General description

The MX16171TLL10 high-side OR-ing FET circuit integrated an N-MOSFET and acts as an ideal diode rectifier when connected in series with the power supply. This OR-ing circuit enables internal MOSFET to replace diode rectifiers in power distribution networks, reducing power loss and voltage drop.

The MX16171TLL10 circuit provides charge pump gate drive for an internal N-channel MOSFET and fast response comparator to turn off the FET when current flows in reverse. The MX16171TLL10 can be connected to power supplies from 5V to 90V and can withstand transient voltages up to 100V.

Features

- ♦ Wide operating input voltage range V_{IN}: 5V to 90V
- ♦100V transient voltage
- ♦ Charge pump gate driver for the internal N-channel MOSFET
- ♦Ultra-small V_{DS} turn-off voltage reduces turn-off time
- ♦ TOLL-8

Applications

Active OR-ing of redundant (N+1) power supplies

General information

Ordering information

Part Number	Description
MX16171TLL10	TOLL-8
MPQ	2000pcs

Package dissipation rating

Package	RθJA（℃/W）	RθJC（℃/W）
TOLL-8	45	0.44

Absolute maximum ratings

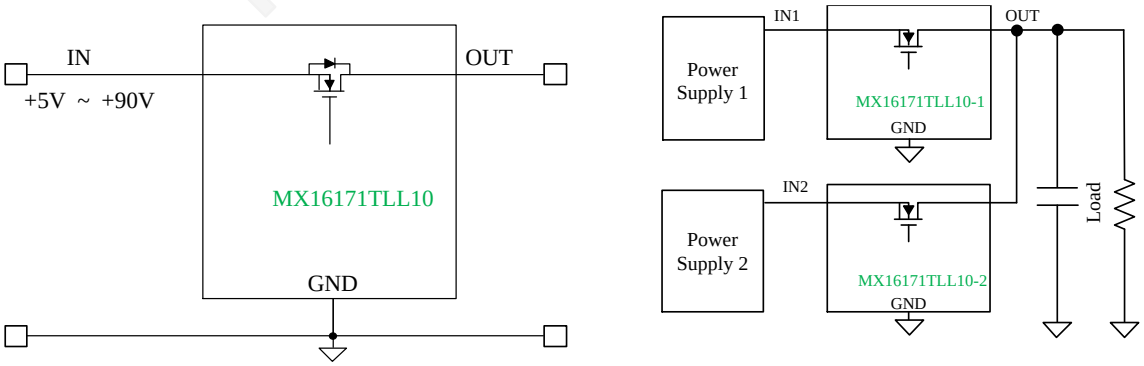
Parameter	Value
IN, OUT Pins to GND	-0.3 to 100V
Junction temperature	150℃
Storage temperature, Tstg	-50 to 150℃
Leading temperature （soldering,10secs）	260℃
ESD Susceptibility HBM	±2000V

Stresses beyond those listed in Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect reliability. Functional operation of the device at any conditions beyond those indicated in the Recommended Operating Conditions section is not implied.

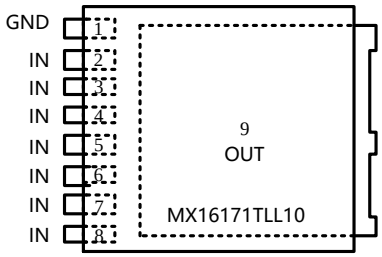
Recommended operating condition

Symbol	Range
IN, OUT Pins	5-90V
Operating temperature	-40~125℃
Moisture sensitive level	MSL3

Typical application

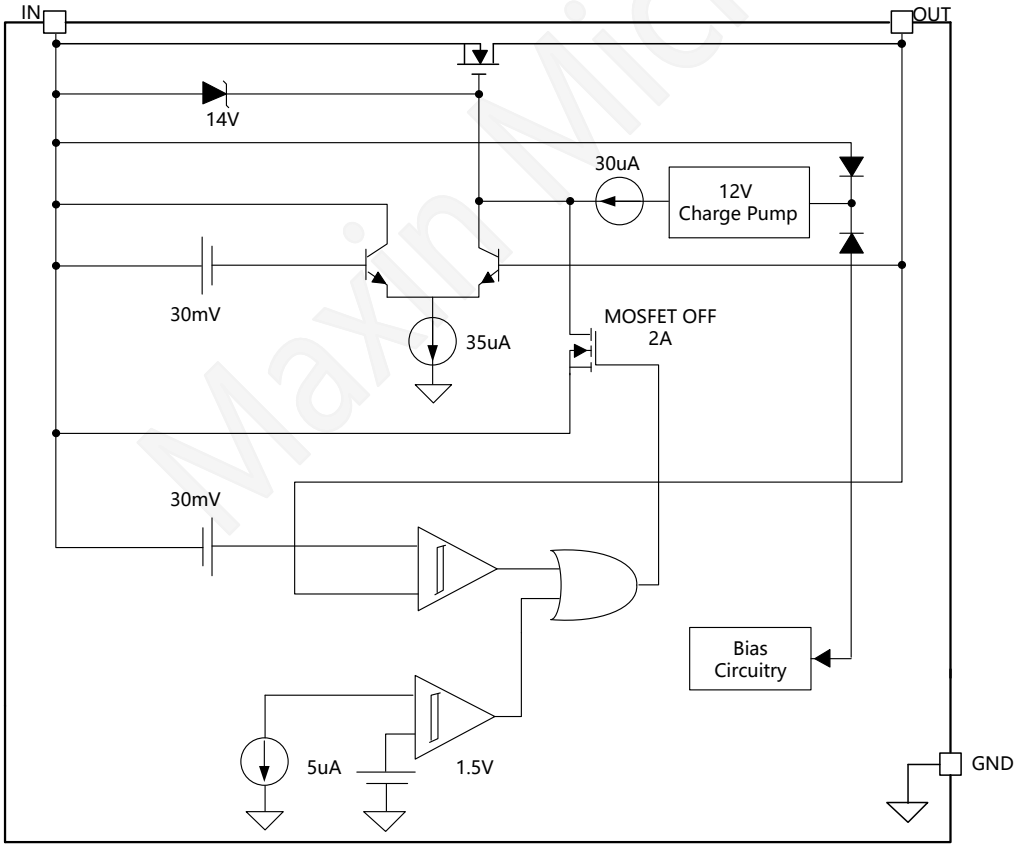


Terminal assignments

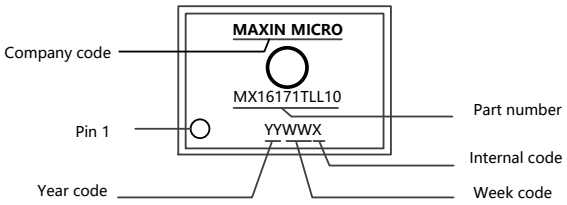


PIN NO.	PIN name	Description
DFN		
1	**GND**	Ground return for the circuit.
2~8	**IN**	Voltage sense connection to the internal MOSFET Source pin and circuit supply.
9	**OUT**	Voltage sense connection to the internal MOSFET Drain pin and circuit output.

Block diagram



Marking information



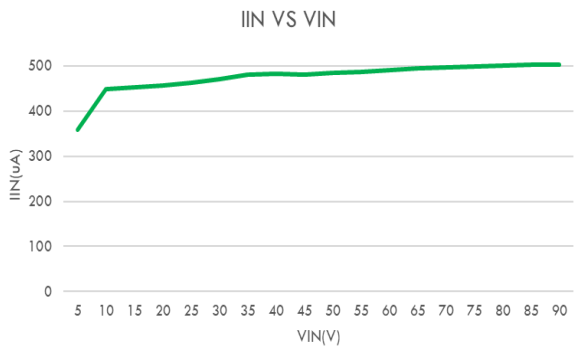
Electrical characteristics

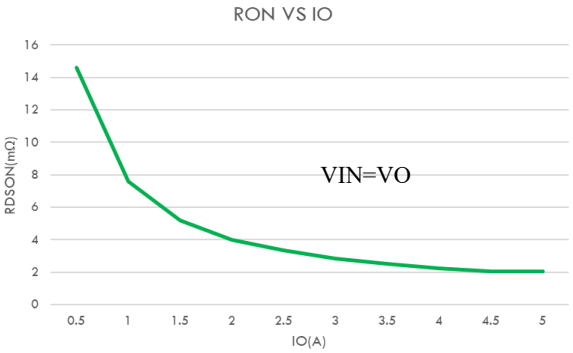
(V_{IN} =5-90V, V_{OUT} = V_{IN}, T_A = 25℃, unless otherwise noted)

Symbol	Parameter	Test condition	Min	Typ.	Max	Unit
IN PIN						
V_{IN}	Operating Input Voltage Range		5		90	V
I_{IN}	IN Pin current	V_{IN} =12V to 90V			700	uA
OUT PIN						
V_{OUT}	Operating Output Voltage Range		5		90	V
I_{OUT}	OUT Pin Current	V_{IN} = 5V to 90V, V_{OUT} = V_{IN}			8	uA
INTERNAL REGULATOR						
$I_{GATE(OFF)}$	Internal Sink Current	V_{GATE} = V_{IN} + 3V, V_{OUT} > V_{IN} + 100mV, t ≤ 10ms		2		A
$V_{SD(REV)}$	Reverse V_{SD} Threshold V_{IN} < V_{OUT}	V_{IN} - V_{OUT}	-40	-15	-10	mV
$V_{SD(REG)}$	Regulated Forward V_{SD} Threshold V_{IN} > V_{OUT}	V_{IN} = 5V, V_{IN} - V_{OUT}	1	15	30	mV
		V_{IN} = 12V, V_{IN} - V_{OUT}	5	25	60	
INTERNAL MOSFET						
V_{DS}	Drain to source voltage	I_{DS} = 250uA	100			V
RDS_{ON}	On resistance	I_D = 10A，VGS=10V		2.5	3	mΩ

Characteristic plots

（V_{IN} = V_{OUT}, C_{IN} = C_O = 1uF, TA = 25℃, unless otherwise noted）





Forward waveform　　Reverse waveform

Operation description

IN and OUT Pins

When power is initially applied, the load current will flow from source to drain through the body diode of the internal MOSFET. Once the voltage across the body diode exceeds $V_{SD(REG)}$ then the MX16171TLL10 begins charging the MOSFET gate through a 30µA (typical) charge pump current source.

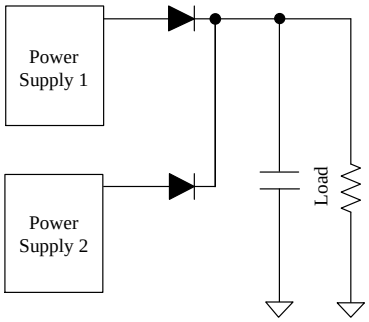
The MX16171TLL10 is designed to regulate the MOSFET gate-to-source voltage. If the MOSFET current decreases to the point that the voltage across the MOSFET falls below the $V_{SD(REG)}$ voltage regulation point of 30mV (typical), the gate voltage will be decreased until the voltage across the MOSFET is regulated at 20mV.

If the internal MOSFET current reverses, possibly due to failure of the input supply, such that the voltage across the MX16171TLL10 IN and OUT pins is more negative than the $V_{SD(REV)}$ voltage of -15mV (typical), the MX16171TLL10 will quickly discharge the MOSFET gate. If the input supply fails abruptly, as would occur if the supply was shorted directly to ground, a reverse current will temporarily flow through the MOSFET until the gate can be fully discharged. This reverse current is sourced from the load capacitance and from the parallel connected supplies.

Application and Implementation

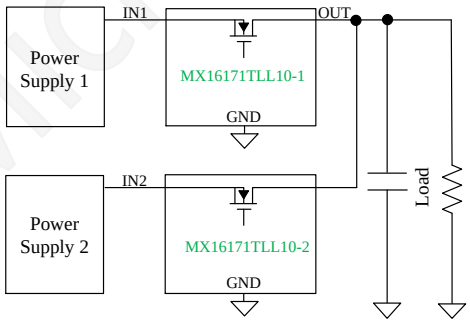
Application Information

Systems that require high availability often use multiple, parallel-connected redundant power supplies to improve reliability. Schottky OR-ing diodes are typically used to connect these redundant power supplies to a common point at the load. The disadvantage of using OR-ing diodes is the forward voltage drop, which reduces the available voltage and the associated power losses as load currents increase. Using MX16171TLL10 to replace the OR-ing diode requires a small increase in the level of complexity, but reduces, or eliminates, the need for diode heat sinks or large thermal copper area in circuit board layouts for high power applications.



OR-ing with Diodes

The MX16171TLL10 is a positive voltage (that is, high-side) OR-ing circuit that integrated with an internal N-channel MOSFET to replace an OR-ing diode. The voltage across the MX16171TLL10 IN and OUT pins is monitored, while the gate drives the MOSFET to control its operation based on the monitored IN-OUT voltage. The resulting behavior is that of an ideal rectifier with IN and OUT pins of the MX16171TLL10 acting as the anode and cathode pins of a diode respectively.



OR-ing With MOSFETs

Short Circuit Failure of an Input Supply

An abrupt 0Ω short circuit across the input supply will cause the highest possible reverse current to flow while the MX16171TLL10 control circuitry discharges the gate of the MOSFET internal. During this time, the reverse current is limited only by the $R_{DS(ON)}$ of the MOSFET, along with parasitic wiring resistances and inductances. Worst case instantaneous reverse current would be limited to:

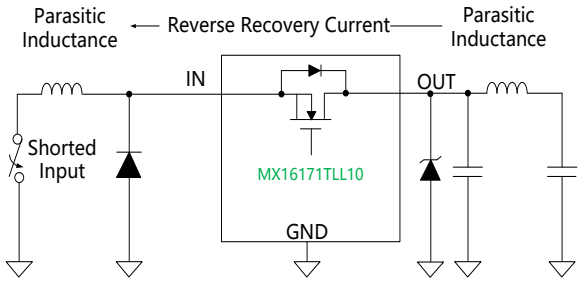
$I_{D(REV)} = (V_{OUT} - V_{IN}) / 2.5m\Omega$ (1)

The internal Reverse Comparator will react, and will start the process of discharging the gate, when the reverse current reaches:

$I_{D(REV)} = V_{SD(REV)} / 2.5m\Omega$ (2)

When the internal MOSFET is finally switched off, the energy stored in the parasitic wiring inductances will be transferred to the rest of the circuit. As a result, the MX16171TLL10 IN pin

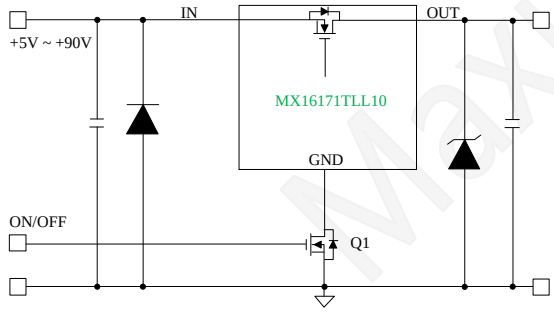
will see a negative voltage spike while the OUT pin will see a positive voltage spike. The IN pin can be protected by diode clamping the pin to GND in the negative direction. The OUT pin can be protected with a TVS protection diode, a local bypass capacitor, or both. In low voltage applications, the MOSFET drain to source breakdown voltage rating may be adequate to protect the OUT pin (that is, $V_{IN} + V_{(BR)DSS(MAX)} < 40V$).



Reverse Recovery Current Generates Spikes at V_{IN} and V_{OUT}

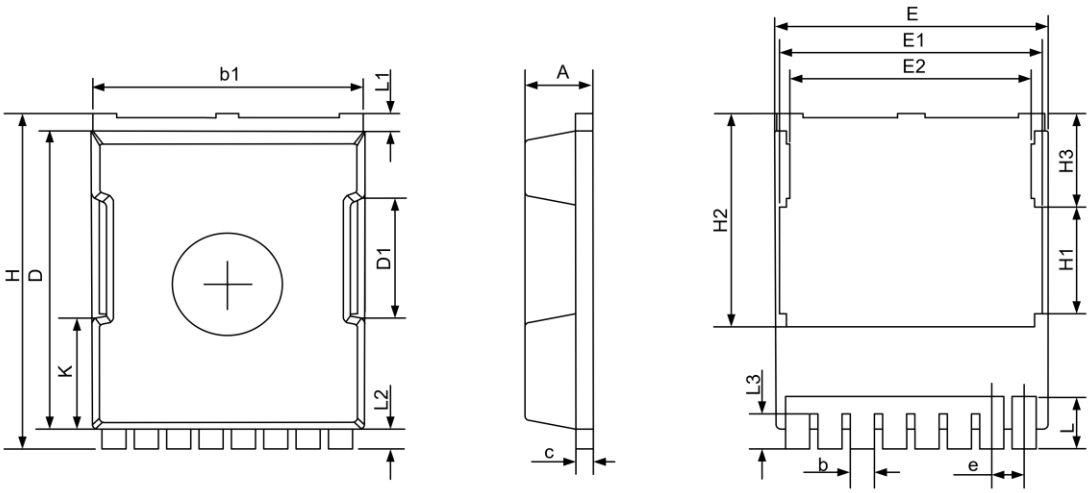
Reverse Input Voltage Protection with IQ Reduction

In battery powered applications, whenever MX16171TLL10 functionality is not needed, the supply to the MX16171TLL10 can be disconnected by turning OFF Q1, as shown in the following figure. This disconnects to the ground path of the MX16171TLL10 eliminates the current leakage from the battery.



Reverse input voltage protection with IQ reduction schematic

Package information



SYMBOL	MILLIMETERS		
	MIN	NOM	MAX
A	2.20	2.30	2.40
B	0.70	0.80	0.90
b1	9.70	9.80	9.90
c	0.40	0.50	0.60
D	10.28	10.38	10.48
D1	3.15	3.30	3.45
E	9.70	9.90	10.10
E1	9.30	9.50	9.70
E2	8.35	8.50	8.65
e	1.20BSC		
H	11.48	11.73	11.88
H1	3.16	3.26	3.36
H2	7.20	7.35	7.50
K	4.03	4.18	4.33
L	1.60	1.85	2.10
L1	0.55	0.70	0.85
L2	0.45	0.60	0.75
L3	1.05	1.20	1.30

TOLL-8 for MX16171TLL10

Restrictions on Product Use

◆ MAXIN micro is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing MAXIN products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such MAXIN products could cause loss of human life, bodily injury or damage to property.

◆ In developing your designs, please ensure that MAXIN products are used within specified operating ranges as set forth in the most recent MAXIN products specifications.

◆ The information contained herein is subject to change without notice.

Version update record:

V10 The original version.