MOTOROLA

MC78LC00 Series

Advance Information

Micropower Voltage Regulator

The MC78LC00 series voltage regulators are specifically designed for use as a power source for video instruments, handheld communication equipment, and battery powered equipment.

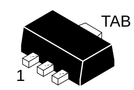
The MC78LC00 series features an ultra–low quiescent current of 1.1 µA and a high accuracy output voltage. Each device contains a voltage reference, an error amplifier, a driver transistor and resistors for setting the output voltage. These devices are available in either SOT–89, 3 pin, or SOT–23, 5 pin, surface mount packages.

MC78LC00 Series Features:

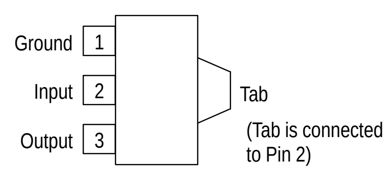
- Low Quiescent Current of 1.1 µA Typical
- Low Dropout Voltage (220 mV at 10 mA)
- Excellent Line Regulation (0.1%)
- High Accuracy Output Voltage (±2.5%)
- Wide Output Voltage Range (2.0 V to 6.0 V)
- Output Current for Low Power (up to 80 mA)
- Two Surface Mount Packages (SOT–89, 3 Pin, or SOT–23, 5 Pin)

MICROPOWER ULTRA–LOW QUIESCENT CURRENT VOLTAGE REGULATORS

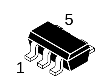
SEMICONDUCTOR TECHNICAL DATA



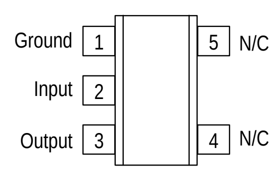
H SUFFIX
PLASTIC PACKAGE
CASE 1213
(SOT–89)



(Top View)



N SUFFIX
PLASTIC PACKAGE
CASE 1212
(SOT–23)



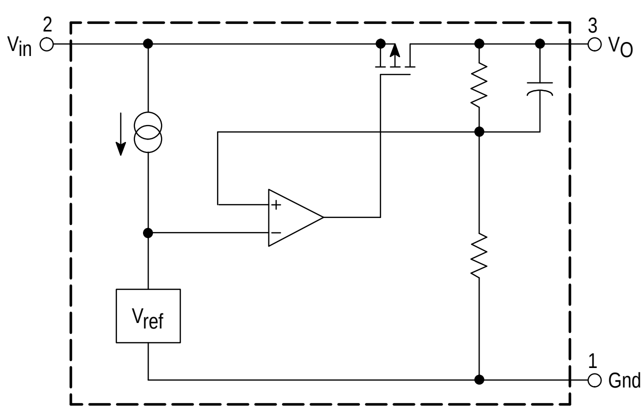
(Top View)

ORDERING INFORMATION

Device	Output Voltage	Operating Temperature Range	Package
MC78LC30HT1	3.0	T_A = –30° to +80°C	SOT–89
MC78LC33HT1	3.3		
MC78LC40HT1	4.0		
MC78LC50HT1	5.0		
MC78LC30NTR	3.0		SOT–23
MC78LC33NTR	3.3		
MC78LC40NTR	4.0		
MC78LC50NTR	5.0		

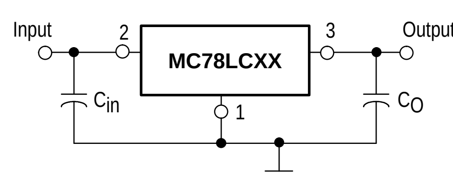
Other voltages from 2.0 to 6.0 V, in 0.1 V increments, are available upon request. Consult factory for information.

Representative Block Diagram



This device contains 8 active transistors.

Standard Application



This document contains information on a new product. Specifications and information herein are subject to change without notice.

Rev 1

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Input Voltage	V_{CC}	10	Vdc
Power Dissipation and Thermal Characteristics Maximum Power Dissipation Case 1213 (SOT–89) H Suffix Thermal Resistance, Junction–to–Ambient Case 1212 (SOT–23) N Suffix Thermal Resistance, Junction–to–Ambient	 P_D $R_{\theta JA}$ P_D $R_{\theta JA}$	 300 333 150 667	 mW °C/W mW °C/W
Operating Junction Temperature	T_J	125	°C
Operating Ambient Temperature	T_A	–30 to +80	°C
Storage Temperature Range	T_{stg}	–40 to +125	°C

NOTE: ESD data available upon request.

ELECTRICAL CHARACTERISTICS (V_{in} = V_O + 1.0 V, I_O = 10 mA, T_J = 25°C [Note 1], unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
Output Voltage 30HT1 and 30NTR Suffixes (V_{in} = 5.0 V) 33HT1 and 33NTR Suffixes (V_{in} = 5.0 V) 40HT1 and 40NTR Suffixes (V_{in} = 6.0 V) 50HT1 and 50NTR Suffixes (V_{in} = 7.0 V)	V_O	 2.950 3.218 3.900 4.875	 3.0 3.3 4.0 5.0	 3.075 3.382 4.100 5.125	V
Line Regulation V_{in} = [V_O + 1.0] V to 10 V, I_O = 1.0 mA	Reg_{line}	–	0.05	0.2	mV
Load Regulation (I_O = 1.0 to 10 mA) 30HT1 and 30NTR Suffixes (V_{in} = 5.0 V) 33HT1 and 33NTR Suffixes (V_{in} = 6.0 V) 40HT1 and 40NTR Suffixes (V_{in} = 7.0 V) 50HT1 and 50NTR Suffixes (V_{in} = 8.0 V)	Reg_{load}	 – – – –	 40 40 50 60	 60 60 70 90	mV
Output Current 30HT1 and 30NTR Suffixes (V_{in} = 5.0 V) 33HT1 and 33NTR Suffixes (V_{in} = 6.0 V) 40HT1 and 40NTR Suffixes (V_{in} = 7.0 V) 50HT1 and 50NTR Suffixes (V_{in} = 8.0 V)	I_O	 35 35 45 55	 50 50 65 80	 – – – –	mA
Dropout Voltage 30HT1 and 30NTR Suffixes (I_O = 1.0 mA) 33HT1 and 33NTR Suffixes (I_O = 1.0 mA) 40HT1 and 40NTR Suffixes (I_O = 1.0 mA) 50HT1 and 50NTR Suffixes (I_O = 1.0 mA)	$V_{in} – V_O$	 – – – –	 40 35 25 25	 60 53 38 38	V
Quiescent Current 30HT1 and 30NTR Suffixes (V_{in} = 5.0 V) 33HT1 and 33NTR Suffixes (V_{in} = 5.0 V) 40HT1 and 40NTR Suffixes (V_{in} = 6.0 V) 50HT1 and 50NTR Suffixes (V_{in} = 7.0 V)	I_{CC}	 – – – –	 1.1 1.1 1.2 1.3	 3.3 3.3 3.6 3.9	µA
Output Voltage Temperature Coefficient	T_C	–	±100	–	ppm/°C

NOTE: 1. Low duty pulse techniques are used during test to maintain junction temperature as close to ambient as possible.

DEFINITIONS

Dropout Voltage – The input/output voltage differential at which the regulator output no longer maintains regulation against further reductions in input voltage. Measured when the output drops 100 mV below its nominal value (which is measured at 1.0 V differential), dropout voltage is affected by junction temperature, load current and minimum input supply requirements.

Line Regulation – The change in output voltage for a change in input voltage. The measurement is made under conditions of low dissipation or by using pulse techniques such that average chip temperature is not significantly affected.

Load Regulation – The change in output voltage for a change in load current at constant chip temperature.

Maximum Power Dissipation – The maximum total device dissipation for which the regulator will operate within specifications.

Quiescent Bias Current – Current which is used to operate the regulator chip and is not delivered to the load.

Figure 1. Output Voltage versus Input Voltage

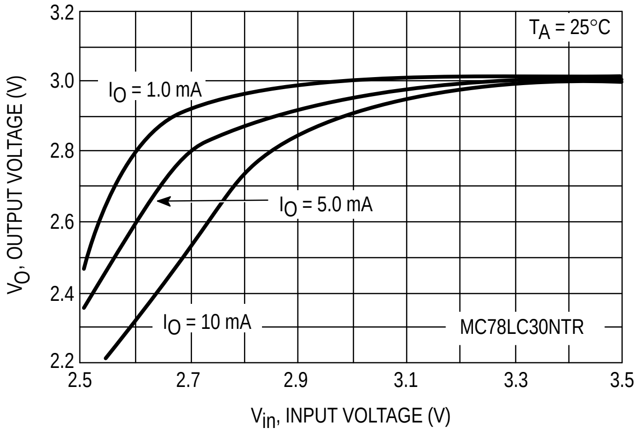


Figure 2. Output Voltage versus Output Current

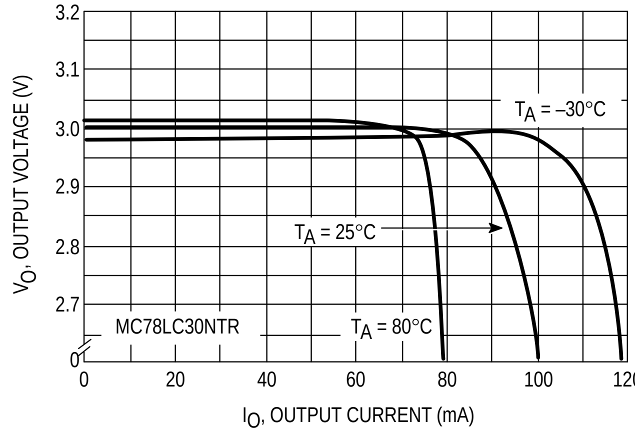


Figure 3. Dropout Voltage versus Output Current

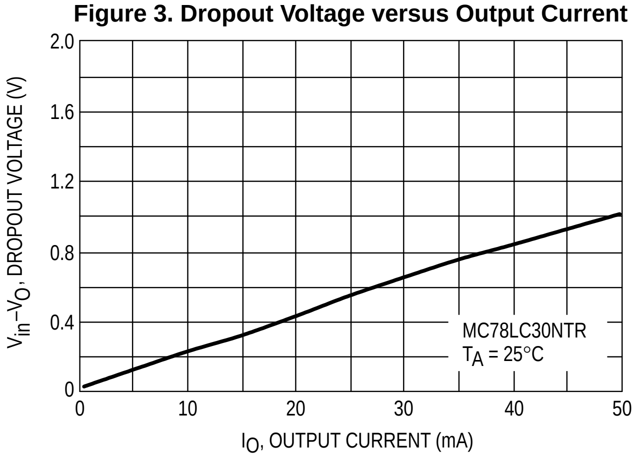


Figure 4. Output Voltage versus Temperature

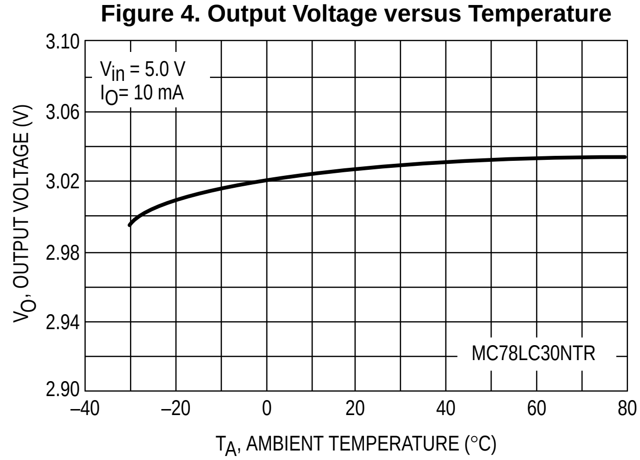


Figure 5. Quiescent Current versus Input Voltage

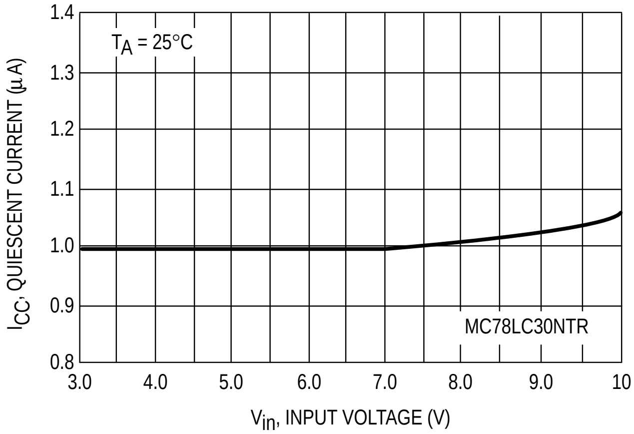


Figure 6. Quiescent Current versus Temperature

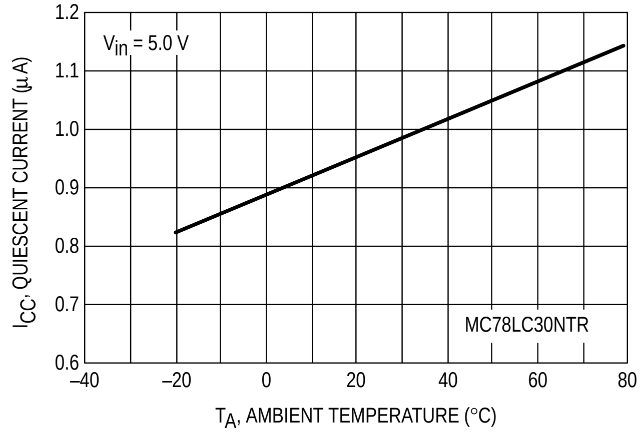


Figure 7. Dropout Voltage versus Set Output Voltage

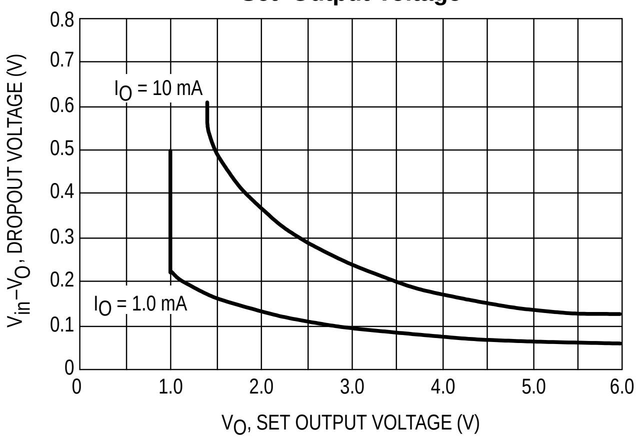
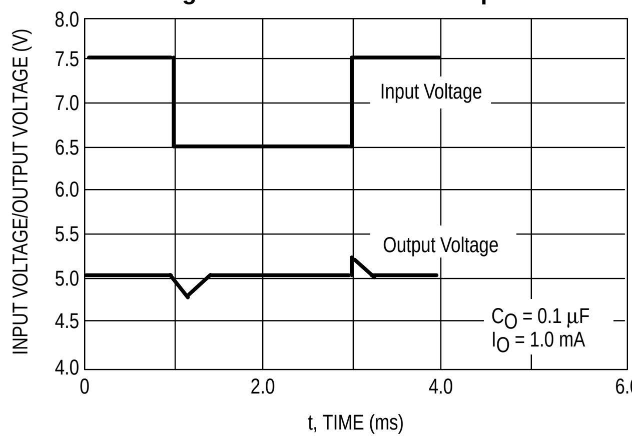


Figure 8. Line Transient Response



APPLICATIONS INFORMATION

Introduction

The MC78LC00 micropower voltage regulators are specifically designed with high accuracy output voltage and ultra low quiescent current by CMOS process making them ideal for battery powered applications and hand–held communication equipment. An input bypass capacitor is recommended if the regulator is located an appreciable distance (≥ 4 inches) from the input voltage source. These regulators require ≥ 0.1 µF capacitance between the output terminal and ground for stability. Most types of aluminum, tantalum or multilayer ceramic will perform adequately. Solid tantalums or other appropriate capacitors are recommended for operation below 25°C. The bypass capacitors should be mounted with the shortest possible leads or track lengths directly across the regulator input and output terminals.

With economical electrolytic capacitors, cold temperature operation can pose a serious stability problem. As the electrolyte freezes, around –30°C, the capacitance will decrease and the equivalent series resistance (ESR) will increase drastically, causing the circuit to oscillate. Quality electrolytic capacitors with extended temperature ranges of –40° to +85°C are readily available. Solid tantalum capacitors may be the better choice if small size is a requirement. However, a maximum ESR limit of 3.0 Ω must be observed over temperature to maintain stability.

In the Current Boost Circuit, shown in Figures 10 and 12, an output current of up to 600 mA can be delivered by the circuit. The circuit of Figure 10 has no current limit. In each case, the external transistor must be rated for the expected power dissipation. Figure 11 shows how a fixed output may be programmed, using R1 and R2, to provide a higher output voltage.

Figure 9. Typical Application

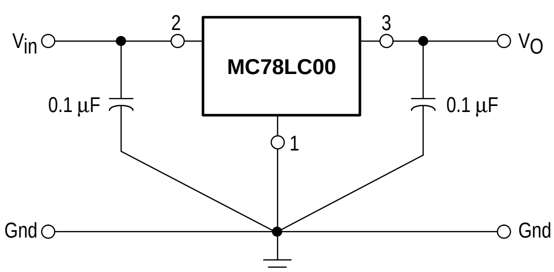


Figure 10. Current Boost Circuit

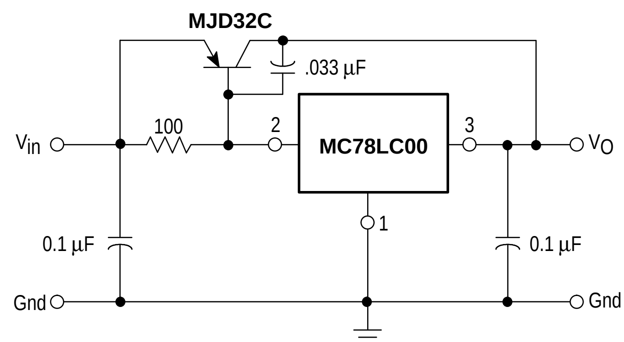
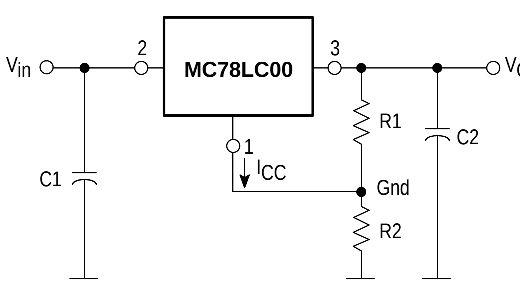
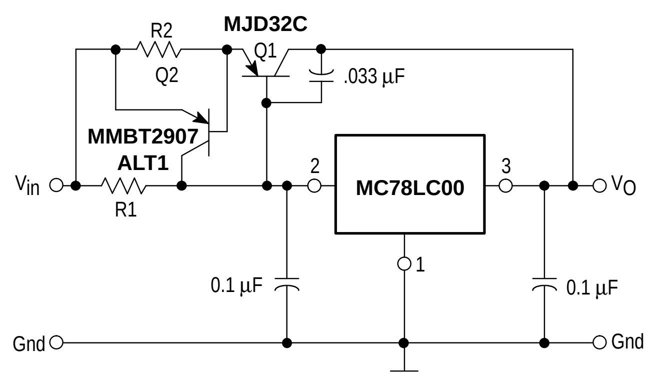


Figure 11. Adjustable V_O



$$V_O = V_{O(Reg)}\left(1 + \frac{R2}{R1}\right) + I_{CC}\,R2$$

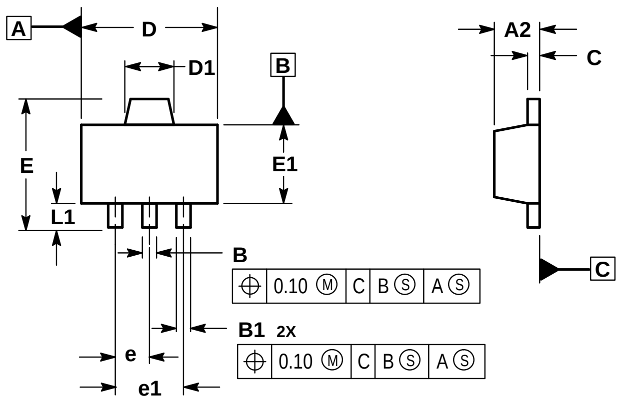
Figure 12. Current Boost Circuit with Overcurrent Limit Circuit



$$I_{O(short\ circuit)} \approx \frac{V_{BE2}}{R2} + \frac{V_{BE1} + V_{BE2}}{R1}$$

OUTLINE DIMENSIONS

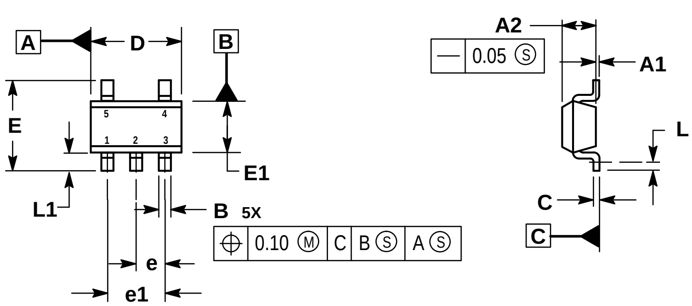
H SUFFIX
PLASTIC PACKAGE
CASE 1213–01
(SOT–89)
ISSUE O



NOTES:
1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCING PER ASME Y14.5M, 1994.
3. DATUM C IS A SEATING PLANE.

	MILLIMETERS	
DIM	MIN	MAX
A2	1.40	1.60
B	0.37	0.57
B1	0.32	0.52
C	0.30	0.50
D	4.40	4.60
D1	1.50	1.70
E	—	4.25
E1	2.40	2.60
e	1.50 BSC	
e1	3.00 BSC	
L1	0.80	—

N SUFFIX
PLASTIC PACKAGE
CASE 1212–01
(SOT–23)
ISSUE O



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2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DATUM C IS A SEATING PLANE.

	MILLIMETERS	
DIM	MIN	MAX
A1	0.00	0.10
A2	1.00	1.30
B	0.30	0.50
C	0.10	0.25
D	2.80	3.00
E	2.50	3.10
E1	1.50	1.80
e	0.95 BSC	
e1	1.90 BSC	
L	0.20	—
L1	0.45	0.75

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