

# 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.

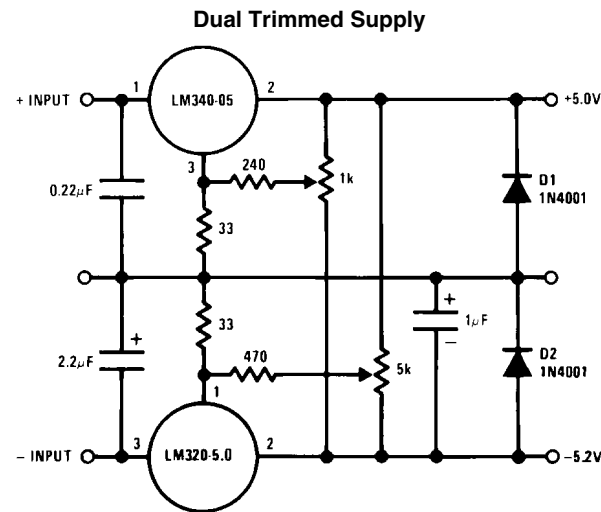
## Features

- 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

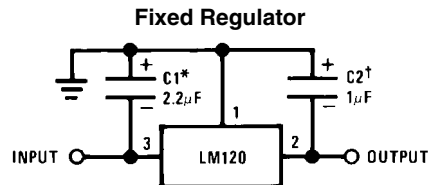
### LM120 Series Packages and Power Capability

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

## Typical Applications



776703



776702

\*Required if regulator is separated from filter capacitor by more than 3 inches. For value given, capacitor must be solid tantalum. 25  $\mu F$  aluminum electrolytic may be substituted.

†Required for stability. For value given, capacitor must be solid tantalum. 25  $\mu F$  aluminum electrolytic may be substituted. Values given may be increased without limit.

For output capacitance in excess of 100  $\mu F$ , a high current diode from input to output (1N4001, etc.) will protect the regulator from momentary input shorts.

**Absolute Maximum Ratings****-15 Volt Regulators** (Note 13)

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

Power Dissipation Internally Limited  
Input Voltage

LM120/LM320 -40V  
LM320T -35V  
Input-Output Voltage Differential 30V  
Junction Temperatures (Note 10)  
Storage Temperature Range -65°C to +150°C  
Lead Temperature (Soldering, 10 sec.) 300°C

**-15 Volt Regulators  
Electrical Characteristics**

Order Numbers		Metal Can Package						Units
		LM120K-15 (TO-3)			LM320K-15 (TO-3)			
Design Output Current ( $I_D$ ) Device Dissipation ( $P_D$ )		1A 20W						
Parameter	Conditions (Note 10)	Min	Typ	Max	Min	Typ	Max	
Output Voltage	$T_J = 25^\circ\text{C}$ , $V_{IN} = 20\text{V}$ , $I_{LOAD} = 5\text{ mA}$	-15.3	-15	-14.7	-15.4	-15	-14.6	V
Line Regulation	$T_J = 25^\circ\text{C}$ , $I_{LOAD} = 5\text{ mA}$ , $V_{MIN} \leq V_{IN} \leq V_{MAX}$		5	10		5	20	mV
Input Voltage		-35		-17	-35		-17	V
Ripple Rejection	$f = 120\text{ Hz}$	56	80		56	80		dB
Load Regulation, (Note 11)	$T_J = 25^\circ\text{C}$ , $V_{IN} = 20\text{V}$ , $5\text{ mA} \leq I_{LOAD} \leq I_D$		30	80		30	80	mV
Output Voltage, (Note 10)	$17.5\text{V} \leq V_{IN} \leq V_{MAX}$ , $5\text{ mA} \leq I_{LOAD} \leq I_D$ , $P \leq P_D$	-15.5		-14.5	-15.6		-14.4	V
Quiescent Current	$V_{MIN} \leq V_{IN} \leq V_{MAX}$		2	4		2	4	mA
Quiescent Current Change	$T_J = 25^\circ\text{C}$ $V_{MIN} \leq V_{IN} \leq V_{MAX}$ $5\text{ mA} \leq I_{LOAD} \leq I_D$		0.1	0.4		0.1	0.4	mA
			0.1	0.4		0.1	0.4	mA
Output Noise Voltage	$T_A = 25^\circ\text{C}$ , $C_L = 1\ \mu\text{F}$ , $I_L = 5\text{ mA}$ , $V_{IN} = 20\text{V}$ , $10\text{ Hz} \leq f \leq 100\text{ kHz}$		400			400		$\mu\text{V}$
Long Term Stability			15	150		15	150	mV
Thermal Resistance	Junction to Case			3			3	$^\circ\text{C/W}$
	Junction to Ambient			35			35	$^\circ\text{C/W}$

**-15 Volt Regulators  
Electrical Characteristics**

Order Numbers		Metal Can Package						Units
		LM120H-15 (TO-39)			LM320H-15 (TO-39)			
Design Output Current ( $I_D$ ) Device Dissipation ( $P_D$ )		0.2A 2W						
Parameter	Conditions (Note 10)	Min	Typ	Max	Min	Typ	Max	
Output Voltage	$T_J = 25^\circ\text{C}$ , $V_{IN} = 20\text{V}$ , $I_{LOAD} = 5\text{ mA}$	-15.3	-15	-14.7	-15.4	-15	-14.6	V
Line Regulation	$T_J = 25^\circ\text{C}$ , $I_{LOAD} = 5\text{ mA}$ , $V_{MIN} \leq V_{IN} \leq V_{MAX}$		5	10		5	20	mV

Order Numbers		Metal Can Package						Units
		LM120H-15 (TO-39)			LM320H-15 (TO-39)			
Design Output Current ( $I_D$ ) Device Dissipation ( $P_D$ )		0.2A 2W						
Parameter	Conditions (Note 10)	Min	Typ	Max	Min	Typ	Max	
Input Voltage		-35		-17	-35		-17	V
Ripple Rejection	$f = 120 \text{ Hz}$	56	80		56	80		dB
Load Regulation, (Note 11)	$T_J = 25^\circ\text{C}$ , $V_{IN} = 20\text{V}$ , $5 \text{ mA} \leq I_{LOAD} \leq I_D$		10	25		10	40	mV
Output Voltage, (Note 10)	$17.5\text{V} \leq V_{IN} \leq V_{MAX}$ , $5 \text{ mA} \leq I_{LOAD} \leq I_D$ , $P \leq P_D$	-15.5		-14.5	-15.6		-14.4	V
Quiescent Current	$V_{MIN} \leq V_{IN} \leq V_{MAX}$		2	4		2	4	mA
Quiescent Current Change	$T_J = 25^\circ\text{C}$ $V_{MIN} \leq V_{IN} \leq V_{MAX}$ $5 \text{ mA} \leq I_{LOAD} \leq I_D$		0.05	0.4		0.05	0.4	mA
			0.03	0.4		0.03	0.4	mA
Output Noise Voltage	$T_A = 25^\circ\text{C}$ , $C_L = 1 \mu\text{F}$ , $I_L = 5 \text{ mA}$ , $V_{IN} = 20\text{V}$ , $10 \text{ Hz} \leq f \leq 100 \text{ kHz}$		400			400		$\mu\text{V}$
Long Term Stability			15	150		15	150	mV
Thermal Resistance Junction to Case Junction to Ambient				(Note 12)			(Note 12)	$^\circ\text{C/W}$
				(Note 12)			(Note 12)	$^\circ\text{C/W}$

## -15 Volt Regulators Electrical Characteristics

Order Numbers		Power Plastic Package			Units
		LM320T-15 (TO-220)			
Design Output Current ( $I_D$ ) Device Dissipation ( $P_D$ )		1A 15W			
Parameter	Conditions (Note 10)	Min	Typ	Max	
Output Voltage	$T_J = 25^\circ\text{C}$ , $V_{IN} = 20\text{V}$ , $I_{LOAD} = 5 \text{ mA}$	-15.5	-15	-14.5	V
Line Regulation	$T_J = 25^\circ\text{C}$ , $I_{LOAD} = 5 \text{ mA}$ , $V_{MIN} \leq V_{IN} \leq V_{MAX}$		5	20	mV
Input Voltage		-35		-17.5	V
Ripple Rejection	$f = 120 \text{ Hz}$	56	80		dB
Load Regulation, (Note 11)	$T_J = 25^\circ\text{C}$ , $V_{IN} = 20\text{V}$ , $5 \text{ mA} \leq I_{LOAD} \leq I_D$		30	80	mV
Output Voltage, (Note 10)	$17.5\text{V} \leq V_{IN} \leq V_{MAX}$ , $5 \text{ mA} \leq I_{LOAD} \leq I_D$ , $P \leq P_D$	-15.7		-14.3	V
Quiescent Current	$V_{MIN} \leq V_{IN} \leq V_{MAX}$		2	4	mA
Quiescent Current Change	$T_J = 25^\circ\text{C}$ $V_{MIN} \leq V_{IN} \leq V_{MAX}$ $5 \text{ mA} \leq I_{LOAD} \leq I_D$		0.1	0.4	mA
			0.1	0.4	mA
Output Noise Voltage	$T_A = 25^\circ\text{C}$ , $C_L = 1 \mu\text{F}$ , $I_L = 5 \text{ mA}$ , $V_{IN} = 20\text{V}$ , $10 \text{ Hz} \leq f \leq 100 \text{ kHz}$		400		$\mu\text{V}$
Long Term Stability			30		mV

Order Numbers		Power Plastic Package			Units
		LM320T-15 (TO-220)			
Design Output Current ( $I_D$ ) Device Dissipation ( $P_D$ )		1A 15W			
Parameter	Conditions (Note 10)	Min	Typ	Max	
Thermal Resistance					
Junction to Case			4		°C/W
Junction to Ambient			50		°C/W

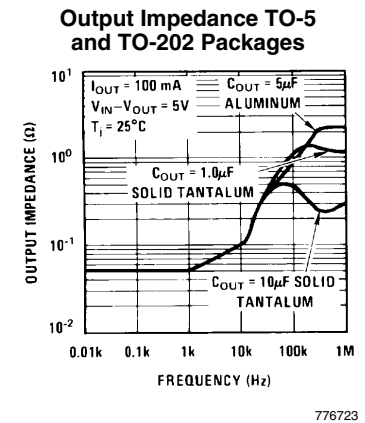
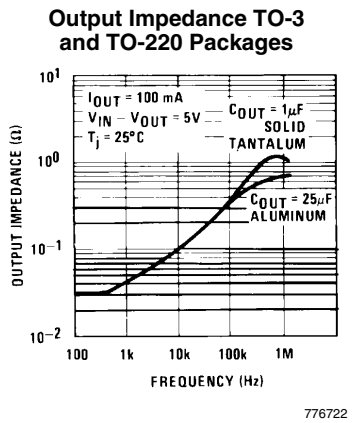
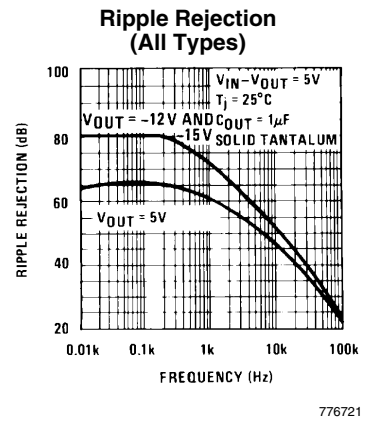
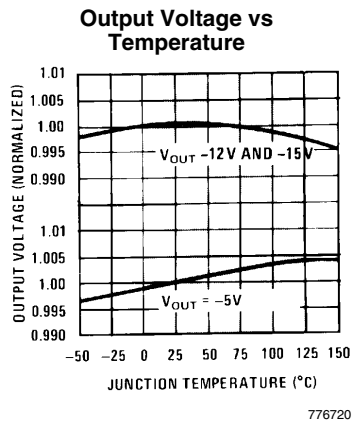
**Note 10:** This specification applies over  $-55^{\circ}\text{C} \leq T_J \leq +150^{\circ}\text{C}$  for the LM120 and  $0^{\circ}\text{C} \leq T_J \leq +125^{\circ}\text{C}$  for the LM320.

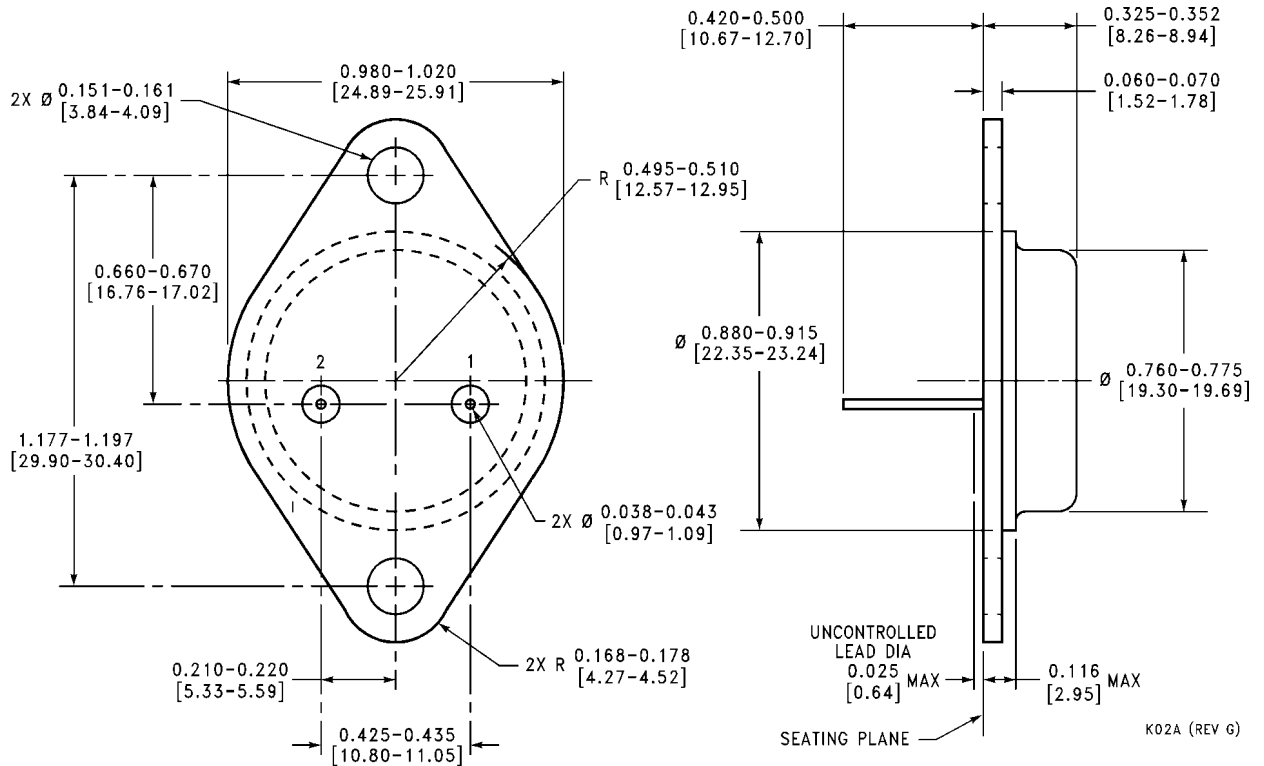
**Note 11:** Regulation is measured at constant junction temperature. Changes in output voltage due to heating effects must be taken into account separately. To ensure constant junction temperature, low duty cycle, pulse testing is used. The LM120/LM320 series does have low thermal feedback, improving line and load regulation. On all other tests, even though power dissipation is internally limited, electrical specifications apply only up to  $P_D$ .

**Note 12:** Thermal resistance of typically  $85^{\circ}\text{C/W}$  (in 400 linear feet/min air flow),  $224^{\circ}\text{C/W}$  (in static air) junction to ambient, of typically  $21^{\circ}\text{C/W}$  junction to case.

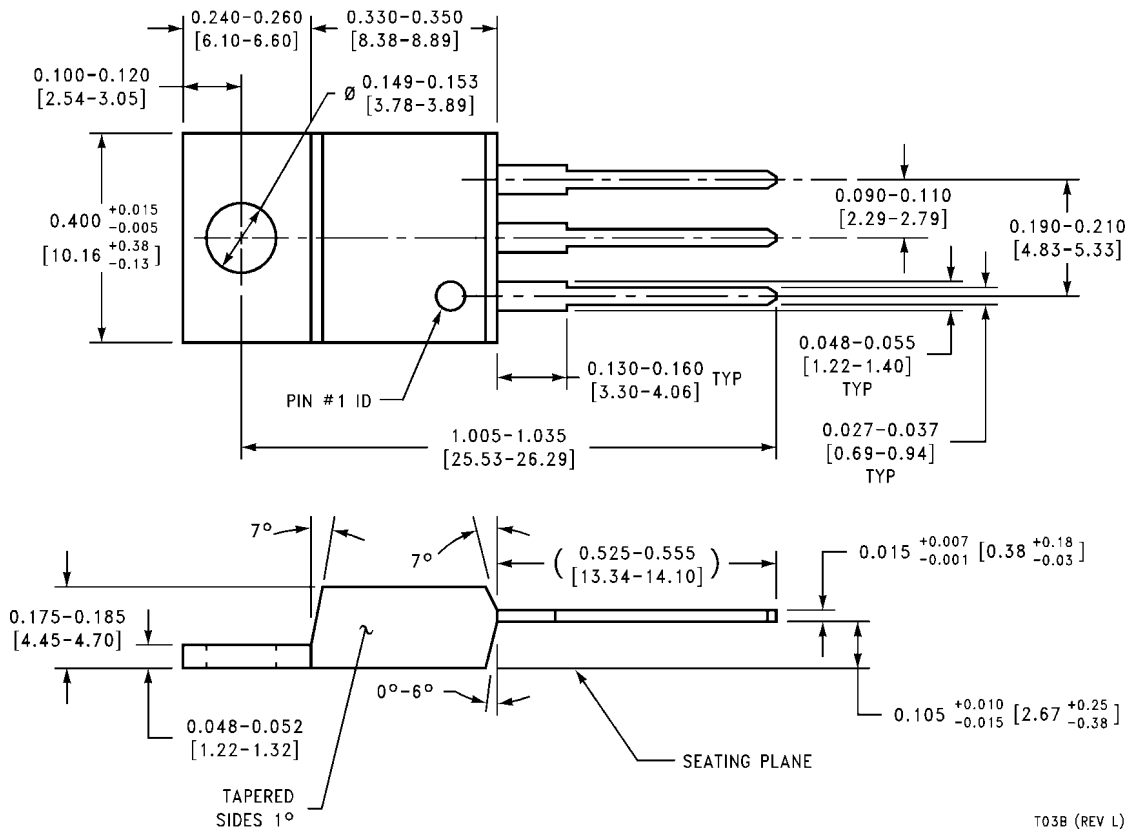
**Note 13:** Refer to RETS120-15H drawing for LM120H-15 or RETS120-15K drawing for LM120K-15 military specifications.

## Typical Performance Characteristics





**Steel Metal Can Package TO-3 (K)**  
**Order Number LM120K-5.0, LM120K-12, LM120K-15, LM320K-5.0, LM320K-12 or LM320K-15**  
**NS Package Number K02A**



**Power Package TO-220 (T)**  
**Order Number LM320T-5.0, LM320T-12 or LM320T-15**  
**NS Package Number T03B**