

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

FSUSB42

Description

The FSUSB42 is a bi-directional, low-power, two-port, high-speed, USB2.0 switch. Configured as a double-pole, double-throw switch (DPDT) switch, it is optimized for switching between any combination of high-speed (480 Mbps) or Full-Speed (12 Mbps) sources.

The FSUSB42 is compatible with the requirements of USB2.0 and features an extremely low on capacitance (CON) of 3.7 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.

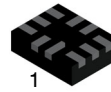
The FSUSB42 contains special circuitry on the switch I/O pins for applications where the V_{CC} supply is powered-off (V_{CC} = 0 V), which allows the device to withstand an over-voltage condition. This device is designed to minimize current consumption even when the control voltage applied to the SEL pin is lower than the supply voltage (V_{CC}). This feature is especially valuable to ultra-portable 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

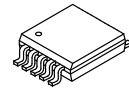
- Low On Capacitance: 3.7 pF Typical
- Low On Resistance: 3.9 Ω Typical
- Low Power Consumption: 1 μA Maximum
 - ◆ 15 μA Maximum I_{CC}T over an Expanded Voltage Range (V_{IN} = 1.8 V, V_{CC} = 4.4 V)
- Wide -3 db Bandwidth: > 720 MHz
- Packaged in:
 - ◆ 10-Lead UMLP (1.4 x 1.8 mm)
 - ◆ 10-Lead MSOP
- 8 kV ESD Rating, >16 kV Power / GND ESD Rating
- Over-Voltage Tolerance (OVT) On All USB Ports Up to 5.25 V without External Components

Typical Applications

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

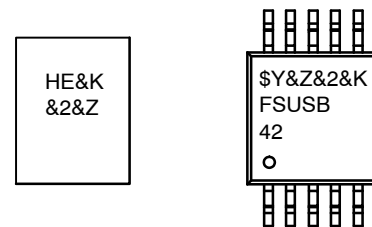


UQFN10 1.4 × 1.8, 0.4 P
CASE 523BC



MSOP10
CASE 846AP

MARKING DIAGRAMS



- HE, FSUCB42 = Specific Device Code
 \$Y = onsemi Logo
 &K = 2 Digit Lot Run Traceability Code
 &2 = 2-Digit Date Code
 &Z = Assembly Location

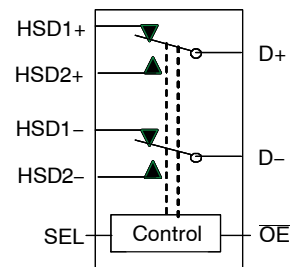


Figure 1. Analog Symbol

ORDERING INFORMATION

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

FSUSB42

Pin Assignments

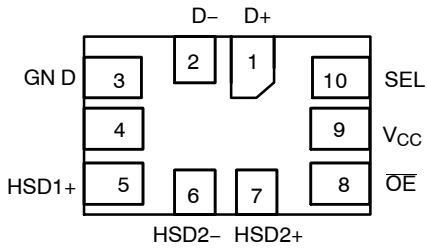


Figure 2. 10-Lead UMLP (Top-Through View)

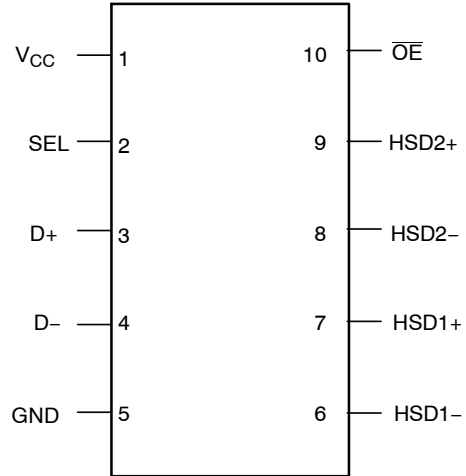


Figure 3. 10-Lead MSOP (Top-Through View)

PIN DESCRIPTION

| UMLP Pin# | MSOP Pin# | Name | Description |
|-----------|-----------|-----------------|----------------------------|
| 1 | 3 | D+ | Common USB Data Bus |
| 2 | 4 | D- | Common USB Data Bus |
| 3 | 5 | GND | Ground |
| 4 | 6 | HSD1- | Multiplexed Source Input 1 |
| 5 | 7 | HSD1+ | Multiplexed Source Input 1 |
| 6 | 8 | HSD2- | Multiplexed Source Input 2 |
| 7 | 9 | HSD2+ | Multiplexed Source Input 2 |
| 8 | 10 | OE | Switch Enable |
| 9 | 1 | V _{CC} | Supply Voltage |
| 10 | 2 | SEL | Switch Select |

TRUTH TABLE

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

1. $LOW \leq V_{IL}$.
2. $HIGH \leq V_{IH}$.
3. X = Don't Care.

FSUSB42

ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Min | Max | Unit | |
|--------------------|--|---------------|-----------------|-------|----|
| V _{CC} | Supply Voltage | -0.5 | 5.6 | V | |
| V _{CNTRL} | DC Input Voltage (S, \overline{OE}) (Note 4) | -0.5 | V _{CC} | V | |
| V _{SW} | DC Switch I/O Voltage (Note 4) (V _{CC} = 0 V) | -0.50 | 5.25 | V | |
| I _{IK} | DC Input Diode Current | -50 | - | mA | |
| I _{OUT} | DC Output Current | - | 100 | mA | |
| T _{STG} | Storage Temperature | -65 | +150 | °C | |
| MSL | Moisture Sensitivity Level (JEDEC J-STD-020A) | - | 1 | Level | |
| ESD | Human Body Model, JEDEC: JESD22-A114 | All Pins | 7 | - | kV |
| | | I/O GND | 8 | - | |
| | | Power to GND | 16 | - | |
| | | D+/D- | 9 | - | |
| | IEC 61000-4-2 System on USB Connector Pins D+ & D- | Air Discharge | 15 | - | |
| | | Contact | 8 | - | |
| | 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.

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

RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Min | Max | Unit |
|--------------------|--|------|-----------------|------|
| V _{CC} | Supply Voltage | 2.4 | 4.4 | V |
| V _{CNTRL} | Control Input Voltage (S, \overline{OE}) (Note 5) | 0 | V _{CC} | V |
| V _{SW} | Switch I/O Voltage | -0.5 | 4.5 | V |
| T _A | Operating Temperature | -40 | +85 | °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.

5. The control input must be held HIGH or LOW and it must not float.

DC ELECTRICAL CHARACTERISTICS

(All typical value are at T_A = 25°C unless otherwise specified.)

| Symbol | Parameter | Condition | V _{CC} (V) | T _A = -40°C to +85°C | | | Unit |
|------------------|---|---|---------------------|---------------------------------|------|------|------|
| | | | | Min | Typ | Max | |
| V _{IK} | Clamp Diode Voltage | I _{IN} = 18 mA | 3.0 | - | - | -1.2 | V |
| V _{IH} | Input Voltage High | | 2.4 to 3.6 | 1.3 | - | - | V |
| | | | 4.3 | 1.7 | - | - | |
| V _{IL} | Input Voltage Low | | 2.4 to 3.6 | - | - | 0.5 | V |
| | | | 4.3 | - | - | 0.7 | |
| I _{IN} | Control Input Leakage | V _{SW} = 0 to V _{CC} | 0 to 4.3 | -1 | - | 1 | μA |
| I _{OZ} | Off State Leakage | 0 ≤ D _n , HSD1n, HSD2n ≤ 3.6 V | 4.3 | -2 | - | 2 | μA |
| I _{OFF} | Power-Off Leakage Current (All I/O Ports) | V _{SW} = 0 V to 4.3 V, V _{CC} = 0 V Figure 5 | 0 | -2 | - | 2 | μA |
| R _{ON} | HS Switch On Resistance (Note 6) | V _{SW} = 0.4 V, I _{ON} = 8 mA Figure 4 | 2.4 | - | 4.5 | 7.5 | Ω |
| | | | 3.0 | - | 3.9 | 6.5 | |
| ΔR _{ON} | HS Delta R _{ON} (Note 7) | V _{SW} = 0.4, I _{ON} = 8 mA | 3.0 | - | 0.65 | - | Ω |
| I _{CC} | Quiescent Supply Current | V _{CNTRL} = 0 or V _{CC} , I _{OUT} = 0 | 4.3 | - | - | 1 | μA |

FSUSB42

DC ELECTRICAL CHARACTERISTICS (continued)

(All typical value are at $T_A = 25^\circ\text{C}$ unless otherwise specified.)

| Symbol | Parameter | Condition | V_{CC} (V) | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ | | | Unit |
|-----------|---|---|--------------|---|-----|-----|---------------|
| | | | | Min | Typ | Max | |
| I_{CCT} | Increase in I_{CC} Current per Control Voltage and V_{CC} | $V_{CNTRL} = 2.6, V_{CC} = 4.3 \text{ V}$ | 4.3 | - | - | 10 | μA |
| | | $V_{CNTRL} = 1.8, V_{CC} = 4.3 \text{ V}$ | 4.3 | - | - | 15 | μA |

6. Measured by the voltage drop between HSDn and Dn pins at the indicated current through the switch. On resistance is determined by the lower of the voltage on the two (HSDn or Dn ports).
 7. Guaranteed by characterization.

AC ELECTRICAL CHARACTERISTICS

(All typical value are for $V_{CC} = 3.3 \text{ V}$ at $T_A = 25^\circ\text{C}$ unless otherwise specified.)

| Symbol | Parameter | Condition | V_{CC} (V) | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ | | | Unit |
|-----------|---|--|--------------|---|------|-----|------|
| | | | | Min | Typ | Max | |
| t_{ON} | Turn-On Time S, \overline{OE} to Output | $R_L = 50 \Omega, C_L = 5 \text{ pF}, V_{SW} = 0.8 \text{ V}$, Figure 6, Figure 7 | 2.4 | - | 24 | 40 | ns |
| | | | 3.0 to 3.6 | - | 13 | 30 | |
| t_{OFF} | Turn-Off Time S, \overline{OE} to Output | $R_L = 50 \Omega, C_L = 5 \text{ pF}, V_{SW} = 0.8 \text{ V}$, Figure 6, Figure 7 | 2.4 | - | 15 | 35 | ns |
| | | | 3.0 to 3.6 | - | 12 | 25 | |
| t_{PD} | Propagation Delay (Note 8) | $C_L = 5 \text{ pF}, R_L = 50 \Omega$, Figure 6, Figure 8 | 3.3 | - | 0.25 | - | ns |
| t_{BBM} | Break-Before-Make | $R_L = 50 \Omega, C_L = 5 \text{ pF}$, $V_{SW1} = V_{SW2} = 0.8 \text{ V}$, Figure 10 | 2.4 | 2.0 | - | 10 | ns |
| | | | 3.0 to 3.6 | 2.0 | - | 6.5 | |
| O_{IRR} | Off Isolation | $R_L = 50 \Omega, f = 240 \text{ MHz}$, Figure 12 | 3.0 to 3.6 | - | -30 | - | dB |
| Xtalk | Non-Adjacent Channel Crosstalk | $R_L = 50 \Omega, f = 240 \text{ MHz}$, Figure 13 | 3.0 to 3.6 | - | -45 | - | dB |
| BW | -3 db Band Width | $R_L = 50 \Omega, C_L = 0 \text{ pF}$, Figure 11 | 3.0 to 3.6 | - | 720 | - | MHz |
| | | $R_L = 50 \Omega, C_L = 5 \text{ pF}$, Figure 11 | | - | 550 | - | |

8. Guaranteed by characterization.

USB HIGH-SPEED-RELATED AC ELECTRICAL CHARACTERISTICS

(All typical value are for $V_{CC} = 3.3 \text{ V}$ at $T_A = 25^\circ\text{C}$ unless otherwise specified.)

| Symbol | Parameter | Condition | V_{CC} (V) | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ | | | Unit |
|-------------|---|--|--------------|---|-----|-----|------|
| | | | | Min | Typ | Max | |
| $t_{SK(P)}$ | Skew of Opposite Transition of the Same Output (Note 9) | $C_L = 5 \text{ pF}, R_L = 50 \Omega$, Figure 9 | - | - | 20 | - | ps |
| t_J | Total Jitter (Note 9) | $R_L = 50 \Omega, C_L = 5 \text{ pF}$, $t_R = t_F = 500 \text{ ps}$ (10-90%) at 480 Mbps (PRBS = $2^{15} - 1$) | - | - | 200 | - | ps |

9. Guaranteed by characterization.

CAPACITANCE

| Symbol | Parameter | Condition | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ | | | Unit |
|-----------|-------------------------------|--|---|-----|-----|------|
| | | | Min | Typ | Max | |
| C_{IN} | Control Pin Input Capacitance | $V_{CC} = 0 \text{ V}$ | - | 1.5 | - | pF |
| C_{ON} | D+/D- On Capacitance | $V_{CC} = 3.3 \text{ V}, \overline{OE} = 0 \text{ V}, f = 240 \text{ MHz}$, Figure 15 | - | 3.7 | - | pF |
| C_{OFF} | D1n, D2n Off Capacitance | V_{CC} and $\overline{OE} = 3.3 \text{ V}$, Figure 14 | - | 2.0 | - | pF |

Test Diagrams

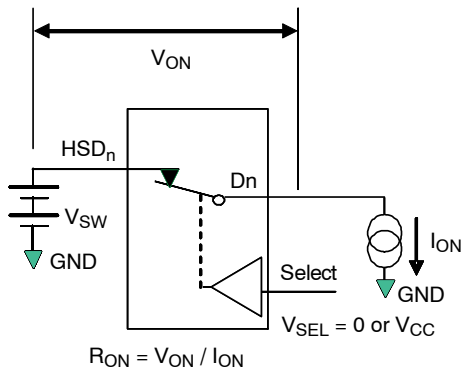
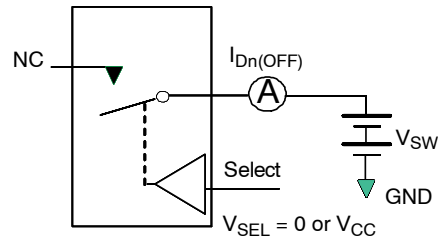
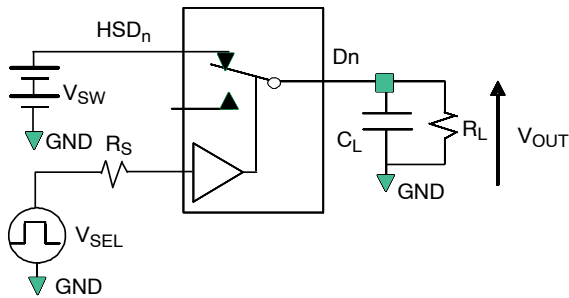


Figure 4. On Resistance



**Each switch port is tested separately

Figure 5. 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 6. AC Test Circuit Load

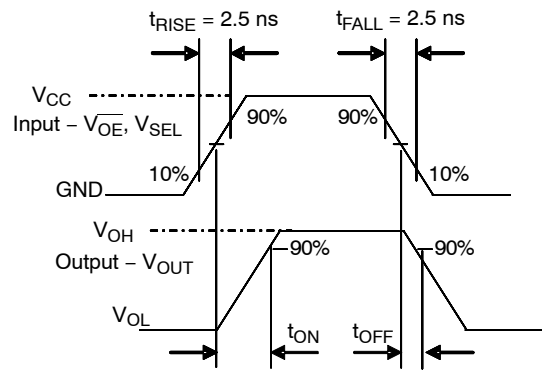


Figure 7. Turn-On / Turn-Off Waveforms

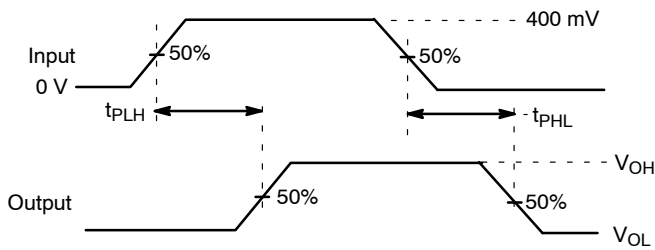


Figure 8. Propagation Delay ($t_{PTF} - 500$ ps)

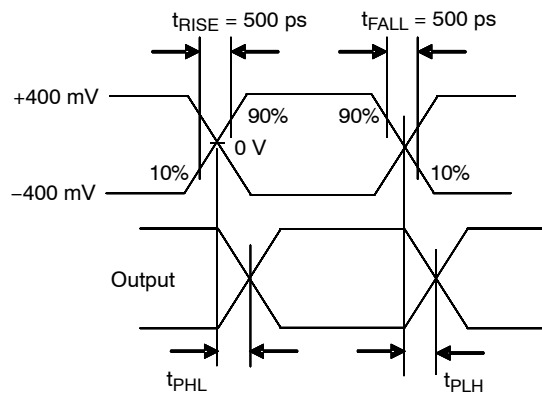


Figure 9. Intra-Pair Skew Test $t_{SK(P)}$

Test Diagrams (continued)

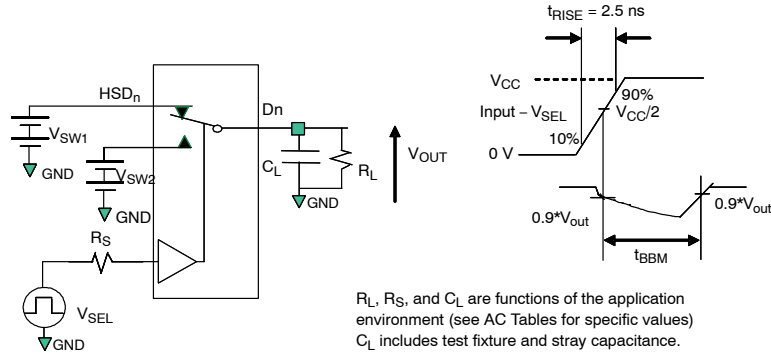


Figure 10. Break-Before-Make Interval Timing

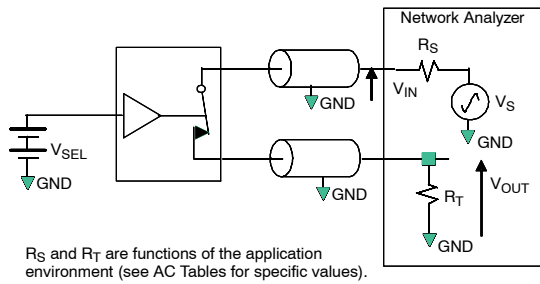


Figure 11. Bandwidth

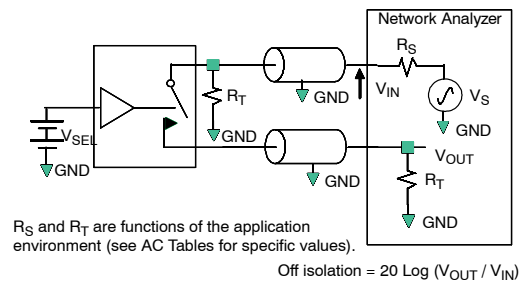


Figure 12. Channel Off Isolation

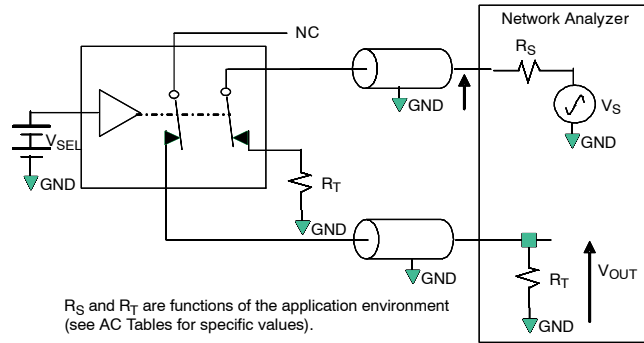


Figure 13. Non-Adjacent Channel-to-Channel Crosstalk

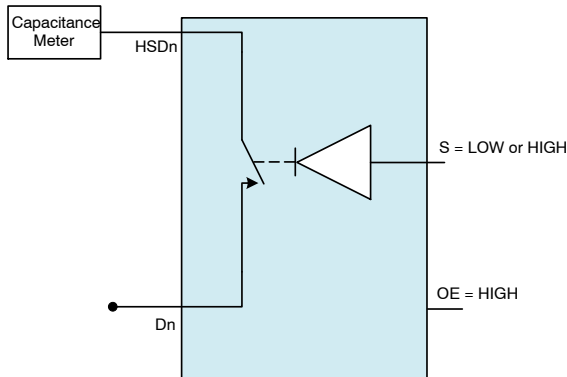


Figure 14. Channel Off Capacitance

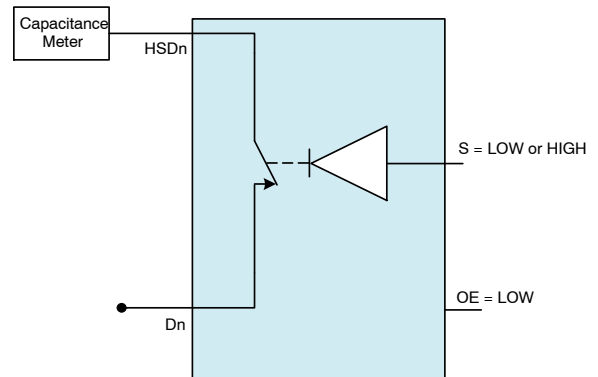


Figure 15. Channel On Capacitance

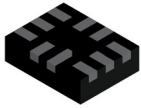
FSUSB42

ORDERING INFORMATION

| Part Number | Device Code | Operating Temperature Range | Package | Shipping† |
|-------------|-------------|-----------------------------|---|----------------------|
| FSUSB42UMX | HE | -40 to 85°C | 10-Lead, Quad, Ultrathin Molded Leadless Package (UQFN10), 1.4 × 1.8 mm | 5000 / Tape and Reel |
| FSUSB42MUX | FSUSB42 | -40 to 85°C | 10-Lead, Molded Small-Outline Package (MSOP) JEDEC MO-187, 3.0 mm Wide | 4000 / Tape and Reel |

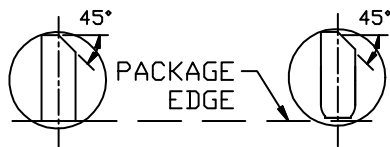
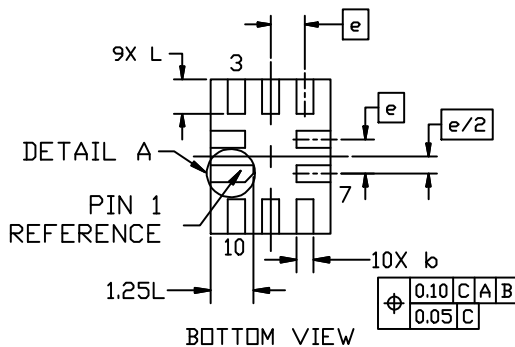
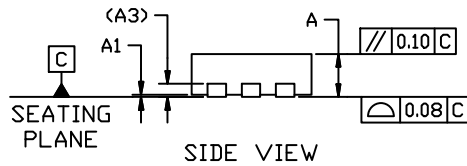
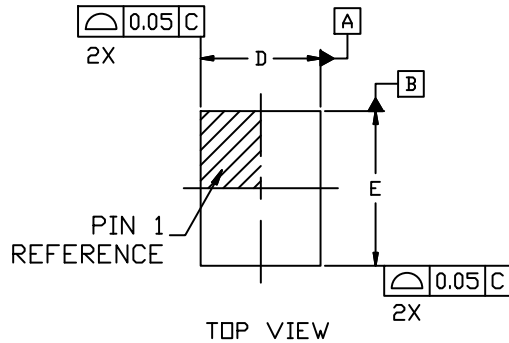
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



UQFN10 1.4x1.8, 0.4P
CASE 523BC
ISSUE B

DATE 13 MAY 2022

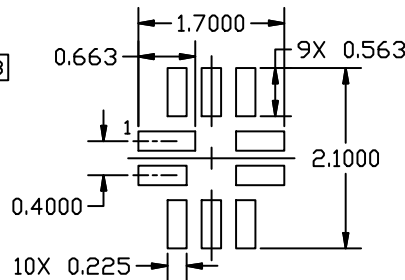


DETAIL A
OPTIONAL CONSTRUCTIONS

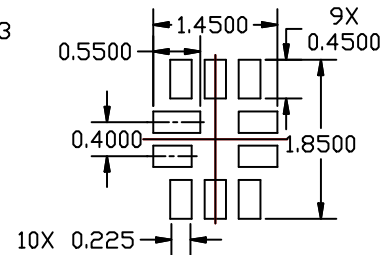
NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5, 2018
2. ALL DIMENSIONS ARE IN MILLIMETERS
3. DIMENSION *b* APPLIES TO PLATED TERMINALS AND IS MEASURED BETWEEN 0.15mm AND 0.30mm FROM THE TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS

| DIM | MILLIMETERS | | |
|----------|-------------|-------|------|
| | MIN. | NOM. | MAX. |
| A | 0.45 | 0.50 | 0.55 |
| A1 | 0.00 | 0.025 | 0.05 |
| A3 | 0.152 REF | | |
| <i>b</i> | 0.15 | 0.20 | 0.25 |
| D | 1.35 | 1.40 | 1.45 |
| E | 1.75 | 1.80 | 1.85 |
| <i>e</i> | 0.40 BSC | | |
| L | 0.35 | 0.40 | 0.45 |



**RECOMMENDED
LAND PATTERN**



**OPTIONAL MINIMAL
TOE LAND PATTERN**

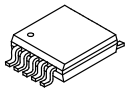
RECOMMENDED MOUNTING FOOTPRINT

For additional information on our Pb-Free strategy and soldering details, please download the onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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| DESCRIPTION: | UQFN10 1.4x1.8, 0.4P | PAGE 1 OF 1 |

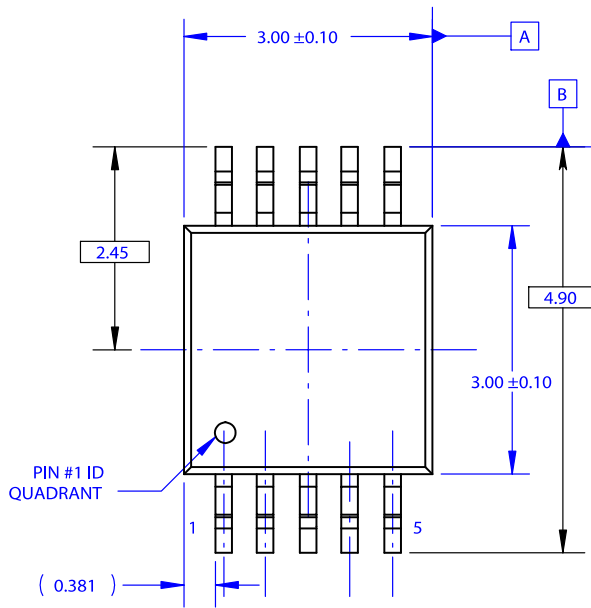
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MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

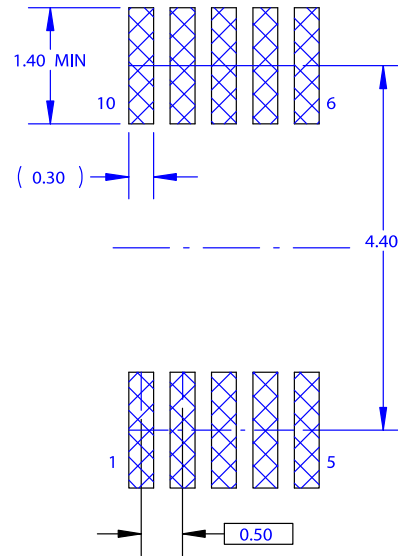


MSOP10
CASE 846AP
ISSUE O

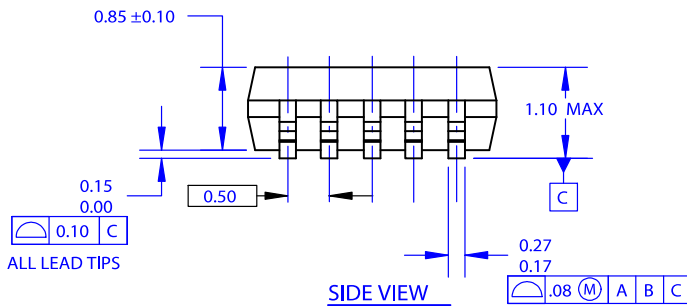
DATE 31 JAN 2017



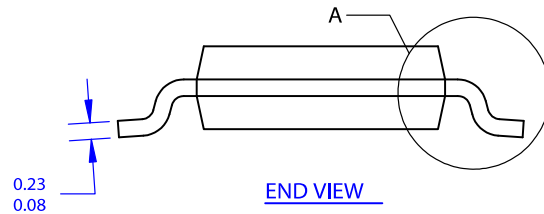
TOP VIEW



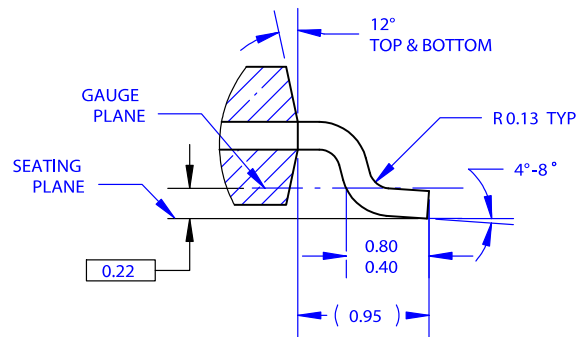
LAND PATTERN RECOMMENDATION



SIDE VIEW



END VIEW



DETAIL A
SCALE 20 : 1

NOTES: UNLESS OTHERWISE SPECIFIED

- A. THIS PACKAGE CONFORMS TO JEDEC MO-187 VARIATION BA.
- B. ALL DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR EXTRUSIONS.
- D. DIMENSIONS AND TOLERANCES AS PER ASME Y14.5-1994.
- E. LAND PATTERN AS PER IPC7351#SOP50P490X110-10AN

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