

TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

## TA78L05F,TA78L06F,TA78L07F,TA78L08F,TA78L09F,TA78L10F, TA78L12F,TA78L15F,TA78L18F,TA78L20F,TA78L24F

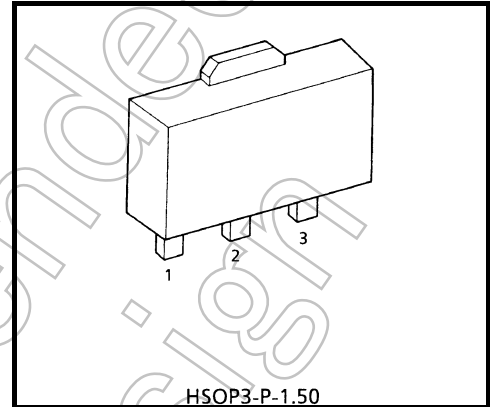
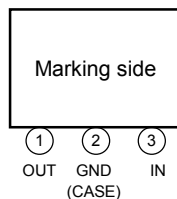
5 V, 6 V, 7 V, 8 V, 9 V, 10 V, 12 V, 15 V, 18 V, 20 V, 24 V

3-Terminal Positive Voltage Regulators

### Features

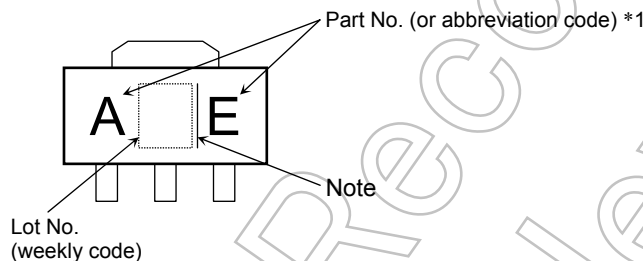
- Best suited to power supply for TTL/CMOS.
- No external parts needed.
- Built-in overheating protection.
- Built-in overcurrent protection.
- Max output current of 150mA. ( $T_j = 25^\circ\text{C}$ ).
- Packaged in PW-mini (SOT-89).

### Pin Assignment



Weight: 0.05 g (Typ.)

### Marking



| Part No.<br>(or abbreviation code) | Part No. |
|------------------------------------|----------|
| AE                                 | TA78L05F |
| BE                                 | TA78L06F |
| KE                                 | TA78L07F |
| CE                                 | TA78L08F |
| DE                                 | TA78L09F |
| EE                                 | TA78L10F |
| FE                                 | TA78L12F |
| GE                                 | TA78L15F |
| HE                                 | TA78L18F |
| IE                                 | TA78L20F |
| JE                                 | TA78L24F |

Note: A line beside a Lot No. identifies the indication of product Labels.

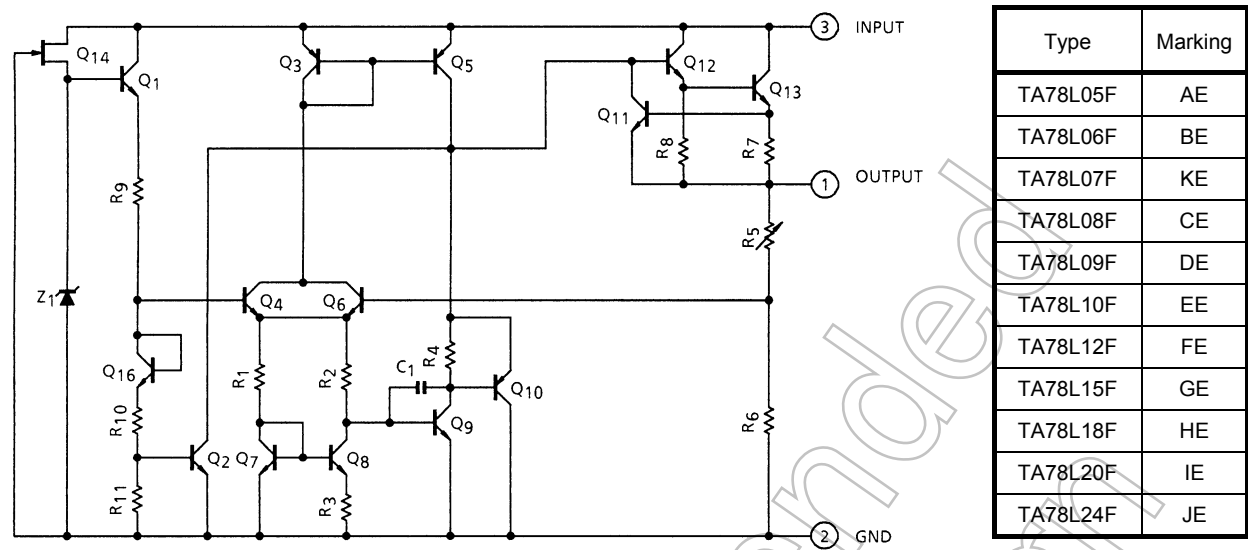
Without a line: [[Pb]]/INCLUDES > MCV

With a line: [[G]]/RoHS COMPATIBLE or [[G]]/RoHS [[Pb]]

Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product. The RoHS is the Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

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.

Equivalent Circuit



Absolute Maximum Ratings (Ta = 25°C)

| Characteristics       |             | Symbol                | Rating     | Unit |
|-----------------------|-------------|-----------------------|------------|------|
| Input voltage         | TA78L05F    | V <sub>IN</sub>       | 35         | V    |
|                       | TA78L06F    |                       |            |      |
|                       | TA78L07F    |                       |            |      |
|                       | TA78L08F    |                       |            |      |
|                       | TA78L09F    |                       |            |      |
|                       | TA78L10F    |                       |            |      |
|                       | TA78L12F    |                       |            |      |
|                       | TA78L15F    |                       |            |      |
|                       | TA78L18F    |                       |            |      |
|                       | TA78L20F    |                       | 40         |      |
|                       | TA78L24F    |                       |            |      |
| Output current        |             | I <sub>OUT</sub>      | 0.15       | A    |
| Power dissipation     | (Ta = 25°C) | P <sub>D</sub>        | 500        | mW   |
| Operating temperature |             | T <sub>opr</sub>      | -30 to 85  | °C   |
| Storage temperature   |             | T <sub>stg</sub>      | -55 to 150 | °C   |
| Junction temperature  |             | T <sub>j</sub>        | 150        | °C   |
| Thermal resistance    |             | R <sub>th (j-a)</sub> | 250        | °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).

**TA78L05F**
**Electrical Characteristics**

 (Unless otherwise specified,  $V_{IN} = 10\text{ V}$ ,  $I_{OUT} = 40\text{ mA}$ ,  $C_{IN} = 0.33\text{ }\mu\text{F}$ ,  $C_{OUT} = 0.1\text{ }\mu\text{F}$ ,  $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$ )

| Characteristics                                   | Symbol                    | Test Circuit | Test Condition  | Min  | Typ. | Max  | Unit                 |
|---|---------------------------|--------------|---|------|------|------|----------------------|
| Output voltage                                    | $V_{OUT}$                 | 1            | $T_j = 25^\circ\text{C}$  | 4.75 | 5.0  | 5.25 | V                    |
| Line regulation                                   | Reg.line                  | 1            | $T_j = 25^\circ\text{C}$  | —    | 55   | 150  | mV                   |
|   |                           |              | $7.0\text{ V} \leq V_{IN} \leq 20\text{ V}$   | —    | 45   | 100  |                      |
| Load regulation                                   | Reg.load                  | 1            | $T_j = 25^\circ\text{C}$  | —    | 11   | 60   | mV                   |
|   |                           |              | $1.0\text{ mA} \leq I_{OUT} \leq 100\text{ mA}$   | —    | 5.0  | 30   |                      |
| Output voltage                                    | $V_{OUT}$                 | 1            | $T_j = 25^\circ\text{C}$  | 4.65 | —    | 5.35 | V                    |
|   |                           |              | $7.0\text{ V} \leq V_{IN} \leq 20\text{ V}$ ,<br>$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ | 4.65 | —    | 5.35 |                      |
|   |                           |              | $1.0\text{ mA} \leq I_{OUT} \leq 70\text{ mA}$  | 4.65 | —    | 5.35 |                      |
| Quiescent current                                 | $I_B$                     | 1            | $T_j = 25^\circ\text{C}$  | —    | 3.1  | 6.0  | mA                   |
|   |                           |              | $T_j = 125^\circ\text{C}$   | —    | —    | 5.5  |                      |
| Quiescent current change                          | $\Delta I_B$              | 1            | $T_j = 25^\circ\text{C}$  | —    | —    | 1.5  | mA                   |
|   |                           |              | $8.0\text{ V} \leq V_{IN} \leq 20\text{ V}$   | —    | —    | 0.1  |                      |
| Output noise voltage                              | $V_{NO}$                  | 2            | $T_a = 25^\circ\text{C}$ , $10\text{ Hz} \leq f \leq 100\text{ kHz}$                            | —    | 40   | —    | $\mu\text{V}_{rms}$  |
| Long term stability                               | $\Delta V_{OUT}/\Delta t$ | 1            | —   | —    | 12   | —    | mV/kh                |
| Ripple rejection ratio                            | R.R.                      | 3            | $f = 120\text{ Hz}$ ,<br>$8.0\text{ V} \leq V_{IN} \leq 18\text{ V}$ , $T_j = 25^\circ\text{C}$ | 41   | 49   | —    | dB                   |
| Dropout voltage                                   | $V_D$                     | 1            | $T_j = 25^\circ\text{C}$  | —    | 1.7  | —    | V                    |
| Average temperature coefficient of output voltage | $T_{CVO}$                 | 1            | $I_{OUT} = 5\text{ mA}$   | —    | -0.6 | —    | mV/ $^\circ\text{C}$ |

**TA78L06F**
**Electrical Characteristics**

(Unless otherwise specified,  $V_{IN} = 11\text{ V}$ ,  $I_{OUT} = 40\text{ mA}$ ,  $C_{IN} = 0.33\text{ }\mu\text{F}$ ,  $C_{OUT} = 0.1\text{ }\mu\text{F}$ ,  $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$ )

| Characteristics                                   | Symbol                    | Test Circuit | Test Condition  | Min  | Typ. | Max  | Unit                 |
|---|---------------------------|--------------|---|------|------|------|----------------------|
| Output voltage                                    | $V_{OUT}$                 | 1            | $T_j = 25^\circ\text{C}$  | 5.7  | 6.0  | 6.3  | V                    |
| Line regulation                                   | Reg.line                  | 1            | $T_j = 25^\circ\text{C}$  | —    | 50   | 150  | mV                   |
|   |                           |              | $8.1\text{ V} \leq V_{IN} \leq 21\text{ V}$   | —    | 45   | 110  |                      |
| Load regulation                                   | Reg.load                  | 1            | $T_j = 25^\circ\text{C}$  | —    | 12   | 70   | mV                   |
|   |                           |              | $1.0\text{ mA} \leq I_{OUT} \leq 100\text{ mA}$   | —    | 5.5  | 35   |                      |
| Output voltage                                    | $V_{OUT}$                 | 1            | $T_j = 25^\circ\text{C}$  | 5.58 | —    | 6.42 | V                    |
|   |                           |              | $8.1\text{ V} \leq V_{IN} \leq 21\text{ V}$ ,<br>$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ | 5.58 | —    | 6.42 |                      |
|   |                           |              | $1.0\text{ mA} \leq I_{OUT} \leq 70\text{ mA}$  | 5.58 | —    | 6.42 |                      |
| Quiescent current                                 | $I_B$                     | 1            | $T_j = 25^\circ\text{C}$  | —    | 3.1  | 6.0  | mA                   |
|   |                           |              | $T_j = 125^\circ\text{C}$   | —    | —    | 5.5  |                      |
| Quiescent current change                          | $\Delta I_B$              | 1            | $T_j = 25^\circ\text{C}$  | —    | —    | 1.5  | mA                   |
|   |                           |              | $9.0\text{ V} \leq V_{IN} \leq 20\text{ V}$ ,<br>$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ | —    | —    | 0.1  |                      |
| Output noise voltage                              | $V_{NO}$                  | 2            | $T_a = 25^\circ\text{C}$ , $10\text{ Hz} \leq f \leq 100\text{ kHz}$                            | —    | 40   | —    | $\mu\text{V}_{rms}$  |
| Long term stability                               | $\Delta V_{OUT}/\Delta t$ | 1            | —   | —    | 14   | —    | mV/kh                |
| Ripple rejection ratio                            | R.R.                      | 3            | $f = 120\text{ Hz}$ ,<br>$9.0\text{ V} \leq V_{IN} \leq 19\text{ V}$ , $T_j = 25^\circ\text{C}$ | 39   | 47   | —    | dB                   |
| Dropout voltage                                   | $V_D$                     | 1            | $T_j = 25^\circ\text{C}$  | —    | 1.7  | —    | V                    |
| Average temperature coefficient of output voltage | $T_{CVO}$                 | 1            | $I_{OUT} = 5\text{ mA}$   | —    | -0.7 | —    | mV/ $^\circ\text{C}$ |

**TA78L07F**
**Electrical Characteristics**

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

| Characteristics                                   | Symbol                    | Test Circuit | Test Condition  | Min  | Typ.  | Max  | Unit                 |
|---|---------------------------|--------------|---|------|-------|------|----------------------|
| Output voltage                                    | $V_{OUT}$                 | 1            | $T_j = 25^\circ\text{C}$  | 6.65 | 7.0   | 7.35 | V                    |
| Line regulation                                   | Reg.line                  | 1            | $T_j = 25^\circ\text{C}$  | —    | 50    | 160  | mV                   |
|   |                           |              | $9.2\text{ V} \leq V_{IN} \leq 22\text{ V}$   | —    | 45    | 115  |                      |
| Load regulation                                   | Reg.load                  | 1            | $T_j = 25^\circ\text{C}$  | —    | 13    | 75   | mV                   |
|   |                           |              | $1.0\text{ mA} \leq I_{OUT} \leq 100\text{ mA}$   | —    | 6.0   | 40   |                      |
| Output voltage                                    | $V_{OUT}$                 | 1            | $T_j = 25^\circ\text{C}$  | 6.51 | —     | 7.49 | V                    |
|   |                           |              | $9.2\text{ V} \leq V_{IN} \leq 22\text{ V}$ ,<br>$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ | 6.51 | —     | 7.49 |                      |
| 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                          | $\Delta I_B$              | 1            | $T_j = 25^\circ\text{C}$  | —    | —     | 1.5  | mA                   |
|   |                           |              | $10\text{ V} \leq V_{IN} \leq 22\text{ V}$  | —    | —     | 0.1  |                      |
| Output noise voltage                              | $V_{NO}$                  | 2            | $T_a = 25^\circ\text{C}$ , $10\text{ Hz} \leq f \leq 100\text{ kHz}$                            | —    | 50    | —    | $\mu\text{V}_{rms}$  |
| Long term stability                               | $\Delta V_{OUT}/\Delta t$ | 1            | —   | —    | 17    | —    | mV/kh                |
| Ripple rejection ratio                            | R.R.                      | 3            | $f = 120\text{ Hz}$ ,<br>$10\text{ V} \leq V_{IN} \leq 20\text{ V}$ , $T_j = 25^\circ\text{C}$  | 37   | 46    | —    | dB                   |
| Dropout voltage                                   | $V_D$                     | 1            | $T_j = 25^\circ\text{C}$  | —    | 1.7   | —    | V                    |
| Average temperature coefficient of output voltage | $T_{CVO}$                 | 1            | $I_{OUT} = 5\text{ mA}$   | —    | -0.75 | —    | mV/ $^\circ\text{C}$ |

**TA78L08F**
**Electrical Characteristics**

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

| Characteristics                                   | Symbol                | Test Circuit | Test Condition  |   | Min  | Typ. | Max  | Unit              |
|---|-----------------------|--------------|---|---|------|------|------|-------------------|
| Output voltage                                    | V <sub>OUT</sub>      | 1            | T <sub>j</sub> = 25°C   |   | 7.6  | 8.0  | 8.4  | V                 |
| Line regulation                                   | Reg.line              | 1            | T <sub>j</sub> = 25°C   | 10.5 V ≤ V <sub>IN</sub> ≤ 23 V                                       | —    | 20   | 175  | mV                |
|   |                       |              |   | 11 V ≤ V <sub>IN</sub> ≤ 23 V   | —    | 12   | 125  |                   |
| Load regulation                                   | Reg.load              | 1            | T <sub>j</sub> = 25°C   | 1.0 mA ≤ I <sub>OUT</sub> ≤ 100 mA                                    | —    | 15   | 80   | mV                |
|   |                       |              |   | 1.0 mA ≤ I <sub>OUT</sub> ≤ 40 mA                                     | —    | 7.0  | 40   |                   |
| Output voltage                                    | V <sub>OUT</sub>      | 1            | T <sub>j</sub> = 25°C   | 10.5 V ≤ V <sub>IN</sub> ≤ 23 V,<br>1.0 mA ≤ I <sub>OUT</sub> ≤ 40 mA | 7.44 | —    | 8.56 | V                 |
|   |                       |              |   | 1.0 mA ≤ I <sub>OUT</sub> ≤ 70 mA                                     | 7.44 | —    | 8.56 |                   |
| Quiescent current                                 | I <sub>B</sub>        | 1            | T <sub>j</sub> = 25°C   | —   | 3.1  | 6.5  | mA   |                   |
|   |                       |              | T <sub>j</sub> = 125°C  | —   | —    | 6.0  |      |                   |
| Quiescent current change                          | ΔI <sub>B</sub>       | 1            | T <sub>j</sub> = 25°C   | 11 V ≤ V <sub>IN</sub> ≤ 23 V   | —    | —    | 1.5  | mA                |
|   |                       |              |   | 1.0 mA ≤ I <sub>OUT</sub> ≤ 40 mA                                     | —    | —    | 0.1  |                   |
| Output noise voltage                              | V <sub>NO</sub>       | 2            | T <sub>a</sub> = 25°C, 10 Hz ≤ f ≤ 100 kHz                          |   | —    | 60   | —    | μV <sub>rms</sub> |
| Long term stability                               | ΔV <sub>OUT</sub> /Δt | 1            | —   |   | —    | 20   | —    | mV/kh             |
| Ripple rejection ratio                            | R.R.                  | 3            | f = 120 Hz,<br>12 V ≤ V <sub>IN</sub> ≤ 23 V, T <sub>j</sub> = 25°C |   | 37   | 45   | —    | dB                |
| Dropout voltage                                   | V <sub>D</sub>        | 1            | T <sub>j</sub> = 25°C   |   | —    | 1.7  | —    | V                 |
| Average temperature coefficient of output voltage | T <sub>CV0</sub>      | 1            | I <sub>OUT</sub> = 5 mA   |   | —    | −0.8 | —    | mV/°C             |

**TA78L09F**
**Electrical Characteristics**

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

| Characteristics                                   | Symbol                    | Test Circuit | Test Condition   | Min  | Typ.  | Max  | Unit                 |
|---|---------------------------|--------------|--|------|-------|------|----------------------|
| Output voltage                                    | $V_{OUT}$                 | 1            | $T_j = 25^\circ\text{C}$   | 8.55 | 9.0   | 9.45 | V                    |
| Line regulation                                   | Reg.line                  | 1            | $T_j = 25^\circ\text{C}$   | —    | 80    | 200  | mV                   |
|   |                           |              | $11.4\text{ V} \leq V_{IN} \leq 24\text{ V}$   | —    | 20    | 160  |                      |
| Load regulation                                   | Reg.load                  | 1            | $T_j = 25^\circ\text{C}$   | —    | 17    | 90   | mV                   |
|   |                           |              | $1.0\text{ mA} \leq I_{OUT} \leq 100\text{ mA}$  | —    | 8.0   | 45   |                      |
| Output voltage                                    | $V_{OUT}$                 | 1            | $T_j = 25^\circ\text{C}$   | 8.37 | —     | 9.63 | V                    |
|   |                           |              | $11.4\text{ V} \leq V_{IN} \leq 24\text{ V}$ ,<br>$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ | 8.37 | —     | 9.63 |                      |
| 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                          | $\Delta I_B$              | 1            | $T_j = 25^\circ\text{C}$   | —    | —     | 1.5  | mA                   |
|   |                           |              | $12\text{ V} \leq V_{IN} \leq 24\text{ V}$   | —    | —     | 0.1  |                      |
| Output noise voltage                              | $V_{NO}$                  | 2            | $T_a = 25^\circ\text{C}$ , $10\text{ Hz} \leq f \leq 100\text{ kHz}$                             | —    | 65    | —    | $\mu\text{V}_{rms}$  |
| Long term stability                               | $\Delta V_{OUT}/\Delta t$ | 1            | —  | —    | 21    | —    | mV/kh                |
| Ripple rejection ratio                            | R.R.                      | 3            | $f = 120\text{ Hz}$ ,<br>$12\text{ V} \leq V_{IN} \leq 24\text{ V}$ , $T_j = 25^\circ\text{C}$   | 36   | 44    | —    | dB                   |
| Dropout voltage                                   | $V_D$                     | 1            | $T_j = 25^\circ\text{C}$   | —    | 1.7   | —    | V                    |
| Average temperature coefficient of output voltage | $T_{CVO}$                 | 1            | $I_{OUT} = 5\text{ mA}$  | —    | -0.85 | —    | mV/ $^\circ\text{C}$ |

**TA78L10F**
**Electrical Characteristics**

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

| Characteristics                                   | Symbol                    | Test Circuit | Test Condition   | Min | Typ. | Max  | Unit                 |
|---|---------------------------|--------------|--|-----|------|------|----------------------|
| Output voltage                                    | $V_{OUT}$                 | 1            | $T_j = 25^\circ\text{C}$   | 9.5 | 10   | 10.5 | V                    |
| Line regulation                                   | Reg.line                  | 1            | $T_j = 25^\circ\text{C}$   | —   | 80   | 230  | mV                   |
|   |                           |              | $12.5\text{ V} \leq V_{IN} \leq 25\text{ V}$   | —   | 30   | 170  |                      |
| Load regulation                                   | Reg.load                  | 1            | $T_j = 25^\circ\text{C}$   | —   | 18   | 90   | mV                   |
|   |                           |              | $1.0\text{ mA} \leq I_{OUT} \leq 100\text{ mA}$  | —   | 8.5  | 45   |                      |
| Output voltage                                    | $V_{OUT}$                 | 1            | $T_j = 25^\circ\text{C}$   | 9.3 | —    | 10.7 | V                    |
|   |                           |              | $12.5\text{ V} \leq V_{IN} \leq 25\text{ V}$ ,<br>$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ | 9.3 | —    | 10.7 |                      |
| 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                          | $\Delta I_B$              | 1            | $T_j = 25^\circ\text{C}$   | —   | —    | 1.5  | mA                   |
|   |                           |              | $13\text{ V} \leq V_{IN} \leq 25\text{ V}$   | —   | —    | 0.1  |                      |
| Output noise voltage                              | $V_{NO}$                  | 2            | $T_a = 25^\circ\text{C}$ , $10\text{ Hz} \leq f \leq 100\text{ kHz}$                             | —   | 70   | —    | $\mu\text{V}_{rms}$  |
| Long term stability                               | $\Delta V_{OUT}/\Delta t$ | 1            | —  | —   | 22   | —    | mV/kh                |
| Ripple rejection ratio                            | R.R.                      | 3            | $f = 120\text{ Hz}$ ,<br>$13\text{ V} \leq V_{IN} \leq 24\text{ V}$ , $T_j = 25^\circ\text{C}$   | 36  | 43   | —    | dB                   |
| Dropout voltage                                   | $V_D$                     | 1            | $T_j = 25^\circ\text{C}$   | —   | 1.7  | —    | V                    |
| Average temperature coefficient of output voltage | $T_{CVO}$                 | 1            | $I_{OUT} = 5\text{ mA}$  | —   | -0.9 | —    | mV/ $^\circ\text{C}$ |



**TA78L12F**
**Electrical Characteristics**

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

| Characteristics                                   | Symbol                    | Test Circuit | Test Condition   | Min   | Typ. | Max   | Unit                 |
|---|---------------------------|--------------|--|-------|------|-------|----------------------|
| Output voltage                                    | $V_{OUT}$                 | 1            | $T_j = 25^\circ\text{C}$   | 11.4  | 12   | 12.6  | V                    |
| Line regulation                                   | Reg.line                  | 1            | $T_j = 25^\circ\text{C}$   | —     | 120  | 250   | mV                   |
|   |                           |              | $14.5\text{ V} \leq V_{IN} \leq 27\text{ V}$   | —     | 100  | 200   |                      |
| Load regulation                                   | Reg.load                  | 1            | $T_j = 25^\circ\text{C}$   | —     | 20   | 100   | mV                   |
|   |                           |              | $1.0\text{ mA} \leq I_{OUT} \leq 100\text{ mA}$  | —     | 10   | 50    |                      |
| Output voltage                                    | $V_{OUT}$                 | 1            | $T_j = 25^\circ\text{C}$   | 11.16 | —    | 12.84 | V                    |
|   |                           |              | $14.5\text{ V} \leq V_{IN} \leq 27\text{ V}$ ,<br>$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ | 11.16 | —    | 12.84 |                      |
| 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                          | $\Delta I_B$              | 1            | $T_j = 25^\circ\text{C}$   | —     | —    | 1.5   | mA                   |
|   |                           |              | $16\text{ V} \leq V_{IN} \leq 27\text{ V}$   | —     | —    | 0.1   |                      |
| Output noise voltage                              | $V_{NO}$                  | 2            | $T_a = 25^\circ\text{C}$ , $10\text{ Hz} \leq f \leq 100\text{ kHz}$                             | —     | 80   | —     | $\mu\text{V}_{rms}$  |
| Long term stability                               | $\Delta V_{OUT}/\Delta t$ | 1            | —  | —     | 24   | —     | mV/kh                |
| Ripple rejection ratio                            | R.R.                      | 3            | $f = 120\text{ Hz}$ ,<br>$15\text{ V} \leq V_{IN} \leq 25\text{ V}$ , $T_j = 25^\circ\text{C}$   | 36    | 41   | —     | dB                   |
| Dropout voltage                                   | $V_D$                     | 1            | $T_j = 25^\circ\text{C}$   | —     | 1.7  | —     | V                    |
| Average temperature coefficient of output voltage | $T_{CVO}$                 | 1            | $I_{OUT} = 5\text{ mA}$  | —     | -1.0 | —     | mV/ $^\circ\text{C}$ |

**TA78L15F**
**Electrical Characteristics**

 (Unless otherwise specified,  $V_{IN} = 23\text{ V}$ ,  $I_{OUT} = 40\text{ mA}$ ,  $C_{IN} = 0.33\text{ }\mu\text{F}$ ,  $C_{OUT} = 0.1\text{ }\mu\text{F}$ ,  $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$ )

| Characteristics                                   | Symbol                    | Test Circuit | Test Condition   | Min   | Typ. | Max   | Unit                 |
|---|---------------------------|--------------|--|-------|------|-------|----------------------|
| Output voltage                                    | $V_{OUT}$                 | 1            | $T_j = 25^\circ\text{C}$   | 14.25 | 15   | 15.75 | V                    |
| Line regulation                                   | Reg.line                  | 1            | $T_j = 25^\circ\text{C}$   | —     | 130  | 300   | mV                   |
|   |                           |              | $17.5\text{ V} \leq V_{IN} \leq 30\text{ V}$   | —     | 110  | 250   |                      |
| Load regulation                                   | Reg.load                  | 1            | $T_j = 25^\circ\text{C}$   | —     | 25   | 150   | mV                   |
|   |                           |              | $1.0\text{ mA} \leq I_{OUT} \leq 100\text{ mA}$  | —     | 12   | 75    |                      |
| Output voltage                                    | $V_{OUT}$                 | 1            | $T_j = 25^\circ\text{C}$   | 13.95 | —    | 16.05 | V                    |
|   |                           |              | $17.5\text{ V} \leq V_{IN} \leq 30\text{ V}$ ,<br>$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$   | 13.95 | —    | 16.05 |                      |
| 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                          | $\Delta I_B$              | 1            | $T_j = 25^\circ\text{C}$   | —     | —    | 1.5   | mA                   |
|   |                           |              | $20\text{ V} \leq V_{IN} \leq 30\text{ V}$   | —     | —    | 0.1   |                      |
| Output noise voltage                              | $V_{NO}$                  | 2            | $T_a = 25^\circ\text{C}$ , $10\text{ Hz} \leq f \leq 100\text{ kHz}$                               | —     | 90   | —     | $\mu\text{V}_{rms}$  |
| Long term stability                               | $\Delta V_{OUT}/\Delta t$ | 1            | —  | —     | 30   | —     | mV/kh                |
| Ripple rejection ratio                            | R.R.                      | 3            | $f = 120\text{ Hz}$ ,<br>$18.5\text{ V} \leq V_{IN} \leq 28.5\text{ V}$ , $T_j = 25^\circ\text{C}$ | 34    | 40   | —     | dB                   |
| Dropout voltage                                   | $V_D$                     | 1            | $T_j = 25^\circ\text{C}$   | —     | 1.7  | —     | V                    |
| Average temperature coefficient of output voltage | $T_{CVO}$                 | 1            | $I_{OUT} = 5\text{ mA}$  | —     | -1.3 | —     | mV/ $^\circ\text{C}$ |

**TA78L18F**
**Electrical Characteristics**

(Unless otherwise specified,  $V_{IN} = 27\text{ V}$ ,  $I_{OUT} = 40\text{ mA}$ ,  $C_{IN} = 0.33\text{ }\mu\text{F}$ ,  $C_{OUT} = 0.1\text{ }\mu\text{F}$ ,  $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$ )

| Characteristics                                   | Symbol                    | Test Circuit | Test Condition   | Min   | Typ. | Max   | Unit                 |
|---|---------------------------|--------------|--|-------|------|-------|----------------------|
| Output voltage                                    | $V_{OUT}$                 | 1            | $T_j = 25^\circ\text{C}$   | 17.1  | 18   | 18.9  | V                    |
| Line regulation                                   | Reg.line                  | 1            | $T_j = 25^\circ\text{C}$   | —     | 32   | 325   | mV                   |
|   |                           |              | $22\text{ V} \leq V_{IN} \leq 33\text{ V}$   | —     | 27   | 275   |                      |
| Load regulation                                   | Reg.load                  | 1            | $T_j = 25^\circ\text{C}$   | —     | 30   | 170   | mV                   |
|   |                           |              | $1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$   | —     | 15   | 75    |                      |
| Output voltage                                    | $V_{OUT}$                 | 1            | $T_j = 25^\circ\text{C}$   | 16.74 | —    | 19.26 | V                    |
|   |                           |              | $1.0\text{ mA} \leq I_{OUT} \leq 70\text{ mA}$   | 16.74 | —    | 19.26 |                      |
| 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                          | $\Delta I_B$              | 1            | $T_j = 25^\circ\text{C}$   | —     | —    | 1.5   | mA                   |
|   |                           |              | $22\text{ V} \leq V_{IN} \leq 33\text{ V}$   | —     | —    | 0.1   |                      |
| Output noise voltage                              | $V_{NO}$                  | 2            | $T_a = 25^\circ\text{C}$ , $10\text{ Hz} \leq f \leq 100\text{ kHz}$                           | —     | 150  | —     | $\mu\text{V}_{rms}$  |
| Long term stability                               | $\Delta V_{OUT}/\Delta t$ | 1            | —  | —     | 45   | —     | mV/kh                |
| Ripple rejection ratio                            | R.R.                      | 3            | $f = 120\text{ Hz}$ ,<br>$23\text{ V} \leq V_{IN} \leq 33\text{ V}$ , $T_j = 25^\circ\text{C}$ | 32    | 38   | —     | dB                   |
| Dropout voltage                                   | $V_D$                     | 1            | $T_j = 25^\circ\text{C}$   | —     | 1.7  | —     | V                    |
| Average temperature coefficient of output voltage | $T_{CVO}$                 | 1            | $I_{OUT} = 5\text{ mA}$  | —     | -1.5 | —     | mV/ $^\circ\text{C}$ |

**TA78L20F**
**Electrical Characteristics**

 (Unless otherwise specified,  $V_{IN} = 29\text{ V}$ ,  $I_{OUT} = 40\text{ mA}$ ,  $C_{IN} = 0.33\text{ }\mu\text{F}$ ,  $C_{OUT} = 0.1\text{ }\mu\text{F}$ ,  $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$ )

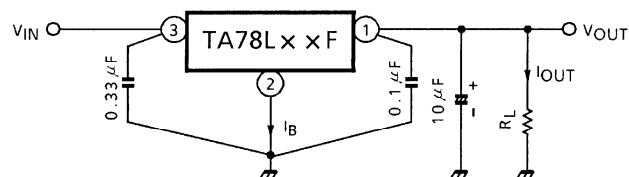
| Characteristics                                   | Symbol                | Test Circuit | Test Condition  |   | Min  | Typ. | Max  | Unit              |
|---|-----------------------|--------------|---|---|------|------|------|-------------------|
| Output voltage                                    | V <sub>OUT</sub>      | 1            | T <sub>j</sub> = 25°C   |   | 19.0 | 20   | 21.0 | V                 |
| Line regulation                                   | Reg.line              | 1            | T <sub>j</sub> = 25°C   | 23.5 V ≤ V <sub>IN</sub> ≤ 35 V                                       | —    | 33   | 330  | mV                |
|   |                       |              |   | 24 V ≤ V <sub>IN</sub> ≤ 35 V   | —    | 28   | 285  |                   |
| Load regulation                                   | Reg.load              | 1            | T <sub>j</sub> = 25°C   | 1.0 mA ≤ I <sub>OUT</sub> ≤ 100 mA                                    | —    | 33   | 180  | mV                |
|   |                       |              |   | 1.0 mA ≤ I <sub>OUT</sub> ≤ 40 mA                                     | —    | 17   | 90   |                   |
| Output voltage                                    | V <sub>OUT</sub>      | 1            | T <sub>j</sub> = 25°C   | 23.5 V ≤ V <sub>IN</sub> ≤ 35 V,<br>1.0 mA ≤ I <sub>OUT</sub> ≤ 40 mA | 18.6 | —    | 21.4 | V                 |
|   |                       |              |   | 1.0 mA ≤ I <sub>OUT</sub> ≤ 70 mA                                     | 18.6 | —    | 21.4 |                   |
| Quiescent current                                 | I <sub>B</sub>        | 1            | T <sub>j</sub> = 25°C   |   | —    | 3.3  | 6.5  | mA                |
|   |                       |              | T <sub>j</sub> = 125°C  |   | —    | —    | 6.0  |                   |
| Quiescent current change                          | ΔI <sub>B</sub>       | 1            | T <sub>j</sub> = 25°C   | 24 V ≤ V <sub>IN</sub> ≤ 35 V   | —    | —    | 1.5  | mA                |
|   |                       |              |   | 1.0 mA ≤ I <sub>OUT</sub> ≤ 40 mA                                     | —    | —    | 0.1  |                   |
| Output noise voltage                              | V <sub>NO</sub>       | 2            | T <sub>a</sub> = 25°C, 10 Hz ≤ f ≤ 100 kHz                          |   | —    | 170  | —    | μV <sub>rms</sub> |
| Long term stability                               | ΔV <sub>OUT</sub> /Δt | 1            | —   |   | —    | 49   | —    | mV/kh             |
| Ripple rejection ratio                            | R.R.                  | 3            | f = 120 Hz,<br>25 V ≤ V <sub>IN</sub> ≤ 35 V, T <sub>j</sub> = 25°C |   | 31   | 37   | —    | dB                |
| Dropout voltage                                   | V <sub>D</sub>        | 1            | T <sub>j</sub> = 25°C   |   | —    | 1.7  | —    | V                 |
| Average temperature coefficient of output voltage | T <sub>CV0</sub>      | 1            | I <sub>OUT</sub> = 5 mA   |   | —    | -1.7 | —    | mV/°C             |

**TA78L24F**
**Electrical Characteristics**

(Unless otherwise specified,  $V_{IN} = 33\text{ V}$ ,  $I_{OUT} = 40\text{ mA}$ ,  $C_{IN} = 0.33\text{ }\mu\text{F}$ ,  $C_{OUT} = 0.1\text{ }\mu\text{F}$ ,  $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$ )

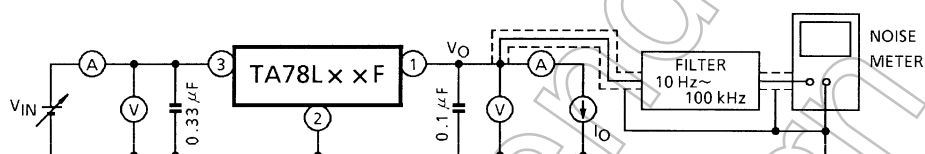
| Characteristics                                   | Symbol                | Test Circuit | Test Condition  |   | Min   | Typ. | Max   | Unit              |
|---|-----------------------|--------------|---|---|-------|------|-------|-------------------|
| Output voltage                                    | V <sub>OUT</sub>      | 1            | T <sub>j</sub> = 25°C   |   | 22.8  | 24   | 25.2  | V                 |
| Line regulation                                   | Reg.line              | 1            | T <sub>j</sub> = 25°C   | 27.5 V ≤ V <sub>IN</sub> ≤ 38 V                                       | —     | 35   | 350   | mV                |
|   |                       |              |   | 28 V ≤ V <sub>IN</sub> ≤ 38 V   | —     | 30   | 300   |                   |
| Load regulation                                   | Reg.load              | 1            | T <sub>j</sub> = 25°C   | 1.0 mA ≤ I <sub>OUT</sub> ≤ 100 mA                                    | —     | 40   | 200   | mV                |
|   |                       |              |   | 1.0 mA ≤ I <sub>OUT</sub> ≤ 40 mA                                     | —     | 20   | 100   |                   |
| Output voltage                                    | V <sub>OUT</sub>      | 1            | T <sub>j</sub> = 25°C   | 27.5 V ≤ V <sub>IN</sub> ≤ 38 V,<br>1.0 mA ≤ I <sub>OUT</sub> ≤ 40 mA | 22.32 | —    | 25.68 | V                 |
|   |                       |              |   | 1.0 mA ≤ I <sub>OUT</sub> ≤ 70 mA                                     | 22.32 | —    | 25.68 |                   |
| Quiescent current                                 | I <sub>B</sub>        | 1            | T <sub>j</sub> = 25°C   | —   | 3.5   | 6.5  | mA    |                   |
|   |                       |              | T <sub>j</sub> = 125°C  | —   | —     | 6.0  |       |                   |
| Quiescent current change                          | ΔI <sub>B</sub>       | 1            | T <sub>j</sub> = 25°C   | 28 V ≤ V <sub>IN</sub> ≤ 38 V   | —     | —    | 1.5   | mA                |
|   |                       |              |   | 1.0 mA ≤ I <sub>OUT</sub> ≤ 40 mA                                     | —     | —    | 0.1   |                   |
| Output noise voltage                              | V <sub>NO</sub>       | 2            | T <sub>a</sub> = 25°C, 10 Hz ≤ f ≤ 100 kHz                          |   | —     | 200  | —     | μV <sub>rms</sub> |
| Long term stability                               | ΔV <sub>OUT</sub> /Δt | 1            | —   |   | —     | 56   | —     | mV/kh             |
| Ripple rejection ratio                            | R.R.                  | 3            | f = 120 Hz,<br>29 V ≤ V <sub>IN</sub> ≤ 39 V, T <sub>j</sub> = 25°C |   | 31    | 35   | —     | dB                |
| Dropout voltage                                   | V <sub>D</sub>        | 1            | T <sub>j</sub> = 25°C   |   | —     | 1.7  | —     | V                 |
| Average temperature coefficient of output voltage | T <sub>CV0</sub>      | 1            | I <sub>OUT</sub> = 5 mA   |   | —     | -2.0 | —     | mV/°C             |

## Test Circuit 1 / Standard Application



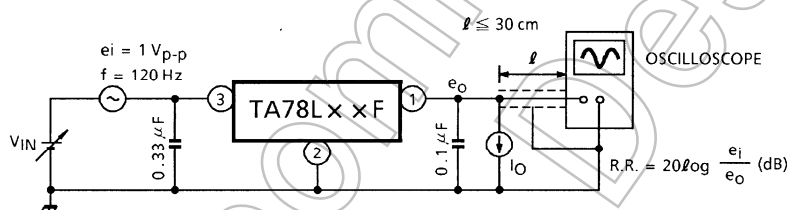
## Test Circuit 2

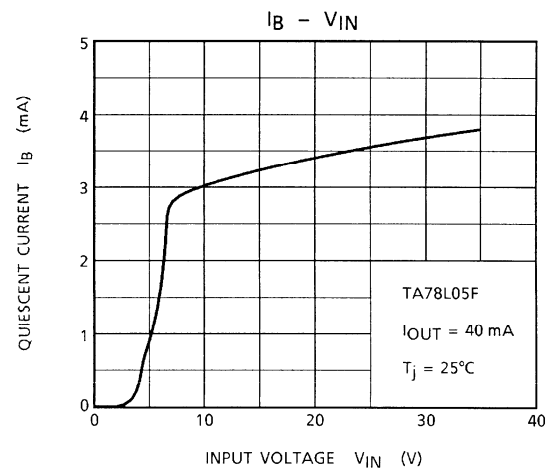
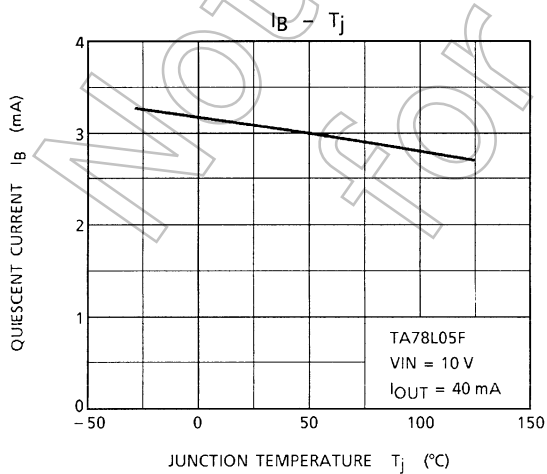
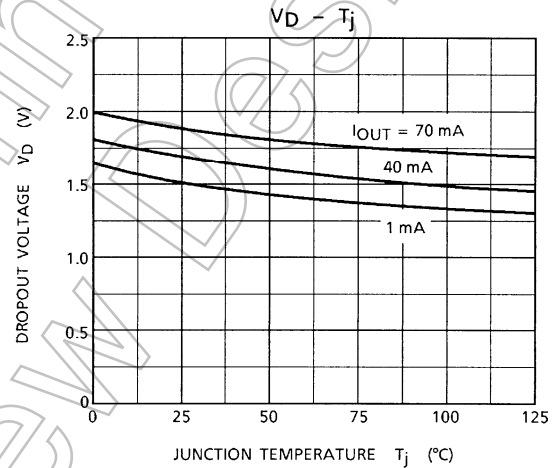
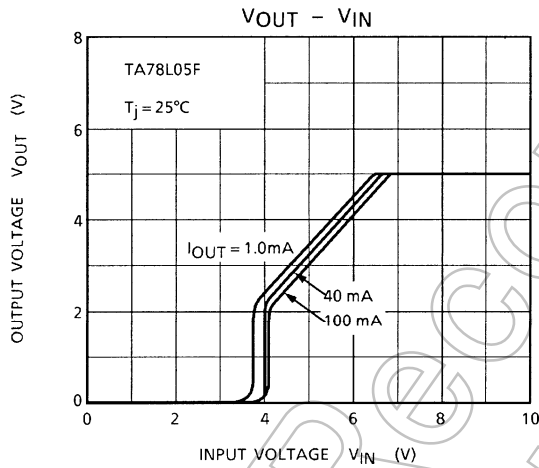
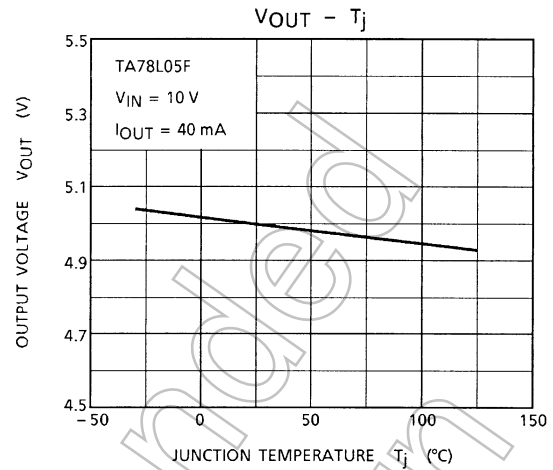
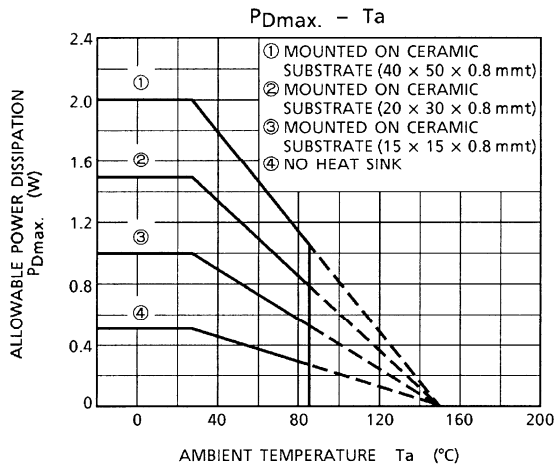
$V_{NO}$

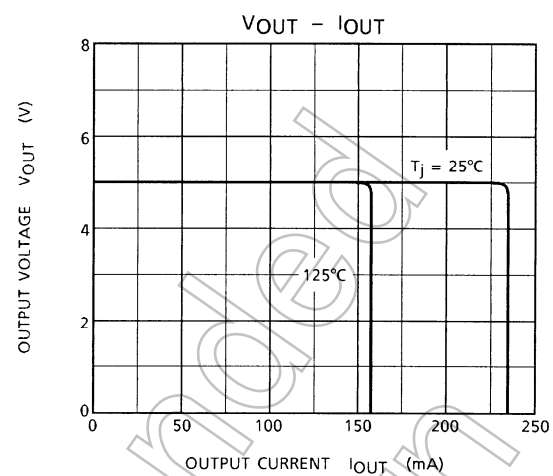
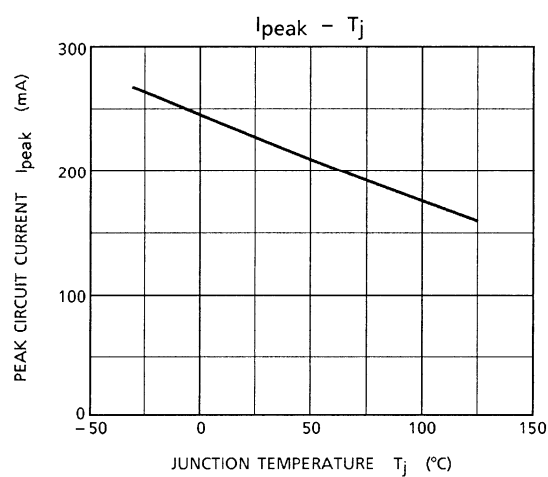


## Test Circuit 3

R.R.





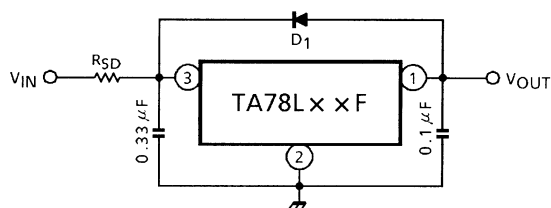


Not Recommended for New Design



## Usage Precautions

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.



D<sub>1</sub> : 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<sub>1</sub>.

R<sub>SD</sub> : Power limiting resistor

If  $V_{IN}$  is too high, always connect R<sub>SD</sub> 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.

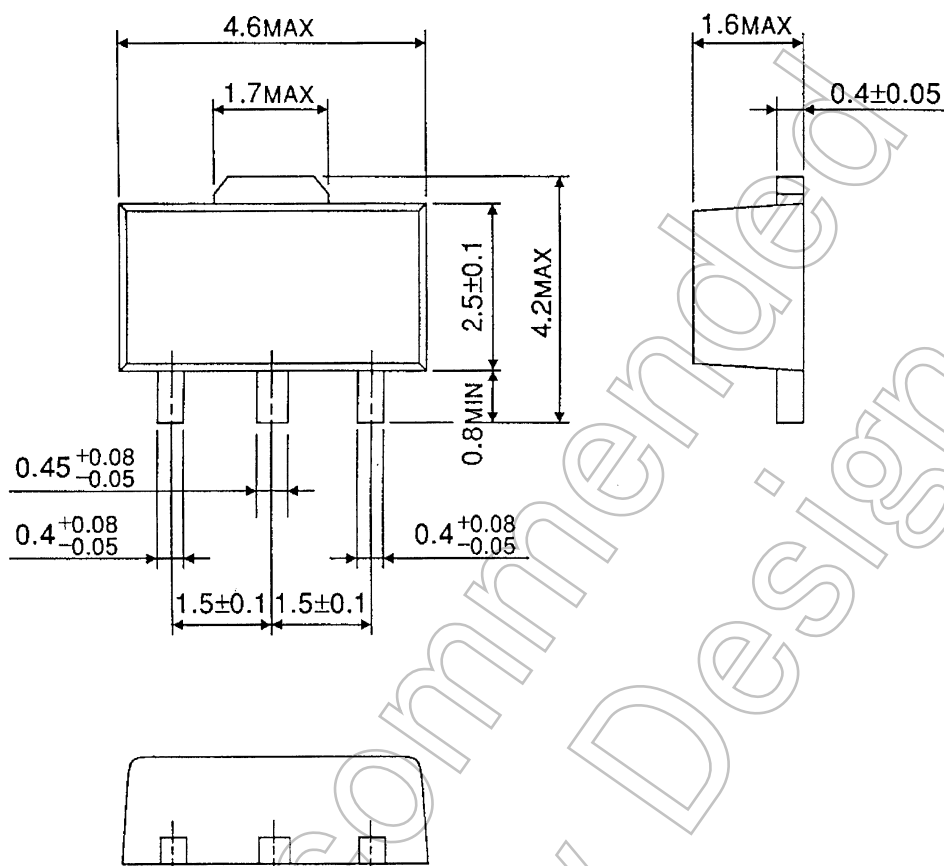
- Overheating Protection

The thermal shutdown circuits in the Product are designed to temporarily protect Product from minor overheating of brief duration. When the overheating 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 overheating protection circuit not to operate properly and/or damage Product permanently even before the protection circuit starts to operate.

## Package Dimensions

HSOP3-P-1.50

Unit : mm



Weight : 0.05 g (Typ.)

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