

Low Loss Power Distribution Switch With Programmable Current limit

General Description

The SY28892Z protection switch is an ultra-low on resistance, compact device with resistor programmable current limit. The device provides an open-drain fault flag output to signal over-current and fault conditions. It incorporates short circuit protection, over-temperature protection, and a reverse current blocking function.

The SY28892Z is available in a compact 2 mm×2mm DFN-6 package.

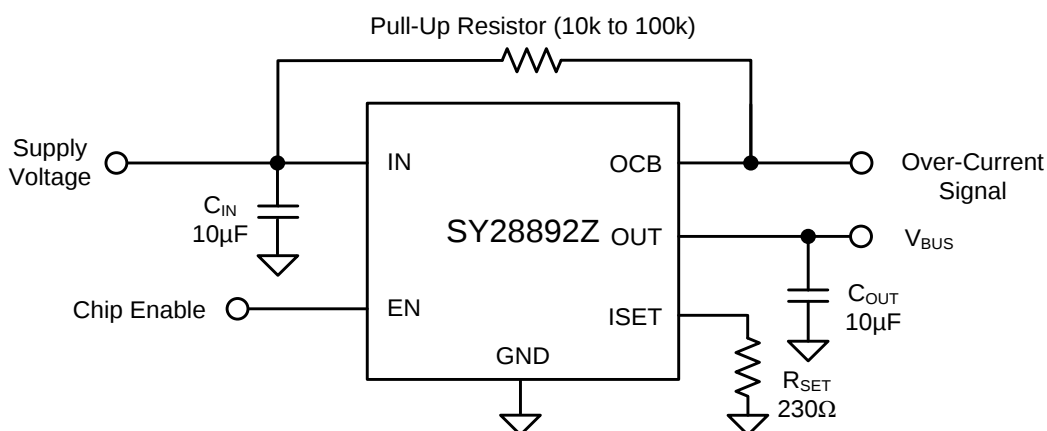
Features

- Input Voltage: 2.5V to 5.5V
- Low Power Path Resistance: 65mΩ (Typ.)
- Adjustable Current Limit up to 2.0A
- Over-Temperature Shutdown and Automatic Retry
- Reverse Blocking (No Body Diode)
- Open-Drain Fault Flag (OCB) Output for Over-Current and Fault Conditions
- Built-in Soft-Start
- Compact Package: DFN2×2-6

Applications

- USB 3.1 Applications
- USB 3G Data Cards
- USB Dongles
- Mini PCI Accessories
- USB Chargers
- Public Multi-USB Chargers
- PC Card Hot Swap Applications

Typical Application Circuit



Note: If 1μF input cap will lead to large V_{in} voltage spike, it is strongly recommended to add additional 10μF ceramic cap.

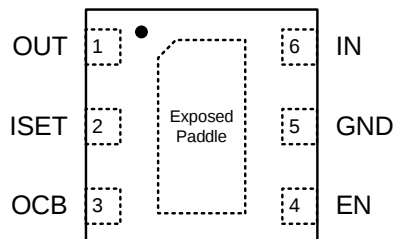
Figure 1. Schematic Diagram

Ordering Information

Ordering Part Number	Package Type	Top Mark
SY28892ZDEC	DFN2×2-6 RoHS Compliant and Halogen Free	nBxyz

x=year code, y=week code, z= lot number code

Pinout (top view)



Pin Name	Pin Number	Pin Description
OUT	1	Output pin, decoupled with a 10μF capacitor to GND.
ISET	2	Current limit programming pin. Connect a resistor R_{SET} from this pin to the ground to program the current limit: $I_{LIM} (A) = 230/R_{SET} (\Omega)$.
OCB	3	Open-drain fault flag.
EN	4	ON/OFF control, active high. Do not leave it floating.
GND	5, Exposed Pad	Ground pin.
IN	6	Input pin, decoupled with a ceramic capacitor to GND.

Block Diagram

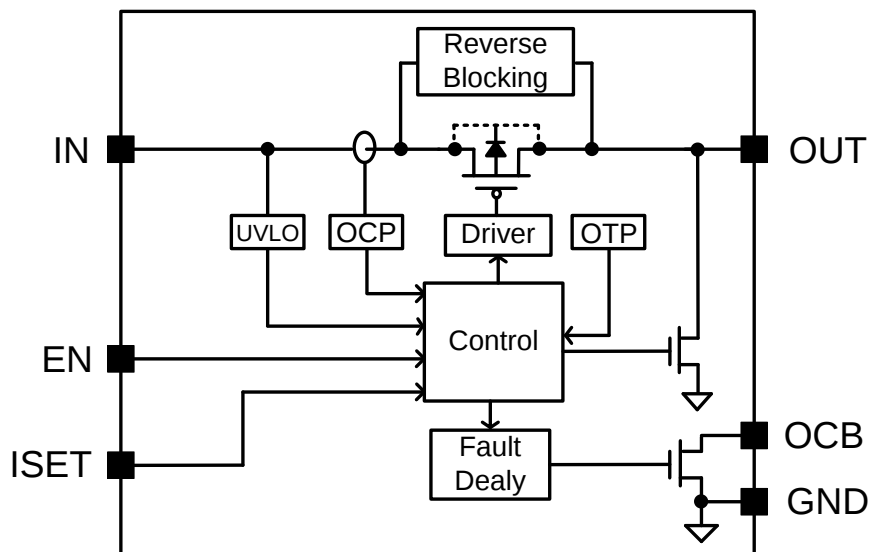


Figure 2. Block Diagram

Absolute Maximum Ratings

Parameter (Note 1)	Min	Max	Unit
IN, OUT, ISET, OCB, EN	-0.3	7	V
Lead Temperature (Soldering, 10s)		260	
Junction Temperature, Operating	-40	150	°C
Storage Temperature	-65	150	

Thermal Information

Parameter (Note 2)	Typ	Unit
θ_{JA} Junction-to-Ambient Thermal Resistance	65.3	°C/W
θ_{JC} Junction-to-Case Thermal Resistance	16.2	
P_D Power Dissipation $T_A = 25^\circ\text{C}$	1.53	W

Recommended Operating Conditions

Parameter (Note 3)	Min	Max	Unit
IN, OUT	2.5	5.5	V
ISET, OCB, EN	0	5.5	
Junction Temperature, Operating	-40	125	°C
Ambient Temperature	-40	105	

Electrical Characteristics

($V_{IN} = 5V$, $C_{OUT} = 10\mu F$, $T_A = 25^\circ\text{C}$, BOLD values indicate -40°C to 125°C , unless otherwise specified. The values are guaranteed by test, design, or statistical correlation.)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Input Voltage Range	V_{IN}		2.5		5.5	V
IN UVLO Threshold	$V_{IN,UVLO}$		2.0		2.45	V
IN UVLO Hysteresis	$V_{IN,HYS}$			0.1		V
Shutdown Input Current	I_{SHDN}	Open load, switch off		0.1	6	μA
		Output grounded, switch off		0.1	40	μA
Reverse Leakage Current		IN tied to GND, $V_{OUT} = 5V$		0.1	40	μA
Reverse Blocking Threshold	V_{RBT}	$V_{OUT} - V_{IN}$		100		mV
Reverse Blocking Recovery Threshold	V_{RBT_REC}	$V_{OUT} - V_{IN}$		-30		mV
Quiescent Supply Current	I_Q	No load, switch on		45	100	μA
FET $R_{DS(ON)}$	$R_{DS(ON)}$	$V_{IN} = 5V$, $I_{OUT} = 0.5A$		65	100	m Ω
Current Limit	I_{LIM}	$V_{OUT} = 4V$, $R_{SET} = 460\Omega$ (Note5)	0.425	0.5	0.575	A
		$V_{OUT} = 4V$, $R_{SET} = 153.3\Omega$ (Note5)	1.382	1.5	1.617	A
EN/ $\overline{EN}$ Threshold	Logic-low Voltage	V_{IL}			0.4	V
	Logic-high Voltage	V_{IH}	1.2			V
EN Input Capacitance	C_{EN}	(Note4)		1		pF

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
EN Leakage Current	I_{ENLK}				1	μA
Output Turn-On Time	t_{ON}	$R_L=10\Omega$, $C_L=1\mu F$. Measure from EN ON to V_{OUT} reach $V_{IN}\times 90\%$	0.9	2	5	ms
Output Turn-On Rise Time	t_R	$R_L=10\Omega$, $C_L=1\mu F$. Measure from $V_{OUT}=10\%$ of V_{IN} to 90% of V_{IN}	0.9	2	5	ms
Output Turn-Off Time	t_{OFF}	$R_L=10\Omega$, $C_L=1\mu F$. Measure from EN OFF to V_{OUT} reach $V_{IN}\times 10\%$		22		μs
Output Turn-Off Fall Time	t_F	$R_L=10\Omega$, $C_L=1\mu F$. Measure from $V_{OUT}=90\%$ of V_{IN} to 10% of V_{IN}		21		μs
OCB Low Resistance	R_{OCB}	$V_{IN}=5V$, $I_L=10\mu A$		9		Ω
		$V_{IN}=3.3V$, $I_L=10\mu A$		12		Ω
OUT Shutdown Discharge Resistance	R_{DSG}	EN=0, $V_{OUT}=0.1V$		25		Ω
OCB Leakage Current	I_{LKG_OCB}	$V_{OCB}=5V$		0.01	1	μA
Thermal Shutdown Temperature	T_{SD}			150		$^{\circ}C$
Thermal Shutdown Hysteresis	T_{HYS}			20		$^{\circ}C$
Current Limit Response Time	t_{OC_RES}	$I_{LOAD}=1.2I_{LIMIT}(\text{Note 5})$		25		μs
Short Circuit Response Time	t_{OC}	$I_{LOAD}=1.5I_{LIMIT}(\text{Note 5})$		2		μs
Over Current Flag Response Time	t_{OCB}	$I_{LOAD}=1.2I_{LIMIT}(\text{Note 5})$	2	8	16	μs
Reverse Blocking Response Time	t_{RBT}	Note 4		800		ns

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.

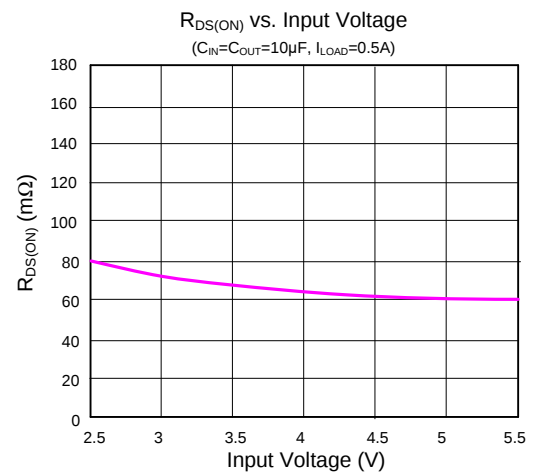
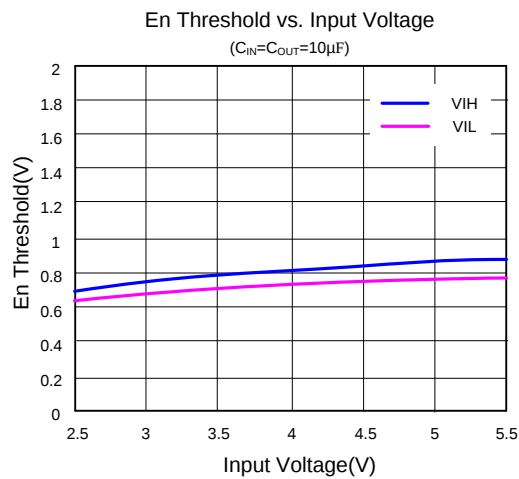
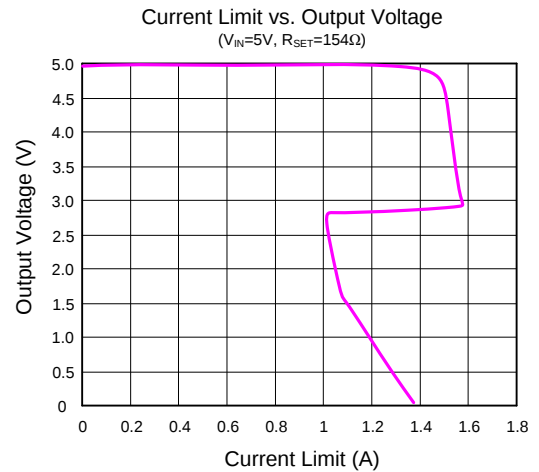
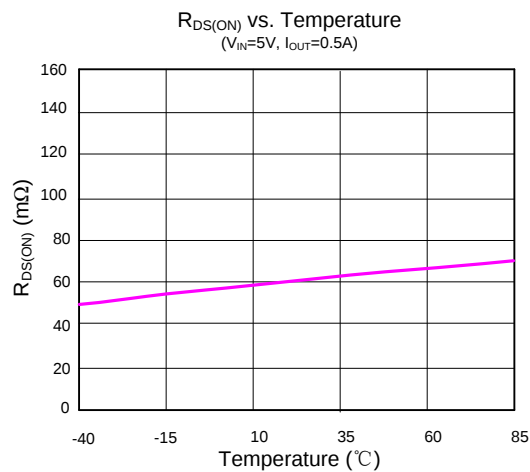
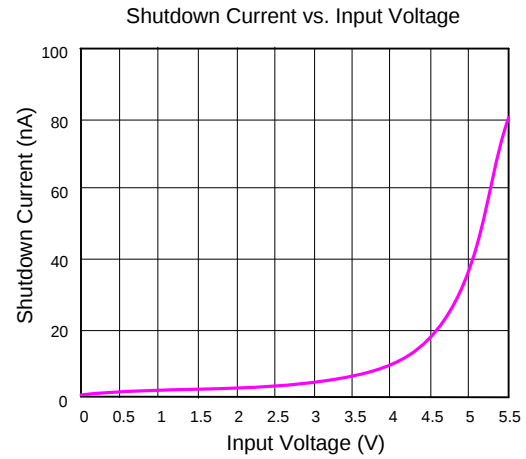
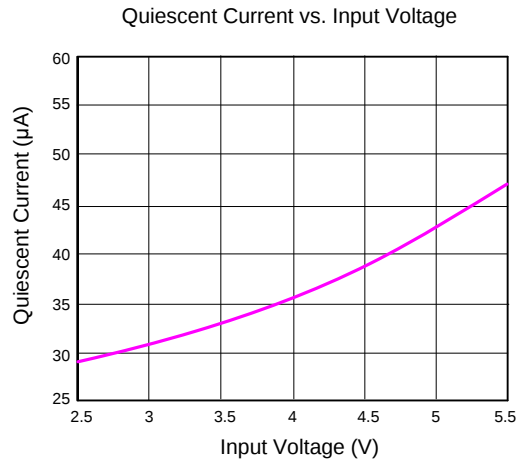
Note 2: θ_{JA} is measured in the natural convection at $T_A = 25^{\circ}C$ on the Silergy evaluation board. The exposed paddle of DFN2 $\times$ 2-6 packages is the case position for θ_{JC} measurement.

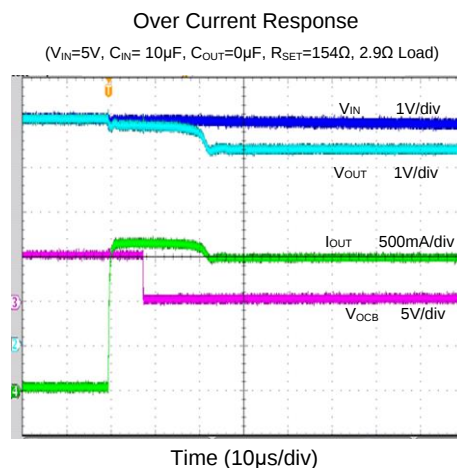
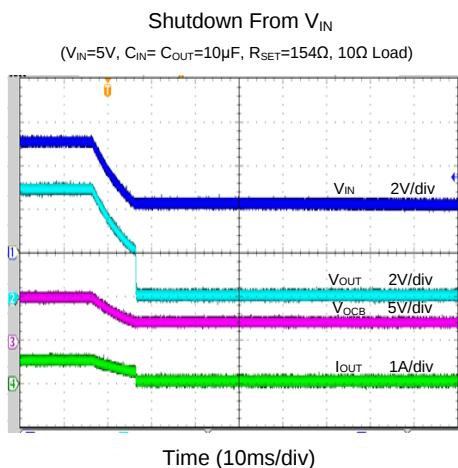
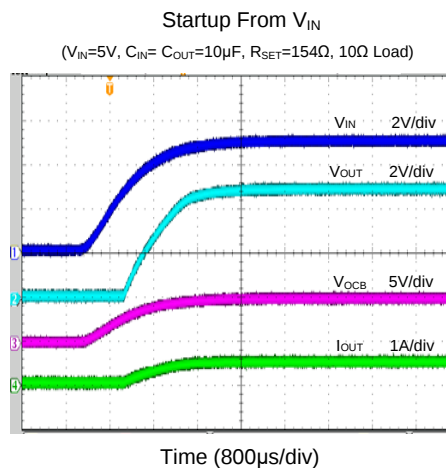
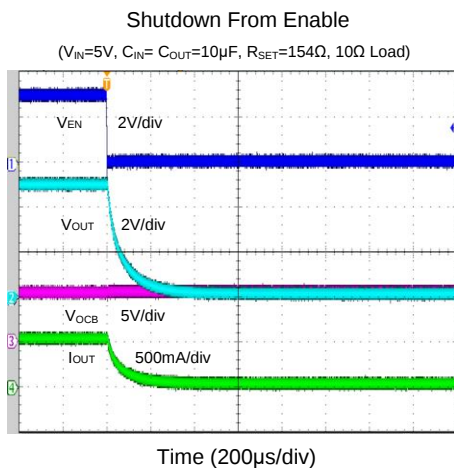
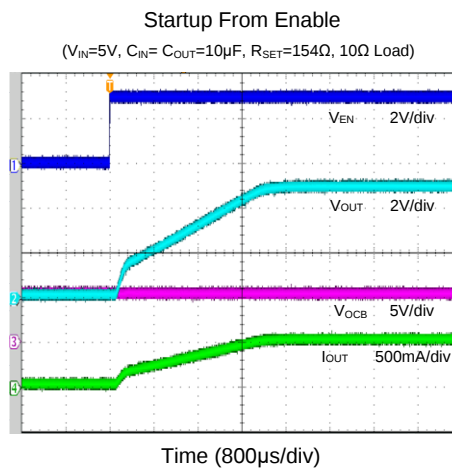
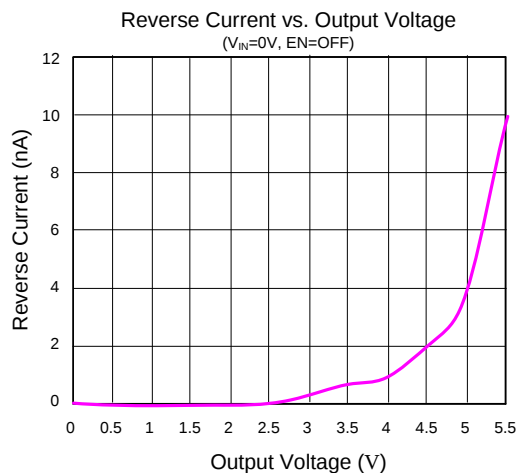
Note 3: The device is not guaranteed to function outside its operating conditions.

Note 4: Guaranteed by design but not production tested.

Note 5: The current limit threshold is determined by $I_{LMT}=230V/R_{SET}$, where R_{SET} is in Ω .

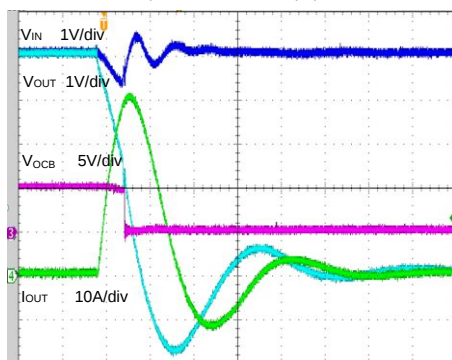
Typical Performance Characteristics





Short Circuit Response

($V_{IN}=5V$, $C_{IN}=C_{OUT}=10\mu F$)

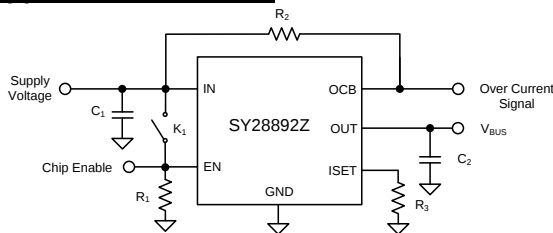


Time (2 μs /div)

Operation

The SY28892Z power switch integrates a P-channel MOSFET. It incorporates over-temperature protection and a current limiting function. Reverse blocking prevents current from flowing from OUT to IN when OUT is externally forced to a higher voltage than IN. The device is ideal for USB load-switching and hot-swap applications.

Application Schematic



BOM List

Reference Designator	Description	Part Number	Manufacturer
C1	10µF/10V, 0805	GRM21BR71A106KA73L+A01	Murata
C2	10µF/10V, 0805	GRM21BR71A106KA73L+A01	Murata
R1	1MΩ, 0603	RC0603FR-071ML	YAGEO
R2	100kΩ, 0603	RC0603FR-07100KL	YAGEO
R3	200kΩ, 0603	RC0603FR-07200L	YAGEO

Over Current Protection

The SY28892Z supports current limit programming. Connect a resistor R_{SET} from the ISET pin to the ground to program the current limit:

$$I_{LIM} (A) = 230 / R_{SET} (\Omega)$$

The minimum current limit is 0.2A. A current limit beyond 2.0A is not recommended.

The internal current-limit amplifier regulates the output current to I_{LIM} for overload conditions. The output voltage will drop when the device operates in current regulation. If the over current condition persists for a long time, the junction temperature may exceed 150°C, and over-temperature protection will shut down the part. Once the temperature drops below 130°C, the part will automatically restart.

Table 1. Current Limit vs. R_{SET}

$R_{SET}(\Omega)$	Current Limit Threshold(mA)		
	MIN	TYP	MAX
460.0	425	500	575
153.3	1380	1500	1620

During current limiting, the value will adjusted to around $60\% \times I_{LIM}$ to decrease power dissipation when $V_{OUT} < 50\% \times V_{IN}$.

Fault Flag(OCB)

The OCB open-drain output is asserted (active low) when thermal shutdown protection is triggered or an over-current condition persists for 8µs. The OCB signal will remain asserted until the fault condition is removed. Connecting a heavy capacitance load to an enabled device can cause a momentary over-current condition. Connect OCB with a pull-up resistor to the IN or OUT voltage rail.

Supply Filter Capacitor

To prevent the input voltage drop during hot-plug events, a 10µF input ceramic bypass capacitor is recommended. However, higher capacitor values can further reduce the voltage drop on the input. Furthermore, shorting the output will generate a positive voltage spike on the input without the input capacitor. When such transients exceed the absolute maximum supply voltage, even for a short duration, it can damage the internal circuitry.

Output Filter Capacitor

A ceramic capacitor higher than 10µF is recommended. Place it close to the OUT pin to reduce the voltage drop during load transient. A larger value capacitor can further reduce the drop during high current applications.

Reverse Block Function

The SY28892Z integrates a reverse current blocking function. It monitors the reverse voltage from IN to OUT, and when it exceeds 100mV, it will shut down the power MOSFET in 700ns to stop the reverse current flow from OUT to IN.

PCB Layout Guide

For best performance of the SY28892Z, the following guidelines must be followed:

- High current carrying power path connections should be as short and wide as possible and use at least 2-ounce copper for all these traces.
- Place the output capacitor as close to the connectors as possible to lower the parasitic impedance (mainly inductance) between the port and the capacitor and improve transient performance.
- Place the input and output capacitors close to the device and connect to the ground plane to reduce noise coupling.

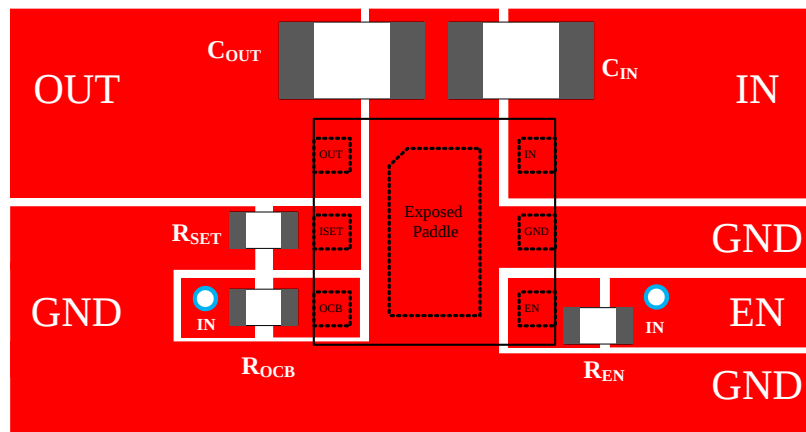
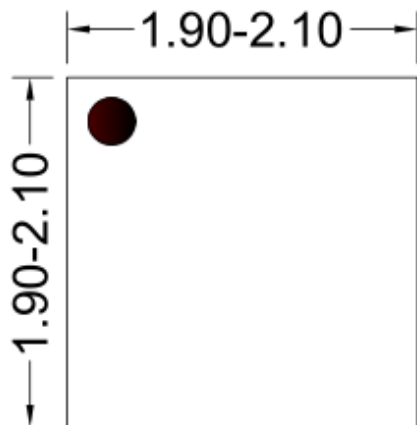
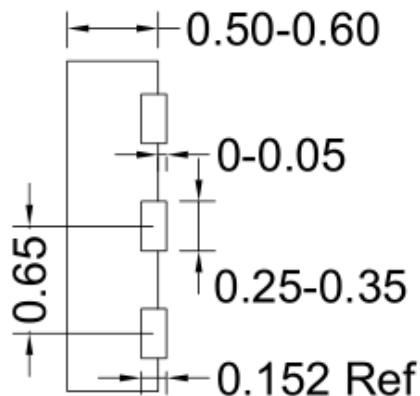


Figure 3. SY28892ZDEC PCB Layout Suggestion

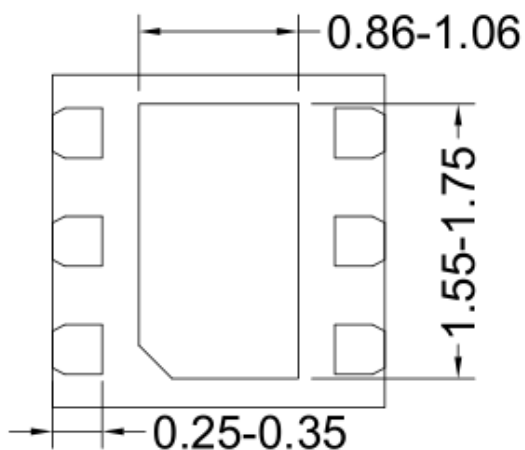
DFN2×2-6 Package Outline



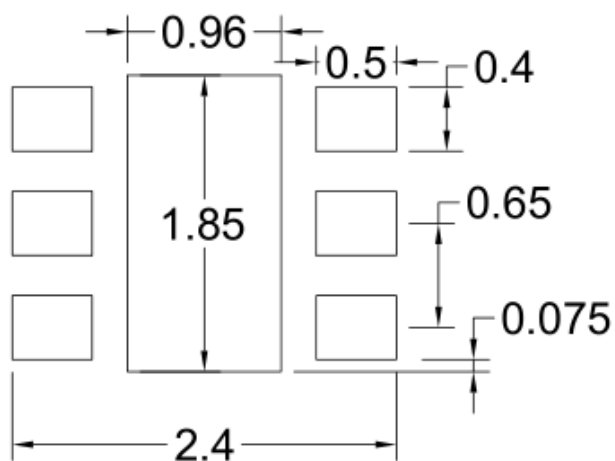
Top View



Side View



Bottom View

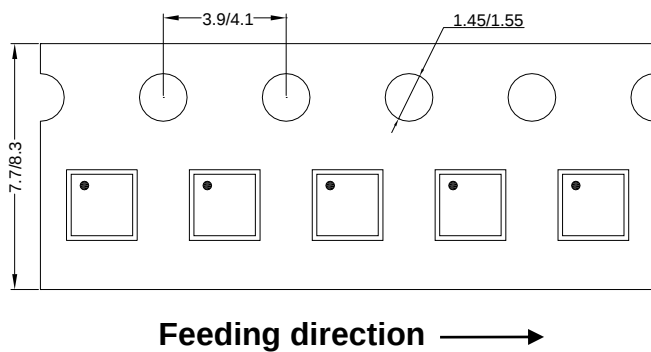


Recommended PCB Layout

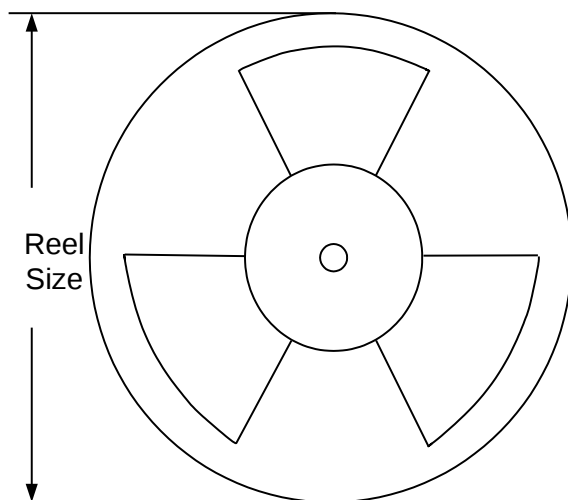
Note: All dimensions are in millimeters and exclude mold flash and metal burr.

Taping & Reel Specification

DFN2×2 Taping Orientation



Carrier Tape & Reel Specification for Packages



Package types	Tape width (mm)	Pocket pitch(mm)	Reel size (Inch)	Trailer length(mm)	Leader length (mm)	Qty per reel
DFN2×2	8	4	7"	400	160	3000

Revision History

Date	Revision	Change
Aug.25, 2023	Revision 1.0	Language improvements for clarity
Nov.21, 2022	Revision 0.9A	Ambient Temperature Range changed from (-40°C to 85°C) to (-40°C to 105°C)
Nov.14, 2018	Revision 0.9	Initial Release

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

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