产品介绍

MX171T 是一款理想的二极管控制器，输入范围为1V至5.5V，采用6针SOT23封装。该器件具备主动反向电流阻断功能。当配置为ORing时，会自动选择输入电压较高的路径，非常适合电池供电应用。此外，ON/OFF 引脚允许外部控制开关外部MOSFET。当ON/OFF为低电位时，静态电流低至100nA，显著降低了关机时的待机功耗。

在无锡明芯微电子之前推出的产品中，适合小电压输入，如1V到5.5V工作的产品1-2A的应用中有MX66100，MX22917等，对于低电压，大电流超过2A的理想二极管，防止电流倒灌的产品还没有，MX171T的推出很好的解决了这个问题，该款产品采用的是控制器的方式，外接低导通阈值的MOSFET，能够满足不同工作电流大小，同时想防止电流倒灌的应用需求

特点

♦输入电压范围：1V至5.5V，最大耐压6V

♦外部NMOSFET

♦超低功耗 开启状态：

♦10uA典型 关闭状态：

♦100nA典型

♦6引脚SOT23-6

典型应用

♦工业体系

♦可穿戴设备

♦机顶盒

♦销售终端

♦血糖仪

♦服务器

订购信息

Part Number	Description
MX171T	SOT23-6
MPQ	3000pcs

Package dissipation rating

Package	RθJA(°C/W)
SOT23-6	200

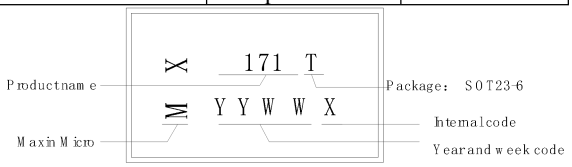
最大工作电压

Parameter	Value
VIN、OUT、ON/OFF to GND	-0.3 to 6V
GATE to GND	-0.3 to 10V
Junction temperature	150°C
Storage temperature, Tstg	-40 to 150°C
Leading temperature(soldering,10secs)	260°C

超出绝对最大额定值所列应力，可能导致设备永久性损坏。长期暴露于绝对最大额定条件下可能影响可靠性。。

推荐工作条件

Symbol	Parameter	Range
VIN	VIN supply	1-5.5V
Junction temperature		-40~125°C
P_{D_MAX}	Power dissipation	0.50W



General description

MX171T is an ideal diode controller with a 1V to 5.5V input, available in a 6-pin SOT23 package. The device features active reverse current blocking. When configured in an ORing arrangement, it automatically selects the path with the higher input voltage, making it well suited for battery-powered applications. In addition, the ON/OFF pin allows external control to turn the external MOSFET on or off. When ON/OFF is low, the quiescent current is as low as 100nA, significantly reducing standby power consumption during shutdown.

Features

- ♦ Input voltage range：1V to 5.5V
- ♦ External NMOSFET
- ♦ Ultra-low power consumption
  On state: 10uA typical
  Off state: 100nA typical
- ♦ 6-Pin SOT23-6

Application

Industrial system
Wearable devices
Set-top box
Sales terminal
Blood glucose meter

General information

Ordering information

Part Number	Description
MX171T	SOT23-6
MPQ	3000pcs

Package dissipation rating

Package	RθJA(℃/W)
SOT23-6	200

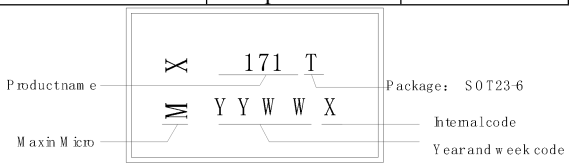
Absolute maximum ratings

Parameter	Value
VIN、OUT、ON/OFF to GND	-0.3 to 6V
GATE to GND	-0.3 to 10V
Junction temperature	150℃
Storage temperature, Tstg	-40 to 150℃
Leading temperature(soldering,10secs)	260℃

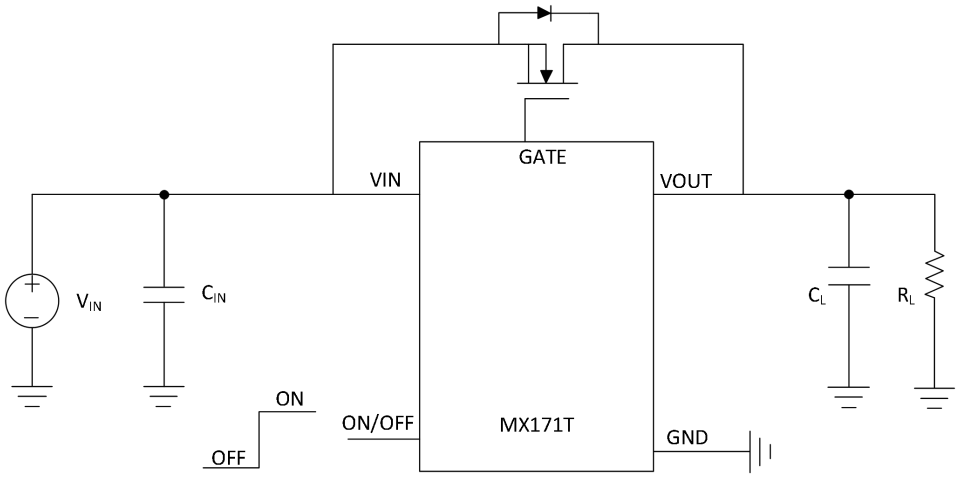
Stresses beyond those listed in Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect reliability. Functional operation of the device at any conditions beyond those indicated in the Recommended Operating Conditions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

Recommended operating condition

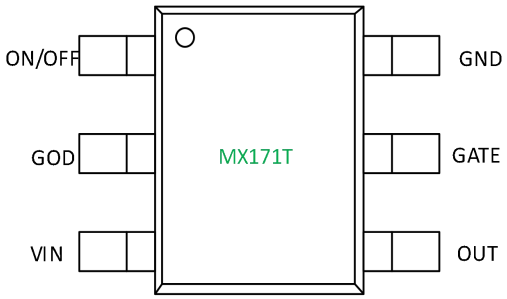
Symbol	Parameter	Range
VIN	VIN supply	1-5.5V
Junction temperature		-40~125℃
P_{D_MAX}	Power dissipation	0.50W



Typical application



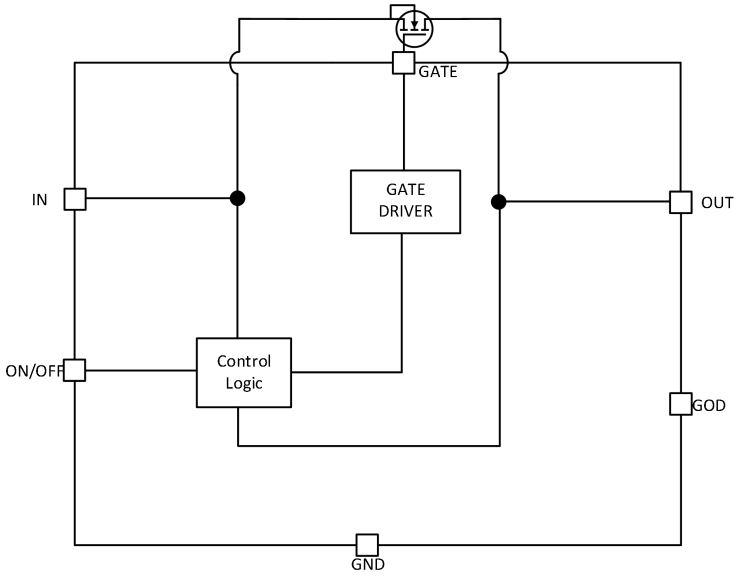
Terminal assignments



SOT23-6 for MX171T

Pin		Description
Name	No.	
ON/OFF	1	ON/OFF chontrol, active high .Do not leave it floating.
GOD	2	Must keep floating.
VIN	3	Input pin.
OUT	4	Output pin.
GATE	5	GATE Driver.
GND	6	Ground Pin.

Block diagram

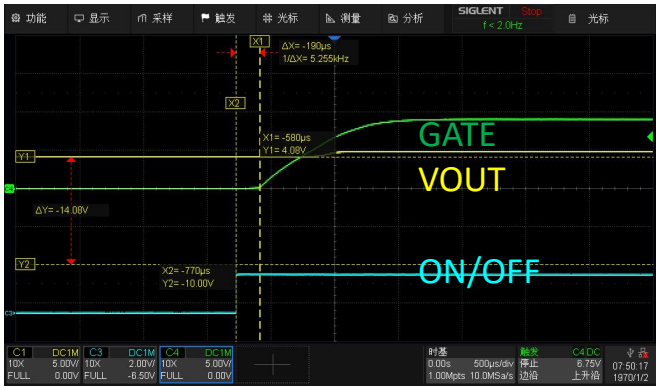


Electrical characteristics

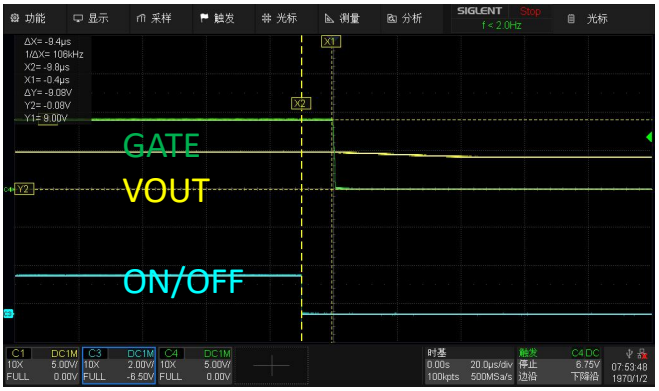
(TA=25℃， VIN=1.0V to 5.5V, CIN=COUT=100nF, unless otherwise noted).

Symbol	Parameter	Test condition	Min	Typ.	Max	Unit
POWER SUPPLY						
I_{Q_VIN}	VIN Quiescent current, VOUT=OPEN	-40℃ to ＋85℃		10	20	μA
		-40℃ to 125℃			22	μA
I_{SD_VIN}	VIN Shutdown current, VOUT=GND	-40℃ to ＋85℃		100		nA
		-40℃ to 125℃			250	nA
ON/OFF PIN (only for MX171T)						
$I_{ON/OFF}$	ON pin leakage, Enabled	-40℃ to 125℃	-10		10	nA
V_{ON/OFF_H}	active threshold、VIN=3V	-40℃ to 105℃	0.65	0.8	1.0	V
	active threshold、VIN=5V	-40℃ to 105℃	0.7	0.85	1.0	V
V_{ON/OFF_L}	off threshold、VIN=3V	-40℃ to 105℃	0.6	0.75	0.9	V
	off threshold、VIN=5V	-40℃ to 105℃	0.65	0.8	0.95	V
GATE						
IGATE	Source current(VIN=5V,EN=2V)	-40℃ to 125℃		1		μA
	Sink current(VIN=5V,EN=0V)	-40℃ to 105℃		3.2		mA
	Sink current(VIN=5V,EN=2V,OUT=5.1V)	-40℃ to 105℃		50		mA
REVERSE CURRENT BLOCKING (RCB)						
IRCB	RCB Activation Current, VOUT>VIN(RDSON=17mΩ)	-40℃ to ＋25℃		1.1		A
	RCB Activation Current, VOUT>VIN(RDSON=5Ω)	-40℃ to ＋25℃		6		mA
tRCB	RCB Activation time, VOUT>VIN+200mV(RDSON=17mΩ)	-40℃ to ＋25℃		750		ns
VRCBR	RCB Active Voltage, VOUT>VIN	-40℃ to ＋25℃		30		mV
VRCBF	RCB Release Voltage, VOUT＜VIN	-40℃ to ＋25℃		5		mV
IIN_RCB	VIN Reverse Leakage Current, GND=VIN≤VOUT	-40℃ to ＋05℃		0		μA

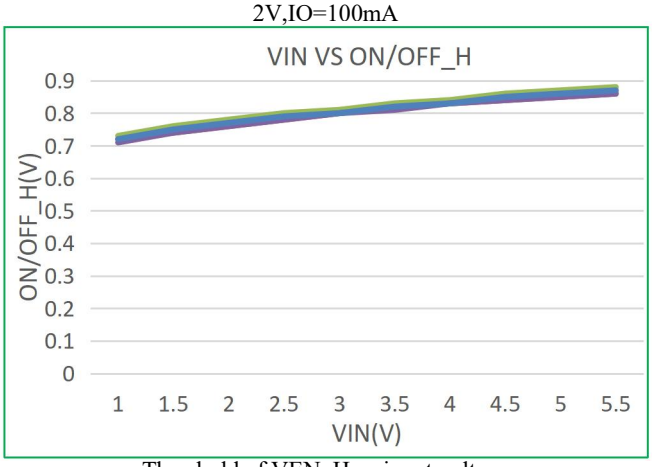
Characteristic plots



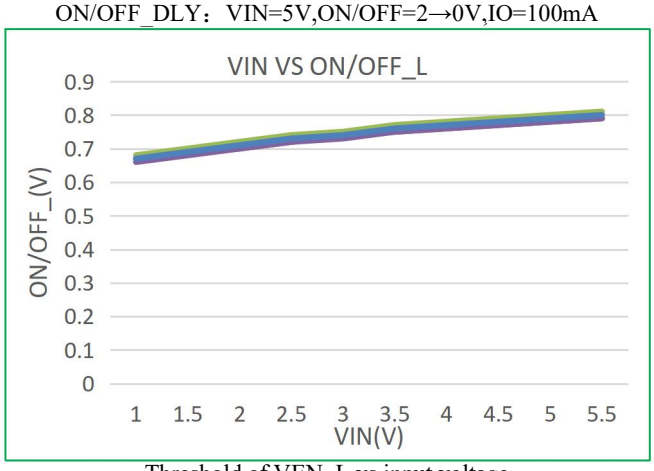
ON/OFF_DLY：VIN=5V,ON/OFF=0→2V,IO=100mA



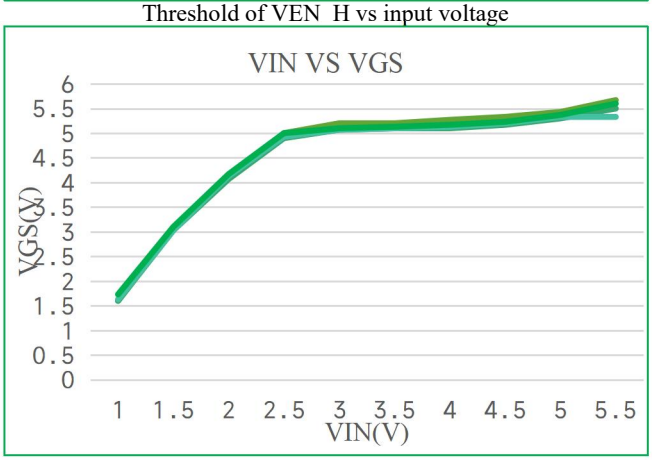
ON/OFF_DLY：VIN=5V,ON/OFF=2→0V,IO=100mA



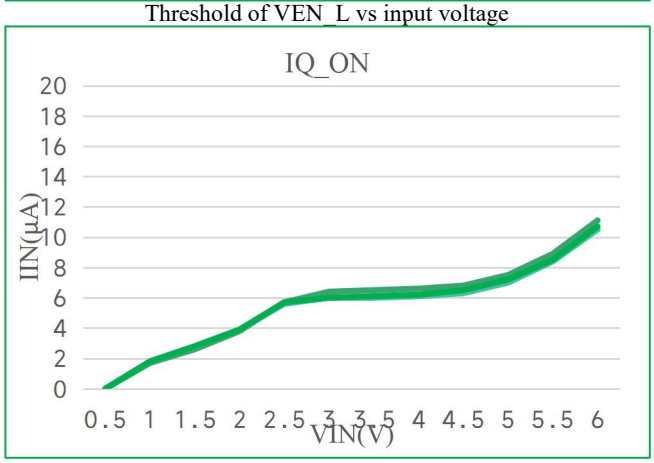
Threshold of VEN_H vs input voltage



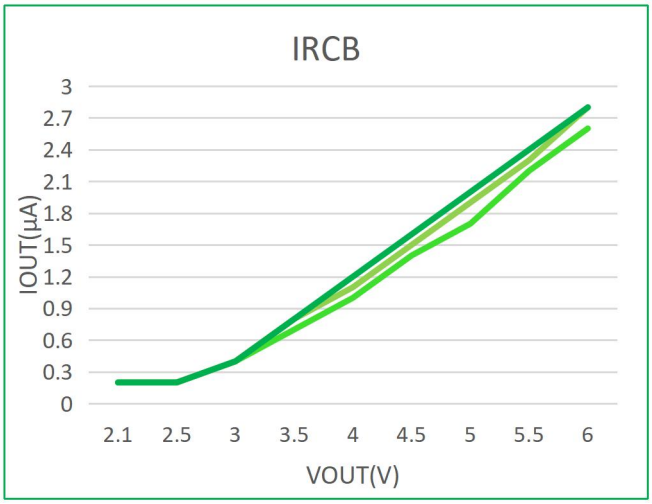
Threshold of VEN_L vs input voltage



Vgs vs input voltage



Quiescent Current vs input voltage



IRCB(VIN=2V,VO=2.1~6V)

Detailed description

IN、GATE and OUT Pins

When power is initially applied, load current will flow from source to drain through the body diode of the MOSFET. The MX171T begins charging the MOSFET gate through a 1μA (typical) charge pump current source. Once the gate of the MOSFET is charged toVGS(th), MOSFET turned on.

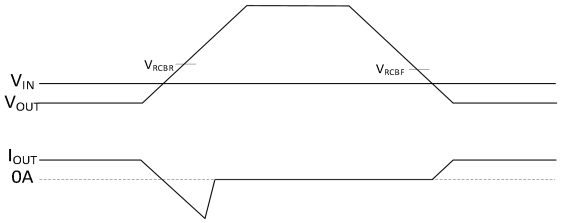
ON/OFF

The MX171T has an ON/OFF pin. The ON/OFF pin allows the gate driver to be either enabled or disabled by an external signal. If the ON/OFF pin voltage is greater than the rising threshold, the gate driver is charged by the charge pump to the specified voltage, turning on the external MOSFET. If the ON/OFF pin voltage is less than the input low threshold, the charge pump and gate driver are disabled, placing the MX171T in shutdown mode. In shutdown mode, the current from input to output flows through the body diode of the MOSFET. In shutdown mode, the quiescent current is as low as 100nA. If ON/OFF functionality is not needed, the ON/OFF pin can be connected directly to the VIN pin.

Reverse Current Blocking

If the MOSFET current reverses (possibly due to a failure of the input supply), causing the voltage across the MX171T VIN and OUT pins to become more negative than the VRCBR voltage of -30mV (typical) , the MX171T will quickly discharge the MOSFET gate through a strong GATE to VIN pin discharge transistor. If the input supply fails abruptly, as would occur if the supply were 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 parallel-connected supplies. The MX171T responds to a voltage reversal condition typically within 1μs(tpy). The actual time required to turn off the MOSFET will depend on the charge held by the gate capacitance of the MOSFET being used. This fast turn-off time minimizes voltage disturbances at the output, as well as current transients from redundant supplies.

If RCB is expected to occur, it is recommended to clamp the output or use a high output capacitance (about 100μF). This will prevent voltage spikes from damaging the device due to output inductance. Additionally, to prevent output current from flowing back into the input when RCB occurs due to delayed shutdown response of the device, please select a MOSFET with low CISS capacitance



MOSFET Selection

1. The gate-to-source threshold voltage, VGS(TH), should be compatible with the MX171T gate drive capabilities. It is recommended to use a MOSFET that meets the VGS(TH) thresholds shown in the table below to ensure proper MOSFET turn-on under different input voltages.

VIN(V)	1	2	3~5
VGS(V)	1.5	4	4.5

2. The dominate MOSFET loss for the MX171T active OR-ing controller is conduction loss due to source-to- drain current to the output load, and the RDS(ON) of the MOSFET. This conduction loss could be reduced by using a MOSFET with the lowest possible RDS(ON). However, contrary to popular belief, arbitrarily selecting a MOSFET based solely on having low RDS(ON) may not always give desirable results for several reasons:

a. Reverse transition detection. Higher RDS(ON) will provide increased voltage information to the MX171T Reverse Comparator at a lower reverse current level. This will give an earlier MOSFET turnoff condition should the input voltage become shorted to ground. This will minimize any disturbance of the redundant bus.

b. Reverse current leakage. In cases where multiple input supplies are closely matched it may be possible for some small current to flow continuously through the MOSFET drain to source (that is, reverse) without activating the MX171T Reverse Comparator. Higher RDS(ON) will reduce this reverse current level.

c. Cost. Generally, as the RDS(ON) rating goes lower, the cost of the MOSFET goes higher.

3. The dominate MOSFET loss for the MX171T active OR-ing controller is conduction loss due to source-to- drain

current to the output load, and the RDS(ON) of the MOSFET. This conduction loss could be reduced by using a MOSFET with the lowest possible RDS(ON). However, contrary to popular belief, arbitrarily selecting a MOSFET based solely on having low RDS(ON) may not always give desirable results for several reasons:

a. Selecting a MOSFET with an RDS(ON) that is too large will result in excessive power dissipation. Additionally, the MOSFET gate will be charged to the full value that the MX171T can provide as it attempts to drive the Drain to Source voltage down to the VRCBF of 5mV typical. This increased Gate charge will require some finite amount of additional discharge time when the MOSFET needs to be turned off.

b. As a guideline, it is suggested that RDS(ON) be selected to provide at least 5mV, and no more than 100mV, at the nominal load current.

c. (5mV / ID) ≤ RDS(ON) ≤ (100mV / ID)

Short Circuit Failure of an Input Supply

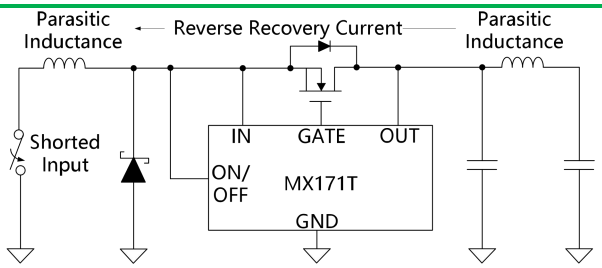
An abrupt 0Ω short circuit across the input supply will cause the highest possible reverse current to flow while the internal MX171T control circuitry discharges the gate of the MOSFET. During this time, the reverse current is limited only by the RDS(ON) of the MOSFET, along with parasitic wiring resistances and inductances. Worst case instantaneous reverse current would be limited to:

ID(REV) = (VOUT - VIN) / RDS(ON) (1)

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

ID(REV) = VSD(REV) / RDS(ON) (2)

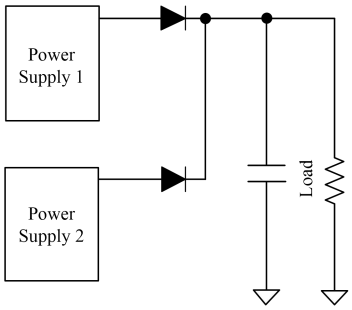
When the MOSFET is finally switched off, the energy stored in the parasitic wiring inductances will be transferred to the rest of the circuit. As a result, the MX171T IN pin will see a negative voltage spike while the OUT pin will see a positive voltage spike. The IN pin can be protected by diode clamping 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, VIN + V(BR)DSS(MAX) < 6.5V), but most MOSFET data sheets do not ensure the maximum breakdown rating, so this method should be used with caution.



Reverse Recovery Current Generates Spikes at VIN and VOUT

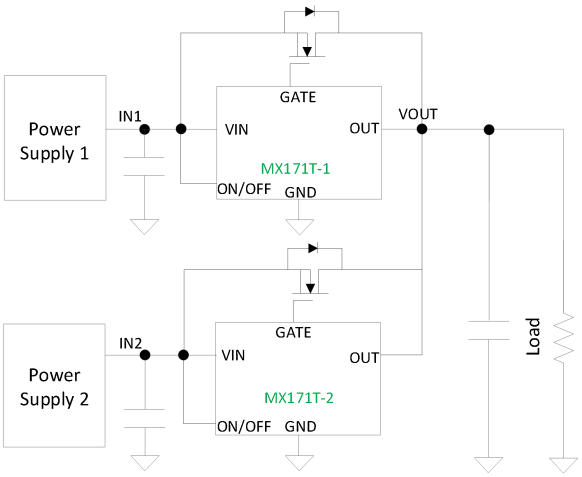
Application Information

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.



OR-ing with Diodes

The MX171T is an OR-ing controller (used on the high-side or positive voltage rail) that replaces an OR-ing diode. When both inputs are applied to the device, the highest voltage is used to power the output.



Power supply recommendations

The device is designed to operate with a VIN range of 1V

to 5.5V. The VIN power supply must be well regulated and placed as close to the device terminal as possible. The power supply must be able to withstand all transient load current steps. In most situations, using an input capacitance of 1μF is sufficient to prevent the supply voltage from dipping when the switch is turned on. In cases where the power supply is slow to respond to a large transient current or large load current step, additional bulk capacitance may be required on the input. Additionally, to prevent input and output ripple interference, it is recommended to add a filter capacitor of no less than 100nF on both the input and output pins.

Layout

Layout Consideration

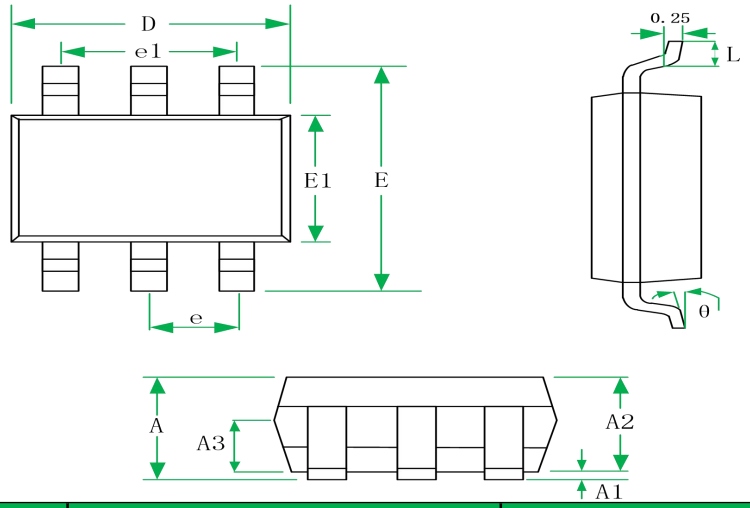
• Connect VIN, GATE and OUT pins of MX171T close to the MOSFET's SOURCE, GATE and DRAIN pins.

• The high current path of for this solution is through the MOSFET, therefore it is important to use thick traces for source and drain of the MOSFET to minimize resistive losses.

• The Gate pin of the MX171T must be connected to the MOSFET gate with short trace. Avoid excessively thin and long trace to the Gate Drive.

• Keep the GATE pin close to the MOSFET to avoid increase in MOSFET turn-off delay due to trace resistance.

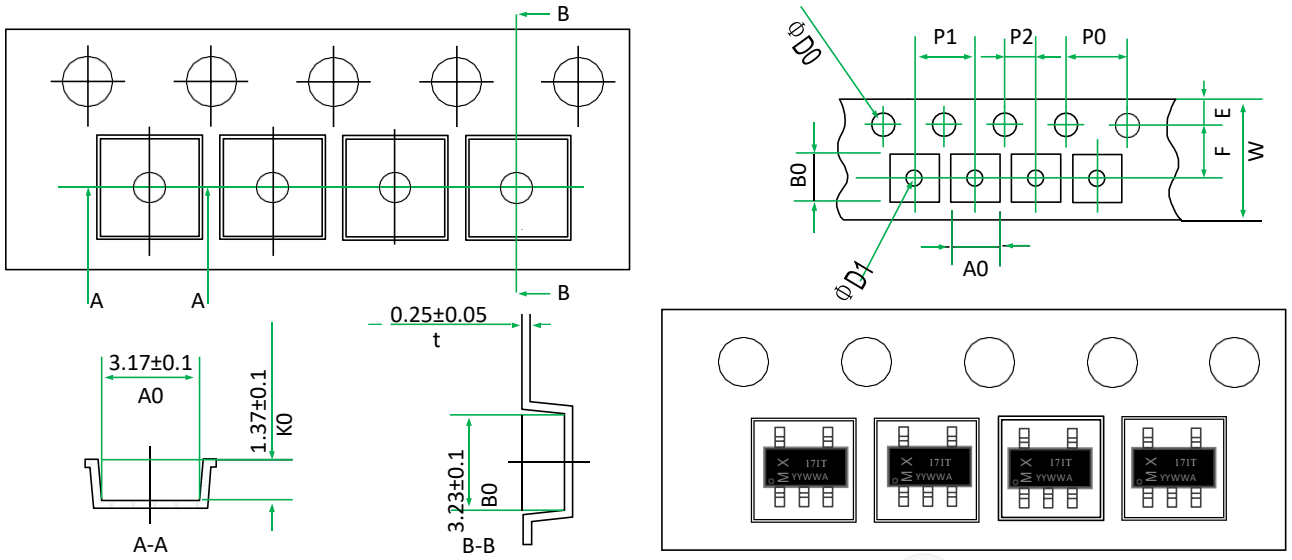
封装信息SOT23-6



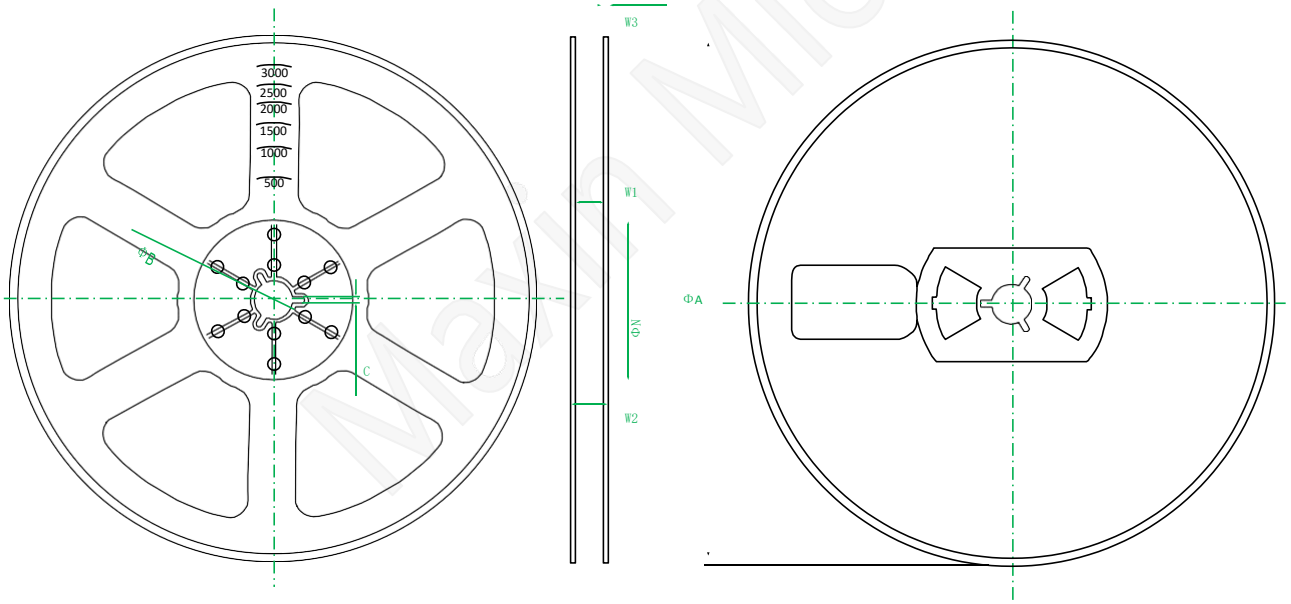
SYMBOL	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.070	1.160	1.250	0.042	0.046	0.049
A1	0.02		0.10	0.001		0.004
A2	1.050	1.100	1.150	0.041	0.043	0.045
A3	0.60	0.65	0.70	0.024	0.026	0.028
D	2.820	2.920	3.020	0.111	0.115	0.119
E	2.650	2.800	2.950	0.104	0.110	0.116
E1	1.500	1.600	1.700	0.059	0.063	0.067
e	0.95BSC			0.037BSC		
e1	1.90BSC			0.075BSC		
L	0.300		0.500	0.012		0.020
θ	0		4°	0		4°

SOT23-6 for MX171T

Tape and Reel Information (unit in mm)



Symbol	W	E	F	ΦD0	ΦD1	P0	P1	P2	A0	B0	K0	t
MAX	8.10	1.85	3.55	1.60	1.25	4.10	4.10	2.05	3.27	3.33	1.47	0.30
MIN	7.90	1.65	3.45	1.40	1.0	3.90	3.90	1.95	3.07	3.13	1.27	0.20



Symbol	ΦA	ΦN	ΦB	C	W1	W2	W3
MAX	180	56	13.5	2.50	9.9	12	1.8
MIN	176	52	13.0	1.90	8.4		1.0

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 （preliminary）

V11 Modify the VGS&VIN voltage relationship in the MOSFET Selection area