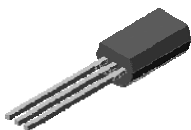
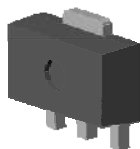
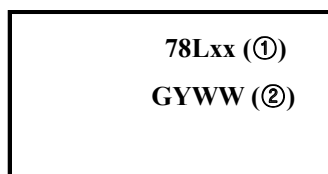

**TO-92**

**TO-92L**

**SOT-89**

### ORDERING INFORMATION

| Product  | Marking | Package |
|----------|---------|---------|
| SN78Lxx  | 78Lxx   | TO-92   |
| SN78LxxL | 78Lxx   | TO-92L  |
| SN78LxxF | 78Lxx   | SOT-89  |

#### ▲ Marking Detail Information



① Device Code

② Grade &amp; Year &amp; Week Code

### Description

The SN78Lxxx series are three-terminal positive regulators providing over 150mA output current with internal current limiting, thermal shutdown and safe area protection. These regulators are useful in a wide range of applications. Although they are just fixed voltage regulators, the SN78Lxxx series can be used with external components to obtain adjustable voltages and currents. It also contains the TCE Cell to protect internal circuit from ESD damage.

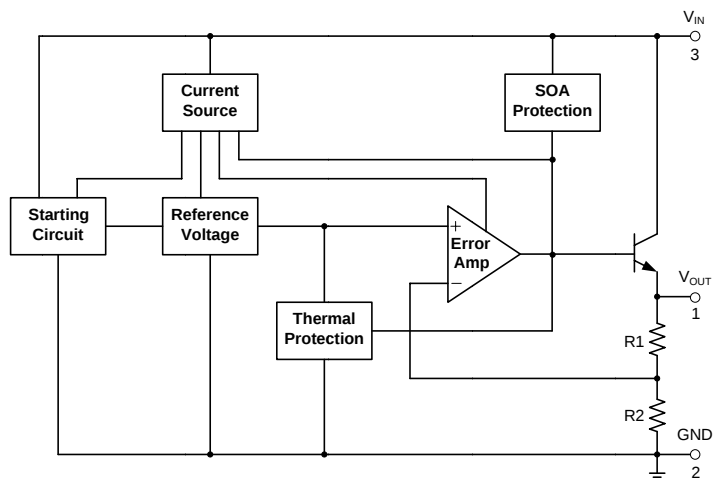
### Application

- ◆ Consumer and personal electronics
- ◆ SMPS post-regulator / dc-to-dc modules
- ◆ High-efficiency linear power supplies

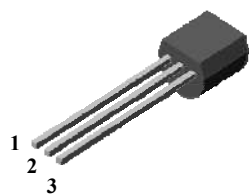
### Features and Benefits

- ◆ Maximum Output Current up to 150mA
- ◆ Output Voltage : 5, 6, 8, 9, 10, 12, 15, 18, 24V
- ◆ Built in OVP, Short Circuit Current Limiting.
- ◆ Built in TSD Protection.
- ◆ No External Components Required.
- ◆ Ultra High level of ESD [ Built in ESD Protection Cell ]  
MM : 500V / HBM 5KV ↑

### Equivalent Circuit



## ◆ Pin Configuration

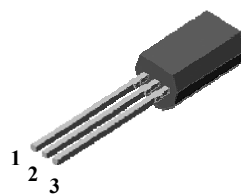


**TO-92**

1:  $V_{OUT}$

2: GND

3:  $V_{IN}$

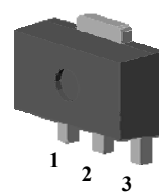


**TO-92L**

1:  $V_{OUT}$

2: GND

3:  $V_{IN}$



**SOT-89**

1:  $V_{OUT}$

2: GND

3:  $V_{IN}$

## ◆ Product Line-up

| Product Name | $V_{OUT}$ | Operating Junction Temperature | Package |
|--------------|-----------|--------------------------------|---------|
| SN78L05      | 5.0V      | -40~125°C                      | TO-92   |
| SN78L06      | 6.0V      | -40~125°C                      | TO-92   |
| SN78L08      | 8.0V      | -40~125°C                      | TO-92   |
| SN78L09      | 9.0V      | -40~125°C                      | TO-92   |
| SN78L10      | 10V       | -40~125°C                      | TO-92   |
| SN78L12      | 12V       | -40~125°C                      | TO-92   |
| SN78L15      | 15V       | -40~125°C                      | TO-92   |
| SN78L18      | 18V       | -40~125°C                      | TO-92   |
| SN78L24      | 24V       | -40~125°C                      | TO-92   |
| SN78L05L     | 5.0V      | -40~125°C                      | TO-92L  |
| SN78L06L     | 6.0V      | -40~125°C                      | TO-92L  |
| SN78L08L     | 8.0V      | -40~125°C                      | TO-92L  |
| SN78L09L     | 9.0V      | -40~125°C                      | TO-92L  |
| SN78L10L     | 10V       | -40~125°C                      | TO-92L  |
| SN78L12L     | 12V       | -40~125°C                      | TO-92L  |
| SN78L15L     | 15V       | -40~125°C                      | TO-92L  |
| SN78L18L     | 18V       | -40~125°C                      | TO-92L  |
| SN78L24L     | 24V       | -40~125°C                      | TO-92L  |
| SN78L05F     | 5.0V      | -40~125°C                      | SOT-89  |
| SN78L06F     | 6.0V      | -40~125°C                      | SOT-89  |
| SN78L08F     | 8.0V      | -40~125°C                      | SOT-89  |
| SN78L09F     | 9.0V      | -40~125°C                      | SOT-89  |
| SN78L10F     | 10V       | -40~125°C                      | SOT-89  |
| SN78L12F     | 12V       | -40~125°C                      | SOT-89  |
| SN78L15F     | 15V       | -40~125°C                      | SOT-89  |
| SN78L18F     | 18V       | -40~125°C                      | SOT-89  |
| SN78L24F     | 24V       | -40~125°C                      | SOT-89  |

◆ **Absolute Maximum Ratings (  $T_a = 25^\circ\text{C}$  )**

| Parameter                            |        | Symbol    | Limits                                     | Unit             |
|--------------------------------------|--------|-----------|--------------------------------------------|------------------|
| Input Voltage                        |        | $V_{IN}$  | 40.0 ( $V_O = 24\text{V}$ )                | V                |
|                                      |        |           | 35.0 ( $V_O = 12 \text{ to } 18\text{V}$ ) |                  |
|                                      |        |           | 30.0 ( $V_O = 5 \text{ to } 10\text{V}$ )  |                  |
| Power Dissipation                    | TO-92  | $P_d$     | 625                                        | mW               |
|                                      | TO-92L |           | 800                                        | mW               |
|                                      | SOT-89 |           | 800                                        | mW               |
| Junction Temperature                 |        | $T_J$     | 150                                        | $^\circ\text{C}$ |
| Operating Junction Temperature Range |        | $T_{opr}$ | -40 ~ +125                                 | $^\circ\text{C}$ |
| Storage Temperature Range            |        | $T_{stg}$ | -55 ~ +150                                 | $^\circ\text{C}$ |

Absolute maximum ratings indicate limits beyond which damage to the component may occur. Electrical specifications do not apply when operating the device outside of its operating ratings. The maximum allowable power dissipation is a function of the maximum junction temperature,  $T_{J(max)}$ , the junction-to-ambient thermal resistance,  $\theta_{JA}$ , and the ambient temperature,  $T_A$ .

The maximum allowable power dissipation at any ambient temperature is calculated using:

$PD(max) = (T_{J(max)} - T_A) \div \theta_{JA}$ . Exceeding the maximum allowable power dissipation will result in excessive die temperature, and the regulator will go into thermal shutdown.

# ◆ Electrical characteristics

(  $V_{IN}=10V$ ,  $C_{IN} = 0.33\mu F$ ,  $C_{OUT} = 0.1 \mu F$ ,  $I_{OUT} = 40mA$ ,  $T_J=0^{\circ}C \sim 125^{\circ}C$  ; unless otherwise specified )

| Characteristic                            | Symbol                  | Test Condition*                                                 |                       | SN78L05x |       |      | Unit               |
|-------------------------------------------|-------------------------|-----------------------------------------------------------------|-----------------------|----------|-------|------|--------------------|
|                                           |                         |                                                                 |                       | Min.     | Typ.  | Max. |                    |
| Output Voltage**                          | V <sub>O</sub>          | T <sub>J</sub> =25 °C                                           |                       | 4.80     | 5.0   | 5.20 | V                  |
|                                           |                         | 7.0V ≤ V <sub>IN</sub> ≤ 20.0V<br>1.0mA ≤ I <sub>O</sub> ≤ 40mA |                       | 4.75     | 5.0   | 5.25 |                    |
| Line Regulation                           | ΔV <sub>O(ΔVI)</sub>    | 7.0V ≤ V <sub>IN</sub> ≤ 20.0V                                  | T <sub>J</sub> =25 °C | -        | 8.0   | 150  | mV                 |
|                                           |                         | 8.0V ≤ V <sub>IN</sub> ≤ 20.0V                                  |                       | -        | 6.0   | 100  |                    |
| Load Regulation                           | ΔV <sub>O(ΔIL)</sub>    | 1.0mA ≤ I <sub>O</sub> ≤ 100 mA                                 | T <sub>J</sub> =25 °C | -        | 11    | 60   | mV                 |
|                                           |                         | 1.0mA ≤ I <sub>O</sub> ≤ 40 mA                                  |                       | -        | 5.0   | 30   |                    |
| Quiescent Current                         | I <sub>QC</sub>         | T <sub>J</sub> =25 °C                                           |                       | -        | 2.0   | 5.5  | mA                 |
| Quiescent Current Change                  | ΔI <sub>QC</sub>        | 8.0V ≤ V <sub>IN</sub> ≤ 20V                                    |                       | -        | -     | 1.5  | mA                 |
|                                           |                         | 1.0mA ≤ I <sub>O</sub> ≤ 40mA                                   |                       | -        | -     | 0.1  |                    |
| Ripple Rejection                          | RR                      | 8.0V ≤ V <sub>IN</sub> ≤ 18.0V<br>f=120 Hz                      |                       | 41       | 80    | -    | dB                 |
| Dropout Voltage                           | V <sub>DROP</sub>       | T <sub>J</sub> =25 °C                                           |                       | -        | 1.7   | -    | V                  |
| Output Noise Voltage                      | V <sub>N</sub>          | 10Hz ≤ f ≤ 100kHz                                               | T <sub>A</sub> =25 °C | -        | 40    | -    | uV/ V <sub>O</sub> |
| Temperature coefficient of Output voltage | ΔV <sub>O</sub> / ΔTemp | I <sub>O</sub> =5.0 mA                                          |                       | -        | -0.65 | -    | mV/ °C             |

\* Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into separately.

\*\* This specification applies only for dc power dissipation permitted by absolute maximum ratings.

◆ Electrical characteristics

(  $V_{IN}=12V$ ,  $C_{IN} = 0.33\mu F$ ,  $C_{OUT} = 0.1 \mu F$ ,  $I_{OUT} = 40mA$ ,  $T_J=0^{\circ}C \sim 125^{\circ}C$  ; unless otherwise specified )

| Characteristic                            | Symbol                          | Test Condition*                                               |                       | SN78L06x |      |      | Unit               |
|-------------------------------------------|---------------------------------|---------------------------------------------------------------|-----------------------|----------|------|------|--------------------|
|                                           |                                 |                                                               |                       | Min.     | Typ. | Max. |                    |
| Output Voltage**                          | V <sub>O</sub>                  | T <sub>J</sub> =25 °C                                         |                       | 5.75     | 6.0  | 6.25 | V                  |
|                                           |                                 | 8.5V ≤ V <sub>IN</sub> ≤ 20V<br>1.0mA ≤ I <sub>O</sub> ≤ 40mA |                       | 5.70     | 6.0  | 6.30 |                    |
| Line Regulation                           | ΔV <sub>O(ΔV<sub>I</sub>)</sub> | 8.5V ≤ V <sub>IN</sub> ≤ 20.0V                                | T <sub>J</sub> =25 °C | -        | 64   | 175  | mV                 |
|                                           |                                 | 9.0V ≤ V <sub>IN</sub> ≤ 20.0V                                |                       | -        | 54   | 125  |                    |
| Load Regulation                           | ΔV <sub>O(ΔI<sub>L</sub>)</sub> | 1.0mA ≤ I <sub>O</sub> ≤ 100mA                                | T <sub>J</sub> =25 °C | -        | 12.8 | 80   | mV                 |
|                                           |                                 | 1.0mA ≤ I <sub>O</sub> ≤ 70 mA                                |                       | -        | 5.8  | 40   |                    |
| Quiescent Current                         | I <sub>QC</sub>                 | T <sub>J</sub> =25 °C                                         |                       | -        | -    | 5.5  | mA                 |
| Quiescent Current Change                  | ΔI <sub>QC</sub>                | 9.0V ≤ V <sub>IN</sub> ≤ 20.0V                                |                       | -        | -    | 1.5  | mA                 |
|                                           |                                 | 1.0mA ≤ I <sub>O</sub> ≤ 40mA                                 |                       | -        | -    | 0.1  |                    |
| Ripple Rejection                          | RR                              | 10.0V ≤ V <sub>IN</sub> ≤ 20.0V<br>f=120 Hz                   |                       | 40       | 46   | -    | dB                 |
| Dropout Voltage                           | V <sub>DROP</sub>               | T <sub>J</sub> =25 °C                                         |                       | -        | 1.7  | -    | V                  |
| Output Noise Voltage                      | V <sub>N</sub>                  | 10Hz ≤ f ≤ 100kHz                                             | T <sub>A</sub> =25 °C | -        | 40   | -    | uV/ V <sub>O</sub> |
| Temperature coefficient of Output voltage | ΔV <sub>O</sub> / ΔTemp         | I <sub>O</sub> =5.0 mA                                        |                       | -        | 0.75 | -    | mV/°C              |

\* Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into separately.

\*\* This specification applies only for dc power dissipation permitted by absolute maximum ratings.

# ◆ Electrical characteristics

(  $V_{IN}=14V$ ,  $C_{IN} = 0.33\mu F$ ,  $C_{OUT} = 0.1 \mu F$ ,  $I_{OUT} = 40mA$ ,  $T_J=0^{\circ}C \sim 125^{\circ}C$  ; unless otherwise specified )

| Characteristic                            | Symbol                    | Test Condition*                                                  |                       | SN78L08x |      |      | Unit               |
|-------------------------------------------|---------------------------|------------------------------------------------------------------|-----------------------|----------|------|------|--------------------|
|                                           |                           |                                                                  |                       | Min.     | Typ. | Max. |                    |
| Output Voltage**                          | V <sub>O</sub>            | T <sub>J</sub> =25 °C                                            |                       | 7.7      | 8.0  | 8.3  | V                  |
|                                           |                           | 10.5V ≤ V <sub>IN</sub> ≤ 23.0V<br>1.0mA ≤ I <sub>O</sub> ≤ 40mA |                       | 7.6      | 8.0  | 8.4  |                    |
| Line Regulation                           | Δ V <sub>O(ΔVI)</sub>     | 10.5V ≤ V <sub>IN</sub> ≤ 23.0V                                  | T <sub>J</sub> =25 °C | -        | 10   | 175  | mV                 |
|                                           |                           | 11.0V ≤ V <sub>IN</sub> ≤ 23.0V                                  |                       | -        | 8.0  | 125  |                    |
| Load Regulation                           | Δ V <sub>O(ΔIL)</sub>     | 1.0mA ≤ I <sub>O</sub> ≤ 100mA                                   | T <sub>J</sub> =25 °C | -        | 15   | 80   | mV                 |
|                                           |                           | 1.0mA ≤ I <sub>O</sub> ≤ 40 mA                                   |                       | -        | 8.0  | 40   |                    |
| Quiescent Current                         | I <sub>QC</sub>           | T <sub>J</sub> =25 °C                                            |                       | -        | 2.0  | 5.5  | mA                 |
| Quiescent Current Change                  | ΔI <sub>QC</sub>          | 11.0V ≤ V <sub>IN</sub> ≤ 23.0V                                  |                       | -        | -    | 1.5  | mA                 |
|                                           |                           | 1.0mA ≤ I <sub>O</sub> ≤ 40mA                                    |                       | -        | -    | 0.1  |                    |
| Ripple Rejection                          | RR                        | 11.5=0V ≤ V <sub>IN</sub> ≤ 21.0V<br>f=120 Hz                    |                       | 39       | 70   | -    | dB                 |
| Dropout Voltage                           | V <sub>DROP</sub>         | T <sub>J</sub> =25 °C                                            |                       | -        | 1.7  | -    | V                  |
| Output Noise Voltage                      | V <sub>N</sub>            | 10Hz ≤ f ≤ 100kHz                                                | T <sub>A</sub> =25 °C | -        | 60   | -    | uV/ V <sub>O</sub> |
| Temperature coefficient of Output voltage | Δ V <sub>O</sub> / Δ Temp | I <sub>O</sub> =5.0 mA                                           |                       | -        | -0.8 | -    | mV/°C              |

\* Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into separately.

\*\* This specification applies only for dc power dissipation permitted by absolute maximum ratings.

### ◆ Electrical characteristics

(  $V_{IN}=15V$ ,  $C_{IN} = 0.33\mu F$ ,  $C_{OUT} = 0.1 \mu F$ ,  $I_{OUT} = 40mA$ ,  $T_J=0^{\circ}C \sim 125^{\circ}C$  ; unless otherwise specified )

| Characteristic                            | Symbol                          | Test Condition*                                                  |                       | SN78L09x |      |      | Unit               |
|-------------------------------------------|---------------------------------|------------------------------------------------------------------|-----------------------|----------|------|------|--------------------|
|                                           |                                 |                                                                  |                       | Min.     | Typ. | Max. |                    |
| Output Voltage**                          | V <sub>O</sub>                  | T <sub>J</sub> =25 °C                                            |                       | 8.64     | 9.0  | 9.36 | V                  |
|                                           |                                 | 11.5V ≤ V <sub>IN</sub> ≤ 24.0V<br>1.0mA ≤ I <sub>O</sub> ≤ 40mA |                       | 8.55     | 9.0  | 9.45 |                    |
| Line Regulation                           | ΔV <sub>O(ΔV<sub>I</sub>)</sub> | 11.5V ≤ V <sub>IN</sub> ≤ 24.0V                                  | T <sub>J</sub> =25 °C | -        | 90   | 200  | mV                 |
|                                           |                                 | 13.0V ≤ V <sub>IN</sub> ≤ 24.0V                                  |                       | -        | 100  | 150  |                    |
| Load Regulation                           | ΔV <sub>O(ΔI<sub>L</sub>)</sub> | 1.0mA ≤ I <sub>O</sub> ≤ 100mA                                   | T <sub>J</sub> =25 °C | -        | 20   | 90   | mV                 |
|                                           |                                 | 1.0mA ≤ I <sub>O</sub> ≤ 40mA                                    |                       | -        | 10   | 45   |                    |
| Quiescent Current                         | I <sub>QC</sub>                 | T <sub>J</sub> =25 °C                                            |                       | -        | 2.1  | 6.0  | mA                 |
| Quiescent Current Change                  | ΔI <sub>QC</sub>                | 13.0V ≤ V <sub>IN</sub> ≤ 24.0V                                  |                       | -        | -    | 1.5  | mA                 |
|                                           |                                 | 1.0mA ≤ I <sub>O</sub> ≤ 40mA                                    |                       | -        | -    | 0.1  |                    |
| Ripple Rejection                          | RR                              | 12.0V ≤ V <sub>IN</sub> ≤ 22.0V<br>f=120 Hz                      |                       | 38       | 44   | -    | dB                 |
| Dropout Voltage                           | V <sub>DROP</sub>               | T <sub>J</sub> =25 °C                                            |                       | -        | 2.0  | -    | V                  |
| Output Noise Voltage                      | V <sub>N</sub>                  | 10Hz ≤ f ≤ 100kHz                                                | T <sub>A</sub> =25 °C | -        | 70   | -    | uV/ V <sub>O</sub> |
| Temperature coefficient of Output voltage | ΔV <sub>O</sub> / ΔTemp         | I <sub>O</sub> =5.0 mA                                           |                       | -        | -0.9 | -    | mV/°C              |

\* Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into separately.

\*\* This specification applies only for dc power dissipation permitted by absolute maximum ratings.

# ◆ Electrical characteristics

(  $V_{IN}=16V$ ,  $C_{IN} = 0.33\mu F$ ,  $C_{OUT} = 0.1 \mu F$ ,  $I_{OUT} = 40mA$ ,  $T_J=0^{\circ}C \sim 125^{\circ}C$  ; unless otherwise specified )

| Characteristic                            | Symbol                          | Test Condition*                                                  |                       | SN78L10x |      |      | Unit               |
|-------------------------------------------|---------------------------------|------------------------------------------------------------------|-----------------------|----------|------|------|--------------------|
|                                           |                                 |                                                                  |                       | Min.     | Typ. | Max. |                    |
| Output Voltage**                          | V <sub>O</sub>                  | T <sub>J</sub> =25 °C                                            |                       | 9.6      | 10.0 | 10.4 | V                  |
|                                           |                                 | 12.5V ≤ V <sub>IN</sub> ≤ 25.0V<br>1.0mA ≤ I <sub>O</sub> ≤ 40mA |                       | 9.5      | 10.0 | 10.5 |                    |
| Line Regulation                           | ΔV <sub>O(ΔV<sub>I</sub>)</sub> | 12.5V ≤ V <sub>IN</sub> ≤ 25.0V                                  | T <sub>J</sub> =25 °C | -        | 100  | 220  | mV                 |
|                                           |                                 | 14.0V ≤ V <sub>IN</sub> ≤ 25.0V                                  |                       | -        | 100  | 170  |                    |
| Load Regulation                           | ΔV <sub>O(ΔI<sub>L</sub>)</sub> | 1.0mA ≤ I <sub>O</sub> ≤ 100mA                                   | T <sub>J</sub> =25 °C | -        | 20   | 94   | mV                 |
|                                           |                                 | 1.0mA ≤ I <sub>O</sub> ≤ 40mA                                    |                       | -        | 10   | 47   |                    |
| Quiescent Current                         | I <sub>QC</sub>                 | T <sub>J</sub> =25 °C                                            |                       | -        | -    | 6.0  | mA                 |
| Quiescent Current Change                  | ΔI <sub>QC</sub>                | 12.5V ≤ V <sub>IN</sub> ≤ 25V                                    |                       | -        | -    | 1.5  | mA                 |
|                                           |                                 | 1.0mA ≤ I <sub>O</sub> ≤ 40mA                                    |                       | -        | -    | 0.1  |                    |
| Ripple Rejection                          | RR                              | 15.0V ≤ V <sub>IN</sub> ≤ 25.0V<br>f=120 Hz                      |                       | 38       | 43   | -    | dB                 |
| Dropout Voltage                           | V <sub>DROP</sub>               | T <sub>J</sub> =25 °C                                            |                       | -        | 1.7  | -    | V                  |
| Output Noise Voltage                      | V <sub>N</sub>                  | 10Hz ≤ f ≤ 100kHz                                                | T <sub>A</sub> =25 °C | -        | 74   | -    | uV/ V <sub>O</sub> |
| Temperature coefficient of Output voltage | ΔV <sub>O</sub> / ΔTemp         | I <sub>O</sub> =5.0 mA                                           |                       | -        | 0.95 | -    | mV/°C              |

\* Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into separately.

\*\* This specification applies only for dc power dissipation permitted by absolute maximum ratings.

# ◆ Electrical characteristics

(  $V_{IN}=19V$ ,  $C_{IN} = 0.33\mu F$ ,  $C_{OUT} = 0.1 \mu F$ ,  $I_{OUT} = 40mA$ ,  $T_J=0^{\circ}C \sim 125^{\circ}C$  ; unless otherwise specified )

| Characteristic                            | Symbol                     | Test Condition*                                                  |                       | SN78L12x |      |      | Unit               |
|-------------------------------------------|----------------------------|------------------------------------------------------------------|-----------------------|----------|------|------|--------------------|
|                                           |                            |                                                                  |                       | Min.     | Typ. | Max. |                    |
| Output Voltage**                          | V <sub>O</sub>             | T <sub>J</sub> =25 °C                                            |                       | 11.5     | 12.0 | 12.5 | V                  |
|                                           |                            | 14.5V ≤ V <sub>IN</sub> ≤ 27.0V<br>1.0mA ≤ I <sub>O</sub> ≤ 40mA |                       | 11.4     | 12.0 | 12.6 |                    |
| Line Regulation                           | ΔV <sub>O(ΔVI)</sub>       | 14.5V ≤ V <sub>IN</sub> ≤ 27.0V                                  | T <sub>J</sub> =25 °C | -        | 20   | 250  | mV                 |
|                                           |                            | 16.0V ≤ V <sub>IN</sub> ≤ 27.0V                                  |                       | -        | 15   | 200  |                    |
| Load Regulation                           | ΔV <sub>O(ΔIL)</sub>       | 1.0mA ≤ I <sub>O</sub> ≤ 100mA                                   | T <sub>J</sub> =25 °C | -        | 20   | 100  | mV                 |
|                                           |                            | 1.0mA ≤ I <sub>O</sub> ≤ 40mA                                    |                       | -        | 10   | 50   |                    |
| Quiescent Current                         | I <sub>QC</sub>            | T <sub>J</sub> =25 °C                                            |                       | -        | 2.1  | 6.0  | mA                 |
| Quiescent Current Change                  | ΔI <sub>QC</sub>           | 16.0V ≤ V <sub>IN</sub> ≤ 27.0V                                  |                       | -        | -    | 1.5  | mA                 |
|                                           |                            | 1.0mA ≤ I <sub>O</sub> ≤ 40mA                                    |                       | -        | -    | 0.1  |                    |
| Ripple Rejection                          | RR                         | 15.0V ≤ V <sub>IN</sub> ≤ 25.0V,<br>f=120 Hz                     |                       | 37       | 65   | -    | dB                 |
| Dropout Voltage                           | V <sub>DROP</sub>          | T <sub>J</sub> =25 °C                                            |                       | -        | 2.0  | -    | V                  |
| Output Noise Voltage                      | V <sub>N</sub>             | 10Hz ≤ f ≤ 100kHz                                                | T <sub>A</sub> =25 °C | -        | 80   | -    | uV/ V <sub>O</sub> |
| Temperature coefficient of Output voltage | ΔV <sub>O</sub> /<br>ΔTemp | I <sub>O</sub> =5.0 mA                                           |                       | -        | -1.0 | -    | mV/°C              |

\* Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into separately.

\*\* This specification applies only for dc power dissipation permitted by absolute maximum ratings.

# ◆ Electrical characteristics

(  $V_{IN}=23V$ ,  $C_{IN} = 0.33\mu F$ ,  $C_{OUT} = 0.1 \mu F$ ,  $I_{OUT} = 40mA$ ,  $T_J=0^{\circ}C \sim 125^{\circ}C$  ; unless otherwise specified )

| Characteristic                            | Symbol                  | Test Condition*                                                  |                       | SN78L15x |      |       | Unit               |
|-------------------------------------------|-------------------------|------------------------------------------------------------------|-----------------------|----------|------|-------|--------------------|
|                                           |                         |                                                                  |                       | Min.     | Typ. | Max.  |                    |
| Output Voltage**                          | V <sub>O</sub>          | T <sub>J</sub> =25 °C                                            |                       | 14.4     | 15.0 | 15.6  | V                  |
|                                           |                         | 17.5V ≤ V <sub>IN</sub> ≤ 30.0V<br>1.0mA ≤ I <sub>O</sub> ≤ 40mA |                       | 14.25    | 15.0 | 15.75 |                    |
| Line Regulation                           | ΔV <sub>O(ΔVI)</sub>    | 17.5V ≤ V <sub>IN</sub> ≤ 30.0V                                  | T <sub>J</sub> =25 °C | -        | 25   | 300   | mV                 |
|                                           |                         | 20.0V ≤ V <sub>IN</sub> ≤ 30.0V                                  |                       | -        | 20   | 250   |                    |
| Load Regulation                           | ΔV <sub>O(ΔIL)</sub>    | 1.0mA ≤ I <sub>O</sub> ≤ 100mA                                   | T <sub>J</sub> =25 °C | -        | 25   | 150   | mV                 |
|                                           |                         | 1.0mA ≤ I <sub>O</sub> ≤ 40mA                                    |                       | -        | 12   | 75    |                    |
| Quiescent Current                         | I <sub>QC</sub>         | T <sub>J</sub> =25 °C                                            |                       | -        | 2.1  | 6.0   | mA                 |
| Quiescent Current Change                  | ΔI <sub>QC</sub>        | 20.0V ≤ V <sub>IN</sub> ≤ 30.0V                                  |                       | -        | -    | 1.5   | mA                 |
|                                           |                         | 1.0mA ≤ I <sub>O</sub> ≤ 40mA                                    |                       | -        | -    | 0.1   |                    |
| Ripple Rejection                          | RR                      | 18.5V ≤ V <sub>IN</sub> ≤ 28.5V<br>f=120 Hz                      |                       | 34       | 60   | -     | dB                 |
| Dropout Voltage                           | V <sub>DROP</sub>       | T <sub>J</sub> =25 °C                                            |                       | -        | 1.7  | -     | V                  |
| Output Noise Voltage                      | V <sub>N</sub>          | 10Hz ≤ f ≤ 100kHz                                                | T <sub>A</sub> =25 °C | -        | 90   | -     | uV/ V <sub>O</sub> |
| Temperature coefficient of Output voltage | ΔV <sub>O</sub> / ΔTemp | I <sub>O</sub> =5.0 mA                                           |                       | -        | -1.3 | -     | mV/°C              |

\* Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into separately.

\*\* This specification applies only for dc power dissipation permitted by absolute maximum ratings.

### ◆ Electrical characteristics

(  $V_{IN}=27V$ ,  $C_{IN} = 0.33\mu F$ ,  $C_{OUT} = 0.1 \mu F$ ,  $I_{OUT} = 40mA$ ,  $T_J=0^{\circ}C \sim 125^{\circ}C$  ; unless otherwise specified )

| Characteristic                            | Symbol                          | Test Condition*                                                  |                       | SN78L18x |      |      | Unit               |
|-------------------------------------------|---------------------------------|------------------------------------------------------------------|-----------------------|----------|------|------|--------------------|
|                                           |                                 |                                                                  |                       | Min.     | Typ. | Max. |                    |
| Output Voltage**                          | V <sub>O</sub>                  | T <sub>J</sub> =25 °C                                            |                       | 17.3     | 18.0 | 18.7 | V                  |
|                                           |                                 | 21.0V ≤ V <sub>IN</sub> ≤ 33.0V<br>1.0mA ≤ I <sub>O</sub> ≤ 40mA |                       | 17.1     | 18.0 | 18.9 |                    |
| Line Regulation                           | ΔV <sub>O(ΔV<sub>I</sub>)</sub> | 21.0V ≤ V <sub>IN</sub> ≤ 33.0V                                  | T <sub>J</sub> =25 °C | -        | 145  | 300  | mV                 |
|                                           |                                 | 22.0V ≤ V <sub>IN</sub> ≤ 33.0V                                  |                       | -        | 135  | 250  |                    |
| Load Regulation                           | ΔV <sub>O(ΔI<sub>L</sub>)</sub> | 1.0mA ≤ I <sub>O</sub> ≤ 100mA                                   | T <sub>J</sub> =25 °C | -        | 30   | 170  | mV                 |
|                                           |                                 | 1.0mA ≤ I <sub>O</sub> ≤ 40mA                                    |                       | -        | 15   | 85   |                    |
| Quiescent Current                         | I <sub>QC</sub>                 | T <sub>J</sub> =25 °C                                            |                       | -        | 2.2  | 6.0  | mA                 |
| Quiescent Current Change                  | ΔI <sub>QC</sub>                | 21.0V ≤ V <sub>IN</sub> ≤ 33.0V                                  |                       | -        | -    | 1.5  | mA                 |
|                                           |                                 | 1.0mA ≤ I <sub>O</sub> ≤ 40mA                                    |                       | -        | -    | 0.1  |                    |
| Ripple Rejection                          | RR                              | 23.0V ≤ V <sub>IN</sub> ≤ 33.0V<br>f=120 Hz                      |                       | 34       | 48   | -    | dB                 |
| Dropout Voltage                           | V <sub>DROP</sub>               | T <sub>J</sub> =25 °C                                            |                       | -        | 1.7  | -    | V                  |
| Output Noise Voltage                      | V <sub>N</sub>                  | 10Hz ≤ f ≤ 100kHz                                                | T <sub>A</sub> =25 °C | -        | 150  | -    | uV/ V <sub>O</sub> |
| Temperature coefficient of Output voltage | ΔV <sub>O</sub> / ΔTemp         | I <sub>O</sub> =5.0 mA                                           |                       | -        | -1.8 | -    | mV/°C              |

\* Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into separately.

\*\* This specification applies only for dc power dissipation permitted by absolute maximum ratings.

## ◆ Electrical characteristics

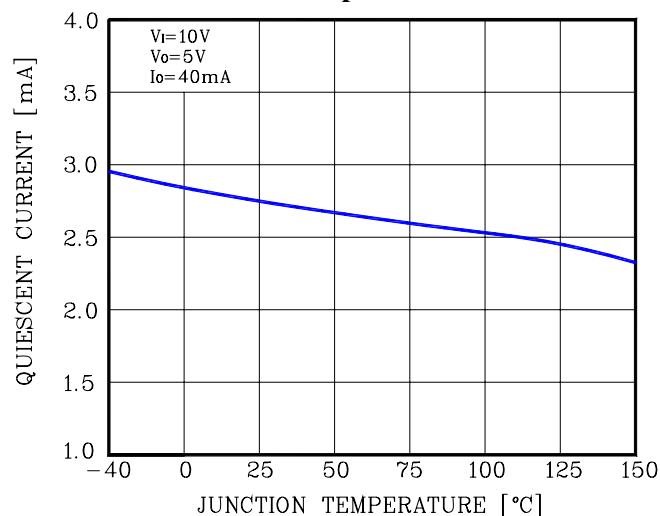
(  $V_{IN}=33V$ ,  $C_{IN} = 0.33\mu F$ ,  $C_{OUT} = 0.1 \mu F$ ,  $I_{OUT} = 40mA$ ,  $T_J=0^{\circ}C \sim 125^{\circ}C$  ; unless otherwise specified )

| Characteristic                            | Symbol                          | Test Condition*                                                                        |                       | SN78L24x |      |      | Unit               |
|-------------------------------------------|---------------------------------|----------------------------------------------------------------------------------------|-----------------------|----------|------|------|--------------------|
|                                           |                                 |                                                                                        |                       | Min.     | Typ. | Max. |                    |
| Output Voltage**                          | V <sub>O</sub>                  | T <sub>J</sub> =25 °C                                                                  |                       | 23.0     | 24.0 | 25.0 | V                  |
|                                           |                                 | 27.0V ≤ V <sub>IN</sub> ≤ 38.0V<br>1.0mA ≤ I <sub>O</sub> ≤ 40mA, P <sub>D</sub> ≤ 15W |                       | 22.8     | 24.0 | 25.2 |                    |
| Line Regulation                           | ΔV <sub>O(ΔV<sub>I</sub>)</sub> | 27.0V ≤ V <sub>IN</sub> ≤ 38.0V                                                        | T <sub>J</sub> =25 °C | -        | 160  | 300  | mV                 |
|                                           |                                 | 28.0V ≤ V <sub>IN</sub> ≤ 38.0V                                                        |                       | -        | 150  | 250  |                    |
| Load Regulation                           | ΔV <sub>O(ΔI<sub>L</sub>)</sub> | 1.0mA ≤ I <sub>O</sub> ≤ 100mA                                                         | T <sub>J</sub> =25 °C | -        | 40   | 200  | mV                 |
|                                           |                                 | 1.0mA ≤ I <sub>O</sub> ≤ 4mA                                                           |                       | -        | 20   | 100  |                    |
| Quiescent Current                         | I <sub>QC</sub>                 | T <sub>J</sub> =25 °C                                                                  |                       | -        | 2.2  | 6.0  | mA                 |
| Quiescent Current Change                  | ΔI <sub>QC</sub>                | 28.0V ≤ V <sub>IN</sub> ≤ 38.0V                                                        |                       | -        | -    | 1.5  | mA                 |
|                                           |                                 | 1.0mA ≤ I <sub>O</sub> ≤ 40mA                                                          |                       | -        | -    | 0.1  |                    |
| Ripple Rejection                          | RR                              | 28.0V ≤ V <sub>IN</sub> ≤ 38.0V<br>f=120 Hz                                            |                       | 34       | 45   | -    | dB                 |
| Dropout Voltage                           | V <sub>DROP</sub>               | T <sub>J</sub> =25 °C                                                                  |                       | -        | 1.7  | -    | V                  |
| Output Noise Voltage                      | V <sub>N</sub>                  | 10Hz ≤ f ≤ 100kHz                                                                      | T <sub>A</sub> =25 °C | -        | 200  | -    | uV/ V <sub>O</sub> |
| Temperature coefficient of Output voltage | ΔV <sub>O</sub> / ΔTemp         | I <sub>O</sub> =5.0 mA                                                                 |                       | -        | -2.0 | -    | mV/°C              |

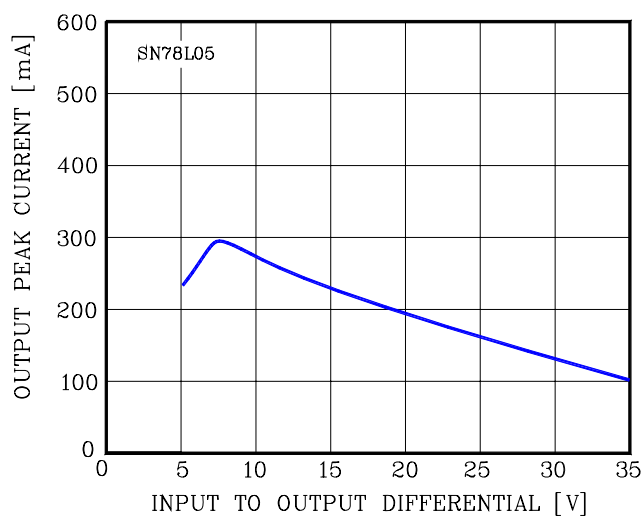
\* Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into separately.

\*\* This specification applies only for dc power dissipation permitted by absolute maximum ratings.

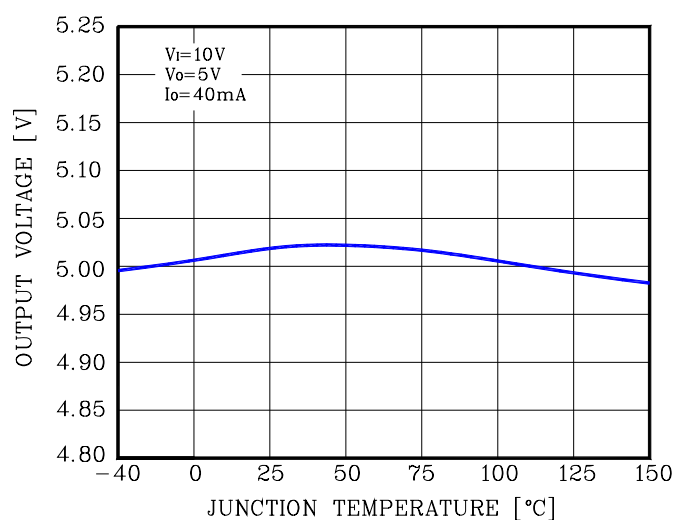
**Fig.1 Quiescent Current vs. Junction Temperature**



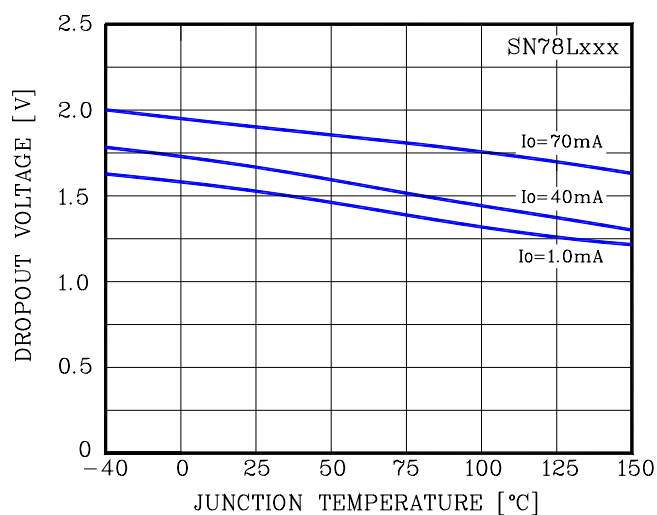
**Fig.2 Output Peak Current vs. Input to Output Differential**



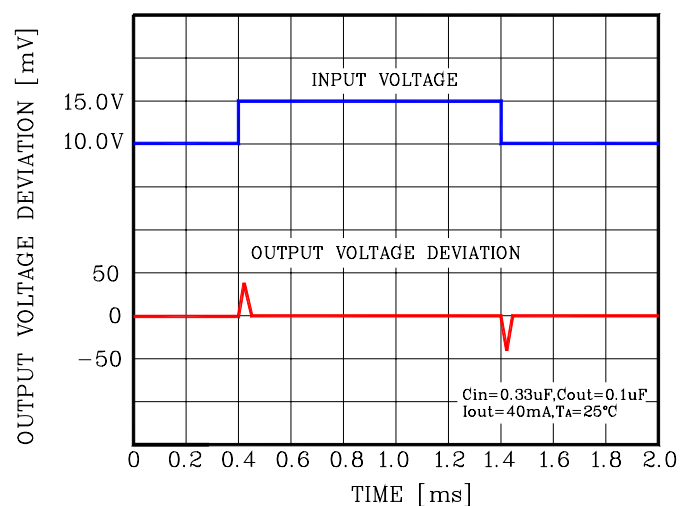
**Fig.3 Output Voltage vs. Junction Temperature**



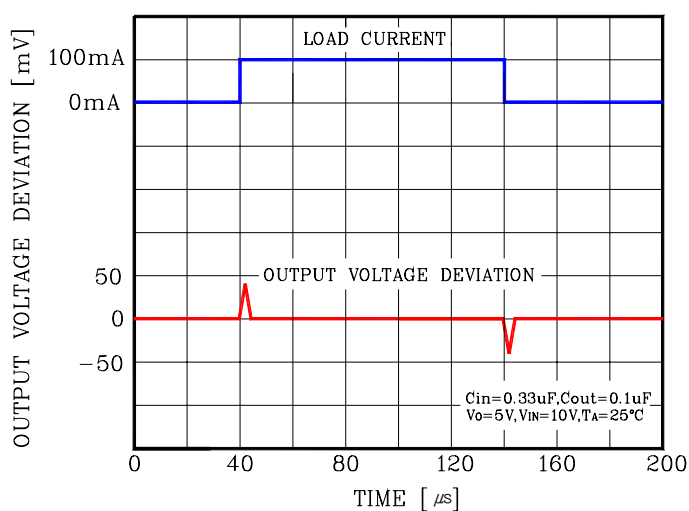
**Fig.4 Dropout Voltage vs. Input Voltage**



**Fig.5 Line Transient Response**

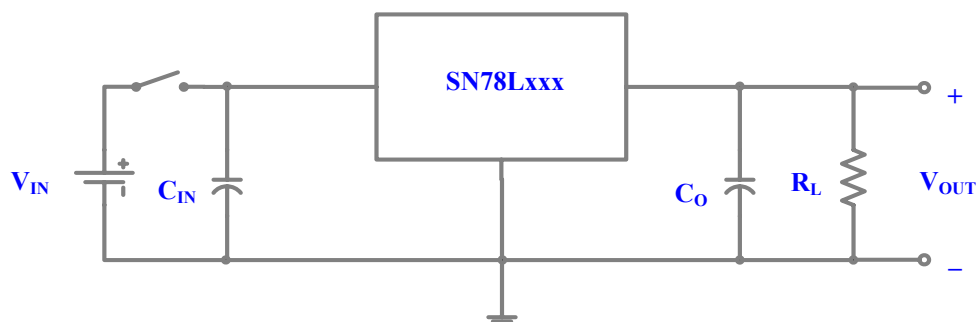


**Fig.6 Load Transient Response**



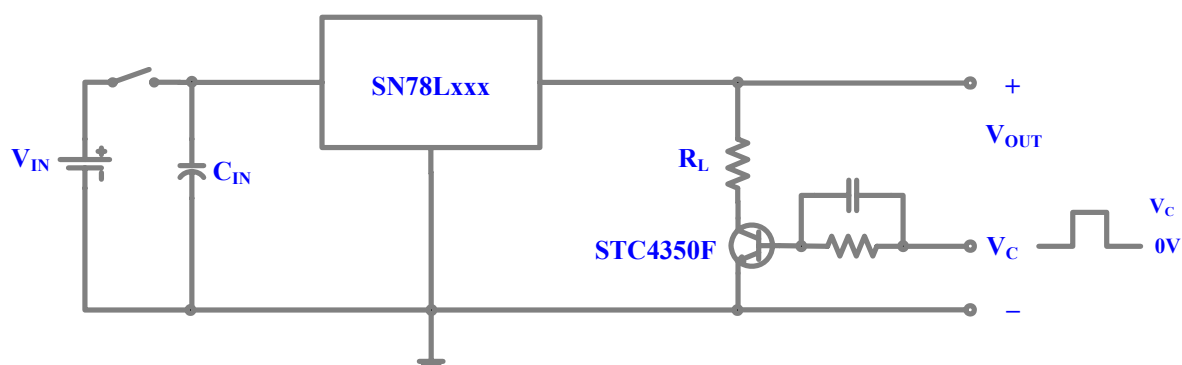
## Typical Application

### Fixed Output Regulator

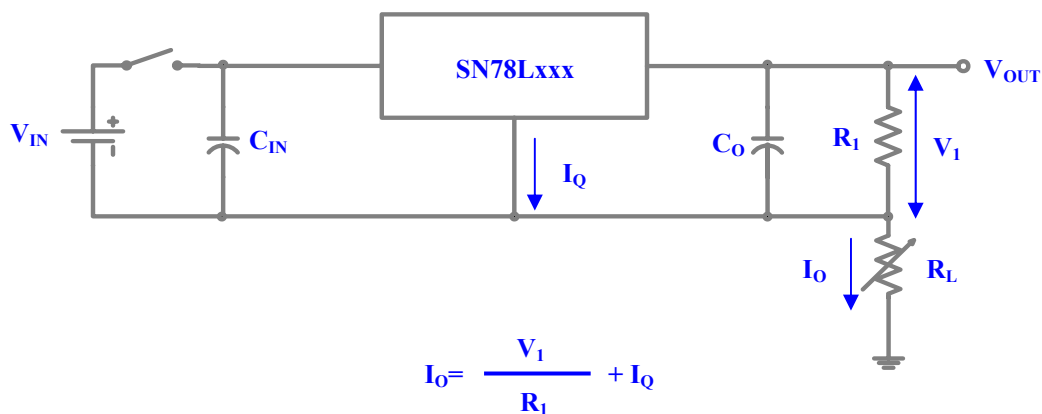


- 1)  $C_{IN}$  should be required if regulators are located far from power supply filter
- 2)  $C_O$  improves output stability and transient response

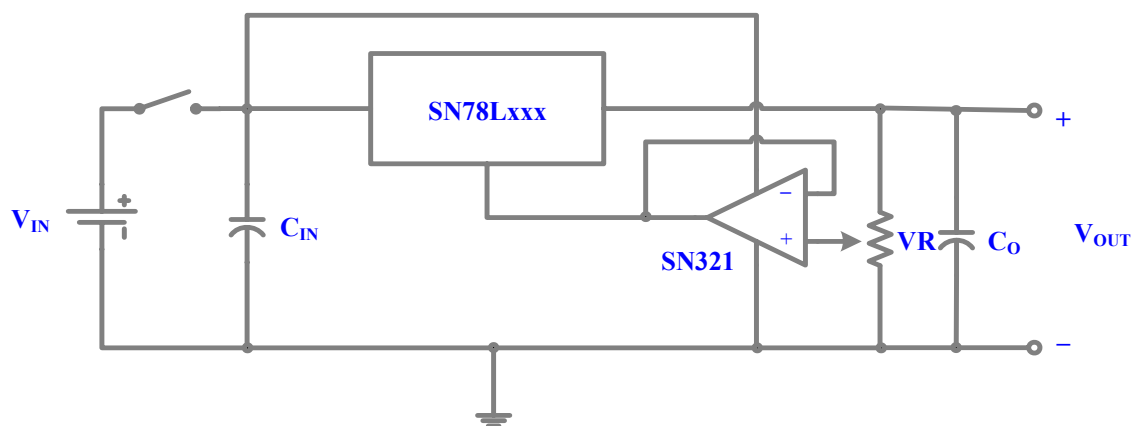
### Load Regulation



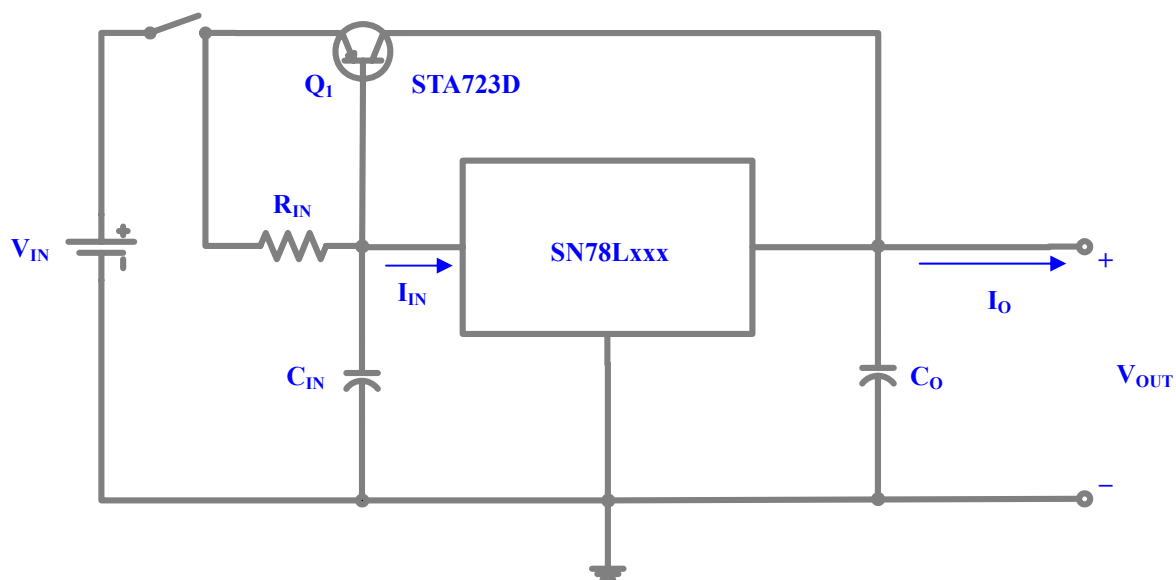
### Constant Current Regulator



## Adjustable Output Regulator

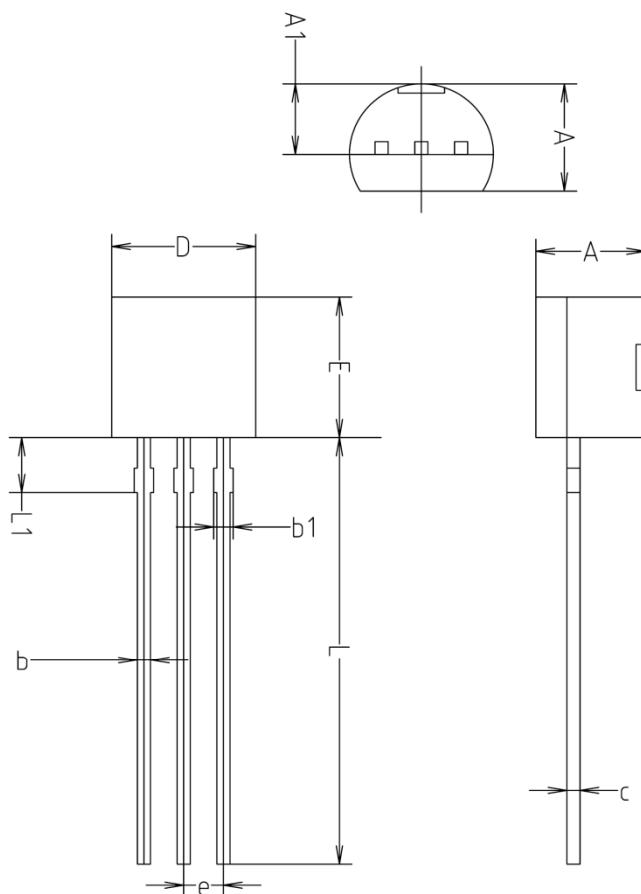


## High Current Voltage Regulator



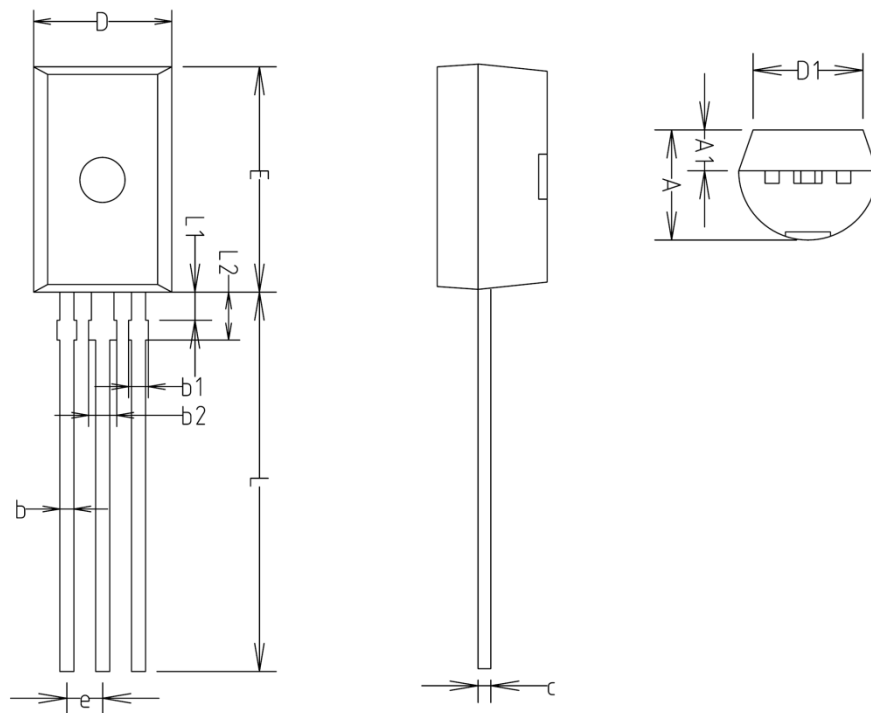
$$I_O = I_{IN} + \beta_{Q1}(I_{IN} - V_{BEQ1} / R_{IN})$$

## ◆ TO-92 Outline Dimension (Unit : mm)



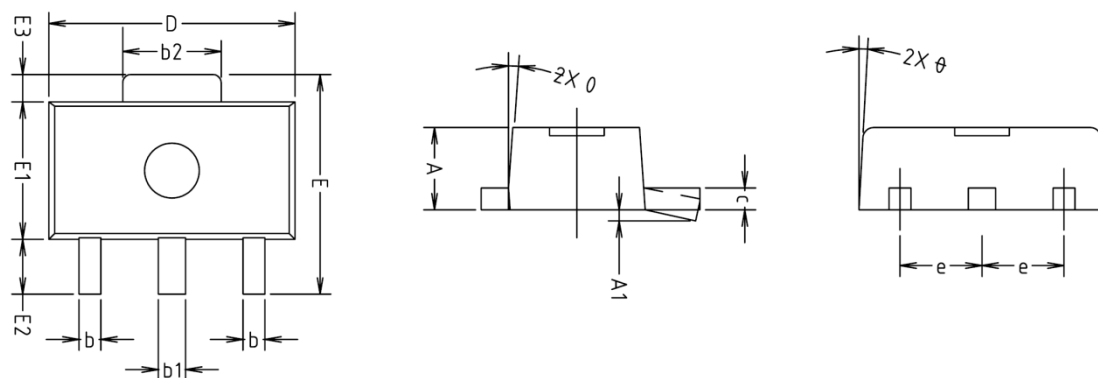
| SYMBOL | MILLIMETERS(mm) |         |         |
|--------|-----------------|---------|---------|
|        | MINIMUM         | NOMINAL | MAXIMUM |
| A      | 3.40            | 3.50    | 3.66    |
| A1     | 2.46            | 2.51    | 2.59    |
| b      | 0.39            | 0.44    | 0.53    |
| b1     | 0.39            | —       | 0.63    |
| c      | 0.35            | 0.42    | 0.47    |
| D      | 4.48            | 4.60    | 4.70    |
| E      | 4.48            | 4.60    | 4.70    |
| e      | 1.17            | 1.27    | 1.37    |
| L      | 13.70           | 14.00   | 14.77   |
| L1     | 1.55            | 1.70    | 2.15    |

## ◆ TO-92L Outline Dimension (Unit : mm)



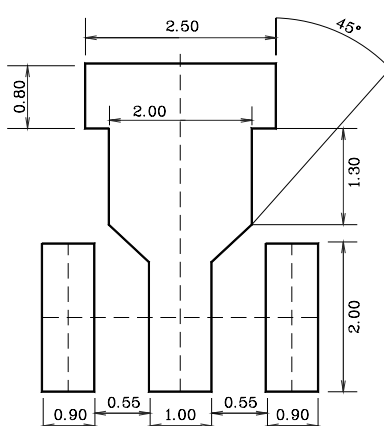
| SYMBOL | MILLIMETERS(mm) |         |         | NOTE |
|--------|-----------------|---------|---------|------|
|        | MINIMUM         | NOMINAL | MAXIMUM |      |
| A      | 3.70            | 3.90    | 4.10    |      |
| A1     | 1.25            | 1.45    | 1.65    |      |
| b      | 0.40            | 0.50    | 0.60    |      |
| b1     | —               | —       | 0.70    |      |
| b2     | —               | —       | 1.00    |      |
| c      | 0.35            | 0.45    | 0.55    |      |
| D      | 4.70            | 4.90    | 5.10    |      |
| D1     | 3.70            | 3.90    | 4.10    |      |
| E      | 7.80            | 8.00    | 8.20    |      |
| e      | 1.27 TYP        |         |         |      |
| L      | 13.10           | 13.50   | 13.90   |      |
| L1     | 0.90            | 1.00    | 1.10    |      |
| L2     | 1.50            | 1.70    | 1.90    |      |

### ◆ SOT-89 Outline Dimension (Unit : mm)



| SYMBOL | MILLIMETERS |         |         | NOTE |
|--------|-------------|---------|---------|------|
|        | MINIMUM     | NOMINAL | MAXIMUM |      |
| A      | 1.40        | 1.50    | 1.60    |      |
| A1     | 0.00        | —       | 0.10    |      |
| b      | 0.38        | 0.42    | 0.48    |      |
| b1     | 0.48        | 0.52    | 0.58    |      |
| b2     | 1.79        | 1.82    | 1.87    |      |
| c      | 0.40        | 0.42    | 0.46    |      |
| D      | 4.40        | 4.50    | 4.70    |      |
| E      | 3.70        | 4.00    | 4.30    |      |
| E1     | 2.40        | 2.50    | 2.70    |      |
| E2     | 0.80        | 1.00    | 1.20    |      |
| E3     | 0.40        | 0.50    | 0.60    |      |
| e      | 1.50 TYP.   |         |         |      |
| θ      | 4° TYP.     |         |         |      |

※ Recommend PCB solder land [Unit: mm]



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