Specification for HTPA64x62L10/0.8F7.15HiM(SPI)

Rev.0: 2013.01.31 Forg/Schnorr

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.

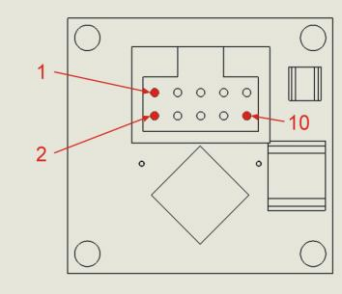
Order Code Example

HTPA64x62L10/0.8HiM(SPI)

- Interface: SPI→A slave only SPI device
  UDP→Ethernet, CAT5 cable connection
  SPI[HP]→SPI, toggles MISO/MOSI direction, delivers full processed stream
  UART→RS232-like, Level: 3.3V
- Type: A→Application set: comes with GUI, housing, power supply
  M→Module: HTPA sensor soldered to PCB, calibrated stream
  S→Sensor: HTPA sensor only. Analogous output.
- Sensitivity: Hi→Increased sensitivity
  Without "Hi"→ Standard sensitivity
- Optics: L→focal length: In example L10 = 10 mm focal length.
  /→ F-Number: In example /0.8
  For optics see also "HTPA standard optics"
- Type: HTPA64x62 (Please contact support for all available HTPA and module combinations.

Pinout

Pin Assignment HTPA64x62M(LC)			
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	-	not connected	-
10	#VD	Valid Data, negotiated.	Digital Output



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SPI Interface:

SCK-Frequency:	350 kHz …10 MHz

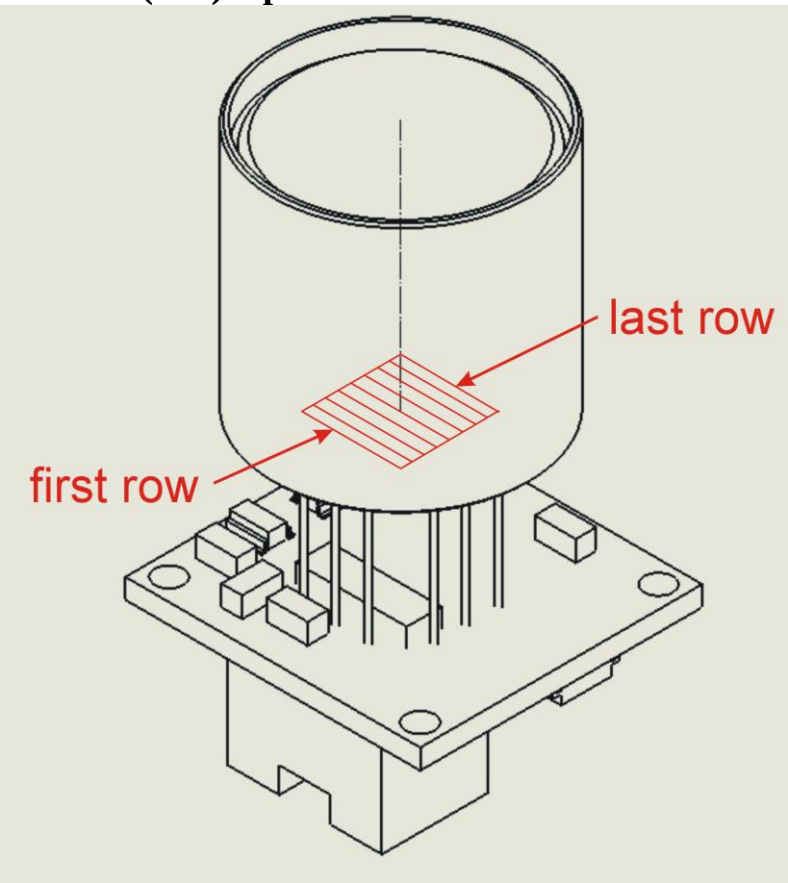
Protocol Specifications:

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:

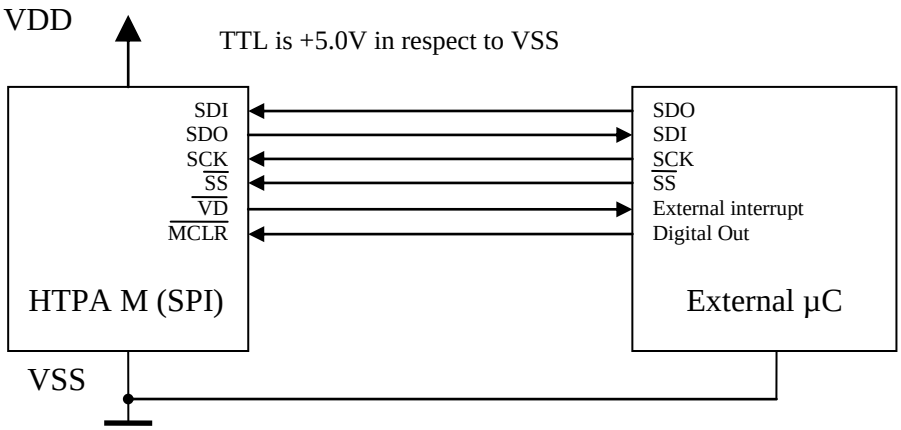
SPI Transmit/Receive:	TTL (**5.0** VDC)
VSS	GND
Power Supply:	**5.0** VDC, 300mA
IDD (Idle mode)	14 mA
IDD (Operating mode)	53 mA

HTPA64x62L10/1.0M(SPI) Optical Orientation of Pixels:

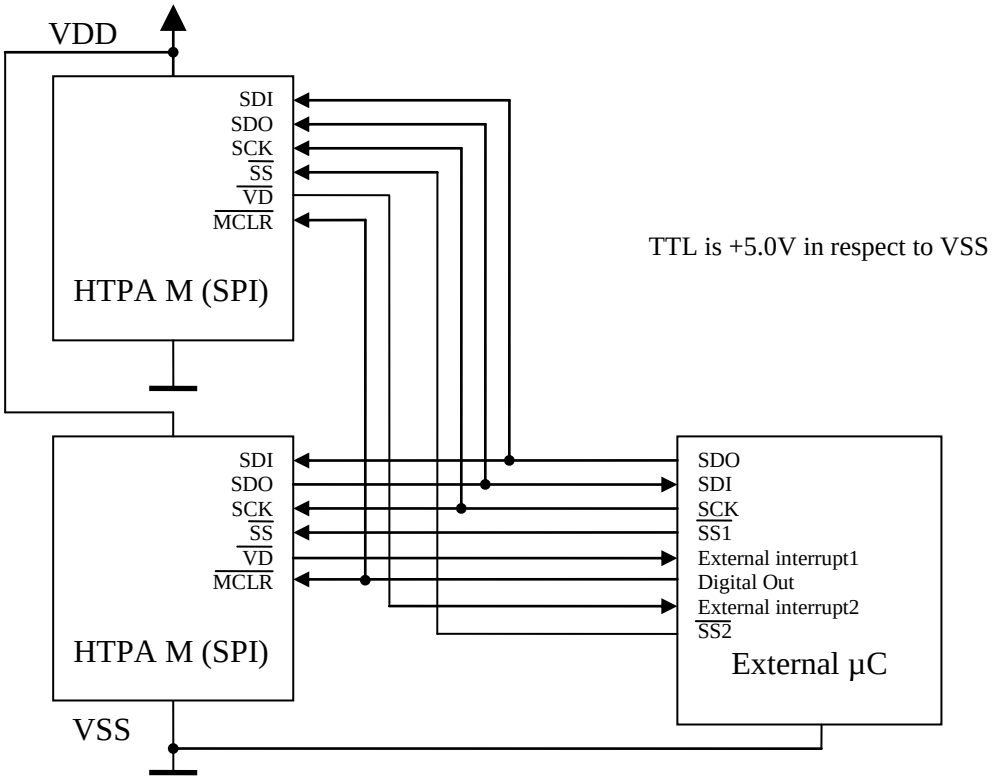


Electrical Connections:

Single Module:

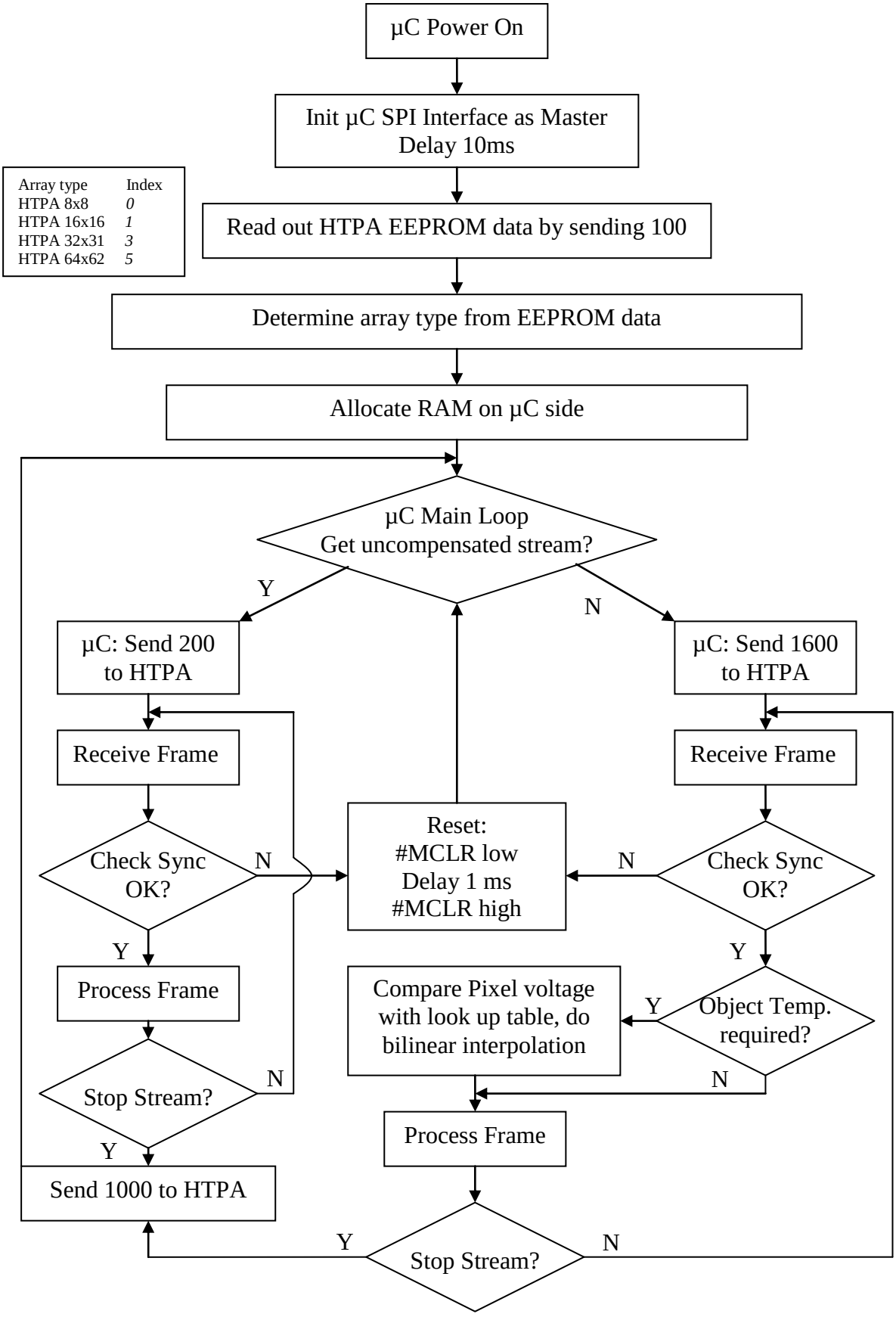


Multiple Modules (preliminary):



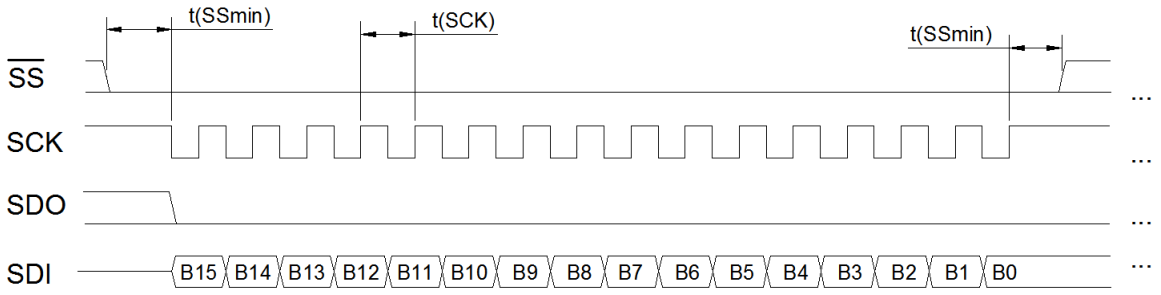
Communication and Timings:

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



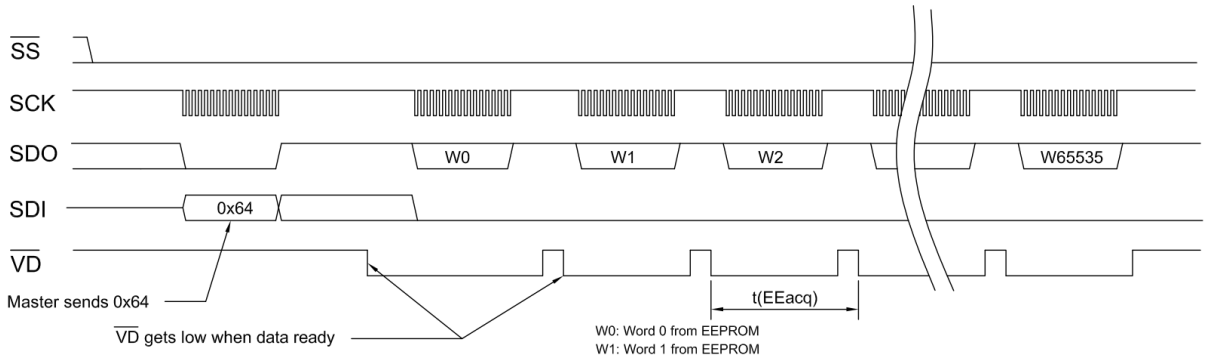
Communication and Timings (continuation):

Receive of command:

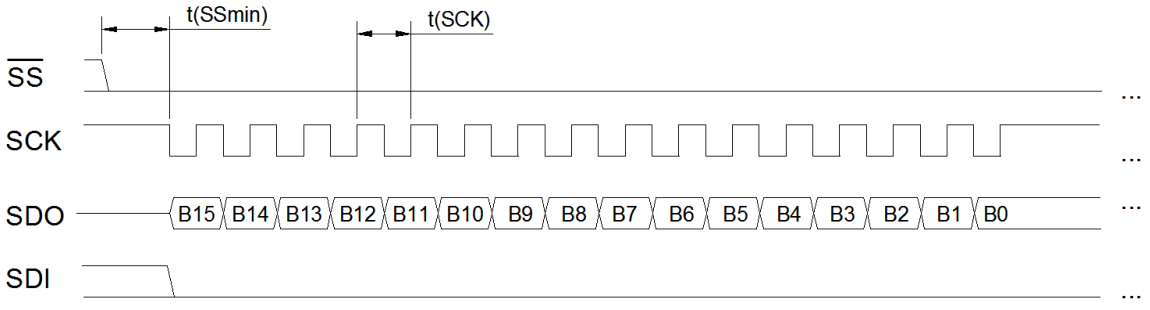


(High state of #SS is not necessary, only for communication with multiple devices)

Send of EEPROM content:

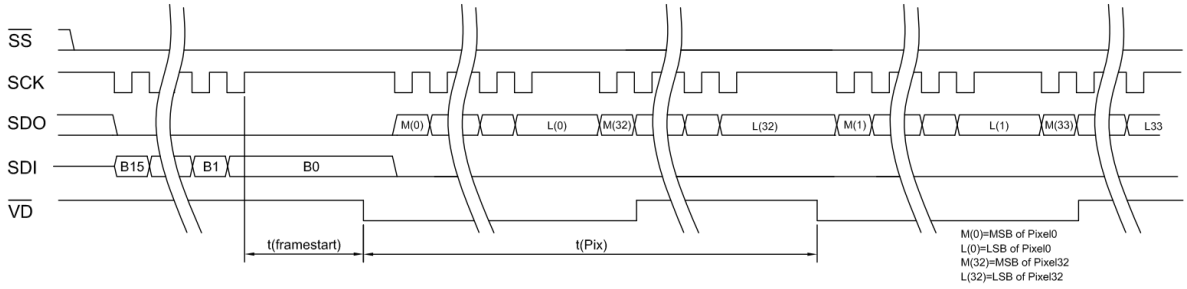


Pixel data:



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

Receive of stream command:



For streaming the adequate frequency needs to be applied to the MCLK pin of the module.

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Communication and Timings (continuation):

Absolute values:

	MIN	NOM	MAX	Unit	Remarks
MCLR pulse width (low)	2			µs	
t(SSmin)	150			ns	
t(SCK)	0.1	0.8	2.48	µs	
t(EEacq)	11			µs	
t(framestart)		160		ms	f(MCLK)=2.66 MHz
t(Pix)		76		µs	f(MCLK)=2.66 MHz

t(Pix) and t(framestart) depend on the given MCLK frequency of the master. In example: MCLK frequency is 2655 kHz, then t(Pix) and t(framestart) is calculated via

$$t(Pix) = \frac{200}{f(MCLK)} = \frac{200}{2655000} = 75.3\mu s$$

$$t(framestart) = \frac{t(Pix) \cdot 64 \cdot 64}{2} + 6\text{ms} = 160.2\text{ms}$$

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	0x3	float	Minimum value of PixC's for scaling
0x4	0x7	float	Maximum value of PixC's for scaling
0x8	0x9		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
0x59	0x5A	unsigned int	MCLK Frequency in kHz
0x5B	0x79		Heimann Sensor reserved
0x80	0x1F7F	unsigned int	scaled down values of PixC's
0x1F80	0xFFFF		Heimann Sensor reserved

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:

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

$$MCLK = 256 \cdot MCLK_{HB} + MCLK_{LB}$$

EEPROM Mapping (continuation):

Details for PixC's:

Start address	End address	Data type	Value
0x80	0x81	unsigned int	scaled PixC value of Pixel 0
0x82	0x83	unsigned int	scaled PixC value of Pixel 32
0x84	0x85	unsigned int	scaled PixC value of Pixel 1
0x86	0x87	unsigned int	scaled PixC value of Pixel 33
0x88	0x89	unsigned int	scaled PixC value of Pixel 2
0x8A	0x8B	unsigned int	scaled PixC value of Pixel 34
…	…	…	…
0xFC	0xFD	unsigned int	scaled PixC value of Pixel 31
0xFE	0xFF	unsigned int	scaled PixC value of Pixel 63
0x100	0x101	unsigned int	scaled PixC value of Pixel 64
0x102	0x103	unsigned int	scaled PixC value of Pixel 96
0x104	0x105	unsigned int	scaled PixC value of Pixel 65
0x106	0x107	unsigned int	scaled PixC value of Pixel 97
…	…	…	…
0x1F7C	0x1F7D	unsigned int	scaled PixC value of Pixel 3935
0x1F7E	0x1F7F	unsigned int	scaled PixC value of Pixel 3967

Calculation of the PixC's:

1. Determine minimum and maximum value of the PixC's out of the EEPROM data by reading associated EEPROM value into a float constant. Pseudocode in C, see function "getPixC(void);"
2. Now scale all scaled down PixC's out of the EEPROM content back to their original value and store them in RAM of your system.

Formulas:

$$PixC_{MAX} = \mathrm{EEPROM}[0x0 - 0x3] \qquad \text{(4 byte float value in little endian)}$$

$$PixC_{MIN} = \mathrm{EEPROM}[0x4 - 0x7] \qquad \text{(4 byte float value in little endian)}$$

$$PixC(PixelX) = \frac{\mathrm{EEPROM}[0x80 + (X \cdot 2)] \cdot (PixC_{MAX} - PixC_{MIN})}{65535} + PixC_{MIN}$$

```
unsigned int PixC[3968];    //The scaled back PixC's. Most likely, this should be global. [3968] for 64x62, [992] for 32x31

void getPixC(void)          //this function detemines the pixel constants. Precondition: EEPROM content is stored in the char array "EEPROM"
{
        float common[2],min,max;
        unsigned int addr=0x80,i;   //the start address for the scaled pixel constants
        unsigned int pcl;           //this stores the two bytes from the scaled down PixC out of EEPROM.

        memcpy((char*)&common,(unsigned char*)&EEPROM[0],sizeof(float)*2);          //the address of the scaling values for the pixc's
        min=common[0];
        max=common[1];
        for(i=0;i<PIXEL;i++){
                memcpy((char*)&pcl,(unsigned char*)&EEPROM[addr],2);          //include string.h for memcpy
                addr+=2;
                PixC[i]=(unsigned int)(((float)pcl/65535.0)*(max-min)+min+0.5);
        }

        return;
}
```

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	elOff0 in digits
3969	elOff32 in digits
3970	elOff1 in digits
3971	elOff33 in digits
…	…
4030	elOff31 in digits
4031	elOff63 in digits
4032	Module transmitts 0x789A (use for sync)
4033	Module transmitts 0xBCDE (use for sync)
4034	least significant 12 bits of TAmb
4035	most significant 4 bits of TAmb
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	elOff0 in digits
3969	elOff32 in digits
3970	elOff1 in digits
3971	elOff33 in digits
…	…
4030	elOff31 in digits
4031	elOff63 in digits
4032	Module transmitts 0x789A (use for sync)
4033	Module transmitts 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

Each dataset consists of a 16 bit value. The 16 bit values are transmitted with LSB 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.

Pixel Map:

0	1	2	3	4	5	6	7	…	61	62	63
64	65	66	67	68	69	70	71	…	125	126	127
.											.
.											.
.											.
3904	3905	3906	3907	3908	3909	3910	3911	…	3965	3967	3968

Communication commands:

Sent Command	Answer / Result
100	Output of EEPROM content. Data ready of each 2 bytes is signified by #VD pin.
200	Module streams out uncompensated, raw data stream. Data ready of each 4 bytes is signified by #VD pin.
1000	Stops streaming mode of module.
1600	Module streams offset corrected stream (electrical and thermal). Data ready of each 4 bytes is signified by #VD pin.

Precondition for all streaming modes:

MCLK signal is set by the HTPAM (SPI).

Preconditions for compensated streams
VDD must be in the given limits (5V +/-2%). False values for this may affect calculated absolute object temperatures.

Absolute Maximum Ratings:

Value	MIN	NOM	MAX	Unit	Remarks
VDD in respect to VSS	-0.3	5	6.5	V	
VDD in streaming mode	4.9	5	5.1	V	False VDD values affect compensation
Voltage on digital pin with respect to VSS	-0.3		VDD+0.3	V	
Current consumption	48	53	60	mA	In streaming
Current consumption	10	14	20	mA	Idle

Temperature Calculation:

1. Init SPI Interface
2. Read out EEPROM data
3. Determine pixel constant PixC for each sensitive pixel, keep them in RAM (Refer also to EEPROM mapping)
4. Enable ISR connected to the #VD pin of the module
5. Write 1600 via the SPI interface to the module
6. Module starts to run and signifies valid data with pull down of #VD
7. In the ISR get 32 bit (2 times 16 bit read) within the given timings from the module
8. These two words represent the compensated pixel voltage of the two corresponding pixels. For serial order of the pixels in frame refer to "Serial order of data in stream"
9. Scale the pixel sensitivity according to the following formula, using the PixC's:

$$V_S(X) = \frac{1E8 \cdot V_C(X)}{PixC(X) \cdot \varepsilon}$$

   Where ε is the emissivity of the object, $V_S(X)$ is the sensitivity corrected voltage of pixel X, $V_C(X)$ is the offset compensated voltage of pixel X (submitted by the module).
10. Compare the $V_S(X)$ value with the pixel voltages in the look up table (vertical axis)
11. Calculate the ambient temperature of the sensor out of the given values from the module (see "Serial order of data in stream"). This formula may be used for ambient temperature calculation:

$$T_{AMB} = 4096 \cdot V_C(1027) + V_C(1026)$$

12. Compare the T_{AMB} value with the horizontal axis of the look up table.
13. Do a bilinear interpolation of the 4 neighbour supporting points, where T_{AMB} and $V_S(X)$ intersect.
14. The result is the object temperature in deci-Kelvin [dK].

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.

Liability:

Important product or process changes require a customer release. Changes or modifications at the product which have no influence to the performance and/or quality of the device do not need to be announced to the customers in advance. Customers are requested to consult with Heimann Sensor representatives before the use of Heimann Sensor products in special applications where failure or abnormal operation may directly affect human lives or cause physical injury or property damage. The company or their representatives will not be responsible for damage arising from such use without prior approval.

Look up table:

Object and Ambient temperatures in deci-Kelvin [dK]. Pixel voltage in digits [dig]. Insert sensitivity (and emissivity) corrected voltage.

Table Number #18
You can find the matching table number to your device in the EEPROM, refer to "EEPROM Mapping"

Pixel voltage	Ambient Temperature [dK] 2582	2732	2882	3032	3182	3332	3482
-400					0	0	0
-392					0	0	948
-384					0	0	1201
-376					0	0	1376
-368					0	0	1515
-360					0	0	1631
-352					0	0	1733
-344					0	846	1823
-336					0	1142	1906
-328					0	1332	1981
-320					0	1479	2051
-312				0	0	1601	2117
-304				0	0	1706	2178
-296				0	948	1799	2236
-288				0	1201	1884	2292
-280				0	1376	1961	2344
-272				0	1515	2032	2395
-264				0	1631	2099	2443
-256				878	1733	2162	2489
-248				1160	1823	2221	2534
-240	0	0	0	1345	1906	2277	2577
-232	0	0	0	1490	1981	2330	2619
-224	0	0	368	1610	2051	2381	2659
-216	0	0	982	1714	2117	2430	2698
-208	0	0	1223	1806	2178	2477	2736
-200	0	0	1393	1890	2236	2522	2773
-192	0	0	1528	1967	2292	2565	2809
-184	0	910	1643	2038	2344	2607	2844
-176	0	1178	1743	2104	2395	2648	2878
-168	0	1359	1833	2166	2443	2687	2912
-160	388	1501	1914	2225	2489	2726	2944
-152	985	1619	1989	2281	2534	2763	2976
-144	1225	1722	2059	2334	2577	2799	3007
-136	1394	1814	2124	2385	2619	2835	3038
-128	1529	1897	2185	2434	2659	2869	3068
-120	1644	1973	2243	2480	2698	2903	3097
-112	1744	2044	2298	2525	2736	2935	3126
-104	1834	2110	2350	2569	2773	2967	3154
-96	1915	2172	2400	2611	2809	2999	3182
-88	1990	2230	2448	2651	2844	3030	3209
-80	2059	2286	2494	2691	2878	3060	3236
-72	2124	2339	2539	2729	2912	3089	3262
-64	2185	2389	2582	2766	2944	3118	3288
-56	2243	2438	2623	2802	2976	3146	3314
-48	2298	2484	2663	2837	3007	3174	3339
-40	2350	2529	2702	2872	3038	3202	3364
-32	2400	2572	2740	2905	3068	3229	3388
-24	2448	2614	2777	2938	3097	3255	3412
-16	2495	2655	2813	2970	3126	3281	3436
-8	2539	2694	2848	3001	3154	3307	3459
0	2582	2732	2882	3032	3182	3332	3482
8	2624	2769	2915	3062	3209	3357	3505
16	2664	2805	2948	3092	3236	3381	3527
24	2703	2840	2980	3120	3262	3405	3549
32	2741	2875	3011	3149	3288	3429	3571
40	2777	2908	3041	3177	3314	3453	3593
48	2813	2941	3071	3204	3339	3476	3614
56	2848	2973	3100	3231	3364	3498	3635
64	2882	3004	3129	3257	3388	3521	3656
72	2916	3035	3157	3283	3412	3543	3676
80	2948	3065	3185	3309	3436	3565	3697
88	2980	3094	3212	3334	3459	3587	3717
96	3011	3123	3239	3359	3482	3608	3737
104	3042	3151	3265	3383	3505	3629	3756
112	3071	3179	3291	3407	3527	3650	3776
120	3101	3206	3317	3431	3549	3671	3795
128	3129	3233	3342	3454	3571	3691	3814
136	3158	3259	3366	3478	3593	3711	3833
144	3185	3285	3391	3500	3614	3731	3852
152	3212	3311	3415	3523	3635	3751	3870
160	3239	3336	3438	3545	3656	3770	3889
168	3265	3361	3461	3567	3676	3790	3907
176	3291	3385	3484	3588	3697	3809	3925
184	3317	3409	3507	3610	3717	3828	3942
192	3342	3433	3530	3631	3737	3847	3960
200	3367	3456	3552	3652	3756	3865	3978
208	3391	3479	3573	3672	3776	3883	3995
216	3415	3502	3595	3693	3795	3902	4012
224	3438	3525	3616	3713	3814	3920	4029
232	3462	3547	3637	3733	3833	3938	4046
240	3485	3569	3658	3753	3852	3955	4063
248	3507	3590	3679	3772	3870	3973	4079
256	3530	3612	3699	3791	3889	3990	4096

264	3552	3633	3719	3810	3907	4007	4112
272	3574	3654	3739	3829	3925	4024	4128
280	3595	3674	3759	3848	3942	4041	4144
288	3616	3694	3778	3867	3960	4058	4160
296	3637	3715	3797	3885	3978	4075	4176
304	3658	3735	3816	3903	3995	4091	4192
312	3679	3754	3835	3921	4012	4108	4207
320	3699	3774	3854	3939	4029	4124	4223
328	3719	3793	3872	3957	4046	4140	4238
336	3739	3812	3891	3974	4063	4156	4253
344	3759	3831	3909	3991	4079	4172	4268
352	3778	3850	3927	4009	4096	4187	4283
360	3797	3868	3944	4026	4112	4203	4298
368	3816	3886	3962	4043	4128	4218	4313
376	3835	3905	3979	4059	4144	4234	4328
384	3854	3923	3997	4076	4160	4249	4342
392	3872	3940	4014	4093	4176	4264	4357
400	3891	3958	4031	4109	4192	4279	4371
408	3909	3976	4048	4125	4207	4294	4386
416	3927	3993	4064	4141	4223	4309	4400
424	3945	4010	4081	4157	4238	4324	4414
432	3962	4027	4098	4173	4253	4338	4428
440	3980	4044	4114	4189	4268	4353	4442
448	3997	4061	4130	4204	4283	4367	4456
456	4014	4077	4146	4220	4298	4382	4469
464	4031	4094	4162	4235	4313	4396	4483
472	4048	4110	4178	4250	4328	4410	4497
480	4065	4126	4193	4265	4342	4424	4510
488	4081	4143	4209	4280	4357	4438	4524
496	4098	4158	4224	4295	4371	4452	4537
504	4114	4174	4240	4310	4386	4466	4550
512	4130	4190	4255	4325	4400	4479	4563
520	4146	4206	4270	4340	4414	4493	4576
528	4162	4221	4285	4354	4428	4506	4589
536	4178	4236	4300	4368	4442	4520	4602
544	4194	4252	4315	4383	4456	4533	4615
552	4209	4267	4329	4397	4469	4546	4628
560	4225	4282	4344	4411	4483	4560	4641
568	4240	4297	4358	4425	4497	4573	4653
576	4255	4311	4373	4439	4510	4586	4666
584	4270	4326	4387	4453	4523	4599	4678
592	4285	4341	4401	4467	4537	4612	4691
600	4300	4355	4415	4480	4550	4624	4703
608	4315	4370	4429	4494	4563	4637	4716
616	4330	4384	4443	4507	4576	4650	4728
624	4344	4398	4457	4521	4589	4662	4740
632	4359	4412	4471	4534	4602	4675	4752
640	4373	4426	4485	4547	4615	4687	4764
648	4387	4440	4498	4561	4628	4700	4776
656	4401	4454	4512	4574	4641	4712	4788
664	4416	4468	4525	4587	4653	4724	4800
672	4430	4482	4538	4600	4666	4737	4812
680	4443	4495	4552	4613	4678	4749	4823
688	4457	4509	4565	4625	4691	4761	4835
696	4471	4522	4578	4638	4703	4773	4847
704	4485	4535	4591	4651	4716	4785	4858
712	4498	4549	4604	4663	4728	4797	4870
720	4512	4562	4617	4676	4740	4808	4881
728	4525	4575	4629	4688	4752	4820	4893
736	4538	4588	4642	4701	4764	4832	4904
744	4552	4601	4655	4713	4776	4844	4915
752	4565	4614	4667	4725	4788	4855	4927
760	4578	4627	4680	4738	4800	4867	4938
768	4591	4639	4692	4750	4812	4878	4949
776	4604	4652	4705	4762	4823	4890	4960
784	4617	4665	4717	4774	4835	4901	4971
792	4629	4677	4729	4786	4847	4912	4982
800	4642	4689	4741	4798	4858	4924	4993
808	4655	4702	4753	4809	4870	4935	5004
816	4667	4714	4765	4821	4881	4946	5015
824	4680	4726	4777	4833	4893	4957	5026
832	4692	4739	4789	4845	4904	4968	5036
840	4705	4751	4801	4856	4915	4979	5047
848	4717	4763	4813	4868	4927	4990	5058
856	4729	4775	4825	4879	4938	5001	5068
864	4741	4787	4836	4891	4949	5012	5079
872	4754	4799	4848	4902	4960	5023	5089
880	4766	4810	4860	4913	4971	5033	5100
888	4778	4822	4871	4924	4982	5044	5110
896	4789	4834	4883	4936	4993	5055	5121
904	4801	4846	4894	4947	5004	5065	5131
912	4813	4857	4905	4958	5015	5076	5141
920	4825	4869	4917	4969	5026	5087	5152
928	4837	4880	4928	4980	5036	5097	5162
936	4848	4891	4939	4991	5047	5107	5172
944	4860	4903	4950	5002	5058	5118	5182

952	4871	4914	4961	5013	5068	5128	5192
960	4883	4925	4972	5023	5079	5139	5202
968	4894	4937	4983	5034	5089	5149	5212
976	4905	4948	4994	5045	5100	5159	5222
984	4917	4959	5005	5056	5110	5169	5232
992	4928	4970	5016	5066	5121	5179	5242
1000	4939	4981	5027	5077	5131	5189	5252
1008	4950	4992	5038	5087	5141	5200	5262
1016	4961	5003	5048	5098	5152	5210	5272
1024	4972	5014	5059	5108	5162	5220	5281
1032	4983	5024	5069	5119	5172	5230	5291
1040	4994	5035	5080	5129	5182	5239	5301
1048	5005	5046	5091	5139	5192	5249	5310
1056	5016	5057	5101	5150	5202	5259	5320
1064	5027	5067	5111	5160	5212	5269	5330
1072	5038	5078	5122	5170	5222	5279	5339
1080	5048	5088	5132	5180	5232	5288	5349
1088	5059	5099	5142	5190	5242	5298	5358
1096	5070	5109	5153	5200	5252	5308	5368
1104	5080	5120	5163	5210	5262	5317	5377
1112	5091	5130	5173	5220	5272	5327	5386
1120	5101	5140	5183	5230	5281	5336	5396
1128	5112	5150	5193	5240	5291	5346	5405
1136	5122	5161	5203	5250	5301	5355	5414
1144	5132	5171	5213	5260	5310	5365	5423
1152	5143	5181	5223	5270	5320	5374	5433
1160	5153	5191	5233	5279	5330	5384	5442
1168	5163	5201	5243	5289	5339	5393	5451
1176	5173	5211	5253	5299	5349	5402	5460
1184	5183	5221	5263	5309	5358	5412	5469
1192	5193	5231	5273	5318	5368	5421	5478
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1208	5214	5251	5292	5337	5386	5439	5496
1216	5223	5261	5302	5347	5396	5448	5505
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1232	5243	5280	5321	5366	5414	5467	5523
1240	5253	5290	5331	5375	5423	5476	5532
1248	5263	5300	5340	5384	5433	5485	5541
1256	5273	5309	5350	5394	5442	5494	5549
1264	5283	5319	5359	5403	5451	5503	5558
1272	5292	5329	5369	5412	5460	5512	5567
1280	5302	5338	5378	5422	5469	5520	5576
1288	5312	5348	5387	5431	5478	5529	5584
1296	5321	5357	5397	5440	5487	5538	5593
1304	5331	5366	5406	5449	5496	5547	5602
1312	5340	5376	5415	5458	5505	5556	5610
1320	5350	5385	5424	5467	5514	5564	5619
1328	5359	5395	5434	5476	5523	5573	5627
1336	5369	5404	5443	5485	5532	5582	5636
1344	5378	5413	5452	5494	5541	5591	5644
1352	5387	5422	5461	5503	5549	5599	5653
1360	5397	5432	5470	5512	5558	5608	5661
1368	5406	5441	5479	5521	5567	5616	5670
1376	5415	5450	5488	5530	5576	5625	5678
1384	5424	5459	5497	5539	5584	5634	5687
1392	5434	5468	5506	5548	5593	5642	5695
1400	5443	5477	5515	5556	5602	5651	5703
1408	5452	5486	5524	5565	5610	5659	5712
1416	5461	5495	5533	5574	5619	5667	5720
1424	5470	5504	5542	5583	5627	5676	5728
1432	5479	5513	5550	5591	5636	5684	5736
1440	5488	5522	5559	5600	5644	5693	5744
1448	5497	5531	5568	5609	5653	5701	5753
1456	5506	5540	5577	5617	5661	5709	5761
1464	5515	5548	5585	5626	5670	5718	5769
1472	5524	5557	5594	5634	5678	5726	5777
1480	5533	5566	5603	5643	5687	5734	5785
1488	5542	5575	5611	5651	5695	5742	5793
1496	5550	5583	5620	5660	5703	5750	5801
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1520	5577	5609	5645	5685	5728	5775	5825
1528	5585	5618	5654	5693	5736	5783	5833
1536	5594	5626	5662	5702	5744	5791	5841
1544	5603	5635	5671	5710	5753	5799	5849
1552	5611	5643	5679	5718	5761	5807	5857
1560	5620	5652	5687	5726	5769	5815	5865
1568	5628	5660	5696	5735	5777	5823	5873
1576	5637	5669	5704	5743	5785	5831	5880
1584	5645	5677	5712	5751	5793	5839	5888
1592	5654	5686	5721	5759	5801	5847	5896
1600	5662	5694	5729	5767	5809	5855	5904
1608	5671	5702	5737	5775	5817	5863	5911
1616	5679	5711	5745	5784	5825	5870	5919
1624	5688	5719	5754	5792	5833	5878	5927
1632	5696	5727	5762	5800	5841	5886	5935

1640	5704	5735	5770	5808	5849	5894	5942
1648	5713	5744	5778	5816	5857	5902	5950
1656	5721	5752	5786	5824	5865	5909	5957
1664	5729	5760	5794	5832	5873	5917	5965
1672	5737	5768	5802	5840	5880	5925	5973
1680	5745	5776	5810	5847	5888	5932	5980
1688	5754	5784	5818	5855	5896	5940	5988
1696	5762	5792	5826	5863	5904	5948	5995
1704	5770	5800	5834	5871	5911	5955	6003
1712	5778	5808	5842	5879	5919	5963	6010
1720	5786	5816	5850	5887	5927	5971	6018
1728	5794	5824	5858	5894	5935	5978	6025
1736	5802	5832	5866	5902	5942	5986	6032
1744	5810	5840	5873	5910	5950	5993	6040
1752	5818	5848	5881	5918	5957	6001	6047
1760	5826	5856	5889	5925	5965	6008	6055
1768	5834	5864	5897	5933	5973	6016	6062
1776	5842	5872	5905	5941	5980	6023	6069
1784	5850	5880	5912	5948	5988	6030	6077
1792	5858	5887	5920	5956	5995	6038	6084
1800	5866	5895	5928	5964	6003	6045	6091
1808	5874	5903	5935	5971	6010	6053	6098
1816	5881	5911	5943	5979	6018	6060	6106
1824	5889	5918	5951	5986	6025	6067	6113
1832	5897	5926	5958	5994	6032	6075	6120
1840	5905	5934	5966	6001	6040	6082	6127
1848	5912	5941	5973	6009	6047	6089	6134
1856	5920	5949	5981	6016	6055	6096	6142
1864	5928	5957	5989	6024	6062	6104	6149
1872	5935	5964	5996	6031	6069	6111	6156
1880	5943	5972	6004	6038	6077	6118	6163
1888	5951	5979	6011	6046	6084	6125	6170
1896	5958	5987	6018	6053	6091	6132	6177
1904	5966	5994	6026	6061	6098	6140	6184
1912	5973	6002	6033	6068	6106	6147	6191
1920	5981	6009	6041	6075	6113	6154	6198
1928	5989	6017	6048	6082	6120	6161	6205
1936	5996	6024	6055	6090	6127	6168	6212
1944	6004	6032	6063	6097	6134	6175	6219
1952	6011	6039	6070	6104	6142	6182	6226
1960	6019	6046	6077	6111	6149	6189	6233
1968	6026	6054	6085	6119	6156	6196	6240
1976	6033	6061	6092	6126	6163	6203	6247
1984	6041	6068	6099	6133	6170	6210	6254
1992	6048	6076	6106	6140	6177	6217	6261
2000	6055	6083	6114	6147	6184	6224	6267
2008	6063	6090	6121	6154	6191	6231	6274
2016	6070	6098	6128	6162	6198	6238	6281
2024	6077	6105	6135	6169	6205	6245	6288
2032	6085	6112	6142	6176	6212	6252	6295
2040	6092	6119	6149	6183	6219	6259	6302
2048	6099	6126	6157	6190	6226	6266	6308
2056	6107	6134	6164	6197	6233	6272	6315
2064	6114	6141	6171	6204	6240	6279	6322
2072	6121	6148	6178	6211	6247	6286	6329
2080	6128	6155	6185	6218	6254	6293	6335
2088	6135	6162	6192	6225	6261	6300	6342
2096	6142	6169	6199	6232	6267	6306	6349
2104	6150	6176	6206	6239	6274	6313	6355
2112	6157	6183	6213	6246	6281	6320	6362
2120	6164	6190	6220	6252	6288	6327	6369
2128	6171	6197	6227	6259	6295	6333	6375
2136	6178	6204	6234	6266	6302	6340	6382
2144	6185	6211	6241	6273	6308	6347	6388
2152	6192	6218	6248	6280	6315	6353	6395
2160	6199	6225	6254	6287	6322	6360	6402
2168	6206	6232	6261	6293	6329	6367	6408
2176	6213	6239	6268	6300	6335	6373	6415
2184	6220	6246	6275	6307	6342	6380	6421
2192	6227	6253	6282	6314	6349	6387	6428
2200	6234	6260	6289	6320	6355	6393	6434
2208	6241	6267	6296	6327	6362	6400	6441
2216	6248	6274	6302	6334	6369	6406	6447
2224	6255	6280	6309	6341	6375	6413	6454
2232	6261	6287	6316	6347	6382	6419	6460
2240	6268	6294	6323	6354	6388	6426	6466
2248	6275	6301	6329	6361	6395	6432	6473
2256	6282	6308	6336	6367	6402	6439	6479
2264	6289	6314	6343	6374	6408	6445	6486
2272	6296	6321	6349	6381	6415	6452	6492
2280	6302	6328	6356	6387	6421	6458	6498
2288	6309	6334	6363	6394	6428	6465	6505
2296	6316	6341	6369	6400	6434	6471	6511
2304	6323	6348	6376	6407	6441	6478	6517
2312	6329	6355	6383	6413	6447	6484	6524
2320	6336	6361	6389	6420	6454	6490	6530

2328	6343	6368	6396	6426	6460	6497	6536
2336	6349	6374	6402	6433	6466	6503	6543
2344	6356	6381	6409	6439	6473	6509	6549
2352	6363	6388	6415	6446	6479	6516	6555
2360	6369	6394	6422	6452	6486	6522	6561
2368	6376	6401	6428	6459	6492	6528	6568
2376	6383	6407	6435	6465	6498	6535	6574
2384	6389	6414	6441	6472	6505	6541	6580
2392	6396	6420	6448	6478	6511	6547	6586
2400	6402	6427	6454	6484	6517	6553	6592
2408	6409	6433	6461	6491	6524	6560	6599
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2432	6428	6453	6480	6510	6543	6578	6617
2440	6435	6459	6486	6516	6549	6585	6623
2448	6441	6466	6493	6523	6555	6591	6629
2456	6448	6472	6499	6529	6561	6597	6635
2464	6454	6479	6505	6535	6568	6603	6641
2472	6461	6485	6512	6541	6574	6609	6648
2480	6467	6491	6518	6548	6580	6615	6654
2488	6474	6498	6524	6554	6586	6621	6660
2496	6480	6504	6531	6560	6592	6628	6666
2504	6486	6510	6537	6566	6599	6634	6672
2512	6493	6517	6543	6573	6605	6640	6678
2520	6499	6523	6550	6579	6611	6646	6684
2528	6506	6529	6556	6585	6617	6652	6690
2536	6512	6536	6562	6591	6623	6658	6696
2544	6518	6542	6568	6597	6629	6664	6702
2552	6525	6548	6575	6604	6635	6670	6708
2560	6531	6554	6581	6610	6641	6676	6714
2568	6537	6561	6587	6616	6648	6682	6720
2576	6543	6567	6593	6622	6654	6688	6726
2584	6550	6573	6599	6628	6660	6694	6731
2592	6556	6579	6605	6634	6666	6700	6737
2600	6562	6586	6612	6640	6672	6706	6743
2608	6568	6592	6618	6646	6678	6712	6749
2616	6575	6598	6624	6652	6684	6718	6755
2624	6581	6604	6630	6658	6690	6724	6761
2632	6587	6610	6636	6665	6696	6730	6767
2640	6593	6616	6642	6671	6702	6736	6773
2648	6599	6623	6648	6677	6708	6742	6778
2656	6606	6629	6654	6683	6714	6748	6784
2664	6612	6635	6660	6689	6720	6753	6790
2672	6618	6641	6666	6695	6726	6759	6796
2680	6624	6647	6672	6701	6731	6765	6802
2688	6630	6653	6678	6707	6737	6771	6808
2696	6636	6659	6684	6713	6743	6777	6813
2704	6642	6665	6690	6718	6749	6783	6819
2712	6648	6671	6696	6724	6755	6789	6825
2720	6654	6677	6702	6730	6761	6794	6831
2728	6660	6683	6708	6736	6767	6800	6836
2736	6666	6689	6714	6742	6773	6806	6842
2744	6672	6695	6720	6748	6778	6812	6848
2752	6678	6701	6726	6754	6784	6817	6853
2760	6684	6707	6732	6760	6790	6823	6859
2768	6690	6713	6738	6766	6796	6829	6865
2776	6696	6719	6744	6771	6802	6835	6871
2784	6702	6725	6750	6777	6808	6840	6876
2792	6708	6731	6756	6783	6813	6846	6882
2800	6714	6737	6762	6789	6819	6852	6888
2808	6720	6743	6767	6795	6825	6858	6893
2816	6726	6749	6773	6801	6831	6863	6899
2824	6732	6754	6779	6806	6836	6869	6904
2832	6738	6760	6785	6812	6842	6875	6910
2840	6744	6766	6791	6818	6848	6880	6916
2848	6750	6772	6797	6824	6853	6886	6921
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2872	6767	6789	6814	6841	6871	6903	6938
2880	6773	6795	6820	6847	6876	6908	6944
2888	6779	6801	6825	6852	6882	6914	6949
2896	6785	6807	6831	6858	6888	6920	6955
2904	6791	6813	6837	6864	6893	6925	6960
2912	6797	6818	6843	6869	6899	6931	6966
2920	6802	6824	6848	6875	6904	6936	6971
2928	6808	6830	6854	6881	6910	6942	6977
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2944	6820	6841	6865	6892	6921	6953	6988
2952	6826	6847	6871	6898	6927	6959	6993
2960	6831	6853	6877	6903	6932	6964	6999
2968	6837	6859	6882	6909	6938	6970	7004
2976	6843	6864	6888	6915	6944	6975	7010
2984	6848	6870	6894	6920	6949	6981	7015
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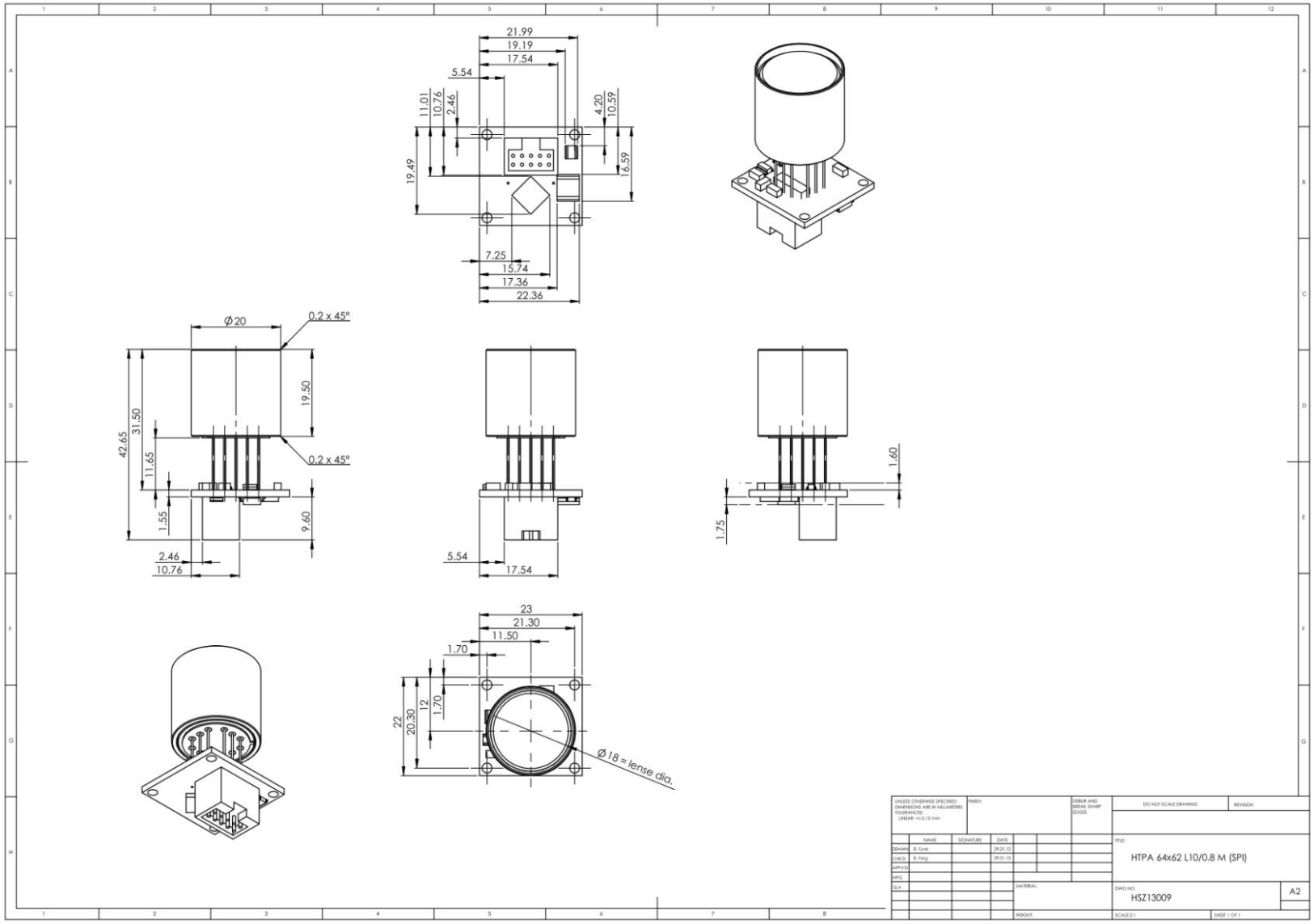
3048	6894	6915	6939	6965	6993	7024	7058
3056	6899	6921	6944	6970	6999	7030	7064
3064	6905	6926	6950	6976	7004	7035	7069
3072	6911	6932	6955	6981	7010	7041	7074
3080	6916	6937	6961	6987	7015	7046	7080
3088	6922	6943	6966	6992	7020	7051	7085
3096	6927	6948	6972	6998	7026	7057	7090
3104	6933	6954	6977	7003	7031	7062	7096
3112	6939	6960	6983	7008	7037	7067	7101
3120	6944	6965	6988	7014	7042	7073	7106
3128	6950	6971	6994	7019	7047	7078	7111
3136	6955	6976	6999	7025	7053	7083	7117
3144	6961	6982	7005	7030	7058	7089	7122
3152	6966	6987	7010	7036	7064	7094	7127
3160	6972	6993	7016	7041	7069	7099	7133
3168	6977	6998	7021	7046	7074	7105	7138
3176	6983	7003	7026	7052	7080	7110	7143
3184	6988	7009	7032	7057	7085	7115	7148
3192	6994	7014	7037	7063	7090	7121	7154
3200	6999	7020	7043	7068	7096	7126	7159
3208	7005	7025	7048	7073	7101	7131	7164
3216	7010	7031	7053	7079	7106	7136	7169
3224	7016	7036	7059	7084	7111	7142	7174
3232	7021	7041	7064	7089	7117	7147	7180
3240	7026	7047	7069	7095	7122	7152	7185
3248	7032	7052	7075	7100	7127	7157	7190
3256	7037	7058	7080	7105	7133	7163	7195
3264	7043	7063	7086	7110	7138	7168	7200
3272	7048	7068	7091	7116	7143	7173	7205
3280	7053	7074	7096	7121	7148	7178	7211
3288	7059	7079	7101	7126	7154	7183	7216
3296	7064	7084	7107	7132	7159	7188	7221
3304	7070	7090	7112	7137	7164	7194	7226
3312	7075	7095	7117	7142	7169	7199	7231
3320	7080	7100	7123	7147	7174	7204	7236
3328	7086	7106	7128	7152	7180	7209	7241
3336	7091	7111	7133	7158	7185	7214	7246
3344	7096	7116	7138	7163	7190	7219	7251
3352	7102	7121	7144	7168	7195	7224	7256
3360	7107	7127	7149	7173	7200	7230	7262
3368	7112	7132	7154	7179	7205	7235	7267
3376	7117	7137	7159	7184	7211	7240	7272
3384	7123	7142	7165	7189	7216	7245	7277
3392	7128	7148	7170	7194	7221	7250	7282
3400	7133	7153	7175	7199	7226	7255	7287
3408	7138	7158	7180	7204	7231	7260	7292
3416	7144	7163	7185	7210	7236	7265	7297
3424	7149	7169	7190	7215	7241	7270	7302
3432	7154	7174	7196	7220	7246	7275	7307
3440	7159	7179	7201	7225	7251	7280	7312
3448	7165	7184	7206	7230	7256	7285	7317
3456	7170	7189	7211	7235	7262	7290	7322
3464	7175	7194	7216	7240	7267	7295	7327
3472	7180	7200	7221	7245	7272	7300	7332
3480	7185	7205	7226	7250	7277	7305	7337
3488	7191	7210	7232	7255	7282	7310	7342
3496	7196	7215	7237	7261	7287	7315	7347
3504	7201	7220	7242	7266	7292	7320	7352
3512	7206	7225	7247	7271	7297	7325	7357
3520	7211	7230	7252	7276	7302	7330	7361
3528	7216	7236	7257	7281	7307	7335	7366
3536	7221	7241	7262	7286	7312	7340	7371
3544	7227	7246	7267	7291	7317	7345	7376
3552	7232	7251	7272	7296	7322	7350	7381
3560	7237	7256	7277	7301	7327	7355	7386
3568	7242	7261	7282	7306	7332	7360	7391
3576	7247	7266	7287	7311	7337	7365	7396
3584	7252	7271	7292	7316	7342	7370	7401
3592	7257	7276	7297	7321	7347	7375	7406
3600	7262	7281	7302	7326	7352	7380	7410
3608	7267	7286	7307	7331	7357	7385	7415
3616	7272	7291	7312	7336	7361	7390	7420
3624	7277	7296	7317	7341	7366	7394	7425
3632	7282	7301	7322	7346	7371	7399	7430
3640	7287	7306	7327	7351	7376	7404	7435
3648	7292	7311	7332	7356	7381	7409	7439
3656	7297	7316	7337	7360	7386	7414	7444
3664	7302	7321	7342	7365	7391	7419	7449
3672	7307	7326	7347	7370	7396	7424	7454
3680	7312	7331	7352	7375	7401	7428	7459
3688	7317	7336	7357	7380	7406	7433	7463
3696	7322	7341	7362	7385	7410	7438	7468

Specification for HTPA64x62L10/0.8F7.15HiM(SPI)

Rev.0: 2013.01.31 Forg/Schnorr

Dimensions:



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