



# HS78XX LINEAR INTEGRATED CIRCUIT

## 3 TERMINAL 1.0A POSITIVE

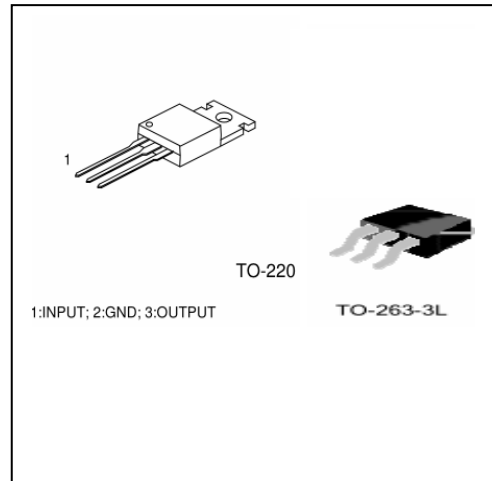
### VOLTAGE REGULATORS

#### DESCRIPTION

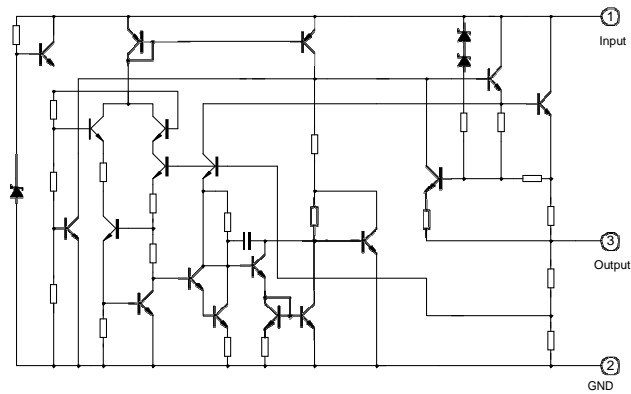
The HS78XX series of three-terminal positive regulators are available in several packages and with several fixed output voltages, making them useful in a wide range of applications. Each type employs internal current limiting, thermal shut-down and safe area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1.0A output current. Although designed as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltage and currents.

#### FEATURES

- \*Output current up to 1.0A
- \*5V;6V;8V;9V;10V;12V;15V;output voltage available
- \*Thermal overload protection
- \*Short circuit protection
- \*Output transistor SOA protection



#### BLOCK DIAGRAM



#### ABSOLUTE MAXIMUM RATINGS(Ta=25°C)

Characteristic	Symbol	Value	Unit
Input voltage (for Vo=5V to 15V)	Vi	36	V
Thermal resistance junction-air	RθJA	65	°C/W
Thermal resistance junction-cases	RθJC	5	°C/W
Operating Temperature	Topr	-10 ~ +105	°C
Storage Temperature	Tstg	-50 ~ +150	°C



# HS78XX LINEAR INTEGRATED CIRCUIT

## 7805 ELECTRICAL CHARACTERISTICS

(Refer to test circuits,  $0 < T_j < 125^\circ\text{C}$ ,  $I_o = 500\text{mA}$ ,  $V_i = 10\text{V}$ ,  $C_i = 0.33\mu\text{F}$ ,  $C_o = 0.1\mu\text{F}$ , unless otherwise specified)

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Units
Output voltage	$V_o$	$T_j = 25^\circ\text{C}$	4.8	5.0	5.2	V
		$5.0\text{mA} < I_o < 1.0\text{A}$ , $P_o < 15\text{W}$ $V_i = 8\text{V to } 20\text{V}$	4.75	5.00	5.25	V
Line regulation	$\Delta V_o$	$T_j = 25^\circ\text{C}$ , $V_i = 7\text{V to } 25\text{V}$			100	mV
		$T_j = 25^\circ\text{C}$ , $V_i = 8\text{V to } 12\text{V}$			50	mV
Load regulation	$\Delta V_o$	$T_j = 25^\circ\text{C}$ , $I_o = 5.0\text{mA to } 1.0\text{A}$			100	mV
		$T_j = 25^\circ\text{C}$ , $I_o = 250\text{mA to } 750\text{mA}$			50	mA
Quiescent current	$I_q$	$T_j = 25^\circ\text{C}$			8	mA
Quiescent current change	$\Delta I_q$	$I_o = 5\text{mA to } 1.0\text{A}$			0.5	mA
		$V_i = 8\text{V to } 25\text{V}$			1.3	mA
Output voltage drift	$\Delta V_o / \Delta T$	$I_o = 5\text{mA}$		-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		$\mu\text{V}$
Ripple rejection	RR	$f = 120\text{Hz}$ , $V_i = 8\text{V to } 18\text{V}$	62	73		dB
Dropout voltage	$V_o$	$I_o = 1.0\text{A}$ , $T_j = 25^\circ\text{C}$		2		V
Output resistance	$R_o$	$f = 1\text{kHz}$		15		$\text{m}\Omega$
Short circuit current	$I_{sc}$	$V_i = 30\text{V}$ , $T_a = 25^\circ\text{C}$		250		mA
peak current	$I_{pk}$	$T_j = 25^\circ\text{C}$		1.2		A

## 7806 ELECTRICAL CHARACTERISTICS

(Refer to test circuits,  $0 < T_j < 125^\circ\text{C}$ ,  $I_o = 500\text{mA}$ ,  $V_i = 11\text{V}$ ,  $C_i = 0.33\mu\text{F}$ ,  $C_o = 0.1\mu\text{F}$ , unless otherwise specified)

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Units
Output voltage	$V_o$	$T_j = 25^\circ\text{C}$	5.75	6.00	6.25	V
		$5.0\text{mA} < I_o < 1.0\text{A}$ , $P_o < 15\text{W}$ $V_i = 9\text{V to } 21\text{V}$				
Line regulation	$\Delta V_o$	$T_j = 25^\circ\text{C}$ , $V_i = 8\text{V to } 25\text{V}$		5	120	mV
		$T_j = 25^\circ\text{C}$ , $V_i = 9\text{V to } 13\text{V}$		1.5	60	mV
Load regulation	$\Delta V_o$	$T_j = 25^\circ\text{C}$ , $I_o = 5.0\text{mA to } 1.0\text{A}$		9	130	mV
		$T_j = 25^\circ\text{C}$ , $I_o = 250\text{mA to } 750\text{mA}$		3	60	mV
Quiescent current	$I_q$	$T_j = 25^\circ\text{C}$		5.0	8	mA
Quiescent current change	$\Delta I_q$	$I_o = 5\text{mA to } 1.0\text{A}$			0.5	mA
		$V_i = 8\text{V to } 25\text{V}$			1.3	mA
Output voltage drift	$\Delta V_o / \Delta T$	$I_o = 5\text{mA}$		-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		$\mu\text{V}$
Ripple rejection	RR	$f = 120\text{Hz}$ , $V_i = 9\text{V to } 19\text{V}$	59	75		dB
Dropout voltage	$V_o$	$I_o = 1.0\text{A}$ , $T_j = 25^\circ\text{C}$		2		V
Output resistance	$R_o$	$f = 1\text{kHz}$		19		$\text{m}\Omega$
Short circuit current	$I_{sc}$	$V_i = 30\text{V}$ , $T_a = 25^\circ\text{C}$		250		mA
peak current	$I_{pk}$	$T_j = 25^\circ\text{C}$		1.2		A



# HS78XX LINEAR INTEGRATED CIRCUIT

## 7808 ELECTRICAL CHARACTERISTICS

(Refer to test circuits,  $0 < T_j < 125^\circ\text{C}$ ,  $I_o = 500\text{mA}$ ,  $V_i = 14\text{V}$ ,  $C_i = 0.33\mu\text{F}$ ,  $C_o = 0.1\mu\text{F}$ , unless otherwise specified)

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Units
Output voltage	$V_o$	$T_j = 25^\circ\text{C}$	7.7	8.0	8.3	V
		$5.0\text{mA} < I_o < 1.0\text{A}$ , $P_o < 15\text{W}$ $V_i = 10.5\text{V}$ to $23\text{V}$	7.6	8.0	8.4	V
Line regulation	$\Delta V_o$	$T_j = 25^\circ\text{C}$ , $V_i = 10.5\text{V}$ to $25\text{V}$		5.0	160	mV
		$T_j = 25^\circ\text{C}$ , $V_i = 11.5\text{V}$ to $17\text{V}$		2.0	80	mV
Load regulation	$\Delta V_o$	$T_j = 25^\circ\text{C}$ , $I_o = 5.0\text{mA}$ to $1.0\text{A}$		10	160	mV
		$T_j = 25^\circ\text{C}$ , $I_o = 250\text{mA}$ to $750\text{mA}$		5.0	80	mV
Quiescent current	$I_q$	$T_j = 25^\circ\text{C}$		5.0	8	mA
Quiescent current change	$\Delta I_q$	$I_o = 5\text{mA}$ to $1.0\text{A}$		0.05	0.5	mA
		$V_i = 11.5\text{V}$ to $25\text{V}$		0.5	1.0	mA
Output voltage drift	$\Delta V_o / \Delta T$	$I_o = 5\text{mA}$		-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		$\mu\text{V}$
Ripple rejection	RR	$f = 120\text{Hz}$ , $V_i = 11.5\text{V}$ to $21.5\text{V}$	56	73		dB
Dropout voltage	$V_o$	$I_o = 1.0\text{A}$ , $T_j = 25^\circ\text{C}$		2		V
Output resistance	$R_o$	$f = 1\text{kHz}$		17		$\text{m}\Omega$
Short circuit current	$I_{sc}$	$V_i = 30\text{V}$ , $T_a = 25^\circ\text{C}$		230		mA
peak current	$I_{pk}$	$T_j = 25^\circ\text{C}$		1.2		A

## 7809 ELECTRICAL CHARACTERISTICS

(Refer to test circuits,  $0 < T_j < 125^\circ\text{C}$ ,  $I_o = 500\text{mA}$ ,  $V_i = 15\text{V}$ ,  $C_i = 0.33\mu\text{F}$ ,  $C_o = 0.1\mu\text{F}$ , unless otherwise specified)

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Units
Output voltage	$V_o$	$T_j = 25^\circ\text{C}$	8.65	9.00	9.35	V
		$5.0\text{mA} < I_o < 1.0\text{A}$ , $P_o < 15\text{W}$ $V_i = 11.5\text{V}$ to $24\text{V}$	8.6	9.0	9.4	V
Line regulation	$\Delta V_o$	$T_j = 25^\circ\text{C}$ , $V_i = 11.5\text{V}$ to $25\text{V}$		6	180	mV
		$T_j = 25^\circ\text{C}$ , $V_i = 12\text{V}$ to $17\text{V}$		2	90	mV
Load regulation	$\Delta V_o$	$T_j = 25^\circ\text{C}$ , $I_o = 5.0\text{mA}$ to $1.0\text{A}$		12	180	mV
		$T_j = 25^\circ\text{C}$ , $I_o = 250\text{mA}$ to $750\text{mA}$		4	90	mV
Quiescent current	$I_q$	$T_j = 25^\circ\text{C}$		5.0	8	mA
Quiescent current change	$\Delta I_q$	$I_o = 5\text{mA}$ to $1.0\text{A}$			0.5	mA
		$V_i = 11.5\text{V}$ to $25\text{V}$			1.3	mA
Output voltage drift	$\Delta V_o / \Delta T$	$I_o = 5\text{mA}$		-1		mV/ $^\circ\text{C}$
Output noise voltage	$V_N$	$f = 10\text{Hz}$ to $100\text{kHz}$ , $T_a = 25^\circ\text{C}$		58		$\mu\text{V}$
Ripple rejection	RR	$f = 120\text{Hz}$ , $V_i = 13\text{V}$ to $23\text{V}$	56	71		dB
Dropout voltage	$V_o$	$I_o = 1.0\text{A}$ , $T_j = 25^\circ\text{C}$		2		V
Output resistance	$R_o$	$f = 1\text{kHz}$		15		$\text{m}\Omega$
Short circuit current	$I_{sc}$	$V_i = 30\text{V}$ , $T_a = 25^\circ\text{C}$		250		mA
peak current	$I_{pk}$	$T_j = 25^\circ\text{C}$		1.2		A



# HS78XX LINEAR INTEGRATED CIRCUIT

## 7810 ELECTRICAL CHARACTERISTICS

(Refer to test circuits,  $0 < T_j < 125^\circ\text{C}$ ,  $I_o = 500\text{mA}$ ,  $V_i = 16\text{V}$ ,  $C_i = 0.33\mu\text{F}$ ,  $C_o = 0.1\mu\text{F}$ , unless otherwise specified)

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Units
Output voltage	$V_o$	$T_j = 25^\circ\text{C}$	9.6	10	10.4	V
		$5.0\text{mA} < I_o < 1.0\text{A}$ , $P_o < 15\text{W}$ $V_i = 12.5\text{V to } 25\text{V}$	9.5	10	10.5	V
Line regulation	$\Delta V_o$	$T_j = 25^\circ\text{C}$ , $V_i = 12.5\text{V to } 25\text{V}$		10	200	mV
		$T_j = 25^\circ\text{C}$ , $V_i = 13\text{V to } 20\text{V}$		3	100	mV
Load regulation	$\Delta V_o$	$T_j = 25^\circ\text{C}$ , $I_o = 5.0\text{mA to } 1.0\text{A}$		12	200	mV
		$T_j = 25^\circ\text{C}$ , $I_o = 250\text{mA to } 750\text{mA}$		4	100	mV
Quiescent current	$I_q$	$T_j = 25^\circ\text{C}$		5.0	8	mA
Quiescent current change	$\Delta I_q$	$I_o = 5\text{mA to } 1.0\text{A}$			0.5	mA
		$V_i = 12.5\text{V to } 25\text{V}$				
Output voltage drift	$\Delta V_o / \Delta T$	$I_o = 5\text{mA}$		-1		mV/ $^\circ\text{C}$
Output noise voltage	$V_N$	$f = 10\text{Hz to } 100\text{kHz}$ , $T_a = 25^\circ\text{C}$		58		$\mu\text{V}$
Ripple rejection	RR	$f = 120\text{Hz}$ , $V_i = 14\text{V to } 24\text{V}$	56	71		dB
Dropout voltage	$V_o$	$I_o = 1.0\text{A}$ , $T_j = 25^\circ\text{C}$		2		V
Output resistance	$R_o$	$f = 1\text{kHz}$		17		$\text{m}\Omega$
Short circuit current	$I_{sc}$	$V_i = 30\text{V}$ , $T_a = 25^\circ\text{C}$		250		mA
peak current	$I_{pk}$	$T_j = 25^\circ\text{C}$		1.2		A

## 7812 ELECTRICAL CHARACTERISTICS

(Refer to test circuits,  $0 < T_j < 125^\circ\text{C}$ ,  $I_o = 500\text{mA}$ ,  $V_i = 16\text{V}$ ,  $C_i = 0.33\mu\text{F}$ ,  $C_o = 0.1\mu\text{F}$ , unless otherwise specified)

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Units
Output voltage	$V_o$	$T_j = 25^\circ\text{C}$	11.5	12.0	12.5	V
		$5.0\text{mA} < I_o < 1.0\text{A}$ , $P_o < 15\text{W}$ $V_i = 14.5\text{V to } 25\text{V}$	11.4	12	12.6	V
Line regulation	$\Delta V_o$	$T_j = 25^\circ\text{C}$ , $V_i = 14.5\text{V to } 25\text{V}$		10	240	mV
		$T_j = 25^\circ\text{C}$ , $V_i = 16\text{V to } 22\text{V}$		3	120	mV
Load regulation	$\Delta V_o$	$T_j = 25^\circ\text{C}$ , $I_o = 5.0\text{mA to } 1.0\text{A}$		11	240	mV
		$T_j = 25^\circ\text{C}$ , $I_o = 250\text{mA to } 750\text{mA}$		5.0	120	mV
Quiescent current	$I_q$	$T_j = 25^\circ\text{C}$		5.1	8	mA
Quiescent current change	$\Delta I_q$	$I_o = 5\text{mA to } 1.0\text{A}$			0.5	mA
		$V_i = 14.5\text{V to } 25\text{V}$				
Output voltage drift	$\Delta V_o / \Delta T$	$I_o = 5\text{mA}$		-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		$\mu\text{V}$
Ripple rejection	RR	$f = 120\text{Hz}$ , $V_i = 15\text{V to } 25\text{V}$	55	71		dB
Dropout voltage	$V_o$	$I_o = 1.0\text{A}$ , $T_j = 25^\circ\text{C}$		2		V
Output resistance	$R_o$	$f = 1\text{kHz}$		18		$\text{m}\Omega$
Short circuit current	$I_{sc}$	$V_i = 30\text{V}$ , $T_a = 25^\circ\text{C}$		230		mA
peak current	$I_{pk}$	$T_j = 25^\circ\text{C}$		1.2		A



# HS78XX LINEAR INTEGRATED CIRCUIT

## 7815 ELECTRICAL CHARACTERISTICS

(Refer to test circuits,  $0 < T_j < 125^\circ\text{C}$ ,  $I_o = 500\text{mA}$ ,  $V_i = 23\text{V}$ ,  $C_i = 0.33\mu\text{F}$ ,  $C_o = 0.1\mu\text{F}$ , unless otherwise specified)

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Units
Output voltage	$V_o$	$T_j = 25^\circ\text{C}$	14.4	15.0	15.6	V
		$5.0\text{mA} < I_o < 1.0\text{A}$ , $P_o < 15\text{W}$ $V_i = 17.5\text{V to } 25\text{V}$	14.25	15.0	15.75	V
Line regulation	$\Delta V_o$	$T_j = 25^\circ\text{C}$ , $V_i = 17.5\text{V to } 28\text{V}$		11	300	mV
		$T_j = 25^\circ\text{C}$ , $V_i = 20\text{V to } 25\text{V}$		3	150	mV
Load regulation	$\Delta V_o$	$T_j = 25^\circ\text{C}$ , $I_o = 5.0\text{mA to } 1.0\text{A}$		12	300	mV
		$T_j = 25^\circ\text{C}$ , $I_o = 250\text{mA to } 750\text{mA}$		4	150	mV
Quiescent current	$I_q$	$T_j = 25^\circ\text{C}$		5.2	8	mA
Quiescent current change	$\Delta I_q$	$I_o = 5\text{mA to } 1.0\text{A}$			0.5	mA
		$V_i = 17.5\text{V to } 25\text{V}$			1.0	mA
Output voltage drift	$\Delta V_o / \Delta T$	$I_o = 5\text{mA}$		-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		$\mu\text{V}$
Ripple rejection	RR	$f = 120\text{Hz}$ , $V_i = 18.5\text{V to } 25\text{V}$	54	70		dB
Dropout voltage	$V_o$	$I_o = 1.0\text{A}$ , $T_j = 25^\circ\text{C}$		2		V
Output resistance	$R_o$	$f = 1\text{kHz}$		19		$\text{m}\Omega$
Short circuit current	$I_{sc}$	$V_i = 30\text{V}$ , $T_a = 25^\circ\text{C}$		250		mA
peak current	$I_{pk}$	$T_j = 25^\circ\text{C}$		1.3		A

### TEST CIRCUITS

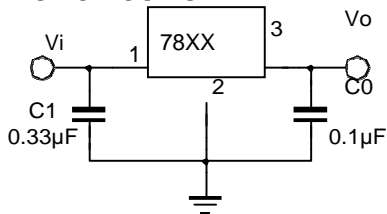


FIG.1 DC PARAMETERS

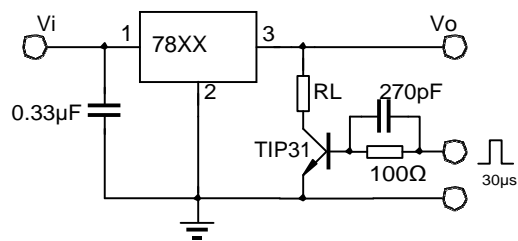


FIG.2 LOAD REGULATION

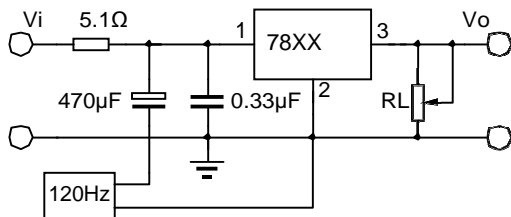


FIG.3 RIPPLE REJECTION



# HS78XX LINEAR INTEGRATED CIRCUIT

## APPLICATION CIRCUITS

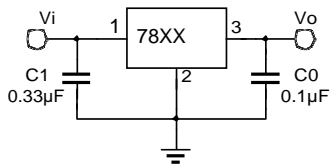


Fig.4 Fixed output regulator

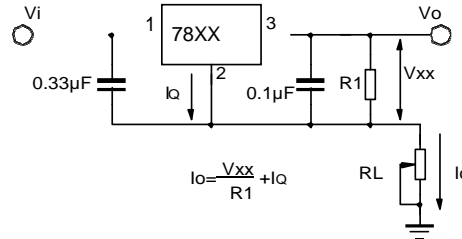


Fig.5 Constant current regulator

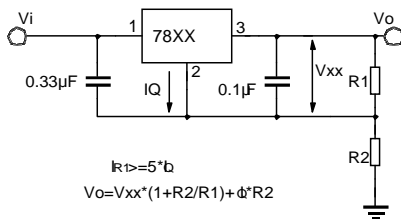


Fig.6 Circuit for increasing Regulator output voltage

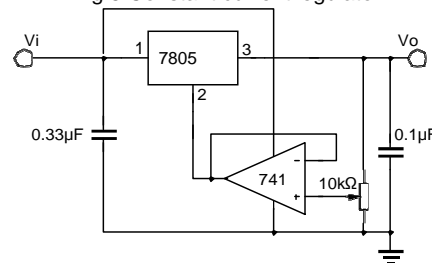


Fig.7 Adjustable output

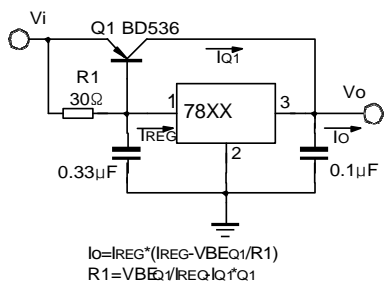


Fig.8 High current with voltage regulator

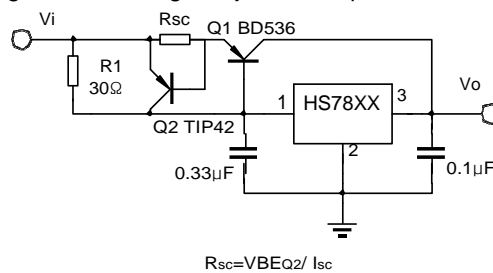


Fig.9 High output current short circuit protection

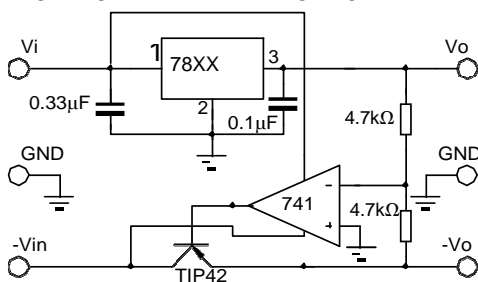


Fig.10 Tracking voltage regulator

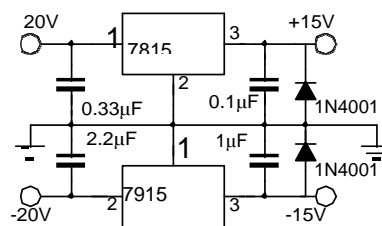


Fig.11 Split power supply(\$\pm 15\text{V}, 1\text{A}\$)



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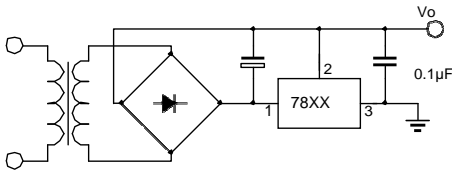


Fig.12 Negative output voltage circuit

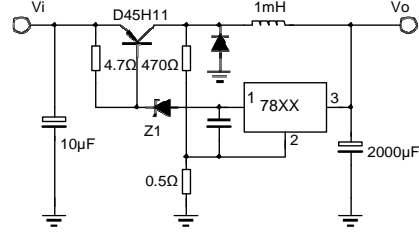


Fig.13 switching regulator

## TYPICAL PERFORMANCE CHARACTERISTICS

Fig.14 Quiescent current

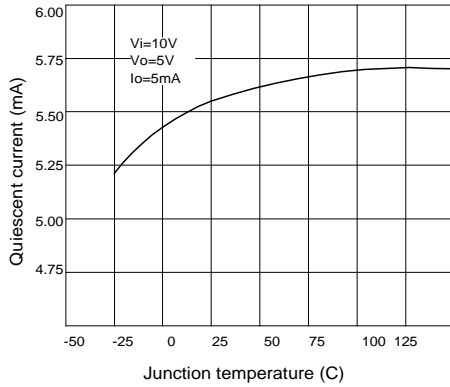


Fig.15 Output voltage

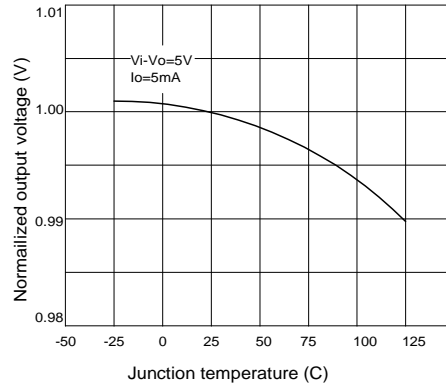


Fig.16 Peak output current

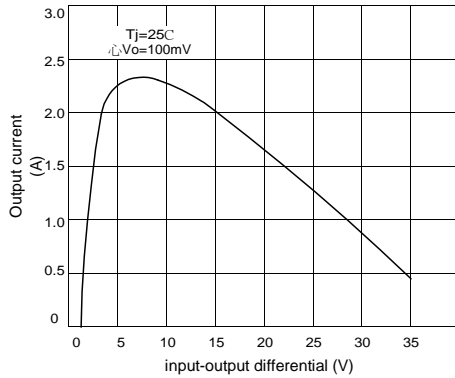


Fig.17 Quiescent current

