

# MC78LC00 Series

## 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  $\mu\text{A}$  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.

### Features

- Low Quiescent Current of 1.1  $\mu\text{A}$  Typical
- Low Dropout Voltage (220 mV at 10 mA)
- Excellent Line Regulation (0.1%)
- High Accuracy Output Voltage ( $\pm 2.5\%$ )
- Output Current for Low Power (up to 80 mA)
- Two Surface Mount Packages (SOT-89, 3 Pin, or SOT-23, 5 Pin)

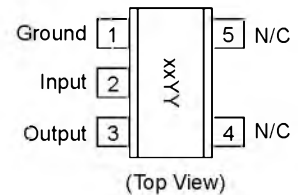


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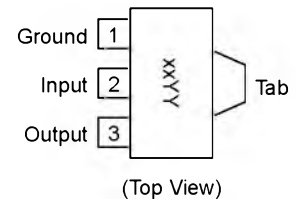
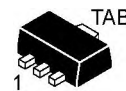
<http://onsemi.com>

### PIN CONNECTIONS AND MARKING DIAGRAMS

**SOT-23  
N SUFFIX  
CASE 1212**

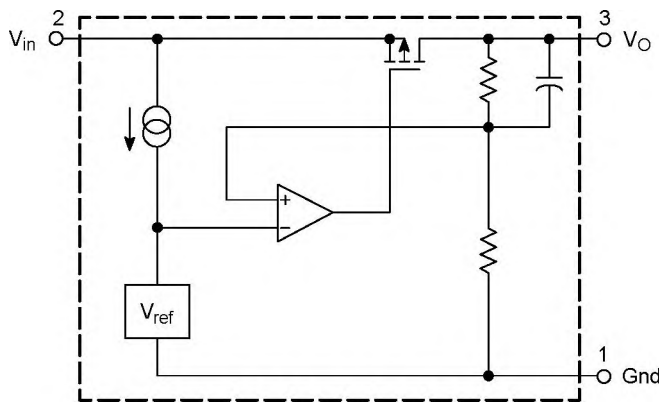


**SOT-89  
H SUFFIX  
CASE 1213**



(Tab is connected to Pin 2)

xx = Version  
YY = Lot



This device contains 8 active transistors.

Figure 1. Representative Block Diagram

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 253 of this data sheet.

# MC78LC00 Series

## MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Input Voltage	$V_{CC}$	12	Vdc
Power Dissipation and Thermal Characteristics			
Maximum Power Dissipation			
Case 1213 (SOT-89) H Suffix	$P_D$	300	mW
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	333	°C/W
Case 1212 (SOT-23) N Suffix	$P_D$	150	mW
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	667	°C/W
Operating Junction Temperature	$T_J$	125	°C
Operating Ambient Temperature	$T_A$	-40 to +80	°C
Storage Temperature Range	$T_{stg}$	-55 to +125	°C

1. This device series contains ESD protection and exceeds the following tests:  
 Human Body Model 2000 V per MIL-STD-883, Method 3015  
 Machine Model Method 200 V

## ELECTRICAL CHARACTERISTICS ( $V_{in} = V_O + 1.0$ V, $I_O = 10$ mA, $T_J = 25^\circ\text{C}$ (Note 2) unless otherwise noted.)

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

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

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## 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.

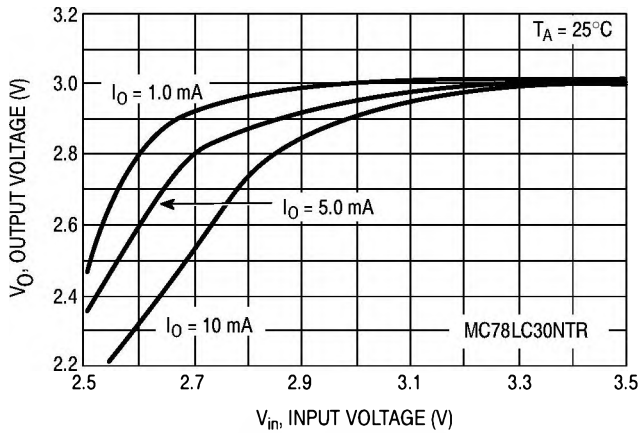


Figure 2. Output Voltage versus Input Voltage

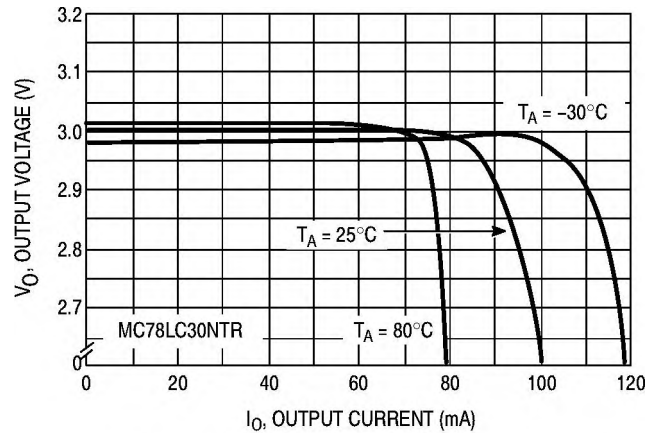


Figure 3. Output Voltage versus Output Current

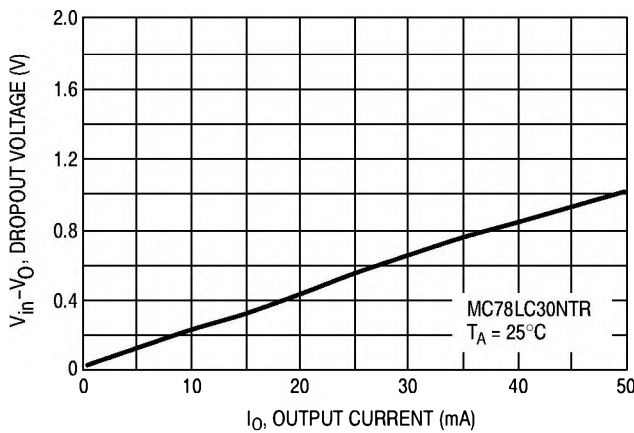


Figure 4. Dropout Voltage versus Output Current

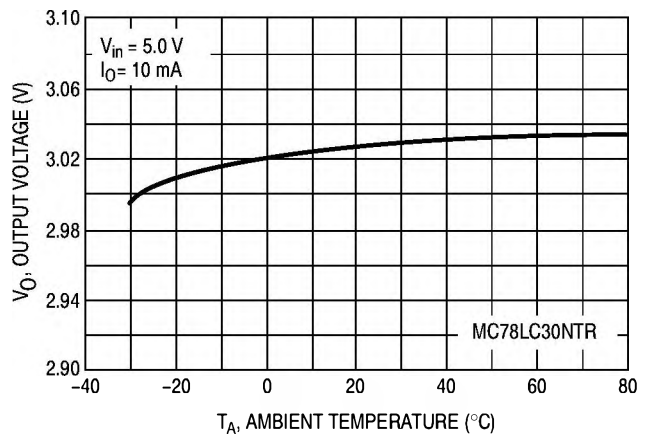


Figure 5. Output Voltage versus Temperature

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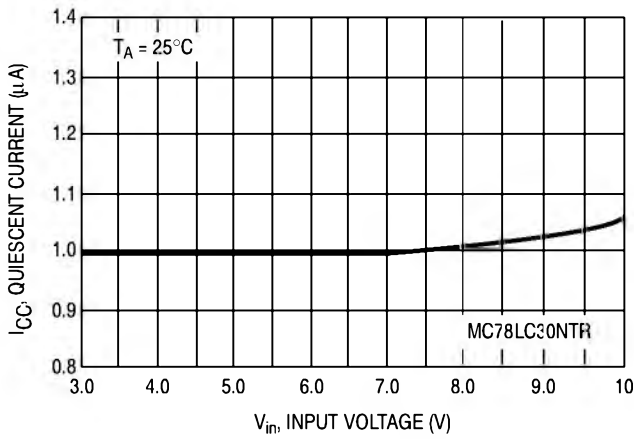


Figure 6. Quiescent Current versus Input Voltage

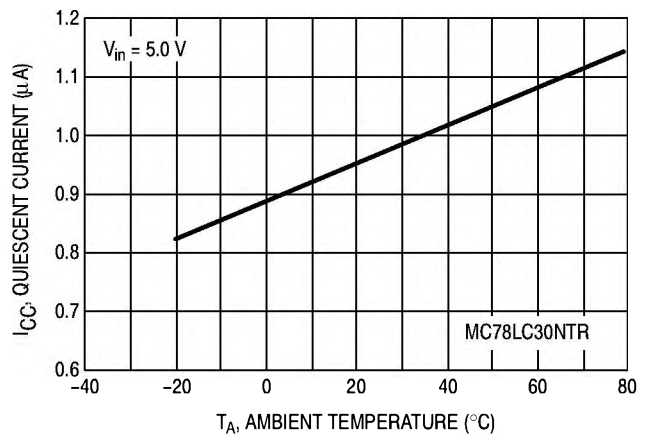


Figure 7. Quiescent Current versus Temperature

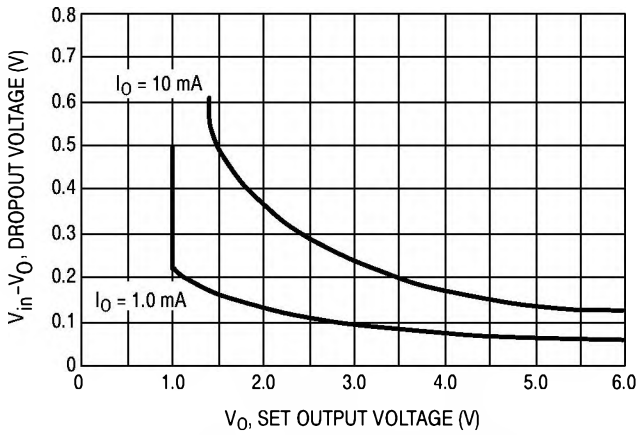


Figure 8. Dropout Voltage versus Set Output Voltage

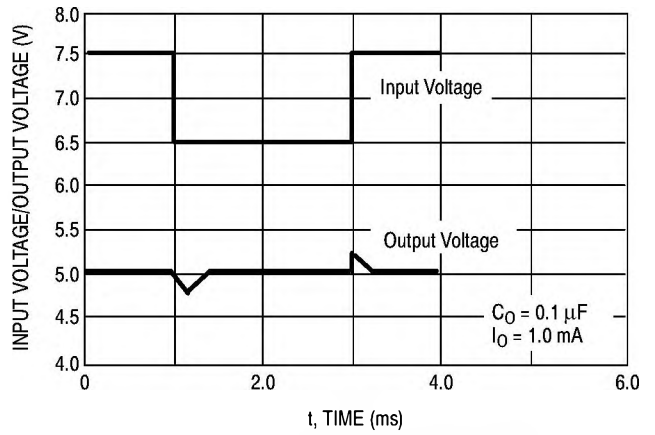


Figure 9. Line Transient Response

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## 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 ( $\geq 4$  inches) from the input voltage source. These regulators require  $\geq 0.1 \mu\text{F}$  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  $25^\circ\text{C}$ . 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  $-30^\circ\text{C}$ , 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  $-40^\circ$  to  $+85^\circ\text{C}$  are readily available. Solid tantalum capacitors may be the better choice if small size is a requirement. However, a maximum ESR limit of  $3.0 \Omega$  must be observed over temperature to maintain stability.

In the Current Boost Circuit, shown in Figures 11 and 13, an output current of up to 600 mA can be delivered by the circuit. The circuit of Figure 11 has no current limit. In each case, the external transistor must be rated for the expected power dissipation. Figure 12 shows how a fixed output may be programmed, using R1 and R2, to provide a higher output voltage.

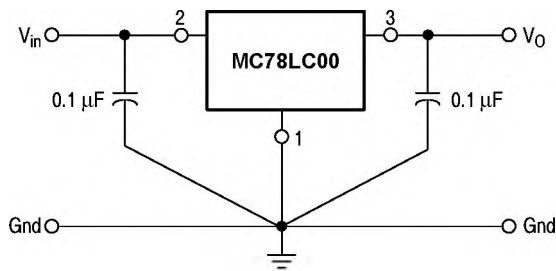


Figure 10. Typical Application

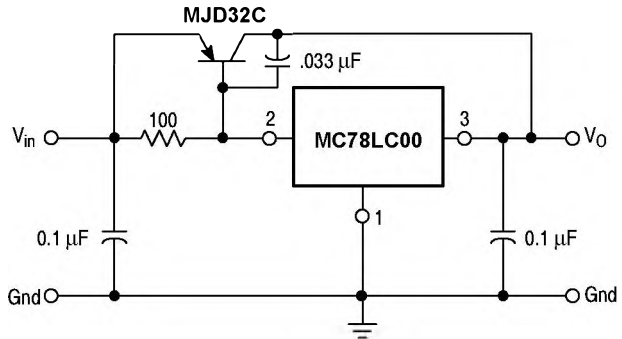
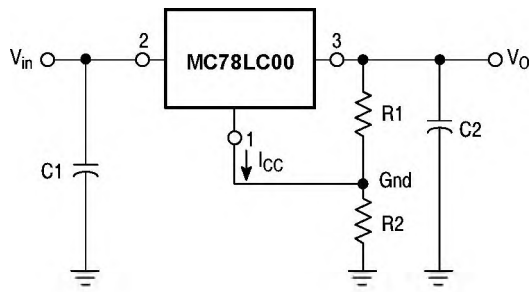
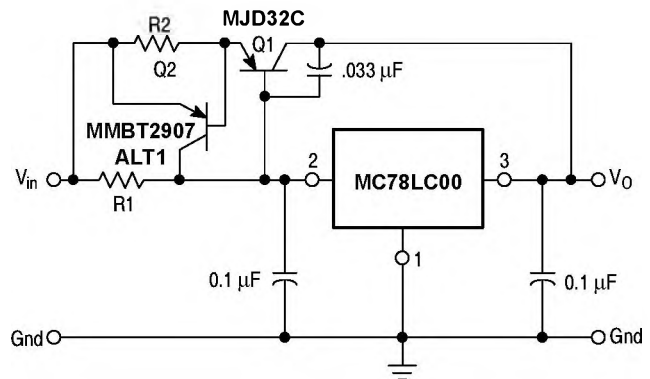


Figure 11. Current Boost Circuit



$$V_O = V_{O(\text{Reg})} \left( 1 + \frac{R_2}{R_1} \right) + I_{CC} R_2$$

Figure 12. Adjustable  $V_O$



$$I_{O(\text{short circuit})} \approx \frac{V_{BE2}}{R_2} + \frac{V_{BE1} + V_{BE2}}{R_1}$$

Figure 13. Current Boost Circuit with Overcurrent Limit Circuit

## MC78LC00 Series

### ORDERING INFORMATION

Device	Nominal Output Voltage	Marking	Package	Shipping
MC78LC30NTR	3.0	0C	SOT-23	3000 Units/7" Tape & Reel
MC78LC30HT1	3.0	0C	SOT-89	1000 Units Tape & Reel
MC78LC33HT1	3.3	3C		
MC78LC40HT1	4.0	0D		
MC78LC50HT1	5.0	0E		

Additional voltages in 100 mV steps are available upon request by contacting your ON Semiconductor representative.