

LM105/LM305/LM305A Voltage Regulators

Check for Samples: [LM105](#), [LM305](#), [LM305A](#)

FEATURES

- Important Characteristics of the Circuits are:
- Output Voltage Adjustable from 4.5V to 40V
- Output Currents in Excess of 10A Possible by Adding External Transistors
- Load Regulation Better than 0.1%, Full Load with Current Limiting
- DC Line Regulation Ensured at 0.03%/V
- Ripple Rejection on 0.01%/V
- 45 mA Output Current Without External Pass Transistor (LM305A)

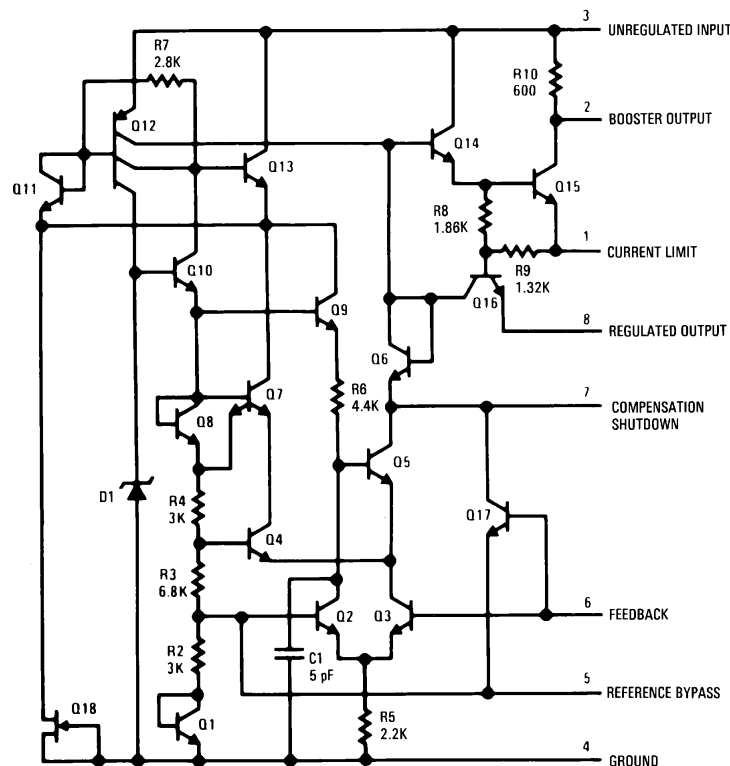
DESCRIPTION

The LM105 series are positive voltage regulators similar to the LM100, except that an extra gain stage has been added for improved regulation. A redesign of the biasing circuitry removes any minimum load current requirement and at the same time reduces standby current drain, permitting higher voltage operation. They are direct, plug-in replacements for the LM100 in both linear and switching regulator circuits with output voltages greater than 4.5V.

Like the LM100, they also feature fast response to both load and line transients, freedom from oscillations with varying resistive and reactive loads and the ability to start reliably on any load within rating. The circuits are built on a single silicon chip and are supplied in a TO-99 metal can.

The LM105 is specified for operation for $-55^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$, and the LM305/LM305A is specified for $0^{\circ}\text{C} \leq T_A \leq +70^{\circ}\text{C}$.

Schematic and Connection Diagrams



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.

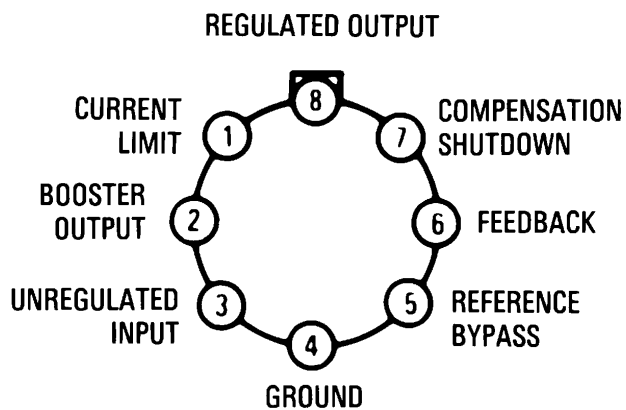


Figure 1. Metal Can Package - TO-99 (Top View)
See Package Number LMC



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⁾⁽³⁾

	LM105	LM305	LM305A
Input Voltage	50V	40V	50V
Input-Output Differential	40V	40V	40V
Power Dissipation ⁽¹⁾	800 mW	800 mW	800 mW
Operating Temperature Range	–55°C to +125°C	0°C to +70°C	0°C to +70°C
Storage Temperature Range	–65°C to +150°C	65°C to +150°C	–65°C to +150°C
Lead Temperature (Soldering, 10 seconds)	300°C	300°C	300°C

- (1) The maximum junction temperature of the LM105 and LM305A is 150°C, and the LM305 is 85°C. For operation at elevated temperatures, devices in the LMC package must be derated based on a thermal resistance of 168°C/W junction to ambient, or 25°C/W junction to case. Peak dissipations to 1W are allowable providing the dissipation rating is not exceeded with the power average over a five second interval for the LM105 and averaged over a two second interval for the LM305.
- (2) Refer to RETS105X Drawing for military specifications for the LM105.
- (3) If Military/Aerospace specified devices are required, please contact the TI Sales Office/ Distributors for availability and specifications.

Electrical Characteristics⁽¹⁾

Parameter	Conditions	LM105			LM305			LM305A			Units
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Input Voltage Range		8.5		50	8.5		40	8.5		50	V
Output Voltage Range		4.5		40	4.5		30	4.5		40	V
Input-Output Voltage Differential		3.0		30	3.0		30	3.0		30	V
Load Regulation ⁽²⁾	$R_{SC} = 10\Omega$, $T_A = 25^\circ\text{C}$		0.02	0.05		0.02	0.05				%
	$R_{SC} = 10\Omega$, $T_A = T_{A(\text{MAX})}$		0.03	0.1		0.03	0.1				%
	$R_{SC} = 10\Omega$, $T_A = T_{A(\text{MIN})}$		0.03	0.1		0.03	0.1				%
		$0 \leq I_O \leq 12 \text{ mA}$			$0 \leq I_O \leq 12 \text{ mA}$						
	$R_{SC} = 0\Omega$, $T_A = 25^\circ\text{C}$								0.02	0.2	%
	$R_{SC} = 0\Omega$, $T_A = 70^\circ\text{C}$								0.03	0.4	%
	$R_{SC} = 0\Omega$, $T_A = 0^\circ\text{C}$								0.03	0.4	%
								$0 \leq I_O \leq 45 \text{ mA}$			
Line Regulation	$T_A = 25^\circ\text{C}$										%/V
	$0^\circ\text{C} \leq T_A \leq +70^\circ\text{C}$										%/V
	$V_{IN} - V_{OUT} \leq 5\text{V}$, $T_A = 25^\circ\text{C}$		0.025	0.06		0.025	0.06		0.025	0.06	%/V
	$V_{IN} - V_{OUT} \geq 5\text{V}$, $T_A = 25^\circ\text{C}$		0.015	0.03		0.015	0.03		0.015	0.03	%/V
Temperature Stability	$T_{A(\text{MIN})} \leq T_A \leq T_{A(\text{MAX})}$		0.3	1.0		0.3	1.0		0.3	1.0	%
Feedback Sense Voltage		1.63	1.7	1.81	1.63	1.7	1.81	1.55	1.7	1.85	V
Output Noise Voltage	$10 \text{ Hz} \leq f \leq 10 \text{ kHz}$										
	$C_{REF} = 0$		0.005			0.005			0.005		%
	$C_{REF} = 0.1 \mu\text{F}$		0.002			0.002			0.002		%
Standby Current Drain	$V_{IN} = 30\text{V}$, $T_A = 25^\circ\text{C}$										mA
	$V_{IN} = 40\text{V}$					0.8	2.0				mA
	$V_{IN} = 50\text{V}$		0.8	2.0					0.8	2.0	mA
Current Limit Sense Voltage	$T_A = 25^\circ\text{C}$, $R_{SC} = 10\Omega$, $V_{OUT} = 0\text{V}$, ⁽³⁾	225	300	375	225	300	375	225	300	375	mV
Long Term Stability			0.1			0.1			0.1		%
Ripple Rejection	$C_{REF} = 10 \mu\text{F}$, $f = 120 \text{ Hz}$		0.003			0.003			0.003		%/V
θ_{JA}	TO-99 Board Mount in Still Air		230			230			230		$^\circ\text{C/W}$
θ_{JA}	TO-99 Board Mount in 400 LF/Min Air Flow		92			92			92		$^\circ\text{C/W}$
θ_{JC}	TO-99		25			25			25		$^\circ\text{C/W}$

- (1) Unless otherwise specified, these specifications apply for temperatures within the operating temperature range, for input and output voltages within the range given, and for a divider impedance seen by the feedback terminal of 2 k Ω . Load and line regulation specifications are for a constant junction temperature. Temperature drift effects must be taken into account separately when the unit is operating under conditions of high dissipation.
- (2) The output currents given, as well as the load regulation, can be increased by the addition of external transistors. The improvement factor will be roughly equal to the composite current gain of the added transistors.
- (3) With no external pass transistor.

Typical Performance Characteristics

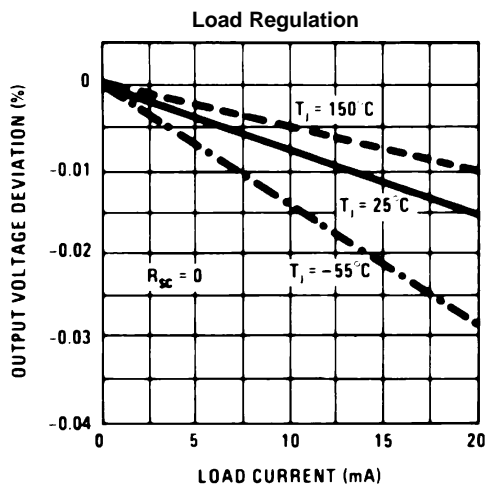


Figure 2.

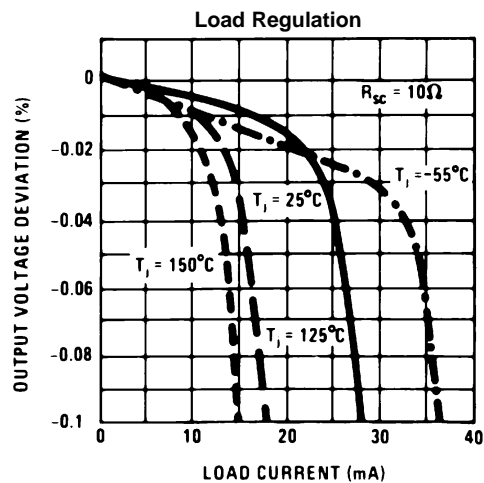


Figure 3.

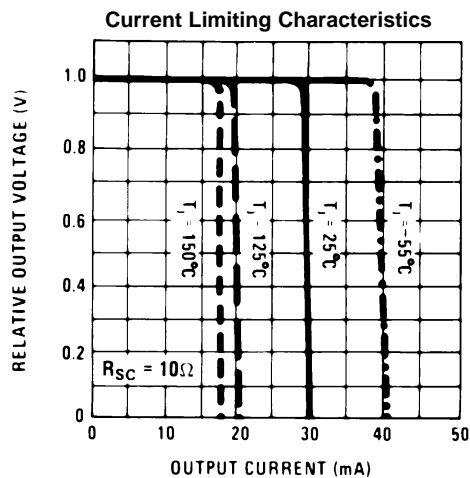


Figure 4.

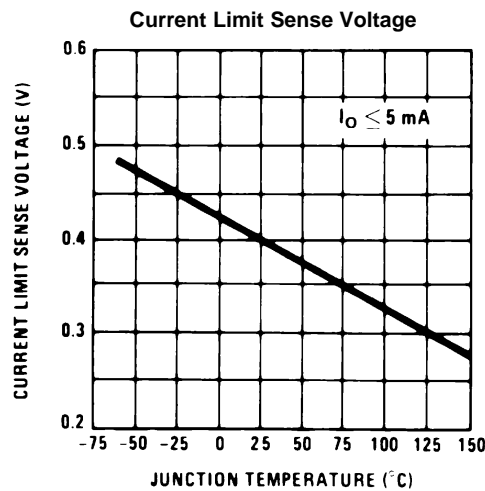


Figure 5.

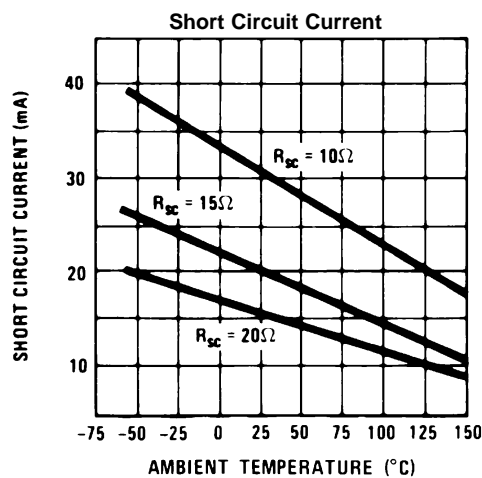


Figure 6.

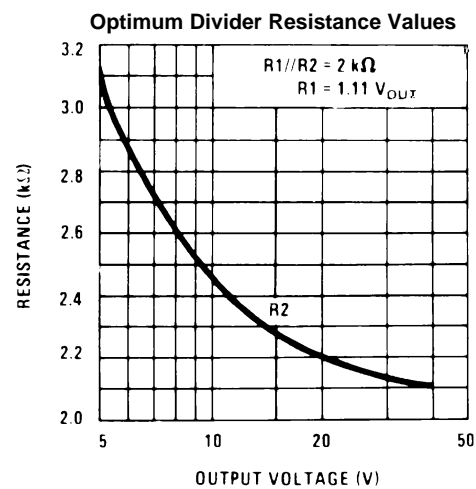
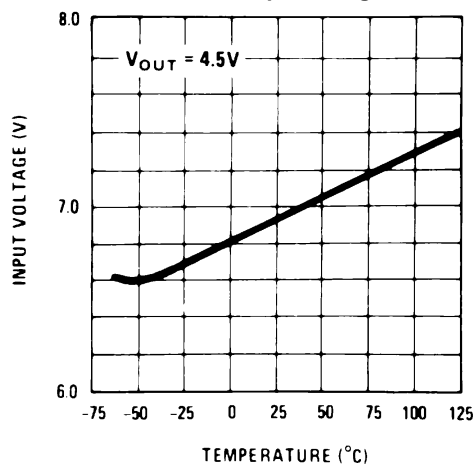
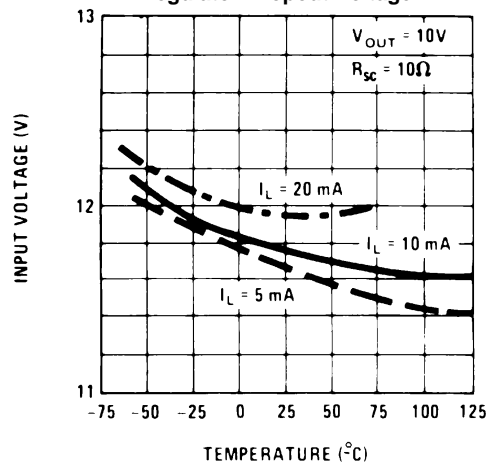
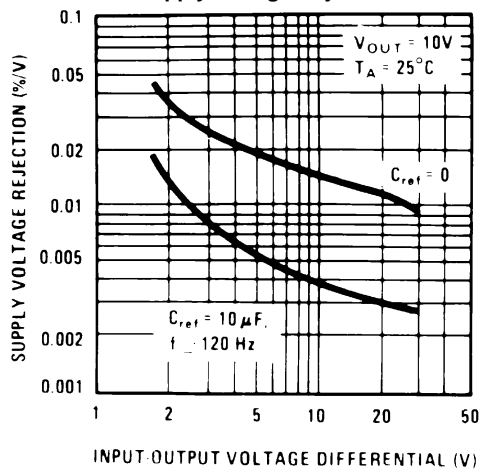
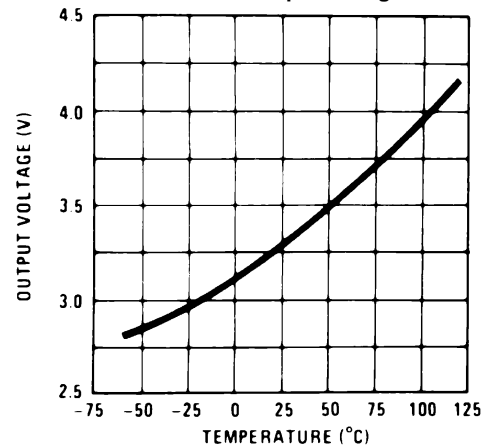
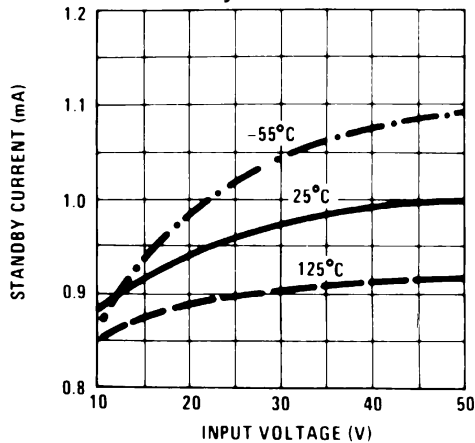
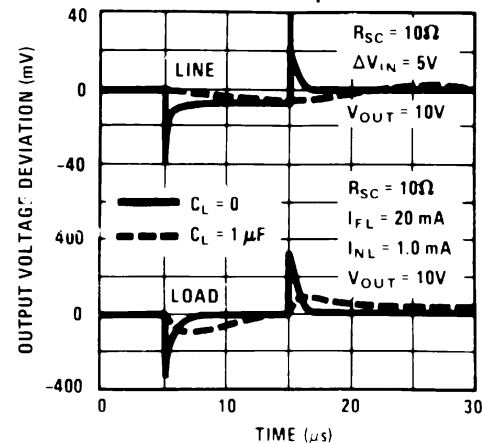
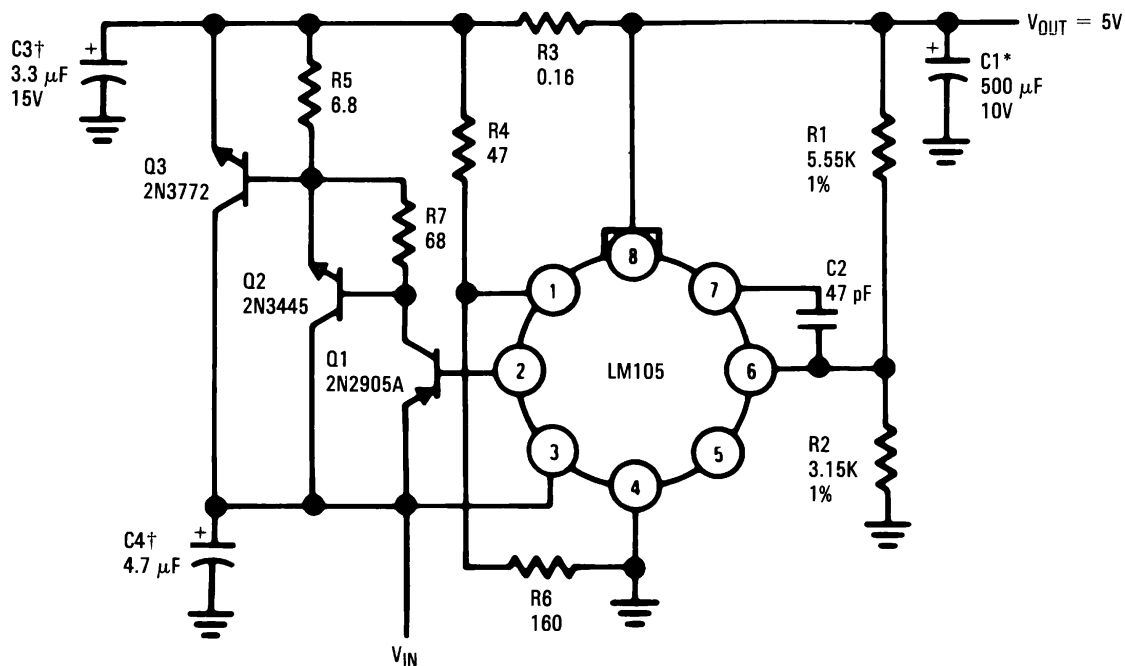


Figure 7.

Typical Performance Characteristics (continued)**Minimum Input Voltage****Figure 8.****Regulator Dropout Voltage****Figure 9.****Supply Voltage Rejection****Figure 10.****Minimum Output Voltage****Figure 11.****Standby Current Drain****Figure 12.****Transient Response****Figure 13.**

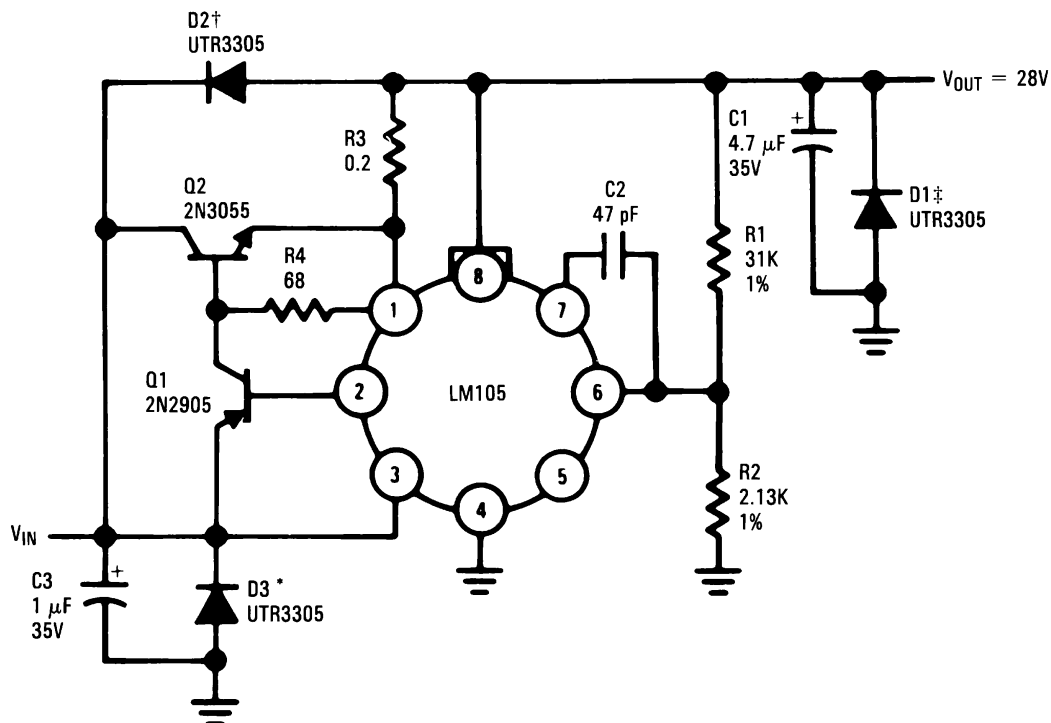
TYPICAL APPLICATIONS



†Solid tantalum.

*Electrolytic

Figure 14. 10A Regulator with Foldback Current Limiting



†Protects against shorted input or inductive leads on unregulated supply.

*Protects against input voltage reversal.

††Protects against output voltage reversal.

Figure 15. 1.0A Regulator with Protective Diodes

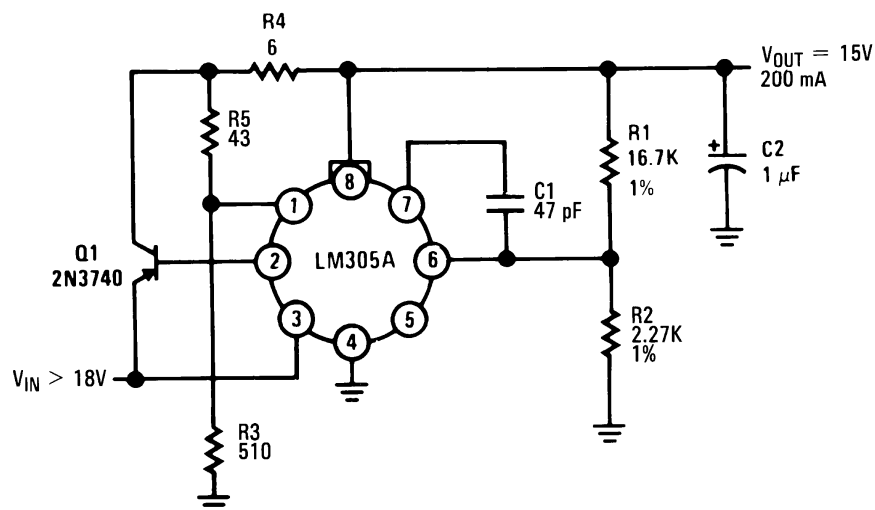


Figure 16. Linear Regulator with Foldback Current Limiting

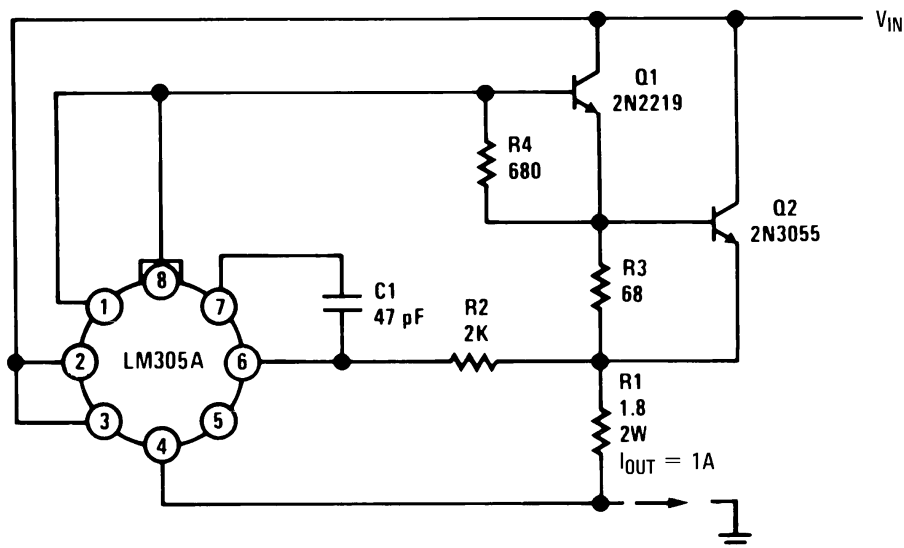


Figure 17. Current Regulator

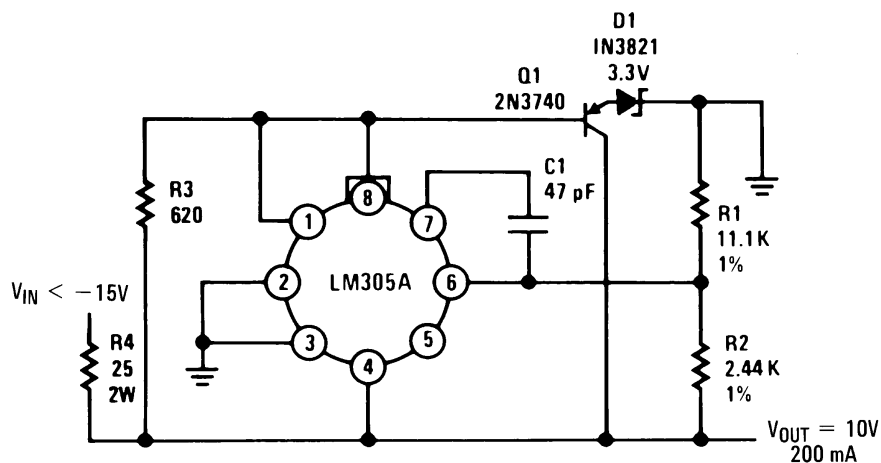
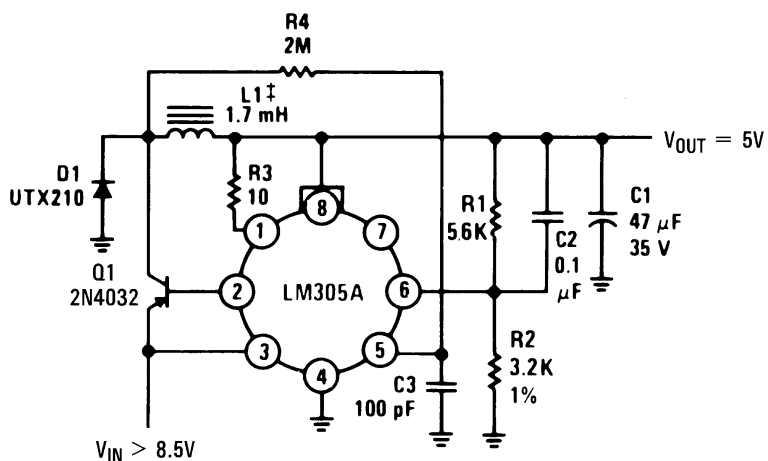


Figure 18. Shunt Regulator



†Solid tantalum.

††125 turns =22 on Arnold

Engineering A262123-2 molybdenum permally core.

Figure 19. Switching Regulator

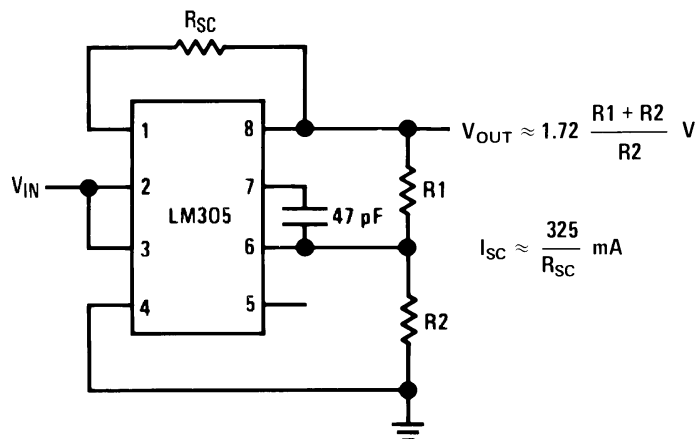
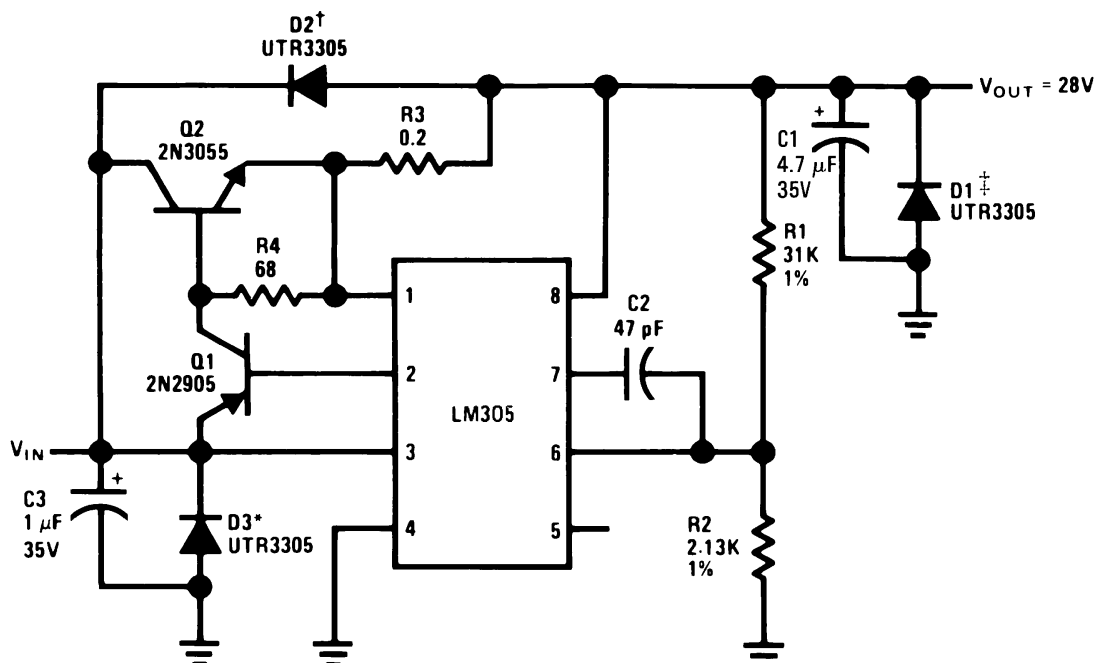


Figure 20. Basic Positive Regulator with Current Limiting



†Protects against shorted input or inductive loads on unregulated supply.

*Protects against input voltage reversal.

††Protects against output voltage reversal.

Figure 21. 1.0A Regulator with Protective Diodes

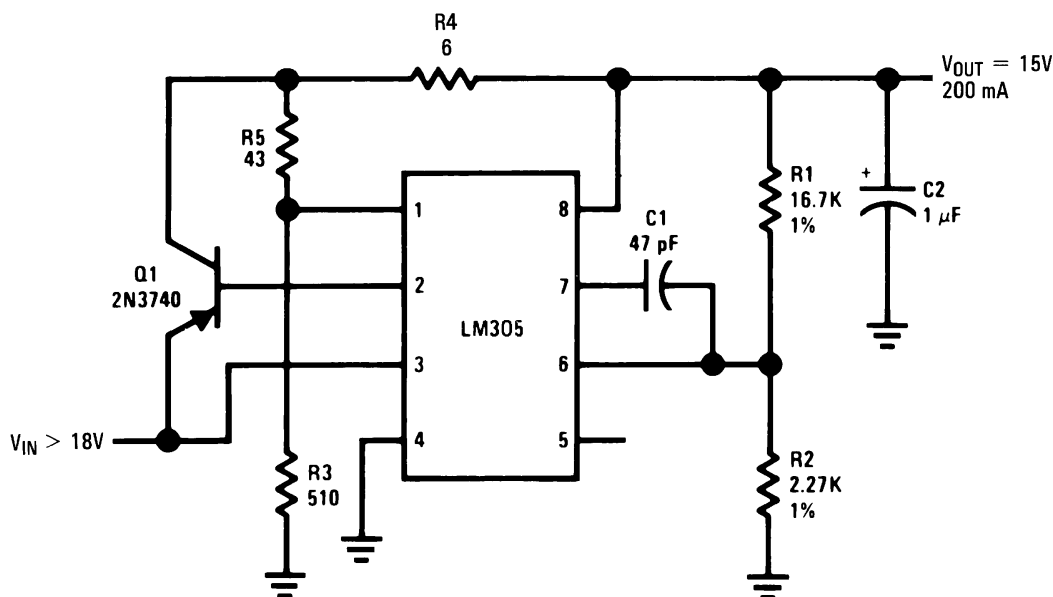


Figure 22. Linear Regulator with Foldback Current Limiting

REVISION HISTORY

Changes from Revision C (April 2013) to Revision D	Page
• Changed layout of National Data Sheet to TI format	7

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community

e2e.ti.com