



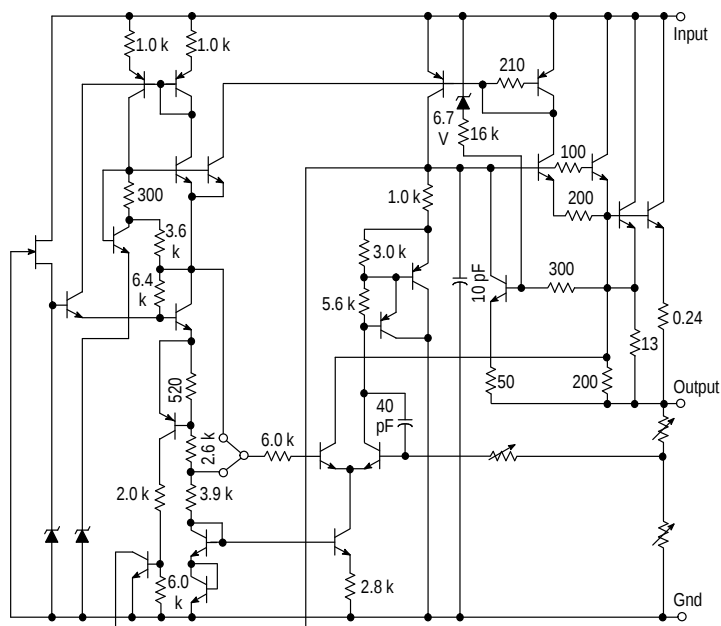
# Three-Terminal Medium Current Positive Voltage Regulators

The MC78M00/MC78M00A Series positive voltage regulators are identical to the popular MC7800 Series devices, except that they are specified for only half the output current. Like the MC7800 devices, the MC78M00 three-terminal regulators are intended for local, on-card voltage regulation.

Internal current limiting, thermal shutdown circuitry and safe-area compensation for the internal pass transistor combine to make these devices remarkably rugged under most operating conditions. Maximum output current, with adequate heatsinking is 500 mA.

- No External Components Required
- Internal Thermal Overload Protection
- Internal Short Circuit Current Limiting
- Output Transistor Safe-Area Compensation
- MC78M00A High Accuracy ( $\pm 2\%$ ) Available for 5.0 V, 8.0 V, 12 V and 15 V
- Previous Commerical Temperature Range has been extended to a Junction Temperature Range of  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$

Representative Schematic Diagram



This device contains 28 active transistors.

DEVICE TYPE/NOMINAL OUTPUT VOLTAGE

|           |       |           |       |          |      |
|-----------|-------|-----------|-------|----------|------|
| MC78M05AC | 5.0 V | MC78M09C  | 9.0 V | MC78M18C | 18 V |
| MC78M05C  | 5.0 V | MC78M12AC | 12 V  | MC78M20C | 20 V |
| MC78M06C  | 6.0 V | MC78M12C  | 12 V  | MC78M24C | 24 V |
| MC78M08AC | 8.0 V | MC78M15AC | 15 V  |          |      |
| MC78M08C  | 8.0 V | MC78M15C  | 15 V  |          |      |

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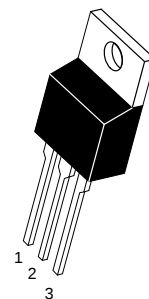
## MC78M00 MC78M00A Series

### THREE-TERMINAL MEDIUM CURRENT POSITIVE FIXED VOLTAGE REGULATORS

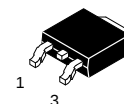
#### SEMICONDUCTOR TECHNICAL DATA

**T SUFFIX**  
PLASTIC PACKAGE  
CASE 221A  
(TO-220)

Heatsink surface  
connected to Pin 2.



Pin 1. Input  
2. Ground  
3. Output



**DT SUFFIX**  
PLASTIC PACKAGE  
CASE 369A  
(DPAK)

**DT-1 SUFFIX**  
PLASTIC PACKAGE  
CASE 369  
(DPAK)

Heatsink surface (shown as terminal 4 in  
case outline drawing) is connected to Pin 2.

#### ORDERING INFORMATION

| Device                                        | Operating Temperature Range                   | Package |
|-----------------------------------------------|-----------------------------------------------|---------|
| MC78MXXCDT                                    | $T_J = -40^{\circ}$ to $+125^{\circ}\text{C}$ | DPAK    |
| MC78MXXACDT*                                  |                                               |         |
| MC78MXXCT                                     |                                               | TO-220  |
| MC78MXXACT*                                   |                                               |         |
| XX Indicates nominal voltage.                 |                                               |         |
| * Available in 5.0, 8.0, 12 and 15 V devices. |                                               |         |

## MC78M00 MC78M00A Series

**MAXIMUM RATINGS** ( $T_A = 25^\circ\text{C}$ , unless otherwise noted.)

| Rating                                                                                                                                                                                                                                                                                                                  | Symbol                                                                             | Value                                                              | Unit                                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|--------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| Input Voltage (5.0 V–18 V)<br>(20 V–24V)                                                                                                                                                                                                                                                                                | $V_I$                                                                              | 35<br>40                                                           | Vdc                                                                                                        |
| Power Dissipation (Package Limitation)<br>Plastic Package, T Suffix<br>$T_A = 25^\circ\text{C}$<br>Thermal Resistance, Junction-to-Air<br>Thermal Resistance, Junction-to-Case<br>Plastic Package, DT Suffix<br>$T_A = 25^\circ\text{C}$<br>Thermal Resistance, Junction-to-Air<br>Thermal Resistance, Junction-to-Case | $P_D$<br>$\theta_{JA}$<br>$\theta_{JC}$<br>$P_D$<br>$\theta_{JA}$<br>$\theta_{JC}$ | Internally Limited<br>70<br>5.0<br>Internally Limited<br>92<br>5.0 | $^\circ\text{C/W}$<br>$^\circ\text{C/W}$<br>$^\circ\text{C/W}$<br>$^\circ\text{C/W}$<br>$^\circ\text{C/W}$ |
| Operating Junction Temperature Range                                                                                                                                                                                                                                                                                    | $T_J$                                                                              | +150                                                               | $^\circ\text{C}$                                                                                           |
| Storage Temperature Range                                                                                                                                                                                                                                                                                               | $T_{stg}$                                                                          | –65 to +150                                                        | $^\circ\text{C}$                                                                                           |

**NOTE:** ESD data available upon request.

**MC78M05C/AC ELECTRICAL CHARACTERISTICS** ( $V_I = 10\text{ V}$ ,  $I_O = 350\text{ mA}$ ,  $-40^\circ\text{C} < T_J < 125^\circ\text{C}$ ,  $P_D \leq 5.0\text{ W}$ , unless otherwise noted.)

| Characteristics                                                                                                                                                                                                                | Symbol                  | Min          | Typ        | Max          | Unit                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|--------------|------------|--------------|----------------------------|
| Output Voltage ( $T_J = 25^\circ\text{C}$ )<br>MC78M05C<br>MC78M05AC                                                                                                                                                           | $V_O$                   | 4.8<br>4.9   | 5.0<br>5.0 | 5.2<br>5.1   | Vdc                        |
| Output Voltage Variation<br>( $7.0\text{ Vdc} \leq V_I \leq 20\text{ Vdc}$ , $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )<br>MC78M05C<br>MC78M05AC                                                                            | $V_O$                   | 4.75<br>4.80 | –<br>–     | 5.25<br>5.20 | Vdc                        |
| Line Regulation<br>( $T_J = 25^\circ\text{C}$ , $7.0\text{ Vdc} \leq V_I \leq 25\text{ Vdc}$ , $I_O = 200\text{ mA}$ )                                                                                                         | Reg <sub>line</sub>     | –            | 3.0        | 5.0          | mV                         |
| Load Regulation<br>( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 200\text{ mA}$ )<br>( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 500\text{ mA}$ )                                                    | Reg <sub>load</sub>     | –<br>–       | 20<br>10   | 100<br>50    | mV                         |
| Input Bias Current ( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                | $I_{IB}$                | –            | 3.2        | 6.0          | mA                         |
| Quiescent Current Change<br>( $8.0\text{ Vdc} \leq V_I \leq 25\text{ Vdc}$ , $I_O = 200\text{ mA}$ )<br>( $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )                                                                        | $\Delta I_{IB}$         | –<br>–       | –<br>–     | 0.8<br>0.5   | mA                         |
| Output Noise Voltage ( $T_A = 25^\circ\text{C}$ , $10\text{ Hz} \leq f \leq 100\text{ kHz}$ )                                                                                                                                  | $V_n$                   | –            | 40         | –            | $\mu\text{V}$              |
| Ripple Rejection<br>( $I_O = 100\text{ mA}$ , $f = 120\text{ Hz}$ , $8.0\text{ V} \leq V_I \leq 18\text{ V}$ )<br>( $I_O = 300\text{ mA}$ , $f = 120\text{ Hz}$ , $8.0 \leq V_I \leq 18\text{ V}$ , $T_J = 25^\circ\text{C}$ ) | RR                      | 62<br>62     | –<br>80    | –<br>–       | dB                         |
| Dropout Voltage<br>( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                | $V_I - V_O$             | –            | 2.0        | –            | Vdc                        |
| Short Circuit Current Limit ( $T_J = 25^\circ\text{C}$ , $V_I = 35\text{ V}$ )                                                                                                                                                 | $I_{OS}$                | –            | 50         | –            | mA                         |
| Average Temperature Coefficient of Output Voltage<br>( $I_O = 5.0\text{ mA}$ )                                                                                                                                                 | $\Delta V_O / \Delta T$ | –            | $\pm 0.2$  | –            | $\text{mV}/^\circ\text{C}$ |
| Peak Output Current<br>( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                            | $I_O$                   | –            | 700        | –            | mA                         |

## MC78M00 MC78M00A Series

**MC78M06C ELECTRICAL CHARACTERISTICS** ( $V_I = 11\text{ V}$ ,  $I_O = 350\text{ mA}$ ,  $-40^\circ\text{C} < T_J < 125^\circ\text{C}$ ,  $P_D \leq 5.0\text{ W}$ , unless otherwise noted.)

| Characteristics                                                                                                                                                                                                                         | Symbol                  | Min      | Typ       | Max        | Unit                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|----------|-----------|------------|----------------------------|
| Output Voltage ( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                             | $V_O$                   | 5.75     | 6.0       | 6.25       | Vdc                        |
| Output Voltage Variation<br>( $8.0\text{ Vdc} \leq V_I \leq 21\text{ Vdc}$ , $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )                                                                                                              | $V_O$                   | 5.7      | —         | 6.3        | Vdc                        |
| Line Regulation<br>( $T_J = 25^\circ\text{C}$ , $8.0\text{ Vdc} \leq V_I \leq 25\text{ Vdc}$ , $I_O = 200\text{ mA}$ )                                                                                                                  | Regline                 | —        | 5.0       | 50         | mV                         |
| Load Regulation<br>( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 500\text{ mA}$ )<br>( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 200\text{ mA}$ )                                                             | Regload                 | —<br>—   | 20<br>10  | 120<br>60  | mV                         |
| Input Bias Current ( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                         | $I_{IB}$                | —        | 3.2       | 6.0        | mA                         |
| Quiescent Current Change<br>( $9.0\text{ Vdc} \leq V_I \leq 25\text{ Vdc}$ , $I_O = 200\text{ mA}$ )<br>( $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )                                                                                 | $\Delta I_{IB}$         | —<br>—   | —<br>—    | 0.8<br>0.5 | mA                         |
| Output Noise Voltage ( $T_A = 25^\circ\text{C}$ , $10\text{ Hz} \leq f \leq 100\text{ kHz}$ )                                                                                                                                           | $V_n$                   | —        | 45        | —          | $\mu\text{V}$              |
| Ripple Rejection<br>( $I_O = 100\text{ mA}$ , $f = 120\text{ Hz}$ , $9.0\text{ V} \leq V_I \leq 19\text{ V}$ )<br>( $I_O = 300\text{ mA}$ , $f = 120\text{ Hz}$ , $9.0\text{ V} \leq V_I \leq 19\text{ V}$ , $T_J = 25^\circ\text{C}$ ) | RR                      | 59<br>59 | —<br>80   | —<br>—     | dB                         |
| Dropout Voltage<br>( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                         | $V_I - V_O$             | —        | 2.0       | —          | Vdc                        |
| Short Circuit Current Limit ( $T_J = 25^\circ\text{C}$ , $V_I = 35\text{ V}$ )                                                                                                                                                          | $I_{OS}$                | —        | 50        | —          | mA                         |
| Average Temperature Coefficient of Output Voltage<br>( $I_O = 5.0\text{ mA}$ )                                                                                                                                                          | $\Delta V_O / \Delta T$ | —        | $\pm 0.2$ | —          | $\text{mV}/^\circ\text{C}$ |
| Peak Output Current<br>( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                     | $I_O$                   | —        | 700       | —          | mA                         |

**MC78M08C/AC ELECTRICAL CHARACTERISTICS** ( $V_I = 14\text{ V}$ ,  $I_O = 350\text{ mA}$ ,  $-40^\circ\text{C} < T_J < 125^\circ\text{C}$ ,  $P_D \leq 5.0\text{ W}$ , unless otherwise noted.)

| Characteristics                                                                                                                                                                                                                               | Symbol                  | Min          | Typ        | Max          | Unit                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|--------------|------------|--------------|----------------------------|
| Output Voltage ( $T_J = 25^\circ\text{C}$ )<br>MC78M08C<br>MC78M08AC                                                                                                                                                                          | $V_O$                   | 7.70<br>7.84 | 8.0<br>8.0 | 8.30<br>8.16 | Vdc                        |
| Output Voltage Variation<br>( $10.5\text{ Vdc} \leq V_I \leq 23\text{ Vdc}$ , $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )<br>MC78M08C<br>MC78M08AC                                                                                          | $V_O$                   | 7.6<br>7.7   | —<br>—     | 8.4<br>8.3   | Vdc                        |
| Line Regulation<br>( $T_J = 25^\circ\text{C}$ , $10.5\text{ Vdc} \leq V_I \leq 25\text{ Vdc}$ , $I_O = 200\text{ mA}$ )                                                                                                                       | Regline                 | —            | 6.0        | 50           | mV                         |
| Load Regulation<br>( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 500\text{ mA}$ )<br>( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 200\text{ mA}$ )                                                                   | Regload                 | —<br>—       | 25<br>10   | 160<br>80    | mV                         |
| Input Bias Current ( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                               | $I_{IB}$                | —            | 3.2        | 6.0          | mA                         |
| Quiescent Current Change<br>( $10.5\text{ Vdc} \leq V_I \leq 25\text{ Vdc}$ , $I_O = 200\text{ mA}$ )<br>( $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )                                                                                      | $\Delta I_{IB}$         | —<br>—       | —<br>—     | 0.8<br>0.5   | mA                         |
| Output Noise Voltage ( $T_A = 25^\circ\text{C}$ , $10\text{ Hz} \leq f \leq 100\text{ kHz}$ )                                                                                                                                                 | $V_n$                   | —            | 52         | —            | $\mu\text{V}$              |
| Ripple Rejection<br>( $I_O = 100\text{ mA}$ , $f = 120\text{ Hz}$ , $11.5\text{ V} \leq V_I \leq 21.5\text{ V}$ )<br>( $I_O = 300\text{ mA}$ , $f = 120\text{ Hz}$ , $11.5\text{ V} \leq V_I \leq 21.5\text{ V}$ , $T_J = 25^\circ\text{C}$ ) | RR                      | 56<br>56     | —<br>80    | —<br>—       | dB                         |
| Dropout Voltage<br>( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                               | $V_I - V_O$             | —            | 2.0        | —            | Vdc                        |
| Short Circuit Current Limit ( $T_J = 25^\circ\text{C}$ , $V_I = 35\text{ V}$ )                                                                                                                                                                | $I_{OS}$                | —            | 50         | —            | mA                         |
| Average Temperature Coefficient of Output Voltage<br>( $I_O = 5.0\text{ mA}$ )                                                                                                                                                                | $\Delta V_O / \Delta T$ | —            | $\pm 0.2$  | —            | $\text{mV}/^\circ\text{C}$ |
| Peak Output Current<br>( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                           | $I_O$                   | —            | 700        | —            | mA                         |

## MC78M00 MC78M00A Series

**MC78M09C ELECTRICAL CHARACTERISTICS** ( $V_I = 15\text{ V}$ ,  $I_O = 350\text{ mA}$ ,  $-40^\circ\text{C} < T_J < 125^\circ\text{C}$ ,  $P_D \leq 5.0\text{ W}$ , unless otherwise noted.)

| Characteristics                                                                                                                                                                                                                               | Symbol                  | Min      | Typ       | Max        | Unit                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|----------|-----------|------------|----------------------------|
| Output Voltage ( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                                   | $V_O$                   | 8.64     | 9.0       | 9.45       | Vdc                        |
| Output Voltage Variation<br>( $11.5\text{ Vdc} \leq V_I \leq 23\text{ Vdc}$ , $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )                                                                                                                   | $V_O$                   | 8.55     | —         | 9.45       | Vdc                        |
| Line Regulation<br>( $T_J = 25^\circ\text{C}$ , $11.5\text{ Vdc} \leq V_I \leq 25\text{ Vdc}$ , $I_O = 200\text{ mA}$ )                                                                                                                       | Regline                 | —        | 6.0       | 50         | mV                         |
| Load Regulation<br>( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 500\text{ mA}$ )<br>( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 200\text{ mA}$ )                                                                   | Regload                 | —<br>—   | 25<br>10  | 180<br>90  | mV                         |
| Input Bias Current ( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                               | $I_{IB}$                | —        | 3.2       | 6.0        | mA                         |
| Quiescent Current Change<br>( $11.5\text{ Vdc} \leq V_I \leq 25\text{ Vdc}$ , $I_O = 200\text{ mA}$ )<br>( $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )                                                                                      | $\Delta I_{IB}$         | —<br>—   | —<br>—    | 0.8<br>0.5 | mA                         |
| Output Noise Voltage ( $T_A = 25^\circ\text{C}$ , $10\text{ Hz} \leq f \leq 100\text{ kHz}$ )                                                                                                                                                 | $V_n$                   | —        | 52        | —          | $\mu\text{V}$              |
| Ripple Rejection<br>( $I_O = 100\text{ mA}$ , $f = 120\text{ Hz}$ , $12.5\text{ V} \leq V_I \leq 22.5\text{ V}$ )<br>( $I_O = 300\text{ mA}$ , $f = 120\text{ Hz}$ , $12.5\text{ V} \leq V_I \leq 22.5\text{ V}$ , $T_J = 25^\circ\text{C}$ ) | RR                      | 56<br>56 | —<br>80   | —<br>—     | dB                         |
| Dropout Voltage<br>( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                               | $V_I - V_O$             | —        | 2.0       | —          | Vdc                        |
| Short Circuit Current Limit ( $T_J = 25^\circ\text{C}$ , $V_I = 35\text{ V}$ )                                                                                                                                                                | $I_{OS}$                | —        | 50        | —          | mA                         |
| Average Temperature Coefficient of Output Voltage<br>( $I_O = 5.0\text{ mA}$ )                                                                                                                                                                | $\Delta V_O / \Delta T$ | —        | $\pm 0.2$ | —          | $\text{mV}/^\circ\text{C}$ |
| Peak Output Current<br>( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                           | $I_O$                   | —        | 700       | —          | mA                         |

**MC78M12C/AC ELECTRICAL CHARACTERISTICS** ( $V_I = 19\text{ V}$ ,  $I_O = 350\text{ mA}$ ,  $-40^\circ\text{C} < T_J < 125^\circ\text{C}$ ,  $P_D \leq 5.0\text{ W}$ , unless otherwise noted.)

| Characteristics                                                                                                                                                                                                                       | Symbol                  | Min            | Typ       | Max            | Unit                       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|----------------|-----------|----------------|----------------------------|
| Output Voltage ( $T_J = 25^\circ\text{C}$ )<br>MC78M12C<br>MC78M12AC                                                                                                                                                                  | $V_O$                   | 11.50<br>11.76 | 12<br>12  | 12.50<br>12.24 | Vdc                        |
| Output Voltage Variation<br>( $14.5\text{ Vdc} \leq V_I \leq 27\text{ Vdc}$ , $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )<br>MC78M12C<br>MC78M12AC                                                                                  | $V_O$                   | 11.4<br>11.5   | —<br>—    | 12.6<br>12.5   | Vdc                        |
| Line Regulation<br>( $T_J = 25^\circ\text{C}$ , $14.5\text{ Vdc} \leq V_I \leq 30\text{ Vdc}$ , $I_O = 200\text{ mA}$ )                                                                                                               | Regline                 | —              | 8.0       | 50             | mV                         |
| Load Regulation<br>( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 500\text{ mA}$ )<br>( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 200\text{ mA}$ )                                                           | Regload                 | —<br>—         | 25<br>10  | 240<br>120     | mV                         |
| Input Bias Current ( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                       | $I_{IB}$                | —              | 3.2       | 6.0            | mA                         |
| Quiescent Current Change<br>( $14.5\text{ Vdc} \leq V_I \leq 30\text{ Vdc}$ , $I_O = 200\text{ mA}$ )<br>( $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )                                                                              | $\Delta I_{IB}$         | —<br>—         | —<br>—    | 0.8<br>0.5     | mA                         |
| Output Noise Voltage ( $T_A = 25^\circ\text{C}$ , $10\text{ Hz} \leq f \leq 100\text{ kHz}$ )                                                                                                                                         | $V_n$                   | —              | 75        | —              | $\mu\text{V}$              |
| Ripple Rejection<br>( $I_O = 100\text{ mA}$ , $f = 120\text{ Hz}$ , $15\text{ V} \leq V_I \leq 25\text{ V}$ )<br>( $I_O = 300\text{ mA}$ , $f = 120\text{ Hz}$ , $15\text{ V} \leq V_I \leq 25\text{ V}$ , $T_J = 25^\circ\text{C}$ ) | RR                      | 55<br>55       | —<br>80   | —<br>—         | dB                         |
| Dropout Voltage<br>( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                       | $V_I - V_O$             | —              | 2.0       | —              | Vdc                        |
| Short Circuit Current Limit ( $T_J = 25^\circ\text{C}$ , $V_I = 35\text{ V}$ )                                                                                                                                                        | $I_{OS}$                | —              | 50        | —              | mA                         |
| Average Temperature Coefficient of Output Voltage<br>( $I_O = 5.0\text{ mA}$ )                                                                                                                                                        | $\Delta V_O / \Delta T$ | —              | $\pm 0.3$ | —              | $\text{mV}/^\circ\text{C}$ |
| Peak Output Current<br>( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                   | $I_O$                   | —              | 700       | —              | mA                         |

## MC78M00 MC78M00A Series

**MC78M15C/AC ELECTRICAL CHARACTERISTICS** ( $V_I = 23\text{ V}$ ,  $I_O = 350\text{ mA}$ ,  $-40^\circ\text{C} < T_J < 125^\circ\text{C}$ ,  $P_D \leq 5.0\text{ W}$ , unless otherwise noted.)

| Characteristics                                                                                                                                                                                                                               | Symbol                  | Min            | Typ       | Max            | Unit                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|----------------|-----------|----------------|----------------------------|
| Output Voltage ( $T_J = 25^\circ\text{C}$ )<br>MC78M15C<br>MC78M15AC                                                                                                                                                                          | $V_O$                   | 14.4<br>14.7   | 15<br>15  | 15.6<br>15.3   | Vdc                        |
| Output Voltage Variation<br>( $17.5\text{ Vdc} \leq V_I \leq 30\text{ Vdc}$ , $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )<br>MC78M15C<br>MC78M15AC                                                                                          | $V_O$                   | 14.25<br>14.40 | —<br>—    | 15.75<br>15.60 | Vdc                        |
| Input Regulation<br>( $T_J = 25^\circ\text{C}$ , $17.5\text{ Vdc} \leq V_I \leq 30\text{ Vdc}$ , $I_O = 200\text{ mA}$ )                                                                                                                      | Regline                 | —              | 10        | 50             | mV                         |
| Load Regulation<br>( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 500\text{ mA}$ )<br>( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 200\text{ mA}$ )                                                                   | Regload                 | —<br>—         | 25<br>10  | 300<br>150     | mV                         |
| Input Bias Current ( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                               | $I_{IB}$                | —              | 3.2       | 6.0            | mA                         |
| Quiescent Current Change<br>( $17.5\text{ Vdc} \leq V_I \leq 30\text{ Vdc}$ , $I_O = 200\text{ mA}$ )<br>( $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )                                                                                      | $\Delta I_{IB}$         | —<br>—         | —<br>—    | 0.8<br>0.5     | mA                         |
| Output Noise Voltage ( $T_A = 25^\circ\text{C}$ , $10\text{ Hz} \leq f \leq 100\text{ kHz}$ )                                                                                                                                                 | $V_n$                   | —              | 90        | —              | $\mu\text{V}$              |
| Ripple Rejection<br>( $I_O = 100\text{ mA}$ , $f = 120\text{ Hz}$ , $18.5\text{ V} \leq V_I \leq 28.5\text{ V}$ )<br>( $I_O = 300\text{ mA}$ , $f = 120\text{ Hz}$ , $18.5\text{ V} \leq V_I \leq 28.5\text{ V}$ , $T_J = 25^\circ\text{C}$ ) | RR                      | 54<br>54       | —<br>70   | —<br>—         | dB                         |
| Dropout Voltage<br>( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                               | $V_I - V_O$             | —              | 2.0       | —              | Vdc                        |
| Short Circuit Current Limit ( $T_J = 25^\circ\text{C}$ , $V_I = 35\text{ V}$ )                                                                                                                                                                | $I_{OS}$                | —              | 50        | —              | mA                         |
| Average Temperature Coefficient of Output Voltage<br>( $I_O = 5.0\text{ mA}$ )                                                                                                                                                                | $\Delta V_O / \Delta T$ | —              | $\pm 0.3$ | —              | $\text{mV}/^\circ\text{C}$ |
| Peak Output Current<br>( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                           | $I_O$                   | —              | 700       | —              | mA                         |

**MC78M18C ELECTRICAL CHARACTERISTICS** ( $V_I = 27\text{ V}$ ,  $I_O = 350\text{ mA}$ ,  $-40^\circ\text{C} < T_J < 125^\circ\text{C}$ ,  $P_D \leq 5.0\text{ W}$ , unless otherwise noted.)

| Characteristics                                                                                                                                                                                                                       | Symbol                  | Min      | Typ       | Max        | Unit                       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|----------|-----------|------------|----------------------------|
| Output Voltage ( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                           | $V_O$                   | 17.3     | 18        | 18.7       | Vdc                        |
| Output Voltage Variation<br>( $21\text{ Vdc} \leq V_I \leq 33\text{ Vdc}$ , $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )                                                                                                             | $V_O$                   | 17.1     | —         | 18.9       | Vdc                        |
| Line Regulation<br>( $T_J = 25^\circ\text{C}$ , $21\text{ Vdc} \leq V_I \leq 33\text{ Vdc}$ , $I_O = 200\text{ mA}$ )                                                                                                                 | Regline                 | —        | 10        | 50         | mV                         |
| Load Regulation<br>( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 500\text{ mA}$ )<br>( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 200\text{ mA}$ )                                                           | Regload                 | —<br>—   | 30<br>10  | 360<br>180 | mV                         |
| Input Bias Current ( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                       | $I_{IB}$                | —        | 3.2       | 6.5        | mA                         |
| Quiescent Current Change<br>( $21\text{ Vdc} \leq V_I \leq 33\text{ Vdc}$ , $I_O = 200\text{ mA}$ )<br>( $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )                                                                                | $\Delta I_{IB}$         | —<br>—   | —<br>—    | 0.8<br>0.5 | mA                         |
| Output Noise Voltage ( $T_A = 25^\circ\text{C}$ , $10\text{ Hz} \leq f \leq 100\text{ kHz}$ )                                                                                                                                         | $V_n$                   | —        | 100       | —          | $\mu\text{V}$              |
| Ripple Rejection<br>( $I_O = 100\text{ mA}$ , $f = 120\text{ Hz}$ , $22\text{ V} \leq V_I \leq 32\text{ V}$ )<br>( $I_O = 300\text{ mA}$ , $f = 120\text{ Hz}$ , $22\text{ V} \leq V_I \leq 32\text{ V}$ , $T_J = 25^\circ\text{C}$ ) | RR                      | 53<br>53 | —<br>70   | —<br>—     | dB                         |
| Dropout Voltage<br>( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                       | $V_I - V_O$             | —        | 2.0       | —          | Vdc                        |
| Short Circuit Current Limit ( $T_J = 25^\circ\text{C}$ , $V_I = 35\text{ V}$ )                                                                                                                                                        | $I_{OS}$                | —        | 50        | —          | mA                         |
| Average Temperature Coefficient of Output Voltage<br>( $I_O = 5.0\text{ mA}$ )                                                                                                                                                        | $\Delta V_O / \Delta T$ | —        | $\pm 0.3$ | —          | $\text{mV}/^\circ\text{C}$ |
| Peak Output Current<br>( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                   | $I_O$                   | —        | 700       | —          | mA                         |

## MC78M00 MC78M00A Series

**MC78M20C ELECTRICAL CHARACTERISTICS** ( $V_I = 29\text{ V}$ ,  $I_O = 350\text{ mA}$ ,  $-30^\circ\text{C} < T_J < 125^\circ\text{C}$ ,  $P_D \leq 5.0\text{ W}$ , unless otherwise noted.)

| Characteristics                                                                                                                                                                                                                       | Symbol                  | Min      | Typ       | Max        | Unit                       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|----------|-----------|------------|----------------------------|
| Output Voltage ( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                           | $V_O$                   | 19.2     | 20        | 20.8       | Vdc                        |
| Output Voltage Variation<br>( $23\text{ Vdc} \leq V_I \leq 35\text{ Vdc}$ , $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )                                                                                                             | $V_O$                   | 19       | —         | 21         | Vdc                        |
| Line Regulation<br>( $T_J = 25^\circ\text{C}$ , $23\text{ Vdc} \leq V_I \leq 35\text{ Vdc}$ , $I_O = 200\text{ mA}$ )                                                                                                                 | Regline                 | —        | 10        | 50         | mV                         |
| Load Regulation<br>( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 500\text{ mA}$ )<br>( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 200\text{ mA}$ )                                                           | Regload                 | —<br>—   | 30<br>10  | 400<br>200 | mV                         |
| Input Bias Current ( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                       | $I_{IB}$                | —        | 3.2       | 6.5        | mA                         |
| Quiescent Current Change<br>( $23\text{ Vdc} \leq V_I \leq 35\text{ Vdc}$ , $I_O = 200\text{ mA}$ )<br>( $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )                                                                                | $\Delta I_{IB}$         | —<br>—   | —<br>—    | 0.8<br>0.5 | mA                         |
| Output Noise Voltage ( $T_A = 25^\circ\text{C}$ , $10\text{ Hz} \leq f \leq 100\text{ kHz}$ )                                                                                                                                         | $V_n$                   | —        | 110       | —          | $\mu\text{V}$              |
| Ripple Rejection<br>( $I_O = 100\text{ mA}$ , $f = 120\text{ Hz}$ , $24\text{ V} \leq V_I \leq 34\text{ V}$ )<br>( $I_O = 300\text{ mA}$ , $f = 120\text{ Hz}$ , $24\text{ V} \leq V_I \leq 34\text{ V}$ , $T_J = 25^\circ\text{C}$ ) | RR                      | 52<br>52 | —<br>70   | —<br>—     | dB                         |
| Dropout Voltage<br>( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                       | $V_I - V_O$             | —        | 2.0       | —          | Vdc                        |
| Short Circuit Current Limit ( $T_J = 25^\circ\text{C}$ , $V_I = 35\text{ V}$ )                                                                                                                                                        | $I_{OS}$                | —        | 50        | —          | mA                         |
| Average Temperature Coefficient of Output Voltage<br>( $I_O = 5.0\text{ mA}$ )                                                                                                                                                        | $\Delta V_O / \Delta T$ | —        | $\pm 0.5$ | —          | $\text{mV}/^\circ\text{C}$ |
| Peak Output Current<br>( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                   | $I_O$                   | —        | 700       | —          | mA                         |

**MC78M24C ELECTRICAL CHARACTERISTICS** ( $V_I = 33\text{ V}$ ,  $I_O = 350\text{ mA}$ ,  $-40^\circ\text{C} < T_J < 125^\circ\text{C}$ ,  $P_D \leq 5.0\text{ W}$ , unless otherwise noted.)

| Characteristics                                                                                                                                                                                                                       | Symbol                  | Min      | Typ       | Max        | Unit                       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|----------|-----------|------------|----------------------------|
| Output Voltage ( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                           | $V_O$                   | 23       | 24        | 25         | Vdc                        |
| Output Voltage Variation<br>( $27\text{ Vdc} \leq V_I \leq 38\text{ Vdc}$ , $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )                                                                                                             | $V_O$                   | 22.8     | —         | 25.2       | Vdc                        |
| Line Regulation<br>( $T_J = 25^\circ\text{C}$ , $27\text{ Vdc} \leq V_I \leq 38\text{ Vdc}$ , $I_O = 200\text{ mA}$ )                                                                                                                 | Regline                 | —        | 10        | 50         | mV                         |
| Load Regulation<br>( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 500\text{ mA}$ )<br>( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 200\text{ mA}$ )                                                           | Regload                 | —<br>—   | 30<br>10  | 480<br>240 | mV                         |
| Input Bias Current ( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                       | $I_{IB}$                | —        | 3.2       | 7.0        | mA                         |
| Quiescent Current Change<br>( $27\text{ Vdc} \leq V_I \leq 38\text{ Vdc}$ , $I_O = 200\text{ mA}$ )<br>( $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )                                                                                | $\Delta I_{IB}$         | —<br>—   | —<br>—    | 0.8<br>0.5 | mA                         |
| Output Noise Voltage ( $T_A = 25^\circ\text{C}$ , $10\text{ Hz} \leq f \leq 100\text{ kHz}$ )                                                                                                                                         | $V_n$                   | —        | 170       | —          | $\mu\text{V}$              |
| Ripple Rejection<br>( $I_O = 100\text{ mA}$ , $f = 120\text{ Hz}$ , $28\text{ V} \leq V_I \leq 38\text{ V}$ )<br>( $I_O = 300\text{ mA}$ , $f = 120\text{ Hz}$ , $28\text{ V} \leq V_I \leq 38\text{ V}$ , $T_J = 25^\circ\text{C}$ ) | RR                      | 50<br>50 | —<br>70   | —<br>—     | dB                         |
| Dropout Voltage<br>( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                       | $V_I - V_O$             | —        | 2.0       | —          | Vdc                        |
| Short Circuit Current Limit ( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                              | $I_{OS}$                | —        | 50        | —          | mA                         |
| Average Temperature Coefficient of Output Voltage<br>( $I_O = 5.0\text{ mA}$ )                                                                                                                                                        | $\Delta V_O / \Delta T$ | —        | $\pm 0.5$ | —          | $\text{mV}/^\circ\text{C}$ |
| Peak Output Current<br>( $T_J = 25^\circ\text{C}$ )                                                                                                                                                                                   | $I_O$                   | —        | 700       | —          | mA                         |

# MC78M00 MC78M00A Series

## DEFINITIONS

**Line Regulation** – The change in output voltage for a change in the input voltage. The measurement is made under conditions of low dissipation or by using pulse techniques such that the average chip temperature is not significantly affected.

**Load Regulation** – The change in output voltage for a change in load current at constant chip temperature.

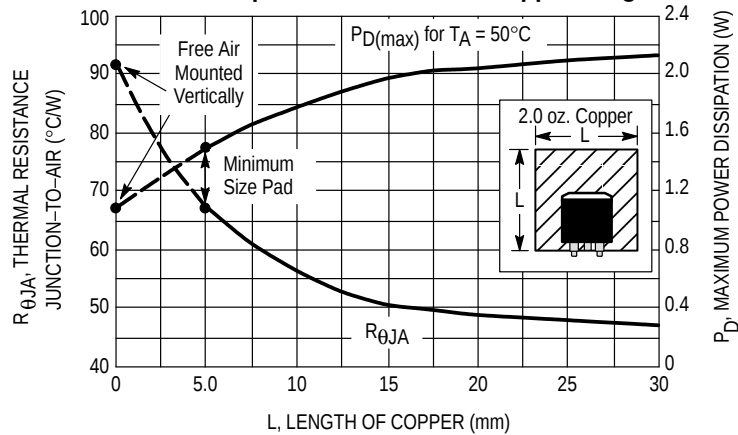
**Maximum Power Dissipation** – The maximum total device dissipation for which the regulator will operate within specifications.

**Input Bias Current** – That part of the input current that is not delivered to the load.

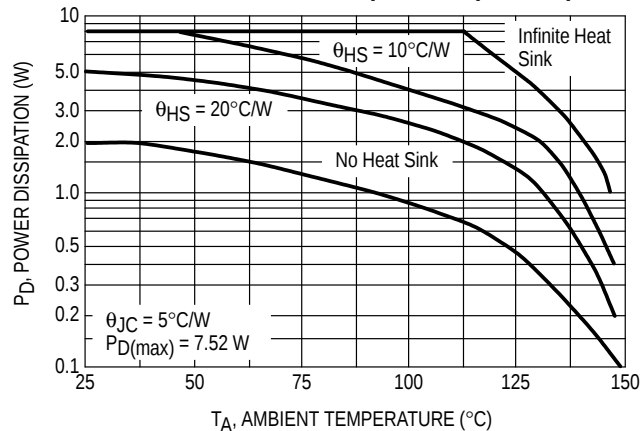
**Output Noise Voltage** – The rms AC voltage at the output, with constant load and no input ripple, measured over a specified frequency range.

**Long Term Stability** – Output voltage stability under accelerated life test conditions with the maximum rated voltage listed in the devices' electrical characteristics and maximum power dissipation.

**Figure 1. DPAK Thermal Resistance and Maximum Power Dissipation versus P.C.B. Copper Length**

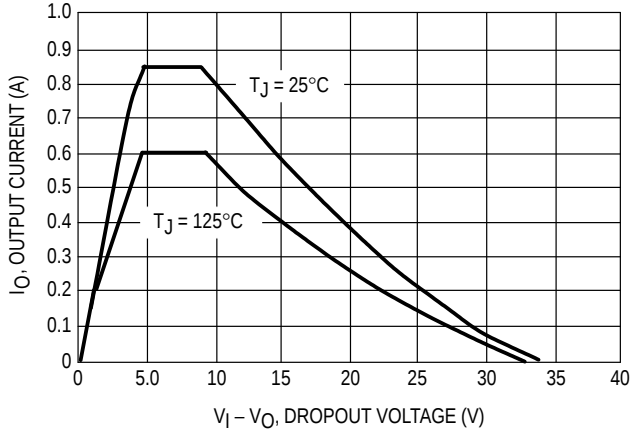


**Figure 2. Worst Case Power Dissipation versus Ambient Temperature (TO-220)**

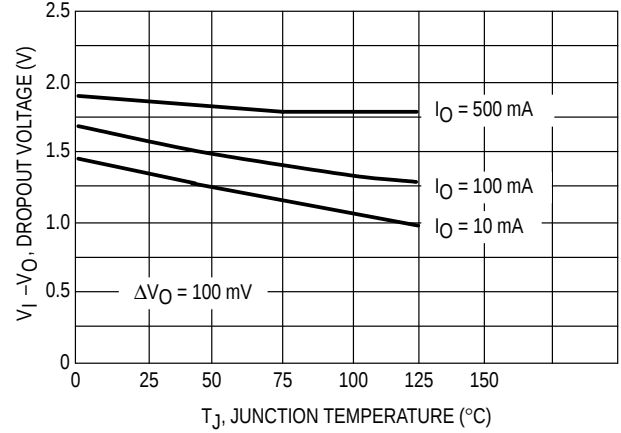


# MC78M00 MC78M00A Series

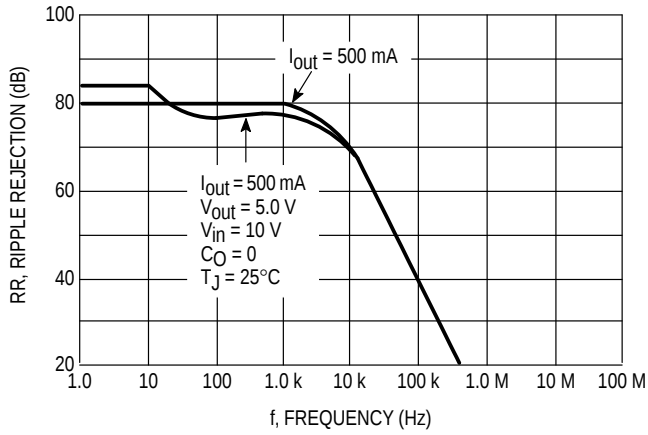
**Figure 3. Peak Output Current versus Dropout Voltage**



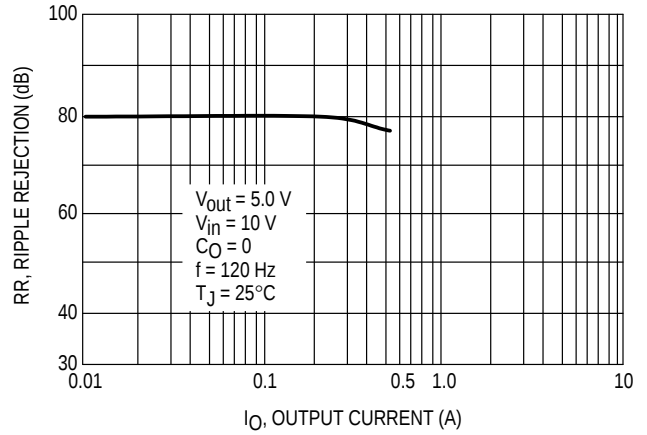
**Figure 4. Dropout Voltage versus Junction Temperature**



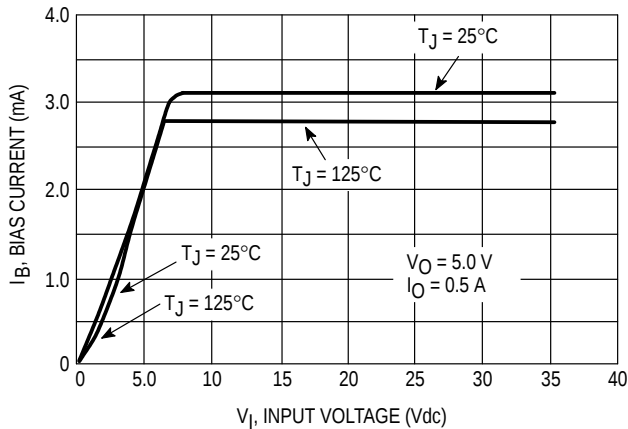
**Figure 5. Ripple Rejection versus Frequency**



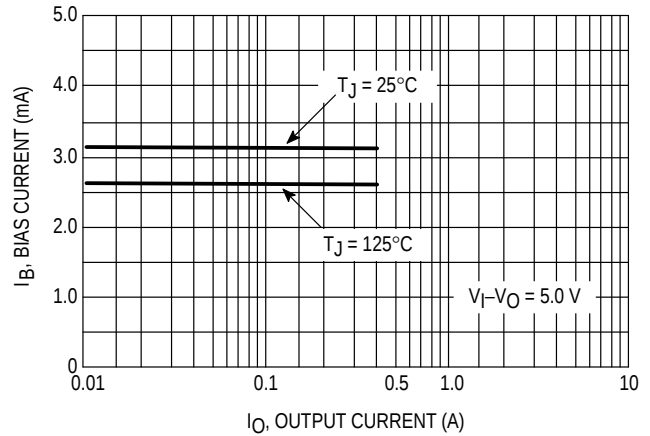
**Figure 6. Ripple Rejection versus Output Current**



**Figure 7. Bias Current versus Input Voltage**



**Figure 8. Bias Current versus Output Current**



# MC78M00 MC78M00A Series

## APPLICATIONS INFORMATION

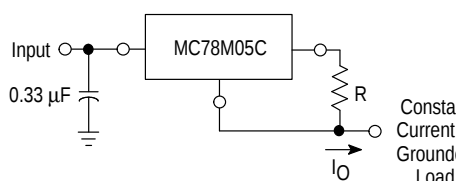
### Design Considerations

The MC78M00/MC78M00A Series of fixed voltage regulators are designed with Thermal Overload Protection that shuts down the circuit when subjected to an excessive power overload condition, Internal Short Circuit Protection that limits the maximum current the circuit will pass, and Output Transistor Safe-Area Compensation that reduces the output short circuit current as the voltage across the pass transistor is increased.

In many low current applications, compensation capacitors are not required. However, it is recommended that the regulator input be bypassed with a capacitor if the regulator is connected to the power supply filter with long wire

lengths, or if the output load capacitance is large. An input bypass capacitor should be selected to provide good high frequency characteristics to insure stable operation under all load conditions. A 0.33  $\mu\text{F}$  or larger tantalum, mylar, or other capacitor having low internal impedance at high frequencies should be chosen. The bypass capacitor should be mounted with the shortest possible leads directly across the regulator's input terminals. Normally good construction techniques should be used to minimize ground loops and lead resistance drops since the regulator has no external sense lead.

**Figure 9. Current Regulator**



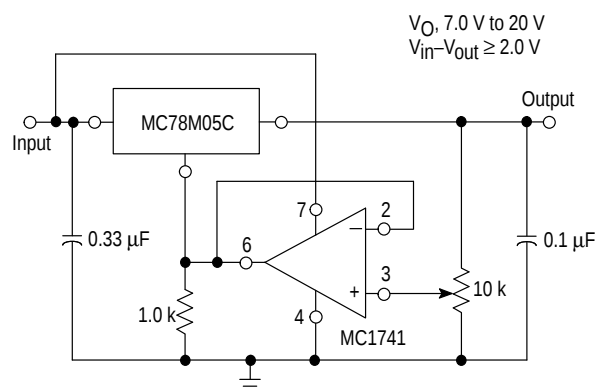
The MC78M00 regulators can also be used as a current source when connected as above. In order to minimize dissipation the MC78M05C is chosen in this application. Resistor R determines the current as follows:

$$I_O = \frac{5.0 \text{ V}}{R} + I_{IB}$$

$$I_{IB} = 1.5 \text{ mA over line and load changes.}$$

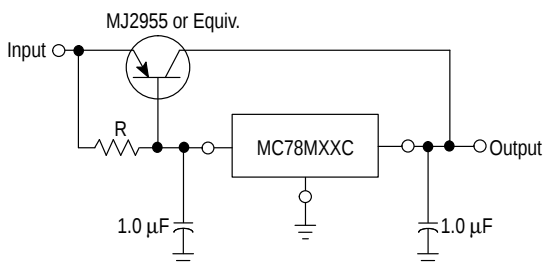
For example, a 500 mA current source would require R to be a 5.0  $\Omega$ , 10 W resistor and the output voltage compliance would be the input voltage less 7.0 V.

**Figure 10. Adjustable Output Regulator**



The addition of an operational amplifier allows adjustment to higher or intermediate values while retaining regulation characteristics. The minimum voltage obtainable with this arrangement is 2.0 V greater than the regulator voltage.

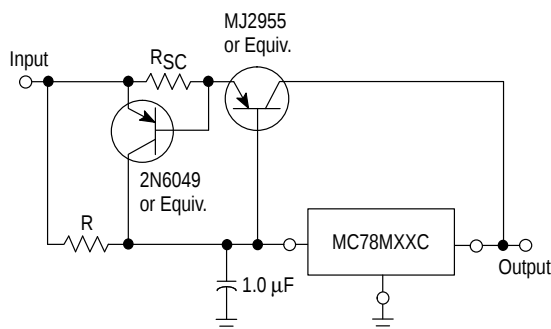
**Figure 11. Current Boost Regulator**



XX = 2 digits of type number indicating voltage.

The MC78M00 series can be current boosted with a PNP transistor. The MJ2955 provides current to 5.0 A. Resistor R in conjunction with the  $V_{BE}$  of the PNP determines when the pass transistor begins conducting; this circuit is not short circuit proof. Input-output differential voltage minimum is increased by  $V_{BE}$  of the pass transistor.

**Figure 12. Current Boost with Short Circuit Protection**



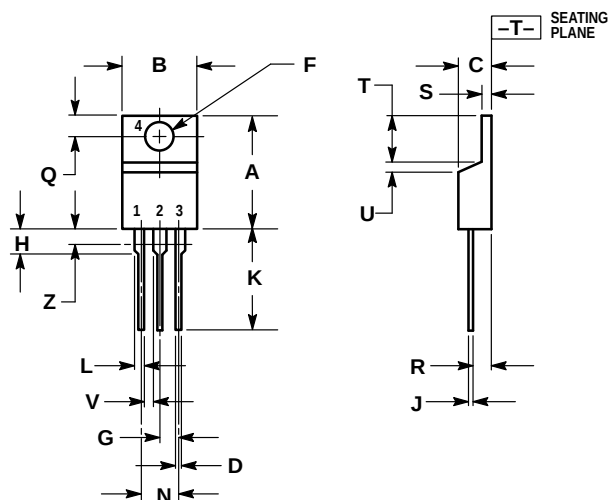
XX = 2 digits of type number indicating voltage.

The circuit of Figure NO TAG can be modified to provide supply protection against short circuits by adding a short circuit sense resistor,  $R_{SC}$ , and an additional PNP transistor. The current sensing PNP must be able to handle the short circuit current of the three-terminal regulator. Therefore, a 4.0 A plastic power transistor is specified.

# MC78M00 MC78M00A Series

## OUTLINE DIMENSIONS

### T SUFFIX PLASTIC PACKAGE CASE 221A-06 (TO-220) ISSUE Y

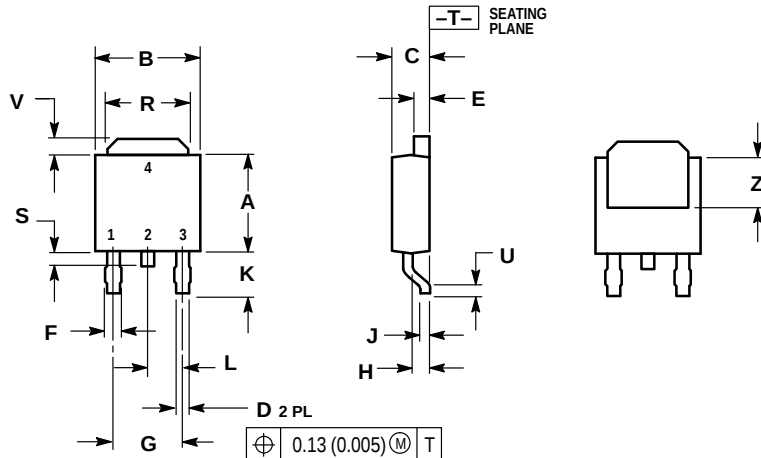


#### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

| DIM | INCHES |       | MILLIMETERS |       |
|-----|--------|-------|-------------|-------|
|     | MIN    | MAX   | MIN         | MAX   |
| A   | 0.570  | 0.620 | 14.48       | 15.75 |
| B   | 0.380  | 0.405 | 9.66        | 10.28 |
| C   | 0.160  | 0.190 | 4.07        | 4.82  |
| D   | 0.025  | 0.035 | 0.64        | 0.88  |
| F   | 0.142  | 0.147 | 3.61        | 3.73  |
| G   | 0.095  | 0.105 | 2.42        | 2.66  |
| H   | 0.110  | 0.155 | 2.80        | 3.93  |
| J   | 0.018  | 0.025 | 0.46        | 0.64  |
| K   | 0.500  | 0.562 | 12.70       | 14.27 |
| L   | 0.045  | 0.060 | 1.15        | 1.52  |
| N   | 0.190  | 0.210 | 4.83        | 5.33  |
| Q   | 0.100  | 0.120 | 2.54        | 3.04  |
| R   | 0.080  | 0.110 | 2.04        | 2.79  |
| S   | 0.045  | 0.055 | 1.15        | 1.39  |
| T   | 0.235  | 0.255 | 5.97        | 6.47  |
| U   | 0.000  | 0.050 | 0.00        | 1.27  |
| V   | 0.045  | —     | 1.15        | —     |
| Z   | —      | 0.080 | —           | 2.04  |

### DT SUFFIX PLASTIC PACKAGE CASE 369A-13 (DPAK) ISSUE Y



#### NOTES:

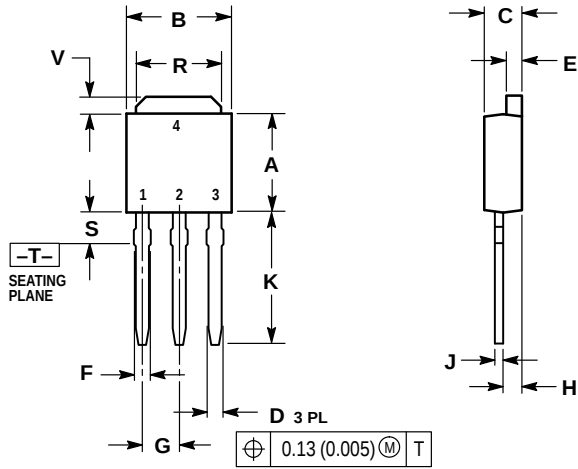
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

| DIM | INCHES    |       | MILLIMETERS |      |
|-----|-----------|-------|-------------|------|
|     | MIN       | MAX   | MIN         | MAX  |
| A   | 0.235     | 0.250 | 5.97        | 6.35 |
| B   | 0.250     | 0.265 | 6.35        | 6.73 |
| C   | 0.086     | 0.094 | 2.19        | 2.38 |
| D   | 0.027     | 0.035 | 0.69        | 0.88 |
| E   | 0.033     | 0.040 | 0.84        | 1.01 |
| F   | 0.037     | 0.047 | 0.94        | 1.19 |
| G   | 0.180 BSC | —     | 4.58 BSC    | —    |
| H   | 0.034     | 0.040 | 0.87        | 1.01 |
| J   | 0.018     | 0.023 | 0.46        | 0.58 |
| K   | 0.102     | 0.114 | 2.60        | 2.89 |
| L   | 0.090 BSC | —     | 2.29 BSC    | —    |
| R   | 0.175     | 0.215 | 4.45        | 5.46 |
| S   | 0.020     | 0.050 | 0.51        | 1.27 |
| U   | 0.020     | —     | 0.51        | —    |
| V   | 0.030     | 0.050 | 0.77        | 1.27 |
| Z   | 0.138     | —     | 3.51        | —    |

# MC78M00 MC78M00A Series

## OUTLINE DIMENSIONS

DT-1 SUFFIX  
PLASTIC PACKAGE  
CASE 369-07  
(DPAK)  
ISSUE L



NOTES:  
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
2. CONTROLLING DIMENSION: INCH.

| DIM | INCHES    |       | MILLIMETERS |      |
|-----|-----------|-------|-------------|------|
|     | MIN       | MAX   | MIN         | MAX  |
| A   | 0.235     | 0.250 | 5.97        | 6.35 |
| B   | 0.250     | 0.265 | 6.35        | 6.73 |
| C   | 0.086     | 0.094 | 2.19        | 2.38 |
| D   | 0.027     | 0.035 | 0.69        | 0.88 |
| E   | 0.033     | 0.040 | 0.84        | 1.01 |
| F   | 0.037     | 0.047 | 0.94        | 1.19 |
| G   | 0.090 BSC |       | 2.29 BSC    |      |
| H   | 0.034     | 0.040 | 0.87        | 1.01 |
| J   | 0.018     | 0.023 | 0.46        | 0.58 |
| K   | 0.350     | 0.380 | 8.89        | 9.65 |
| R   | 0.175     | 0.215 | 4.45        | 5.46 |
| S   | 0.050     | 0.090 | 1.27        | 2.28 |
| V   | 0.030     | 0.050 | 0.77        | 1.27 |

## MC78M00 MC78M00A Series

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