

Specification for HTPA64x62L17/0.8HiM(SPI)

Rev.2: 2016.07.25 Fg



The HTPA64x62L/_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. Object temperatures can be easily obtained by this data stream, a look up table and the calibrated sensitivity constants, which can be found in the EEPROM of the module.

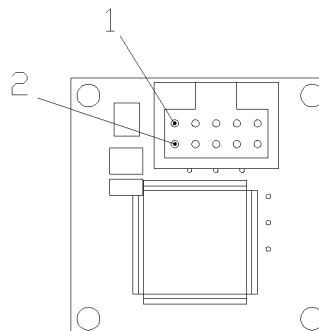
Order Code Example

HTPA32x31	L10 / 0.8	F8-14	Hi	M	(SPI)	[Si]
Type:	HTPA32x31	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 L10 = 10.0 mm focal length				
	/	F-Number: In example /0.8				
		For optics see also "HTPA standard optics"				
Filter:	F	Filter characteristics. In example F8-14 (µm, Bandpass)				
	Not declared	Broad band ARC				
Sensitivity:	Hi	Increased sensitivity				
	Not declared	Standard sensitivity				
Version:	A	Application set: comes with GUI, housing, power supply.				
	C	Always UDP Interface.				
	M	Calibrated sensor (only digital). Carries calibration constants on internal EEPROM				
	S	Module: HTPA sensor soldered to PCB, calibrated stream				
		HTPA sensor only. Raw voltage output, not calibrated				
Interface:	SPI	SPI device; Three variants: HTPA82x62: 16bit ADC all other analogous HTPAs: 14bit ADC Digital HTPA: 12bit ADC				
	LC	SPI,Only Analogous HTPA, 12bit ADC low speed, external processing required				
	UDP	Ethernet, CAT5 cable connection				
	PoE	Power over Ethernet, CAT5 connection, UDP protocol				
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 Assignment 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



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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"

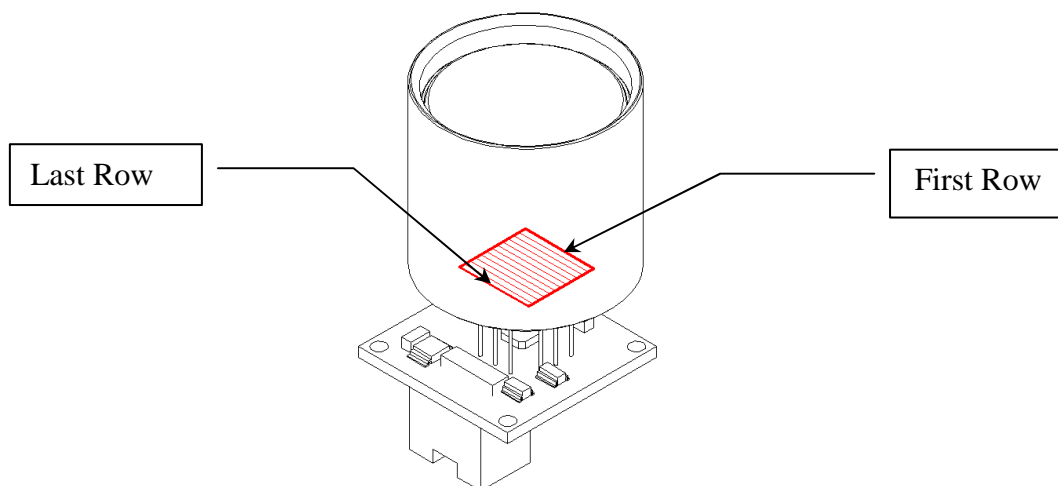
Protocol Specifications:

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:

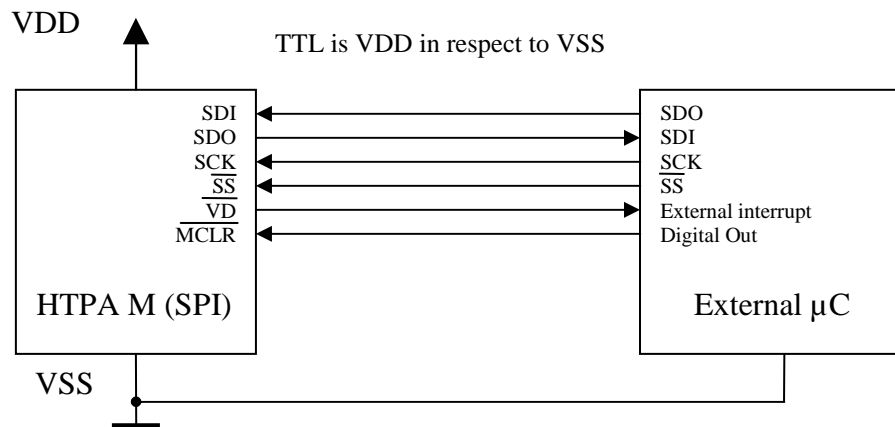
VDD Range:	Supply (2.8 – 3.3 V DC)
SPI Transmit/Receive:	TTL
VSS	GND
Power Supply:	2.8-3.3 VDC
IDD (Idle mode)	30 mA
IDD (Operating mode)	120 mA

HTPA64x62L17/0.8HiM(SPI) Optical Orientation of Pixels:

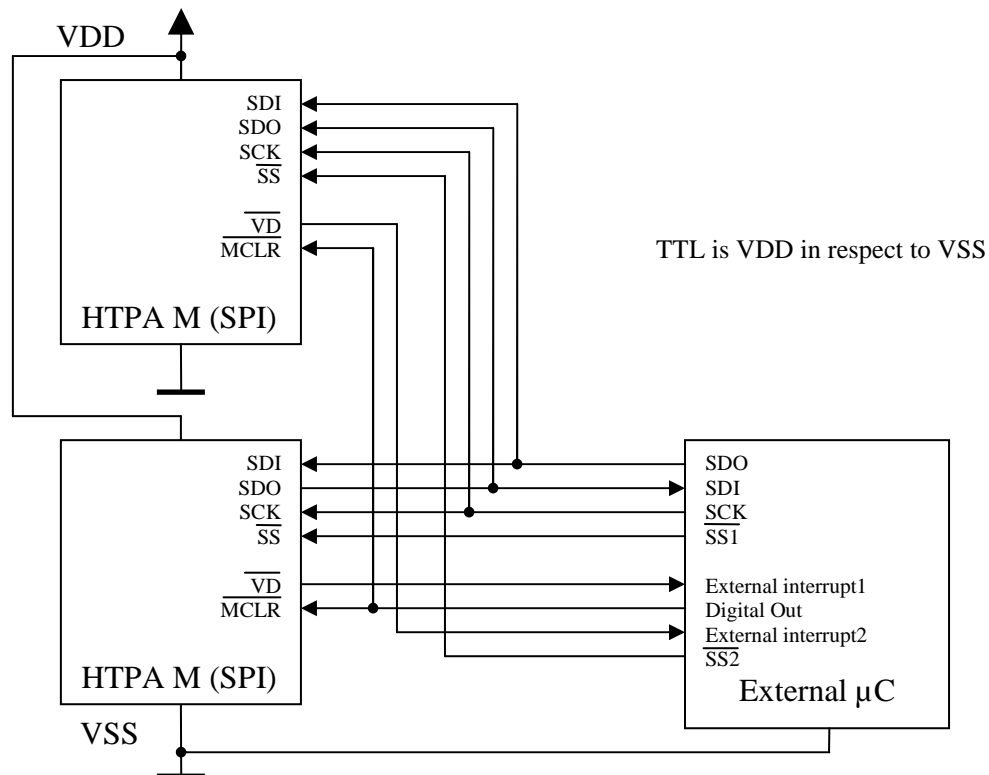


Electrical Connections:

Single Module:

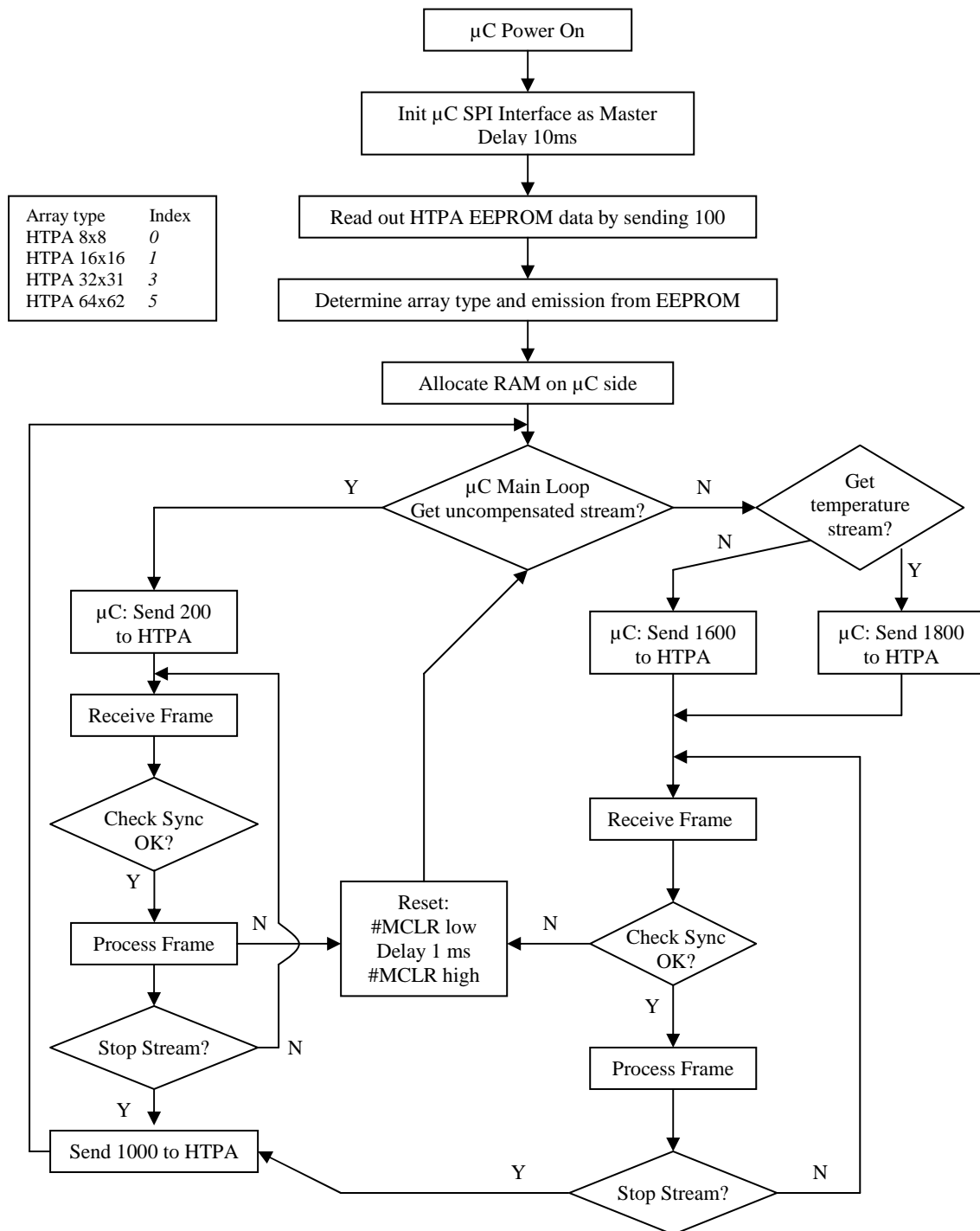


Multiple Modules (preliminary):



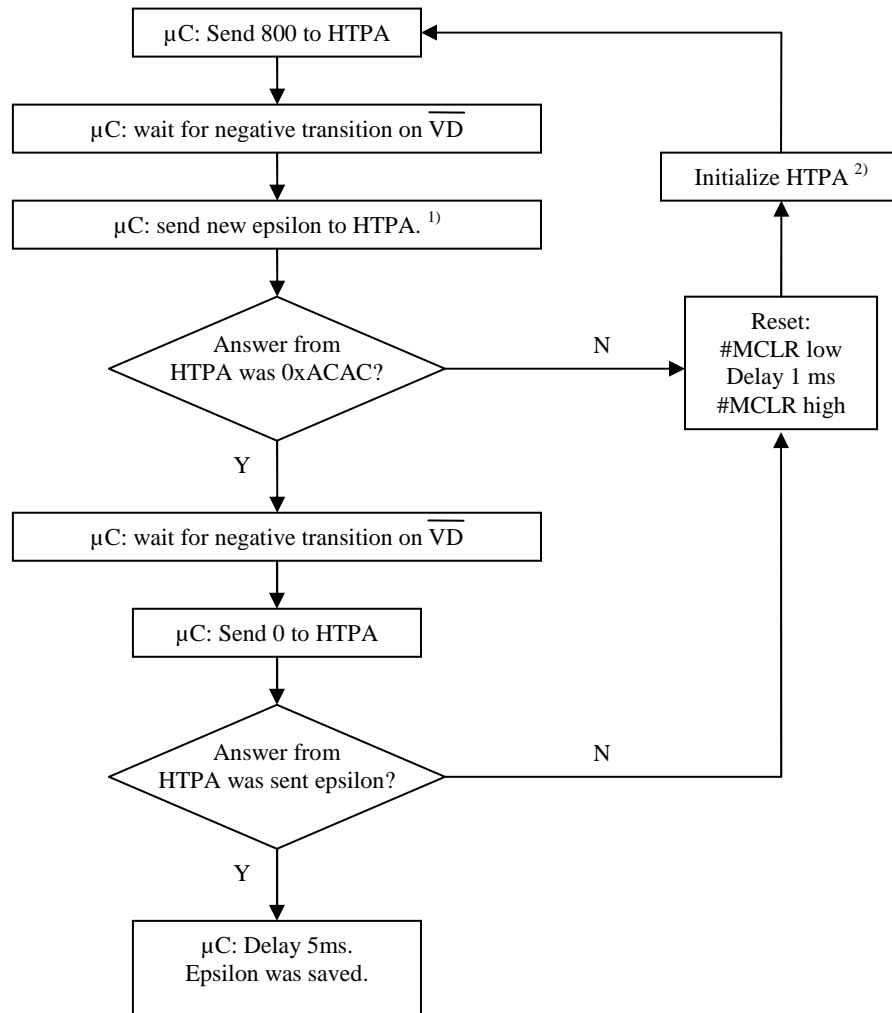
Communication and Timings:

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



Communication and Timings:

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

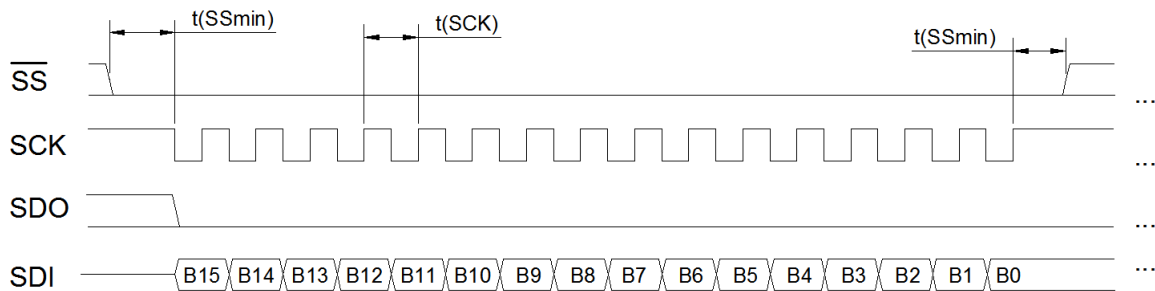


¹⁾ Epsilon needs to be >0 and <=100. (Decimal)

²⁾ See “Proposed flow chart of communication”.

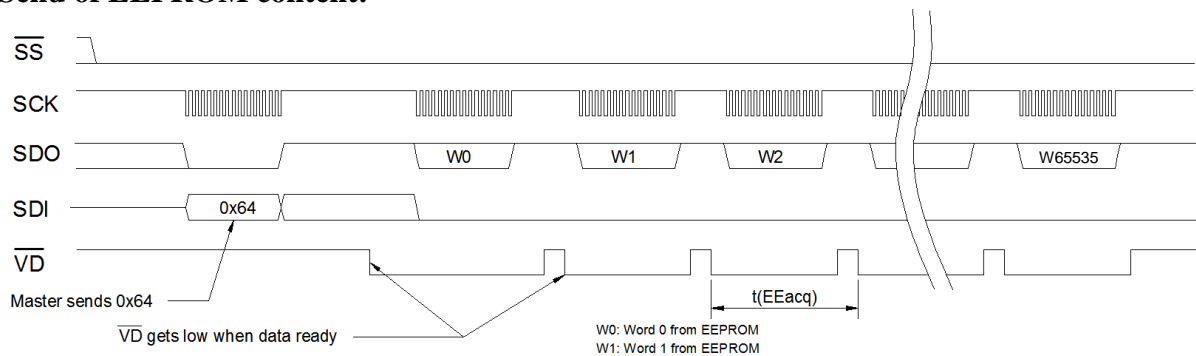
Communication and Timings (continuation):

Receive of command:

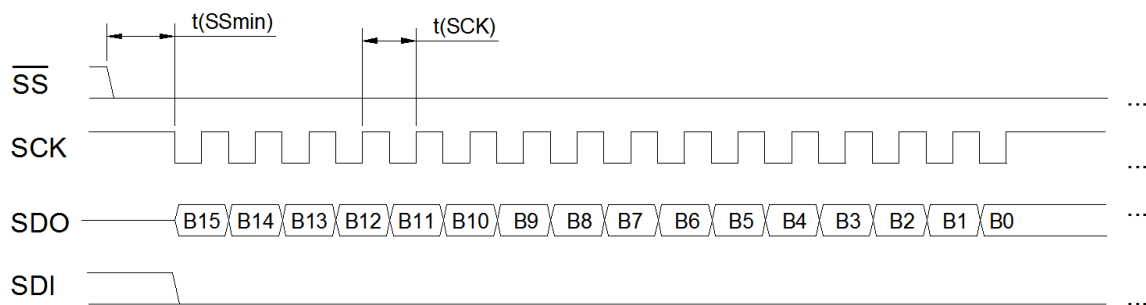


(High state of #SS is not necessary, only for communication with multiple devices)

Send of EEPROM content:

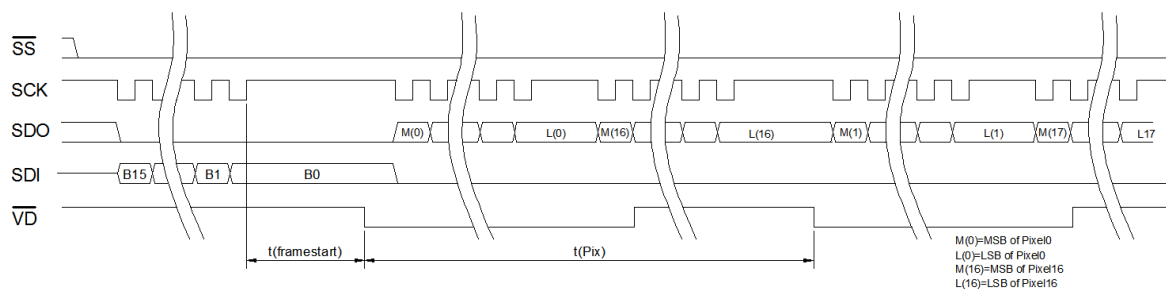


Pixel data:



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	1)
t(EAcq)	185			µs	
t(framestart) [Command: 0d200]		270		ms	f(MCLK)=1.6 MHz
t(Pix)		125		µs	f(MCLK)=1.6 MHz

1) For customer specified devices with higher frame rates than usual, higher SCK-Frequencies than 350 kHz might be needed.
See below comment: $32 \cdot t(SCK) < t(Pix)$

t(Pix) and t(framestart) depend on the given MCLK frequency of the master. t(framestart) also depends on selection of the command. In example:

MCLK frequency is 1003 kHz, then t(Pix) and t(framestart) is calculated via

$t(Pix) = \frac{200}{f(MCLK)} = \frac{200}{1003000} = 199,4 \mu s$	
$t(framestart) = \frac{t(Pix) \cdot 64 \cdot 64}{2} + 14ms = 422,3ms$	Command was 0d200
$t(framestart) = \frac{3 \cdot t(Pix) \cdot 64 \cdot 64}{2} + 14ms = 1.239s$	Command was 0d1600 or 0d1800

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:

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

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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	PT ATgrad
0x38	0x3B	float	PT AToff
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:

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

Details for Moduletype:

Value	Declaration
255	M(LC)
0	M(SPI) + Analogous Chip
1	M(SPI) + Digital Chip
2	M(UDP) + analogous Chip
3	M(PoE) + 16x16d; BCC stored in Flash
4	M(PoE) + 16x16d; BCC stored in Sensor EEPROM

BCC → Binary Calibration Constants

Arraytype:

Arraytype	Value
HTPA 8x8	0
HTPA 16x16	1
HTPA 32x31	3
HTPA 64x62	5
HTPA 82x62	9

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Serial order of data in stream:

Compensated Voltage Mode	
Dataset	Value
0	offset corrected Voltage of Pixel0 in digits
1	offset corrected Voltage of Pixel32 in digits
2	offset corrected Voltage of Pixel1 in digits
3	offset corrected Voltage of Pixel33 in digits
...	...
62	offset corrected Voltage of Pixel31 in digits
63	offset corrected Voltage of Pixel63 in digits
64	offset corrected Voltage of Pixel64 in digits
65	offset corrected Voltage of Pixel96 in digits
...	...
3967	offset corrected Voltage of Pixel3967 in digits
3968	eIOff0 in digits
3969	eIOff32 in digits
3970	eIOff1 in digits
3971	eIOff33 in digits
...	...
4030	eIOff31 in digits
4031	eIOff63 in digits
4032	Module transmits 0x789A (use for sync)
4033	Module transmits 0xBCDE (use for sync)
4034	TAmb
4035	no value, ignore
4036	no value, ignore
4037	no value, ignore
...	...
4047	no value, ignore
4048	PTAT0 in digits
4049	PTAT1 in digits
4050	PTAT2 in digits
...	...
4063	PTAT15 in digits
4064	no value, ignore
...	no value, ignore
4095	no value, ignore

Raw Voltage Mode	
Dataset	Value
0	absolute Voltage of Pixel0 in digits
1	absolute Voltage of Pixel32 in digits
2	absolute Voltage of Pixel1 in digits
3	absolute Voltage of Pixel33 in digits
...	...
62	absolute Voltage of Pixel31 in digits
63	absolute Voltage of Pixel63 in digits
64	absolute Voltage of Pixel64 in digits
65	absolute Voltage of Pixel96 in digits
...	...
3967	absolute Voltage of Pixel3967 in digits
3968	eIOff0 in digits
3969	eIOff32 in digits
3970	eIOff1 in digits
3971	eIOff33 in digits
...	...
4030	eIOff31 in digits
4031	eIOff63 in digits
4032	Module transmits 0x789A (use for sync)
4033	Module transmits 0xBCDE (use for sync)
4034	no value, ignore
4035	no value, ignore
4036	no value, ignore
4037	no value, ignore
...	...
4047	no value, ignore
4048	PTAT0 in digits
4049	PTAT1 in digits
4050	PTAT2 in digits
...	...
4063	PTAT15 in digits
4064	no value, ignore
...	no value, ignore
4095	no value, ignore

Raw Voltage Mode	
Dataset	Value
0	Object temp. at Pixel0 in digits
1	Object temp. at Pixel32 in digits
2	Object temp. at Pixel1 in digits
3	Object temp. at Pixel33 in digits
...	...
62	Object temp. at Pixel31 in digits
63	Object temp. at Pixel63 in digits
64	Object temp. at Pixel64 in digits
65	Object temp. at Pixel96 in digits
...	...
3967	Object temp. at Pixel3967 in digits
3968	eIOff0 in digits
3969	eIOff32 in digits
3970	eIOff1 in digits
3971	eIOff33 in digits
...	...
4030	eIOff31 in digits
4031	eIOff63 in digits
4032	Module transmits 0x789A (use for sync)
4033	Module transmits 0xBCDE (use for sync)
4034	Tamb
4035	no value, ignore
4036	no value, ignore
4037	no value, ignore
...	...
4047	no value, ignore
4048	PTAT0 in digits
4049	PTAT1 in digits
4050	PTAT2 in digits
...	...
4063	PTAT15 in digits
4064	no value, ignore
...	no value, ignore
4095	no value, ignore

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 mode an unsigned 16 bit value. Signed values are always in 2's complement.

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Pixel Map:

0	1	2	3	4	5	6	7	8	9	10	...	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	...	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127
...
3904	3905	3906	3907	3908	3909	3910	3911	3912	3913	3914	...	3951	3952	3953	3954	3955	3956	3957	3958	3959	3960	3961	3962	3963	3964	3965	3966	3967

C-Code for all these calculations can be found in our SDK (Software **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.

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Communication commands:

Sent Command	Answer / Result
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

Precondition for all streaming modes:

VDD must be in the given limits.

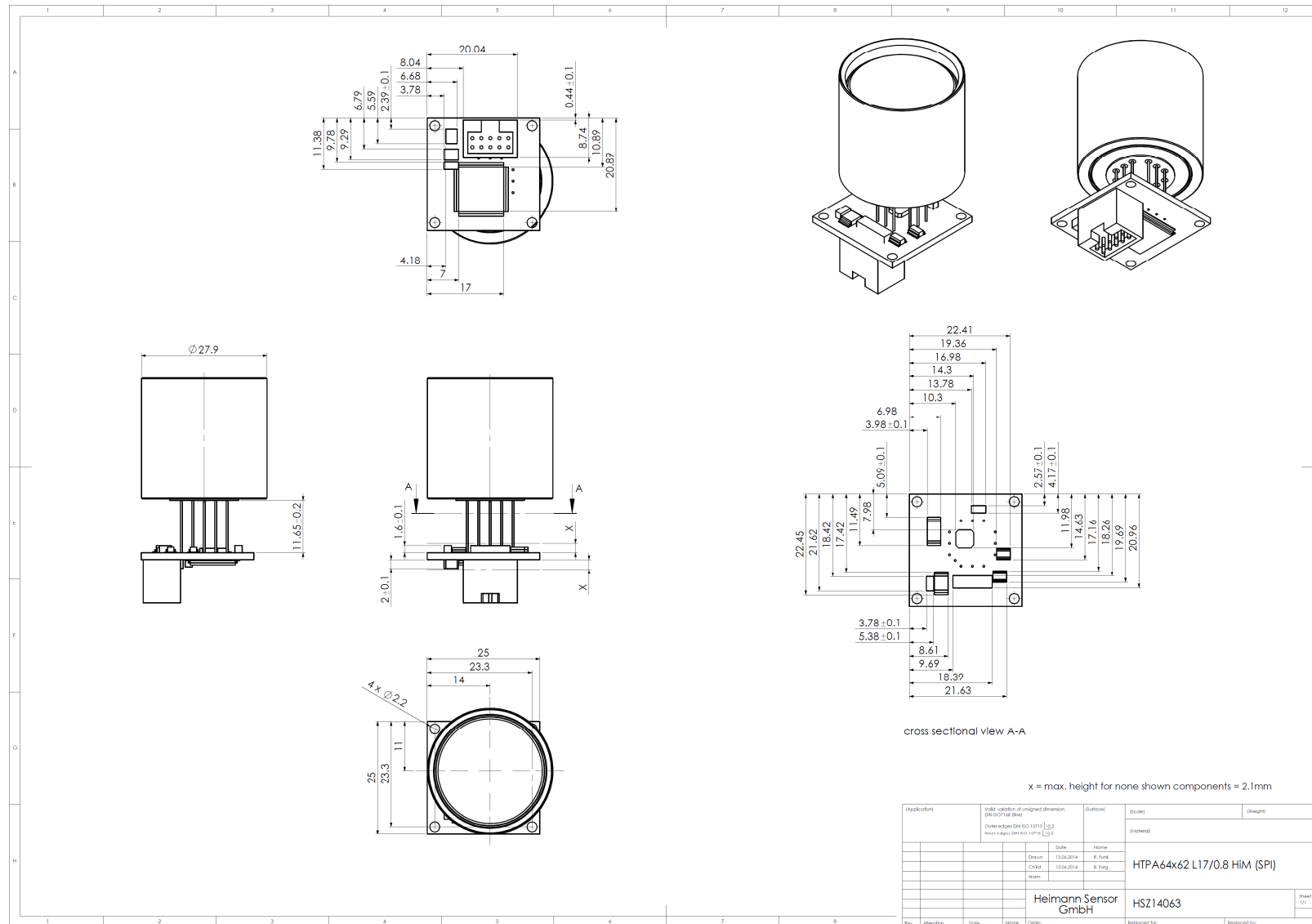
Absolute Maximum Ratings:

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		120	°C	
ADC reference voltages	VSS		4.096	V	high precision references
ADC resolution		14		bit	4dig/mV
Max. current sunk/sourced on any pin		20		mA	
Operating temperature	-20		60	°C	non-condensing
Current consumption		65		mA	In streaming
Current consumption		35		mA	Idle

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Dimensions:



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