

LM79MXX Series

3-Terminal Negative Regulators

General Description

The LM79MXX series of 3-terminal regulators is available with fixed output voltages of $-5V$, $-12V$, and $-15V$. These devices need only one external component—a compensation capacitor at the output. The LM79MXX series is packaged in the TO-220 power package, and is capable of supplying $0.5A$ of output current.

These regulators employ internal current limiting, safe area protection, and thermal shutdown for protection against virtually all overload conditions.

Low ground pin current of the LM79MXX series allows output voltage to be easily boosted above the preset value with

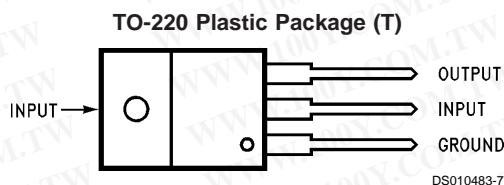
a resistor divider. The low quiescent current of these devices with a specified maximum change with line and load ensures good regulation in the voltage boosted mode.

For output voltage other than $-5V$, $-12V$, and $-15V$ the LM137 series provides an output voltage range from $-1.2V$ to $-57V$.

Features

- Thermal, short circuit and safe area protection
- High ripple rejection
- $0.5A$ output current
- 4% tolerance on preset output voltage

Connection Diagram



Front View

Order Number LM79M05CT, LM79M12CT or LM79M15CT
See NS Package Number T03B

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Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Input Voltage

$V_O = -5V$

$-25V$

$V_O = -12V, -15V$

$-35V$

Input/Output Differential

$V_O = -5V$

$25V$

$V_O = -12V, -15V$

$30V$

Power Dissipation (Note 2)

Internally Limited

Operating Junction
Temperature Range

$0^{\circ}C \text{ to } +125^{\circ}C$

Storage Temperature Range

$-65^{\circ}C \text{ to } +150^{\circ}C$

Lead Temperature
(Soldering, 10 sec.)

$230^{\circ}C$

ESD Susceptibility

TBD

Electrical Characteristics LM79M05CConditions unless otherwise noted: $I_{OUT} = 350mA$, $C_{IN} = 2.2\mu F$, $C_{OUT} = 1\mu F$, $0^{\circ}C \leq T_J \leq +125^{\circ}C$

| Part Number | | | LM79M05C | | | Units |
|--|---|--|-------------------------------|------|-------|-------|
| Output Voltage | | | -5V | | | |
| Input Voltage (Unless Otherwise Specified) | | | -10V | | | |
| Symbol | Parameter | Conditions | Min | Typ | Max | |
| V _O | Output Voltage | T _J = 25°C | -4.8 | -5.0 | -5.2 | V |
| | | 5mA ≤ I _{OUT} ≤ 350mA | -4.75 | | -5.25 | V |
| ΔV _O | Line Regulation | T _J = 25°C (Note 3) | (-25 ≤ V _{IN} ≤ -7) | | | |
| | | | 8 50 | | | mV |
| | | | (-25 ≤ V _{IN} ≤ -7) | | | |
| ΔV _O | Load Regulation | T _J = 25°C, (Note 3) 5mA ≤ I _{OUT} ≤ 0.5A | 2 30 | | | mV |
| | | | (-18 ≤ V _{IN} ≤ - 8) | | | |
| | | | 30 100 | | | mV |
| I _Q | Quiescent Current | T _J = 25°C | 1 2 | | | mA |
| ΔI _Q | Quiescent Current Change | With Input Voltage | 0.4 | | | mA |
| | | With Load, 5mA ≤ I _{OUT} ≤ 350mA | (-25 ≤ V _{IN} ≤ -8) | | | |
| | | | 0.4 | | | mA |
| V _n | Output Noise Voltage | T _A = 25°C, 10Hz ≤ f ≤ 100Hz | 150 | | | μV |
| | Ripple Rejection | f = 120Hz | 54 | 66 | | dB |
| | Dropout Voltage | T _J = 25°C, I _{OUT} = 0.5A | 1.1 | | | V |
| I _{OMAX} | Peak Output Current | T _J = 25°C | 800 | | | mA |
| | Average Temperature Coefficient of Output Voltage | I _{OUT} = 5mA, 0°C ≤ T _J ≤ 100°C | -0.4 | | | mV/°C |

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Electrical Characteristics LM79M12C, LM79M15C

Conditions unless otherwise noted: $I_{OUT} = 350\text{mA}$, $C_{IN} = 2.2\mu\text{F}$, $C_{OUT} = 1\mu\text{F}$, $0^\circ\text{C} \leq T_J \leq +125^\circ\text{C}$

| Part Number | | | LM79M12C | | | LM79M15C | | | Units |
|--|---|--|---------------------------------|-------|-------|---------------------------------|-------|--------|-------|
| Output Voltage | | | -12V | | | -15V | | | |
| Input Voltage (Unless Otherwise Specified) | | | -19V | | | -23V | | | |
| Symbol | Parameter | Conditions | Min | Typ | Max | Min | Typ | Max | |
| V _O | Output Voltage | T _J = 25°C | -11.5 | -12.0 | -12.5 | -14.4 | -15.0 | -15.6 | V |
| | | 5 mA ≤ I _{OUT} ≤ 350mA | -11.4 | | -12.6 | -14.25 | | -15.75 | V |
| | | | (-27 ≤ V _{IN} ≤ -14.5) | | | (-30 ≤ V _{IN} ≤ -10.5) | | | |
| ΔV _O | Line Regulation | T _J = 25°C (Note 3) | 5 80 | | | 5 80 | | | mV |
| | | | (-30 ≤ V _{IN} ≤ -14.5) | | | (-30 ≤ V _{IN} ≤ -17.5) | | | |
| | | | 3 50 | | | 3 50 | | | mV |
| | | | (-25 ≤ V _{IN} ≤ - 15) | | | (-28 ≤ V _{IN} ≤ -18) | | | |
| ΔV _O | Load Regulation | T _J = 25°C, (Note 3) 5mA ≤ I _{OUT} ≤ 0.5A | 30 240 | | | 30 240 | | | mV |
| I _Q | Quiescent Current | T _J = 25°C | 1.5 3 | | | 1.5 3 | | | mA |
| ΔI _Q | Quiescent Current Change | With Input Voltage | 0.4 | | | 0.4 | | | mA |
| | | | (-30 ≤ V _{IN} ≤ -14.5) | | | (-30 ≤ V _{IN} ≤ -27) | | | |
| | | With Load, 5mA ≤ I _{OUT} ≤ 350mA | 0.4 | | | 0.4 | | | mA |
| V _n | Output Noise Voltage | T _A = 25°C, 10Hz ≤ f ≤ 100Hz | 400 | | | 400 | | | μV |
| | Ripple Rejection | f = 120Hz | 54 | 70 | | 54 | 70 | | dB |
| | | | (-25 ≤ V _{IN} ≤ -15) | | | (-30 ≤ V _{IN} ≤ -17.5) | | | |
| | Dropout Voltage | T _J = 25°C, I _{OUT} = 0.5A | 1.1 | | | 1.1 | | | V |
| I _{OMAX} | Peak Output Current | T _J = 25°C | 800 | | | 800 | | | mA |
| | Average Temperature Coefficient of Output Voltage | I _{OUT} = 5mA, 0°C ≤ T _J ≤ 100°C | -0.8 | | | -1.0 | | | mV/°C |

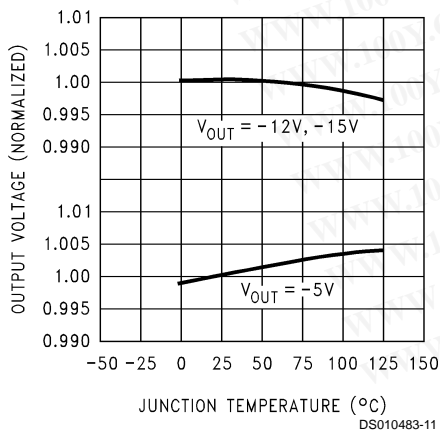
Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see the Electrical Characteristics.

Note 2: Refer to Typical Performance Characteristics and Design Considerations for details.

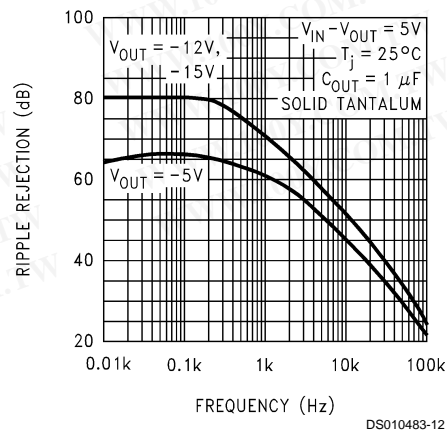
Note 3: Regulation is measured at a constant junction temperature by pulse testing with a low duty cycle. Changes in output voltage due to heating effects must be taken into account.

Typical Performance Characteristics

Output Voltage vs. Temperature



Ripple Rejection

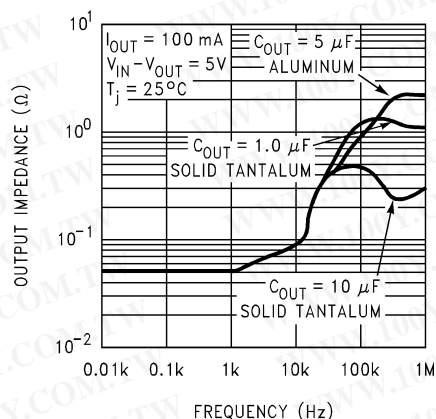


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Typical Performance Characteristics (Continued)

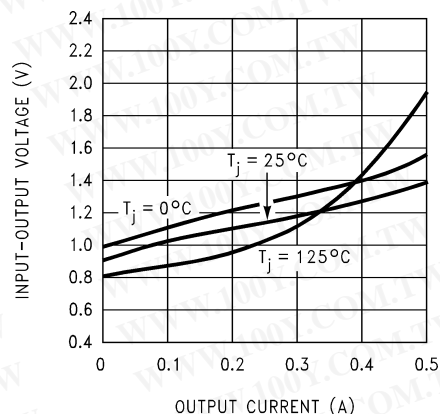
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Output Impedance



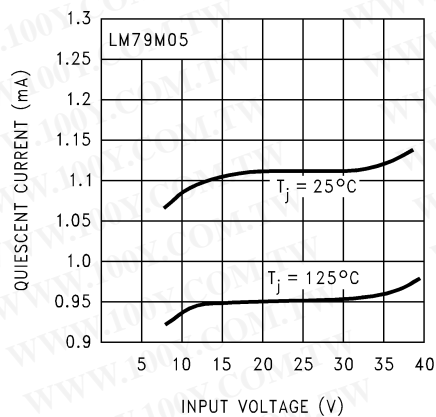
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Minimum Input-Output Differential



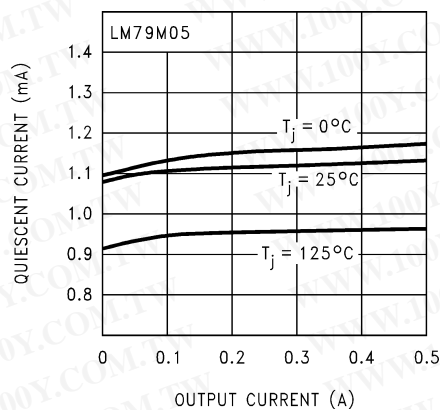
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Quiescent Current vs. Input Voltage



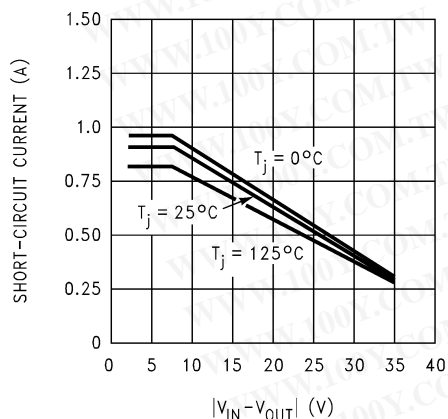
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Quiescent Current vs. Load Current



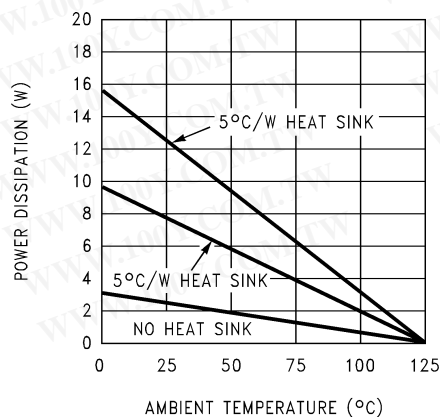
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Short-Circuit Current



DS010483-17

Maximum Average Power Dissipation (TO-220)



DS010483-18

Design Considerations

The LM79MXX fixed voltage regulator series have thermal-overload protection from excessive power, internal short-circuit protection which limits the circuit's maximum current, and output transistor safe-area compensation for reducing the output current as the voltage across the pass transistor is increased.

Although the internal power dissipation is limited, the junction temperature must be kept below the maximum specified temperature in order to meet data sheet specifications. To calculate the maximum junction temperature or heat sink required, the following thermal resistance values should be used:

| Package | θ_{JC} (°C/W) | θ_{JA} (°C/W) |
|---------|-------------------------|-------------------------|
| TO-220 | 3 | 40 |

$$P_{D\text{MAX}} = \frac{T_{J\text{MAX}} - T_A}{\theta_{JC} + \theta_{CA}} \text{ or } \frac{T_{J\text{MAX}} - T_A}{\theta_{JA}} \text{ (Without a Heat Sink)} \quad (1)$$

$$\theta_{CA} = \theta_{CS} + \theta_{SA}$$

Solving for T_J :

$$T_J = T_A + P_D (\theta_{JC} + \theta_{CA}) \text{ or } T_J = T_A + P_D \theta_{JA} \text{ (Without a Heat Sink)}$$

Where

T_J = Junction Temperature

T_A = Ambient Temperature

P_D = Power Dissipation

θ_{JC} = Junction-to-Case Thermal Resistance

θ_{CA} = Case-to-Ambient Thermal Resistance

θ_{CS} = Case-to-Heat Sink Thermal Resistance

θ_{SA} = Heat Sink-to-Ambient Thermal Resistance

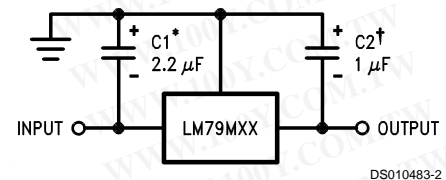
θ_{JA} = Junction-to-Ambient Thermal Resistance

Typical Applications

Bypass capacitors are necessary for stable operation of the LM79MXX series of regulators over the input voltage and output current ranges. Output bypass capacitors will improve the transient response of the regulator.

The bypass capacitors (2.2μF on the input, 1.0μF on the output), should be ceramic or solid tantalum which have good high frequency characteristics. If aluminum electrolytics are used, their values should be 10μF or larger. The bypass capacitors should be mounted with the shortest leads, and if possible, directly across the regulator terminals.

Fixed Regulator



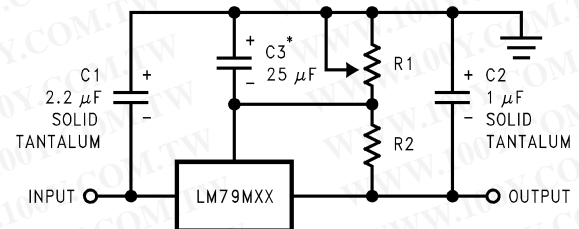
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*Required if regulator is separated from filter capacitor by more than 3". For value given, capacitor must be solid tantalum. 25μF aluminum electrolytic may be substituted.

†Required for stability. For value given, capacitor must be solid tantalum. 25μF aluminum electrolytic may be substituted. Values given may be increased without limit.

For output capacitance in excess of 100μF, a high current diode from input to output (1N4001, etc.) will protect the regulator from momentary input shorts.

Variable Output



DS010483-3

*Improves transient response and ripple rejection. Do not increase beyond 50μF.

$$V_{OUT} = V_{SET} \left(\frac{R1 + R2}{R2} \right)$$

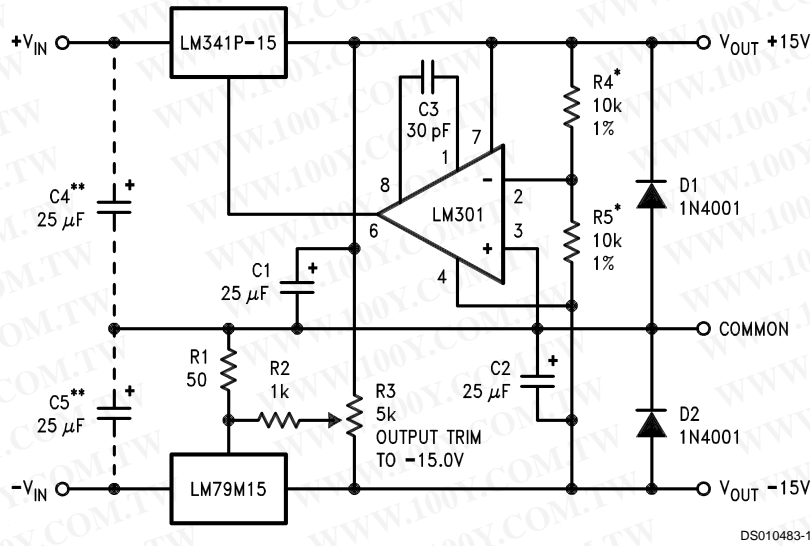
Select R2 as follows:

| | |
|----------|------|
| LM79M05C | 300Ω |
| LM79M12C | 750Ω |
| LM79M15C | 1k |

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Typical Applications (Continued)

±15V, 1 Amp Tracking Regulators



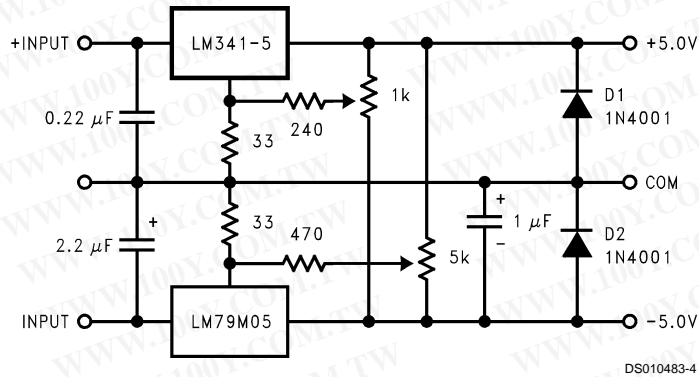
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*Resistor tolerance of R4 and R5 determine matching of (+) and (-) outputs.
 **Necessary only if raw supply filter capacitors are more than 3" from regulators.

Performance (Typical)

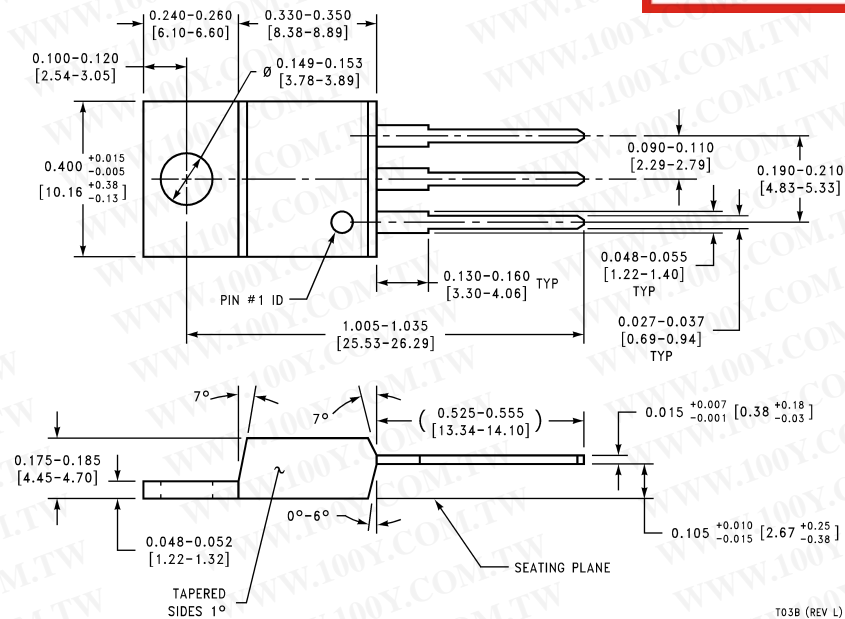
| | (-15) | (+15) |
|--|-------------------|-------------------|
| Load Regulation at 0.5A | 40mV | 2 mV |
| Output Ripple, $C_{IN} = 3000\mu F$, $I_L = 0.5A$ | 100 μV_{rms} | 100 μV_{rms} |
| Temperature Stability | 50mV | 50mV |
| Output Noise $10Hz \leq f \leq 10kHz$ | 150 μV_{rms} | 150 μV_{rms} |

Dual Trimmed Supply



DS010483-4

Physical Dimensions inches (millimeters) unless otherwise noted



TO-220 Plastic Package (T)
Order Number LM79M05CT, LM79M12CT or LM79M15CT
NS Package Number T03B

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