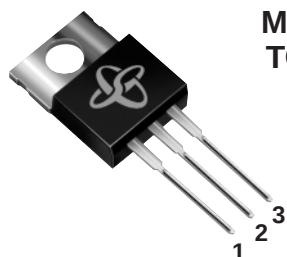


3-Terminal Fixed Positive Voltage Regulators

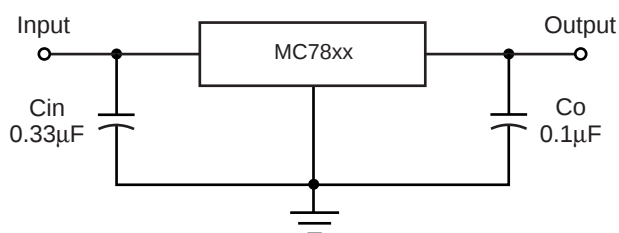


**MC78xxCT
TO-220AB**

Pin Definition

1. Input
2. Ground
3. Output
(Heatsink/tab connected to pin 2)

Standard Application



Notes:

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

xx = these two digits of the part number indicate output 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.

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 the MC78xxCT can deliver output currents in excess of 1.5 ampere.

Although designed primarily as a fixed voltage regulator, these devices can be used with external components to obtain adjustable voltages with currents.

Features

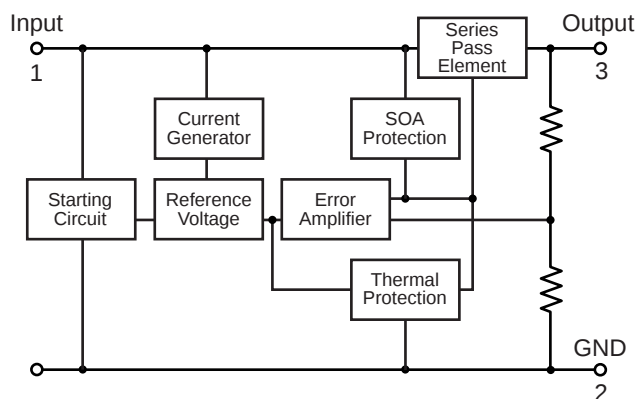
- Output current in excess of 1.0 ampere
- No external components required
- Internal thermal overload protection
- Internal short-circuit current limiting
- Output transistor safe-area compensation
- Output voltage offered in 2% tolerance

Mechanical Data

Case: TO-220 Package

Case outline is on the back page.

Internal Block Diagram



Maximum Ratings

Ratings at 25°C ambient temperature unless otherwise specified.

Parameter	Symbol	Value	Unit
Input Voltage ⁽¹⁾	V_{in}	30	V
Input Voltage ⁽²⁾	V_{in}	40	V
Thermal Resistance ⁽³⁾	$R_{\theta JC}$	5	°C/W
Operating Junction Temperature Range	T_J	–20 to +150	°C
Storage Junction Temperature Range	T_{stg}	–65 to +150	°C

Notes: (1) MC7805 to MC7818

(2) MC7824

(3) Follow the derating curve (fig. 1)

Electrical Characteristics – MC7805

$V_{in} = 10V$, $I_{out} = 500mA$, $0^\circ C \leq T_J \leq 125^\circ C$, $C_{in} = 0.33\mu F$, $C_{out} = 0.1\mu F$; unless otherwise noted.

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	V_{out}	$T_J = 25^\circ C$	4.90	5	5.10	V
		$7V \leq V_{in} \leq 20V$, $5mA \leq I_{out} \leq 1.0A$, $P_D \leq 15W$	4.85	—	5.15	
Line Regulation ($T_J = 25^\circ C$)	ΔREG_{line}	$7V \leq V_{in} < 25V$	—	3	100	mV
		$8V \leq V_{in} < 13V$	—	1	50	
Load Regulation ($T_J = 25^\circ C$)	ΔREG_{load}	$10mA \leq I_{out} < 1.5A$	—	15	100	mV
		$250mA \leq I_{out} < 750mA$	—	5	50	
Quiescent Current	I_q	$I_{out} = 0$, $T_J = 25^\circ C$	—	4.2	8	mA
Quiescent Current Change	ΔI_q	$7V \leq V_{in} \leq 25V$	—	—	1.3	mA
		$5mA \leq I_{out} \leq 1.0A$	—	—	0.5	
Output Noise Voltage	V_n	$10Hz \leq f \leq 100KHz$, $T_J = 25^\circ C$	—	40	—	μV
Ripple Rejection Ratio	RR	$f = 120Hz$	62	78	—	dB
Dropout Voltage	V_{drop}	$I_{out} = 1.0A$, $T_J = 25^\circ C$	—	2	—	V
Output Resistance	R_{out}	$f = 1KHz$	—	17	—	$m\Omega$
Output Short Circuit Current	I_{os}	$T_J = 25^\circ C$	—	750	—	mA
Peak Output Current	$I_{o peak}$	$T_J = 25^\circ C$	—	1.5	—	A
Temperature Coefficient of Output Voltage	$\Delta V_{out}/\Delta T_J$	$I_{out} = 5mA$, $0^\circ C \leq T_J \leq 125^\circ C$	—	–1.1	—	$mV/^\circ C$



Electrical Characteristics – MC7806

$V_{in} = 11V$, $I_{out} = 500mA$, $0^{\circ}C \leq T_J \leq 125^{\circ}C$, $C_{in} = 0.33\mu F$, $C_{out} = 0.1\mu F$; unless otherwise noted.

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	V_{out}	$T_J = 25^{\circ}C$	5.88	6.0	6.12	V
		$8V \leq V_{in} \leq 21V$, $5mA \leq I_{out} \leq 1.0A$, $P_D \leq 15W$	5.83	—	6.17	
Line Regulation ($T_J = 25^{\circ}C$)	ΔREG_{line}	$8V \leq V_{in} < 25V$	—	5	120	mV
		$9V \leq V_{in} < 13V$	—	1.5	60	
Load Regulation ($T_J = 25^{\circ}C$)	ΔREG_{load}	$10mA \leq I_{out} < 1.5A$	—	14	120	mV
		$250mA \leq I_{out} < 750mA$	—	4	60	
Quiescent Current	I_q	$I_{out} = 0$, $T_J = 25^{\circ}C$	—	4.3	8.0	mA
Quiescent Current Change	ΔI_q	$8V \leq V_{in} \leq 25V$	—	—	1.3	mA
		$5mA \leq I_{out} \leq 1.0A$	—	—	0.5	
Output Noise Voltage	V_n	$10Hz \leq f \leq 100KHz$, $T_A = 25^{\circ}C$	—	45	—	μV
Ripple Rejection Ratio	RR	$f = 120Hz$, $9V \leq V_{in} \leq 19V$	59	75	—	dB
Dropout Voltage	V_{drop}	$I_{out} = 1.0A$, $T_J = 25^{\circ}C$	—	2	—	V
Output Resistance	R_{out}	$f = 1KHz$	—	19	—	$m\Omega$
Output Short Circuit Current	I_{os}	$T_J = 25^{\circ}C$	—	550	—	mA
Peak Output Current	$I_{o peak}$	$T_J = 25^{\circ}C$	—	1.5	—	A
Temperature Coefficient of Output Voltage	$\Delta V_{out}/\Delta T_J$	$I_{out} = 5mA$, $0^{\circ}C \leq T_J \leq 125^{\circ}C$	—	-0.8	—	$mV/^{\circ}C$

Electrical Characteristics – MC7808

$V_{in} = 14V$, $I_{out} = 500mA$, $0^{\circ}C \leq T_J \leq 125^{\circ}C$, $C_{in} = 0.33\mu F$, $C_{out} = 0.1\mu F$; unless otherwise noted.

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	V_{out}	$T_J = 25^{\circ}C$	7.84	8.0	8.16	V
		$10.5V \leq V_{in} \leq 23V$, $5mA \leq I_{out} \leq 1.0A$, $P_D \leq 15W$	7.74	—	8.26	
Line Regulation ($T_J = 25^{\circ}C$)	ΔREG_{line}	$10.5V \leq V_{in} < 25V$	—	6	160	mV
		$11V \leq V_{in} < 15V$	—	2	80	
Load Regulation ($T_J = 25^{\circ}C$)	ΔREG_{load}	$10mA \leq I_{out} < 1.5A$	—	12	160	mV
		$250mA \leq I_{out} < 750mA$	—	4	80	
Quiescent Current	I_q	$I_{out} = 0$, $T_J = 25^{\circ}C$	—	4.3	8.0	mA
Quiescent Current Change	ΔI_q	$10.5V \leq V_{in} \leq 25V$	—	—	1	mA
		$5mA \leq I_{out} \leq 1.0A$	—	—	0.5	
Output Noise Voltage	V_n	$10Hz \leq f \leq 100KHz$, $T_J = 25^{\circ}C$	—	52	—	μV
Ripple Rejection Ratio	RR	$f = 120Hz$	56	72	—	dB
Dropout Voltage	V_{drop}	$I_{out} = 1.0A$, $T_J = 25^{\circ}C$	—	2	—	V
Output Resistance	R_{out}	$f = 1KHz$	—	16	—	$m\Omega$
Output Short Circuit Current	I_{os}	$T_J = 25^{\circ}C$	—	450	—	mA
Peak Output Current	$I_{o peak}$	$T_J = 25^{\circ}C$	—	1.5	—	A
Temperature Coefficient of Output Voltage	$\Delta V_{out}/\Delta T_J$	$I_{out} = 5mA$, $0^{\circ}C \leq T_J \leq 125^{\circ}C$	—	-0.8	—	$mV/^{\circ}C$

Electrical Characteristics – MC7809

$V_{in} = 15V$, $I_{out} = 500mA$, $0^{\circ}C \leq T_J \leq 125^{\circ}C$, $C_{in} = 0.33\mu F$, $C_{out} = 0.1\mu F$; unless otherwise noted.

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	V_{out}	$T_J = 25^{\circ}C$	8.82	9	9.18	V
		$11.5V \leq V_{in} \leq 24V$, $5mA \leq I_{out} \leq 1.0A$, $P_D \leq 15W$	8.77	—	9.23	
Line Regulation ($T_J = 25^{\circ}C$)	ΔREG_{line}	$11.5V \leq V_{in} < 27V$	—	6	160	mV
		$12V \leq V_{in} < 16V$	—	2	80	
Load Regulation ($T_J = 25^{\circ}C$)	ΔREG_{load}	$5mA \leq I_{out} < 1.5A$	—	12	160	mV
		$250mA \leq I_{out} < 750mA$	—	4	80	
Quiescent Current	I_q	$I_{out} = 0$, $T_J = 25^{\circ}C$	—	4.3	8	mA
Quiescent Current Change	ΔI_q	$11.5V \leq V_{in} \leq 27V$	—	—	1	mA
		$5mA \leq I_{out} \leq 1.0A$	—	—	0.5	
Output Noise Voltage	V_n	$10Hz \leq f \leq 100KHz$, $T_J = 25^{\circ}C$	—	52	—	μV
Ripple Rejection Ratio	RR	$f = 120Hz$, $12V \leq V_{in} \leq 22V$	55	72	—	dB
Dropout Voltage	V_{drop}	$I_{out} = 1.0A$, $T_J = 25^{\circ}C$	—	2	—	V
Output Resistance	R_{out}	$f = 1KHz$	—	16	—	$m\Omega$
Output Short Circuit Current	I_{os}	$T_J = 25^{\circ}C$	—	450	—	mA
Peak Output Current	$I_{o peak}$	$T_J = 25^{\circ}C$	—	1.5	—	A
Temperature Coefficient of Output Voltage	$\Delta V_{out}/\Delta T_J$	$I_{out} = 5mA$, $0^{\circ}C \leq T_J \leq 125^{\circ}C$	—	—1	—	$mV/^{\circ}C$

Electrical Characteristics – MC7810

$V_{in} = 16V$, $I_{out} = 500mA$, $0^{\circ}C \leq T_J \leq 125^{\circ}C$, $C_{in} = 0.33\mu F$, $C_{out} = 0.1\mu F$; unless otherwise noted.

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	V_{out}	$T_J = 25^{\circ}C$	9.8	10	10.2	V
		$12.5V \leq V_{in} \leq 25V$, $5mA \leq I_{out} \leq 1.0A$, $P_D \leq 15W$	9.75	—	10.25	
Line Regulation ($T_J = 25^{\circ}C$)	ΔREG_{line}	$12.5V \leq V_{in} < 28V$	—	10	240	mV
		$13V \leq V_{in} < 17V$	—	3	120	
Load Regulation ($T_J = 25^{\circ}C$)	ΔREG_{load}	$10mA \leq I_{out} < 1.5A$	—	12	240	mV
		$250mA \leq I_{out} < 750mA$	—	4	120	
Quiescent Current	I_q	$I_{out} = 0$, $T_J = 25^{\circ}C$	—	4.3	8	mA
Quiescent Current Change	ΔI_q	$12.5V \leq V_{in} \leq 28V$	—	—	1	mA
		$5mA \leq I_{out} \leq 1.0A$	—	—	0.5	
Output Noise Voltage	V_n	$10Hz \leq f \leq 100KHz$, $T_J = 25^{\circ}C$	—	52	—	μV
Ripple Rejection Ratio	RR	$f = 120Hz$, $13V \leq V_{in} \leq 23V$	54	72	—	dB
Dropout Voltage	V_{drop}	$I_{out} = 1.0A$, $T_J = 25^{\circ}C$	—	2	—	V
Output Resistance	R_{out}	$f = 1KHz$	—	16	—	$m\Omega$
Output Short Circuit Current	I_{os}	$T_J = 25^{\circ}C$	—	450	—	mA
Peak Output Current	$I_{o peak}$	$T_J = 25^{\circ}C$	—	1.5	—	A
Temperature Coefficient of Output Voltage	$\Delta V_{out}/\Delta T_J$	$I_{out} = 5mA$, $0^{\circ}C \leq T_J \leq 125^{\circ}C$	—	—1	—	$mV/^{\circ}C$



Electrical Characteristics – MC7812

$V_{in} = 19V$, $I_{out} = 500mA$, $0^{\circ}C \leq T_J \leq 125^{\circ}C$, $C_{in} = 0.33\mu F$, $C_{out} = 0.1\mu F$; unless otherwise noted.

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	V_{out}	$T_J = 25^{\circ}C$	11.76	12.0	12.24	V
		$14.5V \leq V_{in} \leq 27V$, $5mA \leq I_{out} \leq 1.0A$, $P_D \leq 15W$	11.66	—	12.34	
Line Regulation ($T_J = 25^{\circ}C$)	ΔREG_{line}	$14V \leq V_{in} < 30V$	—	10	240	mV
		$15V \leq V_{in} < 19V$	—	3	120	
Load Regulation ($T_J = 25^{\circ}C$)	ΔREG_{load}	$10mA \leq I_{out} < 1.5A$	—	12	240	mV
		$250mA \leq I_{out} < 750mA$	—	4	120	
Quiescent Current	I_q	$I_{out} = 0$, $T_J = 25^{\circ}C$	—	4.3	8	mA
Quiescent Current Change	ΔI_q	$14.5V \leq V_{in} \leq 30V$	—	—	1	mA
		$5mA \leq I_{out} \leq 1.0A$	—	—	0.5	
Output Noise Voltage	V_n	$10Hz \leq f \leq 100KHz$, $T_J = 25^{\circ}C$	—	75	—	μV
Ripple Rejection Ratio	RR	$f = 120Hz$, $15V \leq V_{in} \leq 25V$	55	71	—	dB
Dropout Voltage	V_{drop}	$I_{out} = 1.0A$, $T_J = 25^{\circ}C$	—	2	—	V
Output Resistance	R_{out}	$f = 1KHz$	—	18	—	$m\Omega$
Output Short Circuit Current	I_{os}	$T_J = 25^{\circ}C$	—	350	—	mA
Peak Output Current	$I_{o peak}$	$T_J = 25^{\circ}C$	—	1.5	—	A
Temperature Coefficient of Output Voltage	$\Delta V_{out}/\Delta T_J$	$I_{out} = 5mA$, $0^{\circ}C \leq T_J \leq 125^{\circ}C$	—	-1	—	$mV/^{\circ}C$

Electrical Characteristics – MC7815

$V_{in} = 23V$, $I_{out} = 500mA$, $0^{\circ}C \leq T_J \leq 125^{\circ}C$, $C_{in} = 0.33\mu F$, $C_{out} = 0.1\mu F$; unless otherwise noted.

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	V_{out}	$T_J = 25^{\circ}C$	14.7	15.0	15.3	V
		$17.5V \leq V_{in} \leq 30V$, $5mA \leq I_{out} \leq 1.0A$, $P_D \leq 15W$	14.55	—	15.45	
Line Regulation ($T_J = 25^{\circ}C$)	ΔREG_{line}	$17.5V \leq V_{in} < 30V$	—	11	300	mV
		$13V \leq V_{in} < 17V$	—	3	150	
Load Regulation ($T_J = 25^{\circ}C$)	ΔREG_{load}	$10mA \leq I_{out} < 1.5A$	—	12	300	mV
		$250mA \leq I_{out} < 750mA$	—	4	150	
Quiescent Current	I_q	$I_{out} = 0$, $T_J = 25^{\circ}C$	—	4.4	8	mA
Quiescent Current Change	ΔI_q	$17.5V \leq V_{in} \leq 30V$	—	—	1	mA
		$5mA \leq I_{out} \leq 1.0A$	—	—	0.5	
Output Noise Voltage	V_n	$10Hz \leq f \leq 100KHz$, $T_J = 25^{\circ}C$	—	90	—	μV
Ripple Rejection Ratio	RR	$f = 120Hz$, $18V \leq V_{in} \leq 28V$	54	70	—	dB
Dropout Voltage	V_{drop}	$I_{out} = 1.0A$, $T_J = 25^{\circ}C$	—	2	—	V
Output Resistance	R_{out}	$f = 1KHz$	—	19	—	$m\Omega$
Output Short Circuit Current	I_{os}	$T_J = 25^{\circ}C$	—	230	—	mA
Peak Output Current	$I_{o peak}$	$T_J = 25^{\circ}C$	—	1.5	—	A
Temperature Coefficient of Output Voltage	$\Delta V_{out}/\Delta T_J$	$I_{out} = 5mA$, $0^{\circ}C \leq T_J \leq 125^{\circ}C$	—	-1	—	$mV/^{\circ}C$

Electrical Characteristics – MC7818

$V_{in} = 27V$, $I_{out} = 500mA$, $0^{\circ}C \leq T_J \leq 125^{\circ}C$, $C_{in} = 0.33\mu F$, $C_{out} = 0.1\mu F$; unless otherwise noted.

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	V_{out}	$T_J = 25^{\circ}C$	17.64	18.0	18.36	V
		$21V \leq V_{in} \leq 33V$, $5mA \leq I_{out} \leq 1.0A$, $P_D \leq 15W$	17.44	—	18.56	
Line Regulation ($T_J = 25^{\circ}C$)	ΔREG_{line}	$21V \leq V_{in} < 33V$	—	15	360	mV
		$22V \leq V_{in} < 26V$	—	5	180	
Load Regulation ($T_J = 25^{\circ}C$)	ΔREG_{load}	$10mA \leq I_{out} < 1.5A$	—	12	360	mV
		$250mA \leq I_{out} < 750mA$	—	4	180	
Quiescent Current	I_q	$I_{out} = 0$, $T_J = 25^{\circ}C$	—	4.5	8	mA
Quiescent Current Change	ΔI_q	$21V \leq V_{in} \leq 33V$	—	—	1	mA
		$5mA \leq I_{out} \leq 1.0A$	—	—	0.5	
Output Noise Voltage	V_n	$10Hz \leq f \leq 100KHz$, $T_J = 25^{\circ}C$	—	110	—	mV
Ripple Rejection Ratio	RR	$f = 120Hz$, $21V \leq V_{in} \leq 31V$	53	69	—	dB
Dropout Voltage	V_{drop}	$I_{out} = 1.0A$, $T_J = 25^{\circ}C$	—	2	—	V
Output Resistance	R_{out}	$f = 1KHz$	—	22	—	$m\Omega$
Output Short Circuit Current	I_{os}	$T_J = 25^{\circ}C$	—	200	—	mA
Peak Output Current	$I_{o peak}$	$T_J = 25^{\circ}C$	—	1.5	—	A
Temperature Coefficient of Output Voltage	$\Delta V_{out}/\Delta T_J$	$I_{out} = 5mA$, $0^{\circ}C \leq T_J \leq 125^{\circ}C$	—	—1	—	mV/ $^{\circ}C$

Electrical Characteristics – MC7824

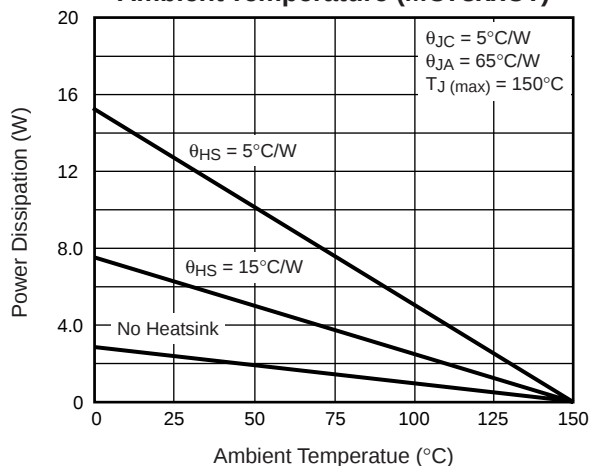
$V_{in} = 33V$, $I_{out} = 500mA$, $0^{\circ}C \leq T_J \leq 125^{\circ}C$, $C_{in} = 0.33\mu F$, $C_{out} = 0.1\mu F$; unless otherwise noted.

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	V_{out}	$T_J = 25^{\circ}C$	23.52	24.0	24.48	V
		$26V \leq V_{in} \leq 38V$, $5mA \leq I_{out} \leq 1.0A$, $P_D \leq 15W$	23.32	—	24.68	
Line Regulation ($T_J = 25^{\circ}C$)	ΔREG_{line}	$26V \leq V_{in} < 38V$	—	18	480	mV
		$27V \leq V_{in} < 32V$	—	6	240	
Load Regulation ($T_J = 25^{\circ}C$)	ΔREG_{load}	$10mA \leq I_{out} < 1.5A$	—	12	480	mV
		$250mA \leq I_{out} < 750mA$	—	4	240	
Quiescent Current	I_q	$I_{out} = 0$, $T_J = 25^{\circ}C$	—	4.6	8	mA
Quiescent Current Change	ΔI_q	$26V \leq V_{in} \leq 38V$	—	—	1	mA
		$5mA \leq I_{out} \leq 1.0A$	—	—	0.5	
Output Noise Voltage	V_n	$10Hz \leq f \leq 100KHz$, $T_J = 25^{\circ}C$	—	170	—	μV
Ripple Rejection Ratio	R_{rej}	$f = 120Hz$, $26V \leq V_{in} \leq 36V$	50	66	—	dB
Dropout Voltage	V_{drop}	$I_{out} = 1.0A$, $T_J = 25^{\circ}C$	—	2	—	V
Output Resistance	R_{out}	$f = 1KHz$	—	28	—	$m\Omega$
Output Short Circuit Current	I_{os}	$T_J = 25^{\circ}C$	—	150	—	mA
Peak Output Current	$I_{o peak}$	$T_J = 25^{\circ}C$	—	1.5	—	A
Temperature Coefficient of Output Voltage	$\Delta V_{out}/\Delta T_J$	$I_{out} = 5mA$, $0^{\circ}C \leq T_J \leq 125^{\circ}C$	—	—1.5	—	mV/ $^{\circ}C$



Ratings and Characteristic Curves ($T_A = 25^\circ\text{C}$ unless otherwise noted)

**Fig. 1 – Power Dissipation vs.
Ambient Temperature (MC78xxCT)**



**Fig. 2 – Dropout Voltage
vs. Junction Temperature**

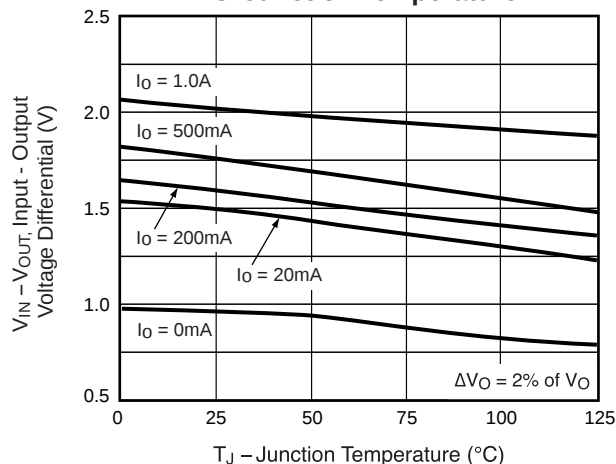
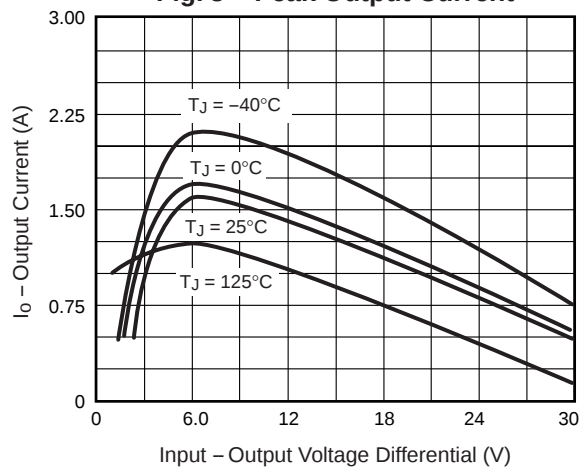
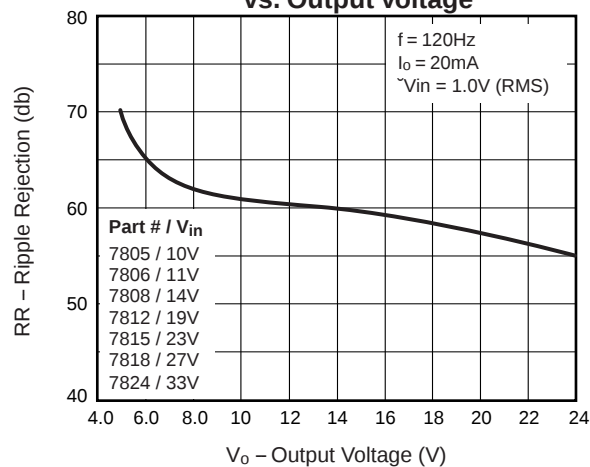


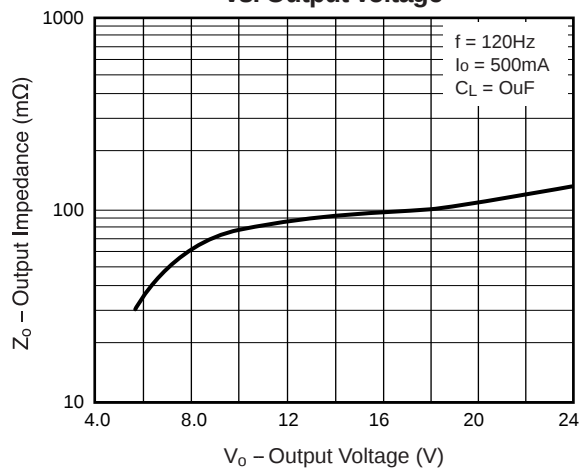
Fig. 3 – Peak Output Current



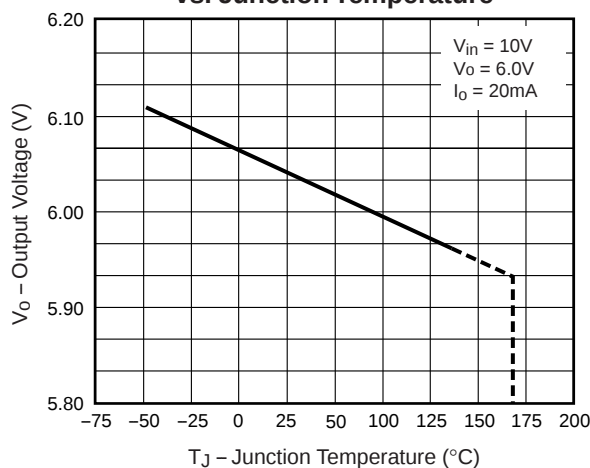
**Fig. 4 – Ripple Rejection Ratio
vs. Output Voltage**



**Fig. 5 – Output Impedance ($\text{m}\Omega$)
vs. Output Voltage**



**Fig. 6 – Output Voltage
vs. Junction Temperature**



Ratings and Characteristic Curves ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Fig. 7 – Quiescent Current vs. Junction Temperature

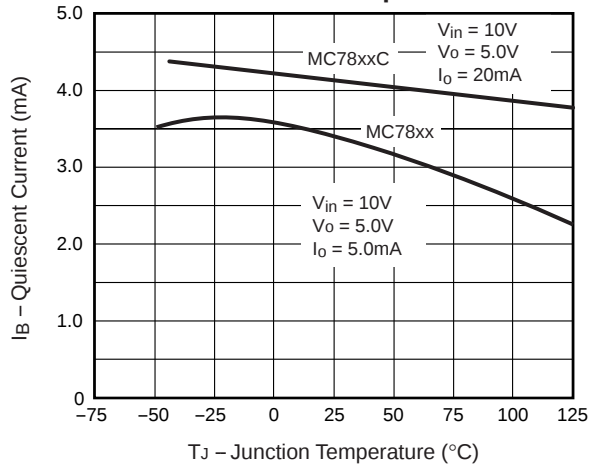
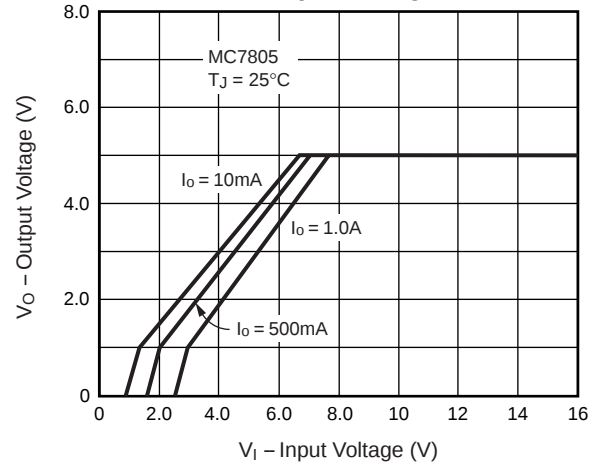
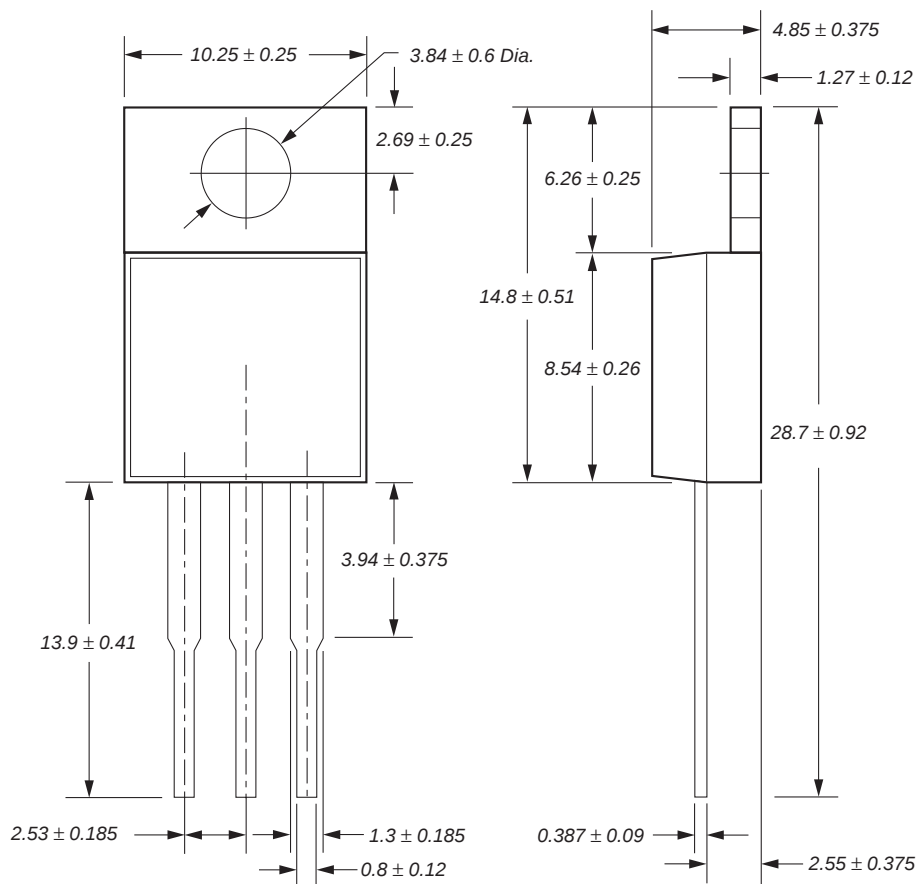


Fig. 8 – Output Voltage vs. Input Voltage



TO-220 Case Outline



Dimensions in millimeters