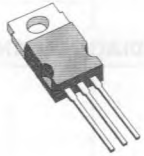
SGS-THOMSON MICROELECTRONICS

L78M00AB SERIES

PRECISION 500mA REGULATORS

- OUTPUT CURRENT UP TO 0.5A
- OUTPUT VOLTAGES OF 5 ; 6 ; 8 ; 12 ; 15 ; 18 ; 20 ; 24V
- THERMAL OVERLOAD PROTECTION
- SHORT CIRCUIT PROTECTION
- OUTPUT TRANSISTORS SOA PROTECTION
- ± 2% OUTPUT VOLTAGE TOLERANCE
- GUARANTEED IN EXTENDED TEMPERATURE RANGES

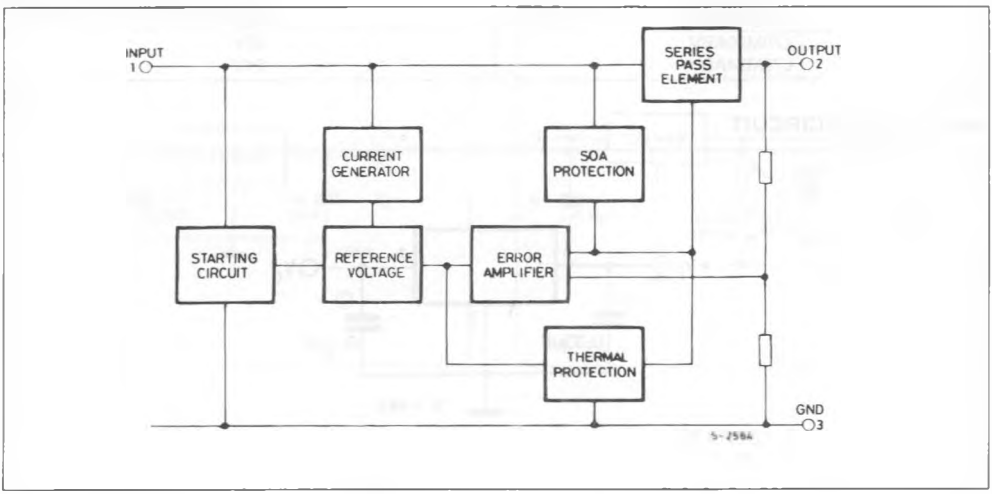


TO-220

DESCRIPTION

The L78M00AB series of three-therminal positive regulators is available in TO-220 package 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



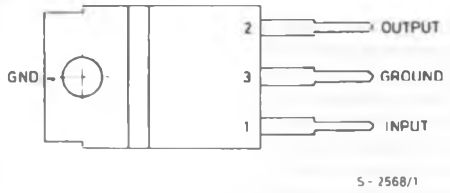
ABSOLUTE MAXIMUM RATINGS

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_j	Operating Junction Temperature	– 40 to 125	°C

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	Max	3	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	50	°C/W

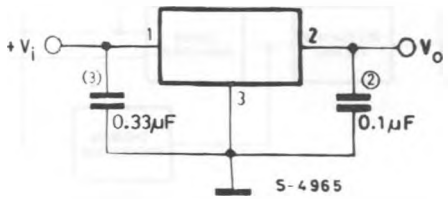
CONNECTION DIAGRAM AND ORDER CODES (top view)



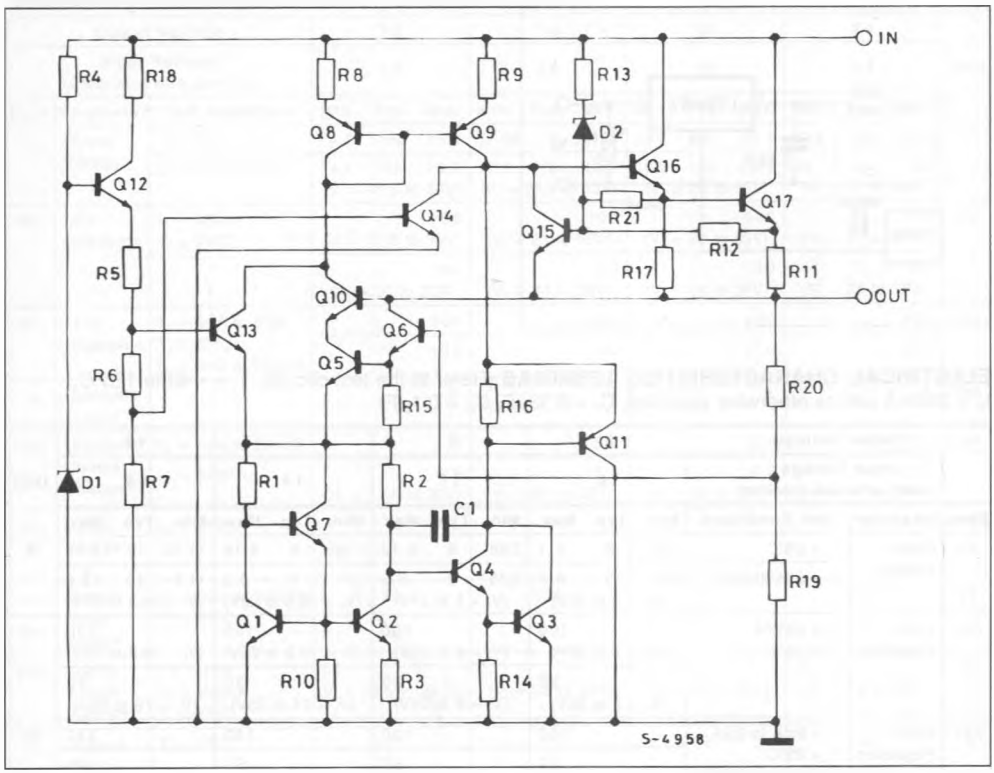
TO-220

Codes	Output Voltage
L78M05ABV	5V
L78M06ABV	6V
L78M08ABV	8V
L78M12ABV	12V
L78M15ABV	15V
L78M18ABV	18V
L78M20ABV	20V
L78M24ABV	24V

APPLICATION CIRCUIT



SCHEMATIC DIAGRAM



TEST CIRCUITS

Figure 1 : DC Parameters.

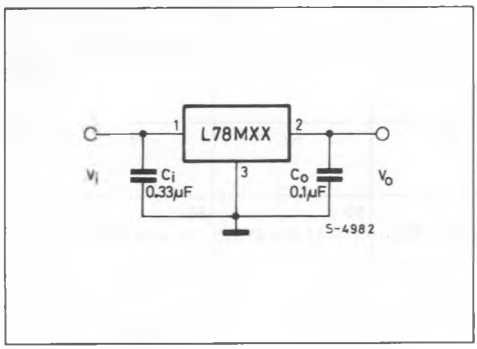


Figure 2 : Load Regulation.

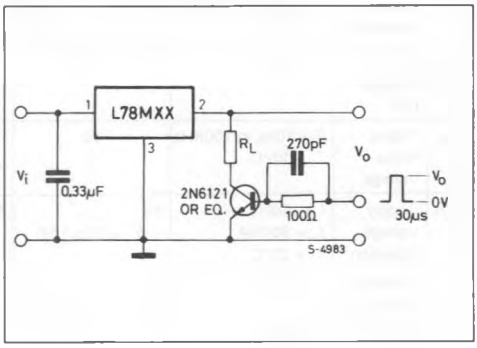
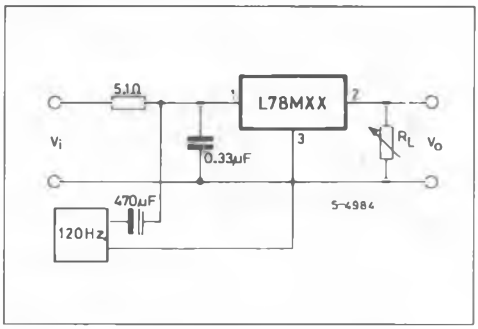


Figure 3 : Ripple Rejection.



ELECTRICAL CHARACTERISTICS L78M00AB (Refer to the test circuits, T_j = – 40 to 125°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	T_j = 25°C	4.9	5	5.1	5.88	6	6.12	7.84	8	8.16	11.75	12	12.25	V
		I_o = 5 to 350mA	4.8	5	5.2	5.75	6	6.3	7.7	8	8.3	11.5	12	12.5	
			(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 T_j = 25°C			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)			
					30			30			30			30	
			(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 T_j = 25°C			100			120			160			240	mV
		I_o = 5mA to 200mA			50			60			80			120	
I_d	Quiescent Current	T_j = 25°C			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		– 0.5			– 0.5			– 0.5			– 1.0		mV/°C
e_N	Output Noise Voltage	B = 10Hz to 100KHz T_j = 25°C		40			45			52			75		µV
SVR	Supply Voltage Rejection	f = 120Hz I_o = 300mA T_j = 25°C	62 (V_i = 8 to 18V)			59 (V_i = 9 to 19V)			56 (V_i = 11.5 to 21.5V)			55 (V_i = 15 to 25V)			dB
V_d	Dropout Voltage	T_j = 25°C		2			2			2			2		V
I_{sc}	Short Circuit Current	V_i = 35V T_j = 25°C		300			270			250			240		mA
I_{scp}	Short Circ Peak Current	T_j = 25°C		700			700			700			700		mA

ELECTRICAL CHARACTERISTICS L78M00AB (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	T_j = 25°C	14.7	15	15.3	17.64	18	18.36	19.6	20	20.4	23.5	24	24.5	V
		I_o = 5 to 350mA	14.4 (V_i = 17.5 to 30V)	15	15.6	17.3 (V_i = 20.5 to 33V)	18	18.7	19.2 (V_i = 23 to 35V)	20	20.8	23 (V_i = 27 to 38V)	24	25	
ΔV_o	Line Regulation	I_o = 200mA, T_j = 25°C			100 (V_i = 17.5 to 30V)			100 (V_i = 21 to 33V)			100 (V_i = 23 to 35V)			100 (V_i = 27 to 38V)	mV
					30 (V_i = 20 to 30V)			30 (V_i = 24 to 33V)			30 (V_i = 24 to 35V)			30 (V_i = 28 to 38V)	
ΔV_o	Load Regulation	I_o = 5mA to 0.5A, T_j = 25°C			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 (V_i = 17.5 to 30V)			0.8 (V_i = 21 to 33V)			0.8 (V_i = 23 to 35V)			0.8 (V_i = 27 to 38V)	
$\frac{\Delta V_o}{\Delta T}$	Output Voltage Drift	I_o = 5mA		– 1			– 1.1			– 1.1			– 1.2		mV/°C
e_N	Output Noise Voltage	B = 10Hz to 100KHz, T_j = 25°C		90			100			110			170		µV
SVR	Supply Voltage Rejection	f = 120Hz, I_o = 300mA, T_j = 25°C	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	T_j = 25°C		2			2			2			2		V
I_{sc}	Short Circuit Current	V_i = 35V, T_j = 25°C		240			240			240			240		mA
I_{scp}	Short Circ. Peak Current	T_j = 25°C		700			700			700			700		mA

Figure 4 : Dropout Voltage vs. Junction Temperature.

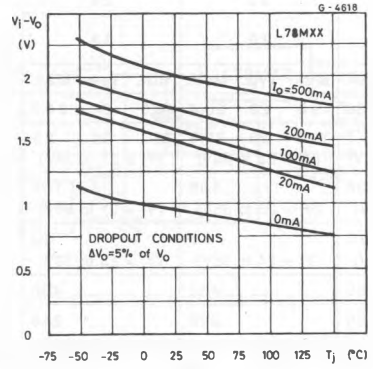


Figure 5 : Dropout Characteristics.

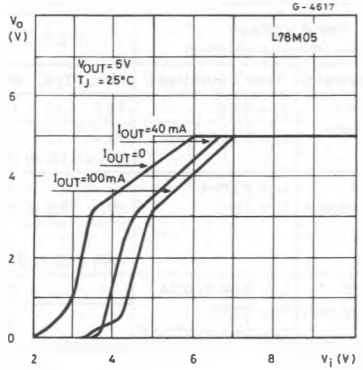


Figure 6 : Peak Output Current vs. Input-Output Differential Voltage.

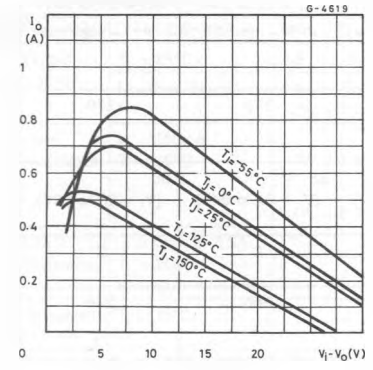


Figure 7 : Output Voltage vs. Junction Temperature.

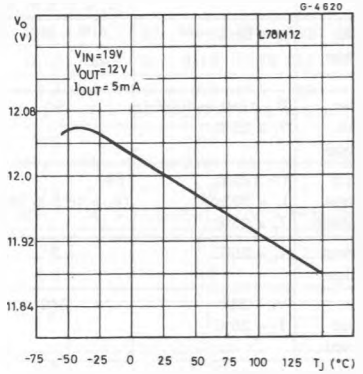


Figure 8 : Supply Voltage Rejection vs. Frequency.

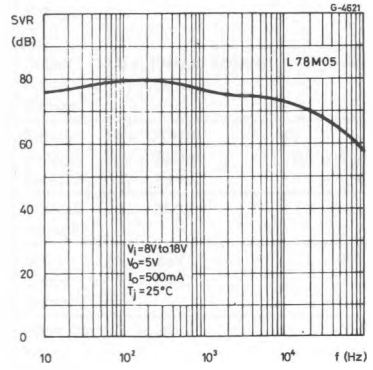


Figure 9 : Quiescent Current vs. Junction Temperature.

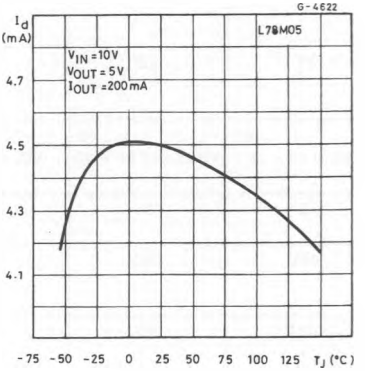


Figure 10 : Load Transient Response.

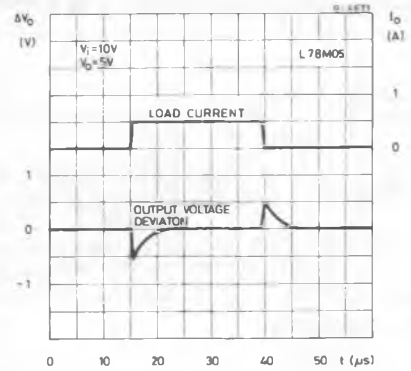


Figure 11 : Line Transient Response.

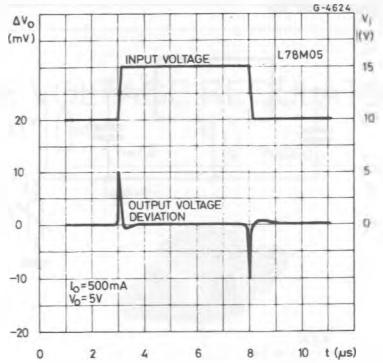
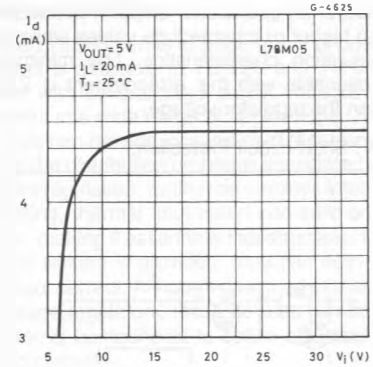


Figure 12 : Quiescent Current vs. Input Voltage.



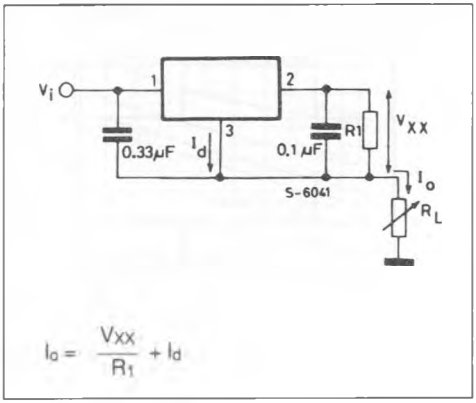
APPLICATIONS INFORMATION

DESIGN CONSIDERATIONS

The L78M00AB 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 as the voltage across the pass transistor is increased.

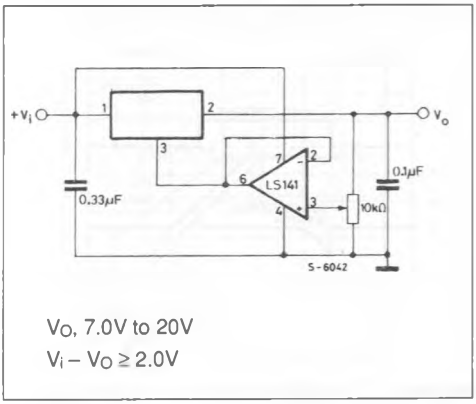
In many low current applications, compensation capacitors are not required. However, it is recommended that the regulator input be bypassed with a capacitor if the regulator is connected to the power supply filter with long wire lengths, or if the output load capacitance is large. An input bypass capacitor 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 13 : Current Regulator.



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

Figure 14 : Adjustable Output Regulator.

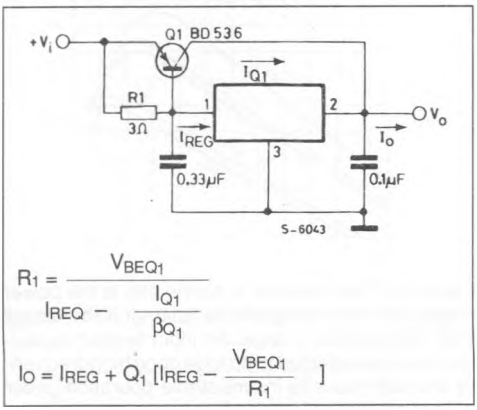


V_O, 7.0V to 20V

$V_i - V_O \geq 2.0V$

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.

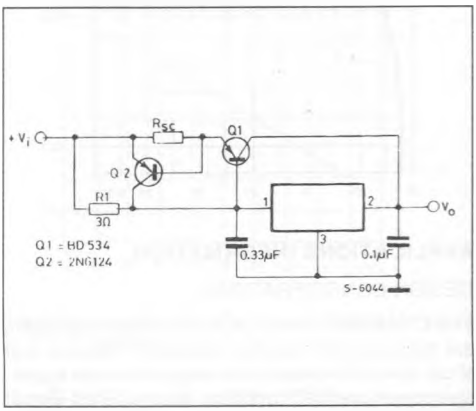
Figure 15 : Current Boost Regulator.



$$R_1 = \frac{V_{BEQ_1}}{I_{REQ} - \frac{I_{Q_1}}{\beta_{Q_1}}}$$

$$I_O = I_{REG} + Q_1 \left[I_{REG} - \frac{V_{BEQ_1}}{R_1} \right]$$

Figure 16 : Short-circuit Protection.



The circuit of figure 6 can be modified to provide supply protection against short circuits 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.