National Semiconductor

Voltage Regulators

LM79XX Series 3-Terminal Negative Regulators

General Description

The LM79XX 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 LM79XX series is packaged in the TO-220 power package and is capable of supplying 1.5A 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 LM79XX series allows output voltage to be easily boosted above the preset value with a resistor divider. The low quiescent current drain of these devices with a specified maximum change with line and load ensures good regulation in the voltage boosted mode.

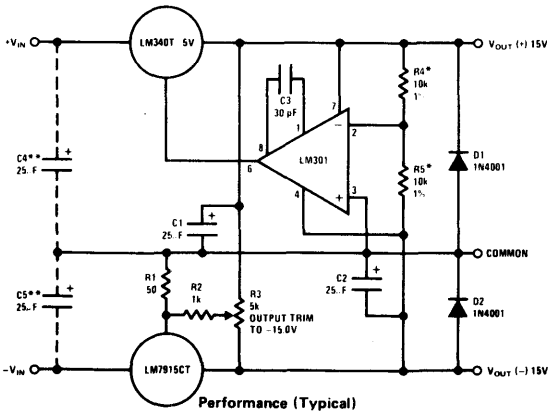
For output voltages other than 5V, 12V and 15V the LM137 series provides an output voltage range from −1.2V to −47V.

Features

- Thermal, short circuit and safe area protection
- High ripple rejection
- 1.5A output current
- 4% preset output voltage

Typical Applications

±15V, 1 Amp Tracking Regulators



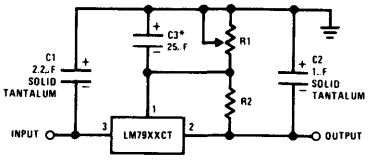
Performance (Typical)

	(−15)	(+15)
Load Regulation at ΔI_L = 1A	40 mV	2 mV
Output Ripple, C_{IN} = 3000μF, I_L = 1A	100μVrms	100μVrms
Temperature Stability	50 mV	50 mV
Output Noise 10 Hz ≤ f ≤ 10 kHz	150μVrms	150μVrms

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

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

Variable Output



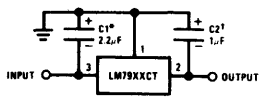
*Improves transient response and ripple rejection. Do not increase beyond 50μF.

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

Select R2 as follows

LM7905CT	300Ω
LM7912CT	750Ω
LM7915CT	1k

Fixed Regulator

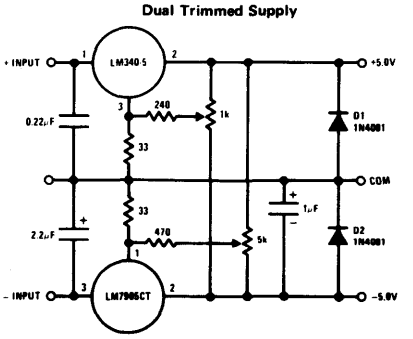


*Required if regulator is separated from filter capacitor by more than 3". For value given, capacitor must be solid tantalum. 25μF aluminum electrolytic may be substituted.

†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.

Dual Trimmed Supply



Absolute Maximum Ratings

Input Voltage	
(V_O = 5V)	−35V
(V_O = 12V and 15V)	−40V
Input-Output Differential	
(V_O = 5V)	25V
(V_O = 12V and 15V)	30V
Power Dissipation	Internally Limited
Operating Junction Temperature Range	0°C to +125°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 10 seconds)	230°C

Electrical Characteristics

Conditions unless otherwise noted: I_{OUT} = 500 mA, C_{IN} = 2.2μF, C_{OUT} = 1μF, 0°C ≤ T_J ≤ +125°C, Power Dissipation ≤ 15W.

PART NUMBER			LM7905C			UNITS
OUTPUT VOLTAGE			5V			
INPUT VOLTAGE (unless otherwise specified)			−10V			
	PARAMETER	CONDITIONS	MIN	TYP	MAX	
V_O	Output Voltage	T_J = 25°C	−4.8	−5.0	−5.2	V
		5 mA ≤ I_{OUT} ≤ 1A, P ≤ 15W	−4.75		−5.25	V
		(−20 ≤ V_{IN} ≤ −7)				V
ΔV_O	Line Regulation	T_J = 25°C, (Note 2)		8	50	mV
		(−25 ≤ V_{IN} ≤ −7)				V
				2	15	mV
		(−12 ≤ V_{IN} ≤ −8)				V
ΔV_O	Load Regulation	T_J = 25°C, (Note 2)				mV
		5 mA ≤ I_{OUT} ≤ 1.5A		15	100	mV
		250 mA ≤ I_{OUT} ≤ 750 mA		5	50	mV
I_Q	Quiescent Current	T_J = 25°C		1	2	mA
ΔI_Q	Quiescent Current Change	With Line			0.5	mA
		(−25 ≤ V_{IN} ≤ −7)				V
		With Load, 5 mA ≤ I_{OUT} ≤ 1A			0.5	mA
V_n	Output Noise Voltage	T_A = 25°C, 10 Hz ≤ f ≤ 100 Hz		125		μV
	Ripple Rejection	f = 120 Hz	54	66		dB
		(−18 ≤ V_{IN} ≤ −8)				V
	Dropout Voltage	T_J = 25°C, I_{OUT} = 1A		1.1		V
I_{OMAX}	Peak Output Current	T_J = 25 C		2.2		A
	Average Temperature Coefficient of Output Voltage	I_{OUT} = 5 mA, 0 C ≤ T_J ≤ 100 C		0.4		mV/ C

Electrical Characteristics (Continued) Conditions unless otherwise noted: I_{OUT} = 500 mA, C_{IN} = 2.2μF, C_{OUT} = 1μF, 0°C ≤ T_J ≤ +125°C, Power Dissipation = 1.5W.

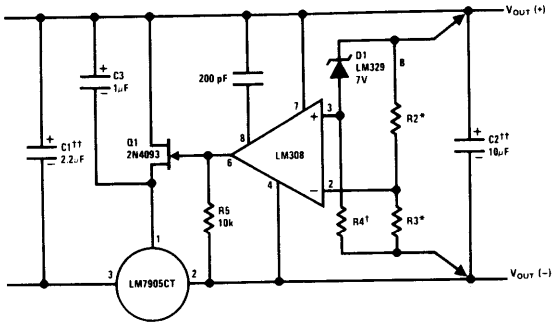
PART NUMBER			LM7912C			LM7915C			UNITS
OUTPUT VOLTAGE			12V			15V			
INPUT VOLTAGE (unless otherwise specified)			−19V			−23V			
PARAMETER		CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	
V_O	Output Voltage	T_J = 25°C	−11.5	−12.0	−12.5	−14.4	−15.0	−15.6	V
		5 mA ≤ I_{OUT} ≤ 1A, P ≤ 15W	−11.4		−12.6	−14.25		15.75	V
			(−27 ≤ V_{IN} ≤ −14.5)			(−30 ≤ V_{IN} ≤ −17.5)			V
ΔV_O	Line Regulation	T_J = 25°C, (Note 2)		5	80		5	100	mV
			(−30 ≤ V_{IN} ≤ −14.5)			(−30 ≤ V_{IN} ≤ −17.5)			V
				3	30		3	50	mV
			(−22 ≤ V_{IN} ≤ −16)			(−26 ≤ V_{IN} ≤ −20)			V
ΔV_O	Load Regulation	T_J = 25°C, (Note 2)		15	200		15	200	mV
		5 mA ≤ I_{OUT} ≤ 1.5A		15	200		15	200	mV
		250 mA ≤ I_{OUT} ≤ 750 mA		5	75		5	75	mV
I_Q	Quiescent Current	T_J = 25°C		1.5	3		1.5	3	mA
ΔI_Q	Quiescent Current Change	With Line			0.5			0.5	mA
			(−30 ≤ V_{IN} ≤ −14.5)			(−30 ≤ V_{IN} ≤ −17.5)			V
		With Load, 5 mA ≤ I_{OUT} ≤ 1A			0.5			0.5	mA
V_n	Output Noise Voltage	T_A = 25°C, 10 Hz ≤ f ≤ 100 Hz		300			375		μV
	Ripple Rejection	f = 120 Hz	54	70		54	70		dB
			(−25 ≤ V_{IN} ≤ −15)			(−30 ≤ V_{IN} ≤ −17.5)			V
	Dropout Voltage	T_J = 25°C, I_{OUT} = 1A		1.1			1.1		V
I_{OMAX}	Peak Output Current	T_J = 25°C		2.2			2.2		A
	Average Temperature Coefficient of Output Voltage	I_{OUT} = 5 mA, 0°C ≤ T_J ≤ 100°C		−0.8			−1.0		mV/°C

Note 1: For calculations of junction temperature rise due to power dissipation, thermal resistance junction to ambient (θ_{JA}) is 50°C/W (no heat sink) and 5°C/W (infinite heat sink).

Note 2: 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 Applications (Continued)

High Stability 1 Amp Regulator



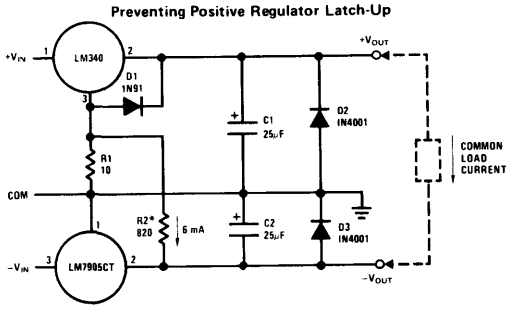
Load and line regulation < 0.01% temperature stability ≤ 0.2%

†Determines Zener current

††Solid tantalum

*Select resistors to set output voltage. 2 ppm/°C tracking suggested

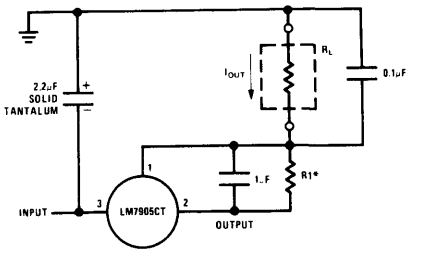
Preventing Positive Regulator Latch-Up



R1 and D1 allow the positive regulator to "start-up" when $+V_{IN}$ is delayed relative to $-V_{IN}$ and a heavy load is drawn between the outputs. Without R1 and D1, most three-terminal regulators will not start with heavy (0.1A–1A) load current flowing to the negative regulator, even though the positive output is clamped by D2.

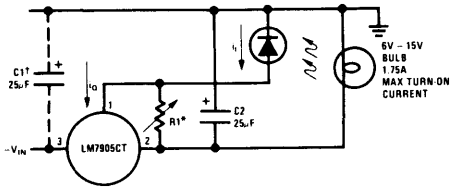
*R2 is optional. Ground pin current from the positive regulator flowing through R1 will increase $+V_{OUT} \approx 60$ mV if R2 is omitted.

Current Source



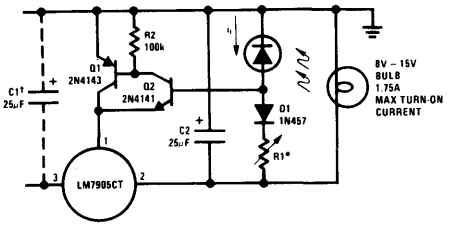
$$*I_{OUT} = 1\ mA + \frac{5V}{R1}$$

Light Controllers Using Silicon Photo Cells



*Lamp brightness increases until $i_L = i_Q$ (≈ 1 mA) + 5V/R1.

†Necessary only if raw supply filter capacitor is more than 2" from LM7905CT



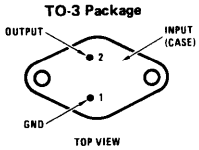
*Lamp brightness increases until $i_L = 5V/R1$ (i_L can be set as low as 1μA)

†Necessary only if raw supply filter capacitor is more than 2" from LM7905CT

Connection Diagrams

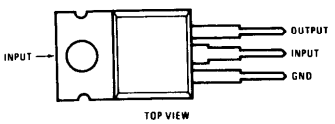
TO-3 Package

Order Numbers:
LM7905CK
LM7912CK
LM7915CK
See NS Package KC02A



TOP VIEW

TO-220 Package

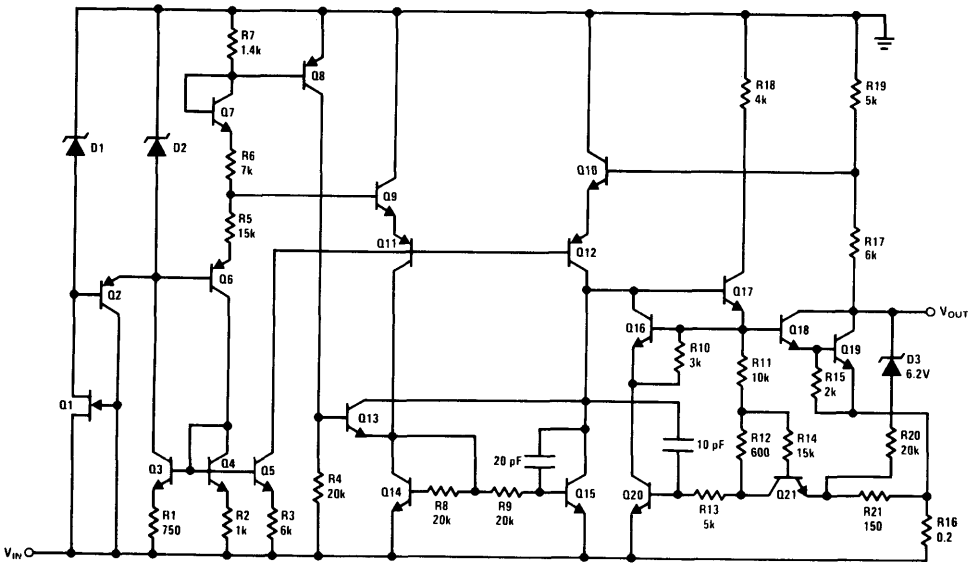


TOP VIEW

Order Numbers:
LM7905CT
LM7912CT
LM7915CT
See NS Package T03B

schematic diagrams

–5V, –5.2V, –6V, –8V



–9V, –12V, –15V, –18V, –24V