SCHUNK Motion

SCHUNK

8th March 2010

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1.00	03.09.2007	Created
1.01	29.10.2007	Revised
1.15	23.01.2008	Added description SRV
1.16	31.01.2008	Adapted to firmware V1.10
1.17	11.02.2008	Corrected specification of SRV
1.18	18.03.2008	Typos corrected
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1.40	10.12.2009	Adapted to firmware V1.40
1.41	08.03.2010	Adapted to firmware V1.41

Contents

Chapter 1

General

1.1 Electrical connection

The module is equipped with separate input terminals for the motor voltage and the logic control voltage (24V DC). We recommend connecting the terminals to two separate power supplies so that the logic control continues to operate even if there is an overload at the motor, ensuring that the motor status is known at all times. For modules with a motor voltage $>$ 24V DC, the connections must be separated as the logic control voltage must be between 18 and 32V DC.

Risk of permanent damage to the electronics! *When using separate power supplies, provide for potential equalization between the two supply systems (connect earth conductors).*

With separate power supply lines to the logic control and the motor, the control can switch off the power to the motor by means of a relay, while the module remains activated through the bus system.

The motor must be supplied through a power supply unit, which provides the current required by the respective module. All cables must have the necessary cross-section.
The voltage drop along the cable can be calculated with the following formula:
$\Delta U = \frac{2*I*l}{\gamma*A}$ where :
I: Current consumption of motor
l: Length of line
γ : Electrical conductivity
$Cu : \gamma = 56\frac{m}{\Omega*mm^2}$

$Al : \gamma = 35 \frac{m}{\Omega * mm^2}$
A: Conductor cross-section

The upper description does not apply for the SRV image processing sensor, for which the specific user's manual is to be consulted. The present document describes, in conjunction with the SRV, only the communication with the SCHUNK Motion Protocol via the serial RS232 connection, see „SRV image processing sensor" (section 2.6) .

1.2 Indicators

All modules are equipped with 3 LED indicators.

In some models, these indicators are not led to the outside of the housing and are thus only visible when the module is opened.

The green LED (POW LED) indicates the motor voltage status. If the LED is not on or only flickers faintly, check the motor supply voltage (24 -48 V DC). The two other LEDs (green and red) indicate the status of the logical circuits:

LED1 (green)	LED2 (red)	Interpretation
continuously on	continuously on	Module is in *flash mode* (section 2.5.4) or no bus system active.
continuously on	flashing	New firmware is programming
briefly on, then off	briefly on, then off	Module booted.
on	off	Module is ready for operation and bus system is active.
flickering	off	Data is being exchanged.
off	off	No logic control voltage. If both LEDs were briefly on (booting phase), the connected bus system could not be initialized. Check bus cable. Is the master active?
off	on / flashing	An *error* (section 2.8.1.1) occurred in the module.
off / on	on / off	Profibus is active, but not yet in ”Data Exchange” mode, or automatic interface detection running.
flickering	flashing / flickering	Data is exchanged on the ”main interface”, while the *diagnostic interface* (section 1.5.2) is active, so that data is also exchanged through this interface.
fast off / on	fast on / off	Firmware status undefined (should never occur).

1.2.1 Factory settings

If the module is reset to the factory settings, the following values in the EEPROM are overwritten and reset:

- ID
  reset to default ID. (gripper: 12)
- CAN baud rate
  reset to default CAN baud rate (500 [kBaud]).
- RS232 baud rate
  reset to default RS232 baud rate (9600 [Baud]).
- Communication system
  reset to default communication system (RS232).

1.2.2 Booting

After successful booting of the module, a number of parameters for movements are already set to the start values. This allows the operator to start module operation without the need to first set all parameters. The following parameters are automatically set during booting:

- *„TargetVel”* (section 2.1.14)
  in [%] of *maximum value* (section 3.2.1.10) . -> 10%
- *„TargetAcc”* (section 2.1.15)
  in [%] of *maximum value* (section 3.2.1.11) . -> 10%
- *„TargetJerk”* (section 2.1.16)
  in [%] of *maximum value* (section 3.2.1.12) . -> 50%
- *„TargetCurrent”* (section 2.1.17)
  Nominal current (section 3.2.1.9) .
- *impulse messages* (section 2.2.6) activated.
- User is set to ”User”.

The upper description does not apply for the SRV image processing sensor, for which the specific user’s manual is to be consulted. The present document describes, in conjunction with the SRV, only the communication with the SCHUNK Motion Protocol via the serial RS232 connection, see „SRV image processing sensor” (section 2.6) .

1.3 Protocol

1.3.1 Data format

Data is sent by the modules in Intel format (”little Endian”) and interpreted in this format upon reception.

If there is any uncertainty about the endianness when setting up the own driver, use „CHECK MC PC COMMUNICATION” (section 2.5.7) , or „CHECK PC MC COMMUNICATION” (section 2.5.8) with predefined test data.

1.3.1.1 Floating point values

The IEEE „Standard for Binary Floating-Point Arithmetic" (IEEE 754) was developed in the early 1980s in order to cater for consistent floating point representation in different computer architectures. If parameters are sent as floating point numbers to/from the modules, this standard applies. A floating point number is thereby represented as a 32-bit value.

Plus/minus sign bit 1 bit (bit 32)	Exponent 8 bit (bit 23.. bit 30)	Mantissa (standardized) 23 bit (bit 1.. bit 22)
s	e	f

As the mantissa is always set to "1", only the decimals are stored, as the leading "1" does not need to be recorded. A floating point value can thus be calculated as follows:

$$(-1)^s * 2^{e-127} * (1.f)_{bin}$$

Examples:

	Sign 1 bit	Exponent 8 bit	Mantissa 23 bit
7/4	0	01111111	11000000000000000000000
-34.432175	1	10000100	00010011011101010001100
-959818	1	10010010	11010100101010010100000
+0	0	00000000	00000000000000000000000
-0	1	00000000	00000000000000000000000
$2^{-126}, or 1.175 * 10^{-38}$ Smallest positive number	0	00000001	00000000000000000000000
$(2-2^{-23})\ 2^{127}, or 3.403 * 10^{38}$ Largest positive number	0	11111110	11111111111111111111111
infinite	0	11111111	11111111111111111111111
NaN	0	11111111	not all „0" or „1"
Macheps $2^{-23}, oder 1.192 * 10^{-7}$ Smallest distinct number	0	01101000	00000000000000000000000
2^{-128}	0	00000000	01000000000000000000000

1.3.1.2 Two's complement

The two's complement offers a way of displaying negative numbers in the binary system. In the module, the two's complement is used for the representation of negative integers. (*Integer system* (section 1.4)).

Positive numbers are represented as two's components with a leading 0 (sign bit). They are not further encoded. Negative numbers are represented with a leading 1 (sign bit) and encoded as follows: all digits of the corresponding positive figure are negated. The value 1 is added to the result. Example of the conversion of the negative decimal figure -4_{dec} in a two's complement:

1. Ignore sign and convert to binary system: $4_{\text{dec}} = 00000100_{\text{bin}} = 0x04_{\text{hex}}$
2. Invert, as the value is negative: $11111011_{\text{bin}} = 0xFB_{\text{hex}}$
3. Add 1, as figure is negative: $11111011_{\text{bin}} + 00000001_{\text{bin}} = 11111100_{\text{bin}} = 0xFC_{\text{hex}} = -4_{\text{dec}}$

Or more mathematically:
Is x is a negative number, x is represented as a two's complement (x_{z}) with n digits as follows:

$$x_z = 2^n - |x|$$

This means that the following equation applies:

$$x_z + |x| = 2^n$$

As the module, when set to *„Integer system"* (section 1.4) always works with Int32 (4 bytes), the byte sequences of negative numbers x (e.g. -112) can be calculated easily as follows:

$$y = 4294967296_{dec} - |x| \Rightarrow y = 4294967296_{dec} - 112_{dec} = 4294967184_{dec}$$

$$y = 0x100000000_{hex} - |x| \Rightarrow y = 0x100000000_{hex} - 0x70_{hex} = 0xFFFFFF90_{hex}$$

1.3.2 Data frame

The data frame of the motion protocol always contains the following elements.

- D-Len (1 byte)
- Command Code (1 byte)

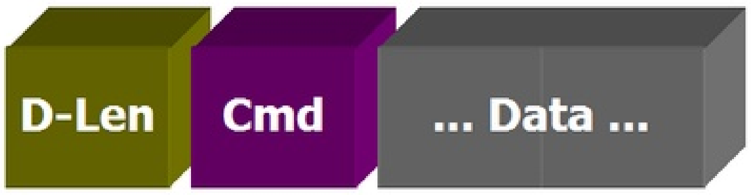


Figure 1.1: Data frame

D-Len (data length) indicates the number of subsequent useful data items including the command byte. The data frame consists of one byte, so that a motion protocol message can consist of maximum 255 data bytes.

The D-Len byte is always followed by the command code consisting of one byte. The command code is followed by the required parameters, if any. If necessary, a ”super command” is complemented with a ”sub command”.

All commands are immediately acknowledged with a response (acknowledge) when they are received by the module. This response also conforms to the above described data frame format (D-Len, command code, parameters). After the request has been processed successfully, D-Len is always > ”0x02” or = ”0x01”. If the request was not successful, D-Len is always ”0x02”. The following bytes indicate the cause of the *unsuccessful request* (section 2.8.2) .

These modules also issue messages if there was not previous request. The format of these ”impulse messages” also conform to the above data frame. The following events trigger impulse messages.

- A serious error occurred.
- A motion was completed successfully.
- Regular *status messages* (section 2.2) , if activated.

1.3.3 Special requirements with RS232

As the RS232 was not intended as a bus system when devised, a number of elements must be added to the data frame in order to enable several modules to communicate through a single serial interface.

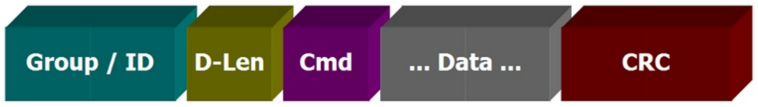


Figure 1.2: RS232 data frame

The data frame is followed by two bytes (group/ID) indicating the module to be targeted or the module that sent the response. Only the first three bits of the first byte are used. The second byte constitutes a unique module ID. => up to 255 different modules can be addressed. The first three bits of the first byte are encoded as follows:

- 0x03 Error signal from module
- 0x05 Message from master to a module
- 0x07 Response from module

The other statuses are not used.

The method of uniquely identifying a module with 11 bits has been adopted for the CAN protocol.

In order to ensure reliable data transfer with RS232, a checksum (CRC16 => 2 bytes) of all data including group/ID, D-Len and Cmd is attached at the end of the data frame. An algorithm for the calculation of a CRC 16 checksum is included in the *appendix* (section 6.2) . As RS232 is not a real bus system but can be wired like a bus system, there is a risk of data collision if several modules are simultaneously sending data to the master. Such collisions can however be easily detected and the necessary measures can be taken in order to clearly identify the status of all modules. If a large number of modules are operated on one "branch", it might be necessary to *disable* (section 2.2.6) *impulse message* (section 2.2) .

1.3.4 Special requirements with CAN

CAN is a message-oriented bus system. In addition to the data frame, it therefore requires identifiers that uniquely identify each message The modules support the standard 11-bit identifier. The low 8 bits are thereby used for the unique module ID => up to 255 different modules can be addressed. The remaining unassigned 3 bits are encoded as follows:

- 0x03 Error signal from module
- 0x05 Message from master to a module
- 0x07 Response from module

The other statuses are not used.

- A message sent to the module thus contains the following identifier: 0x5*XX*. (*XX* module address in hex format).
- A message sent by the module contains the following identifier: 0x7*XX*. (*XX* module address in hex format)
- In the event of an error, the messages from the module to the master are equipped with the identifier: 0x3*XX*. (*XX* module address in hex format)

At most 8 data bytes can be sent with a CAN message. Under certain circumstances, it might be necessary to combine several CAN messages in a longer data frame (D-Len > 7). This can be done with the *fragmentation protocol* (section 1.3.6) .

Fragmentation is normally not necessary, as all commands required for the proper operation of the modules can be encoded in single CAN messages.

1.3.5 Special requirements with Profibus

The following must be observed with Profibus PDV0: The maximum length of a data packet transferred from the master to a module is 8 bytes. This is sufficient for the proper control of the module (maximum 7 bytes are required for a message from the master to the module).

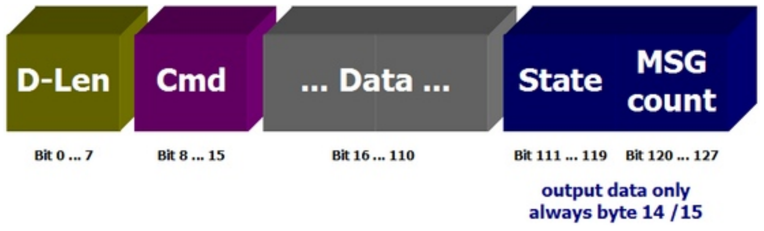


Figure 1.3: Profibus data frame

The maximum length of the data packet sent from the module to the master (reply) is limited to 16 bytes (GSD file). To send / receive larger data packets, you might need to use *fragmentation* (section 1.3.6) . With 16 bytes, the longest message from the module to the master occurring during normal operation (14 bytes) can be catered for. The remaining 2 bytes that are always found at the end of the Profibus message (bytes 14 and 15) indicate

1. the current *state* (section 2.5.1) of the module (byte 14) and

2. command counter (MsgCount) (byte 15)

[1]

[1] In fragmented messages, these two bytes are used for data.

Only the high 8 bits of the status word are written. The error code is omitted. For errors, Profibus offers extended diagnostics. The error code (section 2.8.1.1) is included in the output data.

For messages sent by the master to the module, a response is sent and the MsgCount is incremented by 1. This ensures that each request is acknowledged, event if there are impulse messages.

Impulse messages (section 2.2) do not increase the MsgCount!

If the position in which the module is currently found is to be achieved, the module replies with "command received" followed instantly with "position reached" in the next Profibus cycle. As the control system connected with the Profibus might not query data with each Profibus cycle, the acknowledge messages might be lost during the motion command. The MsgCount ensures that an acknowledgment of the request is received. The *status byte* (section 2.5.1) (byte 14) contains up-to-date information regarding the status of the module.

The last bit of the MsgCount can be evaluated as a toggle bit (module to master messages.). For data transfer from the master to the module, the not yet used byte 8 can be used as the toggle byte, or bit 63 can be used as toggle bit.

Groups are fully supported by the SYNC, FREEZE mechanism implemented in Profibus.
Addresses can be changed at any time with the "Set Slave Address" (SAP 55) service. "Real No Add Change" is stored in the *group byte* (section 3.2.5.14) gespeichert. A set "Real No Add Change" (0xFF) can thus be deleted by *reconfiguring the group byte* (section 2.3.1) .

If consistent data transfer is not possible, the module can be operated as follows:

1. Use SYNC, UNSYNC mechanism.
2. Set D-Len to "0". Fill up all data and set D-Len when all data is added.

1.3.6 Fragmentation

During normal operation, messages do not need to be fragmented!

If messages need to be fragmented, proceed as follows:

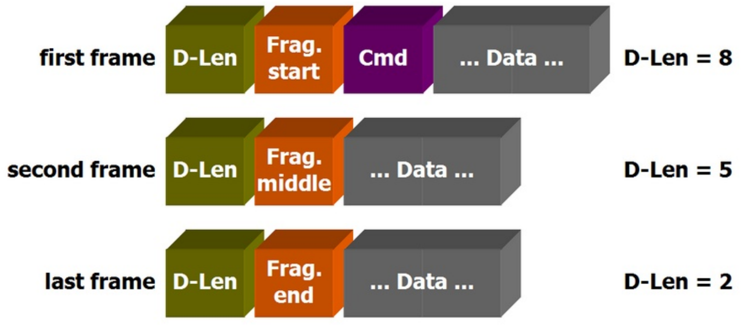


Figure 1.4: Fragmentation

At the start of each message, the length of the subsequent useful data is transmitted. Subsequently, a fragmentation code is sent. This fragmentation code is **not** included in the length byte (D-Len).

- FragStart -> *first fragment* (section 2.7.2) .
- FragMiddle -> *middle fragment* (section 2.7.3) .
- FragEnd -> *last fragment* (section 2.7.4) .

These individual fragments can thus be recombined to form a complete *data frame* (section 1.3.2) , which can be subsequently interpreted.

1.3.6.1 Special requirements for Profibus

With Profibus, a ”token” is constantly transmitted through the system, from which the respective subscribers take the data applicable to them and to which the subscribers write the data for the master, each received fragment must be acknowledged with *„FRAG ACK”* (section 2.7.1) and the D-Len byte of the received fragment. When a fragmented message is sent to the master, each fragment must be acknowledged by the master with ”FRAG ACK” and the D-Len byte of the received fragment, so that the module can dispatch the next module. If a fragmented message is sent by the master to the module, the next fragment can only be dispatched when the module has acknowledged the receipt of the

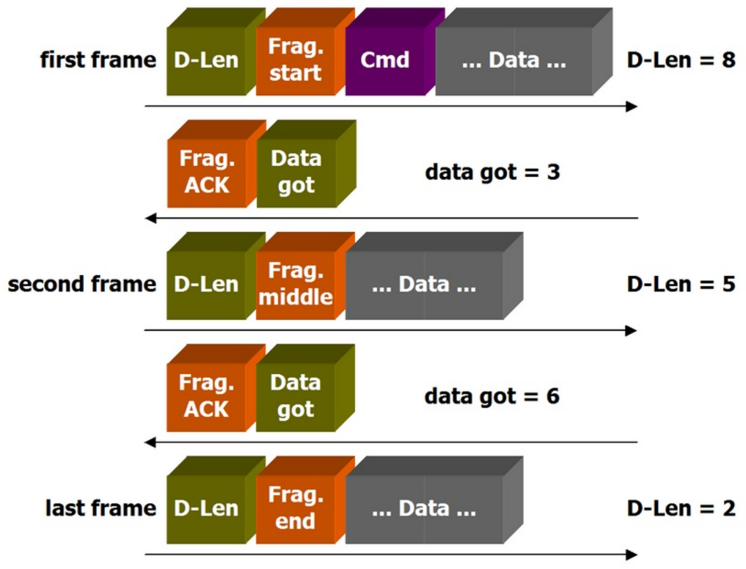


Figure 1.5: Fragmentation for Profibus

previous one (with ”FRAG ACK” and the D-Len byte of the received fragment). The last fragment must not be acknowledged.

1.4 Unit system

All parameter data that refer to units are transmitted with reference to the *preset unit system* (section 3.2.5.2) . The following unit systems can be set:

1.4.1 Float

- $[mm]$ all parameters values are transmitted as float values => position $[mm]$, velocity $[\frac{mm}{s}]$, acceleration $[\frac{mm}{s^2}]$, jerk $[\frac{mm}{s^3}]$, current values $[A]$, times $[s]$
- $[m]$ all parameters values are transmitted as float values => position $[m]$, velocity $[\frac{m}{s}]$, acceleration $[\frac{m}{s^2}]$, jerk $[\frac{m}{s^3}]$, current values $[A]$, times $[s]$
- $[Inch]$ all parameters values are transmitted as float values => position $[Inch]$, velocity $[\frac{Inch}{s}]$, acceleration $[\frac{Inch}{s^2}]$, Ruck $[\frac{Inch}{s^3}]$, current values $[A]$, times $[s]$

- $[rad]$ all parameters values are transmitted as float values =>
position $[rad]$, velocity $[\frac{rad}{s}]$, acceleration $[\frac{rad}{s^2}]$, jerk $[\frac{rad}{s^3}]$, current values $[A]$, times $[s]$
- $[Degree]$ all parameters values are transmitted as float values =>
position $[Degree]$, velocity $[\frac{Degree}{s}]$, acceleration $[\frac{Degree}{s^2}]$, jerk $[\frac{Degree}{s^3}]$, current values $[A]$, times $[s]$
- $[intern]$ all parameters values are transmitted as float values =>
position $[intern]$, velocity $[\frac{intern}{s}]$, acceleration $[\frac{intern}{s^2}]$, jerk $[\frac{intern}{s^3}]$, current values $[A]$, times $[s]$

All data in this unit system is calculated internally with a system that is based on the motor revolutions. The gear transmission ratios are not taken into account.

This system should only be used for testing purposes!

1.4.2 Integer

- $[\mu m]$ values are transmitted as integer values =>
position $[\mu m]$, velocity $[\frac{\mu m}{s}]$, acceleration $[\frac{\mu m}{s^2}]$, jerk $[\frac{\mu m}{s^3}]$, current values $[mA]$, times $[ms]$
- $[\mu Degree]$ values are transmitted as integer values =>
position $[\mu Degree]$, velocity $[\frac{\mu Degree}{s}]$, acceleration $[\frac{\mu Degree}{s^2}]$, jerk $[\frac{\mu Degree}{s^3}]$, current values $[mA]$, times $[ms]$
- $[\mu Inch]$ values are transmitted as integer values =>
position $[\mu Inch]$, velocity $[\frac{\mu Inch}{s}]$, acceleration $[\frac{\mu Inch}{s^2}]$, jerk $[\frac{\mu Inch}{s^3}]$, current values $[mA]$, times $[ms]$
- $[Milli-degree]$ values are transmitted as integer values =>
position $[Milli{-}degree]$, velocity $[\frac{Milli-degree}{s}]$, acceleration $[\frac{Milli-degree}{s^2}]$, jerk $[\frac{Milli-degree}{s^3}]$, current values $[mA]$, times $[ms]$

The configuration data (section 3.2) and the associated units must also be transmitted with the respective unit system!

1.5 Users

The module is equipped with a user management feature in order to provide particular protection for certain actions. The users can be switched via *„CHANGE USER"* (section 2.5.6) . The SRV image processing sensor is not equipped with a user management feature; all of the functions available here via the Motion Protocol can be accessed without password.

1.5.1 User

Is the Standard User, which is always activated when the module is switched on. This can operate the module completely. Parameterization is permitted only for the most important *parameters* (section 3.2) .

1.5.2 Diag

Is the Diagnostics User. If one logs in this user, then a further interface ´ [2] will open. Bus traffic on the Primary Interface can be recorded through this or targeted information can also be called up to a very limited extent. Parameterization of the modules is possible.

Please note! No active control of the modules is possible!

If the Diagnostics User is *activated* (section 2.5.6) through the primary interface, then a „Record" is active. The command *„CMD TOGGLE IMPULSE MESSAGE"* (section 2.2.6) can be used to switch the status of the secondary interface from „eavesdropping" to „active". The command must be sent via the secondary interface. Commands can be sent via the secondary interface when in „active" status. If the module is in fault status, then the opportunity exists of registering at the module directly as *Diagnostics User* (section 2.5.6) via the secondary interface. The status of the secondary interface is then active. With the command *„CMD TOGGLE IMPULSE MESSAGE"* (section 2.2.6) , the status of the secondary interface can be switched from „active" to „eavesdropping".

[2] CAN or PROFIBUS active => RS232 is also opened; RS232 active => CAN will be opened in addition

1.5.3 Profi

Is the Professional User, who has the complete functional range of „user” and who can also adjust additional parameters. Incorrect parameterization can lead to unanticipated behavior on the part of the module. The module cannot however be destroyed. The standard password for the profi-rights is „Schunk”.

1.5.4 Advanced

Is the Advanced User, who has the complete functional range of „profi” and who can also adjust additional parameters.

Incorrect operation or an incorrect parameterization could lead to the destruction of either the electronics or of the motor.

1.5.5 Root

Is the Root User, who has full access to the module. All of the parameters can be adjusted and additional functions are accessible for testing purposes.

Incorrect operation or an incorrect parameterization could lead to the destruction of either the electronics or of the motor.

1.6 Pseudo absolute value transmitter

1.6.1 Requirements

Following requirements are needed for pseudo absolute value transmitter:

- Encoder with index or resolver
- brake
- FRAM (*hardware version* (section 2.3.2) odd)

1.6.2 Function

Actual position is saved to non-volatile memory evry time brake switched on. When loosing logic power module try to save actual position so long enough energy is available.

1.6.2.1 Resolver

After powering up modul compares saved positon with saved controll value. Are this values equal, the saved positon value is compared with the actual resolver position. If both positions equal no referencing is necessary.

When resolver is rotated exactly one turn, when power lost, the actual position is the wrong one.

1.6.2.2 Encoder with index

After powering up modul compares saved positon with saved controll value. Are this values equal, the saved positon is set to actual position. The difference to the index is calculated. With the next moving command the calculated distance is compared with the real moved distance to the next index. If both values equal the module needs not to be referenced. After the first movement command the index must reached in a certain time. If an error occures while moving to index the reference is lost.

When encoder is turned when power is lost it can happen, that module moves to next index with wrong position. (max. one motor turn)

When encoder is rotated exactly one turn, when power lost, the actual position is the wrong one.

1.7 Standstill commutation

1.7.1 Requirements

- Motor type *PMSM* (section 3.2.1.3)
- Encoder with index
- Hallelements

The movement direction by the block commutation and by the space vector modulation must be the same! When the movement direction is different, the motor phases are to change, and the *commutation table* (section 3.2.1.13) is to adjust.

Check movment direction from block-commutation and sine-commutation. They must be the same. If not change phases and check commutation table (section 3.2.1.13) .

1.7.2 Function

If all requirements are fullfilled module will activate standstill commutation. Modules with absolute value transmitter can move directly with sine-commutation. Position of sine-vector is known.
Modules with encoder know the sine-vector at the index. So the module will start with block-commutation an switched to sine-commutation on the index. The position of the sine-vector can adjusted with the parameter *positioning offset* (section 3.2.6.6) . Setting this value to „0" causes a new sine-vector search.

When starting a sine-vector search modul should be free in all directions. Module is moving up to two motor turns. Communication is not possible while sine-vector search.

Chapter 2

Commands

Each example is illustrated with the data frame. The special features and requirements of the various bus systems are described in *chap.* (section 1.3.3) . For a number of selected examples, the special features of the various bus systems are shown in the beschrieben *appendix* (section 6.1) .

All examples are based on the assumption that the unit system [*mm*] *is set.*

In all examples, only the *mandatory parameters* are shown, while the *optional parameters* are not shown.„M" stands for master and „S" stands for slave (= module).

2.1 Motion

2.1.1 CMD REFERENCE (0x92)

Code: 0x92
Description: A reference movement is completed. The type of referencing is set in the *configuration data* (section 3.2.3) .
Parameter (master -> slave): none
Response (slave -> master): „OK" (0x4F4B)) if successful. Module executes command.

Example:

	D-Len	Cmd	Param
M->S	0x01	0x92	
S->M	0x03	0x92	0x4F 0x4B

Note: Impulse responses might occur. Depending on the referencing method, *„CMD MOVE BLOCKED”* (section 2.2.2) or *„CMD POS REACHED”* (section 2.2.3) might be transmitted, depending on the *„MOVE ZERO AFTER REFERENCING”* (section 3.2.3.6) flag. The set flag triggers a positioning movement after referencing *„CMD POS REACHED”* (section 2.2.3) .

2.1.2 CMD REFERENCE HAND (0x97)

Code: 0x97
Description: A manual referencing activity is executed.
If necessary, some initializing movements executed (space vector search, index track search). The next referencing mode is notified with the *CMD WARNING* (section 2.8.1.2) and the code *„NOT REFERENCED”* (section 2.8.2.6) . Sending „CMD REFERENCE HAND” again causes the jog mode for the module. In this mode the user can use *„MOVE POS TIME REL”* (section 2.1.6) for adjusting the position to a reference mark. The configured referencing *acceleration* (section 3.2.3.4) and *velocity* (section 3.2.3.3) may not be exceeded! This step is to be confirmed by the user with „CMD REFERENCE HAND” again. The actual position will be set to the *referencing offset* (section 3.2.3.5) . The manual referencing is completed.
Parameter (master -> slave): none
Response (slave -> master): „OK” (0x4F4B)) if successful. Module executes the next referencing step.
Example:

	D-Len	Cmd	Param			
M->S	0x01	0x97				
S->M	0x03	0x97	0x4F 0x4B			
S->M	0x02	0x89	0x06			Initializing completed
M->S	0x01	0x97				
S->M	0x02	0x97	0x06			Jog mode activated
M->S	0x05	0xB9	0xCD	0xCC	0x4C	Jog movement
			0x3E			
.						
.						
.						
M->S	0x01	0x97				
S->M	0x03	0x97	0x4F 0x4B			Reference mark is set

Note: The manual referencing mode is cancelable with *CMD STOP* (section 2.1.19) . The setting *„MOVE ZERO AFTER REFERENCING”* (section 3.2.3.6) is ignored. The target current is set to nominal.

After a successful execution of the manual referencing, the referencing type is set to „Manual”.

The manual referencing activity can be easily done with MCDemo (section 4.4.4) durchfüren

The reference mark is still known mostly after the module started next time. See „Pseudo absolute value transmitter" (section 1.6)

2.1.3 MOVE POS (0xB0)

Code: 0xB0
Description: The module is moved to the preset position. The position is set in the configured *unit system* (section 1.4) vorgegeben. The positioning movement is based on the *configured motion profile* (section 3.2.5.6)
Parameter (master -> slave):

- *Position* in configured unit system (must be specified).
- Velocity (section 2.1.14) (optional) used for the positioning movement. For motion profiles, *„No Ramp"* (section 3.2.5.6) is not relevant.
- Acceleration (section 2.1.15) (optional) used for the positioning movement. For motion profiles, *„No Ramp"* (section 3.2.5.6) is not relevant.
- Current (section 2.1.17) (optional) that must not be exceeded during the positioning movement. If controller structure *„CURRENT SPEED"* (section 3.2.4.7) is enabled, this value must be transmitted (as jerk is necessary). The value must be set to "0", as signal *„INFO WRONG PARAMETER"* (section 2.8.2.14) occurs otherwise.
- *Jerk* (optional) used for the positioning movement. If a motion profile other than *„JERK"* (section 3.2.5.6) is to be used, this value cannot be transmitted (*„INFO WRONG PARAMETER"* (section 2.8.2.14)).

Response (slave -> master): If possible, the time required for the module to complete the movement is returned. If the time cannot be calculated (e.g. with motion profile *„No Ramp"* (section 3.2.5.6)), the successful request is acknowledged with "OK" (0x4F4B). Module executes command.
Example:

	D-Len	Cmd	Param			
M->S	0x05	0xB0	0x00 0x41	0x00	0x20	Move to position 10.0 [mm]
S->M	0x05	0xB0	0xCD 0x41	0xCC	0x04	Position will be reached in 8.3 [sec.]

Note: Impulse response is generated when position *„CMD POS REACHED"* (section 2.2.3) is reached or if positioning movement *„MOVE ZERO AFTER REFERENCING"* (section 3.2.3.6) is aborted before this position is reached. All parameters must be transmitted in the sequence shown here. If only the current is preset, the velocity and the acceleration must be specified. Subsequent parameters do not need to be transmitted. All parameters remain stored until they are modified or the system is restarted.

If new positioning parameters are entered during a movement, the motion might be temporarily halted. If you wish to enter new positions while movements are carried out, e.g. to move along curves, use the „MOVE POS TIME" (section 2.1.5) command

2.1.4 MOVE POS REL (0xB8)

Code: 0xB8
Description: The module is moved realtiv from start position. The displacement value is set in the configured *unit system* (section 1.4) . The relative positioning movement is based on the *configured motion profile* (section 3.2.5.6)
Parameter (master -> slave):

- *Displacement* in configured unit system (must be specified).
- Velocity (section 2.1.14) (optional) used for the positioning movement. For motion profiles, *„No Ramp"* (section 3.2.5.6) is not relevant.
- Acceleration (section 2.1.15) (optional) used for the positioning movement. For motion profiles, *„No Ramp"* (section 3.2.5.6) is not relevant.
- Current (section 2.1.17) (optional) that must not be exceeded during the positioning movement. If controller structure *„CURRENT SPEED"* (section 3.2.4.7) is enabled, this value must be transmitted (as jerk is necessary). The value must be set to "0", as signal *„INFO WRONG PARAMETER"* (section 2.8.2.14) occurs otherwise.
- *Jerk* (optional) used for the positioning movement. If a motion profile other than *„JERK"* (section 3.2.5.6) is to be used, this value cannot be transmitted (*„INFO WRONG PARAMETER"* (section 2.8.2.14)).

Response (slave -> master): If possible, the time required for the module to complete the movement is returned. If the time cannot be calculated (e.g. with motion profile *„No Ramp"* (section 3.2.5.6)), the successful request is acknowledged with "OK" (0x4F4B). Module executes command.
Example:

	D-Len	Cmd	Param	
M->S	0x05	0xB8	0x00 0x00 0x20 0x41	Move a distance of 10.0 [mm]
S->M	0x05	0xB8	0xCD 0xCC 0x04 0x41	Target position will be reached in 8.3 [sec.]

Note: Impulse response is generated when position *„CMD POS REACHED"* (section 2.2.3) is reached or if positioning movement *„MOVE ZERO AFTER REFERENCING"* (section 3.2.3.6) is aborted before this position is reached. All parameters must be transmitted in the sequence shown here. If only the current is preset, the velocity and the acceleration must be specified. Subsequent parameters do not need to be transmitted. All parameters remain stored until they are modified or the system is restarted.

If new positioning parameters are entered during a movement, the motion might be temporarily halted. If you wish to enter new positions while movements are carried out, e.g. to move along curves, use the „MOVE POS TIME REL" (section 2.1.6) command

2.1.5 MOVE POS TIME (0xB1)

Code: 0xB1
Description: The module moves to fixed position. The position is set in the configured *unit system* (section 1.4) During the movement, new positions can be preset, which are then immediately moved to. When calculating the path, the nominal velocity and acceleration values as well as the actual velocity and acceleration values are taken into account. If the time parameter value is entered, the velocity and acceleration values are adjusted in such a way that the position is reached within the specified time, without exceeding the preset velocity and acceleration limits.
Parameter (master -> slave):

- *Position* in configured unit system (must be specified). The position must differ from the start position by at least *Delta Position* (section 3.2.4.6) .
- Velocity (section 2.1.14) (optional) that must not be exceeded.
- Acceleration (section 2.1.15) (optional) that must not be exceeded.

- Current (section 2.1.17) (optional) that must not be exceeded during the positioning movement. If the controller structure corresponds to *„CURRENT SPEED"* (section 3.2.4.7) , this value cannot not be transmitted (*„INFO WRONG PARAMETER"* (section 2.8.2.14)).
- Time (section 2.1.18) (optional) after which the positioning movement must be completed without exceeding the set velocity and acceleration limits.

Response (slave -> master): If possible, the time required for the module to complete the movement is returned. Module executes command.
Example:

	D-Len	Cmd	Param			
M->S	0x05	0xB1	0x00	0x00	0x20	Move to position
			0x41			10.0 [mm]
S->M	0x05	0xB1	0x00	0x00	0xA0	Position will be
			0x40			reached in 5.0 [sec.]

Note: Impulse response is generated when position *„CMD POS REACHED"* (section 2.2.3) is reached or if positioning movement *„MOVE ZERO AFTER REFERENCING"* (section 3.2.3.6) is aborted before this position is reached. All parameters must be transmitted in the sequence shown here. If only the current is preset, the velocity and the acceleration must be specified. Subsequent parameters do not need to be transmitted. All parameters remain stored until they are modified or the system is restarted. For these types of movement, the motion profile is set to *„Trapezoid"* (section 3.2.5.6) [1]

New position parameters can be entered while a movement is being completed. The new movement is subsequently calculated, based on the entered parameter values and the current actual velocity and acceleration values. This allows for curved paths.

2.1.6 MOVE POS TIME REL (0xB9)

Code: 0xB9
Description: The module is moved relatively from start position. The displacement value is set in the configured *unit system* (section 1.4) During the movement, new displacement value can be preset, which are then immediately moved to. When calculating the path, the nominal velocity and acceleration values as well as the actual velocity and acceleration values are taken into account. If the time parameter value is entered, the velocity and acceleration values are adjusted in such a way that the position is reached within the specified time,

[1]Due to computing time problems, curved paths can only be completed with this profile.

without exceeding the preset velocity and acceleration limits.
Parameter (master -> slave):

- *Displacement* in configured unit system (must be specified). The target position must differ from the start position by at least *Delta Position* (section 3.2.4.6) .
- Velocity (section 2.1.14) (optional) that must not be exceeded.
- Acceleration (section 2.1.15) (optional) that must not be exceeded.
- Current (section 2.1.17) (optional) that must not be exceeded during the positioning movement. If the controller structure corresponds to *„CURRENT SPEED"* (section 3.2.4.7) , this value cannot not be transmitted (*„INFO WRONG PARAMETER"* (section 2.8.2.14)).
- Time (section 2.1.18) (optional) after which the positioning movement must be completed without exceeding the set velocity and acceleration limits.

Response (slave -> master): If possible, the time required for the module to complete the movement is returned. Module executes command.
Example:

	D-Len	Cmd	Param	
M->S	0x05	0xB9	0x00 0x00 0x20 0x41	Move a distance of 10.0 [mm]
S->M	0x05	0xB9	0x00 0x00 0xA0 0x40	Target position will be reached in 5.0 [sec.]

Note: Impulse response is generated when position *„CMD POS REACHED"* (section 2.2.3) is reached or if positioning movement *„MOVE ZERO AFTER REFERENCING"* (section 3.2.3.6) is aborted before this position is reached. All parameters must be transmitted in the sequence shown here. If only the current is preset, the velocity and the acceleration must be specified. Subsequent parameters do not need to be transmitted. All parameters remain stored until they are modified or the system is restarted. For these types of movement, the motion profile is set to *„Trapezoid"* (section 3.2.5.6) [2]

New position parameters can be entered while a movement is being completed. The new movement is subsequently calculated, based on the entered parameter values and the current actual velocity and acceleration values. This allows for curved paths.

[2] Due to computing time problems, curved paths can only be completed with this profile.

2.1.7 MOVE POS LOOP (0xBA)

Code: 0xBA
Description: A cyclic execution of the command *MOVE POS* (section 2.1.3) . The module is moving in loop between the start position and the selected position.

2.1.8 MOVE POS TIME LOOP (0xBB)

Code: 0xBB
Description: A cyclic execution of the command *MOVE POS TIME* (section 2.1.5) . The module is moving in loop between the start position and the selected position.

2.1.9 MOVE POS REL LOOP (0xBC)

Code: 0xBC
Description: A cyclic execution of the command *MOVE POS REL* (section 2.1.4) . The module is moving in loop between the start position and the selected position.

2.1.10 MOVE POS TIME REL LOOP (0xBD)

Code: 0xBD
Description: A cyclic execution of the command *MOVE POS TIME REL* (section 2.1.6) . The module is moving in loop between the start position and the selected position.

2.1.11 MOVE CUR (0xB3)

Code: 0xB3
Description: A current movement is completed.
Parameter (master -> slave):

- *Current* in configured *unit system* (section 1.4) (must be specified).

Response (slave -> master): „OK" (0x4F4B) if successful. Module executes command.
Example:

	D-Len	Cmd	Param	
M->S	0x05	0xB3	0x00 0x00 0x60 0x40	Will complete current movement with 3.5 [A]
S->M	0x03	0xB3	0x4F 0x4B	

Note: impulse message (*„CMD MOVE BLOCKED"* (section 2.2.2) can be sent.

Due to the applied controller structures, the module might „run off". If it exceeds the configured maximum velocity (section 3.2.1.10) , an „ERROR TOW" (section 2.8.2.30) occurs for safety reasons.

With control structure (section 3.2.4.7) other than „Current Speed" this command is not required. All movement types come with automatically adjusted (section 2.1.17) current controllers

2.1.12 MOVE VEL (0xB5)

Code: 0xB5
Description: A velocity movement is completed.
Parameter (master -> slave):

- *Velocity* in configured unit system (must be specified).
- *Current* (optional) that must not be exceeded during the velocity movement. With controller structure *„CURRENT SPEED"* (section 3.2.4.7)), the message *„INFO WRONG PARAMETER"* (section 2.8.2.14) occurs. See also *SET TARGET CUR* (section 2.1.17) .

Response (slave -> master): „OK" (0x4F4B) if successful. Module executes command.
Example:

	D-Len	Cmd	Param	
M->S	0x05	0xB5	0x9A 0x99 0x31 0x41	Will complete velocity movement with 11.1 [$\frac{mm}{s}$].
S->M	0x03	0xB5	0x4F 0x4B	

Note: impulse message *„CMD MOVE BLOCKED"* (section 2.2.2) can be sent, if the module fails to move.

2.1.13 MOVE GRIP (0xB7)

Code: 0xB7
Description: A ”gripping” movement is done.
Parameter (master -> slave):

- *Current* in configured *unit system* (section 1.4) (must be speciffied).
- *Max. Velocity* (optional) in configured *unit system* (section 1.4) . This value can not be exceeded while moving. See *SET TARGET VEL* (section 2.1.14) .

Response (slave -> master): „OK” (0x4F4B) if successful. Module executes command.
Example:

	D-Len	Cmd	Param	
M->S	0x05	0xB7	0x00 0x00 0x60 0x40	Execute gripping with 3.5 [A]
S->M	0x03	0xB7	0x4F 0x4B	

Note: Current is increased until movement or given current is reached. Impulse message (*„CMD MOVE BLOCKED”* (section 2.2.2) can be sent.

Smooth gripping can be done by this command. Other possibilities for smooth gripping are velocity movement (section 2.1.12) or positioning movement (section 2.1.3) with current control (section 3.2.4.7) .

2.1.14 SET TARGET VEL (0xA0)

Code: 0xA0
Description: The velocity parameter is now set.
Parameter (master -> slave):

- *Velocity* in the configured *unit system* (section 1.4) .

Response (slave -> master): „OK” (0x4F4B) if successful.
Example:

	D-Len	Cmd	Param	
M->S	0x05	0xA0	0x33 0x33 0x43 0x41	Will set velocity to 12.2 $[\frac{mm}{s}]$
S->M	0x03	0xA0	0x4F 0x4B	

Note: After first successful configuration, this value remains stored until the module is restarted or the value is changed. Required for *„MOVE POS”* (section

2.1.3) , *„MOVE POS TIME”* (section 2.1.5) , *„MOVE POS REL”* (section 2.1.4) , *„MOVE POS TIME REL”* (section 2.1.6) , *„MOVE POS LOOP”* (section 2.1.7) , *„MOVE POS TIME LOOP”* (section 2.1.8) , *„MOVE POS REL LOOP”* (section 2.1.9) , *„MOVE POS TIME REL LOOP”* (section 2.1.10) .

2.1.15 SET TARGET ACC (0xA1)

Code: 0xA1
Description: The acceleration parameter is now set.
Parameter (master -> slave):

- *Acceleration* in the configured *unit system* (section 1.4)

Response (slave -> master): „OK” (0x4F4B)) if successful.
Example:

	D-Len	Cmd	Param	
M->S	0x05	0xA1	x33 0x33 0x43 0x41	Will set acceleration to 12.2 $[\frac{mm}{s^2}]$
S->M	0x03	0xA1	0x4F 0x4B	

Note: After first successful configuration, this value remains stored until the module is restarted or the value is changed. Required for *„MOVE POS”* (section 2.1.3) , *„MOVE POS TIME”* (section 2.1.5) , *„MOVE POS REL”* (section 2.1.4) , *„MOVE POS TIME REL”* (section 2.1.6) , *„MOVE POS LOOP”* (section 2.1.7) , *„MOVE POS TIME LOOP”* (section 2.1.8) , *„MOVE POS REL LOOP”* (section 2.1.9) , *„MOVE POS TIME REL LOOP”* (section 2.1.10) .

2.1.16 SET TARGET JERK (0xA2)

Code: 0xA2
Description: The jerk parameter is now set.
Parameter (master -> slave): *Jerk* in the configured *unit system* (section 1.4)
Response (slave -> master): „OK” (0x4F4B) if successful.
Example:

	D-Len	Cmd	Param	
M->S	0x05	0xA2	0x00 0x00 0x7A 0x44	Will set jerk to 1000.0 $[\frac{mm}{s^3}]$
S->M	0x03	0xA2	0x4F 0x4B	

Note: After first successful configuration, this value remains stored until the module is restarted or the value is changed. Required for *„MOVE POS”* (section 2.1.3) , *„MOVE POS REL”* (section 2.1.4) , *„MOVE POS LOOP”* (section 2.1.7) , *„MOVE POS REL LOOP”* (section 2.1.9) (motion profile *„Jerk”* (section 3.2.5.6)).

2.1.17 SET TARGET CUR (0xA3)

Code: 0xA3
Description: The current parameter is now set.
Parameter (master -> slave): *Current* in the configured *unit system* (section 1.4)
Response (slave -> master): „OK" (0x4F4B) if successful.
Example:

	D-Len	Cmd	Param	
M->S	0x05	0xA3	0xCD 0xCC 0x2C 0x40	Will set current to 2.7 [A]
S->M	0x03	0xA3	0x4F 0x4B	

Note: After first successful configuration, this value remains stored until the module is restarted or the value is changed. Required for *„MOVE POS"* (section 2.1.3) , *„MOVE POS TIME"* (section 2.1.5) , *„MOVE POS REL"* (section 2.1.4) , *„MOVE POS TIME REL"* (section 2.1.6) , *„MOVE POS LOOP"* (section 2.1.7) , *„MOVE POS TIME LOOP"* (section 2.1.8) , *„MOVE POS REL LOOP"* (section 2.1.9) , *„MOVE POS TIME REL LOOP"* (section 2.1.10) , *„MOVE VEL"* (section 2.1.12) .

Is only evaluated for movements, if this is permitted by the controller structure. Controller structure (section 3.2.4.7) „CURRENT SPEED" does not permit an overlayed current controlling.

2.1.18 SET TARGET TIME (0xA4)

Code: 0xA4
Description: The „time" parameter for the next *„MOVE POS TIME"* (section 2.1.5) command is now set.
Parameter (master -> slave):

- *Time* in the configured *unit system* (section 1.4)

Response (slave -> master): „OK" (0x4F4B)) if successful.
Example:

	D-Len	Cmd	Param	
M->S	0x05	0xA4	0x66 0x66 0x96 0x40	Will set time to 4.7 [s]
S->M	0x03	0xA4	0x4F 0x4B	

Note: Is applied for the next command *„MOVE POS TIME"* (section 2.1.5) , *„MOVE POS TIME REL"* (section 2.1.6) , *„MOVE POS TIME LOOP"* (section 2.1.8) or *„MOVE POS TIME REL LOOP"* (section 2.1.10) .

2.1.19 CMD STOP (0x91)

Code: 0x91
Description: The module is slowed down and held in the current position. For modules with *configured brake* (section 3.2.7.3) , this brake is applied. Otherwise the module is actively controlled.
Parameter (master -> slave): none
Response (slave -> master): „OK" (0x4F4B) if successful.
Example:

	D-Len	Cmd	Param
M->S	0x01	0x91	
S->M	0x03	0x91	0x4F 0x4B

Note: The command might trigger the impulse message *„CMD MOVE BLOCKED"* (section 2.2.2) .

2.1.20 CMD EMERGENCY STOP (0x90)

Code: 0x90
Description: The module is stopped as quickly as possible. If it is equipped with a brake that is *configured* (section 3.2.7.3) accordingly, this brake is applied immediately and the phases of the motor are short-circuited. The current supply to the motor is interrupted.
Parameter (master -> slave): none
Example:

	D-Len	Cmd	Param	
M->S	0x01	0x90		
S->M	0x02	0x88	0xD9	CMD ERROR ERROR EMERGENCY STOP

Response (slave -> master): The *„ERROR EMERGENCY STOP"* (section 2.8.2.29) error message is triggered.
Note: Can be reset with *„CMD ACK"* (section 2.8.1.4)

Risk of injury! *Modules that are not equipped with a brake might drop, as the motor is switched off by the emergency stop command!*

Emergency stops result in serious mechanical wear to the brake.

2.2 Impulse messages

Upon certain events, the module might generate an impulse message. These messages are sent through the standard *data frame* (section 1.3.2) (D-Len, CmdCode, parameters). The user has the option to *disable* (section 2.2.6) impulse messages.

With Profibus, the MsgCount is not increased by impulse messages, as the data is not requested by the control system.

2.2.1 CMD INFO (0x8A)

Code: 0x8A
Description: The module sends an information message. The module is fully operative.
Example:

	D-Len	Cmd	Param	
S->M	0x02	0x8A	0x10	*„INFO TIME-OUT"* (section 2.8.2.10)

Note: When quit a error and while booting the module sends information messages too. (*„INFO BOOT"* (section 2.8.2.1) , *„INFO NO ERROR"* (section 2.8.2.8))

2.2.1.1 SRV image processing sensor

The SRV image processing sensor transmits the following information/error codes as spontaneous messages:

- *„INFO BOOT"* (section 2.8.2.1)
- *„INFO READY"* (section 2.8.2.17)
- *„INFO TRIGGER"* (section 2.8.2.16)
- *„INFO PROGRAM CHANGED"* (section 2.8.2.20)
- *„INFO GUI CONNECTED"* (section 2.8.2.18)
- *„INFO GUI DISCONNECTED"* (section 2.8.2.19)

2.2.2 CMD MOVE BLOCKED (0x93)

Code: 0x93
Description: The module is standing still. Any previous movement is halted and the module is stopped.
Parameter (master -> slave): none
Response (slave -> master): *Position* (current position) in the configured *unit system* (section 1.4)
Example:

	D-Len	Cmd	Param	
S->M	0x05	0x93	0xA4 0x70 0x9D 0x3F	Will stand still in position 1.23 [mm]

Note: This message is generated each time a movement is aborted and the module is blocked (for example, while gripping an object). The requirements for a blocked state are:

- The module moved with velocity over *„Motion Threshold”* (section 3.2.6.7) .
- The velocity was under *„Motion Threshold”* (section 3.2.6.7) for at least 250 [ms].
- The difference between the measured and the given currents must be under a given threshold value.

2.2.3 CMD POS REACHED (0x94)

Code: 0x94
Description: The module is standing still. A positioning movement has reached the target position.
Parameter (master -> slave): none
Response (slave -> master): *Position* (current position) in the configured *unoit system* (section 1.4)
Example:

	D-Len	Cmd	Param	
S->M	0x05	0x94	0xCD 0xCC 0x2C 0x40	Have reached position 2.7 [mm].

2.2.4 CMD ERROR (0x88)

Code: 0x88
Description: A serious error requiring operator intervention has occurred. Such errors must be acknowledged with *„CMD ACK”* (section 2.8.1.4) The

module is not ready for operation. The motor is shut down. Such error messages are sent at regular intervals from the module to the control system (every 15 seconds).

- RS232: the first byte of the message is changed to „0x03”
- CAN: the first three bits of the identifier are changed to „0x3”
- Profibus: an extended diagnosis is generated.

Parameter (master -> slave): none
Response (slave -> master): Error code (section 2.8.2)
Example:

	D-Len	Cmd	Param	
S->M	0x02	0x88	0xDE	An *„ERROR CURRENT”* (section 2.8.2.36) occurred.

Risk of injury! *Modules that are not equipped with a brake might drop, as the motor is switched off by the emergency stop command!*

2.2.5 GET STATE (0x95)

Code: 0x95
Description: Returns the module status and other information, if requested. The module can automatically update this status at regular intervals. For details, see *„GET STATE”* (section 2.5.1) .

2.2.6 CMD TOGGLE IMPULSE MESSAGE (0xE7)

Code: 0xE7
Description: This command is used to enable/disable impulse messages.
Parameters (master -> slave): none
Response (slave -> master): Acknowledge the command with ”ON” (0x4F 0x4E) to enable impulse messages. Acknowledge the command with ”OFF” (0x4F 0x46 0x46) to disable impulse messages.
Example:

	D-Len	Cmd	Param	
M->S	0x01	0xE7		
S->M	0x04	0xE7	0x4F 0x46 0x46	Impulse messages disabled

Note: After a restart, impulse messages are always enabled.

We recommend not disabling impulse messages. Disabling might however be necessary in RS232 mode, if a large number of modules is actuated and if there are frequent collisions. With RS232, it is possible to automatically disable (section 3.2.5.3) impulse messages after restart. These messages can be enabled at any time with CMD TOGGLE IMPULSE MESSAGE.

2.2.7 CAMAT SETTINGS CHANGED (0xF9)

The spontaneous message acknowledges that settings are changed successfully. For details, see *„CAMAT SETTINGS CHANGED"* (section 2.6.2)
Note: Only for SRV image processing sensor

2.2.8 CAMAT RES MEASUREMENT BLOCK (0xFA)

The spontaneous message conveys the results of an image processing on the part of the SRV image processing sensor. For details, see *„CAMAT RES MEASUREMENT BLOCK"* (section 2.6.3) .
Note: Only for SRV image processing sensor

2.3 Settings

2.3.1 SET CONFIG (0x81)

Code: 0x81
Description:Configuration data is set in the module and *permanently stored* (section 3.2) .
Parameters (master -> slave): The configuration data to be written is transferred as parameter.

- EEPROM (0xFE) + EEPROM Struktur
  All configuration data is written in one process (complete EEPROM structure must be transferred in the data). Depending on the type of *user* (section 1.5) certain data might not be written. After successful writing of the data, the module is rebooted.

With one's own applications, this command should not be used as the structure of the data to be sent is not known.

The module must be stopped, and the controller must be inactive. For example, execute an emergency stop (section 2.1.20) before

In such a case, the fragmentation protocol (section 1.3.6) must be used (not with RS232).

- Module ID (0x01) + data (1 byte)
  The module ID is changed. Valid values: 1..255. The new settings are immediately stored in the EEPROM but are only applied after the module has been restarted.

  Profibus supports "Set Slave Address" (SAP 55)

- Group ID (0x02) + data (1 byte)
  Die Gruppe des Moduls wird geändert. Gültige Werte (0 .. 255). Die neuen Einstellungen werden sofort im EEPROM gespeichert, aber erst nach einem Neustart aktiviert.

  With Profibus, the "Real No Add Change" is stored here. Groups are fully supported with the SYNC/FREEZE mechanism.

- RS232 Baud Rate (0x03) + data (2 bytes)
  The RS232 baud rate can be modified. Valid values: 1200, 2400, 4800, 9600, 19200, 38400. The new settings are immediately stored in the EEPROM but are only applied after the module has been restarted.

- CAN Baud Rate (0x04) + data (2 bytes)
  The CAN baud rate can be modified. Valid values: 50, 100, 125, 250, 500, 800, 1000. The new settings are immediately stored in the EEPROM but are only applied after the module has been restarted.

- Communication Mode (0x05) + data (1 byte)
  The communication interface is configured. Valid values: AUTO (0x00), RS232 (0x01), CAN (0x02), Profibus DPV0 (0x03), RS232 Silent (0x04). The new settings are immediately stored in the EEPROM but are only applied after the module has been restarted.

- Unit System (0x06) + data (1 byte)
  The unit system is changed. Valid values: ($[mm]$ = 0x00, $[m]$ = 0x01, $[Inch]$ = 0x02, $[rad]$ = 0x03, $[Degree]$ = 0x04, $[Intern]$ = 0x05, $[\mu m]$ Integer = 0x06, $[\mu Degree]$ Integer = 0x07, $[\mu Inch]$ Integer = 0x08, $[Milli-degree]$ Integer = 0x09). The new settings are immediately stored in the EEPROM but are only applied after the module has been restarted.

- Soft High (0x07) + data (4 bytes)
  The high software limit is changed temporarily (observe *unit system* (section 1.4)). The transferred value is not written to the EEPROM. The settings are applied immediately. [3]

  This function is only accessible on „Profi user" (section 1.5.3) .

- Soft Low (0x08) + data (4 bytes)
  The low software limit is changed temporarily (observe *unit system* (section 1.4)). The transferred value is not written to the EEPROM. The settings are applied immediately. [4]

  This function is only accessible on „Profi user" (section 1.5.3) .

- Gear Ratio (0x18) + data (4 bytes as float)
  The *Gear Ratio 1* (section 3.2.2.2) is changed (the command has no use

[3]Used for SRU in teach mode. For SRU, it must therefore be enabled for "USER".
[4]Used for SRU in teach mode. For SRU, it must therefore be enabled for "USER".

with an *integer unit system* (section 1.4)). The transferred value is written to the EEPROM and applied immediately.

This function is only accessible on „Profi user” (section 1.5.3) .

Response (slave -> master) : „OK” (0x4F4B) if successful. In order to find out which parameters have been set successfully, the parameter code is appended as 1 byte to „OK”.
Example:

	D-Len	Cmd	Param	
M->S	0x03	0x81	0x01 0x0C	Will set module ID to 12
S->M	0x04	0x81	0x4F 0x4B 0x01	

Note: To set configuration data quickly, use the supplied *software tool* (section 4) . If you wish to write all parameters in one single process, you must first halt the module. [5]

2.3.2 GET CONFIG (0x80)

Code: 0x80
Description: A range of configuration data can be read from the module.
Parameters (master -> slave):

- None
  Miscellaneous information of the module is read:
  - Modul type as text (8 chars)
  - Order number (UInt32)
  - Firmware version (UInt16)
  - Protocol version (UInt16)
  - Hardware version (UInt16)
  - Firmware create date/time as text (21 chars)

Modules with an even-numbered hardware version have EEPROM, with an odd-numbered - FRAM. See pseudo absolute value transmitter (section 1.6)

[5] Write processes take a relatively long time to be completed. The control system is thereby switched off, so movements of the module would be interrupted.

- EEPROM (0xFE)
  All configuration data is read in one process.

  This command should not be used with one's own applications, as the structure of the data to be received is not known.

  The module must be stopped, and the controller must be inactive. For example, execute an emergency stop (section 2.1.20) before

  In such a case, fragmentation protocol (section 1.3.6) must be used (not with RS232).

- Module ID (0x01)
  The ID of the module is read (1 byte).
- Group ID (0x02)
  The group data of the module is read (1 byte).
- RS232 Baud Rate (0x03)
  The RS232 baud rate is read (2 bytes).
- CAN Baud Rate (0x04)
  The CAN baud rate is read (2 bytes).
- Communication Mode (0x05)
  The configured communication interface is read (1 byte). Valid values: AUTO (0x00), RS232 (0x01), CAN (0x02), Profibus DPV0 (0x03), RS232 Silent (0x04).
- Unit System (0x06)
  The configured unit system is read. Valid values: ($[mm]$ = 0x00, $[m]$ = 0x01, $[Inch]$ = 0x02, $[rad]$ = 0x03, $[Degree]$ = 0x04, $[Intern]$ = 0x05, $[\mu m]$ Integer = 0x06, $[\mu Degree]$ Integer = 0x07, $[\mu Inch]$ Integer = 0x08, $[Milli-degree]$ Integer = 0x09)

- Soft High (0x07)
  The high software limit is returned (4 bytes, observe *unit system* (section 1.4))
- Soft Low (0x08)
  The low software limit is returned (4 bytes, observe *unit system* (section 1.4))
- MAx. Velocity (0x09)
  The maximum permissible velocity of the module is returned (4 bytes, observe *unit system* (section 1.4))
- Max. Acceleration (0x0A)
  The maximum permissible acceleration of the module is returned (4 bytes, observe *unit system* (section 1.4))
- Max. Current (0x0B)
  The nominal current of the module is returned (4 bytes, observe *unit system* (section 1.4))
- Nom. Current (0x0C)
  The nominal current of the module is returned (4 bytes, observe *unit system* (section 1.4))
- Max. Jerk (0x0D)
  The maximum permissible jerk of the module is returned (4 bytes, observe *unit system* (section 1.4))
- Offset Phase A (0x0E)
  The offset of the current sensor A is returned (2 bytes).
- Offset Phase B (0x0F)
  The offset of the current sensor B is returned (2 bytes).
- Data CRC (0x13)
  A CRC16 over all variable and not module specified paramenters (like serial numeber, current offset) is returned.
- Reference Offset (0x14)
  The reference offset is returned (4 bytes, observe *unit system* (section 1.4))
- Serial Number (0x15)
  The device serial number is returned (4 bytes).
- Order Number (0x16)
  The device order number is returned (4 bytes).

Response (slave -> master): Parameter ID (required to determine the data that can be requested), followed by the requested data.

Example 1:

	D-Len	Cmd	Param	
M->S	0x02	0x80	0x06	Read unit system
S->M	0x03	0x80	0x06 0x00	Unit system is [mm]

Example 2:

	D-Len	Cmd	Param	
M->S	0x01	0x80		Read module info
S->M	0x28	0x80	0x50 0x52 0x2D 0x37 0x30 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x79 0x00 0x03 0x00 0x12 0x02 0x31 0x31 0x3A 0x32 0x32 0x3A 0x32 0x37 0x20 0x20 0x4A 0x75 0x6C 0x20 0x20 0x33 0x20 0x32 0x30 0x30 0x38	Modul type „PR-70”, order number 0, firmware version 1.21, protocol version 3, hardware version 5.30, firmware created at „11:22:27 Jul 3 2008”

Note: To read configuration data quickly, use the supplied *software tool* (section 4) . If you wish to read all parameters in one single process, you must first halt the module. [6]

2.4 Commands for internal programming

The modules can be operated based on internal process programs *instead of external control* (section 3.2.5.7) The system also caters for the running of previously stored programs that are transferred through digital inputs and outputs, so that the module is solely controlled through these digital inputs and outputs. To do this, the *inputs* (section 3.2.5.9) and *outputs* (section 3.2.5.10) must be configured accordingly.

In addition, the module can be controlled with 2 bytes by starting previously programmed complex processes with *special commands* (section 2.4.5) .

In order to program the modules, the data must be *fragmented* (section 1.3.6) To program the module, we recommend using the supplied *software tool* (section 4) via RS232. Programs are always written as complete sets of instructions. If you wish to modify a section of the program script, it must be read in its entirety, amended and then written again to the module.

[7]

[6] Read processes take a relatively long time to be completed. The control system is thereby switched off, so movements of the module would be interrupted.

[7] The program data is compressed in the EEPROM and equipped with checksums, so that no changes can be made within the complex data structure.

2.4.1 SET PHRASE (0xC0)

Code: 0xC0
Description: If this command is added as a prefix to any data frame, the respective data frame is stored in the non-volatile memory. This enables the user to use all available commands for programming. In this mode, a stored data frame is referred to as a ”phrase”. The phrases are automatically incremented by one until the SET PHRASE command is called without parameter (data frame). This indicates that programming is terminated.
Parameters (master -> slave):

- none
  Programming terminated.
- Valid data frame
  The phrase is stored and the phrase counter is incremented by 1.

Response (slave -> master): „OK” (0x4F4B), if the phrase is successfully saved
Example:

	D-Len	Cmd	Param	
M->S	0x07	0xC0	0x05 0xB1 0x00 0x00 0x60 0x40	Will program, move to position 3.5 [mm]
S->M	0x03	0xC0	0x06 0x00	

Note: For programming, we recommend using the supplied *Software* (section 4)) as it makes the process easier.

In this case, fragmentation protocol (section 1.3.6) must be used (not with RS232).

2.4.2 GET PHRASES (0xC2)

Code: 0xC2
Description: Reads the entire program from the module.
Parameters (master -> slave): none
Response (slave -> master): First data frame contains the number of phrases of the program (UInt16). Subsequently, the content of the program is transferred phrase by phrase.
Example:

	D-Len	Cmd	Param	
M->S	0x01	0xC2		
S->M	0x03	0xC2	0x05 0x00	Program contains 5 phrases
S->M	0x05	0xB1	0x00 0x00 0x60 0x40	Phrase 0 contains a „move to position 3.5 [mm]" command
S->M	0x05	0xB1	0x00 .. .	Phrases to program memory end

Note: As soon as the command is initiated once, the program is transferred line by line. For the administration of the programs, we recommend using the supplied *Software* (section 4) .

In this case, fragmentation protocol (section 1.3.6) must be used (not with RS232).

2.4.3 PRG EXE (0xCF)

Code: 0xCF
Description: Program is executed.
Parameters (master -> slave):

- none
  The program execution starts at line „0".
- *Program Nr.* (2 bytes)
  Program with the entered nr. will be executed.

Response (slave -> master): The program line (UInt16) with the command code is sent and the respective phrase is executed.
Example:

	D-Len	Cmd	Param	
M->S	0x01	0xCF		Start program at line „0"
S->M	0x01	0xCF		Command acknowledge from module
S->M	0x04	0xC1	0x00 0x00 0x92	Line „0" contains a „MOVE POS" command
S->M	0x04	0xC1	0x01 .. .	Phrases to program end

2.4.4 EXE PHRASE (0xC1)

Code: 0xC1
Description: Line of the stored program is executed.
Parameters (master -> slave): *Program line* (UInt16) to be executed.
Response (slave -> master): Program line (UInt16) containing the command code is sent.
Example:

	D-Len	Cmd	Param	
M->S	0x03	0xC1	0x02 0x00	Execute phrase „2"
S->M	0x04	0xC1	0x02 0x00 0xB0	Phrase 2 contains a „MOVE POS" command

Note: If the entered program line contains „PRG EXE", the complete subprogram is executed automatically.

2.4.5 EXE PHRASE0 (0xD0)

Code: 0xD0
Description: Special command of size 1 byte designed to call up phrase „0".
Parameters (master -> slave): none
Response (slave -> master): Program line (UInt16) containing the command code is sent.
Example:

	D-Len	Cmd	Param	
M->S	0x01	0xD0		Execute phrase „0"
S->M	0x04	0xD0	0x00 0x00 0xB0	Phrase 0 contains a „MOVE POS" command

Note: If program line 0 contains „PRG EXE", the complete subprogram is executed automatically. This feature allows for the execution of subprograms with 1 byte only. This command is generated internally with the respective phrase number, provided that the digital *I* (section 3.2.5.9) / *O* (section 3.2.5.10) s for operation of the module are used.

2.4.6 EXE PHRASE1 (0xD1)

Code: 0xD1
Description: Special command of size 1 byte designed to call up phrase „1".
Parameters (master -> slave): none
Response (slave -> master): Program line (UInt16) containing the command code is sent.
Example:

	D-Len	Cmd	Param	
M->S	0x01	0xD1		Execute phrase „1”
S->M	0x04	0xD1	0x01 0x00 0xB0	Phrase 1 contains a „MOVE POS” command

Note: If program line 1 contains „PRG EXE”, the complete subprogram is executed automatically. This feature allows for the execution of subprograms with 1 byte only. This command is generated internally with the respective phrase number, provided that the digital *I* (section 3.2.5.9) / *O* (section 3.2.5.10) s for operation of the module are used.

2.4.7 EXE PHRASE2 (0xD2)

Code: 0xD2
Description: Special command of size 1 byte designed to call up phrase „2”.
Parameters (master -> slave): none
Response (slave -> master): Program line (UInt16) containing the command code is sent.
Example:

	D-Len	Cmd	Param	
M->S	0x01	0xD2		Execute phrase „2”
S->M	0x04	0xD2	0x02 0x00 0xB0	Phrase 2 contains a „MOVE POS” command

Note: If program line 2 contains „PRG EXE”, the complete subprogram is executed automatically. This feature allows for the execution of subprograms with 1 byte only. This command is generated internally with the respective phrase number, provided that the digital *I* (section 3.2.5.9) / *O* (section 3.2.5.10) s for operation of the module are used.

2.4.8 EXE PHRASE3 (0xD3)

Code: 0xD3
Description: Special command of size 1 byte designed to call up phrase „3”.
Parameters (master -> slave): none
Response (slave -> master): Program line (UInt16) containing the command code is sent.
Example:

	D-Len	Cmd	Param	
M->S	0x01	0xD3		Execute phrase „3”
S->M	0x04	0xD3	0x03 0x00 0xB0	Phrase 3 contains a „MOVE POS” command

Note: If program line 3 contains „PRG EXE", the complete subprogram is executed automatically. This feature allows for the execution of subprograms with 1 byte only. This command is generated internally with the respective phrase number, provided that the digital *I* (section 3.2.5.9) / *O* (section 3.2.5.10) s for operation of the module are used.

2.4.9 EXE PHRASE4 (0xD4)

Code: 0xD4
Description: Special command of size 1 byte designed to call up phrase „4".
Parameters (master -> slave): none
Response (slave -> master): Program line (UInt16) containing the command code is sent.
Example:

	D-Len	Cmd	Param	
M->S	0x01	0xD4		Execute phrase „4"
S->M	0x04	0xD4	0x04 0x00 0xB0	Phrase 4 contains a „MOVE POS" command

Note: If program line 4 contains „PRG EXE", the complete subprogram is executed automatically. This feature allows for the execution of subprograms with 1 byte only. This command is generated internally with the respective phrase number, provided that the digital *I* (section 3.2.5.9) / *O* (section 3.2.5.10) s for operation of the module are used.

2.4.10 EXE PHRASE5 (0xD5)

Code: 0xD5
Description: Special command of size 1 byte designed to call up phrase „5".
Parameters (master -> slave): none
Response (slave -> master): Program line (UInt16) containing the command code is sent.
Example:

	D-Len	Cmd	Param	
M->S	0x01	0xD5		Execute phrase „5"
S->M	0x04	0xD5	0x05 0x00 0xB0	Phrase 5 contains a „MOVE POS" command

Note: If program line 5 contains „PRG EXE", the complete subprogram is executed automatically. This feature allows for the execution of subprograms with 1 byte only. This command is generated internally with the respective phrase number, provided that the digital *I* (section 3.2.5.9) / *O* (section 3.2.5.10) s for operation of the module are used.

2.4.11 EXE PHRASE6 (0xD6)

Code: 0xD6
Description: Special command of size 1 byte designed to call up phrase „6".
Parameters (master -> slave): none
Response (slave -> master): Program line (UInt16) containing the command code is sent.
Example:

	D-Len	Cmd	Param	
M->S	0x01	0xD6		Execute phrase „6"
S->M	0x04	0xD6	0x06 0x00 0xB0	Phrase 6 contains a „MOVE POS" command

Note: If program line 6 contains „PRG EXE", the complete subprogram is executed automatically. This feature allows for the execution of subprograms with 1 byte only. This command is generated internally with the respective phrase number, provided that the digital *I* (section 3.2.5.9) / *O* (section 3.2.5.10) s for operation of the module are used.

2.4.12 EXE PHRASE7 (0xD7)

Code: 0xD7
Description: Special command of size 1 byte designed to call up phrase „7".
Parameters (master -> slave): none
Response (slave -> master): Program line (UInt16) containing the command code is sent.
Example:

	D-Len	Cmd	Param	
M->S	0x01	0xD7		Execute phrase „7"
S->M	0x04	0xD7	0x07 0x00 0xB0	Phrase 7 contains a „MOVE POS" command

Note: If program line 7 contains „PRG EXE", the complete subprogram is executed automatically. This feature allows for the execution of subprograms with 1 byte only. This command is generated internally with the respective phrase number, provided that the digital *I* (section 3.2.5.9) / *O* (section 3.2.5.10) s for operation of the module are used.

2.4.13 EXE PHRASE8 (0xD8)

Code: 0xD8
Description: Special command of size 1 byte designed to call up phrase „8".
Parameters (master -> slave): none

Response (slave -> master): Program line (UInt16) containing the command code is sent.
Example:

	D-Len	Cmd	Param	
M->S	0x01	0xD8		Execute phrase „8”
S->M	0x04	0xD8	0x08 0x00 0xB0	Phrase 8 contains a „MOVE POS” command

Note: If program line 8 contains „PRG EXE”, the complete subprogram is executed automatically. This feature allows for the execution of subprograms with 1 byte only. This command is generated internally with the respective phrase number, provided that the digital *I* (section 3.2.5.9) / *O* (section 3.2.5.10) s for operation of the module are used.

2.4.14 EXE PHRASE9 (0xD9)

Code: 0xD9
Description: Special command of size 1 byte designed to call up phrase „9”.
Parameters (master -> slave): none
Response (slave -> master): Program line (UInt16) containing the command code is sent.
Example:

	D-Len	Cmd	Param	
M->S	0x01	0xD9		Execute phrase „9”
S->M	0x04	0xD9	0x09 0x00 0xB0	Phrase 9 contains a „MOVE POS” command

Note: If program line 9 contains „PRG EXE”, the complete subprogram is executed automatically. This feature allows for the execution of subprograms with 1 byte only. This command is generated internally with the respective phrase number, provided that the digital *I* (section 3.2.5.9) / *O* (section 3.2.5.10) s for operation of the module are used.

2.4.15 EXE PHRASE10 (0xDA)

Code: 0xDA
Description: Special command of size 1 byte designed to call up phrase „10”.
Parameters (master -> slave): none
Response (slave -> master): Program line (UInt16) containing the command code is sent.
Example:

	D-Len	Cmd	Param	
M->S	0x01	0xDA		Execute phrase „10"
S->M	0x04	0xDA	0x0A 0x00 0xB0	Phrase 10 contains a „MOVE POS" command

Note: If program line 10 contains „PRG EXE", the complete subprogram is executed automatically. This feature allows for the execution of subprograms with 1 byte only. This command is generated internally with the respective phrase number, provided that the digital *I* (section 3.2.5.9) / *O* (section 3.2.5.10) s for operation of the module are used.

2.4.16 EXE PHRASE11 (0xDB)

Code: 0xDB
Description: Special command of size 1 byte designed to call up phrase „11".
Parameters (master -> slave): none
Response (slave -> master): Program line (UInt16) containing the command code is sent.
Example:

	D-Len	Cmd	Param	
M->S	0x01	0xDB		Execute phrase „11"
S->M	0x04	0xDB	0x0B 0x00 0xB0	Phrase 11 contains a „MOVE POS" command

Note: If program line 11 contains „PRG EXE", the complete subprogram is executed automatically. This feature allows for the execution of subprograms with 1 byte only. This command is generated internally with the respective phrase number, provided that the digital *I* (section 3.2.5.9) / *O* (section 3.2.5.10) s for operation of the module are used.

2.4.17 EXE PHRASE12 (0xDC)

Code: 0xDC
Description: Special command of size 1 byte designed to call up phrase „12".
Parameters (master -> slave): none
Response (slave -> master): Program line (UInt16) containing the command code is sent.
Example:

	D-Len	Cmd	Param	
M->S	0x01	0xDC		Execute phrase „12"
S->M	0x04	0xDC	0x0C 0x00 0xB0	Phrase 12 contains a „MOVE POS" command

Note: If program line 12 contains „PRG EXE", the complete subprogram is executed automatically. This feature allows for the execution of subprograms with 1 byte only. This command is generated internally with the respective phrase number, provided that the digital *I* (section 3.2.5.9) / *O* (section 3.2.5.10) s for operation of the module are used.

2.4.18 EXE PHRASE13 (0xDD)

Code: 0xDD
Description: Special command of size 1 byte designed to call up phrase „13".
Parameters (master -> slave): none
Response (slave -> master): Program line (UInt16) containing the command code is sent.
Example:

	D-Len	Cmd	Param	
M->S	0x01	0xDD		Execute phrase „13"
S->M	0x04	0xDD	0x0D 0x00 0xB0	Phrase 13 contains a „MOVE POS" command

Note: If program line 13 contains „PRG EXE", the complete subprogram is executed automatically. This feature allows for the execution of subprograms with 1 byte only. This command is generated internally with the respective phrase number, provided that the digital *I* (section 3.2.5.9) / *O* (section 3.2.5.10) s for operation of the module are used.

2.4.19 EXE PHRASE14 (0xDE)

Code: 0xDE
Description: Special command of size 1 byte designed to call up phrase „14".
Parameters (master -> slave): none
Response (slave -> master): Program line (UInt16) containing the command code is sent.
Example:

	D-Len	Cmd	Param	
M->S	0x01	0xDE		Execute phrase „14”
S->M	0x04	0xDE	0x0E 0x00 0xB0	Phrase 14 contains a „MOVE POS” command

Note: If program line 14 contains „PRG EXE”, the complete subprogram is executed automatically. This feature allows for the execution of subprograms with 1 byte only. This command is generated internally with the respective phrase number, provided that the digital *I* (section 3.2.5.9) / *O* (section 3.2.5.10) s for operation of the module are used.

2.4.20 EXE PHRASE15 (0xDF)

Code: 0xDF
Description: Special command of size 1 byte designed to call up phrase „15”.
Parameters (master -> slave): none
Response (slave -> master): Program line (UInt16) containing the command code is sent.
Example:

	D-Len	Cmd	Param	
M->S	0x01	0xDF		Execute phrase „15”
S->M	0x04	0xDF	0x0F 0x00 0xB0	Phrase 15 contains a „MOVE POS” command

Note: If program line 15 contains „PRG EXE”, the complete subprogram is executed automatically. This feature allows for the execution of subprograms with 1 byte only. This command is generated internally with the respective phrase number, provided that the digital *I* (section 3.2.5.9) / *O* (section 3.2.5.10) s for operation of the module are used.

2.4.21 PRG GOTO (0xC3)

Code: 0xC3
Description: Goes to phrase number
Parameters (master -> slave): *Phrase number*
Response (slave -> master): none
Example: Only useful in the context of programming.
Note: Special command required in processing programs. Nothing happen when this command is called up directly. To program the modules, we recommend using the specially devised *programming software* (section 4) .

2.4.22 PRG WAIT (0xC4)

Code: 0xC4
Description: Waits for the specified time in [ms]
Parameters (master -> slave): *Time* [ms]
Response (slave -> master): none
Example: Only useful in the context of programming.
Note: Special command required in processing programs. If the command is called directly, the processor pauses for the specified period of time. To program the modules, we recommend using the specially devised *programming software* (section 4) .

2.5 Other commands

2.5.1 GET STATE (0x95)

Code: 0x95
Description: Returns the module status and other information, if requested. The module can automatically update this status at regular intervals.
Parameters (master -> slave):

- None
  The module sends the data once. This means that the previously set cyclic sending of data can be disabled.
- *Time* (4 bytes)
  The module automatically transmits its status at the set intervals (in the configured *unit system* (section 1.4)).
- *Time* (4 bytes) *Mode* (1 byte)
  The module automatically transmits its status at the set intervals (in the configured *unit system* (section 1.4)).
  The parameter „Mode" specifies the data that is to be sent in addition to the status:
  Bit 1 (0x01): position
  Bit 2 (0x02): velocity
  Bit 3 (0x04): current

Response (slave -> master): Optional data (depending on the code „Mode") followed by the status (2 bytes), which is configured as follows:

Referenced	Bit 1	0x01
Moving	Bit 2	0x02
Program Mode	Bit 3	0x04
Warning	Bit 4	0x08
Error	Bit 5	0x10
Brake	Bit 6	0x20
Move End	Bit 7	0x40
Position Reached	Bit 8	0x80

- Bit 1: module is referenced
- Bit 2: module is moving
- Bit 3: module is in programming mode (internal processing program activated)
- Bit 4: a *warning* (section 2.8.1.2) has been generated.
- Bit 5: an *error* (section 2.8.1.1) occurred.
- Bit 6: brake applied
- Bit 7: *motion terminated* (section 2.2.2) .
- Bit 8: *target position reached* (section 2.2.3) .
- Bit 9-16 contain the *error code* (section 2.8.2) .

Example 1:

	D-Len	Cmd	Param	
M->S	0x06	0x95	0x00 0x00 0x80 0x3F 0x07	State info is to be sent cyclically each second. Position, velocity and current are to be sent too.
S->M (cyclically each second)	0x0F	0x95	0xD6 0xA3 0x70 0x41 0x56 0xC9 0x41 0x40 0x3C 0x41 0xEB 0x3E 0x03 0x00	Position: 0xD6..0x41, Velocity: 0x56..0x40, Current: 0x3C..0x3E; Module is in motion and referenced (0x03); No error (0x00)

Example 2:

	D-Len	Cmd	Param	
M->S	0x01	0x95		Request state info once. Last requested parameters will be sent too.
S->M	0x0F	0x95	0x0x53 0x63 0xB7 0x41 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x61 0xD9	Position: 0x53..0x41, Velocity: 0x00..0x00, Current: 0x00..0x00; Module is referenced, no movement, brake is on (0x61); Emergency stop executed (0xD9)

Example 3:

	D-Len	Cmd	Param	
M->S	0x06	0x95	0x00 0x00 0x00 0x00 0x01	Request state info once. Position is to be sent too.
S->M	0x07	0x95	0x00 0x00 0x00 0x00 0x20 0x00	Position: 0x00..0x00; Module is not referenced, brake is off (0x20); No error (0x00)

Note: If you wish to receive the position, velocity and current in a message with CAN, use the *fragmentation protocol* (section 1.3.6) . zu verwenden. With Profibus, all information can be compiled into a Profibus message. The set mode is maintained, and needs therefore not to be reset with each message. When the module is switched on, mode is set to „0x07", then all available state information is transmitted.

With Profibus, and if all parameters (position, velocity, current) are to be transmitted, only the low 8 bits of the status are displayed. They are positioned in byte 14, where the latest status is submitted in accordance with the Profibus requirements (section 1.3.5) . Byte 15 contains the MsgCount, which overwrites the high 8 bits of the status word.

With Profibus, automated requests should be used with caution. Under certain circumstances, it might be more useful to poll the data, especially if the SYNC/FREEZE mechanism is used.

2.5.1.1 Status response from SRV

- Bit 1-2: reserved
- Bit 3: Status of the connection of the PC application "SRV-GUI" via USB with the SRV sensor. (1 = connected, 0 = not connected)
- Bit 4-16: reserved

As long as the PC application "SRV-GUI" (the configuration and user interface of the SRV) is connected via USB with the SRV sensor, no change of program (CAMAT CHANGE PROGRAM (section 2.6.1)) can take place. See also „INFO GUI CONNECTED" (section 2.8.2.18) and „INFO GUI DISCONNECTED" (section 2.8.2.19) .

2.5.2 CMD REBOOT (0xE0)

Code: 0xE0
Description: The module is restarted.
Parameters (master -> slave): none
Response (slave -> master): Module confirms with „OK" (0x4F4B). Then, after successful reboot, the module returns *„INFO BOOT"* (section 2.8.2.1) .
Example:

	D-Len	Cmd	Param	
M->S	0x01	0xE0		
S->M	0x03	0xE0	0x4F 0x4B	Confirmation with „OK"
S->M	0x03	0x8A	0x00 0x01	Module restarted successfully

2.5.3 CMD DIO (0xE1)

Code: 0xE1
Description: Digital inputs/outputs can be set or read.
Parameters (master -> slave):

- none
  The current statuses of the digital inputs/outputs are read.
- *1 byte*
  The 4 high bits can be used to set the 4 digital outputs.

Response (slave -> master): In the event of success: „OK" (0x4F4B), with attached byte indicating the current status of the digital inputs in the 4 low bits, and the digital outputs in the 4 high bits.

Input 1	Bit 1	0x01
Input 2	Bit 2	0x02
Input 3	Bit 3	0x04
Input 4	Bit 4	0x08
Output 1	Bit 5	0x10
Output 2	Bit 6	0x20
Output 3	Bit 7	0x40
Output 4	Bit 8	0x80

Example:

	D-Len	Cmd	Param	
M->S	0x01	0xE1		
S->M	0x04	0xE1	0x4F 0x4B 0x00	No inputs/outputs set

2.5.4 FLASH MODE (0xE2)

Code: 0xE2
Description: The module is being prepared for a *firmware update* (section 4.4.3) .
Parameters (master -> slave): Flash password
Response (slave -> master): After successful check of the password: „OK" (0x4F4B).
Example:

	D-Len	Cmd	Param
M->S	0x??	0xE2	<password>
S->M	0x03	0xE2	0x4F 0x4B

Note: After entry of the correct password, it takes about 30 seconds until the module is automatically set to flash mode (green and red LEDs continuously on). In a RS232 bus system with several connected modules, all other modules bar one must be deactivated (*„CMD DISCONNECT"* (section 2.5.5)). Ex firmware V1.20 updating is possible on all available bus systems.

2.5.5 CMD DISCONNECT (0xE6)

Code: 0xE6
Description: The module is disconnected from the bus system and deactivated.
Parameters (master -> slave): Flash password
Response (slave -> master): After successful check of the password: „OK" (0x4F4B).
Example:

	D-Len	Cmd	Param
M->S	0x01	0xE6	<password>
S->M	0x03	0xE6	0x4F 0x4B

Note: After the correct password has been entered, the module is switched off. The LEDs are off (exception: motor voltage LED). If several modules are connected to a RS232 bus system, the modules can be switched off by means of the software. This is for example necessary for a firmware update only on RS232 where the bus is not to be disassembled (only 1 module can be updated at any one time). Modules that are switched off can only be activated by switching the logic voltage off and on again.

2.5.6 CHANGE USER (0xE3)

Code: 0xE3
Description: The current user of the module is changed.
Parameters (master -> slave):

- none
  User *„User"* (section 1.5.1) is set.
- *Password*
  for the respective user

Response (slave -> master):): The command is always acknowledged with „OK (0x4F4B)". A byte indicating the current user is attached (0 = User, 1 = Diag, 2 = Profi, 3 = Advanced).
Example:

	D-Len	Cmd	Param	
M->S	0x01	0xE3	<password>	
S->M	0x04	0xE3	0x4F 0x4B 0x00	User „User" activated.

Note: If an incorrect password is entered, „User" is set. After a restart of the module, „User" is activated.

2.5.7 CHECK MC PC COMMUNICATION (0xE4)

Code: 0xE4
Description: The communication from the module to the control can be tested. Predefined data is sent from the module to the control system. The data can be requested individually, or in its entirety. If individual data is requested, there is **no need** for fragmentation.
Parameters (master -> slave):

- keine
  All test data is sent in one block, and fragmentation is required.

- TEST FLOAT 1 (0x0101)
  The floating point value „-1.2345" (0x19 0x04 0x9E 0xBF) is sent, with affixed parameter code (0x0101).
- TEST FLOAT 2 (0x0202)
  The floating point value „47.11" (0xA4 0x70 0x3C 0x42) is sent, with affixed parameter code (0x0202).
- TEST INT32 1 (0x0303)
  The Int32 value „0x11223344" (287454020) is sent, with affixed parameter code (0x0303).
- TEST INT32 2 (0x0404)
  The Int32 value „0xFFEEDDCC" (-1122868) is sent, with affixed parameter code (0x0404).
- TEST INT16 1 (0x0505)
  The Int16 value „0x0200" (512) is sent, with affixed parameter code (0x0505).
- TEST INT16 2 (0x0606)
  The Int16 value „0xAFFE" (-20482) is sent, with affixed parameter code (0x0606).

Response (slave -> master): If no parameter is transferred, the following values must be received by the control system in the sequence indicated here:

Data type	Value HEX	Value DEC
Float	0x19 0x04 0x9E 0xBF	-1.2345
Float	0xA4 0x70 0x3C 0x42	47.11
Int32	0x11223344	287454020
Int32	0xFFEEDDCC	-1122868
Int16	0x0200	512
Int16	0xAFFE	-20482

With the respective parameters, only one of the values is transmitted.

Example: Siehe *See examples* (section 6.1)

Note: This command is used to check the integrated drivers. This command is not required for normal operation. The data exchange from the module to the control system including fragmentation can be tested with predefined values.

The code parameter is attached at the end of the response to ensure that the test data is sent to the position at which the real data is stored.

2.5.8 CHECK PC MC COMMUNICATION (0xE5)

Code: 0xE5
Description: This command is used to test the communication from the control system to the module.
Parameters (master -> slave):

- Data can be sent in one block in the following sequence:

Data type	Value HEX	Value DEC
Float	0x19 0x04 0x9E 0xBF	-1.2345
Float	0xA4 0x70 0x3C 0x42	47.11
Int32	0x11223344	287454020
Int32	0xFFEEDDCC	-1122868
Int16	0x0200	512
Int16	0xAFFE	-20482

  The data must be fragmented.

- In order to transfer individual data packets for testing purposes, first transfer the test data and then the code indicating the content of the text data:
  - Send floating point value „-1.2345” (0x19 0x04 0x9E 0xBF) with affixed parameter code (0x0101)
  - Send floating point value „47.11” (0xA4 0x70 0x3C 0x42) with affixed parameter code (0x0202)
  - Send Int32 value „0x11223344” (287454020) with affixed parameter code (0x0303)
  - Send Int32 value „0xFFEEDDCC” (-1122868) with affixed parameter code (0x0404)
  - Send Int16 value „0x0200” (512) with affixed parameter code (0x0505)
  - Send Int16 value „0xAFFE” (-20482) with affixed parameter code (0x0606)

Response (slave -> master):): If the respective test value has been interpreted correctly, the module responds with „OK (0x4F4B)”. When all test data is transmitted in one block, the module responds with „OK (0x4F4B)” and an affixed byte specifying in bit code the data that could not be correctly interpreted (bit is set to „1”).

- Bit 1: first floating point value (-1.2345) not recognized
- Bit 2: second floating point value (47.11) not recognized
- Bit 3: first Int32 value (0x11223344) not recognized
- Bit 4: second Int32 value (0xFFEEDDCC) not recognized

- Bit 5: first Int16 value (512) not recognized
- Bit 6: second Int16 value (0xAFFE) not recognized

Example: See *examples* (section 6.1)

Note: This command is used to check the integrated drivers. This command is not required for normal operation. It is possible to test the data exchange from the control system to the module, using individually defined values or pre-defined data packets that require fragmentation.

The code parameter is attached at the end of the response to ensure that the test data is sent to the position at which the real data is stored.

2.6 SRV image processing sensor

The SRV image processing sensor can receive commands in Motion Protocol format via its serial RS- 232 interface. On the one hand, only a limited selection of Motion Protocol commands are available, while on the other hand a small number of commands are available exclusively for the SRV.

The SRV understand the following „Standard" commands:

- *„CHECK PC MC COMMUNICATION"* (section 2.5.8)
- *„CHECK MC PC COMMUNICATION"* (section 2.5.7)
- *„GET CONFIG"* (section 2.3.2) :
  - Identification (inquiry without parameters)
  - Module ID
  - Group ID
  - RS232 baud rate
  - Communication interface
  - Unit system
    - Integer: Micrometers (for lengths) or milli-degrees (for angles)
    - Float: Millimeters (for lengths) or degrees (for angles)
- *„SET CONFIG"* (section 2.3.1)
  - Module ID
  - Group ID

  - RS232 baud rate
  - Unit system
    * Integer: Micrometers (for lengths) or milli-degrees (for angles)
    * Float: Millimeters (for lengths) or degrees (for angles)

- *„CMD DIO”* (section 2.5.3)
- *„TOGGLE IMPULSE MESSAGE”* (section 2.2.6)
- *„GET STATE”* (section 2.5.1)
  - Status: currently the only information transmitted in Bit 2 is whether the PC application “SRV-GUI” is connected with the SRV sensor via USB. This is important, because no program change can be initiated via the SCHUNK protocol via RS232 for as long as the connection to the SRV-GUI remains in effect. Error messages are not transmitted.
  - Switching regular messages on and off.
- *„CMD INFO”* (section 2.2.1)

The SRV also understands the following specific commands:

- *„CAMAT CHANGE PROGRAM”* (section 2.6.1)
- *„CAMAT SETTINGS CHANGED”* (section 2.6.2) (Only as Slave (SRV) -> Master response)
- *„CAMAT RES MEASUREMENT BLOCK”* (section 2.6.3) (Only as Slave (SRV) -> Master response)
- *„CAMAT TRIGGER”* (section 2.6.4)

The upper 3 commands are available only for the SRV, but not for other modules such as gripping or swiveling units.

2.6.1 CAMAT CHANGE PROGRAM (0xF8)

Code: 0xF8
Description: Triggers a program change in the SRV image processing sensor. This can take up to several seconds, which is why the command is confirmed at once with OK. The successful program change is then confirmed with a spontaneous message *„CMD INFO, INFO PROGRAM CHANGED”* (section 2.8.2.20)
.
Parameter (master -> slave): Number of the program as 2 byte integer number (16 bit Intel format: Low-Byte, High-Byte).

Response (slave -> master): The command is confirmed immediately with „OK” (0x4F4B) if a program change is permitted. If a program change is not possible (e.g. GUI connected, see Note), then this will be answered with the error code *„INFO NO RIGHTS”* (section 2.8.2.3) .
Note: Only for SRV image processing sensor.

A program change is only possible if the PC application “SRV-GUI” (the configuration and user interface of the SRV) is not connected with the sensor via USB, see „INFO GUI CONNECTED” (section 2.8.2.18) and „INFO GUI DISCONNECTED” (section 2.8.2.19) .

2.6.2 CAMAT SETTINGS CHANGED (0xF9)

Code: 0xF9
Description: The spontaneous message from the SRV image processing sensor acknowledges that settings are changed successfully.
Response (slave -> master): None.
Note: Only for SRV image processing sensor.

2.6.3 CAMAT RES MEASUREMENT BLOCK (0xFA)

Code: 0xFA
Description: Spontaneous message from the SRV image processing sensor for transmitting the results of the image processing.
Response (slave -> master): The answer contains a fixed part and a variable part, which is dependent on the function type in the activated program of the SRV.

In the fixed part, the following 4 parameters are transmitted as 2 byte integer number (16 bit Intel format: Low-Byte, High-Byte):

- **Program ID** is the „SPS-ID” of the activated program.
- **Function ID** is the ID of the active function (-1 = 0xff, 0xff with program result).
- **Function type**: The type of the function from the SRV functionality.
- **Result**: Good (0), bad (1)

This is followed by the variable part, depending on the function type. Depending on the units system set, the transmitted values are transmitted either as 4 byte integer number (32 bit Intel format (lowestvalue Byte first)) or as 4 bytesFloat (floating point numbers with simple precision, 32 Bit IEEE 754 format):

- Pattern search / Tracking
  - **Match**: Milli-percentage (Integer) or percentage (Float)
  - **Position X**: Micrometer (Integer) or millimeter (Float)
  - **Position Y**: Micrometer (Integer) or millimeter (Float)
  - **Rotation**: Micro-degrees (Integer) or Milli-degrees (Float)
- Area test
  - **Area**: Micrometer^2*1000 (Integer) oder mm^2 (Float)
- Gray value
  - **Gray**: 0..255 (Integer or Float)
- Brightness percentage
  - **Brightness**: Percentage (Integer or Float)

Note: Only for SRV image processing sensor.

2.6.4 CAMAT TRIGGER (0xFE)

Code: 0xFE
Description: Triggers an image recording in the SRV image processing sensor and the image processing with the activated program. This can take up to several seconds, the image recording takes place however at once and is confirmed with „OK". The actual image processing starts afterwards, the result of which is then announced with a spontaneous message *„CMD INFO, INFO TRIGGER"* (section 2.8.2.16) . The actual results are transmitted in further *„CAMAT RES MEASUREMENT BLOCK"* (section 2.6.3) spontaneous messages. Afterwards, the SRV is not ready again until it has dispatched a concluding *„CMD INFO, INFO READY"* (section 2.8.2.17) spontaneous message.
Parameter (master -> slave): None.
Response (slave -> master): The image recording takes place at once and is confirmed with „OK" (0x4F4B).
Note: Only for SRV image processing sensor.

2.7 Fragmentation

2.7.1 FRAG ACK (0x87)

Code: 0x87
Description: Acknowledgement of properly processed fragmentation
Parameters (master -> slave): *D-Len code of the received fragment* (UInt16), if the control system acknowledges the fragment to the module.
Response (slave -> master): *D-Len code of the received fragment* (UInt16),

if the module acknowledges the fragment to the control system.
Example: See *examples* (section 6.1) .
Note: This command is only used in systems with *Profibus* (section 1.3.6.1) and if fragmentation of messages is required.

2.7.2 FRAG START (0x84)

Code: 0x84
Description: Indicates that a fragment of a fragmented message is the first fragment.
Parameters (master -> slave): none
Response (slave -> master): none
Example: See *examples* (section 6.1) .
Note: Is directly written behind the D-Len byte. Does not form part of the D-Len, as it acts only as a marker.

2.7.3 FRAG MIDDLE (0x85)

Code: 0x85
Description: Indicates that a fragment of a fragmented message is the middle fragment.
Parameters (master -> slave): none
Response (slave -> master): none
Example: See *examples* (section 6.1) .
Note: Is directly written behind the D-Len byte. Does not form part of the D-Len, as it acts only as a marker.

2.7.4 FRAG END (0x86)

Code: 0x86
Description: Zeigt bei einer fragmentierten Nachricht, dass es sich um das letzte Fragment handelt.
Parameters (master -> slave): none
Response (slave -> master): none
Example: See *examples* (section 6.1) .
Note: Is directly written behind the D-Len byte. Does not form part of the D-Len, as it acts only as a marker.

2.8 Error messages

In the event of an error, D-Len in the data frame of the module sent to the control unit is always assigned value „2”. The command byte indicates the command that failed, or one of the following „error commands”. The parameter byte contains information regarding the *cause of error* (section 2.8.2) .

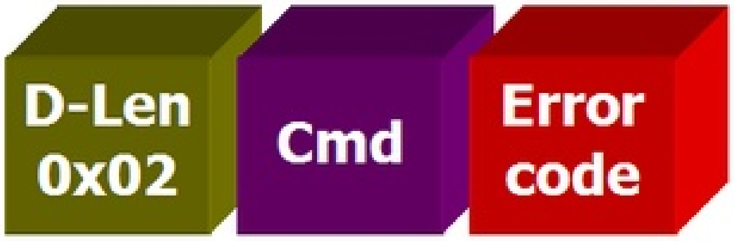


Figure 2.1: Error message

2.8.1 Error commands

2.8.1.1 CMD ERROR (0x88)

Code: 0x88
Example:

	D-Len	Cmd	Param	
S->M	0x02	0x88	0xDA	A towing error occurred. („*ERROR TOW*" (section 2.8.2.30))

Description: A serious error requiring operator intervention has occurred. Such errors must be acknowledged with „CMD ACK". The module is not ready for operation. The motor is shut down. Such error messages are sent at regular intervals from the module to the control system (every 15 seconds). See *error codes* (section 6.4) .

- RS232: the first byte of the message is changed to „0x03"
- CAN: the first three bits of the identifier are changed to „0x3"
- Profibus: an extended diagnosis is generated.

Risk of injury! *Modules that are not equipped with a brake might drop, as the motor is switched off by the emergency stop command!*

2.8.1.2 CMD WARNING (0x89)

Code: 0x89
Example:

	D-Len	Cmd	Param	
S->M	0x02	0x89	0xD6	Module is at the upper software limit (*„ERROR SOFT HIGH”* (section 2.8.2.26))

Description: A serious error has been acknowledged but persists. User intervention is required. After the cause of the error is eliminated, it is automatically acknowledged. Such error messages are sent at regular intervals from the module to the control system (every 30 seconds). See *error codes* (section 6.4) .

- RS232 the first byte of the message is changed to „0x03”
- CAN the first three bits of the identifier are changed to „3”
- Profibus an extended diagnosis is generated.

Note: A warning is issued when the software limits are exceeded. In this case, an emergency stop is triggered and must be acknowledged. Subsequently the module is ready for operation with certain restrictions (movement away from the software limit range is possible). As soon as the module is moved away from the software limit range, the warning is automatically deactivated.

2.8.1.3 CMD INFO (0x8A)

See *„CMD INFO”* (section 2.2.1)

2.8.1.4 CMD ACK (0x8B)

Code: 0x8B
Description: Acknowledgement of a pending error message
Parameters (master -> slave): none
Response (slave -> master): „OK” (0x4F4B)
Example:

	D-Len	Cmd	Param
M->S	0x01	0x8B	
S->M	0x03	0x8B	0x4F 0x4B

Note: If all errors could be acknowledged, „OK” (0x4F4B) is sent followed by the *„INFO NO ERROR”* (section 2.8.2.8) information message.

2.8.1.5 GET DETAILED ERROR INFO (0x96)

Code: 0x96
Description: Read detailed information about the active error on the module.

The shown value can be interpreted by the SCHUNK Service.
Parameters (master -> slave): none
Response (slave -> master): Command (1 byte), error code (1 byte), data (float)
Example:

	D-Len	Cmd	Param
M->S	0x01	0x96	
S->M	0x07	0x96	0x88 0xD9 0x00 0x00 0x00 0x00

Note: If no error is active, or no detailed information is available, the command is replied with *„INFO FAILED”* (section 2.8.2.5) .

2.8.2 Error codes

2.8.2.1 INFO BOOT (0x0001)

Code: 0x0001
Description: The module has been successfully booted. (*Information message* (section 2.2.1)
Note: Is triggered upon a complete failure of the logic voltage, after a *reboot* (section 2.5.2)), or after a restart initiated by the internal „WatchDog”. If this message appears frequently during operation, the logic voltage supply should be checked. Ensure that the performance driver is working properly.

In this case the code consists of 2 bytes => D-Len > „2” => if only the D-Len byte is queried, the message is not interpreted as an error message. The rule of D-Len == „2” => can thus always be adhered to.

If the RS232 Silent (section 3.2.5.3) interface is selected, this message is suppressed.

2.8.2.2 INFO NO FREE SPACE (0x02)

Code: 0x02
Description: There is insufficient storage space.
Note: This error might occur during the programming of internal processing programs in cases where the EEPROM memory is used. With the SRU, it might occur in situations where the size of the dynamically generated table used to

record and optimize internal brake points exceeds the size of the available RAM memory.

2.8.2.3 INFO NO RIGHTS (0x03)

Code: 0x03
Description: The user does not have the user rights necessary to execute the chosen command.
Note: The diagnostic interface does not allow access to movement data. Such commands must be sent through the „main interface".

2.8.2.4 INFO UNKNOWN COMMAND (0x04)

Code: 0x04
Description: The sent command is unknown.
Note: Check the command code for errors. Ensure that you have logged on with the correct user details. Certain commands are not known to all users.

2.8.2.5 INFO FAILED (0x05)

Code: 0x05
Description: The command failed.
Note: All parameters are correct, but the command could nevertheless not be executed. This might for example be the case if the module is in emergency stop mode. With *„MOVE POS TIME"* (section 2.1.5) , *„MOVE POS TIME REL"* (section 2.1.6) , *„MOVE POS TIME LOOP"* (section 2.1.8) and *„MOVE POS TIME REL LOOP"* (section 2.1.10) , this message is issued if the parameters are correct, but the positions can not be reached with the specified values in the specified time. The info message is shown too, when executing any loop mooving command *„MOVE POS LOOP"* (section 2.1.7) , *„MOVE POS TIME LOOP"* (section 2.1.8) , *„MOVE POS REL LOOP"* (section 2.1.9) , *„MOVE POS TIME REL LOOP"* (section 2.1.10) while the module is by the *software limit* (section 2.8.1.2) .

2.8.2.6 NOT REFERENCED (0x06)

Code: 0x06
Description: The module is not referenced and can therefore not execute the command.
Note: In order to carry out a positioning movement, the module must first be referenced.

2.8.2.7 INFO SEARCH SINE VECTOR (0x0007)

Code: 0x0007
Description: Try to find the start vector for space vector modulation. The used current is 60 percent of the max. current.

Note: This is done only once before the first movment command after powering up the device.

In this case the code consists of 2 bytes => D-Len > „2" => if only the D-Len byte is queried, the message is not interpreted as an error message. The rule of D-Len == „2" => can thus always be adhered to.

2.8.2.8 INFO NO ERROR (0x0008)

Code: 0x0008
Description: No other error messages are pending.
Note: This message is generated immediately after „CMD ACK", if no other errors are pending, and after the module has been removed from the software limit ranges.

The code consists of 2 bytes => D-Len > „2" => if only the D-Len byte is queried, the message is not interpreted as an error message. The rule of D-Len == „2" => can thus always be adhered to.

2.8.2.9 INFO COMMUNICATION ERROR (0x09)

Code: 0x09
Description: An error in the communication occured.

2.8.2.10 INFO TIMEOUT (0x10)

Code: 0x10
Description: A timeout occurred during communication.
Note: The data could not be sent, and more data is expected but has not been received within the allocated time.

2.8.2.11 INFO WRONG BAUDRATE (0x16)

Code: 0x16
Description: Wrong baud rate in the communication detected.

2.8.2.12 INFO CHECKSUM (0x19)

Code: 0x19
Description: The checksum is incorrect => data is invalid.

2.8.2.13 INFO MESSAGE LENGTH (0x1D)

Code: 0x1D
Description: D-Len does not match the received data.

2.8.2.14 INFO WRONG PARAMETER (0x1E)

Code: 0x1E
Description: One of the specified parameters is outside the permissible range
Note: If a parameter has been identified as incorrect, the old parameter values are retained, even if the other transmitted new parameters are valid.

2.8.2.15 INFO PROGRAM END (0x1F)

Code: 0x1F
Description: A processing program has been terminated.

2.8.2.16 INFO TRIGGER (0x0040)

Code: 0x0040
Description: The sensor was triggered (image processing was initiated).
Note: Only for SRV image processing sensor.

The code consists of 2 bytes => D-Len > „2" => if only the D-Len Byte is queried, then this message will not be interpreted as an error. The rule D-Len == „2" => error can thus always be complied with.

2.8.2.17 INFO READY (0x0041)

Code: 0x0041
Description: The SRV sensor is (once again) ready.
Note: Only for SRV image processing sensor. Is sent in two-byte form in Intel format (i.e. the second byte is 0x00)

The code consists of 2 bytes => D-Len > „2" => if only the D-Len Byte is queried, then this message will not be interpreted as an error. The rule D-Len == „2" => error can thus always be complied with.

2.8.2.18 INFO GUI CONNECTED (0x0042)

Code: 0x0042
Description: The user interface (GUI) of the sensor was connected (per USB) with the sensor. No program change can be triggered via the Motion Protocol for as long as the GUI is connected.
Note: Only for SRV image processing sensor.

The code consists of 2 bytes => D-Len > „2" => if only the D-Len Byte is queried, then this message will not be interpreted as an error. The rule D-Len == „2" => error can thus always be complied with.

2.8.2.19 INFO GUI DISCONNECTED (0x0043)

Code: 0x0043
Description: The connection between the user interface (GUI) of the sensor and the sensor was ended.
Note: Only for SRV image processing sensor.

The code consists of 2 bytes => D-Len > „2" => if only the D-Len Byte is queried, then this message will not be interpreted as an error. The rule D-Len == „2" => error can thus always be complied with.

2.8.2.20 INFO PROGRAM CHANGED (0x44)

Code: 0x44
Description: The sensor has switched over to a new image processing program.

The program number of the program that is now active is transmitted as an additional parameter in the form of a 16-bit integer (Intel format: Low-Byte, High-Byte).

Note: Only for SRV image processing sensor.

2.8.2.21 ERROR WRONG RAMP TYPE (0xC8)

Code: 0xC8
Description: No valid *motion profile* (section 3.2.5.6) has been selected for the positioning movement.

2.8.2.22 ERROR CONFIG MEMORY (0xD2)

Code: 0xD2
Description: The *configuration range* (section 3.2) is incorrect.
Note: Data could not be written to EEPROM, or EEPROM is defective.

2.8.2.23 ERROR PROGRAM MEMORY (0xD3)

Code: 0xD3
Description: The program memory is defective.
Note: The complete program memory must be cleared.

2.8.2.24 ERROR INVALID PHRASE (0xD4)

Code: 0xD4
Description: The programmed phrase to be executed contains errors.
Note: Check program code. Check parameter limits.

2.8.2.25 ERROR SOFT LOW (0xD5)

Code: 0xD5
Description: The module has exceeded the software limit.
Note: If command byte *„CMD ERROR"* (section 2.8.1.1)) is pending, acknowledge it. => The error is converted to a *„CMD WARNING"* (section 2.8.1.2) . It is now possible to move the module from the software limit range, using any *movement command* (section 2.1) .

2.8.2.26 ERROR SOFT HIGH (0xD6)

Code: 0xD6
Description: The module has exceeded the software limit.
Note: If command byte *„CMD ERROR"* (section 2.8.1.1) is pending, acknowledge it. => The error is converted to a *„CMD WARNING"* (section 2.8.1.2) . It is now possible to move the module from the software limit range, using any *movement command* (section 2.1) .

2.8.2.27 ERROR PRESSURE (0xD7)

Code: 0xD7
Description: Only for SRU. The compressed air pressure dropped suddenly, or coupling broken.
Note: Check compressed air system. The pressure should be approx. 6 [bar]. The pressure drop is detected as it causes an excessive *brake point correction* (section 3.2.8.8) .

2.8.2.28 ERROR SERVICE (0xD8)

Code: 0xD8
Description: Module requires maintenance. Contact customer service.
Note: SRU must be lubricated.

2.8.2.29 ERROR EMERGENCY STOP (0xD9)

Code: 0xD9
Description: The module has been halted with the *„CMD EMERGENCY STOP”* (section 2.1.20) command.

2.8.2.30 ERROR TOW (0xDA)

Code: 0xDA
Description: A *towing error* (section 3.2.5.19) occurred.
Note: Reduce load of module.

2.8.2.31 ERROR TOO FAST (0xE4)

Code: 0xE4
Description: The maximum permissible *velocity* (section 3.2.1.10) has been exceeded during a current motion (motor overspeeding).
Note: Reduce current of module.

2.8.2.32 ERROR MATH (0xEC)

Code: 0xEC
Description: A „mathematical” error happened, for example a division by null.
Note: In the majority of cases a *controller parameter* (section 3.2.4) is wrong.

2.8.2.33 ERROR VPC3 (0xDB)

Code: 0xDB
Description: The Profibus controller does not work properly.
Note: This problem can only be detected by a *„DIAG”* (section 1.5.2) user, as this message cannot be sent via the Profibus with the defective controller.

2.8.2.34 ERROR FRAGMENTATION (0xDC)

Code: 0xDC
Description: An error occurred in the *fragmentation protocol* (section 1.3.6) .
Note: Data packets have been lost.

2.8.2.35 ERROR COMMUTATION (0xE4)

Code: 0xE4
Description: Module fails to commutate.
Note: If this error reoccurs frequently, an unsuitable commutation type has been chosen, or the Hall sensors for block commutation are defective or not connected. With sine commutation, there might be a fault in the position measuring system.

2.8.2.36 ERROR CURRENT (0xDE)

Code: 0xDE
Description: The *maximum current* (section 3.2.1.8) has been exceeded.
Note: Reduce the motor load; if necessary introduce intermediate steps. (*„MOVE VEL”* (section 2.1.12) ,*” MOVE CURRENT”* (section 2.1.11))

2.8.2.37 ERROR I2T (0xDF)

Code: 0xDF
Description: An I^2T error occurred. This error only occurs if *I^2T monitoring activated* (section 3.2.1.4)) is selected.
Note: Reduce load of module.

2.8.2.38 ERROR INITIALIZE (0xE0)

Code: 0xE0
Description: The module could not be initialized properly.
Note: Check *configuration data* (section 3.2) .

2.8.2.39 ERROR INTERNAL (0xE1)

Code: 0xE1
Description: An internal error occurred.
Note: The firmware is in a non-defined status. This must be prevented. If this problem occurs, write down how this happened and contact the service department.

2.8.2.40 ERROR HARD LOW (0xE2)

Code: 0xE2
Description: Module has reached a hardware limit.
Note: Acknowledge error (*„CMD ACK”* (section 2.8.1.4)).If the module is equipped with a brake, release it (*„MOVE CUR”* (section 2.1.11) with parameter 0.0) and move the module by hand away from the hardware limit. If the module is not equipped with a brake, move it by hand away from the hardware limit.

2.8.2.41 ERROR HARD HIGH (0xE3)

Code: 0xE3
Description: Module has reached a hardware limit.
Note: Acknowledge error (*„CMD ACK”* (section 2.8.1.4)).If the module is equipped with a brake, release it (*„MOVE CUR”* (section 2.1.11) with parameter 0.0) and move the module by hand away from the hardware limit. If the module is not equipped with a brake, move it by hand away from the hardware limit.

2.8.2.42 ERROR TEMP LOW (0x70)

Code: 0x70
Description: The temperature is outside the *permissible temperature range* (section 3.2.5.20) .
Note: Warm up the module.

2.8.2.43 ERROR TEMP HIGH (0x71)

Code: 0x71
Description: The temperature is outside the *permissible temperature range* (section 3.2.5.20) .
Note: Let the module cool down, reduce the load.

2.8.2.44 ERROR LOGIC LOW (0x72)

Code: 0x72
Description: The logic voltage is too low.
Note: Check logic voltage.

2.8.2.45 ERROR LOGIC HIGH (0x73)

Code: 0x73
Description: The logic voltage is too high.
Note: Check logic voltage.

2.8.2.46 ERROR MOTOR VOLTAGE LOW (0x74)

Code: 0x74
Description: The motor voltage is too low.
Note: Check motor voltage. If this error reoccurs frequently, the power supply unit of the motor voltage might be underdimensioned, or the voltage supply cable to the module is not suitable.

2.8.2.47 ERROR MOTOR VOLTAGE HIGH (0x75)

Code: 0x75
Description: The motor voltage is too high.
Note: Check motor voltage.

2.8.2.48 ERROR CABLE BREAK (0x76)

Code: 0x76
Description: The communication cable is defective.
Note: This error is caused by a defective communication cable. It is only displayed after the defective cable has been repaired or replaced. If this error reoccurs frequently, there might be a loose contact in the bus cable. [8]

2.8.2.49 ERROR MOTOR TEMP (0x78)

Code: 0x78
Beschreibung: The temperature of the motor is outside the permissible temperature range.

[8]Works currently only with Profibus. Ex firmware V1.20 with CAN Bus and Profibus

Chapter 3

Configuration data

3.1 General

All configuration data to be permanently stored must be written to an internal EEPROM.

3.2 EEPROM

The access to the respective elements is controlled with the firmware of the modules. A number of different user access levels that are password-protected have been set up. The user level can be changed with the *„CHANGE USER”* (section 2.5.6) command. The following users are known to the module:

1. User:
   Standard user. Is automatically activated when the module is switched on. The module can be operated without limitations, while parameteriation is heavily restricted.
2. Diag:
   A secound communication Interface is opend (RS232, Bluetooth, CAN) and useable for diagnosis. You can not send any moving commands!
3. Profi:
   Profi users can modify all important parameters. Incorrect parameterization can cause unexpected machine behavior. The module can however not be permanently damaged by incorrect parameter settings.
4. Advanced:
   Advanced users can modify all important parameters. Incorrect parameterization can cause irreparable damage to the module!

5. Root:
   Root users have access to all parameters. Incorrect parameterization can cause irreparable damage to the module!

3.2.1 Motor

3.2.1.1 Serial Number

Zugriffsrechte: *Root* (section 1.5.5)
Description: Serial number of the built-in motor (UInt32) => 0 .. 4294967296
Data: (UInt32) => 0 .. 4294967296

3.2.1.2 Voltage

Access rights: *Root* (section 1.5.5)
Description: Rated motor voltage. This voltage forms the basis for the calculation of the brake control parameters (sensing ratio) and the maximum permissible PWM for test purposes. The value is also required for the automatic controller configuration.
Data: (UInt16) => 0 .. 65535

Incorrect parameter values can cause irreparable damage to the module!

3.2.1.3 Type

Access rights: *Advanced* (section 1.5.4)
Description: Select the motor type.

- DC (0x00): Direct current motor with brushes
- BLDC (0x01):): Electronically commuted brushless direct current motor with block commutation
- PMSM (0x02): Electronically commuted brushless direct current motor with *space vector modulation* (section 2.8.2.7)
- TORQUE (0x03): SCHUNK Torque Motor with *space vector modulation* (section 2.8.2.7)

In motors with resolver (section 3.2.6) "chatter" might occur with "positioning ramp type" (section 3.2.5.6) "Jerk". If this is the case, select a different "positioning ramp type" (section 3.2.5.6) .

Data: (UInt16) => 0 .. 65535

3.2.1.4 I2T

Access rights: *Advanced* (section 1.5.4)
Description: The I^2T monitoring can be activated. In the event of excessively high load, a I^2T *Fehler* (section 2.8.2.37) will be triggered.
In the case of I^2T monitoring, it is assumed that the maximum current is permitted to be present for 3 sec (corresponds to 100%). If a value <100% has been entered, then the time will be extended accordingly. Values greater than 100% shorten the time accordingly. I^2T switches off when the value is „0".
Data : (UInt8) => 0 .. 255 %

3.2.1.5 Pole Pairs

Access rights: *Root* (section 1.5.5)
Description: Electrical poles of the motor. Only required for brushless DC motors. This parameter affects the calculated velocities, positions and commutation patterns.
Data: (UInt16) => 0 .. 65535

3.2.1.6 Ferrule Resistance

Access rights: *Root* (section 1.5.5)
Description: Connection resistance for test functions, required for the limitation of the maximum permissible currents, and for automatic controller configuration.
Data: (Float) [Ohm]

Incorrect parameter values can cause irreparable damage to the module!

3.2.1.7 Inductance

Access rights: *Root* (section 1.5.5)
Description: The inductance is required for the automatic controller configu-

ration.
Data: (Float) [mH]

Incorrect parameter values can cause irreparable damage to the module!

3.2.1.8 Max. Current

Access rights: *Advanced* (section 1.5.4)
Description: Maximum permissible current of the motor. If this current value is exceeded for a prolonged period of time (ms), an emergency stop is triggered and the error message *MAX CURRENT* (section 2.8.2.36) is displayed.
Data: (4 bytes) 0.00 .. 29.99 [A] or 0..29999 [mA] depending on the *unit system* (section 1.4)

Incorrect parameter values can cause irreparable damage to the module!

3.2.1.9 Nom. Current

Access rights: *Advanced* (section 1.5.4)
Description: Rated current of the motor. If this current value is exceeded for a prolonged period of time, an I^2T *error* (section 2.8.2.37) is triggered.
Typ: (4 bytes) 0.00 .. 29.99 [A] or 0..29999 [mA] depending on the *unit system* (section 1.4)

Incorrect parameter values can cause irreparable damage to the module!

3.2.1.10 Max. Velocity

Access rights: *Advanced* (section 1.5.4)
Description: Maximum permissible velocity of the system (on output side).
Data: (4 bytes) Configured in the preset *unit system* (section 1.4) .

3.2.1.11 Max. Acceleration

Access rights: *Advanced* (section 1.5.4)
Description: Maximum permissible acceleration of the system (on output side).
Data: (4 bytes) Configured in the setting *unit system* (section 1.4) .

3.2.1.12 Max. Jerk

Access rights: *Advanced* (section 1.5.4)
Description: Maximum permissible jerking of the system (on output side). The jerk results from a sudden change in acceleration. This parameter is only evaluated when a *positioning movement with jerk limitation* (section 3.2.5.6) is carried out.
Data: (4 bytes) Configured in the setting *unit system* (section 1.4) .

3.2.1.13 Commutation Table

Access rights: *Root* (section 1.5.5)
Description: Hall table valid for block commutation by means of Hall sensors for the respective unit. If the value is incorrect, the motor fails to move, or works only with minimum torque.
Data: (UInt16) 0 .. 12

3.2.1.14 Offset Phase A

Access rights: *Root* (section 1.5.5)
Description: Zero point adjustment of first current sensor. This value should be within the range from 1700 to 2200. If this is not the case, the hardware might be defective.
Data: (UInt16) 0 .. 65535

An incorrect value can result in unexpected machine behavior (movement in one direction only, excessive jerking, overspeeding).

3.2.1.15 Offset Phase B

Access rights: *Root* (section 1.5.5)
Description: Zero point adjustment of second current sensor. This value should be within the range from 1700 to 2200. If this is not the case, the hardware might be defective.
Data: (UInt16) 0 .. 65535

An incorrect value can result in unexpected machine behavior (movement in one direction only, excessive jerking, overspeeding).

3.2.2 Gear

3.2.2.1 Serial Number

Access rights: *Root* (section 1.5.5)
Description: Serial number of the gear system.
Data: (UInt32) => 0 .. 4294967296

3.2.2.2 Gear Ratio 1

Access rights: *Profi* (section 1.5.3)
Description: Gear ratio from Motor to positioning System.
Data: (Float)

3.2.2.3 Gear Ratio 2

Access rights: *Profi* (section 1.5.3)
Description: Gear ratio from positioning System to drive side. Is only used when positioning system is *middle side* (section 3.2.6.3)
Data: (Float)

3.2.3 Reference

3.2.3.1 Type

Access rights: *Profi* (section 1.5.3)
Description: Enter here the referencing method to be used [1].

- Switch Intern Left (0x00) / Right (0x01)
  The internal reference switches are used for referencing. If the reference switch is activated, the direction of movement is determined as „left” or „right”.

[1] When using encoders with the index track, please observe instructions in chapter (*Pos Type* (section 3.2.6.2)).

- Switch Extern IN0 Left (0x02) / Right (0x03)
  A external referencing switch can used for referencing. This must be connect to the *digital input* (section 3.2.5.9) IN0. The moving direction when switch is high can be select with „left" or „right".

- Velocity Left (0x04) / Right (0x05)
  A velocity movement is completed for referencing purposes. The system detects whether the module moves against a fixed stop. This is the reference point. The direction of rotation is defined as „left" or „right".

  This referencing method is only recommended for systems with a fixed stop!

- Velocity Distance Left (0x06) / Right (0x07)
  In addition to the above referencing procedure, the module moves from the first reached stop to the fixed stop at the opposite side. The traveled distance must be greater than the difference between the *software limits* (section 3.2.5.17) => referencing successful.

  This referencing method is only recommended for systems with a fixed stop!

- Current Left (0x08) / Right (0x09)
  A current movement is completed. The current is increased until the module is set in motion. If the current exceeds the *maximal referencing current* (section 3.2.3.2) , the system assumes that a fixed stop has been reached. This is the reference point.

  This referencing method is only recommended for systems with a fixed stop!

Jamming, stiffness of mechanical parts or workpieces that are left in the path can also cause the current to exceed the rated current level. In such cases the machine assumes that a fixed stop has been reached, even if no such stop is installed.

- Current Distance Left (0x0A) / Right (0x0B)
  In addition to the above referencing procedure, the module moves from the first reached stop to the fixed stop at the opposite side. The traveled distance must be greater than the difference between the *software limits* (section 3.2.5.17) => referencing successful.

  This referencing method is only recommended for systems with a fixed stop!

- None (0x0C)
  After the *CMD REFERENCE* (section 2.1.1) command is sent, the current position is interpreted as the reference position.

- Manual (0x0D)
  With the command *CMD REFERENCE* (section 2.1.1) a „simulated" referncing move will be executed, when the module is referenced already. The module is moving to the referencing mark and then, depending on the *setting* (section 3.2.3.6) , to the positon „0".
  If the module is not referenced already, a *manual referencing* (section 2.1.2) will be started.

  After a successful execution of the manual referencing (section 2.1.2) , the referencing type is set to „Manual".

Daten: (UInt16) 0 .. 65535

3.2.3.2 Max. Reference Current

Zugriffsrechte: *Profi* (section 1.5.3)
Beschreibung: Current as [%] of the *nominal current* (section 3.2.1.9) . The reference current stays below this value.
Daten: (UInt8) 0 .. 255

3.2.3.3 Velocity

Access rights: *Profi* (section 1.5.3)
Description: Rated velocities for reference movements with internal or external reference switches and for velocity reference movements. This parameter is true for the manual referencing too and means 100% velocity.

If, after referencing, the module is to be moved to *position „0.0"* (section 3.2.3.6) the positioning command is executed with the velocity specified here.
Data: (4 bytes) Configured in the preset *unit system* (section 1.4) .

3.2.3.4 Acceleration

Access rights: *Profi* (section 1.5.3)
Description: Acceleration values for reference movements with internal or external reference switches, for velocity reference movements and manual referencing. If, after referencing, the module is to be moved to *position „0.0"* (section 3.2.3.6) the positioning command is executed with the acceleration specified here.
Data: (4 bytes) Configured in the preset *unit system* (section 1.4) .

3.2.3.5 Offset

Access rights: *Profi* (section 1.5.3)
Description: Position offset after successful referencing (zero point adjustment)
Data: (4 bytes) Configured in the preset *unit system* (section 1.4) .

3.2.3.6 Move Zero After Referencing

Access rights: *Profi* (section 1.5.3)
Description: After successful referencing, the module is moved to position „0.0". The specified *velocity* (section 3.2.3.3) and *acceleration* (section 3.2.3.4) are adhered to.
Data: (Bool) TRUE / FALSE

3.2.3.7 Timeout

Access rights: *Profi* (section 1.5.3)
Description: Maximum time for the reference movement.
Data: (Float) [s] or [ms], depending on *unit system* (section 1.4)

3.2.4 Controller

3.2.4.1 KR Current

Access rights: *Profi* (section 1.5.3)
Description: Proportional share of the current controller. With *current limit control* (section 3.2.4.7) , this value indicates the proportional share for the

current limit control.
Data: (Float)

3.2.4.2 TN Current

Access rights: *Profi* (section 1.5.3)
Description: Integral share of the current controller. Not required for *current limit control* (section 3.2.4.7) .
Data: (Float)

3.2.4.3 KR Speed

Access rights: *Profi* (section 1.5.3)
Description: Proportional share of the velocity controller
Data: (Float)

3.2.4.4 TN Speed

Access rights: *Profi* (section 1.5.3)
Description: Integral share of the velocity controller
Data: (Float)

3.2.4.5 KR Position

Access rights: *Profi* (section 1.5.3)
Description: Proportional share of the position controller
Data: (Float)

3.2.4.6 Delta Position

Access rights: *Profi* (section 1.5.3)
Description: Position window in which the position control is interrupted (depending on *brake configuration* (section 3.2.7.3)), the control remains on, the brake is applied and the system signals that the position is reached).
Data: (4 bytes) Configured in the preset *unit system* (section 1.4) .

3.2.4.7 Structure

Access rights: *Profi* (section 1.5.3)
Description: Design of the controller circuit.

- Current Speed (0x00)
  Current and velocity control are independent of each other.
- Cascade (0x01)
  Position, velocity and current control are cascading => current-controlled position and velocity movements are possible (set current is not exceeded) (e.g. no need for pre-positioning for gripping). In this mode, the preset

current (*„SET TARGET CURRENT”* (section 2.1.17)) is not exceeded during all positioning movements.

- Current Speed Limit (0x02)
  Current control is not activated. During velocity and positioning movements, the preset current (*„SET TARGET CURRENT”* (section 2.1.17)) is limited. In contrast to the cascade structure, the current is not controlled, but only limited (current limit control).

- PWM Speed Limit (0x02)
  Current control is not activated. During velocity and positioning movements, the sensing ratio of the PWMs is limited. The ratio between current and sensing ratio is determined from the *resistance* (section 3.2.1.6) of the motor.

  As the sensing ratio of the PWMs is limited directly (voltage limit), the drive system might be unable to reach its maximum velocity. As a result, positioning movements might take much longer than anticipated.

Data: (3 bits) 0 .. 7

If changes are made to the controller structure, it might be necessary to adjust the controller parameters!

3.2.5 Device

3.2.5.1 Serial Number

Access rights: *Root* (section 1.5.5)
Description: Serial number of the device
Data: (UInt32) => 0 .. 4294967296

3.2.5.2 Unit System

Access rights: *User* (section 1.5.1)
Description: All inputs and outputs of the module use the set *unit system* (section 1.4) . If the unit system is changed from float ($[mm]$(0x00),$[m]$(0x01),$[Inch]$(0x02),$[rad]$(0x03),$[Degree]$(0x0
to integer $[\mu m]$(0x06),$[\mu Degree]$(0x07),$[\mu Inch]$(0x08)),$[Milli-degree]$(0x09)), all time and current values are also interpreted as integers => $[s]$ -> $[ms]$; $[A]$ -> $[mA]$. The internal unit system is assigned (0x05).

Data: (5 bits) 0 .. 31

Please note: *Changing the unit system (section 1.4) affects a number of EPROM parameters, so that they must be adjusted immediately!*

3.2.5.3 Communication Mode

Access rights: *User* (section 1.5.1)
Description: The active communication system is configured.

- Auto (0x00)
  The communication system is tried to identified and configured automatically. Checked *hardware* (section 6.5) until now.

  If a module is connected to simultaneously to the RS232 and the Profibus interface, then the Profibus interface (depending on the hardware) will be recognized immediately after the module is switched on. There is no possibility in such cases of communicating via the RS232 interface.

- RS232 (0x01)
- CAN (0x02)
- Profibus DPV0 (0x03)
- RS232 Silent (0x04)
  Impulse messages (section 2.2) deactivated. (inkl. INFO BOOT)

Data: (5 bits) 0 .. 31

3.2.5.4 Invert Motor

Access rights: *Profi* (section 1.5.3)
Description: The direction of rotation of the motor is defined.

Please note: *Incorrect configuration might result in unexpected machine behavior (module rotating very quickly!).*

Data: (Bool) TRUE / FALSE

3.2.5.5 Invert Position System

Access rights: *Profi* (section 1.5.3)
Description: The measuring direction of the position measuring system is defined. If the tracks A and B of the encoder are confused, they can be readjusted with the software.

Please note: *Incorrect configuration might result in unexpected machine behavior (module rotating very quickly!)*

If the direction of rotation of the motor as well as the position measuring system direction are inversed, a left module can become a „right" module, and a „positive" opening gripper can become a „positive" closing gripper.

Data: (Bool) TRUE / FALSE

3.2.5.6 Positioning Ramp Type

Access rights: *Profi* (section 1.5.3)
Description: Enter here the ramp type for the position movement.

- Trapezoid (0x00)
  The movement profile is calculated on the basis of a trapezoid. If necessary, this profile is activated with *„MOVE POS TIME"* (section 2.1.5) , *„MOVE POS TIME REL"* (section 2.1.6) , *„MOVE POS TIME LOOP"* (section 2.1.8) and *„MOVE POS TIME REL LOOP"* (section 2.1.10) (curved paths). The travel time can be calculated (switching points are time-controlled).

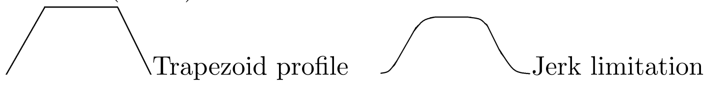
- Jerk (0x01)
  For positioning movements *„MOVE POS"* (section 2.1.3) , *„MOVE POS REL"* (section 2.1.4) , *„MOVE POS LOOP"* (section 2.1.7) and *„MOVE POS REL LOOP"* (section 2.1.9) the path is calculated with jerk limitation. The „Jerk" parameter (*„SET TARGET JERK"* (section 2.1.16)) is only used with this ramp type. This profile is deactivated for curved paths *„MOVE POS TIME"* (section 2.1.5) , *„MOVE POS TIME REL"*

(section 2.1.6) , *„MOVE POS TIME LOOP”* (section 2.1.8) und *„MOVE POS TIME REL LOOP”* (section 2.1.10) [2].

In motors with Resolver (section 3.2.6)) „chatter” might occur with „Positioning ramp type” (section 3.2.5.6)). If this is the case, select a different „Positioning ramp type” (section 3.2.5.6)

- Trapezoid SRU (0x02)
  The movement profile is calculated on the basis of a trapezoid. The travel time cannot be calculated [3].
- No Ramp (0x03)
  With this option, no path profile is calculated, but the position jump is set. It can thus be used for the automatic configuration of the controller. If the jump is set as default, the controller parameters must be adjusted accordingly.

Data: (3 bits) 0 .. 7



3.2.5.7 Start Program On Boot

Access rights: *Advanced* (section 1.5.4)
Description: When the module is switched on, the program stored in the EPROM is started immediately in line „0”.

The module might begin to move even if no control system is connected.

The program starts as soon as the communication interface is available, therefore RS232 should be set (section 2.3.1) as a bus system. With all other bus systems, the module begins only to move after an active master has been found.

Data: (Bool) TRUE / FALSE

[2]This procedure is necessary for computing time reasons.
[3]This is due to the pneumatics, as their effect on the travel time cannot be accurately determined in advance.

3.2.5.8 Endless

Access rights: *Profi* (section 1.5.3)
Description: The axis can be rotated endlessly.
Data: (Bool) TRUE / FALSE

This option is not recommended for grippers!

3.2.5.9 Digital In Usage

Access rights: *Profi* (section 1.5.3)
Description: Digital inputs are used.

- Normal (0x00)
  Digital inputs can be switched externally without affecting the module. They can be queried at any time with *„CMD DIO"* (section 2.5.3) .

- Program (0x01)
  Pre-programmed „phrases" can be executed. Before the very first phrase can be executed, all inputs must be set to „low". Subsequently, up to 7 *program phrases* (section 2.4.5) can be selected. Input 1 is used for „executing". The positions of the inputs 2 to 4 are only accepted, if rising edge at input 1 is used. If only input 1 is set, a *reference movement* (section 2.1.1) is executed.

  Switching sequence:
  1. Set all inputs to „low".
  2. Set inputs 2, 3, 4 to a required state (see the table below).
  3. Change input 1 to „high".

	Input 1	Input 2	Input 3	Input 4	Action
MPC	IN 0	IN 1	IN 2	IN 3	
MCS	DI 1	DI 2	DI 3	DI 4	
	low	low	low	low	Reset (no action)
	low->high	low	low	low	Referencing
	low->high	high	low	low	Program phrase 0
	low->high	low	high	low	Program phrase 1
	low->high	high	high	low	Program phrase 2
	low->high	low	low	high	Program phrase 3
	low->high	high	low	high	Program phrase 4
	low->high	low	high	high	Program phrase 5
	low->high	high	high	high	Program phrase 6

If external switches are activated „program" mode is no longer available

Data: (3 bits) 0 .. 7

3.2.5.10 Digital Out Usage

Access rights: *Profi* (section 1.5.3)
Description: Digital outputs are used.

- Normal (0x00)
  Digital outputs can be set with *„CMD DIO"* (section 2.5.3) .

- State + Moving OUT2 (0x01)
  The module status is signalled to the digital outputs. OUT2 indicates a moving module.

	MPC	MCS	Module state when „low"
Output 1	OUT0	DO1	Referenced
Output 2	OUT1	DO2	Error
Output 3	OUT2	DO3	Moving
Output 4	OUT3	DO4	Move end

- State + Position Reached OUT2 (0x02)
  The module status is signalled to the digital outputs. OUT2 indicates that module reaches a target position.

	MPC	MCS	Module state when „low"
Output 1	OUT0	DO1	Referenced
Output 2	OUT1	DO2	Error
Output 3	OUT2	DO3	Target position reached
Output 4	OUT3	DO4	Move end

- State + Brake OUT2 (0x03)
  The module status is signalled to the digital outputs. OUT2 indicates the state of the brake.

	MPC	MCS	Module state when „low"
Output 1	OUT0	DO1	Referenced
Output 2	OUT1	DO2	Error
Output 3	OUT2	DO3	State of the brake
Output 4	OUT3	DO4	Move end

- State + Warning OUT2 (0x04)
  The module status is signalled to the digital outputs. OUT2 indicates a warning.

	MPC	MCS	Module state when „low”
Output 1	OUT0	DO1	Referenced
Output 2	OUT1	DO2	Error
Output 3	OUT2	DO3	Warning
Output 4	OUT3	DO4	Move end

- State + Phrase Mode OUT2 (0x05)
  The module status is signalled to the digital outputs. OUT2 indicates that module is in ”program mode”.

	MPC	MCS	Module state when „low”
Output 1	OUT0	DO1	Referenced
Output 2	OUT1	DO2	Error
Output 3	OUT2	DO3	Program mode
Output 4	OUT3	DO4	Move end

Data: (3 bits) 0 .. 7

3.2.5.11 Analog OUT Usage

Access rights: *Profi* (section 1.5.3)
Description: The analog output (0 - 10V) is used.

- None (0x00)
  not used => 0V

- Position (0x01)
  Position is converted to an analog value
  Position 0.0 .. 5V
  Maximum absolute values of minimum and maximum positions are converted to 0V or 10V respectively. Example: minimum position is -5.0, maximum position is +10.0 => position = 0 [V], +10.0 = 10.0 [V], -5.0 = 2.5 [V]

- Speed (0x02)
  velocity is converted to an analog value
  Maximum negative velocity 0V
  Standstill 5V
  Maximum positive velocity 10V

- Current (0x03)
  0A => 0V
  Maximum current (section 3.2.1.8) = 10V

- Maximum (0x04)
  Analog output 10V

Data: (3 bits) 0 .. 7

3.2.5.12 Internal Switch Usage

Access rights: *Profi* (section 1.5.3)
Description: Use of internal digital inputs (hardware stop1 (SW1) and hardware stop2 (SW2))

- No Switch (0x00)
  not used

Data: (2 bits) 0 .. 3

3.2.5.13 ID

Access rights: *User* (section 1.5.1)
Description: Unique module identification. See also *SET CONFIG* (section 2.3.1) .
Data: (UInt8) 0 .. 255

3.2.5.14 Group

Access rights: *User* (section 1.5.1)
Description: Unique group identification of the module See also *SET CONFIG* (section 2.3.1) . With Profibus, the ”Real No Add Change” is stored here.
Data: (UInt8) 0 .. 255

3.2.5.15 RS232 Baud Rate

Access rights: *User* (section 1.5.1)
Description: Baud rate of RS232. Values: 1200, 2400, 4800, 9600, 19200, 38400. See also *SET CONFIG* (section 2.3.1) .
Data: (UInt16) 0 .. 65535

3.2.5.16 CAN Baud Rate

Access rights: *User* (section 1.5.1)
Description: Baud rate of CAN. Values: 50, 100, 125, 250, 500, 1000. Siehe auch *SET CONFIG* (section 2.3.1) .
Data: (UInt16) 0 .. 65535

3.2.5.17 Min. Position

Access rights: *Profi* (section 1.5.3)
Description: Minimum permissible position (software limit). Is ignored, if *„endless”* (section 3.2.5.8) is set. Used for *referencing* (section 3.2.3) with ”stroke monitoring.
Data: (4 bytes) Configured in the preset *unit system* (section 1.4) .

3.2.5.18 Max. Position

Access rights: *Profi* (section 1.5.3)
Description: Maximum permissible position (software limit). Is ignored, if *„endless”* (section 3.2.5.8) is set. Used for *referencing* (section 3.2.3) with ”stroke monitoring.
Data: (4 bytes) Configured in the preset *unit system* (section 1.4) .

3.2.5.19 Tow Error

Access rights: *Profi* (section 1.5.3)
Description: Towing error. This value may not be exceeded during a positioning movement. If the value is exceeded, an error occurs (*„ERROR TOW”* (section 2.8.2.30)).
Data: (4 bytes) Configured in the preset *unit system* (section 1.4) .

3.2.5.20 Min. Temperature

Access rights: *Advanced* (section 1.5.4)
Description: Minimum permissible working temperature. If the temperature drops below this value, an error occurs (*„ERROR TEMP LOW”* (section 2.8.2.42)).
Data: (Float) [°C]

3.2.5.21 Max. Temperature

Access rights: *Advanced* (section 1.5.4)
Description: Maximum permissible working temperature. If this value is exceeded, an error occurs (*„ERROR TEMP HIGH”* (section 2.8.2.43)).
Data: (Float) [°C]

3.2.6 Positioning

3.2.6.1 Serial Number

Access rights: *Root* (section 1.5.5)
Description: Serial number of the position measuring system.
Data: (UInt32) => 0 .. 4294967296

3.2.6.2 Type

Access rights: *Advanced* (section 1.5.4)
Description: The measuring system type is defined here.

- Encoder (0x00)
  Encoder measuring system without index track. Observe *Parameter 1* (section 3.2.6.4) .

- Encoder Index (0x01)
  Encoder with index track. The index track is evaluated for all *reference movements* (section 3.2.3) . To ensure that an index track is located at the correct position, with certain referencing methods, the drive might move briefly forward and back or make small movements in the wrong direction. The modules also move with reference method "NONE", as the next index pulse is searched for. Observe *Parameter 1* (section 3.2.6.4) .

- Resolver (0x02)
  Resolver system where the excitation current must be generated internally. Observe *Parameter 1* (section 3.2.6.4) and *Parameter 2* (section 3.2.6.5) .

  In motors with resolver (section 3.2.6) „chatter" might occur with "positioning ramp type„ (section 3.2.5.6) „Jerk". If this is the case, select a different "positioning ramp type„ (section 3.2.5.6) .

- Encoder Differential (0x06)
  Differential encoder without index track. Observe *parameter1* (section 3.2.6.4) !

- Encoder Differential Index (0x07)
  Differential encoder with index track. The index track is evaluated for all *reference movements* (section 3.2.3) . To ensure that an index track is located at the correct position, with certain referencing methods, the drive might move briefly forward and back or make small movements in the wrong direction. The modules also move with reference method „None", as the next index pulse is searched for. Observe *Parameter 1* (section 3.2.6.4)

Data: (UInt8) 0 .. 255

3.2.6.3 Mount

Access rights: *Advanced* (section 1.5.4)
Description: The mount type of the positioning system.

- On Input Side: The positioning system is mounted the motor.
- On Output Side: The positioning system is mounted the drive side.
- On Middle Side: The positioning system is mount between motor and drive side.

Data: (2 bits) 0 .. 3

3.2.6.4 Parameter 1

Access rights: *Advanced* (section 1.5.4)
Description: Parameter 1 for the positioning measuring system.

- Encoder: Ticks in Rotation (4-fold evaluation)
- Resolver: Voltage frequency at the excitation coil in [kHz]. Allowed values: 8 [kHz], 4 [kHz], 2 [kHz], 1 [kHz].

Data: (UInt16) 0 .. 65535

3.2.6.5 Parameter 2

Access rights: *Advanced* (section 1.5.4)
Description: Parameter 2 for the positioning measuring system.

- Encoder: not required
- Resolver: Amplitude of the input voltage at the excitation coil [%]. Must be determined by measurement. The output voltage at the receiver coils may not reach saturation point.

Data: (UInt16) 0 .. 65535

3.2.6.6 Offset

Access rights: *Advanced* (section 1.5.4)
Description: Rotational position of the positioning measuring system relative to the motor phases. Configured in the preset *unit system* (section 1.4) . This value can be calculated automatically (see the *standstill commutation* (section 1.7)). A *„space vector"* (section 1.7) search will be started again, when the value is set to zero by the user.

Data: (Float)

For a space vector search the module should be movable in all directions. The module move fitfully up to two motor rotations. In this time, no communication with the module is possible.

3.2.6.7 Motion Threshold

Access rights: *Profi* (section 1.5.3)
Description: The value [%] of *maximum velocity* (section 3.2.1.10) . If the velocity drops below this value, the modul will be handled as not moving.
Data: (Float)

3.2.6.8 ADC Offset

Access rights: *Root* (section 1.5.5)
Description: ADC Offset to „center" the measured signal. Only used for sin/cos and resolver measurement systems.
Data: (Int16) -32767 .. 32767

3.2.7 Brake

3.2.7.1 Serial Number

Access rights: *Root* (section 1.5.5)
Description: Serial number of the brake.
Data: (UInt32) => 0 .. 4294967296

3.2.7.2 Type

Access rights: *Advanced* (section 1.5.4)
Description: Type of brake. The brake voltage is adjusted by means of the software based on the configured motor voltage and the brake type.
Data: (UInt16) 0 .. 65535

Incorrect configuration might result in a brake failure!

3.2.7.3 Brake Usage

Access rights: *Profi* (section 1.5.3)
Description: Brake usage

- No Use (0x00)
  The brake is not used. It is only applied in the event of a power failure. After the module is started, it is automatically released.

- Error Only (0x01)
  Brake is only applied after an error occurred. Otherwise, the drive is controlled continuously without braking.

- Normal (0x02)
  Brake is automatically applied in the event of a malfunction and at the end of the movement.

If a brake is configured, the *pseudo absolute value transmitter* (section 1.6) is possibly active, when other requirements are fulfilled.

Data: (UInt16) 0 .. 65535

3.2.7.4 Timeout

Access rights: *Profi* (section 1.5.3)
Description: Time required for the brake to generate and release the magnetic field, indicated in [s] or [ms], depending on the *unit system* (section 1.4) .
Data: (Float)

3.2.8 SRU

The following settings must only be made with an SRU and can also only be achieved with an SRU.

3.2.8.1 Type

Access rights: *Root* (section 1.5.5)
Description: Double or single pressurize.
Data: (Bool) TRUE / FALSE

3.2.8.2 Service Notification

Access rights: *Profi* (section 1.5.3)
Description: Activate/deactivate the service notification.
Data: (Bool) TRUE / FALSE

3.2.8.3 Brake Point Coefficient

Access rights: *Root* (section 1.5.5)
Description: Coefficient0 for brake point calculation.
Data: (Float)

3.2.8.4 Brake Point S2X

Access rights: *Root* (section 1.5.5)
Description: Distance from the end of the movement at which the two valves are switched on.
Data: (Float)

3.2.8.5 KR Valve Undershoot

Access rights: *Root* (section 1.5.5)
Description: Proportional share of the brake point controller
Data: (Float)

3.2.8.6 Throw Back

Access rights: *Root* (section 1.5.5)
Description: Distance by which the brake point is set back in the event of a hit-back (SRU reverses direction of rotation) or an overshoot. Observe *unit system* (section 1.4) .
Data: (Float)

3.2.8.7 Delta Position Valve Off

Access rights: *Root* (section 1.5.5)
Description: Position difference at which compressed air assistance is required. Observe *unit system* (section 1.4) .
Data: (Float)

3.2.8.8 Max. Brake Point Difference

Access rights: *Root* (section 1.5.5)
Description: „Tow error" at brake point controller. If the brake point correction deviates by more than this value, it is likely that the compressed air failed or the coupling is disconnected. The (*„ERROR PRESSURE"* (section 2.8.2.27)) is triggered. Observe *unit system* (section 1.4) .
Data: (Float)

3.2.8.9 Hit Back Overshoot

Access rights: *Root* (section 1.5.5)
Description: Position from which a detected hit-back is treated as an overshoot. Observe *unit system* (section 1.4) .
Data: (Float)

3.2.8.10 Turn Count Factor

Access rights: *Root* (section 1.5.5)
Description: Only required for „MD-SE". Conversion of the ticks of the rotary knob into SRU velocities. $target\_velocity = eeprom.Motor.maxVel * eeprom.SRU.turnCountFactor * (rotary\_encoder\_diff)/(time\_diff)$. Usefull values are from [0.5..1.5] (the larger the faster), negative values invert the movement direction.
Data: (Float)

3.2.8.11 Manual Mode Factor

Access rights: *Root* (section 1.5.5)
Description: Only required for „MD-SE". Offset used to ensure that the software limits are not exceeded. Offset for $eeprom.device.minPos$ and $eeprom.device.maxPos$ to keep SRU off the soft limits: The minimal teachable position is $eeprom.Device.minPos+ manualModeFactor$; the maximum teachable position is $eeprom.Device.maxPos- manualModeFactor$.
Data: (Float)

Chapter 4

MCDemo

The software is used for the commissioning and testing of SCHUNK motion modules.

4.1 Requirements

- Operating system: Windows 98SE, Windows NT, Windows 2000, Windows XP, Windows Vista
- RAM: min. 256MB RAM
- Hard disk space: min. 8 MB free
- Graphics: 1024x768 with 16-bit colour depth
- CD-ROM

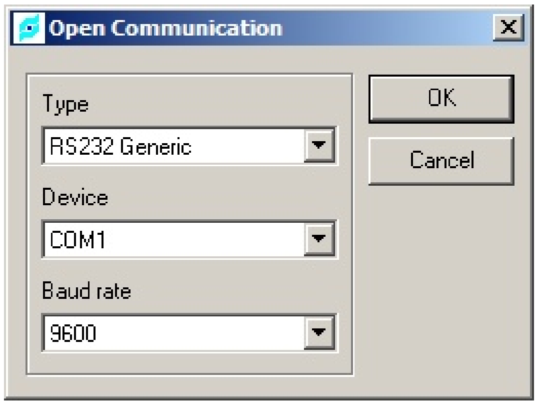
4.2 First steps

All modules must be connected through a suitable communication system to the PC. The following communication interfaces are currently supported by the software:

- RS232
- CAN: cards from VECTOR-Informatik
- CAN: cards from „esd electronic system design gmbh"
- CAN: USB-CAN converter PCAN-USB from PEAK-System Technik GmbH
- CAN: cards from IXXAT Automation GmbH (VCI driver version 3)
- CAN: cards from Softing

- Profibus DPV0: cards from Hilscher GmbH
- Profibus DPV0: Siemens AG CP56xx

The respective card must be first installed. Follow the instructions of the manufacturers. For more details look in the *appendix* (section 6.5) .



Type: RS232 Generic
Device: COM1
Baud rate: 9600

Figure 4.1: Selection of communication interface

After the *selection* (fig. 4.1) of the communication interface is completed it is opened automatically. The bus search automatically detects all connected and switched on modules. If the option „Do not initialize detected modules automatically" in the *preferences* (section 4.3.5) is checked, the module initialization works manually only.

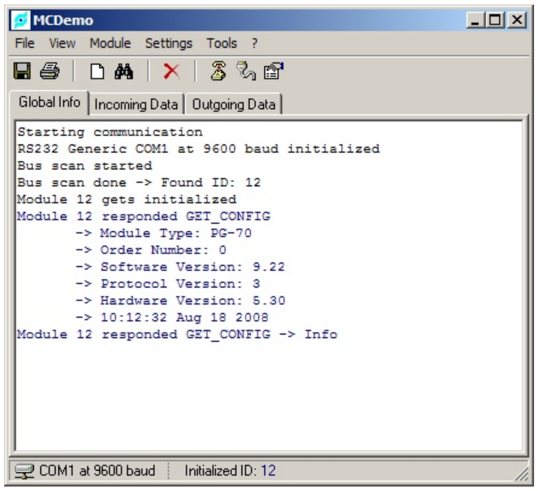
Apart from the *Main window* (fig. 4.2) a separate *module window* (fig. 4.3) is available for each module, allowing for the testing of all module functions. Press *F1* to access the help system for additional assistance.

4.3 Main window

In the *main window* (fig. 4.2) , you can manage the connections, log the communication with the respective bus system and edit the application settings.

The main window features:

Menu bar (fig. 4.4)
Tool bar (fig. 4.5)
Output tabs (fig. 4.6)
Status bar (fig. 4.7)



```
Starting communication
RS232 Generic COM1 at 9600 baud initialized
Bus scan started
Bus scan done -> Found ID: 12
Module 12 gets initialized
Module 12 responded GET_CONFIG
       -> Module Type: PG-70
       -> Order Number: 0
       -> Software Version: 9.22
       -> Protocol Version: 3
       -> Hardware Version: 5.30
       -> 10:12:32 Aug 18 2008
Module 12 responded GET_CONFIG -> Info
```

COM1 at 9600 baud | Initialized ID: 12

Figure 4.2: Main window

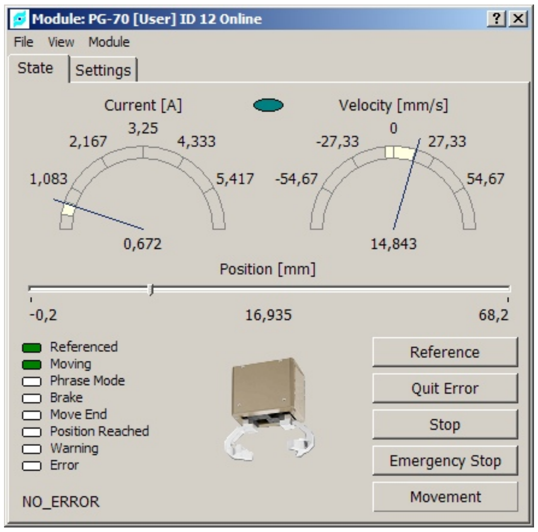


Figure 4.3: Module window

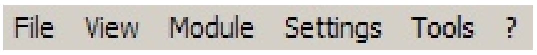


Figure 4.4: Menu bar

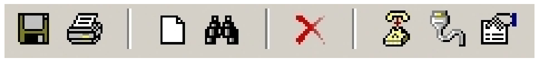
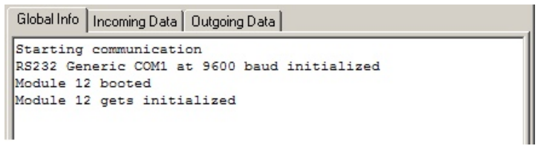


Figure 4.5: Tool bar



```
Starting communication
RS232 Generic COM1 at 9600 baud initialized
Module 12 booted
Module 12 gets initialized
```

Figure 4.6: Output tabs

4.3.1 Toolbar

The toolbar contains the most frequently used functionality.

💾	Save the EEPROM content of all initialized modules.
🖨	Print the EEPROM content of all initialized modules.
🗋	Initialize a module with a known ID.
🔍	Scan the entire bus for modules.
✗	Send an *emergency stop* (section 2.1.20) command to all modules.
☎	Open or close the selected communication interface.
⌇	Search for installed communication interface.
▤	Change application *preferences* (section 4.3.5) .

4.3.2 Menu

- File
  - Save: Save the EEPROM content of all initialized modules.
  - Print: Print the EEPROM content of all initialized modules.

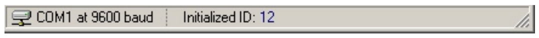


Figure 4.7: Status bar

  - Exit: Close the application.

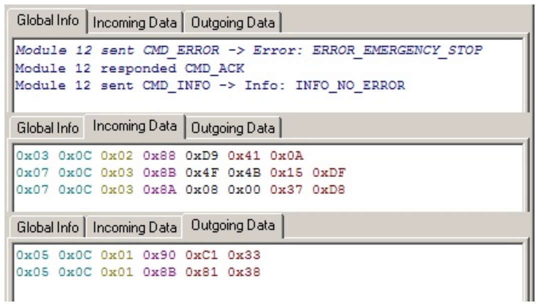
- View
  - Bus Details: „Global Info" shows details regarding the bus system status.
  - Set Bookmark: Set a bookmark in the output tabs.
  - Clear Logs: Clear the content of all output windows.
  - Module ... : Activate the window of the selected module.

- Module
  - Initialize by ID: Initialize a module with a known ID.
  - Close by ID: Deinitialize an already initialized module.
  - Scan Bus: Scan the entire bus for active modules.
  - Emergency Stop: Send the *emergency stop command* (section 2.1.20) to all initialized modules. The function is disabled when SRV modules initialized.

- Settings
  - Connect/Disconnect: Open or close the selected communication interface.
  - Open Communication: Search for installed communication interfaces.
  - Language: Change the language of the MCDemo interface.
  - Preferences: Change application *preferences* (section 4.3.5) .

- Tools
  - CRC *Calculator* (section 4.3.6) : A *tool* (section 4.3.6) used to calculate the CRC. (required for *RS232 communication* (section 1.3.3)
  - Numeric Converter: A *tool* (section 4.3.6) used to convert the various numerical formats. (*data format* (section 1.3.1))
  - Program Editor: A *tool* (section 4.3.6) for the creation of *module programs* (section 2.4) .

- ?
  - SCHUNK Motion: This documentation.
  - MCDemo Help: MCDemo documentation.
  - About: Details regarding the application and version.



```
Module 12 sent CMD_ERROR -> Error: ERROR_EMERGENCY_STOP
Module 12 responded CMD_ACK
Module 12 sent CMD_INFO -> Info: INFO_NO_ERROR
```

```
0x03 0x0C 0x02 0x88 0xD9 0x41 0x0A
0x07 0x0C 0x03 0x8B 0x4F 0x4B 0x15 0xDF
0x07 0x0C 0x03 0x8A 0x08 0x00 0x37 0xD8
```

```
0x05 0x0C 0x01 0x90 0xC1 0x33
0x05 0x0C 0x01 0x8B 0x81 0x38
```

Figure 4.8: Output tabs

4.3.3 Output tabs

On the „*Global Info*" tab, all relevant information regarding the individual connected modules is shown in plain text. Each module is thereby shown in a different colour. On the „*Incoming Data*" tab, the data received from the respective bus system is shown in its raw format. On the „*Outgoing Data*" tab, the sent raw data is shown.

„Incoming" and „outgoing" data can be very useful when developing customized applications. The byte sequences to be sent to the respective bus system and the corresponding responses from the module can be easily identified.

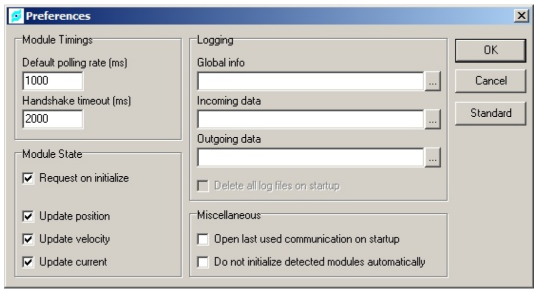
All displayed data can be copied to other applications („*Strg C, Strg V*"). The individual *log elements* (fig. 1.1) are shown in different colours.

4.3.4 Status bar

The *status bar* (fig. 4.7) shows the current communication properties and status as well as the settings of the communication interface, and the number and ID of the initialized modules.

4.3.5 Preferences

- Module Timings
  - Default polling rate: If this option is selected, a *GET STATE* (section 2.5.1)) with preset time is sent when a module is initialized.
  - Handshake Timeout: Time during which the interface expects a response from the module. After this time has lapsed, a timeout is triggered.



Module Timings
Default polling rate (ms): 1000
Handshake timeout (ms): 2000

Module State
☑ Request on initialize
☑ Update position
☑ Update velocity
☑ Update current

Logging
Global info:
Incoming data:
Outgoing data:
☐ Delete all log files on startup

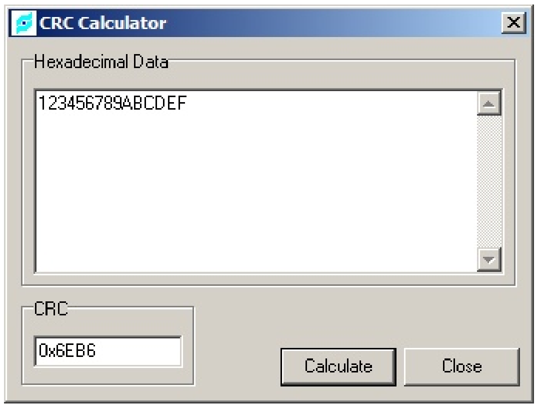
Miscellaneous
☐ Open last used communication on startup
☐ Do not initialize detected modules automatically

Figure 4.9: Preferences

- Module State
  - Request on initialize: If this option is selected, a *GET STATE* (section 2.5.1)) is sent after a module has been initialized.
  - Update position: The position is requested upon *GET STATE* (section 2.5.1) .
  - Update velocity: The velocity is requested upon *GET STATE* (section 2.5.1) .
  - Update current: The current is requested upon *GET STATE* (section 2.5.1) .
- Logging
  - Global Info: File to which the „Global Info" output is written.
  - Incoming Data: File to which the „Incoming Data" output is written.
  - Outgoing Data: File to which the „Outgoing Data" output is written.
  - Delete all log files on startup: All log files are deleted upon application restart.
- Miscellaneous
  - Open last used communication on startup: The last used communication settings are set upon application restart.
  - Do not initialize detected modules automatically: The module initialization works manually only.

4.3.6 Tools

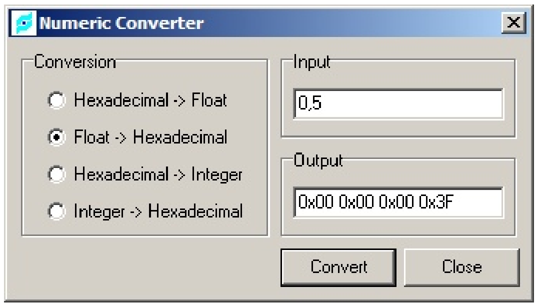
The *CRC calculator* (fig. 4.10) is used to calculate the *CRC16* (section 6.2) by means of previously entered hexadecimal numbers.
The *numeric converter* (fig. 4.11) is used to convert numerical values of various format.
The *program editor* (fig. 4.12) enables users to create customized programs for modules.



123456789ABCDEF

0x6EB6

Figure 4.10: CRC calculator

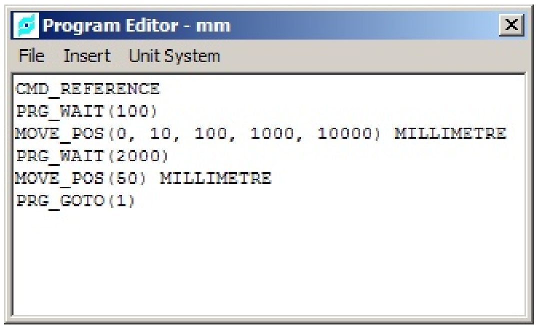


Float -> Hexadecimal [✓]

Input: 0,5

Output: 0x00 0x00 0x00 0x3F

Figure 4.11: Numeric converter



```
CMD_REFERENCE
PRG_WAIT(100)
MOVE_POS(0, 10, 100, 1000, 10000) MILLIMETRE
PRG_WAIT(2000)
MOVE_POS(50) MILLIMETRE
PRG_GOTO(1)
```

Figure 4.12: Program editor

4.4 Module window

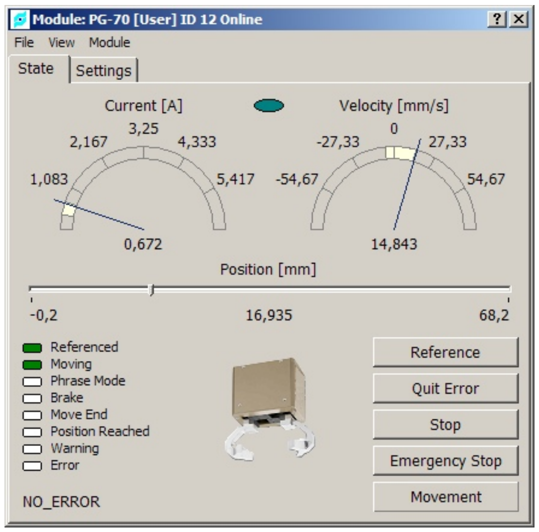


Figure 4.13: Module window

In the *module window* (fig. 4.13) , all module-relevant data can be viewed and managed. From here, users can send individual commands to the respective module. The „State" tab shows the current module status. The information is updated when a *„GET STATE"* (section 2.5.1) is received.

If state request is disabled, or if this command is not selected in the preferences (section 4.3.5) the information on the tab is not updated. However, when communicating via Profibus, the eight indicators on the left side are updating with each incoming message from the module.

The window title is shown as „Module: <module type> [<user rights>] ID <modul-ID> <state (active/inactive)>". If there was no reply to a sent command, the state is changed from „active" to „inactive".

Using the buttons in the right section of the window, the main commands can be sent directly to the module. After the Movement button has been clicked, a separate section of the window for the required *parameterization of the movement commands* (fig. 4.14) is shown.

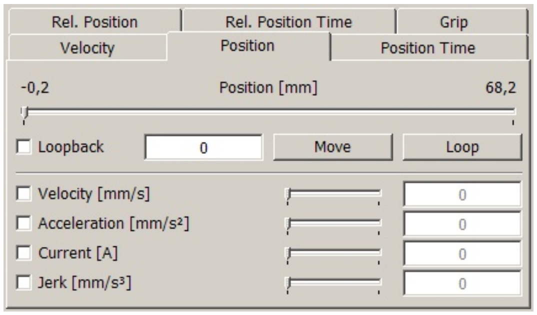


Figure 4.14: Movement commands

4.4.1 Buttons

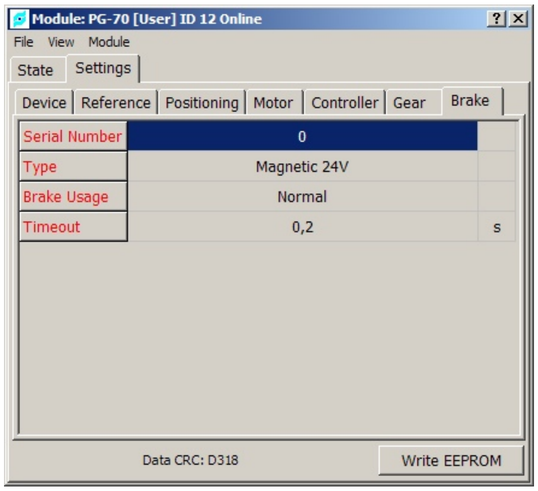
The following commands are available:

- Reference / Move to Nonius: Execute the *CMD REFERENCE* (section 2.1.1) .
- Quit Error: Execute the *„CMD ACK"* (section 2.8.1.4) command.
- Stop: Execute the *Stop* (section 2.1.19) command.
- Emergency Stop: Execute the *emergency stop* (section 2.1.20) .
- Movement: *The module window is extended with movement controls* (fig. 4.14) .

Movement commands:

- Velocity: A *velocity movement* (section 2.1.12) is initialized.
- Position: A *positioning movement* (section 2.1.3) is initialized. If the *Loop* option is selected, the module can be moved back and forth between two user-defined positions.
- Position: A time controlled *positioning movement* (section 2.1.5) is initialized (curved tracks are possible). If the *Loop* option is selected, the module can be moved back and forth between two user-defined positions.
- Rel. Position: A relative *positioning movement* (section 2.1.4) is initialized. If the *Loop* option is selected, two positioning movements will be cyclically executed.
- Rel. Position Time: A time controlled relative *positioning movement* (section 2.1.6) is initialized (curved tracks are possible). If the *Loop* option is selected, two positioning movements will be cyclically executed.
- Grip: A *grip movement* (section 2.1.13) is initialized.

4.4.2 Module configuration


Module: PG-70 [User] ID 12 Online
File View Module
State Settings
Device Reference Positioning Motor Controller Gear Brake
Write EEPROM

Serial Number	0	
Type	Magnetic 24V	
Brake Usage	Normal	
Timeout	0,2	s

Data CRC: D318

Figure 4.15: EEPROM brake data

The view „Settings" is shown as soon as the module configuration is received.

On the various *„tabs"* (fig. 4.15) in the area „Settings" EEPROM entries can be viewed and edited. Depending on the *user access rights* (section 1.5) , certain entries might only be read but not changed.

The following tabs can be called up:

- *Device* (section 3.2.5)
- *Reference* (section 3.2.3)
- *Positioning* (section 3.2.6)
- *Motor* (section 3.2.1)
- *Controller* (section 3.2.4)
- *Gear* (section 3.2.2)
- *Brake* (section 3.2.7)

4.4.3 Menu

The menu allows for the testing of all available module commands and the adjustment of advanced settings. The menu entries are described in detail in the following chapters.

- File
  - Load EEPROM: Load configuration data from a file.
  - Save EEPROM: Save the displayed configuration data in a file.
  - Print EEPROM: Print the displayed configuration data.
  - Print Changes: Print changed (marked) configuration data only.
  - Close: Close the module window. An emergency stop command is sent to the active module.
- View
  - Actual Values: Last received state information is shown.
  - Graph Current: The current is shown in the form of a graph.
  - Graph Velocity: The velocity is shown in the form of a graph.
  - Graph Position: The position is shown in the form of a graph.
  - Combined Graph: Current, velocity and position are shown in a combined graph.
  - Pause/Run Graph: The graph refreshing can be paused and restarted, if necessary.
- Module
  - Movement
    * Move with Current: *Trigger a current movement.* (section 2.1.11)
    * Move with Velocity: *Trigger a velocity movement.* (section 2.1.12)
    * Move to Position: *Trigger a positioning movement.* (section 2.1.3)
    * Move to Position (Time): *Trigger a positioning movement (curved tracks possible).* (section 2.1.5)
    * Move to rel. Position: *Trigger a relative positioning movement.* (section 2.1.4)
    * Move to rel. Position (Time): *Trigger a time controlled relative positioning movement (curved tracks possible).* (section 2.1.6)
    * Move to Grip: *Trigger a grip movement.* (section 2.1.13)
    * Set Target Current: *Set the nominal current for the next movement(s).* (section 2.1.17)
    * Set Target Acceleration: *Set the nominal acceleration for the next movement(s).* (section 2.1.15)
    * Set Target Velocity: *Set the nominal velocity for the next movement(s).* (section 2.1.14)
    * Set Target Jerk: *Set the nominal jerk of the next movement(s).* (section 2.1.16)

    * Set Target Time: *Set the time for the next positioning command.* (section 2.1.18)
- Programming
    * Upload Program: *Transfer a program from a file to a module.* (section 2.4.1)
    * Download Program: Read a program stored in a module and save it in a file.
    * Erase Program: Erase the program memory.
    * Show Program: *Show a program stored in a module.* (section 2.4.2)
    * Execute Program: *Execute program.* (section 2.4.3)
    * Execute Phrase: *Execute program phrase.* (section 2.4.4)
    * Execute Phrase 0: *Execute program phrase no. „0”.* (section 2.4.5)
    * Execute Phrase 1: *Execute program phrase no. „1”.* (section 2.4.6)
    * Execute Phrase 2: *Execute program phrase no. „2”.* (section 2.4.7)
    * Execute Phrase 3: *Execute program phrase no. „3”.* (section 2.4.8)
    * Execute Phrase 4: *Execute program phrase no. „4”.* (section 2.4.9)
    * Execute Phrase 5: *Execute program phrase no. „5”.* (section 2.4.10)
    * Execute Phrase 6: *Execute program phrase no. „6”.* (section 2.4.11)
    * Execute Phrase 7: *Execute program phrase no. „7”.* (section 2.4.12)
    * Execute Phrase 8: *Execute program phrase no. „8”.* (section 2.4.13)
    * Execute Phrase 9: *Execute program phrase no. „9”.* (section 2.4.14)
    * Execute Phrase 10: *Execute program phrase no. „10”.* (section 2.4.15)
    * Execute Phrase 11: *Execute program phrase no. „11”.* (section 2.4.16)
    * Execute Phrase 12: *Execute program phrase no. „12”.* (section 2.4.17)
    * Execute Phrase 13: *Execute program phrase no. „13”.* (section 2.4.18)
    * Execute Phrase 14: *Execute program phrase no. „14”.* (section 2.4.19)

    * Execute Phrase 15: *Execute program phrase no. „15".* (section 2.4.20)

- Test Communication
    * From MC to PC: All Values: *Transfer test data from module to control.* (section 2.5.7)
    * From MC to PC: -1.2345: *Transfer test data from module to control.* (section 2.5.7)
    * From MC to PC: 47.11: *Transfer test data from module to control.* (section 2.5.7)
    * From MC to PC: 287454020: *Transfer test data from module to control.* (section 2.5.7)
    * From MC to PC: -1122868: *Transfer test data from module to control.* (section 2.5.7)
    * From MC to PC: 512: *Transfer test data from module to control.* (section 2.5.7)
    * From MC to PC: -20482: *Transfer test data from module to control.* (section 2.5.7)
    * From PC to MC: All Values: *Transfer test data from control to module.* (section 2.5.8)
    * From PC to MC: -1.2345: *Transfer test data from control to module.* (section 2.5.8)
    * From PC to MC: 47.11: *Transfer test data from control to module.* (section 2.5.8)
    * From PC to MC: 287454020: *Transfer test data from control to module.* (section 2.5.8)
    * From PC to MC: -1122868: *Transfer test data from control to module.* (section 2.5.8)
    * From PC to MC: 512: *Transfer test data from control to module.* (section 2.5.8)
    * From PC to MC: -20482: *Transfer test data from control to module.* (section 2.5.8)
- EEPROM Read
    * Read EEPROM: *Read all configuration data from the module.* (section 2.3.2)
    * Read ID: *Read module ID.* (section 2.3.2)
    * Read Group: *Read group ID.* (section 2.3.2)
    * Read Communication Mode: *Read currently set communication mode.* (section 2.3.2)
    * Read Unit System: *Read currently set unit system.* (section 2.3.2)
    * Read RS232 Baud Rate: *Read currently set RS232 baud rate.* (section 2.3.2)

  - Read CAN Baud Rate: *Read currently set CAN baud rate.* (section 2.3.2)
  - Read Soft-High: *Read currently set software high limit.* (section 2.3.2)
  - Read Soft-Low: *Read currently set software low limit.* (section 2.3.2)
  - Read Nom. Current: *Read currently set nominal current.* (section 2.3.2)
  - Read Max. Current: *Read currently set maximum current.* (section 2.3.2)
  - Read Max. Velocity: *Read currently set maximum velocity.* (section 2.3.2)
  - Read Max. Acceleration: *Read currently set maximum acceleration.* (section 2.3.2)
  - Read Max. Jerk: *Read currently set maximum jerk.* (section 2.3.2)
  - Read Offset Phase A: *Read currently set offset phase A.* (section 2.3.2)
  - Read Offset Phase B: *Read currently set offset phase B.* (section 2.3.2)
  - Read Reference Offset: *Read currently set reference offset.* (section 2.3.2)
  - Read Serial Number: *Read currently set serial number.* (section 2.3.2)
  - Read Data CRC: *Read actual CRC of the configuration data.* (section 2.3.2)
  - Read Order Number: *Read the order number of the module.* (section 2.3.2)

- EEPROM Write
  - Write EEPROM: *Write configuration data.* (section 2.3.1) *Only the data released for the respective user (section 1.5) iswritten.*
  - Write ID: *Edit module ID.* (section 2.3.1) Only takes effect after restart.
  - Write Group: *Edit group ID.* (section 2.3.1) Only takes effect after restart.
  - Write Communication Mode: *Change communication interface.* (section 2.3.1) Only takes effect after restart.
  - Write Unit System: *Change unit system.* (section 2.3.1) Only takes effect after restart.
  - Write RS232 Baud Rate: *Change RS232 baud rate.* (section 2.3.1) Only takes effect after restart.
  - Write CAN Baud Rate: *Change CAN baud rate.* (section 2.3.1) Only takes effect after restart.

- Reference: *Trigger a referencing movement.* (section 2.1.1)
- Quit Error: *Acknowledge an error.* (section 2.8.1.4)
- Stop: *Stop a movement.* (section 2.1.19)
- Emergency Stop: *Trigger an emergency stop.* (section 2.1.20)
- Change User: *Change user.* (section 2.5.6) *Requires password.*
- Get State: *Der aktuelle Status des Moduls wird angefordert* (section 2.5.1)
- Get Error Info: *Read detailed information for the active error.* (section 2.8.1.5)
- Get Module Info: *Read module information (order no., software version, hardware version, device model).* (section 2.3.2)
- Manual Referencing: *Start the manual referencing.* (section 4.4.4)
- Digital I/O State: *Set or read digital inputs/outputs.* (section 2.5.3)
- Reboot: *Restart module.* (section 2.5.2)
- Disconnect: *Disconnect module from the bus system.* (section 2.5.5) Module can only be operated after a module restart.
- Toggle Impulse Message: *Activate or deactivate impulse messaging.* (section 2.2.6)
- Setup Wizard: *Easy installation of a new module.* (section 4.4.5)
- Update Firmware: Update firmware on the module. *Requires password.*

4.4.4 Manual Referencing

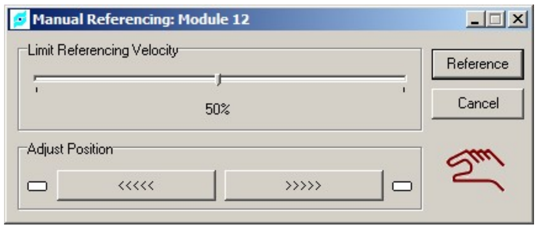


Figure 4.16: Manual Referencing

After the module is set to the manual referencing mode, it is possible to adjust the module position. The max. moving velocity (100%) is adjustable with *reference velocity* (section 3.2.3.3) .

For detailed information see *„CMD REFERENCE HAND"* (section 2.1.2) .

4.4.5 Setup Wizard

With this wizard you can adjust some important configuration data step by step and save them to the module finally. The tool ist developed mainly to setup PSM and PDU modules installed at a linear axis.

4.5 Tips

4.5.1 Supported languages

Currently, English, German, French and Russian are supported. Changes in languages are implemented using the „Settings/Language” menu. The selected language applies after the application has been restarted.

4.5.2 Driver Vector CAN

If the application cannot find the required library file „vcand32.dll”, then the following is to be noted:

- Either copy the above-named DLL file from the Vector CAN Installation directory into the MCDemo Installation directory,
- or paste the directory where the DLL file is located into the PATH variable for Windows,
- or copy the DLL file into the Windows Systems directory „[Windows-Installation]/system32”.

4.5.3 Driver Peak CAN

If the application cannot find the required library file „pcan-usb.dll”, then the following is to be noted:

- Either copy the above-named DLL file from the CD supplied with the device into the MCDemo Installation directory,
- or paste the directory where the DLL file is located into the PATH variable for Windows,
- or copy the DLL file into the Windows Systems directory „[Windows-Installation]/system32”.

4.5.4 Driver Softing CAN

If the application cannot find the required library file „canL2.dll”, then the following is to be noted:

- Either copy the above-named DLL file from the CD supplied with the device into the MCDemo Installation directory,

- or paste the directory where the DLL file is located into the PATH variable for Windows,
- or copy the DLL file into the Windows Systems directory „[Windows-Installation]/system32”.

4.5.5 Interface ESD CAN

The board switches into Bus-Off status and remains there for a certain time if it has searched through the interface for active modules without having switched on at least one module while doing so.

- Switch on at least one module which is ready for the CAN communications.
- Wait a few seconds.
- If no module has reported, then search through the bus.

4.5.6 Interface Siemens Profibus

Communications via Profibus boards made by Siemens is relatively slow in MCDemo.

If MCDemo finds no SMP modules on the bus, even though some do exist, then it needs to be restarted.

4.5.7 Automatically display the module status

In the „Preferences” window, activate the option „Request on initialize” and set the option „Default polling rate” to a positive number (default setting ca. 1000 ms).

4.5.8 Open communications interface by starting MCDemo

In the event of a permanently available communications interface, it is recommendable to have the most recently used interface open automatically when the application is started. To accomplish this, activate the „Initialize last used communication” option in the „Preferences” window.

4.5.9 Data throughput with CAN

The shortest time interval with the command *GET STATE* (section 2.5.1) can be achieved with the CAN interface. The shortest time interval of up to 1-3 ms is possible. This means that the application can display signals arriving every 1 to 3 ms without causing an overflow of the internal message buffer.

4.5.10 Configured modules under Profibus

To view a list of the modules configured for Profibus, one can call up the bus details in the main window in the „View" menu.

4.5.11 Frequent timeouts with RS232 communications

Because the RS232 interface is not a true bus, data collisions may occur sporadically in the event that several modules are communicating simultaneously. The application constantly attempts to handle these data collisions in order to ensure that communications continue running without interruption.
The probability that timeouts occur (i.e. no answer from the module) can be reduced if one:

- Reduces the time interval of the command *GET STATE* (section 2.5.1) or switches it off when status information is not used,
- or/and increases the baud rate of the RS232 interface,
- or/and increases slightly the communications timeout under „Preferences" in the main window,
- or/and initializes or simultaneously triggers fewer modules if at all possible.

4.5.12 Modifying individual EEPROM parameters

If only individual EEPROM parameters such as the Module ID or the communications interface are to be modified, then the execution of the corresponding *SET CONFIG* (section 2.3.1) commands is to be recommended. These can be found in the module window under the „Module/EEPROM Write/Write..." menu.

4.5.13 Do not maximize the main window

The main window should not be maximized, because this would mean that module windows that have already been initialized will remain hidden. A hidden module window can however be found again with the corresponding menu item „View/Module..." wieder finden.

4.5.14 Communication mode „Auto"

Some notices for the communication mode „Auto" of the module:

- After start, the module will send messages not until an active communication is detected.
- Possibly, communication via Profibus will be instantly detected as active (when the Profibus Host is active).

- There should be the only physical communication interface connected, else the module will possibly select a „wrong” interface.

4.5.15 Initialize modules manually

The option „Do not initialize detected modules automatically” in the *preferences* (section 4.3.5) is used to disable auto initialize of detected modules. No module window will be pop up automatically.

This option is useful, when many modules are to forcefully initialize at the same time, and therefore not all modules can be completely initialized.

Chapter 5

Troubleshooting

5.1 Module

5.1.1 Connection description for the module

As SCHUNK modules come with various connection configurations, please refer to the data sheet supplied with your module.

5.1.2 Module fails to reference from some positions

The maximal allowed referencing current is not sufficient to move the module. Try to raise the *max. referencing current* (section 3.2.3.2) .

5.2 Protocol

5.2.1 Fragmentation not possible

The complete module can be properly operated without the need for data fragmentation. This applies to all communication interfaces that are supported by the system.

5.3 RS232

5.3.1 Data collision occurred

- Reduce the number of modules connected to the „RS232-Bus”.
- Disable impulse messages with *CMD TOGGLE IMPULE MESSAGE* (section 2.2.6) .
- Use „RS232 Silent” interface.

5.3.2 I encounter problems when connecting several modules

RS232 is not designed for use as a bus system. If you wish to operate several module through one interface, you should install a „real” bus system (CAN, Profibus). If too many subscribers are connected, there is a risk of frequent *data collision* (section 5.3.1) . If RS232 is used as a bus system, the baud rate is limited to maximum 19200 [Baud].

5.3.3 Which RS232 baud rates are supported by the module?

1200, 2400, 4800, 9600, 19200, 38400 [Baud]. When several modules are on the chain, then baud rates up to 19200 [Baud] are supported.

5.4 CAN

5.4.1 Which CAN baud rates are supported by the module?

50, 100, 125, 250, 500 and 1000 [kBit/s]

5.5 Profibus

5.5.1 Does the system support SSA (Set-Slave-Address)?

Yes

5.5.2 Data transfer is not consistent

1. Set D-Len (first byte) to 0x00, add all data and then reset D-Len to desired value.
2. Use SYNC, FREEZE mechanism.

Chapter 6

Appendix

6.1 Examples

6.1.1 RS232

6.1.1.1 Referencing

1. Send *referencing* (section 2.1.1) command
2. Have understood referencing command
3. After some time, „in position 5.792 [mm]"

	ID	D-Len	Cmd	Data	CRC16
M->S	0x05 0x01	0x01	0x92		0xD1 0x31
S->M	0x07 0x01	0x03	0x92	0x4F 0x4B	0xE9 0xD9
Impulse	0x07 0x01	0x05	0x93	0x21 0x56 0xB9 0x40	0x4D 0x22

6.1.1.2 MOVE POS 10 [mm]

Default positioning command.

1. Send command for movement to *position* (section 2.1.3) 10 [mm]
2. Message „will reach position in 3.358 [s]". Movement is started.
3. After some time„ ,in position 9.9969 [mm]"

	ID	D-Len	Cmd	Data	CRC16
M->S	0x05 0x01	0x05	0xB0	0x00 0x00 0x20 0x41	0x48 0x80
S->M	0x07 0x01	0x05	0xB0	0xEE 0xEE 0x56 0x40	0x7B 0xE4
Impulse	0x07 0x01	0x05	0x94	0xB6 0xF3 0x1F 0x41	0x7E 0xD5

6.1.1.3 GET STATE 1 [s]

Send every 1 [s] the actual position.

1. Command *Get State* (section 2.5.1) 1 [s] only position.
2. Actual position and state. (position 1.011 [mm], moving, no error)
3. Every second new message.
4. Actual position and state. (position 5.054 [mm], moving, no error)

	ID	D-Len	Cmd	Data	CRC16
M->S	0x05 0x01	0x06	0x95	0x00 0x00 0x80 0x3F 0x01	0x54 0x41
S->M	0x07 0x01	0x07	0x95	0x36 0x89 0x81 0x3F 0x02 0x00	0xF9 0xBC
S->M	0x07 0x01	0x07	0x95	.. ..	.. ..
S->M	0x07 0x01	0x07	0x95	0x76 0xBE 0xA1 0x40 0x02 0x00	0x38 0xA0

6.1.1.4 Troubleshooting

An *(„ERROR MOTOR VOLTAGE LOW”)* (section 2.8.2.46) error occurred.

1. Interpret and eliminate error. Power supply to motor switched off => switch on power supply.
2. Acknowledge error with *„CMD ACK”* (section 2.8.1.4)
3. „CMD ACK” confirmed
4. Information message „No other errors” displayed.

	ID	D-Len	Cmd	Data	CRC16
every 15 [s]	0x03 0x01	0x02	0x88	0x74	0x82 0x1B
M->S	0x05 0x01	0x01	0x8B		0x10 0xFB
S->M	0x07 0x01	0x03	0x8B	0x4F 0x4B	0x38 0x1E
Impulse	0x07 0x01	0x03	0x8A	0x08 0x00	0x1A 0x19

6.1.1.5 CHECK MC PC COMMUNICATION (Float)

Check communication from module to control with test data.

1. Request *test data* (section 2.5.7) from module (floating point value - 1.2345).
2. Test data is sent by module.

	ID	D-Len	Cmd	Data	CRC16
M->S	0x05 0x01	0x03	0xE4	0x01 0x01	0xBD 0xB6
S->M	0x07 0x01	0x07	0xE4	0x19 0x04 0x9E 0xBF 0x01 0x01	0x74 0x37

6.1.1.6 CHECK PC MC COMMUNICATION

Check communication from module to control with test data.

1. Send *test data* (section 2.5.7) to module.
2. Module acknowledges receipt of test data and identifies the data that has been interpreted incorrectly (all data OK)

	ID	D-Len	Cmd	Data	CRC16
M->S	0x05 0x01	0x15	0xE5	0x19 0x04 0x9E 0xBF 0xA4 0x70 0x3C 0x42 0x44 0x33 0x22 0x11 0xCC 0xDD 0xEE 0xFF 0x00 0x02 0xFE 0xAF	0x89 0xD7
S->M	0x07 0x01	0x04	0xE5	0x4F 0x4B 0x00	0xB6 0xFA

6.1.2 CAN

6.1.2.1 Referencing

1. Send *referencing* (section 2.1.1) command
2. Have understood referencing command
3. After some time, „in position 5.792 [mm]"

	ID	DLC	D-Len	Cmd	Data
M->S	*0x501*	*0x02*	0x01	0x92	
S->M	*0x701*	*0x04*	0x03	0x92	0x4F 0x4B
Impulse	*0x701*	*0x06*	0x05	0x93	0x21 0x56 0xB9 0x40

6.1.2.2 MOVE POS 10 [mm]

Default *positioning* (section 2.1.3) command.

1. Send command for movement to position 10 [mm].
2. Message „will reach position in 3.358 [s]". Movement is started.
3. After some time„ ,in position 9.9969 [mm]"

	ID	DLC	D-Len	Cmd	Data
M->S	*0x501*	*0x06*	0x05	0xB0	0x00 0x00 0x20 0x41
S->M	*0x701*	*0x06*	0x05	0xB0	0xEE 0xEE 0x56 0x40
Impulse	*0x701*	*0x06*	0x05	0x94	0xB6 0xF3 0x1F 0x41

6.1.2.3 GET STATE 1 [s]

Send every 1 [s] the actual position.

1. Command *Get State* (section 2.5.1) 1 [s] only position.
2. Actual position and state. (position 1.011 [mm], moving, no error)
3. Every second new message.
4. Actual position and state. (position 5.054 [mm], moving, no error)

	ID	DLC	D-Len	Cmd	Data
M->S	*0x501*	*0x07*	0x06	0x95	0x00 0x00 0x80 0x3F 0x01
S->M	*0x701*	*0x08*	0x07	0x95	0x36 0x89 0x81 0x3F 0x02 0x00
S->M	*0x701*	*0x08*	0x07	0x95	.. ..
S->M	*0x701*	*0x08*	0x05	0x94	0x76 0xBE 0xA1 0x40 0x02 0x00

6.1.2.4 Troubleshooting

An *(„ERROR MOTOR VOLTAGE LOW”)* (section 2.8.2.46) error occurred.

1. Interpret and eliminate error. Power supply to motor switched off => switch on power supply.
2. Acknowledge error with *„CMD ACK”* (section 2.8.1.4)
3. „CMD ACK” confirmed
4. Information message „No other errors” displayed.

	ID	DLC	D-Len	Cmd	Data
alle 15 [s]	*0x301*	*0x03*	0x02	0x88	0x74
M->S	*0x501*	*0x02*	0x01	0x8B	
S->M	*0x701*	*0x04*	0x03	0x8B	0x4F 0x4B
Impulse	*0x701*	*0x04*	0x03	0x8A	0x08 0x00

6.1.2.5 CHECK MC PC COMMUNICATION (Float)

Check communication from module to control with *test data* (section 2.5.7) .

1. Request *test data* (section 2.5.7) from module (floating point value -1.2345).
2. Test data is sent by module.

	ID	D-Len	Cmd	Data	
M->S	*0x501*	*0x04*	0x03	0xE4	0x01 0x01
S->M	*0x701*	*0x08*	0x07	0xE4	0x19 0x04 0x9E 0xBF 0x01 0x01

6.1.2.6 CHECK PC MC COMMUNICATION

Check communication from control to module with *test data* (section 2.5.7) . Fragmentation is required.

Fragmentation is not mandatory for the operation and/or testing of the module.

1. Send first fragment of test data to module.
2. Send second fragment of test data to module.
3. Send third fragment of test data to module.
4. Send last fragment of test data to module.
5. Module acknowledges receipt of test data and identifies the data that has been interpreted incorrectly (all data OK)

	ID	DLC	D-Len	Cmd	Data
M->S	*0x501*	*0x08*	0x15	0x84 0xE5	0x19 0x04 0x9B 0xBF 0xA4
M->S	*0x501*	*0x08*	0x0F	0x85	0x70 0x3C 0x42 0x44 0x33 0x22
M->S	*0x501*	*0x08*	0x09	0x85	0x11 0xCC 0xDD 0xEE 0xFF 0x00
M->S	*0x501*	*0x05*	0x03	0x86	0x02 0xFE 0xAF
S->M	*0x701*	*0x05*	0xE4	0x4F 0x4B 0x00	

6.1.3 Profibus

6.1.3.1 Referencing

1. Send *referencing* (section 2.1.1) command
2. Have understood referencing command. The *„MsgCount”* (section 1.3.5) is incremented by 1.
3. After some time, „in position 5.792 [mm]”

	D-Len	Cmd	Data	State/MsgCount
M->S	0x01	0x92	0x?? 0x?? 0x?? 0x?? 0x?? 0x??	
S->M	0x03	0x92	0x4F 0x4B 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x??	0x00 0x01
Impulse	0x05	0x93	0x21 0x56 0xB9 0x40	0x61 0x01

6.1.3.2 MOVE POS 10 [mm]

Default *positioning* (section 2.1.3) command.

1. Send command for movement to position 10 [mm].
2. Message „will reach position in 3.358 [s]". Movement is started. The *„MsgCount"* (section 1.3.5) is incremented by 1.
3. After some time„ ‚in position 9.9969 [mm]"

	D-Len	Cmd	Data	State/MsgCount
M->S	0x05	0xB0	0x00 0x00 0x20 0x41 0x?? 0x??	
S->M	0x05	0xB0	0xEE 0xEE 0x56 0x40 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x??	0x01 0x02
Impulse	0x05	0x94	0xB6 0xF3 0x1F 0x41 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x??	0x61 0x02

6.1.3.3 GET STATE 1 [s]

Send every 1 [s] the actual position.

1. Command *Get State* (section 2.5.1) 1 [s] only position.
2. Actual position and state. (position 1.011 [mm], moving, no error) The *„MsgCount"* (section 1.3.5) is incremented by 1.
3. Every second new message.
4. Actual position and state. (position 5.054 [mm], moving, no error)

	D-Len	Cmd	Data	State/MsgCount
M->S	0x07	0x95	0x00 0x00 0x80 0x3F 0x01 0x??	
S->M	0x08	0x95	0x36 0x89 0x81 0x3F 0x02 0x00 0x?? 0x?? 0x?? 0x?? 0x?? 0x??	0x02 0x03
S->M	0x08	0x95	.. ..	0x02 0x03
S->M	0x08	0x95	0x76 0xBE 0xA1 0x40 0x02 0x00 0x?? 0x?? 0x?? 0x?? 0x?? 0x??	0x02 0x03

6.1.3.4 Troubleshooting

An *(„ERROR MOTOR VOLTAGE LOW")* (section 2.8.2.46) error has occurred.

1. Interpret and eliminate error (extended diagnostics are supported). Switch off power supply to motor => switch on power supply.
2. Acknowledge error with *„CMD ACK"* (section 2.8.1.4) . The *„MsgCount"* (section 1.3.5) is incremented by 1.
3. „CMD ACK" command confirmed. The *„MsgCount"* (section 1.3.5) is incremented by 1.
4. Information message „No other errors" displayed.

	D-Len	Cmd	Data	State/MsgCount
S->M	0x02	0x88	0x74 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x??	0x30 0x02
M->S	0x01	0x8B	0x?? 0x?? 0x?? 0x?? 0x?? 0x??	
S->M	0x03	0x8B	0x4F 0x4B 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x??	0x20 0x03
Impulse	0x03	0x8A	0x08 0x00 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x??	0x20 0x03

6.1.3.5 CHECK MC PC COMMUNICATION (Float)

Check communication from module to control with *test data* (section 2.5.7) .

1. Request *test data* (section 2.5.7) from module (floating point value - 1.2345).

2. Test data is sent by module. The *„MsgCount"* (section 1.3.5) is incremented by 1.

	D-Len	Cmd	Data	State/MsgCount
M->S	0x03	0xE4	0x01 0x01 0x?? 0x?? 0x?? 0x??	
S->M	0x07	0xE4	0x19 0x04 0x9E 0xBF 0x01 0x01 0x?? 0x?? 0x?? 0x?? 0x?? 0x??	0x20 0x04

6.1.3.6 CHECK PC MC COMMUNICATION

Check communication from control to module *test data* (section 2.5.7) Fragmentation is required.

Fragmentation is not mandatory for the operation and/or testing of the module.

1. Send first fragment of test data to module.
2. Wait for *Bestätigung* (section 2.7.1) .
3. Send second fragment of test data to module.
4. Wait for *Bestätigung* (section 2.7.1) .
5. Send third fragment of test data to module.
6. Wait for *Bestätigung* (section 2.7.1) .
7. Send last fragment of test data to module.
8. Module acknowledges receipt of test data and identifies the data that has been interpreted incorrectly (all data OK). The *„MsgCount"* (section 1.3.5) is incremented by 1.

	D-Len	Cmd	Data	State/MsgCount
M->S	0x15	0x84	0xE5 0x19 0x04 0x9E 0xBF 0xA4	
S->M	0x02	0x87	0x15 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x??	0x20 0x04
M->S	0x0F	0x85	0x70 0x3C 0x42 0x44 0x33 0x22	
S->M	0x02	0x87	0x0F 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x??	0x20 0x04
M->S	0x09	0x85	0x11 0xCC 0xDD 0xEE 0xFF 0x00	
S->M	0x02	0x87	0x09 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x??	0x20 0x04
M->S	0x03	0x86	0x02 0xFE 0xAF 0x?? 0x?? 0x??	
S->M	0x04	0xE5	0x4F 0x4B 0x00 0x?? 0x?? 0x?? 0x?? 0x?? 0x??	0x20 0x05

6.2 CRC16 calculation for RS232

The CRC16 algorithm shown here is included in the firmware. There are other algorithms for the CRC16 calculation without table available on the internet.

```
UInt16 CRC16(UInt16 crc, UInt8 data)
{
const UInt16 tbl[256] = {
0x0000, 0xC0C1, 0xC181, 0x0140, 0xC301, 0x03C0, 0x0280, 0xC241,
0xC601, 0x06C0, 0x0780, 0xC741, 0x0500, 0xC5C1, 0xC481, 0x0440,
0xCC01, 0x0CC0, 0x0D80, 0xCD41, 0x0F00, 0xCFC1, 0xCE81, 0x0E40,
0x0A00, 0xCAC1, 0xCB81, 0x0B40, 0xC901, 0x09C0, 0x0880, 0xC841,
0xD801, 0x18C0, 0x1980, 0xD941, 0x1B00, 0xDBC1, 0xDA81, 0x1A40,
0x1E00, 0xDEC1, 0xDF81, 0x1F40, 0xDD01, 0x1DC0, 0x1C80, 0xDC41,
0x1400, 0xD4C1, 0xD581, 0x1540, 0xD701, 0x17C0, 0x1680, 0xD641,
0xD201, 0x12C0, 0x1380, 0xD341, 0x1100, 0xD1C1, 0xD081, 0x1040,
0xF001, 0x30C0, 0x3180, 0xF141, 0x3300, 0xF3C1, 0xF281, 0x3240,
0x3600, 0xF6C1, 0xF781, 0x3740, 0xF501, 0x35C0, 0x3480, 0xF441,
0x3C00, 0xFCC1, 0xFD81, 0x3D40, 0xFF01, 0x3FC0, 0x3E80, 0xFE41,
0xFA01, 0x3AC0, 0x3B80, 0xFB41, 0x3900, 0xF9C1, 0xF881, 0x3840,
0x2800, 0xE8C1, 0xE981, 0x2940, 0xEB01, 0x2BC0, 0x2A80, 0xEA41,
0xEE01, 0x2EC0, 0x2F80, 0xEF41, 0x2D00, 0xEDC1, 0xEC81, 0x2C40,
0xE401, 0x24C0, 0x2580, 0xE541, 0x2700, 0xE7C1, 0xE681, 0x2640,
0x2200, 0xE2C1, 0xE381, 0x2340, 0xE101, 0x21C0, 0x2080, 0xE041,
0xA001, 0x60C0, 0x6180, 0xA141, 0x6300, 0xA3C1, 0xA281, 0x6240,
0x6600, 0xA6C1, 0xA781, 0x6740, 0xA501, 0x65C0, 0x6480, 0xA441,
0x6C00, 0xACC1, 0xAD81, 0x6D40, 0xAF01, 0x6FC0, 0x6E80, 0xAE41,
0xAA01, 0x6AC0, 0x6B80, 0xAB41, 0x6900, 0xA9C1, 0xA881, 0x6840,
0x7800, 0xB8C1, 0xB981, 0x7940, 0xBB01, 0x7BC0, 0x7A80, 0xBA41,
0xBE01, 0x7EC0, 0x7F80, 0xBF41, 0x7D00, 0xBDC1, 0xBC81, 0x7C40,
0xB401, 0x74C0, 0x7580, 0xB541, 0x7700, 0xB7C1, 0xB681, 0x7640,
0x7200, 0xB2C1, 0xB381, 0x7340, 0xB101, 0x71C0, 0x7080, 0xB041,
0x5000, 0x90C1, 0x9181, 0x5140, 0x9301, 0x53C0, 0x5280, 0x9241,
0x9601, 0x56C0, 0x5780, 0x9741, 0x5500, 0x95C1, 0x9481, 0x5440,
0x9C01, 0x5CC0, 0x5D80, 0x9D41, 0x5F00, 0x9FC1, 0x9E81, 0x5E40,
0x5A00, 0x9AC1, 0x9B81, 0x5B40, 0x9901, 0x59C0, 0x5880, 0x9841,
0x8801, 0x48C0, 0x4980, 0x8941, 0x4B00, 0x8BC1, 0x8A81, 0x4A40,
0x4E00, 0x8EC1, 0x8F81, 0x4F40, 0x8D01, 0x4DC0, 0x4C80, 0x8C41,
0x4400, 0x84C1, 0x8581, 0x4540, 0x8701, 0x47C0, 0x4680, 0x8641,
0x8201, 0x42C0, 0x4380, 0x8341, 0x4100, 0x81C1, 0x8081, 0x4040};

return ((crc & 0xFF00) > > 8) ∧ tbl[(crc & 0x00FF) ∧ (data & 0x00FF)];
}
```

6.3 Commands

Hex	Dec	Name [Parameter]	Page
0x80	128	GET CONFIG [*parameter*]	# (section 2.3.2)
0x81	129	SET CONFIG [*parameter*]	# (section 2.3.1)
0x84	132	FRAG START	# (section 2.7.2)
0x85	133	FRAG MIDDLE	# (section 2.7.3)
0x86	134	FRAG END	# (section 2.7.4)
0x87	135	FRAG ACK [*D-Len*]	# (section 2.7.1)
0x88	136	CMD ERROR [*error code*]	# (section 2.8.1.1)
0x89	137	CMD WARNING [*error code*]	# (section 2.8.1.2)
0x8A	138	CMD INFO [*error code*]	# (section 2.2.1)
0x8B	139	CMD ACK	# (section 2.8.1.4)
0x90	144	CMD EMERGENCY STOP	# (section 2.1.20)
0x91	145	CMD STOP	# (section 2.1.19)
0x92	146	CMD REFERENCE	# (section 2.1.1)
0x93	147	CMD MOVE BLOCKED [*current position*]	# (section 2.2.2)
0x94	148	CMD POS REACHED [*current position*]	# (section 2.2.3)
0x95	149	GET STATE [*time*] [*mode*]	# (section 2.5.1)
0x96	150	GET DETAILED ERROR INFO	# (section 2.8.1.5)
0x97	151	CMD REFERENCE HAND	# (section 2.1.2)
0xA0	160	SET TARGET VEL [*velocity*]	# (section 2.1.14)
0xA1	161	SET TARGET ACC [*acceleration*]	# (section 2.1.15)
0xA2	162	SET TARGET JERK [*jerk*]	# (section 2.1.16)
0xA3	163	SET TARGET CUR [*current*]	# (section 2.1.17)
0xA4	164	SET TARGET TIME [*time*]	# (section 2.1.18)

Hex	Dec	Name [Parameter]	Page
0xB0	176	MOVE POS [position] [*velocity*] [*acceleration*] [*current*] [*jerk*]	# (section 2.1.3)
0xB1	177	MOVE POS TIME [position] [*velocity*] [*acceleration*] [*current*] [*time*]	# (section 2.1.5)
0xB3	179	MOVE CUR [*current*]	# (section 2.1.11)
0xB5	181	MOVE VEL [*velocity*]	# (section 2.1.12)
0xB7	182	MOVE GRIP [*current*]	# (section 2.1.13)
0xB8	176	MOVE POS REL [displacement] [*velocity*] [*acceleration*] [*current*] [*jerk*]	# (section 2.1.4)
0xB9	176	MOVE POS TIME REL [displacement] [*velocity*] [*acceleration*] [*current*] [*time*]	# (section 2.1.6)
0xBA	186	MOVE POS LOOP [position] [*velocity*] [*acceleration*] [*current*] [*jerk*]	# (section 2.1.7)
0xBB	187	MOVE POS TIME LOOP [position] [*velocity*] [*acceleration*] [*current*] [*time*]	# (section 2.1.8)
0xBC	188	MOVE POS REL LOOP [displacement] [*velocity*] [*acceleration*] [*current*] [*jerk*]	# (section 2.1.9)
0xBD	189	MOVE POS TIME REL LOOP [displacement] [*velocity*] [*acceleration*] [*current*] [*time*]	# (section 2.1.10)
0xC0	192	SET PHRASE [*data frame*]	# (section 2.4.1)
0xC1	193	EXE PHRASE [*phrase number*]	# (section 2.4.4)
0xC2	194	GET PHRASES	# (section 2.4.2)
0xC3	195	PRG GOTO [*phrase number*]	# (section 2.4.21)
0xC4	196	PRG WAIT [*time*]	# (section 2.4.22)
0xCF	207	PRG EXE [*program number*]	# (section 2.4.3)

Hex	Dec	Name [Parameter]	Page
0xD0	208	EXE PHARSE0	# (section 2.4.5)
0xD1	209	EXE PHARSE1	# (section 2.4.6)
0xD2	210	EXE PHARSE2	# (section 2.4.7)
0xD3	211	EXE PHARSE3	# (section 2.4.8)
0xD4	212	EXE PHARSE4	# (section 2.4.9)
0xD5	213	EXE PHARSE5	# (section 2.4.10)
0xD6	214	EXE PHARSE6	# (section 2.4.11)
0xD7	215	EXE PHARSE7	# (section 2.4.12)
0xD8	216	EXE PHARSE8	# (section 2.4.13)
0xD9	217	EXE PHARSE9	# (section 2.4.14)
0xDA	218	EXE PHARSE10	# (section 2.4.15)
0xDB	219	EXE PHARSE11	# (section 2.4.16)
0xDC	220	EXE PHARSE12	# (section 2.4.17)
0xDD	221	EXE PHARSE13	# (section 2.4.18)
0xDE	222	EXE PHARSE14	# (section 2.4.19)
0xDF	223	EXE PHARSE15	# (section 2.4.20)
0xE0	224	CMD REBOOT	# (section 2.5.2)
0xE1	225	CMD DIO [*Out*]	# (section 2.5.3)
0xE2	226	FLASH MODE [*password*]	# (section 2.5.4)
0xE3	227	CHANGE USER [*password*]	# (section 2.5.6)
0xE4	228	CHECK MC PC COMMUNICATION [*test data*] [*parameter code*]	# (section 2.5.7)
0xE5	229	CHECK PC MC COMMUNICATION [*Test data*] [*parameter code*]	# (section 2.5.8)
0xE6	230	CMD DISCONNECT [*password*]	# (section 2.5.5)
0xE7	231	CMD TOGGLE IMPULSE MESSAGE	# (section 2.2.6)
0xF2	242	CMD MSM PARAM READ	
0xF3	243	CMD MSM PARAM WRITE	
0xF4	244	CMD MSM CONTROL	
0xF8	248	CAMAT CHANGE PROGRAM	# (section 2.6.1)
0xF9	249	CAMAT SETTINGS CHANGED	# (section 2.6.2)
0xFA	250	CAMAT RES MEASUREMENT BLOCK	# (section 2.6.3)
0xFE	254	CAMAT TRIGGER	# (section 2.6.4)

6.4 Info and error codes

Hex	Dec	Name	Page
0x0001	1	INFO BOOT	# (section 2.8.2.1)
0x02	2	INFO NO FREE SPACE	# (section 2.8.2.2)
0x03	3	INFO NO RIGHTS	# (section 2.8.2.3)
0x04	4	INFO UNKNOWN COMMAND	# (section 2.8.2.4)
0x05	5	INFO FAILED	# (section 2.8.2.5)
0x06	6	NOT REFERENCED	# (section 2.8.2.6)
0x0007	7	INFO SEARCH SINE VECTOR	# (section 2.8.2.7)
0x0008	8	INFO NO ERROR	# (section 2.8.2.8)
0x09	9	INFO COMMUNICATION ERROR	# (section 2.8.2.9)
0x10	16	INFO TIMEOUT	# (section 2.8.2.10)
0x16	22	INFO WRONG BAUDRATE	# (section 2.8.2.11)
0x19	25	INFO CHECKSUM	# (section 2.8.2.12)
0x1D	29	INFO MESSAGE LENGTH	# (section 2.8.2.13)
0x1E	30	INFO WRONG PARAMETER	# (section 2.8.2.14)
0x1F	31	INFO PROGRAM END	# (section 2.8.2.15)
0x0040	64	INFO TRIGGER	# (section 2.8.2.16)
0x0041	65	INFO READY	# (section 2.8.2.17)
0x0042	66	INFO GUI CONNECTED	# (section 2.8.2.18)
0x0043	67	INFO GUI DISCONNECTED	# (section 2.8.2.19)

Hex	Dec	Name	Page
0x70	112	ERROR TEMP LOW	# (section 2.8.2.42)
0x71	113	ERROR TEMP HIGH	# (section 2.8.2.43)
0x72	114	ERROR LOGIC LOW	# (section 2.8.2.44)
0x73	115	ERROR LOGIC HIGH	# (section 2.8.2.45)
0x74	116	ERROR MOTOR VOLTAGE LOW	# (section 2.8.2.46)
0x75	117	ERROR MOTOR VOLTAGE HIGH	# (section 2.8.2.47)
0x76	118	ERROR CABLE BREAK	# (section 2.8.2.48)
0x78	120	ERROR MOTOR TEMP	# (section 2.8.2.49)
0xC8	200	ERROR WRONG RAMP TYPE	# (section 2.8.2.21)
0xD2	210	ERROR CONFIG MEMORY	# (section 2.8.2.22)
0xD3	211	ERROR PROGRAM MEMORY	# (section 2.8.2.23)
0xD4	212	ERROR INVALIDE PHRASE	# (section 2.8.2.24)
0xD5	213	ERROR SOFT LOW	# (section 2.8.2.25)
0xD6	214	ERROR SOFT HIGH	# (section 2.8.2.26)
0xD7	215	ERROR PRESSURE	# (section 2.8.2.27)
0xD8	216	ERROR SERVICE	# (section 2.8.2.28)
0xD9	217	ERROR EMERGENCY STOP	# (section 2.8.2.29)
0xDA	218	ERROR TOW	# (section 2.8.2.30)
0xDB	219	ERROR VPC3	# (section 2.8.2.33)
0xDC	220	ERROR FRAGMENTATION	# (section 2.8.2.34)
0xDD	221	ERROR COMMUTATION	# (section 2.8.2.35)
0xDE	222	ERROR CURRENT	# (section 2.8.2.36)
0xDF	223	ERROR I2T	# (section 2.8.2.37)
0xE0	224	ERROR INITIALIZE	# (section 2.8.2.38)
0xE1	225	ERROR INTERNAL	# (section 2.8.2.39)
0xE2	226	ERROR HARD LOW	# (section 2.8.2.40)
0xE3	227	ERROR HARD HIGH	# (section 2.8.2.41)
0xE4	228	ERROR TOO FAST	# (section 2.8.2.31)
0xEC	236	ERROR MATH	# (section 2.8.2.32)

6.5 Tested hardware

Bus system	Type	Auto detect	Remark
RS232	PC-Intern	Yes	if ”real” RS232
RS232	USB-RS232 converter	Yes/No	depends on manufacture of PC and converter
CAN	Vector Informatik CAN-CardXL PCMCIA	Yes	
CAN	Vector Informatik other CAN interface cards	not verified	
CAN	esd CAN USB mini	Yes	
CAN	esd other CAN interface cards	not verified	
CAN	Peak P-CAN USB	Yes	
CAN	IXXAT CAN iPC-320/PCI (VCI driver version 3)	Yes	
CAN	IXXAT other CAN cards	not verified	
CAN	Softing CAN-ACx-PCI	Yes	
CAN	Softing other CAN cards	not verified	
Profibus	Hilscher PCMCIA CIF-60	Yes	
Profibus	Hilscher other interface cards	not verified	
Profibus	WoodHead Applicom I/O	No	
Profibus	CP5611	Yes	
Profibus	Siemens S7	Yes	

Chapter 7

Contact

GERMANY-HEAD OFFICE
SCHUNK GmbH & Co. KG
Spann - und Greiftechnik
Bahnhofstrasse 106 - 134
D - Lauffen / Neckar
Tel. +49-7133-103-0
Fax +49-7133-103-2399
info@de.schunk.com
www.schunk.com

AUSTRIA
SCHUNK Intec GmbH
Holzbauernstr. 20
4050 Traun
Tel. +43-7229-65770-0
Fax +43-7229-65770-14
info@at.schunk.com
www.at.schunk.com

BELGIUM, LUXEMBOURG
SCHUNK Intec N.V./S.A.
Bedrijvencentrum Regio Aalst
Industrielaan 4, Zuid III
9320 Aalst-Erembodegem
Tel. +32-53-853504
Fax +32-53-836022
info@be.schunk.com
www.be.schunk.com

GREAT BRTAIN, IRELAND
SCHUNK Intec Ltd.

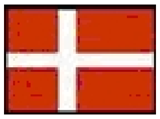
Cromwell Business Centre
10 Howard Way,
Interchange Park,
Newport Pagnell MK16 9QS
Tel. +44-1908-611127
Fax +44-1908-615525
info@gb.schunk.com
www.gb.schunk.com

CHINA

SCHUNK Precision Machinery
(Hangzhou) Co.,Ltd.
6, 24th Street, HEDA
Hangzhou 310018
Tel. +86-571-8672-1000
Fax +86-571-8672-8800
info@cn.schunk.com
www.cn.schunk.com

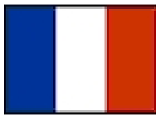
SCHUNK GmbH & Co.KG

Shanghai
Representative Office
777 Zhao Jia Bang Road
Pine City Hotel, Room 923
Xuhui District
Shanghai 200032
Tel. +86-21-64433177
Fax +86-21-64431922
info@cn.schunk.com
www.cn.schunk.com



DENMARK
SCHUNK Intec A/S
Storhaven 7
7100 Vejle

Tel. +45-43601339
Fax +45-43601492
info@dk.schunk.com
www.dk.schunk.com

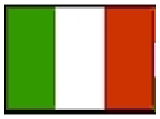


FRANCE
SCHUNK Intec SARL
Parc d´Activités des Trois Noyers 15, Avenue James de Rothschild
Ferrières-en-Brie
77614 Marne-la-Vallée
Cedex 3
Tel. +33-1-64 66 38 24
Fax +33-1-64 66 38 23
info@fr.schunk.com
www.fr.schunk.com

NETHERLANDS
SCHUNK Intec B.V.
Speldenmakerstraat 3d
5232 BH ’s-Hertogenbosch

Tel. +31-73-6441779
Fax +31-73-6448025
info@nl.schunk.com
www.nl.schunk.com

INDIA
SCHUNK India Branch Office
# 80 B, Yeswanthpur
Industrial Suburbs
Bangalore 560 022
Tel. +91-80-41277361
Fax +91-80-41277363
info@in.schunk.com
www.in.schunk.com



ITALY
SCHUNK Intec S.r.l.
Via Caio Plinio 5
22072 Cermenate (CO)
Tel. +39-031-770185
Fax +39-031-771388
info@it.schunk.com
www.it.schunk.com

HUNGARY
SCHUNK Intec Kft.
Széchenyi út. 70.
3530 Miskolc
Tel. +36-46-50900-7
Fax +36-46-50900-6
info@hu.schunk.com
www.hu.schunk.com

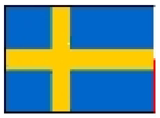
POLAND
SCHUNK Intec Sp.z o.o.
Stara Iwiczna,
ul. Sloneczna 116 A
05-500 Piaseczno
Tel. +48-22-7262500
Fax +48-22-7262525
info@pl.schunk.com
www.pl.schunk.com

PORTUGAL
Sales Representative
Victor Marques
Tel. +34-937-556 020
Fax +34-937-908 692
Mobil +351-963-786 445
info@pt.schunk.com
www.pt.schunk.com

SOUTH KOREA
SCHUNK Intec Korea Ltd.
907 Joongang
Induspia 2 Bldg.,
144-5 Sangdaewon-dong
Jungwon-gu, Seongnam-si
Kyunggi-do, 462-722
Tel. +82-31-7376141
Fax +82-31-7376142
info@kr.schunk.com
www.kr.schunk.com

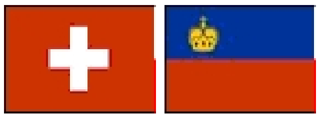
SPAIN

SCHUNK Intec S.L.
Foneria, 27
08304 Mataró (Barcelona)
Tel. +34-937 556 020
Fax +34-937 908 692
info@es.schunk.com
www.es.schunk.com

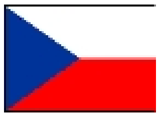


SWEDEN

SCHUNK Intec AB
Morabergsvägen 28
152 42 Södertälje
Tel. +46-8 554 421 00
Fax +46-8 554 421 01
info@se.schunk.com
www.se.schunk.com



SWITZERLAND, LICHTENSTEIN
SCHUNK Intec AG
Soodring 19
8134 Adliswil 2
Tel. +41-44-7102171
Fax +41-44-7102279
info@ch.schunk.com
www.ch.schunk.com

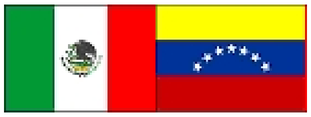


CZECH REPUBLIC

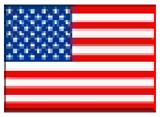
SCHUNK Intec s.r.o

Ernsta Macha 1

643 00 Brno
Tel. +420-545 229 095
Fax +420-545 220 508
info@cz.schunk.com
www.cz.schunk.com



MEXICO, VENEZUELA
SCHUNK Intec S.A. de C.V.
Av. Luis Vega y Monroy # 332
Fracc. Plazas de Sol
Santiago de Querétaro,
Qro. 76099
Tel. +52-442-223-6525
Fax +52-442-223-7665
info@mx.schunk.com
www.mx.schunk.com



USA

SCHUNK Intec Inc.

211 Kitty Hawk Drive

Morrisville, NC 27560
Tel. +1-919-572-2705
Fax +1-919-572-2818
info@us.schunk.com
www.us.schunk.com

CANADA
SCHUNK Intec Corp.
190 Britannia Road East,
Units 23-24
Mississauga, ON L4Z 1W6
Tel. +1-905-712-2200
Fax +1-905-712-2210
info@ca.schunk.com

www.ca.schunk.com

SLOVAKIA
SCHUNK Intec s.r.o.
Mostná 62
919 01 Nitra
Tel. +421-37-3260610
Fax +421-37-6421906
info@sk.schunk.com
www.sk.schunk.com

TURKEY
SCHUNK Intec
Baglama Sistemleri ve
Otomasyon San. ve Tic. Ltd. Sti.
Küçükyali Is Merkezi
Girne Mahallesi
Irmak Sodak, A Blok, No: 9
Tel. +90-216-366-2111
Fax +90-216-366-2277
34852 Maltepe, Istanbul
info@tr.schunk.com
www.tr.schunk.com