

100mA Three Terminal Voltage Regulator

Features

- Quiescent Current: 2.3mA( $V_{OUT} \leq 10V$ )
- Input Voltage: 35V( $V_{OUT} \leq 10V$ ), 40V( $V_{OUT} > 10V$ )
- Output Current: 100mA
- Low Dropout Voltage: 1.95V(Typ.)@200mA
- Built-in Thermal Overload Protection
- Built-in Short Circuit Current Limiting

Applications

- Battery Power Supply Equipment
- Communication Equipment
- Audio/Video Equipment
- Monitor Equipment

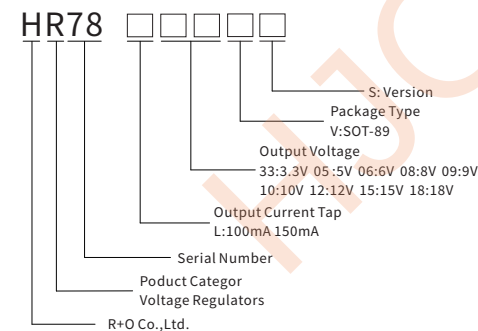
General Description

The HR78LS Series is three-terminal positive regulators. These regulators can deliver up to 100mA of output current. The internal limiting and thermal-shutdown features of the regulator make them essentially immune to overload. When used as are placement for a zener diode-resistor Combination, an effective improvement in output impedance can be obtained, together with lower quiescent current.

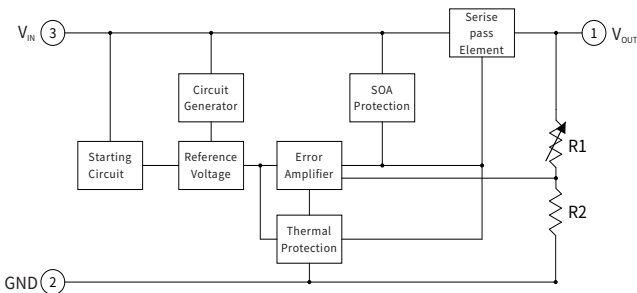
Reference News

SOT-89 Marking:  
HR78L33VS: 78L33 HR78L05VS: 78L05  
HR78L06VS: 78L06 HR78L08VS: 78L08  
HR78L09VS: 78L09 HR78L10VS: 78L10  
HR78L12VS: 78L12 HR78L15VS: 78L15  
HR78L18VS: 78L18

Part Numbering

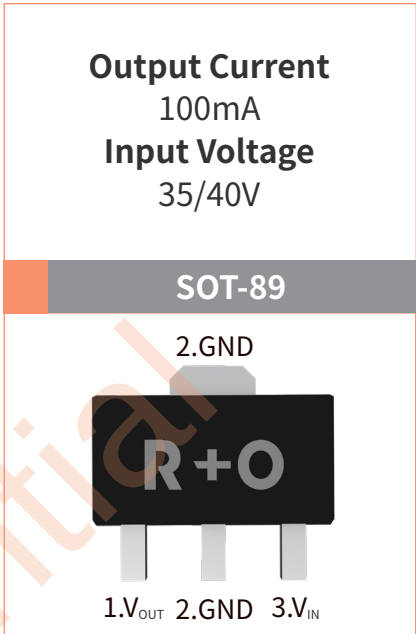


Block Diagram

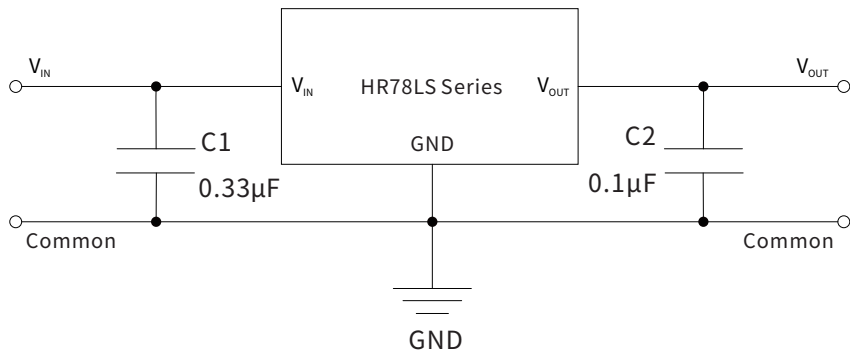


Ordering Information

| Package | Package Code | Unit Weight(g) | Reel(pcs) | Box(pcs) | Carton(pcs) | Delivery Mode | MSL |
|---------|--------------|----------------|-----------|----------|-------------|---------------|-----|
| SOT-89  | R1           | 0.045          | 1000      | 10000    | 40000       | 7"            | 3   |



Typical Application Circuit



Absolute Maximum Ratings (T<sub>A</sub> = 25°C Unless otherwise specified)

| PARAMETER                           | SYMBOL           |                        | Value       | UNIT  |
|-------------------------------------|------------------|------------------------|-------------|-------|
| Input Voltage Limit                 | V <sub>IN</sub>  | V <sub>OUT</sub> ≤ 10V | 35          | V     |
|                                     |                  | V <sub>OUT</sub> > 10V | 40          |       |
| Operating Current                   | I <sub>O</sub>   |                        | 100         | mA    |
| Power Dissipation                   | P <sub>D</sub>   | SOT-89-3               | 630         | mW    |
|                                     |                  | SOT-23-3               | 400         | mW    |
|                                     |                  | TO-92                  | 630         | mW    |
| Thermal Resistance Junction-Ambient | R <sub>θJA</sub> | SOT-89-3               | 160         | °C /W |
|                                     |                  | SOT-23-3               | 250         | °C /W |
|                                     |                  | TO-92                  | 160         | °C /W |
| Solder Temperature/Time             | T <sub>d</sub>   |                        | 260/10      | °C /S |
| Operating Ambient Temperature       | T <sub>A</sub>   |                        | -40 to +85  | °C    |
| Junction Temperature                | T <sub>J</sub>   |                        | -55 to +150 | °C    |
| Storage Temperature                 | T <sub>stg</sub> |                        | -55 to +150 | °C    |

Note: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device.

● **Electrical Characteristics**(HR78L33VS,  $T_A = 25^\circ\text{C}$  Unless otherwise specified)

| PARAMETER                              | SYMBOL                                         | Conditions                                                              | Min.  | Typ. | Max.  | UNIT                       |
|----------------------------------------|------------------------------------------------|-------------------------------------------------------------------------|-------|------|-------|----------------------------|
| Output Voltage                         | $V_{OUT}$                                      | $V_{IN} = 10\text{V}, I_O = 40\text{mA}$                                | 3.2   | 3.3  | 3.4   | V                          |
|                                        |                                                | $5.5\text{V} < V_{IN} < 25\text{V}$<br>$1\text{mA} < I_O < 40\text{mA}$ | 3.168 | 3.3  | 3.432 |                            |
|                                        |                                                | $1\text{mA} < I_O < 100\text{mA}$                                       | 3.135 | 3.3  | 3.465 |                            |
| Line Regulation                        | $\Delta V_{OUT} / \Delta V_{IN} \cdot V_{OUT}$ | $5.5\text{V} < V_{IN} < 25\text{V}, I_O = 10\text{mA}$                  | --    | 18   | 75    | mV                         |
|                                        |                                                | $7\text{V} < V_{IN} < 25\text{V}, I_O = 10\text{mA}$                    | --    | 10   | 55    |                            |
| Load Regulation                        | $\Delta V_{OUT}$                               | $V_{IN} = 6.5\text{V}, 1\text{mA} < I_O < 100\text{mA}$                 | --    | 20   | 50    | mV                         |
|                                        |                                                | $V_{IN} = 6.5\text{V}, 1\text{mA} < I_O < 40\text{mA}$                  | --    | 5    | 30    |                            |
| Quiescent Current                      | $I_Q$                                          | $V_{IN} = 6.5\text{V}, I_O = 0\text{mA}$                                | --    | 2.3  | 5     | mA                         |
| Quiescent Current Change               | $\Delta I_Q$                                   | $6\text{V} < V_{IN} < 25\text{V}$                                       | --    | 0.3  | 1.0   | mA                         |
| Quiescent Current Change               | $\Delta I_Q$                                   | $1\text{mA} < I_O < 40\text{mA}$                                        | --    | --   | 1.0   | mA                         |
| Output Noise Voltage                   | $V_n$                                          | $f = 10\text{Hz to } 100\text{KHz}$                                     | --    | 40   | --    | $\mu\text{V}$              |
| Power-Supply Rejection Ratio           | PSRR                                           | $f=100\text{Hz}, 6\text{V} < V_{IN} < 16\text{V}$                       | 47    | 62   | --    | dB                         |
| Peak Output Current                    | $I_{PK}$                                       | $V_{IN} = 6.5\text{V}$                                                  | --    | 300  | --    | mA                         |
| Output Voltage Temperature Coefficient | $V_{TC}$                                       | $I_O = 10\text{mA}$                                                     | --    | 0.4  | --    | $\text{mV}/^\circ\text{C}$ |
| Dropout Voltage                        | $V_{Drop}$                                     | $I_O = 100\text{mA}$                                                    | --    | 1.75 | 2     | V                          |
|                                        |                                                | $I_O = 200\text{mA}$                                                    | --    | 1.95 | 2.1   |                            |
| Minimum Input Voltage                  | $V_{IN, MIN}$                                  | $I_O = 10\text{mA}$                                                     | --    | 5.5  | 6     | V                          |
| Maximum Input Voltage                  | $V_{IN, MAX}$                                  | $I_O = 10\text{mA}$                                                     | --    | 36   | --    | V                          |

● **Electrical Characteristics**(HR78L05VS,  $T_A = 25^\circ\text{C}$  Unless otherwise specified)

| PARAMETER                              | SYMBOL                                         | Conditions                                | Min. | Typ. | Max. | UNIT          |
|----------------------------------------|------------------------------------------------|-------------------------------------------|------|------|------|---------------|
| Output Voltage                         | $V_{OUT}$                                      | $V_{IN} = 10V, I_O = 40mA$                | 4.85 | 5.0  | 5.15 | V             |
|                                        |                                                | $7V < V_{IN} < 25V$<br>$1mA < I_O < 40mA$ | 4.8  | 5.0  | 5.2  |               |
|                                        |                                                | $1mA < I_O < 100mA$                       | 4.75 | 5.0  | 5.25 |               |
| Line Regulation                        | $\Delta V_{OUT} / \Delta V_{IN} \cdot V_{OUT}$ | $7V < V_{IN} < 25V, I_O = 10mA$           | --   | 18   | 100  | mV            |
|                                        |                                                | $8V < V_{IN} < 25V, I_O = 10mA$           | --   | 10   | 70   |               |
| Load Regulation                        | $\Delta V_{OUT}$                               | $V_{IN} = 8V, 1mA < I_O < 100mA$          | --   | 20   | 60   | mV            |
|                                        |                                                | $V_{IN} = 8V, 1mA < I_O < 40mA$           | --   | 5    | 30   |               |
| Quiescent Current                      | $I_Q$                                          | $V_{IN} = 7V, I_O = 0mA$                  | --   | 2.3  | 5    | mA            |
| Quiescent Current Change               | $\Delta I_Q$                                   | $8V < V_{IN} < 25V$                       | --   | 0.3  | 1.0  | mA            |
| Quiescent Current Change               | $\Delta I_Q$                                   | $1mA < I_O < 40mA$                        | --   | --   | 1.0  | mA            |
| Output Noise Voltage                   | $V_n$                                          | $f = 10Hz \text{ to } 100KHz$             | --   | 40   | --   | $\mu V$       |
| Power-Supply Rejection Ratio           | PSRR                                           | $f = 100Hz, 8V < V_{IN} < 16V$            | 47   | 62   | --   | dB            |
| Peak Output Current                    | $I_{PK}$                                       | $V_{IN} = 8V$                             | --   | 300  | --   | mA            |
| Output Voltage Temperature Coefficient | $V_{TC}$                                       | $I_O = 10mA$                              | --   | 0.5  | --   | $mV/^\circ C$ |
| Dropout Voltage                        | $V_{Drop}$                                     | $I_O = 100mA$                             | --   | 1.75 | 2    | V             |
|                                        |                                                | $I_O = 200mA$                             | --   | 1.95 | 2.1  |               |
| Minimum Input Voltage                  | $V_{IN, MIN}$                                  | $I_O = 10mA$                              | --   | 6.8  | 7    | V             |
| Maximum Input Voltage                  | $V_{IN, MAX}$                                  | $I_O = 10mA$                              | --   | 38   | --   | V             |

● **Electrical Characteristics**(HR78L06VS,  $T_A = 25^\circ\text{C}$  Unless otherwise specified)

| PARAMETER                              | SYMBOL                                         | Conditions                                                            | Min. | Typ. | Max. | UNIT                       |
|----------------------------------------|------------------------------------------------|-----------------------------------------------------------------------|------|------|------|----------------------------|
| Output Voltage                         | $V_{OUT}$                                      | $V_{IN} = 10\text{V}, I_O = 40\text{mA}$                              | 5.82 | 6.0  | 6.18 | V                          |
|                                        |                                                | $8\text{V} < V_{IN} < 25\text{V}$<br>$1\text{mA} < I_O < 40\text{mA}$ | 5.76 | 6.0  | 6.24 |                            |
|                                        |                                                | $1\text{mA} < I_O < 100\text{mA}$                                     | 5.7  | 6.0  | 6.3  |                            |
| Line Regulation                        | $\Delta V_{OUT} / \Delta V_{IN} \cdot V_{OUT}$ | $8\text{V} < V_{IN} < 25\text{V}, I_O = 10\text{mA}$                  | --   | 18   | 100  | mV                         |
|                                        |                                                | $9\text{V} < V_{IN} < 25\text{V}, I_O = 10\text{mA}$                  | --   | 10   | 70   |                            |
| Load Regulation                        | $\Delta V_{OUT}$                               | $V_{IN} = 9\text{V}, 1\text{mA} < I_O < 100\text{mA}$                 | --   | 20   | 60   | mV                         |
|                                        |                                                | $V_{IN} = 9\text{V}, 1\text{mA} < I_O < 40\text{mA}$                  | --   | 5    | 30   |                            |
| Quiescent Current                      | $I_Q$                                          | $V_{IN} = 8\text{V}, I_O = 0\text{mA}$                                | --   | 2.3  | 5    | mA                         |
| Quiescent Current Change               | $\Delta I_Q$                                   | $9\text{V} < V_{IN} < 25\text{V}$                                     | --   | 0.3  | 1.0  | mA                         |
| Quiescent Current Change               | $\Delta I_Q$                                   | $1\text{mA} < I_O < 40\text{mA}$                                      | --   | --   | 1.0  | mA                         |
| Output Noise Voltage                   | $V_n$                                          | $f = 10\text{Hz to } 100\text{KHz}$                                   | --   | 40   | --   | $\mu\text{V}$              |
| Power-Supply Rejection Ratio           | PSRR                                           | $f = 100\text{Hz}, 9\text{V} < V_{IN} < 16\text{V}$                   | 47   | 62   | --   | dB                         |
| Peak Output Current                    | $I_{PK}$                                       | $V_{IN} = 9\text{V}$                                                  | --   | 300  | --   | mA                         |
| Output Voltage Temperature Coefficient | $V_{TC}$                                       | $I_O = 10\text{mA}$                                                   | --   | 0.5  | --   | $\text{mV}/^\circ\text{C}$ |
| Dropout Voltage                        | $V_{Drop}$                                     | $I_O = 100\text{mA}$                                                  | --   | 1.75 | 2    | V                          |
|                                        |                                                | $I_O = 200\text{mA}$                                                  | --   | 1.95 | 2.1  |                            |
| Minimum Input Voltage                  | $V_{IN, MIN}$                                  | $I_O = 10\text{mA}$                                                   | --   | 7.8  | 8    | V                          |
| Maximum Input Voltage                  | $V_{IN, MAX}$                                  | $I_O = 10\text{mA}$                                                   | --   | 39   | --   | V                          |

● **Electrical Characteristics**(HR78L08VS,  $T_A = 25^\circ\text{C}$  Unless otherwise specified)

| PARAMETER                              | SYMBOL                                         | Conditions                                                             | Min. | Typ. | Max. | UNIT                       |
|----------------------------------------|------------------------------------------------|------------------------------------------------------------------------|------|------|------|----------------------------|
| Output Voltage                         | $V_{OUT}$                                      | $V_{IN} = 11\text{V}, I_O = 40\text{mA}$                               | 7.76 | 8.0  | 8.24 | V                          |
|                                        |                                                | $10\text{V} < V_{IN} < 25\text{V}$<br>$1\text{mA} < I_O < 40\text{mA}$ | 7.68 | 8.0  | 8.32 |                            |
|                                        |                                                | $1\text{mA} < I_O < 100\text{mA}$                                      | 7.6  | 8.0  | 8.40 |                            |
| Line Regulation                        | $\Delta V_{OUT} / \Delta V_{IN} \cdot V_{OUT}$ | $10\text{V} < V_{IN} < 25\text{V}, I_O = 10\text{mA}$                  | --   | 25   | 150  | mV                         |
|                                        |                                                | $11\text{V} < V_{IN} < 25\text{V}, I_O = 10\text{mA}$                  | --   | 15   | 100  |                            |
| Load Regulation                        | $\Delta V_{OUT}$                               | $V_{IN} = 11\text{V}, 1\text{mA} < I_O < 100\text{mA}$                 | --   | 30   | 100  | mV                         |
|                                        |                                                | $V_{IN} = 11\text{V}, 1\text{mA} < I_O < 40\text{mA}$                  | --   | 8    | 50   |                            |
| Quiescent Current                      | $I_Q$                                          | $V_{IN} = 10\text{V}, I_O = 0\text{mA}$                                | --   | 2.3  | 5    | mA                         |
| Quiescent Current Change               | $\Delta I_Q$                                   | $11\text{V} < V_{IN} < 25\text{V}$                                     | --   | 0.3  | 1.0  | mA                         |
| Quiescent Current Change               | $\Delta I_Q$                                   | $1\text{mA} < I_O < 40\text{mA}$                                       | --   | --   | 1.0  | mA                         |
| Output Noise Voltage                   | $V_n$                                          | $f = 10\text{Hz to } 100\text{KHz}$                                    | --   | 70   | --   | $\mu\text{V}$              |
| Power-Supply Rejection Ratio           | PSRR                                           | $f = 100\text{Hz}, 14\text{V} < V_{IN} < 25\text{V}$                   | 40   | 56   | --   | dB                         |
| Peak Output Current                    | $I_{PK}$                                       | $V_{IN} = 11\text{V}$                                                  | --   | 300  | --   | mA                         |
| Output Voltage Temperature Coefficient | $V_{TC}$                                       | $I_O = 10\text{mA}$                                                    | --   | 0.8  | --   | $\text{mV}/^\circ\text{C}$ |
| Dropout Voltage                        | $V_{Drop}$                                     | $I_O = 100\text{mA}$                                                   | --   | 1.75 | 2    | V                          |
|                                        |                                                | $I_O = 200\text{mA}$                                                   | --   | 1.95 | 2.1  |                            |
| Minimum Input Voltage                  | $V_{IN, MIN}$                                  | $I_O = 10\text{mA}$                                                    | --   | 9.8  | 10   | V                          |
| Maximum Input Voltage                  | $V_{IN, MAX}$                                  | $I_O = 10\text{mA}$                                                    | --   | 42   | --   | V                          |

● **Electrical Characteristics**(HR78L09VS,  $T_A = 25^\circ\text{C}$  Unless otherwise specified)

| PARAMETER                              | SYMBOL                                         | Conditions                                                             | Min. | Typ. | Max. | UNIT                       |
|----------------------------------------|------------------------------------------------|------------------------------------------------------------------------|------|------|------|----------------------------|
| Output Voltage                         | $V_{OUT}$                                      | $V_{IN} = 12\text{V}, I_O = 40\text{mA}$                               | 8.73 | 9.0  | 9.27 | V                          |
|                                        |                                                | $11\text{V} < V_{IN} < 25\text{V}$<br>$1\text{mA} < I_O < 40\text{mA}$ | 8.55 | 9.0  | 9.45 |                            |
|                                        |                                                | $1\text{mA} < I_O < 100\text{mA}$                                      | 8.55 | 9.0  | 9.45 |                            |
| Line Regulation                        | $\Delta V_{OUT} / \Delta V_{IN} \cdot V_{OUT}$ | $11\text{V} < V_{IN} < 25\text{V}, I_O = 10\text{mA}$                  | --   | 25   | 150  | mV                         |
|                                        |                                                | $12\text{V} < V_{IN} < 25\text{V}, I_O = 10\text{mA}$                  | --   | 15   | 100  |                            |
| Load Regulation                        | $\Delta V_{OUT}$                               | $V_{IN} = 12\text{V}, 1\text{mA} < I_O < 100\text{mA}$                 | --   | 30   | 100  | mV                         |
|                                        |                                                | $V_{IN} = 12\text{V}, 1\text{mA} < I_O < 40\text{mA}$                  | --   | 8    | 50   |                            |
| Quiescent Current                      | $I_Q$                                          | $V_{IN} = 11\text{V}, I_O = 0\text{mA}$                                | --   | 2.3  | 5    | mA                         |
| Quiescent Current Change               | $\Delta I_Q$                                   | $12\text{V} < V_{IN} < 25\text{V}$                                     | --   | 0.3  | 1.0  | mA                         |
| Quiescent Current Change               | $\Delta I_Q$                                   | $1\text{mA} < I_O < 40\text{mA}$                                       | --   | --   | 1.0  | mA                         |
| Output Noise Voltage                   | $V_n$                                          | $f = 10\text{Hz to } 100\text{KHz}$                                    | --   | 70   | --   | $\mu\text{V}$              |
| Power-Supply Rejection Ratio           | PSRR                                           | $f = 100\text{Hz}, 15\text{V} < V_{IN} < 25\text{V}$                   | 40   | 56   | --   | dB                         |
| Peak Output Current                    | $I_{PK}$                                       | $V_{IN} = 12\text{V}$                                                  | --   | 300  | --   | mA                         |
| Output Voltage Temperature Coefficient | $V_{TC}$                                       | $I_O = 10\text{mA}$                                                    | --   | 0.8  | --   | $\text{mV}/^\circ\text{C}$ |
| Dropout Voltage                        | $V_{Drop}$                                     | $I_O = 100\text{mA}$                                                   | --   | 1.75 | 2    | V                          |
|                                        |                                                | $I_O = 200\text{mA}$                                                   | --   | 1.95 | 2.1  |                            |
| Minimum Input Voltage                  | $V_{IN, MIN}$                                  | $I_O = 10\text{mA}$                                                    | --   | 10.8 | 11   | V                          |
| Maximum Input Voltage                  | $V_{IN, MAX}$                                  | $I_O = 10\text{mA}$                                                    | --   | 42   | --   | V                          |

● **Electrical Characteristics**(HR78L10VS,  $T_A = 25^\circ\text{C}$  Unless otherwise specified)

| PARAMETER                              | SYMBOL                                         | Conditions                                                             | Min. | Typ. | Max. | UNIT                       |
|----------------------------------------|------------------------------------------------|------------------------------------------------------------------------|------|------|------|----------------------------|
| Output Voltage                         | $V_{OUT}$                                      | $V_{IN} = 13\text{V}, I_O = 40\text{mA}$                               | 9.70 | 10.0 | 10.3 | V                          |
|                                        |                                                | $12\text{V} < V_{IN} < 26\text{V}$<br>$1\text{mA} < I_O < 40\text{mA}$ | 9.61 | 10.0 | 10.4 |                            |
|                                        |                                                | $1\text{mA} < I_O < 100\text{mA}$                                      | 9.52 | 10.0 | 10.5 |                            |
| Line Regulation                        | $\Delta V_{OUT} / \Delta V_{IN} \cdot V_{OUT}$ | $12\text{V} < V_{IN} < 26\text{V}, I_O = 10\text{mA}$                  | --   | 30   | 180  | mV                         |
|                                        |                                                | $13\text{V} < V_{IN} < 26\text{V}, I_O = 10\text{mA}$                  | --   | 20   | 110  |                            |
| Load Regulation                        | $\Delta V_{OUT}$                               | $V_{IN} = 13\text{V}, 1\text{mA} < I_O < 100\text{mA}$                 | --   | 30   | 100  | mV                         |
|                                        |                                                | $V_{IN} = 12\text{V}, 1\text{mA} < I_O < 40\text{mA}$                  | --   | 10   | 50   |                            |
| Quiescent Current                      | $I_Q$                                          | $V_{IN} = 12\text{V}, I_O = 0\text{mA}$                                | --   | 2.1  | 5    | mA                         |
| Quiescent Current Change               | $\Delta I_Q$                                   | $13\text{V} < V_{IN} < 26\text{V}$                                     | --   | 0.1  | 1.0  | mA                         |
| Quiescent Current Change               | $\Delta I_Q$                                   | $1\text{mA} < I_O < 40\text{mA}$                                       | --   | --   | 1.0  | mA                         |
| Output Noise Voltage                   | $V_n$                                          | $f = 10\text{Hz to } 100\text{KHz}$                                    | --   | 80   | --   | $\mu\text{V}$              |
| Power-Supply Rejection Ratio           | PSRR                                           | $f = 100\text{Hz}, 16\text{V} < V_{IN} < 26\text{V}$                   | 40   | 54   | --   | dB                         |
| Peak Output Current                    | $I_{PK}$                                       | $V_{IN} = 13\text{V}$                                                  | --   | 300  | --   | mA                         |
| Output Voltage Temperature Coefficient | $V_{TC}$                                       | $I_O = 10\text{mA}$                                                    | --   | 1.0  | --   | $\text{mV}/^\circ\text{C}$ |
| Dropout Voltage                        | $V_{Drop}$                                     | $I_O = 100\text{mA}$                                                   | --   | 1.75 | 2    | V                          |
|                                        |                                                | $I_O = 200\text{mA}$                                                   | --   | 1.95 | 2.1  |                            |
| Minimum Input Voltage                  | $V_{IN, MIN}$                                  | $I_O = 10\text{mA}$                                                    | --   | 11.8 | 12   | V                          |
| Maximum Input Voltage                  | $V_{IN, MAX}$                                  | $I_O = 10\text{mA}$                                                    | --   | 43   | --   | V                          |

● **Electrical Characteristics**(HR78L12VS,  $T_A = 25^\circ\text{C}$  Unless otherwise specified)

| PARAMETER                              | SYMBOL                                         | Conditions                                                             | Min.  | Typ. | Max.  | UNIT                       |
|----------------------------------------|------------------------------------------------|------------------------------------------------------------------------|-------|------|-------|----------------------------|
| Output Voltage                         | $V_{OUT}$                                      | $V_{IN} = 15\text{V}, I_O = 40\text{mA}$                               | 11.64 | 12.0 | 12.36 | V                          |
|                                        |                                                | $14\text{V} < V_{IN} < 27\text{V}$<br>$1\text{mA} < I_O < 40\text{mA}$ | 11.4  | 12.0 | 12.6  |                            |
|                                        |                                                | $1\text{mA} < I_O < 100\text{mA}$                                      | 11.4  | 12.0 | 12.6  |                            |
| Line Regulation                        | $\Delta V_{OUT} / \Delta V_{IN} \cdot V_{OUT}$ | $14\text{V} < V_{IN} < 27\text{V}, I_O = 10\text{mA}$                  | --    | 30   | 180   | mV                         |
|                                        |                                                | $15\text{V} < V_{IN} < 27\text{V}, I_O = 10\text{mA}$                  | --    | 20   | 110   |                            |
| Load Regulation                        | $\Delta V_{OUT}$                               | $V_{IN} = 15\text{V}, 1\text{mA} < I_O < 100\text{mA}$                 | --    | 30   | 100   | mV                         |
|                                        |                                                | $V_{IN} = 15\text{V}, 1\text{mA} < I_O < 40\text{mA}$                  | --    | 10   | 50    |                            |
| Quiescent Current                      | $I_Q$                                          | $V_{IN} = 14\text{V}, I_O = 0\text{mA}$                                | --    | 2.1  | 5     | mA                         |
| Quiescent Current Change               | $\Delta I_Q$                                   | $15\text{V} < V_{IN} < 27\text{V}$                                     | --    | 0.1  | 1.0   | mA                         |
| Quiescent Current Change               | $\Delta I_Q$                                   | $1\text{mA} < I_O < 40\text{mA}$                                       | --    | --   | 1.0   | mA                         |
| Output Noise Voltage                   | $V_n$                                          | $f = 10\text{Hz to } 100\text{KHz}$                                    | --    | 80   | --    | $\mu\text{V}$              |
| Power-Supply Rejection Ratio           | PSRR                                           | $f = 100\text{Hz}, 15\text{V} < V_{IN} < 25\text{V}$                   | 40    | 54   | --    | dB                         |
| Peak Output Current                    | $I_{PK}$                                       | $V_{IN} = 15\text{V}$                                                  | --    | 300  | --    | mA                         |
| Output Voltage Temperature Coefficient | $V_{TC}$                                       | $I_O = 10\text{mA}$                                                    | --    | 1.0  | --    | $\text{mV}/^\circ\text{C}$ |
| Dropout Voltage                        | $V_{Drop}$                                     | $I_O = 100\text{mA}$                                                   | --    | 1.75 | 2     | V                          |
|                                        |                                                | $I_O = 200\text{mA}$                                                   | --    | 1.95 | 2.1   |                            |
| Minimum Input Voltage                  | $V_{IN, MIN}$                                  | $I_O = 10\text{mA}$                                                    | --    | 13.8 | 14    | V                          |
| Maximum Input Voltage                  | $V_{IN, MAX}$                                  | $I_O = 10\text{mA}$                                                    | --    | 43   | --    | V                          |

● **Electrical Characteristics**(HR78L15VS,  $T_A = 25^\circ\text{C}$  Unless otherwise specified)

| PARAMETER                              | SYMBOL                                         | Conditions                                                             | Min.  | Typ. | Max.  | UNIT                       |
|----------------------------------------|------------------------------------------------|------------------------------------------------------------------------|-------|------|-------|----------------------------|
| Output Voltage                         | $V_{OUT}$                                      | $V_{IN} = 18\text{V}, I_O = 40\text{mA}$                               | 14.55 | 15.0 | 15.45 | V                          |
|                                        |                                                | $17\text{V} < V_{IN} < 30\text{V}$<br>$1\text{mA} < I_O < 40\text{mA}$ | 14.4  | 15.0 | 15.6  |                            |
|                                        |                                                | $1\text{mA} < I_O < 100\text{mA}$                                      | 14.25 | 15.0 | 15.75 |                            |
| Line Regulation                        | $\Delta V_{OUT} / \Delta V_{IN} \cdot V_{OUT}$ | $17\text{V} < V_{IN} < 30\text{V}, I_O = 10\text{mA}$                  | --    | 50   | 250   | mV                         |
|                                        |                                                | $18\text{V} < V_{IN} < 30\text{V}, I_O = 10\text{mA}$                  | --    | 35   | 180   |                            |
| Load Regulation                        | $\Delta V_{OUT}$                               | $V_{IN} = 18\text{V}, 1\text{mA} < I_O < 100\text{mA}$                 | --    | 30   | 150   | mV                         |
|                                        |                                                | $V_{IN} = 18\text{V}, 1\text{mA} < I_O < 40\text{mA}$                  | --    | 15   | 75    |                            |
| Quiescent Current                      | $I_Q$                                          | $V_{IN} = 17\text{V}, I_O = 0\text{mA}$                                | --    | 2.1  | 5     | mA                         |
| Quiescent Current Change               | $\Delta I_Q$                                   | $18\text{V} < V_{IN} < 30\text{V}$                                     | --    | 0.1  | 1.0   | mA                         |
| Quiescent Current Change               | $\Delta I_Q$                                   | $1\text{mA} < I_O < 40\text{mA}$                                       | --    | --   | 1.0   | mA                         |
| Output Noise Voltage                   | $V_n$                                          | $f = 10\text{Hz to } 100\text{KHz}$                                    | --    | 85   | --    | $\mu\text{V}$              |
| Power-Supply Rejection Ratio           | PSRR                                           | $f = 100\text{Hz}, 18\text{V} < V_{IN} < 28\text{V}$                   | 35    | 40   | --    | dB                         |
| Peak Output Current                    | $I_{PK}$                                       | $V_{IN} = 18\text{V}$                                                  | --    | 300  | --    | mA                         |
| Output Voltage Temperature Coefficient | $V_{TC}$                                       | $I_O = 10\text{mA}$                                                    | --    | 1.2  | --    | $\text{mV}/^\circ\text{C}$ |
| Dropout Voltage                        | $V_{Drop}$                                     | $I_O = 100\text{mA}$                                                   | --    | 1.75 | 2     | V                          |
|                                        |                                                | $I_O = 200\text{mA}$                                                   | --    | 1.95 | 2.1   |                            |
| Minimum Input Voltage                  | $V_{IN, MIN}$                                  | $I_O = 10\text{mA}$                                                    | --    | 16.8 | 17    | V                          |
| Maximum Input Voltage                  | $V_{IN, MAX}$                                  | $I_O = 10\text{mA}$                                                    | --    | 43   | --    | V                          |

● **Electrical Characteristics**(HR78L18VS,  $T_A = 25^\circ\text{C}$  Unless otherwise specified)

| PARAMETER                              | SYMBOL                                         | Conditions                                                             | Min.  | Typ. | Max.  | UNIT                       |
|----------------------------------------|------------------------------------------------|------------------------------------------------------------------------|-------|------|-------|----------------------------|
| Output Voltage                         | $V_{OUT}$                                      | $V_{IN} = 21\text{V}, I_O = 40\text{mA}$                               | 17.46 | 18.0 | 18.54 | V                          |
|                                        |                                                | $20\text{V} < V_{IN} < 33\text{V}$<br>$1\text{mA} < I_O < 40\text{mA}$ | 17.28 | 18.0 | 18.72 |                            |
|                                        |                                                | $1\text{mA} < I_O < 100\text{mA}$                                      | 17.10 | 18.0 | 18.90 |                            |
| Line Regulation                        | $\Delta V_{OUT} / \Delta V_{IN} \cdot V_{OUT}$ | $20\text{V} < V_{IN} < 33\text{V}, I_O = 10\text{mA}$                  | --    | 50   | 250   | mV                         |
|                                        |                                                | $21\text{V} < V_{IN} < 33\text{V}, I_O = 10\text{mA}$                  | --    | 35   | 180   |                            |
| Load Regulation                        | $\Delta V_{OUT}$                               | $V_{IN} = 21\text{V}, 1\text{mA} < I_O < 100\text{mA}$                 | --    | 30   | 150   | mV                         |
|                                        |                                                | $V_{IN} = 21\text{V}, 1\text{mA} < I_O < 40\text{mA}$                  | --    | 15   | 75    |                            |
| Quiescent Current                      | $I_Q$                                          | $V_{IN} = 20\text{V}, I_O = 0\text{mA}$                                | --    | 2.1  | 5     | mA                         |
| Quiescent Current Change               | $\Delta I_Q$                                   | $21\text{V} < V_{IN} < 33\text{V}$                                     | --    | 0.1  | 1.0   | mA                         |
| Quiescent Current Change               | $\Delta I_Q$                                   | $1\text{mA} < I_O < 40\text{mA}$                                       | --    | --   | 1.0   | mA                         |
| Output Noise Voltage                   | $V_n$                                          | $f = 10\text{Hz to } 100\text{KHz}$                                    | --    | 85   | --    | $\mu\text{V}$              |
| Power-Supply Rejection Ratio           | PSRR                                           | $f = 100\text{Hz}, 21\text{V} < V_{IN} < 31\text{V}$                   | 35    | 40   | --    | dB                         |
| Peak Output Current                    | $I_{PK}$                                       | $V_{IN} = 21\text{V}$                                                  | --    | 300  | --    | mA                         |
| Output Voltage Temperature Coefficient | $V_{TC}$                                       | $I_O = 10\text{mA}$                                                    | --    | 1.2  | --    | $\text{mV}/^\circ\text{C}$ |
| Dropout Voltage                        | $V_{Drop}$                                     | $I_O = 100\text{mA}$                                                   | --    | 1.75 | 2     | V                          |
|                                        |                                                | $I_O = 200\text{mA}$                                                   | --    | 1.95 | 2.1   |                            |
| Minimum Input Voltage                  | $V_{IN, MIN}$                                  | $I_O = 10\text{mA}$                                                    | --    | 16.8 | 17    | V                          |
| Maximum Input Voltage                  | $V_{IN, MAX}$                                  | $I_O = 10\text{mA}$                                                    | --    | 43   | --    | V                          |

● **Ratings And Characteristics Curves** (HR78L05VS,  $C_{IN}=220nF$ ,  $C_{OUT}=100nF$ ,  $T_A = 25^{\circ}C$  Unless otherwise specified)

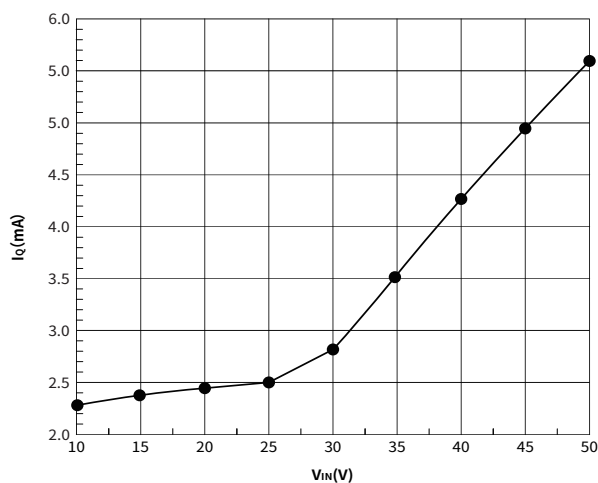


Fig.1  $I_Q$  vs.  $V_{IN}$

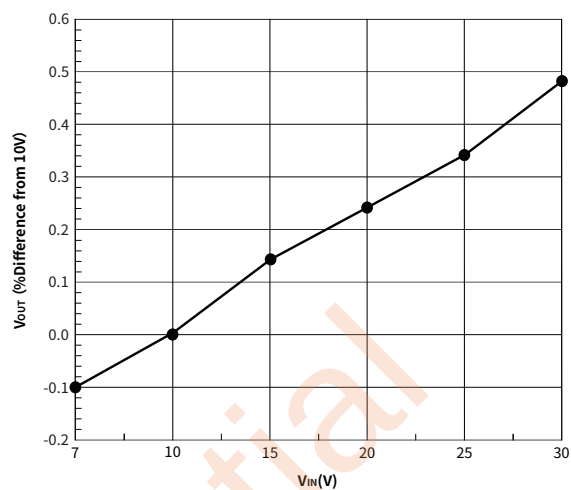


Fig.2  $V_{OUT}$  vs.  $V_{IN}$  ( $I_O=10mA$ )

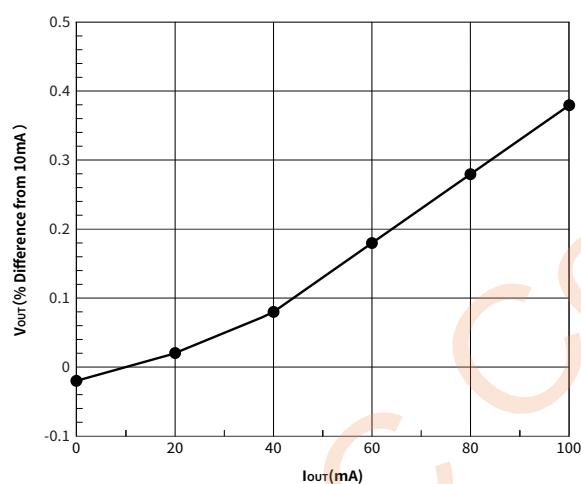


Fig.3  $V_{OUT}$  vs.  $I_{OUT}$  ( $V_{IN}=8V$ )

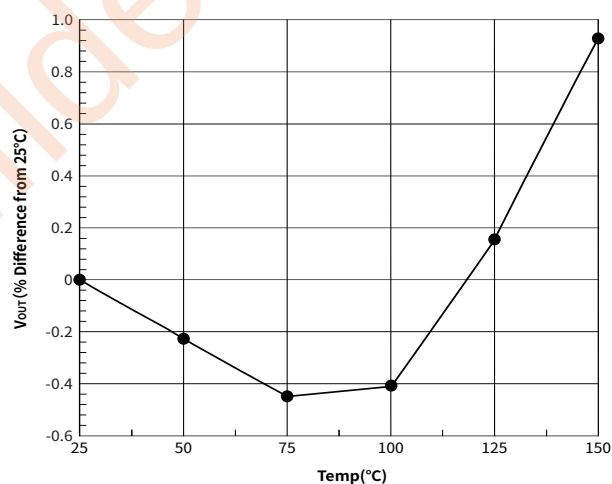


Fig.4  $V_{OUT}$  vs. Temp ( $V_{IN}=10V$ ,  $I_{OUT}=10mA$ )

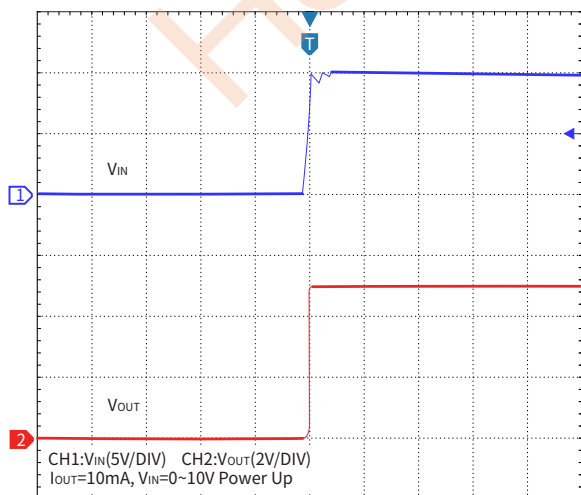


Fig.5 Power Up Response

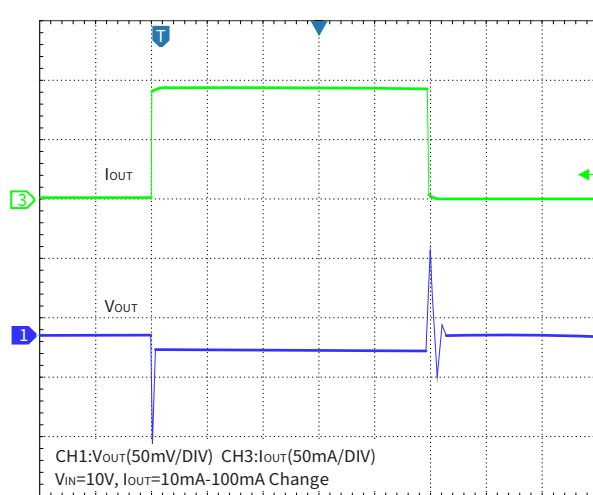
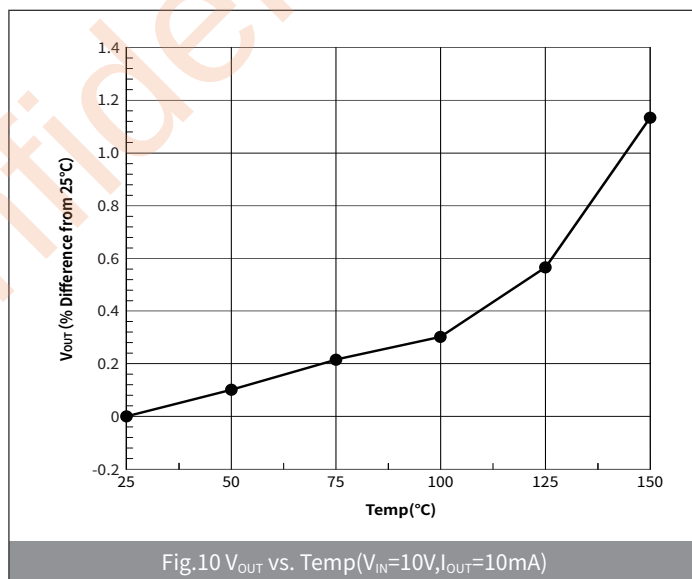
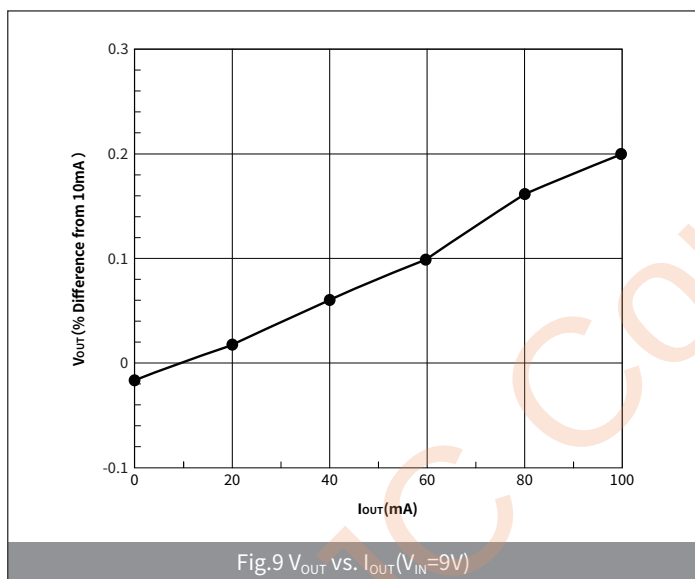
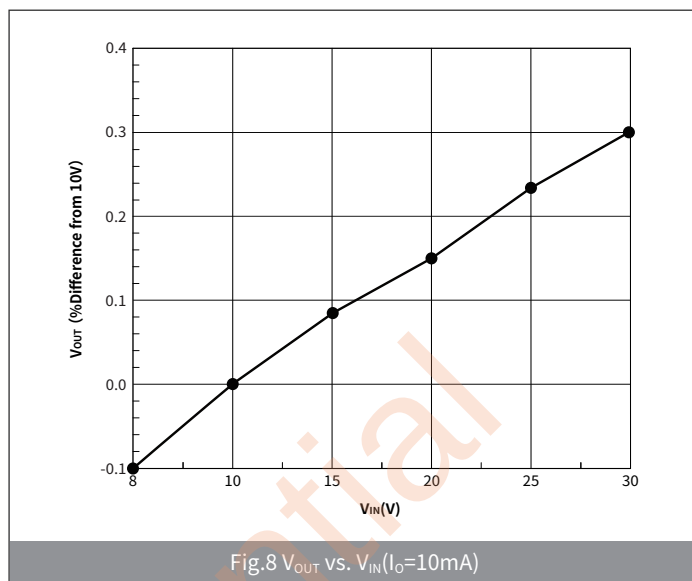
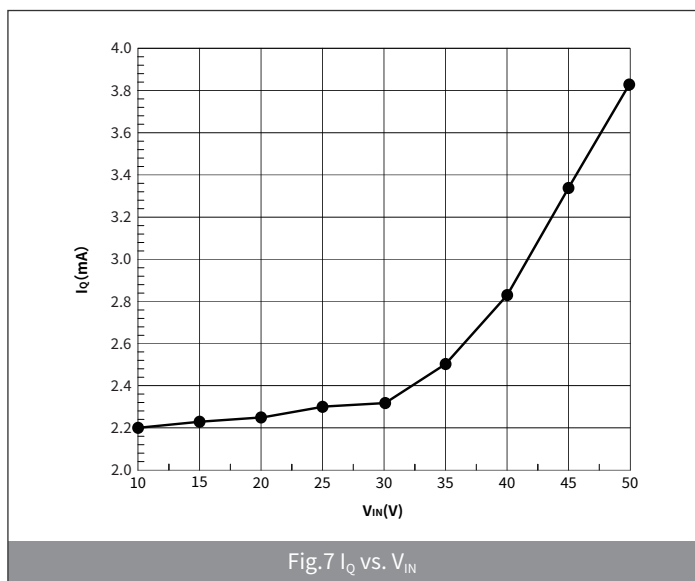
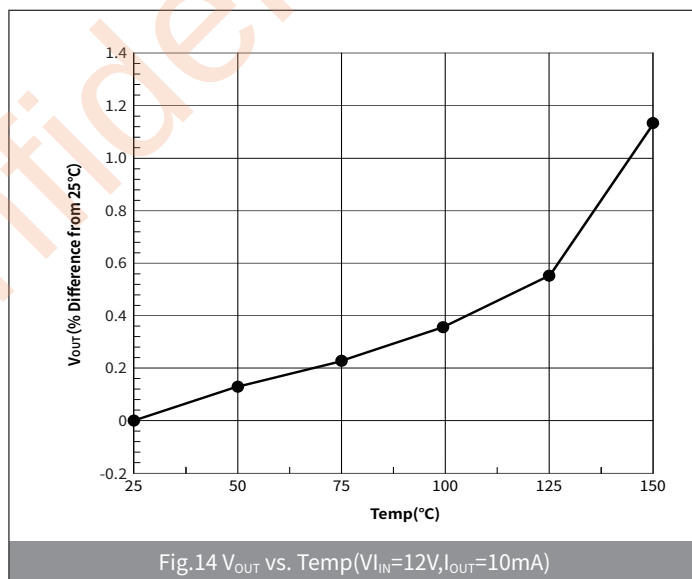
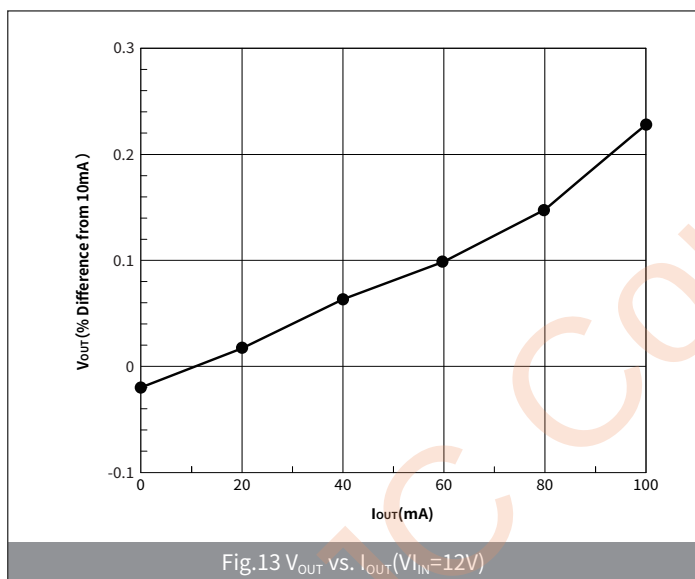
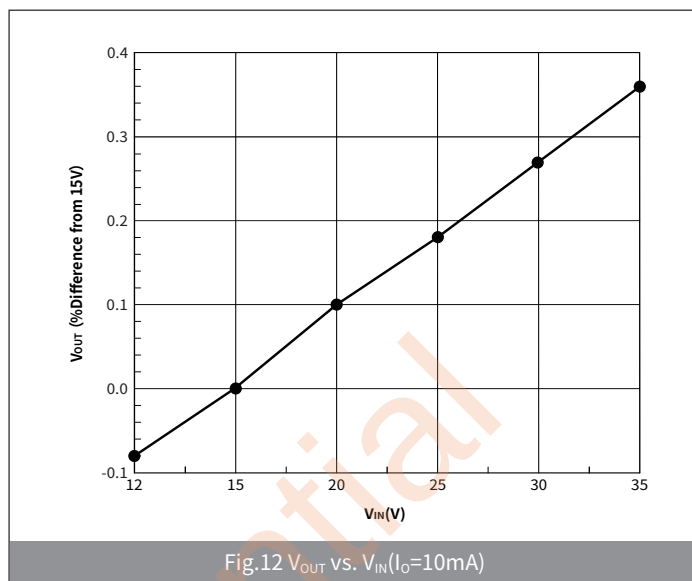
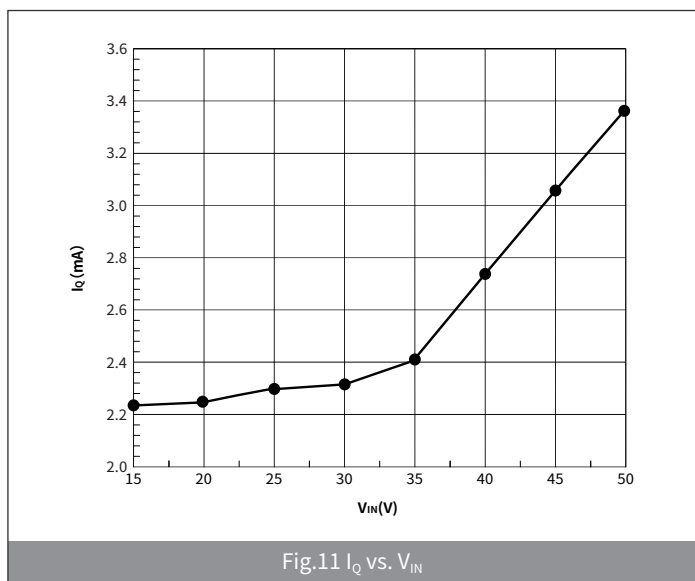


Fig.6 Load Transient Response

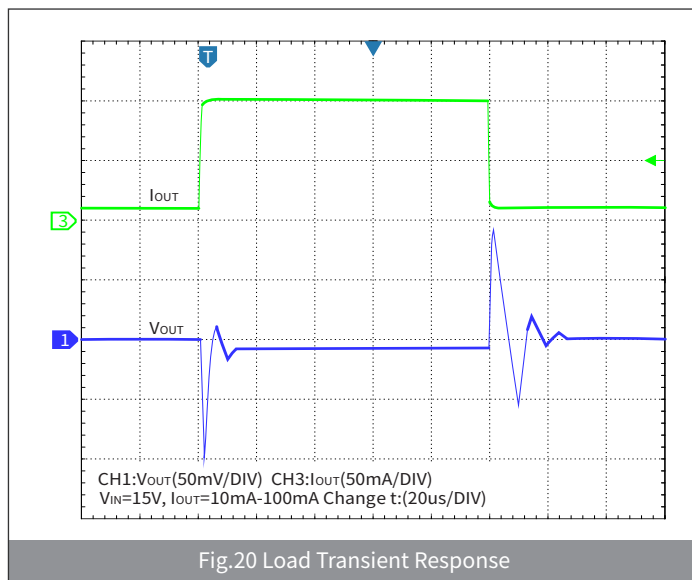
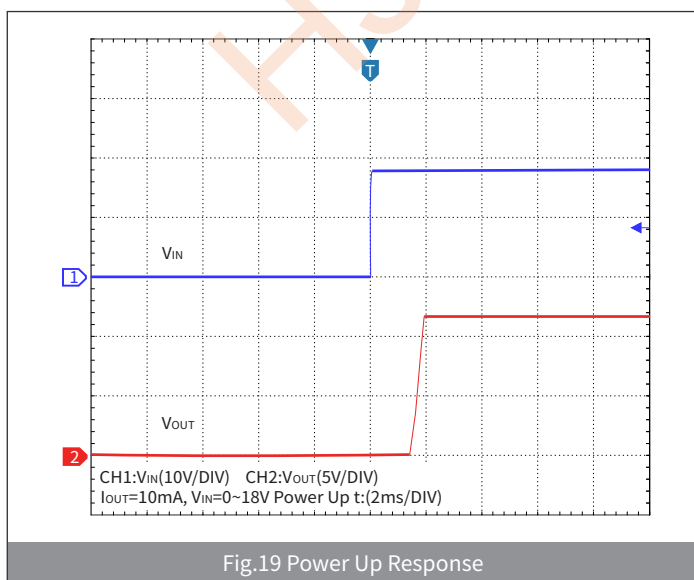
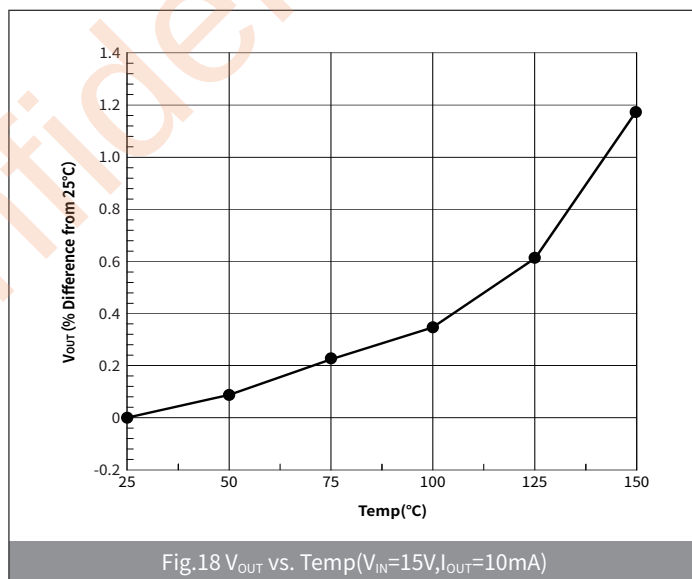
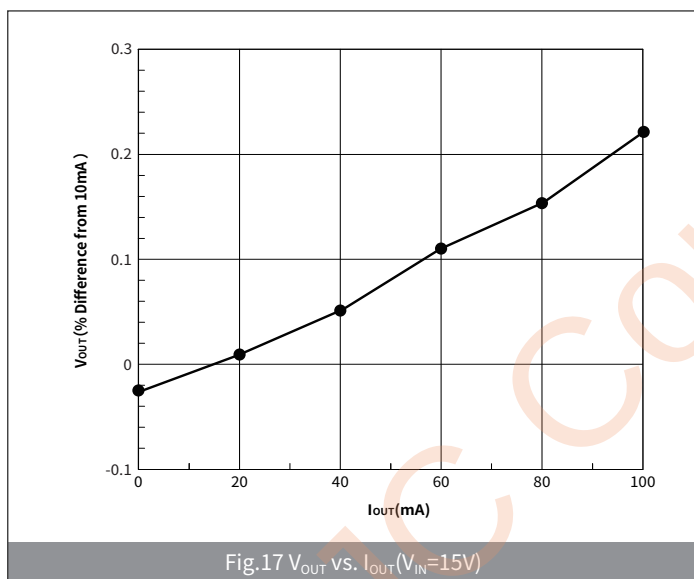
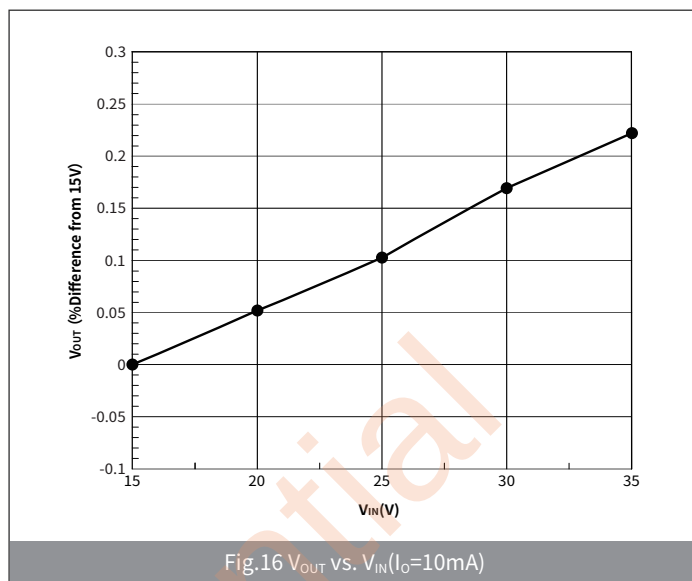
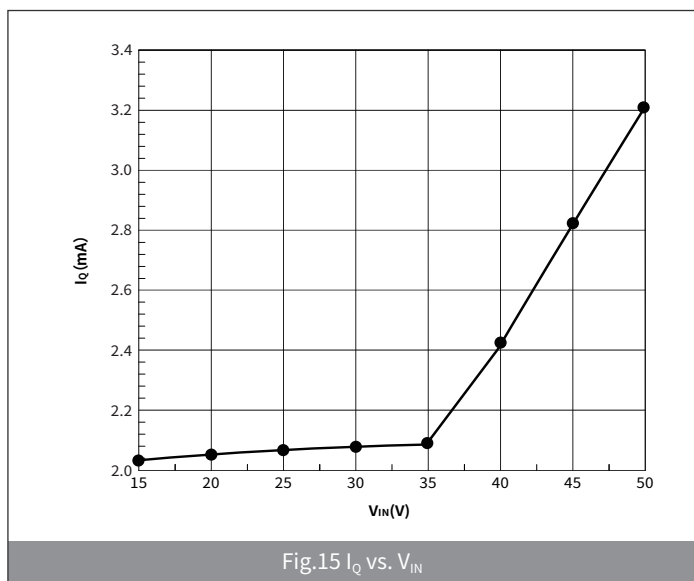
● **Ratings And Characteristics Curves** (HR78L06VS,  $C_{IN}=220nF$ ,  $C_{OUT}=100nF$ ,  $T_A = 25^{\circ}C$  Unless otherwise specified)



● **Ratings And Characteristics Curves** (HR78L09VS,  $C_{IN}=220nF$ ,  $C_{OUT}=100nF$ ,  $T_A = 25^{\circ}C$  Unless otherwise specified)



● **Ratings And Characteristics Curves** (HR78L12VS,  $C_{IN}=220nF$ ,  $C_{OUT}=100nF$ ,  $T_A = 25^{\circ}C$  Unless otherwise specified)



# HR78LS Series

Positive-Voltage Linear Regulators

## Package Outline Dimensions (SOT-89)

| Symbol | Dimensions  |      |        |       |
|--------|-------------|------|--------|-------|
|        | Millimeters |      | Inches |       |
|        | Min.        | Max. | Min.   | Max.  |
| A      | 4.40        | 4.60 | 0.173  | 0.181 |
| B      | 1.35        | 1.83 | 0.053  | 0.072 |
| C      | 3.75        | 4.25 | 0.148  | 0.167 |
| D      | 2.29        | 2.60 | 0.090  | 0.102 |
| E      | 2.95        | 3.05 | 0.116  | 0.120 |
| a      | 0.35        | 0.48 | 0.014  | 0.019 |
| b      | 0.40        | 0.56 | 0.016  | 0.022 |
| L      | 0.80        | 1.20 | 0.031  | 0.047 |
| G      | 0.35        | 0.44 | 0.014  | 0.017 |
| H      | 1.40        | 1.60 | 0.055  | 0.063 |

## Suggested Pad Layout

| Symbol | Dimensions  |      |        |       |
|--------|-------------|------|--------|-------|
|        | Millimeters |      | Inches |       |
|        | Min.        | Max. | Min.   | Max.  |
| c      | 0.80        | 1.00 | 0.032  | 0.04  |
| d      | 1.30        | 1.50 | 0.052  | 0.060 |
| e      | 0.70        | 0.90 | 0.028  | 0.036 |
| J      | 1.80        | 2.00 | 0.072  | 0.080 |
| K      | 1.40        | 1.60 | 0.056  | 0.064 |
| X      | 2.50        | 2.70 | 0.100  | 0.108 |
| X1     | 1.30        | 1.50 | 0.052  | 0.060 |
| Y      | 4.30        | 4.50 | 0.172  | 0.180 |
| Y1     | 3.10        | 3.30 | 0.124  | 0.132 |
| θ      | -           | 45°  | -      | 45°   |