LM2575

52kHz Simple 1A Buck Regulator

General Description

The LM2575 series of monolithic integrated circuits provide all the active functions for a step-down (buck) switching regulator. Fixed versions are available with a 3.3V, 5V, 12V, fixed output. Adjustable versions have an output voltage range from 1.23V to 37V. Both versions are capable of driving a 1A load with excellent line and load regulation.

These regulators are simple to use because they require a minimum number of external components and include internal frequency compensation and a fixed-frequency oscillator.

The LM2575 series offers a high efficiency replacement for popular three-terminal adjustable linear regulators. It substantially reduces the size of the heat sink, and in many cases no heat sink is required.

A standard series of inductors available from several different manufacturers are ideal for use with the LM2575 series. This feature greatly simplifies the design of switch-mode power supplies.

The feedback voltage is guaranteed to ±2% tolerance for adjustable versions, and the output voltage is guaranteed to ±3% for fixed versions, within specified input voltages and output load conditions. The oscillator frequency is guaranteed to ±10%. External shutdown is included, featuring less than 200µA standby current. The output switch includes cycle-by-cycle current limiting and thermal shutdown for full protection under fault conditions.

Data sheets and support documentation can be found on Micrel's web site at www.micrel.com.

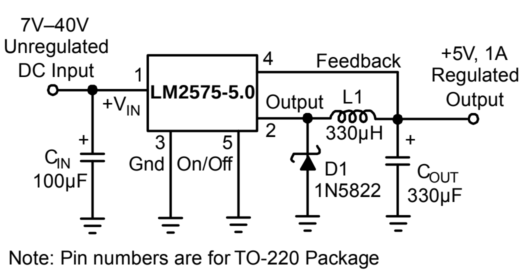
Features

- 3.3V, 5V, 12V, and adjustable output versions
- Voltage over specified line and load conditions:
  - Fixed version: ±3% max. output voltage
  - Adjustable version: ±2% max. feedback voltage
- Guaranteed 1A output current
- Wide input voltage range
  - 4V to 40V
- Wide output voltage range
  - 1.23V to 37V
- Requires only 4 external components
- 52kHz fixed frequency internal oscillator
- Low power standby mode IQ typically <200µA
- 80% efficiency (adjustable version typically >80%)
- Uses readily available standard inductors
- Thermal shutdown and current limit protection
- 100% electrical thermal limit burn-in

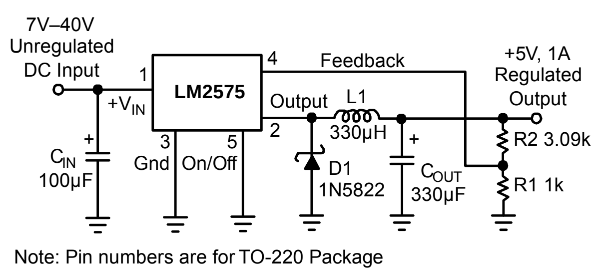
Applications

- Simple high-efficiency step-down (buck) regulator
- Efficient pre-regulator for linear regulators
- On-card switching regulators
- Positive to negative converter (inverting Buck-Boost)
- Isolated flyback converter using minimum number of external components
- Negative boost converter

Typical Applications



Fixed Regulation in Typical Application



$$V_{OUT} = 1.23\left(1 + \frac{R2}{R1}\right)$$

Adjustable Regulation in Fixed Output Application

Micrel Inc. • 2180 Fortune Drive • San Jose, CA 95131 • USA • tel +1 (408) 944-0800 • fax + 1 (408) 474-1000 • http://www.micrel.com

Ordering Information

Part Number			
Standard	**Pb-Free / RoHS Compliant**	**Temperature Range**	**Package**
LM2575BN*	Contact Factory	–40° to +85°C	16-Pin Plastic DIP
LM2575-3.3BN	Contact Factory	–40° to +85°C	16-Pin Plastic DIP
LM2575-5.0BN	LM2575-5.0YN	–40° to +85°C	16-Pin Plastic DIP
LM2575-12BN	LM2575-12YN	–40° to +85°C	16-Pin Plastic DIP
LM2575BWM*	LM2575YWM*	–40° to +85°C	24-Pin Wide SOIC
LM2575-3.3BWM	LM2575-3.3YWM	–40° to +85°C	24-Pin Wide SOIC
LM2575-5.0BWM	LM2575-5.0YWM	–40° to +85°C	24-Pin Wide SOIC
LM2575-12BWM	LM2575-12YWM	–40° to +85°C	24-Pin Wide SOIC
LM2575BT*†	LM2575WT*/**	–40° to +85°C	5-Pin TO-220
LM2575-3.3BT†	LM2575-3.3WT**	–40° to +85°C	5-Pin TO-220
LM2575-5.0BT†	LM2575-5.0WT**	–40° to +85°C	5-Pin TO-220
LM2575-12BT†	LM2575-12WT**	–40° to +85°C	5-Pin TO-220
LM2575BU*	LM2575WU*/**	–40° to +85°C	5-Pin TO-263
LM2575-3.3BU	LM2575-3.3WU**	–40° to +85°C	5-Pin TO-263
LM2575-5.0BU	LM2575-5.0WU**	–40° to +85°C	5-Pin TO-263
LM2575-12BU	LM2575-12WU**	–40° to +85°C	5-Pin TO-263

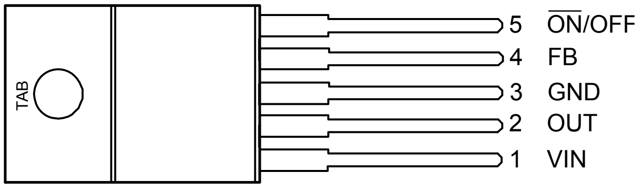
Notes:

* Adjustable output regulators.

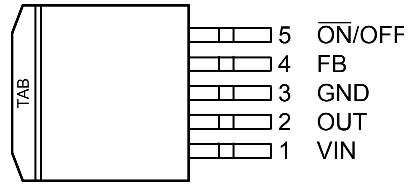
** RoHS compliant with "high-melting solder" exemption.

† Contact factory for bent or staggered leads option.

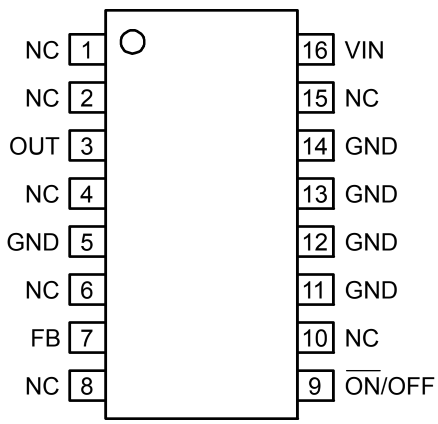
Pin Configuration



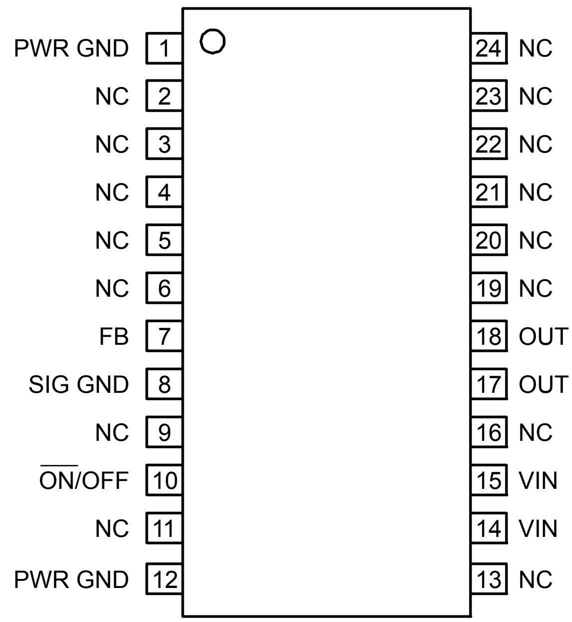
5-Pin TO-220 (T)



5-Pin TO-263 (U)



16-Pin Plastic DIP (N)



24-Pin Wide SOIC (WM)

Absolute Maximum Ratings[1]

Maximum Supply Voltage (V_{IN}) 45V
ON/OFF Pin Input Voltage. ....–0.3V ≤ V ≤ +40V
Output Voltage to Ground (Steady State) ....–1V
Power Dissipation ....Internally Limited
Maximum Junction Temperature................................ 150°C
Lead Temperature (soldering, 10 sec.)...................... 260°C
Storage Temperature (T_s) ....–65°C to +150°C
Minimum ESD Rating
C = 100pF, R = 1.5kΩ... 2kV
FB Pin 1kV

Operating Ratings

Supply Voltage (V_{IN})...40V
Junction Temperature Range (T_J).......–40°C ≤ T_J ≤ +125°C

Electrical Characteristics

Specifications with standard typeface are for T_J = 25°C, and those with **boldface type** apply over full Operating Temperature Range. Unless otherwise specified, V_{IN} = 12V, and I_{LOAD} = 200mA.

Symbol	Parameter	Condition	Typ	LM2575 Limit (Note 2)	Units (Limits)
SYSTEM PARAMETERS, ADJUSTABLE REGULATORS (Note 3) ***Test Circuit Figure 1***					
V_{OUT}	Feedback Voltage	V_{IN} = 12V , I_{LOAD} = 0.2A V_{OUT} = 5V	1.230	 1.217 1.243	V V(min) V(max)
	Feedback Voltage LM2575	0.2A ≤ I_{LOAD} ≤ 1A, 8V ≤ V_{IN} ≤ 40V V_{OUT} = 5V	1.230	 1.193/**1.180** 1.267/**1.280**	V V(min) V(max)
η	Efficiency	V_{IN} = 12V, I_{LOAD} = 1A, V_{OUT} = 5V	82		%
SYSTEM PARAMETERS, 3.3V REGULATORS (Note 3) ***Test Circuit Figure 1***					
V_{OUT}	Output Voltage	V_{IN} = 12V , I_{LOAD} = 0.2A V_{OUT} = 3.3V	3.3	 3.234 3.366	V V(min) V(max)
	Output Voltage LM2575-3.3	0.2A ≤ I_{LOAD} ≤ 1A, 8V ≤ V_{IN} ≤ 40V V_{OUT} = 3.3V	3.3	 3.168/**3.135** 3.432/**3.465**	V V(min) V(max)
η	Efficiency	V_{IN} = 12V, I_{LOAD} = 1A	75		%
SYSTEM PARAMETERS, 5V REGULATORS (Note 3) ***Test Circuit Figure 1***					
V_{OUT}	Output Voltage	V_{IN} = 12V , I_{LOAD} = 0.2A V_{OUT} = 5V	5.0	 4.900 5.100	V V(min) V(max)
	Output Voltage LM2575-5.0	0.2A ≤ I_{LOAD} ≤ 1A, 8V ≤ V_{IN} ≤ 40V V_{OUT} = 5V	5.0	 4.800/**4.750** 5.200/**5.250**	V V(min) V(max)
η	Efficiency	V_{IN} = 12V, I_{LOAD} = 1A	82		%
SYSTEM PARAMETERS, 12V REGULATORS (Note 3) ***Test Circuit Figure 1***					
V_{OUT}	Output Voltage	V_{IN} = 25V , I_{LOAD} = 0.2A V_{OUT} = 12V	12	 11.760 12.240	V V(min) V(max)
	Output Voltage LM2575-12	0.2A ≤ I_{LOAD} ≤ 1A, 15V ≤ V_{IN} ≤ 40V V_{OUT} = 12V	12	 11.520/**11.400** 12.480/**12.600**	V V(min) V(max)
η	Efficiency	V_{IN} = 25V, I_{LOAD} = 1A	88		%

Symbol	Parameter	Condition	Typ	LM2575 Limit (Note 2)	Units (Limits)
DEVICE PARAMETERS, ADJUSTABLE REGULATOR					
I_B	Feedback Bias Current	V_{OUT} = 5V	50	100/**500**	nA
DEVICE PARAMETERS, FIXED and ADJUSTABLE REGULATORS					
f_O	Oscillator Frequency		52	 47/**42** 58/**63**	kHz kHz(min) kHz(max)
V_{SAT}	Saturation Voltage	I_{OUT} = 1A (**Note 4**)	0.9	 1.2/**1.4**	V V(max)
DC	Max Duty Cycle (ON)	(**Note 5**)	98	 93	% %(max)
I_{CL}	Current Limit	Peak Current, t_{ON} ≤ 3µs (**Note 4**)	2.2	 1.7/**1.3** 3.0/**3.2**	A A(min) A(max)
I_L	Output Leakage Current	V_{IN} = 40V, (**Note 6**), Output = 0V Output = –1V (**Note 6**) Output = –1V	 75	2 30	mA(max) mA mA(max)
I_Q	Quiescent Current	(**Note 6**)	5	 10	mA mA(max)
I_{STBY}	Standby Quiescent Current	ON/OFF Pin = 5V (OFF)	50	 200	µA µA(max)
θ_{JA}	Thermal Resistance	T Package, Junction to Ambient (**Note 7**)	65		°C/W
θ_{JA}		T Package, Junction to Ambient (**Note 8**)	45		
θ_{JC}		T Package, Junction to Case	2		
θ_{JA}		N Package, Junction to Ambient (**Note 9**)	85		
θ_{JA}		WM Package, Junction to Ambient (**Note 9**)	100		
ON/OFF CONTROL, FIXED and ADJUSTABLE REGULATORS *Test Circuit Figure 1*					
V_{IH} V_{IL}	ON/OFF Pin Logic Input Level	V_{OUT} = 0V V_{OUT} = 5V	1.4 1.2	2.2/**2.4** 1.0/**0.8**	V(min) V(max)
I_{IH}	ON/OFF Pin Logic Current	ON /OFF Pin = 5V (OFF)	4	 30	µA µA(max)
I_{IL}		ON /OFF Pin = 0V (ON)	0.01	 10	µA µA(max)

Notes:

1. Absolute Maximum Rating 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.
2. All limits guaranteed at room temperature (standard type face) and at **temperature extremes (bold type face)**. All room temperature limits are100% production tested. All limits at **temperature extreme** are guaranteed via testing.
3. External components such as the catch diode, inductor, input and output capacitors can affect switching regulator system performance. When the LM2575/LM1575 is used as shown in Figure 1 test circuit, system performance will be shown in system parameters section of Electrical Characteristics.
4. Output (pin 2) sourcing current. No diode, inductor or capacitor connected to output.
5. Feedback (pin 4) removed from output and connected to 0V.
6. Feedback (pin 4) removed from output and connected to 12V to force the output transistor OFF.
7. Junction to ambient thermal resistance (no external heat sink) for the 5-pin TO-220 package mounted vertically, with 1/2" leads in a socket, or on PC board with minimum copper area.
8. Junction to ambient thermal resistance (no external heat sink) for the 5-pin TO-220 package mounted vertically, with 1/4" leads soldered to PC board containing approximately 4 square inches of copper area surrounding the leads.
9. Junction to ambient thermal resistance with approximately 1 square inch of pc board copper surrounding the leads. Additional copper will lower thermal resistance further.

Test Circuits and Layout Guidelines

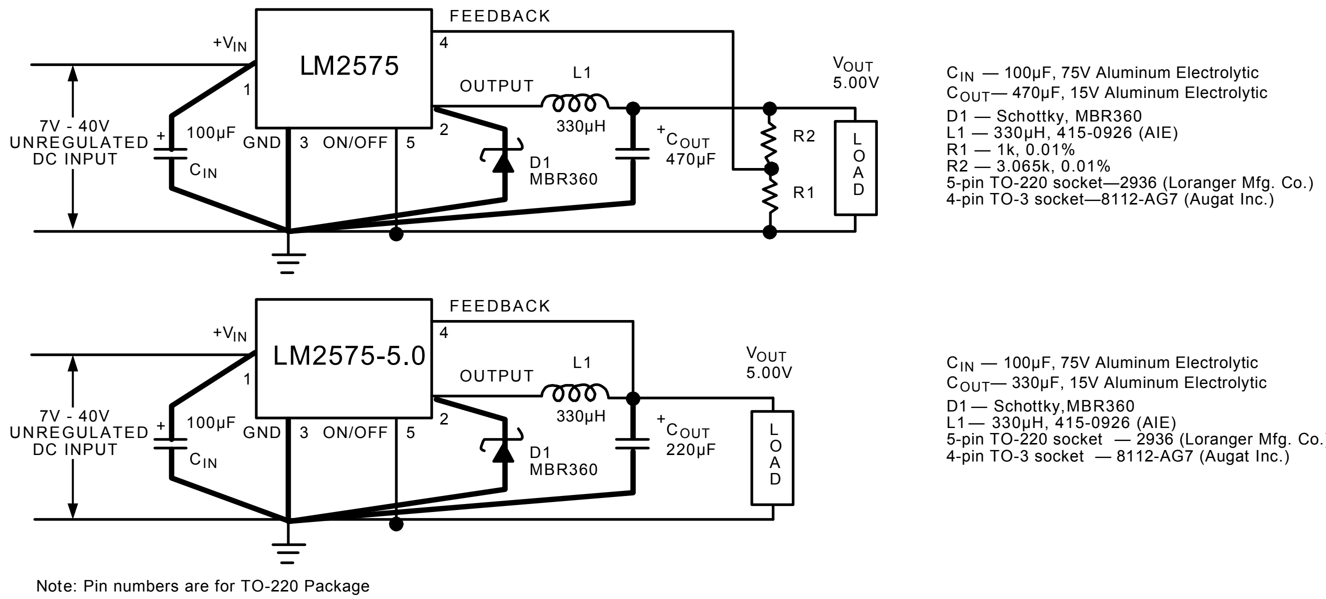
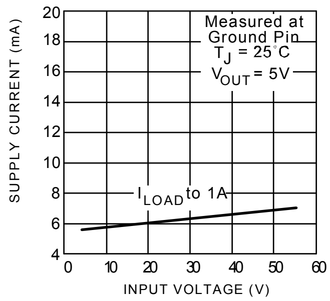


Figure 1.

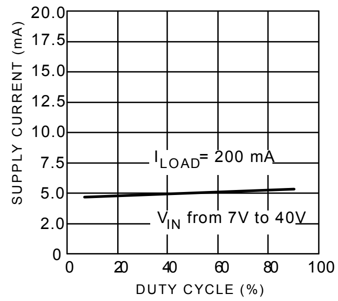
As in any switching regulator, layout is very important. Rapidly switching currents associated with wiring inductance generate voltage transient switch can cause problems. For minimal stray inductance and ground loops, the length of the leads indicated by heavy lines should be kept as short as possible. Single-point grounding (as indicated) or ground plane construction should be used for best results.

Typical Characteristics (circuit of *Figure 1*)

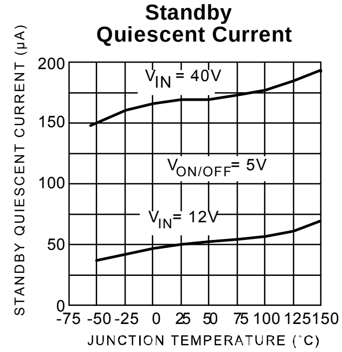
Supply Current



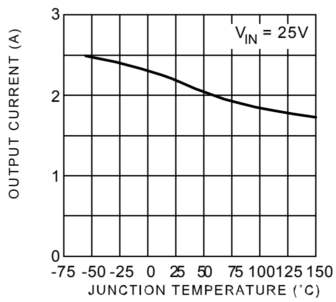
Supply Current vs. Duty Cycle



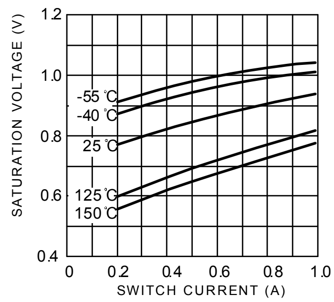
Standby Quiescent Current



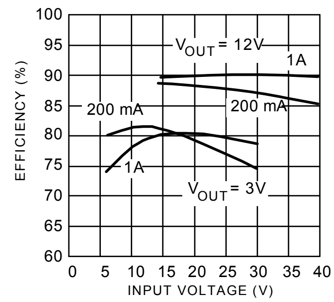
Current Limit



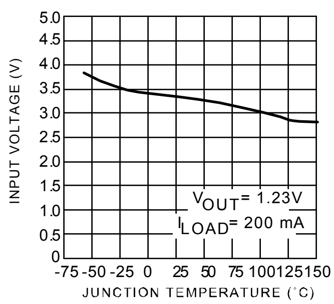
Switch Saturation Voltage



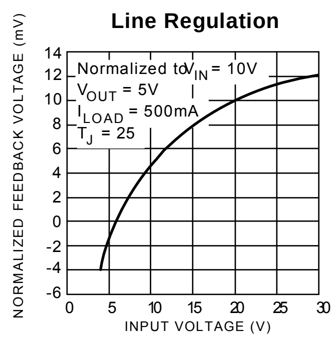
Efficiency



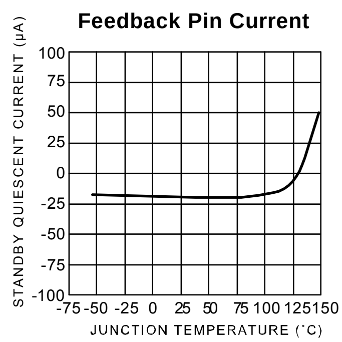
Minimum Operating Voltage



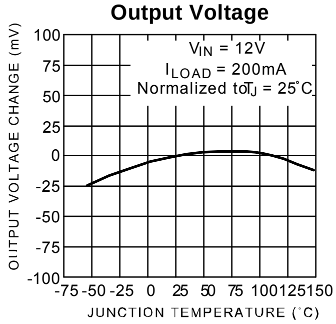
Line Regulation



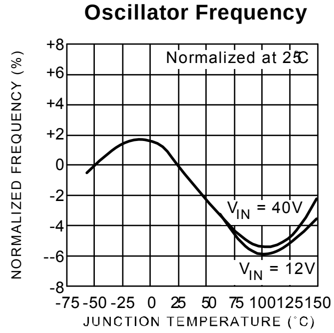
Feedback Pin Current



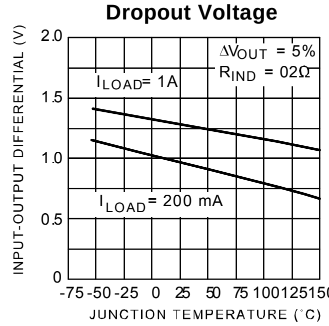
Normalized Output Voltage



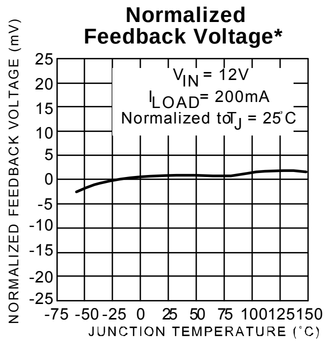
Oscillator Frequency

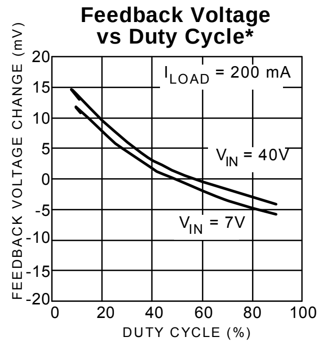


Dropout Voltage



Typical Characteristics (continued)

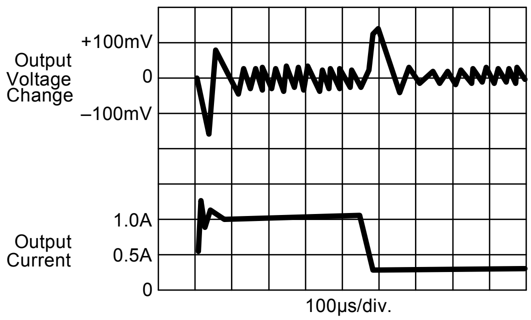




* Adjustable version only

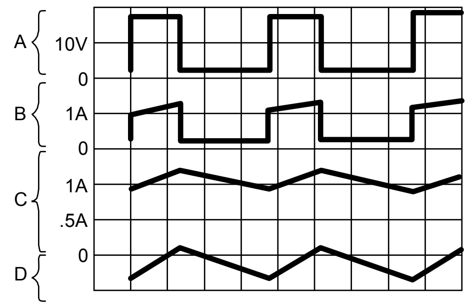
Functional Characteristics (circuit of *Figure 1*)

Load Transient Response



V_{OUT} = 5V

Switching Waveforms

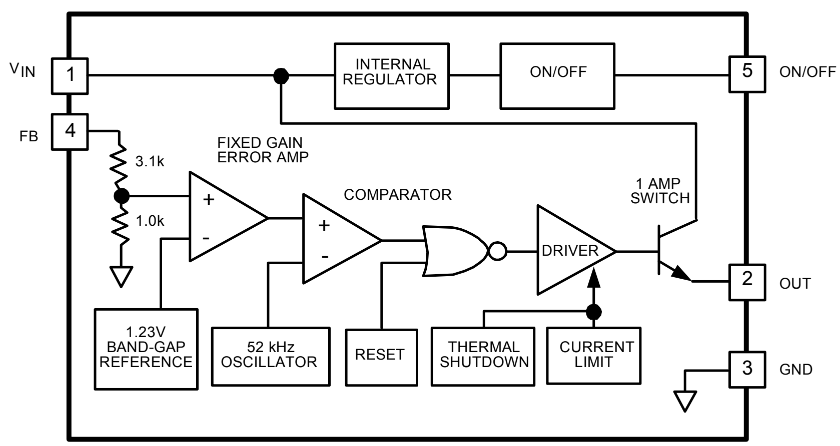


V_{OUT} = 5V V_{IN} = 20V

A: Output pin voltage 10V/div
B: Output pin current 1A/div
C: Inductor current 0.5A/div
D: Output ripple voltage 20 mV/div. AC coupled

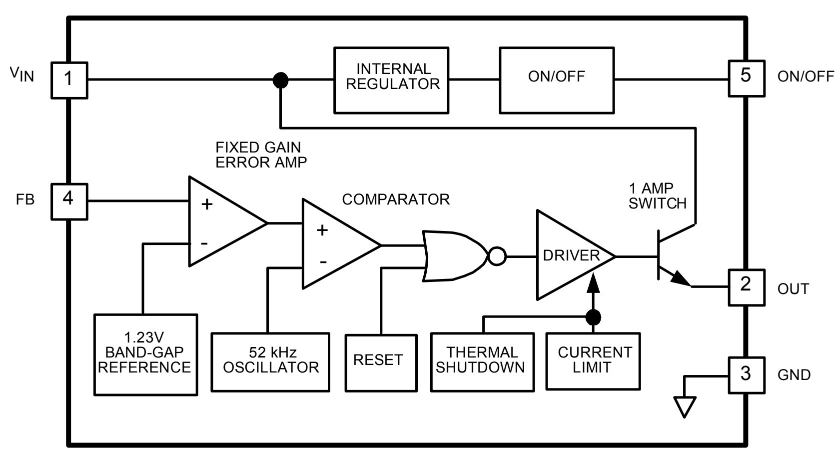
Horizontal Time Base: 5µs/div

Functional Diagrams



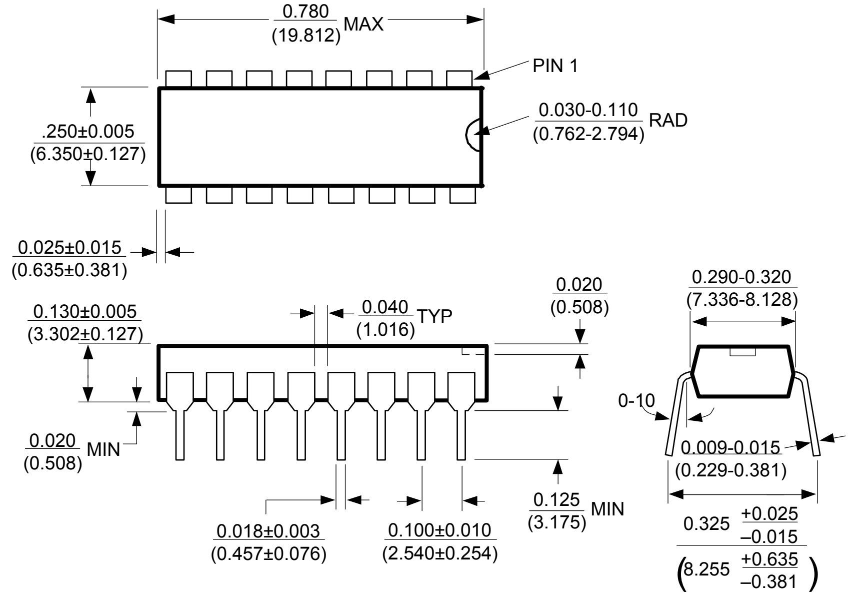
Note: Pin numbers are for the TO-220 package

Fixed Regulator

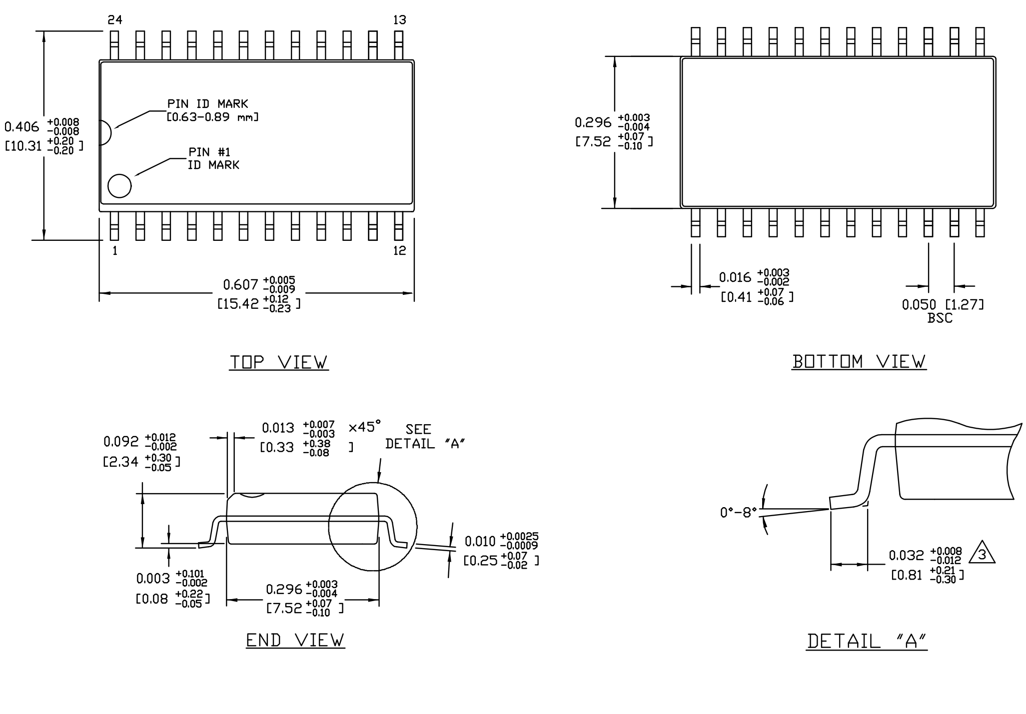


Adjustable Regulator

Package Information

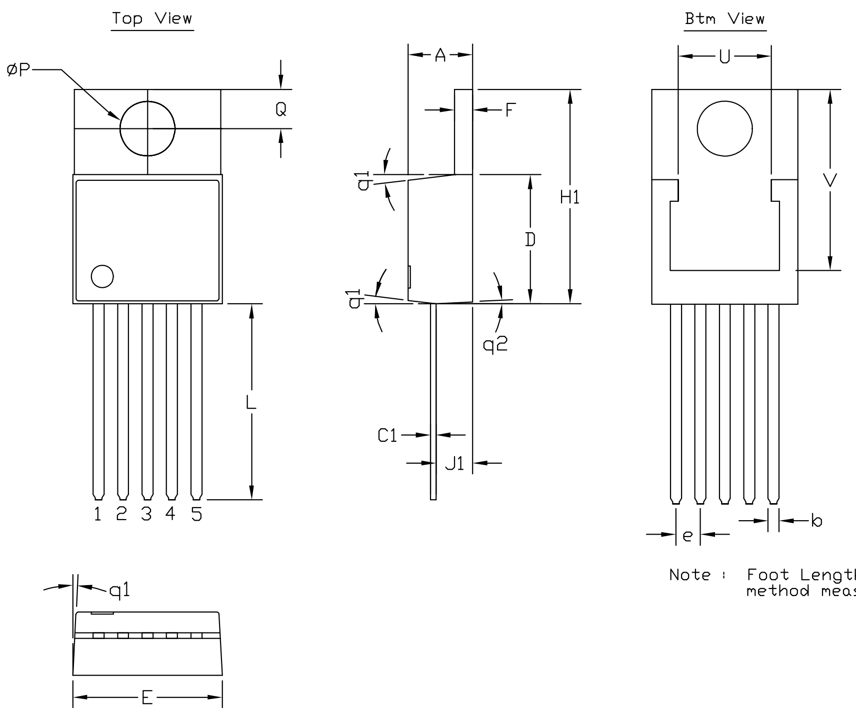


16-Pin Plastic DIP (N)



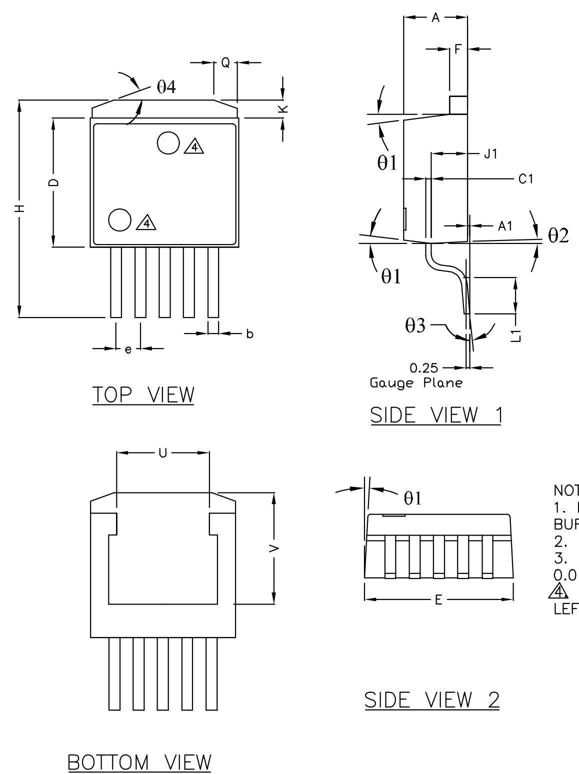
NOTES:
1. DIMENSIONS ARE IN INCHES[MM].
2. CONTROLLING DIMENSION: INCHES.
3. DIMENSION DOES NOT INCLUDE MOLD FLASH OR PROTRUSIONS, EITHER OF WHICH SHALL NOT EXCEED 0.006[0.15] PER SIDE.

24-Pin Wide SOIC (WM)



POS	INCH	
	MIN	MAX
A	0.160	0.190
b	0.025	0.040
C1	0.012	0.022
D	0.351	0.361
E	0.385	0.420
e	0.062	0.072
F	0.045	0.055
H1	0.560	0.595
J1	0.080	0.120
øP	0.146	0.156
Q	0.103	0.113
L	0.500	0.580
q1	3°	10°
q2	1°	7°
U	0.256 Ref.	
V	0.486 Ref.	

5-Pin TO-220 (T)



POS	INCH		MM	
	MIN	MAX	MIN	MAX
A	0.170	0.181	4.318	4.597
A1	0.000	0.012	0.000	0.305
b	0.026	0.036	0.660	0.914
C1	0.012	0.023	0.305	0.584
D	0.330	0.361	8.382	9.169
E	0.396	0.420	10.058	10.668
e	0.062	0.072	1.575	1.829
F	0.045	0.055	1.143	1.397
H	0.575	0.625	14.605	15.875
J1	0.080	0.120	2.032	3.048
K	0.045	0.066	1.143	1.676
L1	0.090	0.110	2.286	2.794
θ1	3°	10°	3°	10°
θ2	1°	7°	1°	7°
θ3	0°	8°	0°	8°
θ4	18°	22°	18°	22°
Q	0.055	0.075	1.397	1.905
U	0.256 Ref.		6.502 Ref.	
V	0.305 Ref.		7.747 Ref.	

NOTE:
1. PACKAGE OUTLINE EXCLUSIVE OF MOLD FLASH & METAL BURR.
2. PACKAGE OUTLINE INCLUSIVE OF PLATING THICKNESS.
3. FOOT LENGTH USING GAUGE PLANE METHOD MEASUREMENT 0.010"
4. PACKAGE TOP MARK MAY BE IN TOP CENTER OR LOWER LEFT CORNER

5-Pin TO-263 (T)

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