

LM105/LM305/LM305A Voltage Regulators

General 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. Important characteristics of the circuits are:

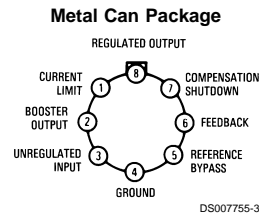
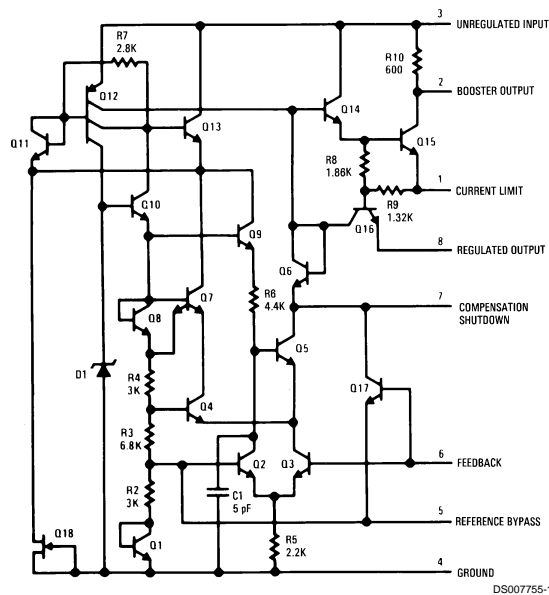
- Output voltage adjustable from 4.5V to 40V
- Output currents in excess of 10A possible by adding external transistors
- Load regulation better than 0.1%, full load with current limiting

- DC line regulation guaranteed at 0.03%/V
- Ripple rejection on 0.01%V
- 45 mA output current without external pass transistor (LM305A)

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



Top View
Order Number LM105H, LM105H/883,
SMD #5962-8958801, LM305H or LM305AH
See NS Package Number H08C

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

(Note 5)

	LM105	LM305	LM305A
Input Voltage	50V	40V	50V
Input-Output Differential	40V	40V	40V
Power Dissipation (Note 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

Electrical Characteristics (Note 2)

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 (Note 3)	$R_{SC} = 10\Omega, T_A = 25^\circ\text{C}$		0.02	0.05		0.02	0.05				%	
	$R_{SC} = 10\Omega, T_A = T_{A(MAX)}$		0.03	0.1		0.03	0.1				%	
	$R_{SC} = 10\Omega, T_A = T_{A(MIN)}$		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	$T_{A(MIN)} \leq T_A \leq T_{A(MAX)}$		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	$T_A = 25^\circ\text{C}, R_{SC} = 10\Omega, V_{OUT} = 0\text{V}, (\text{Note } 4)$	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		°C/W	
θ_{JA}	TO-99 Board Mount in 400 LF/Min Air Flow		92			92			92		°C/W	
θ_{JC}	TO-99		25			25			25		°C/W	

Electrical Characteristics (Note 2) (Continued)

Note 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 H08C 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.

Note 2: 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 kΩ. 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.

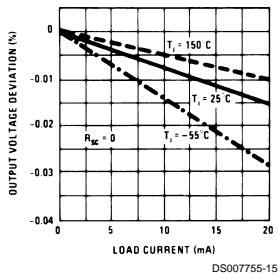
Note 3: The output currents given, as well as the load regulation, can be increased by the addition of external transistors. The improvement factor will be roughly equal to the composite current gain of the added transistors.

Note 4: With no external pass transistor.

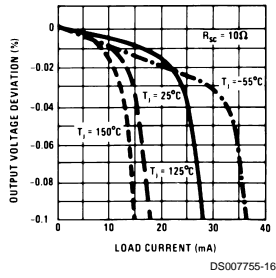
Note 5: Refer to RETS105X Drawing for military specifications for the LM105.

Typical Performance Characteristics

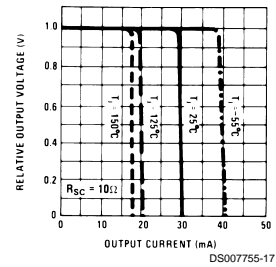
Load Regulation



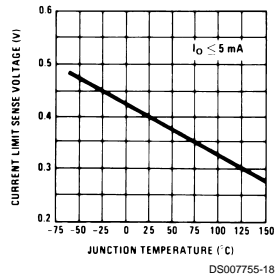
Load Regulation



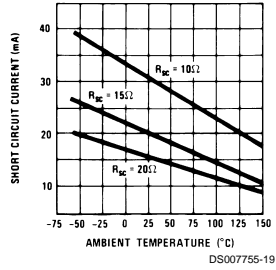
Current Limiting Characteristics



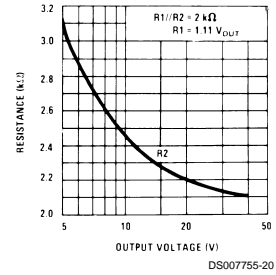
Current Limit Sense Voltage



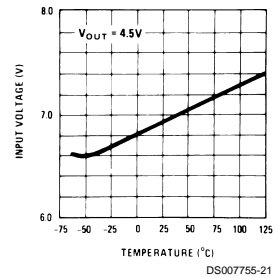
Short Circuit Current



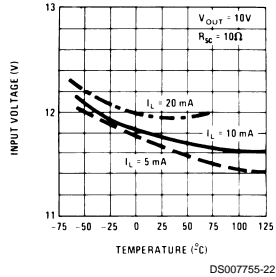
Optimum Divider Resistance Values



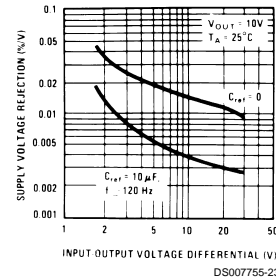
Minimum Input Voltage



Regulator Dropout Voltage

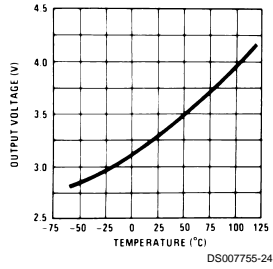


Supply Voltage Rejection

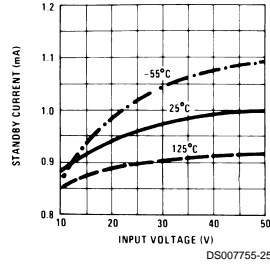


Typical Performance Characteristics (Continued)

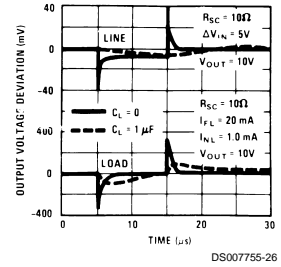
Minimum Output Voltage



Standby Current Drain

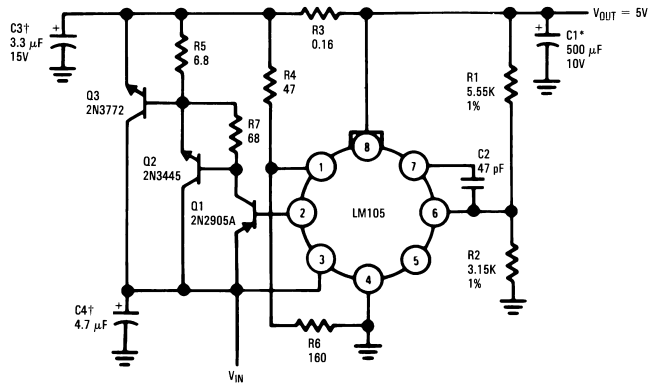


Transient Response



Typical Applications

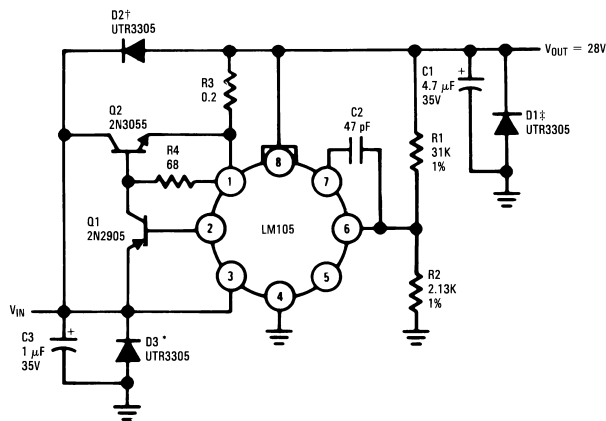
10A Regulator with Foldback Current Limiting



DS007755-4

†Solid tantalum.
*Electrolytic

1.0A Regulator with Protective Diodes

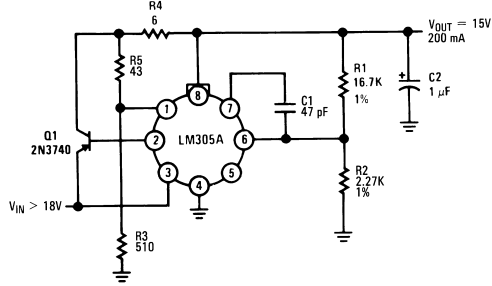


DS007755-5

†Protects against shorted input or inductive loads on unregulated supply.
*Protects against input voltage reversal.
††Protects against output voltage reversal.

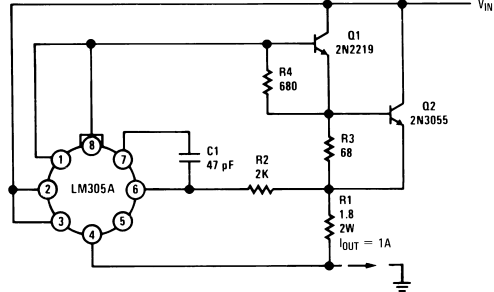
Typical Applications (Continued)

Linear Regulator with Foldback Current Limiting



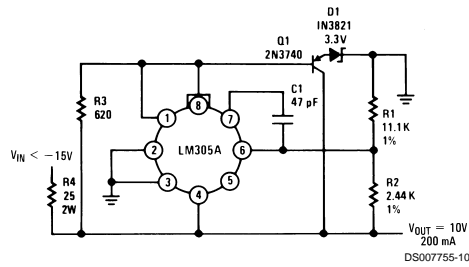
DS007755-8

Current Regulator



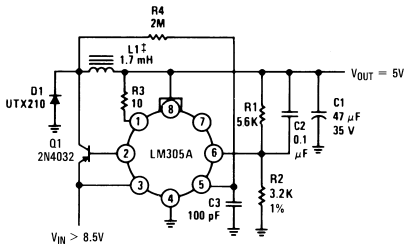
DS007755-9

Shunt Regulator



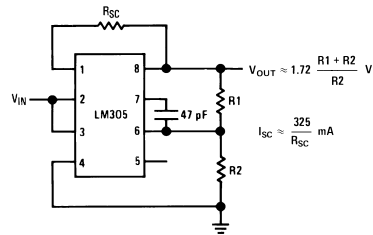
DS007755-10

Switching Regulator



DS007755-11

Basic Positive Regulator with Current Limiting



DS007755-12

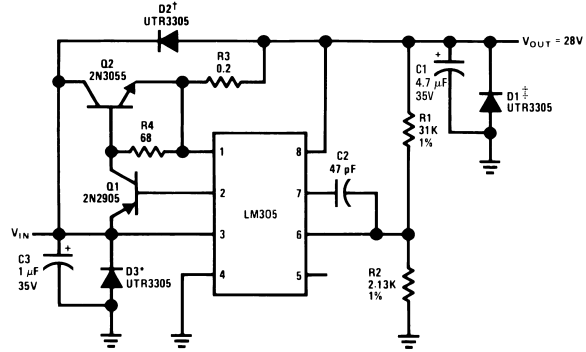
†Solid tantaium.

††125 turns = 22 on Arnold

Engineering A262123-2 molybdenum permally core.

Typical Applications (Continued)

1.0A Regulator with Protective Diodes



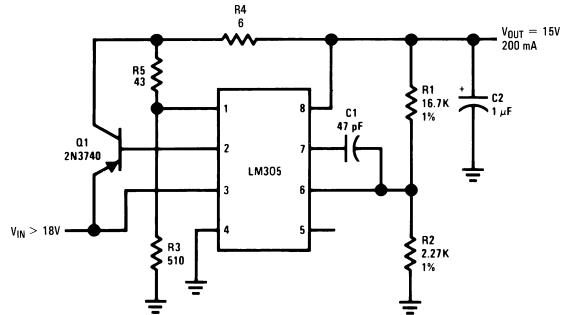
DS007755-13

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

*Protects against input voltage reversal.

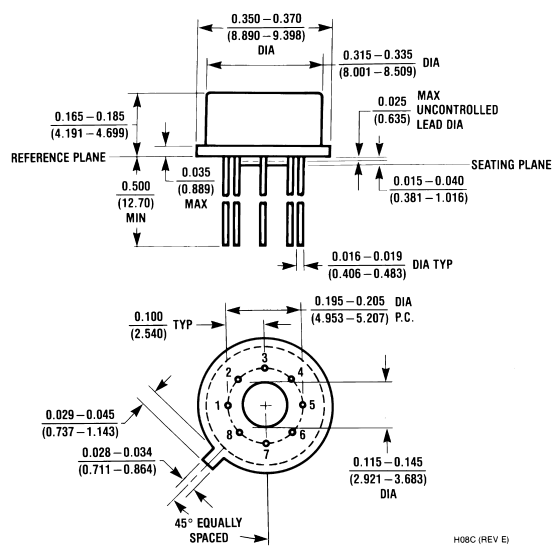
‡Protects against output voltage reversal.

Linear Regulator with Foldback Current Limiting



DS007755-14

Physical Dimensions inches (millimeters) unless otherwise noted




Metal Can Package (H)
Order Number LM105H, LM105H/883, SMD #5962-8958801, LM305H or LM305AH
NS Package Number H08C

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT AND GENERAL COUNSEL OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

 <p>National Semiconductor Corporation Americas Tel: 1-800-272-9959 Fax: 1-800-737-7018 Email: support@nsc.com www.national.com</p>	<p>National Semiconductor Europe Fax: +49 (0) 1 80-530 85 86 Email: europe.support@nsc.com Deutsch Tel: +49 (0) 1 80-530 85 85 English Tel: +49 (0) 1 80-532 78 32 Français Tel: +49 (0) 1 80-532 93 58 Italiano Tel: +49 (0) 1 80-534 16 80</p>	<p>National Semiconductor Asia Pacific Customer Response Group Tel: 65-2544466 Fax: 65-2504466 Email: sea.support@nsc.com</p>	<p>National Semiconductor Japan Ltd. Tel: 81-3-5639-7560 Fax: 81-3-5639-7507</p>
--	---	---	---

National does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and National reserves the right at any time without notice to change said circuitry and specifications.