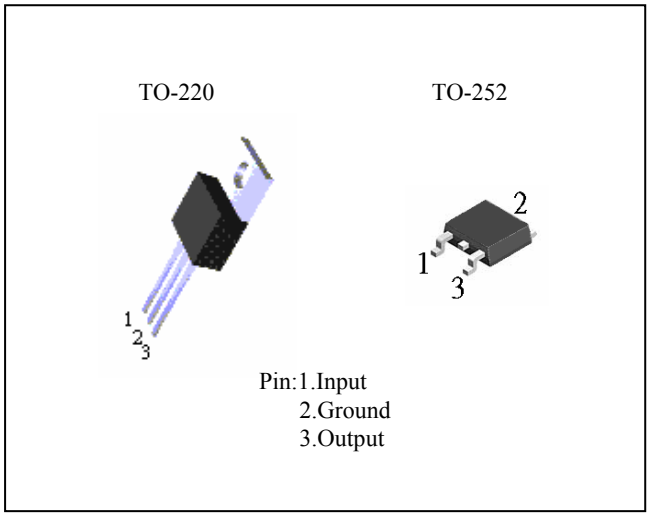
3-Terminal Medium Current Positive Voltage Regulators

The PJ78M00Series positive voltage regulators are identical to the popular PJ7800Series devices, except that they are specified for only half the output current. Like thhe PJ7800 devices, the PJ78Mxx Terminal regulators are intended for local,ocard 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 500mA

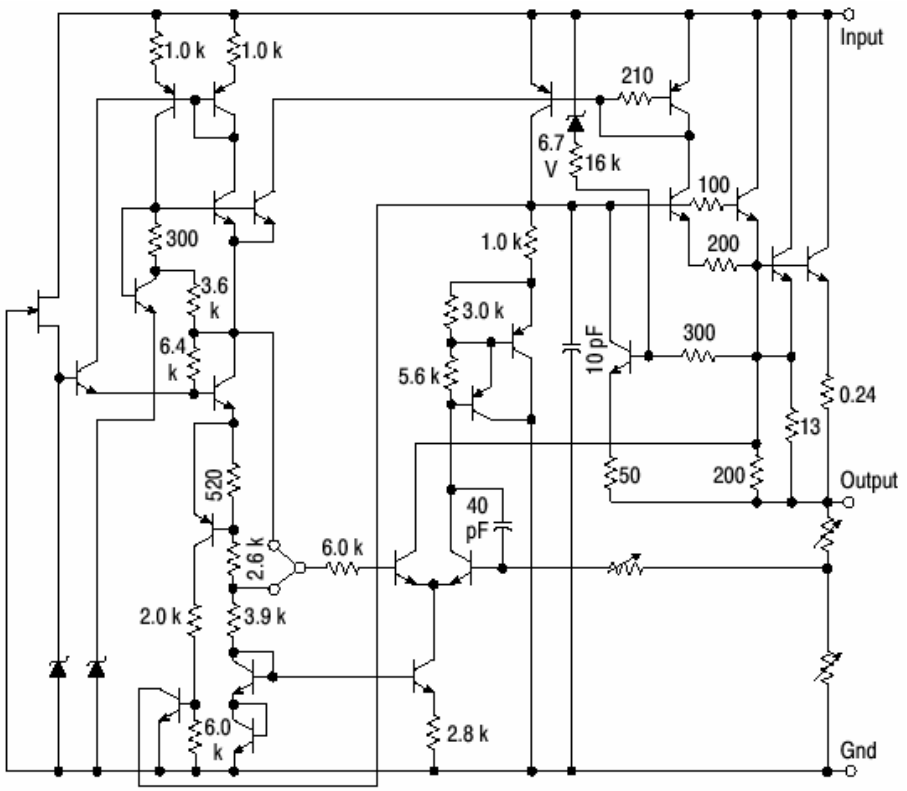


FEATURES

- No External Components Required
- Internal Thermal Overload Protection
- Internal Short Circuit Current Limiting
- Output Transistor Safe-Area Compensation

ORDERING INFORMATION

Device	Operating Temperature	Package
PJ78MxxC Z	-20 ℃ ~ +85℃	TO-220
PJ78MxxCP		TO-252



This device contains 28 active transistors

Figure 1.Representative Schematic Diagram

ABSOLUTE MAXIMUM RATINGS (Ta=25℃,unless otherwise noted.) (Note 1)

Rating	Symbol	Value	Unit
Input Voltage (5.0V-18V) (20V-24V)	VI	35 40	Vdc
Power Dissipation (Package Limitation) Plastic Package, T Suffix TA=25℃ Thermal Resistance, Junction-to-Air Thermal Resistance, Junction-to-Case Plastic Package, DT Suffix TA=25℃ Thermal Resistance, Junction-to-Air Thermal Resistance,Junction-to-Case	 PD ΘJA ΘJC PD ΘJA ΘJC	 Internally Limited 70 5.0 Internally Limited 92 5.0	 ℃/W ℃/W ℃/W ℃/W
Operating Junciton Temperature Range	TJ	+150	℃
Storage Temperatrue Range	Tstg	-65 to +150	℃

1. This device series contains ESD protection and exceeds the following tests:
   Human Body Model 2000 V per MIL-STD-883,Method 3015.
   Machine Model Method 200V.

PJ78M05 ELECTRICAL CHARACTERISTICE (V1=10V,Io=350mA,TJ=Tlow to Thigh,PD≦5.0W

Characteristics	Symbol	Min	Typ	Max	Unit
Output Voltage (TJ=25℃) PJ78M05	Vo	4.9	5.0	5.1	Vdc
Output Voltage Variation (7.0 Vdc ≦VI≦20Vdc,5.0mA≦Io≦350mA) PJ78M05	Vo	 4.8	 -	 5.2	 Vdc
Line Regulation (TJ=25℃,7.0Vdc≦VI≦25Vdc,Io=200mA)	Regline	-	3.0	50	mV
Load Regulation (TJ=25℃,5.0mA≦Io≦500mA) (TJ=25℃,5.0mA≦Io≦200mA)	Regload	 - -	 20 10	 100 50	mV
Input Bias Current (TJ=25℃)	IIB	-	3.2	6.0	mA
Quiescent Current Change (8.0Vdc≦VI≦25Vdc,Io=200mA) (5.0mA≦Io≦350mA)	△IIB	 - -	 - -	 0.8 0.5	 mA
Output Noise Voltage (TA=25℃,10Hz≦f≦100kHz)	Vn	-	40	-	μA
Ripple Rejection (Io=100mA,f=120Hz,9.0V≦VI≦19V) (Io=300mA,f=120Hz,9.0V≦VI≦19V,TJ=25℃)	RR	 62 62	 - 80	 - -	 dB
Dropout Voltage (TJ=25℃)	VI-Vo	-	2.0	-	Vdc
Short Circuit Current Limit (TJ=25℃,VI=35V)	Ios	-	50	-	mA
Average Temperature Coefficient of Output Voltage (Io=5.0mA)	△Vo/△T	-	±0.2	-	mV/℃
Peak Output Current (TJ=25℃)	Io	-	700	-	mA

2.Tlow=0℃ for PJ78Mxx Thigh=+125℃ for PJ78Mxx
=-40℃ for PJ78Mxx

PJ78M06 ELECTRICAL CHARACTERISTICE (V1=11V,Io=350mA,0℃≦TJ≦125℃,PD≦5.0W,unless otherwise noted

Characteristics	Symbol	Min	Typ	Max	Unit
Output Voltage (TJ=25℃)	Vo	5.75	6.0	6.25	Vdc
Output Voltage Variation (8.0 Vdc ≦VI≦21Vdc,5.0mA≦Io≦350mA)	Vo	5.7	-	6.3	Vdc
Line Regulation (TJ=25℃,8.0Vdc≦VI≦25Vdc,Io=200mA)	Regline	-	3.0	50	mV
Load Regulation (TJ=25℃,5.0mA≦Io≦500mA) (TJ=25℃,5.0mA≦Io≦200mA)	Regload	- -	20 10	120 60	mV
Input Bias Current (TJ=25℃)	IIB	-	3.2	6.0	mA
Quiescent Current Change (9.0Vdc≦VI≦25Vdc,Io=200mA) (5.0mA≦Io≦350mA)	△IIB	- -	- -	0.8 0.5	mA
Output Noise Voltage (TA=25℃,10Hz≦f≦100kHz)	Vn	-	45	-	μA
Ripple Rejection (Io=100mA,f=120Hz,9.0V≦VI≦19V) (Io=300mA,f=120Hz,9.0V≦VI≦19V,TJ=25℃)	RR	59 59	- 80	- -	dB
Dropout Voltage (TJ=25℃)	VI-Vo	-	2.0	-	Vdc
Short Circuit Current Limit (TJ=25℃,VI=35V)	Ios	-	50	-	mA
Average Temperature Coefficient of Output Voltage (Io=5.0mA)	△Vo/△T	-	±0.2	-	mV/℃
Peak Output Current (TJ=25℃)	Io	-	700	-	mA

PJ78M08 ELECTRICAL CHARACTERISTICE (V1=14V,Io=350mA,TJ=Tlow to Thigh,PD≦5.0W,unless otherwise noted) (Note 3)

Characteristics	Symbol	Min	Typ	Max	Unit
Output Voltage (TJ=25℃) PJ78M08	Vo	7.84	8.0	8.16	Vdc
Output Voltage Variation (8.0 Vdc ≦VI≦21Vdc,5.0mA≦Io≦350mA)	Vo	7.7	-	8.3	Vdc
Line Regulation (TJ=25℃,8.0Vdc≦VI≦25Vdc,Io=200mA)	Regline	-	60	50	mV
Load Regulation (TJ=25℃,5.0mA≦Io≦500mA) (TJ=25℃,5.0mA≦Io≦200mA)	Regload	- -	25 10	160 80	mV
Input Bias Current (TJ=25℃)	IIB	-	3.2	6.0	mA
Quiescent Current Change (10.5Vdc≦VI≦25Vdc,Io=200mA) (5.0mA≦Io≦350mA)	△IIB	- -	- -	0.8 0.5	mA
Output Noise Voltage (TA=25℃,10Hz≦f≦100kHz)	Vn	-	52	-	μV
Ripple Rejection (Io=100mA,f=120Hz11.5V≦VI≦21.5V) (Io=300mA,f=120Hz,11.5V≦VI≦21.5V,TJ=25℃)	RR	56 56	- 80	- -	dB
Dropout Voltage (TJ=25℃)	VI-Vo	-	2.0	-	Vdc
Short Circuit Current Limit (TJ=25℃,VI=35V)	Ios	-	50	-	mA
Average Temperature Coefficient of Output Voltage (Io=5.0mA)	△Vo/△T	-	±0.2	-	mV/℃
Peak Output Current (TJ=25℃)	Io	-	700	-	mA

3.Tlow=0℃ for PJ78Mxx Thigh=+125℃ for PJ78Mxx
=-40℃ for PJ78Mxx

PJ78M09 ELECTRICAL CHARACTERISTICE (V1=15V,Io=350mA,TJ=Tlow to Thigh,PD≦5.0W,unless otherwise noted) (Note 4)

Characteristics	Symbol	Min	Typ	Max	Unit
Output Voltage (TJ=25℃)	Vo	8.64	9.0	9.45	Vdc
Output Voltage Variation (11.5 Vdc ≦VI≦23Vdc,5.0mA≦Io≦350mA)	Vo	8.55	-	9.45	Vdc
Line Regulation (TJ=25℃,11.5Vdc≦VI≦25Vdc,Io=200mA)	Regline	-	60	50	mV
Load Regulation (TJ=25℃,5.0mA≦Io≦500mA) (TJ=25℃,5.0mA≦Io≦200mA)	Regload	- -	25 10	160 90	mV
Input Bias Current (TJ=25℃)	IIB	-	3.2	6.0	mA
Quiescent Current Change (11.5Vdc≦VI≦25Vdc,Io=200mA) (5.0mA≦Io≦350mA)	△IIB	- -	- -	0.8 0.5	mA
Output Noise Voltage (TA=25℃,10Hz≦f≦100kHz)	Vn	-	52	-	μV
Ripple Rejection (Io=100mA,f=120Hz12.5V≦VI≦22.5V) (Io=300mA,f=120Hz,12.5V≦VI≦22.5V,TJ=25℃)	RR	56 56	- 80	- -	dB
Dropout Voltage (TJ=25℃)	VI-Vo	-	2.0	-	Vdc
Short Circuit Current Limit (TJ=25℃,VI=35V)	Ios	-	50	-	mA
Average Temperature Coefficient of Output Voltage(Io=5.0mA)	△Vo/△T	-	±0.2	-	mV/℃
Peak Output Current (TJ=25℃)	Io	-	700	-	mA

PJ78M12 ELECTRICAL CHARACTERISTICE (V1=19V,Io=350mA,TJ=Tlow to Thigh,PD≦5.0W,unless otherwise noted) (Note 4)

Characteristics	Symbol	Min	Typ	Max	Unit
Output Voltage (TJ=25℃) PJ78M12	Vo	11.76	12	12.24	Vdc
Output Voltage Variation (14.5 Vdc ≦VI≦27Vdc,5.0mA≦Io≦350mA)	Vo	11.5	-	12.5	Vdc
Line Regulation (TJ=25℃,11.5Vdc≦VI≦25Vdc,Io=200mA)	Regline	-	80	50	mV
Load Regulation (TJ=25℃,5.0mA≦Io≦500mA) (TJ=25℃,5.0mA≦Io≦200mA)	Regload	- -	25 10	240 120	mV
Input Bias Current (TJ=25℃)	IIB	-	3.2	6.0	mA
Quiescent Current Change (14.5Vdc≦VI≦30Vdc,Io=200mA) (5.0mA≦Io≦350mA)	△IIB	- -	- -	0.8 0.5	mA
Output Noise Voltage (TA=25℃,10Hz≦f≦100kHz)	Vn	-	75	-	μV
Ripple Rejection (Io=100mA,f=120Hz15V≦VI≦25V) (Io=300mA,f=120Hz,15V≦VI≦25V,TJ=25℃)	RR	55 55	- 80	- -	dB
Dropout Voltage (TJ=25℃)	VI-Vo	-	2.0	-	Vdc
Short Circuit Current Limit (TJ=25℃,VI=35V)	Ios	-	50	-	mA
Average Temperature Coefficient of Output Voltage(Io=5.0mA)	△Vo/△T	-	±0.3	-	mV/℃
Peak Output Current (TJ=25℃)	Io	-	700	-	mA

4. Tlow=0℃ for PJ78Mxx Thigh=+125℃ for PJ78Mxx
=-40℃ for PJ78Mxx

PJ78M15 ELECTRICAL CHARACTERISTICE (V1=23V,Io=350mA,TJ=Tlow to Thigh,PD≦5.0W,unless otherwise noted) (Note 5)

Characteristics	Symbol	Min	Typ	Max	Unit
Output Voltage (TJ=25℃) PJ78M15	Vo	14.7	15	15.3	Vdc
Output Voltage Variation (17.5 Vdc ≦VI≦30Vdc,5.0mA≦Io≦350mA)	Vo	14.4	-	15.6	Vdc
Line Regulation (TJ=25℃,17.5Vdc≦VI≦30Vdc,Io=200mA)	Regline	-	10	50	mV
Load Regulation (TJ=25℃,5.0mA≦Io≦500mA) (TJ=25℃,5.0mA≦Io≦200mA)	Regload	- -	25 10	300 150	mV
Input Bias Current (TJ=25℃)	IIB	-	3.2	6.0	mA
Quiescent Current Change (17.8Vdc≦VI≦30Vdc,Io=200mA) (5.0mA≦Io≦350mA)	△IIB	- -	- -	0.8 0.5	mA
Output Noise Voltage (TA=25℃,10Hz≦f≦100kHz)	Vn	-	90	-	μV
Ripple Rejection (Io=100mA,f=120Hz,18.5V≦VI≦28.5V) (Io=300mA,f=120Hz,18.5V≦VI≦28.5V,TJ=25℃)	RR	54 54	- 70	- -	dB
Dropout Voltage (TJ=25℃)	VI-Vo	-	2.0	-	Vdc
Short Circuit Current Limit (TJ=25℃,VI=35V)	Ios	-	50	-	mA
Average Temperature Coefficient of Output Voltage(Io=5.0mA)	△Vo/△T	-	±0.3	-	mV/℃
Peak Output Current (TJ=25℃)	Io	-	700	-	mA

PJ78M18 ELECTRICAL CHARACTERISTICE (V1=27V,Io=350mA,TJ=Tlow to Thigh,PD≦5.0W,unless otherwise noted)

Characteristics	Symbol	Min	Typ	Max	Unit
Output Voltage (TJ=25℃)	Vo	17.3	18	18.7	Vdc
Output Voltage Variation (21 Vdc ≦VI≦33Vdc,5.0mA≦Io≦350mA)	Vo	17.1	-	18.9	Vdc
Line Regulation (TJ=25℃,17.5Vdc≦VI≦30Vdc,Io=200mA)	Regline	-	10	50	mV
Load Regulation (TJ=25℃,5.0mA≦Io≦500mA) (TJ=25℃,5.0mA≦Io≦200mA)	Regload	- -	30 10	360 180	mV
Input Bias Current (TJ=25℃)	IIB	-	3.2	6.5	mA
Quiescent Current Change (21Vdc≦VI≦33Vdc,Io=200mA) (5.0mA≦Io≦350mA)	△IIB	- -	- -	0.8 0.5	mA
Output Noise Voltage (TA=25℃,10Hz≦f≦100kHz)	Vn	-	100	-	μV
Ripple Rejection (Io=100mA,f=120Hz,22V≦VI≦32V) (Io=300mA,f=120Hz,22V≦VI≦32V,TJ=25℃)	RR	53 53	- 70	- -	dB
Dropout Voltage (TJ=25℃)	VI-Vo	-	2.0	-	Vdc
Short Circuit Current Limit (TJ=25℃,VI=35V)	Ios	-	50	-	mA
Average Temperature Coefficient of Output Voltage (Io=5.0mA)	△Vo/△T	-	±0.3	-	mV/℃
Peak Output Current (TJ=25℃)	Io	-	700	-	mA

5. Tlow=0℃ for PJ78Mxx Thigh=+125℃ for PJ78Mxx
=-40℃ for PJ78Mxx

PJ78M20 ELECTRICAL CHARACTERISTICE (V1=29V,Io=350mA,TJ=Tlow to Thigh,PD≦5.0W,unless otherwise noted)

Characteristics	Symbol	Min	Typ	Max	Unit
Output Voltage (TJ=25℃)	Vo	19.2	20	20.8	Vdc
Output Voltage Variation (23 Vdc ≦VI≦35Vdc,5.0mA≦Io≦350mA)	Vo	19	-	21	Vdc
Line Regulation (TJ=25℃,23Vdc≦VI≦ 35Vdc,Io=200mA)	Regline	-	10	50	mV
Load Regulation (TJ=25℃,5.0mA≦Io≦500mA) (TJ=25℃,5.0mA≦Io≦200mA)	Regload	- -	30 10	400 200	mV
Input Bias Current (TJ=25℃)	IIB	-	3.2	6.5	mA
Quiescent Current Change (23Vdc≦VI≦35Vdc,Io=200mA) (5.0mA≦Io≦350mA)	△IIB	- -	- -	0.8 0.5	mA
Output Noise Voltage (TA=25℃,10Hz≦f≦100kHz)	Vn	-	110	-	μV
Ripple Rejection (Io=100mA,f=120Hz,24V≦VI≦34V) (Io=300mA,f=120Hz,24V≦VI≦34V,TJ=25℃)	RR	52 52	- 70	- -	dB
Dropout Voltage (TJ=25℃)	VI-Vo	-	2.0	-	Vdc
Short Circuit Current Limit (TJ=25℃,VI=35V)	Ios	-	50	-	mA
Average Temperature Coefficient of Output Voltage (Io=5.0mA)	△Vo/△T	-	±0.5	-	mV/℃
Peak Output Current (TJ=25℃)	Io	-	700	-	mA

PJ78M24 ELECTRICAL CHARACTERISTICE (V1=33V,Io=350mA,TJ=Tlow to Thigh,PD≦5.0W,unless otherwise noted)

Characteristics	Symbol	Min	Typ	Max	Unit
Output Voltage (TJ=25℃)	Vo	23	24	25	Vdc
Output Voltage Variation (27 Vdc ≦VI≦38Vdc,5.0mA≦Io≦350mA)	Vo	22.8	-	25.2	Vdc
Line Regulation (TJ=25℃,27Vdc≦VI≦ 38Vdc,Io=200mA)	Regline	-	10	50	mV
Load Regulation (TJ=25℃,5.0mA≦Io≦500mA) (TJ=25℃,5.0mA≦Io≦200mA)	Regload	- -	30 10	480 240	mV
Input Bias Current (TJ=25℃)	IIB	-	3.2	6.5	mA
Quiescent Current Change (27Vdc≦VI≦38Vdc,Io=200mA) (5.0mA≦Io≦350mA)	△IIB	- -	- -	0.8 0.5	mA
Output Noise Voltage (TA=25℃,10Hz≦f≦100kHz)	Vn	-	170	-	μV
Ripple Rejection (Io=100mA,f=120Hz,28V≦VI≦38V) (Io=300mA,f=120Hz,28V≦VI≦38V,TJ=25℃)	RR	50 50	- 70	- -	dB
Dropout Voltage (TJ=25℃)	VI-Vo	-	2.0	-	Vdc
Short Circuit Current Limit (TJ=25℃,VI=35V)	Ios	-	50	-	mA
Average Temperature Coefficient of Output Voltage (Io=5.0mA)	△Vo/△T	-	±0.5	-	mV/℃
Peak Output Current (TJ=25℃)	Io	-	700	-	mA

DEFINITIONS

Line-Regulation-The change in oootput 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 in 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.

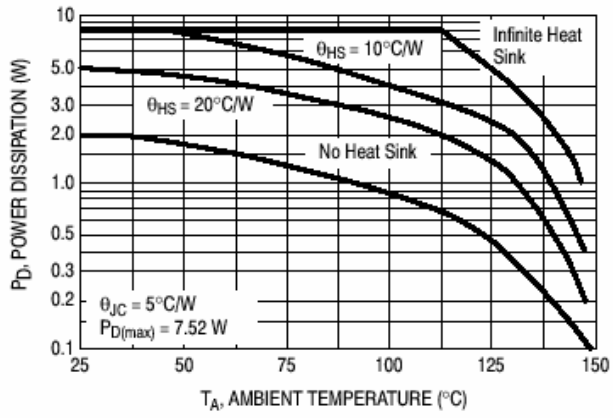


Figure 2. Worst Case Power Dissipation versus Ambient Temperature (TO–220)

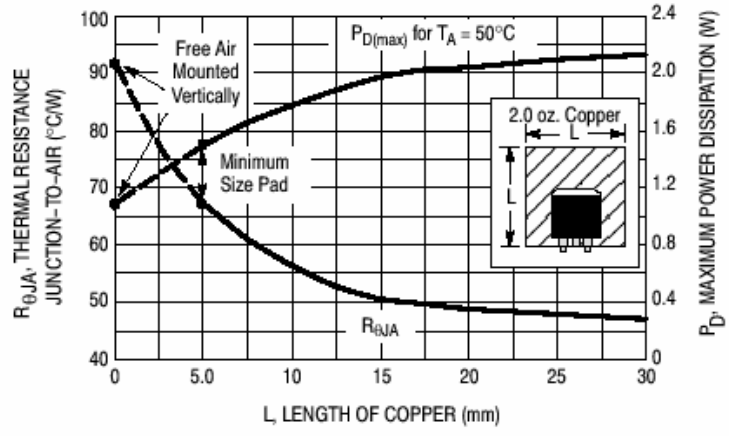


Figure 3. DPAK Thermal Resistance and Maximum Power Dissipation versus P.C.B. Copper Length

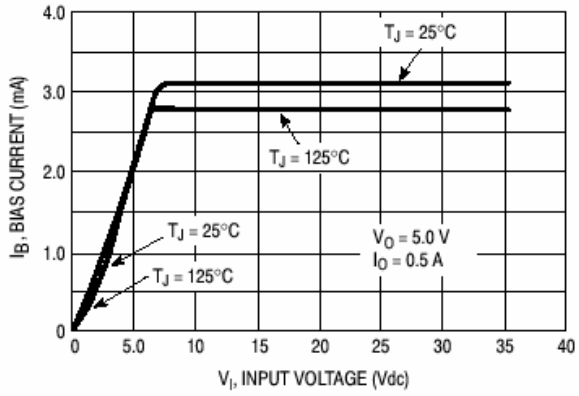


Figure 4. Bias Current versus Input Voltage

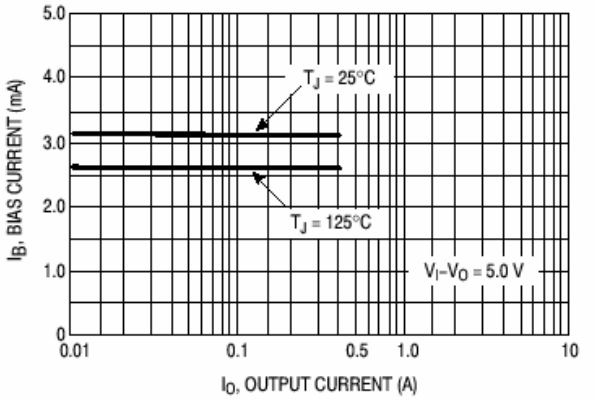


Figure 5. Bias Current versus Output Current

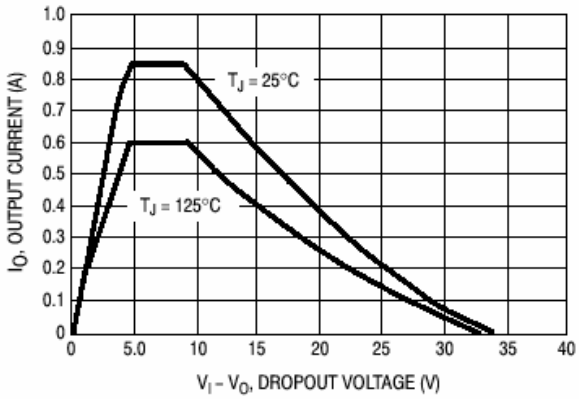


Figure 6. Peak Output Current versus Dropout Voltage

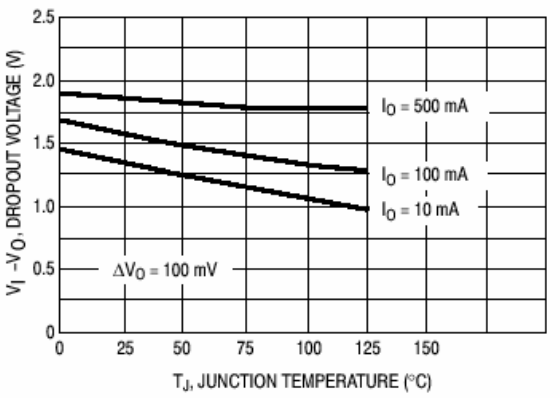


Figure 7. Dropout Voltage versus Junction Temperature

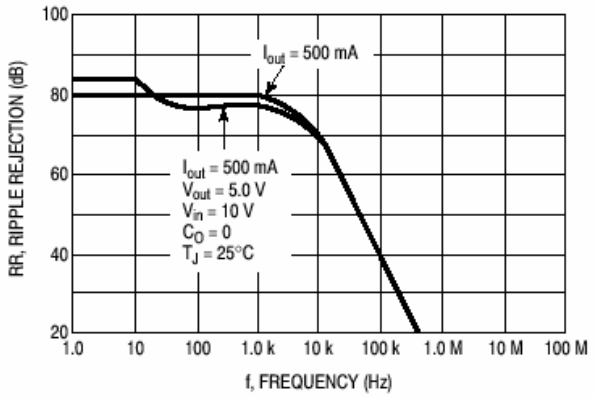


Figure 8. Ripple Rejection versus Frequency

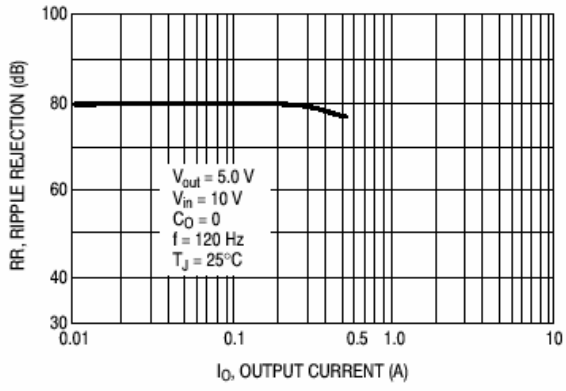


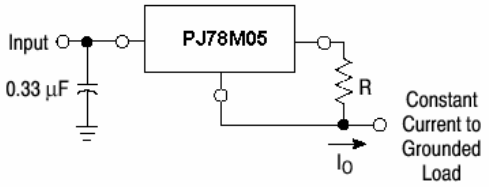
Figure 9. Ripple Rejection versus Output Current

APPLICATIONS INFORMATION

Design Considerations

The PJ78Mxx Series of fixed voltage regulators are designed with Thermal Overload Protection that shuts down the circuit when subjected to an excessive power overload ondition,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 mF 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.



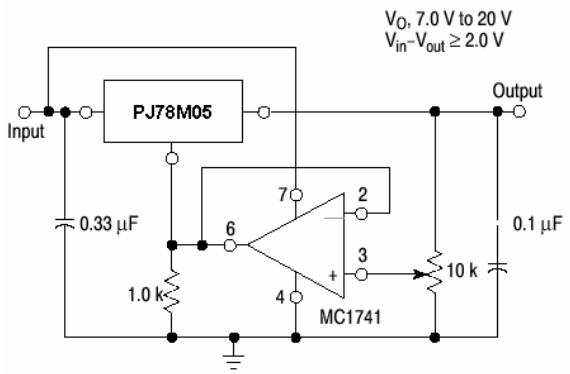
The MC78M00 regulators can also be used as a current source when connected as above. In order to minimize dissipation the MC78M05C is chosen in this application. Resistor R determines the current as follows:

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

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

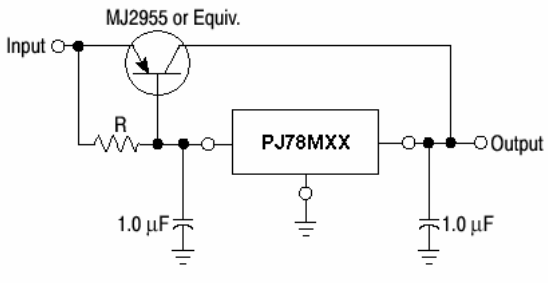
For example, a 500 mA current source would require R to be a 5.0 Ω, 10 W resistor and the output voltage compliance would be the input voltage less 7.0 V.

Figure 10. Current 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.

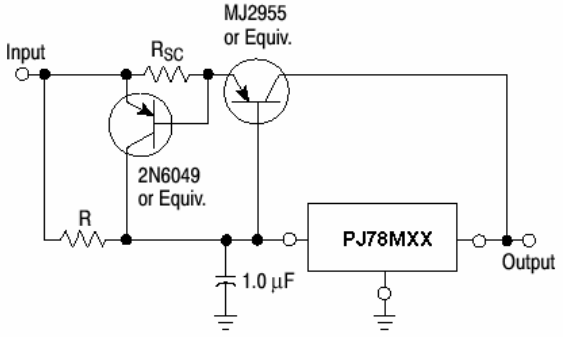
Figure 11. Adjustable Output Regulator



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 Regulator

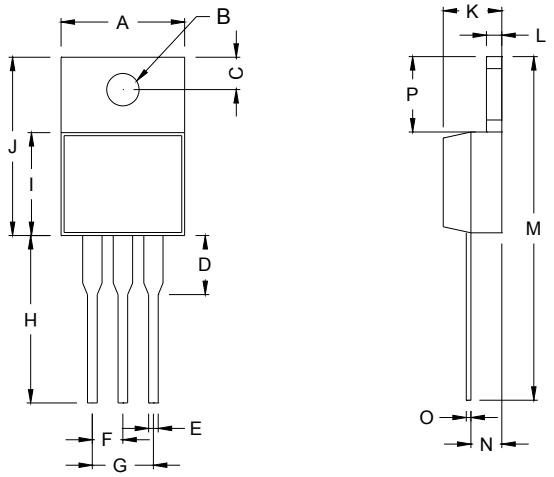


XX = 2 digits of type number indicating voltage.

The circuit of Figure 12 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.

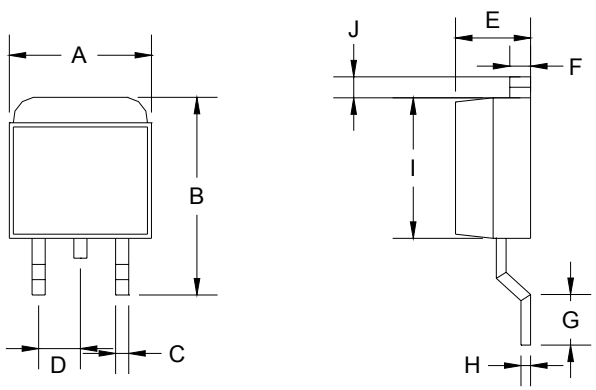
Figure 13. Current Boost with Short Circuit Protection

TO-220 Unit：mm



TO-220 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	10.000	10.500	0.394	0.413
B	3.240	4.440	0.128	0.175
C	2.440	2.940	0.096	0.116
D	-	6.350	-	0.250
E	0.381	1.106	0.015	0.040
F	2.345	2.715	0.092	0.058
G	4.690	5.430	0.092	0.107
H	12.700	14.732	0.500	0.581
I	8.382	9.017	0.330	0.355
J	14.224	16.510	0.560	0.650
K	3.556	4.826	0.140	0.190
L	0.508	1.397	0.020	0.055
M	27.700	29.620	1.060	1.230
N	2.032	2.921	0.080	0.115
O	0.255	0.610	0.010	0.024
P	5.842	6.858	0.230	0.270

TO-252 Unit：mm



TO-252 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	6.570	6.840	0.259	0.269
B	9.250	10.400	0.364	0.409
C	0.550	0.700	0.022	0.028
D	2.560	2.670	0.101	0.105
E	2.300	2.390	0.090	0.094
F	0.490	0.570	0.019	0.022
G	1.460	1.580	0.057	0.062
H	0.520	0.570	0.020	0.022
I	5.340	5.550	0.210	0.219
J	1.460	1.640	0.057	0.065