



September 2014



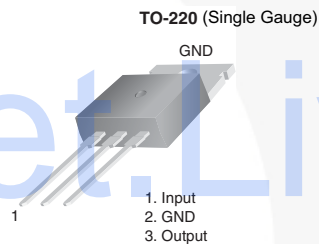
# LM78XX / LM78XXA 3-Terminal 1 A Positive Voltage Regulator

## Features

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

## Description

The LM78XX series of three-terminal positive regulators is available in the TO-220 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. If adequate heat sinking is provided, they can deliver over 1 A output current. Although designed primarily as fixed-voltage regulators, these devices can be used with external components for adjustable voltages and currents.



# Datasheet.Live

LM78XX / LM78XXA — 3-Terminal 1 A Positive Voltage Regulator

## Ordering Information<sup>(1)</sup>

Product Number	Output Voltage Tolerance	Package	Operating Temperature	Packing Method
LM7805CT	±4%	TO-220 (Single Gauge)	-40°C to +125°C	Rail
LM7806CT				
LM7808CT				
LM7809CT				
LM7810CT				
LM7812CT				
LM7815CT				
LM7818CT				
LM7824CT	±2%	TO-220 (Single Gauge)	0°C to +125°C	Rail
LM7805ACT				
LM7809ACT				
LM7810ACT				
LM7812ACT				
LM7815ACT				

### Note:

1. Above output voltage tolerance is available at 25°C.

## Block Diagram

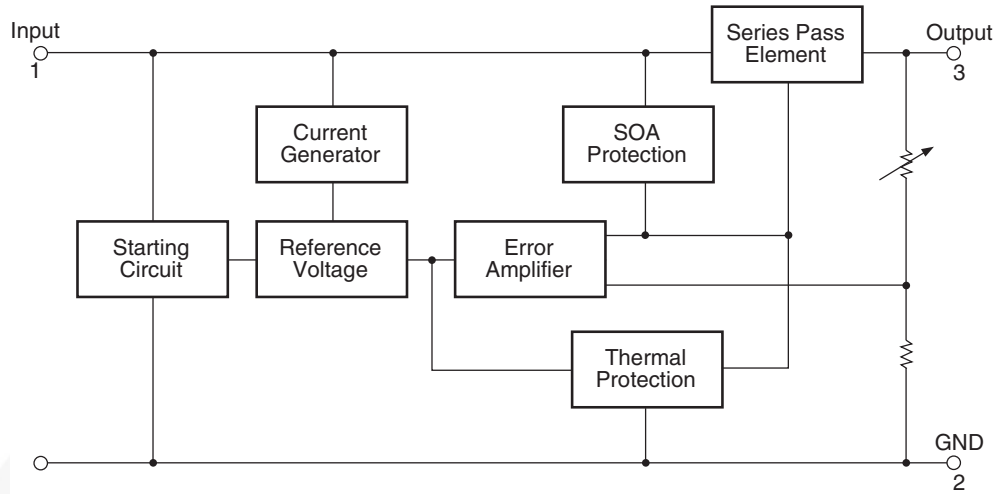


Figure 1. Block Diagram

## Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only. Values are at  $T_A = 25^\circ\text{C}$  unless otherwise noted.

Symbol	Parameter	Value	Unit	
$V_I$	Input Voltage	$V_O = 5\text{ V to }18\text{ V}$	35	V
		$V_O = 24\text{ V}$	40	
$R_{\theta JC}$	Thermal Resistance, Junction-Case (TO-220)	5	$^\circ\text{C/W}$	
$R_{\theta JA}$	Thermal Resistance, Junction-Air (TO-220)	65	$^\circ\text{C/W}$	
$T_{OPR}$	Operating Temperature Range	LM78xx	-40 to +125	$^\circ\text{C}$
		LM78xxA	0 to +125	
$T_{STG}$	Storage Temperature Range	-65 to +150	$^\circ\text{C}$	

**Electrical Characteristics (LM7805)**

Refer to the test circuit,  $-40^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$ ,  $I_O = 500\text{ mA}$ ,  $V_I = 10\text{ V}$ ,  $C_I = 0.1\text{ }\mu\text{F}$ , unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit	
$V_O$	Output Voltage	$T_J = +25^{\circ}\text{C}$	4.80	5.00	5.20	V	
		$I_O = 5\text{ mA to }1\text{ A}$ , $P_O \leq 15\text{ W}$ , $V_I = 7\text{ V to }20\text{ V}$	4.75	5.00	5.25		
Regline	Line Regulation <sup>(2)</sup>	$T_J = +25^{\circ}\text{C}$	$V_I = 7\text{ V to }25\text{ V}$		4.0	100.0	mV
			$V_I = 8\text{ V to }12\text{ V}$		1.6	50.0	
Regload	Load Regulation <sup>(2)</sup>	$T_J = +25^{\circ}\text{C}$	$I_O = 5\text{ mA to }1.5\text{ A}$		9.0	100.0	mV
			$I_O = 250\text{ mA to }750\text{ mA}$		4.0	50.0	
$I_Q$	Quiescent Current	$T_J = +25^{\circ}\text{C}$		5	8	mA	
$\Delta I_Q$	Quiescent Current Change	$I_O = 5\text{ mA to }1\text{ A}$		0.03	0.50	mA	
		$V_I = 7\text{ V to }25\text{ V}$		0.30	1.30		
$\Delta V_O/\Delta T$	Output Voltage Drift <sup>(3)</sup>	$I_O = 5\text{ mA}$		-0.8		mV/ $^{\circ}\text{C}$	
$V_N$	Output Noise Voltage	$f = 10\text{ Hz to }100\text{ kHz}$ , $T_A = +25^{\circ}\text{C}$		42		$\mu\text{V}$	
RR	Ripple Rejection <sup>(3)</sup>	$f = 120\text{ Hz}$ , $V_I = 8\text{ V to }18\text{ V}$	62	73		dB	
$V_{\text{DROP}}$	Dropout Voltage	$T_J = +25^{\circ}\text{C}$ , $I_O = 1\text{ A}$		2		V	
$R_O$	Output Resistance <sup>(3)</sup>	$f = 1\text{ kHz}$		15		m $\Omega$	
$I_{\text{SC}}$	Short-Circuit Current	$T_J = +25^{\circ}\text{C}$ , $V_I = 35\text{ V}$		230		mA	
$I_{\text{PK}}$	Peak Current <sup>(3)</sup>	$T_J = +25^{\circ}\text{C}$		2.2		A	

**Notes:**

- 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.
- These parameters, although guaranteed, are not 100% tested in production.

## Electrical Characteristics (LM7806)

Refer to the test circuit,  $-40^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$ ,  $I_O = 500\text{ mA}$ ,  $V_I = 11\text{ V}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$ , unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit	
$V_O$	Output Voltage	$T_J = +25^{\circ}\text{C}$	5.75	6.00	6.25	V	
		$I_O = 5\text{ mA to }1\text{ A}$ , $P_O \leq 15\text{ W}$ , $V_I = 8.0\text{ V to }21\text{ V}$	5.70	6.00	6.30		
Regline	Line Regulation <sup>(4)</sup>	$T_J = +25^{\circ}\text{C}$	$V_I = 8\text{ V to }25\text{ V}$		5.0	120.0	mV
			$V_I = 9\text{ V to }13\text{ V}$		1.5	60.0	
Regload	Load Regulation <sup>(4)</sup>	$T_J = +25^{\circ}\text{C}$	$I_O = 5\text{ mA to }1.5\text{ A}$		9.0	120.0	mV
			$I_O = 250\text{ mA to }750\text{ mA}$		3.0	60.0	
$I_Q$	Quiescent Current	$T_J = +25^{\circ}\text{C}$		5	8	mA	
$\Delta I_Q$	Quiescent Current Change	$I_O = 5\text{ mA to }1\text{ A}$			0.5	mA	
		$V_I = 8\text{ V to }25\text{ V}$			1.3		
$\Delta V_O/\Delta T$	Output Voltage Drift <sup>(5)</sup>	$I_O = 5\text{ mA}$		-0.8		mV/ $^{\circ}\text{C}$	
$V_N$	Output Noise Voltage	$f = 10\text{ Hz to }100\text{ kHz}$ , $T_A = +25^{\circ}\text{C}$		45		$\mu\text{V}$	
RR	Ripple Rejection <sup>(5)</sup>	$f = 120\text{ Hz}$ , $V_I = 8\text{ V to }18\text{ V}$	62	73		dB	
$V_{\text{DROP}}$	Dropout Voltage	$T_J = +25^{\circ}\text{C}$ , $I_O = 1\text{ A}$		2		V	
$R_O$	Output Resistance <sup>(5)</sup>	$f = 1\text{ kHz}$		19		m $\Omega$	
$I_{\text{SC}}$	Short-Circuit Current	$T_J = +25^{\circ}\text{C}$ , $V_I = 35\text{ V}$		250		mA	
$I_{\text{PK}}$	Peak Current <sup>(5)</sup>	$T_J = +25^{\circ}\text{C}$		2.2		A	

### Notes:

- 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.
- These parameters, although guaranteed, are not 100% tested in production.

## Electrical Characteristics (LM7808)

Refer to the test circuit,  $-40^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$ ,  $I_O = 500\text{ mA}$ ,  $V_I = 14\text{ V}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$ , unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit	
$V_O$	Output Voltage	$T_J = +25^{\circ}\text{C}$	7.7	8.0	8.3	V	
		$I_O = 5\text{ mA to }1\text{ A}$ , $P_O \leq 15\text{ W}$ , $V_I = 10.5\text{ V to }23\text{ V}$	7.6	8.0	8.4		
Regline	Line Regulation <sup>(6)</sup>	$T_J = +25^{\circ}\text{C}$	$V_I = 10.5\text{ V to }25\text{ V}$		5	160	mV
			$V_I = 11.5\text{ V to }17\text{ V}$		2	80	
Regload	Load Regulation <sup>(6)</sup>	$T_J = +25^{\circ}\text{C}$	$I_O = 5\text{ mA to }1.5\text{ A}$		10	160	mV
			$I_O = 250\text{ mA to }750\text{ mA}$		5	80	
$I_Q$	Quiescent Current	$T_J = +25^{\circ}\text{C}$		5	8	mA	
$\Delta I_Q$	Quiescent Current Change	$I_O = 5\text{ mA to }1\text{ A}$ $V_I = 10.5\text{ V to }25\text{ V}$		0.05	0.50	mA	
					0.5		1.0
$\Delta V_O/\Delta T$	Output Voltage Drift <sup>(7)</sup>	$I_O = 5\text{ mA}$		-0.8		mV/ $^{\circ}\text{C}$	
$V_N$	Output Noise Voltage	$f = 10\text{ Hz to }100\text{ kHz}$ , $T_A = +25^{\circ}\text{C}$		52		$\mu\text{V}$	
RR	Ripple Rejection <sup>(7)</sup>	$f = 120\text{ Hz}$ , $V_I = 11.5\text{ V to }21.5\text{ V}$	56	73		dB	
$V_{\text{DROP}}$	Dropout Voltage	$I_O = 1\text{ A}$ , $T_J = +25^{\circ}\text{C}$		2		V	
$R_O$	Output Resistance <sup>(7)</sup>	$f = 1\text{ kHz}$		17		m $\Omega$	
$I_{\text{SC}}$	Short-Circuit Current	$V_I = 35\text{ V}$ , $T_J = +25^{\circ}\text{C}$		230		mA	
$I_{\text{PK}}$	Peak Current <sup>(7)</sup>	$T_J = +25^{\circ}\text{C}$		2.2		A	

### Notes:

- 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.
- These parameters, although guaranteed, are not 100% tested in production.

## Electrical Characteristics (LM7809)

Refer to the test circuit,  $-40^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$ ,  $I_O = 500\text{ mA}$ ,  $V_I = 15\text{ V}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$ , unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$V_O$	Output Voltage	$T_J = +25^{\circ}\text{C}$	8.65	9.00	9.35	V
		$I_O = 5\text{ mA to }1\text{ A}$ , $P_O \leq 15\text{ W}$ , $V_I = 11.5\text{ V to }24\text{ V}$	8.60	9.00	9.40	
Regline	Line Regulation <sup>(8)</sup>	$T_J = +25^{\circ}\text{C}$	$V_I = 11.5\text{ V to }25\text{ V}$	6	180	mV
			$V_I = 12\text{ V to }17\text{ V}$	2	90	
Regload	Load Regulation <sup>(8)</sup>	$T_J = +25^{\circ}\text{C}$	$I_O = 5\text{ mA to }1.5\text{ A}$	12	180	mV
			$I_O = 250\text{ mA to }750\text{ mA}$	4	90	
$I_Q$	Quiescent Current	$T_J = +25^{\circ}\text{C}$		5	8	mA
$\Delta I_Q$	Quiescent Current Change	$I_O = 5\text{ mA to }1\text{ A}$ $V_I = 11.5\text{ V to }26\text{ V}$			0.5	mA
					1.3	
$\Delta V_O/\Delta T$	Output Voltage Drift <sup>(9)</sup>	$I_O = 5\text{ mA}$		-1		mV/ $^{\circ}\text{C}$
$V_N$	Output Noise Voltage	$f = 10\text{ Hz to }100\text{ kHz}$ , $T_A = +25^{\circ}\text{C}$		58		$\mu\text{V}$
RR	Ripple Rejection <sup>(9)</sup>	$f = 120\text{ Hz}$ , $V_I = 13\text{ V to }23\text{ V}$	56	71		dB
$V_{\text{DROP}}$	Dropout Voltage	$I_O = 1\text{ A}$ , $T_J = +25^{\circ}\text{C}$		2		V
$R_O$	Output Resistance <sup>(9)</sup>	$f = 1\text{ kHz}$		17		m $\Omega$
$I_{\text{SC}}$	Short-Circuit Current	$V_I = 35\text{ V}$ , $T_J = +25^{\circ}\text{C}$		250		mA
$I_{\text{PK}}$	Peak Current <sup>(9)</sup>	$T_J = +25^{\circ}\text{C}$		2.2		A

### Notes:

8. 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.
9. These parameters, although guaranteed, are not 100% tested in production.

## Electrical Characteristics (LM7810)

Refer to the test circuit,  $-40^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$ ,  $I_O = 500 \text{ mA}$ ,  $V_I = 16 \text{ V}$ ,  $C_I = 0.33 \mu\text{F}$ ,  $C_O = 0.1 \mu\text{F}$ , unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit	
$V_O$	Output Voltage	$T_J = +25^{\circ}\text{C}$	9.6	10.0	10.4	V	
		$I_O = 5 \text{ mA to } 1 \text{ A}$ , $P_O \leq 15 \text{ W}$ , $V_I = 12.5 \text{ V to } 25 \text{ V}$	9.5	10.0	10.5		
Regline	Line Regulation <sup>(10)</sup>	$T_J = +25^{\circ}\text{C}$	$V_I = 12.5 \text{ V to } 25 \text{ V}$		10	200	mV
			$V_I = 13 \text{ V to } 25 \text{ V}$		3	100	
Regload	Load Regulation <sup>(10)</sup>	$T_J = +25^{\circ}\text{C}$	$I_O = 5 \text{ mA to } 1.5 \text{ A}$		12	200	mV
			$I_O = 250 \text{ mA to } 750 \text{ mA}$		4	400	
$I_Q$	Quiescent Current	$T_J = +25^{\circ}\text{C}$		5.1	8.0	mA	
$\Delta I_Q$	Quiescent Current Change	$I_O = 5 \text{ mA to } 1 \text{ A}$			0.5	mA	
		$V_I = 12.5 \text{ V to } 29 \text{ V}$			1.0		
$\Delta V_O / \Delta T$	Output Voltage Drift <sup>(11)</sup>	$I_O = 5 \text{ mA}$		-1		mV/ $^{\circ}\text{C}$	
$V_N$	Output Noise Voltage	$f = 10 \text{ Hz to } 100 \text{ kHz}$ , $T_A = +25^{\circ}\text{C}$		58		$\mu\text{V}$	
RR	Ripple Rejection <sup>(11)</sup>	$f = 120 \text{ Hz}$ , $V_I = 13 \text{ V to } 23 \text{ V}$	56	71		dB	
$V_{\text{DROP}}$	Dropout Voltage	$I_O = 1 \text{ A}$ , $T_J = +25^{\circ}\text{C}$		2		V	
$R_O$	Output Resistance <sup>(11)</sup>	$f = 1 \text{ kHz}$		17		m $\Omega$	
$I_{\text{SC}}$	Short-Circuit Current	$V_I = 35 \text{ V}$ , $T_J = +25^{\circ}\text{C}$		250		mA	
$I_{\text{PK}}$	Peak Current <sup>(11)</sup>	$T_J = +25^{\circ}\text{C}$		2.2		A	

### Notes:

10. 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.
11. These parameters, although guaranteed, are not 100% tested in production.

## Electrical Characteristics (LM7812)

Refer to the test circuit,  $-40^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$ ,  $I_O = 500\text{ mA}$ ,  $V_I = 19\text{ V}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$ , unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit	
$V_O$	Output Voltage	$T_J = +25^{\circ}\text{C}$	11.5	12.0	12.5	V	
		$I_O = 5\text{ mA to }1\text{ A}$ , $P_O \leq 15\text{ W}$ , $V_I = 14.5\text{ V to }27\text{ V}$	11.4	12.0	12.6		
Regline	Line Regulation <sup>(12)</sup>	$T_J = +25^{\circ}\text{C}$	$V_I = 14.5\text{ V to }30\text{ V}$		10	240	mV
			$V_I = 16\text{ V to }22\text{ V}$		3	120	
Regload	Load Regulation <sup>(12)</sup>	$T_J = +25^{\circ}\text{C}$	$I_O = 5\text{ mA to }1.5\text{ A}$		11	240	mV
			$I_O = 250\text{ mA to }750\text{ mA}$		5	120	
$I_Q$	Quiescent Current	$T_J = +25^{\circ}\text{C}$		5.1	8.0	mA	
$\Delta I_Q$	Quiescent Current Change	$I_O = 5\text{ mA to }1\text{ A}$		0.1	0.5	mA	
		$V_I = 14.5\text{ V to }30\text{ V}$		0.5	1.0		
$\Delta V_O/\Delta T$	Output Voltage Drift <sup>(13)</sup>	$I_O = 5\text{ mA}$		-1		mV/ $^{\circ}\text{C}$	
$V_N$	Output Noise Voltage	$f = 10\text{ Hz to }100\text{ kHz}$ , $T_A = +25^{\circ}\text{C}$		76		$\mu\text{V}$	
RR	Ripple Rejection <sup>(13)</sup>	$f = 120\text{ Hz}$ , $V_I = 15\text{ V to }25\text{ V}$	55	71		dB	
$V_{\text{DROP}}$	Dropout Voltage	$I_O = 1\text{ A}$ , $T_J = +25^{\circ}\text{C}$		2		V	
$R_O$	Output Resistance <sup>(13)</sup>	$f = 1\text{ kHz}$		18		m $\Omega$	
$I_{\text{SC}}$	Short-Circuit Current	$V_I = 35\text{ V}$ , $T_J = +25^{\circ}\text{C}$		230		mA	
$I_{\text{PK}}$	Peak Current <sup>(13)</sup>	$T_J = +25^{\circ}\text{C}$		2.2		A	

### Notes:

12. 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.
13. These parameters, although guaranteed, are not 100% tested in production.



## Electrical Characteristics (LM7815)

Refer to the test circuit,  $-40^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$ ,  $I_O = 500\text{ mA}$ ,  $V_I = 23\text{ V}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$ , unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit	
$V_O$	Output Voltage	$T_J = +25^{\circ}\text{C}$	14.40	15.00	15.60	V	
		$I_O = 5\text{ mA to }1\text{ A}$ , $P_O \leq 15\text{ W}$ , $V_I = 17.5\text{ V to }30\text{ V}$	14.25	15.00	15.75		
Regline	Line Regulation <sup>(14)</sup>	$T_J = +25^{\circ}\text{C}$	$V_I = 17.5\text{ V to }30\text{ V}$		11	300	mV
			$V_I = 20\text{ V to }26\text{ V}$		3	150	
Regload	Load Regulation <sup>(14)</sup>	$T_J = +25^{\circ}\text{C}$	$I_O = 5\text{ mA to }1.5\text{ A}$		12	300	mV
			$I_O = 250\text{ mA to }750\text{ mA}$		4	150	
$I_Q$	Quiescent Current	$T_J = +25^{\circ}\text{C}$		5.2	8.0	mA	
$\Delta I_Q$	Quiescent Current Change	$I_O = 5\text{ mA to }1\text{ A}$			0.5	mA	
		$V_I = 17.5\text{ V to }30\text{ V}$			1.0		
$\Delta V_O/\Delta T$	Output Voltage Drift <sup>(15)</sup>	$I_O = 5\text{ mA}$		-1		mV/ $^{\circ}\text{C}$	
$V_N$	Output Noise Voltage	$f = 10\text{ Hz to }100\text{ kHz}$ , $T_A = +25^{\circ}\text{C}$		90		$\mu\text{V}$	
RR	Ripple Rejection <sup>(15)</sup>	$f = 120\text{ Hz}$ , $V_I = 18.5\text{ V to }28.5\text{ V}$	54	70		dB	
$V_{\text{DROP}}$	Dropout Voltage	$I_O = 1\text{ A}$ , $T_J = +25^{\circ}\text{C}$		2		V	
$R_O$	Output Resistance <sup>(15)</sup>	$f = 1\text{ kHz}$		19		m $\Omega$	
$I_{\text{SC}}$	Short-Circuit Current	$V_I = 35\text{ V}$ , $T_J = +25^{\circ}\text{C}$		250		mA	
$I_{\text{PK}}$	Peak Current <sup>(15)</sup>	$T_J = +25^{\circ}\text{C}$		2.2		A	

### Notes:

14. 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.
15. These parameters, although guaranteed, are not 100% tested in production.

**Electrical Characteristics (LM7818)**

Refer to the test circuit,  $-40^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$ ,  $I_O = 500\text{ mA}$ ,  $V_I = 27\text{ V}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$ , unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit	
$V_O$	Output Voltage	$T_J = +25^{\circ}\text{C}$	17.3	18.0	18.7	V	
		$I_O = 5\text{ mA to }1\text{ A}$ , $P_O \leq 15\text{ W}$ , $V_I = 21\text{ V to }33\text{ V}$	17.1	18.0	18.9		
Regline	Line Regulation <sup>(16)</sup>	$T_J = +25^{\circ}\text{C}$	$V_I = 21\text{ V to }33\text{ V}$		15	360	mV
			$V_I = 24\text{ V to }30\text{ V}$		5	180	
Regload	Load Regulation <sup>(16)</sup>	$T_J = +25^{\circ}\text{C}$	$I_O = 5\text{ mA to }1.5\text{ A}$		15	360	mV
			$I_O = 250\text{ mA to }750\text{ mA}$		5	180	
$I_Q$	Quiescent Current	$T_J = +25^{\circ}\text{C}$		5.2	8.0	mA	
$\Delta I_Q$	Quiescent Current Change	$I_O = 5\text{ mA to }1\text{ A}$			0.5	mA	
		$V_I = 21\text{ V to }33\text{ V}$			1.0		
$\Delta V_O/\Delta T$	Output Voltage Drift <sup>(17)</sup>	$I_O = 5\text{ mA}$		-1		mV/ $^{\circ}\text{C}$	
$V_N$	Output Noise Voltage	$f = 10\text{ Hz to }100\text{ kHz}$ , $T_A = +25^{\circ}\text{C}$		110		$\mu\text{V}$	
RR	Ripple Rejection <sup>(17)</sup>	$f = 120\text{ Hz}$ , $V_I = 22\text{ V to }32\text{ V}$	53	69		dB	
$V_{\text{DROP}}$	Dropout Voltage	$I_O = 1\text{ A}$ , $T_J = +25^{\circ}\text{C}$		2		V	
$R_O$	Output Resistance <sup>(17)</sup>	$f = 1\text{ kHz}$		22		m $\Omega$	
$I_{\text{SC}}$	Short-Circuit Current	$V_I = 35\text{ V}$ , $T_J = +25^{\circ}\text{C}$		250		mA	
$I_{\text{PK}}$	Peak Current <sup>(17)</sup>	$T_J = +25^{\circ}\text{C}$		2.2		A	

**Notes:**

16. 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.
17. These parameters, although guaranteed, are not 100% tested in production.

## Electrical Characteristics (LM7824)

Refer to the test circuit,  $-40^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$ ,  $I_O = 500\text{ mA}$ ,  $V_I = 33\text{ V}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$ , unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit	
$V_O$	Output Voltage	$T_J = +25^{\circ}\text{C}$	23.00	24.00	25.00	V	
		$I_O = 5\text{ mA to }1\text{ A}$ , $P_O \leq 15\text{ W}$ , $V_I = 27\text{ V to }38\text{ V}$	22.80	24.00	25.25		
Regline	Line Regulation <sup>(18)</sup>	$T_J = +25^{\circ}\text{C}$	$V_I = 27\text{ V to }38\text{ V}$		17	480	mV
			$V_I = 30\text{ V to }36\text{ V}$		6	240	
Regload	Load Regulation <sup>(18)</sup>	$T_J = +25^{\circ}\text{C}$	$I_O = 5\text{ mA to }1.5\text{ A}$		15	480	mV
			$I_O = 250\text{ mA to }750\text{ mA}$		5	240	
$I_Q$	Quiescent Current	$T_J = +25^{\circ}\text{C}$		5.2	8.0	mA	
$\Delta I_Q$	Quiescent Current Change	$I_O = 5\text{ mA to }1\text{ A}$ $V_I = 27\text{ V to }38\text{ V}$		0.1	0.5	mA	
				0.5	1.0		
$\Delta V_O/\Delta T$	Output Voltage Drift <sup>(19)</sup>	$I_O = 5\text{ mA}$		-1.5		mV/ $^{\circ}\text{C}$	
$V_N$	Output Noise Voltage	$f = 10\text{ Hz to }100\text{ kHz}$ , $T_A = +25^{\circ}\text{C}$		120		$\mu\text{V}$	
RR	Ripple Rejection <sup>(19)</sup>	$f = 120\text{ Hz}$ , $V_I = 28\text{ V to }38\text{ V}$	50	67		dB	
$V_{\text{DROP}}$	Dropout Voltage	$I_O = 1\text{ A}$ , $T_J = +25^{\circ}\text{C}$		2		V	
$R_O$	Output Resistance <sup>(19)</sup>	$f = 1\text{ kHz}$		28		m $\Omega$	
$I_{\text{SC}}$	Short-Circuit Current	$V_I = 35\text{ V}$ , $T_J = +25^{\circ}\text{C}$		230		mA	
$I_{\text{PK}}$	Peak Current <sup>(19)</sup>	$T_J = +25^{\circ}\text{C}$		2.2		A	

### Notes:

18. 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.
19. These parameters, although guaranteed, are not 100% tested in production.

**Electrical Characteristics (LM7805A)**Refer to the test circuit,  $0^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$ ,  $I_O = 1\text{ A}$ ,  $V_I = 10\text{ V}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$ , unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit	
$V_O$	Output Voltage	$T_J = +25^{\circ}\text{C}$	4.9	5.0	5.1	V	
		$I_O = 5\text{ mA to }1\text{ A}$ , $P_O \leq 15\text{ W}$ , $V_I = 7.5\text{ V to }20\text{ V}$	4.8	5.0	5.2		
Regline	Line Regulation <sup>(20)</sup>	$V_I = 7.5\text{ V to }25\text{ V}$ , $I_O = 500\text{ mA}$		5.0	50.0	mV	
		$V_I = 8\text{ V to }12\text{ V}$		3.0	50.0		
		$T_J = +25^{\circ}\text{C}$	$V_I = 7.3\text{ V to }20\text{ V}$		5.0		50.0
			$V_I = 8\text{ V to }12\text{ V}$		1.5		25.0
Regload	Load Regulation <sup>(20)</sup>	$T_J = +25^{\circ}\text{C}$ , $I_O = 5\text{ mA to }1.5\text{ A}$		9	100	mV	
		$I_O = 5\text{ mA to }1\text{ A}$		9	100		
		$I_O = 250\text{ mA to }750\text{ mA}$		4	50		
$I_Q$	Quiescent Current	$T_J = +25^{\circ}\text{C}$		5	6	mA	
$\Delta I_Q$	Quiescent Current Change	$I_O = 5\text{ mA to }1\text{ A}$			0.5	mA	
		$V_I = 8\text{ V to }25\text{ V}$ , $I_O = 500\text{ mA}$			0.8		
		$V_I = 7.5\text{ V to }20\text{ V}$ , $T_J = +25^{\circ}\text{C}$			0.8		
$\Delta V_O/\Delta T$	Output Voltage Drift <sup>(21)</sup>	$I_O = 5\text{ mA}$		-0.8		mV/ $^{\circ}\text{C}$	
$V_N$	Output Noise Voltage	$f = 10\text{ Hz to }100\text{ kHz}$ , $T_A = +25^{\circ}\text{C}$		42		$\mu\text{V}$	
RR	Ripple Rejection <sup>(21)</sup>	$f = 120\text{ Hz}$ , $V_O = 500\text{ mA}$ , $V_I = 8\text{ V to }18\text{ V}$		68		dB	
$V_{\text{DROP}}$	Dropout Voltage	$I_O = 1\text{ A}$ , $T_J = +25^{\circ}\text{C}$		2		V	
$R_O$	Output Resistance <sup>(21)</sup>	$f = 1\text{ kHz}$		17		m $\Omega$	
$I_{\text{SC}}$	Short-Circuit Current	$V_I = 35\text{ V}$ , $T_J = +25^{\circ}\text{C}$		250		mA	
$I_{\text{PK}}$	Peak Current <sup>(21)</sup>	$T_J = +25^{\circ}\text{C}$		2.2		A	

**Notes:**

20. 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.

21. These parameters, although guaranteed, are not 100% tested in production.

**Electrical Characteristics (LM7809A)**Refer to the test circuit,  $0^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$ ,  $I_O = 1\text{ A}$ ,  $V_I = 15\text{ V}$ ,  $C_I = 0.33\ \mu\text{F}$ ,  $C_O = 0.1\ \mu\text{F}$ , unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit	
$V_O$	Output Voltage	$T_J = +25^{\circ}\text{C}$	8.82	9.00	9.16	V	
		$I_O = 5\text{ mA to }1\text{ A}$ , $P_O \leq 15\text{ W}$ , $V_I = 11.2\text{ V to }24\text{ V}$	8.65	9.00	9.35		
Regline	Line Regulation <sup>(22)</sup>	$V_I = 11.7\text{ V to }25\text{ V}$ , $I_O = 500\text{ mA}$		6	90	mV	
		$V_I = 12.5\text{ V to }19\text{ V}$		4	45		
		$T_J = +25^{\circ}\text{C}$	$V_I = 11.5\text{ V to }24\text{ V}$		6		90
			$V_I = 12.5\text{ V to }19\text{ V}$		2		45
Regload	Load Regulation <sup>(22)</sup>	$T_J = +25^{\circ}\text{C}$ , $I_O = 5\text{ mA to }1.5\text{ A}$		12	100	mV	
		$I_O = 5\text{ mA to }1\text{ A}$		12	100		
		$I_O = 250\text{ mA to }750\text{ mA}$		5	50		
$I_Q$	Quiescent Current	$T_J = +25^{\circ}\text{C}$		5	6	mA	
$\Delta I_Q$	Quiescent Current Change	$I_O = 5\text{ mA to }1\text{ A}$			0.5	mA	
		$V_I = 12\text{ V to }25\text{ V}$ , $I_O = 500\text{ mA}$			0.8		
		$V_I = 11.7\text{ V to }25\text{ V}$ , $T_J = +25^{\circ}\text{C}$			0.8		
$\Delta V_O/\Delta T$	Output Voltage Drift <sup>(23)</sup>	$I_O = 5\text{ mA}$		-1		mV/ $^{\circ}\text{C}$	
$V_N$	Output Noise Voltage	$f = 10\text{ Hz to }100\text{ kHz}$ , $T_A = +25^{\circ}\text{C}$		58		$\mu\text{V}$	
RR	Ripple Rejection <sup>(23)</sup>	$f = 120\text{ Hz}$ , $V_O = 500\text{ mA}$ , $V_I = 12\text{ V to }22\text{ V}$		62		dB	
$V_{\text{DROP}}$	Dropout Voltage	$I_O = 1\text{ A}$ , $T_J = +25^{\circ}\text{C}$		2		V	
$R_O$	Output Resistance <sup>(23)</sup>	$f = 1\text{ kHz}$		17		m $\Omega$	
$I_{\text{SC}}$	Short-Circuit Current	$V_I = 35\text{ V}$ , $T_J = +25^{\circ}\text{C}$		250		mA	
$I_{\text{PK}}$	Peak Current <sup>(23)</sup>	$T_J = +25^{\circ}\text{C}$		2.2		A	

**Notes:**

22. 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.

23. These parameters, although guaranteed, are not 100% tested in production.

**Electrical Characteristics (LM7810A)**Refer to the test circuit,  $0^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$ ,  $I_O = 1\text{ A}$ ,  $V_I = 16\text{ V}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$ , unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit	
$V_O$	Output Voltage	$T_J = +25^{\circ}\text{C}$	9.8	10.0	10.2	V	
		$I_O = 5\text{ mA to }1\text{ A}$ , $P_O \leq 15\text{ W}$ , $V_I = 12.8\text{ V to }25\text{ V}$	9.6	10.0	10.4		
Regline	Line Regulation <sup>(24)</sup>	$V_I = 12.8\text{ V to }26\text{ V}$ , $I_O = 500\text{ mA}$		8	100	mV	
		$V_I = 13\text{ V to }20\text{ V}$		4	50		
		$T_J = +25^{\circ}\text{C}$	$V_I = 12.5\text{ V to }25\text{ V}$		8		100
			$V_I = 13\text{ V to }20\text{ V}$		3		50
Regload	Load Regulation <sup>(24)</sup>	$T_J = +25^{\circ}\text{C}$ , $I_O = 5\text{ mA to }1.5\text{ A}$		12	100	mV	
		$I_O = 5\text{ mA to }1\text{ A}$		12	100		
		$I_O = 250\text{ mA to }750\text{ mA}$		5	50		
$I_Q$	Quiescent Current	$T_J = +25^{\circ}\text{C}$		5	6	mA	
$\Delta I_Q$	Quiescent Current Change	$I_O = 5\text{ mA to }1\text{ A}$			0.5	mA	
		$V_I = 12.8\text{ V to }25\text{ V}$ , $I_O = 500\text{ mA}$			0.8		
		$V_I = 13\text{ V to }26\text{ V}$ , $T_J = +25^{\circ}\text{C}$			0.5		
$\Delta V_O/\Delta T$	Output Voltage Drift <sup>(25)</sup>	$I_O = 5\text{ mA}$		-1		mV/ $^{\circ}\text{C}$	
$V_N$	Output Noise Voltage	$f = 10\text{ Hz to }100\text{ kHz}$ , $T_A = +25^{\circ}\text{C}$		58		$\mu\text{V}$	
RR	Ripple Rejection <sup>(25)</sup>	$f = 120\text{ Hz}$ , $V_O = 500\text{ mA}$ , $V_I = 14\text{ V to }24\text{ V}$		62		dB	
$V_{\text{DROP}}$	Dropout Voltage	$I_O = 1\text{ A}$ , $T_J = +25^{\circ}\text{C}$		2		V	
$R_O$	Output Resistance <sup>(25)</sup>	$f = 1\text{ kHz}$		17		m $\Omega$	
$I_{\text{SC}}$	Short-Circuit Current	$V_I = 35\text{ V}$ , $T_J = +25^{\circ}\text{C}$		250		mA	
$I_{\text{PK}}$	Peak Current <sup>(25)</sup>	$T_J = +25^{\circ}\text{C}$		2.2		A	

**Notes:**

24. 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.

25. These parameters, although guaranteed, are not 100% tested in production.

**Electrical Characteristics (LM7812A)**Refer to the test circuit,  $0^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$ ,  $I_O = 1\text{ A}$ ,  $V_I = 19\text{ V}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$ , unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit	
$V_O$	Output Voltage	$T_J = +25^{\circ}\text{C}$	11.75	12.00	12.25	V	
		$I_O = 5\text{ mA to }1\text{ A}$ , $P_O \leq 15\text{ W}$ , $V_I = 14.8\text{ V to }27\text{ V}$	11.50	12.00	12.50		
Regline	Line Regulation <sup>(26)</sup>	$V_I = 14.8\text{ V to }30\text{ V}$ , $I_O = 500\text{ mA}$		10	120	mV	
		$V_I = 16\text{ V to }22\text{ V}$		4	120		
		$T_J = +25^{\circ}\text{C}$	$V_I = 14.5\text{ V to }27\text{ V}$		10		120
			$V_I = 16\text{ V to }22\text{ V}$		3		60
Regload	Load Regulation <sup>(26)</sup>	$T_J = +25^{\circ}\text{C}$ , $I_O = 5\text{ mA to }1.5\text{ A}$		12	100	mV	
		$I_O = 5\text{ mA to }1\text{ A}$		12	100		
		$I_O = 250\text{ mA to }750\text{ mA}$		5	50		
$I_Q$	Quiescent Current	$T_J = +25^{\circ}\text{C}$		5	6	mA	
$\Delta I_Q$	Quiescent Current Change	$I_O = 5\text{ mA to }1\text{ A}$			0.5	mA	
		$V_I = 14\text{ V to }27\text{ V}$ , $I_O = 500\text{ mA}$			0.8		
		$V_I = 15\text{ V to }30\text{ V}$ , $T_J = +25^{\circ}\text{C}$			0.8		
$\Delta V_O/\Delta T$	Output Voltage Drift <sup>(27)</sup>	$I_O = 5\text{ mA}$		-1		mV/ $^{\circ}\text{C}$	
$V_N$	Output Noise Voltage	$f = 10\text{ Hz to }100\text{ kHz}$ , $T_A = +25^{\circ}\text{C}$		76		$\mu\text{V}$	
RR	Ripple Rejection <sup>(27)</sup>	$f = 120\text{ Hz}$ , $V_O = 500\text{ mA}$ , $V_I = 14\text{ V to }24\text{ V}$		60		dB	
$V_{\text{DROP}}$	Dropout Voltage	$I_O = 1\text{ A}$ , $T_J = +25^{\circ}\text{C}$		2		V	
$R_O$	Output Resistance <sup>(27)</sup>	$f = 1\text{ kHz}$		18		m $\Omega$	
$I_{\text{SC}}$	Short-Circuit Current	$V_I = 35\text{ V}$ , $T_J = +25^{\circ}\text{C}$		250		mA	
$I_{\text{PK}}$	Peak Current <sup>(27)</sup>	$T_J = +25^{\circ}\text{C}$		2.2		A	

**Notes:**

26. 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.

27. These parameters, although guaranteed, are not 100% tested in production.

**Electrical Characteristics (LM7815A)**

Refer to the test circuit,  $0^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$ ,  $I_O = 1\text{ A}$ ,  $V_I = 23\text{ V}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$ , unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit	
$V_O$	Output Voltage	$T_J = +25^{\circ}\text{C}$	14.75	15.00	15.30	V	
		$I_O = 5\text{ mA to }1\text{ A}$ , $P_O \leq 15\text{ W}$ , $V_I = 17.7\text{ V to }30\text{ V}$	14.40	15.00	15.60		
Regline	Line Regulation <sup>(28)</sup>	$V_I = 17.4\text{ V to }30\text{ V}$ , $I_O = 500\text{ mA}$		10	150	mV	
		$V_I = 20\text{ V to }26\text{ V}$		5	150		
		$T_J = +25^{\circ}\text{C}$	$V_I = 17.5\text{ V to }30\text{ V}$		11		150
			$V_I = 20\text{ V to }26\text{ V}$		3		75
Regload	Load Regulation <sup>(28)</sup>	$T_J = +25^{\circ}\text{C}$ , $I_O = 5\text{ mA to }1.5\text{ A}$		12	100	mV	
		$I_O = 5\text{ mA to }1\text{ A}$		12	100		
		$I_O = 250\text{ mA to }750\text{ mA}$		5	50		
$I_Q$	Quiescent Current	$T_J = +25^{\circ}\text{C}$		5.2	6.0	mA	
$\Delta I_Q$	Quiescent Current Change	$I_O = 5\text{ mA to }1\text{ A}$			0.5	mA	
		$V_I = 17.5\text{ V to }30\text{ V}$ , $I_O = 500\text{ mA}$			0.8		
		$V_I = 17.5\text{ V to }30\text{ V}$ , $T_J = +25^{\circ}\text{C}$			0.8		
$\Delta V_O/\Delta T$	Output Voltage Drift <sup>(29)</sup>	$I_O = 5\text{ mA}$		-1		mV/ $^{\circ}\text{C}$	
$V_N$	Output Noise Voltage	$f = 10\text{ Hz to }100\text{ kHz}$ , $T_A = +25^{\circ}\text{C}$		90		$\mu\text{V}$	
RR	Ripple Rejection <sup>(29)</sup>	$f = 120\text{ Hz}$ , $V_O = 500\text{ mA}$ , $V_I = 18.5\text{ V to }28.5\text{ V}$		58		dB	
$V_{\text{DROP}}$	Dropout Voltage	$I_O = 1\text{ A}$ , $T_J = +25^{\circ}\text{C}$		2		V	
$R_O$	Output Resistance <sup>(29)</sup>	$f = 1\text{ kHz}$		19		m $\Omega$	
$I_{\text{SC}}$	Short-Circuit Current	$V_I = 35\text{ V}$ , $T_J = +25^{\circ}\text{C}$		250		mA	
$I_{\text{PK}}$	Peak Current <sup>(29)</sup>	$T_J = +25^{\circ}\text{C}$		2.2		A	

**Notes:**

28. 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.

29. These parameters, although guaranteed, are not 100% tested in production.



## Typical Performance Characteristics

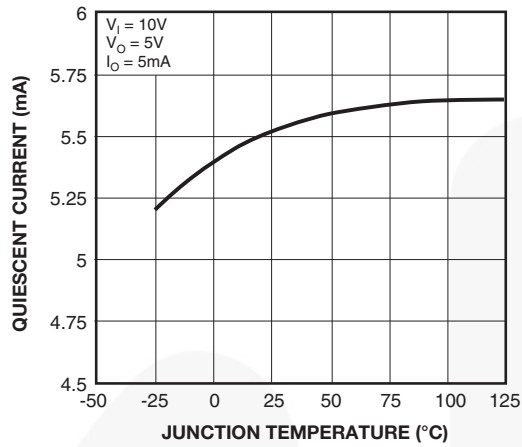


Figure 2. Quiescent Current

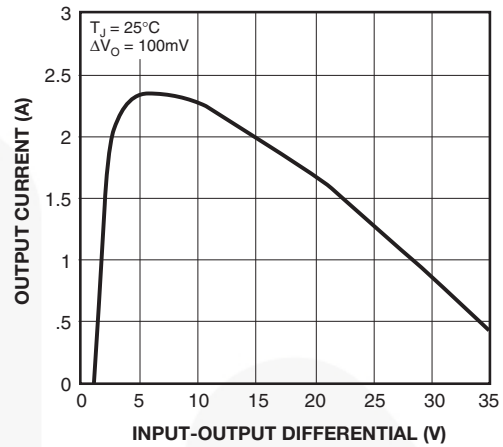


Figure 3. Peak Output Current

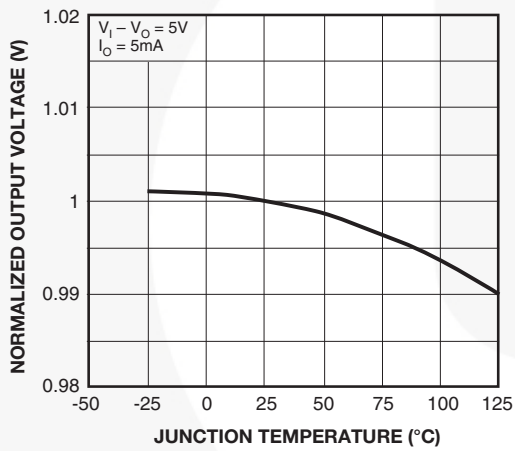


Figure 4. Output Voltage

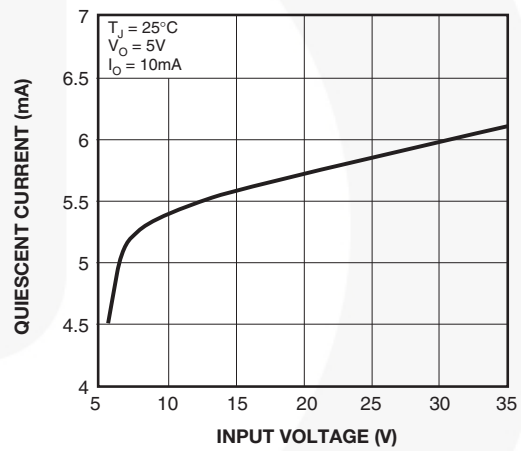


Figure 5. Quiescent Current

## Typical Applications

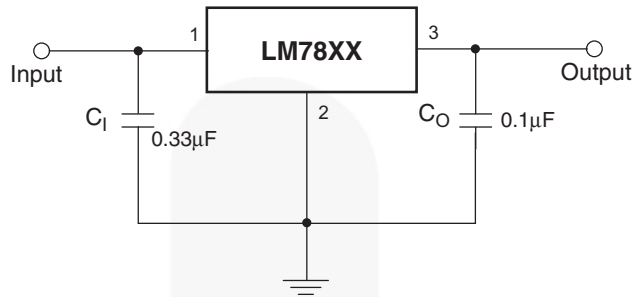


Figure 6. DC Parameters

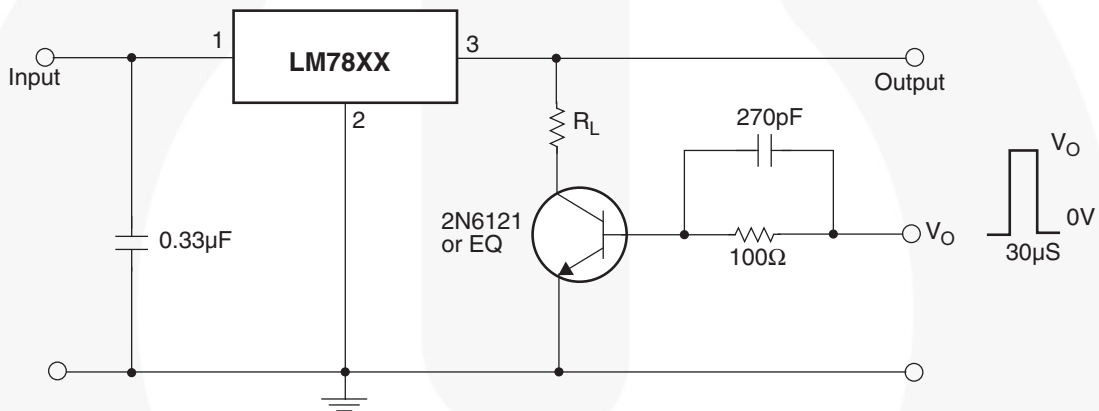


Figure 7. Load Regulation

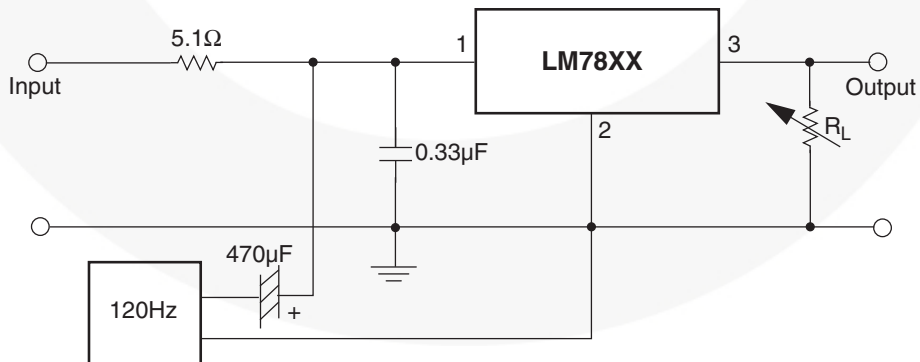
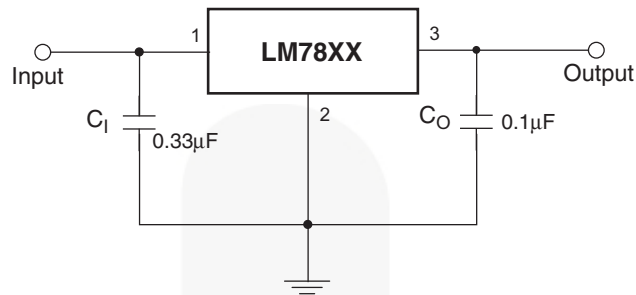
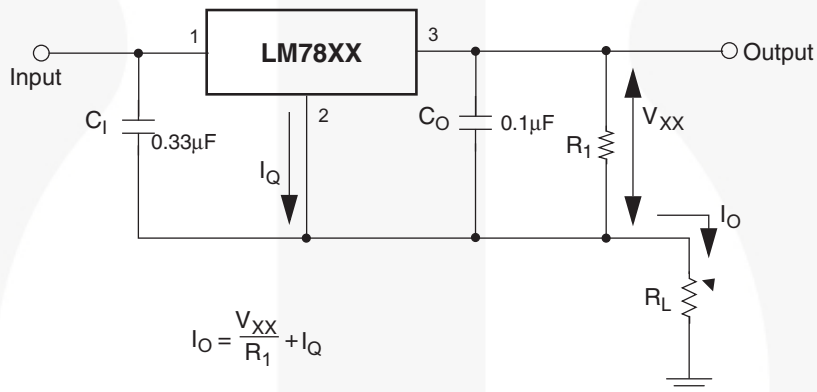


Figure 8. Ripple Rejection

**Typical Applications** (Continued)



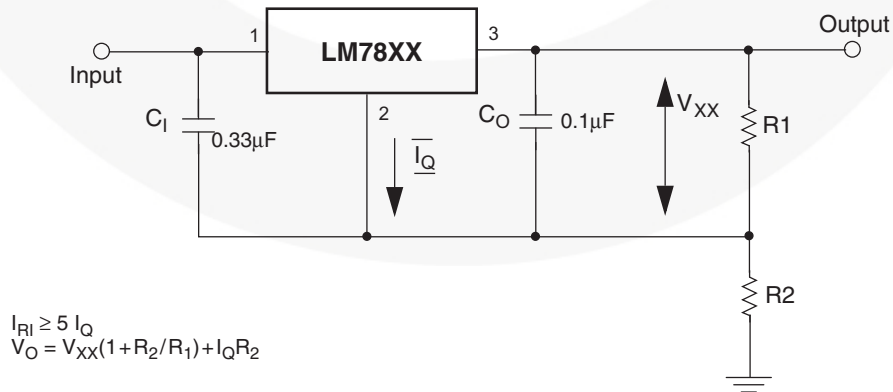
**Figure 9. Fixed-Output Regulator**



**Figure 10. Constant Current Regulator**

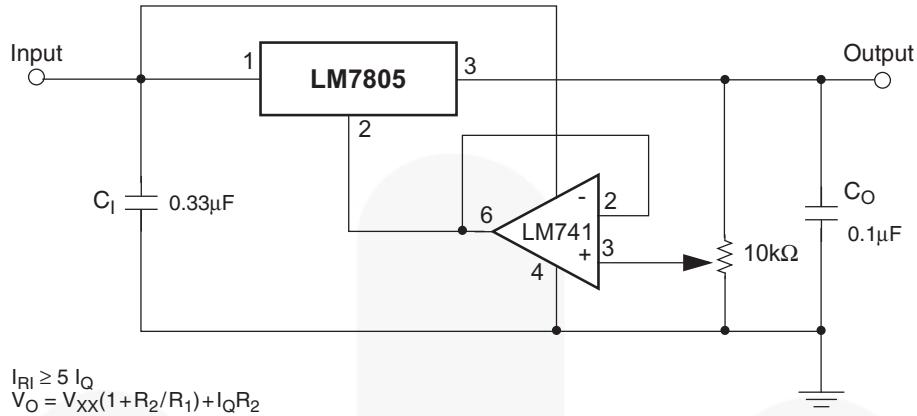
**Notes:**

- 29. 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 2.0 V above the output voltage even during the low point on the input ripple voltage.
- 30. C<sub>1</sub> is required if regulator is located an appreciable distance from power supply filter.
- 31. C<sub>0</sub> improves stability and transient response.

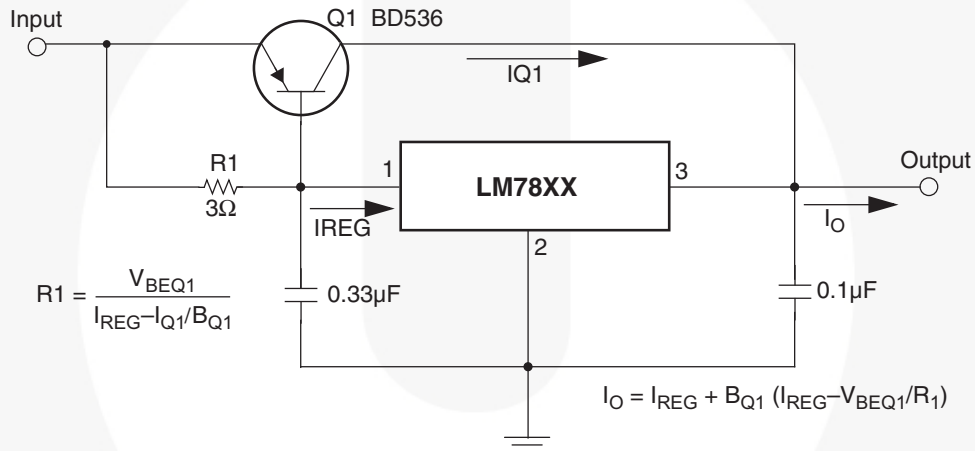


**Figure 11. Circuit for Increasing Output Voltage**

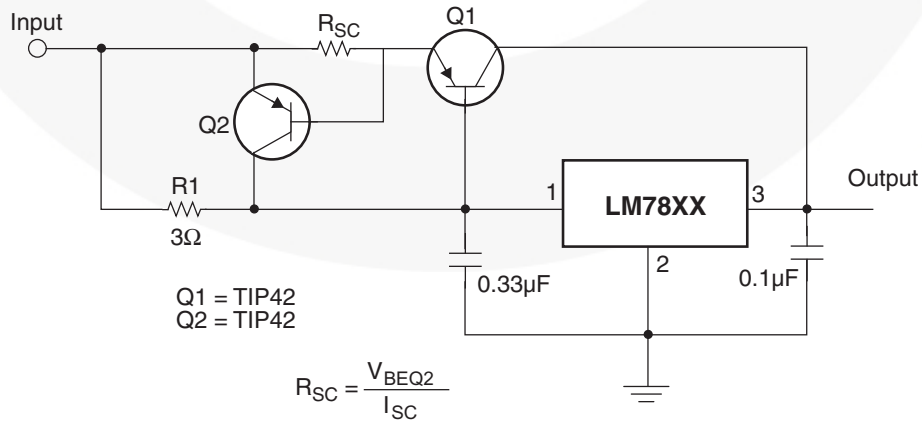
**Typical Applications (Continued)**



**Figure 12. Adjustable Output Regulator (7 V to 30 V)**

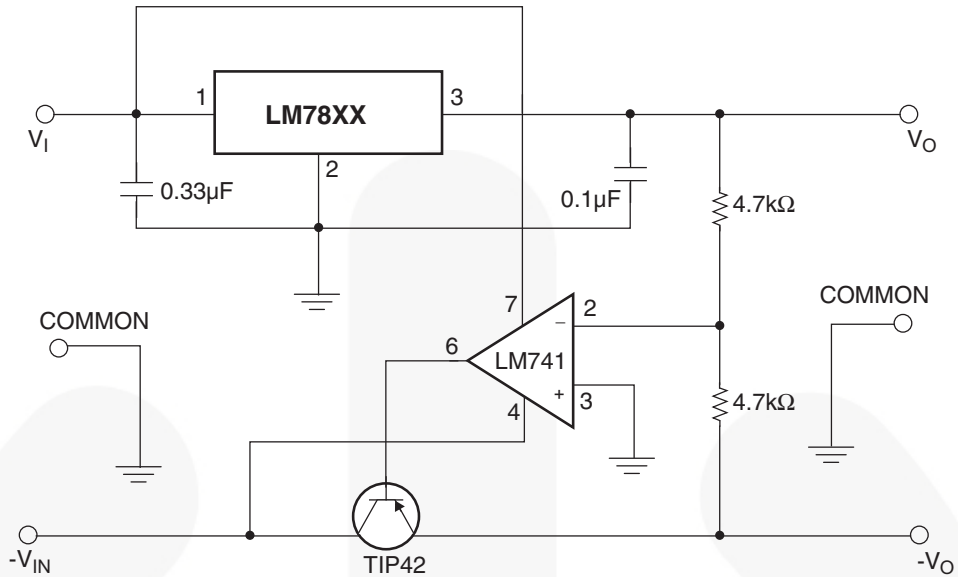


**Figure 13. High-Current Voltage Regulator**

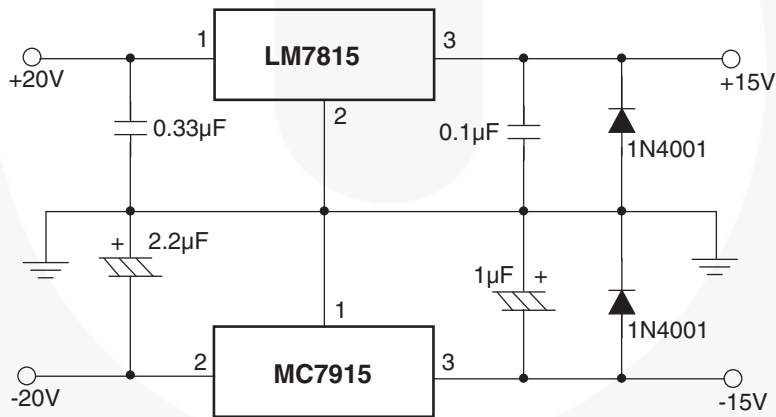


**Figure 14. High Output Current with Short-Circuit Protection**

**Typical Applications** (Continued)



**Figure 15. Tracking Voltage Regulator**



**Figure 16. Split Power Supply ( $\pm 15$  V - 1 A)**

Typical Applications (Continued)

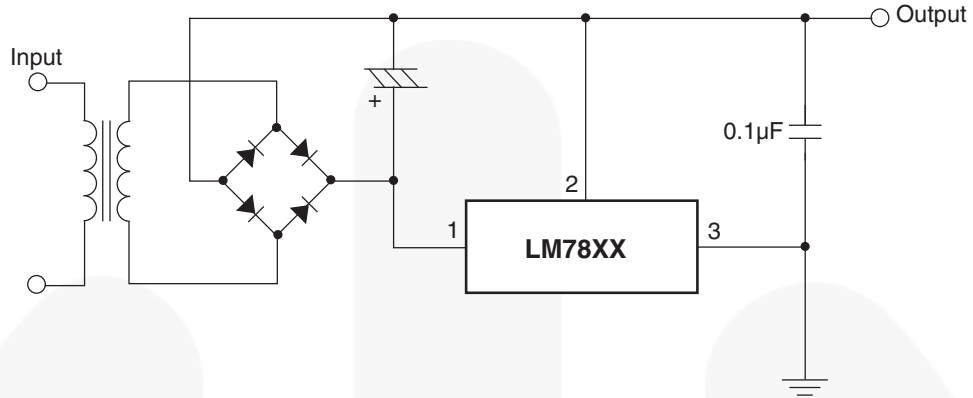


Figure 17. Negative Output Voltage Circuit

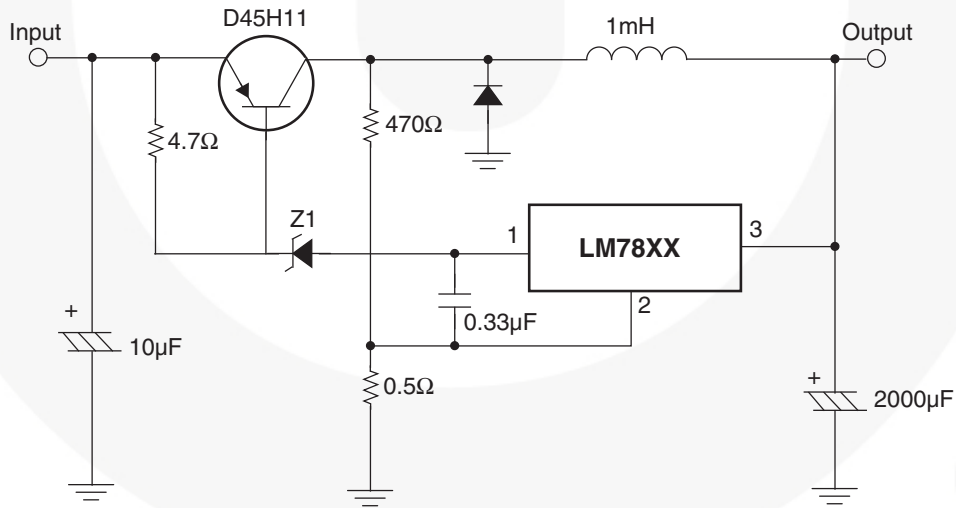
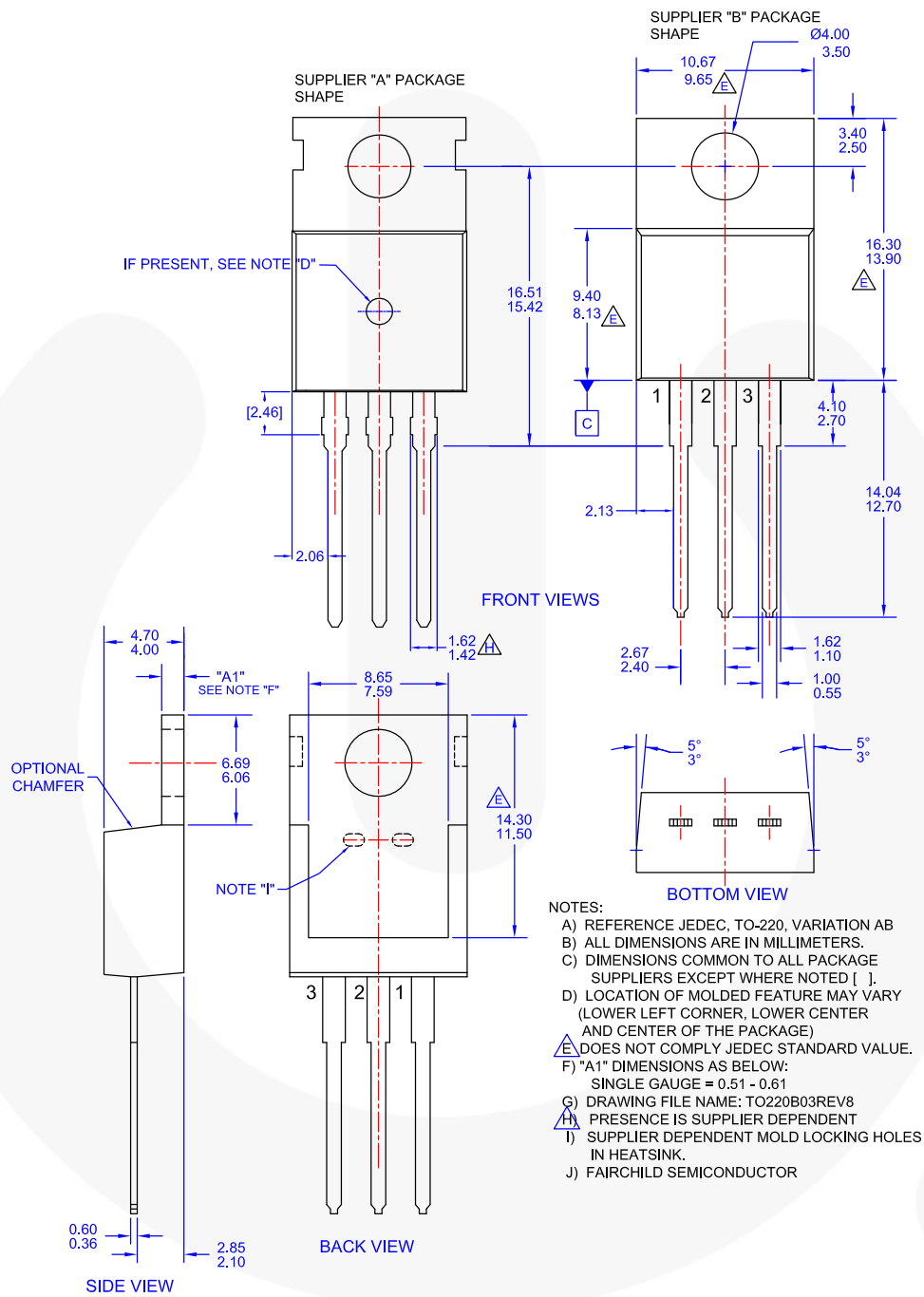


Figure 18. Switching Regulator

## Physical Dimensions



**Figure 19. TO-220, MOLDED, 3-LEAD, JEDEC VARIATION AB (ACTIVE)**



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