Description

LS6820 is an energy harvesting & management IC that can extract DC power from incident light, vibrations, thermal, RF signals to store energy in a storge element. LS6820 can extend battery lifetime and ultimately eliminates the primary energy storage element in a large range of applications. Maximum Power Point Tracking (MPPT) system extracts the maximum energy available from the source. LS6820 integrates an ultra-low power charge pump which converts the source energy to the storage element. LS6820 provides the Charging Control and Battery Safety Monitoring which can control the charging voltage and monitor the OV/UV of the battery. The function and parameters can be modified by the OTP which is integrated in the LS6820.

Key Features

- Cold Start Voltage: VIN ≥ 2.0V
- 200nA (typical value) full running standby current
- Up to over 95% efficiency
- Support 10uA~10mA input current
- Battery OVP/UVP
- Programmable charging output voltage
- Programmable Maximum Power Point Tracking (MPPT) and Programmable Fixed Maximum Power Point Tracking (FMPPT)
- Support Automatic Storage Mode
- VDD/VIN range: 2.3V~5.5V
- Temperature: -40℃ ~ 85℃
- RoHS Compliant/Halogen-Free
- Package: 14-L TQFN: 1.6mm x 2.0mm x 0.55mm, 0.4mm pitch;
  SOP14

Applications

- ESL
- Remote Control
- Independent smoke sensor
- Children and Elder GPS
- IOT

Glossary

E

- ESD: Electrostatic Discharge

F

- FMPPT: Fixed Maximum Power Point Tracking

G

- GPI: General Purpose Input
- GPIO: General Purpose Input/Output

M

- MPPT: Maximum Power Point Tracking

O

- OE: Output Enable
- OSC: Oscillator
- OD: Open Drain
- OVP: Over Voltage Protection

P

- POR: Power-On Reset
- PP: Push-Pull

S

- SCL: I^2C Clock Input
- SDA: I^2C Data Input/Output
- SMT: With Schmitt Trigger

U

- UVP: Under Voltage Protection

V

- VREF: Voltage Reference

Contents

1. Function Diagram

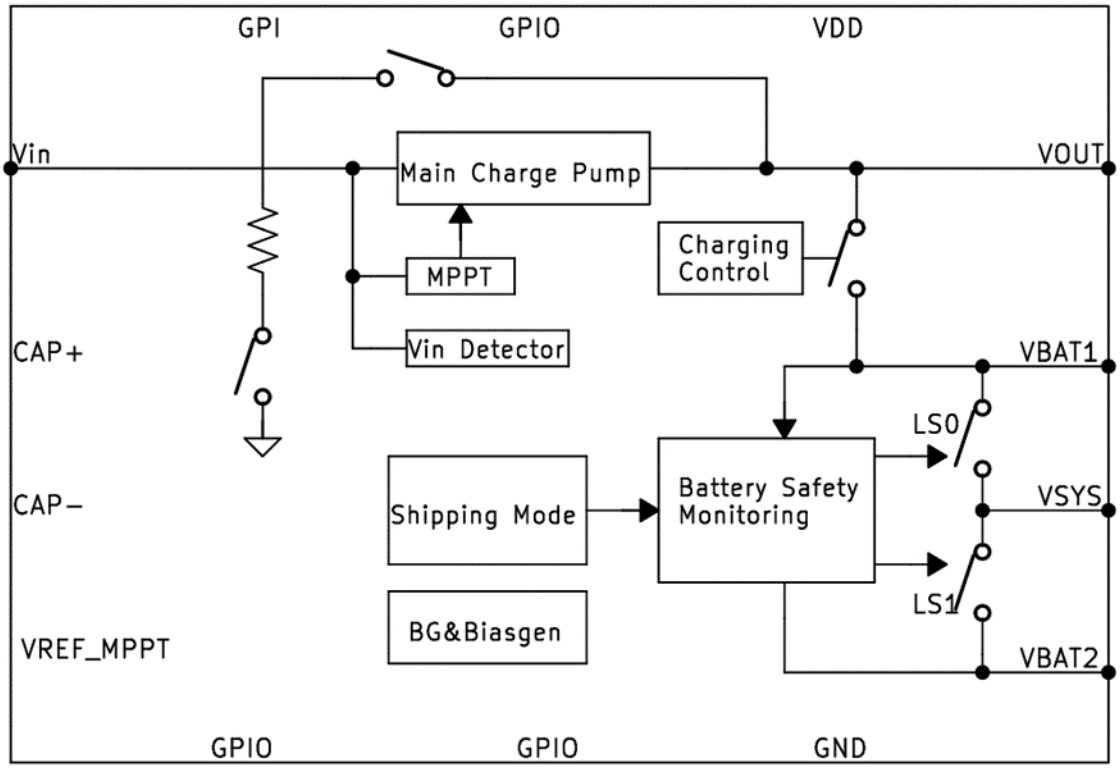


Figure 1：Function Diagram

2. Applications Diagram

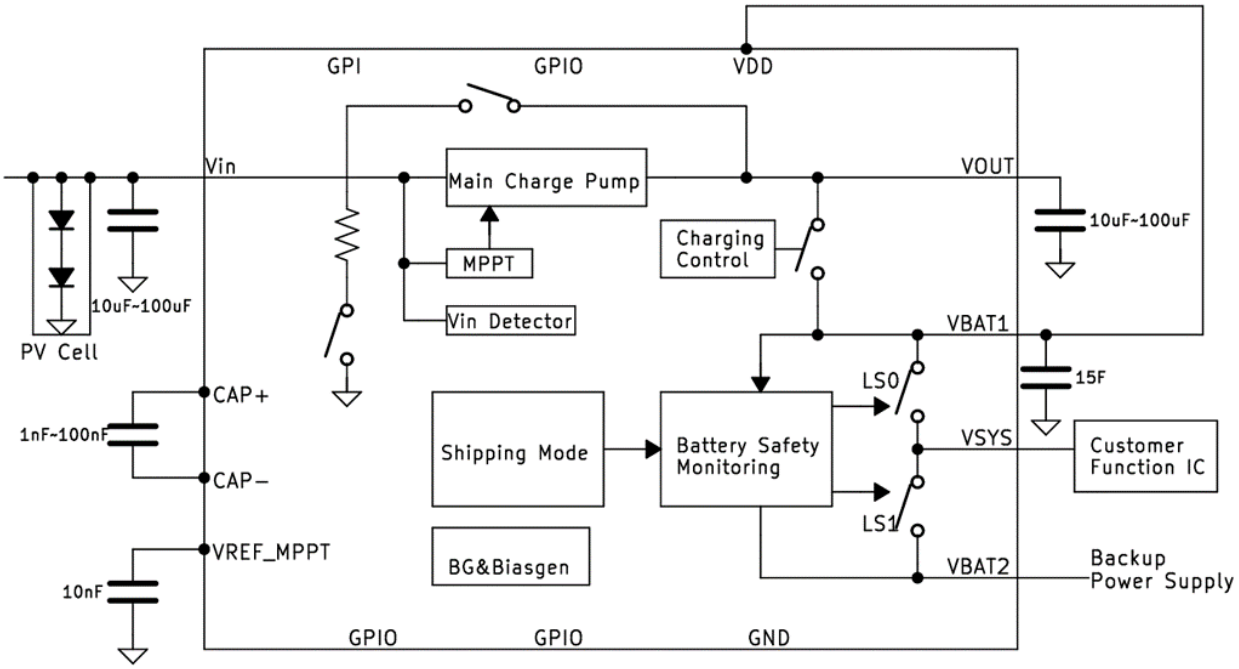


Figure 2：Application Diagram of Dual Power Supply System – with Backup Power Supply (Maximum current ≤ 100mA)

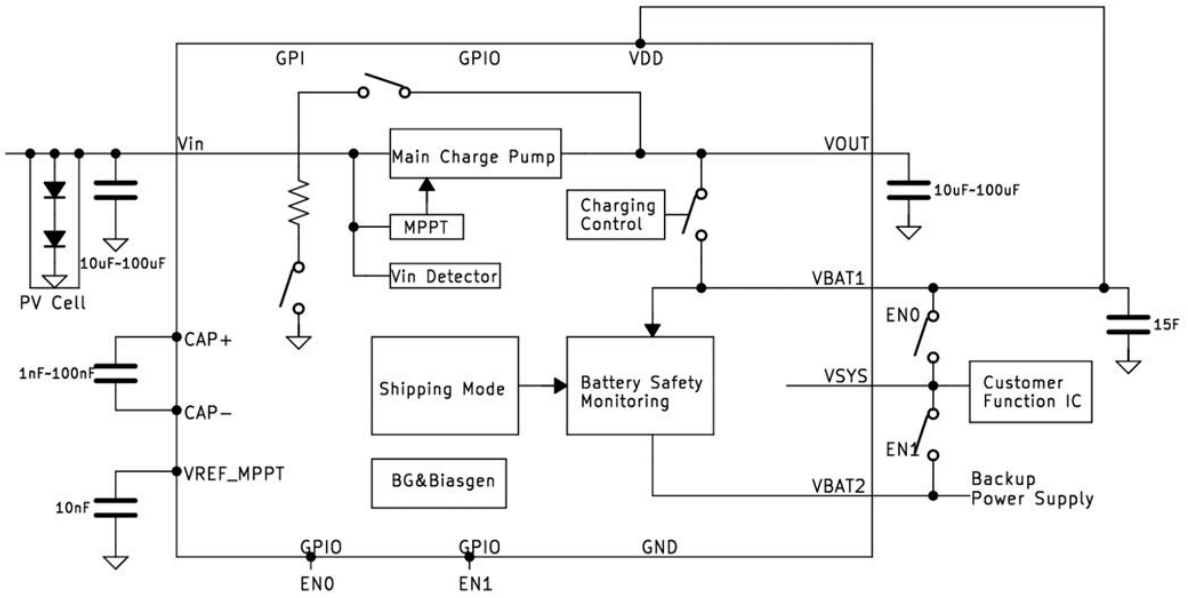


Figure 3：Application Diagram of Dual Power Supply System – with Backup Power Supply (Maximum current ＞ 100mA）

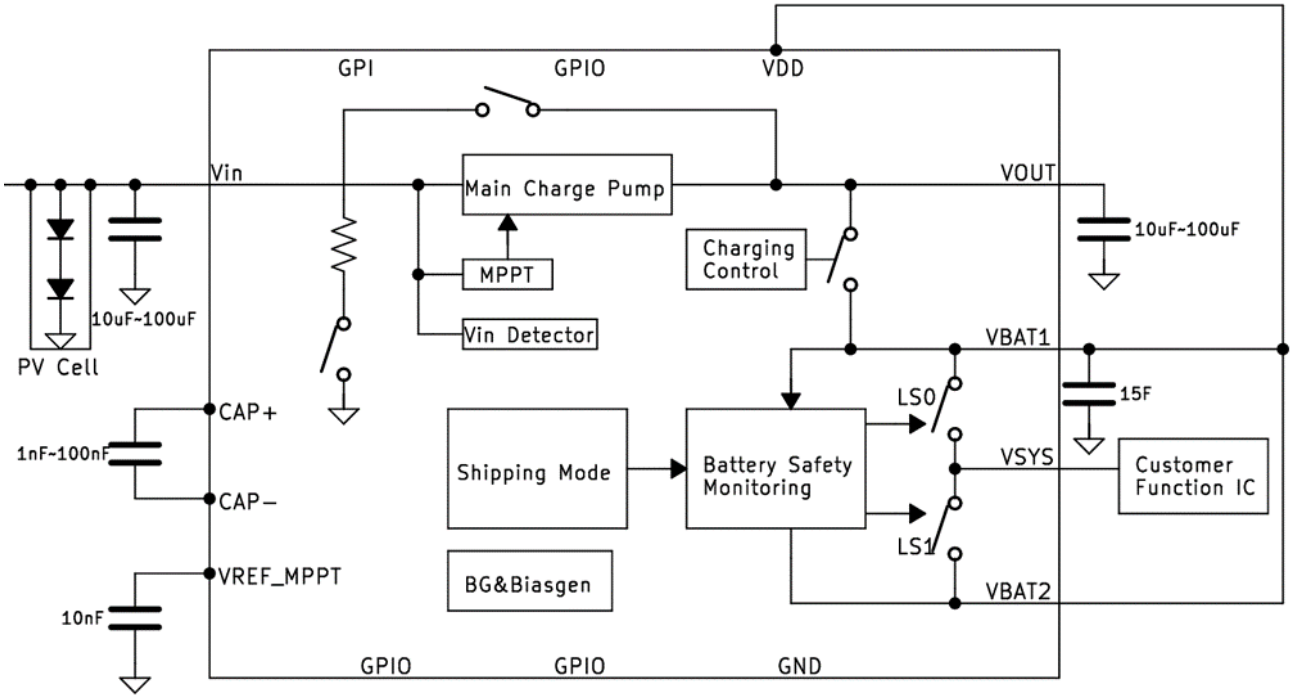


Figure 4：Application Diagram of Single Power Supply System (maximum current ≤ 200mA)

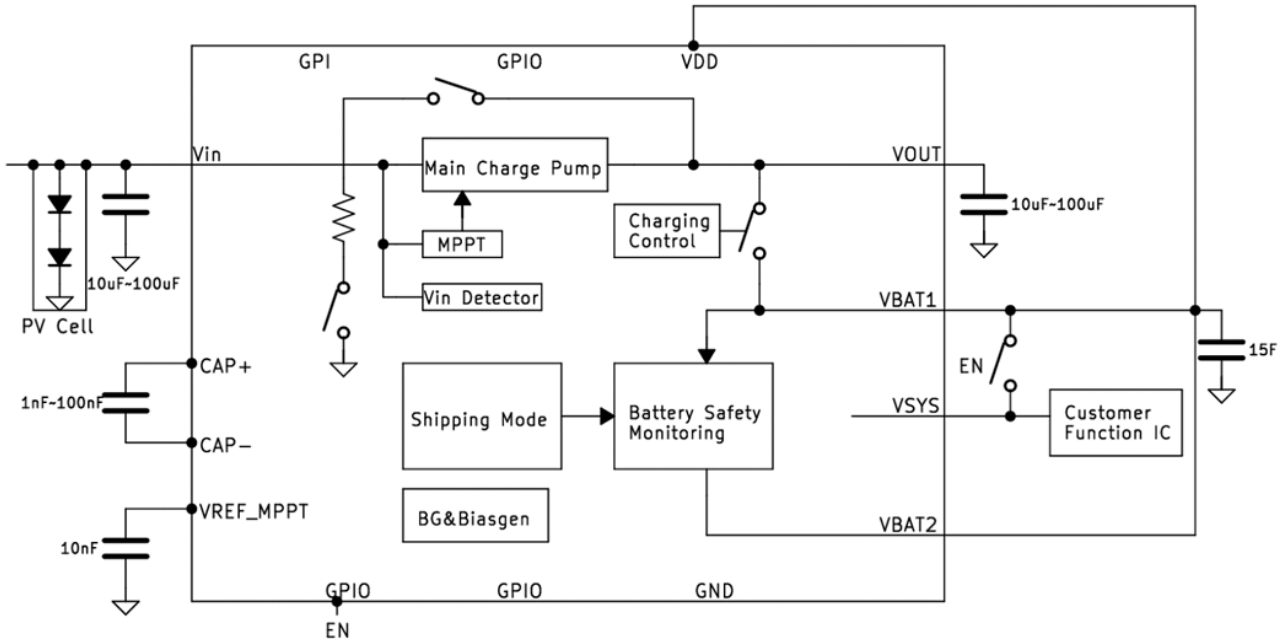


Figure 5：Application Diagram of Single Power Supply System (maximum current ＞ 200mA)

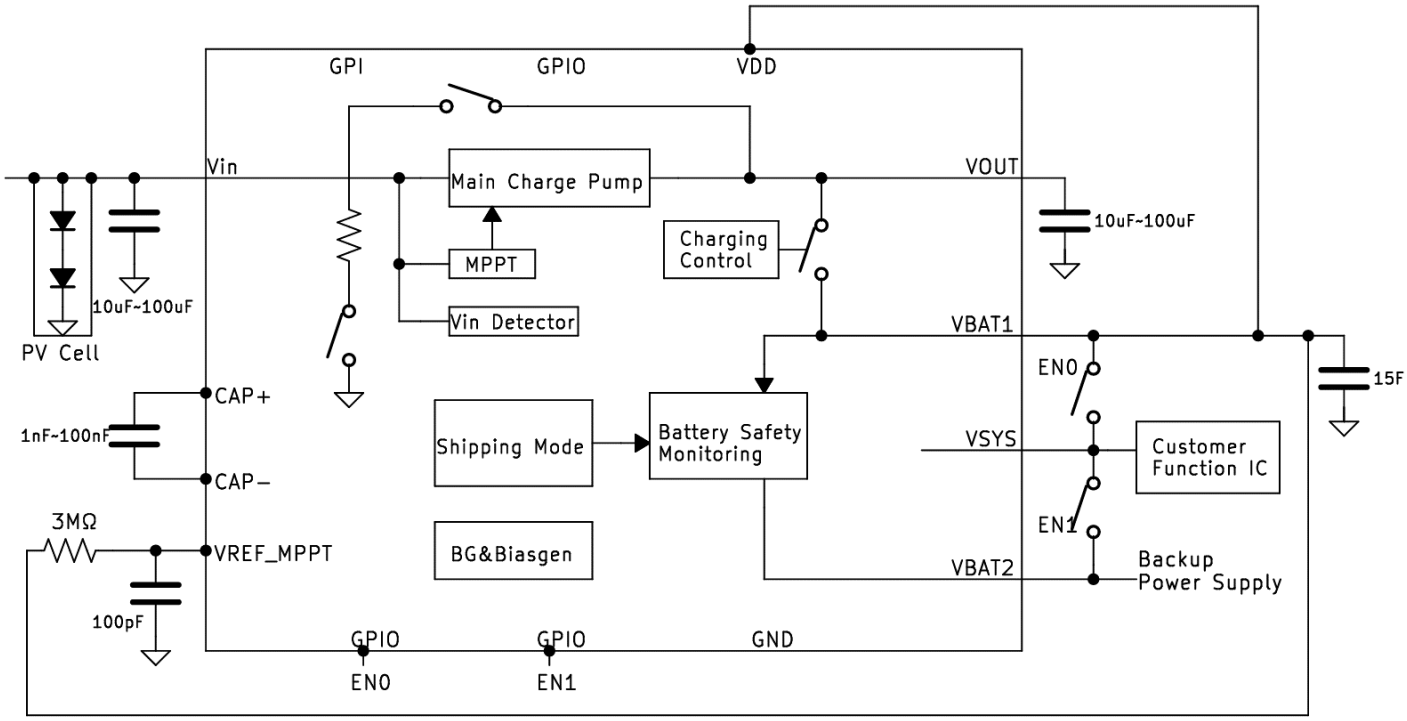


Figure 6：Application Diagram of Direct Charge +FMPPT Charging - with Backup Power Supply System (maximum current > 100mA)

3. Pin Definition

3.1 Pin Configuration of TQFN-14L and SOP14

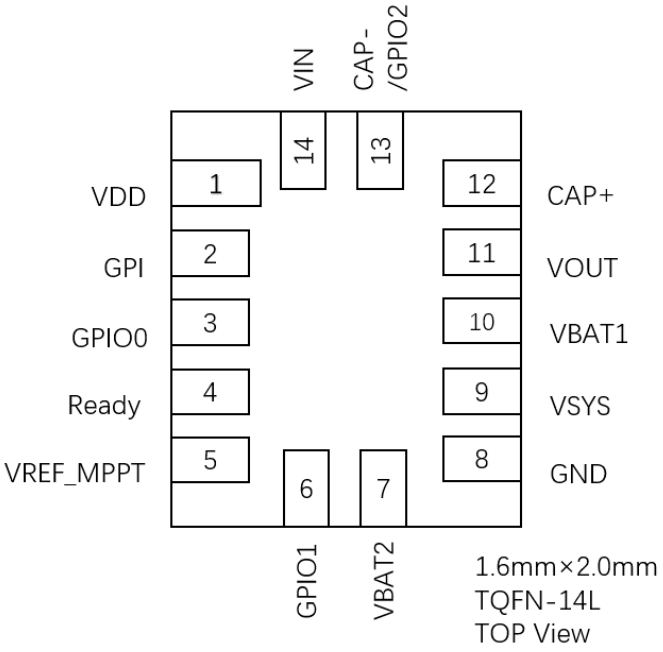


Figure 7：TQFN-14L (TOP View)

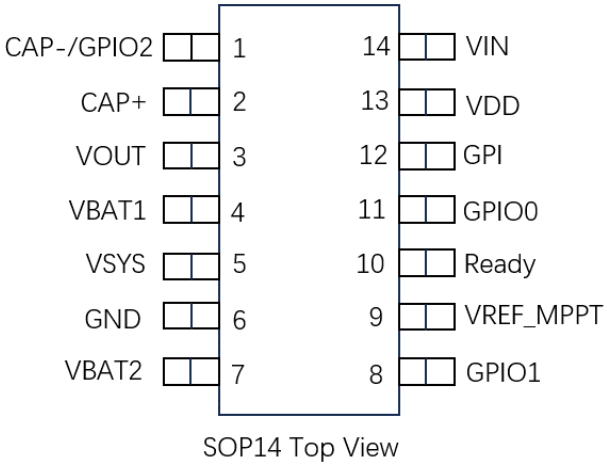


Figure 8：SOP14 (TOP View)

3.2 Pin Function Description

Table 1：Pin Function Description

Pin Number		Name	Type	Function
TQFN-14L	SOP14			
1	13	VDD	POWER / GND	Power Supply, 2.3V-5.5V
2	12	GPI	Digital Input	(VPP program power)
3	11	GPIO0	Digital Input / Output	(I^2C SCL)
4	10	Ready	Digital Output	Battery Ready indicator, (I^2C SDA)
5	9	VREF_MPPT	Analog Input / Output	Connect to 10nF low leakage capacitance to ground to store the voltage for MPPT
6	8	GPIO1	Digital Input / Output	(Vref output)
7	7	VBAT2	Analog Input / Output	Connect to the battery or super capacitance （backup power supply）
8	6	GND	POWER / GND	GND
9	5	VSYS	Analog Input / Output	System power supply pin
10	4	VBAT1	Analog Input / Output	Connect to the battery or super capacitance
11	3	VOUT	Analog Input / Output	Energy output, connect to 10uF capacitance to ground
12	2	CAP+	Analog Input / Output	Charge pump external Cap+
13	1	CAP- / GPIO2	Analog Input / Output	Charge pump external Cap-, Programmable enable pin
14	14	VIN	Analog Input / Output	Energy input, connect to PV cell

4. Characteristics

4.1 Absolute Maximum Ratings

Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, so functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification are not implied. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability. Analog and digital grounds must be connected together on the PCB board. The place of connection depends on customers' schematic. For application cases with low digital current of LS6820, both AGND and GND should be connected to analog ground plane.

Table 2：Absolute Maximum Ratings

Parameter	Min	Max	Unit
VDD to GND	-0.3	7	V
IO maximum voltage	-0.3	7	V
VDD to GND Maximum DC current	--	90	mA
Input leakage current	--	1000	nA
Storage temperature	-65	150	℃
Junction temperature	--	150	℃
Moisture Sensitivity Level (MSL)	1		--

4.2 Recommended Operating Conditions

Table 3：Recommended Operating Conditions

Parameter	Min	Max	Unit
VDD Supply Voltage	2.3	5.5	V
Operating Temperature	-40	85	℃
Maximum voltage input to Pin	-0.2	VDD+0.3	V
Capacitor Value at VDD	0.1	--	uF

4.3 Electrostatic Discharge Ratings

Table 4：Electrostatic Discharge Ratings

Parameter	Min	Max	Unit
ESD Protection (Charged Device Model)	500	--	V
ESD Protection (Human Body Model)	2000	--	V

4.4 Electrical Characteristics

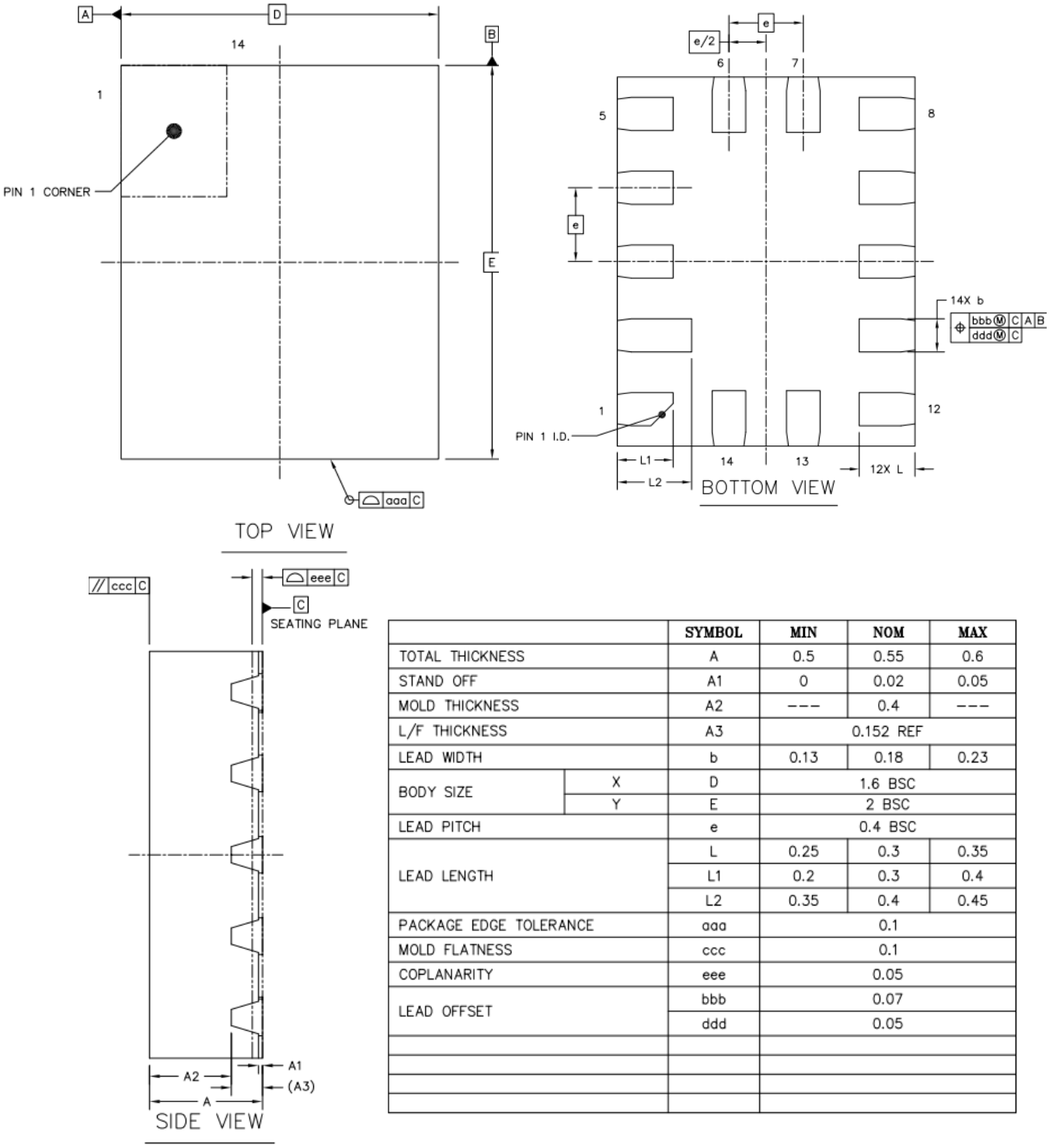
Table 5：Electrical Characteristics (VDD: 2.3V~5.5V, Temp: -40~85°C)

Parameter		Condition/Note	Min.	Typ.	Max.	Unit.
PON_{THR}	Power On Threshold	VDD Level Required to Start Up the Chip	--	1.85	--	V
$POFF_{THR}$	Power Off Threshold	VDD Level Required to Switch Off the Chip	--	0.99	--	V
V_{cold}	Cold Start Voltage	--	2.0	--	--	V
I_{cold}	Cold Start Current	--	40	--	--	uA
T_{SU}	Startup Time	From VDD rising past PON_{THR}	--	1	--	mS
Vin	Input Voltage	--	2.3	--	5.5	V
Vout	Output Voltage	--	2.3	--	5.5	V
V_{IH}	HIGH-Level Input Voltage	Logic Input	0.7*VDD	--	--	V
		Logic Input with Schmitt Trigger	0.8*VDD	--	--	V
		Low-Level Logic Input	0.94	--	--	V
V_{IL}	LOW-Level Input Voltage	Logic Input	--	--	0.3*VDD	V
		Logic Input with Schmitt Trigger	--	--	0.2*VDD	V
		Low-Level Logic Input	--	--	0.72	V
V_{HYS}	Schmitt Trigger Hysteresis Voltage	Logic Input with Schmitt Trigger	--	0.42	--	V
I_{LKG}	Input leakage (Absolute Value)	--	--	1	1000	nA
V_{OH}	HIGH-Level Output Voltage	Push-Pull, I_{OH} = 1 mA, 1X Drive	2.02	--	--	V
		Push-Pull, I_{OH} = 1 mA, 2X Drive	2.10	--	--	V
V_{OL}	LOW-Level Output Voltage	Push-Pull, I_{OL}= 1 mA, 1X Drive	--	--	0.11	V
		Push-Pull, I_{OL} = 1 mA, 2X Drive	--	--	0.06	V
		Open Drain, I_{OL} = 1 mA, 1X Drive	--	--	0.077	V
		Open Drain, I_{OL} = 1 mA, 2X Drive	--	--	0.075	V
I_{OH}	HIGH-Level Output Pulse Current (see Note)	Push-Pull, V_{OH} = VDD-0.2, 1X Drive	1.37	--	--	mA
		Push-Pull, V_{OH} = VDD-0.2, 2X Drive	2.74	--	--	mA
I_{OL}	LOW-Level Output Pulse Current (see Note)	Push-Pull, V_{OL} = 0.15 V, 1X Drive	1.61	--	--	mA
		Push-Pull, V_{OL} = 0.15 V, 2X Drive	3.22	--	--	mA
		Open Drain, V_{OL} = 0.15 V, 1X Drive	4.9	--	--	mA
		Open Drain, V_{OL} = 0.15 V, 2X Drive	9.8	--	--	mA
R_{PUP} / R_{PDWN}	Pull Up / Pull Down Resistance	1 M Pull Up	--	1	--	MΩ
		100 k Pull Up	--	100	--	KΩ
		10 k Pull Up	--	10	--	KΩ
$Freq_{Accuracy}$	Ultra-Low Power OSC	T=+25 °C	--	128	--	Hz
		T=-40 °C to +85 °C	109	--	146	Hz
Power-On time	2KHz OSC	T=+25 °C	--	600	--	uS
$Freq_{Accuracy}$		T=+25 °C	--	2	--	KHz
		T=-40 °C to +85 °C	1.85	--	2.11	KHz
Power Consumption		T=+25 °C	--	0.41	--	uA
		T=-40 °C to +85 °C	--	--	0.57	uA

Parameter		Condition/Note	Min.	Typ.	Max.	Unit.
V_{bat1_OV}	Over Voltage of Battery1	0~5.5V, 9-bit Resolution (define by customer)	-1%		+1%	Fs
V_{bat1_UV}	Under Voltage of Battery1	0~5.5V, 9-bit Resolution (define by customer)	-1%		+1%	Fs
V_{bat2_UV}	Under Voltage of Battery2	0~5.5V, 9-bit Resolution (define by customer)	-1%		+1%	Fs
V_{FMPPT}	Fixed Maximum Power Point Tracking	0~5.5V, 9-bit Resolution (define by customer)	-1%		+1%	Fs
T_{OTP}	Temperature variation of Over Temperature Protection	2℃/step, 9-bit Resolution	-8	69	+8	℃
$I_{current\_capacity}$	Current of Two Low Switches		--	100	--	mA
Standby Current		All function is enable (Vin=0)	--	150	--	nA
$T_{shipping\_mode1}$	Detection Time of Light in Shipping Mode	Define by Customer	-20%		+20%	Fs
$T_{shipping\_mode2}$	Debounce Time	USB Charging or Button	-20%		+20%	Fs
Note: DC or average current through any pin should not exceed value given in Absolute Maximum Conditions.						

5. Package Information

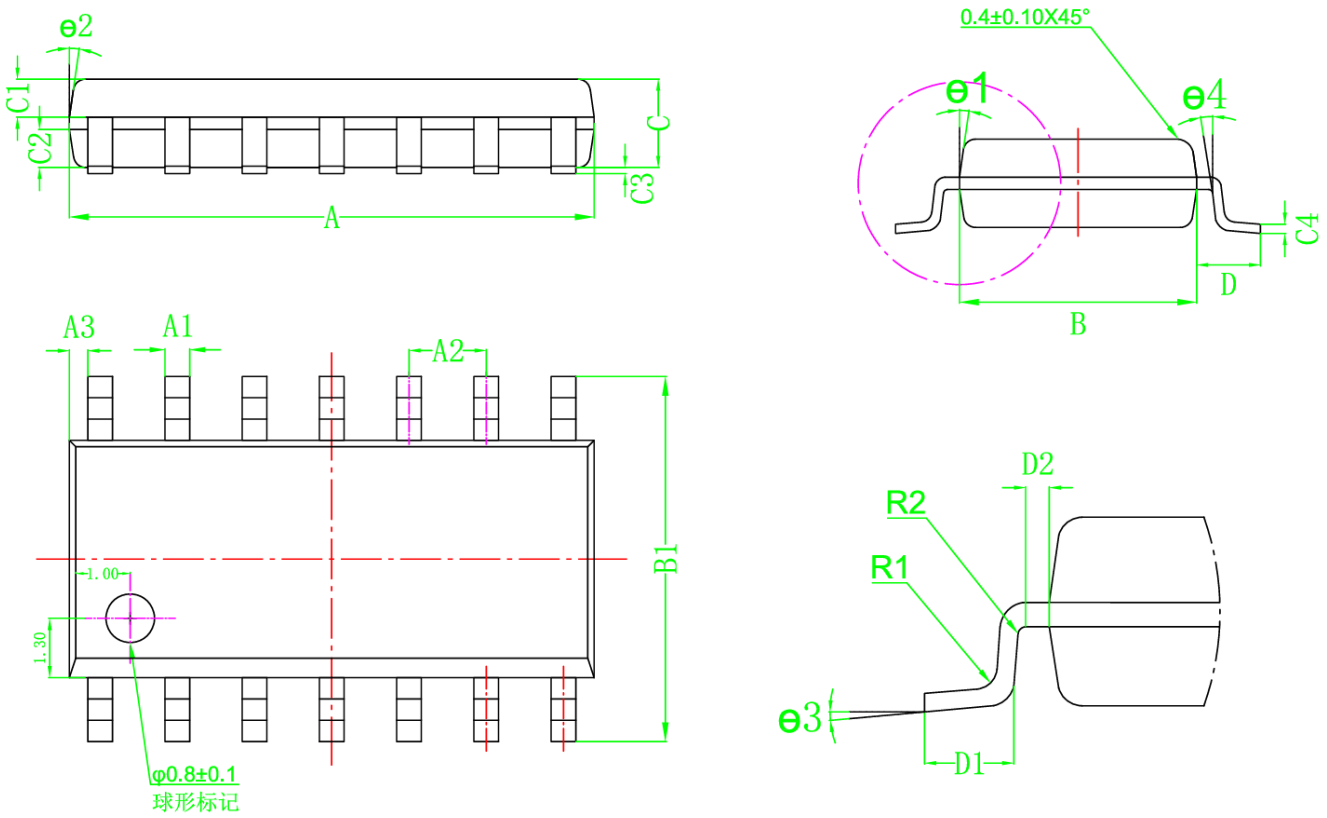
5.1 TQFN-14L



		SYMBOL	MIN	NOM	MAX
TOTAL THICKNESS		A	0.5	0.55	0.6
STAND OFF		A1	0	0.02	0.05
MOLD THICKNESS		A2	---	0.4	---
L/F THICKNESS		A3		0.152 REF	
LEAD WIDTH		b	0.13	0.18	0.23
BODY SIZE	X	D		1.6 BSC	
	Y	E		2 BSC	
LEAD PITCH		e		0.4 BSC	
LEAD LENGTH		L	0.25	0.3	0.35
		L1	0.2	0.3	0.4
		L2	0.35	0.4	0.45
PACKAGE EDGE TOLERANCE		aaa		0.1	
MOLD FLATNESS		ccc		0.1	
COPLANARITY		eee		0.05	
LEAD OFFSET		bbb		0.07	
		ddd		0.05	

Figure 9: Package Outline Diagram

5.2 SOP14



Symbol	Dimensions in mm																		
	A	A1	A2	A3	B	B1	C	C1	C2	C3	C4	D	D1	D2	R1	R2	θ1	θ2	θ3	θ4
Min	8.55	0.356	1.27 TYP	0.312 TYP	3.80	5.80	1.45	0.65	0.55	0.05	0.193	0.95	0.40	0.20 TYP	0.20 TYP	0.20 TYP	8° -12° TYP4	8° -12° TYP4	0° -8°	4° -12°
Max	8.75	0.456			4.00	6.20	1.50	0.69	0.65	0.25	0.213	1.15	0.70							

Figure 10：Package Outline Diagram

6. Ordering Information

6.1 TQFN-14L Ordering Information

6.1.1 Tape and Reel Specifications

Table 6：Package Type

Package Type	Num of Pins	Package Size [mm]	Units/package		Reel & Hub Size [mm]	Leader (min)		Trailer (min)		Tape Width [mm]	Part Pitch [mm]
			SPQ	1 Box		Pockets	Length [mm]	Pockets	Length [mm]		
TQFN-14L 1.6×2mm	14	1.6×2×0.55	3000	3000	178/54	30	120	140	560	8	4

6.1.2 Carrier Tape Drawing and Dimensions

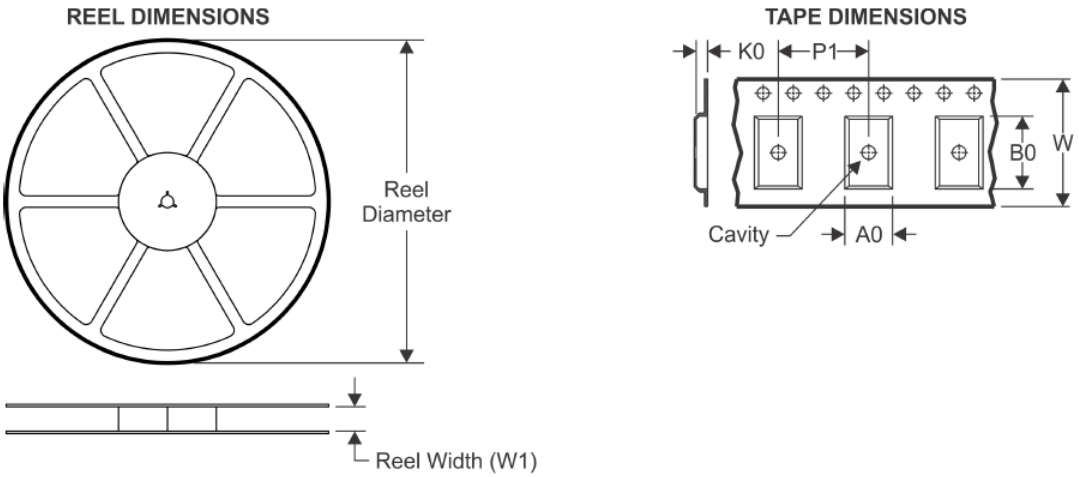


Figure 11：Carrier Tape Drawing and Dimensions

Table 7：Carrier Tape Drawing and Dimensions

A0	Dimension designed to accommodate the component width	1.76mm
B0	Dimension designed to accommodate the component length	2.16mm
K0	Dimension designed to accommodate the component thickness	0.73mm
W	Overall width of the carrier tape	8.00mm
W1	Reel Width	9.50mm
P0	Pitch between Index Hole Pitch	4.00mm
P1	Pitch between successive cavity centers	4.00mm

6.2 SOP14 Ordering Information

6.2.1 Tape and Reel Specifications

Table 8：Package Type

Package Type	Num of Pins	Package Size [mm]	Units/package		Reel & Hub Size [mm]	Leader (min)		Trailer (min)		Tape Width [mm]	Part Pitch [mm]
			SPQ	1 Box		Pockets	Length [mm]	Pockets	Length [mm]		
SOP14	14	8.65×6.0	3000	3000	330&100	30	240	140	1120	16.0	8

6.2.2 Carrier Tape Drawing and Dimensions

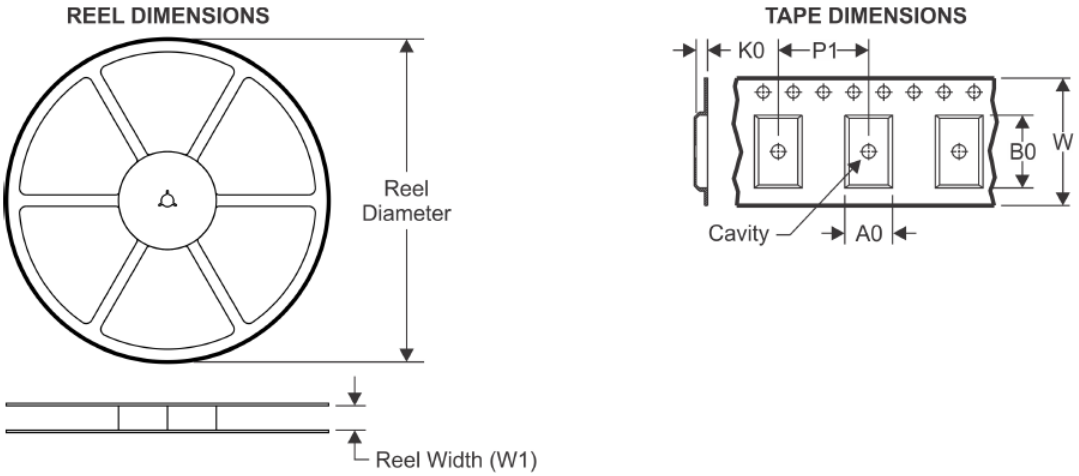


Figure 12：Carrier Tape Drawing and Dimensions

Table 9：Carrier Tape Drawing and Dimensions

A0	Dimension designed to accommodate the component width	6.44mm
B0	Dimension designed to accommodate the component length	9.3mm
K0	Dimension designed to accommodate the component thickness	2.04mm
W	Overall width of the carrier tape	16mm
W1	Reel Width	16.5mm
P0	Pitch between Index Hole Pitch	4.00mm
P1	Pitch between successive cavity centers	8.00mm

7. Recommended Reflow Soldering Profile

Please see IPC/JEDEC J-STD-020

7.1 Recommended Land Pattern

7.1.1 TQFN-14 (1.6mm x 2.0mm)

Dimensions in mm

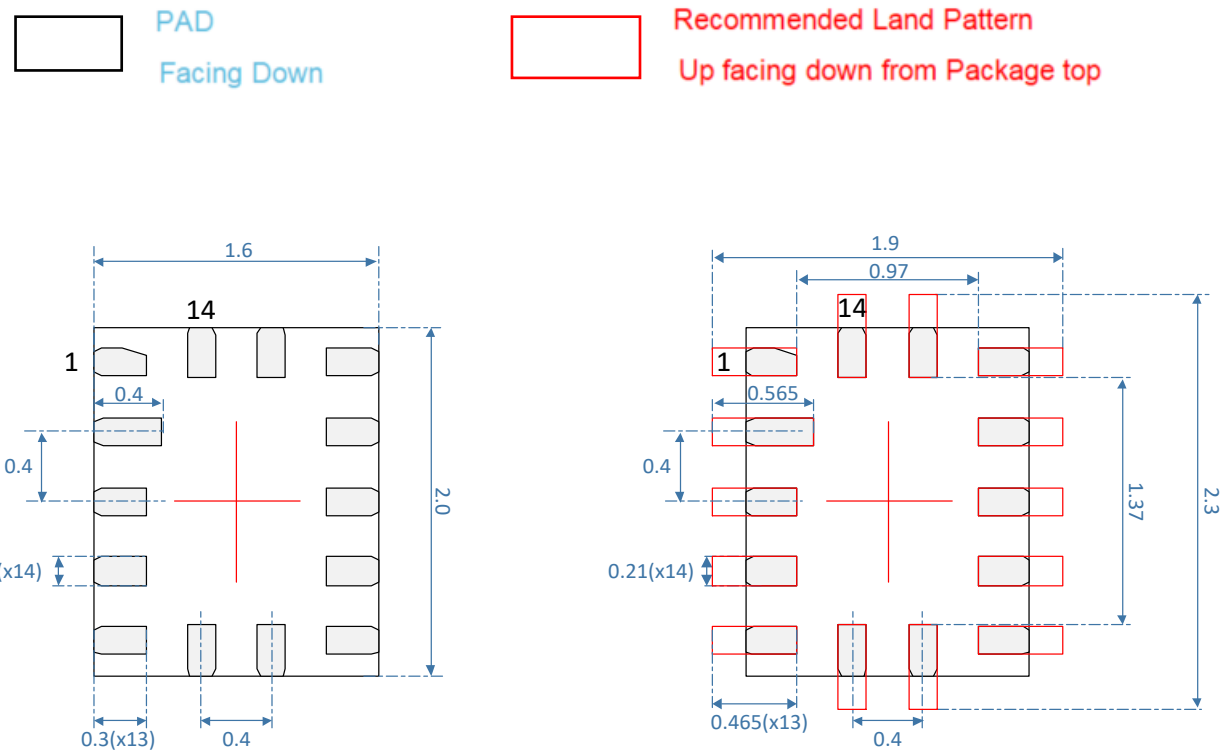


Figure 13：Recommended Land Pattern

7.1.2 SOP14

Dimensions in mm

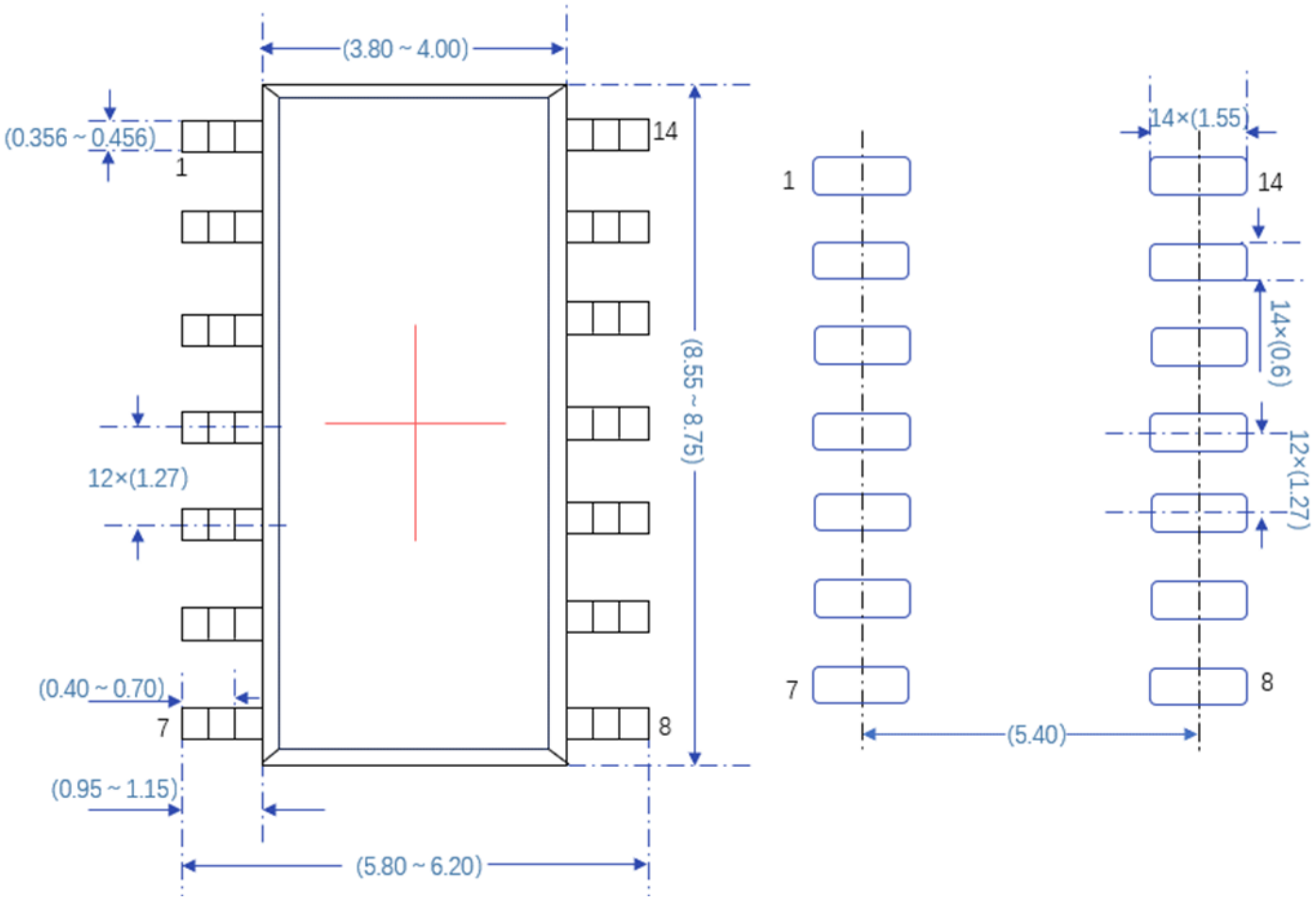


Figure 14：Recommended Land Pattern

8. Revision History

Table 10：Revision History

Version	Revision Contents	Revised By	Date
R01	Initial version		2024-01-15
R02	1. Remove the "NC" description from the "GPI/GPIO0/GPIO1" function. 2. Change the function descriptions for VIN (PIN14) and VOUT (PIN11)		2024-03-13
R03	Added SOP14 Pin configuration diagram (P7) Package contents (P12) and ordering information (P14) and SOP14 Recommended Land Pattern (P16)		2024-07-31
R04	1.Add the Shipping Mode control module in Figure 1-Figure 5 (P4-P6) 2.Add the application diagram in Figure 6 (P7)		2024-08-29
R05	Update Table 5 parameters (P10-11)		2024-09-06
R06	1.Modifying the Title 7.1.1 Size of the Title Bracket (P16) 2.Optimized SOP14 pad size proposal for Figure 14 (P17)		2024-09-10
R07	1.Optimize and update part of parameter data in Table 5 according to the measured data (P10-11)		2024-10-09
R08	Add the Icold parameter to Table 5 and remove the PIN parameter (P10)		2025-03-19