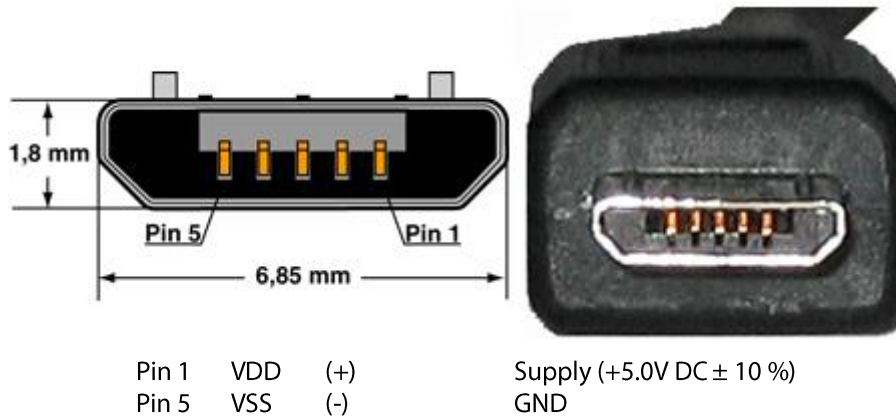


Electrical Specifications:

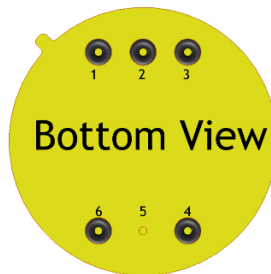
| | |
|-----------------------|----------------------------|
| VDD: | Supply (+5.0 V DC via USB) |
| VSS: | GND |
| Power Supply: | 5.0 V DC $\pm 10\%$ |
| IDD (Operating mode): | 180 mA |

Power connection at Ethernet device:



Pinout

| No. | Function | Type |
|-----|-----------|--------------|
| 1 | MISO | Input/Output |
| 2 | MOSI | Input/Output |
| 3 | SCL | Input |
| 4 | VDD | Power |
| 5 | VSS | Power |
| 6 | EE_Enable | Input/Output |

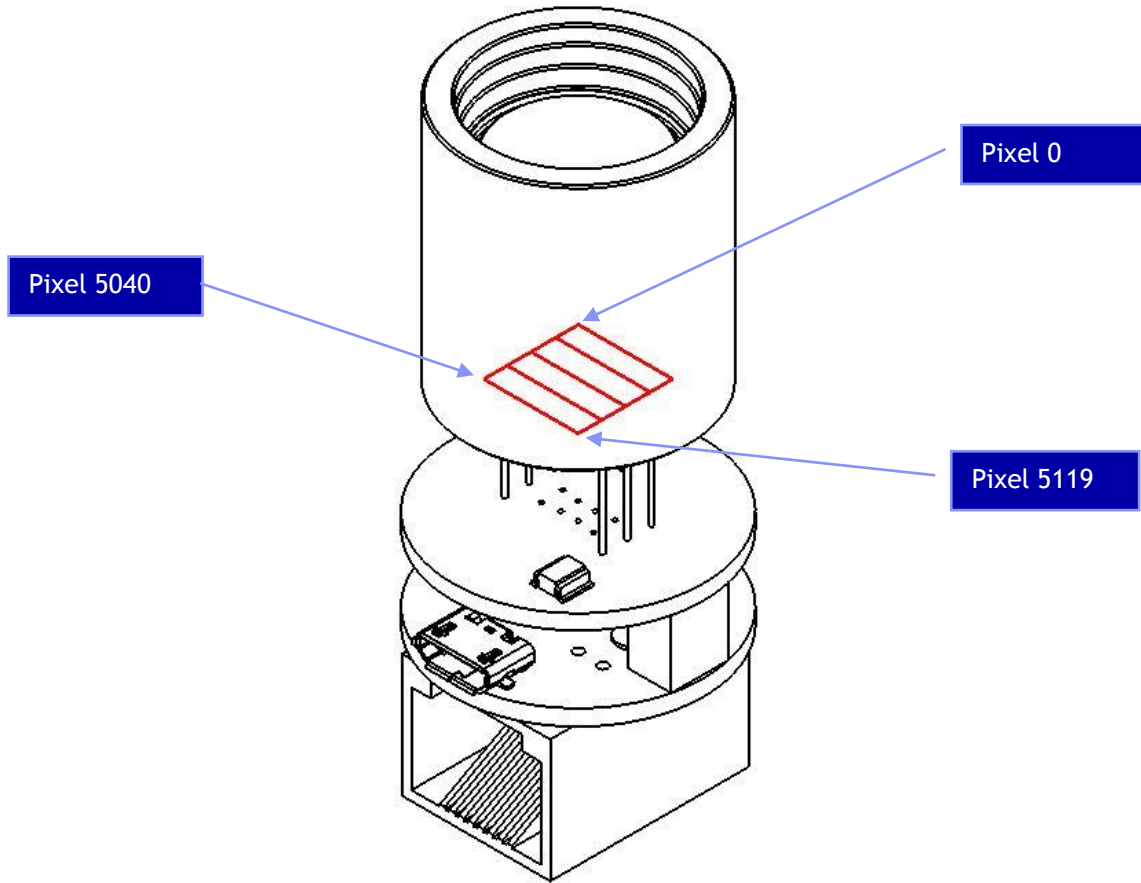


Ethernet-Interface:

Protocol Specifications:

| | |
|----------------------------|-------|
| Protocol type: | UDP |
| All communication on Port: | 30444 |

HTPA80x64d UDP Module Optical Orientation of Pixels:

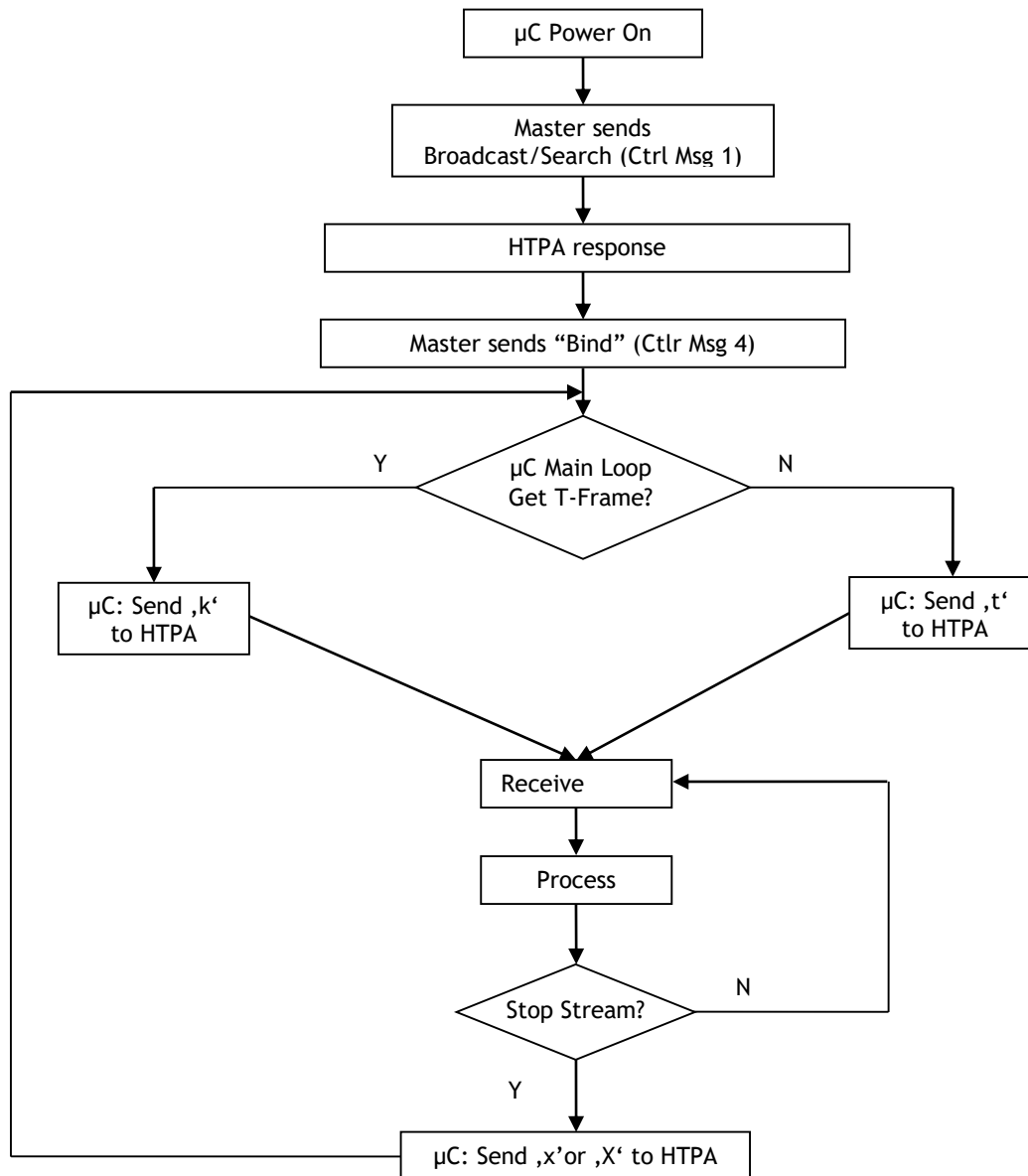


Pixelmap:

| | | | | | | | | | | |
|------|------|------|------|------|------|------|-----|------|------|------|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | ... | 77 | 78 | 79 |
| 80 | 81 | 82 | 83 | 84 | 85 | 86 | ... | 157 | 158 | 159 |
| . | | | | | | | | | | . |
| . | | | | | | | | | | . |
| . | | | | | | | | | | . |
| 5040 | 5041 | 5042 | 5043 | 5044 | 5045 | 5046 | ... | 5117 | 5118 | 5119 |

Communication and Timings:

Proposed flow chart of communication. (Master is referred as μC , Slave as HTPA module)



Communication:

| <i>Communication via UDP</i> | |
|------------------------------|---|
| Sent Char | Result/Received message |
| 'a'/'A' | decreases / increases CLK setting |
| 'b' | Measure VDD (referenced to VREF1225) |
| 'c' | Capture single voltage frame. Use ADC of μ C. |
| 'f' | Toggle between sending raw and compensated voltages when sending 't' |
| 'h' | pushes binary EEDATA out |
| 'i'/'I' | decreases / increases BIAS setting |
| 'j'/'J' | decreases / increases BPA setting |
| 'G' | Shows current configuration settings (CLK, BIAS, BPA,...) |
| 'k' | Read single temperature frame. Output in binary format. |
| 'K' | send continous binary temperature datastream(μ C-ADC)[K*10] Output of a complete cycle <i>For a detailed Description of the serial order see Table2.</i> |
| 'M' | Shows current and calibration settings. Device prints the following stream: "HTPA series responded! I am Arraytype 11 MODTYPE 5" "HTPA80x64d v.X.XX Heimann Sensor GmbH; written by M. Schnorr YYYY-MM-DD" Version information. "I am running on XXXX.X kHz" Actual MCLK-setting in kHz "MAC-ID: X IP: Y DevID: Z\r\n" X=MAC-ID of the device, i.e. "00.97.FF.00.10.08"; Y=current IP of the device, Z=DeviceID, range |
| 'p' | toggle PU (pull-up) setting |
| 'q'/'Q' | Allow Changes (required for Calibration) |
| 'r'/'R' | decreases / increases resolution |
| 't' | Continuous binary voltage data of the sensor is transmitted. Output of a complete cycle <i>For a detailed Description of the serial order see Table2.</i> |
| 'v' | Announce IP (Only Ethernet devices) |
| 'W' | Calibration. ATTENTION! Old Dataset cannot be restored! |
| 'x' | Stops Stream without prompt. |
| 'X' | Stops Stream by sending "STOP!\r\n" |

Please be aware, that the source and destination port has to be 30444.

Serial order of data in stream:

| HTPA80x64d Temperature Mode | |
|-----------------------------|----------------------------------|
| Dataset | Value |
| 0 | Temperature of Pixel0 in K*10 |
| 1 | Temperature of Pixel1 in K*10 |
| 2 | Temperature of Pixel2 in K*10 |
| 3 | Temperature of Pixel3 in K*10 |
| ... | ... |
| 5119 | Temperature of Pixel5119 in K*10 |
| 5120 | el. Offset 0 |
| 5121 | el. Offset 1 |
| ... | ... |
| 6399 | el. Offset 1279 |
| 6400 | VDD |
| 6401 | TAmb |
| 6402 | PTAT0 |
| 6403 | PTAT1 |
| 6404 | PTAT2 |
| 6405 | PTAT3 |
| 6406 | PTAT4 |
| 6407 | PTAT5 |
| 6408 | PTAT6 |
| 6409 | PTAT7 |

| HTPA80x64d Voltage Mode | |
|-------------------------|---|
| Dataset | Value |
| 0 | absolute Voltage of Pixel0 in digits |
| 1 | absolute Voltage of Pixel1 in digits |
| 2 | absolute Voltage of Pixel2 in digits |
| 3 | absolute Voltage of Pixel3 in digits |
| ... | ... |
| 5119 | absolute Voltage of Pixel5119 in digits |
| 5120 | el. Offset 0 |
| 5121 | el. Offset 1 |
| ... | ... |
| 6399 | el. Offset 1279 |
| 6400 | VDD |
| 6401 | TAmb |
| 6402 | PTAT0 |
| 6403 | PTAT1 |
| 6404 | PTAT2 |
| 6405 | PTAT3 |
| 6406 | PTAT4 |
| 6407 | PTAT5 |
| 6408 | PTAT6 |
| 6409 | PTAT7 |

Each dataset consists of a 16-bit value, first the Low-Byte is send, then the High-Byte.

Packets (UDP, only Ethernet device):

| Number of packets | Packet size [byte] | HTPA type |
|-------------------|--------------------|---------------|
| 1 | 262 | HTPA8x8 |
| 1 | 780 | HTPA16x16 |
| 2 | 1058+1054 | HTPA32x31 |
| 2 | 1292+1288 | HTPA32x32d |
| 5 | 1159+1157 | HTPA60x40d |
| 9 | 1285+1281 | HTPA84x60d |
| 10 | 1283 | HTPA80x64d |
| 17 | 1401+1149 | HTPA120x84dR0 |
| 17 | 1401+1153 | HTPA120x84dR2 |
| 30 | 1401 + 1057 | HTPA160x120d |

| Packet details for HTPA80x64d | | |
|-------------------------------|-------------|--|
| Packet No. | Packet size | Packet contains |
| 1 | 1283 | Packet index 1 (8bit), data of Pixel0-Pixel640 |
| 2 | 1283 | Packet index 2 (8bit), data of Pixel641-Pixel1281 |
| 3 | 1283 | Packet index 3 (8bit), data of Pixel1282-Pixel1922 |
| 4 | 1283 | Packet index 4 (8bit), data of Pixel1923-Pixel2563 |
| 5 | 1283 | Packet index 5 (8bit), data of Pixel2564-Pixel3204 |
| 6 | 1283 | Packet index 6 (8bit), data of Pixel3205-Pixel3845 |
| 7 | 1283 | Packet index 7 (8bit), data of Pixel3846-Pixel4486 |
| 8 | 1283 | Packet index 8 (8bit), data of Pixel4487-el.Offset7 |
| 9 | 1283 | Packet index 9 (8bit), data of el.Offset8-el.Offset648 |
| 10 | 1283 | Packet index 10 (8bit), data of el.Offset649 to end of frame |

Each dataset (except of packet index) consists out of a 16-bit value. For serial order of the datasets refer to section “serial order in Frame”.

Control Messages:

In the set of control messages, expressions in angled braces have to be substituted by following strings:

[IP] insert IP in ASCII format, i.e.: "192.168.240.122"
 [MACID] insert MAC ID in ASCII format and hexadecimal, i.e.: "00.1A.22.33.44.55"
 [AT] insert index of array types in ASCII format

| Array type | Index |
|----------------|-------|
| HTPA 8x8 | "0" |
| HTPA 16x16 | "1" |
| HTPA 32x16 | "2" |
| HTPA 32x32d | "10" |
| HTPA 80x64d | "11" |
| HTPA 120x84d | "12" |
| HTPA 84x60d | "13" |
| HTPA 60x40d | "14" |
| HTPA 160x120d | "15" |
| HTPA 120x84dR2 | "16" |

[MCLK] insert Frequency of MCLK in ASCII format and kHz, i.e.: "1050.1"
 [MSK] insert subnet mask in ASCII format, i.e.: "255.255.255.000"
 [DEVID] insert 10 digit device ID in ASCII format, i.e. "0123456789" Range: 0000000000...4294967295
 [MODT] insert index of Modulertype in ASCII format, i.e.: 005
 [ADCRES] insert ADC resolution in ASCII format, i.e.: "16" Range: 08...16

Set of control messages:

Message1: "Calling HTPA series devices" (only Ethernet device)
 Conditions: Can be sent as Broadcast, or if device already known as normal packet.
 Answer: "HTPA series responded! I am Arraytype [AT] MODTYPE [MODT]\r\n
 ADC: [ADCRES]\r\n"
 Firmware version, date and author information.
 "I am running on [MCLK] kHz\r\n"
 "MAC-ID: [MACID] IP: [IP] DevID: [DEVID]\r\n"
 A second packet with calibration depending information is send.

Message2: "x Release HTPA series device" (only Ethernet device)
 Result: Device disables hardware IP filter. All packets except ARP's, DHCP requests, Broadcasts, Message1, Message3 and Message4 are discarded.
 Answer: "HW-Filter released\r\n"

Message3: "HTPA device IP change request to [IP].[MSK]." (only Ethernet device)
 Result: The device changes the IP and the subnet mask to the given value and writes it to EEPROM. The IP becomes the default IP, therefore the device will use it at the next reset, if no DHCP is found.
 Answer: "Device changed IP to [IP]. and Subnet to [MSK].\r\n"

Control Messages [continued]:

Message4: "Bind HTPA series device" (only Ethernet device)
Result: Device enables hardware IP filter. Only packets from sender IP, ARP's, DHCP requests and Broadcasts are accepted. Device accepts now the control characters listed in **Table 1**.
Answer: "HW Filter is [IP] MAC [MACID]\n\r"
Insert in the above string the IP and MAC-ID of the Sender from Message4.

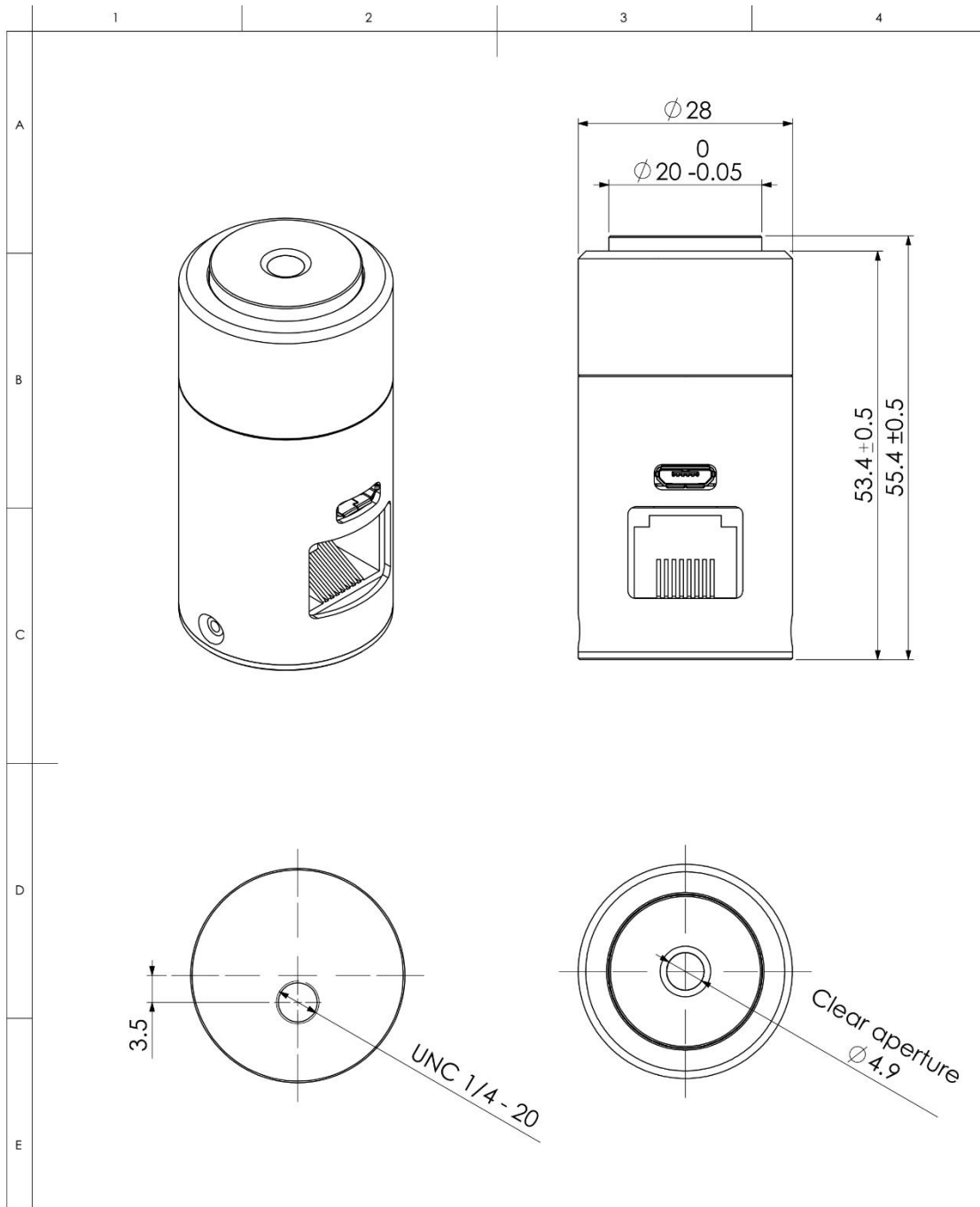
Message5: "Set EEPROM data"
Conditions: Only possible if Message 4 already successful sent.
ATTENTION! Calibration data is overwritten!!!
Result: Writes the next received packets into EEPROM, if packet size is equal to 1024 bytes. Device writes to EEPROM, until EEPROM is completely filled. EEPROM size depends on Device type: HTPA8x8, HTPA16x16 and HTPA32x31/32x32: 16384 byte, HTPA64x62: 65536 byte, HTPA80x64: 32768 byte.
Answer: "Write was successful.\n\r"

Message6: "Set Emission to [EPSILON]"
Result: The given emissivity [EPSILON] is written to the EEPROM. The emissivity can be used for customer specific purposes to compensate the radiation factor of different materials.
Answer: "Emission changed to [EPSILON]%\r\n"

Temperature calculation:

The module is already transmitting calculated temperatures if character "k/K" was sent from the master. For details about the temperature calculation please see the datasheet of the sensor.

Module Dimensions:



| | | | | | | | | | |
|---------------|------------|--|---------|---|------------|--|--|---------------|--|
| (Application) | | Valid variation for untoleranced dimensions DIN ISO 7168 (fine) | | (Surface) | | (Scale) | | Weigh | |
| | | Inner edges DIN ISO 13715 $\begin{smallmatrix} +0.2 \\ -0.2 \end{smallmatrix}$ Outer edges DIN ISO 13715 $\begin{smallmatrix} +0.2 \\ -0.2 \end{smallmatrix}$ | | | | (Material) | | | |
| | | | | Date | Name | HTPA80x64dL3.9/0.8A HTPA80x64dL3.9/0.8HiA | | | |
| | | | | Drawn 04.09.2017 | R. Funk | | | | |
| | | | | ch'kd 04.09.2017 | M. Schnorr | | | | |
| | | | | Norm | | | | | |
| | | | |  | | HSZ17065 | | Sheet 1/1 | |
| Rev0 | Release | 04.09.2017 | R. Funk | | | Origin: | | Replaced for: | |
| Rev. | Alteration | Date | Name | | | | | | |