register sizes, **Modbus taglist (16 bits)** is meant for devices that only support 16 bits registers. In both cases the Modbus type **RTU** should be used.

Modbus type **RTU16** is only to be used in case in the flow computer a Modbus list using the larger register sizes is used, while the communicating device only supports 16 bits registers. In that special case the response of the flow computer is 'translated' to a response that is expected by the device.

Be aware that the use of **RTU16** leads to shifts in the addresses. This is explained by the following example. Regard this query of 4 single precision floats from the **Modbus taglist (complete)**:

14	2600	mod1_LM_RunIPT_CUR	Run 1 - Meter temperature	degC	float
14	2601	mod1_LM_RunIPT_CUR	Run 1 - Meter pressure	bar	float
14	2602	mod1_LM_RunIPT_CUR_ABS	Run 1 - Meter pressure - Absolute	bar_a	float
14	2603	mod1_LM_RunIPT_CUR_GAUGE	Run 1 - Meter pressure - Gauge	bar_g	float

This tag list uses 32 bits registers for floats, so this query consists of 4 registers of 32 bits each. Using Modbus type **RTU**, the device requests 4 registers of 32 bits each (addresses 2600-2603) and the flow computer respond will contain 4 times 32 bits of data (address 2600-2603).

If using **RTU16**, the device requests 8 registers of 16 bits each (addresses 2600, 2602, 2604 and 2606), whereas the flow computer responds with 4 registers of 32 bits each (addresses 2600-2603). From this example it shows that the address of the first register is the same in the flow computer and the device, but that the other addresses are shifted.



Note: the Flow-X does **not** implicitly **subtract** any value (like 1 or 40001) from the start address for Modbus requests as some Modbus devices do. It uses the addresses as defined on the communication sheet.

If the host device implicitly subtracts a value from the start address when sending out a Modbus request, then you need to add the same amount to start address that is entered in the configuration software of the host device.

## Modbus – Modicon compatibility

Modicon compatibility means three things:

- 1 Only 16 bits registers are used (see above)
- 2 Implicitly a value 1 is subtracted from the address
- 3 The byte order for floats is reversed.

This means that in case of a device that is Modicon compatible the following rules have to be taken into account:

- 1 Either use a 16 bits taglist on the flow computer with Modbus type RTU, or a taglist using the higher register sizes combined with Modbus type RTU16 (see above)
- 2 Add 1 to the start address while configuring the request from the device (e.g. to read the value of register 2600, you have to use a request for address 2601).
- 3 Use data type reverse float for all single precision floats. This means that in the flow computer taglist '=xd\_float' in column 'DataType' has to be replaced by '=xd\_revfloat'. For this the Flow-Xpress Professional software is required.

## 12 Modifying the application parameters

In the previous chapters it has been explained how a new application is created and how the flow computer device itself and the external HART and communication devices are set up.

Most other functionality is set up by **configuration parameters**, including but not limited to:

- flow meter inputs
- densitometer and specific gravity transducer inputs
- transmitters and PT100 elements
- factors and constants
- totalizers and averaging
- proving
- sampling
- flow control and motor operated valve control
- density and compressibility calculations
- etc.


The actual configuration parameters that are available in your application depend on the application that has been selected. For each application the parameters are described in the appropriate **Application Manual**.



The configuration parameters can be accessed in several ways, both on-line (directly on the flow computer) and off-line on your computer:



- In Flow-Xpress through section **Parameters**  
This sets the parameter values offline in the loaded application, which can be sent, including the parameters, to the flow computer
- Through Flow-Xpress **Online** mode  
This sets the values directly in the flow computer
- From the **LCD display** of each flow module
- Through the **touch screen display** (Flow-X/P and Flow-X/C only)
- Through a **web browser**

All methods give full control to all parameters. The only restriction is that no alphanumeric characters can be entered on the LCD display.


By default, only the configuration parameters that are applicable for a specific setup are shown. Non-applicable configuration parameters are hidden. E.g. orifice configuration parameters are not shown if Meter type **Pulse** has been selected on display Configuration, Run <x>, Run setup and station configuration parameters are hidden if no station functionality has been selected on display: Configuration, Overall setup, Overall setup.

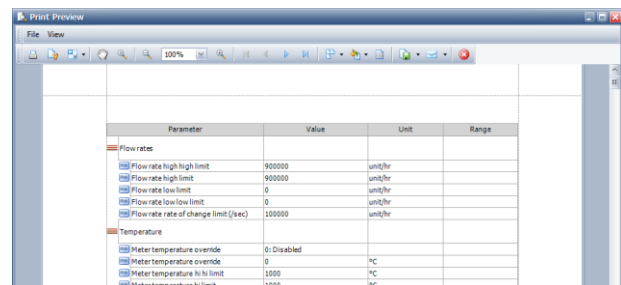
However, in Flow-Xpress section **Parameters** it's possible to show **all configuration parameters**, whether they are applicable or not, by clicking the  icon.

In Flow-Xpress section **Parameters** there are two **display modes**: Tree-view , which shows the parameters in a folder-like view, and List-view , which shows all applicable configuration parameters in one list.


Parameter files can be **loaded**  into and **saved**  from Flow-Xpress. Loading a parameter file will overwrite all current values of the configuration parameters in the application file.

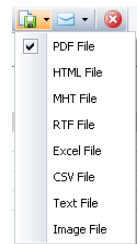
### Parameter printing and exporting

The parameter list can be **printed** or **exported** by clicking the print icon . This brings up a window showing a print preview of the current view.



Parameter	Value	Unit	Range
<b>Flow rates</b>			
Flowrate high high limit	900000	unit/hr	
Flowrate high limit	900000	unit/hr	
Flowrate low limit	0	unit/hr	
Flowrate low low limit	0	unit/hr	
Flowrate rate of change limit (sec)	100000	unit/hr	
<b>Temperature</b>			
Meter temperature override	0: Disabled		
Meter temperature eventide	0	°C	
Meter temperature hi limit	1000	°C	
Meter temperature hi limit	1000	°C	

From this print preview the list can actually be **printed**  or **exported** to a range of file formats.



### Configuring parameters in Debug offline

Configuration parameters can also be set using the **Debug offline** mode.

In this mode the flow computer software, application and configuration can be tested offline on a laptop or PC, without the need to write the application to a flow module. Debug offline mode uses the configuration parameters from Flow-Xpress section Parameters. Modifications to the configuration parameters in debug offline mode are also saved in this section. This means that the flow computer software, application and configuration can be fully tested **without a real Flow-X module**. After configuration and testing in Debug offline, the application can be sent, together with the configuration parameters, to the flow module, after which it will run exactly the same software and configuration as was running on the laptop or PC in debug offline mode.

## 13 Security and Data protection

### W & M switch

Each flow module has a mechanical switch (W & M switch) that ensures that it's not possible to modify the metrological software in any way through either the user interface or the communication interfaces (serial and Ethernet).

- If the W & M switch is enabled, it will not be possible to **overwrite** the application, firmware and FPGA software in the flow computer. It will however still be possible to read all software and data from the flow computer.
- If the W & M switch is enabled, it will not be possible to **change** any configuration setting or to give any control commands with security level 1000 and higher. If the W & M switch is activated only configuration settings with security level less than 1000 can be modified, provided that an authorized user has logged in. All configuration settings that are legally relevant are on security level 1000 or higher.

Normal operation functions such as display selection, alarm acknowledgment and report printing are not disabled by the W & M switch.

### Metrological seal

The flow computer provides a bracket that can be closed and sealed. When the bracket is closed, the W & M switch can no longer be accessed.

Therefore, the W & M switch on all the flow modules needs to be enabled before the bracket is closed and sealed.

It is not possible to dismount a flow module from the flow computer without opening the bracket and breaking the seal.

### Data protection

All software is stored on the internal storage medium. External access is only possible through the flow computer configuration software (called **Flow-Xpress**). However, when the W & M switch is enabled it will not be possible to change the software in the flow module.

As an additional safety measure the flow computer applies a CRC32 checksum on the complete set of software files. When any file has been manually changed, removed or added the software will be rejected and the last known valid software, which is automatically backed up internally after every successful start-up, is used instead.

All parameters are stored on the internal storage medium. Direct access to this internal storage is not possible. Instead external access is only possible through the flow computer configuration software (called **Flow-Xpress**), through the LCD and web display and through the communication interfaces.

All metrological parameters have a security level of 1000 or higher. If the W & M switch is enabled, it is **not** possible to edit any metrological parameter through any interface (Flow-Xpress, user interface or communication interface), even though a user with security level of 1000 or higher has logged in. Every parameter change will be logged as an event.

All retentive and historical measurement data are stored on the internal storage medium. Direct access to this internal storage is not possible.

It is not possible to delete measurement data manually. Instead measurement data is deleted automatically when it has become out of date, i.e. when it is older than a configurable period. Report and event files are stored in an encrypted format and with a checksum. Historical report and events can be previewed and reprinted through the Flow-X flow computer user interface (LCD and web).

### Users, passwords and security levels

The following users and passwords are used by the standard ABB applications.

User name	Password	PIN code	Security level
operator	operator	000123	500
tech	tech	898989	750
engineer	engineer	101010	1000
administrator	admin	123321	2000



PLEASE CHANGE THE DEFAULT PASSWORDS

In Flow-Xpress users and passwords can be modified and added both in online mode (directly in the flow computer, also for multiple flow computers at once) and offline mode (in the loaded application file).

Each user has a specific security level. The security level determines what the user can and can't do with the flow computer. Each parameter has a specific security level. Only users with at least the required level will be able to change the parameter, users with a lower security level will not. Note that visibility of displays can be restricted according to security levels, but these do not affect read-only access of underlying web APIs like syslog, events, reports etc. See sections XML Interface and Cyber security for more information. In addition to this, username is case-insensitive but password is case-sensitive.

Furthermore, there are number of overall settings for which the security level can be set as shown in the following screen shot.

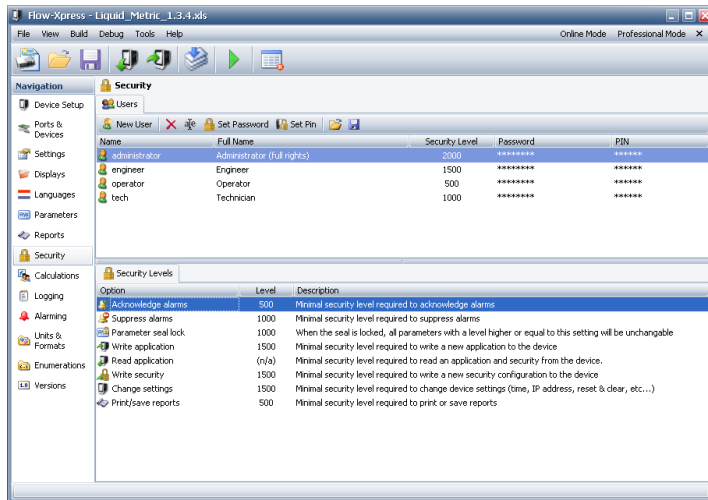


Figure 17: Security settings

## Flow-X Network Ports

Several ports are used by the Flow-X and its Operating System for different functions to work. Blocking these ports by a firewall will impact the functionality of Flow-X devices. The following list provides a comprehensive list of ports with the purpose.

Port number	Type	Version 1 (WinCE 5)	Version 2 (WinCE 8)	Usage
21	FTP	Yes	Yes	FTP (disabled)
23	Telnet	Yes	Yes	Telnet (disabled)
80	TCP	Yes	Yes	Default port for HTTP access, if enabled.
123	UDP	No	Yes	Operating System
443	TCP	Yes	Yes	Default port for HTTPS/SSL, if enabled.
502	TCP	Yes	Yes	MBAP/Modbus TCP (configured via application and can be changed)
818	TCP	Yes	Yes	Flow-X Client Protocol
1026	UDP	Yes	No	Operating System
4500	UDP	No	Yes	Operating System
4875	TCP	Yes	Yes	Net manager, only for multi-module setup
11537	TCP	Yes	Yes	Redundancy, when redundancy is enabled
49152	UDP	No	Yes	Operating System



Note: by default, the Flow-X uses HTTPS protocol with port 443 and unsafe HTTP protocol with port 80 is disabled.

## 14 Reports & printers

Spirit™ Flow-X supports text printers both on serial and Ethernet ports.

### Defining a serial text printer

- 1 In Flow-Xpress select **Ports & Devices**.
- 2 Select the applicable COM port and define port settings (baud rate, parity data bits and stop bits). Refer to section 'Setting up a COM port' in chapter 'Setting up communication devices' for details on COM port settings.
- 3 First select the COM port, then select 'New' (or right-click and select 'New'), and then select 'Text printer (serial)'.

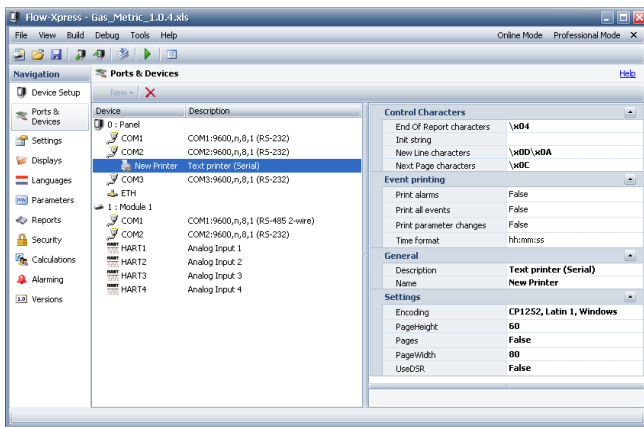


Figure 18: Serial printer settings

- 4 If required change the settings for the printer.

<b>End Of Report characters</b>	Hexadecimal sequence code at the end of the report
<b>Init string</b>	Hexadecimal sequence code to initialize the printout. E.g. for condensed mode printing enter '\x0F'
<b>New line characters</b>	Hexadecimal sequence code for a new line
<b>Next page characters</b>	Hexadecimal sequence code at the end of the page
<b>Print alarms</b>	Automatically prints alarms to the printer
<b>Print all events</b>	Automatically prints events to the printer
<b>Print parameter changes</b>	Automatically print parameter changes to the printer
<b>Time format</b>	Time format used for printer alarms, events and parameter changes.
<b>Description</b>	Description of the printer
<b>Name</b>	Name of the printer as it appears in Flow-Xpress when selecting the printer or referring to the printer from the application.
<b>Encoding</b>	Sets the Code Page. The default code page is CP1252 US English. Set a different code page if non-English characters need to be printed.
<b>PageHeight</b>	The number of lines per page. The flow computer will automatically add blank lines at the end of each report such that each printout takes a whole number of pages, provided that option 'Pages' is enabled.
<b>Pages</b>	In case 'Pages' is enabled, the flow computer will automatically add blank lines at the end of each report such that each printout takes a

<b>PageWidth</b>	whole number of pages (based on setting 'PageHeight'). Page width in number of characters. For each line the flow computer will skip characters that go beyond this number.
<b>UseDSR</b>	Uses the printer handshake signal, which may be a legal requirement.  When the signal is off (indicating that printer is offline, has run out of paper or has an internal error) the flow computer will queue reports.  If enabled the actual DSR signal will be as follows :  Flow-X/P version 1 : Com 1 - pin 8 (CTS) Flow-X/P version 2 : Com 3 - pin 8 (CTS) Flow-X/M : Digital channel 16 of the same module Flow-X/C : if connected to Com 3 - CTS Pin 8, if connected to Com 1 or Com 2 - Digital channel 16

### Defining an Ethernet text printer

The flow computer supports the LPD/LPR printer protocol to print text reports over TCP/IP Ethernet. The LPD/LPR protocol was developed originally for UNIX and has since become the de facto cross-platform printing protocol. It has the advantage that the flow computer can directly access the printer independent of any Windows security settings.



Please make sure that the user defined for the printer has the proper **security rights** to access the printer. Also make sure that the flow computer which is a WINCE device is allowed to access the printer server and to access the network shares. Consult your IT department in case the printer is attached to a Local Area Network with restricted security.

- 1 In Flow-Xpress select **Ports & Devices**.
- 2 Select 'Ethernet', 'New' (or right-click and select 'New') and then select 'Text printer (Ethernet)'.
- 3 The following printer settings are defined in the application:

<b>Name</b>	Name of the printer as it appears in Flow-Xpress when selecting the printer or referring to the printer from the application.
<b>Encoding</b>	Sets the Code Page. The default code page is UTF-8 (Unicode).
<b>PageWidth</b>	Page width in number of characters. For each line the flow computer will skip characters that go beyond this number.

- 4 Other settings can be configured on the flow computer itself, after the application is uploaded to the device. Using e.g. the

Flow-X panel GUI or the Web UI, go to System > Printers and configure the following settings:

Queue	Name of the LPD print queue as defined in the printer. Depending on your printer this setting needs to be defined or not.
Server	IP address of the printer server
User	Identity of the flow computer on the printer (max. 30 characters)
Description	Description of the printer

## Reports

Depending on the application the flow computer provides a number of standard reports. Modifications to existing reports and addition of new reports can be performed through Flow-Xpress Basic and Professional mode.

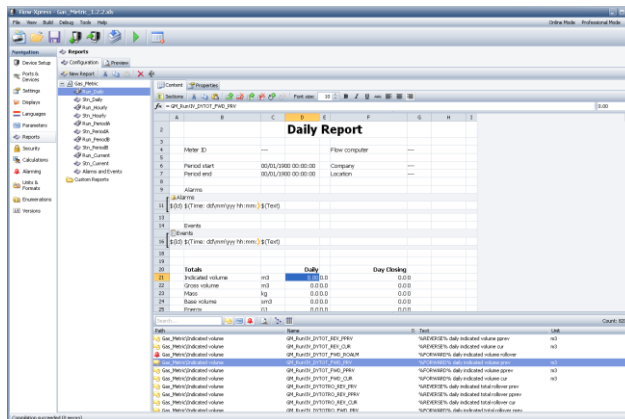








Figure 19: Report Content

The report content can be modified using the spreadsheet-based report editor. Cells can contain static text, tag values or formula results. The number of decimal places used to display formula results can be edited in the right-most field of the formula bar. Tag values and Formulas should start with '=' to display their value. If the = character is omitted, the cell content is displayed as static text.

The report content editor has some special toolbar buttons:

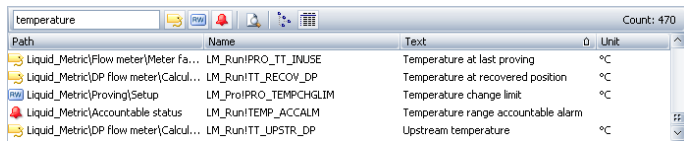
-  **Sections** Change the visibility of Page Header, page body and Page Footer areas.
-  Insert / delete row
-  Insert / delete column
-  Find and replace
-  Insert an Alarm or Event section at the current selected row. A section can contain records of the specified Section type.
-  Remove the selected Alarm or Event section

Report cells can contain special fields. The fields are filled with values when a report is generated. The supported special fields are:

\$ (PageNum)	Current report page number
\$ (NumPages)	Total number of report pages
\$ (PrintTime)	Date and time the report is printed. Use \$(PrintTime: <formatString>) to specify the display format of the print time. The formatString can contain (parts of) string “dd/mm/yyyy hh:mm:ss”

To add a data point to a report, just drag it from the bottom right section (where an overview of all available data points is given), to a cell in the report.

A number of tools is available to make it easier to find a specific tag, such as a limit filter, which shows only the tags that meet the search text, and buttons to limit the output to a specific type of tags (**calculation tags, configuration parameters, alarms**).



**Recurring reports**

Reports can be made **recurring** by right clicking on the report and selecting 'Recurring'. Recurring reports are indicated by the arrows in the icon



If a report is recurring and there are multiple run modules (e.g. on an X/P2) then automatically a similar report will be generated for each run.

**Enabling / disabling report generation**

Generation of a report can be **enabled** or **disabled** by right clicking on the report and selecting / deselecting 'Enabled'.

**Report sections**

Reports can contain sections. A section is a report area that contains records for the specified section type. A section can be created in the body of a report using the 'Create section' button in the Report editor toolbar. If a section cell is selected, the section properties and supported section fields are displayed. The name and type of the section as well as filters for the records shown in the section can be changed in Section properties.

The supported section fields vary by section type. The supported section fields are:

Section Field	Events section	Alarms section
Count	✓	✓
Id	✓	✓
Text	✓	✓
Time	✓	✓
Severity	✓	
Location	✓	

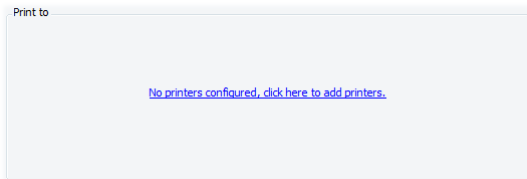
The number of records present in a section can be shown in every cell of the report with the formula:

"=<SectionName>.\$(Count)". Example: =Alarms.\$(Count) to display the number of records present in the Alarms section of the report.

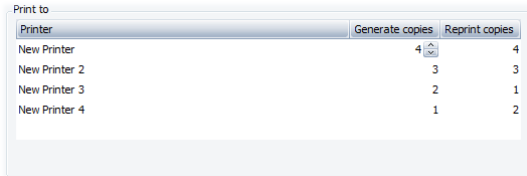
**Report properties**

The Properties tab allows modification of the report properties. The following settings are available for reports:

<b>Generate</b>	Determines if the report is generated automatically or not.  The drop-down list shows the available events that can trigger the automatic generation. Depending on the application there are the following type of events:  <b>Manual</b> Select 'Manual' if the report does not require automatic generation based on period, batch or operator command.  Note: the report may still be automatically generated by application logic.  <b>Period</b> The report is automatically generated at a periodical event, like the hourly and daily period roll-overs.  If trigger type 'Period' is selected then a second selection box shows all period triggers that are available in the application. Select the appropriate period trigger that will generate the report.  <b>Batch</b> The report is automatically generated at the corresponding batch end.  If trigger type 'Batch' is selected then a second selection box shows all batch triggers that are available in the application. Select the appropriate batch trigger that will generate the report.  <b>Command Tag</b> The report is generated on a specific operator command that can be issued from the display.  If trigger type 'Command Tag' is selected then a second selection box shows all command tags that are available in the application. Select the appropriate command tag that will generate the report.
<b>Storage</b>	Determines the limit method of stored reports (Nr. of days, Max. size or Nr. of reports).  
<b>Name suffix</b>	Identification method of each new report  <b>Timestamp</b> Adds a timestamp to each new report file  <b>Count</b> Adds a sequence number to each new report file
<b>Print to</b>	Determines to which printers the report is printed.  If no printers have been configured, a link to the Ports & Devices section will be displayed.



Otherwise a list of configured printers will be shown.



The number of copies under the “Generate copies” column is the number of copies that are printed on that printer when the report is first generated.

The number of copies under the “Reprint copies” column is the number of copies that are printed on that printer when the user manually instructs the flow computer to reprint an already generated report.

### Viewing and retrieving reports from the flow computer

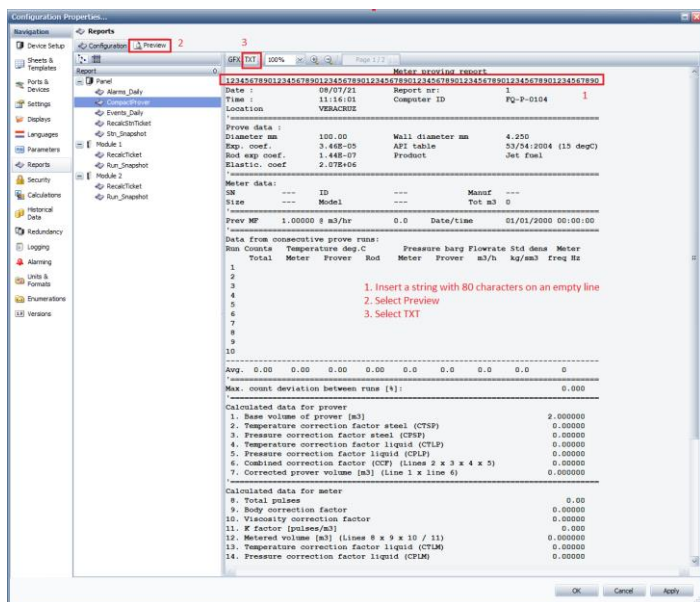
Archived data can be viewed and retrieved in several ways:

- 1 View on X/P and X/C touchscreen
- 2 Retrieve through a web browser
- 3 Retrieve through the XML interface

See the ‘Flow-X Web Services’ manual for more details on how to retrieve reports using web requests.

### Check on report line width

By default the report width is limited to 80 characters. Lines with more characters will overflow to the next line, which is unwanted in most cases. The following figure shows a method to check that a report will not exceed 80 characters per line.



# 15 Displays

## Overview

You can add user-defined displays to the standard applications, if required.

User-defined displays can be added before the standard displays in the menu when defined under section **Custom Displays (Before)** or after the standard displays when defined in section **Custom Displays (After)**.

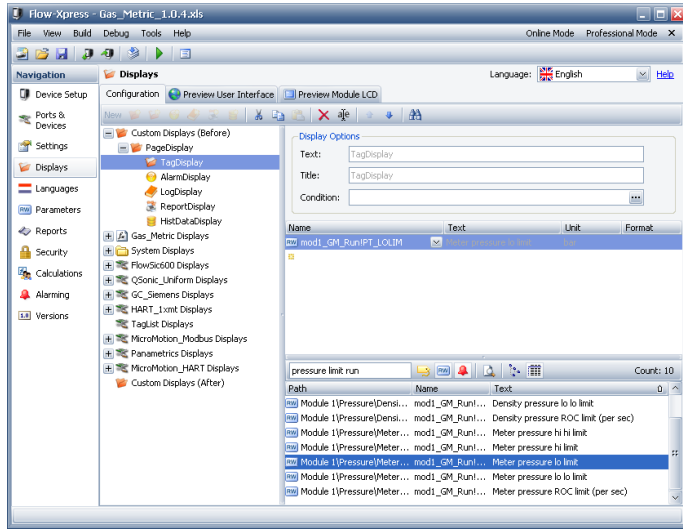









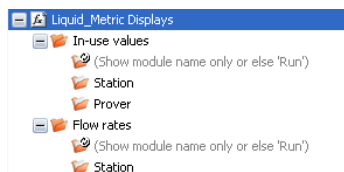
Figure 20: User-defined displays

The following display types can be defined;

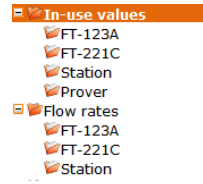
-  A **Page display** is a container for other displays. Multiple levels of page displays may be defined.
-  A **Tag display** contains tags and parameters (i.e. configuration settings or constants)
-  An **Alarm display** contains the actual alarms. This may be all alarms of the flow computer or alarms filtered on their state (active / not active, enabled / disabled, suppressed / not suppressed, acknowledged / not acknowledged, blocked / not blocked).
-  A **Log display** contains historical alarms and event logs
-  A **Report display** shows historical (archived) reports. These may be all reports or reports of a specific type and meter run (or station)
-  A **Historical Data** display shows historical data of either all the archives of a specific archive.

## Recurring displays

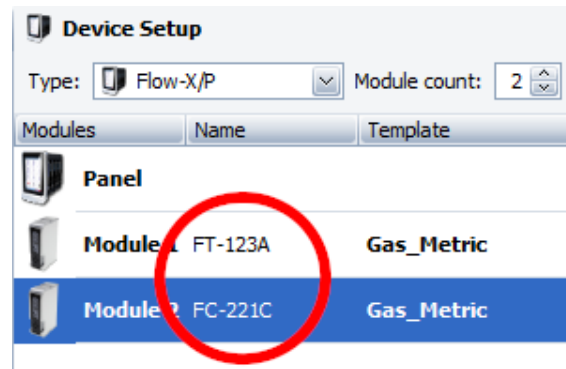
Displays can be made **recurring** by right clicking on the display in the tree-view and selecting 'Recurring'. Recurring displays are indicated by the arrows in the icon . If a display is recurring and there are multiple run modules (e.g. on an X/P2) then automatically a similar display will be created for each run.



This will show on the flow computer display as:



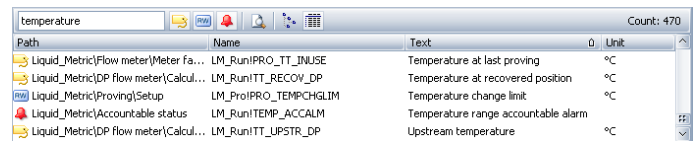
By default, the run displays are named 'Run 1', 'Run 2' etc., unless run names have been filled in at the device setup. In that case these names are used to identify the run displays.



## Adding data points to displays

To add a data point to a display, just drag it from the bottom right section (where an overview of all available data points is given), to the mid-right section (which shows all data points that are shown on the selected display).

A number of tools is available to make it easier to find a specific tag, such as a limit filter, which shows only the tags that meet the search text, and buttons to limit the output to a specific type of tags (**calculation tags, configuration parameters, alarms**).



## 16 Calculations

### Overview

You can add user-defined calculations and logic to the standard applications, if required.

Several examples are provided in application file 'Calculation examples.fxa'. You can copy and paste these examples into your Flow-X application file and modify these calculations to suit your specific installation.

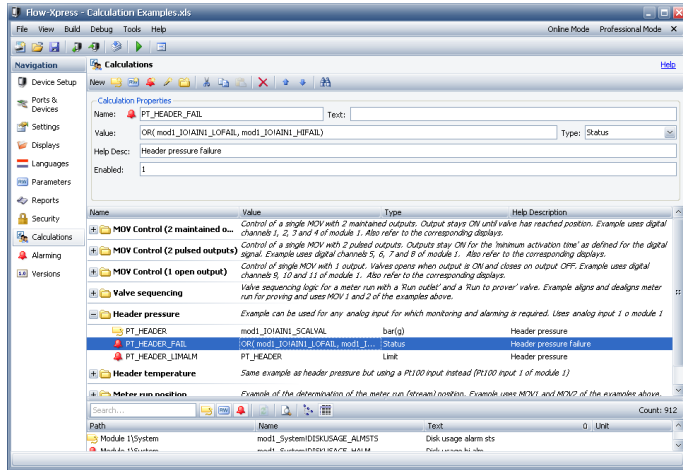







Figure 21: User-defined Calculations

With Calculations you can define additional data values, analog and digital inputs and outputs, alarms and logic

The following type of entries can be defined in section 'Calculations'

-  Defines a new **tag**, e.g. the 'Header pressure'. The tag value can be a constant or any expression. In case of a constant, the value can be set through additional calculations
-  Defines a new **parameter** (i.e. a configuration setting or a constant) that can be modified by the operator / engineer on the local flow computer display or remote web display.
-  Defines a new alarm. The following type of alarms are available:
  - **Status alarm** : any boolean expression may be defined for this purpose
  - **Limit alarm** : applies 4 limits on any variable: low low, low, high and high high
  - **Rate of Change alarm**: generate an alarm when the value changes more rapidly than the ROC limit (value per second)
  - **Deviation alarm**: monitors the deviation between two values and generates an alarm when the deviation is more than the limit.
-  Write a value to a tag whenever a particular event occurs (**set on event**), as long as a condition is true (**set on condition**), or when a value changes (**set on change**). Can be used for any purpose, e.g. for control logic or to write a value to a writeable tag (e.g. a parameter or a control command).
-  Groups a number of calculations together. Multiple group levels may be defined.



Calculations in the calculation editor should be designed 'top-down'. This means that it is possible to use in a calculation expression the result of another calculation that is above it, but not the result of a calculation that is below it.

It is not possible to use the result of a calculation in another calculation group.



Refer to application file 'Calculation Examples' for examples.

## 17 Time synchronization

### Overview

The Spirit<sup>IT</sup> Flow-X flow computer has an option to use the Network Time Protocol. NTP is used to synchronize time with other servers in the network. The time synchronization is using one second precision.

The synchronization of the time is under application control. This means that the synchronization can be paused for the time critical operation like a report printing.

The time synchronization functionality comes with the following recommendations / notes:

1. It's strictly recommended to avoid using the NTP server that is placed behind a NAT, especially if the NAT is using IP masquerade.
2. When using internet located servers: It's recommended to use four NTP servers to detect false tickers (wrong time configured). For private network solutions one NTP server could be feasible if the network quality allows it.
3. Support for time zone functionality **must** be resolved in the application. To correct the time for time zone CET you can adjust the offset with the +3600 seconds.
4. Support for daylight saving functionality **must** be resolved in the application.

The firmware on Flow-X contains the client-side implementation of SNTP. It possible to use domain names or IP addresses of the servers. By default, NTP port 123 is be used, but can be changed if needed.

NTP version 4 is supported but NTP authentication is not supported. Verify that the server is using version 4 before configuring it.
--

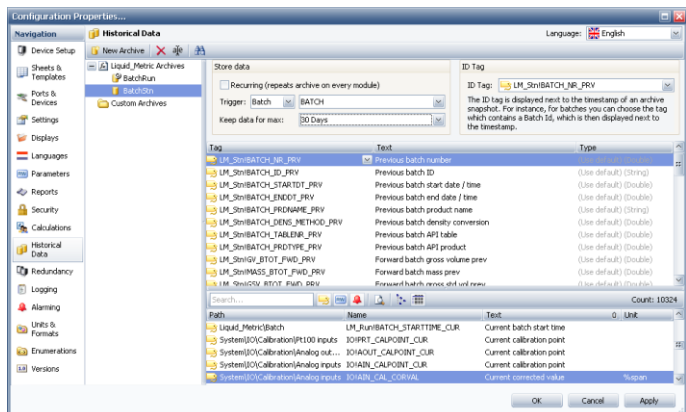
If synchronization fails an alarm will be raised.

# 18 Data Archives

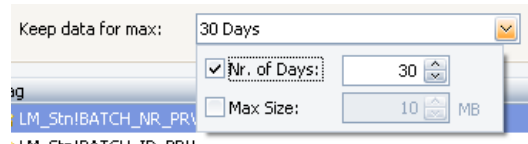
## Overview

The flow computer is able to store any number of data points to a Historical Data archive based on period intervals, batch end or manual command. Any number of archives may be defined.

Data archives are configured through Spirit<sup>IT</sup> Flow-Xpress professional as shown in the figure below.



Each data archive has its own retention period (expressed in number of days) or size in Mb.



### Adding data points to a data archive

Any data point may be added to an archive, not only data that corresponds with the selected period (e.g. a daily period) but also running data of other periods (e.g. monthly data), instantaneous data and actual parameter values.

Because period and batch data archives are generated after the period / batch has been finished, the data archive should contain **previous period** or **previous batch** data points respectively.

To add a data point, just drag it from the bottom right section (where an overview of all available data points is given), to the mid-right section (which shows all data points that are stored in the data archive).

A number of tools is available to make it easier to find a specific tag, such as a limit filter, which shows only the tags that meet the search text, and buttons to limit the output to a specific type of tags (**calculation tags, configuration parameters, alarms**).

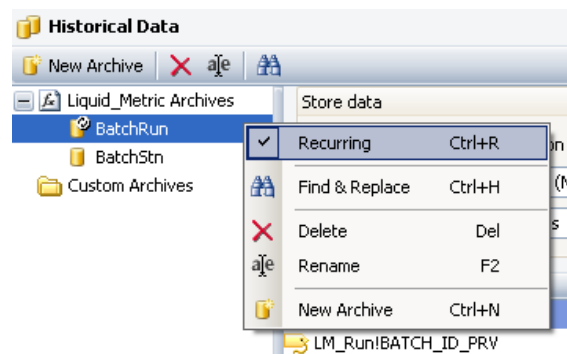
Path	Name	Text	Unit
Liquid_Metric(Flow meter(Meter Fa...	LM_RunIPRO_TT_INUSE	Temperature at last proving	°C
Liquid_Metric(DP flow meter(Calcul...	LM_RunITT_RECOV_DP	Temperature at recovered position	°C
Liquid_Metric(Proving(Setup	LM_ProIPRO_TEMPCHGLIM	Temperature change limit	°C
Liquid_Metric(Accountable status	LM_RunITEMP_ACCALM	Temperature range accountable alarm	
Liquid_Metric(DP flow meter(Calcul...	LM_RunITT_UPSTR_DP	Upstream temperature	°C

The standard applications typically contain archives that store all period and batch totals and averages. Additional archives may be defined.

A performance alarm function exists for the data archives. There are two alarm levels, Hi and HiHi. When Hi alarm is activated, it means that the flow computer is too busy and processing of the internal archive queue with archive requests is too slow. The number of data points in the archive, the triggering frequency, or the trigger moment can be considered to remedy this. For example, triggering periodic reports and archives at the same moment could result in a too high CPU load. When HiHi alarm is activated, the archive queue is almost full and archive items could be lost. The above mentioned measures should be deployed urgently to reduce the archiving load.

### Recurring data archives

Data archives can be made **recurring** by right clicking on the data archive in the tree-view and selecting 'Recurring'. Recurring displays are indicated by the arrows in the icon . If a data archive is recurring and there are multiple run modules (e.g. on an X/P2) then automatically a similar data archive will be created for each run.



### Viewing and retrieving of archive data

Archived data can be viewed and retrieved in several ways:

- 1 Show on a Historical Data **display** on the X/P touchscreen or web browser
- 2 Retrieve as XML-file through a **web browser**
- 3 Retrieve through the **XML interface**
  - See the 'Flow-X Web Services' manual for more details on how to retrieve historical data using web requests.
- 4 Retrieve by **Modbus** communication

---

<b>OMNI 6000</b>	Modbus OMNI 6000. Query size is 8 bytes and length is less than 256. The address space is from 701 to 712 (711 and 712 are special addresses for alarms and events ). Maximum 10 archives can be configured.
<b>OMNI 7000</b>	Modbus OMNI 7000. Query size is 8 bytes and length is less than 256. The address space is from 9701 to 9710 and 9784 to 9798. Maximum 25 archives can be configured.
<b>Enron</b>	Modbus Enron. Query size is 32 bytes and length is less than 256. The address space is from 0 to 65535. Maximum 100 archives can be configured.

---

For retrieval over Modbus, Flow-X emulates the Raw Data Archive feature of Omni flow computers. This allows legacy systems that have an automatic connection to Omni flow computers to directly interface with the Flow-X flow computer without the need to invest in a new software interface.

## 19 Redundancy

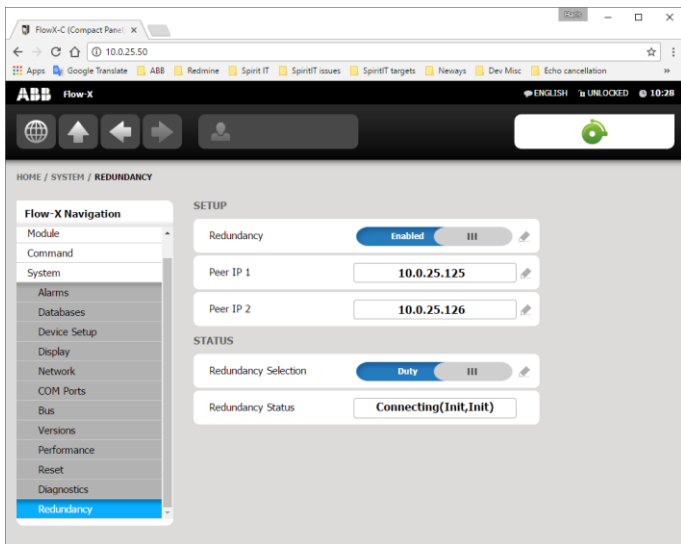
For critical applications two Spirit<sup>IT</sup> Flow-X flow computers can be set up in a **duty / standby** (also called master / slave) mode of operation. Both flow computers interface to the same input and output signals, perform the same flow computations and have equal communication links to external devices.

Data points configured for synchronization are sent from duty to standby flow computer either continuously or once at startup to ensure that no critical data is lost and to allow for bump less switchovers without any hiccups of control signals.

Typical data that are configured for continuous synchronization are PID control parameters and meter factors.

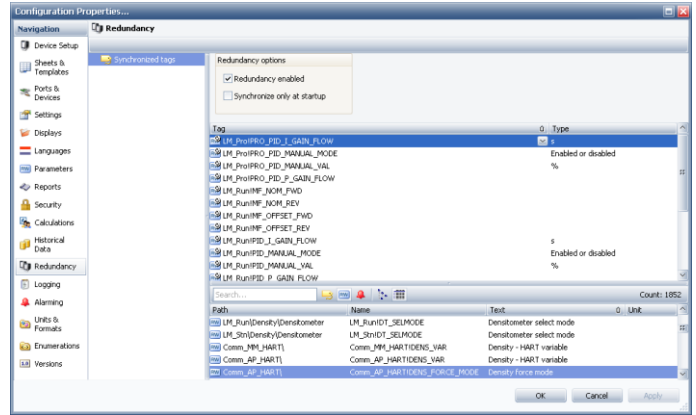
The flow computers exchange IP messages on both Ethernet ports to monitor each other's mode of operation (Duty / Standby) and to exchange a watchdog signal. Data synchronization is operational provided that at least one Ethernet connection is up and running.

To **enable** redundancy, go to display 'System\Redundancy' and enable option 'Redundancy' on both flow computers and define both IP addresses of the other flow computer (on both flow computers).



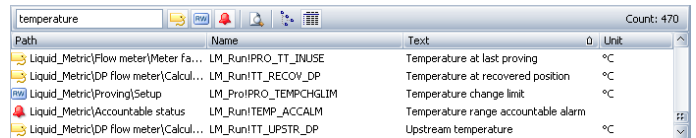
## Data points to be synchronized

The list of tags that is synchronized between the flow computers is set up in the Flow-Xpress Professional in section 'Redundancy'.



To add a data point to be synchronized, just drag it from the bottom right section (where an overview of all available data points is given), to the mid-right section (which shows all data points that are to be synchronized).

A number of tools are available to make it easier to find a specific tag, such as a limit filter, which shows only the tags that meet the search text, and buttons to limit the output to a specific type of tags (**calculation tags, configuration parameters, alarms**).



**!** For the purpose of redundancy it is strongly advised that **both** Ethernet ports **ETH1** and **ETH2** are either connected to an external hub or switch or inter-connected via a direct cross cable in order to have a redundant communication link between the two flow computers. See Security and Data protection → 'Flow-X Network Ports' for port used by Redundancy.

## 20 XML Interface

The Spirit<sup>IT</sup> Flow-X flow computer provides an XML interface in order to establish an automated interface with a host computer.

Web services are available for the following data and actions:

- Alarms state and acknowledgment
- General device information
- Display menu structure
- Text translations to foreign languages
- Event logs
- Historical data archives
- List of archived reports
- Read-out of individual reports
- Read and write data values
- Units and enumerations
- Flow computer application
- Users and security settings

The XML Interface provides read-only access without the need for user authentication. It is possible to configure certain information to be protected even for read-only access. For write access a logged in user with sufficiently high security level is always required. See also section Security and Data protection.

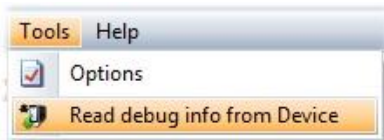
See the 'Flow-X Web Services' manual for more details.

## 21 Reading debugging information from a device

This chapter describes how to download information from a Spirit<sup>IT</sup> Flow-X device to send to ABB for debugging purposes

The procedure is as follows:

- 1 Connect an Ethernet cable between your computer and the Flow-X.
- 2 Set up your computer's Ethernet port.  
Make sure the IP-address of your computer's Ethernet card is in the same range (but not equal to) the IP-address of the corresponding Ethernet port of the Flow-X
- 3 In Flow-Xpress basic and online mode, select 'Read debug info from device' from the Tools menu. In Flow-Xpress professional mode, activate the 'Read debug info from device' button in the 'Tools' section of the ribbon.



- 4 Flow-Xpress will show a window with all the devices that are reachable on the local network. Select the device from which you want to read debugging information and click "Next >".
- 5 Flow-Xpress will ask you to enter the username and password for the user with the highest security rights. This information is necessary for Flow-Xpress to be able to download all debugging information that is available on the device. Pressing cancel on this dialog will allow Flow-Xpress to continue, but it is possible that some information cannot be read from the device.
- 6 Flow-Xpress will download the information from the device. Press the "Details" button to see a description of what Flow-Xpress is currently doing. After the download process is complete, the "Save As" button will become available. Clicking this button will allow you to select a folder and file name to which the debugging information will be saved.
- 7 Send the debugging information to ABB, so we can help you solving the problem.

## 22 Revisions

### Revision A

Date June 2012

- Initial release of the Flow-X Manual Volume IIA - Operation and Configuration.
- Added description of Historical Data Archives.
- Added description of Redundancy functionality.
- Added description of multi-drop HART.
- General review of the manual.

### Revision B

Date April 2017

- New GUI; new format of application files.
- Minor editorial changes.
- Added description of the screensaver functionality for the Flow-X/P flow computer.
- Updated the installer description for the new installer.
- Changed the footer and margin sizes to use the page more effectively.
- Deprecated “Com Port settings”, updated chapters 6 and 12.
- Updated the supported Windows and Excel versions.

### Revision C

Date December 2017

- Flow X/C related changes.
- Flow-X and Flow-Xpress images are updated.
- Supported baud rate range for Serial communication is updated.
- Update to new ABB lay-out.
- New document code: CM/FlowX-EN.
- Reintroduce revisions chapter.
- Include cyber security recommendations.

### Revision D

Date February 2019

- Flow-X/P version 2 hardware specific information added.
- Windows 8 removed from software requirements.
- Section for installation of Virus scanner and Malware added.
- New section with the list of Flow-X Network Ports added.
- Section for SNTP description added.

### Revision E

Date September 2019

- Updated HART description in Ports & Devices pictures.
- Updated Write to Device with Soft-boot possibility.
- Filtering blocked/non blocked alarms mentioned.
- Updated the supported Excel versions.

### Revision F

Date September 2020

- Updated Device Setup pictures.
- Updated “Full reboot and Partial reboot” section.

### Revision G

Date March 2021

- Add information about configuration of network port and protocol.
- Updated the list of Flow-X network ports.
- Updated description of device selection.
- Removed information about defining graphical printers since they are not available anymore.

### Revision H

Date October 2021

- Added documentation to enable faster file opening.
- Added description for RTU over TCP for Modbus Client.

### Revision I

Date July 2023

- Updated the list of Flow-X network ports.
- Added data archive alarm.

### Revision J

Date May 2024

- Updated the supported Excel versions.

### Revision K

Date January 2025

- Updated the list of Flow-X network ports.
- Added data archive alarm.
- Added new Modbus data types.
- Added explanation of username and password case-sensitivity.

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