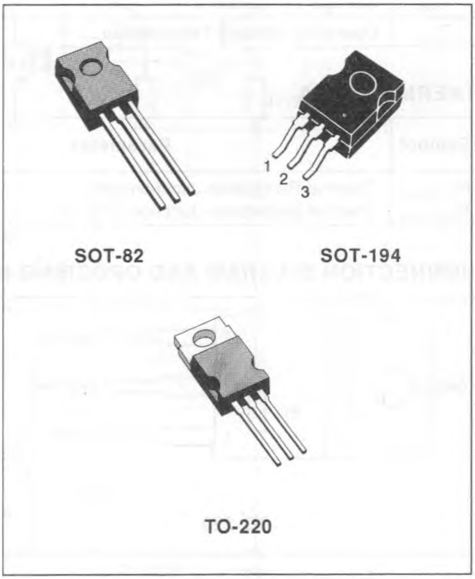
POSITIVE VOLTAGE REGULATORS

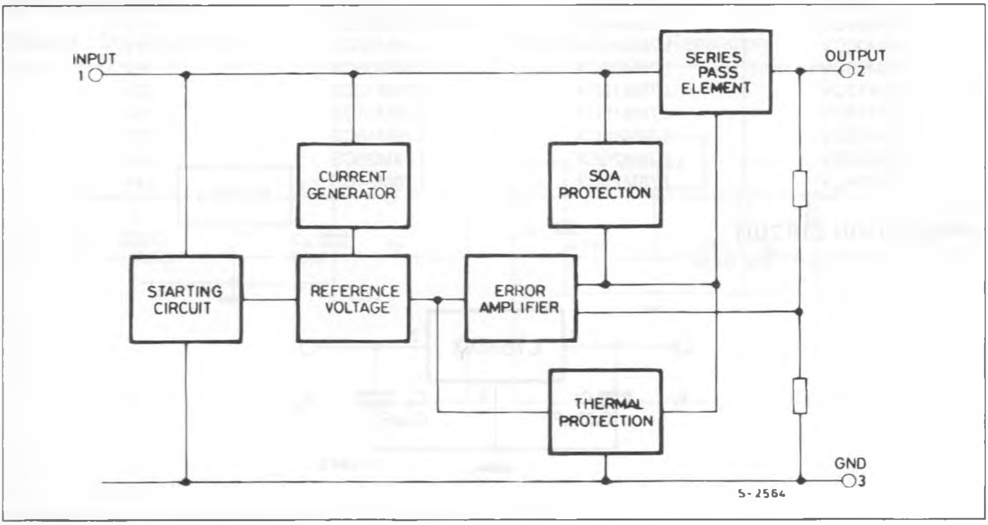
- OUTPUT CURRENT TO 0.5A
- OUTPUT VOLTAGES OF 5 ; 6 ; 8 ; 12 ; 15 ; 18 ; 20 ; 24V
- THERMAL OVERLOAD PROTECTION
- SHORT CIRCUIT PROTECTION
- OUTPUT TRANSISTOR SOA PROTECTION



DESCRIPTION

The L78M00 series of three-terminal positive regulators is available in TO-220 and SOT-82 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 0.5A 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



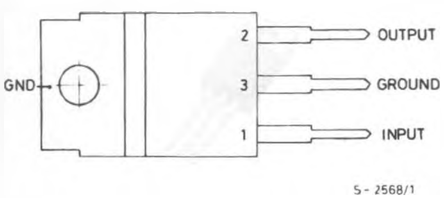
ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_i	DC Input Voltage (for V_o = 5 to 18V) (for V_o = 20, 24V)	35 40	V V
I_o	Output Current	Internally limited	
P_{tot}	Power Dissipation	Internally limited	
T_{stg}	Storage Temperature	– 65 to + 150	°C
T_{op}	Operating Junction Temperature	0 to + 150	°C

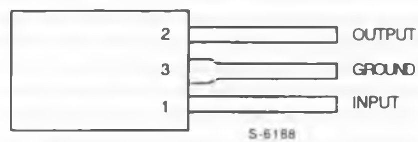
THERMAL DATA

Symbol	Parameter		SOT-82 SOT-194	TO-220	Unit
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	8	3	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	100	50	°C/W

CONNECTION DIAGRAM AND ORDERING NUMBERS (top view)



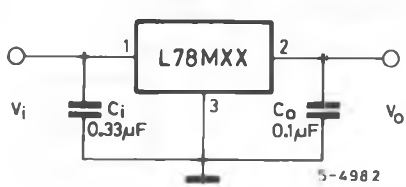
TO-220



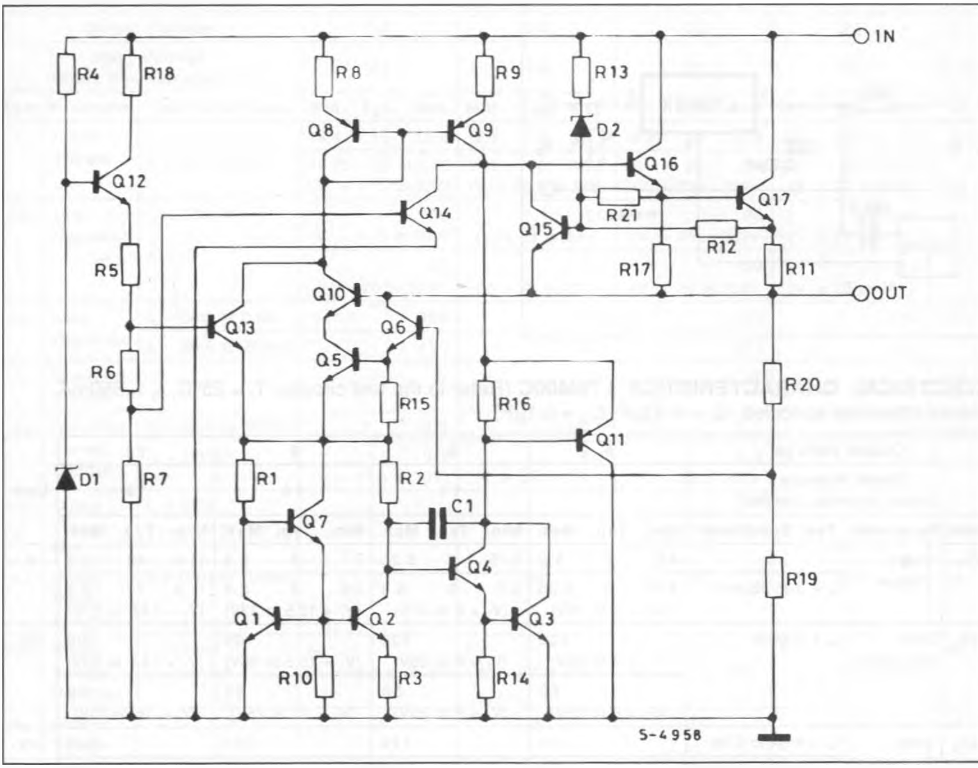
SOT82/194

Order Codes			Output Voltage
TO-220	SOT-82	SOT-194	
L78M05CV	L78M05CX	L78M05CS	5 V
L78M06CV	L78M06CX	L78M06CS	6 V
L78M08CV	L78M08CX	L78M08CS	8 V
L78M12CV	L78M12CX	L78M12CS	12V
L78M15CV	L78M15CX	L78M15CS	15V
L78M18CV	L78M18CX	L78M18CS	18V
L78M20CV	L78M20CX	L78M20CS	20V
L78M24CV	L78M24CX	L78M24CS	24V

APPLICATION CIRCUIT



SCHEMATIC DIAGRAM



TEST CIRCUITS

Figure 1 : DC Parameters.

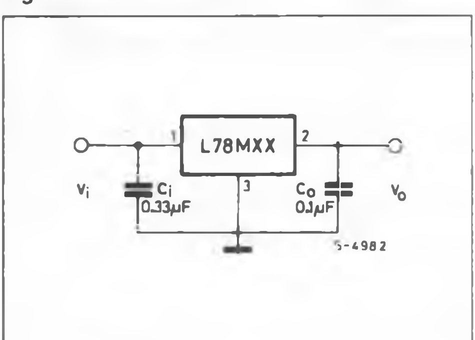


Figure 2 : Load Regulation.

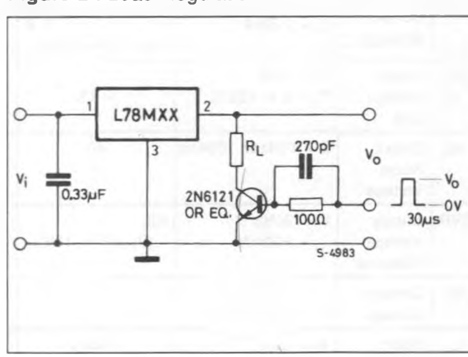
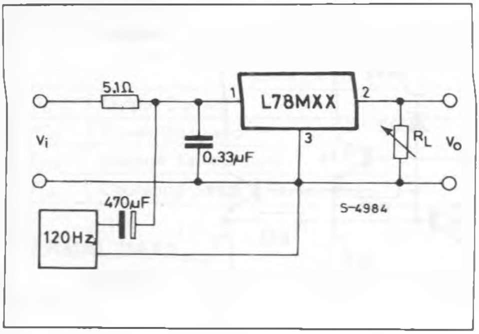


Figure 3 : Ripple Rejection.



ELECTRICAL CHARACTERISTICS L78M00C (Refer to the test circuits, T_j = 25°C, I_o = 350mA unless otherwise specified, C_i = 0.33μF, C_o = 0.1μF)

Output Voltage			5			6			8			12			Unit
Input Voltage (Unless otherwise specified)			10			11			14			19			
Sym.	Parameter	Test Conditions	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
V_o	Output Voltage		4.8	5	5.2	5.75	6	6.25	7.7	8	8.3	11.5	12	12.5	V
		I_o = 5 to 350mA	4.75	5	5.25	5.7	6	6.3	7.6	8	8.4	11.4	12	12.6	
				(V_i = 7 to 20V)			(V_i = 8 to 21V)			(V_i = 10.5 to 23V)			(V_i = 14.5 to 27V)		
ΔV_o	Line Regulation	I_o = 200mA			100			100			100			100	mV
				(V_i = 7 to 25V)			(V_i = 8 to 25V)			(V_i = 10.5 to 25V)			(V_i = 14.5 to 30V)		
					50			50			50			50	
				(V_i = 8 to 25V)			(V_i = 9 to 25V)			(V_i = 11 to 25V)			(V_i = 16 to 30V)		
ΔV_o	Load Regulation	I_o = 5mA to 0.5A			100			120			160			240	mV
		I_o = 5mA to 200mA			50			60			80			120	
I_d	Quiescent Current				6			6			6			6	mA
ΔI_d	Quiescent Current Change	I_o = 5mA to 350mA			0.5			0.5			0.5			0.5	mA
		I_o = 200mA			0.8			0.8			0.8			0.8	
				(V_i = 8 to 25V)			(V_i = 9 to 25V)			(V_i = 10.5 to 25V)			(V_i = 14.5 to 30V)		
$\frac{\Delta V_o}{\Delta T}$	Output Voltage Drift	I_o = 5mA T_j = 0 to 125°C		− 0.5			− 0.5			− 0.5			− 1.0		mV/°C
e_N	Output Noise Voltage	B = 10Hz to 100KHz		40			45			52			75		μV
SVR	Supply Voltage Rejection	f = 120Hz I_o = 300mA	62			59			56			55			dB
				(V_i = 8 to 18V)			(V_i = 9 to 19V)			(V_i = 11.5 to 21.5V)			(V_i = 15 to 25V)		
V_d	Dropout Voltage			2			2			2			2		V
I_{sc}	Short Circuit Current	V_i = 35V		300			270			250			240		mA
I_{scp}	Short Circ. Peak Current			700			700			700			700		mA

ELECTRICAL CHARACTERISTICS L78M00C (continued)

Output Voltage			15			18			20			24			Unit
Input Voltage (Unless otherwise specified)			23			26			29			33			
Sym.	Parameter	Test Conditions	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
V_o	Output Voltage		14.4	15	15.6	17.3	18	18.7	19.2	20	20.8	23	24	25	V
		I_o = 5 to 350mA	14.25	15	15.75	17.1	18	18.9	19	20	21	22.8	24	25.2	
			(V_i = 17.5 to 30V)			(V_i = 20.5 to 33V)			(V_i = 23 to 35V)			(V_i = 27 to 38V)			
ΔV_o	Line Regulation	I_o = 200mA			100			100			100			100	mV
			(V_i = 17.5 to 30V)			(V_i = 21 to 33V)			(V_i = 23 to 35V)			(V_i = 27 to 38V)			
					50			50			50			50	
			(V_i = 20 to 30V)			(V_i = 24 to 33V)			(V_i = 24 to 35V)			(V_i = 28 to 38V)			
ΔV_o	Load Regulation	I_o = 5mA to 0.5A			300			360			400			480	mV
		I_o = 5mA to 200mA			150			180			200			240	
I_d	Quiescent Current				6			6			6			6	mA
ΔI_d	Quiescent Current Change	I_o = 5mA to 350mA			0.5			0.5			0.5			0.5	mA
		I_o = 200mA			0.8			0.8			0.8			0.8	
			(V_i = 17.5 to 30V)			(V_i = 21 to 33V)			(V_i = 23 to 35V)			(V_i = 27 to 38V)			
$\frac{\Delta V_o}{\Delta T}$	Output Voltage Drift	I_o = 5mA, T_{amb} = 0 to 125°C		−1			−1.1			−1.1			−1.2		mV/°C
e_N	Output Noise Voltage	B = 10Hz to 100KHz		90			100			110			170		μV
SVR	Supply Voltage Rejection	f = 120Hz, I_o = 300mA	54 (V_i = 18.5 to 28.5V)			53 (V_i = 22 to 32V)			53 (V_i = 24 to 34V)			50 (V_i = 28 to 38V)			dB
V_d	Dropout Voltage			2			2			2			2		V
I_{sc}	Short Circuit Current	V_i = 35V		240			240			240			240		mA
I_{scp}	Short Circ. Peak Current			700			700			700			700		mA

Figure 4 : Dropout Voltage vs. Junction Temperature.

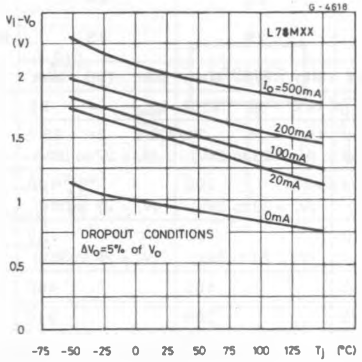


Figure 5 : Dropout Characteristics.

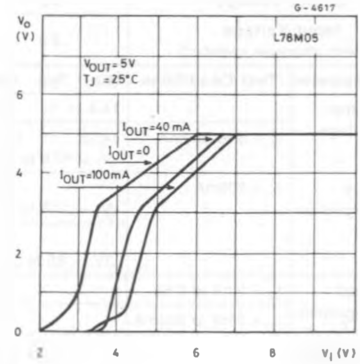


Figure 6 : Peak Output Current vs. Input-Output Differential Voltage.

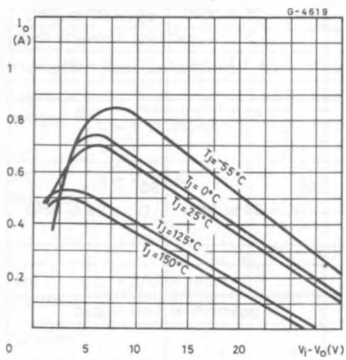


Figure 7 : Output Voltage vs. Junction Temperature.

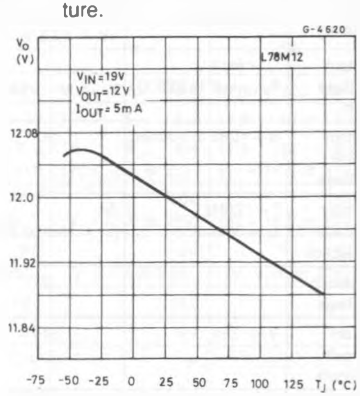


Figure 8 : Supply Voltage Rejection vs. Frequency.

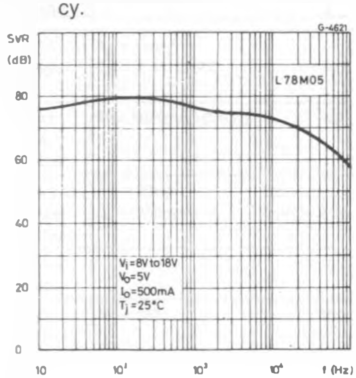


Figure 9 : Quiescent Current vs. Junction Temperature.

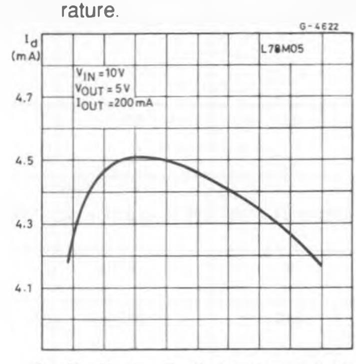


Figure 10 : Load Transient Response.

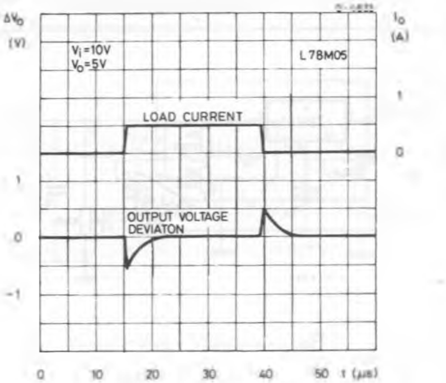


Figure 11 : Line Transient Response.

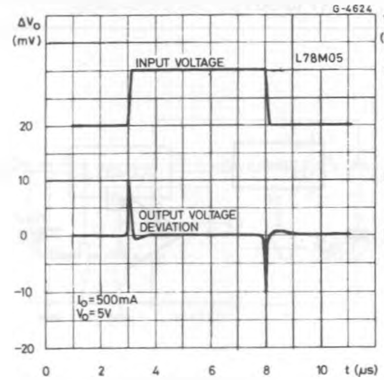


Figure 12 : Quiescent Current vs. Input Voltage.

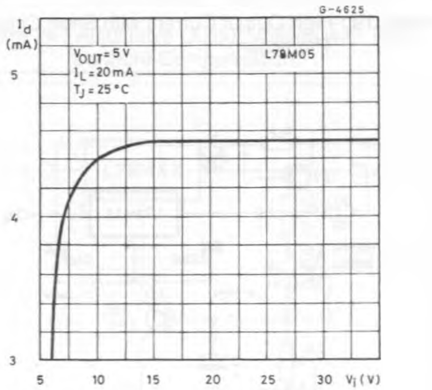
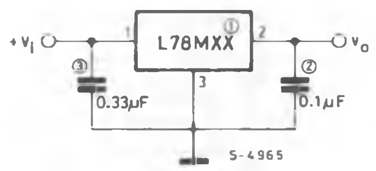


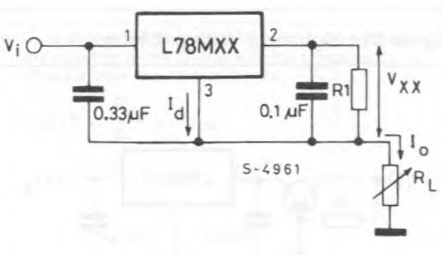
Figure 13 : Fixed Output Regulator.



Notes :

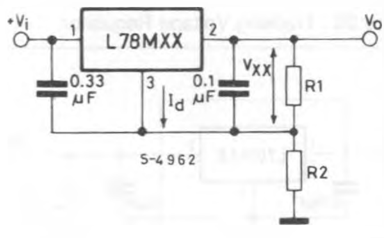
1. To specify an output voltage, substitute voltage value for "XX".
2. Although no output capacitor is needed for stability, it does improve transient response.
3. Required if regulator is located an appreciable distance from power supply filter.

Figure 14 : Constant Current Regulator.



$$I_O = \frac{V_{XX}}{R_1} + I_d$$

Figure 15 : Circuit for Increasing Output Voltage.



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

$$V_O = V_{XX}\ (1 + \frac{R_2}{R_1}) + I_d R_2$$

Figure 16 : Adjustable Output Regulator (7 to 30V).

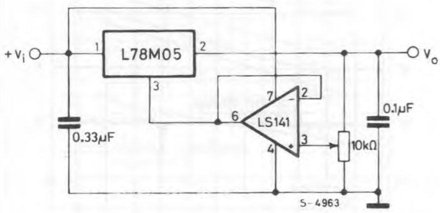
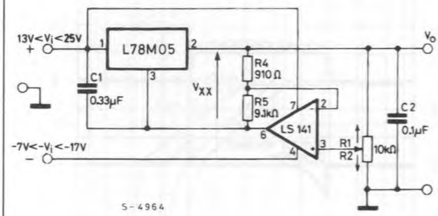
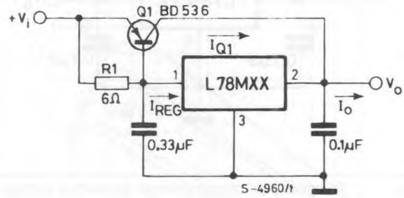


Figure 17 : 0.5 to 10V Regulator.



$$V_O = V_{XX}\,\frac{R_4}{R_1}$$

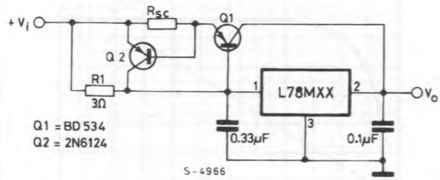
Figure 18 : High Current Voltage Regulator.



$$R_1 = \frac{V_{BEQ1}}{I_{REG} - \dfrac{IQ_1}{\beta Q_1}}$$

$$I_O = I_{REG} + Q_1\,[I_{REG} - \frac{V_{BEQ1}}{R_1}]$$

Figure 19 : High Output Current with Short Circuit Protection.



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

Figure 20 : Tracking Voltage Regulator.

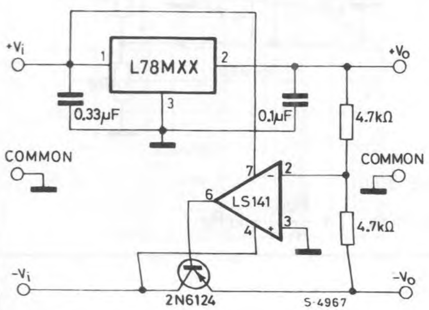
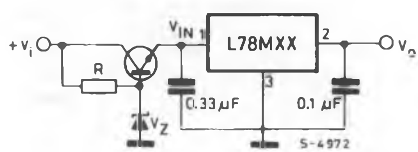
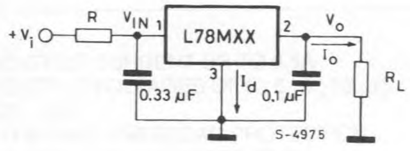


Figure 21 : High Input Voltage Circuit.



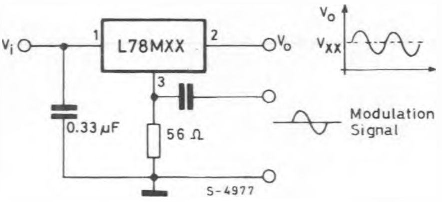
$$V_{IN} = V_Z - V_{BE}$$

Figure 22 : Reducing Power Dissipation with Dropping Resistor.



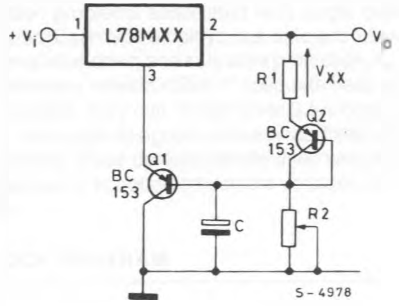
$$R = \frac{V_{i(min)} - V_{XX} - V_{DROP(max)}}{I_{O(max)} + I_{d(max)}}$$

Figure 23 : Power AM Modulator (unity voltage gain, $I_O \leq 0.5$).



Note : The circuit performs well up to 100KHz.

Figure 24 : Adjustable Output Voltage with Temperature Compensation.



Note : Q_2 is connected as a diode in order to compensate the variation of the Q_1 V_{BE} with the temperature. C allows a slow rise-time of the V_O

$$V_O = V_{XX}\left(1 + \frac{R_2}{R_1}\right) + V_{BE}$$