Specification for HTPA32x31L5.8/1.08HiM(SPI)

Rev.0: 2013.11.01 Fg

The HTPA32x31L_/_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

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 L2,1 = 2,1 mm focal length
/	F-Number: In example /0.85
	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. 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

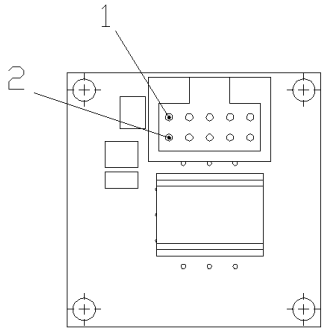
Lens Material:

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

Contact / Customer Support
Phone 49 (0) 6123 60 50 30
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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"

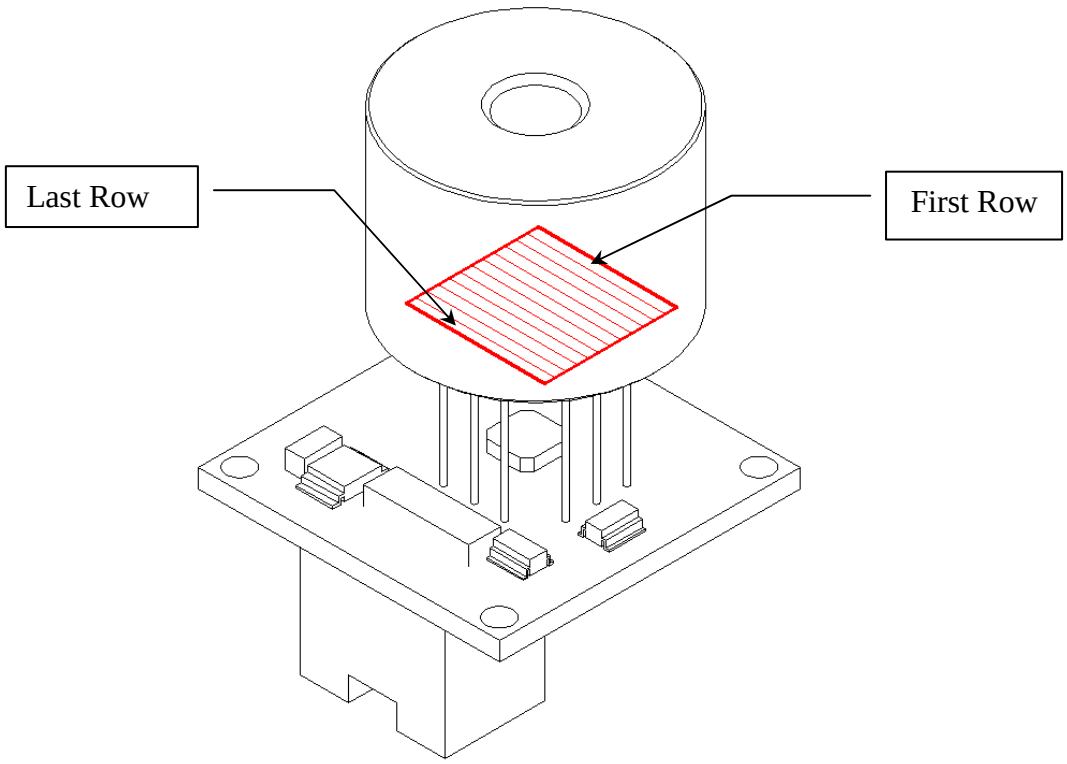
Protocol Specifications:

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)	35 mA
IDD (Operating mode)	65 mA

HTPA32x31L5.8/1.08M(SPI) Optical Orientation of Pixels:



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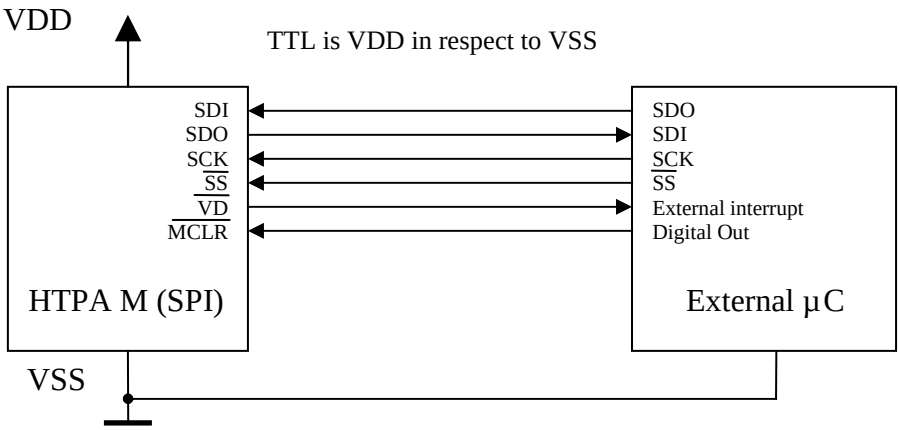
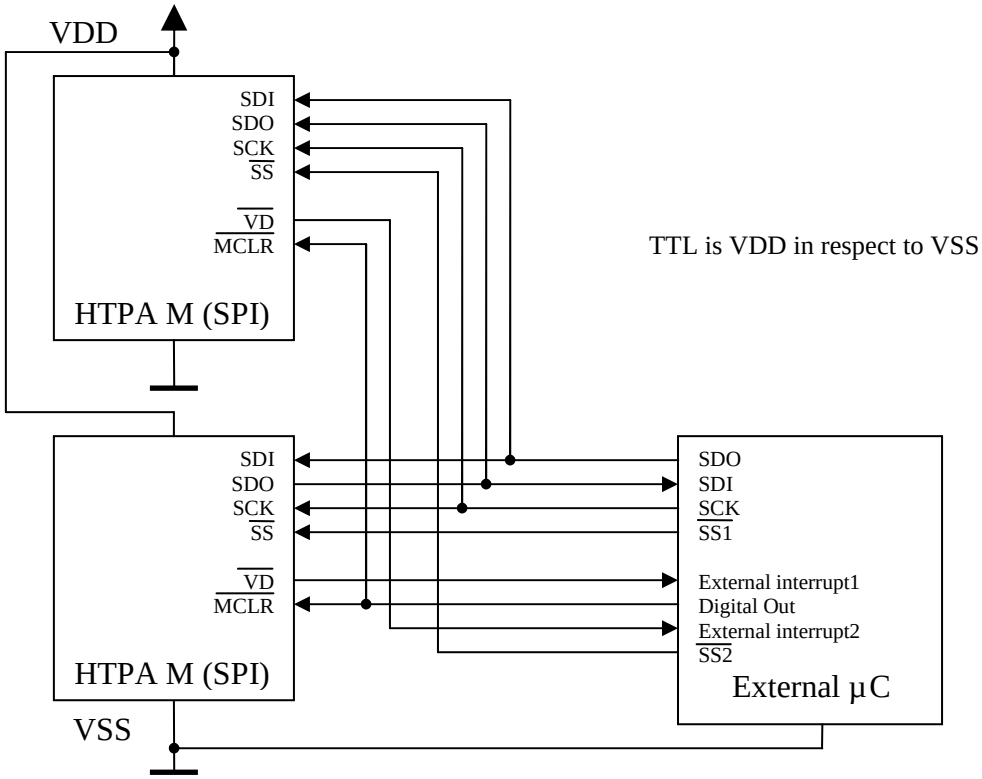
Electrical Connections:

Single Module:

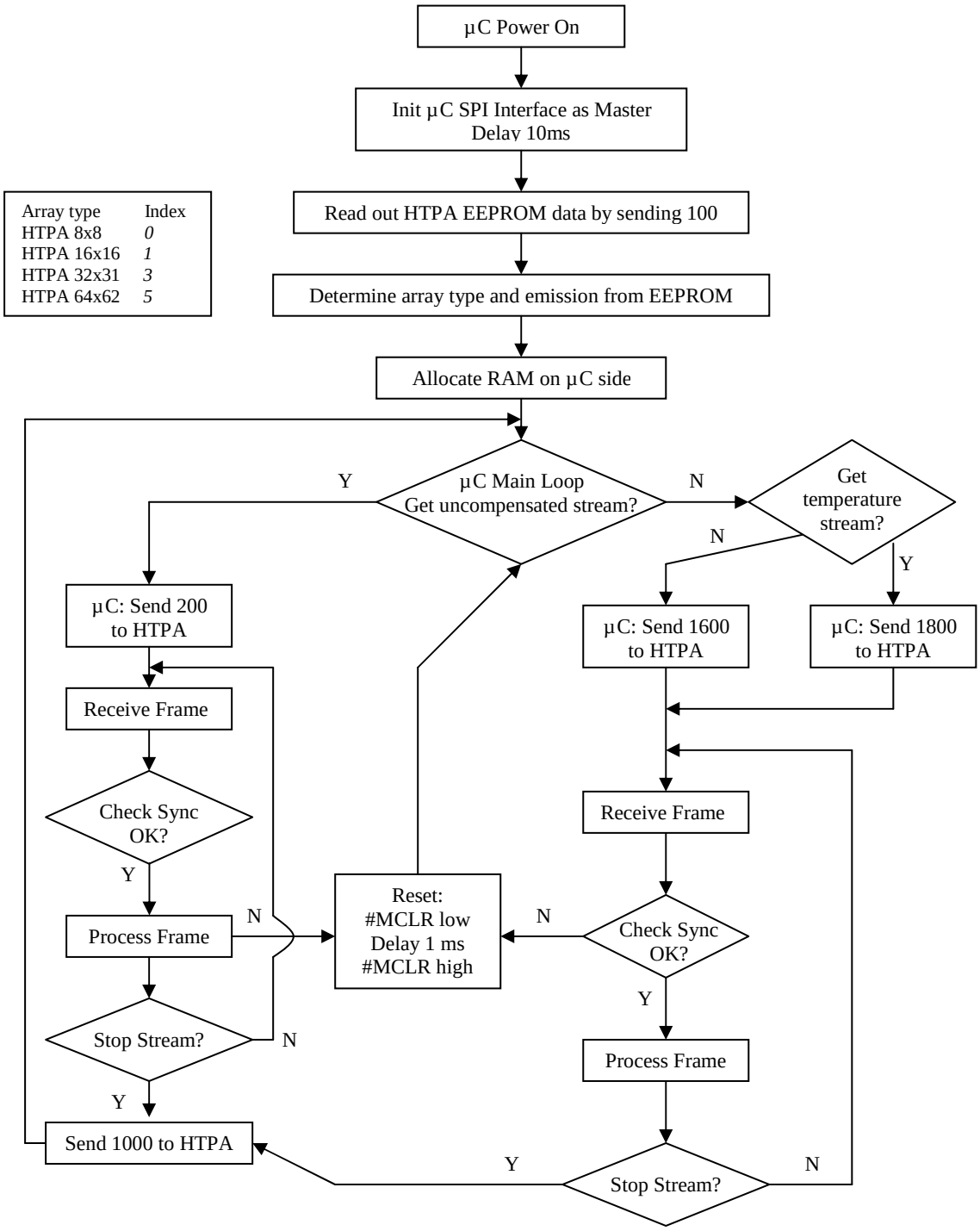


Multiple Modules (preliminary):



Communication and Timings:

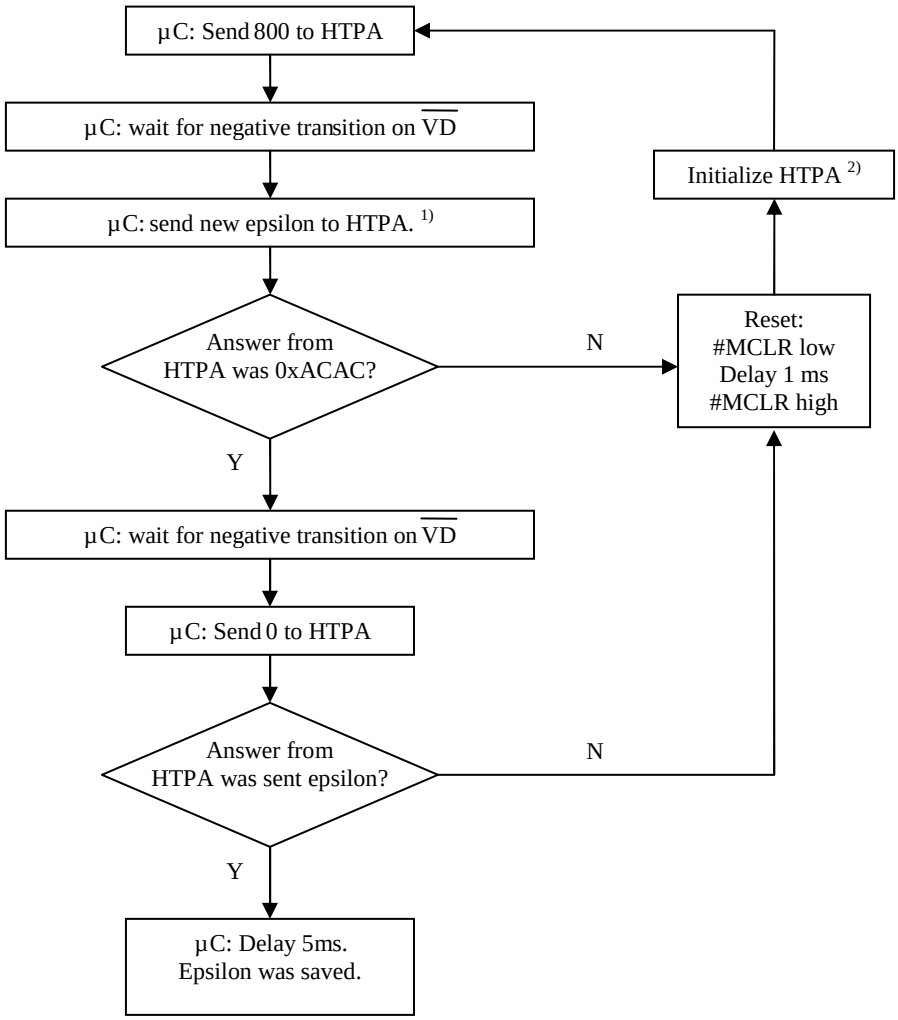
Proposed flow chart of communication. (Master is referred as µC, Slave as HTPA module)



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

Communication and Timings:

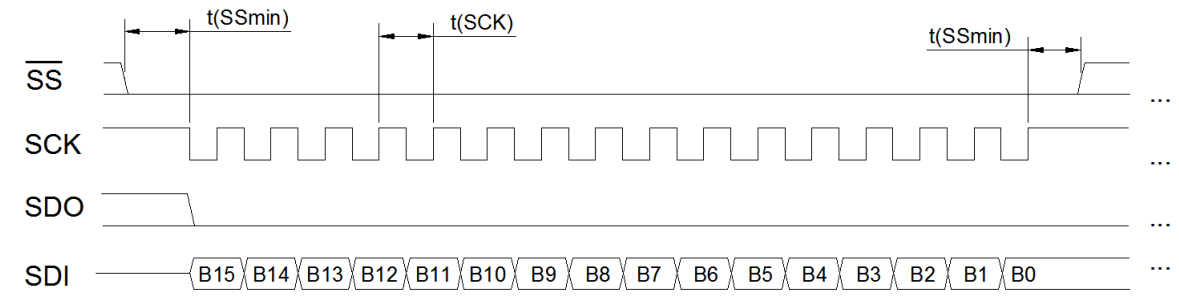
Setting emission coefficient epsilon. (Master is referred as µC, Slave as HTPA module)



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

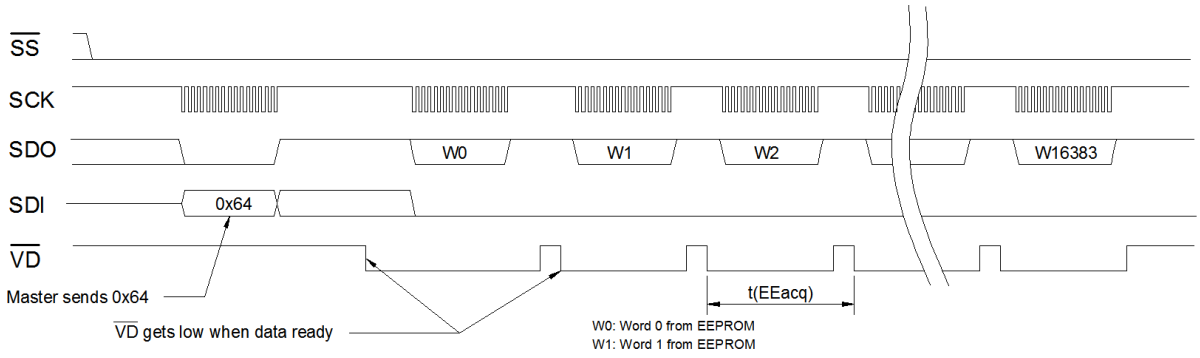
Communication and Timings (continuation):

Receive of command:

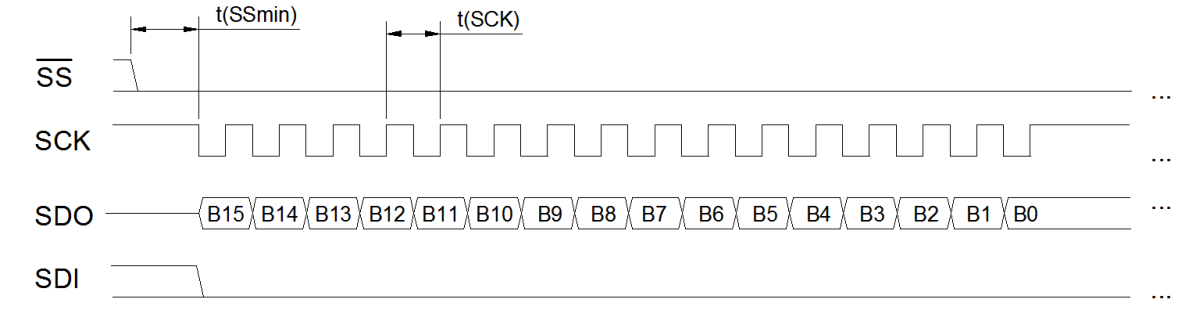


(High state of #SS is not necessary, only for communication with multiple devices)

Send of EEPROM content:

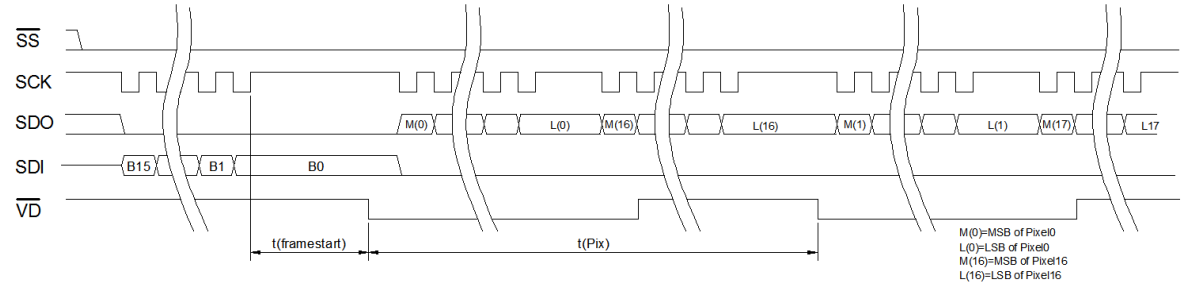


Pixel data:



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	[1)]
t(EEacq)	185			µs	
t(framestart)		120		ms	f(MCLK)=1 MHz
t(Pix)		200		µs	f(MCLK)=1 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*t(SCK)<t(Pix)

t(Pix) and t(framestart) depend on the given MCLK frequency of the master. In example: MCLK frequency is 1003 kHz, then t(Pix) and t(framestart) is calculated via

$$t(Pix) = \frac{200}{f(MCLK)} = \frac{200}{1003000} = 199{,}4\mu s$$

$$t(framestart) = \frac{t(Pix) \cdot 32 \cdot 33}{2} + 14\text{ms} = 119{,}3\text{ms}$$

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 Pixel16 in digits
2	offset corrected Voltage of Pixel1 in digits
3	offset corrected Voltage of Pixel17 in digits
...	...
30	offset corrected Voltage of Pixel15 in digits
31	offset corrected Voltage of Pixel31 in digits
32	offset corrected Voltage of Pixel32 in digits
33	offset corrected Voltage of Pixel48 in digits
...	...
991	offset corrected Voltage of Pixel991 in digits
992	elOff0 in digits
993	elOff16 in digits
994	elOff1 in digits
995	elOff17 in digits
...	...
1022	elOff15 in digits
1023	elOff31 in digits
1024	Module transmitts 0x789A (use for sync)
1025	Module transmitts 0xBCDE (use for sync)
1026	Tamb
1027	no value, ignore
1028	no value, ignore
1029	no value, ignore
...	...
1039	no value, ignore
1040	PTAT0 in digits
1041	no value, ignore
1042	PTAT1 in digits
...	...
1053	no value, ignore
1054	PTAT7 in digits
1055	no value, ignore

Raw Voltage Mode	
Dataset	Value
0	absolute Voltage of Pixel0 in digits
1	absolute Voltage of Pixel16 in digits
2	absolute Voltage of Pixel1 in digits
3	absolute Voltage of Pixel17 in digits
...	...
30	absolute Voltage of Pixel15 in digits
31	absolute Voltage of Pixel31 in digits
32	absolute Voltage of Pixel32 in digits
33	absolute Voltage of Pixel48 in digits
...	...
991	absolute Voltage of Pixel991 in digits
992	elOff0 in digits
993	elOff16 in digits
994	elOff1 in digits
995	elOff17 in digits
...	...
1022	elOff15 in digits
1023	elOff31 in digits
1024	Module transmitts 0x789A (use for sync)
1025	Module transmitts 0xBCDE (use for sync)
1026	no value, ignore
1027	no value, ignore
1028	no value, ignore
1029	no value, ignore
...	...
1039	no value, ignore
1040	PTAT0 in digits
1041	no value, ignore
1042	PTAT1 in digits
...	...
1053	no value, ignore
1054	PTAT7 in digits
1055	no value, ignore

Temperature Mode	
Dataset	Value
0	Object temp. at Pixel0 in dK
1	Object temp. at Pixel16 in dK
2	Object temp. at Pixel1 in dK
3	Object temp. at Pixel17 in dK
...	...
30	Object temp. at Pixel15 in dK
31	Object temp. at Pixel31 in dK
32	Object temp. at Pixel32 in dK
33	Object temp. at Pixel48 in dK
...	...
991	Object temp. at Pixel991 in dK
992	elOff0 in digits
993	elOff16 in digits
994	elOff1 in digits
995	elOff17 in digits
...	...
1022	elOff15 in digits
1023	elOff31 in digits
1024	Module transmitts 0x789A (use for sync)
1025	Module transmitts 0xBCDE (use for sync)
1026	TAmb
1027	no value, ignore
1028	no value, ignore
1029	no value, ignore
...	...
1039	no value, ignore
1040	PTAT0 in digits
1041	no value, ignore
1042	PTAT1 in digits
...	...
1053	no value, ignore
1054	PTAT7 in digits
1055	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 or temperature mode an unsigned 16 bit value. Signed values are always in 2's complement.

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
256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287
288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319
320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351
352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383
384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415
416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447
448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479
480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511
512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543
544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575
576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607
608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639
640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671
672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703
704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735
736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767
768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799
800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831
832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863
864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895
896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927
928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959
960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991

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
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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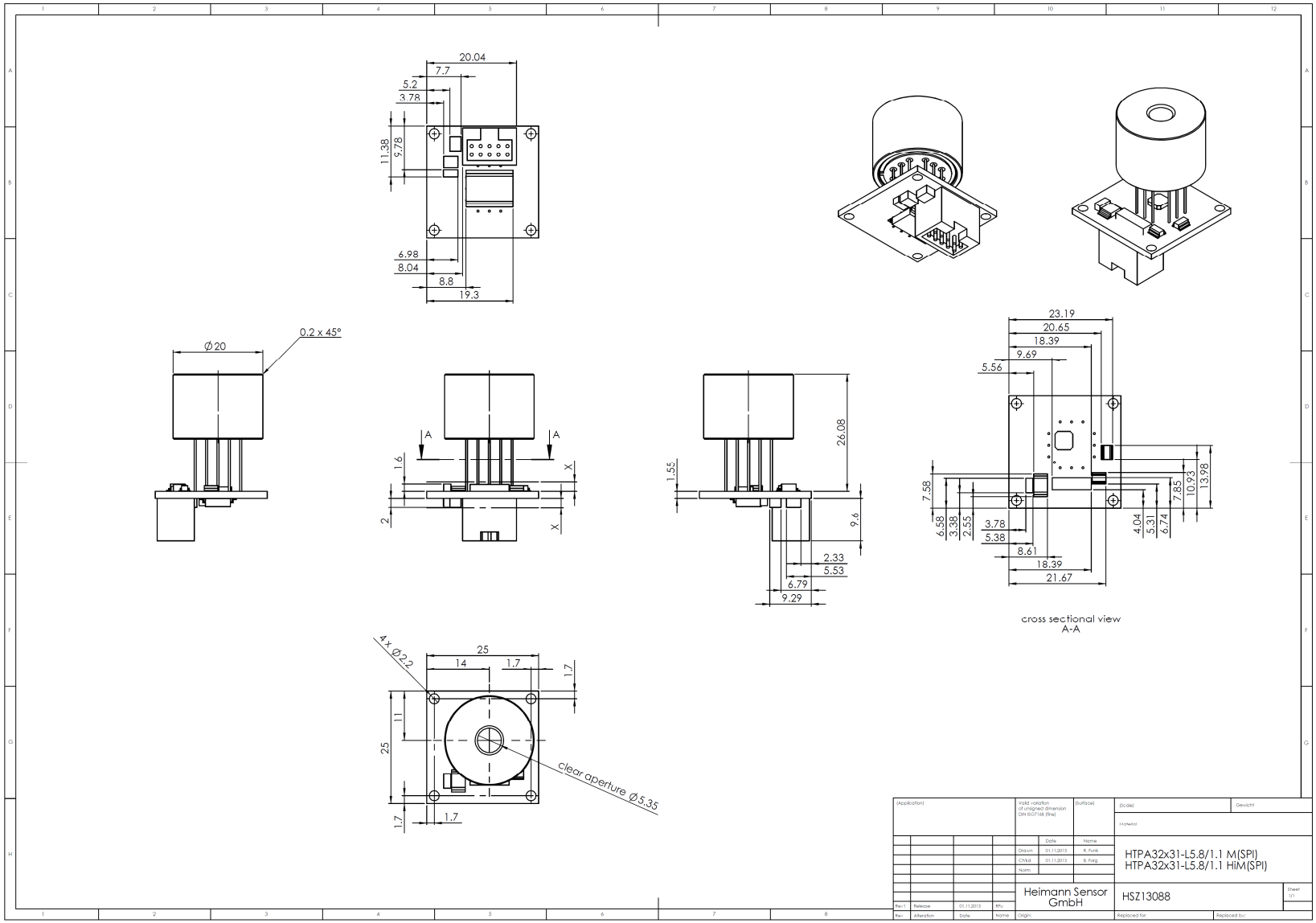
Rev.0: 2013.11.01 Fg

Dimensions:



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