# MC78LC30NTRG Datasheet

www.digi-electronics.com
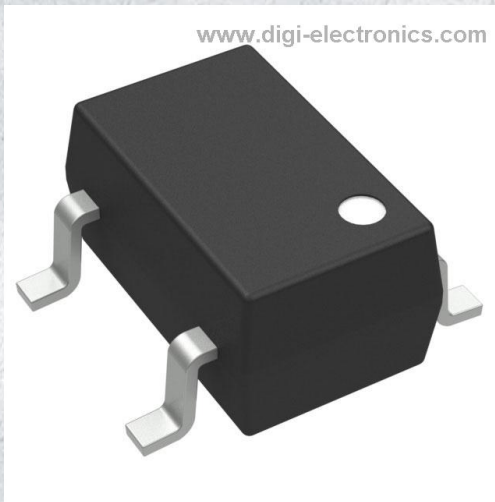
https://www.DiGi-Electronics.com

| | |
|---|---|
| DiGi Electronics Part Number | MC78LC30NTRG-DG |
| Manufacturer | onsemi |
| Manufacturer Product Number | MC78LC30NTRG |
| Description | IC REG LINEAR 3V 80MA 5TSOP |
| Detailed Description | Linear Voltage Regulator IC Positive Fixed 1 Output 80mA 5-TSOP |

# Purchase and inquiry

| | |
|---|---|
| **Manufacturer Product Number:** | **Manufacturer:** |
| MC78LC30NTRG | onsemi |
| **Series:** | **Product Status:** |
| - | Active |
| **Output Configuration:** | **Output Type:** |
| Positive | Fixed |
| **Number of Regulators:** | **Voltage - Input (Max):** |
| 1 | 12V |
| **Voltage - Output (Min/Fixed):** | **Voltage - Output (Max):** |
| 3V | - |
| **Voltage Dropout (Max):** | **Current - Output:** |
| 0.06V @ 1mA | 80mA |
| **Current - Quiescent (Iq):** | **PSRR:** |
| 3.6 µA | - |
| **Control Features:** | **Protection Features:** |
| - | - |
| **Operating Temperature:** | **Mounting Type:** |
| -40°C ~ 85°C | Surface Mount |
| **Package / Case:** | **Supplier Device Package:** |
| SOT-23-5 Thin, TSOT-23-5 | 5-TSOP |
| **Base Product Number:** | |
| MC78LC30 | |

# Environmental & Export classification

| | |
|---|---|
| **RoHS Status:** | **Moisture Sensitivity Level (MSL):** |
| ROHS3 Compliant | 1 (Unlimited) |
| **REACH Status:** | **ECCN:** |
| REACH Unaffected | EAR99 |
| **HTSUS:** | |
| 8542.39.0001 | |

# Voltage Regulator - Micropower

# MC78LC00 Series

The MC78LC00 series of fixed output low dropout linear regulators are designed for handheld communication equipment and portable battery powered applications which require low quiescent current. The MC78LC00 series features an ultra−low quiescent current of 1.1 μA. Each device contains a voltage reference unit, an error amplifier, a PMOS power transistor, and resistors for setting output voltage.
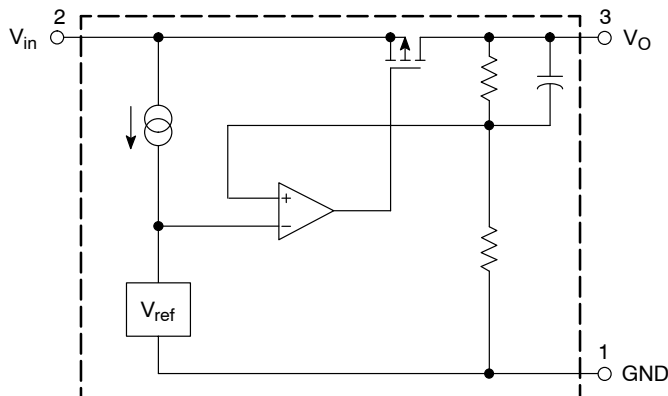
The MC78LC00 has been designed to be used with low cost ceramic capacitors and requires a minimum output capacitor of 0.1 μF. The device is housed in the micro−miniature Thin SOT23−5 surface mount package Standard voltage versions are 1.8, 2.5, 3.0, 3.3, V.

## Features

- Low Quiescent Current of 1.1 μA Typical
- Excellent Line and Load Regulation
- Maximum Operating Voltage of 12 V
- Low Output Voltage Option
- High Accuracy Output Voltage of 2.5%
- Industrial Temperature Range of −40°C to 85°C
- Surface Mount Packages (SOT−23, 5 Pin)
- These are Pb−Free Devices

## Typical Applications

- Battery Powered Instruments
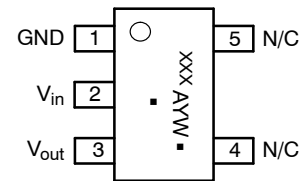- Hand−Held Instruments
- Camcorders and Cameras

**TSOP−5**
**NTR SUFFIX**
**CASE 483**

## MARKING DIAGRAMS AND PIN CONNECTION

GND 1    5 N/C
$V_{in}$ 2    5 N/C
$V_{out}$ 3    4 N/C

XXX AYW

(Top View)

(Tab is connected to Pin 2)

XXX = Specific Device Code
A   = Assembly Location
Y   = Year
W   = Work Week
▪   = Pb−Free Package

(Note: Microdot may be in either location)

## ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 10 of this data sheet.



This device contains 8 active transistors.

**Figure 1. Representative Block Diagram**

**October, 2021 – Rev. 12**

Publication Order Number:
**MC78LC00/D**

# MC78LC00 Series

## PIN FUNCTION DESCRIPTION

| Pin No. | Pin Name | Description |
|---------|----------|-------------|
| 1 | GND | Power supply ground |
| 2 | $V_{in}$ | Positive power supply input voltage |
| 3 | $V_{out}$ | Regulated Output |
| 4 | N/C | No Internal Connection |
| 5 | N/C | No Internal Connection |

## MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|--------|--------|-------|------|
| Input Voltage | $V_{in}$ | 12 | V |
| Output Voltage | $V_{out}$ | −0.3 to $V_{in}$ +0.3 | V |
| Power Dissipation and Thermal Characteristics<br>    Case 483−01 (Thin SOT23−5) NTR Suffix<br>    Power Dissipation @ $T_A$ = 85°C<br>    Thermal Resistance, Junction−to−Ambient | $P_D$<br>$R_{\theta JA}$ | 140<br>280 | mW<br>°C/W |
| Operating Junction Temperature | $T_J$ | +125 | °C |
| Operating Ambient Temperature | $T_A$ | −40 to +85 | °C |
| Storage Temperature | $T_{stg}$ | −55 to +150 | °C |
| Lead Soldering Temperature @ 260°C | $T_{solder}$ | 10 | s |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

# MC78LC00 Series

**ELECTRICAL CHARACTERISTICS** ($V_{in}$ = $V_{out(nom.)}$ + 1.0 V, $C_{in}$ = 1.0 μF, $C_{out}$ = 1.0 μF, $T_J$ = 25°C, unless otherwise noted.) (Note 5)
**NTR SUFFIX**

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Output Voltage ($T_A$ = 25°C, $I_{out}$ = 1.0 mA)<br>    1.5 V<br>    1.8 V<br>    2.5 V<br>    2.7 V<br>    2.8 V<br>    3.0 V<br>    3.3 V<br>    4.0 V<br>    5.0 V | $V_{out}$ | <br><br>1.455<br>1.746<br>2.425<br>2.646<br>2.744<br>2.94<br>3.234<br>3.9<br>4.90 | <br><br>1.5<br>1.8<br>2.5<br>2.7<br>2.8<br>3.0<br>3.3<br>4.0<br>5.0 | <br><br>1.545<br>1.854<br>2.575<br>2.754<br>2.856<br>3.06<br>3.366<br>4.1<br>5.10 | V |
| Output Voltage ($T_A$ = −40°C to 85°C)<br>    1.5 V<br>    1.8 V<br>    2.5 V<br>    2.7 V<br>    2.8 V<br>    3.0 V<br>    3.3 V<br>    4.0 V<br>    5.0 V | $V_{out}$ | <br><br>1.455<br>1.746<br>2.425<br>2.619<br>2.716<br>2.910<br>3.201<br>3.9<br>4.90 | <br><br>1.5<br>1.8<br>2.5<br>2.7<br>2.8<br>3.0<br>3.3<br>4.0<br>5.0 | <br><br>1.545<br>1.854<br>2.575<br>2.781<br>2.884<br>3.09<br>3.399<br>4.1<br>5.10 | V |
| Line Regulation ($V_{in}$ = $V_{O(nom.)}$ + 1.0 V to 12 V, $I_{out}$ = 1.0 mA) | $Reg_{line}$ | – | 0.05 | 0.2 | %/V |
| Load Regulation ($I_{out}$ = 1.0 mA to 10 mA) | $Reg_{load}$ | – | 40 | 60 | mV |
| Output Current (Note 6)<br>    1.5 V, 1.8 V ($V_{in}$ = 4.0 V)<br>    2.5 V, 2.7 V, 2.8 V, 3.0 V ($V_{in}$ = 5.0 V)<br>    3.3 V ($V_{in}$ = 6.0 V)<br>    4.0 V ($V_{in}$ = 7.0 V)<br>    5.0 V ($V_{in}$ = 8.0 V) | $I_{out}$ | <br>35<br>50<br>50<br>80<br>80 | <br>50<br>80<br>80<br>80<br>100 | <br>–<br>–<br>–<br>–<br>– | mA |
| Dropout Voltage ($I_{out}$ = 1.0 mA, Measured at $V_{out}$ −3.0%)<br>    1.5 V<br>    1.6 V−3.2 V<br>    3.3 V−3.9 V<br>    4.0 V−5.0 V | $V_{in}$−$V_{out}$ | <br>–<br>–<br>–<br>– | <br>35<br>30<br>30<br>30 | <br>70<br>60<br>53<br>38 | mV |
| Quiescent Current ($I_{out}$ = 1.0 mA to $I_{O(nom.)}$) | $I_Q$ | – | 1.1 | 3.6 | μA |
| Output Voltage Temperature Coefficient | $T_c$ | – | ± 100 | – | ppm/°C |
| Output Noise Voltage (f = 1.0 kHz to 100 kHz) | $V_n$ | – | 89 | – | μVrms |

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
2. Latch up capability (85°C) ± 100 mA
3. Maximum package power dissipation limits must be observed.

$$PD = \frac{T_{J(max)} - T_A}{R_{\theta JA}}$$

4. Low duty cycle pulse techniques are used during testing to maintain the junction temperature as close to ambient as possible.
5. Low duty pulse techniques are used during test to maintain junction temperature as close to ambient as possible.
6. Output Current is measured when $V_{out}$ = $V_{O1}$ − 3% where $V_{O1}$ = $V_{out}$ at $I_{out}$ = 0 mA.

# MC78LC00 Series

## DEFINITIONS

**Load Regulation**

The change in output voltage for a change in output current at a constant temperature.

**Dropout Voltage**

The input/output differential at which the regulator output no longer maintains regulation against further reductions in input voltage. Measured when the output drops 3% below its nominal. The junction temperature, load current, and minimum input supply requirements affect the dropout level.

**Maximum Power Dissipation**

The maximum total dissipation for which the regulator will operate within its specifications.

**Quiescent Current**

The quiescent current is the current which flows through the ground when the LDO operates without a load on its output: internal IC operation, bias, etc. When the LDO becomes loaded, this term is called the Ground current. It is actually the difference between the input current (measured through the LDO input pin) and the output current.

**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 technique such that the average chip temperature is not significantly affected.

**Line Transient Response**

Typical over and undershoot response when input voltage is excited with a given slope.

**Maximum Package Power Dissipation**

The maximum power package dissipation is the power dissipation level at which the junction temperature reaches its maximum operating value, i.e. 125°C. Depending on the ambient power dissipation and thus the maximum available output current.

# MC78LC00 Series
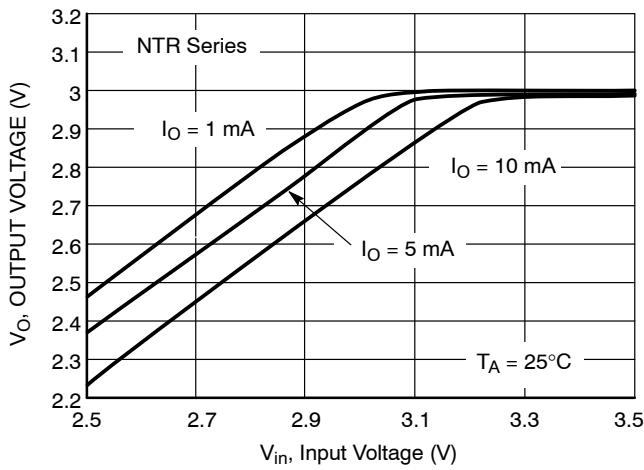
**Figure 2. Output Voltage versus Input Voltage**
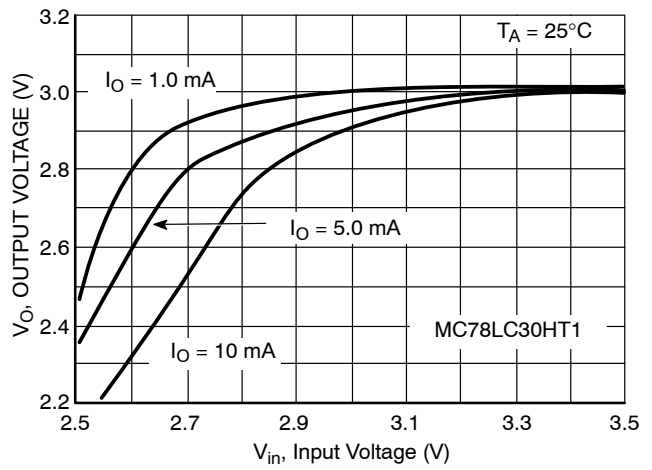
**Figure 3. Output Voltage versus Input Voltage**
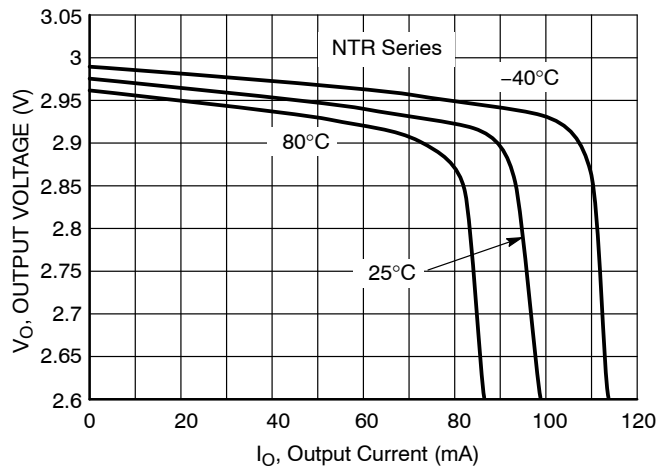
**Figure 4. Output Voltage versus Output Current**
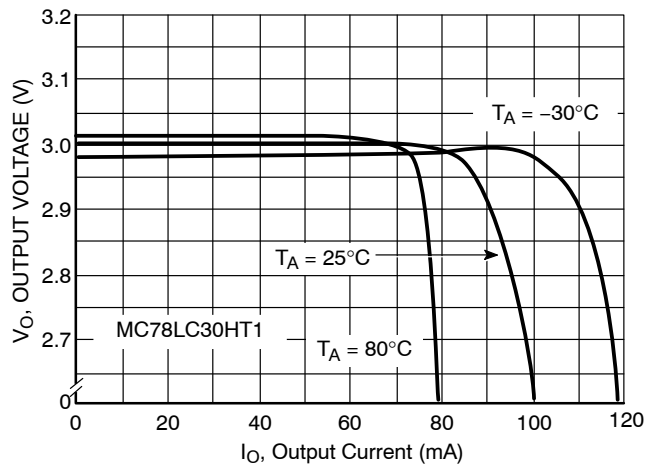
**Figure 5. Output Voltage versus Output Current**
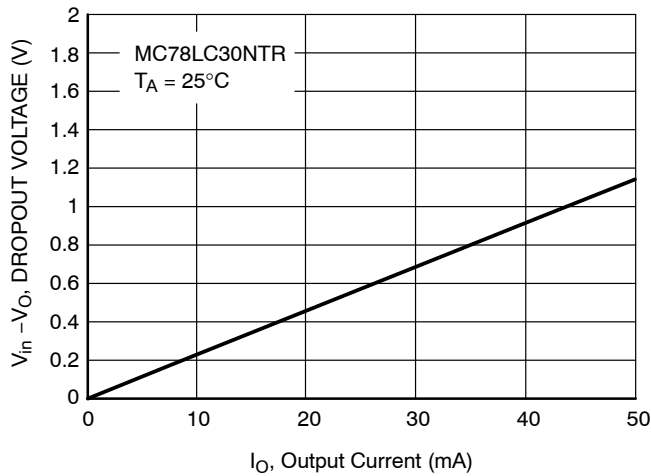
**Figure 6. Dropout Voltage versus Output Current**
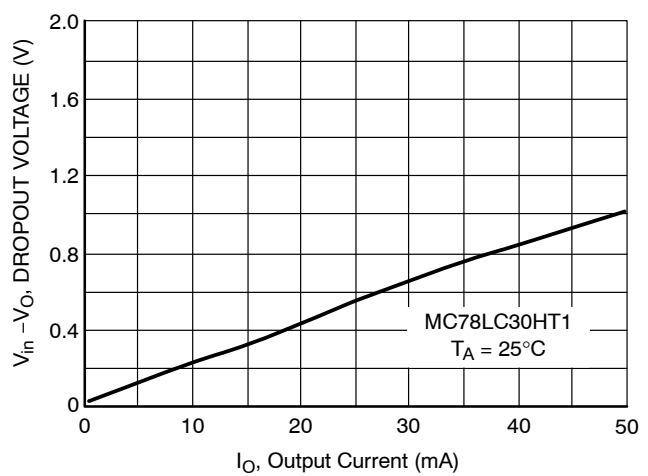
**Figure 7. Dropout Voltage versus Output Current**
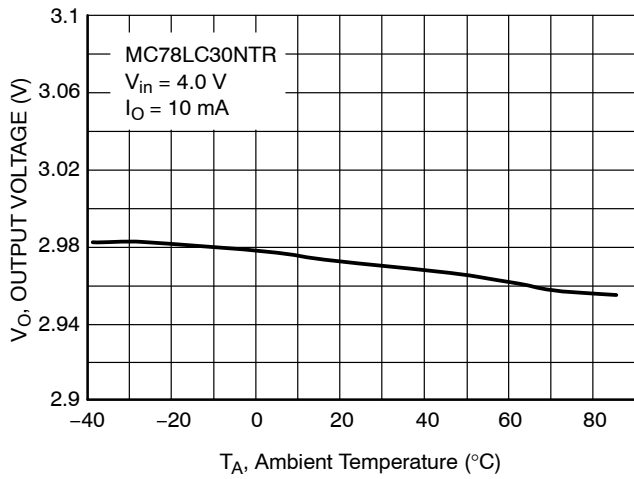
**Figure 8. Output Voltage versus Temperature**
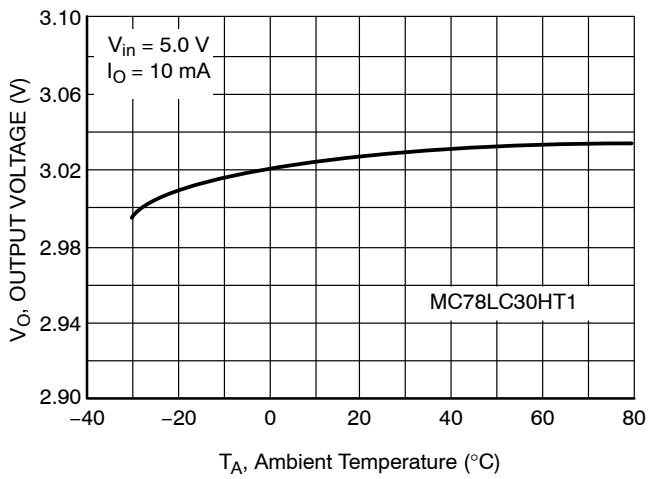


**Figure 9. Output Voltage versus Temperature**
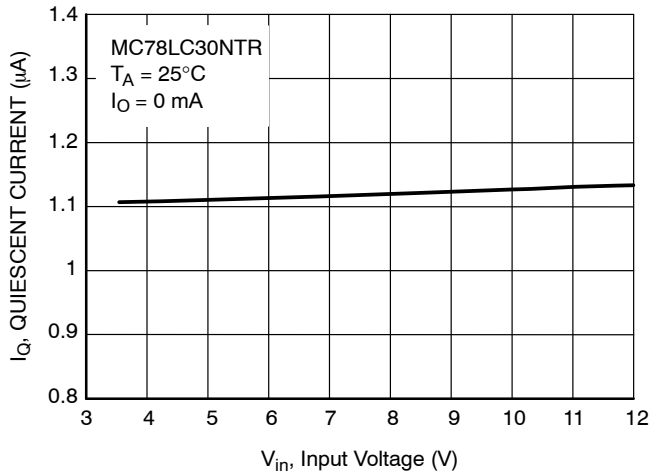


**Figure 10. Quiescent Current versus Input Voltage**
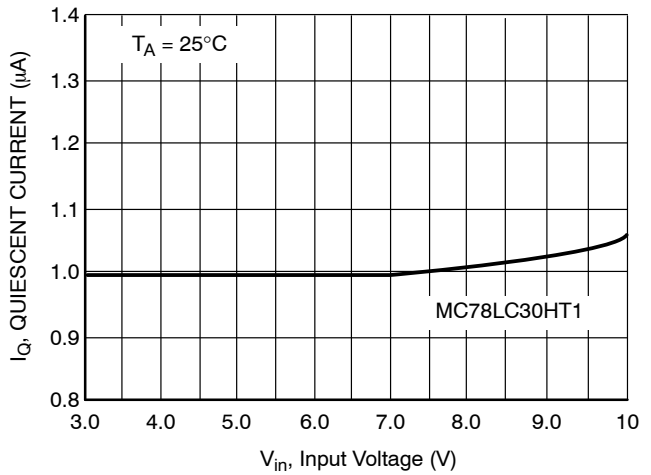


**Figure 11. Quiescent Current versus Input Voltage**
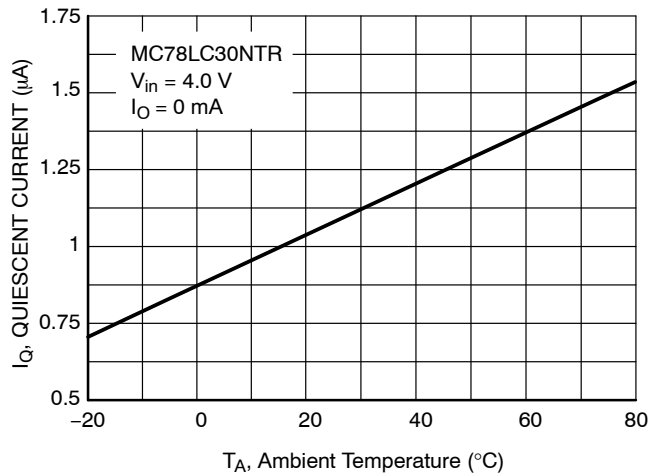


**Figure 12. Quiescent Current versus Temperature**
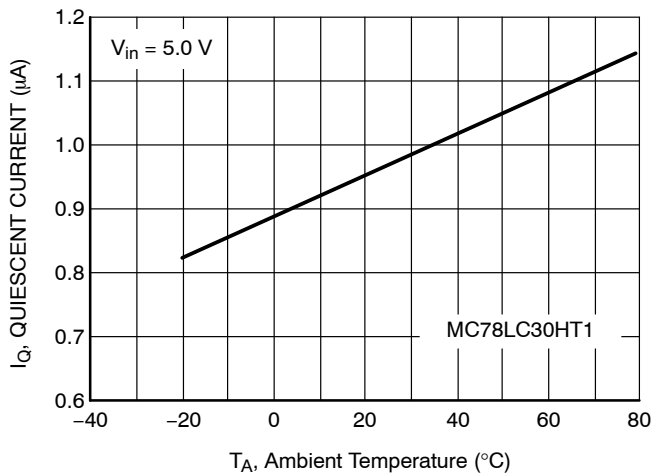


**Figure 13. Quiescent Current versus Temperature**

# MC78LC00 Series
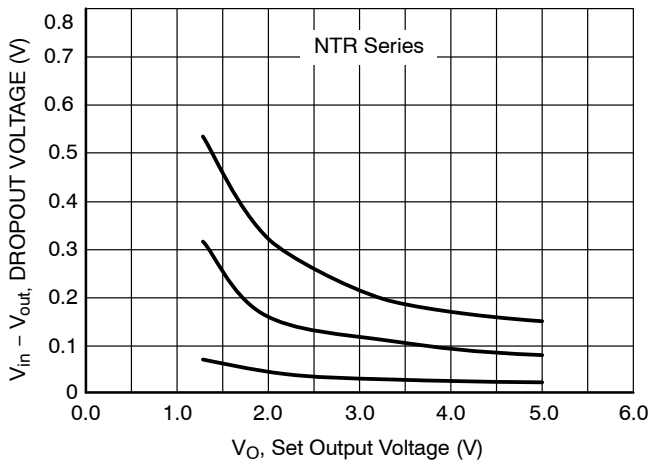


**Figure 14. Dropout Voltage versus Set Output Voltage**
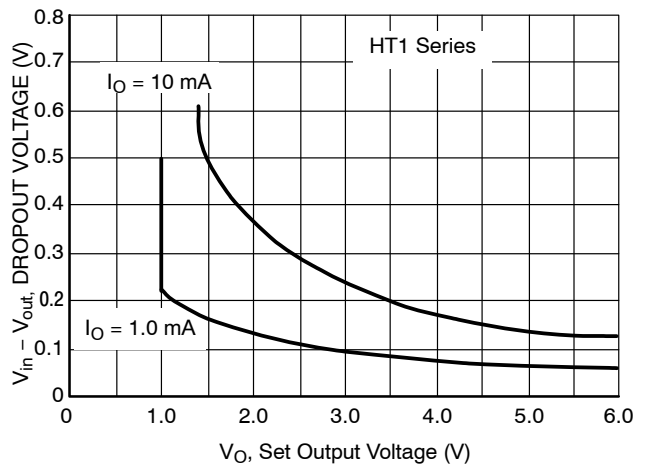


**Figure 15. Dropout Voltage versus Set Output Voltage**
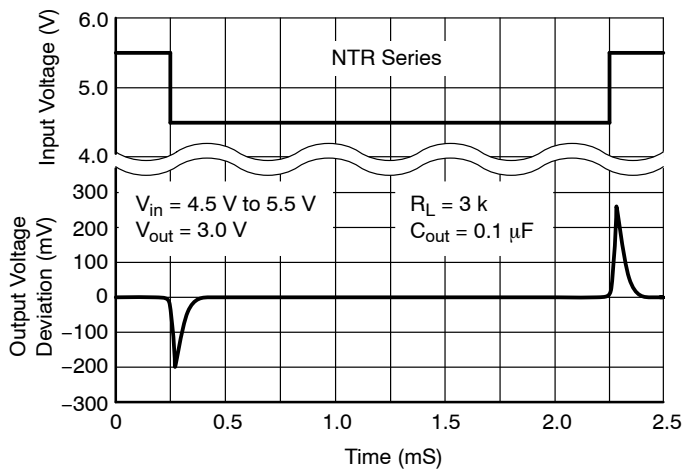


**Figure 16. Line Transient**
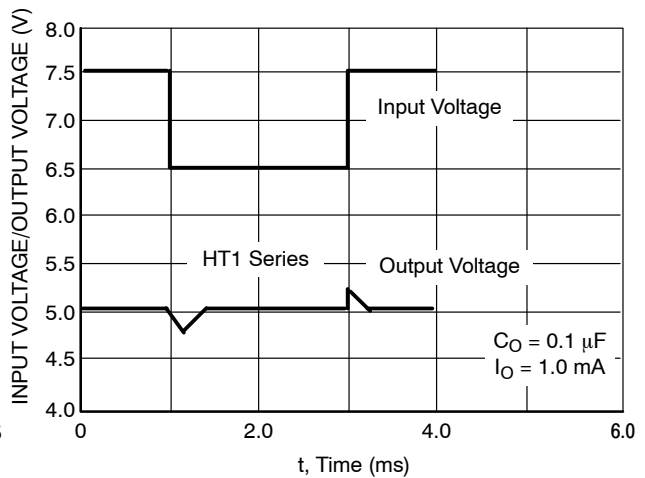


**Figure 17. Line Transient Response**
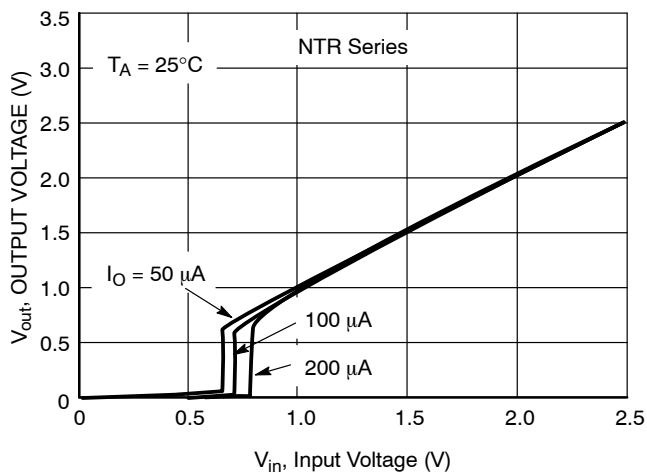


**Figure 18. Output Voltage versus Input Voltage**
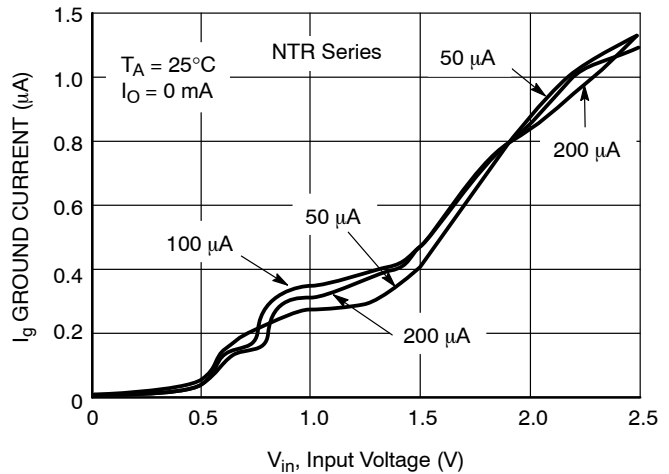


**Figure 19. Ground Current versus Input Voltage**

# MC78LC00 Series

## APPLICATIONS INFORMATION

A typical application circuit for the MC78LC00 series is shown in Figure 20.

**Input Decoupling (C1)**

A 0.1 µF capacitor either ceramic or tantalum is recommended and should be connected close to the MC78LC00 package. Higher values and lower ESR will improve the overall line transient response.

**Output Decoupling (C2)**

The MC78LC00 is a stable component and does not require any specific Equivalent Series Resistance (ESR) or a minimum output current. Capacitors exhibiting ESRs ranging from a few m$\Omega$ up to 3.0 $\Omega$ can thus safely be used. The minimum decoupling value is 0.1 µF and can be augmented to fulfill stringent load transient requirements. The regulator accepts ceramic chip capacitors as well as tantalum devices. Larger values improve noise rejection and load regulation transient response.

**Hints**

Please be sure the Vin and GND lines are sufficiently wide. When the impedance of these lines is high, there is a chance to pick up noise or cause the regulator to malfunction.

Set external components, especially the output capacitor, as close as possible to the circuit, and make leads as short as possible.

**Thermal**

As power across the MC78LC00 increases, it might become necessary to provide some thermal relief. The maximum power dissipation supported by the device is dependent upon board design and layout. Mounting pad configuration on the PCB, the board material, and also the ambient temperature effect the rate of temperature rise for the part. This is stating that when the MC78LC00 has good thermal conductivity through the PCB, the junction temperature will be relatively low with high power dissipation applications.

The maximum dissipation the package can handle is given by:

$$PD = \frac{T_{J(max)} - T_A}{R_{\theta JA}}$$

If junction temperature is not allowed above the maximum 125°C, then the MC78LC00NTR can dissipate up to 357 mW @ 25°C.

The power dissipated by the MC78LC00NTR can be calculated from the following equation:

$$P_{tot} = \left[V_{in} * I_{gnd}\,(I_{out})\right] + [V_{in} - V_{out}] * I_{out}$$

or

$$V_{inMAX} = \frac{P_{tot} + V_{out} * I_{out}}{I_{gnd} + I_{out}}$$

If an 80 mA output current is needed then the ground current from the data sheet is 1.1 µA. For an MC78LC30NTR (3.0 V), the maximum input voltage will then be 7.4 V.
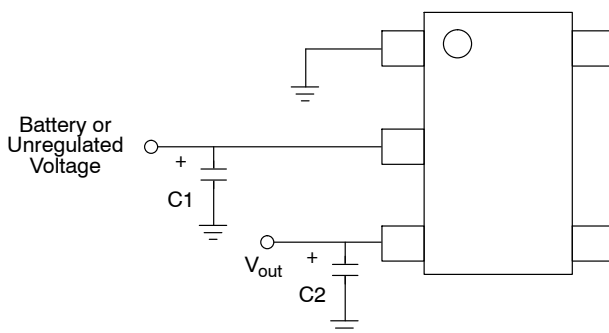


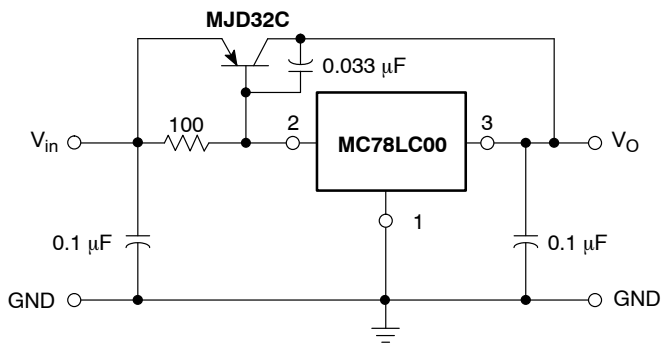**Figure 20. Basic Application Circuit for NTR Suffixes**

# MC78LC00 Series


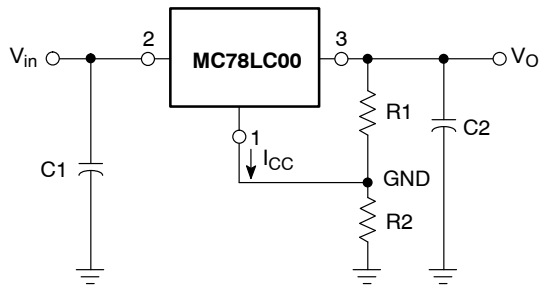
**Figure 21. Current Boost Circuit**
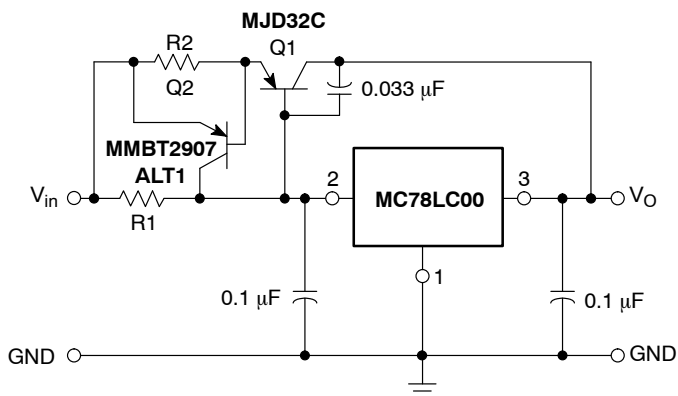


**Figure 22. Adjustable $V_O$**



**Figure 23. Current Boost Circuit with
Overcurrent Limit Circuit**

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

$$I_{O(short\ circuit)} \approx \frac{V_{BE2}}{R2} + \frac{V_{BE1} + V_{BE2}}{R1}$$
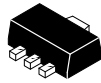
# MC78LC00 Series

**ORDERING INFORMATION**

| Device | Nominal Output Voltage | Marking | Package | Shipping[†] |
|---|---|---|---|---|
| MC78LC18NTRG | 1.8 | LAH | Thin SOT23−5 (Pb−Free) | 3000 Units/7″ Tape & Reel |
| MC78LC25NTRG | 2.5 | LAI | | |
| MC78LC30NTRG | 3.0 | LAL | | |
| MC78LC33NTRG | 3.3 | LAM | | |
| MC78LC50NTRG | 5.0 | LAN | | |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

Additional voltages in 100 mV steps are available upon request by contacting your **onsemi** representative.

**onsemi**™

### SOT−89 (3−LEAD)
### CASE 1213−02
### ISSUE C

DATE 24 MAY 2001

**SCALE 2:1**
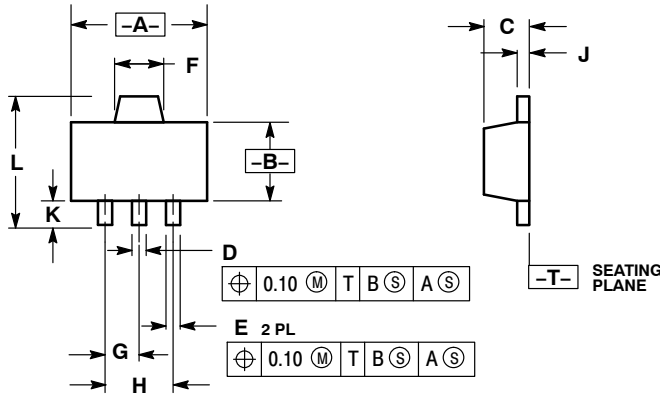
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETERS
3. 1213−01 OBSOLETE, NEW STANDARD 1213−02.

⊕ | 0.10 (M) | T | B (S) | A (S)

E  2 PL

⊕ | 0.10 (M) | T | B (S) | A (S)

−T− SEATING PLANE

| DIM | MILLIMETERS | | INCHES | |
|-----|------|------|------|------|
|     | MIN | MAX | MIN | MAX |
| A | 4.40 | 4.60 | 0.173 | 0.181 |
| B | 2.40 | 2.60 | 0.094 | 0.102 |
| C | 1.40 | 1.60 | 0.055 | 0.063 |
| D | 0.37 | 0.57 | 0.015 | 0.022 |
| E | 0.32 | 0.52 | 0.013 | 0.020 |
| F | 1.50 | 1.83 | 0.059 | 0.072 |
| G | 1.50 BSC | | 0.059 BSC | |
| H | 3.00 BSC | | 0.118 BSC | |
| J | 0.30 | 0.50 | 0.012 | 0.020 |
| K | 0.80 | --- | 0.031 | --- |
| L | --- | 4.25 | --- | 0.167 |
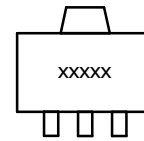
STYLE 1:
PIN 1. EMITTER
2. COLLECTOR
3. BASE

STYLE 2:
PIN 1. BASE
2. COLLECTOR
3. EMITTER

### MARKING DIAGRAM

xxxxx

xxxxx  = Specific Device Code

| DOCUMENT NUMBER: | 98ASH70519A | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. | |
|---|---|---|---|
| DESCRIPTION: | SOT−89 (3−LEAD) | | PAGE 1 OF 1 |

**MECHANICAL CASE OUTLINE**
**PACKAGE DIMENSIONS**

**TSOP−5 3.00x1.50x0.95, 0.95P**
CASE 483
ISSUE P

DATE  01 APR 2024

5X  b

$\oplus$ | 0.20 (M) | C | A | B

NOTE 5

TOP VIEW

SIDE VIEW

DETAIL A

END VIEW

0.250 GAUGE PLANE

**DETAIL "A"**
SCALE 2:1
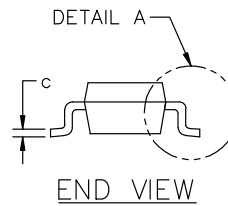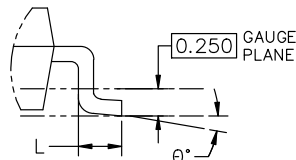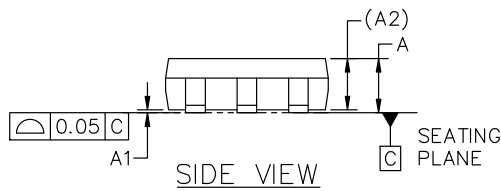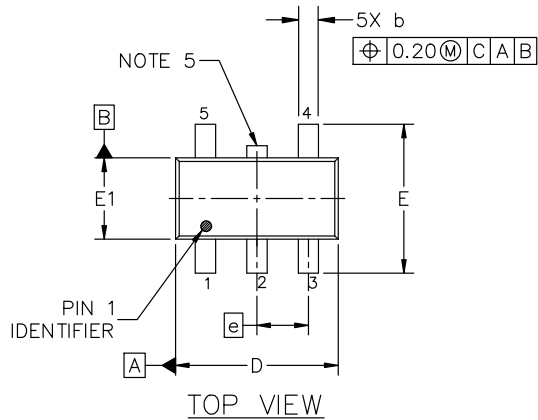
NOTES:

1. DIMENSIONING AND TOLERANCING CONFORM TO ASME Y14.5−2018.
2. ALL DIMENSION ARE IN MILLIMETERS (ANGLES IN DEGREES).
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OF GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.15 PER SIDE. DIMENSION D.
5. OPTIONAL CONSTRUCTION: AN ADDITIONAL TRIMMED LEAD IS ALLOWED IN THIS LOCATION. TRIMMED LEAD NOT TO EXTEND MORE THAN 0.2 FROM BODY.

| DIM | MILLIMETERS | | |
|-----|------|------|------|
|     | MIN. | NOM. | MAX. |
| A   | 0.900 | 1.000 | 1.100 |
| A1  | 0.010 | 0.055 | 0.100 |
| A2  | 0.950 REF. | | |
| b   | 0.250 | 0.375 | 0.500 |
| c   | 0.100 | 0.180 | 0.260 |
| D   | 2.850 | 3.000 | 3.150 |
| E   | 2.500 | 2.750 | 3.000 |
| E1  | 1.350 | 1.500 | 1.650 |
| e   | 0.950 BSC | | |
| L   | 0.200 | 0.400 | 0.600 |
| θ   | 0° | 5° | 10° |

**GENERIC MARKING DIAGRAM***
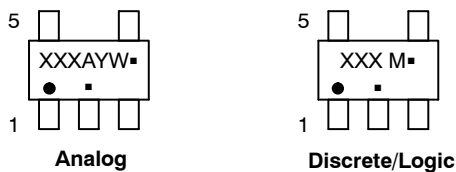
5 XXXAYW▪ 1 (Analog)

5 XXX M▪ 1 (Discrete/Logic)

**Analog**
XXX = Specific Device Code
A   = Assembly Location
Y   = Year
W   = Work Week
▪   = Pb−Free Package

**Discrete/Logic**
XXX = Specific Device Code
M   = Date Code
▪   = Pb−Free Package

(Note: Microdot may be in either location)

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

1.900
0.950
2.400
1.000
0.700

RECOMMENDED MOUNTING FOOTPRINT*
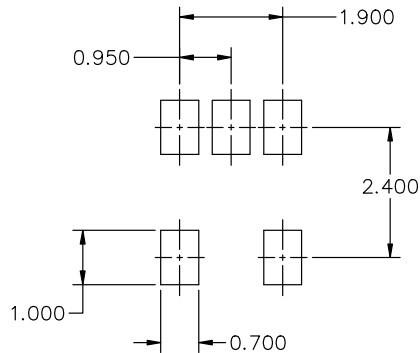
*   FOR ADDITIONAL INFORMATION ON OUR Pb−FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ON SEMICONDUCTOR SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERRM/D.

| DOCUMENT NUMBER: | 98ARB18753C | | |
|---|---|---|---|
| **DESCRIPTION:** | **TSOP−5 3.00x1.50x0.95, 0.95P** | | **PAGE 1 OF 1** |

## ADDITIONAL INFORMATION

**TECHNICAL PUBLICATIONS**:
**Technical Library:** www.onsemi.com/design/resources/technical–documentation
**onsemi Website:** www.onsemi.com

**ONLINE SUPPORT**: www.onsemi.com/support
**For additional information, please contact your local Sales Representative at**
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# OUR CERTIFICATE

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