3-TERMINAL FIXED VOLTAGE REGULATOR

HE78XXA

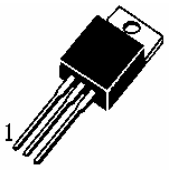
Description

The HE78XXA series of three terminal positive Regulators are available in the TO-220AB 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 regulator, these devices can be used with external components to obtain adjustable voltages and currents.

Features

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

TO-220AB



1—INPUT
2—GND
3—OUTPUT

Absolute Maximum Ratings（T_a=25℃）

V_I——Input Voltage (for V_O=5V to 18V)…… 35V

(for V_O=24V)…… 40V

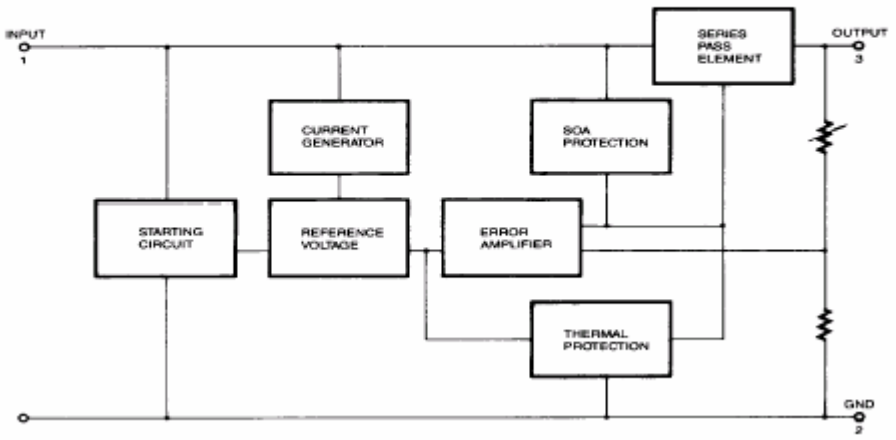
$R_{\theta JC}$——Thermal Resistance Junction-Cases…… 5℃/W

$R_{\theta JA}$——Thermal Resistance Junction-Air…… 65℃/W

T_{OPR}——Operating Temperature Range…… 0~125℃

T_{STG}——Storage Temperature Range…… -65~150℃

Internal Block Digram



(Refer to test circuit, **unless otherwise specified, $0°C \le T_J \le 125°C$, I_O=500mA, V_I=10V, C_I=0.33μF, C_O=0.1μF,**)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Conditions
V_O	Output Voltage	4.8	5.0	5.2	V	T_J=25°C
		4.75	5.0	5.25		5.0mA≤I_O≤1.0A, P_D≤15W, 7V≤V_I≤20V
ΔV_O	Line Regulation (Note1)		5.0	50	mV	T_J=25°C, 7.3V≤V_I≤20V
			1.5	25		T_J=25°C, 8V≤V_I≤12V
ΔV_O	Load Regulation (Note1)		9	100	mV	T_J=25°C, 5.0mA≤I_O≤1.5A
			4	50		T_J=25°C, 250mA≤I_O≤750mA
I_Q	Quiescent Current		5.0	8	mA	T_J=25°C
ΔI_Q	Quiescent Current Change			0.5	mA	5mA≤I_O≤1.0A
				0.8		8V≤V_I≤25V
$\Delta V_O/\Delta T$	Output Voltage Drift		-0.8		mV/°C	I_O=5mA
V_N	Output Noise Voltage		42		μV	T_A=25°C, 10Hz≤f≤100kHz
RR	Ripple Rejection	62	73		dB	f=120Hz, 8V≤V_I≤18V
V_D	Dropout Voltage		2		V	I_O=1A, T_J=25°C
R_O	Output Resistance		15		mΩ	f=1kHz
I_{SC}	Short Circuit Current		230		mA	V_I=35V, T_A=25°C
I_{PK}	Peak Current		2.2		A	T_J=25°C

(Refer to test circuit, **unless otherwise specified, $0°C \le T_J \le 125°C, I_O=500mA, V_I=11V, C_I=0.33\mu F, C_O=0.1\mu F$**)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Conditions
V_O	Output Voltage	5.75	6.0	6.25	V	$T_J=25°C$
		5.7	6.0	6.3		$5.0mA \le I_O \le 1.0A$, $P_D \le 15W$, $8.0V \le V_I \le 21V$
ΔV_O	Line Regulation (Note1)		5.0	60	mV	$T_J=25°C$, $8.3V \le V_I \le 21V$
			1.5	30		$T_J=25°C$, $9V \le V_I \le 13V$
ΔV_O	Load Regulation (Note1)		9	120	mV	$T_J=25°C$, $5.0mA \le I_O \le 1.5A$
			3	50		$T_J=25°C$, $250mA \le I_O \le 750mA$
I_Q	Quiescent Current		5.0	8	mA	$T_J=25°C$
ΔI_Q	Quiescent Current Change			0.5	mA	$5mA \le I_O \le 1.0A$
				0.8		$9V \le V_I \le 25V$
$\Delta V_O/\Delta T$	Output Voltage Drift		-0.8		mV/°C	$I_O=5mA$
V_N	Output Noise Voltage		45		μV	$T_A=25°C$, $10Hz \le f \le 100kHz$
RR	Ripple Rejection	59	75		dB	$f=120Hz$, $9V \le V_I \le 19V$
V_D	Dropout Voltage		2		V	$I_O=1A$, $T_J=25°C$
R_O	Output Resistance		19		mΩ	$f=1kHz$
I_{SC}	Short Circuit Current		250		mA	$V_I=35V$, $T_A=25°C$
I_{PK}	Peak Current		2.2		A	$T_J=25°C$

(Refer to test circuit, **unless otherwise specified, $0°C \leq T_J \leq 125°C$, I_O=500mA, V_I=14V, C_I=0.33μF, C_O=0.1μF**)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Conditions
V_O	Output Voltage	7.7	8.0	8.3	V	T_J=25°C
		7.6	8.0	8.4		5.0mA≤I_O≤1.0A, P_D≤15W, 10.5V≤V_I≤23V
ΔV_O	Line Regulation (Note1)		6	80	mV	T_J=25°C, 10.5V≤V_I≤23V
			2.0	40		T_J=25°C, 11V≤V_I≤17V
ΔV_O	Load Regulation (Note1)		12	100	mV	T_J=25°C, 5.0mA≤I_O≤1.5A
			5.0	50		T_J=25°C, 250mA≤I_O≤750mA
I_Q	Quiescent Current		5.0	8	mA	T_J=25°C
ΔI_Q	Quiescent Current Change			0.5	mA	5mA≤I_O≤1.0A
				0.8		11V≤V_I≤25V
$\Delta V_O/\Delta T$	Output Voltage Drift		-0.8		mV/°C	I_O=5mA
V_N	Output Noise Voltage		52		μV	T_A=25°C, 10Hz≤f≤100kHz
RR	Ripple Rejection	56	73		dB	f=120Hz, 11.5V≤V_I≤21.5V
V_D	Dropout Voltage		2		V	I_O=1A, T_J=25°C
R_O	Output Resistance		17		mΩ	f=1kHz
I_{SC}	Short Circuit Current		230		mA	V_I=35V, T_A=25°C
I_{PK}	Peak Current		2.2		A	T_J=25°C

(Refer to test circuit, **unless otherwise specified, $0°C \leq T_J \leq 125°C$, I_O=500mA, V_I=15V, C_I=0.33μF, C_O=0.1μF**)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Conditions
V_O	Output Voltage	8.65	9.0	9.35	V	T_J=25°C
		8.6	9.0	9.4		5.0mA≤I_O≤1.0A, P_D≤15W, 11.5V≤V_I≤24V
ΔV_O	Line Regulation (Note1)		6.0	90	mV	T_J=25°C, 11.5V≤V_I≤24V
			2.0	45		T_J=25°C, 12.5V≤V_I≤19V
ΔV_O	Load Regulation (Note1)		12	100	mV	T_J=25°C, 5.0mA≤I_O≤1.5A
			5	50		T_J=25°C, 250mA≤I_O≤750mA
I_Q	Quiescent Current		5.0	8.0	mA	T_J=25°C
ΔI_Q	Quiescent Current Change			0.5	mA	5mA≤I_O≤1.0A
				0.8		12V≤V_I≤25V
$\Delta V_O/\Delta T$	Output Voltage Drift		-1		mV/°C	I_O=5mA
V_N	Output Noise Voltage		58		μV	T_A=25°C, 10Hz≤f≤100kHz
RR	Ripple Rejection	56	71		dB	f=120Hz, 13V≤V_I≤23V
V_D	Dropout Voltage		2		V	I_O=1A, T_J=25°C
R_O	Output Resistance		17		mΩ	f=1kHz
I_{SC}	Short Circuit Current		250		mA	V_I=35V, T_A=25°C
I_{PK}	Peak Current		2.2		A	T_J=25°C

(Refer to test circuit, **unless otherwise specified, $0°C \leq T_J \leq 125°C, I_O=500mA, V_I=16V, C_I=0.33\mu F, C_O=0.1\mu F$**)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Conditions
V_O	Output Voltage	9.6	10	10.4	V	$T_J=25°C$
		9.5	10	10.5		$5.0mA \leq I_O \leq 1.0A$, $P_D \leq 15W$, $12.5V \leq V_I \leq 25V$
ΔV_O	Line Regulation (Note1)		8	100	mV	$T_J=25°C$, $12.5V \leq V_I \leq 25V$
			3	50		$T_J=25°C$, $13V \leq V_I \leq 20V$
ΔV_O	Load Regulation (Note1)		12	100	mV	$T_J=25°C$, $5.0mA \leq I_O \leq 1.5A$
			5	50		$T_J=25°C$, $250mA \leq I_O \leq 750mA$
I_Q	Quiescent Current			0.5	mA	$T_J=25°C$
ΔI_Q	Quiescent Current Change			0.8	mA	$5mA \leq I_O \leq 1.0A$
				1.0		$12.8V \leq V_I \leq 25V$
$\Delta V_O/\Delta T$	Output Voltage Drift		-1		mV/°C	$I_O=5mA$
V_N	Output Noise Voltage		58		μV	$T_A=25°C$, $10Hz \leq f \leq 100kHz$
RR	Ripple Rejection	56	71		dB	$f=120Hz$, $14V \leq V_I \leq 24V$
V_D	Dropout Voltage		2		V	$I_O=1A$, $T_J=25°C$
R_O	Output Resistance		17		mΩ	$f=1kHz$
I_{SC}	Short Circuit Current		250		mA	$V_I=35V$, $T_A=25°C$
I_{PK}	Peak Current		2.2		A	$T_J=25°C$

(Refer to test circuit, **unless otherwise specified, $0°C \leq T_J \leq 125°C$, I_O=500mA, V_I=19V, C_I=0.33μF, C_O=0.1μF**)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Conditions
V_O	Output Voltage	11.5	12	12.5	V	T_J=25°C
		11.4	12	12.6		5.0mA≤I_O≤1.0A, P_D≤15W, 14.5V≤V_I≤27V
ΔV_O	Line Regulation (Note1)		10	120	mV	T_J=25°C, 14.5V≤V_I≤27V
			3.0	60		T_J=25°C, 16V≤V_I≤22V
ΔV_O	Load Regulation (Note1)		12	100	mV	T_J=25°C, 5.0mA≤I_O≤1.5A
			5.0	50		T_J=25°C, 250mA≤I_O≤750mA
I_Q	Quiescent Current		5.1	8	mA	T_J=25°C
ΔI_Q	Quiescent Current Change			0.5	mA	5mA≤I_O≤1.0A
				0.8		14V≤V_I≤27V
$\Delta V_O/\Delta T$	Output Voltage Drift		-1		mV/°C	I_O=5mA
V_N	Output Noise Voltage		76		μV	T_A=25°C, 10Hz≤f≤100kHz
RR	Ripple Rejection	55	71		dB	f=120Hz, 15V≤V_I≤25V
V_D	Dropout Voltage		2		V	I_O=1A, T_J=25°C
R_O	Output Resistance		18		mΩ	f=1kHz
I_{SC}	Short Circuit Current		230		mA	V_I=35V, T_A=25°C
I_{PK}	Peak Current		2.2		A	T_J=25°C

(Refer to test circuit, **unless otherwise specified, $0°C \leq T_J \leq 125°C$, I_O=500mA, V_I=23V, C_I=0.33μF, C_O=0.1μF**)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Conditions
V_O	Output Voltage	14.4	15	15.6	V	T_J=25°C
		14.25	15	15.75		5.0mA≤I_O≤1.0A, P_D≤15W, 17.5V≤V_I≤30V
ΔV_O	Line Regulation (Note1)		11	150	mV	T_J=25°C, 17.5V≤V_I≤30V
			3	75		T_J=25°C, 20V≤V_I≤26V
ΔV_O	Load Regulation (Note1)		12	100	mV	T_J=25°C, 5.0mA≤I_O≤1.5A
			5	50		T_J=25°C, 250mA≤I_O≤750mA
I_Q	Quiescent Current		5.2	8	mA	T_J=25°C
ΔI_Q	Quiescent Current Change			0.5	mA	5mA≤I_O≤1.0A
				0.81.0		17.5V≤V_I≤30V
$\Delta V_O/\Delta T$	Output Voltage Drift		-1		mV/°C	I_O=5mA
V_N	Output Noise Voltage		90		μV	T_A=25°C, 10Hz≤f≤100kHz
RR	Ripple Rejection	54	70		dB	f=120Hz, 18.5V≤V_I≤28.5V
V_D	Dropout Voltage		2		V	I_O=1A, T_J=25°C
R_O	Output Resistance		19		mΩ	f=1kHz
I_{SC}	Short Circuit Current		250		mA	V_I=35V, T_A=25°C
I_{PK}	Peak Current		2.2		A	T_J=25°C

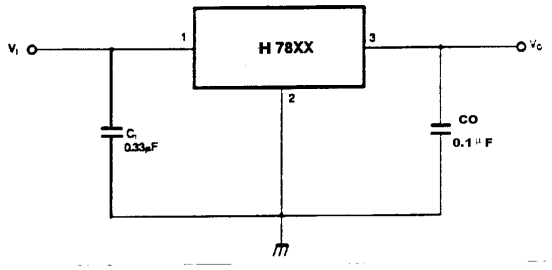
(Refer to test circuit, **unless otherwise specified, $0°C \leq T_J \leq 125°C$, I_O=500mA, V_I=27V, C_I=0.33μF, C_O=0.1μF**)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Conditions
V_O	Output Voltage	17.3	18	18.7	V	T_J=25°C
		17.1	18	18.9		5.0mA≤I_O≤1.0A, P_D≤15W, 21V≤V_I≤33V
ΔV_O	Line Regulation (Note1)		15	180	mV	T_J=25°C, 20.6V≤V_I≤33V
			5	90		T_J=25°C, 24V≤V_I≤30V
ΔV_O	Load Regulation (Note1)		15	100	mV	T_J=25°C, 5.0mA≤I_O≤1.5A
			7	50		T_J=25°C, 250mA≤I_O≤750mA
I_Q	Quiescent Current		5.2	8	mA	T_J=25°C
ΔI_Q	Quiescent Current Change			0.5	mA	5mA≤I_O≤1.0A
				0.8		21V≤V_I≤33V
$\Delta V_O/\Delta T$	Output Voltage Drift		-1		mV/°C	I_O=5mA
V_N	Output Noise Voltage		110		μV	T_A=25°C, 10Hz≤f≤100kHz
RR	Ripple Rejection	53	69		dB	f=120Hz, 22V≤V_I≤32V
V_D	Dropout Voltage		2		V	I_O=1A, T_J=25°C
R_O	Output Resistance		22		mΩ	f=1kHz
I_{SC}	Short Circuit Current		250		mA	V_I=35V, T_A=25°C
I_{PK}	Peak Current		2.2		A	T_J=25°C

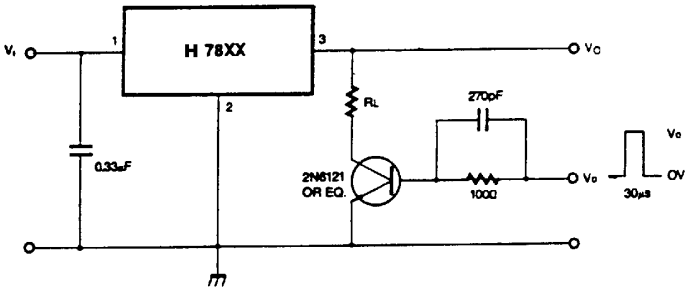
(Refer to test circuit, **unless otherwise specified, $0°C \leq T_J \leq 125°C, I_O=500mA, V_I=33V, C_I=0.33\mu F, C_O=0.1\mu F$**)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Conditions
V_O	Output Voltage	23	24	25	V	$T_J=25°C$
		22.8	24	25.2		$5.0mA \leq I_O \leq 1.0A$, $P_D \leq 15W$, $27V \leq V_I \leq 38V$
ΔV_O	Line Regulation (Note1)		18	240	mV	$T_J=25°C$, $26.7V \leq V_I \leq 38V$
			6	120		$T_J=25°C$, $30V \leq V_I \leq 36V$
ΔV_O	Load Regulation (Note1)		15	100	mV	$T_J=25°C$, $5.0mA \leq I_O \leq 1.5A$
			7	50		$T_J=25°C$, $250mA \leq I_O \leq 750mA$
I_Q	Quiescent Current		5.2	8	mA	$T_J=25°C$
ΔI_Q	Quiescent Current Change			0.5	mA	$5mA \leq I_O \leq 1.0A$
				0.8		$27.3V \leq V_I \leq 38V$
$\Delta V_O/\Delta T$	Output Voltage Drift		-1.5		mV/°C	$I_O=5mA$
V_N	Output Noise Voltage		160		μV	$T_A=25°C$, $10Hz \leq f \leq 100kHz$
RR	Ripple Rejection	50	67		dB	$f=120Hz$, $28V \leq V_I \leq 38V$
V_D	Dropout Voltage		2		V	$I_O=1A$, $T_J=25°C$
R_O	Output Resistance		28		mΩ	$f=1kHz$
I_{SC}	Short Circuit Current		230		mA	$V_I=35V$, $T_A=25°C$
I_{PK}	Peak Current		2.2		A	$T_J=25°C$

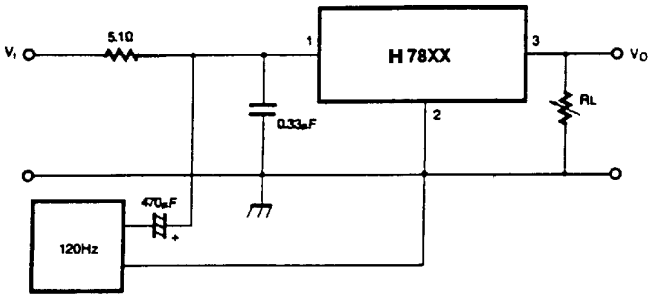
Typical Applications



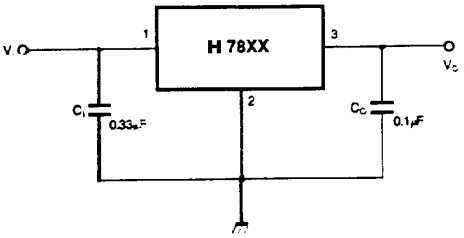
1、DC Parameters



2、Load Regulation



3、Ripple Rejection



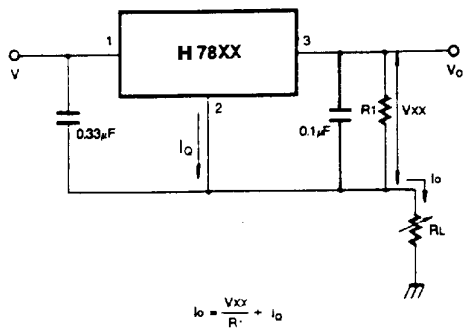
4、Fixed Output Regulator

Notes:

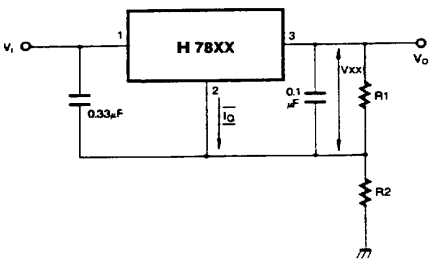
(1) To specify an output voltage. substitute voltage value for "XX." A common ground is required between the input and the Output voltage. The input voltage must remain typically 2.0V above the output voltage even during the low point on the input ripple voltage.

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

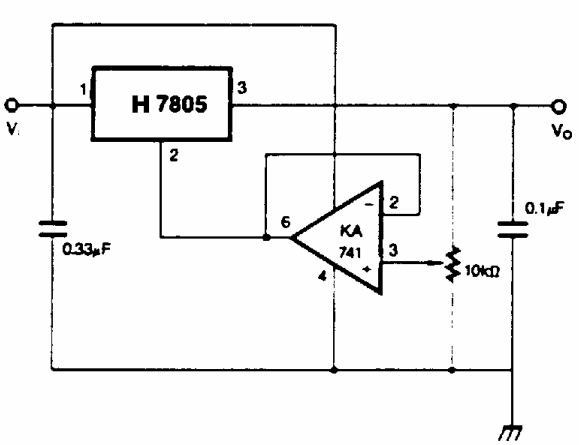
(3) C_O improves stability and transient response.



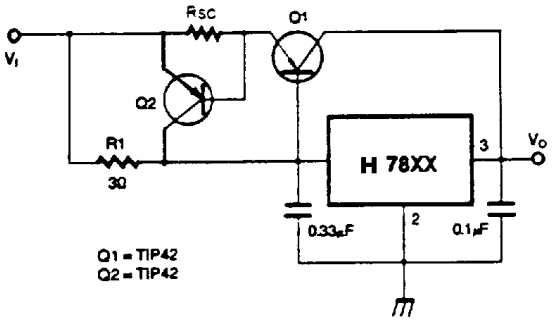
5、Constant Current Regulator



6、Circuit for Increasing Output Voltage

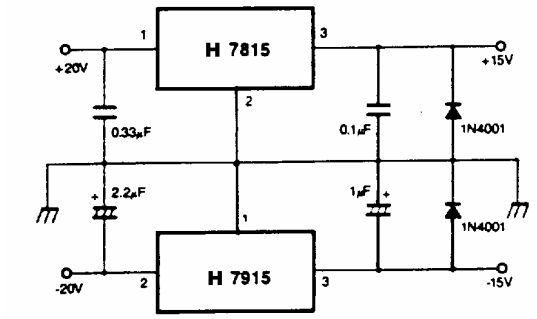


7、 Adjustable Output Regulator (7 to 30V)

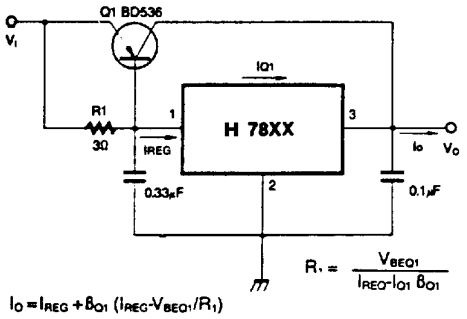


$$R_{SC} = \frac{V_{BEQ2}}{I_{SC}}$$

9、 High Output Current with Short Circuit Protection



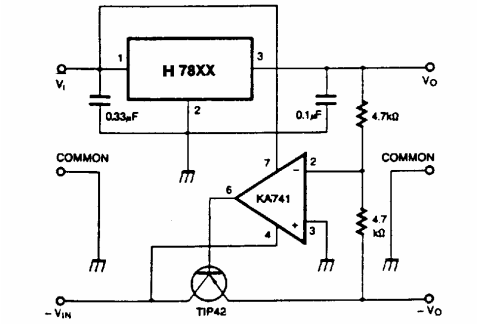
11、 Split Power Supply (±15V-1A)



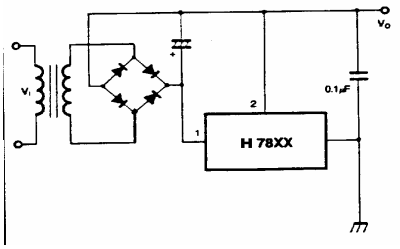
$$R_1 = \frac{V_{BEQ1}}{I_{REG} - I_{Q1}\,\beta_{Q1}}$$

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

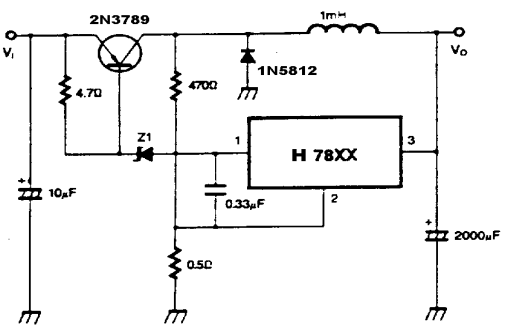
8、 High Current Voltage Regulator



10、 Tracking Voltage Regulator



12、 Negative Output Voltage Circuit



13、 Switching Regulator

Typical Perfomance Characteristics

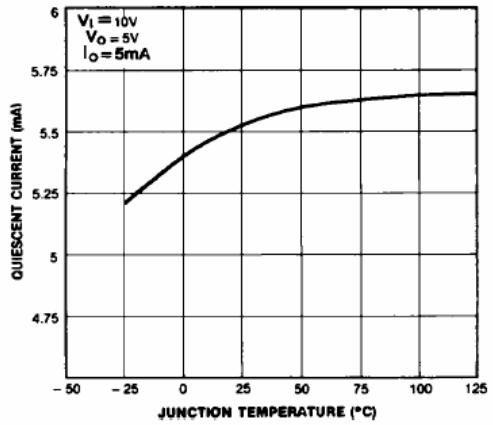


Figure 1. Quiescent Current

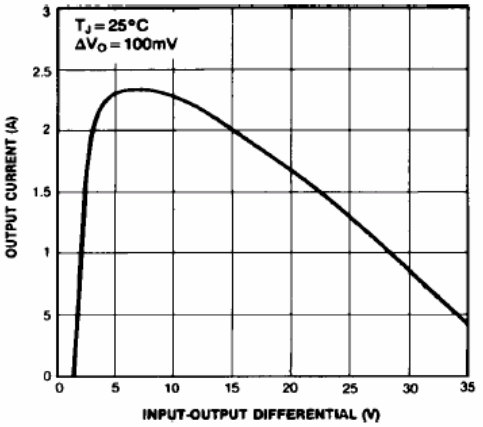


Figure 2. Peak Output Current

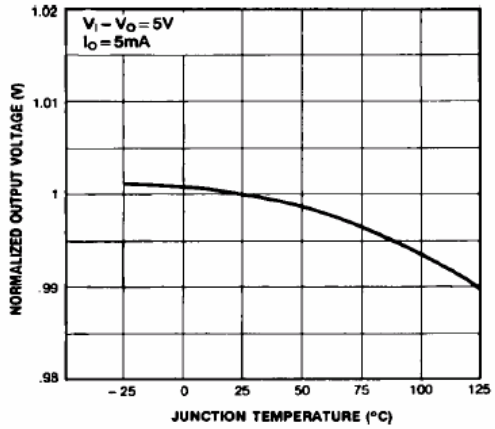


Figure 3. Output Voltage

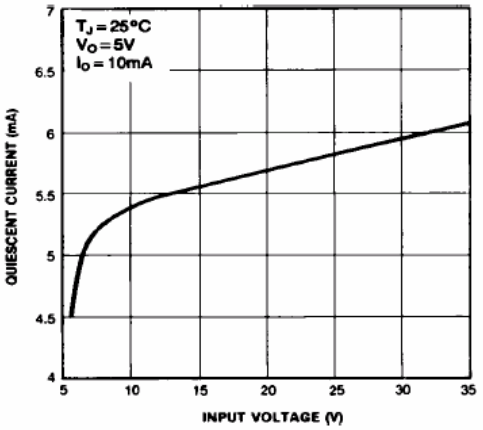


Figure 4. Quiescent Current