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NTE954
Linear Integrated Circuit
4−Terminal Negative Adjustable Voltage Regulator

Description:

The NTE954 4−Terminal adjustable voltage regulator is designed to deliver continuous load currents of up to 1.0A with a maximum input voltage of −40V. Output current capability can be increased to greater than 1.0A through the use of one or more external transistors. The output voltage range is−30V to −2.2V. For systems requiring both a positive and negative, the NTE953 and NTE954 are excellent for use as a dual tracking regulator with appropriate external circuitry.

Features:

- Output Current in Excess of 1A
- Negative Output −30V to 2.2V
- Internal Thermal Overload Protection
- Internal Short Circuit Protection
- Output Transistor Safe−Area Protection
- Power Watt Package

Absolute Maximum Ratings:

Input Voltage . . . . −40V
Control Pin Voltage . . . . $0 \leq V \leq V_{OUT}$
Power Dissipation . . . . Internally Limited
Operating Junction Temperature Range . . . . 0°C to 150°C
Storage Temperature Range . . . . −55°C to +150°C
Lead Temperature (During soldering, 10s) . . . . +230°C

Electrical Characteristics: ($-0°C \le T_J \le 125°C$, $V_{IN} = -10V$, $I_{OUT} = 500mA$, $C_{IN} = 2\mu F$, $C_{OUT} = 1\mu F$, Note 3, unless otherwise specified.)

Parameter	Test Conditions (Note 1)		Min	Typ	Max	Unit
Input Voltage Range	$T_J = 25°C$		–40	–	–7.0	V
Output Voltage Range	$V_{IN} = V_{OUT}$ –5V		–30	–	–2.23	V
Output Voltage Tolerance	V_{OUT} –15V ≤ V_{IN} ≤ V_{OUT} –3V, 5mA ≤ I_{OUT} ≤ 1.0A, P_D ≤ 15W, $V_{IN\ (max)}$ = –38V	$T_J = 25°C$	–	–	4.0	%(V_{OUT})
			–	–	5.0	%(V_{OUT})
Line Regulation	$T_J = 25°C$, V_{OUT} ≤ 10V, (V_{OUT} –20V) ≤ V_{IN} ≤ (V_{OUT} –2.5V)		–	–	1.0	%(V_{OUT})
	$T_J = 25°C$, V_{OUT} ≥ 10V, (V_{OUT} –15V) ≤ V_{IN} ≤ (V_{OUT} –3V)		–	–	0.75	%(V_{OUT})
	(V_{OUT} –7V) ≤ V_{IN} ≤ (V_{OUT} –3V)		–	–	0.67	
Load Regulation	$T_J = 25°C$, $V_{IN} = V_{OUT}$ –5V	250mA ≤ I_{OUT} ≤ 750mA	–	–	1.0	%(V_{OUT})
		5mA ≤ I_{OUT} ≤ 1.5A	–	–	2.0	%(V_{OUT})
Control Pin Current	$T_J = 25°C$		–	0.4	2.0	μA
			–	–	3.0	μA
Quiescent Current	$T_J = 25°C$		–	0.5	1.5	μA
			–	–	2.0	μA
Ripple Rejection	–18V ≤ V_{IN} ≤ –8V, V_{OUT} = –5V, f = 120Hz		50	60	–	dB
Output Noise Voltage	$T_J = 25°C$, 10Hz ≤ f ≤ 100kHz, V_{OUT} = –5V, I_{OUT} = 5mA		–	25	80	μV/V_{OUT}
Dropout Voltage	Note 2		–	–	2.3	V
Short Circuit Current	$T_J = 25°C$, V_{IN} = –30V		–	0.25	1.2	A
Peak Output Current	$T_J = 25°C$		1.3	2.2	3.3	A
Average Temperature Coefficient of Output Voltage	V_{OUT} = –5V, I_{OUT} = 5mA	T_J = –55°C to +25°C	–	–	0.3	mV/°C/V_{OUT}
		T_J = +25°C to +150°C	–	–	0.3	
Control Pin Voltage (Reference)	$T_J = 25°C$		–2.32	–2.23	–2.14	V
			–2.35	–	–2.11	V

Note 1. V_{OUT} is defined as:

$$V_{OUT} = \frac{R1 + R2}{R2}(-2.23)$$

Note 2. Dropout Voltage is defined as that input–output voltage differential which causes the output voltage to decrease by 5% of its initial value.

Note 3. The convention for negative regulators is the algebraic value, thus –15V is less than –10V.

Note 4. All characteristics except noise voltage and ripple rejection ratio are measured using pulse techniques (t_W ≤ 10ms, duty cycle ≤ 5%). Output voltage changes due to changes in internal temperature must be taken into account separately.

Design Considerations:

The NTE954 adjustable voltage regulator has an output voltage which varies from $V_{CONTROL}$ to typically

$$V_{IN} -2V \text{ by } V_{OUT} = V_{CONTROL} \frac{(R1 + R2)}{R2}$$

The nominal reference in the NTE954 is −2.23V. If we allow 1.0mA to flow in the control string to eliminate bias current effects, we can make R2 = 2.2kΩ. The output voltage is then:

$$V_{OUT} = (R1 + R2)V, \text{ where R1 and R2 are in k}\Omega\text{s.}$$

Example: If R2 = 2.2kΩ and R1 = 12.8kΩ then
V_{OUT} = −15.2V nominal

By proper wiring of the feedback resistors, load regulation of the device can be improved significantly.

The NTE954 voltage regulator contains thermal−overload protection from excessive power, internal short−circuit protection which limits each circuit's maximum current, and output transistor safe−area protection for reducing the output current as the voltage across each pass transistor is increased.

Although the internal power dissipation is limited, the junction temperature must be kept below the maximum specified temperature in order to meet data sheet specifications. To calculate the maximum junction temperature or heat sink required, the following thermal resistance values should be used:

Typ °C/W	**Max °C/W**	**Typ °C/W**	**Max °C/W**
Θ_{JC}	Θ_{JC}	Θ_{JA}	Θ_{JA}
7.5	11	75	80

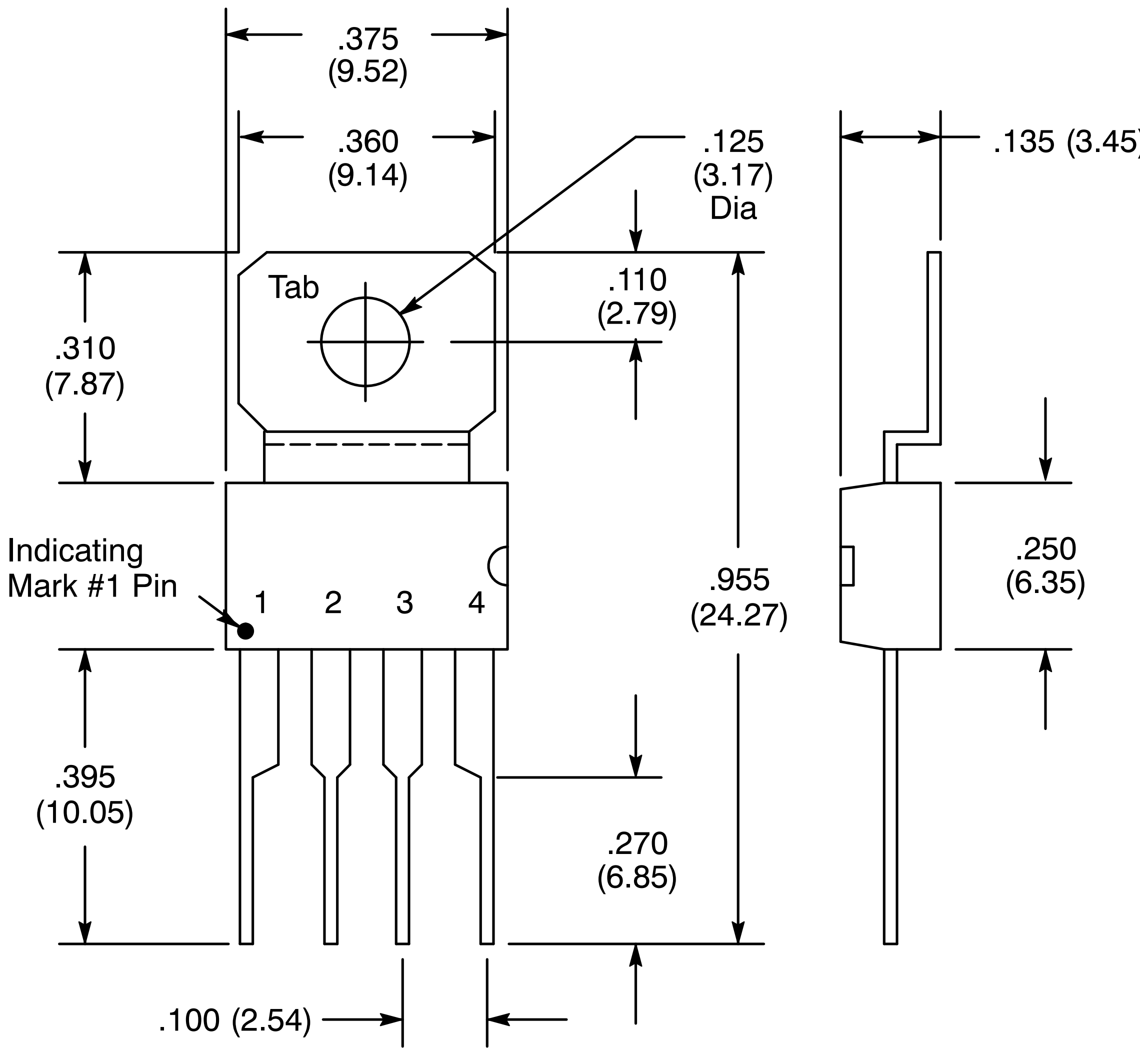
$$P_{D(max)} = \frac{T_{J(max)} - T_A}{\Theta_{JC} + \Theta_{CA}} \text{ or } \frac{T_{J(max)} - T_A}{\Theta_{JA}}$$

(Without a heat sink)

$$\Theta_{CA} = \Theta_{CS} + \Theta_{SA}$$

Solving for T_J: $T_J = T_A + P_D (\Theta_{JC} + \Theta_{CA})$ or
$T_A + P_D \Theta_{JA}$ (Without heat sink)

Where:
T_J = Junction Temperature
T_A = Ambient Temperature
P_D = Power Dissipation
Θ_{JA} = Junction to Ambient Thermal Resistance
Θ_{JC} = Junction to Case Thermal Resistance
Θ_{CA} = Case to Ambient Thermal Resistance
Θ_{CS} = Case to Heat Sink Resistance
Θ_{SA} = Heat Sink to Ambient Thermal Resistance



Pin 1. GND
2. Adjust
3. V_{OUT}
4. V_{IN}
Tab V_{IN}