Instruction manual

FLOW-BUS interface for digital multibus Mass Flow / Pressure instruments

Doc. no.: 9.17.024W Date: 01-03-2023

ATTENTION
Please read this instruction manual carefully before installing and operating the instrument.
Not following the guidelines could result in personal injury and/or damage to the equipment.

Bronkhorst®

Disclaimer

The information in this manual has been reviewed and is believed to be wholly reliable. No responsibility, however, is assumed for inaccuracies. The material in this manual is for information purposes only.

Copyright

Symbols

Important information. Discarding this information could cause injuries to people or damage to the Instrument or installation.

Helpful information. This information will facilitate the use of this instrument.

Additional info available on the internet or from your local sales representative.

Warranty

Bronkhorst® products are warranted against defects in material and workmanship for a period of three years from the date of shipment, provided they are used in accordance with the ordering specifications and the instructions in this manual and that they are not subjected to abuse, physical damage or contamination. Products that do not operate properly during this period may be repaired or replaced at no charge. Repairs are normally warranted for one year or the balance of the original warranty, whichever is the longer.

See also paragraph 9 of the Conditions of sales:
http://www.bronkhorst.com/files/corporate_headquarters/sales_conditions/en_general_terms_of_sales.pdf

The warranty includes all initial and latent defects, random failures, and undeterminable internal causes.

It excludes failures and damage caused by the customer, such as contamination, improper electrical hook-up, physical shock etc.

Re-conditioning of products primarily returned for warranty service that is partly or wholly judged non-warranty may be charged for.

Bronkhorst High-Tech B.V. or affiliated company prepays outgoing freight charges when any party of the service is performed under warranty, unless otherwise agreed upon beforehand. However, if the product has been returned collect to our factory or service center, these costs are added to the repair invoice. Import and/or export charges, foreign shipping methods/carriers are paid for by the customer.

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1 GENERAL PRODUCT INFORMATION

1.1 INTRODUCTION

FLOW-BUS is a field bus, designed by Bronkhorst®, based on RS485 technology, for digital communication between digital devices, offering the possibility of host-control by PC. It can be used with a so called Multibus instrument.

Characteristics:

- Baud rates of 187500 (default) or 400000 Baud
- +15...24Vdc supply voltage
- Easy installation and communication with other Bronkhorst® equipment
- Automatic node search
- Automatic bus optimization. (gap fixing)
- PC-communication through RS232 via local-host function (recommended number of instruments is 10) or stand-alone interface
- Connection of max. 120 instruments to 1 bus
- Maximum bus length: 600 metres

Example of a Bronkhorst® instrument with FLOW-BUS interface

1.2 MULTIBUS TYPES

In 2000 Bronkhorst® developed their first digital instruments according to the "multibus" principle. The basic pc-board on the instrument contained all of the general functions needed for measurement and control, including alarm, totalizing and diagnostic functions. It had **analog** I/O-signals and also an **RS232** connection as a standard feature. In addition to this there is the possibility of integrating an interface board with **DeviceNet**™, **PROFIBUS DP**, **Modbus** , **FLOW-BUS** or **EtherCAT** protocol.

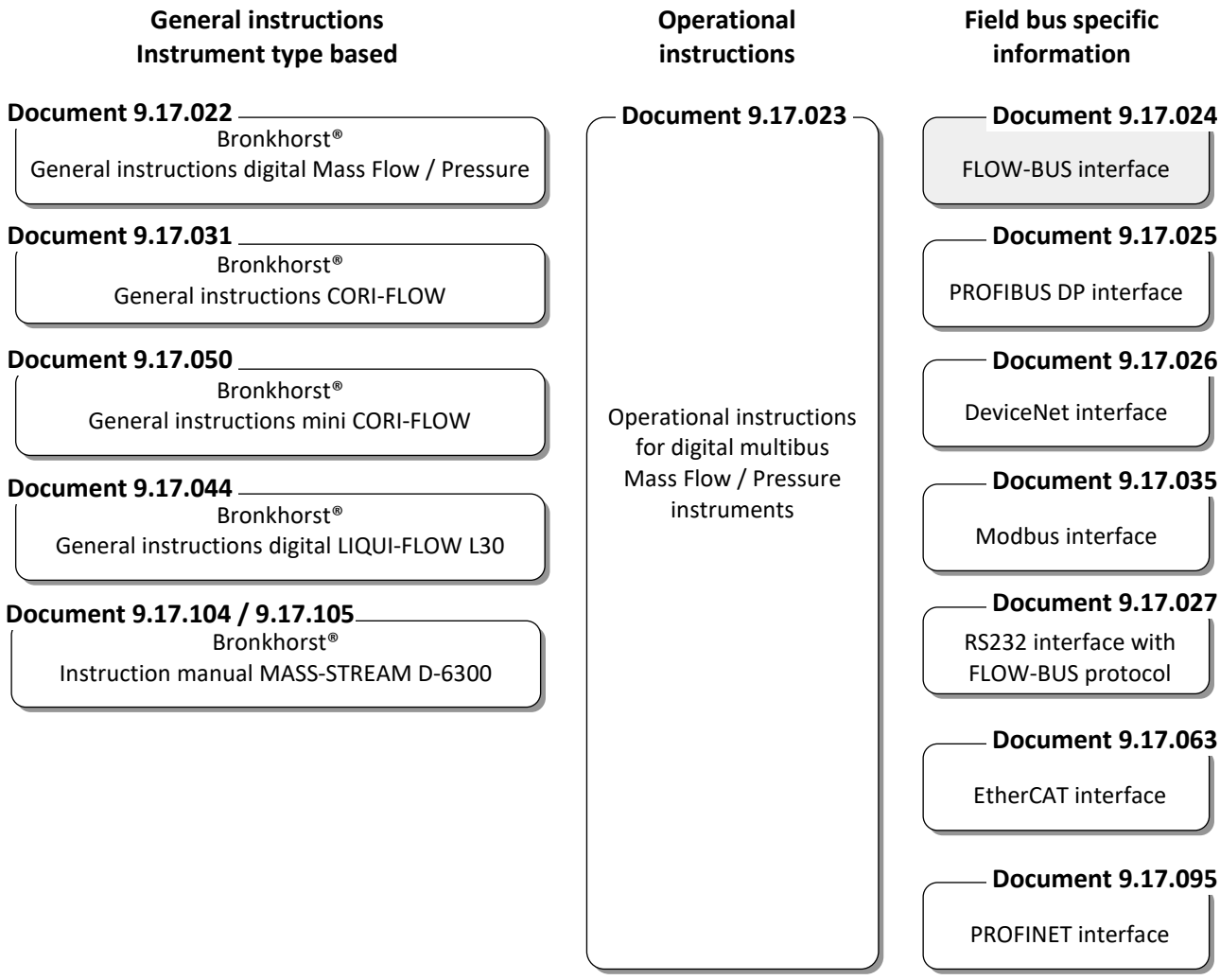
The first generation (**MBC-I**) was based on a 16 bit Fujitsu controller. It was superseded in 2003 by the Multibus type 2 (**MBC-II)**. This version was also based on the 16 bit Fujitsu controller but it had several improvements to the MBC-I. One of them is the current steering of the valve. It reduced heat production and improved control characteristics. The latest version Multibus controller type 3 (**MBC3**) is introduced in 2011. It is built around a 72MHz 32 bit NXP ARM controller. It has AD and DA controllers on board which makes it possible to measure noise free and control valves without delays. The internal control loop runs 6 times faster compared to the MBC-II therefore control stability has improved significantly. It also has several improved functions like reverse voltage protection, inrush current limitation and overvoltage protection.

MBC3 instruments can be recognised by the "MBC3" placed on lower left side of the instrument label (see example).

1.3 REFERENCES TO OTHER APPLICABLE DOCUMENTS

Manuals and guides for digital instruments are modular. General instructions give information about the functioning and installation of instruments. Operational instructions explain the use of the digital instruments features and parameters. Field bus specific information explains the installation and use of the field bus installed on the instrument.

1.3.1 Manuals and user guides:



1.3.2 Technical Drawings:

Hook-up diagram laboratory-style FLOW-BUS	(document nr. 9.16.063)
Hook-up diagram industrial style FLOW-BUS	(document nr. 9.16.052)
Hook-up diagram CORI-FLOW FLOW-BUS	(document nr. 9.16.048)
Hook-up diagram LIQUI-FLOW L30 digital FLOW-BUS	(document nr. 9.16.074)

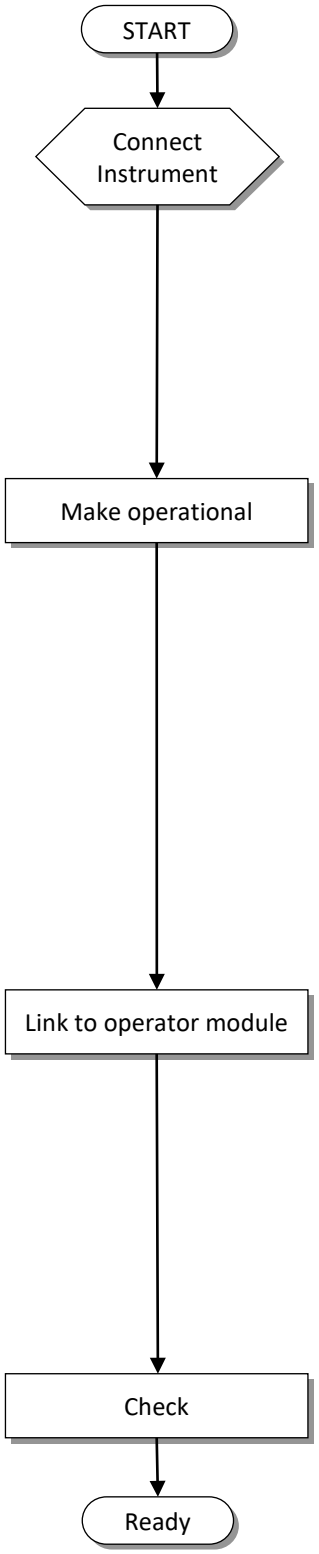
1.3.3 Software tooling:

FlowPlot
FlowView
Flowfix
FlowDDE

All these documents can be found at:
http://www.bronkhorst.com/en/downloads

1.4 SHORT FORM START-UP

All necessary settings for this module are already performed at Bronkhorst®. Following the next steps carefully is the quickest way to get this module operational in your own FLOW-BUS environment.



Connect instrument to the bus

Make instrument operational on the bus (give it a FLOW-BUS node-address)

However, changes in the system or adding new modules could need new (free) addresses on the FLOW-BUS.
The FLOW-BUS address of an instrument can be changed by various methods, these methods are explained in detail in chapter *4 FLOW-BUS installation and addressing*

By LED's and switch:
Watch the LED's of the instrument when the instrument powers-up. If the green LED is burning continuously and the red LED is off, everything is o.k. the instrument is operational on the bus. If the red LED is blinking slowly, the FLOW-BUS address is already occupied. In that case: The auto install can be performed by pressing the micro push-button and release it after 2 seconds. Now the instrument is operational on the bus.

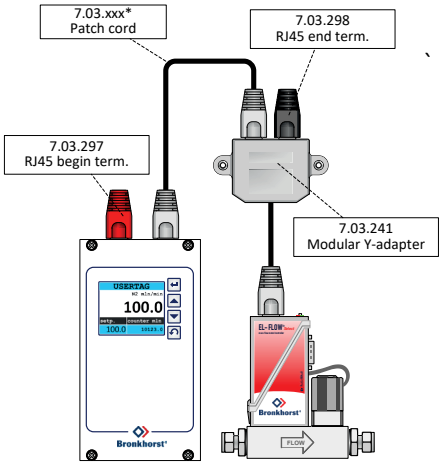
Make link to operator module (search module on the bus with the operator).
You can search for this instrument, looking for type and serial number.

- **With E-8000 module for digital instruments:**
  Enter the instrument mode (see E-8000 manual 9.17.076 for detailed information). In this mode it is possible to search for the instrument, using the <UP> and <Down> buttons. When the instrument is found, press <Enter> to select the instrument.
- **With PC-software application:**
  When you use FLOWDDE or FLOWBUS.DLL (for Windows applications) all modules connected to FLOW-BUS will be recognised automatically. They will be assigned to a channel for operation. (see FLOW-DDE configuration menu) Other programs will have to get procedures for reading identification of instruments. For details, see FLOW-BUS software documentation.

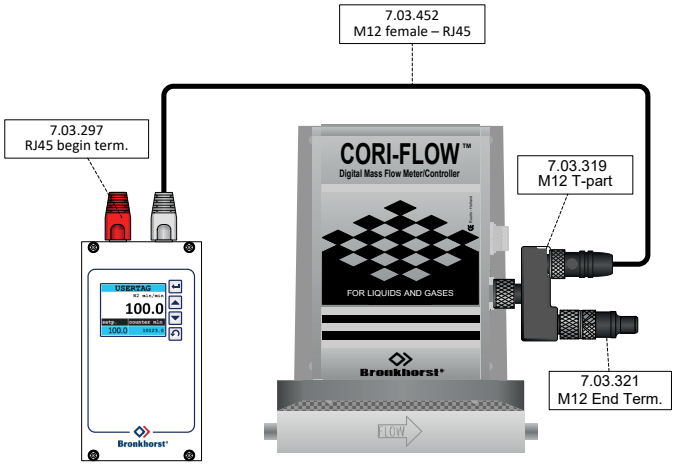
Send a setpoint to the instrument and check the measured value. Let the instrument warm-up for 30 minutes for best accuracy. Your Mass Flow Meter/Controller is now ready for operation.

Below are several examples how to build a FLOW-BUS system. The principle of the FLOW-BUS system is the same for an IP40 or a IP65 system.

1. EL-FLOW with E-8000

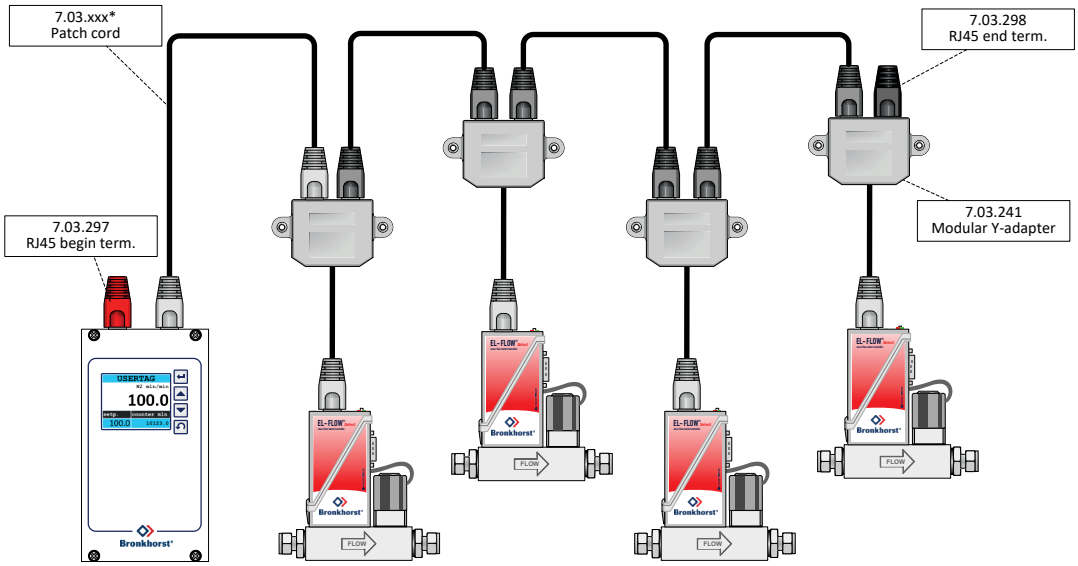


2. CORI-FLOW with E-8000

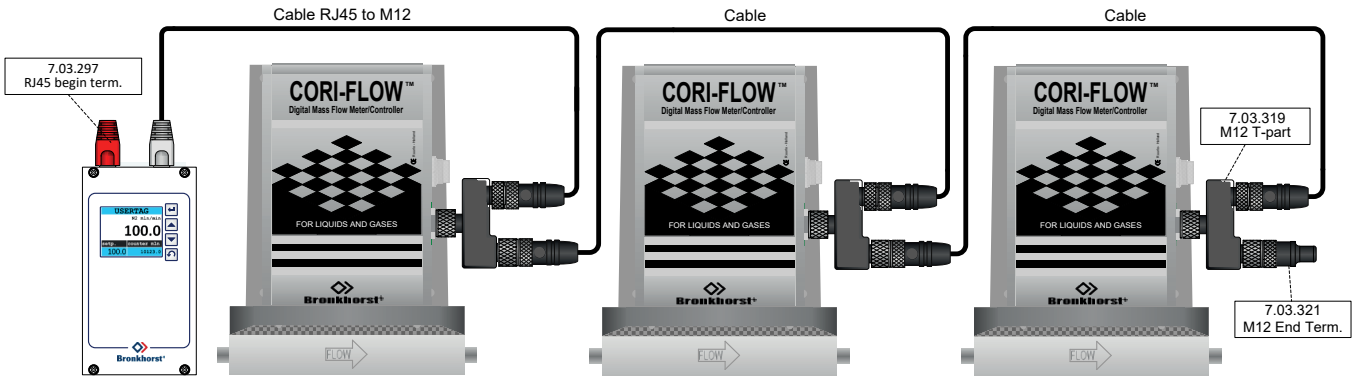


The last instrument on the bus needs a bus-end-termination connector (black).
The first module on the bus (either an E-8000 module for digital instruments or a FLOW-BUS interface module to a PC) needs a bus begin – terminator (red).

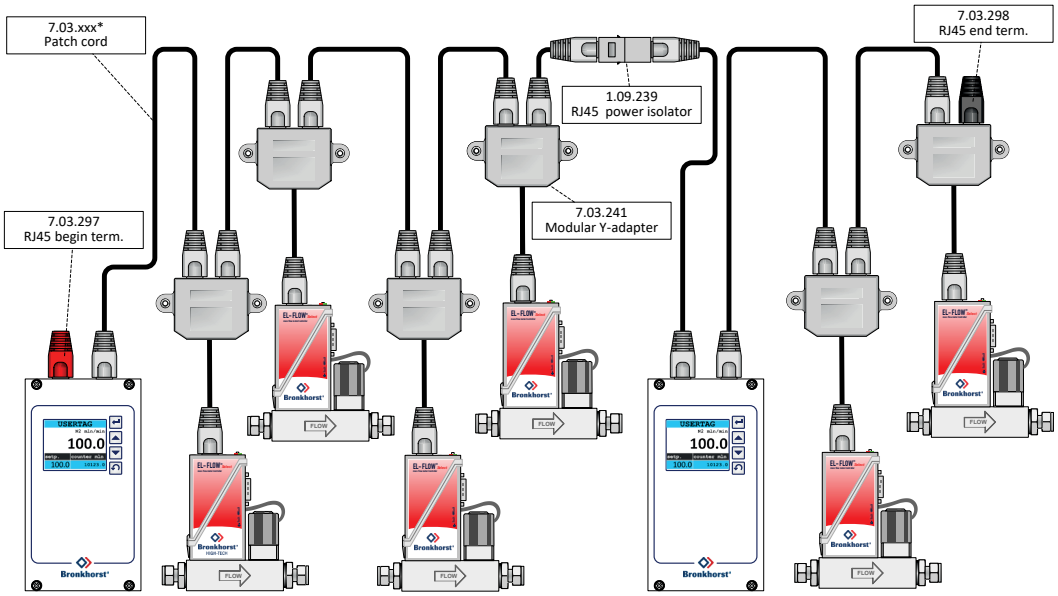
3. Four EL-FLOWS with E-8000



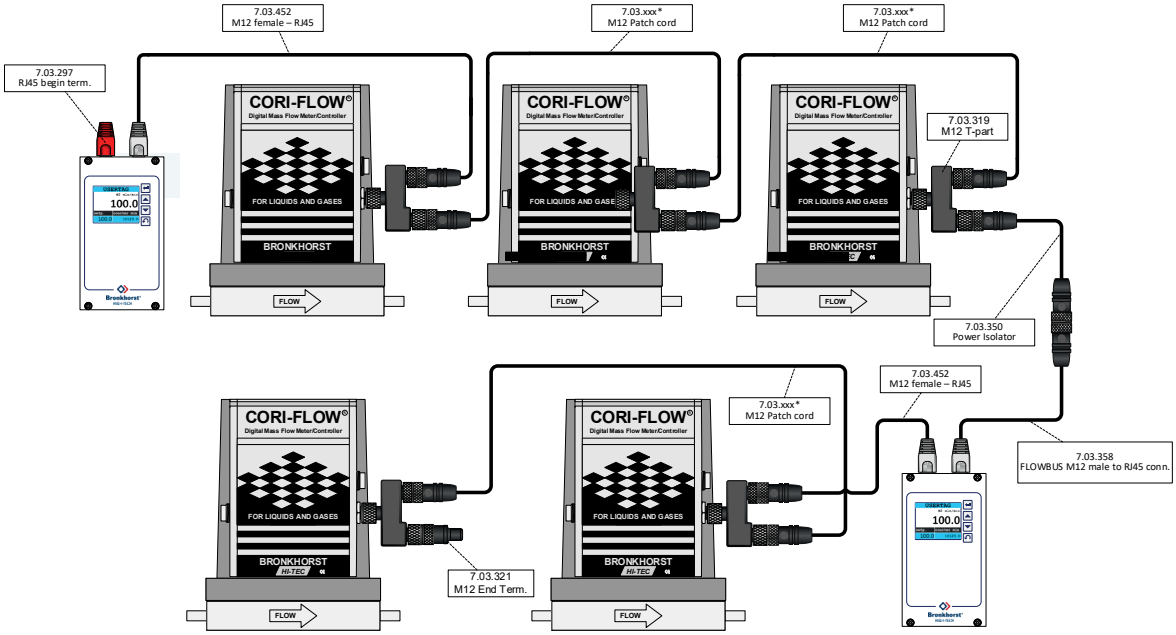
4. Three CORI-FLOWS with E-8000



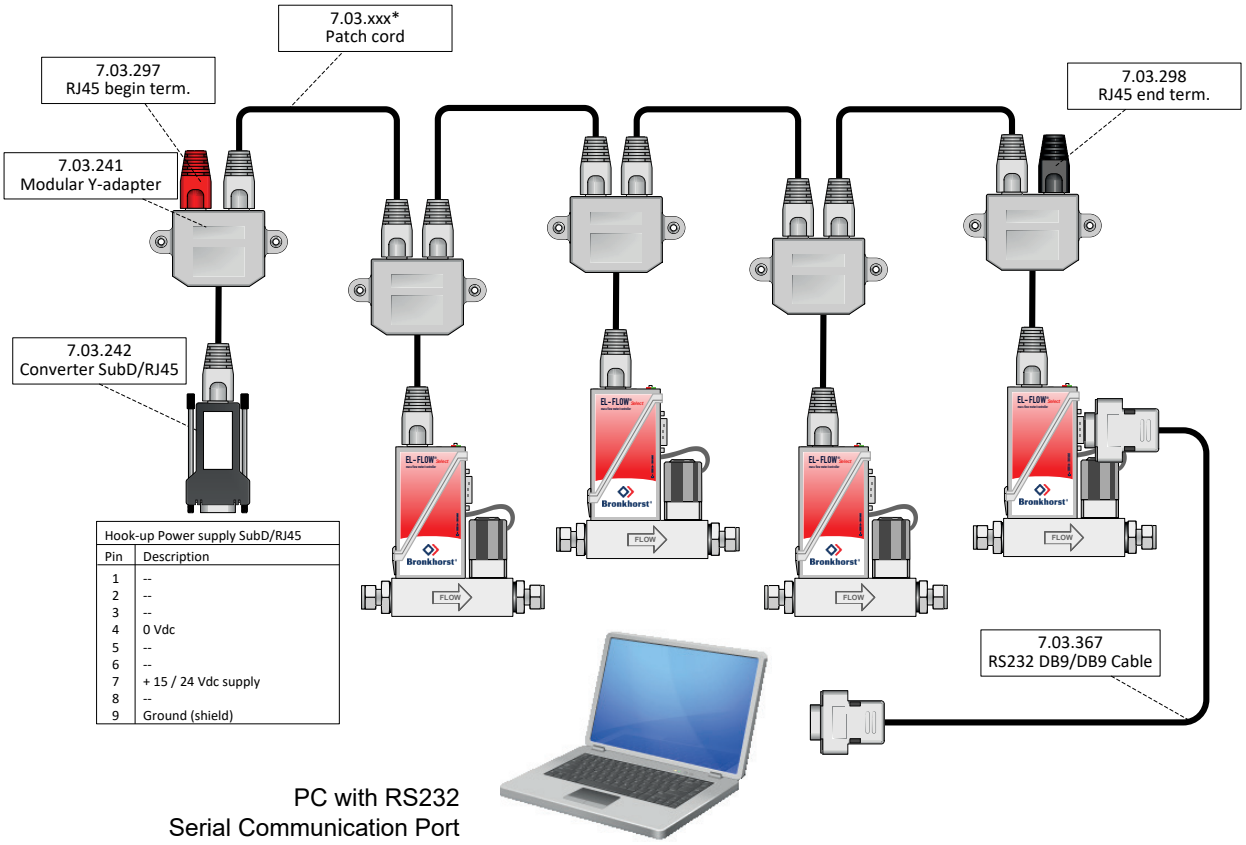
5. Dual power system with six EL-FLOWS and two E-8000's



6. Dual power system with five CORI-FLOW's and two E-8000's



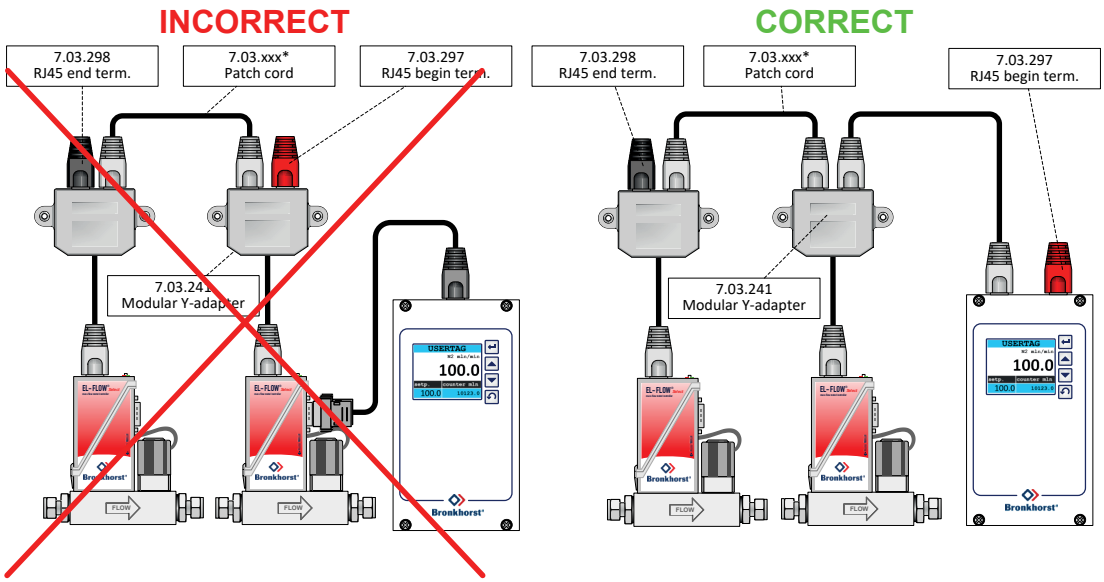
7. Local host with Bronkhorst®/Customer Power supply



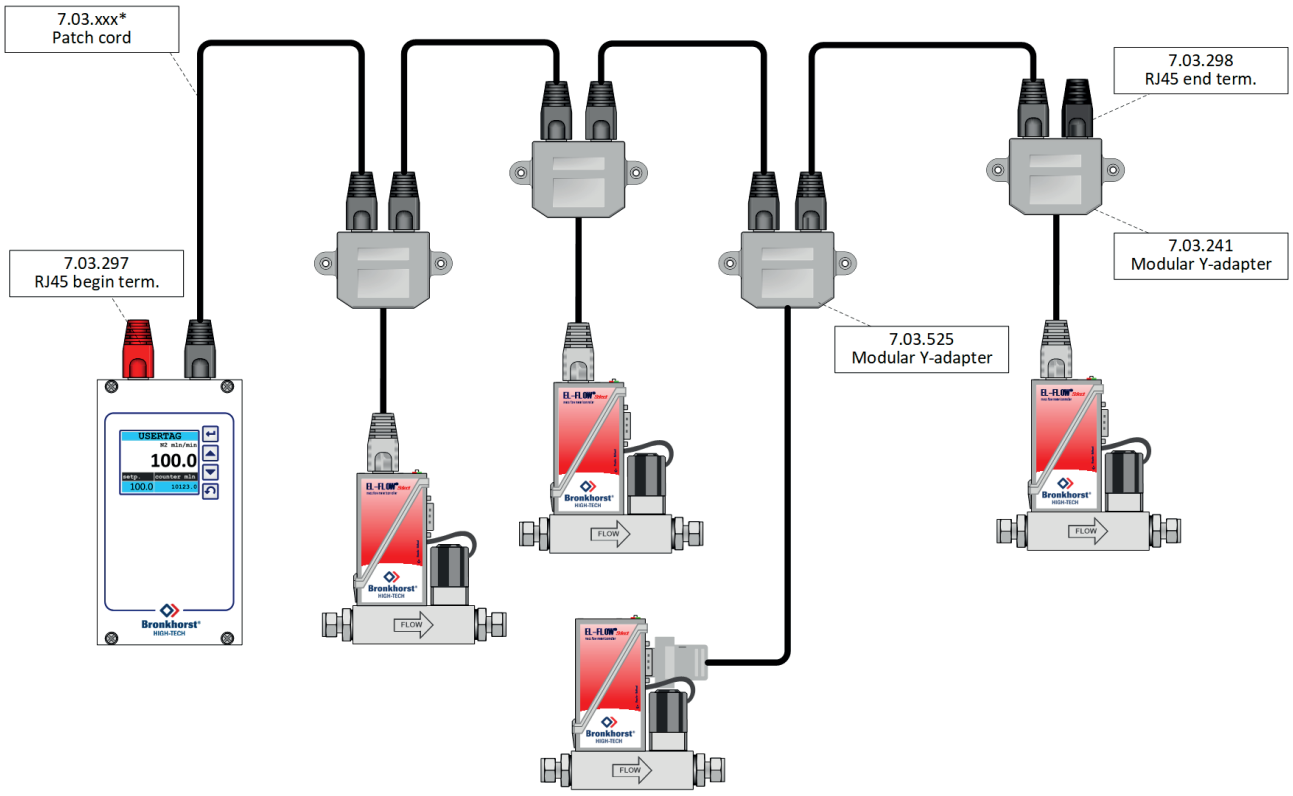
Hook-up Power supply SubD/RJ45	
Pin	Description
1	--
2	--
3	--
4	0 Vdc
5	--
6	--
7	+ 15 / 24 Vdc supply
8	--
9	Ground (shield)

Recommended maximum number of instruments is 10 pieces in a local-host network, for networks with higher number of instruments, use a RS-232 / FLOW-BUS interface box.

8. Incorrect and correct FLOW-BUS system



9. Connection FLOWBUS on subD9



2 FIELD BUS INSTALLATION

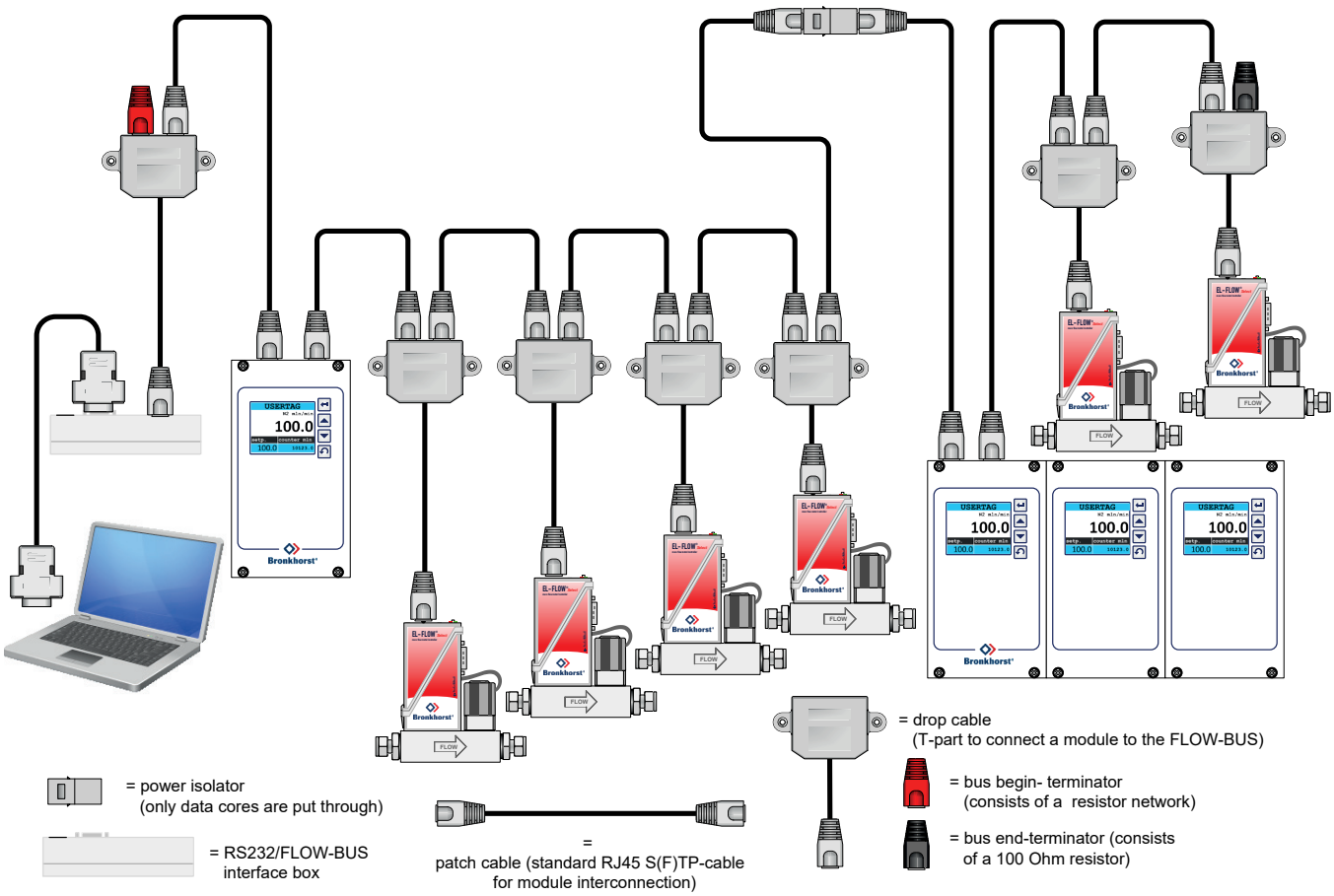
2.1 GENERAL

FLOW-BUS is a RS485-based field bus communication system for parameter value exchange between digital Bronkhorst® products. In this system each instrument / device is equipped with a micro-controller for its own dedicated task but also for exchanging parameter value information with other instruments / devices connected to the same FLOW-BUS system.

FLOW-BUS systems may have a minimum of 2 and a maximum of 126 connections. The maximum length for datelines between the first and the last connection may be up to approx. 600 meters. Longer distances are only possible in combination with special bus-repeater modules. Each instrument/device connection T-part (stub) must be kept as short as possible (**maximum cable length 0.5 meter**).

The baud rate used to transport messages is 187500 baud or 400000* baud.
FLOW-BUS is a multi-master network with a token-ring architecture.

**MBC3 type instruments have an additional baud rate available of 400000 baud.*

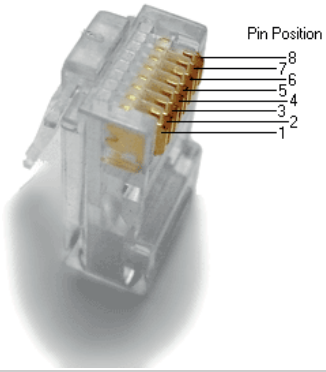
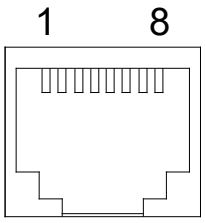


Use only the BUS connector to power the device.
Powering from the BUS connector and Sub-D9 (or 8 DIN) connector could damage the device.
Please refer the corresponding Bus Hook-up manual for the right connections.

2.2 FLOW-BUS CONNECTOR

2.2.1 Shielded RJ45 modular jack

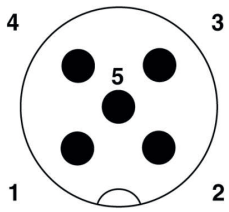
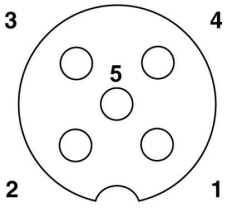
The shielded RJ45 modular jack connector (for non IP65 applications) has the following pin configuration:

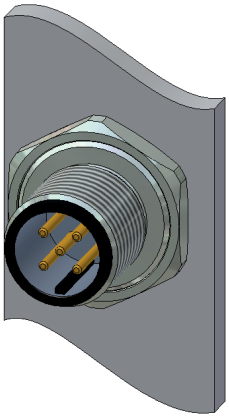
RJ45 Connector	Receptacle	Pin number	Description
		1	+15…24Vdc supply
		2	0V
		3	Shield
		4	0V
		5	+15…24Vdc supply
		6	0V
		7	RS485 - B
		8	RS485 - A

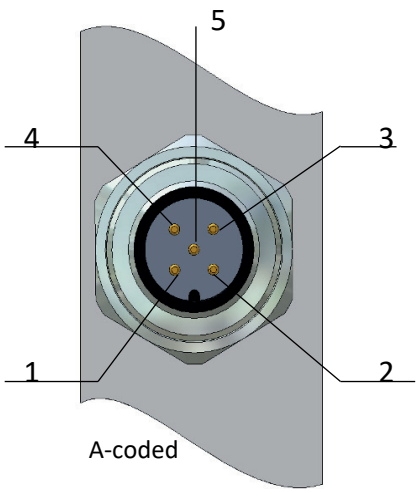
The maximum contact rating for RJ45 connectors is 1.5A.

2.2.2 Shielded a coded M12 connector

The chassis M12 circular connector (for IP65 applications) has the following pin configuration:

M12 Connector	Male	Female	nr	Description
			1	Shield
			2	+15…24 Vdc supply
			3	0V
			4	RS485A
			5	RS485B



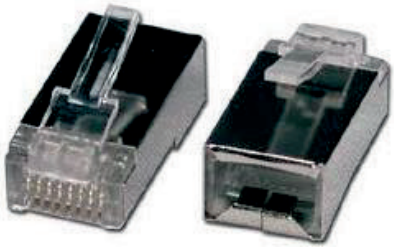


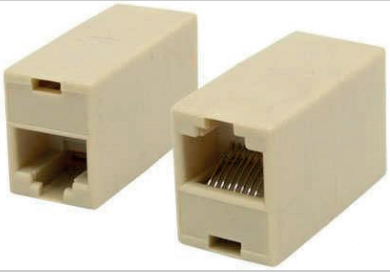
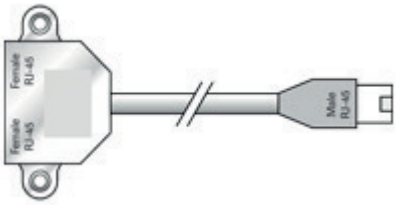
The maximum contact rating for M12 connectors is 4A.

2.3 FLOW-BUS CABLES AND T-PARTS

2.3.1 RJ45 FTP cables

For connecting instruments to the FLOW-BUS you need shielded cables with at least 3 wires (for data only). Recommended are twisted wire cables for RS485-communications with 100 or 120 Ohm impedance. All Bronkhorst® FLOW-BUS cables have also integrated power-supply wires. For the use in the EL-FLOW range (non IP-65) it is best to use Shielded (+Foiled) Twisted Pair patch-cables with RJ45 modular jack connectors (8-pins for data and power-supply connections).

RJ45 shielded FTP CAT.5e cable	RJ45 shielded connectors
	

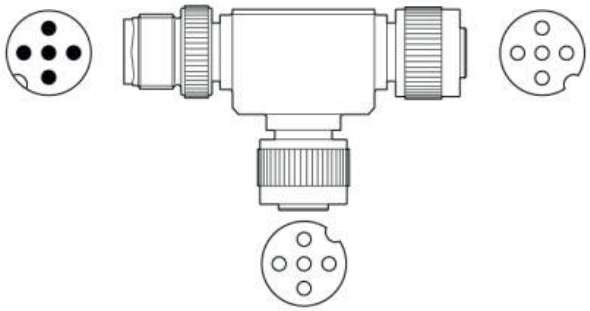
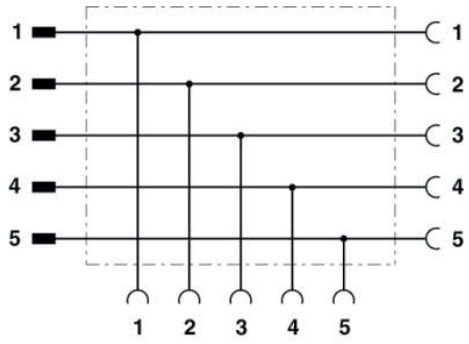
Shielded FTP cable	Power isolator	7.03.241 Modular Y adapter cable
		

CAT.5e cables are available with a wire of:
26AWG (wire diameter 0.140mm^2, with a resistance of 137 Ohm/km).
24AWG (wire diameter 0.205mm^2, with a resistance of 86 Ohm/km).

More information about cat.5e cables can be found at::
http://en.wikipedia.org/wiki/Category_5_cable

2.3.2 M12 DeviceNet drop cables

For the use in for example the IN-FLOW range or CORI-FLOW range (IP-65 applications) it is best to use *DeviceNet Drop* cables assembled on both sides with male connector M12 – female connector M12 (5-pins for data and power-supply connections).

M12 cable	M12 termination resistor
	
T-part	**T-part wiring**
	

In case of powering instruments or transporting data over longer distances Bronkhorst® offers also special RS485 FLOW-BUS data cable, with lower voltage-drop. Bronkhorst® can advise you when to use this special cable, but for most cases the standard patch-cables will do well.

If more cables are used in one system, they have to be connected as a daisy-chain. This means that the total FLOW-BUS system has only one begin and one end. For connecting instruments to the bus, Bronkhorst® offers special drop-cables which enable you to build a daisy chained network of FLOW-BUS modules.

2.4 TERMINATION

For best quality of data transfer FLOW-BUS should be terminated correctly.

2.4.1 Termination resistors

A resistor is added in parallel with the receiver's "A" and "B" lines in order to match the data line characteristic impedance specified by the cable manufacturer (120 Ω is a common value). This value describes the intrinsic impedance of the transmission line and is not a function of the line length. A terminating resistor of less than 90 Ω should not be used. Termination resistors should be placed only at the extreme ends of the data line (see Termination schematics resistors RT1 and RT2), and no more than two terminations should be placed in any system that does not use repeaters.

2.4.2 Biasing resistors

When an RS-485 network is in an idle state, all nodes are in listen (receive) mode. Under this condition there are no active drivers on the network. All drivers are tri-stated. Without anything driving the network, the state of the line is unknown. If the voltage level at the receiver's A and B inputs is less than ±200 mV the logic level at the output of the receivers will be the value of the last bit received. In order to maintain the proper idle voltage state, bias resistors must be applied to force the data lines to the idle condition. Bias resistors are nothing more than a pull-up resistor (RB1) on the data RS485-A line and a pull-down (to ground) on the data RS485-B line. The "Termination schematic" illustrates the placement of bias resistors on a transceiver. The value of the bias resistors is dependent on termination and number of nodes in the system. The goal is to generate enough DC bias current in the network to maintain a minimum of 200 mV between the B and A data line. Consider the following example of bias resistor calculation.

Ideal situation:
Termination resistors: 120 Ohm
Receiver resistance: omitted
Bias supply voltage: 5Vdc
Wanted situation is a minimum of 200mV between A and B lines and a common mode voltage of 2.5V.

Minimum current therefore: 200mV / 60 Ohm = 3.33mA
Total maximum bias resistor value is (5V – 0.2V)/3.33mA = 1440 Ohm.
The maximum value of each biasing resistor: 720 Ohm.

Situation with 127 nodes:
Termination resistors: 120 Ohm
Receiver resistance: 12 KOhm
Number of instruments: 127
Bias supply voltage: 5Vdc
Wanted situation is a minimum of 200mV between A and B lines and a common mode voltage of 2.5V.

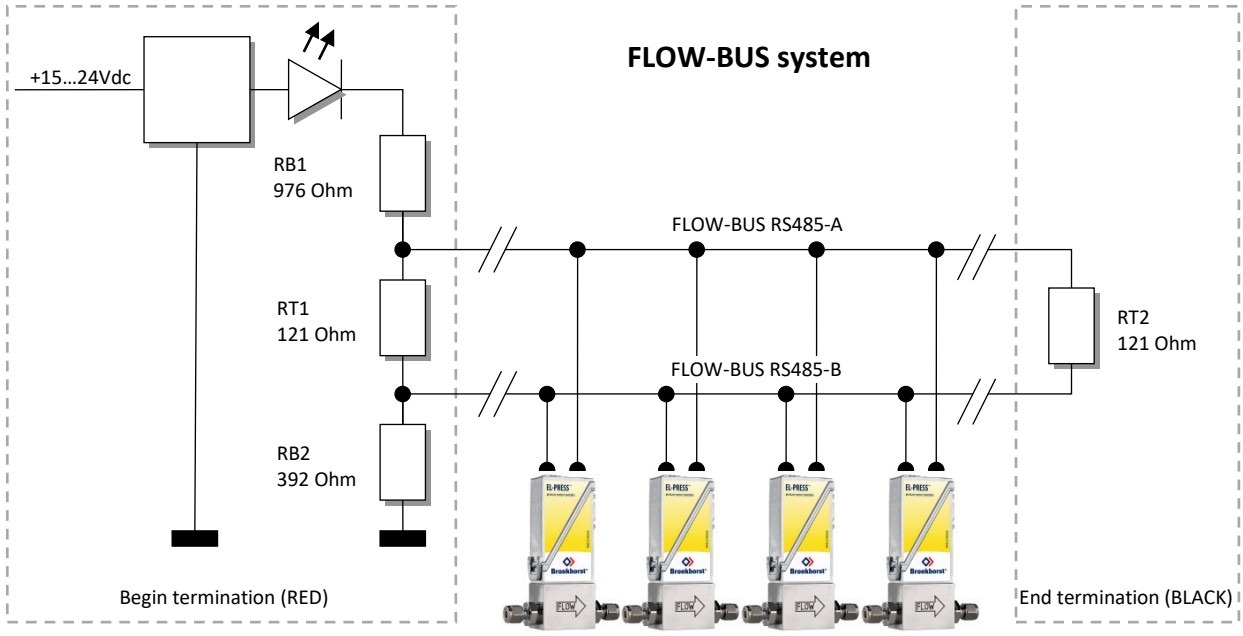
Total termination resistance: 120 // 120 // 12000* 127 = 120 // 120 // 94.5 = 36.7 Ohm
Minimum current therefore: 200mV / 36.7 Ohm = 5.45mA
Total maximum bias resistor value is (5V – 0.2V)/5.45mA = 880 Ohm.
The maximum value of each biasing resistors: 440 Ohm.
Lower values may be used. (Depending on maximum power consumption of the resistors)

Bronkhorst® advices the following resistor values for the following voltages.			
Supply voltage termination	**Termination resistors**	**Bias Pull-up resistor**	**Bias Pull-down resistor**
+5V	121 Ohm	392 Ohm	392 Ohm
+10V	121 Ohm	1210 Ohm	392 Ohm
+15V	121 Ohm	2210 Ohm	392 Ohm
+24V	121 Ohm	3480 Ohm	392 Ohm

Bronkhorst® offers special begin-termination connectors with the resistor network. This handles correct termination but also gives a defined voltage on the RS485-A and -B line for even more reliability of the bus system.
An end-terminator is also offered by Bronkhorst® and handles correct termination ad the end of the bus.

Termination can be performed with special termination-connectors, offered by Bronkhorst®.

Termination schematic



RJ45		M12	
703297 **Begin terminator**	**703298** **End terminator**	**703515** **Begin terminator**	**703321** **End terminator**
			

At the beginning of each FLOW-BUS system there always must be a resistor network as showed above. This begin-terminator needs to be part of your system. Bronkhorst® offers special begin-termination connectors with the resistor network. This handles correct termination but also gives a defined voltage on the RS485-A and -B line for even more reliability of the FLOW-BUS system.

Bronkhorst® advises always to use a termination resistor at the end of the bus in your system. This end-terminator is also offered by Bronkhorst® and handles correct termination for the FLOW-BUS.

2.5 POWER SUPPLY

Bronkhorst® uses FLOW-BUS cables with extra wires inside for +15…24Vdc and 0Vdc in order to handle power supply and communication within the same cable. Because RS485-cabling needs a daisy-chain connection and power-lines prefer a star-point connection, we came to a compromise of both in the FLOW-BUS cabling. Bronkhorst® can advise you how to power your FLOW-BUS system. It is the best to keep the power-lines as short as possible, so local power-supply is preferred. This of course, depends on your demands of building-up your system.

The maximum numbers of instruments on one power supply depends of several parameters.

1. *Minimum voltage on the instrument (+15V -10% = 13.5V).*
2. *Power supply tolerance*
3. *Maximum contact rating of the connectors.*
4. *Voltage drop across cables.*

RJ45 cable systems use two internal wires for power supply, M12 cable systems only one.

Wire resistance can be done manually by the following formula: $$R = \rho \bullet \frac{l}{A}[\Omega]$$

Where "l" is the length of the conductor, measured in meters [m], "A" is the cross-sectional area of the conductor measured in square meters [m²], and "ρ" (rho) is the electrical resistivity (also called *specific electrical resistance*) of the material, measured in ohm-metres (Ωm)

As an example:

Wire diameter 1 mm
Wire length 1 m
Copper specific electrical resistance ρ = 1.75 E-8 Ωm
π = 3.14

$$R = 1.75e-8 \bullet \frac{1}{0.25 \bullet \pi \bullet 0.001^2} = 0.0223\Omega$$

Calculation of wire resistance and maximum wire current can also be done on:
http://circuitcalculator.com/wordpress/2007/09/20/wire-parameter-calculator/

Using standard power-supplies from Bronkhorst® and Shielded Twisted Pair patch-cable with RJ45 connectors for non IP65 applications and DeviceNet cables with circular M12 connectors for IP65 applications:

A cluster of 4 digital controllers can be powered locally from a distance approx. <= 6.5 meters from the power-supply.

Powering more instruments will reduce the distance allowed to the supply-unit in linear relationship.

3 CHANGING PARAMETERS VIA FLOW-BUS

For security reasons all important instrument settings can only be changed after entering a password (using E-8000 readout/control modules) or after sending a security-parameter (using PC-software programs). For operation of instruments there is always free access to the parameters (e.g. setpoint, control mode, setpoint slope, changing fluid).

Changing of settings however, is secured (e.g. calibration parameters, input + output adjustments, identification, FLOW-BUS network settings). When using Bronkhorst® Electronics, like E-8000 systems, changing of parameter settings at digital instruments is possible via the menu. However, when changing of parameter settings via other (self-made) software running on computers using RS232 and/or FLOW-BUS DLL and/or FLOWDDE is wanted, for safety reasons setting of special initialisation parameters is needed first.

4 FLOW-BUS INSTALLATION AND ADDRESSING

4.1 INSTALLATION

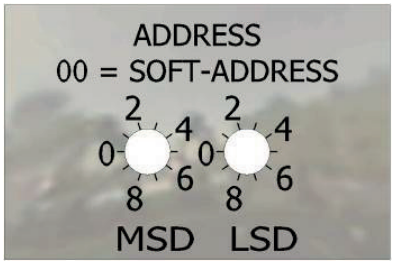
All modules in a FLOW-BUS system must have their own address. FLOW-BUS systems will not function properly when there are more modules on the same address. To avoid this, modules will do a check before getting operational on their bus-address and give a message when this address is occupied.
- See 6.1 for LED indication occupied.
- See 4.1.1 and/or 4.1.2 and/or 4.1.3 to add a FLOW-BUS instrument to a system.

If a new module has to be connected to a bus system, it needs a free address. Normally this will be the first free address counted from address 3. Address 0 is reserved for the start-up procedure. Address 1 is reserved for an interface module to (personal) computers and address 2 has been reserved for operation modules like E-8000. Each time you power-up your system afterwards, the modules will start-up on the same address on the bus, because these settings are stored in their non-volatile memory.

There are four ways to add a new module to your bus system:

4.1.1 Install to bus via rotary switches on the side of the instrument (if present).

On the side of the instrument are rotary switches placed and a label with the explanation of the switches. Make sure to use a screwdriver which is suited for the switches.



The switches have the following function:

NODE ADDRESS (00 – 99)

With the NODE ADDRESS switch, the instruments address can be set. The MSD is the high part of the decimal number and the LSD the low part. For instance address 25 means MSD on 2 and LSD on 5.

The default switch position is 00. In this position the address is software programmable.
The default software programmable address is 3.

During instrument initialisation, the node address switches are read. If the switches specify a valid FLOW-BUS address, i.e. a value from 3 to 99, this value is used.
If the specified address differs from the value stored in the instrument, the new address is saved in memory.
If the switches specify an invalid FLOW-BUS address, i.e. a value of 1 or 2, the value stored in the instrument's memory will be used as the address.

4.1.2 Automatic installation to FLOW-BUS

Most FLOW-BUS modules have the facility to install themselves automatically on the bus. This means that they are able to find the first free node-address counted from 3 and connect themselves to the bus. This action can be started by means of a manual interface on the module. Directly afterwards the new module will be part of the FLOW-BUS system.

Make sure to install only one new module at the same time.

4.1.3 Install to bus on a pre-defined node-address or re-address instrument on the bus

In some applications it is necessary to put FLOW-BUS devices on pre-defined addresses because of the application software expecting this device on this address (e.g. PLC-applications). This can be done as follows:
(Install new module to the bus as described in the previous paragraphs.)

- By means of the rotary switch on the instrument (if present).
- By means of the micro-switch on the instrument. See instruction manual 9.17.023.
- By means of the special menu in an E-8000 module for digital instruments it is possible to (re-) address instruments on the bus.
- Go to the specific menu part and read the PNA (Primary Node Address) number.
- Fill-in the address you want the instrument to have on the bus.
- The module will restart and will get its new address from that moment on.

The E-8000 module will not check if this address is already occupied by another instrument.

Because it is not allowed in a FLOW-BUS system to have 2 devices on the same node-address, at (re)start of the instrument there will also be a check performed if its node-address (in memory) is already occupied by another device. If so, the red LED will blink slowly. At that moment the module is not operational on the bus. You first have to re-install it. The easiest way to do this is to press the micro push-button on top of the instrument and release it after 2 seconds. After releasing the button the instrument will install itself on the bus automatically on a free address. When the green LED is burning continuously, the instrument is operational.

If you take one or more modules out of your system, or if one or more modules do not get power, be careful installing new modules, or changing the configuration. This situation may occur if you take modules out for service. If you don't change the configuration, you can replace your serviced instrument/module in your system without any problem. Mostly new modules will get the first free address, counted from address 3 (3 will be the first). This could be an address which should not be occupied (e.g. from a module which has been taken-out for service). In that case install the new module and re-address it as described, to avoid FLOW-BUS communication problems.

When connecting an instrument/module to the FLOW-BUS, make sure that the instrument/module is in power-off mode. After connection to the bus you can switch power on. At power-up there will be a check to avoid the situation of two modules on the same bus address. This is important for error-free bus-communication.

4.2 SECURITY AND FLEXIBILITY

FLOW-BUS systems are designed to transport data as quickly and reliable as possible. There are integrated mechanisms for checking, retry- and error- handling. Modules can be removed from the FLOW-BUS temporarily (e.g. for service) and can be replaced or re-installed later. New modules will be recognised automatically by other modules in the system. FLOW-BUS systems can consist of at least 2 or maximum 126 Bronkhorst® products.

5 FLOW-BUS SYSTEM OPERATION WITH COMPUTER

There are several options to do this. First see that the chosen hardware is able to communicate with the FLOW-BUS system and that this can be done with a sufficient velocity of parameter transfer for your application.
Bronkhorst® has developed several software tools for communication with the instruments.

- FlowPlot
- FlowView
- Flowfix
- FlowDDE

These tools can be found at:
http://www.bronkhorst.com/en/products/accessories/software_tools/

5.1 COMMUNICATION WITH FLOW-BUS THROUGH FLOW-BUS DDE SERVER

Together with a client-application, either self-made or with a SCADA-program from 3rd-parties. Examples: Genesis, Fix-MMI, Lotus Measure, Paragon, Wizcon, LabView, Intouch. This option is far most convenient, less costful and most user friendly. The FLOW-BUS DDE server also offers a lot of test facilities and user adjustable settings for efficient communication with devices connected to the FLOW-BUS.

Advantage:
Very powerful, fast communication, no special knowledge needed from bus-protocol and bus-system, supported by BHT
Disadvantage:
not really, depends on demands of user:

Programming examples are available for making applications in: Visual Basic, LabView and Excel.

Large systems with need of very high update rates of data (within < 1 sec.) are not possible.

5.2 COMMUNICATION WITH FLOW-BUS DIRECTLY THROUGH DLL

Part of this FLOW-BUS software is a 32-bit DLL. You may call the functions in this library directly to communicate with devices on the FLOW-BUS. Further documentation may be ordered at your local sales representative.

Advantage:
Powerful routines available for fast communication, less overhead, low processor load
Disadvantage:
Knowledge needed from FLOW-BUS system about parameters, processes, nodes etc., complex software structure, not suited for quickly building an application

Programming examples are available for making applications in Visual Basic and LabView.

5.3 COMMUNICATION WITH INTERFACE DIRECTLY THROUGH RS232

Mostly used by PLC-equipment or special PC-applications (e.g. Hyperterminal).
You have to write your own communication routines for operating the FLOW-BUS system by host computer.
The protocol for the communication between the modules is described in a PDF-file doc.nr. 9.17.027.
For an RS232-interface module messages will be send by means of ASCII-strings (or binary).

Advantage:
Simple, straight forward, less overhead
Disadvantage:
Knowledge needed from FLOW-BUS system about parameters, processes, nodes etc.

See document 9.17.027 for a more information.
This document can be found at:
http://www.bronkhorst.com/en/downloads/instruction_manuals/

6 TROUBLESHOOTING

6.1 LED INDICATIONS

Led	Time	Indication
Green		
off	Continuous	Power-off or program not running
on	Continuous	Normal running/operation mode
Short flash	0.1 sec on 2.0 sec off	Initialization mode Secured parameters can be changed Remote install to FLOW-BUS
normal flash	0.2 sec on 0.2 sec off	Special function mode Instrument is busy performing any special function. E.g. auto-zero or self-test
Red		
off	Continuous	No error
Short flash	0.1 sec on 2.0 sec off	Node occupied: Re-install instrument
normal flash	0.2 sec on 0.2 sec off	Warning message. An error occurred of minor importance. It would be wise to investigate the cause of this. You are still able to work with your instrument.
on	Continuous	Critical error message. A serious error occurred in the instrument. Instrument needs service before further using.
Wink Mode Green Red Green Red turn by turn		
slow wink	0.2 sec on 0.2 sec off	Wink mode By a command send via FLOW-BUS the instrument can “wink” with Led’s to indicate its position in a (large) system
normal wink	1.0 sec on 1.0 sec off	Alarm indication: minimum alarm, limit/maximum alarm; power-up alarm or limit exceeded or batch reached.
fast wink	0.1 sec on 0.1 sec off	Switch-released, selected action started

6.2 TROUBLESHOOTING HINTS AND TIPS

Symptom	Possible cause	Action
No output signal on FLOW-BUS interface	Bad communication with FLOW-BUS	Check communication e.g. with local readout module or PC-test program
No or slow response to setpoint changes	Slope value could be set too high (ramp function for setpoint signal)	Check and/or change slope value with readout module or PC-software program
	Control mode/setpoint source for instrument could point to a different setpoint source	Check if correct control mode/setpoint source is selected for the instrument
	Other instrument (or PC) connected to FLOW-BUS could change the setpoint	Make sure who is in charge to change setpoints
	Polynomial factors could be wrong	Check if right fluid has been selected and check polynomial factors A..D with those on your calibration certificate
Inaccuracy of measurement	Wrong fluid (and thus calibration settings) could be selected (up to 8 fluids possible)	Check if correct fluid is selected for this instrument
		Check if powering of instrument is done correctly
Analog output range is too low/high	Wrong output range could be selected	Check if wanted output range (analog) is selected
No/bad connection to FLOW-BUS	Wrong cable used	Check cabling
	Bad termination of RS485 bus-line	Check bus termination
	Other module(s) on the bus could cause trouble	Check correct functioning from other module(s) on the bus (PC-programs with interface modules included)
No communication possible with PC-software program	Interface settings could be wrong	Check settings e.g. for RS232 (COM-port and baud rate)
	Interface has bad connection to FLOW-BUS	Check cabling of interface
Red or green LED's are blinking on top of the instrument	Instrument is in a special operation mode or is indicating some kind of error/warning	See manual 9.17.023 for more details
No/bad reaction to manual instructions by means of micro push-button switch on top	Some actions can only be used under special conditions	See manual 9.17.023 for more details
Master-slave controlling doesn't function well	Connection to master signal could be lost	Check if master output is given correctly
	Settings for this special controlling mode could be wrong	Check if settings are correct (control mode, slave-factor)
Controller doesn't function as wanted	Settings for controller are for other behaviour than you want	Under certain conditions you could run an auto-tune for controller optimisation. (see manual 9.17.023)
		Change response factor settings for controller (see manual of readout/control module or PC-software)
Other troubles	One or more parameter settings could be wrong	Get back original factory settings by means of micro push-button on top (see manual 9.17.023)
		Contact sales representative for assistance if the above doesn't help

7 SERVICE

For current information on Bronkhorst® and service addresses please visit our website:

http://www.bronkhorst.com

Do you have any questions about our products? Our Sales Department will gladly assist you selecting the right product for your application. Contact sales by e-mail:

sales@bronkhorst.com

For after-sales questions, our Customer Service Department is available with help and guidance. To contact CSD by e-mail:

support@bronkhorst.com

No matter the time zone, our experts within the Support Group are available to answer your request immediately or ensure appropriate further action. Our experts can be reached at:

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