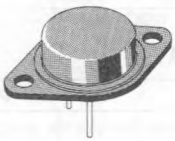
SGS-THOMSON MICROELECTRONICS

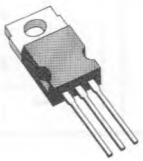
L7800AB/AC SERIES

PRECISION 1A REGULATORS

- OUTPUT CURRENT IN EXCESS OF 1A
- OUTPUT VOLTAGES OF 5; 6; 8; 12; 15; 18; 24V
- THERMAL OVERLOAD PROTECTION
- SHORT CIRCUIT PROTECTION
- OUTPUT TRANSISTOR SOA PROTECTION
- 2% OUTPUT VOLTAGE TOLERANCE
- GUARANTEED IN EXTENDED TEMPERATURE RANGES



TO-3

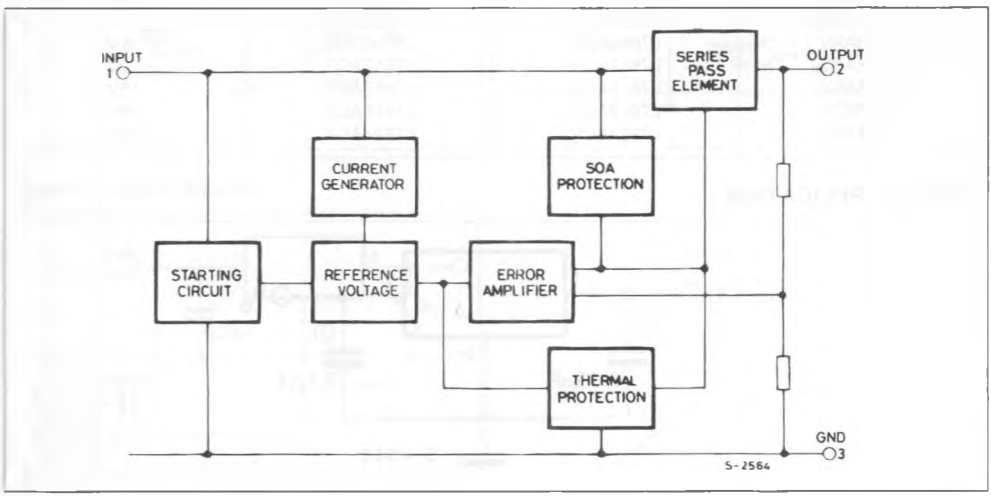


TO-220

DESCRIPTION

The L7800A series of three-terminal positive regulators is available in TO-220 and TO-3 packages and with several fixed output voltages, making it useful in a wide range of applications. These regulators can provide local on-card regulation, eliminating the distribution problems associated with single point regulation. 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 1A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents.

BLOCK DIAGRAM



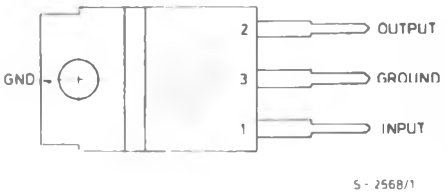
ABSOLUTE MAXIMUM RATINGS

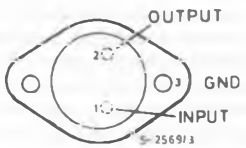
Symbol	Parameter	Value	Unit
V_i	DC Input Voltage (for V_o = 5 to 18V) (for V_o = 24V)	35 40	V V
I_o	Output Current	Internally limited	
P_{tot}	Power Dissipation	Internally limited	
T_j	Operating Junction Temperature for L7800AC for L7800AB	0 to 125 – 40 to 125	°C °C
T_{stg}	Storage Temperature	– 65 to + 150	°C

THERMAL DATA

Symbol	Parameter		TO-220	TO-3	Unit
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	3	4	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	50	35	°C/W

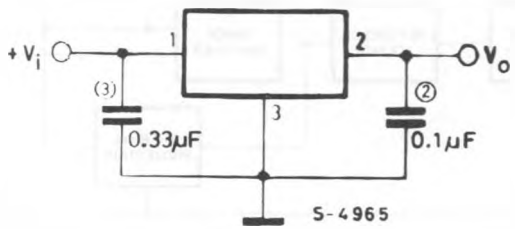
CONNECTION DIAGRAM AND ORDERING NUMBERS (top view)



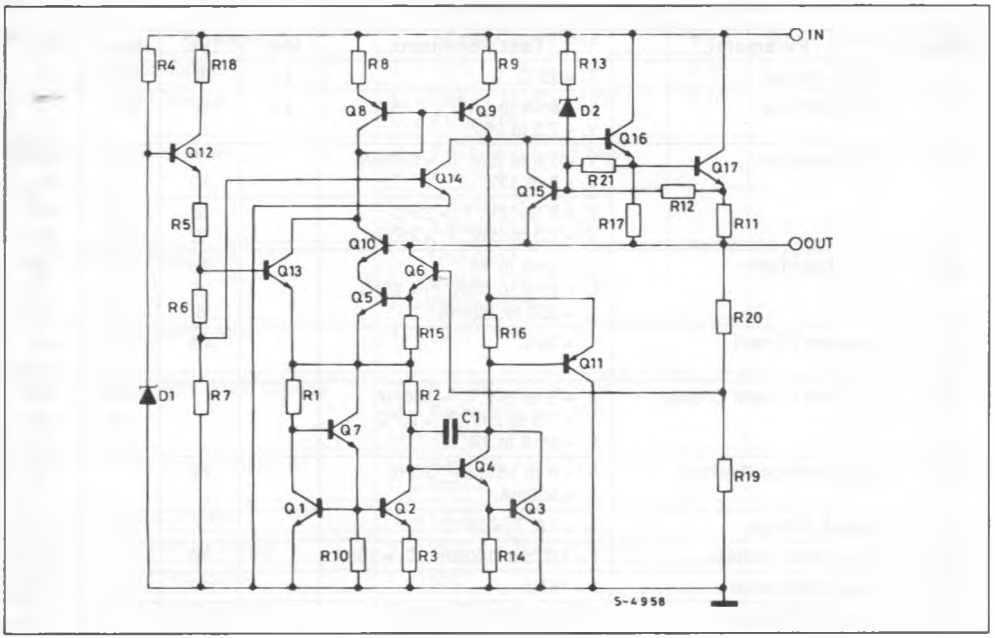


Ordering Numbers			Output Voltage
T_j = – 40 to 125 °C	T_j = 0 to 125°C		
TO-220	TO-220	TO-3	
L7805ABV	L7805ACV	L7805ACT	5V
L7806ABV	L7806ACV	L7806ACT	6V
L7808ABV	L7808ACV	L7808ACT	8V
L7812ABV	L7812ACV	L7812ACT	12V
L7815ABV	L7815ACV	L7815ACT	15V
L7818ABV	L7818ACV	L7818ACT	18V
L7824ABV	L7824ACV	L7824ACT	24V

TYPICAL APPLICATION



SCHEMATIC DIAGRAM



TEST CIRCUITS

Figure 1 : DC Parameters.

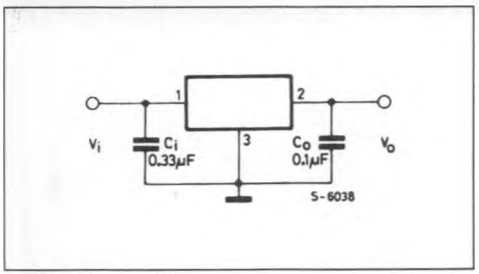


Figure 2 : Load Regulation.

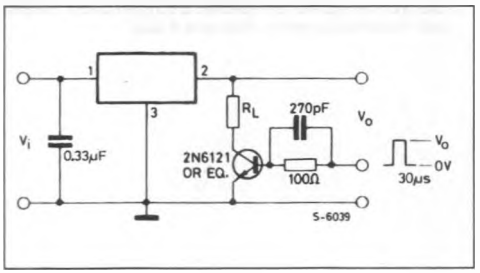
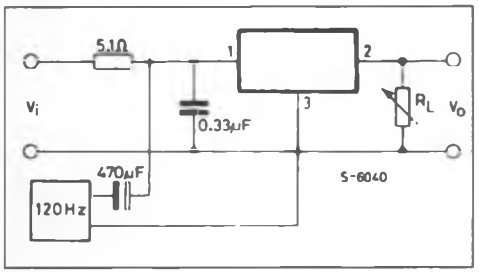


Figure 3 : Ripple Rejection.



ELECTRICAL CHARACTERISTICS L7805A (V_i = 10V, I_o = 1A, T_j = 0 to 125°C (L7805AC), T_j = – 40 to 125°C (L7805AB) unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_o	Output Voltage	T_j = 25°C	4.9	5	5.1	V
V_o	Output Voltage	I_o = 5mA to 1A, $P_o \leq$ 15W V_i = 7.5 to 20V	4.8	5	5.2	V
ΔV_o*	Line Regulation	V_i = 7.5 to 25V, I_o = 500mA V_i = 8 to 12V		7 10	50 50	mV mV
		V_i = 8 to 12V, T_j = 25°C V_i = 7.3 to 20V, T_j = 25°C		2 7	25 50	mV mV
ΔV_o*	Load Regulation	I_o = 5mA to 1A I_o = 5mA to 1.5A, T_j = 25°C I_o = 250 to 750mA		25 25 8	100 100 50	mV mV mV
I_d	Quiescent Current	T_j = 25°C		4.3	6 6	mA mA
ΔI_d	Quiescent Current Change	V_i = 8 to 25V, I_o = 500mA V_i = 7.5 to 20V, T_j = 25°C I_o = 5mA to 1A			0.8 0.8 0.5	mA mA mA
SVR	Supply Voltage Rejection	V_i = 8 to 18V, f = 120Hz I_o = 500mA		68		dB
V_d	Dropout Voltage	I_o = 1A T_j = 25°C		2		V
e_N	Output Noise Voltage	f = 10Hz to 100KHz, T_j = 25°C		10		$\mu V/V_o$
R_o	Output Resistance	f = 1KHz		17		mΩ
I_{sc}	Short Circuit Current	T_{amb} = 25°C V_i = 35V		0.2		A
I_{scp}	Short Circuit Peak Current	T_j = 25°C		2.2		A
$\frac{\Delta V_o}{\Delta T}$	Output Voltage Drift			– 1.1		mV/°C

* 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 cycle is used.

ELECTRICAL CHARACTERISTICS L7806A (V_i = 11V, I_o = 1A, T_j = 0 to 125°C (L7806AC), T_j = – 40 to 125°C (L7806AB) ; unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_o	Output Voltage	T_j = 25°C	5.88	6	6.12	V
V_o	Output Voltage	I_o = 5mA to 1A, $P_o \leq$ 15W V = 8.6 to 21V	5.76	6	6.24	V
ΔV_o*	Line Regulation	V_i = 8.6 to 25V, I_o = 500mA V = 9 to 13V		9 11	60 60	mV mV
		V_i = 9 to 13V, T_j = 25°C V_i = 8.3 to 21V, T_j = 25°C		3 9	30 60	mV mV
ΔV_o*	Load Regulation	I_o = 5mA to 1A I_o = 5mA to 1.5A, T_j = 25°C I_o = 250 to 750mA		43 43 16	100 100 50	mV mV mV
I_d	Quiescent Current	T_j = 25°C		4.3	6 6	mA mA
ΔI_d	Quiescent Current Change	V_i = 9 to 25V, I_o = 500mA V_i = 8.6 to 21V, T_j = 25°C I_o = 5mA to 1A			0.8 0.8 0.5	mA mA mA
SVR	Supply Voltage Rejection	V_i = 9 to 19V, f = 120Hz I_o = 500mA		65		dB
V_d	Dropout Voltage	I_o = 1A, T_j = 25°C		2		V
e_N	Output Noise Voltage	T_j = 25°C, f = 10Hz to 100KHz		10		$\mu V/V_o$
R_o	Output Resistance	f = 1KHz		17		mΩ
I_{sc}	Short Circuit Current	T_{amb} = 25°C, V_i = 35V		0.2		A
I_{scp}	Short Circuit Peak Current	T_j = 25°C		2.2		A
$\frac{\Delta V_o}{\Delta T}$	Output Voltage Drift			– 0.8		mV/°C

* 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 cycle is used.

ELECTRICAL CHARACTERISTICS L7808A (V_i = 14V, I_o = 1A, T_j = 0 to 125°C (L7808AC), T_j = – 40 to 125°C (L7808AB), unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_o	Output Voltage	T_j = 25°C	7.84	8	8.16	V
V_o	Output Voltage	I_o = 5mA to 1A, $P_o \leq$ 15W V_i = 10.6 to 23V	7.7	8	8.3	V
ΔV_o*	Line Regulation	V_i = 10.6 to 25V, I_o = 500mA V_i = 11 to 17V		12 15	80 80	mV mV
		V_i = 11 to 17V, T_j = 25°C V_i = 10.4 to 23V, T_j = 25°C		5 12	40 80	mV mV
ΔV_o*	Load Regulation	I_o = 5mA to 1A I_o = 5mA to 1.5A, T_j = 25°C I_o = 250 to 750mA		45 45 16	100 100 50	mV mV mV
I_d	Quiescent Current	T_j = 25°C		4.3	6 6	mA mA
ΔI_d	Quiescent Current Change	V_i = 11 to 25V, I_o = 500mA V_i = 10.6 to 23V, T_j = 25°C I_o = 5mA to 1A			0.8 0.8 0.5	mA mA mA
SVR	Supply Voltage Rejection	V_i = 11.5 to 21.5V, f = 120Hz I_o = 500mA		62		dB
V_d	Dropout Voltage	I_o = 1A T_j = 25°C		2		V
e_N	Output Noise Voltage	T_j = 25°C, f = 10Hz to 100KHz		10		μV/V_o
R_o	Output Resistance	f = 1KHz		18		mΩ
I_{sc}	Short Circuit Current	T_{amb} = 25°C V_i = 35V		0.2		A
I_{scp}	Short Circuit Peak Current	T_j = 25°C		2.2		A
$\frac{\Delta V_o}{\Delta T}$	Output Voltage Drift			– 0.8		mV/°C

* 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 cycle is used.

ELECTRICAL CHARACTERISTICS L7812A (V_i = 19V, I_o = 1A, T_j = 0 to 125°C (L7812AC), T_j = – 40 to 125°C (L7812AB), unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_o	Output Voltage	T_j = 25°C	11.75	12	12.25	V
V_o	Output Voltage	I_o = 5mA to 1A, $P_o \leq$ 15W V_i = 14.8 to 27V	11.5	12	12.5	V
ΔV_o*	Line Regulation	V_i = 14.8 to 30V, I_o = 500mA V_i = 16 to 22V		13 16	120 120	mV mV
		V_i = 16 to 22V, T_j = 25°C V_i = 14.5 to 27V, T_j = 25°C		6 13	60 120	mV mV
ΔV_o*	Load Regulation	I_o = 5mA to 1A I_o = 5mA to 1.5A, T_j = 25°C I_o = 250 to 750mA		46 46 17	100 100 50	mV mV mV
I_d	Quiescent Current	T_j = 25°C		4.4	6 6	mA mA
ΔI_d	Quiescent Current Change	V_i = 15 to 30V, I_o = 500mA V_i = 14.8 to 27V, T_j = 25°C I_o = 5mA to 1A			0.8 0.8 0.5	mA mA mA
SVR	Supply Voltage Rejection	V_i = 15 to 25V, f = 120Hz I_o = 500mA		60		dB
V_d	Dropout Voltage	I_o = 1A T_j = 25°C		2		V
e_N	Output Noise Voltage	T_j = 25°C, f = 10Hz to 100KHz		10		$\mu V/V_o$
R_o	Output Resistance	f = 1KHz		18		mΩ
i_{sc}	Short Circuit Current	T_{amb} = 25°C V_i = 35V		0.2		A
I_{scp}	Short Circuit Peak Current	T_j = 25°C		2.2		A
$\frac{\Delta V_o}{\Delta T}$	Output Voltage Drift			– 1		mV/°C

* 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 cycle is used.

ELECTRICAL CHARACTERISTICS L7815A (V_i = 23V, I_o = 1A, T_j = 0 to 125°C (L7815AC), T_j = – 40 to 125°C (L7815AB), unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_o	Output Voltage	T_j = 25°C	14.7	15	15.3	V
V_o	Output Voltage	I_o = 5mA to 1A, $P_o \leq$ 15W V_i = 17.9 to 30V	14.4	15	15.6	V
ΔV_o*	Line Regulation	V_i = 17.9 to 30V, I_o = 500mA V_i = 20 to 26V		13 16	150 150	mV mV
		V_i = 20 to 26V, T_j = 25°C V_i = 17.5 to 30V, T_j = 25°C		6 13	75 150	mV mV
ΔV_o*	Load Regulation	I_o = 5mA to 1A I_o = 5mA to 1.5A, T_j = 25°C I_o = 250 to 750mA		52 52 20	100 100 50	mV mV mV
I_d	Quiescent Current	T_j = 25°C		4.4	6 6	mA mA
ΔI_d	Quiescent Current Change	V_i = 17.5 to 30V, I_o = 500mA V_i = 17.5 to 30V, T_j = 25°C I_o = 5mA to 1A			0.8 0.8 0.5	mA mA mA
SVR	Supply Voltage Rejection	V_i = 18.5 to 28.5V, f = 120Hz I_o = 500mA		58		dB
V_d	Dropout Voltage	I_o = 1A, T_j = 25°C		2		V
e_N	Output Noise Voltage	T_j = 25°C, f = 10Hz to 100KHz		10		μV/V_o
R_o	Output Resistance	f = 1KHz		19		mΩ
I_{sc}	Short Circuit Current	T_{amb} = 25°C, V_i = 35V		0.2		A
I_{scp}	Short Circuit Peak Current	T_j = 25°C		2.2		A
$\frac{\Delta V_o}{\Delta T}$	Output Voltage Drift			– 1		mV/°C

* 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 cycle is used.

ELECTRICAL CHARACTERISTICS L7818A (V_i = 27V, I_o = 1A, T_j = 0 to 125°C (L7818AC), T_j = – 40 to 125°C (L7818AB), unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_o	Output Voltage	T_j = 25°C	17.64	18	18.36	V
V_o	Output Voltage	I_o = 5mA to 1A, $P_o \leq$ 15W V_i = 21 to 33V	17.3	18	18.7	V
ΔV_o*	Line Regulation	V_i = 21 to 33V, I_o = 500mA V_i = 24 to 30V		25 28	180 180	mV mV
		V_i = 24 to 30V, T_j = 25°C V_i = 20.6 to 33V, T_j = 25°C		10 25	90 180	mV mV
ΔV_o*	Load Regulation	I_o = 5mA to 1A I_o = 5mA to 1.5A, T_j = 25°C I_o = 250 to 750mA		55 55 22	100 100 50	mV mV mV
I_d	Quiescent Current	T_j = 25°C		4.5	6 6	mA mA
ΔI_d	Quiescent Current Change	V_i = 21 to 33V, I_o = 500mA V_i = 21 to 33V, T_j = 25°C I_o = 5mA to 1A			0.8 0.8 0.5	mA mA mA
SVR	Supply Voltage Rejection	V_i = 22 to 32V, f = 120Hz I_o = 500mA		57		dB
V_d	Dropout Voltage	I_o = 1A T_j = 25°C		2		V
e_N	Output Noise Voltage	T_j = 25°C, f = 10Hz to 100KHz		10		$\mu V/V_o$
R_o	Output Resistance	f = 1KHz		19		mΩ
I_{sc}	Short Circuit Current	T_{amb} = 25°C V_i = 35V		0.2		A
I_{scp}	Short Circuit Peak Current	T_j = 25°C		2.2		A
$\frac{\Delta V_o}{\Delta T}$	Output Voltage Drift			– 1		mV/°C

* 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 cycle is used.

ELECTRICAL CHARACTERISTICS L7824A (V_i = 33V, I_o = 1A, T_j = 0 to 125°C (L7824AC), T_j = – 40 to 125°C (L7824AB), unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_o	Output Voltage	T_j = 25°C	23.5	24	24.5	V
V_o	Output Voltage	I_o = 5mA to 1A, $P_o \leq$ 15W V_i = 27.3 to 38V	23	24	25	V
ΔV_o*	Line Regulation	V_i = 27 to 38V, I_o = 500mA V_i = 30 to 36V		31 35	240 240	mV mV
		V_i = 30 to 36V, T_j = 25°C V_i = 26.7 to 38V, T_j = 25°C		14 31	120 240	mV mV
ΔV_o*	Load Regulation	I_o = 5mA to 1A I_o = 5mA to 1.5A, T_j = 25°C I_o = 250 to 750mA		60 60 25	100 100 50	mV mV mV
I_d	Quiescent Current	T_j = 25°C		4.6	6 6	mA mA
ΔI_d	Quiescent Current Change	V_i = 27.3 to 38V, I_o = 500mA V_i = 27.3 to 38V, T_j = 25°C I_o = 5mA to 1A			0.8 0.8 0.5	mA mA mA
SVR	Supply Voltage Rejection	V_i = 28 to 38V, f = 120Hz I_o = 500mA		54		dB
V_d	Dropout Voltage	I_o = 1A T_j = 25°C		2		V
e_N	Output Noise Voltage	T_j = 25°C, f = 10Hz to 100KHz		10		$\mu V/V_o$
R_o	Output Resistance	f = 1KHz		20		mΩ
I_{sc}	Short Circuit Current	T_{amb} = 25°C V_i = 35V		0.2		A
I_{scp}	Short Circuit Peak Current	T_j = 25°C		2.2		A
$\frac{\Delta V_o}{\Delta T}$	Output Voltage Drift			– 1.5		mV/°C

* 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 cycle is used.

APPLICATIONS INFORMATION

DESIGN CONSIDERATIONS

The L7800A Series of fixed voltage regulators are designed with Thermal Overload Protection that shuts down the circuit when subjected to an excessive power overload condition, Internal Short-circuit Protection that limits the maximum current the circuit will pass, and Output Transistor Safe-Area Compensation that reduces the output short-circuit current as the voltage across the pass transistor is increased.

In many low current applications, compensation capacitors are not required. However, it is recommended that the regulator input be bypassed with a capacitor if the regulator is connected to the power supply filter with long wire lengths, or if the output load capacitance is large. An input bypass capacitor should be selected to provide good high-frequency characteristics to insure stable operation under all load conditions. A 0.33µF or larger tantalum, mylar, or other capacitor having low internal impedance at high frequencies should be chosen. The bypass capacitor should be mounted with the shortest possible leads directly across the regulators input terminals. Normally good construction techniques should be used to minimize ground loops and lead resistance drops since the regulator has no external sense lead.

Figure 4 : Current Regulator.

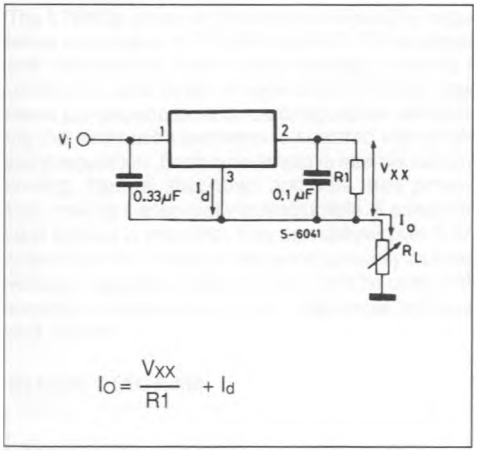
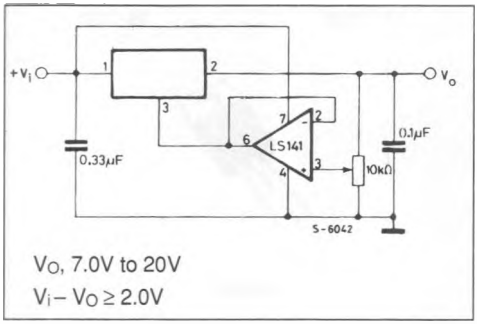


Figure 5 : Adjustable Output Regulator.



The addition of an operational amplifier allows adjustment to higher or intermediate values while retaining regulation characteristics. The minimum voltage obtainable with this arrangement is 2.0V greater than the regulator voltage.

Figure 6 : Current Boost Regulator.

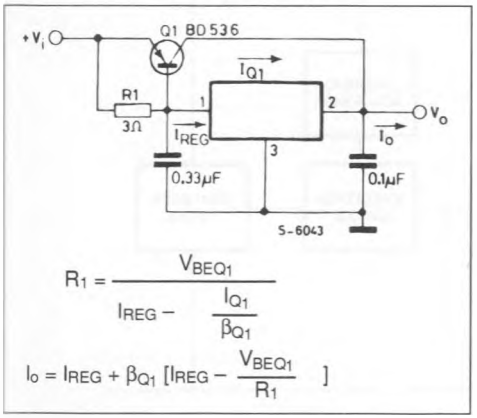
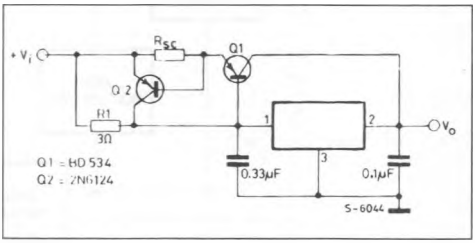


Figure 7 : Short-circuit Protection.



The circuit of figure 6 can be modified to provide supply protection against short circuit by adding a short-circuit sense resistor, R_{SC}, and an additional PNP transistor. The current sensing PNP must be able to handle the short-circuit current of the three-terminal regulator. Therefore, a four-ampere plastic power transistor is specified.