Operating Instructions

Modules

Fieldbus

METTLER TOLEDO

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1 Introduction

1.1 General

The METTLER TOLEDO Fieldbus-Modules allow to connect METTLER TOLEDO weigh modules, industrial scales or laboratory balances (subsequently referenced to as weighing sensors) to an industrial Fieldbus network and make it possible to control the weighing sensor with a PLC master. For each weighing sensor is a separate Fieldbus-Module required.

The following Fieldbus-Modules are currently available:

Part number	Fieldbus-Module	Chapter
42102809	METTLER TOLEDO Profibus-Module	5.1
42102810	METTLER TOLEDO DeviceNet-Module	5.2
42102860	METTLER TOLEDO EtherNet/IP-Module	5.3
42102859	METTLER TOLEDO ProfiNet IO-Module	5.5
30038775	METTLER TOLEDO CC-Link Module	5.6

1.2 Compatibility

The Fieldbus-Modules are compatible to all METTLER TOLEDO weighing sensors and balances communicating with MT-SICS protocol via RS232, RS422 or RS485 Interfaces (see datasheet for list of compatible products).
MT-SICS is a plain ASCII protocol (MT-SICS = METTLER TOLEDO Standard Interface Command Set) which is used for control and configuration of the weighing sensor.

1.3 Related documentation

Important information of the weighing sensor products can be found in the following documents:

- Instructions for installation and operation (of the individual sensor)
- MT-SICS Reference Manual (for respective sensor type)
- Engineering Note: EN121 EtherNet/IP-DeviceNet and Logix5000
- Engineering Note: EN131 ProfiNet IO - Profibus and STEP 7

1.4 Internet addresses

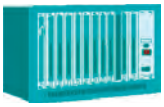
METTLER TOLEDO Automated Precision Weighing	www.mt.com/APW
PROFIBUS Organization	www.profibus.com
Open DeviceNet Vendors Associaton	www.odva.org
ProfiNet Organization	www.profinet.com
CC-Link Organisation	www.cc-link.org

2 Functional Overview

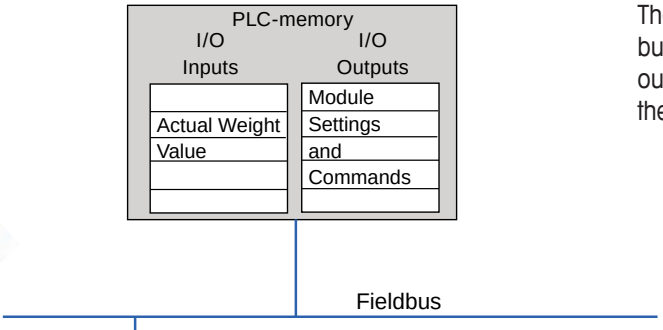
The METTLER TOLEDO Fieldbus-Module is designed to exchange data between a serial sub-network and a higher level network. For easy transfer is a Basic-Mode (see chapter 6.1, page 38) implemented for the most frequent commands. With the Extended-Mode (see chapter 6.2, page 40) is the full flexibility ensured.

2.1 Data exchange model

PLC



The PLC receives data into its internal input area via the fieldbus network from the IN area of the Fieldbus-Module.



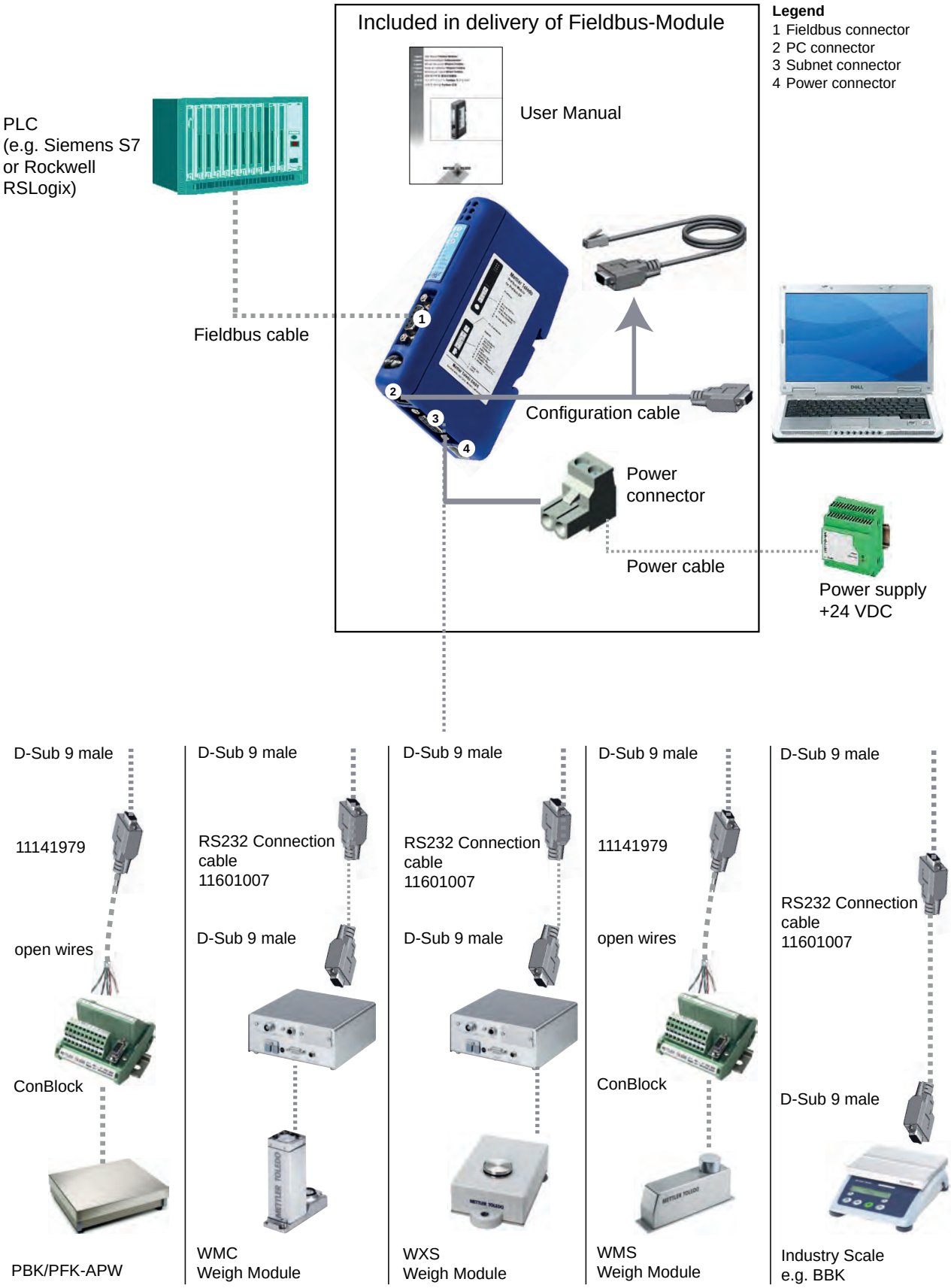
The PLC sends data via the fieldbus network, from its internal output area to the OUT area of the Fieldbus-Module.

Fieldbus-Module

The IN area of the Fieldbus-Module contains data received from the weighing sensor.

The OUT area of the Fieldbus-Module contains output data sent from the Fieldbus-Module to the weighing sensor.

3 Set-up Checklist



4 Step-by-Step Installation and Configuration

The following steps shall be performed to install and configure the weighing sensor and the Fieldbus-Module:

1. Configure the weighing sensor (see chapter 4.1, page 10)
2. DIN-Rail mounting (see chapter 4.2, page 11)
3. Connect the Fieldbus-Module to a PC for initial configuration (see chapter 4.3, page 11)
4. Connect the Fieldbus-Module to the weighing sensor (see chapter 4.4, page 12)
5. Connect the Fieldbus-Module to a power supply (see chapter 4.5, page 13)
6. Configure the Fieldbus-Module and activate the changes in the Fieldbus-Module (see chapter 4.6, page 14)
7. Connect the Fieldbus-Module to the network and check the LED indications (see chapter 5, page 17)

4.1 Configure the weighing sensor

Note

It is not possible to configure the weighing sensors, by use of the PC – Fieldbus-Module configuration cable connection. Please refer to the configuration instructions of the individual weighing sensor.

4.1.1 Adjustment of interface communication parameters of the weigh modules

METTLER TOLEDO recommends to use the RS422 interface for if available the communication between weighing sensors and the Fieldbus-Module. Configure the interface of the weigh module to a baud rate of 38400. Use MT-SICS command: COM (see MT-SICS manual for more information).

Note

Set the data flow control to none if you connect any weighing sensor to a METTLER TOLEDO Fieldbus-Module!

METTLER TOLEDO recommends to set 19200 or 38400 baud to allow an update rate up to 92 updates.

Example: RS422, 38400 baud, 8 bit, no parity,1 stop bit and no handshake -> MT-SICS command: COM_1_8_3_0

4.1.2 Adjustment of interface communication parameters of other weighing sensors

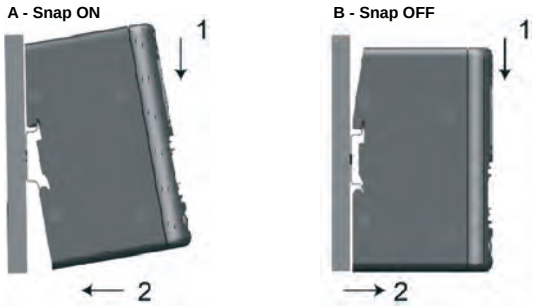
The interface communication parameters can be set via the menu or with the data interface port. Please refer to the user manual and/or the MT-SICS Reference Manual of the respective weighing sensor.

4.2 DIN-Rail mounting

To mount the Fieldbus-Module on a DIN-Rail follow the steps below:

Snap ON: To snap the Fieldbus-Module on, first press the Fieldbus-Module downward to compress the spring contacting the DIN-Rail (1), then push the Fieldbus-Module against the DIN-Rail and release it to make it snap on (2).

Snap OFF: To snap the Fieldbus-Module off, push the Fieldbus-Module downward (1) and pull it away from the DIN-Rail (2) to make it snap off from the DIN-Rail.

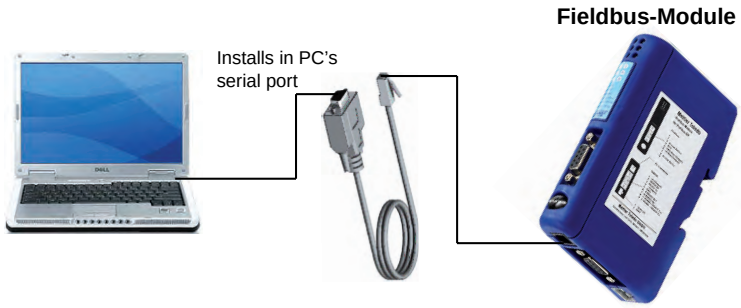


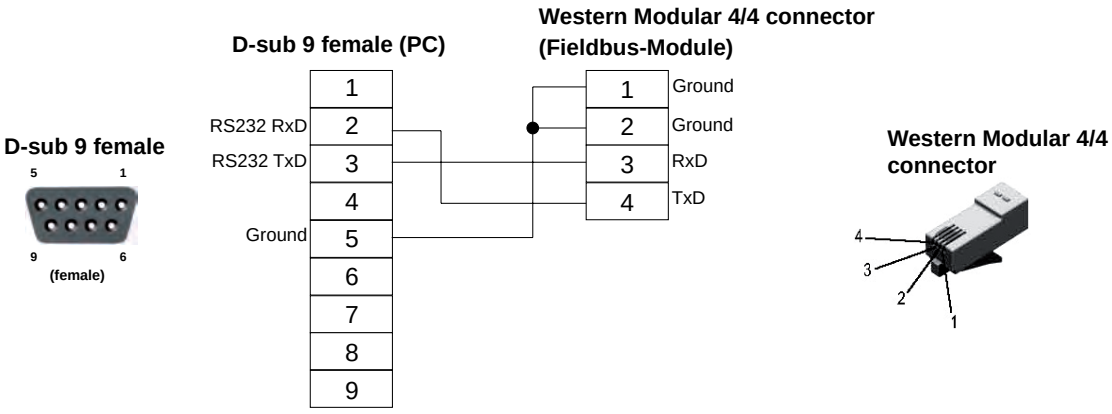
4.3 Connect the Fieldbus-Module to a PC for initial configuration

The PC connector is located at the bottom of the Fieldbus-Module. It is used to the configuration of the Fieldbus-Module. The enclosed configuration cable shall be used (connector type is a Western Modular 4/4 on the Fieldbus-Module side).

Note

This cable connection is only suitable to configure the Fieldbus-Module, it cannot be used for weighing sensor configuration (see also chapter 4.1).





4.4 Connect the Fieldbus-Module to the weighing sensor

The subnet connector is located at the bottom of the Fieldbus-Module and is used to connect a METTLER TOLEDO weighing sensor equipped with either a RS232, a RS422 or a RS485 interface (configuration see chapter 4.1). The respective pin assignment is shown in the table on next page.

Since the physical interface can be chosen by the Fieldbus-Module configuration dialog (see chapter 4.6.2), all necessary signals for all three RS-versions are present at the D-Sub 9-connector.

Note
Make sure to connect only the necessary wires used in your application.

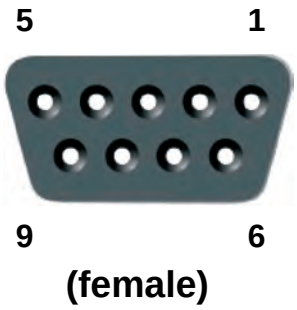
4.4.1 WMS, WM and WMH weighing sensor

DSub9 11141979		ConBlock (11152000) for the WMS weigh module ConModule (42102811) for WM and WMH weigh module and platform	
		RS422	RS232
1	Black	-	-
2	Brown	-	TXD
3	Red	-	RXD
4	Orange	-	-
5	Yellow	GND	GND
6	Green	Tx+	-
7	Blue	Tx-	-
8	Purple	Rx+	-
9	Grey	Rx-	-

4.4.2 Other METTLER TOLEDO balances and weighing sensors

For other balances and weighing sensors with MT-SICS protocol and either a RS232, a RS422 or a RS485 interface please refer to the respective manual of the weighing sensor to determine the pin assignment of its interface.

Subnet connector		Interface Type of weighing sensor		
Pin	**Description**	**RS232**	**RS422**	**RS485**
1	+ 5Volt			
2	RS232 RxD	✓ (TxD)		
3	RS232 TxD	✓ (RxD)		
4	Not connected			
5	Ground	✓ (GND)	✓ (GND)	✓ (GND)
6	RS422 Rx+		✓ (Tx+)	
7	RS422 Rx-		✓ (Tx-)	
8	RS485+ / RS422 Tx+		✓ (Rx+)	✓ (Rx+)
9	RS485- / RS422 Tx-		✓ (Rx-)	✓ (Rx-)



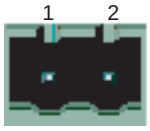
✓ Wires to be used (depending on weighing sensor's interface type)

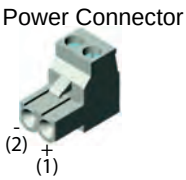
Make sure to connect only the necessary wires depending on the weighing sensor's interface.

4.5 Connect the Fieldbus-Module to a power supply

The power supply connector is located at the bottom of the Fieldbus-Module.

Pin	Description
1	+ 24V DC +/- 10%, 280 mA max.
2	GND





An appropriate connector (type MSTB 2.5/2-ST-5.08) with screw terminals is included in the delivery. The appropriate cable diameter ranges from 0.2 mm^2 to 2.5 mm^2 (AWG 24 to AWG 12). Use 60/75 or 75 °C copper (CU) wire only. The terminal tightening torque must be between 0.5 - 0.8 Nm (5 - 7 lbs-in).

4.6 Configure the Fieldbus-Module

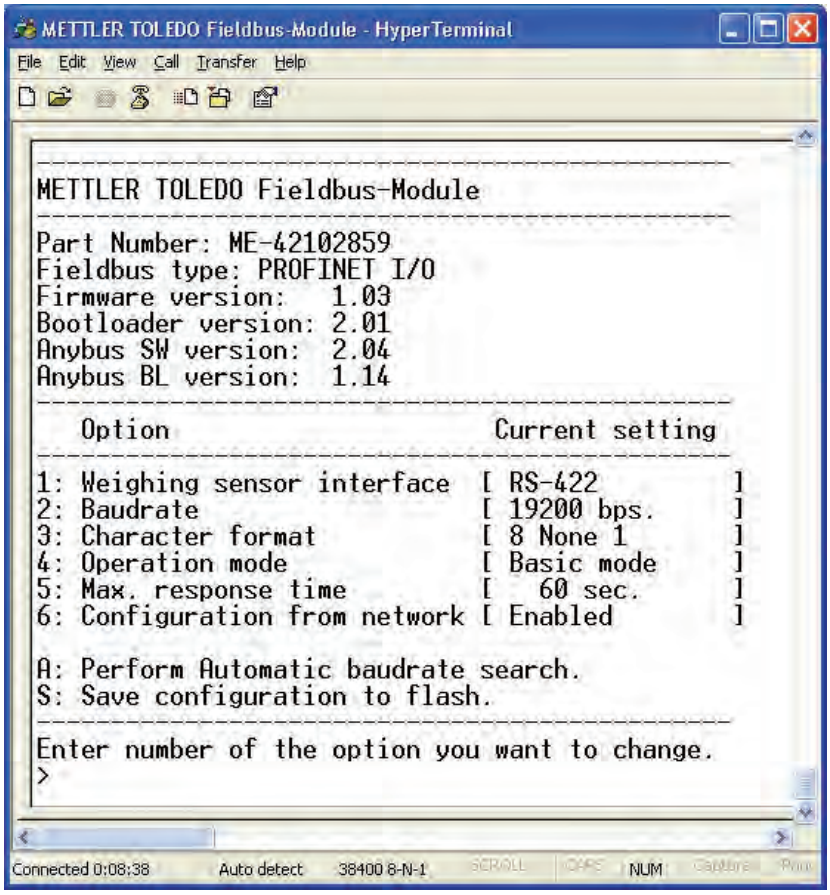
4.6.1 PC terminal software

The Fieldbus-Module provides a serial configuration dialog, which allows to configure the communication parameters of the subnet communication by use of a PC. After power-up, the Fieldbus-Module sends an ASCII based configuration dialog via the PC connector to a terminal or a PC. In case of using a PC, a terminal emulation program (such as hyper terminal which is a standard component of Windows) shall be started **before** power-up of the Fieldbus-Module.

Use the following interface settings at your PC for the terminal program:

- Baud rate: 38400 bps.
- 8 data bits
- 1 stop bit
- No parity check
- No flow control

The dialog will show the following initial Menu on the screen (from a ProfiNet-Module):



The last saved settings will be displayed.

Note

The configuration dialog will be disabled after 60 seconds if no buttons are pressed.
You can always press the Esc button to display the main menu again.

Press the number of the option you want to change and then press enter. A new dialog will be displayed where you can enter your new setting. After a new setting is entered, the main menu will be displayed again. The current setting will now show the settings you have configured, but they will not be permanently stored until you save them to the flash by pressing "S" (save configuration to flash) in the main menu.
To start using the new settings you must power down and restart the Fieldbus-Module.

4.6.2 Weighing sensor interface

The Fieldbus-Module can communicate with weighing sensors using the following different interfaces:

- RS232, full duplex, no handshake.
- RS422, full duplex, no handshake (default).
- RS485, half duplex, no handshake.

Note
Set the handshake control to none if you connect any weighing sensor to a METTLER TOLEDO Fieldbus-Module!

4.6.3 Baudrate

The Fieldbus-Module can communicate using the following baudrates:

- 1200 bps
- 2400 bps.
- 4800 bps.
- 9600 bps.
- 19200 bps. (Default)
- 38400 bps.
- 57600 bps

4.6.4 Character format

The Fieldbus-Module supports the following character formats:

- 7 None 1 (7 data bits, no parity and 1 stop bit)
- 8 None 1 (8 data bits, no parity and 1 stop bit) (default)
- 7 Even 1 (7 data bits, Even parity and 1 stop bit)
- 7 Odd 1 (7 data bits, Odd parity and 1 stop bit)

4.6.5 Operation mode

The Fieldbus-Module can be used in two different modes (Detail see chapter 6.1, page 38 and chapter 6.2, page 40).

1. The Basic-Mode is the default operation mode and supports the most important MT-SICS commands

2. The Extended-Mode supports all MT-SICS commands and uses 32 bytes for communication.

4.6.6 Maximum response time

With the "Max response time"-option you can set the maximum time between two successive responses from the balance. If the Fieldbus-Module does not receive a new response from the balance within the defined maximum response time, the Fieldbus-Module will indicate this communication problem by setting the connection status bit to "False" and the subnet status LED to red (see chapter 7.2, page 48).

The connection status bit will be set to true (operational) again when cleared by the connection status clear bit.

The "Max response time" is defined to 60 seconds as default and can be changed between 10 sec and 9999 sec or completely switched off. In that case the timeout feature is not working anymore. This might be useful for some applications where longer periods of inactivity may occur.

4.6.7 Configuration from network

This menu point is only available in the ProfiNet IO-Module.

If "Configuration from network" is enabled, all parameters must be configured via network from the configuration program (e.g. PLC). In this case no other configurations from the terminal program are possible.

The default setting for "Configuration from network" is enabled.

4.6.8 Automatic baudrate search

All Fieldbus-Modules have the ability to automatically search for correct baudrate and character format on the subnet side. If you want to use automatic baudrate search you first have to configure the correct "Weighing sensor interface" under menu option 1, after that you can start the search by pressing "A" (Perform Automatic baudrate search) in the main menu. The Fieldbus-Module will send a command string to the weighing sensor in all different baudrates and character formats, and if the weighing sensor responds, the Fieldbus-Module has found the correct settings.

Note
Automatic baudrate search can be used for subnet connection test. It will find no baudrate setting in case of failure.

Example of dialog using the automatic baudrate search option:

```
---------------------------------------------------------------------------------------------
Automatic baudrate search
---------------------------------------------------------------------------------------------
Searching with RS232 interface
Pressing ESCAPE interrupts the search.
Testing: 9600 bps, 8 none 1
Interface setting:
9600 bps, 8 none 1, no handshake.
Do you want to save the interface parameters? (Y/N)
>
```

If N (No) is pressed the Fieldbus-Module will reject the setting and return to the main menu.
If Y (Yes) is pressed the Fieldbus-Module will automatically save the new settings to the flash, therefore no additional "Save configuration to flash" is necessary in the main menu.

Note
If an automatic baudrate search is used, the Fieldbus-Module will stop the normal communication with the weighing sensor.

Please refer the LED Indication Table (e.g. for Profibus-Module chapter 5.1.9) for explanations of the LED-signals during automatic baudrate search.

4.6.9 Save configuration to flash

To store the configuration permanently to the Fieldbus-Module you must press "S" (Save configuration to flash).
Before the new settings can be used, the Fieldbus-Module must be restarted by switching off and on the power supply from the Fieldbus-Module.

5 Fieldbus-Modules

5.1 Profibus-Module

The Profibus version of the METTLER TOLEDO Fieldbus-Module is called MT Profibus Module and has the METTLER TOLEDO Part number: 42102809

5.1.1 General

The METTLER TOLEDO Profibus-Module is designed as a Profibus-DP slave (DPV0) according to EN 50170. It supports all mandatory functions of a Profibus-DP slave.
A Profibus master (e.g. a PLC) can send commands and receive data from the Profibus-Module.

For the SIMATIC STEP 7 PLC there is a Engineering note and also a example, specific to METTLER TOLEDO products with SICS communication protocol, available on www.mt.com/ind-APW-fieldbus-support. They significantly shorten integration time and save valuable resources and development time for system integrators and end users.

5.1.2 Supported features

- Auto baudrate detection supported. Baudrate range: 9.6 kbit – 12 Mbit.
- Hardware prepared for DP-V1 extensions.
- Save / Load configuration in Flash supported.
- Address range: 1-99. The node address of the Profibus connection shall always be set via the configuration switches.
- Support all standard diagnostic messages according to standard EN 50170.

5.1.3 Identification numbers

Identification number: 0x0642 Hex.
Product name: "MT Profibus Module"
Part number: 42102809

5.1.4 Profibus node address

Before installing the Profibus-Module in the Profibus network, the node address is to be set with two rotary switches under the lid on the front. The address range is 1 to 99. The lower switch is used for the first digit of the address (value x 10), the upper switch for the second digit of the address (value x 1).

Example
Address = 45 => lower switch to value 4 and upper switch to value 5.

Note
The node address cannot be changed during operation. A new address setting is valid after power-off and power-on of the Profibus-Module.

5.1.5 Cabling

The Profibus-Module connects to a Profibus network with the female D-sub 9 connector on the front.

Pin	Name	Function
Housing	Shield	Connected to PE (connected to spring contacting the DIN-Rail).
1	Not connected	-
2	Not connected	-
3	B-Line	Positive RxD/TxD-signals according to RS485 specification.
4	RTS	Request to send*
5	GND BUS	Isolated GND (RS485 side)*
6	+5V BUS	Isolated +5 V (RS485 side)*
7	Not connected	-
8	A-Line	Negative RxD/TxD-signals according to RS485 specification.
9	Not connected	-

* +5 V BUS and GND BUS are used for bus termination. Some devices, like optical transceivers (RS485 to fiber optics) might require external power supply from these pins (max. 80 mA). RTS is used in some equipment to determine the direction of transmission. In standard applications only A-line, B-line and Shield are used.

5.1.6 Bus termination

The first and the last device of each Profibus line must be terminated with termination resistors to avoid reflections on the bus. Also the METTLER TOLEDO Profibus-Module can be installed as the first or the last device of a Profibus line. The termination is typically done by switching on the termination switch of the Profibus connector of the bus cable at the first and last device. At all other devices of a Profibus line the termination switch should be turned off.

5.1.7 GSD configuration file

Each Profibus-Master (e.g. PLC) requires a GSD file for integration of the METTLER TOLEDO Profibus-Module. The GSD file for the METTLER TOLEDO Profibus-Module is provided on www.mt.com/ind-APW-fieldbus-support.

5.1.8 Configure and start the Profibus network

For general installation and configuration see chapter 4, page 10.

The Profibus node address must be configured shown in chapter 5.1.4.

Correct communication between the Profibus-Module and the weighing sensor is indicated by the following LED status (see chapter 5.1.9): 5 green steady, 6 green steady. Refer to chapter 7.3 if LED's show different status.

Note

The integration shall be carried out by PLC system experts. The respective support for PLC systems is not under METTLER TOLEDO responsibility.

5.1.9 LED indication table

LED	Indication	Description
1 – Network status	Off	Profibus not online
	Green, steady	Profibus online
2 – Profibus status	Off	Profibus not offline
	Red, steady	Profibus offline
3 – Reserved	-	Not used
4 – Fieldbus diagnostic	Off	No diagnostic present
	Red, 1 Hz-flashing	Error in configuration from the Profibus master side
	Red, 2 Hz-flashing	User parameter data error
	Red, 4 Hz-flashing	Error in initialization of Profibus ASIC (internal fault)
5 – Subnet status	Off	Power Off
	Green, steady	Communication with weighing sensor OK
	Green, flashing	Receiving data from weighing sensor
	Red, steady	Communication with weighing sensor failed (timeout)
6 – Device status	Off	Power Off
	Green, steady	Profibus-Module initialized and running
	Green, flashing	Performing auto baudrate detection
	Red, steady	Unrecoverable error
	Red, flashing	Auto baudrate detection failed

5.2 DeviceNet-Module

The DeviceNet version of the METTLER TOLEDO Fieldbus-Module is called MT Devicenet Module and has the METTLER TOLEDO Part number: 42102810.

5.2.1 General

The DeviceNet-Module functions as a DeviceNet adapter according to EN 50325-2. It supports all mandatory functions for polled I/O slave messaging of a DeviceNet adapter.
It acts as a device slave on the network and presents the weighing sensor data to the master controller.

As of RSLogix5000 Version 16, a complimentary open-source Rockwell Automation Logis5000 function block and faceplates with a Engineering note, specific to METTLER TOLEDO products with SICS communication protocol, available on www.mt.com/ind-APW-fieldbus-support. They significantly shorten integration time and save valuable resources and development time for system integrators and end users.

5.2.2 Supported features

- MAC ID and baudrate can be set via onboard switches.
- Explicit messaging
- Polled I/O
- Bit-strobed I/O
- Change-of-state / Cyclinc I/O
- Galvanically isolated bus electronics
- All standard DeviceNet baudrates from 125 kbit/s to 500 kbit/s are supported. Baudrate and node address shall be set via the configuration switches.
- Implemented objects:
  - DeviceNet objects:
    1. Identity object, class 01h
    2. Message router object, class 02h
    3. DeviceNet object, class 03h
    4. Assembly object, class 04h
    5. Connetion object, class 05h
    6. Acknowledge handler object, class 2Bh
  - Vendor specific objects:
    7. I/O data Input mapping object, class A0h
    8. I/O data output mapping object, class A1h
    9. Diagnostic object, class AAh
    10. Parameter data Input mapping object, class B0h
    11. Parameter data output mapping object, class B1h

5.2.3 Identification numbers

Vendor ID: 90
Device ID: 12
Product code: 40
Product name: "MT Devicenet Module"
Part number: 42102810

5.2.4 Network configuration

5.2.4.1 Mac address

Before installing the DeviceNet-Module on a DeviceNet network, it must have a unique Mac ID. The Mac ID shall be set between 0 and 63.

The Mac ID is configured by the DIP-switches 3 to 8 under the lid on the front.

MAC ID	Sw. 3 (MSB)	Sw. 4	Sw. 5	Sw. 6	Sw. 7	Sw. 8 (LSB)
0	OFF	OFF	OFF	OFF	OFF	OFF
1	OFF	OFF	OFF	OFF	OFF	ON
2	OFF	OFF	OFF	OFF	ON	OFF
3	OFF	OFF	OFF	OFF	ON	ON
-	-	-	-	-	-	-
62	ON	ON	ON	ON	ON	OFF
63	ON	ON	ON	ON	ON	ON

5.2.4.2 Baudrate

There are three different baudrates for DeviceNet: 125kbit/s, 250kbit/s and 500kbit/s.
Switches 1 and 2 are used to set the baudrate of the DeviceNet-Module.

Baudrate	Sw. 1	Sw. 2
125k	OFF	OFF
250k	OFF	ON
500k	ON	OFF
(reserved)	ON	ON

5.2.5 Cabling

The DeviceNet-Module connects to a DeviceNet network with a connector with screw terminals at the front.

Pin	Signal	Description
1	V-	Negative supply voltage*
2	CAN_L	CAN_L bus line
3	SHIELD	Cable shield
4	CAN_H	CAN_H bus line
5	V+	Positive supply voltage*

Note
* The bus interface shall be externally supplied with 24V DC +/- 10%.

5.2.6 EDS configuration file

During configuration of the DeviceNet-Module at the DeviceNet master scanner (e.g. PLC), an EDS file (Electronic Data Sheet) is required. This EDS file for the DeviceNet-Module is provided on www.mt.com/ind-APW-fieldbus-support.

5.2.7 Configure and start the DeviceNet network

For general installation and configuration see chapter 4, page 10.

The DeviceNet address (MAC ID) and baudrate must be configured shown in chapter 5.2.4.1 and 5.2.4.2.

Correct communication between the DeviceNet-Module and the weighing sensor is indicated by the following LED status (see chapter 5.2.8): 5 green steady, 6 green steady. Refer to chapter 7.3 if LED's show different status.

Note
The integration shall be carried out by PLC system experts. The respective support for PLC systems is not under METTLER TOLEDO responsibility.

5.2.8 LED indication table

LED	Indication	Description
1 – Network status	Off	Not online
	Green, steady	Link OK, not connected
	Green, flashing	Online, not connected
	Red, steady	Critical link failure
	Red, flashing	Connection timeout
2 – DeviceNet status	Off	Power Off
	Green, steady	Device operational
	Green, flashing	Data size bigger than configured
	Red, steady	Unrecoverable fault
	Red, flashing	Minor fault
3 – Reserved	-	Not used
4 – Reserved	-	Not used
5 – Subnet status	Off	Power Off
	Green, steady	Communication with weighing sensor OK
	Green, flashing	Receiving data from weighing sensor
	Red, steady	Communication with weighing sensor failed (timeout)
6 – Device status	Off	Power Off
	Green, steady	DeviceNet-Module initialized and running
	Green, flashing	Performing auto baudrate detection
	Red, steady	Unrecoverable error
	Red, flashing	Auto baudrate detection failed

5.3 EtherNet/IP-Module

The EtherNet/IP version of the METTLER TOLEDO Fieldbus-Module is called MT Ethernet/IP Module and has the METTLER TOLEDO Part number: 42102860

5.3.1 General

The EtherNet/IP-Module functions as an EtherNet/IP adapter according to EN 50325-2. It supports all mandatory functions for polled I/O slave messaging of an EtherNet/IP adapter.

The Industrial Ethernet Protocoll (EtherNet/IP) was originally developed by Rockwell Automation and is now managed by the Open DeviceNet Vendors Associaton (ODVA).

EtherNet/IP is standardized in the International standard IEC 61158.

As of RSLogix5000 Version 16, a complimentary open-source Rockwell Automation Logis5000 function block and faceplates with a Engineering note, specific to METTLER TOLEDO products with SICS communication protocol, available on www.mt.com/ind-APW-fieldbus-support.They significantly shorten integration time and save valuable resources and development time for system integrators and end users.

5.3.2 Supported features

- Supported shielded (FTP) and unshielded (UTP) cables
- Flexible file system providing both volatile and non-volatile storage areas
- Security framework
- Integrated FTP server provides easy file management using standard FTP clients.
- Server side include (SSI) capability
- Web server
- E-mail client (messages can be triggered by data events or directly by the application)
- All standard EtherNet/IP baudrate 10/100 Mbit are supported. It will detect the actual transmission speed of the bus automatically.
- The node address of the EtherNet/IP connection shall always be set via the IPConfig-Tool (see chapter 5.3.9)
- The following CIP-objects are implemented:
  - Mandatory objects:
    1. Identity object, class 01h
    2. Message router object, class 02h
    3. Assembly object, class 04h
    4. Connection manager, class 06h
    5. Port object, class F4h
    6. TCP/IP interface object, class F5h
    7. Ethernet link object, class F6h
  - Vendor specific objects:
    8. I/O data input mapping object, class A0h
    9. I/O data output mapping object, class A1h
    10. Diagnostic object, class AAh
    11. Parameter data input mapping object, class B0h
    12. Parameter data output mapping object, class B1h

5.3.3 Identification numbers

Vendor ID: 666
Device ID: 12
Product code: 42860
Product name: "MT Ethernet/IP Module"
Part number: 42102860

5.3.4 Network configuration

5.3.4.1 IP address

Make sure each node on the network has a unique IP address. The IP settings of the EtherNet/IP-Module can be configured in various ways. It is recommended to use the IPConfig-Tool (see chapter 5.3.9) for configuring the IP-settings.

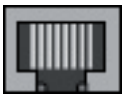
The IP address of the EtherNet/IP-Module can be also set with the configuration switches in the range 192.168.0.1 – 192.168.0.254.
If the switches are set to zero, the settings are specified by the system file "ethcfg.cfg" e.g. with the IPConfig-Tool (see chapter 5.3.9).
Note that the switches are read once during startup; any changes require a reset in order to have effect.

SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	DHCP	Subnet	Gateway	IP
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	(settings determined by 'ethcfg.cfg')			
OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF	255.255.255.0	192.168.0.255	192.168.0.1
OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF	255.255.255.0	192.168.0.255	192.168.0.2
…	…	…	…	…	…	…	…	…	…	…	…
ON	ON	ON	ON	ON	ON	ON	OFF	OFF	255.255.255.0	192.168.0.255	192.168.0.254
ON	ON	ON	ON	ON	ON	ON	ON	(invalid setting)			

To read and write the IP configuration is also possible to use the EtherNet/IP website (e.g. http://192.168.0.1).

5.3.5 Cabling

Pin	Signal
Housing	Cable shield
1	TD+
2	TD-
3	RD+
4	Termination
5	Termination
6	RD-
7	Termination
8	Termination



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5.3.6 EDS configuration file

The EDS file is provided on www.mt.com/ind-APW-fieldbus-support and has the function of an electronic data sheet and includes all parameter and options that an EtherNet/IP device supports. The EtherNet/IP-Module requires one EDS file that contains the necessary definitions for the Basic and the Extended-Mode.

5.3.7 Configure and start the EtherNet/IP network

For general installation and configuration see chapter 4, page 10.

The IP address must be configured shown in chapter 5.3.4.1.

Correct communication between the EtherNet/IP-Module and the weighing sensor is indicated by the following LED status (see chapter 5.3.8): 5 green steady, 6 green steady. Refer to chapter 7.3 if LED's show different status.

Note
The integration shall be carried out by PLC system experts. The respective support for PLC systems is not under METTLER TOLEDO responsibility.

5.3.8 LED indication table

LED	Indication	Description
1 – Module status	Off	(no power)
	Green, steady	Normal operation
	Green, flashing	Stand by, not initialized
	Red	Major fault
	Red, flashing	Minor fault
	Alternating Red/Green	(self test)
2 – Network status	Off	No IP address (or no power)
	Green, steady	EtherNet/IP connection(s) established
	Green, flashing	No EtherNet/IP connection(s) established
	Red	Duplicate IP address detected
	Red, flashing	One or several connections time out
	Alternating Red/Green	(self test)
3 – Link	Off	No link (or power off)
	Green	Connected to an Ethernet network
4 – Activity	Off	No Ethernet activity (or no power)
	Green	Receiving or transmitting Ethernet packet
5 – Subnet status	Off	Power Off
	Green, steady	Communication with weighing sensor OK
	Green, flashing	Receiving data from weighing sensor
	Red, steady	Communication with weighing sensor failed (timeout)
6 – Device status	Off	Power Off
	Green, steady	EtherNet/IP-Module initialized and running
	Green, flashing	Performing auto baudrate detection
	Red, steady	Unrecoverable error
	Red, flashing	Auto baudrate detection failed

5.3.9 IPConfig-Tool

The EtherNet/IP-Module has to be configured for the same I/O size and IP-settings as in the PLC configuration. The IPConfig-Tool (can be found on www.mt.com/ind-APW-fieldbus-support) can be used to configure the IP settings of all EtherNet/IP-Modules.

The IPConfig-Tool scans the network for EtherNet/IP-Modules. To configure the settings manually (default DHCP is activated) double click on the desired module and enter the desired IP-settings.

5.4 EtherNet/IP Configuration for Rockwell Add-on-Profile

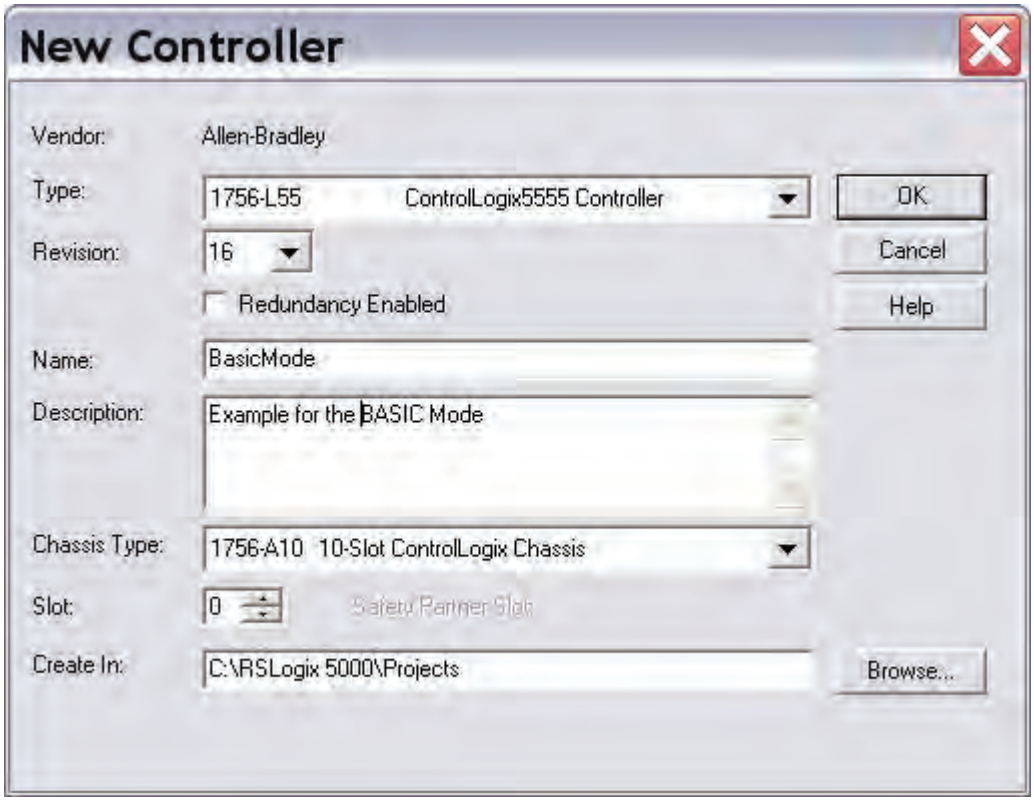
After installation the EtherNet/IP-Module must be configured in the PLC.

5.4.1 Connecting the EtherNet/IP-Module

Refer to the EtherNet/IP-Module instructions for installation and operation for details.
On chapter 4.4.1 you can find information about the RS422 cable connection between the ConModule to the DeviceNet-Module.

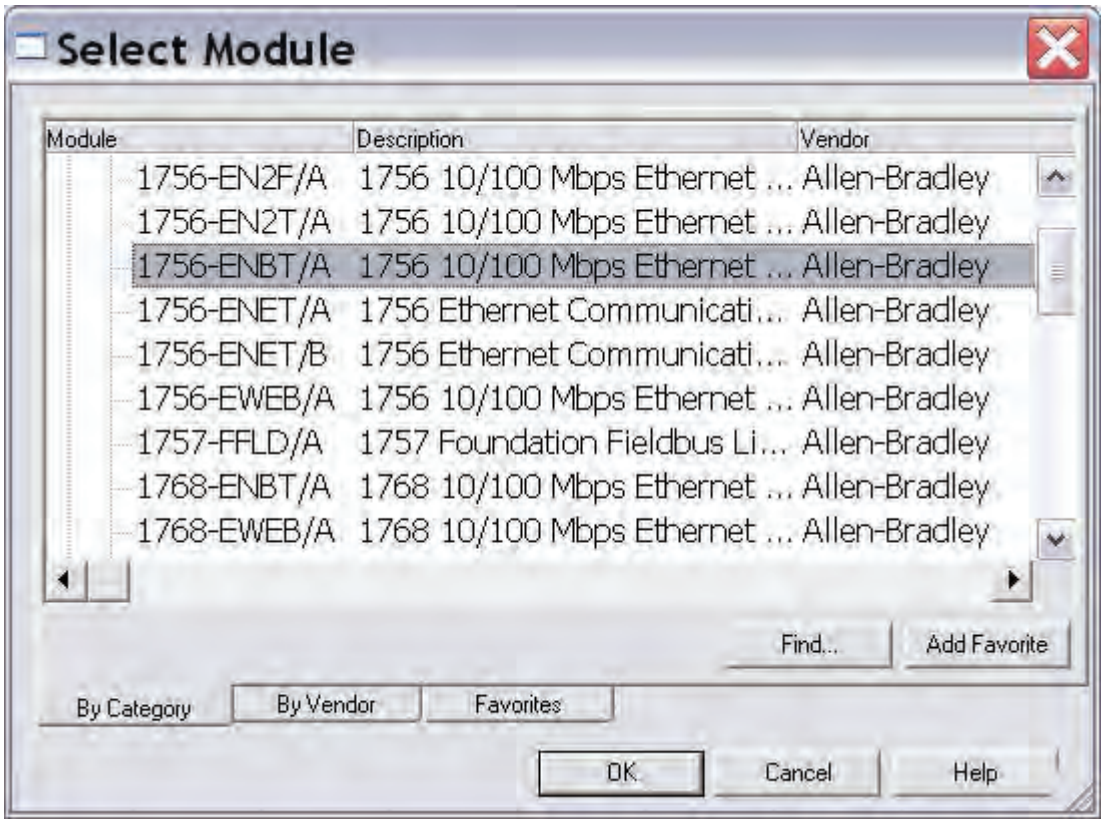
5.4.2 PLC configuration

To create a new configuration, open the file menu and select "New". In the appearing dialogue select the desired type of PLC, in this case the type 1756-L55 is used. Also enter a name for the controller and select chassis type, slot number and project path. To accept the settings press "OK".

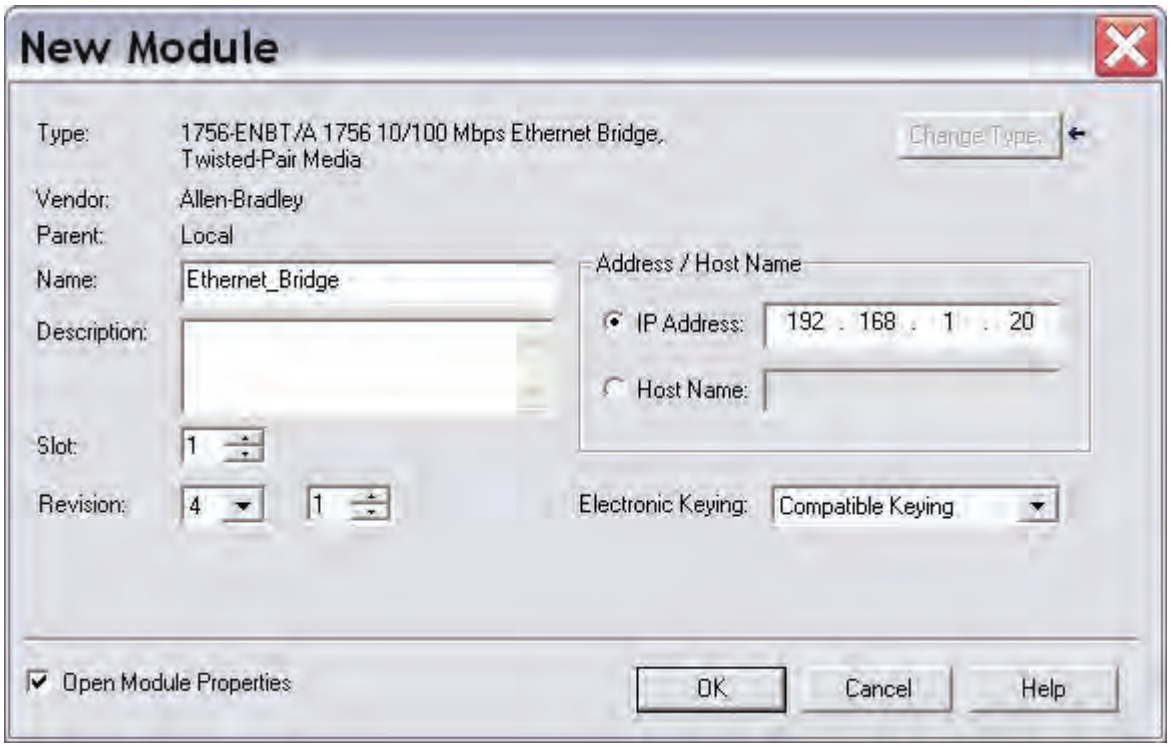


Then add the Ethernet I/O-Module. Right click on the I/O Configuration directory in the navigation list to the left as seen.

Click on "New Module" and select the desired Ethernet-Module, in this case the Ethernet-Bridge. This Module is the Scanner-Module in the PLC.

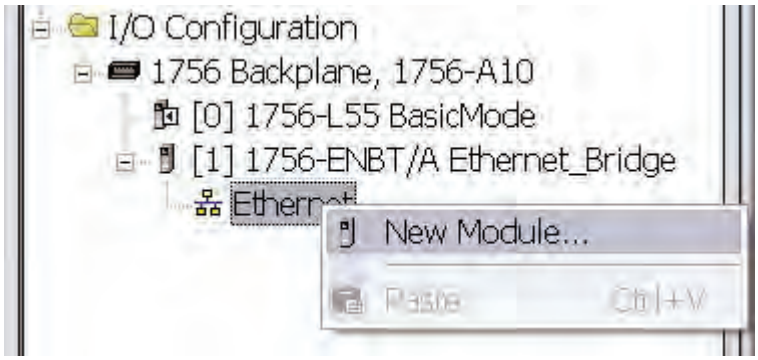


Then enter the desired settings and press "Finish".

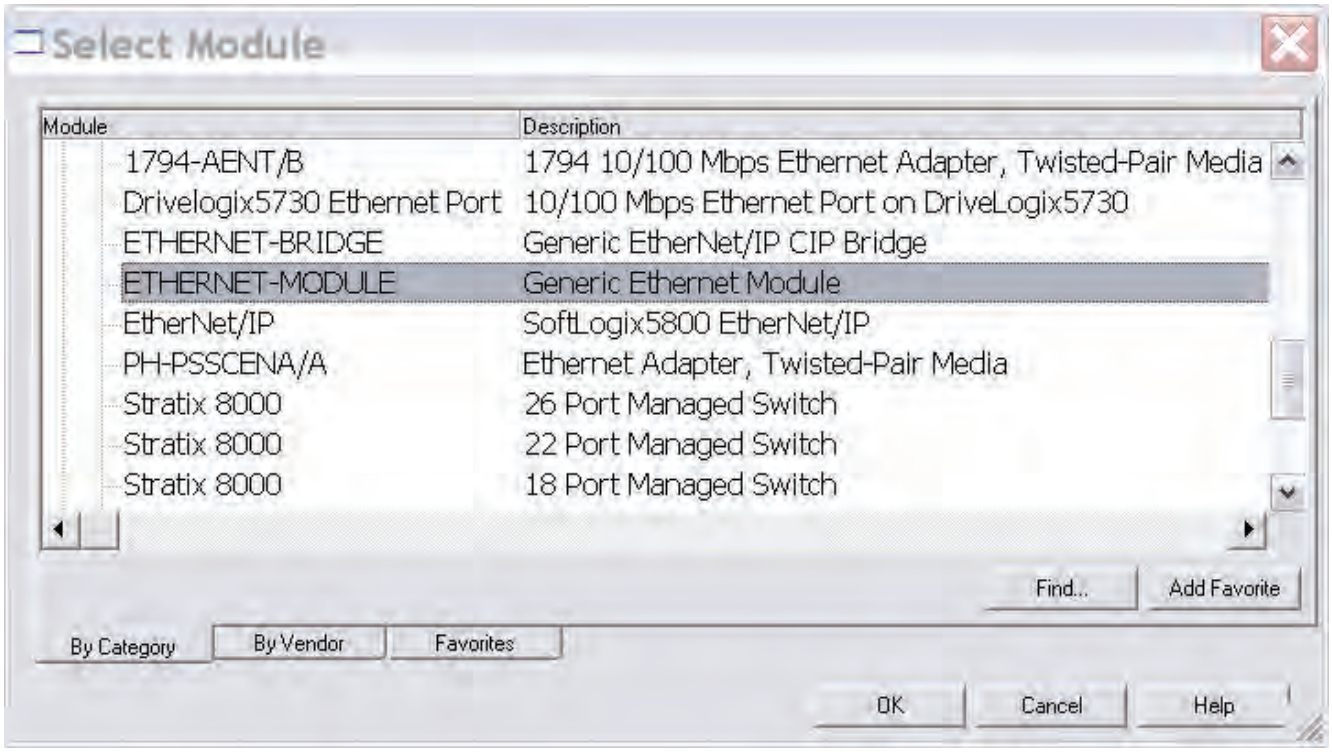


5.4.3 EtherNet/IP-Network configuration

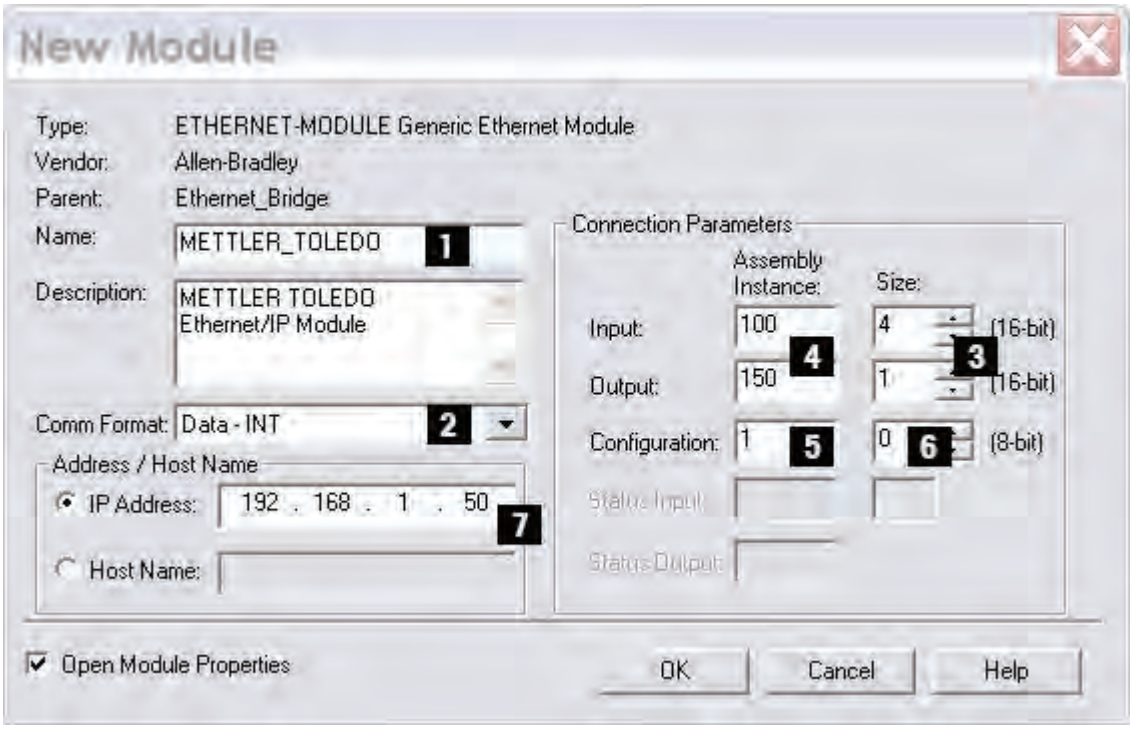
To add the METTLER TOLEDO EtherNet/IP-Module (Generic Ethernet Module) to the configuration in the PLC, the program setting must be in offline mode. Add the module with a right click on the "EtherNet/IP-Bridge" in the I/O Configuration, and select "New Module".



Now a dialogue window will appear. In this dialogue window, select "Generic Ethernet Module" and press "OK".



In the next dialogue window, RSLogix 5000 will ask for information regarding the communication to the METTLER TOLEDO Ethernet/IP-Module. First enter a name for the METTLER TOLEDO Ethernet/IP-Module (1). In the example below we call it METTLER_TOLEDO. This name will create a tag in RSLogix 5000, which can be used to access the memory location in the PLCs memory where the data for the METTLER TOLEDO Ethernet/IP-Module will be stored. A description can also be added, but that is optional.

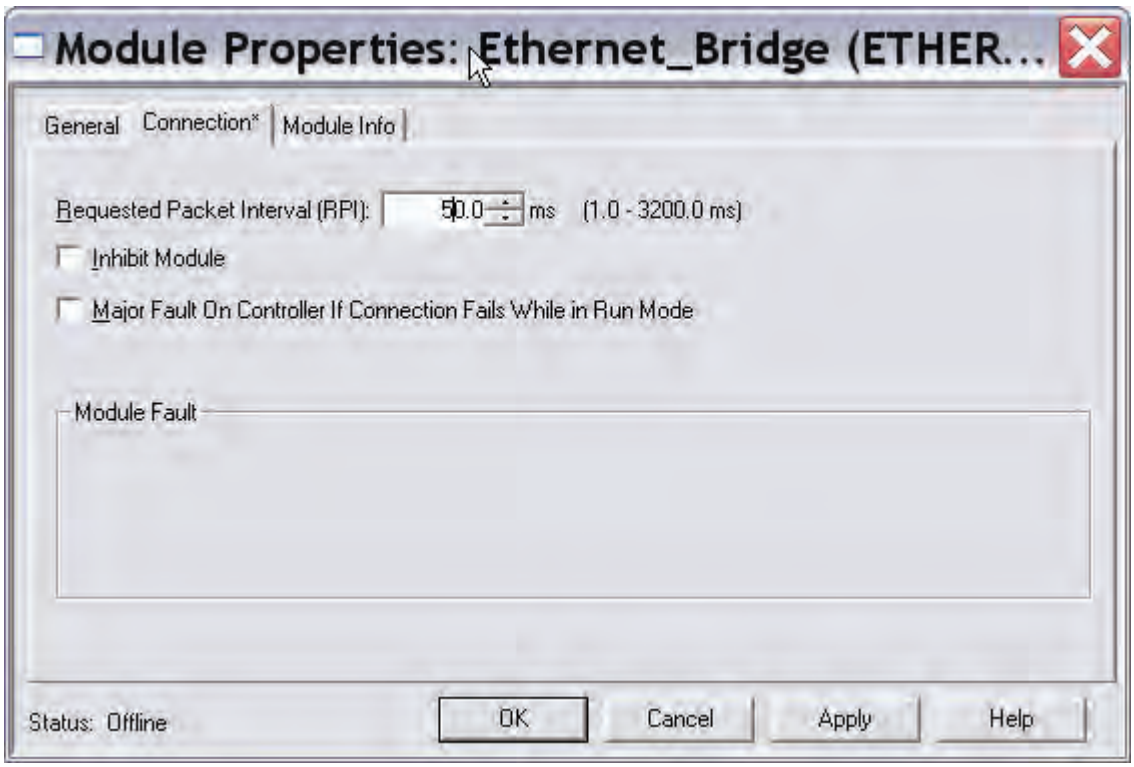


Next step is to select the Comm Format, which tells RSLogix 5000 the format of the data (2). In our example, we have selected Data-INT, which will represent the data in the METTLER TOLEDO Ethernet/IP-Module as a field of 16-bit values. It is also possible to select Data-SINT, which will represent the data as 8-bit values, and Data-DINT, which will represent it as 32 bit values.

In our case (Basic-Mode we are using 64-bit (8 byte) values of input and 16-bit (2 byte) of output data. In this case, the size that we enter in (3) is: 4×16-bit as input and 1×16-bit as output value. If we had been using other data type like Data-SINT or Data-DINT, we would have to recalculate the size to match the data type.

I/O data is accessed in input instance 100 and output instance 150, so these values have to be entered as the instance values for input and output (4). The size of the input connection and the output connection shall correspond to the size that we have configured the METTLER TOLEDO Ethernet/IP-Module for.

The METTLER TOLEDO Ethernet/IP-Module does not have a configuration assembly instance by default, but RSLogix 5000 requires a value for this anyway. An instance value of 0 or 255 is not a valid instance number, but any other non-zero value will work, here we have selected the value 1 (5). The data size of the configuration instance has to be set to 0, otherwise the configuration instance will be accessed and the connection will be refused (6). As a final step we enter the IP address that we have configured for the module, here 192.168.1.50 (7).



In this tab we will enter a value for the time between each scan of the Module. In this example, we have set the interval to 50 ms to reduce the network load. Make sure that Inhibit Module is not checked. After this, press "OK".

Note

Once settings are saved ("OK" clicked), the Comm Format cannot be changed. The Generic Ethernet-Module must be deleted and then re-entered if a different Comm Format is desired. All other settings may be edited.

Now the METTLER TOLEDO EtherNet/IP-Slave has been added to the I/O Configuration in RSLogix 5000.

5.5 ProfiNet IO-Module

The ProfiNet IO version of the METTLER TOLEDO Fieldbus-Module is called MT Profinet Module and has the METTLER TOLEDO Part number: 42102859

5.5.1 General

The ProfiNet IO-Module functions as a ProfiNet IO slave according to IEC 61784 (CPF-3/3) and supports ProfiNet IO baudrate 100 Mbit.

For the SIMATIC STEP 7 PLC there is a Engineering note and also a example, specific to METTLER TOLEDO products with SICS communication protocol, available on www.mt.com/ind-APW-fieldbus-support. They significantly shorten integration time and save valuable resources and development time for system integrators and end users.

5.5.2 Supported features

- Supported shielded (FTP) and unshielded (UTP) cables
- Flexible file system providing both volatile and non-volatile storage areas
- Security framework
- Integrated FTP server provides easy file management using standard FTP clients.
- Server side include (SSI) capability
- Web server
- E-mail client (messages can be triggered by data events or directly by the application)
- Only slot 0 and 1 is used for the ProfiNet IO-Module and no subslots.
- The standard ProfiNet IO baudrate 100 Mbit is supported. It will detect the actual transmission speed of the bus automatically.
- The note address of the ProfiNet IO connection shall always be set via the IPConfig-Tool (see chapter 5.5.9).

5.5.3 Identification numbers

Vendor ID: 142
Device ID: 1111
Product name: "MT Profinet Module"
Part number: 42102859

5.5.4 Network configuration

5.5.4.1 IP address

Make sure each node on the network has a unique IP address. The IP settings of the ProfiNet IO-Module can be configured in various ways. It is recommended to use the IPConfig-Tool (see chapter 5.5.9) for configuring the IP-settings.

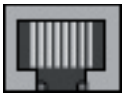
To read and write the IP configuration is also possible to use the ProfiNet IO website (e.g. http://192.168.0.1).

5.5.4.2 Sub-network configuration

An additional parameter according to the sub-network parameters (see chapter 4.6.7, page 16) is available to define how the sub-network parameters will be configured.

5.5.5 Cabling

Pin	Signal
Housing	Cable Shield
1	TD+
2	TD-
3	RD+
4	Termination
5	Termination
6	RD-
7	Termination
8	Termination



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5.5.6 GSDML configuration file

The GSDML file is provided on www.mt.com/ind-APW-fieldbus-support and has the function of an electronic data sheet and includes all parameter and options that an ProfiNet IO device supports. The ProfiNet IO-Module requires one individual GSDML file that contains two Module definitions: Module 1: Basic-Mode and Module 2: Extended-Mode.

5.5.7 Configure and start the ProfiNet IO network

For general installation and configuration see chapter 4, page 10.

The ProfiNet IO MAC and IP address can be read out with the IPConfig-Tool (see chapter 5.5.9) or from the printed label on the ProfiNet IO-Module. Use this information to configure the PLC.

Correct communication between the ProfiNet IO-Module and the weighing sensor is indicated by the following LED status (see chapter 5.5.8): 5 green steady, 6 green steady. Refer to chapter 7.3 if LED's show different status.

Note

The integration shall be carried out by PLC system experts. The respective support for PLC systems is not under METTLER TOLEDO responsibility.

5.5.8 LED indication table

LED	Indication	Description
1 – Comm. status	Off	Offline - No connection with IO Controller
	Green, steady	Online, RUN - Connection with IO Controller established - IO Controller in RUN state
	Green, flashing	Online, STOP - Connection with IO Controller established - IO Controller in STOP state
2 – Module status	Off	No power or not initialized
	Green, steady	Initialized, no error
	Green, 1 flash	Diagnostic data available
	Green, 2 flashes	Blink. Used by engineering tools for identification
	Red, 1 flash	Configure error - Too many modules / submodules - I/O size or configuration mismatch
	Red, 3 flashes	No station name or no IP address assigned
	Red, 4 flashes	Internal error
3 – Link / Activity	Off	No link or power off
	Green	Link established
	Green, flashing	Receiving / transmitting data
4 – (not used)	-	-
5 – Subnet status	Off	Power Off
	Green, steady	Communication with weighing sensor OK
	Green, flashing	Receiving data from weighing sensor
	Red, steady	Communication with weighing sensor failed (timeout)
6 – Device status	Off	Power Off
	Green, steady	ProfiNet IO-Module initialized and running
	Green, flashing	Performing auto baudrate detection
	Red, steady	Unrecoverable error
	Red, flashing	Auto baudrate detection failed

5.5.9 IPConfig-Tool

The ProfiNet IO-Module has to be configured for the same I/O size and IP settings as in the PLC configuration. The IPConfig-Tool (can be found on www.mt.com/ind-APW-fieldbus-support) can be used to configure the IP settings of all ProfiNet IO-Modules.

The IPConfig-Tool scans the network for ProfiNet IO-Modules. To configure the settings manually (default DHCP is deactivated) double click on the desired module and enter the desired IP-settings.

5.6 CC-Link Module

The CC-Link version of the METTLER TOLEDO Fieldbus-Module is called MT CC-Link Module and has the METTLER TOLEDO Part number: 30038775.

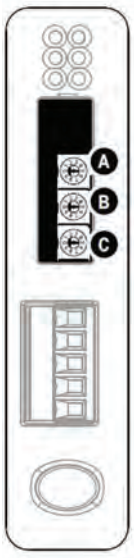
5.6.1 General

The CC-Link Module functions as CC-Link slave according to BTP-05026-D and supports baud rates from 156kb/s to 10Mbit/s.

5.6.2 Supported features

- All mandatory functions of a CC-Link remote device
- Baud rate set via onboard switches
- Address range: 1-64 (Basic-Mode), 1-61 (Extended-Mode)
- CC-Link Version 1.0

5.6.3 Identification numbers



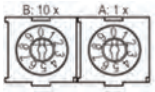
Vendor ID: 1715
Model code: 0x0033 (weight indicator)
Product name: "MT CC-Link Module"
Part number: 30038775

5.6.4 Network configuration

5.6.4.1 Station range

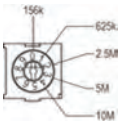
1-64 (if more than one station is used then the upper limit will be lowered with the same number of stations). The station number of the CC-Link connection shall always be set via the configuration switches of the CC-Link Module. The Module will be delivered with station number 01.

Set the CC-Link station number by using the switches as follows:
Station number = (switch B * 10) + (switch A * 1).



5.6.4.2 Baud rate

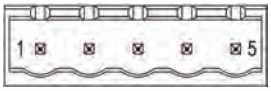
Choose the desired baud rate using the baud rate switch.



0. 156k
1. 625k
2. 2.5M
3. 5M
4. 10M

5.6.5 Cabling

Pin	Signal
1	DA (Communication signal)
2	DB (Communication signal)
3	DG (Digital ground)
4	Shield (Cable shield)
5	FG / PE (Frame ground)



5.6.6 Configuration and start the CC-Link network

For general installation and configuration see chapter 4, page 10.

Correct communication between the CC-Link Module and the weighing sensor is indicated by the following LED status (see chapter 5.6.8): 5 green steady, 6 green steady. Refer to chapter 7.3 if LED's show different status.

Note

The integration shall be carried out by PLC system experts. The respective support for PLC systems is not under METTLER TOLEDO responsibility.

5.6.7 Operation

The tables below show the specific data area layout for the CC-Link Module.
Due to CC-Link's rigid data structure with reserved space for separated bit data and word data, it is required to initialise larger data areas than with other METTLER TOLEDO Fieldbus-Modules. This is the reason why this layout is different than our other Fieldbus Modules.
Basic-Mode uses 12 bytes in the output area and 12 bytes in the input area whilst Extended-Mode requires 48 bytes in the output area and 48 bytes in the input area. In Basic-Mode, the CC-Link device requires 1 station whilst in Extended-Mode 4 stations are required.

5.6.7.1 Basic-Mode

Output register

Bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Byte 0	Reserved (Bit 3-7)					**STC**	**QTB**	**QDV**
Byte 1	Reserved							
Byte 2	Reserved							
Byte 3	Reserved							
Byte 4	**CMD** (RWw0, least significant byte)							

Input register

Bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Byte 0	Reserved (Bit 3-7)					**ST**	**RTB**	**RDV**
Byte 1	Reserved							
Byte 2	Reserved							
Byte 3	Reserved							
Byte 4	**RES** (RWr0, least significant byte)							
Byte 5	Scale Response Status (**BRS**) (RWr0, most significant byte)							
Byte 6	Weight Unit (**WU**) (RWr1, least significant)							
Byte 7	Reserved							
Byte 8-11	Weight Value (**WV**) (RWr2-RWr3)							

5.6.7.2 Extended-Mode

Output register

Bit	7	6	5	4	3	2	1	0
Byte 0	Reserved (Bit 3-7)					**STC**	**QTB**	**QDV**
Byte 1	Reserved							
…	…							
Byte 15	Reserved							
Byte 16	Reserved (bit 5-7)			**CMD** (RWw0, least significant byte)				
Byte 17	…							
Byte 18	MT-SICS Command (1st byte)							
Byte 19	MT-SICS Command (2nd byte)							
…	…							
Byte n	MT-SICS Command (nth byte)							
Byte n+1	CR (Carriage return 0Dhex)							
Byte n+2	LF (Line feed 0Ahex)							
Byte n+3	00hex							
…	…							
Byte 47	00hex							

Input register

Bit	7	6	5	4	3	2	1	0
Byte 0	Reserved (Bit 3-7)					**ST**	**RTB**	**RDV**
Byte 1	Reserved							
…	…							
Byte 15	Reserved							
Byte 16	Reserved (bit 5-7)			**RES** (RWr0, least significant byte)				
Byte 17	Scale Response Status (**BRS)** (RWr0, most significant byte)							
Byte 18	Weight Unit (**WU**) (RWr1, least significant byte)							
Byte 19	Reserved							
Byte 20-23	Weight Value (**WV**) (RWr2-RWr3)							
Byte 24	MT-SICS Command (1st byte)							
Byte 25	MT-SICS Command (2nd byte)							
…	…							
Byte n	MT-SICS Command (nth byte)							
Byte n+1	CR (Carriage return 0Dhex)							
Byte n+2	LF (Line feed 0Ahex)							
Byte n+3	00hex							
…	…							
Byte 47	00hex							

5.6.8 LED indication table

LED	Indication	Description
1 – ERRL	Red	CRC error; illegal station number or baud rate
	Off	Normal operation
2 – EDLED	Green	Receiving data
	Off	Not receiving data
3 – RUN	Green	Normal operation
	Off	No network connction or timeout (or no power)
4 – SDLED	Green	Transmitting data
	Off	No data transmission (or no power)
5 – Subnet status	Off	Power Off
	Green, steady	Communication with weighing sensor OK
	Green, flashing	Receiving data from weighing sensor
	Red, steady	Communication with weighing sensor failed (timeout)
6 – Device status	Off	Power Off
	Green, steady	CC-Link Module initialized and running
	Green, flashing	Performing auto baudrate detection
	Red, steady	Unrecoverable error
	Red, flashing	Auto baudrate detection failed

5.6.9 Operations

CC-Link Module uses a specific data area layout. For more details please see chapter 5.6

6 Operations

The Fieldbus-Module operates in the Basic-Mode with 2 output bytes and 8 input bytes and in the Extended-Mode with 32 output bytes and 32 input bytes in the I/O-area of the PLC.

6.1 Basic-Mode

The Basic-Mode instructions contain the most important commands to operate a weighing sensor (see chapter 6.3 for detailed information of supported commands). The coding of these commands is short and simple and allows a simple PLC interface that requires only 2 bytes in the output area and 8 bytes in the input area of the PLC. In this mode the Fieldbus-Module encodes and decodes the ASCII strings and converts the weight values.

The PLC interface will operate in the Basic-Mode if the user has chosen this option during the configuration of the Fieldbus master and the Fieldbus-Module has been set into the same mode during the Fieldbus-Module configuration dialog, see chapter 4.6.6.

6.1.1 Output register Basic-Mode: 2 bytes

This part contains the information that is sent from the PLC to the weighing sensor i.e. the commands that are sent from the PLC program to the weighing sensor.

Bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Byte 1	Reserved (bit 3-7)					**STC**	**QTB**	**QDV**
Byte 2	Reserved (bit 5-7)			**CMD** (bit 0-4)				

Query data valid (QDV)
The PLC program sets this bit to true if the code in the CMD field is valid and respectively to false if the data in the CMD field is not valid. This bit is controlled by the PLC program and processed by the Fieldbus-Module. It is not visible to the weighing sensor.

Query toggle bit (QTB)
The PLC program toggles this bit (from 0 to 1 or 1 to 0) every time a new command shall be executed. Before the bit is toggled, a valid command code must be present in the CMD field. This bit is controlled by the PLC program and processed by the Fieldbus-Module. It is not visible to the weighing sensor.

Connection status clear (STC)
This bit is used as an acknowledge signal for the connection status bit (ST), see chapter 6.1.2. It is low (false) during normal operation. If the connection between the balance and the Fieldbus-Module is lost ST is set false by the Fieldbus-Module. The PLC reads this bit and acknowledges its value by setting STC true. If STC is true the Fieldbus-Module clears ST back to true. This in turn is being read by the PLC and the STC is set back to false again. This short handshake process ensures that each connection failure is properly sensed and taken care of by the PLC.

Reserved bits
These bits are reserved for future use and are not visible to the weighing sensor.

Weighing sensor command code (CMD)
The PLC program uses this field to specify the selected weighing sensor command. The Fieldbus-Module will convert this code into the ASCII coded MT-SICS-command string. The maximum number of commands is limited to 32 (Basic-Mode only). See chapter 6.3 for detailed information of supported commands.

6.1.2 Input register Basic-Mode: 8 bytes

This part contains the information that is sent from the weighing sensor to the PLC, i.e. the response strings that are generated by the weighing sensor as answers to the query commands from the PLC.

Bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Byte 1						**ST**	**RTB**	**RDV**
Byte 2	Reserved (bit 5-7)			**RES** (bit 0-4)				
Byte 3	Weighing Sensor (**B**alance) Response Status (**BRS**)							
Byte 4	Weight Unit (**WU**)							
Byte 5-8	Weight Value (**WV**)							

Response data valid (RDV)
The Fieldbus-Module will set the response data valid (RDV) bit to true if the data in the weighing sensor (Balance) response bytes 2 – 8 (**RES**, **BRS**, **WU** and **WV**) are valid and comply with the query specified in the weighing sensor query command.

Response toggle bit (RTB)
The Fieldbus-Module will set the response toggle bit (RTB) to the same value as the query toggle bit after it has sent the query command to the weighing sensor. At the same time, the Fieldbus-Module will reset the response data valid bit (RDV). Both bits are controlled by the Fieldbus-Module and are not visible to the weighing sensor.

Connection status bit (ST)
This bit indicates the status of the serial connection between the Fieldbus-Module and the weighing sensor. It is controlled by the Fieldbus-Module and not visible to the weighing sensor. This bit is valid at any time and independent from the RDV bit.
True = serial connection to weighing sensor operational
False = serial connection to weighing sensor not operational (timeout)

Reserved bits
These bits are reserved for future use and are not visible to the weighing sensor.

Weighing sensor response code (RES)
This field is used to indicate the response code that the Fieldbus-Module has received from the weighing sensor. It is controlled by the Fieldbus-Module and not visible to the weighing sensor. During regular operation, it should always have the same value as the CMD code if RDV=True. If the two codes differ, the serial link between the PLC and the weighing sensor may have lost synchronization. In this case a reset command should be issued to re-synchronize the system. Please refer to the flow chart in chapter 6.7.2 for details.

Weighing sensor (Balance) response status (BRS) [Byte 3]
BRS contains the status information that the Fieldbus-Module has received from the weighing sensors response message. In most of the MT-SICS response strings this is the status information (S, D, A, I, +, -, L) following the first blank character after the MT-SICS-command. The Fieldbus-Module will decode the response message from the weighing sensor, will suppress unnecessary information and will encode the RES status field as defined in chapter 7.1 of this document. The values shown in this table are the hexadecimal equivalent of the ASCII values (S, D, A, I, +, -, L).

Weight unit (WU) [Byte 4]
WU contains the hexadecimal equivalent of the weight unit as defined in chapter 6.4.

Weight value (WV) [Byte 5-8]
WV contains the weight value if applicable for the selected command. The Fieldbus-Module will decode the ASCII coded weight value that it has received from the weighing sensor, will suppress unnecessary information and will convert it into a 32 bit single precision real number according to IEEE 754. The weight value is presented in Motorola format MSB in byte 5 and LSB in byte 8. If no weight value is associated with the selected command, the Fieldbus-Module will set this field to 0000hex.

Note
If the weight value is not indicated correctly on the PLC please check the endian order. The bytes from the communicator (Fieldbus-Module) is in big endian order (MSB first) but the PLC could use little endian (LSB first). To achieve correct indication please swap byte 5 and 8 and swap byte 6 and 7 in the PLC.

6.2 Extended-Mode

The Extended-Mode is available for the more sophisticated user of the weighing sensor and is recommended only if the PLC has sufficient free I/O bytes available. The Extended-Mode makes all commands, options and parameters of all the weighing sensors available to the PLC program. It offers full flexibility and all options for the definition of new MT-SICS commands without the need to change the Fieldbus-Module firmware.
The PLC interface will operate in the Extended-Mode, if the user has chosen this option during configuration of the Fieldbus master and the Fieldbus-Module has been set into the same mode during the Fieldbus-Module configuration dialog see chapter 4.6.6.

The principle of the Extended-Mode is that all commands of the Basic-Mode are available and that in addition, the ASCII based MT-SICS commands can be transferred via the Fieldbus and the Fieldbus-Module directly to the weighing sensor and vice versa. If the ASCII coded MT-SICS commands are used, they will not be interpreted by the Fieldbus-Module.
The possibility to still use the Basic-Mode commands in the Extended-Mode has the big advantage that the ASCII-to-real conversion of the weight values and other response values is still done in the Fieldbus-Module and doesn't have to be programmed into the PLC.

6.2.1 Output register Extended-Mode: 32 bytes

This part contains the information that is sent from the PLC/PC to the weighing sensor i.e. the commands that are sent to the weighing sensor.

Bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Byte 1	Reserved (bit 3-7)					**STC**	**QTB**	**QDV**
Byte 2	Reserved (bit 5-7)			**CMD** (bit 0-4)				
Byte 3	MT-SICS Command (1st byte)							
Byte 4	MT-SICS Command (2nd byte)							
:	:							
Byte n	MT-SICS Command (n^{th} byte)							
Byte n+1	CR (Carriage return 0Dhex)							
Byte n+2	LF (Line feed 0Ahex)							
Byte n+3	00hex							
:	:							
Byte 32	00hex							

Query data valid (QDV)
The PLC program sets this bit to true if the code in the CMD field is valid and respectively to false if the data in the CMD field is not valid. This bit is controlled by the PLC program and processed by the Fieldbus-Module. It is not visible to the weighing sensor.

Query toggle bit (QTB)
The PLC program toggles this bit (from 0 to 1 or 1 to 0) every time a new command shall be executed. Before the bit is toggled, a valid command code must be present in the CMD field. This bit is controlled by the PLC program and processed by the Fieldbus-Module. It is not visible to the weighing sensor.

Connection status clear (STC)
This bit is used as an acknowledge signal for the connection status bit (ST), see chapter 6.1.2. It is low (false) during normal operation. If the connection between the balance and the Fieldbus-Module is lost ST is set false by the Fieldbus-Module. The PLC reads this bit and acknowledges its value by setting STC true. If STC is true the Fieldbus-Module clears ST back to true. This in turn is being read by the PLC and the STC is set back to false again. This short handshake process ensures that each connection failure is properly sensed and taken care of by the PLC.

Reserved bits
These bits are reserved for future use and are not visible to the weighing sensor.

Weighing sensor command code (CMD)
The PLC program uses this field to specify the selected weighing sensor command. The Fieldbus-Module will convert this code into the ASCII coded MT-SICS-command string. The maximum number of commands is limited to 32 (Basic-Mode only). See chapter 6.3 for detailed information of supported commands.

MT-SICS command string (Byte 3-32)
If the CMD code 1F hex has been selected, these bytes contain the ASCII coded MT-SICS query string as defined in the weighing sensors user manual. Not used bytes should be set to 00hex. This string will be transparently transmitted via the Fieldbus into the Fieldbus-Module and from there to the weighing sensor. The Fieldbus-Module will not interpret any of this information. It will not suppress or truncate any characters such as CR or LF.
If any other CMD code than 1Fhex has been selected, the PLC program shall set bytes 3-32 of the MT-SICS query string to 00hex.

6.2.2 Input register Extended-Mode: 32 bytes

This part contains the information that is sent from the weighing sensor to the PLC, i.e. the response strings that are generated from the weighing sensor as answers to the query commands from the PLC.

Bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Byte 1	Reserved (bit 3-7)					**ST**	**RTB**	**RDV**
Byte 2	Reserved (bit 5-7)			**RES** (bit 0-4)				
Byte 3	Weighing sensor (**B**alance) Response Status (**BRS**)							
Byte 4	Weight Unit (**WU**)							
Byte 5-8	Weight Value (**WV**)							
Byte 9	MT-SICS response (1st byte)							
Byte 10	MT-SICS response (2nd byte)							
:	:							
Byte n	MT-SICS Command (nth byte)							
Byte n+1	00hex							
:	:							
Byte 32	00hex							

Response data valid (RDV)
The Fieldbus-Module will set the response data valid (RDV) bit to true if the data in the weighing sensor (Balance) response bytes 2 – 32 are valid and comply with the query specified in the weighing sensor query command.

Response toggle bit (RTB)
The Fieldbus-Module will set the response toggle bit (RTB) to the same value as the query toggle bit after it has sent the query command to the weighing sensor. At the same time, the Fieldbus-Module will reset the response data valid Bit (RDV). Both bits are controlled by the Fieldbus-Module and are not visible to the weighing sensor.

Connection status bit (ST)
This bit indicates the status of the serial connection between the Fieldbus-Module and the weighing sensor. It is controlled by the Fieldbus-Module and not visible to the weighing sensor. This bit is valid at any time and independent from the RDV bit.
True = serial connection to weighing sensor operational
False = serial connection to weighing sensor not operational (timeout)

Reserved bits
These bits are reserved for future use and are not visible to the weighing sensor.

Weighing sensor response code (RES)
This field is used to indicate the response code that the Fieldbus-Module has received from the weighing sensor. It is controlled by the Fieldbus-Module and not visible to the weighing sensor. During regular operation, it should always have the same value as the CMD code if RDV=True. If the two codes differ, the serial link between the PLC and the weighing sensor may have lost synchronization. In this case a reset command should be issued to re-synchronize the system. Please refer to the flow chart in chapter 6.7.2 for details.

Weighing sensor (Balance) response status (BRS) [Byte 3]
BRS contains the status information, which the Fieldbus-Module has received from the weighing sensors response message. In most of the MT-SICS response strings this is the status information (S, D, A, I, +, -, L) following the first blank character after the MT-SICS-command. The Fieldbus-Module will decode the response message from the weighing sensor, will suppress unnecessary information and will encode the RES status field as defined in chapter 7.1 of this document. The values shown in this table are the hexadecimal equivalent of the ASCII values (S, D, A, I, +, -, L).

Weight unit (WU) [Byte 4]
WU contains the hexadecimal equivalent of the weight unit as defined in chapter 6.4.

Weight value (WV) [Byte 5-8]
WV contains the weight value if applicable for the selected command. The Fieldbus-Module will decode the ASCII coded weight value that it has received from the weighing sensor, suppresses unnecessary information and converts it into a 32 bit single pre-cision real number according to IEEE 754. The weight value is presented in Motorola format MSB in byte 5 and LSB in byte 8. If no weight value is associated with the selected command, the Fieldbus-Module will set this field to 0000hex.

Note
If the weight value is not indicated correctly on the PLC please check the endian order. The bytes from the communicator (Fieldbus-Module) is in big endian order (MSB first) but the PLC could use little endian (LSB first). To achieve correct indication please swap byte 5 and 8 and swap byte 6 and 7 in the PLC.

MT-SICS response string [Byte 9-32]
These bytes are only relevant if the CMD code 1F hex has been selected. They contain the MT-SICS response string which the Fieldbus-Module has received from the weighing sensor as defined by METTLER TOLEDO in the respective MT-SICS Reference Manual. The MT-SICS string will be transparently sent via the Fieldbus to the input data area of the PLC. The Fieldbus-Module will not encode or decode this information. The response string is restricted to 22 bytes maximal length (plus CR, LF). In addition to the MT-SICS Reference Manual the following rule shall apply: If one or more bytes are not used in a specific response string, the content of these bytes shall be set to 0 (00hex) by the Fieldbus-Module.

6.3 Command codes / Response codes

CMD/RES [hex]	Bit 0-4 [binary]	MT-SICS Command	Description
0	00000	(Idle)	No function
1	00001	S	Send stable weight value
2	00010	SI	Send weight value immediately
3	00011	Z	Zero
4	00100	ZI	Zero immediately
5	00101	@	Reset
6	00110	SIR	Send weight value immediately and repeat
7	00111	T	Tare
8	01000	TA	Inquiry/(presetting) of tare weight value *
9	01001	TI	Tare immediately
A	01010	TAC	Clear tare value (Tare clear)
B	01011	SNR	Send next stable weight and repeat
C	01100	C3	Start adjustment (calibration) with internal weight
D	01101	TST3	Start test function with internal weight
E	01110	SB	(Start batch measurement)
F	01111	TRS [1)]	Send stable weight value if trigger mode is on
10	10000	TRZ [2)]	Zero if trigger mode is on
11	10001	TRMO	Send trigger mode status
12	10010	TRMO 0	Switch trigger mode off
13	10011	TRMO 1	Switch trigger mode on
14	10100	MOD	Inquiry/(setting) of output format (control mode) *
15	10101	MOD 0	Switch control mode off
16	10110	MOD 1	Switch control mode on
17-1E	-		Reserved
1F	11111		Extended-Mode MT-SICS-Command string

* (functions) in brackets are not executable
[1)] Z_D will not be evaluated (TRCF response format "1" is not supported)
[2)] S_D_Weight_unit will not be evaluated (TRCF response format "1" is not supported)

Note
For a detailed description of the MT-SICS-Commands please refer to the MT-SICS Reference Manuals on www.mt.com/ind-APW-fieldbus-support.

6.4 Weight units

The following table will be used by the Fieldbus-Module to convert the weight unit to its equivalent hex value:

MT-SICS unit string	Unit name	Weight unit [Byte 4]
<none>	No unit	0x00
g	gram	0x01
kg	kilogram	0x02
t	ton	0x03
mg	milligram	0x04
µg	microgram	0x05
ct	carat	0x06
N	Newton	0x07
lb	pounds	0x08
oz	ounces	0x09
ozt	troy ounces	0x0A
GN	grain	0x0B
dwt	penny weight	0x0C
mo	Momme	0x0D
msg	Mesghal	0x0E
tl	Tael	0x0F
tcl	Tical	0x10
tola	Tola	0x11
baht	Baht	0x12
PCS	pieces	0x13
%	percent	0x14
#	number	0x15

Note

If the unit is not found in the table, the Fieldbus-Module will copy the hexadecimal code of the first printable character of the MT-SICS unit string from the weighing sensor into weight unit [Byte 4].

6.5 Repetitive weighing commands

METTLER TOLEDO weighing sensors have some commands built in that send repetitive weight values. In the Basic-Mode, the commands SIR and SNR are available.

6.6 Commands with multiple responses

Some MT-SICS-Commands deliver more than one subsequent response string. In the Basic-Mode the commands C3 and TST3 show such a behavior.

6.7 Sequence of the communication between the PLC and the weighing sensor

The following chapter explains the sequence of the telegrams and control bits from the view of the PLC program. The sequence is the same in the Basic-Mode and in the Extended-Mode.

6.7.1 Simple weighing commands

At any time the PLC program can issue a new simple weighing command such as "S" (send stable weight value) to the weighing sensor according to the following sequence.

We recommend you perform the following steps the first time a command is transmitted:

- First step: Set query data valid (QDV) and query toggle bit (QTB) to 0 (false) and weighing sensor command code (CMD) to 00000 (no command). Send it to the Fieldbus-Module.
- Second step: QDV and QTB stays at 0 (false) and CMD is set to 00001 ("S" for send stable weight value). Send it to the Fieldbus-Module.
- Third step: Set QDV and QTB to 1 (true), CMD stays at 00001. Send it to the Fieldbus-Module. The response toggle bit (RTB) changes from 0 to 1 and is equal to QTB.
- Wait for a valid response.

Typical command transmission within the process:

- Leave QDV set to 1 (true), input the required command entry in the CMD (e.g., 0001 for "S") and invert the QTB bit (toggle).
- Wait for a valid response.

A valid response of the weighing sensor is available in the input area of the PLC as soon as:

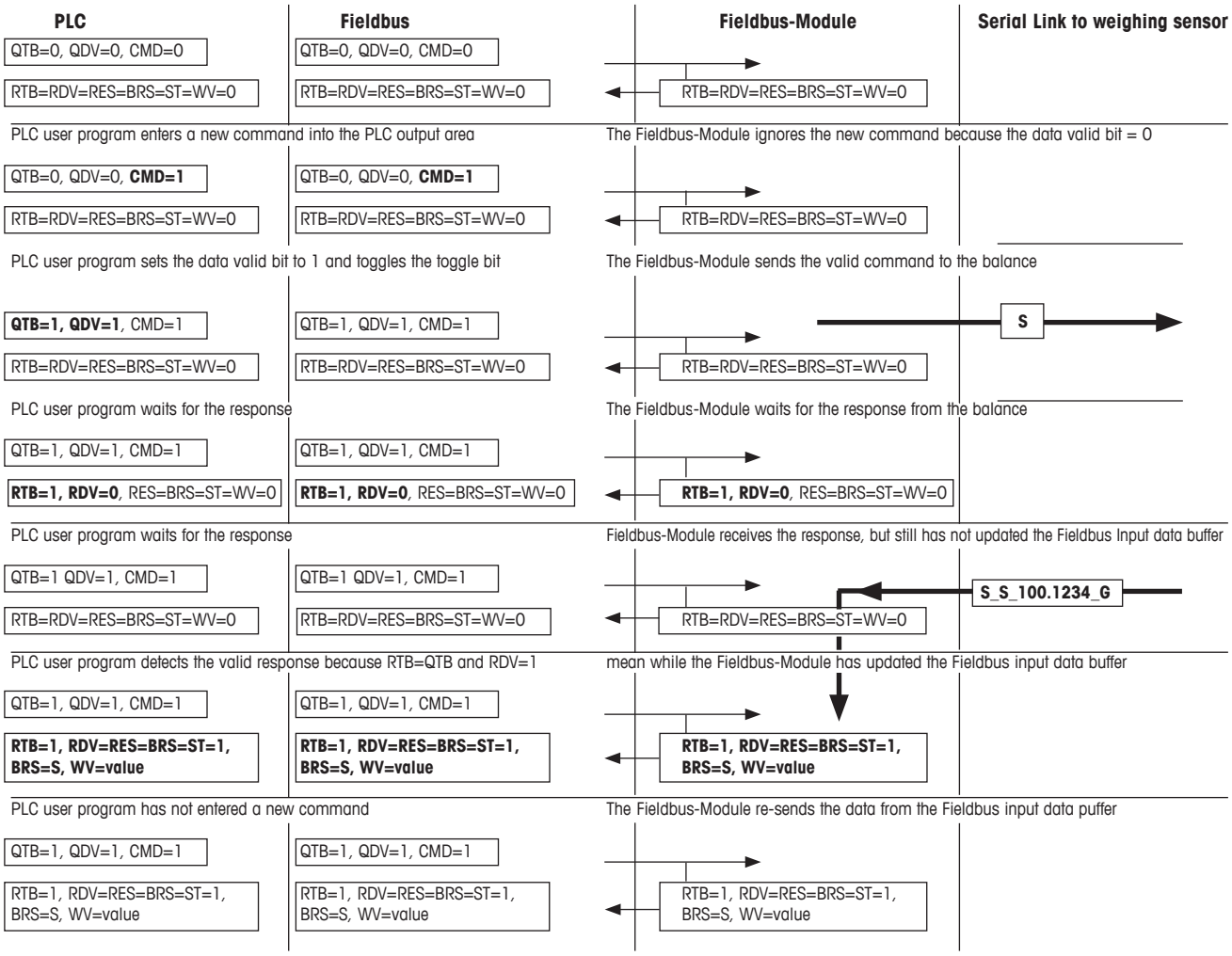
- Query toggle bit (QTB) = Response toggle bit (RTB) and
- Query data valid (QDV) = 1 (true) and
- Response data valid (RDV) = 1 (true).
- The response from the weighing sensor is given in byte 3–8 for Basic-Mode and contains weighing sensor response status (BRS), weight unit (WU) and weight value (WV). In Extended-Mode the response is given in byte 3-32 and contains weighing sensor response status (BRS), weight unit (WU), weight value (WV) and the MT-SICS response string if a Basic-Mode command was issued. If command code 0x1F was used only the bytes containing the MT-SICS response string are valid.

Note

The following figure shows a complete sequence of a simple weighing command in the PLC interface (in Basic-Mode). Please note, that the behavior of the Fieldbus-Module shown is not special to this component but is a fundamental caused by the characteristics of the Fieldbus-Modules.

6.7.2 Communication flowchart when executing a "S" command

This flowchart describes the communication flow.



6.7.3 Commands for repetitive weighing

At any time the PLC program can issue a new repetitive weighing command such as "SIR" (send weight value immediately and repeat) to the weighing sensor according to the following sequence:

We recommend you perform the following steps the first time a command is transmitted:

- First step: Set query data valid (QDV) and query toggle bit (QTB) to 0 (false) and weighing sensor command code (CMD) to 00000 (no command). Send it to the Fieldbus-Module.
- Second step: QDV and QTB stays at 0 (false) and CMD is set i.e. to repetitive weighing command 00110 ("SIR" for send weighing value immediately and repeat). Send it to the Fieldbus-Module.
- Third step: Set QDV and QTB to 1 (true), CMD stays at 00110. Send it to the Fieldbus-Module. The response toggle bit (RTB) changes from 0 to 1 and is equal to QTB.
- Wait for a valid response

Typical command transmission within the process:

- Leave QDV set to 1 (true), input the required command entry in the CMD (e.g., 0001 for "S") and invert the QTB bit (toggle).
- Wait for a valid response.

The first valid response of the weighing sensor is available in the input area of the PLC as soon as:

- Query toggle bit (QTB) = Response toggle bit (RTB) and
- Query Data Valid (QDV) = True and
- Response Data Valid (RDV) = True
- The first response from the weighing sensor is given in byte 3–8 (Basic-Mode) and contains weighing sensor response status (BRS), weight unit (WU) and weight value (WV). In Extended-Mode the response is given in byte 3-32 and contains weighing sensor response status (BRS), weight unit (WU), weight value (WV) and the MT-SICS response string if a Basic-Mode command was issued. If command code 0x1F was used only the bytes containing the MT-SICS response string are valid.
- All subsequent responses from the weighing sensor will automatically overwrite the information given in byte 3–8 (3-32). The Fieldbus-Module will handle data consistency via the Fieldbus. The data consistency of the PLC process data areas shall be taken into account by the PLC program itself.

The repetitive weighing can be stopped by

- Sending a simple weighing command to the weighing sensor (S, SI) or
- Sending a reset command to the weighing sensor (@, FSET)

The mapping of the repetitive weighing commands on the Fieldbus-Module is the same as for the simple weighing commands. The only difference is that the Fieldbus-Module will update the Fieldbus input data buffer automatically every time it receives a new response message from the weighing sensor.

Note

During processing of repetitive weighing commands, such as SIR, the response toggle bit (RTB) will only be toggled once after the first answer of the weighing sensor has been completely received. All subsequent responses will directly overwrite the weight value and the related weighing sensor response status. If the PLC user wants to be sure that the weight values be updated continuously, he should toggle the query toggle bit and then wait until the response toggle bit will toggle accordingly.

7 Error Handling, FAQ

7.1 Weighing sensor response status

The following response codes can be received from the weighing sensor and will be shown in the weighing sensor (Balance) response status (BRS).

Weighing sensor response	Value [hex]	Character	Description
I	0x49	I	Weighing sensor is busy
L	0x4C	L	Command not executable
+	0x2B	+	Upper limit exceeded (Overload)
-	0x2D	-	Lower limit exceeded (Underload)
ES	0x73	s	Syntax error
ET	0x74	t	Transmission error (Fieldbus-Module resends the command automatically once)
EL	0x6C	l	Logical error
S	0x53	S	Stable weight value
D	0x44	D	Unstable ("D" for Dynamic) weight value
A	0x41	A	Command executed successfully
B	0x42	B	Command not yet terminated, additional responses following

In order to interpret hex-coded ASCII characters, we recommend you also use the standardized conversion table, which is widely available on the Internet, for example.

7.2 Timeout

If the Fieldbus-Module will not receive a response from the weighing sensor within the maximum defined response time (default 60 sec. can be changed in configuration dialog), the Fieldbus-Module will indicate this communication problem by setting the connection status bit in the PLC interface to false. The connection status bit will be set to true (operational) again, every time a valid answer has been received. The status of this bit is also displayed with LED 5 (subnet status) at the front of the Fieldbus-Module.

A response string that the Fieldbus-Module receives after the maximum response time has expired, will be ignored and not forwarded to the PLC interface.

7.3 Frequently asked questions

Question	Possible problem	Solution	Chapter
LED 2 is red, steady	Wiring problem	Check wiring, bus termination and reduce Fieldbus speed	5
	Software configuration problem: Basic-Mode or Extended-Mode must be equally set on both sides	Check the configuration of the Fieldbus-Module, and the PLC	5 PLC
	Hardware or software configuration Problem: The node ID is wrong	Check the configuration switches of the Profibus-Module, and the software configuration on the PLC	5.1.4 PLC
LED 4 is red, flashing	Software configuration problem: Basic-Mode or Extended-Mode	Check the configuration (Basic or Extended-Mode) of the Fieldbus-Module, and the PLC	5 PLC
LED 5 "Subnet status" is red, steady	Wiring problem	Check wiring of the RS232 or RS422 connection (Rx-Tx signals must be crossed)	4.4
	Software configuration problem: transmission speed	Configure both weighing sensor and Fieldbus-Module with the same speed. Use the automatic baud rate search functionality. Save the configuration to flash with the "S" Key, and switch the Fieldbus-Module off and on again	4.1
	Software configuration problem: Status bit ST is set to zero	Set the status clear bit STC to 1 or send a command to the Fieldbus-Module. Deactivate the max. response time if not needed	6 4.6.6
In Extended-Mode, the telegram do not contain the weight value in ASCII	The weighing sensor command code CMD (Byte 2.0 to 2.4) is set to a wrong value	The weighing sensor command code CMD (Byte 2.0 to 2.4) must contain the value 1F	6.3
In Extended-Mode, the telegram do not contain the weight value in HEX (Byte 5-8)	In Extended-Mode, the weight value is only transmitted in ASCII format	Do use the ASCII value for your application	6.2
In Extended-Mode, the weighing sensor always answers with error syntax "ES"	The command line must always end with carriage return and line feed signs	Do add the HEX symbols "0D" and "0A" to the end of the command line	6.2
The command set in the output register is not executed (Basic-Mode or Extended-Mode)	The status of the query toggle bit QTB has not been changed since the last command	Do change the status of the QTB (from 0 to 1 or from 1 to 0) each time you want to transmit a command	6
	The query data valid QDV is not set to 1	Do set the QDV to one when you want to transmit a command	6

7.4 Support

For equipment related questions please contact your METTLER TOLEDO contact person.

8 Checklist and Recommendations for Weigh Sensors

METTLER TOLEDO recommend to execute the following steps and chose the respective weighing sensor configurations to successfully connect a weigh sensor to a network:

1. Connect the weigh module via its RS232 interface to a PC.
2. Follow the step by step installation and configuration procedure in the order as mentioned in chapter 4.
3. Chapter 4.1: Configure the RS422 interface of the weigh module to a baud rate of 38400 by sending the following command via a terminal program: COM_1_8_3_0 (the "_" represents a blank-character).
4. Configure the RS422 interface to an update rate of 38 updates or higher per second by sending the following command via a terminal program: Example UPD_38.
5. Chapter 4.3: Connect the Fieldbus-Module to a PC.
6. Chapter 4.4: Connect the Fieldbus-Module to the weigh module. Follow the wiring diagram in chapter 4.5.1. Use only the RS422 connection between weigh module and Fieldbus-Module (use commercial cable with one D-Sub 9 male connector and open wires on the other end). **Note:** Avoid using the RS232 interface between Fieldbus-Module and weigh module since the RS232 shall be reserved for service operations.
7. Chapter 4.5: Connect the Fieldbus-Module to a 24 VDC power supply.
8. Configure the Fieldbus-Module as described in chapter 4.6.
   a. Chapter 4.6.2: Select the RS422 as weighing sensor interface in Option 1 of the Fieldbus-Module configuration dialog.
   b. Chapter 4.6.8: Press A to execute automatic baud rate search (check status of LEDs as described in chapter 5.1.9). This feature should find 38400 baud for Option 2 and "8 None 1" character format for Option 3 if you set the RS422 interface as described above.
   c. Chapter 4.6.5: We recommend to select Basic-Mode in Option 4.
   d. Chapter 4.6.6: We recommend to switch off the "Max response time" in Option 5.
   e. Type S to save the configuration to flash.
9. Activate the changes by switching off and on again the power of the Fieldbus-Module.
10. Check the LED status as described in chapter 5. Correct communication between the Fieldbus-Module and the weigh module is indicated by the following LED status: 5 green steady, 6 green steady.
11. Set the Fieldbus node address to its correct value if needed.
12. Connect the Fieldbus-Module to the network.

After successful execution of the above steps please start with network communication tests. If any problem appears please check address, cabling and configurations according to the above steps and/or read the FAQ in chapter 7.3. Don't forget to use termination resistors at the beginning and end if it is needed for the network.

We recommend to proceed according to chapter 6.7. Please execute such sequences with different commands like "S", "Z", "T" and "SI" and make sure that the command in Byte 2 at bit 0 to 4 is set all the time. In chapter 6.7.2 you find an additional flow chart for a sequence of a simple weighing command.

After being successful with the simple weighing sessions, please proceed like described in chapter 6.7.3 to perform a repetitive weighing command (SIR). The response data should appear in the input register as described in chapter 6.1.2.

Note

The weight value is a Motorola word according to IEEE 754. For interpretation you should also have the following information, see also chapter 6.1.2:

Weight value (WV) [Byte 5-8] contains the weight value if applicable for the selected command. The Fieldbus-Module will decode the ASCII coded weight value that it has received from the weighing sensor, will suppress unnecessary information and will convert it into a 32 bit single precision real number according to IEEE 754. The weight value is presented in Motorola format MSB in byte 5 and LSB in byte 8. If no weight value is associated with the selected command, the Fieldbus-Module will set this field to 0000hex.

Potential problem

The bytes from the communicator is in big endian order (MSB first) but some PLCs use little endian (LSB first). If this is the case you have to swap byte 5 and 8 and to swap byte 6 and 7 in the PLC to solve the problem.

9 Technical Specification

9.1 Mechanical

Housing
Plastic housing with snap-on connection to DIN-Rail, protection class IP20.

Dimensions
120 mm × 75 mm × 27 mm, L × W × H (inches: 4.72" × 2.95" × 1.06"; L × W × H)

9.2 Electrical characteristics

Power supply
Power: 24 V ± 10 %.

Power consumption
Maximum power consumption is 280 mA on 24 V, typically 100 mA.

Protective earth
Internal connection to PE via DIN rail

9.3 Environmental

Relative humidity
The product is designed for a relative humidity of 0 to 95 % non-condensing.

Temperature
Operating: +5 °C to +55 °C (41 to 131 degrees Fahrenheit)
Non Operating: -25 °C to +85 °C

9.4 EMC Compliance

CE-mark
Certified according to European standards unless otherwise stated.

Emission
According to EN 50081-2:1993

Immunity
According to EN 61000-6-2:1999

9.5 UL/c-UL compliance

This unit is open type listed by the underwriters laboratories. The certificate is valid when the unit is installed in a switch cabinet or equivalent. The certification has been documented by UL in file E 214107.

GWP®

Good Weighing Practice™

GWP® is the global weighing standard, ensuring consistent accuracy of weighing processes, applicable to all equipment from any manufacturer. It helps to:

- Choose the appropriate balance or scale
- Calibrate and operate your weighing equipment with security
- Comply with quality and compliance standards in laboratory and manufacturing

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