MXT2576 Series
SIMPLE SWITCHER 3A Step-Down Voltage Regulator

General Description

The MXT2576 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 adjustable 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 MXT2576 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 MXT2576 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.

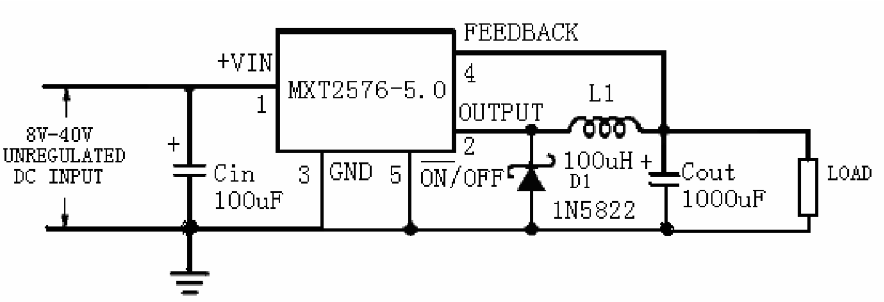
Features

- 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.
- Requires only 4 external components.
- 52 kHz fixed frequency internal oscillator
- TTL shutdown capability, low power standby mode.
- High efficiency.
- Uses readily available standard inductors.
- Thermal shutdown and 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).

Typical Application (Fixed Output Voltage Versions)



Block Diagram

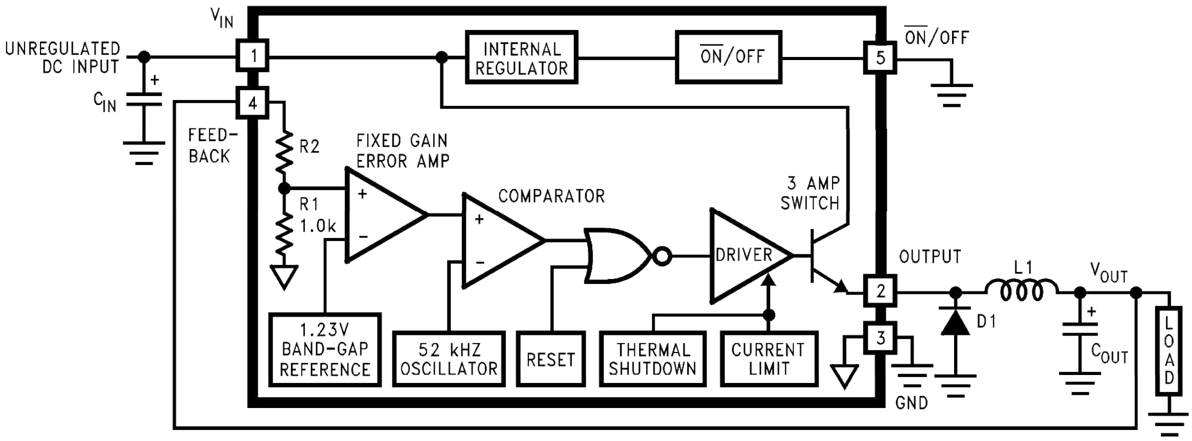


Fig 2

3.3V, R2 = 1.7k

5V, R2 = 3.1k

12V, R2 = 8.84k

15V, R2 = 11.3k

For ADJ. Version

R1 = Open, R2 = 0 Ω

Absolute Maximum Ratings (Note 1)

Maximum Supply Voltage

MXT2576	45V
(Steady State)	
Power Dissipation	internally limited
Internally Limited Storage Temperature Range	−65˚C to +150˚C
Maximum Junction Temperature	150˚C
Minimum ESD Rating	2 kV
Lead Temperature (Soldering, 10 Seconds)	260˚C

Operating Ratings

Temperature Range	$-40^{\circ}C \leq T_J \leq +125^{\circ}C$
Supply Voltage	40V

MXT2576-3.3

Electrical Characteristics

Specifications with standard type face are for Tj=25˚C, and those with boldface type apply over full operating temperature range.

Symbol	Parameter	conditions	Typ	limit N0te2	units
System parameters Note3 test circuit Fig1.					
VOUT	Output voltage	VIN=12V Iload=0.5A	3.3	3.234 3.366	V (min) (max)
VOUT	Output voltage	$0.5A \leq Iload \leq 3A$ $8V \leq VIN \leq 40V$	3.3	3.168/**3.135** 3.432/**3.465**	V (min) (max)
η	efficiency	VIN=12V,Iload=3A	75		%

MXT2576-5.0

Electrical Characteristics

Specifications with standard type face are for Tj=25˚C, and those with boldface type apply over full operating temperature range.

Symbo	Parameter	conditions	Typ	limit N0te2	units

l					
System parameters Note3 test circuit Fig1.					
VOUT	Output voltage	VIN=12V Iload=0.5A	5.0	4.900 5.100	V (min) (max)
VOUT	Output voltage	0.5A ≤ Iload ≤ 3A 8V ≤ VIN ≤ 40V	5.0	4.800/**4.750** 5.200/**5.250**	V (min) (max)
η	efficiency	VIN=12V,Iload=3A	77		%

MXT2576-12

Electrical Characteristics

Specifications with standard type face are for Tj=25˚C, and those with boldface type apply over full operating temperature range.

Symbo l	Parameter	conditions	Typ	limit N0te2	units
System parameters Note3 test circuit Fig1.					
VOUT	Output voltage	VIN=15V Iload=0.5A	12	11.76 12.24	V (min) (max)
VOUT	Output voltage	0.5A ≤ Iload ≤ 3A 15V ≤ VIN ≤ 40V	12	11.52/**11.40** 12.48/**12.60**	V (min) (max)
η	efficiency	VIN=15V,Iload=3A	88		%

MXT2576-ADJ

Electrical Characteristics

Specifications with standard type face are for Tj=25˚C, and those with boldface type apply over full operating temperature range.

Symbol	Parameter	conditions	Typ	limit N0te2	units
System parameters Note3 test circuit Fig1.					
VOUT	Output voltage	VIN=12V Iload=0.5A Circuit fig 2.	1.230	1.217 1.243	V (min) (max)
VOUT	Output voltage	$0.5A \leq Iload \leq 3A$ $8V \leq VIN \leq 40V$	1.230	1.193/**1.180** 1.267/**1.280**	V (min) (max)
η	efficiency	VIN=12V,Iload=3A VOUT=5V	77		%

ALL Output Voltage Versions

Electrical Characteristics

Specifications with standard type face are for Tj=25˚C, and those with boldface type apply over full operating temperature range. Unless otherwise specified, Vin=12V for the 3.3V ,5Vand adjustable version, Vin=25V for the 12V version, Iload=500mA.

Symbol	Parameter	conditions	Typ	limit N0te2	units
Device parameters					
Fo	Oscillator frequency	(Note11)	52	47/**42** 58/**63**	KHz (min) (max)
Vsat	Saturation Voltage	IOUT=3A (Note 4)	1.6	1.8/**2.0**	V (max)
DC	Max Duty cycle(ON)	(Note 5)	98	93	% (min)
ICL	Current Limit	Peak Current (Note 4 12)	5	4.2/**3.5**	A (min)

				6.9/**7.5**	(max)
IL	Output Leakage Current	(Note6 7) OUTPUT=0V OUTPUT=-1V OUTPUT=-1V	0 3	2	(max) mA (max)
IQ	Quiescent Current	Note 6	5	10	mA (max)
ISTBY	Standby Quiescent Current	ON/OFF pin=5V(OFF)	51	200/**500**	uA (max)
θ_{JC}	Thermal resistance	TO-220 and TO-263		2	°C/W
θ_{JA}		TO-220 Note 8		50	
θ_{JA}		TO-263 note9		50	
θ_{JA}		TO-263 note10		30	
θ_{JA}		TO-263 note11		20	
$\overline{ON}$/OFF Control test circuit.					
VIH	ON/OFF pin logic input level	VOUT=0V	1.4	2.2/**2.4**	V(min)
VIL		VOUT=5V	1.2	1.0/**0.8**	V(max)
IIH	ON/OFF pin input current	$\overline{ON}$/OFF pin=5V	19	30	uA (max)
IIL		$\overline{ON}$/OFF pin=0V	0	10	uA (max)

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

Note 2: All limits guaranteed at room temperature (standard type face) and at temperature extremes (bold type face).

Note 3: External components such as the catch diode, inductor, input and output capacitors can affect switching regulator system performance. When the MXT2576 is used as shown in the *Figure 2* test circuit, system performance will be as shown in system parameters section of Electrical Characteristics.

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

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

Note 6: Feedback pin removed from output and connected to +12V for the Adjustable, 3.3V, and 5V versions, and +25V for the 12V versions, to force the output transistor OFF.

Note 7: V_{IN} = 40V.

Note 8: Junction to ambient thermal resistance (no external heat sink) for the 5 lead TO-220 package mounted vertically, with 1⁄2 inch leads in a socket, or on a PC board with minimum copper area.

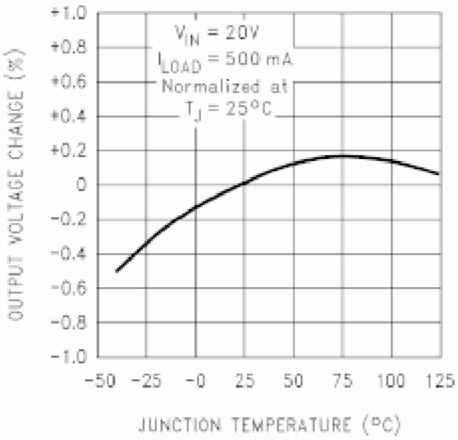
Note 9: Junction to ambient thermal resistance (no external heat sink) for the 5 lead TO-220 package mounted vertically, with 1⁄4 inch leads soldered to a PC board containing approximately 4 square inches of copper area surrounding the leads.

Note 10: If the TO-263 package is used, the thermal resistance can be reduced by increasing the PC board copper area thermally connected to the package. Using 0.5 square inches of copper area, JA is 50˚C/W, with 1 square inch of copper area, JA is 37˚C/W, and with 1.6 or more square inches of copper area, JA is 32˚C/W.

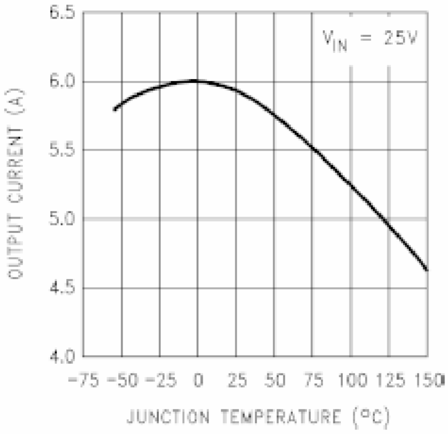
Note 11: The oscillator frequency reduces to approximately 11 kHz in the event of an output short or an overload which causes the regulated output voltage to drop approximately 40% from the nominal output voltage. This self protection feature lowers the average power dissipation of the IC by lowering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

Typical Performance Characteristics

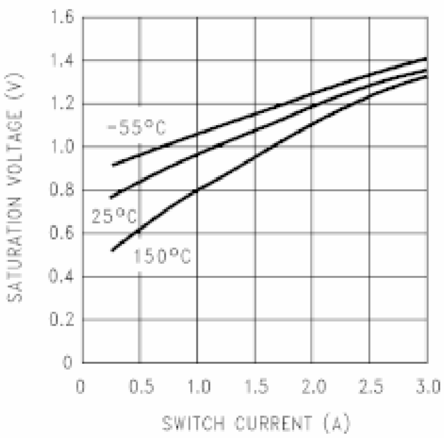
Normalized Output Voltage



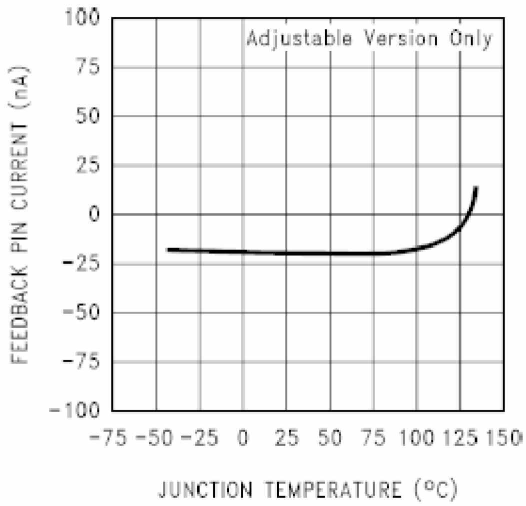
Current Limit



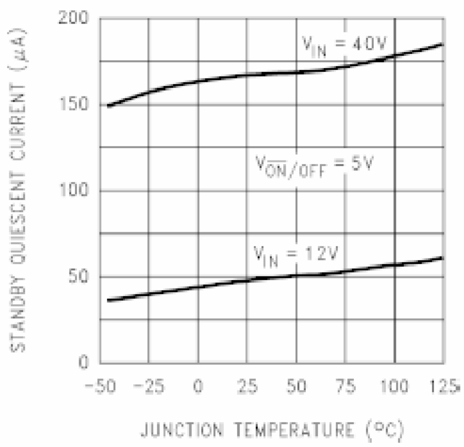
Switch Saturation Voltage



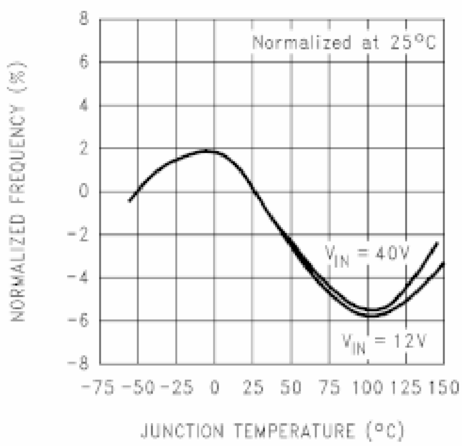
Feedback Pin Current

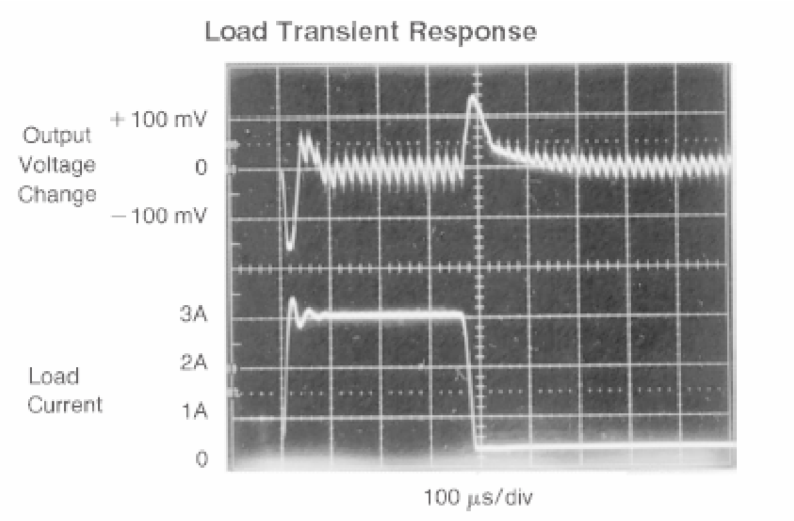


Standby Quiescent Current



Oscillator Frequency





Test Circuit and Layout Guidelines

As in any switching regulator, layout is very important. Rapidly switching currents associated with wiring inductance generate voltage transients which can cause problems. For minimal inductance and ground loops, the length of the leads indicated by heavy lines should be kept as short as possible.

Single-point grounding (as indicated) or ground plane construction should be used for best results. When using the adjustable version, physically locate the programming resistors near the regulator, to keep the sensitive feedback wiring short.

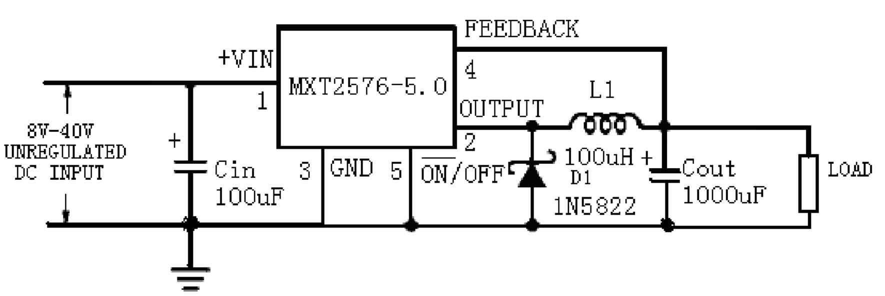


Fig 1

CIN — 100 µF, 75V, Aluminum Electrolytic

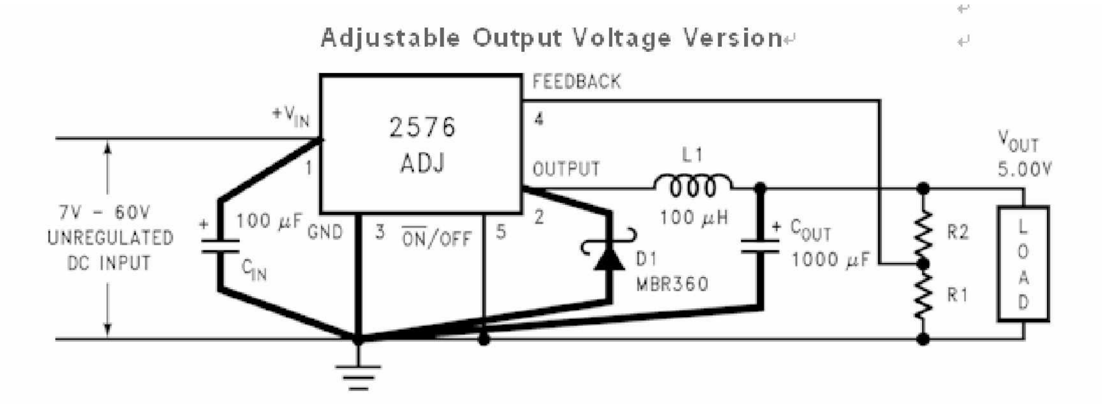
COUT — 1000 µF, 25V, Aluminum Electrolytic

D1 — Schottky , MBR360

L1 — 100 µH, Pulse Eng. PE-92108

R1 — 2k, 0.1%

R2 — 6.12k, 0.1%



$$V_{OUT} = V_{REF}\left(1 + \frac{R_2}{R_1}\right)$$

$$R_2 = R_1\left(\frac{V_{OUT}}{V_{REF}} - 1\right)$$

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

MXT2576 Series Buck Regulator Design Procedure

PROCEDURE (Fixed Output Voltage Versions)

Given: V_{OUT} = Regulated Output Voltage (3.3V, 5V, or 12V) V_{IN}(Max) = Maximum Input Voltage I_{LOAD}(Max) = Maximum Load Current

1. Inductor Selection (L1)

A. Select the correct Inductor value selection guide from *Figures 3, 4* or *Figure5*.

(Output voltages of 3.3V, 5Vor 12V respectively). For other output voltages, see the design procedure for the adjustable version.

B. From the inductor value selection guide, identify the inductance region intersected by V_{IN}(Max) and I_{LOAD}(Max), and note the inductor code for that region.

C. Identify the inductor value from the inductor code, and select an appropriate inductor from the table shown in *Figure 8*. Part numbers are listed for three inductor manufacturers. The inductor chosen must be rated for operation at the MXT2576 switching frequency

(52 kHz) and for a current rating of 1.15 x I_{LOAD}. For additional inductor information, see the inductor section in the Application Hints section of this data sheet.

2. Output Capacitor Selection (C_{OUT})

A. The value of the output capacitor together with the inductor defines the dominate pole-pair of the switching regulator loop. For stable operation and an acceptable output ripple voltage, (approximately 1% of the output voltage) a value between 100 µF and 470 µF is recommended.

B. The capacitor’s voltage rating should be at least 1.5 times greater than the output voltage. For a 5V regulator, a rating of at least 8V is appropriate, and a 10V or 15V rating is recommended. Higher voltage electrolytic capacitors generally have lower ESR numbers, and for this reason it may be necessary to select a capacitor rated for a higher voltage than would normally be needed.

3. Catch Diode Selection (D1)

A. The catch-diode current rating must be at least 1.2 times greater than the maximum load current. Also, if the power supply design must withstand a continuous output short, the diode should have a current rating equal to the maximum current limit of the MXT2576. The most stressful condition for this diode is an overload or shorted output condition.

B. The reverse voltage rating of the diode should be at least 1.25 times the maximum input voltage.

4. Input Capacitor (C_{IN})

An aluminum or tantalum electrolytic bypass capacitor located close to the regulator is needed for stable operation.

MXT2576 Series Buck Regulator Design Procedure

INDUCTOR VALUE SELECTION GUIDES (For Continuous Mode Operation)

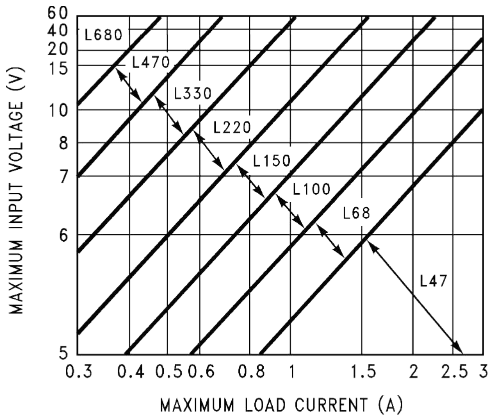


Fig 3 MXT2576-3.3

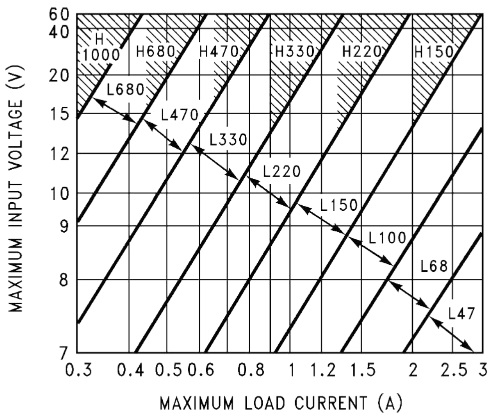


Fig 4 MXT2576-5.0

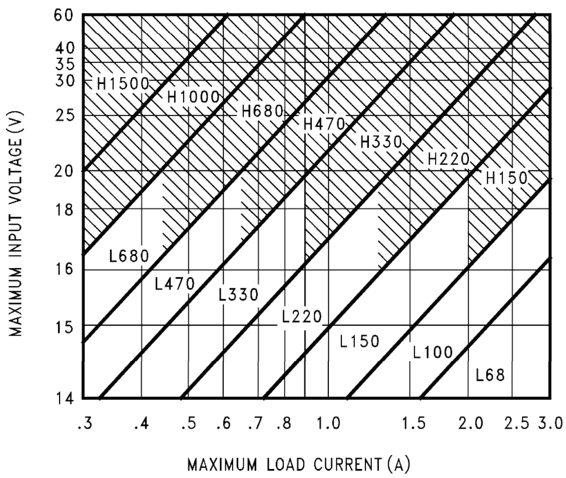


Fig 5 MXT2576-12

MXT2576 Series Buck Regulator Design Procedure

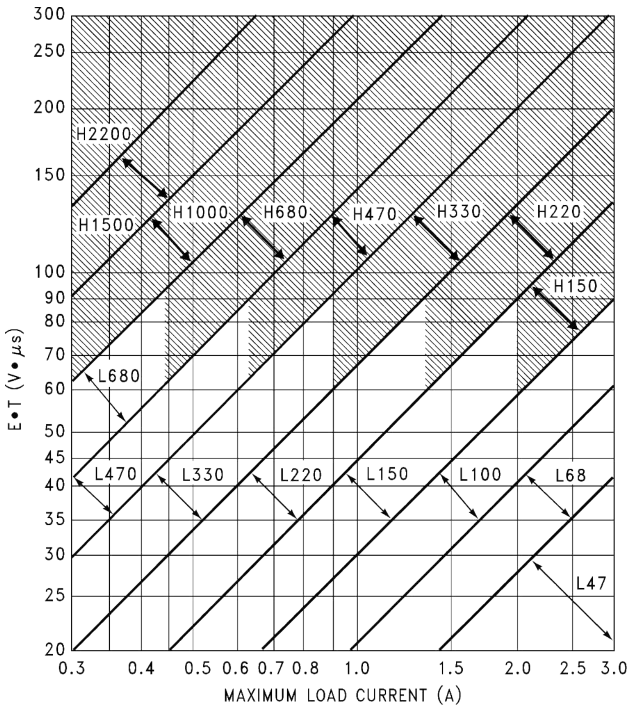


Fig 6 MXT2576-ADJ

PROCEDURE (Adjustable Output Voltage Versions)

Given: VOUT = Regulated Output Voltage VIN(Max) = Maximum Input Voltage ILOAD(Max) = Maximum Load Current F = Switching Frequency *(Fixed at 52 kHz)*

1. Programming Output Voltage *(Selecting R1 and R2, as shown in Figure 1*)

Use the following formula to select the appropriate resistor values.

$$V_{OUT} = V_{REF}\left(1 + \frac{R_2}{R_1}\right) \quad \text{where } V_{REF} = 1.23V$$

R1 can be between 1k and 5k. *(For best temperature coefficient and stability with time, use 1% metal film resistors)*

$$R_2 = R_1\left(\frac{V_{OUT}}{V_{REF}} - 1\right)$$

2. Inductor Selection (L1)

A. Calculate the inductor Volt

• Microsecond constant, E • T (V • μs), from the following formula:

$$E \bullet T = (V_{IN} - V_{OUT})\frac{V_{OUT}}{V_{IN}} \bullet \frac{1000}{F\,(in\ kHz)}\ (V \bullet \mu s)$$

B. Use the E • T value from the previous formula and match it with the E • T number on the vertical axis of the **Inductor Value Selection Guide** shown in *Figure 6.*

C. On the horizontal axis, select the maximum load current.

D. Identify the inductance region intersected by the E • T value and the maximum load current value, and note the inductor code for that region.

E. Identify the inductor value from the inductor code, and select an appropriate inductor from the table shown in *Figure 8.* Part numbers are listed for three inductor manufacturers. The inductor chosen must be rated for operation at the MXT2576 switching frequency (52 kHz) and for a current rating of 1.15 x ILOAD. For additional inductor information, see the inductor section in the application hints section of this data sheet.

3. Output Capacitor Selection (C_{OUT})

A. The value of the output capacitor together with the inductor defines the dominate pole-pair of the switching regulator loop. For stable operation, the capacitor must satisfy the following requirement:

$$C_{OUT} \geq 13{,}300 \frac{V_{IN}(Max)}{V_{OUT} \bullet L(\mu H)} (\mu F)$$

The above formula yields capacitor values between 10 μF and 2200 μF that will satisfy the loop requirements for stable operation. But to achieve an acceptable output ripple voltage, (approximately 1% of the output voltage) and transient response, the output capacitor may need to be several times larger than the above formula yields.

B. The capacitor's voltage rating should be at last 1.5 times greater than the output voltage. For a 10V regulator, a rating of at least 15V or more is recommended. Higher voltage electrolytic capacitors generally have lower ESR numbers, and for this reason it may be necessary to select a capacitor rate for a higher voltage than would normally be needed.

4. Catch Diode Selection (D1)

A. The catch-diode current rating must be at least 1.2 times greater than the maximum load current. Also, if the power supply design must withstand a continuous output short, the diode should have a current rating equal to the maximum current limit of the MXT2576. The most stressful condition for this diode is an overload or shorted output. See diode selection guide in *Figure 7*.

B. The reverse voltage rating of the diode should be at least 1.25 times the maximum input voltage.

5. Input Capacitor (C_{IN})

An aluminum or tantalum electrolytic bypass capacitor located close to the regulator is needed for stable operation

V_R	Schottky		Fast Recovery	
	3A	4A–6A	3A	4A–6A
20V	1N5820 MBR320P SR302	1N5823	The following diodes are all rated to 100V 31DF1 HER302	The following diodes are all rated to 100V 50WF10 MUR410 HER602
30V	1N5821 MBR330 31DQ03 SR303	50WQ03 1N5824		
40V	1N5822 MBR340 31DQ04 SR304	MBR340 50WQ04 1N5825		
50V	MBR350 31DQ05 SR305	50WQ05		
60V	MBR360 DQ06 SR306	50WR06 50SQ060		

Fig 7 Diode Selection Guide

Inductor Code	Inductor Value	Schott (Note 12)	Pulse Eng. (Note 13)	Renco (Note 14)
L47	47 μH	671 26980	PE-53112	RL2442
L68	68 μH	671 26990	PE-92114	RL2443
L100	100 μH	671 27000	PE-92108	RL2444
L150	150 μH	671 27010	PE-53113	RL1954
L220	220 μH	671 27020	PE-52626	RL1953
L330	330 μH	671 27030	PE-52627	RL1952
L470	470 μH	671 27040	PE-53114	RL1951
L680	680 μH	671 27050	PE-52629	RL1950
H150	150 μH	671 27060	PE-53115	RL2445
H220	220 μH	671 27070	PE-53116	RL2446
H330	330 μH	671 27080	PE-53117	RL2447
H470	470 μH	671 27090	PE-53118	RL1961
H680	680 μH	671 27100	PE-53119	RL1960
H1000	1000 μH	671 27110	PE-53120	RL1959
H1500	1500 μH	671 27120	PE-53121	RL1958
H2200	2200 μH	671 27130	PE-53122	RL2448

Fig 8 Inductor Selection by Manufacture's Part Number

Note 12: Schott Corporation, (612) 475-1173, 1000 Parkers Lake Road, Wayzata, MN 55391.

Note 13: Pulse Engineering, (619) 674-8100, P.O. Box 12235, San Diego, CA 92112.

Note 14: Renco Electronics Incorporated, (516) 586-5566, 60 Jeffryn Blvd. East, Deer Park, NY 11729.

Application Hints

INPUT CAPACITOR (C_{IN})

To maintain stability, the regulator input pin must be bypassed with at least a 100 µF electrolytic capacitor. The capacitor's leads must be kept short, and located near the regulator.

If the operating temperature range includes temperatures below −25˚C, the input capacitor value may need to be larger. With most electrolytic capacitors, the capacitance value decreases and the ESR increases with lower temperatures and age. Paralleling a ceramic or solid tantalum capacitor will increase the regulator stability at cold temperatures. For maximum capacitor operating lifetime, the capacitor's RMS ripple current rating should be greater than

$$1.2 \times \left(\frac{t_{ON}}{T}\right) \times I_{LOAD}$$

where $\frac{t_{ON}}{T} = \frac{V_{OUT}}{V_{IN}}$ for a buck regulator

and $\frac{t_{ON}}{T} = \frac{|V_{OUT}|}{|V_{OUT}| + V_{IN}}$ for a buck-boost regulator.

INDUCTOR SELECTION

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 regulator performance and requirements.

The MXT2576 (or any of the SIMPLE SWITCHER family) can be used for both continuous and discontinuous modes of operation.

The inductor value selection guides in *Figure 3* through *Figure 6* were designed for buck regulator designs of the continuous inductor current type. When using inductor values shown in the inductor selection guide, the peak-to-peak inductor ripple current will be approximately 20% to 30% of the maximum DC current. With relatively heavy load currents, the circuit operates in the continuous mode (inductor current always flowing), but under light load conditions, the circuit will be forced to the discontinuous mode (inductor current falls to zero for a period of time). This discontinuous mode of operation is perfectly acceptable. For light loads (less than approximately 300 mA) it may be desirable to operate the regulator in the discontinuous mode, primarily because of the lower inductor values required for the discontinuous mode.

The selection guide chooses inductor values suitable for continuous mode operation, but if the inductor value chosen is prohibitively high, the designer should investigate the possibility of discontinuous operation. The computer design software ***Switchers Made Simple*** will provide all component values for discontinuous (as well as continuous) mode of operation.

Inductors are available in different styles such as pot core, toriod, E-frame, bobbin core, etc., as well as different core materials, such as ferrites and powdered iron. The least expensive, the bobbin core type, consists of wire wrapped on a ferrite rod core. This type of construction makes for an inexpensive inductor, but since the magnetic flux is not completely contained within the core, it generates more electro- magnetic interference (EMI). This EMI can cause problems in sensitive circuits, or can give incorrect scope readings because of induced voltages in the scope probe.

The inductors listed in the selection chart include ferrite pot core construction for AIE, powdered iron toroid for Pulse Engineering, and ferrite bobbin core for Renco.

An inductor should not be operated beyond its maximum rated current because it may saturate. When an inductor begins to saturate, the inductance decreases rapidly and the inductor begins to look mainly resistive (the DC resistance of the winding). This will cause the switch current to rise very rapidly. Different inductor types have different saturation characteristics, and this should be kept in mind when selecting an inductor.

The inductor manufacturer’s data sheets include current and energy limits to avoid inductor saturation.

INDUCTOR RIPPLE CURRENT

When the switcher is operating in the continuous mode, the inductor current waveform ranges from a triangular to a saw tooth type of waveform (depending on the input voltage). For a given input voltage and output voltage, the peak-to-peak amplitude of this inductor current waveform remains constant. As the load current rises or falls, the entire saw tooth current waveform also rises or falls. The average DC value of this waveform is equal to the DC load current (in the buck regulator configuration).

If the load current drops to a low enough level, the bottom of the saw tooth current waveform will reach zero, and the switcher will change to a discontinuous mode of operation. This is a perfectly acceptable mode of operation. Any buck switching regulator (no matter how large the inductor value is) will be forced to run discontinuous if the load current is light enough.

OUTPUT CAPACITOR

An output capacitor is required to filter the output voltage and is needed for loop stability. The capacitor should be located near the MXT2576 using short pc board traces. Standard aluminum electrolytics are usually adequate, but low ESR types are recommended for low output ripple voltage and good stability. The ESR of a capacitor depends on many factors, some which are: the value, the voltage rating, physical size and the type of construction. In general, low value or low voltage (less than 12V) electrolytic capacitors usually have higher ESR numbers.

The amount of output ripple voltage is primarily a function of the ESR (Equivalent Series Resistance) of the output capacitor and the amplitude of the inductor ripple current(ΔI_{IND}). See the section on inductor ripple current in Application Hints.

The lower capacitor values (220µF–1000µF) will allow typically 50 mV to 150 mV of output ripple voltage, while larger-value capacitors will reduce the ripple to approximately 20 mV to 50 mV.

Output Ripple Voltage = (ΔI_{IND}) (ESR of C_{OUT})

To further reduce the output ripple voltage, several standard electrolytic capacitors may be paralleled, or a higher-grade capacitor may be used. Such capacitors are often called"high-frequency," "low-inductance," or "low-ESR." These will reduce the output ripple to 10 mV or 20 mV. However, when operating in the continuous mode, reducing the ESR below 0.03**Ω** can cause instability in the regulator.

Tantalum capacitors can have a very low ESR, and should be carefully evaluated if it is the only output capacitor. Because of their good low temperature characteristics, a tantalum can be used in parallel with aluminum electrolytics, with the tantalum making up 10% or 20% of the total capacitance.

The capacitor's ripple current rating at 52 kHz should be at least 50% higher than the peak-to-peak inductor ripple current.

CATCH DIODE

Buck regulators require a diode to provide a return path for the inductor current when the switch is off. This diode should be located close to the MXT2576 using short leads and short printed circuit traces.

Because of their fast switching speed and low forward voltage drop, Schottky diodes provide the best efficiency, especially in low output voltage switching regulators (less than 5V). Fast-Recovery, High-Efficiency, or Ultra-Fast Recovery diodes are also suitable, but some types with an abrupt turn-off characteristic may cause instability and EMI problems. A fast-recovery diode with soft recovery characteristics is a better choice. Standard 60 Hz diodes (e.g., 1N4001 or1N5400, etc.) are also **not suitable.** See *Figure 7* for Schottky and "soft" fast-recovery diode selection guide.

OUTPUT VOLTAGE RIPPLE AND TRANSIENTS

The output voltage of a switching power supply will contain a saw tooth ripple voltage at the switcher frequency, typically about 1% of the output voltage, and may also contain short voltage spikes at the peaks of the saw tooth waveform.

The output ripple voltage is due mainly to the inductor saw tooth ripple current multiplied by the ESR of the output capacitor. (See the inductor selection in the application hints.)

The voltage spikes are present because of the fast switching action of the output switch, and the parasitic inductance of the output filter capacitor. To minimize these voltage spikes, special low inductance capacitors can be used, and their lead lengths must be kept short. Wiring inductance, stray capacitance, as well as the scope probe used to evaluate these transients, all contribute to the amplitude of these spikes.

An additional small LC filter (20 µH & 100 µF) can be added to the output to further reduce the amount of output ripple and transients. A 10 x reduction in output ripple voltage and transients is possible with this filter.

FEEDBACK CONNECTION

The MXT2576 (fixed voltage versions) feedback pin must be wired to the output voltage point of the switching power supply. When using the adjustable version, physically locate both output voltage programming resistors near the MXT2576 to avoid picking up unwanted noise. Avoid using resistors greater than 100 k**Ω** because of the increased chance of noise pickup.

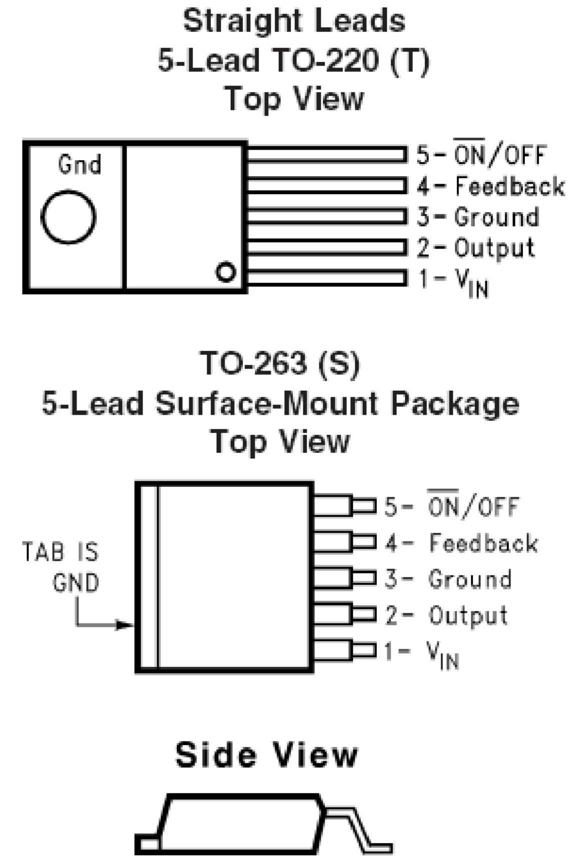
ON /OFF INPUT

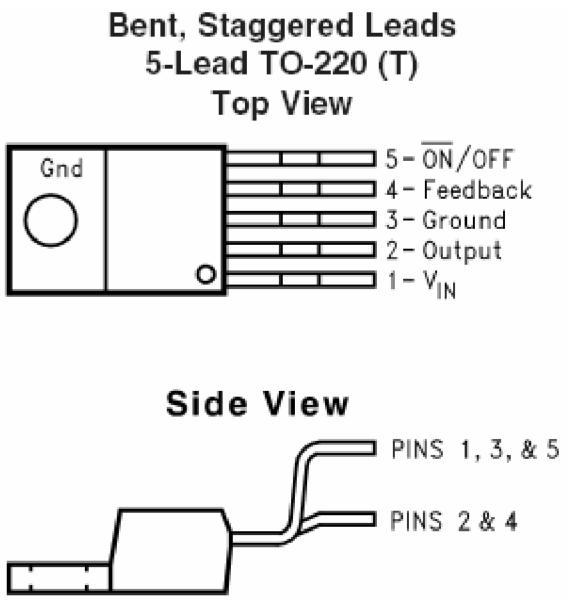
For normal operation, the ON /OFF pin should be grounded or driven with a low-level TTL voltage (typically below 1.4V). To put the regulator into standby mode, drive this pin with a highlevel TTL or CMOS signal. The ON /OFF pin can be safely pulled up to $+V_{IN}$ without a resistor in series with it. The ON /OFF pin should not be left open.

GROUNDING

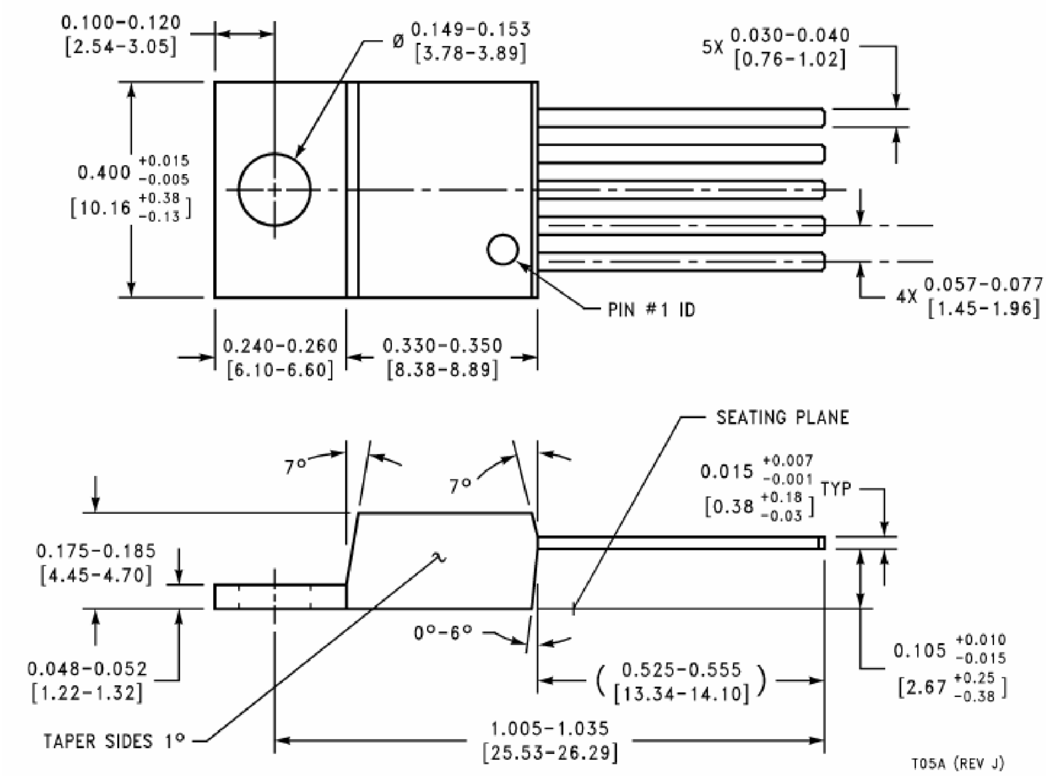
To maintain output voltage stability, the power ground connections must be low impedance (see Figure *2*). For the 5-lead TO-220 and TO-263 style package, both the tab and pin 3 are ground and either connection may be used, as they are both part of the same copper lead frame.

Connection Diagrams

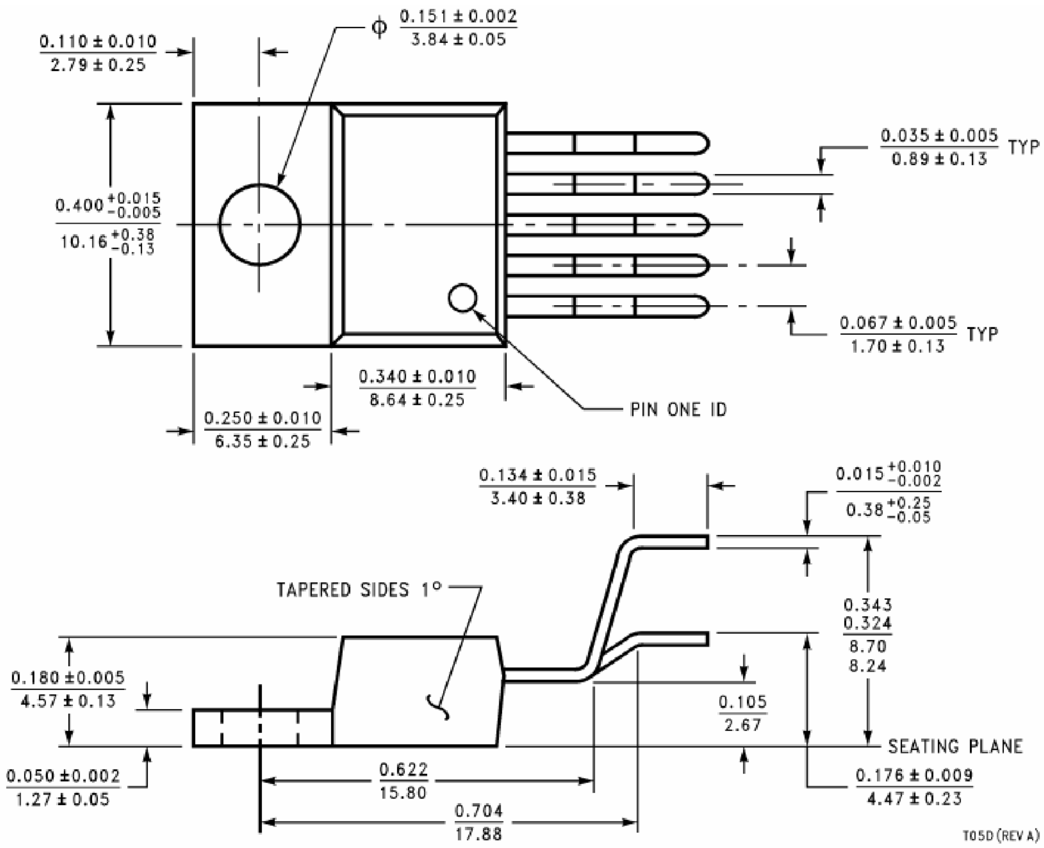




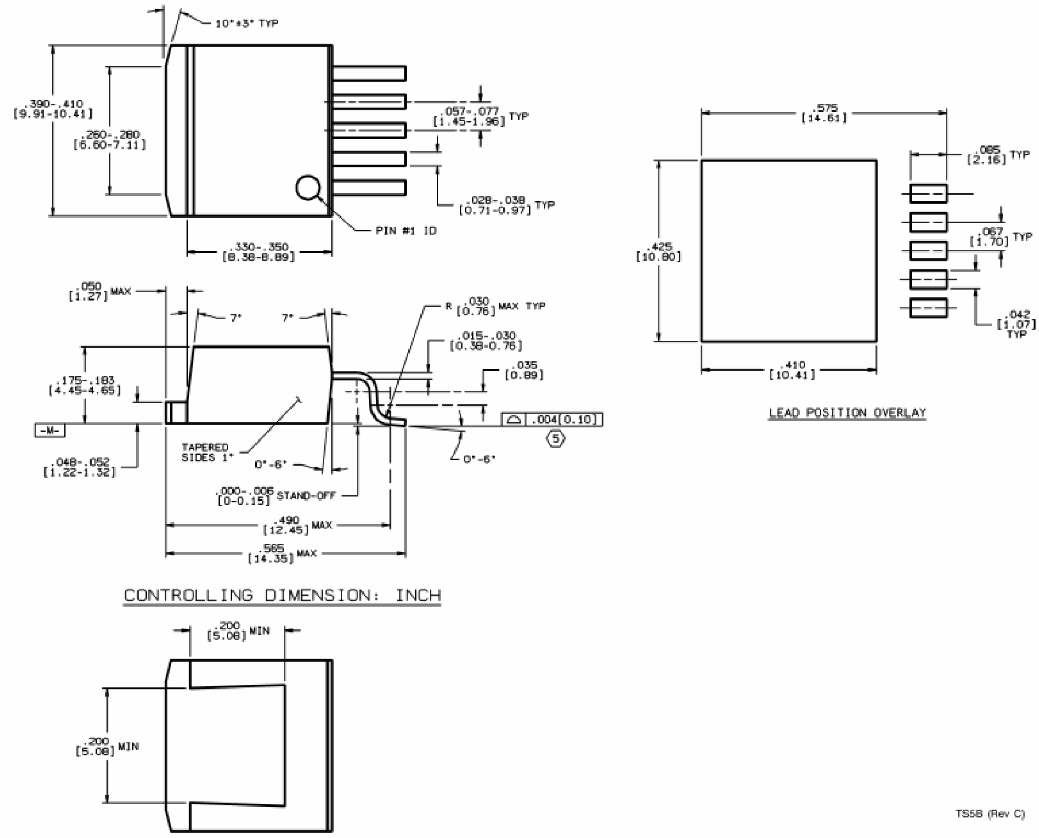
Physical Dimensions inches (millimeters) unless otherwise noted



5-Lead TO-220 (T)



Bent, Staggered 5-Lead TO-220 (T)



5-Lead TO-263 (S)