SQ79002

4.5V-14V Input, 5V/1W Output 3kVDC Isolated DC/DC Converter

General Description

The SQ79002 is a 3kVDC isolated DC/DC converter capable of delivering 5V/1W at the secondary side. This product integrates power switches, transformer, switching controller and LDO into a compact 4×5.5mm package. Only secondary diode and external capacitors are needed to finish the design. The SQ79002 operates over an input voltage range from 4.5V to 14V.

The SQ79002 provides short circuit protection and thermal shutdown protection for reliable operation.

Features

- 3kV DC Isolation Voltage
- 4.5 to 14V Input Voltage Range
- Secondary output: 5V/1W Capability
- Reliable Protection Mode for input UVLO, output SCP, OTP
- Compact Package: MQFN4×5.5-14
- Height: 4.05mm max

Applications

- Industrial Equipment
- Telecommunication
- Isolated Bias Supply
- CAN communication

Typical Application

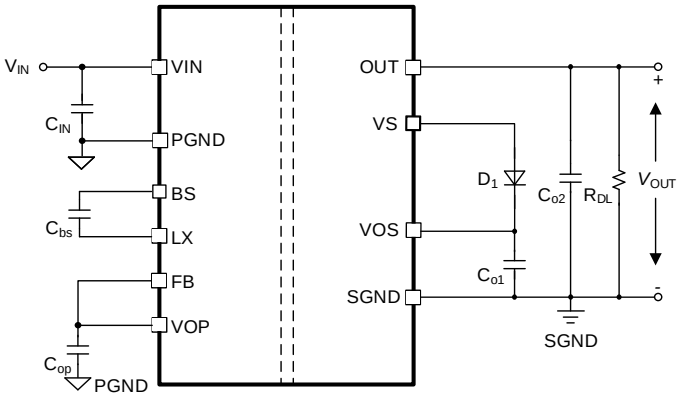

Figure 1. Application Circuit

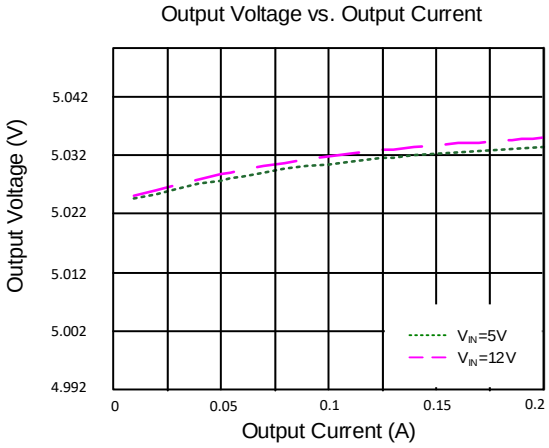

Figure 2. Load Regulation

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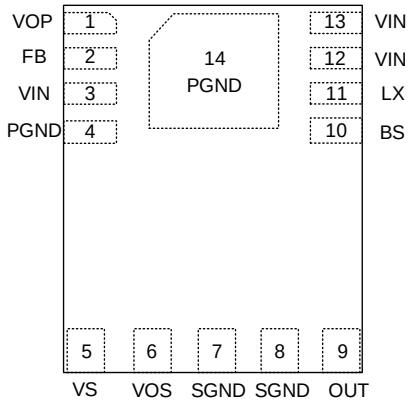
Ordering Information

Ordering Part Number	Package Type
SQ79002AJE	MQFN4×5.5-14

Pinout (top view)



Pin No	Pin Name	Pin Description
1	VOP	Primary output pin.
2	FB	Primary output feedback pin. Connect this pin to primary output capacitor (see detail in PCB layout suggestions).
3, 12, 13	VIN	Primary input pins.
4, 14	PGND	Primary ground pins.
5	VS	Secondary Diode positive pin.
6	VOS	Secondary LDO positive input pin.
7, 8	SGND	Secondary ground pin.
9	OUT	Secondary output pin.
10	BS	Primary boot-strap pin. Supply high side gate driver. Decouple this pin to LX pin with a 0.1uF ceramic cap.
11	LX	Primary switching node. Decouple this pin to BS pin with a 0.1uF ceramic cap.

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Block Diagram

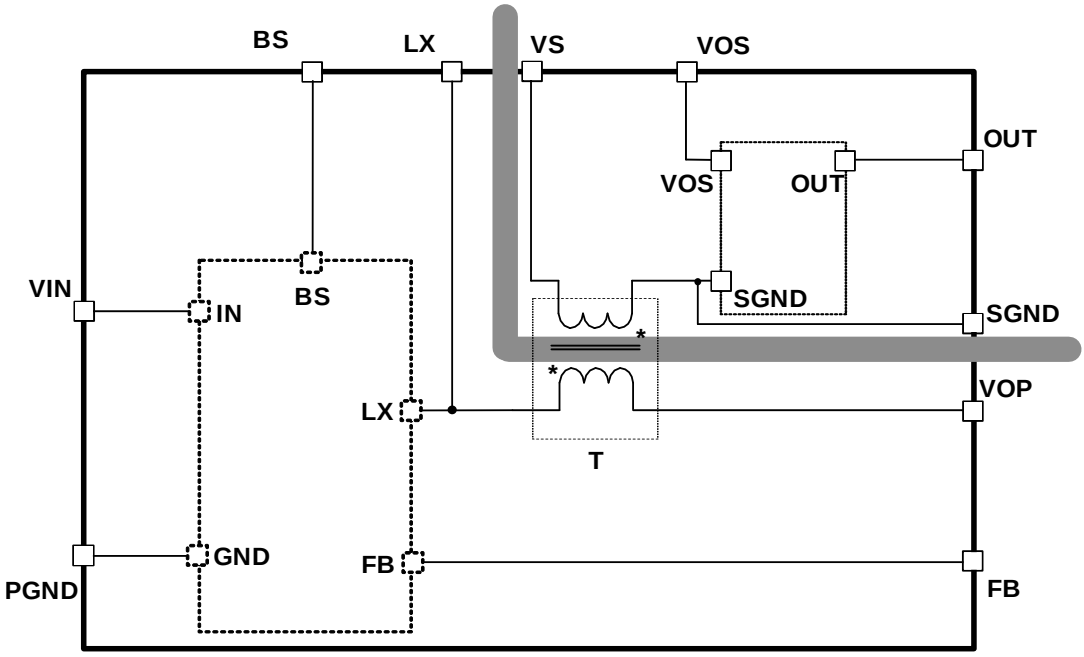

Figure 3. Block Diagram

Absolute Maximum Ratings

Parameter (Note 1)	Min	Max	Unit
VIN to PGND	-0.3	15	V
LX(DC) to PGND	-0.3	VIN+0.3	
BS to PGND	LX - 0.3	LX + 4	
VOP, FB to PGND	-0.3	4	
VOS to SGND	-0.3	16	
VS(DC) to SGND	-40	16	
OUT to SGND	-0.3	10	
Operation Internal Temperature	-40	125	°C
Lead Temperature (Soldering,10sec.)		260	
Storage Temperature	-10	40	

ESD Rating

Parameter	Typ	Unit
HBM(Human Body Model)	±1000	V
CDM(Charge Device Model)	±500	

Thermal Information

Parameter (Note 2)	Typ	Unit
θ_{JA} Junction-to-Ambient Thermal Resistance	40	°C/W
θ_{JC} Junction-to-Case Thermal Resistance	0.01	
Ψ_{JB} Junction-to-Board Thermal Resistance	3	

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P_D Power Dissipation T_A = 25°C	2.5	W

Recommended Operating Conditions

Parameter (Note 3)	Min	Max	Unit
Supply Input Voltage	4.5	14	V
Output Current (Note4)	0	200	mA
Ambient Temperature	-40	105	°C

Electrical Characteristics

(V_{IN} = 5V, V_{OUT} = 5V, -40°C <T_J< 125°C, typical values are at T_A = 25°C, unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Input Specifications						
Input Voltage Range	V_{IN}		4.5	5	14	V
Input UVLO Threshold (rising)	V_{UVLO}		3.8	4.2	4.45	V
Input UVLO Hysteresis	V_{HYS}		0.1	0.2	0.5	V
Input Current with No Load	$I_{IN, NULL}$	V_{IN}=5V, I_{OUT}=0A		15.5		mA
Output Specifications (Secondary Side)						
Output Voltage Set Point	$V_{OUT,SET}$		4.9	5.05	5.2	V
Line Regulation (Note 5)	ΔV_{LNR}	V_{IN}=4.5-14V, T_A=25°C, Io=200mA		±1		%
Load Regulation (Note 5)	ΔV_{LDR}	V_{IN}=5V, T_A=25°C, I_O=0-200mA		±1		%
Temperature Regulation (Note 5)	ΔV_T	V_{IN}=5V, T_A=-40°C to 105°C, I_O=200mA		±1		%
Output Current Limit	I_{LIMT}		230			mA
Rise Time	t_{RISE}	From 10% to 90% of output set-point	0.5	1	2	ms
General Specifications						
Switching Frequency	f_{SW}		1.4	1.6	1.8	MHz
Thermal Shutdown Temperature (Note 5)	T_{SD}	OTP mode: Auto recovery		125		°C
Thermal Shutdown Hysteresis (Note 5)	T_{HYS}			25		°C
Isolation Voltage (DC) (Note 6)	V_{ISO}	T_A=25°C	3000			V

Note 1: Stresses beyond the “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Note 2: θ_{JA}, θ_{JC} and Ψ_{JB} are based on a four-layer 8cm×8cm Silergy Evaluation Board in the natural convection at T_A = 25°C. Board thickness: 1.6mm, copper thickness: 2 oz, copper coverage: 95%. Junction temperature (T_J) refers to the hottest device which is transformer temperature for this product. Ambient temperature (T_A) refers to the air temperature 0.5 inch above module. Case temperature (T_C) refers to the top surface temperature of transformer. Board temperature (T_B) refers to the PCB point to the hottest module pin with a 1mm distance on the same PCB surface layer.

Note 3: The device is not guaranteed to function outside its operating conditions.

Note 4: Please refer to the Thermal Derating Curve to get the maximum output current under different ambient temperatures.The values are guaranteed by design, not production tested.

Note 5: The values are guaranteed by design, statistical correlation, not production tested.

Note 6:

1) SQ79002 is a functional isolation product. The isolation is tested under hi-pot 3000VDC for one second.

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2) Altitude >2000m condition is not guaranteed by isolation of SQ79002. Isolation reduction need to be reviewed by users for altitude >2000m situation.

3) The SQ79002 may be operated with up to 200V(MAX) working voltage in a pollution degree2 environment. Compliance review will be needed by users to ensure that SQ79002 is suitable for the intended application and environment.

4) Isolation clearance of SQ79002 is 2.5mm min.

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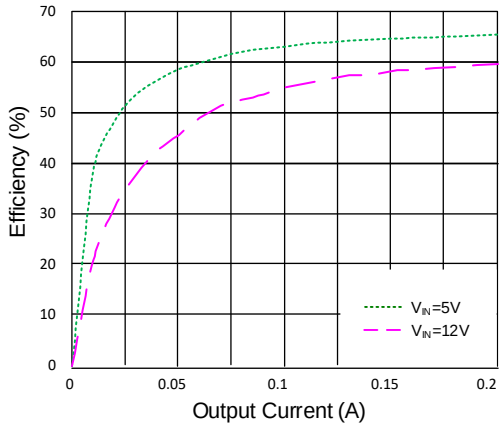
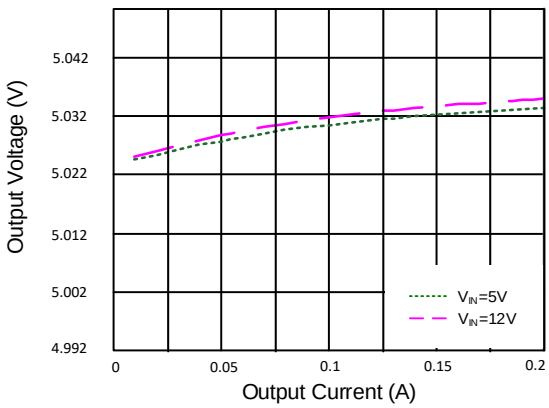
Typical Performance Characteristics

(T_A = 25 ˚C, unless otherwise noted.)

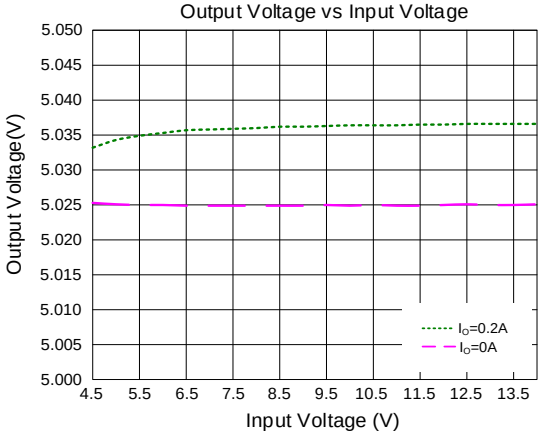
Efficiency vs. Output Current



Output Voltage vs. Output Current

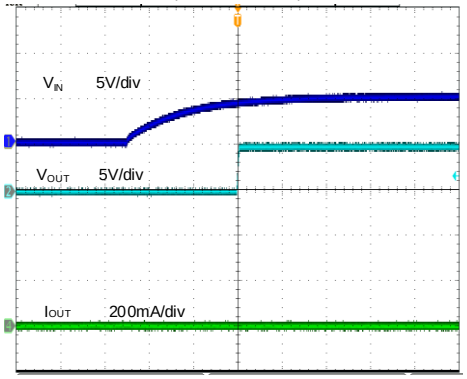


Output Voltage vs Input Voltage



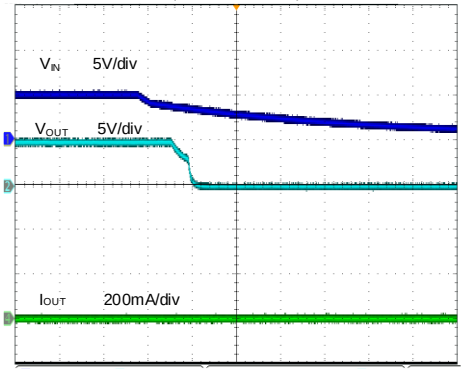
Startup from V_{IN}

(V_{IN}=5V, I_{OUT}=0A)



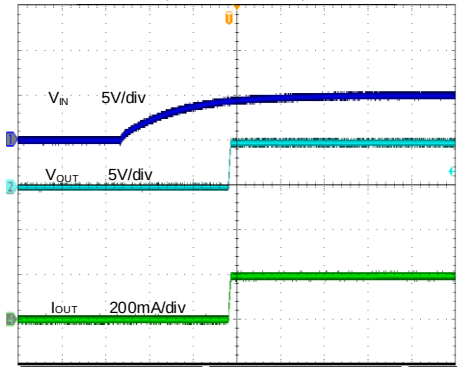
Shutdown from V_{IN}

(V_{IN}=5V, I_{OUT}=0A)



Startup from V_{IN}

(V_{IN}=5V, I_{OUT}=0.2A)



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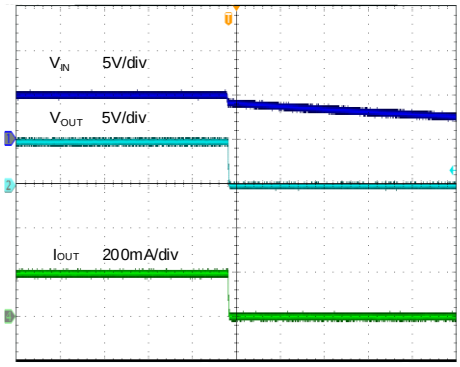
Shutdown from V_{IN}

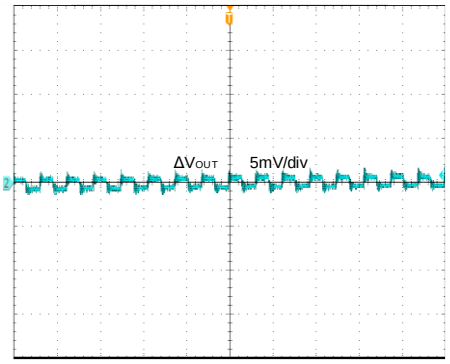
(V_{IN}=5V, I_{OUT}=0.2A)



Time (20ms/div)

Output Ripple

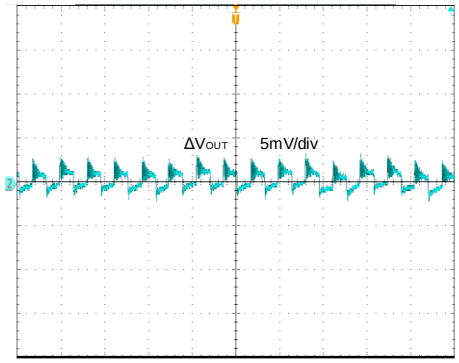
(V_{IN}=5V, I_{OUT}=0A)



Time (1μs/div)

Output Ripple

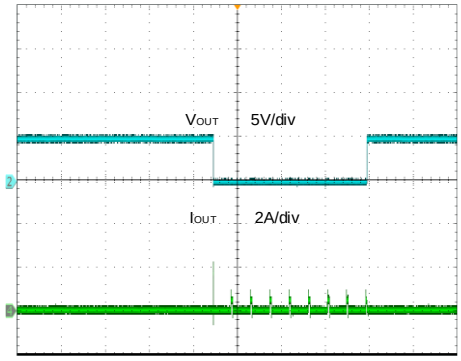
(V_{IN}=5V, I_{OUT}=0.2A)



Time (1μs/div)

Output Short Circuit

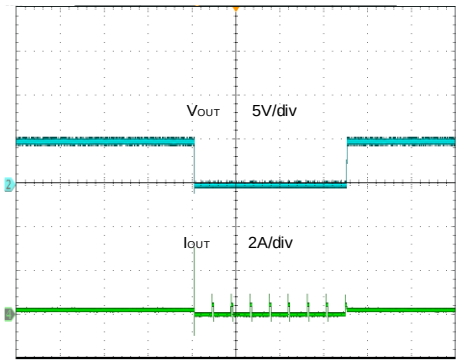
(V_{IN}=5V, I_{OUT}=0A to short)



Time (40ms/div)

Output Short Circuit

(V_{IN}=5V,I_{OUT}=0.2A to short)



Time (40ms/div)

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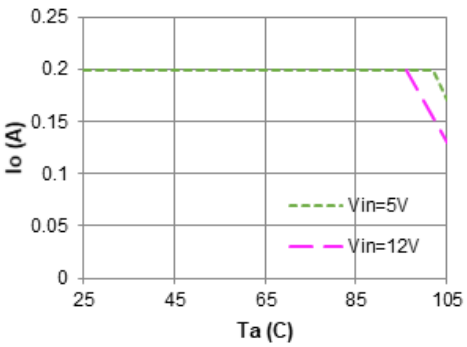
Thermal Derating Curve @V_{IN}=5V
@V_{IN}=12V



- T_A: Ambient temperature, 0.5 inch above IC.
- Based on a four-layer 8cmx8cm Silergy Evaluation Board in the natural convection(No heat sink). Board thickness: 1.6mm, copper thickness: 2 oz, copper coverage: 95%.
- The transformer temperature is not beyond 125℃ under this TD curve.
- For customer's specific application, the recommended transformer temperature limitation is 125℃.

Detailed Description

The SQ79002 is a 3kVDC isolated DC/DC converter, operates over a wide input voltage range from 4.5V to 14V. And it is capable of delivering 5V/1W at the secondary side over a wide ambient temperature range.

Over temperature protection(OTP)

The module includes OTP circuitry to prevent overheating due to excessive power dissipation. This will shut down the device when the die temperature exceeds 125°C. Once the die temperature cools down by approximately 25°C, the device will resume normal operation.

Short circuit protection(SCP)

The device includes short circuit protection. When load current gets higher than current limit threshold(>230mA), SCP will be triggered and LDO will be disabled for $t_{HICCUP,OFF}$, about 16ms. Following the end of $t_{HICCUP,OFF}$, LDO would restart for $t_{HICCUP,ON}$, about 1.7ms. During $t_{HICCUP,ON}$, the output current is limited to current limit threshold to protect IC from damage. If the fault condition remains after a period of $t_{HICCUP,ON}$, this 'hiccup' cycle of startup and shutdown will continue. If the fault condition is resolved, the device will resume normal operation.

Application Information

Because of the high integration in the SQ79002 module, the application circuit based on this regulator is rather simple. Only input capacitor C_{IN}, output capacitor C_{OP}, C_{O1}, C_{O2}, Bootstrap capacitor C_{bs}, diode D_1 and output dead load R_{DL} need to be selected for the targeted applications specifications. And X7 or better grade ceramic capacitors are recommended for reliable operation.

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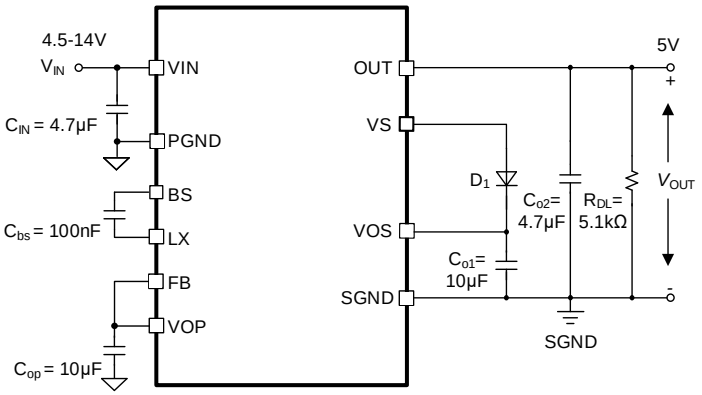
Application Schematic



BOM List

Designator	Description	Part Number	Manufacturer	Note
C_{IN}	4.7uF/16V/X7R, 0603	GRM188Z71C475KE21D	MuRata	
C_{bs}	100nF/50V/X8L, 0603	GCM188L81H104KA57D	MuRata	
C_{op}	10uF/6.3V/X7T, 0603	GRM188D70J106MA73D	MuRata	
C_{o1}	10μF/16V/X7S, 0805	GRM21BC71C106KE11L	MuRata	
C_{o2}	4.7uF/16V/X7R, 0603	GRM188Z71C475KE21D	MuRata	
R_{DL}	5.1kΩ, 1%, 0603			R_{DL} reduces the voltage stress of C_{o1} and D_1 especially for light load and no-load conditions.
D_1	1A/100V, Schottky	RB168VAM100	ROHM	

Layout Design

To achieve optimal design, follow these PCB layout considerations:

- Place C_{IN}, C_{bs}, C_{op}, C_{o1}, C_{o2}, D_1 close to the IC.
- To achieve the best thermal and noise performance, maximize the PCB copper area connecting to the GND pin. A ground plane is highly recommended if board space allows.
- Place C_{IN} close to the VIN and PGND pins, and minimize the loop area formed by C_{IN} and PGND.
- Place C_{bs} on the same layer as the device; keep the BS voltage path (BS, LX, and C_{bs}) as short as possible.
- Place C_{op} close to the VOP and PGND pins, and minimize the loop area formed by C_{op} and PGND.
- Place C_{o1} close to the VOS and SGND pins, and minimize the loop area formed by C_{o1} and SGND.
- Place C_{o2} close to the OUT and SGND pins, and minimize the loop area formed by C_{o2} and SGND.
- Minimize the loop area formed by VS, D_1 and VOS.

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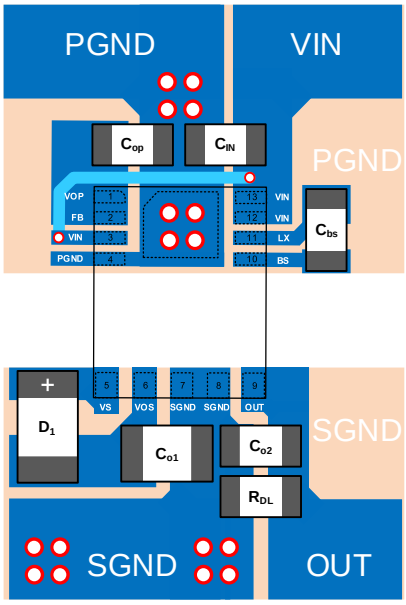

Figure 4. Suggested PCB Layout

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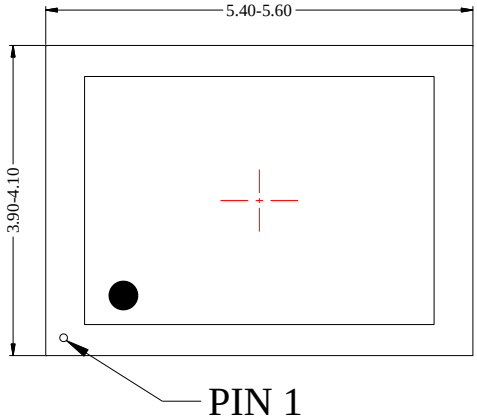
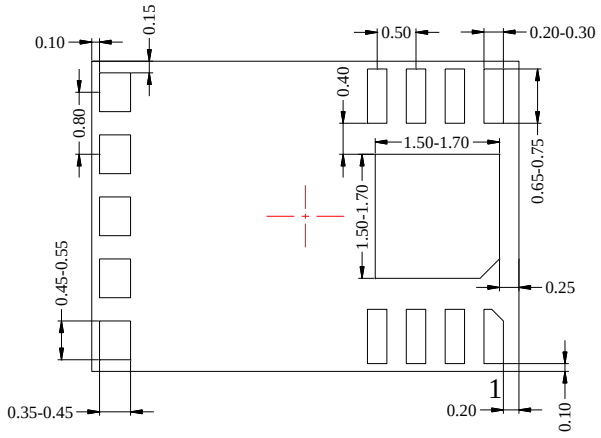
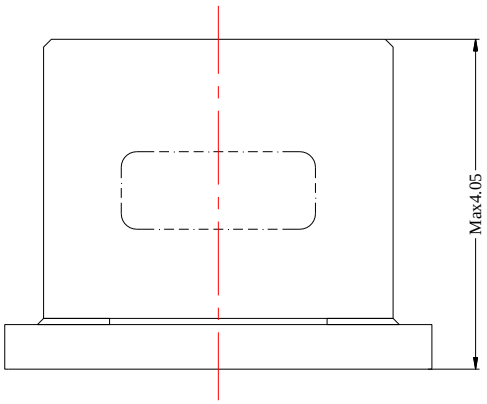
MQFN4X5.5-14 Package Outline Drawing



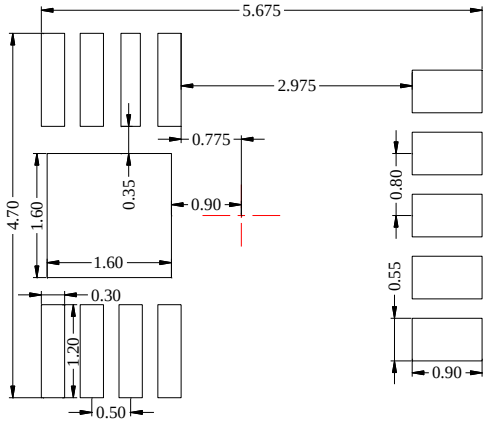
Top View



Bottom View



Side View



Recommended PCB layout
(Reference only)

Notes: *1.All dimension in millimeter and exclude mold flash & metal burr.*

2.Center line on drawing refers to the chip body center.

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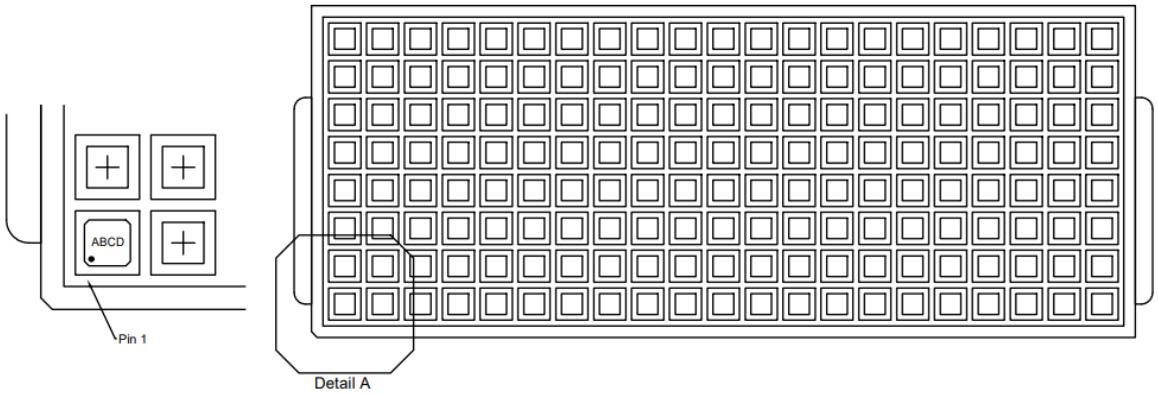
Taping orientation

MQFN5.5*4-14 Tray information



Part number	Package types	Qty Per Tray (pcs)	Trays per box	Qty per box (pcs)
SQ79002AJE	MQFN5.5*4-14	490	10	4900

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Packaging Information

Device Code: HBR

Label Information

W/O: XXXXXXXXXX

P/N: SQ79002AJE

QTY: XXXX

D/C Lot: XXXXXXXXXX

MSL3

Pb-Free

RoHS Compliant
Halogen Free

(The barcode is for demonstration only.)

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Revision History

The revision history provided is for informational purposes only and is believed to be accurate, however, not warranted. Please make sure that you have the latest revision.

Date	Revision	Change
2024/8/20	0.0	Initial Release
2025/5/9	1.0	Production Release
2025/10/30	1.0A	The packaging method change from tape real to tray

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