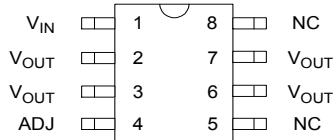


## 3-Terminal Adjustable Voltage Regulator

### Features

- Adjustable Output Down to 1.2V
- Guaranteed 100mA Output Current
- Output Short Circuit Protected
- Line Regulation: 0.01%/V
- Load Regulation: 0.1%
- Current Limit Constant with Temperature
- 70 dB Ripple Rejection
- Available in Lead Free, RoHS Compliant Package

### NSOIC-8 Package



### Applications

- High Efficiency Linear Regulators
- Post Regulation for Switching Supplies
- Microprocessor Power Supply
- Mother Board I/O Power Supply

### General Description

The SP317L is an adjustable 3-terminal positive voltage regulator capable of supplying 100mA over a 1.2V to 12V output range. This voltage regulator is exceptionally easy to use and requires only two external resistors to set the output voltage. Both line and load regulation are better than standard fixed regulators.

In addition to higher performance than fixed regulators, SP317L employs overload protection. Included on the chip are current limiting and thermal overload protection. All overload protection circuitry remains fully functional even when the adjustment terminal is disconnected.

The SP317L is available in standard TO-92 and NSOIC-8 packages.

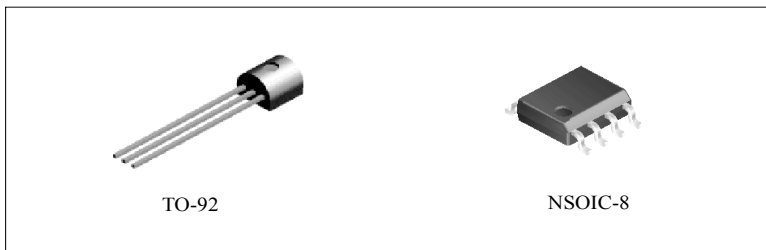


Figure 1. Package Types of SP317L

# Pin Configuration

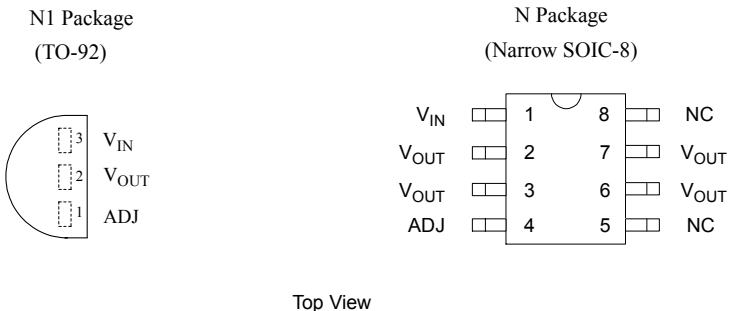


Figure 2. Pin Configuration of SP317L

# Functional Block Diagram

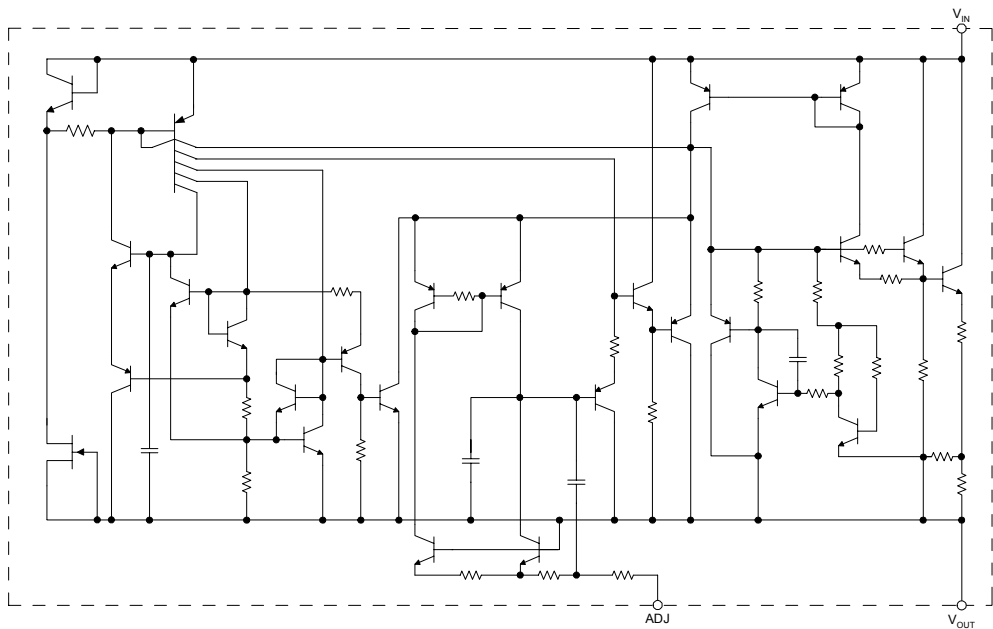


Figure 3. Functional Block Diagram of SP317L

## Absolute Maximum Ratings (Note 1)

| Parameter                            | Symbol     | Value      | Unit |
|--------------------------------------|------------|------------|------|
| Input Voltage                        | $V_{IN}$   | 20         | V    |
| Input-Output Voltage Differential    |            | 15         | V    |
| Operating Junction Temperature Range | $T_J$      | 150        | °C   |
| Storage Temperature Range            | $T_{STG}$  | -65 to 150 | °C   |
| Power Dissipation                    | $P_D$      | 700        | mW   |
| Lead Temperature (Soldering, 4 sec.) | $T_{LEAD}$ | 260        | °C   |
| ESD (Machine Model)                  | ESD        | 250        | V    |

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

## Recommended Operating Conditions

| Parameter                            | Symbol   | Min | Max | Unit |
|--------------------------------------|----------|-----|-----|------|
| Input Voltage                        | $V_{IN}$ |     | 15  | V    |
| Operating Junction Temperature Range | $T_J$    | 0   | 125 | °C   |

## Electrical Characteristics

$0^{\circ}\text{C} \leq T_J \leq 125^{\circ}\text{C}$ ,  $V_{\text{IN}} - V_{\text{OUT}} = 5\text{V}$ ,  $I_{\text{OUT}} = 40\text{mA}$ ,  $P_D \leq 625\text{mW}$ , unless otherwise specified.

| Parameter                                  | Symbol                     | Conditions                                                                                                                        | Min  | Typ   | Max  | Unit                 |
|--------------------------------------------|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------|------|-------|------|----------------------|
| Line Regulation                            | $\text{Reg}_{\text{LINE}}$ | $T_J = 25^{\circ}\text{C}$ , $3\text{V} \leq (V_{\text{IN}} - V_{\text{OUT}}) \leq 15\text{V}$<br>$I_L \leq 20\text{mA}$ (Note 2) |      | 0.01  | 0.04 | %/V                  |
|                                            |                            | $3\text{V} \leq (V_{\text{IN}} - V_{\text{OUT}}) \leq 15\text{V}$ , $I_L \leq 20\text{mA}$<br>(Note 2)                            |      | 0.02  | 0.07 | %/V                  |
| Load Regulation                            | $\text{Reg}_{\text{LOAD}}$ | $T_J = 25^{\circ}\text{C}$ , $5\text{mA} \leq I_{\text{OUT}} \leq 100\text{mA}$<br>(Note 2)                                       |      | 0.1   | 0.5  | %                    |
|                                            |                            | $5\text{mA} \leq I_{\text{OUT}} \leq 100\text{mA}$ (Note 2)                                                                       |      | 0.3   | 1.5  | %                    |
| Thermal Regulation                         |                            | $T_J = 25^{\circ}\text{C}$ , 10ms Pulse                                                                                           |      | 0.04  | 0.2  | %/W                  |
| Adjust Pin Current                         |                            |                                                                                                                                   |      | 50    | 100  | $\mu\text{A}$        |
| Adjust Pin Current Change                  |                            | $5\text{mA} \leq I_L \leq 100\text{mA}$<br>$3\text{V} \leq (V_{\text{IN}} - V_{\text{OUT}}) \leq 15\text{V}$                      |      | 0.2   | 5    | $\mu\text{A}$        |
| Reference Voltage                          | $V_{\text{REF}}$           | $3\text{V} \leq (V_{\text{IN}} - V_{\text{OUT}}) \leq 15\text{V}$<br>$5\text{mA} \leq I_{\text{OUT}} \leq 100\text{mA}$           | 1.20 | 1.25  | 1.30 | V                    |
| Current Limit                              | $I_{\text{LIMIT}}$         | $3\text{V} \leq (V_{\text{IN}} - V_{\text{OUT}}) \leq 13\text{V}$                                                                 | 100  | 200   | 300  | mA                   |
| Minimum Load Current                       |                            | $3\text{V} \leq (V_{\text{IN}} - V_{\text{OUT}}) \leq 13\text{V}$                                                                 |      | 3.5   | 5    | mA                   |
| Ripple Rejection                           |                            | $V_{\text{OUT}} = 10\text{V}$ , $f = 120\text{Hz}$ , $C_{\text{ADJ}} = 0\mu\text{F}$                                              |      | 62    |      | dB                   |
|                                            |                            | $V_{\text{OUT}} = 10\text{V}$ , $f = 120\text{Hz}$ , $C_{\text{ADJ}} = 10\mu\text{F}$                                             | 60   | 70    |      |                      |
| Temperature Stability                      |                            | $0^{\circ}\text{C} \leq T_J \leq 125^{\circ}\text{C}$                                                                             |      | 0.65  |      | %                    |
| Long Term Stability                        |                            | $T_J = 125^{\circ}\text{C}$ , 1000 Hours                                                                                          |      | 0.3   | 1    | %                    |
| RMS Output Noise,<br>% of $V_{\text{OUT}}$ |                            | $T_J = 25^{\circ}\text{C}$ , $10\text{Hz} \leq f \leq 10\text{KHz}$                                                               |      | 0.003 |      | %                    |
| Thermal Resistance<br>Junction to Case     |                            | TO-92<br>NSOIC-8                                                                                                                  |      | 185   |      | $^{\circ}\text{C/W}$ |
|                                            |                            |                                                                                                                                   |      | 175   |      |                      |

Note 2: Regulation is measured at constant junction temperature, using pulse testing with a low duty cycle. Changes in output voltage due to heating effects are covered under the specification of thermal regulation.

## Typical Performance Characteristics

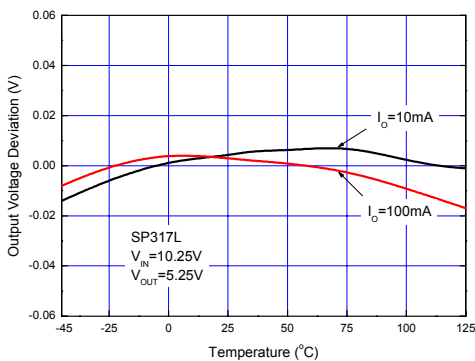


Figure 4. Load Regulation vs. Temperature

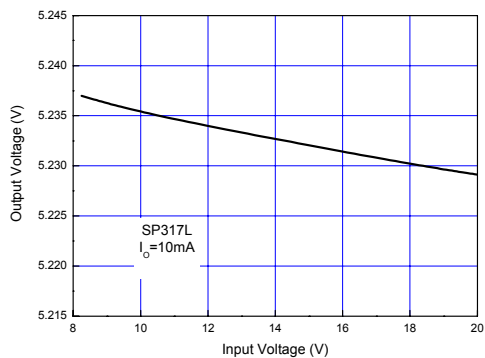


Figure 5. Output Voltage vs. Input Voltage

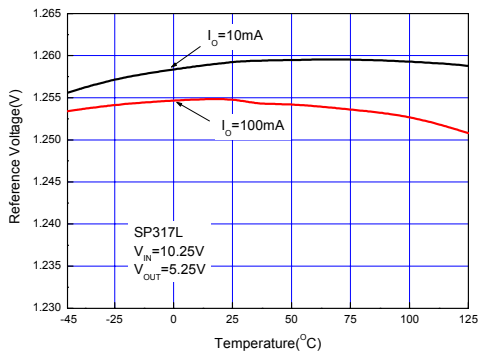


Figure 6. Reference Voltage vs. Temperature

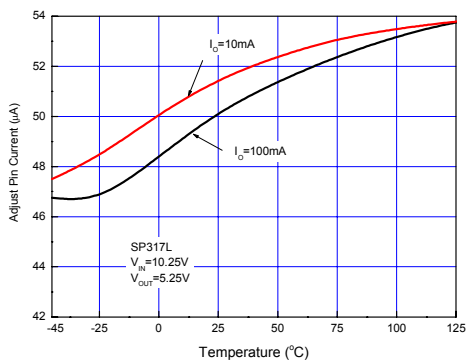


Figure 7. Adjustment Current vs. Temperature

## Typical Performance Characteristics (Continued)

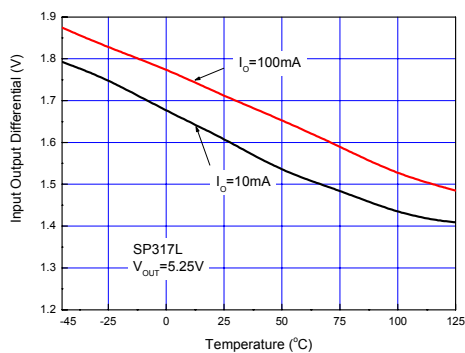


Figure 8. Dropout Voltage vs. Temperature

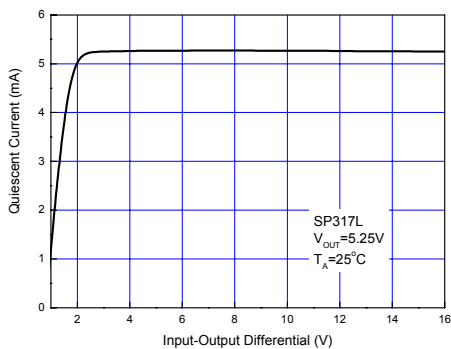


Figure 9. Minimum Operating Current

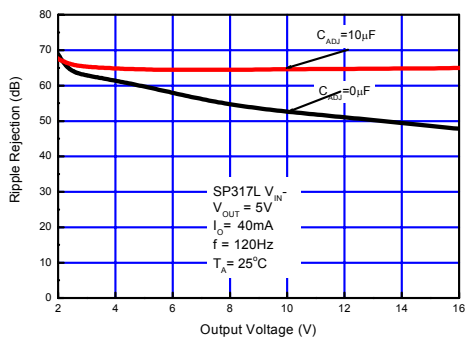


Figure 10. Ripple Rejection vs. Output Voltage

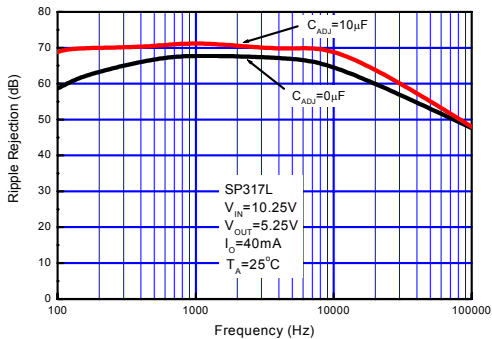


Figure 11. Ripple Rejection vs. Frequency

## Typical Performance Characteristics (Continued)

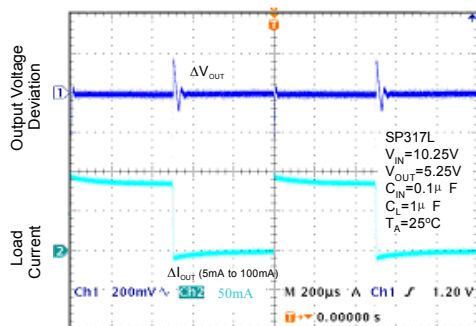


Figure 12. Load Transient Response

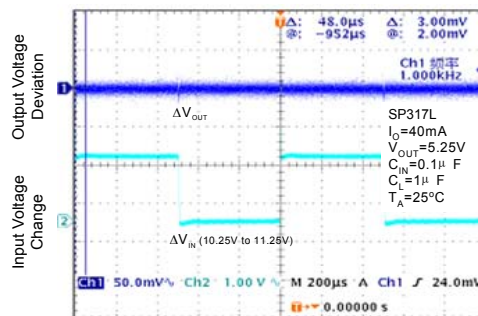


Figure 13. Line Transient Response

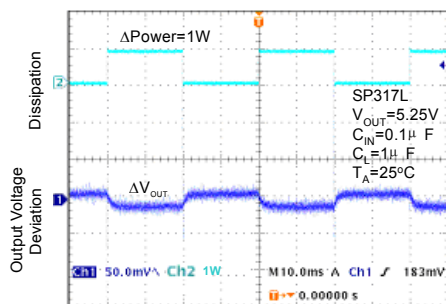


Figure 14. Thermal Regulation

## Typical Application

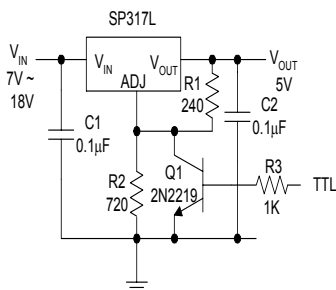


Figure 15. 5V Logic Regulator with Electronic Shutdown (Minimum output = 1.2V)

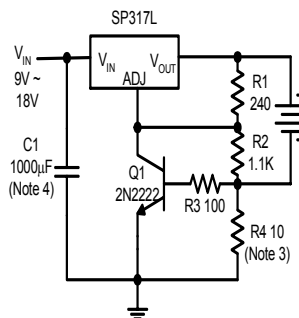


Figure 16. Current Limited 6V Charger  
 Note 3: Sets peak current,  $I_{peak} = 0.6V/R4$   
 Note 4: 1000μF is recommended to filter out any input transients.

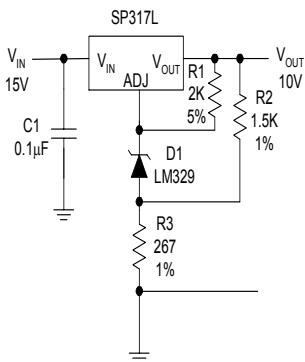


Figure 17. High Stability 10V Regulator

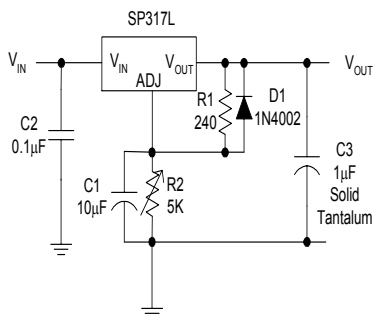


Figure 18. Adjustable Regulator with Improved Ripple Rejection  
 Note 5: Discharge  $C1$  if output is shorted to ground.

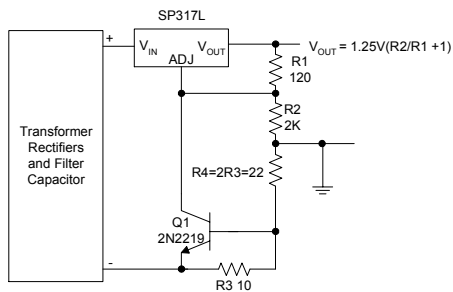


Figure 19. Adjustable Regulator with Current Limit

Note 6: Short circuit current is approximately  $600mV/R3$  or 60mA

Note 7: At 2.5mA output only 3/4V of drop occurs in  $R3$  and  $R4$ .

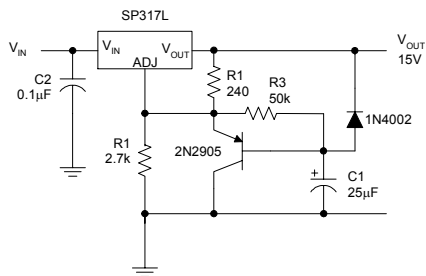


Figure 20. Slow Turn-on 15V Regulator

In operation, the SP317L develops a nominal 1.25V reference voltage,  $V_{REF}$ , between the output and the adjustment terminal. The reference voltage is impressed across program resistor  $R_1$  and, since the voltage is constant, a constant current  $I_1$  then flows through the output set resistor  $R_2$ , giving an output voltage of:

$$V_{OUT} = V_{REF} * \{1 + R_2/R_1\} + I_{ADJ}(R_2)$$

Since the 100 $\mu$ A current from the adjustment terminal represents an error term, the SP317L was designed to minimize  $I_{ADJ}$  and make it very constant with line and load changes. To do this, all quiescent operating current is returned to the output establishing a minimum load current requirement. If there is insufficient load on the output, the output will rise.

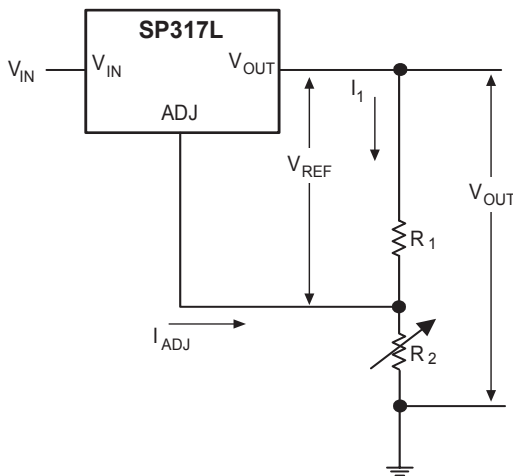


Figure 21:  $R_1$ ,  $R_2$  and Quiescent Current

### EXTERNAL CAPACITORS

Although the SP317L is stable with no output capacitors, like any feedback circuit, certain values of external capacitance can

cause excessive ringing. This occurs with values between 500pF and 5000pF. A 1 $\mu$ F solid tantalum (or 25 $\mu$ F aluminum electrolytic) on the output swamps this effect and insures stability.

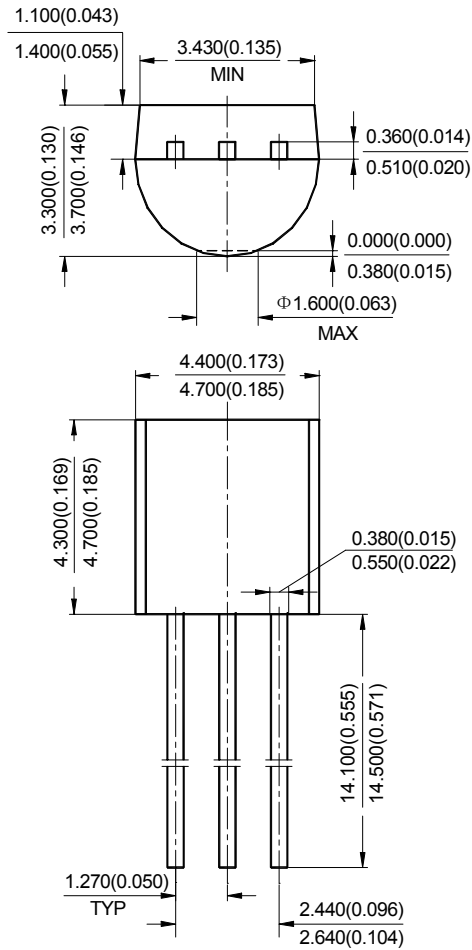
An input bypass capacitor is recommended in case the regulator is more than 6 inches away from the usual large filter capacitor. A 0.1  $\mu$ F disc or 1 $\mu$ F solid tantalum on the input is suitable input bypassing for almost all applications. The device is more sensitive to the absence of input bypassing when adjustment or output capacitors are used, but the above values will eliminate the possibility of problems.

The adjustment terminal can be bypassed to ground on the SP317L to improve ripple rejection and noise. This bypass capacitor prevents ripple and noise from being amplified as the output voltage is increased. With a 10 $\mu$ F bypass capacitor 80dB ripple rejection is obtainable at any output level. Increases over 10 $\mu$ F do not appreciably improve the ripple rejection at frequencies above 120Hz. If the bypass capacitor is used, it is sometimes necessary to include protection diodes to prevent the capacitor from discharging through internal low current paths and damaging the device. In general, the best type of capacitors to use is solid tantalum. **Solid tantalum capacitors have low impedance even at high frequencies.** Depending upon capacitor construction, it takes about 25 $\mu$ F in aluminum electrolytic to equal 1 $\mu$ F solid tantalum at high frequencies. Ceramic capacitors are also good at high frequencies; but some types have a large decrease in capacitance at frequencies around 0.5MHz. For this reason, a 0.01 $\mu$ F disc may seem to work better than a 0.1 $\mu$ F disc as a bypass.

## Mechanical Dimensions

**TO-92**

Unit: mm(inch)



## Mechanical Dimensions (Continued)

NSOIC-8

Unit: mm(inch)

