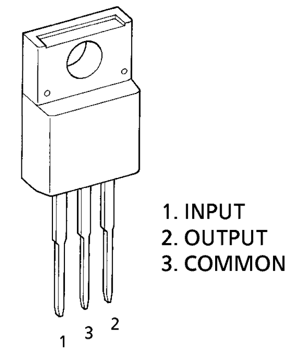
TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

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

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 driver up to 0.5 A of output current.

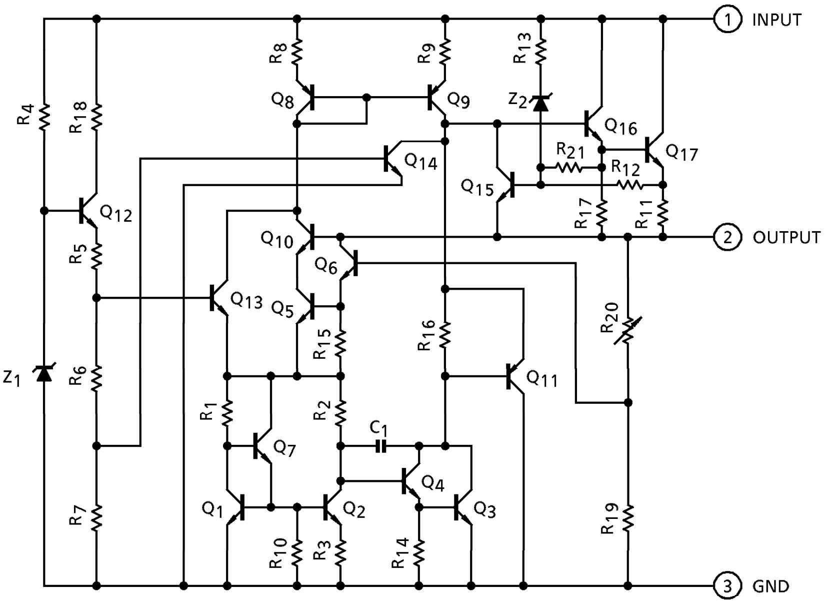


Weight : 1.7 g (Typ.)

FEATURES

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

EQUIVALENT CIRCUIT



980910EBA2

MAXIMUM RATINGS (Ta = 25°C)

<table>
<tr><th colspan="2">CHARACTERISTIC</th><th>SYMBOL</th><th>RATING</th><th>UNIT</th></tr>
<tr><td rowspan="10">Input Voltage</td><td>TA78M05S</td><td rowspan="10">V_{IN}</td><td rowspan="7">35</td><td rowspan="10">V</td></tr>
<tr><td>TA78M06S</td></tr>
<tr><td>TA78M08S</td></tr>
<tr><td>TA78M09S</td></tr>
<tr><td>TA78M10S</td></tr>
<tr><td>TA78M12S</td></tr>
<tr><td>TA78M15S</td></tr>
<tr><td>TA78M18S</td><td rowspan="3">40</td></tr>
<tr><td>TA78M20S</td></tr>
<tr><td>TA78M24S</td></tr>
<tr><td rowspan="2">Power Dissipation</td><td>(Ta = 25°C)</td><td rowspan="2">P_D</td><td>2</td><td rowspan="2">W</td></tr>
<tr><td>(Tc = 25°C)</td><td>20</td></tr>
<tr><td colspan="2">Operating Temperature</td><td>T_{opr}</td><td>−30~85</td><td>°C</td></tr>
<tr><td colspan="2">Storage Temperature</td><td>T_{stg}</td><td>−55~150</td><td>°C</td></tr>
<tr><td colspan="2">Junction Temperature</td><td>T_j</td><td>150</td><td>°C</td></tr>
<tr><td colspan="2" rowspan="2">Thermal Resistance</td><td>$R_{th\ (j\text{-}c)}$</td><td>6.25</td><td rowspan="2">°C / W</td></tr>
<tr><td>$R_{th\ (j\text{-}a)}$</td><td>62.5</td></tr>
</table>

TA78M05S

ELECTRICAL CHARACTERISTICS

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

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	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	Ta = 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_{CVO}	1	I_{OUT} = 5 mA		—	−0.6	—	mV / °C

TA78M06S

ELECTRICAL CHARACTERISTICS

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

CHARACTERISTIC		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	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_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	Ta = 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_{CVO}	1	I_{OUT} = 5 mA		—	−0.7	—	mV / °C

TA78M08S

ELECTRICAL CHARACTERISTICS

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

CHARACTERISTIC		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	Ta = 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_{CVO}	1	I_{OUT} = 5 mA		—	– 1.0	—	mV / °C

TA78M09S

ELECTRICAL CHARACTERISTICS

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

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	11.5 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	Ta = 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_{CVO}	1	I_{OUT} = 5 mA		—	− 1.1	—	mV / °C

TA78M10S

ELECTRICAL CHARACTERISTICS

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

CHARACTERISTIC		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	Ta = 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_{CVO}	1	I_{OUT} = 5 mA		—	− 1.3	—	mV / °C

TA78M12S

ELECTRICAL CHARACTERISTICS

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

CHARACTERISTIC		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	Ta = 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_{CVO}	1	I_{OUT} = 5 mA		—	− 1.6	—	mV / °C

TA78M15S

ELECTRICAL CHARACTERISTICS

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

<table>
<tr><th colspan="2">CHARACTERISTIC</th><th>SYMBOL</th><th>TEST CIR-CUIT</th><th colspan="2">TEST CONDITION</th><th>MIN.</th><th>TYP.</th><th>MAX.</th><th>UNIT</th></tr>
<tr><td colspan="2">Output Voltage</td><td>V_{OUT}</td><td>1</td><td colspan="2">T_j = 25°C</td><td>14.4</td><td>15.0</td><td>15.6</td><td>V</td></tr>
<tr><td colspan="2" rowspan="2">Line Regulation</td><td rowspan="2">Reg·line</td><td rowspan="2">1</td><td rowspan="2">T_j = 25°C</td><td>17.5 V ≦ V_{IN} ≦ 30 V
I_{OUT} = 200 mA</td><td>—</td><td>8</td><td>100</td><td rowspan="2">mV</td></tr>
<tr><td>20 V ≦ V_{IN} ≦ 30 V
I_{OUT} = 200 mA</td><td>—</td><td>4</td><td>50</td></tr>
<tr><td colspan="2" rowspan="2">Load Regulation</td><td rowspan="2">Reg·load</td><td rowspan="2">1</td><td rowspan="2">T_j = 25°C</td><td>5 mA ≦ I_{OUT} ≦ 500 mA</td><td>—</td><td>27</td><td>300</td><td rowspan="2">mV</td></tr>
<tr><td>5 mA ≦ I_{OUT} ≦ 200 mA</td><td>—</td><td>10</td><td>150</td></tr>
<tr><td colspan="2">Output Voltage</td><td>V_{OUT}</td><td>1</td><td>T_j = 25°C</td><td>17.5 V ≦ V_{IN} ≦ 30 V
5 mA ≦ I_{OUT} ≦ 350 mA</td><td>14.25</td><td>—</td><td>15.75</td><td>V</td></tr>
<tr><td colspan="2">Quiescent Current</td><td>I_B</td><td>1</td><td colspan="2">T_j = 25°C</td><td>—</td><td>4.8</td><td>8.0</td><td>mA</td></tr>
<tr><td rowspan="2">Quiescent Current Change</td><td>Line</td><td>ΔI_{BI}</td><td>1</td><td rowspan="2">T_j = 25°C</td><td>18 V ≦ V_{IN} ≦ 30.5 V,
I_{OUT} = 200 mA</td><td>—</td><td>—</td><td>0.8</td><td rowspan="2">mA</td></tr>
<tr><td>Load</td><td>ΔI_{BO}</td><td>1</td><td>5 mA ≦ I_{OUT} ≦ 350 mA</td><td>—</td><td>—</td><td>0.5</td></tr>
<tr><td colspan="2">Output Noise Voltage</td><td>V_{NO}</td><td>2</td><td colspan="2">Ta = 25°C, 10 Hz ≦ f ≦ 100 kHz</td><td>—</td><td>80</td><td>450</td><td>μV_{rms}</td></tr>
<tr><td colspan="2">Ripple Rejection</td><td>R.R.</td><td>3</td><td colspan="2">f = 120 Hz, I_{OUT} = 100 mA
18.5 V ≦ V_{IN} ≦ 28.5 V, T_j = 25°C</td><td>54</td><td>61</td><td>—</td><td>dB</td></tr>
<tr><td colspan="2">Short Circuit Current Limit</td><td>I_{SC}</td><td>1</td><td colspan="2">T_j = 25°C</td><td>—</td><td>960</td><td>—</td><td>mA</td></tr>
<tr><td colspan="2">Dropout Voltage</td><td>V_D</td><td>1</td><td colspan="2">T_j = 25°C</td><td>—</td><td>1.7</td><td>—</td><td>V</td></tr>
<tr><td colspan="2">Average Temperature Coefficient Of Output Voltage</td><td>T_{CVO}</td><td>1</td><td colspan="2">I_{OUT} = 5 mA</td><td>—</td><td>−2.0</td><td>—</td><td>mV / °C</td></tr>
</table>

TA78M18S

ELECTRICAL CHARACTERISTICS

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

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	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	Ta = 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_{CVO}	1	I_{OUT} = 5 mA		—	− 2.5	—	mV / °C

TA78M20S

ELECTRICAL CHARACTERISTICS

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

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	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	Ta = 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

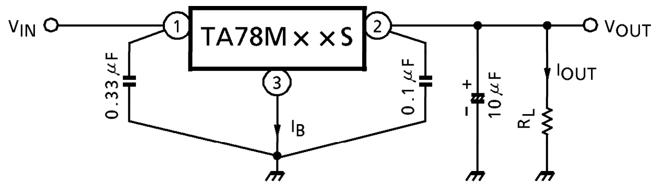
TA78M24S

ELECTRICAL CHARACTERISTICS

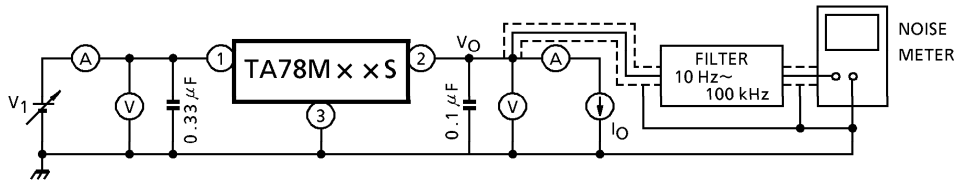
(Unless otherwise specified, V_{IN} = 33 V, I_{OUT} = 350 mA, 0°C ≦ T_j ≦ 125°C, C_{IN} = 0.33 μF, C_{OUT} = 0.1 μF)

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	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	Ta = 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_{CVO}	1	I_{OUT} = 5 mA		—	− 3.5	—	mV / °C

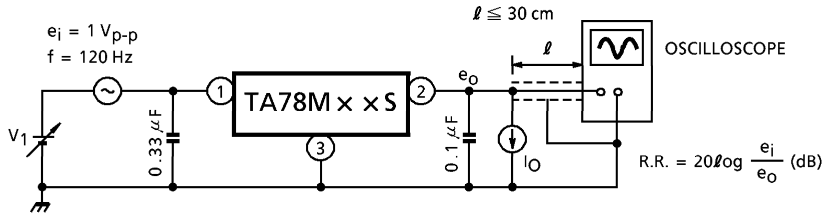
TEST CIRCUIT 1 / STANDARD APPLICATION



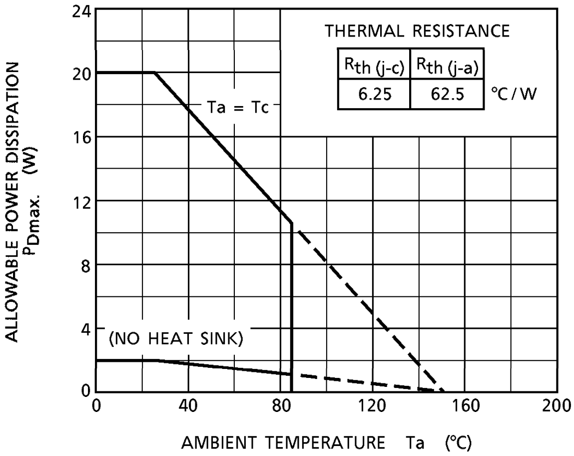
TEST CIRCUIT 2 V_{NO}



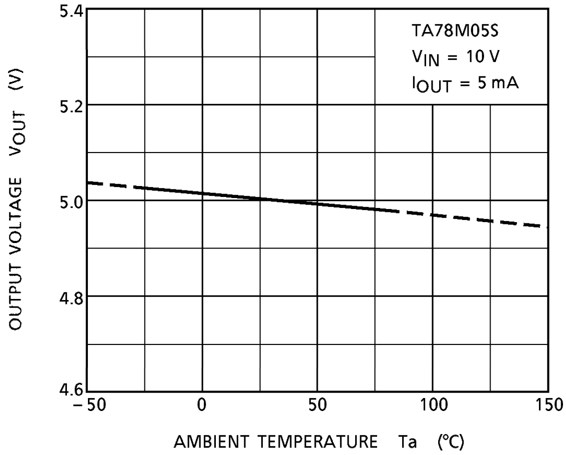
TEST CIRCUIT 3 R.R.



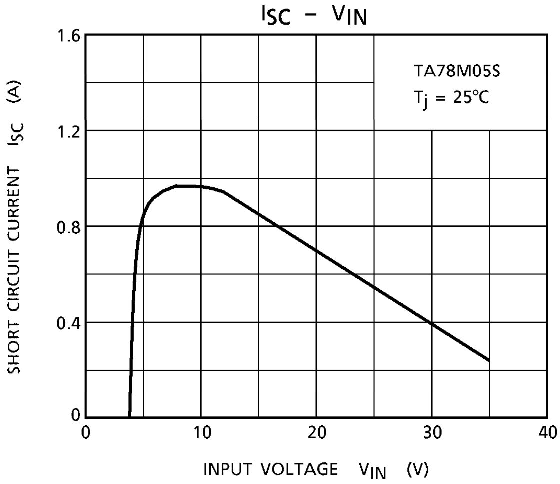
$P_{Dmax.}$ – Ta



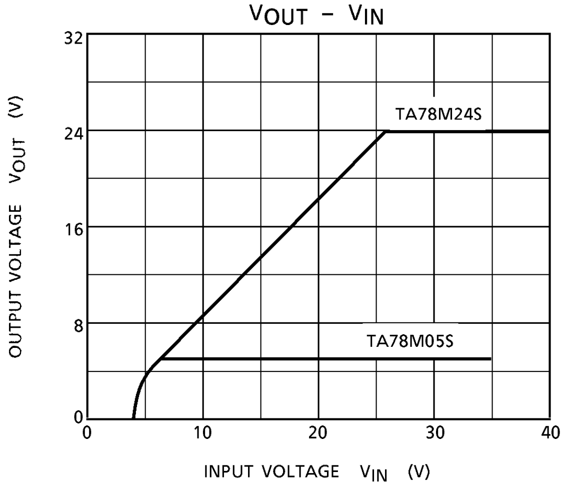
V_{OUT} – Ta



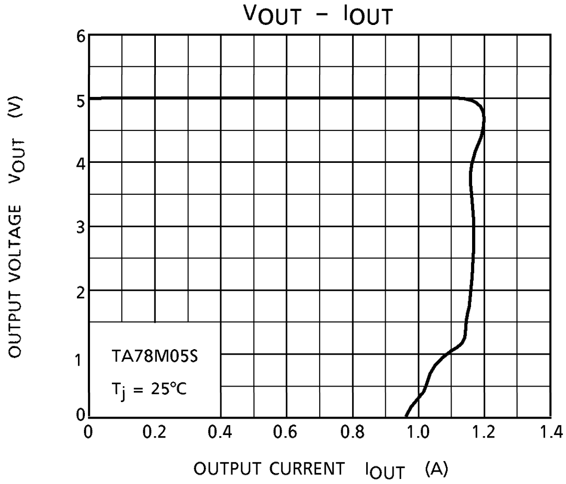
I_{SC} – V_{IN}



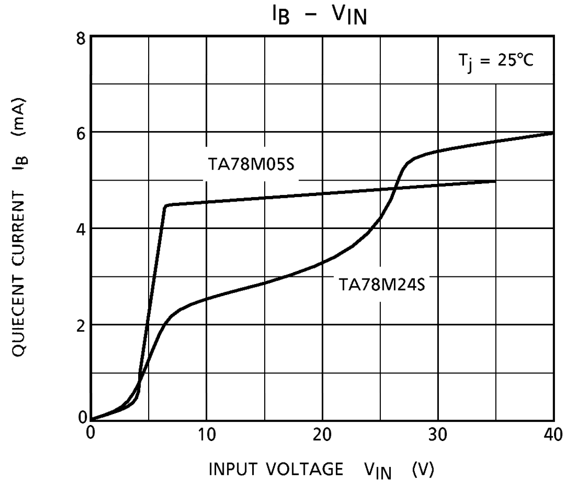
V_{OUT} – V_{IN}

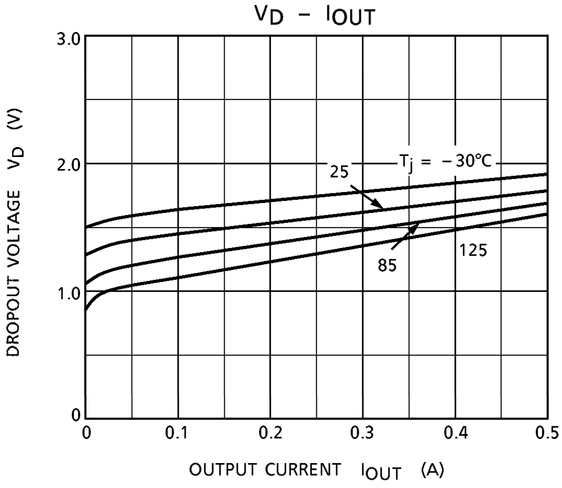


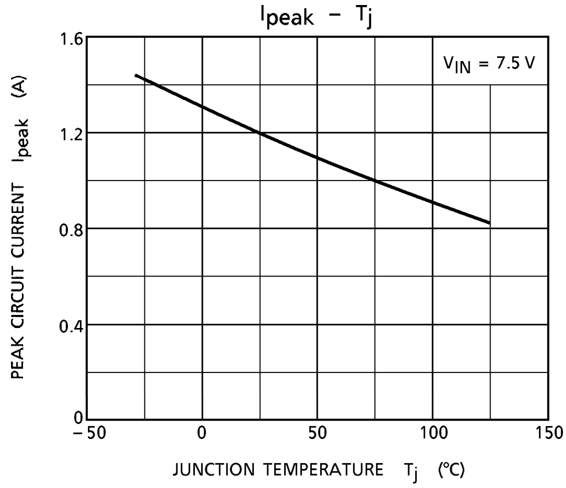
V_{OUT} – I_{OUT}

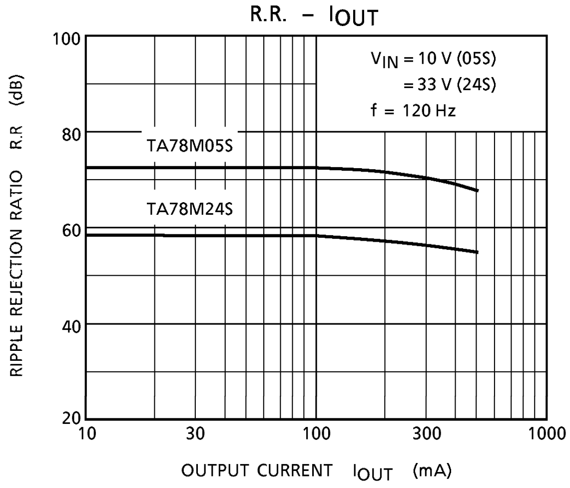


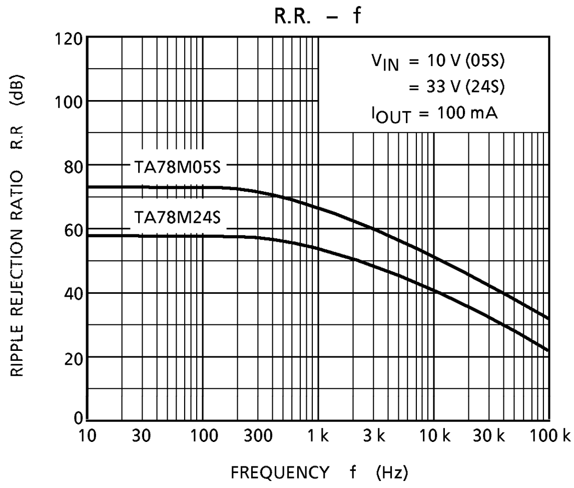
I_B – V_{IN}




VD – IOUT
DROPOUT VOLTAGE VD (V)
OUTPUT CURRENT IOUT (A)
Tj = −30°C
25
85
125
3.0
2.0
1.0
0
0.1
0.2
0.3
0.4
0.5


Ipeak – Tj
PEAK CIRCUIT CURRENT Ipeak (A)
JUNCTION TEMPERATURE Tj (°C)
VIN = 7.5 V
1.6
1.2
0.8
0.4
0
−50
50
100
150

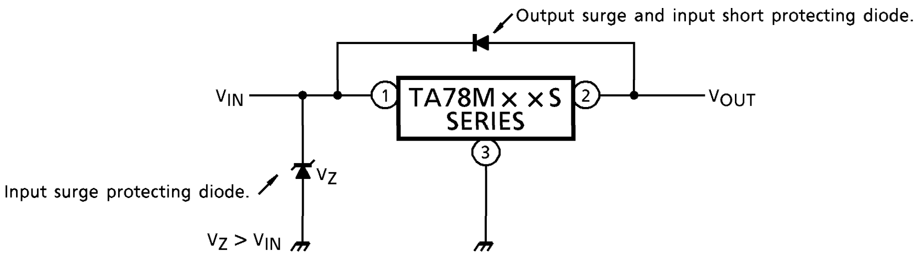

R.R. – IOUT
RIPPLE REJECTION RATIO R.R (dB)
OUTPUT CURRENT IOUT (mA)
VIN = 10 V (05S)
= 33 V (24S)
f = 120 Hz
TA78M05S
TA78M24S
100
80
60
40
20
10
30
300
1000


R.R. – f
RIPPLE REJECTION RATIO R.R (dB)
FREQUENCY f (Hz)
VIN = 10 V (05S)
= 33 V (24S)
IOUT = 100 mA
TA78M05S
TA78M24S
120
100
80
60
40
20
0
10
30
100
300
1 k
3 k
10 k
30 k
100 k

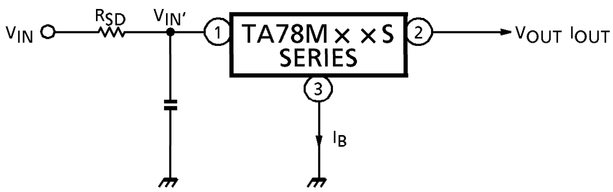
PRECAUTIONS ON APPLICATION

(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 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 (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	0.6 N·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.

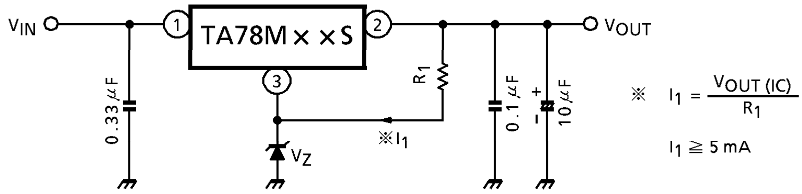
(c) Torque

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

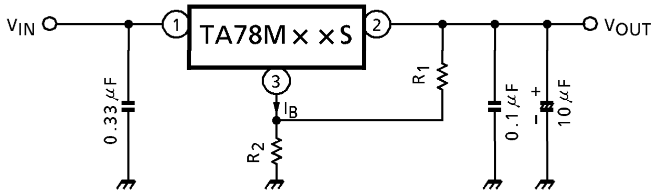
(1) VOLTAGE BOOST REGULATOR

(a) Voltage boost by use of zener diode



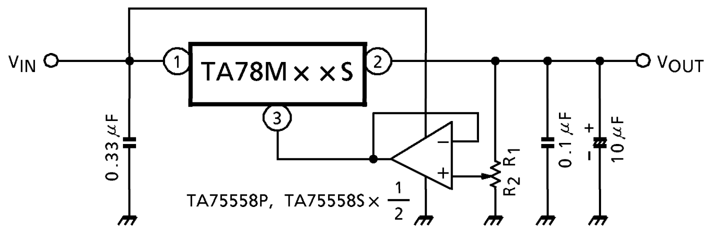
$V_{OUT} = V_{OUT\,(IC)} + V_Z$

(b) Voltage boost by use of resistor



$V_{OUT} = V_{OUT\,(IC)} \left(1 + \frac{R_2}{R_1}\right) + R_2 \cdot I_B$

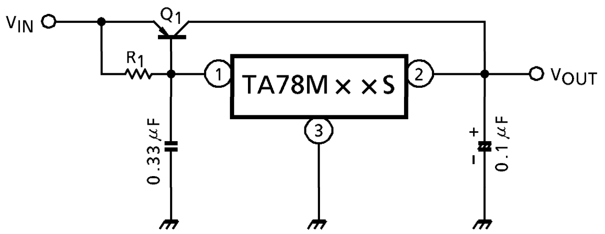
(c) Adjustable output regulator



$V_{OUT} = V_{OUT\,(IC)} \left(1 + \frac{R_2}{R_1}\right)$

(2) CURRENT BOOST REGULATOR

(a) CURRENT BOOST VOLTAGE REGULATOR



Heat sink is needed for Q_1

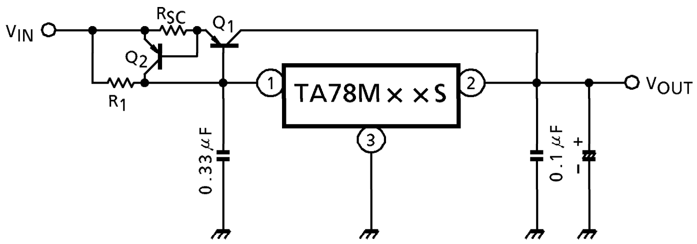
$$R_1 \leqq \frac{V_{BE1}}{I_{B\ MAX}}$$

where,

V_{BE1} : V_{BE} of external transistor Q_1.

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

(b) SHORT-CIRCUIT PROTECTION

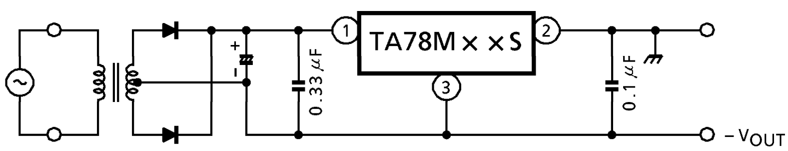


$$R_{SC} = \frac{V_{BE2}}{I_{SC}}$$

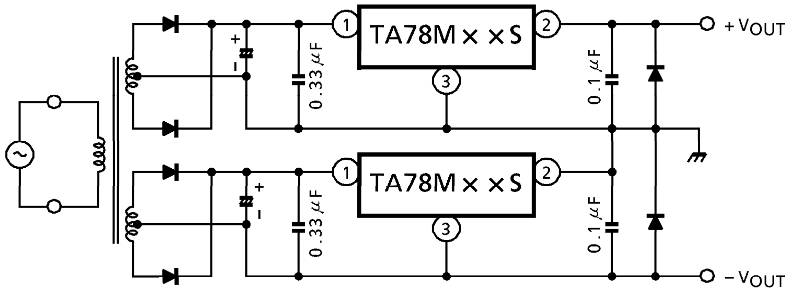
where,

I_{SC} : Short-circuit current

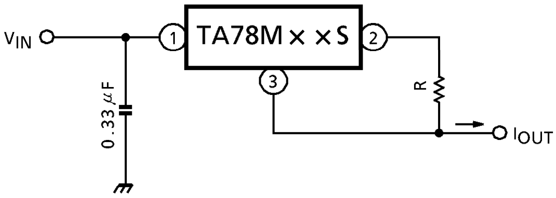
(3) NEGATIVE REGULATOR



(4) POSITIVE AND NEGATIVE REGULATOR



(5) CURRENT REGULATOR

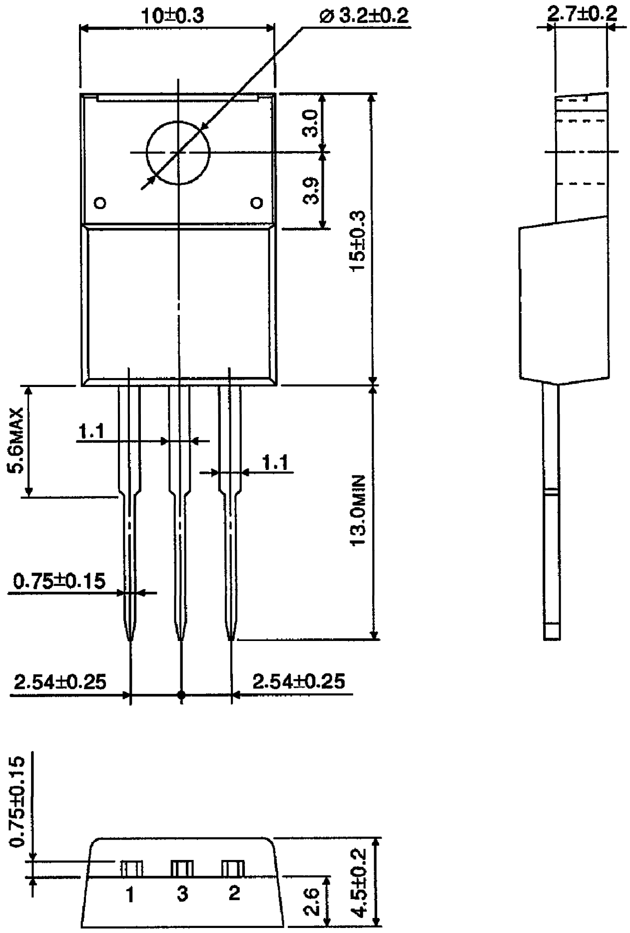


$$I_{OUT} = \frac{V_{OUT}}{R} + I_B$$

PACKAGE DIMENSIONS

P-HSIP3-2.54A

Unit : mm



Weight : 1.7 g (Typ.)