National Semiconductor

June 1999

LM105/LM305/LM305A Voltage Regulators

General Description

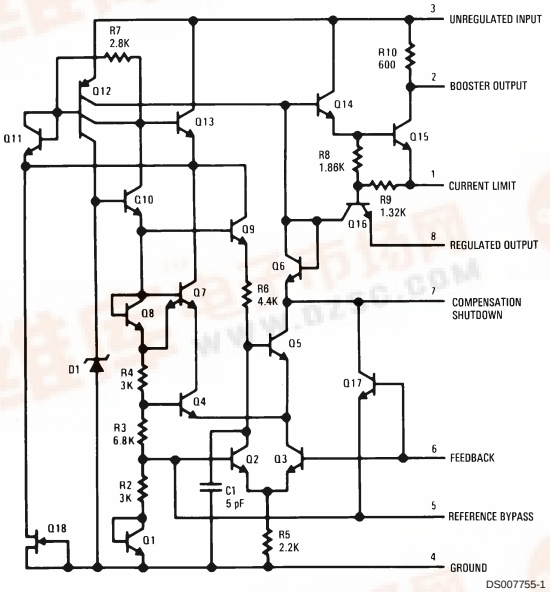
The LM105 series are positive voltage regulators similar to the LM100, except that an extra gain stage has been added for improved regulation. A redesign of the biasing circuitry removes any minimum load current requirement and at the same time reduces standby current drain, permitting higher voltage 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 $-55^{\circ}C \leq T_A \leq +125^{\circ}C$, and the LM305/LM305A is specified for $0^{\circ}C \leq T_A \leq +70^{\circ}C$.

Schematic and Connection Diagrams



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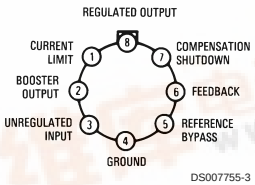
Metal Can Package



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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} = 10Ω, T_A = 25˚C		0.02	0.05		0.02	0.05				%
	R_{SC} = 10Ω, T_A = $T_{A(MAX)}$		0.03	0.1		0.03	0.1				%
	R_{SC} = 10Ω, T_A = $T_{A(MIN)}$		0.03	0.1		0.03	0.1				%
		0 ≤ I_O ≤ 12 mA			0 ≤ I_O ≤ 12 mA						
	R_{SC} = 0Ω, T_A = 25˚C								0.02	0.2	%
	R_{SC} = 0Ω, T_A = 70˚C								0.03	0.4	%
	R_{SC} = 0Ω, T_A = 0˚C								0.03	0.4	%
								0 ≤ I_O ≤ 45 mA			
Line Regulation	T_A = 25˚C										%/V
	0˚C ≤ T_A ≤ +70˚C										%/V
	V_{IN} − V_{OUT} ≤ 5V, T_A = 25˚C		0.025	0.06		0.025	0.06		0.025	0.06	%/V
	V_{IN} − V_{OUT} ≥ 5V, T_A = 25˚C		0.015	0.03		0.015	0.03		0.015	0.03	%/V
Temperature Stability	$T_{A(MIN)}$ ≤ T_A ≤ $T_{A(MAX)}$		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 Hz ≤ f ≤ 10 kHz										
	C_{REF} = 0		0.005			0.005			0.005		%
	C_{REF} = 0.1 µF		0.002			0.002			0.002		%
Standby Current Drain	V_{IN} = 30V, T_A = 25˚C										mA
	V_{IN} = 40V					0.8	2.0				mA
	V_{IN} = 50V		0.8	2.0					0.8	2.0	mA
Current Limit Sense Voltage	T_A = 25˚C, R_{SC} = 10Ω, V_{OUT} = 0V, (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 µF, f = 120 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.

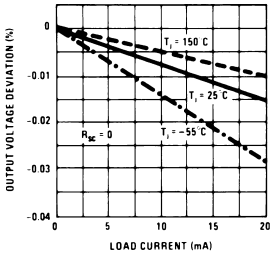
Note 3: The output currents given, as well as the load regulation, can be increased by the addition of external transistors. The improvement factor will be roughly equal to the composite current gain of the added transistors.

Note 4: With no external pass transistor.

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

Typical Performance Characteristics

Load Regulation



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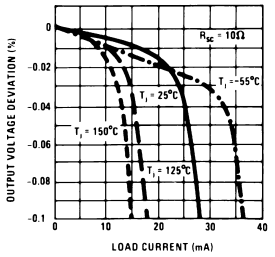
Load Regulation



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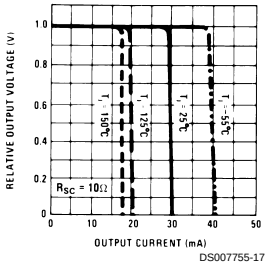
Current Limiting Characteristics



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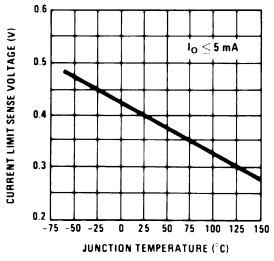
Current Limit Sense Voltage



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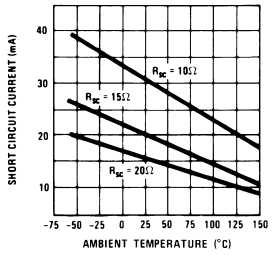
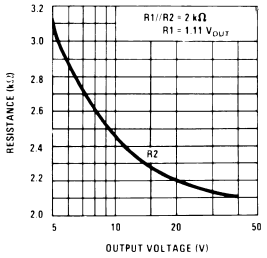
Short Circuit Current



DS007755-19

Optimum Divider Resistance Values



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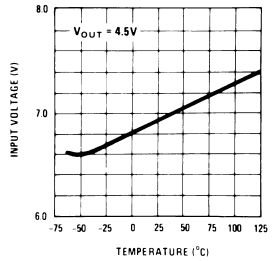
Minimum Input Voltage



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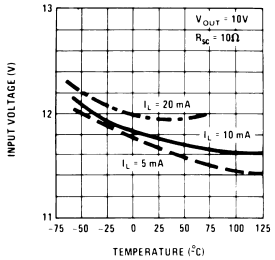
Regulator Dropout Voltage



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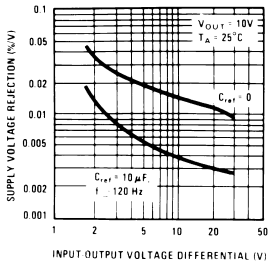
Supply Voltage Rejection



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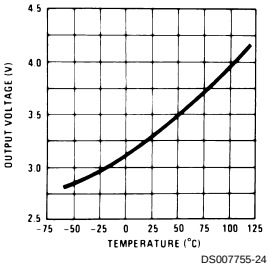
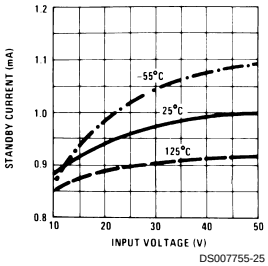
Typical Performance Characteristics (Continued)

Minimum Output Voltage



DS007755-24

Standby Current Drain



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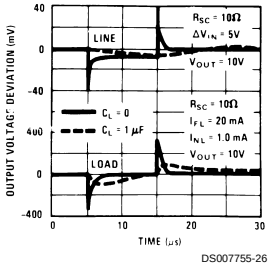
Transient Response



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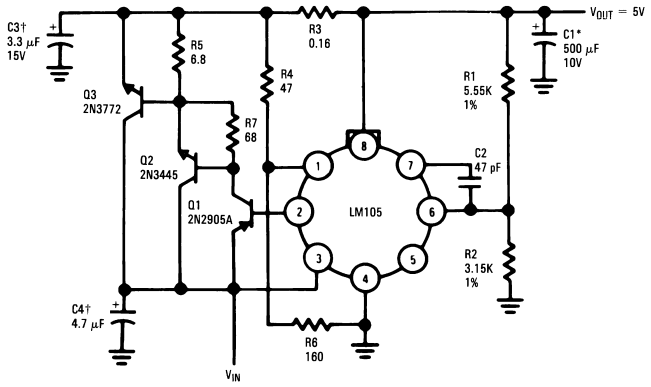
Typical Applications

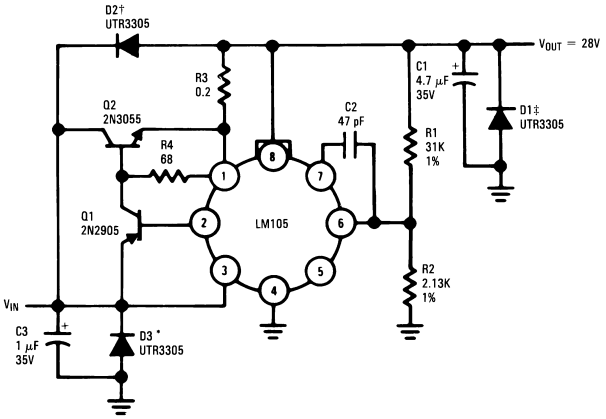
10A Regulator with Foldback Current Limiting



DS007755-4

†Solid tantalum.
*Electrolytic

1.0A Regulator with Protective Diodes

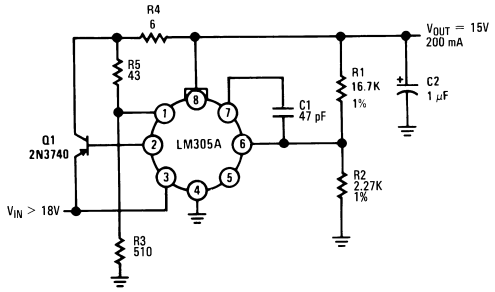


DS007755-5

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

Typical Applications (Continued)

Linear Regulator with Foldback Current Limiting



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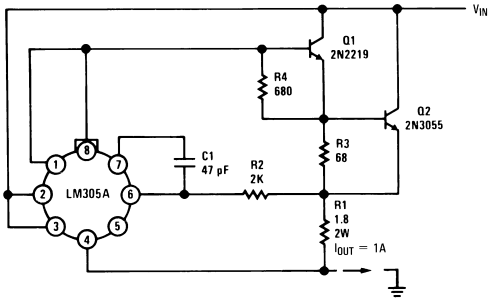
Current Regulator



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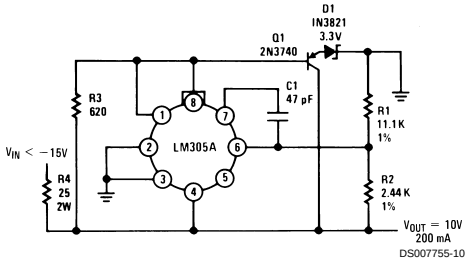
Shunt Regulator



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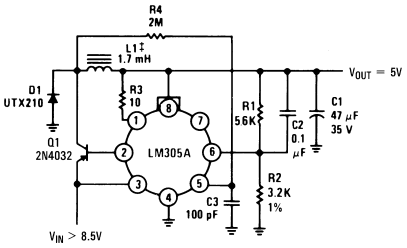
Switching Regulator



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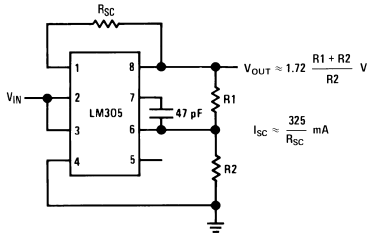
Basic Positive Regulator with Current Limiting

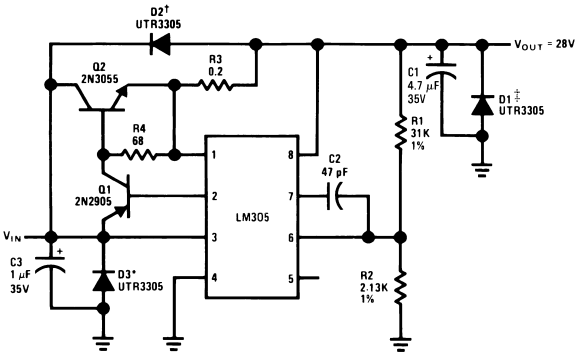


DS007755-12

†Solid tantaium.
††125 turns =22 on Arnold
Engineering A262123-2 molybdenum permally core.

Typical Applications (Continued)

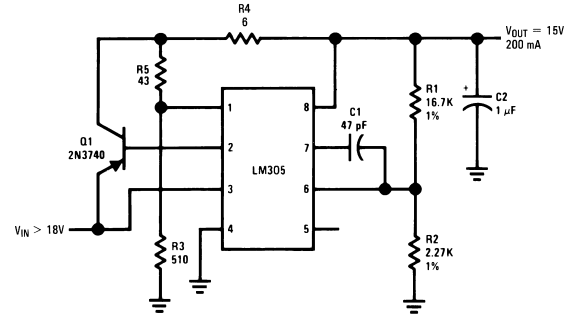
1.0A Regulator with Protective Diodes



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



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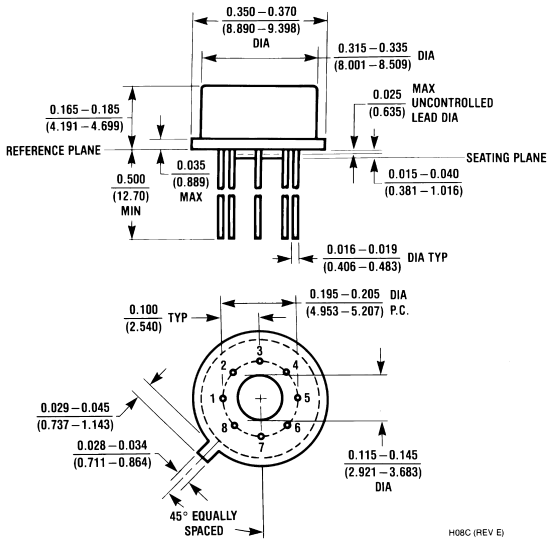
Physical Dimensions inches (millimeters) unless otherwise noted



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

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