FAIRCHILD
A Schlumberger Company

μA7900 Series 3-Terminal Negative Voltage Regulators

Linear Products

Description

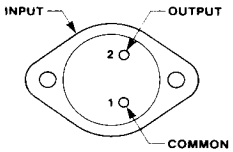
The μA7900 series of Monolithic 3-Terminal Negative Regulators is manufactured using the Fairchild Planar epitaxial process. These negative regulators are intended as complements to the popular μA7800 series of positive voltage regulators, and they are available in the same voltage options from −5 to −15 V. The 7900s employ internal current-limiting, safe-area protection, and thermal shutdown, making them virtually indestructible.

- **OUTPUT CURRENT IN EXCESS OF 1 A**
- **INTERNAL THERMAL-OVERLOAD PROTECTION**
- **INTERNAL SHORT-CIRCUIT CURRENT LIMITING**
- **OUTPUT TRANSISTOR SAFE-AREA COMPENSATION**
- **AVAILABLE IN THE TO-220 AND THE TO-3 PACKAGE**
- **OUTPUT VOLTAGES ARE 5, 8, 12 and 15 V**

Absolute Maximum Ratings

Input Voltage (5 V through 18 V)	−35 V
Internal Power Dissipation	Internally Limited
Storage Temperature Range	
TO-3 (Aluminum or Steel)	−65°C to +150°C
TO-220	−55°C to +150°C
Operating Junction Temperature Range	
Military (μA7900)	−55°C to +150°C
Commercial (μA7900C)	0°C to +125°C
Pin Temperature	
TO-3 (Soldering, 60 s)	300°C
TO-220 (Soldering, 10 s)	230°C

Connection Diagram
TO-3 Package

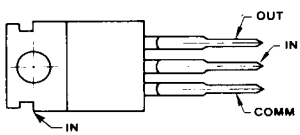


(Top View)

Order Information

Type	Package	Code	Part No.
μA7905	Metal	HJ	μA7905KM
μA7908	Metal	HJ	μA7908KM
μA7912	Metal	HJ	μA7912KM
μA7915	Metal	HJ	μA7915KM
μA7905C	Metal	HJ	μA7905KC
μA7908C	Metal	HJ	μA7908KC
μA7912C	Metal	HJ	μA7912KC
μA7915C	Metal	HJ	μA7915KC

Connection Diagram
TO-220 Package



(Top View)

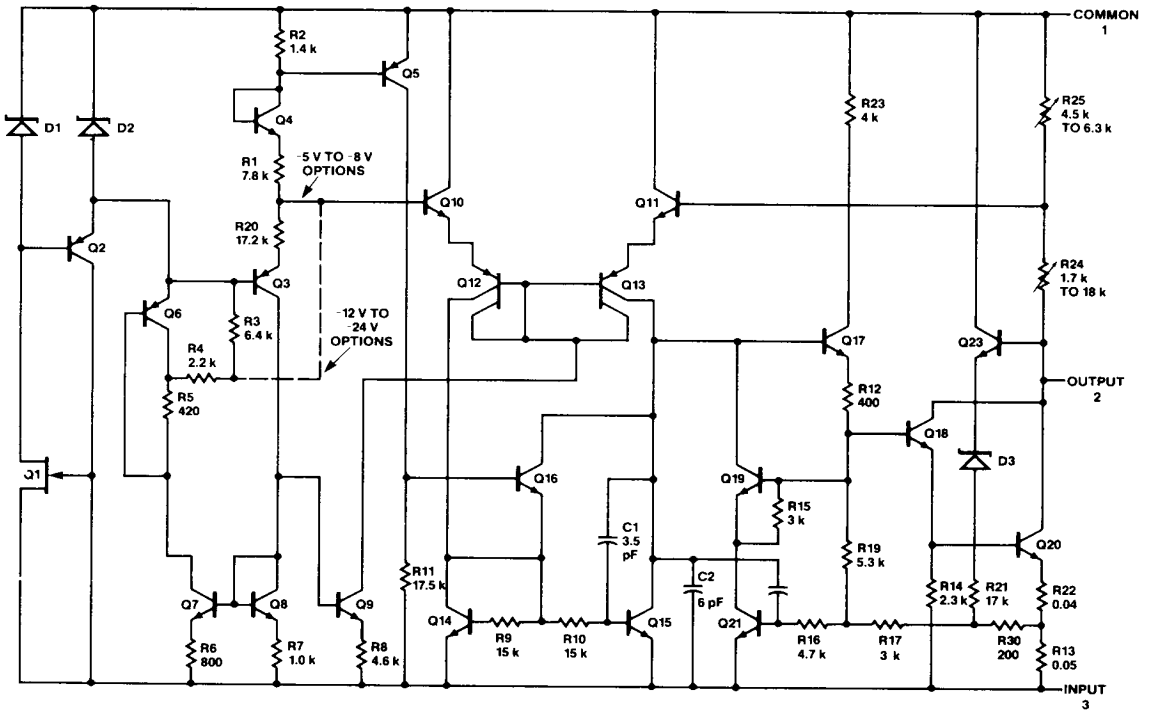
Order Information

Type	Package	Code	Part No.
μA7905C	Molded Power Pack	GH	μA7905UC
μA7908C	Molded Power Pack	GH	μA7908UC
μA7912C	Molded Power Pack	GH	μA7912UC
μA7915C	Molded Power Pack	GH	μA7915UC

Note

The convention for Negative Regulators is the Algebraic value, thus −15 is less than −10 V.

Equivalent Circuit



μA7905

Electrical Characteristics $V_{IN} = -10$ V, $I_{OUT} = 500$ mA, $C_{IN} = 2\ \mu F$, $C_{OUT} = 1\ \mu F$, $-55°C \leq T_J \leq 150°C$, unless otherwise specified.

Characteristic		Condition (Note)		Min	Typ	Max	Unit
Output Voltage		$T_J = 25°C$		−4.8	−5.0	−5.2	V
Line Regulation		$T_J = 25°C$	$-7\ V \leq V_{IN} \leq -25\ V$		3	50	mV
			$-8\ V \leq V_{IN} \leq -12\ V$		1	25	mV
Load Regulation		$T_J = 25°C$	$5\ mA \leq I_{OUT} \leq 1.5\ A$		15	100	mV
			$250\ mA \leq I_{OUT} \leq 750\ mA$		5	25	mV
Output Voltage		$-8.0\ V \leq V_{IN} \leq -20\ V$ $5\ mA \leq I_{OUT} \leq 1.0\ A$ $p \leq 15\ W$		−4.70		−5.30	V
Quiescent Current		$T_J = 25°C$			1.0	2.0	mA
Quiescent Current Change	with line	$-8\ V \leq V_{IN} \leq -25\ V$				1.3	mA
	with load	$5\ mA \leq I_{OUT} \leq 1.0\ A$				0.5	mA
Output Noise Voltage		$T_A = 25°C$, $10\ Hz \leq f \leq 100\ kHz$			25	80	$\mu V/V_{OUT}$
Ripple Rejection		$f = 120\ Hz$, $-8\ V \leq V_{IN} \leq -18\ V$		54	60		dB
Dropout Voltage		$I_{OUT} = 1.0\ A$, $T_J = 25°C$			1.1	2.3	V
Peak Output Current		$T_J = 25°C$		1.3	2.1	3.3	A
Average Temperature Coefficient of Output Voltage		$I_{OUT} = 5\ mA$, $-55°C \leq T_J \leq 150°C$				0.3	mV/°C/V_{OUT}
Short-Circuit Current		$V_{IN} = -35\ V$, $T_J = 25°C$				1.2	A

μA7905C

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

Characteristic		Condition (Note)		Min	Typ	Max	Unit
Output Voltage		$T_J = 25°C$		−4.8	−5.0	−5.2	V
Line Regulation		$T_J = 25°C$	$-7\ V \leq V_{IN} \leq -25\ V$		3.0	100	mV
			$-8\ V \leq V_{IN} \leq -12\ V$		1.0	50	mV
Load Regulation		$T_J = 25°C$	$5\ mA \leq I_{OUT} \leq 1.5\ A$		15	100	mV
			$250\ mA \leq I_{OUT} \leq 750\ mA$		5.0	50	mV
Output Voltage		$-7\ V \leq V_{IN} \leq -20\ V$ $5\ mA \leq I_{OUT} \leq 1.0\ A$ $p \leq 15\ W$		−4.75		−5.25	V
Quiescent Current		$T_J = 25°C$			1.0	2.0	mA
Quiescent Current Change	with line	$-7\ V \leq V_{IN} \leq -25\ V$				1.3	mA
	with load	$5\ mA \leq I_{OUT} \leq 1.0\ A$				0.5	mA
Output Noise Voltage		$T_A = 25°C$, $10\ Hz \leq f \leq 100\ kHz$			125		μV
Ripple Rejection		$f = 120\ Hz$, $-8\ V \leq V_{IN} \leq -18\ V$		54	60		dB
Dropout Voltage		$I_{OUT} = 1.0\ A$, $T_J = 25°C$			1.1		V-
Peak Output Current		$T_J = 25°C$			2.1		A
Average Temperature Coefficient of Output Voltage		$I_{OUT} = 5\ mA$, $0°C \leq T_J \leq 125°C$			0.4		mV/°C

Note

1. 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.

μA7908

Electrical Characteristics $V_{IN} = -14$ V, $I_{OUT} = 500$ mA, $C_{IN} = 2$ μF, $C_{OUT} = 1$ μF, $-55°C \leq T_J \leq 150°C$, unless otherwise specified.

Characteristic		Condition (Note)		Min	Typ	Max	Unit
Output Voltage		$T_J = 25°C$		−7.7	−8.0	−8.3	V
Line Regulation		$T_J = 25°C$	$-10.5\ V \leq V_{IN} \leq -25\ V$		6.0	80	mV
			$-11\ V \leq V_{IN} \leq -17\ V$		2.0	40	mV
Load Regulation		$T_J = 25°C$	$5\ mA \leq I_{OUT} \leq 1.5\ A$		12	100	mV
			$250\ mA \leq I_{OUT} \leq 750\ mA$		4.0	40	mV
Output Voltage		$-11.5\ V \leq V_{IN} \leq -23\ V$ $5\ mA \leq I_{OUT} \leq 1.0\ A$ $p \leq 15\ W$		−7.6		−8.4	V
Quiescent Current		$T_J = 25°C$			1.0	2.0	mA
Quiescent Current Change	with line	$-11.5\ V \leq V_{IN} \leq -25\ V$				1.0	mA
	with load	$5\ mA \leq I_{OUT} \leq 1.0\ A$				0.5	mA
Output Noise Voltage		$T_A = 25°C$, $10\ Hz \leq f \leq 100\ kHz$			25	80	$\mu V/V_{OUT}$
Ripple Rejection		$f = 120\ Hz$, $-11.5\ V \leq V_{IN} \leq -21.5\ V$		54	60		dB
Dropout Voltage		$I_{OUT} = 1.0\ A$, $T_J = 25°C$			1.1	2.3	V
Peak Output Current		$T_J = 25°C$		1.3	2.1	3.3	A
Average Temperature Coefficient of Output Voltage		$I_{OUT} = 5\ mA$, $-55°C \leq T_J \leq 150°C$				0.3	$mV/°C/V_{OUT}$
Short-Circuit Current		$V_{IN} = -35\ V$, $T_J = 25°C$				1.2	A

μA7908C

Electrical Characteristics $V_{IN} = -14$ V, $I_{OUT} = 500$ mA, $C_{IN} = 2$ μF, $C_{OUT} = 1$ μF, $0°C \leq T_J \leq 125°C$, unless otherwise specified.

Characteristic		Condition (Note)		Min	Typ	Max	Unit
Output Voltage		$T_J = 25°C$		−7.7	−8.0	−8.3	V
Line Regulation		$T_J = 25°C$	$-10.5\ V \leq V_{IN} \leq -25\ V$		6.0	160	mV
			$-11\ V \leq V_{IN} \leq -17\ V$		2.0	80	mV
Load Regulation		$T_J = 25°C$	$5\ mA \leq I_{OUT} \leq 1.5\ A$		12	160	mV
			$250\ mA \leq I_{OUT} \leq 750\ mA$		4.0	80	mV
Output Voltage		$-10.5\ V \leq V_{IN} \leq -23\ V$ $5\ mA \leq I_{OUT} \leq 1.0\ A$ $p \leq 15\ W$		−7.6		−8.4	V
Quiescent Current		$T_J = 25°C$			1.0	2.0	mA
Quiescent Current Change	with line	$-10.5\ V \leq V_{IN} \leq -25\ V$				1.0	mA
	with load	$5\ mA \leq I_{OUT} \leq 1.0\ A$				0.5	mA
Output Noise Voltage		$T_A = 25°C$, $10\ Hz \leq f \leq 100\ kHz$			200		μV
Ripple Rejection		$f = 120\ Hz$, $-11.5\ V \leq V_{IN} \leq -21.5\ V$		54	60		dB
Dropout Voltage		$I_{OUT} = 1.0\ A$, $T_J = 25°C$			1.1		V
Peak Output Current		$T_J = 25°C$			2.1		A
Average Temperature Coefficient of Output Voltage		$I_{OUT} = 5\ mA$, $0°C \leq T_J \leq 125°C$			0.6		$mV/°C$

Note

1. 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.

μA7912
Electrical Characteristics $V_{IN} = -19$ V, $I_{OUT} = 500$ mA, $C_{IN} = 2\ \mu F$, $C_{OUT} = 1\ \mu F$, $-55°C \leq T_J \leq 150°C$, unless otherwise specified.

Characteristic		Condition (Note)		Min	Typ	Max	Unit
Output Voltage		$T_J = 25°C$		−11.5	−12.0	−12.5	V
Line Regulation		$T_J = 25°C$	$-14.5\ V \leq V_{IN} \leq -30\ V$		10	120	mV
			$-16\ V \leq V_{IN} \leq -22\ V$		3.0	60	mV
Load Regulation		$T_J = 25°C$	$5\ mA \leq I_{OUT} \leq 1.5\ A$		12	120	mV
			$250\ mA \leq I_{OUT} \leq 750\ mA$		4.0	60	mV
Output Voltage		$-15.5\ V \leq V_{IN} \leq -27\ V$ $5\ mA \leq I_{OUT} \leq 1.0\ A$ $p \leq 15\ W$		−11.4		−12.6	V
Quiescent Current		$T_J = 25°C$			1.5	3.0	mA
Quiescent Current Change	with line	$-15\ V \leq V_{IN} \leq -30\ V$				1.0	mA
	with load	$5\ mA \leq I_{OUT} \leq 1.0\ A$				0.5	mA
Output Noise Voltage		$T_A = 25°C$, $10\ Hz \leq f \leq 100\ kHz$			25	80	$\mu V/V_{OUT}$
Ripple Rejection		$f = 120\ Hz$, $-15\ V \leq V_{IN} \leq -25\ V$		54	60		dB
Dropout Voltage		$I_{OUT} = 1.0\ A$, $T_J = 25°C$			1.1	2.3	V
Peak Output Current		$T_J = 25°C$		1.3	2.1	3.3	A
Average Temperature Coefficient of Output Voltage		$I_{OUT} = 5\ mA$, $-55°C \leq T_J \leq 150°C$				0.3	$mV/°C/V_{OUT}$
Short-Circuit Current		$V_{IN} = -35\ V$, $T_J = 25°C$				1.2	A

μA7912C
Electrical Characteristics $V_{IN} = -19$ V, $I_{OUT} = 500$ mA, $C_{IN} = 2\ \mu F$, $C_{OUT} = 1\ \mu F$, $0°C \leq T_J \leq 125°C$, unless otherwise specified.

Characteristic		Condition (Note)		Min	Typ	Max	Unit
Output Voltage		$T_J = 25°C$		−11.5	−12.0	−12.5	V
Line Regulation		$T_J = 25°C$	$-14.5\ V \leq V_{IN} \leq -30\ V$		10	240	mV
			$-16\ V \leq V_{IN} \leq -22\ V$		3.0	120	mV
Load Regulation		$T_J = 25°C$	$5\ mA \leq I_{OUT} \leq 1.5\ A$		12	240	mV
			$250\ mA \leq I_{OUT} \leq 750\ mA$		4.0	120	mV
Output Voltage		$-14.5\ V \leq V_{IN} \leq -27\ V$ $5\ mA \leq I_{OUT} \leq 1.0\ A$ $p \leq 15\ W$		−11.4		−12.6	V
Quiescent Current		$T_J = 25°C$			1.5	3.0	mA
Quiescent Current Change	with line	$-14.5\ V \leq V_{IN} \leq -30\ V$				1.0	mA
	with load	$5\ mA \leq I_{OUT} \leq 1.0\ A$				0.5	mA
Output Noise Voltage		$T_A = 25°C$, $10\ Hz \leq f \leq 100\ kHz$			300		μV
Ripple Rejection		$f = 120\ Hz$, $-15\ V \leq V_{IN} \leq -25\ V$		54	60		dB
Dropout Voltage		$I_{OUT} = 1.0\ A$, $T_J = 25°C$			1.1		V
Peak Output Current		$T_J = 25°C$			2.1		A
Average Temperature Coefficient of Output Voltage		$I_{OUT} = 5\ mA$, $0°C \leq T_J \leq 125°C$			0.8		mV/°C

Note
1. 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.

μA7915

Electrical Characteristics $V_{IN} = -23$ V, $I_{OUT} = 500$ mA, $C_{IN} = 2\ \mu F$, $C_{OUT} = 1\ \mu F$, $-55°C \leq T_J \leq 150°C$, unless otherwise specified.

Characteristic		Condition (Note)		Min	Typ	Max	Unit
Output Voltage		$T_J = 25°C$		−14.4	−15.0	−15.6	V
Line Regulation		$T_J = 25°C$	$-17.5\ V \leq V_{IN} \leq -30\ V$		11	150	mV
			$-20\ V \leq V_{IN} \leq -26\ V$		3.0	75	mV
Load Regulation		$T_J = 25°C$	$5\ mA \leq I_{OUT} \leq 1.5\ A$		12	150	mV
			$250\ mA \leq I_{OUT} \leq 750\ mA$		4.0	75	mV
Output Voltage		$-18.5\ V \leq V_{IN} \leq -30\ V$ $5\ mA \leq I_{OUT} \leq 1.0\ A$ $p \leq 15\ W$		−14.25		−15.75	V
Quiescent Current		$T_J = 25°C$			1.5	3.0	mA
Quiescent Current Change	with line	$-18.5\ V \leq V_{IN} \leq -30\ V$				1.0	mA
	with load	$5\ mA \leq I_{OUT} \leq 1.0\ A$				0.5	mA
Output Noise Voltage		$T_A = 25°C$, $10\ Hz \leq f \leq 100\ kHz$			25	80	$\mu V/V_{OUT}$
Ripple Rejection		$f = 120\ Hz$, $-18.5\ V \leq V_{IN} \leq -28.5\ V$		54	60		dB
Dropout Voltage		$I_{OUT} = 1.0\ A$, $T_J = 25°C$			1.1	2.3	V
Peak Output Current		$T_J = 25°C$		1.3	2.1	3.3	A
Average Temperature Coefficient of Output Voltage		$I_{OUT} = 5\ mA$, $-55°C \leq T_J \leq 150°C$			−1.0	1.3	$mV/°C/V_{OUT}$
Short-Circuit Current		$V_{IN} = -35\ V$, $T_J = 25°C$				1.2	A

μA7915C

Electrical Characteristics $V_{IN} = -23$ V, $I_{OUT} = 500$ mA, $C_{IN} = 2\ \mu F$, $C_{OUT} = 1\ \mu F$, $0°C \leq T_J \leq 125°C$, unless otherwise specified.

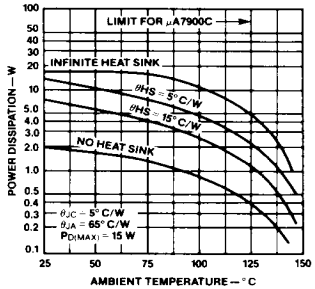
Characteristic		Condition (Note)		Min	Typ	Max	Unit
Output Voltage		$T_J = 25°C$		−14.4	−15.0	−15.6	V
Line Regulation		$T_J = 25°C$	$-17.5\ V \leq V_{IN} \leq -30\ V$		11	300	mV
			$-20\ V \leq V_{IN} \leq -26\ V$		3.0	150	mV
Load Regulation		$T_J = 25°C$	$5\ mA \leq I_{OUT} \leq 1.5\ A$		12	300	mV
			$250\ mA \leq I_{OUT} \leq 750\ mA$		4.0	150	mV
Output Voltage		$-17.5\ V \leq V_{IN} \leq -30\ V$ $5\ mA \leq I_{OUT} \leq 1.0\ A$ $p \leq 15\ W$		−14.25		−15.75	V
Quiescent Current		$T_J = 25°C$			1.5	3.0	mA
Quiescent Current Change	with line	$-17.5\ V \leq V_{IN} \leq -30\ V$				1.0	mA
	with load	$5\ mA \leq I_{OUT} \leq 1.0\ A$				0.5	mA
Output Noise Voltage		$T_A = 25°C$, $10\ Hz \leq f \leq 100\ kHz$			375		μV
Ripple Rejection		$f = 120\ Hz$, $-18.5\ V \leq V_{IN} \leq -28.5\ V$		54	60		dB
Dropout Voltage		$I_{OUT} = 1.0\ A$, $T_J = 25°C$			1.1		V
Peak Output Current		$T_J = 25°C$			2.1		A
Average Temperature Coefficient of Output Voltage		$I_{OUT} = 5\ mA$, $0°C \leq T_J \leq 125°C$			1.0		mV/°C

Note

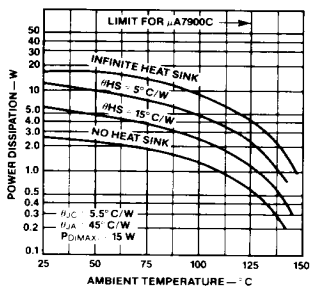
1. All characteristics except noise voltage and ripple rejection ratio are measured using pulse techniques ($t_w \leq 10$ ms, duty cycle $\leq 5\%$). Output voltage changes due to changes in internal temperature must be taken into account separately.

Typical Performance Curves

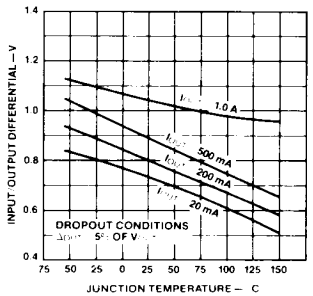
Worst Case Power Dissipation as a Function of Ambient Temperature (TO-220)



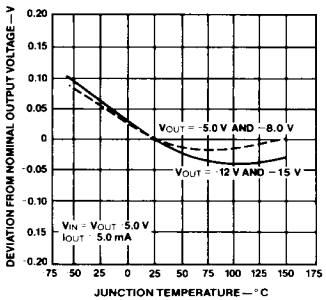
Worst Case Power Dissipation as a Function of Ambient Temperature (TO-3)



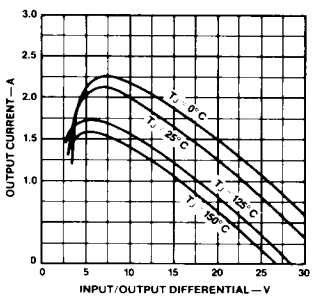
Dropout Voltage as a Function of Junction Temperature



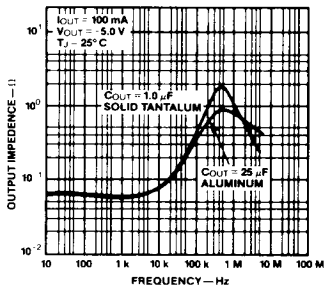
Output Voltage as a Function of Junction Temperature



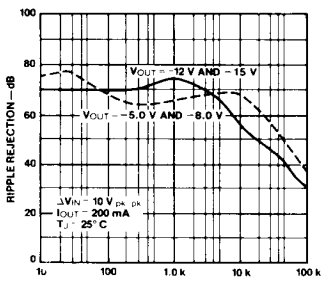
Peak Output Current as a Function of Input-Output Differential Voltage



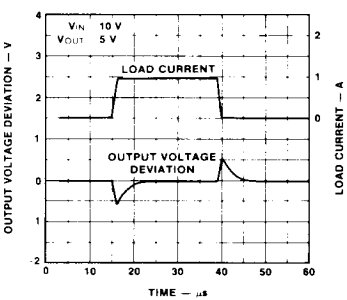
Output Impedance as a Function of Frequency



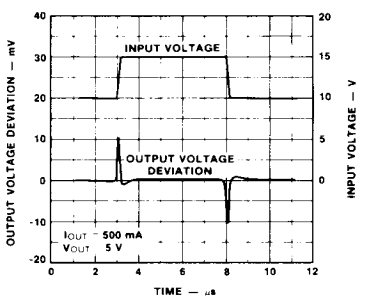
Ripple Rejection as a Function of Frequency



Load Transient Response

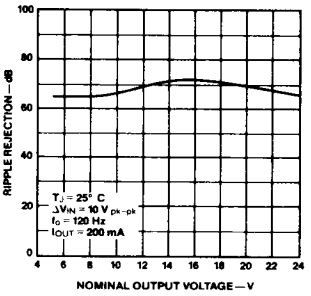


Line Transient Response

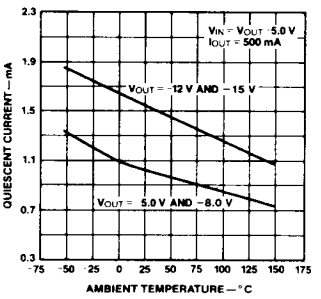


Typical Performance Curves (Cont.)

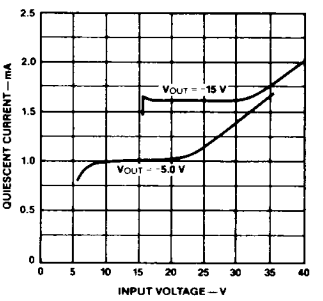
Ripple Rejection as a Function of Output Voltages



Quiescent Current as a Function of Input Voltage



Quiescent Current as a Function of Temperature



Design Considerations

The μA7900 fixed voltage regulator series has thermal-overload protection from excessive power dissipation, internal short-circuit protection which limits the circuit's maximum current, and output transistor safe-area compensation for reducing the output current as the voltage across the pass transistor is increased.

Although the internal power dissipation is limited, the junction temperature must be kept below the maximum specified temperature (150°C for 7900, 125°C for 7900C) 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:

Package	Typ θ_{JC} °C/W	Max θ_{JC} °C/W	Typ θ_{JA} °C/W	Max θ_{JA} °C/W
TO-3	3.5	5.5	40	45
TO-220	3.0	5.0	60	65

$$P_{D(MAX)} = \frac{T_{J\,(Max)} - T_A}{\theta_{JC} + \theta_{CA}} \text{ or } \frac{T_{J\,(Max)}\ T_A}{\theta_{JA}}$$

$$\theta_{CA} = \theta_{CS} + \theta_{SA} \text{ (Without heat sink)}$$

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

or $T_A + P_D\theta_{JA}$ (Without heat sink)

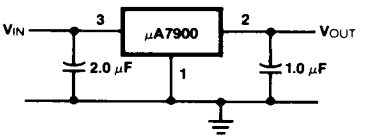
Where T_J = Junction Temperature
T_A = Ambient Temperature
P_D = Power Dissipation
θ_{JA} = Junction-to-Ambient Thermal Resistance
θ_{JC} = Junction-to-Case Thermal Resistance
θ_{CA} = Case-to-Ambient Thermal Resistance
θ_{CS} = Case-to-Heat Sink Thermal Resistance
θ_{SA} = Heat Sink-to-Ambient Thermal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

Typical Applications

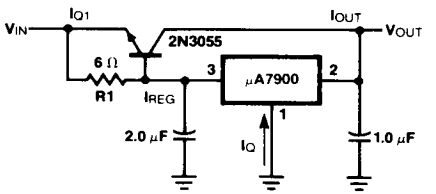
Bypass capacitors are recommended for stable operation of the μA7900 series of regulators over the input voltage and output current ranges. Output bypass capacitors will improve the transient response of the regulator.

The bypass capacitors, (2 μF on the input, 1 μF on the output) should be ceramic or solid tantalum which have good high frequency characteristics. If aluminum electrolytics are used, their values should be 10 μF or larger. The bypass capacitors should be mounted with the shortest leads, and if possible, directly across the regulator terminals.

Fixed Output Regulator

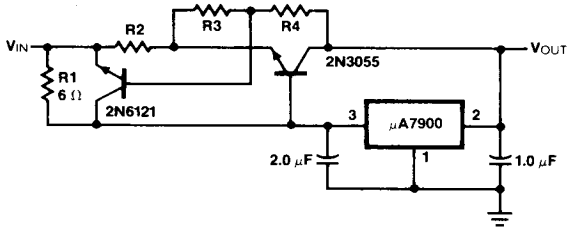


High Current Voltage Regulator

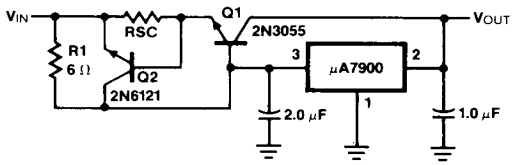


$$R1 = \frac{V_{BE(QI)}}{I_{REG}} \quad I_{QI} = \beta(Q1)I_{REG}$$

High Output Current, Foldback Current Limited



High Output Current, Short-Circuit Protected



$$RSC = \frac{V_{BE(Q2)}}{I_{SC}}$$

Operational Amplifier Supply (± 15 V @ 1.0 A)