GENERAL DESCRIPITION

The MX22917 device is a 5.5V, 2A load switch in a 6 pin SOT23 package. To reduce voltage drop for low voltage and high current rails, the device implements a low resistance P channel MOSFET which reduces the drop out voltage across the device. The MX22917 device has a configurable slew rate which helps reduce or eliminate power supply droop because of large inrush currents. Furthermore, the device features a QOD pin, which allows the configuration of the discharge rate of VOUT after the switch is disabled. During shutdown, the device has very low leakage currents, thereby reducing unnecessary leakages for downstream modules during standby. Integrated control logic, driver, charge pump, and output discharge FET eliminates the need for any external components which reduces solution size and bill of materials count.

FEATURES

♦ Input voltage range： 1V to 5.5V

♦ Maximum continuous current：2A

♦ On-resistance:

80mΩ at 5V input voltage（typical）

120mΩ at 1.8V input voltage (typical)

220mΩ at 1V input voltage (typical)

♦ Ultra low power consumption

On state: 0.5uA typical

Off state: 10nA typical

♦ Soft start time can be adjusted

5V Ton=100us at CT open

5V Ton=4000us at C_T=1000pF

♦Output discharge time can be adjusted

♦ 6-Pin SOT23-6

APPLICATIONS

Industrial system

Wearable devices

Set-top box

Sales terminal

Blood glucose meter

GENERAL INFORMATION

Ordering information

Part Number	Description
MX22917T	SOT23-6, non-inverting
MX22917L	SOT23-6, inverting
MPQ	3000pcs

Package dissipation rating

Package	RθJA（°C/W）
SOT23-6	108.1

Absolute maximum ratings

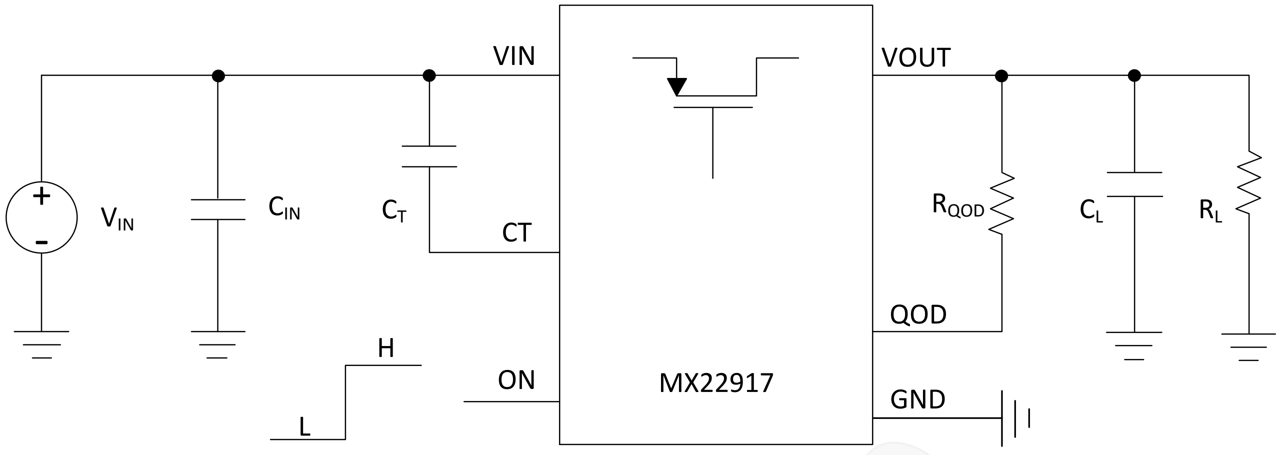
Parameter	Value
VIN/VOUT/ON/QOD	-0.3 to 6V
IOUT MAX	2A
I_{PULSE} pulse<300us, 2% duty cycle	2.5A
Junction temperature	150°C
Storage temperature, Tstg	-55 to 150°C
Leading temperature （soldering，10secs）	260℃
ESD Susceptibility HBM	±2000V

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.

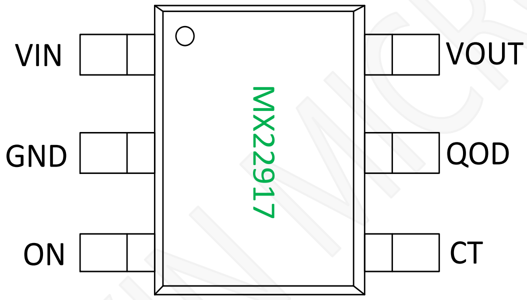
Recommended operating condition

Symbol	Parameter	Range
VDD	VDD supply voltage	1-5.5V
Junction temperature		-40~125°C
PD_MAX	Power dissipation	0.59W

TYPICAL APPLICATION



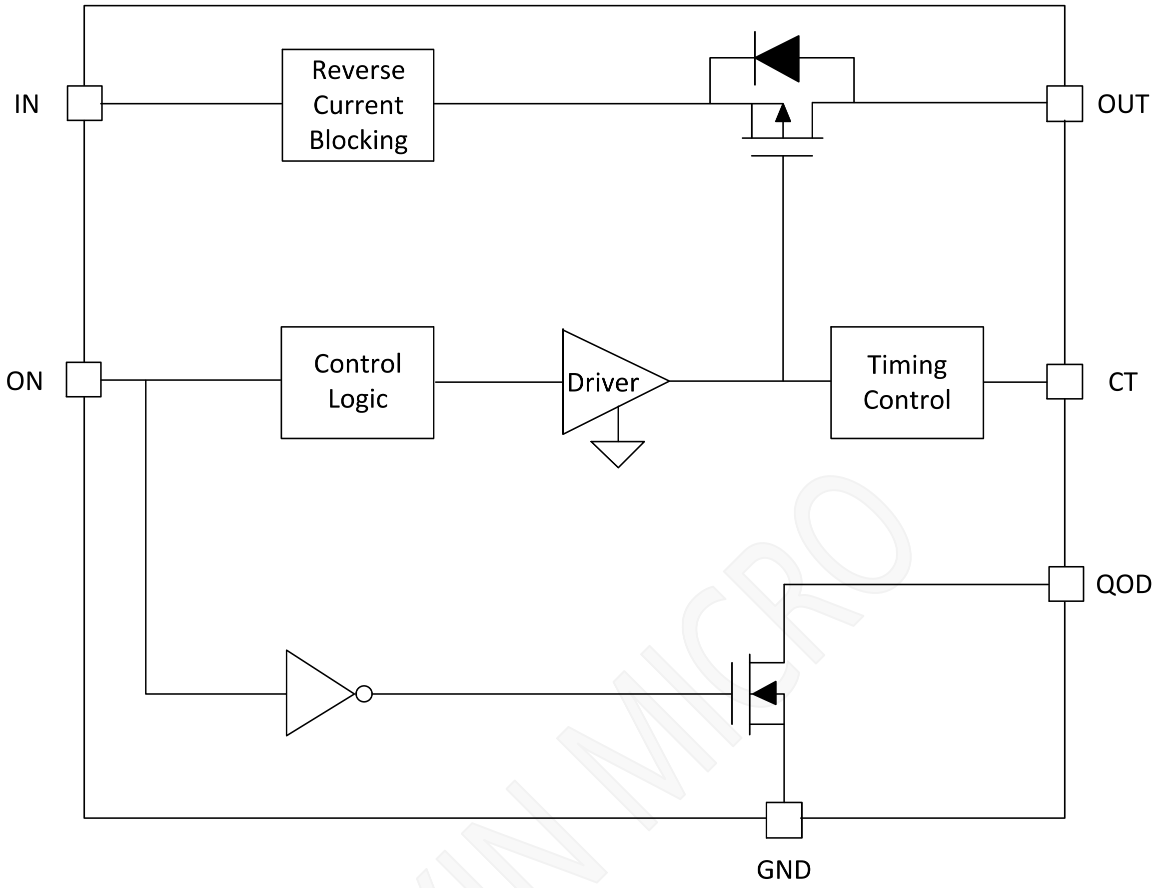
TERMINAL ASSIGMENTS



Pin information

PIN NO.	PIN name	Description
1	VIN	Load switch input
2	GND	The device ground
3	ON	Active high switch control input. Do not leave floating.
4	CT	Switch slew rate control. Connect capacitor from this pin to VIN to increase output slew rate and turn on time. Can be left floating for fastest timing.
5	QOD	Quick output discharge pin. This functionality can be enabled in one of three ways: Placing an external resistor between VOUT and QOD Tying QOD directly to VOUT and using the internal resistor value (RPD) Disabling QOD by leaving this pin floating
6	VOUT	Load switch output.

BLOCK DIAGRAM



Electrical characteristics

（TA=25℃，VDD=1.0V to 5.5V, unless otherwise noted）

Symbol	Parameter	Test condition	Min	Typ.	Max	Unit
POWER SUPPLY						
I_{Q_VIN}	VIN Quiescent current, VOUT=OPEN	-40℃ to +85℃		0.5	1.0	µA
		-40℃ to +125℃			1.2	µA
I_{SD_VIN}	VIN Shutdown current, VOUT=GND MX22917	-40℃ to +85℃		10	100	nA
		-40℃ to +125℃			250	nA
	VIN Shutdown current, VOUT=GND MX22917L	-40℃ to +85℃		175	300	nA
		-40℃ to +125℃			400	nA
ENABLE PIN (ON)						
I_{ON}	ON pin leakage, Enabled MX22917	-40℃ to +125℃	-10		10	nA
	ON pin leakage, Enabled MX22917L	-40℃ to +125℃	-20		20	nA
R_{PD}	Smart pulldown resistance, V_{ON}≤V_{IL}	-40℃ to +105℃		750		kΩ
REVERSE CURRENT BLOCKING (RCB)						
IRCB	RCB Activation Current, VOUT>VIN	-40℃ to +125℃		-0.5	-1	A
tRCB	RCB Activation time, VOUT>VIN+200mV	-40℃ to +125℃		10		µs
VRCB	RCB Release Voltage, VOUT>VIN	-40℃ to +125℃		25		mV
IIN_RCB	VIN Reverse Leakage Current, 0V≤VIN+VRCB≤VOUT	-40℃ to +105℃	-1			µA
QUICK OUTPUT DISCHARGE (QOD)						
QOD	Output discharge resistance, disabled	-40℃ to +105℃		150		Ω
ON STATE RESISTANCE (RON)						
R_{ON}	IOUT=200mA，VIN=5.0V	25℃		80	100	mΩ
		-40℃ to +85℃			120	mΩ
		-40℃ to +105℃			130	mΩ
		-40℃ to +125℃			140	mΩ
	IOUT=200mA，VIN=3.6V	25℃		90	110	mΩ
		-40℃ to +85℃			140	mΩ
		-40℃ to +105℃			150	mΩ
		-40℃ to +125℃			160	mΩ
	IOUT=200mA，VIN=1.8V	25℃		120	150	mΩ
		-40℃ to +85℃			175	mΩ
		-40℃ to +105℃			185	mΩ
		-40℃ to +125℃			200	mΩ
	IOUT=200mA，VIN=1.2V	25℃		170	220	mΩ
		-40℃ to +85℃			265	mΩ
		-40℃ to +105℃			280	mΩ
		-40℃ to +125℃			300	mΩ
	IOUT=200mA，VIN=1.0V	25℃		220	300	mΩ
		-40℃ to +85℃			350	mΩ
		-40℃ to +105℃			370	mΩ
		-40℃ to +125℃			390	mΩ

Note：OUT is tied to VDD from a small resistor

Switching characteristics

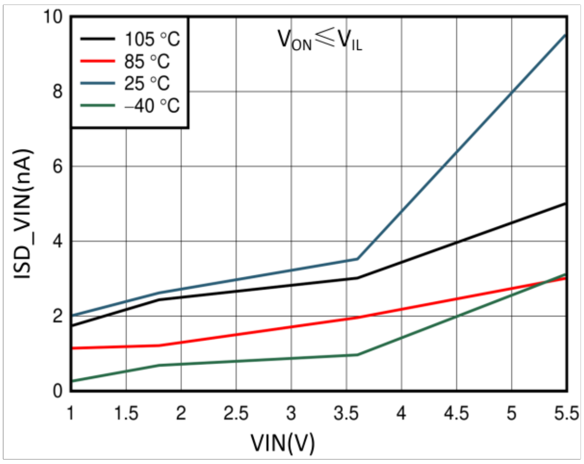
(TA=25℃，VDD=1.0V to 5.5V with a load of CL=1μF and RL=10Ω, unless otherwise noted）

Symbol	Parameter	Test condition	Min	Typ.	Max	Unit
POWER SUPPLY						
T_{ON} turn on time	VIN=5.0V	C_T = OPEN		100		μs
		C_T ⩾ 100pF		4		μs/pF
	VIN=3.6V	C_T = OPEN		120		μs
		C_T ⩾ 100pF		3.8		μs/pF
	VIN=1.8V	C_T = OPEN		200		μs
		C_T ⩾ 100pF		3.6		μs/pF
	VIN=1.2V	C_T = OPEN		300		μs
		C_T ⩾ 200pF		3.4		μs/pF
	VIN=1.0V	C_T = OPEN		400		μs
		C_T ⩾ 400pF		3		μs/pF
T_R output rise time	VIN=5.0V	C_T = OPEN		55		μs
		C_T ⩾ 100pF		1.8		μs/pF
	VIN=3.6V	C_T = OPEN		65		μs
		C_T ⩾ 100pF		1.6		μs/pF
	VIN=1.8V	C_T = OPEN		100		μs
		C_T ⩾ 100pF		1.2		μs/pF
	VIN=1.2V	C_T = OPEN		150		μs
		C_T ⩾ 200pF		0.95		μs/pF
	VIN=1.0V	C_T = OPEN		200		μs
		C_T ⩾ 400pF		0.6		μs/pF
T_{SR} Turn on slew rate (1)	VIN=5.0V	C_T = OPEN		72		mV/μs
		C_T ⩾ 100pF		2300		(mV/μs)/pF
	VIN=3.6V	C_T = OPEN		44		mV/μs
		C_T ⩾ 100pF		1900		(mV/μs)/pF
	VIN=1.8V	C_T = OPEN		14		mV/μs
		C_T ⩾ 100pF		1100		(mV/μs)/pF
	VIN=1.2V	C_T = OPEN		6.2		mV/μs
		C_T ⩾ 200pF		1000		(mV/μs)/pF
	VIN=1.0V	C_T = OPEN		3.9		mV/μs
		C_T ⩾ 400pF		1100		(mV/μs)/pF
T_{OFF} Turn off time				10		μs
T_{FALL} Output fall time (2)	R_L=10Ω	C_L=1μF, R_{QOD}=Short		22		μs
	R_L = OPEN	C_L=10μF, R_{QOD}=Short		3.8		ms
		C_L=10μF, R_{QOD}=100Ω		5.9		ms
		C_L=220μF, R_{QOD}=Short		72		ms

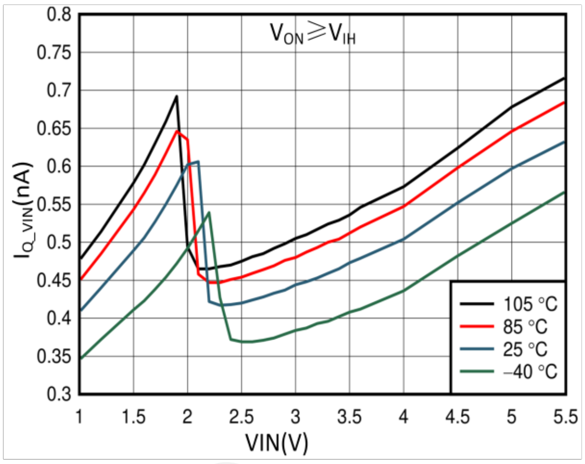
(1) TSR is the fastest slew rate during the turn on time

(2) Output may not discharge completely id QOD is not connected to VOUT.

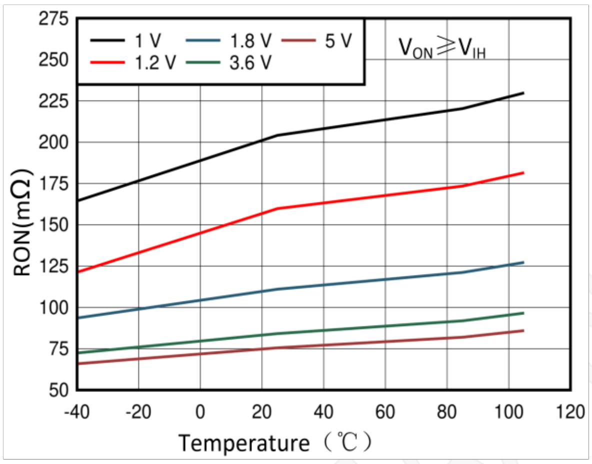
Characteristic plots



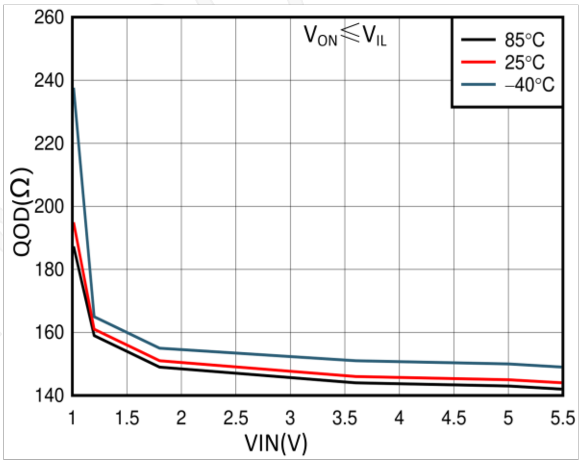
Shutdown current



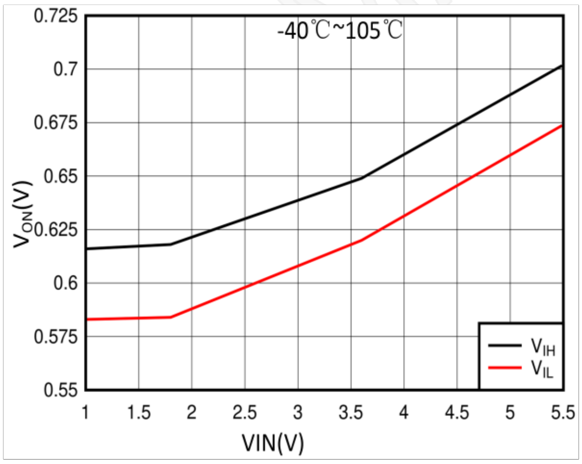
Quiescent current



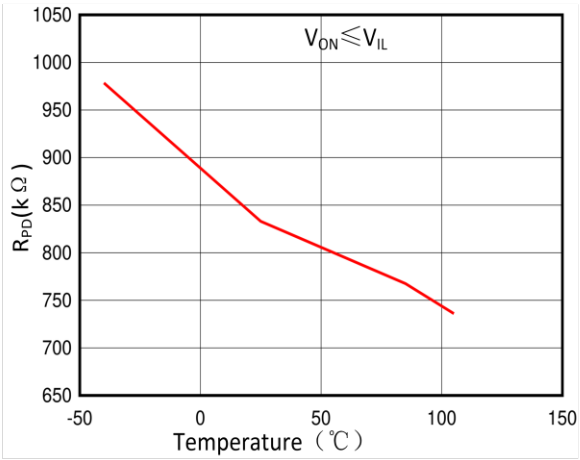
On state resistance



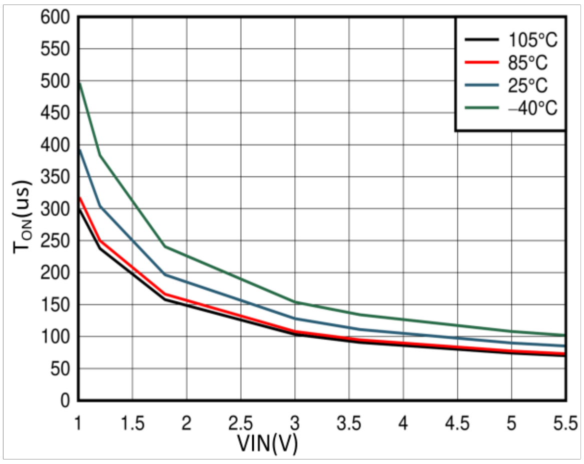
Quick output discharge



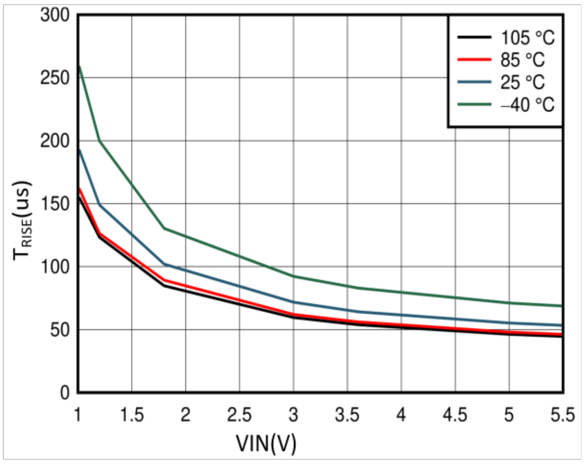
ON pin threshold



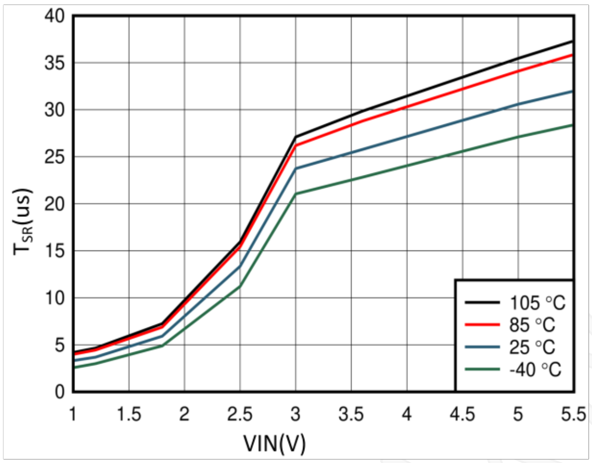
ON pin smart pulldown



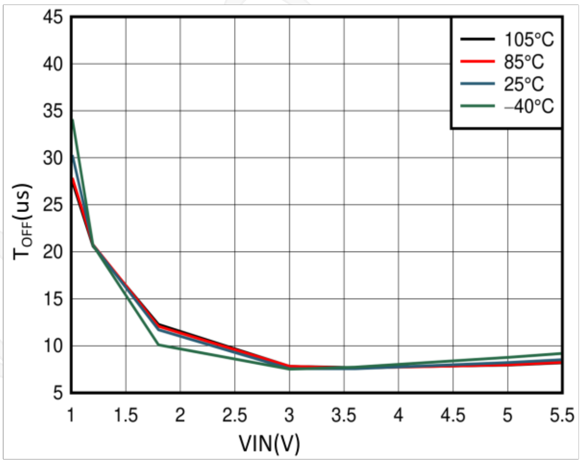
Turn on time (CT = OPEN)



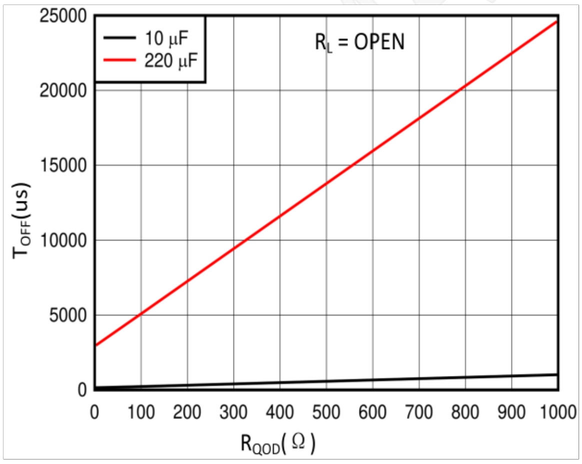
Rise time （CT = OPEN）



Slew rate (CT = OPEN)



Turn off time



Turn off time (open load)

Operation description

The MX22917 device is a 5.5V, 2A load switch in a 6 pin SOT23 package. To reduce voltage drop for low voltage and high current rails, the device implements a low resistance P channel MOSFET which reduces the drop out voltage across the device. The MX22917 device has a configurable slew rate which helps reduce or eliminate power supply droop because of large inrush currents. Furthermore, the device features a QOD pin, which allows the configuration of the discharge rate of VOUT after the switch is disabled. During shutdown, the device has very low leakage currents, thereby reducing unnecessary leakages for downstream modules during standby. Integrated control logic, driver, charge pump, and output discharge FET eliminates the need for any external components which reduces solution size and bill of materials count.

On and off control

The ON pin controls the state of the switch. The ON pin is compatible with standard GPIO logic threshold so it can be used in a wide variety of applications. The MX22917 is enabled when the voltage applied to the ON pin is pulled above V_{IH}, while the MX22917L is enabled when the voltage is below V_{IL}.

When power is first applied to VIN, a smart pulldown is used to keep the ON pin from floating until system sequencing is complete. After the ON pin is deliberately driven high, the smart pulldown is disconnected to prevent unnecessary power loss. The next table shown when the ON pin smart pulldown is active.

VON	Pulldown
≤VIL	Connected
≥VIH	Disconnected

Turn on time and adjustable slew rate

A capacitor to VIN on the CT pin sets the slew rate of VOUT. The CT capacitor voltage ramps until shortly after the switch is turned on and VOUT becomes stable.

Leaving the CT pin open results in the highest slew rate and fastest turn on time. These values can be found in the switching characteristics table. For slower slew rates the required CT capacitor can be found using the next formular:

$CT = (\text{Slew Rate}) \div SR_{ON}$

Where

Slew Rate = desired slew rate (mV/us)

CT = the capacitance value on the CT pin (pF)

SR_{ON} = Slew rate constant from table

The total turn on time has a direct correlation to the output slew rate. The fastest turn on time, with CT pin open, can be found in the switching characteristics. For slower slew rates, the resulting turn on time can be found with:

Turn on time = $CT \times t_{ON}$

Where

Turn on time = total time from enable until VOUT rises to 90% of Vin (us)

CT= the capacitance value of the CT pin (pF)

t_{ON} = turn on time constant (us/pF)

Fall time and quick output discharge

The MX22917 device includes a QOD pin that can be figured in one of three ways:

● QOD pin shorted to VOUT pin. Using this method, the discharge rate after the switch becomes disabled is controlled with the value of internal resistance QOD.

● QOD pin connected to VOUT pin using an external resistor R_{QOD}. After the switch becomes disabled, the discharge rate is controlled by the value of the total discharge resistance. To adjust the total discharge resistance, the next formula can be used:

$R_{DIS} = QOD + R_{QOD}$

Where

R_{DIS} = total output discharge resistance （Ω）

QOD = internal pulldown resistance (Ω)

R_{QOD} = external resistance placed between the VOUT and QOD pins (Ω)

● QOD pin is unused and left floating. Using this method, there is no quick output discharge functionality, and the output capacitance (C_L). To calculate the approximate fall time of VOUT use:

$t_{FALL} = 2.2 \times (R_{DIS} \| R_L) \times C_L$

QOD when system power removed

The adjustable QOD can be used to control the power down sequencing of a system even when the system power supply is removed. When the power is removed, the input capacitor discharges at VIN. Past a certain VIN level, the strength of the

RPD is reduced. If there is still remaining charge on the output capacitor, this results in longer fall times.

Full time reverse current blocking

In a scenario where the device is enabled and VOUT is greater than VIN there is potential for reverse current to flow through the pass FET or the body diode. When the reverse current threshold (I_{RCB}) is exceeded, the switch is disabled within t_{RCB}. The switch remains off and block reverse current as long as the reverse voltage condition exists. After VOUT has dropped below the V_{RCB} release threshold the device turns back on with slew rate control.

Device functional modes

The next table describes the connection of the VOUT pin depending on the state of the ON pin as well as the various QOD pin configurations.

ON	QOD configuration	VOUT
L	Connected to VOUT with R_{QOD}	GND
L	Tied to VOUT directly	GND
L	Left opening	Floating
H	Connected to VOUT with R_{QOD}	VIN
H	Tied to VOUT directly	VIN
H	Left opening	VIN

MX22917

ON	QOD configuration	VOUT
L	Connected to VOUT with R_{QOD}	VIN
L	Tied to VOUT directly	VIN
L	Left opening	VIN
H	Connected to VOUT with R_{QOD}	GND
H	Tied to VOUT directly	GND
H	Left opening	Floating

MX22917L

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 1uF is sufficient to prevent the supply voltage from dipping when switch is turned on. In case where the power supply is slow to respond to a large transient current or large load current step, additional bulk capacitance can be required on the input.

Thermal considerations

The maximum IC junction temperature must be restricted to 125℃ under normal operating conditions. To calculate the maximum allowable dissipation, PD(MAX) for a given output current and ambient temperature, use formula:

$$P_{D(MAX)} = \frac{T_{J(MAX)} - T_A}{\theta_{JA}}$$

Where

$P_{D(MAX)}$ = maximum allowable power dissipation

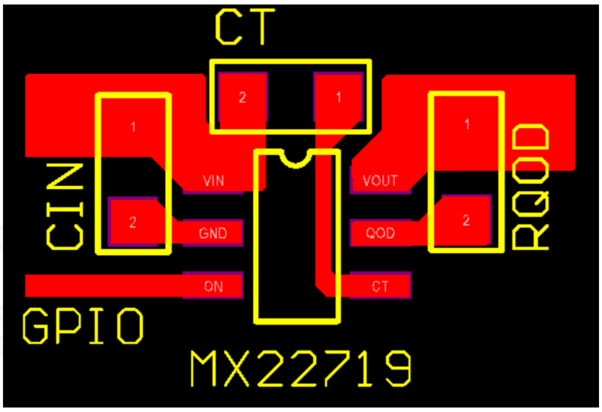
$T_{J(MAX)}$ = maximum allowable junction temperature

T_A = ambient temperature of the device

θ_{JA} = junction to air thermal impedance.

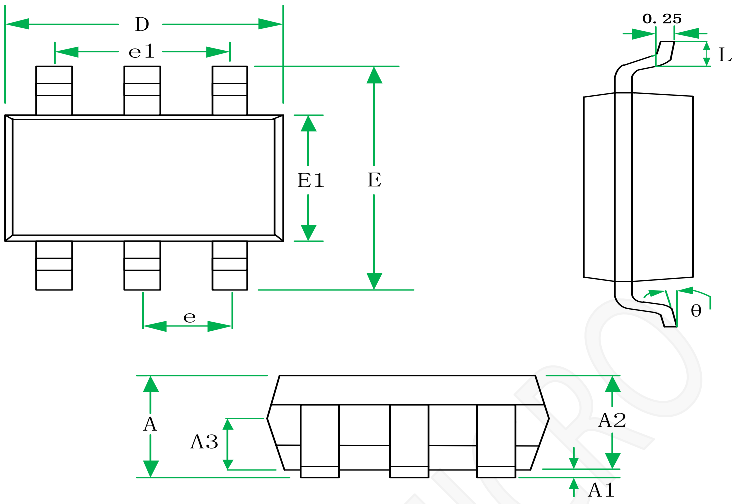
Layout guidelines

For best performance, all traces must be as short as possible. To be most effective, the input and output capacitors must be placed as close to the device to minimize the effects that parasitic electrical effects.



Ordering PN	Package	Vendor	Product	MOQ
MX22917T	SOT23-6	Wuxi Maxin micro	Load switch 1-5.5v	3K
MX22917L	SOT23-6	Wuxi Maxin micro	Load switch 1-5.5v	3K

Package information



SYMBOL	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A						
A1	0.04		0.15	0.0016		0.0059
A2	1.00	1.10	1.20	0.039	0.043	0.047
A3	0.55	0.65	0.75	0.022	0.026	0.029
D	2.72	2.92	3.12	0.107	0.115	0.123
E	2.60	2.80	3.00	0.102	0.110	0.118
E1	1.40	1.60	1.80	0.055	0.063	0.071
e	0.95BSC			0.037BSC		
e1	1.90BSC			0.074BSC		
L	0.30		0.60	0.012		0.024
θ	0		8°	0		8°

SOT23-6L for MX22917

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.