

Three-Terminal Positive Voltage Regulators

FEATURES

- Output Current in Excess of 1.0A
- No External Components Required
- Internal Thermal Overload Protection
- Internal Short Circuit Current Limiting
- Output Transistor Safe-Area Compensation
- Output Voltage Offered in 2% Tolerance
- Available in Surface Mount DPAK and Standard 3-Lead Transistor Packages
- Previous Commercial Temperature Range has been Extended to a Junction Temperature Range of -40°C to $+125^{\circ}\text{C}$

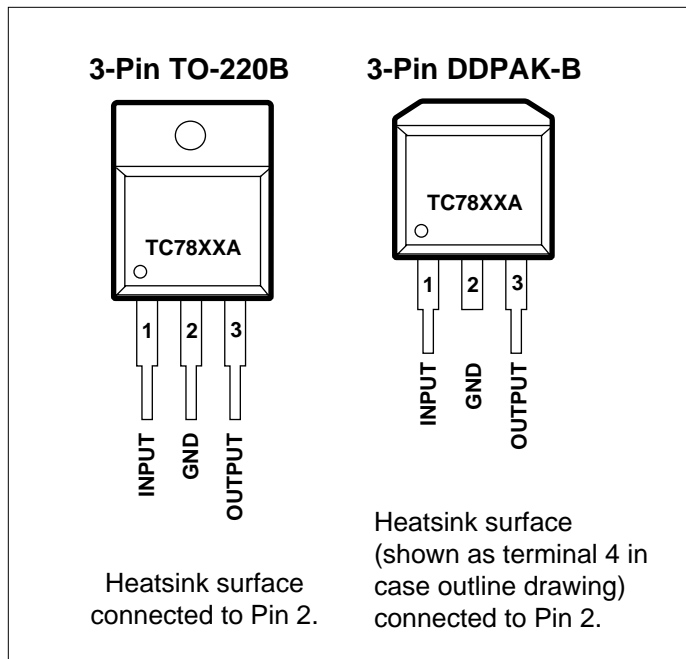
GENERAL DESCRIPTION

These voltage regulators are monolithic integrated circuits designed as fixed-voltage regulators for a wide variety of applications including local, on-card regulation. These regulators employ internal current limiting, thermal shut-down, and safe-area compensation. With adequate heatsinking they can deliver output currents in excess of 1.0A. Although designed primarily as a fixed voltage regulator, these devices can be used with external components to obtain adjustable voltages and currents.

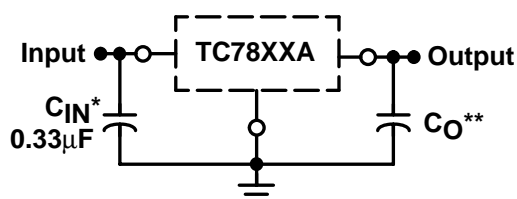
ORDERING INFORMATION

Part Number*	Package	Temperature Range
TC7805A-5.0VBB	3-Pin TO-220B	-40° to $+125^{\circ}\text{C}$
TC7812A-12.0VBB	3-Pin TO-220B	-40° to $+125^{\circ}\text{C}$
TC7815A-15.0VBB	3-Pin TO-220B	-40° to $+125^{\circ}\text{C}$
TC7805A-5.0VRB	3-Pin DPAK-B	-40° to $+125^{\circ}\text{C}$
TC7812A-12.0VRB	3-Pin DPAK-B	-40° to $+125^{\circ}\text{C}$
TC7815A-15.0VRB	3-Pin DPAK-B	-40° to $+125^{\circ}\text{C}$
TC7824A-24.0VRB	3-Pin DPAK-B	-40° to $+125^{\circ}\text{C}$

Note: Contact company about other voltage and package options.



STANDARD APPLICATION



A common ground is required between the input and the output voltages. The input voltage must remain typically 2.0 V above the output voltage even during the low point on the input ripple voltage.

XX, These two digits of the type number indicate nominal voltage.

* C_{IN} is required if regulator is located an appreciable distance from power supply filter.

** C_O is not needed for stability; however, it does improve transient response. Values of less than $0.1\mu\text{F}$ could cause instability.

Three-Terminal Positive Voltage Regulators

TC7800A Series

ABSOLUTE MAXIMUM RATINGS*

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

Input Voltage (5.0 – 18V)	$V_{IN} = 35V_{DC}$
(24V)	$V_{IN} = 40V_{DC}$
Power Dissipation ($T_A = 25^\circ\text{C}$) .. $P_D =$ Internally Limited W	
Case TO-220B	
Thermal Resistance, Junction-to-Ambient	$\theta_{JA} = 65^\circ\text{C/W}$
Junction-to-Case	$\theta_{JC} = 5.0^\circ\text{C/W}$

Power Dissipation ($T_A = 25^\circ\text{C}$) $P_D =$ Internally Limited W
DDPAK-B

Thermal Resistance,
Junction-to-Ambient

$\theta_{JA} =$ (See Figure 13) $^\circ\text{C/W}$
Junction-to-Case

$\theta_{JC} = 5.0^\circ\text{C/W}$
Storage Junction
Temperature Range

$T_{STG} = -65^\circ\text{C}$ to $+150^\circ\text{C}$
Operating Junction Temperature

$T_J = +150^\circ\text{C}$

*Note: ESD Data Available upon request.

ELECTRICAL CHARACTERISTICS: ($V_{IN} = 10V$, $I_{OUT} = 1.0A$, $T_J = T_{LOW}$ to T_{HIGH} [Note 1], unless otherwise noted.)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
TC7805A						
V_{OUT}	Output Voltage	$T_J = 25^\circ\text{C}$	4.9	5.0	5.1	V_{DC}
V_{OUT}	Output Voltage	$5.0\text{mA} \leq I_{OUT} \leq 0.1A$, $P_D \leq 15W$ $7.5V_{DC} \leq V_{IN} \leq 20V_{DC}$	4.8	5.0	5.2	V_{DC}
REG_{LINE}	Line Regulation	Note 2 $7.5V_{DC} \leq V_{IN} \leq 25V_{DC}$, $I_{OUT} = 500\text{mA}$ $8.0V_{DC} \leq V_{IN} \leq 12V_{DC}$, $I_{OUT} = 1.0A$ $8.0V_{DC} \leq V_{IN} \leq 12V_{DC}$, $I_{OUT} = 1.0A$, $T_J = 25^\circ\text{C}$ $7.3V_{DC} \leq V_{IN} \leq 20V_{DC}$, $I_{OUT} = 1.0A$, $T_J = 25^\circ\text{C}$	—	0.5 0.8 1.3 4.5	10 12 4.0 10	mV
REG_{LOAD}	Load Regulation	Note 2 $5.0\text{mA} \leq I_{OUT} \leq 1.5A$, $T_J = 25^\circ\text{C}$ $5.0\text{mA} \leq I_{OUT} \leq 1.0A$ $250\text{mA} \leq I_{OUT} \leq 750\text{mA}$	—	1.3 0.8 0.53	25 25 15	mV
I_B	Quiescent Current		—	3.2	6.0	mA
ΔI_B	Quiescent Current Change	$8.0V_{DC} \leq V_{IN} \leq 25V_{DC}$, $I_{OUT} = 500\text{mA}$ $7.5V_{DC} \leq V_{IN} \leq 20V_{DC}$, $T_J = 25^\circ\text{C}$ $5.0\text{mA} \leq I_{OUT} \leq 1.0A$	—	0.3 — 0.08	0.8 0.8 0.5	mA
RR	Ripple Rejection	$8.0V_{DC} \leq V_{IN} \leq 18V_{DC}$, $f = 120\text{Hz}$, $I_{OUT} = 500\text{mA}$	68	83	—	dB
$V_{IN} - V_{OUT}$	Dropout Voltage	$I_{OUT} = 1.0A$, $T_J = 25^\circ\text{C}$	—	2.0	—	V_{DC}
V_N	Output Noise Voltage	$T_A = 25^\circ\text{C}$ $10\text{Hz} \leq f \leq 100\text{kHz}$	—	10	—	$\mu\text{V}/V_{OUT}$
R_{OUT}	Output Resistance	$f = 1.0\text{kHz}$	—	0.9	—	$\text{m}\Omega$
I_{SC}	Short Circuit Current Limit	$T_A = 25^\circ\text{C}$ $V_{IN} = 35V_{DC}$	—	0.2	—	A
I_{MAX}	Peak Output Current	$T_J = 25^\circ\text{C}$	—	2.2	—	A
TCV_{OUT}	Average Temperature Coefficient of Output Voltage		—	-0.3	—	$\text{mV}/^\circ\text{C}$

NOTES: 1. $T_{LOW} = -40^\circ\text{C}$ for TC78XXA, $T_{HIGH} = +125^\circ\text{C}$ for TC78XX

2. Load and line regulation are specified at constant junction temperature. Changes in V_{OUT} due to heating effects must be taken into account separately. Pulse testing with low duty cycle is used.

Three-Terminal Positive Voltage Regulators

TC7800A Series

ELECTRICAL CHARACTERISTICS: ($V_{IN} = 19V$, $I_{OUT} = 1.0A$, $T_J = T_{LOW}$ to T_{HIGH} [Note 1], unless otherwise noted.)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
TC7812A						
V_{OUT}	Output Voltage	$T_J = 25^{\circ}C$	11.75	12	12.25	V_{DC}
V_{OUT}	Output Voltage	$5.0mA \leq I_{OUT} \leq 0.1A$, $P_D \leq 15W$ $14.8V_{DC} \leq V_{IN} \leq 27V_{DC}$	11.5	12	12.5	V_{DC}
REG_{LINE}	Line Regulation	Note 2 $14.8V_{DC} \leq V_{IN} \leq 30V_{DC}$, $I_{OUT} = 500mA$ $16V_{DC} \leq V_{IN} \leq 22V_{DC}$, $I_{OUT} = 1.0A$ $14.5V_{DC} \leq V_{IN} \leq 27V_{DC}$, $T_J = 25^{\circ}C$	—	3.8	18	mV
REG_{LOAD}	Load Regulation	Note 2 $5.0mA \leq I_{OUT} \leq 1.5A$, $T_J = 25^{\circ}C$ $5.0mA \leq I_{OUT} \leq 1.0A$	—	—	25	mV
I_B	Quiescent Current		—	3.4	6.0	mA
ΔI_B	Quiescent Current Change	$15V_{DC} \leq V_{IN} \leq 30V_{DC}$, $I_{OUT} = 500mA$ $14.8V_{DC} \leq V_{IN} \leq 27V_{DC}$, $T_J = 25^{\circ}C$ $5.0mA \leq I_{OUT} \leq 1.0A$, $T_J = 25^{\circ}C$	—	—	0.8	mA
RR	Ripple Rejection	$15V_{DC} \leq V_{IN} \leq 25V_{DC}$, $f = 120Hz$, $I_{OUT} = 500mA$	55	60	—	dB
$V_{IN} - V_{OUT}$	Dropout Voltage	$I_{OUT} = 1.0A$, $T_J = 25^{\circ}C$	—	2.0	—	V_{DC}
V_N	Output Noise Voltage	$T_A = 25^{\circ}C$ $10Hz \leq f \leq 100kHz$	—	10	—	$\mu V/V_{OUT}$
R_{OUT}	Output Resistance	$f = 1.0kHz$	—	1.1	—	$m\Omega$
I_{SC}	Short Circuit Current Limit	$T_A = 25^{\circ}C$ $V_{IN} = 35V_{DC}$	—	0.2	—	A
I_{MAX}	Peak Output Current	$T_J = 25^{\circ}C$	—	2.2	—	A
TCV_{OUT}	Average Temperature Coefficient of Output Voltage		—	-0.8	—	$mV/^{\circ}C$

NOTES: 1. $T_{LOW} = -40^{\circ}C$ for TC78XXA, $T_{HIGH} = +125^{\circ}C$ for TC78XX

2. Load and line regulation are specified at constant junction temperature. Changes in V_{OUT} due to heating effects must be taken into account separately. Pulse testing with low duty cycle is used.

Three-Terminal Positive Voltage Regulators

TC7800A Series

ELECTRICAL CHARACTERISTICS: ($V_{IN} = 23V$, $I_{OUT} = 1.0A$, $T_J = T_{LOW}$ to T_{HIGH} [Note 1], unless otherwise noted.)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
TC7815A						
V_{OUT}	Output Voltage	$T_J = 25^\circ C$	14.7	15	15.3	V_{DC}
V_{OUT}	Output Voltage	$5.0mA \leq I_{OUT} \leq 0.1A$, $P_D \leq 15W$ $17.9V_{DC} \leq V_{IN} \leq 30V_{DC}$	14.4	15	15.6	V_{DC}
REG_{LINE}	Line Regulation	Note 2 $17.9V_{DC} \leq V_{IN} \leq 30V_{DC}$, $I_{OUT} = 500mA$ $20V_{DC} \leq V_{IN} \leq 26V_{DC}$ $17.5V_{DC} \leq V_{IN} \leq 30V_{DC}$, $I_{OUT} = 1.0A$, $T_J = 25^\circ C$	—	8.5 3.0 7.0	20 22 20	mV
REG_{LOAD}	Load Regulation	Note 2 $5.0mA \leq I_{OUT} \leq 1.5A$, $T_J = 25^\circ C$ $5.0mA \leq I_{OUT} \leq 1.0A$ $250mA \leq I_{OUT} \leq 750mA$	—	1.8 1.5 1.2	25 25 15	mV
I_B	Quiescent Current		—	3.5	6.0	mA
ΔI_B	Quiescent Current Change	$17.5V_{DC} \leq V_{IN} \leq 30V_{DC}$, $I_{OUT} = 500mA$ $17.5V_{DC} \leq V_{IN} \leq 30V_{DC}$, $I_{OUT} = 1.0A$, $T_J = 25^\circ C$ $5.0mA \leq I_{OUT} \leq 1.0A$	—	—	0.8 0.8 0.5	mA
RR	Ripple Rejection	$18.5V_{DC} \leq V_{IN} \leq 28.5V_{DC}$, $f = 120Hz$, $I_{OUT} = 500mA$	60	80	—	dB
$V_{IN} - V_{OUT}$	Dropout Voltage	$I_{OUT} = 1.0A$, $T_J = 25^\circ C$	—	2.0	—	V_{DC}
V_N	Output Noise Voltage	$T_A = 25^\circ C$ $10Hz \leq f \leq 10kHz$	—	10	—	$\mu V/V_{OUT}$
R_{OUT}	Output Resistance	$f = 1.0kHz$	—	1.2	—	$m\Omega$
I_{SC}	Short Circuit Current Limit	$T_A = 25^\circ C$ $V_{IN} = 35V_{DC}$	—	0.2	—	A
I_{MAX}	Peak Output Current	$T_J = 25^\circ C$	—	2.2	—	A
TCV_{OUT}	Average Temperature Coefficient of Output Voltage		—	-1.0	—	$mV/^\circ C$

NOTES: 1. $T_{LOW} = -40^\circ C$ for TC78XXA, $T_{HIGH} = +125^\circ C$ for TC78XX

2. Load and line regulation are specified at constant junction temperature. Changes in V_{OUT} due to heating effects must be taken into account separately. Pulse testing with low duty cycle is used.

Three-Terminal Positive Voltage Regulators

TC7800A Series

ELECTRICAL CHARACTERISTICS: ($V_{IN} = 33V$, $I_{OUT} = 1.0A$, $T_J = T_{LOW}$ to T_{HIGH} [Note 1], unless otherwise noted.)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
TC7824A						
V_{OUT}	Output Voltage	$T_J = 25^\circ C$	23.5	24	24.5	V_{DC}
V_{OUT}	Output Voltage	$5.0mA \leq I_{OUT} \leq 0.1A$, $P_D \leq 15W$ $27.3V_{DC} \leq V_{IN} \leq 38V_{DC}$	23.2	24	25.8	V_{DC}
REG_{LINE}	Line Regulation	Note 2 $27V_{DC} \leq V_{IN} \leq 38V_{DC}$, $I_{OUT} = 500mA$ $30V_{DC} \leq V_{IN} \leq 36V_{DC}$, $I_{OUT} = 1.0A$ $30V_{DC} \leq V_{IN} \leq 36V_{DC}$, $T_J = 25^\circ C$ $26.7V_{DC} \leq V_{IN} \leq 38V_{DC}$, $I_{OUT} = 1.0A$, $T_J = 25^\circ C$	—	11.5	25	mV
REG_{LOAD}	Load Regulation	Note 2 $5.0mA \leq I_{OUT} \leq 1.5A$, $T_J = 25^\circ C$ $5.0mA \leq I_{OUT} \leq 1.0A$ $250mA \leq I_{OUT} \leq 750mA$	—	2.1	15	mV
I_B	Quiescent Current		—	3.6	6.0	mA
ΔI_B	Quiescent Current Change	$27.3V_{DC} \leq V_{IN} \leq 38V_{DC}$, $I_{OUT} = 500mA$ $27V_{DC} \leq V_{IN} \leq 38V_{DC}$, $T_J = 25^\circ C$ $5.0mA \leq I_{OUT} \leq 1.0A$	—	—	0.8	mA
RR	Ripple Rejection	$28V_{DC} \leq V_{IN} \leq 38V_{DC}$, $f = 120Hz$, $I_{OUT} = 500mA$	45	54	—	dB
$V_{IN} - V_{OUT}$	Dropout Voltage	$I_{OUT} = 1.0A$, $T_J = 25^\circ C$	—	2.0	—	V_{DC}
V_N	Output Noise Voltage	$T_A = 25^\circ C$ $10Hz \leq f \leq 100kHz$	—	10	—	$\mu V/V_{OUT}$
R_{OUT}	Output Resistance	$f = 1.0kHz$	—	1.4	—	$m\Omega$
I_{SC}	Short Circuit Current Limit	$T_A = 25^\circ C$ $V_{IN} = 35V_{DC}$	—	0.2	—	A
I_{MAX}	Peak Output Current	$T_J = 25^\circ C$	—	2.2	—	A
TCV_{OUT}	Average Temperature Coefficient of Output Voltage		—	-2.0	—	$mV/^\circ C$

NOTES: 1. $T_{LOW} = -40^\circ C$ for TC78XXA, $T_{HIGH} = +125^\circ C$ for TC78XX

2. Load and line regulation are specified at constant junction temperature. Changes in V_{OUT} due to heating effects must be taken into account separately. Pulse testing with low duty cycle is used.

Three-Terminal Positive Voltage Regulators

TC7800A Series

APPLICATIONS INFORMATION

Design Considerations

The TC7800A 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 0.33μF 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 regulators 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.

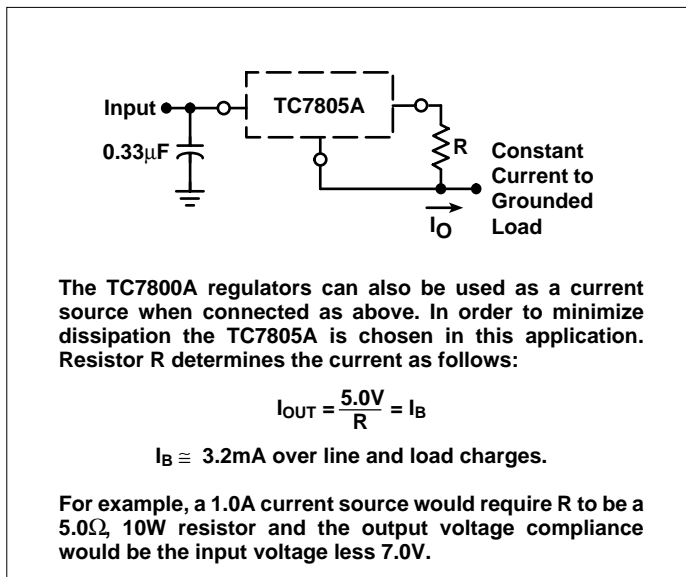


Figure 1. Current Regulator

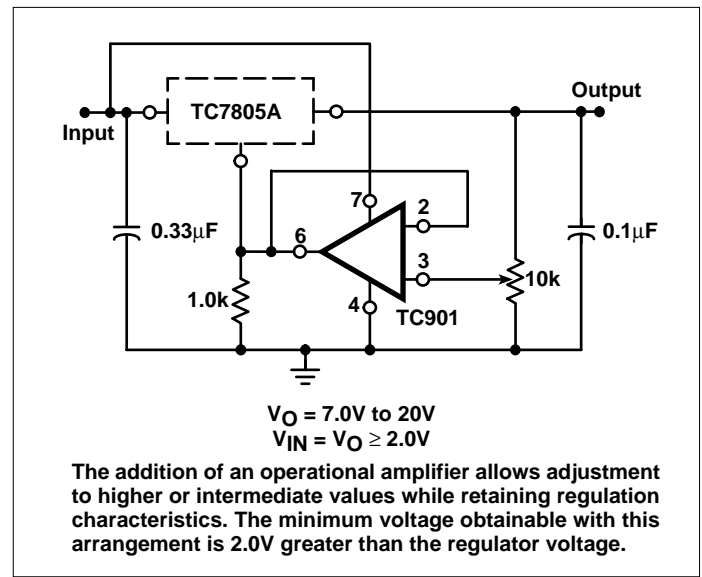


Figure 2. Adjustable Output Regulator

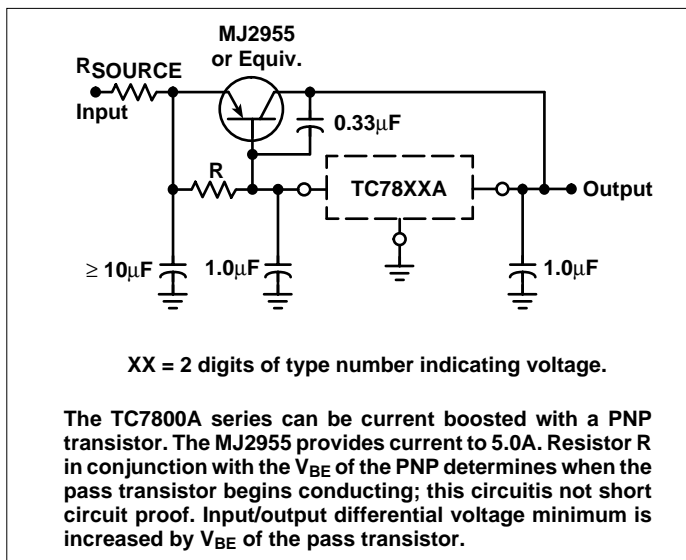


Figure 3. Current Boost Regulator

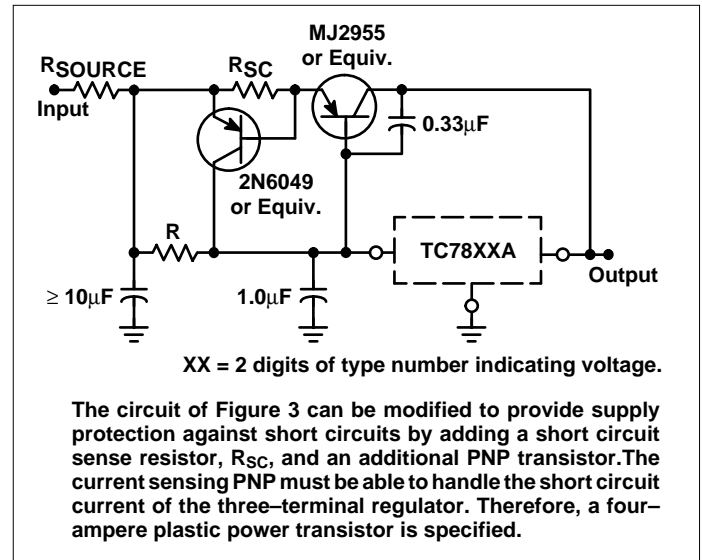


Figure 4. Short Circuit Protection

TYPICAL CHARACTERISTICS

Figure 5. Peak Output Current as a Function of Input/Output Differential Voltage

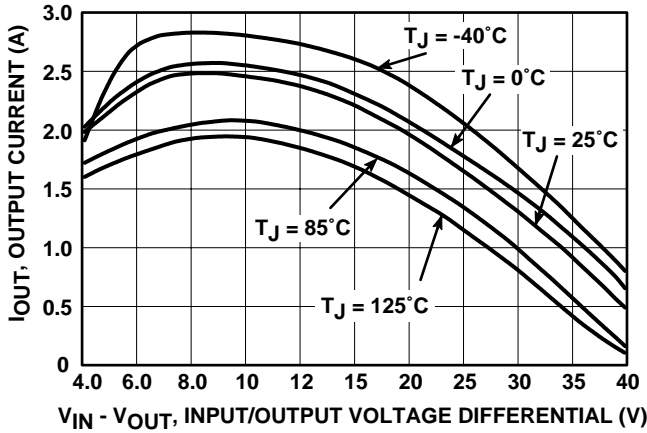


Figure 6. Ripple Rejection as a Function of Output Voltages

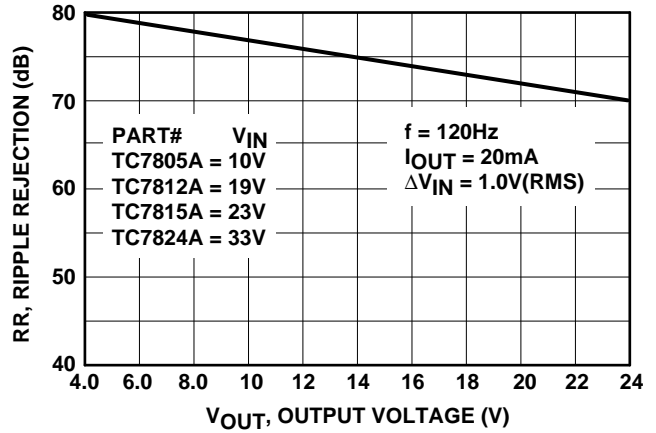


Figure 7. Ripple Rejection as a Function of Frequency

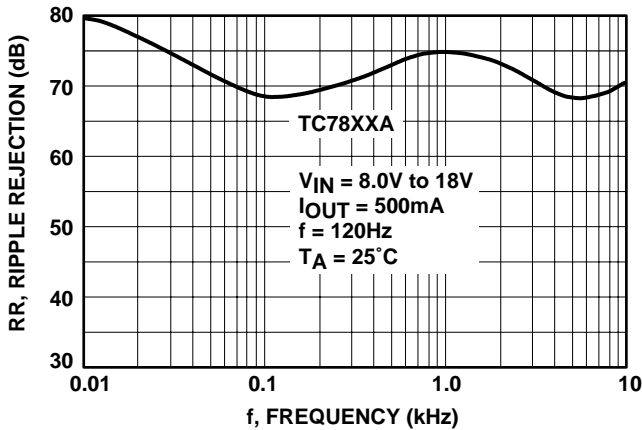


Figure 8. Output Voltage as a Function of Junction Temperature (TC7805A)

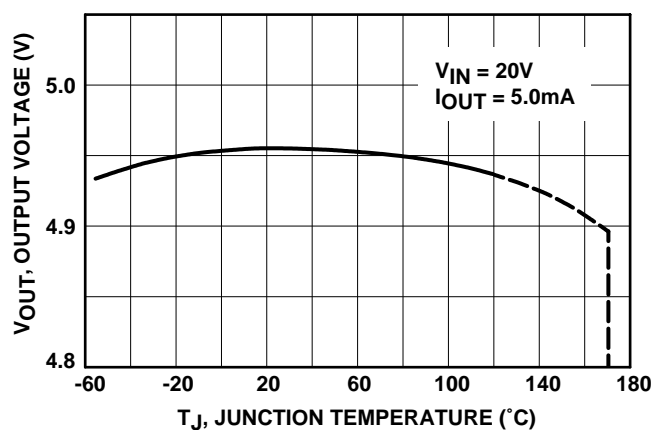


Figure 9. Output Impedance as a Function of Output Voltage

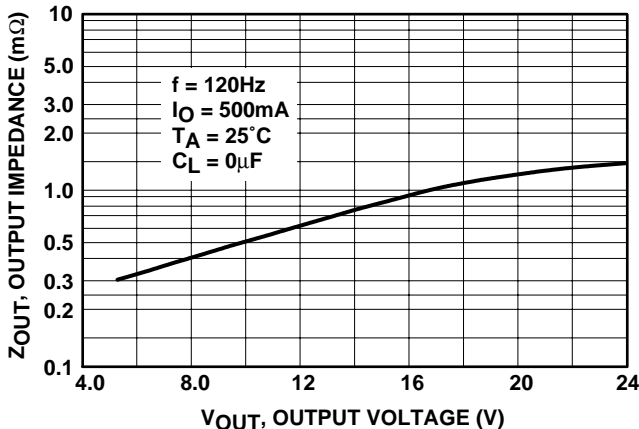
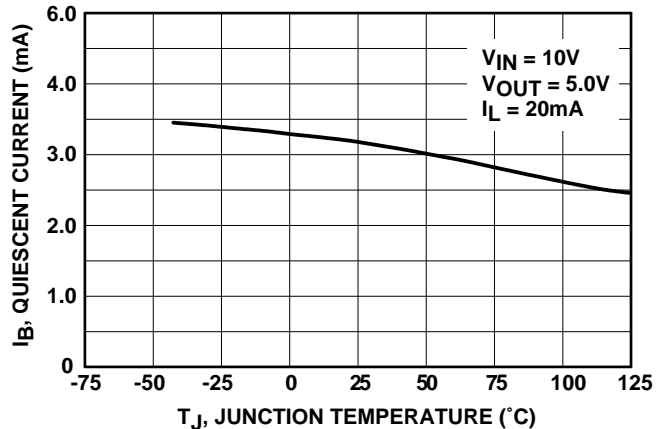


Figure 10. Quiescent Current as a Function of Temperature



TC7800A Series

Figure 11. Worst Case Power Dissipation versus Ambient Temperature (TO-220B)

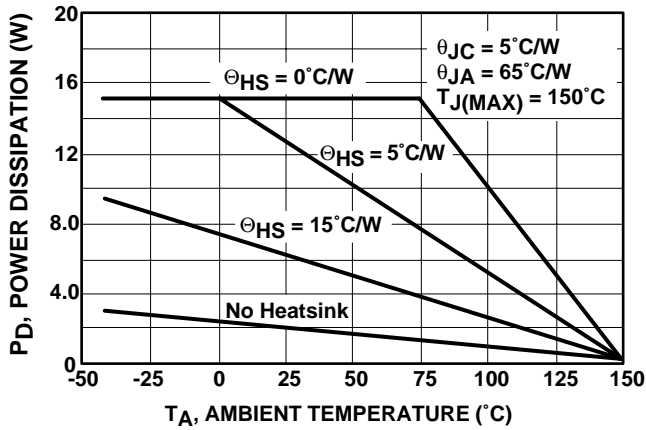


Figure 12. Input Output Differential as a Function of Junction Temperature

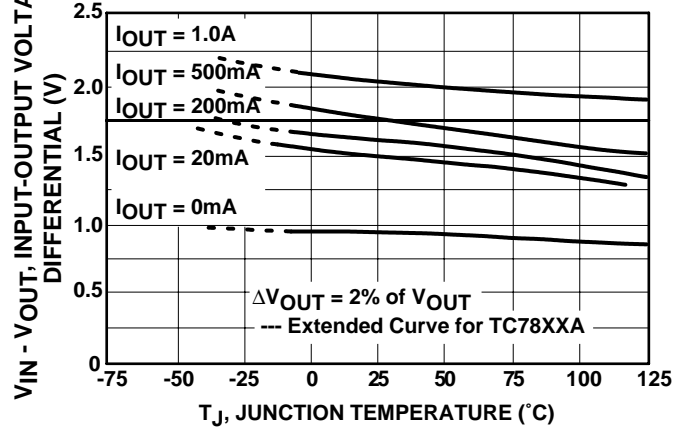
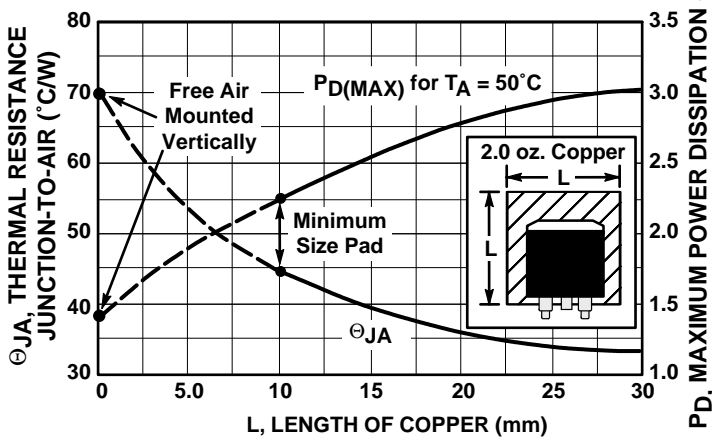


Figure 13. DPAK Thermal Resistance and Maximum Power Dissipation versus P.C.B. Copper Length



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 the load current at constant chip temperature.

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

Quiescent 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.

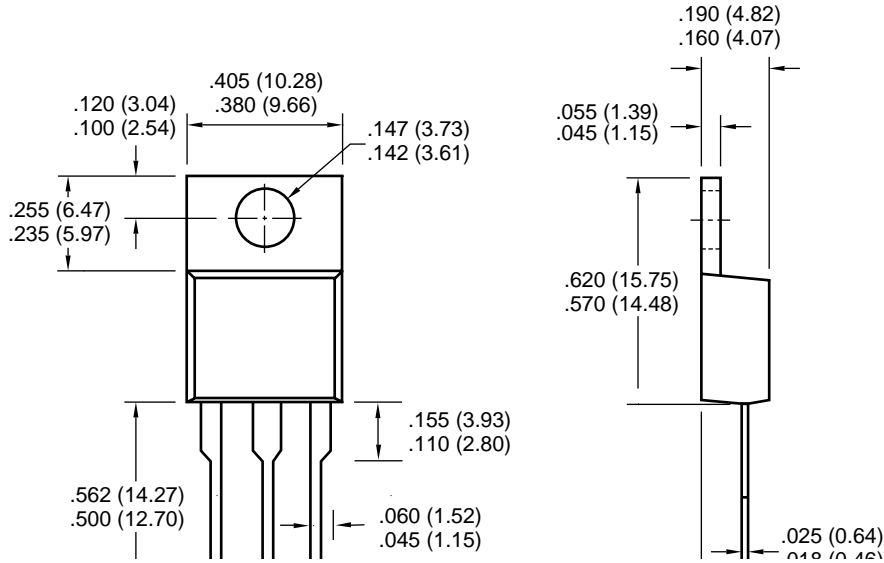
Long Term Stability – Output voltage stability under accelerated life test conditions with the maximum rated voltage listed in the devices' electrical characteristics and maximum power dissipation.

Three-Terminal Positive Voltage Regulators

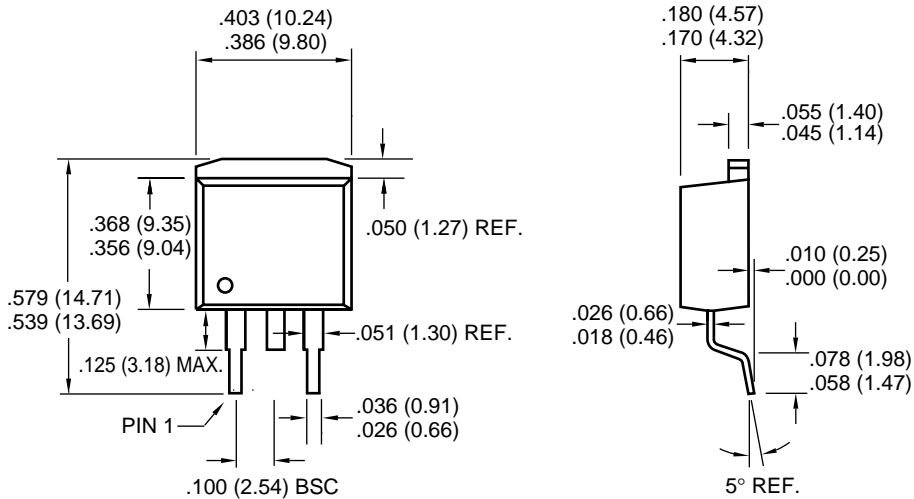
TC7800A Series

PACKAGE DIMENSIONS

3-Pin TO-220B



3-Pin DPAK-B





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