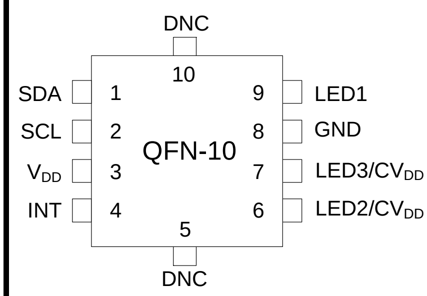
Si1141/42/43

带 I^2C 接口的临近 / 环境光传感器 IC

功能

- 集成红外线临近探测器
  - 临近探测可从 1 cm 以下调节到超过 200 cm
  - 三个独立的 LED 驱动器
  - 每个 LED 驱动器有 15 个电流设置，从 5.6 mA 到 360 mA
  - 25.6 µs LED 驱动器脉冲宽度
  - 50 cm 临近范围，具有单个脉冲 (<3 klx)
  - 15 cm 临近范围，具有单个脉冲 (>3 klx)
  - 运行时高达 128 klx （阳光直射）
  - 高反射灵敏度 < 1 µW/cm^2
  - 高电磁抗扰性，无屏蔽封装
- 集成环境光传感器
  - 分辨率可以达到 100 mlx，允许在深色玻璃下工作
  - 在两个 ADC 范围设置之间动态范围可以达到 1 至 128 klx
  - 使用红外校正算法可以准确测量照明度
- 业界最低的功耗
  - 1.71 至 3.6 V 电源电压
  - 9 µA 平均电流 （180 mA 和 3 µA Si114x 电源时每 800 ms LED 脉冲 25.6 µs ）
  - < 500 nA 待机电流
  - 25.6µs LED “ 开启 ” 时间使总功耗占空比较低，不会影响性能和抗扰度
  - 支持内部和外部唤醒
  - 内置电压电源监控器和接通电源复位控制器
- 串行通信
  - 数据速率高达 3.4 Mbps
  - 从模式硬件地址解码 (0x5A)
- 小外形 10 引线 2x2 mm QFN
- 温度范围
  - –40 至 +85 °C

Pin Assignments



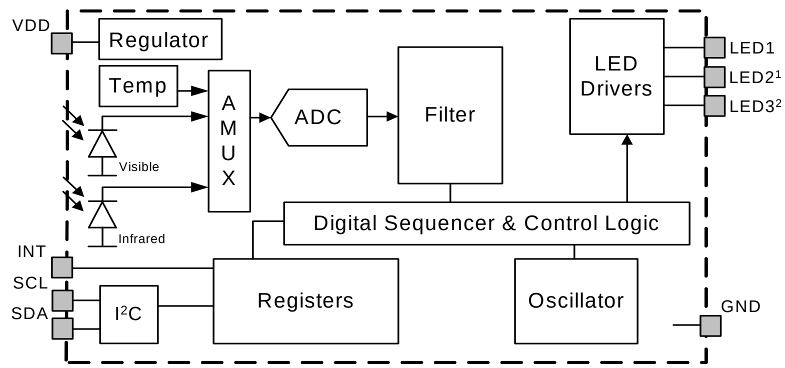
应用

- 手机
- 心率监控
- 脉搏血氧计
- 可穿戴
- 音频产品
- 安全面板
- 窜改探测电路
- 分配器
- 阀门控制
- 烟雾探测器
- 非接触开关
- 非接触滑动器
- 占位传感器
- 消费类电子设备
- 工业自动化
- 显示屏背光控制
- 光中断器

说明

Si1141/42/43 是基于反射的低功率红外线临近和环境光传感器，带有 I^2C 数字接口和可编程事件中断输出。此非接触传感器 IC 包括模拟到数字转换器、集成高灵敏度可见和红外线光电二极管 、数字信号处理器和具有十五个可选驱动电平的一个、两个或三个集成红外线 LED 驱动器。 Si1141/42/43 在广泛的动态范围和包括阳光直射在内的各种光源下可提供优异性能。 Si1141/42/43 还可以在深色玻璃盖下工作。光电二极管响应和关联的数字转换电路对人造光闪烁噪声和自然光颤动噪声具有优异的抗扰性。Si1142/43 具有两个或多个 LED，能够支持多轴式临近运动探测。 Si1141/42/43 器件在 10 引线 2x2 mm QFN 封装中提供，能够在 –40 至 +85 °C 温度范围中在 1.71 至 3.6 V 的条件下运行。

功能框图



1. Si1142 and Si1143 only. Must be tied to V_{DD} with Si1141.
2. Si1143 only. Must be tied to V_{DD} with Si1141 and Si1142.

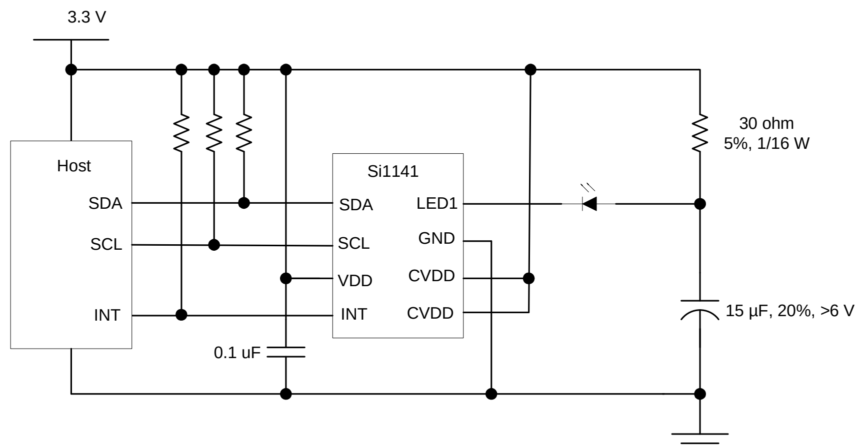


Figure 1. Si1141 Basic Application

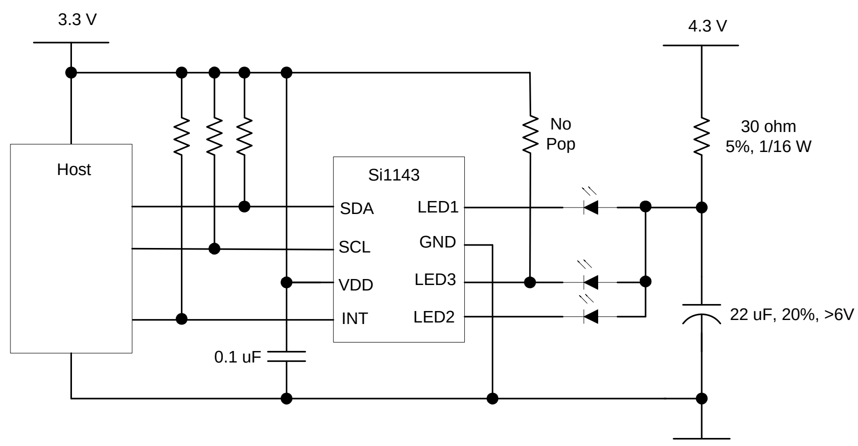


Figure 2. Si1143 Application with Three LEDs and Separate LED Power Supply

注： 有关更多的应用示例，请参阅 “AN498：Si114x 设计者指南 ”。

目录

1. 电气规格

1.1. 性能表

Table 1. Recommended Operating Conditions

Parameter	Symbol	Condition	Min	Typ	Max	Unit
V_{DD} Supply Voltage	V_{DD}		1.71	—	3.6	V
V_{DD} OFF Supply Voltage	V_{DD_OFF}	OFF mode	–0.3		1.0	V
V_{DD} Supply Ripple Voltage		V_{DD} = 3.3 V 1 kHz–10 MHz	—	—	50	mVpp
Operating Temperature	T		–40	25	85	°C
SCL, SDA, Input High Logic Voltage	I^2C_{VIH}		V_{DD}x0.7	—	V_{DD}	V
SCL, SDA Input Low Logic Voltage	I^2C_{VIL}		0	—	V_{DD}x0.3	V
PS Operation under Direct Sunlight	Edc		—	—	128	klx
IrLED Emission Wavelength	l		750	850	950	nm
IrLED Supply Voltage	VLED	IrLED V_F = 1.0 V nominal	V_{DD}	—	4.3	V
IrLED Supply Ripple Voltage		Applies if IrLEDs use separate supply rail 0–30 kHz 30 kHz–100 MHz	 — —	 — —	 250 100	 mVpp mVpp
Start-Up Time		V_{DD} above 1.71 V	25	—	—	ms
LED3 Voltage		Start-up	V_{DD}x0.77	—	—	V

Table 2. Performance Characteristics[1]

Parameter	Symbol	Condition	Min	Typ	Max	Unit
I_{DD} OFF Mode	I_{off}	$V_{DD} < V_{DD\_OFF}$ (leakage from SCL, SDA, and INT not included)	—	240	1000	nA
I_{DD} Standby Mode	I_{sb}	No ALS / PS Conversions No I^2C Activity V_{DD} = 1.8 V	—	150	500	nA

Notes:
1. Unless specifically stated in "Conditions", electrical data assumes ambient light levels < 1 klx.
2. Proximity-detection performance may be degraded, especially when there is high optical crosstalk, if the LED supply and voltage drop allow the driver to saturate and current regulation is lost.
3. Guaranteed by design and characterization.
4. Represents the time during which the device is drawing a current equal to I_{active} for power estimation purposes. Assumes default settings.

Table 2. Performance Characteristics[1] (Continued)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
I_{DD} Standby Mode	I_{sb}	No ALS / PS Conversions No I^2C Activity V_{DD} =3.3 V	—	1.4	—	µA
I_{DD} Actively Measuring	I_{active}	Without LED influence, V_{DD} = 3.3 V	—	4.3	5.5	mA
Peak IDD while LED1, LED2, or LED3 is Actively Driven		V_{DD} = 3.3 V	—	8	—	mA
LED Driver Saturation Voltage[2,3]		Vdd = 1.71 to 3.6 V PS_LEDn = 0001 PS_LEDn = 0010 PS_LEDn = 0011 PS_LEDn = 0100 PS_LEDn = 0101 PS_LEDn = 0110 PS_LEDn = 0111 PS_LEDn = 1000 PS_LEDn = 1010 PS_LEDn = 1010 PS_LEDn = 1011 PS_LEDn = 1100 PS_LEDn = 1101 PS_LEDn = 1110 PS_LEDn = 1111	 — — — — — — — — — — — — — — —	 50 60 70 80 115 150 185 220 255 290 315 340 360 385 410	 70 105 105 105 450 450 450 450 450 450 600 600 600 600 600	mV
LED1, LED2, LED3 Pulse Width	t_{PS}		—	25.6	30	µs
LED1, LED2, LED3, INT, SCL, SDA Leakage Current		V_{DD} = 3.3 V	–1	—	1	µA

Notes:

1. Unless specifically stated in "Conditions", electrical data assumes ambient light levels < 1 klx.
2. Proximity-detection performance may be degraded, especially when there is high optical crosstalk, if the LED supply and voltage drop allow the driver to saturate and current regulation is lost.
3. Guaranteed by design and characterization.
4. Represents the time during which the device is drawing a current equal to I_{active} for power estimation purposes. Assumes default settings.

Table 2. Performance Characteristics[1] (Continued)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
LED1, LED2, LED3 Active Current	I_{LEDx}	V_{DD} = 3.3 V, single drive				mA
		V_{LEDn} = 1 V, PS_LEDn = 0001	3.5	5.6	7	
		V_{LEDn} = 1 V, PS_LEDn = 0010	—	11.2	—	
		V_{LEDn} = 1 V, PS_LEDn = 0011	13	22.4	29	
		V_{LEDn} = 1 V, PS_LEDn = 0100	—	45	—	
		V_{LEDn} = 1 V, PS_LEDn = 0101	—	67	—	
		V_{LEDn} = 1 V, PS_LEDn = 0110	—	90	—	
		V_{LEDn} = 1 V, PS_LEDn = 0111	—	112	—	
		V_{LEDn} = 1 V, PS_LEDn = 1000	—	135	—	
		V_{LEDn} = 1 V, PS_LEDn = 1001	—	157	—	
		V_{LEDn} = 1 V, PS_LEDn = 1010	—	180	—	
		V_{LEDn} = 1 V, PS_LEDn = 1011	—	202	—	
		V_{LEDn} = 1 V, PS_LEDn = 1100	—	224	—	
		V_{LEDn} = 1 V, PS_LEDn = 1101	—	269	—	
		V_{LEDn} = 1 V, PS_LEDn = 1110	—	314	—	
		V_{LEDn} = 1 V, PS_LEDn = 1111	—	359	—	
Actively Measuring Time[4]		Single PS	—	155	—	µs
		ALS VIS + ALS IR	—	285	—	µs
		Two ALS plus three PS	—	660	—	µs
Visible Photodiode Response		Sunlight ALS_VIS_ADC_GAIN = 0 VIS_RANGE = 0	—	0.282	—	ADC counts/lux
		2500K incandescent bulb ALS_VIS_ADC_GAIN = 0 VIS_RANGE = 0	—	0.319	—	ADC counts/lux
		“Cool white” fluorescent ALS_VIS_ADC_GAIN = 0 VIS_RANGE = 0	—	0.146	—	ADC counts/lux
		Infrared LED (875 nm) ALS_VIS_ADC_GAIN = 0 VIS_RANGE = 0	—	8.277	—	ADC counts.m^2/W

Notes:

1. Unless specifically stated in "Conditions", electrical data assumes ambient light levels < 1 klx.
2. Proximity-detection performance may be degraded, especially when there is high optical crosstalk, if the LED supply and voltage drop allow the driver to saturate and current regulation is lost.
3. Guaranteed by design and characterization.
4. Represents the time during which the device is drawing a current equal to I_{active} for power estimation purposes. Assumes default settings.

Table 2. Performance Characteristics[1] (Continued)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Small Infrared Photodiode Response		Sunlight ALS_IR_ADC_GAIN = 0 IR_RANGE = 0	—	2.44	—	ADC counts/lux
		2500K incandescent bulb ALS_IR_ADC_GAIN = 0 IR_RANGE = 0	—	8.46	—	ADC counts/lux
		“Cool white” fluorescent ALS_IR_ADC_GAIN = 0 IR_RANGE = 0	—	0.71	—	ADC counts/lux
		Infrared LED (875 nm) ALS_IR_ADC_GAIN = 0 IR_RANGE = 0	—	452.38	—	ADC counts.m^2/W
Large Infrared Photodiode Response		Sunlight PS_ADC_GAIN = 0 PS_RANGE = 0 PS_ADC_MODE = 0	—	14.07	—	ADC counts/lux
		2500K incandescent bulb PS_ADC_GAIN = 0 PS_RANGE = 0 PS_ADC_MODE = 0	—	50.47	—	ADC counts/lux
		“Cool white” fluorescent PS_ADC_GAIN = 0 PS_RANGE = 0 PS_ADC_MODE = 0	—	3.97	—	ADC counts/lux
		Infrared LED (875 nm) PS_ADC_GAIN = 0 PS_RANGE = 0 PS_ADC_MODE = 0	—	2734	—	ADC counts.m^2/W
Visible Photodiode Noise		All gain settings	—	7	—	ADC counts RMS
Small Infrared Photodiode Noise		All gain settings	—	1	—	ADC counts RMS

Notes:
1. Unless specifically stated in "Conditions", electrical data assumes ambient light levels < 1 klx.
2. Proximity-detection performance may be degraded, especially when there is high optical crosstalk, if the LED supply and voltage drop allow the driver to saturate and current regulation is lost.
3. Guaranteed by design and characterization.
4. Represents the time during which the device is drawing a current equal to I_{active} for power estimation purposes. Assumes default settings.

Table 2. Performance Characteristics[1] (Continued)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Large Infrared Photodiode Noise		All gain settings	—	10	—	ADC counts RMS
Visible Photodiode Offset Drift		VIS_RANGE = 0 ALS_VIS_ADC_GAIN = 0 ALS_VIS_ADC_GAIN = 1 ALS_VIS_ADC_GAIN = 2 ALS_VIS_ADC_GAIN = 3 ALS_VIS_ADC_GAIN = 4 ALS_VIS_ADC_GAIN = 5 ALS_VIS_ADC_GAIN = 6 ALS_VIS_ADC_GAIN = 7	—	 –0.3 –0.11 –0.06 –0.03 –0.01 –0.008 –0.007 –0.008	—	ADC counts/°C
Small Infrared Photodiode Offset Drift		IR_RANGE = 0 IR_GAIN = 0 IR_GAIN = 1 IR_GAIN = 2 IR_GAIN = 3	—	 –0.3 –0.06 –0.03 –0.01	—	ADC counts/°C
SCL, SDA, INT Output Low Voltage	V_{OL}	I = 4 mA, V_{DD} > 2.0 V I = 4 mA, V_{DD} < 2.0 V	— —	— —	V_{DD} x 0.2 0.4	V V
Temperature Sensor Offset		25 °C	—	11136	—	ADC counts
Temperature Sensor Gain			—	35	—	ADC counts/°C

Notes:
1. Unless specifically stated in "Conditions", electrical data assumes ambient light levels < 1 klx.
2. Proximity-detection performance may be degraded, especially when there is high optical crosstalk, if the LED supply and voltage drop allow the driver to saturate and current regulation is lost.
3. Guaranteed by design and characterization.
4. Represents the time during which the device is drawing a current equal to I_{active} for power estimation purposes. Assumes default settings.

Table 3. I^2C Timing Specifications

Parameter	Symbol	Min	Typ	Max	Unit
Clock Frequency	f_{SCL}	0.09	—	3.4	MHz
Clock Pulse Width Low	t_{LOW}	160	—	—	ns
Clock Pulse Width High	t_{HIGH}	60	—	—	ns
Rise Time	t_R	10	—	40	ns
Fall Time	t_F	10	—	40	ns
Start Condition Hold Time	$t_{HD.STA}$	160	—	—	ns
Start Condition Setup Time	$t_{SU.STA}$	160	—	—	ns
Input Data Setup Time	$t_{SU.DAT}$	10	—	—	ns
Input Data Hold Time	$t_{HD.DAT}$	0	—	—	ns
Stop Condition Setup Time	$t_{SU.STO}$	160	—	—	ns

Table 4. Absolute Maximum Limits

Parameter	Condition	Min	Typ	Max	Unit
V_{DD} Supply Voltage		–0.3	—	4	V
Operating Temperature		–40	—	85	°C
Storage Temperature		–65	—	85	°C
LED1, LED2, LED3 Voltage	at V_{DD} = 0 V, T_A < 85 °C	–0.5	—	3.6	V
INT, SCL, SDA Voltage	at V_{DD} = 0 V, T_A < 85 °C	–0.5	—	3.6	V
Maximum total current through LED1, LED2 and LED3		—	—	500	mA
Maximum total current through GND		—	—	600	mA
ESD Rating	Human Body Model Machine Model Charged-Device Model	— — —	— — —	2 225 2	kV V kV

1.2. 典型性能图

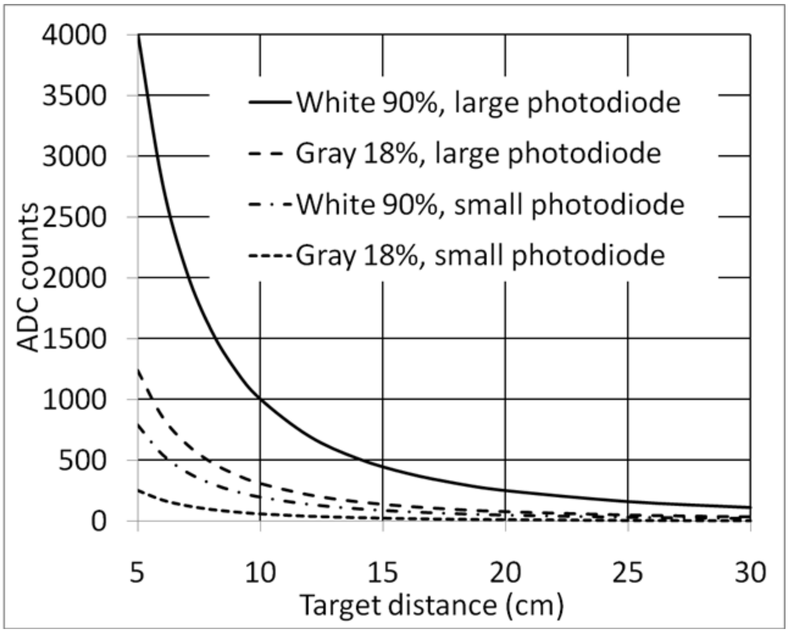


Figure 3. Proximity response using Kodak gray cards, PS_RANGE=0, PS_ADC_GAIN=0 (single 25.6µs LED pulse), ± 22°LED view angle, 850 nm, 22.5 mW/sr, no overlay, 5 mm LED center to Si114x center

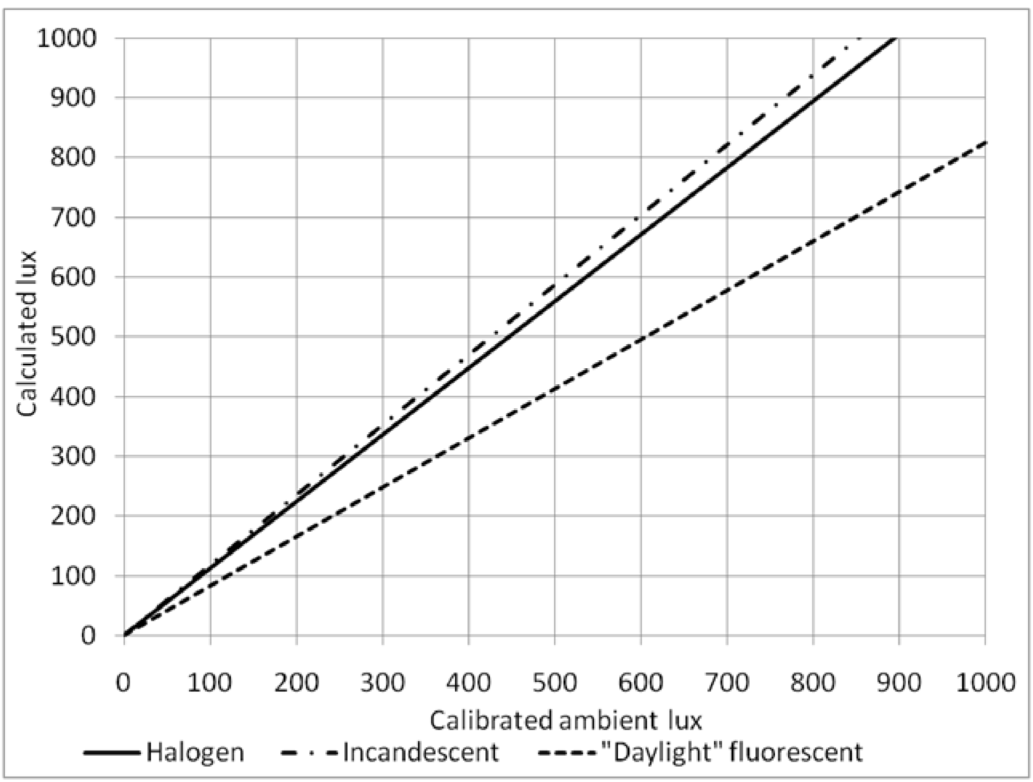


Figure 4. ALS variability with different light sources

SILICON LABS

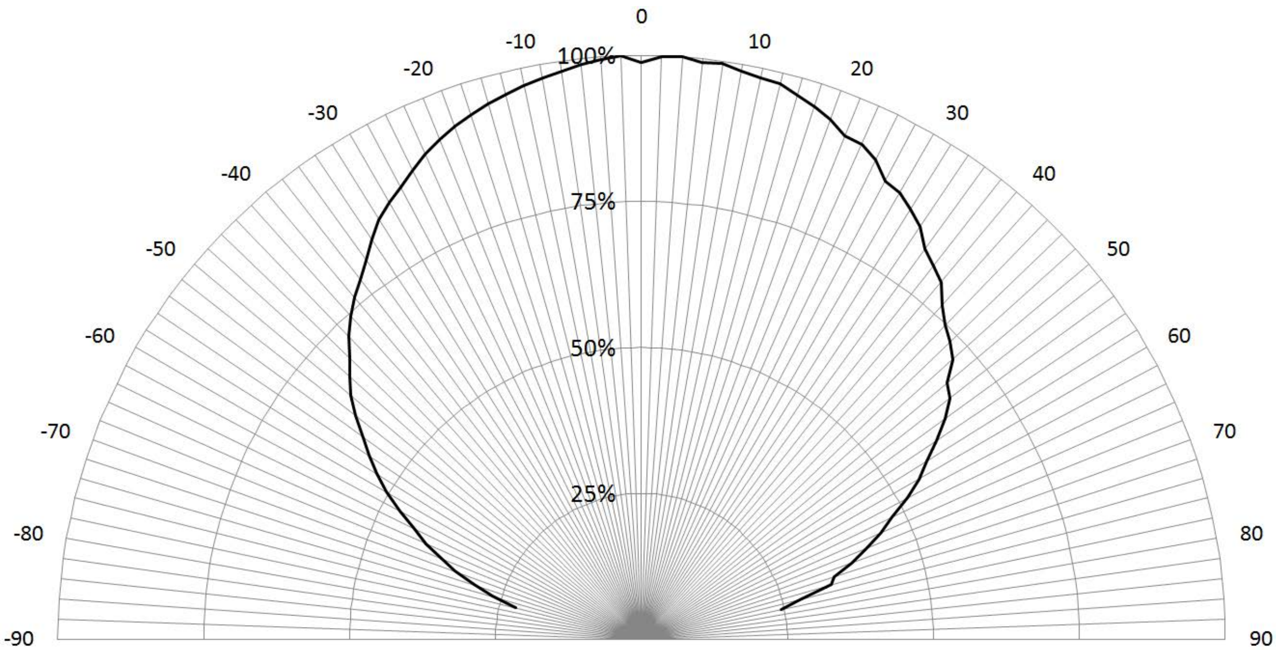


Figure 5. View angle, large photodiode rotated around the pin-5/pin-10 (“vertical”) axis

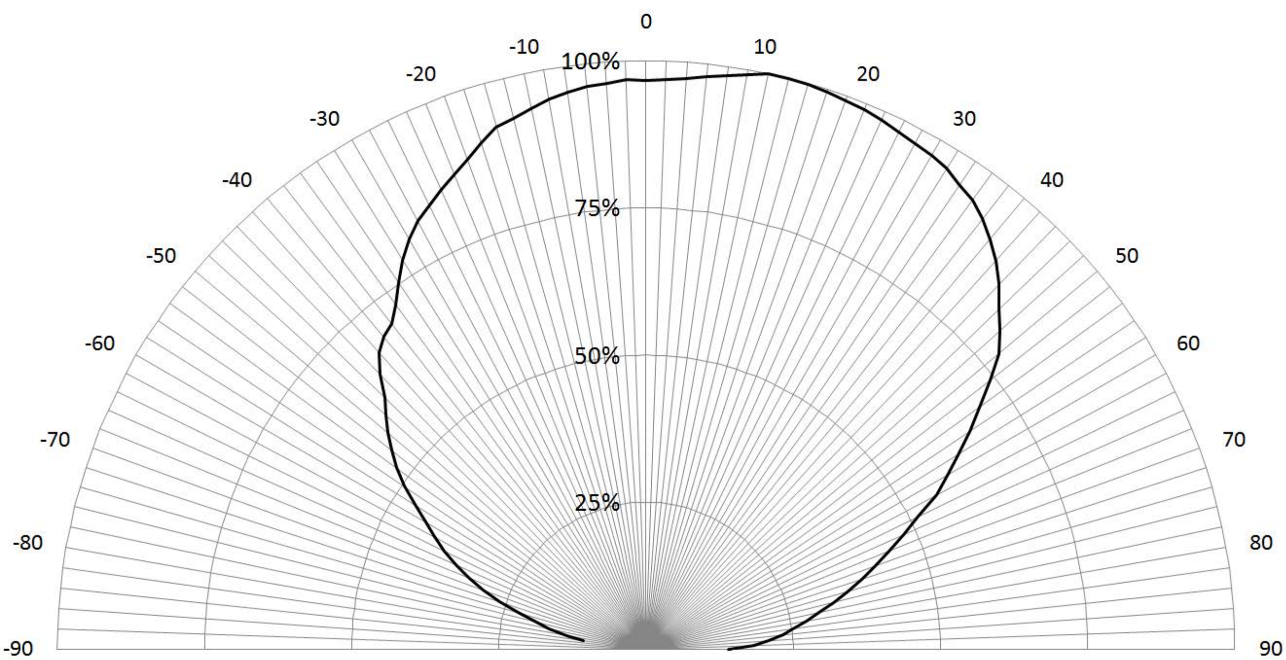


Figure 6. View angle, large photodiode rotated around “horizontal”axis and small photodiode rotated around either axis

2. 功能描述

2.1. 简介

Si1141/42/43 是有源光学反射临近探测器和环境光传感器，其运行状态可通过寄存器控制，这些寄存器可通过 I^2C 接口使用。主机可以命令 Si1141/42/43 启动按需临近探测或环境光感应。主机还可以将 Si1141/42/43 置于自发运行状态，在此状态中，它按设定间隔执行测量，并在完成每次测量后或每当超过设定阈值时中断主机。这导致整体系统节电，允许主机控制器在休眠状态下运行更长时间，而不轮询 Si1141/42/43。有关更多详细信息，请参阅 "AN498：Si114x 设计者指南 "。

2.2. 临近感应 (PS)

Si1141/42/43 已被优化用作双端口或单端口的活跃反射临近探测器。在短于 50 cm 的距离内，双端口有源反射临近探测器比基于运动的单端口红外线系统有显著优势，基于运动的单端口红外线系统仅适用于已触发事件。基于运动的红外线探测器可识别临近的物体，但这些物体必须是正在移动才能识别。即使静止物体在临近场地内，基于运动的单端口红外线系统对于这些物体也没什么反应。即使物体没有正在移动或很缓慢地移动， Si1141/42/43 也可以可靠地探测到进入或退出指定临近场地的物体。然而，在大约 30–50 cm 外，即使光学隔离效果良好，由于桌面、墙等旁边物体的静止反射，可能必须进行单端口信号处理。如果运动探测可以接受， Si1141/42/43 通过单个产品窗口可以实现高达 50 cm 的范围。

对于小物体，反射率的降低多达距离的四次方。这意味着距离模糊性比基于运动的无源器件低。例如，物体反射率变化十六倍，意味着探测范围仅缩小 50%。

Si1143 可以驱动三个单独的红外线 LED。将这三个红外线 LED 放入 L 形配置中时，可以对三维临近场地内的物体进行三角测量。因此，可以借助主机软件实施非接触用户界面。

在接到主机的明确命令时， Si1141/42/43 可以启动临近感应测量，或者可以通过自发流程定期启动临近感应测量。有关 Si1141/42/43 运行模式的更多详细信息，请参阅第 17 页上 "3. 运行模式 "。

每当到了进行 PS 测量的时候， Si1141/42/43 进行多达三次测量，具体视在 CHLIST 参数中启用了什么参数而定。还可以修改这些测量的其他 ADC 参数，允许在不同环境光条件下正常运行。

在这三次测量中，都可以对 LED 选择进行设定。默认情况下，每次测量打开一个 LED 驱动器。但是，可以容易地颠倒测量顺序，或者让所有 LED 同时打开。根据情况，可以将每次临近测量值与主机设定的阈值进行比较。每个 PS 通道都有阈值设置，因此每当超过阈值时， Si1141/42/43 可以通知主机。这可以降低主机的中断次数，使软件算法有效。

Si1141/42/43 还可以在一整套临近测量后生成中断，忽略任何阈值设置。

为了动态支持不同的电源使用效率情形，每个输出的红外线 LED 电流都可以独立设定。电流可以设定为几毫安到几百毫安之间的任何值。因此，主机可以动态地为临近探测性能或节能优化。此功能可能非常有用，因为它允许主机在一个物体已进入临近范围后降低 LED 电流，而且在采用较低的电流设置时仍然可以跟踪该物体。最后，通过灵活的电流设置，可以采用受控制的电流吸收器控制红外线 LED 电流，从而提高精确度。

ADC 属性可设定。对于室内运行， ADC 应配置为低信号范围，以获得最佳反射灵敏度。在高环境条件下时， ADC 应配置为高信号电平范围运行。

在低信号范围中运行时，在环境光照度较高的情况下，可能会使 ADC 饱和。任何溢出状况都会在 RESPONSE 寄存器中报告，相应的数据寄存器报告 0xFFFF 值。然后，主机可以调节 ADC 灵敏度。但请注意，溢出状况并不是棘手的问题。如果光照度恢复到 ADC 能力内的范围，相应的数据寄存器将开始正常运行。但是， RESPONSE 寄存器将继续保持溢出状况到收到 NOP 命令为止。即使 RESPONSE 寄存器具有溢出状况，仍然会接受并处理命令。

通过选择更长的积分时间，没有透镜作用也可以实现超过 50 cm 和多达几米的临近探测范围。通过算出多次测量结果的平均值，即使环境光照度较高，也可以进一步加大探测范围。请参阅 "AN498：Si114x 设计者指南 " 中的详细信息。

2.3. 环境光

Si1141/42/43 具有能够同时测量可见光和红外光的光电二极管。但是，可见光光电二极管也受红外光影响。测量照明度时，需要与人眼相同的光谱响应。如果需要准确测量照明度，则必须补偿可见光光电二极管的额外 IR 响应。因此，为了让主机可以对红外光的影响进行校正， Si1141/42/43 在单独通道报告红外光测量结果。单独的可见光光电二极管和 IR 光电二极管适合于各种算法解决方案。然后，主机可以执行这两次测量，运行算法以推导出与人眼感觉相当的照明度。在主机中运行 IR 校正算法可以非常灵活地调节系统相关变量。例如，如果在系统中使用的玻璃阻止的可见光超过红外光，则需要调节 IR 校正。

如果主机没有进行任何红外线校正，则可以在 CHLIST 参数中关闭红外线测量。

默认情况下，针对室内环境光照度优化了测量参数，可以探测低至 6 lx 的光照度。为了在阳光直射的情形中运行，可以将 ADC 设定为在高信号运行条件下运行，以便可以测量阳光直射而不会使 16 位结果溢出。

对于低照度应用，可以延长 ADC 积分时间。通常，积分时间是 25.6 µs。将此积分时间延长到 410 µs 后， ADC 可以探测低至 1 lx 的光照度。可以对 ADC 设定长达 3.28 ms 的积分时间，允许测量高达 100 mlx 的光照度。可见光环境测量的 ADC 积分时间与红外光环境测量的 ADC 积分时间可以分别设定。有了独立的 ADC 参数，就可以在红外光透光率高于可见光透光率的玻璃罩下运行。

在低信号范围中运行或当积分时间延长时，在环境光照度突然升高的情况下，可能会使 ADC 饱和。任何溢出状况都会在 RESPONSE 寄存器中报告，相应的数据寄存器报告 0xFFFF 值。根据这两个溢出指示器中的任一个，主机可以调节 ADC 灵敏度。但是，溢出状况并不是棘手的问题。如果光照度恢复到 ADC 能力内的范围，相应的数据寄存器将开始正常运行。RESPONSE 寄存器将继续保持溢出状况到收到 NOP 命令为止。即使 RESPONSE 寄存器具有溢出状况，仍然会接受并处理命令。

在接到主机的明确命令时， Si1141/42/43 可以启动 ALS 测量，或者可以通过自发流程定期启动 ALS 测量。有关 Si1141/42/43 运行模式的更多详细信息，请参阅第 17 页上 “3. 运行模式 ”。转换频率设置可设定，与临近传感器无关。这样，临近传感器和环境光传感器便可以采用不同转换率运行，从而加强主机对 Si1141/42/43 的控制。

自发运行时，与临近传感器相比， ALS 具有略微不同的中断结构。在每个样本中，或当环境光变化时，可以向主机生成中断。

“ 环境光变化 ” 中断通过结合两个阈值形成一个范围来实现。只要环境光保持在这两个阈值定义的范围内，就不会中断主机。当环境光变化并且超过任一阈值时，将向主机发送一个中断，从而允许通知主机环境光已变化。主机可以使用此中断触发照明度值的重新计算。

此范围可以应用于可见光环境测量或红外光环境测量，但不能同时应用于两者。但是，监测任一通道的环境变化应允许通知环境光照度已变化。

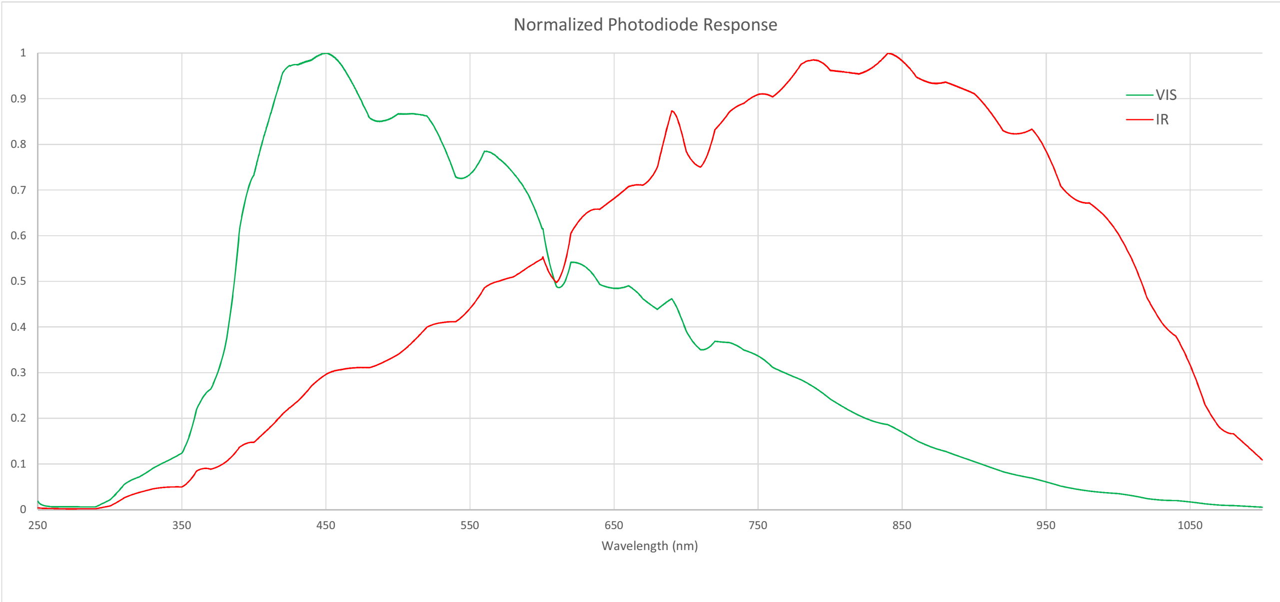


Figure 7. Photodiode Spectral Response to Visible and Infrared Light (Indicative)

2.4. 主机接口

Si1141/42/43 的主机接口由三个引脚组成：

- SCL
- SDA
- INT

SCL 和 SDA 是 I²C 运行所需的标准开路漏极引脚。

Si1141/42/43 使 INT 引脚有效以中断主机处理器。INT 引脚是开路漏极输出。为了正常运行，需要一个上拉电阻器。开路漏极输出可以与系统中的其他开路漏极中断来源共享。

为了正常运行， Si1141/42/43 在 I²C 上进行任何活动之前，应完全完成其初始化模式。

设计 INT、SCL 和 SDA 引脚的目的是使 Si1141/42/43 可以通过软件命令进入关闭模式，而不会干扰总线上其他 I²C 器件的正常运行。

Si1141/42/43 I²C 从地址是 0x5A。 Si1141/42/43 也响应全局地址 (0x00) 和全局复位命令 (0x06)。仅支持 7 位 I²C 地址；不支持 10 位 I²C 地址。

从概念上讲， I²C 接口允许访问 Si1141/42/43 内部寄存器。第 29 页上表 15 汇总了这些寄存器。

I²C 写访问始终以开始 （或重新开始）条件开始。开始条件后的第一个字节是 I²C 地址和读写位。第二个字节指定 Si1141/42/43 内部寄存器的起始地址。随后的字节按顺序写入 Si1141/42/43 内部寄存器中，直到遇到停止条件为止。只有两个字节的 I²C 写访问通常用于设置 Si1141/42/43 内部地址以准备进行 I²C 读取。

I²C 读访问像 I²C 写访问一样，以开始或重新开始条件开始。在 I²C 读取中，I²C 主模块继续为 SCK 计时，使 Si1141/42/43 可以使用内部寄存器内容驱动 I²C。

Si1141/42/43 还支持突发读取和突发写入。突发读取在收集相邻的连续寄存器中很有用。 Si1141/42/43 寄存器映射的设计目的是优化中断处理程序的突发读取，突发写入的目的是方便快速设定常用字段，例如阈值寄存器。

内部寄存器地址是六位 （位 5 至位 0）加上自动递增禁用 （在位 6）。默认情况下，自动递增禁用被关闭。通过禁用自动递增功能，使主机可以反复轮询任何单个内部寄存器，而不必在每当读取寄存器时保持更新 Si1141/42/43 内部地址。

建议当 Si1141/42/43 使 INT 有效时，主机应读取 PS 或 ALS 测量结果（在 I2C 寄存器映射中）。虽然主机可以随时读取 Si1141/42/43 的任何 I2C 寄存器，但在中断处理程序的上下文之外读取 2 字节测量结果时必须谨慎。当内部定序器碰巧正在更新 2 字节测量结果时，主机可能读取这个测量结果的部分内容。发生这种情况时，主机可能读取混合 2 字节数量，其高位字节和低位字节是不同样本的部分。如果主机必须在中断处理程序的上下文之外读取这些 2 字节寄存器，如果测量结果与上一个读数有很大偏差，主机应 " 复查 " 该测量结果。

I2C 广播复位： I2C 广播复位应该在任何 I2C 寄存器访问 Si114x 之前发送。如果在 I2C 广播复位发出时，任何 I2C 寄存器或参数已经写入到 Si114x，则主机必须发送一个复位命令并对 Si114x 进行完全重新初始化。

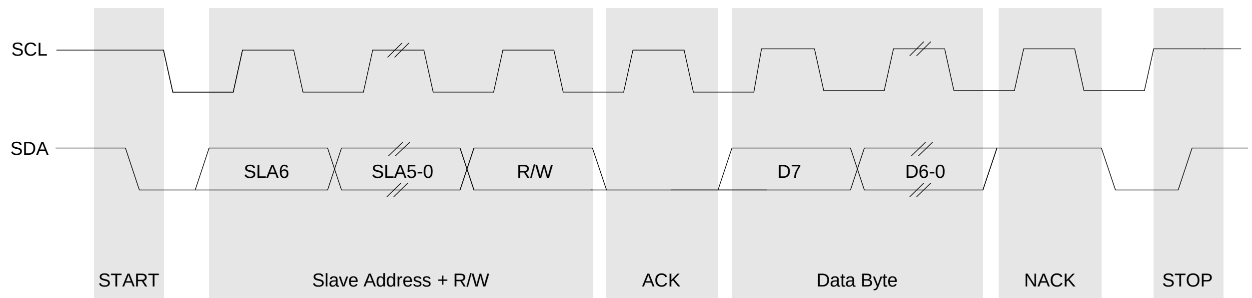


Figure 8. I2C Bit Timing Diagram

S	SLAVE ID	0	A	REG ADDRESS	A	DATA	A	P

Figure 9. Host Interface Single Write

S	SLAVE ID	1	A	DATA	N	STOP

Figure 10. Host Interface Single Read

S	SLAVE ID	0	A	REG ADDRESS	A	DATA	A	DATA	A	DATA	A	P

Figure 11. Host Interface Burst Write

S	SLAVE ID	0	A	REG ADDRESS	A	Sr	SLAVE ID	1	DATA	A	DATA	A	DATA	N	STOP

Figure 12. Host Interface Burst Read

7	6	5:0
0	AI	6 bit address 0x00 to 0x3F

Figure 13. Si1141/42/43 REG ADDRESS Format

注释：

- 灰盒由主机推动到 Si1141/42/43
- 白盒由 Si1141/42/43 推动到主机
- A = ACK 或 " 确认 "
- N = NACK 或 " 无确认 "
- S = 开始条件
- Sr = 重复开始条件
- P = 停止条件
- AI = 设置时禁用自动递增

3. 运行模式

Si1141/42/43 在任何时候可以处于众多运行模式中的一种。必须考虑运行模式，因为该模式对 Si1141/42/43 的整体功耗有影响。各种模式如下：

- 关闭模式
- 初始化模式
- 备用模式
- 强制转换模式
- 自发模式

3.1. 关闭模式

当 V_{DD} 未连接到电源设备或 V_{DD} 电压低于电气规格中所述的规定 VDD_OFF 电压时，Si1141/42/43 处于关闭模式。只要不违反第 9 页上表 4, “Absolute Maximum Limits,” 中叙述的参数，就没有电流流过 Si1141/42/43。在关闭模式中， Si1141/42/43 SCL 和 SDA 引脚不会干扰总线上的其他 I^2C 器件。 LED 引脚不会消耗通过红外二极管的电流。使 V_{DD} 低于 VDD_OFF 不是用于实现最低系统电流消耗量的方法。原因在于 SCL、 SDA 和 INT 引脚上的 ESD 保护器件也来自通过 V_{DD} 的电流通路。例如，如果 V_{DD} 接地，则电流通过 SCL、 SDA 和 INT 上拉电阻器及 ESD 保护器件从系统电源流到系统接地。

允许 V_{DD} 小于 VDD_OFF 旨在充当无专用复位引脚情况下复位 Si1141/42/43 的硬件方法。

在收到一般 I^2C 复位或启动软件复位序列后， Si1141/42/43 也可以重新进入关闭模式。使用这些软件方法之一进入关闭模式时， Si1141/42/43 通常直接从关闭模式进入初始化模式。

3.2. 初始化模式

当 V_{DD} 通电并且电压高于第 4 页上表 1, “Recommended Operating Conditions,” 中所述的最低 V_{DD} 电源电压时，Si1141/42/43 就进入初始化模式。在初始化模式中， Si1141/42/43 执行初始启动序列。由于 I^2C 尚未有效，因此建议在这个短暂的初始化模式期间，不进行任何 I^2C 活动。表 1 中的 “Start-Up Time” 规格是主机在通电序列之后发送任何 I^2C 访问之前需要等待的最短建议时间。初始化模式完成后， Si1141/42/43 进入备用模式。为了正常运行，主机必须将 0x17 写入到 HW_KEY 寄存器。

3.3. 备用模式

Si1141/42/43 大部分时间都处于备用模式。 Si1141/42/43 完成初始化模式序列后，就进入备用模式。处于备用模式时， Si1141/42/43 不执行任何环境光测量或临近探测功能。但是， I^2C 接口处于有效状态并且随时可以接受到 Si1141/42/43 寄存器的读取和写入。内部数字顺序控制器处于休眠状态，不会消耗很多电源。此外， INT 输出保持状态到其被主机清除为止。

I^2C 访问不一定会导致 Si1141/42/43 退出备用模式。例如，数字顺序控制器不必从休眠状态唤醒，即可完成 Si1141/42/43 寄存器读取。

3.4. 强制转换模式

在主机处理器的特定命令情况下， Si1141/42/43 可以在强制转换模式中运行。如果发出 ALS_FORCE 或 PS_FORCE 命令，就会进入强制转换模式。转换完毕后，如果启用了相应中断， Si1141/42/43 可以向主机生成中断。通过使用 PSALS_FORCE 命令，可以使用一个命令寄存器写访问启动 ALS 和多次 PS 测量。

3.5. 自发运行模式

可以将 Si1141/42/43 置于自发运行模式，在此模式中，不必为每次测量发出明确的主机命令，即可自动执行测量。PS_AUTO、 ALS_AUTO 和 PSALS_AUTO 命令用于将 Si1141/42/43 置于自发运行模式。

Si1141/42/43 自动更新 PS 和 ALS 的 I^2C 寄存器。在 I^2C 映射中，为每次测量分配一个 16 位寄存器。Si1141/42/43 可以无中断运行。这样做时，主机轮询率必须至少是转换率频率的两倍，主机才能始终收到新测量结果。主机还可以通过启用中断，选择在这些新测量结果可用时收到通知。

在 PS_AUTO、 ALS_AUTO 或 PSALS_AUTO 命令之前，主机设置 PS 和 ALS 测量的转换频率。主机可以设置与 ALS 转换频率不同的 PS 转换频率。但是，这两个频率都必须是 I^2C 映射中 MEAS_RATE 寄存器中基本转换频率的倍数。

PS 或 ALS 测量结果到达预设的阈值时， Si1141/42/43 可以中断主机。为了帮助处理中断，对寄存器进行调整，使中断处理程序能够执行 I^2C 突发读取操作以读取必要的寄存器，以中断状态寄存器开始，并循环通过 ALS 数据寄存器，接着是各个临近读数。

4. 编程指南

4.1. 命令和响应结构

在读取或写入所有 Si1141/42/43 I^2C 寄存器（除了写入 COMMAND 寄存器之外）时都不唤醒内部定序器。第 29 页上 “4.5. I^2C 寄存器 ” 完整列出了 I^2C 寄存器。除了 I^2C 寄存器之外，RAM 参数是内部定序器维护的存储器位置。这些 RAM 参数可通过命令协议访问（请参阅第 52 页上 “4.6. 参数 RAM” ）。第 52 页上 “4.6. 参数 RAM” 完整列出了 RAM 参数。

Si1141/42/43 可以在强制测量模式或自发模式中运行。处于强制测量模式时，除非主机通过特定命令明确请求 Si1141/42/43 进行测量，否则 Si1141/42/43 不进行任何测量（请参阅第 3.2 节）。需要写入 CHLIST 参数，以便让 Si1141/42/43 知道要进行哪些测量。参数 MEAS_RATE 为零时会将内部定序器置于强制测量模式。处于强制测量模式时，仅当主机写入 COMMAND 寄存器时，内部定序器才唤醒。处于强制测量模式时 (MEAS_RATE = 0)，耗电量最低。

当 MEAS_RATE 不是零时， Si1141/42/43 在自发运行模式中运行。MEAS_RATE 表示 Si1141/42/43 定期唤醒的时间间隔。内部定序器唤醒后，定序器根据 PS_RATE 和 ALS_RATE 寄存器管理内部 PS 计数器和 ALS 计数器。

当内部 PS 计数器过期时，根据通过 CHLIST 参数高位启用了哪些测量，最多执行三个临近测量（PS1、 PS2 和 PS3）。按顺序执行这三个 PS 测量，从 PS1 测量通道开始。同样，当 ALS 计数器过期时，根据通过 CHLIST 参数高位启用了哪些测量，最多执行三个测量（ALS_VIS、 ALS_IR 和 AUX）。按以下顺序执行这三个测量：ALS_VIS、ALS_IR 和 AUX。

PS_RATE 和 ALS_RATE 通常不是零。PS_RATE 或 ALS_RATE 值为零时，将导致内部定序器永不执行该测量组。通常， PS_RATE 或 ALS_RATE 值为 1。值为 1 时，基本上说明每当器件唤醒时执行特定测量组。

PS 计数器和 ALS 计数器可能同时过期。发生这种情况时，先执行 PS 测量，再执行 ALS 测量。执行了所有测量后，内部定序器恢复到休眠状态，直到 MEAS_RATE 参数规定的下一次为止。

Si1141/42/43 操作可以描述为一些常见因素绑定的两个测量组。 PS 测量组由三个 PS 测量组成，而 ALS 测量组由可见光环境测量 (ALS_VIS)、红外光环境测量 (ALS_IR) 和辅助测量 (AUX) 组成。每个测量组各有三个测量。通道列表 (CHLIST) 参数启用该测量组的特定测量。

每个测量（PS1、 PS2、 PS3、 ALS_VIS、 ALS_IR、 AUX）通过结合使用 I^2C 寄存器或参数 RAM 控制。下面的表 7 至 9 汇总了每次测量所用的属性和资源。

4.2. 命令协议

I^2C 映射在主机和 Si1141/42/43 定序器之间实施双向消息框。主机可写入的 I^2C 寄存器有助于主机至 Si1141/42/43 的通信，而只读 I^2C 寄存器用于 Si1141/42/43 至主机的通信。

与其他主机可写入的 I^2C 寄存器不同的是， COMMAND 寄存器导致内部定序器从备用模式唤醒，以处理主机请求。

执行命令时，将更新 RESPONSE 寄存器。通常，没有错误时，高四位为零。为了允许命令跟踪，低四位实施 4 位循环计数器。一般而言，如果 RESPONSE 寄存器的高半字节不是零，表示有错误或需要特殊处理。

PARAM_WR 和 PARAM_RD 寄存器是附加的邮箱寄存器。

除了 I^2C 映射中的寄存器之外，还有可通过 “Command/Response” （命令 / 响应）界面访问的环境参数。这些参数存储在内部 RAM 空间中。这些参数一般接受更多 I^2C 访问以便进行读写。第 52 页上 “4.6. 参数 RAM” 介绍了参数 RAM。

每次写入 Command 寄存器都需要以下顺序：

1. 将 0x00 写入到 Command 寄存器以清空 Response 寄存器。
2. 读取 Response 寄存器并验证内容为 0x00。
3. 将 Command 值从 表 5 写入 Command 寄存器。
4. 读取 Response 寄存器并验证现在内容非零。如果内容仍为 0x00，重复此步骤。

注释： 步骤 4 不适用于 Reset Command，因为设备将重置，而重置后不会增加 Response 寄存器。发出 Reset 之后至少 1 ms 内不应向设备发出任何命令。

成功完成一个命令后， Response 寄存器将成功增加。如果 Response 寄存器在 Command 写入后保持 0x00 超过 25 ms，则整个 Command 流程都应该从步骤 1 开始重复。

Table 5. Command Register Summary

COMMAND Register		PARAM_WR Register	PARAM_RD Register	Error Code in RESPONSE Register	Description
Name	Encoding				
PARAM_QUERY	100 aaaaa	—	nnnn nnnn	✓	Reads the parameter pointed to by bitfield [4:0] and writes value to PARAM_RD. See ? 10 for parameters.
PARAM_SET	101 aaaaa	dddd dddd	nnnn nnnn	✓	Sets parameter pointed by bit-field [4:0] with value in PARAM_WR, and writes value out to PARAM_RD. See ? 10 for parameters.
PARAM_AND	110 aaaaa	dddd dddd	nnnn nnnn	✓	Performs a bit-wise AND between PARAM_WR and Parameter pointed by bitfield [4:0], writes updated value to PARAM_RD. See ? 10 for parameters.
PARAM_OR	111 aaaaa	dddd dddd	nnnn nnnn	✓	Performs a bit-wise OR of PARAM_WR and parameter pointed by bitfield [4:0], writes updated value to PARAM_RD. See ? 10 for parameters.

Table 5. Command Register Summary (Continued)

COMMAND Register		PARAM_WR Register	PARAM_RD Register	Error Code in RESPONSE Register	Description
Name	Encoding				
NOP	000 00000	—	—	✓	Forces a zero into the RESPONSE register
RESET	000 00001	—	—	✓	Performs a software reset of the firmware
BUSADDR	000 00010	—	—	—	Modifies I^2C address
Reserved	000 00011	—	—	—	—
Reserved	000 00100	—	—	—	—
PS_FORCE	000 00101	—	—	✓	Forces a single PS measurement
ALS_FORCE	000 00110	—	—	✓	Forces a single ALS measurement
PSALS_FORCE	000 00111	—	—	✓	Forces a single PS and ALS measurement
Reserved	000 01000	—	—	—	—
PS_PAUSE	000 01001	—	—	✓	Pauses autonomous PS
ALS_PAUSE	000 01010	—	—	✓	Pauses autonomous ALS
PSALS_PAUSE	000 01011	—	—	✓	Pauses PS and ALS
Reserved	000 01100	—	—	✓	—
PS_AUTO	000 01101	—	—	✓	Starts/Restarts an autonomous PS Loop
ALS_AUTO	000 01110	—	—	✓	Starts/Restarts an autonomous ALS Loop
PSALS_AUTO	000 01111	—	—	✓	Starts/Restarts autonomous ALS and PS loop
Reserved	000 1xxxx	—	—	—	—

Table 6. Response Register Error Codes

RESPONSE Register	Description
0000 cccc	NO_ERROR. The lower bit is a circular counter and is incremented every time a command has completed. This allows the host to keep track of commands sent to the Si1141/42/43. The circular counter may be cleared using the NOP command.
1000 0000	INVALID_SETTING. An invalid setting was encountered. Clear using the NOP command.
1000 1000	PS1_ADC_OVERFLOW. Indicates proximity channel one conversion overflow.
1000 1001	PS2_ADC_OVERFLOW. Indicates proximity channel two conversion overflow.
1000 1010	PS3_ADC_OVERFLOW. Indicates proximity channel three conversion overflow.
1000 1100	ALS_VIS_ADC_OVERFLOW. Indicates visible ambient light channel conversion overflow.
1000 1101	ALS_IR_ADC_OVERFLOW. Indicates infrared ambient light channel conversion overflow.
1000 1110	AUX_ADC_OVERFLOW. Indicates auxiliary channel conversion overflow.

4.3. 资源汇总

Table 7. Resource Summary for Interrupts and Threshold Checking

Measurement Channel	Channel Enable	Interrupt Status Output	Interrupt Enable	Interrupt Mode	Threshold Registers	Threshold Hysteresis	History Checking	Autonomous Measurement Time Base	
Proximity Sense 1	EN_PS1 in CHLIST[0]	PS1_INT in IRQ_STATUS[2]	PS1_IE in IRQ_ENABLE[2]	PS1_IM[1:0] in IRQ_MODE1[5:4]	PS1_TH[7:0]	PS_HYST[7:0]	PS_HISTORY[7:0]	MEAS_RATE[7:0]	PS_RATE[7:0]
Proximity Sense 2	EN_PS2 in CHLIST[1]	PS2_INT in IRQ_STATUS[3]	PS2_IE in IRQ_ENABLE[3]	PS2_IM[1:0] in IRQ_MODE1[7:6]	PS2_TH[7:0]				
Proximity Sense 3	EN_PS3 in CHLIST[2]	PS3_INT in IRQ_STATUS[4]	PS3_EN in IRQ_ENABLE[4]	PS3_IM[1:0] in IRQ_MODE2[1:0]	PS3_TH[7:0]				
ALS Visible	EN_ALS_VIS in CHLIST[4]	ALS_INT[1:0] in IRQ_STATUS[1:0]	ALS_IE[1:0] in IRQ_ENABLE[1:0]	ALS_IM[2:0] in IRQ_MODE1[2:0]	ALS_LOW_TH[7:0] / ALS_HI_TH[7:0]	ALS_HYST[7:0]	ALS_HISTORY[7:0]		ALS_RATE[7:0]
ALS IR	EN_ALS_IR in CHLIST[5]								
Auxiliary Measurement	EN_AUX in CHLIST[6]	—	—	—	—	—	—		

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Table 8. Resource Summary for LED Choice and ADC Parameters

Measurement Channel	LED Selection	ADC Mode	ADC Output	ADC Input Source	ADC Recovery Count	ADC High Signal Mode	ADC Clock Divider	ADC Alignment	ADC Offset
Proximity Sense 1	PS1_LED[2:0] in PSLED12_SELECT[2:0]	PS_ADC_MODE in PS_ADC_MISC[2]	PS1_DATA1[7:0] / PS1_DATA0[7:0]	PS1_ADCMUX[7:0]	PS_ADC_REC in PS_ADC_COUNTER [6:4]	PS_RANGE in PS_ADC_MISC[5]	PS_ADC_GAIN[3:0]	PS1_ALIGN in PS_ENCODING[4]	ADC_OFFSET [7:0]
Proximity Sense 2	PS2_LED[2:0] in PSLED12_SELECT[6:4]		PS2_DATA1[7:0] / PS2_DATA0[7:0]	PS2_ADCMUX[7:0]				PS2_ALIGN in PS_ENCODING[5]	
Proximity Sense 3	PS3_LED[2:0] in PSLED3_SELECT[2:0]		PS3_DATA1[7:0] / PS3_DATA0[7:0]	PS3_ADCMUX[7:0]				PS3_ALIGN in PS_ENCODING[6]	
ALS Visible	—	—	ALS_VIS_DATA1 / ALS_VIS_DATA0		VIS_ADC_REC in ALS_VIS_ADC_COUNTER [6:4]	VIS_RANGE in ALS_VIS_ADC_MISC[5]	ALS_VIS_ADC_GAIN [3:0]	ALS_VIS_ALIGN in ALS_ENCODING[4]	
ALS IR			ALS_IR_DATA1[7:0] / ALS_IR_DATA0[7:0]		IR_ADC_REC in ALS_IR_ADC_COUNTER [6:4]	IR_RANGE in ALS_IR_ADC_MISC[5]	ALS_IR_ADC_GAIN [3:0]	ALS_IR_ALIGN in ALS_ENCODING[5]	
Auxiliary Measurement			AUX_DATA1[7:0] / AUX_DATA0[7:0]	AUX_ADCMUX[7:0]	—	—	—	—	

Table 9. Resource Summary for Hardware Pins

Pin Name	LED Current Drive	Output Drive Disable	Analog Voltage Input Enable
LED1	LED1_I in PSLED12[3:0]		ANA_IN_KEY[31:0]
LED2	LED2_I in PSLED12[7:4]	HW_KEY[7:0]	ANA_IN_KEY[31:0]
LED3	LED3_I in PSLED3[3:0]	HW_KEY[7:0]	
INT		INT_OE in INT_CFG[0]	ANA_IN_KEY[31:0]

Si1141/42/43 中断通过 INT_CFG、 IRQ_ENABLE、 IRQ_MODE1、 IRQ_MODE2 和 IRQ_STATUS 寄存器控制。

INT 硬件引脚通过 INT_CFG 寄存器中的 INT_OE 位启用。硬件基本上在 IRQ_ENABLE 寄存器和 IRQ_STATUS 寄存器之间执行 " 与 " 功能。执行 " 与 " 功能后，如果设置了任何位，将使 INT 引脚有效。从概念上讲， INT_CFG 寄存器中的 INT_MODE 位是一种确定如何使 INT 引脚无效的方法。当 INT_MODE = 0 时，主机负责通过写入 IRQ_STATUS 寄存器清除中断。向 IRQ_STATUS 寄存器的特定位写入 '1' 时，将清除该特定 IRQ_STATUS 位。

通常，主机软件应读取 IRQ_STATUS 寄存器，存储本地副本，然后将相同值写回 IRQ_STATUS 以清除中断来源。除非明确说明，对于正常中断处理操作， INT_MODE 应为零。总之，通常向 INT_CFG 寄存器写入 '1'。

IRQ_MODE1、IRQ_MODE2 和 IRQ_ENABLE 寄存器配合使用，定义内部定序器如何设置 IRQ_STATUS 寄存器中的位（因此，使 INT 引脚有效）。

表 10 介绍了 PS1 中断。表 11 介绍了 PS2 中断。表 12 介绍了 PS3 中断。表 13 介绍了 ALS 中断，表 14 介绍了命令界面中断。

Table 10. PS1 Channel Interrupt Resources

IRQ_ENABLE[2]	IRQ_MODE1[5:4]		Description
PS1_IE	PS1_IM[1:0]		
0	0	0	No PS1 Interrupts
1	0	0	PS1_INT set after every PS1 sample
1	0	1	PS1_INT set whenever PS1 threshold (PS1_TH) is crossed
1	1	1	PS1_INT set whenever PS1 sample is above PS1 threshold (PS1_TH)
Note: There is hysteresis applied (PS_HYST) and history checking (PS_HISTORY). PS_HYST is encoded in 8-bit compressed format. In the Si114x, PS1_TH is also encoded in compressed format.			

Table 11. PS2 Channel Interrupt Resources

IRQ_ENABLE[3]	IRQ_MODE1[7:6]		Description
PS2_IE	PS2_IM[1:0]		
0	0	0	No PS2 Interrupts
1	0	0	PS2_INT set after every PS2 sample
1	0	1	PS2_INT set whenever PS2 threshold (PS2_TH) is crossed
1	1	1	PS2_INT set when PS2 sample is above PS2 threshold (PS2_TH)
Note: There is hysteresis applied (PS_HYST) and history checking (PS_HISTORY). PS_HYST is encoded in 8-bit compressed format. In the Si114x, PS2_TH is also encoded in compressed format.			

Table 12. PS3 Channel Interrupt Resources

IRQ_ENABLE[4]	IRQ_MODE2[1:0]		Description
PS3_IE	PS3_IM[1:0]		
0	0	0	No PS3 Interrupts
1	0	0	PS3_INT set after every PS3 sample
1	0	1	PS3_INT set whenever PS3 threshold (PS3_TH) is crossed
1	1	1	PS3_INT set whenever PS3 sample is above PS3 threshold (PS3_TH)
Note: There is hysteresis applied (PS_HYST) and history checking (PS_HISTORY). PS_HYST is encoded in 8-bit compressed format. In the Si114x, PS3_TH is also encoded in compressed format.			

Table 13. Ambient Light Sensing Interrupt Resources

IRQ_ENABLE[1:0]		IRQ_MODE1[2:0]			Description
ALS_IE[1:0]		ALS_IM[2:0]			
0	0	0	0	0	No ALS Interrupts
0	1	0	0	0	ALS_INT [0] set after every ALS_VIS sample[1]
x	1	x	0	1	Monitors ALS_VIS, ALS_INT [0] upon exiting region between low and high thresholds (ALS_LOW_TH and ALS_HI_TH)
1	x	1	0	x	Monitors ALS_VIS, ALS_INT [1] set upon entering region between low and high thresholds (ALS_LOW_TH and ALS_HI_TH)
x	1	x	1	1	Monitors ALS_IR, ALS_INT [0] set upon exiting region between low and high thresholds (ALS_LOW_TH and ALS_HI_TH)
1	x	1	1	x	Monitors ALS_IR, ALS_INT [1] set upon entering region between low and high thresholds (ALS_LOW_TH and ALS_HI_TH)

Notes:
1. For ALS_IR channel, interrupts per sample is not possible without also enabling ALS_VIS
2. All other combinations are invalid and may result in unintended operation
3. There is hysteresis applied (ALS_TH) and history checking (ALS_HISTORY). ALS_HYST is encoded in 8-bit compressed format.
4. In the Si114x, ALS_LOW_TH and ALS_HI_TH are also encoded in compressed format.

Table 14. Command Interrupt Resources

IRQ_ENABLE[5]	IRQ_MODE2[3:2]		Description
CMD_IE	CMD_IM[1:0]		
0	x	0	No CMD Interrupts
1	x	0	CMD_INT set when there is a new RESPONSE
1	x	1	CMD_INT set when there is a new error code in RESPONSE

4.4. 信号通路软件模型

下图概述了信号通路，以及控制它们的 I^2C 寄存器和 RAM 参数位字段。随后几节详细介绍 I^2C 寄存器和参数 RAM。

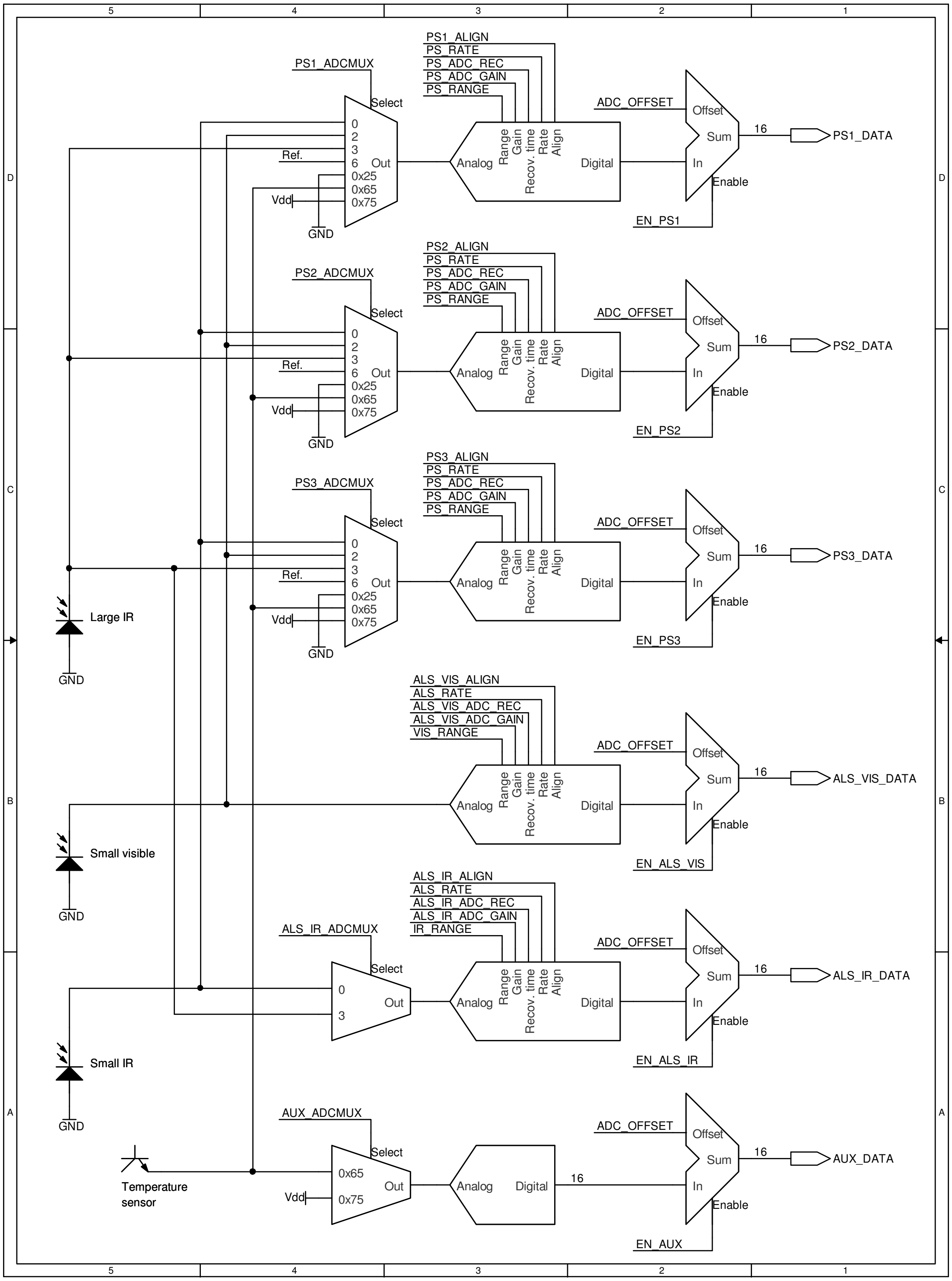


Figure 14. Signal Path Programming Model

4.5. I²C 寄存器

Table 15. I²C Register Summary

I²C Register Name	Address	7	6	5	4	3	2	1	0
PART_ID	0x00	PART_ID							
REV_ID	0x01	REV_ID							
SEQ_ID	0x02	SEQ_ID							
INT_CFG	0x03							INT_-MODE	INT_OE
IRQ_ENABLE	0x04			CMD_IE	PS3_IE	PS2_IE	PS1_IE	ALS_IE	
IRQ_MODE1	0x05	PS2_IM		PS1_IM			ALS_IM		
IRQ_MODE2	0x06					CMD_IM		PS3_IM	
HW_KEY	0x07	HW_KEY							
MEAS_RATE	0x08	MEAS_RATE							
ALS_RATE	0x09	ALS_RATE							
PS_RATE	0x0A	PS_RATE							
ALS_LOW_TH0	0x0B	ALS_LOW_TH0							
ALS_LOW_TH1	0x0C	ALS_LOW_TH1							
ALS_HI_TH0	0x0D	ALS_HI_TH0							
ALS_HI_TH1	0x0E	ALS_HI_TH1							
PS_LED21	0x0F	LED2_I				LED1_I			
PS_LED3	0x10					LED3_I			
PS1_TH0	0x11	PS1_TH0							
PS1_TH1	0x12	PS1_TH1							
PS2_TH0	0x13	PS2_TH0							
PS2_TH1	0x14	PS2_TH1							
PS3_TH0	0x15	PS3_TH0							
PS3_TH1	0x16	PS3_TH1							
PARAM_WR	0x17	PARAM_WR							
COMMAND	0x18	COMMAND							
RESPONSE	0x20	RESPONSE							

Table 15. I²C Register Summary (Continued)

I²C Register Name	Address	7	6	5	4	3	2	1	0
IRQ_STATUS	0x21			CMD_INT	PS3_INT	PS2_INT	PS1_INT	ALS_INT	
ALS_VIS_DATA0	0x22	ALS_VIS_DATA0							
ALS_VIS_DATA1	0x23	ALS_VIS_DATA1							
ALS_IR_DATA0	0x24	ALS_IR_DATA0							
ALS_IR_DATA1	0x25	ALS_IR_DATA1							
PS1_DATA0	0x26	PS1_DATA0							
PS1_DATA1	0x27	PS1_DATA1							
PS2_DATA0	0x28	PS2_DATA0							
PS2_DATA1	0x29	PS2_DATA1							
PS3_DATA0	0x2A	PS3_DATA0							
PS3_DATA1	0x2B	PS3_DATA1							
AUX_DATA0	0x2C	AUX_DATA0							
AUX_DATA1	0x2D	AUX_DATA1							
PARAM_RD	0x2E	PARAM_RD							
CHIP_STAT	0x30						RUNNING	SUSPEND	SLEEP
ANA_IN_KEY	0x3B–0x3E	ANA_IN_KEY							

PART_ID @ 0x00

Bit	7	6	5	4	3	2	1	0
Name	PART_ID							
Type	R							

复位值 = 0100 0001 (Si1141)
复位值 = 0100 0010 (Si1142)
复位值 = 0100 0011 (Si1143)

REV_ID @ 0x1

Bit	7	6	5	4	3	2	1	0
Name	REV_ID							
Type	R							

复位值 = 0000 0000

SEQ_ID @ 0x02

Bit	7	6	5	4	3	2	1	0
Name	SEQ_ID							
Type	R							

复位值 = 0000 1000

Bit	Name	Function
7:0	SEQ_ID	**Sequencer Revision.** 0x01 Si114x-A01 (MAJOR_SEQ=0, MINOR_SEQ=1) 0x02 Si114x-A02 (MAJOR_SEQ=0, MINOR_SEQ=2) 0x03 Si114x-A03 (MAJOR_SEQ=0, MINOR_SEQ=3) 0x08 Si114x-A10 (MAJOR_SEQ=1, MINOR_SEQ=0) 0x09 Si114x-A11 (MAJOR_SEQ=1, MINOR_SEQ=1)

INT_CFG @ 0x03

Bit	7	6	5	4	3	2	1	0
Name							INT_MODE	INT_OE
Type							RW	RW

复位值 = 0000 0000

Bit	Name	Function
7:2	Reserved	**Reserved.**
1	INT_MODE	**Interrupt Mode.** The INT_MODE describes how the bits in the IRQ_STATUS Registers are cleared. 0: The IRQ_STATUS Register bits are set by the internal sequencer and are sticky. It is the host's responsibility to clear the interrupt status bits in the IRQ_STATUS register to clear the interrupt. 1: If the Parameter Field PSx_IM = 11, the internal sequencer clears the INT pin automatically.
0	INT_OE	**INT Output Enable.** INT_OE controls the INT pin drive 0: INT pin is never driven 1: INT pin driven low whenever an IRQ_STATUS and its corresponding IRQ_ENABLE bits match

IRQ_ENABLE @ 0x04

Bit	7	6	5	4	3	2	1	0
Name			CMD_IE	PS3_IE	PS2_IE	PS1_IE	ALS_IE	
Type			RW	RW	RW	RW	RW	

复位值 = 0000 0000

Bit	Name	Function
7:6	Reserved	**Reserved.**
5	CMD_IE	**Command Interrupt Enable.** Enables interrupts based on COMMAND/RESPONSE activity. 0: INT never asserts due to COMMAND/RESPONSE interface activity. 1: Assert INT pin whenever CMD_INT is set by the internal sequencer.
4	PS3_IE	**PS3 Interrupt Enable.** Enables interrupts based on PS3 Channel Activity. 0: INT never asserts due to PS3 Channel activity. 1: Assert INT pin whenever PS3_INT is set by the internal sequencer.
3	PS2_IE	**PS2 Interrupt Enable.** Enables interrupts based on PS2 Channel Activity. 0: INT never asserts due to PS2 Channel activity. 1: Assert INT pin whenever PS2_INT is set by the internal sequencer.
2	PS1_IE	**PS1 Interrupt Enable.** Enables interrupts based on PS1 Channel Activity. 0: INT never asserts due to PS1 Channel activity. 1: Assert INT pin whenever PS1_INT is set by the internal sequencer.
1:0	ALS_IE	**ALS Interrupt Enable.** Enables interrupts based on ALS Activity. 00: INT never asserts due to ALS activity. 1x: Assert INT pin whenever ALS_INT[1] bit is set by the internal sequencer. x1: Assert INT pin whenever ALS_INT[0] is set by the internal sequencer.

IRQ_MODE1 @ 0x05

Bit	7	6	5	4	3	2	1	0
Name	PS2_IM		PS1_IM			ALS_IM		
Type	RW		RW			RW		

复位值 = 0000 0000

Bit	Name	Function
7:6	PS2_IM	PS2 Interrupt Mode applies only when PS2_IE is also set. 00: PS2_INT is set whenever a PS2 measurement has completed. 01: PS2_INT is set whenever the current PS2 measurement crosses the PS2_TH threshold. 11: PS2_INT is set whenever the current PS2 measurement is greater than the PS2_TH threshold.
5:4	PS1_IM	PS1 Interrupt Mode applies only when PS1_IE is also set. 00: PS1_INT is set whenever a PS1 measurement has completed. 01: PS1_INT is set whenever the current PS1 measurement crosses the PS1_TH threshold. 11: PS1_INT is set whenever the current PS1 measurement is greater than the PS1_TH threshold.
3	Reserved	**Reserved.**
2:0	ALS_IM	ALS Interrupt Mode function is defined in conjunction with ALS_IE[1:0]. ALS_IE[1:0] / ALS_IM[2:0]: 00 / 000: Neither ALS_INT[1] nor ALS_INT[0] is ever set. 01 / 000: ALS_INT[0] sets after every ALS_VIS sample. x1 / x01: Monitors ALS_VIS channel, ALS_INT[0] asserts if measurement exits window between ALS_LOW_TH and ALS_HIGH_TH. x1 / x11: Monitors ALS_IR channel, ALS_INT[0] asserts if measurement exits window between ALS_LOW_TH and ALS_HIGH_TH. 1x /10x: Monitors ALS_VIS channel, ALS_INT[1] asserts if measurement enters window between ALS_LOW_TH and ALS_HIGH_TH. 1x /11x: Monitors ALS_IR channel, ALS_INT[1] asserts if measurement enters window between ALS_LOW_TH and ALS_HIGH_TH.

Note: The ALS_IM description apples only to sequencer revisions A03 or later.

IRQ_MODE2 @ 0x06

Bit	7	6	5	4	3	2	1	0
Name					CMD_IM		PS3_IM	
Type					RW		RW	

复位值 = 0000 0000

Bit	Name	Function
7:4	Reserved	**Reserved.**
3:2	CMD_IM	Command Interrupt Mode applies only when CMD_IE is also set. 00: CMD_INT is set whenever the RESPONSE register is written. 01: CMD_INT is set whenever the RESPONSE register is written with an error code (MSB set). 1x: Reserved.
1:0	PS3_IM	PS3 Interrupt Mode applies only when PS3_IE is also set. 00: PS3_INT is set whenever a PS3 measurement has completed. 01: PS3_INT is set whenever the current PS3 measurement crosses the PS3_TH threshold. 11: PS3_INT is set whenever the current PS3 measurement is greater than the PS3_TH threshold.

HW_KEY @ 0x07

Bit	7	6	5	4	3	2	1	0
Name	HW_KEY							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	HW_KEY	The system must write the value 0x17 to this register for proper Si114x operation.

MEAS_RATE @ 0x08

Bit	7	6	5	4	3	2	1	0
Name	MEAS_RATE							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	MEAS_RATE	MEAS_RATE is an 8-bit compressed value representing a 16-bit integer. The uncompressed 16-bit value, when multiplied by 31.25 us, represents the time duration between wake-up periods where measurements are made. Example Values: 0x00: Turns off any internal oscillator and disables autonomous measurement. Use this setting to achieve lowest V_{DD} current draw for systems making use of only forced measurements. 0x01-0x17: These values are not allowed. 0x84: The device wakes up every 10 ms (0x140 x 31.25 µs) 0x94: The device wakes up every 20 ms (0x280 x 31.25 µs) 0xB9: The device wakes up every 100 ms (0x0C80 x 31.25 µs) 0xDF: The device wakes up every 496 ms (0x3E00 x 31.25 µs) 0xFF: The device wakes up every 1.984 seconds (0xF800 x 31.25 µs) Please refer to “AN498: Si114x Designer’s Guide”, Section 5.4 “Compression Concept.”

ALS_RATE @ 0x09

Bit	7	6	5	4	3	2	1	0
Name	ALS_RATE							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	ALS_RATE	ALS_RATE is an 8-bit compressed value representing a 16-bit multiplier. This multiplier, in conjunction with the MEAS_RATE time, represents how often ALS Measurements are made. For a given ALS measurement period, MEAS_RATE should be as high as possible and ALS_RATE as low as possible in order to optimize power consumption. Example Values: 0x00: Autonomous ALS Measurements are not made. 0x08: ALS Measurements made every time the device wakes up. (0x0001 x timeValueOf(MEAS_RATE)) 0x32: ALS Measurements made every 10 times the device wakes up. (0x000A x timeValueOf(MEAS_RATE) 0x69: ALS Measurements made every 100 times the device wakes up. (0x0064 x timeValueOf(MEAS_RATE) Please refer to “AN498: Si114x Designer’s Guide”, Section 5.4 “Compression Concept.”

PS_RATE @ 0x0A

Bit	7	6	5	4	3	2	1	0
Name	PS_RATE							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	PS_RATE	PS_RATE is an 8-bit compressed value representing a 16-bit multiplier. This multiplier, in conjunction with the MEAS_RATE time, represents how often PS Measurements are made. For a given proximity measurement period, MEAS_RATE should be as high as possible and PS_RATE as low as possible in order to optimize power consumption. Example Values: 0x00: Autonomous PS Measurements are not made 0x08: PS Measurements made every time the device wakes up (0x0001 x timeValueOf(MEAS_RATE)) 0x32: PS Measurements made every 10 times the device wakes up (0x000A x timeValueOf(MEAS_RATE) 0x69: PS Measurements made every 100 times the device wakes up (0x0064 x timeValueOf(MEAS_RATE) Please refer to “AN498: Si114x Designer’s Guide”, Section 5.4 “Compression Concept.”

ALS_LOW_TH0: ALS_LOW_TH Data Word Low Byte @ 0x0B

Bit	7	6	5	4	3	2	1	0
Name	ALS_LOW_TH[7:0]							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	ALS_LOW_TH[7:0]	ALS_LOW_TH is a 16-bit threshold value. When used in conjunction with ALS_HI_TH, it forms a window region applied to either ALS_VIS or ALS_IR measurements for interrupting the host. Once autonomous measurements have started, modification to ALS_LOW_TH should be preceded by an ALS_PAUSE or PSALS_PAUSE command. For revisions A10 and below, ALS_LOW_TH uses an 8-bit compressed format. Refer to “AN498: Si114x Designer’s Guide”, Section 5.4 “Compression Concept.”

ALS_LOW_TH1:ALS_LOW_TH Data Word High Byte @ 0x0C

Bit	7	6	5	4	3	2	1	0
Name	ALS_LOW_TH[15:8]							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	ALS_LOW_TH[15:8]	ALS_LOW_TH is a 16-bit threshold value. When used in conjunction with ALS_HI_TH, it forms a window region applied to either ALS_VIS or ALS_IR measurements for interrupting the host. Once autonomous measurements have started, modification to ALS_LOW_TH should be preceded by an ALS_PAUSE or PSALS_PAUSE command. For revisions A10 and below, ALS_LOW_TH uses an 8-bit compressed format. Refer to “AN498: Si114x Designer's Guide", Section 5.4 “Compression Concept.”

ALS_HI_TH0: ALS_HI_TH Data Word Low Byte @ 0x0D

Bit	7	6	5	4	3	2	1	0
Name	ALS_HI_TH[7:0]							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	ALS_HI_TH[7:0]	ALS_HI_TH is a 16-bit threshold value. When used in conjunction with ALS_LOW_TH, it forms a window region applied to either ALS_VIS or ALS_IR measurements for interrupting the host. Once autonomous measurements have started, modification to ALS_HI_TH should be preceded by an ALS_PAUSE or PSALS_PAUSE command. For revisions A10 and below, ALS_HI_TH uses an 8-bit compressed format. Refer to “AN498: Si114x Designer's Guide”, Section 5.4 “Compression Concept.”
Note: This register available for sequencer revisions A03 or later.		

ALS_HI_TH1: ALS_HI_TH Data Word High Byte @ 0x0E

Bit	7	6	5	4	3	2	1	0
Name	ALS_HI_TH[15:8]							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	ALS_HI_TH[15:8]	ALS_HI_TH is a 16-bit threshold value. When used in conjunction with ALS_LOW_TH, it forms a window region applied to either ALS_VIS or ALS_IR measurements for interrupting the host. Once autonomous measurements have started, modification to ALS_HI_TH should be preceded by an ALS_PAUSE or PSALS_PAUSE command. For revisions A10 and below, ALS_HI_TH uses an 8-bit compressed format. Refer to “AN498: Si114x Designer's Guide” Section 5.4 “Compression Concept.”
Note: ‘		

PS_LED21 @ 0x0F

Bit	7	6	5	4	3	2	1	0
Name	LED2_I				LED1_I			
Type	RW				RW			

复位值 = 0000 0000

Bit	Name	Function
7:4	LED2_I	LED2_I Represents the irLED current sunk by the LED2 pin during a PS measurement. On the Si1141, these bits must be set to zero.
3:0	LED1_1	LED1_I Represents the irLED current sunk by the LED1 pin during a PS measurement. LED3_I, LED2_I, and LED1_I current encoded as follows: 0000: No current 0001: Minimum current 1111: Maximum current Refer to ? 4 ??? 2, “Performance Characteristics[1],” for LED current values.

PS_LED3 @ 0x10

Bit	7	6	5	4	3	2	1	0
Name					LED3_I			
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:4	Reserved	**Reserved.**
3:0	LED3_I	LED3_I Represents the irLED current sunk by the LED3 pin during a PS measurement. See PS_LED21 Register for additional details. On the Si1141 and Si1142, these bits must be set to zero.

PS1_TH0: PS1_TH Data Word Low Byte @ 0x11

Bit	7	6	5	4	3	2	1	0
Name	PS1_TH[7:0]							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	PS1_TH[7:0]	PS1_TH is a 16-bit threshold value. It is compared to PS1 measurements during autonomous operation for interrupting the host. If the threshold register is updated while a measurement is in progress, it is possible that an invalid threshold will be applied if the first new threshold byte has been written and not the second. Remedies include ensuring no measurement during threshold updates and discarding measurements results immediately after threshold updates.Once autonomous measurements have started, modification to PS1_TH should be preceded by a PS_PAUSE or PSALS_PAUSE command. For Si114x revision A10 and below, PS1_TH uses an 8-bit compressed format at address 0x11. Refer to “AN498: Si114x Designer's Guide” Section 5.4 “Compression Concept.”

PS1_TH1: PS1_TH Data Word High Byte @ 0x12

Bit	7	6	5	4	3	2	1	0
Name	PS1_TH[15:8]							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	PS1_TH[15:8]	PS1_TH is a 16-bit threshold value. It is compared to PS1 measurements during autonomous operation for interrupting the host. If the threshold register is updated while a measurement is in progress, it is possible that an invalid threshold will be applied if the first new threshold byte has been written and not the second. Remedies include ensuring no measurement during threshold updates and discarding measurements results immediately after threshold updates. Once autonomous measurements have started, modification to PS1_TH should be preceded by a PS_PAUSE or PSALS_PAUSE command. For Si114x revision A10 and below, PS1_TH uses an 8-bit compressed format at address 0x11. Refer to "AN498: Si114x Designer's Guide" Section 5.4 "Compression Concept."

PS2_TH0: PS2_TH Data Word Low Byte @ 0x13

Bit	7	6	5	4	3	2	1	0
Name	PS2_TH[7:0]							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	PS2_TH[7:0]	PS2_TH is a 16-bit threshold value. It is compared to PS2 measurements during autonomous operation for interrupting the host. If the threshold register is updated while a measurement is in progress, it is possible that an invalid threshold will be applied if the first new threshold byte has been written and not the second. Remedies include ensuring no measurement during threshold updates and discarding measurements results immediately after threshold updates. Once autonomous measurements have started, modification to PS2_TH should be preceded by a PS_PAUSE or PSALS_PAUSE command. For Si114x revision A10 and below, PS2_TH uses an 8-bit compressed format at address 0x13. Refer to "AN498: Si114x Designer's Guide" Section 5.4 "Compression Concept."

PS2_TH1: PS2_TH Data Word High Byte @ 0x14

Bit	7	6	5	4	3	2	1	0
Name	PS2_TH[15:8]							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	PS2_TH[15:8]	PS2_TH is a 16-bit threshold value. It is compared to PS2 measurements during autonomous operation for interrupting the host. If the threshold register is updated while a measurement is in progress, it is possible that an invalid threshold will be applied if the first new threshold byte has been written and not the second. Remedies include ensuring no measurement during threshold updates and discarding measurements results immediately after threshold updates.Once autonomous measurements have started, modification to PS2_TH should be preceded by a PS_PAUSE or PSALS_PAUSE command. For Si114x revision A10 and below, PS2_TH uses an 8-bit compressed format at address 0x13. Refer to “AN498: Si114x Designer's Guide” Section 5.4 “Compression Concept.”

PS3_TH0: PS3_TH Data Word Low Byte @ 0x15

Bit	7	6	5	4	3	2	1	0
Name	PS3_TH[7:0]							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	PS3_TH[7:0]	PS3_TH is a 16-bit threshold value. It is compared to PS3 measurements during autonomous operation for interrupting the host. If the threshold register is updated while a measurement is in progress, it is possible that an invalid threshold will be applied if the first new threshold byte has been written and not the second. Remedies include ensuring no measurement during threshold updates and discarding measurements results immediately after threshold updates.Once autonomous measurements have started, modification to PS3_TH should be preceded by a PS_PAUSE or PSALS_PAUSE command. For Si114x revision A10 and below, PS3_TH uses an 8-bit compressed format at address 0x15. Refer to “AN498: Si114x Designer's Guide” Section 5.4 “Compression Concept.”

PS3_TH1: PS3_TH Data Word High Byte @ 0x16

Bit	7	6	5	4	3	2	1	0
Name	PS3_TH[15:8]							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	PS3_TH[15:8]	PS3_TH is a 16-bit threshold value. It is compared to PS3 measurements during autonomous operation for interrupting the host. If the threshold register is updated while a measurement is in progress, it is possible that an invalid threshold will be applied if the first new threshold byte has been written and not the second. Remedies include ensuring no measurement during threshold updates and discarding measurements results immediately after threshold updates.Once autonomous measurements have started, modification to PS3_TH should be preceded by a PS_PAUSE or PSALS_PAUSE command. For Si114x revision A10 and below, PS3_TH uses an 8-bit compressed format at address 0x15. Refer to “AN498: Si114x Designer's Guide” Section 5.4 “Compression Concept.”

PARAM_WR @ 0x17

Bit	7	6	5	4	3	2	1	0
Name	PARAM_WR							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	PARAM_WR	Mailbox register for passing parameters from the host to the sequencer.

COMMAND @ 0x18

Bit	7	6	5	4	3	2	1	0
Name	COMMAND							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	COMMAND	**COMMAND Register.** The COMMAND Register is the primary mailbox register into the internal sequencer. Writing to the COMMAND register is the only I^2C operation that wakes the device from standby mode.

RESPONSE @ 0x20

Bit	7	6	5	4	3	2	1	0
Name	RESPONSE							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	RESPONSE	The Response register is used in conjunction with command processing. When an error is encountered, the response register will be loaded with an error code. All error codes will have the MSB is set. The error code is retained until a RESET or NOP command is received by the sequencer. Other commands other than RESET or NOP will be ignored. However, any autonomous operation in progress continues normal operation despite any error. 0x00–0x0F: No Error. Bits 3:0 form an incrementing roll-over counter. The roll over counter in bit 3:0 increments when a command has been executed by the Si114x. Once autonomous measurements have started, the execution timing of any command becomes non-deterministic since a measurement could be in progress when the COMMAND register is written. The host software must make use of the rollover counter to ensure that commands are processed. 0x80: Invalid Command Encountered during command processing 0x88: ADC Overflow encountered during PS1 measurement 0x89: ADC Overflow encountered during PS2 measurement 0x8A: ADC Overflow encountered during PS3 measurement 0x8C: ADC Overflow encountered during ALS-VIS measurement 0x8D: ADC Overflow encountered during ALS-IR measurement 0x8E: ADC Overflow encountered during AUX measurement

IRQ_STATUS @ 0x21

Bit	7	6	5	4	3	2	1	0
Name			CMD_INT	PS3_INT	PS2_INT	PS1_INT	ALS_INT	
Type			RW	RW	RW	RW	RW	

复位值 = 0000 0000

Bit	Name	Function
7:6	Reserved	**Reserved.**
5	CMD_INT	**Command Interrupt Status.**
4	PS3_INT	**PS3 Interrupt Status.**
3	PS2_INT	**PS3 Interrupt Status.**
2	PS1_INT	**PS1 Interrupt Status.**
1:0	ALS_INT	**ALS Interrupt Status. (Refer to Table 13 for encoding.)**

Notes:
1. If the corresponding IRQ_ENABLE bit is also set when the IRQ_STATUS bit is set, the INT pin is asserted.
2. When INT_MODE = 0, the host must write '1' to the corresponding XXX_INT bit to clear the interrupt.
3. When INT_MODE = 1, the internal sequencer clears all the XXX_INT bits (and INT pin) automatically unless used with PS (Parameter Field PSx_IM = 11). Use of INT_MODE = 0 is recommended.

ALS_VIS_DATA0: ALS_VIS_DATA Data Word Low Byte @ 0x22

Bit	7	6	5	4	3	2	1	0
Name	ALS_VIS_DATA[7:0]							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	ALS_VIS_DATA[7:0]	**ALS VIS Data LSB.** Once autonomous measurements have started, this register must be read after INT has asserted but before the next measurement is made. Refer to “AN498: Si114x Designer’s Guide” Section 5.6.2 “Host Interrupt Latency.”

ALS_VIS_DATA1: ALS_VIS_DATA Data Word High Byte @ 0x23

Bit	7	6	5	4	3	2	1	0
Name	ALS_VIS_DATA[15:8]							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	ALS_VIS_DATA[15:8]	**ALS VIS Data MSB.** Once autonomous measurements have started, this register must be read after INT has asserted but before the next measurement is made. Refer to “AN498: Si114x Designer’s Guide” Section 5.6.2 “Host Interrupt Latency.”

ALS_IR_DATA0: ALS_IR_DATA Data Word Low Byte@ 0x24

Bit	7	6	5	4	3	2	1	0
Name	ALS_IR_DATA[7:0]							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	ALS_IR_DATA[7:0]	**ALS IR Data LSB.** Once autonomous measurements have started, this register must be read after INT has asserted but before the next measurement is made. Refer to “AN498: Si114x Designer’s Guide” Section 5.6.2 “Host Interrupt Latency.”

ALS_IR_DATA1: ALS_IR_DATA Data Word High Byte @ 0x25

Bit	7	6	5	4	3	2	1	0
Name	ALS_IR_DATA[15:8]							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	ALS_IR_DATA[15:8]	**ALS IR Data MSB.** Once autonomous measurements have started, this register must be read after INT has asserted but before the next measurement is made. Refer to “AN498: Si114x Designer’s Guide” Section 5.6.2 “Host Interrupt Latency.”

PS1_DATA0: PS1_DATA Data Word Low Byte @ 0x26

Bit	7	6	5	4	3	2	1	0
Name	PS1_DATA[7:0]							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	PS1_DATA[7:0]	**PS1 Data LSB.** Once autonomous measurements have started, this register must be read after INT has asserted but before the next measurement is made. Refer to “AN498: Si114x Designer’s Guide” Section 5.6.2 “Host Interrupt Latency.”

PS1_DATA1: PS1_DATA Data Word High Byte @ 0x27

Bit	7	6	5	4	3	2	1	0
Name	PS1_DATA[15:8]							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	PS1_DATA[15:8]	**PS1 Data MSB.** Once autonomous measurements have started, this register must be read after INT has asserted but before the next measurement is made. Refer to “AN498: Si114x Designer’s Guide” Section 5.6.2 “Host Interrupt Latency.”

PS2_DATA0: PS2_DATA Data Word Low Byte @ 0x28

Bit	7	6	5	4	3	2	1	0
Name	PS2_DATA[7:0]							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	PS2_DATA[7:0]	**PS2 Data LSB.** Once autonomous measurements have started, this register must be read after INT has asserted but before the next measurement is made. Refer to “AN498: Si114x Designer’s Guide” Section 5.6.2 “Host Interrupt Latency.”

PS2_DATA1: PS2_DATA Data Word High Byte @ 0x29

Bit	7	6	5	4	3	2	1	0
Name	PS2_DATA[15:8]							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	PS2_DATA[15:8]	**PS2 Data MSB.** Once autonomous measurements have started, this register must be read after INT has asserted but before the next measurement is made. Refer to “AN498: Si114x Designer’s Guide” Section 5.6.2 “Host Interrupt Latency.”

PS3_DATA0: PS3_DATA Data Word Low Byte @ 0x2A

Bit	7	6	5	4	3	2	1	0
Name	PS3_DATA[7:0]							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	PS3_DATA[7:0]	**PS3 Data LSB.** Once autonomous measurements have started, this register must be read after INT has asserted but before the next measurement is made. Refer to “AN498: Si114x Designer’s Guide” Section 5.6.2 “Host Interrupt Latency.”

PS3_DATA1: PS3_DATA Data Word High Byte @ 0x2B

Bit	7	6	5	4	3	2	1	0
Name	PS3_DATA[15:8]							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	PS3_DATA[15:8]	**PS3 Data MSB.** Once autonomous measurements have started, this register must be read after INT has asserted but before the next measurement is made. Refer to “AN498: Si114x Designer’s Guide” Section 5.6.2 “Host Interrupt Latency.”

AUX_DATA0: AUX_DATA Data Word Low Byte @ 0x2C

Bit	7	6	5	4	3	2	1	0
Name	AUX_DATA[7:0]							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	AUX_DATA[7:0]	**AUX Data LSB.** Once autonomous measurements have started, this register must be read after INT has asserted but before the next measurement is made. Refer to “AN498: Si114x Designer’s Guide” Section 5.6.2 “Host Interrupt Latency.”

AUX_DATA1: AUX_DATA Data Word High Byte @ 0x2D

Bit	7	6	5	4	3	2	1	0
Name	AUX_DATA[15:8]							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	AUX_DATA[15:8]	**AUX Data MSB.** Once autonomous measurements have started, this register must be read after INT has asserted but before the next measurement is made. Refer to “AN498: Si114x Designer’s Guide” Section 5.6.2 “Host Interrupt Latency.”

PARAM_RD @ 0x2E

Bit	7	6	5	4	3	2	1	0
Name	PARAM_RD							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	PARAM_RD	Mailbox register for passing parameters from the sequencer to the host.

CHIP_STAT @ 0x30

Bit	7	6	5	4	3	2	1	0
Name						RUNNING	SUSPEND	SLEEP
Type						R	R	R

复位值 = 0000 0000

Bit	Name	Function
7:3	Reserved	**Reserved**
2	RUNNING	Device is awake.
1	SUSPEND	Device is in a low-power state, waiting for a measurement to complete.
0	SLEEP	Device is in its lowest power state.

ANA_IN_KEY @ 0x3B to 0x3E

Bit	7	6	5	4	3	2	1	0
0x3B	ANA_IN_KEY[31:24]							
0x3C	ANA_IN_KEY[23:16]							
0x3D	ANA_IN_KEY[15:8]							
0x3E	ANA_IN_KEY[7:0]							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
31:0	ANA_IN_KEY[31:0]	**Reserved.**

4.6. 参数 RAM

参数在内存中，不可直接通过 I^2C 解址。他们必须直接使用 PARAM_QUERY 和 PARAM_SET 命令解址，详见 第 20 页上 “4.2. 命令协议 ”。

Table 16. Parameter RAM Summary Table

Parameter Name	Offset	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
I2C_ADDR	0x00	I^2C Address							
CHLIST	0x01	—	EN_AUX	EN_ALS_IR	EN_ALS_VIS	—	EN_PS3	EN_PS2	EN_PS1
PSLED12_SELECT	0x02	—	PS2_LED			—	PS1_LED		
PSLED3_SELECT	0x03	—					PS3_LED		
Reserved	0x04	Reserved (always set to 0)							
PS_ENCODING	0x05	—	PS3_ALIGN	PS2_ALIGN	PS1_ALIGN	Reserved (always set to 0)			
ALS_ENCODING	0x06	—		ALS_IR_ALIGN	ALS_VIS_ALIGN	Reserved (always set to 0)			
PS1_ADCMUX	0x07	PS1 ADC Input Selection							
PS2_ADCMUX	0x08	PS2 ADC Input Selection							
PS3_ADCMUX	0x09	PS3 ADC Input Selection							
PS_ADC_COUNTER	0x0A	—	PS_ADC_REC			Reserved (always set to 0)			
PS_ADC_GAIN	0x0B	—					PS_ADC_GAIN		
PS_ADC_MISC	0x0C	—		PS_RANGE	—		PS_ADC_MODE	—	
Reserved	0x0D	Reserved (do not modify from default setting of 0x02)							
ALS_IR_ADCMUX	0x0E	ALS_IR_ADCMUX							
AUX_ADCMUX	0x0F	AUX ADC Input Selection							
ALS_VIS_ADC_COUNTER	0x10	—	VIS_ADC_REC			Reserved (always set to 0)			
ALS_VIS_ADC_GAIN	0x11	—					ALS_VIS_ADC_GAIN		
ALS_VIS_ADC_MISC	0x12	Reserved (always set to 0)		VIS_RANGE	Reserved (always set to 0)				
Reserved	0x13	Reserved (do not modify from default setting of 0x40)							
Reserved	0x14–0x15	Reserved (do not modify from default setting of 0x00)							
ALS_HYST	0x16	ALS Hysteresis							
PS_HYST	0x17	PS Hysteresis							
PS_HISTORY	0x18	PS History Setting							
ALS_HISTORY	0x19	ALS History Setting							

Table 16. Parameter RAM Summary Table (Continued)

Parameter Name	Offset	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
ADC_OFFSET	0x1A	ADC Offset							
Reserved	0x1B	Reserved (do not modify from default setting of 0x00)							
LED_REC	0x1C	LED recovery time							
ALS_IR_ADC_COUNTER	0x1D	—	IR_ADC_REC			Reserved (always set to 0)			
ALS_IR_ADC_GAIN	0x1E	—					ALS_IR_ADC_GAIN		
ALS_IR_ADC_MISC	0x1F	Reserved (always set to 0)		IR_RANGE	Reserved (always set to 0)				

I2C @ 0x00

Bit	7	6	5	4	3	2	1	0
Name	I^{2}C Address[7:0]							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	I^{2}C Address[7:0]	Specifies a new I^{2}C Address for the device to respond to. The new address takes effect when a BUSADDR command is received.

CHLIST @ 0x01

Bit	7	6	5	4	3	2	1	0
Name		EN_AUX	EN_ALS_IR	EN_ALS_VIS		EN_PS3	EN_PS2	EN_PS1
Type	RW					RW		

复位值 = 0000 0000

Bit	Name	Function
7	Reserved	
6	EN_AUX	Enables Auxiliary Channel, data stored in AUX_DATA1[7:0] and AUX_DATA0[7:0].
5	EN_ALS_IR	Enables ALS IR Channel, data stored in ALS_IR_DATA1[7:0] and ALS_IR_DATA0[7:0].
4	EN_ALS_VIS	Enables ALS Visible Channel, data stored in ALS_VIS_DATA1[7:0] and ALS_VIS_DATA0[7:0].
3	Reserved	
2	EN_PS3	Enables PS Channel 3, data stored in PS3_DATA1[7:0] and PS3_DATA0[7:0].

1	EN_PS2	Enables PS Channel 2, data stored in PS2_DATA1[7:0] and PS2_DATA0[7:0].
0	EN_PS1	Enables PS Channel 1, data stored in PS1_DATA1[7:0] and PS1_DATA0[7:0].
Note: For proper operation, CHLIST must be written with a non-zero value before forced measurements or autonomous operation is requested.		

PSLED12_SELECT @ 0x02

Bit	7	6	5	4	3	2	1	0
Name		PS2_LED[2:0]				PS1_LED[2:0]		
Type	RW				RW			

复位值 = 0010 0001

Bit	Name	Function
7	Reserved	
6:4	PS2_LED[2:0]	Specifies the LED pin driven during the PS2 Measurement. Note that any combination of irLEDs is possible. 000: NO LED DRIVE xx1: LED1 Drive Enabled x1x: LED2 Drive Enabled (Si1142 and Si1143 only. Clear for Si1141) 1xx: LED3 Drive Enabled (Si1143 only. Clear for Si1141 and Si1142)
3	Reserved	
2:0	PS1_LED[2:0]	Specifies the LED pin driven during the PS1 Measurement. Note that any combination of irLEDs is possible. 000: NO LED DRIVE xx1: LED1 Drive Enabled x1x: LED2 Drive Enabled (Si1142 and Si1143 only. Clear for Si1141) 1xx: LED3 Drive Enabled (Si1143 only. Clear for Si1141 and Si1142)

PSLED3_SELECT @ 0x03

Bit	7	6	5	4	3	2	1	0
Name						PS3_LED[2:0]		
Type	RW							

复位值 = 0000 0100

Bit	Name	Function
7:3	Reserved	
2:0	PS3_LED[2:0]	Specifies the LED pin driven during the PS3 Measurement. Note that any combination of irLEDs is possible. 000: No LED drive. xx1: LED1 drive enabled. x1x: LED2 drive enabled (Si1142 and Si1143 only. Clear for Si1141). 1xx: LED3 drive enabled (Si1143 only. Clear for Si1141 and Si1142).

PS_ENCODING @ 0x05

Bit	7	6	5	4	3	2	1	0
Name		PS3_ALIGN	PS2_ALIGN	PS1_ALIGN				
Type		RW	R/W	R/W				

复位值 = 0000 0000

Bit	Name	Function
7	Reserved	
6	PS3_ALIGN	When set, the ADC reports the least significant 16 bits of the 17-bit ADC when performing PS3 Measurement. Reports the 16 MSBs when cleared.
5	PS2_ALIGN	When set, the ADC reports the least significant 16 bits of the 17-bit ADC when performing PS2 Measurement. Reports the 16 MSBs when cleared.
4	PS1_ALIGN	When set, the ADC reports the least significant 16 bits of the 17-bit ADC when performing PS1 Measurement. Reports the 16 MSBs when cleared.
3:0	Reserved	Always set to 0.

ALS_ENCODING @ 0x06

Bit	7	6	5	4	3	2	1	0
Name			ALS_IR_ALIGN	ALS_VIS_ALIGN				
Type			RW	RW				

复位值 = 0000 0000

Bit	Name	Function
7:6	Reserved	
5	ALS_IR_ALIGN	When set, the ADC reports the least significant 16 bits of the 17-bit ADC when performing ALS VIS Measurement. Reports the 16 MSBs when cleared.

4	ALS_VIS_ALIGN	When set, the ADC reports the least significant 16 bits of the 17-bit ADC when performing ALS IR Measurement. Reports the 16 MSBs when cleared.
3:0	Reserved	Always set to 0.

PS1_ADCMUX @ 0x07

Bit	7	6	5	4	3	2	1	0
Name	PS1_ADCMUX[7:0]							
Type	RW							

复位值 = 0000 0011

Bit	Name	Function
7:0	PS1_ADCMUX[7:0]	**Selects ADC Input for PS1 Measurement.** The following selections are valid when PS_ADC_MODE = 1 (default). This setting is for normal Proximity Detection function. 0x03: Large IR Photodiode 0x00: Small IR Photodiode In addition, the following selections are valid for PS_ADC_MODE = 0. With this setting, irLED drives are disabled and the PS channels are no longer operating in normal Proximity Detection function. The results have no reference and the references needs to be measured in a separate measurement. 0x02: Visible Photodiode A separate 'No Photodiode' measurement should be subtracted from this reading. Note that the result is a negative value. The result should therefore be negated to arrive at the Ambient Visible Light reading. 0x03: Large IR Photodiode A separate “No Photodiode” measurement should be subtracted to arrive at Ambient IR reading. 0x00: Small IR Photodiode A separate “No Photodiode” measurement should be subtracted to arrive at Ambient IR reading. 0x06: No Photodiode This is typically used as reference for reading ambient IR or visible light. 0x25: GND voltage This is typically used as the reference for electrical measurements. **0x65: Temperature** (Should be used only for relative temperature measurement. Absolute Temperature not guaranteed) A separate GND measurement should be subtracted from this reading. 0x75: V_{DD} voltage A separate GND measurement is needed to make the measurement meaningful.

PS2_ADCMUX @ 0x08

Bit	7	6	5	4	3	2	1	0
Name	PS2_ADCMUX[7:0]							
Type	R/W							

复位值 = 0000 0011

Bit	Name	Function
7:0	PS2_ADCMUX[7:0]	Selects input for PS2 measurement. See PS1_ADCMUX register description for details.

PS3_ADCMUX @ 0x09

Bit	7	6	5	4	3	2	1	0
Name	PS3_ADCMUX[7:0]							
Type	R/W							

复位值 = 0000 0011

Bit	Name	Function
7:0	PS3_ADCMUX[7:0]	Selects input for PS3 measurement. See PS1_ADCMUX register description for details.

PS_ADC_COUNTER @ 0x0A

Bit	7	6	5	4	3	2	1	0
Name		PS_ADC_REC[2:0]						
Type		RW	R/W	R/W				

复位值 = 0111 0000

Bit	Name	Function
7	Reserved	
6:4	PS_ADC_REC[2:0]	Recovery period the ADC takes before making a PS measurement. 000: 1 ADC Clock (50 ns times $2^{PS\_ADC\_GAIN}$) 001: 7 ADC Clock (350 ns times $2^{PS\_ADC\_GAIN}$) 010: 15 ADC Clock (750 ns times $2^{PS\_ADC\_GAIN}$) 011: 31 ADC Clock (1.55 µs times $2^{PS\_ADC\_GAIN}$) 100: 63 ADC Clock (3.15 µs times $2^{PS\_ADC\_GAIN}$) 101: 127 ADC Clock (6.35 µs times $2^{PS\_ADC\_GAIN}$) 110: 255 ADC Clock (12.75 µs times $2^{PS\_ADC\_GAIN}$) 111: 511 ADC Clock (25.55 µs times $2^{PS\_ADC\_GAIN}$) The recommended PS_ADC_REC value is the one's complement of PS_ADC_GAIN.
3:0	Reserved	Always set to 0.

PS_ADC_GAIN @ 0x0B

Bit	7	6	5	4	3	2	1	0
Name						PS_ADC_GAIN[2:0]		
Type						R/W	R/W	R/W

复位值 = 0000 0000

Bit	Name	Function
7:3	Reserved	
2:0	PS_ADC_GAIN[2:0]	Increases the irLED pulse width and ADC integration time by a factor of (2 ^ PS_ADC_GAIN) for all PS measurements. Care must be taken when using this feature. At an extreme case, each of the three PS measurements can be configured to drive three separate irLEDs, each of which, are configured for 359 mA. The internal sequencer does not protect the device from such an error. To prevent permanent damage to the device, do not enter any value greater than 5 without consulting with Silicon Labs. For Example: 0x0: ADC Clock is divided by 1 0x4: ADC Clock is divided by 16 0x5: ADC Clock is divided by 32

PS_ADC_MISC @ 0x0C

Bit	7	6	5	4	3	2	1	0
Name			PS_RANGE			PS_ADC_MODE		
Type			RW			RW		

复位值 = 0000 0100

Bit	Name	Function
7:6	Reserved	
5	PS_RANGE	When performing PS measurements, the ADC can be programmed to operate in high sensitivity operation or high signal range. The high signal range is useful in operation under direct sunlight. 0: Normal Signal Range 1: High Signal Range (Gain divided by 14.5)
4:3	Reserved	
2	PS_ADC_MODE	PS Channels can either operate normally as PS channels, or it can be used to perform raw ADC measurements: 0: Raw ADC Measurement Mode 1: Normal Proximity Measurement Mode
1:0	Reserved	

ALS_IR_ADCMUX @ 0x0E

Bit	7	6	5	4	3	2	1	0
Name	ALS_IR_ADCMUX							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	ALS_IR_ADCMUX	**Selects ADC Input for ALS_IR Measurement.** 0x00: Small IR photodiode 0x03: Large IR photodiode

AUX_ADCMUX @ 0x0F

Bit	7	6	5	4	3	2	1	0
Name	AUX_ADCMUX[7:0]							
Type	RW							

复位值 = 0110 0101

Bit	Name	Function
7:0	AUX_ADCMUX[7:0]	Selects input for AUX Measurement. These measurements are referenced to GND. 0x65: Temperature (Should be used only for relative temperature measurement. Absolute Temperature not guaranteed) 0x75: V_{DD} voltage

ALS_VIS_ADC_COUNTER @ 0x10

Bit	7	6	5	4	3	2	1	0
Name		VIS_ADC_REC[2:0]						
Type		RW	R/W	R/W				

复位值 = 0111 0000

Bit	Name	Function
7	Reserved	
6:4	VIS_ADC_REC[2:0]	Recovery period the ADC takes before making a ALS-VIS measurement. 000: 1 ADC Clock (50 ns times $2^{\text{ALS\_VIS\_ADC\_GAIN}}$) 001: 7 ADC Clock (350 ns times $2^{\text{ALS\_VIS\_ADC\_GAIN}}$) 010: 15 ADC Clock (750 ns times $2^{\text{ALS\_VIS\_ADC\_GAIN}}$) 011: 31 ADC Clock (1.55 µs times $2^{\text{ALS\_VIS\_ADC\_GAIN}}$) 100: 63 ADC Clock (3.15 µs times $2^{\text{ALS\_VIS\_ADC\_GAIN}}$) 101: 127 ADC Clock (6.35 µs times $2^{\text{ALS\_VIS\_ADC\_GAIN}}$) 110: 255 ADC Clock (12.75 µs times $2^{\text{ALS\_VIS\_ADC\_GAIN}}$) 111: 511 ADC Clock (25.55 µs times $2^{\text{ALS\_VIS\_ADC\_GAIN}}$) The recommended VIS_ADC_REC value is the one's complement of ALS_VIS_ADC_GAIN.
3:0	Reserved	Always set to 0.
Note: For A02 and earlier, this parameter also controls ALS-IR measurements.		

ALS_VIS_ADC_GAIN @ 0x11

Bit	7	6	5	4	3	2	1	0
Name						ALS_VIS_ADC_GAIN[2:0]		
Type						RW	R/W	RW

复位值 = 0000 0000

Bit	Name	Function
7:3	Reserved	
2:0	ALS_VIS_ADC_GAIN[2:0]	Increases the ADC integration time for ALS Visible measurements by a factor of (2 ^ ALS_VIS_ADC_GAIN). This allows visible light measurement under dark glass. The maximum gain is 128 (0x7). For Example: 0x0: ADC Clock is divided by 1 0x4: ADC Clock is divided by 16 0x6: ADC Clock is divided by 64
Note: For A02 and earlier, this parameter also controls ALS-IR measurements.		

ALS_VIS_ADC_MISC @ 0x12

Bit	7	6	5	4	3	2	1	0
Name			VIS_RANGE					
Type			RW					

复位值 = 0000 0000

Bit	Name	Function
7:6	Reserved	
5	VIS_RANGE	When performing ALS-VIS measurements, the ADC can be programmed to operate in high sensitivity operation or high signal range. The high signal range is useful in operation under direct sunlight. 0: Normal Signal Range 1: High Signal Range (Gain divided by 14.5)
4:0	Reserved	
Note: For A02 and earlier, this parameter also controls ALS-IR measurements.		

ALS_HYST @ 0x16

Bit	7	6	5	4	3	2	1	0
Name	ALS_HYST[7:0]							
Type	RW							

复位值 = 0100 1000

Bit	Name	Function
7:0	ALS_HYST[7:0]	ALS_HYST represents a hysteresis applied to the ALS_LOW_TH and ALS_HIGH_TH thresholds. This is in an 8-bit compressed format, representing a 16-bit value. For example: 0x48: 24 ADC Codes Please refer to “AN498: Si114x Designer’s Guide”, Section 5.4 “Compression Concept.”

PS_HYST @ 0x17

Bit	7	6	5	4	3	2	1	0
Name	PS_HYST[7:0]							
Type	RW							

复位值 = 0100 1000

Bit	Name	Function
7:0	PS_HYST[7:0]	PS_HYST represents a hysteresis applied to the PS1_TH, PS2_TH and PS3_TH thresholds. This is in an 8-bit compressed format, representing a 16-bit value. For example: 0x48: 24 ADC Codes. Please refer to “AN498: Si114x Designer’s Guide”, Section 5.4 “Compression Concept.”

PS_HISTORY @ 0x18

Bit	7	6	5	4	3	2	1	0
Name	PS_HISTORY[7:0]							
Type	RW							

复位值 = 0000 0011

Bit	Name	Function
7:0	PS_HISTORY[7:0]	PS_HISTORY is a bit-field representing the number of consecutive samples exceeding the threshold and hysteresis to change status. For example: 0x03: 2 consecutive samples 0x07: 3 consecutive samples 0xFF: 8 consecutive samples

ALS_HISTORY @ 0x19

Bit	7	6	5	4	3	2	1	0
Name	ALS_HISTORY[7:0]							
Type	RW							

复位值 = 0000 0011

Bit	Name	Function
7:0	ALS_HISTORY[7:0]	ALS_HISTORY is a bit-field representing the number of consecutive samples exceeding the threshold and hysteresis to change status. For example: 0x03: Two consecutive samples 0x07: Three consecutive samples 0xFF: Eight consecutive samples

ADC_OFFSET @ 0x1A

Bit	7	6	5	4	3	2	1	0
Name	ADC_OFFSET[7:0]							
Type	RW							

复位值 = 1000 0000

Bit	Name	Function
7:0	ADC_OFFSET[7:0]	ADC_OFFSET is an 8-bit compressed value representing a 16-bit value added to all measurements. Since most measurements are relative measurements involving a arithmetic subtraction and can result in a negative value. Since 0xFFFF is treated as an overrange indicator, the ADC_OFFSET is added so that the values reported in the I^2C register map are never confused with the 0xFFFF overrange indicator. For example: 0x60: Measurements have a 64-code offset 0x70: Measurements have a 128-code offset 0x80: Measurements have a 256-code offset Please refer to "AN498: Si114x Designer's Guide", Section 5.4 "Compression Concept."

LED_REC @ 0x1C

Bit	7	6	5	4	3	2	1	0
Name	LED_REC[7:0]							
Type	RW							

复位值 = 0000 0000

Bit	Name	Function
7:0	LED_REC[7:0]	**Reserved.**

ALS_IR_ADC_COUNTER @ 0x1D

Bit	7	6	5	4	3	2	1	0
Name		IR_ADC_REC[2:0]						
Type	RW							

复位值 = 0111 0000

Bit	Name	Function
7	Reserved	
6:4	IR_ADC_REC[2:0]	Recovery period the ADC takes before making a ALS-IR measurement. 000: 1 ADC Clock (50 ns times $2^{ALS\_IR\_ADC\_GAIN}$) 001: 7 ADC Clock (350 ns times $2^{ALS\_IR\_ADC\_GAIN}$) 010: 15 ADC Clock (750 ns times $2^{ALS\_IR\_ADC\_GAIN}$) 011: 31 ADC Clock (1.55 µs times $2^{ALS\_IR\_ADC\_GAIN}$) 100: 63 ADC Clock (3.15 µs times $2^{ALS\_IR\_ADC\_GAIN}$) 101: 127 ADC Clock (6.35 µs times $2^{ALS\_IR\_ADC\_GAIN}$) 110: 255 ADC Clock (12.75 µs times $2^{ALS\_IR\_ADC\_GAIN}$) 111: 511 ADC Clock (25.55 µs times $2^{ALS\_IR\_ADC\_GAIN}$) The recommended IR_ADC_REC value is the one's complement of ALS_IR_ADC_GAIN.
3:0	Reserved	Always set to 0.
Note: This parameter available for sequencer revisions A03 or later.		

ALS_IR_ADC_GAIN @ 0x1E

Bit	7	6	5	4	3	2	1	0
Name						ALS_IR_ADC_GAIN[2:0]		
Type						R/W	R/W	R/W

复位值 = 0000 0000

Bit	Name	Function
7:3	Reserved	
2:0	ALS_IR_ADC_GAIN[2:0]	Increases the ADC integration time for IR Ambient measurements by a factor of (2 ^ ALS_IR_ADC_GAIN). The maximum gain is 128 (0x7). For Example: 0x0: ADC Clock is divided by 1 0x4: ADC Clock is divided by 16 0x6: ADC Clock is divided by 64
Note: This parameter available for sequencer revisions A03 or later.		

ALS_IR_ADC_MISC @ 0x1F

Bit	7	6	5	4	3	2	1	0
Name			IR_RANGE					
Type			RW					

复位值 = 0000 0000

Bit	Name	Function
7:6	Reserved	
5	IR_RANGE	When performing ALS-IR measurements, the ADC can be programmed to operate in high sensitivity operation or high signal range. The high signal range is useful in operation under direct sunlight. 0: Normal Signal Range 1: High Signal Range (Gain divided by 14.5)
4:0	Reserved	Write operations to this RAM parameter must preserve this bit-field value using read-modify-write.
Note: This parameter is available for sequencer revisions A03 or later.		

5. 引脚说明

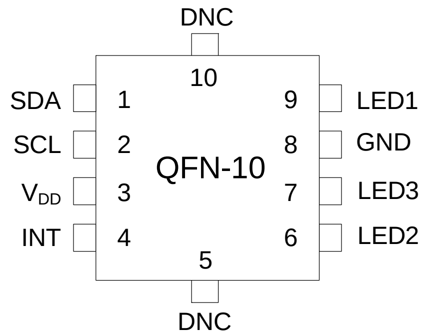


Table 17. Pin Descriptions

Pin	Name	Type	Description
1	SDA	Bidirectional	I^2C Data.
2	SCL	Input	I^2C Clock.
3	V_{DD}	Power	Power Supply. Voltage source.
4	INT	Bidirectional	Interrupt Output. Open-drain interrupt output pin. Must be at logic level high during power-up sequence to enable low power operation.
5	DNC		Do Not Connect. This pin is electrically connected to an internal Si1141/42/43 node. It should remain unconnected.
6	$LED2/CV_{DD}$[1]	Output	LED2 Output/Connect to V_{DD}.[1] Programmable constant current sink normally connected to an infrared LED cathode. Connect directly to V_{DD} when not in use.
7	$LED3/CV_{DD}$[2]	Output	LED3 Output./Connect to V_{DD}.[2] Programmable constant current sink normally connected to an infrared LED cathode. If VLED < (V_{DD} + 0.5 V), a 47 kΩ pull-up resistor from LED3 to V_{DD} is needed for proper operation. Connect directly to V_{DD} when not in use.
8	GND	Power	Ground. Reference voltage.
9	LED1	Output	LED1 Output. Programmable constant current sink normally connected to an infrared LED cathode.
10	DNC		Do Not Connect. This pin is electrically connected to an internal Si1141/42/43 node. It should remain unconnected.

Notes:

1. Si1142 and Si1143 only. Must connect to V_{DD} in Si1141.
2. Si1143 only. Must connect to V_{DD} in Si1141 and Si1142.

6. 订购指南

Part Number	Package	LED Drivers	AEC-Q100
Si1141-A11-GMR	QFN-10	1	N
Si1142-A11-GMR	QFN-10	2	N
Si1143-A11-GMR	QFN-10	3	N
Si1141-A11-YM0R	QFN-10	1	Y
Si1142-A11-YM0R	QFN-10	2	Y
Si1143-A11-YM0R	QFN-10	3	Y
Si1141-A10-GMR*	QFN-10	1	N
Si1142-A10-GMR*	QFN-10	2	N
Si1143-A10-GMR*	QFN-10	3	N
***Note:** Not recommended for new designs.			

7. 包装外形：10 引脚 QFN

Figure 15 说明 Si1141/42/43 QFN 包装的包装详细信息。表 18 列出插图中尺寸的值。

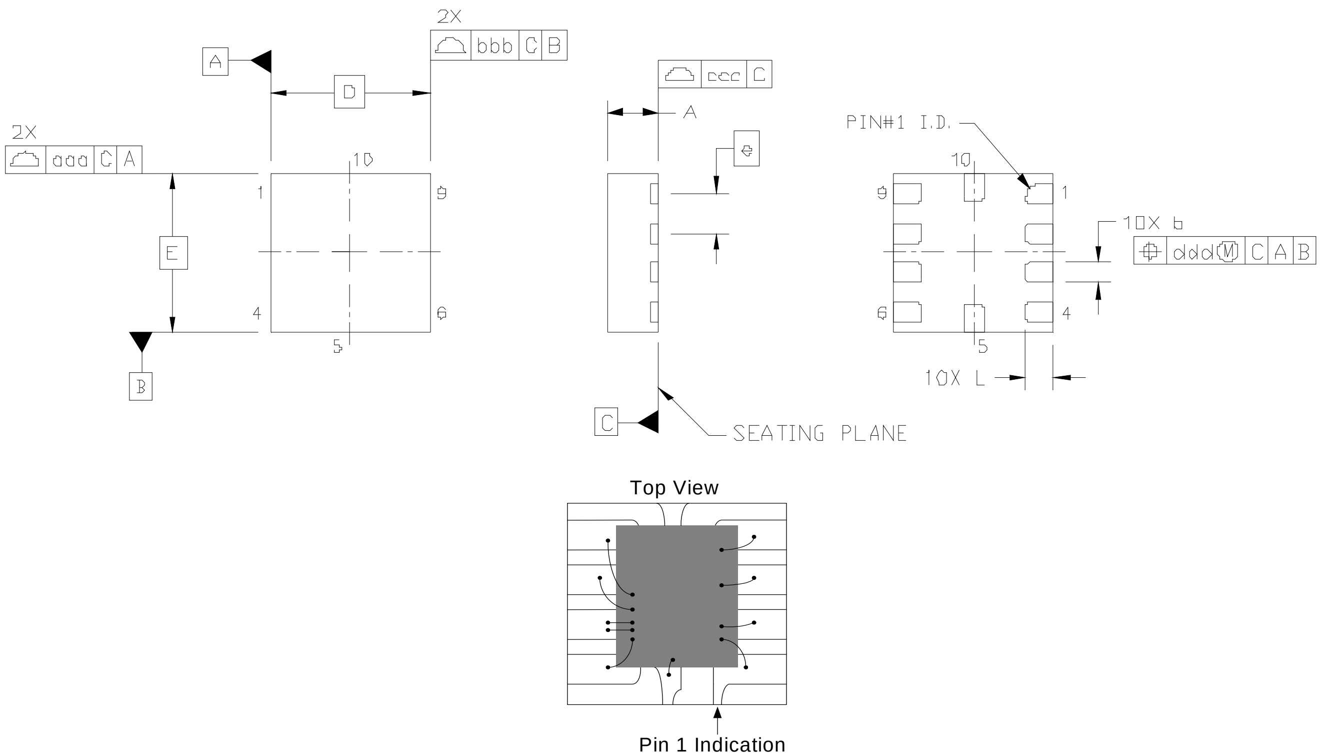


Figure 15. QFN Package Diagram Dimensions

Table 18. Package Diagram Dimensions

Dimension	Min	Nom	Max
A	0.55	0.65	0.75
b	0.20	0.25	0.30
D		2.00 BSC.	
e		0.50 BSC.	
E		2.00 BSC.	
L	0.30	0.35	0.40
aaa		0.10	
bbb		0.10	
ccc		0.08	
ddd		0.10	

Notes:

1. All dimensions shown are in millimeters (mm).
2. Dimensioning and Tolerancing per ANSI Y14.5M-1994.

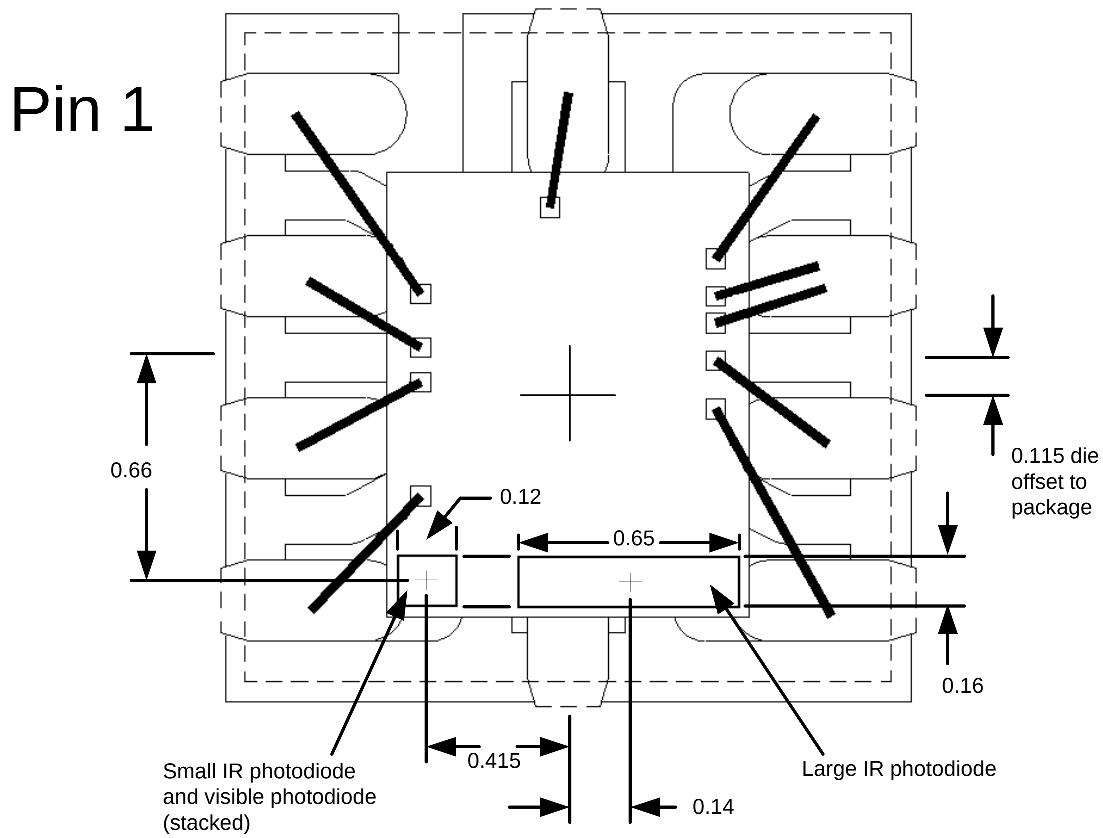
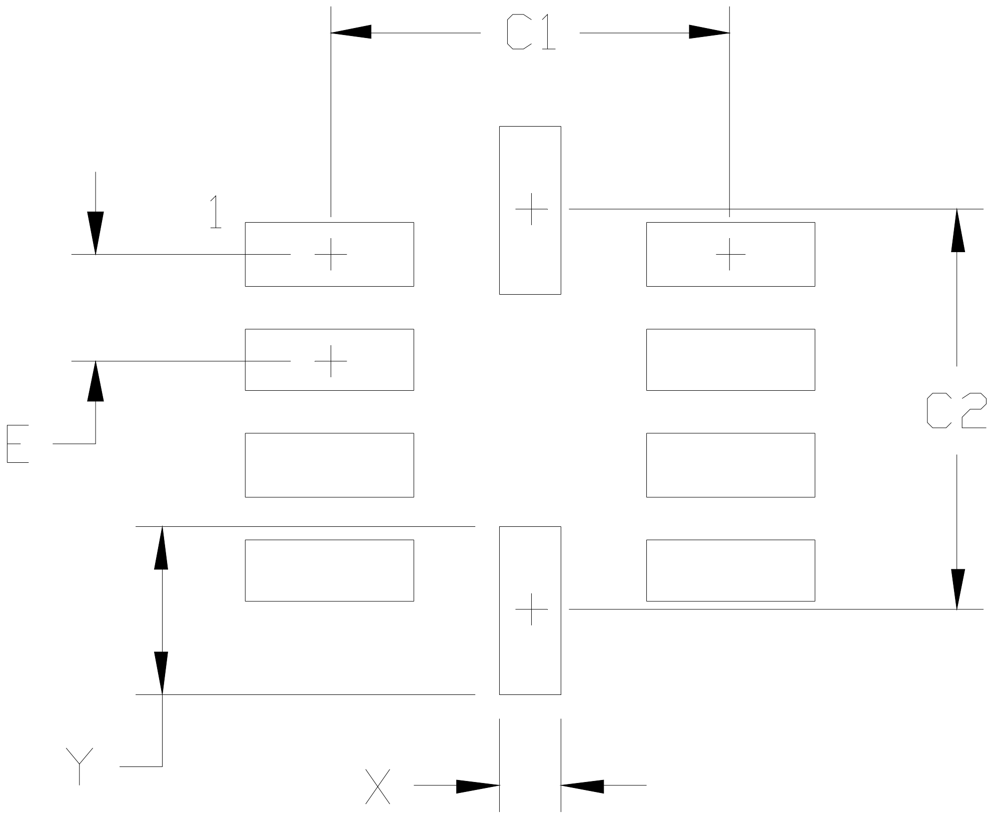


Figure 16. Photodiode Centers

8. 建议的 PCB 焊盘图案



Dimension	mm
C1	1.90
C2	1.90
E	0.50
X	0.30
Y	0.80

Notes:
General
1. All dimensions shown are in millimeters (mm).
2. This Land Pattern Design is based on the IPC-7351 guidelines.
3. All dimensions shown are at Maximum Material Condition (MMC). Least Material Condition (LMC) is calculated based on a Fabrication Allowance of 0.05 mm.

Solder Mask Design
4. All metal pads are to be non-solder mask defined (NSMD). Clearance between the solder mask and the metal pad is to be 60 mm minimum, all the way around the pad.

Stencil Design
5. A stainless steel, laser-cut and electro-polished stencil with trapezoidal walls should be used to assure good solder paste release.
6. The stencil thickness should be 0.125 mm (5 mils).
7. The ratio of stencil aperture to land pad size should be 1:1 for all pads.

Card Assembly
8. A No-Clean, Type-3 solder paste is recommended.
9. The recommended card reflow profile is per the JEDEC/IPC J-STD-020D specification for Small Body Components.

文档更改列表

修订版 0.2 至修订版 0.3

- 已将文档标题从 Si1140 更新为 Si114x。
- 已更新第 69 页上 “7. 包装外形：10 引脚 QFN”。
- 已更新表 4、 1 和 2。
- 已增加图 1、 2 和 4。
- 已增加寄存器映射和说明。

修订版 0.3 至修订版 0.4

- 已将文档标题从 Si114x 更新为 Si1143。
- 已更新应用章节
- 已更新表 2 和 3。
- 已更新图 1、图 4。
- 已更新表 8、表 9。
- 已更新引脚分配。
- 已更新寄存器映射和说明。

修订版 0.4 至修订版 0.41

- 除 Si1143 之外，已增加 Si1141 和 Si1142。
- 已增加 ODFN-8 包装选项。
- 重新排列了一些章节。
- 已增加信号通路软件模型图。
- 已将 PARAM_IN 重命名为 PARAM_WR 以便更清楚。
- 已将 PARAM_OUT 重命名为 PARAM_RD 以便更清楚。
- 已将 PS_ADC_CLKDIV 重命名为 PS_ADC_GAIN 以便更清楚。
- 已将 ALS_VIS_ADC_CLKDIV 重命名为 ALS_VIS_ADC_GAIN 以便更清楚。
- 已将 ALS_IR_ADC_CLKDIV 重命名为 ALS_IR_ADC_GAIN 以便更清楚。
- 对寄存器和参数术语做出了细微更改。

修订版 0.41 至修订版 0.5

- 已更新表 1、 4、 2 和 15。
- 已更新 Figure 1。
- 已增加图 2 和 16。
- 已更新寄存器表复位值。
- 已增加 “ HW_KEY @ 0x07” 寄存器。
- 已更新 “ALS_VIS_ADC_MISC @ 0x12” 寄存器。
- 已更新 “ALS_IR_ADC_MISC @ 0x1F” 寄存器。
- 已更新 “6. 订购指南 ” 。
- 已更新 “ 功能 ” 。
- 已更新 “ 说明 ” 。
- 已更新 “5. 引脚说明 ” 。
- 已更新 “6. 订购指南 ” 。
- 已更新 “7. 包装外形：10 引脚 QFN” 。
- 已删除第 7.1 节。
- 已删除第 7.2 节。

修订版 0.5 至修订版 1.0

- 在标题页做出了照明度范围和其他细微更改。
- 为三个光电二极管增加了敏感度数据。
- 为三个光电二极管增加了失调漂移数据。
- 已将启动时间更新到 25 ms。
- 对位字段定义做出了细微更正。
- 解释了波纹电压建议。
- 已增加 MM 和 CDM ESD 额定值。
- 已解释备用模式 Idd。
- 已解释 LED 输出泄漏电流。
- 已增加 LED 有功电流的限值。
- 订购代码更新。

修订版 1.0 至修订版 1.1

- 已更正 PS_ADC_COUNTER 的复位状态。
- 对信号通路设定模型图做出了细微更正。
- 已将 ALS_IR_ADCMUX 的访问模式从寄存器空间更正为参数空间。

修订版 1.1 至修订版 1.2

- 已更正 PS_ADC_COUNTER 的复位状态。
- 新增了 INT、 SCL 和 SDA 引脚的泄漏规格。
- 将临近阈值寄存器的格式从压缩更改为未压缩。
- 将固件修订版本从 A10 更改为 A11。
- 新增了有关压缩模式详细信息的 AN498 参考。
- 阐明了 PS_ADC_REC、 VIS_ADC_REC 和 IR_ADC_REC 中规定的恢复时间。
- 建议了 PCB 焊盘图案。
- 将光电二极管坐标原点改为封装中心。
- 新增了温度传感器的信息。
- 新增了使用 MEAS_RATE、 ALS_RATE 和 PS_RATE 的备注。
- 新增了有关 I^2C 广播复位的备注。
- 新增了性能图。
- 将 PS1TH、 PS2TH、 PS3TH、 ALS_LO_TH 和 ALS_HIGH_TH 的格式从 8 位压缩更改为 16 位线性，以获得更精细的阈值控制。

修订版 1.2 至修订版 1.3

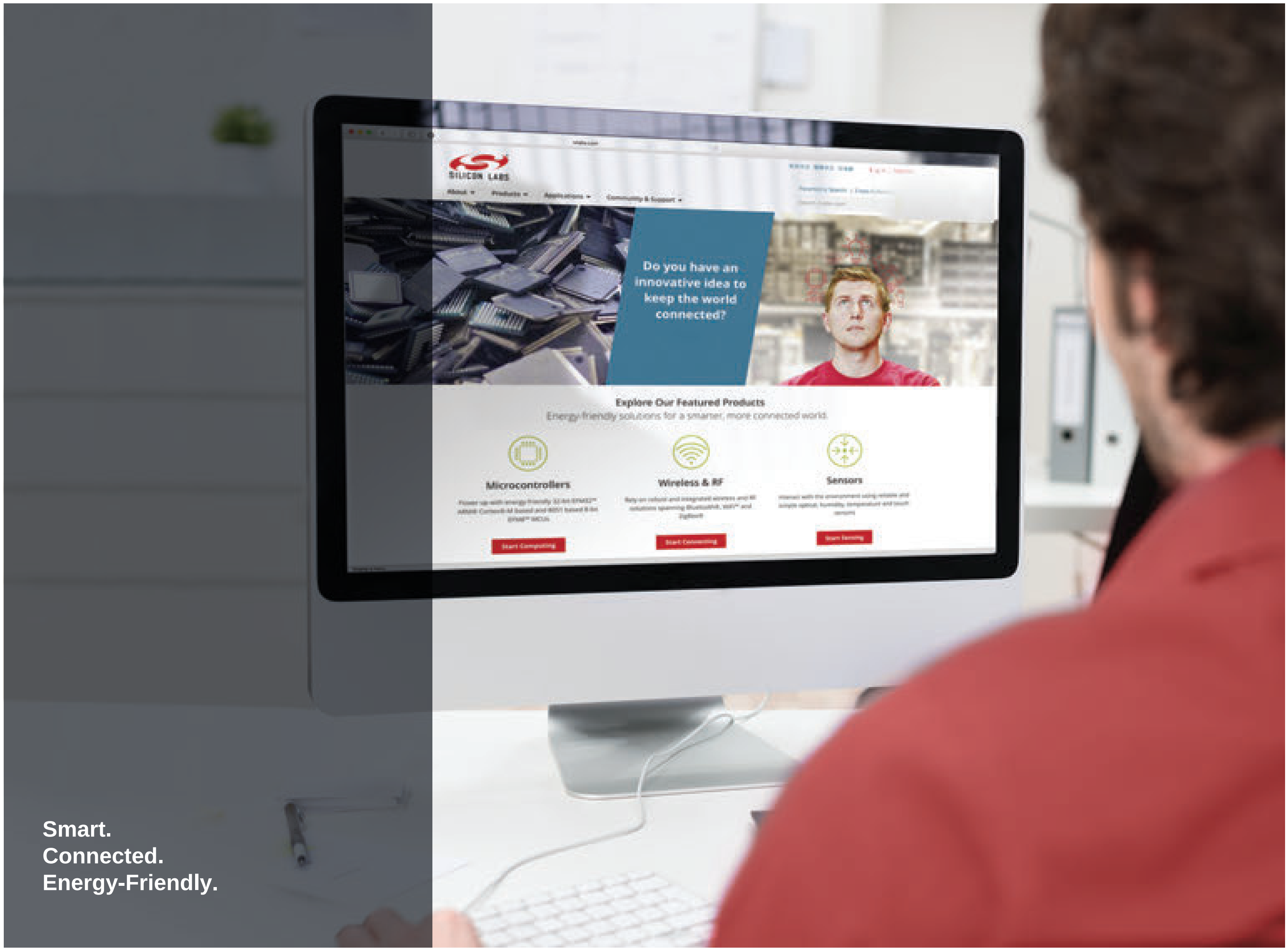
- 更新 ALS_LOW_TH0 @ 0x0B、ALS_LOW_TH1@0x0C、 ALS_HI_TH0@0x0D 和 ALS_HI-TH1@0x0E 的位名称。
- 将表 14 中的 IRQ_MODE1 更改为 IRQ_MODE2。
- 将第一页和第 5 节开始处的引脚图中的引脚 5 的引脚名称从 NC 更改为 DNC。
- 更改表 17 中引脚 5 的引脚名称和描述。
- 最小 V_{DD} 从 1.8 V 变为 1.71 V。

修订版 1.3 至修订版 1.4

- 增加最小 I^2C 时钟频率。
- 更新光电二极管频谱响应。
- 阐明 Command 寄存器和参数 RAM 的使用。
- 阐明使用 Si1141 和 Si1142 时的 LED2 和 LED3 连接。

修订版 1.4 至修订版 1.41

- 将文档标题从 Si114x 修改为 Si1141-42-43。
- 更新了 “6. 订购指南 ” 。
  - 添加了通过 AEC-Q100 认证的可订购部件号。



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