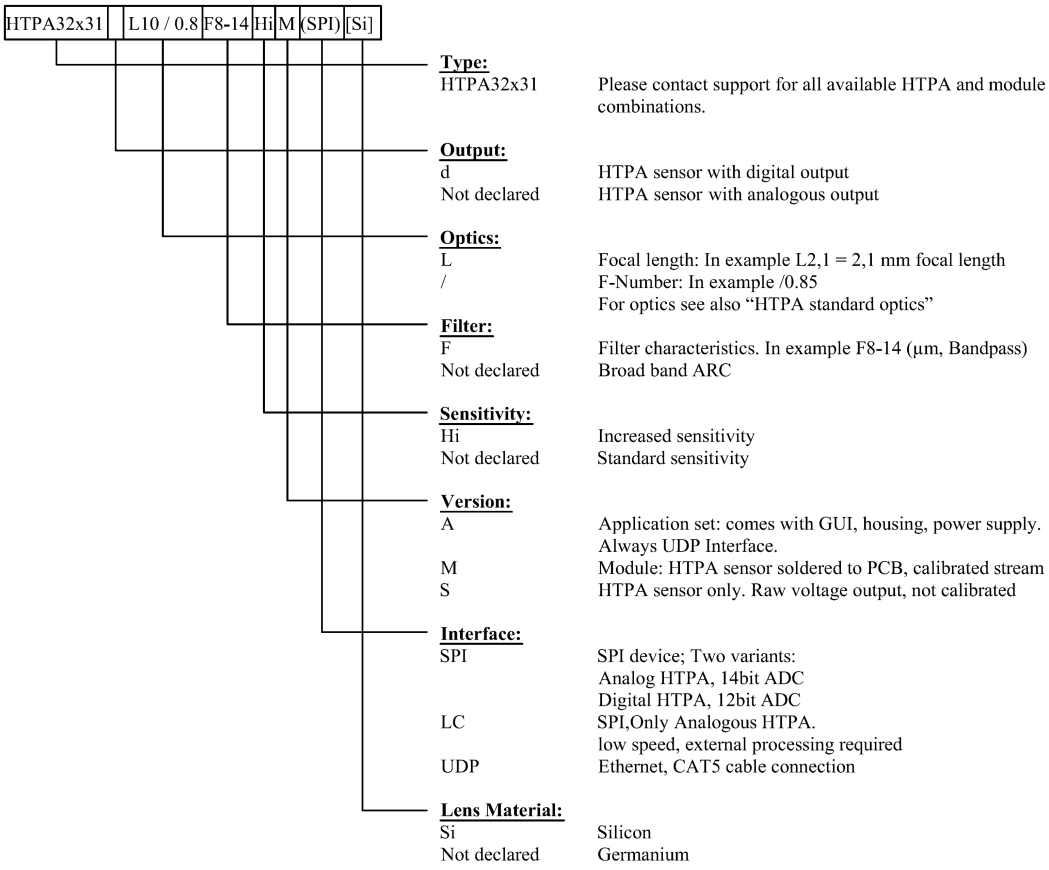
Specification for HTPA8x8L5.5M(UDP)

Rev.0: 2014.04.29 Fg

The HTPA8x8L_/_M(UDP) is a fully calibrated, low cost thermopile array module, with fully digital UDP interface. The module delivers an electrical offset and ambient temperature compensated output stream, which can be already used for image processing, pattern recognition and presence detection purposes. Object temperatures can be easily obtained by this data stream.

Order Code Example

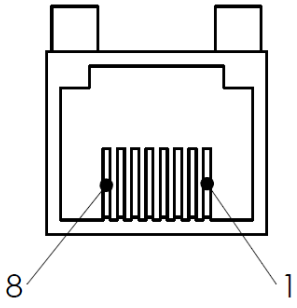


For modules, M(UART) and M(LC) are not recommended anymore. M(SPI) and M(UDP) offer a wider input voltage range, better ADC resolution and a wider measurement range.

Pinout

Pin Assignment HTPA32x31M(UDP)

Pin	Name	Description	Type
1	TPOut+	Differential Signal Output	Digital Output
2	VDD	Positive supply voltage	Power
3	TPOut-	Differential Signal Output	Digital Output
4	TPIn+	Differential Signal Input	Digital Input
5		not connected	
6	TPIn-	Differential Signal Input	Digital Input
7		not connected	
8	VSS	Ground reference	Power



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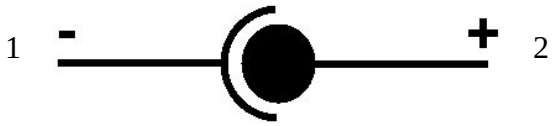
Ethernet-Interface:

Protocol Specifications:

Protocol type:	UDP
All communication on Port:	30444

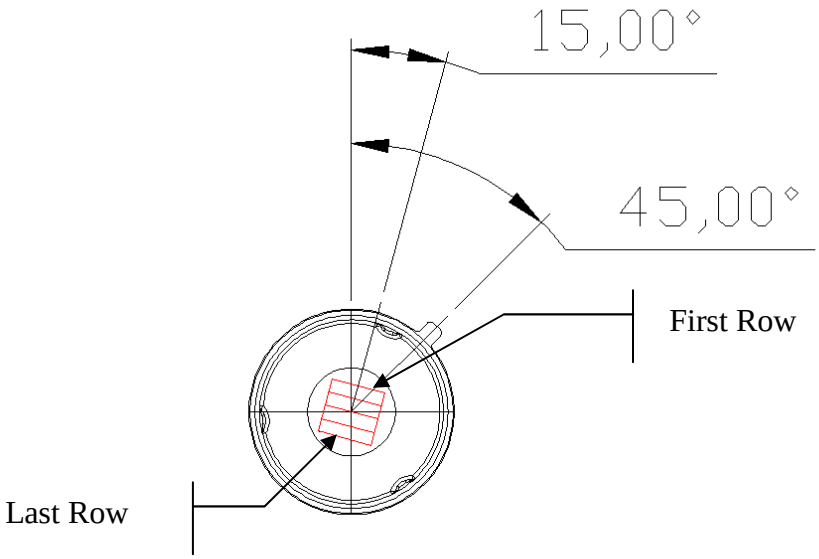
Power connection at Ethernet device:



1	VSS	(-)	GND
2	VDD	(+)	Supply (+3.3V DC)

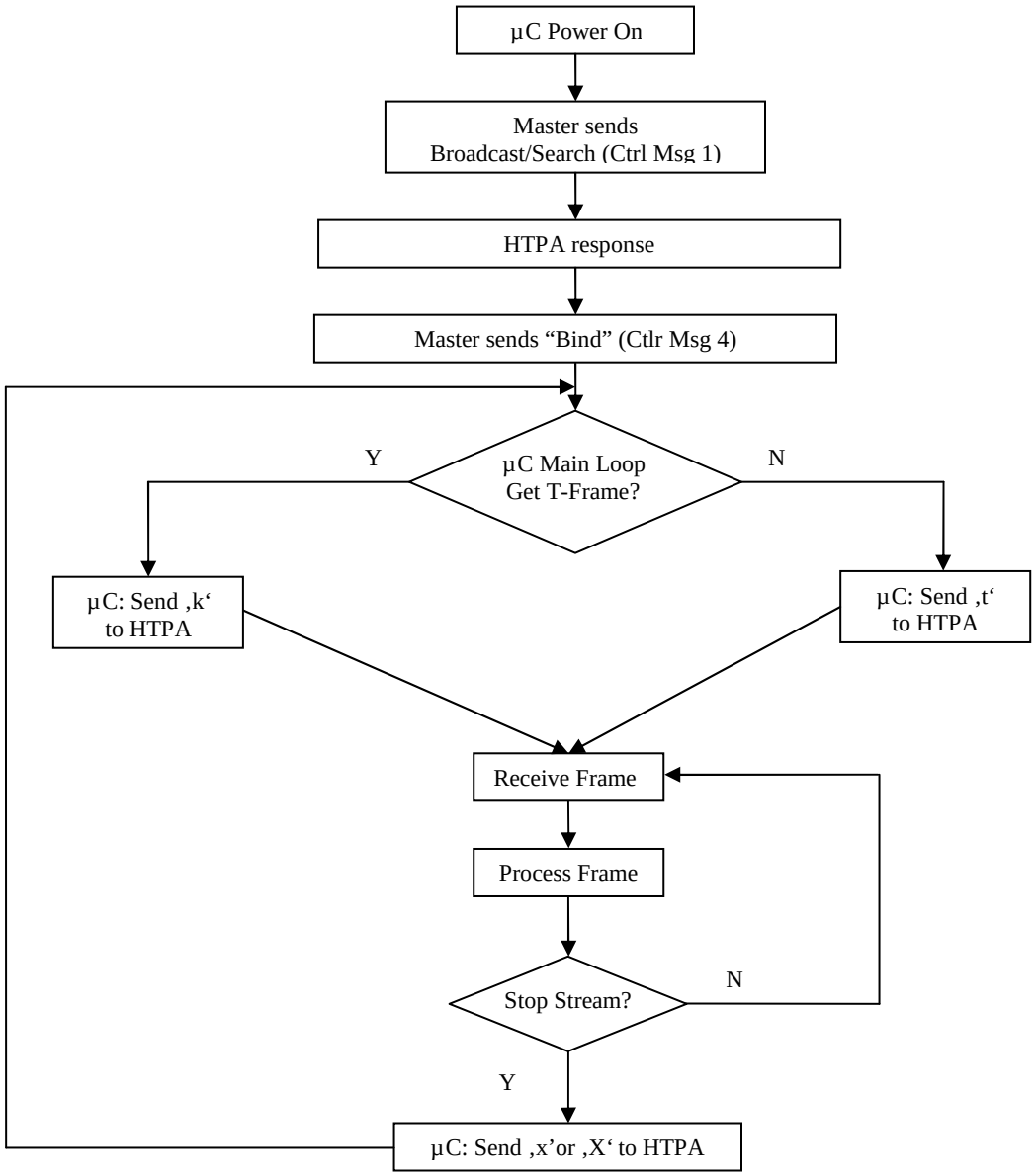
Power Supply: **3.3** VDC +/- 5%, 300mA

HTPA8x8L5.5M(UDP) Optical Orientation of Pixels:



Communication and Timings:

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



Communication:

Communication via Terminal / UDP				
Sent Char	**HTPA8x8**	**HTPA16x16**	**HTPA32x31 HTPA64x62**	**Result/Received message**
'a'	X	X	X	Decreases the operating frequency of the array
'A'	X	X	X	Increases the operating frequency of the array
'b'	X	X	X	Measure VDD (referenced to VREF1225)
'C'	X	X		Capture single voltage frame. Use ADC of ASIC. Output via ASCII if sent via UART, binary if sent via UDP.
'c'	X	X	X	Capture single voltage frame. Use ADC of µC. Output via ASCII if sent via UART, binary if sent via UDP.
'd'/'D'	X	X		Toggle POR_N
'f'	X	X	X	Toggle Resetbit
'F'	X	X		Analog operating point is at start of AD-range, only positive signals convertable
'G'	X	X		Analog operating point is in the middle of AD-range, positive and negative signals convertable
'g'	X	X		Analog operating point is at end of AD-range, only negative signals convertable
'h'	X	X	X	pushes binary EEDATA out
'i'			X	Read single voltage frame. Output in ASCII format. Serial order: Pixeldata[K*10], el. Offsets, Ambient Temperature
'I'			X	Read single temperature frame. Output in ASCII format. Serial order: Pixeldata[K*10], el. Offsets, Ambient Temperature
'J'	X	X	X	Toggle Amplification
'k'	X	X	X	Read single temperature frame. Output in binary format.
'K'	X	X	X	send continous binary temperature datastream(µC-ADC)[K*10] Output of a complete cycle in this order: *HTPA 8x8 and HTPA16x16: Pixel0,Pixel1, ….PixelX, el.Offset0, el.Offset1,…, el.OffsetY,PTAT0,PTAT1,…,PTATZ* *HTPA32x31: see Table2.* ***For a detailed Description of the serial order see Table2.*** 16x16 Array: X=255; Y=7; Z=7 — 8x8 Array: X=63; Y=4; Z=4 One dataset has exactly 2 bytes: first the low-Byte is send, then the high-byte. Each Dataset contains the measured Temperature in Kelvin*10. The first 4 datasets *el.Offset0…el.Offset3* after the last Pixel voltage *PixelX* transmit additional the current VDD in the MSB's:
'l'	X	X	X	Get Ambient Temperature (Calculates the Ambient Temperature from the **last measured** Frame)
'm'	X	X	X	Toggle usage of µC-Buffer for el. Offsets (Stack depth = 64 for HTPA8x8 and HTPA16x16; Stack depth = 32 for HTPA32x31)
'M'	X	X	X	Shows current and calibration settings. Device prints the following stream: **"HTPA series responsed! I am Arraytype X"** Possible values for X: "0"=HTPA8x8, "1"=HTPA16x16, "3"=HTPA32x31 **"Firmware v.X.XX written by B.Forg; Heimann Sensor GmbH; YYYY-MM-DD"** Version information. **"I am running on XXXX.X kHz"** Actual MCLK-setting in kHz **"Amplification is X" Actual set amplification.** Possible strings for X: "low" or "high" **"MAC-ID: X IP: Y DevID: Z\r\n"** (Only Ethernet devices show a MAC-ID, DevID is shown in any case) X= MAC-ID of the device, i.e. "00.97.FF.00.10.08"; Y=current IP of the device, Z=user setable ID, range 00000…65535 **"PIXCvsTA *X* , BFL3 *X* , F8_14 *X* , THvsTA *X* IGNORE_EL OFF *X* ELOFF32 *X* SBY *Y* FC *X* EXP *Z* "**

VDD and TAmb for HTPA8x8 and HTPA16x16:

Dataset	Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	…	Bit1	Bit0
elOff0	MSB VDD	…	…	Bit12 VDD	MSB elOff0	…	…	…	LSB elOff0
elOff1	Bit11 VDD	…	…	Bit8 VDD	MSB elOff1	…	…	…	LSB elOff1
elOff2	Bit7 VDD	…	…	Bit4 VDD	MSB elOff2	…	…	…	LSB elOff2
elOff3	Bit3 VDD	…	…	LSB VDD	MSB elOff3	…	…	…	LSB elOff3

The Sensor temperature is available in the datasets after *el.Offset3*:

Dataset	Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	…	Bit1	Bit0
elOff3+1	MSB TAmb	…	…	Bit12 TAmb	MSB elOff3+1	…	…	…	LSB elOff3+1
elOff3+2	Bit11 TAmb	…	…	Bit8 TAmb	MSB elOff3+2	…	…	…	LSB elOff3+2
elOff3+3	Bit7 TAmb	…	…	Bit4 TAmb	MSB elOff3+3	…	…	…	LSB elOff3+3
elOff3+4	Bit3 TAmb	…	…	LSB TAmb	MSB elOff3+4	…	…	…	LSB elOff3+4
elOff3+5	0	0	0	0	MSB elOff3+5	…	…	…	LSB elOff3+5

Table 1a: Control Characters

<table>
<tr><th colspan="5">Communication via Terminal / UDP</th></tr>
<tr><th>Sent Char</th><th>HTPA8x8</th><th>HTPA16x16</th><th>HTPA32x31
HTPA64x62</th><th>Result/Received message</th></tr>
<tr><td>'o'</td><td></td><td>X</td><td>X</td><td>Use external reference voltages</td></tr>
<tr><td>'O'</td><td></td><td>X</td><td>X</td><td>Use internal reference voltages</td></tr>
<tr><td>'q'/'Q'</td><td>X</td><td>X</td><td>X</td><td>Allow Changes (required for Calibration)</td></tr>
<tr><td>'t'</td><td>X</td><td>X</td><td>X</td><td>Continuous binary voltage data of the µC-ADC is transmitted.
Output of a complete cycle in this order:

HTPA 8x8 and HTPA16x16: Pixel0,Pixel1, ….PixelX, el.Offset0, el.Offset1,…, el.OffsetY,PTAT0,PTAT1,…,PTATZ
HTPA32x31: see Table2.
For a detailed Description of the serial order see Table2.

16x16 Array: X=255; Y=7; Z=7   8x8 Array: X=63; Y=4; Z=4

One dataset has exactly 2 bytes: first the low-Byte is send, then the high-byte. Each Dataset contains the ADC-Data in digits and The first 4 datasets el.Offset0…el.Offset3 after the last Pixel voltage PixelX transmit additional the current VDD in the MSB’s:

VDD for HTPA8x8 and HTPA16x16:
<table>
<tr><td>Dataset</td><td>Bit 15</td><td>Bit 14</td><td>Bit 13</td><td>Bit 12</td><td>Bit 11</td><td>Bit 10</td><td>…</td><td>Bit 1</td><td>Bit 0</td></tr>
<tr><td>elOff0</td><td>MSB VDD</td><td>…</td><td>…</td><td>Bit 12 VDD</td><td>MSB elOff0</td><td>…</td><td>…</td><td>…</td><td>LSB elOff0</td></tr>
<tr><td>elOff1</td><td>Bit 11 VDD</td><td>…</td><td>…</td><td>Bit 8 VDD</td><td>MSB elOff1</td><td>…</td><td>…</td><td>…</td><td>LSB elOff1</td></tr>
<tr><td>elOff2</td><td>Bit 7 VDD</td><td>…</td><td>…</td><td>Bit 4 VDD</td><td>MSB elOff2</td><td>…</td><td>…</td><td>…</td><td>LSB elOff2</td></tr>
<tr><td>elOff3</td><td>Bit 3 VDD</td><td>…</td><td>…</td><td>LSB VDD</td><td>MSB elOff3</td><td>…</td><td>…</td><td>…</td><td>LSB elOff3</td></tr>
</table></td></tr>
<tr><td>'T'</td><td>X</td><td>X</td><td></td><td>Continuous binary data of the ASIC-ADC is transmitted.
Output order is equal to ‘t’.</td></tr>
<tr><td>'u'</td><td>X</td><td>X</td><td></td><td>Continuous binary data of the ASIC-ADC is transmitted. PTAT-Voltages are sampled with the uC-ADC.
Output order is equal to ‘t’.</td></tr>
<tr><td>'U'</td><td>X</td><td>X</td><td></td><td>Capture single frame. Use ADC of ASIC. Output via ASCII. PTAT-Voltages are sampled with the uC-ADC.</td></tr>
<tr><td>'v'</td><td>X</td><td>X</td><td>X</td><td>Announce IP (Only Ethernet devices)</td></tr>
<tr><td>'V'</td><td>X</td><td>X</td><td>X</td><td>Device awaits control message (only non-Ethernet devices)</td></tr>
<tr><td>'w'</td><td>X</td><td>X</td><td>X</td><td>shows Calibration-constants</td></tr>
<tr><td>'W'</td><td>X</td><td>X</td><td>X</td><td>Calibration. ATTENTION! Old Dataset cannot be restored!</td></tr>
<tr><td>'x'</td><td>X</td><td>X</td><td>X</td><td>Stops Stream without prompt.</td></tr>
<tr><td>'X'</td><td>X</td><td>X</td><td>X</td><td>Stops Stream by sending “STOP!\r\n”</td></tr>
<tr><td>'y'</td><td>X</td><td>X</td><td>X</td><td>switch off ASIC-Supply (5V)</td></tr>
<tr><td>'Y'</td><td>X</td><td>X</td><td>X</td><td>switch on ASIC-Supply (5V)</td></tr>
</table>

Table 1b: Control Characters (continuation)

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

Serial order of data in stream:

HTPA8x8 Temperature Mode	
Dataset	Value
0	Temperature of PixelI0 in K*10
1	Temperature of PixelI1 in K*10
2	Temperature of PixelI2 in K*10
3	Temperature of PixelI3 in K*10
…	…
63	Temperature of PixelI63 in K*10
64	4 bits of VDD and elOff0 in digits (refer to Table1)
65	4 bits of VDD and elOff1 in digits (refer to Table1)
66	4 bits of VDD and elOff2 in digits (refer to Table1)
67	4 bits of VDD and elOff4 in digits (refer to Table1)
68	4 bits of TAmb and PTAT0 in digits (refer to Table1)
68	4 bits of TAmb and PTAT1 in digits (refer to Table1)
68	4 bits of TAmb and PTAT2 in digits (refer to Table1)
68	4 bits of TAmb and PTAT3 in digits (refer to Table1)

HTPA8x8 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
…	…
63	absolute Voltage of Pixel63 in digits
64	4 bits of VDD and elOff0 in digits (refer to Table1)
65	4 bits of VDD and elOff1 in digits (refer to Table1)
66	4 bits of VDD and elOff2 in digits (refer to Table1)
67	4 bits of VDD and elOff4 in digits (refer to Table1)
68	4 bits of TAmb and PTAT0 in digits (refer to Table1)
68	4 bits of TAmb and PTAT1 in digits (refer to Table1)
68	4 bits of TAmb and PTAT2 in digits (refer to Table1)
68	4 bits of TAmb and PTAT3 in digits (refer to Table1)

Table 2: Serial order of data in stream

Each dataset consists of a 16 bit value. If a frame consists out of more than one packet, packets are appended.

Pixel Map:

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

Table 3: Pixelmap

Packets (UDP, only Ethernet device):

Number of packets	Packet size [byte]	HTPA type	Comments
1	144	HTPA8x8	-
1	544	HTPA16x16	-
2	1058+1054	HTPA32x31	see below for details
8	1101+493	HTPA64x62	see below for details

Packet details for HTPA32x31		
Packet No.	Packet size	Packet contains
1	1058	Data of Pixel0 - Pixel528
2	1054	Data of Pixel529 to end of frame

Packet details for HTPA64x62		
Packet No.	Packet size	Packet contains
1	1101	Packet index 1 (8bit), data of Pixel0-Pixel550
2	1101	Packet index 2 (8bit), data of Pixel551-Pixel1101
3	1101	Packet index 3 (8bit), data of Pixel1102-Pixel1652
4	1101	Packet index 4 (8bit), data of Pixel1653-Pixel2203
5	1101	Packet index 5 (8bit), data of Pixel2204-Pixel2754
6	1101	Packet index 6 (8bit), data of Pixel2755-Pixel3305
7	1101	Packet index 7 (8bit), data of Pixel3306-Pixel3856
8	493	Packet index 8 (8bit), data of Pixel3857 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 32x31	*"3"*
HTPA 64x62	*"5"*

[MCLK] insert Frequency of MCLK in ASCII format and kHz, i.e.: *"1050.1"*

[AMP] insert state of amplification in ASCII format:

State	String
Low	*"low"*
High	*"high"*

[MSK] insert subnet mask in ASCII format, i.e.: *"255.255.255.000"*

[DEVID] insert 5 digit device ID in ASCII format, i.e. *"00197"* Range: 00000… 65535

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 responsed! I am Arraytype **[AT]**"
Firmware version, date and author information.
"I am running on **[MCLK]** kHz"
"Amplification is **[AMP]**\r\n"
"MAC-ID: **[MACID]** IP: **[IP]**\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"

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.

Control Messages [continued]:

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: 16384 byte; HTPA64x62: 65536 byte.
Answer:	"Write was successful.\n\r"

Message6:	"Set DeviceID to **[DEVID]**"
Result:	The given Device ID **[DEVID]** is written to EEPROM. This ID is shown on receive of 'M'. The eDevice ID can be used for customer specific purposes.
Answer:	"DeviceID changed to **[DEVID]**\r\n"

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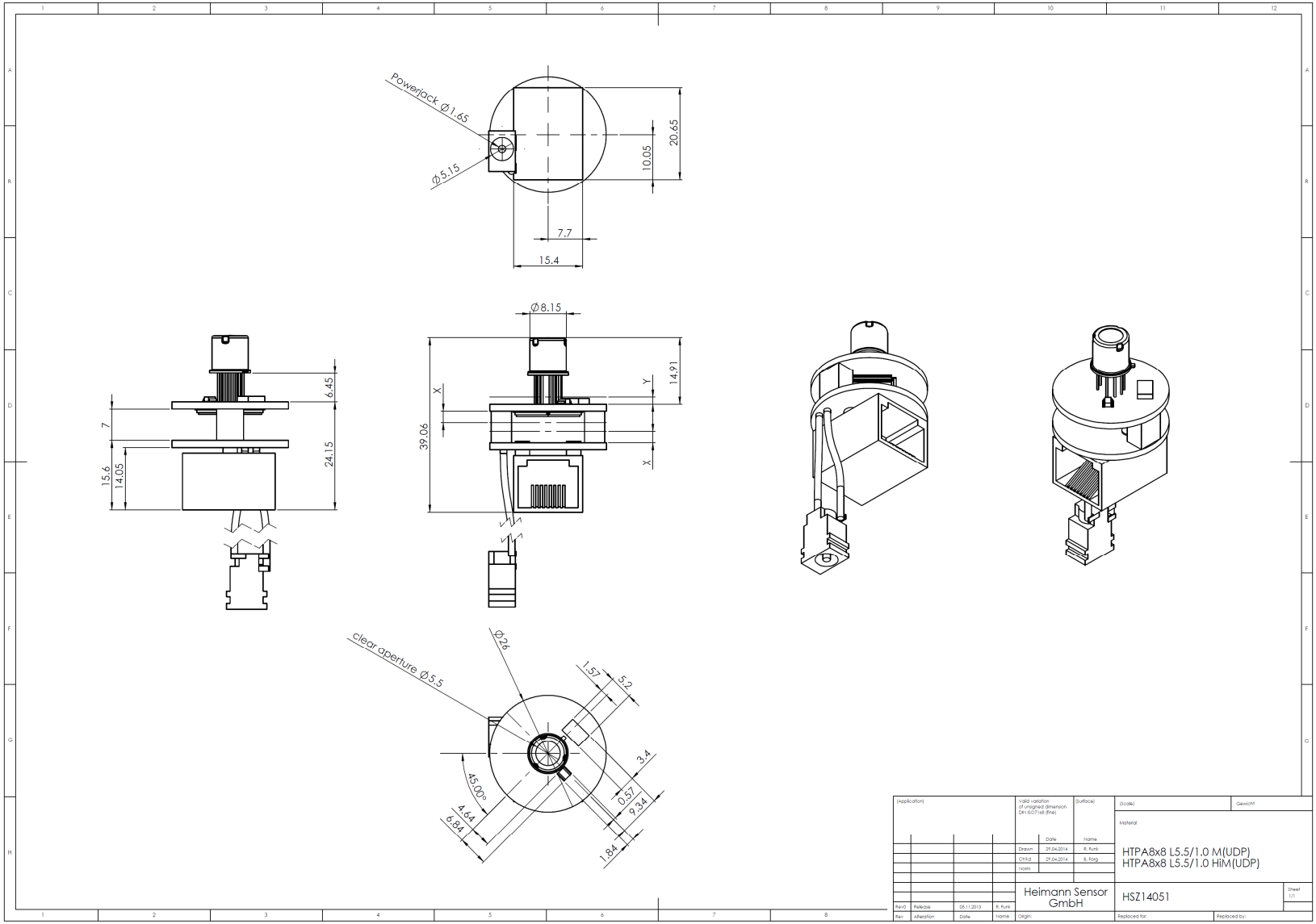
Dimensions:



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