

# Low-Power, Two-Port, High-Speed, USB2.0 (480 Mbps) Switch

## FSUSB43

### Description

The FSUSB43 is a bi-directional, low-power, two-port, high-speed, USB2.0 switch. Configured as a double-pole, double-throw (DPDT) switch, it is optimized for switching between two high-speed (480 Mbps) sources or a high-speed and full-speed (12 Mbps) source.

The FSUSB43 is compatible with the requirements of USB2.0 and features an extremely low on capacitance ( $C_{ON}$ ) of 5.7 pF. The wide bandwidth of this device (720 MHz) exceeds the bandwidth needed to pass the third harmonic, resulting in signals with minimum edge and phase distortion. Superior channel-to-channel crosstalk also minimizes interference.

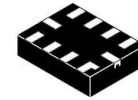
The FSUSB43 contains special circuitry on the switch I/O pins for applications where the  $V_{CC}$  supply is powered-off ( $V_{CC} = 0$ ), which allows the device to withstand an over-voltage condition. This minimizes current consumption even when the control voltage applied to the SEL pin is lower than the supply voltage ( $V_{CC}$ ). This feature is especially valuable to mobile applications, such as cell phones, allowing for direct interface with the general-purpose I/Os of the baseband processor. Other applications include switching and connector sharing in portable cell phones, PDAs, digital cameras, printers, and notebook computers.

### Features

- Over-Voltage Tolerance (OVT) on all USB Ports up to 5.25 V without External Components
- Low On Capacitance: 5.7 pF Typical
- Low On Resistance: 3.9  $\Omega$  Typical
- Low Power Consumption: 1  $\mu$ A Maximum
  - ♦ 20  $\mu$ A Maximum ICCT over an Expanded Voltage Range ( $V_{IN} = 1.8$  V,  $V_{CC} = 4.3$  V)
- Wide -3 db Bandwidth: > 720 MHz
- Packaged in 10-Lead MicroPak™ (1.6 mm x 2.1 mm)
- 8 kV ESD Rating, > 16 kV Power/GND ESD Rating
- Power-Off Protection on All Ports when  $V_{CC} = 0$  V
  - ♦ D+/D- Pins Tolerate up to 5.25 V

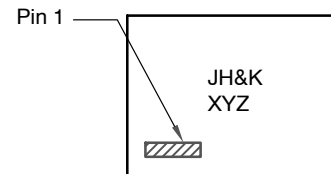
### Typical Applications

- Cell phone, PDA, Digital Camera, and Notebook
- LCD Monitor, TV, and Set-Top Box



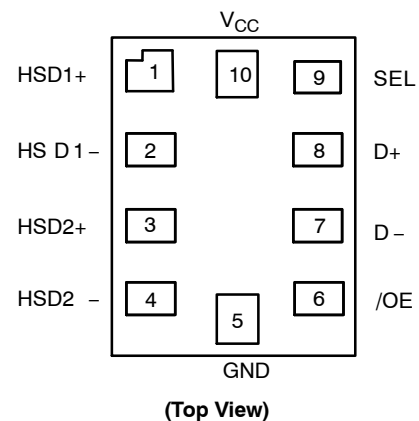
UQFN10 1.6 x 2.1  
CASE 523AZ

### MARKING DIAGRAM

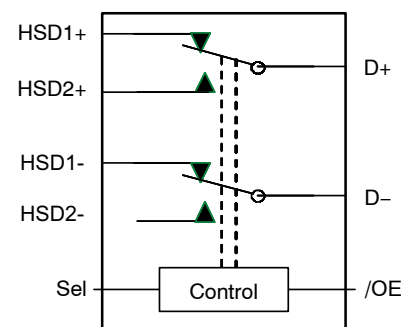


JH = Specific Device Code  
&K = 2 Digit Lot Run Code  
X = Year  
Y = 2 Week Data Code  
Z = Plant Code

### PIN CONNECTION



### ANALOG SYMBOL



### ORDERING INFORMATION

See detailed ordering and shipping information on page 7 of this data sheet.

# FSUSB43

**Table 1. PIN DESCRIPTION**

| Pin # | Name            | Description               |
|-------|-----------------|---------------------------|
| 1     | HSD1+           | Multiplexed Source Inputs |
| 2     | HSD1–           | Multiplexed Source Inputs |
| 3     | HSD2+           | Multiplexed Source Inputs |
| 4     | HSD2–           | Multiplexed Source Inputs |
| 5     | GND             | Ground                    |
| 6     | OE              | Switch Enable             |
| 7     | D–              | USB Data Bus              |
| 8     | D+              | USB Data Bus              |
| 9     | SEL             | Switch Select             |
| 10    | V <sub>CC</sub> | Supply Voltage            |

**Table 2. TRUTH TABLE**

| SEL  | OE   | Function              |
|------|------|-----------------------|
| X    | HIGH | Disconnect            |
| LOW  | LOW  | D+, D– = HSD1+, HSD1– |
| HIGH | LOW  | D+, D– = HSD2+, HSD2– |

**Table 3. ABSOLUTE MAXIMUM RATINGS**

| Symbol             | Parameter                               | Min          | Max             | Unit |
|--------------------|-----------------------------------------|--------------|-----------------|------|
| V <sub>CC</sub>    | Supply Voltage                          | –0.5         | +5.5            | V    |
| V <sub>CNTRL</sub> | DC Input Voltage (SEL, OE) (Note 1)     | –0.5         | V <sub>CC</sub> | V    |
| W <sub>SW</sub>    | ALL PINS for V <sub>CC</sub> 0 to 5.5 V | –0.5         | 5.5             | V    |
| I <sub>IK</sub>    | DC Input Diode Current                  | –50          |                 | mA   |
| I <sub>OUT</sub>   | DC Output Current                       |              | 100             | mA   |
| T <sub>STG</sub>   | Storage Temperature                     | –65          | +150            | °C   |
| ESD                | Human Body Model: JEDEC JESD22–A114     | All Pins     | 8               | kV   |
|                    |                                         | I/O to GND   | 9               |      |
|                    |                                         | Power to GND | 16              |      |
|                    | Charged Device Model: JEDEC JESD22–C101 |              | 2               |      |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. The input and output negative ratings may be exceeded if the input and output diode current ratings are observed.

**Table 4. RECOMMENDED OPERATING CONDITIONS**

| Symbol             | Parameter                                | Min  | Max             | Unit |
|--------------------|------------------------------------------|------|-----------------|------|
| V <sub>CC</sub>    | Supply Voltage                           | 2.4  | 4.4             | V    |
| V <sub>CNTRL</sub> | Control Input Voltage (SEL, OE) (Note 2) | 0    | V <sub>CC</sub> | V    |
| V <sub>SW</sub>    | Switch I/O Voltage                       | –0.5 | 4.5             | V    |
| T <sub>A</sub>     | Operating Temperature                    | –40  | +125            | °C   |

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

2. The control input must be held HIGH or LOW; it must not float.

Table 5. DC ELECTRICAL CHARACTERISTICS

| Symbol           | Parameter                                                                  | Conditions                                                                 | V <sub>CC</sub> (V) | T <sub>A</sub> (Note 3) |      |      | Unit |
|------------------|----------------------------------------------------------------------------|----------------------------------------------------------------------------|---------------------|-------------------------|------|------|------|
|                  |                                                                            |                                                                            |                     | Min                     | Typ  | Max  |      |
| V <sub>IK</sub>  | Clamp Diode Voltage                                                        | I <sub>IN</sub> = -18 mA                                                   | 3.0                 |                         |      | -1.2 | V    |
| V <sub>IH</sub>  | Input Voltage High                                                         |                                                                            | 2.4 to 3.6          | 1.3                     |      |      | V    |
|                  |                                                                            |                                                                            | 4.3                 | 1.7                     |      |      | V    |
| V <sub>IL</sub>  | Input Voltage Low                                                          |                                                                            | 2.4 to 3.6          |                         |      | 0.5  | V    |
|                  |                                                                            |                                                                            | 4.3                 |                         |      | 0.7  | V    |
| I <sub>IN</sub>  | Control Input Leakage                                                      | V <sub>SW</sub> = 0 V to V <sub>CC</sub>                                   | 4.3                 | -1.0                    |      | 1.0  | μA   |
| I <sub>OZ</sub>  | Off State Leakage                                                          | 0 ≤ D <sub>n</sub> , HSD1 <sub>n</sub> , HSD2 <sub>n</sub> ≤ 3.6 V         | 4.3                 | -2.0                    |      | 2.0  | μA   |
| I <sub>OFF</sub> | Power-Off Leakage Current (All I/O Ports)                                  | V <sub>SW</sub> = 0 V to 4.3 V, V <sub>CC</sub> = 0 V (Figure 2)           | 0                   | -2                      |      | 2    | μA   |
| R <sub>ON</sub>  | HS Switch On Resistance (Note 4)                                           | V <sub>SW</sub> = 0.4 V, I <sub>ON</sub> = -8 mA (Figure 1)                | 2.4                 |                         | 4.5  | 7.5  | Ω    |
|                  |                                                                            |                                                                            | 3.0                 |                         | 3.9  | 6.5  | Ω    |
| R <sub>ON</sub>  | HS Switch On Resistance (Note 4)                                           | V <sub>SW</sub> = 0.4 V, I <sub>ON</sub> = -8 mA -40°C to 125°C (Figure 1) | 2.4                 |                         | 4.5  | 9    | Ω    |
|                  |                                                                            |                                                                            | 3.0                 |                         | 3.9  | 8    | Ω    |
| ΔR <sub>ON</sub> | HS Delta R <sub>ON</sub> (Note 5)                                          | V <sub>SW</sub> = 0.4 V, I <sub>ON</sub> = -8 mA                           | 3.0                 |                         | 0.65 |      | Ω    |
| I <sub>Q</sub>   | Quiescent Supply Current                                                   | V <sub>CNTRL</sub> = 0 or V <sub>CC</sub> , I <sub>OUT</sub> = 0           | 4.3                 |                         |      | 1.0  | μA   |
| I <sub>CC</sub>  | Increase in I <sub>Q</sub> Current per Control Voltage and V <sub>CC</sub> | V <sub>CNTRL</sub> = 2.6 V, V <sub>CC</sub> = 4.3 V                        | 4.3                 |                         |      | 10.0 | μA   |
|                  |                                                                            | V <sub>CNTRL</sub> = 1.8 V, V <sub>CC</sub> = 4.3 V                        | 4.3                 |                         |      | 20.0 | μA   |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

3. All typical values are 25°C, and Min/Max values are -40°C to +85°C unless otherwise specified.

4. Measured by the voltage drop between HSD<sub>n</sub> and D<sub>n</sub> pins at the indicated current through the switch. On resistance is determined by the lower of the voltage on the two (HSD<sub>n</sub> or D<sub>n</sub> ports).

5. Guaranteed by characterization.

Table 6. AC ELECTRICAL CHARACTERISTICS

| Symbol           | Parameter                               | Conditions                                                                                           | V <sub>CC</sub> (V) | T <sub>A</sub> (Note 3) |      |     | Unit |
|------------------|-----------------------------------------|------------------------------------------------------------------------------------------------------|---------------------|-------------------------|------|-----|------|
|                  |                                         |                                                                                                      |                     | Min                     | Typ  | Max |      |
| t <sub>ON</sub>  | Turn-On Time, SEL, OE to Output         | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, V <sub>SW</sub> = 0.8 V (Figure 3), (Figure 4)         | 2.4                 |                         | 24   | 40  | ns   |
|                  |                                         |                                                                                                      | 3.0 to 3.6          |                         | 13   | 30  | ns   |
| t <sub>OFF</sub> | Turn-Off Time, SEL, OE to Output        | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, V <sub>SW</sub> = 0.8 V (Figure 3), (Figure 4)         | 2.4                 |                         | 15   | 35  | ns   |
|                  |                                         |                                                                                                      | 3.0 to 3.6          |                         | 12   | 25  | ns   |
| t <sub>PD</sub>  | Propagation Delay (Note 6)              | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF -40°C to 125°C (Figure 3), (Figure 5)                   | 3.3                 |                         | 0.25 |     | ns   |
| t <sub>BBM</sub> | Break-Before-Make Time (Note 6)         | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, V <sub>SW1</sub> = V <sub>SW2</sub> = 0.8 V (Figure 7) | 2.4                 | 2.0                     |      | 10  | ns   |
|                  |                                         |                                                                                                      | 3.0 to 3.6          | 2.0                     |      | 6.5 | ns   |
| OIRR             | Off Isolation (Note 6)                  | R <sub>L</sub> = 50 Ω, f = 240 Mhz (Figure 9)                                                        | 3.0 to 3.6          |                         | -30  |     | dB   |
| Xtalk            | Non-Adjacent Channel Crosstalk (Note 6) | R <sub>L</sub> = 50 Ω, f = 240 Mhz (Figure 10)                                                       | 3.0 to 3.6          |                         | -45  |     | dB   |
| BW               | -3dB Bandwidth (Note 6)                 | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 0 pF (Figure 8)                                              | 3.0 to 3.6          |                         | 720  |     | MHz  |
|                  |                                         | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF (Figure 8)                                              |                     |                         | 550  |     | MHz  |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

6. Guaranteed by characterization.

**Table 7. USB HIGH-SPEED-RELATED AC ELECTRICAL CHARACTERISTICS**

| Symbol             | Parameter                                                | Conditions                                                                                                                               | V <sub>CC</sub> (V) | T <sub>A</sub> (Note 3) |     |     | Unit |
|--------------------|----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------|-----|-----|------|
|                    |                                                          |                                                                                                                                          |                     | Min                     | Typ | Max |      |
| t <sub>SK(P)</sub> | Skew of Opposite Transitions of the Same Output (Note 7) | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF (Figure 6)                                                                                  | 3.0 to 3.6          |                         | 20  |     | ps   |
| t <sub>J</sub>     | Total Jitter (Note 7)                                    | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, t <sub>r</sub> = t <sub>f</sub> = 500 ps (10–90%) at 480 Mbps (PRBS = 2 <sup>15</sup> – 1) | 3.0 to 3.6          |                         | 200 |     | ps   |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

7. Guaranteed by characterization.

**Table 8. CAPACITANCE**

| Symbol           | Parameter                              | Conditions                                                                                | T <sub>A</sub> (Note 3) |     |     | Unit |
|------------------|----------------------------------------|-------------------------------------------------------------------------------------------|-------------------------|-----|-----|------|
|                  |                                        |                                                                                           | Min                     | Typ | Max |      |
| C <sub>IN</sub>  | Control Pin Input Capacitance (Note 8) | V <sub>CC</sub> = 0 V                                                                     |                         | 1.5 |     | pF   |
| C <sub>ON</sub>  | D+/D– On Capacitance (Note 8)          | V <sub>CC</sub> = 3.3 V, $\overline{OE}$ = 0 V, –40°C to 125°C<br>f = 240 Mhz (Figure 12) |                         | 5.5 |     |      |
| C <sub>OFF</sub> | D1n, D2n Off Capacitance (Note 8)      | V <sub>CC</sub> and $\overline{OE}$ = 3.3 V (Figure 11)                                   |                         | 2.0 |     |      |

8. Guaranteed by characterization.

TEST DIAGRAMS

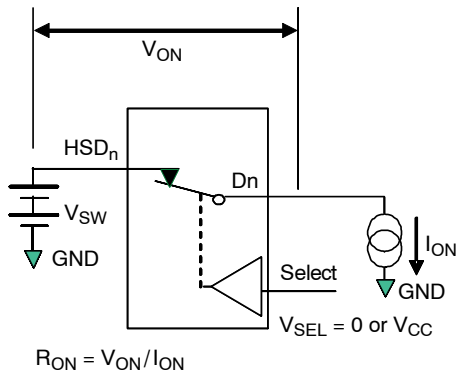
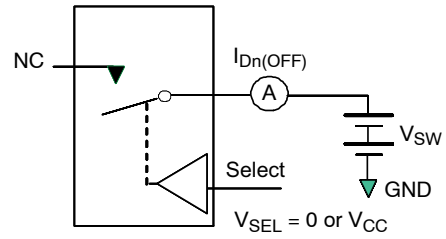
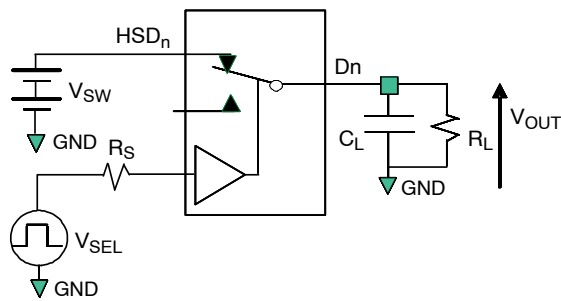


Figure 1. On Resistance



\*\*Each switch port is tested separately

Figure 2. Off Leakage



$R_L$ ,  $R_S$ , and  $C_L$  are functions of the application environment (see AC Tables for specific values)  
 $C_L$  includes test fixture and stray capacitance.

Figure 3. AC Test Circuit Load

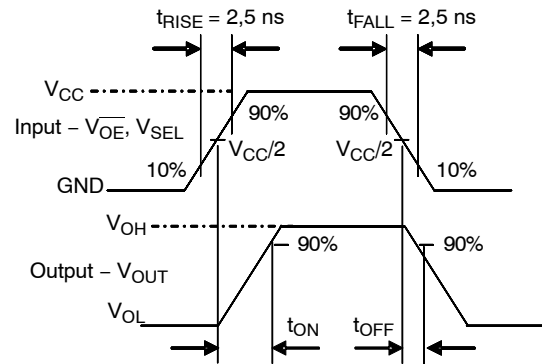


Figure 4. Turn-On / Turn-Off Waveforms

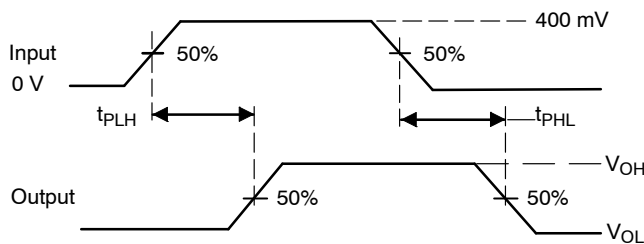


Figure 5. Propagation Delay ( $t_R t_F - 500$  ps)

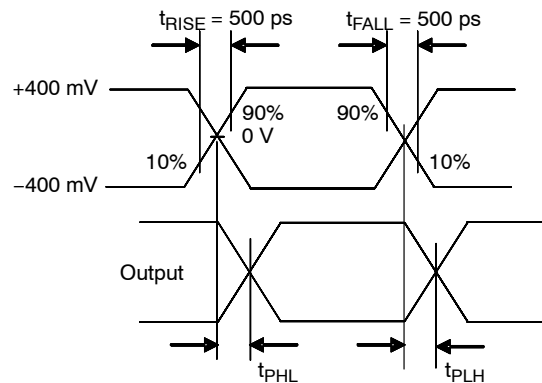


Figure 6. Intra-Pair Skew Test  $t_{SK(P)}$

TEST DIAGRAMS (Continued)

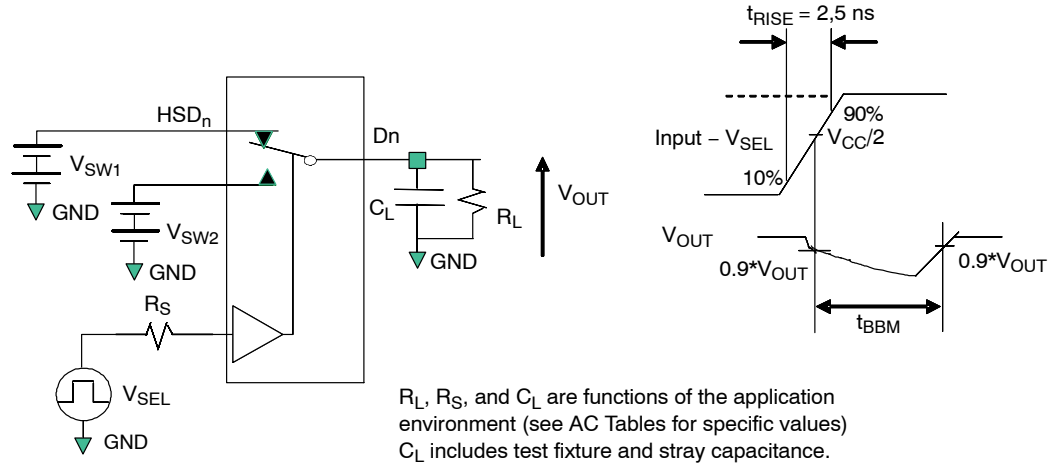


Figure 7. Break-Before-Make Interval Timing

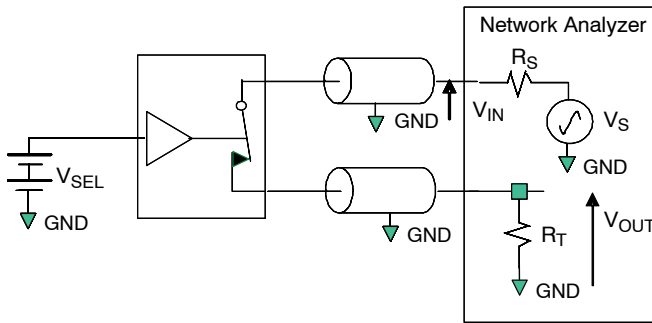


Figure 8. Bandwidth

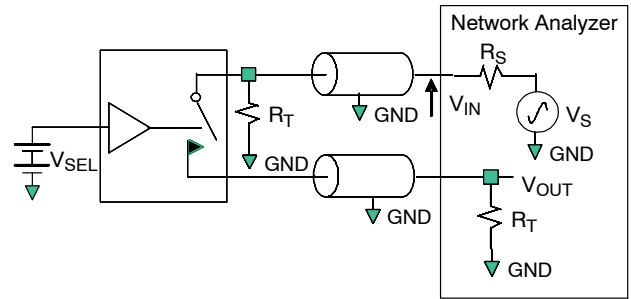


Figure 9. Channel Off Isolation

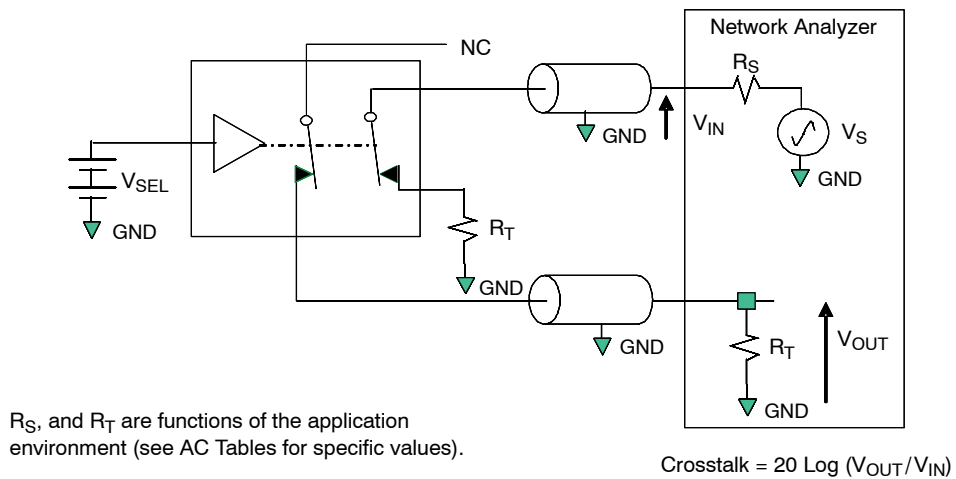


Figure 10. Non-Adjacent Channel-to-Channel Crosstalk

TEST DIAGRAMS (Continued)

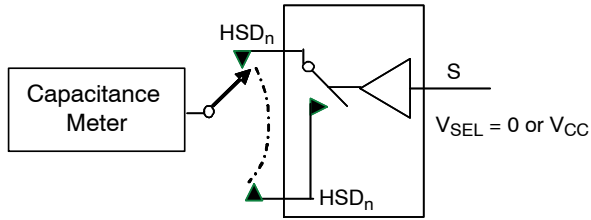


Figure 11. Channel Off Capacitance

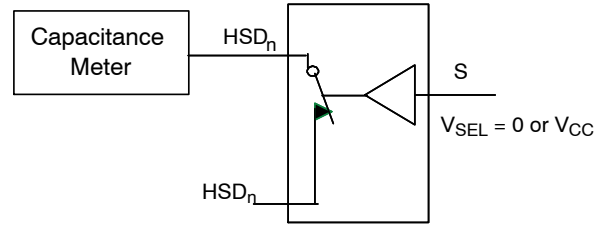
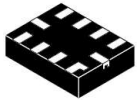


Figure 12. Channel On Capacitance

Table 9. ORDERING INFORMATION

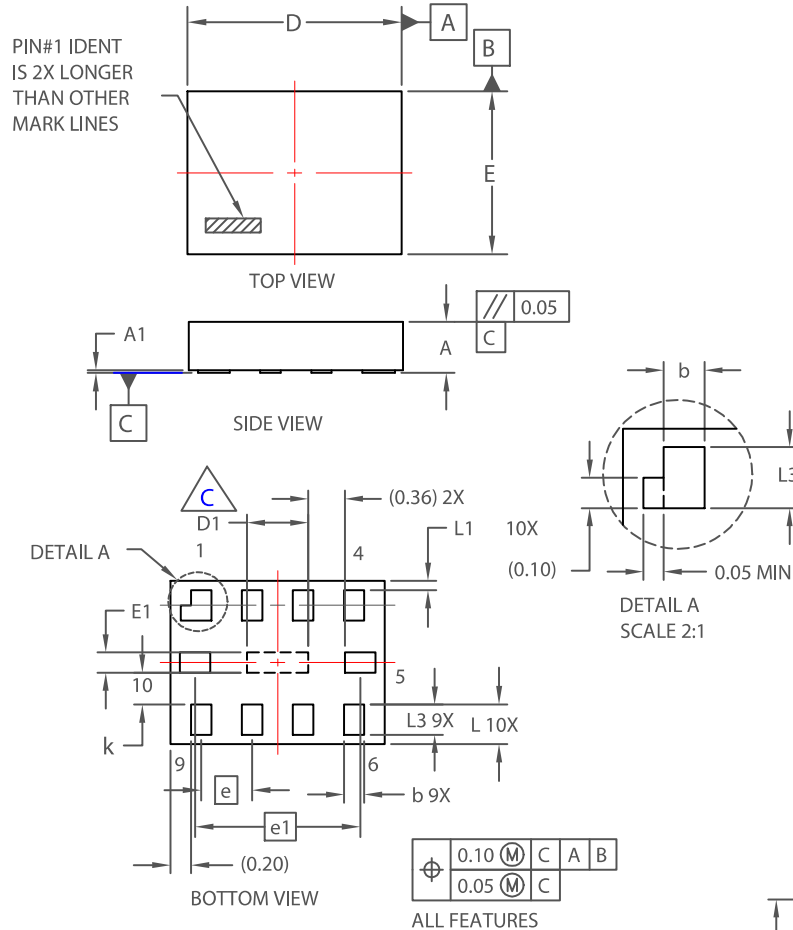
| Part Number | Device Code | Operating Temperature Range | Package                                             | Shipping <sup>†</sup> |
|-------------|-------------|-----------------------------|-----------------------------------------------------|-----------------------|
| FSUSB43L10X | JH          | -40 to 125°C                | 10-Lead MicroPak<br>(1.6 x 2.1 mm)<br>JEDEC MO-255B | 5000 / Tape and Reel  |

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.



**UQFN10 (MICROPAK™), 1.6X2.1, 0.5P**  
CASE 523AZ  
ISSUE A

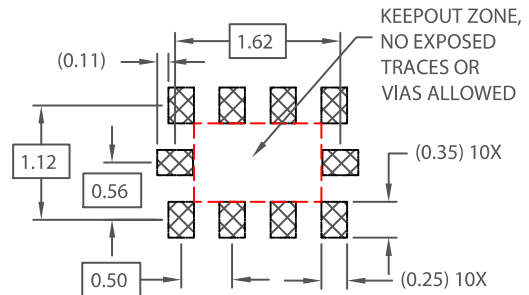
DATE 11 DEC 2019



NOTES:

- A. PACKAGE CONFORMS TO JEDEC REGISTRATION MO-255, VARIATION UABD.  
B. DIMENSIONS ARE IN MILLIMETERS.  
C. PRESENCE OF CENTER PAD IS PACKAGE SUPPLIER DEPENDENT. IF PRESENT IT IS NOT INTENDED TO BE SOLDERED AND HAS A BLACK OXIDE FINISH.  
D. DIMENSIONS WITHIN ( ) ARE UNCONTROLLED.

| DIM | MIN.     | NOM.  | MAX. |
|-----|----------|-------|------|
| A   | 0.50     | 0.55  | 0.65 |
| A1  | 0.00     | 0.025 | 0.05 |
| b   | 0.15     | 0.20  | 0.25 |
| D   | 2.00     | 2.10  | 2.20 |
| D1  | 0.55     | 0.60  | 0.65 |
| E   | 1.50     | 1.60  | 1.70 |
| E1  | 0.15     | 0.20  | 0.25 |
| e   | 0.50 BSC |       |      |
| e1  | 1.62 BSC |       |      |
| k   | 0.20     | --    | --   |
| L   | 0.25     | 0.30  | 0.42 |
| L1  | 0.00     | 0.09  | 0.15 |
| L3  | 0.25     | 0.30  | 0.35 |



**RECOMMENDED  
MOUNTING FOOTPRINT \***

\*FOR ADDITIONAL INFORMATION ON OUR Pb-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ON SEMICONDUCTOR SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERM/D.

|                         |                                          |                                                                                                                                                                                  |
|-------------------------|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| <b>DESCRIPTION:</b>     | <b>UQFN10 (MICROPAK™), 1.6X2.1, 0.5P</b> | <b>PAGE 1 OF 1</b>                                                                                                                                                               |

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