

TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

TA78L05S, TA78L07S, TA78L08S, TA78L09S, TA78L10S, TA78L12S, TA78L15S

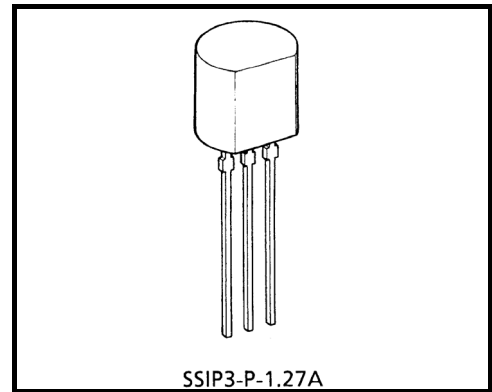
Three-Terminal Positive Voltage Regulators

5 V, 7 V, 8 V, 9 V, 10 V, 12 V, 15 V

The TA78L×S series of fixed voltage monolithic integrated circuit voltage regulators is designed for a wide range of applications.

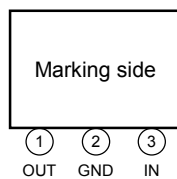
Features

- Suitable for TTL, C²MOS power supply.
- Internal short-circuit current limiting.
- Internal thermal overload protection.
- Maximum output current of 100 mA ($T_j = 25^\circ\text{C}$).
- TO-92 package

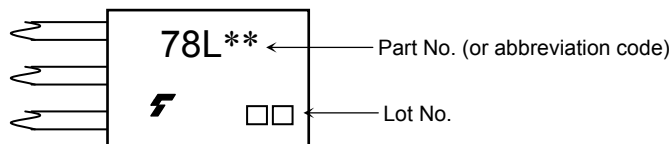


Weight: 0.21 g (typ.)

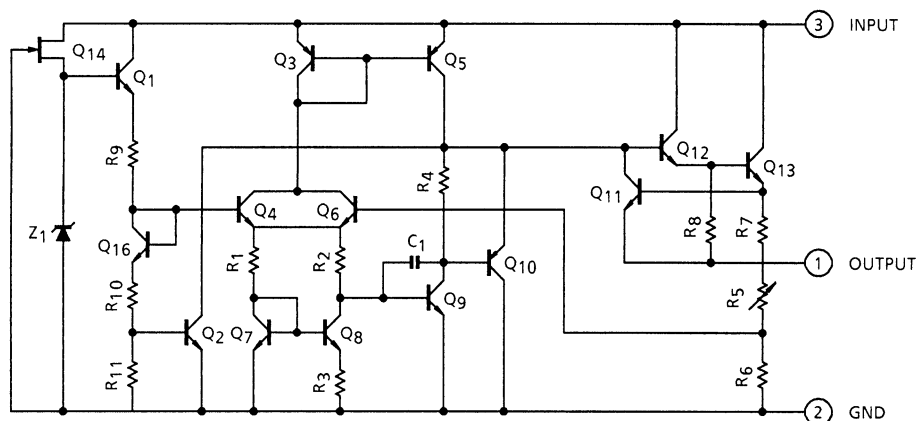
Pin Assignment



Marking



Equivalent Circuit



Absolute Maximum Ratings (Ta = 25°C)

Characteristics		Symbol	Rating	Unit
Input voltage		V _{IN}	35	V
Power dissipation	(Ta = 25°C)	P _D	600	mW
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-a)}	208	°C/W

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).

TA78L05S

Electrical Characteristics

(Unless otherwise specified, V_{IN} = 10 V, I_{OUT} = 40 mA, C_{IN} = 0.33 µF, C_{OUT} = 0.1 µF, 0°C ≤ T_j ≤ 125°C)

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	7.0 V ≤ V _{IN} ≤ 20 V	—	55	mV
				8.0 V ≤ V _{IN} ≤ 20 V	—	45	
Load regulation	Reg-load	1	T _j = 25°C	1.0 mA ≤ I _{OUT} ≤ 100 mA	—	11	mV
				1.0 mA ≤ I _{OUT} ≤ 40 mA	—	5.0	
Output voltage	V _{OUT}	1	T _j = 25°C	7.0 V ≤ V _{IN} ≤ 20 V, 1.0 mA ≤ I _{OUT} ≤ 40 mA	4.75	—	V
				1.0 mA ≤ I _{OUT} ≤ 70 mA	4.75	—	
Quiescent current	I _B	1	T _j = 25°C	—	3.1	6.0	mA
			T _j = 125°C	—	—	5.5	
Quiescent current change	ΔI _B	1	T _j = 25°C	8.0 V ≤ V _{IN} ≤ 20 V	—	—	mA
				1.0 mA ≤ I _{OUT} ≤ 40 mA	—	—	
Output noise voltage	V _{NO}	2	Ta = 25°C, 10 Hz ≤ f ≤ 100 kHz	—	40	—	µV _{rms}
Long term stability	ΔV _{OUT} /Δt	1	—	—	12	—	mV/kh
Ripple rejection	R.R.	3	f = 120 Hz, 8 V ≤ V _{IN} ≤ 18 V, T _j = 25°C	41	49	—	dB
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

TA78L07S
Electrical Characteristics

(Unless otherwise specified, $V_{IN} = 12\text{ V}$, $I_{OUT} = 40\text{ mA}$, $C_{IN} = 0.33\text{ }\mu\text{F}$, $C_{OUT} = 0.1\text{ }\mu\text{F}$, $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$)

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Output voltage	V_{OUT}	1	$T_j = 25^\circ\text{C}$	6.72	7.0	7.28	V
Line regulation	Reg.line	1	$T_j = 25^\circ\text{C}$	—	50	160	mV
			$10\text{ V} \leq V_{IN} \leq 22\text{ V}$	—	45	115	
Load regulation	Reg.load	1	$T_j = 25^\circ\text{C}$	—	13	75	mV
			$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$	—	6.0	40	
Output voltage	V_{OUT}	1	$T_j = 25^\circ\text{C}$	6.65	—	7.35	V
			$1.0\text{ mA} \leq I_{OUT} \leq 70\text{ mA}$	6.65	—	7.35	
Quiescent current	I_B	1	$T_j = 25^\circ\text{C}$	—	3.1	6.5	mA
			$T_j = 125^\circ\text{C}$	—	—	6.0	
Quiescent current change	ΔI_B	1	$T_j = 25^\circ\text{C}$	—	—	1.5	mA
			$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$	—	—	0.1	
Output noise voltage	V_{NO}	2	$T_a = 25^\circ\text{C}$, $10\text{ Hz} \leq f \leq 100\text{ kHz}$	—	50	—	μV_{rms}
Long term stability	$\Delta V_{OUT}/\Delta t$	1	—	—	17	—	mV/kh
Ripple rejection	R.R.	3	$f = 120\text{ Hz}$, $10\text{ V} \leq V_{IN} \leq 20\text{ V}$, $T_j = 25^\circ\text{C}$	37	46	—	dB
Dropout voltage	V_D	1	$T_j = 25^\circ\text{C}$, $I_{OUT} = 100\text{ mA}$	—	1.7	—	V
Average temperature coefficient of output voltage	T_{CVO}	1	$I_{OUT} = 5\text{ mA}$	—	-0.84	—	mV/ $^\circ\text{C}$

TA78L08S

Electrical Characteristics

(Unless otherwise specified, $V_{IN} = 14\text{ V}$, $I_{OUT} = 40\text{ mA}$, $C_{IN} = 0.33\text{ }\mu\text{F}$, $C_{OUT} = 0.1\text{ }\mu\text{F}$, $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$)

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} ≤ 23 V	—	20	175	mV
				11 V ≤ V _{IN} ≤ 23 V	—	12	125	
Load regulation	Reg.load	1	T _j = 25°C	1.0 mA ≤ I _{OUT} ≤ 100 mA	—	15	80	mV
				1.0 mA ≤ I _{OUT} ≤ 40 mA	—	7.0	40	
Output voltage	V _{OUT}	1	T _j = 25°C	10.5 V ≤ V _{IN} ≤ 23 V, 1.0 mA ≤ I _{OUT} ≤ 40 mA	7.6	—	8.4	V
				1.0 mA ≤ I _{OUT} ≤ 70 mA	7.6	—	8.4	
Quiescent current	I _B	1	T _j = 25°C		—	3.1	6.5	mA
			T _j = 125°C		—	—	6.0	
Quiescent current change	ΔI _B	1	T _j = 25°C	11 V ≤ V _{IN} ≤ 23 V	—	—	1.5	mA
				1.0 mA ≤ I _{OUT} ≤ 40 mA	—	—	0.1	
Output noise voltage	V _{NO}	2	T _a = 25°C, 10 Hz ≤ f ≤ 100 kHz		—	60	—	μV _{rms}
Long term stability	ΔV _{OUT} /Δt	1	—		—	20	—	mV/kh
Ripple rejection	R.R.	3	f = 120 Hz, 12 V ≤ V _{IN} ≤ 23 V, T _j = 25°C		37	45	—	dB
Dropout voltage	V _D	1	T _j = 25°C, I _{OUT} = 100 mA		—	1.7	—	V
Average temperature coefficient of output voltage	T _{CVO}	1	I _{OUT} = 5 mA		—	−0.97	—	mV/°C

TA78L09S

Electrical Characteristics

(Unless otherwise specified, $V_{IN} = 15\text{ V}$, $I_{OUT} = 40\text{ mA}$, $C_{IN} = 0.33\text{ }\mu\text{F}$, $C_{OUT} = 0.1\text{ }\mu\text{F}$, $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$)

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Output voltage	V_{OUT}	1	$T_j = 25^\circ\text{C}$	8.64	9.0	9.36	V
Line regulation	Reg·line	1	$T_j = 25^\circ\text{C}$	—	80	200	mV
			$11.4\text{ V} \leq V_{IN} \leq 24\text{ V}$	—	20	160	
Load regulation	Reg·load	1	$T_j = 25^\circ\text{C}$	—	17	90	mV
			$1.0\text{ mA} \leq I_{OUT} \leq 100\text{ mA}$	—	8.0	45	
Output voltage	V_{OUT}	1	$T_j = 25^\circ\text{C}$	8.55	—	9.45	V
			$11.4\text{ V} \leq V_{IN} \leq 24\text{ V}$, $1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$	8.55	—	9.45	
Quiescent current	I_B	1	$T_j = 25^\circ\text{C}$	—	3.2	6.5	mA
			$T_j = 125^\circ\text{C}$	—	—	6.0	
Quiescent current change	ΔI_B	1	$T_j = 25^\circ\text{C}$	—	—	1.5	mA
			$12\text{ V} \leq V_{IN} \leq 24\text{ V}$	—	—	0.1	
Output noise voltage	V_{NO}	2	$T_a = 25^\circ\text{C}$, $10\text{ Hz} \leq f \leq 100\text{ kHz}$	—	65	—	μV_{rms}
Long term stability	$\Delta V_{OUT}/\Delta t$	1	—	—	21	—	mV/kh
Ripple rejection	R.R.	3	$f = 120\text{ Hz}$, $12\text{ V} \leq V_{IN} \leq 24\text{ V}$, $T_j = 25^\circ\text{C}$	36	44	—	dB
Dropout voltage	V_D	1	$T_j = 25^\circ\text{C}$, $I_{OUT} = 100\text{ mA}$	—	1.7	—	V
Average temperature coefficient of output voltage	T_{CVO}	1	$I_{OUT} = 5\text{ mA}$	—	-1.09	—	mV/ $^\circ\text{C}$

TA78L10S
Electrical Characteristics

(Unless otherwise specified, $V_{IN} = 16\text{ V}$, $I_{OUT} = 40\text{ mA}$, $C_{IN} = 0.33\text{ }\mu\text{F}$, $C_{OUT} = 0.1\text{ }\mu\text{F}$, $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$)

Characteristics	Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit
Output voltage	V _{OUT}	1	T _j = 25°C		9.6	10	10.4	V
Line regulation	Reg·line	1	T _j = 25°C	12.5 V ≤ V _{IN} ≤ 25 V	—	80	230	mV
				13 V ≤ V _{IN} ≤ 25 V	—	30	170	
Load regulation	Reg·load	1	T _j = 25°C	1.0 mA ≤ I _{OUT} ≤ 100 mA	—	18	90	mV
				1.0 mA ≤ I _{OUT} ≤ 40 mA	—	8.5	45	
Output voltage	V _{OUT}	1	T _j = 25°C	12.5 V ≤ V _{IN} ≤ 25 V, 1.0 mA ≤ I _{OUT} ≤ 40 mA	9.5	—	10.5	V
				1.0 mA ≤ I _{OUT} ≤ 70 mA	9.5	—	10.5	
Quiescent current	I _B	1	T _j = 25°C		—	3.2	6.5	mA
			T _j = 125°C		—	—	6.0	
Quiescent current change	ΔI _B	1	T _j = 25°C	13 V ≤ V _{IN} ≤ 25 V	—	—	1.5	mA
				1.0 mA ≤ I _{OUT} ≤ 40 mA	—	—	0.1	
Output noise voltage	V _{NO}	2	T _a = 25°C, 10 Hz ≤ f ≤ 100 kHz		—	70	—	μV _{rms}
Long term stability	ΔV _{OUT} /Δt	1	—		—	22	—	mV/kh
Ripple rejection	R.R.	3	f = 120 Hz, 13 V ≤ V _{IN} ≤ 24 V, T _j = 25°C		36	43	—	dB
Dropout voltage	V _D	1	T _j = 25°C, I _{OUT} = 100 mA		—	1.7	—	V
Average temperature coefficient of output voltage	T _{CVO}	1	I _{OUT} = 5 mA		—	−1.21	—	mV/°C

TA78L12S
Electrical Characteristics

(Unless otherwise specified, $V_{IN} = 19\text{ V}$, $I_{OUT} = 40\text{ mA}$, $C_{IN} = 0.33\text{ }\mu\text{F}$, $C_{OUT} = 0.1\text{ }\mu\text{F}$, $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$)

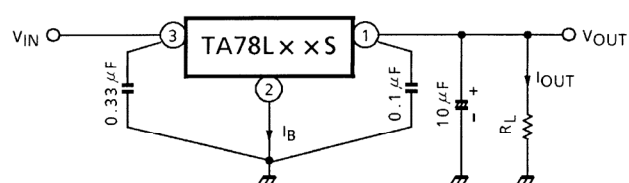
Characteristics	Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit
Output voltage	V _{OUT}	1	T _j = 25°C		11.5	12	12.5	V
Line regulation	Reg.line	1	T _j = 25°C	14.5 V ≤ V _{IN} ≤ 27 V	—	120	250	mV
				16 V ≤ V _{IN} ≤ 27 V	—	100	200	
Load regulation	Reg.load	1	T _j = 25°C	1.0 mA ≤ I _{OUT} ≤ 100 mA	—	20	100	mV
				1.0 mA ≤ I _{OUT} ≤ 40 mA	—	10	50	
Output voltage	V _{OUT}	1	T _j = 25°C	14.5 V ≤ V _{IN} ≤ 27 V, 1.0 mA ≤ I _{OUT} ≤ 40 mA	11.4	—	12.6	V
				1.0 mA ≤ I _{OUT} ≤ 70 mA	11.4	—	12.6	
Quiescent current	I _B	1	T _j = 25°C		—	3.2	6.5	mA
			T _j = 125°C		—	—	6.0	
Quiescent current change	ΔI _B	1	T _j = 25°C	16 V ≤ V _{IN} ≤ 27 V	—	—	1.5	mA
				1.0 mA ≤ I _{OUT} ≤ 40 mA	—	—	0.1	
Output noise voltage	V _{NO}	2	Ta = 25°C, 10 Hz ≤ f ≤ 100 kHz		—	80	—	μV _{rms}
Long term stability	ΔV _{OUT} /Δt	1	—		—	24	—	mV/kh
Ripple rejection	R.R.	3	f = 120 Hz, 15 V ≤ V _{IN} ≤ 25 V, T _j = 25°C		36	41	—	dB
Dropout voltage	V _D	1	T _j = 25°C, I _{OUT} = 100 mA		—	1.7	—	V
Average temperature coefficient of output voltage	T _{CVO}	1	I _{OUT} = 5 mA		—	−1.45	—	mV/°C

TA78L15S
Electrical Characteristics

(Unless otherwise specified, $V_{IN} = 23\text{ V}$, $I_{OUT} = 40\text{ mA}$, $C_{IN} = 0.33\text{ }\mu\text{F}$, $C_{OUT} = 0.1\text{ }\mu\text{F}$, $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$)

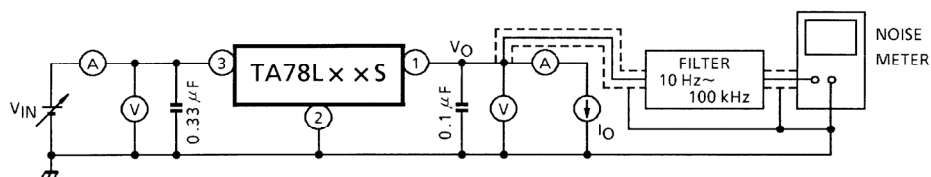
Characteristics	Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit
Output voltage	V _{OUT}	1	T _j = 25°C		14.4	15	15.6	V
Line regulation	Reg.line	1	T _j = 25°C	17.5 V ≤ V _{IN} ≤ 30 V	—	130	300	mV
				20 V ≤ V _{IN} ≤ 30 V	—	110	250	
Load regulation	Reg.load	1	T _j = 25°C	1.0 mA ≤ I _{OUT} ≤ 100 mA	—	25	150	mV
				1.0 mA ≤ I _{OUT} ≤ 40 mA	—	12	75	
Output voltage	V _{OUT}	1	T _j = 25°C	17.5 V ≤ V _{IN} ≤ 30 V, 1.0 mA ≤ I _{OUT} ≤ 40 mA	14.25	—	15.75	V
				1.0 mA ≤ I _{OUT} ≤ 70 mA	14.25	—	15.75	
Quiescent current	I _B	1	T _j = 25°C		—	3.3	6.5	mA
			T _j = 125°C		—	—	6.0	
Quiescent current change	ΔI _B	1	T _j = 25°C	20 V ≤ V _{IN} ≤ 30 V	—	—	1.5	mA
				1.0 mA ≤ I _{OUT} ≤ 40 mA	—	—	0.1	
Output noise voltage	V _{NO}	2	T _a = 25°C, 10 Hz ≤ f ≤ 100 kHz		—	90	—	μV _{rms}
Long term stability	ΔV _{OUT} /Δt	1	—		—	30	—	mV/kh
Ripple rejection	R.R.	3	f = 120 Hz, 18.5 V ≤ V _{IN} ≤ 28.5 V, T _j = 25°C		34	40	—	dB
Dropout voltage	V _D	1	T _j = 25°C, I _{OUT} = 100 mA		—	1.7	—	V
Average temperature coefficient of output voltage	T _{CVO}	1	I _{OUT} = 5 mA		—	−1.82	—	mV/°C

Test Circuit 1/Standard Application



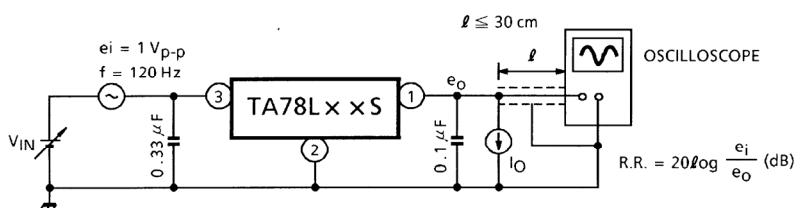
Test Circuit 2

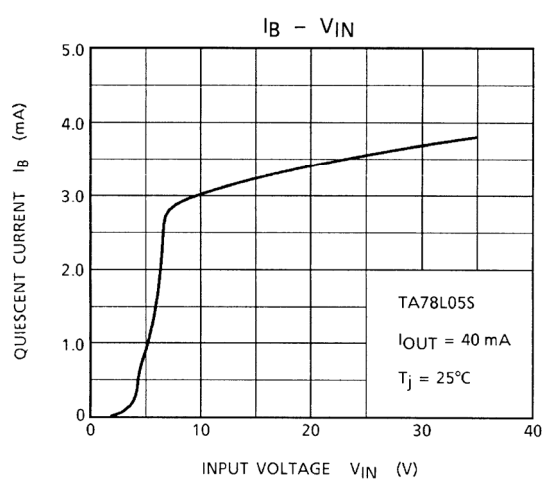
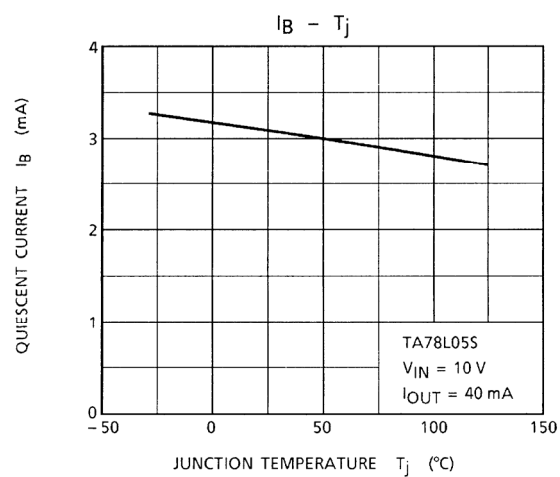
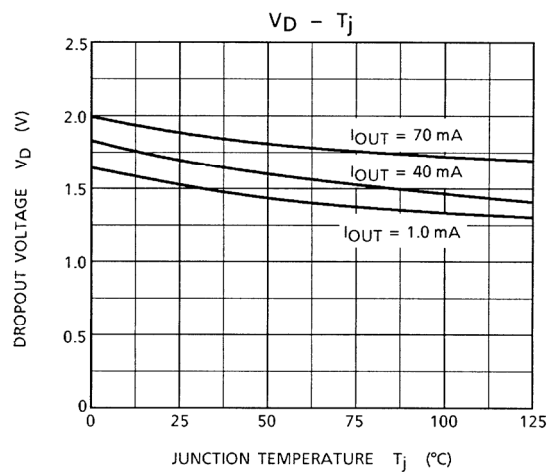
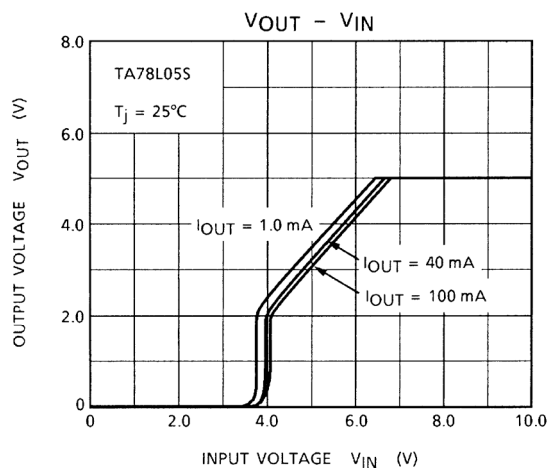
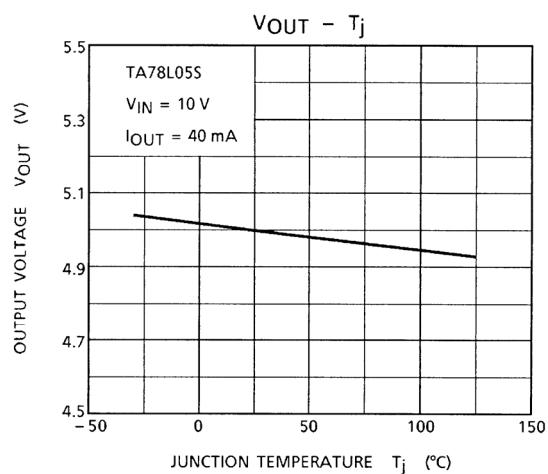
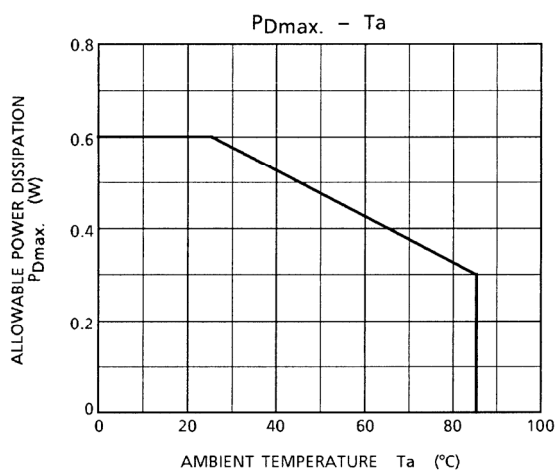
V_{NO}

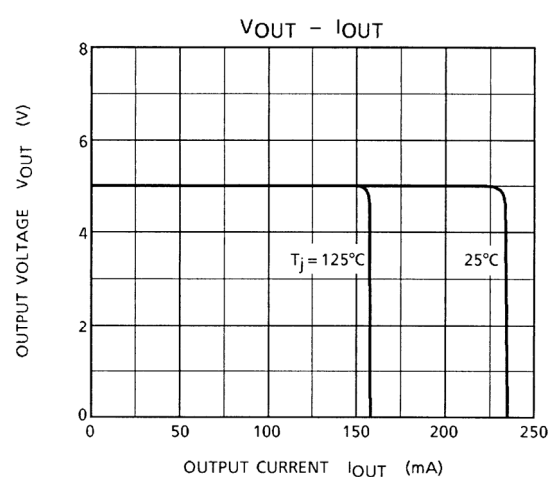
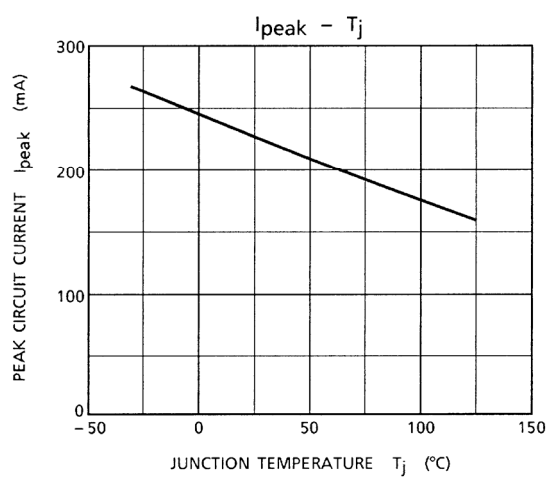


Test Circuit 3

R.R.





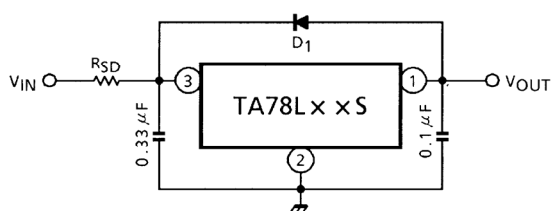


Precautions for Use

Destruction of the IC may occur if high voltage in excess of the IC output voltage (typ. value) is applied to the IC output terminal. Where this possibility exists, connect a Zener diode between the output terminal and GND to prevent any application of excessive voltage. In particular, in a current boosting circuit such as that shown in Application Circuit Example (2), if the input voltage is suddenly applied by stages and, furthermore, load is light, excessive voltage may be applied transiently to the output terminal of the IC. In such a case, it may become necessary to increase the capacity of the output capacitor as appropriate, use a smaller R_1 (a resistor for bypassing IC bias current) or gradually raise the input voltage, in addition to using a Zener diode as mentioned above.

Application Circuits

(1) Standard Application



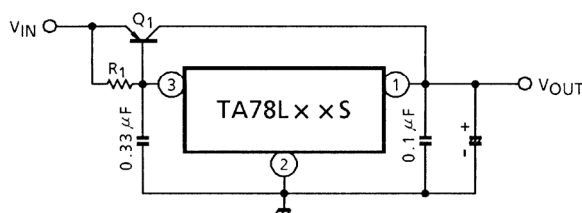
D_1 : IC protective diode

When surge voltage is applied to IC output terminal or $V_{IN} < V_{OUT}$ at the time of power ON/OFF, always connect the high speed switching diode D_1 .

R_{SD} : Power limiting resistor

If V_{IN} is too high, always connect R_{SD} in order to reduce power consumption of IC.

(2) A. Current Boost Voltage Regulator



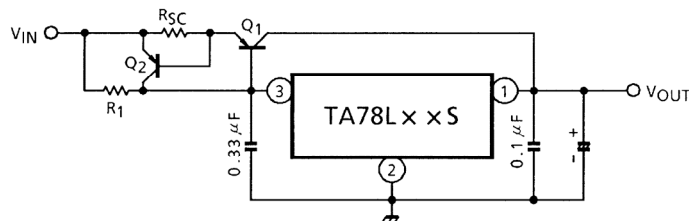
Use a required radiation plate for Q_1 .

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

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

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

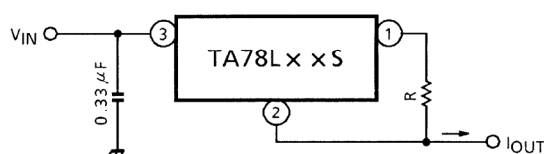
B. Short-Circuit Protection



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

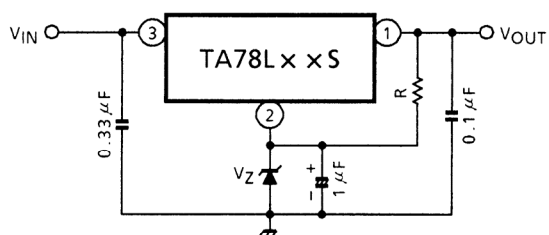
where, I_{SC} : Short-Circuit current

(3) Current Regulator

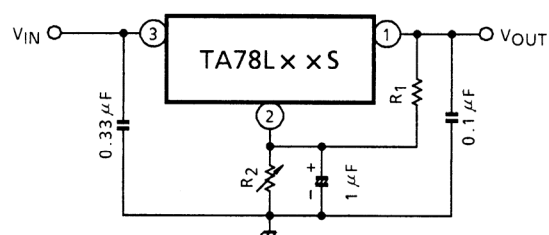


$$I_{OUT} = \frac{V_{OUT}}{R} + I_B$$

(4) Voltage Boost Regulator

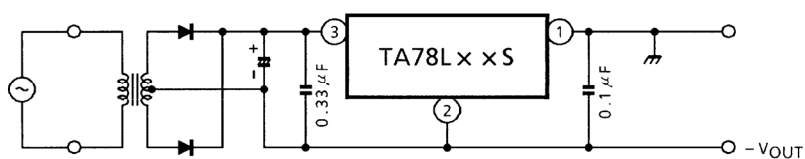


$V_{OUT} = V_Z + V_{OUT}(\text{of IC})$
Apply current of several mA to R.

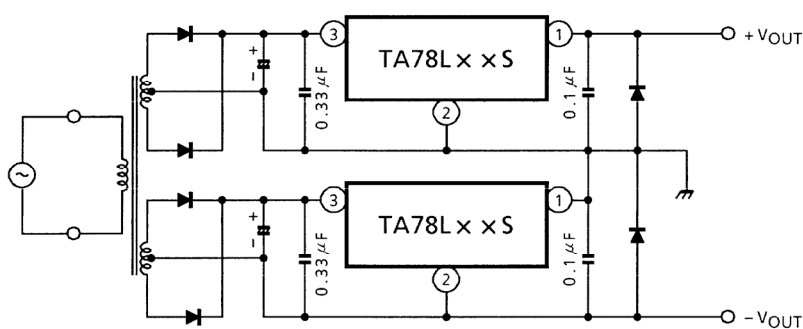


$V_{OUT} = R_2 (I_B + \frac{V_{OUT}(\text{of IC})}{R_1}) + V_{OUT}(\text{of IC})$

(5) Negative Regulator



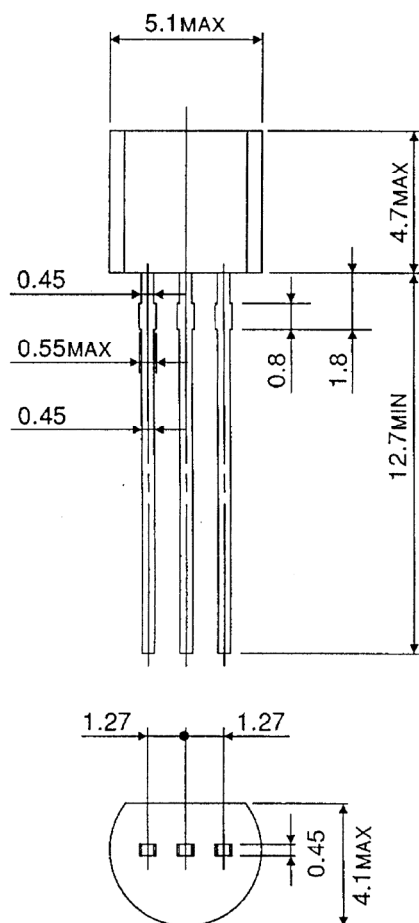
(6) Positive and Negative Regulator



Package Dimensions

SSIP3-P-1.27A

Unit : mm



Weight : 0.21 g (Typ.)

RESTRICTIONS ON PRODUCT USE

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