

TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

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

Output Current of 0.5 A, Three-Terminal Positive Voltage Regulators

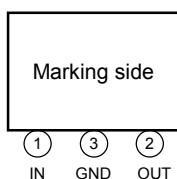
5 V, 6 V, 8 V, 9 V, 10 V, 12 V, 15 V, 18 V, 20 V, 24 V

The TA78M××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 drive up to 0.5 A of output current.

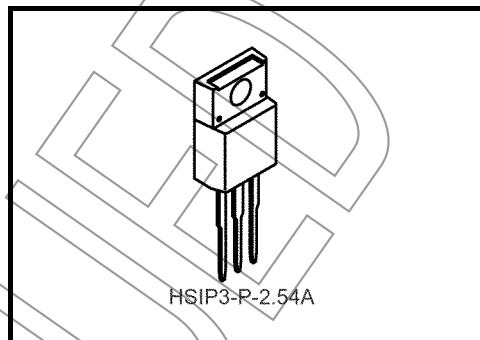
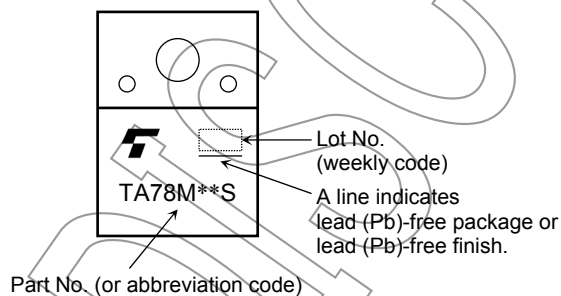
Features

- Suitable for CMOS, TTL and the power supply of other digital ICs
- Maximum output current of 0.5 A.
- Internal thermal overload protection.
- Internal short circuit current limiting.
- Package in the plastic case TO-220NIS.

Pin Assignment

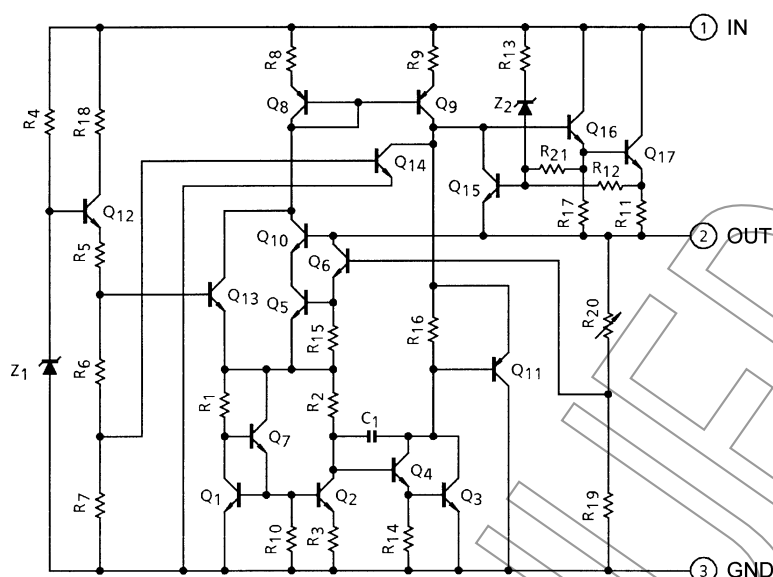


Marking



Weight: 1.7 g (typ.)

Equivalent Circuit



Absolute Maximum Ratings (Ta = 25°C)

Characteristics		Symbol	Rating	Unit
Input voltage	TA78M05S	V_{IN}	35	V
	TA78M06S			
	TA78M08S			
	TA78M09S			
	TA78M10S			
	TA78M12S			
	TA78M15S			
	TA78M18S			
	TA78M20S		40	
	TA78M24S			
Power dissipation	(Ta = 25°C)	P_D	2	W
	(Tc = 25°C)		20	
Operating temperature		T_{opr}	-30~85	°C
Storage temperature		T_{stg}	-55~150	°C
Junction temperature		T_j	150	°C
Thermal resistance	$R_{th(j-c)}$		6.25	°C/W
	$R_{th(j-a)}$		62.5	

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/Derating Concept and Methods) and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

TA78M05S

Electrical Characteristics

(Unless otherwise specified, $V_{IN} = 10\text{ V}$, $I_{OUT} = 350\text{ mA}$, $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$, $C_{IN} = 0.33\text{ }\mu\text{F}$, $C_{OUT} = 0.1\text{ }\mu\text{F}$)

Characteristics		Symbol	Test Circuit	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	7 V ≤ V _{IN} ≤ 25 V, I _{OUT} = 200 mA	—	4	100	mV	
				8 V ≤ V _{IN} ≤ 25 V, I _{OUT} = 200 mA	—	2	50		
Load regulation	Reg:load	1	T _j = 25°C	5 mA ≤ I _{OUT} ≤ 500 mA	—	25	100	mV	
				5 mA ≤ I _{OUT} ≤ 200 mA	—	10	50		
Output voltage		V _{OUT}	1	T _j = 25°C 7 V ≤ V _{IN} ≤ 20 V, 5 mA ≤ I _{OUT} ≤ 350 mA	4.75	—	5.25	V	
Quiescent current		I _B	1	T _j = 25°C	—	4.5	8.0	mA	
Quiescent current change	Line	ΔI _{BI}	1	T _j = 25°C	8.5 V ≤ V _{IN} ≤ 25.5 V, I _{OUT} = 200 mA	—	—	0.8	mA
	Load	ΔI _{BO}	1		5 mA ≤ I _{OUT} ≤ 350 mA	—	—	0.5	
Output noise voltage		V _{NO}	2	T _a = 25°C, 10 Hz ≤ f ≤ 100 kHz	—	50	200	μV _{rms}	
Ripple rejection		R.R.	3	f = 120 Hz, I _{OUT} = 100 mA, 8 V ≤ V _{IN} ≤ 18 V, 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 _j = 25°C	—	1.7	—	V	
Average temperature coefficient of output voltage		T _{CV0}	1	I _{OUT} = 5 mA	—	−0.6	—	mV/°C	

TA78M06S

Electrical Characteristics

(Unless otherwise specified, $V_{IN} = 11\text{ V}$, $I_{OUT} = 350\text{ mA}$, $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$, $C_{IN} = 0.33\text{ }\mu\text{F}$, $C_{OUT} = 0.1\text{ }\mu\text{F}$)

Characteristics		Symbol	Test Circuit	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	8 V ≤ V _{IN} ≤ 25 V, I _{OUT} = 200 mA	—	4	100	mV	
				9 V ≤ V _{IN} ≤ 25 V, I _{OUT} = 200 mA	—	2	50		
Load regulation	Reg.load	1	T _j = 25°C	5 mA ≤ I _{OUT} ≤ 500 mA	—	25	120	mV	
				5 mA ≤ I _{OUT} ≤ 200 mA	—	10	60		
Output voltage		V _{OUT}	1	T _j = 25°C	5.7	—	6.3	V	
Quiescent current		I _B	1	T _j = 25°C	—	4.5	8.0	mA	
Quiescent current change	Line	ΔI _{BI}	1	T _j = 25°C	9.5 V ≤ V _{IN} ≤ 25.5 V, I _{OUT} = 200 mA	—	—	0.8	mA
	Load	ΔI _{BO}	1		5 mA ≤ I _{OUT} ≤ 350 mA	—	—	0.5	
Output noise voltage		V _{NO}	2	T _a = 25°C, 10 Hz ≤ f ≤ 100 kHz	—	55	220	μV _{rms}	
Ripple rejection		R.R.	3	f = 120 Hz, I _{OUT} = 100 mA, 9 V ≤ V _{IN} ≤ 19 V, 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 _j = 25°C	—	1.7	—	V	
Average temperature coefficient of output voltage		T _{CV0}	1	I _{OUT} = 5 mA	—	−0.7	—	mV/°C	

TA78M08S

Electrical Characteristics

(Unless otherwise specified, $V_{IN} = 14\text{ V}$, $I_{OUT} = 350\text{ mA}$, $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$, $C_{IN} = 0.33\text{ }\mu\text{F}$, $C_{OUT} = 0.1\text{ }\mu\text{F}$)

Characteristics		Symbol	Test Circuit	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	10.5 V ≤ V _{IN} ≤ 25 V, I _{OUT} = 200 mA	—	5	100	mV	
				11 V ≤ V _{IN} ≤ 25 V, I _{OUT} = 200 mA	—	3	50		
Load regulation	Reg:load	1	T _j = 25°C	5 mA ≤ I _{OUT} ≤ 500 mA	—	26	160	mV	
				5 mA ≤ I _{OUT} ≤ 200 mA	—	10	80		
Output voltage		V _{OUT}	1	T _j = 25°C	10.5 V ≤ V _{IN} ≤ 23 V, 5 mA ≤ I _{OUT} ≤ 350 mA	7.6	—	8.4	V
Quiescent current		I _B	1	T _j = 25°C		—	4.6	8.0	mA
Quiescent current change	Line	ΔI _{BI}	1	T _j = 25°C	11 V ≤ V _{IN} ≤ 25.5 V, I _{OUT} = 200 mA	—	—	0.8	mA
	Load	ΔI _{BO}	1		5 mA ≤ I _{OUT} ≤ 350 mA	—	—	0.5	
Output noise voltage		V _{NO}	2	T _a = 25°C, 10 Hz ≤ f ≤ 100 kHz		—	60	250	μV _{rms}
Ripple rejection		R.R.	3	f = 120 Hz, I _{OUT} = 100 mA, 11.5 V ≤ V _{IN} ≤ 21.5 V, 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 _j = 25°C		—	1.7	—	V
Average temperature coefficient of output voltage		T _{CV0}	1	I _{OUT} = 5 mA		—	−1.0	—	mV/°C

TA78M09S

Electrical Characteristics

(Unless otherwise specified, $V_{IN} = 15\text{ V}$, $I_{OUT} = 350\text{ mA}$, $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$, $C_{IN} = 0.33\text{ }\mu\text{F}$, $C_{OUT} = 0.1\text{ }\mu\text{F}$)

Characteristics		Symbol	Test Circuit	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	11.5 V ≤ V _{IN} ≤ 26 V, I _{OUT} = 200 mA	—	5	100	mV	
				13 V ≤ V _{IN} ≤ 26 V, I _{OUT} = 200 mA	—	3	50		
Load regulation	Reg.load	1	T _j = 25°C	5 mA ≤ I _{OUT} ≤ 500 mA	—	26	180	mV	
				5 mA ≤ I _{OUT} ≤ 200 mA	—	10	90		
Output voltage		V _{OUT}	1	T _j = 25°C	11.5 V ≤ V _{IN} ≤ 24 V, 5 mA ≤ I _{OUT} ≤ 350 mA	8.55	—	9.45	V
Quiescent current		I _B	1	T _j = 25°C		—	4.6	8.0	mA
Quiescent current change	Line	ΔI _{BI}	1	T _j = 25°C	12 V ≤ V _{IN} ≤ 26.5 V, I _{OUT} = 200 mA	—	—	0.8	mA
	Load	ΔI _{BO}	1		5 mA ≤ I _{OUT} ≤ 350 mA	—	—	0.5	
Output noise voltage		V _{NO}	2	T _a = 25°C, 10 Hz ≤ f ≤ 100 kHz		—	60	270	μV _{rms}
Ripple rejection		R.R.	3	f = 120 Hz, I _{OUT} = 100 mA, 12.5 V ≤ V _{IN} ≤ 22.5 V, 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 _j = 25°C		—	1.7	—	V
Average temperature coefficient of output voltage		T _{CV0}	1	I _{OUT} = 5 mA		—	−1.1	—	mV/°C

TA78M10S
Electrical Characteristics

 (Unless otherwise specified, $V_{IN} = 16\text{ V}$, $I_{OUT} = 350\text{ mA}$, $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$, $C_{IN} = 0.33\text{ }\mu\text{F}$, $C_{OUT} = 0.1\text{ }\mu\text{F}$)

Characteristics		Symbol	Test Circuit	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	12.5 V ≤ V _{IN} ≤ 26 V, I _{OUT} = 200 mA	—	6	100	mV	
				14 V ≤ V _{IN} ≤ 26 V, I _{OUT} = 200 mA	—	3	50		
Load regulation	Reg:load	1	T _j = 25°C	5 mA ≤ I _{OUT} ≤ 500 mA	—	26	200	mV	
				5 mA ≤ I _{OUT} ≤ 200 mA	—	10	100		
Output voltage		V _{OUT}	1	T _j = 25°C	12.5 V ≤ V _{IN} ≤ 25 V, 5 mA ≤ I _{OUT} ≤ 350 mA	9.5	—	10.5	V
Quiescent current		I _B	1	T _j = 25°C		—	4.7	8.0	mA
Quiescent current change	Line	ΔI _{BI}	1	T _j = 25°C	13 V ≤ V _{IN} ≤ 26.5 V, I _{OUT} = 200 mA	—	—	0.8	mA
	Load	ΔI _{BO}	1		5 mA ≤ I _{OUT} ≤ 350 mA	—	—	0.5	
Output noise voltage		V _{NO}	2	T _a = 25°C, 10 Hz ≤ f ≤ 100 kHz		—	65	280	μV _{rms}
Ripple rejection		R.R.	3	f = 120 Hz, I _{OUT} = 100 mA, 13.5 V ≤ V _{IN} ≤ 23.5 V, 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 _j = 25°C		—	1.7	—	V
Average temperature coefficient of output voltage		T _{CV0}	1	I _{OUT} = 5 mA		—	-1.3	—	mV/°C

TA78M12S

Electrical Characteristics

(Unless otherwise specified, $V_{IN} = 19\text{ V}$, $I_{OUT} = 350\text{ mA}$, $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$, $C_{IN} = 0.33\text{ }\mu\text{F}$, $C_{OUT} = 0.1\text{ }\mu\text{F}$)

Characteristics		Symbol	Test Circuit	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	14.5 V ≤ V _{IN} ≤ 30 V, I _{OUT} = 200 mA	—	7	100	mV	
				16 V ≤ V _{IN} ≤ 30 V, I _{OUT} = 200 mA	—	3	50		
Load regulation	Reg:load	1	T _j = 25°C	5 mA ≤ I _{OUT} ≤ 500 mA	—	27	240	mV	
				5 mA ≤ I _{OUT} ≤ 200 mA	—	10	120		
Output voltage		V _{OUT}	1	T _j = 25°C	14.5 V ≤ V _{IN} ≤ 27 V, 5 mA ≤ I _{OUT} ≤ 350 mA	11.4	—	12.6	V
Quiescent current		I _B	1	T _j = 25°C		—	4.8	8.0	mA
Quiescent current change	Line	ΔI _{BI}	1	T _j = 25°C	15 V ≤ V _{IN} ≤ 30.5 V, I _{OUT} = 200 mA	—	—	0.8	mA
	Load	ΔI _{BO}	1		5 mA ≤ I _{OUT} ≤ 350 mA	—	—	0.5	
Output noise voltage		V _{NO}	2	T _a = 25°C, 10 Hz ≤ f ≤ 100 kHz		—	70	300	μV _{rms}
Ripple rejection		R.R.	3	f = 120 Hz, I _{OUT} = 100 mA, 15 V ≤ V _{IN} ≤ 25 V, 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 _j = 25°C		—	1.7	—	V
Average temperature coefficient of output voltage		T _{CV0}	1	I _{OUT} = 5 mA		—	−1.6	—	mV/°C

TA78M15S

Electrical Characteristics

(Unless otherwise specified, $V_{IN} = 23\text{ V}$, $I_{OUT} = 350\text{ mA}$, $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$, $C_{IN} = 0.33\text{ }\mu\text{F}$, $C_{OUT} = 0.1\text{ }\mu\text{F}$)

Characteristics		Symbol	Test Circuit	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	17.5 V ≤ V _{IN} ≤ 30 V, I _{OUT} = 200 mA	—	8	100	mV	
				20 V ≤ V _{IN} ≤ 30 V, I _{OUT} = 200 mA	—	4	50		
Load regulation	Reg.load	1	T _j = 25°C	5 mA ≤ I _{OUT} ≤ 500 mA	—	27	300	mV	
				5 mA ≤ I _{OUT} ≤ 200 mA	—	10	150		
Output voltage		V _{OUT}	1	T _j = 25°C	17.5 V ≤ V _{IN} ≤ 30 V, 5 mA ≤ I _{OUT} ≤ 350 mA	14.25	—	15.75	V
Quiescent current		I _B	1	T _j = 25°C		—	4.8	8.0	mA
Quiescent current change	Line	ΔI _{BI}	1	T _j = 25°C	18 V ≤ V _{IN} ≤ 30.5 V, I _{OUT} = 200 mA	—	—	0.8	mA
	Load	ΔI _{BO}	1		5 mA ≤ I _{OUT} ≤ 350 mA	—	—	0.5	
Output noise voltage		V _{NO}	2	T _a = 25°C, 10 Hz ≤ f ≤ 100 kHz		—	80	450	μV _{rms}
Ripple rejection		R.R.	3	f = 120 Hz, I _{OUT} = 100 mA, 18.5 V ≤ V _{IN} ≤ 28.5 V, 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 _j = 25°C		—	1.7	—	V
Average temperature coefficient of output voltage		T _{CV0}	1	I _{OUT} = 5 mA		—	−2.0	—	mV/°C

TA78M18S

Electrical Characteristics

(Unless otherwise specified, $V_{IN} = 27\text{ V}$, $I_{OUT} = 350\text{ mA}$, $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$, $C_{IN} = 0.33\text{ }\mu\text{F}$, $C_{OUT} = 0.1\text{ }\mu\text{F}$)

Characteristics		Symbol	Test Circuit	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	21 V ≤ V _{IN} ≤ 33 V, I _{OUT} = 200 mA	—	9	100	mV	
				24 V ≤ V _{IN} ≤ 33 V, I _{OUT} = 200 mA	—	5	50		
Load regulation	Reg.load	1	T _j = 25°C	5 mA ≤ I _{OUT} ≤ 500 mA	—	28	360	mV	
				5 mA ≤ I _{OUT} ≤ 200 mA	—	10	180		
Output voltage		V _{OUT}	1	T _j = 25°C	21 V ≤ V _{IN} ≤ 33 V, 5 mA ≤ I _{OUT} ≤ 350 mA	17.1	—	18.9	V
Quiescent current		I _B	1	T _j = 25°C		—	4.8	8.0	mA
Quiescent current change	Line	ΔI _{BI}	1	T _j = 25°C	21.5 V ≤ V _{IN} ≤ 33.5 V, I _{OUT} = 200 mA	—	—	0.8	mA
	Load	ΔI _{BO}	1		5 mA ≤ I _{OUT} ≤ 350 mA	—	—	0.5	
Output noise voltage		V _{NO}	2	T _a = 25°C, 10 Hz ≤ f ≤ 100 kHz		—	90	490	μV _{rms}
Ripple rejection		R.R.	3	f = 120 Hz, I _{OUT} = 100 mA, 22 V ≤ V _{IN} ≤ 32 V, 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 _j = 25°C		—	1.7	—	V
Average temperature coefficient of output voltage		T _{CV0}	1	I _{OUT} = 5 mA		—	-2.5	—	mV/°C

TA78M20S

Electrical Characteristics

(Unless otherwise specified, $V_{IN} = 29\text{ V}$, $I_{OUT} = 350\text{ mA}$, $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$, $C_{IN} = 0.33\text{ }\mu\text{F}$, $C_{OUT} = 0.1\text{ }\mu\text{F}$)

Characteristics		Symbol	Test Circuit	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	23 V ≤ V _{IN} ≤ 35 V, I _{OUT} = 200 mA	—	10	100	mV
					24 V ≤ V _{IN} ≤ 35 V, I _{OUT} = 200 mA	—	6	50	
Load regulation		Reg-load	1	T _j = 25°C	5 mA ≤ I _{OUT} ≤ 500 mA	—	28	400	mV
					5 mA ≤ I _{OUT} ≤ 200 mA	—	10	200	
Output voltage		V _{OUT}	1	T _j = 25°C	23 V ≤ V _{IN} ≤ 35 V, 5 mA ≤ I _{OUT} ≤ 350 mA	19.0	—	21.0	V
Quiescent current		I _B	1	T _j = 25°C		—	4.9	8.0	mA
Quiescent current change	Line	ΔI _{BI}	1	T _j = 25°C	23.5 V ≤ V _{IN} ≤ 35.5 V, I _{OUT} = 200 mA	—	—	0.8	mA
	Load	ΔI _{BO}	1		5 mA ≤ I _{OUT} ≤ 350 mA	—	—	0.5	
Output noise voltage		V _{NO}	2	T _a = 25°C, 10 Hz ≤ f ≤ 100 kHz		—	95	540	μV _{rms}
Ripple rejection		R.R.	3	f = 120 Hz, I _{OUT} = 100 mA, 24 V ≤ V _{IN} ≤ 34 V, 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 _j = 25°C		—	1.7	—	V
Average temperature coefficient of output voltage		T _{CVO}	1	I _{OUT} = 5 mA		—	−3.0	—	mV/°C

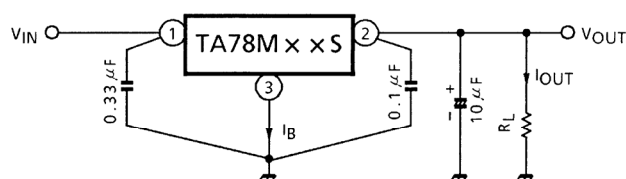
TA78M24S

Electrical Characteristics

(Unless otherwise specified, $V_{IN} = 33\text{ V}$, $I_{OUT} = 350\text{ mA}$, $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$, $C_{IN} = 0.33\text{ }\mu\text{F}$, $C_{OUT} = 0.1\text{ }\mu\text{F}$)

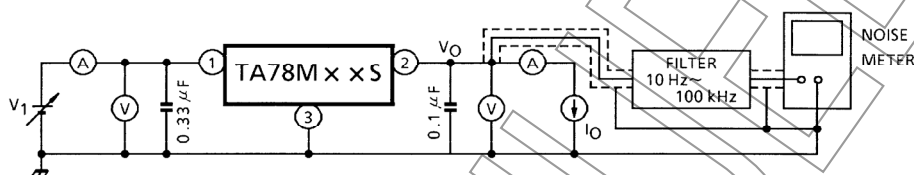
Characteristics		Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit
Output voltage		V _{OUT}	1	T _j = 25°C		23.0	24.0	25.0	V
Line regulation		Reg:line	1	T _j = 25°C	27 V ≤ V _{IN} ≤ 38 V, I _{OUT} = 200 mA	—	12	100	mV
					28 V ≤ V _{IN} ≤ 38 V, I _{OUT} = 200 mA	—	7	50	
Load regulation		Reg:load	1	T _j = 25°C	5 mA ≤ I _{OUT} ≤ 500 mA	—	30	480	mV
					5 mA ≤ I _{OUT} ≤ 200 mA	—	10	240	
Output voltage		V _{OUT}	1	T _j = 25°C	27 V ≤ V _{IN} ≤ 38 V, 5 mA ≤ I _{OUT} ≤ 350 mA	22.8	—	25.2	V
Quiescent current		I _B	1	T _j = 25°C		—	5.0	8.0	mA
Quiescent current change	Line	ΔI _{BI}	1	T _j = 25°C	27.5 V ≤ V _{IN} ≤ 38.5 V, I _{OUT} = 200 mA	—	—	0.8	mA
	Load	ΔI _{BO}	1		5 mA ≤ I _{OUT} ≤ 350 mA	—	—	0.5	
Output noise voltage		V _{NO}	2	T _a = 25°C, 10 Hz ≤ f ≤ 100 kHz		—	115	650	μV _{rms}
Ripple rejection		R.R.	3	f = 120 Hz, I _{OUT} = 100 mA, 28 V ≤ V _{IN} ≤ 38 V, 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 _j = 25°C		—	1.7	—	V
Average temperature coefficient of output voltage		T _{CV0}	1	I _{OUT} = 5 mA		—	−3.5	—	mV/°C

Test Circuit 1/Standard Application



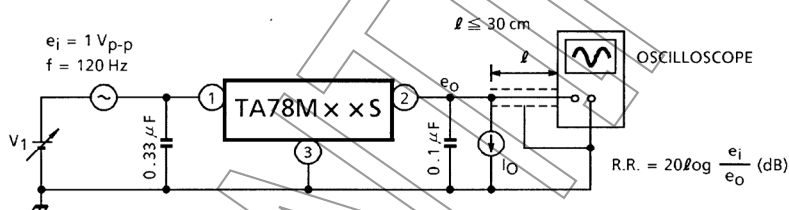
Test Circuit 2

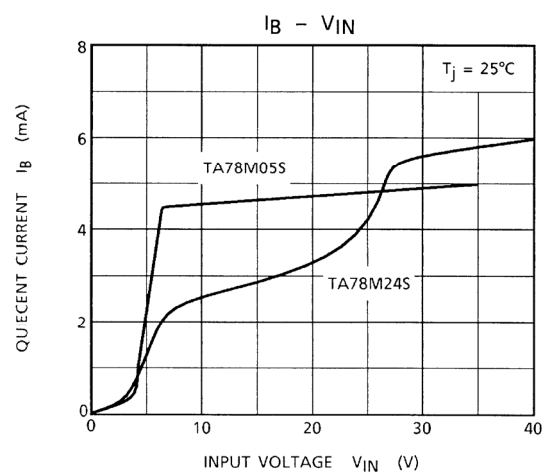
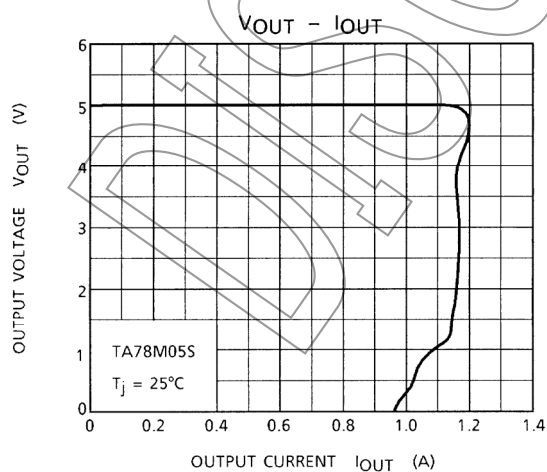
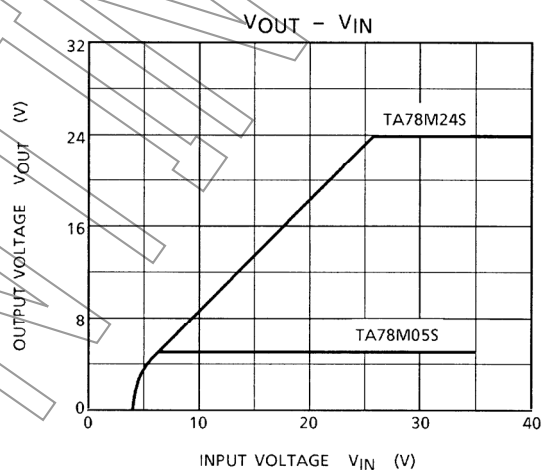
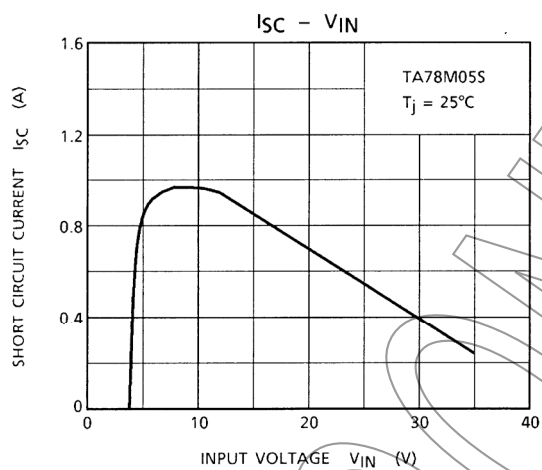
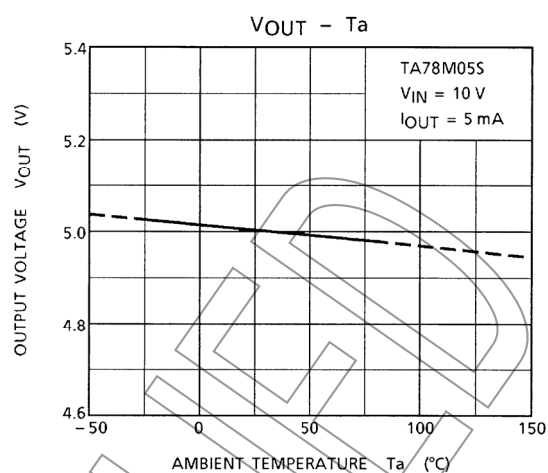
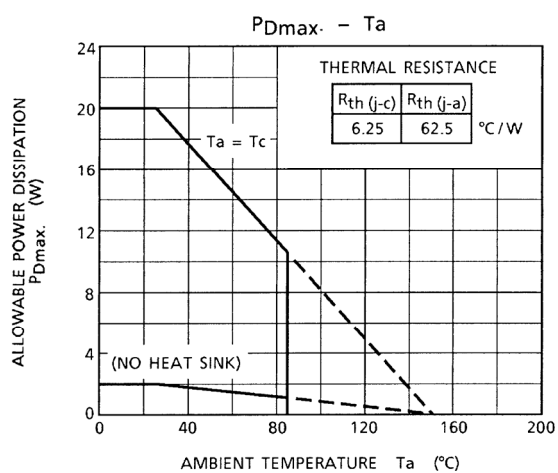
V_{NO}

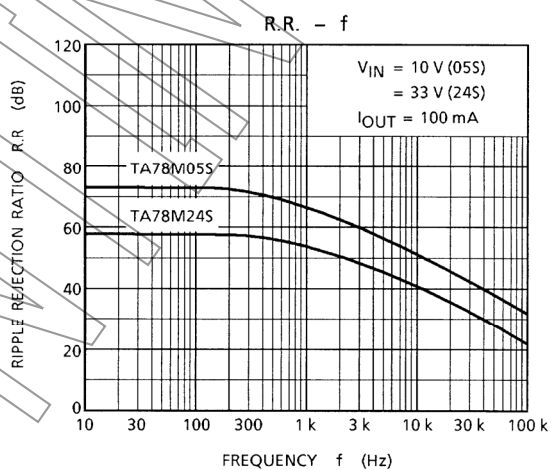
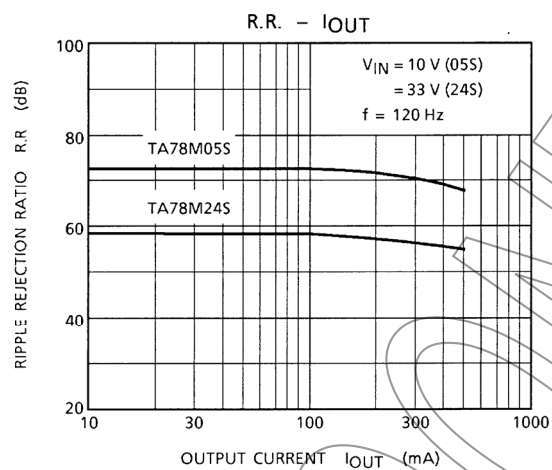
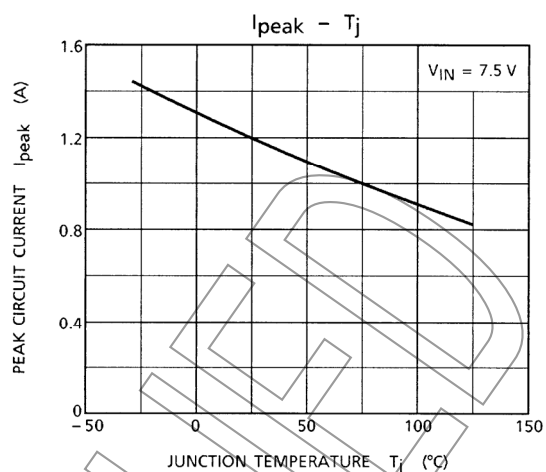
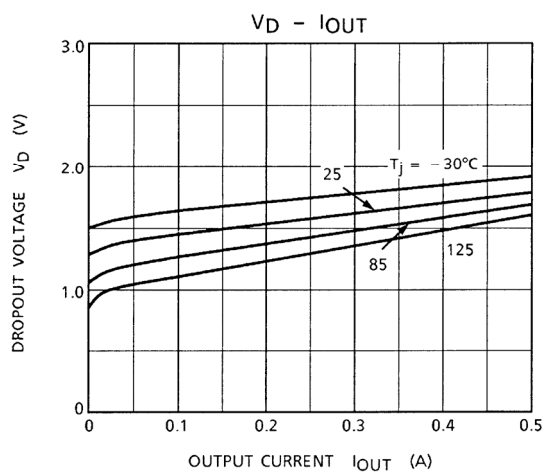


Test Circuit 3

R.R.







Precautions on Application

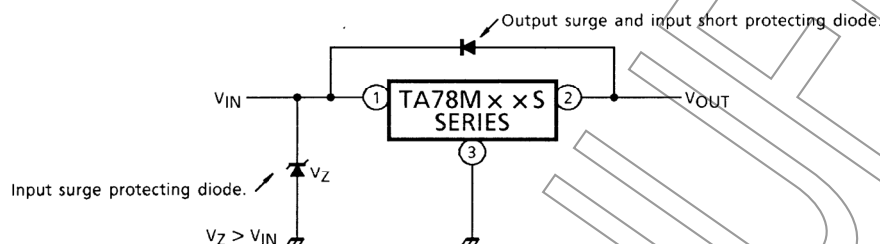
- (1) In regard to GND, be careful not to apply a negative voltage to the input/output terminal. Further, special care is necessary in the case of a voltage boost application.

- (2) If a surge voltage exceeding the maximum rating is applied to the input terminal or if a voltage in excess of the input terminal voltage is applied to the output terminal, the circuit may be destroyed.

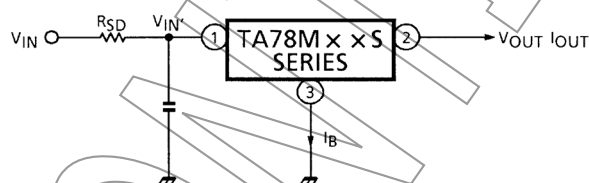
Particular care is necessary in the case of the latter.

Circuit destruction may also occur if the input terminal shorts to GND in a state of normal operation, causing the output terminal voltage to exceed the input voltage (GND potential) and the electrical charge of the chemical capacitor connected to the output terminal to flow into the input side.

Where these risks exist, take steps such as connecting zener and general silicon diodes to the circuit, as shown in the figure below.



- (3) When the input voltage is too high, the power dissipation of the three-terminal regulator, which is a series regulator, increases, causing the junction temperature to rise. In such a case, it is recommended to reduce the power dissipation, and hence the junction temperature, by inserting a power-limiting resistor R_{SD} in the input terminal.



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

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

Reducing $V_{IN'}$ below the lowest voltage necessary for the IC will cause ripple, deterioration in output regulation and, in certain circumstances, parasitic oscillation.

To determine the resistance value of R_{SD} , design with a margin, referring to the following equation.

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

- (4) Be sure to connect a capacitor near the input terminal and output terminal between both terminals and GND. The capacitances should be determined experimentally because they depend on printed circuit board patterns. In particular, adequate investigation should be made to ensure there is no problem even in high or low temperatures.

- (5) Installation of IC for power supply

To obtain high reliability on the heat sink design of a 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 the IC on a heat sink.

- (a) Heat sink design

The thermal resistance of the 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	0.6 N·m	Not provided	0.3~0.5 (1.5~2.0)

The figures given in parentheses denote the values for when there is no grease.

(b) Silicon grease

In the design of a circuit not exceeding the maximum rating, grease should be used if possible. If it is necessary to reduce the contact thermal resistance for the sake of circuit design, the following methods are recommended.

A: If using grease, use YG6260 (TOSHIBA SILICON CORPORATION).

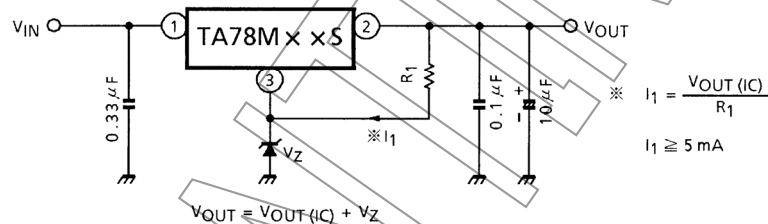
(c) Torque

When installing the IC on a heat sink or the like, tighten the IC with a torque of less than the rated value. Tightening in excess of the rated value may cause internal elements of the IC to be adversely affected. Therefore, great care should be given to the installation procedure.

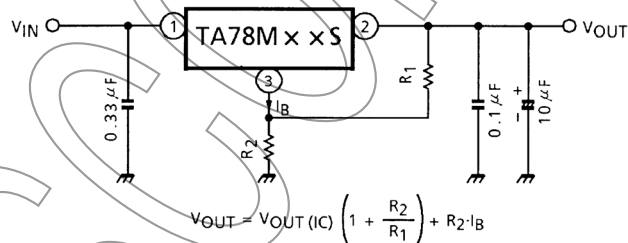
Application Circuits

(1) Voltage Boost Regulator

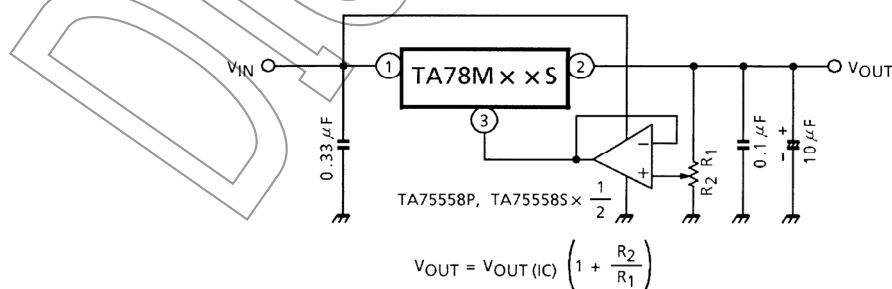
(a) Voltage boost by use of zener diode



(b) Voltage boost by use of resistor

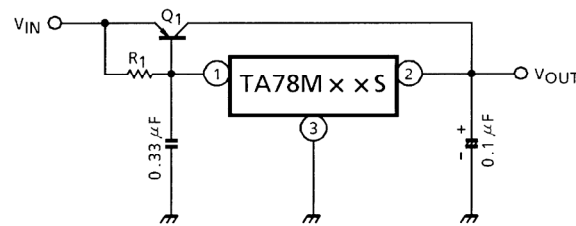


(c) Adjustable output regulator



(2) Current Boost Regulator

(a) Current boost voltage regulator



Heat sink is needed for Q₁

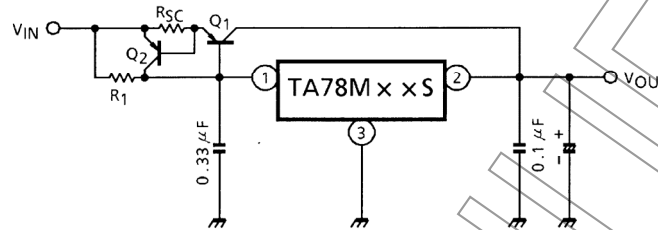
$$R_1 \cong \frac{V_{BE1}}{I_B \text{ MAX}}$$

where,

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

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

(b) Short.circuit protection

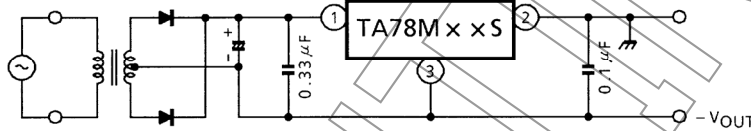


$$R_{SC} = \frac{V_{BE2}}{I_{SC}}$$

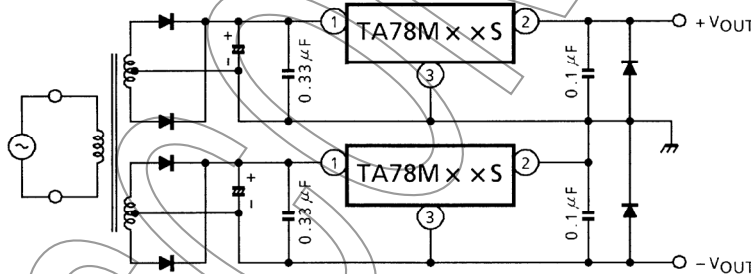
where,

I_{SC} : Short-circuit current

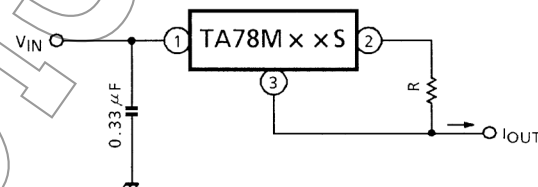
(3) Negative Regulator



(4) Positive and Negative Regulator



(5) Current Regulator

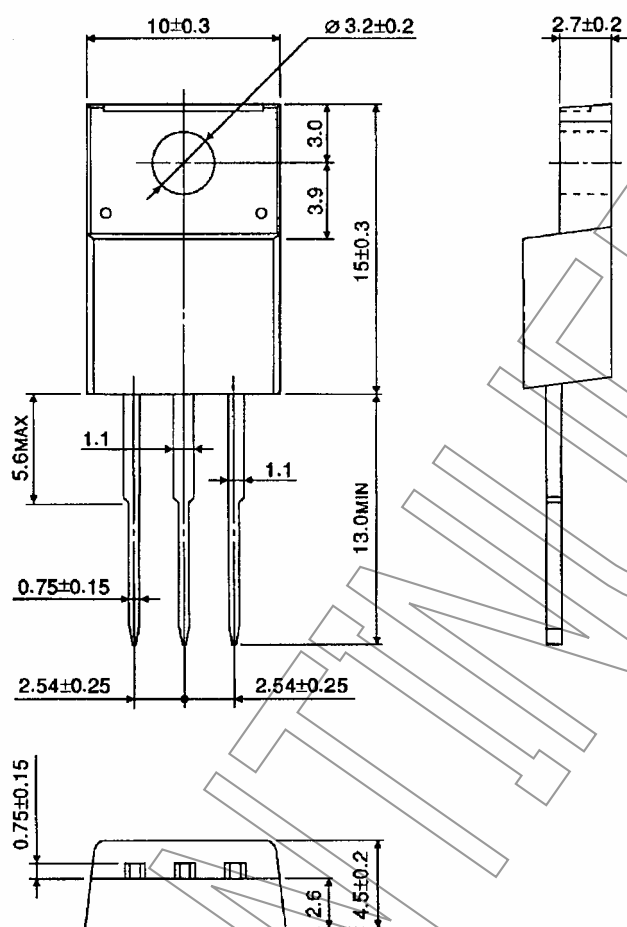


$$I_{OUT} = \frac{V_{OUT}}{R} + I_B$$

Package Dimensions

HSIP3-P-2.54A

Unit: mm



Weight: 1.7 g (typ.)

RESTRICTIONS ON PRODUCT USE

20070701-EN

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