FAIRCHILD

A Schlumberger Company

μA78G • μA79G 4-Terminal Adjustable Voltage Regulators

Linear Division Voltage Regulators

Description

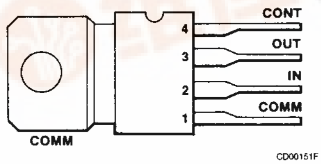
The μA78G and μA79G are 4-terminal adjustable voltage regulators. They are designed to deliver continuous load currents of up to 1.0 A with a maximum input voltage of +40 V for the positive regulator μA78G and −40 V for the negative regulator μA79G. Output current capability can be increased to greater than 1.0 A through use of one or more external transistors. The output voltage range of the μA78G positive voltage regulator is +5 V to +30 V and the output voltage range of the negative μA79G is −30 V to −2.2 V. For systems requiring both a positive and negative, the μA78G and μA79G are excellent for use as a dual tracking regulator with appropriate external circuitry. These 4-terminal voltage regulators are constructed using the Fairchild Planar process.

- **Output Current In Excess Of 1 A**
- **μA78G Positive Output +5 To +30 V**
- **μA79G Negative Output −30 To −2.2 V**
- **Internal Thermal Overload Protection**
- **Internal Short Circuit Protection**
- **Output Transistor Safe-Area Protection**

Absolute Maximum Ratings

Storage Temperature Range	−65°C to +150°C
Operating Junction Temperature Range	0°C to 150°C
Lead Temperature (soldering, 10 s)	265°C
Power Dissipation	Internally Limited
Input Voltage	
μA78G	+40 V
μA79G	−40 V
Control Lead Voltage	
μA78G	$0\ V \leq V+ \leq V_O$
μA79G	$V_O- \leq V- \leq 0\ V$

Connection Diagram
4-Lead TO-202 Package
(Top View)

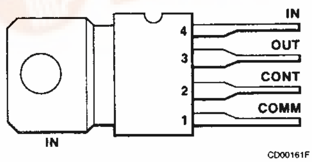


Heat sink tabs connected to common through device substrate.

Order Information

Device Code	Package Code	Package Description
μA78GU1C	8Z	Power Watt

Connection Diagram
4-Lead TO-202 Package
(Top View)

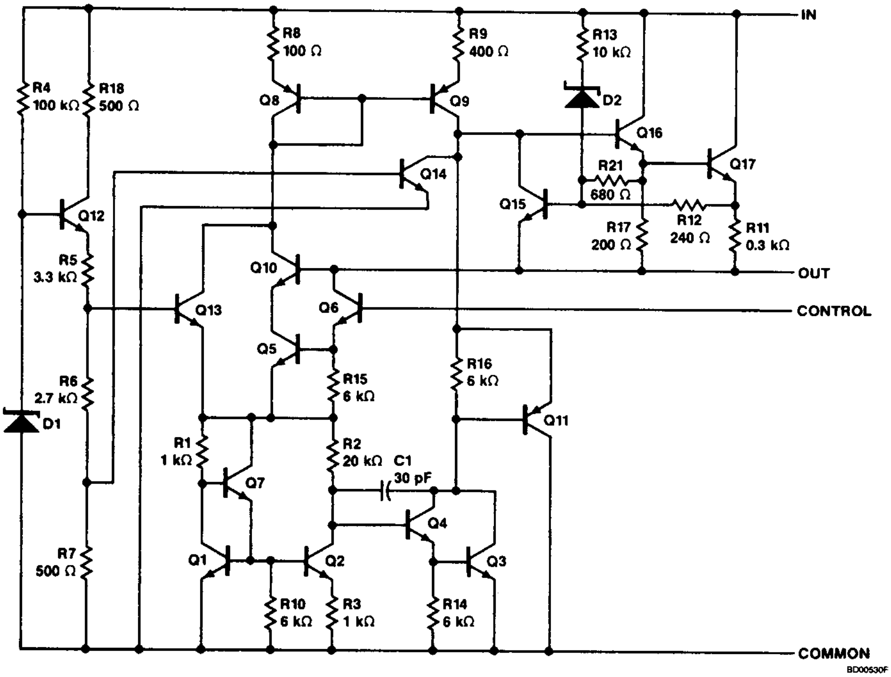


Heat sink tabs connected to input through device substrate. Not recommended for direct electrical connection.

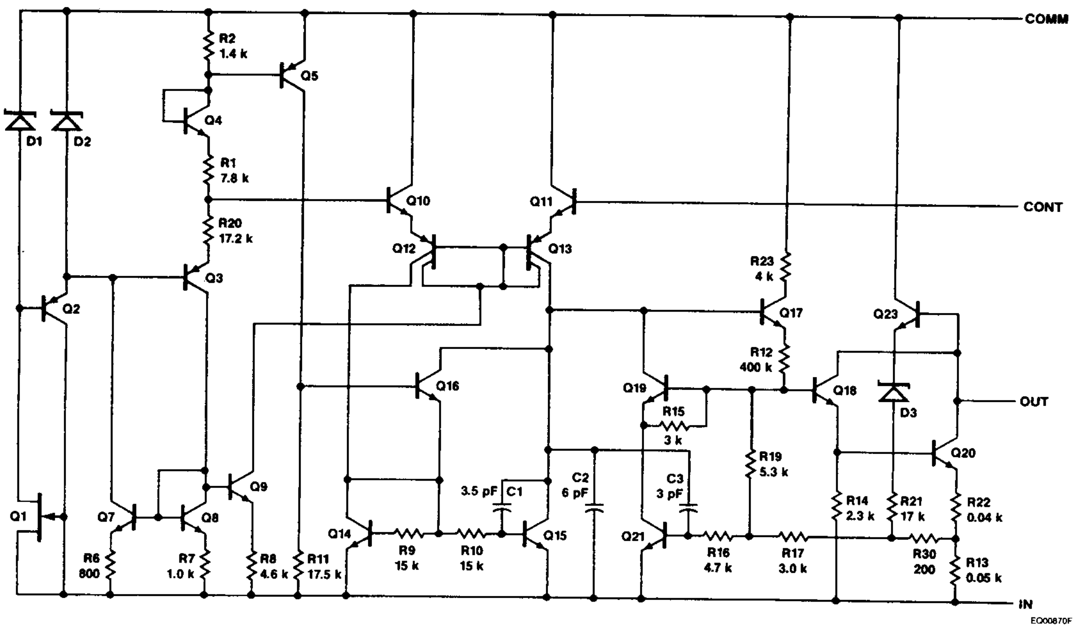
Order Information

Device Code	Package Code	Package Description
μA79GU1C	8Z	Power Watt

μA78G Equivalent Circuit



μA79G Equivalent Circuit (Note 1)



Note

1. All Resistor values in ohms

μA78G

Electrical Characteristics $0°C \leq T_A \leq 125°C$, $C_I = 0.33$ μF, $C_O = 0.1$ μF, $V_I = 10$ V, $I_O = 500$ mA, Test Circuit 1, unless otherwise specified.

Symbol	Characteristic	Condition[1,3]		Min	Typ	Max	Unit
V_{IR}	Input Voltage Range	$T_J = 25°C$		7.5		40	V
V_{OR}	Output Voltage Range	$V_I = V_O + 5.0$ V		5.0		30	V
V_O	Output Voltage Tolerance	$V_O + 3.0 \text{ V} \leq V_I \leq V_O + 15$ V, $5.0 \text{ mA} \leq I_O \leq 1.0$ A, $P_D \leq 15$ W, $V_{I\ max} = 38$ V	$T_J = 25°C$			4.0	% V_O
						5.0	
$V_{O\ LINE}$	Line Regulation	$T_J = 25°C$, $V_O \leq 10$ V, $(V_O + 2.5 \text{ V}) \leq V_I \leq (V_O + 20 \text{ V})$				1.0	% V_O
$V_{O\ LOAD}$	Load Regulation	$T_J = 25°C$, $V_I = V_O + 5.0$ V	$250 \text{ mA} \leq I_O \leq 750$ mA			1.0	% V_O
			$5.0 \text{ mA} \leq I_O \leq 1.5$ A			2.0	
I_C	Control Lead Current	$T_J = 25°C$			1.0	5.0	μA
						8.0	
I_Q	Quiescent Current	$T_J = 25°C$			3.2	6.0	mA
						7.0	
$\Delta V_I/\Delta V_O$	Ripple Rejection	$8.0 \text{ V} \leq V_I \leq 18$ V, f = 2400 Hz, $V_O = 5.0$ V, $I_C = 350$ mA		68	78		dB
N_O	Noise	$T_J = 25°C$, 10 Hz < f < 100 kHz, $V_O = 5.0$ V, $I_O = 5.0$ mA			8.0	40	μV/V_O
V_{DO}	Dropout Voltage[2]				2.0	2.5	V
I_{OS}	Output Short Circuit Current	$T_J = 25°C$, $V_I = 30$ V			.750	1.2	A
I_{pk}	Peak Output Current	$T_J = 25°C$		1.3	2.2	3.3	A
$\Delta V_O/\Delta T$	Average Temperature Coefficient of Output Voltage	$V_O = 5.0$ V, $I_O = 5.0$ mA	$T_A = -55°C$ to $+25°C$			0.4	mV/°C/V_O
			$T_A = 25°C$ to $125°C$			0.3	
V_C	Control Lead Voltage (Reference)	$T_J = 25°C$		4.8	5.0	5.2	V
				4.75		5.25	

Notes

1. V_O is defined for the μA78G as $V_O = \frac{R1 + R2}{R2}(5.0)$; the μA79G as $V_O = \frac{R1 + R2}{R2}(-2.23)$.
2. Dropout Voltage is defined as that input/output voltage differential which causes the output voltage to decrease by 5% of its initial value.
3. All characteristics except noise voltage and ripple rejection ratio are measured using pulse techniques ($t_w \leq 10$ ms, duty cycle $\leq 5\%$). Output voltage changes due to changes in internal temperature must be taken into account separately.

μA79G

Electrical Characteristics $0°C \leqslant T_A \leqslant 125°C$ for μA79G, $V_I = -10$ V, $I_O = 500$ mA, $C_I = 2.0$ μF, $C_O = 1.0$ μF, Test Circuit 2 and Note 3, unless otherwise specified.

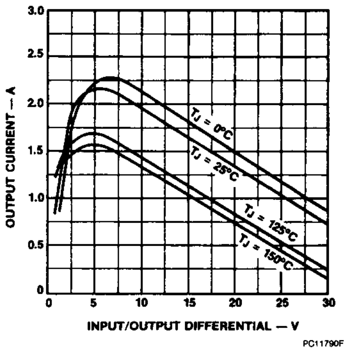
Symbol	Charateristic	Condition[1]		Min	Typ	Max	Unit
V_{IR}	Input Voltage Range	$T_J = 25°C$		−40		−7.0	V
V_{OR}	Nominal Output Voltage Range	$V_I = V_O - 5.0$ V		−30		−2.23	V
V_O	Output Voltage Tolerance	$V_O - 15\ V \leqslant V_I \leqslant V_O - 3.0$ V $5.0\ mA \leqslant I_O \leqslant 1.0$ A $P_D \leqslant 15$ W, $V_{I\ Max} = -3.8$ V	$T_J = 25°C$			4.0	$\%V_O$
						5.0	
$V_{O\ LINE}$	Line Regulation	$T_J = 25°C$, $V_O \geqslant -10$ V $(V_O - 20\ V) \leqslant V_I \leqslant (V_O - 2.5\ V)$				1.0	$\%V_O$
$V_{O\ LOAD}$	Load Regulation	$T_J = 25°C$, $V_I = V_O - 5.0$ V	$250\ mA \leqslant I_O \leqslant 750$ mA			1.0	$\%V_O$
			$5.0\ mA \leqslant I_O \leqslant 1.5$ A			2.0	
I_C	Control Lead Current	$T_J = 25°C$			0.4	2.0	μA
						3.0	
I_Q	Quiescent Current	$T_J = 25°C$			0.5	2.5	mA
						3.0	
$\Delta V_I/\Delta V_O$	Ripple Rejection	$V_O = -8.0$ V, $V_I = -13$ V, f = 2400 Hz, $I_C = 350$ mA		50	60		dB
N_O	Noise	$T_J = 25°C$, $10\ Hz \leqslant f \leqslant 100$ kHz, $V_O = -8.0$ V, $I_O = 5.0$ mA			25	80	$\mu V/V_O$
V_{DO}	Dropout Voltage[2]				1.1	2.3	V
I_{OS}	Output Short Circuit Current	$T_J = 25°C$, $V_I = -30$ V			0.25	1.2	A
I_{pk}	Peak Output Current	$T_J = 25°C$		1.3	2.1	3.3	A
$\Delta V_O/\Delta T$	Average Temperature Coefficient of Output Voltage	$V_O = -5.0$ V, $I_O = 5.0$ mA	$T_A = -55°C$ to $+25°C$			0.3	mV/°C/ V_O
			$T_A = 25°C$ to $125°C$			0.3	
V_C	Control Lead Voltage (Reference)	$T_J = 25°C$		−2.32	−2.23	−2.14	V
				−2.35		−2.11	

Notes

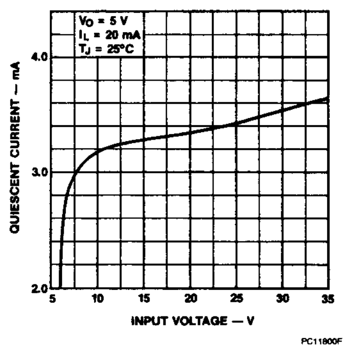
1. V_O is defined for the μA78G as $V_O = \frac{R1 + R2}{R2}(5.0)$; the μA79G as $V_O = \frac{R1 + R2}{R2}(-2.23)$.
2. Dropout voltage is defined as that input/output voltage differential which causes the output voltage to decrease by 5% of its initial value.
3. The convention for negative regulators is the algebraic value, thus −15 V is less than −10 V.
4. All characteristics except noise voltage and ripple rejection ratio are measured using pulse techniques ($t_W \leqslant 10$ ms, duty cycle $\leqslant 5\%$). Output voltage changes due to changes in internal temperature must be taken into account separately.

Typical Performance Curves for µA78G

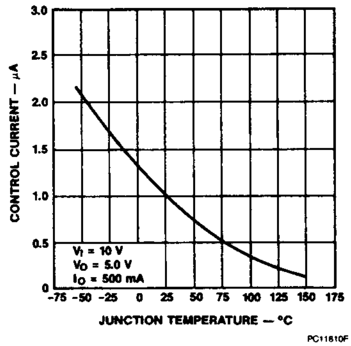
Peak Output Current vs Input/Output Differential Voltage



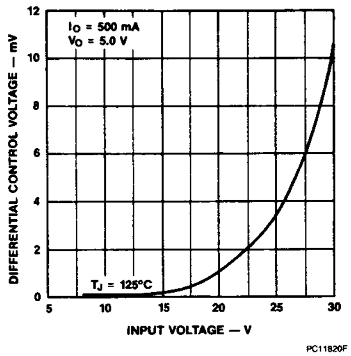
Quiescent Current vs Input Voltage



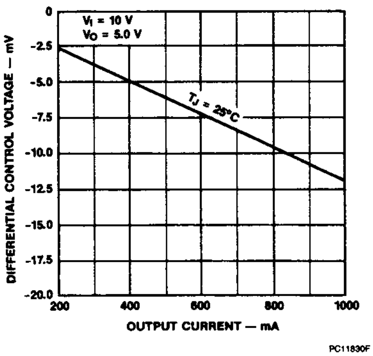
Control Current vs Junction Temperature



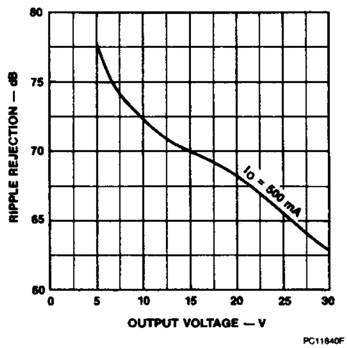
Differential Control Voltage vs Input Voltage



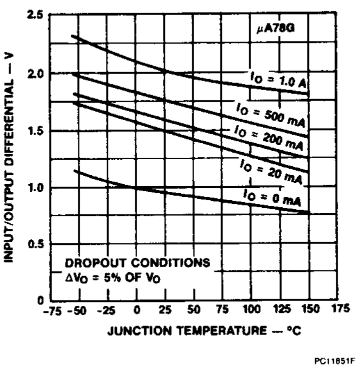
Differential Control Voltage vs Output Current



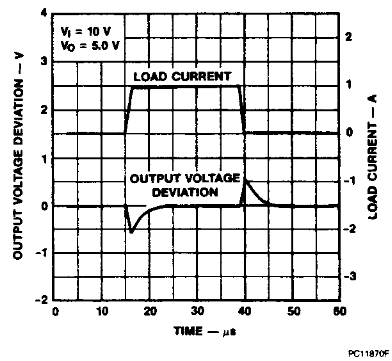
Ripple Rejection vs Output Voltage



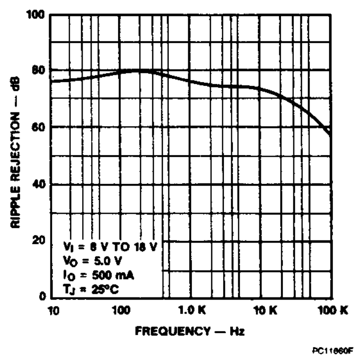
Dropout Voltage vs Junction Temperature vs Frequency



Load Transient Response

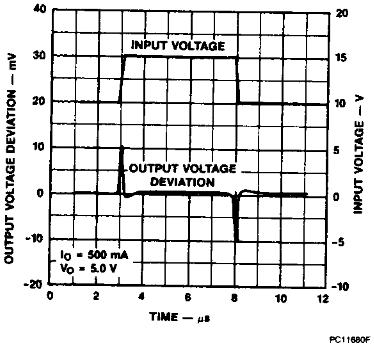


Ripple Rejection vs Frequency

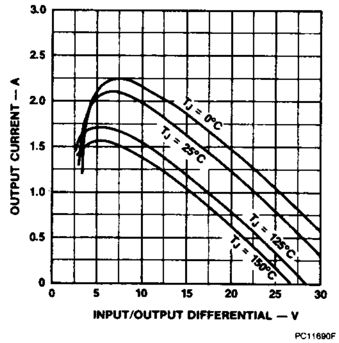


Typical Performance Curves for μA79G

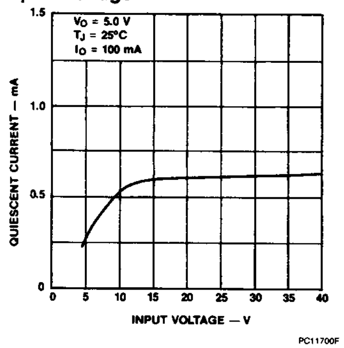
Line Transient Response for μA78G



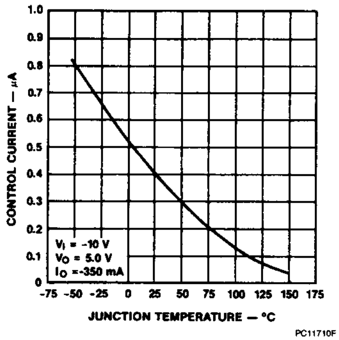
Peak Output Current vs Input/Output Differential Voltage



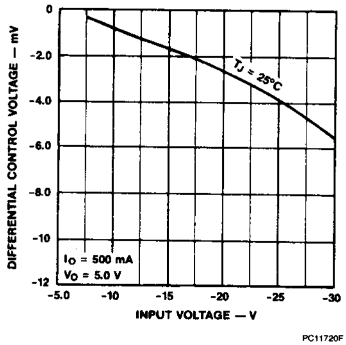
Quiescent Current vs Input Voltage



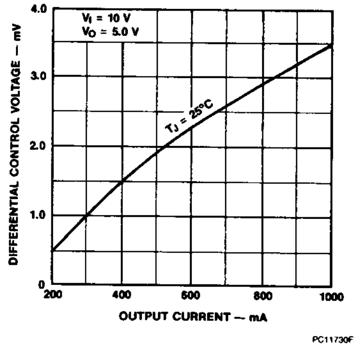
Control Current vs Junction Temperature



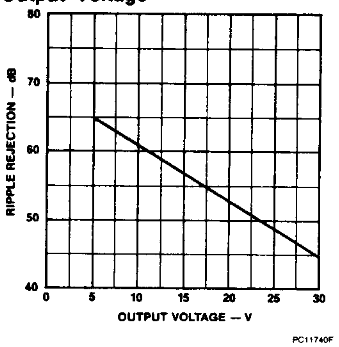
Differential Control Voltage vs Input Voltage



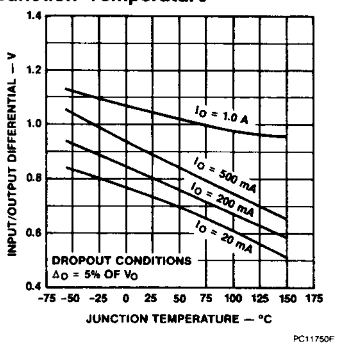
Differential Control Voltage vs Output Current



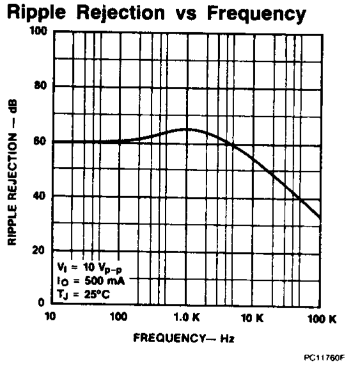
Ripple Rejection vs Output Voltage



Dropout Voltage vs Junction Temperature

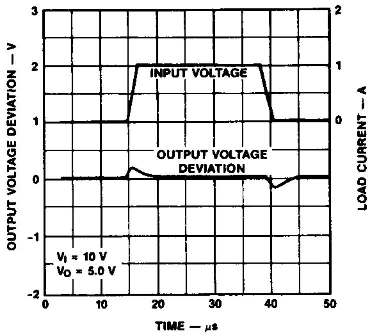


Ripple Rejection vs Frequency



Typical Performance Curves for μA79G (Cont.)

Load Transient Response



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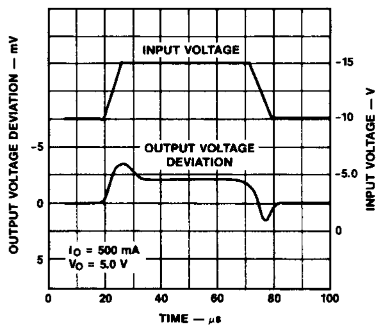
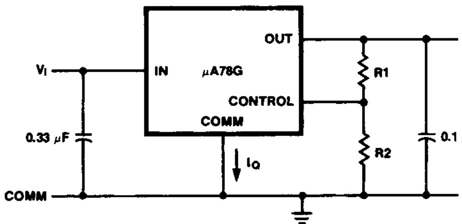
Line Transient Response



PC11780F

Test Circuits

μA78G Test Circuit 1

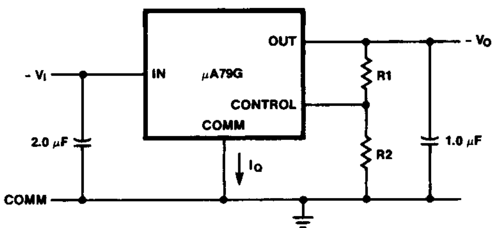


CR05650F

$$V_O = \left(\frac{R1 + R2}{R2}\right) V_{CONT}$$

V_{CONT} Nominal = 5.0 V

μA79G Test Circuit 2



CR05660F

$$V_O = \left(\frac{R1 + R2}{R2}\right) V_{CONT}$$

V_{CONT} Nominal = −2.23 V
Recommended R2 current ≈ 1.0 mA
∴ R2 = 5.0 kΩ (μA78G)
R2 = 2.2 kΩ (μA79G)

Design Considerations

The μA78G and μA79G Adjustable Voltage Regulators have an output voltage which varies from V_{CONT} to typically

$$V_I - 2.0 \text{ V by } V_O = V_{CONT} \frac{R1 + R2}{R2}$$

The nominal reference in the μA78G is 5.0 V and μA79G is −2.23 V. If we allow 1.0 mA to flow in the control string to eliminate bias current effects, we can make R2 = 5.0 kΩ in the μA78G. Then, the output voltage is; V_O = (R1 + R2) V, where R1 and R2 are in kΩs.

Example: If R2 = 5.0 kΩ and R1 = 10 kΩ then
V_O = 15 V nominal, for the μA78G
R2 = 2.2 kΩ and R1 = 12.8 kΩ then
V_O = −15.2 nominal, for the μA79G

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

Both μA78G and μA79G regulators have 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
Package	θ_{JC}	θ_{JC}	θ_{JA}	θ_{JA}
Power Watt	7.5	11	75	80

$$P_{D\ Max} = \frac{T_{J\ Max} - T_A}{\theta_{JC} + \theta_{CA}} \text{ or}$$

$$= \frac{T_{J\ Max} - T_A}{\theta_{JA}} \text{ (without a heat sink)}$$

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

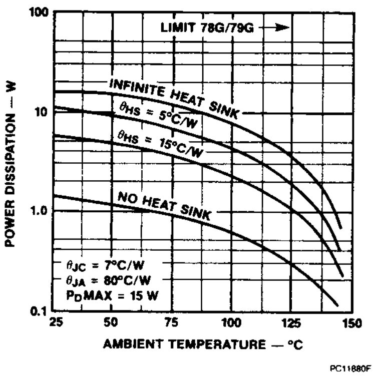
Solving for T_J:

$$T_J = T_A + P_D(\theta_{JC} + \theta_{CA}) \text{ or}$$
$$= T_A + P_D\theta_{JA} \text{ (without heat sink)}$$

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

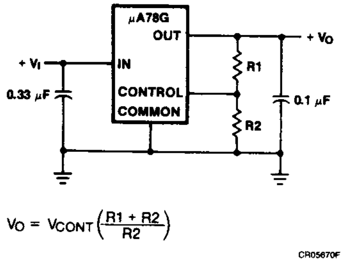
μA78G and μA79G
Power Tab (U1) Package
Worst Case Power Dissipation vs Ambient Temperature



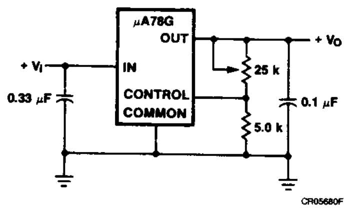
Typical Applications For μA78G (Note 1)

Bypassing of the input and output (0.33 μF and 0.1 μF, respectively) is necessary.

Basic Positive Regulator



Positive 5.0 V to 30 V Adjustable Regulator

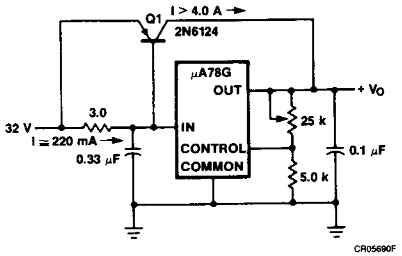


Note
1. All resistor values in ohms.

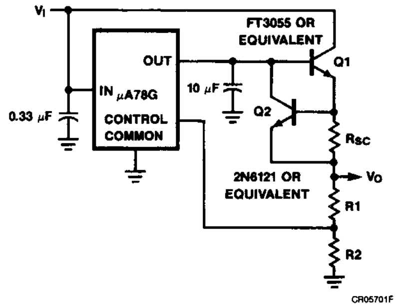
Typical Applications For μA78G (Note 1) (Cont.)

Positive 5.0 V to 30 V Adjustable Regulator

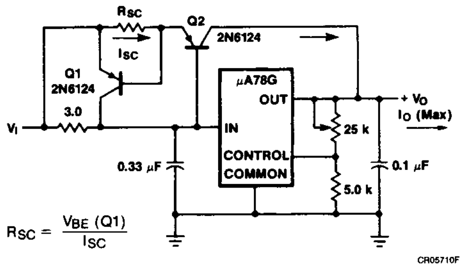
($I_O > 5.0$ A) (Note 2)



Positive High Current, Short Circuit Protected Regulator

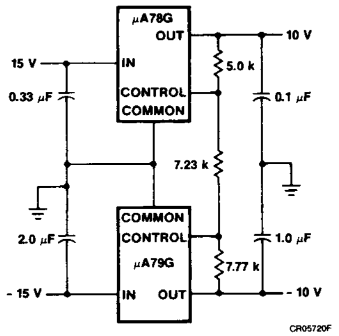


Positive High Current Short Circuit, Protected Regulator



$$R_{SC} = \frac{V_{BE}\ (Q1)}{I_{SC}}$$

± 10 V, 1.0 A Dual Tracking Regulator (Note 3)



Notes

1. All resistor values in ohms.
2. External series pass device is not short circuit protected.
3. If load is not ground referenced, connect reverse biased diodes from outputs to ground.