Type：PCD-2F21-DA

- **主要特点：**

  Specified Design

1. 高可靠性的传感器结构设计；
2. 单芯片数字信号处理；
3. 全部信号处理集成在一个TO5 封装内；
4. 14位模数转换和数字信号处理；
5. 卓越的抗干扰能力；

- **典型应用：**

  Key Application

1. 无线入侵报警；
2. 电池供电门铃；
3. 应急照明灯 ；
4. 运动检测；

- **规格参数：**

参数 Parameters	下限 Min	典型值 Typical	上限 Max	单位 Unit	条件 Condition
敏感元尺寸 Sensing Element Size		2 X 1		mm^2	两个双元相同
响应率 Responsivity	3.3	4.0		kV/W	100℃, 1Hz
双元匹配度 Match		5%	15%		100℃， 1Hz
噪声 Noise	20		80	μVp-p	25℃ 0.3～3Hz
噪声等效功率 NEP		$7.5X10^{-10}$	$30X10^{-10}$	$W·Hz^{-1/2}$	100℃, 1Hz
探测率 D*	$4.7X10^{7}$	$19X10^{7}$		$cm·Hz^{1/2}·W^{-1}$	100℃, 1Hz
电源电压 V_{DD}	2.5	3.0	3.6	Vdc	
工作电流 I_{DD}		3	5	μA	Regulator off, Vdd=3.0V，No load
输出电流 Out I_{OL}	200			uA	V_{OL} <1 V
I_{OH}			-200	uA	V_{OL} > (V_{DD}-1)
带通滤波 Brand Filter	0.4		7.0	Hz	Frequency 64kHz
视场角 Field of View	115°				水平方向不遮挡
	148°				水平方向有遮挡
Gnd	TO5 Metal Package Ground				V_{SS}
Operating Temperature	-20		85	℃	
Storage Temperature	-40		85	℃	

ESD特性：所有引脚都能够承受100pF的电容充电到1.6KV串联1500Ω电阻的放电，测试方法：MIL-STD-883D- 3015

屏蔽时间

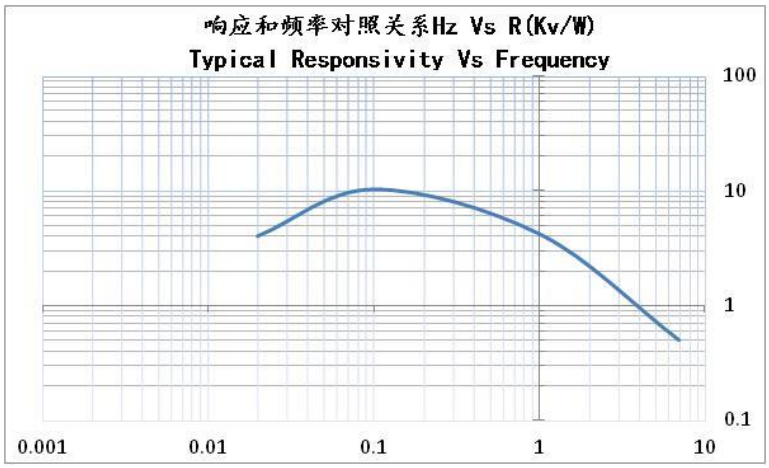
屏蔽时间可选，详见技术参数。

响应触发模式:

触发模式可自定义，详见技术参数。

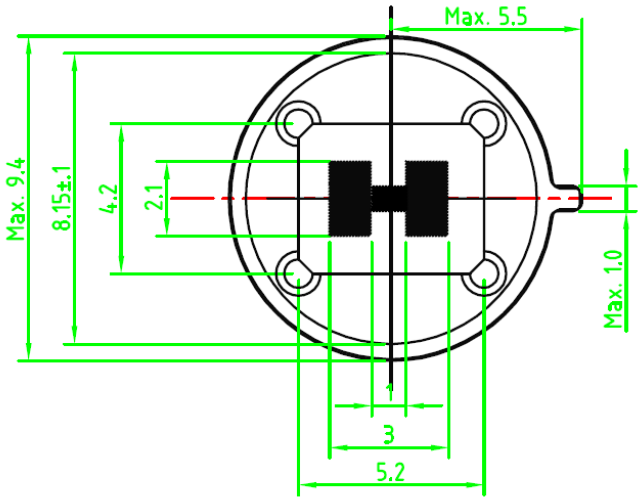
- **典型响应和频率:**

Typical Responsivity Vs. Frequency（频率响应在 0.4 Hz~7.0Hz 显著）

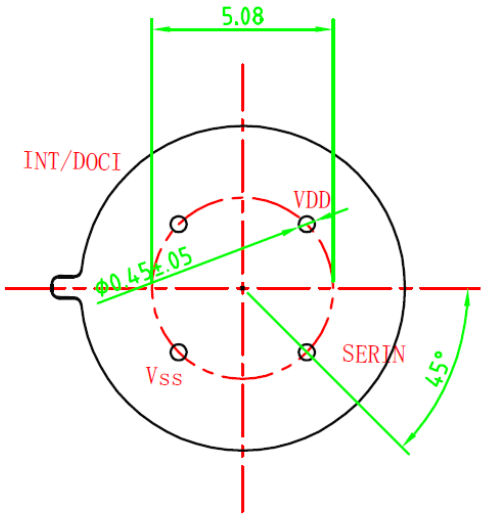


- **尺寸和等效电路:**

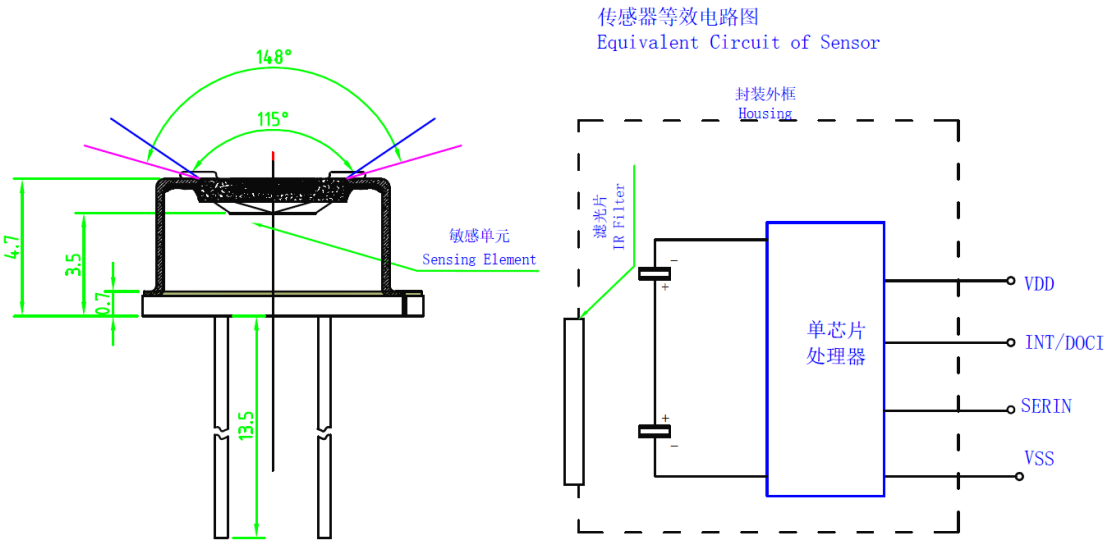
Dimensions and Equivalent Circuit



Top View



Bottom View



- **管脚注释：**

Pin Names:

Pin Name	Pin No.	Description
Vss	1	供电地
INT/DOCI	2	中断、数据读写
Vdd	3	供电正极
SERIN	4	串口输入

- **技术参数：**

最大绝对值

参数	符号	最小	最大	单位	备注
供电电压	Vdd	-0.3	3.6	V	
流入 PIN 脚电流		-100	100	mA	每次一根 PIN
保存温度	Tst	-45	85	℃	

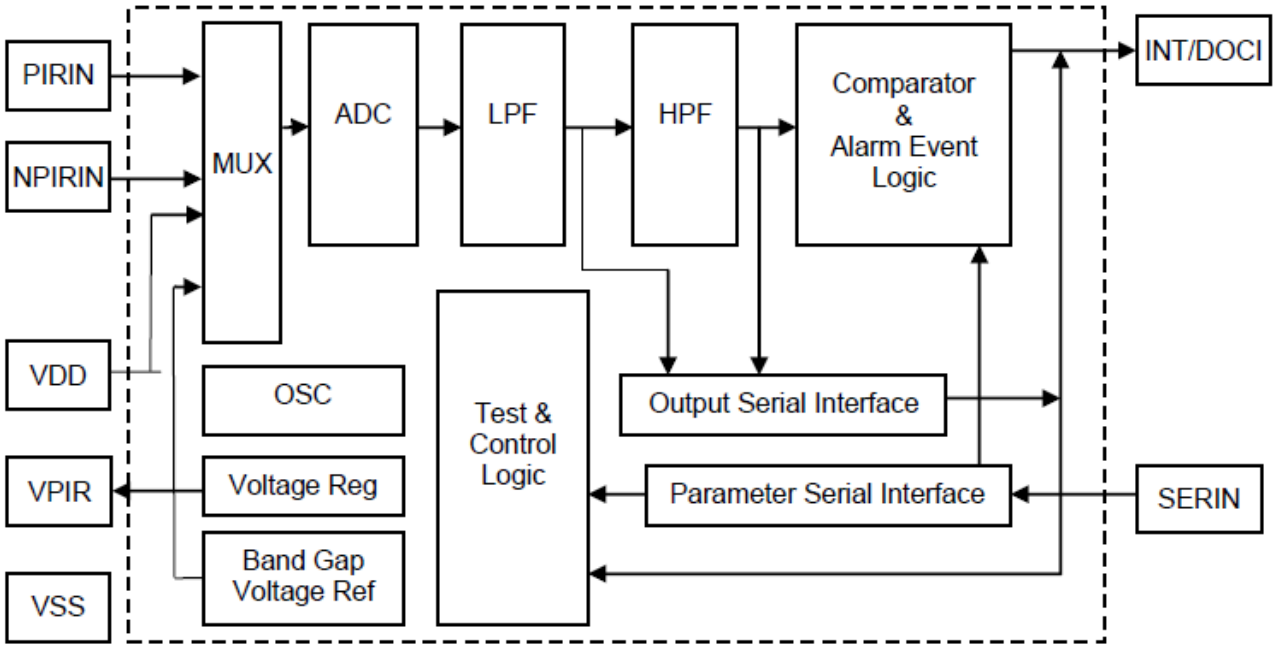
PS：1. 上述参数中超过任意一项都会造成传感器永久损坏。在极限条件下使用会影响传感器可靠性。
2. ESD 防护：所有引脚均能承受一个 100pF 电容在 1.6kV 的情况下通过 1500Ω 电阻放电的冲击。测试方法按：MIL-STD-883D method 3015。

操作条件

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Operating Temperature						
Operating temperature range		-40		85	°C	
Operating Voltage						
Supply Voltage	V_{DD}	2.5		3.6	V	
Supply Current						
Supply current, V_{PIR} Regulator On	I_{DD1}		6	8	μA	VDD=3V, no load
Supply current, V_{PIR} Regulator Off	I_{DD}		3	5	μA	VDD=3V, no load
Voltage Regulator VPIR						
Regulator voltage	V_{DP}		2.2		V	I_R = 5uA
Regulator Output Current	I_R	10			μA	
Input SERIN						
Input low voltage	V_{IL}			0.2	V_{DD}	
Input high voltage	V_{IH}	0.8			V_{DD}	
Input Current	I_I	-1		1	μA	$V_{SS}<V_{IN}<V_{DD}$
Data clock low time	t_L	200			ns	
Data clock high time	t_H	200			ns	
Data bit write time	t_{BW}	$2/F_{CLK}$			μs	
Write timeout	t_{WL}	$16/F_{CLK}$			μs	
Input / Output INT/DOCI						
Input low voltage	V_{IL}			0.2	V_{DD}	
Input high voltage	V_{IH}	0.8			V_{DD}	
Output current high	I_{OH}			-200	μA	$V_{OL}>(V_{DD}-1V)$
Output current low	I_{OL}	200			μA	$V_{OL}<1V$
Input Capacitance			5		pF	
Force read setup time	t_{FR}	$2/F_{CLK}$				
Time to clear interrupt	t_{CL}	$2/F_{CLK}$				
Data clock low time	t_L	200			ns	
Data clock high time	t_H	200			ns	
Data bit settling time, DOCI out	t_{bit}	1			μs	CLOAD = 10pF
Read timeout	t_{RA}	$4/F_{CLK}$			μs	

PIRIN / NPIRIN Inputs						
PIRIN /NPIRIN input resistance to V_{SS}		50			GΩ	-60mV < VIN < 60mV
PIRIN /NPIRIN input resistance differential		100			GΩ	-60mV < VIN < 60mV
PIRIN input voltage range		-53		53	mV	
Resolution		5.9	6.5	7.2	µV/count	
ADC output range		511		2^14-511	Counts	
ADC Offset		7000	8000	9000	Counts	
ADC Noise referred to Input					√Hz	F = 0.1Hz .. 10Hz
Supply Voltage Measurement						
Resolution		590	650	720	µV/count	
ADC output range		2^13		2^14-511	counts	
Temperature Measurement						
Resolution			80		Counts/K	
ADC output range		511		2^14-511	Counts	
Value at 300K		6700	8200	9900	Counts	
Oscillator and Filter						
LPF cutoff frequency		F_{CLK} * 1.41 / 2048 / PI			Hz	
HPF cutoff frequency		F_{CLK} /16 * 1.41 / 2048 / PI			Hz	
On chip oscillator frequency	F_{OSC}	56	64	74	kHz	
System Clock	F_{CLK}		F_{OSC}/2			

逻辑框图



功能介绍

MUX
The multiplexer selects the source signal for the ADC. It can select between the differential PIR inputs, differential temperature sensor output and asymmetrical supply voltage divider.

Voltage Regulator
The integrated voltage regulator provides a regulated 2.2V supply for an externally connected conventional PIR detector. The regulator can be activated through the control register.

Bandgap Voltage Reference
The bandgap voltage reference provides constant reference currents and voltages to the analog circuitry on chip across the specified operating temperature range of the device.
In addition, it contains a temperature voltage generator (temperature sensor).

Oscillator
The IC contains an on chip low power oscillator. The frequency is set to 64kHz. The timing signals and cutoff frequencies of the digital filters are derived from this frequency.

Band-Pass Filter
A 2nd order low-pass filter with a cut-off frequency of 7Hz eliminates unwanted higher frequency components. This signal is then passed to a 2^{nd} order high pass filter with a 0.4Hz cut-off frequency. Both filter output are accessible through the serial interface.

Alarm Event Logic
The signal from the band pass filter is rectified. When the signal level exceeds the sensitivity threshold, an internal pulse is generated. Subsequent pulses are counted, whenever the signals changes sign and exceeds the threshold again. The conditions for an alarm event such as the amount of pulses as well as the time window in which the pulses occur are programmable.

If an alarm event is cleared by resetting the interrupt, any motion detection is stopped during the programmable blind time. This feature is important to prevent self-triggering in applications, where high detection sensitivity is required.

The interrupt will be cleared by driving a "0" (<0.8V) for at least 100ns (t_{CL}). Thereafter, the processor can switch the port back to high impedance.

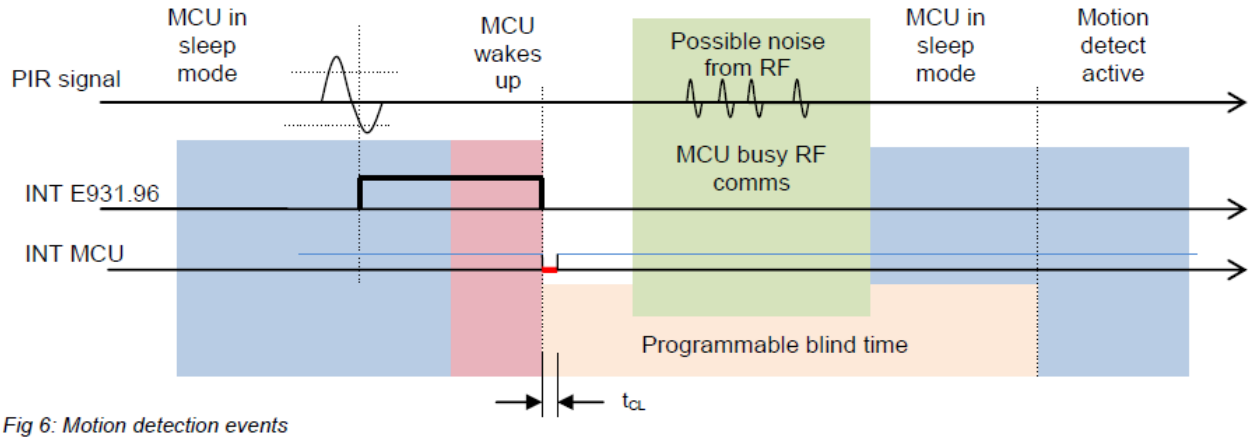


Fig 6: Motion detection events

Serial Interface
The device setup is done by programming setup registers via the SERIN pin. A simple clocked data-in protocol is used. Information from the device is read out with the INT/DOCI pin. A similar clocked data-out protocol is used.
The E931.96A accepts new data, whenever the SERIN has been at low level for at least 16 system clocks and the supply voltage is above 2V.

配置簿

Configuration Register

The device contains a configuration register. Write access is through the serial input. Read access is performed through the interrupt output.
The following parameters can be adjusted through the control / configuration registers:

1. **Sensitivity**
   The sensitivity / detection threshold is defined with the register value. The resolution of the register is 6.5µV.
   The threshold is [Register Value] * 6.5µV

2. **Blind Time**
   Ignores motion after the interrupt output is switched back to 0
   Range: 0.5s... 8s.
   The blind time is [Register Value] *0.5s

3. **Programmable pulse counter**
   1... 4 pulses with sign change in between
   Amount of pulses = [Register Value] + 1

4. **Window time**
   For noisy environments
   4s... 16s window
   Window time = [Register Value] * 4s + 4s

5. **Motion Detect Enable**
   0 = disable, 1 = enabled

6. **Interrupt Source**
   The interrupt source can be selected between Motion (default) or ADC Decimation Filter. If the decimation filter is selected, interrupts are generated every 14ms.
   0 = Motion, 1 = Filter
   The Interrupt can be switched off by setting the mask bit to Motion and switching off the motion detector function.

7. **Voltage Source**
   There is only one ADC integrated on chip. The following source voltages are selectable for the ADC:
   PIR Signal, BFP Output = 0
   PIR Signal, LPF Output = 1
   Chip Supply Voltage = 2
   On Chip Temperature Sensor = 3
   For Motion Detector Mode, '0' or '1' has to be selected.

8. **Supply Regulator Enable for conventional PIR Detector (2.2V)**
   Supply a regulated 2.2V on the V_{REG} output.
   1 = disabled, 0 = enabled

9. **Start Self-Test**
   Initiates PIR self-test procedure that takes 2seconds to complete.
   0 to 1 change = start

10. **Sample Capacitor Value**
    For different size pyro ceramics, different sample capacitors can be selected for the pyro ceramic test

11. **User test-modes**
    Reserved, program with 0

串口数据输入

The configuration data is transferred into the device via the serial input. The external microcontroller has to generate a zero to one transition on the SERIN input and subsequently apply the data bit value (0/1).
The 'zero' and 'one' time for the transition can be very short (1 instruction cycle of the microcontroller). The data bit value must be applied for at least 2 system clocks (t_{bit}) of the E931.96A.

Whenever the transfer of data bits is interrupted for a period greater than 16 system clocks (t_R), the last data received is latched into the configuration register. The transmission of a 25 bit data should not be interrupted for more than 15 system clocks, as the device may latch the data already at this stage.

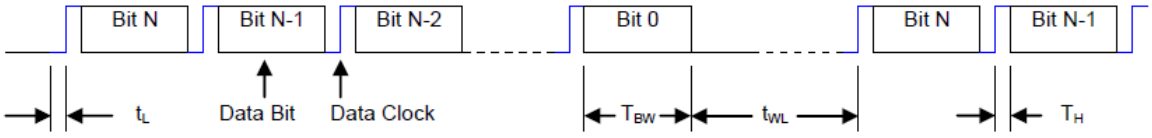


Fig 7: Serial Data clocked into device by MCU

Bit-No	Register	Remarks
[24:17]	[7:0] Sensitivity	The values defines threshold for detection in 6.5µV steps
[16:13]	[3:0] Blind Time	No motion detection for the time programmed (0.5s .. 8s), after the interrupt output changed from "H" to "L"
[12:11]	[1:0] Pulse Counter	Amount of pulses during the specified time window which triggers an alarm event (interrupt = "H")
[10:9]	[1:0] Window Time	The specified time window (4s .. 16s) in which the amount of pulses will trigger an alarm event (interrupt = "H")
[8]	[0] Motion Detector Enable	1 = enable
[7]	[0] Interrupt Source	0 = Motion, 1 = Filter / ADC
[6:5]	[1:0] ADC / Filter Voltage source	0 = PIR (BPF), 1 = PIR (LPF), 2 = Supply Voltage (LPF), 3 = Temperature Sensor (LPF)
[4]	[0] Supply Regulator Enable	0 = Switches on supply voltage regulator for conventional detector
[3]	[0] Start Self-Test	0 to 1 transition initiates PIR self-test procedure
[2]	[0] Sample capacitor size	1 = 2 * default capacitance for self-test
[1:0]	[1:0] User test-modes select	Test modes

Table 3: Register values and corresponding parameters

串口数据输出、中断

The serial output serves as an Interrupt output, indicating motion and as a serial output for reading status and configuration data from the circuit.

Read Procedure

The E931.96 accepts readout with MCU defined timing. The MCU has to force DOCI to a high level for the duration of more than 2 device clock cycles (t_{FR}) and subsequently read out the data bits as described in the timing diagram below. Reading can be terminated at any time by forcing the DOCI line to "0" for at least 4 system clock cycles.

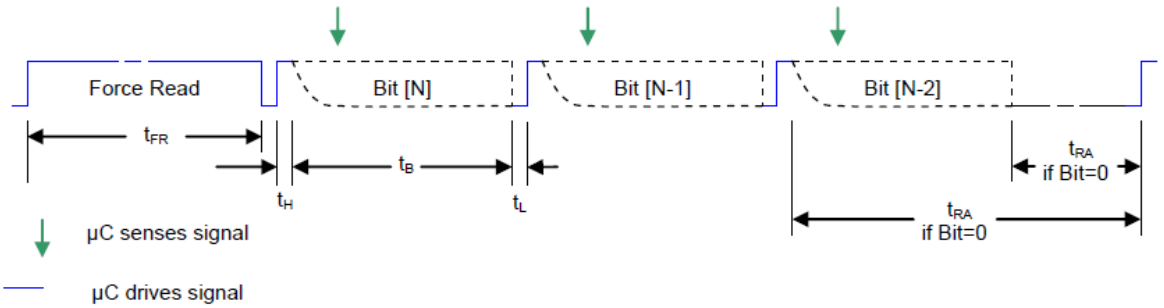


Fig 8: Timing diagram for the DOCI interface

The interrupt source for the DOCI / INTR output can be selected between the ADC and the motions detect logic. If the ADC is selected, an interrupt is produced every 512 system clocks. If not, the alarm event logic will set the interrupt, whenever it detects motion AND motion detection is activated. No interrupt will be generated while the microcontroller accesses the interface.

状态及配置数据

The PIR voltage as well as all internal data can be read through the DOCI interface. The sequence of the data is fixed due to priority. The device outputs the PIR voltage value first, followed by status and configuration information. It is not required to read all data.

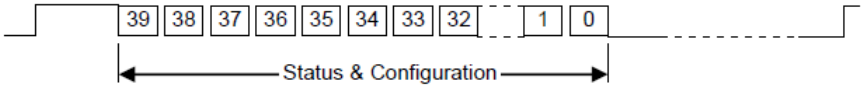


Fig 9: Data words available on DOCI interface

Bit-No	Register	Remarks
[39]	[0] PIR out of range	Indicates, that Sensor Ceramic was discharged
[38:25]	[13:0] PIR Voltage, 6.5µV/cnt	LPF or BPF output, depending on configuration
[24:17]	[7:0] Sensitivity	The values defines threshold for detection
[16:13]	[3:0] Blind Time	No motion detection for the time programmed, after the interrupt output changed from “H” to “L”
[12:11]	[1:0] Pulse Counter	Amount of pulses during the specified time window which triggers an alarm event (interrupt = “H”)
[10:9]	[1:0] Window Time	The specified time window in which the amount of pulses will trigger an alarm event (interrupt = “H”)
[8]	[0] Motion detector Enable	
[7]	[0] Interrupt Source	0 = Motion, 1 = Filter
[6:5]	[1:0] ADC / Filter Voltage source	0 = PIR (HPF), 1 = PIR, 2 = Supply Voltage, 3 = Temperature Sensor
[4]	[0] Supply Regulator Enable	0 = Switches on supply voltage regulator for conventional detector
[3]	[0] Start Self-Test	Initiates PIR self-test procedure
[2]	[0] Sample capacitor size	1 = 2 * default capacitance
[1:0]	[1:0] User test-modes select	Test modes

Table 4: Register values and corresponding parameters

其他

PIR Voltage Measurement

a) LPF Output
The ADC Source [6:5] has to be switched to the PIR inputs and the digital LPF output needs to be selected (=1).
V_{PIR} = (ADC_out – ADC_offset) * 6.5µV.

b) HPF Output
The ADC Source [6:5] has to be switched to PIR input and the digital HPF output needs to be selected (=0).
V_{PIR} = ADC_out * 6.5µV.

Supply Voltage Measurement

The ADC Source [6:5] has to be switched to Chip Supply (=2).
V_{DD} = (ADC_out – ADC_offset) * 650µV.

Temperature Measurement

The ADC Source [6:5] has to be switched to the temperature sensor (=3).
Temperature = Tcal + (ADC_out – ADC_offset(Tcal)) / 80 * counts/K

ADC_offset = ADC value @ VIN = 0, typical value = 2^13
ADC_offset(Tcal) = ADC value at defined ambient temperature, typical value = 6400@300K

- 使用注意事项：
  Handling Tips

不当的使用方法可能会损伤或永久损坏传感器，以下操作方法有助于保护器件的高性能：

1. 为了让传感器具有高灵敏度，传感器中通常使用的感应材料对热比较敏感，敏感材料可能在高温下丧失性能。使用波峰焊接时，我们建议的焊接温度是 285℃，在高温区停留时间应小于 5 秒。如果焊接过程中有预加热器，则必须采取相应措施避免传感器受到烘烤。传感器除引线焊接处外，其它部分不宜经受 100℃以上的高温。

2. 使用焊铁手工焊接时，焊铁温度应设定在 240℃-280℃，焊接时间应控制在 2-4 秒。

3. 无论使用何种焊接方式，焊点与传感器底座之间应留出 3-4mm 或以上的距离。

4. 传感器由气密性极好的外壳封焊而成，且内充干燥氮气。为了保证器件的气密性，我们不建议对引线进行弯折，弯折可能会破坏玻璃-金属封接部位的气密性，造成器件漏气。如果确需弯折使用，请使用工具辅助，并保证弯折过程中引线根部不受力。请保证弯折点与传感器底座之间有 3mm 以上的距离。任何时候不要轴向扭动引线。

5. 传感器的窗口滤光片镀有精密的增透膜以提高红外线的透过率，请避免用裸手直接接触传感器的窗口。操作过程中也需要避免窗口与其它物体接触、摩擦，以防止滤光片划伤。如滤光片表面有脏污，可用绒布粘无水乙醇适度擦拭。

6. 取放传感器需要作为防静电敏感设备对待并保护他们免受静电损坏，工作区域应静电防护。人员取放传感器需要佩戴防静电防护。

7. 避免机械的冲击传感器，特别是引线部位，并请避免传感器直接跌落到地面。