

TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

**TA78M05S, TA78M06S, TA78M08S, TA78M09S, TA78M10S
TA78M12S, TA78M15S, TA78M18S, TA78M20S, TA78M24S**

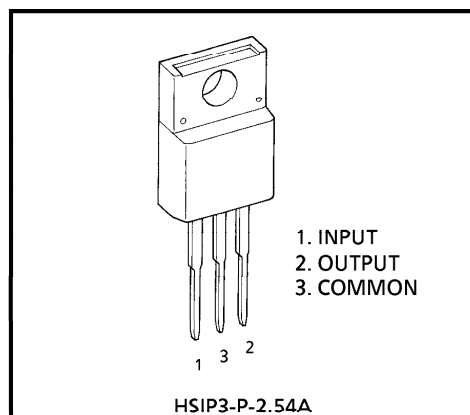
0.5A THREE TERMINAL POSITIVE VOLTAGE REGULATORS

5V, 6V, 8V, 9V, 10V, 12V, 15V, 18V, 20V, 24V

The TA78M $\times$ S series of fixed-voltage monolithic integrated circuit voltage regulators is designed for a wide range of applications. These regulators employ internal current-limiting, thermal-shutdown and safe-area compensation, making them essentially indestructible. One of these regulators can driver up to 0.5A of output current.

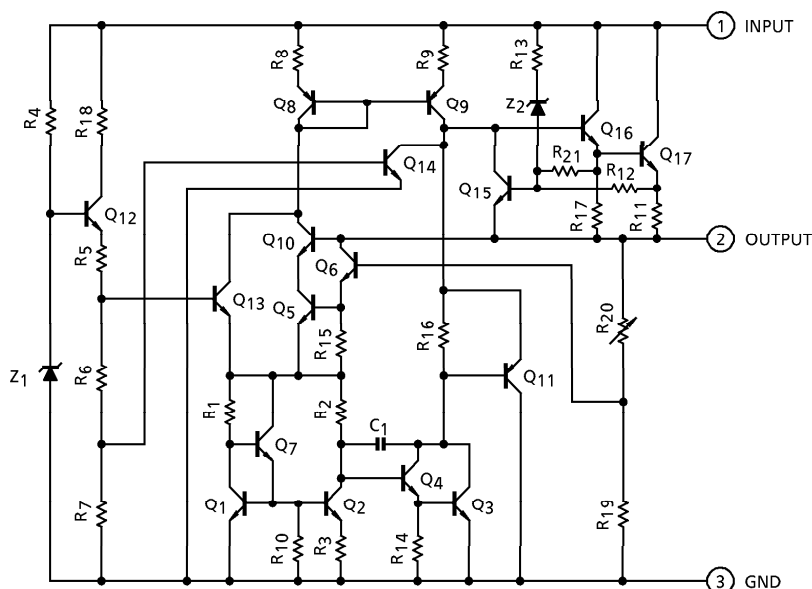
FEATURES

- Suitable for CMOS, 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-220NIS



Weight : 1.7g (Typ.)

EQUIVALENT CIRCUIT



961001EBA2

● TOSHIBA is continually working to improve the quality and the reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to observe standards of safety, and to avoid situations in which a malfunction or failure of a TOSHIBA product could cause loss of human life, bodily injury or damage to property. In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent products specifications. Also, please keep in mind the precautions and conditions set forth in the TOSHIBA Semiconductor Reliability Handbook.

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Input Voltage	TA78M05S	V _{IN}	35	V
	TA78M06S			
	TA78M08S			
	TA78M09S			
	TA78M10S			
	TA78M12S			
	TA78M15S			
	TA78M18S		40	
	TA78M20S			
	TA78M24S			
Power Dissipation	(Ta = 25°C)	P _D	2	W
	(Tc = 25°C)		20	
Operating Temperature		T _{opr}	– 30~75	°C
Storage Temperature		T _{stg}	– 55~150	°C
Operating Junction Temperature		T _j	– 30~150	°C
Thermal Resistance		R _{th} (j-c)	6.25	°C / W
		R _{th} (j-a)	62.5	

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TA78M05S

ELECTRICAL CHARACTERISTICS(V_{IN} = 10V, I_{OUT} = 350mA, 0°C ≤ T_j ≤ 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	T _j = 25°C	4.8	5.0	5.2	V
Line Regulation	Reg.line	1	T _j = 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	T _j = 25°C 5mA ≤ I _{OUT} ≤ 500mA	—	25	100	mV
			5mA ≤ I _{OUT} ≤ 200mA	—	10	50	
Output Voltage	V _{OUT}	1	T _j = 25°C 7V ≤ V _{IN} ≤ 20V 5mA ≤ I _{OUT} ≤ 350mA	4.75	—	5.25	V
Quiescent Current	I _B	1	T _j = 25°C	—	4.5	8.0	mA
Quiescent Current Change	Line	1	8.5V ≤ V _{IN} ≤ 25.5V, I _{OUT} = 200mA	—	—	0.8	mA
	Load	1	5mA ≤ I _{OUT} ≤ 350mA	—	—	0.5	
Output Noise Voltage	V _{NO}	2	T _a = 25°C, 10Hz ≤ f ≤ 100kHz	—	50	200	μV _{rms}
Ripple Rejection	R.R.	3	f = 120Hz, I _{OUT} = 100mA 8V ≤ V _{IN} ≤ 18V, T _j = 25°C	62	69	—	dB
Short Circuit Current Limit	I _{SC}	1	T _j = 25°C	—	960	—	mA
Dropout Voltage	V _D	1	T _a = 25°C	—	1.7	—	V
Average Temperature Coefficient Of Output Voltage	T _{CVO}	1	I _{OUT} = 5mA	—	−0.6	—	mV / °C

TA78M06S

ELECTRICAL CHARACTERISTICS

(V_{IN} = 11V, I_{OUT} = 350mA, 0°C ≤ T_j ≤ 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	T _j = 25°C	5.75	6.0	6.25	V
Line Regulation	Reg.line	1	T _j = 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	T _j = 25°C 5mA ≤ I _{OUT} ≤ 500mA	—	25	120	mV
			5mA ≤ I _{OUT} ≤ 200mA	—	10	60	
Output Voltage	V _{OUT}	1	T _j = 25°C 8V ≤ V _{IN} ≤ 21V 5mA ≤ I _{OUT} ≤ 350mA	5.7	—	6.3	V
Quiescent Current	I _B	1	T _j = 25°C	—	4.5	8.0	mA
Quiescent Current Change	Line	1	9.5V ≤ V _{IN} ≤ 25.5V, I _{OUT} = 200mA	—	—	0.8	mA
	Load	1	5mA ≤ I _{OUT} ≤ 350mA	—	—	0.5	
Output Noise Voltage	V _{NO}	2	T _a = 25°C, 10Hz ≤ f ≤ 100kHz	—	55	220	μV _{rms}
Ripple Rejection	R.R.	3	f = 120Hz, I _{OUT} = 100mA 9V ≤ V _{IN} ≤ 19V, T _j = 25°C	59	66	—	dB
Short Circuit Current Limit	I _{SC}	1	T _j = 25°C	—	960	—	mA
Dropout Voltage	V _D	1	T _a = 25°C	—	1.7	—	V
Average Temperature Coefficient Of Output Voltage	T _{CVO}	1	I _{OUT} = 5mA	—	−0.7	—	mV / °C

TA78M08S

ELECTRICAL CHARACTERISTICS

(V_{IN} = 14V, I_{OUT} = 350mA, 0°C ≤ T_j ≤ 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	T _j = 25°C	7.7	8.0	8.3	V
Line Regulation	Reg.line	1	T _j = 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	T _j = 25°C 5mA ≤ I _{OUT} ≤ 500mA	—	26	160	mV
			5mA ≤ I _{OUT} ≤ 200mA	—	10	80	
Output Voltage	V _{OUT}	1	T _j = 25°C 10.5V ≤ V _{IN} ≤ 23V 5mA ≤ I _{OUT} ≤ 350mA	7.6	—	8.4	V
Quiescent Current	I _B	1	T _j = 25°C	—	4.6	8.0	mA
Quiescent Current Change	Line	1	11V ≤ V _{IN} ≤ 25.5V, I _{OUT} = 200mA	—	—	0.8	mA
	Load	1	5mA ≤ I _{OUT} ≤ 350mA	—	—	0.5	
Output Noise Voltage	V _{NO}	2	T _a = 25°C, 10Hz ≤ f ≤ 100kHz	—	60	250	μV _{rms}
Ripple Rejection	R.R.	3	f = 120Hz, I _{OUT} = 100mA 11.5V ≤ V _{IN} ≤ 21.5V, T _j = 25°C	56	63	—	dB
Short Circuit Current Limit	I _{SC}	1	T _j = 25°C	—	960	—	mA
Dropout Voltage	V _D	1	T _a = 25°C	—	1.7	—	V
Average Temperature Coefficient Of Output Voltage	T _{CVO}	1	I _{OUT} = 5mA	—	− 1.0	—	mV / °C

TA78M09S

ELECTRICAL CHARACTERISTICS(V_{IN} = 15V, I_{OUT} = 350mA, 0°C ≤ T_j ≤ 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	T _j = 25°C	8.64	9.0	9.36	V
Line Regulation	Reg.line	1	T _j = 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	T _j = 25°C 5mA ≤ I _{OUT} ≤ 500mA	—	26	180	mV
			5mA ≤ I _{OUT} ≤ 200mA	—	10	90	
Output Voltage	V _{OUT}	1	T _j = 25°C 11.5V ≤ V _{IN} ≤ 24V 5mA ≤ I _{OUT} ≤ 350mA	8.55	—	9.45	V
Quiescent Current	I _B	1	T _j = 25°C	—	4.6	8.0	mA
Quiescent Current Change	Line	1	12V ≤ V _{IN} ≤ 26.5V, I _{OUT} = 200mA	—	—	0.8	mA
	Load	1	5mA ≤ I _{OUT} ≤ 350mA	—	—	0.5	
Output Noise Voltage	V _{NO}	2	T _a = 25°C, 10Hz ≤ f ≤ 100kHz	—	60	270	μV _{rms}
Ripple Rejection	R.R.	3	f = 120Hz, I _{OUT} = 100mA 12.5V ≤ V _{IN} ≤ 22.5V, T _j = 25°C	56	63	—	dB
Short Circuit Current Limit	I _{SC}	1	T _j = 25°C	—	960	—	mA
Dropout Voltage	V _D	1	T _a = 25°C	—	1.7	—	V
Average Temperature Coefficient Of Output Voltage	T _{CVO}	1	I _{OUT} = 5mA	—	− 1.1	—	mV / °C

TA78M10S

ELECTRICAL CHARACTERISTICS(V_{IN} = 16V, I_{OUT} = 350mA, 0°C ≤ T_j ≤ 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	T _j = 25°C	9.6	10.0	10.4	V
Line Regulation	Reg.line	1	T _j = 25°C 12.5V ≤ V _{IN} ≤ 26V I _{OUT} = 200mA	—	6	100	mV
			14V ≤ V _{IN} ≤ 26V I _{OUT} = 200mA	—	3	50	
Load Regulation	Reg.load	1	T _j = 25°C 5mA ≤ I _{OUT} ≤ 500mA	—	26	200	mV
			5mA ≤ I _{OUT} ≤ 200mA	—	10	100	
Output Voltage	V _{OUT}	1	T _j = 25°C 12.5V ≤ V _{IN} ≤ 25V 5mA ≤ I _{OUT} ≤ 350mA	9.5	—	10.5	V
Quiescent Current	I _B	1	T _j = 25°C	—	4.7	8.0	mA
Quiescent Current Change	Line	1	13V ≤ V _{IN} ≤ 26.5V, I _{OUT} = 200mA	—	—	0.8	mA
	Load	1	5mA ≤ I _{OUT} ≤ 350mA	—	—	0.5	
Output Noise Voltage	V _{NO}	2	T _a = 25°C, 10Hz ≤ f ≤ 100kHz	—	65	280	μV _{rms}
Ripple Rejection	R.R.	3	f = 120Hz, I _{OUT} = 100mA 13.5V ≤ V _{IN} ≤ 23.5V, T _j = 25°C	55	62	—	dB
Short Circuit Current Limit	I _{SC}	1	T _j = 25°C	—	960	—	mA
Dropout Voltage	V _D	1	T _a = 25°C	—	1.7	—	V
Average Temperature Coefficient Of Output Voltage	T _{CVO}	1	I _{OUT} = 5mA	—	− 1.3	—	mV / °C

TA78M12S

ELECTRICAL CHARACTERISTICS

(V_{IN} = 19V, I_{OUT} = 350mA, 0°C ≤ T_j ≤ 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	T _j = 25°C	11.5	12.0	12.5	V
Line Regulation	Reg.line	1	T _j = 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	T _j = 25°C 5mA ≤ I _{OUT} ≤ 500mA	—	27	240	mV
			5mA ≤ I _{OUT} ≤ 200mA	—	10	120	
Output Voltage	V _{OUT}	1	T _j = 25°C 14.5V ≤ V _{IN} ≤ 27V 5mA ≤ I _{OUT} ≤ 350mA	11.4	—	12.6	V
Quiescent Current	I _B	1	T _j = 25°C	—	4.8	8.0	mA
Quiescent Current Change	Line	1	15V ≤ V _{IN} ≤ 30.5V, I _{OUT} = 200mA	—	—	0.8	mA
	Load	1	5mA ≤ I _{OUT} ≤ 350mA	—	—	0.5	
Output Noise Voltage	V _{NO}	2	T _a = 25°C, 10Hz ≤ f ≤ 100kHz	—	70	300	μV _{rms}
Ripple Rejection	R.R.	3	f = 120Hz, I _{OUT} = 100mA 15V ≤ V _{IN} ≤ 25V, T _j = 25°C	55	62	—	dB
Short Circuit Current Limit	I _{SC}	1	T _j = 25°C	—	960	—	mA
Dropout Voltage	V _D	1	T _a = 25°C	—	1.7	—	V
Average Temperature Coefficient Of Output Voltage	T _{CVO}	1	I _{OUT} = 5mA	—	− 1.6	—	mV / °C

TA78M15S

ELECTRICAL CHARACTERISTICS(V_{IN} = 23V, I_{OUT} = 350mA, 0°C ≤ T_j ≤ 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	T _j = 25°C	14.4	15.0	15.6	V
Line Regulation	Reg.line	1	T _j = 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	T _j = 25°C 5mA ≤ I _{OUT} ≤ 500mA	—	27	300	mV
			5mA ≤ I _{OUT} ≤ 200mA	—	10	150	
Output Voltage	V _{OUT}	1	T _j = 25°C 17.5V ≤ V _{IN} ≤ 30V 5mA ≤ I _{OUT} ≤ 350mA	14.25	—	15.75	V
Quiescent Current	I _B	1	T _j = 25°C	—	4.8	8.0	mA
Quiescent Current Change	Line	1	18V ≤ V _{IN} ≤ 30.5V, I _{OUT} = 200mA	—	—	0.8	mA
	Load	1	5mA ≤ I _{OUT} ≤ 350mA	—	—	0.5	
Output Noise Voltage	V _{NO}	2	T _a = 25°C, 10Hz ≤ f ≤ 100kHz	—	80	450	μV _{rms}
Ripple Rejection	R.R.	3	f = 120Hz, I _{OUT} = 100mA 18.5V ≤ V _{IN} ≤ 28.5V, T _j = 25°C	54	61	—	dB
Short Circuit Current Limit	I _{SC}	1	T _j = 25°C	—	960	—	mA
Dropout Voltage	V _D	1	T _a = 25°C	—	1.7	—	V
Average Temperature Coefficient Of Output Voltage	T _{CVO}	1	I _{OUT} = 5mA	—	−2.0	—	mV / °C

TA78M18S

ELECTRICAL CHARACTERISTICS(V_{IN} = 27V, I_{OUT} = 350mA, 0°C ≤ T_j ≤ 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	T _j = 25°C	17.3	18.0	18.7	V
Line Regulation	Reg.line	1	T _j = 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	T _j = 25°C 5mA ≤ I _{OUT} ≤ 500mA	—	28	360	mV
			5mA ≤ I _{OUT} ≤ 200mA	—	10	180	
Output Voltage	V _{OUT}	1	T _j = 25°C 21V ≤ V _{IN} ≤ 33V 5mA ≤ I _{OUT} ≤ 350mA	17.1	—	18.9	V
Quiescent Current	I _B	1	T _j = 25°C	—	4.8	8.0	mA
Quiescent Current Change	Line	1	21.5V ≤ V _{IN} ≤ 33.5V, I _{OUT} = 200mA	—	—	0.8	mA
	Load	1	5mA ≤ I _{OUT} ≤ 350mA	—	—	0.5	
Output Noise Voltage	V _{NO}	2	T _a = 25°C, 10Hz ≤ f ≤ 100kHz	—	90	490	μV _{rms}
Ripple Rejection	R.R.	3	f = 120Hz, I _{OUT} = 100mA 22V ≤ V _{IN} ≤ 32V, T _j = 25°C	53	60	—	dB
Short Circuit Current Limit	I _{SC}	1	T _j = 25°C	—	960	—	mA
Dropout Voltage	V _D	1	T _a = 25°C	—	1.7	—	V
Average Temperature Coefficient Of Output Voltage	T _{CVO}	1	I _{OUT} = 5mA	—	−2.5	—	mV / °C

TA78M20S

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

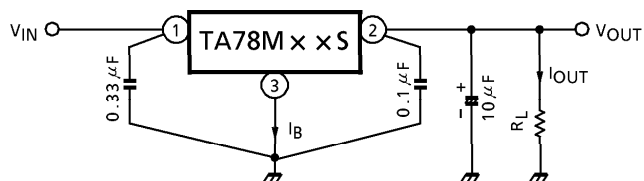
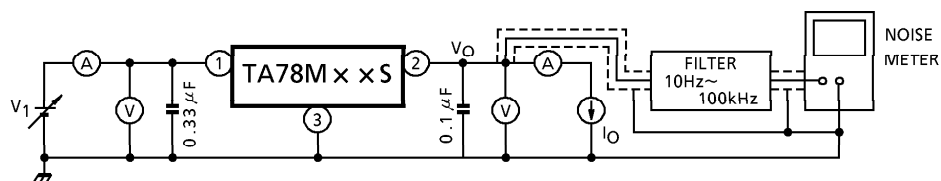
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	V _{OUT}	1	T _j = 25°C	19.2	20.0	20.8	V
Line Regulation	Reg.line	1	T _j = 25°C 23V ≤ V _{IN} ≤ 35V I _{OUT} = 200mA	—	10	100	mV
			24V ≤ V _{IN} ≤ 35V I _{OUT} = 200mA	—	6	50	
Load Regulation	Reg.load	1	T _j = 25°C 5mA ≤ I _{OUT} ≤ 500mA	—	28	400	mV
			5mA ≤ I _{OUT} ≤ 200mA	—	10	200	
Output Voltage	V _{OUT}	1	T _j = 25°C 23V ≤ V _{IN} ≤ 35V 5mA ≤ I _{OUT} ≤ 350mA	19.0	—	21.0	V
Quiescent Current	I _B	1	T _j = 25°C	—	4.9	8.0	mA
Quiescent Current Change	Line	1	23.5V ≤ V _{IN} ≤ 35.5V, I _{OUT} = 200mA	—	—	0.8	mA
	Load	1	5mA ≤ I _{OUT} ≤ 350mA	—	—	0.5	
Output Noise Voltage	V _{NO}	2	T _a = 25°C, 10Hz ≤ f ≤ 100kHz	—	95	540	μV _{rms}
Ripple Rejection	R.R.	3	f = 120Hz, I _{OUT} = 100mA 24V ≤ V _{IN} ≤ 34V, T _j = 25°C	53	60	—	dB
Short Circuit Current Limit	I _{SC}	1	T _j = 25°C	—	960	—	mA
Dropout Voltage	V _D	1	T _a = 25°C	—	1.7	—	V
Average Temperature Coefficient Of Output Voltage	T _{CVO}	1	I _{OUT} = 5mA	—	−3.0	—	mV / °C

TA78M24S

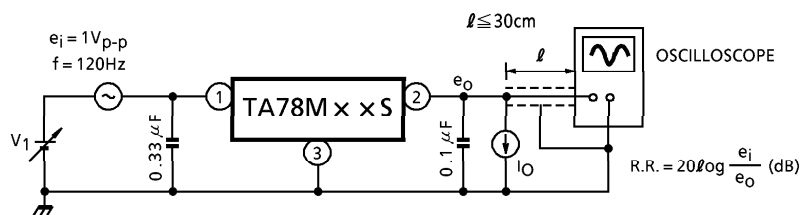
ELECTRICAL CHARACTERISTICS(V_{IN} = 33V, I_{OUT} = 350mA, 0°C ≤ T_j ≤ 125°C, C_{IN} = 0.33μF, C_{OUT} = 0.1μF, unless otherwise noted)

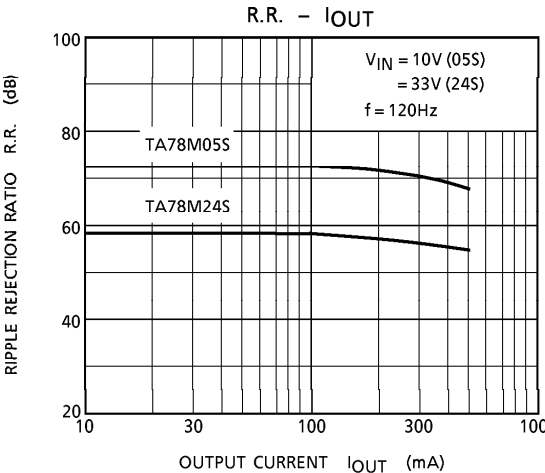
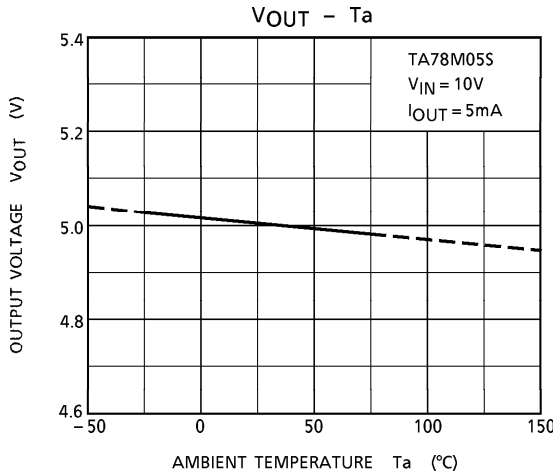
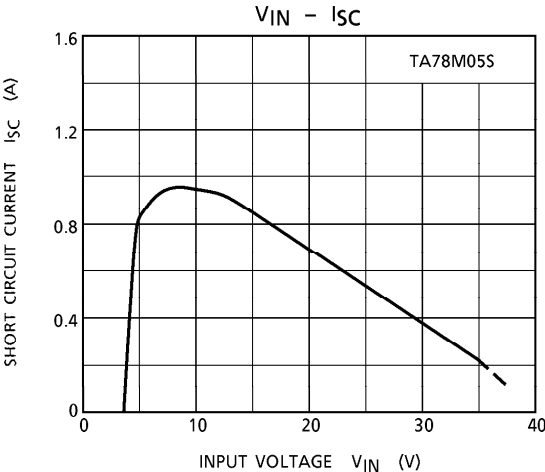
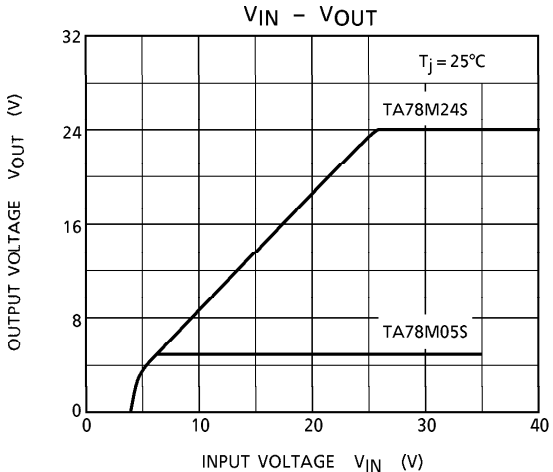
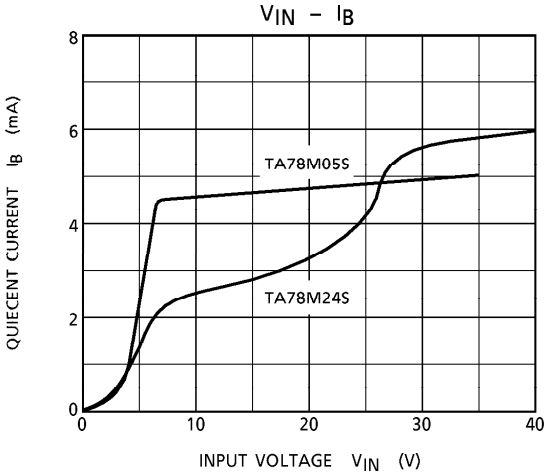
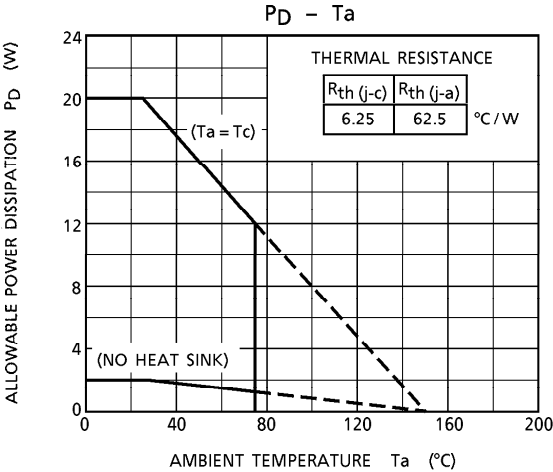
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	V _{OUT}	1	T _j = 25°C	23.0	24.0	25.0	V
Line Regulation	Reg.line	1	T _j = 25°C 27V ≤ V _{IN} ≤ 38V I _{OUT} = 200mA	—	12	100	mV
			28V ≤ V _{IN} ≤ 38V I _{OUT} = 200mA	—	7	50	
Load Regulation	Reg.load	1	T _j = 25°C 5mA ≤ I _{OUT} ≤ 500mA	—	30	480	mV
			5mA ≤ I _{OUT} ≤ 200mA	—	10	240	
Output Voltage	V _{OUT}	1	T _j = 25°C 27V ≤ V _{IN} ≤ 38V 5mA ≤ I _{OUT} ≤ 350mA	22.8	—	25.2	V
Quiescent Current	I _B	1	T _j = 25°C	—	5.0	8.0	mA
Quiescent Current Change	Line	1	27.5V ≤ V _{IN} ≤ 38.5V, I _{OUT} = 200mA	—	—	0.8	mA
	Load	1	5mA ≤ I _{OUT} ≤ 350mA	—	—	0.5	
Output Noise Voltage	V _{NO}	2	T _a = 25°C, 10Hz ≤ f ≤ 100kHz	—	115	650	μV _{rms}
Ripple Rejection	R.R.	3	f = 120Hz, I _{OUT} = 100mA 28V ≤ V _{IN} ≤ 38V, T _j = 25°C	50	57	—	dB
Short Circuit Current Limit	I _{SC}	1	T _j = 25°C	—	960	—	mA
Dropout Voltage	V _D	1	T _a = 25°C	—	1.7	—	V
Average Temperature Coefficient Of Output Voltage	T _{CVO}	1	I _{OUT} = 5mA	—	−3.5	—	mV / °C

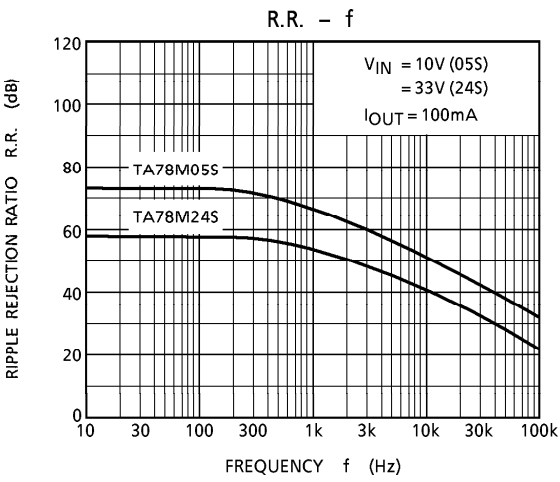
TEST CIRCUIT 1 / STANDARD APPLICATION

TEST CIRCUIT 2 V_{NO} 

TEST CIRCUIT 3 R.R.







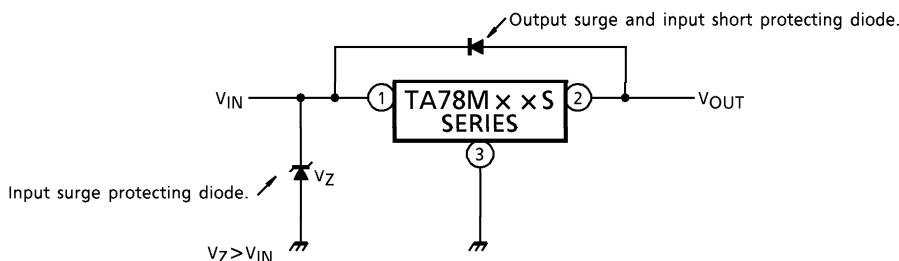
PRECAUTIONS ON APPLICATION

- (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.

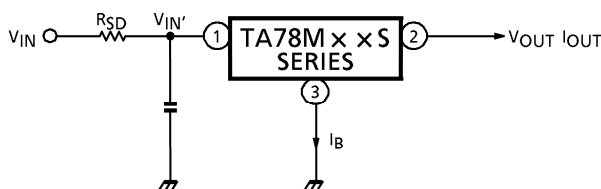
Specially, in the latter case, great care is necessary.

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 R_{SD} 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 determining 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 printed 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 (T_j 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 viewpoint 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 ($\theta_c + \theta_s$) is changed by heat sink grease.

TABLE 1

Unit : °C/W

PACKAGE	MODEL No.	TORQUE	MICA	$\theta_c + \theta_s$
TO-220NIS	TA78M × × S	0.6N·m	Not Provided	0.3~0.5 (1.5~2.0)

The figures given in parentheses denote the values at time of no grease.

(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 contact thermal resistance is reduced from the viewpoint of the circuit design, it is recommended that the following methods be adopted.

A : Use YG6260 (TOSHIBA SILICON CORPORATION), if grease is used.

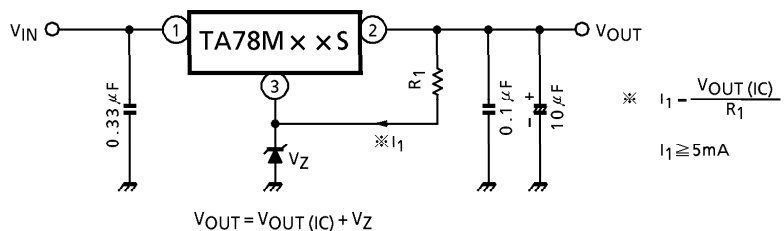
(c) Torque

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.

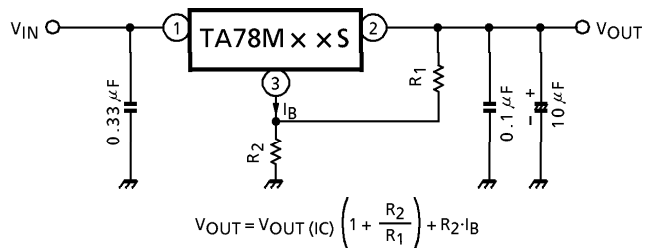
APPLICATION CIRCUITS

(1) VOLTAGE BOOST REGULATOR

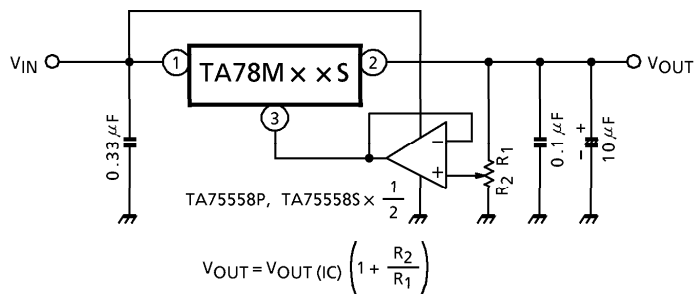
(a) Voltage boost by use of zener diode



(b) Voltage boost by use of resistor

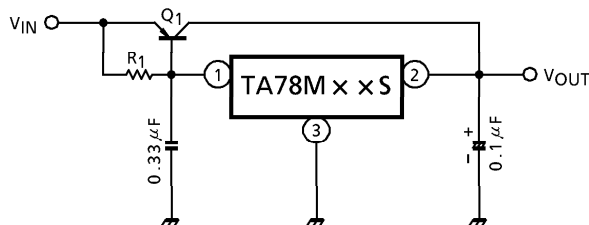


(c) Adjustable output regulator



(2) CURRENT BOOST REGULATOR

(a) CURRENT BOOST VOLTAGE REGULATOR



Heat sink is needed for Q1

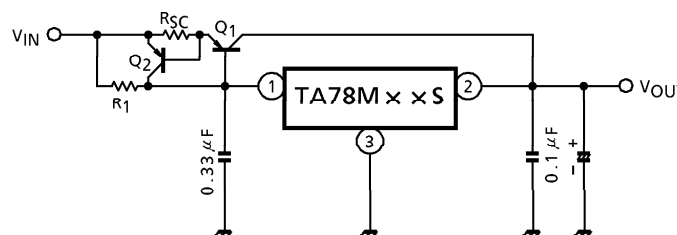
$$R_1 \cong \frac{V_{BE1}}{I_{B \text{ MAX}}}$$

where,

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

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

(b) SHORT-CIRCUIT PROTECTION

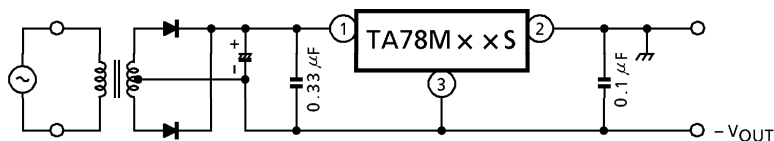


$$R_{SC} = \frac{V_{BE2}}{I_{SC}}$$

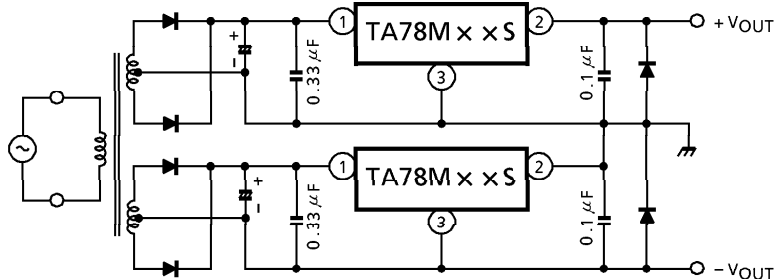
where,

I_{SC} : Short-circuit current

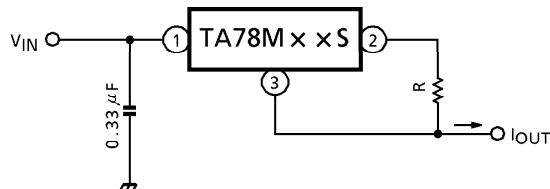
(3) NEGATIVE REGULATOR



(4) POSITIVE AND NEGATIVE REGULATOR



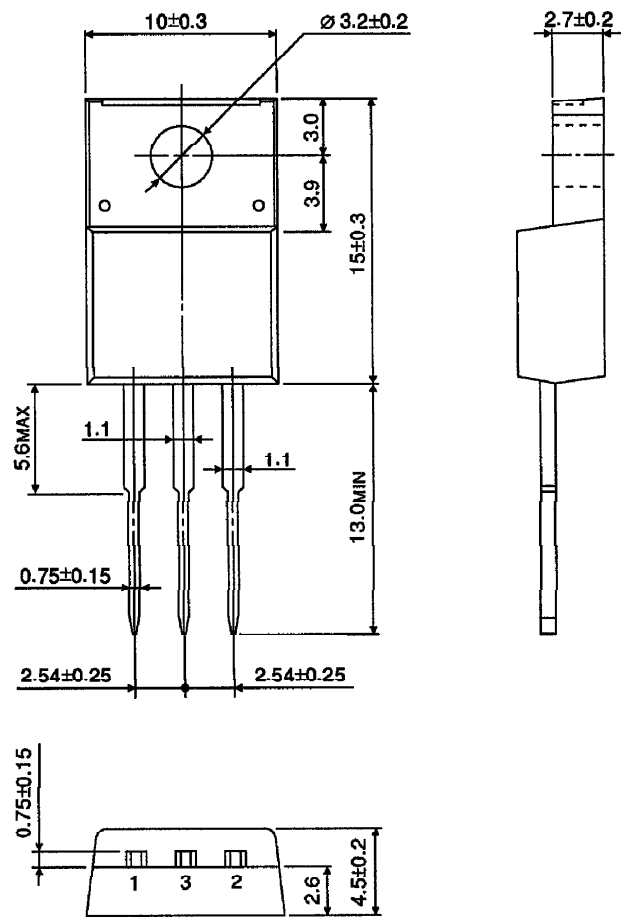
(5) CURRENT REGULATOR



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

OUTLINE DRAWING
HSIP3-P-2.54A

Unit : mm



Weight : 1.7g (Typ.)