INITIAL RELEASE
Final Electrical Specifications

LTC1258

Micropower Low Dropout Reference

December 1998

FEATURES

- **200mV Max Dropout at 10mA Output Current**
- **4µA Typical Quiescent Current**
- **0.4% Max Initial Accuracy**
- **No Output Capacitor Required**
- Output Sources 10mA, Sinks 2mA
- 40ppm/°C Max Drift Over Commercial Temp Range
- Load Regulation Over Temperature:
  0.1mV/mA, Source up to 10mA
  1.75mV/mA, Sink up to 2mA
- Supply Voltage Range: (V_{OUT} + 0.2V) to 12.6V

APPLICATIONS

- Battery-Powered Systems
- Handheld Instruments
- Precision Power Supply
- A/D and D/A Converters

DESCRIPTION

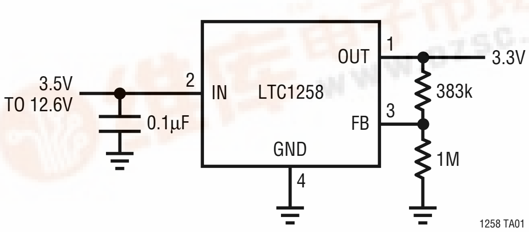
The LTC®1258 is a micropower bandgap reference that combines high accuracy and low drift with very low supply current and small package size. The combination of ultralow quiescent current and low dropout voltage of only 200mV max makes it ideal for battery-powered equipment. The output voltage is set by an external resistor divider.

This reference uses curvature compensation to obtain low temperature coefficient and trimmed thin-film resistors to achieve high output accuracy. This reference can supply up to 10mA and sink up to 2mA, making it ideal for precision regulator applications. The LTC1258 is stable without an output bypass capacitor, but is also stable with capacitance up to 1µF. This feature is important in critical applications where PC board space is a premium and fast settling is demanded.

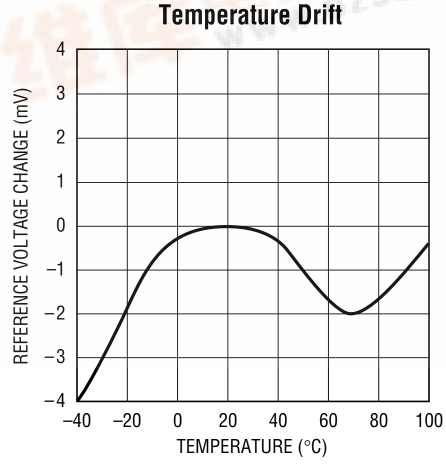
Series references provide power dissipation advantages over shunt references. In addition to supply current, shunt references must also idle the entire load current to operate.

The LTC1258 is available in the 8-pin SO package.

TYPICAL APPLICATION



Temperature Drift



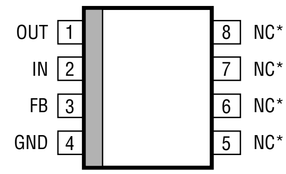
ABSOLUTE MAXIMUM RATINGS

(Note 1)

Supply Voltage 13V
Input Voltages .... –0.3V to 13V
Output Voltages .... –0.3V to 13V
Output Short Circuit Duration .... Indefinite
Operating Temperature Range .... 0°C to 70°C
Storage Temperature Range (Note 2) ... –65°C to 150°C
Lead Temperature (Soldering, 10 sec) .... 300°C

PACKAGE/ORDER INFORMATION

TOP VIEW



S8 PACKAGE
8-LEAD PLASTIC SO
T_{JMAX} = 125°C, θ_{JA} = 190°C/W

*CONNECTED INTERNALLY. DO NOT CONNECT EXTERNAL CIRCUITRY TO THESE PINS.

ORDER PART NUMBER
LTC1258CS8
S8 PART MARKING
1258

Consult factory for Industrial and Military grade parts.

ELECTRICAL CHARACTERISTICS V_{IN} = 2.6V, FB = OUT, I_{OUT} = 0mA, T_A = 25°C unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
V_{IN}	Input Voltage Range		●			12.6	V
I_{IN}	Input Current	FB = OUT				6.5	µA
		FB = OUT	●			8.5	µA
V_{OUT}	Output Voltage (Note 3)	FB = OUT		2.3755	2.385	2.3945	V
e_n	Output Voltage Noise (Note 4)	0.1Hz ≤ f ≤ 10Hz			40		µVp-p
TC	Output Voltage Temp Coefficient (Note 5)	$T_{MIN} \le T_J \le T_{MAX}$	●		15	40	ppm/°C
V_{OUT}/V_{IN}	Line Regulation	V_{IN} = 2.6V to 12.6V	●		75	150	µV/V
V_{OUT}/I_{OUT}	Load Regulation (Note 6)	Sourcing 0mA to 10mA			0.1	0.2	mV/mA
			●			0.3	mV/mA
		Sinking 0mA to 2mA			1.75	4.0	mV/mA
			●			6.5	mV/mA
I_{SC}	Short-Circuit Output Current	V_{OUT} Shorted to GND		20	40	60	mA
		V_{OUT} Shorted to V_{IN}		2	4	15	mA
ΔV_{DO}	Dropout Voltage (Note 7)	I_{OUT} = 0, $\Delta V_{OUT} \le 0.1\%$	●			100	mV
		I_{OUT} = 10mA, $\Delta V_{OUT} \le 0.1\%$	●			200	mV
V_{HYST}	Output Hysteresis (Note 8)	ΔT = –40°C to 85°C			200		ppm
		ΔT = 0°C to 70°C			50		ppm

The ● denotes specifications which apply over the full operating temperature range.

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

Note 2: If the part is stored outside of the specified operating temperature range, the output may shift due to hysteresis.

Note 3: ESD (Electrostatic Discharge) sensitive device. Extensive use of ESD protection devices are used internal to the LTC1258, however, high electrostatic discharge can damage or degrade the device. Use proper ESD handling precautions.

Note 4: Peak-to-peak noise is measured with a single highpass filter at 0.1Hz and 2-pole lowpass filter at 10Hz.

Note 5: Temperature coefficient is measured by dividing the change in output voltage by the specified operating temperature range.

Note 6: Load regulation is measured on a pulse basis from no load to the specified load current. Output changes due to die temperature change must be taken into account separately.

Note 7: Dropout voltage is ($V_{IN} - V_{OUT}$) when V_{OUT} falls to 0.1% below its nominal value at $V_{IN} = V_{OUT} + 0.5V$.

Note 8: Hysteresis in output voltage is created by package stress that differs depending on whether the IC was previously at a higher or lower temperature. Output voltage is always measured at 25°C, but the IC is cycled to 85°C or –40°C before successive measurements. Hysteresis is roughly proportional to the square of the temperature change. Hysteresis is not normally a problem for operational temperature excursions where the instrument might be stored at high or low temperature.

PIN FUNCTIONS

OUT (Pin 1): Reference Output. The output can source up to 10mA and sink up to 2mA. Stable with output bypass capacitor ranges from 0μF to 1μF.

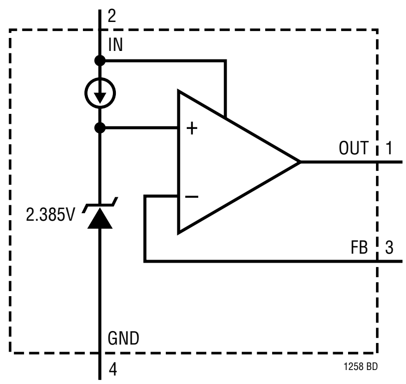
IN (Pin 2): Positive Supply. Bypass with a 0.1μF capacitor is recommended if the output loading changes. $(V_{OUT} + 0.2V) \leq V_{IN} \leq 12.6V$.

FB (Pin 3): Resistor Divider Feedback Pin. Connect a resistor divider from OUT to GND and the center tap to FB. This pin sets the output potential.

GND (Pin 4): Negative Supply or Ground Connection.

NC (Pins 5, 6, 7, 8): No Connection. Connected internally for post package trim. These pins should be left unconnected.

BLOCK DIAGRAM



APPLICATIONS INFORMATION

Longer Battery Life

Series references have an advantage over shunt style references. To operate, shunt references require a resistor between the power supply and the output. This resistor must be chosen to supply the maximum current that is demanded by the circuit being regulated. When the circuit being controlled is not operating at this maximum current, the shunt reference must always sink this current, resulting in high power dissipation and short battery life.

The LTC1258 low dropout reference does not require a current setting resistor and can operate with any supply voltage from $(V_{OUT} + 0.2V)$ to 12.6V. When the circuitry being regulated does not demand current, the LTC1258 reduces its dissipation and battery life is extended. If the reference is not delivering load current it dissipates only 13.2μW on a 3.3V supply, yet the same connection can deliver 10mA of load current when demanded.

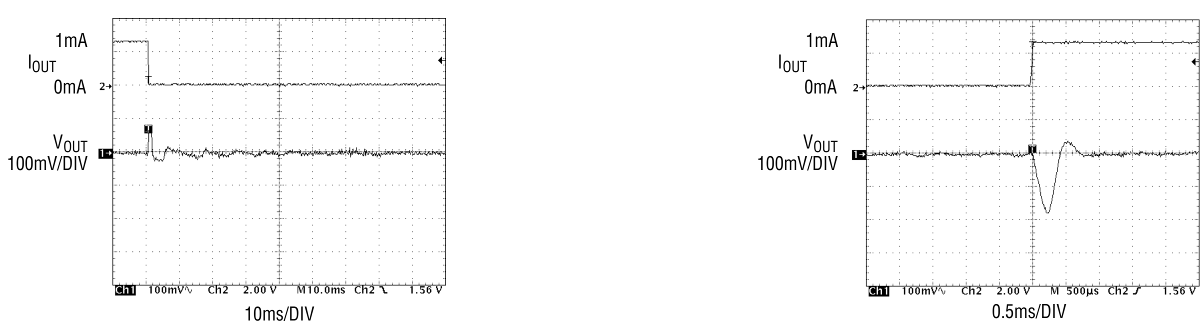


Figure 1. Reference Output Load Transient Response

APPLICATIONS INFORMATION

Output Bypass Capacitor

The LTC1258 is designed to be stable with or without capacitive loads. With no capacitive load, the reference is ideal for fast settling applications, or where PC board space is a premium.

In applications with significant output loading changes, an output bypass capacitor of up to 1μF can be used to improve the output transient response. Figure 1 shows the response of the reference to a 1mA to 0μA load step with a 1μF output capacitor. If more than 1μF of output capacitance is required, a resistor in series with the capacitor is recommended to reduce the output ringing. Figure 2 shows the resistor and capacitor values required to achieve critical damping.

Internal P-Channel Pass Transistor

The LTC1258 features an internal P-channel MOSFET pass transistor. This provides several advantages over similar designs using a PNP bipolar pass transistor.

The LTC1258 consumes only 4μA of quiescent current under light and heavy loads as well as in dropout; whereas, PNP based references waste considerable amounts of current when the pass transistor is saturated. In addition, the LTC1258 provides a lower dropout voltage (200mV max) than PNP based references.

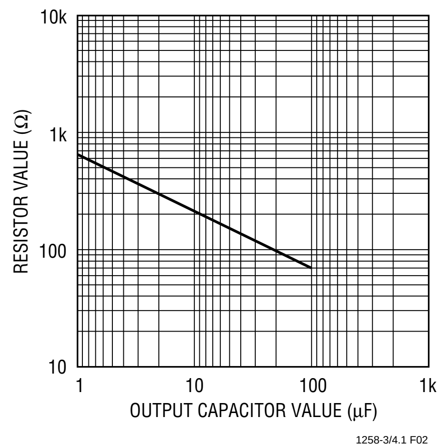
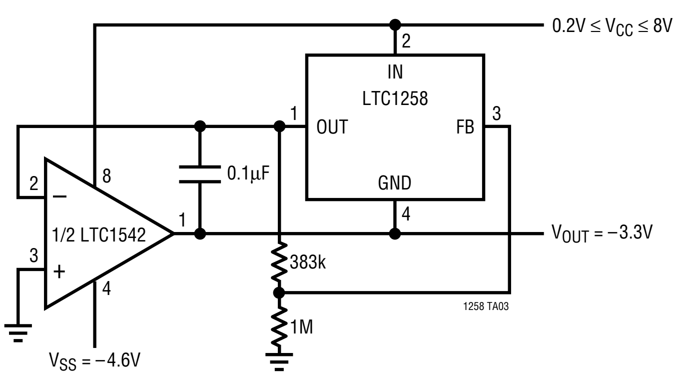


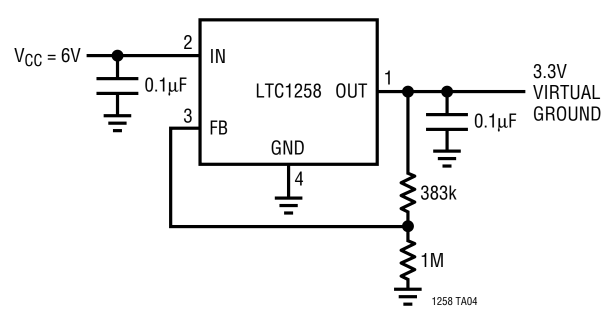
Figure 2. Damping Resistance vs Output Capacitor Value

TYPICAL APPLICATIONS

Micropower Low Dropout Negative Reference



Supply Splitter



RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LT®1389	Nanopower Precision Shunt Voltage Reference	800nA Quiescent Current, 0.05% Max, 10ppm/°C Max Drift, 1.25V and 2.5V Versions, SO-8 Package
LT1634	Micropower Precision Shunt Voltage Reference	0.05% Max, 10ppm/°C Max Drift, 1.25V, 2.5V, 4.096V and 5V Outputs
LT1460	Micropower Series Reference	0.075% Max, 10ppm/°C Max Drift, 2.5V, 5V and 10V Outputs
LTC1540	Nanopower Comparator with Reference	600nA Max I_{CC}, 2% 1.182V Reference, Adjustable Hysteresis

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