

LM79XX Series 3-Terminal Negative Regulators

Check for Samples: [LM7905](#), [LM7912](#), [LM7915](#)

FEATURES

- Thermal, Short Circuit and Safe Area Protection
- High Ripple Rejection
- 1.5A Output Current
- 4% Tolerance on Preset Output Voltage

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 applications requiring other voltages, see LM137 datasheet.

Connection Diagram

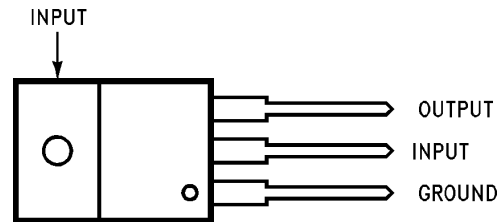
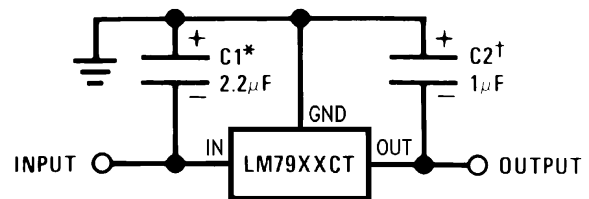


Figure 1. TO-220 Package Front View
See Package Number NDE0003B

Typical Applications



*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 2. Fixed Regulator



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

All trademarks are the property of their respective owners.



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⁾

Input Voltage	
($V_O = -5V$)	-25V
($V_O = -12V$ and $-15V$)	-35V
Input-Output Differential	
($V_O = -5V$)	25V
($V_O = -12V$ and $-15V$)	30V
Power Dissipation ⁽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

(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 ensure Specific Performance limits. For ensured specifications and test conditions, see the Electrical Characteristics.

(2) Refer to [DESIGN CONSIDERATIONS](#) for details.

ELECTRICAL CHARACTERISTICS

Conditions unless otherwise noted: $I_{OUT} = 500mA$, $C_{IN} = 2.2\mu F$, $C_{OUT} = 1\mu F$, $0^\circ C \leq T_J \leq +125^\circ C$, Power Dissipation $\leq 1.5W$.

Part Number			LM7905C			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} ≤ 1A, P ≤ 15W	-4.75		-5.25	V
				(-20 ≤ V _{IN} ≤ -7)		V
ΔV _O	Line Regulation	T _J = 25°C, ⁽¹⁾		8	50	mV
				(-25 ≤ V _{IN} ≤ -7)		V
				2	15	mV
				(-12 ≤ V _{IN} ≤ -8)		V
ΔV _O	Load Regulation	T _J = 25°C, ⁽¹⁾ 5mA ≤ I _{OUT} ≤ 1.5A 250mA ≤ I _{OUT} ≤ 750mA				
				15	100	mV
				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, 5mA ≤ I _{OUT} ≤ 1A			0.5	mA
V _n	Output Noise Voltage	T _A = 25°C, 10Hz ≤ f ≤ 100Hz f = 120Hz	54	125		μV
				66		dB
	Ripple Rejection		(-18 ≤ V _{IN} ≤ -8)		V	
		Dropout Voltage	T _J = 25°C, I _{OUT} = 1A		1.1	
I _{OMAX}	Peak Output Current	T _J = 25°C		2.2		A
	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

Conditions unless otherwise noted: $I_{OUT} = 500\text{mA}$, $C_{IN} = 2.2\mu\text{F}$, $C_{OUT} = 1\mu\text{F}$, $0^\circ\text{C} \leq T_J \leq +125^\circ\text{C}$, Power Dissipation $\leq 1.5\text{W}$.

Part Number			LM7912C			LM7915C			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
		5mA ≤ I _{OUT} ≤ 1A,	-11.4		-12.6	-14.25		-15.75	V
		P ≤ 15W	(-27 ≤ V _{IN} ≤ -14.5)			(-30 ≤ V _{IN} ≤ -17.5)			V
ΔV _O	Line Regulation	T _J = 25°C, ⁽¹⁾	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, ⁽¹⁾ 5mA ≤ I _{OUT} ≤ 1.5A 250mA ≤ I _{OUT} ≤ 750mA							
				15	200		15	200	mV
				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, 5mA ≤ I _{OUT} ≤ 1A	0.5			0.5			mA
V _n	Output Noise Voltage Ripple Rejection	T _A = 25°C, 10Hz ≤ f ≤ 100Hz	300			375			μV
		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} = 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.

DESIGN CONSIDERATIONS

The LM79XX fixed voltage regulator series has thermal overload protection from excessive power dissipation, 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 (125°C) 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	Typ θ_{JC} °C/W	Max θ_{JC} °C/W	Typ θ_{JA} °C/W	Max θ_{JA} °C/W
TO-220	3.0	5.0	60	40

$$P_{D\text{ MAX}} = \frac{T_{J\text{ MAX}} - T_A}{\theta_{JC} + \theta_{CA}} \text{ or } \frac{T_{J\text{ MAX}} - T_A}{\theta_{JA}}$$

$$\theta_{CA} = \theta_{CS} + \theta_{SA} \text{ (without heat sink)}$$
(1)

Solving for T_J :

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

or

$$= T_A + P_D \theta_{JA} \text{ (without heat sink)}$$

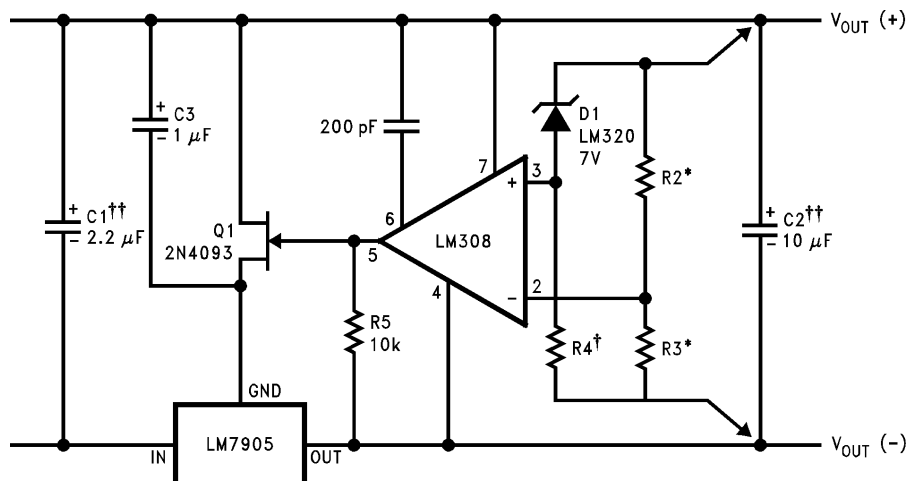
where

- T_J = Junction Temperature
- T_A = Ambient Temperature
- P_D = Power Dissipation
- θ_{JA} = Junction-to-Ambient Thermal Resistance
- 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

Typical Applications

Bypass capacitors are necessary for stable operation of the LM79XX series of regulators over the input voltage and output current ranges. Output bypass capacitors will improve the transient response by 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.



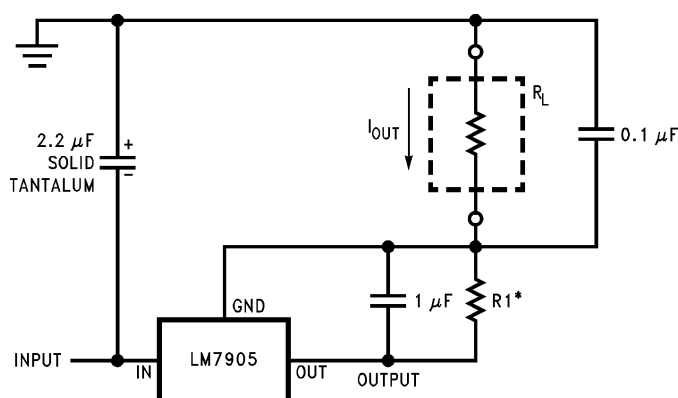
Load and line regulation $< 0.01\%$ temperature stability $\leq 0.2\%$

†Determine Zener current

††Solid tantalum

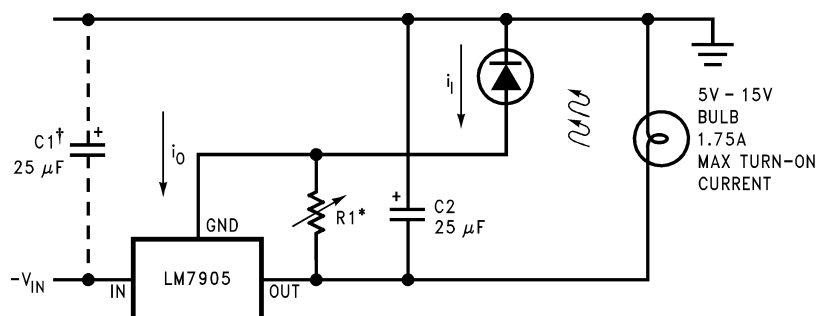
*Select resistors to set output voltage. 2 ppm/°C tracking suggested

Figure 3. High Stability 1 Amp Regulator



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

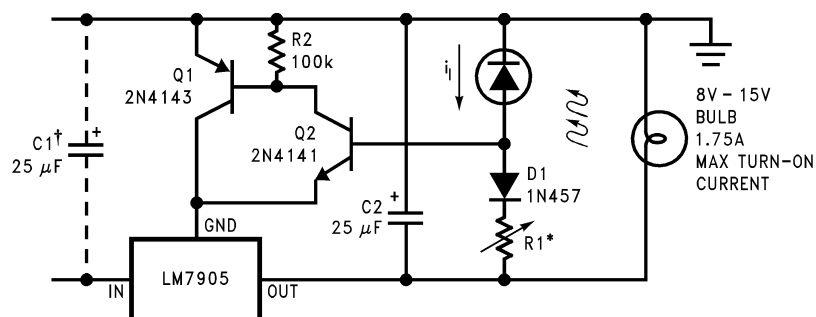
Figure 4. Current Source



*Lamp brightness increase until $i_l = i_0 (\approx 1 \text{ mA}) + 5V/R_1$.

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

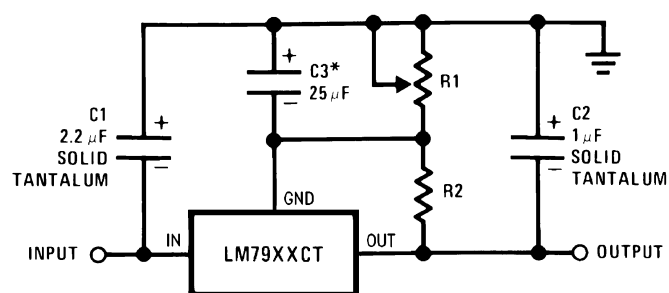
Figure 5. Light Controller Using Silicon Photo Cell



*Lamp brightness increases until $i_i = 5V/R1$ (i_i can be set as low as $1 \mu A$)

†Necessary only if raw supply filter capacitor is more than 2" from LM7905

Figure 6. High-Sensitivity Light Controller



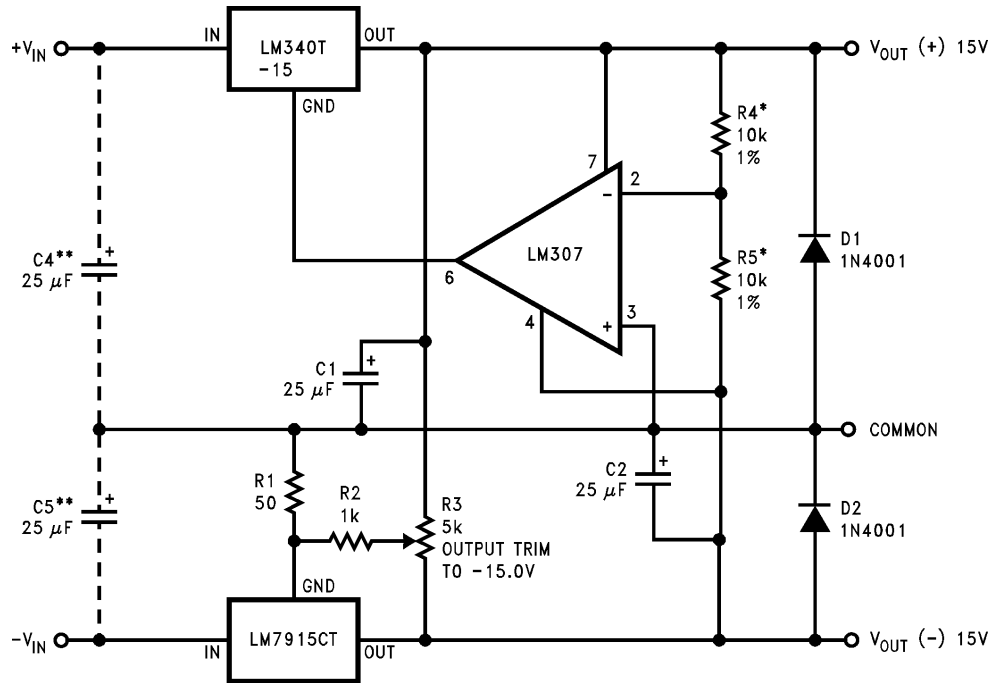
*Improves transient response and ripple rejection. Do not increase beyond $50 \mu F$.

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

Select R2 as follows:

LM7905CT	300Ω
LM7912CT	750Ω
LM7915CT	1k

Figure 7. Variable Output



	(-15)	(+15)
Load Regulation at $\Delta I_L = 1A$	40mV	2mV
Output Ripple, $C_{IN} = 3000\mu F$, $I_L = 1A$	100 μVms	100 μVms
Temperature Stability	50mV	50mV
Output Noise $10Hz \leq f \leq 10kHz$	150 μVms	150 μVms

*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 8. $\pm 15V$, 1 Amp Tracking Regulators

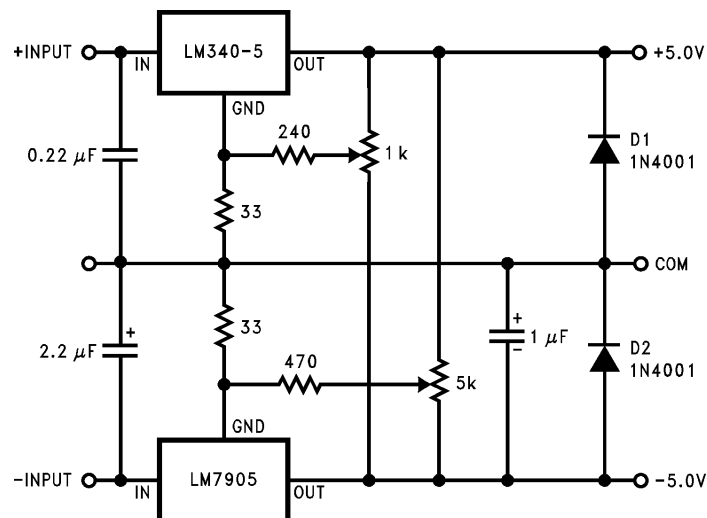


Figure 9. Dual Trimmed Supply

Schematic Diagrams

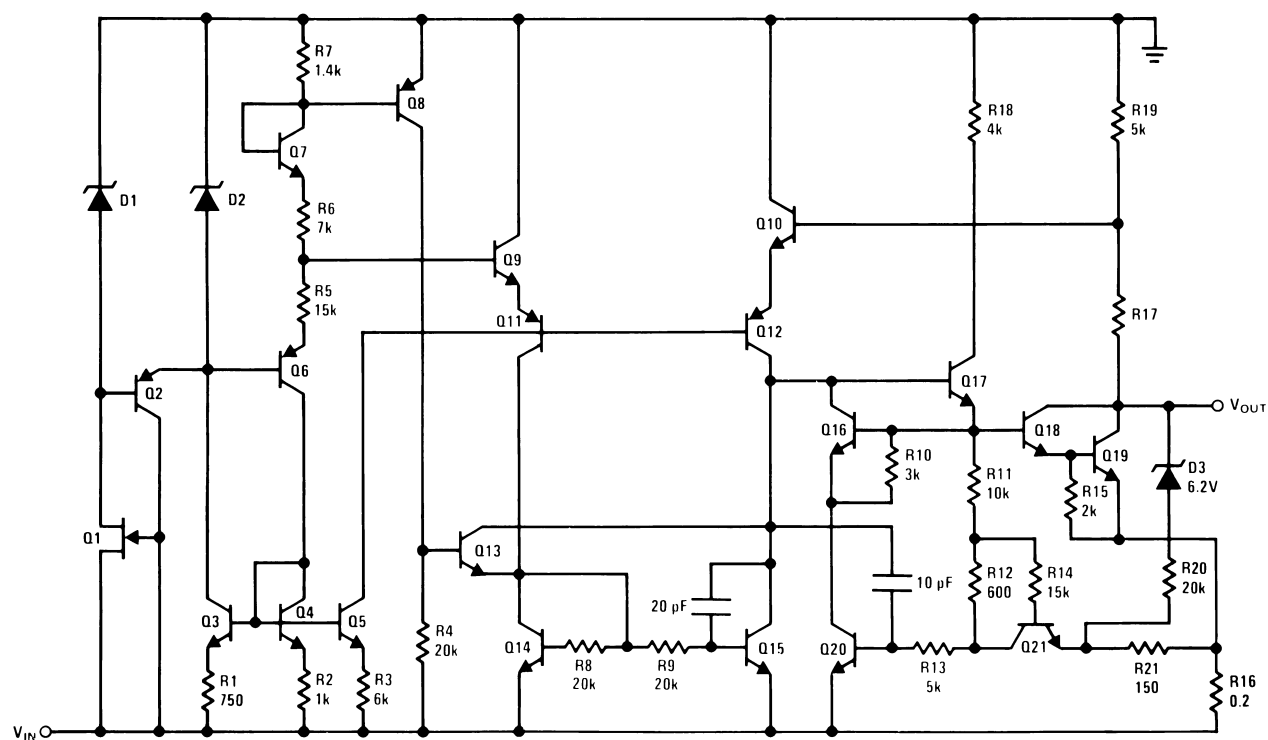


Figure 10. -5V

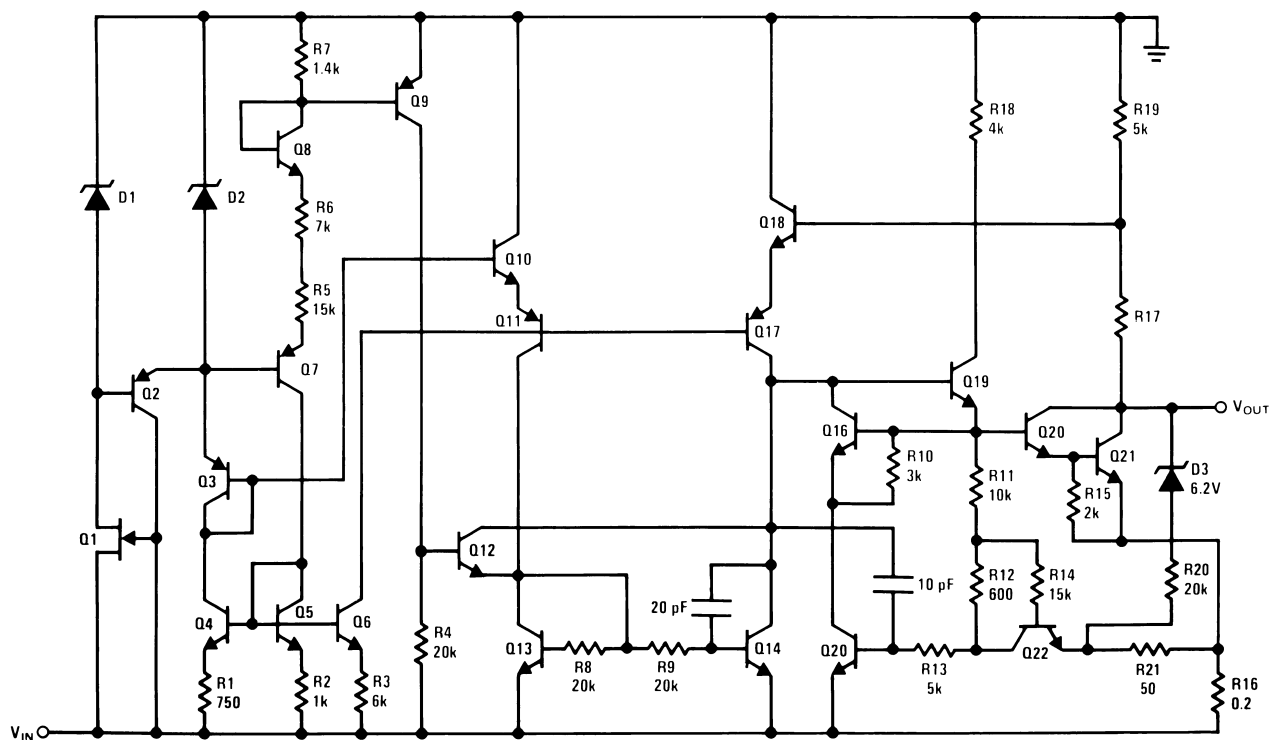


Figure 11. -12V and -15V

REVISION HISTORY

Changes from Revision B (May 2013) to Revision C	Page
• Changed layout of National Data Sheet to TI format.	8

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LM7905CT	NRND	TO-220	NDE	3	45	Non-RoHS & Green	Call TI	Level-1-NA-UNLIM	0 to 125	LM7905CT	
LM7905CT/NOPB	ACTIVE	TO-220	NDE	3	45	RoHS & Green	SN	Level-1-NA-UNLIM	0 to 125	LM7905CT	Samples
LM7912CT	NRND	TO-220	NDE	3	45	Non-RoHS & Green	Call TI	Level-1-NA-UNLIM	0 to 125	LM7912CT	
LM7912CT/NOPB	ACTIVE	TO-220	NDE	3	45	RoHS & Green	SN	Level-1-NA-UNLIM	0 to 125	LM7912CT	Samples
LM7915CT	NRND	TO-220	NDE	3	45	Non-RoHS & Green	Call TI	Level-1-NA-UNLIM	0 to 125	LM7915CT	
LM7915CT/NOPB	ACTIVE	TO-220	NDE	3	45	RoHS & Green	SN	Level-1-NA-UNLIM	0 to 125	LM7915CT	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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

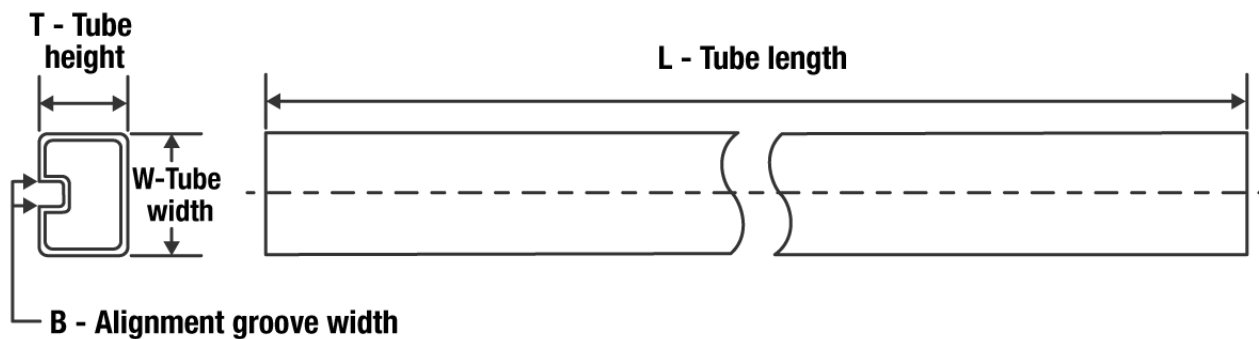
(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

⁽⁶⁾ Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

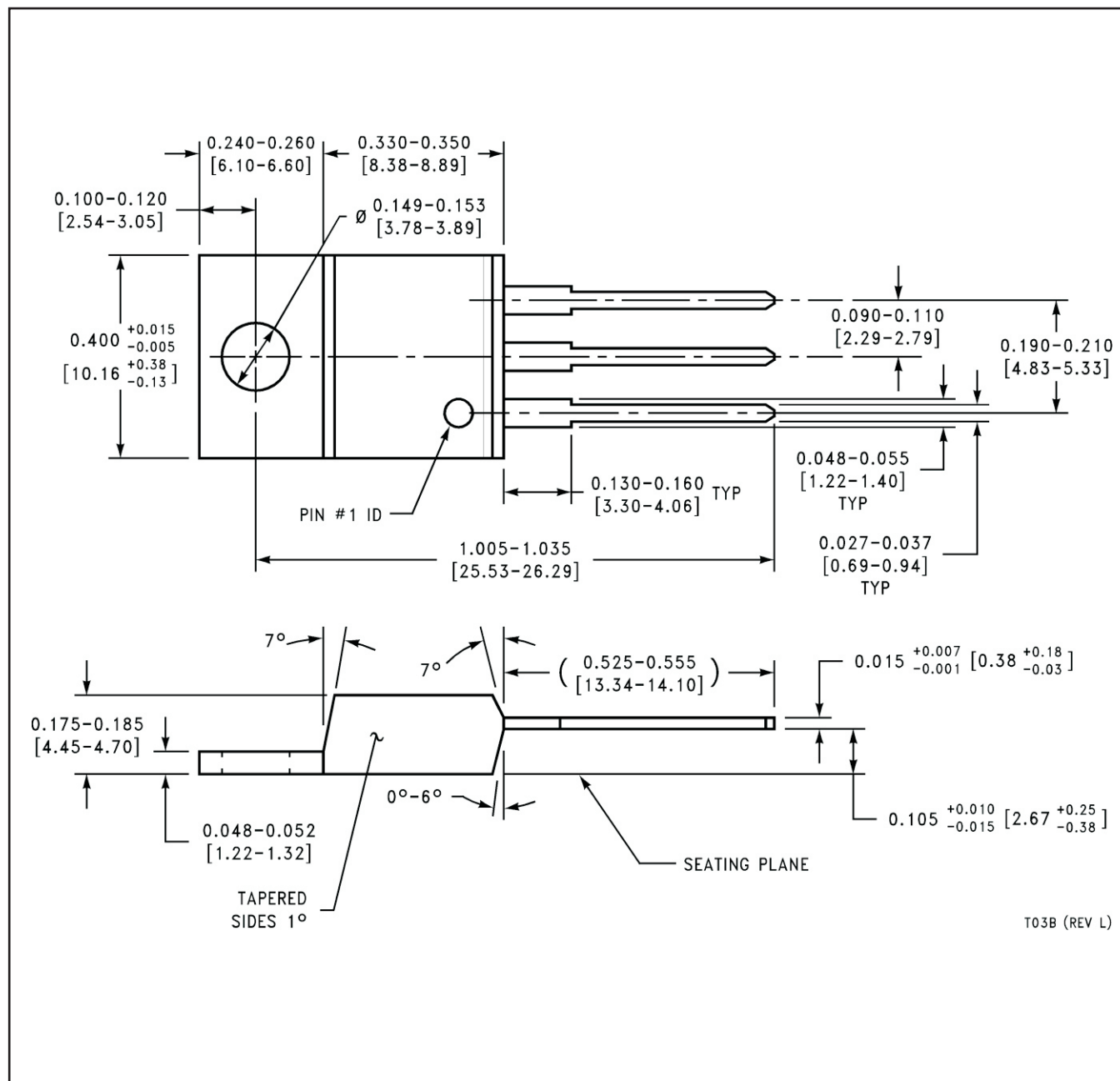
TUBE



*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
LM7905CT	NDE	TO-220	3	45	502	33	6985	4.06
LM7905CT	NDE	TO-220	3	45	502	33	6985	4.06
LM7905CT/NOPB	NDE	TO-220	3	45	502	33	6985	4.06
LM7912CT	NDE	TO-220	3	45	502	33	6985	4.06
LM7912CT	NDE	TO-220	3	45	502	33	6985	4.06
LM7912CT/NOPB	NDE	TO-220	3	45	502	33	6985	4.06
LM7915CT	NDE	TO-220	3	45	502	33	6985	4.06
LM7915CT	NDE	TO-220	3	45	502	33	6985	4.06
LM7915CT/NOPB	NDE	TO-220	3	45	502	33	6985	4.06

NDE0003B



IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#) or other applicable terms available either on [ti.com](#) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2022, Texas Instruments Incorporated