Specification for HTPA16x16L2.1/0.85HiM(SPI)

Rev.2: 2013.12.20 Fg

The HTPA16x16L_/_M(SPI) is a fully calibrated, low cost thermopile array module, with fully digital SPI 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. Furthermore, this module type can deliver already an object temperature stream, which is measured by each single element of the matrix.

Order Code Example

HTPA16x16	d	L2.1 / 0.85	Hi	M	(SPI)	[Si]

Type:

HTPA16x16	Please contact support for all available HTPA and module combinations.

Output:

d	HTPA sensor with digital output
Not declared	HTPA sensor with analogous output

Optics:

L	Focal length: In example L2,1 = 2,1 mm focal length
/	F-Number: In example /0.85
	For optics see also “HTPA standard optics”

Sensitivity:

Hi	Increased sensitivity
Not declared	Standard sensitivity

Version:

A	Application set: comes with GUI, housing, power supply. Always UDP Interface.
M	Module: HTPA sensor soldered to PCB, calibrated stream
S	HTPA sensor only. Raw voltage output, not calibrated

Interface:

SPI	SPI device; Two variants: Analog HTPA, 14bit ADC Digital HTPA, 12bit ADC
LC	SPI,Only Analogous HTPA. low speed, external processing required
UDP	Ethernet, CAT5 cable connection

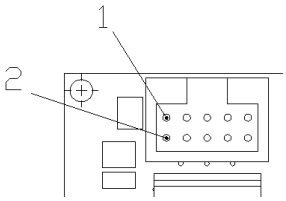
Lens Material:

Si	Silicon
Not declared	Germanium

For modules, the recommended type is M(SPI). The advantages are the better ADC resolution, wider input voltage range, wider measurement range.

Pinout

Pin Assignement HTPA32x31M(SPI)			
Pin	Name	Description	Type
1	#MCLR	Master clear, negotiated	Digital Input
2	VDD	Positive supply voltage	Power
3	VSS	Negative supply voltage	Power
4	VSS	Negative supply voltage	Power
5	#SS	Slave select, negotiated	Digital Input
6	SDO	Serial data out of module	Digital output
7	SDI	Serial data in of module	Digital Input
8	SCK	Serial clock	Digital Input
9	MCLK	Master clock, drives Sensor	Digital output
10	#VD	Valid Data, negotiated	Digital output



Connector: B10B-PUDSS-1 (LF)(SN)
Supplier: J.S.T.

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D-01109 Dresden / Germany

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SPI Interface:

SCK-Frequency: 350 kHz …10 MHz [1)]

[1)] For customer specified devices with higher frame rates than usual, higher SCK-Frequencies than 350 kHz might be needed. See also "Communication and Timings"

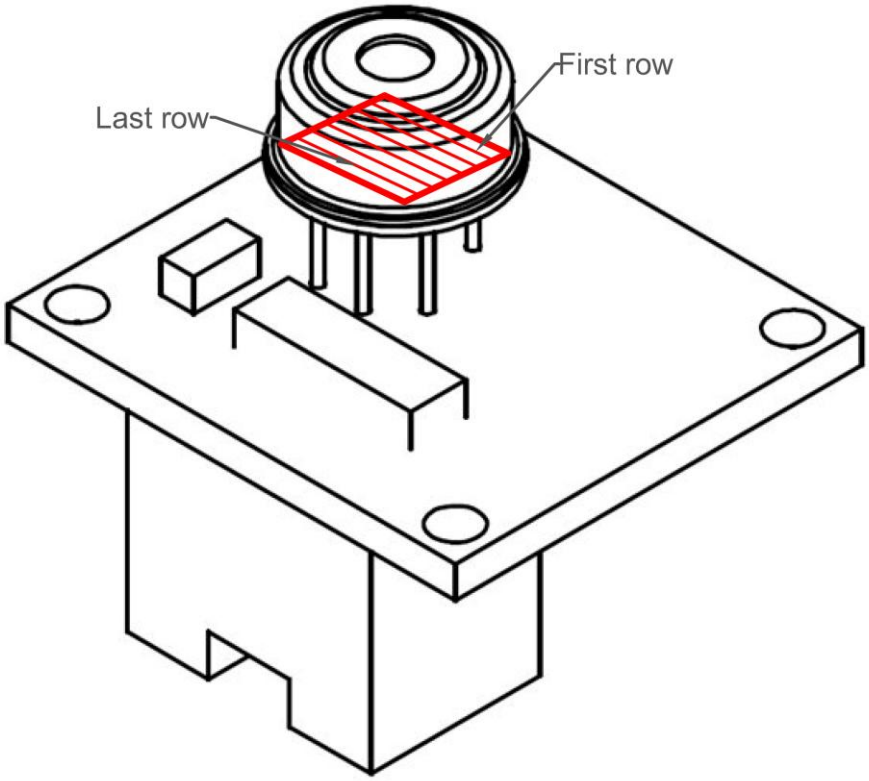
Protocol Specifications:

Data format:	16 data bits
Frame Sync:	None
Module-Selection:	$\overline{SS}$-Pin
Clock Edge Select:	Serial output data changes on transition from idle to active clock state
SPI Data Input Sample Phase:	Data sampled on transition from active to idle clock state
Clock Polarity:	Idle state is high level, active is low level.

Electrical Specifications:

VDD Range:	Supply (2.8 – 3.3 V DC)
SPI Transmit/Receive:	TTL
VSS	GND
Power Supply:	**2.8-3.3** VDC
IDD (Idle mode)	58 mA
IDD (Operating mode)	9 mA

HTPA16x16L2.1/0.85M(SPI) Optical Orientation of Pixels:



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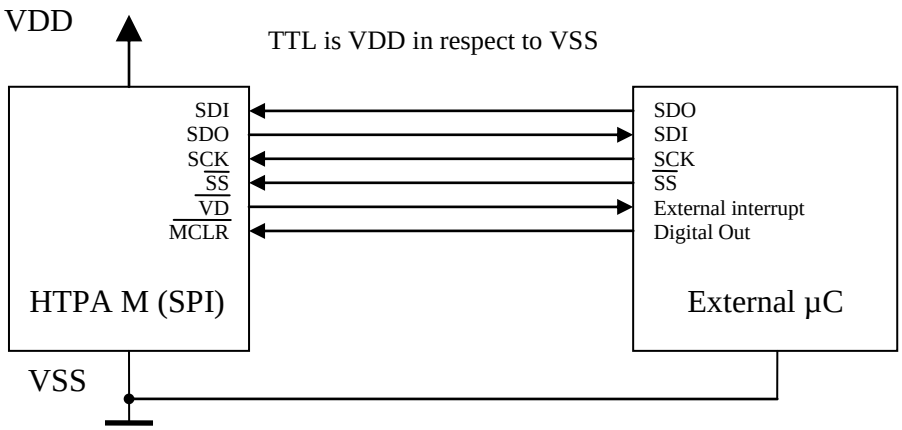
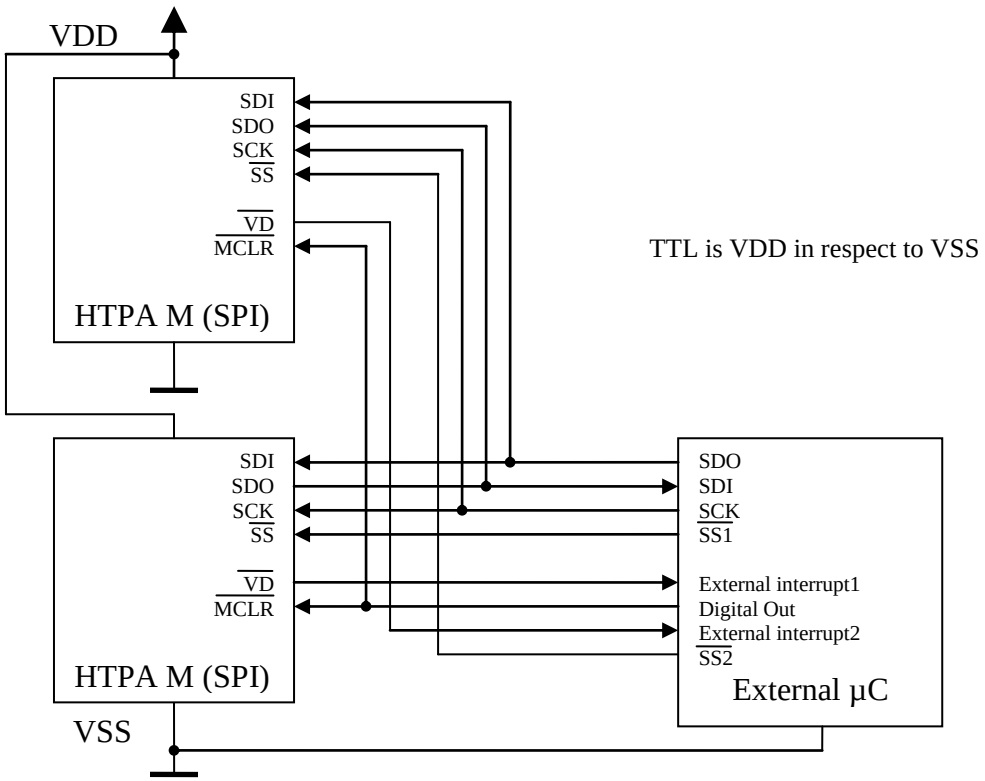
Electrical Connections:

Single Module:

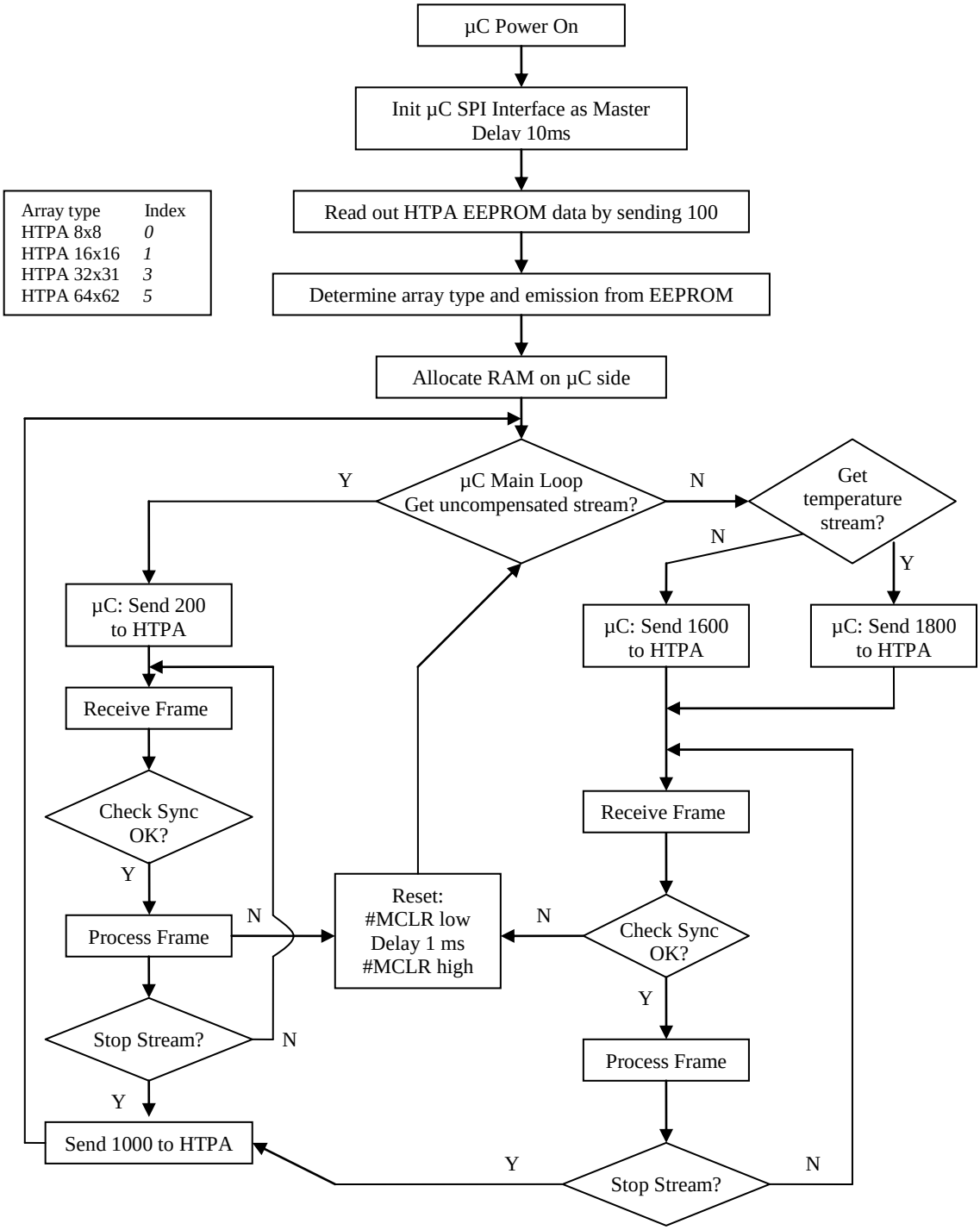


Multiple Modules (preliminary):



Communication and Timings:

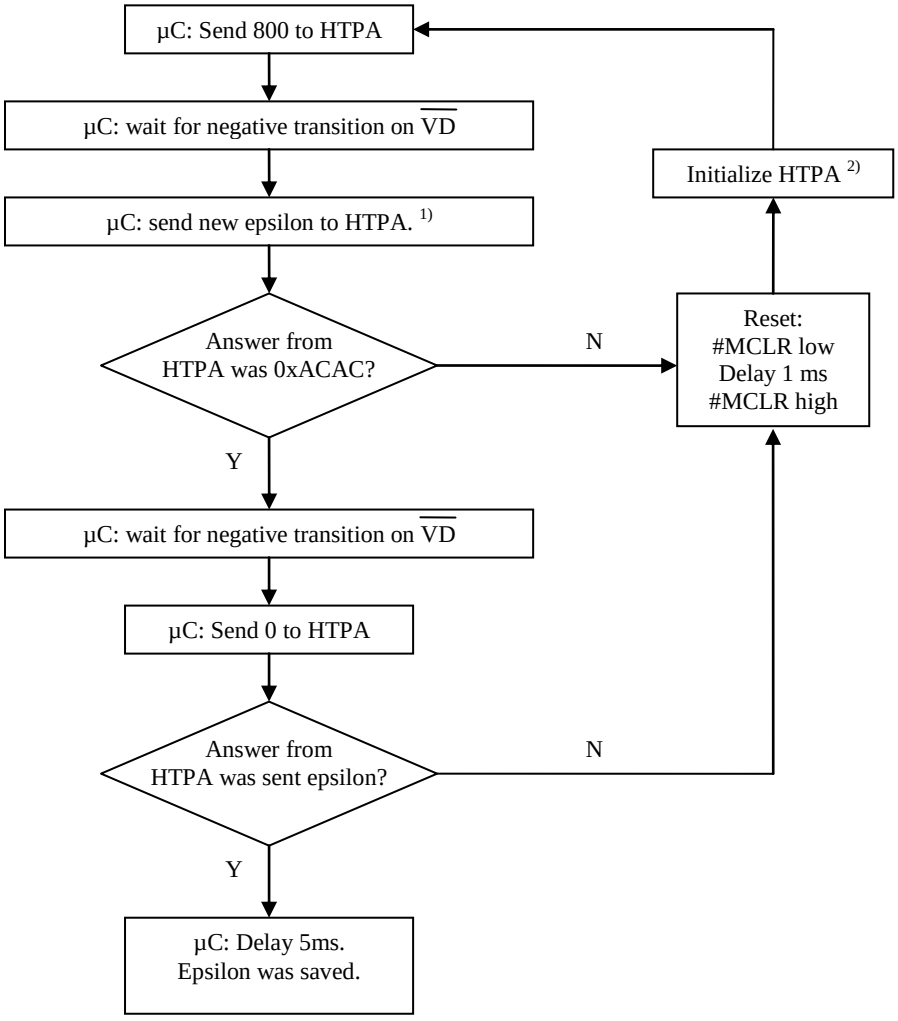
Proposed flow chart of communication. (Master is referred as µC, Slave as HTPA module)



Array type	Index
HTPA 8x8	*0*
HTPA 16x16	*1*
HTPA 32x31	*3*
HTPA 64x62	*5*

Communication and Timings:

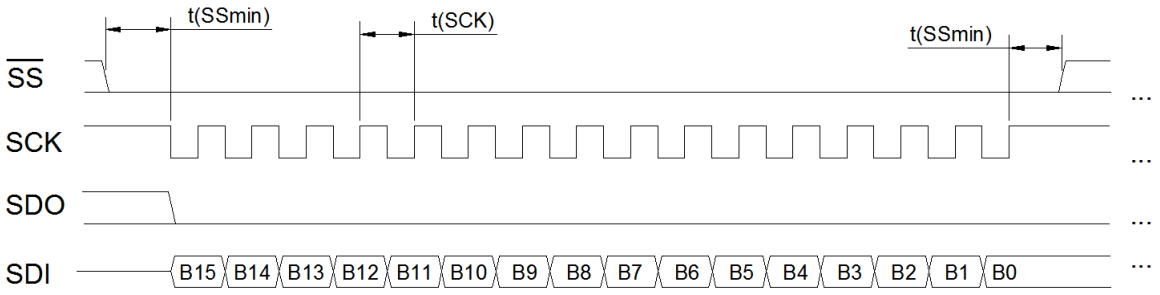
Setting emission coefficient epsilon. (Master is referred as µC, Slave as HTPA module)



1) Epsilon needs to be >0 and <=100. (Decimal)
2) See “Proposed flow chart of communication”.

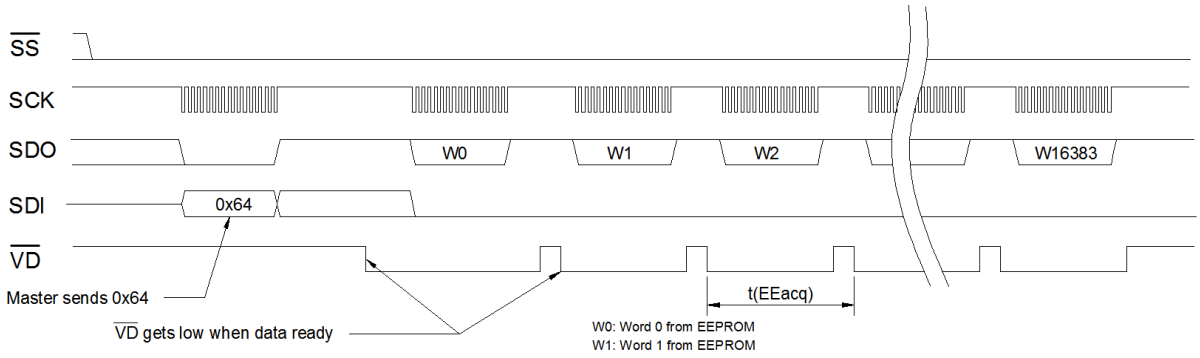
Communication and Timings (continuation):

Receive of command:

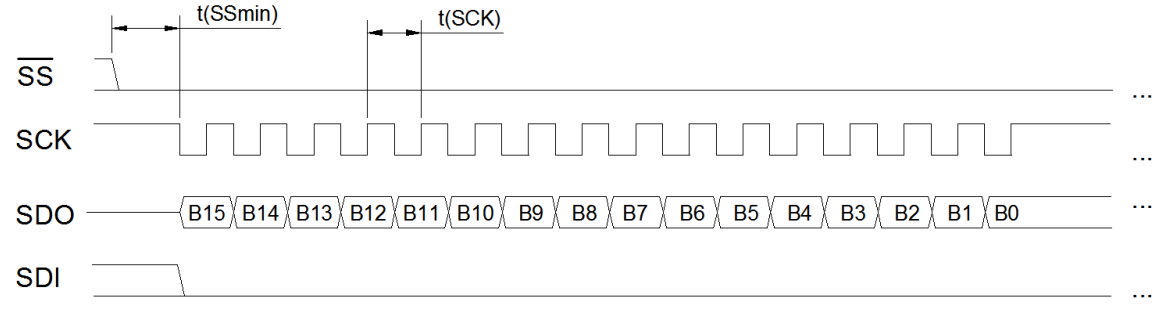


(High state of #SS is not necessary, only for communication with multiple devices)

Send of EEPROM content:

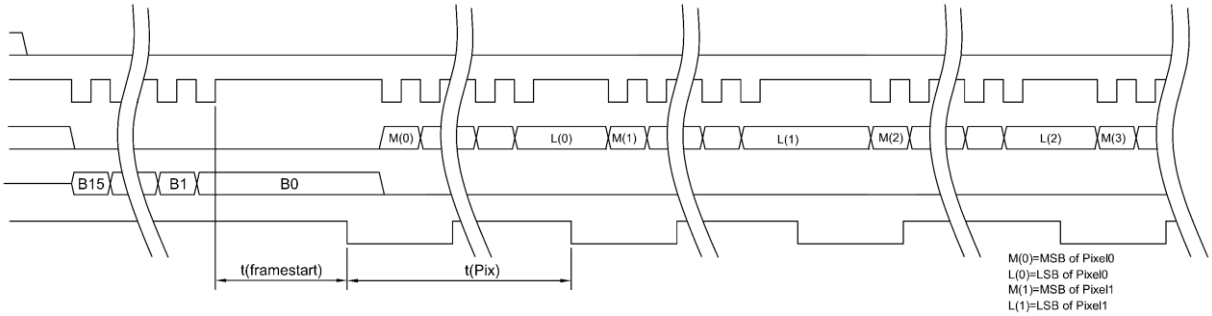


Pixel data:



B15...B0: Raw or compensated ADC reading (depending from streaming mode)

Receive of stream command:



Communication and Timings (continuation):

Absolute values:

	MIN	NOM	MAX	Unit	Remarks
MCLR pulse width (low)	2			µs	
t(SSmin)	175			ns	
t(SCK)	0.1	1	2.86	µs	
t(EEacq)	19			µs	
t(framestart)		1.6		µs	f(MCLK)=1.9 MHz
t(Pix)		549		µs	f(MCLK)=1.9 MHz

t(Pix) and t(framestart) depend on the given acquisition settings of the module. The more acquisitons, the longer t(framestart).

Important:
The SCK frequency needs to be at least that large, that the 32 bits can be submitted within tPix. Therefore, the following condition must be always true:

$$32 \cdot t(SCK) < t(Pix)$$

EEPROM Mapping:

Overview:

Start address	End address	Data type	Value
0x0	0x9	float	Heimann Sensor reserved
0xA	0xA	char	Table number
0xB	0x33		Heimann Sensor reserved
0x34	0x37	float	PTATgrad
0x38	0x3B	float	PTAToff
0x3C	0x58		Heimann Sensor reserved
0x46	0x46	unsigned char	Emission coefficient epsilon
0x59	0x5A	unsigned int	MCLK Frequency in kHz
0x5B	0x75		Heimann Sensor reserved
0x76	0x76	unsigned char	Moduletype [2)]
0x80	0x3FFF		Heimann Sensor reserved

[2)] Shows which sensor and PCB type the current module is. Refer to table "Details for Moduletype" for details.

Important Note:

unsigned int: 2 byte; float: 4 byte; char: 1 byte
All the values are stored (if larger than one byte) in little endian, the so called „Intel-Format".
Example for the MCLK-Frequency:

$$MCLK_{LB} = \mathrm{EEPROM}[0x59] \quad MCLK_{HB} = \mathrm{EEPROM}[0x5A]$$
$$MCLK = 256 \cdot MCLK_{HB} + MCLK_{LB}$$

Details for Moduletype:

Value	Declaration
255	M(LC)
0	M(SPI) + Analogous Chip
1	M(SPI) + Digital Chip

Serial order of data in stream:

Compensated Voltage Mode	
Dataset	Value
0	offset corrected Voltage of Pixel0 in digits
1	offset corrected Voltage of Pixel8 in digits
2	offset corrected Voltage of Pixel1 in digits
3	offset corrected Voltage of Pixel9 in digits
…	…
14	offset corrected Voltage of Pixel7 in digits
15	offset corrected Voltage of Pixel15 in digits
32	offset corrected Voltage of Pixel16 in digits
33	offset corrected Voltage of Pixel24 in digits
…	…
255	offset corrected Voltage of Pixel255 in digits
256	elOff0 in digits+0x7000
257	elOff8 in digits+0x8000
258	elOff1 in digits+0x9000
259	elOff9 in digits+0xA000
…	…
270	elOff7 in digits
271	elOff15 in digits
272	TAmb
273	PTAT0 in digits

Raw Voltage Mode	
Dataset	Value
0	absolute Voltage of Pixel0 in digits
1	absolute Voltage of Pixel8 in digits
2	absolute Voltage of Pixel1 in digits
3	absolute Voltage of Pixel9 in digits
…	…
14	absolute Voltage of Pixel7 in digits
15	absolute Voltage of Pixel15 in digits
32	absolute Voltage of Pixel16 in digits
33	absolute Voltage of Pixel24 in digits
…	…
255	absolute Voltage of Pixel255 in digits
256	elOff0 in digits+0x7000
257	elOff8 in digits+0x8000
258	elOff1 in digits+0x9000
259	elOff9 in digits+0xA000
…	…
270	elOff7 in digits
271	elOff15 in digits
272	TAmb
273	PTAT0 in digits

Temperature Mode	
Dataset	Value
0	Object temp. at Pixel0 in dK
1	Object temp. at Pixel8 in dK
2	Object temp. at Pixel1 in dK
3	Object temp. at Pixel9 in dK
…	…
14	Object temp. at Pixel7 in dK
15	Object temp. at Pixel15 in dK
32	Object temp. at Pixel16 in dK
33	Object temp. at Pixel24 in dK
…	…
255	Object temp. at Pixel255 in dK
256	elOff0 in digits+0x7000
257	elOff8 in digits+0x8000
258	elOff1 in digits+0x9000
259	elOff9 in digits+0xA000
…	…
270	elOff7 in digits
271	elOff15 in digits
272	TAmb
273	PTAT0 in digits

Each dataset consists of a 16 bit value. The 16 bit values are transmitted with MSB first. In case of compensated voltage mode a signed 16 bit value is transmitted, in case of raw voltage or temperature mode an unsigned 16 bit value. Signed values are always in 2's complement.
Some bytes for synchronizing purposes are also transmitted in the first 4 readings of the electrical offsets. They are always located in the 4 MSB's of the corresponding words.

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
64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111
112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127
128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143
144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159
160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175
176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191
192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207
208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223
224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239
240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255

C-Code for all these calculations can be found in our SDK (**S**oftware **D**evelopment **K**it). Furthermore, the SDK is able to fetch the data from the module and sends it to our GUI (**G**raphical **U**ser **I**nterface) which can visualize the data, records videos and text files and has many additional features. For more information see www.heimannsensor.com.

Communication commands:

Sent Command	Answer / Result
0d50	Re-initialise Sensor
0d100	Output of EEPROM content. Data ready of each 2 bytes is signified by #VD pin.
0d200	Module streams out uncompensated, raw data stream. Data ready of each 4 bytes is signified by #VD pin.
0d700	Device goes in IDLE mode
0d1000	Stops streaming mode of module.
0d1600	Module streams offset corrected stream (electrical and thermal). Data ready of each 4 bytes is signified by #VD pin.
0d1800	Module streams temperature stream in deci-Kelvin. Data ready of each 4 bytes is signified by #VD pin.
0d2000	Decrease FPS (12.5, 25, 50, 100 and 200 FPS possible)
0d2001	Increase FPS (12.5, 25, 50, 100 and 200 FPS possible)

Precondition for all streaming modes:
VDD must be in the given limits.

Absolute Maximum Ratings:

Value	MIN	NOM	MAX	Unit	Remarks
VDD in respect to VSS	-0.3	3	4	V	
VDD in streaming mode	2.8	3	3.3	V	False VDD values affect compensation
Voltage on digital pin with respect to VSS	-0.3		VDD+0.3	V	
Storage temperature	-40		85	°C	
ADC reference voltages	VSS		2.4	V	
ADC resolution		12		bit	1.7 dig/mV
Max. current sunk/ sourced on any pin		20		mA	
Operating temperature	-20		60	°C	non-condensing
Current consumption		58		mA	In streaming
Current consumption		9		mA	Idle

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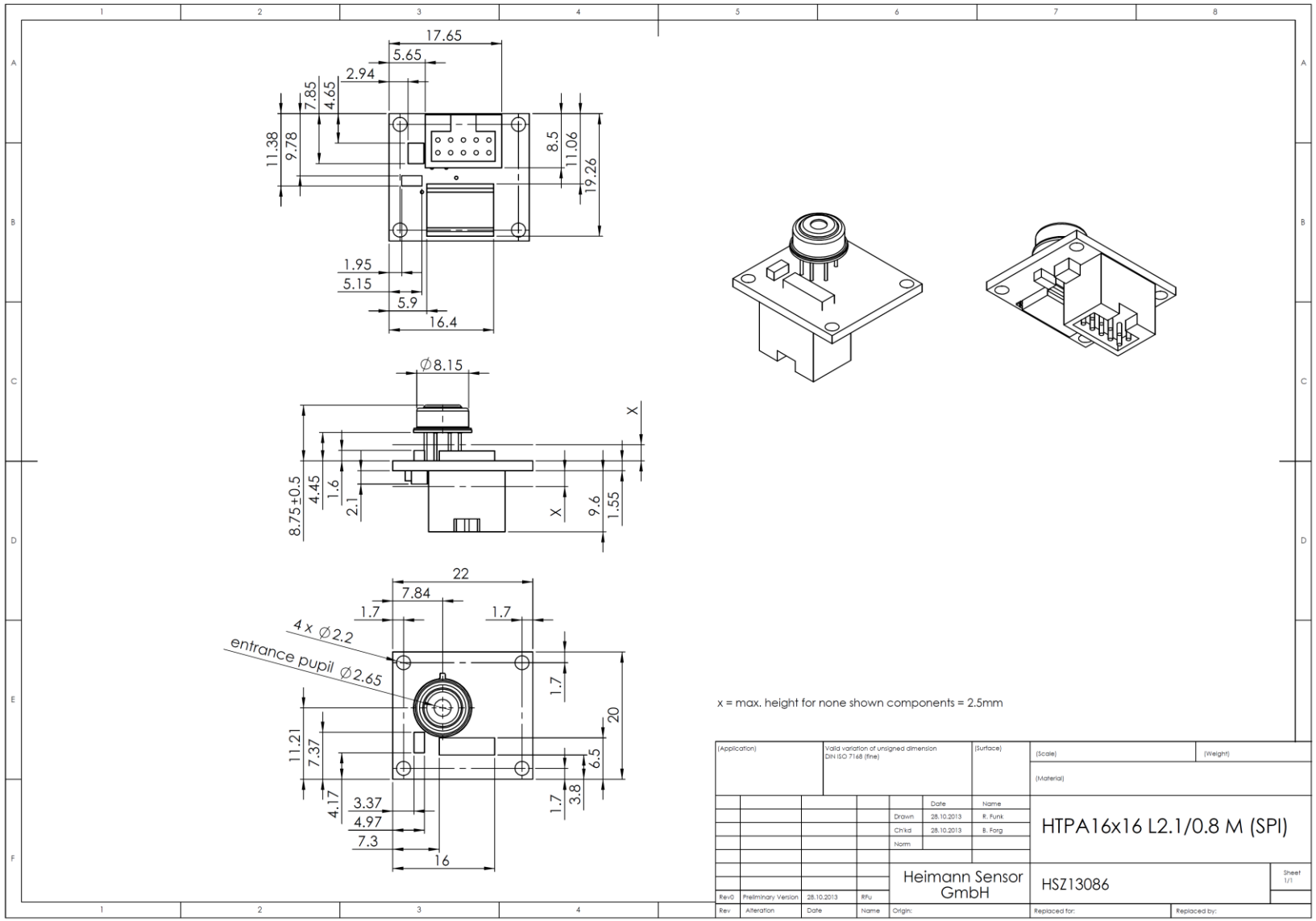
Dimensions:



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