3A Step-down Voltage Regulator Power Converter 52kHz

Lead(Pb)-Free

General Description:

The WT2576 series of regulators are monolithic integrated circuits that provide all the active functions for a step-down (buck) switching regulator, capable of driving 3A load with excellent line and load regulation. These devices are available in fixed output voltages of 3.3V, 5V, 12V and an ADJ output version.

Requiring a minimum number of external components, these regulators are simple to use and include internal frequency compensation and a fixed-frequency oscillator.

The WT2576 series offers a high-efficiency replacement for popular three-terminal linear regulators. It substantially reduces the size of the heat sink, and in some cases no heat sink is required. A standard series of inductors optimized for use with the WT2576 are available from several different manufacturers. This feature greatly simplifies the design of switch-mode power supplies.

Other features include a guaranteed ±4% tolerance on output voltage within specified input voltages and output load conditions, and ±10% on the oscillator frequency. External shutdown is included, featuring 50 μA (typical) standby current. The output switch includes cycle-by-cycle current limiting, as well as thermal shutdown for full protection under fault conditions.

Features:

* 3.3V, 5V, 12V and adjustable output versions
* Adjustable version output voltage range, 1.23V to 37V ±4% max over line and load conditions
* Guaranteed 3A output current
* Wide input voltage range up to 40V
* Requires only 4 external components
* 52kHz fixed frequency internal oscillator
* TTLshutdown capability, low powerstandby mode
* High efficiency
* Uses readily available standard inductors
* Thermal shutdownand current limit protection

Applications:

* Simple high-efficiency step-down (buck) regulator
* Efficient pre-regulator for linear regulators
* On-card switching regulators
* Positive to negative converter (Buck-Boost)

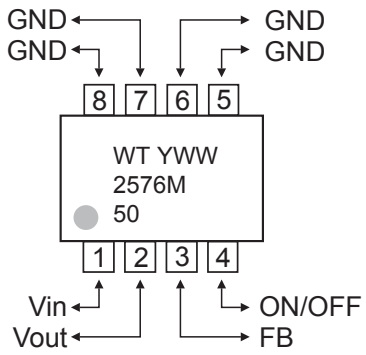
Ordering Information

Part Number	Voltage	Package	Packing Type
WT2576M33	3.3V	SOP-8	2,500Units / Tape & Reel
WT2576M50	5.0V	SOP-8	2,500Units / Tape & Reel
WT2576M12	12.0V	SOP-8	2,500Units / Tape & Reel
WT2576M	ADJ	SOP-8	2,500Units / Tape & Reel

Connection Diagrams

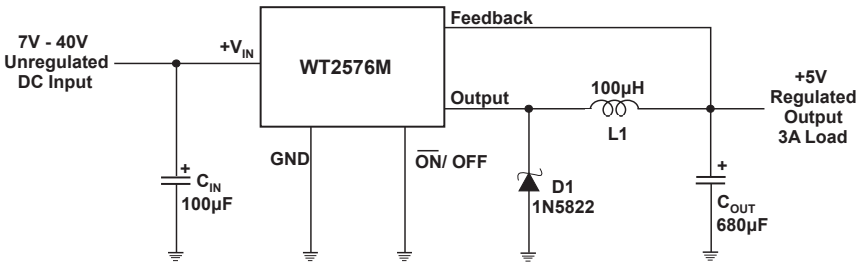
Surface Mount Package (Top View)

SOP- 8

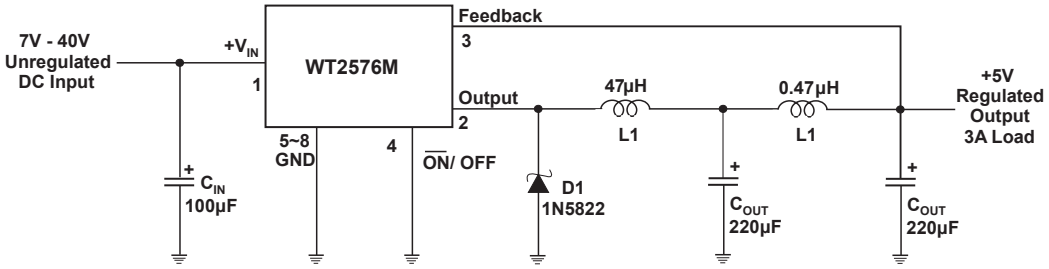


Y =Year
W W =Weekly

Typical Application



Low Noise APPLICATIONS



Pin Functions:

+VIN —This is the positive input supply for the IC switching regulator. A suitable input bypass capacitor must be present at this pin to minimize voltage transients and to supply the switching currents needed by the regulator.

Ground —Circuit ground.

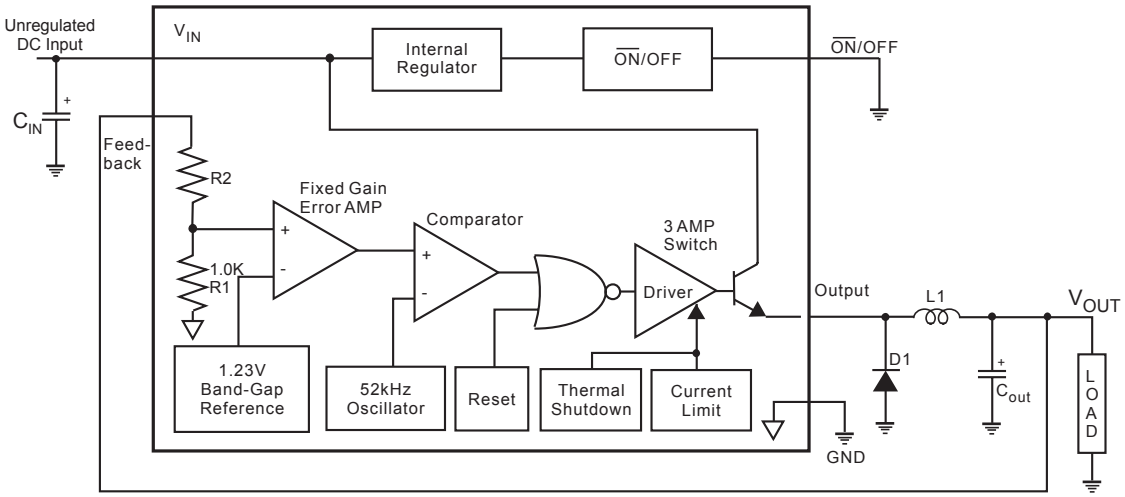
Output —Internal switch, the voltage at this pin switches between (+VIN VSAT) and approximately -0.5V. To minimize coupling to sensitive circuitry, the PC board copper area connected to this pin should be kept to a minimum.

FeedBack —Senses the regulated output voltage to complete the feedback loop**.**

—Allows the switching regulator circuit to be shut down using logic level signals. Pulling this pin below a threshold voltage of approximately 1.5V turns the regulator on, and

shutdown feature is not needed, the $\overline{ON}/OFF$ pin can be wired to the ground pin or it can be left open, in either case the regulator will be in the ON condition.

Block Diagram



3.3V R2 = 1.7K

5V, R2 = 3.1K

For ADJ Version R1 = Open, R2 = 0Ω

Absolute Maximum Ratings (Note1)

Parameter	Rating	Unit
Maximum Supply Voltage	45	V
$\overline{ON/OFF}$ Pin Input voltage	−0.3～+ V_{IN}	V
Output Voltage to Ground (Steady state)	−1	V
Power Dissipation	Internally limited	--
Storage Temperature Range	−65～150	℃
ESD Susceptibility (Human Body Model)	2	KV
Maximum Junction Temperature	150	℃

Operating Ratings

Temperature Range	−40～125	℃
Supply Voltage	6～40	V

Electrical Characteristics Specifications with standard type face are for T_J = 25°C

Symbol	Parameter	Conditions	Min (Note2)	Typ	Max (Note 2)	Units
WT2576M	**3.3 V** System Parameters (Note 3) Test Circuit Figure 2					
V_{OUT}	Output Voltage	6V≦V_{IN}≦40V 0.5A≦I_{LOAD}≦3A	3.234	3.3	3.366	V
η	Efficiency	V_{IN} = 12V, I_{LOAD} = 3A	--	73	--	%
WT2576M	**5V** System Parameters (Note 3) Test Circuit Figure 2					
V_{OUT}	Output Voltage	8V≦V_{IN}≦40V 0.5A≦I_{LOAD}≦3A	4.800	5.0	5.20	V
η	Efficiency	V_{IN} = 12V, I_{LOAD} = 3A	--	77	--	%
WT2576M	**12V** System Parameters (Note 3) Test Circuit Figure 2					
V_{OUT}	Feedback Voltage	15V≦V_{IN}≦40V 0.5A≦I_{LOAD}≦3A	11.52	12.0	12.48	V
η	Efficiency	V_{IN} = 15V, I_{LOAD} = 3A	--	88	--	%
WT2576M	**ADJ** System Parameters (Note 3) Test Circuit Figure 2					
V_{OUT}	Feedback Voltage	8V≦V_{IN}≦40V 0.5A≦I_{LOAD}≦3A V_{OUT} = 5V	1.193	1.230	1.267	V
η	Efficiency	V_{IN} = 12V, I_{LOAD} = 3A V_{OUT} = 5V	--	77	--	%

All Output Voltage Versions Electrical Characteristics (Conditions：T_J = 25℃)

Symbol	Parameter	Conditions	Min (Note2)	Typ	Max (Note 2)	Units
Device Parameters						
I_b	Feedback Bias Current	Adjustable Version Only, V_{OUT}= 5V	--	50	100	nA
f_O	Oscillator Frequency	(Note 8)	47	52	58	KHz
V_{SAT}	V_{SAT} Saturation Voltage	I_{OUT}=3A(Note 4)	--	1.4	1.8	V
DC	Max Duty Cycle(ON)	(Note 5)	93	98	--	%
I_{CL}	Current Limit	(Notes 4, 8)	4.2	5.8	6.9	A
I_L	Output Leakage Current	Output = 0V (Note 6,7)	--	7.5	2.3	mA
		Output = -1V(Note 10)	--		30	mA
I_Q	Quiescent Current	(Note 6)	--	5	10	mA
I_{STBY}	Standby Quiescent Current	$\overline{ON}/OFF$ PIN = 5V (OFF)	--	50	200	μA

$\overline{ON}/OFF$ CONTROL						
V_{IH}	$\overline{ON}/OFF$ Pin Logic Input Level	V_{OUT} = 0V	2.2	1.4	--	V
V_{IL}		V_{OUT} = Nominal Output Voltage	--	1.2	1.0	V
I_{IH}	$\overline{ON}/OFF$ Pin Input Current	ON/OFF Pin = 5V(OFF)	--	12	30	μA
I_{IL}		ON/OFF Pin = 0V(ON)	--	0	10	μA

Note 1：Absolute Maximum Ratings indicates limits beyond which damage to the device May occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not guaranteed. For guaranteed specifications and the best conditions, see the Electrical Characteristics.

Note 2：All limits guaranteed at room temperature (standard type face) and at temperature extremes (bold type face). All room temperature limits are 100% production tested. All limits at temperature extremes are guaranteed via correlation using standard Statistical Quality Control (SQC) methods.

Note 3：External components such as the catch diode, inductor, input and output capacitors, and voltage programming resistors can affect switching regulator system performance.

Note 4：Output pin sourcing current. No diode, inductor or capacitor connected to output pin.

Note 5：Feedback pin removed from output and connected to 0V.

Note 6：Feedback pin removed from output and connected to +12V for the 3.3V, 5V, and the ADJ version,

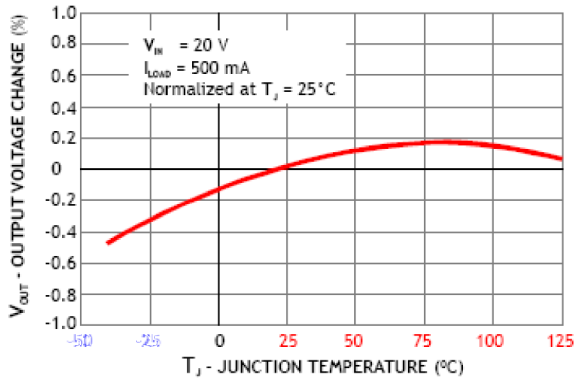
to force the output transistor switch OFF.

Note 7：V_{IN} = 40V

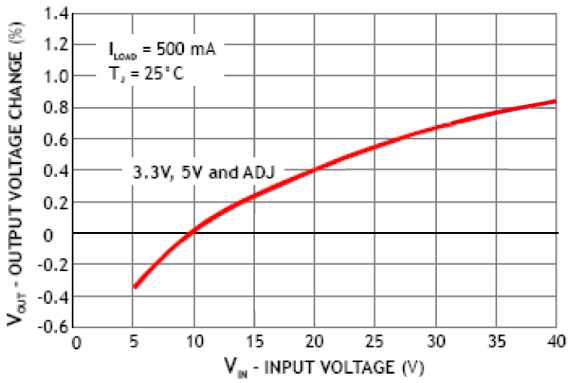
Note 8：The oscillator frequency reduces to approximately 11 KHz in the event of an output short or an overload which causes the regulated output voltage to drop approximately 40% from the nominal output voltage. The self-protection feature lowers the average power dissipation of the minimum duty cycle from 5% down to approximately 2%.

Typical Performance Characteristics

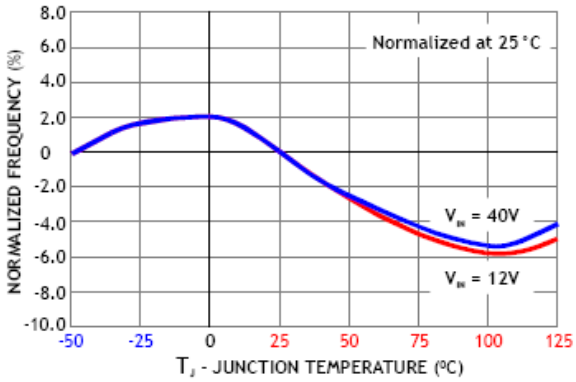
Normalized Output Voltage



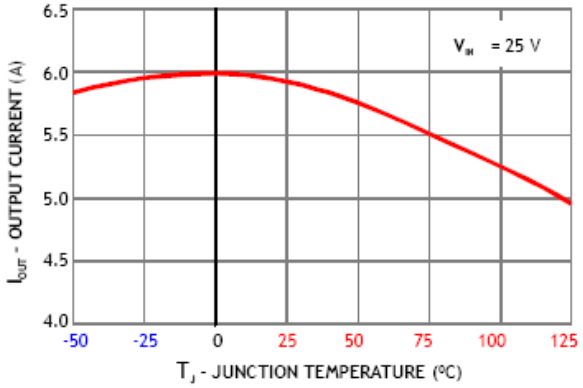
Line Regulation



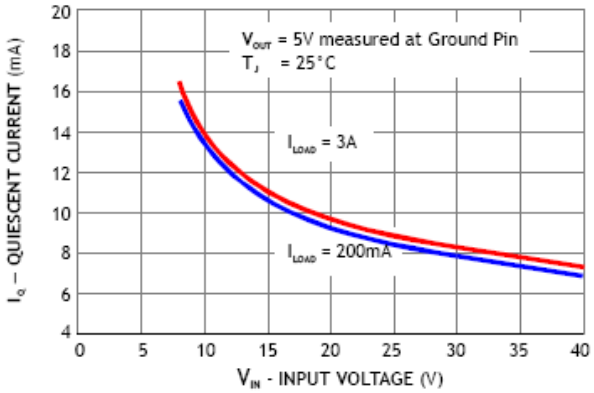
Oscillator Frequency



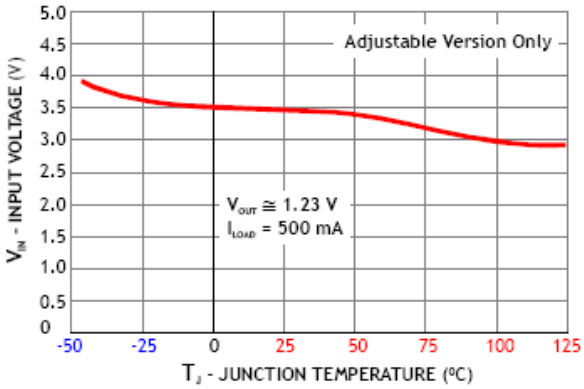
Current Limit



Quiescent Current



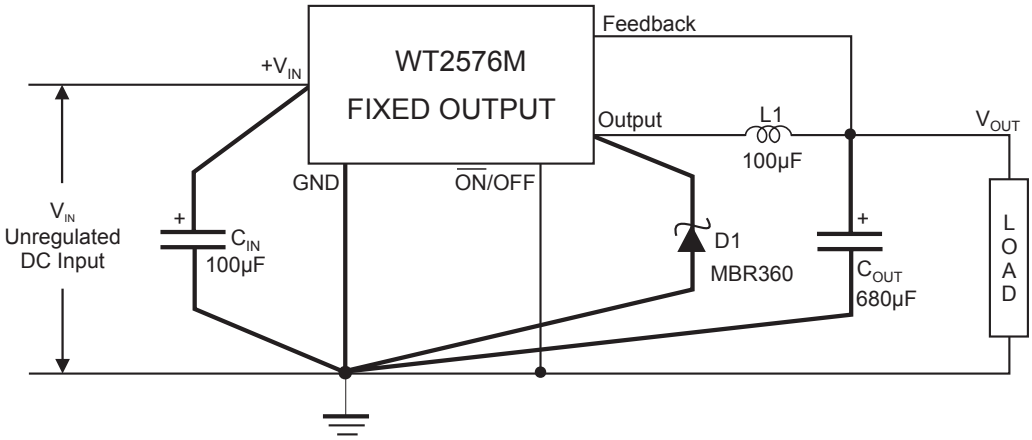
Minimum Operating Voltage



TEST CIRCUIT AND LAYOUT GUIDELINES

Careful layout is important with any switching regulator. Rapidly switching currents associated with wiring inductance generate voltage transients which can cause problems. To minimize inductance and ground loops, the lengths of the leads indicated by heavy lines in Figure 1 below should be kept as short as possible. Single-point grounding (as indicated in Figure 1) or ground plane construction should be used for best results. When using the Adjustable version, place the programming resistors as close as possible to WT2576M, to keep the sensitive feedback wiring short.

Figure.1a Fixed Output Voltage Versions



C_{IN} - 100µF, 75V, Aluminum Electrolytic

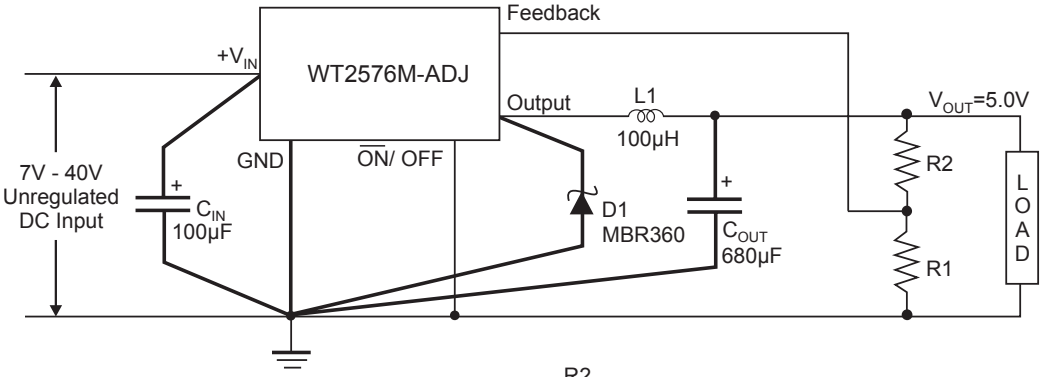
C_{OUT} - 680µF, 25V, Aluminum Electrolytic

D1 - Schottky, MBR360

L1 - 100µH, 3L Electronic Corp. TC-101M-3.0A-6826

R1 - 2k, 0.1%

R2 - 6.12k, 0.1%



$$V_{OUT} = V_{REF} \left(1 + \frac{R2}{R1} \right)$$

$$R2 = R1 \left(\frac{V_{OUT}}{V_{REF}} - 1 \right)$$

where V_{REF} = 1.23V, R1 between 1k and 5k.

Figure.1b Adjustable Output Voltage Versions

INPUT CAPACITOR C_{IN} —A low ESR aluminum or tantalum bypass capacitor is needed between the input pin and ground pin**.** It must be located near the regulator using short leads. This capacitor prevents large voltage transients from appearing at the input, and provides the instantaneous current needed each time the switch turns on. Selecting an input capacitor requires consulting the manufacturers data sheet for maximum allowable RMS ripple current. For a maximum ambient temperature of 40°C, a general guideline would be to select a capacitor with a ripple current rating of approximately 50% of the DC load current. For ambient temperatures up to 70°C, a current rating of 75% of the DC load current would be a good choice for a conservative design. The capacitor voltage rating must be at least 1.25 times greater than the maximum input voltage, and often a much higher voltage capacitor is needed to satisfy the RMS current requirements.

OUTPUT CAPACITOR C_{OUT} —-An output capacitor is required to filter the output and provide regulator loop stability. Low impedance or low ESR Electrolytic or solid tantalum capacitors designed for switching regulator applications must be used. When selecting an output capacitor, the important capacitor parameters are; the 100 kHz Equivalent Series resistance (ESR), the RMS ripples current rating, voltage rating, and capacitance value. For the output capacitor, the ESR value is the most important parameter. The output capacitor requires an ESR value that has an upper and lower limit. For low output ripple voltage, a low ESR value is needed. This value is determined by the maximum allow able output ripple voltage, typically 1% to 2% of the output voltage. But if the selected capacitor's ESR is extremely low, there is a possibility of an unstable feedback loop, resulting in an oscillation at the output.

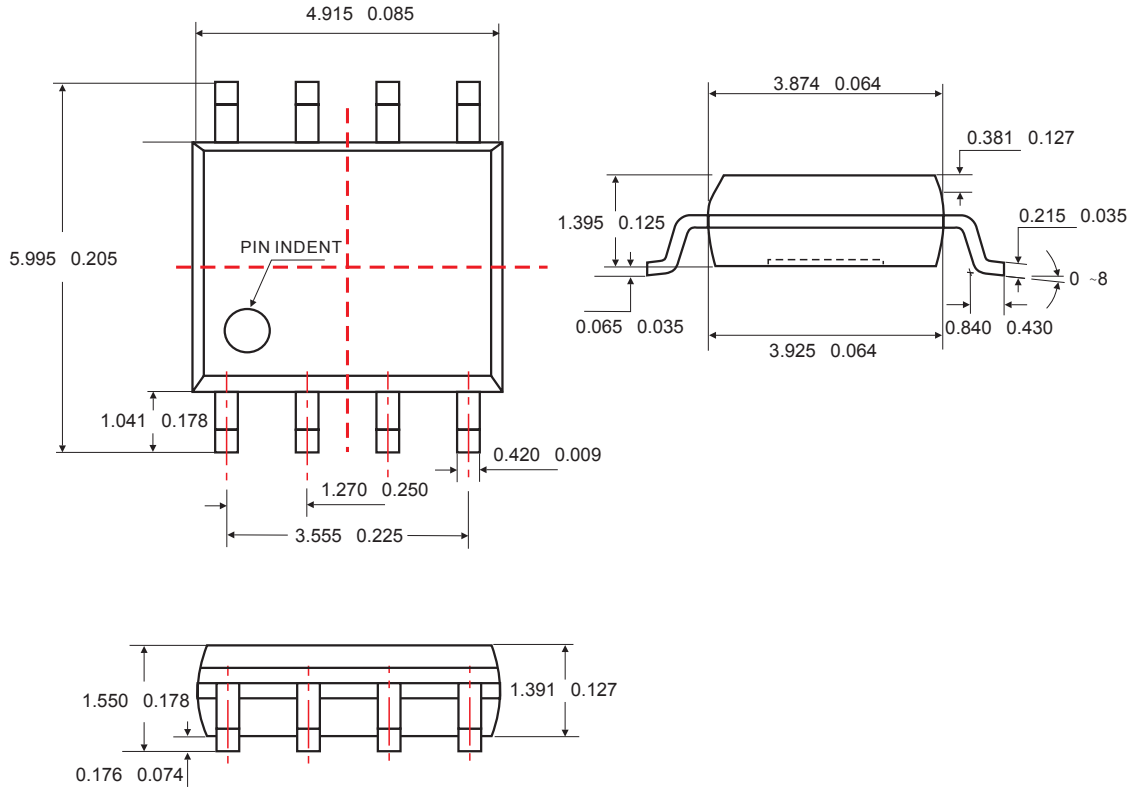
CATCH DIODE D —-Buck regulators require a diode to provide a return path for the inductor current when the switch turns off. This must be a fast diode and must be located close to the WT2576 using short leads and short printed circuit traces. Because of their very fast switching speed and low forward voltage drop, Schottky diodes provide the best performance, especially in low output voltage applications (5V and lower). Ultra fast recovery, or High-Efficiency rectifiers are also a good choice, but some types with an abrupt turnoff characteristic may cause instability or EMI problems.

INDUCTOR SELECTION L —-All switching regulators have two basic modes of operation; continuous and discontinuous. The difference between the two types relates to the inductor current, whether it is flowing continuously, or if it drops to zero for a period of time in the normal switching cycle. Each mode has distinctively different operating characteristics, which can affect the regulators performance and requirements. Most switcher designs will operate in the discontinuous mode when the load current is low. The WT2576 (or any of the Simple Switcher family) can be used for both continuous and discontinuous modes of operation. There is a formula for general applications:

$$L=(5\sim10)\ \frac{V_o}{100I_o}\ (1-\frac{V_o}{V_{IN}})\text{mH}$$

(Note：The unit of voltage is V, the unit of current is A)

SOP-8 PACKAGE OUTLINE DIMENSIONS(Unit: mm)



ORDERING NUMBER

WT2576MXX

Circuit Type

Package
SOP-8

Output Voltage
33 : 3.3V
50 : 5.0V
12 : 12V
- : ADJ