

BL78XX

3-Terminal 1A Positive Voltage Regulator

BL78XX

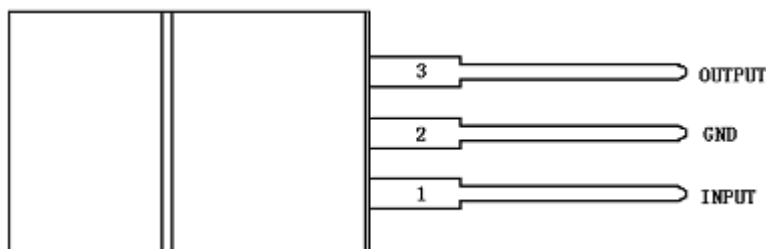
GENERAL DESCRIPTION

The BL78XX series of three-terminal positive regulator are 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, 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.

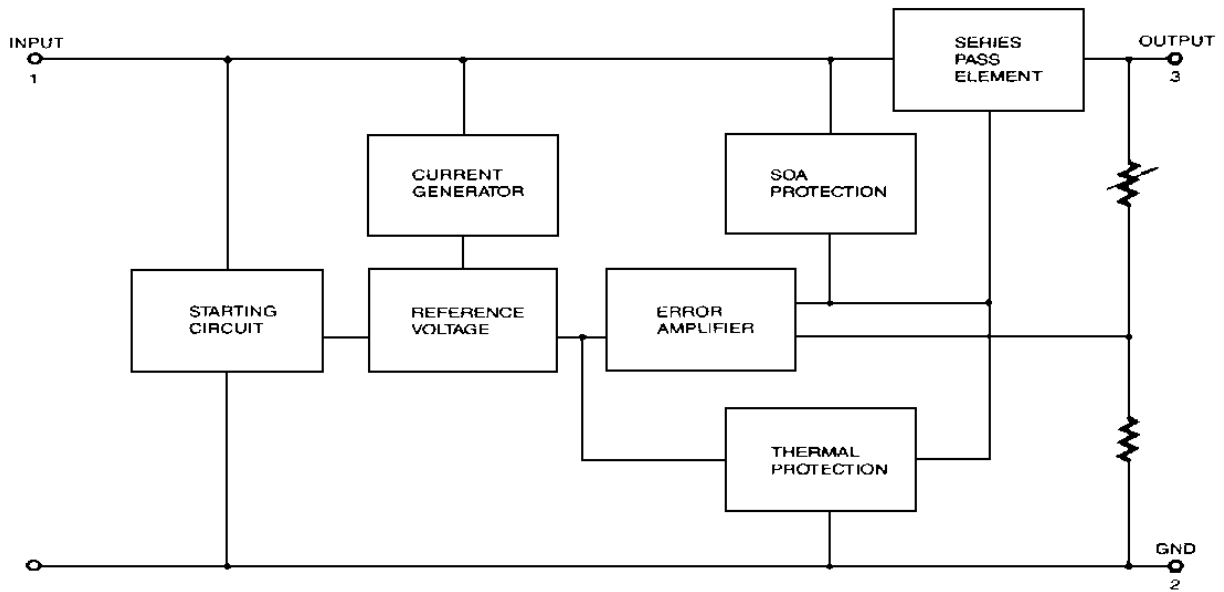
FEATURE

- Output Current up to 1A
- Thermal Overload Protection
- Short Circuit Protection
- Output Transistor Safe Operating Area Protection
- Output Voltages : BL7805: 5V BL7806: 6V BL7808: 8V
 BL7809: 9V BL7812: 12V BL7815: 15V

PIN CONNECTIONS



BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

Characteristics	Symbol	Value	Units
Input Voltage	V_i	35	V
Thermal Resistance Junction-Case	$R_{\theta JC}$	5	°C/W
Thermal Resistance Junction-Air	$R_{\theta JA}$	65	°C/W
Operating Temperature Range	T_{OPR}	-20~+85	°C
Storage Temperature Range	T_{STG}	-55~+150	°C

BL7805 ELECTRICAL CHARACTERISTICS

(Refer to the test circuit, $-20^{\circ}\text{C} < T_J < 85^{\circ}\text{C}$, $I_o=500\text{mA}$, $V_i=10\text{V}$, $C_i=0.33\mu\text{F}$, $C_o=0.1\mu\text{F}$, unless otherwise specified)

Characteristics	Symbol	Test Conditions	Min	Typ	Max	Unit	
Output Voltage	V_o	$T_J=+25^{\circ}\text{C}$	4.8	5.0	5.2	V	
		$5.0\text{mA} \leq I_o \leq 1.0\text{A}, P_o \leq 15\text{W}$ $V_i=7\text{V to } 20\text{V}$	4.75	5.0	5.25		
Line Regulation*	Regline	$T_J=+25^{\circ}\text{C}$	$V_i=7\text{V to } 25\text{V}$		4.0	100	mV
			$V_i=8\text{V to } 12\text{V}$		1.6	50	
Load Regulation*	Regload	$T_J=+25^{\circ}\text{C}$	$I_o=5.0\text{mA to } 1.5\text{A}$		15	100	mV
			$I_o=250\text{mA to } 750\text{mA}$		4	50	
Quiescent Current	I_Q	$T_J=+25^{\circ}\text{C}$		5.0	8.0	mA	
Quiescent Current Change	ΔI_Q	$I_o=5.0\text{mA to } 1.0\text{A}$		0.03	0.5	mA	
		$V_i=7\text{V to } 25\text{V}$		0.3	1.3		
Output Voltage Drift	$\Delta V_o / \Delta T$	$I_o=5.0\text{mA}$		-0.8		mV/ $^{\circ}\text{C}$	
Output Noise Voltage	V_N	$f=10\text{Hz to } 100\text{KHz}, T_A=+25^{\circ}\text{C}$		42		$\mu\text{V}/V_o$	
Ripple Rejection	RR	$f=120\text{Hz}$ $V_i=8\text{V to } 18\text{V}$	62	73		dB	
Dropout Voltage	V_{Drop}	$I_o=1\text{A}, T_J=+25^{\circ}\text{C}$		2		V	
Short Circuit Current	I_{SC}	$V_i=35\text{V}, T_A=+25^{\circ}\text{C}$		230		mA	
Peak Current	I_{PK}	$T_J=+25^{\circ}\text{C}$		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.

BL7806 ELECTRICAL CHARACTERISTICS

(Refer to the test circuit, $-20^{\circ}\text{C} < T_J < 85^{\circ}\text{C}$, $I_o=500\text{mA}$, $V_i=11\text{V}$, $C_i=0.33\mu\text{F}$, $C_o=0.1\mu\text{F}$, unless otherwise specified)

Characteristics	Symbol	Test Conditions	Min	Typ	Max	Unit	
Output Voltage	V_o	$T_J=+25^{\circ}\text{C}$	5.75	6.0	6.25	V	
		$5.0\text{mA} \leq I_o \leq 1.0\text{A}, P_o \leq 15\text{W}$ $V_i=8\text{V to } 21\text{V}$	5.7	6.0	6.3		
Line Regulation*	Regline	$T_J=+25^{\circ}\text{C}$	$V_i=8\text{V to } 25\text{V}$		5.0	120	mV
			$V_i=9\text{V to } 13\text{V}$		1.5	60	
Load Regulation*	Regload	$T_J=+25^{\circ}\text{C}$	$I_o=5.0\text{mA to } 1.5\text{A}$		9	120	mV
			$I_o=250\text{mA to } 750\text{mA}$		3	60	
Quiescent Current	I_Q	$T_J=+25^{\circ}\text{C}$		5.0	8.0	mA	
Quiescent Current Change	ΔI_Q	$I_o=5.0\text{mA to } 1.0\text{A}$			0.5	mA	
		$V_i=8\text{V to } 25\text{V}$			1.3		
Output Voltage Drift	$\Delta V_o / \Delta T$	$I_o=5.0\text{mA}$		-0.8		mV/ $^{\circ}\text{C}$	
Output Noise Voltage	V_N	$f=10\text{Hz to } 100\text{KHz}, T_A=+25^{\circ}\text{C}$		45		$\mu\text{V}/V_o$	
Ripple Rejection	RR	$f=120\text{Hz}$ $V_i=9\text{V to } 19\text{V}$	59	75		dB	
Dropout Voltage	V_{Drop}	$I_o=1\text{A}, T_J=+25^{\circ}\text{C}$		2		V	
Short Circuit Current	I_{SC}	$V_i=35\text{V}, T_A=+25^{\circ}\text{C}$		250		mA	
Peak Current	I_{PK}	$T_J=+25^{\circ}\text{C}$		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.

BL7808 ELECTRICAL CHARACTERISTICS

(Refer to the test circuit, $-20^{\circ}\text{C} < T_J < 85^{\circ}\text{C}$, $I_o=500\text{mA}$, $V_i=14\text{V}$, $C_i=0.33\mu\text{F}$, $C_o=0.1\mu\text{F}$, unless otherwise specified)

Characteristics	Symbol	Test Conditions	Min	Typ	Max	Unit	
Output Voltage	V_o	$T_J=+25^{\circ}\text{C}$	7.7	8.0	8.3	V	
		$5.0\text{mA} \leq I_o \leq 1.0\text{A}, P_o \leq 15\text{W}$ $V_i=10.5\text{V to } 23\text{V}$	7.6	8.0	8.4		
Line Regulation*	Regline	$T_J=+25^{\circ}\text{C}$	$V_i=10.5\text{V to } 25\text{V}$		5.0	160	mV
			$V_i=11.5\text{V to } 17\text{V}$		2.0	80	
Load Regulation*	Regload	$T_J=+25^{\circ}\text{C}$	$I_o=5.0\text{mA to } 1.5\text{A}$		10	160	mV
			$I_o=250\text{mA to } 750\text{mA}$		5.0	80	
Quiescent Current	I_Q	$T_J=+25^{\circ}\text{C}$		5.0	8.0	mA	
Quiescent Current Change	ΔI_Q	$I_o=5.0\text{mA to } 1.0\text{A}$		0.05	0.5	mA	
		$V_i=10.5\text{V to } 25\text{V}$		0.5	1.0		
Output Voltage Drift	$\Delta V_o / \Delta T$	$I_o=5.0\text{mA}$		-0.8		mV/ $^{\circ}\text{C}$	
Output Noise Voltage	V_N	$f=10\text{Hz to } 100\text{KHz}, T_A=+25^{\circ}\text{C}$		52		$\mu\text{V}/V_o$	
Ripple Rejection	RR	$f=120\text{Hz}$ $V_i=11.5\text{V to } 21.5\text{V}$	56	73		dB	
Dropout Voltage	V_{Drop}	$I_o=1\text{A}, T_J=+25^{\circ}\text{C}$		2		V	
Short Circuit Current	I_{SC}	$V_i=35\text{V}, T_A=+25^{\circ}\text{C}$		230		mA	
Peak Current	I_{PK}	$T_J=+25^{\circ}\text{C}$		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.

BL7809 ELECTRICAL CHARACTERISTICS

(Refer to the test circuit, $-20^{\circ}\text{C} < T_J < 85^{\circ}\text{C}$, $I_o=500\text{mA}$, $V_i=15\text{V}$, $C_i=0.33\mu\text{F}$, $C_o=0.1\mu\text{F}$, unless otherwise specified)

Characteristics	Symbol	Test Conditions	Min	Typ	Max	Unit	
Output Voltage	V_o	$T_J=+25^{\circ}\text{C}$	8.68	9.0	9.32	V	
		$5.0\text{mA} \leq I_o \leq 1.0\text{A}, P_o \leq 15\text{W}$ $V_i=11.5\text{V to } 26\text{V}$	8.55	9.0	9.45		
Line Regulation*	Regline	$T_J=+25^{\circ}\text{C}$	$V_i=11.5\text{V to } 26\text{V}$		5.0	150	mV
			$V_i=12.5\text{V to } 18\text{V}$		2.0	80	
Load Regulation*	Regload	$T_J=+25^{\circ}\text{C}$	$I_o=5.0\text{mA to } 1.5\text{A}$		10	160	mV
			$I_o=250\text{mA to } 750\text{mA}$		5.0	80	
Quiescent Current	I_Q	$T_J=+25^{\circ}\text{C}$		5.0	8.0	mA	
Quiescent Current Change	ΔI_Q	$I_o=5.0\text{mA to } 1.0\text{A}$		0.05	0.5	mA	
		$V_i=11.5\text{V to } 26\text{V}$		0.5	1.0		
Output Voltage Drift	$\Delta V_o / \Delta T$	$I_o=5.0\text{mA}$		-0.8		mV/ $^{\circ}\text{C}$	
Output Noise Voltage	V_N	$f=10\text{Hz to } 100\text{KHz}, T_A=+25^{\circ}\text{C}$		52		$\mu\text{V}/V_o$	
Ripple Rejection	RR	$f=120\text{Hz}$ $V_i=11.5\text{V to } 21.5\text{V}$	56	73		dB	
Dropout Voltage	V_{Drop}	$I_o=1\text{A}, T_J=+25^{\circ}\text{C}$		2		V	
Short Circuit Current	I_{SC}	$V_i=35\text{V}, T_A=+25^{\circ}\text{C}$		230		mA	
Peak Current	I_{PK}	$T_J=+25^{\circ}\text{C}$		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.

BL7812 ELECTRICAL CHARACTERISTICS

(Refer to the test circuit, $-20^{\circ}\text{C} < T_J < 85^{\circ}\text{C}$, $I_o=500\text{mA}$, $V_i=19\text{V}$, $C_i=0.33\mu\text{F}$, $C_o=0.1\mu\text{F}$, unless otherwise specified)

Characteristics	Symbol	Test Conditions	Min	Typ	Max	Unit	
Output Voltage	V_o	$T_J=+25^{\circ}\text{C}$	11.5	12	12.5	V	
		$5.0\text{mA} \leq I_o \leq 1.0\text{A}, P_o \leq 15\text{W}$ $V_i=14.5\text{V to } 27\text{V}$	11.4	12	12.6		
Line Regulation*	Regline	$T_J=+25^{\circ}\text{C}$	$V_i=14.5\text{V to } 30\text{V}$		10	240	mV
			$V_i=16\text{V to } 22\text{V}$		3.0	120	
Load Regulation*	Regload	$T_J=+25^{\circ}\text{C}$	$I_o=5.0\text{mA to } 1.5\text{A}$		11	240	mV
			$I_o=250\text{mA to } 750\text{mA}$		5.0	120	
Quiescent Current	I_Q	$T_J=+25^{\circ}\text{C}$		5.1	8.0	mA	
Quiescent Current Change	ΔI_Q	$I_o=5.0\text{mA to } 1.0\text{A}$		0.1	0.5	mA	
		$V_i=14.5\text{V to } 30\text{V}$		0.5	1.0		
Output Voltage Drift	$\Delta V_o / \Delta T$	$I_o=5.0\text{mA}$		-1		mV/ $^{\circ}\text{C}$	
Output Noise Voltage	V_N	$f=10\text{Hz to } 100\text{KHz}, T_A=+25^{\circ}\text{C}$		76		$\mu\text{V}/V_o$	
Ripple Rejection	RR	$f=120\text{Hz}$ $V_i=15\text{V to } 25\text{V}$	55	71		dB	
Dropout Voltage	V_{Drop}	$I_o=1\text{A}, T_J=+25^{\circ}\text{C}$		2		V	
Short Circuit Current	I_{SC}	$V_i=35\text{V}, T_A=+25^{\circ}\text{C}$		230		mA	
Peak Current	I_{PK}	$T_J=+25^{\circ}\text{C}$		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.

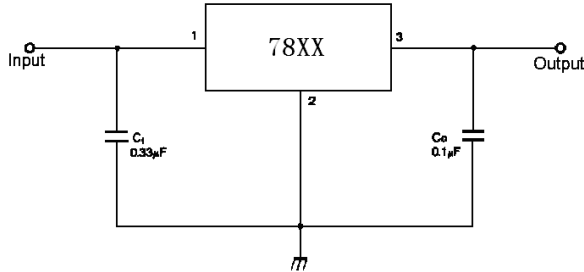
BL7815 ELECTRICAL CHARACTERISTICS

(Refer to the test circuit, $-20^{\circ}\text{C} < T_J < 85^{\circ}\text{C}$, $I_o=500\text{mA}$, $V_i=23\text{V}$, $C_i=0.33\mu\text{F}$, $C_o=0.1\mu\text{F}$, unless otherwise specified)

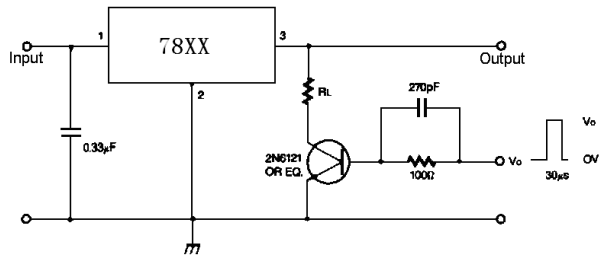
Characteristics	Symbol	Test Conditions	Min	Typ	Max	Unit	
Output Voltage	V_o	$T_J=+25^{\circ}\text{C}$	14.4	15	15.6	V	
		$5.0\text{mA} \leq I_o \leq 1.0\text{A}, P_o \leq 15\text{W}$ $V_i=17.5\text{V to } 30\text{V}$	14.25	15	15.75		
Line Regulation*	Regline	$T_J=+25^{\circ}\text{C}$	$V_i=17.5\text{V to } 30\text{V}$		11	300	mV
			$V_i=20\text{V to } 26\text{V}$		3.0	150	
Load Regulation*	Regload	$T_J=+25^{\circ}\text{C}$	$I_o=5.0\text{mA to } 1.5\text{A}$		12	300	mV
			$I_o=250\text{mA to } 750\text{mA}$		4.0	150	
Quiescent Current	I_Q	$T_J=+25^{\circ}\text{C}$		5.2	8.0	mA	
Quiescent Current Change	ΔI_Q	$I_o=5.0\text{mA to } 1.0\text{A}$			0.5	mA	
		$V_i=17.5\text{V to } 30\text{V}$			1.0		
Output Voltage Drift	$\Delta V_o / \Delta T$	$I_o=5.0\text{mA}$		-1		mV/ $^{\circ}\text{C}$	
Output Noise Voltage	V_N	$f=10\text{Hz to } 100\text{KHz}, T_A=+25^{\circ}\text{C}$		90		$\mu\text{V}/V_o$	
Ripple Rejection	RR	$f=120\text{Hz}$ $V_i=18.5\text{V to } 28.5\text{V}$	54	70		dB	
Dropout Voltage	V_{Drop}	$I_o=1\text{A}, T_J=+25^{\circ}\text{C}$		2		V	
Short Circuit Current	I_{SC}	$V_i=35\text{V}, T_A=+25^{\circ}\text{C}$		250		mA	
Peak Current	I_{PK}	$T_J=+25^{\circ}\text{C}$		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.

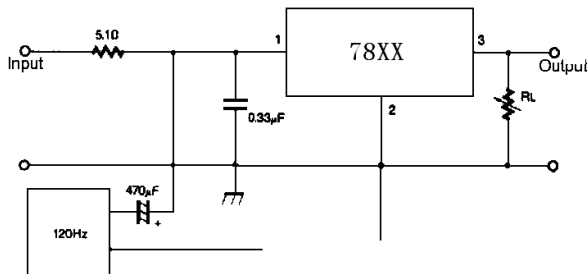
APPLICATION CIRCUIT



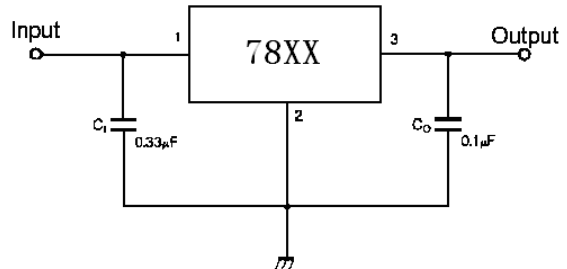
DC Parameters



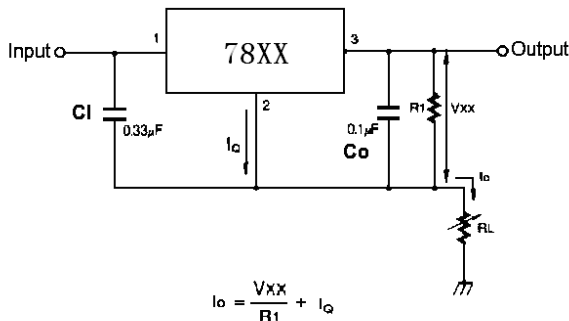
Load Regulation



Ripple Rejection



Fixed Output Regulator



Constant Current Regulator

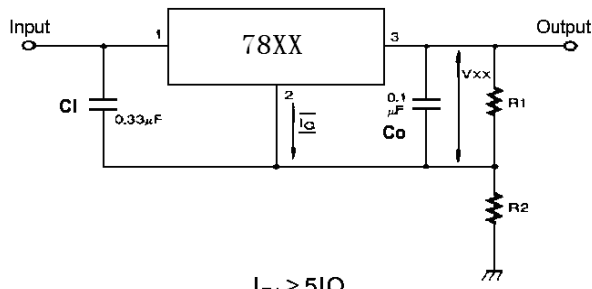
Notes:

(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.

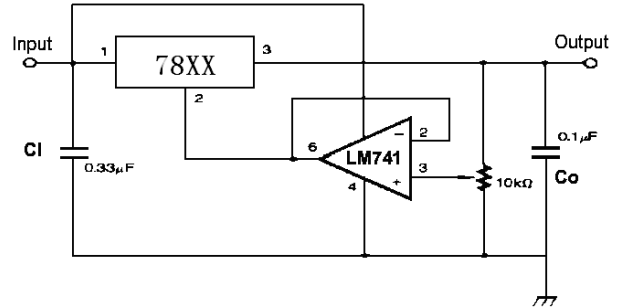
BL78XX



$$I_{R1} \geq 5I_Q$$

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

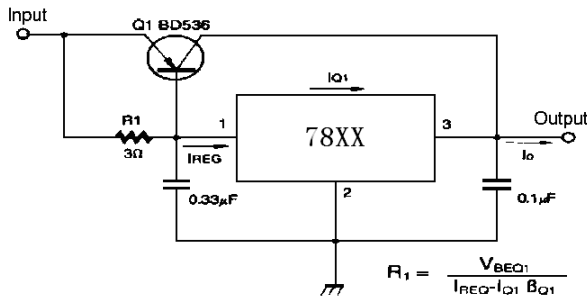
Circuit for Increasing Output Voltage



$$I_{R1} \geq 5I_Q$$

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

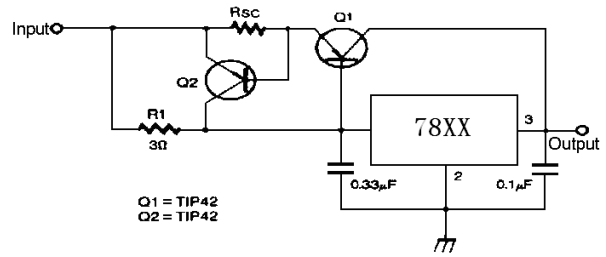
Adjustable Output Regulator (7 to 30V)



$$I_O = I_{REG} + \beta_{Q1} (I_{REG} - V_{BEQ1}/R_1)$$

$$R_1 = \frac{V_{BEQ1}}{I_{REG} - I_{O1} \beta_{Q1}}$$

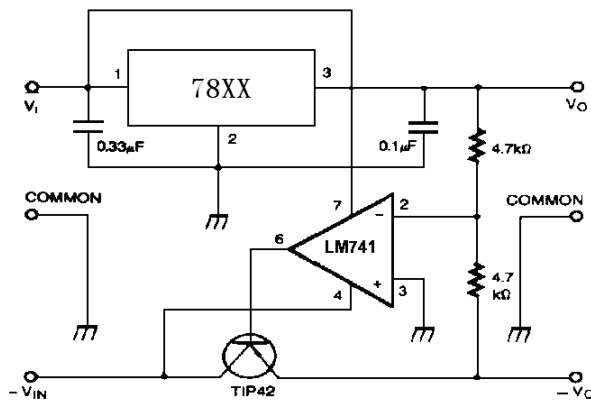
High Current Voltage Regulator



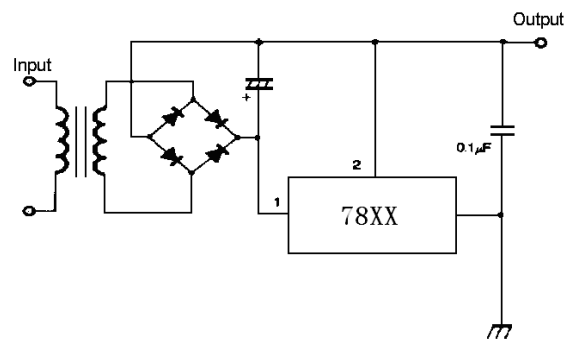
Q1 = TIP42
Q2 = TIP42

$$R_{SC} = \frac{V_{BEQ2}}{I_{SC}}$$

High Output Current with Short Circuit Protection

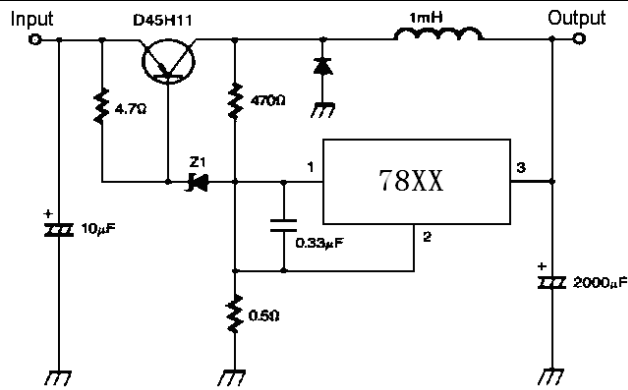


Tracking Voltage Regulator



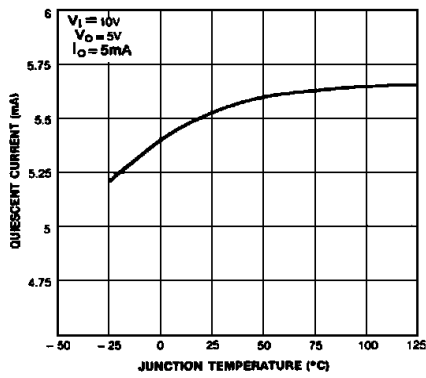
Negative Output Voltage Circuit

Tracking Voltage Regulator

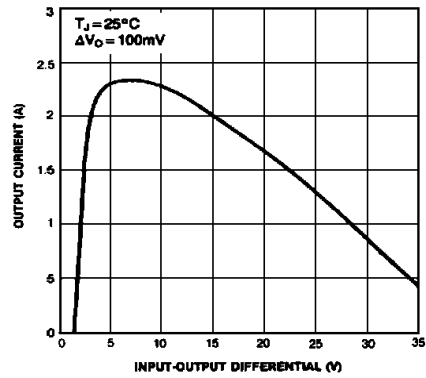


Switching Regulator

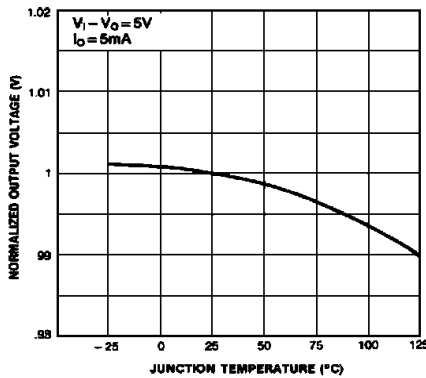
CHARACTERISTIC CURVES



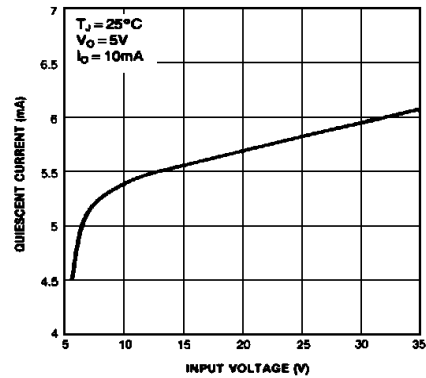
Quiescent Current



Peak Output Current



Output Voltage



Quiescent Current

BL78XX

OUTLINE DRAWING

