

TOSHIBA

TA78L05,07,08,09,10,12,15S

TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

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

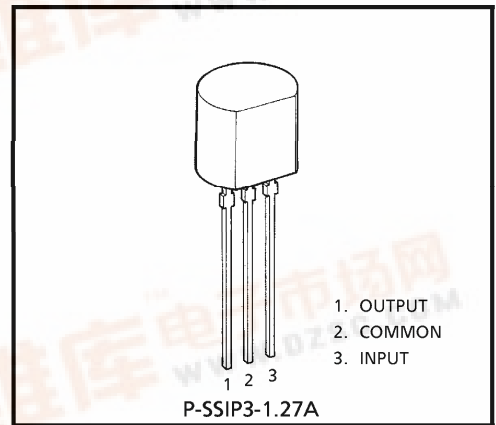
THREE TERMINAL POSITIVE VOLTAGE REGULATORS

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

The TA78Lx xS series of fixed voltage monolithic integrated circuit voltage regulators is designed for a wide range of applications.

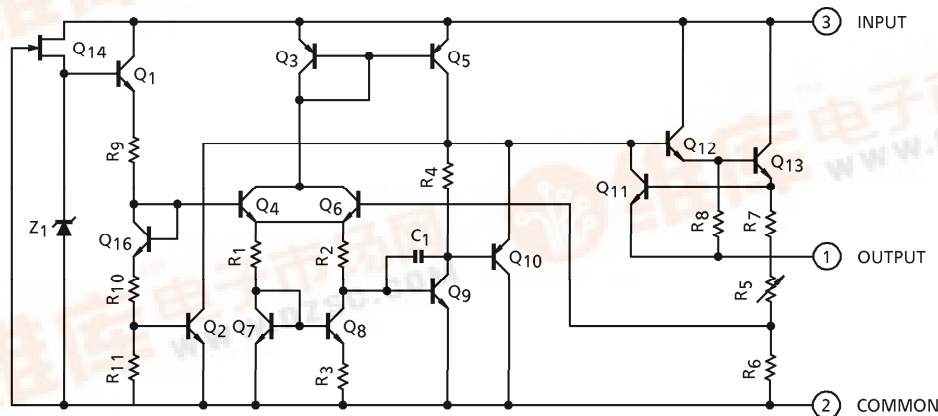
FEATURES

- Suitable for TTL, C²MOS Power Supply
- Internal Short-Circuit Current Limiting
- Internal Thermal Overload Protection
- Maximum Output Current of 100 mA (T_j = 25°C)
- TO-92 Package



Weight : 0.21 g (Typ.)

EQUIVALENT CIRCUIT



980910EBA1

● TOSHIBA is continually working to improve the quality and the reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to observe standards of safety, and to avoid situations in which a malfunction or failure of a TOSHIBA product could cause loss of human life, bodily injury or damage to property. In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent products specifications. Also, please keep in mind the precautions and conditions set forth in the TOSHIBA Semiconductor Reliability Handbook.

● The products described in this document are subject to the foreign exchange and foreign trade laws.

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MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	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

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	4.75	—	5.25	V
				1.0 mA ≤ I _{OUT} ≤ 40 mA	4.75	—	5.25	
				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	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} = 5mA	—	-0.6	—	mV/°C	

TA78L07S

ELECTRICAL CHARACTERISTICS

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

CHARACTERISTIC	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	$T_j = 25^\circ\text{C}$	$9.2\text{ V} \leq V_{IN} \leq 22\text{ V}$	—	50	160	mV
				$10\text{ V} \leq V_{IN} \leq 22\text{ V}$	—	45	115	
Load Regulation	Reg·load	1	$T_j = 25^\circ\text{C}$	$1.0\text{ mA} \leq I_{OUT} \leq 100\text{ mA}$	—	13	75	mV
				$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$	—	6.0	40	
Output Voltage	V_{OUT}	1	$T_j = 25^\circ\text{C}$	$9.2\text{ V} \leq V_{IN} \leq 22\text{ V}$	6.65	—	7.35	V
				$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$	6.65	—	7.35	
				$1.0\text{ mA} \leq I_{OUT} \leq 70\text{ mA}$	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	$T_j = 25^\circ\text{C}$	$10\text{ V} \leq V_{IN} \leq 22\text{ V}$	—	—	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 / °C	

TA78L08S

ELECTRICAL CHARACTERISTICS

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

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT	
Output Voltage	V_{OUT}	1	$T_j = 25^\circ\text{C}$	7.7	8.0	8.3	V	
Line Regulation	Reg·line	1	$T_j = 25^\circ\text{C}$	$10.5\text{ V} \leq V_{IN} \leq 23\text{ V}$	—	20	175	mV
				$11\text{ V} \leq V_{IN} \leq 23\text{ V}$	—	12	125	
Load Regulation	Reg·load	1	$T_j = 25^\circ\text{C}$	$1.0\text{ mA} \leq I_{OUT} \leq 100\text{ mA}$	—	15	80	mV
				$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$	—	7.0	40	
Output Voltage	V_{OUT}	1	$T_j = 25^\circ\text{C}$	$10.5\text{ V} \leq V_{IN} \leq 23\text{ V}$	7.6	—	8.4	V
				$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$	7.6	—	8.4	
				$1.0\text{ mA} \leq I_{OUT} \leq 70\text{ mA}$	7.6	—	8.4	
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	$T_j = 25^\circ\text{C}$	$11\text{ V} \leq V_{IN} \leq 23\text{ V}$	—	—	1.5	mA
				$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$	—	—	0.1	
Output Noise Voltage	V_{NO}	2	$T_a = 25^\circ\text{C}$, $10\text{ Hz} \leq f \leq 100\text{ kHz}$	—	60	—	μV_{rms}	
Long Term Stability	$\Delta V_{OUT} / \Delta t$	1	—	—	20	—	mV / kh	
Ripple Rejection	R.R.	3	$f = 120\text{ Hz}$, $12\text{ V} \leq V_{IN} \leq 23\text{ V}$, $T_j = 25^\circ\text{C}$	37	45	—	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	$I_{OUT} = 5\text{ mA}$	—	-0.97	—	mV / °C	

TA78L09S

ELECTRICAL CHARACTERISTICS

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

CHARACTERISTIC	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	$T_j = 25^\circ\text{C}$	$11.4\text{ V} \leq V_{IN} \leq 24\text{ V}$	—	80	200	mV
				$12\text{ V} \leq V_{IN} \leq 24\text{ V}$	—	20	160	
Load Regulation	Reg·load	1	$T_j = 25^\circ\text{C}$	$1.0\text{ mA} \leq I_{OUT} \leq 100\text{ mA}$	—	17	90	mV
				$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$	—	8.0	45	
Output Voltage	V_{OUT}	1	$T_j = 25^\circ\text{C}$	$11.4\text{ V} \leq V_{IN} \leq 24\text{ V}$	8.55	—	9.45	V
				$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$	8.55	—	9.45	
				$1.0\text{ mA} \leq I_{OUT} \leq 70\text{ mA}$	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	$T_j = 25^\circ\text{C}$	$12\text{ V} \leq V_{IN} \leq 24\text{ V}$	—	—	1.5	mA
				$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$	—	—	0.1	
Output Noise Voltage	V_{NO}	2	$T_a = 25^\circ\text{C}$, $10\text{ Hz} \leq f \leq 100\text{ kHz}$	—	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 / °C	

TA78L10S

ELECTRICAL CHARACTERISTICS

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

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT	
Output Voltage	V_{OUT}	1	$T_j = 25^\circ\text{C}$	9.6	10	10.4	V	
Line Regulation	Reg·line	1	$T_j = 25^\circ\text{C}$	$12.5\text{ V} \leq V_{IN} \leq 25\text{ V}$	—	80	230	mV
				$13\text{ V} \leq V_{IN} \leq 25\text{ V}$	—	30	170	
Load Regulation	Reg·load	1	$T_j = 25^\circ\text{C}$	$1.0\text{ mA} \leq I_{OUT} \leq 100\text{ mA}$	—	18	90	mV
				$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$	—	8.5	45	
Output Voltage	V_{OUT}	1	$T_j = 25^\circ\text{C}$	$12.5\text{ V} \leq V_{IN} \leq 25\text{ V}$	9.5	—	10.5	V
				$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$	9.5	—	10.5	
				$1.0\text{ mA} \leq I_{OUT} \leq 70\text{ mA}$	9.5	—	10.5	
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	$T_j = 25^\circ\text{C}$	$13\text{ V} \leq V_{IN} \leq 25\text{ V}$	—	—	1.5	mA
				$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$	—	—	0.1	
Output Noise Voltage	V_{NO}	2	$T_a = 25^\circ\text{C}$, $10\text{ Hz} \leq f \leq 100\text{ kHz}$	—	70	—	μV_{rms}	
Long Term Stability	$\Delta V_{OUT} / \Delta t$	1	—	—	22	—	mV / kh	
Ripple Rejection	R.R.	3	$f = 120\text{ Hz}$, $13\text{ V} \leq V_{IN} \leq 24\text{ V}$, $T_j = 25^\circ\text{C}$	36	43	—	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	$I_{OUT} = 5\text{ mA}$	—	-1.21	—	mV / °C	

TA78L12S

ELECTRICAL CHARACTERISTICS

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

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT	
Output Voltage	V_{OUT}	1	$T_j = 25^\circ\text{C}$	11.5	12	12.5	V	
Line Regulation	Reg·line	1	$T_j = 25^\circ\text{C}$	$14.5\text{ V} \leq V_{IN} \leq 27\text{ V}$	—	120	250	mV
				$16\text{ V} \leq V_{IN} \leq 27\text{ V}$	—	100	200	
Load Regulation	Reg·load	1	$T_j = 25^\circ\text{C}$	$1.0\text{ mA} \leq I_{OUT} \leq 100\text{ mA}$	—	20	100	mV
				$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$	—	10	50	
Output Voltage	V_{OUT}	1	$T_j = 25^\circ\text{C}$	$14.5\text{ V} \leq V_{IN} \leq 27\text{ V}$	11.4	—	12.6	V
				$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$	11.4	—	12.6	
				$1.0\text{ mA} \leq I_{OUT} \leq 70\text{ mA}$	11.4	—	12.6	
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	$T_j = 25^\circ\text{C}$	$16\text{ V} \leq V_{IN} \leq 27\text{ V}$	—	—	1.5	mA
				$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$	—	—	0.1	
Output Noise Voltage	V_{NO}	2	$T_a = 25^\circ\text{C}$, $10\text{ Hz} \leq f \leq 100\text{ kHz}$	—	80	—	μV_{rms}	
Long Term Stability	$\Delta V_{OUT} / \Delta t$	1	—	—	24	—	mV / kh	
Ripple Rejection	R.R.	3	$f = 120\text{ Hz}$, $15\text{ V} \leq V_{IN} \leq 25\text{ V}$, $T_j = 25^\circ\text{C}$	36	41	—	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	$I_{OUT} = 5\text{ mA}$	—	-1.45	—	mV / °C	

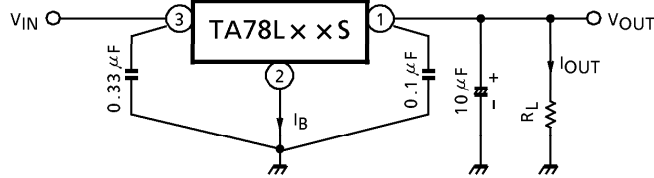
TA78L15S

ELECTRICAL CHARACTERISTICS

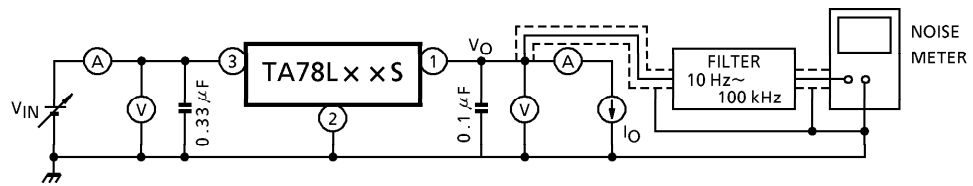
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CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT	
Output Voltage	V_{OUT}	1	$T_j = 25^\circ\text{C}$	14.4	15	15.6	V	
Line Regulation	Reg·line	1	$T_j = 25^\circ\text{C}$	$17.5\text{ V} \leq V_{IN} \leq 30\text{ V}$	—	130	300	mV
				$20\text{ V} \leq V_{IN} \leq 30\text{ V}$	—	110	250	
Load Regulation	Reg·load	1	$T_j = 25^\circ\text{C}$	$1.0\text{ mA} \leq I_{OUT} \leq 100\text{ mA}$	—	25	150	mV
				$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$	—	12	75	
Output Voltage	V_{OUT}	1	$T_j = 25^\circ\text{C}$	$17.5\text{ V} \leq V_{IN} \leq 30\text{ V}$	14.25	—	15.75	V
				$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$	14.25	—	15.75	
				$1.0\text{ mA} \leq I_{OUT} \leq 70\text{ mA}$	14.25	—	15.75	
Quiescent Current	I_B	1	$T_j = 25^\circ\text{C}$	—	3.3	6.5	mA	
			$T_j = 125^\circ\text{C}$	—	—	6.0		
Quiescent Current Change	ΔI_B	1	$T_j = 25^\circ\text{C}$	$20\text{ V} \leq V_{IN} \leq 30\text{ V}$	—	—	1.5	mA
				$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$	—	—	0.1	
Output Noise Voltage	V_{NO}	2	$T_a = 25^\circ\text{C}$, $10\text{ Hz} \leq f \leq 100\text{ kHz}$	—	90	—	μV_{rms}	
Long Term Stability	$\Delta V_{OUT} / \Delta t$	1	—	—	30	—	mV / kh	
Ripple Rejection	R.R.	3	$f = 120\text{ Hz}$, $18.5\text{ V} \leq V_{IN} \leq 28.5\text{ V}$, $T_j = 25^\circ\text{C}$	34	40	—	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	$I_{OUT} = 5\text{ mA}$	—	-1.82	—	mV / °C	

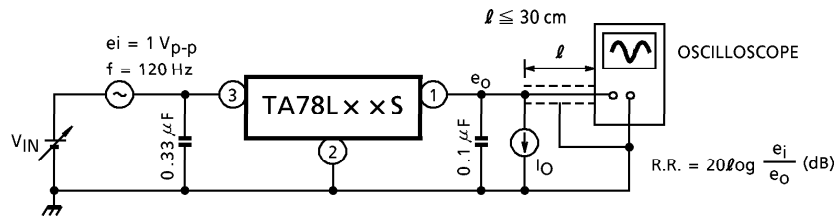
TEST CIRCUIT 1 / STANDARD APPLICATION

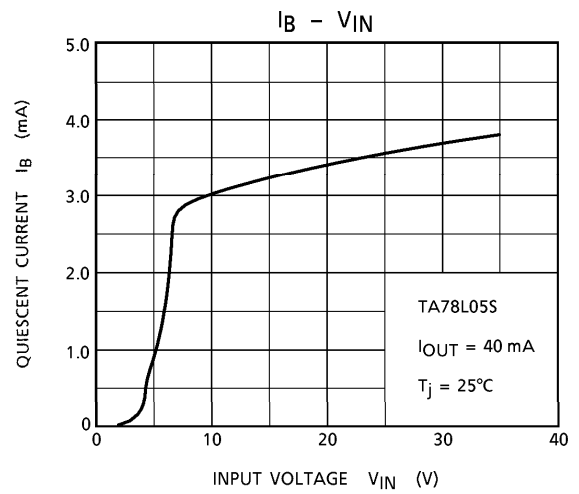
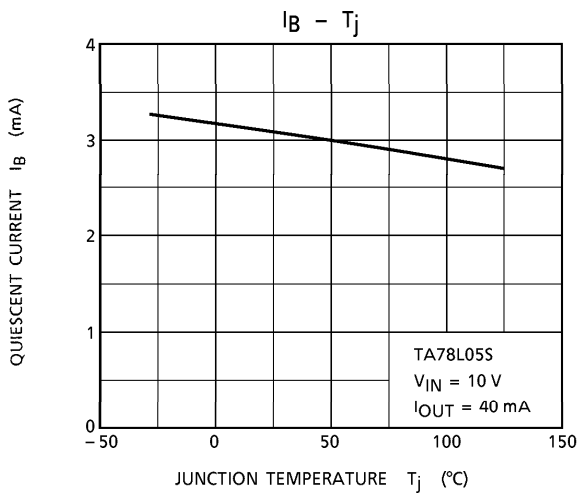
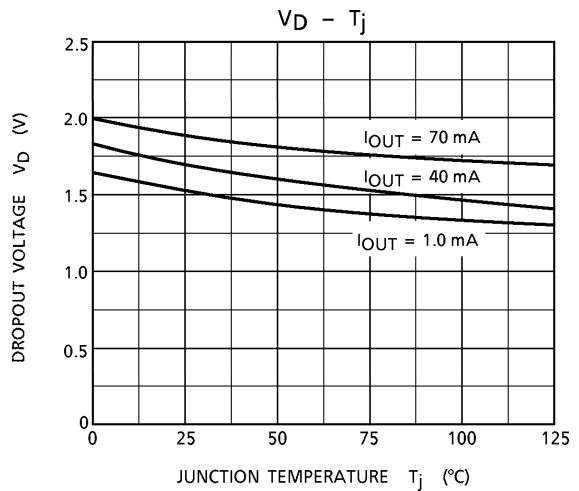
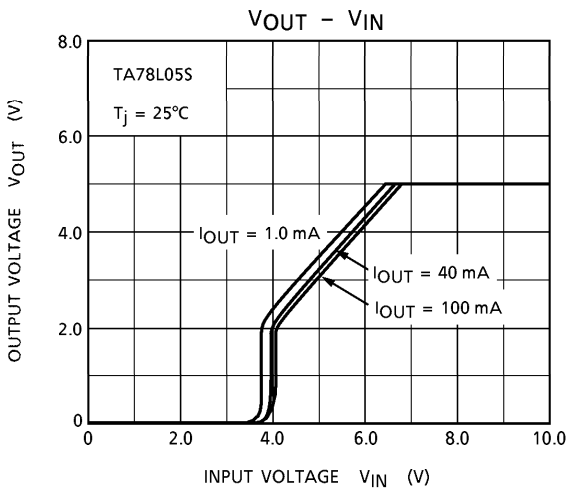
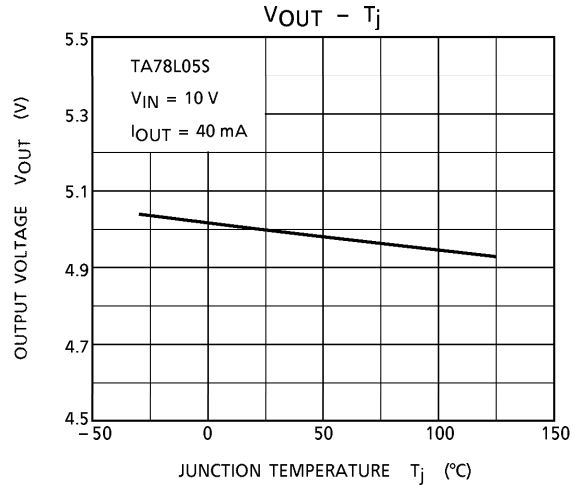
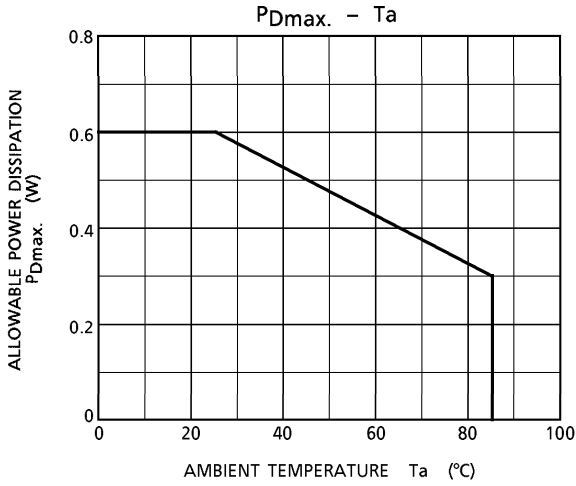


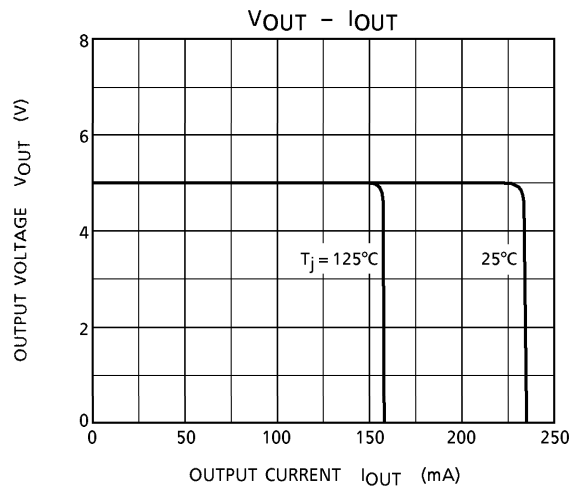
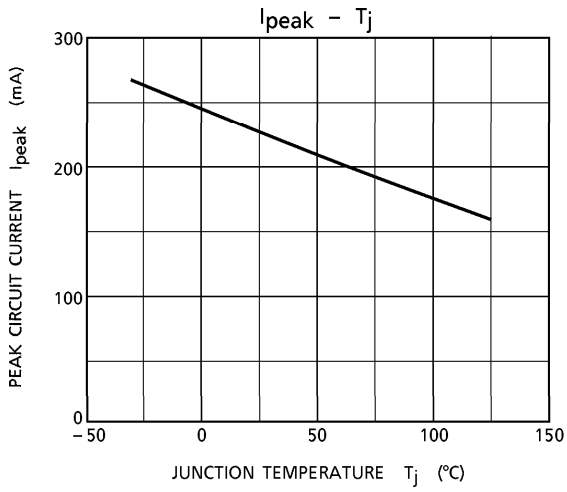
TEST CIRCUIT 2 V_{NO}



TEST CIRCUIT 3 R.R.





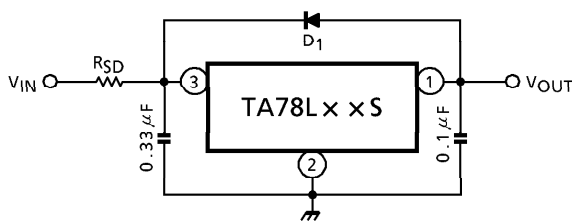


Precautions for Use

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.

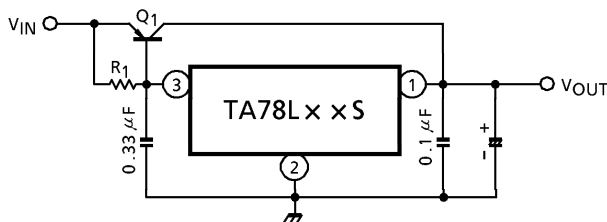
APPLICATION CIRCUIT

(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 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.

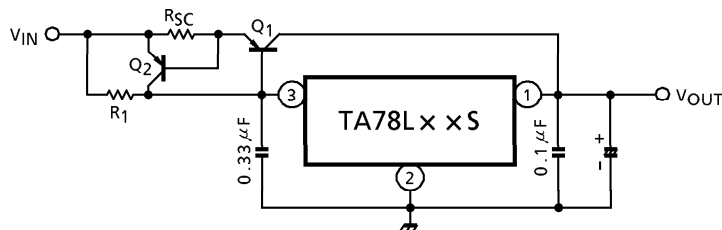
(2) A. CURRENT BOOST VOLTAGE REGULATOR



Use a required radiation plate for Q_1 .

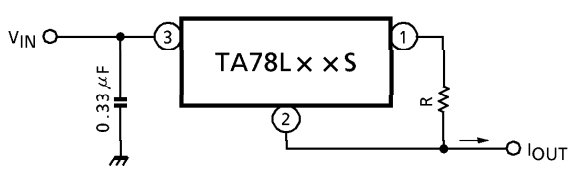
$$R_1 \leq \frac{V_{BE1}}{I_B \text{ MAX}}$$
 where, V_{BE1} : V_{BE} of external transistor Q_1 .
 $I_B \text{ MAX}$: Max. bias current of IC.

B. SHORT-CIRCUIT PROTECTION



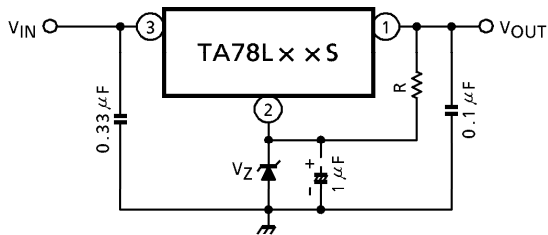
$$R_{SC} = \frac{V_{BE2}}{I_{SC}}$$
 where, I_{SC} : Short-Circuit current

(3) CURRENT REGULATOR

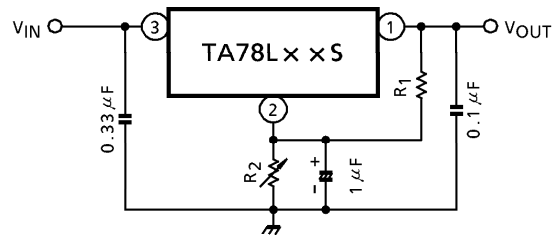


$$I_{OUT} = \frac{V_{OUT}}{R} + I_B$$

(4) VOLTAGE BOOST REGULATOR

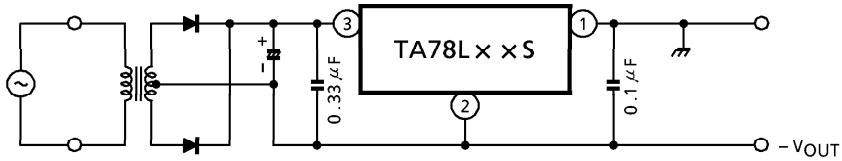


$V_{OUT} = V_Z + V_{OUT}(\text{of IC})$
Apply current of several mA to R.

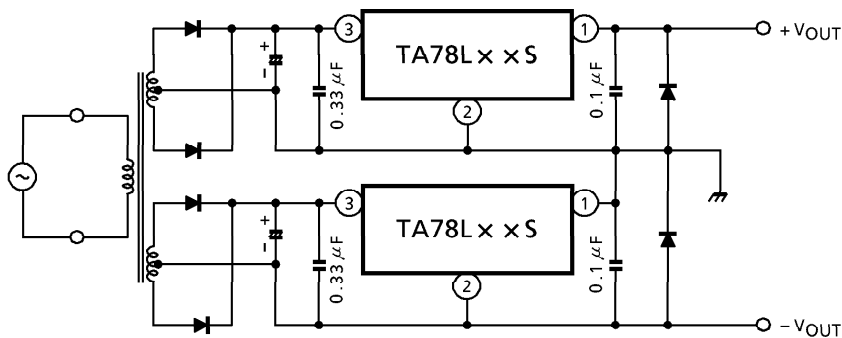


$$V_{OUT} = R_2(I_B + \frac{V_{OUT}(\text{of IC})}{R_1}) + V_{OUT}(\text{of IC})$$

(5) NEGATIVE REGULATOR

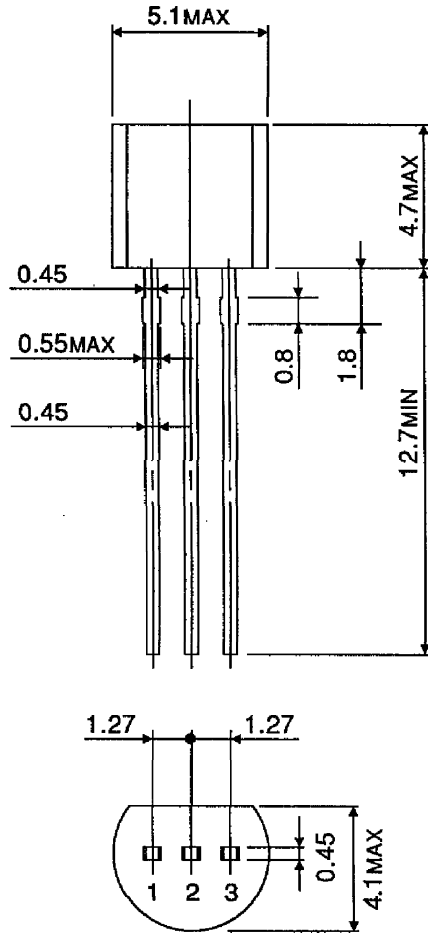


(6) POSITIVE AND NEGATIVE REGULATOR



PACKAGE DIMENSIONS
P-SSIP3-1.27A

Unit : mm



Weight : 0.21 g (Typ.)