Operating Manual

ML71B

HBM

1 Safety instructions

Appropriate use

The ML71B Profibus module is to be used for measurement tasks and directly related control tasks exclusively. Any other use is considered to be not in accordance with the regulations.

To ensure safe operation the device may only be used as described in the operating manual. In addition, the legal and safety regulations for the respective application have to be observed. The same applies for the use of accessories.

General dangers of failing to follow the safety instructions

The Profibus module complies with the state of the art and is fail-safe. The instrument can give rise to remaining dangers if it is inappropriately installed or operated by untrained personnel.

Everyone involved with the installing, putting into operation, maintaining or repairing of the device must have read and understood the operating manual and, in particular, the safety instructions.

Remaining dangers

The ML71Bs performance and scope of supply cover only part of the field of measurement technology. Equipment planners, installers, and operators in addition must plan, implement and respond to safety engineering considerations of measurement technology in such a way as to minimise remaining dangers. Prevailing regulations have to be complied with at any time. Remaining dangers connected with measurement technology must be indicated explicitly.

Working safely

Error messages may only be acknowledged if the cause of the error has been removed and no further danger exists.

The device complies with the safety requirements of DIN EN 61010-part 1 (VDE 0411-part 1); protection class I.

To ensure adequate immunity from interference, use *Greenline* shielded ducting only (see HBM offprint "*Greenline* shielding design, EMC-compliant measuring cable"; G36.Green.0e).

Conversions and modifications

The ML71B CAN bus module must not be modified from the design or safety engineering point without our express agreement. Any modification shall exclude any liability on our part for any damage resulting therefrom.

In particular, any repair and soldering work on motherboards is prohibited. When replacing complete subassemblies, do only use original HBM parts.

Qualified personnel

This instrument is to be installed and used by qualified personnel only, strictly in accordance with the specifications and with the safety instructions. In addition, the legal and safety regulations for the respective application have to be observed. The same applies for the use of accessories.

Qualified personnel means persons familiar with the installing, assembling, putting into service, and operating of the product, and adequately qualified for their task.

Maintenance and repair work on an open device with the power on must only be carried out by trained personnel who are aware of the dangers involved.

2 Markings used

2.1 The markings used in this document

Important instructions for your safety are specifically identified. It is essential to follow these instructions in order to prevent accidents and damage to property.

Symbol	Significance
Notice	This marking draws your attention to a situation in which failure to comply with safety requirements *can* lead to damage to property.
i Important	This marking draws your attention to *important* information about the product or about handling the product.
i Tip	This marking indicates application tips or other information that is useful to you.
i Information	This marking draws your attention to information about the product or about handling the product.
Emphasis *See….*	Italics are used to emphasize and highlight text and references to other chapters and external documents.

2.2 Symbols on the product

CE mark

C E

The CE mark enables the manufacturer to guarantee that the product complies with the requirements of the relevant EC directives (the declaration of conformity is available at http://www.hbm.com/HBMdoc).

3   Introduction

The ML71B records the signals and information communicated via the CAN bus. The type of CAN bus protocol, whether CANopen, DeviceNet, CANKingdom or similar, is irrelevant. All these protocols use the same "physical layer", which is fully supported by the ML71B.

The ML71B is *not* a CAN logger, that logs the entire CAN data stream with information about the identifier and the data content. The ML71B monitors the CAN bus, extracts selected signals in the data stream and forwards them as a measured value to the MGCplus.

If you want to record the information that is communicated in a CAN network with the ML71B, you first need to know the baud rate in use on the CAN bus. The maximum baud rate according to the CAN specification is 1 Mbit/s.

Even if only one CAN node on the CAN bus is transmitting at the wrong baud rate, it is still possible for all data communication on the CAN bus to break down.
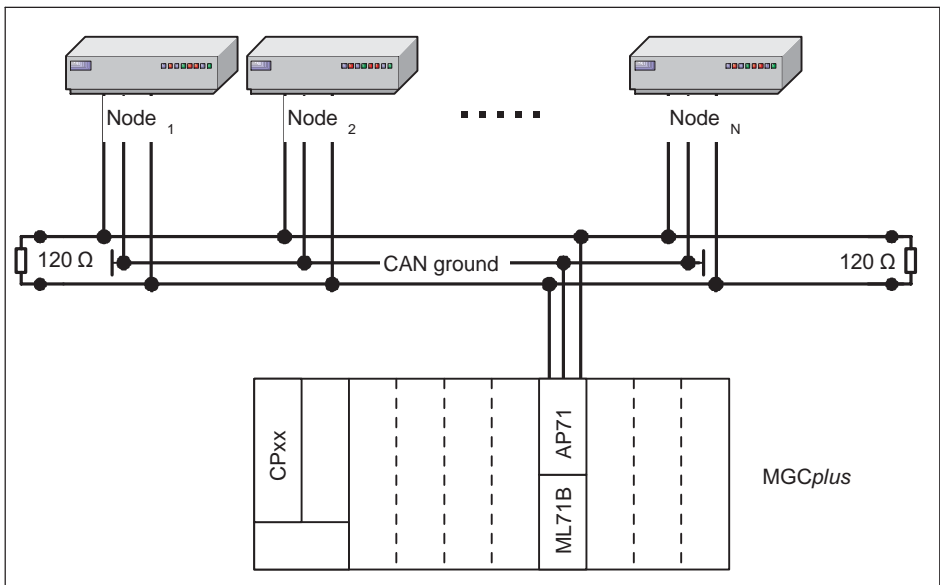
Fig. 3.1   CAN bus schematic

Each of the CAN nodes can transmit CAN messages. These messages are uniquely identified by an identifier. Identifiers are represented by 11 bits (standard CAN, specification CAN 2.0a). With extended CAN format (specification CAN 2.0b), identifiers are represented by 29 bits. Both of these message types (standard / extended) can generally be used in a CAN network.

Each of these messages can contain one or more signals. The ML71B can passively monitor these CAN message signals and place their value on one of its subchannels (8...128).

The following graphic shows the structure of a standard CAN message (identifier comprising 11 bits). There are three essential areas that are important for the user.

CAN identifier 11 bits (standard) 29 bits (extended)	reserved	Number of bytes available for signals	Data Max. 8 bytes			reserved
			Sig. 1	...	Sig. M	
			Signals			
CAN message						
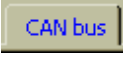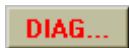
To take a signal from the data stream to a subchannel of the ML71B, you need the following information:

		CAN database
Baud rate on the CAN bus		
Message format of message N: - standard (11 bits) - extended (29 bits)		
Identifier of message N		
Message name		
Number of bytes within the CAN message that contain data (useful data).		
Information about signals		
Signal 1	CAN signal name	
	Allocation of bits to signals: Which bits represent a signal ? - start bit - number of bits	•
	Data format - signed / unsigned / float - Intel / Motorola	•
	Scaling	
	Unit	
Signal M	Minimum /maximum values	
	⋮	
	CAN signal name	
	Allocation of bits to signals: Which bits represent a signal ? - start bit - number of bits	•
	Data format - signed / unsigned / float - Intel / Motorola	•
	Scaling	
	Unit	
	Minimum /maximum values	
Message format of message (N+1): - standard (11 bits) - extended (29 bits)		
Identifier of message (N+1)		
...		

All details can be obtained from the CAN node manufacturer. Sometimes these details (apart from the baud rate of the CAN bus) are also already summarized in a database. You should convert an electronic database that is not available in vector database format (file extension *.dbc) to this format.

We refer you to the software products of Messrs Vector-Informatik GmbH (http://www.vector-informatik.com)

You can use the "MGCplus-Assistant" software (readily available over the Internet at http://www.hbm.com) to load the database directly onto the ML71B:

- In the MGCplus channel overview, move to the   CAN bus   tab.

- In the channel overview, press the   **DIAG...**   button. This will open a window for loading the database.

Once the database has been successfully loaded, you can assign the ML71B subchannels to the CAN signals.

If there is no database available in dbc format, you can also enter all the requisite details manually in the display and control panel or via the MGCplus Assistant.

In the MGCplus Assistant, select an ML71B channel, right click and then choose the "CAN Signal" entry. You can then enter the CAN signal parameters (identifier, position within the useful data, format, etc). You can also enter these parameters via the display and control panel:

- Press the SET key

- Use keys F3 and F4 to set the ML71B. Details of how to operate the ML71B via the AB22A can be found in the subsequent sections.

4　Connection

4.1　Pin assignment

A 9-pin Sub-D connector (complying with standard) on the AP71 connection board is used for connecting the CAN bus. Two independent CAN Fieldbus systems can be connected (CAN1 and CAN2).
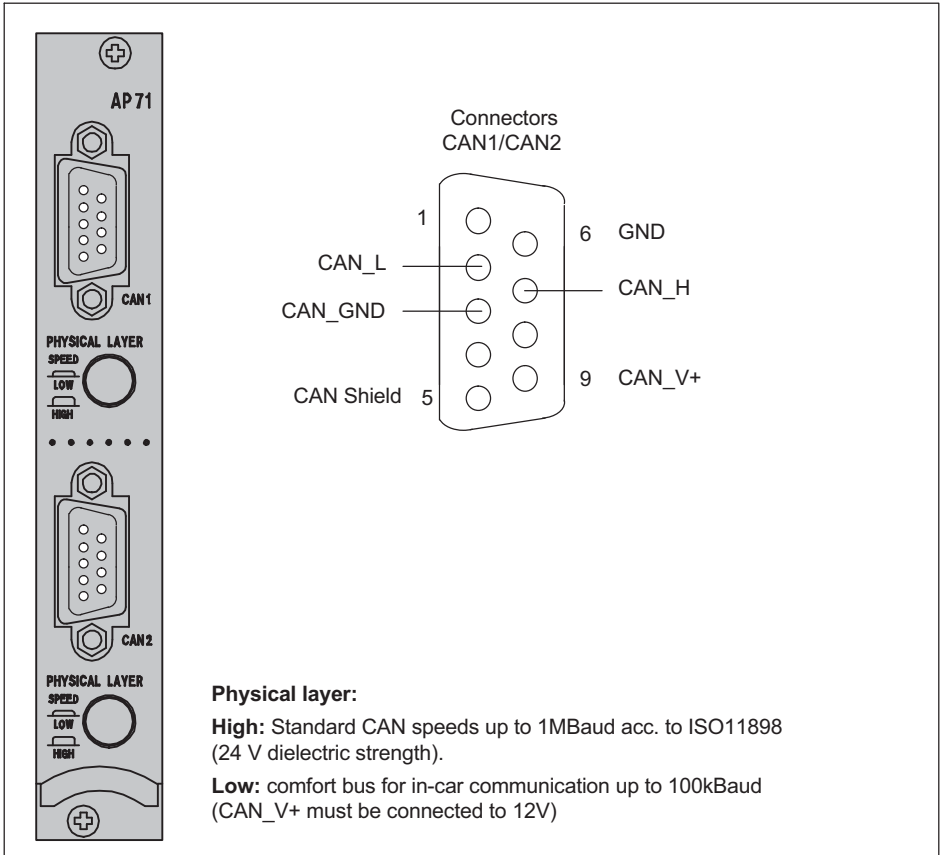
Fig. 4.1　CAN connection

5   Front panel

The front panel LEDs have twin function:

- Level mode is used for displaying the signal level on the analogue output.
- In Status mode the LEDs have the below assignment:
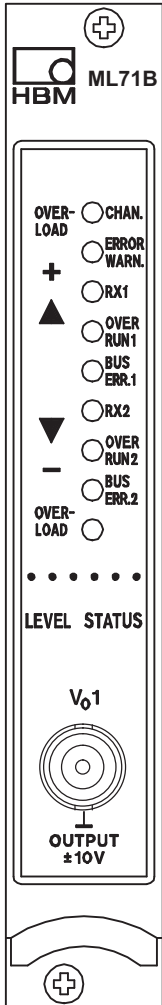
LED designation	Colour	Meaning in Status mode
CHAN.	yellow	Channel selected
ERROR/WARN.	red	Error/Warning
Rx1	yellow	CAN protocol received on CAN1 input
Tx1 OVRN1	yellow red	CAN protocol sends CAN1 Overrun at CAN1
BUS-/ERR1	red	Bus error at CAN1
Rx2	green	CAN protocol received on CAN2 input
Tx2 OVRN2	yellow red	CAN protocol sends CAN2 Overrun at CAN2
OVERRUN2	red	Overrun of CAN2 controller memory
BUSERR2	red	Bus error on CAN2
-	-	-

Analogue output (female BNC connector)

A signal selected from the database can be assigned to the analogue output. The output is scaled over two characteristic curve points (see chapter 7.1.4, page 27).

6   Configuration

On principle, there are two ways to configure the ML71B:

• Configuration via a database.

• Manual configuration via the AB22A Display and control panel.

6.1   Configuration via a database

1. Use the "CAN-Datenbasis-Editor" software (Vector-Informatik company) for creating a database on your PC. You will obtain a file with the extension ".DBC".

2. Use the "MGC*plus* Assistant" software by HBM for transferring the newly created database from the PC to the ML71B amplifier module ("DIAG" function in the Assistant).

i   Information

A separate database is assigned to each CAN input. With the signals of both channels stored in one database, you will load the same database twice.

3. Press the (SET) key to switch to the Setup mode and then press the (F3) function key. Use the cursor keys to select "CAN messages" and confirm with (⏎).

4. To activate the ML71B channel to be used for the acquisition of measured values, select "YES" from the "Active" menu and confirm with (⏎).

i   Information

Channels that have not been activated will produce no display. They will be skipped upon channel selection in Measure mode.

5. Use the ⊕ cursor keys to select the "Interface" selection field. Press ⟵ to call the selection list and select the desired interface CAN1/CAN2. Use ⟵ to confirm.

6. For selecting the desired message, proceed as described in 5. (the contents of the selection list will be generated from the ML71B internal database).

7. For selecting the desired signal, proceed as described in 5. (the contents of the selection list will be generated from the ML71B internal database).

8. Use the (SET) key to switch to Measure mode and use ⟵ to confirm the "Save set-up?" prompt.
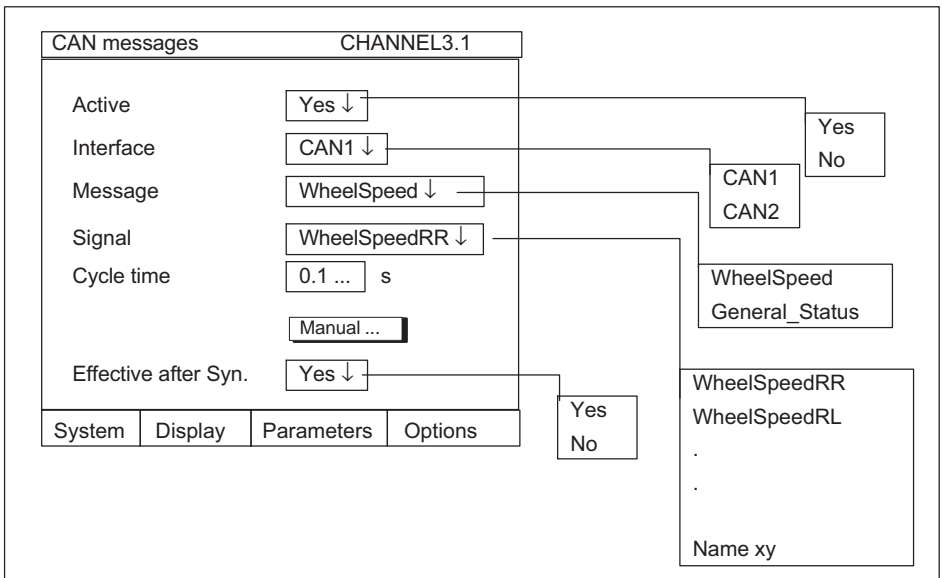
Fig. 6.1   "CAN messages" standard dialogue window

CAN Messages	CHANNEL3.1	

Active   Yes ↓

Interface   CAN1 ↓

                      Yes
                      No

PG   Tire condition ↓

          CAN1
          CAN2

Signal   WheelSpeedRR ↓

         Tire condition
         Time
         Date

Source address   ...

Destination addr.   ...

Signal name   WheelSpeedRR

         WheelSpeedRR
         WheelSpeedRL
         .
         .

Cycle time   0.1 ...   s

          Manual ...

System	Display	Parameters	Options

         Name xy
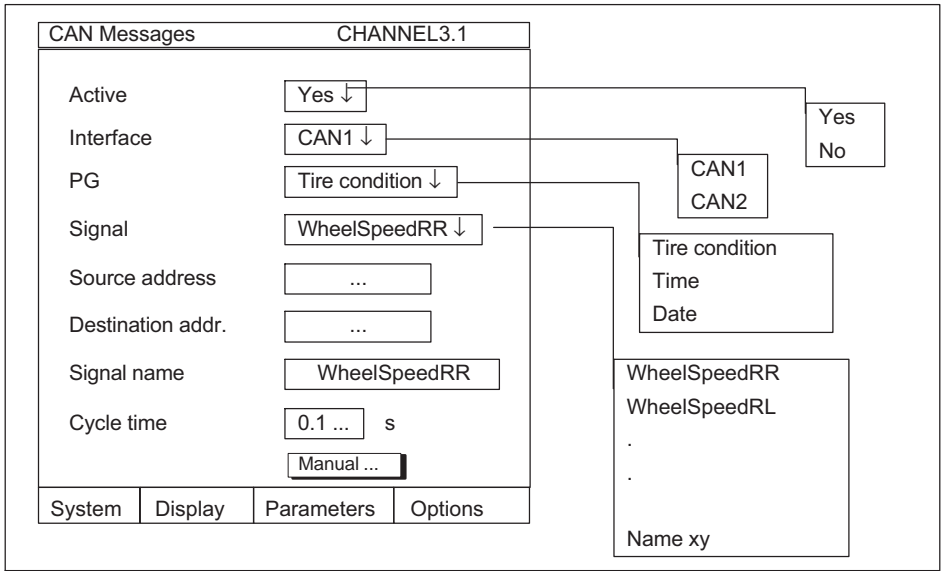
Fig. 6.2   "CAN messages" dialogue window for the J1939 protocol

6.2 Manual configuration

6.2.1 Standard configuration
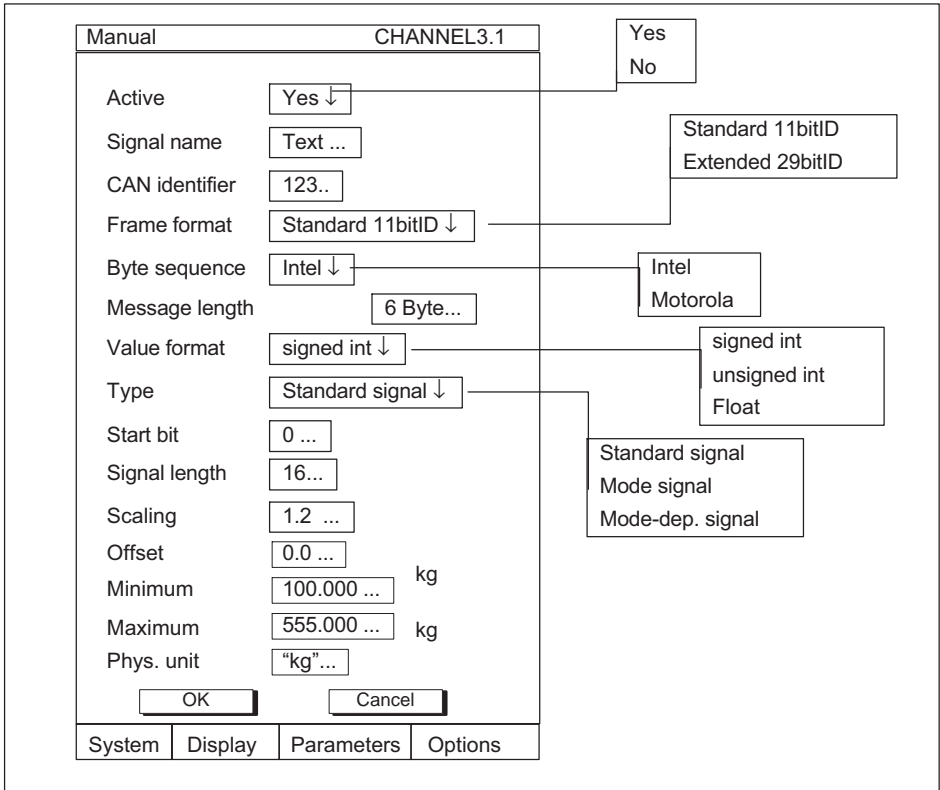
Fig. 6.3   "Manual" standard dialogue window

1. Use the (SET) key to switch to the Setup mode and then press the (F3) function key. Use the cursor keys to select "CAN messages" and confirm with (⏎).

2. Select the desired interface CAN1/CAN2.

3. Use the ⟨✦⟩ cursor keys to select the ⌞Manual...⌟ button and confirm with ⟨⟵⟩.

4. To activate the ML71B channels to be used for the acquisition of measured values, select "YES" from the "Active" menu and confirm with ⟨⟵⟩.

5. Use the ⟨✦⟩ cursor keys to select the "Signal name" edit field and enter the desired name.

ℹ️ Information

As soon as you modify the signal properties, the "CAN messages" dialogue window will be extended by the "Signal name" edit field and the entry "user-defined" will be displayed in the "Signal" edit field.

6. Use the ⟨✦⟩ cursor keys to select the "CAN identifier" edit field and enter the desired number (decimal).

7. Use the ⟨✦⟩ cursor keys to select the "Frame format" selection field and select the desired format ("Extended 29bit" for J1939 protocol).

8. Use the ⟨✦⟩ cursor keys to select the "Byte sequence" selection field and select the desired format (Motorola: MSB ...LSB; Intel: LSB ... MSB).

9. Use the ⟨✦⟩ cursor keys to select the "Value format" selection field and select the desired format.

10. Use the ⟨✦⟩ cursor keys to select the "Type" selection field and select the desired signal type (with mode signals, steps13 to 17 may be omitted, with mode-dependent signals, additional entries are required, see "Manual" dialogue window, page 24).

11. Use the ⟨✦⟩ cursor keys to select the "Start bit" edit field and enter the desired value.

12. Use the ⟨✛⟩ cursor keys to select the "Signal length" edit field and enter the desired value.

13. Use the ⟨✛⟩ cursor keys to select the "Scaling" edit field and enter the desired value.

![i] **Information**

The below formula applies for measurement scaling:
Measured value= (CANSignal x Scaling) + Offset

14. Use the ⟨✛⟩ cursor keys to select the "Offset" edit field and enter the desired value.

15. Use the ⟨✛⟩ cursor keys to select the "Minimum" edit field and enter the desired value.

16. Use the ⟨✛⟩ cursor keys to select the "Maximum" edit field and enter the desired value.

    We recommand to enter the minimum and maximum values in any case, since they are used for the internal scaling.

17. Use the ⟨✛⟩ cursor keys to select the "Phys. unit" edit field and enter the desired unit (the first four places are valid).

18. Use the ⟨✛⟩ cursor keys to select the ⟨ OK ⟩ button and confirm with ⟨⏎⟩.

19. Use the (SET) key to switch to Measure mode and use ⟨⏎⟩ to confirm the "Save set-up?" prompt.

6.2.2   Configuration for the J1939 protocol

In this dialogue window, you manually assign the individual signals at the CAN bus to the subchannels. Specify the PGN (parameter group number) instead of a complete identifier. The source and destination addresses are set in the higher-ranking dialogue box.

Manual	CHANNEL3.1		Yes
			No
Active	Yes ↓		
Signal name	Text ...		
PGN	123..		
Byte sequence	Intel ↓		Intel
Message length	6 Byte...		Motorola
Value format	signed int ↓		signed int
Start bit	0 ...		unsigned int
Signal length	16...		Float
Scaling	1.2 ...		
Offset	0.0 ...	kg	
Minimum	100.000 ...	kg	
Maximum	555.000 ...	kg	
Phys. unit	"kg"...		
OK		Cancel	
System	Display	Parameters	Options
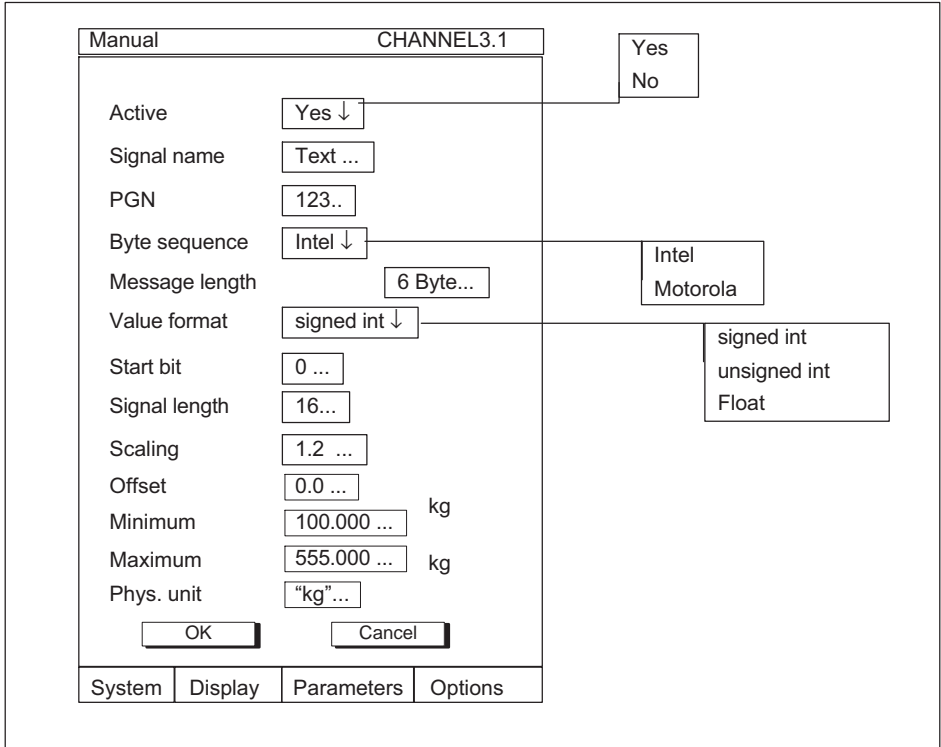
Fig. 6.4   "Manual" dialogue window for the J1939 protocol

7 Menu structure in Setup mode

The MGC*plus* device setup is structured in functional groups. Press the (SET) key to access the setup dialogue. The setup menu will be displayed.

Display in Setup mode

HBM HOTTINGER BALDWIN MESSTECHNIK GMBH   AB22A

Setup for channel 3.2

CHANNEL + −

System | Display | Parameters | Options

Setup menu

System	Display	Parameters	Options
System-specific setup that is only usually necessary for the initial startup procedure or for a new measurement task.	User-oriented display setup such as the desired measured value presentation, function key assignment, assignment of channel names.	CAN messages Conditioning Display Analogue outputs Switch	CAN busses Functions CAN bus diagnosis

For more information on operation using the AB22A Display and control panel, refer to the manual on "MGCplus with AB22A/AB32".

7.1   Menu parameters

7.1.1   CAN messages dialogue window
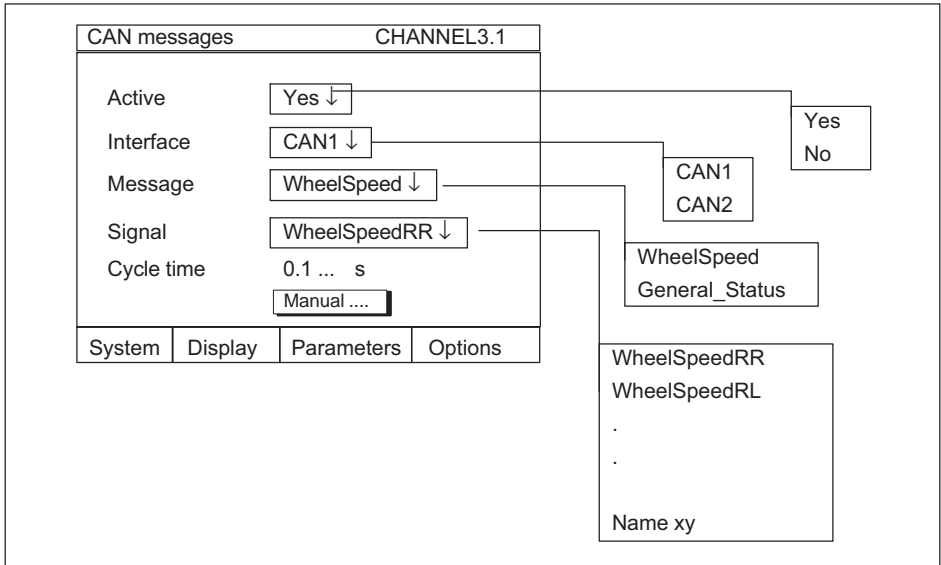
Fig. 7.1   "CAN messages" dialogue window

This menu enables the signals from the two databases to be assigned to the subchannels.

Parameterisation is also possible via the ⌊Manual ...⌋ button. If a subchannel has been set up manually, "user-defined" will automatically be output for the signal. The "Signal name" menu item then will be displayed to provide additional information.

A cycle time can be specified for each signal. If the signal has not occurred for more than three cycles, an error will be signalled thus ensuring that no old values are displayed although data acquisition has been stopped already for some time, for example, due to the fact that the transmitting side is no longer active or defective.

For cycle time=0, error monitoring is disabled.

Selecting a signal from the database appertaining to the CAN database editor

The database includes various messages. A message is a CAN message with a specific ID. Each message contains signals.

For assigning a signal to a subchannel, first select the appropriate message. The choice of messages depends on the database appertaining to the selected CAN interface. The "Signal" menu comprises the choice of signals appertaining to the message.

"Manual" dialogue window

Use this window to manually assign the individual signals on the CAN bus to the subchannels.

Menu items marked *A* are always available. Menu items marked *B* are only displayed with standard signals and mode-dependent signal. Menu items marked *C* are provided for mode-dependent signals only.

Manual	CHANNEL3.1		Yes
			No
Active	Yes ↓		
Signal name	Text ...		
CAN identifier	123..		Standard 11bitID
Frame format	Standard 11bitID ↓		Extended 29bitID

A

Byte sequence	Intel ↓		Intel
Message length	6 Byte...		Motorola
Value format	signed int ↓		signed int
Type	Standard signal ↓		unsigned int
			Float
Start bit	0 ...		
Signal length	16...		Standard signal
			Mode signal
			Mode-dep. signal

B

Scaling	1.2 ...
Offset	0.0 ...
Minimum	100.000 ... kg
Maximum	555.000 ... kg
Phys. Unit	"kg"...

C

Mode signal			
Byte sequence	Intel ↓		Intel
Mode value	3 ...		Motorola
Mode start bit	0 ...		
Mode length	8 ...		

| OK | Cancel |

| System | Display | Parameters | Options |

Fig. 7.2   "Manual" dialogue window

7.1.2 *Conditioning* **dialogue window**

CONDITIONING			Channel 3.1
Zero reference	1000.000 ...	mm	
Zero offset	20.000 ...	mm	
	->0<-		No / Yes
Disable zeroing:	No ↓		
System	Display	Parameter	Options
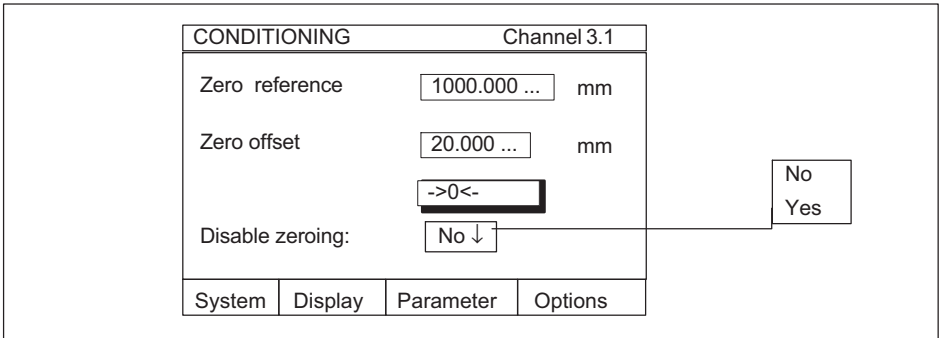
Fig. 7.3   *Conditioning dialogue window*

Zero reference

Amount by which the relative zero point is offset in relation to the absolute zero.

Example:

A displacement transducer (nominal displacement ± 20 mm) is intended to be measured from an engine seating and is fastened at a height of 1 m above. The display is intended to show the displacement as an absolute value.

Displacement transducer

±20mm — Relative zero point

Zero reference=1000mm

Engine seating — Absolute zero point
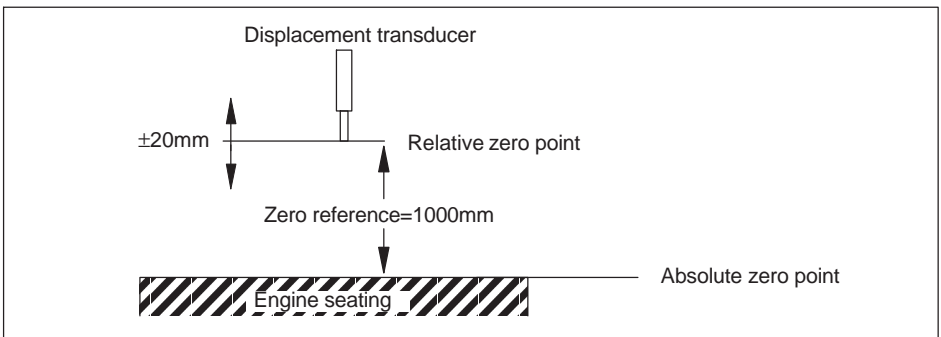
Zero offset

By activating the button labelled ⎡ ->0<- ⎤ you trigger zero balancing. If the value of the zero offset is known, you can input it directly in the edit field. Zero balancing affects how the gross value is displayed.

Disable zeroing

You can disable Zero Balance and/or Taring. Disabling applies to all triggering mechanisms (F-keys, remote contacts, software).

7.1.3   *Display* **dialogue window**

The signal name displayed here is identical with the entry made in the *CAN messages/Manual* menu. It is used for information only and cannot be modified in this menu.

The adjustable number of decimal places is only provided for the AB22A display. It is not displayed in the Assistant setup dialogue.

Use the ⎡   Set   ⎤ button to set the names of the adjusted signals as channel names for all subchannels (*Display/Channel names* dialogue window).

Confirm the ⊕ CHANNEL ⊖ channel selection keys to change between the individual sub-

channels.

Display	CHANNEL3.1
Signal name	WheelSpeedRR
Decimal places	3 ...
Signal names as channel names	
	Set
System	Display	Parameters	Options
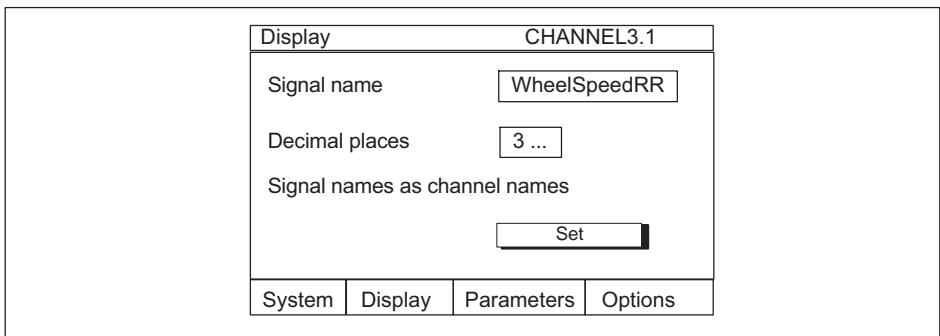
Fig. 7.4   "Display" dialogue window

7.1.4 *Analogue output* dialogue window

Use this dialogue window to specify the subchannel to be connected to the analogue output (front panel) and the scaling for the output characteristic.

```
Analogue output
  Subchannel           3 ...
  Output characteristics
  Point1               0  ...    V
                       0  ...    kg
  Point2               10 ...    V
                       100 ...   kg
  System | Display | Parameters | Options
```

Fig. 7.5   "Analogue output" dialogue window

7.1.5 *Switch* dialogue window

Use this window to switch the front panel LED display between *Status* and *Level.*

Status

Status display of the communications module (receive protocol, bus error, etc.; also see chapter 5, page 13).

Level

Level display of the signal connected to the analogue output.

```
Switch                    CHANNEL 3.1
  LED display          Status ↓              Status
                                             Level

  System | Display | Parameters | Options
```

Fig. 7.6   "Switch" dialogue window

7.2 Options menu

7.2.1 *CAN* busses

Baud rate

For setting the baud rate for both CAN interfaces.

SAE J1939

Use the "SAE J1939" button to open a new dialogue window in which to define the J1939 standard for one or both CAN ports.

Default cycle time

The new signal cycle time set here, will be used for all subchannels with a cycle time corresponding to the default cycle time.

Reset CAN1-Port

Reset and reinitialise CAN bus 1.

Reset CAN2-Port

Reset and reinitialise CAN bus 2.
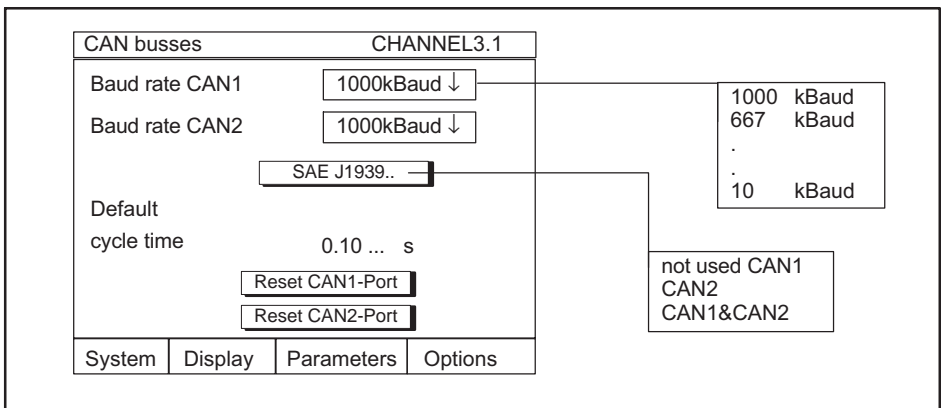
Fig. 7.7   "CAN busses" dialogue window

7.2.2 *Functions* dialogue window (standard)

Use this dialogue window to assign specific CAN messages (e.g. measurement request) to up to 10 functions. These functions can later be assigned to the AB22A function keys via the *Display/F keys.* Upon presssing the function key in the Measure mode, the assigned message will be transmitted.

Functions	CHANNEL 3.1
Function	Function 1 ↓
Rename	xyz
Interface	CAN 1 ↓
Frame format	Standard 11bitID ↓
Period	20 ... ms
Transmission	Manual ↓
CAN identifier	123 ...
Length	5 ...
Byte 1	1 ...
Byte 2	2 ...
Byte 3	3 ...
Byte 4	4 ...
Byte 5	5 ...
Byte 6	0 ...
Byte 7	0 ...
Byte 8	0 ...

OK   Cancel

| System | Display | Parameters | Options |

Callouts:
- F 1 / F 2 / . / . / F 10
- CAN 1 / CAN 2
- Standard 11bitID / Extended 29bitID
- Manual / Automatic
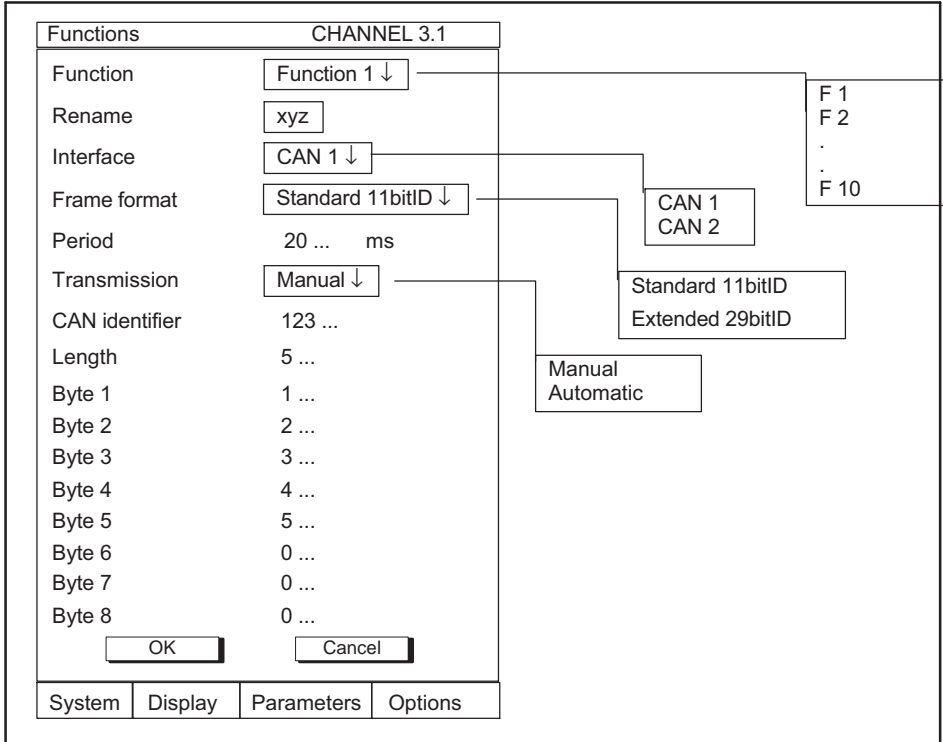
Fig. 7.8   "Functions" dialogue window

7.2.3   Functions dialogue window (SAE J1939)

Functions	CHANNEL 3.1
Function	F 1 ↓
Rename	xyz
	Request for PG...
Interface	CAN 1 ↓
Frame format	Standard 11bitID ↓
Period	20 ... ms
Transmission	Manual ↓
CAN identifier	123 ...
Length	5 ...
Byte 1	1 ...
Byte 2	2 ...
Byte 3	3 ...
Byte 4	4 ...
Byte 5	5 ...
Byte 6	0 ...
Byte 7	0 ...
Byte 8	0 ...

F 1
F 2
.
.
F 10

Request for PG   CHANNEL 3.1

PG   Tire Condition ...

PGN   65268 ...

OK   Cancel

CAN 1
CAN 2

Standard 11bitID
Extended 29bitID

OK   Cancel

System | Display | Parameters | Options

Fig. 7.9   *"Functions" dialogue window for the J1939 protocol*

Request for PG

This dialogue box should make it easier for you to define an SAE J1939 request. Choose either the parameter group being requested from the database, or enter its PGN. The relevant message content and identifier will then be generated automatically. The period specified in the higher-ranking dialogue box should correspond to the cycle time for signal definition in the CAN messages menu (*see section 7.1.1, page 22*).

Period

Specify the time interval after which the CAN message is to be retransmitted. The maximum period you can set is 65535ms.

Transmission/*manual* (period=0)

To make sure that when you press the function key exactly one message is transmitted, you must enter "0ms" as the period in the "Functions" dialogue window (transmission will automatically be changed to "manual").

Transmission/*manual* (period>0)

For manual transmission to be possible, you have to enter greater than zero for a period. Once this setting is made, pressing the key starts cyclical CAN message transmission using the set period. To stop and also to restart transmission, press the key again.

Transmission/*automatic* (period>0)

For automatic transmission to be possible, you have to enter greater than zero for a period and select "Automatic transmission". Transmission starts as soon as the input is confirmed (exiting Setup mode), using the set period.

i **Information**

Cyclical messages are sent again as soon as the device is switched on.

Select F key assignment dialogue window

1. Use the (SET) key to switch to the Setup mode.

2. Press (F2) .

3. Select "F keys" from the popup menu and confirm with (⏎).

   You are now in the "F keys" dialogue window where you can call the functions entered into the selection fields and assign them to the F keys.

7.2.4   *CAN bus diagnosis* **dialogue window**

The last five bus messages for both interfaces and the error counters are displayed on this window.

```
┌─────────────────────────────────────────────────────────┐
│        ┌───────────────────────────────────────┐        │
│        │ CAN bus diagnosis        CHANNEL 3.1   │        │
│        ├───────────────────────────────────────┤        │
│        │ CAN-Port 1      stuff err, Tx, ID.28 to ID.21 │ │
│        │                 err, Tx, tolerate dom. bits   │ │
│        │                 err, Tx, tolerate dom. bits   │ │
│        │                 err, Tx, tolerate dom. bits   │ │
│        │                 err, Tx, tolerate dom. bits   │ │
│        │                                               │ │
│        │ Tx error counter   0                          │ │
│        │ Rx error counter   0                          │ │
│        │                                               │ │
│        │ CAN-Port 2      no error                      │ │
│        │                 no error                      │ │
│        │                 no error                      │ │
│        │                 no error                      │ │
│        │                 no error                      │ │
│        │                                               │ │
│        │ Tx error counter   0                          │ │
│        │ Rx error counter   0                          │ │
│        ├────────┬─────────┬────────────┬──────────┤    │
│        │ System │ Display │ Parameters │ Options  │    │
│        └────────┴─────────┴────────────┴──────────┘    │
└─────────────────────────────────────────────────────────┘
```

Fig. 7.10   "CAN bus diagnosis" dialogue window

8 Byte sequence at the CAN bus

There are two possible byte order alternatives available for data transfer at the CAN bus (Motorola : big-endian; Intel : little-endian).

Key to abbreviations:

MSB: most significant byte

LSB: least significant byte

msb: most significant bit

lsb: least significant bit

Motorola format:

The most significant byte is transferred first via the CAN bus.

MSB	...	...	LSB

Intel format:

The least significant byte is transferred first.

LSB	...	...	MSB

In each case, transmission of a byte starts with the most significant bit.

msb	...	...	...	...	...	...	lsb

Methods of counting in the Vector Informatik exchange format:

The editor is aware of two counting methods: **forwards Motorola** and **backwards Motorola.**

In addition to this, a third counting method is used when the start bit is stored in the database: **Internal CANdb Motorola.** This format is used for manual configuration in the ML71B.

8.1 Intel format

The least significant bit position, lsb, is specified as the start bit for signals in Intel format. The bits in an Intel CAN message are always counted as follows (horizontal bold: bit number within a byte; vertical bold: byte number, standard: bit number in the message):

7	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
7	6	5	4	3	2	1	0	**0**
15	14	13	12	11	10	9	8	**1**
23	22	21	20	19	18	17	16	**2**
31	30	29	28	27	26	25	24	**3**
39	38	37	36	35	34	33	32	**4**
47	46	45	44	43	42	41	40	**5**
55	54	53	52	51	50	49	48	**6**
63	62	61	60	59	58	57	56	**7**

Example:

7	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
7	6	5	4	3	2	1	0	**0**
15	14	13	12	11	10	9	8	**1**

--------------------------<lsb

23	22	21	20	19	18	17	16	**2**

      msb<----------------

31	30	29	28	27	26	25	24	**3**
39	38	37	36	35	34	33	32	**4**
47	46	45	44	43	42	41	40	**5**
55	54	53	52	51	50	49	48	**6**
63	62	61	60	59	58	57	56	**7**

In this example, a twelve-bit long message begins at start bit 9, that is to say, the lsb of the LSB is at position 9, counting upward from the start of the message.

8.2   Forwards Motorola

i   **Important**

The correct message byte length must always be specified for messages with Motorola signals!

The start bit indicates the position of the least significant bit, lsb. The byte-counting method for forwards Motorola is the same as for Intel format.

Example:

7	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
7	6	5	4	3	2	1	0	**0**
15	14	13	12	11	10	9	8	**1**
	msb<----------------							
23	22	21	20	19	18	17	16	**2**
----------------------<lsb								
31	30	29	28	27	26	25	24	**3**
39	38	37	36	35	34	33	32	**4**
47	46	45	44	43	42	41	40	**5**
55	54	53	52	51	50	49	48	**6**
63	62	61	60	59	58	57	56	**7**

In this example, a twelve-bit long Motorola message begins at start bit 18, that is to say, the lsb of the LSB is at position 9, counting upward from the start of the message.

8.3   Backwards Motorola

The start bit indicates the position of the least significant bit, lsb. The byte-counting sequence is reversed:

7	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
56	57	58	59	60	61	62	63	**7**
55	54	53	52	51	50	49	48	**6**
47	46	45	44	43	42	41	40	**5**
39	38	37	36	35	34	33	32	**4**
31	30	29	28	27	26	25	24	**3**
23	22	21	20	19	18	17	16	**2**
15	14	13	12	11	10	9	8	**1**
7	6	6	4	3	2	1	0	**0**

Example:

7	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
56	57	58	59	60	61	62	63	**7**
55	54	53	52	51	50	49	48	**6**
		msb<----------------						
47	46	45	44	43	42	41	40	**5**
----------------------<lsb								
39	38	37	36	35	34	33	32	**4**
31	30	29	28	27	26	25	24	**3**
23	22	21	20	19	18	17	16	**2**
15	14	13	12	11	10	9	8	**1**
7	6	6	4	3	2	1	0	**0**

In this example, the same twelve-bit long Motorola message as in the forwards Motorola example begins, but at start bit 42, that is to say, the lsb of the LSB is at position 42, counting upward from the end of the message.

8.4   Internal CANdb Motorola

In the CAN database for Motorola format, the position of the msb from the MSB is stored with the byte-counting method of Intel or forwards Motorola. The ML71B also expects this detail when the messages are configured manually. For Intel, the lsb of the LSB is stored here, as it is above.

Example:

7	6	5	4	3	2	1	0	
7	6	5	4	3	2	1	0	**0**
15	14	13	12	11	10	9	8	**1**
	msb<--------------------							
23	22	21	20	19	18	17	16	**2**
----------------------<lsb								
31	30	29	28	27	26	25	24	**3**
39	38	37	36	35	34	33	32	**4**
47	46	45	44	43	42	41	40	**5**
55	54	53	52	51	50	49	48	**6**
63	62	61	60	59	58	57	56	**7**

The twelve-bit long Motorola message from the above examples begins in this counting method at start bit 13, that is to say, the msb of the MSB is at position 13, counting upward from the start of the message.

For more information, refer to the Online Help of the Vector Database Editor in the ”Intel and Motorola formats in CANdb” section.

Practical tip

The database editor provides an extremely helpful presentation of the individual message bits. When defining a signal, you can use the ”Display Message Assignment” button to check whether the entered start bits have led to the correct signal location within the message.

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