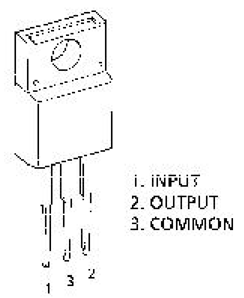
TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

# TA78M05S, TA78M06S, TA78M08S, TA78M09S, TA78M10S TA78M12S, TA78M15S, TA78M18S, TA78M20S, TA78M24S

## 0.5A THREE TERMINAL POSITIVE VOLTAGE REGULATORS

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

The TA78M××S series of fixed-voltage monolithic integrated circuit voltage regulators is designed for a wide range of applications. These regulators employ internal current-limiting, thermal-shutdown and safe-area compensation, making them essentially indestructible. One of these regulators can driver up to 0.5A of output current.



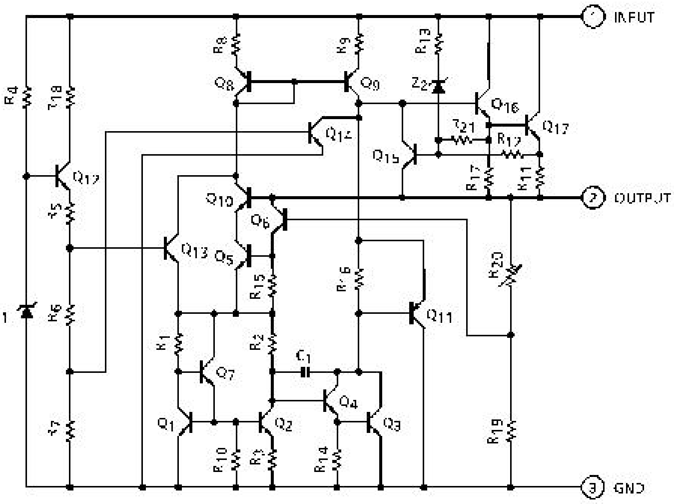

HSIP3-P-2.54A

Weight : 1.7g (Typ.)

### FEATURES

- Suitable for CMOS, TTL and the other Digital IC's Power Supply.
- Output Current in Excess of 0.5A
- Internal Thermal Overload Protection
- Internal Short Circuit Current Limiting
- Package in the Plastic Case TO-220NIS

### EQUIVALENT CIRCUIT




961001EBA2

**MAXIMUM RATINGS** (Ta = 25°C)

| CHARACTERISTIC | | SYMBOL | RATING | UNIT |
|---|---|---|---|---|
| Input Voltage | TA78M05S | $V_{IN}$ | 35 | V |
| | TA78M06S | | | |
| | TA78M08S | | | |
| | TA78M09S | | | |
| | TA78M10S | | | |
| | TA78M12S | | | |
| | TA78M15S | | | |
| | TA78M18S | | 40 | |
| | TA78M20S | | | |
| | TA78M24S | | | |
| Power Dissipation | (Ta = 25°C) | $P_D$ | 2 | W |
| | (Tc = 25°C) | | 20 | |
| Operating Temperature | | $T_{opr}$ | −30~75 | °C |
| Storage Temperature | | $T_{stg}$ | −55~150 | °C |
| Operating Junction Temperature | | $T_j$ | −30~150 | °C |
| Thermal Resistance | | $R_{th\ (j\text{-}c)}$ | 6.25 | °C / W |
| | | $R_{th\ (j\text{-}a)}$ | 62.5 | |

TA78M05S

**ELECTRICAL CHARACTERISTICS**

($V_{IN}$ = 10V, $I_{OUT}$ = 350mA, 0°C ≦ $T_j$ ≦ 125°C, $C_{IN}$ = 0.33μF, $C_{OUT}$ = 0.1μF, unless otherwise noted)

| CHARACTERISTIC | | 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 | 7V ≦ $V_{IN}$ ≦ 25V, $I_{OUT}$ = 200mA | — | 4 | 100 | mV |
| | | | | | 8V ≦ $V_{IN}$ ≦ 25V, $I_{OUT}$ = 200mA | — | 2 | 50 | |
| Load Regulation | | Reg.load | 1 | $T_j$ = 25°C | 5mA ≦ $I_{OUT}$ ≦ 500mA | — | 25 | 100 | mV |
| | | | | | 5mA ≦ $I_{OUT}$ ≦ 200mA | — | 10 | 50 | |
| Output Voltage | | $V_{OUT}$ | 1 | $T_j$ = 25°C | 7V ≦ $V_{IN}$ ≦ 20V, 5mA ≦ $I_{OUT}$ ≦ 350mA | 4.75 | — | 5.25 | V |
| Quiescent Current | | $I_B$ | 1 | $T_j$ = 25°C | | — | 4.5 | 8.0 | mA |
| Quiescent Current Change | Line | $\Delta I_{BI}$ | 1 | 8.5V ≦ $V_{IN}$ ≦ 25.5V, $I_{OUT}$ = 200mA | | — | — | 0.8 | mA |
| | Load | $\Delta I_{BO}$ | 1 | 5mA ≦ $I_{OUT}$ ≦ 350mA | | — | — | 0.5 | |
| Output Noise Voltage | | $V_{NO}$ | 2 | Ta = 25°C, 10Hz ≦ f ≦ 100kHz | | — | 50 | 200 | $\mu V_{rms}$ |
| Ripple Rejection | | R.R. | 3 | f = 120Hz, $I_{OUT}$ = 100mA, 8V ≦ $V_{IN}$ ≦ 18V, $T_j$ = 25°C | | 62 | 69 | — | dB |
| Short Circuit Current Limit | | $I_{SC}$ | 1 | $T_j$ = 25°C | | — | 960 | — | mA |
| Dropout Voltage | | $V_D$ | 1 | Ta = 25°C | | — | 1.7 | — | V |
| Average Temperature Coefficient Of Output Voltage | | $T_{CVO}$ | 1 | $I_{OUT}$ = 5mA | | — | −0.6 | — | mV / °C |

TA78M06S

**ELECTRICAL CHARACTERISTICS**

($V_{IN}$ = 11V, $I_{OUT}$ = 350mA, 0°C ≦ $T_j$ ≦ 125°C, $C_{IN}$ = 0.33μF, $C_{OUT}$ = 0.1μF, unless otherwise noted)

| CHARACTERISTIC | | SYMBOL | TEST CIRCUIT | TEST CONDITION | | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| Output Voltage | | $V_{OUT}$ | 1 | $T_j$ = 25°C | | 5.75 | 6.0 | 6.25 | V |
| Line Regulation | | Reg.line | 1 | $T_j$ = 25°C | 8V ≦ $V_{IN}$ ≦ 25V, $I_{OUT}$ = 200mA | — | 4 | 100 | mV |
| | | | | | 9V ≦ $V_{IN}$ ≦ 25V, $I_{OUT}$ = 200mA | — | 2 | 50 | |
| Load Regulation | | Reg.load | 1 | $T_j$ = 25°C | 5mA ≦ $I_{OUT}$ ≦ 500mA | — | 25 | 120 | mV |
| | | | | | 5mA ≦ $I_{OUT}$ ≦ 200mA | — | 10 | 60 | |
| Output Voltage | | $V_{OUT}$ | 1 | $T_j$ = 25°C | 8V ≦ $V_{IN}$ ≦ 21V, 5mA ≦ $I_{OUT}$ ≦ 350mA | 5.7 | — | 6.3 | V |
| Quiescent Current | | $I_B$ | 1 | $T_j$ = 25°C | | — | 4.5 | 8.0 | mA |
| Quiescent Current Change | Line | $\Delta I_{BI}$ | 1 | 9.5V ≦ $V_{IN}$ ≦ 25.5V, $I_{OUT}$ = 200mA | | — | — | 0.8 | mA |
| | Load | $\Delta I_{BO}$ | 1 | 5mA ≦ $I_{OUT}$ ≦ 350mA | | — | — | 0.5 | |
| Output Noise Voltage | | $V_{NO}$ | 2 | Ta = 25°C, 10Hz ≦ f ≦ 100kHz | | — | 55 | 220 | $\mu V_{rms}$ |
| Ripple Rejection | | R.R. | 3 | f = 120Hz, $I_{OUT}$ = 100mA, 9V ≦ $V_{IN}$ ≦ 19V, $T_j$ = 25°C | | 59 | 66 | — | dB |
| Short Circuit Current Limit | | $I_{SC}$ | 1 | $T_j$ = 25°C | | — | 960 | — | mA |
| Dropout Voltage | | $V_D$ | 1 | Ta = 25°C | | — | 1.7 | — | V |
| Average Temperature Coefficient Of Output Voltage | | $T_{CVO}$ | 1 | $I_{OUT}$ = 5mA | | — | −0.7 | — | mV / °C |

TA78M08S

**ELECTRICAL CHARACTERISTICS**

($V_{IN}$ = 14V, $I_{OUT}$ = 350mA, 0°C ≦ $T_j$ ≦ 125°C, $C_{IN}$ = 0.33μF, $C_{OUT}$ = 0.1μF, unless otherwise noted)

| CHARACTERISTIC | | SYMBOL | TEST CIR-CUIT | TEST CONDITION | | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| Output Voltage | | $V_{OUT}$ | 1 | $T_j$ = 25°C | | 7.7 | 8.0 | 8.3 | V |
| Line Regulation | | Reg.line | 1 | $T_j$ = 25°C | 10.5V ≦ $V_{IN}$ ≦ 25V $I_{OUT}$ = 200mA | — | 5 | 100 | mV |
| | | | | | 11V ≦ $V_{IN}$ ≦ 25V $I_{OUT}$ = 200mA | — | 3 | 50 | |
| Load Regulation | | Reg.load | 1 | $T_j$ = 25°C | 5mA ≦ $I_{OUT}$ ≦ 500mA | — | 26 | 160 | mV |
| | | | | | 5mA ≦ $I_{OUT}$ ≦ 200mA | — | 10 | 80 | |
| Output Voltage | | $V_{OUT}$ | 1 | $T_j$ = 25°C | 10.5V ≦ $V_{IN}$ ≦ 23V 5mA ≦ $I_{OUT}$ ≦ 350mA | 7.6 | — | 8.4 | V |
| Quiescent Current | | $I_B$ | 1 | $T_j$ = 25°C | | — | 4.6 | 8.0 | mA |
| Quiescent Current Change | Line | $\Delta I_{BI}$ | 1 | 11V ≦ $V_{IN}$ ≦ 25.5V, $I_{OUT}$ = 200mA | | — | — | 0.8 | mA |
| | Load | $\Delta I_{BO}$ | 1 | 5mA ≦ $I_{OUT}$ ≦ 350mA | | — | — | 0.5 | |
| Output Noise Voltage | | $V_{NO}$ | 2 | Ta = 25°C, 10Hz ≦ f ≦ 100kHz | | — | 60 | 250 | $\mu V_{rms}$ |
| Ripple Rejection | | R.R. | 3 | f = 120Hz, $I_{OUT}$ = 100mA 11.5V ≦ $V_{IN}$ ≦ 21.5V, $T_j$ = 25°C | | 56 | 63 | — | dB |
| Short Circuit Current Limit | | $I_{SC}$ | 1 | $T_j$ = 25°C | | — | 960 | — | mA |
| Dropout Voltage | | $V_D$ | 1 | Ta = 25°C | | — | 1.7 | — | V |
| Average Temperature Coefficient Of Output Voltage | | $T_{CVO}$ | 1 | $I_{OUT}$ = 5mA | | — | −1.0 | — | mV / °C |

TA78M09S

**ELECTRICAL CHARACTERISTICS**

($V_{IN}$ = 15V, $I_{OUT}$ = 350mA, 0°C ≦ $T_j$ ≦ 125°C, $C_{IN}$ = 0.33μF, $C_{OUT}$ = 0.1μF, unless otherwise noted)

| CHARACTERISTIC | | SYMBOL | TEST CIR-CUIT | TEST CONDITION | | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| Output Voltage | | $V_{OUT}$ | 1 | $T_j$ = 25°C | | 8.64 | 9.0 | 9.36 | V |
| Line Regulation | | Reg.line | 1 | $T_j$ = 25°C | 11.5V ≦ $V_{IN}$ ≦ 26V, $I_{OUT}$ = 200mA | — | 5 | 100 | mV |
| | | | | | 13V ≦ $V_{IN}$ ≦ 26V, $I_{OUT}$ = 200mA | — | 3 | 50 | |
| Load Regulation | | Reg.load | 1 | $T_j$ = 25°C | 5mA ≦ $I_{OUT}$ ≦ 500mA | — | 26 | 180 | mV |
| | | | | | 5mA ≦ $I_{OUT}$ ≦ 200mA | — | 10 | 90 | |
| Output Voltage | | $V_{OUT}$ | 1 | $T_j$ = 25°C | 11.5V ≦ $V_{IN}$ ≦ 24V, 5mA ≦ $I_{OUT}$ ≦ 350mA | 8.55 | — | 9.45 | V |
| Quiescent Current | | $I_B$ | 1 | $T_j$ = 25°C | | — | 4.6 | 8.0 | mA |
| Quiescent Current Change | Line | $\Delta I_{BI}$ | 1 | 12V ≦ $V_{IN}$ ≦ 26.5V, $I_{OUT}$ = 200mA | | — | — | 0.8 | mA |
| | Load | $\Delta I_{BO}$ | 1 | 5mA ≦ $I_{OUT}$ ≦ 350mA | | — | — | 0.5 | |
| Output Noise Voltage | | $V_{NO}$ | 2 | Ta = 25°C, 10Hz ≦ f ≦ 100kHz | | — | 60 | 270 | μ$V_{rms}$ |
| Ripple Rejection | | R.R. | 3 | f = 120Hz, $I_{OUT}$ = 100mA, 12.5V ≦ $V_{IN}$ ≦ 22.5V, $T_j$ = 25°C | | 56 | 63 | — | dB |
| Short Circuit Current Limit | | $I_{SC}$ | 1 | $T_j$ = 25°C | | — | 960 | — | mA |
| Dropout Voltage | | $V_D$ | 1 | Ta = 25°C | | — | 1.7 | — | V |
| Average Temperature Coefficient Of Output Voltage | | $T_{CVO}$ | 1 | $I_{OUT}$ = 5mA | | — | −1.1 | — | mV / °C |

TA78M10S

**ELECTRICAL CHARACTERISTICS**

($V_{IN}$ = 16V, $I_{OUT}$ = 350mA, 0°C ≦ $T_j$ ≦ 125°C, $C_{IN}$ = 0.33μF, $C_{OUT}$ = 0.1μF, unless otherwise noted)

| CHARACTERISTIC | | SYMBOL | TEST CIR-CUIT | TEST CONDITION | | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| Output Voltage | | $V_{OUT}$ | 1 | $T_j$ = 25°C | | 9.6 | 10.0 | 10.4 | V |
| Line Regulation | | Reg.line | 1 | $T_j$ = 25°C | 12.5V ≦ $V_{IN}$ ≦ 26V, $I_{OUT}$ = 200mA | — | 6 | 100 | mV |
| | | | | | 14V ≦ $V_{IN}$ ≦ 26V, $I_{OUT}$ = 200mA | — | 3 | 50 | |
| Load Regulation | | Reg.load | 1 | $T_j$ = 25°C | 5mA ≦ $I_{OUT}$ ≦ 500mA | — | 26 | 200 | mV |
| | | | | | 5mA ≦ $I_{OUT}$ ≦ 200mA | — | 10 | 100 | |
| Output Voltage | | $V_{OUT}$ | 1 | $T_j$ = 25°C | 12.5V ≦ $V_{IN}$ ≦ 25V, 5mA ≦ $I_{OUT}$ ≦ 350mA | 9.5 | — | 10.5 | V |
| Quiescent Current | | $I_B$ | 1 | $T_j$ = 25°C | | — | 4.7 | 8.0 | mA |
| Quiescent Current Change | Line | $\Delta I_{BI}$ | 1 | 13V ≦ $V_{IN}$ ≦ 26.5V, $I_{OUT}$ = 200mA | | — | — | 0.8 | mA |
| | Load | $\Delta I_{BO}$ | 1 | 5mA ≦ $I_{OUT}$ ≦ 350mA | | — | — | 0.5 | |
| Output Noise Voltage | | $V_{NO}$ | 2 | Ta = 25°C, 10Hz ≦ f ≦ 100kHz | | — | 65 | 280 | $\mu V_{rms}$ |
| Ripple Rejection | | R.R. | 3 | f = 120Hz, $I_{OUT}$ = 100mA, 13.5V ≦ $V_{IN}$ ≦ 23.5V, $T_j$ = 25°C | | 55 | 62 | — | dB |
| Short Circuit Current Limit | | $I_{SC}$ | 1 | $T_j$ = 25°C | | — | 960 | — | mA |
| Dropout Voltage | | $V_D$ | 1 | Ta = 25°C | | — | 1.7 | — | V |
| Average Temperature Coefficient Of Output Voltage | | $T_{CVO}$ | 1 | $I_{OUT}$ = 5mA | | — | −1.3 | — | mV / °C |

TA78M12S

**ELECTRICAL CHARACTERISTICS**

($V_{IN}$ = 19V, $I_{OUT}$ = 350mA, 0°C ≦ $T_j$ ≦ 125°C, $C_{IN}$ = 0.33μF, $C_{OUT}$ = 0.1μF, unless otherwise noted)

| CHARACTERISTIC | SYMBOL | TEST CIRCUIT | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|---|
| Output Voltage | $V_{OUT}$ | 1 | $T_j$ = 25°C | 11.5 | 12.0 | 12.5 | V |
| Line Regulation | Reg.line | 1 | $T_j$ = 25°C, 14.5V ≦ $V_{IN}$ ≦ 30V, $I_{OUT}$ = 200mA | — | 7 | 100 | mV |
| | | | $T_j$ = 25°C, 16V ≦ $V_{IN}$ ≦ 30V, $I_{OUT}$ = 200mA | — | 3 | 50 | |
| Load Regulation | Reg.load | 1 | $T_j$ = 25°C, 5mA ≦ $I_{OUT}$ ≦ 500mA | — | 27 | 240 | mV |
| | | | $T_j$ = 25°C, 5mA ≦ $I_{OUT}$ ≦ 200mA | — | 10 | 120 | |
| Output Voltage | $V_{OUT}$ | 1 | 14.5V ≦ $V_{IN}$ ≦ 27V, 5mA ≦ $I_{OUT}$ ≦ 350mA | 11.4 | — | 12.6 | V |
| Quiescent Current | $I_B$ | 1 | $T_j$ = 25°C | — | 4.8 | 8.0 | mA |
| Quiescent Current Change — Line | $\Delta I_{BI}$ | 1 | 15V ≦ $V_{IN}$ ≦ 30.5V, $I_{OUT}$ = 200mA | — | — | 0.8 | mA |
| Quiescent Current Change — Load | $\Delta I_{BO}$ | 1 | 5mA ≦ $I_{OUT}$ ≦ 350mA | — | — | 0.5 | |
| Output Noise Voltage | $V_{NO}$ | 2 | Ta = 25°C, 10Hz ≦ f ≦ 100kHz | — | 70 | 300 | μ$V_{rms}$ |
| Ripple Rejection | R.R. | 3 | f = 120Hz, $I_{OUT}$ = 100mA, 15V ≦ $V_{IN}$ ≦ 25V, $T_j$ = 25°C | 55 | 62 | — | dB |
| Short Circuit Current Limit | $I_{SC}$ | 1 | $T_j$ = 25°C | — | 960 | — | mA |
| Dropout Voltage | $V_D$ | 1 | Ta = 25°C | — | 1.7 | — | V |
| Average Temperature Coefficient Of Output Voltage | $T_{CVO}$ | 1 | $I_{OUT}$ = 5mA | — | −1.6 | — | mV / °C |

TA78M15S

**ELECTRICAL CHARACTERISTICS**

($V_{IN}$ = 23V, $I_{OUT}$ = 350mA, 0°C ≦ $T_j$ ≦ 125°C, $C_{IN}$ = 0.33μF, $C_{OUT}$ = 0.1μF, unless otherwise noted)

| CHARACTERISTIC | | SYMBOL | TEST CIRCUIT | TEST CONDITION | | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| Output Voltage | | $V_{OUT}$ | 1 | $T_j$ = 25°C | | 14.4 | 15.0 | 15.6 | V |
| Line Regulation | | Reg.line | 1 | $T_j$ = 25°C | 17.5V ≦ $V_{IN}$ ≦ 30V, $I_{OUT}$ = 200mA | — | 8 | 100 | mV |
| | | | | | 20V ≦ $V_{IN}$ ≦ 30V, $I_{OUT}$ = 200mA | — | 4 | 50 | |
| Load Regulation | | Reg.load | 1 | $T_j$ = 25°C | 5mA ≦ $I_{OUT}$ ≦ 500mA | — | 27 | 300 | mV |
| | | | | | 5mA ≦ $I_{OUT}$ ≦ 200mA | — | 10 | 150 | |
| Output Voltage | | $V_{OUT}$ | 1 | $T_j$ = 25°C | 17.5V ≦ $V_{IN}$ ≦ 30V, 5mA ≦ $I_{OUT}$ ≦ 350mA | 14.25 | — | 15.75 | V |
| Quiescent Current | | $I_B$ | 1 | $T_j$ = 25°C | | — | 4.8 | 8.0 | mA |
| Quiescent Current Change | Line | $\Delta I_{BI}$ | 1 | 18V ≦ $V_{IN}$ ≦ 30.5V, $I_{OUT}$ = 200mA | | — | — | 0.8 | mA |
| | Load | $\Delta I_{BO}$ | 1 | 5mA ≦ $I_{OUT}$ ≦ 350mA | | — | — | 0.5 | |
| Output Noise Voltage | | $V_{NO}$ | 2 | Ta = 25°C, 10Hz ≦ f ≦ 100kHz | | — | 80 | 450 | μ$V_{rms}$ |
| Ripple Rejection | | R.R. | 3 | f = 120Hz, $I_{OUT}$ = 100mA, 18.5V ≦ $V_{IN}$ ≦ 28.5V, $T_j$ = 25°C | | 54 | 61 | — | dB |
| Short Circuit Current Limit | | $I_{SC}$ | 1 | $T_j$ = 25°C | | — | 960 | — | mA |
| Dropout Voltage | | $V_D$ | 1 | Ta = 25°C | | — | 1.7 | — | V |
| Average Temperature Coefficient Of Output Voltage | | $T_{CVO}$ | 1 | $I_{OUT}$ = 5mA | | — | −2.0 | — | mV / °C |

TA78M18S

**ELECTRICAL CHARACTERISTICS**

($V_{IN}$ = 27V, $I_{OUT}$ = 350mA, 0°C ≦ $T_j$ ≦ 125°C, $C_{IN}$ = 0.33μF, $C_{OUT}$ = 0.1μF, unless otherwise noted)

| CHARACTERISTIC | | SYMBOL | TEST CIRCUIT | TEST CONDITION | | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| Output Voltage | | $V_{OUT}$ | 1 | $T_j$ = 25°C | | 17.3 | 18.0 | 18.7 | V |
| Line Regulation | | Reg.line | 1 | $T_j$ = 25°C | 21V ≦ $V_{IN}$ ≦ 33V, $I_{OUT}$ = 200mA | — | 9 | 100 | mV |
| | | | | | 24V ≦ $V_{IN}$ ≦ 33V, $I_{OUT}$ = 200mA | — | 5 | 50 | |
| Load Regulation | | Reg.load | 1 | $T_j$ = 25°C | 5mA ≦ $I_{OUT}$ ≦ 500mA | — | 28 | 360 | mV |
| | | | | | 5mA ≦ $I_{OUT}$ ≦ 200mA | — | 10 | 180 | |
| Output Voltage | | $V_{OUT}$ | 1 | $T_j$ = 25°C | 21V ≦ $V_{IN}$ ≦ 33V, 5mA ≦ $I_{OUT}$ ≦ 350mA | 17.1 | — | 18.9 | V |
| Quiescent Current | | $I_B$ | 1 | $T_j$ = 25°C | | — | 4.8 | 8.0 | mA |
| Quiescent Current Change | Line | $\Delta I_{BI}$ | 1 | 21.5V ≦ $V_{IN}$ ≦ 33.5V, $I_{OUT}$ = 200mA | | — | — | 0.8 | mA |
| | Load | $\Delta I_{BO}$ | 1 | 5mA ≦ $I_{OUT}$ ≦ 350mA | | — | — | 0.5 | |
| Output Noise Voltage | | $V_{NO}$ | 2 | Ta = 25°C, 10Hz ≦ f ≦ 100kHz | | — | 90 | 490 | $\mu V_{rms}$ |
| Ripple Rejection | | R.R. | 3 | f = 120Hz, $I_{OUT}$ = 100mA, 22V ≦ $V_{IN}$ ≦ 32V, $T_j$ = 25°C | | 53 | 60 | — | dB |
| Short Circuit Current Limit | | $I_{SC}$ | 1 | $T_j$ = 25°C | | — | 960 | — | mA |
| Dropout Voltage | | $V_D$ | 1 | Ta = 25°C | | — | 1.7 | — | V |
| Average Temperature Coefficient Of Output Voltage | | $T_{CVO}$ | 1 | $I_{OUT}$ = 5mA | | — | −2.5 | — | mV / °C |

TA78M20S

**ELECTRICAL CHARACTERISTICS**

($V_{IN}$ = 29V, $I_{OUT}$ = 350mA, 0°C ≦ $T_j$ ≦ 125°C, $C_{IN}$ = 0.33μF, $C_{OUT}$ = 0.1μF, unless otherwise noted)

| CHARACTERISTIC | | SYMBOL | TEST CIR-CUIT | TEST CONDITION | | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| Output Voltage | | $V_{OUT}$ | 1 | $T_j$ = 25°C | | 19.2 | 20.0 | 20.8 | V |
| Line Regulation | | Reg.line | 1 | $T_j$ = 25°C | 23V ≦ $V_{IN}$ ≦ 35V $I_{OUT}$ = 200mA | — | 10 | 100 | mV |
| | | | | | 24V ≦ $V_{IN}$ ≦ 35V $I_{OUT}$ = 200mA | — | 6 | 50 | |
| Load Regulation | | Reg.load | 1 | $T_j$ = 25°C | 5mA ≦ $I_{OUT}$ ≦ 500mA | — | 28 | 400 | mV |
| | | | | | 5mA ≦ $I_{OUT}$ ≦ 200mA | — | 10 | 200 | |
| Output Voltage | | $V_{OUT}$ | 1 | $T_j$ = 25°C | 23V ≦ $V_{IN}$ ≦ 35V 5mA ≦ $I_{OUT}$ ≦ 350mA | 19.0 | — | 21.0 | V |
| Quiescent Current | | $I_B$ | 1 | $T_j$ = 25°C | | — | 4.9 | 8.0 | mA |
| Quiescent Current Change | Line | $\Delta I_{BI}$ | 1 | 23.5V ≦ $V_{IN}$ ≦ 35.5V, $I_{OUT}$ = 200mA | | — | — | 0.8 | mA |
| | Load | $\Delta I_{BO}$ | 1 | 5mA ≦ $I_{OUT}$ ≦ 350mA | | — | — | 0.5 | |
| Output Noise Voltage | | $V_{NO}$ | 2 | Ta = 25°C, 10Hz ≦ f ≦ 100kHz | | — | 95 | 540 | $\mu V_{rms}$ |
| Ripple Rejection | | R.R. | 3 | f = 120Hz, $I_{OUT}$ = 100mA 24V ≦ $V_{IN}$ ≦ 34V, $T_j$ = 25°C | | 53 | 60 | — | dB |
| Short Circuit Current Limit | | $I_{SC}$ | 1 | $T_j$ = 25°C | | — | 960 | — | mA |
| Dropout Voltage | | $V_D$ | 1 | Ta = 25°C | | — | 1.7 | — | V |
| Average Temperature Coefficient Of Output Voltage | | $T_{CVO}$ | 1 | $I_{OUT}$ = 5mA | | — | −3.0 | — | mV / °C |

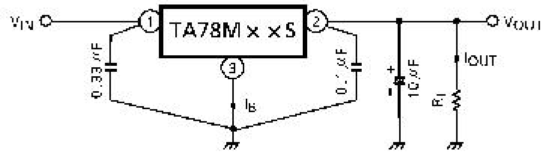
TA78M24S

**ELECTRICAL CHARACTERISTICS**

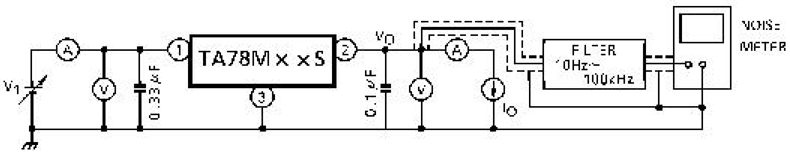
($V_{IN}$ = 33V, $I_{OUT}$ = 350mA, 0°C ≤ $T_j$ ≤ 125°C, $C_{IN}$ = 0.33μF, $C_{OUT}$ = 0.1μF, unless otherwise noted)

| CHARACTERISTIC | | SYMBOL | TEST CIR-CUIT | TEST CONDITION | | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| Output Voltage | | $V_{OUT}$ | 1 | $T_j$ = 25°C | | 23.0 | 24.0 | 25.0 | V |
| Line Regulation | | Reg.line | 1 | $T_j$ = 25°C | 27V ≤ $V_{IN}$ ≤ 38V, $I_{OUT}$ = 200mA | — | 12 | 100 | mV |
| | | | | | 28V ≤ $V_{IN}$ ≤ 38V, $I_{OUT}$ = 200mA | — | 7 | 50 | |
| Load Regulation | | Reg.load | 1 | $T_j$ = 25°C | 5mA ≤ $I_{OUT}$ ≤ 500mA | — | 30 | 480 | mV |
| | | | | | 5mA ≤ $I_{OUT}$ ≤ 200mA | — | 10 | 240 | |
| Output Voltage | | $V_{OUT}$ | 1 | $T_j$ = 25°C | 27V ≤ $V_{IN}$ ≤ 38V, 5mA ≤ $I_{OUT}$ ≤ 350mA | 22.8 | — | 25.2 | V |
| Quiescent Current | | $I_B$ | 1 | $T_j$ = 25°C | | — | 5.0 | 8.0 | mA |
| Quiescent Current Change | Line | $\Delta I_{BI}$ | 1 | 27.5V ≤ $V_{IN}$ ≤ 38.5V, $I_{OUT}$ = 200mA | | — | — | 0.8 | mA |
| | Load | $\Delta I_{BO}$ | 1 | 5mA ≤ $I_{OUT}$ ≤ 350mA | | — | — | 0.5 | |
| Output Noise Voltage | | $V_{NO}$ | 2 | Ta = 25°C, 10Hz ≤ f ≤ 100kHz | | — | 115 | 650 | $\mu V_{rms}$ |
| Ripple Rejection | | R.R. | 3 | f = 120Hz, $I_{OUT}$ = 100mA, 28V ≤ $V_{IN}$ ≤ 38V, $T_j$ = 25°C | | 50 | 57 | — | dB |
| Short Circuit Current Limit | | $I_{SC}$ | 1 | $T_j$ = 25°C | | — | 960 | — | mA |
| Dropout Voltage | | $V_D$ | 1 | Ta = 25°C | | — | 1.7 | — | V |
| Average Temperature Coefficient Of Output Voltage | | $T_{CVO}$ | 1 | $I_{OUT}$ = 5mA | | — | −3.5 | — | mV / °C |

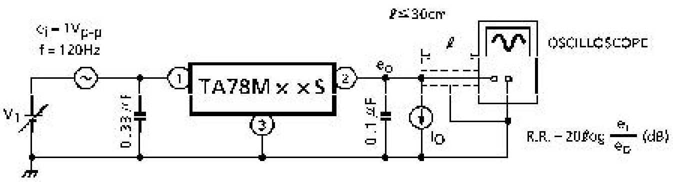
**TEST CIRCUIT 1 / STANDARD APPLICATION**



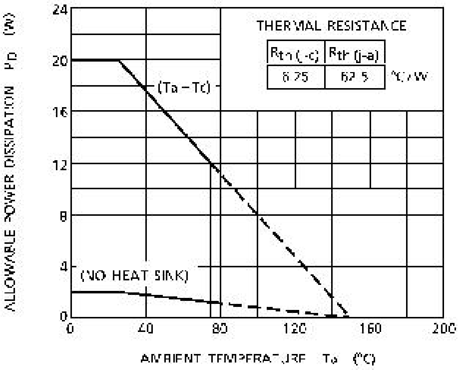

**TEST CIRCUIT 2** $V_{NO}$



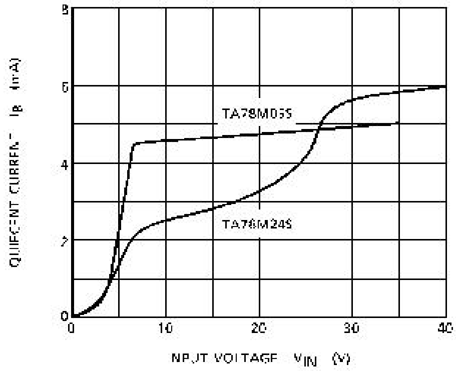

**TEST CIRCUIT 3** R.R.



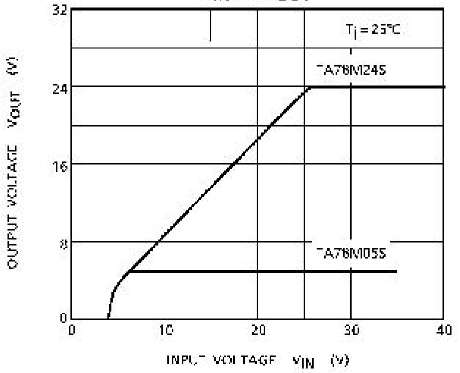
$P_D$ – Ta



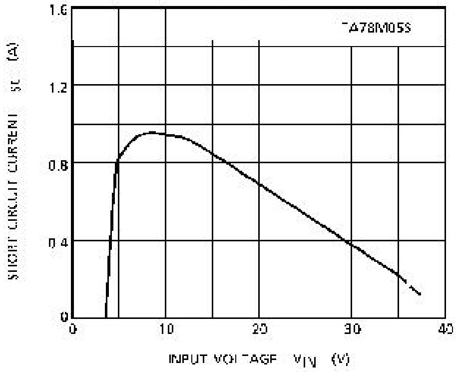

$V_{IN}$ – $I_B$



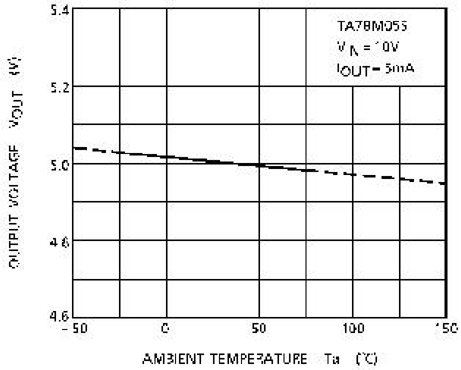

$V_{IN}$ – $V_{OUT}$



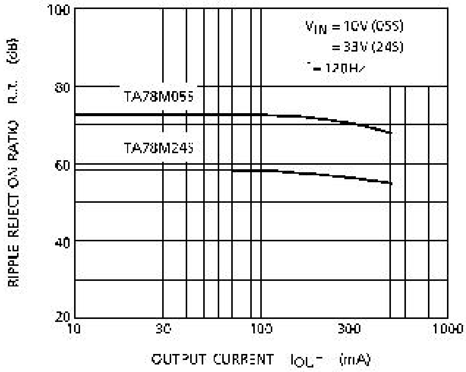

$V_{IN}$ – $I_{SC}$

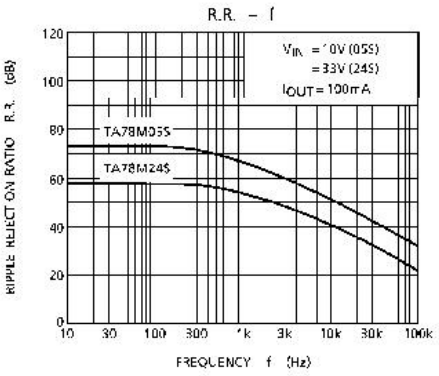



$V_{OUT}$ – Ta




R.R. – $I_{OUT}$

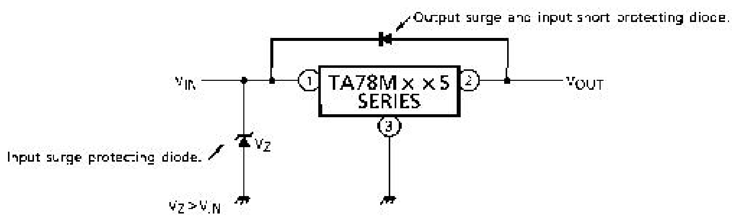



R.R. – f
VIN = 10V (05S)
= 33V (24S)
IOUT = 100mA
TA78M05S
TA78M24S
RIPPLE REJECTION RATIO R.R. (dB)
FREQUENCY f (Hz)
0
20
40
60
80
100
120
10
30
100
300
1k
3k
10k
30k
100k

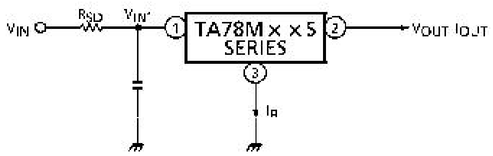
**PRECAUTIONS ON APPLICATION**

(1) In regard to GND, be careful not to apply a negative voltage to the input/output terminal. Further, special care is necessary in case of a voltage boost application.

(2) When a surge voltage exceeding maximum rating is applied to the input terminal or when a voltage in excess of the input terminal voltage is applied to the output terminal, the circuit may be destroyed.
Specially, in the latter case, great care is necessary.
Further, if the input terminal sorts to GND in a state of normal operation, the output terminal voltage becomes higher than the input voltage (GND potential), and the electric charge of a chemical capacitor connected to the output terminal flows into the input side, which may cause the destruction of circuit.
In these cases, take such steps as a zener diode and a general silicon diode are connected to the circuit, as shown in the following figure.




(3) When the input voltage is too high, the power dissipation of three terminal regulator increases because of series regulator, so that the junction temperature rises. In such a case, it is recommended to reduce the power dissipation by inserting the power limiting resistor $R_{SD}$ in the input terminal, and to reduce the junction temperature as a result.




The power dissipation $P_D$ of IC is expressed in the following equation.

$$P_D = (V_{IN'} - V_{OUT}) \cdot I_{OUT} + V_{IN'} \cdot I_B$$

If $V_{IN'}$ is reduced below the lowest voltage necessary for the IC, the parasitic oscillation will be caused according to circumstances.
In determing the resistance value of $R_{SD}$, design with margin should be made by making reference to the following equation.

$$R_{SD} < \frac{V_{IN} - V_{IN'}}{I_{OUT} + I_B}$$

(4) Connect the input terminal and GND, and the output terminal and GND, by capacitor respectively. The capacitances should be determined experimentally because they depend on prented patterns. In particular, adequate investigation should be made so that there is no problem even at time of high or low temperature.

(5) Installation of IC for power supply
For obtaining high reliability on the heat sink design of the regulator IC, it is generally required to derate more than 20% of maximum junction temperature ($T_j$ MAX.).
Further, full consideration should be given to the installation of IC to the heat sink.

(a) Heat sink design

The thermal resistance of IC itself is required from the viewpoint of the design of elements, but the thermal resistance from the IC package to the open air varies with the contact thermal resistance.
Table 1 shows how much the value of the contact thermal resistance ($\theta_C + \theta_S$) is changed by heat sink grease.

TABLE 1 Unit : °C/W

| PACKAGE | MODEL No. | TORQUE | MICA | $\theta_C + \theta_S$ |
|---|---|---|---|---|
| TO-220NIS | TA78M××S | 0.6N·m | Not Provided | 0.3~0.5 (1.5~2.0) |

The figures given in parentheses denote the values at time of no grease.

(b) Silicon grease

When a circuit not exceeding maximum rating is designed, it is to be desired that the grease should be used if possible. If it is required that the contact thermal resistance is reduced from the viewpoint of the circuit design, it is recommended that the following methods be adopted.

A : Use YG6260 (TOSHIBA SILICON CORPORATION), if grease is used.

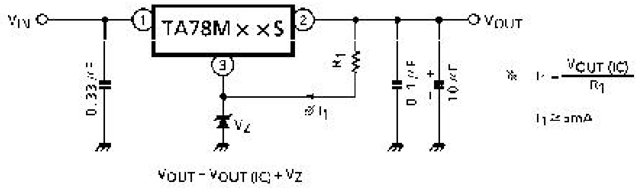
(c) Torque

When installing IC on a heat sink or the like, tighten the IC with the torque of less than the rated value. If it is tightened with the torque in excess of the rated value, sometimes the internal elements of the IC are adversely affected. Therefore, great care should be given to the installing operation.

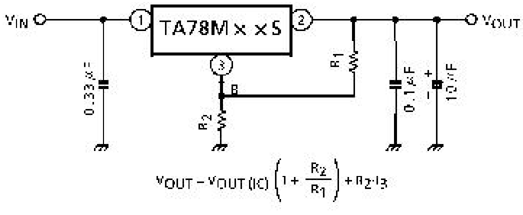
## APPLICATION CIRCUITS

(1) VOLTAGE BOOST REGULATOR

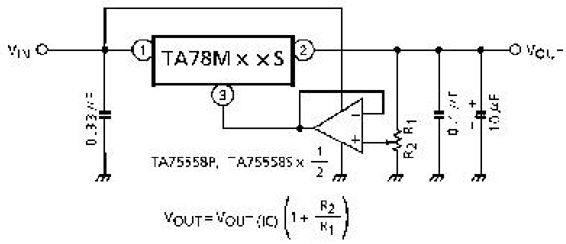
(a) Voltage boost by use of zener diode




(b) Voltage boost by use of resistor

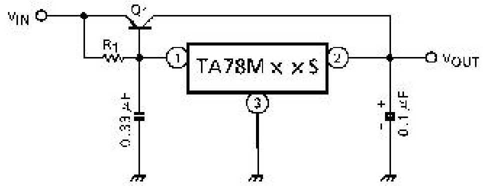



(c) Adjustable output regulator



(2) CURRENT BOOST REGULATOR

(a) CURRENT BOOST VOLTAGE REGULATOR




Heat sink is needed for $Q_1$

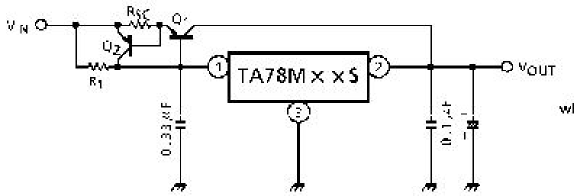
$$R_1 \leq \frac{V_{BE1}}{I_{B\ MAX}}$$

where,

$V_{BE1}$ : $V_{BE}$ of external transistor $Q_1$.

$I_{B\ MAX}$ : Quiescent current of IC

(b) SHORT-CIRCUIT PROTECTION

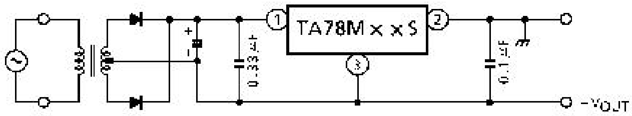



$$R_{SC} = \frac{V_{BE2}}{I_{SC}}$$

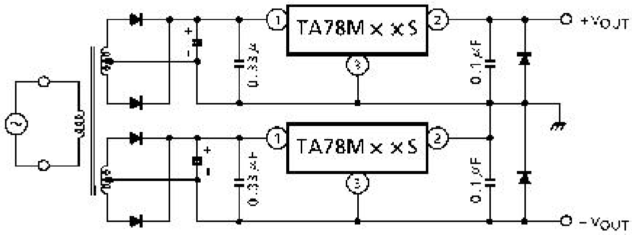
where,

$I_{SC}$ : Short-circuit current

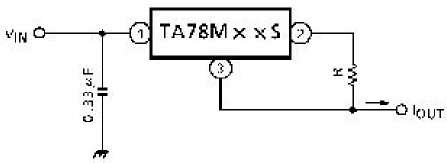
(3) NEGATIVE REGULATOR




(4) POSITIVE AND NEGATIVE REGULATOR



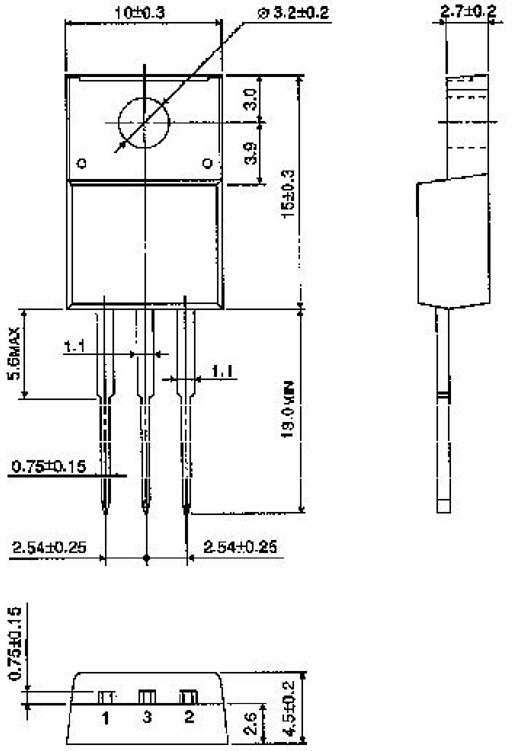

(5) CURRENT REGULATOR




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

**OUTLINE DRAWING**
HSIP3-P-2.54A

Unit : mm




Weight : 1.7g (Typ.)