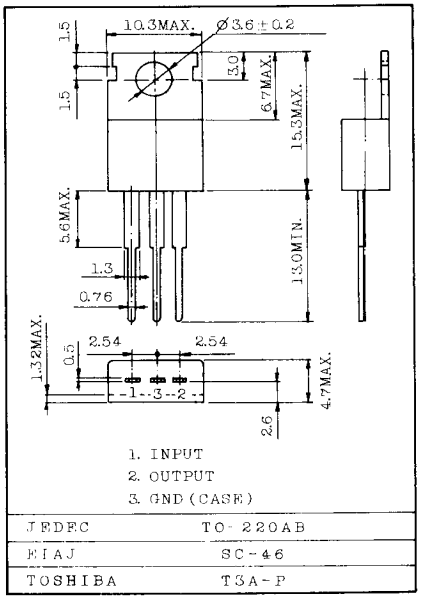
TA78M05P ~ TA78M24P

0.5A THREE TERMINAL POSITIVE VOLTAGE REGULATORS
5V, 6V, 8V, 9V, 10V, 12V, 15V, 18V, 20V, 24V

The TA78M00 series of fixed-voltage monolithic integrated circuit voltage regulators is designed for a wide range of applications. These regulators employ internal current-limitting, thermal-shutdown and safe-area compensation, making them essentially indestructible. One of these regulators can driver up to 0.5A of output current.

- Suitable for C-MOS, TTL and the other Digital IC's Power Supply.
- Output Current in Excess of 0.5A
- Internal Thermal Overload Protection
- Internal Short Circuit Current Limiting
- Package in the Plastic Case TO-220AB

Unit in mm

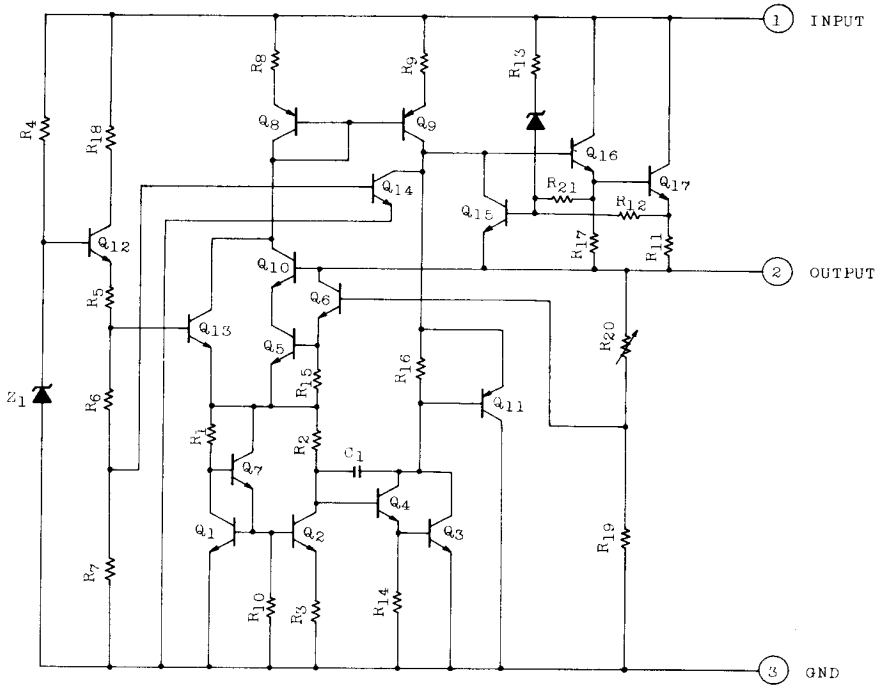


Mounting Kit No. AC75

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Input Voltage	TA78M05P	V_{IN}	35	V
	TA78M06P			
	TA78M08P			
	TA78M09P			
	TA78M10P			
	TA78M12P			
	TA78M15P			
Input Voltage	TA78M18P	V_{IN}	40	V
	TA78M20P			
	TA78M24P			
Power Dissipation		P_D	1.49	W
Power Dissipation (Tc=25°C)		P_D	20.8	W
Operating Junction Temperature Range		T_{opr}	0~150	°C
Storage Temperature Range		Tstg	-55~150	°C

EQUIVALENT CIRCUIT



ELECTRICAL CHARACTERISTICS

(V_{IN}=10V, I_{OUT}=350mA, 0°C≦Tj≦125°C, C_{IN}=0.33μF, C_{OUT}=0.1μF, unless otherwise noted)

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C		4.8	5.0	5.2	V
Line Regulation		Reg.Line	1	Tj=25°C	7V≦V_{IN}≦25V I_{OUT}=200mA	-	4	100	mV
					8V≦V_{IN}≦25V I_{OUT}=200mA	-	2	50	
Load Regulation		Reg.Load	1	Tj=25°C	5mA≦I_{OUT}≦500mA	-	25	100	mV
					5mA≦I_{OUT}≦200mA	-	10	50	
Output Voltage		V_{OUT}	1	7V≦V_{IN}≦20V 5mA≦I_{OUT}≦350mA		4.75	-	5.25	V
Quiescent Current		I_B	1	Tj=25°C		-	4.5	8.0	mA
Quiescent Current Change	Line	ΔI_{BI}	1	8V≦V_{IN}≦25V, I_{OUT}=200mA		-	-	0.8	mA
	Load	ΔI_{BO}	1	5mA≦I_{OUT}≦350mA		-	-	0.5	
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	50	200	μV
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=100mA 8V≦V_{IN}≦18V		62	69	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C, V_{IN}=35V		-	300	-	mA
Dropout Voltage		V_D	1	Ta=25°C		-	1.7	-	V
Average Temperature Coefficient Output Voltage		T_{CVO}	1	I_{OUT}=5mA		-	-1.0	-	mV/deg
Long-Term Stability		$\Delta V_{OUT}/\Delta t$	1			-	-	20	mV/1.0 KHrs
Peak Output Current		I_{max}	1	Tj=25°C		-	700	-	mA

ELECTRICAL CHARACTERISTICS

(V_{IN}=11V, I_{OUT}=350mA, 0°C≦Tj≦125°C, C_{IN}=0.33μF, C_{OUT}=0.1μF, unless otherwise noted)

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C		5.75	6.0	6.25	V
Line Regulation		Reg.Line	1	Tj=25°C	8V≦V_{IN}≦25V I_{OUT}=200mA	-	4	100	mV
					9V≦V_{IN}≦25V I_{OUT}=200mA	-	2	50	
Load Regulation		Reg.Load	1	Tj=25°C	5mA≦I_{OUT}≦500mA	-	25	120	mV
					5mA≦I_{OUT}≦200mA	-	10	60	
Output Voltage		V_{OUT}	1	8V≦V_{IN}≦21V 5mA≦I_{OUT}≦350mA		5.7	-	6.3	V
Quiescent Current		I_B	1	Tj=25°C		-	4.5	8.0	mA
Quiescent Current Change	Line	ΔI_{BI}	1	9V≦V_{IN}≦25V, I_{OUT}=200mA		-	-	0.8	mA
	Load	ΔI_{BO}	1	5mA≦I_{OUT}≦350mA		-	-	0.5	
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	55	220	μV
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=100mA 9V≦V_{IN}≦19V		59	66	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C, V_{IN}=35V		-	270	-	mA
Dropout Voltage		V_D	1	Ta=25°C		-	1.7	-	V
Average Temperature Coefficient Output Voltage		T_{CVO}	1	I_{OUT}=5mA		-	-1.0	-	mV/deg
Long Term Stability		$\Delta V_{OUT}/\Delta t$	1			-	-	24	mV/1.0 KHrs
Peak Output Current		Imax	1	Tj=25°C		-	700	-	mA

ELECTRICAL CHARACTERISTICS

(V_{IN}=14V, I_{OUT}=350mA, 0°C≦Tj≦125°C, C_{IN}=0.33μF, C_{OUT}=0.1μF, unless otherwise noted)

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C		7.7	8.0	8.3	V
Line Regulation		Reg.Line	1	Tj=25°C	10.5V≦V_{IN}≦25V I_{OUT}=200mA	-	5	100	mV
					11V≦V_{IN}≦25V I_{OUT}=200mA	-	3	50	
Load Regulation		Reg.Load	1	Tj=25°C	5mA≦I_{OUT}≦500mA	-	26	160	mV
					5mA≦I_{OUT}≦200mA	-	10	80	
Output Voltage		V_{OUT}	1	10.5V≦V_{IN}≦23V 5mA≦I_{OUT}≦350mA		7.6	-	8.4	V
Quiescent Current		I_B	1	Tj=25°C		-	4.6	8.0	mA
Quiescent Current Change	Line	ΔI_{BI}	1	10.5V≦V_{IN}≦25V, I_{OUT}=200mA		-	-	0.8	mA
	Load	ΔI_{BO}	1	5mA≦I_{OUT}≦350mA		-	-	0.5	
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	60	250	μV
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=100mA 11.5V≦V_{IN}≦21.5V		56	63	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C, V_{IN}=35V		-	250	-	mA
Dropout Voltage		V_D	1	Ta=25°C		-	1.7	-	V
Average Temperature Coefficient Output Voltage		T_{CVO}	1	I_{OUT}=5mA		-	-1.0	-	mV/deg
Long Term Stability		$\Delta V_{OUT}/\Delta t$	1			-	-	32	mV/1.0 KHrs
Peak Output Current		I_{max}	1	Tj=25°C		-	700	-	mA

ELECTRICAL CHARACTERISTICS

(V_{IN}=15V, I_{OUT}=350mA, 0°C≦Tj≦125°C, C_{IN}=0.33μF, C_{OUT}=0.1μF, unless otherwise noted)

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C		8.64	9.0	9.36	V
Line Regulation		Reg.Line	1	Tj=25°C	11.5V≦V_{IN}≦26V, I_{OUT}=200mA	-	5	100	mV
					13V≦V_{IN}≦26V, I_{OUT}=200mA	-	3	50	
Load Regulation		Reg.Load	1	Tj=25°C	5mA≦I_{OUT}≦500mA	-	26	180	mV
					5mA≦I_{OUT}≦200mA	-	10	90	
Output Voltage		V_{OUT}	1	11.5V≦V_{IN}≦24V, 5mA≦I_{OUT}≦350mA		8.55	-	9.45	V
Quiescent Current		I_B	1	Tj=25°C		-	4.6	8.0	mA
Quiescent Current Change	Line	ΔI_{BI}	1	12V≦V_{IN}≦26.5V, I_{OUT}=200mA		-	-	0.8	mA
	Load	ΔI_{BO}	1	5mA≦I_{OUT}≦350mA		-	-	0.5	
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	60	270	μV
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=100mA, 12.5V≦V_{IN}≦22.5V		56	63	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C, V_{IN}=35V		-	250	-	mA
Dropout Voltage		V_D	1	Ta=25°C		-	1.7	-	V
Average Temperature Coefficient Output Voltage		T_{CVO}	1	I_{OUT}=5mA		-	-1.0	-	mV/deg
Long Term Stability		$\Delta V_{OUT}/\Delta t$	1			-	-	36	mV/1.0 KHrs
Peak Output Current		I_{max}	1	Tj=25°C		-	700	-	mA

ELECTRICAL CHARACTERISTICS

(V_{IN}=16V, I_{OUT}=350mA, 0°C≦Tj≦125°C, C_{IN}=0.33μF, C_{OUT}=0.1μF, unless otherwise noted)

CHARACTERISTIC		SYBMOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C		9.6	10.0	10.4	V
Line Regulation		Reg.Line	1	Tj=25°C	12.5V≦V_{IN}≦28V I_{OUT}=200mA	-	6	100	mV
					14V≦V_{IN}≦28V I_{OUT}=200mA	-	3	50	
Load Regulation		Reg.Line	1	Tj=25°C	5mA≦I_{OUT}≦500mA	-	26	200	mV
					5mA≦I_{OUT}≦200mA	-	10	100	
Output Voltage		V_{OUT}	1	12.5V≦V_{IN}≦25V 5mA≦I_{OUT}≦350mA		9.5	-	10.5	V
Quiescent Current		I_B	1	Tj=25°C		-	4.7	8.0	mA
Quiescent Current Change	Line	ΔI_{BI}	1	12.5V≦V_{IN}≦28V, I_{OUT}=200mA		-	-	0.8	mA
	Load	ΔI_{BO}	1	5mA≦I_{OUT}≦350mA		-	-	0.5	
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	65	280	μV
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=100mA 13.5V≦V_{IN}≦23.5V		55	62	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C, V_{IN}=35V		-	245	-	mA
Dropout Voltage		V_D	1	Ta=25°C		-	1.7	-	V
Average Temperature Coefficient Output Voltage		T_{CVO}	1	I_{OUT}=5mA		-	-1.0	-	mV/deg
Long Term Stability		$\Delta V_{OUT}/\Delta t$	1			-	-	40	mV/1.0 KHrs
Peak Output Current		I_{max}	1	Tj=25°C		-	700	-	mA

ELECTRICAL CHARACTERISTICS

(V_{IN}=19V, I_{OUT}=350mA, 0°C≦Tj≦125°C, C_{IN}=0.33μF, C_{OUT}=0.1μF, unless otherwise noted)

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C		11.5	12.0	12.5	V
Line Regulation		Reg.Line	1	Tj=25°C	14.5V≦V_{IN}≦30V, I_{OUT}=200mA	-	7	100	mV
					16V≦V_{IN}≦30V, I_{OUT}=200mA	-	3	50	
Load Regulation		Reg.Load	1	Tj=25°C	5mA≦I_{OUT}≦500mA	-	27	240	mV
					5mA≦I_{OUT}≦200mA	-	10	210	
Output Voltage		V_{OUT}	1	14.5V≦V_{IN}≦27V, 5mA≦I_{OUT}≦350mA		11.4	-	12.6	V
Quiescent Current		I_B	1	Tj=25°C		-	4.8	8.0	mA
Quiescent Current Change	Line	ΔI_{BI}	1	14.5V≦V_{IN}≦30V, I_{OUT}=200mA		-	-	0.8	mA
	Load	ΔI_{BO}	1	5mA≦I_{OUT}≦350mA		-	-	0.5	
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	70	300	μV
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=100mA, 15V≦V_{IN}≦35V		55	62	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C, V_{IN}=35V		-	240	-	mA
Dropout Voltage		V_D	1	Ta=25°C		-	1.7	-	V
Average Temperature Coefficient Output Voltage		T_{CVO}	1	I_{OUT}=5mA		-	-1.0	-	mV/deg
Long Term Stability		$\Delta V_{OUT}/\Delta t$	1			-	-	48	mV/1.0 KHrs
Peak Output Current		I_{max}	1	Tj=25°C		-	700	-	mA

ELECTRICAL CHARACTERISTICS

(V_{IN}=23V, I_{OUT}=350mA, 0°C≦Tj≦125°C, C_{IN}=0.33μF, C_{OUT}=0.1μF, unless otherwise noted)

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C		14.4	15.0	15.6	V
Line Regulation		Reg.Line	1	Tj=25°C	17.5V≦V_{IN}≦30V I_{OUT}=200mA	-	8	100	mV
					20V≦V_{IN}≦30V I_{OUT}=200mA	-	4	50	
Load Regulation		Reg.Load	1	Tj=25°C	5mA≦I_{OUT}≦500mA	-	27	300	mV
					5mA≦I_{OUT}≦200mA	-	10	150	
Output Voltage		V_{OUT}	1	17.5V≦V_{IN}≦30V 5mA≦I_{OUT}≦350mA		14.25	-	15.75	V
Quiescent Current		I_B	1	Tj=25°C		-	4.8	8.0	mA
Quiescent Current Change	Line	ΔI_{BI}	1	18.5V≦V_{IN}≦30V, I_{OUT}=200mA		-	-	0.8	mA
	Load	ΔI_{BO}	1	5mA≦I_{OUT}≦350mA		-	-	0.5	
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	80	450	μV
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=100mA 18.5V≦V_{IN}≦28.5V		54	61	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C, V_{IN}=35V		-	240	-	mA
Dropout Voltage		V_D	1	Ta=25°C		-	1.7	-	V
Average Temperature Coefficient Output Voltage		T_{CVO}	1	I_{OUT}=5mA		-	-1.0	-	mV/deg
Long Term Stability		$\Delta V_{OUT}/\Delta t$	1			-	-	60	mV/1.0 KHrs
Peak Output Current		I_{max}	1	Tj=25°C		-	700	-	mA

ELECTRICAL CHARACTERISTICS

(V_{IN}=27V, I_{OUT}=350mA, 0°C≦Tj≦125°C, C_{IN}=0.33μF, C_{OUT}=0.1μF, unless otherwise noted)

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C		17.3	18.0	18.7	V
Line Regulation		Reg.Line	1	Tj=25°C	21V≦V_{IN}≦33V I_{OUT}=200mA	-	9	100	mV
					24V≦V_{IN}≦33V I_{OUT}=200mA	-	5	50	
Load Regulation		Reg.Load	1	Tj=25°C	5mA≦I_{OUT}≦500mA	-	28	360	mV
					5mA≦I_{OUT}≦200mA	-	10	180	
Output Voltage		V_{OUT}	1	21V≦V_{IN}≦33V 5mA≦I_{OUT}≦350mA		17.1	-	18.9	V
Quiescent Current		I_B	1	Tj=25°C		-	4.8	8.0	mA
Quiescent Current Change	Line	ΔI_{BI}	1	21V≦V_{IN}≦33V, I_{OUT}=200mA		-	-	0.8	mA
	Load	ΔI_{BO}	1	5mA≦I_{OUT}≦350mA		-	-	0.5	
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	90	490	μV
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=100mA 22V≦V_{IN}≦32V		53	60	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C, V_{IN}=35V		-	240	-	mA
Dropout Voltage		V_D	1	Ta=25°C		-	1.7	-	V
Average Temperature Coefficient Output Voltage		T_{CVO}	1	I_{OUT}=5mA		-	-1.0	-	mV/deg
Long Term Stability		$\Delta V_{OUT}/\Delta t$	1			-	-	72	mV/1.0 KHrs
Peak Output Current		I_{max}	1	Tj=25°C		-	700	-	mA

ELECTRICAL CHARACTERISTICS

(V_{IN}=29V, I_{OUT}=350mA, 0°C≦Tj≦125°C, C_{IN}=0.33μF, C_{OUT}=0.1μF, unless otherwise noted)

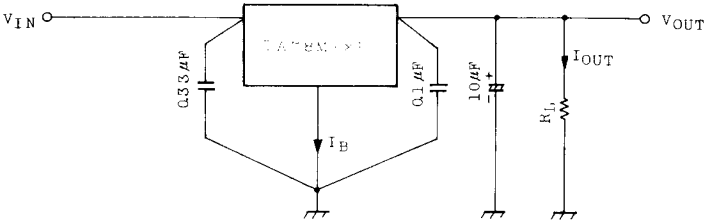
CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C		19.2	20.0	20.8	V
Line Regulation		Reg.Line	1	Tj=25°C	23V≦V_{IN}≦35V I_{OUT}=200mA	-	10	100	mV
					24V≦V_{IN}≦35V I_{OUT}=200mA	-	6	50	
Load Regulation		Reg.Load	1	Tj=25°C	5mA≦I_{OUT}≦500mA	-	28	400	mV
					5mA≦I_{OUT}≦200mA	-	10	200	
Output Voltage		V_{OUT}	1	23V≦V_{IN}≦35V 5mA≦I_{OUT}≦350mA		19.0	-	21.0	V
Quiescent Current		I_B	1	Tj=25°C		-	4.9	8.0	mA
Quiescent Current Change	Line	ΔI_{BI}	1	23V≦V_{IN}≦35V, I_{OUT}=200mA		-	-	0.8	mA
	Load	ΔI_{BO}	1	5mA≦I_{OUT}≦350mA		-	-	0.5	
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	95	540	μV
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=100mA 24V≦V_{IN}≦34V		53	60	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C, V_{IN}=35V		-	240	-	mA
Dropout Voltage		V_D	1	Ta=25°C		-	1.7	-	V
Average Temperature Coefficient Output Voltage		T_{CVO}	1	I_{OUT}=5mA		-	-1.0	-	mV/deg
Long Term Stability		$\Delta V_{OUT}/\Delta t$	1			-	-	80	mV/1.0 KHrs
Peak Output Current		I_{max}	1	Tj=25°C		-	700	-	mA

ELECTRICAL CHARACTERISTICS

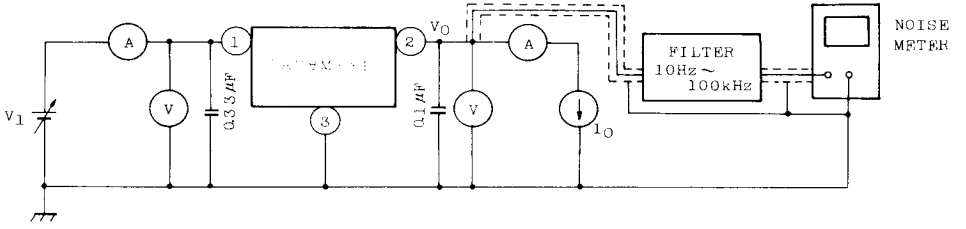
(V_{IN}=33V, I_{OUT}=350mA, 0°C≦Tj≦125°C, C_{IN}=0.33μF, C_{OUT}=0.1μF, unless otherwise noted)

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C		23.0	24.0	25.0	V
Line Regulation		Reg.Line	1	Tj=25°C	27V≦V_{IN}≦38V I_{OUT}=200mA	-	12	100	mV
					28V≦V_{IN}≦38V I_{OUT}=200mA	-	7	50	
Load Regulation		Reg.Load	1	Tj=25°C	5mA≦I_{OUT}≦500mA	-	30	480	mV
					5mA≦I_{OUT}≦200mA	-	10	240	
Output Voltage		V_{OUT}	1	27V≦V_{IN}≦38V 5mA≦I_{OUT}≦350mA		22.8	-	25.2	V
Quiescent Current		I_B	1	Tj=25°C		-	5.0	8.0	mA
Quiescent Current Change	Line	ΔI_{BI}	1	27V≦V_{IN}≦38V, I_{OUT}=200mA		-	-	0.8	mA
	Load	ΔI_{BO}	1	5mA≦I_{OUT}≦350mA		-	-	0.5	
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	115	650	μV
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=100mA 28V≦V_{IN}≦38V		50	57	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C, V_{IN}=35V		-	240	-	mA
Dropout Voltage		V_D	1	Ta=25°C		-	1.7	-	V
Average Temperature Coefficient Output Voltage		T_{CVO}	1	I_{OUT}=5mA		-	-1.0	-	mV/deg
Long Term Stability		$\Delta V_{OUT}/\Delta t$	1			-	-	96	mV/1.0 KHrs
Peak Output Current		I_{max}	1	Tj=25°C		-	700	-	mA

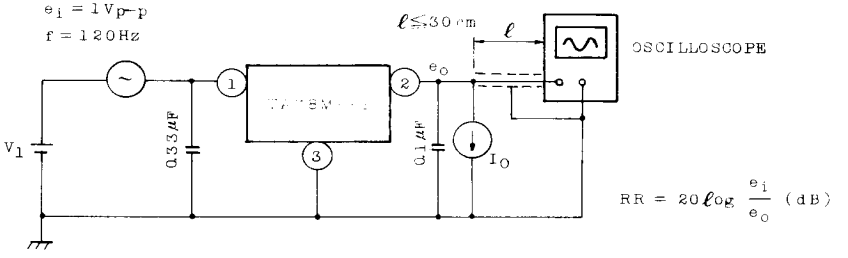
TEST CIRCUIT 1 / STANDARD APPLICATION



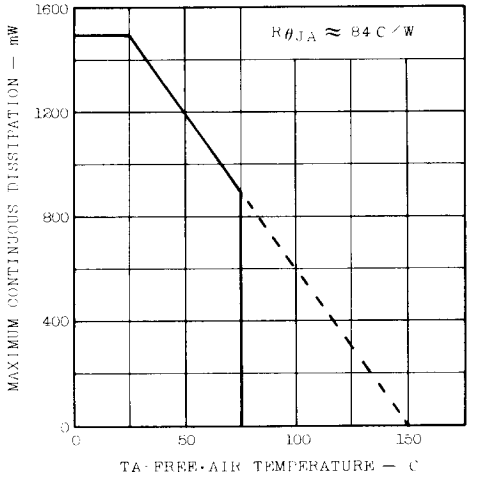
TEST CIRCUIT 2 V_{NO}



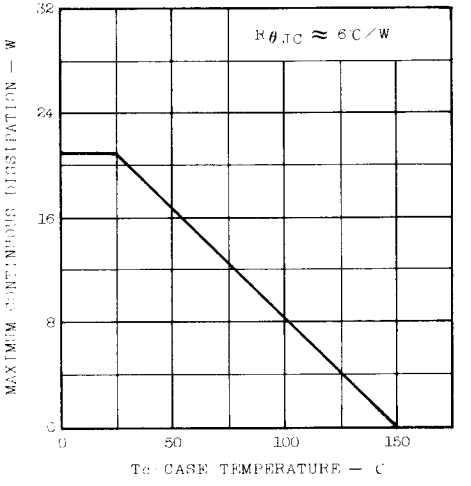
TEST CIRCUIT 3 R.R.



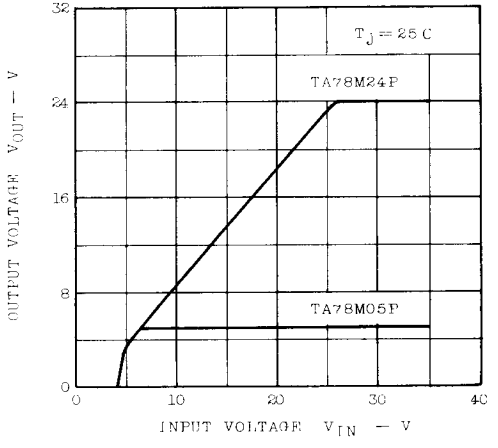
FREE · AIR TEMPERATURE
DISSIPATION DERATING CURVE



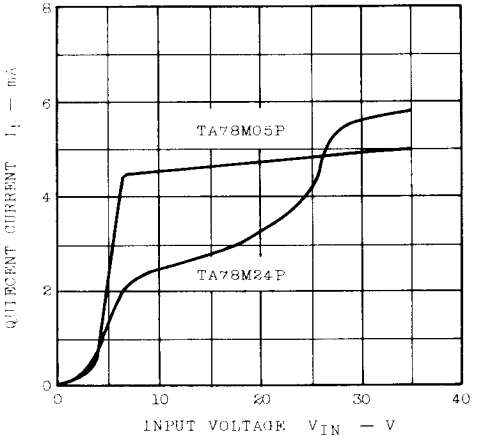
CASE TEMPERATURE
DISSIPATION DERATING CURVE



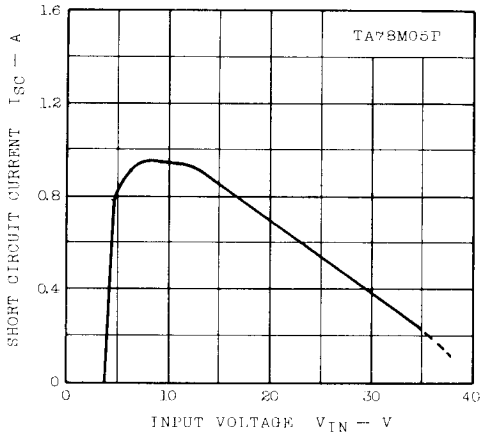
V_{IN} – V_{OUT}



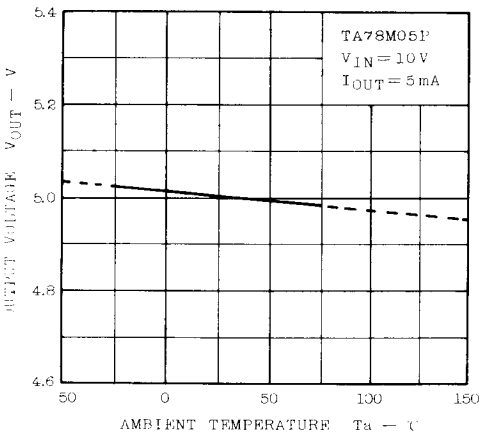
V_{IN} – I_b



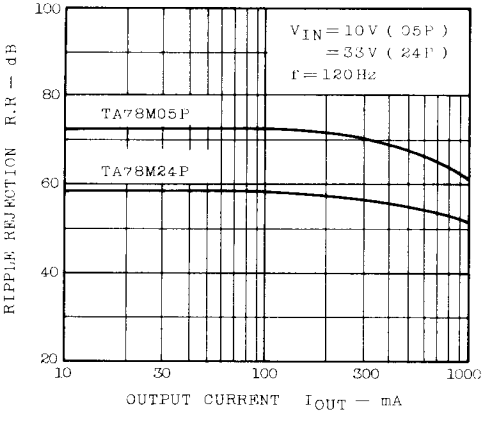
V_{IN} – I_{SC}



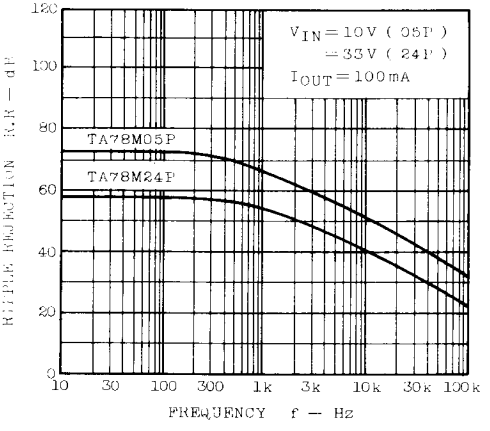
V_{OUT} – Ta



R.R. – I_{OUT}



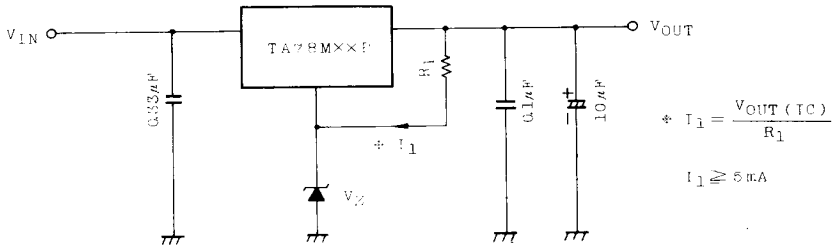
R.R. – f



APPLICATION CIRCUITS

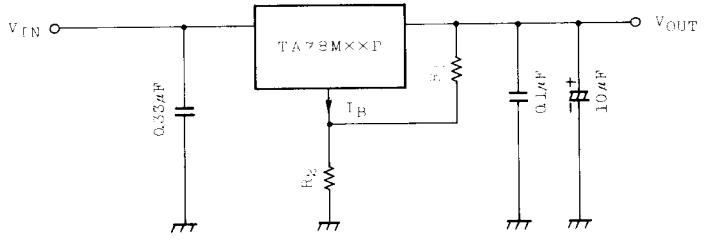
(1) VOLTAGE BOOST REGULATOR

(a) Voltage boost by use of zener diode



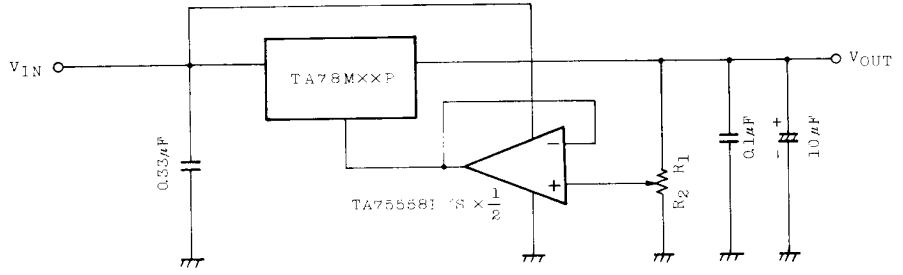
$V_{OUT}=V_{OUT(IC)}+V_Z$

(b) Voltage boost by use of resistor



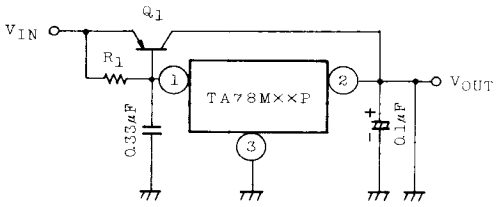
$$V_{OUT}=V_{OUT(IC)}\left(1+\frac{R2}{R1}\right)+R2\cdot I_B$$

(c) Adjustable output regulator



$$V_{OUT}=V_{OUT(IC)}\left(1+\frac{R2}{R1}\right)$$

(2) CURRENT BOOST VOLTAGE REGULATOR



Heat sink is needed for Q1

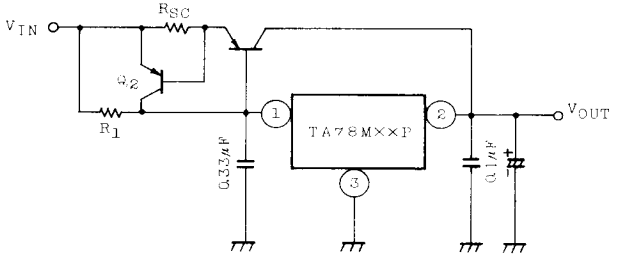
$$R_1 \leqq \frac{V_{BE1}}{I_{B\ MAX}}$$

where,

V_{BE1} : V_{BE} of external transistor Q1.

$I_{B\ MAX}$: Quiescent current of IC.

(3) SHORT-CIRCUIT PROTECTION

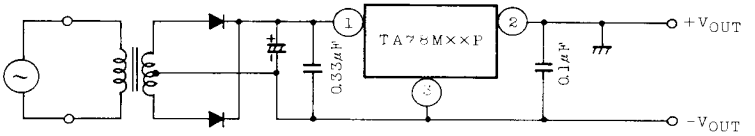


$$R_{SC} = \frac{V_{BE2}}{I_{SC}}$$

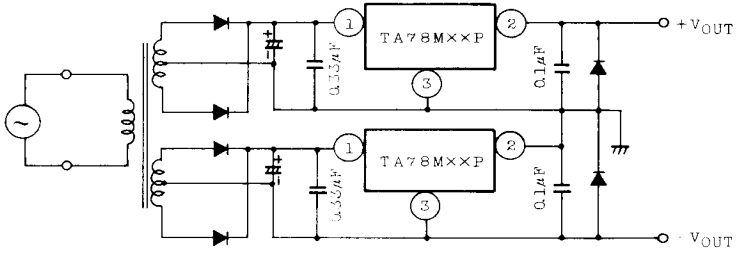
where,

I_{SC} : Short-circuit current

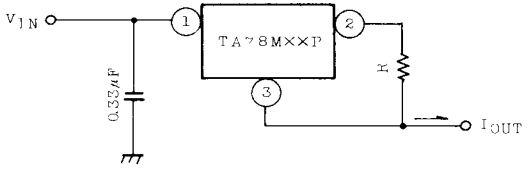
(4) NEGATIVE REGULATOR



(5) POSITIVE AND NEGATIVE REGULATOR



(6) CURRENT REGULATOR

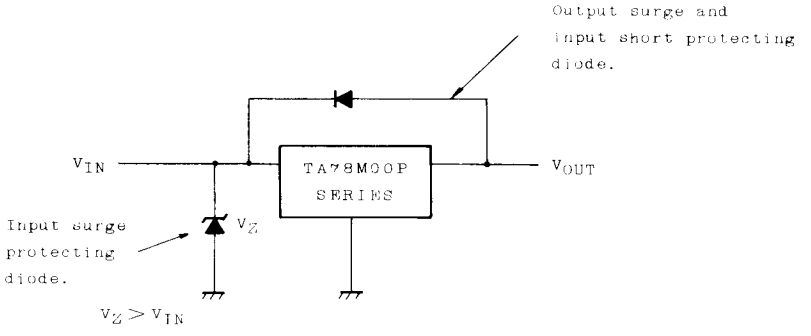


$$I_{OUT} = \frac{V_{OUT}}{R} + I_B$$

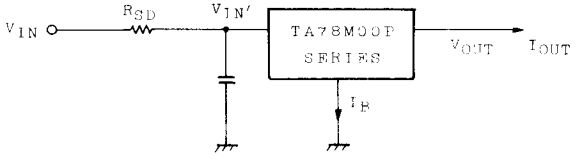
PRECAUTIONS ON APPLICATION

(1) In regard to GND, be careful not to apply a negative voltage to the input/output terminal. Further, special care is necessary in case of a voltage boost application.

(2) When a surge voltage exceeding maximum rating is applied to the input terminal or when a voltage in excess of the input terminal voltage is applied to the output terminal, the circuit may be destroyed.
Specially, in the latter case, great care is necessary.
Further, if the input terminal sorts to GND in a state of normal operation, the output terminal voltage becomes higher than the input voltage (GND potential), and the electric charge of a chemical capacitor connected to the output terminal flows into the input side, which may cause the destruction of circuit.
In these cases, take such steps as a zener diode and a general silicon diode are connected to the circuit, as shown in the following figure.



(3) When the input voltage is too high, the power dissipation of three terminal regulator increases because of series regulator, so that the junction temperature rises. In such a case, it is recommended to reduce the power dissipation by inserting the power limiting resistor RSD in the input terminal, and to reduce the junction temperature as a result.



The power dissipation P_D of IC is expressed in the following equation.

$$P_D = (V_{IN'} - V_{OUT}) \cdot I_{OUT} + V_{IN'} \cdot I_B$$

If $V_{IN'}$ is reduced below the lowest voltage necessary for the IC, the parasitic oscillation will be caused according to circumstances.
In determing the resistance value of R_{SD}, design with margin should be made by making reference to the following equation.

$$R_{SD} < \frac{V_{IN} - V_{IN'}}{I_{OUT} + I_B}$$

(4) Connect the input terminal and GND, and the output terminal and GND, by capacitor respectively. The capacitances should be determined experimentally because they depend on prented patterns. In particular, adequate investigation should be made so that there is no problem even at time of high or low temperature.

(5) Installation of IC for power supply
For obtaining high reliability on the heat sink design of the regulator IC, it is generally required to derate more than 20% of maximum junction temperature (Tj MAX.).
Further, full consideration should be given to the installation of IC to the heat sink.

(a) Heat sink design

The thermal resistance of IC itself is required from the viewpont of the design of elements, but the thermal resistance from the IC package to the open air varies with the contact thermal resistance.
Table 1 shows how much the value of the contact thermal resistance (Q_C+Q_S) is changed by insulating sheet (mica) and heat sink grease.

TABLE Unit: °C/W

PACKAGE	MODEL No.	TORQUE	MICA	$Q_C + Q_S$
TO-220AB	TA78M00P	6kg·cm	Not Provided	0.3 0.5(1.5~2.0)
			Provided	2.0 2.5(4.0~6.0)

The figures given in parentheses denote the values at time of no grease.
The package of regulator IC serves as GND, therefore, usually use the value at time of "no mica".

(b) Silicon grease

When a circuit not exceeding maximum rating is designed, it is to be desired that the grease should be used if possible. If it is required that the contace thermal resistance is reduced from the viewpoint of the circuit design, it is recommended that the following methods be adopted.

A: Use UG6260 (TOSHIBA CORPORATION), if grease is used.

(c) Torque

When installing IC on a heat sink or the like, tighten the IC with the torque of less than the rated value. If it is tightened with the torque in excess of the rated value, sometimes the internal elements of the IC are adversely affected. Therefore, great care should be given to the installing operation.