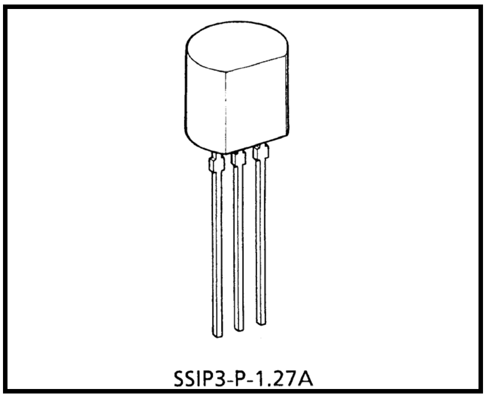
TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

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.

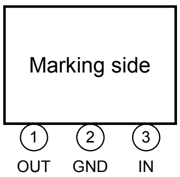


Weight: 0.21 g (typ.)

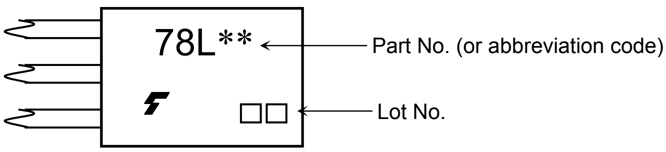
Features

- 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

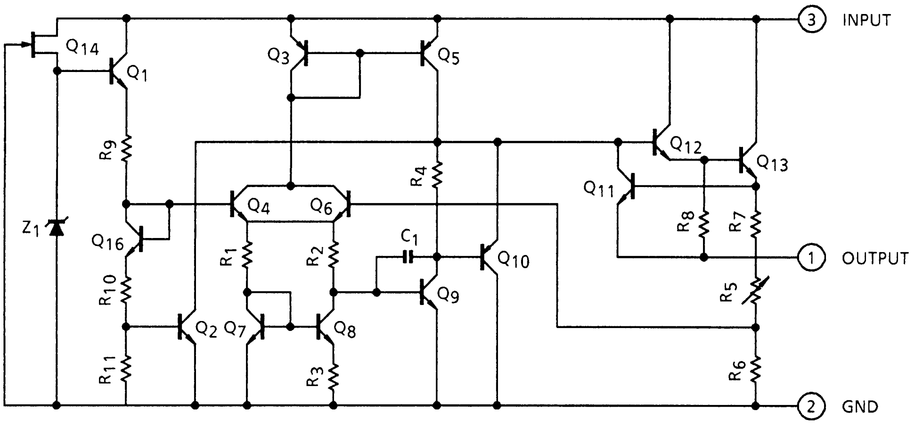
Pin Assignment



Marking



Equivalent Circuit



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		$R_{th\ (j\text{-}a)}$	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	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	Symbol	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	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	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	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	11.4 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	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	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

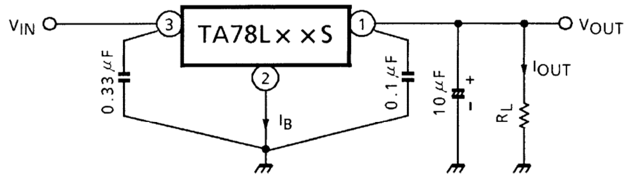
TA78L12S
Electrical Characteristics
(Unless otherwise specified, V_{IN} = 19 V, I_{OUT} = 40 mA, C_{IN} = 0.33 μF, C_{OUT} = 0.1 μF, 0°C ≤ T_j ≤ 125°C)

Characteristics	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	$\Delta V_{OUT}/\Delta t$	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)

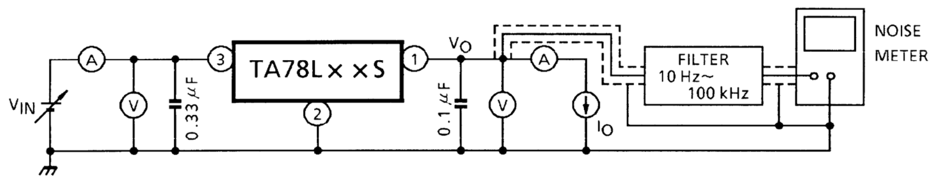
Characteristics	Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit
Output voltage	V_{OUT}	1	T_j = 25°C		14.4	15	15.6	V
Line regulation	Reg·line	1	T_j = 25°C	17.5 V ≤ V_{IN} ≤ 30 V	—	130	300	mV
				20 V ≤ V_{IN} ≤ 30 V	—	110	250	
Load regulation	Reg·load	1	T_j = 25°C	1.0 mA ≤ I_{OUT} ≤ 100 mA	—	25	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	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



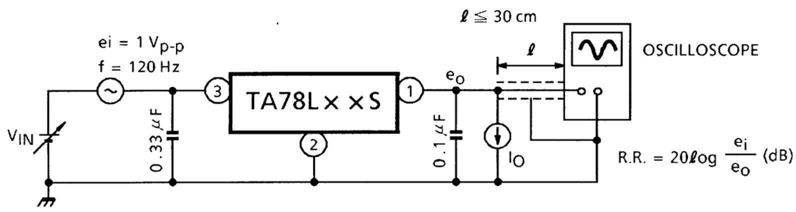
Test Circuit 2

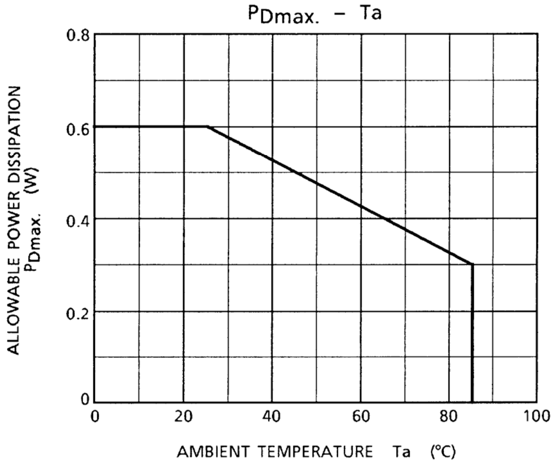
V_{NO}

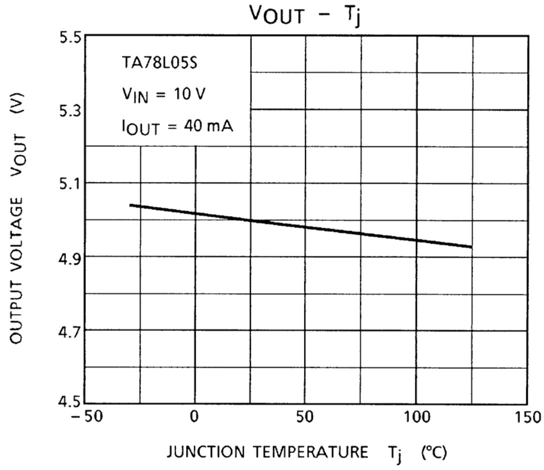


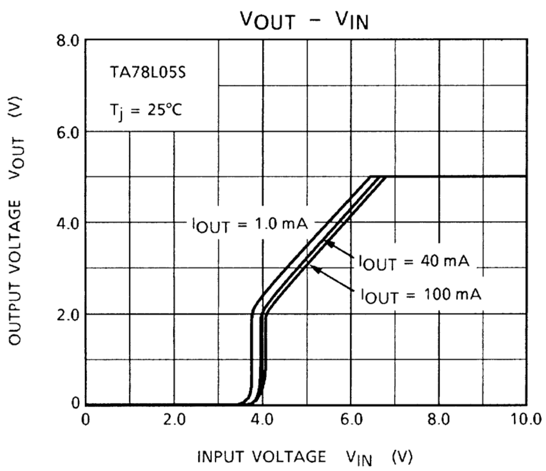
Test Circuit 3

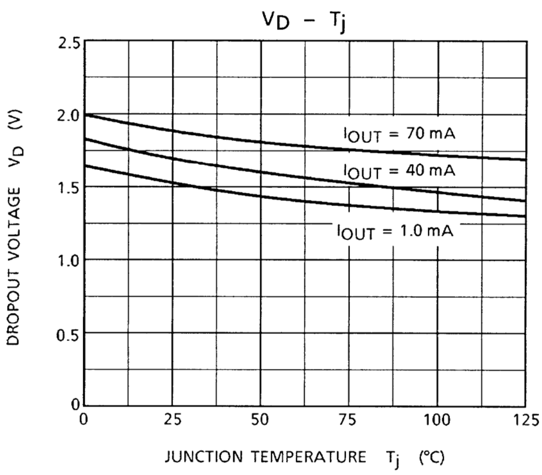
R.R.

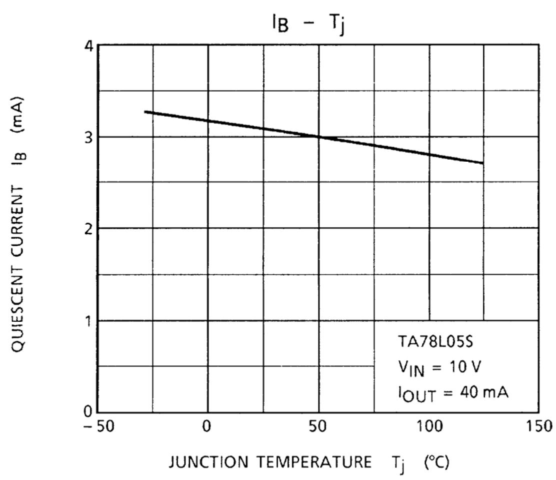


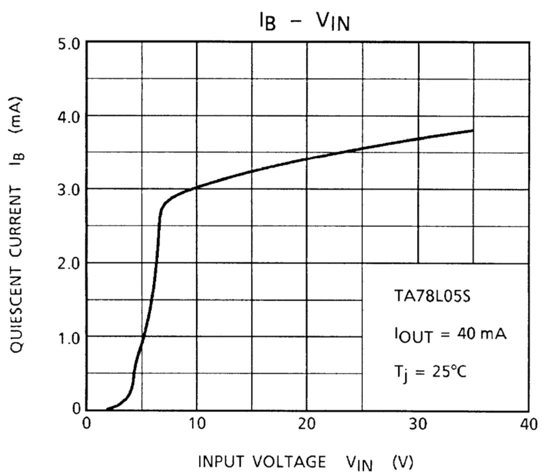

PDmax. – Ta
ALLOWABLE POWER DISSIPATION PDmax. (W)
AMBIENT TEMPERATURE Ta (°C)
0.8
0.6
0.4
0.2
0
0
20
40
60
80
100

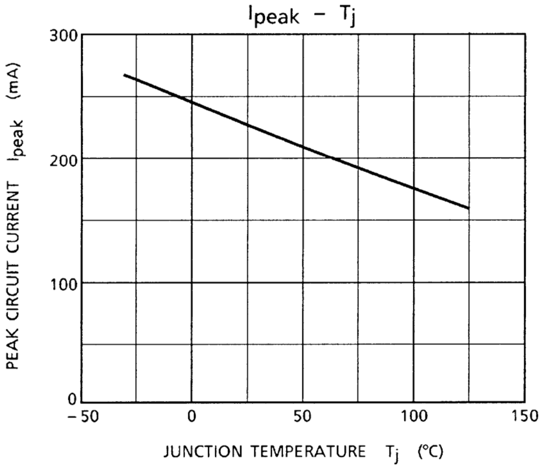

VOUT – Tj
TA78L05S
VIN = 10 V
IOUT = 40 mA
OUTPUT VOLTAGE VOUT (V)
JUNCTION TEMPERATURE Tj (°C)
5.5
5.3
5.1
4.9
4.7
4.5
−50
0
50
100
150

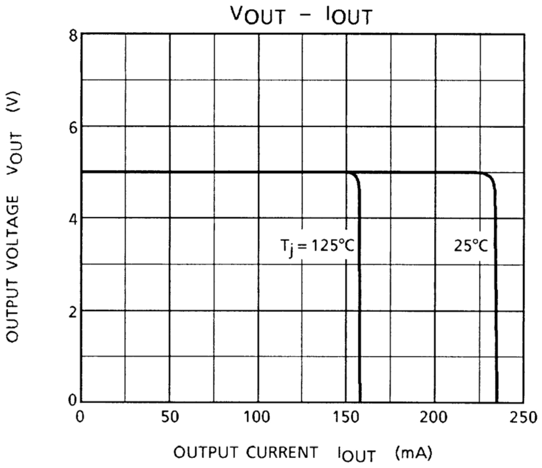

VOUT – VIN
TA78L05S
Tj = 25°C
IOUT = 1.0 mA
IOUT = 40 mA
IOUT = 100 mA
OUTPUT VOLTAGE VOUT (V)
INPUT VOLTAGE VIN (V)
8.0
6.0
4.0
2.0
0
0
2.0
4.0
6.0
8.0
10.0


VD – Tj
IOUT = 70 mA
IOUT = 40 mA
IOUT = 1.0 mA
DROPOUT VOLTAGE VD (V)
JUNCTION TEMPERATURE Tj (°C)
2.5
2.0
1.5
1.0
0.5
0
0
25
50
75
100
125


IB – Tj
TA78L05S
VIN = 10 V
IOUT = 40 mA
QUIESCENT CURRENT IB (mA)
JUNCTION TEMPERATURE Tj (°C)
4
3
2
1
0
−50
0
50
100
150


IB – VIN
TA78L05S
IOUT = 40 mA
Tj = 25°C
QUIESCENT CURRENT IB (mA)
INPUT VOLTAGE VIN (V)
5.0
4.0
3.0
2.0
1.0
0
0
10
20
30
40


I_{peak} – T_j
PEAK CIRCUIT CURRENT I_{peak} (mA)
300
200
100
0
−50
0
50
100
150
JUNCTION TEMPERATURE T_j (°C)

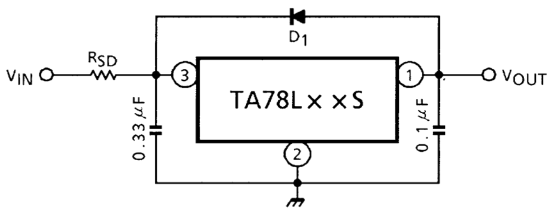

V_{OUT} – I_{OUT}
OUTPUT VOLTAGE V_{OUT} (V)
8
6
4
2
0
T_j = 125°C
25°C
0
50
100
150
200
250
OUTPUT CURRENT I_{OUT} (mA)

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

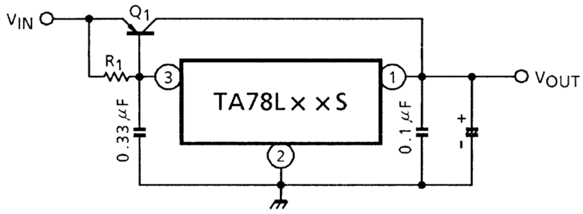
(1) Standard Application



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

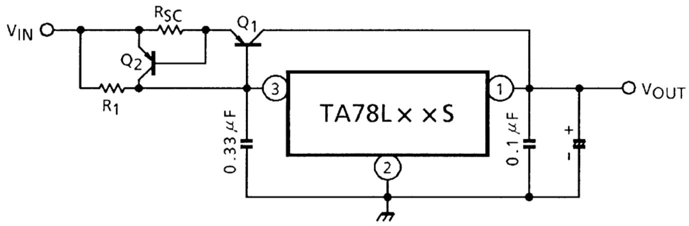


Use a required radiation plate for Q_1.

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

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

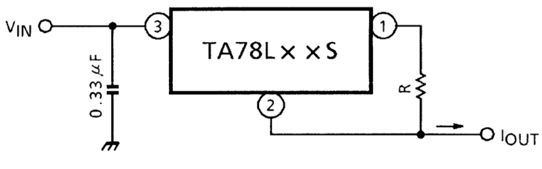
B. Short-Circuit Protection



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

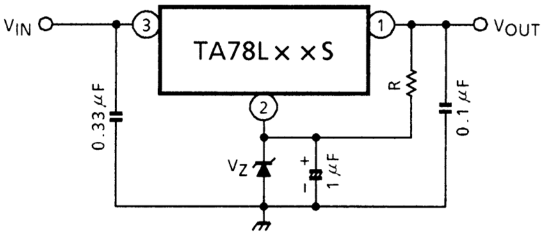
where, I_{SC} : Short-Circuit current

(3) Current Regulator

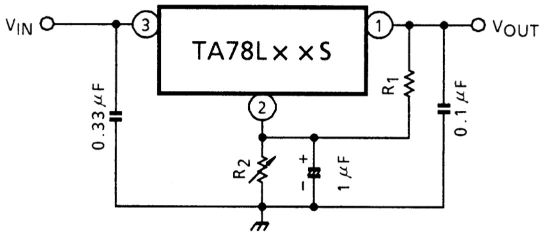


$$I_{OUT} = \frac{V_{OUT}}{R} + I_B$$

(4) Voltage Boost Regulator

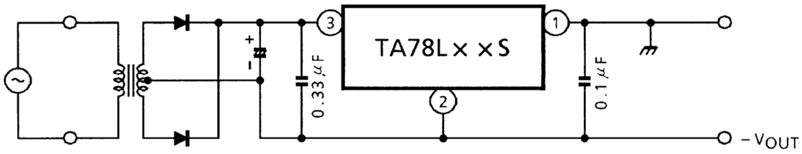


$V_{OUT} = V_Z + V_{OUT}$ (of IC)
Apply current of several mA to R.

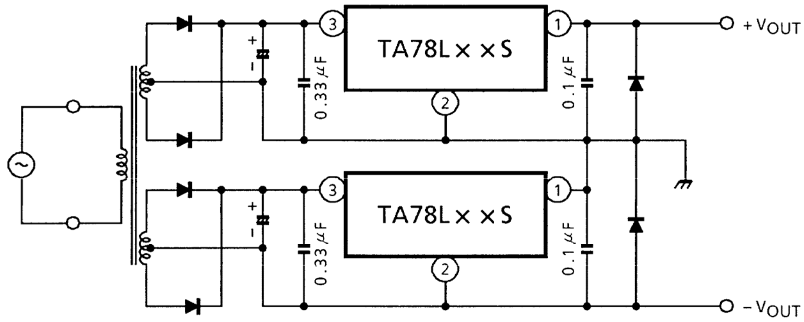


$V_{OUT} = R_2 \left(I_B + \frac{V_{OUT}\text{(of IC)}}{R_1}\right) + V_{OUT}\text{(of IC)}$

(5) Negative Regulator

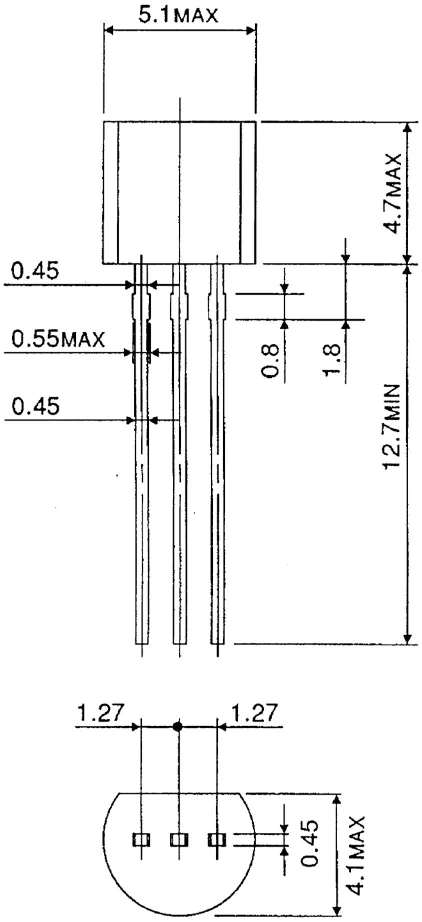


(6) Positive and Negative Regulator



Package Dimensions

SSIP3-P-1.27A Unit : mm



Weight : 0.21 g (Typ.)

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20070701-EN

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