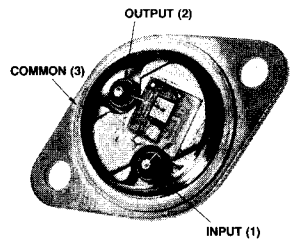
μA78H12 • μA78H15
5 AMP VOLTAGE REGULATORS
FAIRCHILD HYBRID PRODUCTS

GENERAL DESCRIPTION

Fixed Output – The μA78H12 and μA78H15 are regulators with fixed output voltages and 5 A output current capability with all the inherent characteristics of the monolithic 3-terminal regulators, i.e., full thermal overload, short-circuit and safe-area protection. The μA78H12 and μA78H15 are packaged in a hermetically sealed TO-3 providing 50 W power dissipation. The regulator consists of a monolithic chip driving a discrete series-pass element and two short-circuit detection transistors. A beryllium-oxide substrate is used in conjunction with an isothermal layout to optimize the thermal characteristics of the 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, the device simply shuts down, rather than failing or damaging other system components. This feature eliminates the need to design costly output circuitry and overly conservative heat sinking arrangements typical of high-current regulators built from discrete components.

- **5 A OUTPUT CURRENT**
- **INTERNAL-CURRENT AND THERMAL-LIMITING**
- **INTERNAL SHORT-CIRCUIT CURRENT LIMIT**
- **LOW DROP-OUT VOLTAGE**
- **50 W POWER DISSIPATION**

CONNECTION DIAGRAM
TO-3 PACKAGE
(TOP VIEW)
PACKAGE OUTLINE GJ
PACKAGE CODE K



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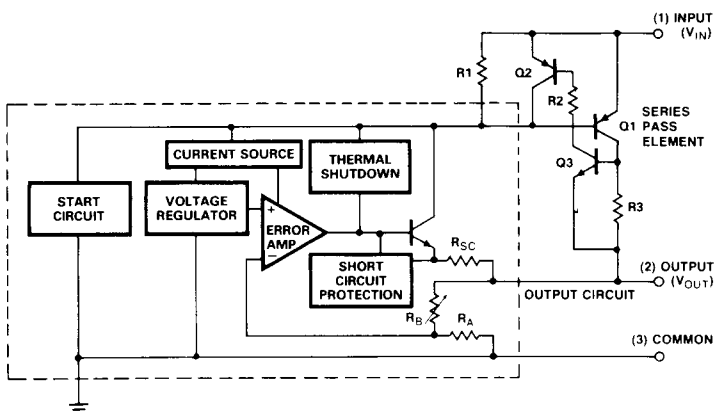
ABSOLUTE MAXIMUM RATINGS

Input Voltage	25 V
Internal Power Dissipation	50 W @ 25°C Case
Maximum Input-to-Output Voltage Differential	25 V
Operating Junction Temperature Range	0°C to 150°C
Military Temperature Range (consult factory)	−55°C to 150°C
Storage Temperature Range	−55°C to 150°C
Lead Temperature (Soldering, 60 s)	300°C

ORDER INFORMATION

OUTPUT VOLTAGE	TEMP. RANGE	PART NO.
12 V	0°C to +150°C	μA78H12SC
15 V	0°C to +150°C	μA78H15SC

BLOCK DIAGRAM



ELECTRICAL CHARACTERISTICS: T_J = 25°C, I_{OUT} = 2.0 A unless otherwise specified.

SYMBOL	CHARACTERISTICS	CONDITIONS	μA78H12			UNITS
			MIN	TYP	MAX	
V_{OUT}	Output Voltage	I_{OUT} = 2.0 A, V_{IN} = 19 V	11.5	12	12.5	V
ΔV_{OUT}	Line Regulation (Note 1)	V_{IN} = 16 to 25 V		20	120	mV
ΔV_{OUT}	Load Regulation (Note 1)	10 mA ≤ I_{OUT} ≤ 5.0 A, V_{IN} = 19 V		20	120	mV
I_Q	Quiescent Current	I_{OUT} = 0, V_{IN} = 17 V			10	mA
RR	Ripple Rejection	I_{OUT} = 1.0 A, f = 210 Hz, 5.0 V_{p-p}	60			dB
V_n	Output Noise	10 Hz ≤ f ≤ 100 kHz, V_{IN} = 17 V		75		μV_{RMS}
	Dropout Voltage	I_O = 5.0 A		3.0		V
		I_O = 3.0 A		2.6		V
I_{OS}	Short Circuit Current Limit	V_{IN} = 19 V		7.0		A_{pk}

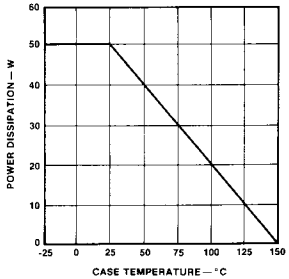
ELECTRICAL CHARACTERISTICS: T_J = 25°C, I_{OUT} = 2.0 A unless otherwise specified.

SYMBOL	CHARACTERISTICS	CONDITIONS	μA78H15			UNITS
			MIN	TYP	MAX	
V_{OUT}	Output Voltage	I_{OUT} = 2.0 A, V_{IN} = 20 V	14.4	15	15.6	V
ΔV_{OUT}	Line Regulation (Note 1)	V_{IN} = 19 to 25 V		30	150	mV
ΔV_{OUT}	Load Regulation (Note 1)	10 mA ≤ I_{OUT} ≤ 5.0 A, V_{IN} = 20 V		30	150	mV
I_Q	Quiescent Current	I_{OUT} = 0, V_{IN} = 20 V			10	mA
RR	Ripple Rejection	I_{OUT} = 1.0 A, f = 210 Hz, 5.0 V_{p-p}	60			dB
V_n	Output Noise	10 Hz ≤ f ≤ 100 kHz, V_{IN} = 20 V		75		μV_{RMS}
	Dropout Voltage	I_O = 5.0 A		3.0		V
		I_O = 3.0 A		2.6		V
I_{OS}	Short Circuit Current Limit	V_{IN} = 20 V		7.0		A_{pk}

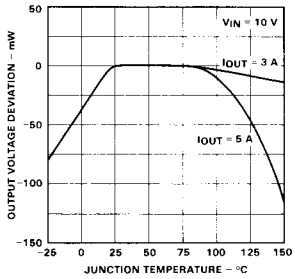
Note 1: Load and line regulations are specified at constant junction temperature. Pulse testing is required with a pulse width ≤ 1 ms and a duty cycle ≤5%. Full Kelvin connection methods must be used to measure these parameters.

TYPICAL PERFORMANCE CHARACTERISTICS

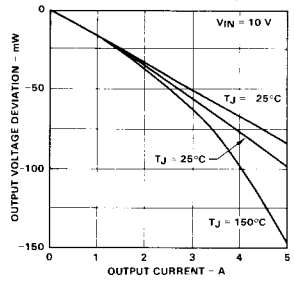
MAXIMUM POWER DISSIPATION



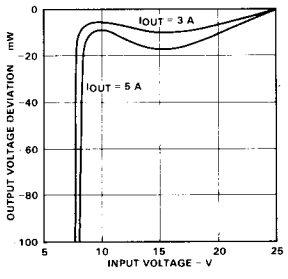
OUTPUT VOLTAGE DEVIATION AS A FUNCTION OF JUNCTION TEMPERATURE



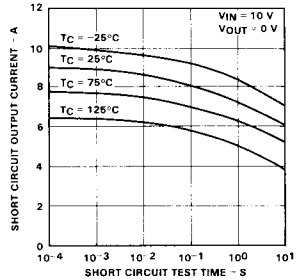
LOAD REGULATION



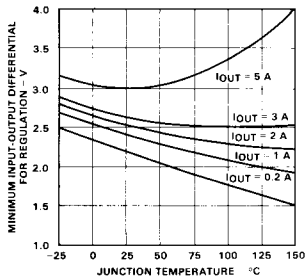
LINE REGULATION



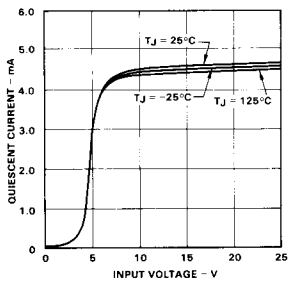
SHORT CIRCUIT CURRENT



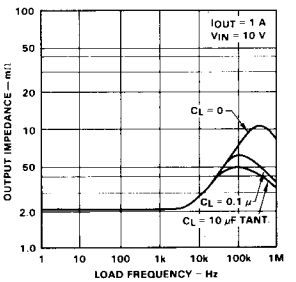
DROP OUT VOLTAGE



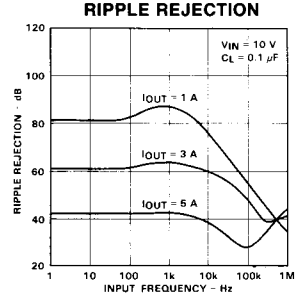
QUIESCENT CURRENT



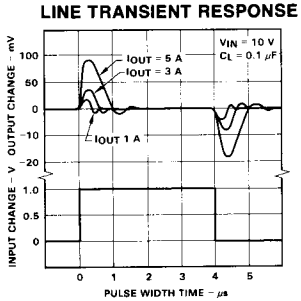
OUTPUT IMPEDANCE



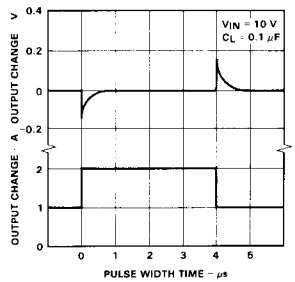
RIPPLE REJECTION



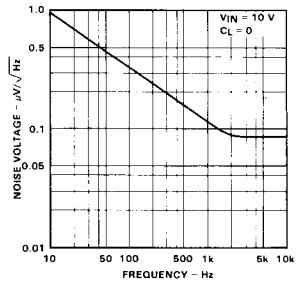
LINE TRANSIENT RESPONSE



LOAD TRANSIENT RESPONSE



OUTPUT NOISE VOLTAGE



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DESIGN CONSIDERATIONS

The μA78H12 and μA78H15 fixed voltage regulators have thermal-overload protection from excessive power, internal short-circuit protection which limits the circuit's maximum current, and output transistor safe-area-compensation to prevent excessive instantaneous power appearing across the pass transistor as the voltage across it increases. Thus, the device is fully protected from all overload abnormalities.

Although the internal power dissipation is limited, the junction temperature must be kept below the maximum specified temperature (150°C) 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}	MAX θ_{JC}	TYP θ_{JA}	MAX θ_{JA}
TO-3	2.0	2.5	32	38

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

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

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

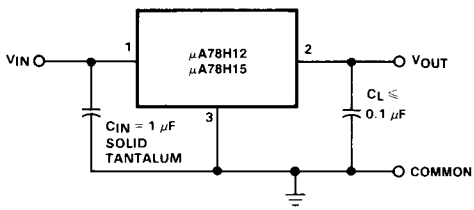
Where:

T_J = Junction Temperature
T_A = Ambient Temperature
P_D = Power Dissipation
θ_{JC} = Junction-to-case thermal resistance
θ_{CA} = Case-to-ambient thermal resistance
θ_{CS} = Case-to-ambient thermal resistance
θ_{SA} = Heat sink-to-ambient thermal resistance
θ_{JA} = Junction-to-ambient thermal resistance

TEST CIRCUIT

μA78H12 • μA78H15

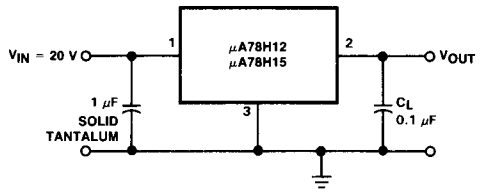
FIXED OUTPUT VOLTAGE



TYPICAL APPLICATIONS FOR μA78H12 AND μA78H15

In many applications, compensation capacitors may not be required. However, for stable operation of the regulators over all input voltage and output current ranges, bypassing of the input and output (1.0 μF solid tantalum and 0.1 μF respectively) is recommended. Input bypassing is necessary if the regulator is located far from the filter capacitor of the power supply. Bypassing the output will improve the transient response of the regulators.

5 AMP REGULATOR



SIGNAL DRIVER/MODULATOR