

LINEAR INTEGRATED CIRCUITS

TYPES LM105, LM205, LM305, LM305A, LM376 POSITIVE-VOLTAGE REGULATORS

BULLETIN NO. DL-S 12057, SEPTEMBER 1973—REVISED JUNE 1976

FORMERLY SN52105, SN72305,
SN72305A, SN72376

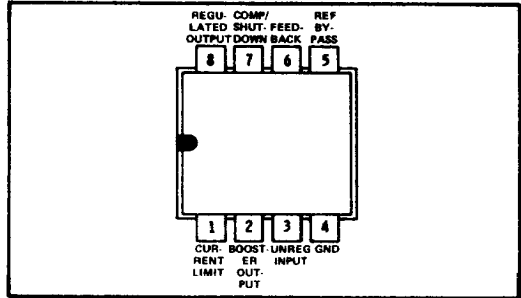
- Low Standby Current . . . 0.8 mA Typ
- Adjustable Output Voltage
- Load Regulation . . . 0.1% Max (LM105, LM205, LM305)
- Input Regulation . . . 0.06%/V Max
- Designed to be Interchangeable with National LM105, LM205, LM305, LM305A, and LM376 Respectively

description

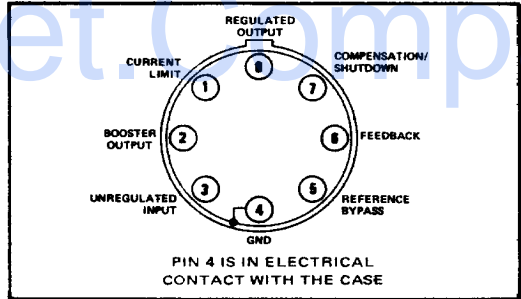
The LM105, LM205, LM305, LM305A and LM376 are monolithic positive-voltage regulators designed for a wide range of applications from digital power supplies to precision regulators for analog systems. These devices will not oscillate under conditions of varying resistive and reactive loads and will start reliably with any load within the rating of the circuits.

The LM105 is characterized for operation over the full military temperature range of -55°C to 125°C ; the LM205 is characterized for operation from -25°C to 85°C , and the LM305, LM305A, and LM376 are characterized for operation from 0°C to 70°C .

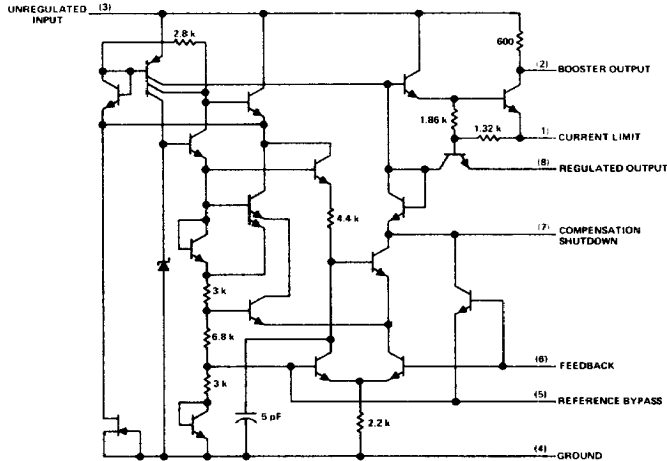
LM105 . . . JG
LM205, LM305, LM305A, LM376 . . . JG OR P
DUAL-IN-LINE PACKAGE (TOP VIEW)



LM105, LM205, LM305, LM305A, LM376 . . . L
PLUG-IN PACKAGE (TOP VIEW)



schematic



Component values shown are nominal.
Resistor values are in ohms.

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TYPES LM105, LM205, LM305, LM305A, LM376

POSITIVE-VOLTAGE REGULATORS

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

	LM105	LM205	LM305A	LM305 LM376	UNIT
Input voltage (see Note 1)	50	50	50	40	V
Input-to-output voltage differential	40	40	40	40	V
Continuous total dissipation at (or below) 25°C free-air temperature (see Note 2)	800	800	800	800	mW
Operating free-air temperature range	-55 to 125	-25 to 85	0 to 70	0 to 70	°C
Storage temperature range	-65 to 150	-65 to 150	-65 to 150	-65 to 150	°C
Lead temperature 1/16 inch from case for 60 seconds: JG or L package	300	300	300	300	°C
Lead temperature 1/16 inch from case for 10 seconds: P package		260	260	260	°C

NOTES: 1. Voltage values, except input-to-output voltage differential, are with respect to network ground terminal.
2. For operation above 25°C free-air temperature, refer to Dissipation Derating Curves, Figures I, II, and IV, page 90. This rating for the L package requires a heat sink that provides a thermal resistance from case to free-air, $R_{\theta CA}$, of not more than 105°C/W.

recommended operating conditions

	LM105		LM205		LM305A		LM305		LM376		UNIT
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
Input voltage, V_I	8.5	50	8.5	50	8.5	50	8.5	40	9	40	V
Output voltage, V_O	4.5	40	4.5	40	4.5	40	4.5	30	5	37	V
Input-to-output voltage differential, $V_I - V_O$	3	30	3	30	3	30	3	30	3	30	V
Output current, I_O	0	12	0	12	0	45	0	12	0	25	mA
Operating free-air temperature, T_A	-55	125	-25	85	0	70	0	70	0	70	°C

LM105, LM205, LM305 electrical characteristics[†] at 25°C free-air temperature (unless otherwise noted)

PARAMETER	TEST CONDITIONS [‡]			LM105, LM205			LM305			UNIT	
	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX		
Input regulation	$V_I - V_O \leq 5$ V			See Note 3			0.025	0.06	0.025	0.06	% / V
	$V_I - V_O > 5$ V						0.015	0.03	0.015	0.03	
Ripple sensitivity	$C_{ref} = 10 \mu\text{F}$, $f = 120$ Hz						0.003	0.01	0.003	0.01	% / V
Output regulation (see Note 4)	$I_O = 0$ to $I_O = 12$ mA, See Note 3			$R_{SC} = 10 \Omega$, $T_A = 25^\circ\text{C}$			0.02	0.05	0.02	0.05	%
				$R_{SC} = 10 \Omega$, $T_A = \text{MIN}$			0.03	0.1	0.03	0.1	
				$R_{SC} = 10 \Omega$, $T_A = \text{MAX}$			0.03	0.1			
				$R_{SC} = 15 \Omega$, $T_A = \text{MAX}$					0.03	0.1	
Output voltage change with temperature	$T_A = \text{MIN}$ to $T_A = 25^\circ\text{C}$						1		1	%	
	$T_A = 25^\circ\text{C}$ to $T_A = \text{MAX}$						1		1		
Output noise voltage	$f = 10$ Hz to 10 kHz			$C_{ref} = 0$			0.005		0.005		%
				$C_{ref} > 0.1 \mu\text{F}$			0.002		0.002		
Feedback sense voltage				1.63	1.7	1.81	1.63	1.7	1.81	V	
Current-limit sense voltage	$R_{SC} = 10 \Omega$, $V_O = 0$, See Note 5			225	300	375	225	300	375	mV	
Standby current	$V_I = 50$ V						0.8	2		mA	
	$V_I = 40$ V								0.8		2

[†] These specifications apply for input and output voltages within the ranges specified under recommended operating conditions and for a divider impedance of 2 k Ω presented to the feedback terminal, unless otherwise noted.

[‡] For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

NOTES: 3. Input regulation and output regulation are measured using pulse techniques ($t_w < 10 \mu\text{s}$, duty cycle $\leq 5\%$) to limit changes in average internal dissipation. Output voltage changes due to large changes in internal dissipation must be taken into account separately.

4. Load regulation and output current capacity can be improved by the addition of external transistors. The improvement factor will be approximately equal to the composite current gain of the added transistors.

5. Current-limit sense voltage is measured without an external pass transistor.

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TYPES LM105, LM205, LM305, LM305A, LM376 POSITIVE-VOLTAGE REGULATORS

LM305A, LM376 electrical characteristics[†] at 25°C free-air temperature (unless otherwise noted)

PARAMETER	TEST CONDITIONS [‡]		LM305A			LM376			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
Input regulation	$V_I - V_O \leq 5 \text{ V}$	See Note 3	0.025	0.06				0.03	% / V
	$V_I - V_O > 5 \text{ V}$		0.015	0.03			0.03		
	$T_A = 0^\circ \text{C to } 70^\circ \text{C}$						0.1		
Ripple sensitivity	$C_{\text{ref}} = 10 \mu\text{F}$, $f = 120 \text{ Hz}$		0.003					% / V	
							0.1	% / V	
Output regulation (see Note 4)	$I_O = 0 \text{ to } I_O = \text{MAX}$, See Note 3	$R_{\text{SC}} = 0 \Omega$, $T_A = 25^\circ \text{C}$	0.02	0.2			0.2	%	
		$R_{\text{SC}} = 0 \Omega$, $T_A = 0^\circ \text{C}$	0.03	0.4			0.5		
		$R_{\text{SC}} = 0 \Omega$, $T_A = 70^\circ \text{C}$	0.03	0.4			0.5		
Output voltage change with temperature	$T_A = 0^\circ \text{C to } T_A = 25^\circ \text{C}$			1			1	%	
	$T_A = 25^\circ \text{C to } T_A = 70^\circ \text{C}$			1			1		
Output noise voltage	$f = 10 \text{ Hz to } 10 \text{ kHz}$	$C_{\text{ref}} = 0$	0.005					%	
		$C_{\text{ref}} > 0.1 \mu\text{F}$	0.002						
Feedback sense voltage	$T_A = 0^\circ \text{C to } T_A = 70^\circ \text{C}$		1.55	1.7	1.85			V	
Current limit sense voltage	$R_{\text{SC}} = 10 \Omega$, $V_O = 0 \text{ V}$, See Note 5		225	300	375		300	mV	
Standby current	$V_I = 50 \text{ V}$		0.8	2				mA	
	$V_I = 30 \text{ V}$						2.5		

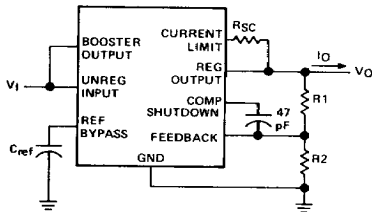
[†]These specifications apply for input and output voltages within the ranges specified under recommended operating conditions, and for a divider impedance of 2 kΩ presented to the feedback terminal, unless otherwise noted.

[‡]For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

NOTES: 3. Input regulation and output regulation are measured using pulse techniques ($t_w \leq 10 \mu\text{s}$, duty cycle $\leq 5\%$) to limit changes in average internal dissipation. Output voltage changes due to large changes in internal dissipation must be taken into account separately.

4. Load regulation and output current capacity can be improved by the addition of external transistors. The improvement factor will be approximately equal to the composite current gain of the added transistors.
5. Current-limit sense voltage is measured without an external pass transistor.

TYPICAL APPLICATION DATA



$$V_O \approx 1.7 \frac{R_1 + R_2}{R_2} \text{ V}$$

$$I_{\text{SC}} \approx \frac{325}{R_{\text{SC}}} \text{ mA}$$

FIGURE 1—BASIC REGULATOR WITH CURRENT LIMITING

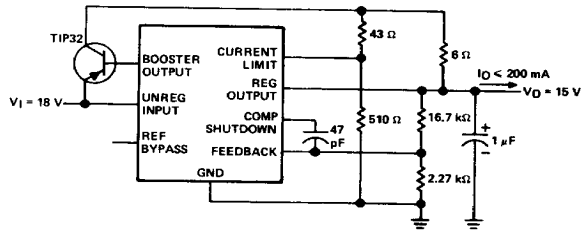


FIGURE 2—LINEAR REGULATOR WITH FOLDBACK CURRENT LIMITING

TYPES LM105, LM205, LM305, LM305A, LM376 POSITIVE-VOLTAGE REGULATORS

TYPICAL APPLICATION DATA

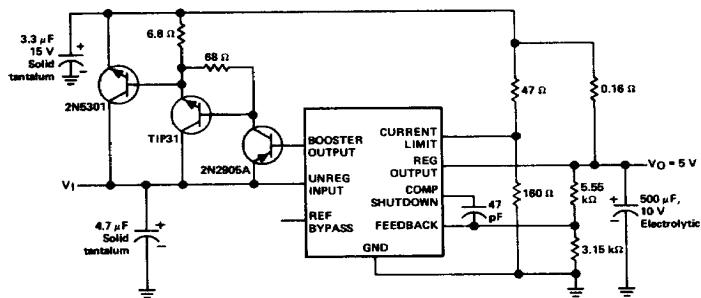


FIGURE 3—10-A REGULATOR WITH
FOLDBACK CURRENT LIMITING

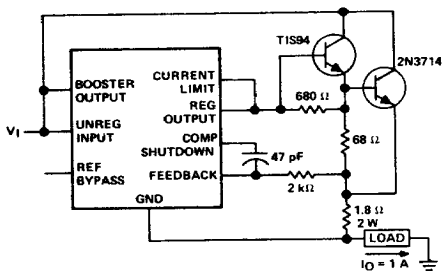
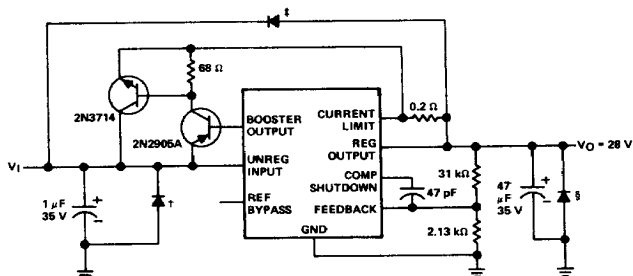


FIGURE 4—CURRENT REGULATOR



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

FIGURE 5—1-A REGULATOR WITH
PROTECTIVE DIODES

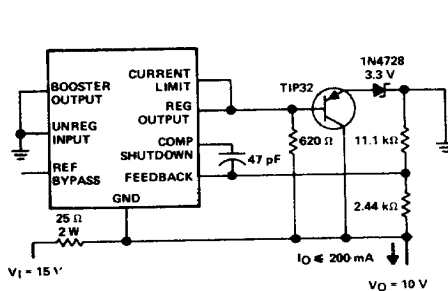


FIGURE 6—SHUNT REGULATOR

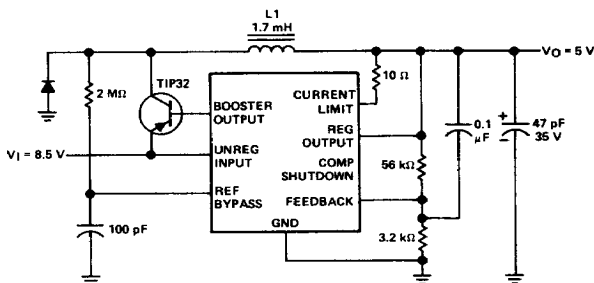


FIGURE 7—SWITCHING REGULATOR

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