LM79MXX Series
3-Terminal Negative Regulators

General Description

The LM79MXX series of 3-terminal regulators is available with fixed output voltages of −5V, −8V, −12V, and −15V. These devices need only one external component—a compensation capacitor at the output. The LM79MXX series is packaged in the TO-202 power package, TO-220 power package, and TO-39 metal can and is capable of supplying 0.5A of output current.

These regulators employ internal current limiting, safe area protection, and thermal shotdown 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.

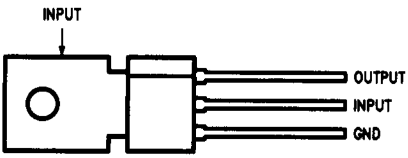
For output voltage other than −5V, −8V, −12V, and −15V the LM137 series provides an output voltage range from −1.2V to −57V.

Features

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

Connection Diagrams

TO-202 Plastic Package (P)



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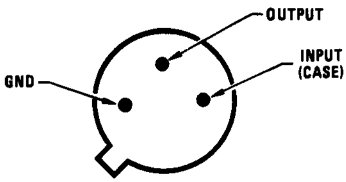
Front View

Order Number LM79M05CP, LM79M12CP or LM79M15CP
See NS Package Number P03A

TO-39 Metal Can Package (H)



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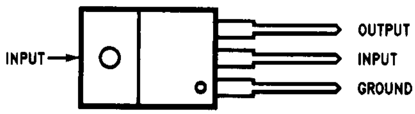
Bottom View

Order Number LM79M05CH, LM79M08CH, LM79M12CH or LM79M15CH
See NS Package Number H03A

TO-220 Plastic Package (T)



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Front View

Order Number LM79M05CT, LM79M08CT, 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
$V_O = -8V, -12V, -15V$	−35V
Input/Output Differential	
$V_O = -5V$	25V
$V_O = -8V, -12V, -15V$	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 Susceptability	TBD

Electrical Characteristics LM79M05C, LM79M08C

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

Part Number			**LM79M05C**			**LM79M08C**			**Units**
Output Voltage			**−5V**			**−8V**			
Input Voltage (Unless Otherwise Specified)			**−10V**			**−14V**			
Symbol	**Parameter**	**Conditions**	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	
V_O	Output Voltage	T_J = 25°C	−4.8	−5.0	−5.2	−7.7	−8.0	−8.3	V
		5 mA ≤ I_{OUT} ≤ 350 mA	−4.75		−5.25	−7.6		−8.4	V
			(−25 ≤ V_{IN} ≤ −7)			(−25 ≤ V_{IN} ≤ −10.5)			
ΔV_O	Line Regulation	T_J = 25°C (Note 3)		8	50		5	80	mV
			(−25 ≤ V_{IN} ≤ −7)			(−25 ≤ V_{IN} ≤ −10.5)			
				2	30		3	50	mV
			(−18 ≤ V_{IN} ≤ −8)			(−21 ≤ V_{IN} ≤ −11)			
ΔV_O	Load Regulation	T_J = 25°C, (Note 3) 5 mA ≤ I_{OUT} ≤ 0.5A		30	100		30	160	mV
I_Q	Quiescent Current	T_J = 25°C		1	2		1.5	3	mA
ΔI_Q	Quiescent Current Change	With Input Voltage			0.4			0.4	mA
			(−25 ≤ V_{IN} ≤ −8)			(−25 ≤ V_{IN} ≤ −10.5)			
		With Load, 5 mA ≤ I_{OUT} ≤ 350 mA			0.4			0.4	mA
V_n	Output Noise Voltage	T_A = 25°C, 10 Hz ≤ f ≤ 100 Hz		150			250		μV
	Ripple Rejection	f = 120 Hz	54	66		54	66		dB
			(−18 ≤ V_{IN} ≤ −8)			(−21 ≤ V_{IN} ≤ −11)			
	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} = 5 mA, 0°C ≤ T_J ≤ 100°C		−0.4			−0.6		mV/°C

Electrical Characteristics LM79M12C, LM79M15C

Conditions unless otherwise noted: I_{OUT} = 350 mA, C_{IN} = 2.2 μF, 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} ≤ 350 mA	−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) 5 mA ≤ 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, 5 mA ≤ I_{OUT} ≤ 350 mA			0.4			0.4	mA
V_n	Output Noise Voltage	T_A = 25°C, 10 Hz ≤ f ≤ 100 Hz		400			400		μV
	Ripple Rejection	f = 120 Hz	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} = 5 mA, 0°C ≤ T_J ≤ 100°C		−0.8			−1.0		mV/°C

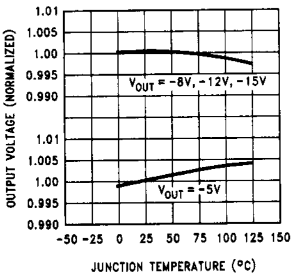
Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see the Electrical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

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

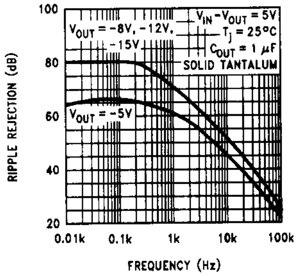
Note 3: Regulation is measued at a constant junction temperature by pulse testing with a low duty cycle. Changes in output voltage due to heating effects must be taken into account.

Typical Performance Characteristics

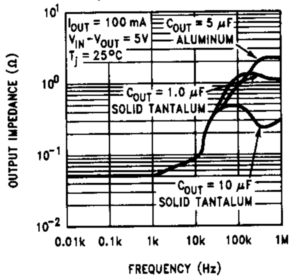
Output Voltage vs Temperature



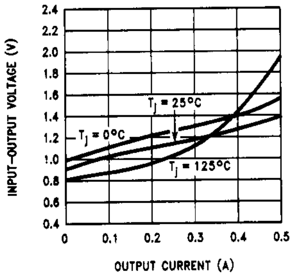
Ripple Rejection



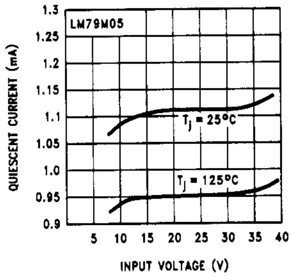
Output Impedance



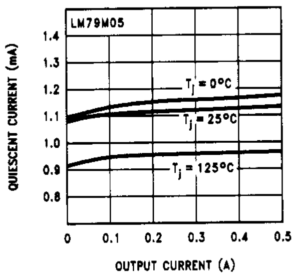
Minimum Input-Output Differential



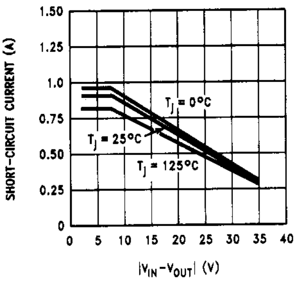
Quiescent Current vs Input Voltage



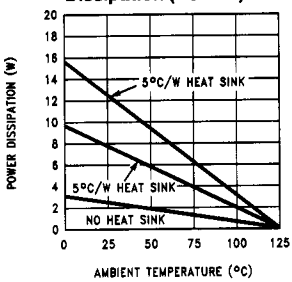
Quiescent Current vs Load Current



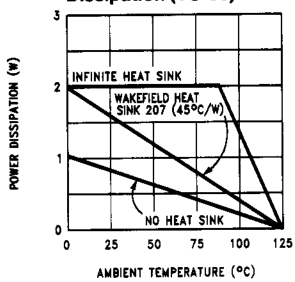
Short-Circuit Current



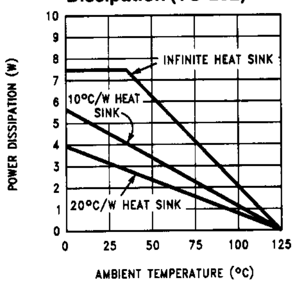
Maximum Average Power Dissipation (TO-220)



Maximum Average Power Dissipation (TO-39)



Maximum Average Power Dissipation (TO-202)



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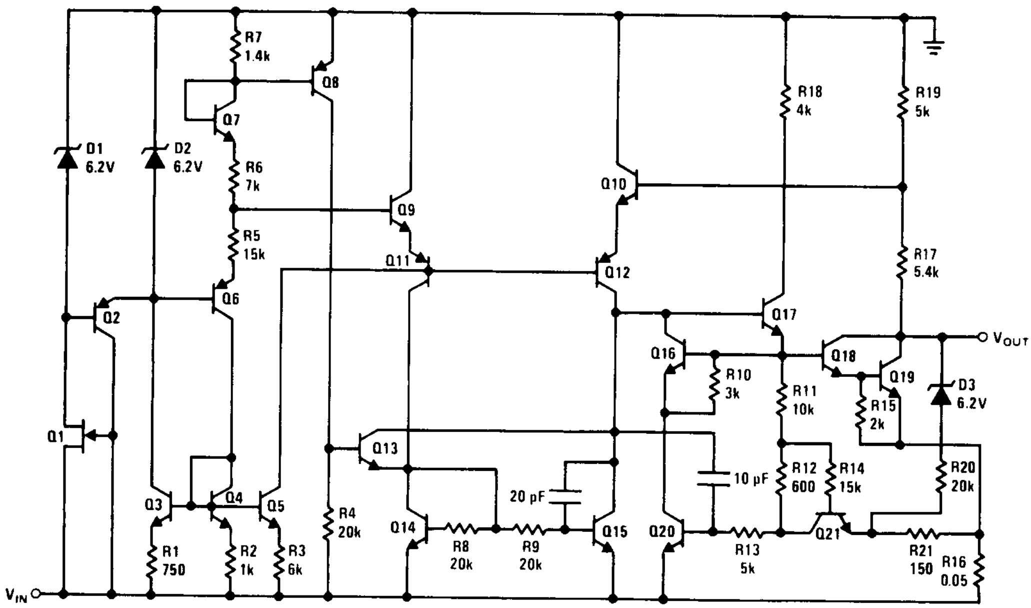
Schematic Diagrams

−5V



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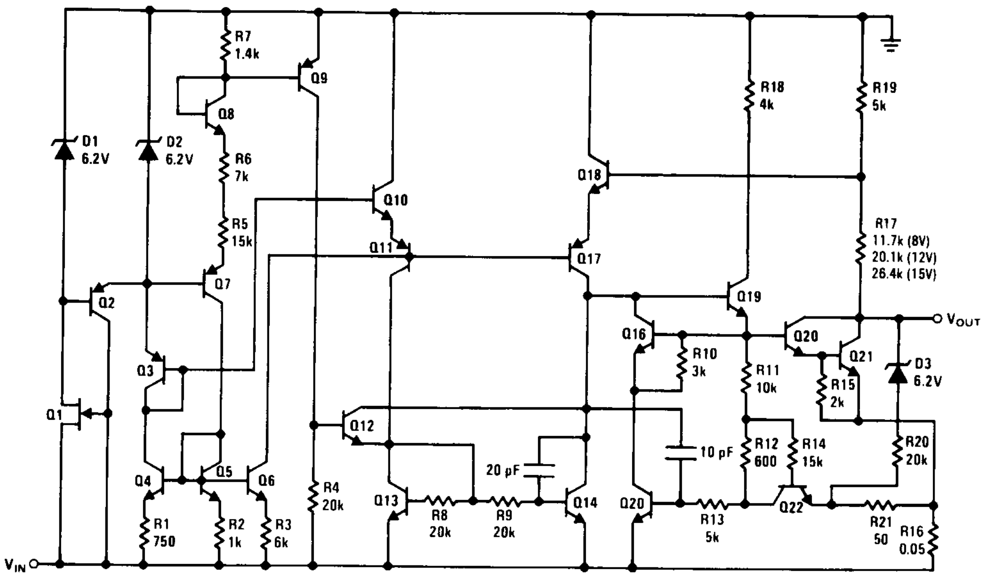
−8V, −12V and −15V



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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-39	18	120
TO-202	12	70
TO-220	3	40

$$P_{DMAX} = \frac{T_{JMax} - T_A}{\theta_{JC} + \theta_{CA}} \text{ or} \quad (1)$$

$$= \frac{T_{JMax} - T_A}{\theta_{JA}} \text{ (Without a Heat Sink)}$$

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

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

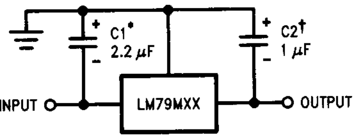
θ_{JA} = Junction-to-Ambient Thermal Resistance

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 (2.2 μF on the input, 1.0 μF on the output), should be ceramic or solid tantalum which have good high frequency characteristics. If aluminum electrolytics are used, their values should be 10 μF 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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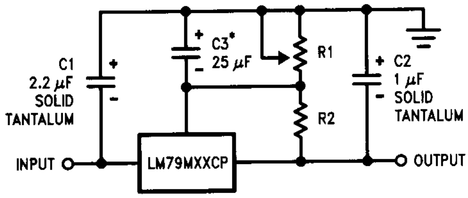
*Required if regulator is separated from filter capacitor by more than 3". For value given, capacitor must be solid tantalum. 25 μF aluminum electrolytic may be substituted.

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

For output capacitance in excess of 100 μF, 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 50 μF.

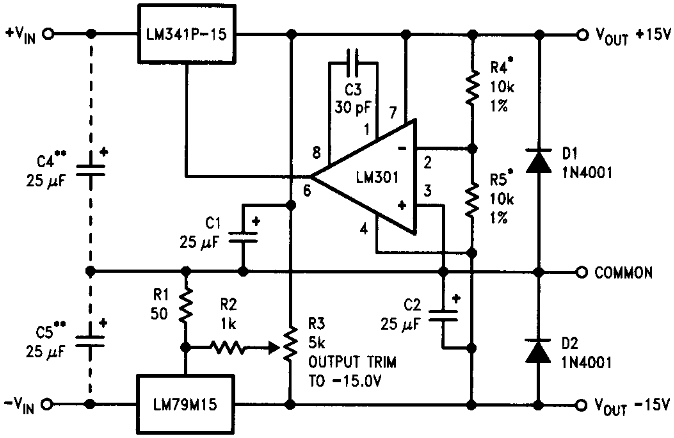
$$V_{OUT} = V_{SET} \left(\frac{R1 + R2}{R2} \right)$$

Select R2 as follows:

LM79M05C	300Ω
LM79M08C	500Ω
LM79M12C	750Ω
LM79M15C	1k

Typical Applications (Continued)

± 15V, 1 Amp Tracking Regulators



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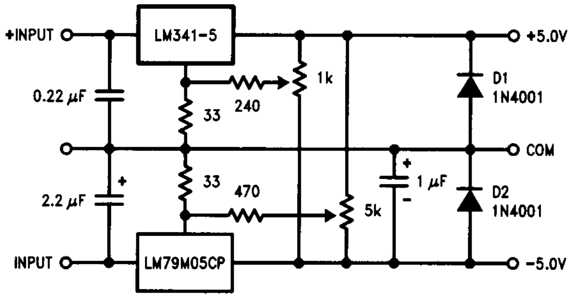
Performance (Typical)

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

*Resistor tolerance of R4 and R5 determine matching of (+) and (−) outputs.

**Necessary only if raw supply filter capacitors are more than 3" from regulators.

Dual Trimmed Supply



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