

LM120/LM320 Series 3-Terminal Negative Regulators

Check for Samples: [LM120](#), [LM320-N](#)

FEATURES

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

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.

Table 1. LM120 Series Packages and Power Capability

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



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Typical Applications

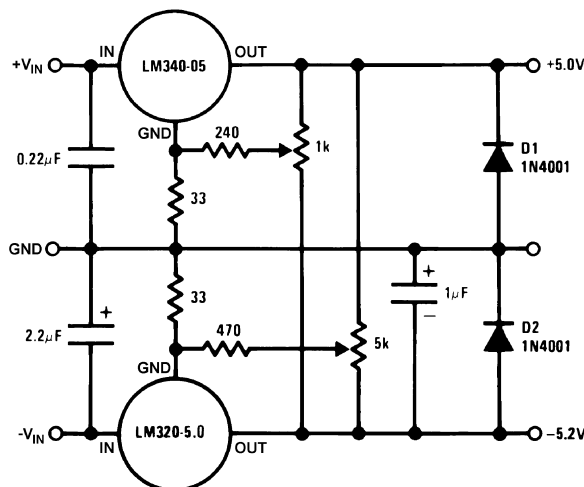
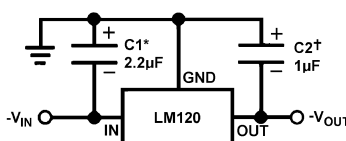


Figure 1. Dual Trimmed Supply



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

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

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

Figure 2. Fixed Regulator



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

Absolute Maximum Ratings–5 Volt Regulators ^{(1) (2)}

Power Dissipation	Internally Limited
Input Voltage	–25V
Input-Output Voltage Differential	25V
Junction Temperatures	⁽³⁾
Storage Temperature Range	–65°C to +150°C
Lead Temperature	
(Soldering, 10 sec.)	300°C
Plastic	260°C

(1) Refer to RETS120-5H drawing for LM120H-5.0 or RETS120-5K drawing for LM120-5K military specifications.

(2) For –5V 3 amp regulators, see LM145 data sheet.

(3) 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.

LM120K-5.0 and LM320K-5.0 Electrical Characteristics ⁽¹⁾

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

(1) For -5V 3 amp regulators, see LM145 data sheet.

(2) 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.

(3) 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 .

LM120H-5.0 Electrical Characteristics ⁽¹⁾

Order Numbers		Metal Can Package			Units
		LM120H-5.0 (TO-39)			
Design Output Current (I _D) Device Dissipation (P _D)		0.5A 2W			
Parameter	Conditions ⁽²⁾	Min	Typ	Max	
Output Voltage	T _J = 25°C, V _{IN} =10V, I _{LOAD} = 5 mA	-5.1	-5	-4.9	V
Line Regulation	T _J = 25°C, I _{LOAD} = 5 mA, V _{MIN} ≤ V _{IN} ≤ V _{MAX}		10	25	mV
Input Voltage		-25		-7	V
Ripple Rejection	f = 120 Hz	54	64		dB
Load Regulation, ⁽³⁾	T _J = 25°C, V _{IN} = 10V, 5 mA ≤ I _{LOAD} ≤ I _D		30	50	mV
Output Voltage, ⁽⁴⁾	-7.5V ≤ V _{IN} ≤ V _{MAX} , 5 mA ≤ I _{LOAD} ≤ I _D , P ≤ P _D	-5.20		-4.80	V
Quiescent Current	V _{MIN} ≤ V _{IN} ≤ V _{MAX}		1	2	mA
Quiescent Current	T _J = 25°C				
Change	V _{MIN} ≤ V _{IN} ≤ V _{MAX}		0.05	0.4	mA
	5 mA ≤ I _{LOAD} ≤ I _D		0.04	0.4	mA
Output Noise Voltage	T _A = 25°C, C _L = 1 μF, I _L = 5 mA, V _{IN} = 10V, 10 Hz ≤ f ≤ 100 kHz		150		μV
Long Term Stability			5		mV
Thermal Resistance					
Junction to Case				(5)	°C/W
Junction to Ambient				(5)	°C/W

(1) For -5V 3 amp regulators, see LM145 data sheet.

(2) 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.

(3) 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 .

(4) 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.

(5) 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.

Absolute Maximum Ratings–12 Volt Regulators ⁽¹⁾

Power Dissipation	Internally Limited
Input Voltage	-35V
Input-Output Voltage Differential	30V
Junction Temperatures	⁽²⁾
Storage Temperature Range	-65°C to $+150^\circ\text{C}$
Lead Temperature	
(Soldering, 10 sec.)	300 $^\circ\text{C}$

(1) Refer to RETS120H-12 drawing for LM120H-12 or RETS120-12K drawing for LM120K-12 military specifications.

(2) 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.

LM120K-12 Electrical Characteristics

Order Numbers		Metal Can Package			Units
		LM120K-12 (TO-3)			
Design Output Current (I _D)		1A			
Device Dissipation (P _D)		20W			
Parameter	Conditions ⁽¹⁾	Min	Typ	Max	
Output Voltage	T _J = 25°C, V _{IN} = 17V, I _{LOAD} = 5 mA	-12.3	-12	-11.7	V
Line Regulation	T _J = 25°C, I _{LOAD} = 5 mA, V _{MIN} ≤ V _{IN} ≤ V _{MAX}		4	10	mV
Input Voltage		-32		-14	V
Ripple Rejection	f = 120 Hz	56	80		dB
Load Regulation, ⁽²⁾	T _J = 25°C, V _{IN} = 17V, 5 mA ≤ I _{LOAD} ≤ I _D		30	80	mV
Output Voltage, ⁽¹⁾	14.5V ≤ V _{IN} ≤ V _{MAX} , 5 mA ≤ I _{LOAD} ≤ I _D , P ≤ P _D	-12.5		-11.5	V
Quiescent Current	V _{MIN} ≤ V _{IN} ≤ V _{MAX}		2	4	mA
Quiescent Current	T _J = 25°C				
Change	V _{MIN} ≤ V _{IN} ≤ V _{MAX} 5 mA ≤ I _{LOAD} ≤ I _D		0.1	0.4	mA
Output Noise Voltage	T _A = 25°C, C _L = 1 μF, I _L = 5 mA, V _{IN} = 17V, 10 Hz ≤ f ≤ 100 kHz		400		μV
Long Term Stability			12	120	mV
Thermal Resistance					
Junction to Case				3	°C/W
Junction to Ambient				35	°C/W

- (1) 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.
- (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 .

LM120H-12 Electrical Characteristics

Order Numbers		Metal Can Package			Units
		LM120H-12 (TO-39)			
Design Output Current (I _D)		0.2A			
Device Dissipation (P _D)		2W			
Parameter	Conditions ⁽¹⁾	Min	Typ	Max	
Output Voltage	T _J = 25°C, V _{IN} = 17V, I _{LOAD} = 5 mA	-12.3	-12	-11.7	V
Line Regulation	T _J = 25°C, I _{LOAD} = 5 mA, V _{MIN} ≤ V _{IN} ≤ V _{MAX}		4	10	mV
Input Voltage		-32		-14	V
Ripple Rejection	f = 120 Hz	56	80		dB
Load Regulation, ⁽²⁾	T _J = 25°C, V _{IN} = 17V, 5 mA ≤ I _{LOAD} ≤ I _D		10	25	mV
Output Voltage, ⁽¹⁾	14.5V ≤ V _{IN} ≤ V _{MAX} , 5 mA ≤ I _{LOAD} ≤ I _D , P ≤ P _D	-12.5		-11.5	V
Quiescent Current	V _{MIN} ≤ V _{IN} ≤ V _{MAX}		2	4	mA
Quiescent Current	T _J = 25°C				
Change	V _{MIN} ≤ V _{IN} ≤ V _{MAX} 5 mA ≤ I _{LOAD} ≤ I _D		0.05 0.03	0.4 0.4	mA mA
Output Noise Voltage	T _A = 25°C, C _L = 1 μF, I _L = 5 mA, V _{IN} = 17V, 10 Hz ≤ f ≤ 100 kHz		400		μV
Long Term Stability			12	120	mV
Thermal Resistance					
Junction to Case				(3)	°C/W
Junction to Ambient				(3)	°C/W

(1) 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.

(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 .

(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.

LM320T-12 Electrical Characteristics

Order Numbers		Power Plastic Package			Units
		LM320T-12 (TO-220)			
Design Output Current (I _D)		1A			
Device Dissipation (P _D)		15W			
Parameter	Conditions ⁽¹⁾	Min	Typ	Max	
Output Voltage	T _J = 25°C, V _{IN} = 17V, I _{LOAD} = 5 mA	-12.4	-12	-11.6	V
Line Regulation	T _J = 25°C, I _{LOAD} = 5 mA, V _{MIN} ≤ V _{IN} ≤ V _{MAX}		4	20	mV
Input Voltage		-32		-14.5	V
Ripple Rejection	f = 120 Hz	56	80		dB
Load Regulation, ⁽²⁾	T _J = 25°C, V _{IN} = 17V, 5 mA ≤ I _{LOAD} ≤ I _D		30	80	mV
Output Voltage, ⁽¹⁾	14.5V ≤ V _{IN} ≤ V _{MAX} , 5 mA ≤ I _{LOAD} ≤ I _D , P ≤ P _D	-12.6		-11.4	V
Quiescent Current	V _{MIN} ≤ V _{IN} ≤ V _{MAX}		2	4	mA
Quiescent Current	T _J = 25°C				
Change	V _{MIN} ≤ V _{IN} ≤ V _{MAX}		0.1	0.4	mA
	5 mA ≤ I _{LOAD} ≤ I _D		0.1	0.4	mA
Output Noise Voltage	T _A = 25°C, C _L = 1 μF, I _L = 5 mA, V _{IN} = 17V, 10 Hz ≤ f ≤ 100 kHz		400		μV
Long Term Stability			24		mV
Thermal Resistance Junction to Case			4		°C/W
Junction to Ambient			50		°C/W

- (1) 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.
- (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 .

Absolute Maximum Ratings–15 Volt Regulators ⁽¹⁾

Power Dissipation	Internally Limited
Input Voltage	
LM120/LM320	-40V
LM320T	-35V
Input-Output Voltage Differential	30V
Junction Temperatures	⁽²⁾
Storage Temperature Range	-65°C to +150°C
Lead Temperature	
(Soldering, 10 sec.)	300°C

- (1) Refer to RETS120-15H drawing for LM120H-15 or RETS120-15K drawing for LM120K-15 military specifications.
- (2) 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.

LM120K-15 and LM320K-15 Electrical Characteristics

Order Numbers		Metal Can Package						Units
		LM120K-15 (TO-3)			LM320K-15 (TO-3)			
Design Output Current (I _D)		1A						
Device Dissipation (P _D)		20W						
Parameter	Conditions ⁽¹⁾	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	V
Line Regulation	T _J = 25°C, I _{LOAD} = 5 mA, V _{MIN} ≤ V _{IN} ≤ V _{MAX}		5	10		5	20	mV
Input Voltage		-35		-17	-35		-17	V
Ripple Rejection	f = 120 Hz	56	80		56	80		dB
Load Regulation, (2)	T _J = 25°C, V _{IN} = 20V, 5 mA ≤ I _{LOAD} ≤ I _D		30	80		30	80	mV
Output Voltage, (1)	17.5V ≤ V _{IN} ≤ V _{MAX} , 5 mA ≤ I _{LOAD} ≤ I _D , P ≤ P _D	-15.5		-14.5	-15.6		-14.4	V
Quiescent Current	V _{MIN} ≤ V _{IN} ≤ V _{MAX}		2	4		2	4	mA
Quiescent Current	T _J = 25°C							
Change	V _{MIN} ≤ V _{IN} ≤ V _{MAX}		0.1	0.4		0.1	0.4	mA
	5 mA ≤ I _{LOAD} ≤ I _D		0.1	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		μV
Long Term Stability			15	150		15	150	mV
Thermal Resistance								
Junction to Case				3			3	°C/W
Junction to Ambient				35			35	°C/W

(1) 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.

(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 .

LM120H-15 Electrical Characteristics

Order Numbers		Metal Can Package			Units
		LM120H-15 (TO-39)			
Design Output Current (I _D)		0.2A			
Device Dissipation (P _D)		2W			
Parameter	Conditions ⁽¹⁾	Min	Typ	Max	
Output Voltage	T _J = 25°C, V _{IN} = 20V, I _{LOAD} = 5 mA	-15.3	-15	-14.7	V
Line Regulation	T _J = 25°C, I _{LOAD} = 5 mA, V _{MIN} ≤ V _{IN} ≤ V _{MAX}		5	10	mV
Input Voltage		-35		-17	V
Ripple Rejection	f = 120 Hz	56	80		dB
Load Regulation, ⁽²⁾	T _J = 25°C, V _{IN} = 20V, 5 mA ≤ I _{LOAD} ≤ I _D		10	25	mV
Output Voltage, ⁽¹⁾	17.5V ≤ V _{IN} ≤ V _{MAX} , 5 mA ≤ I _{LOAD} ≤ I _D , P ≤ P _D	-15.5		-14.5	V
Quiescent Current	V _{MIN} ≤ V _{IN} ≤ V _{MAX}		2	4	mA
Quiescent Current	T _J = 25°C				
Change	V _{MIN} ≤ V _{IN} ≤ V _{MAX} 5 mA ≤ I _{LOAD} ≤ I _D		0.05 0.03	0.4 0.4	mA 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		μV
Long Term Stability			15	150	mV
Thermal Resistance					
Junction to Case				(3)	°C/W
Junction to Ambient				(3)	°C/W

- (1) 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.
- (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 .
- (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.

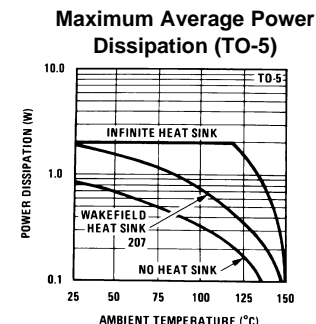
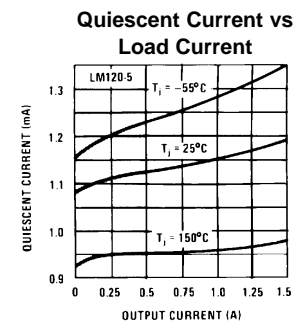
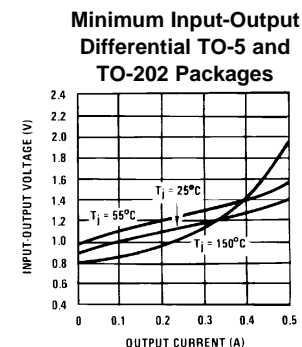
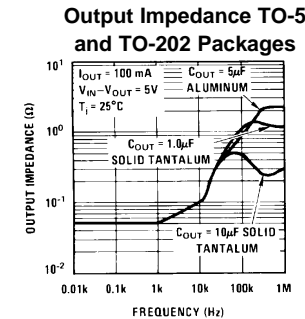
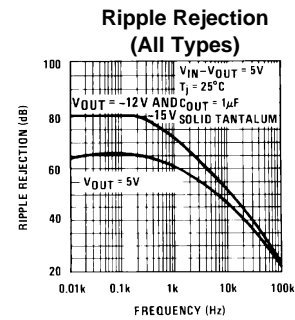
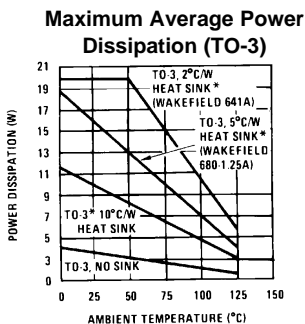
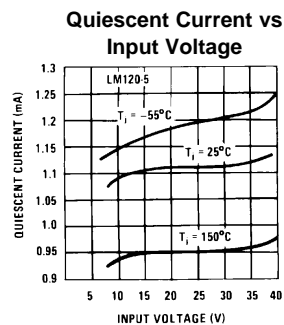
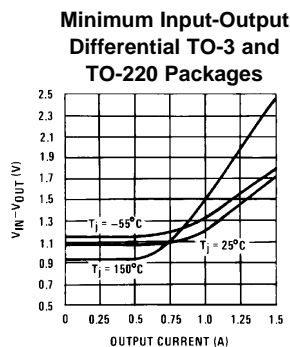
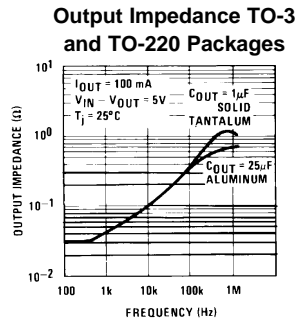
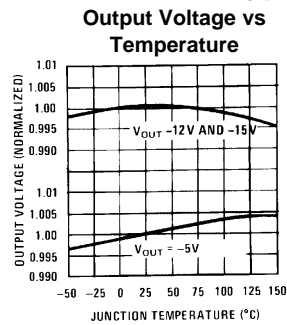
LM320T-15 Electrical Characteristics

Order Numbers		Power Plastic Package			Units
		LM320T-15 (TO-220)			
Design Output Current (I _D)		1A			
Device Dissipation (P _D)		15W			
Parameter	Conditions ⁽¹⁾	Min	Typ	Max	
Output Voltage	T _J = 25°C, V _{IN} = 20V, I _{LOAD} = 5 mA	-15.5	-15	-14.5	V
Line Regulation	T _J = 25°C, I _{LOAD} = 5 mA, V _{MIN} ≤ V _{IN} ≤ V _{MAX}		5	20	mV
Input Voltage		-35		-17.5	V
Ripple Rejection	f = 120 Hz	56	80		dB
Load Regulation, ⁽²⁾	T _J = 25°C, V _{IN} = 20V, 5 mA ≤ I _{LOAD} ≤ I _D		30	80	mV
Output Voltage, ⁽¹⁾	17.5V ≤ V _{IN} ≤ V _{MAX} , 5 mA ≤ I _{LOAD} ≤ I _D , P ≤ P _D	-15.7		-14.3	V
Quiescent Current	V _{MIN} ≤ V _{IN} ≤ V _{MAX}		2	4	mA
Quiescent Current	T _J = 25°C				
Change	V _{MIN} ≤ V _{IN} ≤ V _{MAX} 5 mA ≤ I _{LOAD} ≤ I _D		0.1 0.1	0.4 0.4	mA 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		μV
Long Term Stability			30		mV
Thermal Resistance					
Junction to Case			4		°C/W
Junction to Ambient			50		°C/W

(1) 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.

(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 .

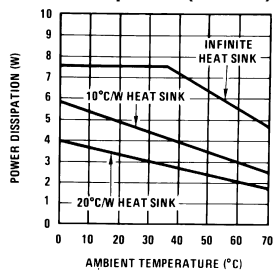
Typical Performance Characteristics



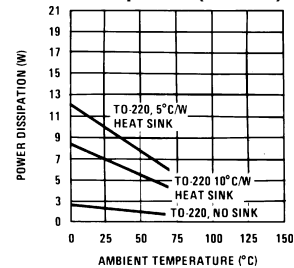
*These curves for LM120. Derate 25°C further for LM320.

Typical Performance Characteristics (continued)

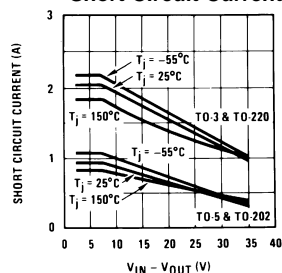
Maximum Average Power Dissipation (TO-202)



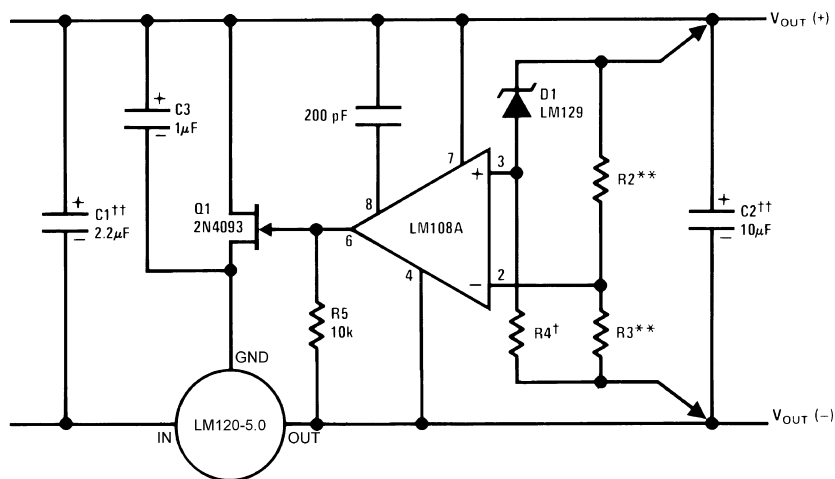
Maximum Average Power Dissipation (TO-220)



Short Circuit Current



Typical Applications



Load and line regulation — 0.01% temperature stability — 0.2%

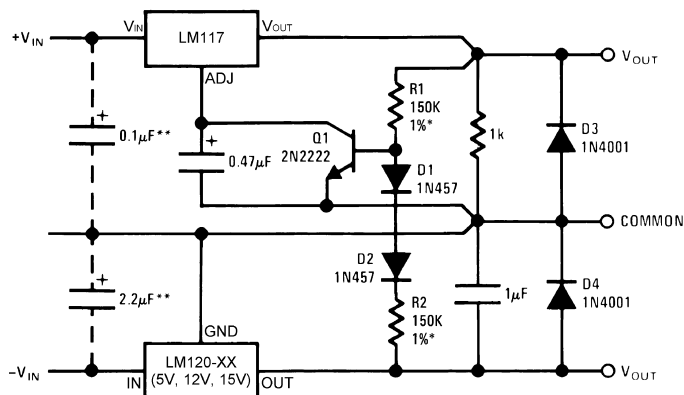
†Determines Zener current.

††Solid tantalum.

An LM120-12 or LM120-15 may be used to permit higher input voltages, but the regulated output voltage must be at least -15V when using the LM120-12 and -18V for the LM120-15.

**Select resistors to set output voltage. 2 ppm/°C tracking suggested.

Figure 3. High Stability 1 Amp Regulator

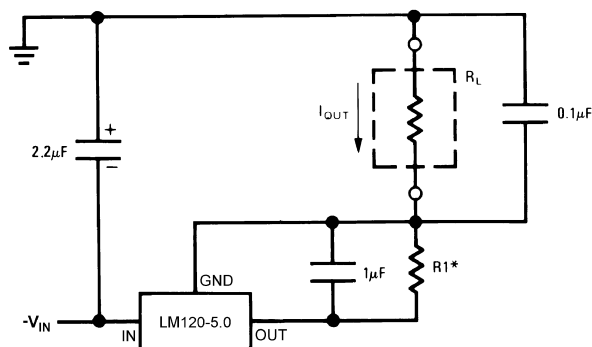


*Resistor tolerance of R1 and R2 determine matching of (+) and (-) inputs.

**Necessary only if raw supply capacitors are more than 3" from regulators

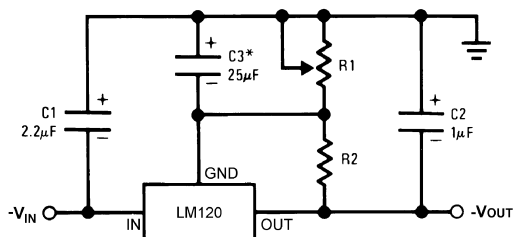
An LM3086N array may substitute for Q1, D1 and D2 for better stability and tracking. In the array diode transistors Q5 and Q4 (in parallel) make up D2; similarly, Q1 and Q2 become D1 and Q3 replaces the 2N2222.

Figure 4. Wide Range Tracking Regulator



$$I_{OUT} = 1 \text{ mA} + \frac{5.0\text{V}}{R1}$$

Figure 5. Current Source



SELECT R2 AS FOLLOWS:

LM120-5 300Ω

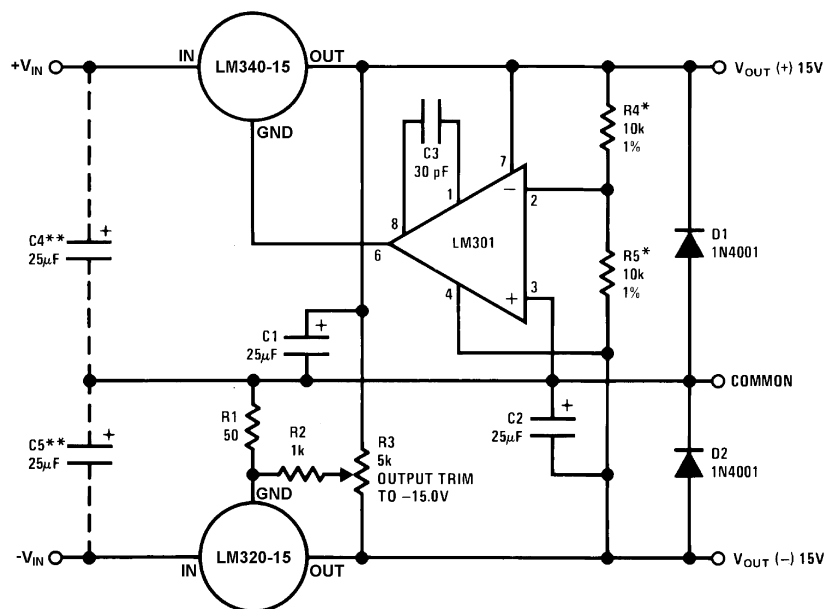
LM120-12 750Ω

LM120-15 1k

$$V_{OUT} = V_{SET} \frac{R1 + R2}{R2}$$

*C3 optional. Improves transient response and ripple rejection.

Figure 6. Variable Output Current Source



See Performance Typical table

*Resistor tolerance of R4 and R5 determine matching of (+) and (-) outputs.

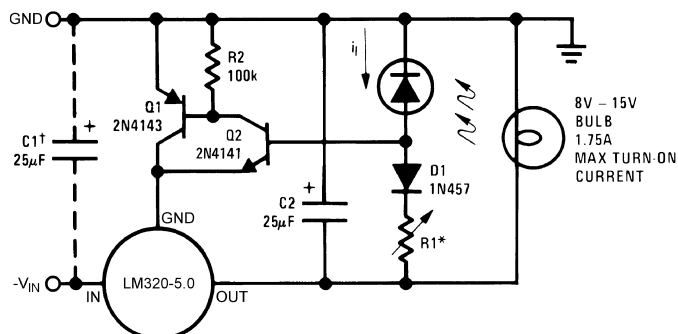
- A. **Necessary only if raw supply filter capacitors are more than 2 inches from regulators.

Figure 7. ±15V, 1 Amp Tracking Regulators

Performance (Typical)

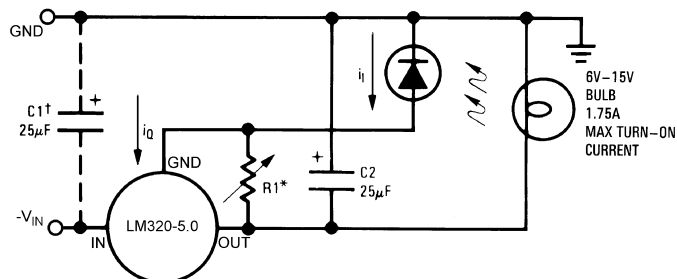
Load Regulation at $\Delta I_L = 1A$	10 mV	1 mV
Output Ripple, $C_{IN} = 3000 \mu F$, $I_L = 1A$	100 μV_{rms}	100 μV_{rms}
Temperature Stability	+50 mV	+50 mV
Output Noise 10 Hz $\leq f \leq$ 10 kHz	150 μV_{rms}	150 μV_{rms}

Light Controllers Using Silicon Photo Cells



*Lamp brightness increases until $i_l = 5V/R1$ (i_l can be set as low as 1 μA).

†Necessary only if raw supply filter capacitor is more than 2 inches from LM320MP.



*Lamp brightness increases until $i_l = i_Q (1 \text{ mA}) + 5V/R1$.

†Necessary only if raw supply filter capacitor is more than 2 inches from LM320.

Connection Diagram

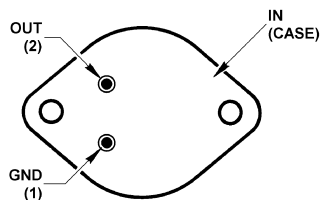


Figure 8. Steel Metal Can Package TO-3 (K)
(Bottom View)

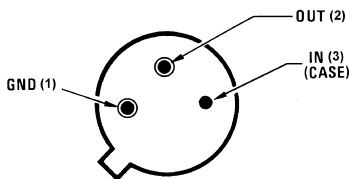


Figure 9. Metal Can Package TO-39 (H)
(Bottom View)

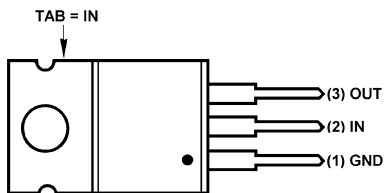


Figure 10. Power Package TO-220 (T)
(Front View)

Schematic Diagrams

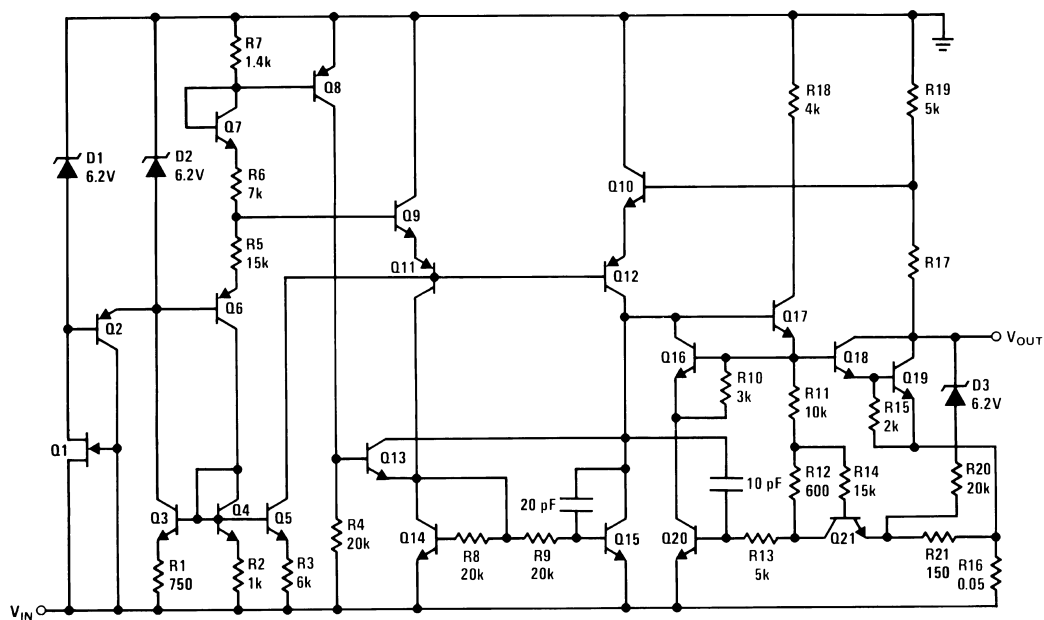


Figure 11. -5V

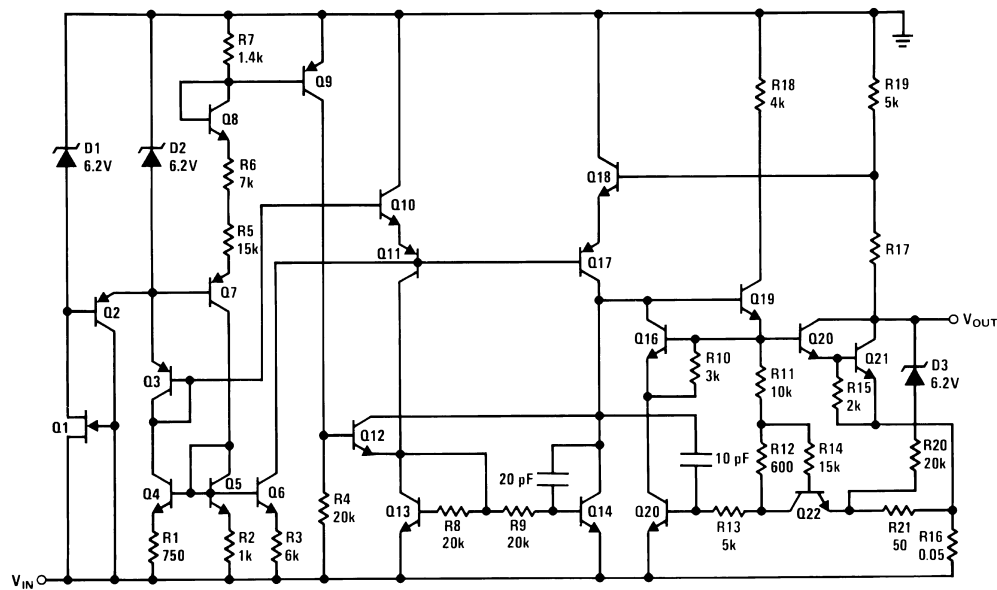


Figure 12. -12V and -15V

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Samples (Requires Login)
LM120H-12	ACTIVE	TO	NDT	3	500	Green (RoHS & no Sb/Br)	POST-PLATE	Level-1-NA-UNLIM	
LM120H-12/NOPB	ACTIVE	TO	NDT	3	500	Green (RoHS & no Sb/Br)	POST-PLATE	Level-1-NA-UNLIM	
LM120H-15	ACTIVE	TO	NDT	3	500	Green (RoHS & no Sb/Br)	POST-PLATE	Level-1-NA-UNLIM	
LM120H-15/NOPB	ACTIVE	TO	NDT	3	500	Green (RoHS & no Sb/Br)	POST-PLATE	Level-1-NA-UNLIM	
LM120H-5.0	ACTIVE	TO	NDT	3	500	Green (RoHS & no Sb/Br)	POST-PLATE	Level-1-NA-UNLIM	
LM120H-5.0/NOPB	ACTIVE	TO	NDT	3	500	Green (RoHS & no Sb/Br)	POST-PLATE	Level-1-NA-UNLIM	
LM320T-15	ACTIVE	TO-220	NDE	3	45	TBD	CU SNPB	Level-1-NA-UNLIM	
LM320T-15/NOPB	ACTIVE	TO-220	NDE	3	45	Green (RoHS & no Sb/Br)	CU SN	Level-1-NA-UNLIM	

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

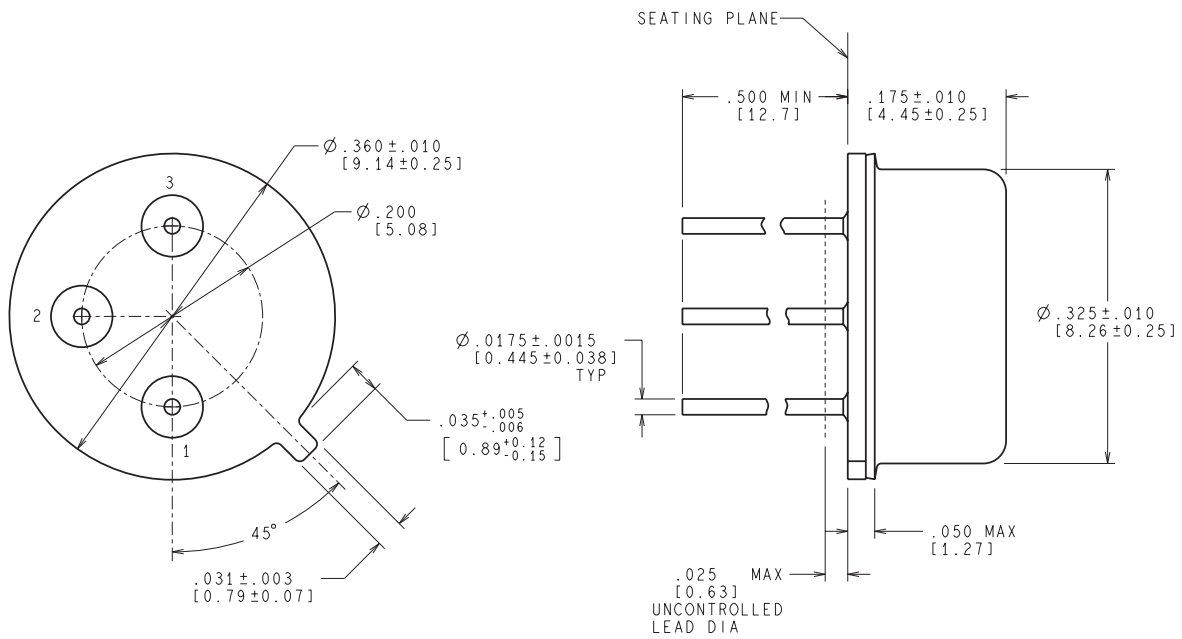
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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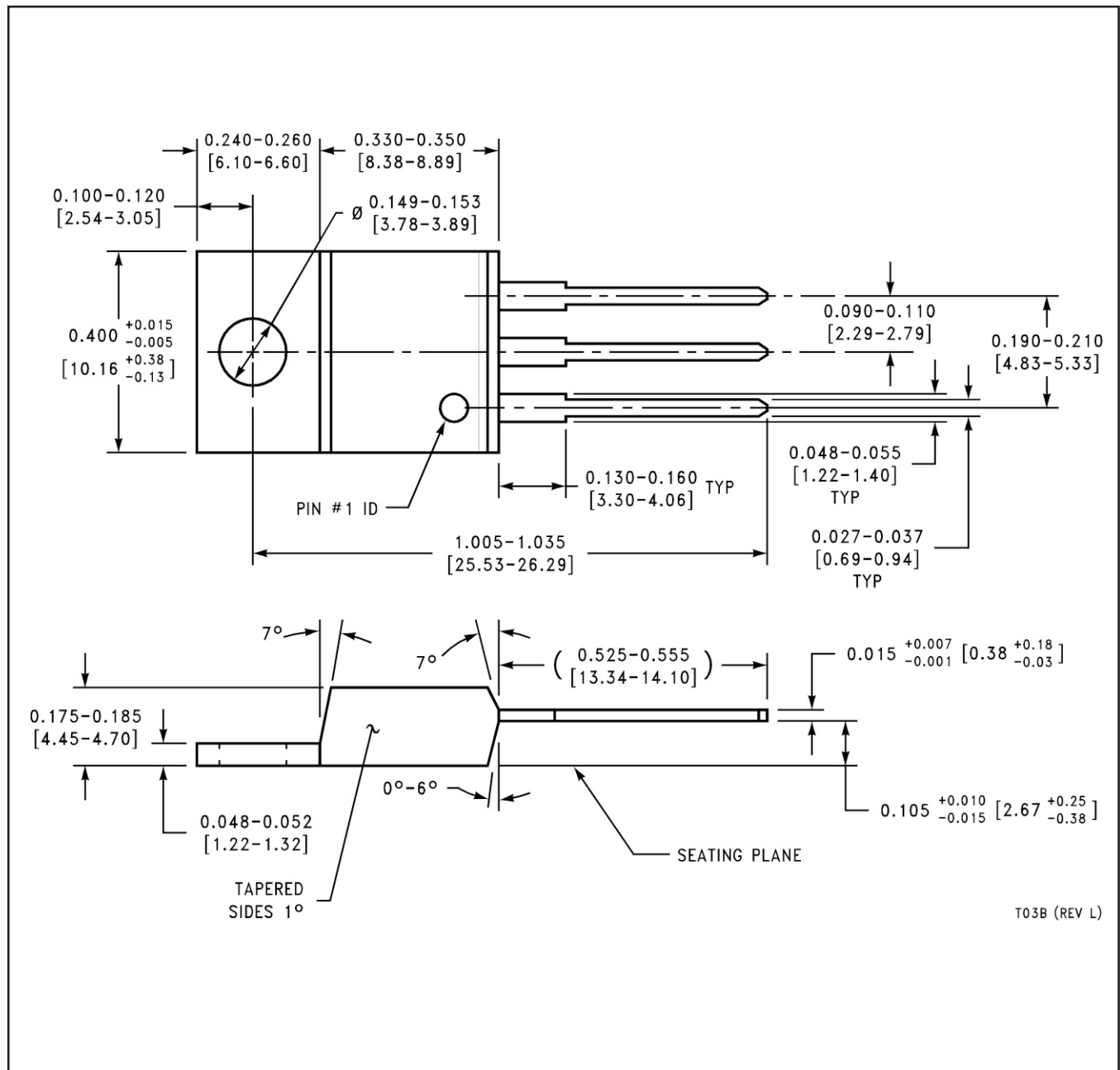


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