

## 2.85 TO 12 VOLT FIXED POSITIVE LOCAL VOLTAGE REGULATOR

ISSUE 5 - JUNE 2006

## ZR78L SERIES

### DEVICE DESCRIPTION

The ZR78L Series three terminal fixed positive voltage regulators feature internal circuit current limit and thermal shutdown making the devices difficult to destroy. The circuit design allows creation of any custom voltage in the range 2.85 to 12 volts. The devices are available in a small outline surface mount package, ideal for applications where space saving is important, as well as through hole TO92 style packaging. The devices are suited to local voltage regulation applications, where problems could be encountered with distributed single source regulation, as well as more general voltage regulation applications.

The ZR78L Series show performance characteristics superior to other local voltage regulators. The initial output voltage is maintained to within 2.5% with a quiescent current of typically 350µA. Output voltage change, with input voltage and load current, is much lower than competitive devices. The ZR78L devices are completely stable with no external components. The device will shut down under thermal overload conditions but as the device cools, regulation will restart.

### FEATURES

- 2.85 to 12 Volt
- Output current up to 200mA
- Tight initial tolerance
- Low quiescent current
- -55 to 125°C temperature range
- No external components
- Internal thermal shutdown
- Internal short circuit current limit

| Device   | Output voltage | Package options     |                     |          |
|----------|----------------|---------------------|---------------------|----------|
|          |                | TO92(C)             | SOT223(G)           | SO8(N8)  |
| ZR78L028 | 2.85V          | Obsolete            | Obsolete            | N/A      |
| ZR78L03  | 3.0V           | Obsolete            | Obsolete            | N/A      |
| ZR78L033 | 3.3V           | Obsolete            | Obsolete            | N/A      |
| ZR78L04  | 4.0V           | Obsolete            | Obsolete            | N/A      |
| ZR78L048 | 4.85V          | Obsolete            | Obsolete            | N/A      |
| ZR78L05  | 5.0V           | Not for new designs | Not for new designs | Obsolete |
| ZR78L052 | 5.2V           | Obsolete            | Obsolete            | N/A      |
| ZR78L057 | 5.7V           | Obsolete            | Obsolete            | N/A      |
| ZR78L06  | 6.0V           | Not for new designs | Not for new designs | Obsolete |
| ZR78L07  | 7.0V           | Obsolete            | Obsolete            | N/A      |
| ZR78L08  | 8.0V           | Obsolete            | Obsolete            | N/A      |
| ZR78L085 | 8.5V           | Obsolete            | Obsolete            | N/A      |
| ZR78L09  | 9.0V           | Obsolete            | Obsolete            | N/A      |
| ZR78L10  | 10.0V          | Obsolete            | Obsolete            | N/A      |
| ZR78L12  | 12.0V          | Obsolete            | Obsolete            | N/A      |

N/A - never available

The ZSRxxx family of linear regulators are alternatives to the ZR78L family

## ZR78L SERIES

### ABSOLUTE MAXIMUM RATING

Input voltage 20V  
Output Current( $I_O$ ) 200mA  
Operating Temperature -55 to 125°C  
Storage Temperature -65 to 150°C

### Power Dissipation ( $T_{amb}=25^{\circ}\text{C}$ )

SOT223 2W(Note 3)  
TO92 600mW  
S08 780mW(Note 3)

### ELECTRICAL CHARACTERISTICS:

#### Notes:

1. The maximum operating input voltage and output current of the device will be governed by the maximum power dissipation of the selected package. Maximum package power dissipation is specified at 25 °C and must be linearly derated to zero at  $T_{amb}=125^{\circ}\text{C}$ .
2. The following data represents pulse test conditions with junction temperatures as indicated at the initiation of the test. Continuous operation of the devices with the stated conditions might exceed the power dissipation limits of the chosen package.

3. Maximum power dissipation, for the SOT223 and SO8 packages, is calculated assuming that the device is mounted on a PCB measuring 2 inches square.

4. The shut down feature of the device operates if its temperature exceeds its design limit as might occur during external faults, short circuits etc. If the regulator is supplied from an inductive source then a large voltage transient, on the regulator input, can result should the shut down circuit operate. It is advised that a capacitor (1 $\mu\text{F}$  or greater) should be applied across the regulator input to ensure that the maximum voltage rating of the device is not exceeded under shutdown conditions.

### ZR78L028 TEST CONDITIONS (Unless otherwise stated): $T_j=25^{\circ}\text{C}$ , $I_O=100\text{mA}$ , $V_{in}=6.85\text{V}$

| SYMBOL                     | PARAMETER                                     | CONDITIONS                                      | MIN.  | TYP. | MAX.       | UNITS                          |
|----------------------------|-----------------------------------------------|-------------------------------------------------|-------|------|------------|--------------------------------|
| $V_O$                      | Output Voltage                                |                                                 | 2.78  | 2.85 | 2.92       | V                              |
|                            |                                               | $I_O=1$ to 200mA $\tau$                         | 2.736 |      | 2.964      | V                              |
|                            |                                               | $V_{in}=4.85$ to 20V<br>$I_O=1$ to 100mA $\tau$ | 2.736 |      | 2.964      | V                              |
| $\Delta V_O$               | Line Regulation                               | $V_{in}=4.85$ to 20V                            |       | 10   | 40         | mV                             |
| $\Delta V_O$               | Load Regulation                               | $I_O=1$ to 200mA                                |       | 5    | 25         | mV                             |
|                            |                                               | $I_O=1$ to 100mA                                |       | 2    |            | mV                             |
| $I_q$                      | Quiescent Current                             | $\tau$                                          |       | 350  | 600        | $\mu\text{A}$                  |
| $\Delta I_q$               | Quiescent Current Change                      | $I_O=1$ to 200mA<br>$V_{in}=4.85$ to 20V        |       |      | 100<br>100 | $\mu\text{A}$<br>$\mu\text{A}$ |
| $V_n$                      | Output Noise Voltage                          | $f=10\text{Hz}$ to 10kHz                        |       | 75   |            | $\mu\text{V rms}$              |
| $\Delta V_{in}/\Delta V_O$ | Ripple Rejection                              | $V_{in}=5.85$ to 18V<br>$f=120\text{Hz}$        | 48    | 62   |            | dB                             |
| $V_{in}$                   | Input Voltage Required To Maintain Regulation |                                                 | 4.85  | 4.55 |            | V                              |
| $\Delta V_O/\Delta T$      | Average Temperature Coefficient of $V_O$      | $I_O=5.0\text{mA}$ $\tau$                       |       | 0.1  |            | mV/ $^{\circ}\text{C}$         |

$\tau=T_j=-55$  to  $125^{\circ}\text{C}$

## ZR78L SERIES

### ZR78L03 TEST CONDITIONS (Unless otherwise stated): $T_j=25^{\circ}\text{C}$ , $I_O=100\text{mA}$ , $V_{in}=7\text{V}$

| SYMBOL                     | PARAMETER                                     | CONDITIONS                                                     | MIN. | TYP.   | MAX.       | UNITS                          |
|----------------------------|-----------------------------------------------|----------------------------------------------------------------|------|--------|------------|--------------------------------|
| $V_O$                      | Output Voltage                                |                                                                | 2.92 | 3.0    | 3.08       | V                              |
|                            |                                               | $I_O=1$ to $200\text{mA}$ $\tau$                               | 2.88 |        | 3.12       | V                              |
|                            |                                               | $V_{in}=5$ to $20\text{V}$<br>$I_O=1$ to $100\text{mA}$ $\tau$ | 2.88 |        | 3.12       | V                              |
| $\Delta V_O$               | Line Regulation                               | $V_{in}=5$ to $20\text{V}$                                     |      | 10     | 40         | mV                             |
| $\Delta V_O$               | Load Regulation                               | $I_O=1$ to $200\text{mA}$<br>$I_O=1$ to $100\text{mA}$         |      | 5<br>2 | 25         | mV<br>mV                       |
| $I_q$                      | Quiescent Current                             | $\tau$                                                         |      | 350    | 600        | $\mu\text{A}$                  |
| $\Delta I_q$               | Quiescent Current Change                      | $I_O=1$ to $200\text{mA}$<br>$V_{in}=5$ to $20\text{V}$        |      |        | 100<br>100 | $\mu\text{A}$<br>$\mu\text{A}$ |
| $V_n$                      | Output Noise Voltage                          | $f=10\text{Hz}$ to $10\text{kHz}$                              |      | 75     |            | $\mu\text{V rms}$              |
| $\Delta V_{in}/\Delta V_O$ | Ripple Rejection                              | $V_{in}=6$ to $18\text{V}$<br>$f=120\text{Hz}$                 | 48   | 62     |            | dB                             |
| $V_{in}$                   | Input Voltage Required To Maintain Regulation |                                                                | 5    | 4.7    |            | V                              |
| $\Delta V_O/\Delta T$      | Average Temperature Coefficient of $V_O$      | $I_O=5.0\text{mA}$ $\tau$                                      |      | 0.1    |            | $\text{mV}/^{\circ}\text{C}$   |

### ZR78L033 TEST CONDITIONS (Unless otherwise stated): $T_j=25^{\circ}\text{C}$ , $I_O=100\text{mA}$ , $V_{in}=7.3\text{V}$

| SYMBOL                     | PARAMETER                                     | CONDITIONS                                                       | MIN.  | TYP.   | MAX.       | UNITS                          |
|----------------------------|-----------------------------------------------|------------------------------------------------------------------|-------|--------|------------|--------------------------------|
| $V_O$                      | Output Voltage                                |                                                                  | 3.218 | 3.3    | 3.382      | V                              |
|                            |                                               | $I_O=1$ to $200\text{mA}$ $\tau$                                 | 3.168 |        | 3.432      | V                              |
|                            |                                               | $V_{in}=5.3$ to $20\text{V}$<br>$I_O=1$ to $100\text{mA}$ $\tau$ | 3.168 |        | 3.432      | V                              |
| $\Delta V_O$               | Line Regulation                               | $V_{in}=5.3$ to $20\text{V}$                                     |       | 7.5    | 30         | mV                             |
| $\Delta V_O$               | Load Regulation                               | $I_O=1$ to $200\text{mA}$<br>$I_O=1$ to $100\text{mA}$           |       | 5<br>2 | 25         | mV<br>mV                       |
| $I_q$                      | Quiescent Current                             | $\tau$                                                           |       | 350    | 600        | $\mu\text{A}$                  |
| $\Delta I_q$               | Quiescent Current Change                      | $I_O=1$ to $200\text{mA}$<br>$V_{in}=5.3$ to $20\text{V}$        |       |        | 100<br>100 | $\mu\text{A}$<br>$\mu\text{A}$ |
| $V_n$                      | Output Noise Voltage                          | $f=10\text{Hz}$ to $10\text{kHz}$                                |       | 50     |            | $\mu\text{V rms}$              |
| $\Delta V_{in}/\Delta V_O$ | Ripple Rejection                              | $V_{in}=6.3$ to $18\text{V}$<br>$f=120\text{Hz}$                 | 50    | 64     |            | dB                             |
| $V_{in}$                   | Input Voltage Required To Maintain Regulation |                                                                  | 5.3   | 5      |            | V                              |
| $\Delta V_O/\Delta T$      | Average Temperature Coefficient of $V_O$      | $I_O=5.0\text{mA}$ $\tau$                                        |       | 0.1    |            | $\text{mV}/^{\circ}\text{C}$   |

## ZR78L SERIES

### ZR78L04 TEST CONDITIONS (Unless otherwise stated): $T_j=25^{\circ}\text{C}$ , $I_O=100\text{mA}$ , $V_{in}=8\text{V}$

| SYMBOL                     | PARAMETER                                     | CONDITIONS                                                     | MIN. | TYP.   | MAX.       | UNITS                          |
|----------------------------|-----------------------------------------------|----------------------------------------------------------------|------|--------|------------|--------------------------------|
| $V_O$                      | Output Voltage                                |                                                                | 3.9  | 4.0    | 4.1        | V                              |
|                            |                                               | $I_O=1$ to $200\text{mA}$ $\tau$                               | 3.84 |        | 4.16       | V                              |
|                            |                                               | $V_{in}=6$ to $20\text{V}$<br>$I_O=1$ to $100\text{mA}$ $\tau$ | 3.84 |        | 4.16       | V                              |
| $\Delta V_O$               | Line Regulation                               | $V_{in}=6$ to $20\text{V}$                                     |      | 10     | 40         | mV                             |
| $\Delta V_O$               | Load Regulation                               | $I_O=1$ to $200\text{mA}$<br>$I_O=1$ to $100\text{mA}$         |      | 5<br>2 | 25         | mV<br>mV                       |
| $I_q$                      | Quiescent Current                             | $\tau$                                                         |      | 350    | 600        | $\mu\text{A}$                  |
| $\Delta I_q$               | Quiescent Current Change                      | $I_O=1$ to $200\text{mA}$<br>$V_{in}=6$ to $20\text{V}$        |      |        | 100<br>100 | $\mu\text{A}$<br>$\mu\text{A}$ |
| $V_n$                      | Output Noise Voltage                          | $f=10\text{Hz}$ to $10\text{kHz}$                              |      | 75     |            | $\mu\text{V rms}$              |
| $\Delta V_{in}/\Delta V_O$ | Ripple Rejection                              | $V_{in}=7$ to $18\text{V}$<br>$f=120\text{Hz}$                 | 48   | 62     |            | dB                             |
| $V_{in}$                   | Input Voltage Required To Maintain Regulation |                                                                | 6    | 5.3    |            | V                              |
| $\Delta V_O/\Delta T$      | Average Temperature Coefficient of $V_O$      | $I_O=5.0\text{mA}$ $\tau$                                      |      | 0.1    |            | $\text{mV}/^{\circ}\text{C}$   |

### ZR78L048 TEST CONDITIONS (Unless otherwise stated): $T_j=25^{\circ}\text{C}$ , $I_O=100\text{mA}$ , $V_{in}=8.85\text{V}$

| SYMBOL                     | PARAMETER                                     | CONDITIONS                                                       | MIN.  | TYP.   | MAX.       | UNITS                          |
|----------------------------|-----------------------------------------------|------------------------------------------------------------------|-------|--------|------------|--------------------------------|
| $V_O$                      | Output Voltage                                |                                                                  | 4.729 | 4.85   | 4.971      | V                              |
|                            |                                               | $I_O=1$ to $200\text{mA}$ $\tau$                                 | 4.656 |        | 5.044      | V                              |
|                            |                                               | $V_{in}=6.8$ to $20\text{V}$<br>$I_O=1$ to $100\text{mA}$ $\tau$ | 4.656 |        | 5.044      | V                              |
| $\Delta V_O$               | Line Regulation                               | $V_{in}=6.85$ to $20\text{V}$                                    |       | 10     | 40         | mV                             |
| $\Delta V_O$               | Load Regulation                               | $I_O=1$ to $200\text{mA}$<br>$I_O=1$ to $100\text{mA}$           |       | 5<br>2 | 25         | mV<br>mV                       |
| $I_q$                      | Quiescent Current                             | $\tau$                                                           |       | 350    | 600        | $\mu\text{A}$                  |
| $\Delta I_q$               | Quiescent Current Change                      | $I_O=1$ to $200\text{mA}$<br>$V_{in}=6.85$ to $20\text{V}$       |       |        | 100<br>100 | $\mu\text{A}$<br>$\mu\text{A}$ |
| $V_n$                      | Output Noise Voltage                          | $f=10\text{Hz}$ to $10\text{kHz}$                                |       | 50     |            | $\mu\text{V rms}$              |
| $\Delta V_{in}/\Delta V_O$ | Ripple Rejection                              | $V_{in}=7.85$ to $18\text{V}$<br>$f=120\text{Hz}$                | 50    | 64     |            | dB                             |
| $V_{in}$                   | Input Voltage Required To Maintain Regulation |                                                                  | 6.85  | 6.55   |            | V                              |
| $\Delta V_O/\Delta T$      | Average Temperature Coefficient of $V_O$      | $I_O=5.0\text{mA}$ $\tau$                                        |       | 0.1    |            | $\text{mV}/^{\circ}\text{C}$   |

## ZR78L SERIES

### ZR78L10 TEST CONDITIONS (Unless otherwise stated): $T_i=25^{\circ}\text{C}$ , $I_O=100\text{mA}$ , $V_{in}=14\text{V}$

| SYMBOL                     | PARAMETER                                     | CONDITIONS                                                      | MIN. | TYP. | MAX.  | UNITS                        |
|----------------------------|-----------------------------------------------|-----------------------------------------------------------------|------|------|-------|------------------------------|
| $V_O$                      | Output Voltage                                |                                                                 | 9.75 | 10   | 10.25 | V                            |
|                            |                                               | $I_O=1$ to $200\text{mA}$ $\tau$                                | 9.6  |      | 10.4  | V                            |
|                            |                                               | $V_{in}=12$ to $20\text{V}$<br>$I_O=1$ to $100\text{mA}$ $\tau$ | 9.6  |      | 10.4  | V                            |
| $\Delta V_O$               | Line Regulation                               | $V_{in}=12$ to $20\text{V}$                                     |      | 12   | 40    | mV                           |
| $\Delta V_O$               | Load Regulation                               | $I_O=1$ to $200\text{mA}$                                       |      | 9    | 30    | mV                           |
|                            |                                               | $I_O=1$ to $100\text{mA}$                                       |      | 3    |       | mV                           |
| $I_q$                      | Quiescent Current                             | $\tau$                                                          |      | 350  | 600   | $\mu\text{A}$                |
| $\Delta I_q$               | Quiescent Current Change                      | $I_O=1$ to $200\text{mA}$                                       |      |      | 100   | $\mu\text{A}$                |
|                            |                                               | $V_{in}=12$ to $20\text{V}$                                     |      |      | 100   | $\mu\text{A}$                |
| $V_n$                      | Output Noise Voltage                          | $f=10\text{Hz}$ to $10\text{kHz}$                               |      | 150  |       | $\mu\text{V rms}$            |
| $\Delta V_{in}/\Delta V_O$ | Ripple Rejection                              | $V_{in}=13$ to $18\text{V}$<br>$f=120\text{Hz}$                 | 43   | 57   |       | dB                           |
| $V_{in}$                   | Input Voltage Required To Maintain Regulation |                                                                 | 12   | 11.7 |       | V                            |
| $\Delta V_O/\Delta T$      | Average Temperature Coefficient of $V_O$      | $I_O=5.0\text{mA}$ $\tau$                                       |      | 0.25 |       | $\text{mV}/^{\circ}\text{C}$ |

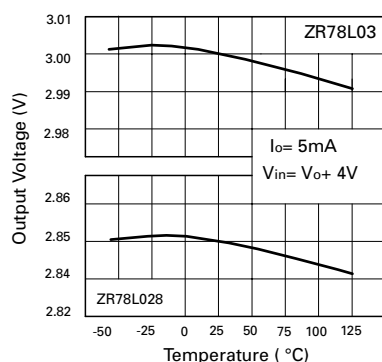
### ZR78L12 TEST CONDITIONS (Unless otherwise stated): $T_i=25^{\circ}\text{C}$ , $I_O=100\text{mA}$ , $V_{in}=16\text{V}$

| SYMBOL                     | PARAMETER                                     | CONDITIONS                                                      | MIN.  | TYP. | MAX.  | UNITS                        |
|----------------------------|-----------------------------------------------|-----------------------------------------------------------------|-------|------|-------|------------------------------|
| $V_O$                      | Output Voltage                                |                                                                 | 11.7  | 12   | 12.3  | V                            |
|                            |                                               | $I_O=1$ to $200\text{mA}$ $\tau$                                | 11.52 |      | 12.48 | V                            |
|                            |                                               | $V_{in}=14$ to $20\text{V}$<br>$I_O=1$ to $100\text{mA}$ $\tau$ | 11.52 |      | 12.48 | V                            |
| $\Delta V_O$               | Line Regulation                               | $V_{in}=14$ to $20\text{V}$                                     |       | 12   | 40    | mV                           |
| $\Delta V_O$               | Load Regulation                               | $I_O=1$ to $200\text{mA}$                                       |       | 9    | 30    | mV                           |
|                            |                                               | $I_O=1$ to $100\text{mA}$                                       |       | 3    |       | mV                           |
| $I_q$                      | Quiescent Current                             | $\tau$                                                          |       | 350  | 600   | $\mu\text{A}$                |
| $\Delta I_q$               | Quiescent Current Change                      | $I_O=1$ to $200\text{mA}$                                       |       |      | 100   | $\mu\text{A}$                |
|                            |                                               | $V_{in}=14$ to $20\text{V}$                                     |       |      | 100   | $\mu\text{A}$                |
| $V_n$                      | Output Noise Voltage                          | $f=10\text{Hz}$ to $10\text{kHz}$                               |       | 150  |       | $\mu\text{V rms}$            |
| $\Delta V_{in}/\Delta V_O$ | Ripple Rejection                              | $V_{in}=15$ to $18\text{V}$<br>$f=120\text{Hz}$                 | 43    | 57   |       | dB                           |
| $V_{in}$                   | Input Voltage Required To Maintain Regulation |                                                                 | 14    | 13.7 |       | V                            |
| $\Delta V_O/\Delta T$      | Average Temperature Coefficient of $V_O$      | $I_O=5.0\text{mA}$ $\tau$                                       |       | 0.25 |       | $\text{mV}/^{\circ}\text{C}$ |

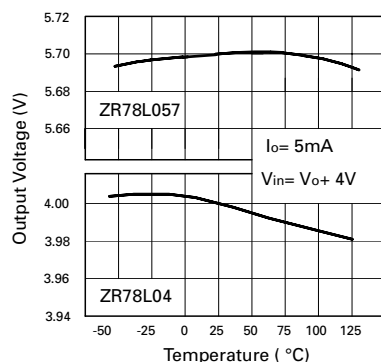
ZR78L028 ZR78L03  
 ZR78L04 ZR78L057  
 ZR78L09

## ZR78L SERIES

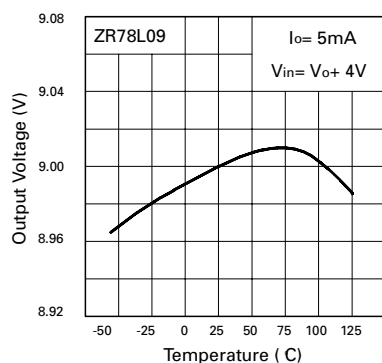
### TYPICAL CHARACTERISTICS



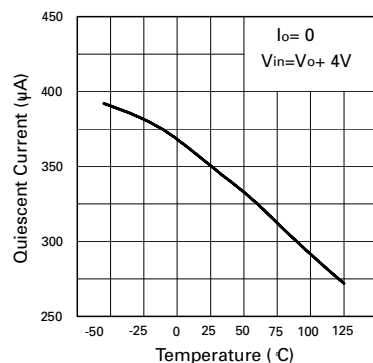
Output Voltage Temperature Coefficient



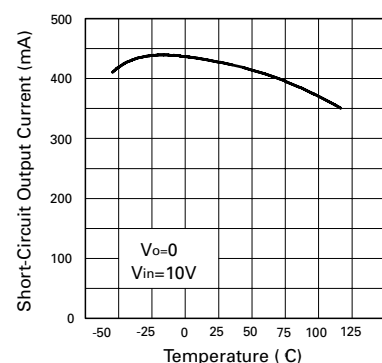
Output Voltage Temperature Coefficient



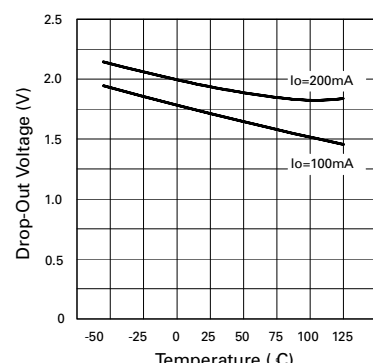
Output Voltage Temperature Coefficient



Quiescent Current vs. Temperature



Peak Output Current vs. Temperature

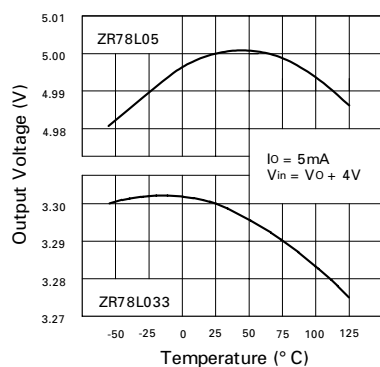


Drop-Out Voltage vs. Temperature

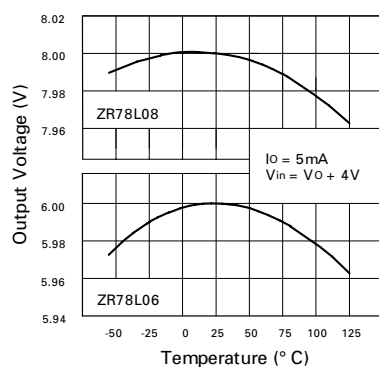
ZR78L033 ZR78L05  
 ZR78L06 ZR78L08  
 ZR78L10

## ZR78L SERIES

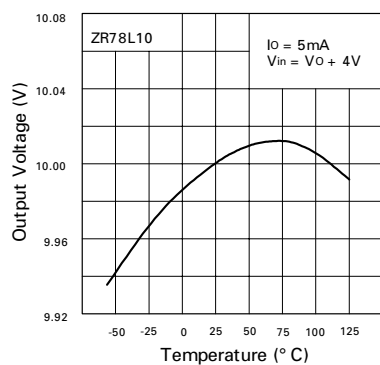
### TYPICAL CHARACTERISTICS



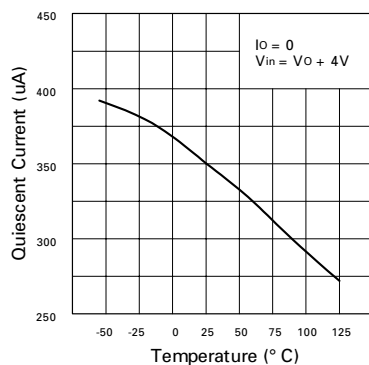
Output Voltage Temperature Coefficient



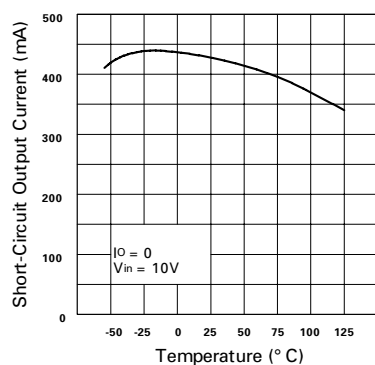
Output Voltage Temperature Coefficient



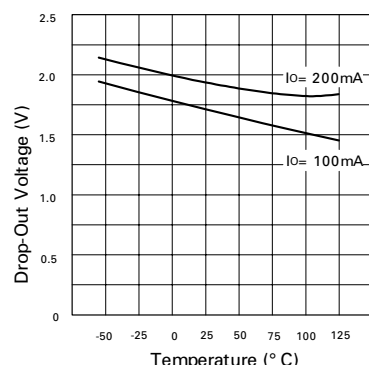
Output Voltage Temperature Coefficient



Quiescent Current v Temperature



Peak Output Current v Temperature



Drop-Out Voltage v Temperature

## ZR78L SERIES

### ZR78L057 TEST CONDITIONS (Unless otherwise stated): $T_j=25^{\circ}\text{C}$ , $I_O=100\text{mA}$ , $V_{in}=9.7\text{V}$

| SYMBOL                     | PARAMETER                                     | CONDITIONS                                                       | MIN.  | Typ. | MAX.  | UNITS                        |
|----------------------------|-----------------------------------------------|------------------------------------------------------------------|-------|------|-------|------------------------------|
| $V_O$                      | Output Voltage                                |                                                                  | 5.557 | 5.7  | 5.843 | V                            |
|                            |                                               | $I_O=1$ to $200\text{mA}$ $\tau$                                 | 5.47  |      | 5.93  | V                            |
|                            |                                               | $V_{in}=7.7$ to $20\text{V}$<br>$I_O=1$ to $100\text{mA}$ $\tau$ | 5.47  |      | 5.93  | V                            |
| $\Delta V_O$               | Line Regulation                               | $V_{in}=7.7$ to $20\text{V}$                                     |       | 10   | 40    | mV                           |
| $\Delta V_O$               | Load Regulation                               | $I_O=1$ to $200\text{mA}$                                        |       | 7    | 30    | mV                           |
|                            |                                               | $I_O=1$ to $100\text{mA}$                                        |       | 2.5  |       | mV                           |
| $I_q$                      | Quiescent Current                             | $\tau$                                                           |       | 350  | 600   | $\mu\text{A}$                |
| $\Delta I_q$               | Quiescent Current Change                      | $I_O=1$ to $200\text{mA}$                                        |       |      | 100   | $\mu\text{A}$                |
|                            |                                               | $V_{in}=7.7$ to $20\text{V}$                                     |       |      | 100   | $\mu\text{A}$                |
| $V_n$                      | Output Noise Voltage                          | $f=10\text{Hz}$ to $10\text{kHz}$                                |       | 90   |       | $\mu\text{V rms}$            |
| $\Delta V_{in}/\Delta V_O$ | Ripple Rejection                              | $V_{in}=8.7$ to $18\text{V}$<br>$f=120\text{Hz}$                 | 48    | 62   |       | dB                           |
| $V_{in}$                   | Input Voltage Required To Maintain Regulation |                                                                  | 7.7   | 7.4  |       | V                            |
| $\Delta V_O/\Delta T$      | Average Temperature Coefficient of $V_O$      | $I_O=5.0\text{mA}$ $\tau$                                        |       | 0.15 |       | $\text{mV}/^{\circ}\text{C}$ |

### ZR78L06 TEST CONDITIONS (Unless otherwise stated): $T_j=25^{\circ}\text{C}$ , $I_O=100\text{mA}$ , $V_{in}=10\text{V}$

| SYMBOL                     | PARAMETER                                     | CONDITIONS                                                     | MIN. | TYP. | MAX. | UNITS                        |
|----------------------------|-----------------------------------------------|----------------------------------------------------------------|------|------|------|------------------------------|
| $V_O$                      | Output Voltage                                |                                                                | 5.85 | 6    | 6.15 | V                            |
|                            |                                               | $I_O=1$ to $200\text{mA}$ $\tau$                               | 5.76 |      | 6.24 | V                            |
|                            |                                               | $V_{in}=8$ to $20\text{V}$<br>$I_O=1$ to $100\text{mA}$ $\tau$ | 5.76 |      | 6.24 | V                            |
| $\Delta V_O$               | Line Regulation                               | $V_{in}=8$ to $20\text{V}$                                     |      | 10   | 40   | mV                           |
| $\Delta V_O$               | Load Regulation                               | $I_O=1$ to $200\text{mA}$                                      |      | 7    | 30   | mV                           |
|                            |                                               | $I_O=1$ to $100\text{mA}$                                      |      | 2.5  |      | mV                           |
| $I_q$                      | Quiescent Current                             | $\tau$                                                         |      | 350  | 600  | $\mu\text{A}$                |
| $\Delta I_q$               | Quiescent Current Change                      | $I_O=1$ to $200\text{mA}$                                      |      |      | 100  | $\mu\text{A}$                |
|                            |                                               | $V_{in}=8$ to $20\text{V}$                                     |      |      | 100  | $\mu\text{A}$                |
| $V_n$                      | Output Noise Voltage                          | $f=10\text{Hz}$ to $10\text{kHz}$                              |      | 90   |      | $\mu\text{V rms}$            |
| $\Delta V_{in}/\Delta V_O$ | Ripple Rejection                              | $V_{in}=9$ to $18\text{V}$<br>$f=120\text{Hz}$                 | 48   | 62   |      | dB                           |
| $V_{in}$                   | Input Voltage Required To Maintain Regulation |                                                                | 8    | 7.7  |      | V                            |
| $\Delta V_O/\Delta T$      | Average Temperature Coefficient of $V_O$      | $I_O=5.0\text{mA}$ $\tau$                                      |      | 0.15 |      | $\text{mV}/^{\circ}\text{C}$ |

## ZR78L SERIES

### ZR78L05 TEST CONDITIONS (Unless otherwise stated): $T_j=25^{\circ}\text{C}$ , $I_O=100\text{mA}$ , $V_{in}=9\text{V}$

| SYMBOL                     | PARAMETER                                     | CONDITIONS                                                     | MIN.  | TYP. | MAX.  | UNITS                        |
|----------------------------|-----------------------------------------------|----------------------------------------------------------------|-------|------|-------|------------------------------|
| $V_O$                      | Output Voltage                                |                                                                | 4.875 | 5    | 5.125 | V                            |
|                            |                                               | $I_O=1$ to $200\text{mA}$ $\tau$                               | 4.8   |      | 5.2   | V                            |
|                            |                                               | $V_{in}=7$ to $20\text{V}$<br>$I_O=1$ to $100\text{mA}$ $\tau$ | 4.8   |      | 5.2   | V                            |
| $\Delta V_O$               | Line Regulation                               | $V_{in}=7$ to $20\text{V}$                                     |       | 10   | 40    | mV                           |
| $\Delta V_O$               | Load Regulation                               | $I_O=1$ to $200\text{mA}$                                      |       | 5    | 25    | mV                           |
|                            |                                               | $I_O=1$ to $100\text{mA}$                                      |       | 2    |       | mV                           |
| $I_q$                      | Quiescent Current                             | $\tau$                                                         |       | 350  | 600   | $\mu\text{A}$                |
| $\Delta I_q$               | Quiescent Current Change                      | $I_O=1$ to $200\text{mA}$                                      |       |      | 100   | $\mu\text{A}$                |
|                            |                                               | $V_{in}=7$ to $20\text{V}$                                     |       |      | 100   | $\mu\text{A}$                |
| $V_n$                      | Output Noise Voltage                          | $f=10\text{Hz}$ to $10\text{kHz}$                              |       | 75   |       | $\mu\text{V rms}$            |
| $\Delta V_{in}/\Delta V_O$ | Ripple Rejection                              | $V_{in}=8$ to $18\text{V}$<br>$f=120\text{Hz}$                 | 48    | 62   |       | dB                           |
| $V_{in}$                   | Input Voltage Required To Maintain Regulation |                                                                | 7     | 6.7  |       | V                            |
| $\Delta V_O/\Delta T$      | Average Temperature Coefficient of $V_O$      | $I_O=5.0\text{mA}$ $\tau$                                      |       | 0.1  |       | $\text{mV}/^{\circ}\text{C}$ |

### ZR78L052 TEST CONDITIONS (Unless otherwise stated): $T_j=25^{\circ}\text{C}$ , $I_O=100\text{mA}$ , $V_{in}=9.2\text{V}$

| SYMBOL                     | PARAMETER                                     | CONDITIONS                                                       | MIN.  | TYP. | MAX.  | UNITS                        |
|----------------------------|-----------------------------------------------|------------------------------------------------------------------|-------|------|-------|------------------------------|
| $V_O$                      | Output Voltage                                |                                                                  | 5.070 | 5.2  | 5.330 | V                            |
|                            |                                               | $I_O=1$ to $200\text{mA}$ $\tau$                                 | 4.99  |      | 5.41  | V                            |
|                            |                                               | $V_{in}=7.2$ to $20\text{V}$<br>$I_O=1$ to $100\text{mA}$ $\tau$ | 4.99  |      | 5.41  | V                            |
| $\Delta V_O$               | Line Regulation                               | $V_{in}=7.2$ to $20\text{V}$                                     |       | 10   | 40    | mV                           |
| $\Delta V_O$               | Load Regulation                               | $I_O=1$ to $200\text{mA}$                                        |       | 5    | 25    | mV                           |
|                            |                                               | $I_O=1$ to $100\text{mA}$                                        |       | 2    |       | mV                           |
| $I_q$                      | Quiescent Current                             | $\tau$                                                           |       | 350  | 600   | $\mu\text{A}$                |
| $\Delta I_q$               | Quiescent Current Change                      | $I_O=1$ to $200\text{mA}$                                        |       |      | 100   | $\mu\text{A}$                |
|                            |                                               | $V_{in}=7.2$ to $20\text{V}$                                     |       |      | 100   | $\mu\text{A}$                |
| $V_n$                      | Output Noise Voltage                          | $f=10\text{Hz}$ to $10\text{kHz}$                                |       | 75   |       | $\mu\text{V rms}$            |
| $\Delta V_{in}/\Delta V_O$ | Ripple Rejection                              | $V_{in}=8.2$ to $18\text{V}$<br>$f=120\text{Hz}$                 | 48    | 62   |       | dB                           |
| $V_{in}$                   | Input Voltage Required To Maintain Regulation |                                                                  | 7.2   | 6.9  |       | V                            |
| $\Delta V_O/\Delta T$      | Average Temperature Coefficient of $V_O$      | $I_O=5.0\text{mA}$ $\tau$                                        |       | 0.1  |       | $\text{mV}/^{\circ}\text{C}$ |

## ZR78L SERIES

### ZR78L085 TEST CONDITIONS (Unless otherwise stated): $T_j=25^{\circ}\text{C}$ , $I_O=100\text{mA}$ , $V_{in}=12.5\text{V}$

| SYMBOL                     | PARAMETER                                     | CONDITIONS                                                      | MIN.  | TYP.   | MAX.       | UNITS                          |
|----------------------------|-----------------------------------------------|-----------------------------------------------------------------|-------|--------|------------|--------------------------------|
| $V_O$                      | Output Voltage                                |                                                                 | 8.288 | 8.5    | 8.712      | V                              |
|                            |                                               | $I_O=1$ to $200\text{mA}$ $\tau$                                | 8.16  |        | 8.84       | V                              |
|                            |                                               | $V_{in}=10$ to $20\text{V}$<br>$I_O=1$ to $100\text{mA}$ $\tau$ | 8.16  |        | 8.84       | V                              |
| $\Delta V_O$               | Line Regulation                               | $V_{in}=10.5$ to $20\text{V}$                                   |       | 11     | 40         | mV                             |
| $\Delta V_O$               | Load Regulation                               | $I_O=1$ to $200\text{mA}$<br>$I_O=1$ to $100\text{mA}$          |       | 8<br>3 | 30         | mV<br>mV                       |
| $I_q$                      | Quiescent Current                             | $\tau$                                                          |       | 350    | 600        | $\mu\text{A}$                  |
| $\Delta I_q$               | Quiescent Current Change                      | $I_O=1$ to $200\text{mA}$<br>$V_{in}=10.5$ to $20\text{V}$      |       |        | 100<br>100 | $\mu\text{A}$<br>$\mu\text{A}$ |
| $V_n$                      | Output Noise Voltage                          | $f=10\text{Hz}$ to $10\text{kHz}$                               |       | 115    |            | $\mu\text{V rms}$              |
| $\Delta V_{in}/\Delta V_O$ | Ripple Rejection                              | $V_{in}=11.5$ to $18\text{V}$<br>$f=120\text{Hz}$               | 44    | 60     |            | dB                             |
| $V_{in}$                   | Input Voltage Required To Maintain Regulation |                                                                 | 10.5  | 10.2   |            | V                              |
| $\Delta V_O/\Delta T$      | Average Temperature Coefficient of $V_O$      | $I_O=5.0\text{mA}$ $\tau$                                       |       | 0.25   |            | $\text{mV}/^{\circ}\text{C}$   |

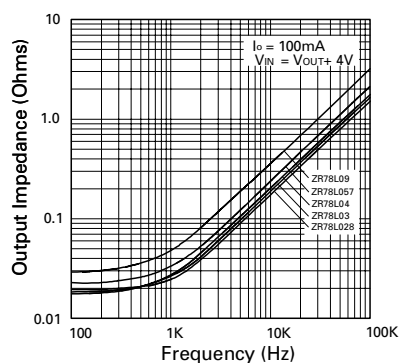
### ZR78L09TEST CONDITIONS (Unless otherwise stated): $T_j=25^{\circ}\text{C}$ , $I_O=100\text{mA}$ , $V_{in}=13\text{V}$

| SYMBOL                     | PARAMETER                                     | CONDITIONS                                                      | MIN.  | TYP.   | MAX.       | UNITS                          |
|----------------------------|-----------------------------------------------|-----------------------------------------------------------------|-------|--------|------------|--------------------------------|
| $V_O$                      | Output Voltage                                |                                                                 | 8.775 | 9.0    | 9.225      | V                              |
|                            |                                               | $I_O=1$ to $200\text{mA}$ $\tau$                                | 8.64  |        | 9.36       | V                              |
|                            |                                               | $V_{in}=11$ to $20\text{V}$<br>$I_O=1$ to $100\text{mA}$ $\tau$ | 8.64  |        | 9.36       | V                              |
| $\Delta V_O$               | Line Regulation                               | $V_{in}=11$ to $20\text{V}$                                     |       | 12     | 40         | mV                             |
| $\Delta V_O$               | Load Regulation                               | $I_O=1$ to $200\text{mA}$<br>$I_O=1$ to $100\text{mA}$          |       | 9<br>3 | 30         | mV<br>mV                       |
| $I_q$                      | Quiescent Current                             | $\tau$                                                          |       | 350    | 600        | $\mu\text{A}$                  |
| $\Delta I_q$               | Quiescent Current Change                      | $I_O=1$ to $200\text{mA}$<br>$V_{in}=11$ to $20\text{V}$        |       |        | 100<br>100 | $\mu\text{A}$<br>$\mu\text{A}$ |
| $V_n$                      | Output Noise Voltage                          | $f=10\text{Hz}$ to $10\text{kHz}$                               |       | 150    |            | $\mu\text{V rms}$              |
| $\Delta V_{in}/\Delta V_O$ | Ripple Rejection                              | $V_{in}=12$ to $18\text{V}$<br>$f=120\text{Hz}$                 | 43    | 57     |            | dB                             |
| $V_{in}$                   | Input Voltage Required To Maintain Regulation |                                                                 | 11    | 10.7   |            | V                              |
| $\Delta V_O/\Delta T$      | Average Temperature Coefficient of $V_O$      | $I_O=5.0\text{mA}$ $\tau$                                       |       | 0.25   |            | $\text{mV}/^{\circ}\text{C}$   |

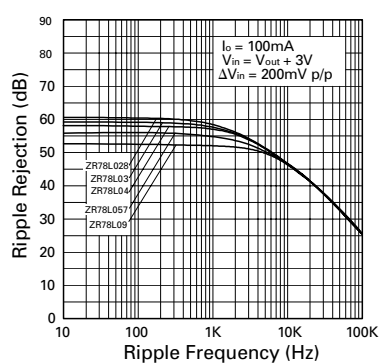
## ZR78L SERIES

ZR78L028 ZR78L03  
ZR78L04 ZR78L057  
ZR78L09

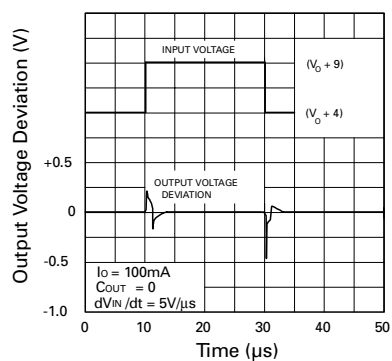
### TYPICAL CHARACTERISTICS



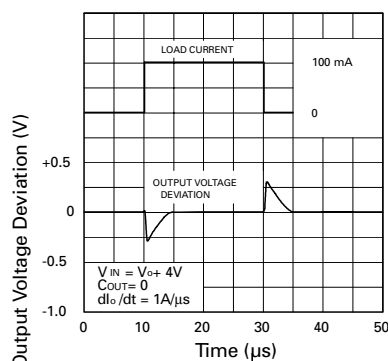
Output Impedance vs. Frequency



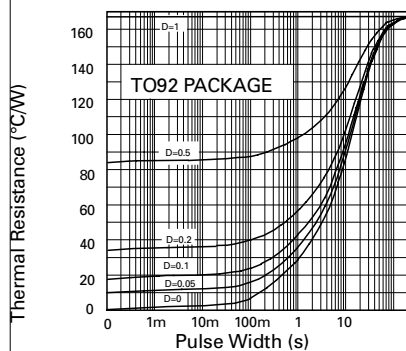
Ripple Rejection vs. Ripple Frequency



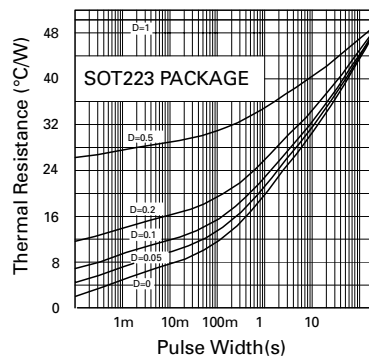
Line Transient Response



Load Transient Response



Thermal Resistance v Pulse Width

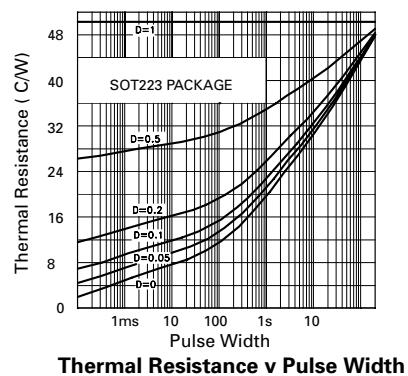
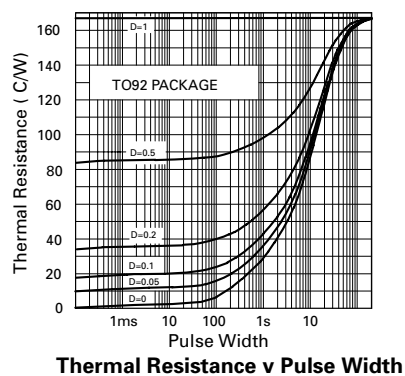
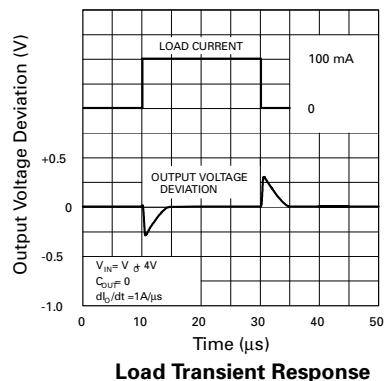
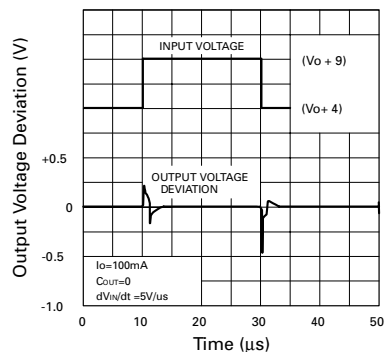
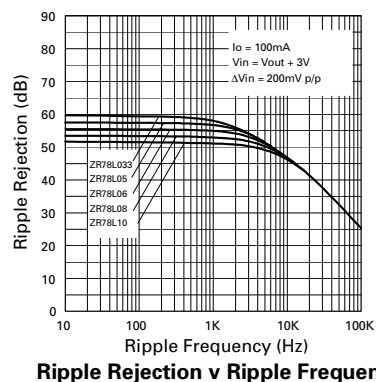
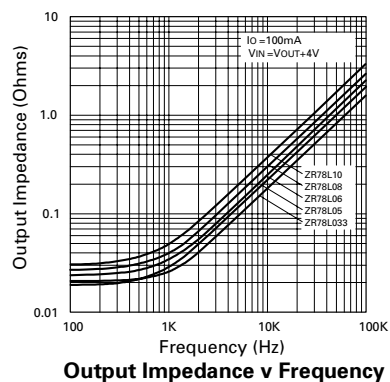


Thermal Resistance v Pulse Width

## ZR78L SERIES

ZR78L033 ZR78L05  
ZR78L06 ZR78L08  
ZR78L10

### TYPICAL CHARACTERISTICS



## ZR78L SERIES

### ZR78L07 TEST CONDITIONS (Unless otherwise stated): $T_j=25^{\circ}\text{C}$ , $I_O=100\text{mA}$ , $V_{in}=11\text{V}$

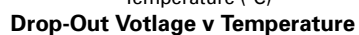
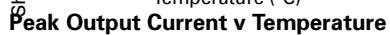
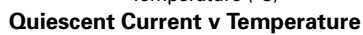
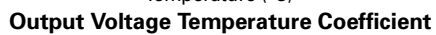
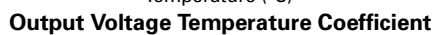
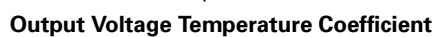
| SYMBOL                     | PARAMETER                                     | CONDITIONS                                                     | MIN.  | TYP. | MAX.  | UNITS                        |
|----------------------------|-----------------------------------------------|----------------------------------------------------------------|-------|------|-------|------------------------------|
| $V_O$                      | Output Voltage                                |                                                                | 6.825 | 7    | 7.175 | V                            |
|                            |                                               | $I_O=1$ to $200\text{mA}$ $\tau$                               | 6.72  |      | 7.28  | V                            |
|                            |                                               | $V_{in}=9$ to $20\text{V}$<br>$I_O=1$ to $100\text{mA}$ $\tau$ | 6.72  |      | 7.28  | V                            |
| $\Delta V_O$               | Line Regulation                               | $V_{in}=9$ to $20\text{V}$                                     |       | 10   | 40    | mV                           |
| $\Delta V_O$               | Load Regulation                               | $I_O=1$ to $200\text{mA}$                                      |       | 5    | 25    | mV                           |
|                            |                                               | $I_O=1$ to $100\text{mA}$                                      |       | 2    |       | mV                           |
| $I_q$                      | Quiescent Current                             | $\tau$                                                         |       | 350  | 600   | $\mu\text{A}$                |
| $\Delta I_q$               | Quiescent Current Change                      | $I_O=1$ to $200\text{mA}$                                      |       |      | 100   | $\mu\text{A}$                |
|                            |                                               | $V_{in}=9$ to $20\text{V}$                                     |       |      | 100   | $\mu\text{A}$                |
| $V_n$                      | Output Noise Voltage                          | $f=10\text{Hz}$ to $10\text{kHz}$                              |       | 75   |       | $\mu\text{V rms}$            |
| $\Delta V_{in}/\Delta V_O$ | Ripple Rejection                              | $V_{in}=10$ to $18\text{V}$<br>$f=120\text{Hz}$                | 48    | 62   |       | dB                           |
| $V_{in}$                   | Input Voltage Required To Maintain Regulation |                                                                | 9     | 8.7  |       | V                            |
| $\Delta V_O/\Delta T$      | Average Temperature Coefficient of $V_O$      | $I_O=5.0\text{mA}$ $\tau$                                      |       | 0.1  |       | $\text{mV}/^{\circ}\text{C}$ |

### ZR78L08 TEST CONDITIONS (Unless otherwise stated): $T_j=25^{\circ}\text{C}$ , $I_O=100\text{mA}$ , $V_{in}=12\text{V}$

| SYMBOL                     | PARAMETER                                     | CONDITIONS                                                      | MIN. | TYP. | MAX. | UNITS                        |
|----------------------------|-----------------------------------------------|-----------------------------------------------------------------|------|------|------|------------------------------|
| $V_O$                      | Output Voltage                                |                                                                 | 7.8  | 8    | 8.2  | V                            |
|                            |                                               | $I_O=1$ to $200\text{mA}$ $\tau$                                | 7.68 |      | 8.32 | V                            |
|                            |                                               | $V_{in}=10$ to $20\text{V}$<br>$I_O=1$ to $100\text{mA}$ $\tau$ | 7.68 |      | 8.32 | V                            |
| $\Delta V_O$               | Line Regulation                               | $V_{in}=10$ to $20\text{V}$                                     |      | 11   | 40   | mV                           |
| $\Delta V_O$               | Load Regulation                               | $I_O=1$ to $200\text{mA}$                                       |      | 8    | 30   | mV                           |
|                            |                                               | $I_O=1$ to $100\text{mA}$                                       |      | 3    |      | mV                           |
| $I_q$                      | Quiescent Current                             | $\tau$                                                          |      | 350  | 600  | $\mu\text{A}$                |
| $\Delta I_q$               | Quiescent Current Change                      | $I_O=1$ to $200\text{mA}$                                       |      |      | 100  | $\mu\text{A}$                |
|                            |                                               | $V_{in}=10$ to $20\text{V}$                                     |      |      | 100  | $\mu\text{A}$                |
| $V_n$                      | Output Noise Voltage                          | $f=10\text{Hz}$ to $10\text{kHz}$                               |      | 115  |      | $\mu\text{V rms}$            |
| $\Delta V_{in}/\Delta V_O$ | Ripple Rejection                              | $V_{in}=11$ to $18\text{V}$<br>$f=120\text{Hz}$                 | 44   | 60   |      | dB                           |
| $V_{in}$                   | Input Voltage Required To Maintain Regulation |                                                                 | 10   | 9.7  |      | V                            |
| $\Delta V_O/\Delta T$      | Average Temperature Coefficient of $V_O$      | $I_O=5.0\text{mA}$ $\tau$                                       |      | 0.25 |      | $\text{mV}/^{\circ}\text{C}$ |

**ZR78L048 ZR78L052**  
**ZR78L07 ZR78L085**  
**ZR78L12**

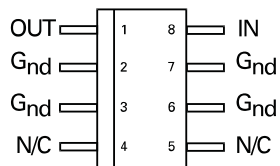
**ZR78L048 ZR78L052**  
**ZR78L07 ZR78L085**  
**ZR78L12**



## ZR78L SERIES

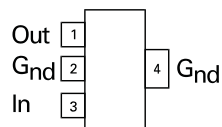
### CONNECTION DIAGRAMS

#### SO8 Package Suffix – N8



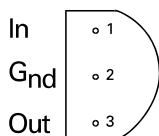
Top View

#### SOT223 Package Suffix – G



Top View –  
Connect pin 4 to pin 2 or leave pin 4 electrically isolated

#### TO92 Package Suffix – C



Bottom View

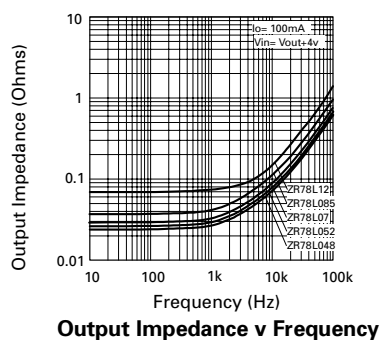
### OPTIONS

| Voltage | Voltage Options | TO92 | SOT223 | SO8 |
|---------|-----------------|------|--------|-----|
| 2.85V   | 028             | ✓    | ✓      |     |
| 3.0V    | 03              | ✓    | ✓      |     |
| 3.3V    | 033             | ✓    | ✓      | ✓   |
| 4.0V    | 04              | ✓    | ✓      |     |
| 4.8V    | 048             | ✓    | ✓      |     |
| 5.0V    | 05              | ✓    | ✓      | ✓   |
| 5.2V    | 052             | ✓    | ✓      |     |
| 5.7V    | 057             | ✓    | ✓      |     |
| 6.0V    | 06              | ✓    | ✓      |     |
| 7.0V    | 07              | ✓    | ✓      |     |
| 8.0V    | 08              | ✓    | ✓      |     |
| 8.5V    | 085             | ✓    | ✓      |     |
| 9.0V    | 09              | ✓    | ✓      |     |
| 10.0V   | 10              | ✓    | ✓      |     |
| 12.0V   | 12              | ✓    | ✓      |     |

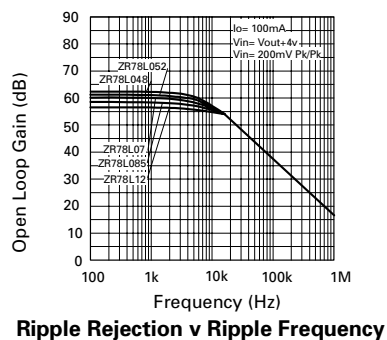
ZR78L048 ZR78L052  
ZR78L07 ZR78L085  
ZR78L12

**ZR78L  
SERIES**

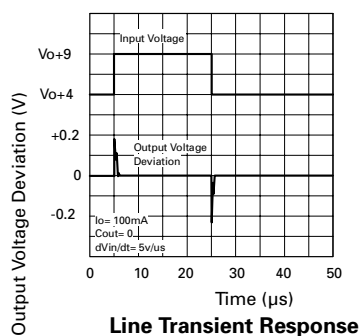
# TYPICAL CHARACTERISTICS



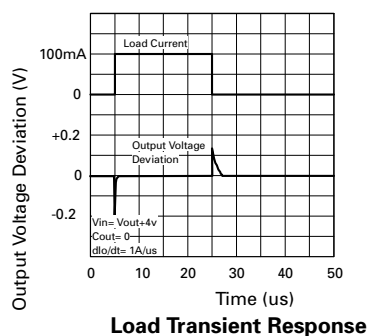
Output Impedance v Frequency



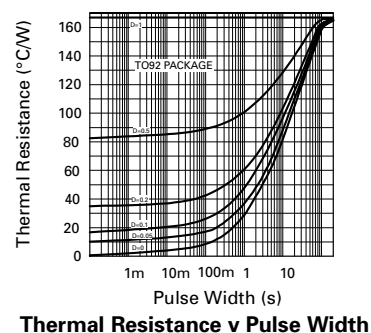
Ripple Rejection v Ripple Frequency



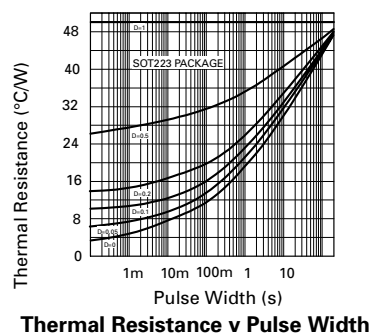
Line Transient Response



Load Transient Response



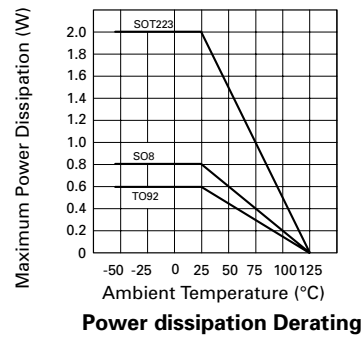
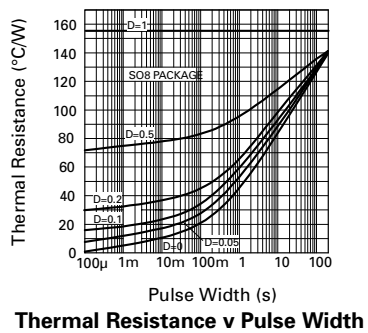
Thermal Resistance v Pulse Width



Thermal Resistance v Pulse Width

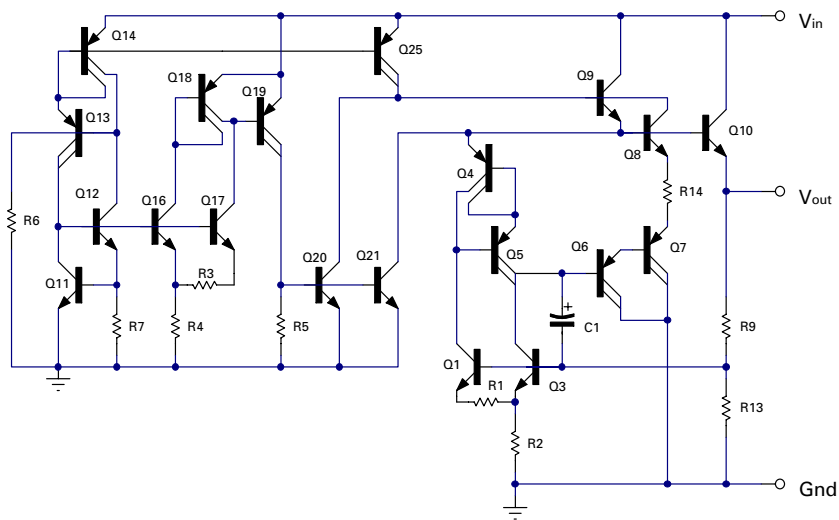
## ZR78L SERIES

### THERMAL CHARACTERISTICS



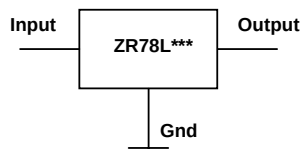
# ZR78L SERIES

## SCHEMATIC DIAGRAM

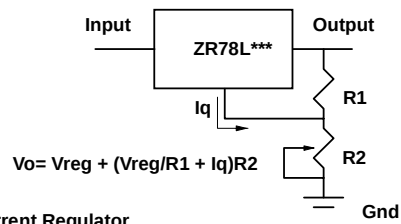


## APPLICATIONS

### Fixed Output Regulator



### Adjustable Output Regulator



### Current Regulator

