CM36652

Proximity Sensor and Color Sensor with Interrupt in Single Package

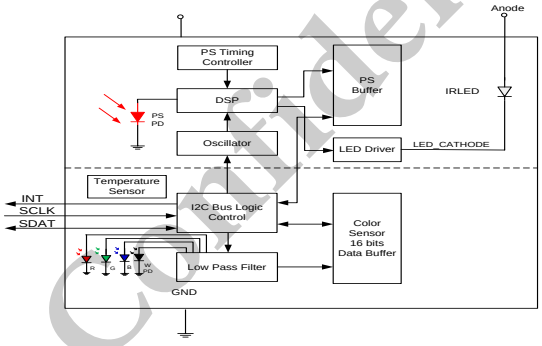
Rev: 1.00 04th-Jul-2014

Description

CM36652 integrates a proximity sensor (PS), a color sensor (CS of Red, Green, Blue and White) and an IR LED in one small package. It incorporates a photodiode, amplifiers and analog/digital circuits into a single chip by the CMOS process. The active programmable color sensor and PS interruption features offer the best utilization on the microcontroller. With the color sensor applied, the brightness and color temperature of backlight of panel can be adjusted based on ambient light source that makes panel looks more comfortable for end users' eyes. In addition, the cross talk phenomenon is reduced by the intelligent cancellation scheme. The adoption of the Filtron™ technology achieves the closest ambient light spectral sensitivity to real human eye responses and offers the best background light cancellation capability (including sunlight) without utilizing the microcontrollers' resources.

CM36652 provides an excellent temperature compensation capability for keeping output stable under various temperature configurations. CS and PS functions are easily operated via the simple command format of I^2C (SMBus compatible) interface protocol. CM36652's operating voltage ranges from 2.5 V to 3.6 V. CM36652 is packaged in a lead-free 8-pin molding package which offers the best market-proven reliability.

Block Diagram



Applications

- Handheld device
- Notebook
- Consumer device
- Industrial and medical application

Features

- Operates CS and PS in parallel structure
- Filtron™ technology adoption for background light cancellation including fluorescent light, incandescent light, and sunlight
- Supports low transmittance (dark) lens design

Color Sensor(RGBW)

- Fluorescent light flicker immunity
- Linearity CS response for easy design
- Spectrum close to real human eye responses
- Selectable Maximum detection range (1442\2884\5768\11536) lux with highest sensitivity 0.022 lux/step

Proximity Sensor

- Immunity to red glow (940 nm IR LED)
- Programmable ILED sink current
- Intelligent cancellation to reduce cross talk phenomenon
- Smart persistence scheme to reduce PS response time

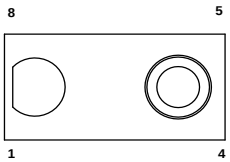
Interrupt

- Programmable interrupt function for CS(Green) and PS with upper and lower thresholds
- Adjustable persistence to prevent false triggers for CS(Green) and PS

Additional Features

- Temperature compensation
- Low power consumption I^2C (SMBus Compatible) Interface
- Output type: I^2C Bus (CS/PS)
- Operation voltage of 2.5 V to 3.6 V
- Package: Molding Package
- Lead-free package (RoHS compliant)

Pin Definition



1	GND	5	Cathode (LED)
2	Cathode (Sensor)	6	INT
3	VDD	7	SDAT
4	Anode	8	SCLK

<Top View>

Ordering Information

PART NUMBER	PACKING	PACKAGE	PIN NO.	QUANTITY	LEAD FREE	REMARK
CM36652M3OE	Tape and Reel	4 x 2 x 1.1 mm	8	2500	Compliant	
CM36652M3OE-H1 CM36652M3OE-H2 CM36652M3OE-H3 CM36652M3OE-H4 CM36652M3OE-H5 CM36652M3OE-H6	Tape and Reel	4.34 x 2.35 x 2.65 4.34 x 2.35 x 2.95 4.34 x 2.35 x 3.25 4.34 x 2.35 x 3.45 4.34 x 2.35 x 3.65 4.34 x 2.35 x 3.15	8	1500	Compliant	H1= 1.5 mm, H2 =1.8 mm, H3 =2.1 mm, H4 =2.3 mm, H5 =2.5 mm, H6 =2.0 mm

Absolute Maximum Ratings

PARAMETER	SYMBOL	MIN.	MAX.	UNIT	CONDITION
Storage temperature	T_S	-40	+100	°C	
Operating temperature	T_A	-40	+85	°C	
Supply voltage	V_{DD}	2.6	3.6	V	

Recommended Operating Conditions

PARAMETER	SYMBOL	MIN.	MAX.	UNIT	CONDITION
Operating temperature	T_A	-40	+85	°C	
Supply voltage	V_{DD}	2.5	3.6	V	
I^2C Bus operating frequency	$f_{(I2CCLK)}$	10	400	kHz	

Pin Descriptions

PIN ASSIGNMENT	SYMBOL	TYPE	FUNCTION
1	GND	I	Ground
2	LED_CATHODE	I	IR LED cathode connection
3	V_{DD}	I	Power supply input
4	Anode	I	Anode of IR LED
5	LED_CATHODE	I	IR LED cathode connection
6	INT	O	Interrupt pin
7	SDAT	I/O (Open Drain)	I^2C data bus data in/output
8	SCLK	I	I^2C digital bus clock input

Electrical & Optical Specifications

PARAMETER		SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITION
Supply voltage		V_{DD}	2.5		3.6	V	
Supply current		I_{DD}	115	200	460	uA	Excluded LED driving
I^2C signal input	Logic High	VIH	1.5			V	Note1, V_{DD} = 3.3V
	Logic Low	VIL			0.8		Note1, V_{DD} = 3.3V
I^2C signal input	Logic High	VIH	1.4			V	Note1, V_{DD} = 2.6V
	Logic Low	VIL			0.6		Note1, V_{DD} = 2.6V
Peak sensitivity wavelength		λ_{PR}		650		nm	
		λ_{PG}		550			
		λ_{PB}		450			
Irradiance responsivity				180		LSB/(μW/cm²)	λp_R= 630nm
				144			λp_G= 530nm
				52			λp_B= 467nm
Peak wavelength of LED		λ_{PLED}		940		nm	I_F =100mA
Detectable intensity	Minimum			0.022		Lux	ALS only, IT = 640ms, Note1, 2, 3
	Maximum			11536			ALS only, IT = 80ms, Note1, 2, 3
Dark offset			0		3	STEP	IT = 80ms, Note 1,2
Operating temperature		T_A	-40		+85	°C	
Shutdown current		I_{DD} (SD)	0.01	800	1000	nA	Light Condition = Dark; V_{DD}= 3.6 V, Ta= 25°C
LED driving current					400	mA	Note 4

Note:

1. Test condition: V_{DD} = 3.3 V, Temperature: 25°C.
2. Light source: White LED.
3. Maximum detection range can be determined by refresh time adjustment.
4. Base on LED duty ratio=1/80, 1/160, 1/320 and 1/640 and R, G, B and W channel are all in shutdown mode.

I²C Bus Timing Characteristics

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		us
Hold time after (repeated) start condition. After this period, the first clock is generated	$t_{(HDSTA)}$	4.0		0.6		us
Repeated start condition setup time	$t_{(SUSTA)}$	4.7		0.6		us
Stop condition setup time	$t_{(SUSTO)}$	4.0		0.6		us
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		us
I²C clock (SCK) high period	$t_{(HIGH)}$	4.0		0.6		us
Clock / Data fall time	$t_{(F)}$		300		300	ns
Clock / Data rise time	$t_{(R)}$		1000		300	ns

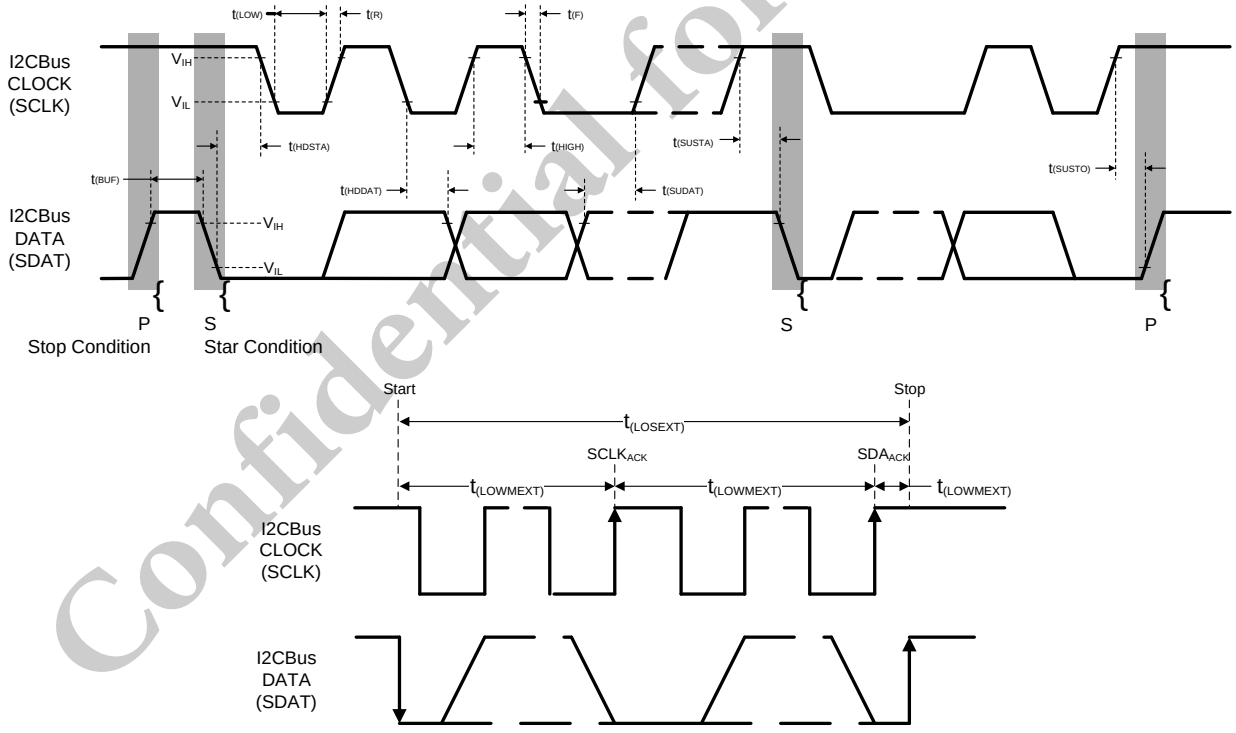


Figure 1. I²C Bus Timing Diagram

Parameter Timing Information

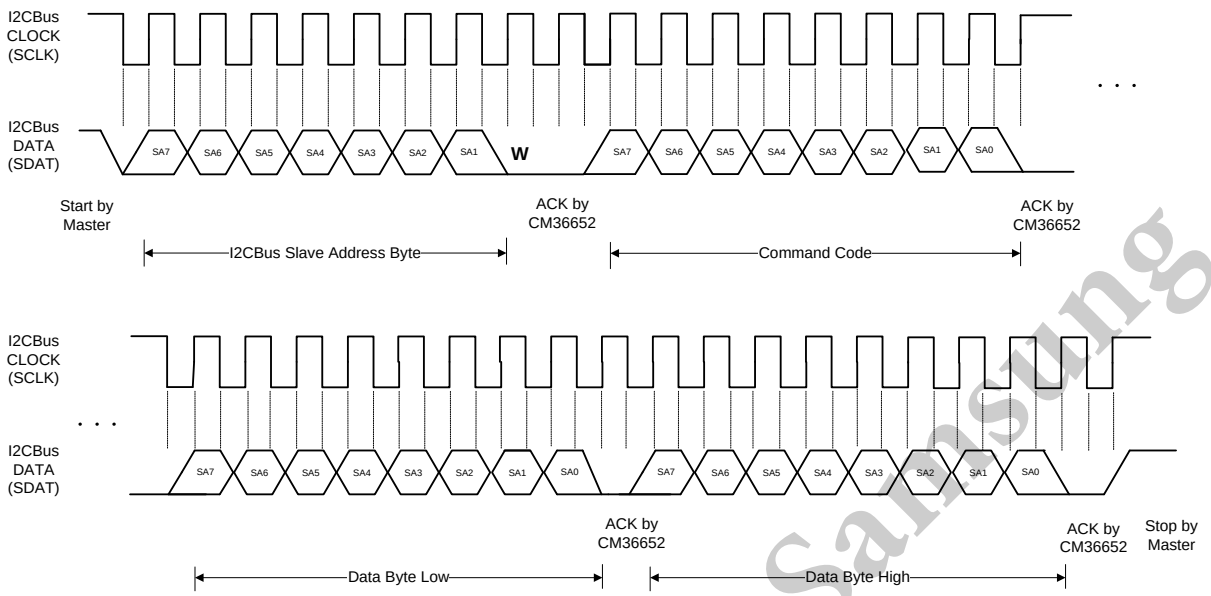


Figure 2. I²C Bus Timing for Sending Word Data Command Format

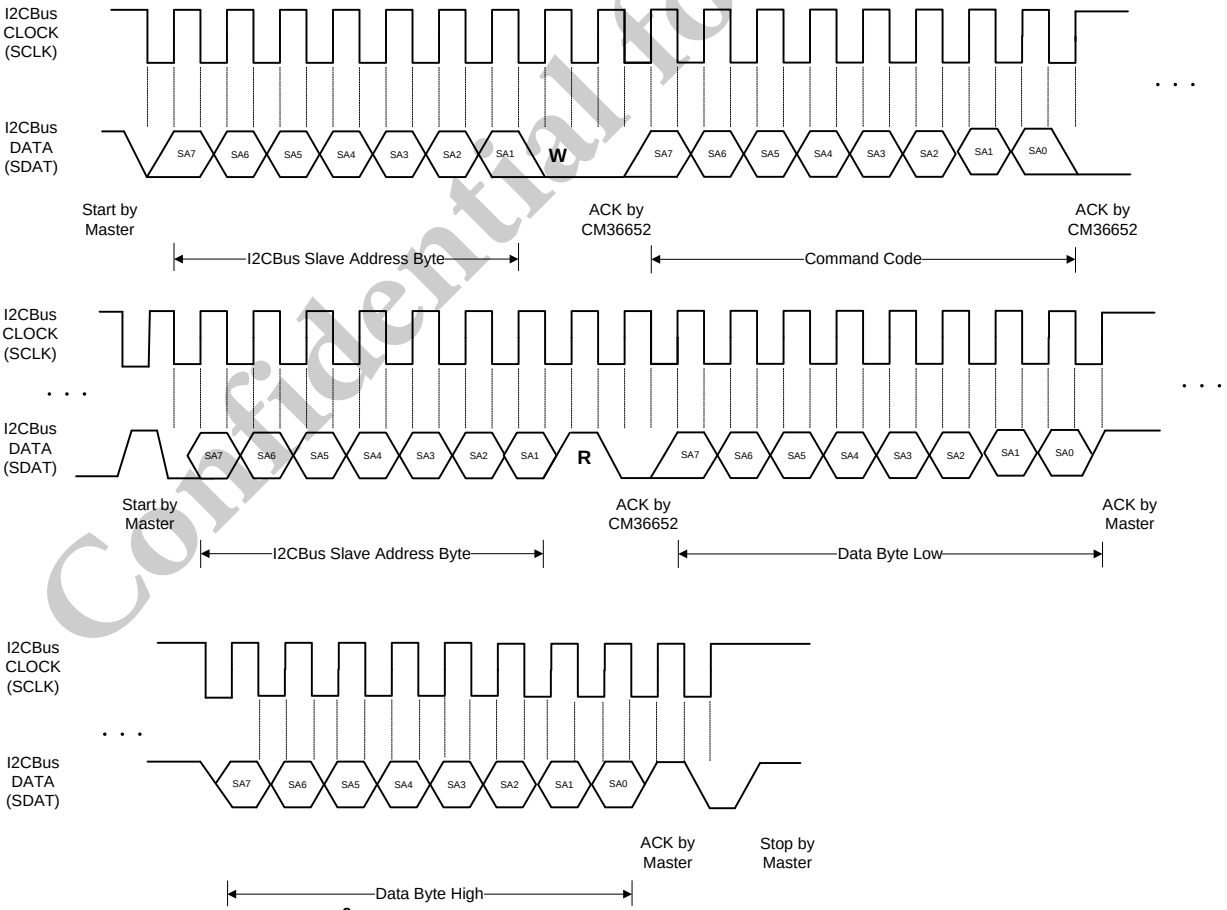


Figure 3. I²C Bus Timing for Receiving Word Data Command Format

Typical Performance Characteristics

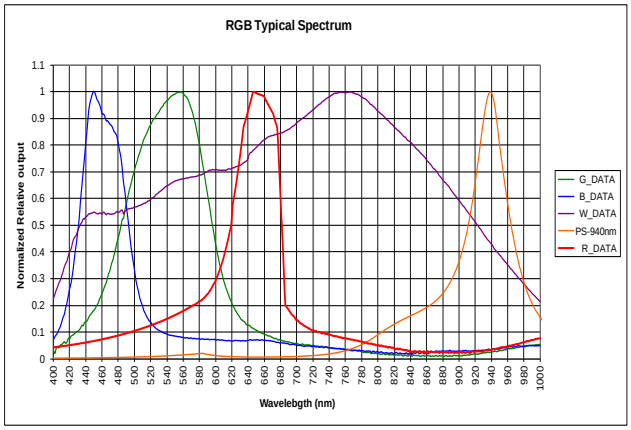


Figure 4. Normalized Spectral Response

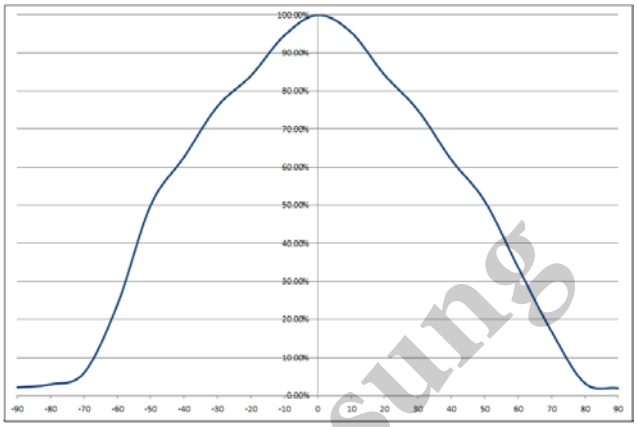


Figure 5. ALS Normalized Output vs. View Angle

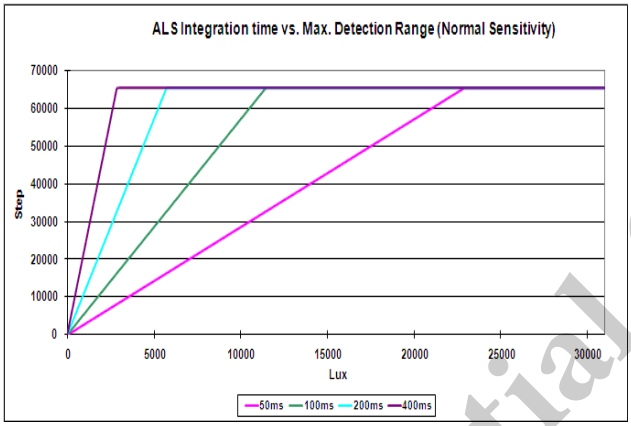


Figure 6. ALS Refresh Time vs. Maximum Detection Range

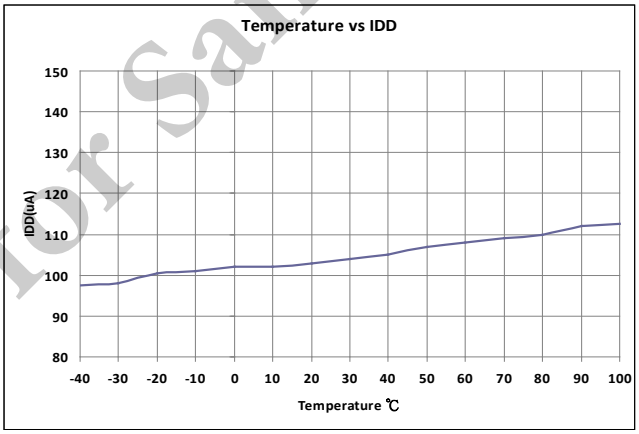


Figure 7. IDD vs. Temperature

Application Information

Pin Connection with the Host

CM36652 integrates a proximity sensor, Color Sensor(R, G, B and W), and IR LED all in one package with I^2C interface. It is very easy for the baseband (CPU) to access PS and CS output data via I^2C interface without extra software algorithms. The hardware schematic is shown in the following diagram.

Two additional capacitors in the circuit can be used for the following purposes: (1) the 0.1uF capacitor near the V_{DD} pin is used for power supply noise rejection (2) the 2.2uF capacitor, which connects parallel to the R_{LED}, is used to prevent the IR LED voltage from instantly dropping when the IR LED is turned on, and (3) 2.2K ohm is suitable for the pull high resistor of I^2C except 8.2K ohm applied on INT pin.

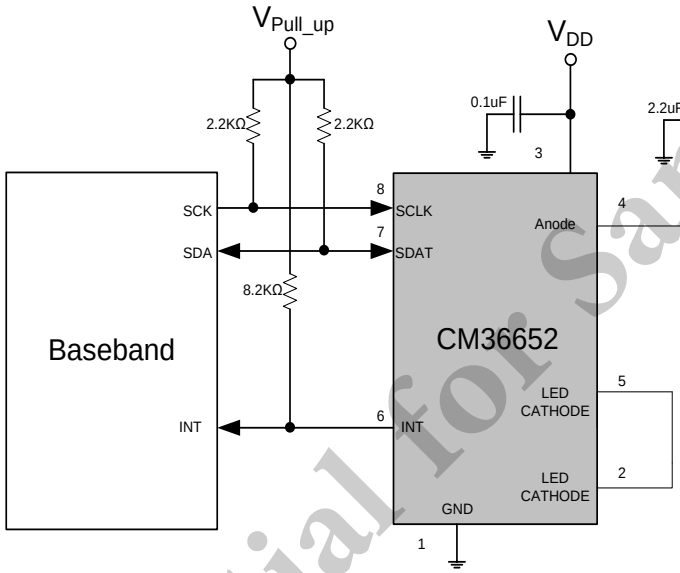
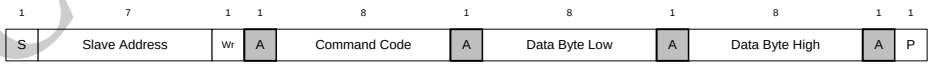


Figure 8. Hardware Pin Connection Diagram

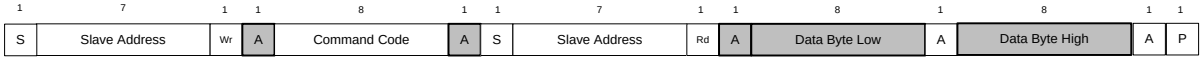
Digital Interface

CM36652 apply single slave address 0x60 of 7 bit addressing protocol for I2C. CM36652 contains an 8-bit command register following each of slave address as shown in Figure 9. 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 CM36652. Following I^2C command format is simple for Read and Write operations between CM36652 and the host as shown in Figure 9. The white sections indicate host activity and the gray sections indicate CM36652's acknowledgement of the host access activity. All of command register should follow Read Word and Write Word Protocol.

Send Word → Write Command to CM36652



Receive Word → Read Data from CM36652



S = Start Condition
P = Stop Condition
A = Acknowledge
Shaded area = CM36652 acknowledge

Figure 9. Write Word and Read Word Protocol

Slave Address and Function Description

CM36652 has 16-bit resolution for each channel(R,G, B and W) of CS that provides with sensitivity up to 0.022 Lux/Step for ALS, which work very well under a low transmittance lens design (dark lens). A flexible interrupt function of ALS (Register: ALS_CONF1) is supported , in which the INT signal will not be asserted by CM36652 if the ALS value is not over maximum window level, or lower than minimum window level of ALS, which all can be defined by the user (Register: ALS_WH and ALS_WL).

For the proximity sensor function, all the basic 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_THDH) setting. If the Interrupt function is enabled, the host reads the PS output data from CM36652 that save host loading from periodically reading PS data. INT flag(Register: INT_Flag) indicates the behavior of INT triggered under different conditions. Persistence (1\2\4\8) decides when a PS INT will be asserted 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.

CM36652 also supports an alternative PS function that outputs just High/Low levels, which save loading from the host. Normal operation mode or Proximity Detection Logic Output Mode can be selected on the Register: PS_INT. A Smart Persistence (Register: PS_SMART_PERS) is provided to get faster PS response time and prevent false trigger for PS.

COMMAND CODE	Date Byte Low/High	REGISTER NAME	R/W	DEFAULT VALUE	FUNCTION DESCRIPTION
0x00	L	CS_CONF	R/W	0x00	CS integration time, persistence, interrupt and function enable and disable
	H	Reserved	R/W	0x00	Reserved
0x01	L	ALS_THDH_L	R/W	0x00	ALS high interrupt threshold LSB byte
	H	ALS_THDH_M	R/W	0x00	ALS high interrupt threshold MSB byte
0x02	L	ALS_THDL_L	R/W	0x00	ALS low interrupt threshold LSB byte
	H	ALS_THDL_M	R/W	0x00	ALS low interrupt threshold MSB byte
0x03	L	PS_CONF1	R/W	0x00	PS duty ratio, integration time, persistence, and PS enable/disable
	H	PS_CONF2	R/W	0x00	PS integration time bank and ratio, PS sink current
0x04	L	Reserved	R/W	0x00	Reserved
	H	Reserved	R/W	0x00	Reserved
0x05	H	PS_THDL	R/W	0x00	PS high interrupt threshold setting
	H	PS_THDH	R/W	0x00	PS high interrupt threshold setting
0x06	L	PS_CANC	R/W	0x00	PS cancellation level setting
	H	Reserved	R/W	0x00	Reserved
0x07	L	PS_Data	R	0x00	PS output data
	H	Reserved	R/W	0x00	Reserved
0x08	L	CS_R_DataL	R	0x00	CS R channel LSB output data
	H	CS_R_DataM	R	0x00	CS R channel MSB output data
0x09	L	CS_G_DataL	R	0x00	CS G(ALS) channel LSB output data
	H	CS_G_DataM	R	0x00	CS G(ALS) channel MSB output data
0x0A	L	CS_B_DataL	R	0x00	CS B channel LSB output data
	H	CS_B_DataM	R	0x00	CS B channel MSB output data
0x0B	L	White_DataL	R	0x00	White channel LSB output data
	H	White_DataM	R	0x00	White channel MSB output data
0x0C	L	Reserved	R	0x00	Reserved
	H	INT_Flag	R	0x00	CS and PS interrupt flag
0x0D	L	ID_L	R	0x52	Device ID LSB
	H	ID_M	R	0x00	Device ID MSB

Note: Slave address is 7-bit addressing protocol

Table 1. Slave Address and Command Code Description

Command Register Format

CM36652 provides an 8-bit command register for CS and PS controlling independently. The description of each command format is shown in the following tables.

Color Sensor Command

REGISTER NAME		Command Code: 0x00_L (0x00 Data Byte Low) or 0x00_H (0x00 Data Byte High)							
COMMAND	BIT	7	6	5	4	3	2	1	0

REGISTER: CS_CONF		Command Code: 0x00_L (0x00 Data Byte Low)
COMMAND	BIT	Description
Reserved	7:6	Default = (0: 0)
RGBW_IT	5:4	(0 : 0) = 80 ms, (0 : 1) = 160 ms, (1 : 0) = 320 ms, (1 : 1) = 640 ms ALS integration time setting, longer integration time has higher sensitivity
ALS_PERS	3:2	(0 : 0) = 1, (0 : 1) = 2, (1 : 0)=4, (1 : 1)= 8 ALS interrupt persistence setting
ALS_INT_EN	1	0 = ALS interrupt disable, 1= ALS interrupt enable
CS_SD	0	0 = CS power on, 1 = CS shut down, Default = 1

Table 2. Register: CS_CONF Description

REGISTER: Reserved		Command Code: 0x00_H (0x00 Data Byte High)
COMMAND	BIT	Description
Reserved	7:0	Default=(0 : 0 : 0 : 0 : 0 : 0 : 0 : 0)

Table 3. Register 0x00_H Description

Command Code: 0x01_L (0x01 Data Byte Low) and 0x01_H(0x01 Data Byte High)		
REGISTER	BIT	Description
ALS_THDH_L	7:0	0x00 ~ 0xFF, ALS high interrupt threshold LSB byte
ALS_THDH_M	7:0	0x00 ~ 0xFF, ALS high interrupt threshold MSB byte

Table 4. Register ALS_THDH_L and ALS_THDH_M Description

Command Code: 0x02_L (0x02 Data Byte Low) and 0x02_H(0x02 Data Byte High)		
REGISTER	BIT	Description
ALS_THDL_L	7:0	0x00 ~ 0xFF, ALS low interrupt threshold LSB byte
ALS_THDL_M	7:0	0x00 ~ 0xFF, ALS low interrupt threshold MSB byte

Table 5. Register ALS_THDL_L and ALS_THDL_M Description

REGISTER: PS_CONF1		Command Code: 0x03_L (0x03 Data Byte Low)
COMMAND	BIT	Description
PS_Duty	7:6	(0 : 0) = 1/80, (0 : 1) = 1/160, (1 : 0) = 1/320, (1 : 1) = 1/640 PS IR LED on/off duty ratio setting
PS_IT	5:4	(0 : 0) = 1T, (0 : 1) = 1.3T, (1 : 0) = 1.6T, (1 : 1) = 2T PS integration time setting
PS_PERS	3:2	(0 : 0) = 1, (0 : 1) = 2, (1 : 0) = 3, (1 : 1) = 4 PS interrupt persistence setting
Reserved	0	Default = 0
PS_SD	0	0 = PS power on, 1= PS shut down, Default = 1

Table 6. Register PS_CONF1 Description

REGISTER: PS_CONF2		Command Code: 0x03_H (0x03 Data Byte High)
COMMAND	BIT	Description
PS_ITB	7:6	(0 : 0) = 1/2 * PS_IT, (0 : 1) = 1 * PS_IT, (1 : 0) = 2* PS_IT, (1 : 1) = 4 * PS_IT
PS_SMART_PERS	5	0 = disable Smart Persistence, 1 = enable Smart Persistence
LED_I	4:2	(0 : 0 : 0)=100 mA, (0 : 0 : 1)=115 mA, (0 : 1 : 0)=130 mA, (0 : 1 : 1)=140 mA, (1 : 0 : 0)=160 mA, (1 : 0 : 1)=200 mA, (1 : 1 : 0)= 75 mA, (1 : 1 : 1)=50 mA,
PS_INT	1:0	(0 : 0) = interrupt disable, (0 : 1) = interrupt disable, (1 : 0)= PS interrupt enable (1 : 1)= Proximity detection logic output mode enable

Table 7. Register PS_CONF2 Description

REGISTER: Reserved		Command Code: 0x04_H (0x00 Data Byte High)
COMMAND	BIT	Description
Reserved	7:0	Default=(0 : 0 : 0 : 0 : 0 : 0 : 0 : 0)

Table 8. Register 0x04_H Description

REGISTER: Reserved		Command Code: 0x04_L (0x00 Data Byte High)
COMMAND	BIT	Description
Reserved	7:0	Default=(0 : 0 : 0 : 0 : 0 : 0 : 0 : 0)

Table 9. Register 0x04_L Description

		Command Code: 0x05_L (0x05 Data Byte Low)
REGISTER	BIT	Description
PS_THDL	7:0	0x00 – 0xFF, PS low interrupt threshold setting

Table 10. Register PS_THDL Description

		Command Code: 0x05_H (0x05 Data Byte High)
REGISTER	BIT	Description
PS_THDH	7:0	00H – FFH, PS high interrupt threshold setting

Table 11. Register PS_THDH Description

		Command Code: 0x06_L (0x06 Data Byte Low)
REGISTER	BIT	Description
PS_CANC	7:0	0x00 – 0xFF, PS intelligent cancellation level setting

Table 12. Register PS_CANC Description

REGISTER: Reserved		Command Code: 0x06_H (0x00 Data Byte High)
COMMAND	BIT	Description
Reserved	7:0	Default=(0 : 0 : 0 : 0 : 0 : 0 : 0 : 0)

Table 13. Register 06H_H Description

REGISTER	Command Code	BIT	Description
PS_Data	0x07_L (0x07 Data Byte Low)	7:0	0x00 – 0xFF, PS output data
Reserved	0x07_H (0x07 Data Byte High)	7:0	Reserved
CS_R_DataL	0x08_L (0x08 Data Byte Low)	7:0	0x00 – 0xFF, Red channel output data
CS_R_DataM	0x08_H (0x08 Data Byte High)	7:0	0x00 – 0xFF, Red channel output data
CS_G_DataL	0x09_L (0x09 Data Byte Low)	7:0	0x00 – 0xFF, Green(ALS) channel output data
CS_G_DataM	0x09_H (0x09 Data Byte High)	7:0	0x00 – 0xFF, Green(ALS) channel output data
CS_B_DataL	0x0A_L (0x0A Data Byte Low)	7:0	0x00 – 0xFF, Blue channel output data
CS_B_DataM	0x0A_H (0x0A Data Byte High)	7:0	0x00 – 0xFF, Blue channel output data
White_DataL	0x0B_L (0x0B Data Byte Low)	7:0	0x00 – 0xFF, White channel output data
White_DataM	0x0B_H (0x0B Data Byte High)	7:0	0x00 – 0xFF, White channel output data
Reserved	0x0C_L (0x0C Data Byte Low)	7:0	Reserved
INT_Flag	0x0C_H(0x0B Data Byte High)	7 6 5 4 3 2 1 0	Reserved PS_SPFLAG, PS entering protection mode ALS_IF_L, ALS crossing low THD INT trigger event ALS_IF_H, ALS crossing high THD INT trigger event Reserved Reserved PS_IF_CLOSE, PS rises above PS_THDH INT trigger event PS_IF_AWAY, PS drops below PS_THDL INT trigger event
ID_L	0DH_L (0CH Data Byte Low)	7:0	Default = 0101 0011 , Device ID LSB byte
ID_M	0DH_H (0CH Data Byte High)	7:6 5:4 3:0	(0 : 0) (0 : 0) Slave address = 0x60 Version code (0 : 0 : 0 : 0) Device ID MSB byte

Table 14. Read Out Register Description

Initialization

CM36652 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

ALS Threshold Window Setting (Applying CS Green channel with INT enabled)

The threshold window in CM36652 can be dynamically programmed by the register setting via Write command. There are two ALS Threshold methods. (Register: CS_CONF). In case of ALS high/low threshold mode selected. To further define the high and low threshold value, ALS_WH and ALS_WL represent the ALS interrupt threshold window High and Low. In case the ALS INT function is enabled, which will be asserted once the ALS data exceeds ALS_WH or goes below ALS_WL. To easily define the threshold range, multiply the value of the resolution (Lux/Step) by the threshold level. The ALS resolutions that help define the threshold window are shown in Table 15.

ALS_IT		Sensitivity	Maximum Detection Range
ALS_IT[7:6]	Integration time(typ)	Unit: Lux/Step	Unit: Lux
(0,0)	80ms	0.176	11536
(0,1)	160ms	0.088	5768
(1,0)	320ms	0.044	2884
(1,1)	640ms	0.022	1442

Table 15. ALS Resolution and Maximum Detection Range

ALS Persistence

The ALS INT is asserted as the ALS value is higher or lower than the threshold window when ALS_PERS is set to one time. If ALS_PERS is set to four times, then the ALS INT will not be asserted if the ALS value is not over (or lower) than the threshold window for four continued refresh times (integration time).

Programmable PS Threshold

CM36652 provides a flexible way to determine the threshold window for the PS interruption activity. The 8-bit command code register PS_THDL and PS_THDH is for the programming. The interrupt signal is activated when the PS data crosses over the PS_THDH value. Once PS INT is disengaged by host, it will be asserted again when PS value lower than PS_THDL.

PS Persistence

The PS persistence function PS_PERS, avoid the 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(or equal to) the PS_THDH value for three periods of time or less than PS_THDL value.

Data Access

All of CM36652 command registers are readable. To access 16-bit high resolution CS output data, it is suitable to use Read Word protocol to read out data by just one command at Register: CS_R\G\B\White_DataL and CS_R\G\B\White_DataM. To represent the 16-bit data of CS, it has to apply two bytes. One byte is for LSB, and the other byte is for MSB as shown in Table 16. For PS data reading, Read Word protocol is applied that host can read out PS data from register PS_Data of 0x07 data byte low.

	CM36652 16-BIT ALS DATA FORMAT															
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Register	CS_DataM								CS_DataL							

Table 16. 16-BIT CS DATA FORMAT

Intelligent Cancellation

CM36652 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)

CM36652 has ALS and 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 doesn’t 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 ALS interrupt (Register: ALS_INT_EN) or PS interrupt (Register: PS_INT) function, the level of INT pin (pin 4) is pulled low once INT asserted. All registers are accessible even if INT is asserted.

ALS INT asserted when ALS value cross over the value set by Register: ALS_THDH or lower than the value set by Register: ALS_THDL. To effectively adopt PS INT function, it is recommended to use Capella 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 ALS and PS. Any flag value changes from ‘0’ to ‘1’ state, the level of INT pin will be pulles low. As long as Host reads INT_Flag data, the bit will chang from ‘1’ state to ‘0’ state after reading out, the INT level will be returned to high afterwards.

Intelligent Cancellation

CM36652 provides an Intelligent Cancellation method to reduce the cross talk phenomenon for the proximity sensor. CM36652 subtracts the value input on PS_CANC before outputting the PS value.

Proximity Detection Logic Output Mode

CM36652 provides a Proximity Detection Logic Output Mode that uses INT pin (pin 4) as a proximity detection logic high/low output(Register: PS_INT = (1 : 1)). When this mode is selected, the PS output (pin 4; INT/Pout) is pulled low when an object is closing to be detected and returned to level high when the object moves away. Register: PS_THDH\L 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. If host would like to use ALS with INT function, Register: PS_INT has to be selected to interrupt mode (PS_INT =(1 : 0). 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.

The hardware design should follow suggestions below when the PS logic output mode is enabled:

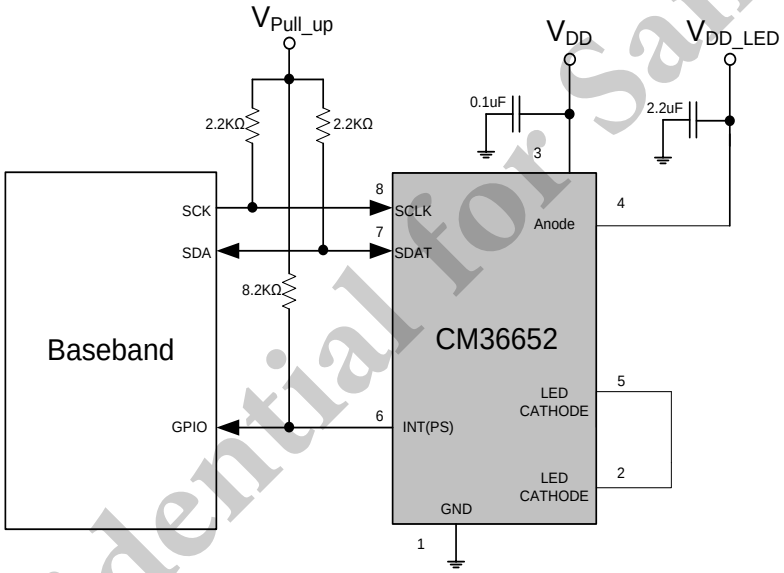
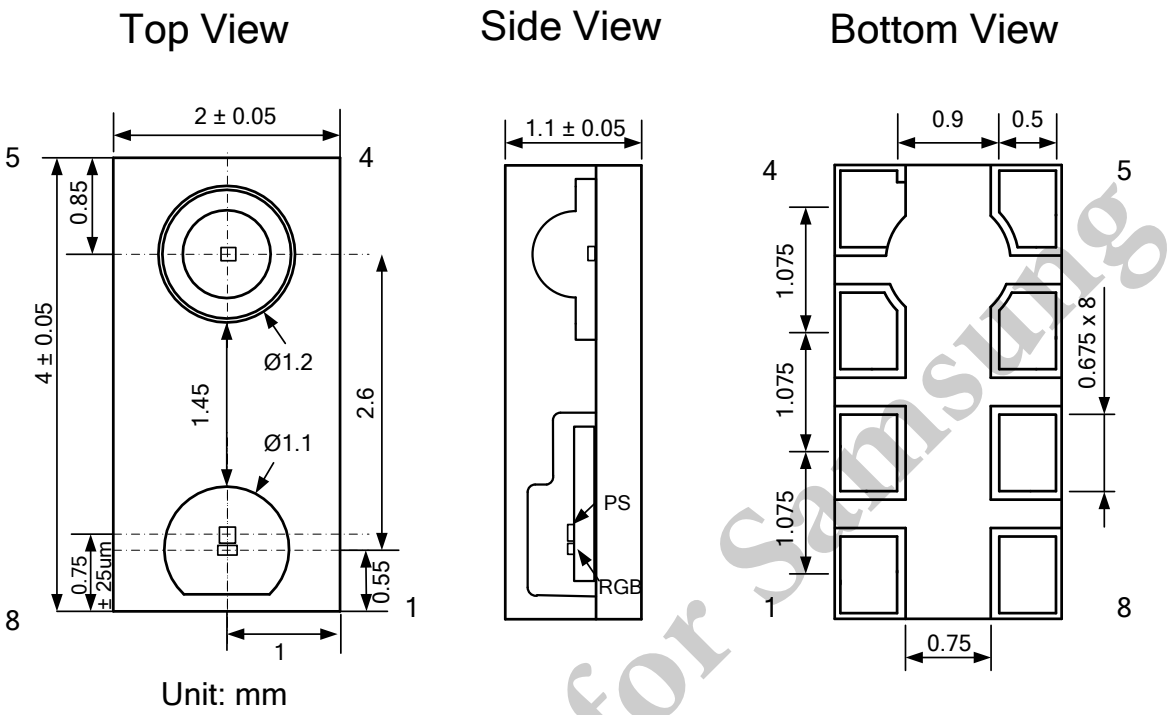


Figure 10. CM36652 Reference Circuit Connection with Host (Proximity Detection Logic Output Mode) (CM36652 INT pin connecting to BB GPIO instead of INT pin)

ALS Data Auto-Memorization

CM36652 can memorize the last ambient light data before shutting down and keeps this data before waking up again. When CM36652 is in shutdown mode, the host can freely read this data directly via Read command. When CM36652 wakes up, the data is refreshed by a newly acquired detection.

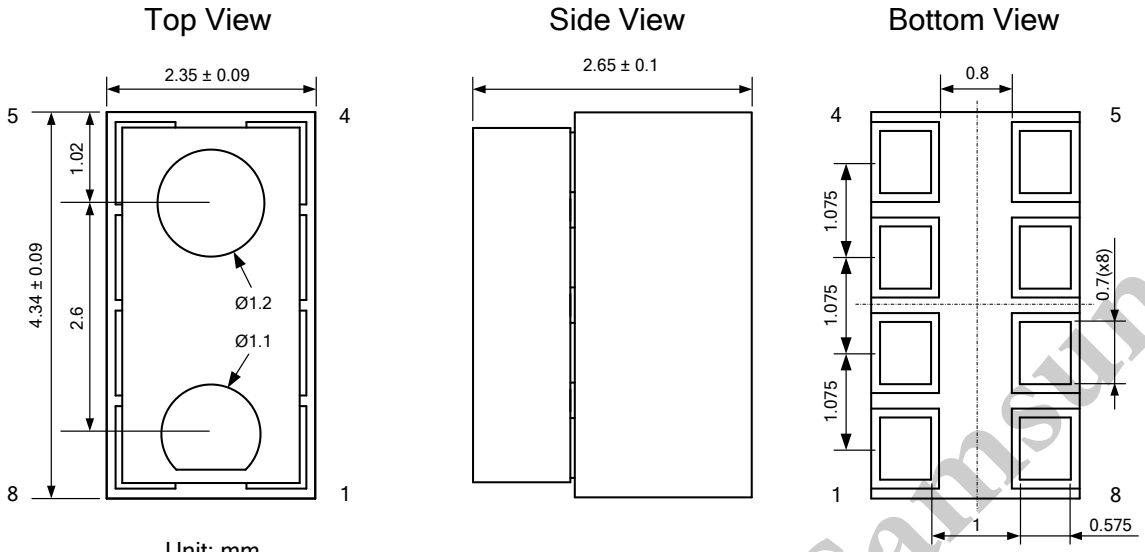
Package Information (CM36652M3OE)



1	GND	5	Cathode (LED)
2	Cathode (Sensor)	6	INT
3	VDD	7	SDAT
4	Anode	8	SCLK

Figure 11. CM36652 Package Dimensions

Package Information (CM36652M3OE-H1)



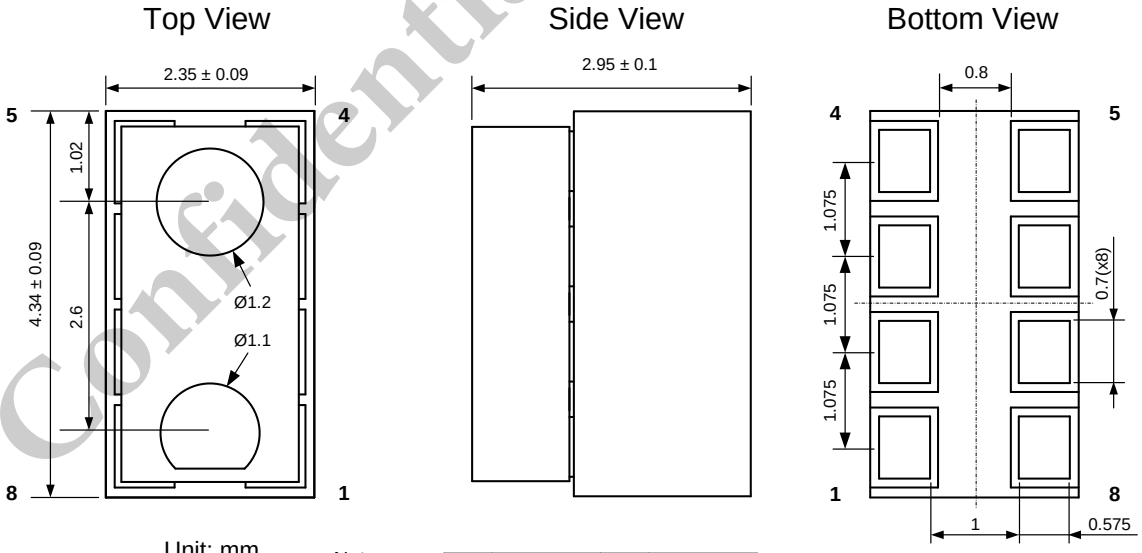
Unit: mm

Note:
H1=1.5 mm
H2=1.8 mm
H3=2.1 mm
H4=2.3 mm
H5=2.5 mm
H6=2.0 mm

1	GND	5	Cathode (LED)
2	Cathode (Sensor)	6	INT
3	VDD	7	SDAT
4	Anode	8	SCLK

Figure 11-1. CM36652M3OE-H1 Package Dimensions

Package Information (CM36652M3OE-H2)



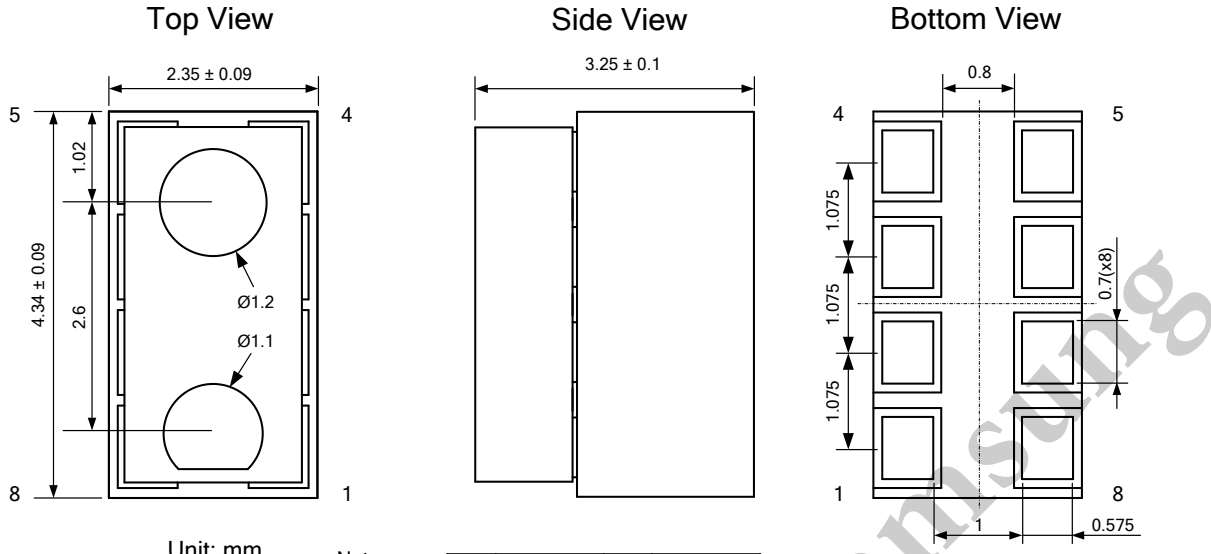
Unit: mm

Note:
H1=1.5 mm
H2=1.8 mm
H3=2.1 mm
H4=2.3 mm
H5=2.5 mm
H6=2.0 mm

1	GND	5	Cathode (LED)
2	Cathode (Sensor)	6	INT
3	VDD	7	SDAT
4	Anode	8	SCLK

Figure 11-2. CM36652M3OE-H2 Package Dimensions

Package Information (CM36652M3OE-H3)



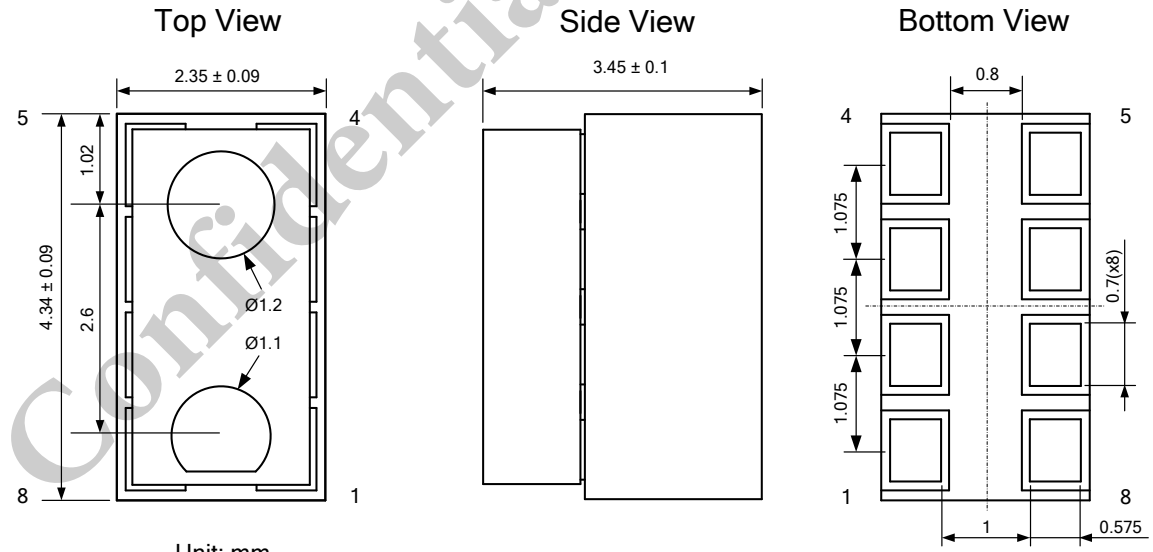
Unit: mm

Note:
H1=1.5 mm
H2=1.8 mm
H3=2.1 mm
H4=2.3 mm
H5=2.5 mm
H6=2.0 mm

1	GND	5	Cathode (LED)
2	Cathode (Sensor)	6	INT
3	VDD	7	SDAT
4	Anode	8	SCLK

Figure 11-3. CM36652M3OE-H3 Package Dimensions

Package Information (CM36652M3OE-H4)



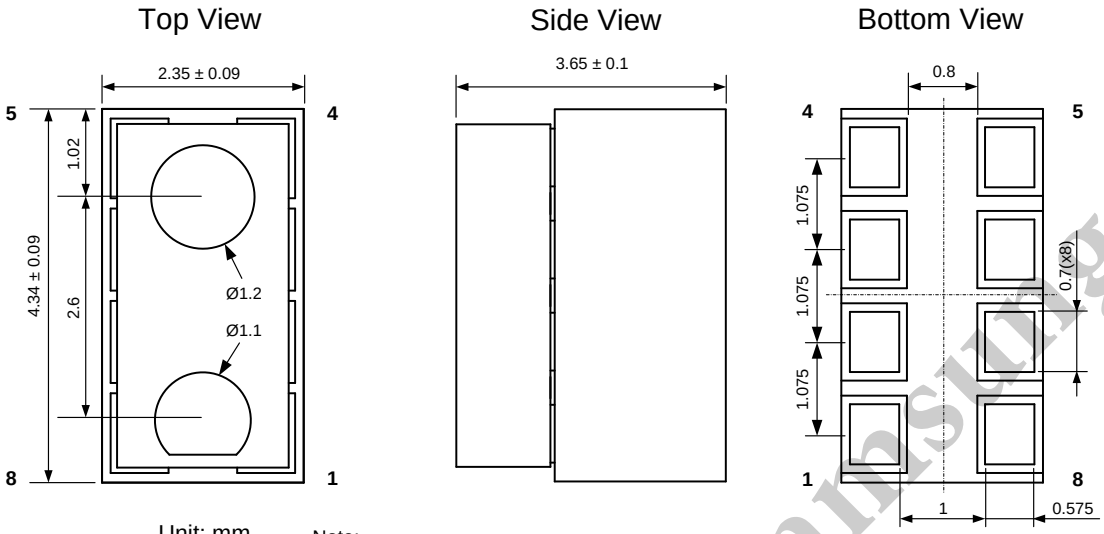
Unit: mm

Note:
H1=1.5 mm
H2=1.8 mm
H3=2.1 mm
H4=2.3 mm
H5=2.5 mm
H6=2.0 mm

1	GND	5	Cathode (LED)
2	Cathode (Sensor)	6	INT
3	VDD	7	SDAT
4	Anode	8	SCLK

Figure 11-4. CM36652M3OE-H4 Package Dimensions

Package Information (CM36652M3OE-H5)



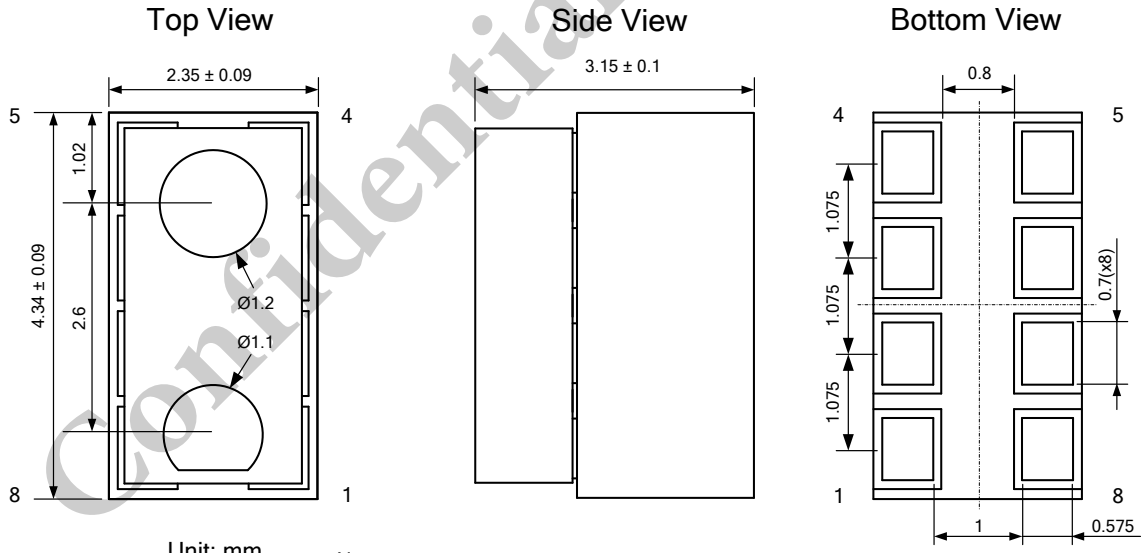
Unit: mm

Note:
H1=1.5 mm
H2=1.8 mm
H3=2.1 mm
H4=2.3 mm
H5=2.5 mm
H6=2.0 mm

1	GND	5	Cathode (LED)
2	Cathode (Sensor)	6	INT
3	VDD	7	SDAT
4	Anode	8	SCLK

Figure 11-5. CM36652M3OE-H5 Package Dimensions

Package Information (CM36652M3OE-H6)



Unit: mm

Note:
H1=1.5 mm
H2=1.8 mm
H3=2.1 mm
H4=2.3 mm
H5=2.5 mm
H6=2.0 mm

1	GND	5	Cathode (LED)
2	Cathode (Sensor)	6	INT
3	VDD	7	SDAT
4	Anode	8	SCLK

Figure 11-6. CM36652M3OE-H6 Package Dimensions

Layout Notice and Reference Circuit

Pad Layout Reference (CM36652M3OE)

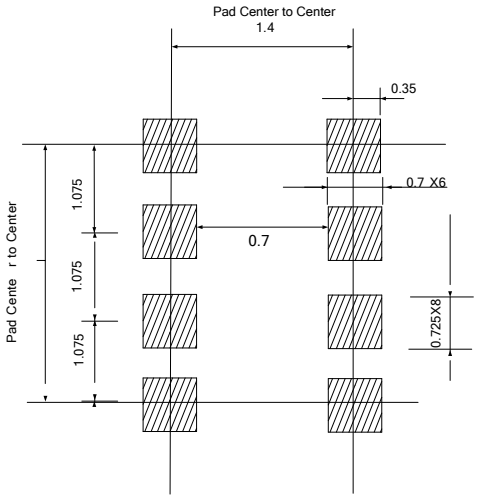


Figure 12. CM36652M3OE PCB Layout Footprint

Pad Layout Reference (CM36652M3OE-H1-H6)

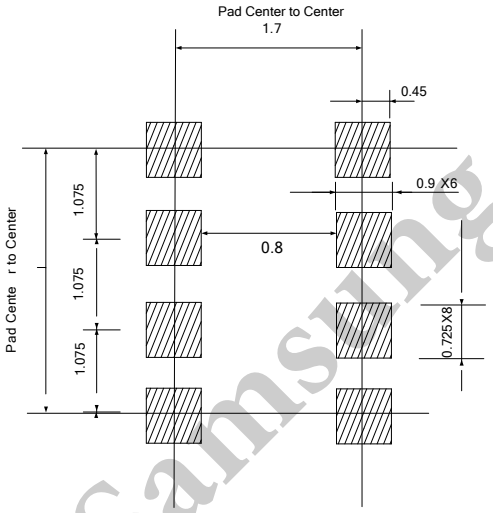


Figure 12-1. CM36652M3OE-H1-H6 PCB Layout Footprint

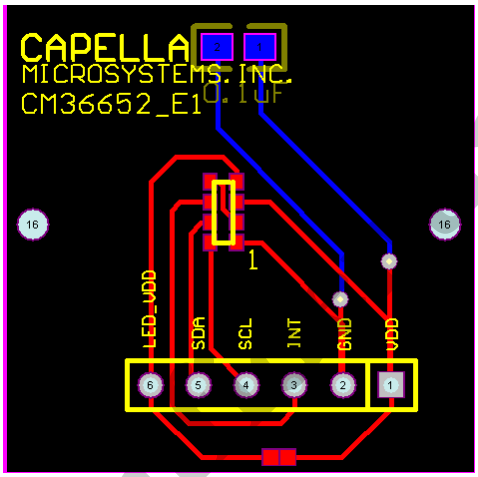


Figure 13. Suggested CM36652 Layout

Application Circuit Block Reference

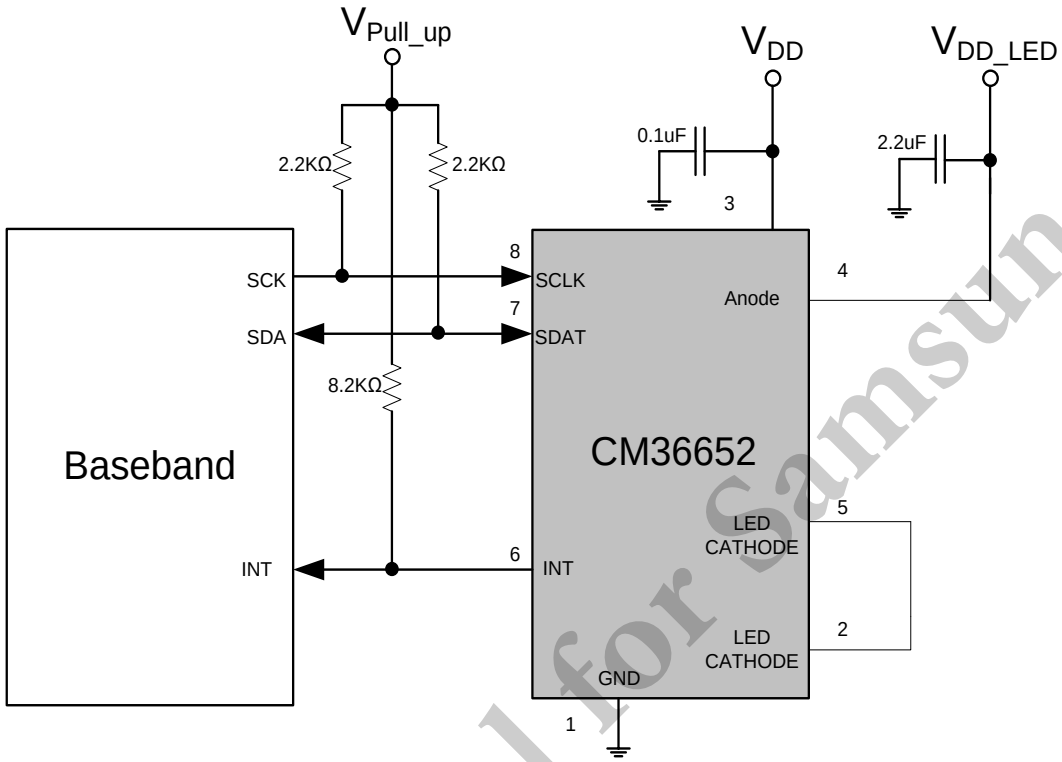


Figure 14. CM36652 Application Circuit

Recommended Storage and Rebaking Conditions

PARAMETER	MIN.	MAX.	UNITS	CONDITION
Storage temperature	5	50	°C	
Relative humidity		60	%	
Open time		168	hrs	
Total time	12 months from the date code on the aluminized envelope (unopened)			
Rebaking	1. Tape and Reel: 60ºC, 22 hours 2. Tube: 60ºC, 22 hours			

Recommended Infrared Reflow

Soldering conditions which are based on J-STD-020 C

1. IR reflow profile condition

PARAMETER	TEMPERATURE	TIME	CONDITION
Peak temperature	255+0/-5 ºC (max.: 260ºC)	10 seconds	
Preheat temperature range and timing	150 ~ 200ºC	60 ~ 180 seconds	
Timing within 5ºC to peak temperature		10 ~ 30 seconds	
Timing maintained above temperature / time	217ºC	60 ~ 150 seconds	
Timing from 25ºC to peak temperature		8 minutes (max.)	
Ramp-up rate	3ºC/seconds (max.)		
Ramp-down rate	6ºC/seconds (max.)		

2. Recommend normal solder reflow is: 235 ~ 255℃.

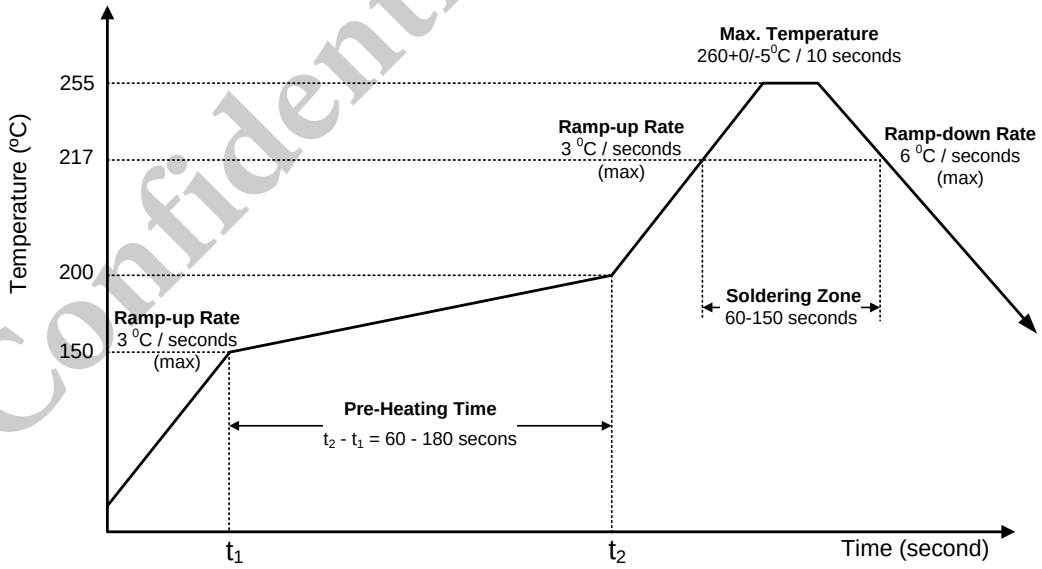


Figure 15. CM36652 Solder Reflow Profile Chart

Recommended Iron Tip Soldering Condition and Warning Handling

1 Solder the device with the following conditions:

1.1 Soldering temperature: 400℃ (max.)

1.2 Soldering time: 3 seconds (max.)

2 If the temperature of the method portion rises in addition to the residual stress between the leads, the possibility that an open or short circuit occurs due to the deformation or destruction of the resin increases.

3 The following methods: VPS and wave soldering, have not been suggested for the component assembly.

4 Cleaning method conditions:

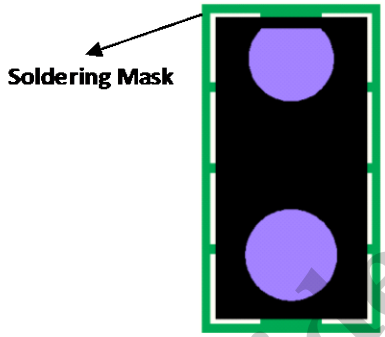
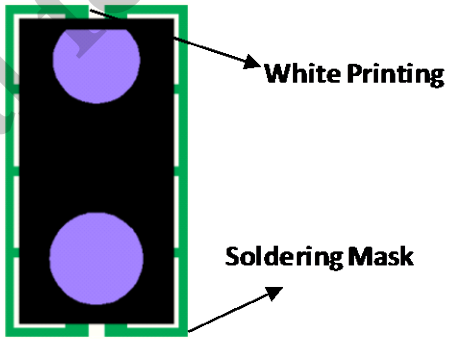
4.1 Solvent: Methyl Alcohol, Ethyl Alcohol, Isopropyl Alcohol

4.2 Solvent temperature < 45℃ (max.)

4.3 Time: 3 minutes (min.)

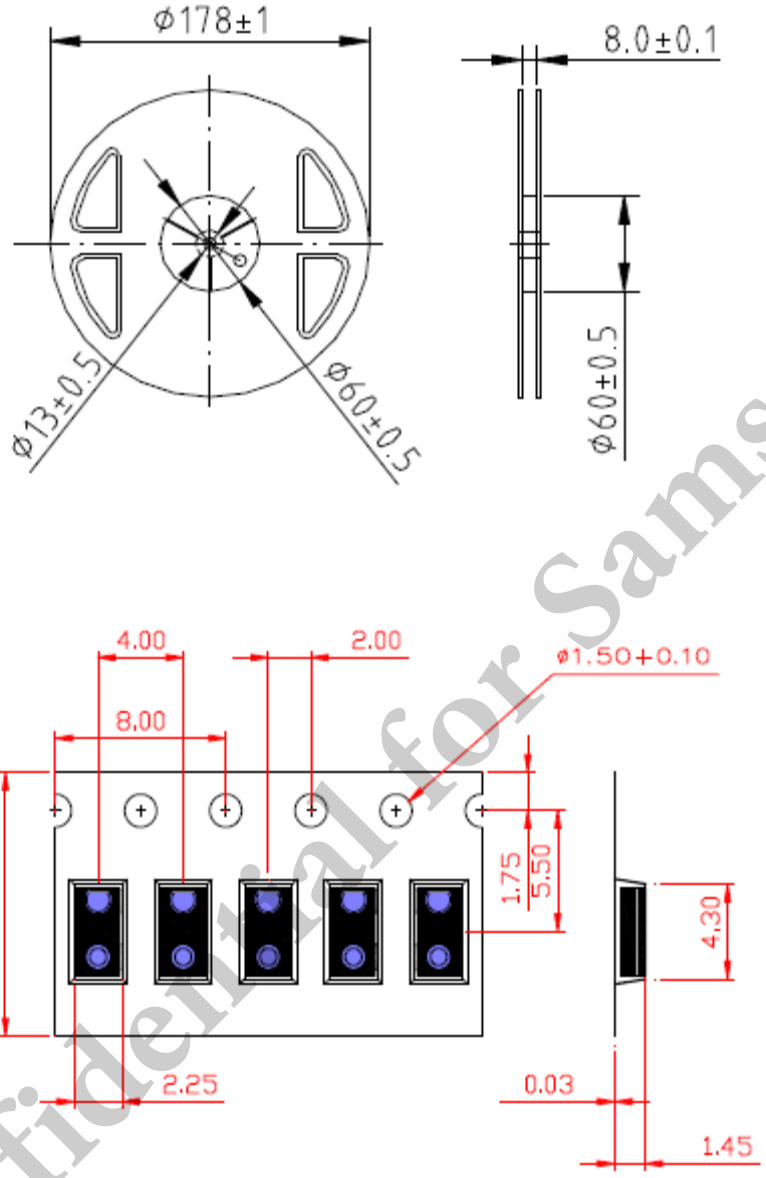
Interposer Thickness Identification

Interposer Thickness Identification

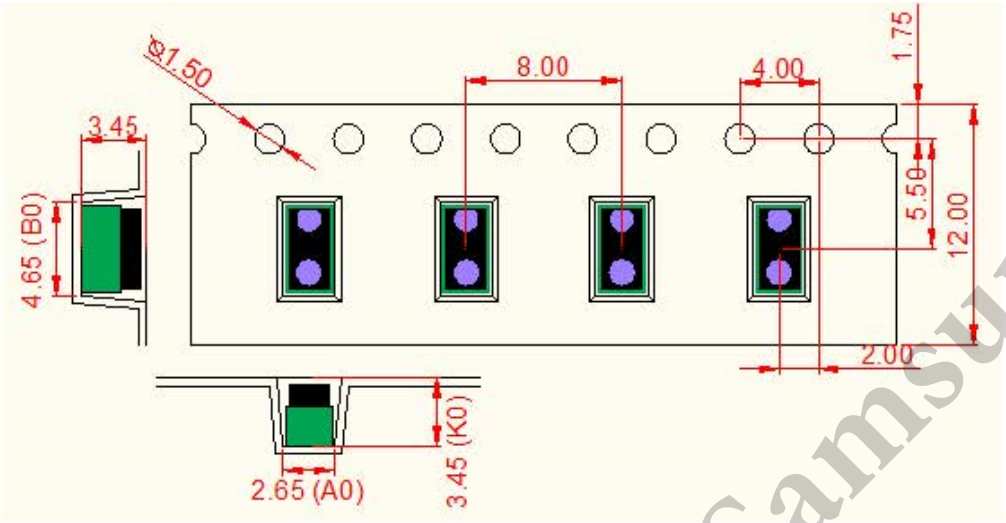
Only Soldering Mask	Soldering Mask & Printing
	

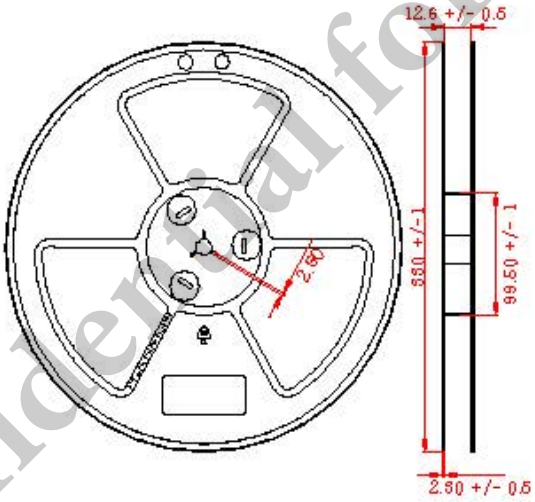
Top View	Interposer Thickness
Soldering Mask(Blue)	1.5mm H1
Soldering Mask(Blue) & White Printing	1.8mm H2
Soldering Mask(Green) & White Printing	2.1mm H3
Soldering Mask(Black) & White Printing	2.3mm H4
Soldering Mask(Black)	2.5mm H5
Soldering Mask(Green)	2.0mm H6

Tape Packaging Information (CM36652M3OE)



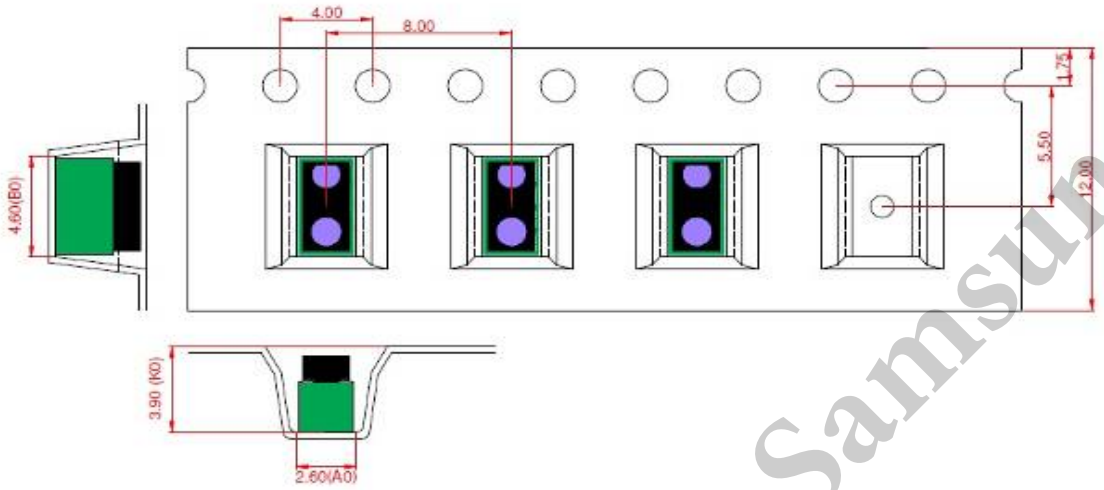
Tape Packagin Information (CM36652M3OE-H1\H2\H3\H6)

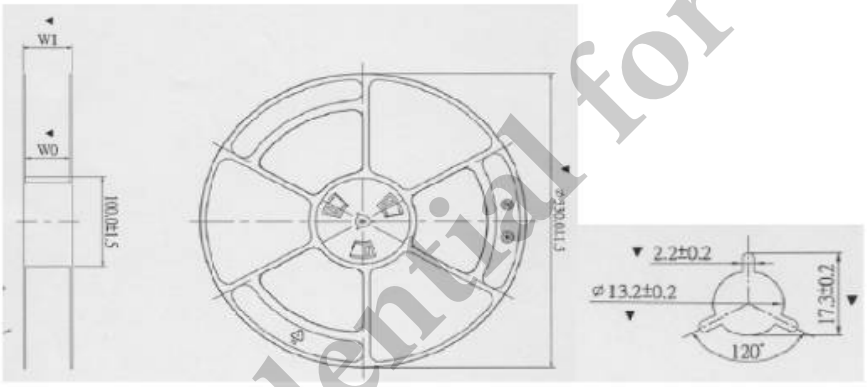




Tape Packagin Information (CM36652M3OE-H4\H5)

■ Taping Dimension (unit= mm)





W0 : 12.6 +/- 0.5 mm W1 : 20.6 +/- 0.5mm
Tolerance:±0.1(unit=mm)
Quantity:1500pcs/Reel

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