

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 storage 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: $V_{IN} \geq 2.0V$
- 200nA (typical value) full running standby current
- Up to over 95% efficiency
- Support 10uA~10mA input current
- Battery OVP/UV
- Programmable charging output voltage
- Programmable Maximum Power Point Tracking (MPPT) and Programmable Fixed Maximum Power Point Tracking (FMPPT)
- VDD/VIN range: 2.3V~5.5V
- Temperature: -40°C ~ 85°C
- RoHS Compliant/Halogen-Free
- Package: 14-L TQFN: 1.6mm x 2.0mm x 0.55mm, 0.4mm pitch

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: I²C Clock Input
- SDA: I²C Data Input/Output
- SMT: With Schmitt Trigger

U

- UVP: Under Voltage Protection

V

- VREF: Voltage Reference

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1. Function Diagram

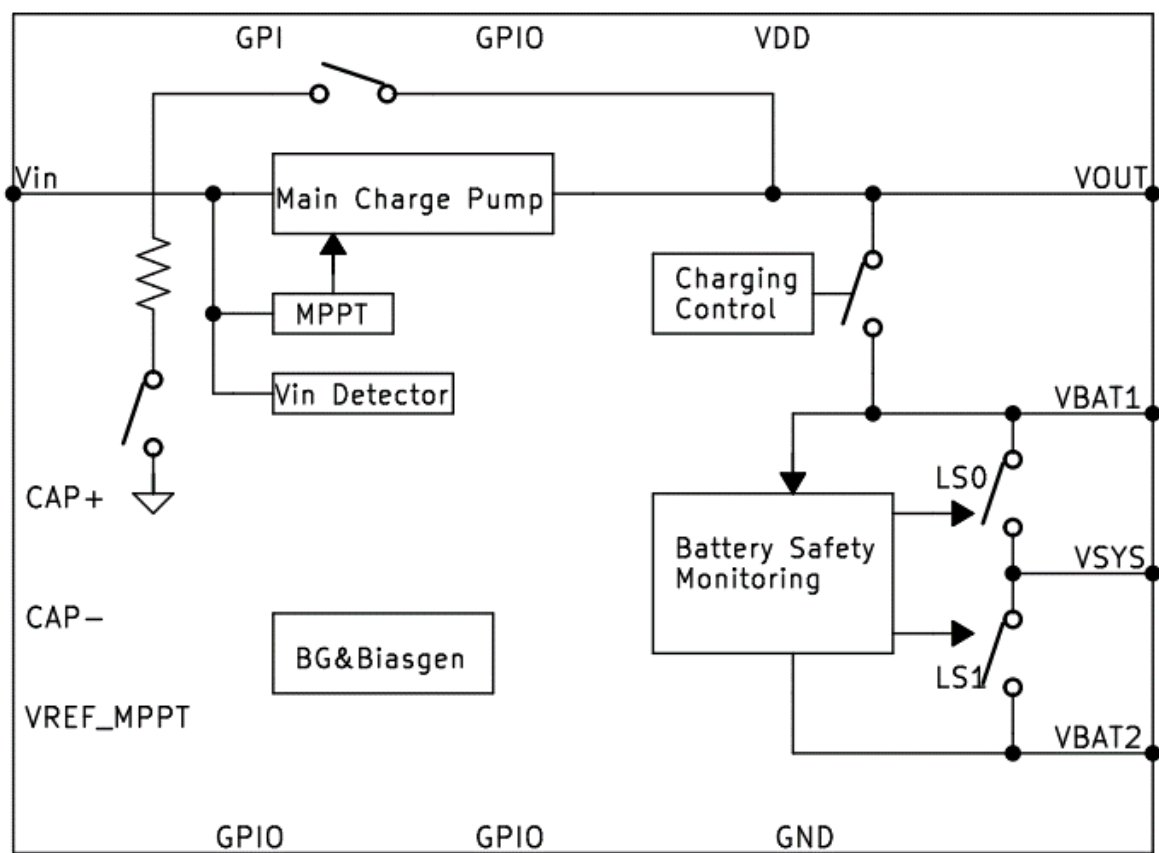
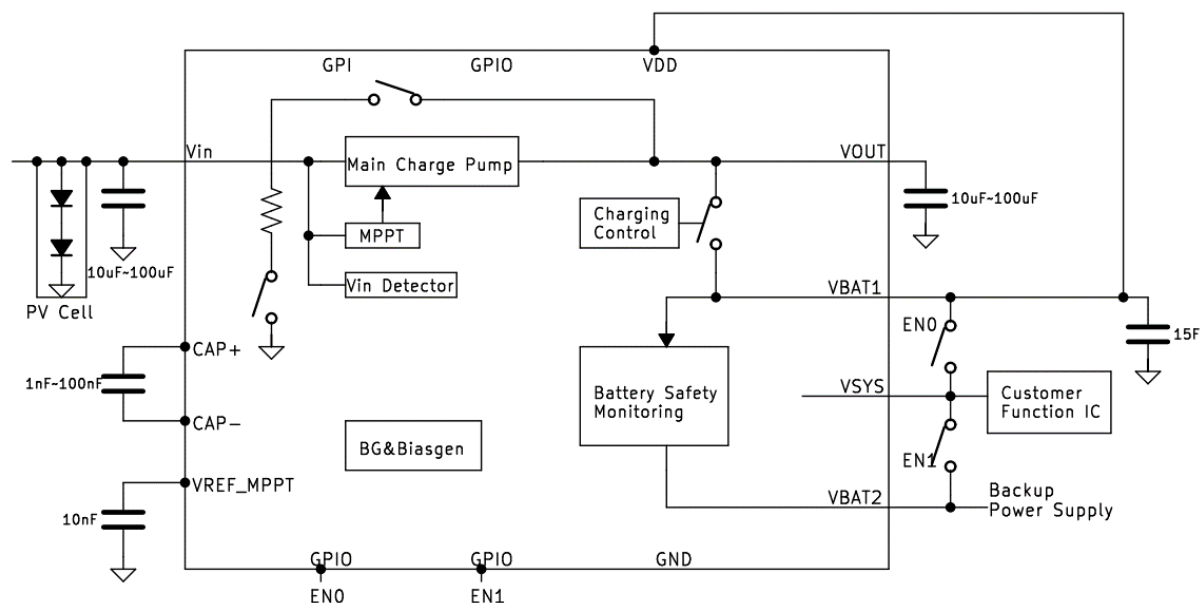
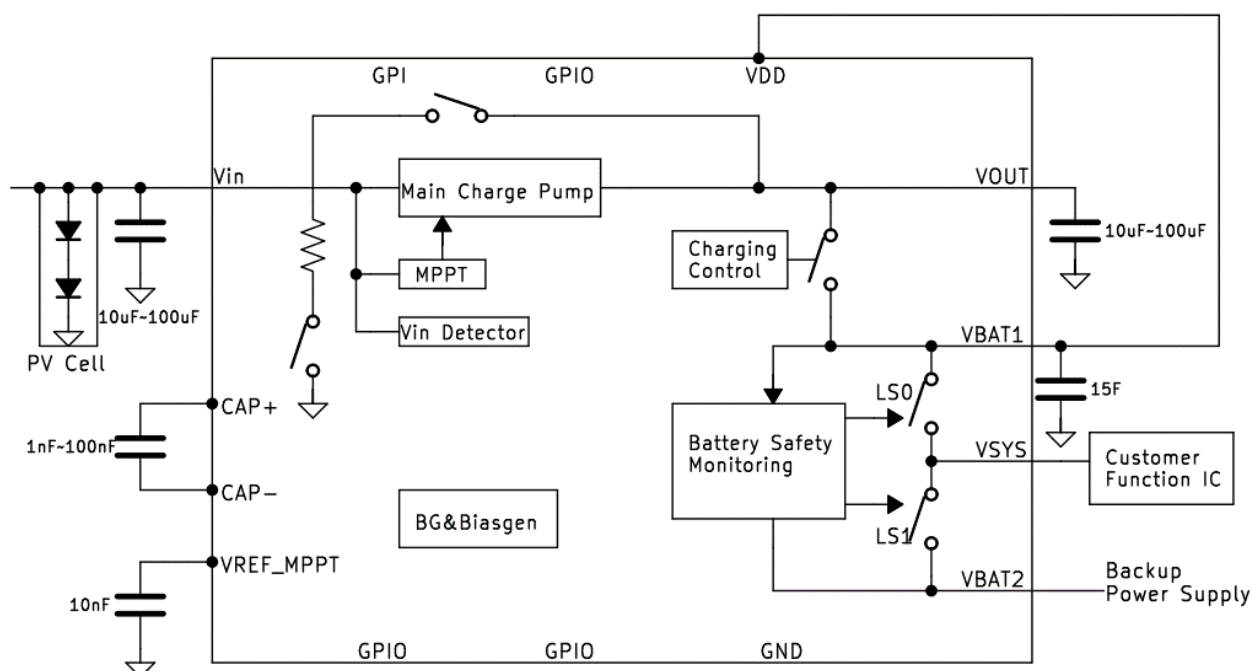


Figure 1: Function Diagram



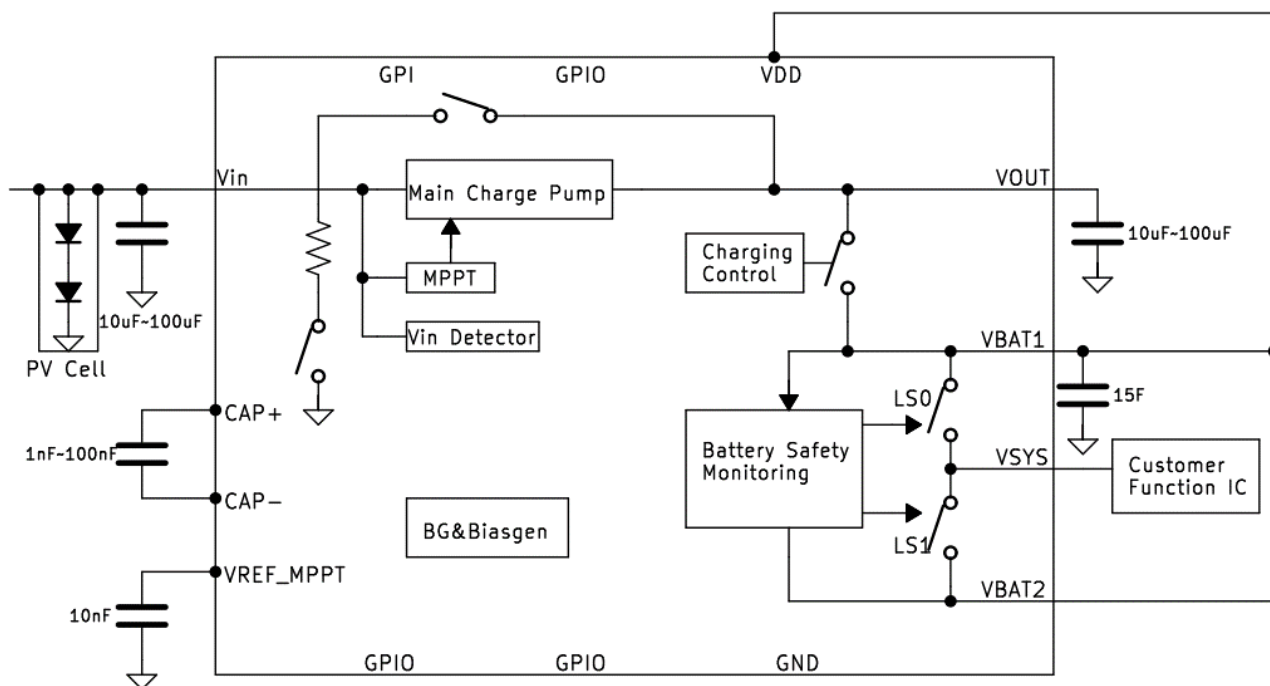


Figure 4: Application Diagram of Single Power Supply System (maximum current $\leq 200\text{mA}$)

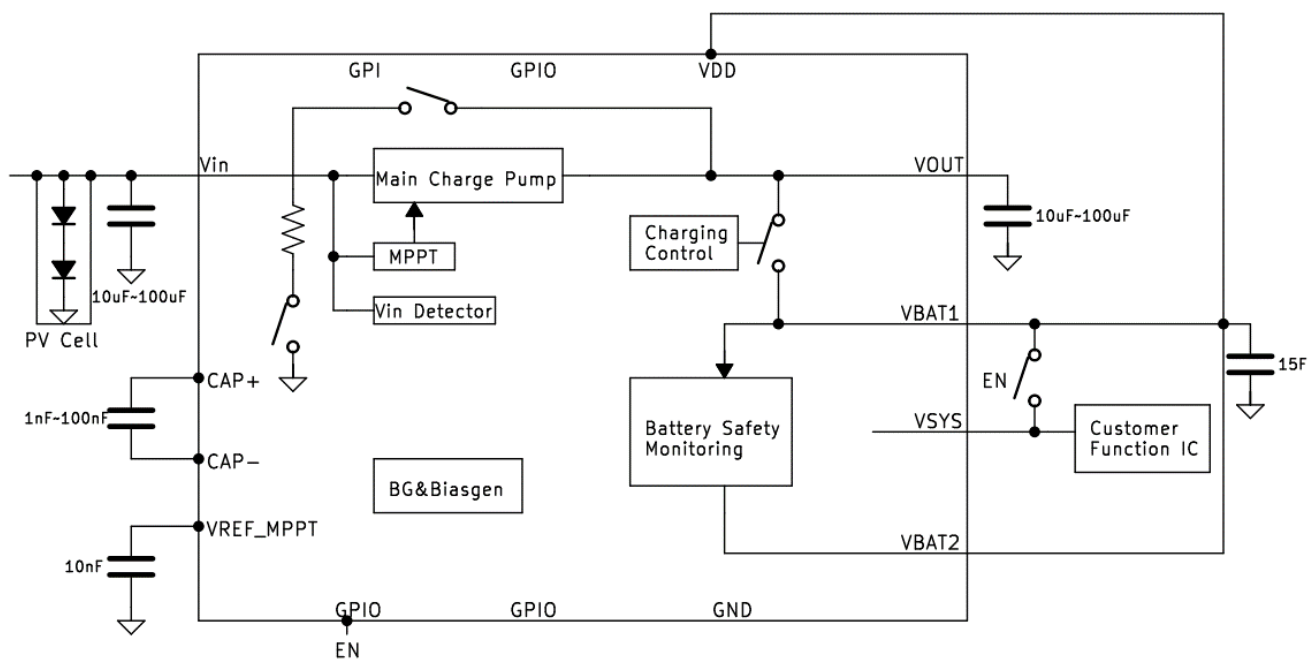


Figure 5: Application Diagram of Single Power Supply System (maximum current $> 200\text{mA}$)

3. Pin Definition

3.1 Pin Configuration of TQFN-14L

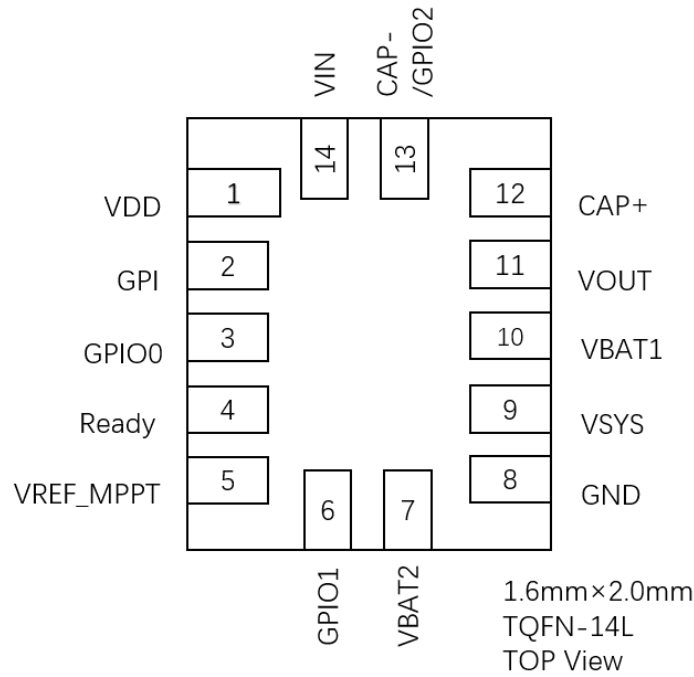


Figure 6: TQFN-14L (TOP View)

3.2 Pin Function Description

Table 1: Pin Function Description

Pin	Name	Type	Function
1	VDD	POWER / GND	Power Supply, 2.3V-5.5V
2	GPI	Digital Input	(VPP program power)
3	GPIO0	Digital Input / Output	(I2C SCL)
4	Ready	Digital Output	Battery Ready indicator, (I2C SDA)
5	VREF_MPPT	Analog Input / Output	Connect to 10nF low leakage capacitance to ground to store the voltage for MPPT
6	GPIO1	Digital Input / Output	(Vref output)
7	VBAT2	Analog Input / Output	Connect to the battery or super capacitance (backup power supply)
8	GND	POWER / GND	GND
9	VSYS	Analog Input / Output	System power supply pin
10	VBAT1	Analog Input / Output	Connect to the battery or super capacitance
11	VOUT	Analog Input / Output	Energy output, connect to 10uF capacitance to ground
12	CAP+	Analog Input / Output	Charge pump external Cap+
13	CAP- / GPIO2	Analog Input / Output	Charge pump external Cap-, Programmable enable pin
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	°C
Junction temperature	--	150	°C
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	°C
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	1.67	1.80	1.92	V
POFF _{THR}	Power Off Threshold	VDD Level Required to Switch Off the Chip	0.95	1.25	1.54	V
V _{cold}	Cold Start Voltage		2.0	--	--	V
I _{loadswitch}	Battery Load Switch		200	500	--	mA
T _{SU}	Startup Time	From VDD rising past PON _{THR}	--	1.20	--	ms
I _{stand_by}		T=+25 °C	--	70	--	nA
PIN	Minimum input power	At Vin=2.3V	46	--	--	uW
Vin	Input Voltage		2.3	--	5.5	V
Vout	Output Voltage		2.3	--	5.5	V
VIH	HIGH-Level Input Voltage	Logic Input	0.7*VDD	--	--	V
		Logic Input with Schmitt Trigger	0.8*VDD	--	--	V
		Low-Level Logic Input	0.82	--	--	V
VIL	LOW-Level Input Voltage	Logic Input	--	--	0.3*VDD	V
		Logic Input with Schmitt Trigger	--	--	0.2*VDD	V
		Low-Level Logic Input	--	--	0.70	V
VHYS	Schmitt Trigger Hysteresis Voltage	Logic Input with Schmitt Trigger	--	0.42	--	V
ILKG	Input leakage (Absolute Value)	--	--	1	1000	nA
VOH	HIGH-Level Output Voltage	Push-Pull, IOH = 1 mA, 1X Drive	2.02	--	--	V
		Push-Pull, IOH = 1 mA, 2X Drive	2.10	--	--	V
VOL	LOW-Level Output Voltage	Push-Pull, IOL = 1 mA, 1X Drive	--	--	0.11	V
		Push-Pull, IOL = 1 mA, 2X Drive	--	--	0.06	V
		Open Drain, IOL = 1 mA, 1X Drive	--	--	0.077	V
		Open Drain, IOL = 1 mA, 2X Drive	--	--	0.075	V
IOH	HIGH-Level Output Pulse Current (see Note)	Push-Pull, VOH = VDD-0.2, 1X Drive	1.37	--	--	mA
		Push-Pull, VOH = VDD-0.2, 2X Drive	2.74	--	--	mA
IOL	LOW-Level Output Pulse Current (see Note)	Push-Pull, VOL = 0.15 V, 1X Drive	1.61	--	--	mA
		Push-Pull, VOL = 0.15 V, 2X Drive	3.22	--	--	mA
		Open Drain, VOL = 0.15 V, 1X Drive	4.9	--	--	mA
		Open Drain, VOL = 0.15 V, 2X Drive	9.8	--	--	mA
RPUP	Pull Up Resistance	1 M Pull Up	--	1	--	MΩ
		100 k Pull Up	--	100	--	KΩ
		10 k Pull Up	--	10	--	KΩ
RPDWN	Pull Down Resistance	1 M Pull Down	--	1	--	MΩ
		100 k Pull Down	--	100	--	KΩ
		10 k Pull Down	--	10	--	KΩ
Freq _{Accuracy}	Ultra-Low Power OSC	T=+25 °C	--	2	--	KHz
		T=-40 °C to +85 °C	1.6	--	2.4	KHz

Parameter		Condition/Note	Min.	Typ.	Max.	Unit.
Power-On time	2KHz OSC	T=+25 °C	--	600	--	uS
FreqAccuracy		T=+25 °C	--	2	--	KHz
		T=-40 °C to +85 °C	1.847	--	2.074	KHz
Power Consumption		T=+25 °C	--	0.41	--	uA
		T=-40 °C to +85 °C	--	--	0.57	uA
V _{bat1_OV}	Over Voltage of Battery1	0~5.5V, 9-bit Resolution (programmable)				
V _{bat1_UV}	Under Voltage of Battery1	0~5.5V, 9-bit Resolution (programmable)				
V _{bat2_UV}	Under Voltage of Battery2	0~5.5V, 9-bit Resolution (programmable)				
V _{FMPPT}	Fixed Maximum Power Point Tracking	0~5.5V, 9-bit Resolution (programmable)				
V _{MPPT}	Maximum Power Point Tracking	55%~90%, step: 5%				
V _{OUT_TH}	VO _{UT} charging Switch turn on threshold voltage	0~5.5V, 9-bit Resolution (programmable)				
T _{OTP}	Temperature of Over Temperature Protection	2°C/step, 9-bit Resolution				
I _{LS}	Current of Two Low Switches	100mA per channel	200	--	--	mA
Standby Current		All function is enable (Vin=0)	--	200	--	nA
Note: DC or average current through any pin should not exceed value given in Absolute Maximum Conditions.						

5. Package Information

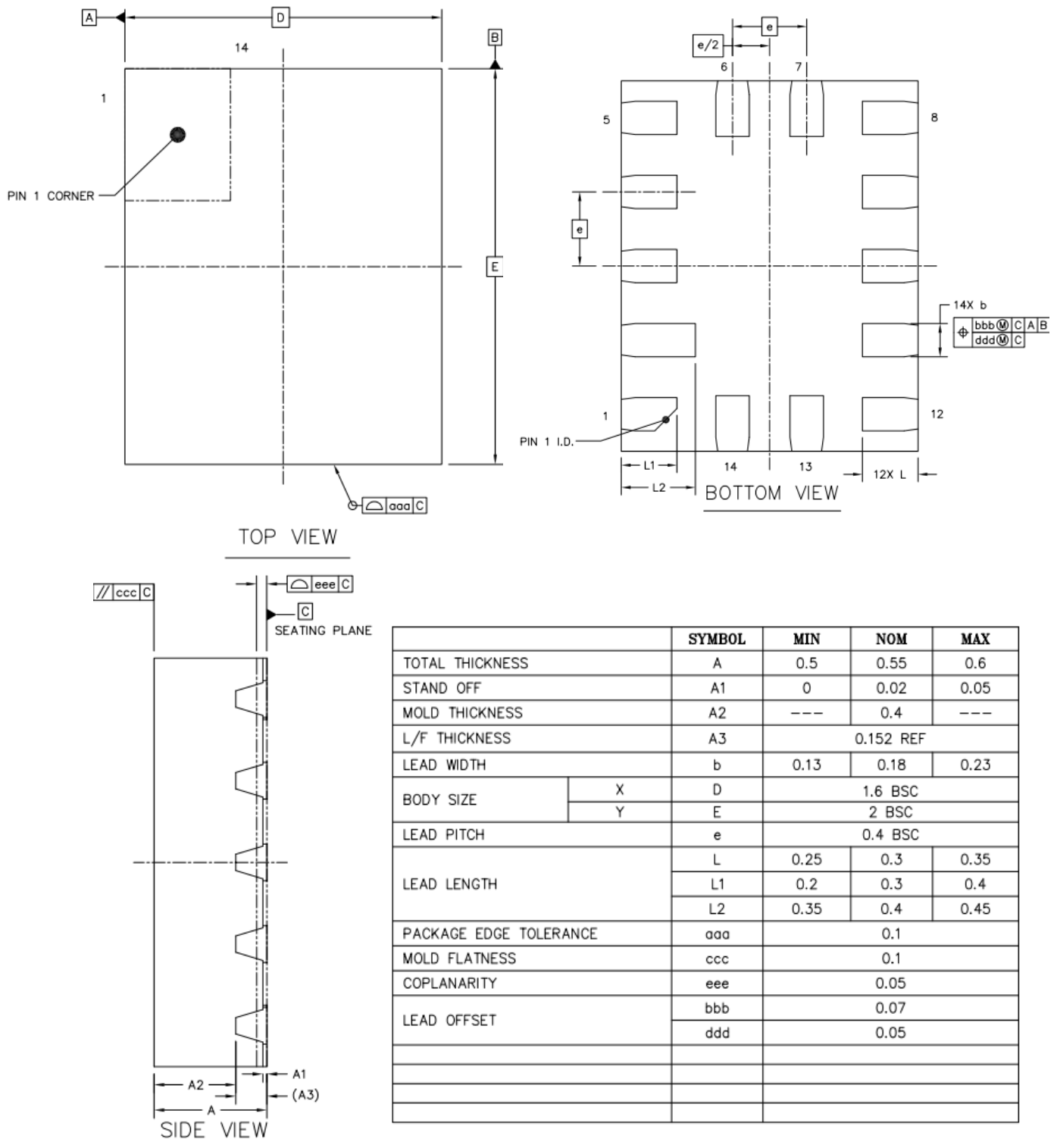


Figure 7: Package Outline Diagram

6. Ordering Information

6.1 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

6.2 Carrier Tape Drawing and Dimensions

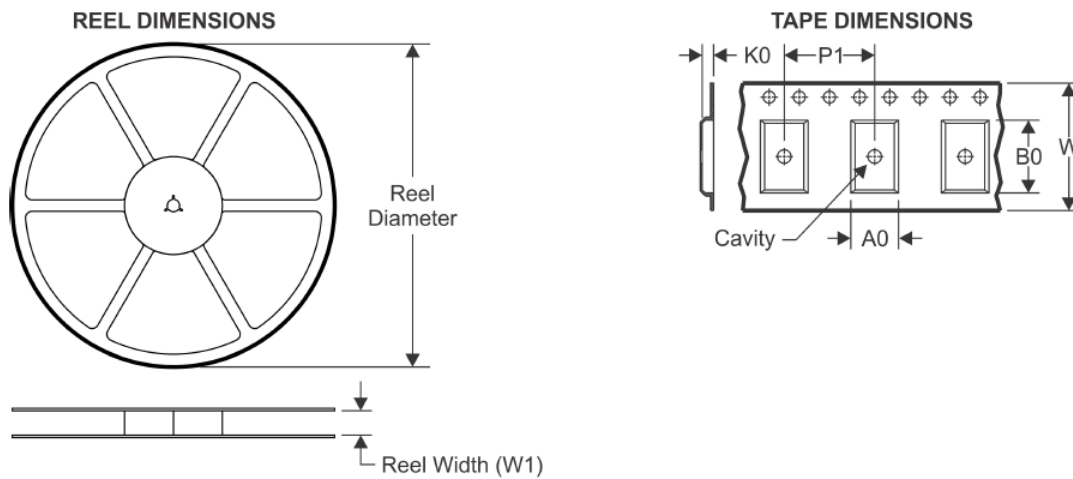


Figure 8: Carrier Tape Drawing and Dimensions

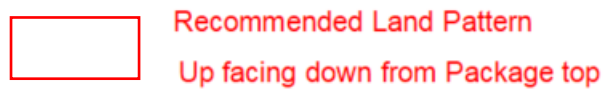
Table 7: Carrier Tape Drawing and Dimensions

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

7. Recommended Reflow Soldering Profile

Please see IPC/JEDEC J-STD-020

7.1 Recommended Land Pattern



1.6mm x 2.0mm

TQFN-14

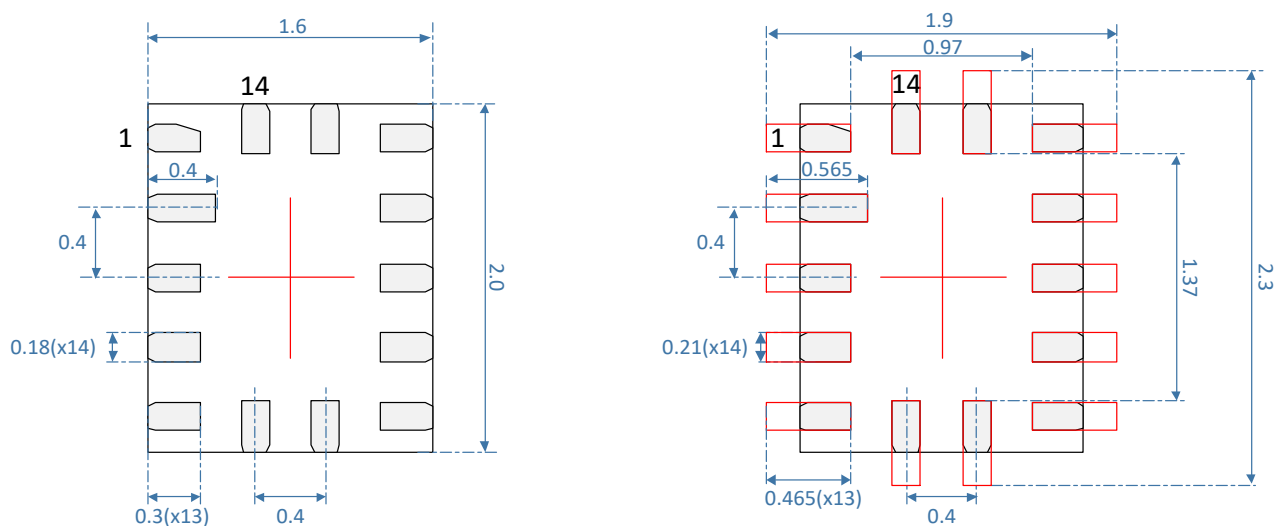


Figure 9: Recommended Land Pattern

8. Revision History

Table 8: 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