National Semiconductor

September 2001

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.

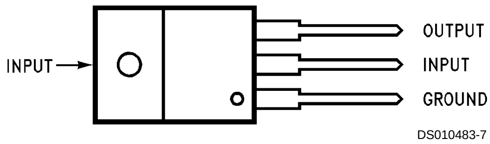
For output voltage other than −5V, −12V, and −15V the LM137 series provides an output voltage range from −1.2V to −57V.

Features

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

Connection Diagram

TO-220 Plastic Package (T)



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

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˚C to +125˚C
Storage Temperature Range	−65˚C to +150˚C
Lead Temperature (Soldering, 10 sec.)	230˚C
ESD Susceptibility	TBD

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			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
				(−25 ≤ V_{IN} ≤ −7)		
ΔV_O	Line Regulation	T_J = 25˚C (Note 3)		8	50	mV
				(−25 ≤ V_{IN} ≤ −7)		
				2	30	mV
				(−18 ≤ V_{IN} ≤ − 8)		
ΔV_O	Load Regulation	T_J = 25˚C, (Note 3) 5mA ≤ I_{OUT} ≤ 0.5A		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
				(−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

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 (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

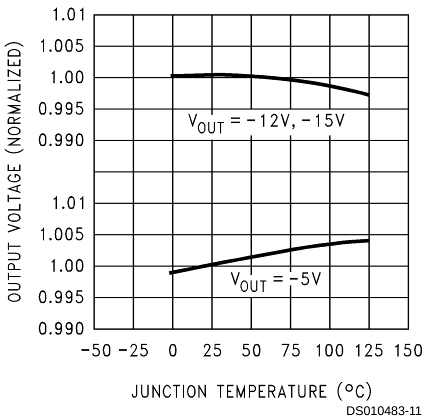
Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see the Electrical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

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

Note 3: Regulation is measued 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



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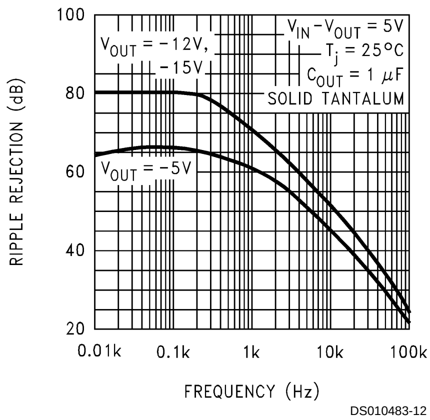
Ripple Rejection



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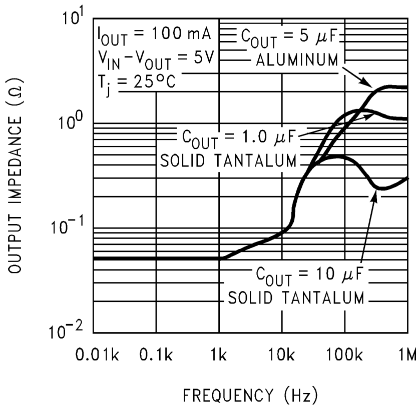
Typical Performance Characteristics (Continued)

Output Impedance



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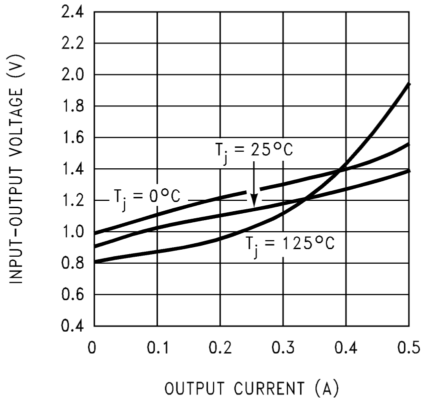
Minimum Input-Output Differential



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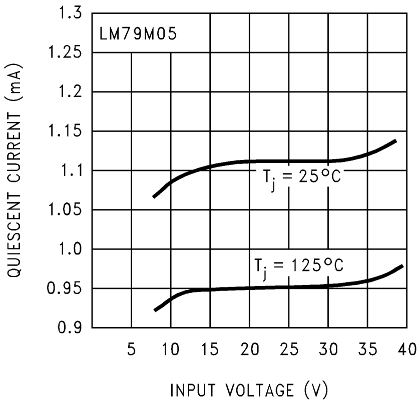
Quiescent Current vs. Input Voltage



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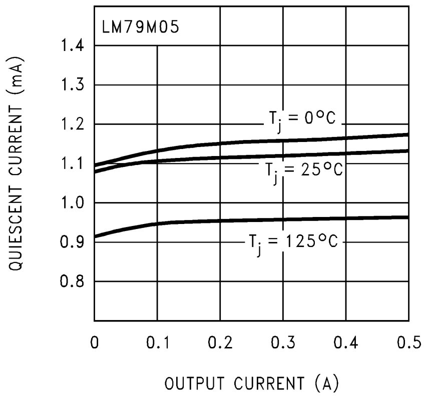
Quiescent Current vs. Load Current



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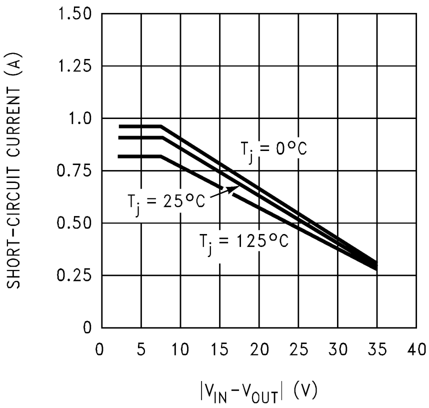
Short-Circuit Current



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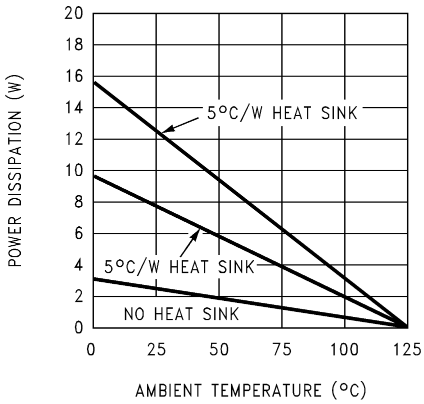
Maximum Average Power Dissipation (TO-220)



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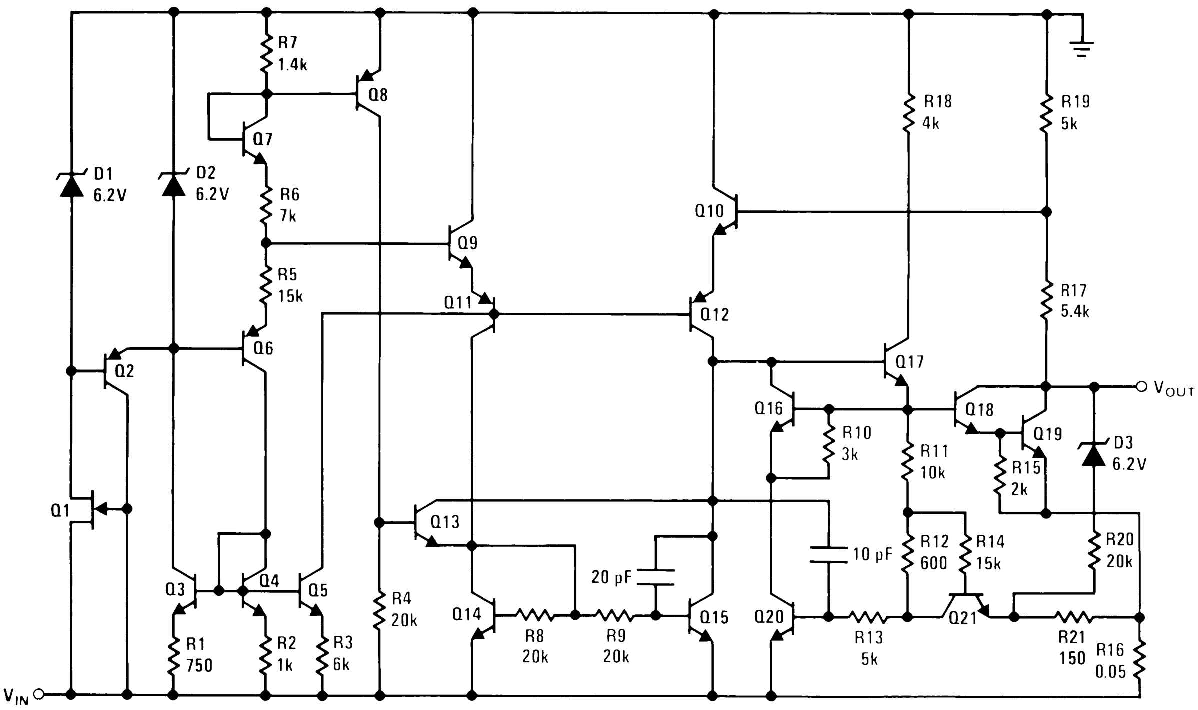
Schematic Diagrams

−5V



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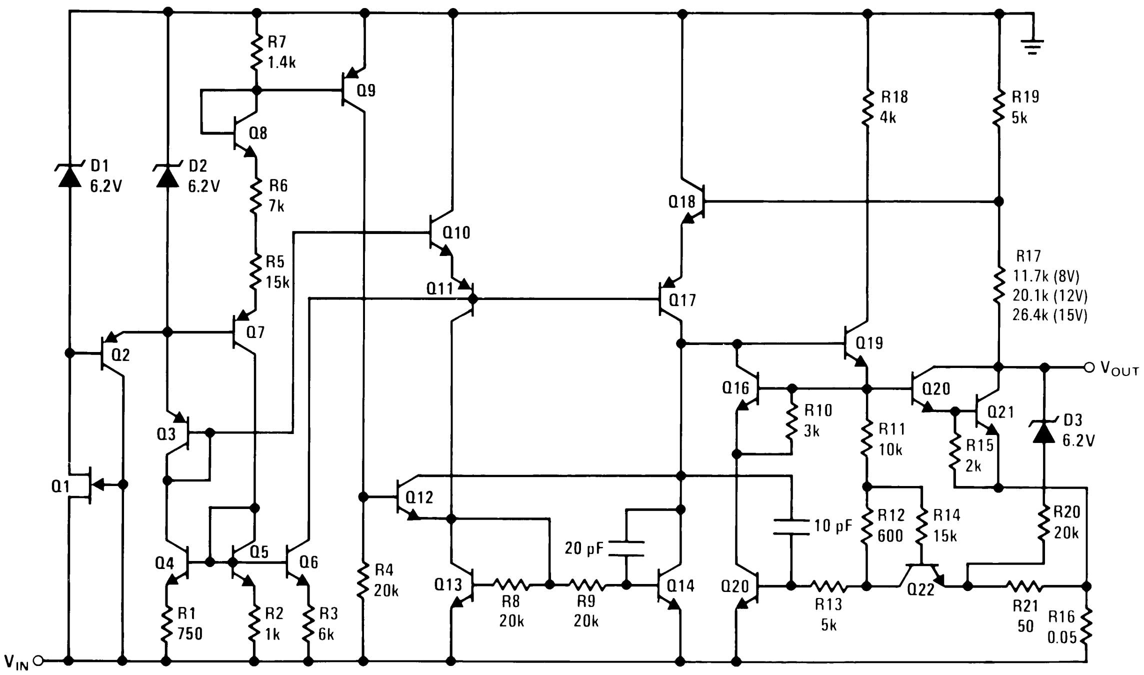
−12V and −15V



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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

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

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

Solving for T_J:

$T_J = T_A + P_D (\theta_{JC}+\theta_{CA})$ 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

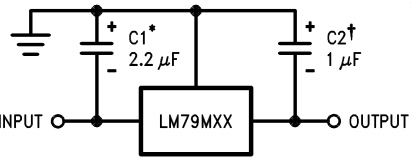
θ_{JA} = Junction-to-Ambient Thermal Resistance

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.

Fixed Regulator



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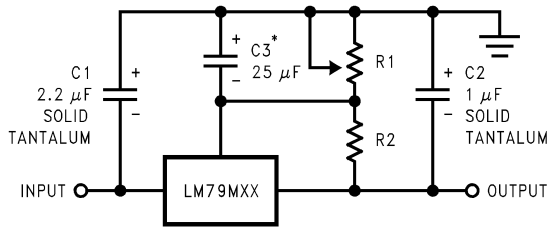
*Required if regulator is separated from filter capacitor by more than 3". For value given, capacitor must be solid tantalum. 25µF aluminum electrolytic may be substituted.

†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



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

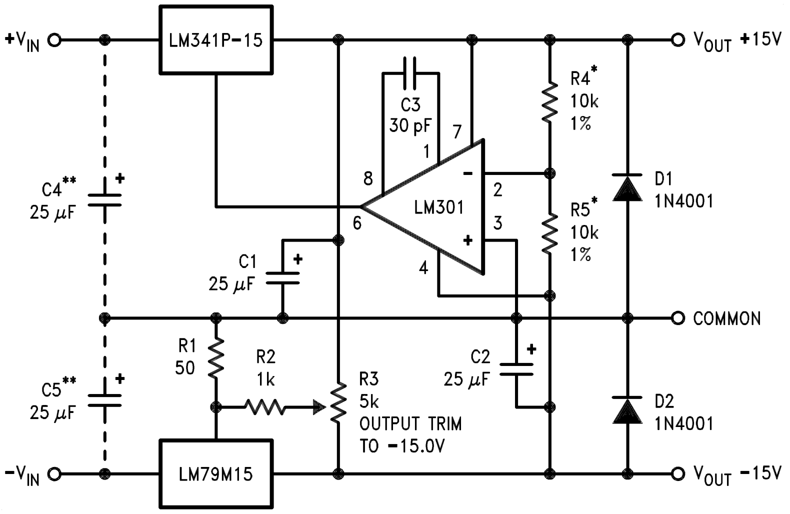
$$V_{OUT} = V_{SET}\left(\frac{R1 + R2}{R2}\right)$$

Select R2 as follows:

LM79M05C	300Ω
LM79M12C	750Ω
LM79M15C	1k

Typical Applications (Continued)

±15V, 1 Amp Tracking Regulators



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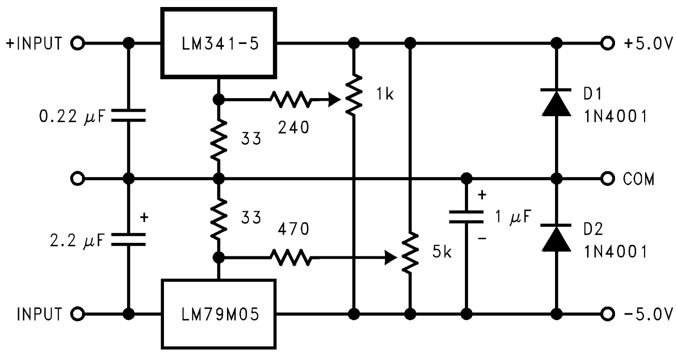
*Resistor tolerance of R4 and R5 determine matching of (+) and (−) outputs.
**Necessary only if raw supply filter capacitors are more than 3" from regulators.

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

Dual Trimmed Supply



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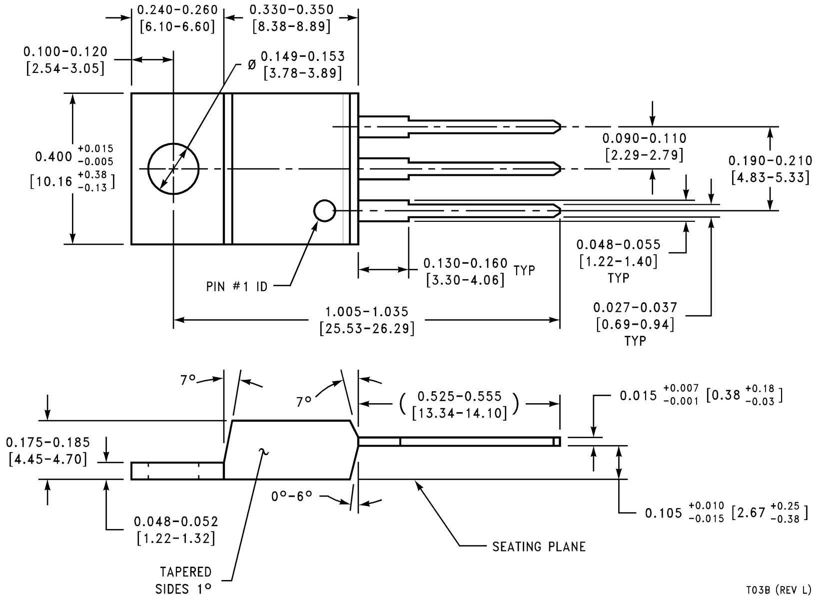
Physical Dimensions inches (millimeters) unless otherwise noted



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

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