

# MC78M00, MC78M00A Series



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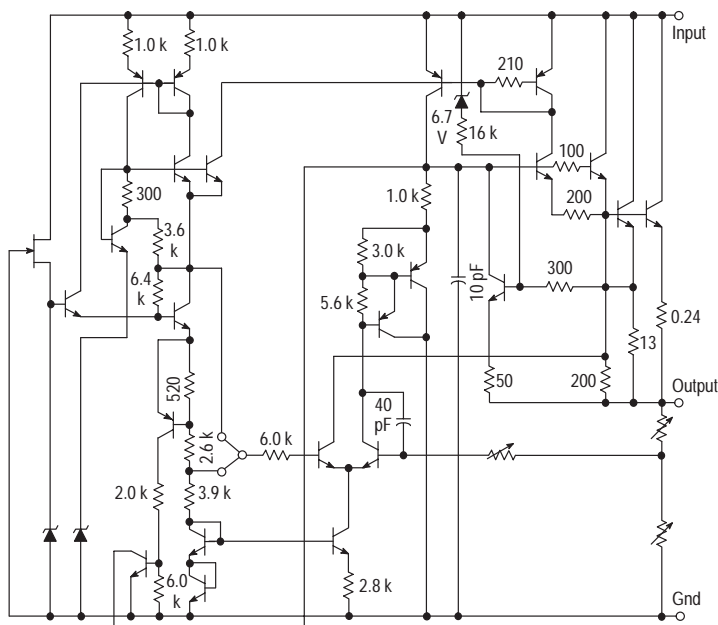
## Three-Terminal Medium Current Positive Voltage Regulators

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.

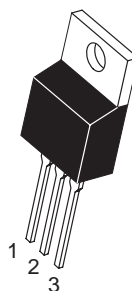
Internal current limiting, thermal shutdown circuitry and safe-area compensation for the internal pass transistor combine to make these devices remarkably rugged under most operating conditions. Maximum output current, with adequate heatsinking is 500 mA.

- 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

### Representative Schematic Diagram



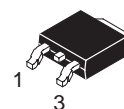
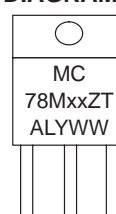
This device contains 28 active transistors.



**TO-220  
T SUFFIX  
CASE 221A**

Heatsink surface connected to Pin 2.

### MARKING DIAGRAMS



**DPAK  
DT SUFFIX  
CASE 369A**



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

- Pin 1. Input  
2. Ground  
3. Output

xx = Voltage Option  
Z = A, B, or C Option  
A = Assembly Location  
WL, L = Wafer Lot  
YY, Y = Year  
WW, W = Work Week

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 10 of this data sheet.

## 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) (20 V–24V)	$V_I$	35 40	Vdc
Power Dissipation (Package Limitation) Plastic Package, T Suffix $T_A = 25^\circ\text{C}$ Thermal Resistance, Junction-to-Air Thermal Resistance, Junction-to-Case	$P_D$ $\theta_{JA}$ $\theta_{JC}$	Internally Limited 70 5.0	 $^\circ\text{C/W}$ $^\circ\text{C/W}$
Plastic Package, DT Suffix $T_A = 25^\circ\text{C}$ Thermal Resistance, Junction-to-Air Thermal Resistance, Junction-to-Case	$P_D$ $\theta_{JA}$ $\theta_{JC}$	Internally Limited 92 5.0	 $^\circ\text{C/W}$ $^\circ\text{C/W}$
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/B ELECTRICAL CHARACTERISTICS** ( $V_I = 10\text{ V}$ ,  $I_O = 350\text{ mA}$ ,  $0^\circ\text{C} < T_J < 125^\circ\text{C}$ ,  $P_D \leq 5.0\text{ W}$ , unless otherwise noted.)

Characteristics	Symbol	Min	Typ	Max	Unit
Output Voltage ( $T_J = 25^\circ\text{C}$ ) MC78M05C MC78M05AC	$V_O$	4.8 4.9	5.0 5.0	5.2 5.1	Vdc
Output Voltage Variation ( $7.0\text{ Vdc} \leq V_I \leq 20\text{ Vdc}$ , $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ ) MC78M05C MC78M05AC	$V_O$	4.75 4.80	– –	5.25 5.20	Vdc
Line Regulation ( $T_J = 25^\circ\text{C}$ , $7.0\text{ Vdc} \leq V_I \leq 25\text{ Vdc}$ , $I_O = 200\text{ mA}$ )	Regline	–	3.0	5.0	mV
Load Regulation ( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 200\text{ mA}$ ) ( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 500\text{ mA}$ )	Regload	– –	20 10	100 50	mV
Input Bias Current ( $T_J = 25^\circ\text{C}$ )	$I_{IB}$	–	3.2	6.0	mA
Quiescent Current Change ( $8.0\text{ Vdc} \leq V_I \leq 25\text{ Vdc}$ , $I_O = 200\text{ mA}$ ) ( $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )	$\Delta I_{IB}$	– –	– –	0.8 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 ( $I_O = 100\text{ mA}$ , $f = 120\text{ Hz}$ , $8.0\text{ V} \leq V_I \leq 18\text{ V}$ ) ( $I_O = 300\text{ mA}$ , $f = 120\text{ Hz}$ , $8.0 \leq V_I \leq 18\text{ V}$ , $T_J = 25^\circ\text{C}$ )	RR	62 62	– 80	– –	dB
Dropout Voltage ( $T_J = 25^\circ\text{C}$ )	$V_I - V_O$	–	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 ( $I_O = 5.0\text{ mA}$ )	$\Delta V_O / \Delta T$	–	$\pm 0.2$	–	$\text{mV}/^\circ\text{C}$
Peak Output Current ( $T_J = 25^\circ\text{C}$ )	$I_O$	–	700	–	mA

## MC78M00, MC78M00A Series

### MC78M06C ELECTRICAL CHARACTERISTICS ( $V_I = 11\text{ V}$ , $I_O = 350\text{ mA}$ , $0^\circ\text{C} < T_J < 125^\circ\text{C}$ , $P_D \leq 5.0\text{ W}$ , 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 ( $8.0\text{ Vdc} \leq V_I \leq 21\text{ Vdc}$ , $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )	$V_O$	5.7	–	6.3	Vdc
Line Regulation ( $T_J = 25^\circ\text{C}$ , $8.0\text{ Vdc} \leq V_I \leq 25\text{ Vdc}$ , $I_O = 200\text{ mA}$ )	Regline	–	5.0	50	mV
Load Regulation ( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 500\text{ mA}$ ) ( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 200\text{ mA}$ )	Regload	– –	20 10	120 60	mV
Input Bias Current ( $T_J = 25^\circ\text{C}$ )	$I_{IB}$	–	3.2	6.0	mA
Quiescent Current Change ( $9.0\text{ Vdc} \leq V_I \leq 25\text{ Vdc}$ , $I_O = 200\text{ mA}$ ) ( $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )	$\Delta I_{IB}$	– –	– –	0.8 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 ( $I_O = 100\text{ mA}$ , $f = 120\text{ Hz}$ , $9.0\text{ V} \leq V_I \leq 19\text{ V}$ ) ( $I_O = 300\text{ mA}$ , $f = 120\text{ Hz}$ , $9.0\text{ V} \leq V_I \leq 19\text{ V}$ , $T_J = 25^\circ\text{C}$ )	RR	59 59	– 80	– –	dB
Dropout Voltage ( $T_J = 25^\circ\text{C}$ )	$V_I - V_O$	–	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 ( $I_O = 5.0\text{ mA}$ )	$\Delta V_O / \Delta T$	–	$\pm 0.2$	–	$\text{mV}/^\circ\text{C}$
Peak Output Current ( $T_J = 25^\circ\text{C}$ )	$I_O$	–	700	–	mA

### MC78M08C/AC/B ELECTRICAL CHARACTERISTICS ( $V_I = 14\text{ V}$ , $I_O = 350\text{ mA}$ , $0^\circ\text{C} < T_J < 125^\circ\text{C}$ , $P_D \leq 5.0\text{ W}$ , unless otherwise noted.)

Characteristics	Symbol	Min	Typ	Max	Unit
Output Voltage ( $T_J = 25^\circ\text{C}$ ) MC78M08C MC78M08AC	$V_O$	7.70 7.84	8.0 8.0	8.30 8.16	Vdc
Output Voltage Variation ( $10.5\text{ Vdc} \leq V_I \leq 23\text{ Vdc}$ , $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ ) MC78M08C MC78M08AC	$V_O$	7.6 7.7	– –	8.4 8.3	Vdc
Line Regulation ( $T_J = 25^\circ\text{C}$ , $10.5\text{ Vdc} \leq V_I \leq 25\text{ Vdc}$ , $I_O = 200\text{ mA}$ )	Regline	–	6.0	50	mV
Load Regulation ( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 500\text{ mA}$ ) ( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 200\text{ mA}$ )	Regload	– –	25 10	160 80	mV
Input Bias Current ( $T_J = 25^\circ\text{C}$ )	$I_{IB}$	–	3.2	6.0	mA
Quiescent Current Change ( $10.5\text{ Vdc} \leq V_I \leq 25\text{ Vdc}$ , $I_O = 200\text{ mA}$ ) ( $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )	$\Delta I_{IB}$	– –	– –	0.8 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 ( $I_O = 100\text{ mA}$ , $f = 120\text{ Hz}$ , $11.5\text{ V} \leq V_I \leq 21.5\text{ V}$ ) ( $I_O = 300\text{ mA}$ , $f = 120\text{ Hz}$ , $11.5\text{ V} \leq V_I \leq 21.5\text{ V}$ , $T_J = 25^\circ\text{C}$ )	RR	56 56	– 80	– –	dB
Dropout Voltage ( $T_J = 25^\circ\text{C}$ )	$V_I - V_O$	–	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 ( $I_O = 5.0\text{ mA}$ )	$\Delta V_O / \Delta T$	–	$\pm 0.2$	–	$\text{mV}/^\circ\text{C}$
Peak Output Current ( $T_J = 25^\circ\text{C}$ )	$I_O$	–	700	–	mA

## MC78M00, MC78M00A Series

### MC78M09C/B ELECTRICAL CHARACTERISTICS ( $V_I = 15\text{ V}$ , $I_O = 350\text{ mA}$ , $0^\circ\text{C} < T_J < 125^\circ\text{C}$ , $P_D \leq 5.0\text{ W}$ , 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 ( $11.5\text{ Vdc} \leq V_I \leq 23\text{ Vdc}$ , $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )	$V_O$	8.55	–	9.45	Vdc
Line Regulation ( $T_J = 25^\circ\text{C}$ , $11.5\text{ Vdc} \leq V_I \leq 25\text{ Vdc}$ , $I_O = 200\text{ mA}$ )	Reg <sub>line</sub>	–	6.0	50	mV
Load Regulation ( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 500\text{ mA}$ ) ( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 200\text{ mA}$ )	Reg <sub>load</sub>	– –	25 10	180 90	mV
Input Bias Current ( $T_J = 25^\circ\text{C}$ )	$I_{IB}$	–	3.2	6.0	mA
Quiescent Current Change ( $11.5\text{ Vdc} \leq V_I \leq 25\text{ Vdc}$ , $I_O = 200\text{ mA}$ ) ( $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )	$\Delta I_{IB}$	– –	– –	0.8 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 ( $I_O = 100\text{ mA}$ , $f = 120\text{ Hz}$ , $12.5\text{ V} \leq V_I \leq 22.5\text{ V}$ ) ( $I_O = 300\text{ mA}$ , $f = 120\text{ Hz}$ , $12.5\text{ V} \leq V_I \leq 22.5\text{ V}$ , $T_J = 25^\circ\text{C}$ )	RR	56 56	– 80	– –	dB
Dropout Voltage ( $T_J = 25^\circ\text{C}$ )	$V_I - V_O$	–	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 ( $I_O = 5.0\text{ mA}$ )	$\Delta V_O / \Delta T$	–	$\pm 0.2$	–	$\text{mV}/^\circ\text{C}$
Peak Output Current ( $T_J = 25^\circ\text{C}$ )	$I_O$	–	700	–	mA

### MC78M12C/AC/B ELECTRICAL CHARACTERISTICS ( $V_I = 19\text{ V}$ , $I_O = 350\text{ mA}$ , $0^\circ\text{C} < T_J < 125^\circ\text{C}$ , $P_D \leq 5.0\text{ W}$ , unless otherwise noted.)

Characteristics	Symbol	Min	Typ	Max	Unit
Output Voltage ( $T_J = 25^\circ\text{C}$ ) MC78M12C MC78M12AC	$V_O$	11.50 11.76	12 12	12.50 12.24	Vdc
Output Voltage Variation ( $14.5\text{ Vdc} \leq V_I \leq 27\text{ Vdc}$ , $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ ) MC78M12C MC78M12AC	$V_O$	11.4 11.5	– –	12.6 12.5	Vdc
Line Regulation ( $T_J = 25^\circ\text{C}$ , $14.5\text{ Vdc} \leq V_I \leq 30\text{ Vdc}$ , $I_O = 200\text{ mA}$ )	Reg <sub>line</sub>	–	8.0	50	mV
Load Regulation ( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 500\text{ mA}$ ) ( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 200\text{ mA}$ )	Reg <sub>load</sub>	– –	25 10	240 120	mV
Input Bias Current ( $T_J = 25^\circ\text{C}$ )	$I_{IB}$	–	3.2	6.0	mA
Quiescent Current Change ( $14.5\text{ Vdc} \leq V_I \leq 30\text{ Vdc}$ , $I_O = 200\text{ mA}$ ) ( $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )	$\Delta I_{IB}$	– –	– –	0.8 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 ( $I_O = 100\text{ mA}$ , $f = 120\text{ Hz}$ , $15\text{ V} \leq V_I \leq 25\text{ V}$ ) ( $I_O = 300\text{ mA}$ , $f = 120\text{ Hz}$ , $15\text{ V} \leq V_I \leq 25\text{ V}$ , $T_J = 25^\circ\text{C}$ )	RR	55 55	– 80	– –	dB
Dropout Voltage ( $T_J = 25^\circ\text{C}$ )	$V_I - V_O$	–	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 ( $I_O = 5.0\text{ mA}$ )	$\Delta V_O / \Delta T$	–	$\pm 0.3$	–	$\text{mV}/^\circ\text{C}$
Peak Output Current ( $T_J = 25^\circ\text{C}$ )	$I_O$	–	700	–	mA

## MC78M00, MC78M00A Series

**MC78M15C/AC/B ELECTRICAL CHARACTERISTICS** ( $V_I = 23\text{ V}$ ,  $I_O = 350\text{ mA}$ ,  $0^\circ\text{C} < T_J < 125^\circ\text{C}$ ,  $P_D \leq 5.0\text{ W}$ , unless otherwise noted.)

Characteristics	Symbol	Min	Typ	Max	Unit
Output Voltage ( $T_J = 25^\circ\text{C}$ ) MC78M15C MC78M15AC	$V_O$	14.4 14.7	15 15	15.6 15.3	Vdc
Output Voltage Variation ( $17.5\text{ Vdc} \leq V_I \leq 30\text{ Vdc}$ , $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ ) MC78M15C MC78M15AC	$V_O$	14.25 14.40	– –	15.75 15.60	Vdc
Input Regulation ( $T_J = 25^\circ\text{C}$ , $17.5\text{ Vdc} \leq V_I \leq 30\text{ Vdc}$ , $I_O = 200\text{ mA}$ )	Reg <sub>line</sub>	–	10	50	mV
Load Regulation ( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 500\text{ mA}$ ) ( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 200\text{ mA}$ )	Reg <sub>load</sub>	– –	25 10	300 150	mV
Input Bias Current ( $T_J = 25^\circ\text{C}$ )	$I_{IB}$	–	3.2	6.0	mA
Quiescent Current Change ( $17.5\text{ Vdc} \leq V_I \leq 30\text{ Vdc}$ , $I_O = 200\text{ mA}$ ) ( $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )	$\Delta I_{IB}$	– –	– –	0.8 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 ( $I_O = 100\text{ mA}$ , $f = 120\text{ Hz}$ , $18.5\text{ V} \leq V_I \leq 28.5\text{ V}$ ) ( $I_O = 300\text{ mA}$ , $f = 120\text{ Hz}$ , $18.5\text{ V} \leq V_I \leq 28.5\text{ V}$ , $T_J = 25^\circ\text{C}$ )	RR	54 54	– 70	– –	dB
Dropout Voltage ( $T_J = 25^\circ\text{C}$ )	$V_I - V_O$	–	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 ( $I_O = 5.0\text{ mA}$ )	$\Delta V_O / \Delta T$	–	$\pm 0.3$	–	$\text{mV}/^\circ\text{C}$
Peak Output Current ( $T_J = 25^\circ\text{C}$ )	$I_O$	–	700	–	mA

**MC78M18C ELECTRICAL CHARACTERISTICS** ( $V_I = 27\text{ V}$ ,  $I_O = 350\text{ mA}$ ,  $0^\circ\text{C} < T_J < 125^\circ\text{C}$ ,  $P_D \leq 5.0\text{ W}$ , 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 ( $21\text{ Vdc} \leq V_I \leq 33\text{ Vdc}$ , $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )	$V_O$	17.1	–	18.9	Vdc
Line Regulation ( $T_J = 25^\circ\text{C}$ , $21\text{ Vdc} \leq V_I \leq 33\text{ Vdc}$ , $I_O = 200\text{ mA}$ )	Reg <sub>line</sub>	–	10	50	mV
Load Regulation ( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 500\text{ mA}$ ) ( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 200\text{ mA}$ )	Reg <sub>load</sub>	– –	30 10	360 180	mV
Input Bias Current ( $T_J = 25^\circ\text{C}$ )	$I_{IB}$	–	3.2	6.5	mA
Quiescent Current Change ( $21\text{ Vdc} \leq V_I \leq 33\text{ Vdc}$ , $I_O = 200\text{ mA}$ ) ( $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )	$\Delta I_{IB}$	– –	– –	0.8 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 ( $I_O = 100\text{ mA}$ , $f = 120\text{ Hz}$ , $22\text{ V} \leq V_I \leq 32\text{ V}$ ) ( $I_O = 300\text{ mA}$ , $f = 120\text{ Hz}$ , $22\text{ V} \leq V_I \leq 32\text{ V}$ , $T_J = 25^\circ\text{C}$ )	RR	53 53	– 70	– –	dB
Dropout Voltage ( $T_J = 25^\circ\text{C}$ )	$V_I - V_O$	–	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 ( $I_O = 5.0\text{ mA}$ )	$\Delta V_O / \Delta T$	–	$\pm 0.3$	–	$\text{mV}/^\circ\text{C}$
Peak Output Current ( $T_J = 25^\circ\text{C}$ )	$I_O$	–	700	–	mA

## MC78M00, MC78M00A Series

### MC78M20C ELECTRICAL CHARACTERISTICS ( $V_I = 29\text{ V}$ , $I_O = 350\text{ mA}$ , $0^\circ\text{C} < T_J < 125^\circ\text{C}$ , $P_D \leq 5.0\text{ W}$ , 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 ( $23\text{ Vdc} \leq V_I \leq 35\text{ Vdc}$ , $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )	$V_O$	19	–	21	Vdc
Line Regulation ( $T_J = 25^\circ\text{C}$ , $23\text{ Vdc} \leq V_I \leq 35\text{ Vdc}$ , $I_O = 200\text{ mA}$ )	Reg <sub>line</sub>	–	10	50	mV
Load Regulation ( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 500\text{ mA}$ ) ( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 200\text{ mA}$ )	Reg <sub>load</sub>	– –	30 10	400 200	mV
Input Bias Current ( $T_J = 25^\circ\text{C}$ )	$I_{IB}$	–	3.2	6.5	mA
Quiescent Current Change ( $23\text{ Vdc} \leq V_I \leq 35\text{ Vdc}$ , $I_O = 200\text{ mA}$ ) ( $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )	$\Delta I_{IB}$	– –	– –	0.8 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 ( $I_O = 100\text{ mA}$ , $f = 120\text{ Hz}$ , $24\text{ V} \leq V_I \leq 34\text{ V}$ ) ( $I_O = 300\text{ mA}$ , $f = 120\text{ Hz}$ , $24\text{ V} \leq V_I \leq 34\text{ V}$ , $T_J = 25^\circ\text{C}$ )	RR	52 52	– 70	– –	dB
Dropout Voltage ( $T_J = 25^\circ\text{C}$ )	$V_I - V_O$	–	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 ( $I_O = 5.0\text{ mA}$ )	$\Delta V_O / \Delta T$	–	$\pm 0.5$	–	$\text{mV}/^\circ\text{C}$
Peak Output Current ( $T_J = 25^\circ\text{C}$ )	$I_O$	–	700	–	mA

### MC78M24C ELECTRICAL CHARACTERISTICS ( $V_I = 33\text{ V}$ , $I_O = 350\text{ mA}$ , $0^\circ\text{C} < T_J < 125^\circ\text{C}$ , $P_D \leq 5.0\text{ W}$ , 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 ( $27\text{ Vdc} \leq V_I \leq 38\text{ Vdc}$ , $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )	$V_O$	22.8	–	25.2	Vdc
Line Regulation ( $T_J = 25^\circ\text{C}$ , $27\text{ Vdc} \leq V_I \leq 38\text{ Vdc}$ , $I_O = 200\text{ mA}$ )	Reg <sub>line</sub>	–	10	50	mV
Load Regulation ( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 500\text{ mA}$ ) ( $T_J = 25^\circ\text{C}$ , $5.0\text{ mA} \leq I_O \leq 200\text{ mA}$ )	Reg <sub>load</sub>	– –	30 10	480 240	mV
Input Bias Current ( $T_J = 25^\circ\text{C}$ )	$I_{IB}$	–	3.2	7.0	mA
Quiescent Current Change ( $27\text{ Vdc} \leq V_I \leq 38\text{ Vdc}$ , $I_O = 200\text{ mA}$ ) ( $5.0\text{ mA} \leq I_O \leq 350\text{ mA}$ )	$\Delta I_{IB}$	– –	– –	0.8 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 ( $I_O = 100\text{ mA}$ , $f = 120\text{ Hz}$ , $28\text{ V} \leq V_I \leq 38\text{ V}$ ) ( $I_O = 300\text{ mA}$ , $f = 120\text{ Hz}$ , $28\text{ V} \leq V_I \leq 38\text{ V}$ , $T_J = 25^\circ\text{C}$ )	RR	50 50	– 70	– –	dB
Dropout Voltage ( $T_J = 25^\circ\text{C}$ )	$V_I - V_O$	–	2.0	–	Vdc
Short Circuit Current Limit ( $T_J = 25^\circ\text{C}$ )	$I_{OS}$	–	50	–	mA
Average Temperature Coefficient of Output Voltage ( $I_O = 5.0\text{ mA}$ )	$\Delta V_O / \Delta T$	–	$\pm 0.5$	–	$\text{mV}/^\circ\text{C}$
Peak Output Current ( $T_J = 25^\circ\text{C}$ )	$I_O$	–	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.

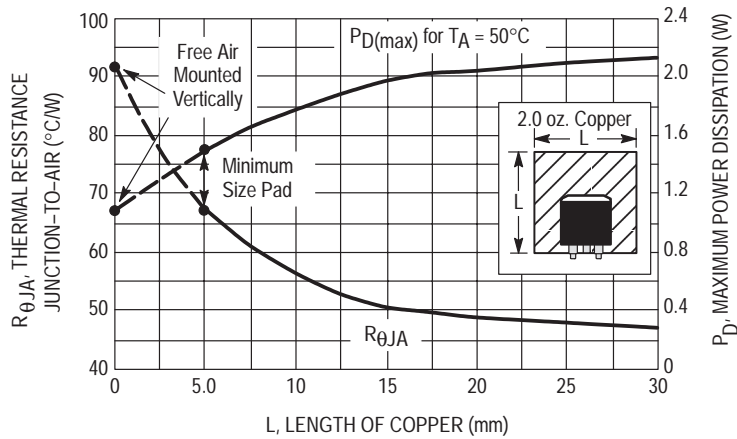
**Load Regulation** – The change in output voltage for a change in load current at constant chip temperature.

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

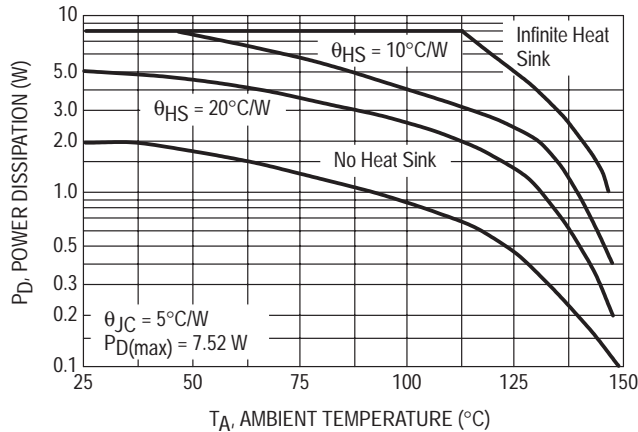
**Input Bias Current** – That part of the input current that is not delivered to the load.

**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.

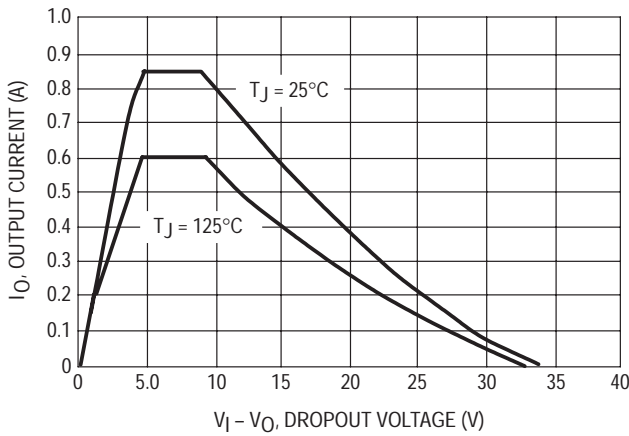


**Figure 1. DPAK Thermal Resistance and Maximum Power Dissipation versus P.C.B. Copper Length**

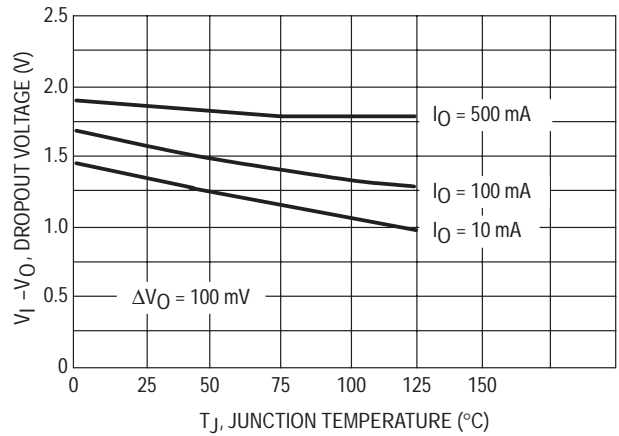


**Figure 2. Worst Case Power Dissipation versus Ambient Temperature (TO-220)**

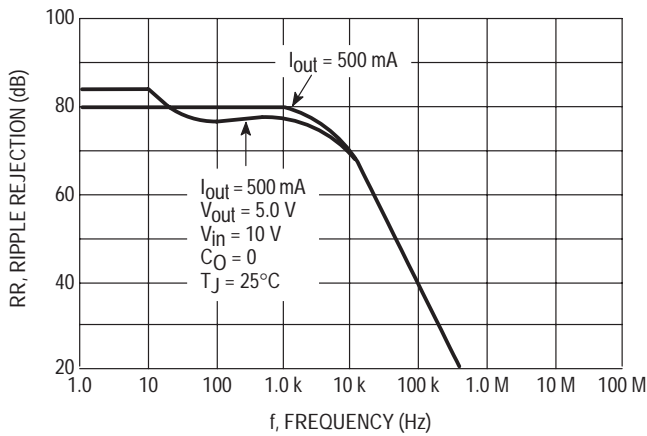
# MC78M00, MC78M00A Series



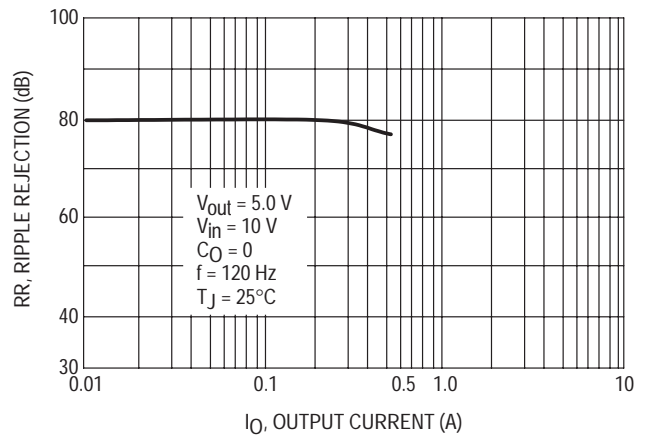
**Figure 3. Peak Output Current versus Dropout Voltage**



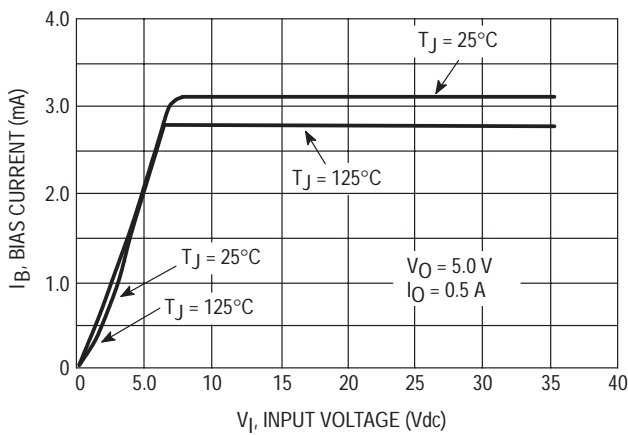
**Figure 4. Dropout Voltage versus Junction Temperature**



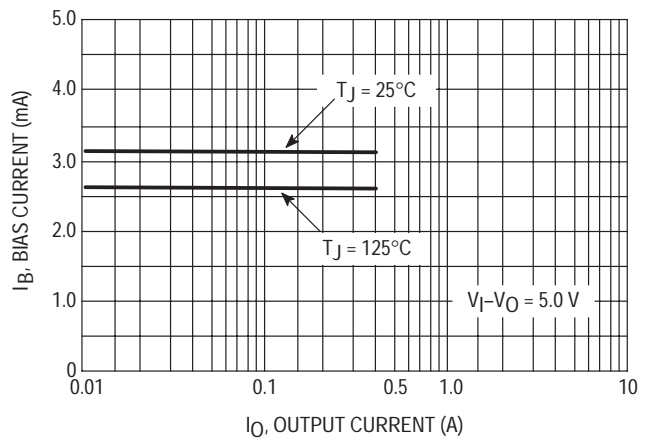
**Figure 5. Ripple Rejection versus Frequency**



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



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



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



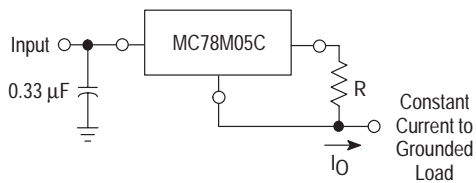
## APPLICATIONS INFORMATION

### 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.



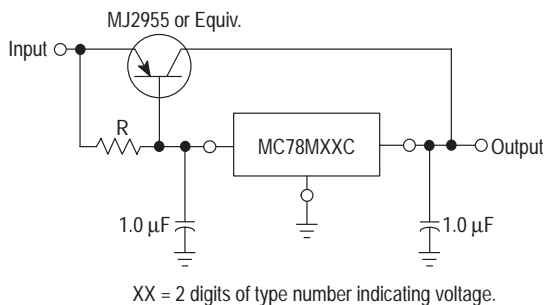
The MC78M00 regulators can also be used as a current source when connected as above. In order to minimize dissipation the MC78M05C is chosen in this application. Resistor R determines the current as follows:

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

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

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.

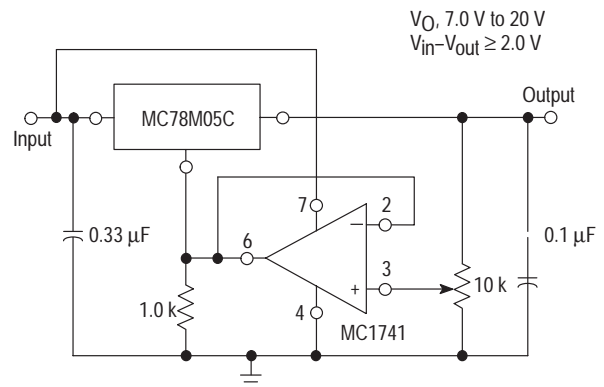
**Figure 9. Current Regulator**



XX = 2 digits of type number indicating voltage.

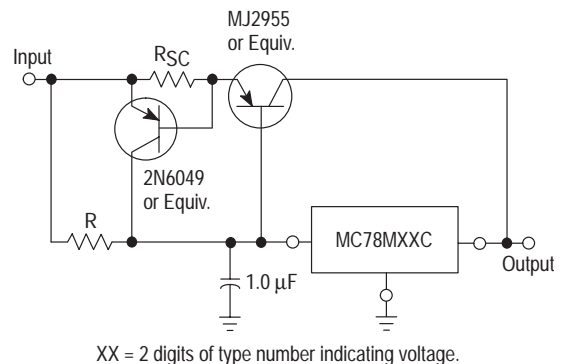
The MC78M00 series can be current boosted with a PNP transistor. The MJ2955 provides current to 5.0 A. Resistor R in conjunction with the  $V_{BE}$  of the PNP determines when the pass transistor begins conducting; this circuit is not short circuit proof. Input-output differential voltage minimum is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

**Figure 11. Current Boost 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 10. Adjustable Output Regulator**



XX = 2 digits of type number indicating voltage.

The circuit of Figure 11 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.

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

# MC78M00, MC78M00A Series

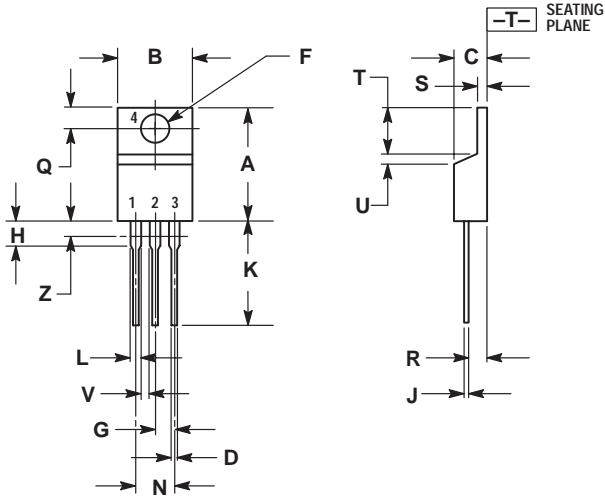
## ORDERING INFORMATION

Device	Output Voltage	Temperature Range	Package	Shipping	
				Rails (No Suffix)	Tape & Reel (RK Suffix)
MC78M05CDT/RK	5.0 V	$T_J = 0^\circ \text{ to } +125^\circ\text{C}$	DPAK	75 Units/Rail	2500 Units/Reel
MC78M05ACDT/RK			TO-220	50 Units/Rail	–
MC78M05CT		$T_J = -40^\circ \text{ to } +125^\circ\text{C}$	DPAK	75 Units/Rail	2500 Units/Reel
MC78M05ACT			TO-220	50 Units/Rail	–
MC78M05BDT/RK			DPAK	75 Units/Rail	2500 Units/Reel
MC78M05BT				TO-220	50 Units/Rail
MC78M06CDT/RK	6.0 V	$T_J = 0^\circ \text{ to } +125^\circ\text{C}$	DPAK	75 Units/Rail	2500 Units/Reel
MC78M06CT			TO-220	50 Units/Rail	–
MC78M06BT		$T_J = -40^\circ \text{ to } +125^\circ\text{C}$			
MC78M08CDT/RK	8.0 V	$T_J = 0^\circ \text{ to } +125^\circ\text{C}$	DPAK	75 Units/Rail	2500 Units/Reel
MC78M08ACDT/RK			TO-220	50 Units/Rail	–
MC78M08CT		$T_J = -40^\circ \text{ to } +125^\circ\text{C}$	DPAK	75 Units/Rail	2500 Units/Reel
MC78M08ACT			TO-220	50 Units/Rail	–
MC78M08BDT/RK			DPAK	75 Units/Rail	2500 Units/Reel
MC78M08BT				TO-220	50 Units/Rail
MC78M09CDT/RK	9.0 V	$T_J = 0^\circ \text{ to } +125^\circ\text{C}$	DPAK	75 Units/Rail	2500 Units/Reel
MC78M09CT			TO-220	50 Units/Rail	–
MC78M09BDT/RK		$T_J = -40^\circ \text{ to } +125^\circ\text{C}$	DPAK	75 Units/Rail	2500 Units/Reel
MC78M09BT			TO-220	50 Units/Rail	–
MC78M12CDT/RK	12 V	$T_J = 0^\circ \text{ to } +125^\circ\text{C}$	DPAK	75 Units/Rail	2500 Units/Reel
MC78M12ACDT/RK			TO-220	50 Units/Rail	–
MC78M12CT		$T_J = -40^\circ \text{ to } +125^\circ\text{C}$	DPAK	75 Units/Rail	2500 Units/Reel
MC78M12ACT			TO-220	50 Units/Rail	–
MC78M12BDT/RK			DPAK	75 Units/Rail	2500 Units/Reel
MC78M12BT				TO-220	50 Units/Rail
MC78M15CDT/RK	15 V	$T_J = 0^\circ \text{ to } +125^\circ\text{C}$	DPAK	75 Units/Rail	2500 Units/Reel
MC78M15ACDT/RK			TO-220	50 Units/Rail	–
MC78M15CT		$T_J = -40^\circ \text{ to } +125^\circ\text{C}$	DPAK	75 Units/Rail	2500 Units/Reel
MC78M15ACT			TO-220	50 Units/Rail	–
MC78M15BDT/RK			DPAK	75 Units/Rail	2500 Units/Reel
MC78M15BT				TO-220	50 Units/Rail
MC78M18CDT	18 V	$T_J = 0^\circ \text{ to } +125^\circ\text{C}$	DPAK	75 Units/Rail	–
MC78M18CT		$T_J = -40^\circ \text{ to } +125^\circ\text{C}$			
MC78M18BT					
MC78M20CT	20 V	$T_J = 0^\circ \text{ to } +125^\circ\text{C}$	TO-220	50 Units/Rail	
MC78M20BT		$T_J = -40^\circ \text{ to } +125^\circ\text{C}$			
MC78M24CT	24 V	$T_J = 0^\circ \text{ to } +125^\circ\text{C}$			
MC78M24BT		$T_J = -40^\circ \text{ to } +125^\circ\text{C}$			

# MC78M00, MC78M00A Series

## PACKAGE DIMENSIONS

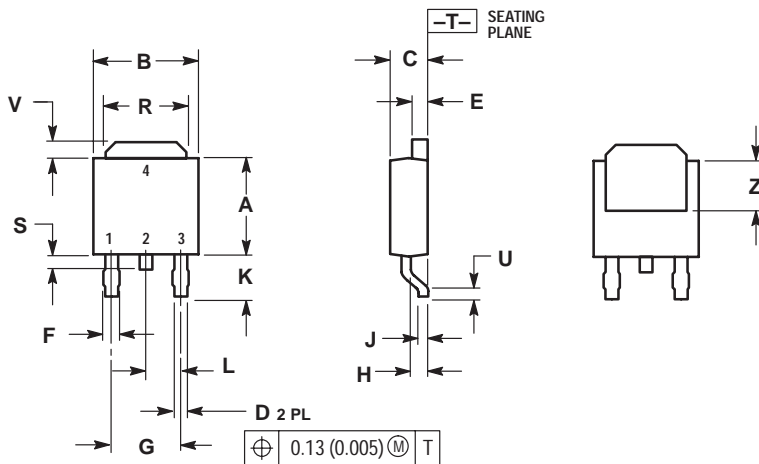
TO-220  
T SUFFIX  
CASE 221A-09  
ISSUE AA



- 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


DPAK  
DT SUFFIX  
CASE 369A-13  
ISSUE Z



- 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

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