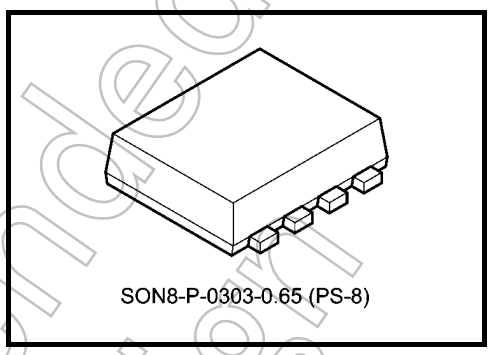
TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

TA78L05PF,TA78L06PF,TA78L07PF,TA78L08PF TA78L09PF,TA78L10PF,TA78L12PF,TA78L15PF

5 V, 6 V, 7V, 8 V, 9 V, 10 V, 12 V, 15V

0.15A Positive Voltage Regulators

Housed in a very small and thin PS-8 package, the TA78L**PF series of fixed-voltage monolithic integrated circuit voltage regulators is designed for a wide range of applications. One of these regulators can drive up to 0.15 A of output current.
The series offers devices with various output voltages: 5 V, 6 V, 7 V,8 V, 9 V, 10 V, 12 V, and 15 V.



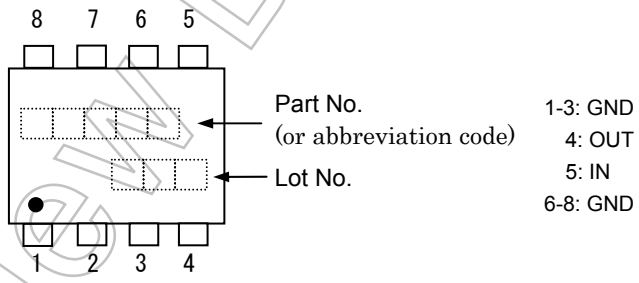
Weight: 0.017 g (typ.)

Features

- Maximum output current: 0.15 A
- Output voltage accuracy: V_{OUT} ± 4% (@T_j = 25°C)
- Protection function: Overcurrent/Thermal shutdown
- Package type: PS-8 is a flat lead, 8-pin package.
  This is smaller and thinner than the previous PW-Mini(SOT-89), with a 47% decrease in height and a 54% decrease in mounting area.

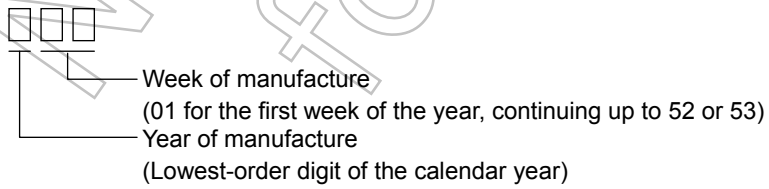
Pin Assignment/Marking

Part No.	Part No. (abbreviation code)
TA78L05PF	78L05
TA78L06PF	78L06
TA78L07PF	78L07
TA78L08PF	78L08
TA78L09PF	78L09
TA78L10PF	78L10
TA78L12PF	78L12
TA78L15PF	78L15



(●) on the lower left of the marking indicates Pin 1.

* Lot No.: The lot no. consists of three digits. The first digit represents the last digit of the year of manufacture, and the following two digits indicates the week of manufacture between 01 and either 52 or 53.



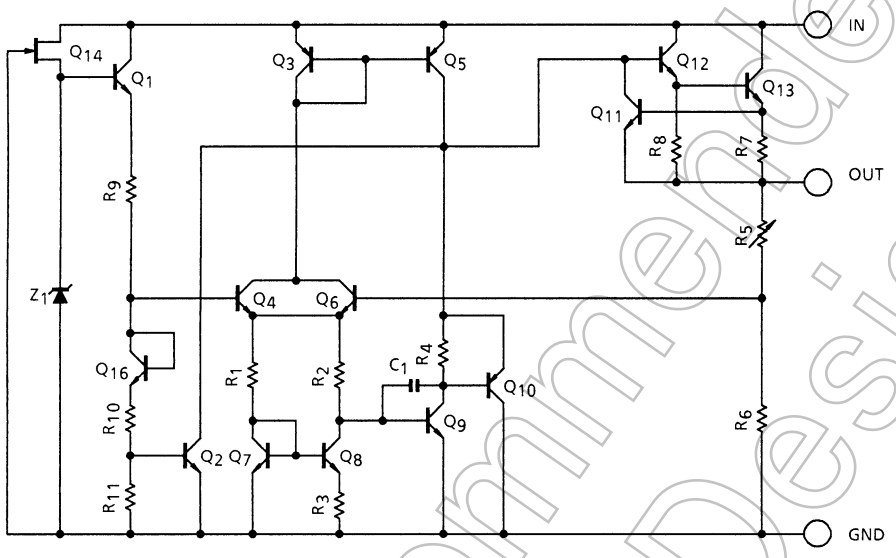
The product(s) in this document ("Product") contain functions intended to protect the Product from temporary small overloads such as minor short-term overcurrent or overheating. The protective functions do not necessarily protect Product under all circumstances. When incorporating Product into your system, please design the system (1) to avoid such overloads upon the Product, and (2) to shut down or otherwise relieve the Product of such overload conditions immediately upon occurrence. For details, please refer to the notes appearing below in this document and other documents referenced in this document.

How to Order

Part No.	Packing Type and Unit for Orders
TA78L**PF (TE85L,F)	Embossed-tape packing: 3000 (1 tape)

Note 1: In the actual product number, ” **” is replaced by the output voltage of the product.

Block Diagram



Absolute Maximum Ratings (Ta = 25°C)

Characteristics		Symbol	Rating	Unit
Input voltage		V_{IN}	35	V
Output current		I_{OUT}	0.15	A
Operating temperature		T_{opr}	−30 to 85	°C
Junction temperature		T_j	150	°C
Storage temperature		T_{stg}	−55 to 150	°C
Power dissipation	(Note 4a)	P_D	1.3	W
Power dissipation	(Note 4b)	P_D	0.62	W

Note 2: Do not apply external current and voltage (including negative voltage) to pins other than those specified.

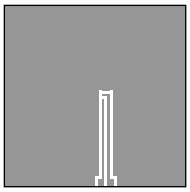
Note 3: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) 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).

Thermal Resistance

Characteristics	Symbol	Rating	Unit
Thermal resistance (junction to ambient) (Note 4a)	$R_{th(j-a)}$	97	°C/W
Thermal resistance (junction to ambient) (Note 4b)	$R_{th(j-a)}$	202	°C/W

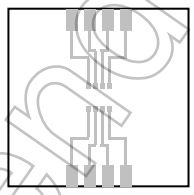
Note 4:

(a) Device mounted on a glass-epoxy board



FR-4
25.4 × 25.4 × 1.6
Unit: (mm)
Cu base thickness
35 μm

(b) Device mounted on a glass-epoxy board



FR-4
25.4 × 25.4 × 1.6
Unit: (mm)
Cu base thickness
35 μm

TA78L05PF
Electrical Characteristics

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

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}
Ripple rejection ratio	R.R.	3	f = 120 Hz, 8.0 V ≤ V_{IN} ≤ 18 V, T_j = 25°C		41	49	—	dB
Dropout voltage	V_D	1	T_j = 25°C, I_{OUT} = 150 mA		—	2.0	—	V
Average temperature coefficient of output voltage	T_{CVO}	1	I_{OUT} = 5 mA		—	−0.6	—	mV/°C

TA78L06PF
Electrical Characteristics

(V_{IN} = 11 V, I_{OUT} = 40 mA, C_{IN} = 0.33 µF, C_{OUT} = 0.1 µF, 0°C ≤ T_j ≤ 125°C, unless otherwise specified)

Characteristics	Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit
Output voltage	V_{OUT}	1	T_j = 25°C		5.76	6.0	6.24	V
Line regulation	Reg·line	1	T_j = 25°C	8.1 V ≤ V_{IN} ≤ 21 V	—	50	150	mV
				9.0 V ≤ V_{IN} ≤ 21 V	—	45	110	
Load regulation	Reg·load	1	T_j = 25°C	1.0 mA ≤ I_{OUT} ≤ 100 mA	—	12	70	mV
				1.0 mA ≤ I_{OUT} ≤ 40 mA	—	5.5	35	
Output voltage	V_{OUT}	1	T_j = 25°C	8.1 V ≤ V_{IN} ≤ 21 V, 1.0 mA ≤ I_{OUT} ≤ 40 mA	5.7	—	6.3	V
				1.0 mA ≤ I_{OUT} ≤ 70 mA	5.7	—	6.3	
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	9.0 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}
Ripple rejection ratio	R.R.	3	f = 120 Hz, 9.0 V ≤ V_{IN} ≤ 19 V, T_j = 25°C		39	47	—	dB
Dropout voltage	V_D	1	T_j = 25°C, I_{OUT} = 150 mA		—	2.0	—	V
Average temperature coefficient of output voltage	T_{CVO}	1	I_{OUT} = 5 mA		—	−0.7	—	mV/°C

TA78L07PF
Electrical Characteristics

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

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}
Ripple rejection ratio	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} = 150 mA		—	2.0	—	V
Average temperature coefficient of output voltage	T_{CVO}	1	I_{OUT} = 5 mA		—	−0.75	—	mV/°C

TA78L08PF
Electrical Characteristics

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

Characteristics	Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit
Output voltage	V_{OUT}	1	T_j = 25°C		7.68	8.0	8.32	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}
Ripple rejection ratio	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} = 150 mA		—	2.0	—	V
Average temperature coefficient of output voltage	T_{CVO}	1	I_{OUT} = 5 mA		—	−0.8	—	mV/°C

TA78L09PF
Electrical Characteristics

(V_{IN} = 15 V, I_{OUT} = 40 mA, C_{IN} = 0.33 μF, C_{OUT} = 0.1 μF, 0°C ≤ T_j ≤ 125°C, unless otherwise specified)

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}
Ripple rejection ratio	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} = 150 mA		—	2.0	—	V
Average temperature coefficient of output voltage	T_{CVO}	1	I_{OUT} = 5 mA		—	−0.85	—	mV/°C

TA78L10PF
Electrical Characteristics

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

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}
Ripple rejection ratio	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} = 150 mA		—	2.0	—	V
Average temperature coefficient of output voltage	T_{CVO}	1	I_{OUT} = 5 mA		—	−0.9	—	mV/°C

TA78L12PF
Electrical Characteristics

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

Characteristics	Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit
Output voltage	V_{OUT}	1	T_j = 25°C		11.52	12	12.48	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}
Ripple rejection ratio	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} = 150 mA		—	2.0	—	V
Average temperature coefficient of output voltage	T_{CVO}	1	I_{OUT} = 5 mA		—	−1.0	—	mV/°C

TA78L15PF
Electrical Characteristics

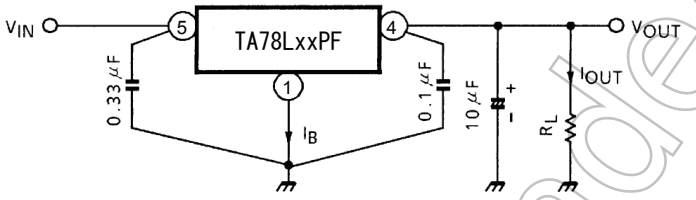
(V_{IN} = 23 V, I_{OUT} = 40 mA, C_{IN} = 0.33 μF, C_{OUT} = 0.1 μF, 0°C ≤ T_j ≤ 125°C, unless otherwise specified)

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}
Ripple rejection ratio	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} = 150 mA		—	2.0	—	V
Average temperature coefficient of output voltage	T_{CVO}	1	I_{OUT} = 5 mA		—	−1.3	—	mV/°C

Electrical Characteristics for All Products

Generally, the characteristics of power supply ICs change according to temperature fluctuations. The specification T_j = 25°C is based on a state where temperature increase has no effect (assuming no fluctuation in the characteristics) as ascertained by pulse tests.

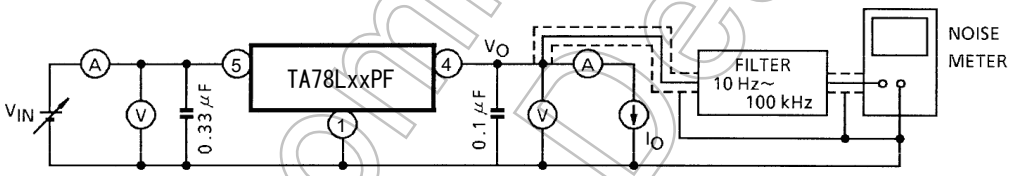
Test Circuit 1/Standard Application Example



Use capacitors to connect the input terminal and GND and the output terminal and GND. The capacitances should be determined experimentally. In particular, adequate investigation should be made to ensure there is no problem even in high or low temperatures.

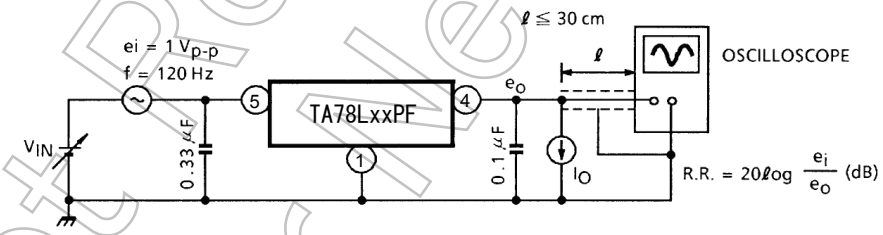
Test Circuit 2

V_{NO}



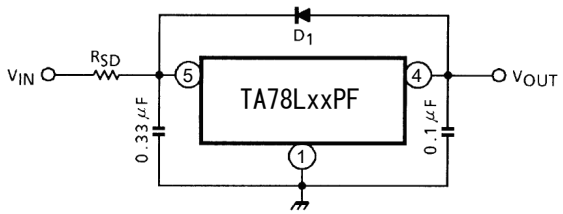
Test Circuit 3

R.R.



Usage Precautions

- If a high voltage in excess of the output voltage (typ. value) of the IC is applied to the output terminal of the IC, the IC may be destroyed. To prevent such application of excessive voltage, connect a Zener diode between the output terminal and GND.



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.

- Low voltage

  Do not apply voltage to the Product that is lower than the minimum operating voltage, or the Product's protective functions will not operate properly and the Product may be permanently damaged.

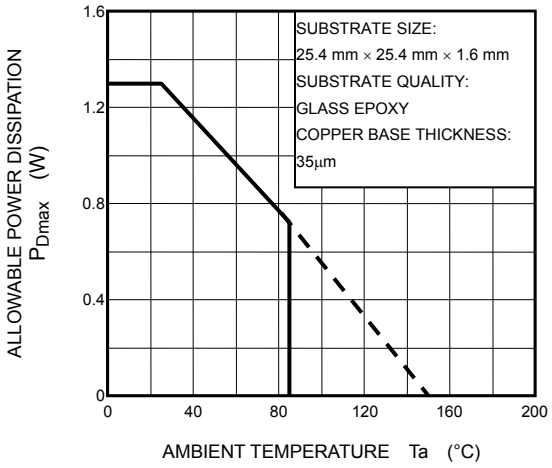
- Overcurrent Protection

  The overcurrent protection circuits in the Product are designed to temporarily protect Product from minor overcurrent of brief duration. When the overcurrent protective function in the Product activates, immediately cease application of overcurrent to Product. Improper usage of Product, such as application of current to Product exceeding the absolute maximum ratings, could cause the overcurrent protection circuit not to operate properly and/or damage Product permanently even before the protection circuit starts to operate.

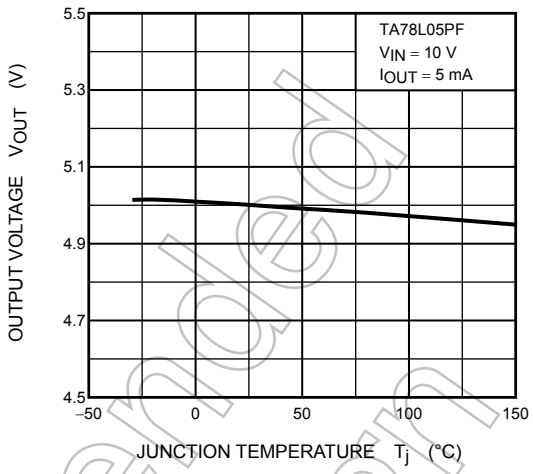
- Thermal shutdown Protection

  The thermal shutdown circuits in the Product are designed to temporarily protect Product from minor overheating of brief duration. When the thermal shutdown protective function in the Product activates, immediately correct the overheating situation. Improper usage of Product, such as the application of heat to Product exceeding the absolute maximum ratings, could cause the thermal shutdown protection circuit not to operate properly and/or damage Product permanently even before the protection circuit starts to operate.

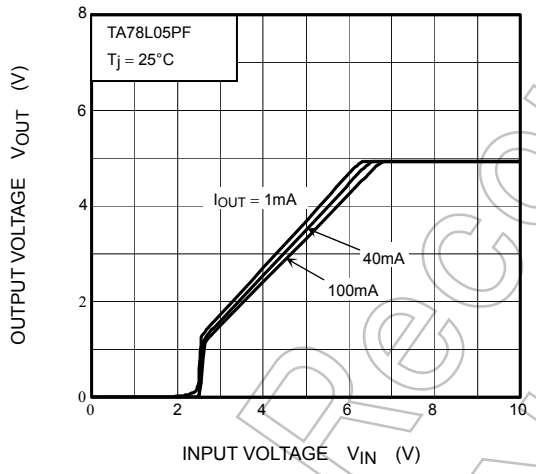
P_{Dmax} – Ta



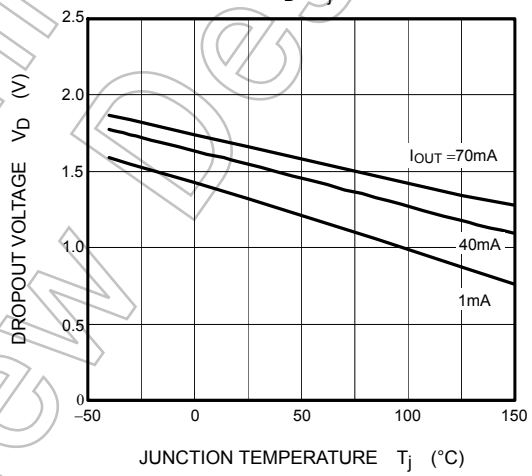
V_{OUT} – T_j



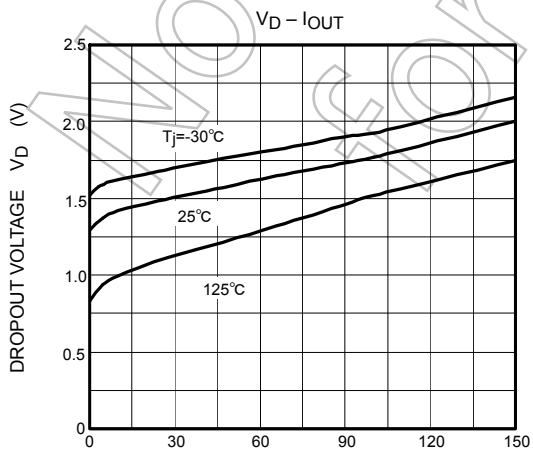
V_{OUT} – V_{IN}



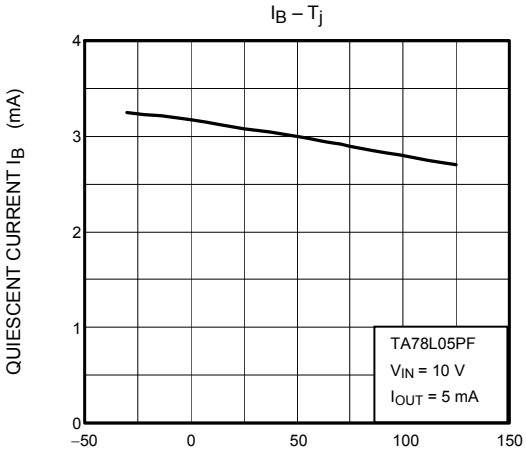
V_D – T_j



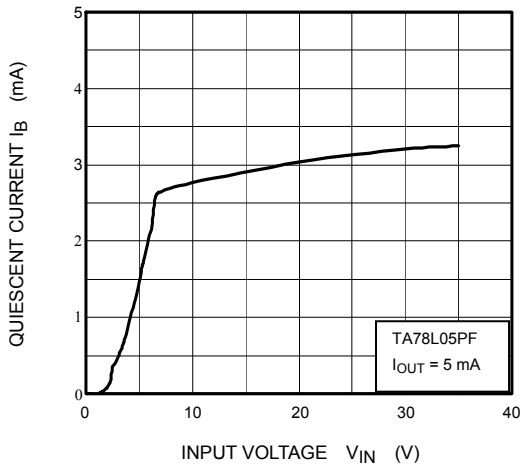
V_D – I_{OUT}



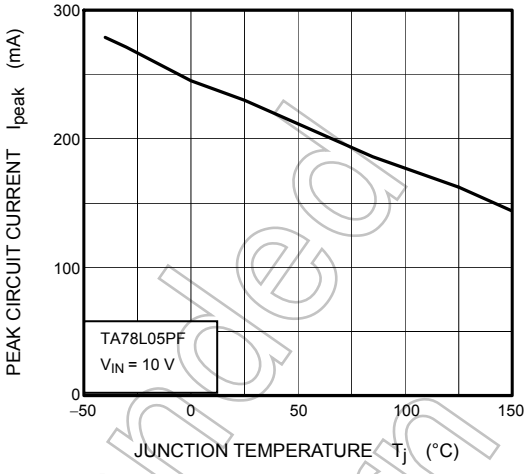
I_B – T_j



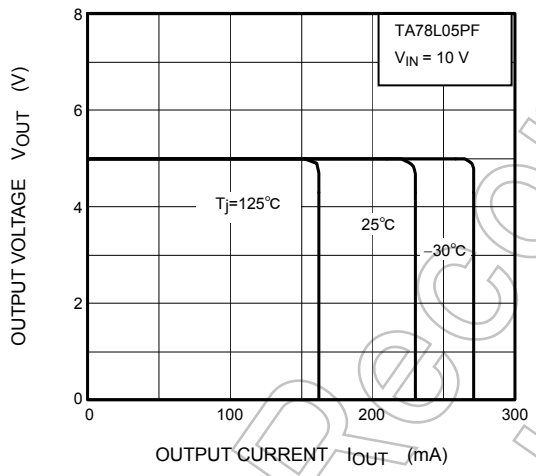
$I_B - V_{IN}$



$I_{peak} - T_j$

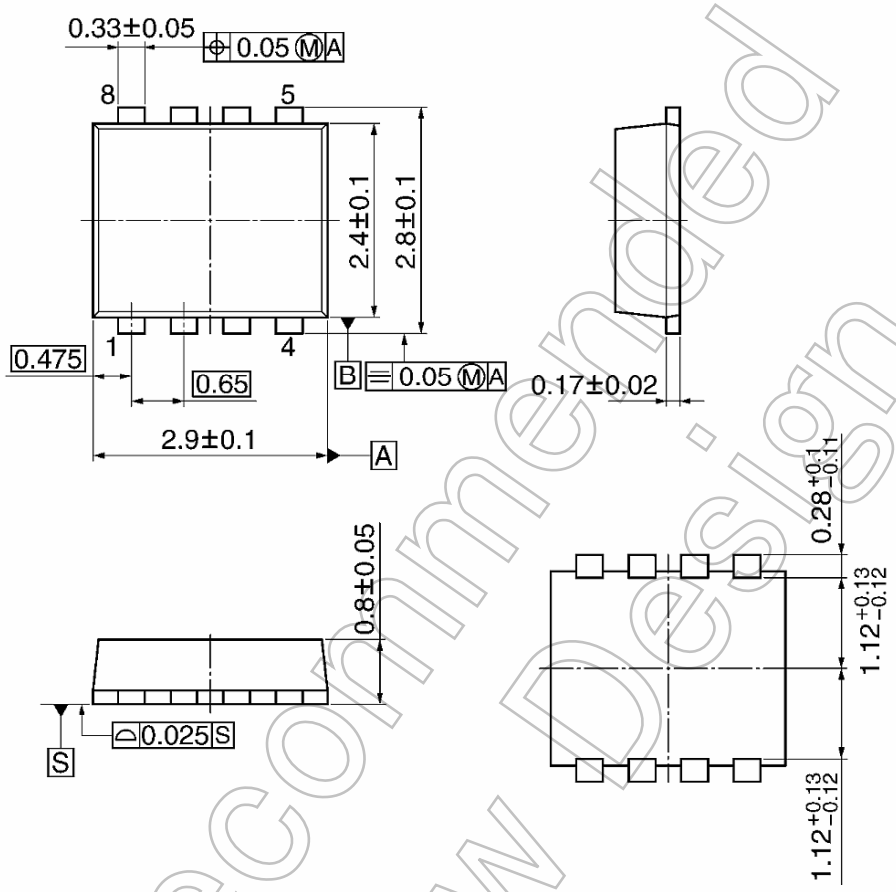


$V_{OUT} - I_{OUT}$



Package Dimensions

SON8-P-0303-0.65 (PS-8) Unit: mm



Weight: 0.017 g (typ.)

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