

3-Terminal Positive voltage Regulators

DESCRIPTION

These voltage regulators are designed as fixed-voltage regulators for a wide variety of applications including local, on-card regulation. Although designed primarily as a fixed voltage regulator, these devices can be used with external components to obtain adjustable voltages and currents.

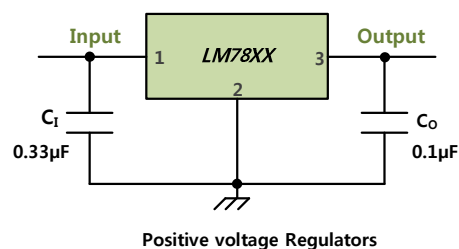
FEATURES

- Output current in excess of 1.5A
- No external components required
- Output Voltages (5V, 6V, 8V, 9V, 10V, 12V, 15V, 18V)
- Internal Thermal shutdown and SOA protection
- Output voltage offered in 4% Tolerance
- Pb-Free Packages are available
- High ESD Level (HBM>8000V, MM>800V)

TYPICAL APPLICATION

The input voltage must remain typically 2.0V above the output voltage even during the low point on the ripple voltage.

- * C_1 is required if regulator is located an appreciable Distance from power filter.
- * C_o improves transient response.
Values of $\leq 0.1 \mu\text{F}$ could cause instability.



Maximum Ratings (TA=25 °C, unless otherwise noted)

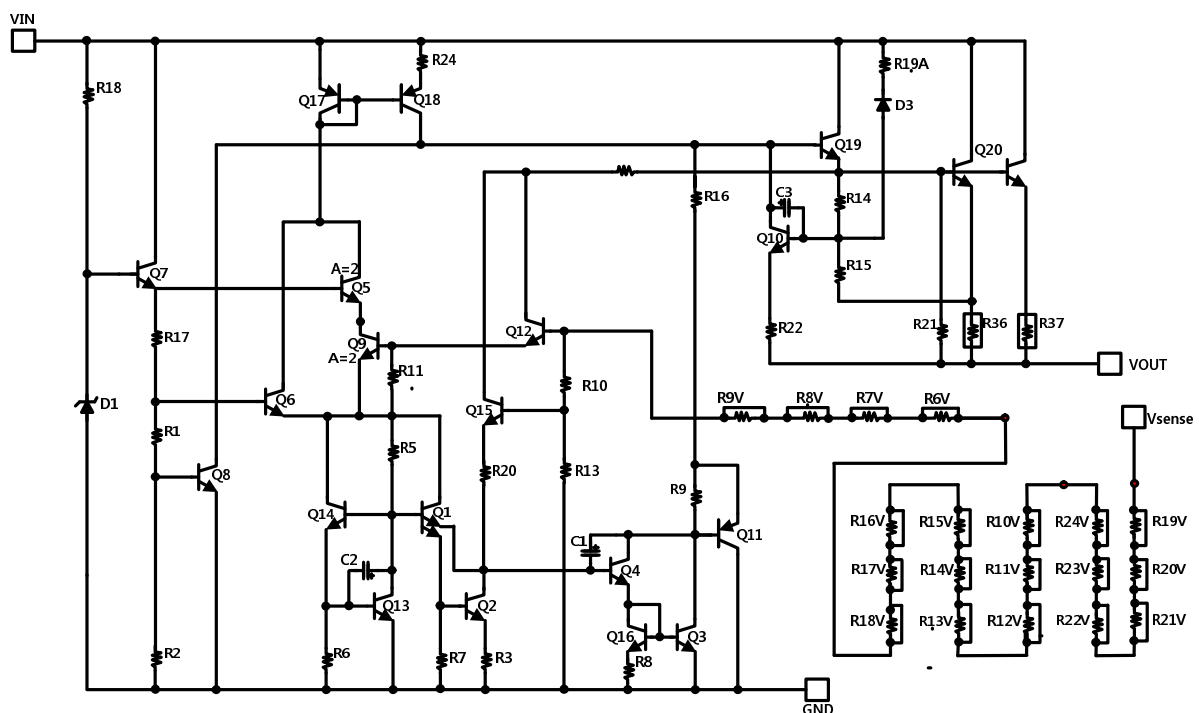
Rating	Symbol	Value		Unit
		TO-220F	TO-252	
Input Voltage (Vout 5V ~ 18V)	VI	35		V
Power Dissipation	PD	2	1.3	W
Thermal Resistance of Junction to Ambient	RθJA	65	92	°C/W
Thermal Resistance of Junction to Case	RθJC	5	5	°C/W
Storage Temperature	TSTG	-55 ~ 125		°C
Junction Temperature	TJ	+ 150		°C
Operating Temperature	TOPR	-40 ~ 125		°C

Stresses exceeding Maximum ratings may damage the device. Maximum ratings are stress ratings. Functional operation above the recommended operating conditions is not implied.

Extended exposure to stresses the above the recommended operating conditions may affect device reliability.

$PD(max) = (TJ(max) - TA) \div \theta JA$. Exceeding the maximum allowable power dissipation will result in excessive die temperature, and the regulator will go into thermal shutdown.

Representative Schematic of LM78XX



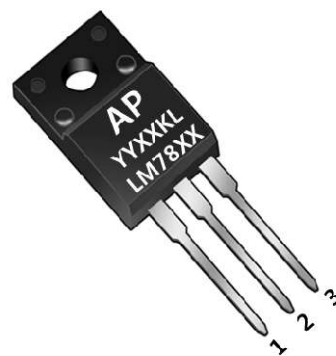
REV. 03

Ordering Information

Part No	Package	Packing	Finish	Halogen	Packing Unit	Remark
LM78XXRTRL	TO-252	Reel & Tape	Sn	Free	2,500ea	XX : Output Voltage option *
LM78XXFTL	TO-220F	Tube	Sn	Free	5,000ea	XX : Output Voltage option *

* Voltage option (XX) : 5V(05), 6V(06), 8V(08), 9V(09), 10V(10),12V(12),15V(15), 18V(18),24V(24)

Package Outline



TO-220F



TO-252

PIN INFO. 1. INPUT PIN 2. GND PIN 3.OUTPUT PIN

Electrical characteristics

***Note 1** Line and Load regulation are specified at constant junction temperature. Changes of V_O due to heating effects must be taken into account separately. Pulse testing with low duty circle is used.

Electrical characteristics (LM7805)

($T_J = 0$ to 125°C , $V_{IN}=10\text{V}$, $I_O=500\text{ mA}$, $C_I=0.33\text{ }\mu\text{F}$, $C_O=0.1\text{ }\mu\text{F}$, unless otherwise noted)

Characteristic	Symbol	Condition	Min	Typ	Max	Unit
Output voltage	VO	$T_J=25^\circ\text{C}$	4.8	5.0	5.2	V
		$5\text{mA} \leq I_O \leq 1.0\text{A}$, $PD \leq 15\text{W}$ $7\text{V} \leq V_{IN} \leq 20\text{V}$	4.75	5.0	5.25	
Line regulation ($T_J=25^\circ\text{C}$) (Note 1)	Regline	$7.0\text{V} \leq V_{IN} \leq 25\text{V}$			100	mV
		$8.0\text{V} \leq V_{IN} \leq 12\text{V}$			50	
Load regulation ($T_J=25^\circ\text{C}$) (Note 1)	Regload	$5.0\text{ mA} \leq I_O \leq 1.5\text{A}$			100	mV
		$250\text{ mA} \leq I_O \leq 750\text{ mA}$			50	
Quiescent current	IQ	$T_J=25^\circ\text{C}$			8	mA
Quiescent current change	ΔIQ	$5.0\text{ mA} \leq I_O \leq 1.0\text{ A}$			0.5	mA
		$7.0\text{V} \leq V_{IN} \leq 25\text{V}$			1.3	
Output Voltage Drift	$\Delta V_O/\Delta T$	$I_O = 5\text{ mA}$		-0.8		mV/ $^\circ\text{C}$
Output noise voltage	VN	$10\text{ Hz} \leq f \leq 100\text{ KHz}$, $T_A=25^\circ\text{C}$		42		$\mu\text{V}/V_O$
Ripple rejection	RR	$8.0\text{V} \leq V_{IN} \leq 18\text{V}$, $f=120\text{ Hz}$	62	73		dB
Dropout voltage	VDROP	$I_O = 1.0\text{A}$, $T_J=25^\circ\text{C}$		2		V
Output Resistance	r_o	$f=1\text{ KHz}$		15		m Ω
Short circuit current limit	ISC	$V_{IN} = 35\text{V}$, $T_A=25^\circ\text{C}$		450		mA
Peak output current	IPK	$T_J=25^\circ\text{C}$		2.2		A

Electrical characteristics (LM7806)

($T_J = 0$ to 125°C , $V_{IN}=11\text{V}$, $I_O=500\text{ mA}$, $C_I=0.33\text{ }\mu\text{F}$, $C_O=0.1\text{ }\mu\text{F}$, unless otherwise noted)

Characteristic	Symbol	Condition	Min	Typ	Max	Unit
Output voltage	VO	$T_J=25^\circ\text{C}$	5.75	6.0	6.25	V
		$5\text{mA} \leq I_O \leq 1.0\text{A}$, $PD \leq 15\text{W}$ $8\text{V} \leq V_{IN} \leq 21\text{V}$	5.7	6.0	6.3	
Line regulation ($T_J=25^\circ\text{C}$) (Note 1)	Regline	$8.0\text{V} \leq V_{IN} \leq 25\text{V}$			120	mV
		$9.0\text{V} \leq V_{IN} \leq 13\text{V}$			60	
Load regulation ($T_J=25^\circ\text{C}$) (Note 1)	Regload	$5.0\text{ mA} \leq I_O \leq 1.5\text{A}$			120	mV
		$250\text{ mA} \leq I_O \leq 750\text{ mA}$			60	
Quiescent current	IQ	$T_J=25^\circ\text{C}$			8	mA
Quiescent current change	ΔIQ	$5.0\text{ mA} \leq I_O \leq 1.0\text{ A}$			0.5	mA
		$8.0\text{V} \leq V_{IN} \leq 25\text{V}$			1.3	
Output Voltage Drift	$\Delta V_O/\Delta T$	$I_O = 5\text{ mA}$		-0.8		mV/ $^\circ\text{C}$
Output noise voltage	VN	$10\text{ Hz} \leq f \leq 100\text{ KHz}$, $T_A=25^\circ\text{C}$		45		$\mu\text{V}/V_O$
Ripple rejection	RR	$9.0\text{V} \leq V_{IN} \leq 19\text{V}$, $f=120\text{ Hz}$	59	75		dB
Dropout voltage	VDROP	$I_O = 1.0\text{A}$, $T_J=25^\circ\text{C}$		2		V
Output Resistance	r_o	$f=1\text{ KHz}$		19		m Ω
Short circuit current limit	ISC	$V_{IN} = 35\text{V}$, $T_A=25^\circ\text{C}$		450		mA
Peak output current	IPK	$T_J=25^\circ\text{C}$		2.2		A



Electrical characteristics (LM7808)

(T_J = 0 to 125 °C, V_{IN}=14V, I_O=500 mA, C_I=0.33 μF, C_O=0.1 μF, unless otherwise noted)

Characteristic	Symbol	Condition	Min	Typ	Max	Unit
Output voltage	V _O	T _J =25°C	7.7	8.0	8.3	V
		5mA ≤ I _O ≤ 1.0A, P _D ≤15W 10.5V ≤ V _{IN} ≤ 23V	7.6	8.0	8.4	
Line regulation (T _J =25°C) (Note 1)	Regline	10.5V ≤ V _{IN} ≤ 25V			160	mV
		11.5V ≤ V _{IN} ≤ 17V			80	
Load regulation (T _J =25°C) (Note 1)	Regload	5.0 mA ≤ I _O ≤ 1.5A			160	mV
		250 mA ≤ I _O ≤ 750 mA			80	
Quiescent current	I _Q	T _J =25°C			8	mA
Quiescent current change	Δ I _Q	5.0 mA ≤ I _O ≤ 1.0 A			0.5	mA
		10.5V ≤ V _{IN} ≤ 25V			1.3	
Output Voltage Drift	ΔV _O /ΔT	I _O = 5 mA		-0.8		mV/°C
Output noise voltage	V _N	10 Hz ≤ f ≤ 100 KHz, T _A =25°C		52		μV/V _O
Ripple rejection	RR	11.5V ≤ V _{IN} ≤ 21.5V, f=120 Hz	56	73		dB
Dropout voltage	V _{DROP}	I _O = 1.0A, T _J =25°C		2		V
Output Resistance	r _o	f=1 KHz		17		mΩ
Short circuit current limit	I _{SC}	V _{IN} = 35V, T _A =25°C		450		mA
Peak output current	I _{PK}	T _J =25°C		2.2		A

Electrical characteristics (LM7809)

(T_J = 0 to 125 °C, V_{IN}=15V, I_O=500 mA, C_I=0.33 μF, C_O=0.1 μF, unless otherwise noted)

Characteristic	Symbol	Condition	Min	Typ	Max	Unit
Output voltage	V _O	T _J =25°C	8.65	9.0	9.35	V
		5mA ≤ I _O ≤ 1.0A, P _D ≤15W 11.5V ≤ V _{IN} ≤ 24V	8.6	9.0	9.4	
Line regulation (T _J =25°C) (Note 1)	Regline	11.5V ≤ V _{IN} ≤ 25V			180	mV
		12V ≤ V _{IN} ≤ 17V			90	
Load regulation (T _J =25°C) (Note 1)	Regload	5.0 mA ≤ I _O ≤ 1.5A			180	mV
		250 mA ≤ I _O ≤ 750 mA			90	
Quiescent current	I _Q	T _J =25°C			8	mA
Quiescent current change	Δ I _Q	5.0 mA ≤ I _O ≤ 1.0 A			0.5	mA
		11.5V ≤ V _{IN} ≤ 26V			1.3	
Output Voltage Drift	ΔV _O /ΔT	I _O = 5 mA		-1.0		mV/°C
Output noise voltage	V _N	10 Hz ≤ f ≤ 100 KHz, T _A =25°C		58		μV/V _O
Ripple rejection	RR	13V ≤ V _{IN} ≤ 23V, f=120 Hz	56	71		dB
Dropout voltage	V _{DROP}	I _O = 1.0A, T _J =25°C		2		V
Output Resistance	r _o	f=1 KHz		17		mΩ
Short circuit current limit	I _{SC}	V _{IN} = 35V, T _A =25°C		450		mA
Peak output current	I _{PK}	T _J =25°C		2.2		A

Electrical characteristics (LM7810)

(T_J = 0 to 125 °C, V_{IN}=16V, I_O=500 mA, C_I=0.33 μF, C_O=0.1 μF, unless otherwise noted)

Characteristic	Symbol	Condition	Min	Typ	Max	Unit
Output voltage	V _O	T _J =25°C	9.6	10	10.4	V
		5mA ≤ I _O ≤ 1.0A, P _D ≤15W 12.5V ≤ V _{IN} ≤ 25V	9.5	10	10.5	
Line regulation (T _J =25°C) (Note 1)	Regline	12.5V ≤ V _{IN} ≤ 25V 13V ≤ V _{IN} ≤ 25V			200	mV
					100	
Load regulation (T _J =25°C) (Note 1)	Regload	5.0 mA ≤ I _O ≤ 1.5A 250 mA ≤ I _O ≤ 750 mA			200	mV
					100	
Quiescent current	I _Q	T _J =25°C			8	mA
Quiescent current change	Δ I _Q	5.0 mA ≤ I _O ≤ 1.0 A 12.5V ≤ V _{IN} ≤ 29V			0.5	mA
					1.3	
Output Voltage Drift	ΔV _O /ΔT	I _O = 5 mA		-1.0		mV/°C
Output noise voltage	V _N	10 Hz ≤ f ≤ 100 KHz, T _A =25°C		58		μV/V _O
Ripple rejection	RR	13V ≤ V _{IN} ≤ 23V, f=120 Hz	56	71		dB
Dropout voltage	V _{DROP}	I _O = 1.0A, T _J =25°C		2		V
Output Resistance	r _o	f=1 KHz		17		mΩ
Short circuit current limit	I _{SC}	V _{IN} = 35V, T _A =25°C		450		mA
Peak output current	I _{PK}	T _J =25°C		2.2		A

Electrical characteristics (LM7812)

(T_J = 0 to 125 °C, V_{IN}=19V, I_O=500 mA, C_I=0.33 μF, C_O=0.1 μF, unless otherwise noted)

Characteristic	Symbol	Condition	Min	Typ	Max	Unit
Output voltage	V _O	T _J =25°C	11.5	12	12.5	V
		5mA ≤ I _O ≤ 1.0A, P _D ≤15W 14.5V ≤ V _{IN} ≤ 27V	11.4	12	12.6	
Line regulation (T _J =25°C) (Note 1)	Regline	14.5V ≤ V _{IN} ≤ 30V 16V ≤ V _{IN} ≤ 22V			240	mV
					120	
Load regulation (T _J =25°C) (Note 1)	Regload	5.0 mA ≤ I _O ≤ 1.5A 250 mA ≤ I _O ≤ 750 mA			240	mV
					120	
Quiescent current	I _Q	T _J =25°C			8	mA
Quiescent current change	Δ I _Q	5.0 mA ≤ I _O ≤ 1.0 A 14.5V ≤ V _{IN} ≤ 30V			0.5	mA
					1.3	
Output Voltage Drift	ΔV _O /ΔT	I _O = 5 mA		-1.0		mV/°C
Output noise voltage	V _N	10 Hz ≤ f ≤ 100 KHz, T _A =25°C		76		μV/V _O
Ripple rejection	RR	15V ≤ V _{IN} ≤ 25V, f=120 Hz	55	71		dB
Dropout voltage	V _{DROP}	I _O = 1.0A, T _J =25°C		2		V
Output Resistance	r _o	f=1 KHz		18		mΩ
Short circuit current limit	I _{SC}	V _{IN} = 35V, T _A =25°C		450		mA
Peak output current	I _{PK}	T _J =25°C		2.2		A

Electrical characteristics (LM7815)

(T_J = 0 to 125 °C, V_{IN}=23V, I_O=500 mA, C_I=0.33 μF, C_O=0.1 μF, unless otherwise noted)

Characteristic	Symbol	Condition	Min	Typ	Max	Unit
Output voltage	V _O	T _J =25°C	14.4	15	15.6	V
		5mA ≤ I _O ≤ 1.0A, P _D ≤15W 17.5V ≤ V _{IN} ≤ 30V	14.25	15	15.75	
Line regulation (T _J =25°C) (Note 1)	Regline	17.5V ≤ V _{IN} ≤ 30V 20V ≤ V _{IN} ≤ 26V			300	mV
					150	
Load regulation (T _J =25°C) (Note 1)	Regload	5.0 mA ≤ I _O ≤ 1.5A 250 mA ≤ I _O ≤ 750 mA			300	mV
					150	
Quiescent current	I _Q	T _J =25°C			8	mA
Quiescent current change	Δ I _Q	5.0 mA ≤ I _O ≤ 1.0 A 17.5V ≤ V _{IN} ≤ 30V			0.5	mA
					1.3	
Output Voltage Drift	ΔV _O /ΔT	I _O = 5 mA		-1.0		mV/°C
Output noise voltage	V _N	10 Hz ≤ f ≤ 100 KHz, T _A =25°C		90		μV/V _O
Ripple rejection	RR	18.5V ≤ V _{IN} ≤ 28.5V, f=120 Hz	54	70		dB
Dropout voltage	V _{DROP}	I _O = 1.0A, T _J =25°C		2		V
Output Resistance	r _o	f=1 KHz		19		mΩ
Short circuit current limit	I _{SC}	V _{IN} = 35V, T _A =25°C		450		mA
Peak output current	I _{PK}	T _J =25°C		2.2		A

Electrical characteristics (LM7818)

(T_J = 0 to 125 °C, V_{IN}=27V, I_O=500 mA, C_I=0.33 μF, C_O=0.1 μF, unless otherwise noted)

Characteristic	Symbol	Condition	Min	Typ	Max	Unit
Output voltage	V _O	T _J =25°C	17.3	18	18.7	V
		5mA ≤ I _O ≤ 1.0A, P _D ≤15W 21V ≤ V _{IN} ≤ 33V	17.1	18	18.9	
Line regulation (T _J =25°C) (Note 1)	Regline	21V ≤ V _{IN} ≤ 33V 24V ≤ V _{IN} ≤ 30V			360	mV
					180	
Load regulation (T _J =25°C) (Note 1)	Regload	5.0 mA ≤ I _O ≤ 1.5A 250 mA ≤ I _O ≤ 750 mA			360	mV
					180	
Quiescent current	I _Q	T _J =25°C			8	mA
Quiescent current change	Δ I _Q	5.0 mA ≤ I _O ≤ 1.0 A 21V ≤ V _{IN} ≤ 33V			0.5	mA
					1.3	
Output Voltage Drift	ΔV _O /ΔT	I _O = 5 mA		-1.0		mV/°C
Output noise voltage	V _N	10 Hz ≤ f ≤ 100 KHz, T _A =25°C		110		μV/V _O
Ripple rejection	RR	22V ≤ V _{IN} ≤ 32V, f=120 Hz	53	69		dB
Dropout voltage	V _{DROP}	I _O = 1.0A, T _J =25°C		2		V
Output Resistance	r _o	f=1 KHz		22		mΩ
Short circuit current limit	I _{SC}	V _{IN} = 35V, T _A =25°C		450		mA
Peak output current	I _{PK}	T _J =25°C		2.2		A

Electrical characteristics (LM7824)

(T_J = 0 to 125 °C, V_{IN}=33V, I_O=500 mA, C_I=0.33 μF, C_O=0.1 μF, unless otherwise noted)

Characteristic	Symbol	Condition	Min	Typ	Max	Unit
Output voltage	V _O	T _J =25°C	23.0	24.0	25.0	V
		5.0mA ≤ I _O ≤ 1.0A, PD≤15W				
		27.0V ≤ V _{IN} ≤ 38.0V	22.8	24.0	25.25	
Line regulation (T _J =25°C) (Note 1)	Regline	27.0V ≤ V _{IN} ≤ 38.0V			480	mV
		30.0V ≤ V _{IN} ≤ 36.0V			240	
Load regulation (T _J =25°C) (Note 1)	Regload	5.0 mA ≤ I _O ≤ 1.5A			480	mV
		250 mA ≤ I _O ≤ 750 mA			240	
Quiescent current	I _Q	T _J =25°C			8.0	mA
Quiescent current change	Δ I _Q	5.0 mA ≤ I _O ≤ 1.0 A			0.5	mA
		27.0V ≤ V _{IN} ≤ 38.0V			1.3	
Output Voltage Drift	ΔV _O /ΔT	I _O = 5.0 mA		-1.5		mV/°C
Output noise voltage	V _N	10 Hz ≤ f ≤ 100 KHz, T _A =25°C		60		μV/V _O
Ripple rejection	RR	28.0V ≤ V _{IN} ≤ 38.0V, f=120 Hz	50	67		dB
Dropout voltage	V _{DROP}	I _O = 1.0A, T _J =25°C		2.0		V
Output Resistance	R _O	f=1 KHz		28		mΩ
Short circuit current limit	I _{SC}	V _{IN} = 35V, T _A =25°C		450		mA
Peak output current	I _{PK}	T _J =25°C		2.2		A



Typical Performance Characteristics

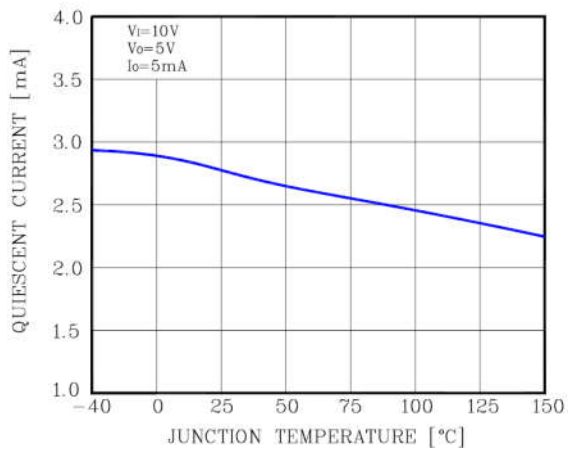


Figure 1. Quiescent Current

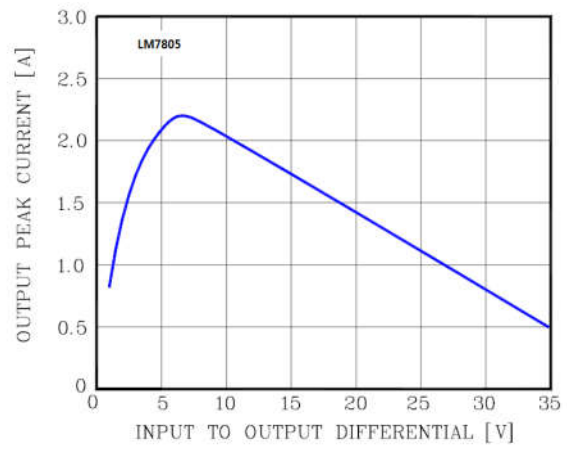


Figure 2. Peak Output Current

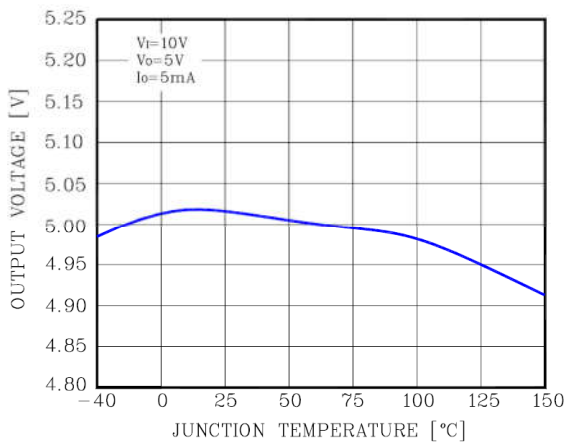


Figure 3. Output Voltage

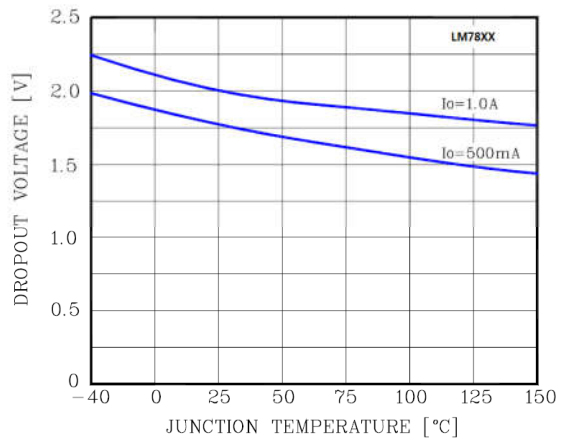


Figure 4. Dropout Voltage

Typical Applications

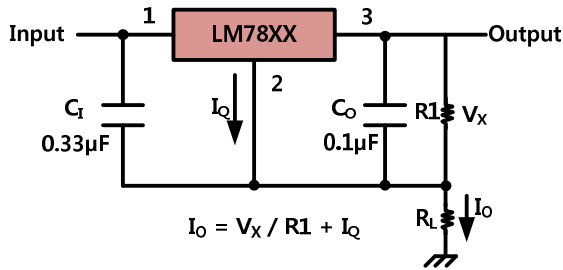


Figure 5. Constant Current Regulator

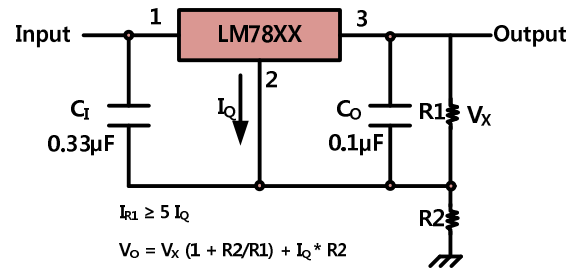


Figure 6. Circuit for increasing output voltage

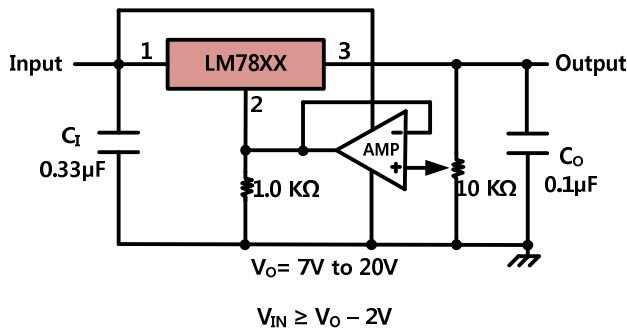


Figure 7 Adjustable Output Regulator

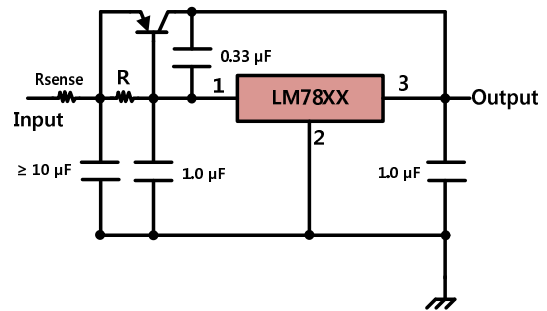


Figure 8 Current Boost Regulator

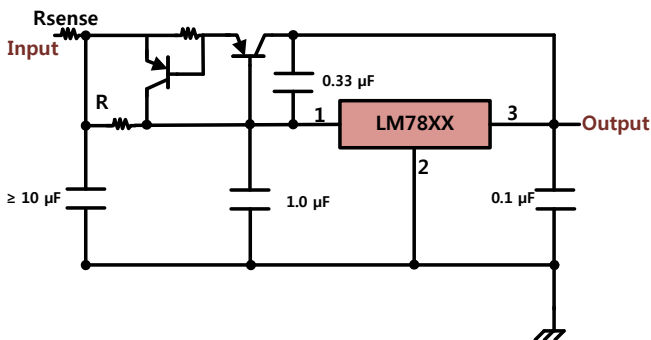


Figure 9 High output current with short circuit current

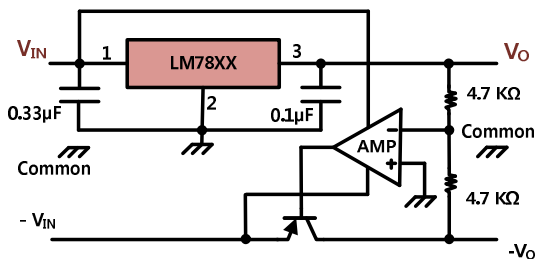
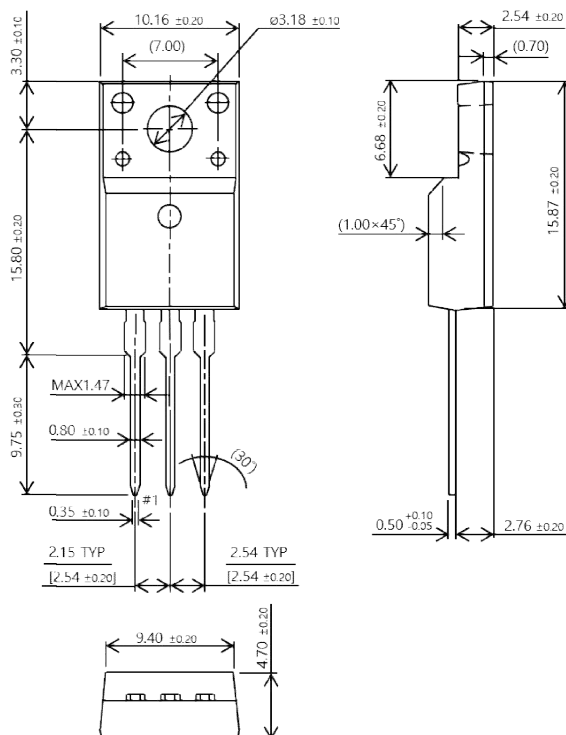


Figure 10 Tracking Voltage Regulator

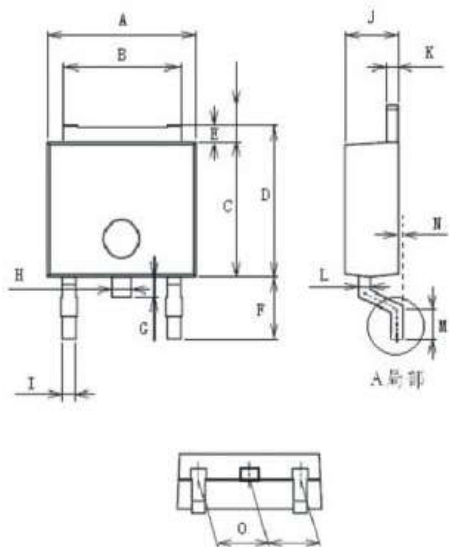
Package Dimensions

TO-220F

Dimension : mm



TO-252



Unit: mm

Item	Min	Max
A	6.40	6.70
B	5.20	5.40
C	6.00	6.30
D	6.55	6.85
E	0.45	0.60
F	3.07	3.35
G	0.85	1.05
H	0.75	0.95
I	0.55	0.75
J	2.20	2.40
K	0.43	0.58
L	0.43	0.58
M	0.90	1.10
N	0.90	1.10
O	2.20	2.40

Revision History

No	Date	Contents
1	2015-01-30	Initial Brief Datasheet Release
2	2015-06-22	ESD Level Update
3	2016-11-07	Power Dissipation Update

<http://www.apsemi.com>

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