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# MA 238i

## Fieldbus Gateway – EtherCAT

en 04-2017/01 50120383
We reserve the right to
make technical changes

Original operating instructions

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# 1 General information

## 1.1 Explanation of symbols

The symbols used in this operating manual are explained below.

***Attention!***

*This symbol precedes text messages which must strictly be observed. Failure to comply with this information results in injuries to persons or damage to the equipment.*

***Notice!***

*This symbol indicates text passages containing important information.*

## 1.2 Declaration of Conformity

The MA 238*i* modular interfacing units have been designed and manufactured in accordance with applicable European directives and standards.

***Notice!***

*The Declaration of Conformity for these devices can be requested from the manufacturer.*

The manufacturer of the product, Leuze electronic GmbH + Co. KG in D-73277 Owen, possesses a certified quality assurance system in accordance with ISO 9001.

The modular interfacing unit is "UL LISTED" in accordance with American and Canadian safety standards and fulfills the requirements of Underwriter Laboratories Inc. (UL).

EtherCAT® is a licensed and registered brand of Beckhoff Automation GmbH.

## 1.3 Description of functions

The MA 238*i* modular interfacing unit is used to connect Leuze devices directly to the fieldbus.

| | |
|---|---|
| Bar code reader: | BCL 8, 22, 300i, 500i, 600i, 90, 900i |
| 2D-code reader: | LSIS 122, LSIS 222, LSIS 4x2i, DCR 200i |
| Hand-held scanner | ITxxxx, HFU/HFM |
| RFID read-write devices: | RFM 12, 32, 62 & RFI 32, RFU 100, RFU 200 |
| Bar code positioning system: | BPS 8, BPS 300 |
| Optical distance sensors: | ODSL 9, ODSL 30, ODSL 96B |
| Measuring light curtain: | KONTURflex to Quattro-RSX/M12 |
| multiNet master connection box: | MA 3x |
| Additional RS 232 devices: | Scales, third-party devices |

This is accomplished by transmitting the data from the DEV via an RS 232 (V.24) interface to the MA 238*i* where a module converts it into the EtherCAT format. The data format on the RS 232 interface corresponds to the Leuze standard data format (9600 bd, 8N1 and STX, data, CR, LF).

The corresponding Leuze devices are selected using a rotary code switch on the circuit board of the connector unit. Many additional RS 232 devices can be connected through a universal position.

Leuze electronic can only provide support for the devices offered in the product range.

## 1.4 Definition of terms

For better understanding of the explanations provided in this document, a definition of terms follows below:

- **Bit designation:**
  The 1st bit or byte begins with count number "0" and means bit/byte $2^0$.
- **Data length:**
  Size of a valid, continuous data packet in bytes.
- **ESI file (EtherCat Slave Information):**
  Description of the device for the control.
- **Consistent:**
  Data which belongs together with regard to content and which must not be separated is referred to as consistent data. When identifying objects, it must be ensured that the data is transmitted completely and in the correct order, otherwise the result is falsified.
- **Leuze device (DEV):**
  Leuze devices, e.g., bar code readers, RFID readers, VisionReader…
- **Online command:**
  These commands refer to the respective, connected ident device and may be different depending on the device. These commands are not interpreted by the MA 238*i*, but are instead transmitted transparently (see description of Ident device).
- **CR:**
  Cross reference.
- **Perspective of I/O data in the description:**
  Output data is data which is sent by the control to the MA. Input data is data which is sent by the MA to the control.
- **Toggle bits:**
  **Status toggle bit**
  Each change of state indicates that an action was performed, e.g., bit ND (new data): each change of state indicates that new received data was transmitted to the PLC.
  **Control toggle bit**
  An action is performed on each change of state, e.g., bit SDO: on each change of state, the registered data is sent by the PLC to the MA 238*i*.

# 2 Safety

This device was developed, manufactured and tested in line with the applicable safety standards. It corresponds to the state of the art.

## 2.1 Intended use

The MA 238*i* modular interfacing unit is used for connecting Leuze devices such as bar code or 2D-code readers, hand-held scanners, RFID read-write devices, etc. directly to the fieldbus.

**CAUTION**

**Observe intended use!**

- Only operate the device in accordance with its intended use. The protection of personnel and the device cannot be guaranteed if the device is operated in a manner not complying with its intended use.
  Leuze electronic GmbH + Co. KG is not liable for damages caused by improper use.
- Read the technical description before commissioning the device. Knowledge of this technical description is an element of proper use.

**NOTICE**

**Comply with conditions and regulations!**

- Observe the locally applicable legal regulations and the rules of the employer's liability insurance association.

***Attention***

*For UL applications, use is permitted exclusively in Class 2 circuits according to NEC (National Electric Code).*

## 2.2 Foreseeable misuse

Any use other than that defined under "Intended use" or which goes beyond that use is considered improper use.

In particular, use of the device is not permitted in the following cases:

- Rooms with explosive atmospheres
- As stand-alone safety component in accordance with the machinery directive [1)]
- For medicinal purposes

1) Use as safety-related component within the safety function is possible, if the component combination is designed correspondingly by the machine manufacturer.

| NOTICE |
| --- |
| **Do not modify or otherwise interfere with the device.**<br>Do not carry out modifications or otherwise interfere with the device.<br>The device must not be tampered with and must not be changed in any way.<br>The device must not be opened. There are no user-serviceable parts inside.<br>Repairs must only be performed by Leuze electronic GmbH + Co. KG. |

## 2.3 Competent persons

Connection, mounting, commissioning and adjustment of the device must only be carried out by competent persons.

Prerequisites for competent persons:

- They have a suitable technical education.
- They are familiar with the rules and regulations for occupational safety and safety at work.
- They are familiar with the technical description of the device.
- They have been instructed by the responsible person on the mounting and operation of the device.

***Certified electricians***

Electrical work must be carried out by a certified electrician.

Due to their technical training, knowledge and experience as well as their familiarity with relevant standards and regulations, certified electricians are able to perform work on electrical systems and independently detect possible dangers.

In Germany, certified electricians must fulfill the requirements of accident-prevention regulations BGV A3 (e.g. electrician foreman). In other countries, there are respective regulations that must be observed.

## 2.4 Disclaimer

Leuze electronic GmbH + Co. KG is not liable in the following cases:

- The device is not being used properly.
- Reasonably foreseeable misuse is not taken into account.
- Mounting and electrical connection are not properly performed.
- Changes (e.g., constructional) are made to the device.

# 3 Fast commissioning / operating principle

***Notice!***

*Below you will find a **short description for the initial commissioning** of the EtherCAT gateway MA 238i. Detailed explanations for the listed points can be found throughout the handbook.*

## 3.1 Mounting

The gateway mounting plate MA 238*i* can be mounted in two different ways:

- using four threaded holes (M6) or
- using two M8x6 screws on the two lateral grooves.

## 3.2 Device arrangement and selection of the mounting location

Ideally, the MA 238*i* should be mounted so that it is easily accessible near the Ident device in order to ensure good operability, e.g., for configuring the connected device.

**Detailed information can be found in chapter 6.3.1.**

## 3.3 Electrical connection

The devices from the MA 2xx*i* family feature four M12 connectors/sockets which are coded differently depending on the interface.

The voltage supply (**PWR IN**) as well as the switching inputs/outputs (**PWR OUT** or **PWR IN**) are connected there. The number and function of the switching inputs/outputs is dependent on the connected end device.

An internal RS 232 interface is used for connecting the respective Leuze device. Another internal RS 232 interface functions as a service interface for configuring the connected device via a serial null modem cable.

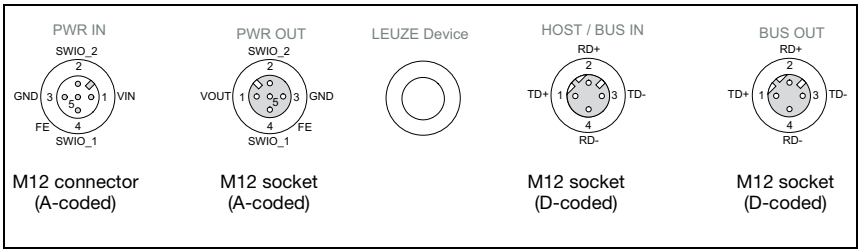


Figure 3.1: MA 238*i* connections

**Detailed information can be found in chapter 7.**

### 3.3.1 Connecting the Leuze device

- *To connect the Leuze device to the internal RS 232 device interface, open the housing of the MA 238i and lead the corresponding device cable (see chapter 14.6) through the middle threaded opening.*
- *Connect the cable to the internal device interface (**X30**, **X31** or **X32**,* see chapter 7.5.1*).*
- *Use rotary switch **S4** (see chapter 8.2.5) to select the connected device.*
- *Now screw the PG cable gland into the threaded opening to provide strain relief and ensure protection class IP 65.*
- *Finally, close the housing of the MA 238i.*

***Attention!***

*Only then may the supply voltage be applied.*
*Upon startup of the MA 238i, the device selection switch is queried and the gateway automatically sets itself to the Leuze device.*

***Connecting functional earth FE***

- *Ensure that the functional earth (FE) is connected correctly.*

Unimpaired operation is only guaranteed when the functional earth is connected properly. All electrical disturbances (EMC couplings) are discharged via the functional earth connection.

### 3.3.2 Connecting the power supply and the bus cable

- *Ideally, use the ready-made cables listed in chapter 14.4.3 to connect the gateway to the power supply via the **PWR IN** connection.*
- *The ready-made cables listed in chapter 14.5.4 are preferred for connecting the gateway to the fieldbus via the **HOST / BUS IN** connection.*
- *If applicable, use the **BUS OUT** connection if you would like to construct a network with linear topology.*

## 3.4 Starting the device

- *Apply the supply voltage +18 … 30VDC (typ. +24VDC); the MA 238i starts up.*
  *The PWR LED displays that it is ready for operation.*

## 3.5 MA 238*i* on the EtherCat

### 3.5.1 Device description file

For EtherCAT, all process data and parameters are described in objects. The compilation of all process data and parameters of the gateway - the object directory - is stored in a so-called ESI file (EtherCAT Slave Information).

The ESI file contains all objects with index, sub-index, name, data type, default value, minimum and maximum, and access possibilities. That means the ESI file describes the entire functionality of the MA 238*i*.

The ESI file has the name MA 238*i*.xml and is available for download on the Leuze home page.

***Vendor ID for the MA 238i***

The Vendor ID assigned by Leuze electronic for the MA 238*i* is $121_h = 289_d$.

**Detailed information on the device description file and the object directory can be found in chapter 12.5.3.**

### 3.5.2 Device profile

The device profile describes the application parameters and the functional behavior of the MA 238*i*. For EtherCAT, one does not specify individual device profiles for device classes. Instead, simple interfaces for existing device profiles are provided.

### 3.5.3 Starting up the MA 238*i* in the EtherCAT system

As is common for EtherCAT, the gateway runs through different states when starting up: "INIT", "PREOP", "SAFEOP" and "OPERATIONAL".

**Detailed information can be found in chapter 12.4.**

# 4 Device description

## 4.1 General Information to the connector units

The modular interfacing unit of the MA 2xx*i* family is a versatile gateway for integrating Leuze RS 232 devices (e.g., BCL 22 bar code readers, RFID devices, RFM 32, …) into the respective fieldbus. The MA 2xx*i* gateways are intended for use in industrial environments with a high protection class. Various device versions are available for the conventional fieldbuses. With a stored parameter structure for the connectable RS 232 devices, commissioning could hardly be simpler.

## 4.2 Characteristics of the connector units

A special characteristic of the MA 238*i* device family are three function modes:

1. **Transparent mode**
   In this function mode, the MA 238*i* functions as a pure gateway with automatic communication from and to the PLC. Absolutely no special programming by the user is necessary for this purpose. The data is not buffered or stored temporarily, however. Instead, it is "passed on".
   The programmer must make certain to retrieve the data from the input memory of the PLC at the right time, as it is otherwise overwritten by new data.

2. **Collective mode**
   In this operating mode, data and telegram parts are temporarily stored in the memory (buffer) of the MA and sent to the RS 232 interface or to the PLC in a telegram by means of bit activation. In this mode, however, all communication control must be programmed on the PLC.
   This function mode is helpful, for example, for very long telegrams or when one or more codes with long code lengths are read.

3. **Command mode**
   With this special operating mode, it is possible to use the first bytes of the data range to transmit predefined commands to the connected device by means of bit activation. For this purpose, device-dependent commands (so-called online commands) are predefined via the device selection switch, see chapter 16 "Specifications for Leuze end devices".

## 4.3 Device construction

The MA 238*i* modular interfacing unit is used for interconnecting Leuze devices, such as the BCL 8, BCL 22, etc., directly to the fieldbus. This is accomplished by transmitting the data from the Leuze device via an RS 232 (V.24) interface to the MA 238*i* where a module converts it into the fieldbus format. The data format of the RS 232 interface corresponds to the standard Leuze data format.

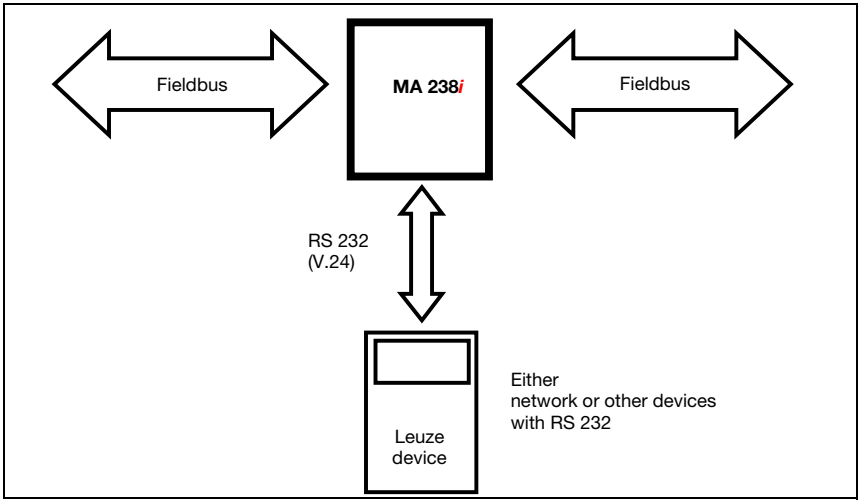


Figure 4.1: Connection of a Leuze device (BCL, RFI, RFM, …) to the fieldbus

The cable of the respective Leuze device is guided through cable bushings with PG cable glands into the MA 238*i* and connected there with the PCB connectors.

The MA 238*i* is intended as a gateway for any RS 232 devices, e.g., BCL 300i, hand-held scanners, scales or for coupling a multiNet network.

The RS 232 cables are internally connectable using JST plug connectors. The cable can be connected to the device using a stable PG cable gland which provide strain relief and protection against contamination.

With the help of adapter cables with Sub-D 9 or open cable end, other RS 232 devices can also be connected.

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## 4.4 Operating modes

For fast commissioning, the MA 238*i* offers an additional operating mode, the "Service mode", in addition to the "Standard mode".In this operating mode, the Leuze device can, for example, be configured on the MA 238*i* and the network settings of the MA can be displayed. To do this, you need a PC/laptop with a suitable terminal program, as BCL-Config from Leuze or similar.

### *Service switch*

Select between "operation" and "service" modes with the service switch. You have the following options:

**Pos. RUN:**

**Operation**
The Leuze device is connected to the fieldbus and communicates with the PLC.

**Pos. DEV:**

**Service Leuze device**
The connection between the Leuze device and the fieldbus is interrupted. With this switch position, you can communicate directly with the Leuze device at the fieldbus gateway via RS 232. You can send online commands via the service interface, configure the Leuze device using the corresponding BCL- BPS-, …-Config configuration software and have the read data of the Leuze device output.

**Pos. MA:**

**Service fieldbus gateway**
With this switch setting, your PC/terminal is connected with the fieldbus gateway.In doing so, the current setting values of the MA (e.g. address, RS 232 parameters) can be called up via a command.

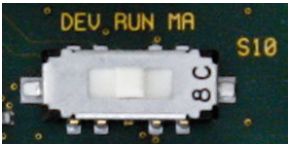



Figure 4.2: Service-switch switch positions

***Notice!***

*If the service switch is on one of the service settings, the PWR LED flashes on the front side of the device, see chapter 8.1.2 "LED indicators on the housing".*

*Furthermore, on the control, the SMA service bit of the status bytes signals that the MA is in service mode.*

### *Service interface*

The service interface can be accessed once the MA 238*i* housing cover has been removed and features a 9-pin Sub-D connector (male). A crossed RS 232 connection cable is required to make the RxD, TxD and GND connections.

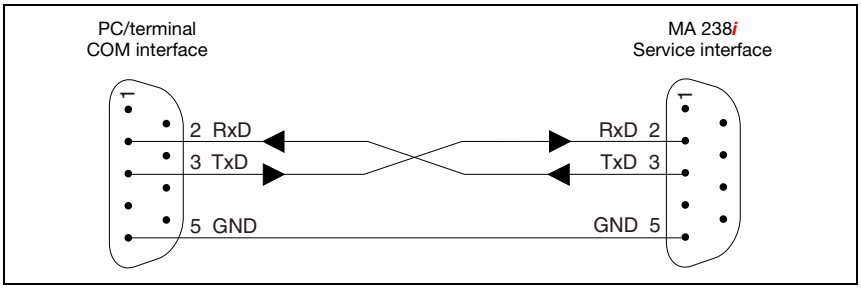



Figure 4.3: Connecting the service interface to a PC/terminal

***Attention!***

*For the service PC to function, the RS 232 parameters must be the same as those of the MA. The Leuze standard setting of the interface is 9600 bd, 8N1 and STX, data, CR, LF.*

## 4.5 Fieldbus systems

Various product variants of the MA 2xx*i* series are available for connecting to different fieldbus systems such as PROFIBUS DP, PROFINET-IO, DeviceNet and Ethernet or EtherCAT.

### 4.5.1 EtherCAT

#### *General information about EtherCAT*

EtherCAT is an Ethernet-based fieldbus initiated by the Beckhoff corporation. The EtherCAT Technology Group (ETG) is the official standardization partner of the IEC working groups.

EtherCAT has been an IEC standard since 2005.

- IEC 61158: protocols and services
- IEC 61784-2: Communication profiles for the specific device classes

All EtherCAT-specific communication mechanisms are described in detail in the standards mentioned above. This technical description will describe parts of the IEC standard if this assists general understanding.

#### *EtherCAT topology*

EtherCAT permits a multitude of topologies such as line, tree, ring, star and combinations of these. The bus or line structure known from the fieldbuses is thus also available for EtherCAT.

Telegrams are sent on a wire pair in the "processing direction" from the master to the slave. The EtherCAT device processes the frames only in this direction and passes them on to the

subsequent device until the telegram has passed through all devices. The last device sends the telegram back to the master on the second wire pair in the cable in the "forward direction". Here, the EtherCAT always forms a logical ring structure regardless of the topology installed.

From an Ethernet point of view, an EtherCAT bus segment is nothing more than a single, large Ethernet participant which sends and receives Ethernet telegrams. Within the "participant", however, there is a multitude of EtherCAT slaves rather than one single Ethernet controller with a downstream micro-processor.

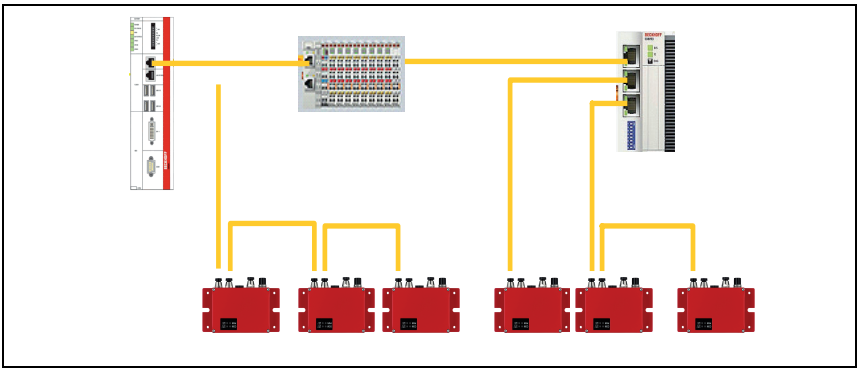


Figure 4.4: Topology example

# 5 Specifications

## 5.1 General specifications

**Electrical data**

| | |
|---|---|
| Interface type | 2x EtherCat, integrated switch,<br>BUS: 2x M12 socket (D-coded)<br>PWR/IO: 1x M12 connector (A-coded), 1x M12 socket (A-coded) |
| protocols | EtherCat communication |
| Baud rate | 10/100 MBaud |
| vendor ID | 289Dec / 121H |
| device type | 12Dec / 0CH (communications adapter) |
| position sensor type | Product type 04 (gateway) |
| Data formats | Data bit: 8, parity: None, stop bit: 1 |
| Service interface | RS 232, 9-pin Sub-D connector, Leuze standard |
| Switching input/output | 1 switching input/1 switching output<br>device-dependent voltage |
| Operating voltage | 18 … 30 VDC (PELV, Class 2) [1)] |
| Power consumption | max. 5VA (without DEV, current consumption max. 300 mA) |
| Max stress on the connector (PWR IN/OUT) | 3A |
| Hand-held scanner operating voltage | 4.75 … 5.25 VDC / max. 1 A |

**Indicators**

| | | |
|---|---|---|
| LED L0 / A0 | green | Connection possible |
| | yellow | Data transmission |
| LED L1 / A1 | green | Connection possible |
| | yellow | Data transmission |
| PWR LED | green | Power |
| | red | Collection error |
| STA LED | green | Bus state ok |
| | red | Configuration error |

**Mechanical data**

| | |
|---|---|
| Protection class | IP 65 (with screwed-on M12 and connected Leuze device) |
| Weight | 700 g |
| Dimensions (HxWxD) | 130 x 90 x 41 mm / with plate: 180 x 108 x 41 mm |
| Housing | Diecast aluminum |
| Connection | 2 x M12: BUS IN / BUS OUT PROFINET-IO<br>1 connector: RS 232<br>1 x M12: Power IN/GND and switching input/output<br>1 x M12: Power OUT/GND and switching input/output |

**Environmental data**

| | |
|---|---|
| Operating temperature range | 0 °C … +55 °C |

| | |
|---|---|
| Storage temperature range | -20°C … +60°C |
| Air humidity | Max. 90% rel. humidity, non-condensing |
| Vibration | IEC 60068-2-6, test FC |
| Shock | IEC 60068-2-27, test Ea |
| Electromagnetic compatibility | EN 61000-6-3:2007 (interference emissions for residential, commercial and light-industrial environments)<br>EN 61000-6-2:2005 (interference rejection for industrial sectors) |
| Certifications | UL 60950-1, CSA C22.2 No. 60950-1 [1)] |

1) For UL applications: only for use in "Class 2" circuits acc. to NEC.

## 5.2 Dimensioned drawings

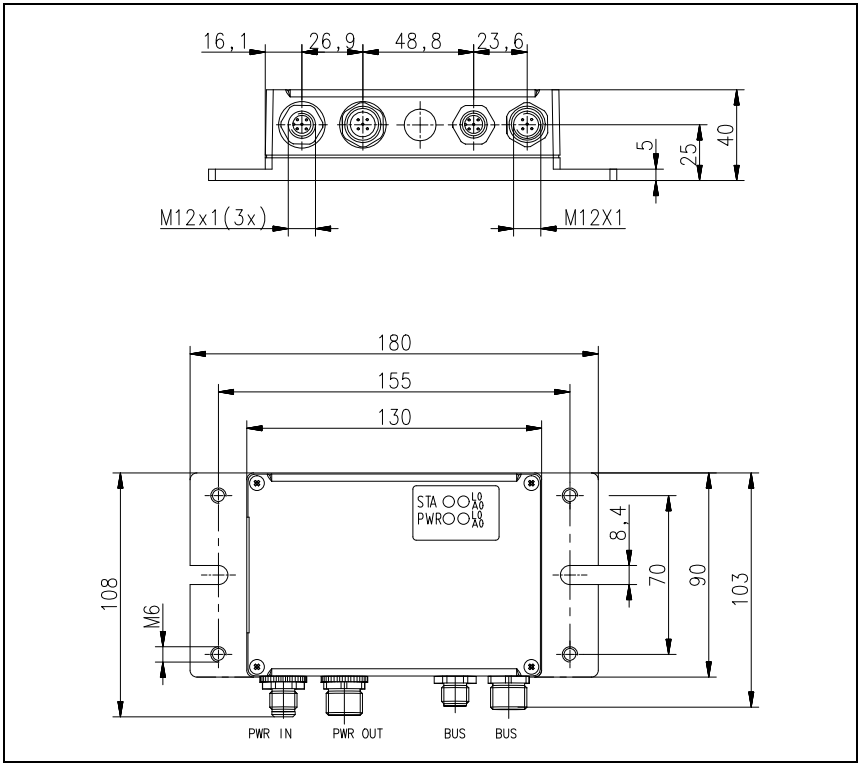



Figure 5.1: MA 238*i* dimensioned drawing

## 5.3 Type overview

The following versions of the MA 2xx*i* gateway family are available for facilitating the integration of Leuze RS 232 devices in the various fieldbus types.

| Fieldbus | Device type | Part no. |
|---|---|---|
| | | |
| PROFIBUS DP V0 | MA 204*i* | 50112893 |
| Ethernet TCP/IP | MA 208*i* | 50112892 |
| PROFINET-IO RT | MA 248*i* | 50112891 |
| DeviceNet | MA 255*i* | 50114156 |
| CANopen | MA 235*i* | 50114154 |
| EtherCAT | MA 238*i* | 50114155 |
| EtherNet/IP | MA 258*i* | 50114157 |

Table 5.1: Type overview MA 2xx*i*

# 6 Installation and mounting

## 6.1 Storage, transportation

***Attention!***

*When transporting or storing, package the device so that it is protected against collision and humidity. Optimal protection is achieved when using the original packaging. Heed the required environmental conditions specified in the technical data.*

***Unpacking***

- *Check the packaging for any damage. If damage is found, notify the post office or shipping agent as well as the supplier.*
- *Check the delivery contents using your order and the delivery papers:*
  - Delivered quantity
  - Device type and model as indicated on the name plate
  - Brief manual

The name plate provides information as to what MA 2xx*i* type your device is. For specific information, please refer to the package insert or chapter 14.2.

***Name plate of the connector unit***

Figure 6.1: MA 238*i* device name plate

***Note!***

Please note that the shown name plate is for illustration purposes only; the contents do not correspond to the original.

- *Save the original packaging for later storage or shipping.*

If you have any questions concerning your shipment, please contact your supplier or your local Leuze electronic sales office.

↳ *Observe the applicable local regulations when disposing of the packaging materials.*

## 6.2 Mounting

The gateway mounting plate MA 238*i* can be mounted in two different ways:

- using four threaded holes (M6) or
- using two M8 screws on the two lateral grooves.

***Fastening by means of four M6 or two M8 screws***

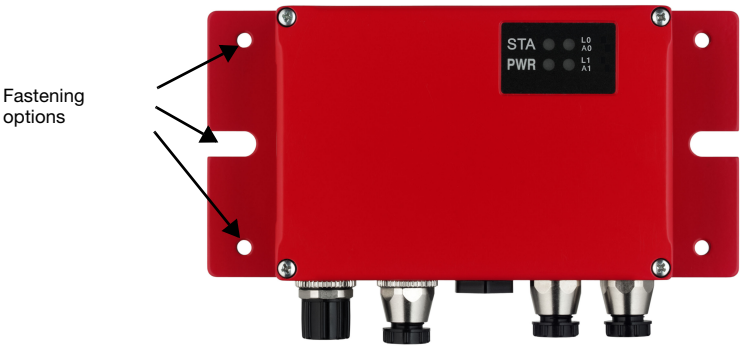



Figure 6.2: Fastening options

## 6.3 Device arrangement

Ideally, the MA 238*i* should be mounted so that it is easily accessible near the Ident device in order to ensure good operability - e.g., for configuring the connected device.

### 6.3.1 Selecting a mounting location

In order to select the right mounting location, several factors must be considered:

- The permissible cable lengths between the MA 238*i* and the host system depending on which interface is used.
- The housing cover should be easily accessible, so that the internal interfaces (device interface for connecting the Leuze device via PCB connectors, service interface) and other operational controls are easy to reach.
- Maintaining the required environmental conditions (temperature, humidity).
- Lowest possible chance of damage to the MA 238*i* by mechanical collision or jammed parts.

## 6.4 Cleaning

↳ *Clean the housing of the MA 238i with a soft cloth after mounting. Remove all packaging remains, e.g. carton fibers or Styrofoam balls.*

***Attention!***

*Do not use aggressive cleaning agents such as thinner or acetone for cleaning the device.*

# 7 Electrical connection

The fieldbus gateways MA 2xx*i* are connected using variously coded M12 connectors.

An RS 232 device interface allows the respective devices to be connected with system connectors. The device cables are equipped with a prefabricated PG cable gland.

Coding varies and the design is implemented as either socket or connector depending on the HOST (fieldbus) interface and function. For the exact design, refer to the corresponding description of the MA 2xx*i* device type.

***Notice!***

*The corresponding mating connectors and ready-made cables are available as accessories for all cables. For further information, see chapter 14 "Type overview and accessories".*

Figure 7.1: Location of the electrical connections

## 7.1 Safety notices for the electrical connection

***Attention!***

*Before connecting the device please ensure that the supply voltage matches the value printed on the nameplate.*
*Connection of the device and cleaning must only be carried out by a qualified electrician.*
*Ensure that the functional earth (FE) is connected correctly. Unimpaired operation is only guaranteed when the functional earth is connected properly.*
*If faults cannot be corrected, the device should be removed from operation and protected against possible commissioning.*

***Attention!***

*For UL applications, use is only permitted in class 2 circuits in accordance with the NEC (National Electric Code).*

*The fieldbus gateways are designed in accordance with safety class III for supply by PELV (protective extra-low voltage with reliable disconnection).*

***Notice!***

*Protection class IP65 is achieved only if the connectors and caps are screwed into place!*

## 7.2 Electrical connection

The MA 238*i* features two M12 connectors/sockets for voltage supply; each is A-coded.

The voltage supply (**PWR IN**) as well as the switching inputs/outputs (**PWR OUT** or **PWR IN**) are connected there. The number and function of the switching inputs/outputs is dependent on the connected end device. Two additional M12 sockets are used for connection to the fieldbus. Both of these connections are D-coded.

An internal RS 232 interface is used for connecting the respective Leuze device. Another internal RS 232 interface functions as a service interface for configuring the connected device via a serial null modem cable.

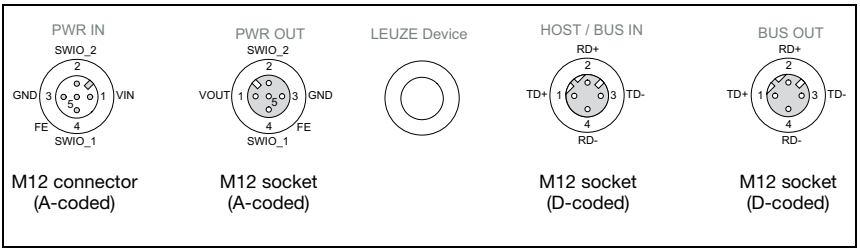



Figure 7.2: MA 238*i* connections

Described in detail in the following are the individual connections and pin assignments.

***Attention!***

*Voltage supply and bus cable are coded in the same way. Please observe the printed connection designations*

### 7.2.1 PWR IN – voltage supply / switching input/output

| PWR IN (5-pin connector, A-coded) | | | |
|---|---|---|---|
| PWR IN<br>SWIO_2<br>2<br>GND 3 5 1 VIN<br>FE 4<br>SWIO_1<br>M12 connector<br>(A-coded) | **Pin** | **Name** | **Remark** |
| | 1 | VIN | Positive supply voltage +18 … +30VDC |
| | 2 | SWIO_2 | Switching input/switching output 2 |
| | 3 | GND | Negative supply voltage 0VDC |
| | 4 | SWIO_1 | Switching input/switching output 1 |
| | 5 | FE | Functional earth |
| | Thread | FE | Functional earth (housing) |

Table 7.1: PWR IN pin assignment

***Notice!***

*The designation and function of the SWIO depends on the connected device. Please observe the following table!*

| Device | PIN 2 | PIN 4 |
|---|---|---|
| BCL 22 | SWOUT_1 | SWIN_1 |
| BCL 8 | SW_0 | SW_I |
| Hand-held scanner/BCL 90 | n.c. | n.c. |
| RFM/RFU/RFI | SWOUT_1 | SWIN_1 |
| LSIS 122, LSIS 222, DCR 202i | SWOUT | SWIN |
| LSIS 4x2/BCL 300, BCL 500, BCL 600i | configurable<br>IO 1 / SWIO 3<br>IO 2 / SWIO 4 | configurable |
| KONTURflex | n.c. | n.c. |
| ODSL 9, ODSL 96B | Q1 | n.c. |
| ODSL 30 | Q1 | active/reference<br>(on SWIN_1, PWRIN) |

Table 7.1: Device-specific function of the SWIOs

### *Supply voltage*

***Attention!***

*For UL applications, use is only permitted in class 2 circuits in accordance with the NEC (National Electric Code).*

*The fieldbus gateways are designed in accordance with safety class III for supply by PELV (protective extra-low voltage with reliable disconnection).*

### *Connecting functional earth FE*

***Notice!***

*Ensure that the functional earth (FE) is connected correctly. Unimpaired operation is only guaranteed when the functional earth is connected properly. All electrical disturbances (EMC couplings) are discharged via the functional earth connection.*

### *Switching input/output*

The MA 238*i* is equipped with the **SWIO_1 and SWIO_2** switching inputs/outputs. This is located on the PWR IN M12 connector and on the PWR OUT M12 connector. The connection of the switching inputs/outputs from PWR IN to PWR OUT can be interrupted by means of a jumper. In this case, only the switching input and output on PWR IN are active.

The function of the switching inputs and outputs is dependent on the connected Leuze device. Detailed information on this topic can be found in the respective operating instructions.

### 7.2.2 PWR OUT switching input/output

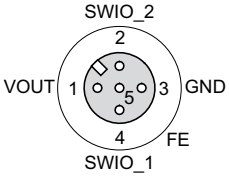
| PWR OUT (5-pin socket, A-coded) | | | |
|---|---|---|---|
| PWR OUT<br>  <br><br>M12 socket<br>(A-coded) | **Pin** | **Name** | **Remark** |
| | 1 | VOUT | Voltage supply for additional devices (VOUT identical to VIN at PWR IN) |
| | 2 | SWIO_2 | Switching input/switching output 2 |
| | 3 | GND | GND |
| | 4 | SWIO_1 | Switching input/switching output 1 |
| | 5 | FE | Functional earth |
| | Thread | FE | Functional earth (housing) |

Table 7.2: PWR OUT pin assignment

***Notice!***

*The maximum admissible current of the PWR OUT and IN connectors is maximum 3A. To be subtracted from this is the current consumption of both the MA and of the connected end device.*

The function of the switching inputs and outputs is dependent on the connected Leuze device. Detailed information on this topic can be found in the respective operating instructions.

On delivery, the SWIO 1/2 are connected in parallel on PWR IN/OUT. This connection can be separated with a jumper.

## 7.3 BUS IN

The MA 238*i* makes an EtherCAT interface available as host interface.

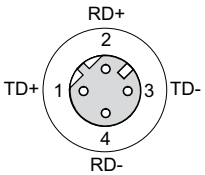
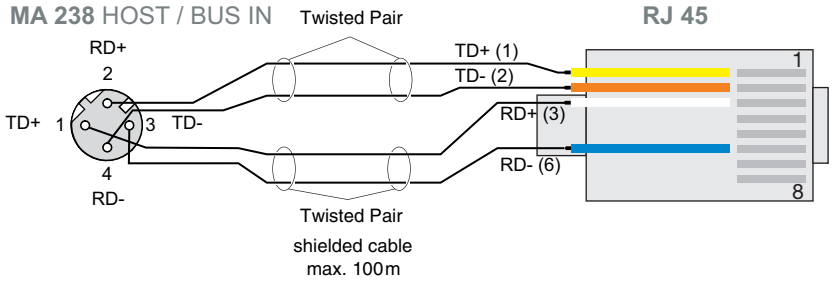
| BUS IN (4-pin socket, D-coded) | | | |
|---|---|---|---|
| HOST / BUS IN<br>  <br><br>M12 socket<br>(D-coded) | **Pin** | **Name** | **Remark** |
| | 1 | TD+ | Transmit Data + |
| | 2 | RD+ | Receive Data + |
| | 3 | TD- | Transmit Data - |
| | 4 | RD- | Receive Data - |
| | Thread | FE | Functional earth (housing) |

Table 7.3: Pin assignment HOST / BUS IN

↳ *For the host connection of the MA 238i, the "KB ET - … - SA-RJ45" ready-made cables are preferred, see table 14.4 Bus connection cable for the MA 238ion page 74.*

### *EtherCAT cable assignments*




**RJ45 - assignment and wire colors**

| Pin | Signal | Name | Wire color according to PROFINET | Wire color according to EIA T568B |
|---|---|---|---|---|
| 1 | TD+ | Transmission Data + | yellow | white/orange |
| 2 | TD- | Transmission Data – | orange | orange |
| 3 | RD+ | Receive Data + | white | white/green |
| 6 | RD- | Receive Data – | blue | green |

Figure 7.3: HOST/BUS IN cable assignments on RJ-45 (shown here is the device connection)

***Notice for connecting the EtherCAT interface!***

*Ensure adequate shielding. The entire connection cable must be shielded and earthed. The RD+/RD- and TD+/TD- wires must be stranded in pairs.*
*Use CAT 5 cable for the connection.*

## 7.4 BUS OUT

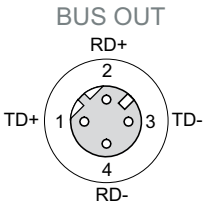
| BUS OUT (4-pin socket, D-coded) | | | |
|---|---|---|---|
|  | **Pin** | **Name** | **Remark** |
| | 1 | TD+ | Transmit Data + |
| | 2 | RD+ | Receive Data + |
| | 3 | TD- | Transmit Data - |
| | 4 | RD- | Receive Data - |
| | Thread | FE | Functional earth (housing) |

Table 7.4: Pin assignment HOST/BUS OUT

↳ *For the host connection of the MA 238i, the "KB ET - … - SSA" ready-made cables are preferred, see table 14.4 Bus connection cable for the MA 238ion page 74.*

If you use user-configurable cables, note the following:

***Notice!***

*Ensure adequate shielding. The entire connection cable must be shielded and earthed. The signal lines must be stranded in pairs.*
*Use CAT 5 cable for the connection.*

***Notice!***

*For the MA 238i as standalone device or as the last participant in a linear topology, termination on the BUS OUT socket is **not** mandatory!*

## 7.5 Device interfaces

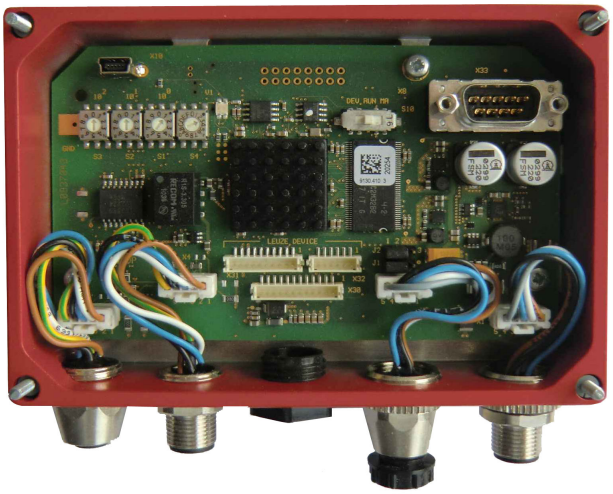


Figure 7.4: Open the MA 238*i*

### 7.5.1 RS 232 device interface (accessible after opening the device, internal)

The device interface is prepared for the system plugs (PCB connectors) for Leuze devices RFI xx, RFM xx, BCL 22.

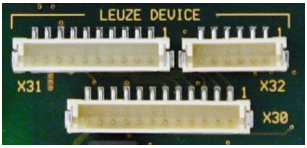



Figure 7.5: RS 232 device interface

The standard devices are connected with 6- or 10-pin connector piece to X31 or X32, respectively. For hand-held scanners, BCL 8 and BPS 8 with 5VDC ±10% supply (from the MA) on pin 9, the 12-pin X30 PCB connection is available as well.

By using an additional cable (cf. "Type overview and accessories" on page 71), the system connection can be established on M12 or 9-pin Sub-D, e.g., for hand-held scanners.

***Notice!***

*When using third-party devices, check the pin assignment and voltage without fail.*

### 7.5.2 Service interface (internal)

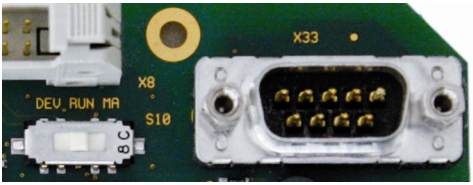



Figure 7.6: RS 232 service switch and service interface

Following activation, this interface enables access via the RS 232 to the connected Leuze device and the MA for configuration using the 9-pin Sub-D. The connection between the fieldbus interface and the device interface is switched off during access. The fieldbus itself is, however, not interrupted as a result.

The service interface can be accessed once the MA 238*i* housing cover has been removed and features a 9-pin Sub-D connector (male). A crossed RS 232 connection cable is required to make the RxD, TxD and GND connections. A hardware handshake via RTS, CTS is not supported at the service interface.

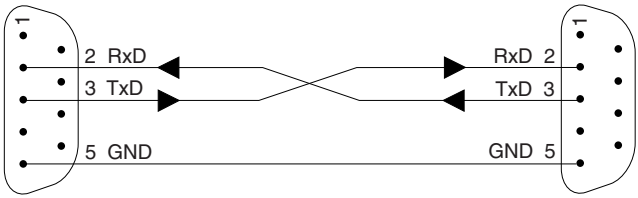



Figure 7.7: Connecting the service interface to a PC/terminal

***Attention!***

*For the service PC to function, the RS 232 parameters must be the same as those of the MA. The Leuze standard setting of the interface is 9600Bd, 8N1 and STX, data, CR, LF.*

***Notice!***

*To configure the devices connected to the external interface, e.g., BCL 8 (JST plug connector "X30"), a cable specially configured for this purpose is necessary. The service switch must be in the "DEV" or "MA" position (Service Leuze device/MA).*

## 7.6 EtherCAT wiring

A Cat. 5 Ethernet cable should be used for wiring.

For the connection technology transition from M12 to RJ45, a "KDS ET M12 / RJ 12 45 W - 4P" adapter is available that lets you connect standard network cables.

If no standard network cables are to be used (e.g., due to lacking IP… protection class), you can use the "KB ET - … - SA" user-configurable cables on the side of the MA 238*i*, see table 14.4 Bus connection cable for the MA 238ion page 74.

The individual MA 238*i* devices in a linear topology are connected with the "KB ET - … - SSA" cable, see "Bus connection cable for the MA 238i" on page 74.

For unavailable cable lengths, you can configure your cables yourself. When doing so, make certain that you connect **TD+** on the M12 connector with **RD+** on the RJ-45 connector and **TD-** on the M12 connector with **RD-** on the RJ-45 connector, respectively, etc.

***Notice!***

*Use the recommended connectors / sockets or the ready-made cables (see chapter 14 "Type overview and accessories").*
*For further information on the topologies, see chapter 4.5.1 "EtherCAT".*

## 7.7 Cable lengths and shielding

↳ *Observe the following maximum cable lengths and shielding types:*

| Connection | Interface | Max. cable length | Shielding |
|---|---|---|---|
| **MA 238*i*– – Service** | RS 232 | 10 m | not necessary |
| **MA 238*i* – Host** | EtherCAT | 100 m | absolutely required, shielded |
| **Network from the first MA 238*i* to the last MA 238*i*** | EtherCAT | the maximum segment length must not exceed 100 m for 100Base-TX Twisted Pair (min. Cat. 5) | absolutely required, shielded |
| **MA 238*i* – Power supply unit** | | 30 m | not necessary |
| **Switching input** | | 10 m | not necessary |
| **Switching output** | | 10 m | not necessary |

Table 7.5: Cable lengths and shielding

# 8 Status displays and operational controls

Figure 8.1: LED indicators on the MA 238*i*

## 8.1 LED status indicators

### 8.1.1 LED indicators on the circuit board

***LED (Status)***

| | | |
|---|---|---|
| | **off** | **Device OFF**<br>- no operating voltage or device defect |
| | **continuous green light** | **Device ok**<br>- readiness for operation |
| | **continuous orange light** | **Device error / firmware available** |
| | **flashing green-orange** | **Device in boot mode**<br>- no firmware |

### 8.1.2 LED indicators on the housing

***PWR LED***

| | | |
|---|---|---|
| PWR | **off** | **Device OFF**<br>- no operating voltage or device error |
| PWR | **continuous green light** | **Device ok**<br>- self test successfully finished<br>- ready |
| PWR | **flashing green** | **Device ok, device in service mode** |
| PWR | **flashing red** | **Configuration error**<br>- baud rate or address incorrect |

***STA LED***

| | | |
|---|---|---|
| STATUS | **continuous green light** | **Bus operation ok**<br>- network mode ok<br>- connection and communication to the host established |
| STATUS | **continuous red light** | **Configuration error**<br>- network error<br>- no connection established<br>- no communication possible |

***L0/A0 LED***

| | | |
|---|---|---|
| L0<br>A0 | **continuous green light** | **L0**<br>- connection exists |
| L0<br>A0 | **flashing yellow** | **A0**<br>- data exchange |

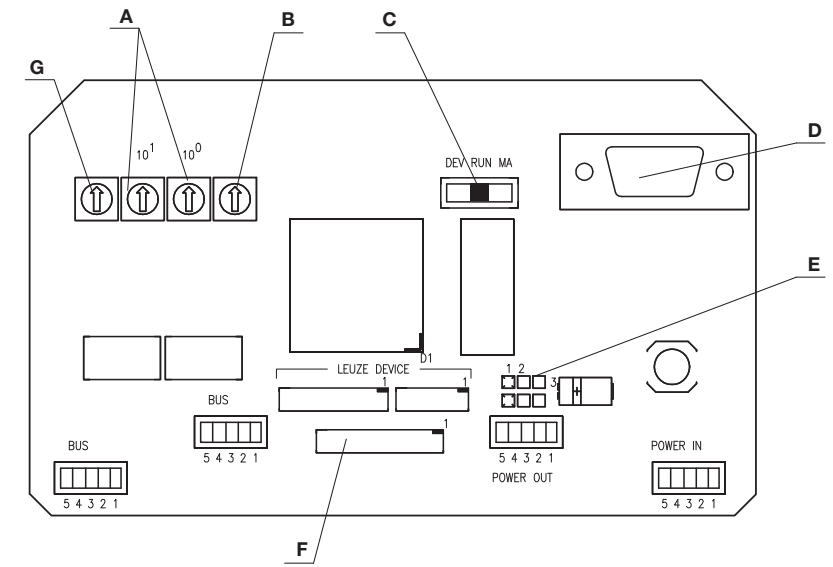
***L1/A1 LED***

| | | |
|---|---|---|
| L1<br>A1 | **continuous green light** | **L1**<br>- connection exists |
| L1<br>A1 | **flashing yellow** | **A1**<br>- data exchange |

## 8.2 Internal interfaces and operational controls

### 8.2.1 Overview of operational controls of the

The operational controls of the MA 238*i* are described in the following. The figure shows the MA 238*i* with opened housing cover.




= Standard settings

**A** MA 238*i*: not equipped
**B** Rotary switch S4 for device selection
**C** Service switch
**D** RS 232 Sub-D service interface
**E** Jumper for bridging, separating switching input/output PWR IN/OUT
**F** 3 JST plug connectors: connection of the Leuze devices
**G** MA 238*i*: without function/not equipped

Figure 8.2: Front view: operational controls of the MA 238*i*

| Circuit board element desig. | Function |
|---|---|
| X1<br>Operating voltage | PWR IN<br>M12 connector for operating voltage (18 … 30VDC) MA 238*i* and connected Leuze device xx |
| X2<br>Output voltage | PWR OUT<br>M12 connector for other devices (MA, BCL, sensor, …)<br>VOUT = VIN max. 3A |
| X4<br>HOST interface | BUS IN<br>HOST interface for connecting to the fieldbus |
| X5<br>HOST interface | BUS OUT<br>Second BUS interface for creating a network with other participants in a linear topology |
| X30<br>Leuze device | JST plug connector with 12 pins<br>Connection of the Leuze devices with 4.75 … 5.25VDC / 1A (BCL 8, BPS 8 and hand-held scanner) |
| X31<br>Leuze device | JST plug connector with 10 pins<br>Connection of the Leuze devices (BCL, RFI, RFM,…)<br>Pin VINBCL with standard setting = V+ (18 - 30V) |
| X32<br>Leuze device | JST plug connector with 6 pins<br>Connection of the Leuze devices (BCL, RFI, RFM,…)<br>Pin VINBCL with standard setting = V+ (18 - 30V) |
| X33<br>RS 232 service interface | 9-pin SUB-D connector<br>RS 232 interface for service/setup operation. Enables the connection of a PC via serial null modem cable for configuring the Leuze device and the MA 238*i* |
| S4<br>Rotary switch | Rotary switch (0 … F) for device selection<br>Standard setting = 0 |
| S10<br>DIP switch | Service switch<br>Switch between service Leuze device (DEV), service fieldbus gateway (MA) and operation (RUN).<br>Standard setting = operation. |
| J1, J2<br>Jumper | Bridging, separating switching input/output<br>(interruption of connection between the two PWR M12 connectors of the SWIO 1 or SWIO 2) |

### 8.2.2 Connector X30 … connectors

PCB connectors **X30 … X32** are available in the MA 238*i* for connecting the respective Leuze devices via RS 232.

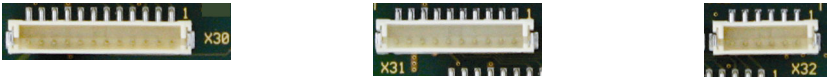



Figure 8.3: Connections for Leuze devices

***Attention!***

*Several Leuze devices may not be connected to the MA 238i simultaneously, as only one RS 232 interface can be operated.*

### 8.2.3 RS 232 service interface – X33

The **X33** RS 232 interface facilitates the configuration of the Leuze device and the MA 238*i* via PC, which is connected by means of a serial null modem cable.

***X33 pin assignment – service connector***

| SERVICE (9-pin SUB-D connector) | | | |
|---|---|---|---|
| | **Pin** | **Name** | **Remark** |
| | 2 | RXD | Receive Data |
| | 3 | TXD | Transmit Data |
| | 5 | GND | Functional earth |

Table 8.1: SERVICE pin assignment

### 8.2.4 S10 service switch

The **S10** DIP switch can be used to select between the "operation" and "service" modes, i.e. you switch between the following options here:

- Operation (RUN) = default setting
- Service Leuze device (DEV) and
- Service fieldbus gateway (MA)

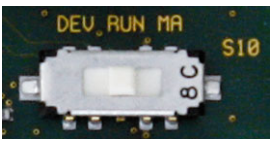



Figure 8.4: DIP switch service - operation

For further information on the corresponding options, see chapter 4.4 "Operating modes".

### 8.2.5 Rotary switch S4 for device selection

The **S4** rotary switch is used to select the Leuze end device.

Figure 8.5: Rotary switch for device selection

The following switch positions are assigned to the Leuze devices:

| Leuze device | Switch position |
|---|---|
| Standard setting<br>Other RS 232 devices such as KONTURflex QUATTRO | 0 |
| BCL 8 | 1 |
| BCL 22 | 2 |
| n.c. | 3 |
| BCL 300i, BCL 500i, BCL 600i | 4 |
| BCL 90, BCL 900i | 5 |
| LSIS 122, LSIS 222 | 6 |

| Leuze device | Switch position |
|---|---|
| LSIS 4x2i, DCR 202i | 7 |
| Hand scanner | 8 |
| RFID (RFI xx, RFM xx, RFU xx) | 9 |
| BPS 8 | A |
| ODS 9, ODSL 30, ODSL 96B, BPS 300i | B |
| MA 3x | C |
| Reset to factory setting | F |

The gateway is set via the switch position on the Leuze device. If the switch position is changed, the device must be restarted, since the switch position is only queried after switching off completely and then restarting the device.

***Notice!***

*In switch position "0", a distance of >20ms must be maintained between two telegrams so they can be distinguished from one another.*

The parameters of the Leuze end devices are described in chapter 16.

# 9 Configuration

The MA 238*i* is configured using the ESI file via the device manager of the control. The connected device is normally configured via the service interface of the MA with the help of a suitable configuration program.

The respective configuration programs – e.g. for bar code readers the BCL-Config, for RFID devices the RF-Config etc. – and the associated documentation is provided on the Leuze home page **www.leuze.com** in the respective Download area.

***Notice!***

*In order to display the help texts, a PDF viewer program (not included in the delivery contents) must also be installed. For important information on configuring and on the configurable functions, please refer to the description of the respective device.*

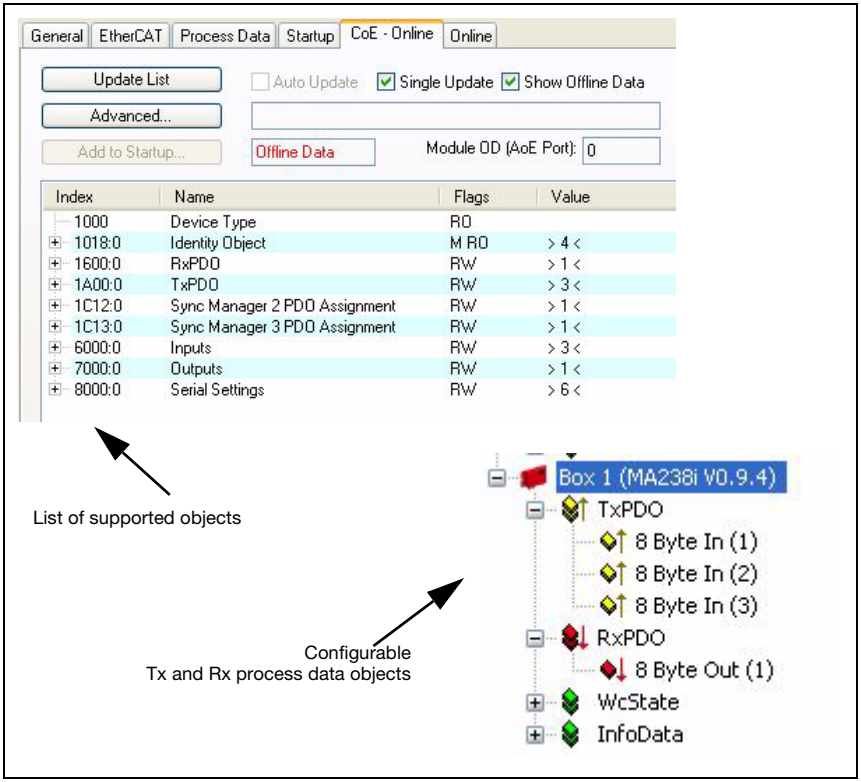



Figure 9.1: Configuration options

## 9.1 Connecting the service interface

The RS 232 service interface is connected after opening the device cover of the MA 238*i* via the 9-pin Sub-D and a cross-wired null modem cable (RxD/TXD/GND). For connection, see chapter "Service interface (internal)" on page 31.

The service interface is activated with the help of the service switch and establishes a direct connection to the connected device with the "DEV" (Leuze device) or "MA" (gateway) setting.

## 9.2 Reading out information in Service mode

- *After starting up in the "RUN" switch position, set the service switch of the MA to the "MA" position.*
- *Now start one of the following terminal programs: e.g., BCL, RF, BPS Config.*

Alternatively, you can also use the Windows tool "Hyperterminal".

- *Start the program.*
- *Select the correct COM port (e.g., COM1) and set the interface as follows:*

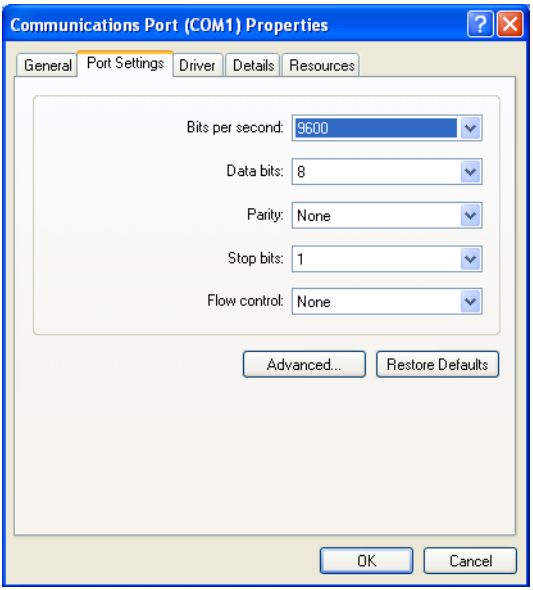



Figure 9.2: COM port settings

***Notice!***

*Observe that STX, data, CR, LF framing must be set on the PC terminal program so that communication is possible with the connected Leuze device.*

### *Commands*

You can now call up information on the MA 238*i* by sending the following commands.

| | |
|---|---|
| v | General service information. |
| s | Enable memory mode for the last frames. |
| l | The memory mode shows the last RX and TX frames for ASCII and fieldbus. |

Table 9.1: Available commands

### *Information*

| | |
|---|---|
| Version | Version information. |
| Firmware date | Firmware date. |

Table 9.2: General firmware information

| | |
|---|---|
| Selected scanner | Currently selected Leuze device (selected via switch S4). |
| Gateway mode | Transparent or Collective mode. |
| Ring buffer fill level | Current fill level of the ring memory in Collective mode (ASCII->Fieldbus). 1024 bytes max. |
| Received ASCII Frames | Number of received ASCII frames. |
| ASCII Framing Error (GW) | Number of received framing errors. |
| Number of Received CTB's | Number of CTB commands. |
| Number of Received SFB's | Number of SFB commands. |
| Command-Buffer fill level | Current fill level of the ring memory in Command mode (fieldbus->ASCII). 1024 bytes max. |
| Number of received transparent frames | Number of received fieldbus frames without CTB/SFB. |
| Number of send fieldbus frames | Number of frames sent via the fieldbus. |
| Number of invalid commands | Number of invalid commands. |
| Number of ASCII stack send errors | Number of frames that the ASCII memory could not send. |
| Number of good ASCII send frames | Number of frames that the ASCII memory sent successfully. |

Table 9.3: General gateway information

| | |
|---|---|
| ND | Current status of ND bit. |
| W-Ack | Current status of W-Ack bit. |
| R-Ack | Current status R-Ack bit. |
| Data loss | Current status of data loss bit. |
| Ring buffer overflow | Current status of ring buffer overflow bit. |
| DEX | Current status of DEX bit. |
| BLR | Current status of BLR bit. |

Table 9.4: Current states of the status and control bits

| | |
|---|---|
| ASCII-Start-Byte | Currently configured start byte<br>(dependent on switch position S4). |
| ASCII-End-Byte1 | Currently configured stop byte 1<br>(dependent on switch position S4). |
| ASCII-End-Byte2 | Currently configured stop byte 2<br>(dependent on switch position S4). |
| ASCII framing | Character length, parity, stop bit(s). |
| ASCII baud rate | Currently configured baud rate<br>(dependent on switch position S4). |
| ASCII warm start status | Indicates whether the ASCII memory has detected and accepted a valid configuration. |

Table 9.5: ASCII configuration

| | |
|---|---|
| ECAT Input Data Length | Length of the data received (consumed data, default 8 bytes). |
| ECAT Output Data Length | Length of the data supplied (produced data, default 24 bytes). |
| Set IO Size Error(s) | Input/output size error. |
| Status Change Error(s) | Status change error. |
| Enable Control Status Change Error(s) | Activate control status change error output. |
| Local SDO Download Error(s) | Local error SDO download. |
| Status Indication(s) | Status display(s). |

Table 9.6: MA 238*i* communication parameters

# 10 Telegram

## 10.1 Structure of the fieldbus telegram

All operations are performed by control and status bits. Two bytes of control information and two bytes of status information are available for this purpose. The control bits are a part of the output module and the status bits are a part of the input bytes. The data starts with the third byte.

If the actual data length is longer than the data length configured in the gateway, only part of the data is transmitted; the remaining data is lost. In this case, the DL (data loss) bit is set.

The following telegram structure is used between **PLC -> fieldbus gateway**:

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | |
|---|---|---|---|---|---|---|---|---|
| ND | Address 4 | Address 3 | Address 2 | Address 1 | Address 0 | Broadcast | Command mode | Control byte 0 |
| | | | | CTB | SFB | | R-ACK | Control byte 1 |

| | |
|---|---|
| Data byte / parameter byte 0 | Data |
| Data byte / parameter byte 1 | |
| … | |

This telegram structure is used between **fieldbus gateway -> PLC**:

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | |
|---|---|---|---|---|---|---|---|---|
| ND | BO | DL | BLR | DEX | SMA | | W-ACK | Status byte 0 |
| DLC7 | DLC6 | DLC5 | DLC4 | DLC3 | DLC2 | DLC1 | DLC0 | Status byte 1 |

| | |
|---|---|
| Data byte / parameter byte 0 | Data |
| Data byte / parameter byte 1 | |
| … | |

Only the data part with the corresponding frame (e.g., STX, CR & LF) is then transmitted between the fieldbus gateway and the Leuze end device. The two control bytes are processed by the fieldbus gateway.

The corresponding control and status bits and their meaning are specified in section 10.2 and section 10.3.

Further information on the broadcast control bytes and address bits 0 … 4 can be found in chapter "Modular interfacing unit MA 3x (S4 switch position C)" on page 90.

## 10.2 Description of the input bytes (status bytes)

### 10.2.1 Structure and meaning of the input bytes (status bytes)

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | |
|---|---|---|---|---|---|---|---|---|
| ND | BO | DL | BLR | DEX | SMA | | W-ACK | Status byte 0 |
| DLC7 | DLC6 | DLC5 | DLC4 | DLC3 | DLC2 | DLC1 | DLC0 | Status byte 1 |

| | |
|---|---|
| Data byte / parameter byte 0 | Data |
| Data byte / parameter byte 1 | |
| … | |

Table 10.1: Structure of the input bytes (status bytes)

***Bits of the input byte (status byte) 0***

| Bit no. | Designation | Meaning |
|---|---|---|
| 0 | W-ACK | Write-Acknowledge (write confirmation when using buffer) |
| 2 | SMA | Service mode active(service mode activated) |
| 3 | DEX | Data exist (data in transmit buffer) |
| 4 | BLR | Next block ready (new block ready) |
| 5 | DL | Data loss |
| 6 | BO | Buffer overflow |
| 7 | ND | New data only in Transparent mode |

***Bits of the input byte (status byte) 1***

| Bit no. | Designation | Meaning |
|---|---|---|
| 0 … 7 | DLC0 … DLC7 | **D**ata **L**ength **C**ode (length of the following user data) |

***Notice!***

*T-bit means toggle bit, i.e. this bit changes its state on each event ("0" → "1" or "1" → "0").*

### 10.2.2 Detailed description of the bits (input byte 0)

#### *Bit 0: Write-Acknowledge: W-ACK*

This bit is only relevant for writing slave data in blocks, see chapter 11.1.2 (buffer data on RS 232). It toggles when data from the PLC are sent to the MA with CTB or SFB.

| Input data | Description | Addr. | Data type | Value range | Default |
|---|---|---|---|---|---|
| W-ACK | **W**rite-**Ack**nowledge<br>(write confirmation)<br>Write handshake<br>Indicates that the data was successfully sent by the PLC to the gateway.<br>Write-Acknowledge is indicated via this bit. The W-ACK bit is toggled by the fieldbus gateway whenever a transmit command has been successfully executed. This applies both for the transmission of data to the transmit buffer with the CTB command and for sending the transmit buffer contents with the SFB command. | 0.0 | Bit | 0->1: Successfully written<br>1->0: Successfully written | 0 |

#### *Bit 2: Service mode active: SMA*

| Input data | Description | Addr. | Data type | Value range | Default |
|---|---|---|---|---|---|
| SMA | **S**ervice **m**ode **a**ctive (SMA)<br>The SMA bit is set if the service switch is set to "MA" or "DEV", i.e. if the device is in either fieldbus gateway or Leuze device service mode. This is also indicated by a flashing PWR LED on the front side of the device. Upon changing to the normal operating mode "RUN", the bit is reset. | 0.2 | Bit | 0: Device in operating mode<br>1: Device in service mode | 0h |

#### *Bit 3: Data exist: DEX*

This bit is only relevant for reading slave data in Collective mode relevant, see chapter 11.1.1.

| Input data | Description | Addr. | Data type | Value range | Default |
|---|---|---|---|---|---|
| DEX | **D**ata **e**xist<br>(data in transmit buffer)<br>Indicates that further data is stored in the transmit buffer which is ready for transmission to the control. This flag bit is always set to high ("1") by the fieldbus gateway as long as data is in the buffer. | 0.3 | Bit | 0: No data in the transmit buffer<br>1: Further data in the transmit buffer | 0h |

### *Bit 4: Next block ready to transmit: BLR*

This bit is only relevant for reading slave data in Collective mode relevant, see chapter 11.1.1.

| Input data | Description | Addr. | Data type | Value range | Default |
|---|---|---|---|---|---|
| BLR | Next **bl**ock **r**eady to transmit<br>(new block ready)<br>The Block Ready toggle bit changes its state whenever the fieldbus gateway has removed received data from the receive buffer and registered it in the corresponding receive-data bytes. This signals to the master that the quantity of data indicated in the DLC bits to be present in the input data bytes originated in the data buffer and is current. | 0.4 | Bit | 0->1: Data transmitted<br>1->0: Data transmitted | 0 |

### *Bit 5: Data loss: DL*

This bit is important for monitoring data transmission in Transparent and Collective mode.

| Input data | Description | Addr. | Data type | Value range | Default |
|---|---|---|---|---|---|
| DL | **D**ata **l**oss<br>(Data transmission monitoring)<br>This bit is set until the device is reset (bit pattern see chapter 10.4 "RESET function / deleting memory") in case gateway data was not able to be sent to the PLC and was lost. Furthermore, this bit is set in case the configured data frame, e.g. 8 bit, should be smaller than the data to be transmitted to the PLC, e.g. bar code with 20 digits. In this case, the first 8 digits are transmitted to the PLC, the rest are truncated and are lost. In this process, the Data loss bit is also set. | 0.6 | Bit | 0->1:<br>Data loss | 0 |

### *Bit 6: Buffer overflow: BO*

| Input data | Description | Addr. | Data type | Value range | Default |
|---|---|---|---|---|---|
| BO | Buffer overflow<br>(buffer overflow)<br>This flag bit is set to high ("1") when the buffer overflows. The bit is automatically reset when the buffer again has memory space available. While the BO bit is set, the RTS signal of the serial interface is deactivated.<br>The memory size of the gateway for the data of both the PLC and the Leuze end device is 1 kByte. | 0.6 | Bit | 0->1: Buffer overflow<br>1->0:<br>Buffer o.k. | 0 |

### *Bit 7: New data: ND*

This bit is only relevant in Transparent mode.

| Input data | Description | Addr. | Data type | Value range | Default |
|---|---|---|---|---|---|
| ND | **N**ew **d**ata<br>(new data)<br>This bit is toggled on each data set that is sent from the gateway to the PLC. This can be used to differentiate between multiple, identical data sets that are sent to the PLC. | 0.7 | Bit | 0->1; 1->0:<br>On each status change for new data | 0 |

## 10.2.3 Detailed description of the bits (input byte 1)

### *Bit 0 … 7: Data length code: DLC0 … DLC7*

| Input data | Description | Addr. | Data type | Value range | Default |
|---|---|---|---|---|---|
| DLC0 … DLC7 | **D**ata **l**ength **c**ode<br>(number of user data in bytes)<br>Stored in these bits is the number of user data bytes transmitted to the PLC which follow. | 1.0 … 1.7 | Bit | $1_h$ ($00001_b$) … $FF_h$ ($00255_b$) | 0h (00000b) |

# 10.3 Description of the output bytes (control bytes)

## 10.3.1 Structure and meaning of the output bytes (control bytes)

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | |
|---|---|---|---|---|---|---|---|---|
| ND | Address 4 | Address 3 | Address 2 | Address 1 | Address 0 | Broadcast | Command mode | Control byte 0 |
| | | | | CTB | SFB | | R-ACK | Control byte 1 |

| | |
|---|---|
| Data byte 1 | Data |
| Data byte 2 | |
| … | |

Table 10.2: Structure of the output bytes (control bytes)

### *Bits of the output byte (control byte) 0*

| Bit no. | Designation | Meaning |
|---|---|---|
| 0 | Command mode | Command mode |
| 1 | Broadcast | Broadcast<br>(only relevant with a connected MA 3x) |
| 2 … 6 | Address 0 .. 4 | Address bits 0 .. 4<br>(only relevant with a connected MA 3x) |
| 7 | ND | New data |

### *Bits of the output byte (control byte) 1*

| Bit no. | Designation | Meaning |
|---|---|---|
| 0 | R-ACK | **R**ead-**Ack**nowledge |
| 2 | SFB | **S**end data **f**rom transmit **b**uffer |
| 3 | CTB | **C**opy to **t**ransmit-**b**uffer |

## 10.3.2 Detailed description of the bits (output byte 0)

### *Bit 0: Command mode: Command mode*

| Output data | Description | Addr. | Data type | Value range | Default |
|---|---|---|---|---|---|
| Command mode | Command mode<br>This bit is used to activate Command mode. In Command mode, no data is sent by the PLC to the Leuze end device via the gateway. In Command mode, various bits that execute corresponding commands depending on the selected Leuze device can be set in the data- or parameter field. For further information, see chapter 11.1.3 "Command mode". | 0.0 | Bit | 0: Default, transparent data transmission<br>1: Command mode | 0 |

The following two control bits ("Bit 1: Broadcast: Broadcast" on page 48 and "Bits 2 … 6: address bits 0 .. 4: address 0 .. 4" on page 48) are only relevant with a connected MA 3x. With other devices, these fields are ignored.

### *Bit 1: Broadcast: Broadcast*

| Output data | Description | Addr. | Data type | Value range | Default |
|---|---|---|---|---|---|
| Broadcast | Broadcast<br>A broadcast only functions with a multiNet network connected via the MA 3x. If this bit is activated, the gateway automatically adds the broadcast command "00B" before the data. This is directed at all participants in the multiNet. | 0.1 | Bit | 0: No broadcast<br>1: Broadcast | 0 |

### *Bits 2 … 6: address bits 0 .. 4: address 0 .. 4*

| Output data | Description | Addr. | Data type | Value range | Default |
|---|---|---|---|---|---|
| Address 0..4 | Address bits 0 .. 4<br>As with the broadcast command, individual devices in the multiNet can also be addressed via the MA 3x . In this case, the corresponding address of the device precedes the data field telegram. | 0.2<br>…<br>0.6 | Bit | 00000: Addr. 0<br>00001: Addr. 1<br>00010: Addr. 2<br>00011: Addr. 3<br>… | 0 |

### *Bit 7: New data: ND*

| Output data | Description | Addr. | Data type | Value range | Default |
|---|---|---|---|---|---|
| ND | **N**ew **d**ata<br>This bit is needed if several identical pieces of data are to be sent in sequence. | 0.7 | Bit | 0->1; 1->0:<br>On each status change for new data | 0 |

### 10.3.3 Detailed description of the bits (output byte 1)

#### *Bit 0: Read-Acknowledge: R-ACK*

This bit is only relevant for writing slave data in blocks (Collective mode), see chapter 11.1.2.

| Output data | Description | Addr. | Data type | Value range | Default |
|---|---|---|---|---|---|
| R-ACK | **R**ead-**Ack**nowledge<br>(read confirmation)<br>Toggle bit: Indicates to the fieldbus gateway that the "old" data has been processed and that new data can be received. At the end of a read cycle, this bit must be toggled in order to be able to receive the next data set. This toggle bit is switched by the master after valid received data has been read out of the input bytes and the next datablock can be requested. If the gateway detects a signal change in the R-ACK bit, the next bytes are automatically written from the receive buffer to the input data words and the BLR bit toggled. Further toggling erases the memory (to 00h). | 1.0 | Bit | 0->1 or<br>1->0: Successfully written & ready for the next transmission | 0 |

#### *Bit 2: Send data from buffer: SFB*

This bit is only relevant for writing slave data in blocks (Collective mode), see chapter 11.1.2.

| Output data | Description | Addr. | Data type | Value range | Default |
|---|---|---|---|---|---|
| SFB | **S**end **d**ata from **b**uffer<br>(send data from the gateway transmit buffer to the RS 232)<br>Toggle bit: changing this bit causes all data which was copied to the transmit buffer of the fieldbus gateway via the CTB bit to be transmitted to the RS 232 interface or the connected Leuze device. | 1.2 | Bit | 0->1: Data to RS 232<br>1->0: Data to RS 232 | 0 |

### *Bit 3: Copy to transmit buffer: CTB*

This bit is only relevant for writing slave data in blocks (Collective mode), see chapter 11.1.2.

| Output data | Description | Addr. | Data type | Value range | Default |
|---|---|---|---|---|---|
| CTB | **C**opy to **t**ransmit **b**uffer<br>(transmission data to transmit buffer)<br>Toggle bit: Changing this bit writes the data from the PLC to the transmit buffer of the fieldbus gateway. This is used, for example, for long command strings which must be transmitted to the connected ident device.<br>The CTB toggle bit is switched whenever transmit data is not to be sent directly via the serial interface, but instead transferred to the transmit buffer. | 1.3 | Bit | 0->1: Data in buffer<br>1->0: Data in buffer | 0 |

***Notice!***

*The state change of the CTB bit signals the MA that the data is going into the buffer; therefore, it's essential to observe the order!*
*When the CTB is not used, the telegram (which fits in one cycle) is transmitted directly to the RS 232 interface. Please make sure it is complete!*

## 10.4 RESET function / deleting memory

For many applications, it is helpful to be able to reset the MA buffer (in Collective mode) or status bits.

The following bit pattern can be transmitted from the PLC for this purpose (if >20 ms is pending):

| | |
|---|---|
| Control byte 0: | 10101010 (AAh) |
| Control byte 1: | 10101010 (AAh) |
| OUT data byte 0/parameter byte 0: | AAh |
| OUT data byte 1/parameter byte 1: | AAh |

This sets the memory or status/control bits to 00h.

Please observe that the data image may need to be updated by toggling in Collective mode.

# 11 Modes

## 11.1 Functionality of the data exchange

The fieldbus gateway has two different modes that can be selected via the PLC:

- **Transparent mode (standard setting)**
  In Transparent mode, all data is sent 1:1 and directly by the serial end device to the PLC. It is not necessary to use status and control bits here. However, only data bytes possible for **one** transmission cycle are transmitted - all others are lost.
  The distance between two successive telegrams (without frame) must be more than 20 ms, since there is otherwise no clear separation between them.
  ASCII characters are typically expected as data content; under certain circumstances, the MA therefore detects different control characters as invalid characters in the data range and truncates them. At $00_h$ in the data range, the MA cuts the telegram off because unnecessary bytes are also filled with $00_h$.
- **Collective mode**
  In Collective mode, the data of the serial end device is stored temporarily in the fieldbus gateway by toggling the CTB bit and is not sent to the PLC in blocks until prompted to do so by the PLC.
  On the PLC, a status bit (DEX) then signals that new data is ready for retrieval. This data is then read out from the fieldbus gateway in blocks (toggle bit).
  In order to distinguish between the individual telegrams on the PLC, in Collective mode the serial frame is sent to the PLC in addition to the data.

  The size of the buffer is 1 kByte.

***Notice!***

*In Collective mode, the CTB and SFB bits are needed for communication handling via the buffer. Telegrams that can also be completely transmitted in one cycle in Collective mode (including data frame) go directly through. If PLC data is provided and transferred without a state change of the CTB bit, it goes directly to the RS 232 interface with the set telegram data length. Incomplete (incl. data frame) or faulty telegrams can cause error messages in the connected device!*

*Combination with the Command mode is possible.*

*Data exchange in blocks must be programmed on the PLC.*

### 11.1.1 Reading slave data in Collective mode (gateway -> PLC)

If the Leuze device transmits data to the fieldbus gateway, the data is stored temporarily in a buffer. The PLC is signaled via the "DEX" bit that data is ready for retrieval in the memory. Data is not automatically transmitted.

If no further user data is present in the MA 238*i* ("DEX" bit = "0"), the "R-ACK" bit must be toggled once as read confirmation to release data transmission for the next read cycle.

If the buffer still contains more data ("DEX bit = 1), the next remaining user data present in the buffer is transmitted by toggling the "R-ACK" control bit. This process is to be repeated until the "DEX" bit returns to "0"; all data has then been removed from the buffer. "R-ACK" must be toggled here again once more as a terminating read confirmation in order to release data transmission for the next read cycle.

Used status and control bits:

- DLC
- BLR
- DEX
- R-ACK

### 11.1.2 Writing slave data in Collective mode (PLC -> gateway)

***Writing in blocks***

The data sent by the master to the slave is first collected in a "transmit buffer" by setting the "CTB" bit (**C**opy to **t**ransmit **b**uffer). Please observe that data provided is transmitted directly by toggling the bit.

The data is then sent in the order received from the buffer to the connected Leuze device via the serial interface with the command: "SFB" (**S**end data **f**rom transmit **b**uffer). Please don't forget the suitable data frame!

Afterward, the buffer is again empty and can be written with new data.

***Notice!***

*With this function, it is possible to temporarily store longer data strings in the gateway independent of how many bytes the used fieldbus can transmit at once. With this function, longer PT sequences or RFID write sequences, for example, can be transmitted, since the connected devices can, in this way, receive their commands (e.g., PT or W) in a continuous string. The respective frame (STX CR LF) is needed to differentiate between the individual telegrams.*

Used status and control bits:

- CTB
- SFB
- W-ACK

If PLC data is provided and transferred without a state change of the CTB bit, it goes directly to the RS 232 interface with the set telegram data length. Incomplete (incl. data frame) or faulty telegrams can cause error messages in the connected device!

### *Examples for the activation of a Leuze device*

In the data part (starting at byte 2) of the telegram to the gateway, a "+" (ASCII) is sent for activation.

This means that the hex value "2B" (corresponds to a "+") is to be entered in control or output byte 2. To deactivate the reading gate, a "2D" (hex) must be used instead (corresponds to a "-" ASCII).

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | |
|---|---|---|---|---|---|---|---|---|
| ND | Address 4 | Address 3 | Address 2 | Address 1 | Address 0 | Broadcast | Command mode | Control byte 0 |
| | | | | CTB | SFB | | R-ACK | Control byte 1 |

| | |
|---|---|
| Data byte 1 | Data |
| Data byte 2 | |
| … | |

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Output byte 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Output byte 1 |
| 0 | 0 | 0 | 0 | 0 | 0 | B | 2 | Output byte 2 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Output byte 3 |

### *Collective mode sequence diagram*

Send long online commands to the DEV, read RS 232 answer from DEV

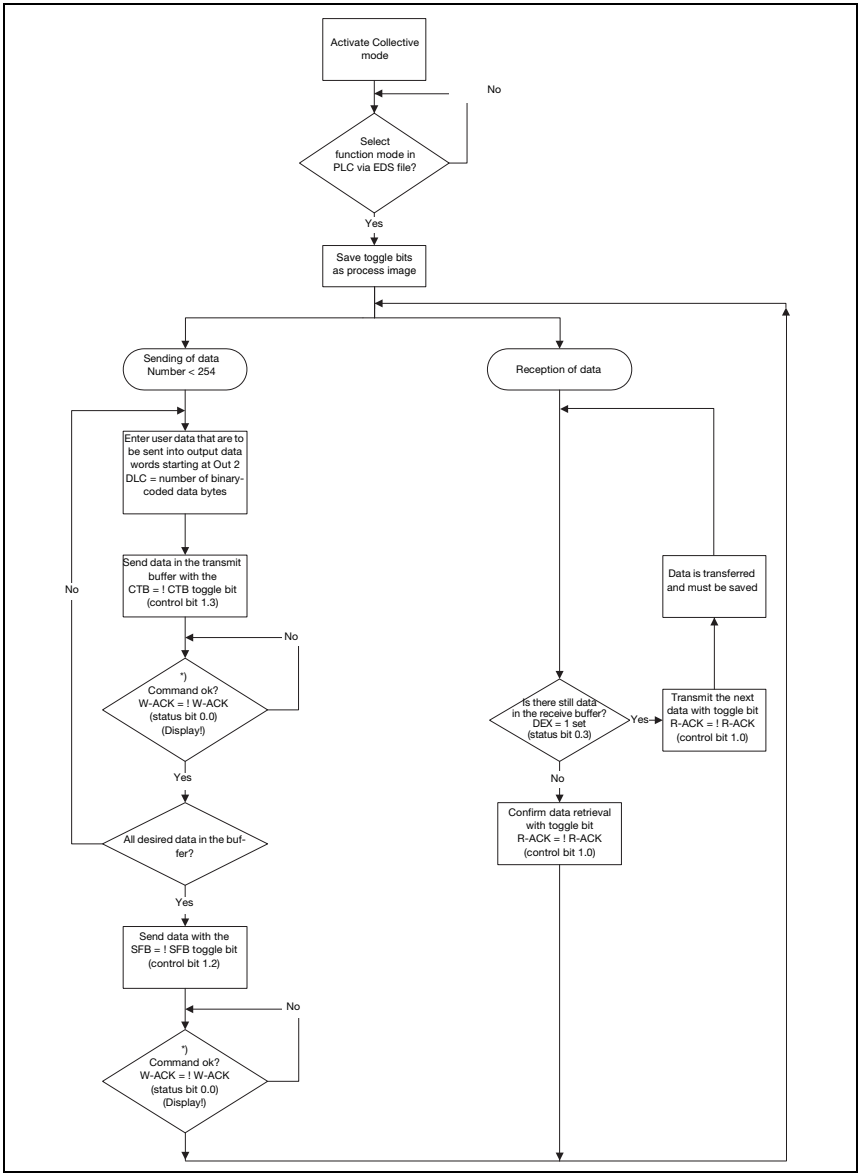



Figure 11.1: Data transmission scheme with long online commands

### 11.1.3 Command mode

One specific feature is the so-called Command mode, which is defined via the output control byte 0 (bit 0) ... and enables the control of the connected device per bit.

If the command mode is activated (command mode = 1), no data is sent by the PLC to the Leuze end device via the gateway. The data from the MA to the PLC is transmitted in the selected operating mode (Transparent/Collective).

With the Command mode, it is possible to set various device-specific bits in the data- or parameter field that execute the corresponding serial commands (e.g., v, +, -, etc.). If, for example, the version of the Leuze end device is to be queried, the corresponding bit is to be set so that a "v" is sent to the Leuze device with the <STX> v <CR> <LF> frame.

The Leuze end device also answers the gateway with data (e.g. bar code content, NoRead, device version, etc.) in response to most commands. The answer is immediately passed on to the PLC by the gateway.

***Notice!***

*The parameters available for the individual Leuze devices are listed in chapter 16.*
*Command mode cannot be used with hand-held scanners.*

#### *Examples for the activation of a Leuze device*

In Command mode, control or output byte 0.0 is to be set for activating the Command mode. Only the corresponding bit (control or output byte 2.1) then needs to be set for activating and deactivating the reading gate.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Output byte 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Output byte 1 |
| 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | Output byte 2 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Output byte 3 |

### *Command mode sequence diagram*

Set control byte 0, bit 0.0 to 1

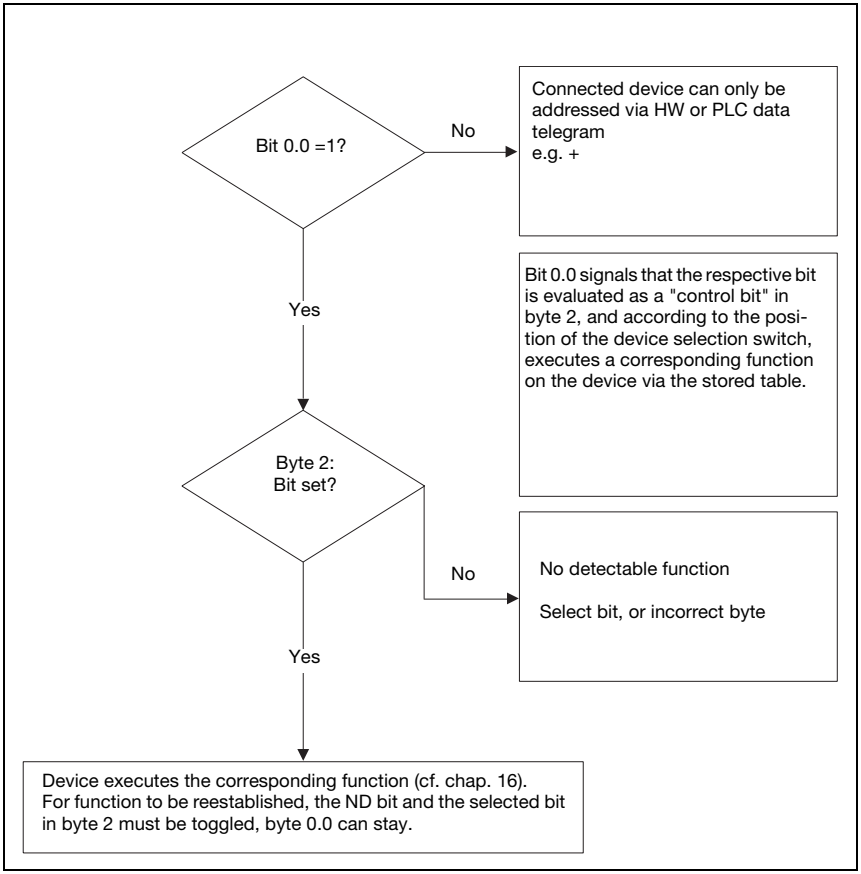



Figure 11.2: Execution of command after activation of the Command mode

### *Triggering the ident devices and reading the data*

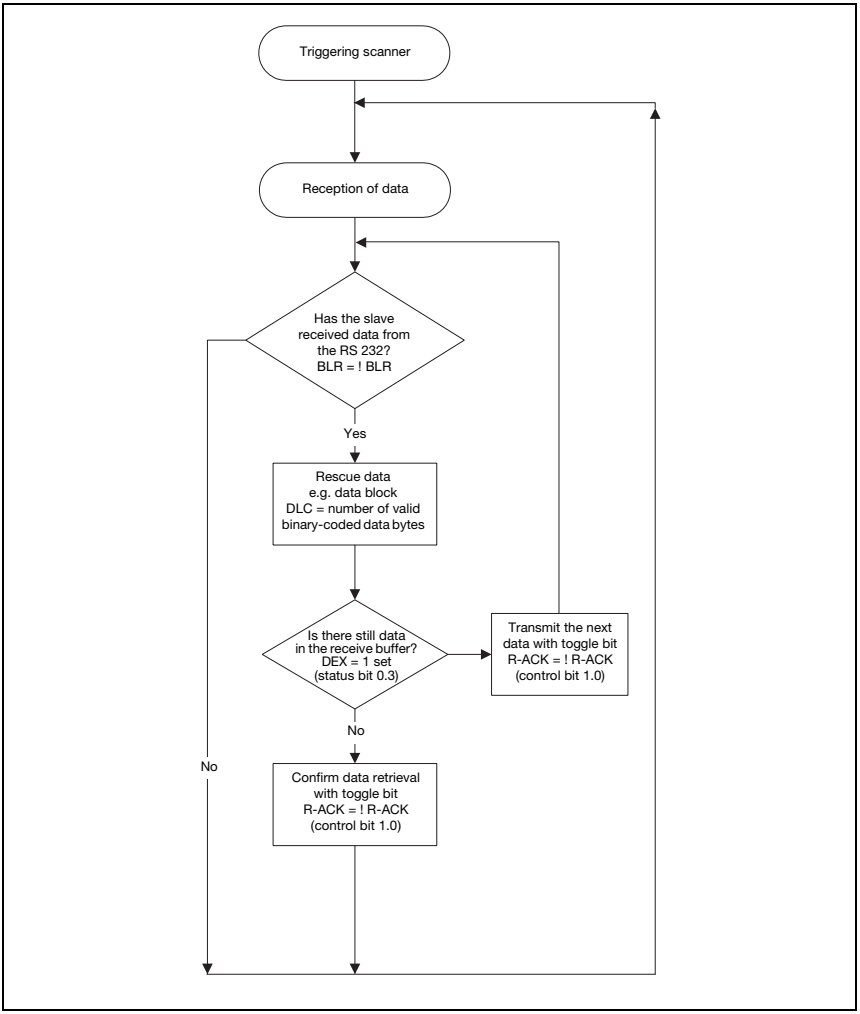



Figure 11.3: Activating DEV and reading data

***Notice!***

*Further information on fieldbus telegram structure can be found in chapter 10.1. A specification of all usable commands can be found in chapter "Specifications for Leuze end devices" on page 77.*

# 12 Commissioning and configuration

## 12.1 Measures to be performed prior to the initial commissioning

- *Before commissioning, familiarize yourself with the operation and configuration of the MA 238i.*
- ***Before connecting the supply voltage**, recheck all connections and ensure that they have been properly made.*

The Leuze device must be connected to the internal RS 232 device interface.

### *Connecting the Leuze device*

- *Open the housing of the MA 238i and lead the corresponding device cable (see chapter 14.6) through the middle threaded opening.*
- *Connect the cable to the internal device interface (X30, X31 or X32,* see chapter 7.5.1*).*
- *Use rotary switch S4 (see chapter 8.2.5) to select the connected device.*
- *Now screw the PG cable gland into the threaded opening to provide strain relief and ensure protection class IP 65.*
- *Finally, close the housing of the MA 238i.*

***Attention!***

*Only then may the supply voltage be applied.*
*Upon startup of the MA 238i, the device selection switch is queried and the gateway automatically sets itself to the Leuze device.*

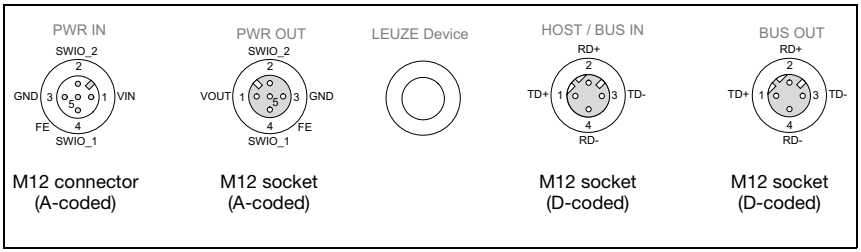



Figure 12.1: Connections of the MA 238*i* seen from below, device on mounting plate

- *Check the applied voltage. It must be in the range between +18V … 30VDC.*

### *Connecting functional earth FE*

- *Ensure that the functional earth (FE) is connected correctly.*

Unimpaired operation is only guaranteed when the functional earth is connected properly. All electrical disturbances (EMC couplings) are discharged via the functional earth connection.

On delivery, the SWIO 1/2 are connected in parallel on PWR IN/OUT. This connection can be separated with a jumper.

### 12.1.1 Connecting the power supply and the bus cable

- *Ideally, use the ready-made cables listed in chapter 14.4.3 to connect the gateway to the power supply via the **PWR IN** connection.*
- *The ready-made cables listed in chapter 14.5.4 are preferred for connecting the gateway to the fieldbus via the **HOST / BUS IN** connection.*
- *If applicable, use the **BUS OUT** connection if you would like to construct a network with linear topology.*

## 12.2 Starting the device

- *Apply the supply voltage +18 … 30VDC (typ. +24VDC); the MA 238i starts up. The PWR LED displays that it is ready for operation.*

## 12.3 MA 238i in the EtherCAT system

## 12.4 Starting the MA 238i in the EtherCAT system

During starting up, the gateway runs through different states which are explained in brief in the following.

***INIT***

The MA 238i initializes itself. No direct communication between the master and MA 238i is possible. The EtherCAT master will transit the MA 238i step by step into the "operational" state.

In the status change from "INIT" to "PREOP", the TwinCAT or master writes the so-called EtherCAT address (=station address) to the respective register of the EtherCAT slave controller (here: MA 238i). This EtherCAT address is typically specified in relation to the position, i.e., the master's address is 1000, the first slave's address is 1001, etc. This is also called the auto-increment method.

***PRE-OPERATIONAL***

The master and the MA 238*i* exchange application-specific initializations and device-specific parameters. In the PRE-OPERATIONAL state, configuration is initially possible via SDOs only.

***SAFE-OPERATIONAL***

The "Start Input Update" command puts the gateway into the "Safe-Operational" state. The master produces output data, but input data are not considered. This means the MA 238*i* does not return output data (=PLC input data) in SAFEOP. The gateway does not process input process data (=PLC output data). Mailbox communication via CoE services is possible.

***OPERATIONAL***

The "Start Output Update" command puts the gateway into the OPERATIONAL state. In this state, the MA 238*i* supplies valid input data and the master valid output data. After the MA 238*i* has detected the data received via the process data service, the state transition is confirmed by the MA 238*i*. If the activation of the output data was not possible, the gateway remains in the SAFE OPERATIONAL state and outputs an error message.

## 12.5 CANopen over EtherCAT

EtherCAT provides the communication mechanisms described below. In this context, the SDO accesses to the online dictionary via CoE (CANopen over EtherCAT) are carried out via mailbox services. PDO services via CoE mailboxes are not supported.

- Object index
- PDO, process data object
- SDO, service data object
- NMT, network management

Master and slave must be located in the same EtherCAT network.

### 12.5.1 Device profile

The device profile describes the application parameters and the functional behavior of the MA 238*i*. For EtherCAT, one does not specify individual device profiles for device classes. Instead, simple interfaces for existing device profiles are provided.

### 12.5.2 Device description file

For EtherCAT, all process data and parameters are described in objects. The compilation of all process data and parameters of the gateway - the object directory - is stored in a so-called ESI file (EtherCAT Slave Information).

The ESI file contains all objects with index, sub-index, name, data type, default value, minimum and maximum, and access possibilities. That means the ESI file describes the entire functionality of the MA 238*i*, and it is possible to adjust both the communication of the gateway with the control and the RS 232 interface.

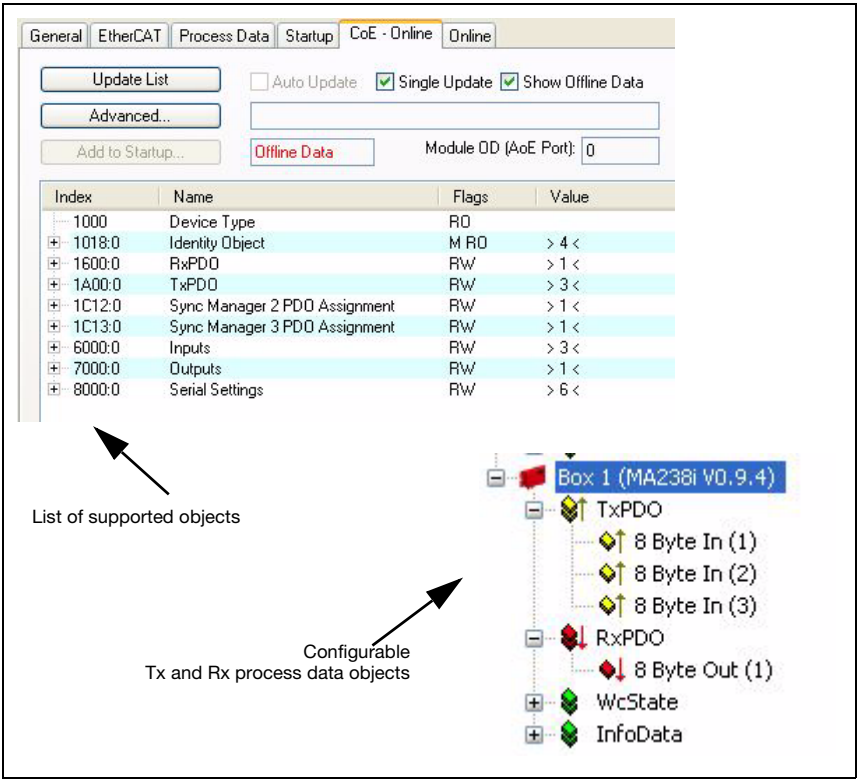



Figure 12.2: Configuration options

The ESI file has the name MA 238*i*.xml and is available for download on the Leuze home page.

### *Vendor ID for the MA 238i*

The Vendor ID assigned by Leuze electronic for the MA 238*i* is $121_h = 289_d$.

### 12.5.3 Object index

The object directory of the MA 238*i* is the compilation of all process data and parameters of the MA.

The following overview table shows all objects supported by the MA 238*i*.

| Object address in hex | EtherCAT-specific object area |
|---|---|
| 1000 | Device Type |
| 1018:0 | Identity Object (contains general information regarding the device) |
| 1600:0 | RxPDO1 |
| 1A00:0 | TxPDO1 |
| 1C12:0 | Sync Manager 2 PDO Assignment |
| 1C13:0 | Sync Manager 3 PDO Assignment |
| 6000:0 | Inputs (Input Data, 8 bytes by 8 bytes (Rx)) |
| 7000:0 | Outputs (Output Data, 8 bytes by 8 bytes (Tx)) |
| 8000:0 | Serial Settings (RS 232) |

Afterwards, you will find the respective detailed descriptions of the individual objects.

#### *12.5.3.1 Object $1000_h$ Device Type*

The object describes the MA 238*i* device type.

| Index (hex) | Sub-index (hex) | Name | Data type | Access | Value range | | | Remark |
|---|---|---|---|---|---|---|---|---|
| | | | | | Minimum | Maximum | Default | |
| 1000 | -- | Device type | u32 | ro | -- | -- | 0000 | |

#### *12.5.3.2 Object $1018_h$ Identity Object*

This object contains general specifications about the MA 238*i*.

| Index (hex) | Sub-index (hex) | Name | Data type | Access | Value range | | | Remark |
|---|---|---|---|---|---|---|---|---|
| | | | | | Minimum | Maximum | Default | |
| 1018 | 01 | Vendor ID | u32 | ro | -- | -- | $121_h$ | Manufacturer ID number |
| | 02 | Product Code | u32 | ro | -- | -- | $F1_h$ | |
| | 03 | Revision | u32 | ro | -- | -- | -- | |
| | 04 | Serial Number | u32 | ro | -- | -- | -- | |

The Vendor ID assigned by Leuze electronic for the MA 238*i* is $121_h = 289_d$.

### 12.5.3.3 Object $1600_h$ RxPDO

The object describes the Rx process data object.

| Index (hex) | Sub-index (hex) | Name | Data type | Access | Value range Minimum | Value range Maximum | Value range Default | Remark |
|---|---|---|---|---|---|---|---|---|
| 1600 | -- | RxPDO | u32 | rw | -- | -- | -- | |
| | 01 | 8 Byte OUT (1) | u32 | rw | -- | -- | 0x7000:01,64 | |
| | 1E | 8 Byte OUT (30) | u32 | rw | -- | -- | -- | |
| | 1F | 8 Byte OUT (31) | u32 | rw | -- | -- | -- | |
| | 20 | 8 Byte OUT (32) | u32 | rw | -- | -- | -- | |

### 12.5.3.4 Object $1A00_h$ TxPDO

The object describes the Tx process data objects.

| Index (hex) | Sub-index (hex) | Name | Data type | Access | Value range Minimum | Value range Maximum | Value range Default | Remark |
|---|---|---|---|---|---|---|---|---|
| 1A00 | -- | TxPDO | u32 | rw | -- | -- | -- | |
| | 01 | 8 Byte In (1) | | rw | -- | -- | 0x6000:01,64 | |
| | 02 | 8 Byte In (2) | | rw | -- | -- | 0x6000:02,64 | |
| | 03 | 8 Byte In (3) | | rw | -- | -- | 0x6000:03,64 | |
| | 04 | 8 Byte In (4) | | rw | -- | -- | -- | |
| | 05 | 8 Byte In (5) | | rw | -- | -- | -- | |
| | 06 | 8 Byte In (6) | | rw | -- | -- | -- | |
| | 1F | 8 Byte In (31) | | rw | -- | -- | -- | |
| | 20 | 8 Byte In (20) | | rw | -- | -- | -- | |

### 12.5.3.5 Object 1C12 Sync Manager 2 PDO Assignment

The object assigns the Rx process data objects to Sync Manager 2.

| Index (hex) | Sub-index (hex) | Name | Data type | Access | Value range Minimum | Value range Maximum | Value range Default | Remark |
|---|---|---|---|---|---|---|---|---|
| 1C12 | -- | Sync Manager 2 PDO Assignment | u32 | rw | -- | -- | -- | |
| | 01 | SubIndex 001 | | rw | -- | -- | 0x1600 (5632) | |

### 12.5.3.6 Object 1C13 Sync Manager 3 PDO Assignment

The object assigns the Tx process data objects to Sync Manager 3.

| Index (hex) | Sub-index (hex) | Name | Data type | Access | Value range | | | Remark |
|---|---|---|---|---|---|---|---|---|
| | | | | | Minimum | Maximum | Default | |
| 1C13 | -- | Sync Manager 3 PDO Assignment | u32 | rw | -- | -- | -- | |
| | 01 | SubIndex 001 | | rw | -- | -- | 0x1A00 (6656) | |

### 12.5.3.7 Object 6000 Inputs

The object describes the input data of the MA 238*i*, which is transmitted cyclically, 8 bytes by 8 bytes (Rx).

| Index (hex) | Sub-index (hex) | Name | Data type | Access | Value range | | | Remark |
|---|---|---|---|---|---|---|---|---|
| | | | | | Minimum | Maximum | Default | |
| 6000 | -- | Inputs | u32 | rw | | -- | | |
| | 01 | 8 Byte Inputs (1) | | ro | | | 00 00 00 00 00 00 00 00 | |
| | 02 | 8 Byte Inputs (2) | | ro | | | 00 00 00 00 00 00 00 00 | |
| | 03 | 8 Byte Inputs (3) | | ro | | | 00 00 00 00 00 00 00 00 | |
| | 04 | 8 Byte Inputs (4) | | ro | | | | |
| | 05 | 8 Byte Inputs (5) | | ro | | | | |
| | 06 | 8 Byte Inputs (6) | | ro | | | | |
| | 07 | 8 Byte Inputs (7) | | ro | | | | |
| | 08 | 8 Byte Inputs (8) | | ro | | | | |
| | 1F | 8 Byte Inputs (31) | | ro | | | | |
| | 20 | 8 Byte Inputs (32) | | ro | | | | |

### 12.5.3.8 Object 7000 Outputs

The object describes the output data of the MA 238*i*, which is transmitted cyclically, 8 bytes by 8 bytes (Tx).

| Index (hex) | Sub-index (hex) | Name | Data type | Access | Value range | | | Remark |
|---|---|---|---|---|---|---|---|---|
| | | | | | Minimum | Maximum | Default | |
| 7000 | -- | Outputs | u32 | rw | -- | -- | | |
| | 01 | 8 Byte Outputs (1) | | ro | | | 00 00 00 00 00 00 00 00 | |
| | 02 | 8 Byte Outputs (2) | | ro | | | | |
| | 03 | 8 Byte Outputs (3) | | ro | | | | |
| | 04 | 8 Byte Outputs (4) | | ro | | | | |
| | 1E | 8 Byte Outputs (30) | | ro | | | | |
| | 1F | 8 Byte Outputs (31) | | ro | | | | |
| | 20 | 8 Byte Outputs (32) | | ro | | | | |

### 12.5.3.9 Object 8000 Serial Settings

The object describes the serial RS 232 settings of the MA 238*i*.

| Index (hex) | Sub-index (hex) | Name | Data type | Access | Value range | | | Remark |
|---|---|---|---|---|---|---|---|---|
| | | | | | Minimum | Maximum | Default | |
| 8000 | -- | Serial Settings | u32 | rw | -- | -- | | |
| | 01 | Data Mode | u32 | rw | -- | -- | Transparent Mode (0) | |
| | 02 | Use Rotary Switch | u32 | rw | -- | -- | Use Rotary Switch (1) | |
| | 03 | Baud Rate | u32 | rw | -- | -- | 9600 Baud (96) | |
| | 04 | Data Bits | u32 | rw | -- | -- | 8 Data Bits (8) | |
| | 05 | Parity | u32 | rw | -- | -- | None (1) | |
| | 06 | Stop Bits | u32 | rw | -- | -- | 1 Stop Bit (1) | |

## 12.6 Setting the read parameters on the Leuze device

### *Commissioning the Leuze device*

To commission a read station, you must prepare the Leuze device on the MA 238*i* for its reading task. Communication with the Leuze device occurs via the service interface.

***Notice!***

*For further information on connecting and using the service interface, see chapter 9 "Configuration".*

↳ *To do this, connect the Leuze device to the MA 238i.*

Depending on the Leuze device, this occurs either via a connection cable (accessory no.: KB 031-1000) or directly on the MA 238*i*. The service connector and corresponding switches can be accessed with the housing cover open.

↳ *Select the "DEV" service switch position.*

### *Connect the service interface; call up the terminal program*

↳ *Connect your PC to the service connector via the RS 232 cable.*

↳ *On the PC, call up a terminal program (e.g., BCL-Config) and check whether the interface (COM 1 or COM 2) to which you have connected the MA 238i is set to the following Leuze standard setting: 9600 baud, 8 data bits, no parity, 1 stop bit and STX, data, CR, LF.*

You can download the config. tool from **www.leuze.com** for BCL, RFID, etc.

In order to communicate with the connected Leuze device, the **STX, data, CR, LF** framing must be set on the PC terminal program, as the Leuze device is preconfigured ex works for this frame character.

| | |
|---|---|
| STX (02h): | Prefix 1 |
| CR (0Dh): | Postfix 1 |
| LF (0Ah): | Postfix 2 |

***Operation***

↳ *Switch the MA 238i to switch position "RUN" (operation).*

The Leuze device is now connected to the fieldbus. Activation of the Leuze device can now occur via the switching input on the MA 238*i*, via the process data word Out bit 1 (bit 0.2) or by transmitting a "+" command to the Leuze device (see chapter 16 "Specifications for Leuze end devices"). For further information on the fieldbus transmission protocol, see see chapter 10 "Telegram".

***Reading out information in service mode***

↳ *Set the service switch of the gateway to switch position "MA" (gateway).*

↳ *Send a "v" command to call up all service information of the MA 238i.*

An overview of the available commands and information can be found in chapter "Reading out information in Service mode" on page 40.

### 12.6.1 Specific feature for the use of hand-held scanners (bar code and 2D devices, combi devices with RFID)

***Notice!***

*A description of the device configuration and the required codes can be found in the respective documentation at **www.leuze.com.** Cable-connected hand-held scanners on the MA 238i*

All hand-held scanners and mobile combi devices available in the Leuze electronic product line can be used with the corresponding connection cable.

When using the MA 238*i*, the voltage supply of the hand-held scanner (4.75 … 5.25 VDC/ at 1 A) can be connected to the interface by means of a cable via the 9-pin Sub-D connector (voltage on PIN 9). The corresponding cable is to be selected for the respective hand-held scanner and ordered separately. The 9-pin Sub-D cable (KB JST-HS-300, part no. 50113397) is connected to this cable, which is connected to the MA 238*i*. This cable must also be ordered separately.

In this example, triggering occurs by means of a trigger button on the hand-held scanner.

***Notice!***

*When using third-party devices, check the pin assignment and interface settings without fail and adjust them if necessary.*

#### 12.6.1.1 *Wireless hand-held scanners on the MA 238i*

All wireless hand-held scanners and mobile combi devices available in the Leuze electronic product line can be used with the corresponding connection cable via the base station.

A 230VAC connection (socket) is usually necessary for the charging station. Here, a data connection of the charging station is established with the MA 238*i*. The corresponding cable is to be selected for the respective hand-held scanner and ordered separately. The 9-pin Sub-D cable (KB JST-HS-300, part no. 50113397) is connected to this cable, which is connected to the MA 238*i*. This cable must also be ordered separately.

In this example, triggering occurs by means of a trigger button on the hand-held scanner.

The following codes for configuring the devices are necessary for these devices as well.

### 12.6.2 Specific features in the operation of an RFM/RFI

When using the MA 238*i* in connection with an RFID device, we recommend a data width of at least 24 bytes to be able to transmit information to or from the reader in a telegram.

Shown here is a sample telegram for a write command in combination with an RFID device.

***Notice!***

*Also note that all characters which are sent to a transponder are hex-encoded ASCII characters. Each of these (hexadecimal) characters is, in turn, to be handled as an individual ASCII character and converted to hexadecimal format for transmission via the fieldbus.*

**Example:**

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | |
|---|---|---|---|---|---|---|---|---|
| 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | Control byte 0 |
| 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | Control byte 1 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 34 | 35 | 31 | 31 | 30 | 35 | 30 | 57 | Data |
| 00 | 00 | 34 | 37 | 33 | 37 | 35 | 36 | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HEX | 57 | 30 | 35 | 30 | 31 | 31 | 35 | 34 | 36 | 35 | 37 | 33 | 37 | 34 |
| CHAR | W | 0 | 5 | 0 | 1 | 1 | 5 | 4 | 6 | 5 | 7 | 3 | 7 | 4 |
| Plain text | T e s t | | | | | | | | | | | | | |

# 13 Diagnostics and troubleshooting

If problems should occur during commissioning of the MA 238*i* you can refer to the following table. Typical errors and their possible causes are described here as well as tips for their elimination.

## 13.1 General causes of errors

| Error | Possible error causes | Measures |
|---|---|---|
| No data to the PLC | Device setting incorrect. | Adjust device settings (data protocol, baud rate, etc.). |
| No data sporadically and/or the device "stalls" | Problems with the voltage supply. | Check voltage range, supply separately if needed. |
| Data loss (DL bit) | Data telegram longer than the bus telegram in bus cycle/memory size. | Increase in bus telegram length.<br>Toggle out data earlier. |
| Data in the RS 232 instead of in the buffer | Incorrect order. | Correct order:<br>Provide data, toggle CTB. |
| | | |
| **PWR** status LED on the circuit board | | |
| Off | No supply voltage connected to the device. | Check supply voltage. |
| | Hardware error. | Send the device to customer service. |
| Green/orange, flashing | Device in boot mode. | No valid firmware, send device to customer service. |
| Continuous orange light | Device error. | Send the device to customer service. |
| | Firmware update failed. | |
| **STATUS** LED on the housing (see figure 5.1 on page 19) | | |
| Red continuous light | Configuration error. | Check interface. |
| **PWR** LED on the housing (see figure 5.1 on page 19) | | |
| Off | No supply voltage connected to the device. | Check supply voltage. |
| Green, flashing | SERVICE active. | Service switch on RUN. |
| Red, flashing | Incorrect baud rate / address. | Check switch settings.<br>Check baud rate or address. |
| Red continuous light | Device error. | Send the device to customer service. |
| **L / A** LEDs on the housing (see figure 5.1 on page 19) | | |
| Off | No connection | Check wiring/IP address. |

Table 13.1: General causes of errors

## 13.2 Interface errors

| Error | Possible error causes | Measures |
|---|---|---|
| No communication via EtherCAT interface **STATUS** continuous red light LED | Incorrect wiring. | Check wiring. |
| | Different protocol settings. | Check protocol settings. |
| | Protocol not released. | Activate TCP/ IP or UDP. |
| Sporadic errors at the EtherCAT interface | Incorrect wiring. | Check wiring.<br>In particular, check wire shielding.<br>Check the cable used. |
| | Effects due to EMC. | Check shielding (shield covering in place up to the clamping point).<br>Check grounding concept and connection to functional earth (FE).<br>Avoid EMC coupling caused by power cables laid parallel to device lines. |
| | Overall network expansion exceeded. | Check max. network expansion as a function of the max. cable lengths. |

Figure 13.1: Interface error

***Notice!***

*Please use **chapter 13 as a master copy** should servicing be required.*
*Cross the items in the "Measures" column which you have already examined, fill out the following address field and fax the pages together with your service contract to the fax number listed below.*

***Customer data (please complete)***

| | |
|---|---|
| **Device type:** | |
| **Company:** | |
| **Contact partner / department:** | |
| **Phone (direct):** | |
| **Fax:** | |
| **Street / No:** | |
| **ZIP code/City:** | |
| **Country:** | |

***Leuze Service fax number:***

**+49 7021 573 - 199**

# 14 Type overview and accessories

## 14.1 Part number code

**MA 2xx** i

| | | |
|---|---|---|
| | i = | Integrated fieldbus technology |
| Interface | 04 | PROFIBUS DP |
| | 08 | Ethernet TCP/IP |
| | 35 | CANopen |
| | 38 | EtherCAT |
| | 48 | PROFINET RT |
| | 55 | DeviceNet |
| | 58 | EtherNet/IP |
| | MA | Modular interfacing unit |

## 14.2 Type overview

| Type designation | Description | Description |
|---|---|---|
| MA 204*i* | PROFIBUS gateway | 50112893 |
| MA 208*i* | Ethernet TCP/IP gateway | 50112892 |
| MA 235*i* | CANopen gateway | 50114154 |
| MA 238*i* | EtherCAT gateway | 50114155 |
| MA 248*i* | PROFINET-IO RT gateway | 50112891 |
| MA 255*i* | DeviceNet gateway | 50114156 |
| MA 258*i* | EtherNet/IP gateway | 50114157 |

Table 14.1: Type overview MA 2xx*i*

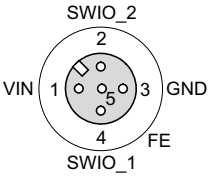
## 14.3 Accessory connectors

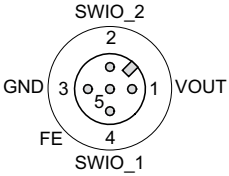
| Type designation | Description | Description |
|---|---|---|
| KD 095-5A | M12 socket for voltage supply | 50020501 |
| KS 095-4A | M12 connector for SW IN/OUT | 50040155 |
| D-ET1 | RJ45 connector for user-configuration | 50108991 |
| S-M12A-ET | Connector, axial, M12 connector, D-coded, terminals | 50112155 |

Table 14.2: Connectors for the MA 238*i*

## 14.4 Accessory ready-made cables for voltage supply

### 14.4.1 Contact assignment of PWR connection cable

| PWR IN (5-pin socket, A-coded) | | | |
|---|---|---|---|
| PWR IN<br>  <br><br>M12 socket<br>(A-coded) | **Pin** | **Name** | **Core color** |
| | 1 | VIN | **brown** |
| | 2 | SWIO_2 | **white** |
| | 3 | GND | **blue** |
| | 4 | SWIO_1 | **black** |
| | 5 | FE | **gray** |
| | Thread | FE | **bare** |

| PWR OUT (5-pin connector, A-coded) | | | |
|---|---|---|---|
| PWR OUT<br>  <br><br>M12 connector<br>(A-coded) | **Pin** | **Name** | **Core color** |
| | 1 | VOUT | **brown** |
| | 2 | SWIO_2 | **white** |
| | 3 | GND | **blue** |
| | 4 | SWIO_1 | **black** |
| | 5 | FE | **gray** |
| | Thread | FE | **bare** |

### 14.4.2 Specifications of the cables for voltage supply

| | | |
|---|---|---|
| **Operating temperature range** | in rest state: | -30°C … +70°C |
| | in motion: | 5°C … +70°C |
| **Material** | sheathing: | PVC |
| **Bending radius** | > 50mm | |

### 14.4.3 Order codes of the cables for voltage supply

| Type designation | Description | Part no. |
|---|---|---|
| K-D M12A-5P-5m-PVC | M12 socket for PWR, axial plug outlet, open cable end, cable length 5m | 50104557 |
| K-D M12A-5P-10m-PVC | M12 socket for PWR, axial plug outlet, open cable end, cable length 10m | 50104559 |

Table 14.3: PWR cables for the MA 238*i*

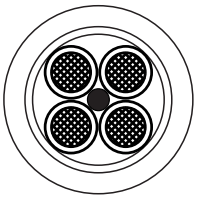
## 14.5 Accessory ready-made cables for bus connection

### 14.5.1 General information

- Cable KB ET… for connecting to EtherCAT via M12 connector
- Standard cable available in lengths from 2 … 30m
- Special cables on request

### 14.5.2 M12 contact assignments-Ethernet connection cable KB ET…

| M12 EtherNet connection cable (4-pin connector, D-coded, on both sides) | | | |
|---|---|---|---|
| Ethernet<br>RD+<br>2<br>TD− 3 1 TD+<br>4<br>SH<br>RD−<br>M12 connector<br>(D-coded) | **Pin** | **Name** | **Core color** |
| | 1 | TD+ | **yellow** |
| | 2 | RD+ | **white** |
| | 3 | TD- | **orange** |
| | 4 | RD- | **blue** |
| | SH (thread) | FE | **bare** |



Core color

**WH**
**YE**
**BU**
**OG**

Conductor class: VDE 0295, EN 60228, IEC 60228 (class 5)

Figure 14.1: Cable structure of Industrial Ethernet connection cable

### 14.5.3 Technical data M12 Ethernet connection cable KB ET...

**Operating temperature range** in rest state: -50°C … +80°C
in motion: -25°C … +80°C
in motion: -25°C … +60°C (when used with drag chains)

**Material** cable sheath: PUR (green), wire insulation: PE foam, free of halogens, silicone and PVC

**Bending radius** > 65 mm, suitable for drag chains
**Bending cycles** > $10^6$, perm. acceleration < 5 m/s$^2$

### 14.5.4 Order code M12 Ethernet connection cable KB ET...

| Type designation | Description | Part no. |
|---|---|---|
| **M12 connector for BUS IN, axial connector, open cable end** | | |
| KB ET - 1000 - SA | Cable length 1 m | 50106738 |
| KB ET - 2000 - SA | Cable length 2 m | 50106739 |
| KB ET - 5000 - SA | Cable length 5 m | 50106740 |
| KB ET - 10000 - SA | Cable length 10 m | 50106741 |
| **M12 connector for BUS IN to RJ-45 connector** | | |
| KB ET - 1000 - SA-RJ45 | Cable length 1 m | 50109879 |
| KB ET - 2000 - SA-RJ45 | Cable length 2 m | 50109880 |
| KB ET - 5000 - SA-RJ45 | Cable length 5 m | 50109881 |
| KB ET - 10000 - SA-RJ45 | Cable length 10 m | 50109882 |
| **M12 plug + M12 plug for BUS OUT to BUS IN** | | |
| KB ET - 1000 - SSA | Cable length 1 m | 50106898 |
| KB ET - 2000 - SSA | Cable length 2 m | 50106899 |
| KB ET - 5000 - SSA | Cable length 5 m | 50106900 |
| KB ET - 10000 - SSA | Cable length 10 m | 50106901 |

Table 14.4: Bus connection cable for the MA 238*i*

## 14.6 Accessory ready-made cables for connecting Leuze Ident devices

### 14.6.1 Order codes for the device connection cables

| Type designation | Description | Part no. |
|---|---|---|
| KB JST-3000 | MA 31, BCL 90, IMRFU-1(RFU), cable length 3m | 50115044 |
| KB JST-HS-300 | Hand-held scanner, cable length 0.3m | 50113397 |
| KB JST-M12A-5P-3000 | BPS 8, BCL 8, cable length 3m | 50113467 |
| KB JST-M12A-8P-Y-3000 | LSIS 4x2i, cable length 3m | 50113468 |
| KB JST-M12A-8P-3000 | LSIS 122, LSIS 222, cable length 3m | 50111225 |
| K-D M12A-5P-5m-PVC | Voltage supply, cable length 5m | 50104557 |
| K-D M12A-5P-10m-PVC | Voltage supply, cable length 10m | 50104559 |
| K-DS M12A-MA-5P-3m-S-PUR | ODS 96B with RS 232 | 50115049 |
| K-DS M12A-MA-8P-3m-S-PUR | ODSL 30/D 232-M12 | 50115050 |
| K-DS M12A-MA-5P-3m-1S-PUR | Konturflex Quattro RSX | 50116791 |
| KB 500-3000-Y | BCL 500i, cable length 3m | 50110240 |
| KB 301-3000-MA200 | BCL 300i, cable length 3m | 50120463 |

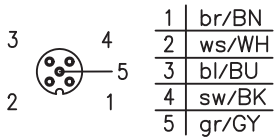
Table 14.5: Device connection cables for the MA 238*i*

***Notice!***

*The BCL 22 devices with JST connector, RFM xx and RFI xx can be connected directly with the injection molded device cable.*

### 14.6.2 Contact assignment for the device connection cables

**K-D M12A-5P-5000/10000 connection cable (5-pin with molded connector), open cable end**




| Pin | Core color |
|---|---|
| 1 | brown |
| 2 | white |
| 3 | blue |
| 4 | black |
| 5 | gray |

**KB JST 3000 (RS 232 connection cable, JST pin strip 10-pin, open cable end)**

| Signal | Core color | JST 10-pin |
|---|---|---|
| TxD 232 | red | 5 |
| RxD 232 | brown | 4 |
| GND | orange | 9 |
| FE | shield | 10 |

# 15 Maintenance

## 15.1 General maintenance information

The MA 238*i* does not require any maintenance by the operator.

## 15.2 Repairs, servicing

Repairs to the device must only be carried out by the manufacturer.

↳ *Contact your Leuze distributor or service organization should repairs be required. The addresses can be found on the inside of the cover and on the back.*

***Notice!***

*When sending devices to Leuze electronic for repair, please provide an accurate description of the error.*

## 15.3 Disassembling, packing, disposing

***Repacking***

For later reuse, the device is to be packed so that it is protected.

***Notice!***

*Electrical scrap is a special waste product! Observe the locally applicable regulations regarding disposal of the product.*

# 16 Specifications for Leuze end devices

***Serial interface and Command mode***

The corresponding Leuze end device can be selected while configuring the fieldbus gateway (see chapter 9 "Configuration").

The exact specifications for the individual Leuze end devices can be found in the following sections and in the device description.

The corresponding serial command is sent to the Leuze end device in Command mode. To send the corresponding command to the RS 232 device after activating the Command mode in byte 0 (control bit 0.0), set the corresponding bit in byte 2.

The Leuze end device also responds to most commands by sending data, such as the bar code contents, NoRead, device version, etc., back to the gateway. The answer is not evaluated by the gateway, but is instead passed on to the PLC.

For the BPS 8, BPS 300i and hand-held scanners, a number of specific features are to be noted.

***Notice!***

*Please note that Leuze only assumes liability for the function of Leuze products. When using third-party devices, Leuze does not assume liability for the function of third-party devices!*

## 16.1 Standard setting, KONTURflex (S4 switch position 0)

This switch position can be used with almost all devices, since a data frame is transmitted along with it if necessary. A 00h in the data range of the control is interpreted as the end of a telegram/invalid, however.

The distance between two successive telegrams (without frame) must be more than 20ms in this switch position, since there is otherwise no clear separation between them. If necessary, the settings have to be adjusted on the device.

Leuze measuring sensors with RS 232 interface (such as a KONTURflex Quattro RS) do not necessarily use a telegram frame, which is why these are also operated in switch position 0.

***Specifications for the serial interface***

| Default parameter | Standard |
|---|---|
| Baud rate | 9600 |
| Data mode | 8N1 |
| Handshake | no |
| Protocol | framing protocol without acknowledgment |
| Frame | <Data> |
| Data Mode | transparent |

***Notice!***

*The data frame is specified via the switch position.*
*In the factory setting, the S4 switch position is 0.Resetting the settings to these is possible in S4 switch position F. The procedure for doing this is described in chapter 16.13.*

### *KONTURflex specifications*

Settings on the MA 238*i*

- EtherCAT address is freely selectable
- Device selection switch at position "0"

EtherCAT settings

- Module selection:
  Dependent on number of beams used, but at least "8 bytes In"
- User parameters:
  "Transparent Mode", "Use software settings", baud rate 38400, "8 Data Bits", "No parity", "2 stop bits"

KONTURflex settings

First, the following settings are to be performed on the device using KONTURFlex-Soft:

- Either "Autosend (fast)" or "Autosend with data in Modbus format"
- Repeat time "31.5 ms"
- Autosend baud rate "38.4 KB"
- 2 stop bits, no parity

## 16.2 Bar code reader BCL 8 (S4 switch position 1)

### *Specifications for the serial interface*

| Default parameter | BCL 8 |
|---|---|
| Baud rate | 9600 |
| Data mode | 8N1 |
| Handshake | no |
| Protocol | framing protocol without acknowledgment |
| Frame | <STX> <Data> <CR> <LF> |

### *Specifications for Command mode*

To activate the Command mode, bit 0 must be set to 1 in control byte 0.

For further information, see chapter 11.1.3 "Command mode", figure 11.2.

| Control bit | Meaning | Corresponds to serial command (ASCII) |
|---|---|---|
| 0 | Version query | v |
| 1 | Activation / deactivation reading gate | + / - |
| 2 | Reference-code 1 teach-in | RT1 |
| 3 | Reference-code 2 teach-in | RT2 |
| 4 | Automatic configuration of reading task activation / deactivation | CA+ / CA- |
| 5 | Switching output 1 activation | OA1 |
| 6 | | |
| 7 | Switching output 1 deactivation | OD1 |
| 8 | System standby | SOS |
| 9 | System active | SON |
| 10 | Query reflector polling | AR? |
| 11 | Output version of the boot kernel with check sum | VB |
| 12 | Output version of the decoder program with check sum | VK |
| 13 | Reset parameters to default values | PC20 |
| 14 | Device restart | H |

### *Recommended settings*

- Input data: dependent on the number of digits of the bar code that is to be read.

  With an 18-digit bar code (+ 2 bytes of status bytes), for example, it is advisable to use the 24-byte setting.

- Output data: 8 bytes

## 16.3 Bar code reader BCL 22 (S4 switch position 2)

### *Specifications for the serial interface*

| Default parameter | BCL 22 |
|---|---|
| Baud rate | 9600 |
| Data mode | 8N1 |
| Handshake | no |
| Protocol | framing protocol without acknowledgment |
| Frame | <STX> <Data> <CR> <LF> |

### *Specifications for Command mode*

To activate the Command mode, bit 0 must be set to 1 in control byte 0.

For further information, see chapter 11.1.3 "Command mode", figure 11.2.

| Control bit | Meaning | Corresponds to serial command (ASCII) |
|---|---|---|
| 0 | Version query | v |
| 1 | Activation / deactivation reading gate | + / - |
| 2 | Reference-code 1 teach-in | RT1 |
| 3 | Reference-code 2 teach-in | RT2 |
| 4 | Automatic configuration of reading task activation / deactivation | CA+ / CA- |
| 5 | Switching output 1 activation | OA1 |
| 6 | Switching output 2 activation | OA2 |
| 7 | Switching output 1 deactivation | OD1 |
| 8 | Switching output 2 deactivation | OD2 |
| 9 | | |
| 10 | | |
| 11 | Output version of the boot kernel with check sum | VB |
| 12 | Output version of the decoder program with check sum | VK |
| 13 | Reset parameters to default values | PC20 |
| 14 | Device restart | H |
| 15 | | |

### *Recommended settings*

- Input data: dependent on the number of digits of the bar code that is to be read.

  With an 18-digit bar code (+ 2 bytes of status bytes), for example, it is advisable to use the 24-byte setting.

- Output data: 8 bytes

## 16.4 Bar code reader BCL 300i, BCL 500i, BCL 600i (S4 switch position 4)

### *Specifications for the serial interface*

| Default parameter | BCL 300i, BCL 500i, BCL 600i |
|---|---|
| Baud rate | 9600 |
| Data mode | 8N1 |
| Handshake | no |
| Protocol | framing protocol without acknowledgment |
| Frame | <STX> <Data> <CR> <LF> |

### *Specifications for Command mode*

To activate the Command mode, bit 0 must be set to 1 in control byte 0.

For further information, see chapter 11.1.3 "Command mode", figure 11.2.

| Control bit | Meaning | Corresponds to serial command (ASCII) |
|---|---|---|
| 0 | Version query | v |
| 1 | Activation / deactivation reading gate | + / - |
| 2 | Reference code teach-in activation / deactivation | RT+ / RT- |
| 3 | | |
| 4 | Autom. configuration of reading task activation / deact. | CA+ / CA- |
| 5 | Switching output 1 activation | OA1 |
| 6 | Switching output 2 activation | OA2 |
| 7 | Switching output 1 deactivation | OD1 |
| 8 | Switching output 2 deactivation | OD2 |
| 9 | | |
| 10 | | |
| 11 | | |
| 12 | | |
| 13 | Parameter - difference to default parameter set | PD20 |
| 14 | Reset parameters to default values | PC20 |
| 15 | Device restart | H |

### *Recommended settings*

- Input data: dependent on the number of digits of the bar code that is to be read.

  With an 18-digit bar code (+ 2 bytes of status bytes), for example, it is advisable to use the 24-byte setting.

- Output data: 8 bytes

## 16.5 Bar code reader BCL 90, BCL 900i (S4 switch position 5)

### *Specifications for the serial interface*

| Default parameter | BCL 90, BCL 900i |
|---|---|
| Baud rate | 9600 |
| Data mode | 8N1 |
| Handshake | no |
| Protocol | framing protocol without acknowledgment |
| Frame | <STX> <Data> <CR> <LF> |

### *Specifications for Command mode*

To activate the Command mode, bit 0 must be set to 1 in control byte 0.

For further information, see chapter 11.1.3 "Command mode", figure 11.2.

| Control bit | Meaning | Corresponds to serial command (ASCII) |
|---|---|---|
| 0 | Version query | v |
| 1 | Activation / deactivation reading gate | + / - |
| 2 | Configuration mode | 11 |
| 3 | Alignment mode | 12 |
| 4 | Read operation | 13 |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |
| 9 | | |
| 10 | | |
| 11 | | |
| 12 | | |
| 13 | | |
| 14 | Reset parameters to default values | PC20 |
| 15 | Device restart | H |

### *Recommended settings*

- Input data: dependent on the number of digits of the bar code that is to be read.

  With an 18-digit bar code (+ 2 bytes of status bytes), for example, it is advisable to use the 24-byte setting.

- Output data: 8 bytes

***Notice!***

When using the command mode, make sure that 00H is shown in the data range; otherwise the device only performs one alignment cycle.

## 16.6 LSIS 122, LSIS 222 (S4 switch position 6)

### *Specifications for the serial interface*

| Default parameter | LSIS 122, LSIS 222 |
|---|---|
| Baud rate | 9600 |
| Data mode | 8N1 |
| Handshake | no |
| Protocol | framing protocol without acknowledgment |
| Frame | <STX> <Data> <CR> <LF> |

### *Specifications for Command mode*

To activate the Command mode, bit 0 must be set to 1 in control byte 0.

For further information, see chapter 11.1.3 "Command mode", figure 11.2.

| Control bit | Meaning | Corresponds to serial command (ASCII) |
|---|---|---|
| 0 | Version query | i |
| 1 | Activation/Deactivation of reading gate: 12h/14h (**LSIS 122 only**) | <DC2> / <DC4> |
| 2 | Activation of reading gate (**LSIS 222 only**) | <SYN>T<CR> |
| 3 | Deactivation of reading gate (**LSIS 222 only**) | <SYN>U<CR> |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |
| 9 | | |
| 10 | | |
| 11 | | |
| 12 | | |
| 13 | | |
| 14 | | |
| 15 | | |

### *Recommended settings*

- Input data: dependent on the number of digits of the code that is to be read.

  With an 18-digit code (+ 2 bytes of status bytes), for example, it is advisable to use the 24-byte setting.

- Output data: 8 bytes

## 16.7 LSIS 4x2i, DCR 202i (S4 switch position 7)

### *Specifications for the serial interface*

| Default parameter | LSIS 4x2i, DCR 202i |
|---|---|
| Baud rate | 9600 |
| Data mode | 8N1 |
| Handshake | no |
| Protocol | framing protocol without acknowledgment |
| Frame | <STX> <Data> <CR> <LF> |

### *Specifications for Command mode*

To activate the Command mode, bit 0 must be set to 1 in control byte 0.

For further information, see chapter 11.1.3 "Command mode", figure 11.2.

| Control bit | Meaning | Corresponds to serial command (ASCII) |
|---|---|---|
| 0 | Version query | v |
| 1 | Image acquisition trigger | + |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |
| 9 | | |
| 10 | | |
| 11 | | |
| 12 | | |
| 13 | | |
| 14 | | |
| 15 | | |

### *Recommended settings*

- Input data: dependent on the number of digits of the code that is to be read.

  With an 18-digit code (+ 2 bytes of status bytes), for example, it is advisable to use the 24-byte setting.

- Output data: 8 bytes

## 16.8 Hand-held scanner (S4 switch position 8)

### *Specifications for the serial interface*

| Default parameter | Hand-held scanner |
|---|---|
| Baud rate | 9600 |
| Data mode | 8N1 |
| Handshake | no |
| Protocol | framing protocol without acknowledgment |
| Frame | <Data> <CR> <LF> |

***Notice!***

*Command mode cannot be used with hand-held scanners.*

### *Recommended settings*

- Input data: dependent on the number of digits of the bar code or 2D code that is to be read.

  With an 12-digit code (+ 2 bytes of status bytes), for example, it is advisable to use the 16-byte setting.

- Output data: none

## 16.9 RFI, RFM, RFU RFID readers (S4 switch position 9)

### *Specifications for the serial interface*

| **Default parameter** | **RFM 12,RFM 32 and RFM 62**<br>**RFI 32**<br>**RFU (via IMRFU)** |
|---|---|
| Baud rate | 9600 |
| Data mode | 8N1 |
| Handshake | no |
| Protocol | framing protocol without acknowledgment |
| Frame | <STX> <Data> <CR> <LF> |

### *Specifications for Command mode*

To activate the Command mode, bit 0 must be set to 1 in control byte 0.

For further information, see chapter 11.1.3 "Command mode", figure 11.2.

| **Control bit** | **Meaning** | **Corresponds to serial command (ASCII)** |
|---|---|---|
| 0 | Version query | v [1)] |
| 1 | Activation / deactivation reading gate | + / - |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |
| 9 | | |
| 10 | | |
| 11 | | |
| 12 | | |
| 13 | | |
| 14 | Reset parameters to default values | R [1)] |
| 15 | Device restart | H |

1) Not for IMRFU/RFU

### *Recommended settings*

- Input data: dependent on the number of digits of the RFID code that is to be read.

  For example, it is advisable to use the input data/output data setting with 24 bytes during the reading of a serial number with 16 characters (+ 2 bytes of status bytes).

- Output data: 8 bytes

The RFID devices expect the telegrams / data in HEX format.

## 16.10 BPS 8 bar code positioning system (S4 switch position A)

### *Specifications for the serial interface*

| Default parameter | BPS 8 |
|---|---|
| Baud rate | 57600 |
| Data mode | 8N1 |
| Handshake | no |
| Protocol | binary protocol without acknowledgment |
| Frame | <Data> |

### *Specifications for Command mode*

To activate the Command mode, bit 0 must be set to 1 in control byte 0.

For further information, see chapter 11.1.3 "Command mode", figure 11.2.

| Control bit | Meaning | Corresponds to serial command (HEX) | |
|---|---|---|---|
| | | byte 1 | byte 2 |
| 0 | Request diagnostic info | 01 | 01 |
| 1 | Request marker info | 02 | 02 |
| 2 | Request SLEEP mode | 04 | 04 |
| 3 | Request position info | 08 | 08 |
| 4 | Request individual measurement | 10 | 10 |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |

### *Recommended settings*

- Input data: 8 bytes
- Output data: 8 bytes

In this switch position, the MA automatically sends a position request to the BPS 8 every 10ms until another command comes via the control. Automatic request only restarts when a new position request is sent by the PLC or when the MA is restarted.

## 16.11 BPS 300i bar code positioning system, ODSL xx optical distance sensors with RS 232 interface (S4 switch position B)

***Notice!***

*In this switch position, 6-byte data (fixed) is always expected by the device. This is why a quick telegram sequence can be transmitted reliably even without a data frame.*

**BPS 300i**

### *Specifications for the serial interface*

| Default parameter | BPS 300i |
|---|---|
| Baud rate | 38400 |
| Data mode | 8N1 |
| Handshake | no |
| Protocol | binary protocol without acknowledgment |
| Frame | <Data> |

### *Specifications for Command mode*

To activate the Command mode, bit 0 must be set to 1 in control byte 0.

For further information, see chapter 11.1.3 "Command mode", figure 11.2.

| Control bit | Meaning | Corresponds to serial command (ASCII) |
|---|---|---|
| 0 | Transmit individual position value = single shot | C0F131 |
| 1 | Cyclically transmit position values | C0F232 |
| 2 | Stop cyclical transmission | C0F333 |
| 3 | Laser diode on | C0F434 |
| 4 | Laser diode off | C0F535 |
| 5 | Transmit single speed value | C0F636 |
| 6 | Cyclically transmit speed values | C0F737 |
| 7 | Transmit single position and speed value | C0F838 |
| 8 | Cyclically transmit position and speed values | C0F939 |
| 9 | Transmit marker information | C0FA3A |
| 10 | Not used / reserved | |
| 11 | Transmit diagnostic information | C0FC3C |
| 12 | Activate standby | C0FD3D |
| 13 | | |
| 14 | | |
| 15 | | |

### *Recommended settings*

- Input data: 8 bytes
- Output data: 8 bytes

### ODSL 9, ODSL 30 and ODSL 96B

***Notice!***

*The default settings of the ODS serial interface have to be adjusted! Further information on configuration of the interface can be found in the technical description of the corresponding device.*

#### *Specifications for the serial interface*

| Default parameter | ODSL xx |
|---|---|
| Baud rate | 38400 |
| Data mode | 8N1 |
| Handshake | no |
| Protocol | ASCII transmission, 5-digit measurement value |
| Frame | <Data> |

#### *Specifications for Command mode*

*Command mode cannot be used with the ODSL 9, ODSL 30 and ODSL 96B.*

The ODSL 9/96B is to be operated in the "Precision" measure mode. The mode is set through the display menu via `Application` -> `Measure mode` -> `Precision`. You can find more details on this in the technical description.

## 16.12 Modular interfacing unit MA 3x (S4 switch position C)

### *Specifications for the serial interface*

| Default parameter | MA 3x |
|---|---|
| Baud rate | 9600 |
| Data mode | 8N1 |
| Handshake | no |
| Protocol | framing protocol without acknowledgment |
| Frame | <STX> <Data> <CR> <LF> |

### *Specifications for Command mode*

To activate the Command mode, bit 0 must be set to 1 in control byte 0.

For further information, see chapter 11.1.3 "Command mode", figure 11.2.

| Control bit | Meaning | Corresponds to serial command (ASCII) |
|---|---|---|
| 0 | Version query | v |
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |
| 9 | | |
| 10 | | |
| 11 | | |
| 12 | | |
| 13 | | |
| 14 | Reset parameters to default values | PC20 |
| 15 | Device restart | H |

### *Recommended settings*

- Input data: dependent on the number of digits of the code that is to be read.

  With an 18-digit bar code (+ 2 bytes of status bytes + 2 bytes of slave address), for example, it is advisable to use the 24-byte setting.

- Output data: 8 bytes

***Notice!***

*In this switch position, the address of the multiNet slave is also transmitted in the first two bytes of the data range!*

## 16.13 Resetting the parameters (S4 switch position F)

To reset all parameters of the MA that can be configured with software (such as baud rate, IP address, dependent on type) to the factory settings, do the following:

- *Set device switch S4 to F in a voltage free state.*
- *Switch the voltage on and wait until it is ready for operation.*
- *If necessary, switch the voltage off to prepare for commissioning.*
- *Set service switch S10 to the "RUN" position.*

# 17 Appendix

## 17.1 ASCII Table

| HEX | DEC | CTRL | ABB | DESIGNATION | MEANING |
|---|---|---|---|---|---|
| 00 | 0 | ^@ | NUL | NULL | Zero |
| 01 | 1 | ^A | SOH | START OF HEADING | Start of heading |
| 02 | 2 | ^B | STX | START OF TEXT | Start of text characters |
| 03 | 3 | ^C | ETX | END OF TEXT | Last character of text |
| 04 | 4 | ^D | EOT | END OF TRANSMISSION | End of transmission |
| 05 | 5 | ^E | ENQ | ENQUIRY | Request to transmit data |
| 06 | 6 | ^F | ACK | ACKNOWLEDGE | Positive acknowledgment |
| 07 | 7 | ^G | BEL | BELL | Bell signal |
| 08 | 8 | ^H | BS | BACKSPACE | Backspace |
| 09 | 9 | ^I | HT | HORIZONTAL TABULATOR | Horizontal tabulator |
| 0A | 10 | ^J | LF | LINE FEED | Line feed |
| 0B | 11 | ^K | VT | VERTICAL TABULATOR | Vertical tabulator |
| 0C | 12 | ^L | FF | FORM FEED | Form feed |
| 0D | 13 | ^M | CR | CARRIAGE RETURN | Carriage return |
| 0E | 14 | ^N | SO | SHIFT OUT | Shift out |
| 0F | 15 | ^O | SI | SHIFT IN | Shift in |
| 10 | 16 | ^P | DLE | DATA LINK ESCAPE | Data link escape |
| 11 | 17 | ^Q | DC1 | DEVICE CONTROL 1 (X-ON) | Device control character 1 |
| 12 | 18 | ^R | DC2 | DEVICE CONTROL 2 (TAPE) | Device control character 2 |
| 13 | 19 | ^S | DC3 | DEVICE CONTROL 3 (X-OFF) | Device control character 3 |
| 14 | 20 | ^T | DC4 | DEVICE CONTROL 4 | Device control character 4 |
| 15 | 21 | ^U | NAK | NEGATIVE (/Tape) ACKNOWLEDGE | Negative acknowledge |
| 16 | 22 | ^V | SYN | SYNCHRONOUS IDLE | Synchronization |
| 17 | 23 | ^W | ETB | END OF TRANSMISSION BLOCK | End of data transmission block |
| 18 | 24 | ^X | CAN | CANCEL | Invalid |
| 19 | 25 | ^Y | EM | END OF MEDIUM | End of medium |
| 1A | 26 | ^Z | SUB | SUBSTITUTE | Substitution |
| 1B | 27 | ^[ | ESC | ESCAPE | Escape |
| 1C | 28 | ^\ | FS | FILE SEPARATOR | File separator |
| 1D | 29 | ^] | GS | GROUP SEPARATOR | Group separator |
| 1E | 30 | ^^ | RS | RECORD SEPARATOR | Record separator |
| 1F | 31 | ^_ | US | UNIT SEPARATOR | Unit separator |
| 20 | 32 | | SP | SPACE | Space |
| 21 | 33 | | ! | EXCLAMATION POINT | Exclamation point |
| 22 | 34 | | " | QUOTATION MARK | Quotation mark |
| 23 | 35 | | # | NUMBER SIGN | Number sign |
| 24 | 36 | | $ | DOLLAR SIGN | Dollar sign |
| 25 | 37 | | % | PERCENT SIGN | Percent sign |
| 26 | 38 | | & | AMPERSAND | Ampersand |
| 27 | 39 | | ' | APOSTROPHE | Apostrophe |
| 28 | 40 | | ( | OPENING PARENTHESIS | Opening parenthesis |

| HEX | DEC | CTRL | ABB | DESIGNATION | MEANING |
|---|---|---|---|---|---|
| 29 | 41 | | ) | CLOSING PARENTHESIS | Closing parenthesis |
| 2A | 42 | | * | ASTERISK | Asterisk |
| 2B | 43 | | + | PLUS | Plus sign |
| 2C | 44 | | , | COMMA | Comma |
| 2D | 45 | | - | HYPHEN (MINUS) | Hyphen (minus) |
| 2E | 46 | | . | PERIOD (DECIMAL) | Period (decimal) |
| 2F | 47 | | / | SLANT | Slant |
| 30 | 48 | | 0 | | |
| 31 | 49 | | 1 | | |
| 32 | 50 | | 2 | | |
| 33 | 51 | | 3 | | |
| 34 | 52 | | 4 | | |
| 35 | 53 | | 5 | | |
| 36 | 54 | | 6 | | |
| 37 | 55 | | 7 | | |
| 38 | 56 | | 8 | | |
| 39 | 57 | | 9 | | |
| 3A | 58 | | : | COLON | Colon |
| 3B | 59 | | ; | SEMICOLON | Semicolon |
| 3C | 60 | | < | LESS THAN | Less than |
| 3D | 61 | | = | EQUALS | Equals |
| 3E | 62 | | > | GREATER THAN | Greater than |
| 3F | 63 | | ? | QUESTION MARK | Question mark |
| 40 | 64 | | @ | COMMERCIAL AT | Commercial AT |
| 41 | 65 | | A | | |
| 42 | 66 | | B | | |
| 43 | 67 | | C | | |
| 44 | 68 | | D | | |
| 45 | 69 | | E | | |
| 46 | 70 | | F | | |
| 47 | 71 | | G | | |
| 48 | 72 | | H | | |
| 49 | 73 | | I | | |
| 4A | 74 | | J | | |
| 4B | 75 | | K | | |
| 4C | 76 | | L | | |
| 4D | 77 | | M | | |
| 4E | 78 | | N | | |
| 4F | 79 | | O | | |
| 50 | 80 | | P | | |
| 51 | 81 | | Q | | |
| 52 | 82 | | R | | |
| 53 | 83 | | S | | |
| 54 | 84 | | T | | |
| 55 | 85 | | U | | |
| 56 | 86 | | V | | |
| 57 | 87 | | W | | |
| 58 | 88 | | X | | |

| HEX | DEC | CTRL | ABB | DESIGNATION | MEANING |
|---|---|---|---|---|---|
| 59 | 89 | | Y | | |
| 5A | 90 | | Z | | |
| 5B | 91 | | [ | OPENING BRACKET | Opening bracket |
| 5C | 92 | | \ | REVERSE SLANT | Reverse slant |
| 5D | 93 | | ] | CLOSING BRACKET | Closing bracket |
| 5E | 94 | | ^ | CIRCUMFLEX | Circumflex |
| 5F | 95 | | _ | UNDERSCORE | Underscore |
| 60 | 96 | | ‘ | GRAVE ACCENT | Grave accent |
| 61 | 97 | | a | | |
| 62 | 98 | | b | | |
| 63 | 99 | | c | | |
| 64 | 100 | | d | | |
| 65 | 101 | | e | | |
| 66 | 102 | | f | | |
| 67 | 103 | | g | | |
| 68 | 104 | | h | | |
| 69 | 105 | | i | | |
| 6A | 106 | | j | | |
| 6B | 107 | | k | | |
| 6C | 108 | | l | | |
| 6D | 109 | | m | | |
| 6E | 110 | | n | | |
| 6F | 111 | | o | | |
| 70 | 112 | | p | | |
| 71 | 113 | | q | | |
| 72 | 114 | | r | | |
| 73 | 115 | | s | | |
| 74 | 116 | | t | | |
| 75 | 117 | | u | | |
| 76 | 118 | | v | | |
| 77 | 119 | | w | | |
| 78 | 120 | | x | | |
| 79 | 121 | | y | | |
| 7A | 122 | | z | | |
| 7B | 123 | | { | OPENING BRACE | Opening brace |
| 7C | 124 | | \| | VERTICAL LINE | Vertical line |
| 7D | 125 | | } | CLOSING BRACE | Closing brace |
| 7E | 126 | | ~ | TILDE | Tilde |
| 7F | 127 | | DEL | DELETE (RUBOUT) | Delete |

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