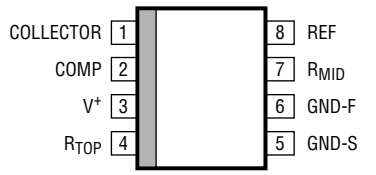
ABSOLUTE MAXIMUM RATINGS (Note 1)

V^+, $V_{COLLECTOR}$ 36V
V_{COMP}, R_{TOP}, R_{MID}, V_{REF} 6V
GND-F to GND-S 0.7V
Ambient Temperature Range
LT1431M **(OBSOLETE)** ..... –55°C to 125°C
LT1431I ..... –40°C to 85°C
LT1431C ..... 0°C TO 70°C

JunctionTemperature Range
LT1431M **(OBSOLETE)** ..... –55°C to 150°C
LT1431I ..... –40°C to 100°C
LT1431C ..... 0°C to 100°C
Storage Temperature Range ..... –65°C to 150°C
Lead Temperature (Soldering, 10 sec) ..... 300°C

PACKAGE/ORDER INFORMATION



N8 PACKAGE
8-LEAD PDIP

S8 PACKAGE
8-LEAD PLASTIC SO

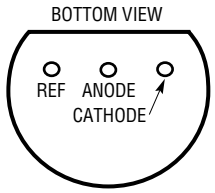
$T_{J\,MAX}$ = 100°C, θ_{JA} = 130°C/W (N)
$T_{J\,MAX}$ = 100°C, θ_{JA} = 170°C/W (S)

ORDER PART NUMBER
LT1431CN8 LT1431IN8 LT1431CS8 LT1431IS8
S8 PART MARKING
1431 1431I

$T_{J\,MAX}$ = 150°C, θ_{JA} = 100°C/W (J)

ORDER PART NUMBER
LT1431MJ8

OBSOLETE PACKAGE
Consider the N8 or S8 for Alternate Source



Z PACKAGE
3-LEAD TO-92 PLASTIC

$T_{J\,MAX}$ = 100°C, θ_{JA} = 150°C/W

ORDER PART NUMBER
LT1431CZ LT1431IZ

Consult LTC Marketing for parts specified with wider operating temperature ranges.

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at T_A = 25°C. I_K = 10mA unless otherwise specified (Note 2)

SYMBOL	PARAMETER	CONDITIONS		LT1431M/I MIN	LT1431M/I TYP	LT1431M/I MAX	LT1431C MIN	LT1431C TYP	LT1431C MAX	UNITS
V_{REF}	Reference Voltage	V_{KA} = 5V, I_K = 2mA, (Note 3)	 ●	2.490 2.465	2.500	2.510 2.535	2.490 2.480	2.500	2.510 2.520	V V
$\Delta V_{REF}/\Delta T$	Reference Drift	V_{KA} = 5V, I_K = 2mA	●		50			30		ppm/°C
$\Delta V_{REF}/\Delta V_{KA}$	Voltage Ratio, Reference to Cathode (Open-Loop Gain)	I_K = 2mA, V_{KA} = 3V to 36V	●		0.2	0.5		0.2	0.5	mV/V
$\lvert I_{REF}\rvert$	Reference Input Current	V_{KA} = 5V, T_A = 25°C	 ●		0.2	1.0 1.5		0.2	1.0 1.2	µA µA
I_{MIN}	Minimum Operating Current	V_{KA} = V_{REF} to 36V			0.6	1.0		0.6	1.0	mA
$\lvert I_{OFF}\rvert$	Off-State Cathode Current	V_{KA} = 36V, V_{REF} = 0V	 ●			1 15			1 2	µA µA
$\lvert I_{LEAK}\rvert$	Off-State Collector Leakage Current	V_{COLL} = 36V, V^+ = 5V, V_{REF} = 2.4V	 ●			1 5			1 2	µA µA
$\lvert Z_{KA}\rvert$	Dynamic Impedance	V_{KA} = V_{REF}, I_K = 1mA to 100mA, f ≤ 1kHz				0.2			0.2	Ω
I_{LIM}	Collector Current Limit	V_{KA} = V_{REF} + 50mV	●	80		360	100		260	mA
	5V Reference Output	Internal Divider Used, I_K = 2mA		4.950	5.000	5.050	4.950	5.000	5.050	V

ELECTRICAL CHARACTERISTICS

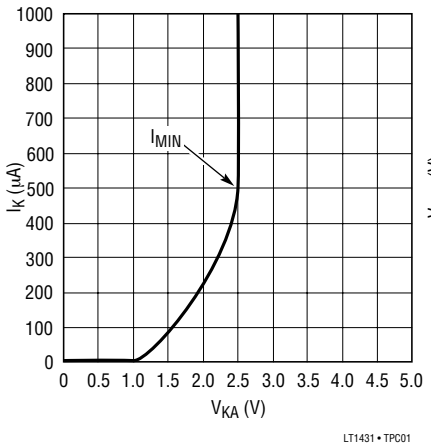
Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

Note 2: V_{KA} is the cathode voltage of the LT1431CZ/IZ and corresponds to V^+ of the LT1431CN8/IN8/CS8/IS8. I_K is the cathode current of the LT1431CZ/IZ and corresponds to $I(V^+) + I_{COLLECTOR}$ of the LT1431CN8/IN8/CS8/IS8.

Note 3: The LT1431 has bias current cancellation which is effective only for $V_{KA} \geq 3V$. A slight (≈2mV) shift in reference voltage occurs when V_{KA} drops below 3V. For this reason, these tests are not performed at $V_{KA} = V_{REF}$.

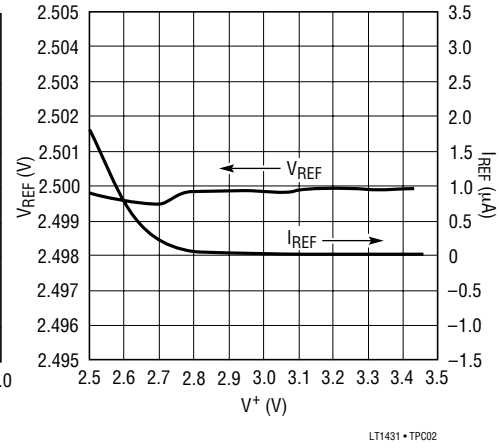
TYPICAL PERFORMANCE CHARACTERISTICS

2.5V Reference I_K vs V_{KA}



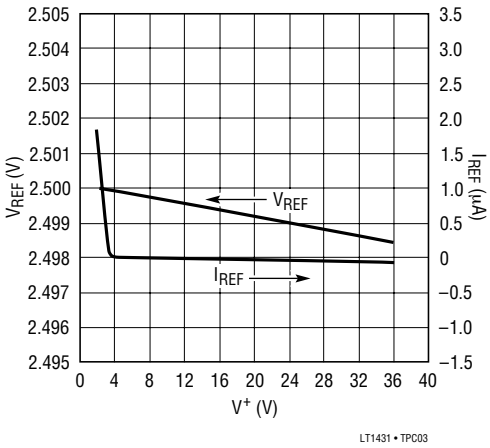
LT1431 • TPC01

V_{REF} and I_{REF} vs V^+



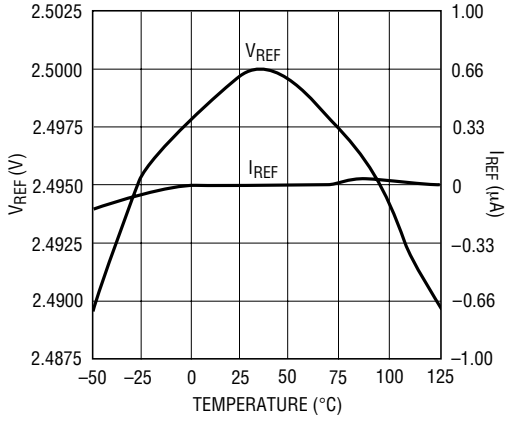
LT1431 • TPC02

V_{REF} and I_{REF} vs V^+



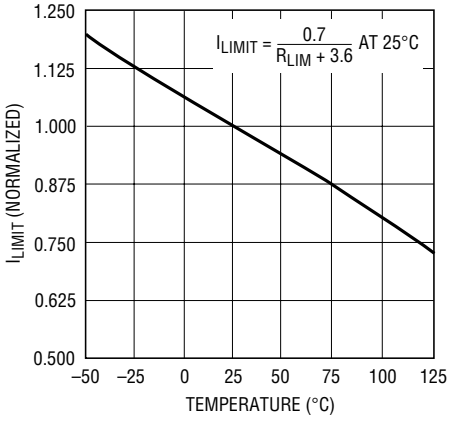
LT1431 • TPC03

V_{REF} and I_{REF} vs Temperature



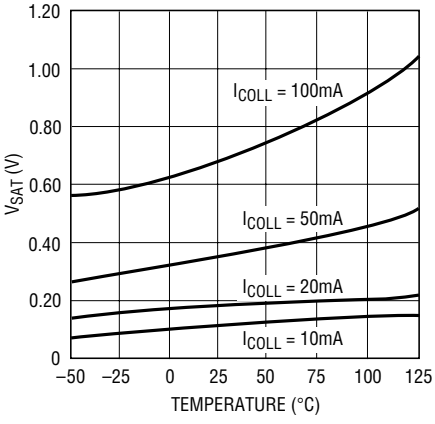
LT1431 • TPC04

I_{LIMIT} vs Temperature with External Resistor



LT1431 • TPC05

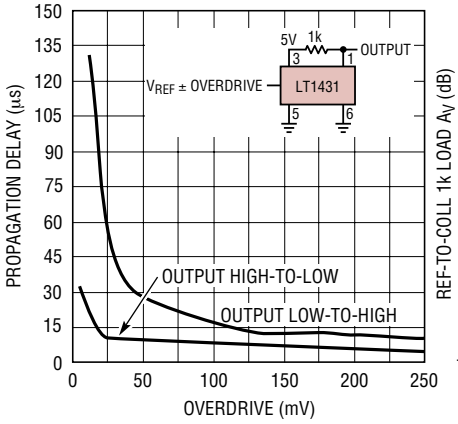
COLLECTOR V_{SAT} vs Temperature vs Current



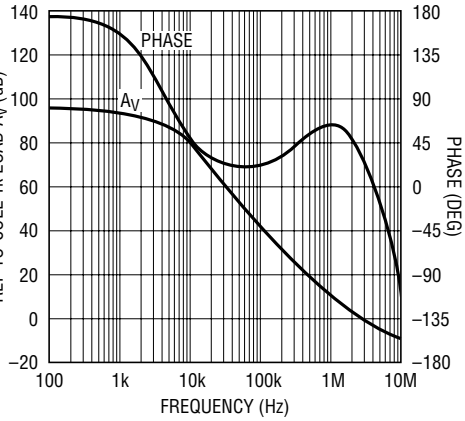
LT1431 • TPC06

TYPICAL PERFORMANCE CHARACTERISTICS

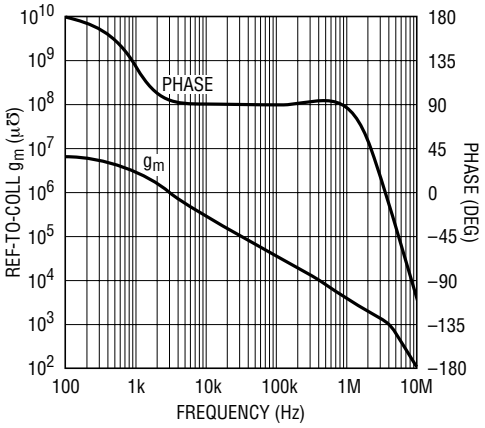
Propagation Delay vs Overdrive



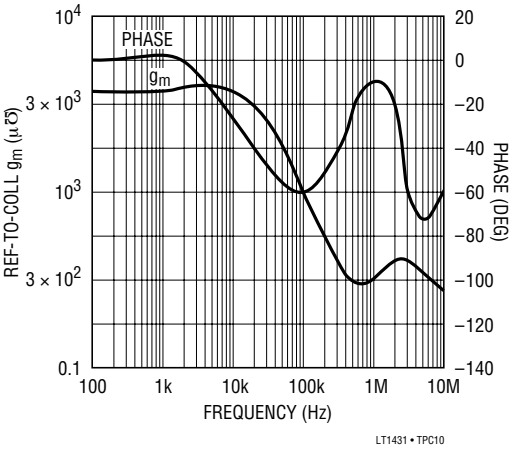
Voltage Gain and Phase vs Frequency



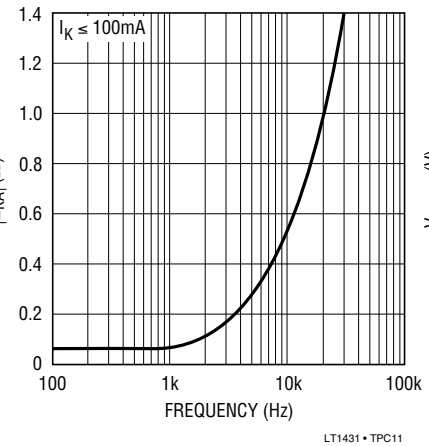
Transconductance and Phase vs Frequency (REF to COLL)



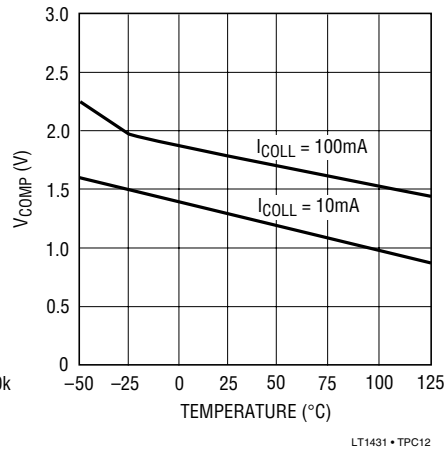
Transconductance and Phase vs Frequency (Ref to Comp)



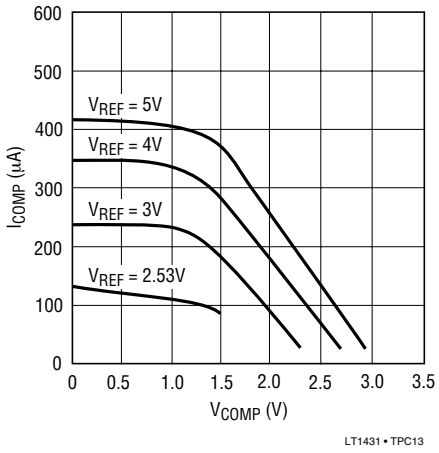
Dynamic Impedance vs Frequency



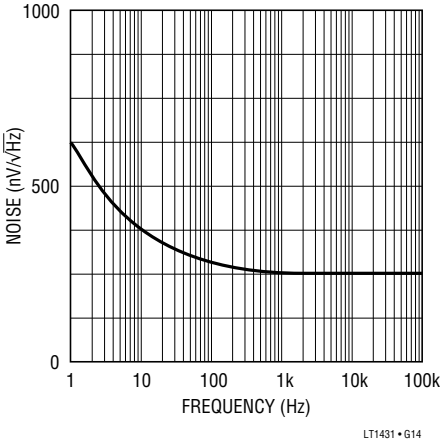
VCOMP vs Temperature vs ICOLL



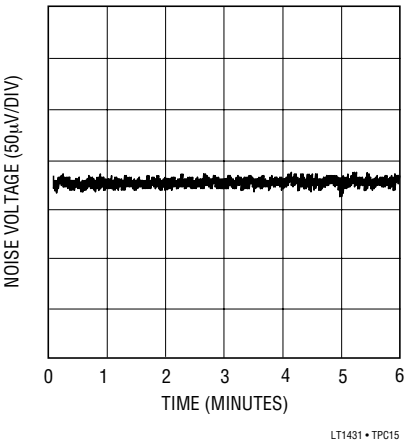
ICOMP vs VCOMP vs VREF



Noise vs Frequency



0.1Hz to 10Hz Noise



PIN FUNCTIONS

COLL (Pin 1): Open collector of the output transistor. The maximum pin voltage is 36V. The saturation voltage at 100mA is approximately 1V.

COMP (Pin 2): Base of the driver for the output transistor. This pin allows additional compensation for complex feedback systems and shutdown of the regulator. It must be left open if unused.

V^+ (Pin 3): Bias voltage for the entire shunt regulator. The maximum input voltage is 36V and the minimum to operate is equal to V_{REF} (2.5V). The quiescent current is typically 0.6mA.

R_{TOP} (Pin 4): Top of the on-chip 5k-5k resistive divider that guarantees 1% accuracy of operation as a 5V shunt regulator with no external trim. The pin is tied to COLL for self-contained 5V operation. It may be left open if unused. See note on parasitic diodes below.

GND-S (Pin 5): Ground reference for the on-chip resistive divider and shunt regulator circuitry except for the output transistor. This pin allows external current limit of the output transistor with one resistor between GND-F (force) and GND-S (sense).

GND-F (Pin 6): Emitter of the output transistor and substrate connection for the die.

R_{MID} (Pin 7): Middle of the on-chip resistive divider string between R_{TOP} and GND-S. The pin is tied to REF for self-contained 5V operation. It may be left open if unused.

REF (Pin 8): Control pin of the shunt regulator with a 2.5V threshold. If $V^+ > 3V$, input bias current cancellation reduces I_B to 0.2μA typical.

COMP, R_{TOP}, R_{MID}, and REF have static discharge protection circuits that must not be activated on a continuous basis. Therefore, the absolute maximum DC voltage on these pins is 6V, well beyond the normal operating conditions.

As with all bipolar ICs, the LT1431 contains parasitic diodes which must not be forward biased or else anomalous behavior will result. Pin conditions to be avoided are R_{TOP} below R_{MID} in voltage and any pin below GND-F in voltage (except for GND-S).

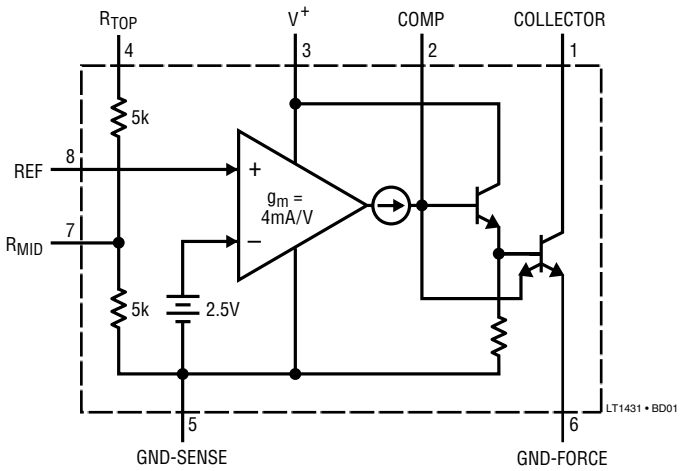
The following pin definitions apply to the Z package.

CATHODE: Corresponds to COLL and V^+ tied together.

ANODE: Corresponds to GND-S and GND-F tied together.

REF: Corresponds to REF.

BLOCK DIAGRAM



APPLICATIONS INFORMATION

Frequency Compensation

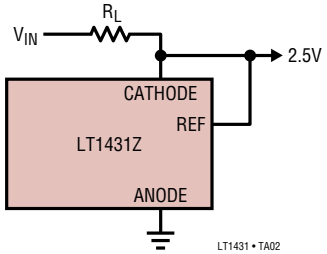
As a shunt regulator, the LT1431 is stable for all capacitive loads on the COLL pin. Capacitive loading between 0.01μF and 18μF causes reduced phase margin with some ringing under transient conditions. Output capacitors should not be used arbitrarily because output noise is not necessarily reduced.

Excess capacitance on the REF pin can introduce enough phase shift to induce oscillation when configured as a reference >2.5V. This can be compensated with capacitance between COLL and REF (phase lead). More complicated feedback loops may require shaping of the frequency response of the LT1431 with dominant pole or pole-zero compensation. This can be accomplished with a capacitor or series resistor and capacitor between COLL and COMP.

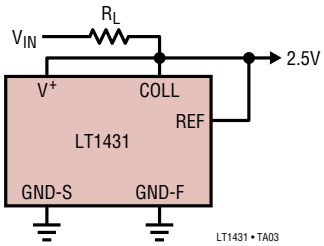
The compensation schemes mentioned above use voltage feedback to stabilize the circuits. There must be voltage gain at the COLL pin for them to be effective, so the COLL pin must see a reasonable AC impedance. Capacitive loading of the COLL pin reduces the AC impedance, voltage gain, and frequency response, thereby decreasing the effectiveness of the compensation schemes, but also decreasing their necessity.

TYPICAL APPLICATIONS

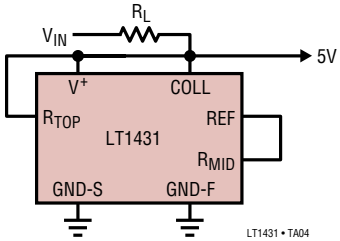
2.5V Reference 3-Pin Package



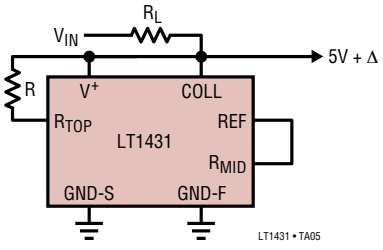
2.5V Reference 8-Pin Package



5V Reference

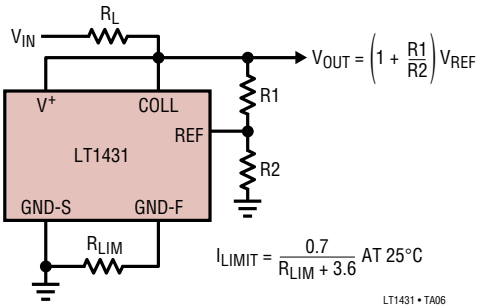


Increasing 5V Reference



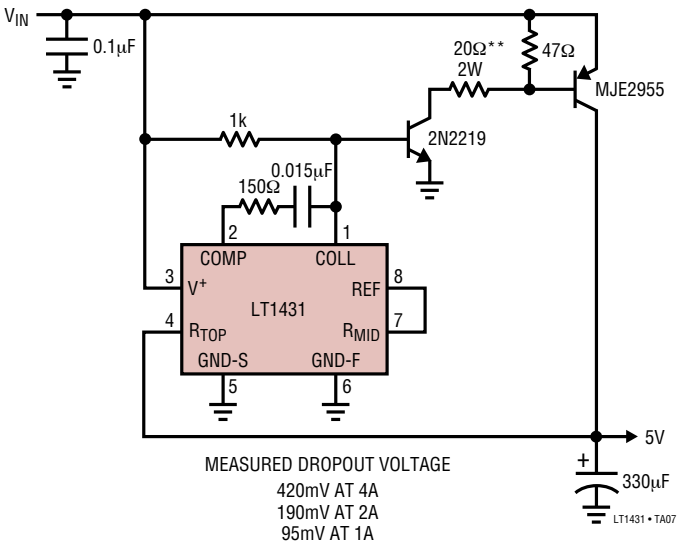
Δ = R • (0.5mA) ±25% PROCESS TOLERANCE
Δ ≤ 500mV

Programmable Reference with Adjustable Current Limit



TYPICAL APPLICATIONS

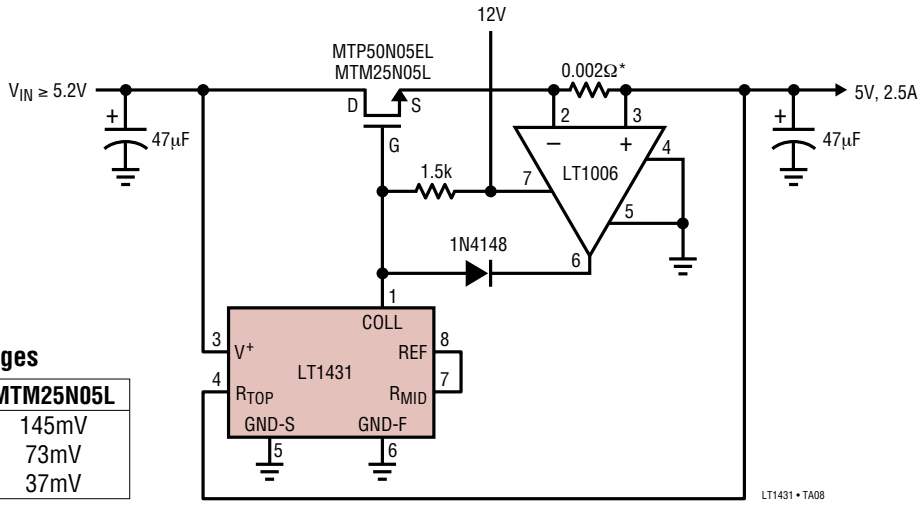
PNP Low Dropout 5V Regulator*



MEASURED DROPOUT VOLTAGE
420mV AT 4A
190mV AT 2A
95mV AT 1A
60mV AT 0.5A

*NO SHORT-CIRCUIT PROTECTION
**MAY BE INCREASED AT LOWER WATTAGE FOR LOWER OUTPUT CURRENTS

FET Low Dropout 5V Regulator with Current Limit



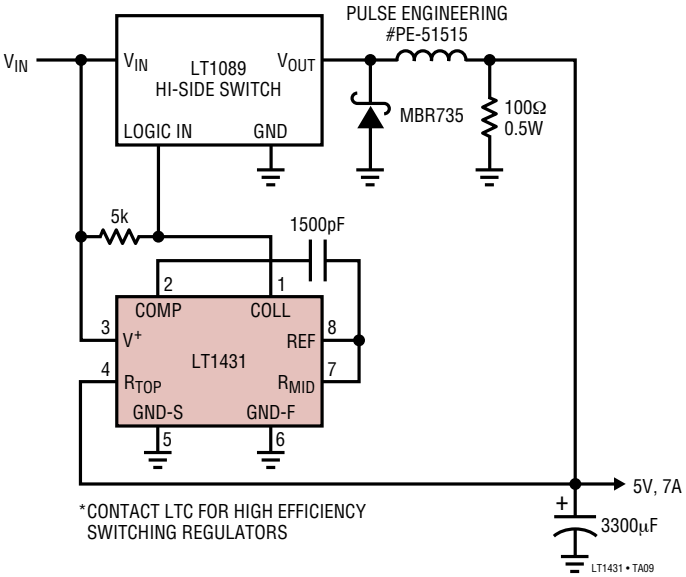
*1.5" #23 SOLID COPPER WIRE
~0.002Ω → 3A LIMIT

Measured Dropout Voltages

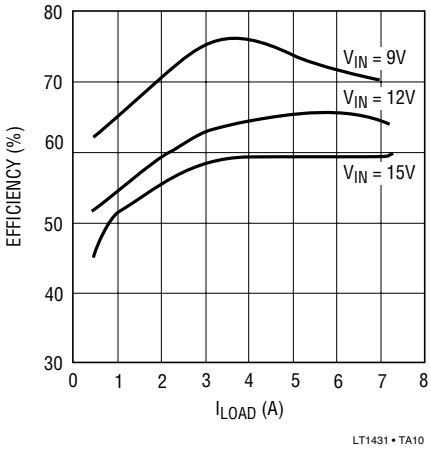
I_{LOAD}	MTP50N05EL	MTM25N05L
2A	47mV	145mV
1A	22mV	73mV
0.5A	11.5mV	37mV

TYPICAL APPLICATIONS

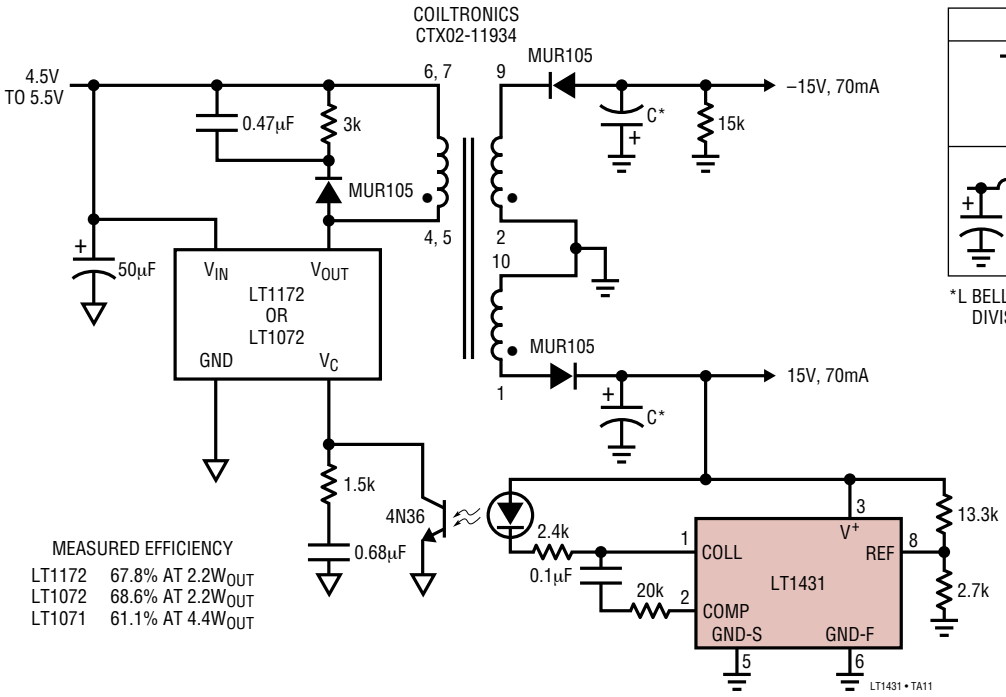
12V to 5V Buck Converter with Foldback Current Limit*



Buck Converter Efficiency



Isolated 5V to ±15V Flyback Converter



MEASURED EFFICIENCY

LT1172	67.8% AT $2.2W_{OUT}$
LT1072	68.6% AT $2.2W_{OUT}$
LT1071	61.1% AT $4.4W_{OUT}$

Fully Loaded Output Ripple vs Filtering

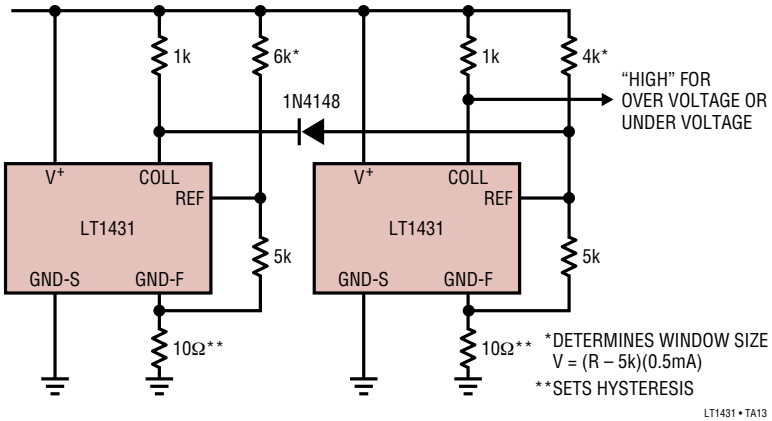
C*	LT1172	LT1072
210µF	$30mV_{P-P}$	$40mV_{P-P}$
L* + 100µF + 100µF	$6mV_{P-P}$	$8mV_{P-P}$

*L BELL INDUSTRIES J.W. MILLER
DIVISION 9310-36 10µH, 450mA

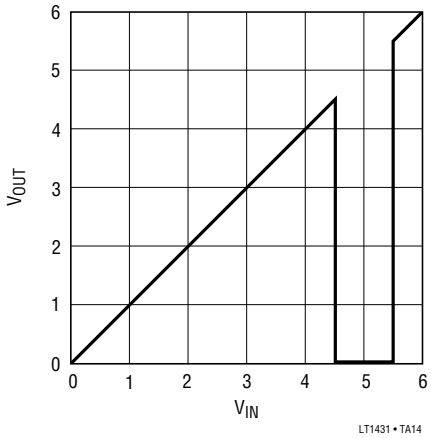
LT1431 • TA12

TYPICAL APPLICATIONS

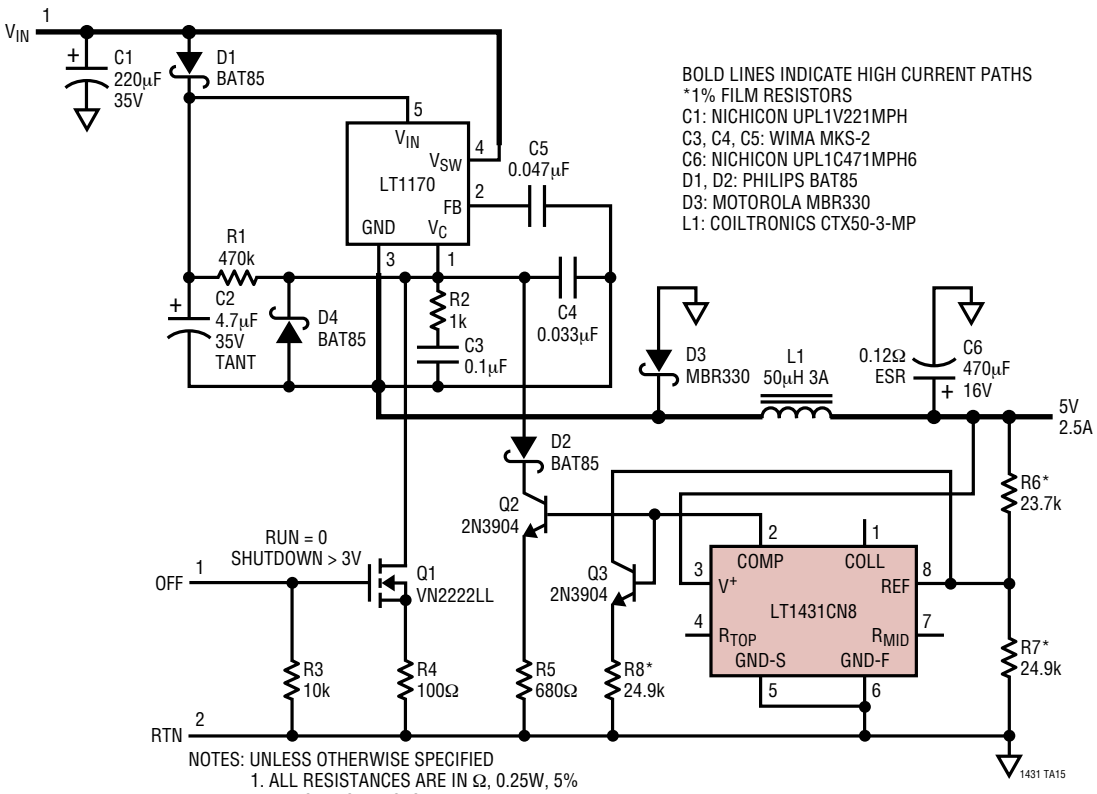
5V Power Supply Monitor with ±500mV Window and 50mV Hysteresis



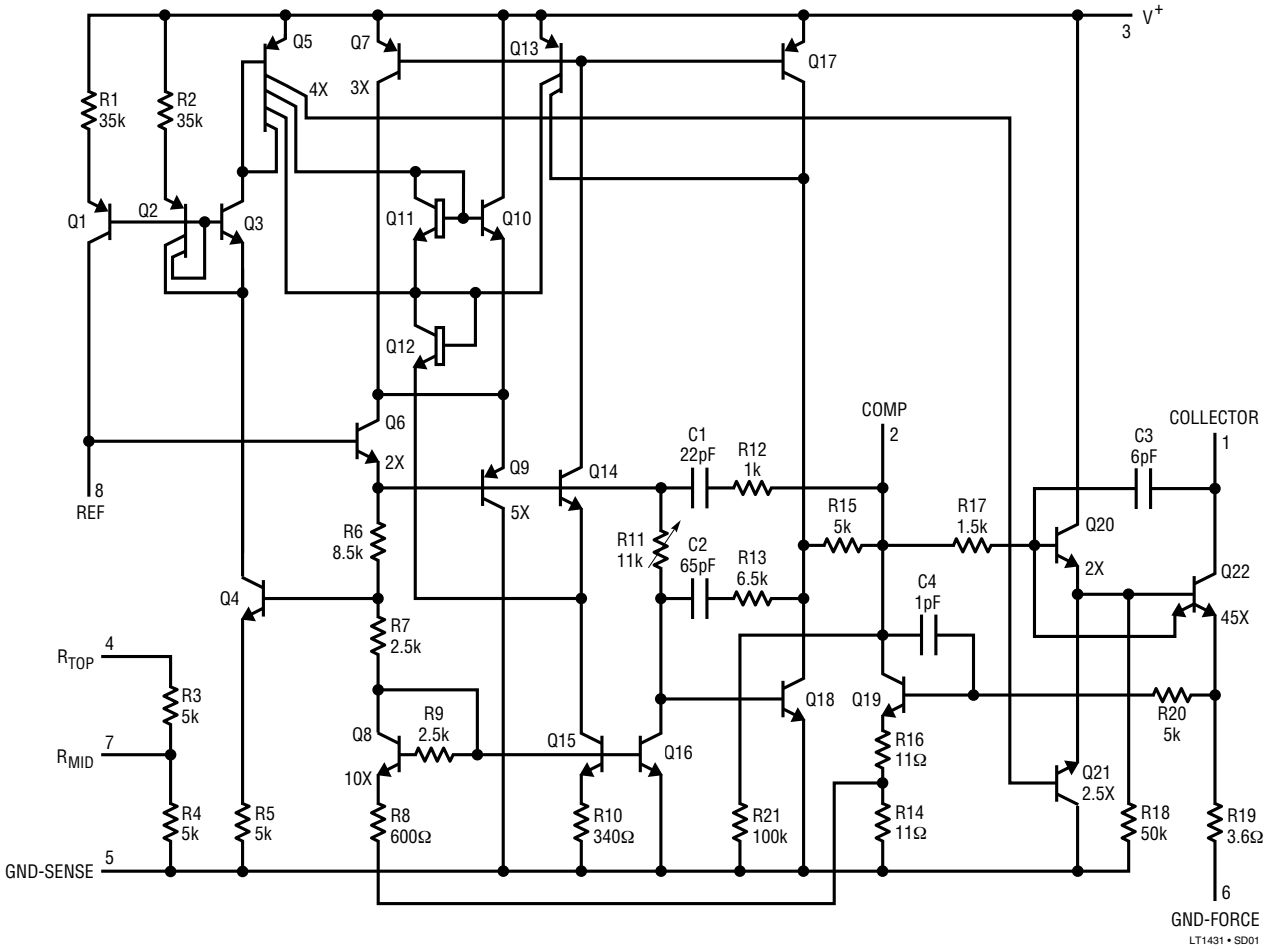
Transfer Function



High Efficiency Buck Converter E = 85% to 89%

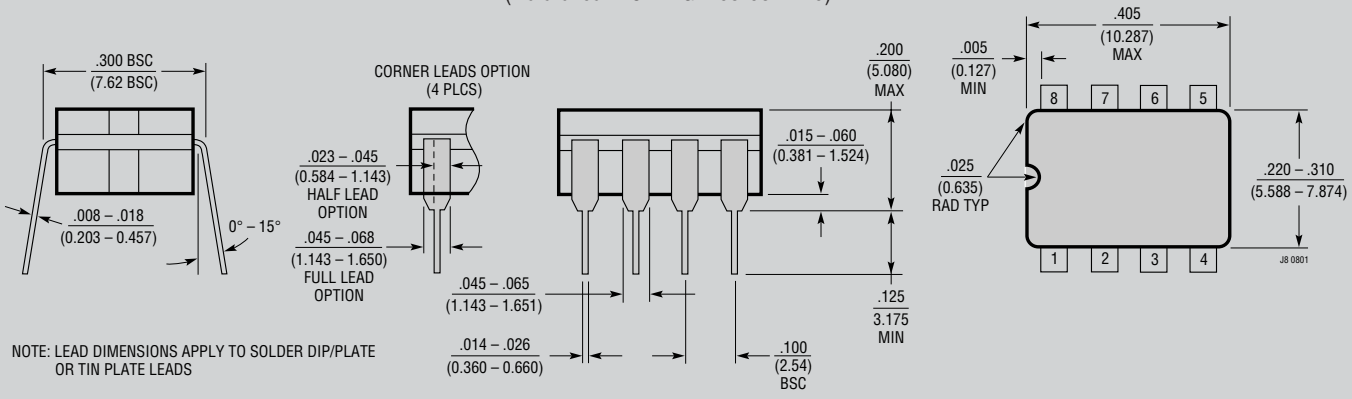


SCHEMATIC DIAGRAM



PACKAGE DESCRIPTION

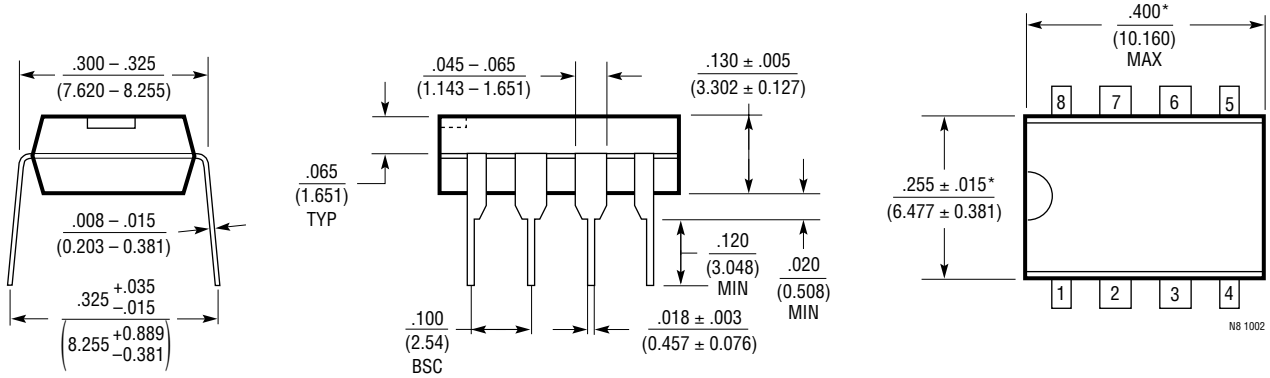
J8 Package
8-Lead CERDIP (Narrow .300 Inch, Hermetic)
(Reference LTC DWG # 05-08-1110)



OBSOLETE PACKAGE

PACKAGE DESCRIPTION

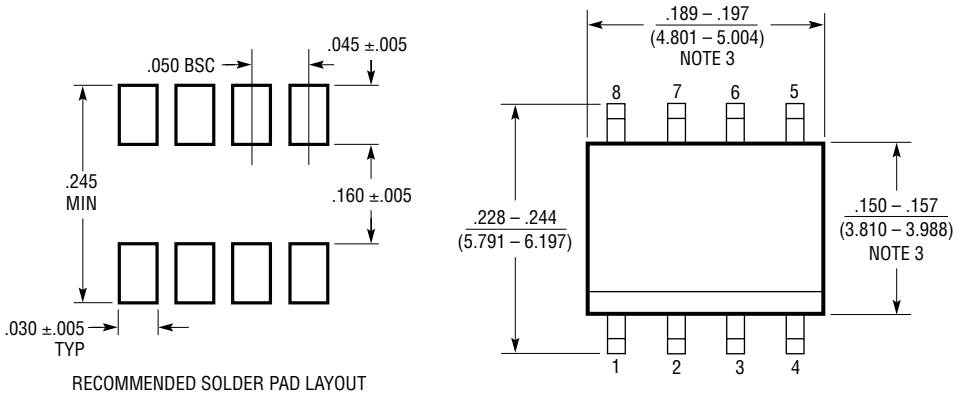
N8 Package
8-Lead PDIP (Narrow .300 Inch)
(Reference LTC DWG # 05-08-1510)



NOTE:
1. DIMENSIONS ARE INCHES / MILLIMETERS

*THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .010 INCH (0.254mm)

S8 Package
8-Lead Plastic Small Outline (Narrow .150 Inch)
(Reference LTC DWG # 05-08-1610)

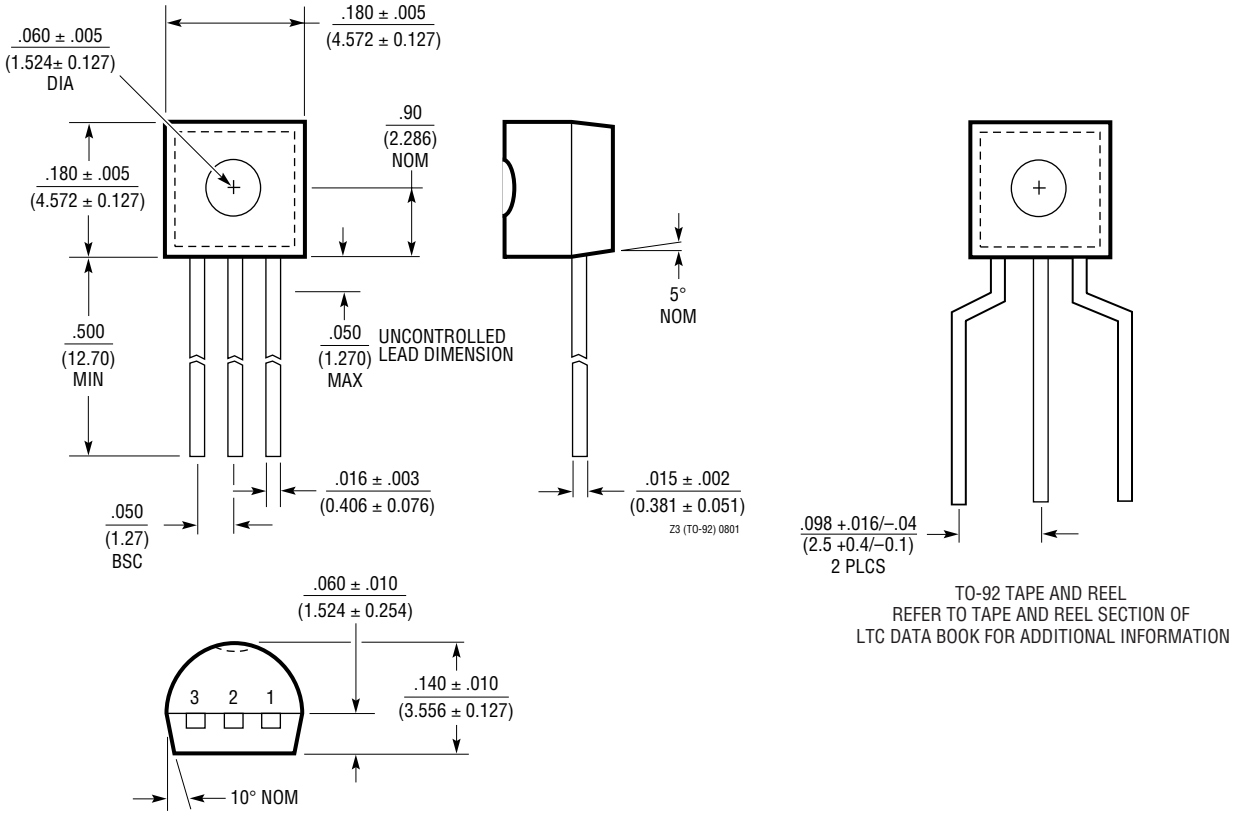


NOTE:
1. DIMENSIONS IN INCHES / (MILLIMETERS)
2. DRAWING NOT TO SCALE
3. THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .006" (0.15mm)

SO8 0303

PACKAGE DESCRIPTION

Z Package
3-Lead Plastic TO-92 (Similar to TO-226)
(Reference LTC DWG # 05-08-1410)



TO-92 TAPE AND REEL
REFER TO TAPE AND REEL SECTION OF
LTC DATA BOOK FOR ADDITIONAL INFORMATION

RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LTC®3722	Synchronous Full-Bridge Controller	Zero Voltage Switching, Adjustable $2V_S$ Timing
LTC3723	Synchronous Push-Pull PWM Controller	1.5A Sink, 1A Source Output Drivers, Adjustable Dead Time
LTC3803	SOT-23 Flyback Controller	Adjustable Slope Compensation, 200kHz Operation
LTC3806	Synchronous Flyback Controller	Excellent Cross Regulation, High Efficiency
LTC3900/LTC3901	Synchronous Rectifiers for Forward and Push-Pull Converters	Programmable Time Out, Reverse Inductor Current Sense
LT4430	Optocoupler Driver in SOT-23	Overshoot Control, 600mV Reference, High Bandwidth Error Amplifier

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