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Spirit it
Innovative Technologies

Flow-X

Operation and Configuration

Software installation
User interface & Parameters
Reports & Communication
Historical data

Product	**Flow-X** Operation and Configuration manual
Reference number	02.10.03.A-2A
Revision	B.1
Date	Feb 2013

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Special note

Printed in the Netherlands.

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Chapter 1 - Document Control

Revision Coding

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

Example document:

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

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

Revision History

Revision A.0

Author : J.C.H.M. van Dal
Date : April 2010

Initial release of the Flow-X Manual Volume IIA - Operation and Configuration.

Revision A.1

Author : J.C.H.M. van Dal
Date : June 2010

Added description of Historical Data Archives

Revision A.2

Author : J.C.H.M. van Dal
Date : July 2010

Added description of Redundancy functionality

Revision A.3

Author : J.C.H.M. van Dal
Date : October 2010

Added description of multi-drop HART.

Revision A.4

Author : L.A.J. Joosten
Date : June 2012

General review of the manual.

Revision B.0

Author : M. Vorotilov
Date : August 2012

New GUI; new format of application files.

Revision B.1

Author : J.C.H.M. van Dal
Date : February 2013

Minor editorial changes.

Chapter 2 - Introduction

Manual set

Welcome to the exciting world of Flow-X!

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

This manual Volume IIA describes the generic Operation and Configuration manual that apply for all Flow-X models.

There are three reference manuals:

- *Volume I - 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

Purpose of this manual

The Flow-X manuals are written for a variety of readers:

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

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

Abbreviations

Throughout this document the following abbreviations are used:

ADC	**A**nalog to **D**igital converter
AI	**A**nalog **I**nput
AO	**A**nalog **O**utput
API	**A**pplication **P**rogramming **I**nterface An interface that allows an application to interact with another application or operating system, in our case, **Flow-X**. Most of the **Flow-X** API is implemented through Excel worksheet functions.
ASCII	**A**merican **S**tandard **C**ode for **I**nformation **I**nterchange. A set of standard numerical values for printable, control, and special characters used by PCs and most other computers. Other commonly used codes for character sets are ANSI (used by Windows 3.1+), Unicode (used by Windows 95 and Windows NT), and EBCDIC (Extended Binary-Coded Decimal Interchange Code, used by IBM for mainframe computers).
CPU	**C**entral **P**rocessing **U**nit
DAC	**D**igital to **A**nalog **C**onverter
DCS	**D**istributed **C**ontrol **S**ystem
DDE	**D**ynamic **D**ata **E**xchange A relatively old mechanism for exchanging simple data among processes in MS-Windows.
DI	**D**igital **I**nput
DO	**D**igital **O**utput
EGU	**Eng**ineering **U**nits
EIA	**E**lectrical **I**ndustries **A**ssociation
FET	**F**ield **E**ffect **T**ransistor
GC	G**as C**h**romatograph**
GUI	**G**raphical **U**ser **I**nterface

HART	**H**ighway **A**ddressable **R**emote **T**ransducer. A protocol defined by the HART Communication Foundation to exchange information between process control devices such as transmitters and computers using a two-wire 4-20mA signal on which a digital signal is superimposed using Frequency Shift Keying at 1200 bps.
HMI	**H**uman **M**achine **I**nterface. Also referred to as a GUI or MMI. This is a process that displays graphics and allows people to interface with the control system in graphic form. It may contain trends, alarm summaries, pictures, and animations.
I/O	**I**nput/**O**utput
IEEE	**I**nstitute for **E**lectrical and **E**lectronics **E**ngineers
ISO	**I**nternational **S**tandards **O**rganization
MMI	**M**an **M**achine **I**nterface (see HMI)
MIC	**M**achine **I**dentification **C**ode. License code of **Flow-X** which uniquely identifies your computer.
OEM	**O**riginal **E**quipment **M**anufacturer
P&ID	**P**iping and **I**nstrumentation **D**iagram
PC	**P**ersonal **C**omputer
PCB	**P**rinted **C**ircuit **B**oard
PLC	**P**rogrammable **L**ogic **C**ontroller. A specialized device used to provide high-speed, low-level control of a process. It is programmed using Ladder Logic, or some form of structured language, so that engineers can program it. PLC hardware may have good redundancy and fail-over capabilities.
RS232	EIA standard for point to point serial communications in computer equipment
RS422	EIA standard for two- and four-wire differential unidirectional multi-drop serial
RS485	EIA standard for two-wire differential bidirectional multi-drop serial communications in computer equipment
RTU	**R**emote **T**erminal **U**nit
SCADA	**S**upervisory **C**ontrol **a**nd **D**ata **A**cquisition

SQL	**S**tandard **Q**uery **L**anguage
SVC	**S**uper**v**isory **C**omputer
TCP/IP	**T**ransmission **C**ontrol **P**rotocol/**I**nternet **P**rotocol. Transmission Control Protocol/Internet Protocol. The control mechanism used by programs that want to speak over the Internet. It was established in 1968 to help remote tasks communicate over the original ARPANET.
TTL	**T**ransistor-**T**ransistor **L**ogic
UART	**U**niversal **A**synchronous **R**eceiver & **T**ransmitter
URL	**U**niform **R**esource **L**ocator. The global address for documents and resources on the World Wide Web.
XML	**E**xtensible **M**arkup **L**anguage. A specification for Web documents that allows developers to create custom tags that enable the definition, transmission, validation and interpretation of data contained therein.

Terms and definitions

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

Asynchronous	A type of message passing where the sending task does not wait for a reply before continuing processing. If the receiving task cannot take the message immediately, the message often waits on a queue until it can be received.
Client/server	A network architecture in which each computer or process on the network is either a client or a server. Clients rely on servers for resources, such as files, devices, and even processing power. Another type of network architecture is known as a peer-to-peer architecture. Both client/server and peer-to-peer architectures are widely used, and each has unique advantages and disadvantages. Client/server architectures are sometimes called two-tier architectures
Device driver	A program that sends and receives data to and from the outside world. Typically a device driver will communicate with a hardware interface card that receives field device messages and maps their content into a region of memory on the card. The device driver then reads this memory and delivers the contents to the spreadsheet.

Engineering units	Engineering units as used throughout this manual refers in general to the units of a tag, for example 'bar', or 'ºC', and not to a type of unit, as with 'metric' units, or 'imperial' units.
Ethernet	A LAN protocol developed by Xerox in cooperation with DEC and Intel in 1976. Standard Ethernet supports data transfer rates of 10 Mbps. The Ethernet specification served as the basis for the IEEE 802.3 standard, which specifies physical and lower software layers. A newer version, called 100-Base-T or Fast Ethernet supports data transfer rates of 100 Mbps, while the newest version, Gigabit Ethernet supports rates of 1 gigabit (1000 megabits) per second.
Event	Anything that happens that is significant to a program, such as a mouse click, a change in a data point value, or a command from a user.
Exception	Any condition, such as a hardware interrupt or software error-handler, that changes a program's flow of control.
Fieldbus	A set of communication protocols that various hardware manufacturers use to make their field devices talk to other field devices. Fieldbus protocols are often supported by manufacturers of sensor hardware. There are debates as to which of the different fieldbus protocols is the best. Popular types of fieldbus protocol include Modbus, Hart, Profibus, Devicenet, InterBus, and CANopen.
Kernel	The core of **Flow-X** that handles basic functions, such as hardware and/or software interfaces, or resource allocation.
Peer-to-peer	A type of network in which each workstation has equivalent capabilities and responsibilities. This differs from client/server architectures, in which some computers are dedicated to serving the others. Peer-to-peer networks are generally simpler, but they usually do not offer the same performance under heavy loads. Peer-to-peer is sometimes shortened to the term P2P.
Polling	A method of updating data in a system, where one task sends a message to a second task on a regular basis, to check if a data point has changed. If so, the change in data is sent to the first task. This method is most effective when there are few data points in the system. Otherwise, exception handling is generally faster.

Process visualization software	A system for monitoring and controlling for production processes, and managing related data. Typically such a system is connected to external devices, which are in turn connected to sensors and production machinery. The term 'process visualization software' in this document is generally used for software with which SCADA software, HMI software, or supervisory computer software applications can be built. In this document, although strictly not correct, the terms 'SCADA, 'HMI, 'supervisory', and 'process visualization' are alternately used, and refer to the computer software applications that can be realized with ***eXLerate***, Spirit IT's PC-based supervisory software.
Protocol	An agreed-up format for transmitting data between two devices. In this context, a protocol mostly references to the Data Link Layer in the OSI 7-Layer Communication Model.
Query	In SCADA/HMI terms a message from a computer to a client in a master/client configuration utilizing the message protocol with the purpose to request for information. Usually, more than 1 data-point is transmitted in a single query.
Real-time	The characteristic of determinism applied to computer hardware and/or software. A real-time process must perform a task in a determined length of time. The phrase "real-time" does not directly relate to how fast the program responds, even though many people believe that real-time means real-fast.
Resource	Any component of a computing machine that can be utilized by software. Examples include: RAM, disk space, CPU time, real-world time, serial devices, network devices, and other hardware, as well as O/S objects such as semaphores, timers, file descriptors, files, etc.
Synchronous	A type of message passing where the sending task waits for a reply before continuing processing.
Tag	A 'tag' as used within this document refers to a data point existing in the tag database, with a number of properties, such as its assigned I/O address, current value, engineering units, description, alias name, and many others.
Web Server	A computer that has server software installed on it and is used to deliver web pages to an intranet/Internet.

Document conventions

When the book symbol as displayed at the left appears in the text in this manual, a reference is made to another section of this or another 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.

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Chapter 3 - Flow-Xpress software

Flow-Xpress is the software package to configure and engineer Flow-X software applications

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

Figure 1: Flow-Xpress configuration software

A 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 Flow-Xpress software step-by-step a flow computer configuration is made using an Explorer-like tree. At this user level simple check-boxes 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, 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 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 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 Flow-Xpress is shipped with each flow computer. 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 Flow-X templates for a fit-for-purpose approach, tailor-made “firmware” can be created

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.

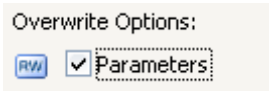
Parameters

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.

To change a parameter value in the flow computer you can do any of the following:

- Modify the parameter value directly on the flow computer display
- Enter the Flow-Xpress Online mode and change the parameter accordingly
- 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 **overwrite all** parameter values in the flow computer.



Reports

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.

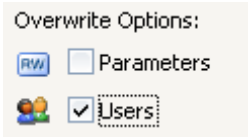
Security

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.

The actual users as stored in the loaded application are shown. These may be different from the actual as known by each flow computer.

To change security settings you can do any of the following:

- Enter the Flow-Xpress Online mode and make the changes accordingly
- 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 **overwrite all** security settings in the flow computer.



Calculations	Contains the user-defined calculations
Logging	Event log options
Alarming	Defines overall alarm settings including the colors used on the displays for the different alarm states.
Units & Formats	Defines the units that are used for the displays and the conversions between units.
Versions	Allows for version control of the applications and shows the revision history of the loaded application

Flow-Xpress Online mode

The 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.

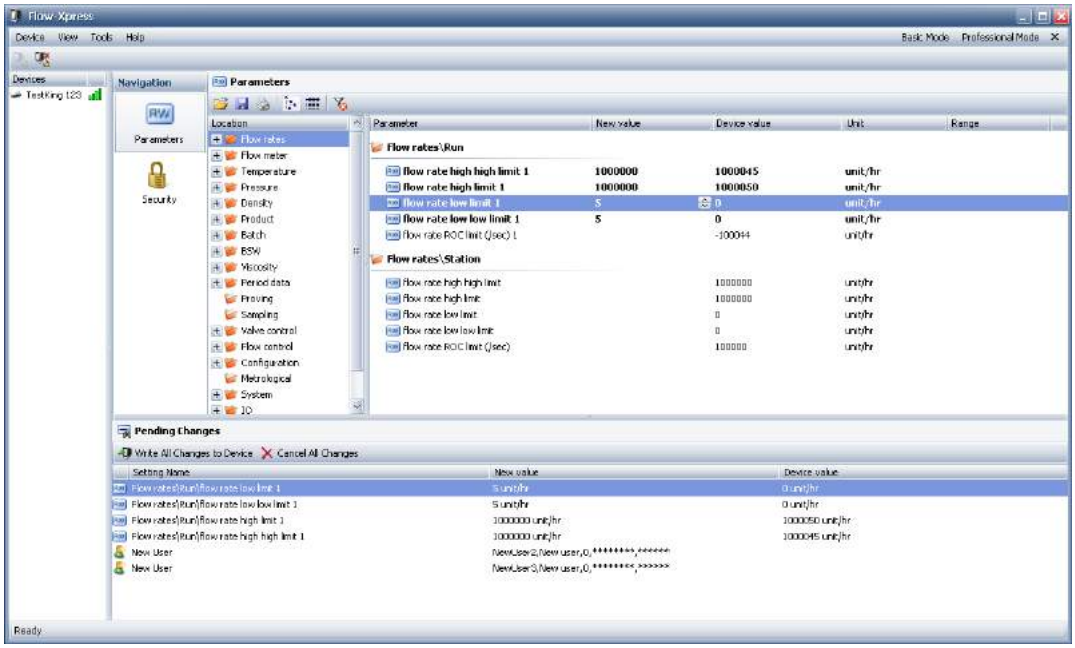
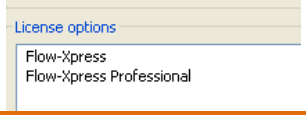


Figure 2: Flow-Xpress Online mode

Flow-Xpress Professional mode

Flow-Xpress Professional mode provides full access to all the functions and features.



Flow-Xpress Professional mode requires the 'Flow-Xpress Professional' license.

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

Flow-Xpress Professional mode is described *In* Flow-X manual *Volume IIIa - Advanced configuration*

The following functions are additional to the Flow-Xpress Basic mode

Structures the worksheets in templates

Defines the historical data archives

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.

Chapter 4 - Flow-X applications

Introduction

A 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).

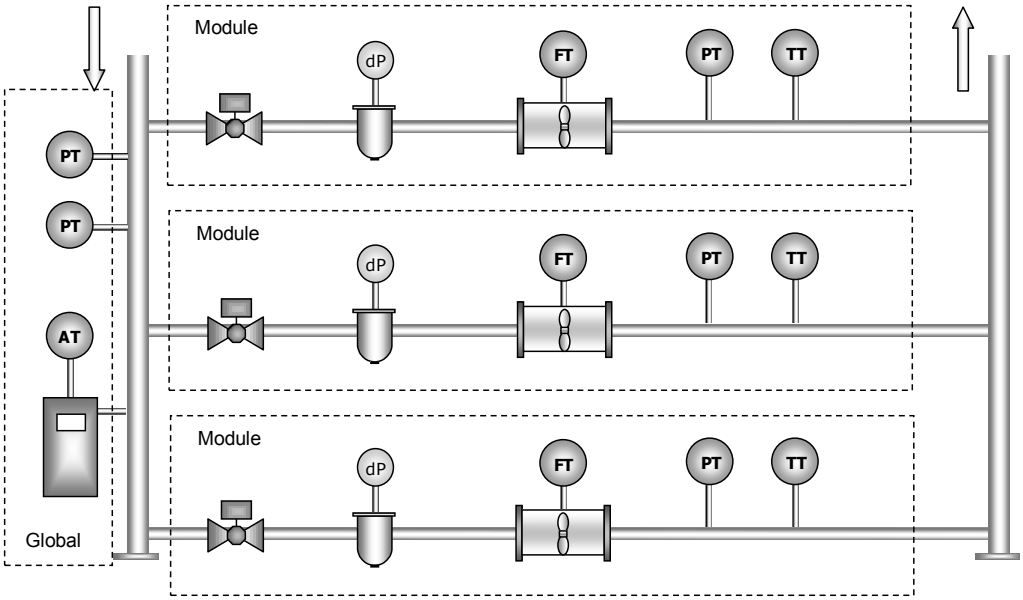


Figure 3: Typical gas metering station

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

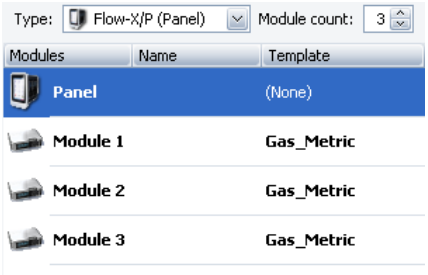


Figure 4: Flow-X/P template assignment

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 Flow-Xpress professional software.

Creating applications

Prior to version 1.5, Flow-Xpress stored 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 upgrading.

Flow-X Masters can only be created by 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 Flow-X application can be customized in Flow-Xpress Basic and written to a Flow-X flow computer. In order to create a Flow-X Application from a Flow-X Master, use the command “Create from Master” from the File menu.

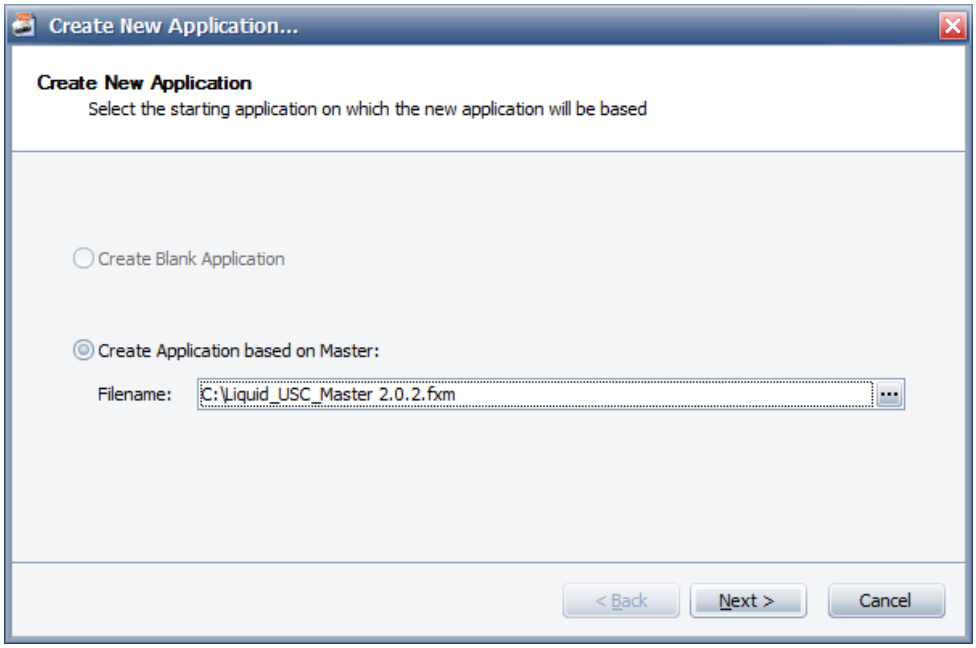


Figure 5: Creating an Application from the Master

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

Upgrading applications

Applications that were created from a Master can be upgraded to a newer version of that Master using the command “Upgrade to Master” from the File menu.

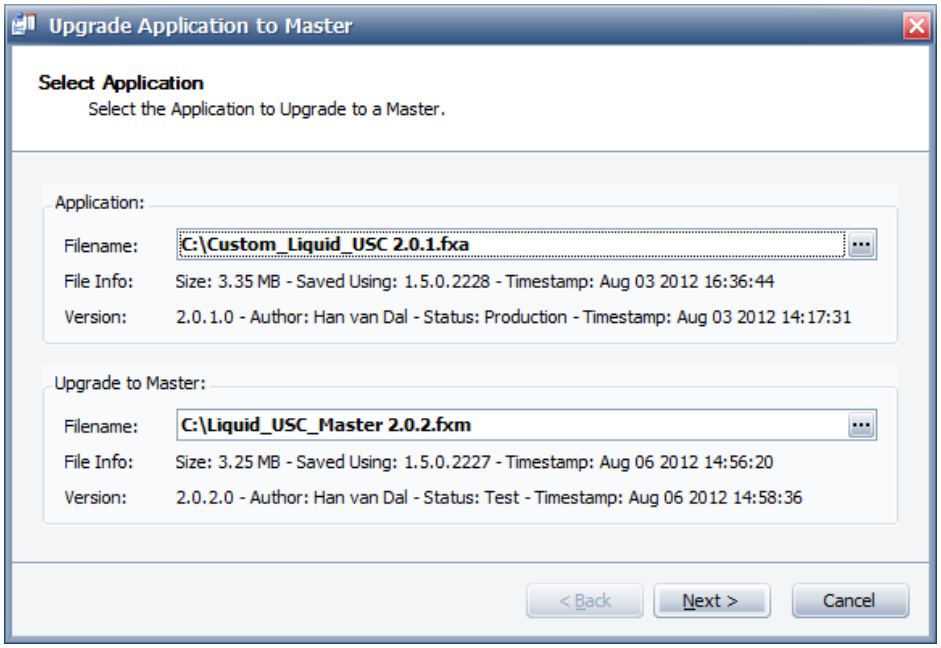


Figure 6: Upgrading application to the new master

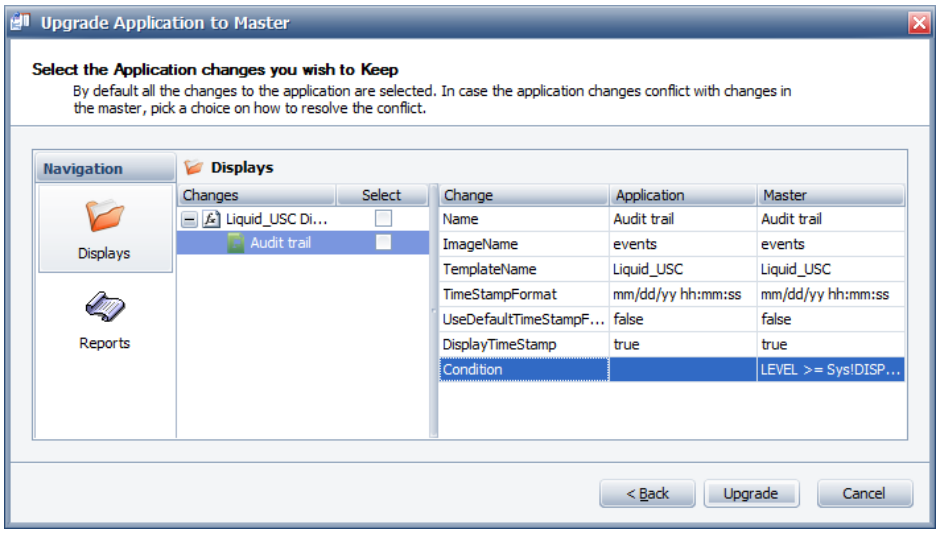


Figure 7: Selecting changes to keep during upgrade

It can happen that changes in the Master conflict with changes in the Application, e.g. one display has been deleted in the Master but the same display is modified in the Application. In this case, a choice must be taken during the upgrade.

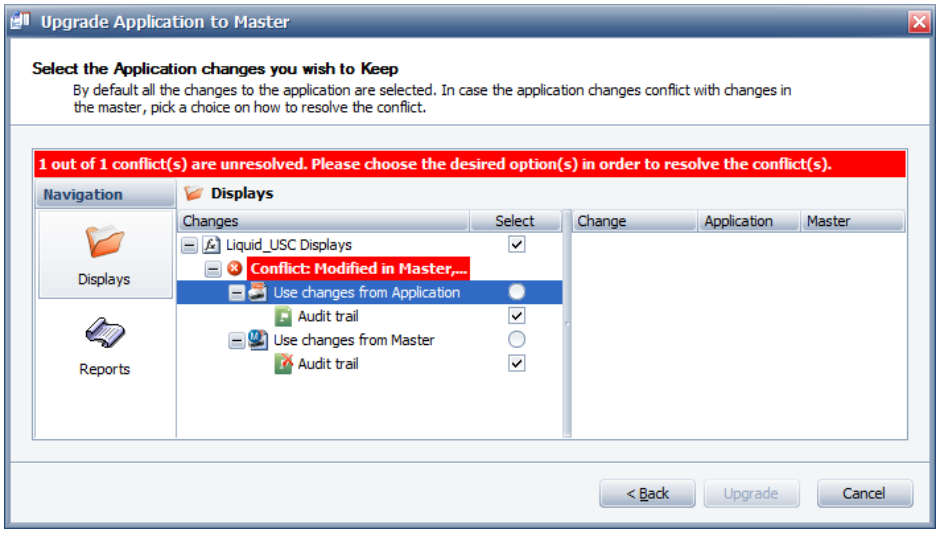


Figure 8: Conflict during upgrade

To resolve the conflict, simply select one of the given choices.

Spirit IT Master applications

Spirit IT provides several Master applications that are under revision and quality control of Spirit IT. 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 Flow-X Application Manuals.

Besides of the master applications provided by Spirit IT you can also set up and use your own application and communication templates, provided that you are authorized to use Flow-Xpress Pro. Refer to the Flow-Xpress Pro manual for more information.

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Chapter 5 - Software installation

This chapter describes how to install the FlowX-press configuration software to your computer.

Prerequisites

Flow-Xpress requires the following software to be installed on your computer:

- Microsoft Windows XP, Vista, 7, Server 2003 or Server 2008
- Microsoft Excel 2003 SP3 or Excel 2007 SP2

Software installation

by the end-user rather than by just our own software engineers. Such a concept allows total freedom of flow computer software for a system integrator or OEM customer.

The software installation process is through an automated procedure that is started by activating the setup file.

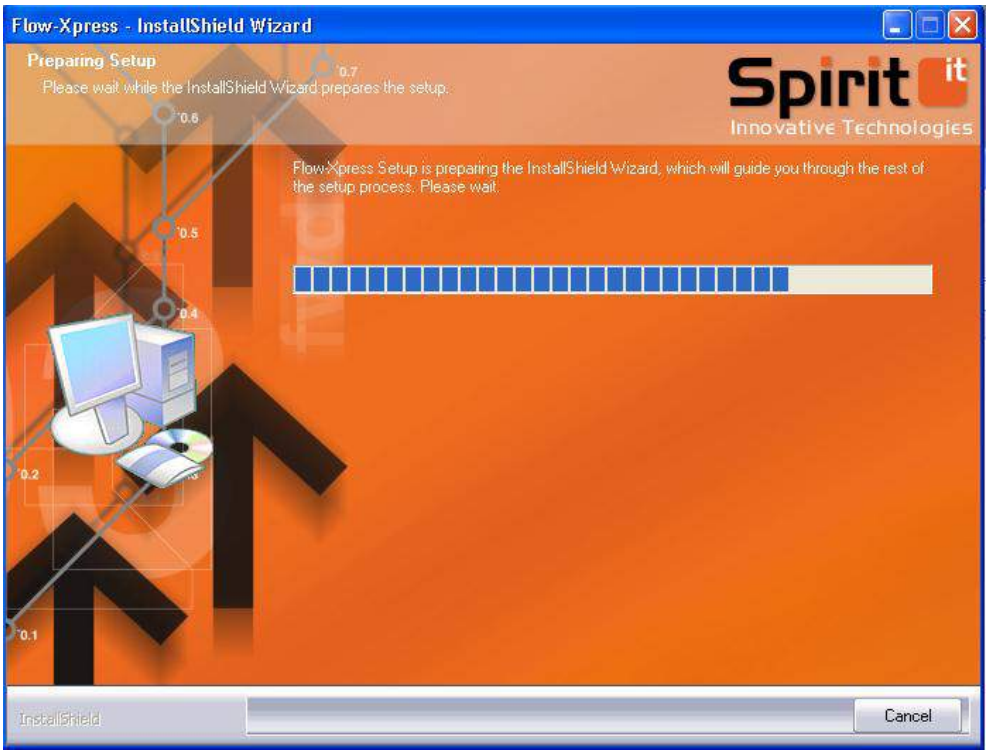


Figure 9: Flow-Xpress installation

Software de-installation

Software de-installation is through the Windows Add/remove programs option.

Chapter 6 - Writing an application to a device

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

The procedure is as follows:

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

Step 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

Step 3 : Open the application file in Flow-Xpress.

Flow-Xpress → Open File…

Step 4 : Load parameter file (if available) in Flow-Xpress.

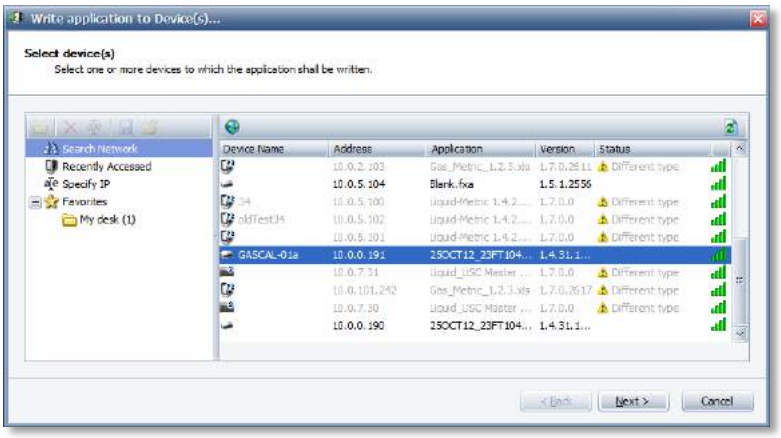
If no parameter file is loaded the default parameter set will be used.

Flow-Xpress → Parameters, Load

Step 5 : Write the application to the device.

Flow-Xpress → File, Write to device…

Flow-Xpress starts compiling the application. When this has been finished, Flow-Xpress shows a list of all available Flow-X devices on the network.

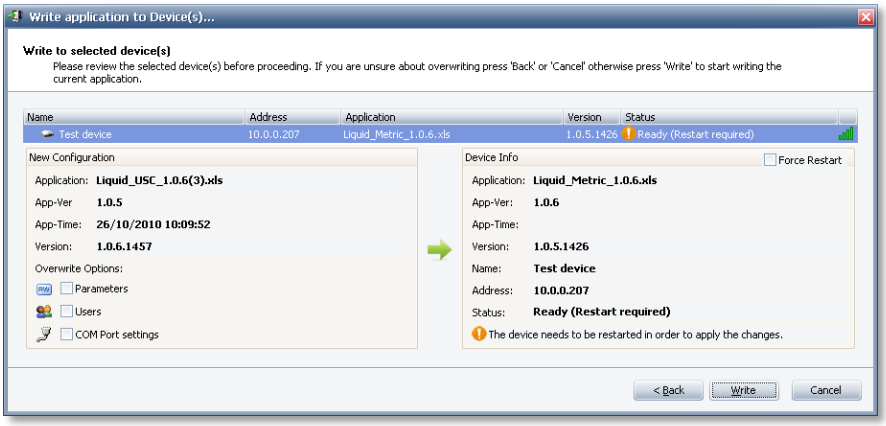


Select the device you want write the application to and click Next >.

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.

Step 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 (user names, passwords, etc.) from Flow-Xpress are written to the Flow-X as well, overwriting the settings in the Flow-X.

- **COM port settings**: If selected, the COM port settings (baudrate, databits, etc.) from Flow-Xpress are written to the Flow-X as well, overwriting the settings in the Flow-X.

WARNING: If you select one of these options (Parameters / COM-port settings / 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.

Step 7 : Enter administrator user name and password.

The administrator user name 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.

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Chapter 7 - Reading an application from a device

This chapter describes how to read an application from a Flow-X device

The procedure is as follows:

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

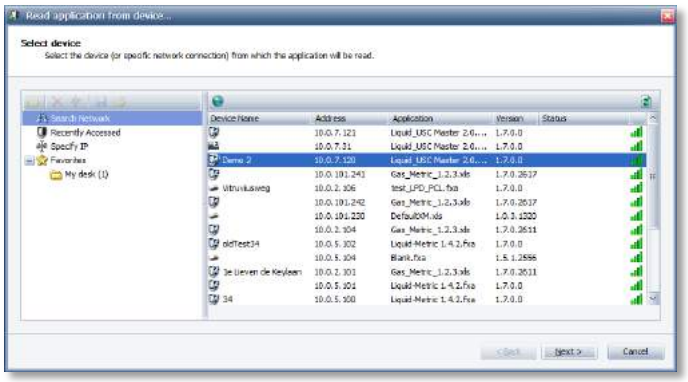
Step 2 : Set up your computer's Ethernet port.

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.

Step 3 : Start Flow-Xpress and select 'Read from device…'

Flow-Xpress → File, Read from device…

Flow-Xpress shows a list of all available Flow-X devices on the network.



Step 4 : 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.

Step 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&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.

Chapter 8 - Setting up the device

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

Overall set-up procedure

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

Step 1 : Setting up **Ethernet**

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

Step 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 touch screen can be re-calibrated if required.

Step 3 : Setting up the **communication bus**

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

Step 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.

Step 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.

Step 6 : Setting up **HART devices**

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

Step 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.

Step 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.

Step 9 : Setting up **security**

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

Step 10 : Setting up **printers and reports**

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

Step 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.

Step 12 : Add **user-defined calculations**

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

Step 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.

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

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

IP address Unique IP address

Subnet Mask 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'.

Default Gateway 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

Usually not defined ("0.0.0.0"), typically required for VPN connections.

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 10: Ethernet settings on the LCD display

Display → System, Network

Setting up Ethernet on a Flow-X/P

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

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

Figure 11: Ethernet settings on the LCD display

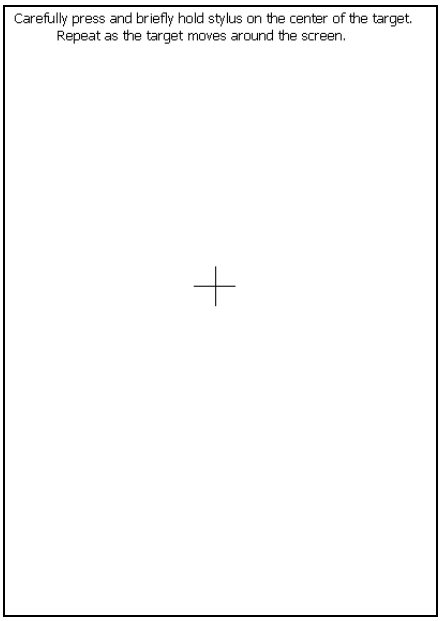
Display → System, Display

Setting up the display on a Flow-X/P

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

Orientation Sets the display orientation to either 'Vertical' (the default) or 'Horizontal'.

Re-calibrate Enables a 5-point recalibration of the Flow-X/P touch screen the next time the device is powered up.



Display → System, Display

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Chapter 9 - 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:

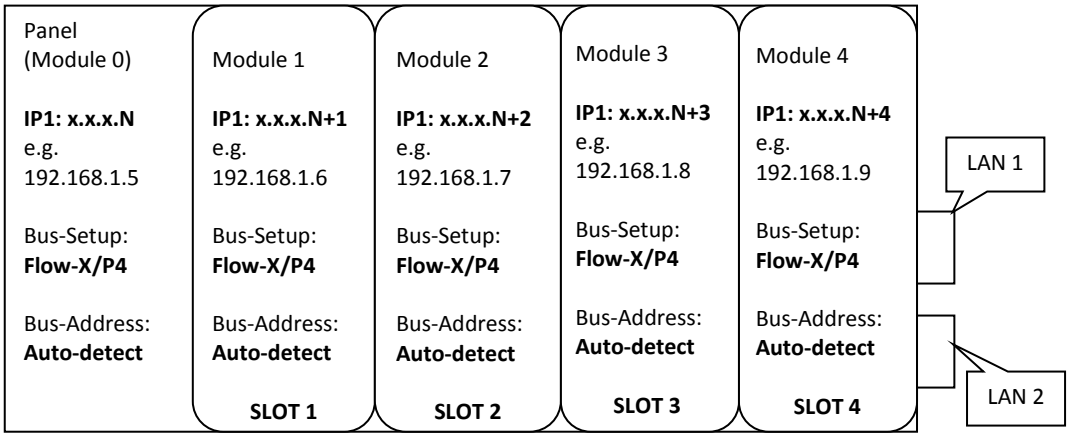
- Step 1: Install the flow modules in the Flow-X/P chassis

  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.

- Step 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'

- ## Step 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)

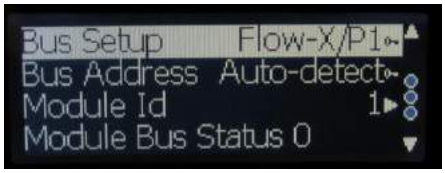
1 module	**Flow-X/P1**
2 modules	**Flow-X/P2**
3 modules	**Flow-X/P3**
4 modules	**Flow-X/P4**

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

- ## Step 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.



- Step 5 Power the flow computer off and on again
- Step 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)

- Step 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).

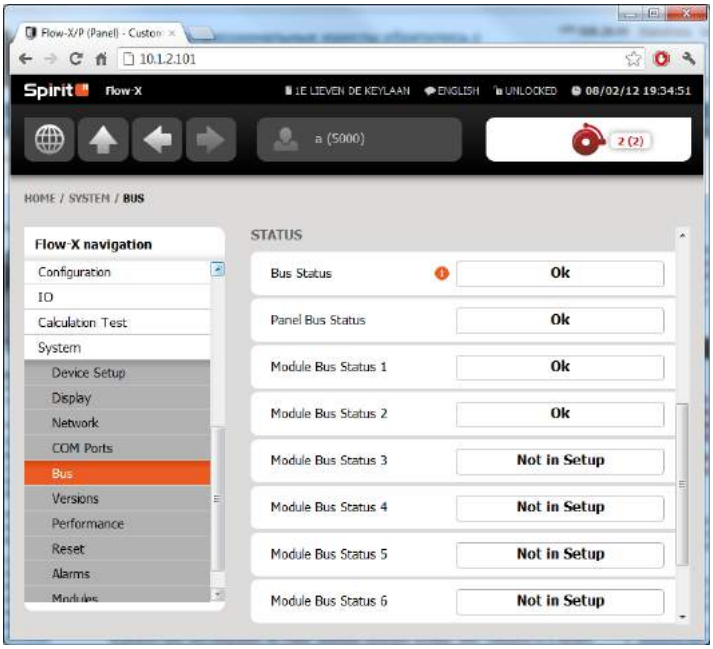


Figure 12: Checking the communication bus status

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Chapter 10 - Setting up the application

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

- Start **Flow-Xpress**

Figure 13: Flow-Xpress startup display

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

or alternatively:

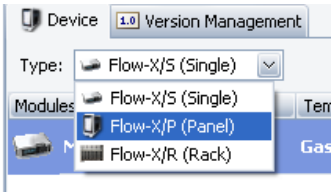
- Select **Read from Device** under **Start Here** to read an application file from a flow computer and use that as a string point for your modified configuration.

Figure 14: Flow-Xpress Basic mode main display

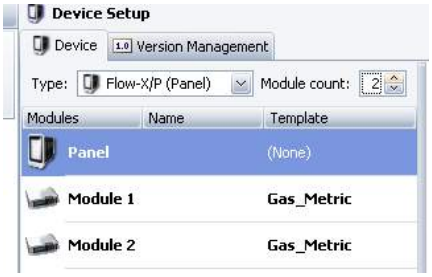
The next step is to the set-up the flow computer device.

Device Setup

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



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



- 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.

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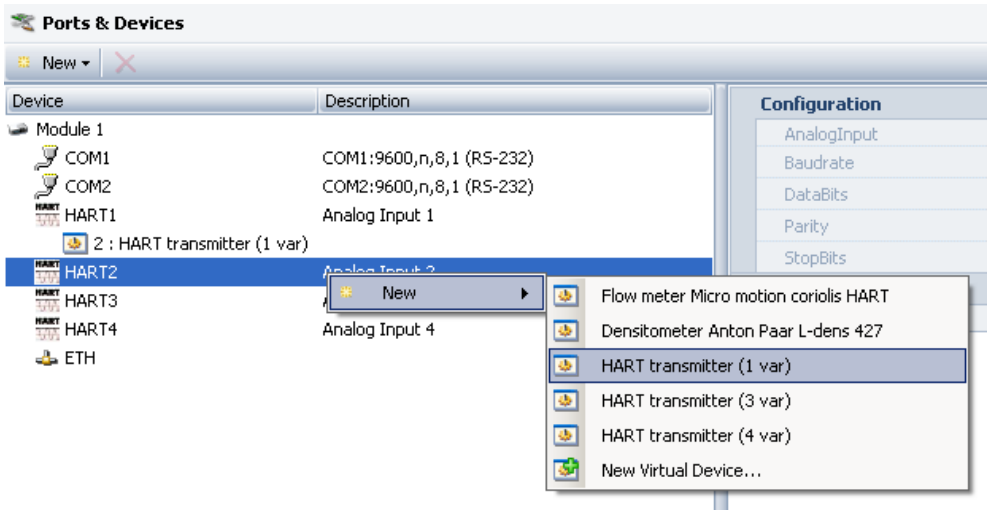
Chapter 11 - Setting up HART communication

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.

- In Flow-Xpress select **Ports & Devices**.
- Select the Flow-X/M flow module to which the HART loop is / will be connected.
- 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**.

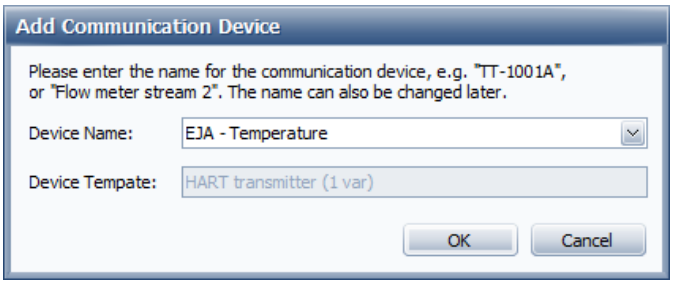


- Select the HART device from the pop-up list.

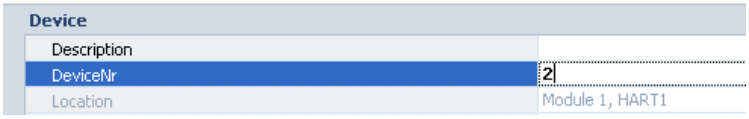
Select **HART transmitter (1 var)** for generic HART communication with any HART device. This will have the flow computer read the primary variable only.

If the flow computer should read the 2nd, 3th or 4th 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.

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



- 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.



You may modify the DeviceNr.

- 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*):

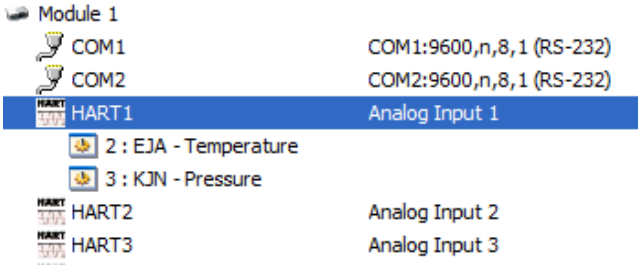
For single HART transmitters (no multi-drop) the HART slave address is usually 0.

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.

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



- Write the application to the Flow-X device
- 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).

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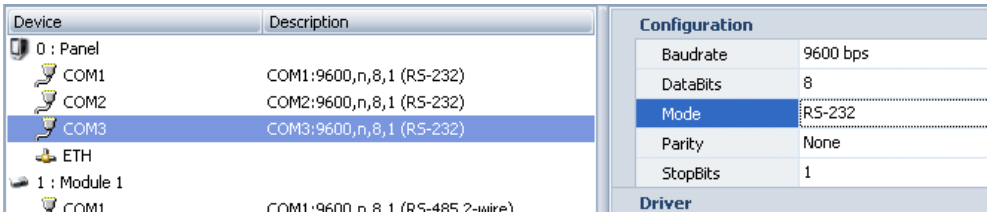
Chapter 12 - Setting up communication devices

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

- In Flow-Xpress select **Ports & Devices**.
- Select the COM port and make sure all settings match with the connected device.



Baudrate Baud rate (110 to 256000)

DataBits Number of data bits (5, 6, 7 or 8).

Mode Type of electrical connection: **RS232**, **RS485 (2-wire)** or **RS485 (4-wire)**.

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.

Note that COM1 of the touch screen panel (0: Panel) is a RS232 port only.

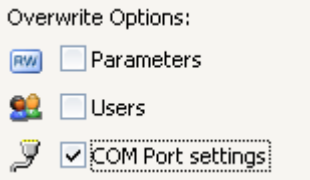
Refer to Flow-X Volume Installation manual for electrical connection details.

Parity Type of data parity bit: None, Odd, Even, Mark or Space.

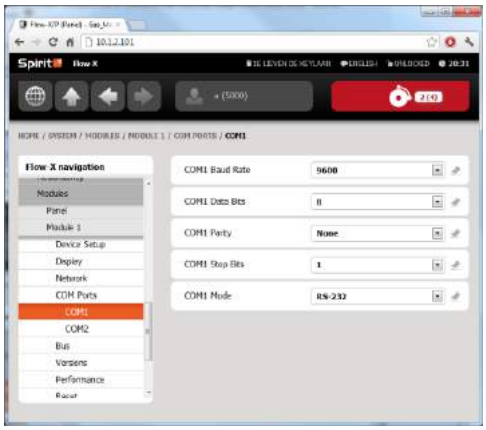
If the parity bit is present but not used, it may be referred to as mark parity (when the parity bit is always 1) or space parity (the bit is always 0).

Stopbits Number of stop bits (1, 2 or 1.5)

Note: When writing the application to the flow computer, a selection can be made whether or not to write the COM port settings. Note that this will **overwrite all** COM port settings in the flow computer.



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>*.

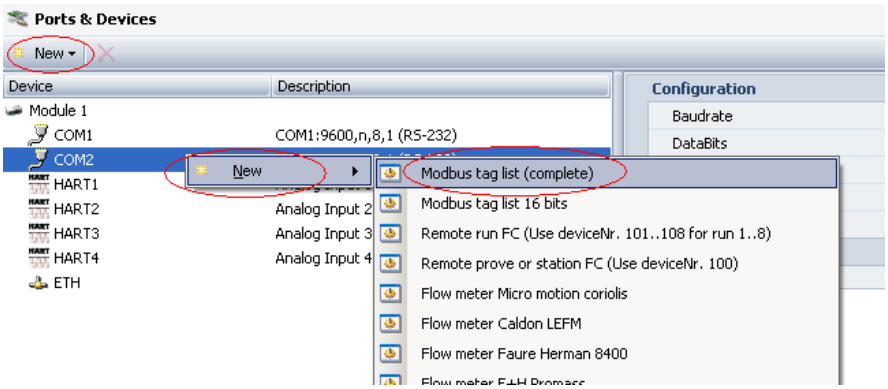


Setting up communication with a host computer

- 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'*).

- Select the COM port to which the device will be connected, then

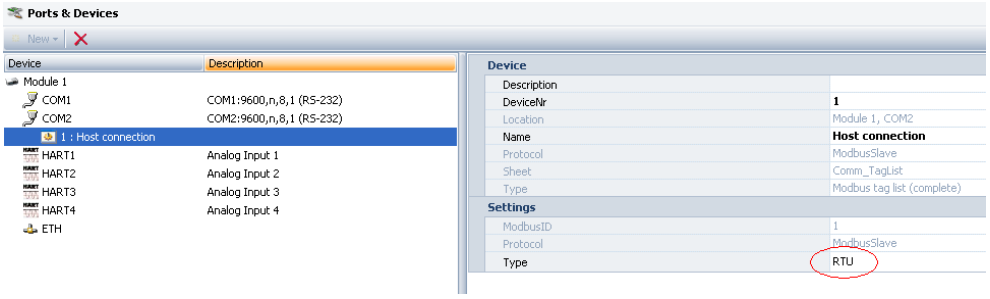
  either select **New** or right-click the port and select **New**.



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

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

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



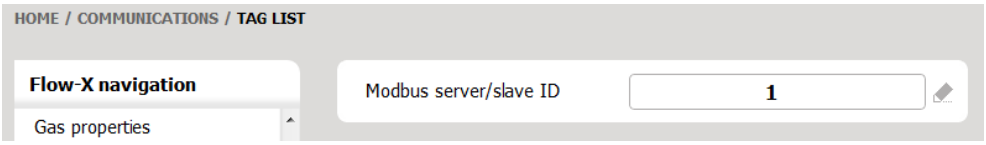
RTU Modbus RTU.

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.

RTU16 Modbus RTU, 16-bit register based. Refer to section 'Modbus – Register sizes' for further details.

ASCII Modbus ASCII (uses the same type of register addressing as Modbus RTU)

- 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*):

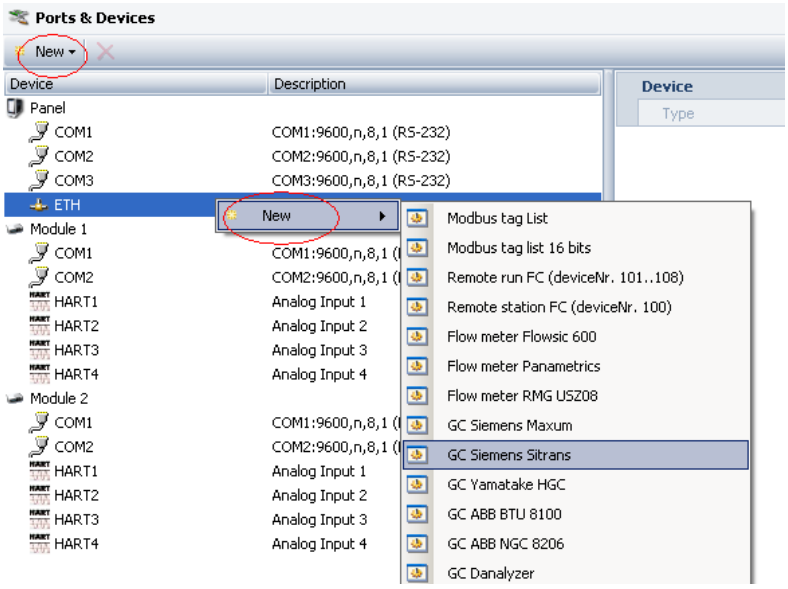


The actual Modbus addresses can be inspected by opening the application file in Flow-Xpress professional.

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:

- 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.

- Define a name for the device. This name will be used on the displays.

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

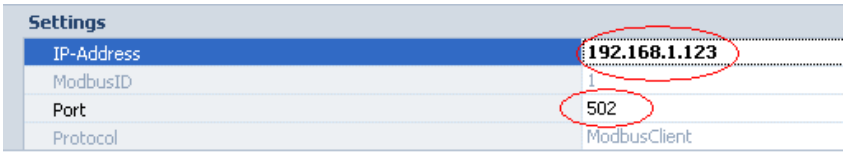
RTU Modbus RTU.

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.

RTU16 Modbus RTU, 16-bit register based. Refer to section 'Modbus – Register sizes' for further details.

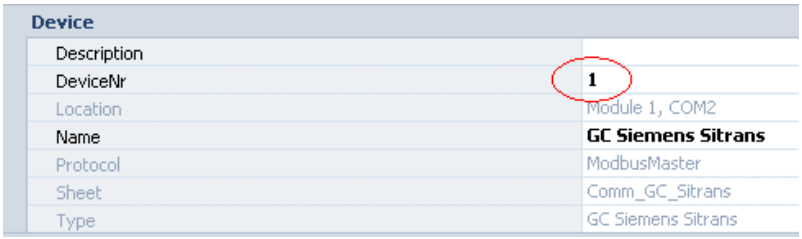
ASCII Modbus ASCII (uses the same type of register addressing as Modbus RTU)

- In case of Ethernet communication, fill in the **IP-address** of the device and the **port number** to be used.

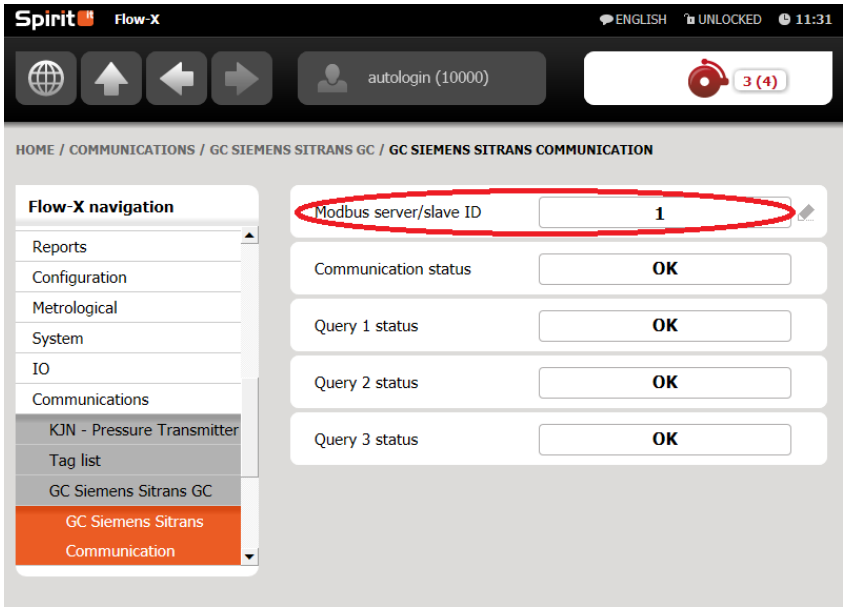


- Note the **DeviceNR** that has been assigned to the device. This deviceNR you will need later in the configuration process, to define for which purpose this communication device will be used (f.e. GC A of meter run 3).

  You may modify the DeviceNr.



- 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. F.e. 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_Run!TT_CUR	Run 1 - Meter temperature	degC	float
14	2601	mod1_LM_Run!PT_CUR	Run 1 - Meter pressure	bar	float
14	2602	mod1_LM_Run!PT_CUR_ABS	Run 1 - Meter pressure - Absolute	bar_a	float
14	2603	mod1_LM_Run!PT_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 (f.e. 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.

Chapter 13 - 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 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.*

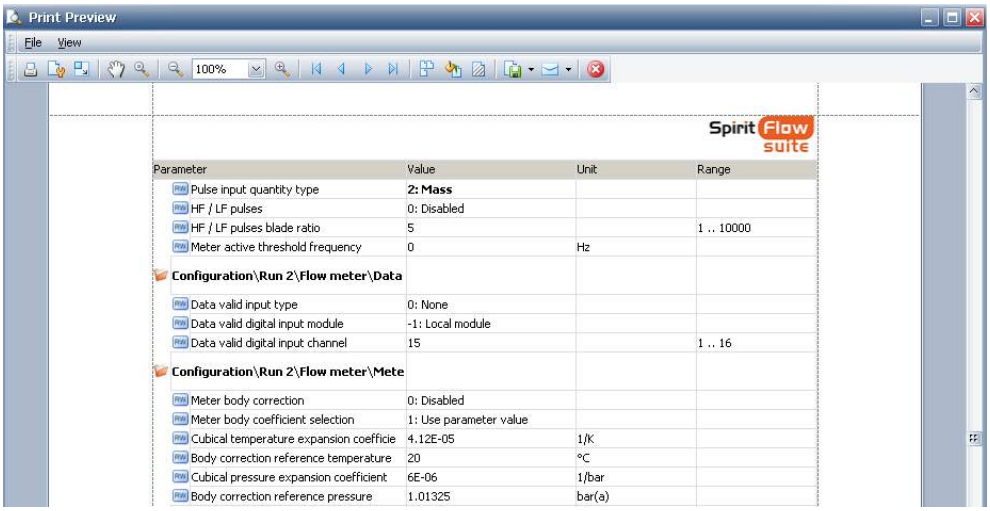
However, in Flow-Xpress section **Parameters** it's possible to show **all configuration parameters**, whether they are applicable or not, by clicking the  icon.

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.

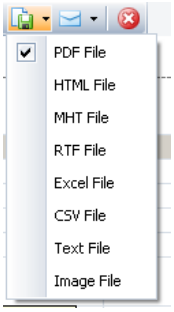
Parameter files can be **loaded**  into and **saved**  from Flow-Xpress. Loading a parameter file will overwrite all current values of the configuration parameters in the application file.

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.



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.

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Chapter 14 - 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.

Figure 15: 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 Spirit IT applications.

User name	Password	PIN code	Security level
operator	operator	000123	500
tech	tech	898989	1000
engineer	engineer	101010	1500
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.

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

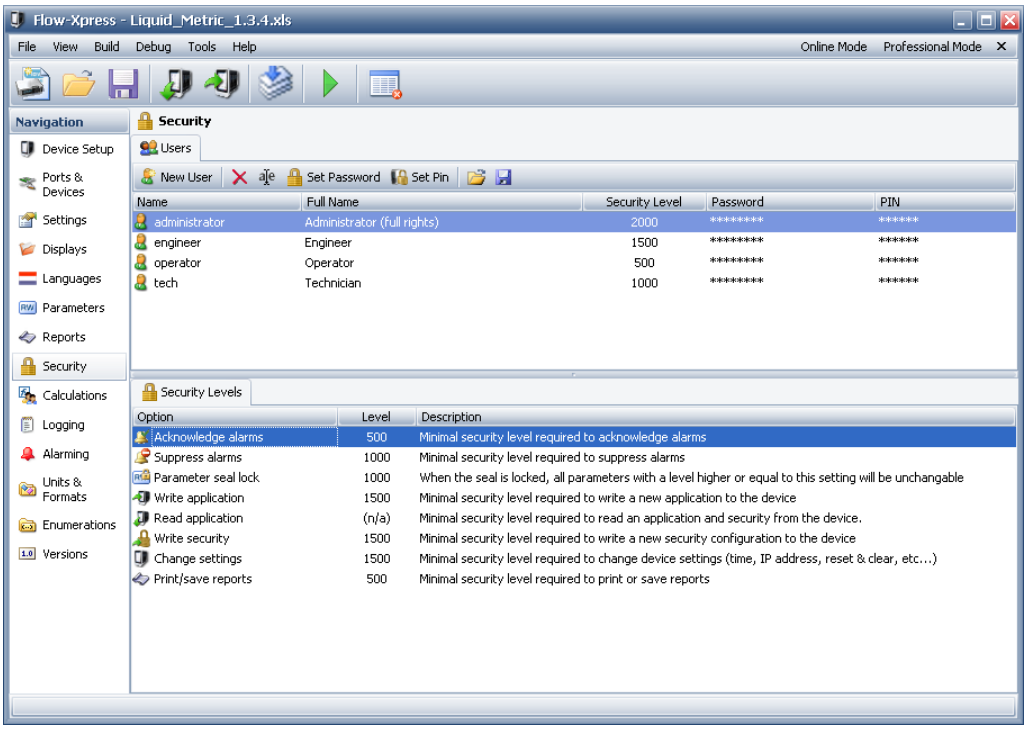

Figure 16: Security settings

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Chapter 15 - Reports & printers

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

Defining a serial text printer

- In Flow-Xpress select **Ports & Devices**.
- 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.
- First select the COM port, then select 'New' (or right-click and select 'New'), and then select 'Text printer (serial)'.

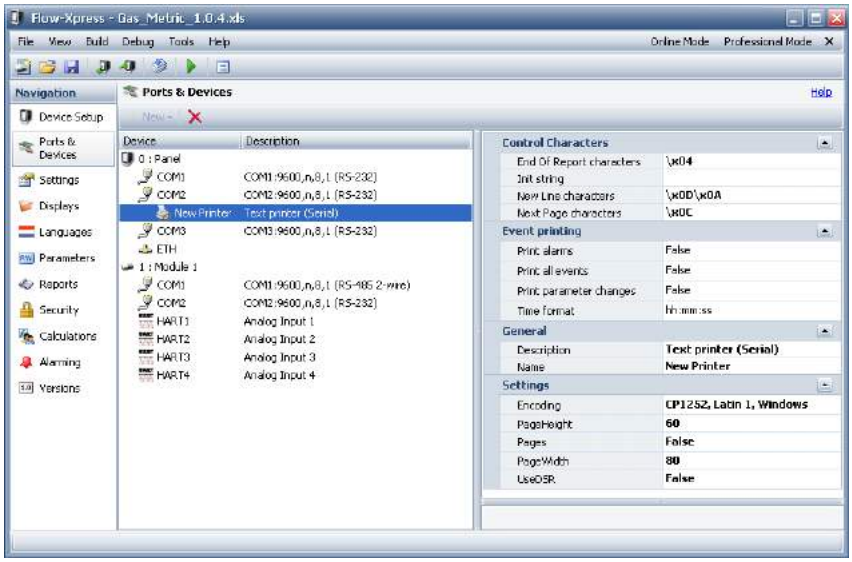


Figure 17: Serial printer settings

- If required change the settings for the printer.

End Of Report characters	Hexadecimal sequence code at the end of the report
Init string	Hexadecimal sequence code to initialize the printout. E.g. for *condensed mode* printing enter '\x0F'
New line characters	Hexadecimal sequence code for a new line
Next page characters	Hexadecimal sequence code at the end of the page

Print alarms	Automatically prints alarms to the printer
Print all events	Automatically prints events to the printer
Print parameter changes	Automatically print parameter changes to the printer
Time format	Time format used for printer alarms, events and parameter changes.
Description	Description of the printer
Name	Name of the printer as it appears in Flow-Xpress when selecting the printer or referring to the printer from the application.
Encoding	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.
PageHeight	The number of lines per page. The flow computer will automatically add blank lines at the end of each report such that ach printout takes a whole number of pages, provided that option 'Pages' is enabled.
Pages	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 whole number of pages (based on setting 'PageHeight').
PageWidth	Page width in number of characters. For each line the flow computer will skip characters that go beyond this number.
UseDSR	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 : **Com 1 - pin 8 (CTS)** Flow-X/M : Digital channel **16** of the same module

Defining an Ethernet graphical printer

The flow computer supports the **PCL** printer protocol to print graphical reports over TCP/IP Ethernet.

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

Description Description of the printer

Name Name of the printer as it appears in Flow-Xpress when selecting the printer or referring to the printer from the application.

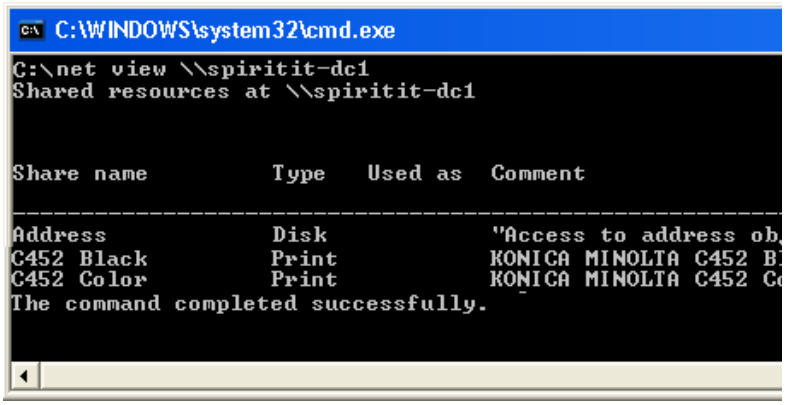
- Other settings can be configured on the flow computer itself, after the application is uploaded to the device. Using e.g. the Flow-X panel GUI or the Web UI, go to System > Printers and configure the following settings:

Network share Name of the printer port as it defined on the Ethernet network, defined as:

*server name**printer share*

e.g. "\\spirit-dc1\C452 Black"

To check the printer shares you can use the command prompt and then type the 'NET VIEW \\<*server name*>' command.



Make sure that the flow computer is allowed to access the printer share (also see note below).

User name (Domain) user to connect to the printer. Required when accessing the printer over a network with restricted security

*domain**user*

User password Password to connect to the printer

Please make sure that the user defied 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.

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.

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

  Name Name of the printer as it appears in Flow-Xpress when selecting the printer or referring to the printer from the application.

  Encoding Sets the Code Page. The default code page is UTF-8 (Unicode).

  PageWidth Page width in number of characters. For each line the flow computer will skip characters that go beyond this number.

- 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.

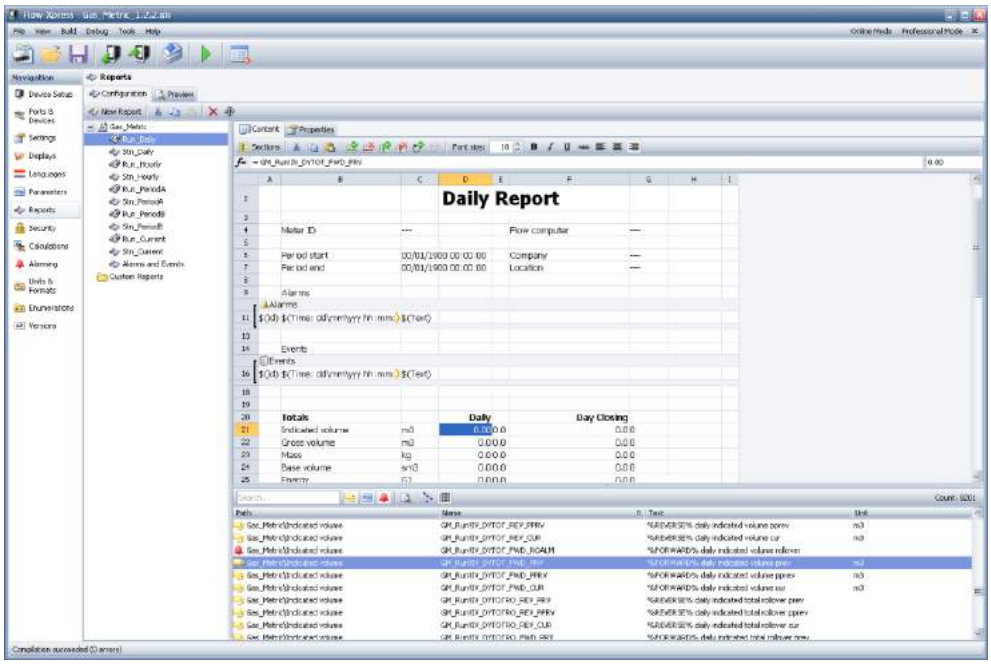


Figure 18: Report Content

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:

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.

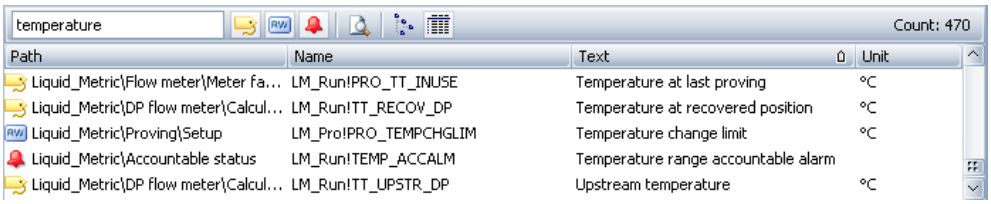
Remove the selected Alarm or Event section

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/yyy hh:mm:ss”

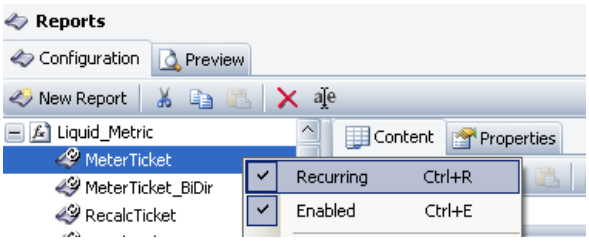
To add a data point to a report, just drag it from the bottom right section (where an an overview of all available data points is given), to a cell in the report.

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:

Generate 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:

Manual

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.

Period

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.

Batch

The report is automatically generated at the corresponding batch end.

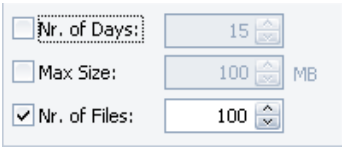
If trigger type 'Batch' is selected then a second selection box shows all batch triggers that are available in the application. Select the appropriate batch trigger that will generate the report.

Command Tag

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.

Storage Determines the limit method of stored reports (**Nr. of days, Max. size** or **Nr. of reports**).



Name suffix Identification method of each new report

Timestamp

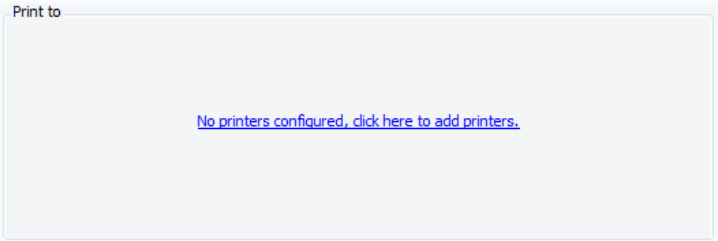
Adds a timestamp to each new report file

Count

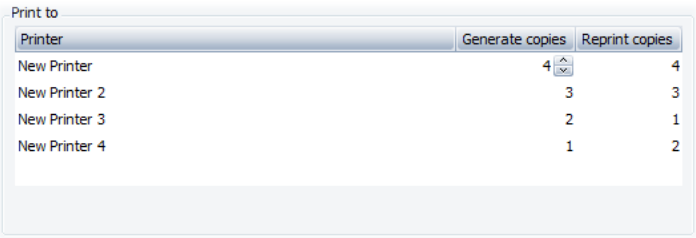
Adds a sequence number to each new report file

Print to 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 printer 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 touchscreen**
2. Retrieve throug 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.

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Chapter 16 - 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)**.

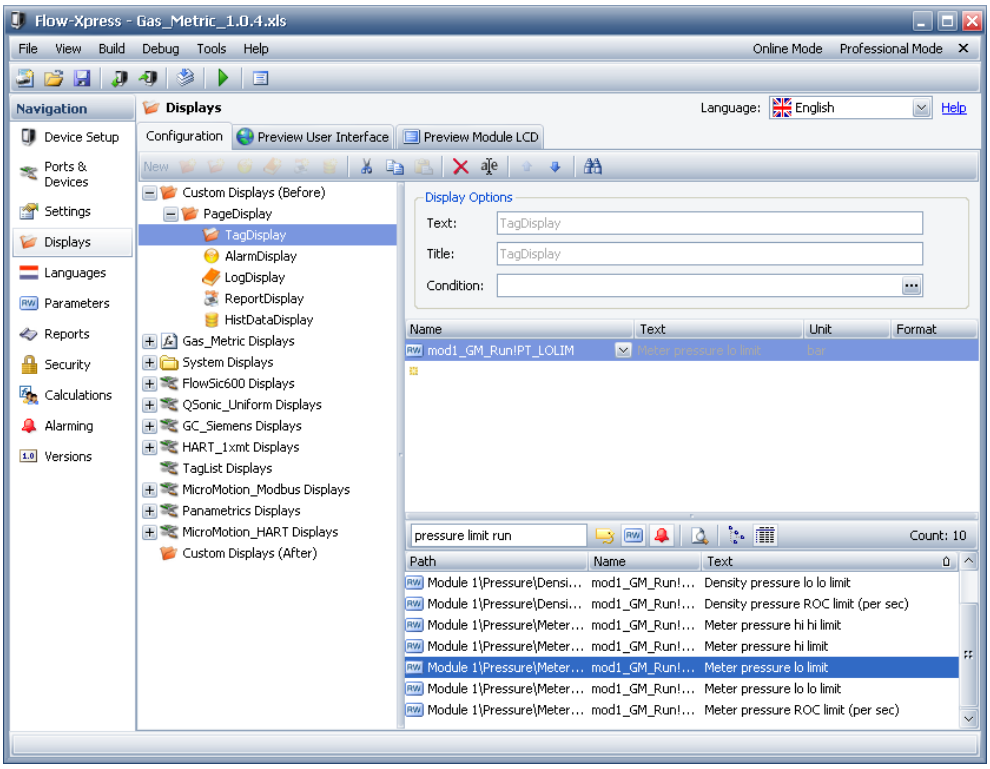


Figure 19: User-defined displays

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).

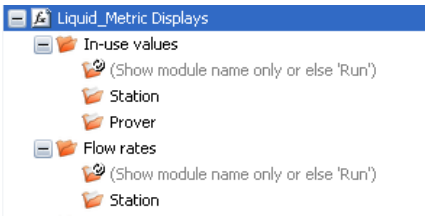
A **Log display** contains historical alarms and event logs

A **Report display** shows historical (archived) reports. These may be all reports or reports of a specific type and meter run (or station)

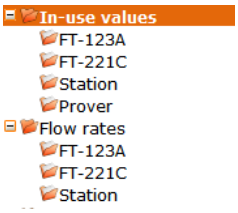
A **Historical Data** display shows historical data of either all the archives of a specific archive.

Recurring displays

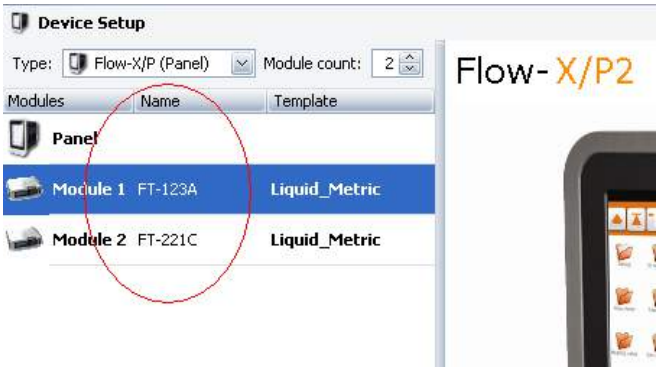
Displays can be made **recurring** by right clicking on the display in the tree-view and selecting 'Recurring'. Recurring displays are indicated by the arrows in the icon . If a display is recurring and there are multiple run modules (e.g. on an X/P2) then automatically a similar display will be created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



This will show on the flow computer display as:



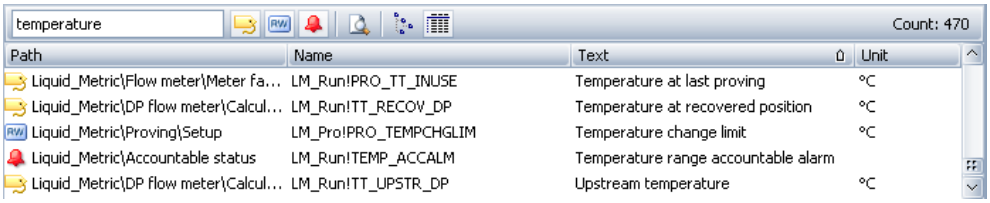
By default the run displays are named 'Run 1', 'Run 2' etc., unless run names have been filled in at the device setup. In that case these names are used to identify the run displays.



Adding data points to displays

To add a data point to a display, just drag it from the bottom right section (where an 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**).



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Chapter 17 - Calculations

Overview

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

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

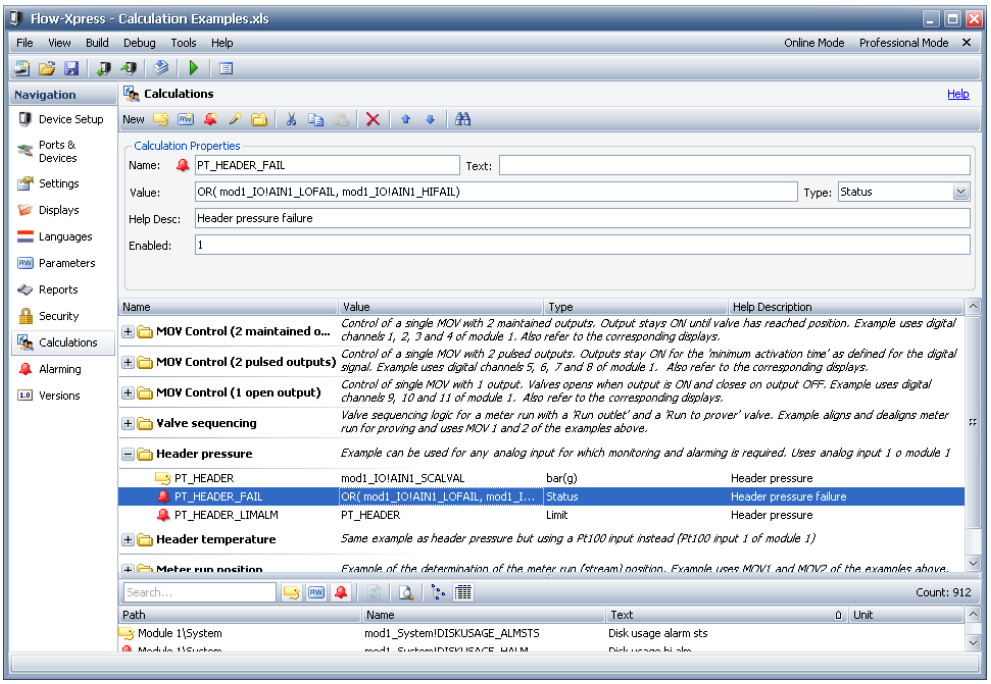


Figure 20: User-defined Calculations

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.

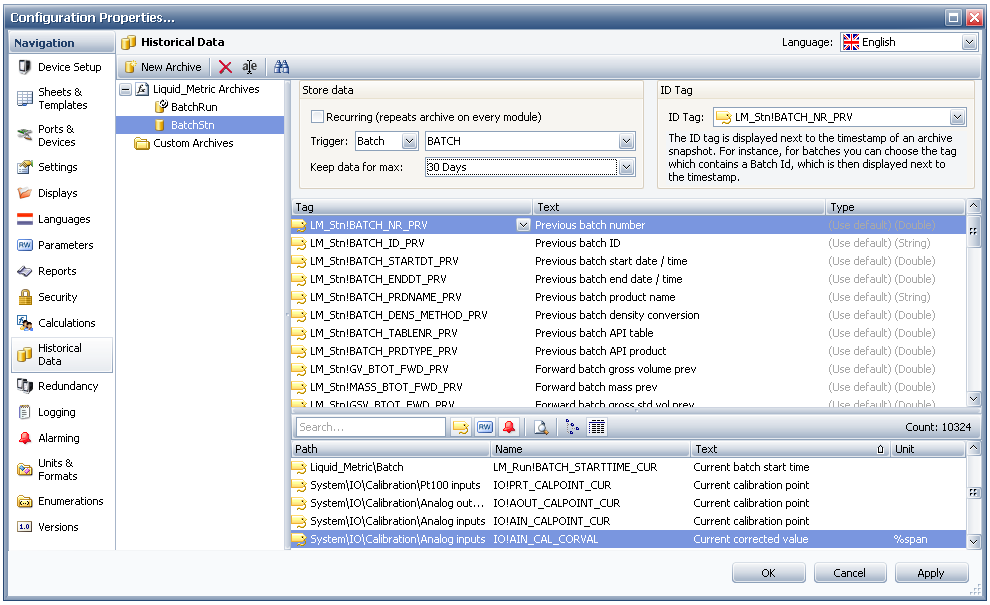
Refer to application file '**Calculation Examples**' for examples.

Chapter 18 - Data Archives

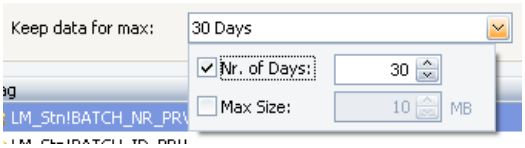
Overview

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 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.



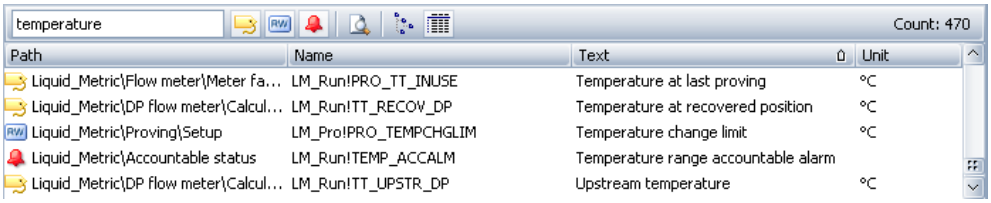
Adding data points to a data archive

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 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).

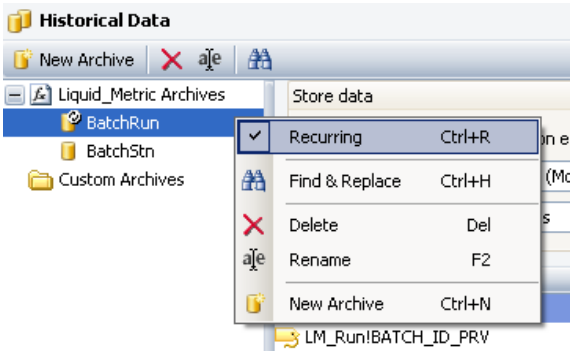
A number of tools is available to make it easier to find a specific tag, such as a limit filter, which shows only the tags that meet the search text, and buttons to limit the output to a specific type of tags (**calculation tags**, **configuration parameters**, **alarms**).



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

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

   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.

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Chapter 19 - Redundancy

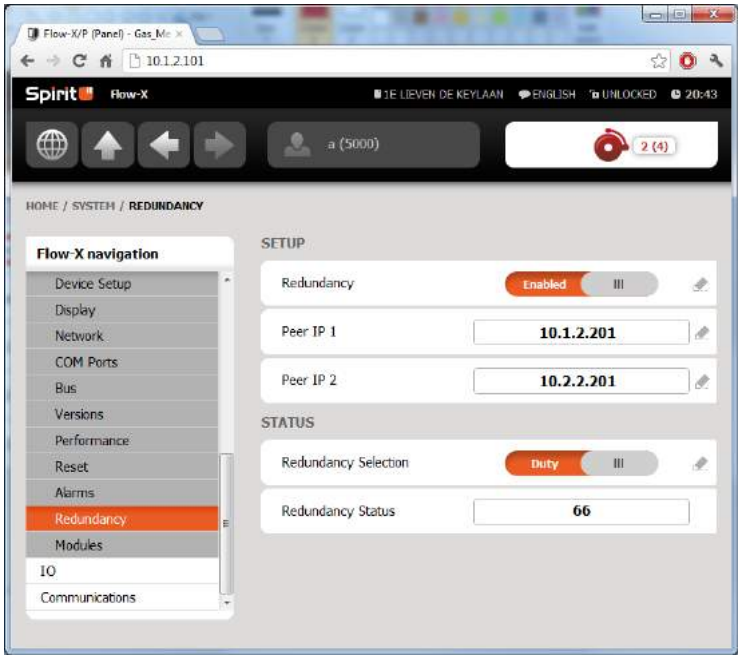
For critical applications two Flow-X flow computers can be set up in a **duty / standby** (also called master / slave) mode of operation. Both flow computers interface to the same input and output signals, perform the same flow computations and have equal communication links to external devices.

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 bumpless switchovers without any hiccups of control signals.

Typical data that are configured for continuous synchronization are PID control parameters and historical meter factors. Data that are synchronized at flow computer startup typically include cumulative (non-resetable) totalizers, and period and batch totals and averages.

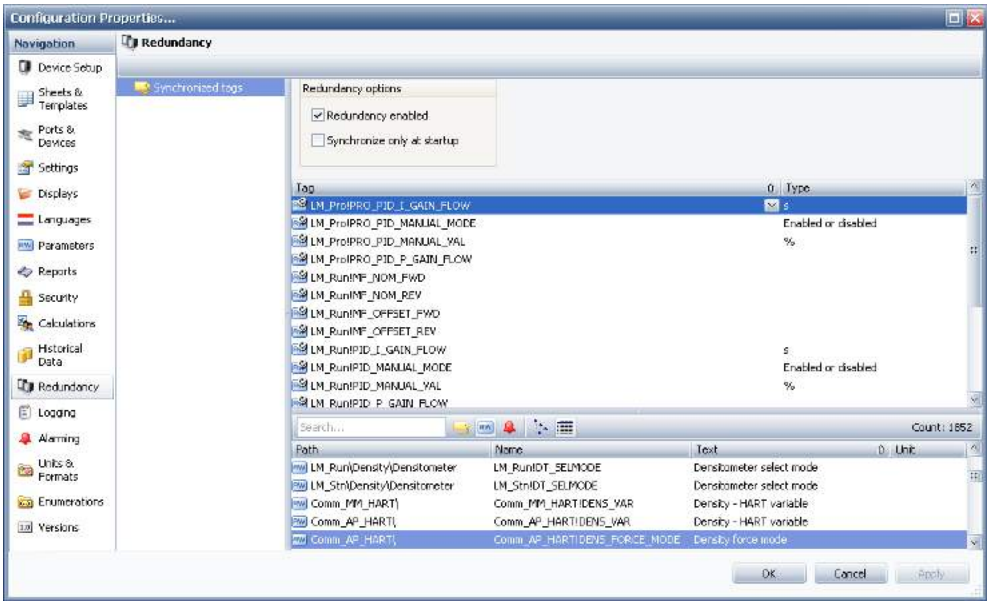
The flow computers exchange IP messages on both Ethernet ports to monitor each other's mode of operation (Duty / Standby) and to exchange a watchdog signal. Data synchronization is operational provided that at least one Ethernet connection is up and running.

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).



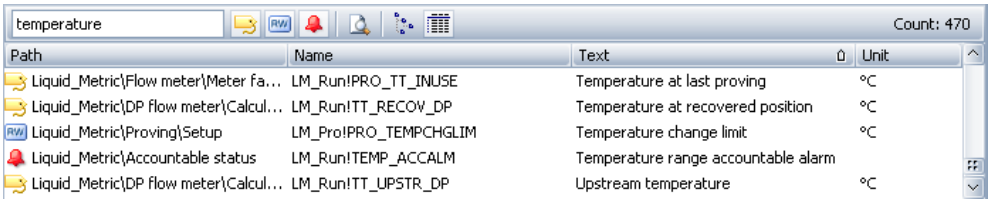
Data points to be synchronized

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 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 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**).



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.

Chapter 20 - XML Interface

The Flow-X flow computer provides a secured 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

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

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Chapter 21 - Reading debugging information from a device

This chapter describes how to download information from a Flow-X device to send to Spirit IT for debugging purposes

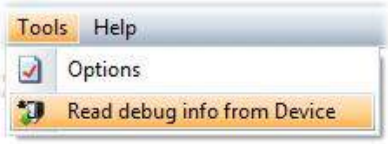
The procedure is as follows:

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

Step 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

Step 3: In Flow-Xpress basic and online mode, select 'Read debug info from device' from the Tools menu. In Flow-Xpress professional mode, click on the 'Read debug info from device' button in the 'Tools' section of the ribbon.



Step 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 >".

Step 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.

Step 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.

Step 7: Send the debugging information to Spirit IT, so we can help you solving the problem.

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