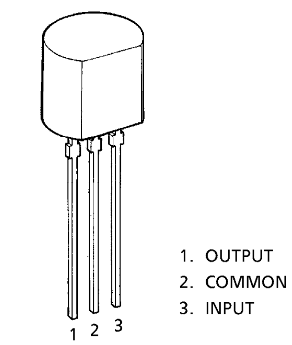
TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

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.



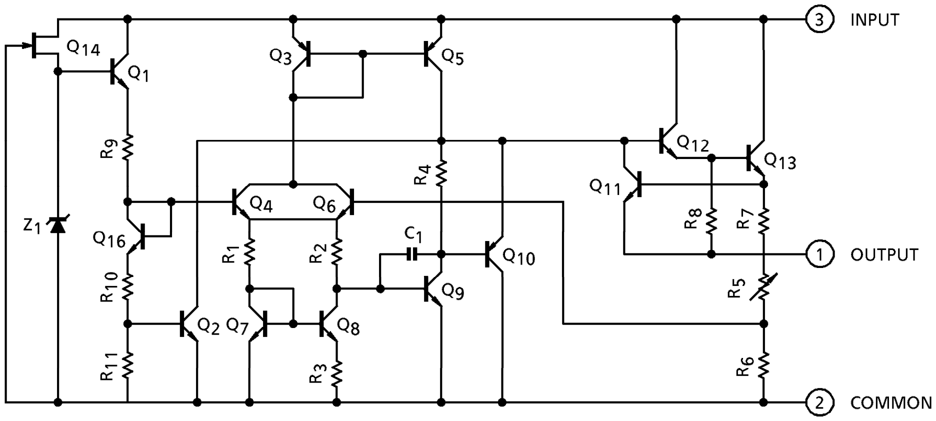
P-SSIP3-1.27A

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

EQUIVALENT CIRCUIT



MAXIMUM RATINGS (T_a = 25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Input Voltage		V_{IN}	35	V
Power Dissipation	(T_a = 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)

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	7.0 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	T_a = 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} = 5mA		—	−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)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	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} = 5mA		—	− 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)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	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)

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	11.4 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)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	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)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	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

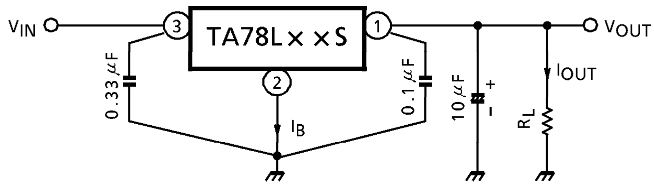
TA78L15S

ELECTRICAL CHARACTERISTICS

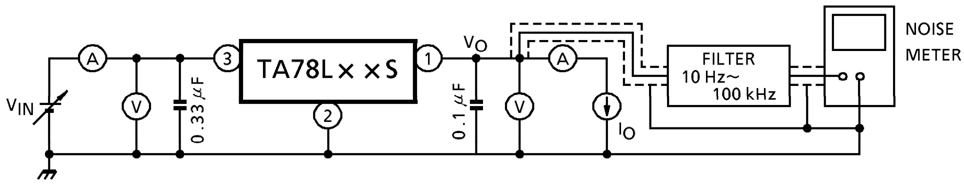
(Unless otherwise specified, V_{IN} = 23 V, I_{OUT} = 40 mA, C_{IN} = 0.33 μF, C_{OUT} = 0.1 μF, 0°C ≦ T_j ≦ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	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

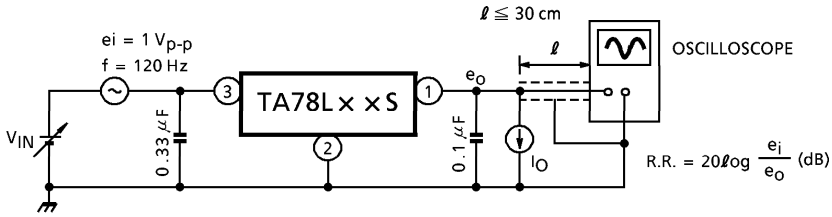
TEST CIRCUIT 1 / STANDARD APPLICATION

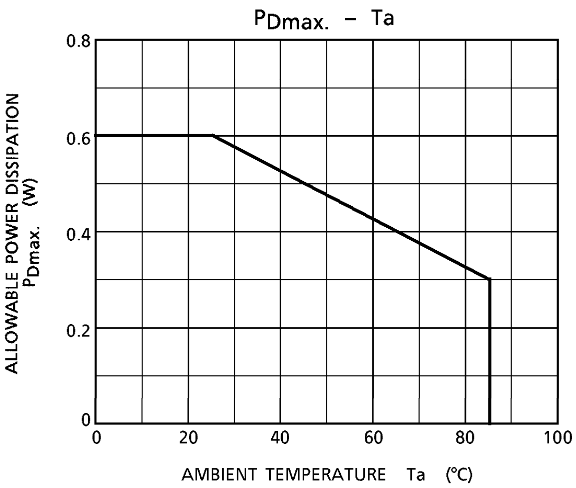


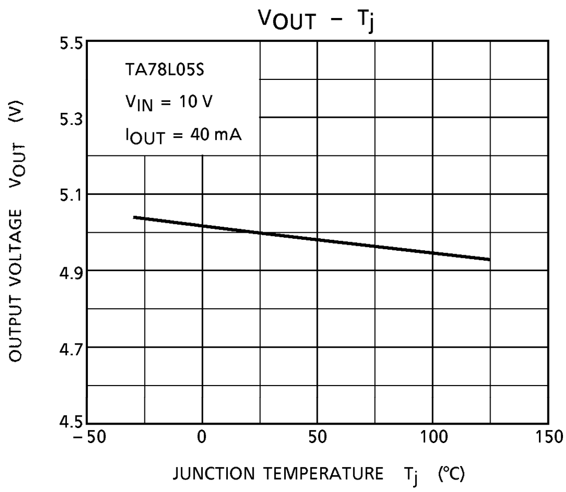
TEST CIRCUIT 2 V_{NO}

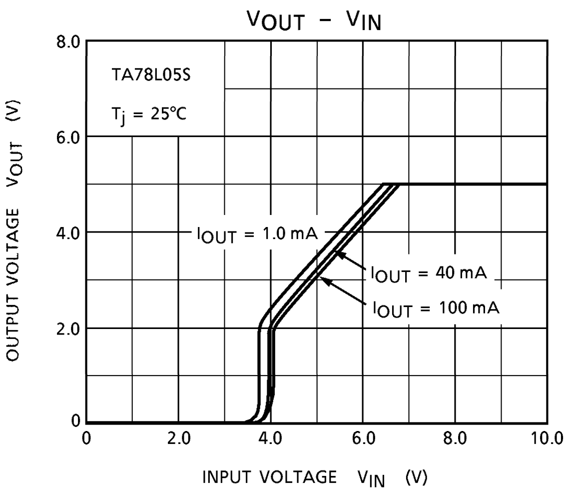


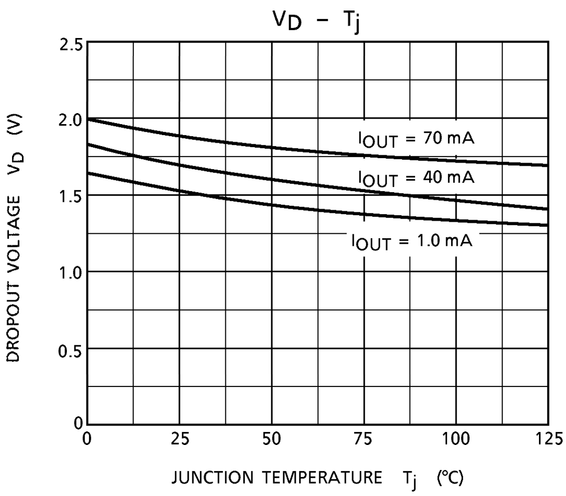
TEST CIRCUIT 3 R.R.

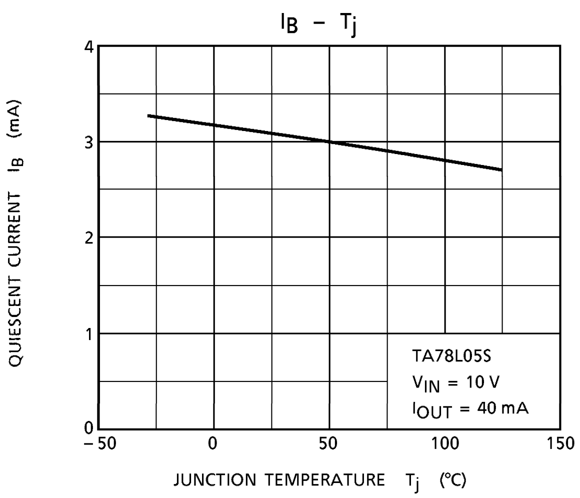


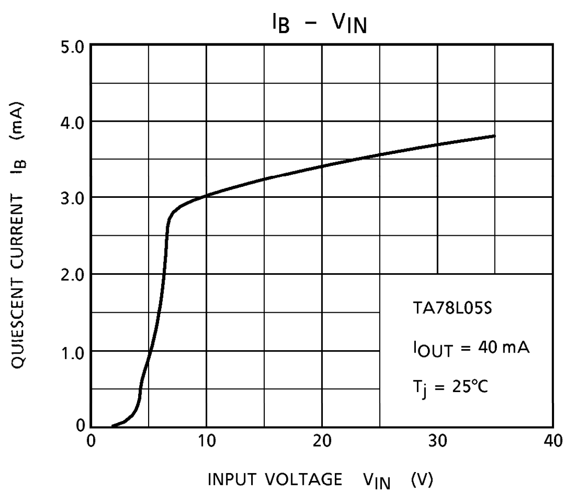

PDmax. – Ta
ALLOWABLE POWER DISSIPATION PDmax. (W)
AMBIENT TEMPERATURE Ta (°C)
0.8
0.6
0.4
0.2
0
0
20
40
60
80
100

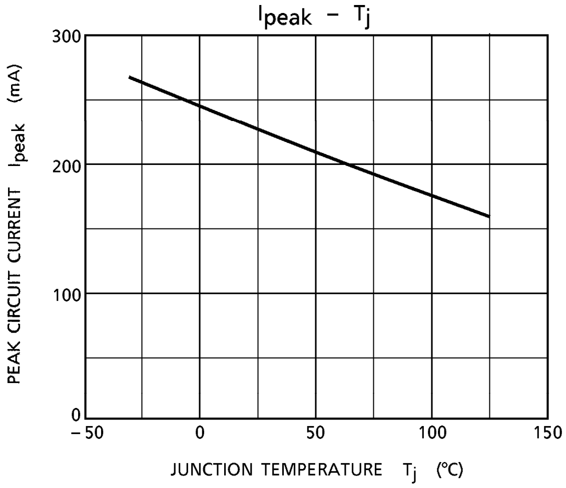

VOUT – Tj
TA78L05S
VIN = 10 V
IOUT = 40 mA
OUTPUT VOLTAGE VOUT (V)
JUNCTION TEMPERATURE Tj (°C)
5.5
5.3
5.1
4.9
4.7
4.5
−50
0
50
100
150

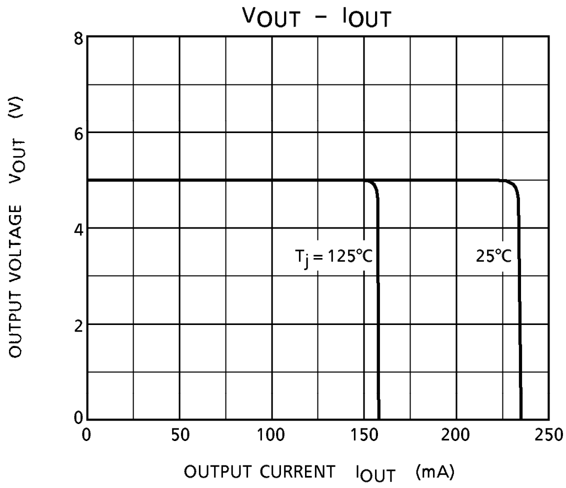

VOUT – VIN
TA78L05S
Tj = 25°C
IOUT = 1.0 mA
IOUT = 40 mA
IOUT = 100 mA
OUTPUT VOLTAGE VOUT (V)
INPUT VOLTAGE VIN (V)
8.0
6.0
4.0
2.0
0
0
2.0
4.0
6.0
8.0
10.0


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


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

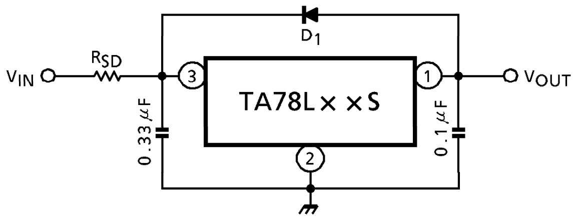

VOUT – IOUT
8
6
4
2
0
0
50
100
150
200
250
Tj = 125°C
25°C
OUTPUT VOLTAGE VOUT (V)
OUTPUT CURRENT IOUT (mA)

Precautions for Use

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

APPLICATION CIRCUIT

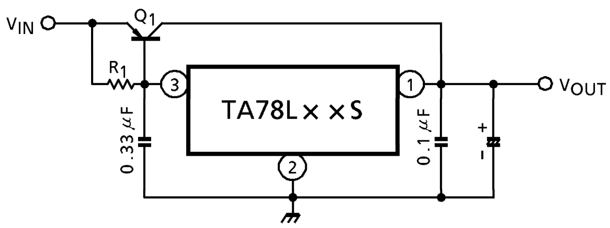
(1) STANDARD APPLICATION



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 swithing 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

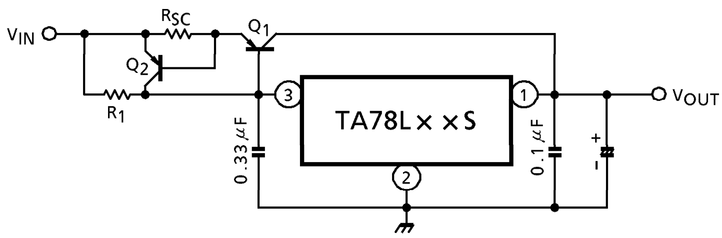


Use a required rediation plate for Q_1.

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

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

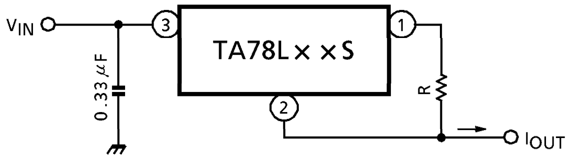
B. SHORT-CIRCUIT PROTECTION



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

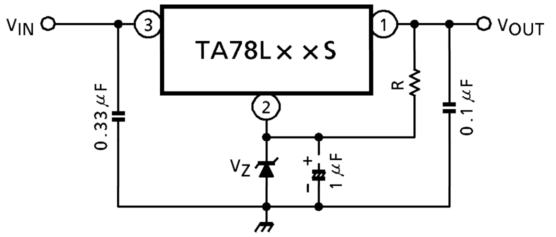
where, I_{SC} : Short-Circuit current

(3) CURRENT REGULATOR

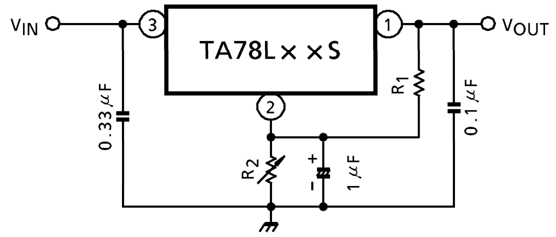


$$I_{OUT} = \frac{V_{OUT}}{R} + I_B$$

(4) VOLTAGE BOOST REGULATOR

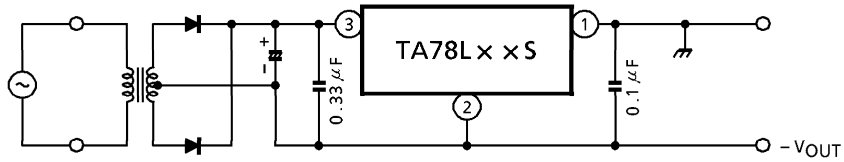


$V_{OUT} = V_Z + V_{OUT}$ (of IC)
Apply current of several mA to R.

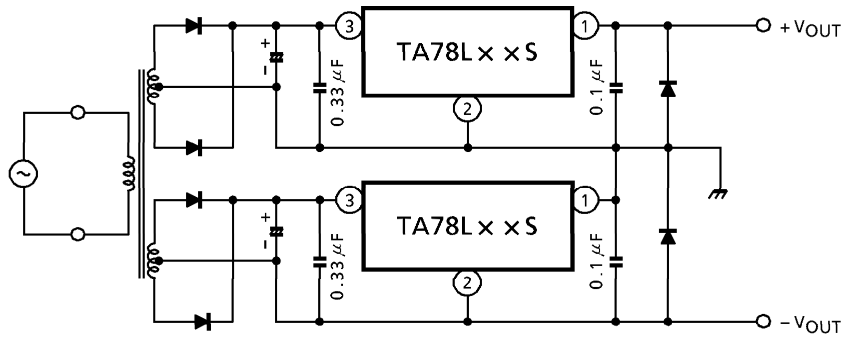


$$V_{OUT} = R_2 \left(I_B + \frac{V_{OUT}\text{ (of IC)}}{R_1}\right) + V_{OUT}\text{ (of IC)}$$

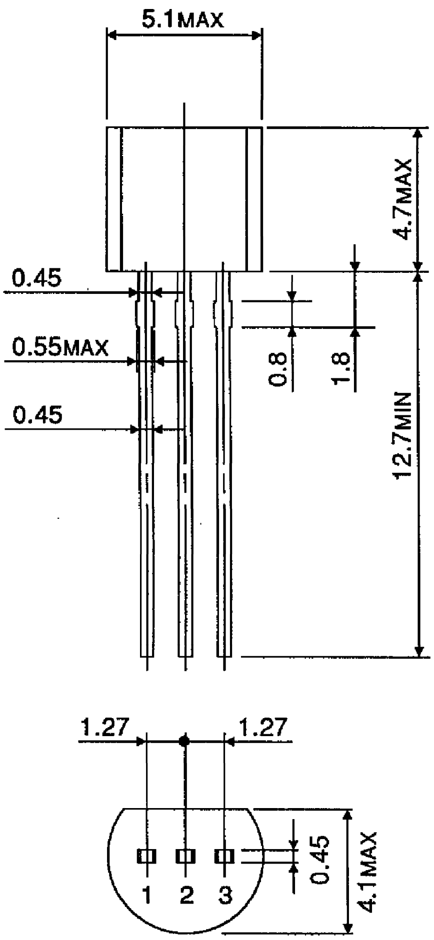
(5) NEGATIVE REGULATOR



(6) POSITIVE AND NEGATIVE REGULATOR



PACKAGE DIMENSIONS
P-SSIP3-1.27A Unit : mm



Weight : 0.21 g (Typ.)