TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

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

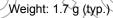
Output Current of 0.5 A, Three-Terminal Positive Voltage Regulators

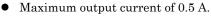
5 V, 6 V, 8 V, 9 V, 10 V, 12 V, 15 V, 18 V, 20 V, 24 V

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 $0.5~\mathrm{A}$ of output current.



Suitable for CMOS, TTL and the power supply of other digital ICs





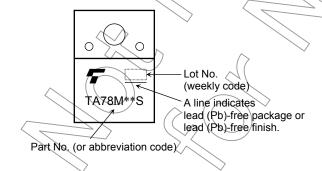
- Internal thermal overload protection.
- Internal short circuit current limiting.

• Package in the plastic case TO-220NIS.

Pin Assignment

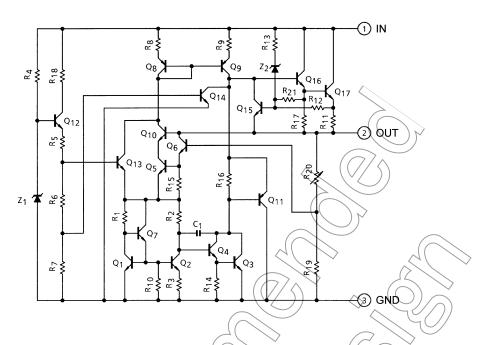


Marking





Equivalent Circuit



Absolute Maximum Ratings (Ta = 25°C)

Characteris	tics	Symbol	Rating	Unit
	TA78M05S	<		
	TA78M06S			
	TA78M08S			
	TA78M09S		35	`
Input voltage	TA78M10S			
iliput voltage	TA78M12S	VIN	1	
	TA78M15\$	// 5)		4
	TA78M18S		((//\)	
<	TA78M20S	7	40	
	TA78M24S			
Power dissipation	(Ta = 25°C)	PD	2	W
Fower dissipation	(Tc = 25°C)	_ FD	20	VV
Operating temperature		Topr	-30~85	°C
Storage temperature		T _{stg}	-55~150	°C
Junction temperature	\wedge	(I)	150	°C
Thermal resistance		Rth (j-c)	6.25	°C/W
THEMILALIESISIANCE		R _{th (j-a)}	62.5	0, 44

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.

2

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 V, I_{OUT} = 350 mA, 0°C \leq T $_{j}$ \leq 125°C, C_{IN} = 0.33 μ F, C_{OUT} = 0.1 μ F)

Characteristic	s	Symbol	Test Circuit		Test Condition	Min	Тур.	Max	Unit
Output voltage		V _{OUT}	1	T _j = 25°C	T _j = 25°C		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
Line regulation		rveg iiile			8 V ≤ V _{IN} ≤ 25 V, I _{OUT} = 200 mA		2	50	IIIV
Load regulation		Reg·load	1	T _i = 25°C	5 mA ≤ I _{OUT} ≤ 500 mA	<u> </u>	25	100	mV
Load regulation		rteg load	'	,	5 mA ≤ I _{OUT} ≤ 200 mA	· –	10	50	IIIV
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	٧
Quiescent current		ΙΒ	1	T _j = 25°C			4.5	8.0	mA
Quiescent current change	Line	ΔI _{BI}	1	T _i = 25°C	8.5 V = V _{IN} ≤ 25.5 V, IOUT = 200 mA	(0.8	mA
change	Load	Δl _{BO}	1		5 mA ≤ 1 _{0UT} ≤ 350 mA	X	(4)	0.5	
Output noise voltage	•	V _{NO}	2	Ta = 25°C	, 10 Hz ≤ f≤ 100 kHz	7	50	200	μV_{rms}
Ripple rejection		R.R.	3	f = 120 Hz 8 V ≤ V _{IN} :	z, I _{OUT} ≠ 100 mA, ≤ 18 V, T _j = 25°C	62	69	_	dB
Short circuit current lir	nit	I _{SC}	1	T € 25°C	\$ ((//<	\ -	960	_	mA
Dropout voltage		V _D	1,	T _j = 25°C		/ _	1.7	_	V
Average temperature coefficient of output vo	oltage	T _{CVO}		louT = 5 n	mA ()	_	-0.6		mV/°C



TA78M06S Electrical Characteristics (Unless otherwise specified, V_{IN} = 11 V, I_{OUT} = 350 mA, 0°C \leq T $_{j}$ \leq 125°C, C_{IN} = 0.33 μ F, C_{OUT} = 0.1 μ F)

Characteristic	cs	Symbol	Test Circuit		Test Condition	Min	Тур.	Max	Unit
Output voltage		V _{OUT}	1	T _j = 25°C	ζ	5.75	6.0	6.25	V
Line regulation		Reg·line	1	T _i = 25°C	8 V ≤ V _{IN} ≤ 25 V, I _{OUT} = 200 mA) \ 4	100	mV
Line regulation		Regille	'	1 _j = 25 C	9 V ≤ V _{IN} ≤ 25 V, I _{OUT} = 200 mA) } {	2	50	IIIV
Load regulation		Reg·load	1	T _i = 25°C	5 mA ≤ I _{OUT} ≤ 500 mA	<u> </u>	25	120	mV
Load regulation		rteg load	'	,	5 mA ≤ I _{OUT} ≤ 200 mA	· –	10	60	IIIV
Output voltage		V _{OUT}	1	T _j = 25°C	8 V ≤ V _{IN} ≤ 21-V, 5 mA ≤ I _{OUT} ≤ 350 mA	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 _i = 25°C	9.5 V ≤ V _{IN} ≤ 25.5 V, I _{OUT} = 200 mA	(0.8	mA
Change	Load	Δl _{BO}	1		5 mA ≤ 1 _{0UT} ≤ 350 mA	(7	(4)	0.5	
Output noise voltage		V _{NO}	2	Ta = 25°C	, 10 Hz ≤ f≤ 100 kHz	7 _	55	220	μV_{rms}
Ripple rejection		R.R.	3	f = 120 Hz 9 V ≤ V _{IN} :	z, I _{OUT} = 100 mA, ≤ 19 V, T _j = 25°C	59	66	_	dB
Short circuit current lin	mit	I _{SC}	1	T € 25°C	\$ (0//) —	960	_	mA
Dropout voltage		V _D	1,	$T_j = 25^{\circ}C$		/ _	1.7	_	V
Average temperature coefficient of output v	oltage	T _{CVO}	1	louT = 5 n	mA (_	-0.7	_	mV/°C

4



TA78M08S Electrical Characteristics (Unless otherwise specified, V_{IN} = 14 V, I_{OUT} = 350 mA, 0°C \leq T $_{j}$ \leq 125°C, C_{IN} = 0.33 μ F, C_{OUT} = 0.1 μ F)

Characteristic	:s	Symbol	Test Circuit		Test Condition	Min	Тур.	Max	Unit
Output voltage		V _{OUT}	1	T _j = 25°C		7.7	8.0	8.3	V
Line regulation		Reg·line	1	T. = 25°C	$10.5 \text{ V} \le \text{V}_{\text{IN}} \le 25 \text{ V},$ $\text{I}_{\text{OUT}} = 200 \text{ mA}$		5	100	- mV
Line regulation		Regille	1 T _j = 25°C		11 V ≤ V _{IN} ≤ 25 V, I _{OUT} = 200 mA		3	50	IIIV
Load regulation		Reg·load	1	T _i = 25°C	5 mA ≤ I _{OUT} ≤ 500 mA	<u> </u>	26	160	mV
Load regulation		Negricau	'	1, - 25 C	5 mA ≤ I _{OUT} ≤ 200 mA	· –	10	80	IIIV
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	Line	ΔI _{BI}	1	T _i = 25°C	11 V ≤ V _{IN} ≥ 25.5 V, I _{OUT} = 200 mA	(0.8	mA
change	Load	Δl _{BO}	1		5 mA ≤ 1 _{0UT} ≤ 350 mA	(-	(4)	0.5	
Output noise voltage		V _{NO}	2	Ta = 25°C	, 10 Hz ≤ f≤ 100 kHz		60	250	μV_{rms}
Ripple rejection		R.R.	3	f = 120 Hz 11.5 V ≤ V	, I _{OUT} ≠ 100 mA, I _N ≤ 21.5 V, T _j = 25°C	56	63	_	dB
Short circuit current lin	nit	I _{SC}	1	T € 25°C	\$ (0/3	\ -	960	_	mA
Dropout voltage		V _D	1,	$T_j = 25^{\circ}C$		/ _	1.7	_	V
Average temperature coefficient of output vo	oltage	T _{CVO}		10UT = 5 n	nA (_	-1.0	_	mV/°C



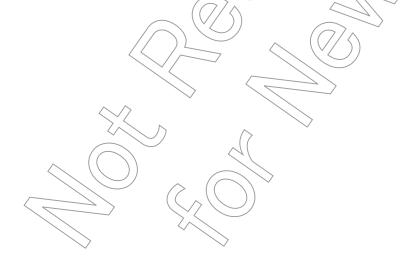
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TA78M09S Electrical Characteristics (Unless otherwise specified, V_{IN} = 15 V, I_{OUT} = 350 mA, 0°C \leq T $_{j}$ \leq 125°C, C_{IN} = 0.33 μ F, C_{OUT} = 0.1 μ F)

Characteristic	s	Symbol	Test Circuit		Test Condition	Min	Тур.	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	$11.5 \text{ V} \le \text{V}_{\text{IN}} \le 26 \text{ V},$ $\text{I}_{\text{OUT}} = 200 \text{ mA}$		5	100	mV
Line regulation		rveg iirie	'	1] - 23 0	$13 \text{ V} \le \text{V}_{\text{IN}} \le 26 \text{ V},$ $\text{I}_{\text{OUT}} = 200 \text{ mA}$		3	50	IIIV
Load regulation		Reg·load	1	T _i = 25°C	5 mA ≤ I _{OUT} ≤ 500 mA	<i>J</i>	26	180	mV
Load regulation		rteg load		,	5 mA ≤ I _{OUT} ≤ 200 mA	· —	10	90	1110
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		ΙΒ	1	T _j = 25°C			4.6	8.0	mA
Quiescent current change	Line	Δl _{Bl}	1	T _i = 25°C	12 V ≤ V _{IN} ≤ 26.5 V, I _{OUT} = 200 mA	(0.8	mA
change	Load	Δl _{BO}	1		5 mA ≤ 1 _{0UT} ≤ 350 mA	4	((/),	0.5	
Output noise voltage		V _{NO}	2	Ta = 25°C	, 10 Hz ≤ f≤ 100 kHz	7 _	> 60	270	μV_{rms}
Ripple rejection		R.R.	3	f = 120 Hz 12.5 V ≤ V	$ I_{OUT} = 100 \text{ mA},$ $ I_{N} \le 22.5 \text{ V}, T_{j} = 25^{\circ}\text{C}$	56	63	_	dB
Short circuit current lir	mit	I _{SC}	1	T € 25°C	\$ (0/3) —	960	_	mA
Dropout voltage		V_{D}	1	T _j = 25°C		/ _	1.7	_	V
Average temperature coefficient of output vo	oltage	T _{CVO}		1007 = 5 n	nA	_	-1.1	_	mV/°C





TA78M10S Electrical Characteristics (Unless otherwise specified, V_{IN} = 16 V, I_{OUT} = 350 mA, 0°C \leq T $_{j}$ \leq 125°C, C_{IN} = 0.33 μ F, C_{OUT} = 0.1 μ F)

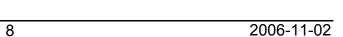
Characteristic	s	Symbol	Test Circuit		Test Condition	Min	Тур.	Max	Unit
Output voltage		V _{OUT}	1	T _j = 25°C	T _j = 25°C		10.0	10.4	V
Line regulation		Reg·line	1	T. = 25°C	$12.5 \text{ V} \le \text{V}_{\text{IN}} \le 26 \text{ V},$ $\text{I}_{\text{OUT}} = 200 \text{ mA}$		6	100	mV
Line regulation		Regillie			14 V ≤ V _{IN} ≤ 26 V, I _{OUT} = 200 mA		3	50	IIIV
Load regulation		Regiload	1	T _j = 25°C	5 mA ≤ I _{OUT} ≤ 500 mA	<u> </u>	26	200	mV
Load regulation		rteg load	'	1] - 23 0	5 mA ≤ I _{OUT} ≤ 200 mA	· –	10	100	IIIV
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 _i = 25°C	13 V ≤ V _{IN} ≥ 26.5 V, I _{OUT} = 200 mA	(0.8	mA
change	Load	Δl _{BO}	1		5 mA ≤ 1 _{0UT} ≤ 350 mA	X	(4)	0.5	
Output noise voltage		V _{NO}	2	Ta = 25°C	, 10 Hz ≤ f≤ 100 kHz) [65	280	μV_{rms}
Ripple rejection		R.R.	3	f = 120 Hz 13.5 V ≤ V	$x_i, I_{OUT} = 100 \text{ mA},$ $y_i \le 23.5 \text{ V}, T_j = 25^{\circ}\text{C}$	55	62	_	dB
Short circuit current lin	nit	I _{SC}	1	T € 25°C	\$ (0/3	\ -	960	_	mA
Dropout voltage		V _D	1	T _j = 25°C		/ _	1.7	_	V
Average temperature coefficient of output vo	oltage	T _{CVO}		10UT = 5 n	nA A	_	-1.3	_	mV/°C





TA78M12S Electrical Characteristics (Unless otherwise specified, V_{IN} = 19 V, I_{OUT} = 350 mA, 0°C \leq T $_{j}$ \leq 125°C, C_{IN} = 0.33 μ F, C_{OUT} = 0.1 μ F)

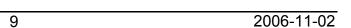
Characteristic	s	Symbol	Test Circuit		Test Condition	Min	Тур.	Max	Unit
Output voltage		V _{OUT}	1	T _j = 25°C		11.5	12.0	12.5	V
Line regulation		Reg·line	1	T. = 25°C	14.5 V ≤ V _{IN} ≤ 30 V, I _{OUT} = 200 mA) >7	100	- mV
Line regulation		rteg iiile			16 V ≤ V _{IN} ≤ 30 V, I _{OUT} = 200 mA		3	50	IIIV
Load regulation		Reg·load	1	T _i = 25°C	5 mA ≤ I _{OUT} ≤ 500 mA	<u> </u>	27	240	mV
Load regulation		rteg load	'	1] - 23 0	5 mA ≤ I _{OUT} ≤ 200 mA	· –	10	120	IIIV
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	Δl _{Bl}	1	T _i = 25°C	15 V ≤ V _{IN} ≥ 30.5 V, I _{OUT} = 200 mA	(0.8	mA
Change	Load	Δl _{BO}	1		5 mA ≤ 1 _{0UT} ≤ 350 mA	7	(4)	0.5	
Output noise voltage		V _{NO}	2	Ta = 25°C	, 10 Hz ≤ f≤ 100 kHz) [> 70	300	μV_{rms}
Ripple rejection		R.R.	3	f = 120 Hz 15 V ≤ V _{IN}	, l _{OUT} ≠ 100 mA, 1≤25 V, T _j = 25°C	55	62	_	dB
Short circuit current lin	nit	I _{SC}	1	T € 25°C	\$ (0/3	\ -	960	_	mA
Dropout voltage		V _D	1,	T _j = 25°C		/ _	1.7	_	V
Average temperature coefficient of output vo	oltage	T _{CVO}	1	lo⊎T = 5 n	nA ()	_	-1.6		mV/°C





TA78M15S Electrical Characteristics (Unless otherwise specified, V_{IN} = 23 V, I_{OUT} = 350 mA, 0°C \leq T $_{j}$ \leq 125°C, C_{IN} = 0.33 μ F, C_{OUT} = 0.1 μ F)

Characteristi	cs	Symbol	Test Circuit	Test Condition		Min	Тур.	Max	Unit
Output voltage		V _{OUT}	1	T _j = 25°C	<	14.4	15.0	15.6	V
Line regulation		Reg·line	1	T. = 25°C	17.5 V ≤ V _{IN} ≤ 30 V, I _{OUT} = 200 mA		8	100	mV
Line regulation		Reguirle	1 T _j = 25°C		20 V ≤ V _{IN} ≤ 30 V, I _{OUT} = 200 mA) / /	4	50	IIIV
Load regulation		Reg·load	1	T _i = 25°C	5 mA ≤ I _{OUT} ≤ 500 mA	<u> </u>	27	300	mV
Load regulation		Negricau		'	5 mA ≤ I _{OUT} ≤ 200 mA	· –	10	150	IIIV
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		IB	1	T _j = 25°C		- /	4.8	8.0	mA
Quiescent current change	Line	ΔI _{BI}	1	T _i = 25°C	18 V ≤ V _{IN} ≥ 30.5 V, I _{OUT} = 200 mA	-(0.8	mA
Change	Load	Δl _{BO}	1] ′	5 mA ≤ 1 _{0UT} ≤ 350 mA	(-	(4)	0.5	
Output noise voltage		V _{NO}	2	Ta = 25°C	, 10 Hz ≤ f≤ 100 kHz	7	> 80	450	μV _{rms}
Ripple rejection		R.R.	3	f = 120 Hz 18.5 V ≤ V	z, I _{OUT} ≠ 100 mA, I _N ≤ 28.5 V, T _j = 25°C	54	61	_	dB
Short circuit current li	mit	I _{SC}	1	T = 25°C	\$ (0//	_	960		mA
Dropout voltage		V _D	1,	T _j = 25°C		/ _	1.7	_	V
Average temperature coefficient of output v		T _{CVO}	1	10UT = 5 n	mA)	_	-2.0	_	mV/°C





TA78M18S Electrical Characteristics (Unless otherwise specified, V_{IN} = 27 V, I_{OUT} = 350 mA, 0°C \leq T $_{j}$ \leq 125°C, C_{IN} = 0.33 μ F, C_{OUT} = 0.1 μ F)

Characteristic	s	Symbol	Test Circuit		Test Condition	Min	Тур.	Max	Unit
Output voltage		V _{OUT}	1	T _j = 25°C		17.3	18.0	18.7	V
Line regulation		Reg·line	1	T. = 25°C	21 V ≤ V _{IN} ≤ 33 V, I _{OUT} = 200 mA		9	100	mV
Line regulation		rteg iiile			24 V ≤ V _{IN} ≤ 33 V, I _{OUT} = 200 mA		5	50	IIIV
Load regulation		Reg·load	1	T _i = 25°C	5 mA ≤ I _{OUT} ≤ 500 mA	<u> </u>	28	360	mV
Load regulation		rteg load	'	,	5 mA ≤ I _{OUT} ≤ 200 mA	-	10	180	IIIV
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		ΙΒ	1	T _j = 25°C		- /	4.8	8.0	mA
Quiescent current change	Line	ΔI _{BI}	1	T _i = 25°C	21.5 V = V _{IN} = 33.5 V, I _{OUT} = 200 mA	(0.8	mA
change	Load	Δl _{BO}	1		5 mA ≤ 1 _{0UT} ≤ 350 mA	(7	(4)	0.5	
Output noise voltage		V _{NO}	2	Ta = 25°C	, 10 Hz ≤ f≤ 100 kHz	7	90	490	μV_{rms}
Ripple rejection		R.R.	3	f = 120 Hz 22 V ≤ V _{IN}	z, I _{OUT} ≠ 100 mA, 1≤32 V, T _j = 25°C	53	60	_	dB
Short circuit current lin	nit	I _{SC}	1	T) € 25°C	\$ (7/3	_	960	-	mA
Dropout voltage		V _D	1,	T _j = 25°C		/ _	1.7	_	V
Average temperature coefficient of output vo	ltage	T _{CVO}		10UT = 5 n	nA (_	-2.5	_	mV/°C





TA78M20S Electrical Characteristics (Unless otherwise specified, V_{IN} = 29 V, I_{OUT} = 350 mA, 0°C \leq T $_{j}$ \leq 125°C, C_{IN} = 0.33 μ F, C_{OUT} = 0.1 μ F)

Characteristic	s	Symbol	Test Circuit	٦	Test Condition	Min	Тур.	Max	Unit
Output voltage		V _{OUT}	1	T _j = 25°C		19.2	20.0	20.8	V
Line regulation		Reg·line	1	$T_j = 25^{\circ}C$	23 V ≤ V _{IN} ≤ 35 V, _{OUT} = 200 mA) 70	100	mV
Line regulation		rteg iiile	ı	2	$24 \text{ V} \le \text{V}_{\text{IN}} \le 35 \text{ V},$ OUT = 200 mA		6	50	IIIV
Load regulation		Reg·load	1	T _i = 25°C	5 mA ≤ I _{OUT} ≤ 500 mA	<u> </u>	28	400	mV
Load regulation		rteg load	'	1	5 mA ≤ I _{OUT} ≤ 200 mA	1	10	200	IIIV
Output voltage		V _{OUT}	1	$T_j = 25^{\circ}C$ $\begin{bmatrix} 2\\5 \end{bmatrix}$	$23 \text{ V} \le \text{V}_{\text{IN}} \le 35 \text{ V},$ $5 \text{ mA} \le \text{I}_{\text{OUT}} \le 350 \text{ mA}$	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 _i = 25°C 10	23.5 V ≤ V _I N ≤ 35.5 V, OUT = 200 mA	(0.8	mA
change	Load	Δl _{BO}	1	5	5 mA ≤ 1 _{0UT} ≤ 350 mA	(+	((/)	0.5	
Output noise voltage		V _{NO}	2	Ta = 25°C, 1	10 Hz ≤ f≤ 100 kHz] <u> </u>	95	540	μV _{rms}
Ripple rejection		R.R.	3	f = 120 Hz, I ₀ 24 V ≤ V _{IN} ≤	OUT ≠ 100 mA, ≤ 34 V, T _j = 25°C	53	60	_	dB
Short circuit current lin	nit	I _{SC}	1	T = 25°C	, ((//<	\ -	960	_	mA
Dropout voltage		V _D	1,	T _j = 25°C		_	1.7	_	V
Average temperature coefficient of output vo	oltage	T _{CVO}		10UT = 5 mA		_	-3.0	_	mV/°C

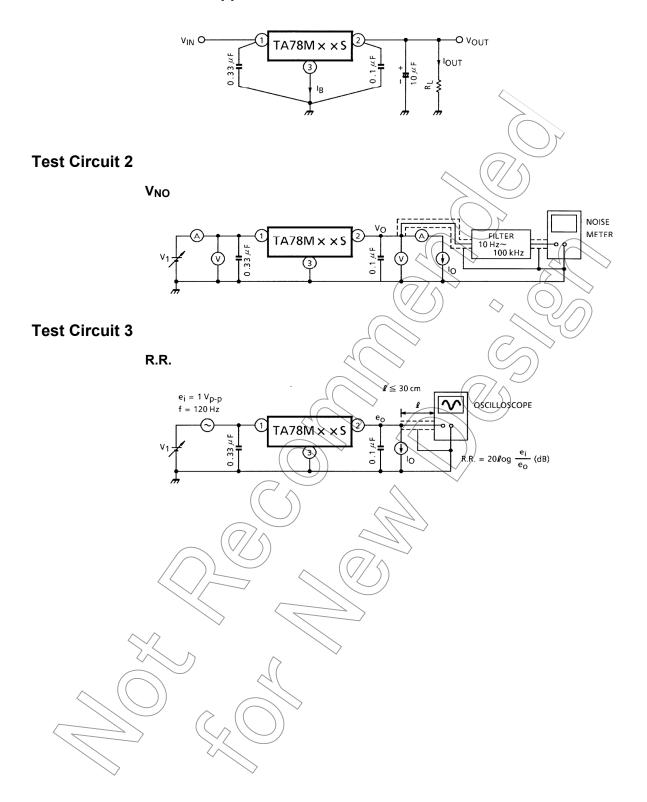


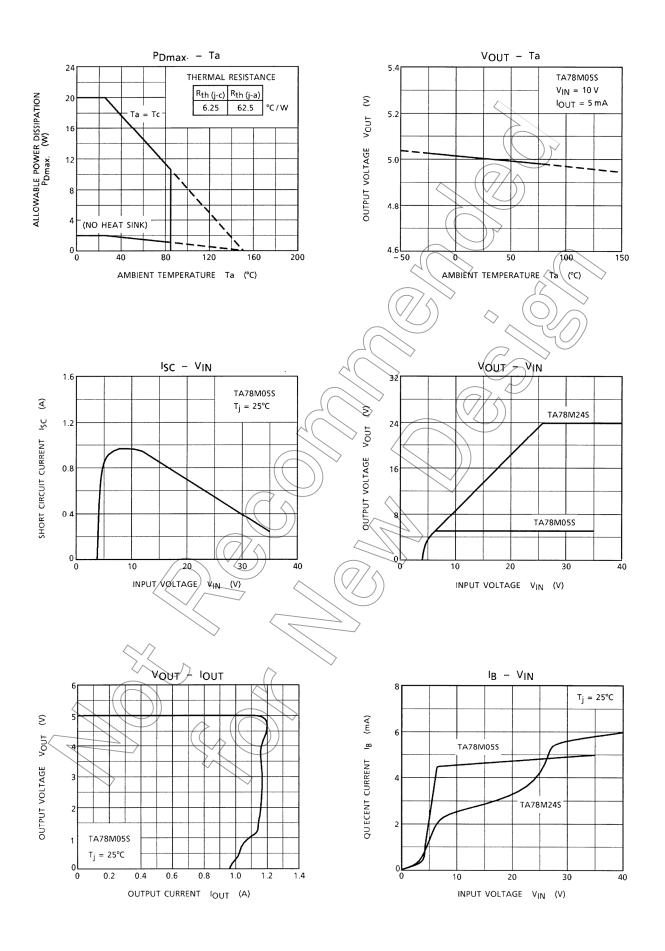
TA78M24S Electrical Characteristics (Unless otherwise specified, V_{IN} = 33 V, I_{OUT} = 350 mA, 0°C \leq T $_{j}$ \leq 125°C, C_{IN} = 0.33 μ F, C_{OUT} = 0.1 μ F)

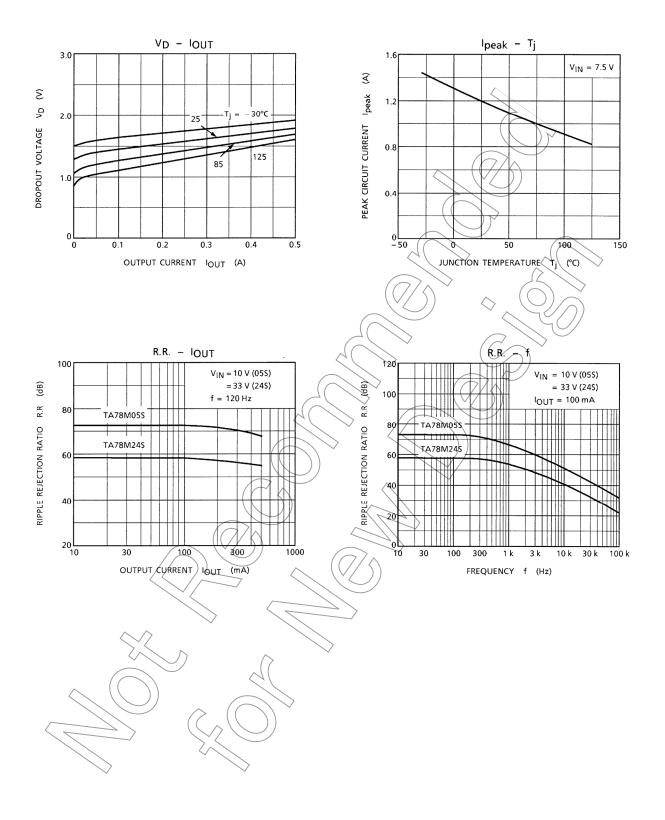
Characteristic	es	Symbol	Test Circuit		Test Condition	Min	Тур.	Max	Unit
Output voltage		V _{OUT}	1	T _j = 25°C		23.0	24.0	25.0	V
Line regulation		Reg·line	1	T _j = 25°C	27 V ≤ V _{IN} ≤ 38 V, I _{OUT} = 200 mA) 12	100	mV
Line regulation		rteg iiile			28 V ≤ V _{IN} ≤ 38 V, I _{OUT} = 200 mA		7	50	IIIV
Load regulation		Reg·load	1	T _i = 25°C	5 mA ≤ I _{OUT} ≤ 500 mA	<i>)</i>	30	480	mV
Load regulation		rteg load	'	'	5 mA ≤ I _{OUT} ≤ 200 mA	-	10	240	IIIV
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	٧
Quiescent current		ΙΒ	1	T _j = 25°C		- /	5.0	8.0	mA
Quiescent current change	Line	ΔI _{BI}	1	T _i = 25°C	27.5 V ≤ V _{IN} ≤ 38.5 V, I _{OUT} = 200 mA	(0.8	mA
change	Load	Δl _{BO}	1]	5 mA ≤ 1 _{0UT} ≤ 350 mA	(7	((/)	0.5	
Output noise voltage		V _{NO}	2	Ta = 25°C	, 10 Hz ≤ f≤ 100 kHz	7 _	115	650	μV_{rms}
Ripple rejection		R.R.	3	f = 120 Hz 28 V ≤ V _{IN}	t, I _{OUT} ≠ 100 mA, 1≤38 V, T _j = 25°C	50	57	_	dB
Short circuit current lir	mit	I _{SC}	1	T € 25°C	\$ (0/3) —	960	_	mA
Dropout voltage		V _D	1,	T _j = 25°C		/ _	1.7	_	V
Average temperature coefficient of output vo	oltage	T _{CVO}		10UT = 5 n	nA (_	-3.5	_	mV/°C



Test Circuit 1/Standard Application







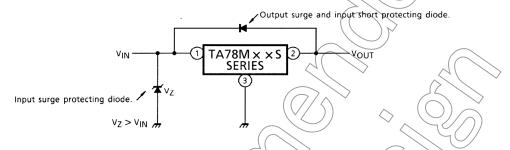


Precautions on Application

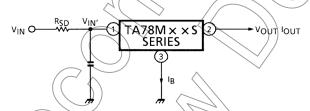
- (1) In regard to GND, be careful not to apply a negative voltage to the input/output terminal. Further, special care is necessary in the case of a voltage boost application.
- (2) If a surge voltage exceeding the maximum rating is applied to the input terminal or if a voltage in excess of the input 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 RSD in the input terminal.



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

Reducing VIN' 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 RSD, 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 $(T_j \text{ max})$.

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	$\theta_{\rm C} + \theta_{\rm S}$
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)

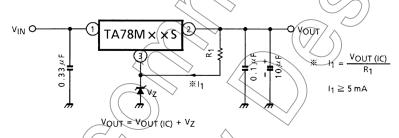
(c) Torque

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.

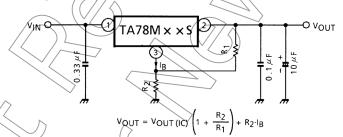
Application Circuits

(1) Voltage Boost Regulator

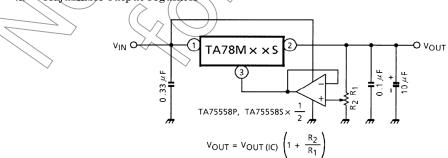
(a) Voltage boost by use of zener diode



(b) Voltage boost by use of resistor



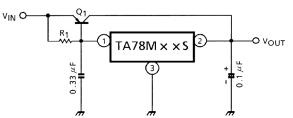
(c) Adjustable output regulator



17

(2) Current Boost Regulator

(a) Current boost voltage regulator



Heat sink is needed for Q_1

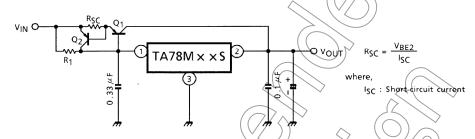
$$R_1 \le \frac{V_{BE1}}{I_{B MAX}}$$

where,

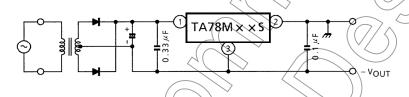
V_{BE1} : V_{BE} of external transistor Q₁.

B MAX : Quiescent current of IC.

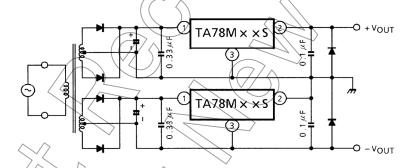
(b) Short-circuit protection



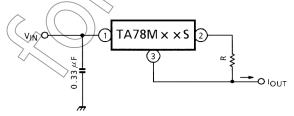
(3) Negative Regulator



(4) Positive and Negative Regulator



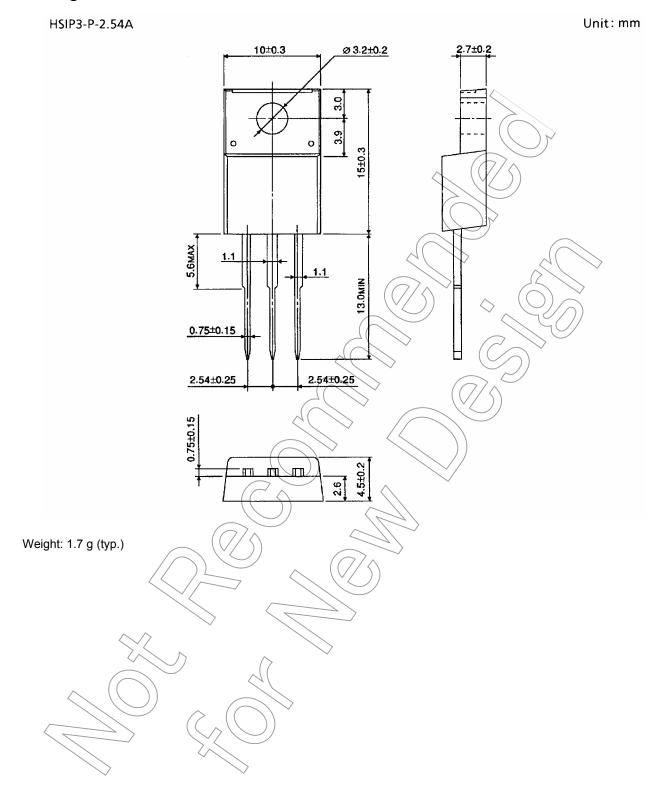
(5) Current Regulator



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



Package Dimensions





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