

μ A78P05 5-Volt 10-Amp Voltage Regulator

Hybrid Products

Description

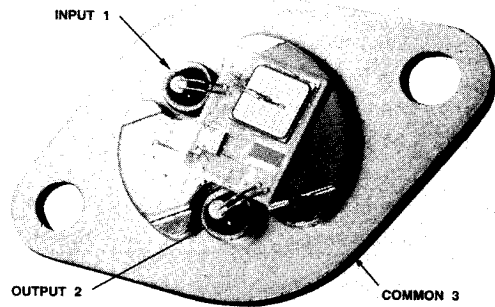
The μ A78P05 3-terminal positive 5 V regulator, consisting of a monolithic control chip driving a series-pass transistor, is capable of delivering 10 A. This hybrid device is virtually blow-out proof and contains all the protection features inherent in monolithic regulators such as internal short-circuit current limiting, thermal overload and safe-area protection. If the safe-operating area is exceeded, the device shuts down rather than failing or damaging other system components (Note 1). This feature eliminates costly output circuitry and overly conservative heat sinks typical of high-current regulators built with discrete components. The μ A78P05 is packaged in a hermetically sealed TO-3 providing 70 W power dissipation.

- 10 A OUTPUT CURRENT
- INTERNAL THERMAL OVERLOAD PROTECTION
- INTERNAL SHORT CIRCUIT CURRENT LIMIT
- LOW DROPOUT VOLTAGE (TYPICALLY 2.3 V @ 10 A)
- 70 W POWER DISSIPATION
- PIN-FOR-PIN COMPATIBLE WITH THE μ A78H05, μ A78H05A AND SH323
- STEEL TO-3 PACKAGE

Note

1. 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 ratings as listed on this data sheet under "Absolute Maximum Ratings." For applications violating these limits, device will not be fully protected.

Connection Diagram TO-3 Metal Package

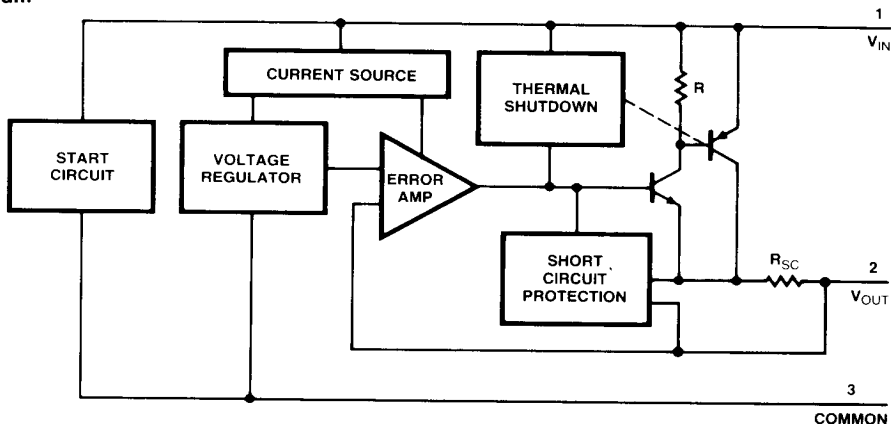


(Top View)

Order Information

| Type | Package | Code | Part No. |
|--------------|---------|------|----------------|
| μ A78P05 | Metal | 6N | μ A78P05SC |
| μ A78P05 | Metal | 6N | μ A78P05SM |

Block Diagram



Absolute Maximum Ratings

| | | | |
|--------------------------------------|------------------|----------------------------------------|-----------------|
| Input Voltage | 40 V | Military Temperature Range | -55°C to +150°C |
| Input-to-Output Voltage | | μA78P05SM | |
| Differential, Output Short-Circuited | 35 V | Commercial Temperature Range μA78P05SC | 0°C to +150°C |
| Internal Power Dissipation | 70 W @ 25°C Case | Storage Temperature Range | -55°C to +150°C |
| Operating Junction Temperature | 150°C | Pin Temperature (Soldering, 60 s) | 300°C |

μA78P05

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

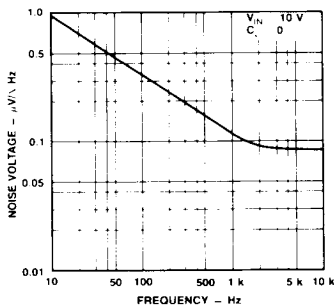
| Symbol | Characteristic | Condition | Limits | | | Unit |
|------------------|-----------------------------|-------------------------------------------------------------------------|--------|-----|------|---------------------|
| | | | Min | Typ | Max | |
| V_{OUT} | Output Voltage | $I_{OUT} = 2.0\text{ A}$ | 4.85 | 5.0 | 5.25 | V |
| ΔV_{OUT} | Line Regulation (Note 2) | $V_{IN} = 8\text{ to }25\text{ V}$ | | 10 | 50 | mV |
| ΔV_{OUT} | Load Regulation (Note 2) | $10\text{ mA} \leq I_{OUT} \leq 5\text{ A}$ | | 25 | 40 | mV |
| ΔV_{OUT} | Load Regulation (Note 2) | $10\text{ mA} \leq I_{OUT} \leq 10\text{ A}$ | | 50 | 75 | mV |
| I_Q | Quiescent Current | $I_{OUT} = 0$ | | 3.4 | 10 | mA |
| RR | Ripple Rejection | $I_{OUT} = 1.0\text{ A}$, $f = 120\text{ Hz}$, 5.0 V_{pk-pk} | 60 | | | dB |
| V_n | Output Noise | $10\text{ Hz} \leq f \leq 100\text{ kHz}$ | | 40 | | μV_{RMS} |
| V_{DD} | Dropout Voltage (Note 3) | $I_{OUT} = 5.0\text{ A}$ | | 2.0 | 2.3 | V |
| | | $I_{OUT} = 10\text{ A}$ | | 2.5 | 3.0 | V |
| I_{OS} | Short-Circuit Current Limit | | | 14 | | A _{pk} |

Notes

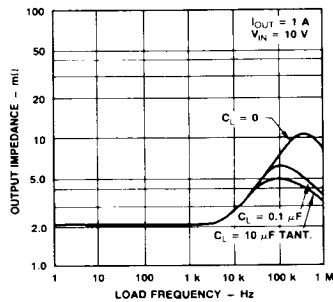
2. Load and line regulation are specified at constant junction temperature. Pulse testing is required with a pulse width $\leq 1\text{ ms}$ and a duty cycle $\leq 5\%$. Full Kelvin connection methods must be used to measure these parameters.
3. Dropout Voltage is the input-output voltage differential that causes the output voltage to decrease by 5% of its initial value.

Typical Performance Curves

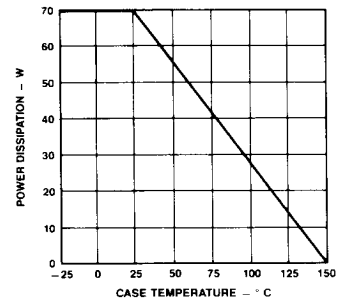
Output Noise Voltage



Output Impedance

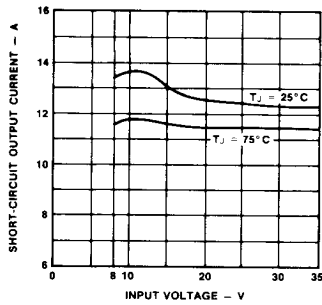


Maximum Power Dissipation

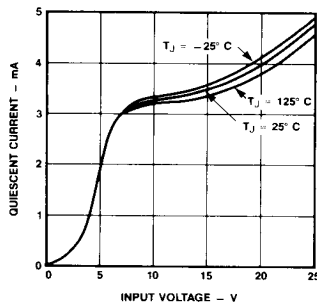


Typical Performance Curves (Cont.)

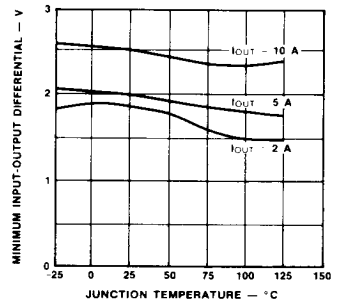
Short Circuit Current



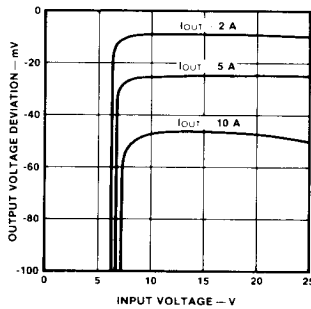
Quiescent Current



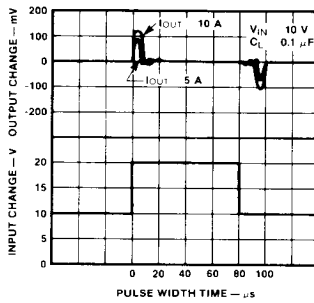
Dropout Voltage



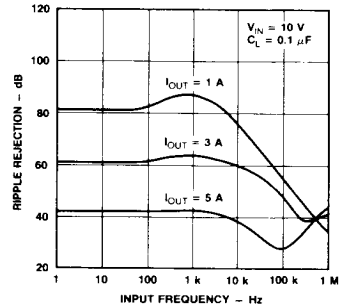
Line Regulation



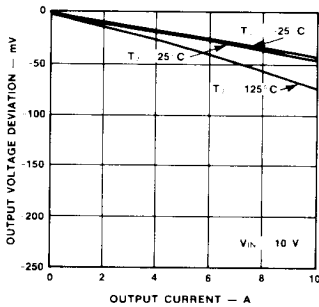
Line Transient Response



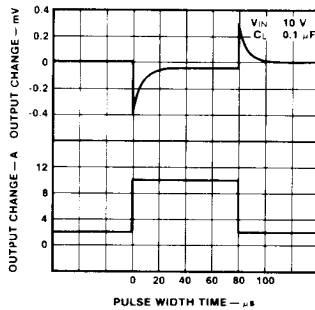
Ripple Rejection



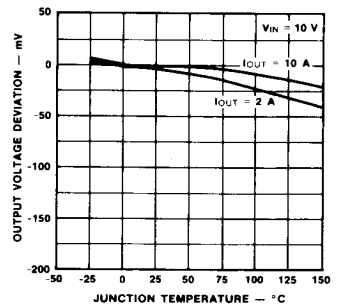
Load Regulation



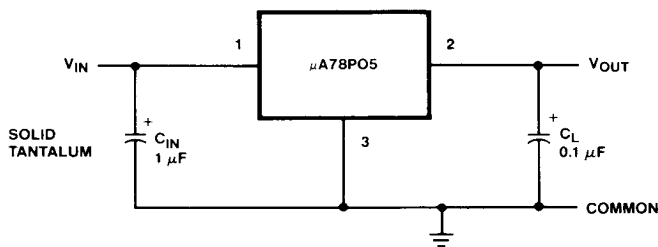
Load Transient Response



Output Voltage Deviation vs Junction Temperature



Basic Test Circuit



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 devices are 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 | Typ θ_{JC} | Max θ_{JC} |
|---------|----------------------|----------------------|
| TO-3 | 1.5 | 1.8 |

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

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

Solving for T_J :

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

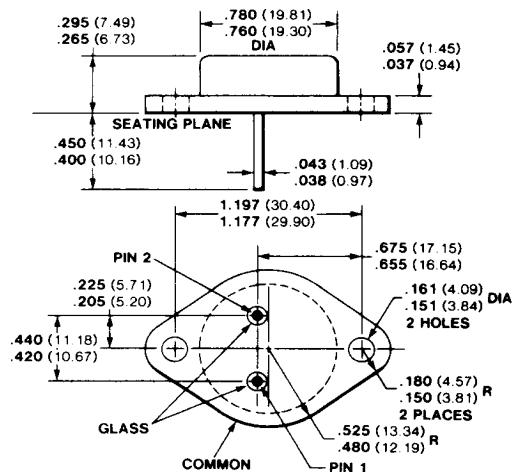
Where:

- 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-heat sink thermal resistance
- θ_{SA} = Heat sink-to-ambient thermal resistance

The μA78P05 is designed to operate without external compensation components. However, the amount of external filtering of this voltage regulator depends upon the circuit layout. If in a specific application the regulator is more than four inches from the filter capacitor, a 1 μF solid tantalum capacitor should be used at the input. A 0.1 μF 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.

Package Outline (S Package — Steel)



Notes

All dimensions in inches bold and millimeters (parentheses)
Pins are solder-dipped alloy 52