

### FEATURES

- Pin for pin interchangeable with National's LM2575/LM2576 Series
- DC-to-DC buck or buck/boost converter requiring only 4 support components
- Fixed or adjustable voltages
- Preset output voltages of 3.3, 5 and 12 V
- Wide output voltage range, 1.23V to 35V
- 82% typical efficiency @ 5V
- Wide input voltage range, 4V to 40V
- Inhibit/enable control pin

### DESCRIPTION

The LM2575/76 Series switching regulators are monolithic integrated circuits designed for use in "buck" or "buck/boost" regulator applications requiring accurate output voltages over combined variations of line, load and temperature. This unique Series greatly simplifies switching power supply design. The LM2575 has a maximum output current of 1A; the LM2576 is rated for 3A.

The LM2575/76 Series miniconverters include a switching regulator and compensation network all within the same package. Just add a choke, catch diode and two capacitors to obtain an efficient DC-to-DC converter. Current limit and thermal shutdown features of the LM2575/76 Series fully protect the device against overstress conditions.

The LM2575/76 Series offer replacement for popular 3 terminal linear regulators by providing higher efficiency with reduced heatsink size. In many applications a heat sink will not be required.

### ABSOLUTE MAXIMUM RATINGS

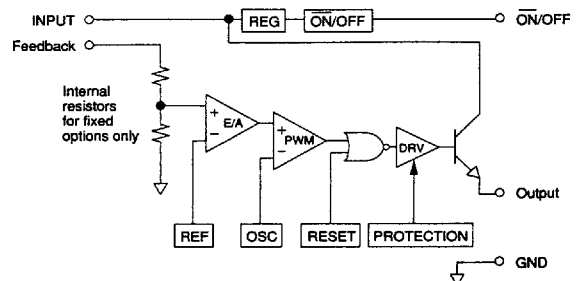
Parameter	Symbol	Maximum	Units
Input Voltage	V <sub>IN</sub>	45	V
On/Off Pin Input Voltage		-0.3 ≤ V ≤ V <sub>IN</sub>	
Output Voltage to Common (Steady State)		-1	
Power Dissipation	P <sub>D</sub>	Internally Limited	W
Thermal Resistance Junction to Case TO-220, TO-263	θ <sub>JC</sub>	2.0	°C/W
Thermal Resistance Junction to Ambient TO-263 TO-220	θ <sub>JA</sub>	60 55	
Operating Junction Temperature Range TO-220, TO-263	T <sub>J</sub>	-40 to 125	°C
Storage Temperature Range TO-220, TO-263	T <sub>STG</sub>	-40 to 125	
Lead Temperature (Soldering) 10 Sec. (Plastic)	T <sub>LEAD</sub>	260	
ESD Class		2	

### DEVICE SELECTION GUIDE

DEVICE(1)	CURRENT	TEMP. RANGE	PACKAGE
LM2575T-XX	1A	-40 to 125°C	TO-220(2)
LM2575S-XX			TO-263
LM2576T-XX	3A		TO-220(2)
LM2576S-XX			TO-263

- (1) XX = Voltage Option 3.3, 5.0, 12, ADJ (1.23V to 35V).  
 (2) T-XX = Straight in-line; T-XX-V = Vertical Staggered;  
 T-XX-H = Horizontal Staggered.

### BLOCK DIAGRAM



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### ELECTRICAL CHARACTERISTICS

Unless otherwise specified,  $V_{IN} = 12V$  for 3.3V, 5V and ADJ options; 25V for 12V;  $V_{OUT} = 5V$  for ADJ,  $T_J = 25^\circ C$ .  
 $V_{IN}$  rated = 40V.  $I_O = 0.5A$  to 3A (LM2576), 0.2A to 1A (LM2575).

PARAMETER	SYMBOL	Test Conditions			Test Limits			UNITS
		$V_{IN}$	$I_O$	$T_J$	MIN	TYP	MAX	
Output Voltage LM2576-3.3	$V_O$		0.5A		3.23	3.3	3.37	V
		8V to $V_{IN}$ RATED	0.5A	Over Temp.	3.14		3.47	
					3.20		3.40	
LM2576-5		8V to $V_{IN}$ RATED	0.5A	Over Temp.	4.90	5.0	5.10	
					4.76		5.25	
LM2576-12		15V to $V_{IN}$ RATED	0.5A	Over Temp.	4.85	12.0	5.15	
	11.76				12.24			
	11.40				12.60			
Feedback Voltage $V_{OUT} = 5V$ LM2576-ADJ	$I_{FB}$	0.5A	Over Temp.	11.52	1.23	12.48		
				1.217		1.243		
				1.180		1.280		
Feedback Bias Current LM2576-ADJ	$I_B$	12V	0.5A	Over Temp.	50	100	nA	
						500		
Output Voltage LM2575-3.3	$V_O$		0.2A		3.23	3.3	3.37	V
		8V to $V_{IN}$ RATED	0.2A	Over Temp.	3.14		3.47	
					3.20		3.40	
LM2575-5		8V to $V_{IN}$ RATED	0.2A	Over Temp.	4.90	5.0	5.10	
					4.75		5.25	
LM2575-12		15V to $V_{IN}$ RATED	0.2A	Over Temp.	4.85	12.0	5.15	
	11.76				12.24			
	11.40				12.60			
Feedback Voltage $V_{OUT} = 5V$ LM2575-ADJ	$I_{FB}$	0.2A	Over Temp.	11.52	1.23	12.48		
				1.217		1.243		
				1.180		1.280		
Feedback Bias Current LM2575-ADJ	$I_B$	12V	0.2A	Over Temp.	50	500	nA	
						500		

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### ELECTRICAL CHARACTERISTICS (continued)

PARAMETER	SYMBOL	Test Conditions			Test Limits			UNITS	
		V <sub>IN</sub>	I <sub>o</sub>	T <sub>J</sub>	MIN	TYP	MAX		
Efficiency/Option	η	12V	3A			77		%	
3.3						82			
5						88			
12						82			
ADJ V <sub>o</sub> = 5V									
Switching Frequency	F <sub>SW</sub>				47	52	58	kHz	
			Over Temp.	43		62			
Saturation Voltage (1)	V <sub>SAT</sub>		LM2575 - 1A LM2576 - 3A	Over Temp.		0.9	1.2 1.4	V	
Max Duty Cycle (On) (3)	DC				93	98		%	
Current Limit (1) Peak Current LM2576	I <sub>CL</sub>					4.2	5.8	6.9	A
					Over Temp.	3.5		7.5	
Current Limit (1) LM2575					Over Temp.	1.7	2.2	3.0	
Output Leakage Current (2) Output = 0V Output = -1V	I <sub>L</sub>	V <sub>IN</sub> RATED					2	mA	
						7.5	30		
Quiescent Current (2)	I <sub>Q</sub>			Over Temp.		5	10		
							12		
Standby Quiescent Current (On/Off Pin = 5V)	I <sub>STBY</sub>			Over Temp.		50	500	μA	
On/Off Pin Logic Input Level V <sub>OUT</sub> = 0V	V <sub>IH</sub>				2.2			V	
				Over Temp.	2.4	1.4			
V <sub>OUT</sub> = Option	V <sub>IL</sub>			Over Temp.		1.2	1.0 0.8		
On/Off Input Current On/Off = 5V (Off) On/Off = 0V (On)	I <sub>IH</sub> I <sub>IL</sub>		0.5A			12	30	μA	
						0	10		

**NOTES:**

Over temperature: -40°C to 125°C

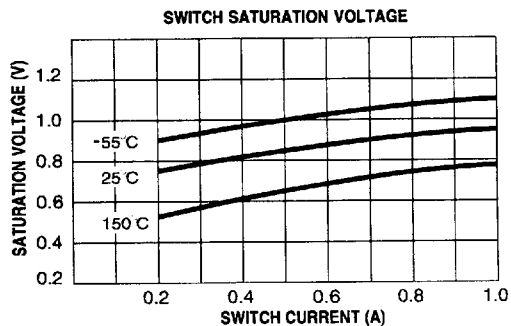
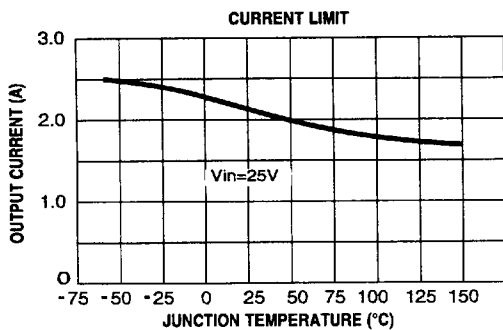
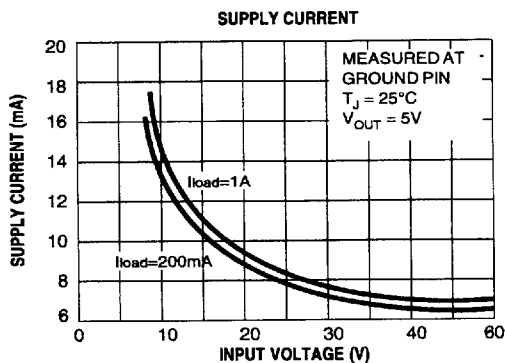
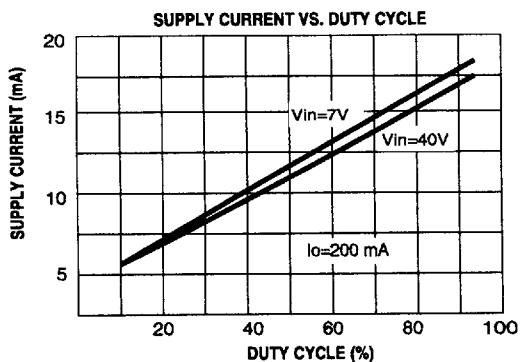
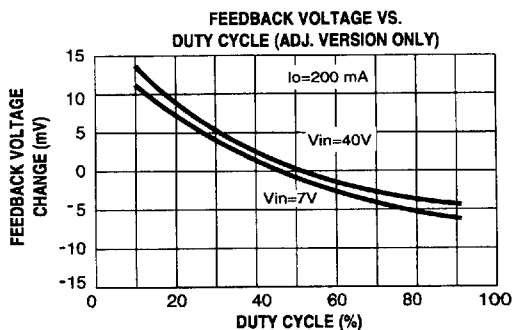
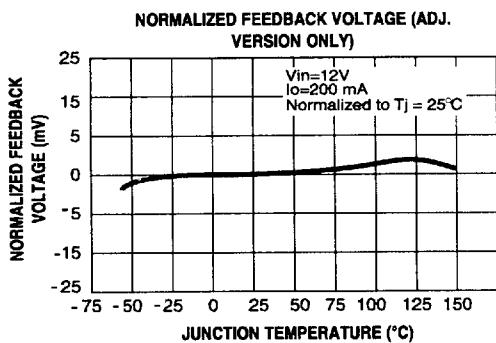
(1) Output sourcing current-resistive load, no inductor or capacitor.

(2) Feedback = V<sub>o</sub> + 1.0V.

(3) Feedback = 0V.

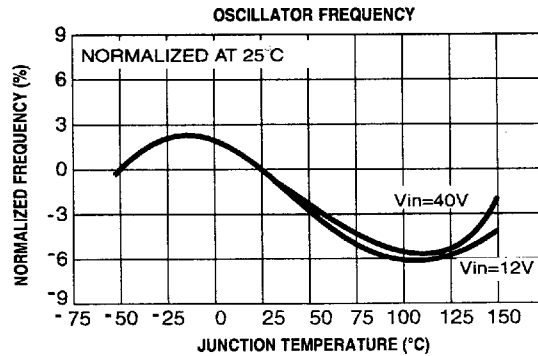
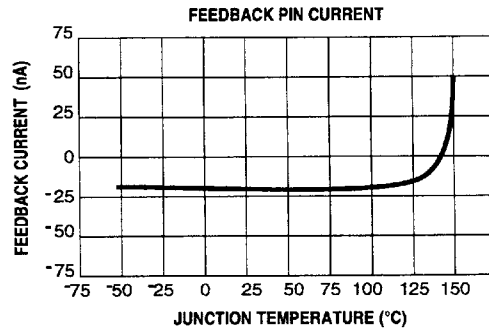
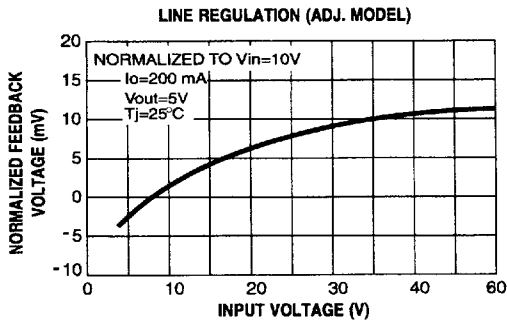
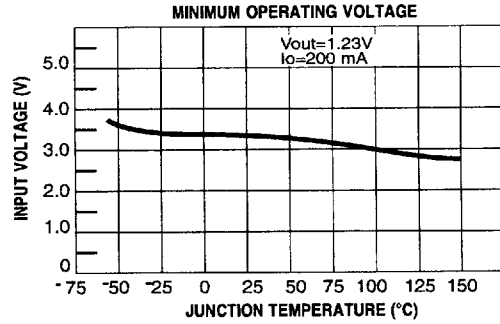
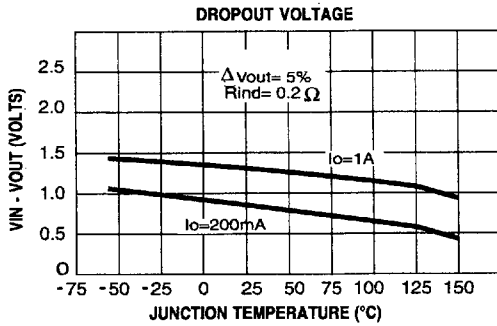
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### LM2575 - OPERATIONAL DATA



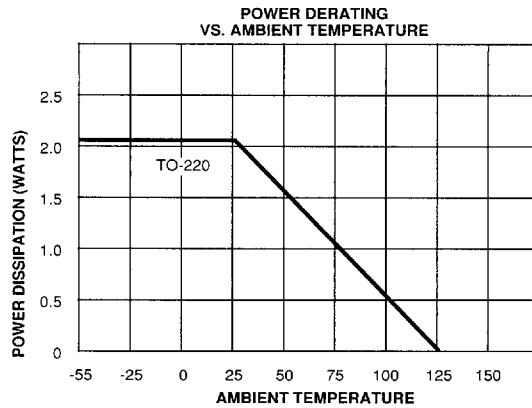
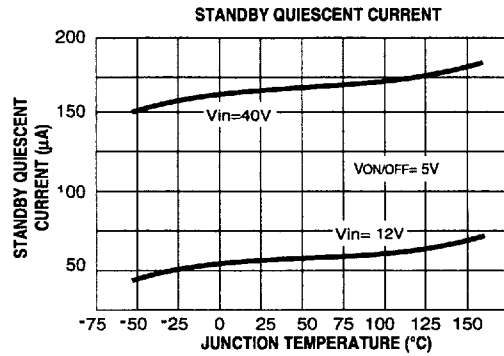
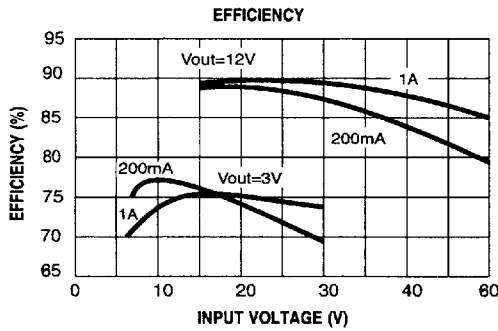
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### LM2575 - OPERATIONAL DATA



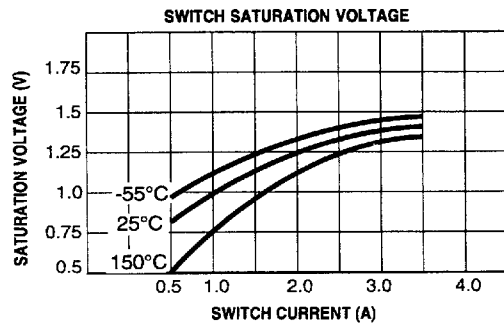
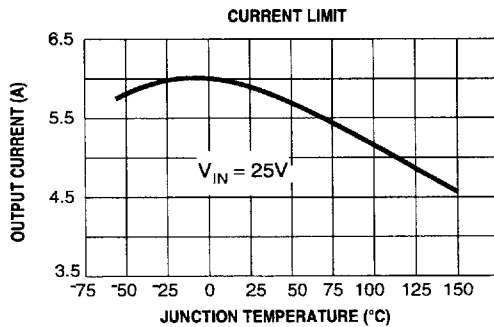
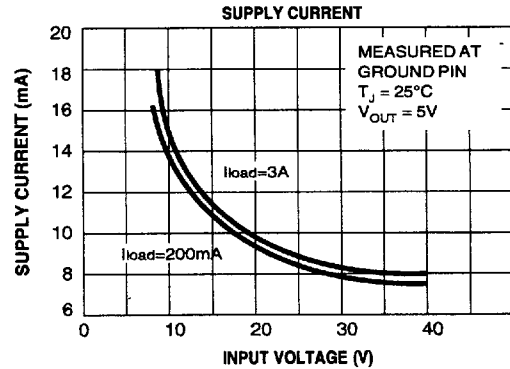
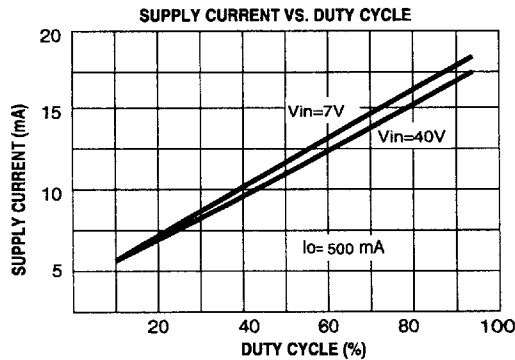
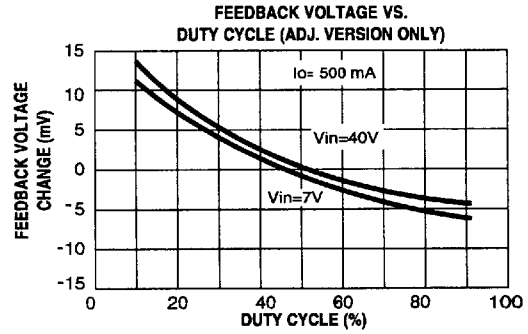
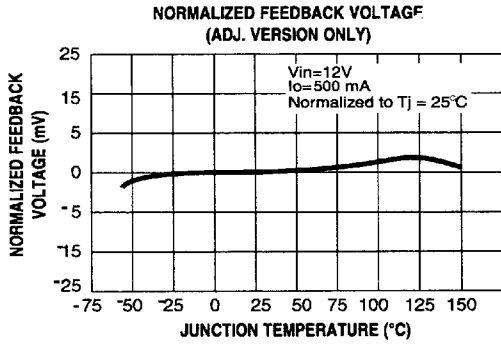
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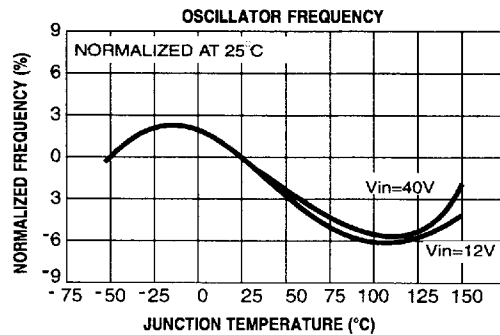
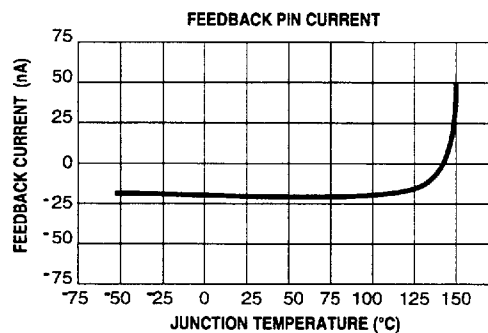
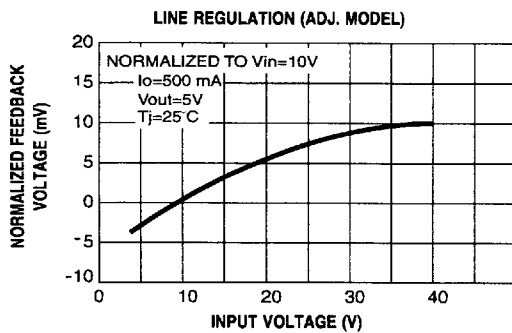
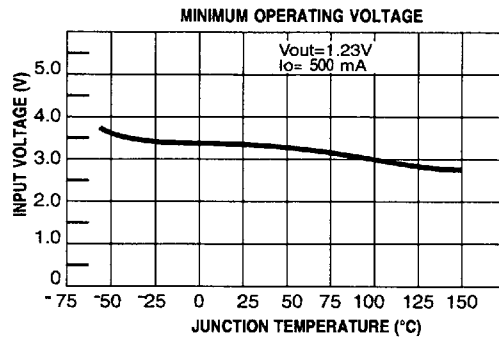
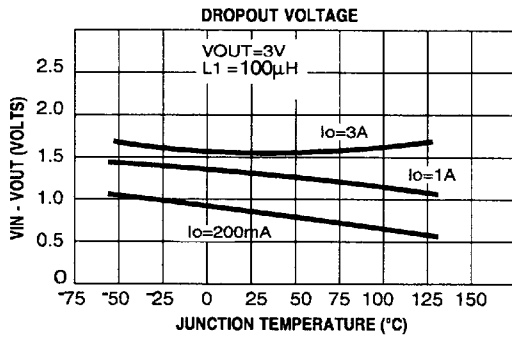


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### LM2576 - OPERATIONAL DATA



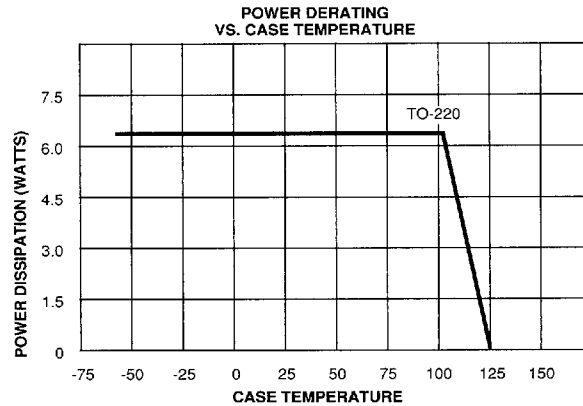
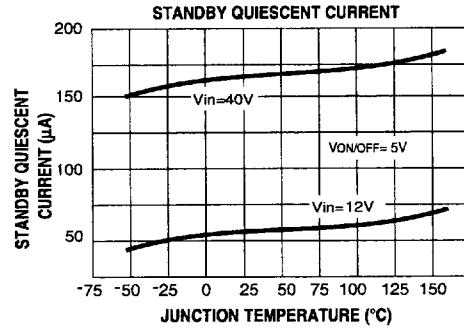
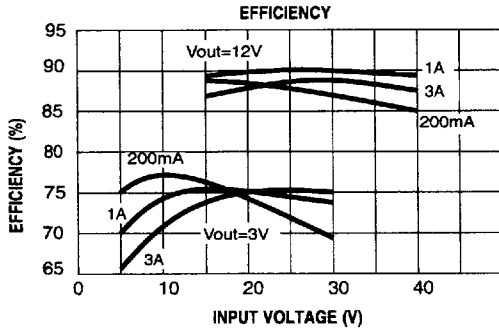
### LM2576 - OPERATIONAL DATA



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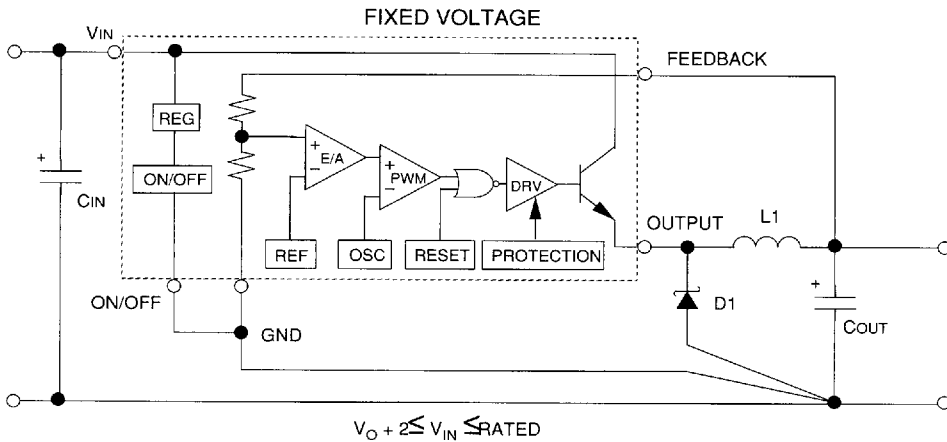


### LM2576 - OPERATIONAL DATA

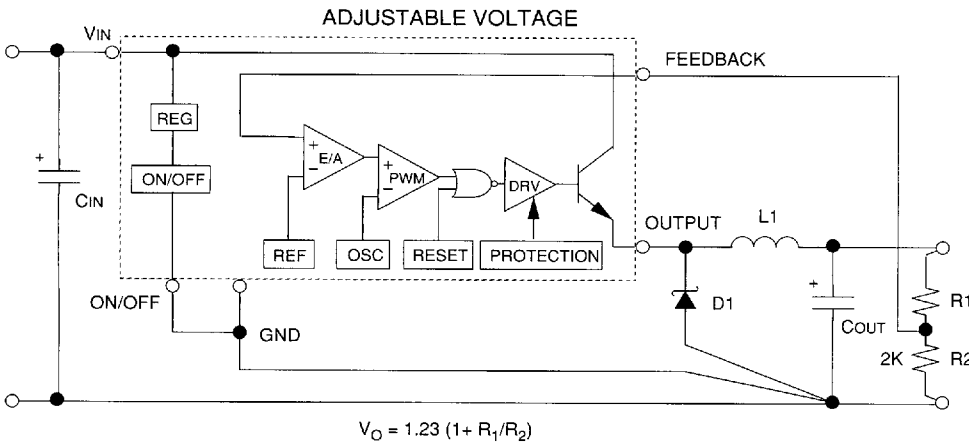


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### TYPICAL APPLICATION - BUCK MODE



	LM2575	LM2576
L1	330μH	100μH
D1	3A	7A
CIN	68μF	120μF
COUT	330μF	1,000μF



	LM2575	LM2576
L1	330μH	100μH
D1	3A	7A
CIN	68μF	120μF
COUT	330μF	1,000μF

The above component selections will be adequate for most applications for output currents from 250mA to 3.0A (LM2576) or 150mA to 1.0A (LM2575). Applications of  $V_{OUT}$ s below 5V or above 24V may require component adjustment for maximum performance; please contact factory for application assistance.

**1. DEVICE SELECTION.** Select an appropriate device from the "Selection Guide" based upon voltage option, temperature range and package.

**2. THERMAL CONDITIONS.** Most applications will not require a heatsink for the TO-220 package. Approximate power dissipation is:

$$P = \frac{V_{O} I_{O} V_{SAT}}{V_{IN}} + \frac{V_{O}}{V_{IN}} (20mA)$$

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**3. CATCH DIODE.** If the output must be capable of a sustained short, the IF rating must be above 3A for the LM2575 and 7A for the LM2576. The use of an ultra fast diode with soft recovery characteristics or a Schottky will be adequate. The major impact on Schottky versus an ultra fast is efficiency. Schottkys will provide approximately 4% to 5% improvement for  $V_{OUT}$ s below 12V, whereas above 12V the difference will become less significant. Breakdown rating must be in excess of  $V_{IN}$  for margin.

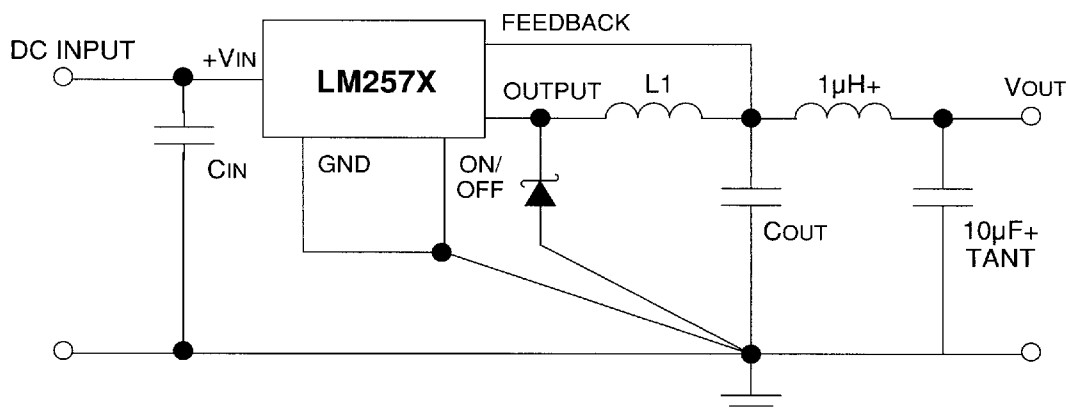
**4. INPUT CAPACITOR.** The value shown will be adequate for most applications. Ripple voltage at the switching frequency is caused by the input capacitor supplying load current during the on time of the power switch. The use of a low ESR switching type capacitor will minimize ripple to an acceptable level.

**5. LAYOUT.** Use short connections with a central point ground to prevent improper operation caused by stray inductance and ground loops.

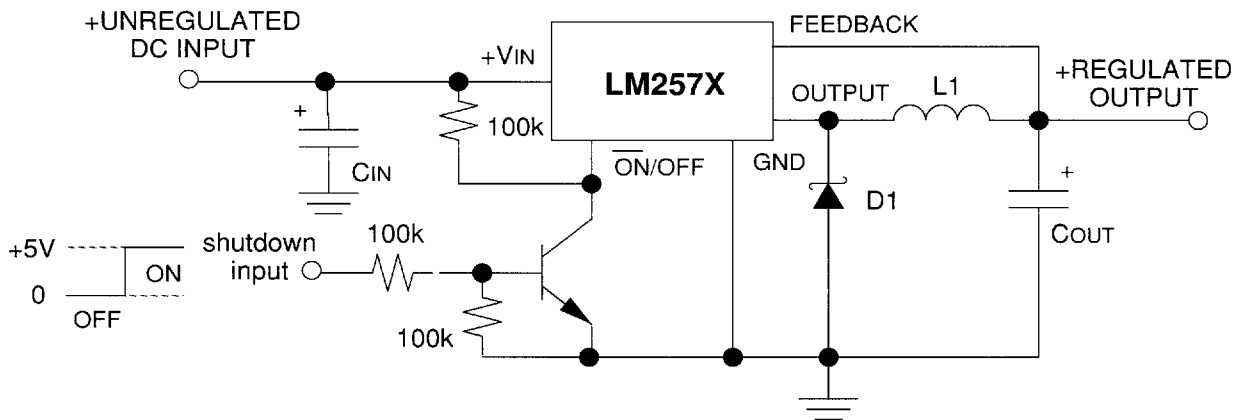
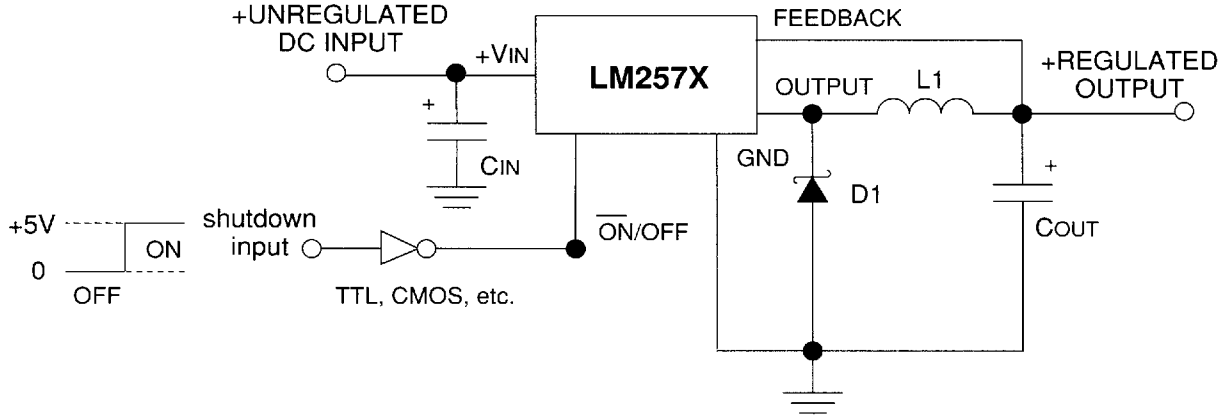
**6. OUTPUT CAPACITOR.** Ripple voltage on  $V_{OUT}$  is directly related to the value of  $C_{OUT}$  and the internal resistance ESR of  $C_{OUT}$ . Output noise can be lowered by increasing  $C_{OUT}$  or by selecting a capacitor with a lower ESR. ESR must be approximately  $0.03 \Omega$  for the LM2576 or  $0.07 \Omega$  for the LM2575, or above to maintain stability, otherwise raise value of  $C_{OUT}$ .

**7. SWITCHING SPIKES.** Switching spikes will also occur due to distributive capacitance across turns of the inductor when combined with output capacitor series inductance (ESL). Reduction to a level at or below the switching ripple can be achieved by using a post filter as shown.

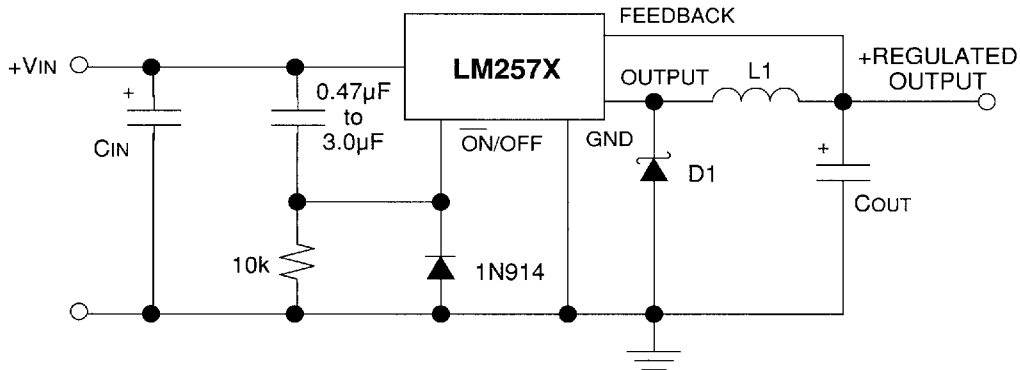
## SWITCHING SPIKE REDUCTION



### TYPICAL BUCK SHUTDOWN



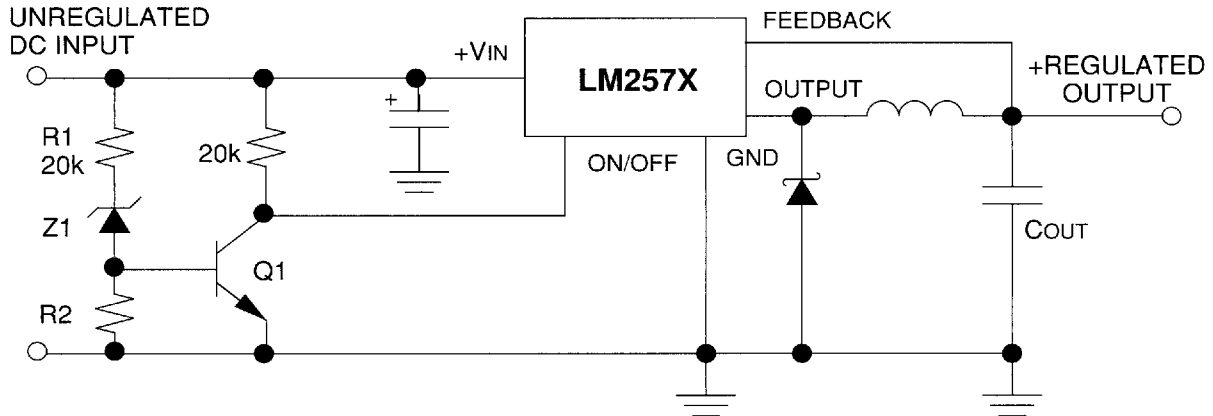
### TURN-ON DELAY



Circuit allows for  $C_{IN}$  to be fully charged before start-up, provides  $C_{IN}$  to supply hi-peak current instead of input supply.

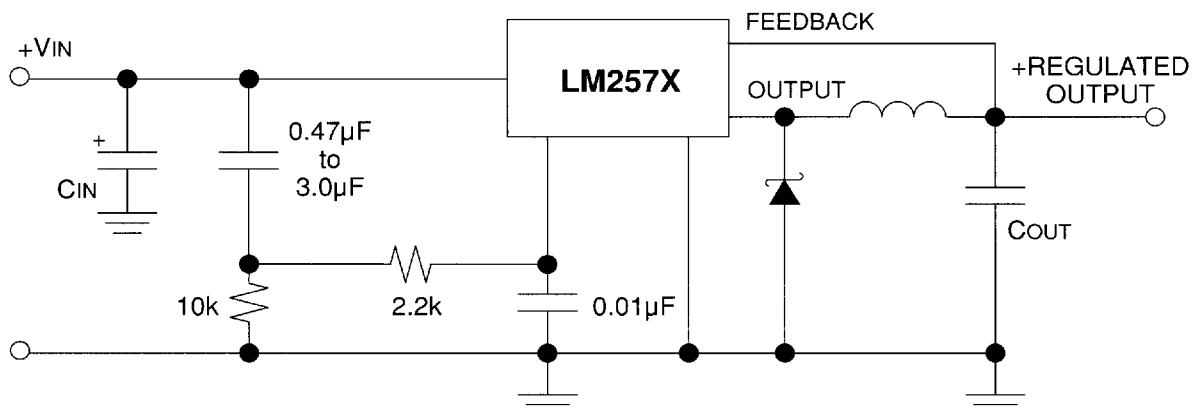
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### UNDER VOLTAGE LOCKOUT



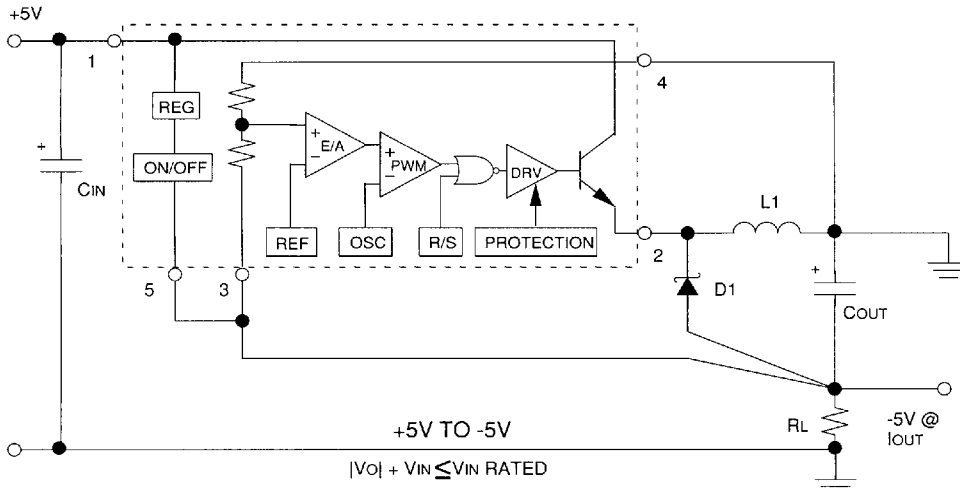
Regulator will be off until a  $V_{IN}$  set point is reached.  $V_{O(ON)} \cong V_Z + 3V_{BE Q1}$

### TURN-ON DELAY WITH SPIKE FILTER

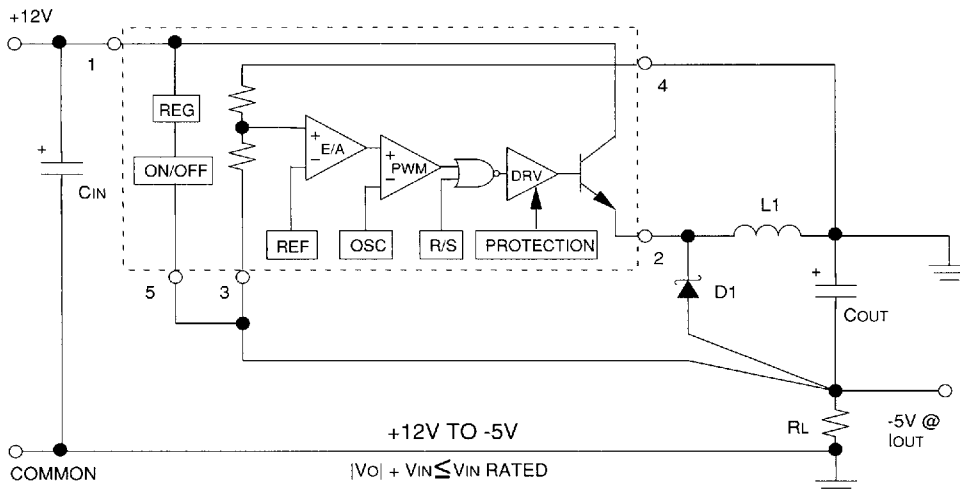


Spike filter reduces input noise, causing false triggering of delay.

### TYPICAL APPLICATION - INVERTING BUCK/BOOST



	LM2575	LM2576
CIN	47µF	100µF
D1	3A	7A
L1	100µH	68µH
COUT	2,700µF	6,800µF
IOUT	250mA	500mA



	LM2575	LM2576
CIN	47µF	100µF
D1	3A	7A
L1	100µH	68µH
COUT	470µF	2,700µF
IOUT	100mA	750mA

Inverting buck/boost operation is a different topology of operation than buck. This difference reduces the output current capability of the device, in that the inductor must supply all of the load current during the time the power switch is off. Maximum output current is approximately:

$$I_{OUT} \approx 3.5 / (2 (1 + |V_O| / V_{IN})) \text{ LM2576}$$

$$I_{OUT} \approx 1.3 / (2 (1 + |V_O| / V_{IN})) \text{ LM2575}$$

Component requirement stress is very similar to the buck with a few exceptions:

- catch diode breakdown  $V_{BR}$  must be greater than  $V_{IN} + |V_{OUT}|$
- input capacitor is larger due to the increased peak current during switch turn on. Power dissipation is approximately:

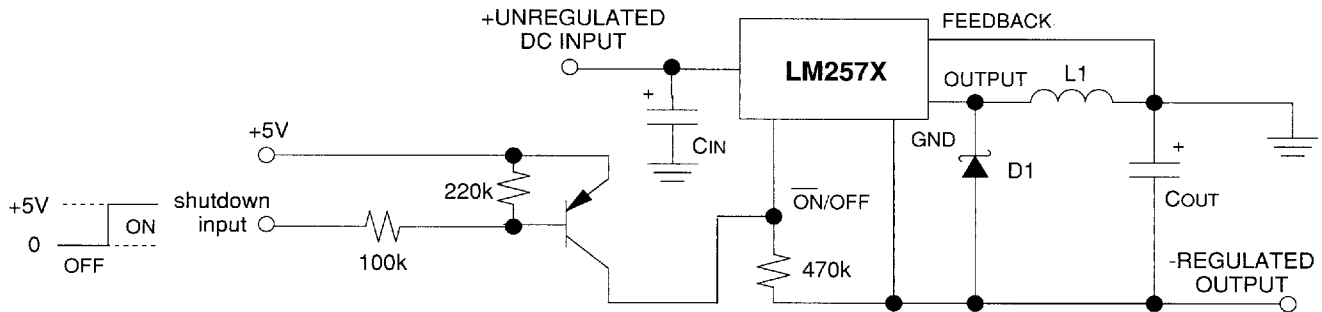
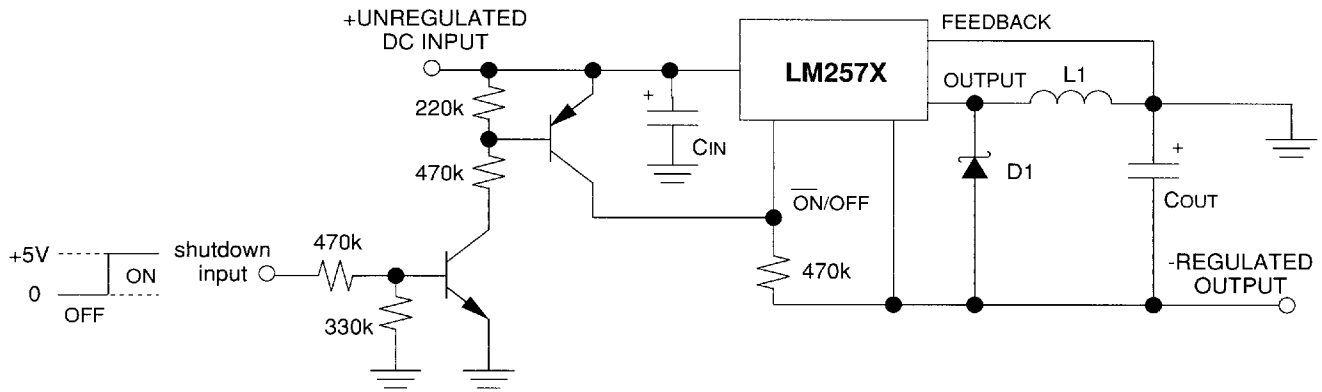
$$P_D \approx [ |V_O| / (|V_O| + V_{IN}) ] I_O \times$$

$$(1 + |V_O| / V_{IN}) V_{SAT} + 0.02 |V_O| / V_{IN}$$

Please contact factory for additional assistance when using the buck/boost topology.

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### INVERTING BUCK/BOOST SHUTDOWN



## SUPPORT COMPONENTS INFORMATION

**PRE-WOUND INDUCTORS:**

Hurricane Electronics Lab  
P.O. Box 1280, Hurricane Industrial Park  
Hurricane, UT 84737 (801) 635-2003

**LXF Series**

United Chemi-con  
9801 West Higgins Road  
Rosemont, IL 60018 (708) 696-2000

**CORE SOURCE:**

Micro Metals, Inc.  
1190 N. Hawk Circle  
Anaheim, CA 92807 (714) 630-7420

**HEAT SINKS:**

AAVID Engineering Co.  
P.O. Box 400, One Kool Path  
Laconia, NH 03247 (603) 528-3400

**CAPACITORS:**

VPR Series  
Mallory Capacitor Co.  
4760 Kentucky Avenue  
Indianapolis, IN 46241 (317) 856-3731

**Thermalloy, Inc.**

2021 W. Valley View Lane  
Dallas, TX 76381 (214) 243-4321

**511D & 673 Series**

Sprague Electric Co.  
North Adams, MA (413) 664-4411

**DIODES - CATCH**

Ultra Fast/Soft Recovery  
Semtech Corporation  
652 Mitchell Road  
Newbury Park, CA 91320 (805) 498-2111

**HFQ, HFZ Series**

Panasonic Industrial Co.  
2 Panasonic Way  
Secaucus, NJ 07094 (201) 392-6142

**SCHOTTKY**

Fuji/Collmer Semiconductor  
14368 Proton Road  
Dallas, TX 76244 (800) 527-0521

**PF, PL Series**

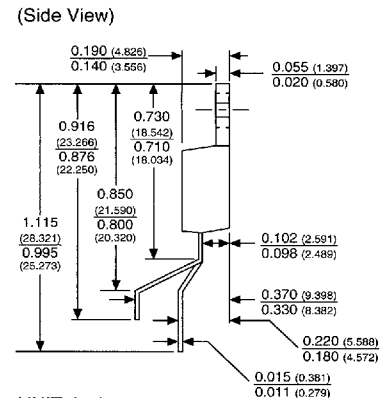
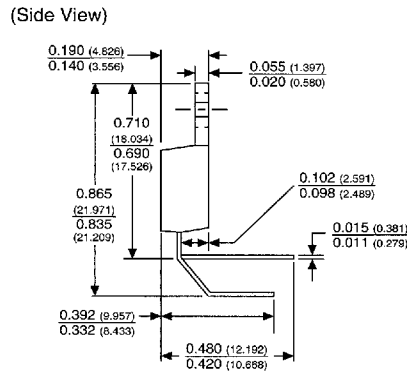
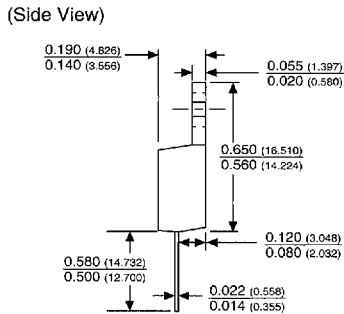
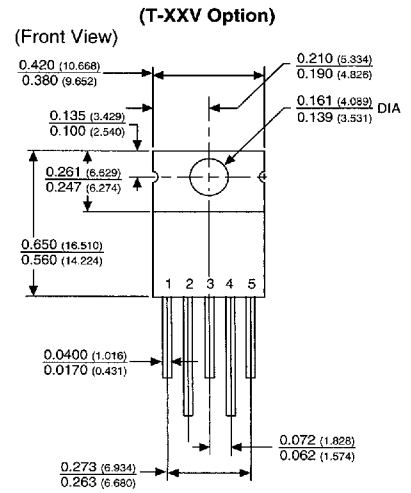
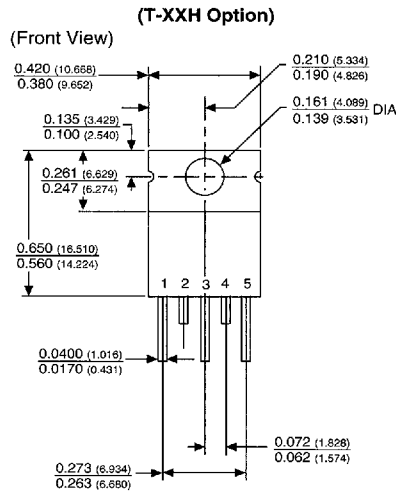
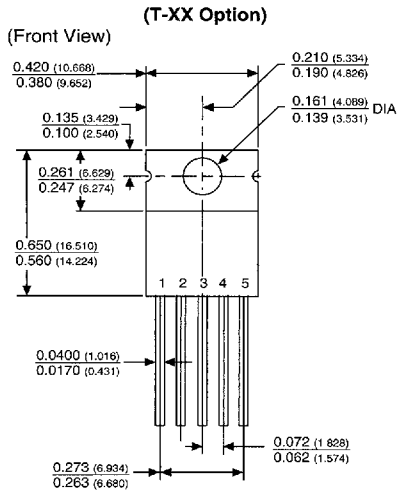
Nichicon Corp.  
927 E. State Pkwy.  
Schaumburg, IL 60195 (708) 843-7600

**Micro Quality**

1000 N. Shiloh  
Garland, TX 76046 (214) 272-7811



### TO-220 DEVICE OUTLINES



UNIT: Inch (mm)

UNIT: Inch (mm)

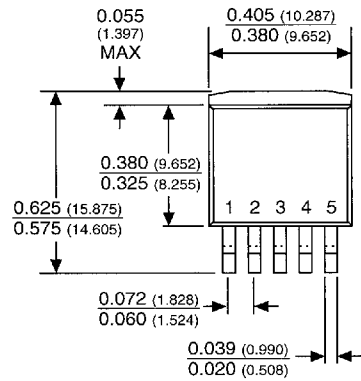
UNIT: Inch (mm)

LM2575T, LM2576T	
PIN	FUNCTION
1	V <sub>IN</sub>
2	OUTPUT
3	COMMON
4	FEEDBACK
5	ON/OFF
TAB IS COMMON	

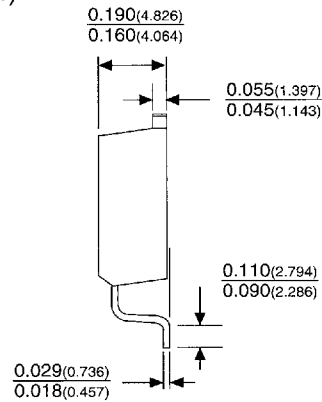
8139139 0004395 095

### TO-263 DEVICE OUTLINE

(Front View)



(Side View)



UNIT: Inch (mm)

LM2575S, LM2576S	
PIN	FUNCTION
1	V <sub>IN</sub>
2	OUTPUT
3	COMMON
4	FEEDBACK
5	ON/OFF
CASE IS COMMON	