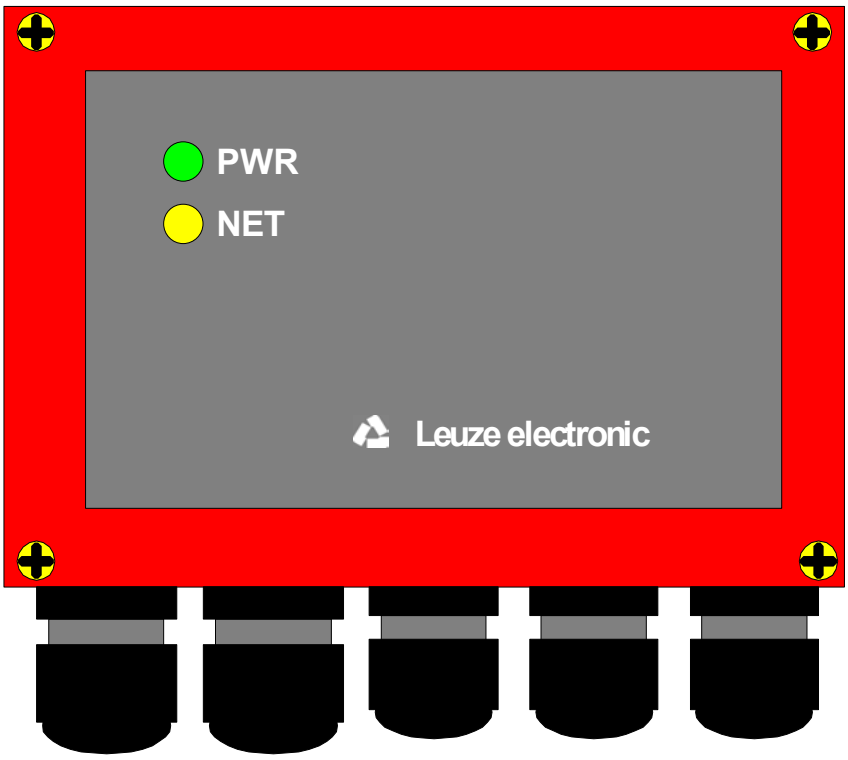
Modular Connector Unit MA 40 IS

Connecting Leuze Bar Code Readers to the InterBus-S

Technical Description



Part No.: *50028970*
Print No. : *D 066/00-10/96*

Changes due to technical improvement may be made.

Table of contents:

1. General Information

1.1. Function of the MA 40 IS

General information

The Modular Connector Unit MA 40 IS serves to connect Leuze bar code readers of the generation BCL 40/80 directly to the InterBus-S. This is accomplished by transferring the data from the scanner via an RS 232 (V.24) interface to the MA 40 IS where a module converts it into the InterBus-S format. The data format of the RS 232 interface corresponds to the standard Leuze data format.

```
9600 baud, 8 data bits, no parity, 1 stop bit
```

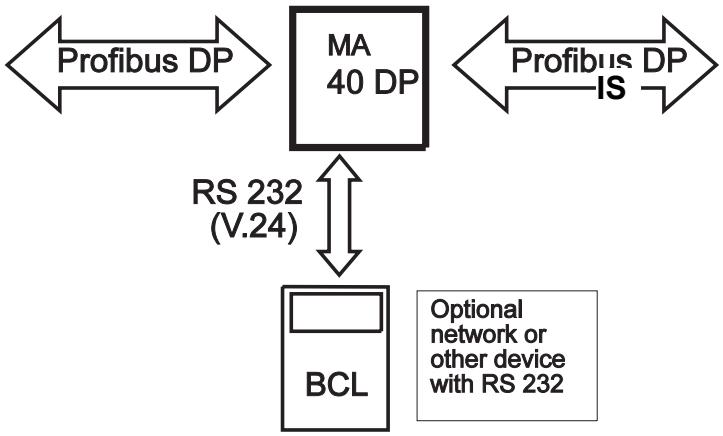


Fig. 1: Connecting a BCL to the InterBus-S

All Leuze bar code readers are pre-set to this data format at the factory so that no further adjustment of the RS 232 format is needed. The bar code reader can be connected directly to the MA 40 IS using the L-shaped housing cover or mounted separately from the MA and connected via a connection cable, which is advantageous when mounting the bar code reader in restricted spaces.

In addition to the bar code readers, any device with an RS 232 interface can be connected to the InterBus-S. The data format and baud rate of the RS 232 can be matched to various interface formats via the InterBus-S.
It is, thus, also possible to connect hand readers, scales and other devices to the MA 40 IS via the RS 232 interface. For this case, a flat housing cover is available. The RS 232 wires can be connected internally via spring terminals. All cables can be connected to the device using the 5, stable PG cable glands which provide strain relief and protection against contamination.

It is also possible to connect a scanner network to the InterBus-S, whereby the network master is coupled to the MA 40 IS via the RS 232.

1.2. Control elements of the MA 40 IS

MA 40 IS control elements

The control elements of the MA 40 IS are described below. The illustration shows the MA 40 IS with the housing cover opened.

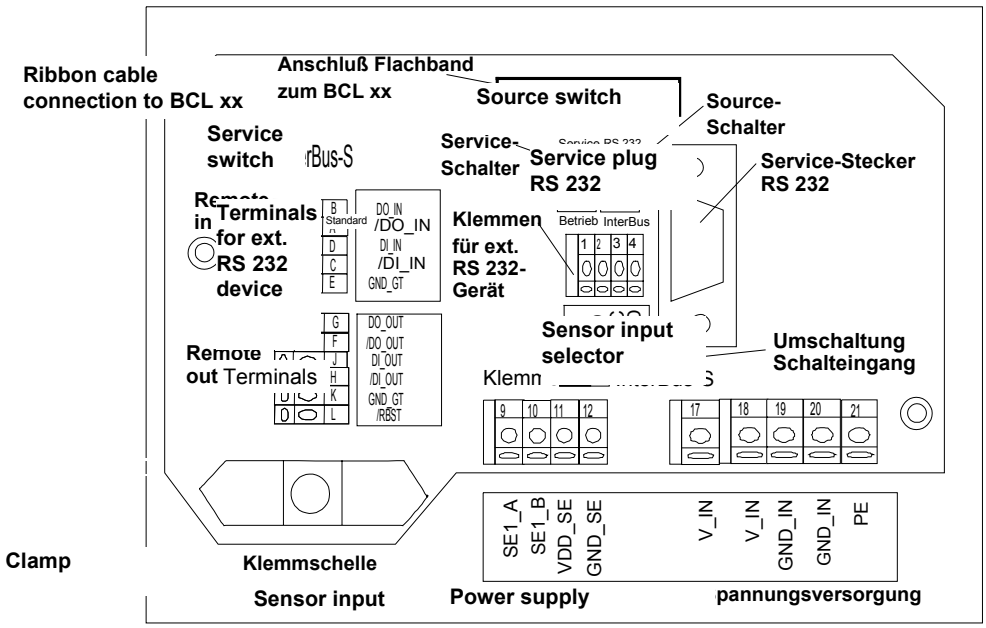


Fig. 2: Front view: Control elements of the MA 40 IS

Element	Function
InterBus-S Remote in Remote out	Connection terminals for the InterBus-S remote bus (Remote Bus)
Ribbon cable connection to BCL xx	Connects the Sub D plug in the housing cover with the electronics in the MA 40 IS base
Terminals for ext. RS 232 device	An optional external device with RS 232 interface can be connected here instead of the BCL
Service switch	1: Service mode 2: Standard operation
Source switch	Switches the transmitted data to monitor/service: 1: BCL (or ext. RS 232) 2: InterBus-S module
Service plug	Sub D 9 pole male, RS 232 interface for service/setup operation, monitoring of data in standard operation
Sensor input	Terminals 9 to 12: connection terminals for sensor input 12..36V (any polarity) for activating the BCL Potential-free/not potential-free operation can be selected
Sensor input selector	Source for the sensor input of the BCL Terminals: external switches or buttons can be connected to the terminals InterBus-S: the sensor input of the BCL is activated via the InterBus-S
Operating voltage	Terminals 17 to 21: connection terminals for the operating voltage (18-36V DC) MA 40 IS and connected BCL xx

Indicator LEDs

Two LEDs which indicate the operating status of the MA 40 IS are located on the rear of the device:

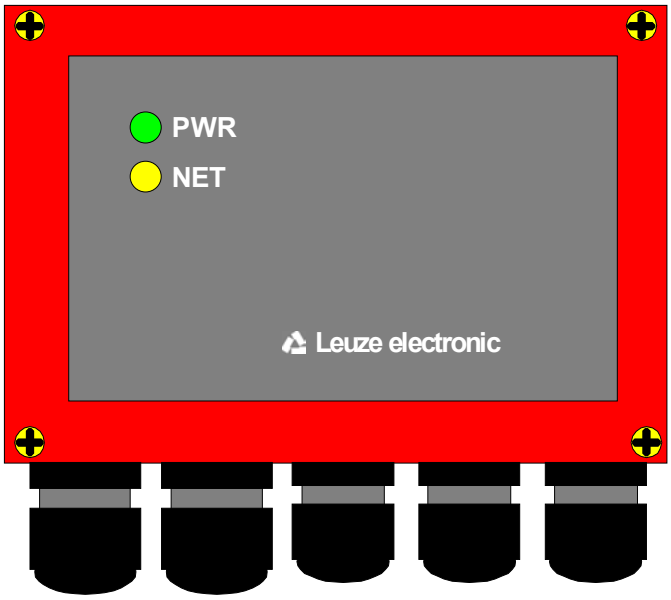


Fig. 3: Rear view: LEDs on the MA 40 IS

LED Label	Status	Description
PWR green	Power LED	operation indicator, illuminates when the operating voltage is applied
NET yellow	InterBus-S operating status	flashing: initialisation phase of the InterBus-S on: lights up as soon as the InterBus-S initialisation has been completed successfully

1.3. Operating modes of the MA 40 IS

For fast commissioning, the MA 40 IS offers a further operating mode "Service mode" in addition to the Standard mode. In this operating mode, the BCL can, for example, be parameterised on the MA 40 IS and the communication can be tested on the InterBus-S. To do this, you need a PC/laptop with a suitable terminal program, e.g. TERM 3.0 from Leuze or similar.

Standard operation:

Standard operation

The BCL is connected to the MA 40 IS via RS 232. The data are transfered to, and commands are received from, the InterBus-S. The transmitted data of the BCL or the InterBus-S can be monitored at the service interface.

Service mode:

Service mode

Communication between the InterBus-S and the BCL is interrupted. Communication with either the InterBus-S or the BCL can take place via the service interface, i.e. commands to the BCL or the InterBus module can also be sent.

Service interface:

Service interface

The service interface can be reached by removing the housing cover on the MA 40 IS and consists of a 9 pole SubD connecter (male). A transposed RS 232 connection cable is required to make the RxD, TxD and GND connections. The service interface does not support hardware handshaking via RTS, CTS.

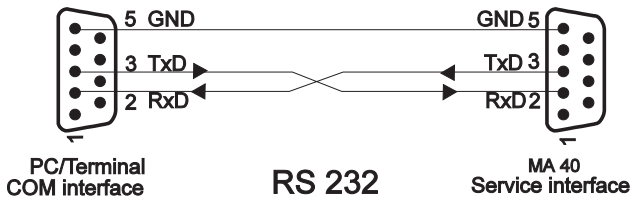


Fig. 4: Connecting the service interface to a PC/terminal

Standard data format

Important:
Always select the standard data format on the service PC
`9600 baud, 8 data bits, no parity, 1 stop bit`

Operating modes of the MA 40 IS

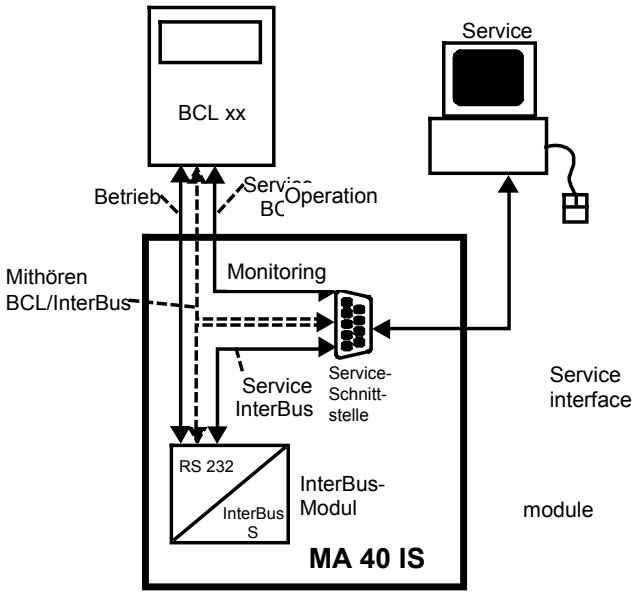


Fig. 5: Operating modes of the MA 40 IS

Service switch

Using the **service switch**, you can switch between:

Pos. 2: **Operation** (monitoring of the service interface possible)
Pos. 1: **Service** (BCL xx-InterBus interface interrupted)

Source switch

In both positions, you can use the **Source switch** to switch between the **BCL** and **InterBus**.

Pos. 2: **InterBus module**
Pos. 1: **BCL/RS 232 ext.**

This results in four possible switch settings for the MA 40 IS:

1) Operation / monitor BCL:

The BCL is connected to the InterBus-S. The transmitted data of the BCL can be monitored at the service interface, i.e. can be output to a terminal.

2) Operation / monitor InterBus:

The BCL is connected to the InterBus-S. The data transmitted from the InterBus module to the BCL can be monitored at the service interface. The standard data format must be selected on the terminal (see above).

3) Service BCL:

The switch must be set to "BCL". With this setting, you can communicate directly with the BCL xx at the MA 40. You can send on-line commands, parameterise the BCL (setup) and have the read data of the scanner output.

4) Service InterBus-S:

With this switch setting, your PC/terminal is connected with the InterBus-S module. This allows you to send data telegrams to the InterBus via the RS 232 interface or receive and evaluate telegrams from the InterBus. For example, transmission problems on the InterBus can be quickly localised.

2. Connection

2.1. Connecting the InterBus-S interface

Remote bus connection

The MA 40 IS is connected to the remote bus via the terminals **"Remote in"** and **"Remote out"**. Ensure that the polarity of the connection wires is correct; failure to do this will lead to improper functioning of the InterBus-S.

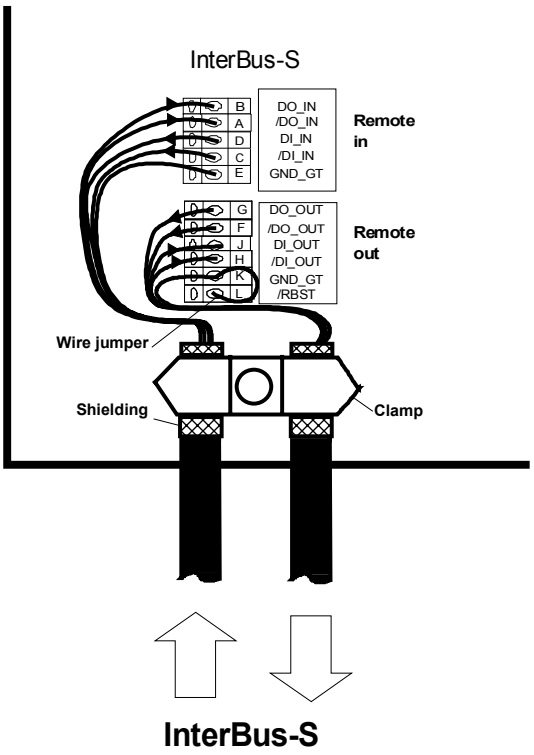


Fig. 6: Connecting the InterBus-S

Important notice:
If the MA 40 IS is **not** the last subscriber on the bus, a wire jumper must be inserted between the terminals **K** (GND_GT) and **L** (/RBST).

Shield connection

The shield is connected to the MA 40 IS via the clamp. Pull back approx. a finger width of the braided shield of the InterBus-S cable over the outer sheath and tighten the clamp over the cable. Ensure that there are no small strands of the shielding sticking into the electronics.
Leave the remaining wires long enough that they can be easily connected to the spring terminals.

2.2. Connecting the sensor input

Connection terminals: 9-12

Sensor input

The MA 40 IS has a galvanically isolated sensor input. This input is used to activate the BCL. Other functions for the sensor input can be programmed via software-setup of the BCL.

Input voltage: 12..36V DC /AC.
Insulation voltage: 500V

The sensor input is equipped with a bi-directional optical coupler and wired with protective resistors.
The switching voltage and GND can be externally applied or taken from the operating voltage VDD_SE and GND_SE.

Attention: The jumper above the spring terminals (sensor input selector) must be set to "Terminals".

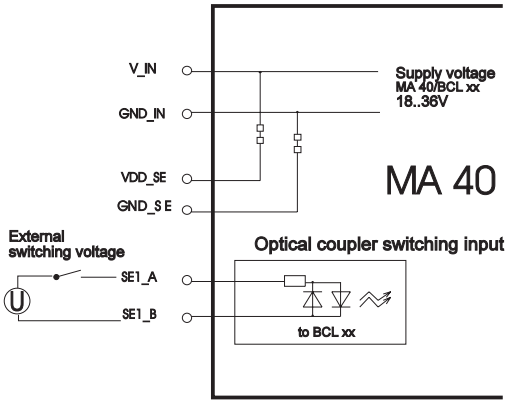


Fig. 7: Connecting the sensor input to an external switching voltage

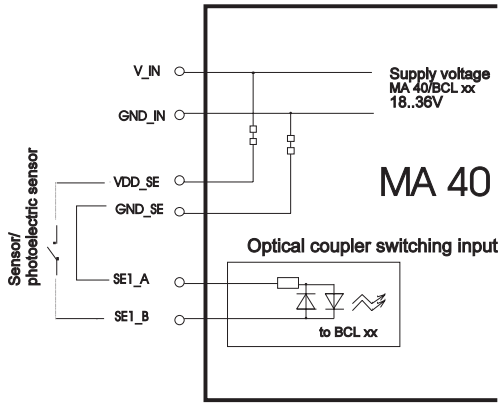


Fig. 8: Connecting the sensor input without an external switching voltage

It is possible to activate the sensor input via the InterBus-S process-data channel. This is accomplished by setting the jumper above the terminals to "InterBus-S" and inserting a wire bridge in the terminals (see Fig. 9).

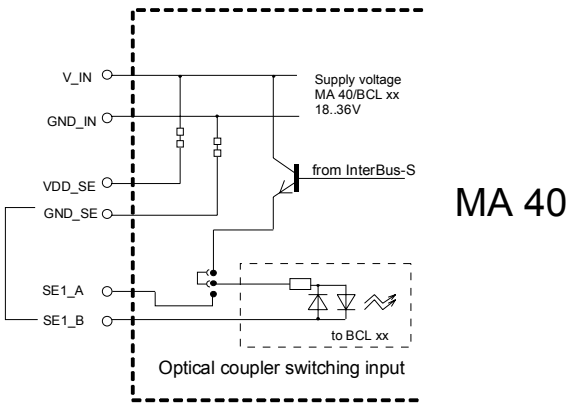


Fig. 9: Switching via the InterBus-S process-data channel

2.3. Connecting the voltage supply

Connection terminals: 17-21

Voltage supply

Connection terminals for the voltage supply of the MA 40 IS and the connected BCL xx.

Input voltage:	18..36V DC
Power consumption:	1.5 W max., MA 40 IS without BCL
	6 W max., MA 40 IS with BCL 40
	7 W max., MA 40 IS with BCL 80

Terminal 17, 18:	V_IN	(pos. operating voltage)
Terminal 19, 20:	GND_IN	(reference voltage, ground)
Terminal 21:	PE	(earth lead; earth)

Note: The terminals for V_IN and GND_IN are doubled to ease wiring. This allows the supply voltage to be looped through from one read station to the next.

2.4. Connecting an external device via RS 232 (V.24) interface

Connection terminals: 1-4

External device with RS 232

In place of a BCL, you can connect an external device with an RS 232 interface to the MA 40 IS. To do this, use spring terminals **1-4.**

Attention:
You may not connect both an external device and a BCL to the MA 40 IS at the same time since only one RS 232 can be operated.

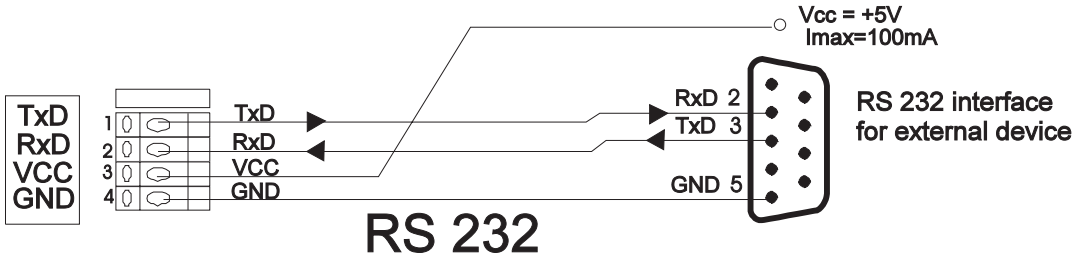


Fig. 10: Connecting an external device via RS 232

Voltage supply +5V

The terminal VCC provides a supply voltage of +5V DC with respect to GND. The MA 40 IS supply voltage can be used to power small devices (e.g. scanning pen, etc.) with **max. 100mA** current consumption. Devices with higher current consumption require their own power supply.

Note:
If your external device cannot be set to the standard data format (9600, 8-N-1), it is possible to change the RS 232 format of the InterBus module. Please refer to Chapter 4.5 for a listing of the supported settings. The data format and the baud rate can be changed there using InterBus variables.

3. Commissioning

3.1. Setting the reading parameters on the BCL xx

Commissioning the BCL xx

In order to commission a scanning station, the BCL xx must first be connected to the MA 40 IS and configured for the desired task. Connect the BCL to the MA 40 IS. This can be done either via a connection cable (accessory: KB 040-3000), or by plugging the BCL directly onto the MA 40 IS and screwing it down.
The service plug and corresponding switches can be accessed with the housing cover open. Commissioning is now performed by carrying out the following steps:

Step 1:
Select the switch position "Service BCL" and connect a PC to the service plug via an RS 232 cable.

Connecting to the service interface

Run the terminal program on the PC (e.g. TERM 3.0) and check that the interface (COM 1 or COM 2) to which the MA 40 IS is connected is set to the data format **`9600 baud, 8 data bits, no parity, 1 stop bit`** .

Step 2:
Now switch on the operating voltage. The BCL runs and loads its operating software. After an initialisation phase, the BCL returns the start character ("S") to the terminal. As soon as this character appears on the screen the device is ready. The initialisation phase may last from 3-30 s depending on the type of BCL.

Version command

If you now enter a "v" (version command) from the terminal and send it to the BCL, the device type and software version should be returned. The following echo should appear on the screen:

o> v
i> BCL 40
i> V 50.04
i> 05.06.96

Should this not appear on the screen, then the communication between the BCL and terminal program has been interrupted. Check for proper connection between the PC and MA 40 IS, as well as the settings of the terminal program.

Step 3:
If the above echo is received, communication between the BCL and the terminal has been established. You will now have available all online BCL commands described in the BCL handbook.

Running Setup

The command "e" brings you into the setup of the BCL. Here, the reading parameters such as code type, precision, output format, etc. can now be set. A detailed description of how to set the BCL parameters online can be found in the BCL handbook.

Saving setup

Once you have set all of the desired parameters, exit setup with "x" and save the changes.

Attention:
The serial host interface of the BCL xx is set to the Leuze standard data format (9600, 8-N-1). Do ***not*** change these settings, as the BCL will otherwise not be able to communicate with the InterBus-S module.

Step 4:

Reading code

Now check if the reading parameters are set correctly by activating the BCL using the command "+" and holding the bar code to be read in front of the reading window. The scanning beam of the BCL must appear on the bar code, and then disappear again after decoding the bar code. The decoded information is transferred to the terminal via the serial interface and output there. If the code cannot be read, check again that the reading parameters are correct and change if necessary.

AutoConfig

If you are not sure of the correct setting for the code type or the precision, use the AutoConfig command ("CA+" and "CA-", see the BCL handbook), in order to automatically set the code parameters.

Step 5:

Operation

Switch the MA 40 IS to "Operation". Now the BCL is connected to the InterBus-S. The MA 40 IS can now be activated either using the sensor input on the MA 40 IS, using a process data word, or by sending a "+" command to the BCL. Further information on the InterBus-S communication protocol can be found in the next chapter.

In operation mode, data at the serial interface between the BCL and the InterBus-S module can be monitored via the service plug. You can switch between "Monitor BCL" and "Monitor InterBus-S" using the "Source" switch.

3.2. Operating parameters for the InterBus

In order to operate an InterBus subscriber, it must be registered on the master with the **identification number**. For the MA 40 IS, this number is

F3 (hex.) or 243 (dec.)

4. Operating the MA 40 on the InterBus-S

4.1. Process data word and PCP data word

Process data word/PCP data word

In the InterBus-S cycle, two 16-bit data words are available per subscriber:
The process data word (PDW) and the peripheral communication protocol (PCP) data word. Both of these data words are passed on to all subscribers in each cycle.

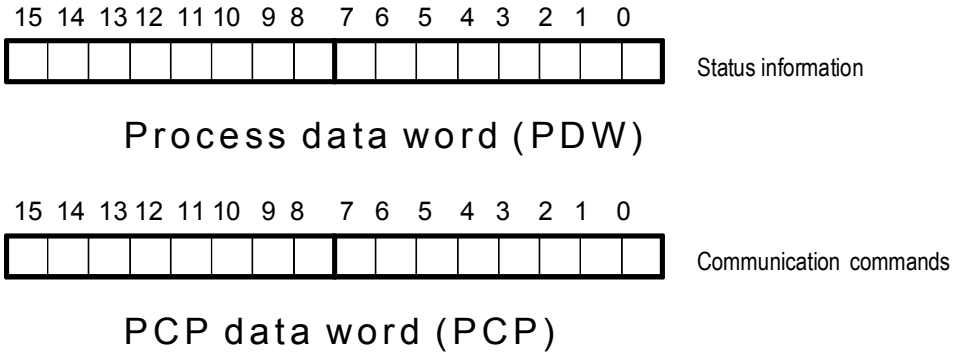


Fig. 11: Data words in the InterBus-S cycle

Explanation:

1. Process data word (PDW):
Transmits per cycle 16-bit status information from the *master (control system) to the slave* (output data word) and 16-bit status information from the *slave to the master* (input data word). Used to activate/deactivate slaves or for acknowledging slaves at the control.

2. PCP data word (PCP):
Exchanges data between master and slave via the so-called PCP communication commands. The master manages the sequential transmission of relatively long data telegrams, as the PCP data word can only be 16-bits long.
These commands are used for the data traffic between the bar code reader and the control. A description of the commands supported by Leuze can be found below.

4.2. Input data word

Input data word

Contained in the input data word (Process I/O: In Data) is MA 40 IS status information (InterBus-S information). This information is reported from the InterBus-S module to the master. This allows the master to, e.g. detect that the slave has read data in its buffer.

```
1-word input:

    Bits    0..7     status information (control channel)
    Bits    8..15    reserved
```

The individual bits are assigned as follows:

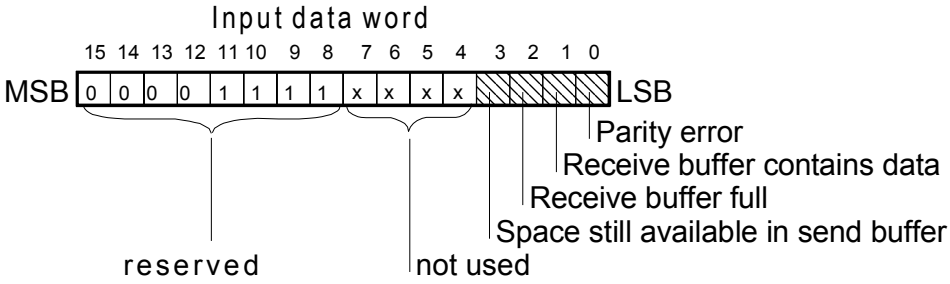


Fig. 12: status information: input data word

Status bits:

Status bits

Bits 0..7 of the input word are assigned as follows:

Bit 0: 0 ==> last data transfer OK: no parity error
1 ==> last data transfer faulty: parity error

Bit 1: 0 ==> RS 232 receive buffer is empty
1 ==> RS 232 receive buffer contains data

Bit 2: 0 ==> at least 64 bytes free in receive buffer
1 ==> less than 64 bytes free in receive buffer
(receive buffer full)

Bit 3: 0 ==> send buffer full
1 ==> there is still adequate space in the send buffer for a telegram
(> 16 bytes are free)

Bits 4..7: ==> not used

Note:
The bits 8..15 are linked on the MA 40 IS to the processor port. The HI byte always returns the status 0x0F (binary: 0000 1111).

Relevant for the evaluation are the bits **0..3:**

Result of the PDW (input data word):
0x0F0A: The data is ready to be retrieved in the receive buffer of the InterBus module
0x0F08: There is no data in the receive buffer of the InterBus module
0x0F0B: Error on the RS 232 while receiving (e.g. incorrect data format)

4.3. Output data word

Output data word

In the output data word (Process I/O: Out Data), the master passes on the sensor activation to the MA 40 IS.
This switches on the BCL.

Attention:
Activation via the InterBus-S only functions if the jumper "sensor input selector" is set to "InterBus-S" and terminals 10 and 12 are connected together (flexible lead). Neither an external switch nor button may be connected (see Chap. 2.2).

```
1 word output:

    Bits    0..7        reserved
    Bits    8..15       status information (control channel)
```

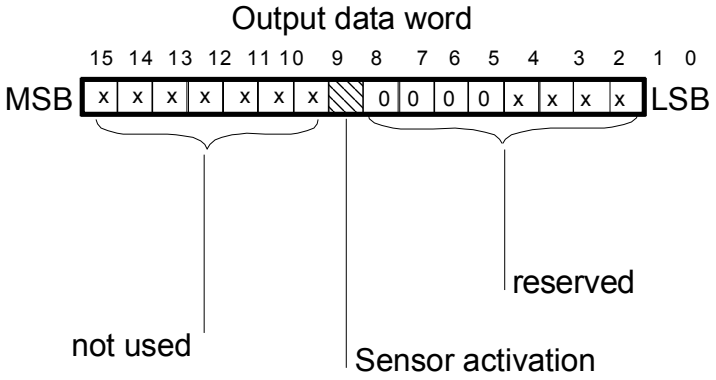


Fig. 13: Status information: Output data word

Status bits:

Status bits

Bits 8..15 of the input word are assigned as follows:

Bit 8: 0 ==> sensor inactive ==> BCL off (output data word: 0x0000)
1 ==> sensor active ==> BCL on (output data word: 0x0100)

Bits 9..15: not used

4.4. Communication with PCP

Communication commands

In addition to binary inputs and outputs (one data word each), connection to the MA 40 IS can also be established via communication commands (ISO/OSI, layers 1,2 and 7) (1 data word PCP).
Of the 39 FMS commands recognised by the Profibus, 10 commands are implemented in the InterBus protocol.

Of these 10 commands, the following 8 commands can be used in the MA 40 IS:

4.4.1. Implemented commands

Implemented commands

`Initiate`	establish communication connection
`Abort`	terminate communication connection
`Read`	read data
`Write`	write data
`Status`	read device and user status of the MA 40 IS
`Identify`	read manufacturer, type and version of the InterBus module in the MA 40 IS
`Get_OV`	read object directory of the InterBus module
`Reject`	reject a sevice request

Variables

Variables:

The MA 40 IS supports the reading and writing of simple variables. Before variables can be read or written, the MA 40 IS must first be registered as a KBL-entry.
The functional entry for slave no. 2 is, for example:

```
.kbl_entry
com_ref   = 2;
*---- LLI - part ----------------------------------------
rem_addr  = 1;
conn_type = 0;
max_scc   = 1;
max_rcc   = 1;
max_sac   = 1;
max_rac   = 1;
max_aci   = 0;
conn_attr = D;
*---- PMS - part ----------------------------------------
req_len_h       = 0;
req_len_l       = 33;                * send buffer size
ind_len_h       = 0;
ind_len_l       = F9;                * receive buffer size
serv_sup[]      = 80 30 00   80 b0 80; * request/indication
out_serv_client = 1;
out_serv_server = 1;
com_typ         = 1;
*-- USER - part (used by ALI ) -------------------------
symbol[]        = ;
```

The supported commands are entered in line **`serv_sup[]`**.

Variables

Variables for the serial interface RS 232 - InterBus-S:

Four variables are used to control the InterBus module. These variables can be used to parameterise the serial RS 232 channel between BCL and MA 40 IS and to read/write data from/to the BCL.

Name	Index	Type	Access rights
SER_MODE	0x4000	UNSIGNED16	ACC_WRITE_ALL | ACC_READ_ALL
SER_BAUD	0x4001	UNSIGNED16	ACC_WRITE_ALL | ACC_READ_ALL
SIO_SEND	0x4002	OCTET_STRING [17]	ACC_WRITE_ALL
SIO_RECV	0x4003	OCTET_STRING [17]	ACC_READ_ALL

4.4.2. Description of the implemented commands

Command

Read (read data)

Index: 4000 (interface: parameter)
Index: 4001 (interface: baud rate)

Index: **4003** (read data from slave to master)

With the serial port, **17-byte** blocks are transmitted. Here, the first byte specifies the length of the user data in the block.

Write (write data)

Index: 4000 (interface: parameter)
Index: 4001 (interface: baud rate)

Index: **4002** (write data from master to slave)

With the serial port, **17-byte** blocks must be transmitted. Here, the first byte specifies the length of the user data in the block.

Identify (read manufacturer, type and version of the InterBus module)

```
ISK AUTOMATION
SERIA ID Module
Revision 1.5
```

Get_OV (read object directory)

```
First_index_S_OV   4000

4000      simple Variable    unsigned 16         02 length
4001      simple Variable    unsigned 16         02 length
4002      simple Variable    octet string        11 length
4003      simple Variable    octet string        11 length
```

4.5. Description of the used variables

4.5.1. SER_MODE (0x4000)

This variable sets the operating mode of the serial channel between the RS 232 and the InterBus module:

Data format

```
0  ==>   ASCII protocol, 8 bit, 1 stop bit, no parity (default)
1  ==>   ASCII protocol, 8 bit, 1 stop bit, odd parity
2  ==>   ASCII protocol, 8 bit, 1 stop bit, even parity
3..7     reserved  (error now)
8  ==>   XON/XOFF protocol, 8 bit, 1 stop bit, no parity
9  ==>   XON/XOFF protocol, 8 bit, 1 stop bit, odd parity
10 ==>   XON/XOFF protocol, 8 bit, 1 stop bit, even parity
11..15   reserved  (error now)
16..255  error
```

To connect a Leuze bar code reader, please always select the **operating mode 0**. If you have connected an external device via RS 232, you can use this variable to change the data format.

The high byte is also reserved, but is not evaluated.

4.5.2. SER_BAUD (0x4001)

This variable sets the baud rate of the serial channel between the RS 232 and the InterBus module:

Baud rate

```
19200 ==>  19200 baud
 9600 ==>   9600 baud
 4800 ==>   4800 baud
 2400 ==>   2400 baud
 1200 ==>   1200 baud
  600 ==>    600 baud
  300 ==>    300 baud
  150 ==>    150 baud
  110 ==>    110 baud
   75 ==>     75 baud
```

All other values result in an error message and are ignored.

To connect a Leuze bar code reader, please always select the **9600 baud**.
External devices with RS 232 interface can also be operated at other baud rates.

Attention:
After switching on, the interface parameters are **always** set to the values indicated above. If your external device requires other parameters, you must always transmit the parameters **SER_MODE** and **SER_BAUD** after initialising the MA40 IS before it is possible to communicate via the RS232.

4.5.3. SIO_SEND (0x4002)

Writing data

Send buffer, for writing data to the InterBus-S

```
sio_send [0]       ==> length of net data ( 0..16 )
sio_send [1 .. 16] ==> net data, or filler bytes
```

When transmitting data to the MA 40 IS, the the length of the net data from the master must be specified using the ***write*** command.

4.5.4. SIO_RECV (0x4003)

Reading data

Receive buffer, for reading data from the Interbus-S

```
sio_recv [0]     ==> length of net data ( 0..16 )
sio_recv [1..16] ==> net data, or filler bytes
```

The user must evaluate the length byte, as the filler bytes contain no user data!

4.6. Non-implemented commands

`Start`	start program
`Stop`	stop program

5. InterBus-S diagnosis with PC

5.1. PCPM (monitoring program for InterBus)

PCPM monitor program

With this monitoring program and a suitable PC-interface card (e.g. IBS PC AT UM) for the InterBus, communication with the MA 40 IS can be established via the PCP:

5.1.1. Initialising the PCP communication: `initiate request`

Initialisation

The initialisation of the PCP communication is started with the `initiate request` command.
The following functions in the PCPM must first be activated:

```
1.) Communication
2.) PMS services
3.) Context management
4.) Initiate
5.) Request
      Initiate request                (*Note: request command)
      "Communication Reference: 02"   (*Note: InterBus Addr. 02)
      ok

→ Initiate confirmation               (*Note: pos. acknowledgement
                                      of the slave)
```

After the slave has been correctly initialised, the data of the receive buffer can be read out with the `read request` command or data written to the send buffer with the `write request` command.

5.1.2. Reading the receive buffer: `read request`

Read request

After a label has been read, the input word contains the number `0x0F0A`. "`0A`" indicates that the receive buffer is full and can be read out. The receive buffer is read out by using the communication command `read request`.

```
1.) Communication
2.) PMS services
3.) Variable access
4.) Read
5.) Request
      Read Request
      "Communication Reference: 02
      "Index                  : 4003"
      ok
--> Read confirmation
      "Result (+)"
      "Data
       10 02 30 31 32 33 34 33 32 31
       30 39 39 0d 0a 02 35"
```

Note: All numbers are displayed in hexadecimal format `0x10` --> 16_{dec}.
A total of 17 data bytes are transmitted per request. Here, the first byte specifies how many of subsequent data bytes are valid: here `0x10` --> 16 bytes.

Read request

If the number 0x0F0A is still contained in the input word, this indicates that the receive butter still contains data. To read out this data as well, the procedure described above must be repeated. The result is, for example:

```
"Data
 0e 34 33 32 31 30 31 32 33 34
 35 36 37 0d 0a ff ff"
```

with 0x0E --> 14_{dec} user data

The receive buffer is now empty, and the input word now contains 0x0F08.

Address of the receive buffer: 0x4003

5.1.3. Writing the send buffer: `write request`

Write request

If data are to be sent to the device, communication is performed via the PCP command `write request`. The data transmitted via the InterBus-S are passed on immediately to the RS232 interface.

```
1.) Communication
2.) PMS services
3.) Variable access
4.) Write
5.) Request

  Write Request
  "Communication Reference: 02
  "Index                  : 4002"
  "Data
   04 02 61 0d 0a 00 00 00 00 00
   00 00 00 00 00 00 00"
```

Note: All numbers are displayed in hexadecimal format. 17 bytes of data must always be transmitted. Here, the first byte specifies the number of relevant data (here: 4). Successful transmission is indicated with

```
Write confirmation
"Result (+)"
```

The data is then passed on via the RS232 interface.

Address of the send buffer: 0x4002

5.2. User program in "C"

Automatic communication

To maintain automatic, continuous MA 40 IS communication with a PC switching component, a user program can be written (e.g. in the programming language "C").

5.2.1. Receiving MA 40 IS data

Receiving data

During the cycle, the status bit "receive buffer contains data" is analysed by the program, and if necessary, the command `read request` sent.

Input data word = `0x0F08`: no data in receive buffer
`0x0F0A`: receive buffer contains data

This procedure is repeated until the receive buffer in the MA 40 IS is completely empty (input data word = `0x0f08`).

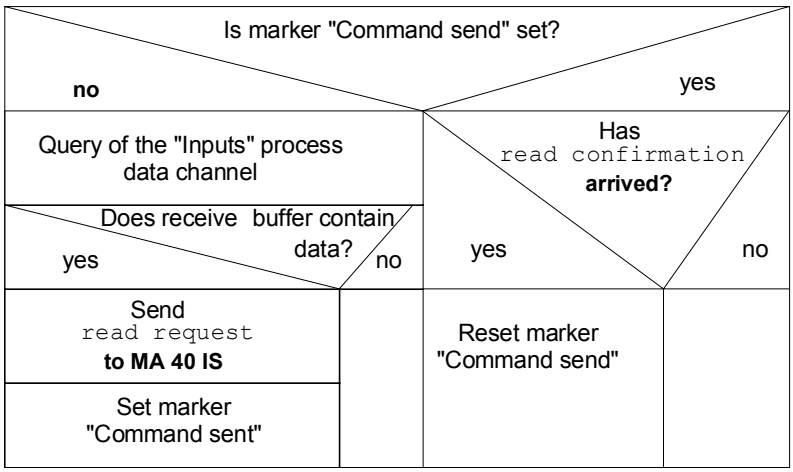


Fig. 14: ***Structogram: get data from MA 40 IS***

5.2.2. Sending data

Sending data

If data are to be sent to the MA 40 IS (e.g. parameter set or control commands), then these data will be packed in blocks of max. 16 bytes, with the length byte correspondingly calculated, and this block sent using the `write request` command. After confirmation by the MA 40 IS (`write confirmation`), the next block can be sent.

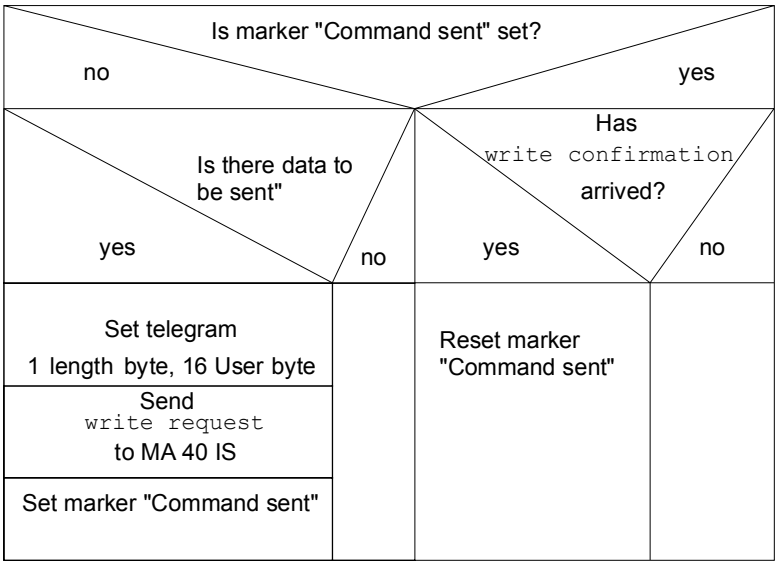


Fig. 15: ***Structogram: Send data to the MA 40 IS***

Monitoring the send buffer

If many data blocks are to be sent in succession to the MA 40 IS, it is useful to query the "Send buffer full" status bit in order to avoid a buffer overflow.

Literature about programming the PC switching component:

[1] Phoenix Contact, InterBus-S User Manual for the InterBus-S, PC Interface Card IBS PC AT UM Order No.: 2754477

6. Appendix

6.1. ASCII Table

ASCII Table

HEX	DEC	CTRL	ABV	ENGLISH	GERMAN
00	0	^@	NUL	NULL	Null
01	1	^A	SOH	START OF HEADING	Kopfzeilenbeginn
02	2	^B	STX	START OF TEXT	Textanfangszeichen
03	3	^C	ETX	END OF TEXT	Textendezeichen
04	4	^D	EOT	END OF TRANSMISSION	Ende der Übertragung
05	5	^E	ENQ	ENQUIRY	Aufforderung zur Datenübertragung
06	6	^F	ACK	ACKNOWLEDGE	Positive Rückmeldung
07	7	^G	BEL	BELL	Klingelzeichen
08	8	^H	BS	BACKSPACE	Rückwärtsschritt
09	9	^I	HT	HORIZONTAL TABULATOR	Horizontal Tabulator
0A	10	^J	LF	LINE FEED	Zeilenvorschub
0B	11	^K	VT	VERTICAL TABULATOR	Vertikal Tabulator
0C	12	^L	FF	FORM FEED	Seitenvorschub
0D	13	^M	CR	CARRIAGE RETURN	Wagenrücklauf
0E	14	^N	SO	SHIFT OUT	Dauerumschaltungszeichen
0F	15	^O	SI	SHIFT IN	Rückschaltungszeichen
10	16	^P	DLE	DATA LINK ESCAPE	Datenübertragungsumschaltung
11	17	^Q	DC1	DEVICE CONTROL 1 (X-ON)	Gerätesteuerzeichen 1
12	18	^R	DC2	DEVICE CONTROL 2 (TAPE)	Gerätesteuerzeichen 2
13	19	^S	DC3	DEVICE CONTROL 3 (X-OFF)	Gerätesteuerzeichen 3
14	20	^T	DC4	DEVICE CONTROL 4	Gerätesteuerzeichen 4
15	21	^U	NAK	NEGATIVE (/Tape) ACKNOWLEDGE	Negative Rückmeldung
16	22	^V	SYN	SYNCRONOUS IDLE	Synchronisierung
17	23	^W	ETB	END OF TRANSMISSION BLOCK	Ende des Datenübertragungsblocks
18	24	^X	CAN	CANCEL	Ungültig
19	25	^Y	EM	END OF MEDIUM	Ende der Aufzeichnung
1A	26	^Z	SUB	SUBSTITUTE	Substitution
1B	27	^[	ESC	ESCAPE	Umschaltung
1C	28	^\	FS	FILE SEPARATOR	Hauptgruppentrennzeichen
1D	29	^]	GS	GROUP SEPARATOR	Gruppentrennzeichen
1E	30	^^	RS	RECORD SEPARATOR	Untergruppentrennzeichen
1F	31	^_	US	UNIT SEPARATOR	Teilgruppentrennzeichen
20	32		SP	SPACE	Leerzeichen
21	33		!	EXCLAMATION POINT	Ausrufungszeichen
22	34		"	QUOTATION MARK	Anführungszeichen
23	35		#	NUMBER SIGN	Nummerzeichen
24	36		$	DOLLAR SIGN	Dollarzeichen
25	37		%	PERCENT SIGN	Prozentzeichen
26	38		&	AMPERSAND	Kommerzielles UND-Zeichen
27	39		'	APOSTROPHE	Apostroph
28	40		(	OPENING PARENTHESIS	runde Klammer (offen)
29	41		)	CLOSING PARENTHESIS	runde Klammer (geschlossen)
2A	42		*	ASTERISK	Stern
2B	43		+	PLUS	Pluszeichen
2C	44		,	COMMA	Komma
2D	45		-	HYPHEN (MINUS)	Bindestrich (Minuszeichen)
2E	46		.	PERIOD (DECIMAL)	Punkt
2F	47		/	SLANT	Schrägstrich (rechts)
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	Doppelpunkt
3B	59		;	SEMI-COLON	Semikolen
3C	60		<	LESS THEN	Kleiner als
3D	61		=	EQUALS	Gleichheitszeichen
3E	62		>	GREATER THEN	Größer als
3F	63		?	QUESTION MARK	Fragezeichen
40	64		@	COMMERCIAL AT	Kommerzielles a-Zeichen

ASCII Table

HEX	DEC	CTRL	ABV	ENGLISH	GERMAN
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		
59	89		Y		
5A	90		Z		
5B	91		[	OPENING BRACKET	eckige Klammer (offen)
5C	92		\	REVERSE SLANT	Schrägstrich (links)
5D	93		]	CLOSING BRACKET	eckige Klammer (geschlossen)
5E	94		^	CIRCUMFLEX	Zirkumflex
5F	95		_	UNDERSCORE	Unterstrich
60	96		`	GRAVE ACCENT	Gravis
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	geschweifte Klammer (offen)
7C	124		|	VERTICAL LINE	Vertikalstrich
7D	125		}	CLOSING BRACE	geschweifte Klammer (geschlossen)
7E	126		~	TILDE	Tilde
7F	127		DEL	DELETE (RUBOUT)	Löschen