

EM20918 Datasheet

Long Distance proximity sensor with I2C

Revision 1.3

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1. Description

EM20918 is a low-power I²C interface 2 in1 module includes Long-Distance Proximity Sensor (PS) and internal Current Drivers with IR VCSEL Diode. It is designed for applications which requires long distance detection

EM20918 is application specific for custom-made products and no need of a controller to initialize and control. The gain and threshold values could be custom-made and detection result could automatically output.

Proximity Sensor is 850nm wavelength IR VCSEL Diode outputs IR light outwards and reflects to pixel arrays. In order to removing component variations and eliminate crosstalk caused by IR reflection, EM20918 set 2 registers for compensation. 8 steps programmable current driver is more flexible to remove component-to-component variation, and also increased dynamic range for PS detection.

2. Features

- Proximity Sensor with corner compensation, Long-Distance Proximity Sensor, 1 current drivers and IR VCSEL Diode integrated in a single Optical Module
- Temperature Compensation
- Higher Sensitivity of Proximity Sensing, Detecting Distance of grey card up to 50cm and white card up to 80cm
- Proximity Sensor (PS) with Ambient Light Rejection
- 8 Steps Programmable current driver for flexibility and removing component variations
- More than 2 pixels for proximity detection compensation
- Proximity detection in parallel for Long-Distance Proximity Detection
- Offset register adjustment for compensation of IR reflection caused system crosstalk
- Programmable Interrupt for PS
- Low Average Operation Power consumption
- Output Type: I²C Bus (ALS/PS) up to 400K Hz
- Operation Voltage 2.5V ~ 3.6V
- Logic Interface Voltage VBUS=1.8V or VBUS=VDD
- Minimum External Components
- Package: (4mmX2.4mmX1.4mm)
- Rosh package

3. Functional Block Diagram

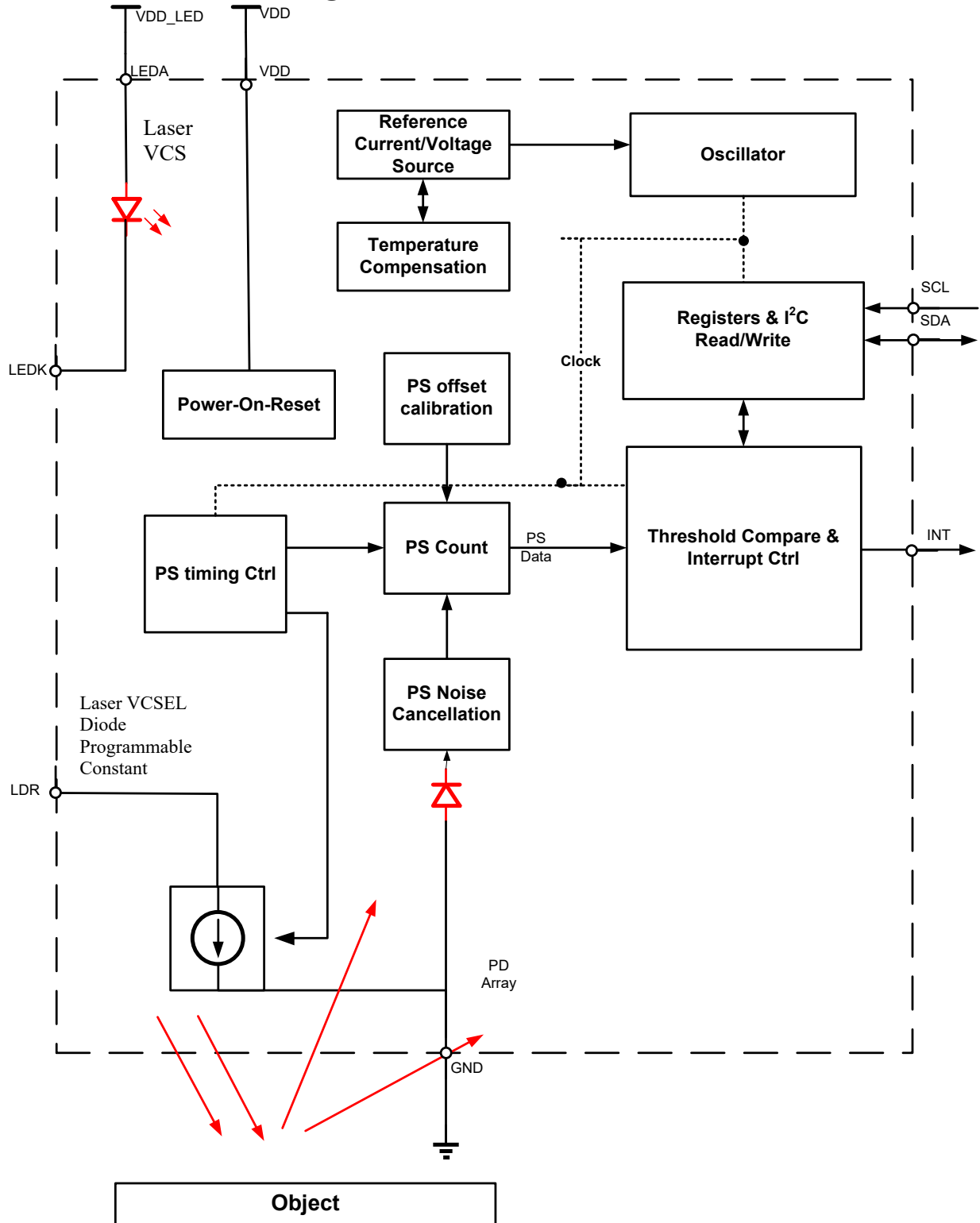


Fig. 1 EM20918 Functional Block Diagram

4. PIN Define

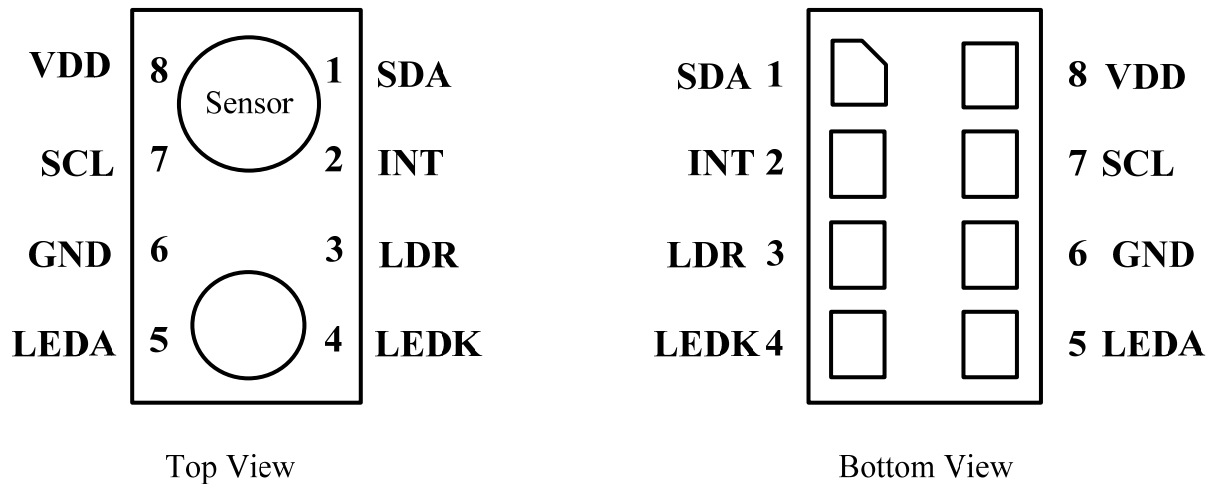


Fig. 2 Pin define

5. PIN Configuration

Table. 1 Pin Configuration

Pin No.	Pin Name	Type	Description
1	SDA	I/O(Open Drain)	I ² C Serial data I/O terminal -serial data I/O for I ² C
2	INT	O(Open Drain)	Interrupt.
3	LDR	O(Open Drain)	Current driver for proximity emitter - up to 200mA
4	LEDK	O	VCSEL Diode Cathode, connect to LDR pin in most systems to use internal current driver circuit
5	LEDA	I	VCSEL Diode Anode, connect to VDD on PCB
6	GND		Power supply ground. All voltages are referenced to GND
7	SCL	I(Open Drain)	I ² C serial clock input terminal — clock signal for I ² C serial data.
8	VDD		Power Supply voltage

6. Parameters

 Table. 2 I²C bus timing characteristics

Symbol	Parameters	Minimum	Typical	Maximum	Units	Condition
f _{clk}	SCL clock frequency	10k		100k	Hz	Normal Mode
		10k		400k	Hz	Fast Mode
t _{SUDAT}	data set up time	250			ns	Normal Mode
		100			ns	Fast Mode
t _{HDDAT}	data hold time			300	ns	Normal Mode

				90	ns	Fast Mode
t _{rise}	clock/data rise time			1000	ns	Normal Mode
				300	ns	Fast Mode
t _{fall}	clock/data fall time			300	ns	Normal Mode
				300	ns	Fast Mode
t _{LOW}	I ² C clock (SCL) low cycle	4.7			μs	Normal Mode
		1.3			μs	Fast Mode
t _{HIGH}	I ² C clock (SCL) high cycle	4.0			μs	Normal Mode
		0.6			μs	Fast Mode
t _{BUF}	Bus free time between the start and stop state	4.7			μs	Normal Mode
		1.3			μs	Fast Mode
t _{HDSTA}	(repeat) started state holding time after this period produce the first clock	4.0			μs	Normal Mode
		0.6			μs	Fast Mode
t _{SUSTA}	Repeat the start state set up time	4.7			μs	Normal Mode
		0.6			μs	Fast Mode
t _{SUSTO}	Stop state set up time	4.0			μs	Normal Mode
		0.6			μs	Fast Mode
t _{TIMEOUT}	Low detection clock/data timeout time	25	35		ms	Normal Mode
					ms	Fast Mode
C _{load}	The capacitive load for each bus line			400	pF	
R _{BUS}	Pull up resistors SDA and SCL system bus	1		-	KΩ	
t _{VD}	Data valid time			0.9	μs	
t _{VDACK}	Data valid ack now VCSEL Diode time			0.9	μs	

Table. 3 Electrical Characteristics

Symbol	Min	Typ	Max	Units	Introductions
V _{DDLED}	2.6		4.5	V	Supply VCSEL Diode voltage
V _{DD}	2.6		3.6	V	Supply voltage
I _{DD}		150		μA	DC power supply current (with VCSEL

					Diode turned off)
V _{pull_up}	1.6		3.6	V	I ² C power supply voltage
I _{DD_SD}			500	nA	Shut Down Current
T _A	-20		70	°C	Recommended operating temperature
V _{IL}			0.54	V	SCL/SDA Input low voltage
V _{IH}	1.25			V	SCL/SDA Input high voltage

Table. 4 Optical Characteristics

Parameters	Min	Typ	Max	Units	Descriptions (T _a = +25 °C)
Full scale PS ADC count value			255	counts	PS ADC maximum count
PS VCSEL Diode drive	15		200	mA	PS VCSEL Diode drive current
VCSEL Diode duty cycle		1/500			VCSEL Diode duty cycle, cycle of PS 100 ms
V _F		2.5		V	VCSEL Diode Forward Voltage, I _F =200 mA
V _R				V	VCSEL Diode Reverse Voltage, I _R =10 μA
P _O	130	140		mW	VCSEL Diode Radiant Power, I _F =200 mA
Average P _O		0.28		mW	VCSEL Diode Average Radiant Power, I _F =200 mA,
λ _p	835	850	865	nm	VCSEL Diode Peak Wavelength, I _F =200 mA
Δλ				nm	Spectrum Width of Half Value, I _F =200 mA
T _R				ns	VCSEL Diode Optical Rise Time, I _F =20 mA
T _F				ns	VCSEL Diode Optical Fall Time, I _F =20 mA

7. PS Functional Description

7.1 PS View Angle

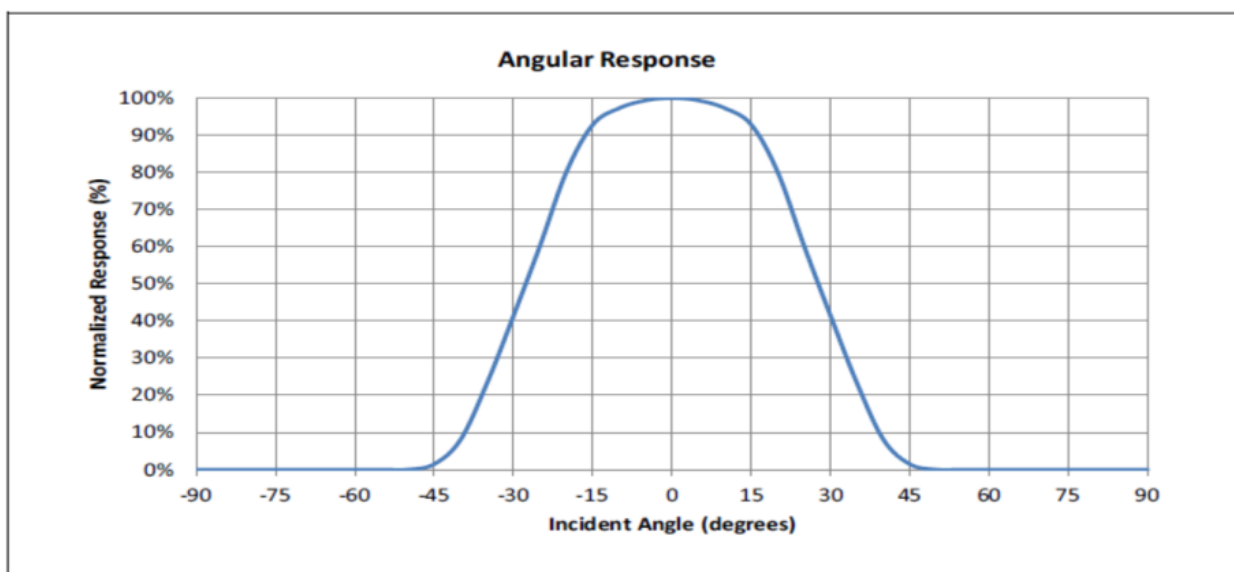


Fig. 3 EM20918 PS view angle

7.2 PS Spectral Response Range

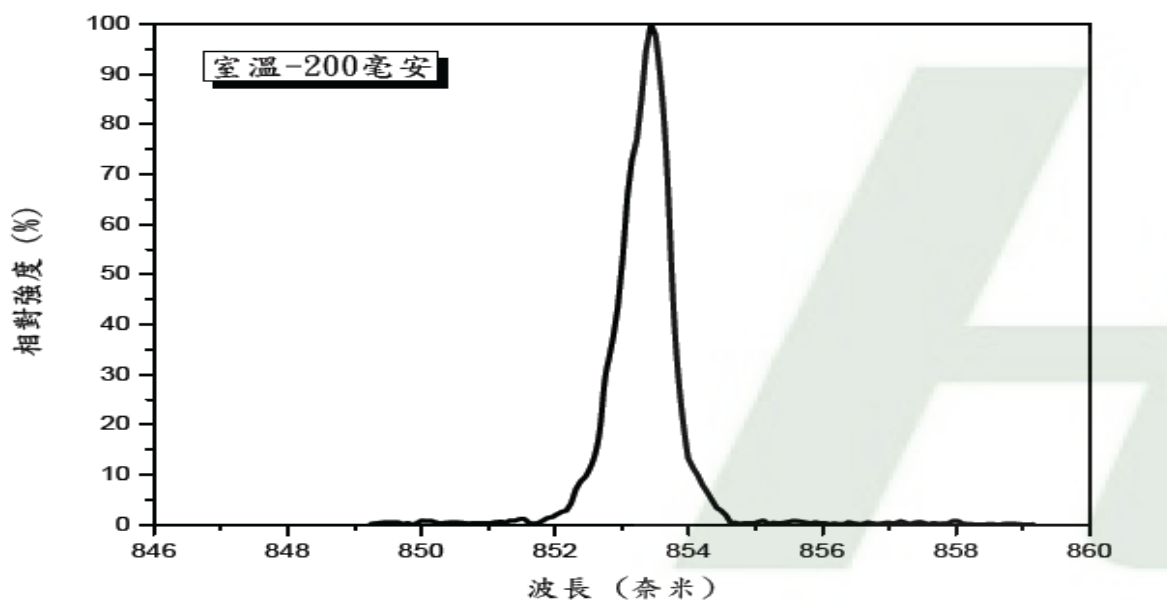


Fig. 4 PS Spectral Response Range

8. Absolute Maximum Ratings

Table. 5 Absolute Maximum Ratings

Parameters	Symbol	Min.	Max.	Units	Condition
Storage Temperature	T_S	-40	85	°C	
Operation Temperature	T_A	-20	70	°C	
Supply Voltage	V_{DD}	2.25	3.6	V	
ESD	V_{ESD}	2K		V	HBM
ESD	V_{ESD}	200		V	MM

9. I²C State Machine

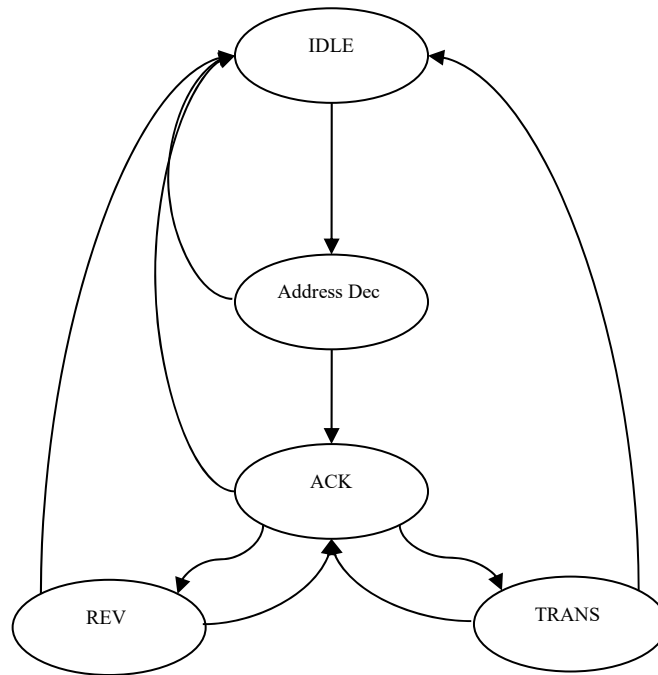


Fig. 5 Slave State Machine

10. Timing

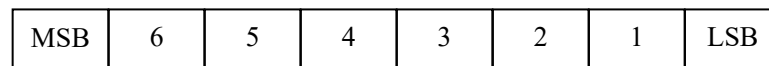


Fig. 6 Data Structure

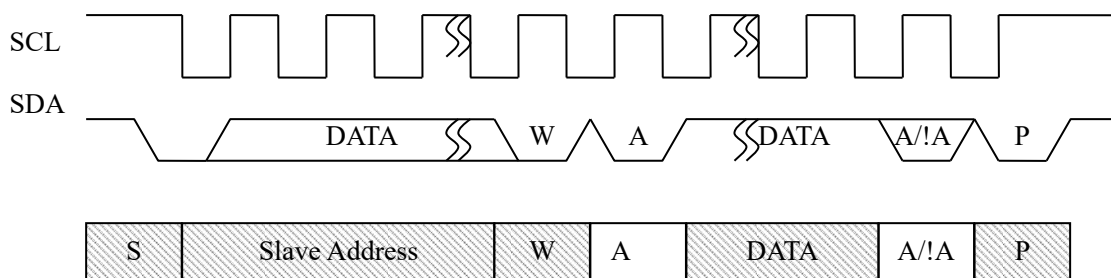
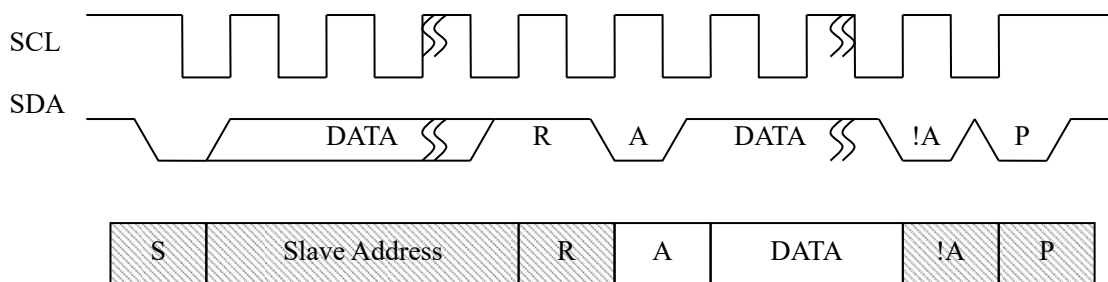
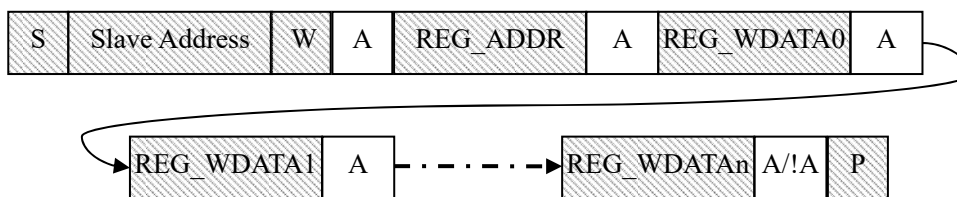
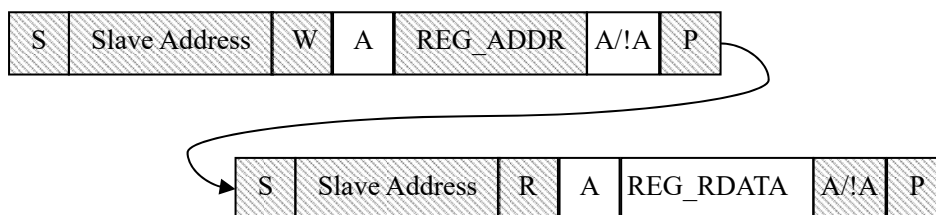


Fig. 7 Write waveform


Fig. 8 Read waveform

11. Registers Operation


Fig. 9 Register random write operation

Fig. 10 Register page write operation

Fig. 11 Register random read operation

12. Registers Definition

Table. 6 Registers Set

ADDR	REG NAME	BIT								Default
		7	6	5	4	3	2	1	0	
0x00	PID	PID								0x31

0x01	CONFIG	PS_EN	PS_SLP	PS_DR[2:0]	Reserved		0xBF	
0x02	INTERRUPT	PS_FLAG	PS_PRST[1:0]	(write 0)	Reserved	INT_CTRL	0x00	
0x03	PS_LT	PS_LT[7:0]						0x00
0x04	PS_HT	PS_HT[7:0]						0xFF
0x05	Reserved	Reserved						0x00
0x06	Reserved	Reserved						0xF0
0x07	Reserved	Reserved						0xFF
0x08	PS_DATA	Reserved						0x00
0x09	Reserved	Reserved						0x00
0x0A	Reserved	Reserved						0x00
0x0E	OFFSET							0x00
0x0F	Reset	(write 0x00)						0x00

Table. 7 REGISTER 0x00 (RESERVED)

BIT #	Access	Default	Name	Function/Operation
7:0	RO	0x31	PID	Product ID - readable

Table. 8 REGISTER 0x01 (CONFIGURE) - PROX/ALS CONFIGURATION

BIT #	Access	Default	Name	Function/Operation
7	RW	1	PS_EN (PS Enable)	When= 0, proximity sensing is disable VCSEL Diode When=1, proximity sensing is enable VCSEL Diode.
6	RW	0	PS_SLP (PS Sleep)	When=0, PS IR VCSEL Diode for pulse spacing 100ms, typically used in smart phone/tablet applications; When=1, PS IR VCSEL Diode for pulse spacing 800ms, typically used in low-power proximity wake-up applications;
5:3	RW	111	PS_DR (PS Drive)	111; VCSEL Diode drive current for 200mA;(TBD) 110; VCSEL Diode drive current for 100mA; (TBD) 101; VCSEL Diode drive current for 50mA; (TBD) 100; VCSEL Diode drive current for 25mA; (TBD) 011; VCSEL Diode drive current for 120mA; (TBD) 010; VCSEL Diode drive current for 60mA; (TBD) 001; VCSEL Diode drive current for 30mA; (TBD) 000; VCSEL Diode drive current for 15mA; (TBD)
2:0				Reserved

Table. 9 REGISTER 0x02 (INTERRUPT) - PROX/ALS INTERRUPT CONTROL

BIT #	Access	Default	BIT Name	Function/Operation
7	FLAG	0	PS_FLAG	When=0, no interrupt event has occurred since power-on or last "clear"

				When=1,PS must be enable VCSEL Diode and an interrupt event occurred. Clearable by writing "0"
6 : 4	RW	000	(Unused)	Unused register bit - write 0
3	FLAG	0	ALS_FLAG	When = 0, no interrupt event has occurred since power-on or last "clear" When = 1, ALS must be enable VCSEL Diode and an interrupt event occurred. Clearable by writing "0"
2:0	RW	000	(Unused)	Unused the register bit -write 0

Table. 10 REGISTER 0x03 (PROX_LT) - INTERRUPT LOW THRESHOLD FOR PROXIMITY SENSOR

BIT #	Access	Default	BIT Name	Function/Operation
7:0	RW	0x00	PS_LT (Prox Threshold)	Low 8-bit interrupt threshold for proximity sensing

Table. 11 REGISTER 0x04 (PROX_HT) - INTERRUPT HIGH THRESHOLD FOR PROXIMITY SENSOR

BIT #	Access	Default	BIT Name	Function/Operation
7:0	RW	0xFF	PS_HT (Prox Threshold)	High 8-bit interrupt threshold for proximity sensing

Table. 12 REGISTER 0x08 (PROX_DATA) - PROXIMITY SENSOR DATA

BIT #	Access	Default	BIT Name	Function/Operation
7:0	RO	0x00	PS_DATA (Proximity Data)	Lower 8-bits output of internal 11-bits proximity sensor ADC, and result shows 0xFF for values larger than 0xFF

Table. 13 Register 0x0E (RESET) - Soft Reset

BIT #	Access	Default	BIT Name	Function/Operation
7:0	RW	0x00	Write as 0x00	Soft Reset register. When 0x00, in normal operation When Register 0x0E = 0x9C and Register 0x0F =0xE1, the soft reset is triggered.

Table. 14 Register 0x0F (OFFSET) - Offset Control of PS

BIT #	Access	Default	BIT Name	Function/Operation
7:5	RW	0	Unused (write as 0)	Unused the register bit - write zero unless to soft trigger mode
4:1	RW	0000	Offset_Ctrl	Offset_Ctrl control VCSEL Diode by 0 x0f to register, the default value is 0 x00 1111; PS offset value is around -480 counts; 1110; PS offset value is around -448 counts; 1101; PS offset value is around -416 counts; 1100; PS offset value is around -384 counts;

				1011; PS offset value is around -352 counts; 1010; PS offset value is around -320 counts; 1001; PS offset value is around -288 counts; 1000; PS offset value is around -256 counts; 0111; PS offset value is around -224 counts; 0110; PS offset value is around -192 counts; 0101; PS offset value is around -160 counts; 0100; PS offset value is around -128 counts; 0011; PS offset value is around -96 counts; 0010; PS offset value is around -64 counts; 0001; PS offset value is around -32 counts; 0000; PS offset value is 0 count;
0	RW	0	Unused (write as 0)	Unused the register bit - write zero unless to soft trigger mode

 Table. 15 I²C Device address

operation	I ² C Device address								address
	7	6	5	4	3	2	1	0	
Write Register	0	1	0	0	1	0	0	0	0x48H
Read Register	0	1	0	0	1	0	0	1	0x49H

13. Sample Application

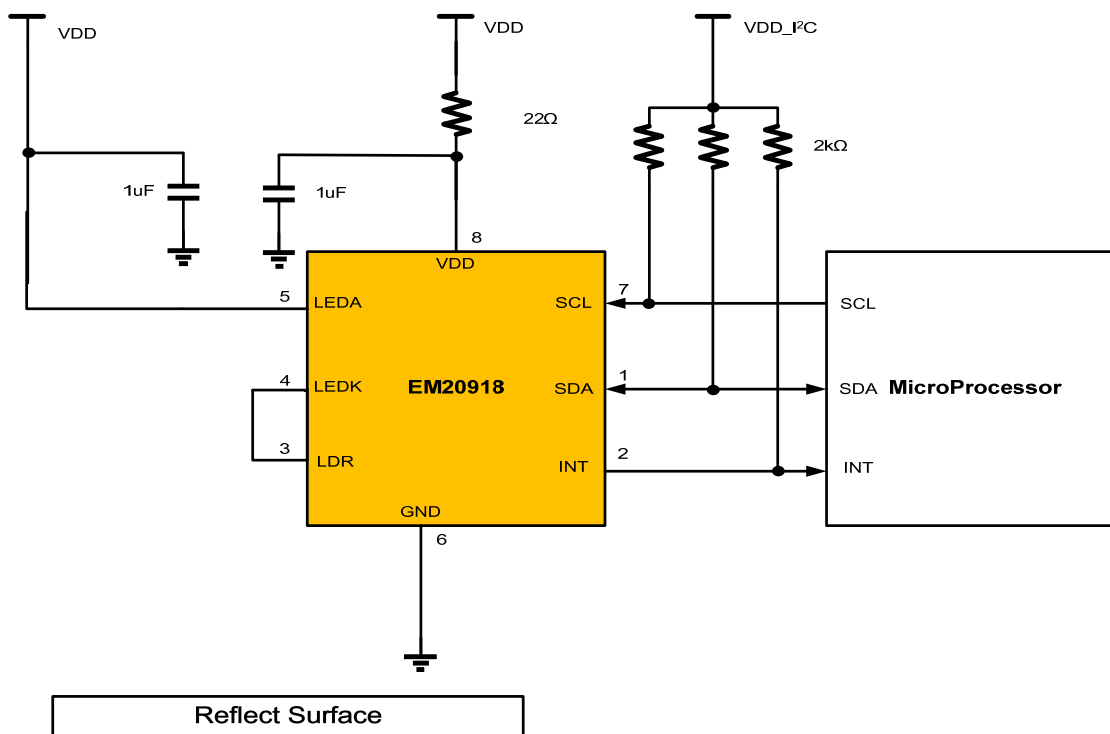


Fig. 12 Typical Application Circuit I: VDD_LED = VDD (Typically 2.8V)

14. PCB Design

Suggested PCB pad layout guidelines for the Dual Flat No-Lead surface mount package are shown below.

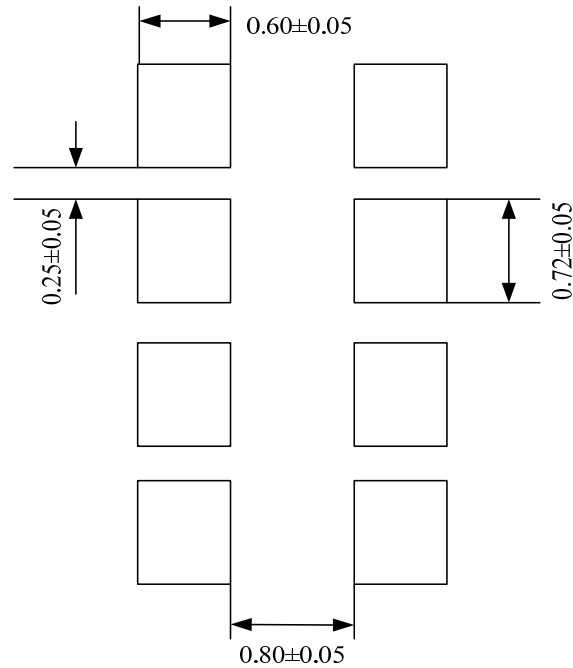
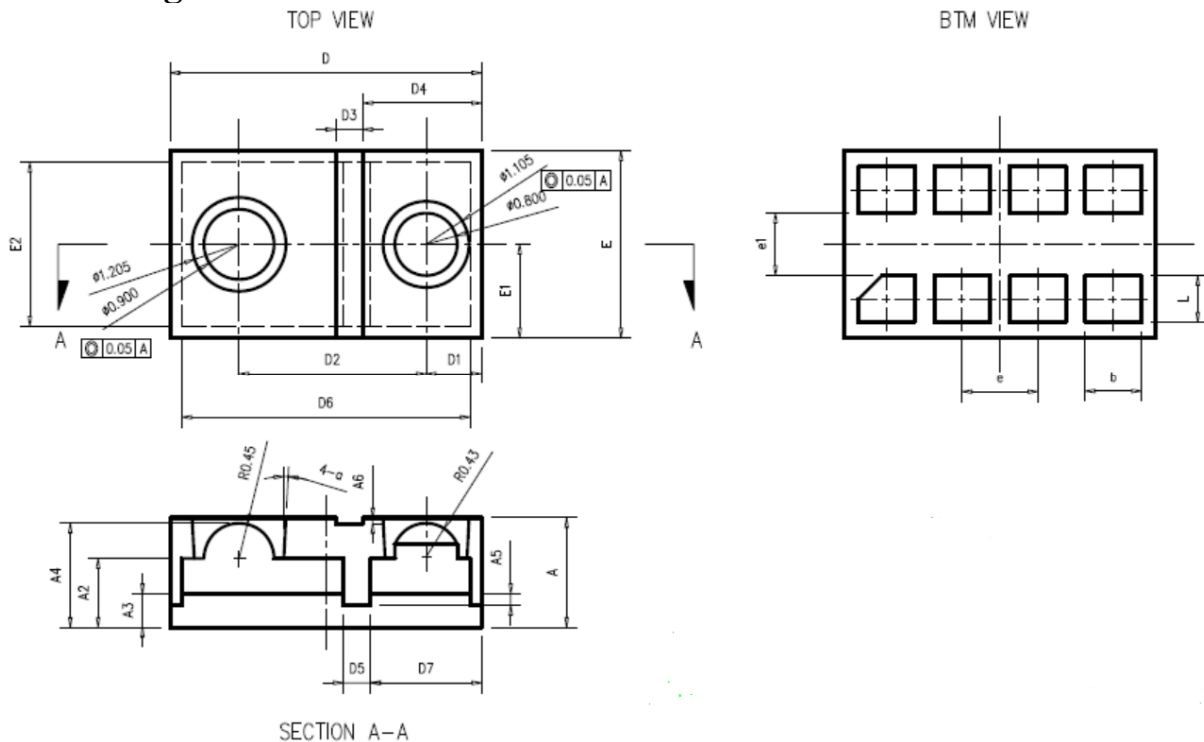


Fig. 13 PCB layout design guide for EM20918 (all linear dimensions are in mm)

15. Package Outline Dimensions

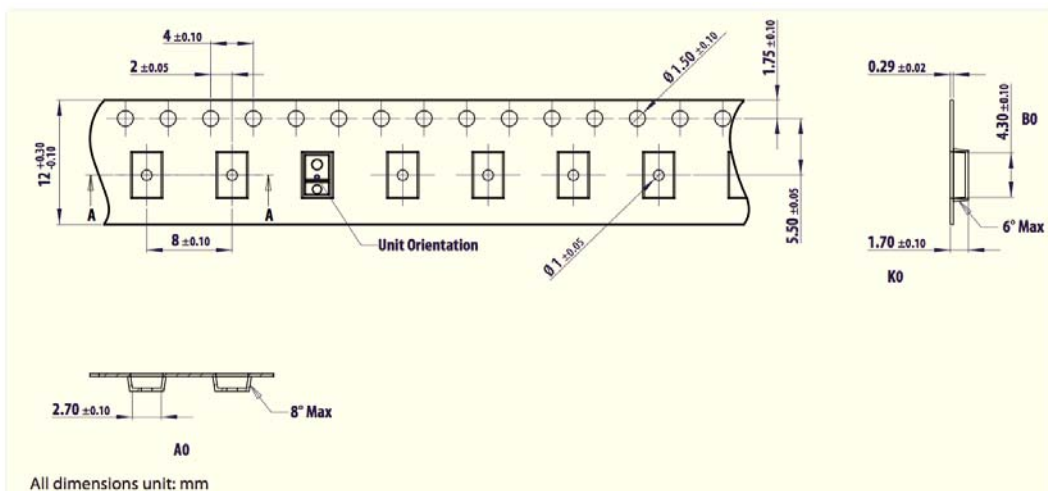


Symbol	Dimensions in millimeter		
	MIN.	NOM.	MAX.
A	1.35	1.40	1.45
A2	0.83	0.88	0.92
A3	0.38	0.43	0.48
A4	1.28	1.33	1.38
b	0.67	0.72	0.77
L	0.55	0.60	0.65
D	3.90	4.00	4.10
D1	0.665	0.715	0.765
D2	2.30	2.40	2.50
E	2.30	2.40	2.50
E1	1.15	1.20	1.25
e	0.92	0.97	1.02
e1	0.75	0.80	0.85
D3	0.325	0.35	0.375
D4	1.475	1.525	1.575
D5	0.30	0.35	0.40
A5	0.010	0.015	0.025
A6	0.100	—	0.125
E2	2.00	2.10	2.20
D6	3.60	3.70	3.80
D7	1.375	1.425	1.475
α	3° TYP		

Fig. 14 EM20918 Package Outline Dimensions

16. Packing

Tape and reel dimensions is compliant to JEDEC MSL 3





Ordering Information	Q'TY/REEL	Q'TY/inside box	Q'TY/outside box	Remark
EM20918 (7' reel)	1000EA	2000EA	20000EA	MBB/Label/Temperature Card/Silica gel

Fig. 15 Tape & Reel Information

17. Recommended Reflow Profile

PARAMETER	REFERENCE	DEVICE
Average temperature gradient in preheating		2.5°C/sec
Soak time	t_{soak}	2 to 3 minutes
Time above 217°C(T_1)	T_1	Max 60 sec
Time above 230°C(T_2)	T_2	Max 50 sec
Time above $T_{\text{peak}}-10^\circ\text{C}$ (T_3)	T_3	Max 10 sec
Peak temperature in reflow	T_{peak}	260°C
Temperature gradient in cooling		Max-5°C/sec

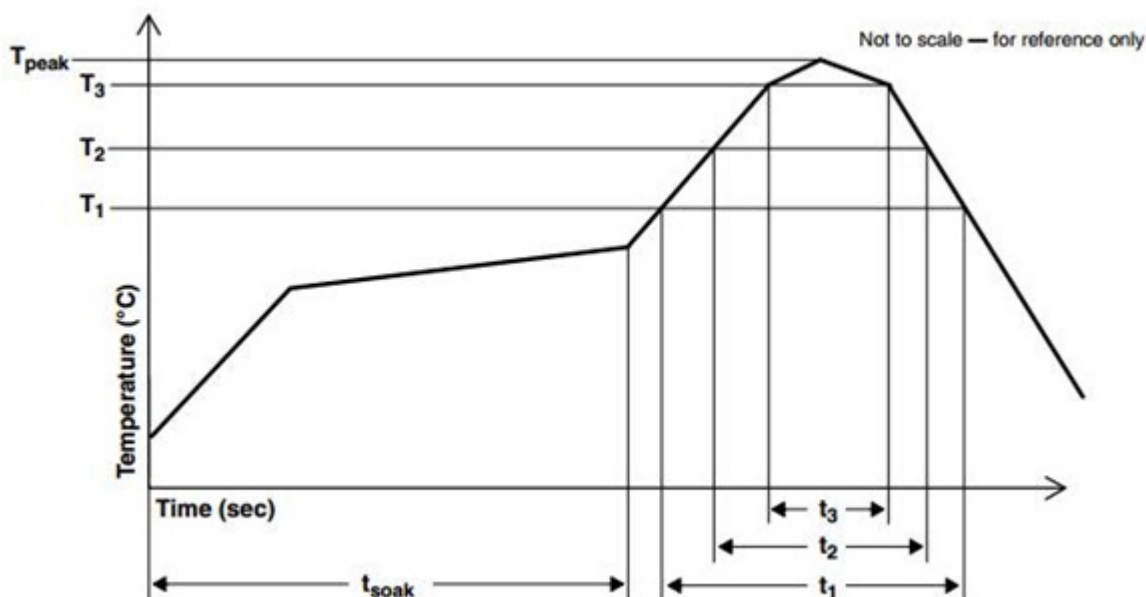
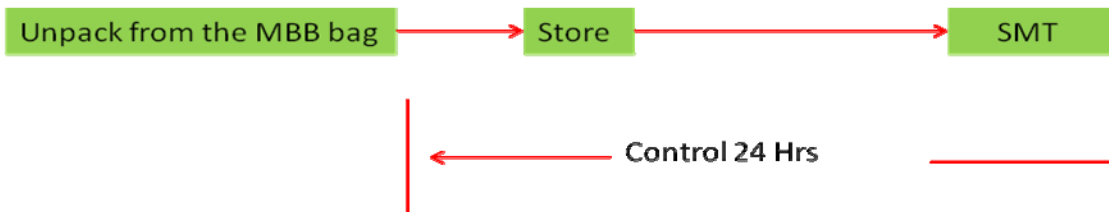


Fig. 16 Recommended Reflow Profile for SMT

The product require to control strictly to prevent moisture absorption into unit. The recommend control is as following. Rebaking of the reel will be required if the devices is unpack from the MBB bag more than 24 hours. If rebaking is required, it should be done at 50°C for 12 hours.



History

Date	Author	Modification
2016-11-13	Michael Li	First Created
2018-03-05		Add receive angle
2019-10-29	Vincent Guo	Change PCB Pad information

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