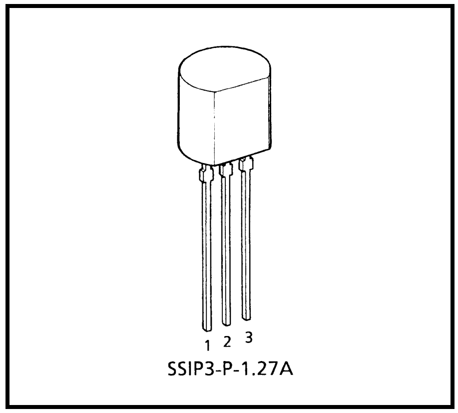
TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

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.

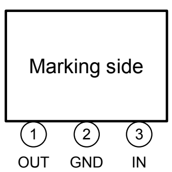


Weight: 0.21 g (Typ.)

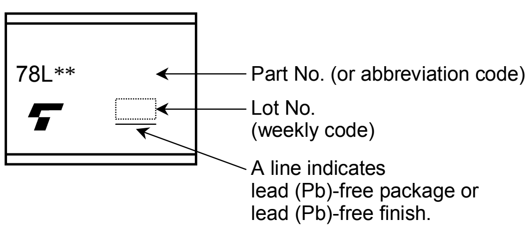
Features

- Suitable for TTL, C^2MOS power supply.
- Internal short-circuit current limiting.
- Internal thermal overload protection.
- Maximum output current of 100 mA (T_j = 25°C).
- TO-92 package

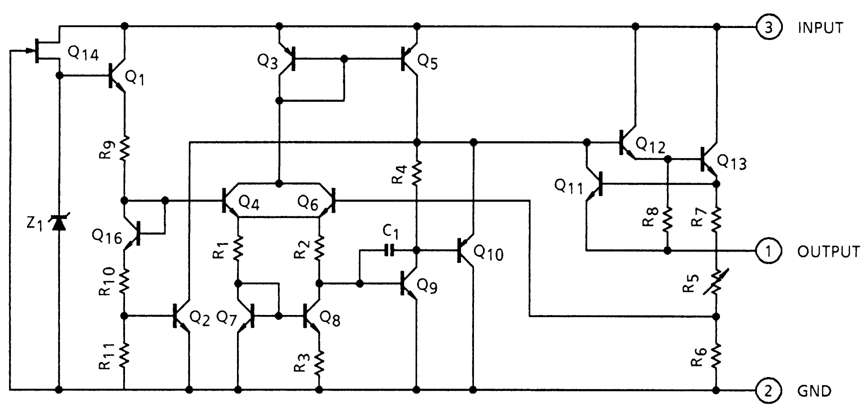
Pin Assignment



Marking



Equivalent Circuit



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		$R_{th\ (j\text{-}a)}$	208	°C/W

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 Sy	mbol	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	150	mV
				8.0 V ≤ V_{IN} ≤ 20 V	—	45	100	
Load regulation	Reg·load	1	T_j = 25°C	1.0 mA ≤ I_{OUT} ≤ 100 mA	— 11		60	mV
				1.0 mA ≤ I_{OUT} ≤ 40 mA	—	5.0	30	
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	— 5.	25	V
				1.0 mA ≤ I_{OUT} ≤ 70 mA	4.75	— 5.	25	
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	—	— 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		— 40		— μV	rms
Long term stability	$\Delta V_{OUT}/\Delta t$ 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_{CVO}	1	I_{OUT} = 5 mA		—	−0.6	—	mV/°C

TA78L07S
Electrical Characteristics
(Unless otherwise specified, V_{IN} = 12 V, I_{OUT} = 40 mA, C_{IN} = 0.33 μF, C_{OUT} = 0.1 μF, 0°C ≤ T_j ≤ 125°C)

Characteristics Sy	mbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit
Output voltage	V_{OUT} 1		T_j = 25°C		6.72	7.0	7.28	V
Line regulation	Reg·line	1	T_j = 25°C	9.2 V ≤ V_{IN} ≤ 22 V	—	50	160	mV
				10 V ≤ V_{IN} ≤ 22 V	— 45		115	
Load regulation	Reg·load	1	T_j = 25°C	1.0 mA ≤ I_{OUT} ≤ 100 mA	— 13		75	mV
				1.0 mA ≤ I_{OUT} ≤ 40 mA	— 6.	0	40	
Output voltage	V_{OUT} 1		T_j = 25°C	9.2 V ≤ V_{IN} ≤ 22 V, 1.0 mA ≤ I_{OUT} ≤ 40 mA	6.65	— 7.	35	V
				1.0 mA ≤ I_{OUT} ≤ 70 mA	6.65	— 7.	35	
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	10 V ≤ V_{IN} ≤ 22 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		— 50		— μV	rms
Long term stability	$\Delta V_{OUT}/\Delta t$ 1		—		— 17		— mV	/kh
Ripple rejection	R.R.	3	f = 120 Hz, 10 V ≤ V_{IN} ≤ 20 V, T_j = 25°C		37 46		— 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		—	−0.84	— mV	/°C

TA78L08S
Electrical Characteristics
(Unless otherwise specified, V_{IN} = 14 V, I_{OUT} = 40 mA, C_{IN} = 0.33 μF, C_{OUT} = 0.1 μF, 0°C ≤ T_j ≤ 125°C)

Characteristics Sy	mbol	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	Ta = 25°C, 10 Hz ≤ f ≤ 100 kHz		— 60		— μV	rms
Long term stability	$\Delta V_{OUT}/\Delta t$ 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 V, I_{OUT} = 40 mA, C_{IN} = 0.33 μF, C_{OUT} = 0.1 μF, 0°C ≤ T_j ≤ 125°C)

Characteristics Sy	mbol	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	11.4 V ≤ V_{IN} ≤ 24 V	—	80	200	mV
				12 V ≤ V_{IN} ≤ 24 V	— 20		160	
Load regulation	Reg·load	1	T_j = 25°C	1.0 mA ≤ I_{OUT} ≤ 100 mA	— 17		90	mV
				1.0 mA ≤ I_{OUT} ≤ 40 mA	— 8.	0	45	
Output voltage	V_{OUT} 1		T_j = 25°C	11.4 V ≤ V_{IN} ≤ 24 V, 1.0 mA ≤ I_{OUT} ≤ 40 mA	8.55	— 9.	45	V
				1.0 mA ≤ I_{OUT} ≤ 70 mA	8.55	— 9.	45	
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	12 V ≤ V_{IN} ≤ 24 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		— 65		— μV	rms
Long term stability	$\Delta V_{OUT}/\Delta t$ 1		—		— 21		— mV	/kh
Ripple rejection	R.R.	3	f = 120 Hz, 12 V ≤ V_{IN} ≤ 24 V, T_j = 25°C		36 44		— 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		—	−1.09	— mV	/°C

TA78L10S
Electrical Characteristics
(Unless otherwise specified, V_{IN} = 16 V, I_{OUT} = 40 mA, C_{IN} = 0.33 μF, C_{OUT} = 0.1 μF, 0°C ≤ T_j ≤ 125°C)

Characteristics Sy	mbol	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	Ta = 25°C, 10 Hz ≤ f ≤ 100 kHz		— 70		— μV	rms
Long term stability	$\Delta V_{OUT}/\Delta t$ 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

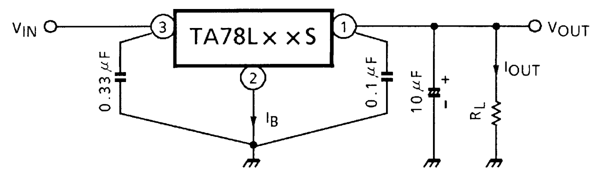
TA78L12S
Electrical Characteristics
(Unless otherwise specified, V_{IN} = 19 V, I_{OUT} = 40 mA, C_{IN} = 0.33 μF, C_{OUT} = 0.1 μF, 0°C ≤ T_j ≤ 125°C)

Characteristics Sy	mbol	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	$\Delta V_{OUT}/\Delta t$ 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 V, I_{OUT} = 40 mA, C_{IN} = 0.33 μF, C_{OUT} = 0.1 μF, 0°C ≤ T_j ≤ 125°C)

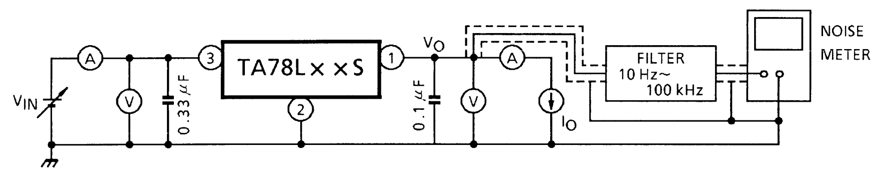
Characteristics Sy	mbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit
Output voltage	V_{OUT} 1		T_j = 25°C		14.4	15	15.6	V
Line regulation	Reg·line	1	T_j = 25°C	17.5 V ≤ V_{IN} ≤ 30 V	—	130	300	mV
				20 V ≤ V_{IN} ≤ 30 V	— 110		250	
Load regulation	Reg·load	1	T_j = 25°C	1.0 mA ≤ I_{OUT} ≤ 100 mA	— 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	Ta = 25°C, 10 Hz ≤ f ≤ 100 kHz		— 90		— μV	rms
Long term stability	$\Delta V_{OUT}/\Delta t$ 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



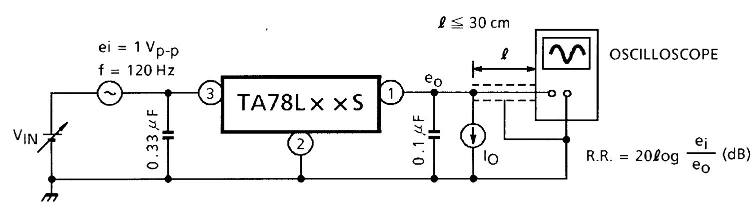
Test Circuit 2

VNO

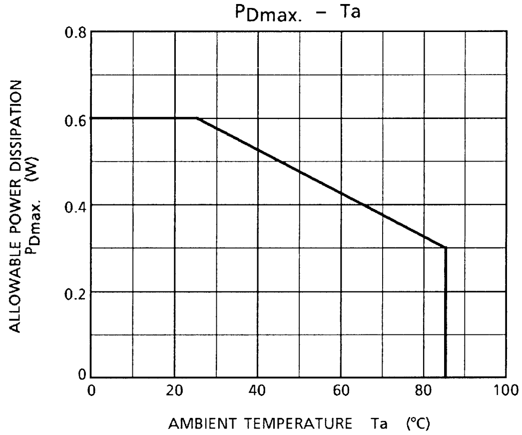


Test Circuit 3

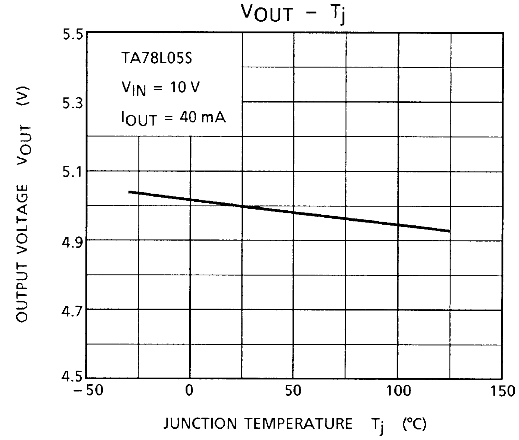
R.R.



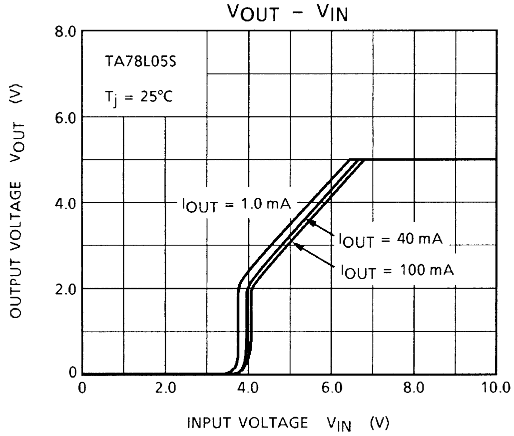
$P_{Dmax.}$ – Ta



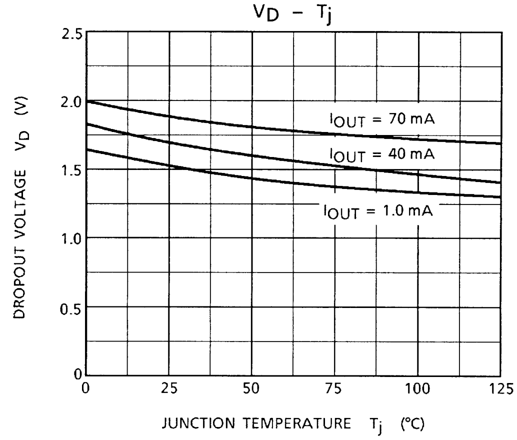
V_{OUT} – T_j



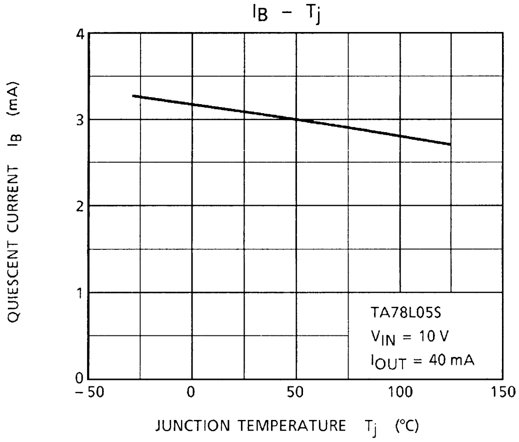
V_{OUT} – V_{IN}



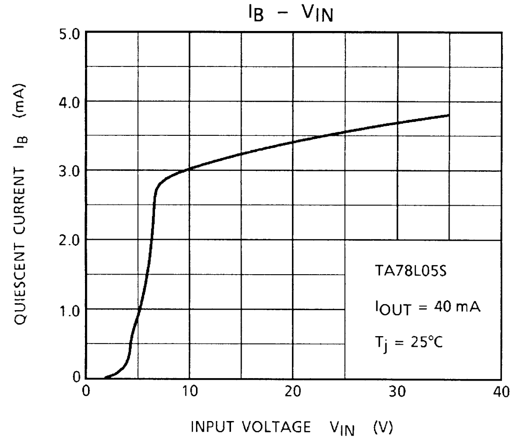
V_D – T_j

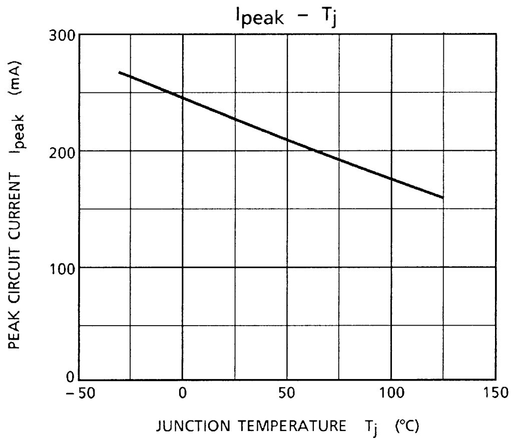


I_B – T_j

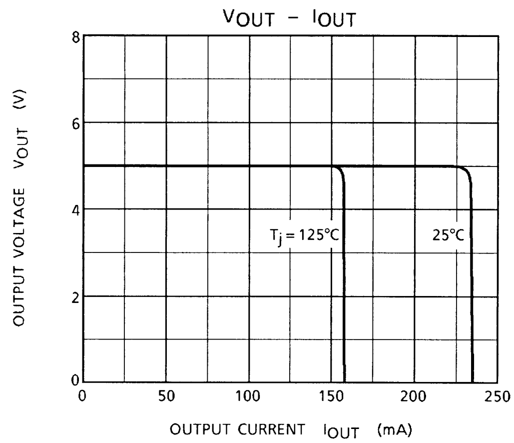


I_B – V_{IN}





Ipeak – Tj
PEAK CIRCUIT CURRENT Ipeak (mA)
300
200
100
0
−50
0
50
100
150
JUNCTION TEMPERATURE Tj (°C)



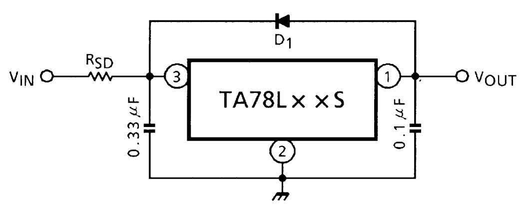
VOUT – IOUT
OUTPUT VOLTAGE VOUT (V)
8
6
4
2
0
Tj = 125°C
25°C
0
50
100
150
200
250
OUTPUT CURRENT IOUT (mA)

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

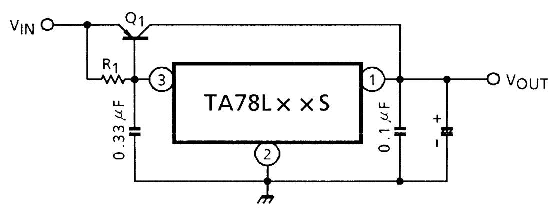
(1) S tandard Application



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

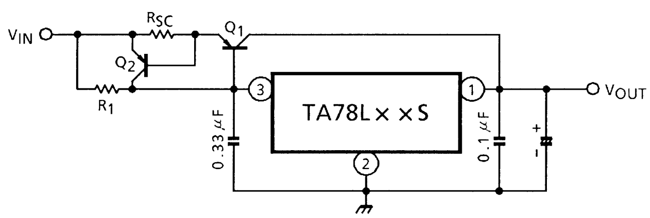


Use a required radiation plate for Q_1.

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

where, V_{BE1} : V_{BE} of external transistor Q_1.
I_B MAX : Max. bias current of IC.

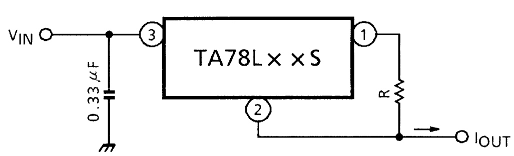
B. Short-Circuit Protection



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

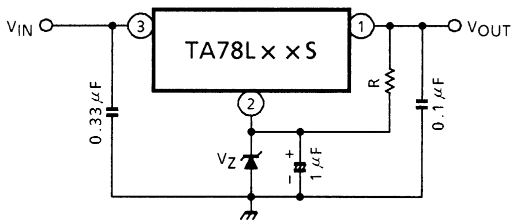
where, I_{SC} : Short-Circuit current

(3) C urrent Regulator

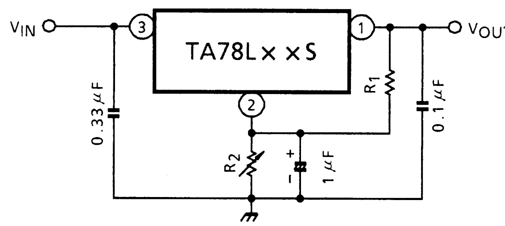


$$I_{OUT} = \frac{V_{OUT}}{R} + I_B$$

(4) Voltage Boost Regulator

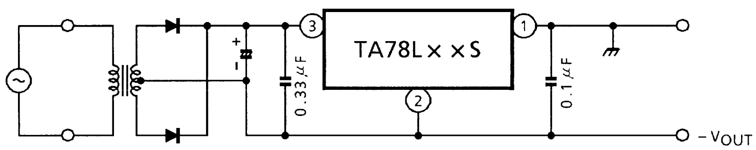


$V_{OUT} = V_Z + V_{OUT}$ (of IC)
Apply current of several mA to R.

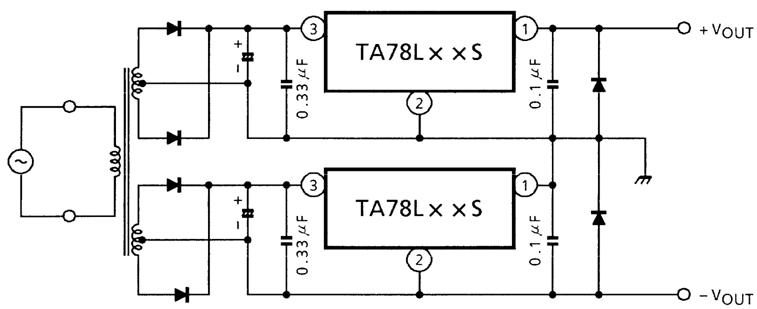


$$V_{OUT} = R_2 \left(I_B + \frac{V_{OUT}\text{ (of IC)}}{R_1}\right) + V_{OUT}\text{ (of IC)}$$

(5) Negat ive Regulator

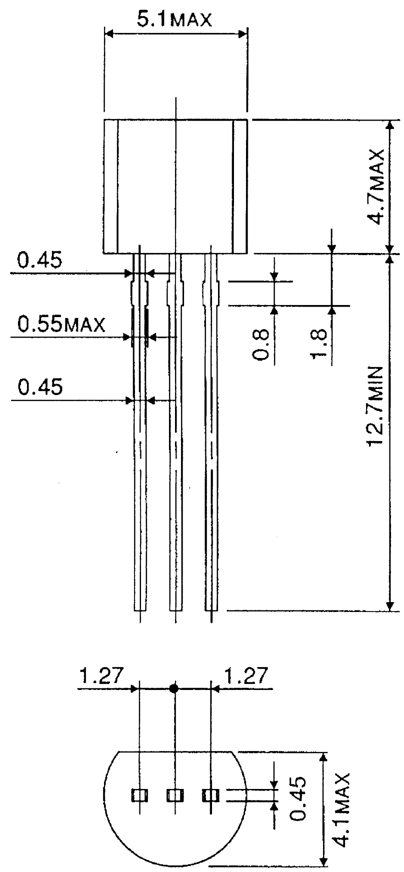


(6) P ositive and Negative Regulator



Package Dimensions

SSIP3-P-1.27A Unit : mm



Weight : 0.21 g (Typ.)

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