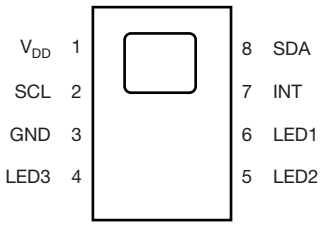
Биосенсоры
VCNL3036, VCNL4020C
Технические характеристики

High Resolution Digital Biosensor for Wearable Applications With I²C Interface



FEATURES

- Package type: surface-mount
- Dimensions (L x W x H in mm): 4.0 x 2.36 x 0.75
- Integrated modules: biosensor (BIO), photo diode (PD), and signal conditioning IC
- Temperature compensation: -25 °C to +85 °C
- Low power consumption I²C (SMBus compatible) interface
- Output type: I²C bus
- Operation voltage: 2.5 V to 3.6 V
- Floor life: 168 h, MSL 3, according to J-STD-020

Pb-free

e4

RoHS COMPLIANT

HALOGEN FREE

GREEN (5-2008)

DESCRIPTION

VCNL3036 integrates a biosensor (BIO), a mux, and a driver for up to 3 external IREDs / LEDs into one small package. It incorporates photodiodes, amplifiers, and analog to digital converting circuits into a single chip by CMOS process. BIO programmable interrupt features of individual high and low thresholds offers the best utilization of resource and power saving on the microcontroller.

The biosensor features an intelligent cancellation scheme, so that cross talk phenomenon is eliminated effectively. To accelerate the BIO response time, smart persistence prevents the misjudgment of proximity sensing but also keeps a fast response time. Active force mode, one time trigger by one instruction, is another good approach for more design flexibility to fulfill different kinds of applications with more power saving.

VCNL3036 provides an excellent temperature compensation capability for keeping output stable under various temperature configurations. BIO functions are easily operated via the simple command format of I²C (SMBus compatible) interface protocol. Operating voltage ranges from 2.5 V to 3.6 V. VCNL3036 is packaged in a lead (Pb)-free 8-pin QFN package, which offers the best market-proven reliability quality.

OPTICAL BIOSENSORS FUNCTION

- Broader sensitivity photodiode allows to also work with green and red LED
- Programmable LED sink current
- Intelligent cancellation to reduce cross talk phenomenon
- Smart persistence scheme to reduce response time
- Selectable for 12-bit / 16-bit BIO output data

INTERRUPT

- Programmable interrupt function for BIO with upper and lower thresholds
- Adjustable persistence to prevent false triggers

APPLICATIONS

- Handheld device
- Wearable devices
- Consumer device
- Fitness and medical monitoring applications

PRODUCT SUMMARY

PART NUMBER	OPERATING VOLTAGE RANGE (V)	I²C BUS VOLTAGE RANGE (V)	LED PULSE CURRENT (1) (mA)	SPECTRAL BANDWIDTH RANGE $\lambda_{0.5}$ (nm)	OUTPUT CODE	ADC RESOLUTION BIOSENSOR
VCNL3036	2.5 to 3.6	1.8 to 5.5	200	500 to 910	16 bit, I²C	16 bit

Notes

(1) Adjustable through I²C interface

ORDERING INFORMATION			
ORDERING CODE	**PACKAGING**	**VOLUME (1)**	**REMARKS**
VCNL3036-GS08	Tape and reel	MOQ: 3300 pcs	4.0 mm x 2.36 mm x 0.75 mm
VCNL3036-GS18		MOQ: 13 000 pcs	

Note

(1) MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS (T_{amb} = 25 °C, unless otherwise specified)					
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**MAX.**	**UNIT**
Supply voltage		V_{DD}	2.5	3.6	V
Operation temperature range		T_{amb}	-25	+85	°C
Storage temperature range		T_{stg}	-25	+85	°C

RECOMMENDED OPERATING CONDITIONS (T_{amb} = 25 °C, unless otherwise specified)					
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**MAX.**	**UNIT**
Supply voltage		V_{DD}	2.5	3.6	V
Operation temperature range		T_{amb}	-25	+85	°C
I^2C bus operating frequency		$f_{(I2CCLK)}$	10	400	kHz

PIN DESCRIPTIONS			
PIN ASSIGNMENT	**SYMBOL**	**TYPE**	**FUNCTION**
1	V_{DD}	-	Power supply input
2	SCL	I	I^2C digital bus clock input
3	GND	-	Ground
4	LED3	I	Cathode (LED3) connection
5	LED2	I	Cathode (LED2) connection
6	LED1	I	Cathode (LED1) connection
7	INT	O	Interrupt pin
8	SDA	I / O (open drain)	I^2C data bus data input / output

BASIC CHARACTERISTICS (T_{amb} = 25 °C, unless otherwise specified)							
PARAMETER		**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Supply voltage			V_{DD}	2.5	-	3.6	V
Supply current		Excluded LED driving	I_{DD}	-	300	-	µA
		Light condition = dark, V_{DD} = 3.3 V	I_{DD} (SD)	-	0.2	-	µA
I^2C supply voltage			$V_{PULL\ UP}$	1.8	-	5.5	V
PS enable			I_{PSSD}	-	200	-	µA
I^2C signal input	Logic high	V_{DD} = 3.3 V	V_{IH}	1.55	-	-	V
	Logic low		V_{IL}	-	-	0.4	
	Logic high	V_{DD} = 2.6 V	V_{IH}	1.4	-	-	V
	Logic low		V_{IL}	-	-	0.4	
Full BIO counts		12-bit / 16-bit resolution		-	-	4096 / 65 535	steps
PS detection range		Kodak gray card (1)		0	-	500	mm
Operating temperature range			T_{amb}	-25	-	+85	°C
LED_Anode voltage				-	-	5.5	V
LED driving current				-	-	200	mA

Note

(1) Depending on external LED

I²C BUS TIMING CHARACTERISTICS (T_{amb} = 25 °C, unless otherwise specified)						
PARAMETER	**SYMBOL**	**STANDARD MODE**		**FAST MODE**		**UNIT**
		MIN.	**MAX.**	**MIN.**	**MAX.**	
Clock frequency	$f_{(SMBCLK)}$	10	100	10	400	kHz
Bus free time between start and stop condition	$t_{(BUF)}$	4.7	-	1.3	-	µs
Hold time after (repeated) start condition; after this period, the first clock is generated	$t_{(HDSTA)}$	4.0	-	0.6	-	µs
Repeated start condition setup time	$t_{(SUSTA)}$	4.7	-	0.6	-	µs
Stop condition setup time	$t_{(SUSTO)}$	4.0	-	0.6	-	µs
Data hold time	$t_{(HDDAT)}$	-	3450	-	900	ns
Data setup time	$t_{(SUDAT)}$	250	-	100	-	ns
I²C clock (SCK) low period	$t_{(LOW)}$	4.7	-	1.3	-	µs
I²C clock (SCK) high period	$t_{(HIGH)}$	4.0	-	0.6	-	µs
Clock / data fall time	$t_{(F)}$	-	300	-	300	ns
Clock / data rise time	$t_{(R)}$	-	1000	-	300	ns

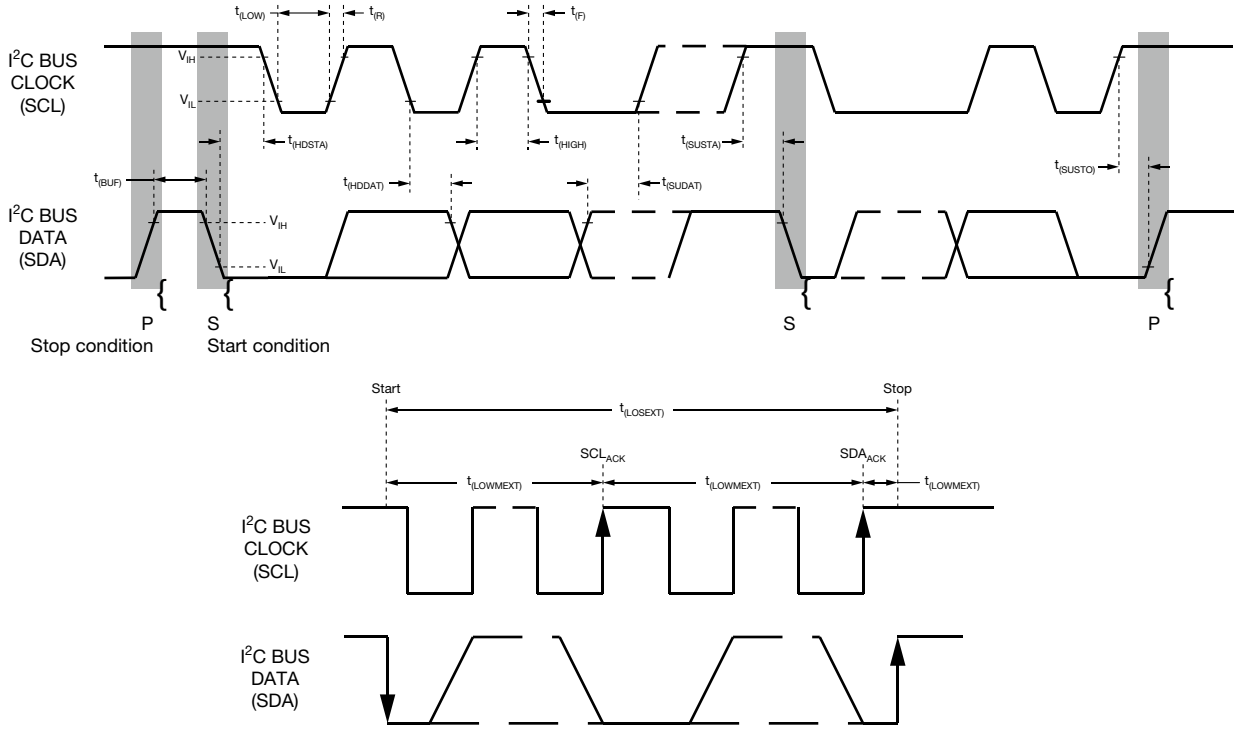


Fig. 1 - I²C Bus Timing Diagram

PARAMETER TIMING INFORMATION

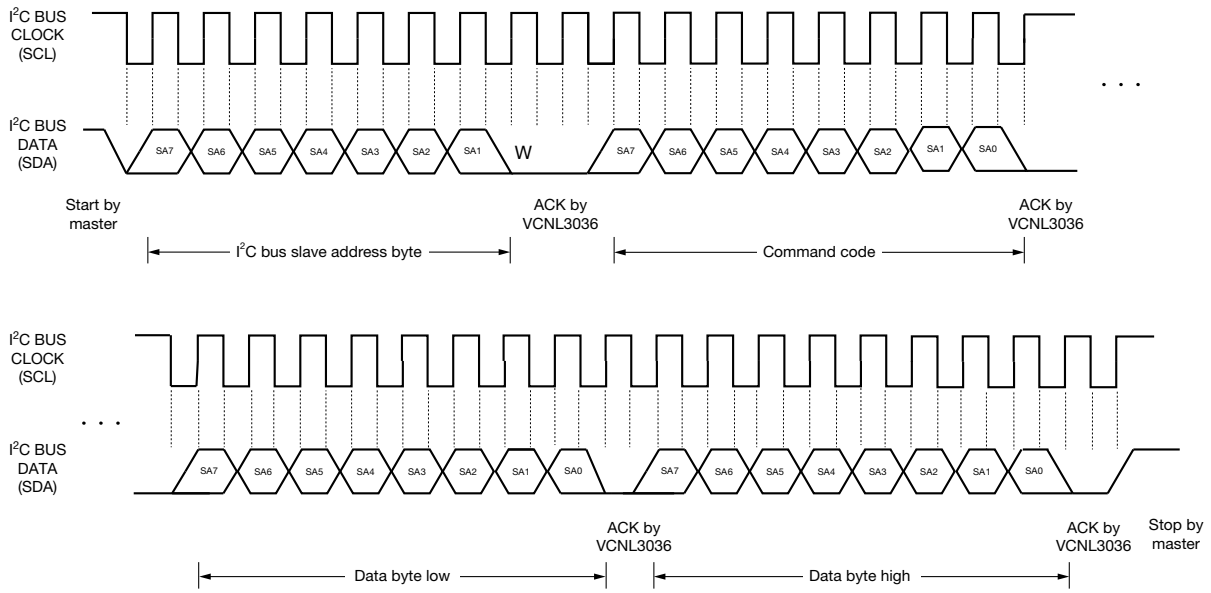


Fig. 2 - I²C Bus Timing for Sending Word Command Format

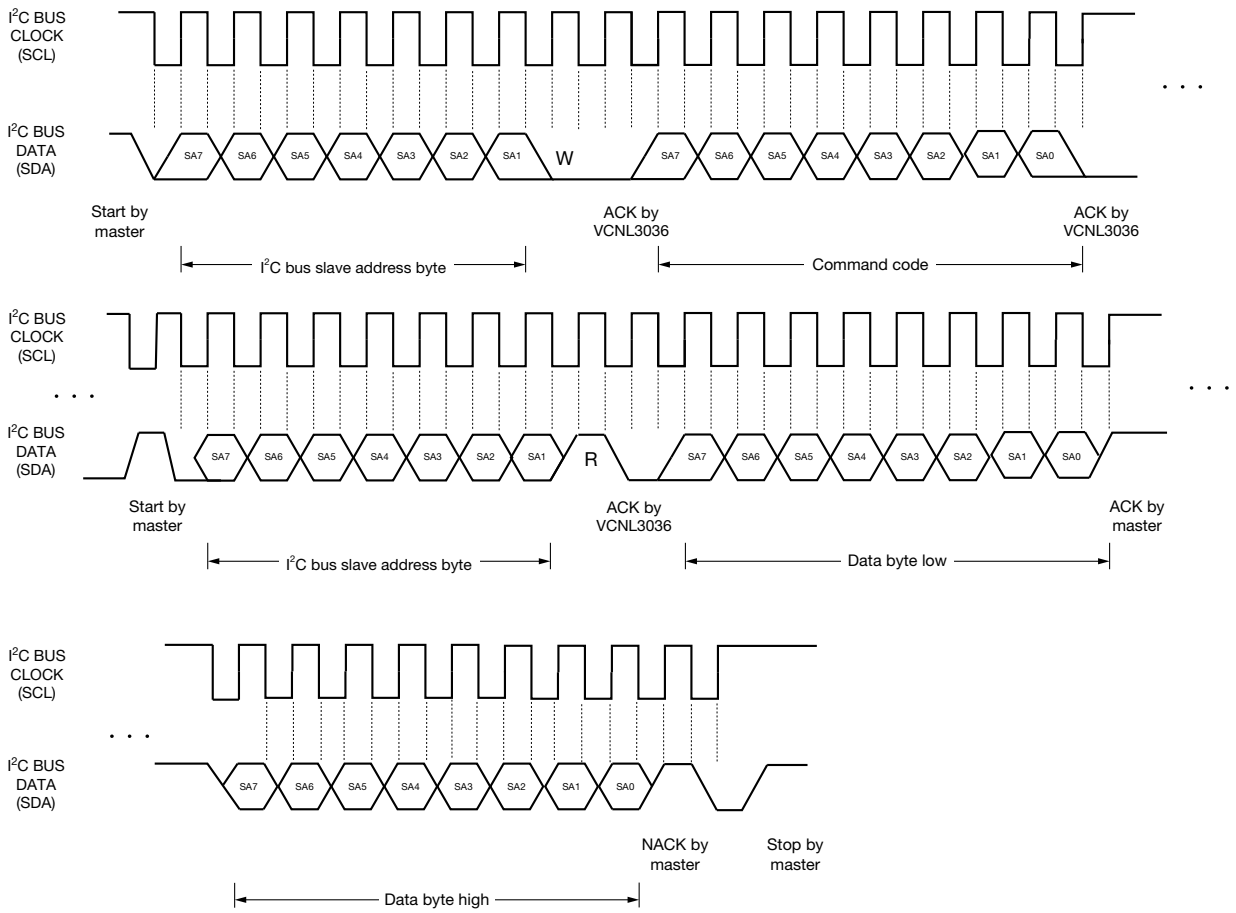


Fig. 3 - I²C Bus Timing for Receiving Word Command Format

TYPICAL PERFORMANCE CHARACTERISTICS (T_{amb} = 25 °C, unless otherwise specified)

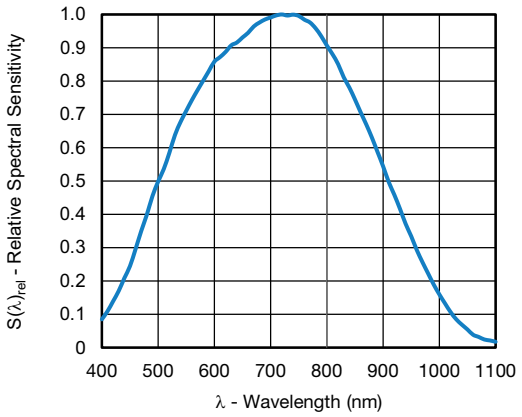


Fig. 4 - Relative Spectral Sensitivity vs. Wavelength (biosensor)

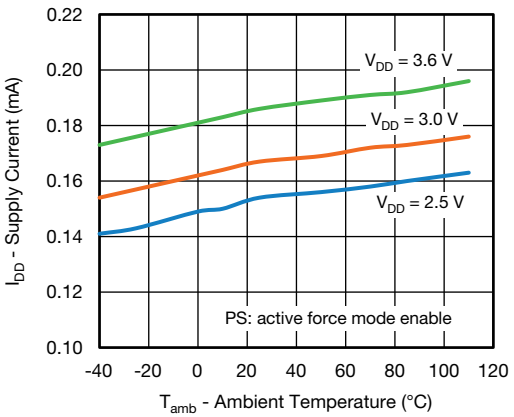


Fig. 5 - Supply Current vs. Ambient Temperature

APPLICATION INFORMATION

Pin Connection with the Host

VCNL3036 integrates biosensor and an LED driver with three inputs for external LEDs / IREDs all together with I²C interface. It is very easy for the baseband (CPU) to access PS output data via I²C interface without extra software algorithms. The hardware schematic is shown in the following diagram.

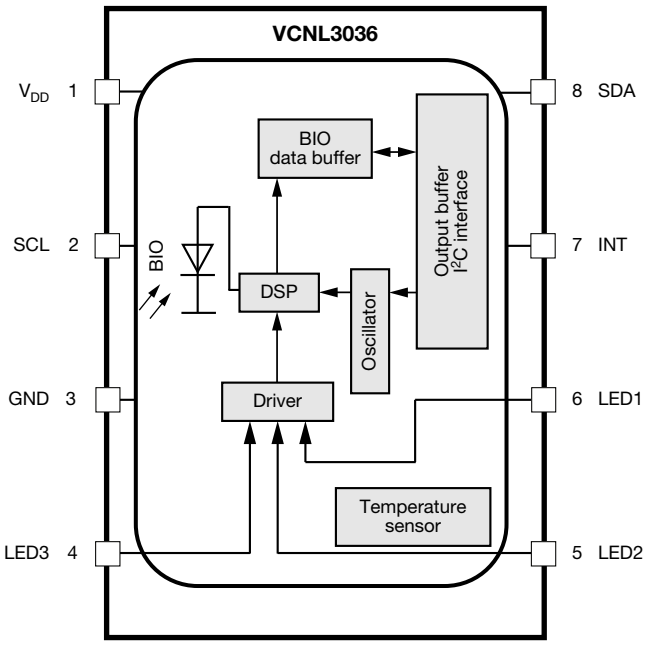
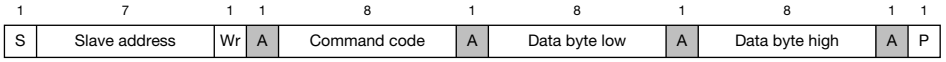


Fig. 6 - Detailed Block Diagram

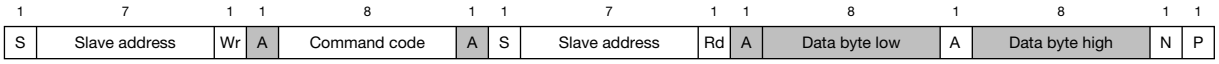
Digital Interface

VCNL3036 applies single slave address 0x41 (HEX) of 7-bit addressing following I²C protocol. All operations can be controlled by the command register. The simple command structure helps users easily program the operation setting and latch the light data from VCNL3036. As Fig. 10 shows, VCNL3036's I²C command format is simple for read and write operations between VCNL3036 and the host. The white sections indicate host activity and the gray sections indicate VCNL3036's acknowledgement of the host access activity. Write word and read word protocol is suitable for accessing registers particularly for 12-bit / 16-bit PS data. Interrupt can be cleared by reading data out from register: INT_Flag. All command codes should follow read word and write word protocols.

Send Byte → Write Command to VCNL3036



Receive Byte → Read Data from VCNL3036



S = start condition
P = stop condition
A = acknowledge
N = no acknowledge
Shaded area = VCNL3036 acknowledge

Fig. 7 - Write Word and Read Word Protocol

Function Description

For proximity sensor function, VCNL3036 supports different kinds of mechanical designs to achieve the best proximity detection performance for any color of object with more flexibility. The basic PS function settings, such as duty ratio, integration time, interrupt, and PS enable / disable, and persistence, are handled by the register: PS_CONF1. Duty ratio controls the PS response time. Integration time represents the duration of the energy being received. The interrupt is asserted when the PS detection levels over the high threshold level setting (register: PS_THDH) or lower than low threshold (register: PS_THDL). If the interrupt function is enabled, the host reads the PS output data from VCNL3036 that saves host loading from periodically reading PS data. More than that, INT flag (register: INT_Flag) indicates the behavior of INT triggered under different conditions. PS persistence (PS_PERS) sets up the PS INT asserted conditions as long as the PS output value continually exceeds the threshold level. The intelligent cancellation level can be set on register: PS_CANC to reduce the cross talk phenomenon.

VCNL3036 also supports an easy use of proximity detection logic output mode that outputs just high / low levels saving loading from the host. Normal operation mode or proximity detection logic output mode can be selected on the register: PS_MS. A smart persistence is provided to get faster PS response time and prevent false trigger for PS. Descriptions of each slave address operation are shown in table 1.

TABLE 1 - COMMAND CODE AND REGISTER DESCRIPTION

COMMAND CODE	DATE BYTE LOW / HIGH	REGISTER NAME	R / W	DEFAULT VALUE	FUNCTION DESCRIPTION
0x00	L	Reserved	R	0x01	Reserved
	H	Reserved	R	0x01	Reserved
0x01	L	Reserved	R	0x00	Reserved
	H	Reserved	R	0x00	Reserved
0x02	L	Reserved	R	0x00	Reserved
	H	Reserved	R	0x00	Reserved
0x03	L	PS_CONF1	R / W	0x01	PS duty ratio, integration time, persistence, and PS enable / disable
	H	PS_CONF2	R / W	0x00	PS gain, PS output resolution selection, PS interrupt trigger method
0x04	L	PS_CONF3	R / W	0x00	PS smart persistence, active force mode, LED select
	H	PS_MS	R / W	0x00	LED current selection
0x05	L	PS_CANC_L	R / W	0x00	PS cancellation level setting
	H	PS_CANC_M	R / W	0x00	PS cancellation level setting
0x06	L	PS_THDL_L	R / W	0x00	PS low interrupt threshold setting LSB byte
	H	PS_THDL_M	R / W	0x00	PS low interrupt threshold setting MSB byte
0x07	L	PS_THDH_L	R / W	0x00	PS high interrupt threshold setting LSB byte
	H	PS_THDH_M	R / W	0x00	PS high interrupt threshold setting MSB byte
0x08	L	PS1_Data_L	R	0x00	PS1 LSB output data
	H	PS1_Data_M	R	0x00	PS1 MSB output data
0x09	L	PS2_Data_L	R	0x00	PS2 LSB output data
	H	PS2_Data_M	R	0x00	PS2 MSB output data
0x0A	L	PS3_Data_L	R	0x00	PS3 LSB output data
	H	PS3_Data_M	R	0x00	PS3 MSB output data
0x0B	L	Reserved	R	0x00	Reserved
	H	Reserved	R	0x00	Reserved
0x0C	L	Reserved	R	0x00	Reserved
	H	Reserved	R	0x00	Reserved
0x0D	L	Reserved	R	0x00	Reserved
	H	INT_Flag	R	0x00	PS interrupt flags
0x0E	L	ID_L	R	0x80	Device ID LSB
	H	ID_M	R	0x00	Device address 0x41

Note

- All of reserved register are used for internal test. Please keep as default setting

Command Register Format

VCNL3036 provides an 8-bit command register for PS controlling independently. The description of each command format is shown in following tables.

TABLE 2 - REGISTER: RESERVED		
REGISTER NAME		**COMMAND CODE: 0x00_L (0x00 DATA BYTE LOW)**
Command	Bit	Description
Reserved	7 : 0	Default = 01H

TABLE 3 - REGISTER: RESERVED		
		COMMAND CODE: 0x00_H (0x00 DATA BYTE HIGH)
Command	Bit	Description
Reserved	7 : 0	Default = 01H

TABLE 4 - REGISTER RESERVED		
		COMMAND CODE: 0x01_L (0x01 DATA BYTE LOW) AND 0x01_H (0x01 DATA BYTE HIGH)
Register	Bit	Description
Reserved	7 : 0	Reserved

TABLE 5 - REGISTER: RESERVED		
		COMMAND CODE: 0x02_L (0x02 DATA BYTE LOW) AND 0x02_H (0x02 DATA BYTE HIGH)
Register	Bit	Description
Reserved	7 : 0	Reserved

TABLE 6 - REGISTER: PS_CONF1 DESCRIPTION		
REGISTER: PS_CONF1		**COMMAND CODE: 0x03_L (0x03 DATA BYTE LOW)**
Command	Bit	Description
PS_Duty	7 : 6	(0 : 0) = 1/40, (0 : 1) = 1/80, (1 : 0) = 1/160, (1 : 1) = 1/320 PS LED on / off duty ratio setting
PS_PERS	5 : 4	(0 : 0) = 1, (0 : 1) = 2, (1 : 0) = 3, (1 : 1) = 4 PS interrupt persistence setting
PS_ IT	3 : 1	(0 : 0 : 0) = 1T, (0 : 0 : 1) = 1.5T, (0 : 1 : 0) = 2T, (0 : 1 : 1) = 2.5T, (1 : 0 : 0) = 3T, (1 : 0 : 1) = 3.5T, (1 : 1 : 0) = 4T, (1 : 1 : 1) = 8T, PS integration time setting
PS_SD	0	0 = PS power on, 1 = PS shut down, default = 1

TABLE 7 - REGISTER: PS_CONF2 DESCRIPTION		
REGISTER: PS_CONF2		**COMMAND CODE: 0x03_H (0x03 DATA BYTE HIGH)**
Command	Bit	Description
MPX_INT_EN	7	0 = disabled, 1 = enabled
MPX_MODE	6	0 = disabled, 1 = enabled
PS_Gain	5 : 4	(0 : 0) and (0 : 1) = two step mode, (1: 0) single mode x 8, (1 : 1) single mode x 1
PS_HD	3	0 = PS output is 12 bits, 1 = PS output is 16 bits
PS_NS	2	(0 : 0) and (0 : 1) = two step mode, (1: 0) single mode x 8, (1 : 1) single mode x 1
PS_INT	1 : 0	(0 : 0) = interrupt disable, (0 : 1) = trigger by closing, (1 : 0) = trigger by away, (1 : 1) = trigger by closing and away

TABLE 8 - REGISTER: PS_CONF3 DESCRIPTION		
REGISTER: PS_CONF3		**COMMAND CODE: 0x04_L (0x04 DATA BYTE LOW)**
Command	Bit	Description
LED_I_LOW	7	0 = disabled = normal current, 1 = enabled = 1/10 of normal current, with that the current is accordingly: 5 mA, 7.5 mA, 10 mA, 12 mA, 14 mA, 16 mA, 18 mA, 20 mA
LED select	6 : 5	(0 : 0) = LED1, (0 : 1) = LED2, (1 : 0) = LED3, (1 : 1) = LED3
PS_SMART_PERS	4	0 = disable; 1 = enable PS smart persistence
PS_AF	3	0 = active force mode disable (normal mode), 1 = active force mode enable
PS_TRIG	2	0 = no PS active force mode trigger, 1 = trigger one time cycle VCNL3036 output one cycle data every time host writes in '1' to sensor. The state returns to '0' automatically.
PS_MS	1	0 = proximity normal operation with interrupt function 1 = proximity detection logic output mode enable
PS_SC_EN	0	0 = turn off sunlight cancel; 1 = turn on sunlight cancel PS sunlight cancel function enable setting

TABLE 9 - REGISTER: PS_MS DESCRIPTION		
REGISTER: PS_MS		**COMMAND CODE: 0x04_H (0x04 DATA BYTE HIGH)**
Command	Bit	Description
Reserved	7	0
PS_SC_CUR	6 : 5	(0 : 0) = 1 x typical sunlight cancel current, (0 : 1) = 2 x typical sunlight cancel current, (1 : 0) = 4 x typical sunlight cancel current, (1 : 1) = 8 x typical sunlight cancel current
PS_SP	4	0 = typical sunlight capability, 1 = 1.5 x typical sunlight capability
PS_SPO	3	0 = output is 00h in sunlight protect mode, 1 = output is FFh in sunlight protect mode,
LED_I	2 : 0	(0 : 0 : 0) = 50 mA; (0 : 0 : 1) = 75 mA; (0 : 1 : 0) = 100 mA; (0 : 1 : 1) = 120 mA (1 : 0 : 0) = 140 mA; (1 : 0 : 1) = 160 mA; (1 : 1 : 0) = 180 mA; (1 : 1 : 1) = 200 mA LED current selection setting

TABLE 10 - REGISTER PS_CANC_L AND PS_CANC_M DESCRIPTION		
		COMMAND CODE: 0x05_L (0x05 DATA BYTE LOW) AND 0x05_H (0x05 DATA BYTE HIGH)
Register	Bit	Description
PS_CANC_L	7 : 0	0x00 to 0xFF, PS cancellation level setting_LSB byte
PS_CANC_M	7 : 0	0x00 to 0xFF, PS cancellation level setting_MSB byte

TABLE 11 - REGISTER: PS_THDL_L AND PS_THDL_M DESCRIPTION		
		COMMAND CODE: 0x06_L (0x06 DATA BYTE LOW) AND 0x06_H (0x06 DATA BYTE HIGH)
Register	Bit	Description
PS_THDL_L	7 : 0	0x00 to 0xFF, PS interrupt low threshold setting_LSB byte
PS_THDL_M	7 : 0	0x00 to 0xFF, PS interrupt low threshold setting_MSB byte

TABLE 12 - REGISTER: PS_THDH_L AND PS_THDH_M DESCRIPTION		
		COMMAND CODE: 0x07_L (0x07 DATA BYTE LOW) AND 0x07_H (0x07 DATA BYTE HIGH)
Register	Bit	Description
PS_THDH_L	7 : 0	0x00 to 0xFF, PS interrupt high threshold setting_LSB byte
PS_THDH_M	7 : 0	0x00 to 0xFF, PS interrupt high threshold setting_MSB byte

TABLE 13 - READ OUT REGISTER DESCRIPTION			
Register	Command Code	Bit	Description
PS1_Data_L	0x08_L (0x08 data byte low)	7 : 0	0x00 to 0xFF, PS1 LSB output data
PS1_Data_M	0x08_H (0x08 data byte high)	7 : 0	0x00 to 0xFF, PS1 MSB output data
PS2_Data_L	0x09_L (0x09 data byte low)	7 : 0	0x00 to 0xFF, PS2 LSB output data
PS2_Data_M	0x09_H (0x09 data byte high)	7 : 0	0x00 to 0xFF, PS2 MSB output data
PS3_Data_L	0x0A_L (0x0A data byte low)	7 : 0	0x00 to 0xFF, PS3 LSB output data
PS3_Data_M	0x0A_H (0x0A data byte high)	7 : 0	0x00 to 0xFF, PS3 MSB output data
Reserved	0x0B_L (0x0B data byte low)	7 : 0	Reserved
Reserved	0x0B_H (0x0B data byte high)	7 : 0	Reserved
Reserved	0x0C_L (0x0C data byte low)	7 : 0	Reserved
Reserved	0x0C_H (0x0C data byte high)	7 : 0	Reserved
Reserved	0x0D_L (0x0D data byte low)	7 : 0	Default = 0x00
INT_Flag	0x0D_H (0x0D data byte high)	7	MPX_DATA_READY_FLAG
		6	PS_SPFLAG, PS entering protection mode
		5 : 2	Reserved
		1	PS_IF_CLOSE, PS rises above PS_THDH INT trigger event
		0	PS_IF_AWAY, PS drops below PS_THDL INT trigger event
ID_L	0x0E_H (0x0E data byte low)	7 : 0	0x80
ID_M	0x0E_H (0x0E data byte high)	7 : 6	(0 : 0)
		5 : 4	(0 : 0) Slave address = 0x41 (7-bit)
		3 : 0	Version code (0 : 0 : 0 : 0)

Adjustable Sampling Time

VCNL3036's embedded LED driver drives up to 3 external LEDs by a pulsed duty cycle. The LED on / off duty ratio is programmable by I^2C command at register: PS_Duty which is related to the current consumption and PS response time. The higher the duty ratio adopted, the faster response time achieved with higher power consumption. For example, PS_Duty = 1/320, peak LED current = 100 mA, averaged current consumption is 100 mA/320 = 0.3125 mA.

Initialization

VCNL3036 includes default values for each register. As long as power is on, it is ready to be controlled by host via I^2C bus.

Threshold Window Setting

- Programmable PS Threshold

  VCNL3036 provides both high and low thresholds for PS (register: PS_THDL, PS_THDH)

- PS Persistence

  The PS persistence function (PS_PERS, 1, 2, 3, 4) helps to avoid false trigger of the PS INT. For example, if PS_PERS = 3 times, the PS INT will not be asserted unless the PS value is greater than the PS threshold (PS_THDH) value for three periods of time continuously

- PS Active Force Mode

  An extreme power saving way to use PS is to apply PS active force (register: PS_CONF3 command: PS_FOR = 1) mode. Anytime host would like to read out just one of PS data, write in '1' at register: PS_CONF3 command: PS_FOR_Trig. Without commands placed, there is no PS data output. VCNL3036 stays in standby mode constantly

Intelligent Cancellation

VCNL3036 provides an intelligent cancellation method to reduce cross talk phenomenon for the proximity sensor. The output data will be subtracted by the input value on register: PS_CANC.

Interruption (INT)

VCNL3036 has PS interrupt feature operated by a single pin “INT”. The purpose of the interrupt feature is to actively inform the host once INT has been asserted. With the interrupt function applied, the host does not need to be constantly pulling data from the sensor, but to read data from the sensor while receiving interrupt request from the sensor. As long as the host enables PS interrupt (register: PS_INT) function, the level of INT pin (pin 7) is pulled low once INT asserted. All registers are accessible even if INT is asserted.

To effectively adopt PS INT function, it is recommended to use PS detection mechanism at register: PS_INTT = 1 for the best PS detection performance which can be adjusted by high / low THD level of PS. PS INT trigger way is defined by register: PS_INT.

Interruption Flag

Register: INT_Flag represents all of interrupt trigger status for PS. Any flag value changes from “0” to “1” state, the level of INT pin will be pulled low. As long as host reads INT_Flag data, the bit will change from “1” state to “0” state after reading out, the INT level will be returned to high afterwards.

PROXIMITY DETECTION LOGIC OUTPUT MODE

VCNL3036 provides a proximity detection logic output mode that uses INT pin (pin 7) as a proximity detection logic high / low output (register: PS_MS). When this mode is selected, the PS output (pin 7; INT/P_{out}) is pulled low when an object is closing to be detected and returned to level high when the object moves away. Register: PS_THDH / PS_THDL defines how sensitive PS detection is.

One thing to be stated is that whenever proximity detection logic mode applied, INT pin is only used as a logic high / low output. Meanwhile, host has to simulate the GPIO pin as an INT pin function. If not, host needs to periodically reading the state of INT at this GPIO pin.

PROXIMITY DETECTION HYSTERESIS

A PS detection hysteresis is important that keeps PS state in a certain range of detection distance. For example, PS INT asserts when PS value over PS_THDH. Host switches off panel backlight and then clears INT. When PS value is less than PS_THDL, host switches on panel backlight. Any PS value lower than PS_THDH or higher than PS_THDL, PS INT will not be asserted. Host does keep the same state.

MULTIPLEX FEATURE WITH VCNL3036

VCNL3036 allows to connect up to 3 external LEDs. Each may be selected separate to allow for normal proximity.

If one select e.g. LED2 then also PS2 delivers the corresponding proximity data. To allow for a fast quasi-parallel measurements of all three channels the MPX_MODE may be activated (set to “1”).

Within “PS_FORCE_MODE” all three LEDs will be sequentially switched and available proximity result of this directly shown within the three PS_DATA register.

Beside MPX_MODE enabled and PS_FORCE_MODE set this sequence starts direct after setting the PS_TRIG bit. Availability of the data will be indicated with setting the MPX_DATA_READY flag or also the Interrupt if this is set-up also. Please see below diagram.

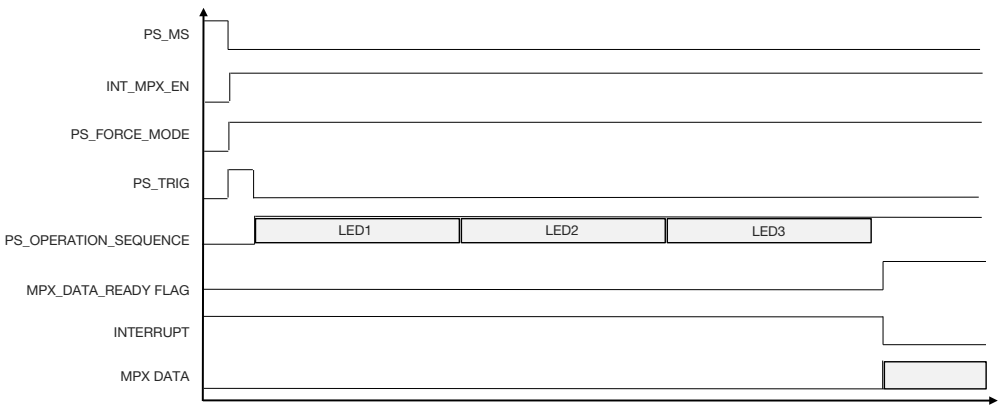


Fig. 8 - VCNL3036 MPX Mode Sequence

APPLICATION CIRCUIT BLOCK REFERENCE

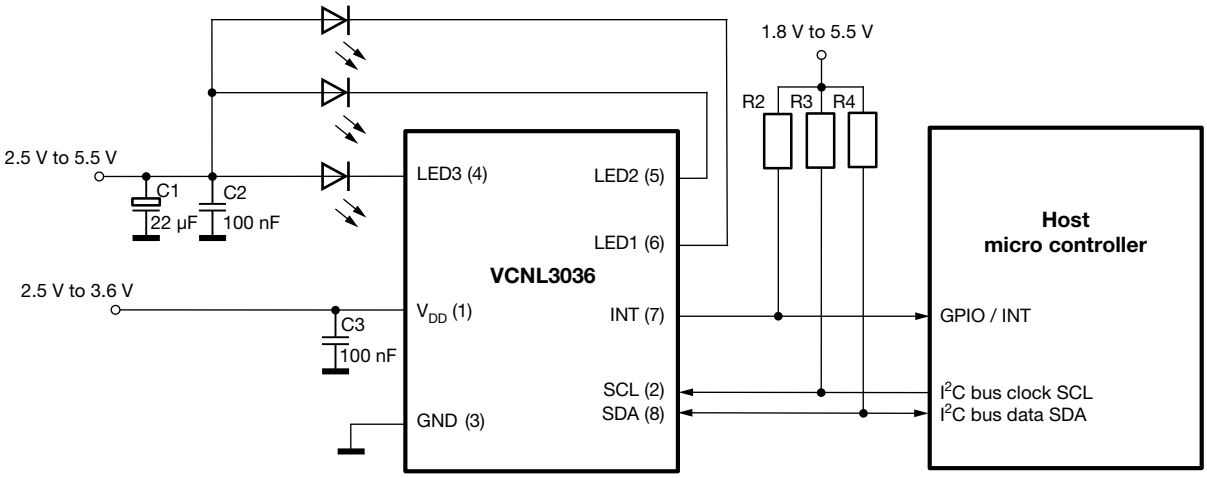


Fig. 9 - Circuitry with Two Separate Power Supply Sources

Three additional capacitors in the circuit are proposed for the following purposes: (1) the 100 nF capacitor near the V_{DD} pin is used for power supply noise rejection, (2) the 22 µF plus parallel 100 nF capacitors - connected to the common anode of the external IREDs / LEDs - are used to prevent the LED voltage from instantly dropping when an LED is switched on, and (3) 2.2 kΩ to 4.7 kΩ are recommended values for the pull up resistor of I^2C. The value of the pull-up resistor at the INT line could be 10 kΩ applied on the INT pin.

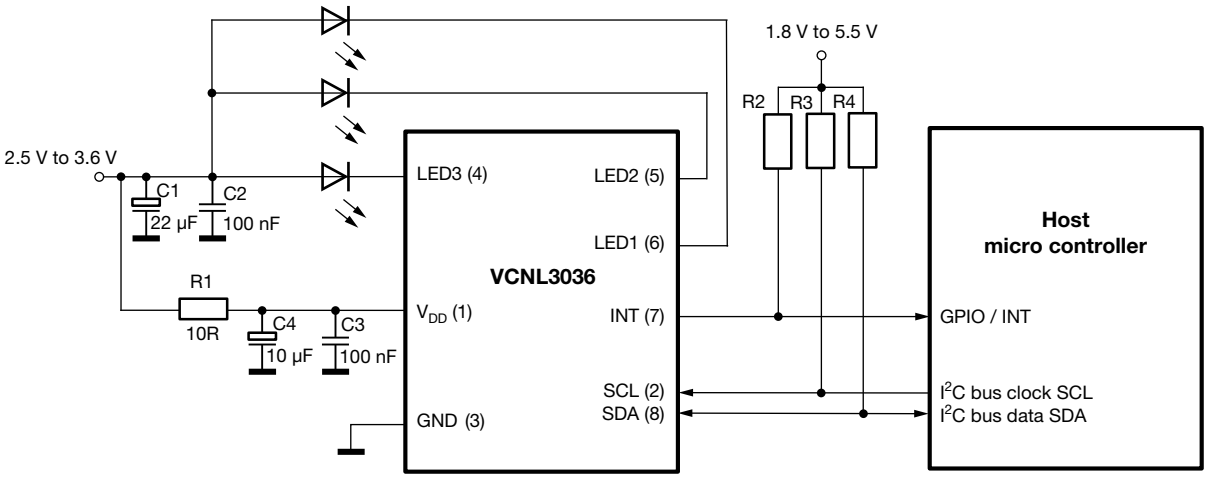


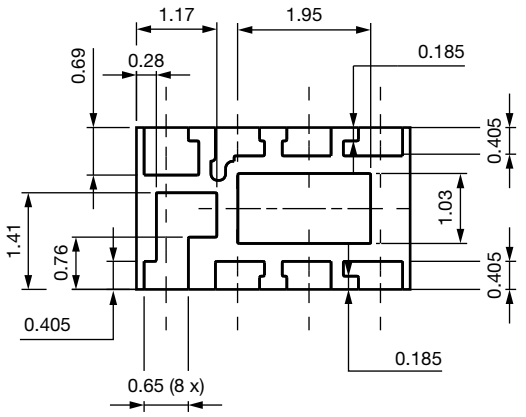
Fig. 10 - Circuitry with just One Common Power Supply Source

For high currents of the LEDs and / or power supply close to the lower limit of 2.5 V this R-C decoupling will prevent that the V_{DD} voltage drop below specified minimum.

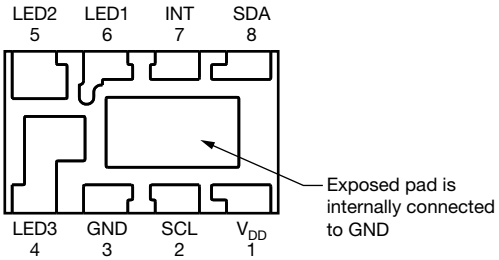
LEDs / IREDs between 550 nm (green) and 950 nm (IR) fit to the sensitivity of the proximity photodiode.

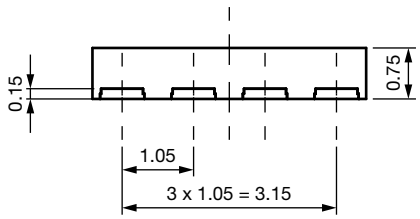
Mechanical placement of the external IRED depends on the application. Please study also the AN: designing VCNL3036 into an application

PACKAGE DIMENSIONS in millimeters

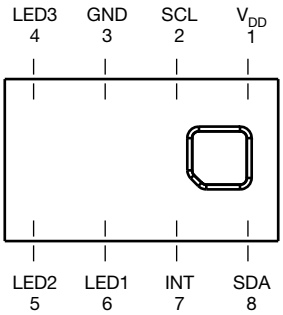


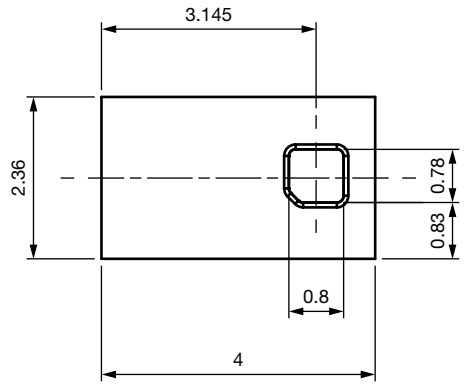
Pinning bottom view



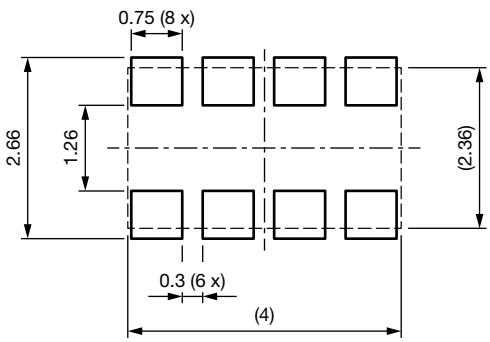


Pinning top view



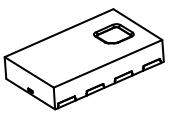


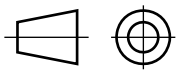
Recommended solder foot print



Drawing No.: 6.550-5331.01-4
Issue: 1; 21.02.2017

Not indicated tolerances ± 0.1 mm





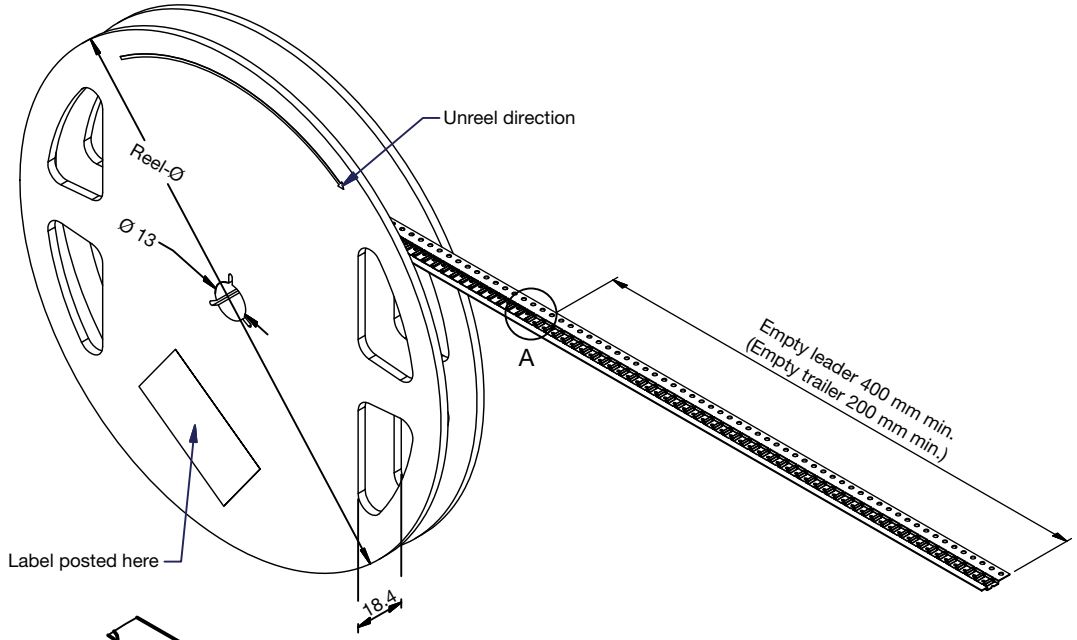
Technical drawings according to DIN specification.

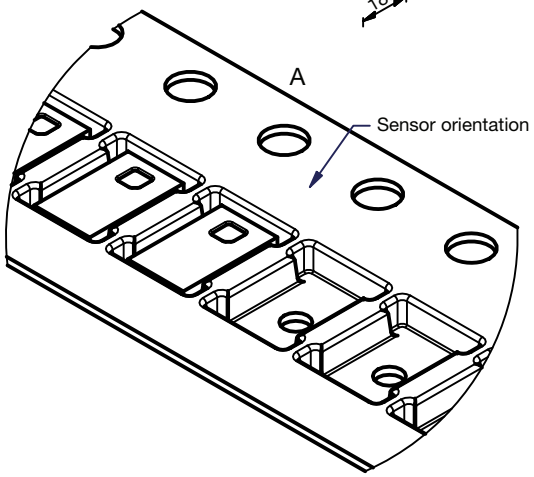
TAPE AND REEL DIMENSIONS in millimeters

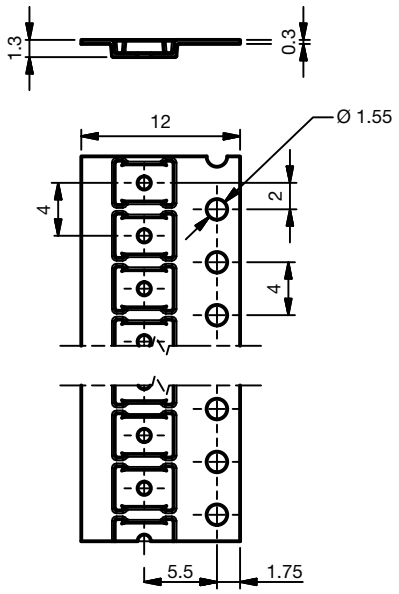
Reel-size:
GS 08: Ø 180 mm ± 2 mm = 3300 pcs.
GS 18: Ø 330 mm ± 2 mm = 13 000 pcs.

Non tolerated dimensions ± 0.1 mm

Reel-design is representative for different types.







Drawing No.: 9.800-5143.01-4
Issue: prel., 06.06.2017

SOLDER PROFILE

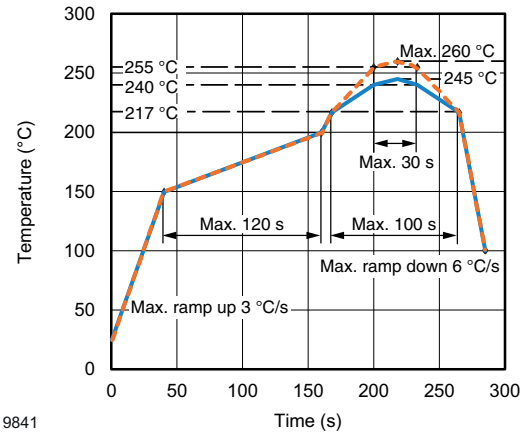


Fig. 11 - Lead (Pb)-free Reflow Solder Profile according to J-STD-020

DRYPACK

Devices are packed in moisture barrier bags (MBB) to prevent the products from moisture absorption during transportation and storage. Each bag contains a desiccant.

FLOOR LIFE

Floor life (time between soldering and removing from MBB) must not exceed the time indicated on MBB label:

Floor life: 168 h

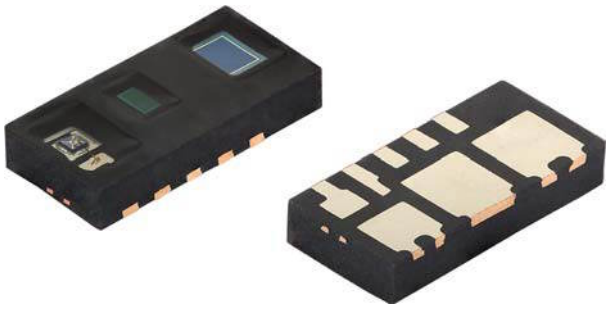
Conditions: T_{amb} < 30 °C, RH < 60 %

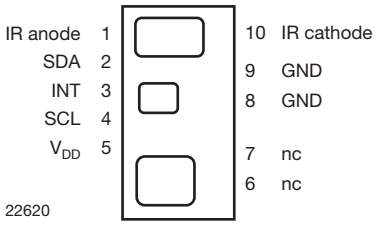
Moisture sensitivity level 3, according to J-STD-020.

DRYING

In case of moisture absorption devices should be baked before soldering. Conditions see J-STD-020 or label. Devices taped on reel dry using recommended conditions 192 h at 40 °C (+ 5 °C), RH < 5 %.

High Resolution Digital Biosensor for Wearable Applications With I²C Interface





FEATURES

- Package type: surface-mount
- Package form: SMD
- Dimensions (L x W x H in mm): 4.90 x 2.40 x 0.83
- Integrated modules: infrared emitter (IRED), ambient light sensor (ALS), photo diode (PD), and signal conditioning IC
- Interrupt function
- Supply voltage range V_{DD}: 2.5 V to 3.6 V
- Supply voltage range IR anode: 2.5 V to 5 V
- Communication via I²C interface
- I²C bus H-level range: 1.7 V to 5 V
- Floor life: 72 h, MSL 4, according to J-STD-020
- Low stand by current consumption: 1.5 µA

Pb-free

e4

RoHS COMPLIANT

HALOGEN FREE

GREEN (5-2008)

DESCRIPTION

The VCNL4020C is a fully integrated biosensor and ambient light sensor. Fully integrated means that the infrared emitter is included in the package. It has 16 bit resolution. It includes a signal processing IC and features standard I²C communication interface. It features an interrupt function.

APPLICATIONS

- Wearables
- Health monitoring
- Pulse oximetry

OPTICAL BIOSENSORS FUNCTION

- Built-in infrared emitter and broader sensitivity photodiode allows to also work with green and red LEDs
- 16 bit effective resolution ensures excellent cross talk immunity
- Programmable LED drive current from 10 mA to 200 mA in 10 mA steps
- Excellent ambient light suppression through signal modulation

AMBIENT LIGHT FUNCTION

- Built-in ambient light photo-pin-diode with close-to-human-eye sensitivity
- 16 bit dynamic range from 0.25 lx to 16 klx
- 100 Hz and 120 Hz flicker noise rejection

PRODUCT SUMMARY

PART NUMBER	OPERATING VOLTAGE RANGE (V)	I²C BUS VOLTAGE RANGE (V)	LED PULSE CURRENT (1) (mA)	AMBIENT LIGHT RANGE (lx)	SPECTRAL BANDWIDTH RANGE $\lambda_{0.5}$ (nm)	OUTPUT CODE	ADC RESOLUTION BIOSENSOR / AMBIENT LIGHT SENSOR
VCNL4020C	2.5 to 3.6	1.7 to 5	10 to 200	0.25 to 16 383	550 to 970	16 bit, I²C	16 bit / 16 bit

Note

(1) Adjustable through I²C interface

ORDERING INFORMATION			
ORDERING CODE	**PACKAGING**	**VOLUME (1)**	**REMARKS**
VCNL4020C-GS08	Tape and reel	MOQ: 3300 pcs	4.90 mm x 2.40 mm x 0.83 mm
VCNL4020C-GS18		MOQ: 13 000 pcs	

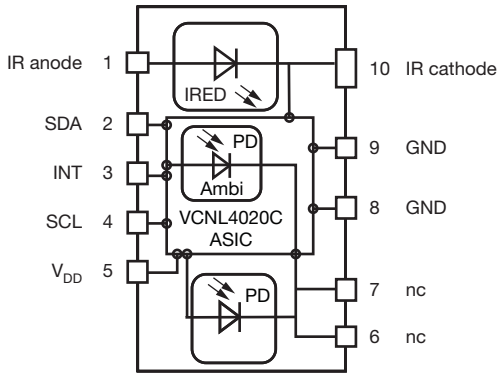
Note

(1) MOQ: minimum order quantity

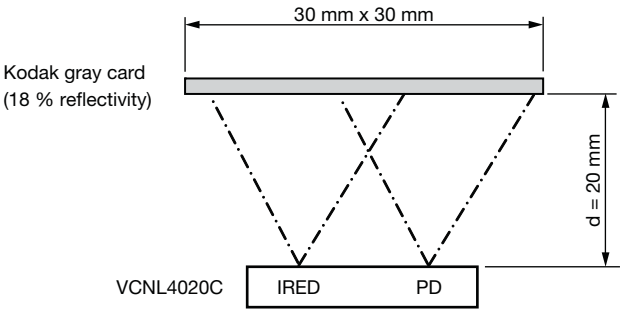
ABSOLUTE MAXIMUM RATINGS (T_{amb} = 25 °C, unless otherwise specified)					
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**MAX.**	**UNIT**
Supply voltage		V_{DD}	-0.3	5.5	V
Operation temperature range		T_{amb}	-25	+85	°C
Storage temperature range		T_{stg}	-25	+85	°C
Total power dissipation	$T_{amb} \leq 25$ °C	P_{tot}	-	50	mW
Junction temperature		T_j	-	100	°C

BASIC CHARACTERISTICS (T_{amb} = 25 °C, unless otherwise specified)						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Supply voltage V_{DD}			2.5	-	3.6	V
Supply voltage IR anode			2.5	-	5	V
I^2C bus H-level range			1.7	-	5	V
INT H-level range			1.7	-	5	V
INT low voltage	3 mA sink current		-	-	0.4	V
Current consumption	Standby current, no LED-operation		-	1.5	2	µA
Current consumption pulse mode incl. LED (averaged)	2 measurements per second, LED current 20 mA		-	5	-	µA
	250 measurements per second, LED current 20 mA		-	520	-	µA
	2 measurements per second, LED current 200 mA		-	35	-	µA
	250 measurements per second, LED current 200 mA		-	4	-	mA
Current consumption ambient light mode	2 measurements per second averaging = 1		-	2.5	-	µA
	8 measurements per second averaging = 1		-	10	-	µA
	2 measurements per second averaging = 64		-	160	-	µA
	8 measurements per second averaging = 64		-	640	-	µA
Ambient light resolution	Digital resolution (LSB count)		-	0.25	-	lx
Ambient light output	E_V = 100 lx averaging = 64		-	400	-	counts
I^2C clock rate range		f_{SCL}	-	-	3400	kHz

CIRCUIT BLOCK DIAGRAM



TEST CIRCUIT



Note

- nc must not be electrically connected
  Pads 6 and 7 are only considered as solder pads

BASIC CHARACTERISTICS (T_{amb} = 25 °C, unless otherwise specified)

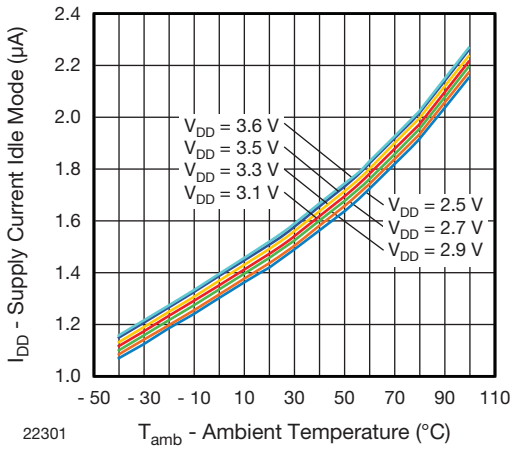


Fig. 1 - Idle Current vs. Ambient Temperature

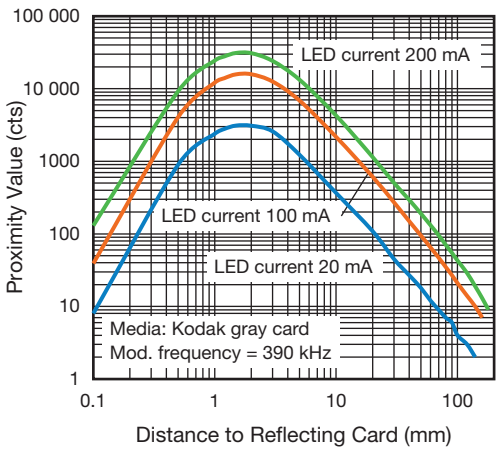


Fig. 3 - Proximity Value vs. Distance

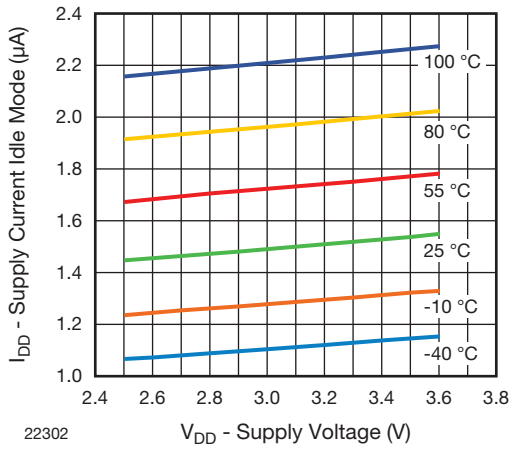


Fig. 2 - Idle Current vs. V_{DD}

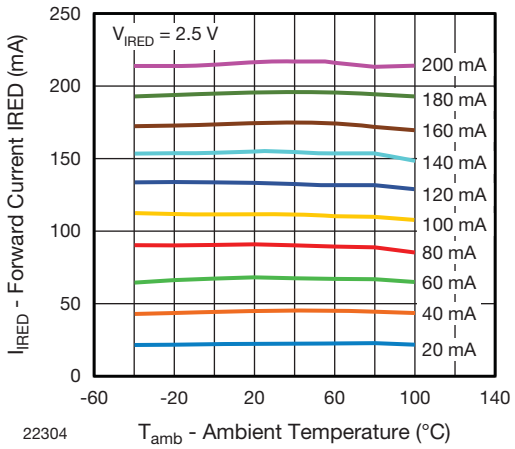


Fig. 4 - Forward Current vs. Temperature

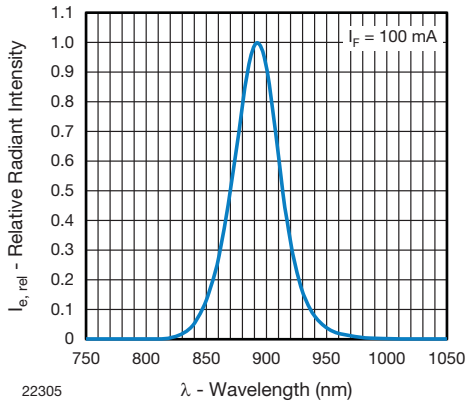


Fig. 5 - Relative Radiant Intensity vs. Wavelength

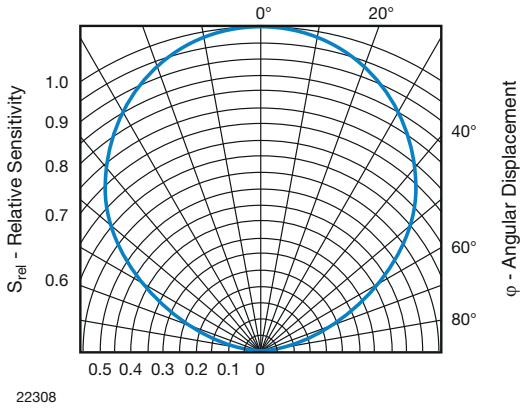


Fig. 8 - Relative Radiant Sensitivity vs. Angular Displacement (Proximity Sensor)

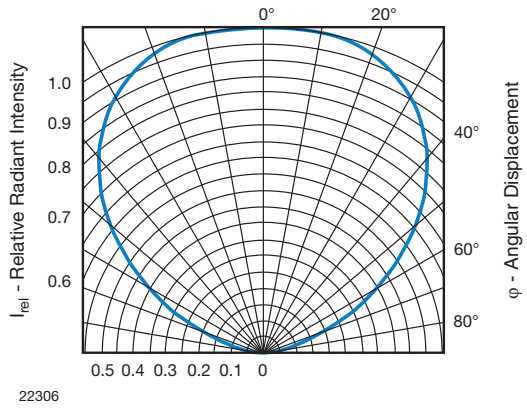


Fig. 6 - Relative Radiant Intensity vs. Angular Displacement

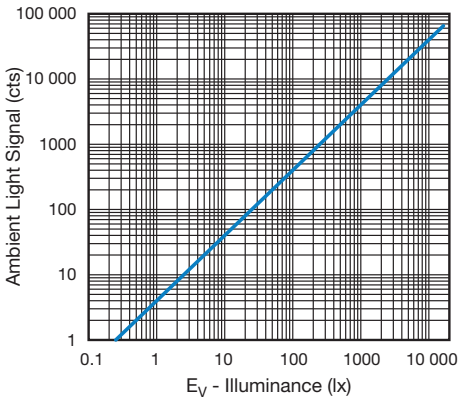


Fig. 9 - Ambient Light Value vs. Illuminance

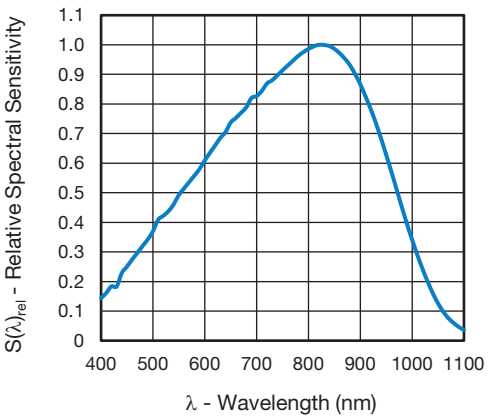


Fig. 7 - Relative Spectral Sensitivity vs. Wavelength (Biosensor)

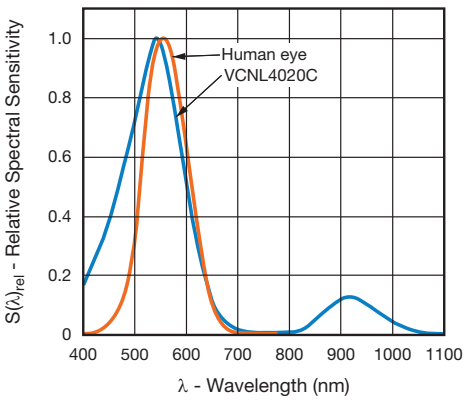


Fig. 10 - Relative Spectral Sensitivity vs. Wavelength (Ambient Light Sensor)

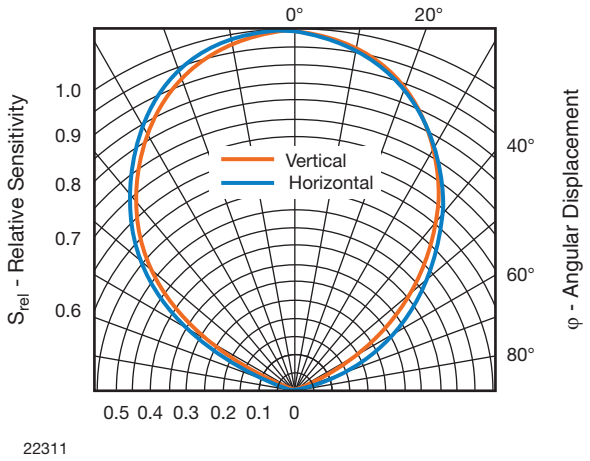


Fig. 11 - Relative Radiant Sensitivity vs. Angular Displacement
(Ambient Light Sensor)

APPLICATION INFORMATION

The digital biosensor VCNL4020C needs just one decoupling-C at V_{DD} if connected to a regulated power supply.

IR cathode needs no external connection as the connection to the driver is done internally, but this allows also for adding external LEDs / IREDs to the driver.

1. Application Circuit

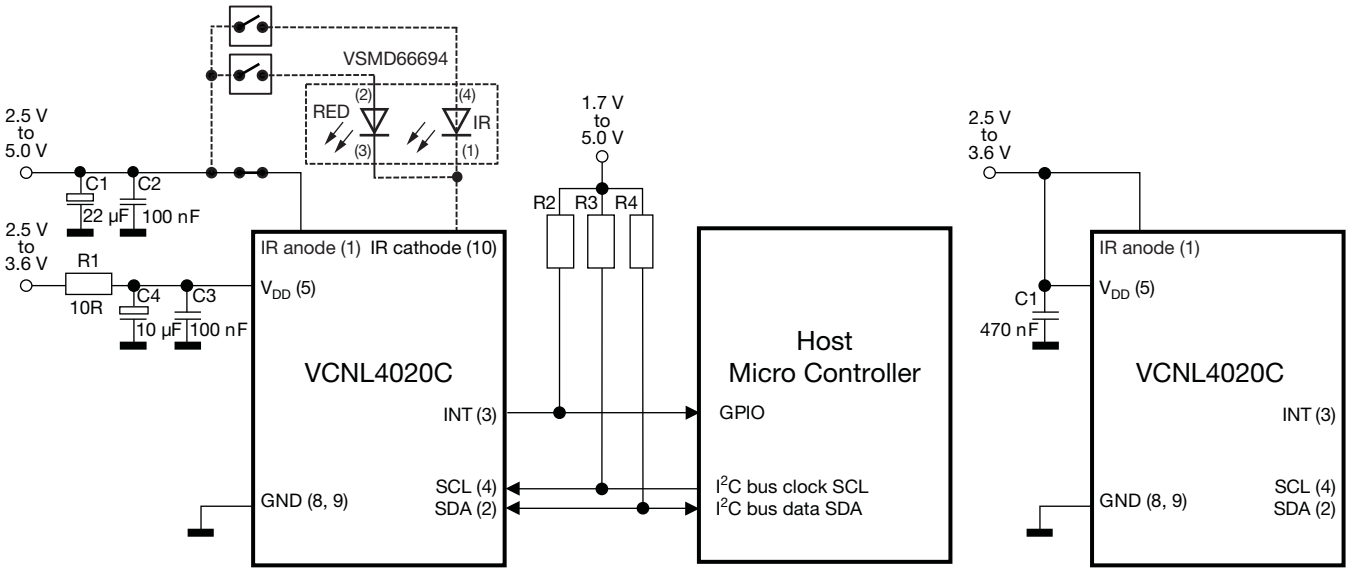


Fig. 12 - Application Circuit
(x) = Pin Number

Note

- The interrupt pin is an open drain output. The needed pull-up resistor may be connected to the same supply voltage as the application controller and the pull-up resistors at SDA / SCL. Proposed value R2 should be >1 kΩ , e.g. 10 kΩ to 100 kΩ.
  Proposed value for R3 and R4, e.g. 2.2 kΩ to 4.7 kΩ, depend also on the I²C bus speed.
  For detailed description about set-up and use of the interrupt as well as more application related information see AN: “Designing VCNL4020C into an Application”.

2. I²C Interface

The VCNL4020C contains seventeen 8 bit registers for operation control, parameter setup and result buffering. All registers are accessible via I²C communication. Figure 13 shows the basic I²C communication with VCNL4020C.

The built in I²C interface is compatible with all I²C modes (standard, fast and high speed).

I²C H-level range = 1.7 V to 5 V.

Please refer to the I²C specification from NXP for details.

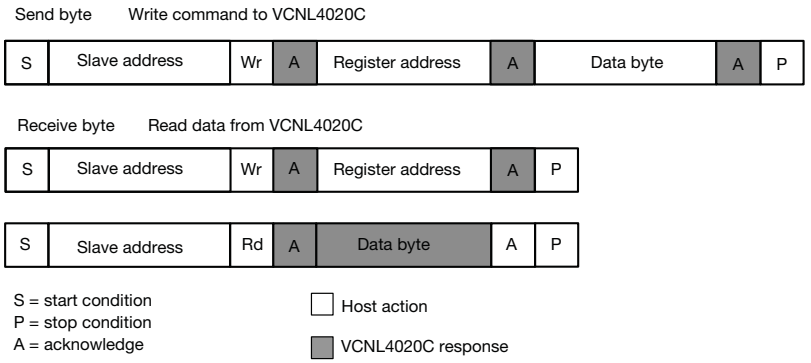


Fig. 13 - Send Byte/Receive Byte Protocol

Device Address

The VCNL4020C has a fix slave address for the host programming and accessing selection. The predefined 7 bit I²C bus address is set to 0010 011 = 13h. The least significant bit (LSB) defines read or write mode. Accordingly the bus address is set to 0010 011x = 26h for write, 27h for read.

Register Addresses

VCNL4020C has seventeen user accessible 8 bit registers. The register addresses are 80h (register #0) to 90h (register #16).

REGISTER FUNCTIONS

Register #0 Command Register

Register address = 80h

The register #0 is for starting ambient light or biosensor measurements. This register contains 2 flag bits for data ready indication.

TABLE 1 - COMMAND REGISTER #0

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
config_lock	als_data_rdy	bs_data_rdy	als_od	bs_od	als_en	bs_en	selftimed_en

Description	
config_lock	Read only bit. Value = 1
als_data_rdy	Read only bit. Value = 1 when ambient light measurement data is available in the result registers. This bit will be reset when one of the corresponding result registers (reg #5, reg #6) is read.
bs_data_rdy	Read only bit. Value = 1 when biosensor measurement data is available in the result registers. This bit will be reset when one of the corresponding result registers (reg #7, reg #8) is read.
als_od	R/W bit. Starts a single on-demand measurement for ambient light. If averaging is enabled, starts a sequence of readings and stores the averaged result. Result is available at the end of conversion for reading in the registers #5(HB) and #6(LB).
bs_od	R/W bit. Starts a single on-demand measurement for biosensor. Result is available at the end of conversion for reading in the registers #7(HB) and #8(LB).
als_en	R/W bit. Enables periodic als measurement
bs_en	R/W bit. Enables periodic biosensor measurement
selftimed_en	R/W bit. Enables state machine and LP oscillator for self timed measurements; no measurement is performed until the corresponding bit is set

Note

- With setting bit 3 and bit 4 at the same write command, a simultaneously measurement of ambient light and biosensor is done. Beside als_en and / or bs_en first selftimed_en needs to be set. On-demand measurement modes are disabled if selftimed_en bit is set. For the selftimed_en mode changes in reading rates (reg #4 and reg #2) can be made only when b0 (selftimed_en bit) = 0. For the als_od mode changes to the reg #4 can be made only when b4 (als_od bit) = 0; this is to avoid synchronization problems and undefined states between the clock domains. In effect this means that it is only reasonable to change rates while no selftimed conversion is ongoing.

Register #1 Product ID Revision Register

Register address = 81h. This register contains information about product ID and product revision.

Register data value of current revision = 21h.

TABLE 2 - PRODUCT ID REVISION REGISTER #1							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Product ID				Revision ID			
Description							
Product ID	Read only bits. Value = 2						
Revision ID	Read only bits. Value = 1						

Register #2 Rate of Biosensor Measurement

Register address = 82h.

TABLE 3 - BIOSENSOR RATE REGISTER #2							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
n/a					Rate of biosensor Measurement (no. of measurements per second)		
Description							
Biosensor rate	R/W bits. 000 - 1.95 measurements/s (DEFAULT) 001 - 3.90625 measurements/s 010 - 7.8125 measurements/s 011 - 16.625 measurements/s 100 - 31.25 measurements/s 101 - 62.5 measurements/s 110 - 125 measurements/s 111 - 250 measurements/s						

Note

- If self_timed measurement is running, any new value written in this register will not be taken over until the mode is actualy cycled.

Register #3 LED Current Setting for Biosensor Mode

Register address = 83h. This register is to set the LED current value for biosensor measurement.

The value is adjustable in steps of 10 mA from 0 mA to 200 mA.

This register also contains information about the used device fuse program ID.

TABLE 4 - LED CURRENT REGISTER #3							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Fuse prog ID		LED current value					
Description							
Fuse prog ID	Read only bits. Information about fuse program revision used for initial setup/calibration of the device.						
LED current value	R/W bits. LED current = Value (dec.) x 10 mA. Valid Range = 0 to 20d. e.g. 0 = 0 mA, 1 = 10 mA, …., 20 = 200 mA (2 = 20 mA = DEFAULT) LED Current is limited to 200 mA for values higher as 20d.						

Register #4 Ambient Light Parameter Register

Register address = 84h.

TABLE 5 - AMBIENT LIGHT PARAMETER REGISTER #4							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Cont. conv. mode	als_rate			Auto offset compensation	Averaging function (number of measurements per run)		
Description							
Cont. conversion mode	R/W bit. Continuous conversion mode. Enable = 1; Disable = 0 = DEFAULT This function can be used for performing faster ambient light measurements. This mode should only be used with ambient light on-demand measurements. Do not use with self-timed mode. Please refer to the application information chapter 3.3 for details about this function.						
Ambient light measurement rate	R/W bits. Ambient light measurement rate 000 - 1 samples/s 001 - 2 samples/s = DEFAULT 010 - 3 samples/s 011 - 4 samples/s 100 - 5 samples/s 101 - 6 samples/s 110 - 8 samples/s 111 - 10 samples/s						
Auto offset compensation	R/W bit. Automatic offset compensation. Enable = 1 = DEFAULT; Disable = 0 In order to compensate a technology, package or temperature related drift of the ambient light values there is a built in automatic offset compensation function. With active auto offset compensation the offset value is measured before each ambient light measurement and subtracted automatically from actual reading.						
Averaging function	R/W bits. Averaging function. Bit values sets the number of single conversions done during one measurement cycle. Result is the average value of all conversions. Number of conversions = $2^{decimal\_value}$ e.g. 0 = 1 conv., 1 = 2 conv, 2 = 4 conv., ….7 = 128 conv. DEFAULT = 32 conv. (bit 2 to bit 0: 101)						

Note

- If self_timed measurement is running, any new value written in this register will not be taken over until the mode is actualy cycled.

Register #5 and #6 Ambient Light Result Register

Register address = 85h and 86h. These registers are the result registers for ambient light measurement readings.

The result is a 16 bit value. The high byte is stored in register #5 and the low byte in register #6.

TABLE 6 - AMBIENT LIGHT RESULT REGISTER #5							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Description							
Read only bits. High byte (15:8) of ambient light measurement result							

TABLE 7 - AMBIENT LIGHT RESULT REGISTER #6							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Description							
Read only bits. Low byte (7:0) of ambient light measurement result							

Register #7 and #8 Biosensor Measurement Result Register

Register address = 87h and 88h. These registers are the result registers for biosensor measurement readings.

The result is a 16 bit value. The high byte is stored in register #7 and the low byte in register #8.

TABLE 8 - BIOSENSOR RESULT REGISTER #7

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Description							
Read only bits. High byte (15:8) of biosensor measurement result							

TABLE 9 - BIOSENSOR RESULT REGISTER #8

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Description							
Read only bits. Low byte (7:0) of biosensor measurement result							

Register #9 Interrupt Control Register

Register address = 89h.

TABLE 10 - INTERRUPT CONTROL REGISTER #9

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Int count exceed			n/a	INT_BS_ ready_EN	INT_ALS_ ready_EN	INT_THRES_EN	INT_THRES_ SEL

Description	
Int count exceed	R/W bits. These bits contain the number of consecutive measurements needed above/below the threshold 000 - 1 count = DEFAULT 001 - 2 count 010 - 4 count 011 - 8 count 100 -16 count 101 - 32 count 110 - 64 count 111 - 128 count
INT_BS_ready_EN	R/W bit. Enables interrupt generation at biosensor data ready
INT_ALS_ ready_EN	R/W bit. Enables interrupt generation at ambient data ready
INT_THRES_EN	R/W bit. Enables interrupt generation when high or low threshold is exceeded
INT_THRES_SEL	R/W bit. If 0: thresholds are applied to biosensor measurements If 1: thresholds are applied to als measurements

Register #10 and #11 Low Threshold

Register address = 8Ah and 8Bh. These registers contain the low threshold value. The value is a 16 bit word. The high byte is stored in register #10 and the low byte in register #11.

TABLE 11 - LOW THRESHOLD REGISTER #10

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Description							
R/W bits. High byte (15:8) of low threshold value							

TABLE 12 - LOW THRESHOLD REGISTER #11

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Description							
R/W bits. Low byte (7:0) of low threshold value							

Register #12 and #13 High Threshold

Register address = 8Ch and 8Dh. These registers contain the high threshold value. The value is a 16 bit word. The high byte is stored in register #12 and the low byte in register #13.

TABLE 13 - HIGH THRESHOLD REGISTER #12

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Description							
R/W bits. High byte (15:8) of high threshold value							

TABLE 14 - HIGH THRESHOLD REGISTER #13

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Description							
R/W bits. Low byte (7:0) of high threshold value							

Register #14 Interrupt Status Register

Register address = 8Eh. This register contains information about the interrupt status for either biosensor or ALS function and indicates if high or low going threshold exceeded.

TABLE 15 - INTERRUPT STATUS REGISTER #14

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
n/a				int_bs_ready	int_als_ready	int_th_low	int_th_hi

Description	
int_bs_ready	R/W bit. Indicates a generated interrupt for biosensor
int_als_ready	R/W bit. Indicates a generated interrupt for als
int_th_low	R/W bit. Indicates a low threshold exceed
int_th_hi	R/W bit. Indicates a high threshold exceed

Note

- Once an interrupt is generated the corresponding status bit goes to 1 and stays there unless it is cleared by writing a 1 in the corresponding bit. The int pad will be pulled down while at least one of the status bit is 1.

Register #15 Biosensor Modulator Timing Adjustment

Register address = 8Fh.

TABLE 16 - BIOSENSOR MODULATOR TIMING ADJUSTMENT #15							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Modulation delay time			Biosensor frequency		Modulation dead time		
Description							
Modulation delay time	R/W bits. Setting a delay time between LED signal and detectors input signal evaluation. This function is for compensation of delays from LED and photo diode. Also in respect to the possibility for setting different proximity signal frequency. Correct adjustment is optimizing measurement signal level. (DEFAULT = 0)						
Biosensor frequency	R/W bits. Setting the biosensor test signal frequency The biosensor measurement is using a square signal as measurement signal. Four different values are possible: 00 = 390.625 kHz (DEFAULT) 01 = 781.25 kHz 10 = 1.5625 MHz 11 = 3.125 MHz						
Modulation dead time	R/W bits. Setting a dead time in evaluation of LED signal at the slopes of the signal. (DEFAULT = 1) This function is for reducing of possible disturbance effects. This function is reducing signal level and should be used carefully.						

Note

- The settings for best performance will be provided by Vishay. With first samples this is evaluated to:
  Delay time = 0; dead time = 1 and BS frequency = 00. With that register #15 should be programmed with 1 (= default value).

Register #16 Ambient IR Light Level Register

Register address = 90h.

This register is not intended to be used by customer.

3. IMPORTANT APPLICATION HINTS AND EXAMPLES

3.1 Receiver standby mode

In standby mode the receiver has the lowest current consumption of about 1.5 µA. In this mode only the I^2C interface is active. This is always valid, when there are no measurement demands executed. Also the current sink for the LED is inactive, so there is no need for changing register #3 (LED current).

3.2 Data Read

In order to get a certain register value, the register has to be addressed without data like shown in the following scheme. After this register addressing, the data from the addressed register is written after a subsequent read command.

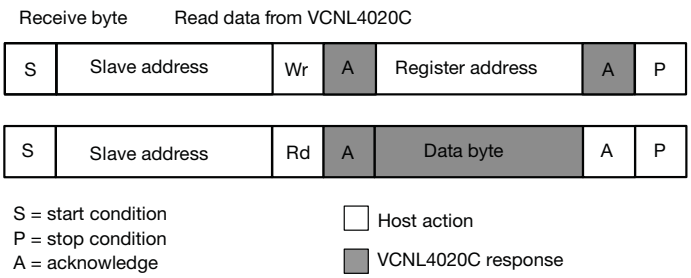


Fig. 14 - Send Byte / Receive Byte Protocol

The stop condition between these write and read sequences is not mandatory. It works also with a repeated start condition.

Note

- For reading out 2 (or more) subsequent registers like the result registers, it is not necessary to address each of the registers separately. After one read command the internal register counter is increased automatically and any subsequent read command is accessing the next register.

Example: read register “Ambient Light Result Register” #5 and #6:

Addressing:command: 26h, 85h (VCNL4020C_I²C_Bus_Write_Adr., Ambient Light Result Register #5 [85])

Read register #5:command: 27h, data (VCNL4020C_I²C_Bus_Read_Adr., {High Byte Data of Ambient Light Result register #5 [85]})

Read register #6:command: 27h, data (VCNL4020C_I²C_Bus_Read_Adr., {Low Byte Data of Ambient Light Result register #6 [86]})

3.3 Continuous Conversion Mode in Ambient Light Measurement

In the following is a detail description of the function “continuous conversion” (bit 7 of register #4)

Standard mode (bit 7 of reg #4 = 0):
In standard mode the ambient light measurement is done during a fixed time frame of 100 ms. The single measurement itself takes actually only appr. 300 µs.

The following figures show examples of this measurement timing in standard mode using averaging function 2 and 8 as examples for illustration (possible values up to 128).

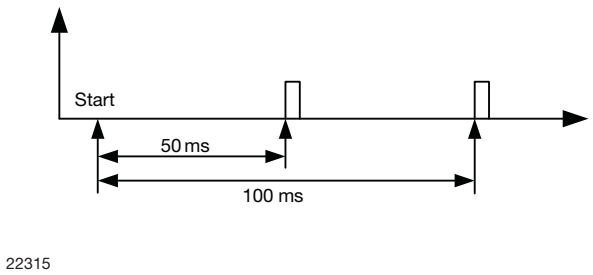


Fig. 15 - Ambient Light Measurement with Averaging = 2;
Final Measurement Result = Average of these 2 Measurements

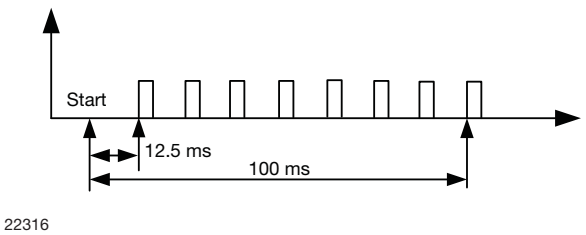


Fig. 16 - Ambient Light Measurement with Averaging = 8;
Final Measurement Result = Average of these 8 Measurements

Note

- ≥ Independent of setting of averaging the result is available only after 100 ms.

Continuous conversion mode (bit 7 of register #4 = 1):
In continuous conversion mode the single measurements are done directly subsequent after each other.

See following examples in figure 17 and 18

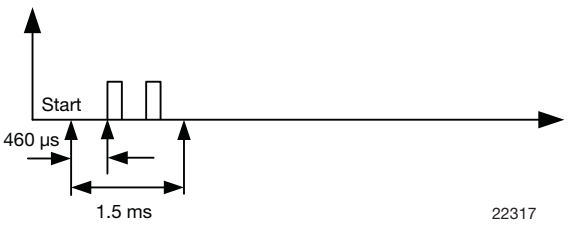


Fig. 17 - Ambient Light Measurement with Averaging = 2;
using Continuous Conversion Mode

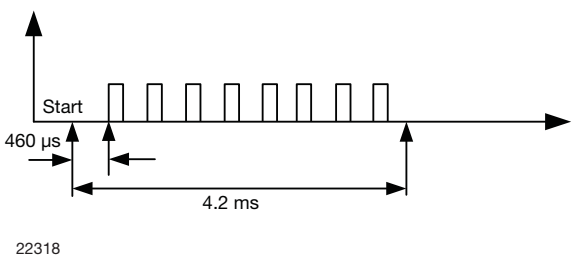
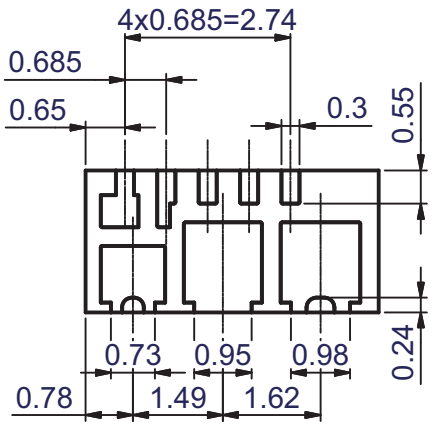
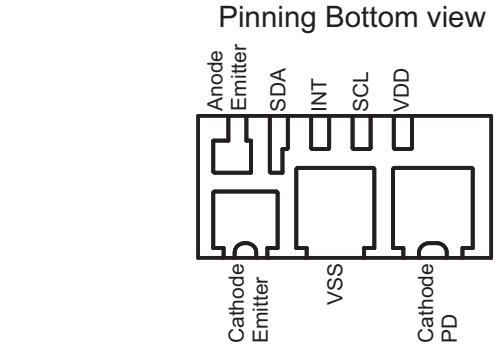
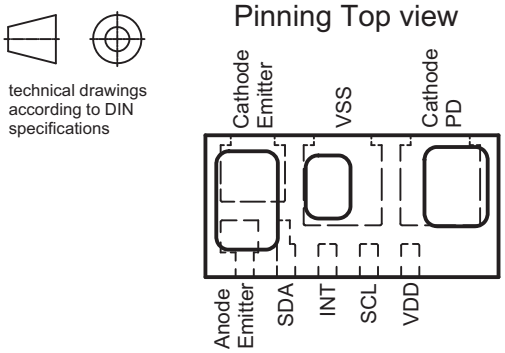


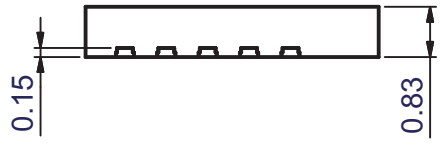
Fig. 18 - Ambient Light Measurement with Averaging = 8;
using Continuous Conversion Mode

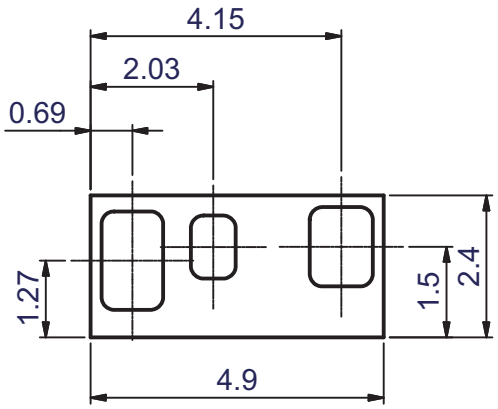
PACKAGE DIMENSIONS in millimeters

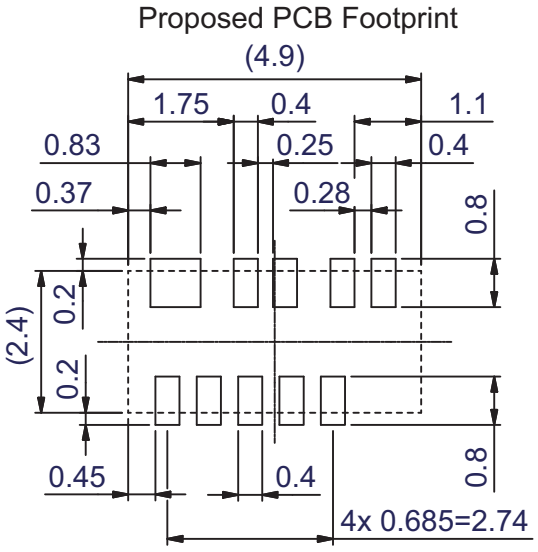








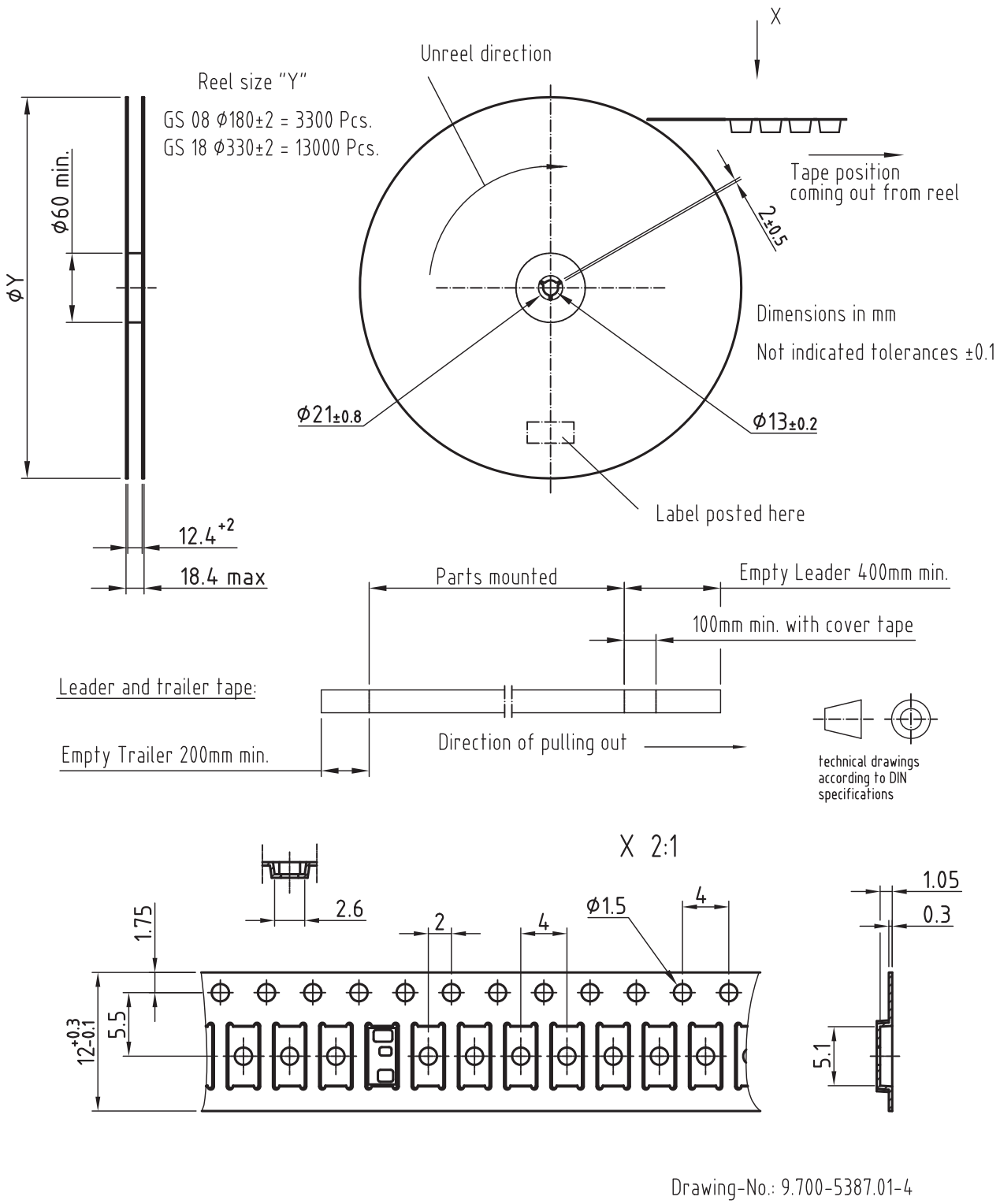




Drawing-No.: 6.550-5319

Not indicated tolerances ± 0.1

TAPE AND REEL DIMENSIONS in millimeters



Drawing-No.: 9.700-5387.01-4

SOLDER PROFILE

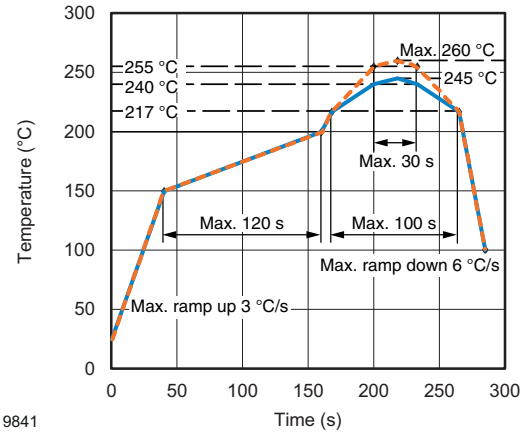


Fig. 19 - Lead (Pb)-free Reflow Solder Profile
According to J-STD-020

DRYPACK

Devices are packed in moisture barrier bags (MBB) to prevent the products from moisture absorption during transportation and storage. Each bag contains a desiccant.

FLOOR LIFE

Floor life (time between soldering and removing from MBB) must not exceed the time indicated on MBB label:

Floor life: 72 h

Conditions: T_{amb} < 30 °C, RH < 60 %

Moisture sensitivity level 4, according to J-STD-020.

DRYING

In case of moisture absorption devices should be baked before soldering. Conditions see J-STD-020 or label. Devices taped on reel dry using recommended conditions 192 h at 40 °C (+ 5 °C), RH < 5 %.

По вопросам продаж и поддержки обращайтесь:

Алматы (7273)495-231
Архангельск (8182)63-90-72
Астрахань (8512)99-46-04
Барнаул (3852)73-04-60
Белгород (4722)40-23-64
Брянск (4832)59-03-52
Владивосток (423)249-28-31
Волгоград (844)278-03-48
Вологда (8172)26-41-59
Воронеж (473)204-51-73
Екатеринбург (343)384-55-89
Иваново (4932)77-34-06
Ижевск (3412)26-03-58
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Калининград (4012)72-03-81
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Кемерово (3842)65-04-62
Киров (8332)68-02-04
Краснодар (861)203-40-90
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Магнитогорск (3519)55-03-13
Москва (495)268-04-70
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Набережные Челны (8552)20-53-41
Нижний Новгород (831)429-08-12
Новокузнецк (3843)20-46-81
Новосибирск (383)227-86-73
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Орел (4862)44-53-42
Оренбург (3532)37-68-04
Пенза (8412)22-31-16
Пермь (342)205-81-47
Ростов-на-Дону (863)308-18-15
Рязань (4912)46-61-64
Самара (846)206-03-16
Санкт-Петербург (812)309-46-40
Саратов (845)249-38-78
Севастополь (8692)22-31-93
Симферополь (3652)67-13-56
Смоленск (4812)29-41-54
Сочи (862)225-72-31
Ставрополь (8652)20-65-13
Сургут (3462)77-98-35
Тверь (4822)63-31-35
Томск (3822)98-41-53
Тула (4872)74-02-29
Тюмень (3452)66-21-18
Ульяновск (8422)24-23-59
Уфа (347)229-48-12
Хабаровск (4212)92-98-04
Челябинск (351)202-03-61
Череповец (8202)49-02-64
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