TPS75R01C Series

75-V High-Side Ideal Diode/OR-ing MOSFET Controller

Features

- Wide Input Voltage Range
  - Normal Operation: 5 V to 75 V
  - Wide Operating Input Voltage Range, Vin: 1 V to 75 V (V_{BIAS} required for Vin < 5 V)
  - Maximum: 100 V Transient
- External N-channel MOSFET Driver
  - Charge Pump with Integrated Capacitor
  - Gate Driver for External N-Channel MOSFET
  - 20-mV V_{SD} for Regulated Conduction Mode
  - −10-mV V_{SD} for Reverse Current Blocking
  - 2.5-A Sink Current to Turn-off NMOS
  - Dedicate OFF Pin to Turn off External MOSFET
- Low Quiescent Current
- Fast Reverse Current Blocking: 450 ns Maximum
- SOT23-6 Package

Applications

- Industry Control, Factory Automation
- Server, Network, and Enterprise Power Supply
- Active OR-ing for Redundant Power Supplies

Description

The TPS75R01C is an ideal diode controller that operates with an external N-channel MOSFET for reverse protection applications or redundant power supply applications. The forward voltage drop is controlled at as low as 20 mV, which can significantly reduce power loss to replace an ordinary Schottky Diode in power distribution networks.

The TPS75R01C supports a wide operating voltage range from 5 V to 75 V, with an absolute maximum rating of 100 V. The support for a transient 100-V input voltage is particularly suitable to meet the severe requirements in 48-V power supply systems.

The TPS75R01C integrates a charge pump to drive the external N-channel MOSFET. The device provides precise gate control to regulate the voltage drop between the source and drain at 20 mV. When it detects a reverse voltage of −10 mV from IN to OUT, the TPS75R01C turns off the external MOSFET within 450 ns maximum to ensure no reverse current flows. The TPS75R01C also features a dedicated MOSFET control pin. It allows the MCU controller to turn on or off the external NMOS.

The TPS75R01C provides a small SOT23-6 package, and it is qualified to operate within the junction temperature range from −40°C to +125°C.

Typical Application Circuit

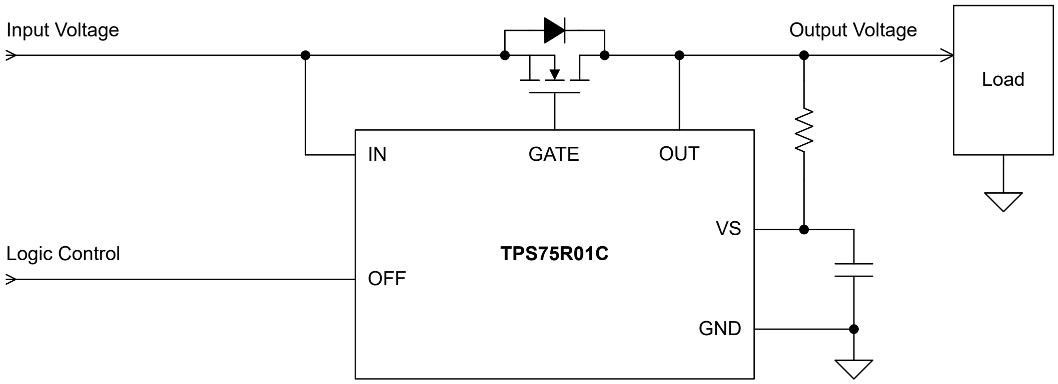

Table of Contents

Product Family Table

Order Number	Voltage Range (V)	Regulated Forward Voltage (mV)	Reverse Protection Threshold (mV)	Package
TPS75R01C-S6TR-S	5 to 75	20	–10	SOT23-6

Revision History

Date	Revision	Notes
2025-11-15	Rev.A.0	Initial release.

Pin Configuration and Functions

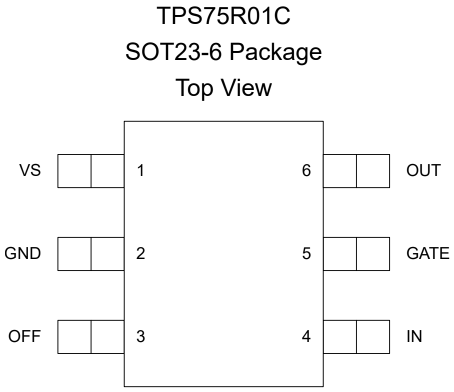

Table 1. Pin Functions: TPS75R01C

Pin No.	Pin Name	I/O	Description
5	GATE	O	Gate drive output pin. Connect this pin to the gate of the external N-channel MOSFET.
2	GND	-	Ground reference pin.
4	IN	I	Input supply voltage sense pin. Connect this pin to the source of the external N-channel MOSFET.
3	OFF	I	External MOSFET test control pin. When the OFF pin is logic low or left open, the MOSFET test function is disabled. When the OFF pin is logic high, the GATE pin will be pulled down and the MOSFET will be turned off, and the MOSFET test function is enabled.
6	OUT	I	Output voltage sense pin. Connect this pin to the drain of the external N-channel MOSFET.
1	VS	I	Main power supply for the internal bias voltage and an auxiliary supply voltage for the internal gate drive charger pump. Connect this pin to V_{OUT}, V_{IN} or a separate power supply.

Specifications

Absolute Maximum Ratings (1) (2) (3)

Parameter		Min	Max	Unit
IN, OUT		−0.3	100	V
GATE		−0.3	100	V
VS		−0.3	100	V
OFF		−0.3	7	V
T_J	Junction Temperature Range	−40	150	°C
T_A	Ambient Temperature Range	−40	125	°C
T_{STG}	Storage Temperature Range	−65	150	°C
T_L	Lead Temperature (Soldering 10 sec)		260	°C

(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.
(2) All voltage values are with respect to GND.
(3) Not subject to production test, specified by design.

ESD, Electrostatic Discharge Protection

Parameter		Condition	Minimum Level	Unit
HBM	Human Body Model ESD	ANSI/ESDA/JEDEC JS-001 (1)	±2	kV
CDM	Charged Device Model ESD	ANSI/ESDA/JEDEC JS-002 (2)	±1	kV

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

Recommended Operating Conditions

Parameter		Min	Max	Unit
V_{IN}, V_S	Power Supply Voltage	5	75	V
V_{OUT}	Output Voltage	5	75	V
V_{OFF}	OFF Control Voltage	0	5.5	V
T_J	Junction Temperature Range	−40	125	°C

Thermal Information

Package Type	θ_{JA}	θ_{JB}	$\theta_{JC,TOP}$	Unit
SOT23-6	155	48	81	°C/W

Electrical Characteristics

All test conditions: T_J = −40°C to +125°C; typical values at T_J = 25°C, V_{IN} = 12 V, V_{OUT} = 12 V, V_{OFF} = 0 V, C_{GATE} = 47 nF, over operating free-air temperature range (unless otherwise noted)

Parameter		Conditions	Min	Typ	Max	Unit
VS Pin						
V_{VS}	Supply Voltage		5		75	V
I_{IVS}	Supply Input Current	$V_S = V_{IN} = 5$ V, $V_{OUT} = V_{IN} - 100$ mV, GATE = OPEN		40	80	µA
		$V_S = V_{IN} = 12$ V, $V_{OUT} = V_{IN} -$ 100 mV, GATE = OPEN		50	100	µA
		$V_S = V_{IN} = 75$ V, $V_{OUT} = V_{IN} -$ 100 mV, GATE = OPEN		80	160	µA
IN Pin						
V_{IN}	Supply Voltage		5		75	V
I_{IN}	Supply Input Current	$V_S = V_{IN} = 5$ V, $V_{OUT} = V_{IN} - 100$ mV, GATE = OPEN		300	400	µA
		$V_S = V_{IN} = 12$ V, $V_{OUT} = V_{IN} -$ 100 mV, GATE = OPEN		450	550	µA
		$V_S = V_{IN} = 75$ V, $V_{OUT} = V_{IN} -$ 100 mV, GATE = OPEN		450	550	µA
OUT Pin						
I_{OUT}	OUT Pin Current	$V_S = V_{IN} = 5$ V, $V_{OUT} = V_{IN} - 100$ mV		3	6	µA
		$V_S = V_{IN} = 12$ V, $V_{OUT} = V_{IN} -$ 100 mV		3	6	µA
		$V_S = V_{IN} = 75$ V, $V_{OUT} = V_{IN} -$ 100 mV		3	6	µA
Gate Pin						
$I_{GATE,ON}$	GATE Pin Source Current	$V_S = V_{IN} = 5$ V to 75 V, $V_{GATE} = V_{IN}$, $V_{OUT} = V_{IN} - 175$ mV	25	30	45	µA
$I_{GATE,OFF}$	Gate Pin Sink Current	$V_S = V_{GATE} = V_{IN} + 3$ V, $V_{OUT} > V_{IN} + 100$ mV, $t \le 10$ ms		2.5		A
V_{GS} (1)	$V_{GATE} - V_{IN}$ in Forward Operation (1)	$V_S = V_{IN} = 5$ V, $V_{GATE} = V_{IN}$, $V_{OUT} = V_{IN} - 175$ mV	4	6.5	9	V
		$V_S = V_{IN} = 12$ V, $V_{GATE} = V_{IN}$, $V_{OUT} = V_{IN} - 175$ mV	8	9.2	14	V
		$V_S = V_{IN} = 75$ V, $V_{GATE} = V_{IN}$, $V_{OUT} = V_{IN} - 175$ mV	8	11	14	V
$V_{SD,REG}$	Regulated Forward V_{SD} Threshold, $V_{IN} > V_{OUT}$	$V_S = V_{IN}$, $V_{IN} - V_{OUT}$	10	20	30	mV

Parameter		Conditions	Min	Typ	Max	Unit
$V_{SD,REV}$	Reverse V_{SD} Threshold, $V_{IN} < V_{OUT}$	$V_S = V_{IN}$, $V_{IN} - V_{OUT}$	−15	−10	−5	mV
$\Delta V_{SD,REV}$	Reverse V_{SD} Hysteresis			10		mV
$t_{GATE,REV}$ (2)	Gate Capacitance Discharge Time at Forward to Reverse Transition	$C_{GATE} = 0$		25	85	ns
		$C_{GATE} = 10$ nF		80		ns
		$C_{GATE} = 47$ nF		260		ns
$t_{GATE,OFF}$ (2)	Gate Capacitance Discharge Time at OFF Pin Low to High Transition	$C_{GATE} = 47$ nF		450		ns
OFF Pin						
$V_{OFF,IH}$	OFF Input High-Level Voltage	$V_{OUT} = V_{IN} - 500$ mV, V_{OFF} Rising		1.55	1.75	V
$V_{OFF,IL}$	OFF Input Low-Level Voltage	$V_{OUT} = V_{IN} - 500$ mV, V_{OFF} Falling	1.1	1.4		V
ΔV_{OFF}	OFF Threshold Voltage Hysteresis	$V_{OFF,IH} - V_{OFF,IL}$		160		mV
I_{OFF}	OFF Pin Internal Pulldown Current	$V_{OFF} = 5$ V		5	8	μA

(1) Measurement of V_{GS} voltage (i.e., $V_{GATE} - V_{IN}$) includes 1 MΩ in parallel with C_{GATE}.

(2) Not subject to production test, specified by design.

Typical Performance Characteristics

All test conditions: T_A = 25°C, V_{IN} = 12 V, V_{OFF} = 0 V, over operating free-air temperature range (unless otherwise noted).

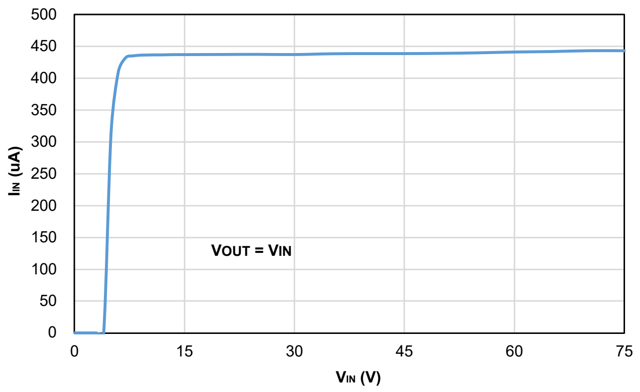

Figure 1. I_{IN} vs. V_{IN}

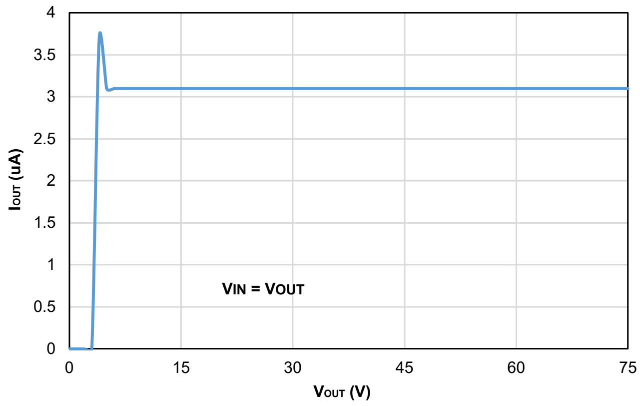

Figure 2. I_{OUT} vs. V_{OUT}

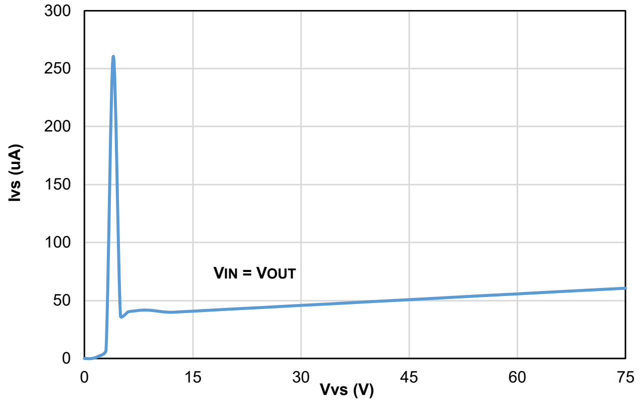

Figure 3. I_{VS} vs. V_{VS}

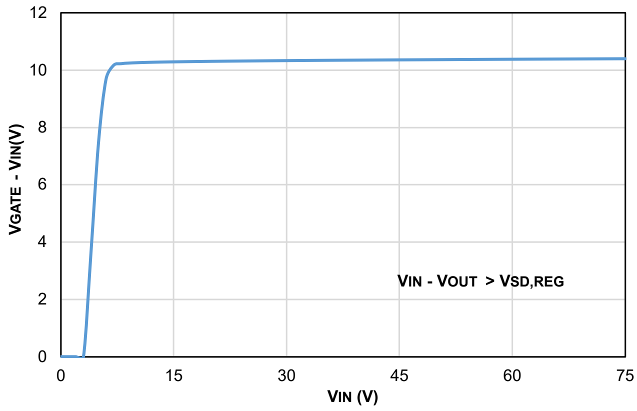

Figure 4. V_{GS} vs. V_{IN}

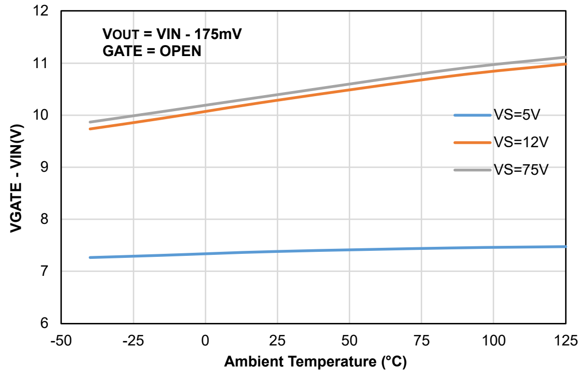

Figure 5. VGS vs. Temperature

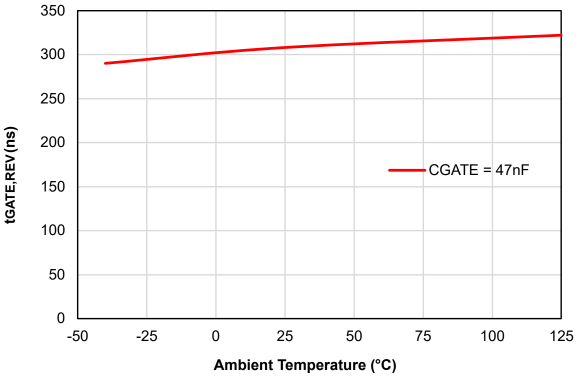

Figure 6. Forward Gate Charge Time 10 nF

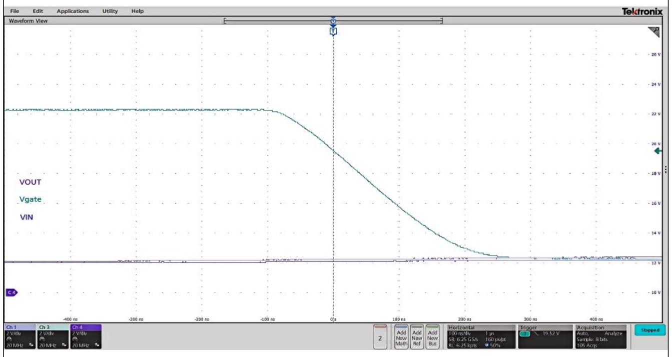

Figure 7. Reverse Gate Charge Time 10 nF

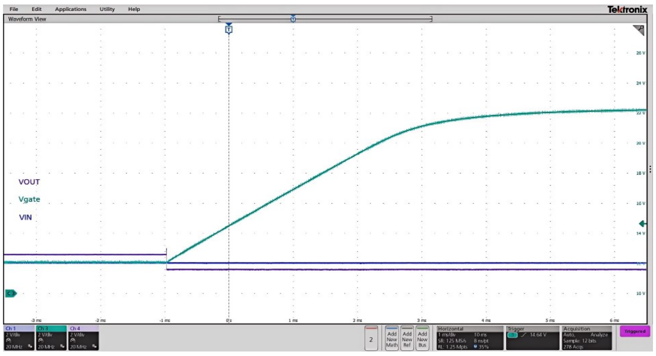

Figure 8. t_{GATE} vs. Temperature

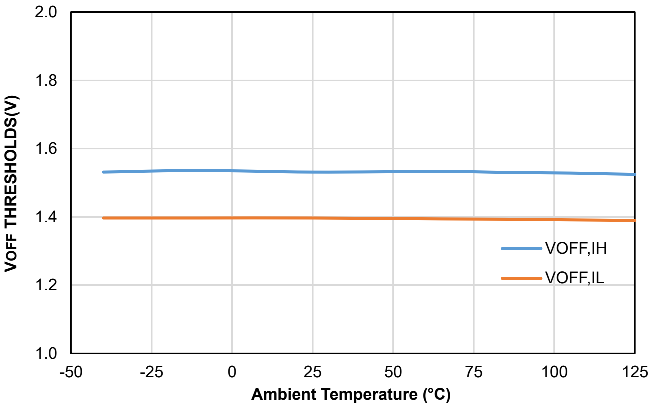

Figure 9. OFF Pin Threshold

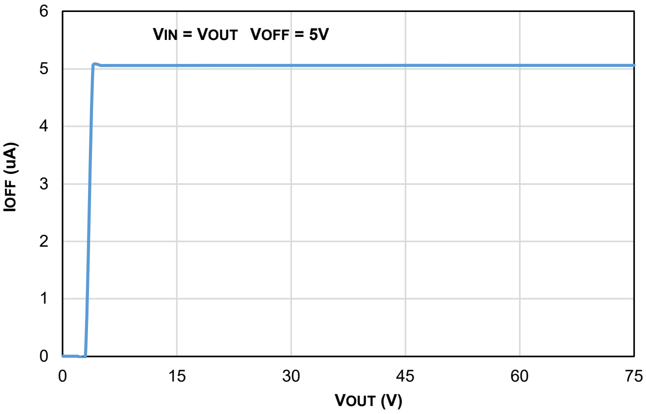

Figure 10. OFF Pin Pull down

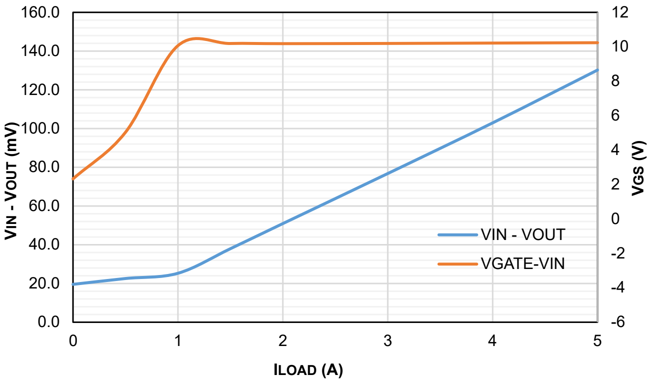

Figure 11. Gate Pin vs. Load Current

Detailed Description

Overview

The TPS75R01C is an ideal diode controller that operates with an external N-channel MOSFET for reverse protection applications or redundant power supply applications. The forward voltage drop is controlled as low as 20 mV, which significantly reduces power loss to replace an ordinary Schottky Diode in power distribution networks.

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Functional Block Diagram

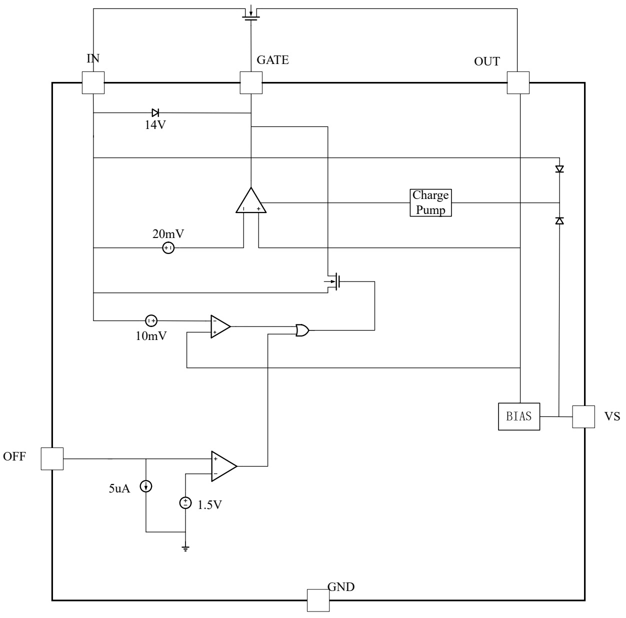


Figure 12. Functional Block Diagram

Feature Description

Input Power Supply Voltage (IN)

The TPS75R01C uses the IN pin to power up the internal circuitry with a supply voltage ranging from 5 V to 75 V. The maximum voltage range from IN to GND is 100 V.

Application and Implementation

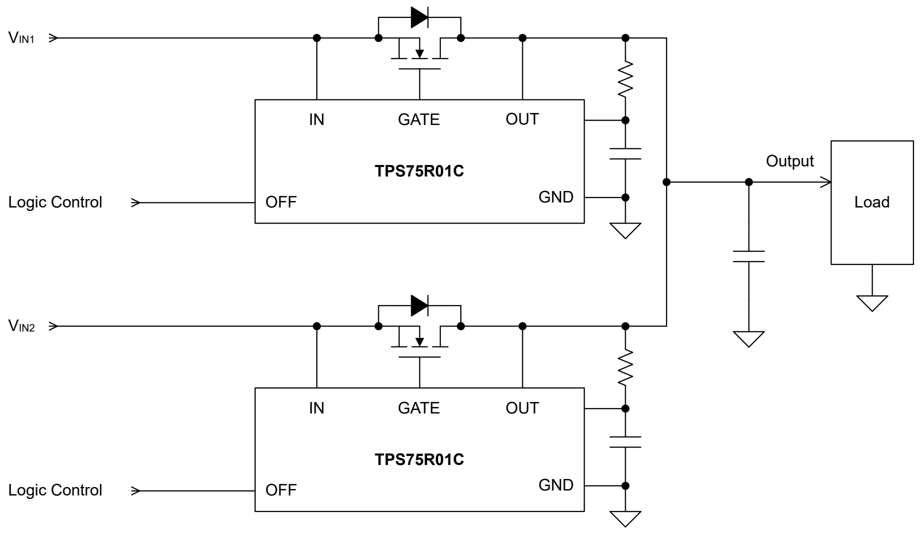
Note

Information in the following application sections is not part of the 3PEAK's component specification and 3PEAK does not warrant its accuracy or completeness. 3PEAK's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

Application Information

The TPS75R01C is an ideal diode controller operating with an external N-channel MOSFET for reverse protection and redundant power supplies applications. The following Typical Application section shows a typical usage of the TPS75R01C.

Typical Application



The TPS75R01C is an ideal diode controller that operates with an external N-channel MOSFET for reverse protection applications or redundant power supply applications.

Layout

Layout Guideline

- Connect the IN, GATE, and OUT pins of TPS75R01C close to the source, gate, and drain pins of the external N-channel MOSFET.
- Connect the GATE pin of TPS75R01C to the gate pin of the external N-channel MOSFET with short and wide trace to avoid turn-off delay due to the trace resistance.
- For the high current path through the external N-channel MOSFET, it is recommended to use wide trace lengths or thick copper weight to minimize I×R drop and heat dissipation.

Layout Example

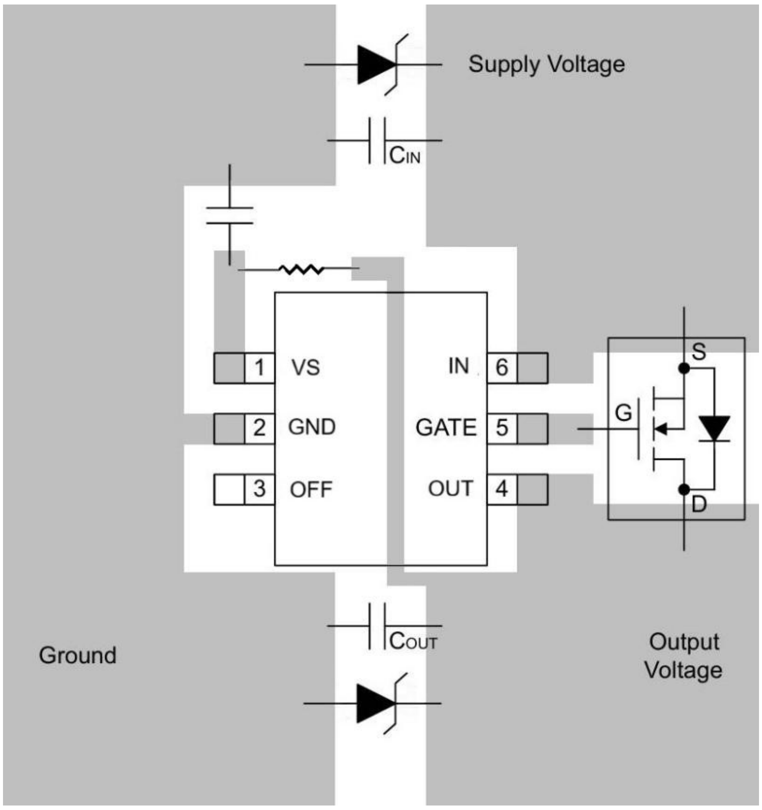
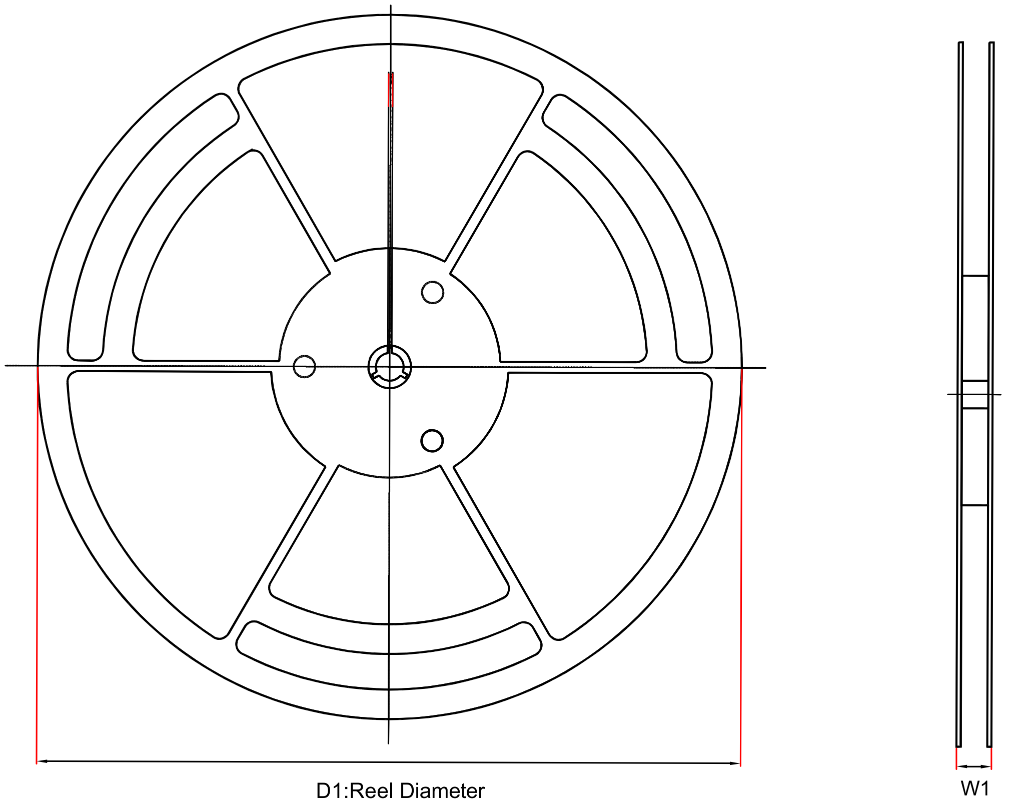
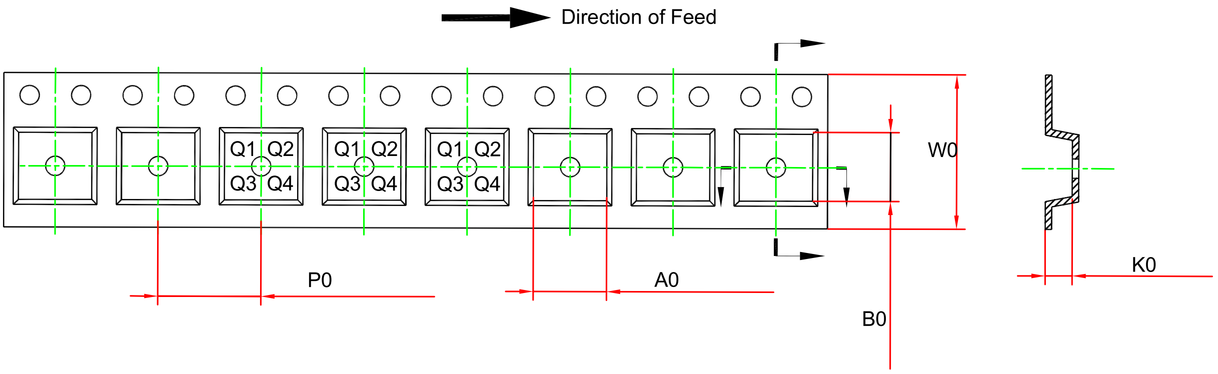


Figure 13. Layout Example

Tape and Reel Information



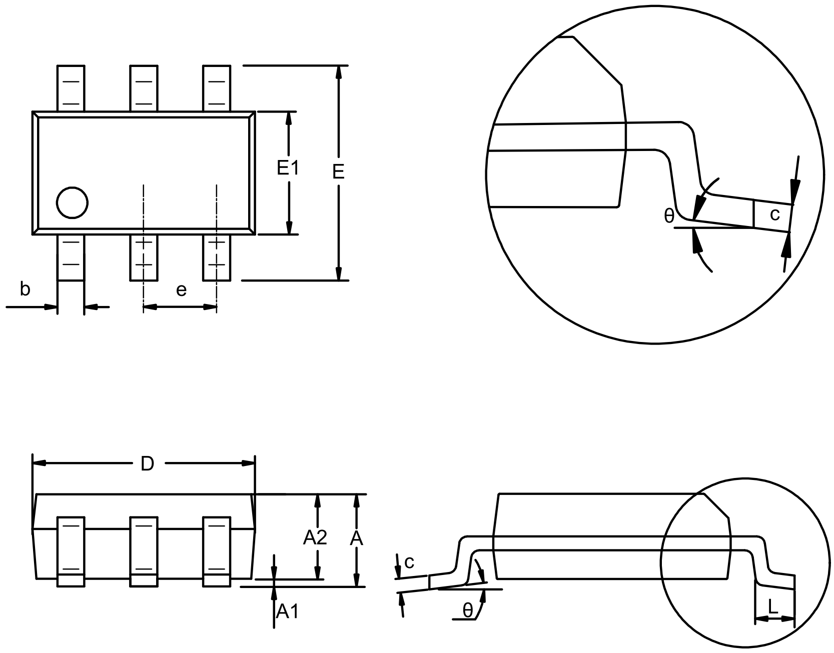


Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPS75R01C-S6TR-S	SOT23-6	180	12	3.3	3.2	1.4	4	8	Q3

Package Outline Dimensions

SOT23-6

Package Outline Dimensions S6T(SOT23-6-A)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.150	0.000	0.006
A2	1.000	1.200	0.039	0.047
b	0.280	0.500	0.011	0.020
c	0.100	0.230	0.004	0.009
D	2.820	3.020	0.111	0.119
E	2.600	3.000	0.102	0.118
E1	1.500	1.720	0.059	0.068
e	0.950 BSC		0.037 BSC	
L	0.300	0.600	0.012	0.024
θ	0	8°	0	8°

NOTES

1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.
3. Reference JEDEC MO-178.

Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
TPS75R01C-S6TR-S	−40 to 125°C	SOT23-6	S7C	MSL2	Tape and Reel,3000	Green

Green: 3PEAK defines "Green" to mean RoHS compatible and free of halogen substances.

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