LM79MXX Series 3-Terminal Negative Regulators

Check for Samples: LM79M05, LM79M12, LM79M15

FEATURES

- **Thermal, Short Circuit and Safe Area Protection**
- **High Ripple Rejection**
- **0.5A Output Current**
- **4% Tolerance on Preset Output Voltage**

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.

Connection Diagram

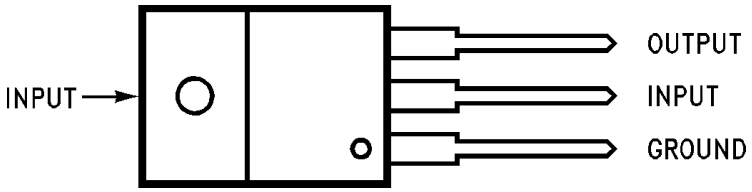


Figure 1. TO-220 Plastic Package (NDE)
Front View
See Package Number NDE0003B

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

Absolute Maximum Ratings[1][2]

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 [3]		Internally Limited
Operating Junction Temperature Range		0°C to +125°C
Storage Temperature Range		−65°C to +150°C
Lead Temperature (Soldering, 10 sec.)		230°C
ESD Susceptibility		TBD

(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.
(2) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/Distributors for availability and specifications.
(3) Refer to Typical Performance Characteristics and Design Considerations for details.

Electrical Characteristics LM79M05C

Conditions unless otherwise noted: I_{OUT} = 350mA, C_{IN} = 2.2µF, C_{OUT} = 1µF, 0°C ≤ T_J ≤ +125°C

Part Number			**LM79M05C**			
Output Voltage			**−5V**			**Units**
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
			(−25 ≤ V_{IN} ≤ −7)			
ΔV_O	Line Regulation	T_J = 25°C [1]		8	50	mV
			(−25 ≤ V_{IN} ≤ −7)			
				2	30	mV
			(−18 ≤ V_{IN} ≤ − 8)			
ΔV_O	Load Regulation	T_J = 25°C, [1]		30	100	mV
		5mA ≤ I_{OUT} ≤ 0.5A				
I_Q	Quiescent Current	T_J = 25°C		1	2	mA
ΔI_Q	Quiescent Current Change	With Input Voltage			0.4	mA
			(−25 ≤ V_{IN} ≤ −8)			
		With Load,				
		5mA ≤ I_{OUT} ≤ 350mA			0.4	mA
V_n	Output Noise Voltage	T_A = 25°C, 10Hz ≤ f ≤ 100Hz		150		µV
	Ripple Rejection	f = 120Hz	54	66		dB
			(−18 ≤ V_{IN} ≤ −8)			
	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

(1) 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.

Electrical Characteristics LM79M12C, LM79M15C

Conditions unless otherwise noted: I_{OUT} = 350mA, C_{IN} = 2.2µF, C_{OUT} = 1 µF, 0°C ≤ T_J ≤ +125°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 (1)		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, (1) 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

(1) 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

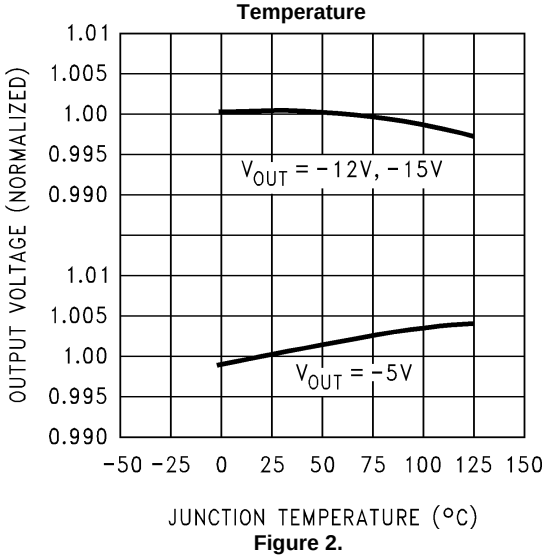


Figure 2.

Ripple Rejection

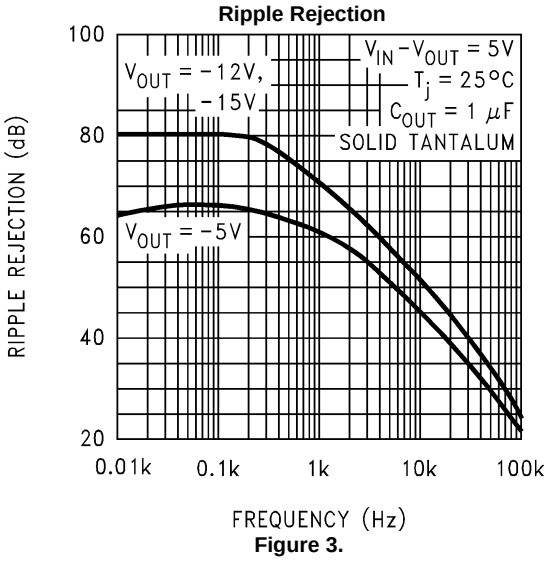


Figure 3.

Output Impedance

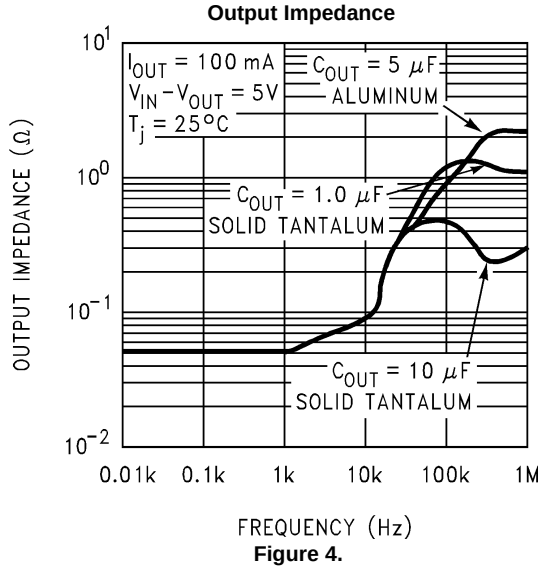


Figure 4.

Minimum Input-Output Differential

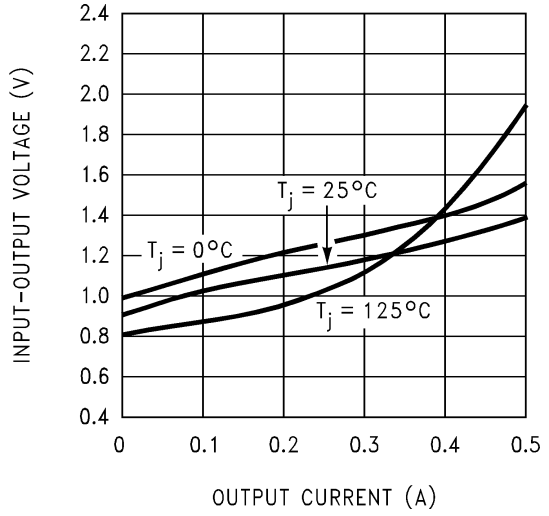


Figure 5.

Typical Performance Characteristics (continued)

Quiescent Current vs. Input Voltage

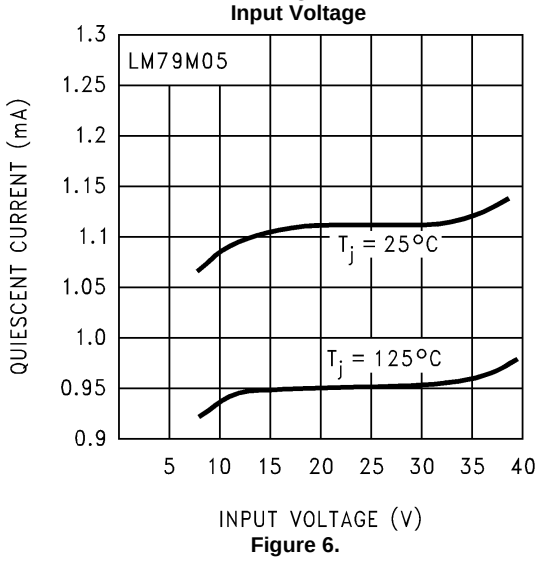


Figure 6.

Quiescent Current vs. Load Current

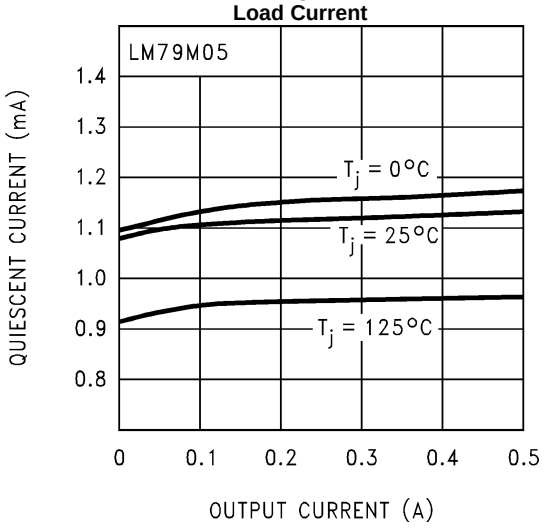


Figure 7.

Short-Circuit Current

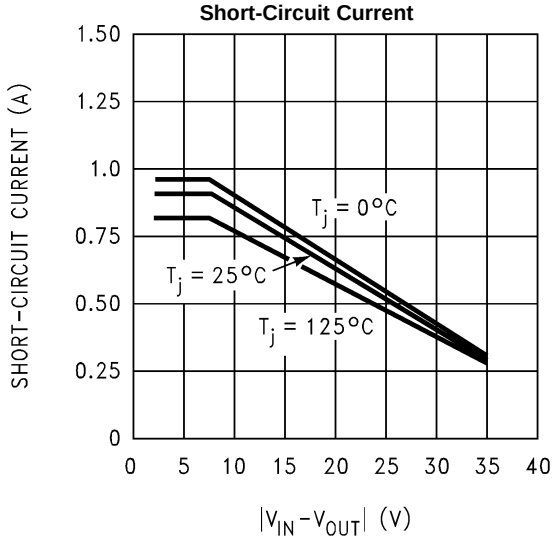


Figure 8.

Maximum Average Power Dissipation (TO-220)

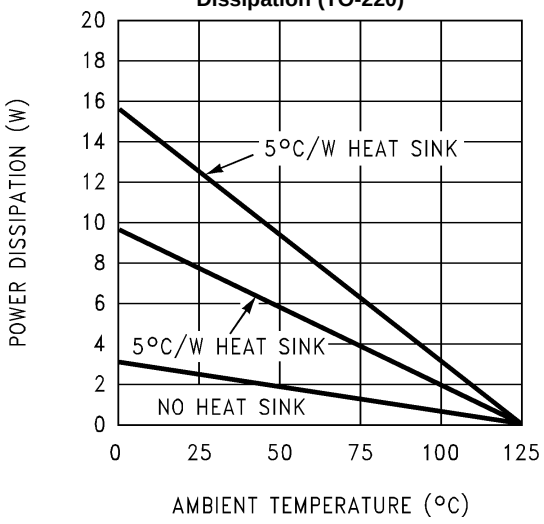


Figure 9.

Schematic Diagrams

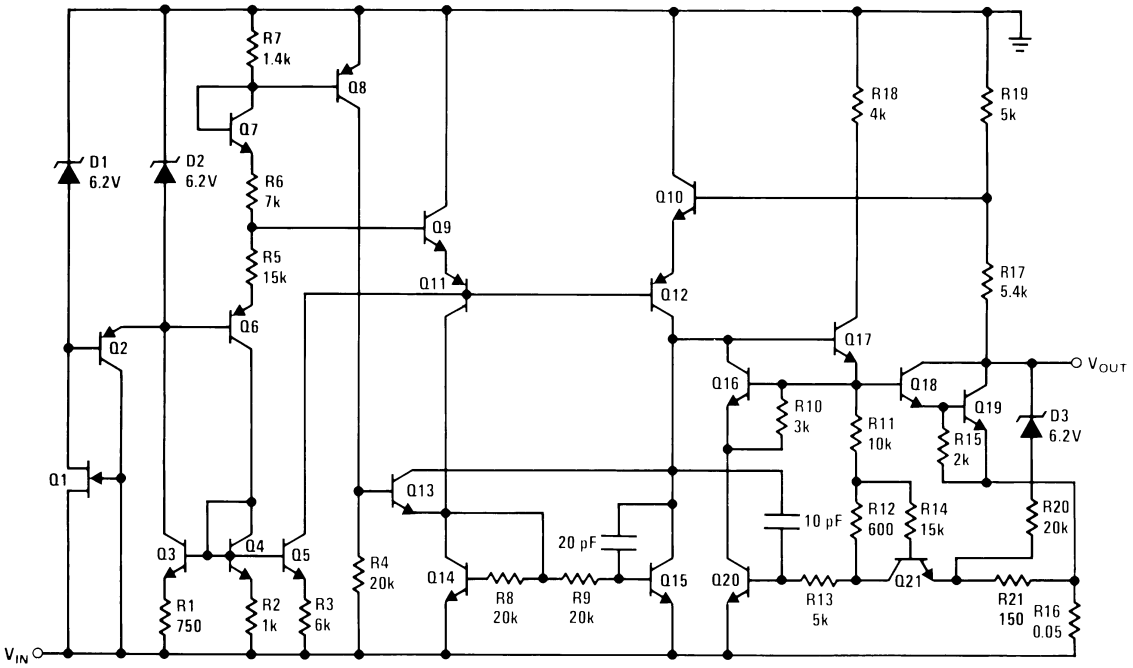


Figure 10. −5V

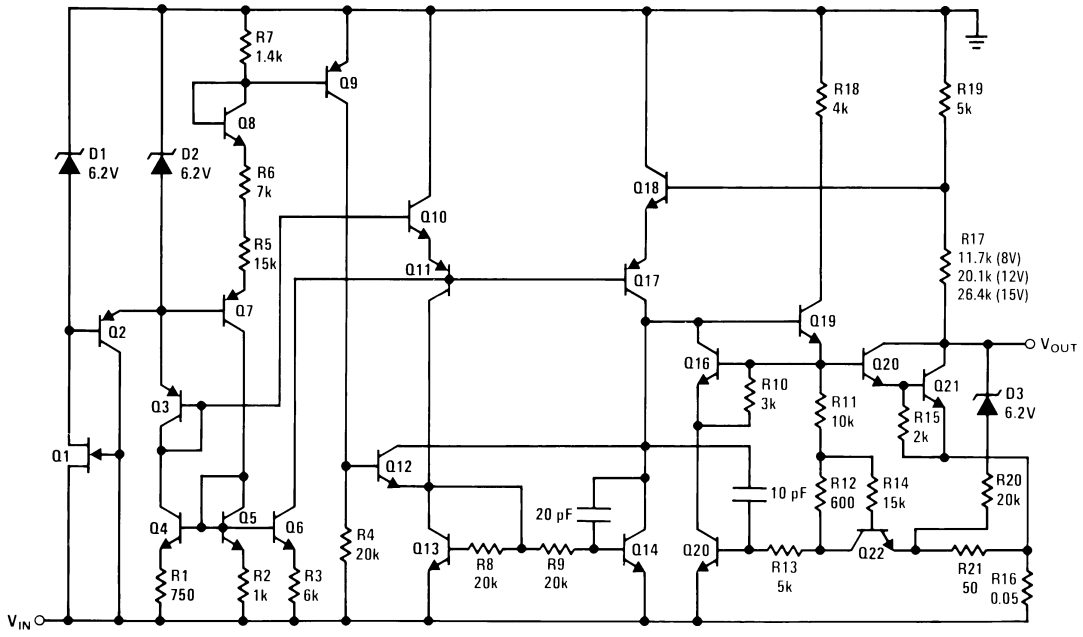


Figure 11. −12V and −15V

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}	θ_{JA}
	(°C/W)	(°C/W)
TO-220	3	40

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

θ_{CA} = θ_{CS}+θ_{SA}

Solving for T_J:

T_J = T_A+ P_D (θ_{JC}+θ_{CA}) or

= T_A=+ $P_D\theta_{JA}$(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

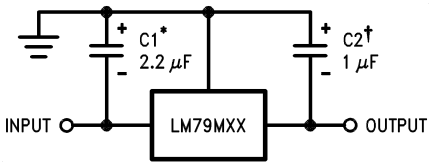
θ_{SA} = Heat Sink-to-Ambient Thermal Resistance

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

Typical Applications

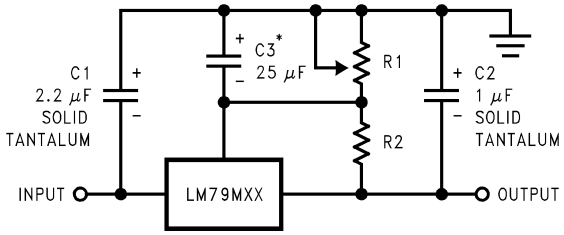
Bypass capacitors are necessary for stable operation of the LM79MXX series of regulators over the input voltage and output current ranges. Output bypass capacitors will improve the transient response of the regulator.

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.



*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.

Figure 12. Fixed Regulator



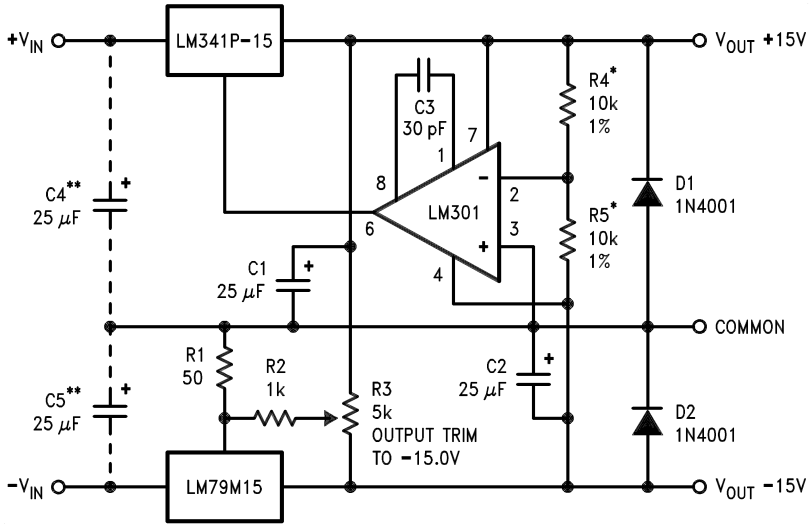
*Improves transient response and ripple rejection.
Do not increase beyond 50μF.

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

Select R2 as follows:

LM79M05C	300Ω
LM79M12C	750Ω
LM79M15C	1k

Figure 13. Variable Output



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

Figure 14. ±15V, 1 Amp Tracking Regulators

	Performance (Typical)	
	(−15)	**(+15)**
Load Regulation at 0.5A	40mV	2 mV
Output Ripple, C_{IN} = 3000µF, I_L = 0.5A	100 µVrms	100 µVrms
Temperature Stability	50mV	50mV
Output Noise 10Hz ≤ f ≤ 10kHz	150 µVrms	150 µVrms

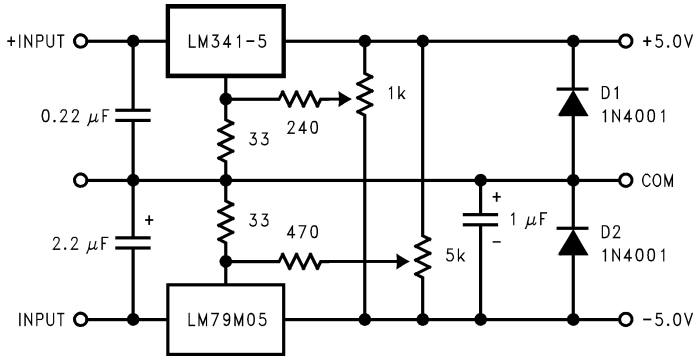


Figure 15. Dual Trimmed Supply

REVISION HISTORY

Changes from Revision C (April 2013) to Revision D	Page
• Changed layout of National Data Sheet to TI format	9

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
LM79M12CT	ACTIVE	TO-220	NDE	3	45	TBD	Call TI	Call TI	0 to 125	LM79M 12CT	Samples
LM79M12CT/NOPB	ACTIVE	TO-220	NDE	3	45	Green (RoHS & no Sb/Br)	CU SN	Level-1-NA-UNLIM	0 to 125	LM79M 12CT	Samples

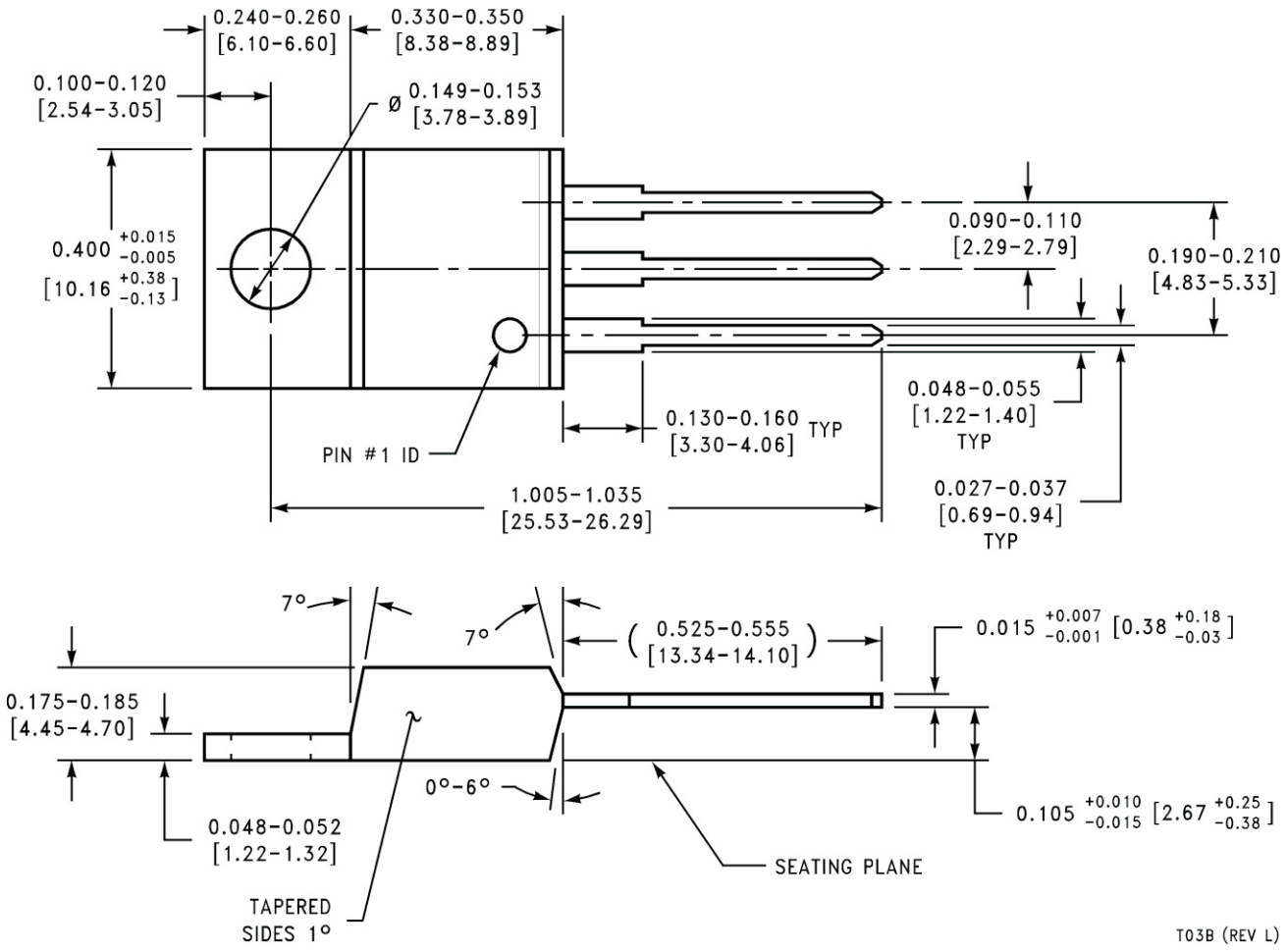
(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) Multiple Top-Side Markings will be inside parentheses. Only one Top-Side Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Top-Side Marking for that device.

NDE0003B


0.240-0.260
[6.10-6.60]
0.330-0.350
[8.38-8.89]
0.100-0.120
[2.54-3.05]
Ø 0.149-0.153
[3.78-3.89]
0.400 +0.015 -0.005
[10.16 +0.38 -0.13]
0.090-0.110
[2.29-2.79]
0.190-0.210
[4.83-5.33]
PIN #1 ID
0.130-0.160 TYP
[3.30-4.06]
0.048-0.055
[1.22-1.40]
TYP
1.005-1.035
[25.53-26.29]
0.027-0.037
[0.69-0.94]
TYP
7°
7°
(0.525-0.555
[13.34-14.10])
0.015 +0.007 -0.001 [0.38 +0.18 -0.03]
0.175-0.185
[4.45-4.70]
0°-6°
0.105 +0.010 -0.015 [2.67 +0.25 -0.38]
0.048-0.052
[1.22-1.32]
SEATING PLANE
TAPERED
SIDES 1°
T03B (REV L)

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