

LM120/LM320 Series 3-Terminal Negative Regulators

General Description

The LM120 series are three-terminal negative regulators with a fixed output voltage of $-5V$, $-12V$, and $-15V$, and up to 1.5A load current capability. Where other voltages are required, the LM137 and LM137HV series provide an output voltage range of $-1.2V$ to $-47V$.

The LM120 need only one external component—a compensation capacitor at the output, making them easy to apply. Worst case guarantees on output voltage deviation due to any combination of line, load or temperature variation assure satisfactory system operation.

Exceptional effort has been made to make the LM120 Series immune to overload conditions. The regulators have current limiting which is independent of temperature, combined with thermal overload protection. Internal current limiting protects against momentary faults while thermal shutdown prevents junction temperatures from exceeding safe limits during prolonged overloads.

Although primarily intended for fixed output voltage applications, the LM120 Series may be programmed for higher output voltages with a simple resistive divider. The low quiescent drain current of the devices allows this technique to be used with good regulation.

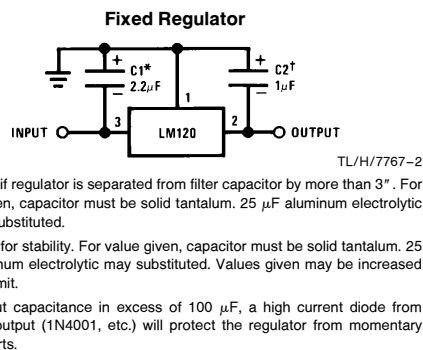
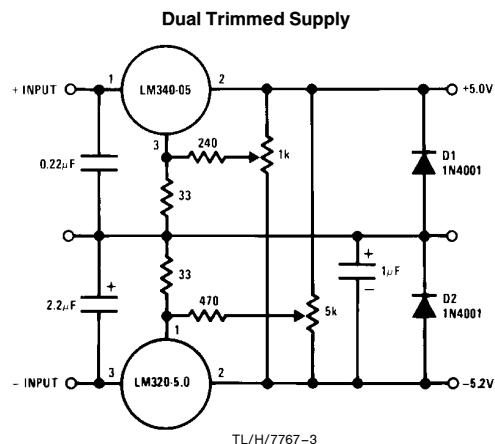
Features

- Preset output voltage error less than $\pm 3\%$
- Preset current limit
- Internal thermal shutdown
- Operates with input-output voltage differential down to 1V
- Excellent ripple rejection
- Low temperature drift
- Easily adjustable to higher output voltage

LM120 Series Packages and Power Capability

Device	Package	Rated Power Dissipation	Design Load Current
LM120/LM320	TO-3 (K)	20W	1.5A
	TO-39 (H)	2W	0.5A
LM320	TO-220 (T)	15W	1.5A
LM320M	TO-202 (P)	7.5W	0.5A

Typical Applications



—5 Volt Regulators (Note 3)

Absolute Maximum Ratings

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications. (Note 5)

Power Dissipation
Input Voltage

Internally Limited
–25V

Input-Output Voltage Differential
Junction Temperatures

25V
See Note 1

Storage Temperature Range

–65°C to +150°C

Lead Temperature (Soldering, 10 sec.)

300°C

Plastic

260°C

Electrical Characteristics

Order Numbers		Metal Can Package										Power Plastic Package		Units
		LM120K-5.0 (TO-3)		LM320K-5.0 (TO-3)		LM120H-5.0 (TO-39)		LM320H-5.0 (TO-39)		LM320T-5.0 (TO-220)				
Design Output Current (I _O) Device Dissipation (P _D)		1.5A 20W	1.5A 20W	0.5A 2W	0.5A 2W	1.5A 20W	1.5A 20W	0.5A 2W	0.5A 2W	1.5A 15W	1.5A 15W			
Parameter	Conditions (Note 1)	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Output Voltage	T _J = 25°C, V _{IN} = 10V, I _{LOAD} = 5 mA	–5.1	–5	–4.9	–5.2	–5	–4.8	–5.1	–5	–4.9	–5.2	–5	–4.8	
Line Regulation	T _J = 25°C, I _{LOAD} = 5 mA, V _{MIN} ≤ V _{IN} ≤ V _{MAX}		10	25		10	40		10	25		10	40	
Input Voltage		–25		–7	–25		–7	–25		–7	–25		–7.5	
Ripple Rejection	f = 120 Hz	54	64		54	64		54	64		54	64		
Load Regulation, (Note 2)	T _J = 25°C, V _{IN} = 10V, 5 mA ≤ I _{LOAD} ≤ I _D		50	75		60	100		30	50		50	100	
Output Voltage, (Note 1)	–7.5V ≤ V _{IN} ≤ V _{MAX} , 5 mA ≤ I _{LOAD} ≤ I _D , P ≤ P _D	–5.20		–4.80	–5.25		–4.75	–5.20		–4.80	–5.25		–4.75	
Quiescent Current	V _{MIN} ≤ V _{IN} ≤ V _{MAX}		1	2		1	2		1	2		1		
Quiescent Current Change	T _J = 25°C V _{MIN} ≤ V _{IN} ≤ V _{MAX} 5 mA ≤ I _{LOAD} ≤ I _D		0.1 0.1	0.4 0.4		0.1 0.1	0.4 0.4		0.05 0.04	0.4 0.4		0.1 0.1	0.4 0.4	
Output Noise Voltage	T _A = 25°C, C _L = 1 μF, I _L = 5 mA, V _{IN} = 10V, 10 Hz ≤ f ≤ 100 kHz		150			150			150			150		
Long Term Stability			5	50		5	50		5	50		10		
Thermal Resistance Junction to Case Junction to Ambient			3 35				3 35		Note 4 Note 4			4 50		

Note 1: This specification applies over –55°C ≤ T_J ≤ +150°C for the LM120 and 0°C ≤ T_J ≤ +125°C for the LM320.

Note 2: Regulation is measured at constant junction temperature. Changes in output voltage due to heating effects must be taken into account separately. To ensure constant junction temperature, low duty cycle, pulse testing is used. The LM120/LM320 series does have low thermal feedback, improving line and load regulation. On all other tests, even though power dissipation is internally limited, electrical specifications apply only up to P_D.

Note 3: For –5V 3 amp regulators, see LM145 data sheet.

Note 4: Thermal resistance of typically 85°C/W (in 400 linear feet air flow), 224°C/W (in static air) junction to ambient, of typically 21°C/W junction to case.

Note 5: Refer to RETS120-5H drawing for LM120H-5.0 or RETS120-5K drawing for LM120-5K military specifications.

— 12 Volt Regulators

Absolute Maximum Ratings

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications. (Note 4)

Power Dissipation

Internally Limited

Input Voltage

–35V

Input-Output Voltage Differential

30V

Junction Temperatures

See Note 1

Storage Temperature Range

–65°C to +150°C

Lead Temperature (Soldering, 10 sec.)

300°C

Electrical Characteristics

Order Numbers		Metal Can Package												Power Plastic Package			Units
		LM120K-12 (TO-3)			LM320K-12 (TO-3)			LM120H-12 (TO-39)			LM320H-12 (TO-39)			LM320T-12 (TO-220)			
Design Output Current (I _D) Device Dissipation (P _D)		1A 20W		1A 20W		0.2A 2W		0.2A 2W		0.2A 2W		0.2A 2W		1A 15W			
Parameter	Conditions (Note 1)	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Output Voltage	T _J = 25°C, V _{IN} = 17V, I _L LOAD = 5 mA	−12.3	−12	−11.7	−12.4	−12	−11.6	−12.3	−12	−11.7	−12.4	−12	−11.6	−12.4	−12	−11.6	
Line Regulation	T _J = 25°C, I _L LOAD = 5 mA, V _{MIN} ≤ V _{IN} ≤ V _{MAX}		4	10		4	20		4	10		4	20		4	20	
Input Voltage		−32		−14	−32		−14	−32		−14	−32		−14	−32		−14.5	
Ripple Rejection	f = 120 Hz	56	80		56	80		56	80		56	80		56	80		
Load Regulation, (Note 2)	T _J = 25°C, V _{IN} = 17V, 5 mA ≤ I _L LOAD ≤ I _D		30	80		30	80		10	25		10	40		30	80	
Output Voltage, (Note 1)	14.5V ≤ V _{IN} ≤ V _{MAX} ; 5 mA ≤ I _L LOAD ≤ I _D , P ≤ P _D	−12.5		−11.5	−12.6		−11.4	−12.5		−11.5	−12.6		−11.4	−12.6		−11.4	
Quiescent Current	V _{MIN} ≤ V _{IN} ≤ V _{MAX}		2	4		2	4		2	4		2	4		2	4	
Quiescent Current Change	T _J = 25°C V _{MIN} ≤ V _{IN} ≤ V _{MAX} 5 mA ≤ I _L LOAD ≤ I _D		0.1	0.4		0.1	0.4		0.05	0.4		0.05	0.4		0.1	0.4	
Output Noise Voltage	T _A = 25°C, C _L = 1 μF, I _L = 5 mA, V _{IN} = 17V, 10 Hz ≤ f ≤ 100 kHz		400			400			400			400			400		
Long Term Stability			12	120		12	120		12	120		12	120		24		
Thermal Resistance Junction to Case				3			3			Note 3			Note 3		4		
Junction to Ambient				35			35			Note 3			Note 3		50		

Note 1: This specification applies over –55°C ≤ T_J ≤ +150°C for the LM120 and 0°C ≤ T_J ≤ +125°C for the LM320.

Note 2: Regulation is measured at constant junction temperature. Changes in output voltage due to heating effects must be taken into account separately. To ensure constant junction temperature, low duty cycle, pulse testing is used. The LM120/LM320 series does have low thermal feedback, improving line and load regulation. On all other tests, even though power dissipation is internally limited, electrical specifications apply only up to P_D.

Note 3: Thermal resistance of typically 85°C/W (in 400 linear feet/min air flow), 224°C/W (in static air) junction to ambient, of typically 21°C/W junction to case.

Note 4: Refer to RETS120H-12 drawing for LM120H-12 or RETS120-12K drawing for LM120K-12 military specifications.

— 15 Volt Regulators

Absolute Maximum Ratings

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications. (Note 4)

Power Dissipation

Input Voltage

LM120/LM320

LM320T

Internally Limited

—40V

—35V

Input-Output Voltage Differential

Junction Temperatures

Storage Temperature Range

Lead Temperature (Soldering, 10 sec.)

30V

See Note 1

—65°C to +150°C

300°C

Electrical Characteristics

Order Numbers		Metal Can Package												Power Plastic Package				Units
		LM120K-15 (TO-3)		LM320K-15 (TO-3)		LM120H-15 (TO-39)		LM320H-15 (TO-39)		LM320T-15 (TO-220)								
		1A 20W		1A 20W		0.2A 2W		0.2A 2W		1A 15W		1A 15W						
Parameter	Conditions (Note 1)	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max		
Output Voltage	T _J = 25°C, V _{IN} = 20V, I _{LOAD} = 5 mA	−15.3	−15	−14.7	−15.4	−15	−14.6	−15.3	−15	−14.7	−15.4	−15	−14.6	−15.5	−15	−14.5	V	
Line Regulation	T _J = 25°C, I _{LOAD} = 5 mA, V _{MIN} ≤ V _{IN} ≤ V _{MAX}		5	10		5	20		5	10		5	20		5	20	mV	
Input Voltage		−35		−17	−35		−17	−35		−17	−35		−17	−35		−17.5	V	
Ripple Rejection	f = 120 Hz	56	80		56	80		56	80		56	80		56	80		dB	
Load Regulation, (Note 2)	T _J = 25°C, V _{IN} = 20V, 5 mA ≤ I _{LOAD} ≤ I _O		30	80		30	80		10	25		10	40		30	80	mV	
Output Voltage, (Note 1)	17.5V ≤ V _{IN} ≤ V _{MAX} , 5 mA ≤ I _{LOAD} ≤ I _O , P ≤ P _D	−15.5		−14.5	−15.6		−14.4	−15.5		−14.5	−15.6		−14.4	−15.7		−14.3	V	
Quiescent Current	V _{MIN} ≤ V _{IN} ≤ V _{MAX}		2	4		2	4		2	4		2	4		2	4	mA	
Quiescent Current Change	T _J = 25°C V _{MIN} ≤ V _{IN} ≤ V _{MAX} 5 mA ≤ I _{LOAD} ≤ I _O		0.1	0.4		0.1	0.4		0.05	0.4		0.05	0.4		0.1	0.4	mA	
Output Noise Voltage	T _A = 25°C, C _L = 1 μF, I _L = 5 mA, V _{IN} = 20V, 10 Hz ≤ f ≤ 100 kHz		400			400			400			400			400		μV	
Long Term Stability			15	150		15	150		15	150		15	150		30		mV	
Thermal Resistance Junction to Case Junction to Ambient				3			3			Note 3 Note 3			Note 3 Note 3		4		°C/W °C/W	

Note 1: This specification applies over —55°C ≤ T_J ≤ +150°C for the LM120 and 0°C ≤ T_J ≤ +125°C for the LM320.

Note 2: Regulation is measured at constant junction temperature. Changes in output voltage due to heating effects must be taken into account separately. To ensure constant junction temperature, low duty cycle, pulse testing is used. The LM120/LM320 series does have low thermal feedback, improving line and load regulation. On all other tests, even though power dissipation is internally limited, electrical specifications apply only up to P_D.

Note 3: Thermal resistance of typically 85°C/W (in 400 linear feet/min air flow), 224°C/W (in static air) junction to ambient, of typically 21°C/W junction to case.

Note 4: Refer to RETS120-15H drawing for LM120H-15 or RETS120-15K drawing for LM120K-15 military specifications.