TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

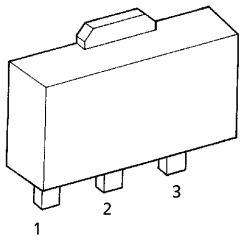
# TA78L05F, TA78L06F, TA78L07F, TA78L08F, TA78L09F, TA78L10F TA78L12F, TA78L15F, TA78L18F, TA78L20F, TA78L24F

## 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 part needed
- Built-in thermal protective circuit
- Built-in short-circuit current limiting
- Max. output current 150mA. ($T_j$ = 25°C)
- Packaged in POWER MINI. (SOT-89)

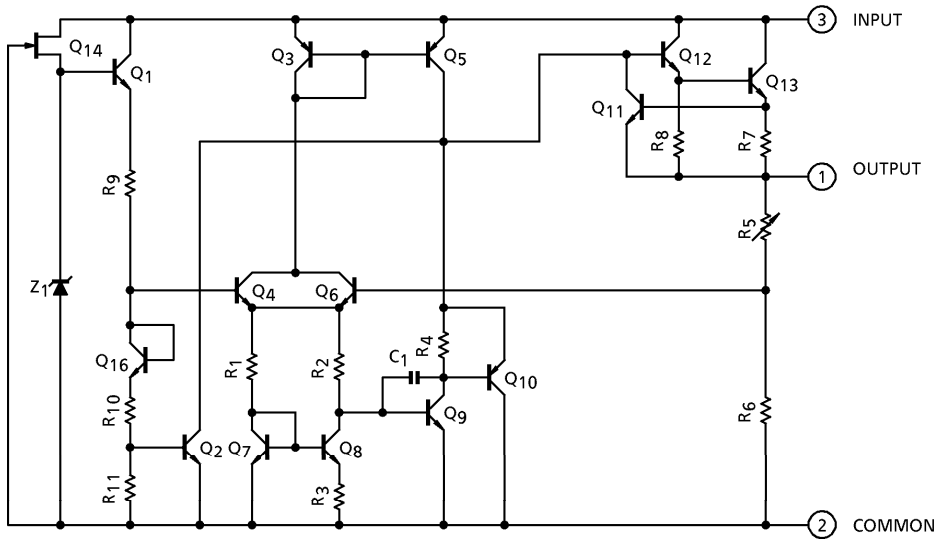



1. OUTPUT
2. COMMON (CASE)
3. INPUT

P-HSOP3-1.50

Weight : 0.05 g (Typ.)

### EQUIVALENT CIRCUIT




| TYPE | MARKING |
|---|---|
| TA78L05F | AE |
| TA78L06F | BE |
| TA78L07F | KE |
| TA78L08F | CE |
| TA78L09F | DE |
| TA78L10F | EE |
| TA78L12F | FE |
| TA78L15F | GE |
| TA78L18F | HE |
| TA78L20F | IE |
| TA78L24F | JE |

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**MAXIMUM RATINGS** (Ta = 25°C)

| CHARACTERISTIC | | SYMBOL | RATING | UNIT |
|---|---|---|---|---|
| Input Voltage | TA78L05F | $V_{IN}$ | 35 | V |
| | TA78L06F | | | |
| | TA78L07F | | | |
| | TA78L08F | | | |
| | TA78L09F | | | |
| | TA78L10F | | | |
| | TA78L12F | | | |
| | TA78L15F | | | |
| | TA78L18F | | 40 | |
| | TA78L20F | | | |
| | TA78L24F | | | |
| Power Dissipation | (Ta = 25°C) | $P_D$ | 500 | mW |
| Power Dissipation | | $P_D$ | 500 | mW |
| Operating Temperature | | $T_{opr}$ | −30~85 | °C |
| Storage Temperature | | $T_{stg}$ | −55~150 | °C |
| Junction Temperature | | $T_j$ | 150 | °C |
| Thermal Resistance | | $R_{th\ (j-a)}$ | 250 | °C / W |

TA78L05F

**ELECTRICAL CHARACTERISTICS**

(Unless otherwise specified, $V_{IN}$ = 10 V, $I_{OUT}$ = 40 mA, $C_{IN}$ = 0.33 $\mu$F, $C_{OUT}$ = 0.1 $\mu$F, 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 | | 4.75 | 5.0 | 5.25 | 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 | 4.65 | — | 5.35 | V |
| | | | | 1.0 mA ≦ $I_{OUT}$ ≦ 70 mA | 4.65 | — | 5.35 | |
| Quiescent Current | $I_B$ | 1 | $T_j$ = 25°C | | — | 3.1 | 6.0 | mA |
| | | | $T_j$ = 125°C | | — | — | 5.5 | |
| Quiescent Current Change | $\Delta I_B$ | 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 | — | $\mu V_{rms}$ |
| Long Term Stability | $\Delta V_{OUT} / \Delta t$ | 1 | — | | — | 12 | — | mV /kh |
| 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 | | — | 1.7 | — | V |
| Average Temperature Coefficient of Output Voltage | $T_{CVO}$ | 1 | $I_{OUT}$ = 5 mA | | — | −0.6 | — | mV / °C |

TA78L06F

**ELECTRICAL CHARACTERISTICS**

(Unless otherwise specified, $V_{IN}$ = 11 V, $I_{OUT}$ = 40 mA, $C_{IN}$ = 0.33 $\mu$F, $C_{OUT}$ = 0.1 $\mu$F, 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 | | 5.7 | 6.0 | 6.3 | 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 | 5.58 | — | 6.42 | V |
| | | | | 1.0 mA ≦ $I_{OUT}$ ≦ 70 mA | 5.58 | — | 6.42 | |
| Quiescent Current | $I_B$ | 1 | $T_j$ = 25°C | | — | 3.1 | 6.0 | mA |
| | | | $T_j$ = 125°C | | — | — | 5.5 | |
| Quiescent Current Change | $\Delta I_B$ | 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 | — | $\mu V_{rms}$ |
| Long Term Stability | $\Delta V_{OUT} / \Delta t$ | 1 | — | | — | 14 | — | mV /kh |
| 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 | | — | 1.7 | — | V |
| Average Temperature Coefficient of Output Voltage | $T_{CVO}$ | 1 | $I_{OUT}$ = 5 mA | | — | −0.7 | — | mV / °C |

TA78L07F

**ELECTRICAL CHARACTERISTICS**

(Unless otherwise specified, $V_{IN}$ = 12 V, $I_{OUT}$ = 40 mA, $C_{IN}$ = 0.33 $\mu$F, $C_{OUT}$ = 0.1 $\mu$F, 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 | | 6.65 | 7.0 | 7.35 | 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 | 6.51 | — | 7.49 | V |
| | | | | 1.0 mA ≦ $I_{OUT}$ ≦ 70 mA | 6.51 | — | 7.49 | |
| Quiescent Current | $I_B$ | 1 | $T_j$ = 25°C | | — | 3.1 | 6.5 | mA |
| | | | $T_j$ = 125°C | | — | — | 6.0 | |
| Quiescent Current Change | $\Delta I_B$ | 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 | — | $\mu V_{rms}$ |
| Long Term Stability | $\Delta V_{OUT} / \Delta t$ | 1 | — | | — | 17 | — | mV /kh |
| 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 | | — | 1.7 | — | V |
| Average Temperature Coefficient of Output Voltage | $T_{CVO}$ | 1 | $I_{OUT}$ = 5 mA | | — | − 0.75 | — | mV / °C |

TA78L08F

**ELECTRICAL CHARACTERISTICS**

(Unless otherwise specified, $V_{IN}$ = 14 V, $I_{OUT}$ = 40 mA, $C_{IN}$ = 0.33 $\mu$F, $C_{OUT}$ = 0.1 $\mu$F, 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 | | 7.6 | 8.0 | 8.4 | V |
| Line Regulation | Reg·line | 1 | $T_j$ = 25°C | 10.5V ≦ $V_{IN}$ ≦ 23V | — | 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 | 7.44 | — | 8.56 | V |
| | | | | 1.0 mA ≦ $I_{OUT}$ ≦ 70 mA | 7.44 | — | 8.56 | |
| Quiescent Current | $I_B$ | 1 | $T_j$ = 25°C | | — | 3.1 | 6.5 | mA |
| | | | $T_j$ = 125°C | | — | — | 6.0 | |
| Quiescent Current Change | $\Delta I_B$ | 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 | — | $\mu V_{rms}$ |
| Long Term Stability | $\Delta V_{OUT} / \Delta t$ | 1 | — | | — | 20 | — | mV /kh |
| 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 | | — | 1.7 | — | V |
| Average Temperature Coefficient of Output Voltage | $T_{CVO}$ | 1 | $I_{OUT}$ = 5 mA | | — | −0.8 | — | mV / °C |

TA78L09F

**ELECTRICAL CHARACTERISTICS**

(Unless otherwise specified, $V_{IN}$ = 15 V, $I_{OUT}$ = 40 mA, $C_{IN}$ = 0.33 $\mu$F, $C_{OUT}$ = 0.1 $\mu$F, 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 | | 8.55 | 9.0 | 9.45 | 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 | 8.37 | — | 9.63 | V |
| | | | | 1.0 mA ≦ $I_{OUT}$ ≦ 70 mA | 8.37 | — | 9.63 | |
| Quiescent Current | $I_B$ | 1 | $T_j$ = 25°C | | — | 3.2 | 6.5 | mA |
| | | | $T_j$ = 125°C | | — | — | 6.0 | |
| Quiescent Current Change | $\Delta I_B$ | 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 | — | $\mu V_{rms}$ |
| Long Term Stability | $\Delta V_{OUT} / \Delta t$ | 1 | — | | — | 21 | — | mV /kh |
| 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 | | — | 1.7 | — | V |
| Average Temperature Coefficient of Output Voltage | $T_{CVO}$ | 1 | $I_{OUT}$ = 5 mA | | — | − 0.85 | — | mV / °C |

TA78L10F

**ELECTRICAL CHARACTERISTICS**

(Unless otherwise specified, $V_{IN}$ = 16 V, $I_{OUT}$ = 40 mA, $C_{IN}$ = 0.33 $\mu$F, $C_{OUT}$ = 0.1 $\mu$F, 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 | | 9.5 | 10 | 10.5 | 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 | 9.3 | — | 10.7 | V |
| | | | | 1.0 mA ≦ $I_{OUT}$ ≦ 70 mA | 9.3 | — | 10.7 | |
| Quiescent Current | $I_B$ | 1 | $T_j$ = 25°C | | — | 3.2 | 6.5 | mA |
| | | | $T_j$ = 125°C | | — | — | 6.0 | |
| Quiescent Current Change | $\Delta I_B$ | 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 | — | $\mu V_{rms}$ |
| Long Term Stability | $\Delta V_{OUT} / \Delta t$ | 1 | — | | — | 22 | — | mV /kh |
| 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 | | — | 1.7 | — | V |
| Average Temperature Coefficient of Output Voltage | $T_{CVO}$ | 1 | $I_{OUT}$ = 5 mA | | — | −0.9 | — | mV / °C |

TA78L12F

**ELECTRICAL CHARACTERISTICS**

(Unless otherwise specified, $V_{IN}$ = 19 V, $I_{OUT}$ = 40 mA, $C_{IN}$ = 0.33 $\mu$F, $C_{OUT}$ = 0.1 $\mu$F, 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 | | 11.4 | 12 | 12.6 | 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 | 11.16 | — | 12.84 | V |
| | | | | 1.0 mA ≦ $I_{OUT}$ ≦ 70 mA | 11.16 | — | 12.84 | |
| Quiescent Current | $I_B$ | 1 | $T_j$ = 25°C | | — | 3.2 | 6.5 | mA |
| | | | $T_j$ = 125°C | | — | — | 6.0 | |
| Quiescent Current Change | $\Delta I_B$ | 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 | — | $\mu V_{rms}$ |
| Long Term Stability | $\Delta V_{OUT} / \Delta t$ | 1 | — | | — | 24 | — | mV /kh |
| 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 | | — | 1.7 | — | V |
| Average Temperature Coefficient of Output Voltage | $T_{CVO}$ | 1 | $I_{OUT}$ = 5 mA | | — | − 1.0 | — | mV / °C |

TA78L15F

**ELECTRICAL CHARACTERISTICS**

(Unless otherwise specified, $V_{IN}$ = 23 V, $I_{OUT}$ = 40 mA, $C_{IN}$ = 0.33 $\mu$F, $C_{OUT}$ = 0.1 $\mu$F, 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 | | 14.25 | 15 | 15.75 | 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 | 13.95 | — | 16.05 | V |
| | | | | 1.0 mA ≦ $I_{OUT}$ ≦ 70 mA | 13.95 | — | 16.05 | |
| Quiescent Current | $I_B$ | 1 | $T_j$ = 25°C | | — | 3.3 | 6.5 | mA |
| | | | $T_j$ = 125°C | | — | — | 6.0 | |
| Quiescent Current Change | $\Delta I_B$ | 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 | — | $\mu V_{rms}$ |
| Long Term Stability | $\Delta V_{OUT} / \Delta t$ | 1 | — | | — | 30 | — | mV /kh |
| 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 | | — | 1.7 | — | V |
| Average Temperature Coefficient of Output Voltage | $T_{CVO}$ | 1 | $I_{OUT}$ = 5 mA | | — | − 1.3 | — | mV / °C |

TA78L18F

**ELECTRICAL CHARACTERISTICS**

(Unless otherwise specified, $V_{IN}$ = 27 V, $I_{OUT}$ = 40 mA, $C_{IN}$ = 0.33 $\mu$F, $C_{OUT}$ = 0.1 $\mu$F, 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 | | 17.1 | 18 | 18.9 | V |
| Line Regulation | Reg·line | 1 | $T_j$ = 25°C | 21.4 V ≦ $V_{IN}$ ≦ 33 V | — | 32 | 325 | mV |
| | | | | 22 V ≦ $V_{IN}$ ≦ 33 V | — | 27 | 275 | |
| Load Regulation | Reg·load | 1 | $T_j$ = 25°C | 1.0 mA ≦ $I_{OUT}$ ≦ 100 mA | — | 30 | 170 | mV |
| | | | | 1.0 mA ≦ $I_{OUT}$ ≦ 40 mA | — | 15 | 75 | |
| Output Voltage | $V_{OUT}$ | 1 | $T_j$ = 25°C | 21.4 V ≦ $V_{IN}$ ≦ 33 V, 1.0 mA ≦ $I_{OUT}$ ≦ 40 mA | 16.74 | — | 19.26 | V |
| | | | | 1.0 mA ≦ $I_{OUT}$ ≦ 70 mA | 16.74 | — | 19.26 | |
| Quiescent Current | $I_B$ | 1 | $T_j$ = 25°C | | — | 3.3 | 6.5 | mA |
| | | | $T_j$ = 125°C | | — | — | 6.0 | |
| Quiescent Current Change | $\Delta I_B$ | 1 | $T_j$ = 25°C | 22 V ≦ $V_{IN}$ ≦ 33 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 | | — | 150 | — | $\mu V_{rms}$ |
| Long Term Stability | $\Delta V_{OUT} / \Delta t$ | 1 | — | | — | 45 | — | mV /kh |
| Ripple Rejection Ratio | R.R. | 3 | f = 120 Hz, 23 V ≦ $V_{IN}$ ≦ 33 V, $T_j$ = 25°C | | 32 | 38 | — | dB |
| Dropout Voltage | $V_D$ | 1 | $T_j$ = 25°C, $I_{OUT}$ = 150 mA | | — | 1.7 | — | V |
| Average Temperature Coefficient of Output Voltage | $T_{CVO}$ | 1 | $I_{OUT}$ = 5 mA | | — | − 1.5 | — | mV / °C |

TA78L20F

**ELECTRICAL CHARACTERISTICS**

(Unless otherwise specified, $V_{IN}$ = 29 V, $I_{OUT}$ = 40 mA, $C_{IN}$ = 0.33 $\mu$F, $C_{OUT}$ = 0.1 $\mu$F, 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 | | 19.0 | 20 | 21.0 | V |
| Line Regulation | Reg·line | 1 | $T_j$ = 25°C | 23.5 V ≦ $V_{IN}$ ≦ 35 V | — | 33 | 330 | mV |
| | | | | 24 V ≦ $V_{IN}$ ≦ 35 V | — | 28 | 285 | |
| Load Regulation | Reg·load | 1 | $T_j$ = 25°C | 1.0 mA ≦ $I_{OUT}$ ≦ 100 mA | — | 33 | 180 | mV |
| | | | | 1.0 mA ≦ $I_{OUT}$ ≦ 40 mA | — | 17 | 90 | |
| Output Voltage | $V_{OUT}$ | 1 | $T_j$ = 25°C | 23.5 V ≦ $V_{IN}$ ≦ 35 V. 1.0 mA ≦ $I_{OUT}$ ≦ 40 mA | 18.6 | — | 21.4 | V |
| | | | | 1.0 mA ≦ $I_{OUT}$ ≦ 70 mA | 18.6 | — | 21.4 | |
| Quiescent Current | $I_B$ | 1 | $T_j$ = 25°C | | — | 3.3 | 6.5 | mA |
| | | | $T_j$ = 125°C | | — | — | 6.0 | |
| Quiescent Current Change | $\Delta I_B$ | 1 | $T_j$ = 25°C | 24 V ≦ $V_{IN}$ ≦ 35 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 | | — | 170 | — | $\mu V_{rms}$ |
| Long Term Stability | $\Delta V_{OUT} / \Delta t$ | 1 | — | | — | 49 | — | mV /kh |
| Ripple Rejection Ratio | R.R. | 3 | f = 120 Hz, 25 V ≦ $V_{IN}$ ≦ 35 V, $T_j$ = 25°C | | 31 | 37 | — | dB |
| Dropout Voltage | $V_D$ | 1 | $T_j$ = 25°C, $I_{OUT}$ = 150 mA | | — | 1.7 | — | V |
| Average Temperature Coefficient of Output Voltage | $T_{CVO}$ | 1 | $I_{OUT}$ = 5 mA | | — | − 1.7 | — | mV / °C |

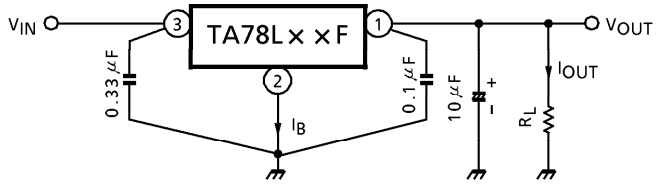
TA78L24F

**ELECTRICAL CHARACTERISTICS**

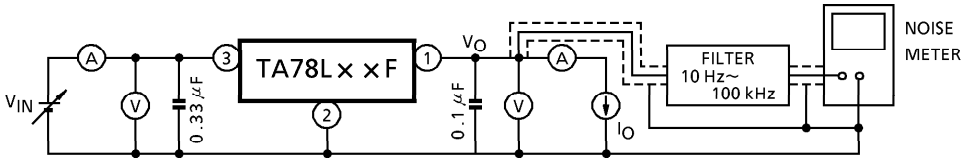
(Unless otherwise specified, $V_{IN}$ = 33 V, $I_{OUT}$ = 40 mA, $C_{IN}$ = 0.33 $\mu$F, $C_{OUT}$ = 0.1 $\mu$F, 0°C ≦ $T_j$ ≦ 125°C)

| CHARACTERISTIC | SYMBOL | TEST CIR-CUIT | TEST CONDITION | | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|---|---|
| Output Voltage | $V_{OUT}$ | 1 | $T_j$ = 25°C | | 22.8 | 24 | 25.2 | V |
| Line Regulation | Reg·line | 1 | $T_j$ = 25°C | 27.5 V ≦ $V_{IN}$ ≦ 38 V | — | 35 | 350 | mV |
| | | | | 28 V ≦ $V_{IN}$ ≦ 38 V | — | 30 | 300 | |
| Load Regulation | Reg·load | 1 | $T_j$ = 25°C | 1.0 mA ≦ $I_{OUT}$ ≦ 100 mA | — | 40 | 200 | mV |
| | | | | 1.0 mA ≦ $I_{OUT}$ ≦ 40 mA | — | 20 | 100 | |
| Output Voltage | $V_{OUT}$ | 1 | $T_j$ = 25°C | 27.5 V ≦ $V_{IN}$ ≦ 38 V, 1.0 mA ≦ $I_{OUT}$ ≦ 40 mA | 22.32 | — | 25.68 | V |
| | | | | 1.0 mA ≦ $I_{OUT}$ ≦ 70 mA | 22.32 | — | 25.68 | |
| Quiescent Current | $I_B$ | 1 | $T_j$ = 25°C | | — | 3.5 | 6.5 | mA |
| | | | $T_j$ = 125°C | | — | — | 6.0 | |
| Quiescent Current Change | $\Delta I_B$ | 1 | $T_j$ = 25°C | 28 V ≦ $V_{IN}$ ≦ 38 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 | | — | 200 | — | $\mu V_{rms}$ |
| Long Term Stability | $\Delta V_{OUT} / \Delta t$ | 1 | — | | — | 56 | — | mV /kh |
| Ripple Rejection Ratio | R.R. | 3 | f = 120 Hz, 29 V ≦ $V_{IN}$ ≦ 39 V, $T_j$ = 25°C | | 31 | 35 | — | dB |
| Dropout Voltage | $V_D$ | 1 | $T_j$ = 25°C, $I_{OUT}$ = 150 mA | | — | 1.7 | — | V |
| Average Temperature Coefficient of Output Voltage | $T_{CVO}$ | 1 | $I_{OUT}$ = 5 mA | | — | −2.0 | — | mV / °C |

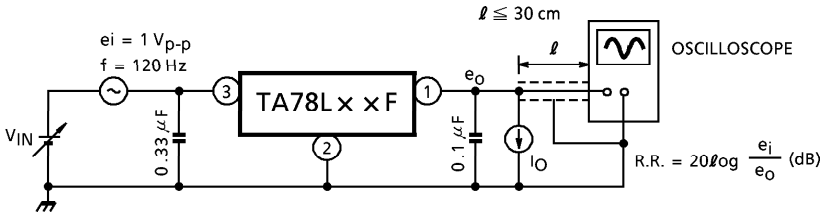
**TEST CIRCUIT 1 / STANDARD APPLICATION**



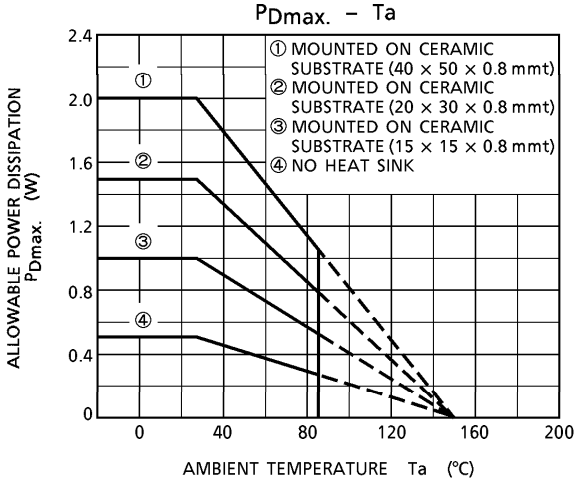

**TEST CIRCUIT 2** $V_{NO}$



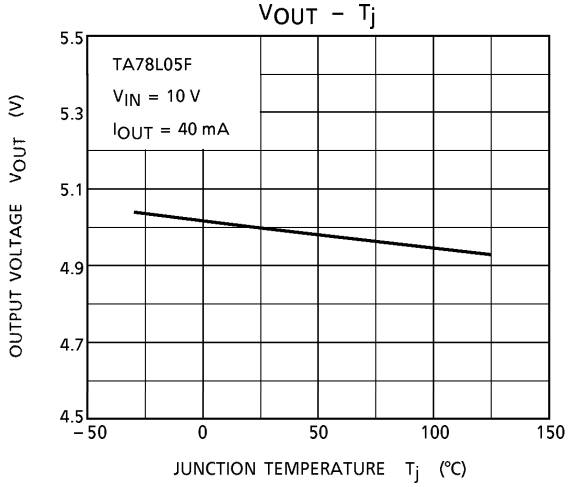

**TEST CIRCUIT 3** R.R.



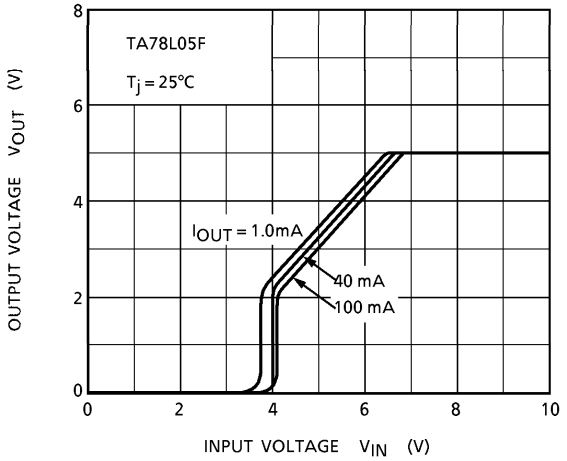
$P_{Dmax.}$ – Ta



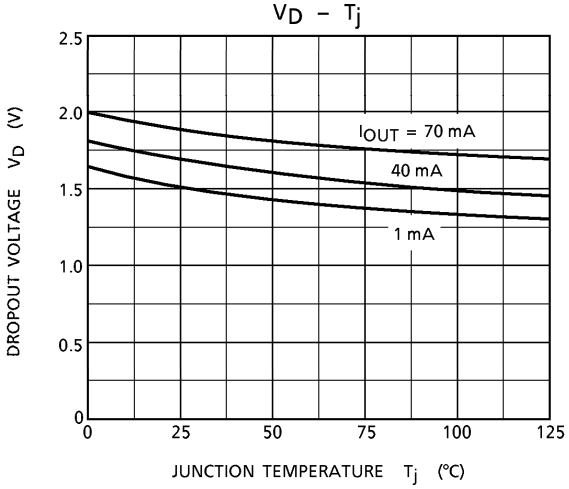

$V_{OUT}$ – $T_j$



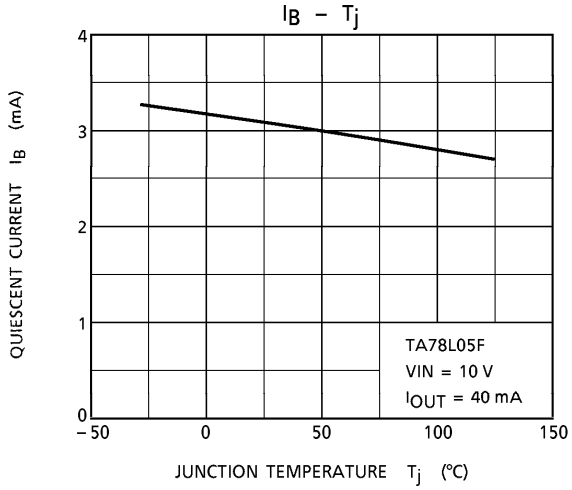

$V_{OUT}$ – $V_{IN}$



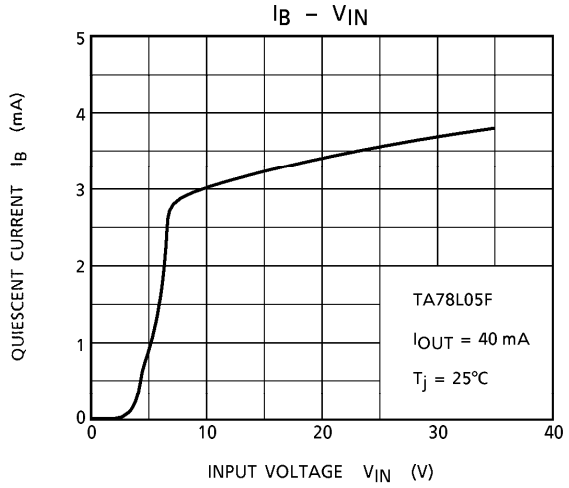

$V_D$ – $T_j$

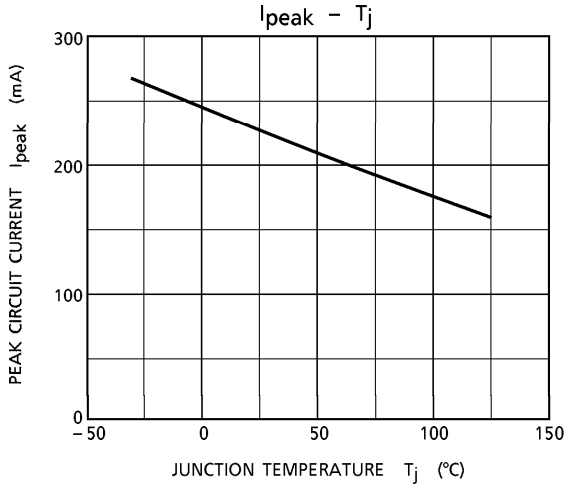


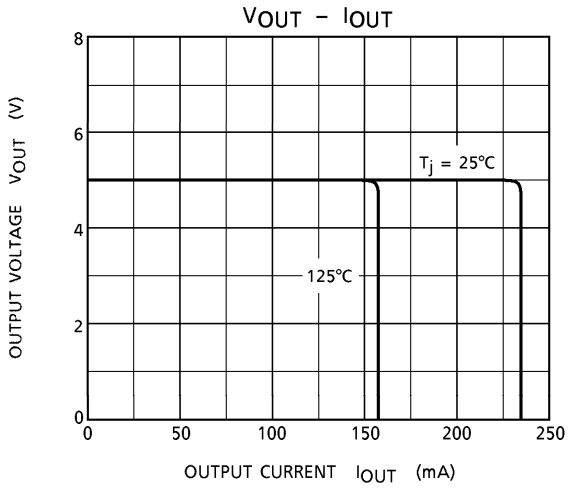

$I_B$ – $T_j$




$I_B$ – $V_{IN}$




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

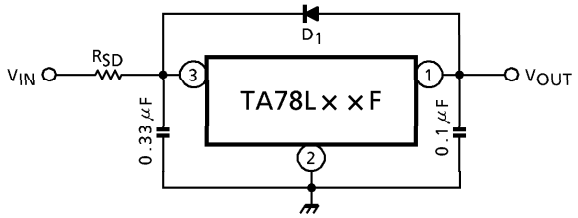

$V_{OUT}$ – $I_{OUT}$
OUTPUT VOLTAGE $V_{OUT}$ (V)
8
6
4
2
0
$T_j$ = 25°C
125°C
0
50
100
150
200
250
OUTPUT CURRENT $I_{OUT}$ (mA)

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**

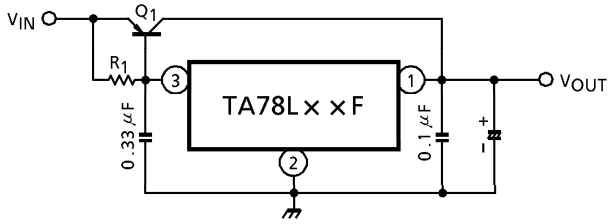
(1) STANDARD APPLICATION




$D_1$ : 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

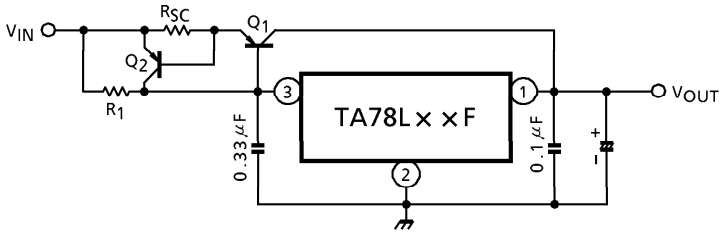



Use a required rediation plate for $Q_1$.

$$R_1 \leqq \frac{V_{BE1}}{I_B \text{ MAX}}$$

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

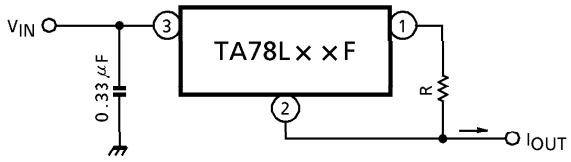
B. SHORT-CIRCUIT PROTECTION




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

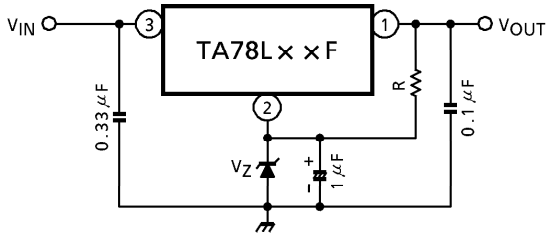
where, $I_{SC}$ : Short-Circuit current

(3) CURRENT REGULATOR

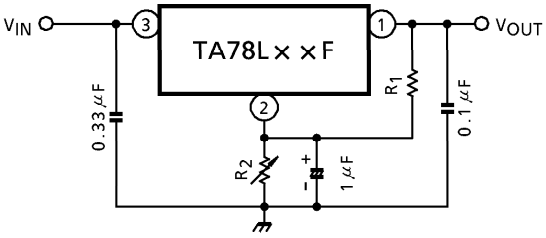



$$I_{OUT} = \frac{V_{OUT}}{R} + I_B$$

(4) VOLTAGE BOOST REGULATOR

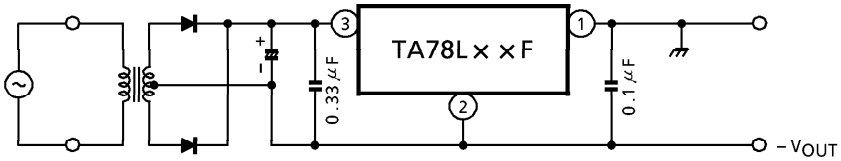



$V_{OUT} = V_Z + V_{OUT}$ (of IC)
Apply current of several mA to R.

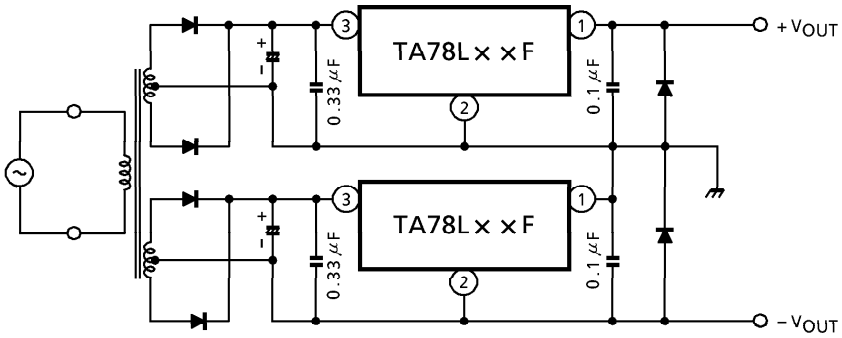



$$V_{OUT} = R_2 \left(I_B + \frac{V_{OUT}\,(\text{of IC})}{R_1}\right) + V_{OUT}\,(\text{of IC})$$

(5) NEGATIVE REGULATOR

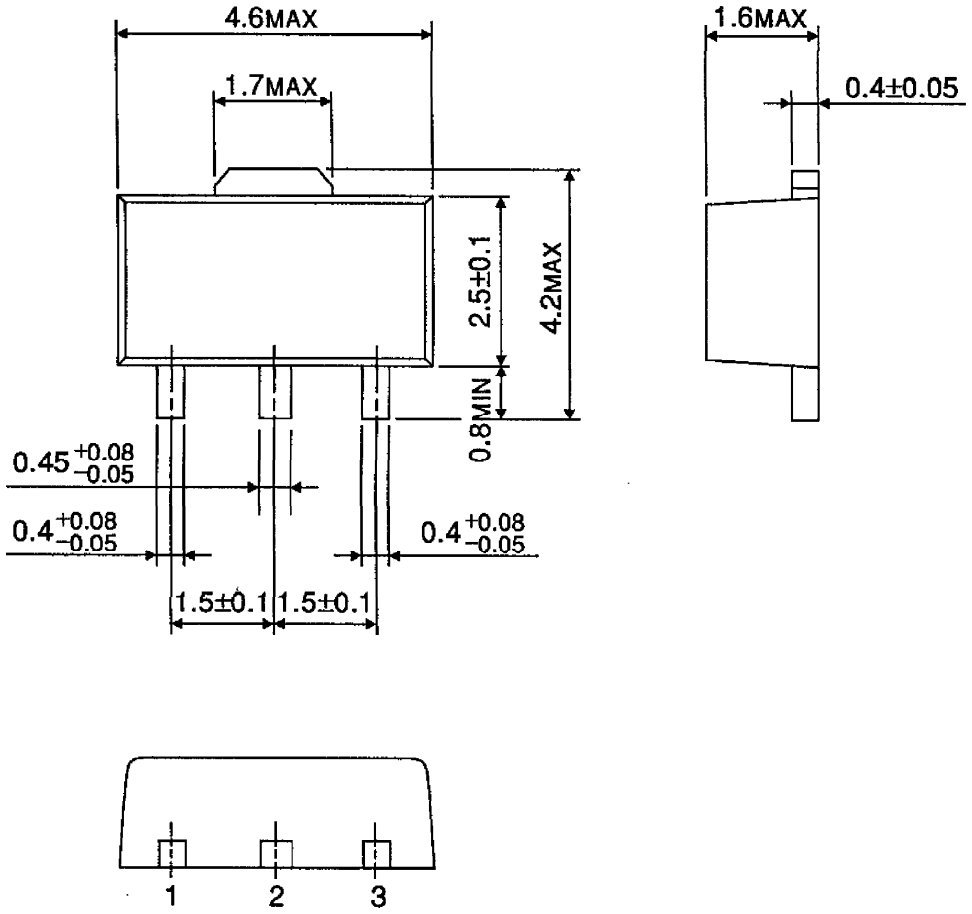



(6) POSITIVE AND NEGATIVE REGULATOR



**PACKAGE DIMENSIONS**

P-HSOP3-1.50 Unit : mm




Weight : 0.05 g (Typ.)