

**500mA 3-TERMINAL POSITIVE VOLTAGE REGULATOR****AZ78MXX****General Description**

The AZ78MXX series are monolithic integrated circuits designed as fixed-voltage regulators for a wide variety of applications including local, on-card regulation.

This series of regulators are complete with internal current limiting, thermal shutdown protection, and safe-area compensation which make them virtually immune from output overload. If adequate heat sinking are provided, these regulators can deliver output currents up to 0.5A.

The AZ78MXX series are available in two standard plastic packages: TO-220 and TO-252.

**Features**

- Output Current up to 0.5A
- Fixed Output Voltages of 5V, 6V, 8V, 9V and 12V
- Output Voltage Tolerances of  $\pm 5\%$  over the Full Temperature Range
- Internal Short Circuit Current-Limiting
- Internal Thermal Overload Protection

**Applications**

- Consumer Electronics
- Microprocessor Power Supply
- Mother Board I/O Power Supply

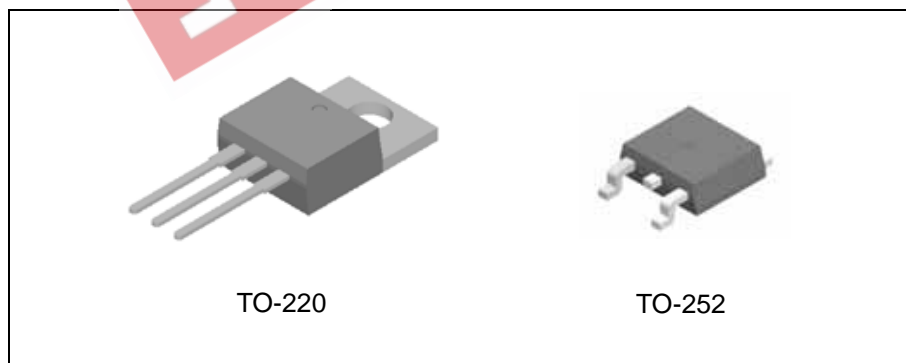


Figure 1. Package Types of AZ78MXX



**500mA 3-TERMINAL POSITIVE VOLTAGE REGULATOR**

**AZ78MXX**

**Pin Configuration**

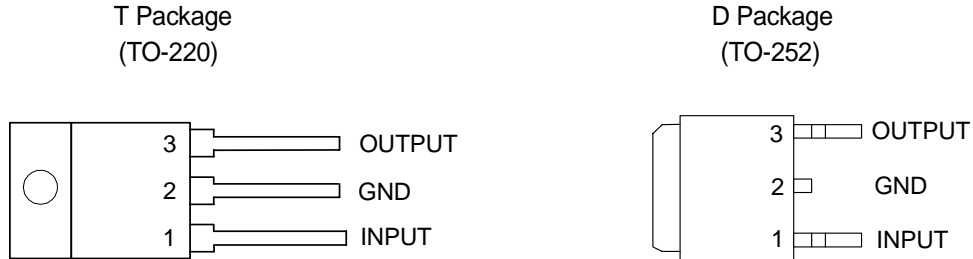


Figure 2. Pin Configuration of AZ78MXX (Top View)



**Pin Description**

| Pin Number | Pin Name | Function       |
|------------|----------|----------------|
| 1          | INPUT    | Voltage Input  |
| 2          | GND      | Ground         |
| 3          | OUTPUT   | Voltage Output |



**500mA 3-TERMINAL POSITIVE VOLTAGE REGULATOR**

**AZ78MXX**

**Functional Block Diagram**

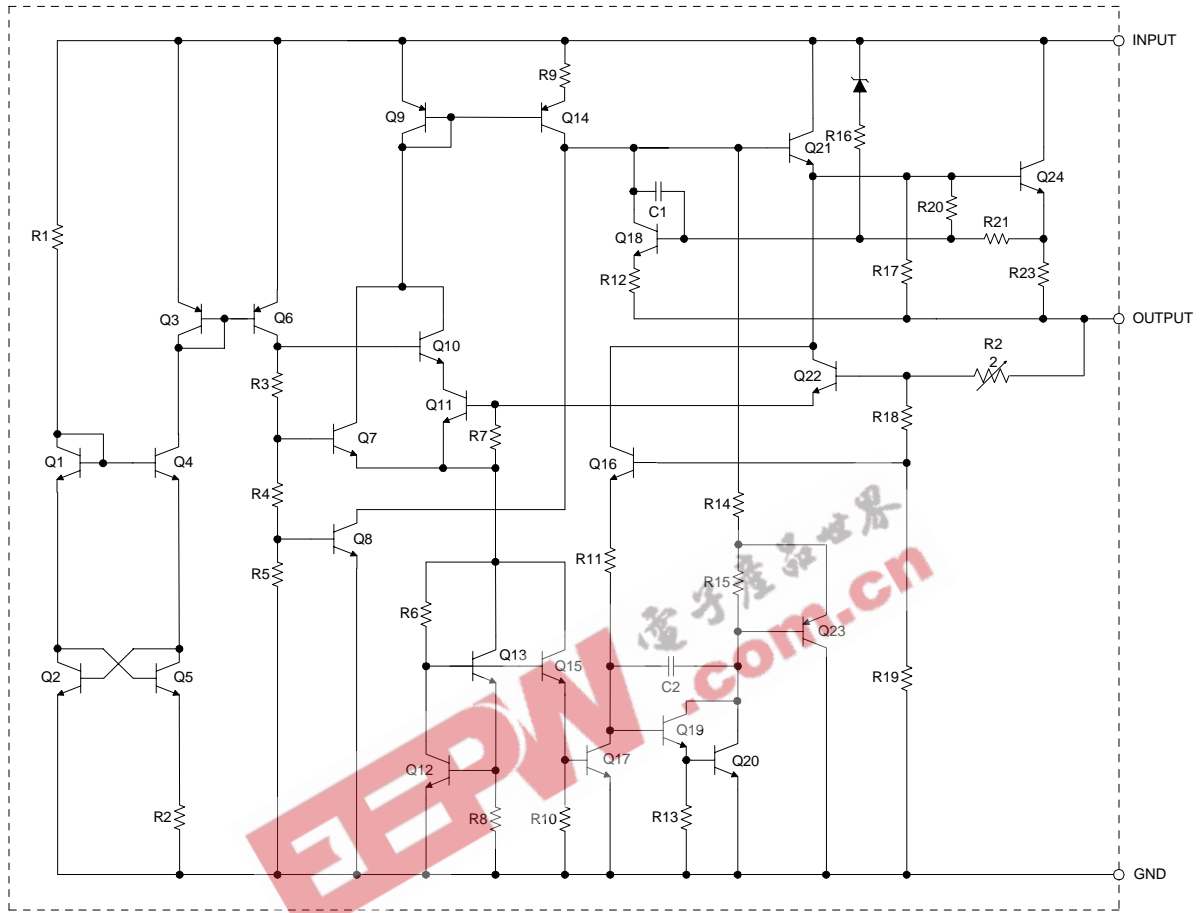


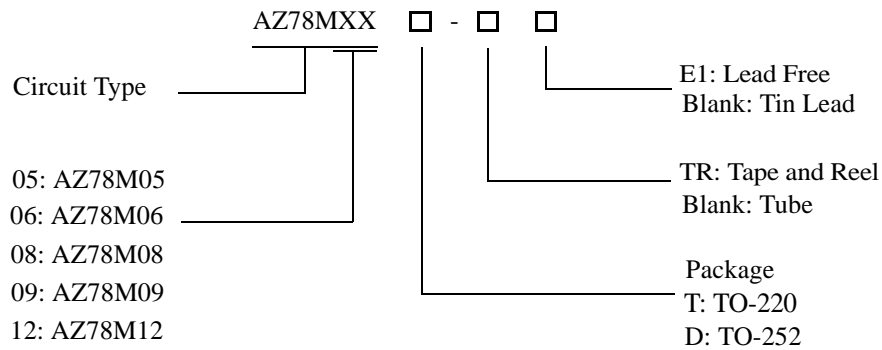
Figure 3. Functional Block Diagram of AZ78MXX



**500mA 3-TERMINAL POSITIVE VOLTAGE REGULATOR**

**AZ78MXX**

**Ordering Information**



| Package | Temperature Range | Part Number |               | Marking ID |             | Packing Type |
|---------|-------------------|-------------|---------------|------------|-------------|--------------|
|         |                   | Tin Lead    | Lead Free     | Tin Lead   | Lead Free   |              |
| TO-220  | -40 to 125°C      | AZ78M05T    | AZ78M05T-E1   | AZ78M05T   | AZ78M05T-E1 | Tube         |
|         |                   | AZ78M06T    | AZ78M06T-E1   | AZ78M06T   | AZ78M06T-E1 | Tube         |
|         |                   | AZ78M08T    | AZ78M08T-E1   | AZ78M08T   | AZ78M08T-E1 | Tube         |
|         |                   | AZ78M09T    | AZ78M09T-E1   | AZ78M09T   | AZ78M09T-E1 | Tube         |
|         |                   | AZ78M12T    | AZ78M12T-E1   | AZ78M12T   | AZ78M12T-E1 | Tube         |
| TO-252  | -40 to 125°C      | AZ78M05D    | AZ78M05D-E1   | AZ78M05D   | AZ78M05D-E1 | Tube         |
|         |                   | AZ78M05DTR  | AZ78M05DTR-E1 | AZ78M05D   | AZ78M05D-E1 | Tape & Reel  |
|         |                   | AZ78M06D    | AZ78M06D-E1   | AZ78M06D   | AZ78M06D-E1 | Tube         |
|         |                   | AZ78M06DTR  | AZ78M06DTR-E1 | AZ78M06D   | AZ78M06D-E1 | Tape & Reel  |
|         |                   | AZ78M08D    | AZ78M08D-E1   | AZ78M08D   | AZ78M08D-E1 | Tube         |
|         |                   | AZ78M08DTR  | AZ78M08DTR-E1 | AZ78M08D   | AZ78M08D-E1 | Tape & Reel  |
|         |                   | AZ78M09D    | AZ78M09D-E1   | AZ78M09D   | AZ78M09D-E1 | Tube         |
|         |                   | AZ78M09DTR  | AZ78M09DTR-E1 | AZ78M09D   | AZ78M09D-E1 | Tape & Reel  |
|         |                   | AZ78M12D    | AZ78M12D-E1   | AZ78M12D   | AZ78M12D-E1 | Tube         |
|         |                   | AZ78M12DTR  | AZ78M12DTR-E1 | AZ78M12D   | AZ78M12D-E1 | Tape & Reel  |

BCD Semiconductor's Pb-free products, as designated with "E1" suffix in the part number, are RoHS compliant.

**500mA 3-TERMINAL POSITIVE VOLTAGE REGULATOR****AZ78MXX****Absolute Maximum Ratings (Note 1)**

| Parameter                             | Symbol    | Value              | Unit |
|---------------------------------------|-----------|--------------------|------|
| Input Voltage                         | $V_{IN}$  | 20                 | V    |
| Lead Temperature (Soldering, 10 sec.) |           | 300                | °C   |
| Power Dissipation                     | $P_D$     | Internally Limited |      |
| Storage Temperature Range             | $T_{STG}$ | -65 to 150         | °C   |
| ESD (Machine Model)                   | ESD       | 450                | V    |

Note 1: Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "Recommended Operating Conditions" is not implied. Exposure to "Absolute Maximum Ratings" for extended periods may affect device reliability.

**Recommended Operating Conditions**

| Parameter                            | Symbol   | Min | Max | Unit |
|--------------------------------------|----------|-----|-----|------|
| Supply Voltage                       | $V_{CC}$ | 7.5 | 18  | V    |
| Operating Junction Temperature Range | $T_J$    | -40 | 125 | °C   |



**500mA 3-TERMINAL POSITIVE VOLTAGE REGULATOR**

**AZ78MXX**

**Electrical Characteristics**

**AZ78M05** ( $V_{IN}=10V$ ,  $I_{OUT}=350mA$ ,  $T_J=-40^{\circ}C$  to  $125^{\circ}C$ ,  $P_D \leq 5W$ , unless otherwise noted)

| Parameter                | Symbol                         | Conditions   | Min  | Typ       | Max  | Unit           |
|--------------------------|--------------------------------|--|------|-----------|------|----------------|
| Output Voltage           | $V_{OUT}$                      | $T_J=25^{\circ}C$  | 4.8  | 5         | 5.2  | V              |
|                          |                                | $V_{IN}=7V$ to $15V$ , $I_{OUT}=5mA$ to $350mA$            | 4.75 | 5         | 5.25 | V              |
| Line Regulation          | $V_{RLINE}$                    | $T_J=25^{\circ}C$ , $V_{IN}=7V$ to $15V$ , $I_{OUT}=200mA$ |      | 3         | 50   | mV             |
| Load Regulation          | $V_{RLOAD}$                    | $T_J=25^{\circ}C$ , $I_{OUT}=5mA$ to $500mA$               |      | 20        | 100  | mV             |
| Quiescent Current        | $I_Q$                          | $T_J=25^{\circ}C$  |      | 3.2       | 6    | mA             |
| Quiescent Current Change | $\Delta I_Q$                   | $V_{IN}=8V$ to $15V$ , $I_{OUT}=200mA$                     |      |           | 0.8  | mA             |
|                          |                                | $I_{OUT}=5mA$ to $350mA$                                   |      |           | 0.5  |                |
| Ripple Rejection         | $\Delta V_{IN}/\Delta V_{OUT}$ | $V_{IN}=8V$ to $15V$ , $f=120Hz$ , $I_{OUT}=200mA$         | 62   | 73        |      | dB             |
| Dropout Voltage          | $V_{IN}-V_{OUT}$               | $\Delta V_{OUT}=1\%$ , $T_J=25^{\circ}C$                   |      | 2         |      | V              |
| Output Noise Voltage     | $N_O$                          | $T_A=25^{\circ}C$ , $f=10Hz$ to $100KHz$                   |      | 40        |      | $\mu V$        |
| Short Circuit Current    | $I_{SC}$                       | $T_J=25^{\circ}C$ , $V_{IN}=15V$                           |      | 350       |      | mA             |
| Peak Output Current      | $I_{PK}$                       | $T_J=25^{\circ}C$  |      | 700       |      | mA             |
| Output Voltage Drift     | $\Delta V_{OUT}/\Delta T$      | $I_{OUT}=5mA$  |      | $\pm 0.2$ |      | $mV/^{\circ}C$ |

**AZ78M06** ( $V_{IN}=11V$ ,  $I_{OUT}=350mA$ ,  $T_J=-40^{\circ}C$  to  $125^{\circ}C$ ,  $P_D \leq 5W$ , unless otherwise noted)

| Parameter                | Symbol                         | Condition  | Min  | Typ       | Max  | Unit           |
|--------------------------|--------------------------------|--|------|-----------|------|----------------|
| Output Voltage           | $V_{OUT}$                      | $T_J=25^{\circ}C$  | 5.75 | 6         | 6.25 | V              |
|                          |                                | $V_{IN}=8V$ to $15V$ , $I_{OUT}=5mA$ to $350mA$            | 5.7  | 6         | 6.3  | V              |
| Line Regulation          | $V_{RLINE}$                    | $T_J=25^{\circ}C$ , $V_{IN}=8V$ to $15V$ , $I_{OUT}=200mA$ |      | 5         | 50   | mV             |
| Load Regulation          | $V_{RLOAD}$                    | $T_J=25^{\circ}C$ , $I_{OUT}=5mA$ to $500mA$               |      | 20        | 120  | mV             |
| Quiescent Current        | $I_Q$                          | $T_J=25^{\circ}C$  |      | 3.2       | 6    | mA             |
| Quiescent Current Change | $\Delta I_Q$                   | $V_{IN}=9V$ to $15V$ , $I_{OUT}=200mA$                     |      |           | 0.8  | mA             |
|                          |                                | $I_{OUT}=5mA$ to $350mA$                                   |      |           | 0.5  |                |
| Ripple Rejection         | $\Delta V_{IN}/\Delta V_{OUT}$ | $V_{IN}=9V$ to $15V$ , $f=120Hz$ , $I_{OUT}=200mA$         | 59   | 65        |      | dB             |
| Dropout Voltage          | $V_{IN}-V_{OUT}$               | $\Delta V_{OUT}=1\%$ , $T_J=25^{\circ}C$                   |      | 2         |      | V              |
| Output Noise Voltage     | $N_O$                          | $T_A=25^{\circ}C$ , $f=10Hz$ to $100KHz$                   |      | 45        |      | $\mu V$        |
| Short Circuit Current    | $I_{SC}$                       | $T_J=25^{\circ}C$ , $V_{IN}=15V$                           |      | 350       |      | mA             |
| Peak Output Current      | $I_{PK}$                       | $T_J=25^{\circ}C$  |      | 700       |      | mA             |
| Output Voltage Drift     | $\Delta V_{OUT}/\Delta T$      | $I_{OUT}=5mA$  |      | $\pm 0.2$ |      | $mV/^{\circ}C$ |



**500mA 3-TERMINAL POSITIVE VOLTAGE REGULATOR**

**AZ78MXX**

**Electrical Characteristics (Continued)**

**AZ78M08** ( $V_{IN}=14V$ ,  $I_{OUT}=350mA$ ,  $T_J=-40^{\circ}C$  to  $125^{\circ}C$ ,  $P_D \leq 5W$ , unless otherwise noted)

| Parameter                | Symbol                         | Conditions  | Min | Typ       | Max | Unit            |
|--------------------------|--------------------------------|---|-----|-----------|-----|-----------------|
| Output Voltage           | $V_{OUT}$                      | $T_J=25^{\circ}C$   | 7.7 | 8         | 8.3 | V               |
|                          |                                | $V_{IN}=10.5V$ to $15V$ , $I_{OUT}=5mA$ to $350mA$            | 7.6 | 8         | 8.4 | V               |
| Line Regulation          | $V_{RLINE}$                    | $T_J=25^{\circ}C$ , $V_{IN}=10.5V$ to $15V$ , $I_{OUT}=200mA$ |     | 6         | 50  | mV              |
| Load Regulation          | $V_{RLOAD}$                    | $T_J=25^{\circ}C$ , $I_{OUT}=5mA$ to $500mA$                  |     | 25        | 160 | mV              |
| Quiescent Current        | $I_Q$                          | $T_J=25^{\circ}C$   |     | 3.2       | 6   | mA              |
| Quiescent Current Change | $\Delta I_Q$                   | $V_{IN}=10.5V$ to $15V$ , $I_{OUT}=200mA$                     |     |           | 0.8 | mA              |
|                          |                                | $I_{OUT}=5mA$ to $350mA$                                      |     |           | 0.5 |                 |
| Ripple Rejection         | $\Delta V_{IN}/\Delta V_{OUT}$ | $V_{IN}=11V$ to $15V$ , $f=120Hz$ , $I_{OUT}=200mA$           | 56  | 62        |     | dB              |
| Dropout Voltage          | $V_{IN}-V_{OUT}$               | $\Delta V_{OUT}=1\%$ , $T_J=25^{\circ}C$                      |     | 2         |     | V               |
| Output Noise Voltage     | $N_O$                          | $T_A=25^{\circ}C$ , $f=10Hz$ to $100KHz$                      |     | 52        |     | $\mu V$         |
| Short Circuit Current    | $I_{SC}$                       | $T_J=25^{\circ}C$ , $V_{IN}=15V$                              |     | 350       |     | mA              |
| Peak Output Current      | $I_{PK}$                       | $T_J=25^{\circ}C$   |     | 700       |     | mA              |
| Output Voltage Drift     | $\Delta V_{OUT}/\Delta T$      | $I_{OUT}=5mA$   |     | $\pm 0.2$ |     | mV/ $^{\circ}C$ |

**AZ78M09** ( $V_{IN}=15V$ ,  $I_{OUT}=350mA$ ,  $T_J=-40^{\circ}C$  to  $125^{\circ}C$ ,  $P_D \leq 5W$ , unless otherwise noted)

| Parameter                | Symbol                         | Condition   | Min  | Typ       | Max  | Unit            |
|--------------------------|--------------------------------|---|------|-----------|------|-----------------|
| Output Voltage           | $V_{OUT}$                      | $T_J=25^{\circ}C$   | 8.65 | 9         | 9.35 | V               |
|                          |                                | $V_{IN}=11.5V$ to $15V$ , $I_{OUT}=5mA$ to $350mA$            | 8.55 | 9         | 9.45 | V               |
| Line Regulation          | $V_{RLINE}$                    | $T_J=25^{\circ}C$ , $V_{IN}=11.5V$ to $15V$ , $I_{OUT}=200mA$ |      | 6         | 50   | mV              |
| Load Regulation          | $V_{RLOAD}$                    | $T_J=25^{\circ}C$ , $I_{OUT}=5mA$ to $500mA$                  |      | 25        | 180  | mV              |
| Quiescent Current        | $I_Q$                          | $T_J=25^{\circ}C$   |      | 3.2       | 6    | mA              |
| Quiescent Current Change | $\Delta I_Q$                   | $V_{IN}=11.5V$ to $15V$ , $I_{OUT}=200mA$                     |      |           | 0.8  | mA              |
|                          |                                | $I_{OUT}=5mA$ to $350mA$                                      |      |           | 0.5  |                 |
| Ripple Rejection         | $\Delta V_{IN}/\Delta V_{OUT}$ | $V_{IN}=12V$ to $15V$ , $f=120Hz$ , $I_{OUT}=200mA$           | 56   | 61        |      | dB              |
| Dropout Voltage          | $V_{IN}-V_{OUT}$               | $\Delta V_{OUT}=1\%$ , $T_J=25^{\circ}C$                      |      | 2         |      | V               |
| Output Noise Voltage     | $N_O$                          | $T_A=25^{\circ}C$ , $f=10Hz$ to $100KHz$                      |      | 52        |      | $\mu V$         |
| Short Circuit Current    | $I_{SC}$                       | $T_J=25^{\circ}C$ , $V_{IN}=15V$                              |      | 350       |      | mA              |
| Peak Output Current      | $I_{PK}$                       | $T_J=25^{\circ}C$   |      | 700       |      | mA              |
| Output Voltage Drift     | $\Delta V_{OUT}/\Delta T$      | $I_{OUT}=5mA$   |      | $\pm 0.2$ |      | mV/ $^{\circ}C$ |

**500mA 3-TERMINAL POSITIVE VOLTAGE REGULATOR****AZ78MXX****Electrical Characteristics (Continued)**AZ78M12 ( $V_{IN}=17V$ ,  $I_{OUT}=350mA$ ,  $T_J=-40^{\circ}C$  to  $125^{\circ}C$ ,  $P_D \leq 5W$ , unless otherwise noted)

| Parameter                | Symbol                         | Conditions  | Min  | Typ       | Max  | Unit            |
|--------------------------|--------------------------------|---|------|-----------|------|-----------------|
| Output Voltage           | $V_{OUT}$                      | $T_J=25^{\circ}C$   | 11.5 | 12        | 12.5 | V               |
|                          |                                | $V_{IN}=14.5V$ to $17V$ , $I_{OUT}=5mA$ to $350mA$            | 11.4 | 12        | 12.6 | V               |
| Line Regulation          | $V_{RLINE}$                    | $T_J=25^{\circ}C$ , $V_{IN}=14.5V$ to $17V$ , $I_{OUT}=200mA$ |      | 8         | 50   | mV              |
| Load Regulation          | $V_{RLOAD}$                    | $T_J=25^{\circ}C$ , $I_{OUT}=5mA$ to $500mA$                  |      | 25        | 240  | mV              |
| Quiescent Current        | $I_Q$                          | $T_J=25^{\circ}C$   |      | 3.2       | 6    | mA              |
| Quiescent Current Change | $\Delta I_Q$                   | $V_{IN}=14.5V$ to $17V$ , $I_{OUT}=200mA$                     |      |           | 0.8  | mA              |
|                          |                                | $I_{OUT}=5mA$ to $350mA$                                      |      |           | 0.5  |                 |
| Ripple Rejection         | $\Delta V_{IN}/\Delta V_{OUT}$ | $V_{IN}=15V$ to $17V$ , $f=120Hz$ , $I_{OUT}=200mA$           | 55   | 60        |      | dB              |
| Dropout Voltage          | $V_{IN}-V_{OUT}$               | $\Delta V_{OUT}=1\%$ , $T_J=25^{\circ}C$                      |      | 2         |      | V               |
| Output Noise Voltage     | $N_O$                          | $T_A=25^{\circ}C$ , $f=10Hz$ to $100KHz$                      |      | 75        |      | $\mu V$         |
| Short Circuit Current    | $I_{SC}$                       | $T_J=25^{\circ}C$ , $V_{IN}=17V$                              |      | 350       |      | mA              |
| Peak Output Current      | $I_{PK}$                       | $T_J=25^{\circ}C$   |      | 700       |      | mA              |
| Output Voltage Drift     | $\Delta V_{OUT}/\Delta T$      | $I_{OUT}=5mA$   |      | $\pm 0.3$ |      | mV/ $^{\circ}C$ |





**500mA 3-TERMINAL POSITIVE VOLTAGE REGULATOR**

**AZ78MXX**

**Typical Performance Characteristics**

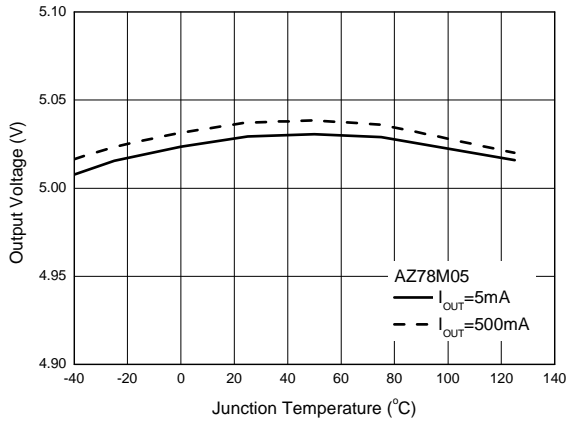


Figure 4. Output Voltage vs. Junction Temperature

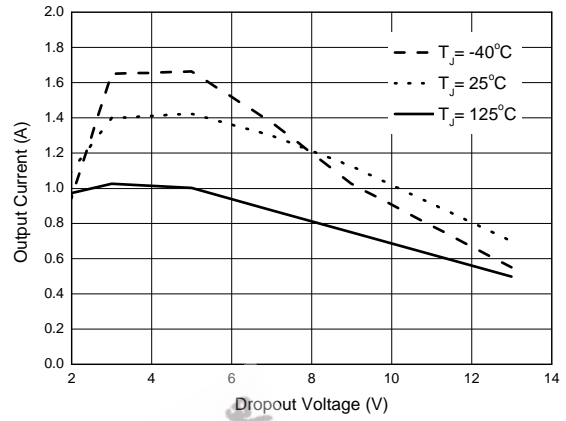


Figure 5. Peak Output Current vs. Dropout Voltage

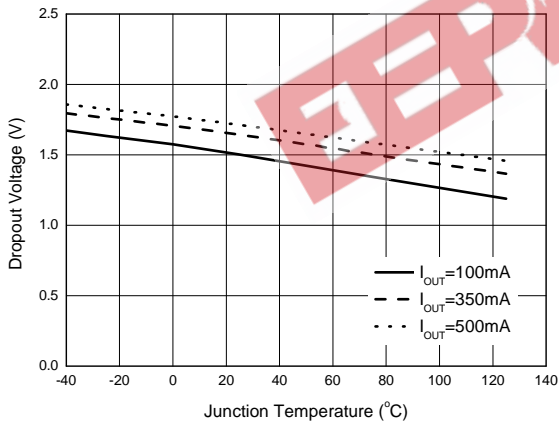


Figure 6. Dropout Voltage vs. Junction Temperature

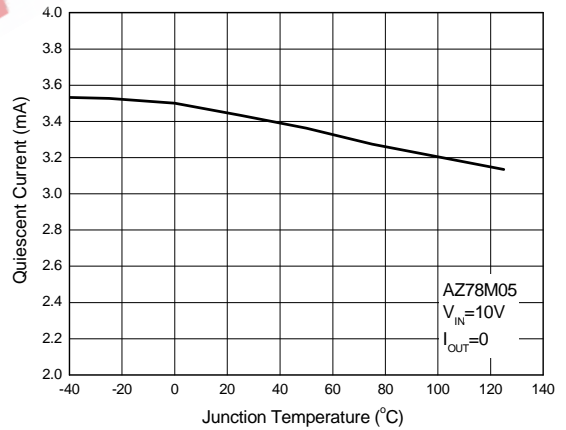


Figure 7. Quiescent Current vs. Junction Temperature



**500mA 3-TERMINAL POSITIVE VOLTAGE REGULATOR**

**AZ78MXX**

**Typical Performance Characteristics (Continued)**

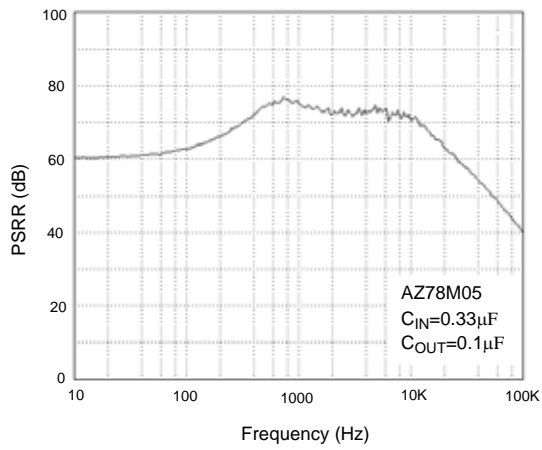


Figure 8. PSRR vs. Frequency





### Typical Application

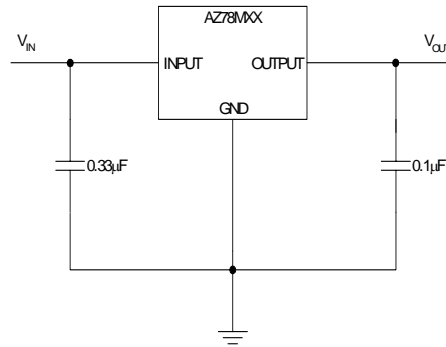


Figure 9. Typical Application of AZ78MXX

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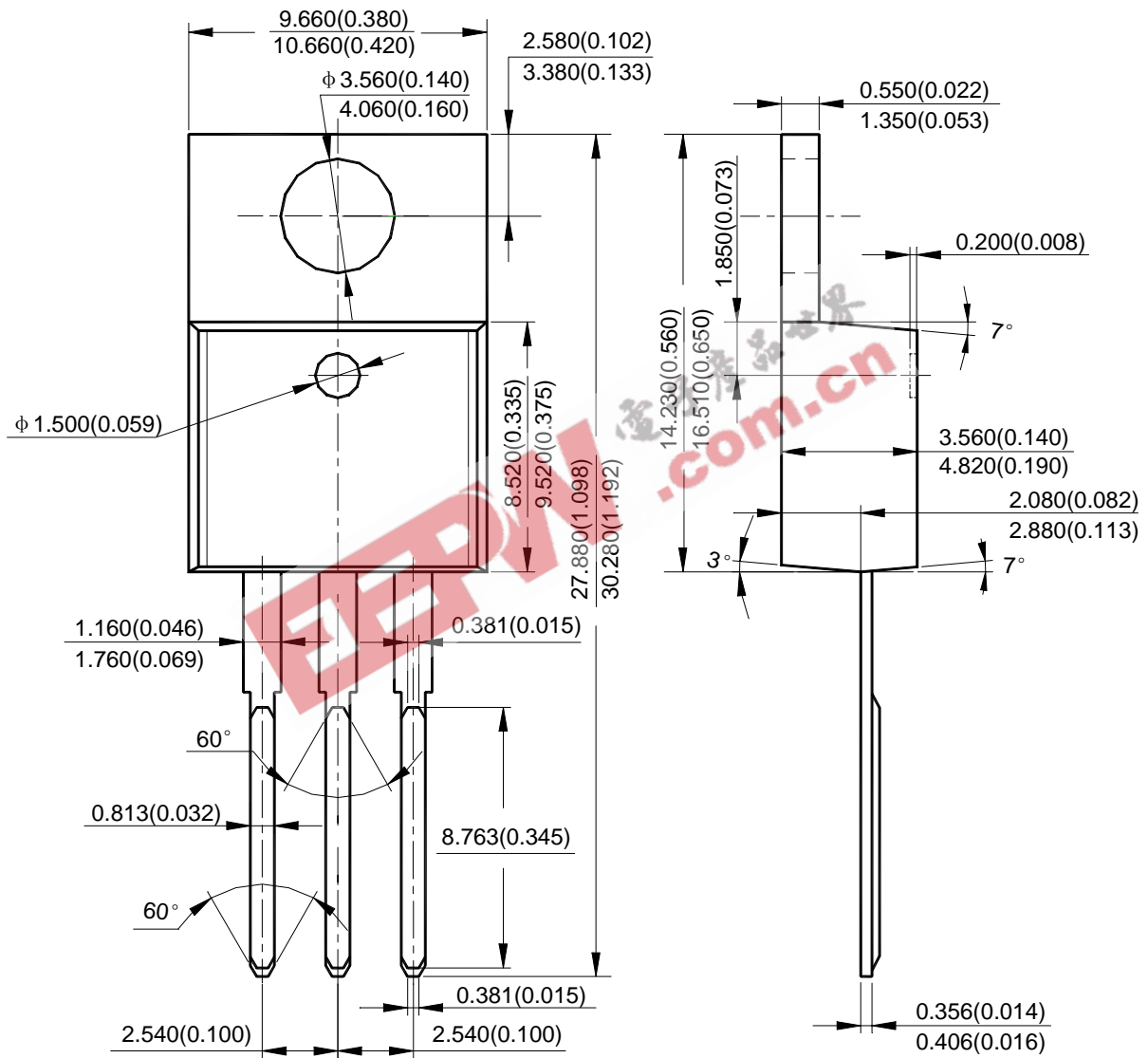
**500mA 3-TERMINAL POSITIVE VOLTAGE REGULATOR**

**AZ78MXX**

**Mechanical Dimensions**

**TO-220**

**Unit: mm(inch)**





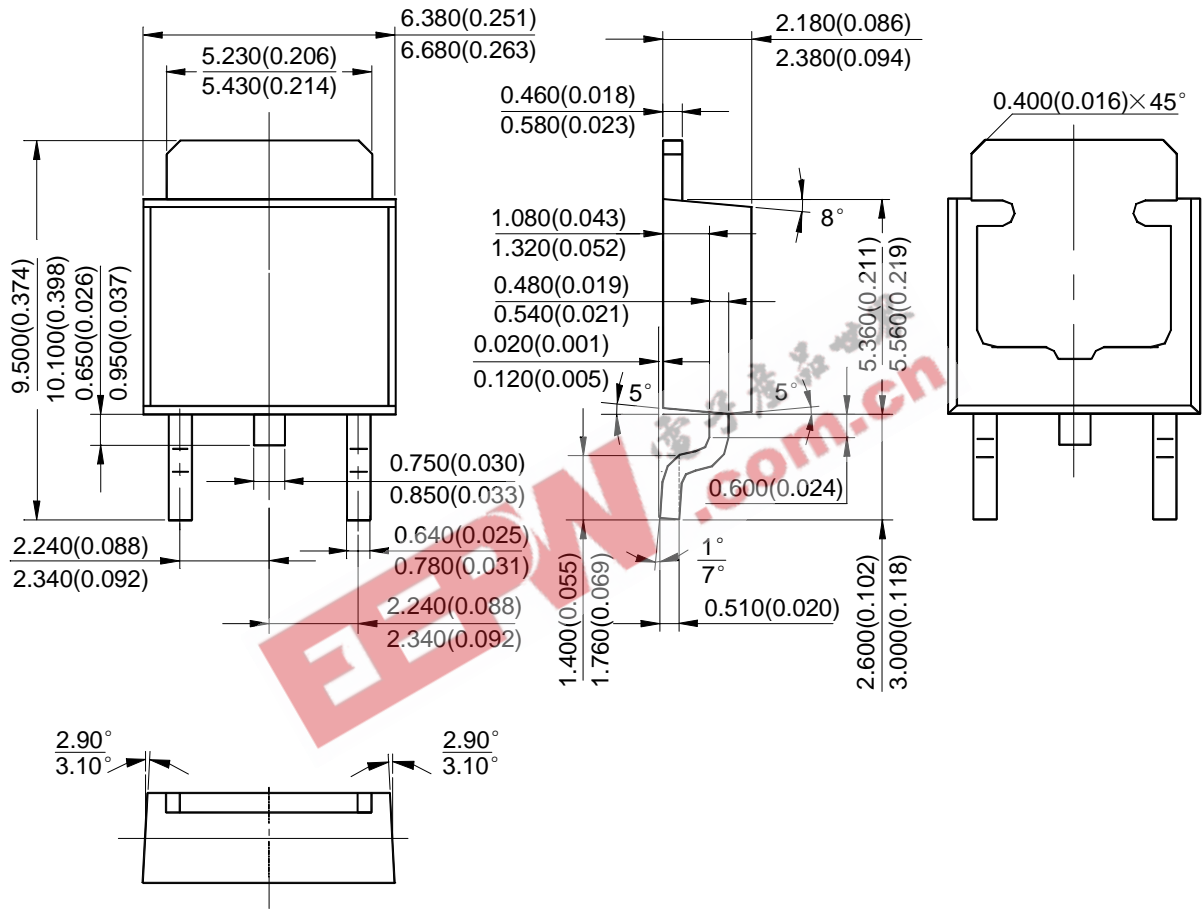
**500mA 3-TERMINAL POSITIVE VOLTAGE REGULATOR**

**AZ78MXX**

**Mechanical Dimensions (Continued)**

**TO-252**

**Unit: mm(inch)**





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