

### 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 4x5.5mm 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: MQFN4x5.5-14
- Height: 4.05mm max

### Applications

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

### Typical Application

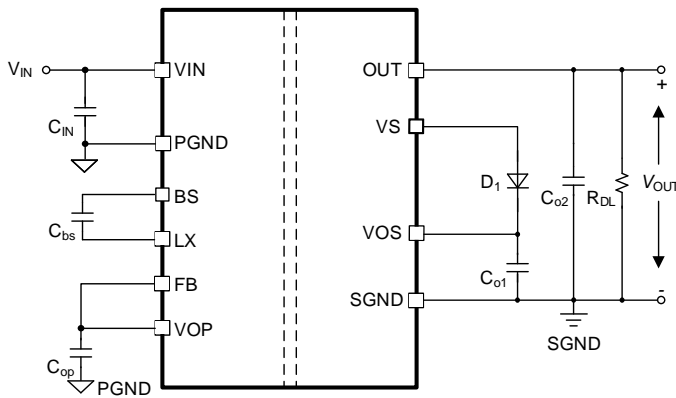


Figure 1. Application Circuit

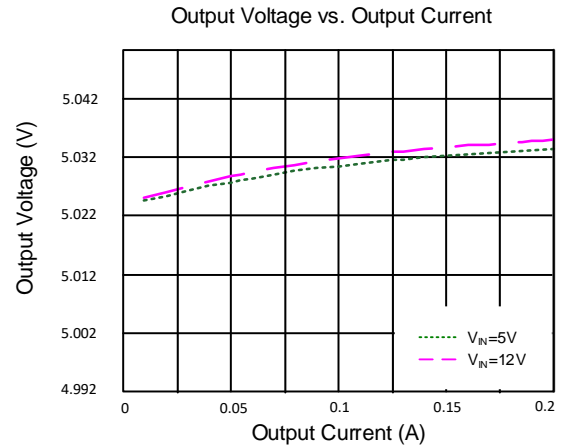


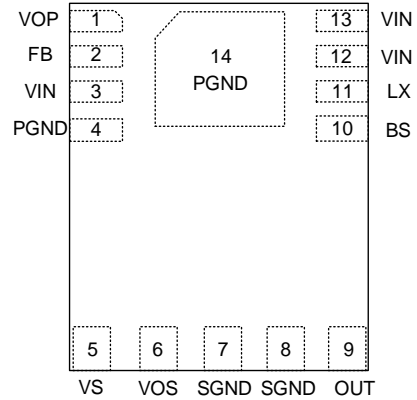
Figure 2. Load Regulation



### Ordering Information

Ordering Part Number	Package Type
SQ79002AJE	MQFN4x5.5-14

### 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.

## Block Diagram

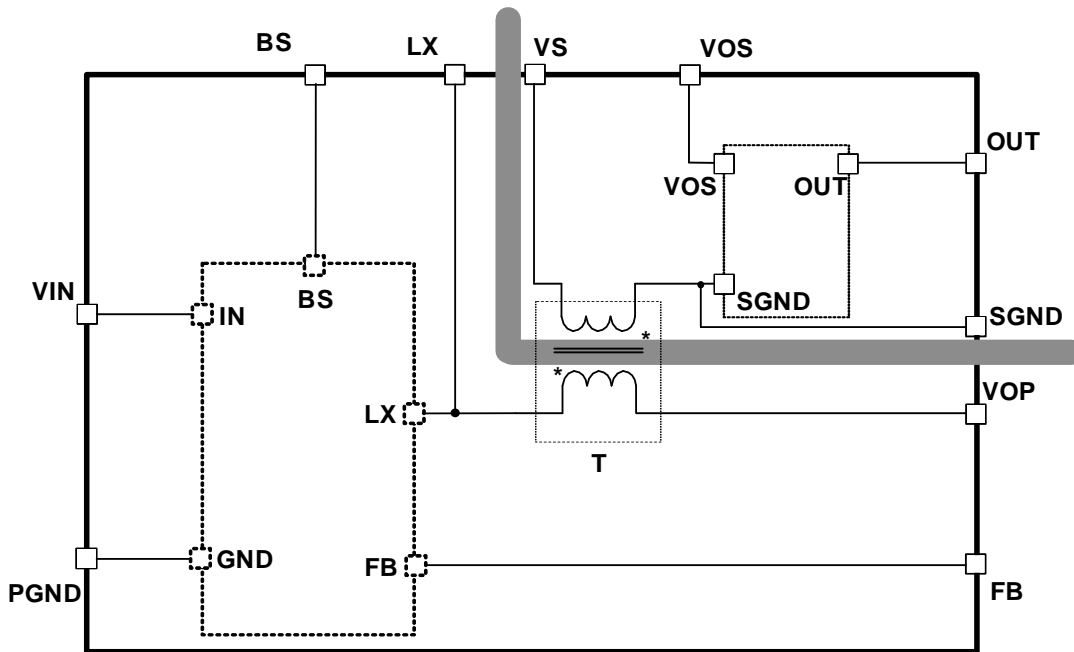


Figure 3. Block Diagram

## 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
$\theta_{JA}$ Junction-to-Ambient Thermal Resistance	40	°C/W
$\theta_{JC}$ Junction-to-Case Thermal Resistance	0.01	
$\Psi_{JB}$ Junction-to-Board Thermal Resistance	3	

$P_D$ Power Dissipation $T_A = 25^\circ\text{C}$	2.5	W
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## 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	$^\circ\text{C}$

## Electrical Characteristics

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
<b>Input Specifications</b>						
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
<b>Output Specifications (Secondary Side)</b>						
Output Voltage Set Point	$V_{OUT, SET}$		4.9	5.05	5.2	V
Line Regulation (Note 5)	$\Delta V_{LNR}$	$V_{IN}=4.5-14V, T_A=25^\circ\text{C}, I_O=200\text{mA}$		$\pm 1$		%
Load Regulation (Note 5)	$\Delta V_{LDR}$	$V_{IN}=5V, T_A=25^\circ\text{C}, I_O=0-200\text{mA}$		$\pm 1$		%
Temperature Regulation (Note 5)	$\Delta V_T$	$V_{IN}=5V, T_A=-40^\circ\text{C} \text{ to } 105^\circ\text{C}, I_O=200\text{mA}$		$\pm 1$		%
Output Current Limit	$I_{LIMIT}$		230			mA
Rise Time	$t_{RISE}$	From 10% to 90% of output set-point	0.5	1	2	ms
<b>General Specifications</b>						
Switching Frequency	$f_{SW}$		1.4	1.6	1.8	MHz
Thermal Shutdown Temperature (Note 5)	$T_{SD}$	OTP mode: Auto recovery		125		$^\circ\text{C}$
Thermal Shutdown Hysteresis (Note 5)	$T_{HYS}$			25		$^\circ\text{C}$
Isolation Voltage (DC) (Note 6)	$V_{ISO}$	$T_A=25^\circ\text{C}$	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:**  $\theta_{JA}$ ,  $\theta_{JC}$  and  $\Psi_{JB}$  are based on a four-layer 8cm×8cm Silergy Evaluation Board in the natural convection at  $T_A = 25^\circ\text{C}$ . 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:**

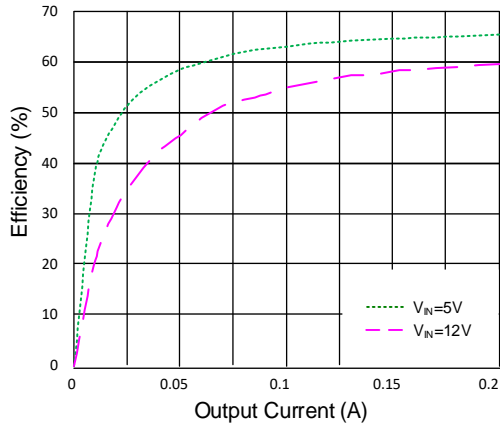
1) SQ79002 is a functional isolation product. The isolation is tested under hi-pot 3000VDC for one second.

- 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.

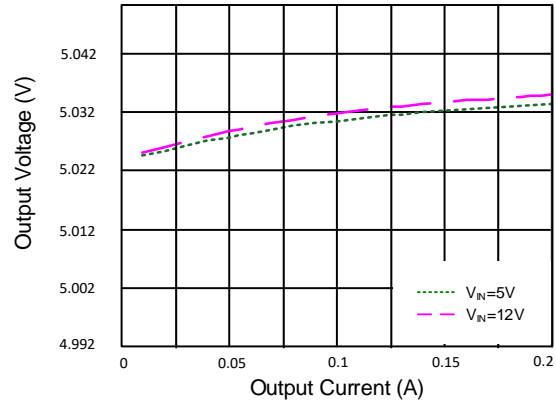
## Typical Performance Characteristics

( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted.)

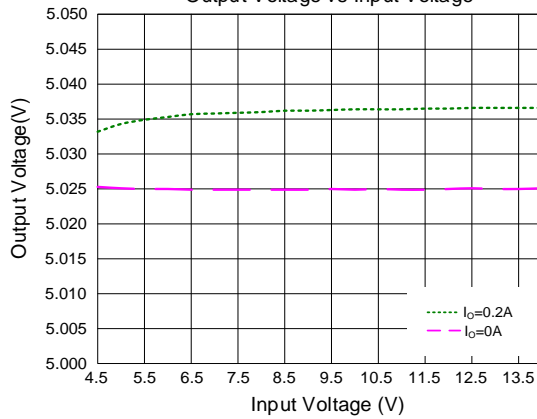
Efficiency vs. Output Current



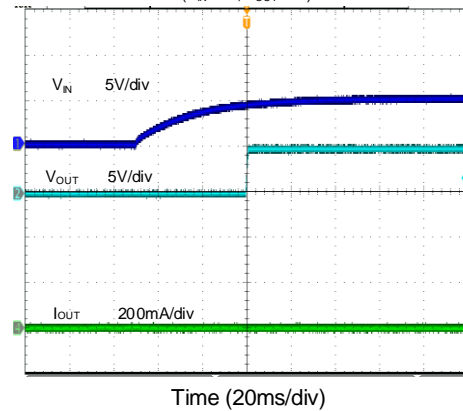
Output Voltage vs. Output Current



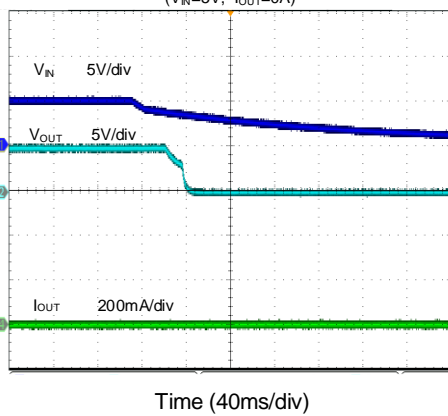
Output Voltage vs. Input Voltage



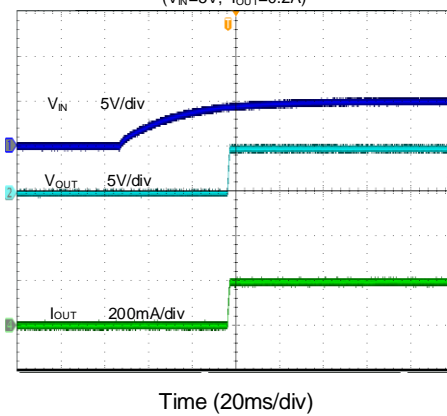
Startup from  $V_{IN}$   
( $V_{IN}=5V, I_{OUT}=0A$ )



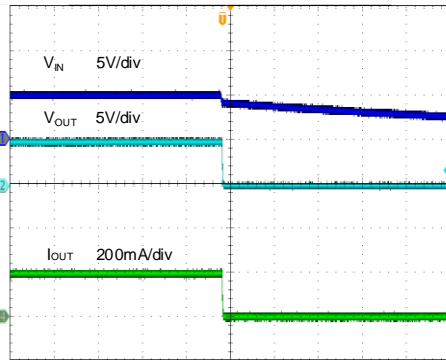
Shutdown from  $V_{IN}$   
( $V_{IN}=5V, I_{OUT}=0A$ )



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

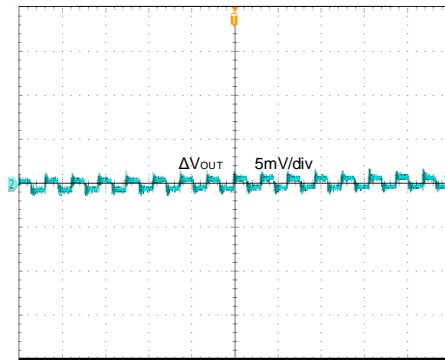


Shutdown from  $V_{IN}$   
( $V_{IN}=5V$ ,  $I_{OUT}=0.2A$ )



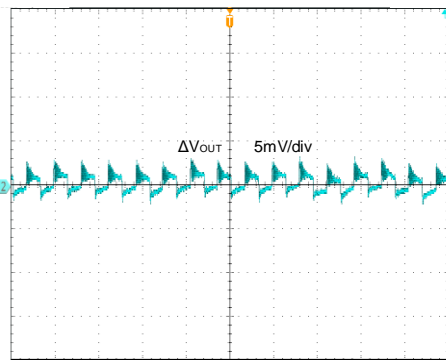
Time (20ms/div)

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



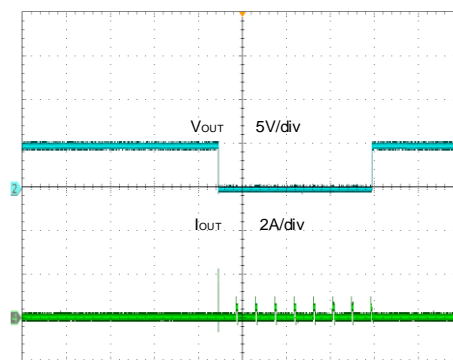
Time (1 $\mu$ s/div)

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



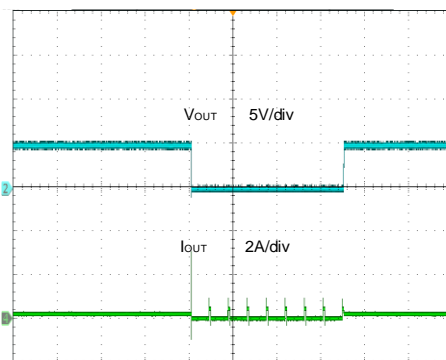
Time (1 $\mu$ s/div)

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



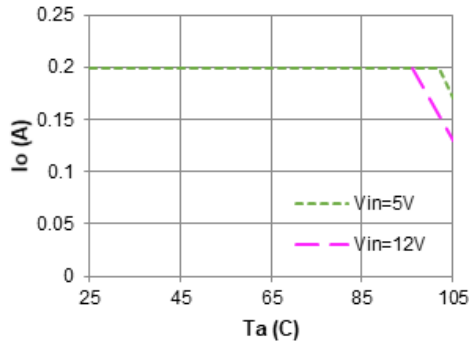
Time (40ms/div)

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



Time (40ms/div)

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°C under this TD curve.
- For customer's specific application, the recommended transformer temperature limitation is 125°C.

## 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)

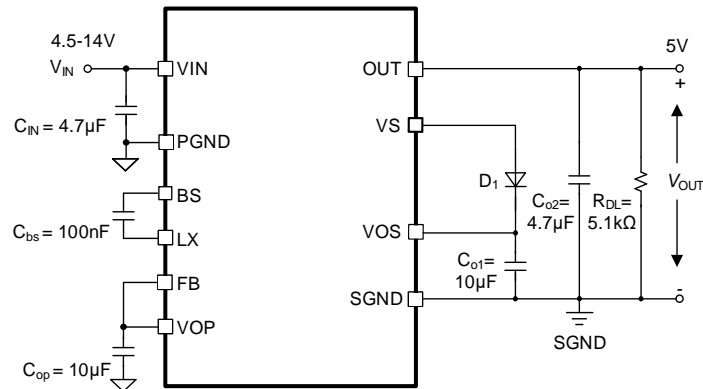
The device includes short circuit protection. When load current gets higher than current limit threshold(>230mA), SCP will be triggered and LDO will be disabled for  $t_{HICCUP,OFF}$ , about 16ms. Following the end of  $t_{HICCUP,OFF}$ ,

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.

## Application Schematic



## BOM List

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

## Layout Design

To achieve optimal design, follow these PCB layout considerations:

- Place C<sub>IN</sub>, C<sub>bs</sub>, C<sub>op</sub>, C<sub>o1</sub>, C<sub>o2</sub>, D<sub>1</sub> 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<sub>IN</sub> close to the VIN and PGND pins, and minimize the loop area formed by C<sub>IN</sub> and PGND.
- Place C<sub>bs</sub> on the same layer as the device; keep the BS voltage path (BS, LX, and C<sub>bs</sub>) as short as possible.
- Place C<sub>op</sub> close to the VOP and PGND pins, and minimize the loop area formed by C<sub>op</sub> and PGND.
- Place C<sub>o1</sub> close to the VOS and SGND pins, and minimize the loop area formed by C<sub>o1</sub> and SGND.
- Place C<sub>o2</sub> close to the OUT and SGND pins, and minimize the loop area formed by C<sub>o2</sub> and SGND.
- Minimize the loop area formed by VS, D<sub>1</sub> and VOS.

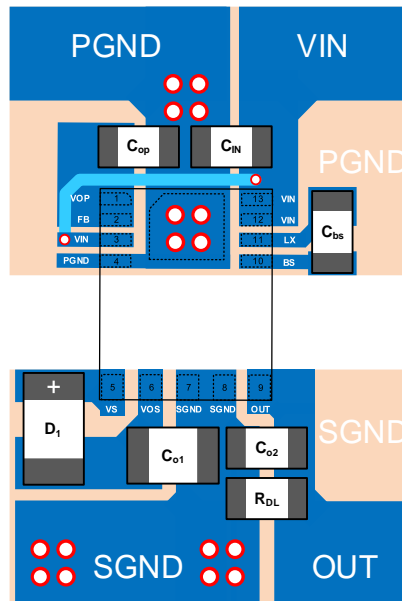
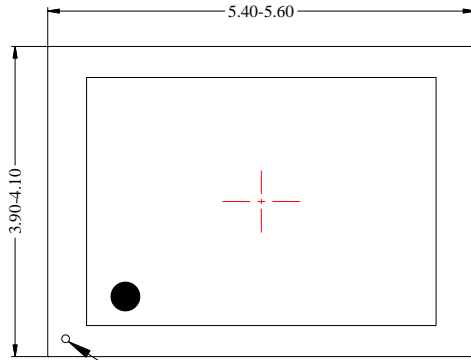
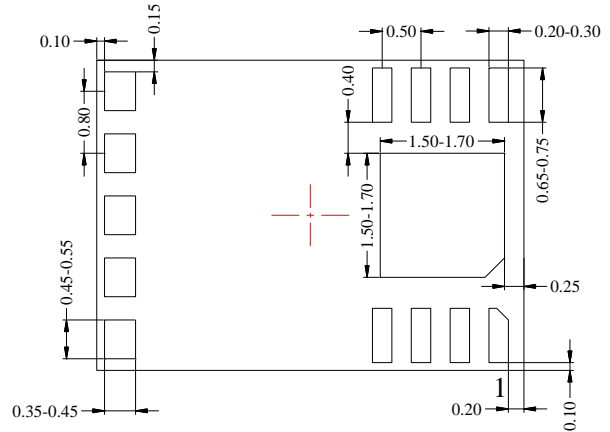


Figure 4. Suggested PCB Layout

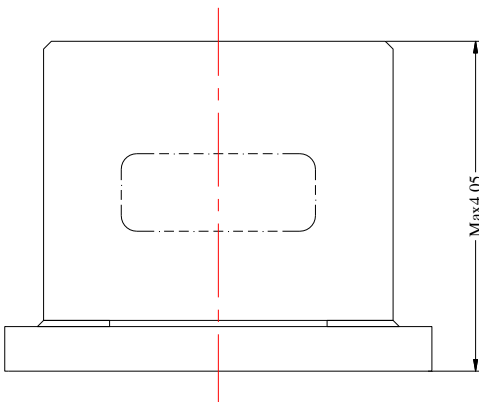
# MQFN4X5.5-14 Package Outline Drawing



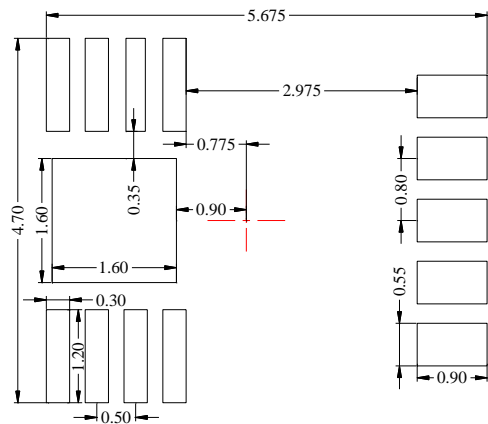
**PIN 1**  
**Top View**



**Bottom View**



**Side View**

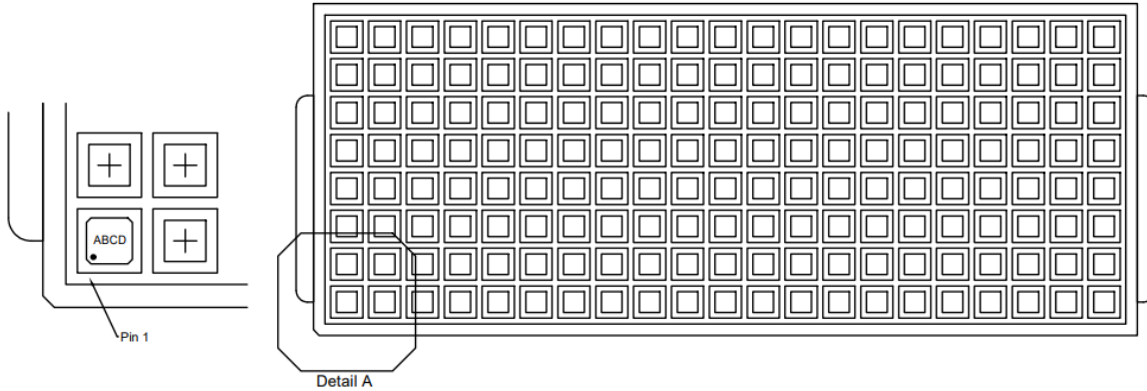


**Recommended PCB layout**  
**(Reference only)**

- Notes:** 1. All dimension in millimeter and exclude mold flash & metal burr.  
2. Center line on drawing refers to the chip body center.

# Taping orientation

## MQFN5.5\*4-14 Tray information





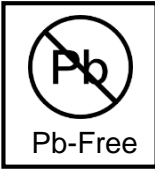



Part number	Package types	Qty Per Tray (pcs)	Trays per box	Qty per box (pcs)
SQ79002AJE	MQFN5.5*4-14	490	10	4900

**Packaging Information**

Device Code: HBR

**Label Information**

W/O: XXXXXXXXXXXX 	
P/N: SQ79002AJE 	<b>MSL3</b>
QTY: XXXX 	
D/C Lot: XXXXXXXXXXXX 	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 reel to tray

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