![Baumer logo]

Passion for Sensors

# Operating instructions
**Interface description**
**N 150 spindle position display (SPA)**
**Software 01**
Version 1.50 and up

## Content                                                        Page

# 1. General information

## 1.1. Safety precautions
**General remarks**
The equipment is designed and assembled according to the prevailing regulations of technology. The equipment left the manufacturer in perfect working order and in line with all safety-relevant conditions. To maintain this status of the equipment, it is imperative to stick to the following when installing and using the device:
- use only according to the intended purpose,
- observation of any precautions regarding safety and hazards,
- observe the present manual and especially the relevant safety precautions!

Make sure that the operating manual and especially the chapter describing the safety precautions is read and well understood by the staff in charge. Supplementary to the operating instructions, ad other generally or legally relevant regulations regarding accident prevention and environmental care are to be considered and observed. This manual is a supplement to already existing documentation (product information, mounting instructions, catalogues).

**Intended purpose of the equipment**
Intended purpose of the equipment is industrial process monitoring and control in metal, wood, plastic, paper, glass and textile etc. industry.
It is imperative that the equipment is applied only
- in properly installed condition and
- in line with the relevant technical data!

Any operation outside the technical specifications/parameters is improper use and in conjunction with the equipment/processes/machines to be monitored/controlled might lead to
- fatal injuries
- serious damage to health,
- damage to property or corporate equipment or
- damage to the device!

Any overvoltage the device might be exposed to at its connecting terminals has to be limited to the values stipulated in overvoltage category II (see technical data).

The device must not be operated
- in hazardous areas where is danger of explosion,
- as medical equipment or in medical areas,
- or in any applications expressly named in EN 61010!

If the device is utilized for control/monitoring of machines or processes where as the result of a failure/malfunction or incorrect operation of the device might occur
- any threats to life,
- risks of damage to health or
- any risk of damage to property or environment
the corresponding appropriate safety precautions must be taken!

Do not open the housing of the device or proceed any modifications! Any modifications of the device can affect operating safety and result in danger!
Do not proceed any repairs but return defective devices to the manufacturer!

**Installation/commissioning**
In case of any extraordinary incidents (including in the operating behaviour) that impair safety switch off the device immediately.
Installation must be carried out by suitably trained experts only. After proper mounting and installation the device is ready for operation.
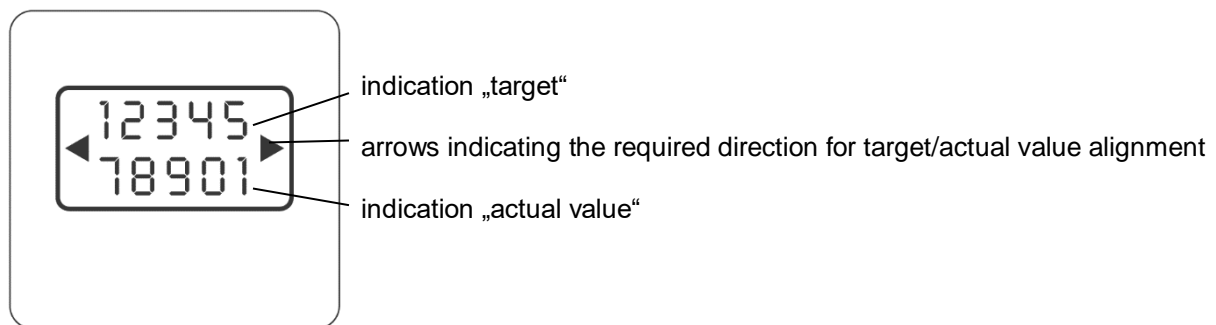
**Maintenance/repairs**
Always disconnect the power supply of all appliances involved. Maintenance and repair work must only be carried out by suitably trained experts.
If troubleshooting is unsuccessful, do not continue using the device but contact the manufacturer.

## 1.2.  SPA description and explanation

Mounting the spindle position display (SPA) is by docking hollow shaft onto spindle shaft (max.14 mm in diameter).The hollow shaft is fixed to the spindle shaft by hexagon screw and secured by power grip.
This way, the SPA is mounted in an overhung position and secured against torsion at rear of the housing by the attached spreader pin. The SPA features an absolute multiturn sensing system capable of detecting the position after several spindle turns even in powerless state. Position data will be retained even in case of power failure (min. 10 years).
The current position value is indicated in the two-line backlit LCD display (2x 5 digits, numeric), optionally together with the target transmitted by the control (master). Two arrows indicate the editing engineer the direction the spindle must be turned to for aligning actual value with target. As soon as the actual value is in alignment with the target and within the permitted tolerances, the target will disappear. By corresponding master parameterization the display can be turned by 180° enabling vertical respectively horizontal installation. SPAs are networked by M8 connector,  power supply is by the same cable directly from master. SPA parameterization by master only.

indication „target"

arrows indicating the required direction for target/actual value alignment

indication „actual value"

# 2. Terminal assignment

| Pin | Assignment | Core colour DIN47100 | IEC757 |
|---|---|---|---|
| Pin 1 | Tx/Rx-, RS485 | white | orange |
| Pin 2 | Tx/Rx+, RS485 | brown | brown |
| Pin 3 | sensor supply +24 V | yellow | red |
| Pin 4 | sensor supply 0 V | green | black |

male connector M8          female connector M8

Titel:
N150-05.eps
Erstellt von:
FreeHand 9.0
Vorschau:
Diese EPS-Grafik wu
mit einer enthaltenen
Kommentar:

Titel:
N150-06.eps
Erstellt von:
FreeHand 9.0
Vorschau:
Diese EPS-Grafik wu
mit einer enthaltenen
Kommentar:

| Pin | Assignment | Core colour DIN47100 | IEC757 |
|---|---|---|---|
| Pin 1 | sensor supply +24 V | yellow | red |
| Pin 2 | sensor supply 0 V | green | black |
| Pin 3 | -- | -- | -- |
| Pin 4 | Tx/Rx+, RS485 | brown | brown |
| Pin 5 | Tx/Rx-, RS485 | white | orange |

male M16          female M16

Titel:
N142-06.eps
Erstellt von:
FreeHand 9.0
Vorschau:
Diese EPS-Grafik wurde nicht gespeichert
mit einer enthaltenen Vorschau

Connect power supply that is free from interference emission. The supply must not be used as parallel supply of drives, shields, magnetic valves, etc.
Apply DC according to the terminal assignment
Power supply: 24 VDC ±20 %

**Shield**
Use shielded cables only. Ground of the shield must be provided at the machine (two examples corresponding to the cable applied, see drawings).

Titel:
Kabelabschirmung.eps
Erstellt von:
FreeHand 9.0
Vorschau:
Diese EPS-Grafik wurde nicht gespeichert
mit einer enthaltenen Vorschau.
Kommentar:
Diese EPS-Grafik wird an einen
PostScript-Drucker gedruckt, aber nicht
an andere Druckertypen.

Titel:
Z165-D05-01.eps
Erstellt von:
FreeHand 9.0
Vorschau:

# 3. Interface

## 3.1. Interface data

| Type: | RS485 |
|---|---|
| Baudrate: | 19200 |
| Parity: | No |
| Data bits: | 8 |
| Stop bits: | 1 |
| Handshake: | No |
| Checksum: | Yes (CRC) |
| Timeout reply*: | 1...16 ms |
| BUS switching time**: | <0,1 ms |

\* To avoid bus collisions a minimum timeout reply of 1 ms (default parameter) is to be kept, i.e. the time elapsed between transmitting the last bit of the query until start transmitting the 1st bit of the N 150 reply. The operator should see that due to the minimum timeout reply of 1 ms the bus switching time after having transmitted the last bit must not exceed 1 ms.

\*\* The BUS switching time is the time the SPA requires to be ready again for transmission receipt after having replied to host.

## 3.2. Protocol

The spindle position display operates with ASCII protocol (clear text protocol). Depending on the command, the protocol data package varies between 5 and 17 bytes.
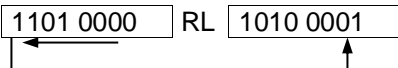
| Byte | Hex-Code | Significance | | Parameters |
|---|---|---|---|---|
| 1 | 01H | SOH | = start of heading | permanent 01h |
| 2 | XXh | Adr | = address/identifier | 00 ... 31dez + 20h Offset (identifier 00 = 20h) |
| 3 | XXh | Cmd | = command code | Defined commands |
| 4-n | [XXh..XXh] | [Data] | = data | 20h-7Fh |
| n+1 | 04h | EOT | = end of transmission | Permanent 04h |
| n+2 | XXh | CRC | = checksum | 00h ... FFh |

## 3.3. Checksum (Cyclic Redundancy Check)

For optimized error-free data transmission the CRC byte is added after the footer token (EOT, end of transmission) to the string to be transferred. Upon receiving a command the CRC byte transmitted is crosschecked with the auto-calculated CRC byte.

**Algorithm:**
1) Reset CRC byte.
2) Rotate CRC byte by 1 bit to the left.
3) Link result to first data byte XOR.
4) Rotate result by 1 bit to the left.
5) Link result to the second data byte XOR.
    :
x) Rotate result by 1 bit to the left.
y) Link result to the last data byte (ever 04H) XOR.
z) Add result as CRC after the footer token (04H) to the transmitted string.

**Note:** | 1101 0000 | RL | 1010 0001 | Important: Bit 7 is shifted in bit 0 during rotation

**Example:**
String less CRC = 01h 20h 43h 04h
CRC-Byte = 0Ah

| 0000 0000 | RL | 0000 0000 | XOR | 0000 0001 (01h) | = | 0000 0001 |

| 0000 0001 | RL | 0000 0010 | XOR | 0010 0000 (20h) | = | 0010 0010 |

| 0010 0010 | RL | 0100 0100 | XOR | 0100 0011 (43h) | = | 0000 0111 |

| 0000 0111 | RL | 0000 1110 | XOR | 0000 0100 (04h) | = | **0000 1010** | = CRC |

Legend: RL = rotate left; XOR = antivalence link

## 3.4.  Data transmission properties

For reasons of compatibility, within the complete multicon system the data amount is always the same (see table in chapter 6), no matter how many digits are provided in the display. For example, command "R" (read actual value) comprises a transmitted data amount of 6 bytes, but only 5 digits are indicated in the display.

## 3.5.  Broadcast commands

Some specific commands are designated so-called broadcast commands. As soon as the master broadcasts a command to identifier 99, the command is addressed to every N 150 in the network. Each individual spindle position display will accomplish the respective command but will not respond any confirmation to master.

## 3.6.  Data saving

Specific parameters are saved in EEPROM (1.000.000 writing cycles). Data saving is via interface upon every parameter transmission to SPA.
**Important:**
There should not be a cyclic transmission of these parameters to SPA but only if necessary, for example in case of parameter alteration. The relevant parameters saved in EEPROM are listed in the charts in chapter "Command explanations" or "Overview on commands".

# 4. Command explanations

## 4.1.  General information

The following is describing the individual interface commands broken down into the four groups below:

- operating commands      [ commands required during operation ]
- parameter commands    [ commands for SPA parameterization ]
- identifier commands      [ commands to indicate or alter the device identifier (address)]
- specific commands      [ commands for specific functions as device reset or version number readout]

The following abbreviations are applied:

SOH   = Start of heading (header token)
EOT   = End of transmission (footer token)
Adr   = Device identifier /address, including offset 20h
Cmd= Command
Data   = Data transmitted or received

## 4.2.  Operating commands

| Command code | Data length in bytes | read | write | Broad-cast | Save in EEPROM | Significance |
|---|---|---|---|---|---|---|
| C  (43h) | 3 / 11 | X | - | - | - | Check if current value = target |
| R  (52h) | 6 | X | - | - | - | Read current value |
| S  (53h) | 8 | X | X | - | X | Read/write target |
| U  (55h) | 6 | X | X | - | - | Offset |
| V  (56h) | 2 | X | X | X | X | Read/write profile number |
| Z  (5Ah) | 6 | X | X | X | X | Set preset |
| t  (74h) | 6 | - | X | - | - | Transmit tool number |
| u  (75h) | 6 | - | X | - | - | Transmit optional column of figures |

### 4.2.1. Check Position „C" (43h)

This command provides the alignment status of target versus actual value. If the actual value is within the target tolerance window, the response will be „o" (6Fh) for OK together with the current profile number. If the actual value is outside the tolerances, „x" (78H) followed by the current profile number will be replied.

Example: (active profile number = 05)

| Transmission | SOH | Adr | Cmd | EOT | CRC |
|---|---|---|---|---|---|
| | 01h | 20h | 43h | 04h | 0Ah |

Response if actual value is within the tolerances:

| Response | SOH | Adr | Cmd | Stat. | Profile no.=05 | EOT | CRC |
|---|---|---|---|---|---|---|---|
| | 01h | 20h | 43h | **6Fh** | **30h** | **35h** | 04h | A5h |

Response in case of actual value is outside the tolerances:

| Response | SOH | Adr | Cmd | Stat. | Profile no.=05 | EOT | CRC |
|---|---|---|---|---|---|---|---|
| | 01h | 20h | 43h | **78h** | **30h** | **35h** | 04h | 1D |

### 4.2.2. Read actual value „R" (52h)

This command is utilized to read the 5-digit actual value (bottom line of display). The amount of data is always 6 bytes. In case of a negative value, the "minus" sign (2Dh) together with 5 data bytes is replied. Positive values are represented by 6 data bytes without sign. Values of less than 5 (4) digits will come with preceding zeroes. Please note that N 150 provides a 5-digit actual value.

Example: Actual value = -32.50

| Transmission | SOH | Adr | Cmd | EOT | CRC |
|---|---|---|---|---|---|
| | 01h | 20h | 52h | 04h | 40h |

| Response | SOH | Adr | Cmd | Actual value = –32.50 | | | | | | EOT | CRC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01h | 20h | 52h | **2Dh** | **30h** | **33h** | **32h** | **35h** | **30h** | 04h | 54h |

### 4.2.3. Read / write target (profile) „S" (53h)

This command is utilized to read the presently active target (profile value) respectively to read or write a specific target. Data are composed by profile number (2 bytes) and target (6 bytes). Note: Negative targets are transmitted as 5-digit number (see example 3). Please consider that SPA targets comprise 5 digits only.

Example 1: Read active target (profile number = 12; target = 12.50)

| Transmission | SOH | Adr | Cmd | EOT | CRC |
|---|---|---|---|---|---|
| | 01h | 20h | 53h | 04h | 2A |

| Response | SOH | Adr | Cmd | Profile no. = 12 | | Target = 12.50 | | | | | | EOT | CRC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01h | 20h | 53h | **31h** | **32** | **30h** | **30h** | **31h** | **32h** | **35h** | **30h** | 04h | 3E |

Response upon clearing all targets:

| Response | SOH | Adr | Cmd | Profile no. = FFh | | Target = FFFFFFh | | | | | | EOT | CRC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01h | 20h | 53h | **3Fh** | **3F** | **3Fh** | **3Fh** | **3Fh** | **3Fh** | **3Fh** | **3Fh** | 04h | 2Ah |

Example 2: Read specific target (profile number = 17; target = 12.50)

| Transmission | SOH | Adr | Cmd | Profile no. = 17 | | EOT | CRC |
|---|---|---|---|---|---|---|---|
| | 01h | 20h | 53h | **31h** | **37h** | 04h | 16h |

| Response | SOH | Adr | Cmd | Profile no. = 17 | | Target = 12.50 | | | | | | EOT | CRC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01h | 20h | 53h | **31h** | **37h** | **30h** | **30h** | **31h** | **32h** | **35h** | **30h** | 04h | BCh |

Example 3: Write specific target (profile number = 17; target = -12.50)

| Transmission | SOH | Adr | Cmd | Profile no. = 17 | | Target = -12.50 | | | | | | EOT | CRC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01h | 20h | 53h | **31h** | **37h** | **2Dh** | **30h** | **31h** | **32h** | **35h** | **30h** | 04h | FBh |

| Response | SOH | Adr | Cmd | Profile no. = 17 | | Target = -12.50 | | | | | | EOT | CRC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01h | 20h | 53h | **31h** | **37h** | **2Dh** | **30h** | **31h** | **32h** | **35h** | **30h** | 04h | FBh |

## 4.2.4. Read /write offset „U" (55h)

This command is utilized to read or write the offset that is added to the true actual value. First however the function must be enabled in command bit parameter ‚a' (61h).

Example 1: Read offset

| Transmission | SOH | Adr | Cmd | EOT | CRC |
|---|---|---|---|---|---|
| | 01h | 20h | 55h | 04h | 26h |

Example 2: Write offset

| Transmission | SOH | Adr | Cmd | Data (offset = –20,00) | | | | | | EOT | CRC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01h | 20h | 55h | **2Dh** | **30h** | **32h** | **30h** | **30h** | **30h** | 04h | C3h |

Response in both examples:

| Response | SOH | Adr | Cmd | Data (offset = –20,00) | | | | | | EOT | CRC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01h | 20h | 55h | **2Dh** | **30h** | **32h** | **30h** | **30h** | **30h** | 04h | C3h |

## 4.2.5. Read / write profile number „V" (56h)

This command is utilized to read the presently active profile number or to alter the profile.

Example 1: Read active profile (active profile number = 38)

| Transmission | SOH | Adr | Cmd | EOT | CRC |
|---|---|---|---|---|---|
| | 01h | 20h | 56h | 04h | 20h |

| Response | SOH | Adr | Cmd | Profile no. = 38 | | EOT | CRC |
|---|---|---|---|---|---|---|---|
| | 01h | 20h | 56h | **33h** | **38h** | 04h | 28h |

Response after reset upon having cleared all profiles:

| Response | SOH | Adr | Cmd | Profil-Nr. = FF | | EOT | CRC |
|---|---|---|---|---|---|---|---|
| | 01h | 20h | 56h | **3Fh** | **3Fh** | 04h | 16h |

Example 2: Transmit profile (new profile number = 17)

| Transmission | SOH | Adr | Cmd | Profile no. = 17 | | EOT | CRC |
|---|---|---|---|---|---|---|---|
| | 01h | 20h | 56h | **31h** | **37h** | 04h | 3E |

| Response | SOH | Adr | Cmd | Profile no. = 17 | | EOT | CRC |
|---|---|---|---|---|---|---|---|
| | 01h | 20h | 56h | **31h** | **37h** | 04h | 3E |

Example 3: New profile to all N 150 by broadcast (identifier = 99 (83h); new profile number = 17)

| Transmission | SOH | Adr | Cmd | Profile no. = 17 | | EOT | CRC |
|---|---|---|---|---|---|---|---|
| | 01h | 83h | 56h | **31h** | **37h** | 04h | 04 |

| Response | not confirmed |
|---|---|

To check whether the new profile has been adopted by all N150 utilize check command „C" (43h).

### 4.2.6. Set actual value as preset „Z" (5Ah)

Command "Z" is utilized to set the actual value at any optional value. The required position value is transmitted to SPA. The SPA will calculate a so-called "preset offset" value relating to the true absolute encoder position. When calculating the preset offset, any programmed offset transmitted by command "U" will be considered, so that after having accomplished command "Z" the current value always equals the preset.
**Note:** When altering the resolution (see command „a") from 1/100 to 1/10 or vice-versa, any already assigned preset must be assigned anew. The internally calculated offset is available in the resolution previously programmed.

The indicated actual value is composed as follows:

$$\text{actual value}_{Anz} = \text{actual value}_{Abs} + \text{preset offset} + \text{offset}$$

| | |
|---|---|
| Actual value$_{Anz}$ | indicated actual value for readout by interface |
| Actual value$_{Abs}$ | internal absolute actual value. |
| Preset offset | offset generated by command „Z". |
| Offset | supplementary offset defined by command „U". This function however must be enabled in command bit parameter ‚a' (61h), otherwise applies offset = 0. |

Example 1: Readout presently active preset

| Transmission | SOH | Adr | Cmd | EOT | CRC |
|---|---|---|---|---|---|
| | 01h | 20h | 5Ah | 04h | 38h |

| Response | SOH | Adr | Cmd | preset = 2.50 | | | | | | EOT | CRC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01h | 20h | 5Ah | **30h** | **30h** | **30h** | **32h** | **35h** | **30h** | 04h | 27h |

Example 2: Set actual value as preset value (preset = 17.25)

| Transmission | SOH | Adr | Cmd | preset = 17.25 | | | | | | EOT | CRC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01h | 20h | 5Ah | **30h** | **30h** | **31h** | **37h** | **32h** | **35h** | 04h | 09h |

| Response | SOH | Adr | Cmd | preset = 17.25 | | | | | | EOT | CRC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01h | 20h | 5Ah | **30h** | **30h** | **31h** | **37h** | **32h** | **35h** | 04h | 09h |

Example 3: Set actual value as preset in all SPAs by broadcast command

| Transmission | SOH | Adr | Cmd | preset = 17.25 | | | | | | EOT | CRC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01h | 83h | 5Ah | **30h** | **30h** | **31h** | **37h** | **32h** | **35h** | 04h | AAh |

| Response | not confirmed |
|---|---|

### 4.2.7. Indicate optional column of figures in upper line „t" (74h)

This command is utilized to indicate a 5-digit number in the upper line of the display. The numerical column is indicated less dot respectively comma. Preceding zeroes as well as both arrows are suppressed. The bottom line still indicates the actual value.
The numerals are indicated in the display until any command except „t", „u" or „R" is received by interface. The number will be retained after power failure.

Example: (column of figures = 054321)

| Transmission | SOH | Adr | Cmd | Column of figures = 054321 | | | | | | EOT | CRC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01h | 20h | 74h | **30h** | **35h** | **34h** | **33h** | **32h** | **31h** | 04h | C6h |

| Response | SOH | Adr | Cmd | Column of figures = 054321 | | | | | | EOT | CRC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01h | 20h | 74h | **30h** | **35h** | **34h** | **33h** | **32h** | **31h** | 04h | C6h |

### 4.2.8. Indicate optional column of figures in bottom line „u" (75h)

The command is utilized to indicate a 5-digit column of figures in the bottom line of the display. The number is indicated less dot respectively comma. Preceding zeroes as well as both arrows are suppressed. The upper line still indicates the actual target or column of figures.
The column is indicated until any optional command except „t", „u" or „R" is received by the interface. The number will be retained after power failure.

Example: (column of figures = 012345)

| Transmission | SOH | Adr | Cmd | Column of figures = 012345 | | | | | | EOT | CRC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01h | 20h | 75h | **30h** | **31h** | **32h** | **33h** | **34h** | **35h** | 04h | B6h |

| Response | SOH | Adr | Cmd | Column of figures = 012345 | | | | | | EOT | CRC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01h | 20h | 75h | **30h** | **31h** | **32h** | **33h** | **34h** | **35h** | 04h | B6h |

**Note:**
Command "t" in conjunction with command "u" enables indication of a 10-digit number.
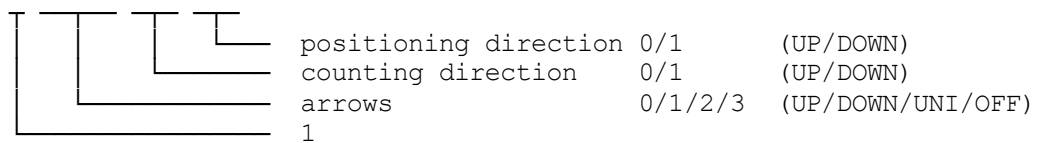Both columns are not saved in EEPROM.

## 4.3. Parameter commands

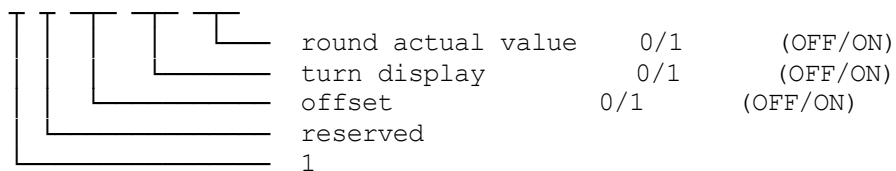| Command code | Data amount in bytes | read | write | Broad-cast | Save in EEPROM | Significance |
|---|---|---|---|---|---|---|
| a (61h) | 5 | X | X | - | X | Read/write general parameters |
| b (62h) | 8 | X | X | - | X | Parameter: Tolerance compensation, window |
| c (63h) | 8 | X | X | - | X | Parameter: scaling of spindle pitch |
| i (69h) | 1 | X | X | X | X | Parameter: mm / inch |

### 4.3.1. Read / write bit parameter „a" (61h)

To exploit maximum memory capacity, several parameters are put together and transferred as "data pack" under the following parameter codes:
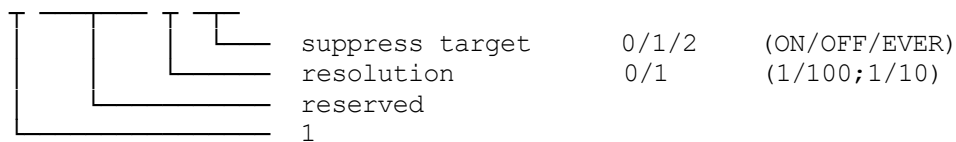
```
Data1:     1 0 X X 0 X 0 X

                     positioning direction 0/1       (UP/DOWN)
                     counting direction    0/1       (UP/DOWN)
                     arrows                0/1/2/3   (UP/DOWN/UNI/OFF)
                     1

Data2:     1 0 0 X 0 X 0 X

                     round actual value    0/1       (OFF/ON)
                     turn display          0/1       (OFF/ON)
                     offset                0/1       (OFF/ON)
                     reserved
                     1

Data3:     1 0 0 0 0 X X X

                     suppress target       0/1/2     (ON/OFF/EVER)
                     resolution            0/1       (1/100;1/10)
                     reserved
                     1

Data4/5:   0 0 1 1 0 0 0 0

                     reserved
```

**Important:** Only the bits marked 'X' may be altered. The permanent parameters „1" and „0" must not be altered since this might create a control token ( tokens < 20h)  what is not permitted in ASCII protocol.

Example 1: read bit parameter (data1 to data3 = 80h; data4 to data5 = 30h)

| Transmission | SOH | Adr | Cmd | EOT | CRC |
|---|---|---|---|---|---|
| | 01h | 20h | 61h | 04h | 4E |

| Response | SOH | Adr | Cmd | Data1 | Data2 | Data3 | Data4 | Data5 | EOT | CRC | bit parameter default |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01h | 20h | 61h | **80h** | **80h** | **80h** | **30h** | **30h** | 04h | F1 | |

Example 2: write bit parameter (positioning direction = down; turn display = On)

| Transmission | SOH | Adr | Cmd | Data1 | Data2 | Data3 | Data4 | Data5 | EOT | CRC |
|---|---|---|---|---|---|---|---|---|---|---|
| | 01h | 20h | 61h | **81h** | **84h** | **80h** | **30h** | **30h** | 04h | 91h |

| Response | SOH | Adr | Cmd | Data1 | Data2 | Data3 | Data4 | Data5 | EOT | CRC |
|---|---|---|---|---|---|---|---|---|---|---|
| | 01h | 20h | 61h | **81h** | **84h** | **80h** | **30h** | **30h** | 04h | 91h |

## Significance of parameter „a"

**Positioning direction**
**Positioning direction**
This parameter defines the direction the target is aimed for. Tolerances that occur for example at cogwheels, joints, shafts etc during a precise positioning operation requires a tolerance compensation. The tolerance compensation is proceeded by aiming for the target position always from the same direction utilizing so-called loops. Loops mean that the target position is first crossed by a defined distance and then aimed for again from the opposite direction. The parameter for the crossing distance is programmed by command "b". Whether a loop is required or not is indicated by the arrows in the display. A flashing arrow means tolerance compensation required. Upon reaching the turning point the direction changes and the arrow stops flashing. Targets allowing direct positioning are marked by a non-flashing arrow. Upon achieving the target within the programmed tolerances (see command "b") the arrows will not disappear until the required tolerance compensation has been completed.

| | | |
|---|---|---|
| 00 = Up | Direct positioning if target position > current position; otherwise proceed tolerance compensation |
| 01 = Down | Direct positioning if target position < current position; otherwise proceed tolerance compensation |

**Counting mode**
This parameter assigns either „ascending" or „descending" counted values in relation to the shaft's direction of rotation. Following parameters are available:

| | |
|---|---|
| 00 = Up | Clockwise rotation, ascending counted values |
| 01 = Down | Clockwise rotation, descending counted values |

**Arrows**
This parameter relates to the arrows in the display that indicate the operator the direction (to the right or to the left) of the new positioning operation. Following parameters are available:

| | |
|---|---|
| 00 = Up | If current value < target = arrow to the right; actual value > target = arrow to the left |
| 01 = Down | As „Up", but inverted arrows direction |
| 10 = Uni | If actual value ≠ target arrows ever indicated |
| 11 = Off | Arrows ever hidden |

**Rounding the actual value**
This means that the actual value being within the tolerances but still differing from the target is rounded up or down to the target value as soon as the shaft remains idle for approx. 3 seconds. The rounding operation is only visualized, the true internal actual value remains unchanged. For actual value readout by serial interface (command "R") the true, not rounded actual position value is provided. The true actual value will immediately reappear on the display upon key actuation. If the position is still within the tolerance window the rounding operation will be repeated after 3 seconds.
Note: In operating mode „Suppress target = Ever" the target is deactivated and the SPA serves as pure actual value display with disabled rounding function. The following parameters are available:

| | |
|---|---|
| 0 = Off | Round actual value disabled |
| 1 = On | Round actual value enabled |

**Turn display**
This parameter is utilized to turn the display by 180°.

| | |
|---|---|
| 0 = Off | Display readout with standard mounting, i.e. display above keypad |
| 1 = On | Display readout with inverted mounting, i.e. display below keypad |

**Offset**
The command „U" is utilized for programming the offset that is added to actual value and actual target. This parameter defines whether the offset is considered in the calculation.

| | |
|---|---|
| 0 = Off | Offset disabled. Any offset previously transmitted is NOT added neither to actual value nor target. |
| 1 = On | Offset enabled. The offset is added to actual value and actual target. |

**Suppress target**
This parameter defines when to indicate the target in the upper line of the display.

| | |
|---|---|
| 0 = On | Target indicated if target ≠ current value. |
| 1 = Off | Target ever indicated, also if target = current value. Indicate arrows too if target ≠ current value. |
| 2 = Ever | Target and arrows ever suppressed. |

**Resolution**

This parameter defines the resolution of the actual value. Upon altering the resolution the decimal point is shifted correspondingly by one digit to the right or left, same applies also to actual value and target. The target values however are not converted correspondingly but only the decimal point is shifted. When editing the machine please pay attention to defining the resolution first so that the target values are transmitted to the SPAs with the corresponding resolution.

| | | |
|---|---|---|
| 0 | Resolution  1/100 mm resp. 1/1000 inch | visualized in the display: 000.00 mm resp. 00.000 inch |
| 1 | Resolution  1/10 mm  resp.  1/100 inch | visualized in the display: 0000.0 mm resp. 000.00 inch |

### 4.3.2. Read /write tolerance compensation and tolerance window, „b" (62h)

This command is utilized to read or write the parameters tolerance compensation and tolerance window.

Example 1: Read parameter (tolerance compensation = 0.15;  tolerance window = 0.25)

| Transmission | SOH | Adr | Cmd | EOT | CRC | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01h | 20h | 62h | 04h | 48h | | | | | | |

| Response | SOH | Adr | Cmd | Tolerance compensation=0.15 | | | | Tolerance window=0.25 | | | | EOT | CRC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01h | 20h | 62h | **30h** | **30h** | **31h** | **35h** | **30h** | **30h** | **32h** | **35h** | 04h | AAh |

Example 2: Write parameter (tolerance compensation = 1.30; tolerance window = 5.00)

| Transmission | SOH | Adr | Cmd | Tolerance compensation =1.30 | | | | Tolerance window r=5.00 | | | | EOT | CRC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01h | 20h | 62h | **30h** | **31h** | **33h** | **30h** | **30h** | **35h** | **30h** | **30h** | 04h | 20h |

| Response | SOH | Adr | Cmd | Tolerance compensation =1.30 | | | | Tolerance window r=5.00 | | | | EOT | CRC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01h | 20h | 62h | **30h** | **31h** | **33h** | **30h** | **30h** | **35h** | **30h** | **30h** | 04h | 20h |

### 4.3.3. Read / write spindle pitch (scaling factor) „c" (63h)

This command is utilized to read or write the scaling factor of the spindle pitch within the range from 0,0000001...9,9999999. The decimal point is not transmitted.

How to calculate the scaling factor:

Resolution per turn:    14,40 mm
Spindle pitch:          4,00 mm

$$\text{Scaling factor} = \frac{\text{pitch}}{\text{Resolution per turn}} = \frac{4,00}{14,40} = 0,2777777$$

Example 1: Read scaling factor (scaling = 1.000000)

| Transmission | SOH | Adr | Cmd | EOT | CRC | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01h | 20h | 63h | 04h | 4Ah | | | | | | |

| Response | SOH | Adr | Cmd | scaling = 1.0000000 | | | | | | | | EOT | CRC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01h | 20h | 63h | **31h** | **30h** | **30h** | **30h** | **30h** | **30h** | **30h** | **30h** | 04h | 4B |

Example 2: Write scaling factor (scaling = 0.2777777)

| Transmission | SOH | Adr | Cmd | scaling = 0.2777777 | | | | | | | | EOT | CRC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01h | 20h | 63h | **30h** | **32h** | **37h** | **37h** | **37h** | **37h** | **37h** | **37h** | 04h | 30h |

| Response | SOH | Adr | Cmd | scaling = 0.2777777 | | | | | | | | EOT | CRC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01h | 20h | 63h | **30h** | **32h** | **37h** | **37h** | **37h** | **37h** | **37h** | **37h** | 04h | 30h |

### 4.3.4. Read / write measuring unit „i" (69h)

The command is utilized to read or write the measuring unit in mm or inches.

Data = 0 (30h) = mm
Data = 1 (31h) = inch

Example 1: Read parameter (setting = mm)

| Transmission | SOH | Adr | Cmd | EOT | CRC |
|---|---|---|---|---|---|
| | 01h | 20h | 69h | 04h | 5E |

| Response | SOH | Adr | Cmd | Data | EOT | CRC |
|---|---|---|---|---|---|---|
| | 01h | 20h | 69h | **30h** | 04h | D0h |

Example 2: Change measuring unit to inch

| Transmission | SOH | Adr | Cmd | Data | EOT | CRC |
|---|---|---|---|---|---|---|
| | 01h | 20h | 69h | **31h** | 04h | D2 |

| Response | SOH | Adr | Cmd | Data | EOT | CRC |
|---|---|---|---|---|---|---|
| | 01h | 20h | 69h | **31h** | 04h | D2 |

Example 3: Write measuring unit mm into all  N 150 by broadcast command (Identifier=99)

| Transmission | SOH | Adr | Cmd | Data | EOT | CRC |
|---|---|---|---|---|---|---|
| | 01h | 83h | 69h | **30h** | 04h | CDh |

| Response | Not confirmed |
|---|---|

**Important:** Parameters are programmed in mm and auto-converted by N 150 into inches upon displaying the position values.
.

## 4.4. Identifier commands

| Command code | Data amount in bytes | read | write | Broad-cast | Save in EEPROM | Significance |
|---|---|---|---|---|---|---|
| A  (41h) | 2 | X | X | X | X | Assign or indicate device identifier |
| B  (42h) | 2 | - | - | - | - | SPA feedback in addressing mode |

### 4.4.1. Assigning device identifiers in the network „A" (41h)

This command is creating an automated process where the device identifier is assigned in successive order to every single N 150 upon commissioning of the system. The first identifier to be assigned is broadcasted to all networked N 150 as follows:

| Transmission | SOH | Adr | Cmd | identifier = 01 | | EOT | CRC |
|---|---|---|---|---|---|---|---|
| | 01h | 83h | 41h | **30h** | **31h** | 04h | B4h |

All N 150 now show the identifier just transmitted and that is to be assigned in the upper line of the display. The bottom line indicates the device-specific identifier. o enter the new identifier, the shaft of the respective N 150 must be turned by at least a half (direction does not matter).The identifier is now adopted and appears in the bottom line of the display (as device-specific identifier). Both identifiers are now identical. As soon as the shaft is in idle position again and after having elapsed 3 seconds, N 150 will transmit to master the following acknowledging command „B" (42h):

| Transmitted To master | SOH | Adr | Cmd | identifier = 01 | | EOT | CRC |
|---|---|---|---|---|---|---|---|
| | 01h | 21h | 42h | **30h** | **31h** | 04h | 86h |

The Master may now transmits command „A" with the next identifier to be assigned as previously described.
This way, the respective (successive) identifiers are automatically assigned to all networked N 150, one after the other.

**Important:** The confirmatory command **„B"** transmitted by N 150 to master will be repeated after 3 seconds provided the master has not previously transmitted another „A" command.

### Indicate identifier in the display „A" (41h)

This command less parameters as broadcast command (address/Identifier=99) will make every networked N 150 indicate the device-specific identifier in the bottom line of the display. The upper line is blind.
This command is a designated broadcast command.

| Transmission | SOH | Adr | Cmd | EOT | CRC |
|---|---|---|---|---|---|
| | 01h | 83h | 41h | 04h | 80h |

| Response | Not confirmed | | | | |
|---|---|---|---|---|---|

SPA remains in this mode until being switched off and on again or until transmission of another command except „A", „R", „t" or „u".

If this command is transmitted to a valid device identifier (except 99) without any parameters, the respective SPA will return to standard operating mode and reply the actual device identifier.

| Transmission | SOH | Adr | Cmd | EOT | CRC |
|---|---|---|---|---|---|
| | 01h | 21h | 41h | 04h | 0Ah |

| Response | SOH | Adr | Cmd | Adr=01 | | EOT | CRC |
|---|---|---|---|---|---|---|---|
| | 01h | 21h | 41h | **30h** | **31h** | 04h | 9Eh |

## Extended identifier command „AX" (41h,58h)

This extended command is utilized to address individual SPAs in the bus network in a similar way as described above. By broadcast command the identifier to be assigned is transmitted to all networked SPAs as follows:

| Transmission | SOH | Adr | Cmd | Cmd2 | Identifier = 01 | | EOT | CRC |
|---|---|---|---|---|---|---|---|---|
| | 01h | 83h | 41h | 58h | **30h** | **31h** | 04h | 40h |

Similar to the standard command all N 150 now indicate the identifier just transmitted and that is to be assigned in the upper display line. Adopting the identifier is the same way. However, contrary to the above there won't be any acknowledging „B" replied. Checking whether the new identifier has been adopted is up to master,, for example utilizing command "R" (read actual value). The R-command is transmitted with the corresponding identifier to the N 150. If the addressed SPA is confirming that the assignment was successful, the master can proceed with next identifier. Regarding other commands the display of the respective SPA switches to standard operation.

## 4.5.  Specific commands

| Command code | Data amount in bytes | read | write | Broad-cast | Save in EEPROM | Significance |
|---|---|---|---|---|---|---|
| K  (4Bh) | - | - | X | X | X | Specific command: Profile reset (clear) |
| Q  (51h) | 1 | - | X | X | X | Specific command: SPA reset |
| X  (58h) | 2 / 4 / 8 | X | - | - | - | Specific command: Read device data |

### 4.5.1. SPA profile reset „K" (4Bh)

This command is clearing all previously programmed profiles.

Example 1: profile reset of a specific N SPA

| Transmission | SOH | Adr | Cmd | Data | EOT | CRC |
|---|---|---|---|---|---|---|
| | 01h | 20h | 4Bh | **7Fh** | 04h | C6h |

| Response | SOH | Adr | Data | EOT | CRC | |
|---|---|---|---|---|---|---|
| | 01h | 20h | **6Fh** | 04h | 52h | N 150 replies by standard response ‚o' (6Fh)  = OK |

Example 2: profile reset in all SPA by broadcast command (identifier=99)

| Transmission | SOH | Adr | Cmd | Data | EOT | CRC |
|---|---|---|---|---|---|---|
| | 01h | 83h | 4Bh | **7Fh** | 04h | DBh |

| Response | Not confirmed |
|---|---|

**Important:** After profile reset all profile data are set to FFFFFFhex, the current profile number to FFhex. The SPA display now is indicating 5 hyphens instead of target.

### 4.5.2. N 150 restore default „Q" (51h)

This command restores default either of individual or collective parameters.

    Data  =  q  (71h)  =  Parameters restore default
    Data  =  t  (74h)  =  Device identifier = 98
    Data  =  x  (78h)  =  Multiturn counter reset to 0. No singleturn reset possible.
    Data  =  ∆  (7Fh)  =  Enable all above functions.

Note: No profile reset. Profile reset by command „R".

Example 1:  Restore default in specific SPA

| Transmission | SOH | Adr | Cmd | Data | EOT | CRC |
|---|---|---|---|---|---|---|
| | 01h | 20h | 51h | **7Fh** | 04h | AEh |

| Response | SOH | Adr | Data | EOT | CRC | |
|---|---|---|---|---|---|---|
| | 01h | 20h | **6Fh** | 04h | 52h | N 150 replies by standard response ‚o' (6Fh)  = OK |

Example 2:  Restore default in all SPA by broadcast command (identifier=99)

| Transmission | SOH | Adr | Cmd | Data | EOT | CRC |
|---|---|---|---|---|---|---|
| | 01h | 83h | 51h | **7Fh** | 04h | B3 |

| Response | Not confirmed |
|---|---|

### 4.5.3. Read version, type or serial number „X" (58h)

This command is utilized to read version number, device type or serial number. The following sub-commands are available:

        Data  =  V  (56h)  =  read version
        Data  =  T  (54h)  =  read device type
        Data  =  S  (53h)  =  read serial number

Example 1: Read version number
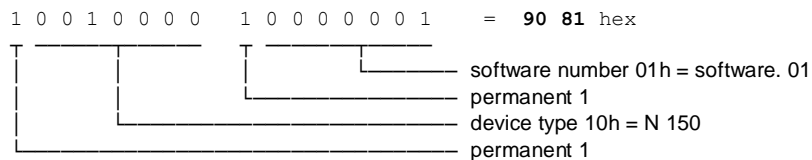
| Transmission | SOH | Adr | Cmd | Data | EOT | CRC |
|---|---|---|---|---|---|---|
| | 01h | 20h | 58h | **56h** | 04h | D8h |

| Response | SOH | Adr | Cmd | Data | Version number = 2.00 | | | EOT | CRC |
|---|---|---|---|---|---|---|---|---|---|
| | 01h | 20h | 58h | 56h | **20h** | **32h** | **30h** **30h** | 04h | FAh |

Example 2: Read device type (device type = N 150; software version = 01)

| Transmission | SOH | Adr | Cmd | Data | EOT | CRC |
|---|---|---|---|---|---|---|
| | 01h | 20h | 58h | **54h** | 04h | DCh |

| Response | SOH | Adr | Cmd | Data | Type | | EOT | CRC |
|---|---|---|---|---|---|---|---|---|
| | 01h | 20h | 58h | 54h | **90h** | **81h** | 04h | 26h |

**Code configuration of the transmitted device type:**

```
1 0 0 1 0 0 0 0   1 0 0 0 0 0 0 1   =  90 81 hex
```
```
                                    software number 01h = software. 01
                                    permanent 1
                                    device type 10h = N 150
                                    permanent 1
```

Example 3: Read serial number

| Transmission | SOH | Adr | Cmd | Data | EOT | CRC |
|---|---|---|---|---|---|---|
| | 01h | 20h | 58h | **53h** | 04h | D2h |

| Response | SOH | Adr | Cmd | Data | Kodierte Seriennummer = 07090EA4 | | | | | | | | EOT | CRC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01h | 20h | 58h | 53h | **30h** | **37h** | **30h** | **39h** | **30h** | **3Eh** | **3Ah** | **34h** | 04h | 20h |

**Code configuration of the transmitted serial number:**

The Low-Nibble (lower 4 bits of a byte) of the 8 data bits received equal together a 4 byte value comprising the serial number.
The serial number is composed by date and time of production. Since also the seconds are coded and by assigning only one number per second the serial number is unique.

Example: serial number for   **01.06.2005  16:58:36  =  15 83 0E A4** hex

```
X X X X X X X X   X X X X X X X X   X X X X X X X X   X X X X X X X X   bit position
J J J J J J M M   M M T T T T T h   h h h h m m m m   m m s s s s s s   content
0 0 0 1 0 1 0 1   1 0 0 0 0 0 1 1   0 0 0 0 1 1 1 0   1 0 1 0 0 1 0 0   example = 15 83 0E A4 hex

                                                       seconds 10 0100 = 24h = 36d
                                                       minutes 11 1010 = 3Ah = 58d
                                                       hours    1 0000 = 10h = 16d
                                                       day        0 0001 = 01h = 01d
                                                       month        0110 = 06h = 06d
                                                       year    00 0101 = 05h = 05d

                                                       01.06.05  16:58:36 <
```
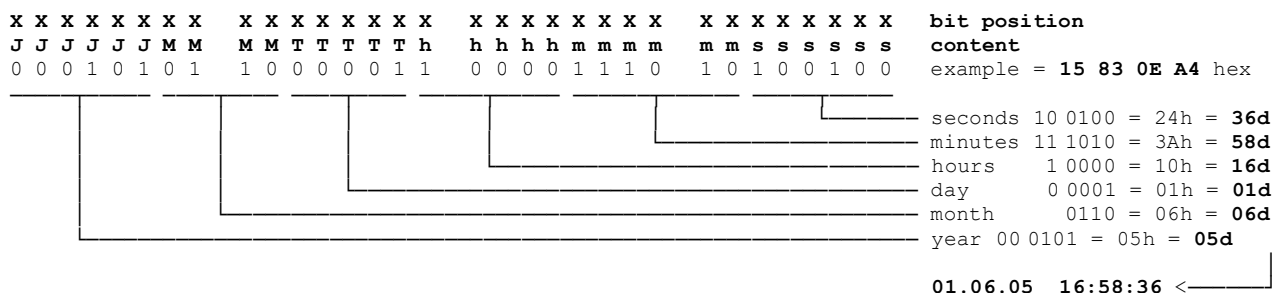
# 5. Error warnings

## 5.1. CRC error

Upon recognizing a CRC error in a transmitted command the SPA will respond as follows:

| Response | SOH | Adr | Error | EOT | CRC |
|---|---|---|---|---|---|
| | 01h | 20h | 65h | 04h | 46h |

Error = „e" (65h)  = CRC error

## 5.2. Format error

Upon recognizing a format error (incorrect length of protocol or void command (Cmd) in a command transmitted the SPA will respond as follows:

| Response | SOH | Adr | Error | EOT | CRC |
|---|---|---|---|---|---|
| | 01h | 20h | 66h | 04h | 40h |

Error = „f" (66h)  = Format error

# 6. Overview on commands

The following chart shows in alphabetical order all available commands (Cmd) as well as options regarding read and write (parameterization).

| Command code | Data amount in bytes | read | write | Broadcast | Save in EEPROM | Significance |
|---|---|---|---|---|---|---|
| a  (61h) | 5 | X | X | - | X | Read / write general parameter |
| b  (62h) | 8 | X | X | - | X | Parameter: tolerance compensation, window |
| c  (63h) | 8 | X | X | - | X | Parameter: scaling of spindle pitch |
| i  (69h) | 1 | X | X | X | X | Parameter: mm / inch |
| t  (74h) | 6 | - | X | - | - | Transmit tool number |
| u  (75h) | 6 | - | X | - | - | Transmit optional column of figures |
| A  (41h) | 2 | X | X | X | X | Assign or indicate device identifier |
| C  (43h) | 3 | X | - | - | - | Check if actual value = target |
| K  (4Bh) | - | - | X | X | X | Profile reset |
| Q  (51h) | 1 | - | X | X | X | Specific command: N 150 reset |
| R  (52h) | 6 | X | - | - | - | Read actual value |
| S  (53h) | 8 | X | X | - | X | Read / write target |
| U  (55h) | 6 | X | X | - | - | Offset |
| V  (56h) | 2 | X | X | X | X | Read / write profile number |
| X  (58h) | 4 | X | - | - | - | Specicfic command: read version number |
| Z  (5Ah) | 6 | X | X | X | X | Set preset |

# 7. Technical data

**Technical data - electrical ratings**

| | |
|---|---|
| Supply voltage | 24 VDC ±10 % |
| Current consumption | ≤30 mA |
| Display | LCD, 7 segments, two lines, backlit |
| Sensing principle | Absolute multiturn sensing |
| Sensing range | -99,99...+999,99 mm |
| | -9.999...+99.999 inch |
| Number of steps/revolution | 1440 |
| Number of revolutions | 4096 / 12 bit |
| Spindle pitch | ≤14 mm |
| Interface | RS485 (ASCII protocol) |
| Data saving | Parameter buffer: EEPROM |
| | Actual value buffer: >10 years by integrated 3 V Lithium battery |
| Programmable parameters | Display position horizontal/vertical |
| | Measuring unit mm/inch |
| | Counting direction |
| | Spindle pitch |
| | Spindle tolerances |
| | Positioning direction |
| | Directional arrows |
| | Tolerance window |
| | Rounding |
| Standard DIN EN 61010-1 | Protection class II |
| | Overvoltage category II |
| | Pollution degree 2 |
| Interference emission | DIN EN 61000-6-3 |
| Interference immunity | DIN EN 61000-6-2 |
| Approvals | UL/cUL |

**Technical data – mechanical design**

| | |
|---|---|
| Hollow shaft | ø14 mm |
| Operating speed | ≤600 U/min (short-term) |
| Protection DIN EN 60529 | IP 65 |
| Operating temperature | -10...+50 °C |
| Storage temperature | -20...+70 °C |
| Relative humidity | 80 % not condensing |
| Torque support | Torque pin at housing |
| E-connection | - male/female 4-pin connector M8 |
| | - cable output (30/15 cm) with male/female 4-pin connector M8 |
| Housing | with hollow shaft for direct shaft mount |
| Dimensions W x H x L | 37 x 75 x 45 mm |
| Mounting | by hollow shaft |
| Weight approx. | 120 g |
| Material | Polyamide black, UL 94V-0 |

## 7.1. Dimensions

Titel:
N150-MZ-X-01_EN.eps
Erstellt von:
Adobe Illustrator(R) 12
Vorschau:
Diese EPS-Grafik wurde nicht gespeichert
mit einer enthaltenen Vorschau.
Kommentar:
Diese EPS-Grafik wird an einen
PostScript-Drucker gedruckt, aber nicht
an andere Druckertypen.

# 8. Part number

| Part no. | Interface |
|----------|-----------|
| 1 | RS485 |
| | **E-connection** |
| 0 | Connector output, M8 |
| 1 | Cable output M8 |
| | **Voltage supply** |
| 3 | 24 VDC |
| | **Display** |
| A | At slope |
| B | At face |
| | **Hollow shaft** |
| A | Hollow shaft ø14 mm |

**N 150.1 ☐ 3 ☐ A01**