MC78XX/LM78XX

3-terminal 1A positive voltage regulator

Features

- Output Current up to 1A
- Output Voltages of 5, 6, 8, 9, 10, 11, 12, 15, 18, 24V
- Thermal Overload Protection
- Short Circuit Protection
- Output Transistor Safe Operating area Protection

Description

The MC78XX/LM78XX series of three-terminal positive regulators are available in the TO-220/D-PAK package and with several fixed output voltages, making them useful in a wide range of applications. Each type employs internal current limiting, thermal shut-down and safe operating area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents.

TO-220

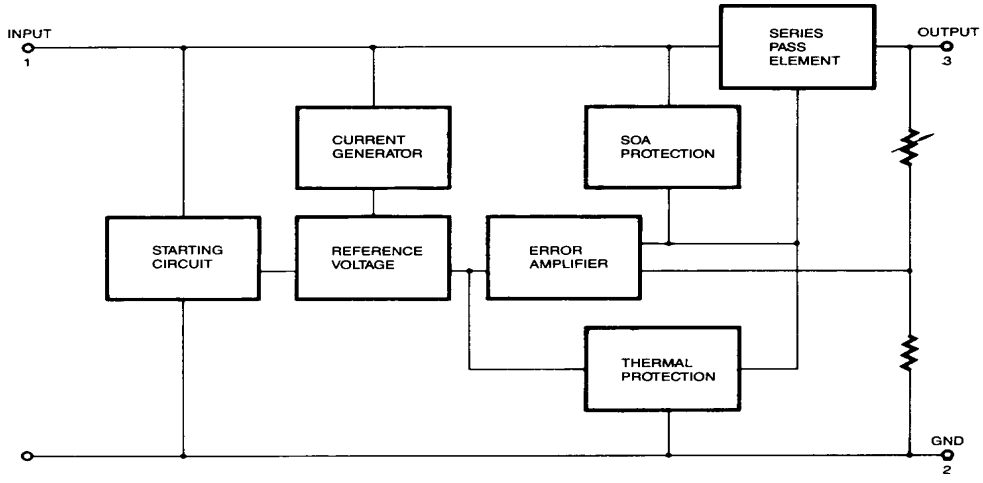
1

D-PAK

1

1. Input 2. GND 3. Output

Internal Block Digram



Rev. 5.0

Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Input Voltage (for V_O = 5V to 18V) (for V_O = 24V)	V_I V_I	35 40	V V
Thermal Resistance Junction-Cases	$R_{\theta JC}$	5	$^oC/W$
Thermal Resistance Junction-Air	$R_{\theta JA}$	65	$^oC/W$
Operating Temperature Range (MC78XXCT/LM78XXCT/MC78XXCDT)	T_{OPR}	0 ~ +125	^oC
Storage Temperature Range	T_{STG}	-65 ~ +150	^oC

Electrical Characteristics (MC7805/LM7805)

(Refer to test circuit ,$0^oC < T_J < 125^oC$, I_O = 500mA, V_I = 10V, C_I= 0.33µF, C_O= 0.1µF, unless otherwise specified)

Parameter	Symbol	Conditions		MC7805/LM7805			Unit
				Min.	Typ.	Max.	
Output Voltage	V_O	T_J =+25 ^oC		4.8	5.0	5.2	V
		5.0mA ≤ Io ≤ 1.0A, P_O ≤ 15W V_I = 7V to 20V V_I = 8V to 20V		4.75	5.0	5.25	
Line Regulation	ΔV_O	T_J=+25 ^oC	V_O = 7V to 25V	-	4.0	100	mV
			V_I = 8V to 12V	-	1.6	50	
Load Regulation	ΔV_O	T_J=+25 ^oC	I_O = 5.0mA to1.5A	-	9	100	mV
			I_O =250mA to 750mA	-	4	50	
Quiescent Current	I_Q	T_J =+25 ^oC		-	5.0	8	mA
Quiescent Current Change	ΔI_Q	I_O = 5mA to 1.0A		-	0.03	0.5	mA
		V_I= 7V to 25V		-	0.3	1.3	
Output Voltage Drift	$\Delta V_O/\Delta T$	I_O= 5mA		-	-0.8	-	mV/ ^oC
Output Noise Voltage	V_N	f = 10Hz to 100KHz, T_A=+25 ^oC		-	42	-	µV
Ripple Rejection	RR	f = 120Hz V_O = 8V to 18V		62	73	-	dB
Dropout Voltage	V_O	I_O = 1A, T_J =+25 ^oC		-	2	-	V
Output Resistance	R_O	f = 1KHz		-	15	-	mΩ
Short Circuit Current	I_{SC}	V_I = 35V, T_A =+25 ^oC		-	230	-	mA
Peak Current	I_{PK}	T_J =+25 ^oC		-	2.2	-	A

- Load and line regulation are specified at constant junction temperature. Changes in V_o due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Electrical Characteristics (MC7806)

(Refer to test circuit ,$0^{o}C < T_J < +125^{o}C$, I_O = 500mA, V_I = 11V, C_I= 0.33µF, C_O= 0.1µF, unless otherwise specified)

Parameter	Symbol	Conditions		MC7806			Unit
				Min.	Typ.	Max.	
Output Voltage	V_O	T_J =+25 ^{o}C		5.75	6.0	6.25	V
		5.0mA ≤ I_O ≤ 1.0A, P_D ≤ 15W V_I = 8.0V to 21V V_I = 9.0V to 21V		5.7	6.0	6.3	
Line Regulation	ΔV_O	T_J =+25 ^{o}C	V_I = 8V to 25V	-	5	120	mV
			V_I = 9V to 13V	-	1.5	60	
Load Regulation	ΔV_O	T_J =+25 ^{o}C	I_O =5mA to 1.5A	-	9	120	mV
			I_O =250mA to750A	-	3	60	
Quiescent Current	I_Q	T_J =+25 ^{o}C		-	5.0	8	mA
Quiescent Current Change	ΔI_Q	I_O = 5mA to 1A		-	-	0.5	mA
		V_I = 8V to 25V		-	-	1.3	
Output Voltage Drift	$\Delta V_O/\Delta T$	I_O = 5mA		-	-0.8	-	mV/ ^{o}C
Output Noise Voltage	V_N	f = 10Hz to 100KHz, T_A =+25 ^{o}C		-	45	-	µV
Ripple Rejection	RR	f = 120Hz V_I = 9V to 19V		59	75	-	dB
Dropout Voltage	V_O	I_O = 1A, T_J =+25 ^{o}C		-	2	-	V
Output Resistance	R_O	f = 1KHz		-	19	-	mΩ
Short Circuit Current	I_{SC}	V_I= 35V, T_A=+25 ^{o}C		-	250	-	mA
Peak Current	I_{PK}	T_J =+25 ^{o}C		-	2.2	-	A

- Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Electrical Characteristics (MC7808)

(Refer to test circuit ,$0^{o}C < T_J < +125^{o}C$, I_O = 500mA, V_I = 14V, C_I= 0.33µF, C_O= 0.1µF, unless otherwise specified)

Parameter	Symbol	Conditions		MC7808			Unit
				Min.	Typ.	Max.	
Output Voltage	V_O	T_J =+25 ^{o}C		7.7	8.0	8.3	V
		5.0mA ≤ I_O ≤ 1.0A, P_O ≤ 15W V_I = 10.5V to 23V V_I = 11.5V to 23V		7.6	8.0	8.4	
Line Regulation	ΔV_O	T_J =+25 ^{o}C	V_I = 10.5V to 25V	-	5.0	160	mV
			V_I = 11.5V to 17V	-	2.0	80	
Load Regulation	ΔV_O	T_J =+25 ^{o}C	I_O = 5.0mA to 1.5A	-	10	160	mV
			I_O= 250mA to 750mA	-	5.0	80	
Quiescent Current	I_Q	T_J =+25 ^{o}C		-	5.0	8	mA
Quiescent Current Change	ΔI_Q	I_O = 5mA to 1.0A		-	0.05	0.5	mA
		V_I = 10.5A to 25V		-	0.5	1.0	
		V_I = 11.5V to 25V		-		-	
Output Voltage Drift	$\Delta V_O/\Delta T$	I_O = 5mA		-	-0.8	-	mV/ ^{o}C
Output Noise Voltage	V_N	f = 10Hz to 100KHz, T_A =+25 ^{o}C		-	52	-	µV
Ripple Rejection	RR	f = 120Hz, V_I= 11.5V to 21.5		56	73	-	dB
Dropout Voltage	V_O	I_O = 1A, T_J=+25 ^{o}C		-	2	-	V
Output Resistance	R_O	f = 1KHz		-	17	-	mΩ
Short Circuit Current	I_{SC}	V_I= 35V, T_A =+25 ^{o}C		-	230	-	mA
Peak Current	I_{PK}	T_J =+25 ^{o}C		-	2.2	-	A

- Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Electrical Characteristics (MC7809)

(Refer to test circuit ,$0^{o}C < T_J < +125^{o}C$, I_O = 500mA, V_I = 15V, C_I= 0.33µF, C_O= 0.1µF, unless otherwise specified)

Parameter	Symbol	Conditions		MC7809			Unit
				Min.	Typ.	Max.	
Output Voltage	V_O	T_J =+25 ^{o}C		8.65	9	9.35	V
		5.0mA≤ I_O ≤1.0A, P_D ≤15W V_I= 11.5V to 24V V_I = 12.5V to 24V		8.6	9	9.4	
Line Regulation	ΔV_O	T_J=+25 ^{o}C	V_I = 11.5V to 25V	-	6	180	mV
			V_I = 12V to 25v	-	2	90	
Load Regulation	ΔV_O	T_J=+25 ^{o}C	I_O = 5mA to 1.5A	-	12	180	mV
			I_O = 250mA to 750mA	-	4	90	
Quiescent Current	I_Q	T_J=+25 ^{o}C		-	5.0	8	mA
Quiescent Current Change	ΔI_Q	I_O = 5mA to 1.0A		-	-	0.5	mA
		V_I = 11.5V to 26V		-	-	1.3	
		V_I = 12.5V to 26V		-	-	-	
Output Voltage Drift	$\Delta V_O/\Delta T$	I_O = 5mA		-	-1	-	mV/ ^{o}C
Output Noise Voltage	V_N	f = 10Hz to 100KHz, T_A =+25 ^{o}C		-	58	-	µV
Ripple Rejection	RR	f = 120Hz V_I = 13V to 23V		56	71	-	dB
Dropout Voltage	V_O	I_O = 1A, T_J=+25 ^{o}C		-	2	-	V
Output Resistance	R_O	f = 1KHz		-	17	-	mΩ
Short Circuit Current	I_{SC}	V_I= 35V, T_A =+25 ^{o}C		-	250	-	mA
Peak Current	I_{PK}	T_J= +25 ^{o}C		-	2.2	-	A

- Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Electrical Characteristics (MC7812)

(Refer to test circuit ,$0^{o}C < T_J < +125^{o}C$, I_O = 500mA, V_I = 19V, C_I= 0.33µF, C_O= 0.1µF, unless otherwise specified)

Parameter	Symbol	Conditions		MC7812			Unit
				Min.	Typ.	Max.	
Output Voltage	V_O	T_J =+25 ^{o}C		11.5	12	12.5	V
		5.0mA ≤ I_O≤1.0A, P_D≤15W V_I = 14.5V to 27V V_I= 15.5V to 27V		11.4	12	12.6	
Line Regulation	ΔV_O	T_J =+25 ^{o}C	V_I = 14.5V to 30V	-	10	240	mV
			V_I = 16V to 22V	-	3.0	120	
Load Regulation	ΔV_O	T_J =+25 ^{o}C	I_O = 5mA to 1.5A	-	11	240	mV
			I_O = 250mA to 750mA	-	5.0	120	
Quiescent Current	I_Q	T_J =+25 ^{o}C		-	5.1	8	mA
Quiescent Current Change	ΔI_Q	I_O = 5mA to 1.0A		-	0.1	0.5	mA
		V_I = 14.5V to 30V		-	0.5	1.0	
		V_I = 15V to 30V		-	-	-	
Output Voltage Drift	$\Delta V_O/\Delta T$	I_O = 5mA		-	-1	-	mV/ ^{o}C
Output Noise Voltage	V_N	f = 10Hz to 100KHz, T_A =+25 ^{o}C		-	76	-	µV
Ripple Rejection	RR	f = 120Hz V_I = 15V to 25V		55	71	-	dB
Dropout Voltage	V_O	I_O = 1A, T_J=+25 ^{o}C		-	2	-	V
Output Resistance	R_O	f = 1KHz		-	18	-	mΩ
Short Circuit Current	I_{SC}	V_I = 35V, T_A=+25 ^{o}C		-	230	-	mA
Peak Current	I_{PK}	T_J = +25 ^{o}C		-	2.2	-	A

- Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Electrical Characteristics (MC7815)

(Refer to test circuit ,$0^{o}C < T_J < +125^{o}C$, I_O = 500mA, V_I = 23V, C_I= 0.33µF, C_O= 0.1µF, unless otherwise specified)

Parameter	Symbol	Conditions		MC7815			Unit
				Min.	Typ.	Max.	
Output Voltage	V_O	T_J =+25 ^{o}C		14.4	15	15.6	V
		5.0mA ≤ I_O≤1.0A, P_D≤15W V_I = 17.5V to 30V V_I= 18.5V to 30V		14.25	15	15.75	
Line Regulation	ΔV_O	T_J =+25 ^{o}C	V_I = 17.5V to 30V	-	11	300	mV
			V_I = 20V to 26V	-	3	150	
Load Regulation	ΔV_O	T_J =+25 ^{o}C	I_O = 5mA to 1.5A	-	12	300	mV
			I_O = 250mA to 750mA	-	4	150	
Quiescent Current	I_Q	T_J =+25 ^{o}C		-	5.2	8	mA
Quiescent Current Change	ΔI_Q	I_O = 5mA to 1.0A		-	-	0.5	mA
		V_I = 17.5V to 30V		-	-	1.0	
		V_I = 18.5V to 30V		-	-	-	
Output Voltage Drift	$\Delta V_O/\Delta T$	I_O = 5mA		-	-1	-	mV/ ^{o}C
Output Noise Voltage	V_N	f = 10Hz to 100KHz, T_A =+25 ^{o}C		-	90	-	µV
Ripple Rejection	RR	f = 120Hz V_I = 18.5V to 28.5V		54	70	-	dB
Dropout Voltage	V_O	I_O = 1A, T_J=+25 ^{o}C		-	2	-	V
Output Resistance	R_O	f = 1KHz		-	19	-	mΩ
Short Circuit Current	I_{SC}	V_I = 35V, T_A=+25 ^{o}C		-	250	-	mA
Peak Current	I_{PK}	T_J =+25 ^{o}C		-	2.2	-	A

- Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Electrical Characteristics (MC7818)

(Refer to test circuit ,$0^{o}C < T_J < +125^{o}C$, I_O = 500mA, V_I = 27V, C_I= 0.33µF, C_O= 0.1µF, unless otherwise specified)

Parameter	Symbol	Conditions		MC7818			Unit
				Min.	Typ.	Max.	
Output Voltage	V_O	T_J =+25 ^{o}C		17.3	18	18.7	V
		5.0mA ≤ I_O ≤1.0A, P_D ≤15W V_I = 21V to 33V V_I= 22V to 33V		17.1	18	18.9	
Line Regulation	ΔV_O	T_J =+25 ^{o}C	V_I = 21V to 33V	-	15	360	mV
			V_I = 24V to 30V	-	5	180	
Load Regulation	ΔV_O	T_J =+25 ^{o}C	I_O = 5mA to 1.5A	-	15	360	mV
			I_O = 250mA to 750mA	-	5.0	180	
Quiescent Current	I_Q	T_J =+25 ^{o}C		-	5.2	8	mA
Quiescent Current Change	ΔI_Q	I_O = 5mA to 1.0A		-	-	0.5	mA
		V_I = 21V to 33V		-	-	1	
		V_I = 22V to 33V		-	-		
Output Voltage Drift	$\Delta V_O/\Delta T$	I_O = 5mA		-	-1	-	mV/ ^{o}C
Output Noise Voltage	V_N	f = 10Hz to 100KHz, T_A =+25 ^{o}C		-	110	-	µV
Ripple Rejection	RR	f = 120Hz V_I = 22V to 32V		53	69	-	dB
Dropout Voltage	V_O	I_O = 1A, T_J=+25 ^{o}C		-	2	-	V
Output Resistance	R_O	f = 1KHz		-	22	-	mΩ
Short Circuit Current	I_{SC}	V_I = 35V, T_A=+25 ^{o}C		-	250	-	mA
Peak Current	I_{PK}	T_J =+25 ^{o}C		-	2.2	-	A

- Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Electrical Characteristics (MC7824)

(Refer to test circuit ,$0^{o}C < T_J < +125^{o}C$, I_O = 500mA, V_I = 33V, C_I= 0.33µF, C_O= 0.1µF, unless otherwise specified)

Parameter	Symbol	Conditions		MC7824			Unit
				Min.	Typ.	Max.	
Output Voltage	V_O	T_J =+25 ^{o}C		23	24	25	V
		5.0mA ≤ I_O ≤ 1.0A, P_D ≤ 15W V_I = 27V to 38V V_I= 28V to 38V		22.8	24	25.25	
Line Regulation	ΔV_O	T_J =+25 ^{o}C	V_I = 27V to 38V	-	17	480	mV
			V_I = 30V to 36V	-	6	240	
Load Regulation	ΔV_O	T_J =+25 ^{o}C	I_O = 5mA to 1.5A	-	15	480	mV
			I_O = 250mA to 750mA	-	5.0	240	
Quiescent Current	I_Q	T_J =+25 ^{o}C		-	5.2	8	mA
Quiescent Current Change	ΔI_Q	I_O = 5mA to 1.0A		-	0.1	0.5	mA
		V_I = 27V to 38V		-	0.5	1	
		V_I = 28V to 38V		-	-	-	
Output Voltage Drift	$\Delta V_O/\Delta T$	I_O = 5mA		-	-1.5	-	mV/ ^{o}C
Output Noise Voltage	V_N	f = 10Hz to 100KHz, T_A =+25 ^{o}C		-	60	-	µV
Ripple Rejection	RR	f = 120Hz V_I = 28V to 38V		50	67	-	dB
Dropout Voltage	V_O	I_O = 1A, T_J=+25 ^{o}C		-	2	-	V
Output Resistance	R_O	f = 1KHz		-	28	-	mΩ
Short Circuit Current	I_{SC}	V_I = 35V, T_A=+25 ^{o}C		-	230	-	mA
Peak Current	I_{PK}	T_J =+25 ^{o}C		-	2.2	-	A

- Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Typical Perfomance Characteristics

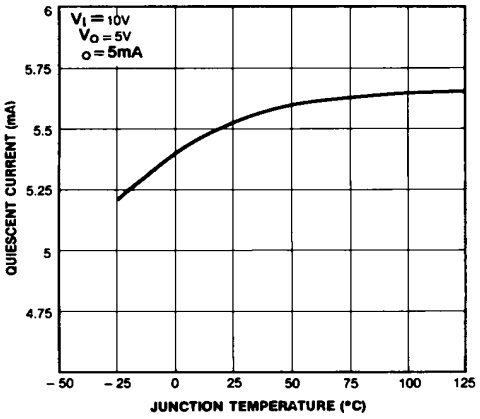


Figure 1. Quiescent Current

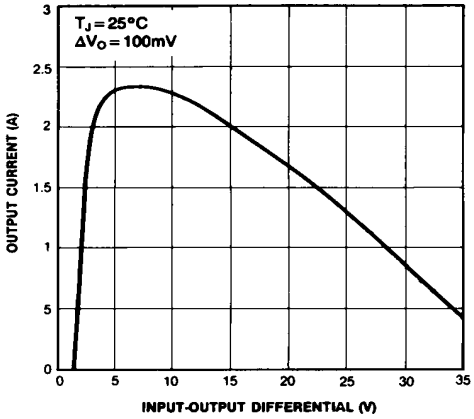


Figure 2. Peak Output Current

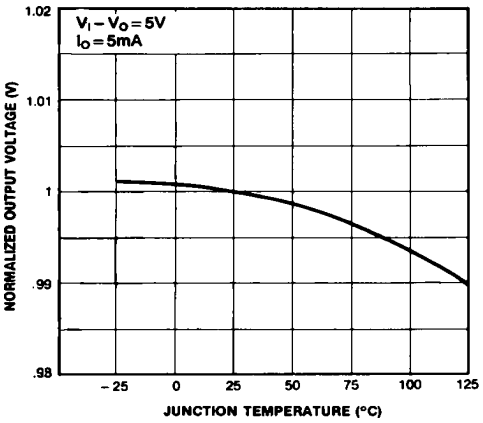


Figure 3. Output Voltage

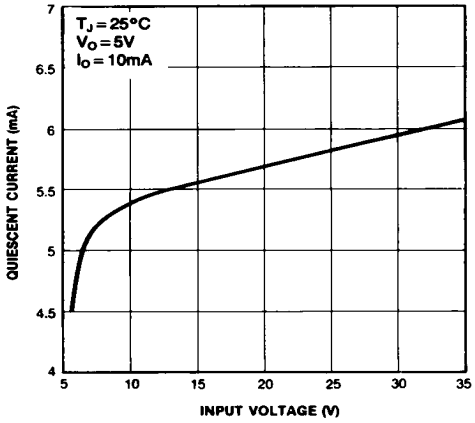


Figure 4. Quiescent Current

Typical Applications

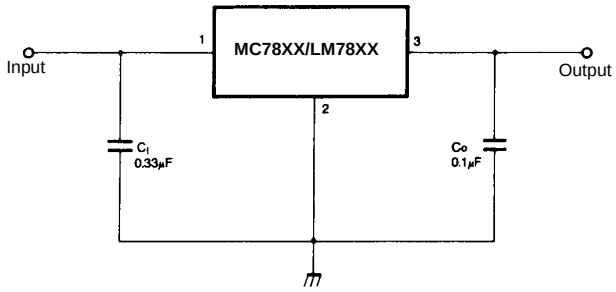


Figure 5. DC Parameters

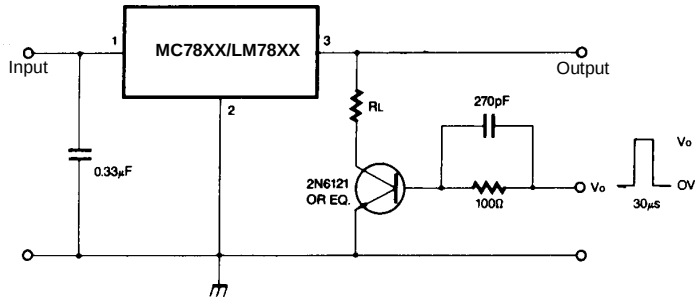


Figure 6. Load Regulation

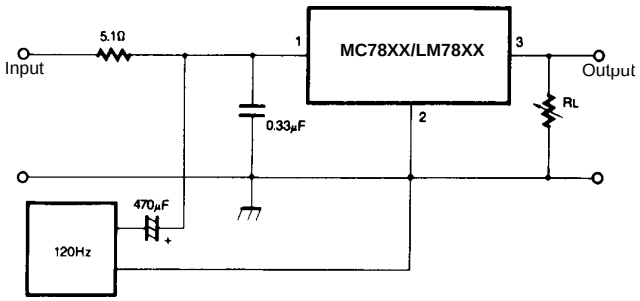


Figure 7. Ripple Rejection

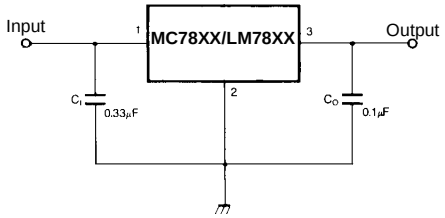
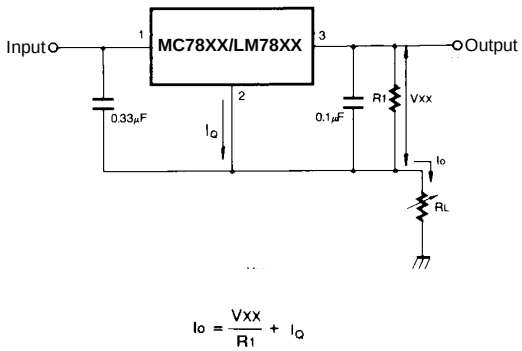


Figure 8. Fixed Output Regulator



$$I_O = \frac{V_{XX}}{R_1} + I_Q$$

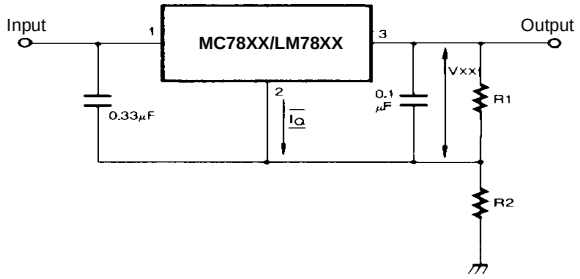
Figure 9. Constant Current Regulator

Notes:

(1) To specify an output voltage. substitute voltage value for "XX." A common ground is required between the input and the Output voltage. The input voltage must remain typically 2.0V above the output voltage even during the low point on the input ripple voltage.

(2) C_I is required if regulator is located an appreciable distance from power Supply filter.

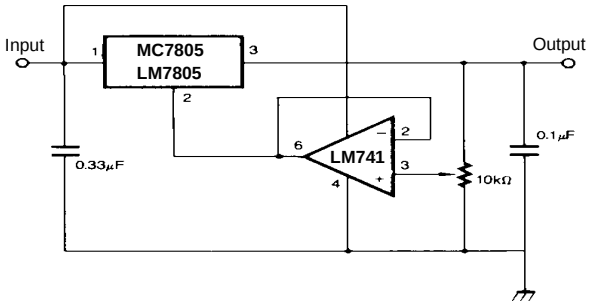
(3) C_O improves stability and transient response.



$$I_{RI} \geq 5IQ$$

$$V_O = V_{XX}(1+R_2/R_1)+I_QR_2$$

Figure 10. Circuit for Increasing Output Voltage



$$I_{RI} \geq 5\ I_Q$$

$$V_O = V_{XX}(1+R_2/R_1)+I_QR_2$$

Figure 11. Adjustable Output Regulator (7 to 30V)

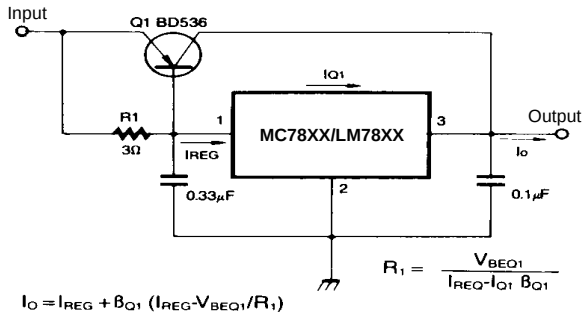


Figure 12. High Current Voltage Regulator

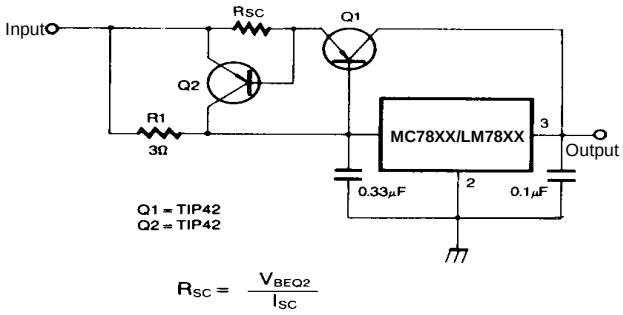


Figure 13. High Output Current with Short Circuit Protection

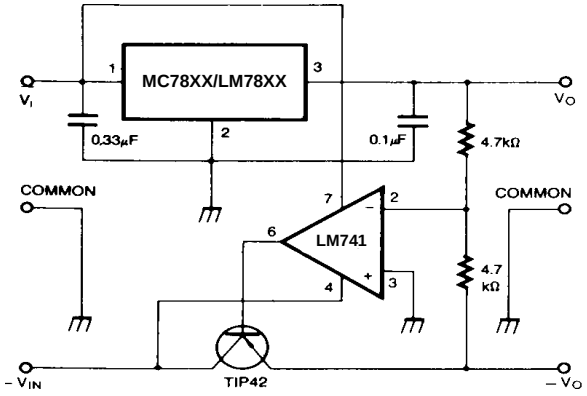


Figure 14. Tracking Voltage Regulator

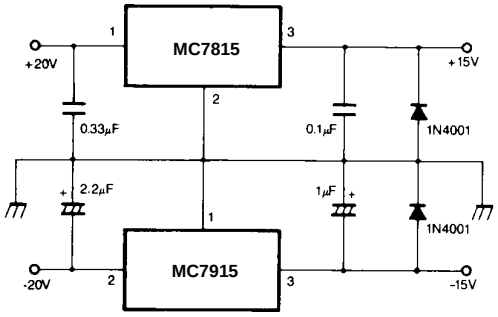


Figure 15. Split Power Supply (±15V-1A)

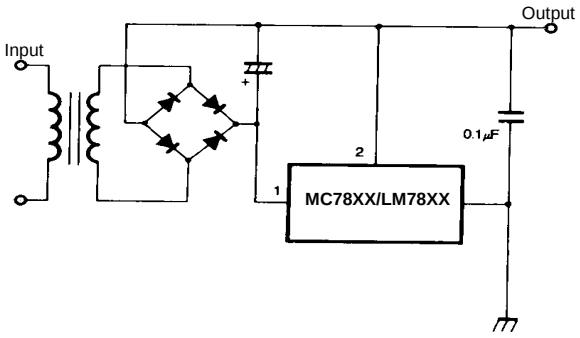


Figure 16. Negative Output Voltage Circuit

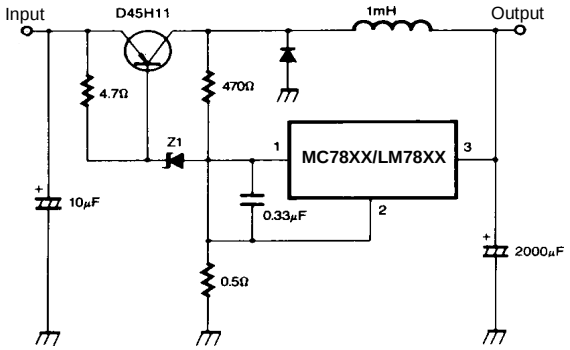
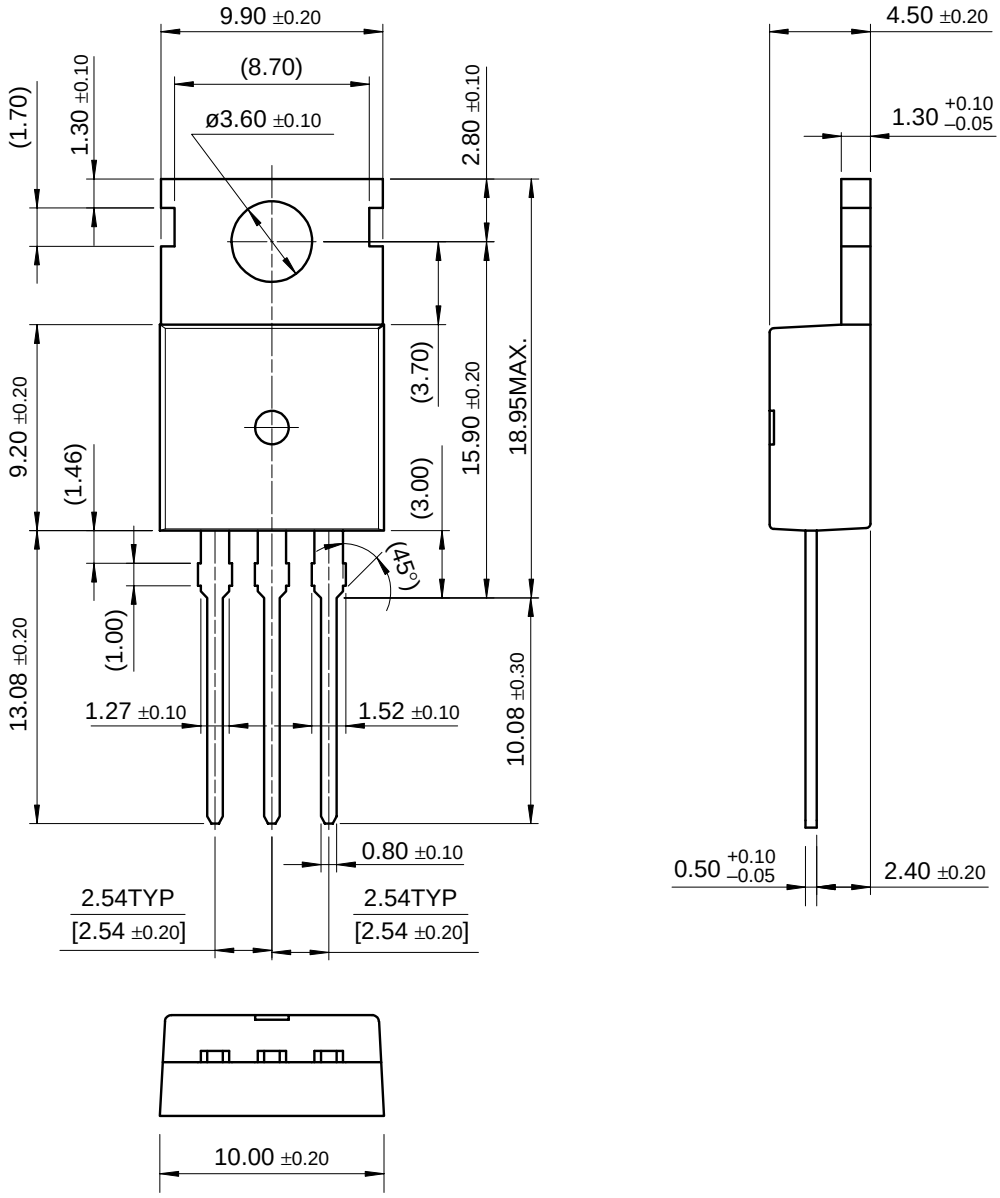


Figure 17. Switching Regulator

Mechanical Dimensions

Package

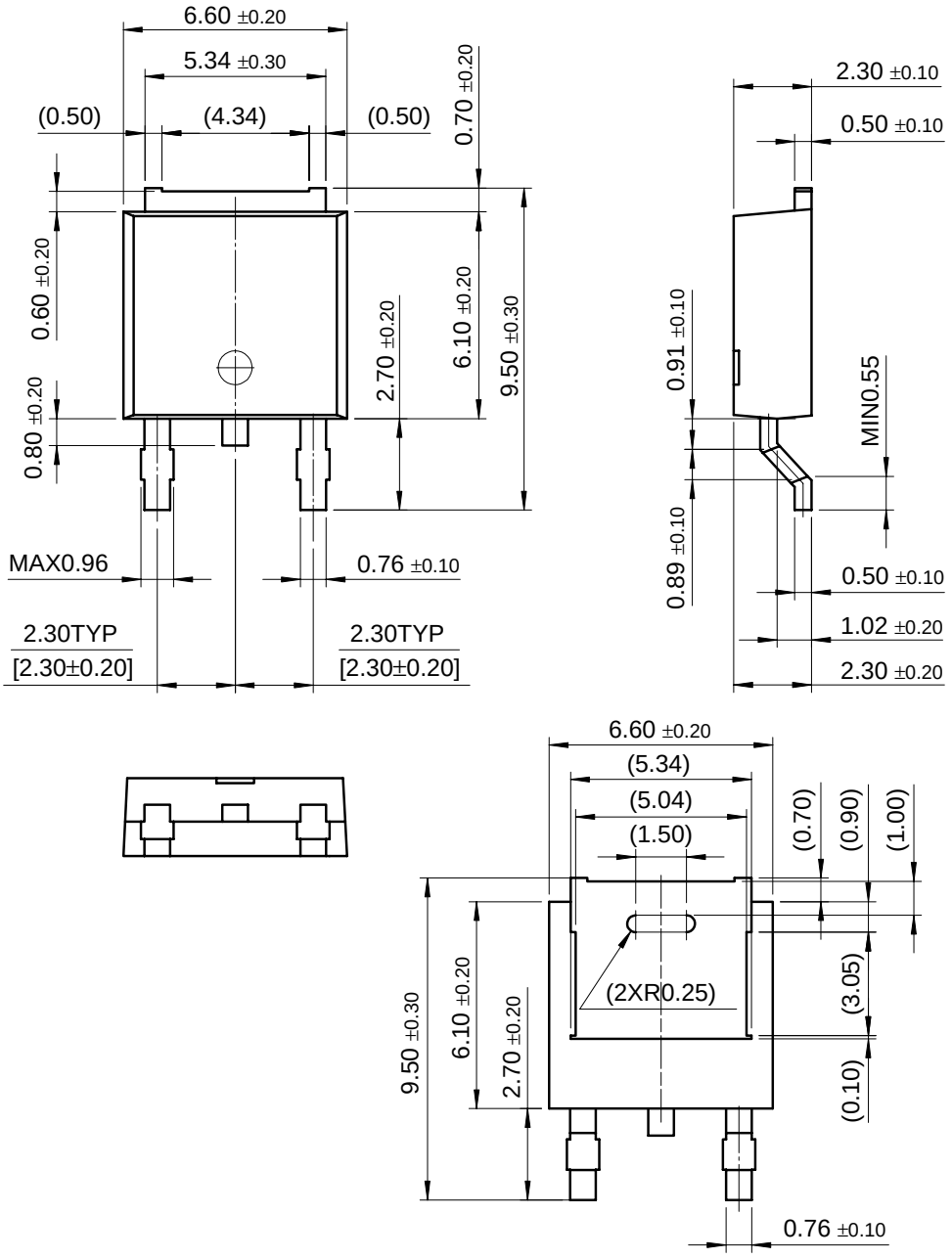
TO-220



Mechancal Dimensions (Continued)

Package

D-PAK



Ordering Information

Product Number	Output Voltage Tolerance	Package	Operating Temperature
LM7805CT	±4%	TO-220	0 ~ + 125°C

Product Number	Output Voltage Tolerance	Package	Operating Temperature
MC7805CT	±4%	TO-220	0 ~ + 125°C
MC7806CT			
MC7808CT			
MC7809CT			
MC7812CT			
MC7815CT			
MC7818CT			
MC7824CT			
MC7809CDT		D-PAK	

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2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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