

**52150/52175**  
78HGA REPLACEMENT

**POSITIVE ADJUSTABLE 5-AMP  
VOLTAGE REGULATOR**

**Mii**

MICROPAC

MICROCIRCUITS PRODUCTS  
DIVISION

**Features:**

- Replacement for 78HGA
- 5.0 A Output Current
- Internal Current And Thermal Limiting
- Internal Short Circuit Current Limit
- Low Drop-Out Voltage (Typically 2.3 V @ 5.0 A)
- 50W Power Dissipation
- Electrically Isolated Case
- Steel TO-3 Case

**Applications:**

- Designed for use in general purpose applications where adjustability is advantageous.
- Military and Hi Rel Industrial applications where hermeticity is required.

**ORDER INFORMATION**

52150            Standard  
52175            MIL-STD-883 Screened

**DESCRIPTION**

The 52150/52175, which is a replacement for the 78HGA, is an adjustable 4-terminal positive voltage regulator capable of supplying in excess of 5.0 A over a 5.0 V to 24 V output range. Only two external resistors are required to set the output voltage. It is packaged in a hermetically sealed TO-3, and provides 50W power dissipation. The regulator consists of a monolithic chip driving a discrete series-pass element. A beryllium-oxide substrate is used in conjunction with an isothermal layout to optimize the thermal characteristics of each device and still maintain electrical isolation between the various chips. This unique circuit design limits the maximum junction temperature of the power output transistor to provide full automatic thermal overload protection. If the safe operating area is ever exceeded (Note 1), the device simply shuts down rather than fail or damage other system components. This feature eliminates the need to design costly regulators built from discrete components.

**ABSOLUTE MAXIMUM RATINGS**

Input Voltage.....	40 V
Internal Power Dissipation @T <sub>c</sub> = 25°C.....	50W
Maximum Input-to-Output Voltage Differential .....	35 V
Operating Junction Temperature .....	150°C
Storage Temperature Range .....	-55°C to +150°C
Pin Temperature (Soldering, 60 seconds).....	300°C
Commercial Temperature Range 52150 .....	0°C to +125°C
Military Temperature Range 52175 .....	-55°C to +125°C

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## ELECTRICAL CHARACTERISTICS

$T_J = 25^\circ\text{C}$ ,  $V_{IN} = 10\text{ V}$  and  $I_{OUT} = -2.0\text{A}$  unless otherwise specified

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output Voltage (Note 4)	$V_{OUT}$	$I_{OUT} = 2.0\text{A}$ , $V_{IN} = V_{OUT} + 3.5\text{V}$	5.0		24	V
Line Regulation (Note 2)	$\Delta V_{OUT}$	$V_{IN} = 7.5\text{ to }25\text{V}$		0.2%	1%	V
Load Regulation (Note 2)	$\Delta V_{OUT}$	$10\text{mA} \leq I_{OUT} \leq 5.0\text{A}$		0.2%	1%	V
Quiescent Current	$I_Q$	$I_{OUT} = 0$		3.4	10	mA
Ripple Rejection	RR	$I_{OUT} = 1.0\text{A}$ , $f = 210\text{Hz}$ , $5.0\text{V}_{\text{pk-pk}}$	60			dB
Output Noise	$V_n$	$10\text{Hz} \leq f \leq 100\text{ kHz}$ $V_{IN} = V_{OUT} + 5.0\text{V}$		50		$\mu\text{V}_{\text{RMS}}$
Dropout Voltage (Note 5)	$V_{DD}$	$I_{OUT} = 5.0\text{A}$		2.3	2.5	V
		$I_{OUT} = 3.0\text{A}$		2.0	2.3	V
Short-Circuit Current Limit	$I_{OS}$	$V_{IN} = 15\text{V}$ , $V_{OUT} = 5\text{V}$		7.0	12.0	A
Control Pin Voltage	$V_C$		4.85	5.0	5.25	V

## NOTES:

- This voltage regulator offers output transistor safe-area protection. However, to maintain full protection, the device must be operated within the maximum input-to-output voltage differential rating listed on the data sheet under "Absolute Maximum Ratings". For applications violating these limits, device will not be fully protected.
- Load and line regulation are specified at constant junction temperature. Pulse testing is required with a pulse width  $\leq 1\text{ ms}$  and a duty cycle  $\leq 5\%$ . Full Kelvin connection methods must be used to measure these parameters.
- The performance characteristics of the adjustable series (78HGA) is specified for  $V_{OUT} = 5.0\text{ V}$ , unless otherwise noted.
- $V_{OUT}$  is defined as  $V_{OUT} = \frac{R1 + R2}{R2} (V_{CONT})$  where R1 and R2 are defined in the Basic Test Circuit diagram.
- Dropout Voltage is the input-output voltage differential that causes the output voltage to decrease by 5% of its initial value.

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## DESIGN CONSIDERATIONS

This device has thermal overload protection from excessive power and internal short circuit protection which limits the circuit's maximum current. Thus, the device is protected from overload abnormalities. Although the internal power dissipation is limited, the junction temperature must be kept below the maximum specified temperature (150°C). It is recommended by the manufacturer that the maximum junction temperature be kept as low as possible for increased reliability. To calculate the maximum junction temperature or heat sink required, the following thermal resistance values should be used.

Package	Type	Max
	$\theta_{JC}$	$\theta_{JC}$
TO-3	1.8	2.5

Where:  $T_J$  = Junction Temperature  
 $T_A$  = Ambient Temperature

$P_D$  = Power Dissipation     $\theta_{CS}$  = Case-to-heat sink thermal resistance  
 $\theta_{JC}$  = Junction-to-case thermal resistance     $\theta_{SA}$  = Heat sink-to-ambient thermal resistance

$$P_{D(MAX)} = \frac{T_{J(max)} - T_A}{\theta_{JC} + \theta_{CA}} \quad \theta_{CA} = \theta_{CS} + \theta_{SA}$$

$$\text{Solving for } T_J = T_A + P_D (\theta_{JC} + \theta_{CA})$$

$\theta_{CA}$  = Case-to-ambient thermal resistance

The device is designed to operate without external compensation components. However, the amount of external filtering of these voltage regulators depends upon the circuit layout. If in a specific application the regulator is more than four inches from the filter capacitor, a 2 $\mu$ F solid tantalum capacitor should be used at the input. A 1 $\mu$ F capacitor should be used at the output to reduce transients created by fast switching loads, as seen in the basic test circuit. These filter capacitors must be located as close to the regulator as possible.

**Caution:** Permanent damage can result from forcing the output voltage higher than the input voltage. A protection diode from output to input should be used if this condition exists.

## VOLTAGE OUTPUT

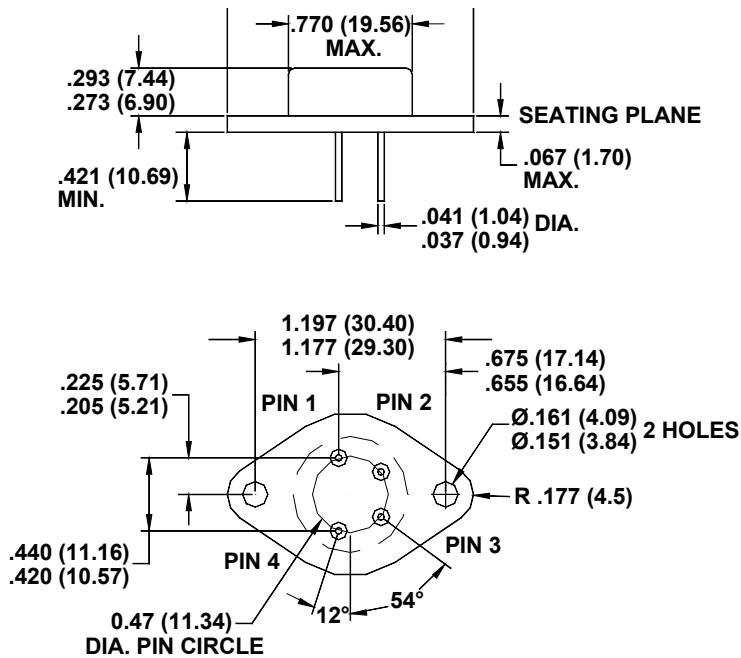
The device has an adjustable output voltage from 5.0V to 24V which can be programmed by the external resistor network (potentiometer or two fixed resistors) using the relationship:

$$V_{OUT} = V_{CONTROL} \times \frac{R1 + R2}{R2}$$

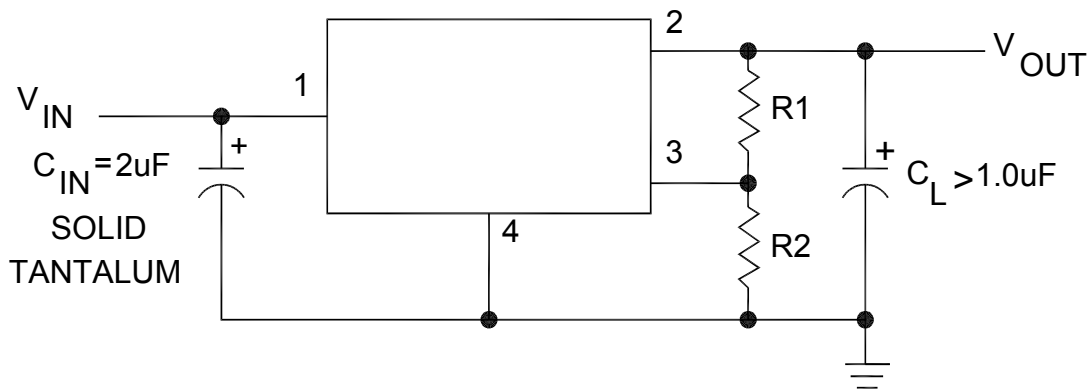
Example: If  $R1 = 0\Omega$  and  $R2 = 5k\Omega$ , Then  
 $V_{OUT} = 5V$  nominal.  
 Or, if  $R1 = 10k\Omega$  and  $R2 = 5k\Omega$  then  
 $V_{OUT} = 15V$

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Mechanical Configuration



Test Circuit Adjustable Output Voltage



**Note:** All dimensions in inches and millimeters (parentheses).

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