# High-Speed USB 2.0 (480-Mbps) 1:2 Multiplexer/Demultiplexer Switch

## FEATURES

- **-3dB Bandwidth: 550MHz**
- **Supply Range: +1.8V to +5.5V**
- **$R_{ON}$ is Typically 6Ω**
- **Fast Switching Times:**
  **$t_{ON}$ 20ns**
  **$t_{OFF}$ 15ns**
- **Break-Before-Make Switching**
- **Low Power Consumption (1μA Maximum)**
- **Rail-to-Rail Input and Output Operation**
- **Extended Industrial Temperature Range: -40°C to +85°C**
- ***Micro*SIZE PACKAGES: MSOP-10**

## APPLICATIONS

- **Routes Signals for USB 1.0, 1.1, and 2.0**
- **MP3 and Other Personal Media Players**
- **Portable Instrumentation**
- **USB Switching**
- **Digital Cameras**
- **Set-Top Box**
- **Cell Phones**
- **PDAs**

## DESCRIPTION

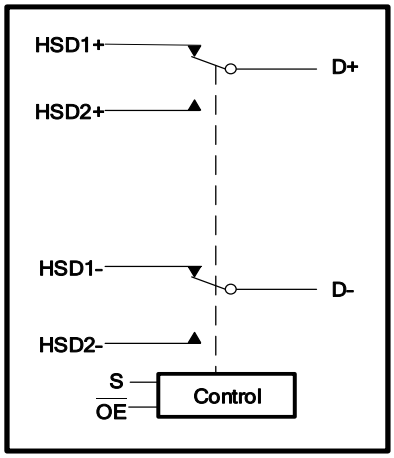
The RS2227 is a high-speed, low-power double-pole/double-throw (DPDT) analog switch with single Enable. It is designed to operate from 1.8 V to 5.5 V.

The RS2227 has a bus-switch enable pin, $\overline{OE}$, that can place the signal paths in high impedance. This allows the user to isolate the bus when it is not in use and consume less current.

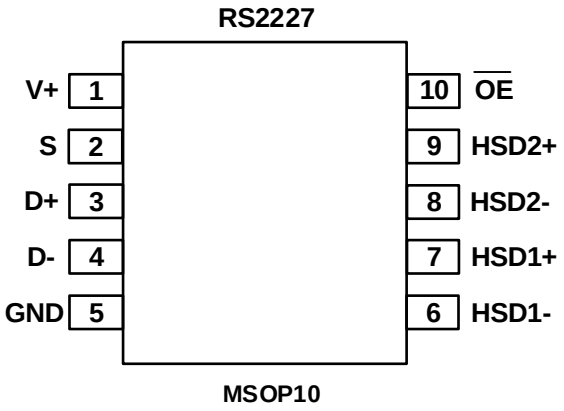
The RS2227 is a high-bandwidth switch specially designed for the switching of high-speed USB2.0 signals in handset and consumer applications, such as cell phones, digital cameras, and notebooks with hubs or controllers with limited USB I/Os.

The RS2227 is available MSOP-10 package. It operates over an ambient temperature range of -40°C to +85°C.

### Functional Block Diagram



## PIN CONFIGURATIONS




## PIN DESCRIPTION

| NAME | PIN | FUNCTION |
|---|---|---|
| V+ | 1 | Power Supply |
| GND | 5 | Ground |
| S | 2 | Select Input |
| $\overline{OE}$ | 10 | Output Enable |
| HSD1+, HSD2+ | 7,9 | Data Port |
| HSD1-, HSD2- | 6,8 | |
| D+, D- | 3,4 | |

## FUNCTION TABLE

| $\overline{OE}$ | S | HSD1+, HSD1- | HSD2+, HSD2- |
|---|---|---|---|
| 0 | 0 | ON | OFF |
| 0 | 1 | OFF | ON |
| 1 | X | OFF | OFF |

X =Don't care

## ABSOLUTE MAXIMUM RATINGS (1)

| | |
|---|---|
| V+ to GND | 0V to 6V |
| Analog, Digital Voltage Range (2) | – 0.3 to (V+) + 0.3V |
| Continuous Current HSDn or Dn | ±100mA |
| Peak Current HSDn or Dn | ±150mA |
| Storage Temperature | −65°C to +150°C |
| Operating Temperature | −40°C to +85°C |
| Junction Temperature | 150°C |
| Lead Temperature (Soldering, 10s) | 260°C |
| ESD Susceptibility | |
| HBM | 3000V |
| MM | 200V |

(1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not implied.

(2) Input terminals are diode-clamped to the power-supply rails. Input signals that can swing more than 0.3V beyond the supply rails should be current-limited to 10mA or less.

**ESD SENSITIVITY CAUTION**

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

## PACKAGE/ORDERING INFORMATION

| PRODUCT | ORDERING NUMBER | TEMPERATURE RANGE | PACKAGE LEAD | PACKAGE MARKING | PACKAGE OPTION |
|---|---|---|---|---|---|
| RS2227 | RS2227XN | -40°C ~+85°C | MSOP-10 | RS2227 | Tape and Reel,3000 |

## ELECTRICAL CHARACTERISTICS

(V+ = +1.8V to +5.5V, GND = 0V, $V_{IH}$ = +1.5V, $V_{IL}$ = +0.5V, $T_A$ = -40°C to + 85°C. Typical values are at V+ = +3.3V, $T_A$ = +25°C, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | $T_A$ | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| **ANALOG SWITCH** | | | | | | | |
| Analog I/O Voltage (HSD1+, HSD1-, HSD2+, HSD2-) | $V_{IS}$ | | -40°C to +85°C | 0 | | V+ | V |
| On-Resistance | $R_{ON}$ | V+ = 3.0V, $V_{IS}$ = 0V to 0.4V, $I_D$ = 8mA, Test Circuit 1 | +25°C | | 6 | 10 | Ω |
| | | | -40°C to +85°C | | | 10.5 | |
| On-Resistance Match Between Channels | $\Delta R_{ON}$ | V+ = 3.0V, $V_{IS}$ = 0V to 0.4V, $I_D$ = 8mA, Test Circuit 1 | +25°C | | 0.15 | 0.6 | Ω |
| | | | -40°C to +85°C | | | 1.6 | Ω |
| On-Resistance Flatness | $R_{FLAT(ON)}$ | V+ = 3.0V, $V_{IS}$ = 0V to 1.0V, $I_D$ = 8mA, Test Circuit 1 | +25°C | | 5 | 7 | Ω |
| | | | -40°C to +85°C | | | 8 | |
| Power Off Leakage Current (D+, D-) | $I_{OFF}$ | V+ = 0V, $V_D$ = 0V to 3.6 V, $V_S$, $V_{\overline{OE}}$ = 0V or 3.6 V | -40°C to +85°C | | | 1 | μA |
| Increase in $I_+$ per Control Voltage | $I_{CCT}$ | V+ = 4.3V, $V_S$ or $V_{\overline{OE}}$ = 2.6 V | -40°C to +85°C | | | 40 | μA |
| Source Off Leakage Current | $I_{HSD2(OFF)}$ $I_{HSD1(OFF)}$ | V+ = 3.6V, $V_{IS}$ = 3.3V/ 0.3V, $V_D$ = 0.3V/ 3.3V | -40°C to +85°C | | | 1 | μA |
| Channel On Leakage Current | $I_{HSD2(ON)}$ $I_{HSD1(ON)}$ | V+ = 3.6V, $V_{IS}$ = 3.3V/ 0.3V, $V_D$ = 0.3V/ 3.3V or floating | -40°C to +85°C | | | 1 | μA |
| **DIGITAL CONTROL INPUTS(1)** | | | | | | | |
| Input High Voltage | $V_{IH}$ | | -40°C to +85°C | 1.6 | | | V |
| Input Low Voltage | $V_{IL}$ | | -40°C to +85°C | | | 0.5 | V |
| Input Leakage Current | $I_{IN}$ | V+ = 3.0V, $V_S$, $V_{\overline{OE}}$ = 0V or V+ | -40°C to +85°C | | | 1 | μA |

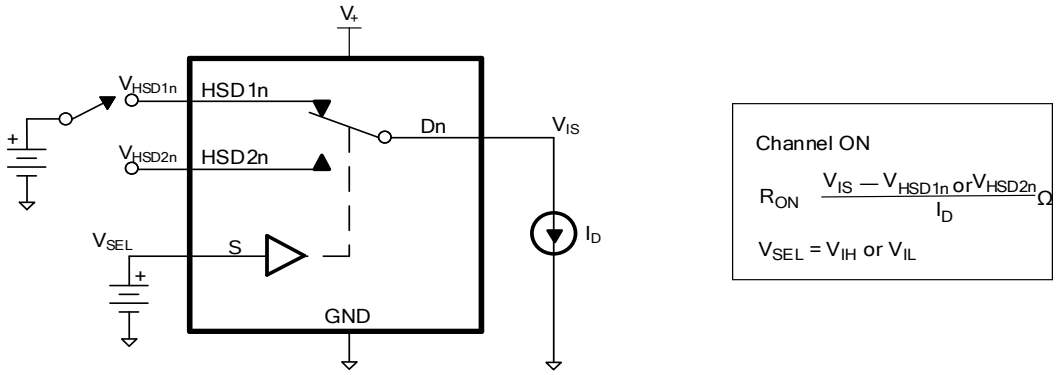
(1) All unused digital inputs of the device must be held at $V_{IO}$ or GND to ensure proper device operation.

## ELECTRICAL CHARACTERISTICS (continued)

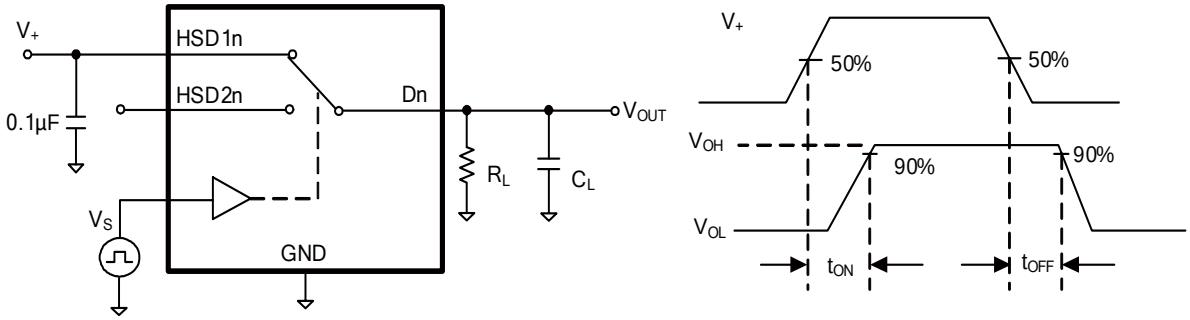
(V+ = +1.8V to +5.5V, GND = 0V, $V_{IH}$ = +1.5V, $V_{IL}$ = +0.5V, $T_A$ = -40°C to + 85°C. Typical values are at V+ = +3.3V, $T_A$ = +25°C, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | TEMP | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| **DYNAMIC CHARACTERISTICS** | | | | | | | |
| Turn-On Time | $t_{ON}$ | $V_{IS}$ = 0.8V, $R_L$ = 50Ω, $C_L$ = 10pF, Test Circuit 2 | +25°C | | 20 | | ns |
| Turn-Off Time | $t_{OFF}$ | | +25°C | | 15 | | ns |
| Break-Before-Make Time Delay | $t_D$ | $V_{IS}$ = 0.8V, $R_L$ = 50Ω, $C_L$ = 10pF, Test Circuit 3 | +25°C | | 4 | | ns |
| Propagation Delay | $t_{PD}$ | $R_L$ = 50Ω, $C_L$ = 10pF | +25°C | | 0.35 | | ns |
| Off Isolation | $O_{ISO}$ | Signal = 0dBm, $R_L$ = 50Ω, f = 250MHz, Test Circuit 4 | +25°C | | -35 | | dB |
| Channel-to-Channel Crosstalk | $X_{TALK}$ | Signal = 0dBm, $R_L$ = 50Ω, f = 250MHz, Test Circuit 5 | +25°C | | -40 | | dB |
| -3dB Bandwidth | BW | Signal = 0dBm, $R_L$ = 50Ω, $C_L$ = 5pF, Test Circuit 6 | +25°C | | 550 | | MHz |
| Channel-to-Channel Skew | $t_{SKEW}$ | $R_L$ = 50Ω, $C_L$ = 10pF | +25°C | | 0.05 | | ns |
| Charge Injection Select Input to Common I/O | Q | $V_G$ = GND, $C_L$ = 1.0nF, $R_G$ = 0Ω, Q = $C_L$ x $V_{OUT}$, Test Circuit 7 | +25°C | | 11 | | pC |
| HSD+, HSD-, D+, D- ON Capacitance | $C_{ON}$ | | +25°C | | 7 | | pF |
| **POWER REQUIREMENTS** | | | | | | | |
| Power Supply Range | $V_+$ | | -40°C to +85°C | 1.8 | | 5.5 | V |
| Power Supply Current | $I_+$ | V+ = 3.0V, $V_S$, $V_{\overline{OE}}$ = 0V or V+ | -40°C to +85°C | | | 1 | μA |

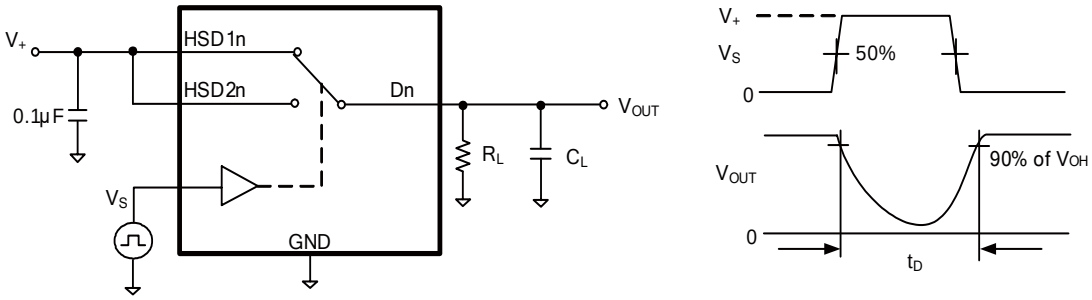
## Parameter Measurement Information



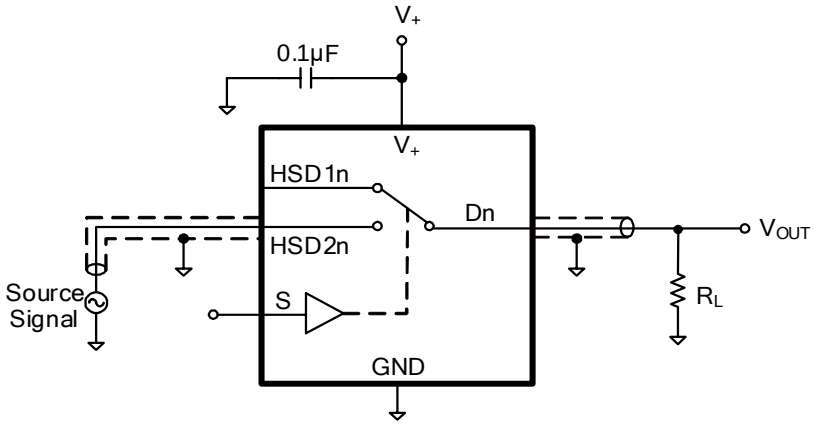

**Test Circuit 1. ON-State Resistance ($R_{ON}$)**



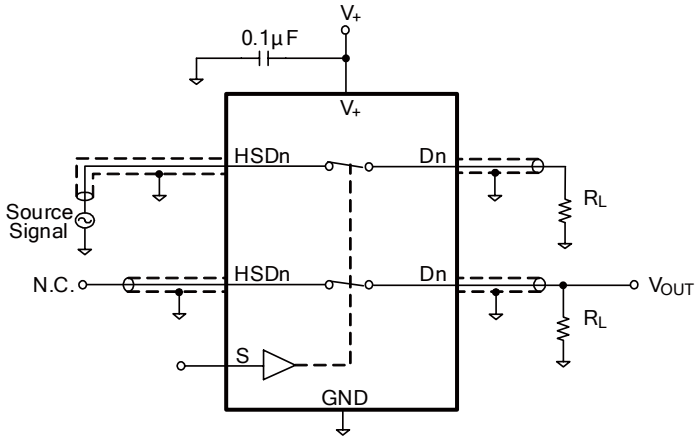

**Test Circuit 2. Turn-On ($t_{ON}$) and Turn-Off Time ($t_{OFF}$)**




**Test Circuit 3. Break-Before-Make Time ($t_D$)**

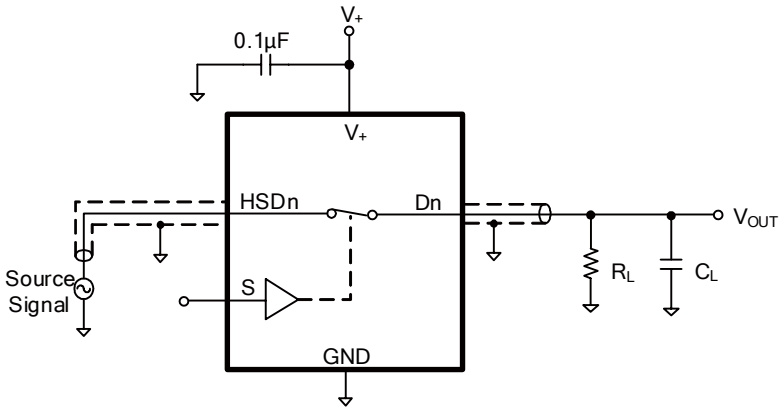



**Test Circuit 4.OFF Isolation ($O_{ISO}$)**

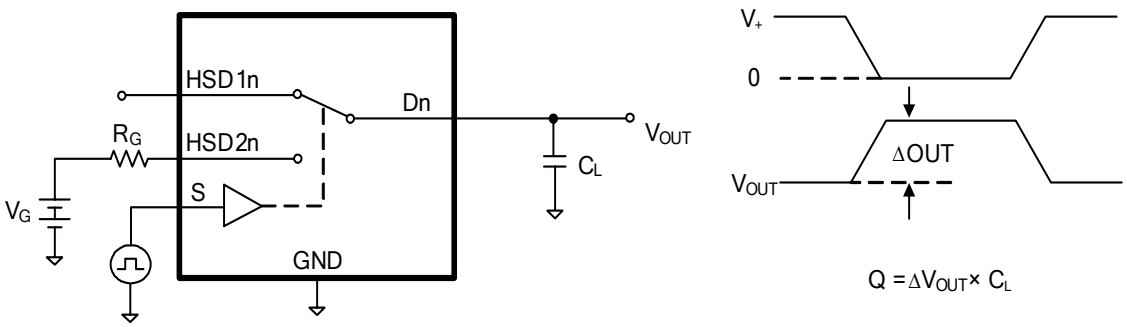



$$\text{Channel To Channel Crosstalk} = -20 \times \log \frac{V_{HSDn}}{V_{OUT}}$$

**Test Circuit 5. Channel-to-Channel Crosstalk**




**Test Circuit 6. -3dB Bandwidth**




**Test Circuit 7. Charge Injection(Q)**

## APPLICATION NOTES

There are many USB applications in which the USB hubs or controllers have a limited number of USB I/Os. The RS2227 solution can effectively expand the limited USB I/Os by switching between multiple USB buses in order to interface them to a single USB hub or controller. RS2227 can also be used to connect a single controller to two USB connectors or controllers.

Design requirements of the USB 1.0, 1.1, and 2.0 standards should be followed. It is recommended that the digital control pins S and $\overline{OE}$ be pulled up to V+ or down to GND to avoid undesired switch positions that could result from the floating pin.

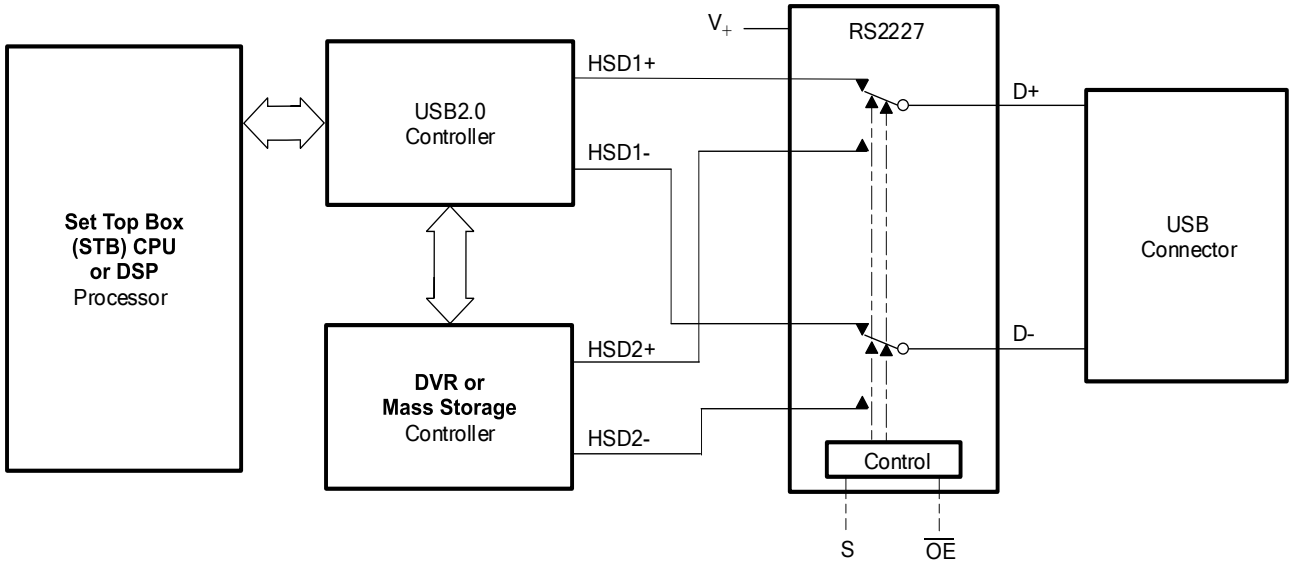
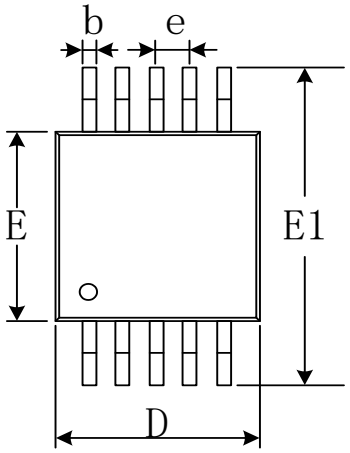
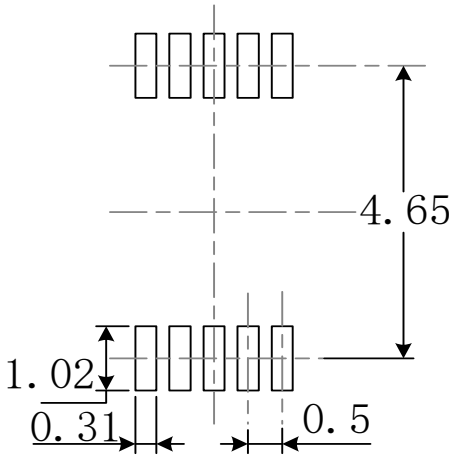



**Figure 1. Application Diagram**

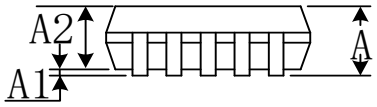
## PACKAGE OUTLINE DIMENSIONS

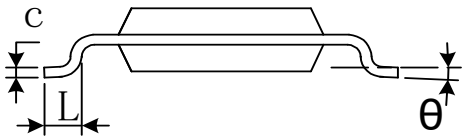
# MSOP-10




**RECOMMENDED LAND PATTERN (Unit: mm)**




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 0.820 | 1.100 | 0.032 | 0.043 |
| A1 | 0.020 | 0.150 | 0.001 | 0.006 |
| A2 | 0.750 | 0.950 | 0.030 | 0.037 |
| b | 0.180 | 0.280 | 0.007 | 0.011 |
| c | 0.090 | 0.230 | 0.004 | 0.009 |
| D | 2.900 | 3.100 | 0.114 | 0.122 |
| e | 0.50(BSC) | | 0.020(BSC) | |
| E | 2.900 | 3.100 | 0.114 | 0.122 |
| E1 | 4.750 | 5.050 | 0.187 | 0.199 |
| L | 0.400 | 0.800 | 0.016 | 0.031 |
| θ | 0° | 6° | 0° | 6° |