

4:1 High-Speed USB Multiplexer/Switch

FSUSB74

Description

The FSUSB74 is a Bi-directional, Low-Power, High-Speed USB 2.0 4:1 MUX. It is Optimized for Switching from four High-Speed (480Mbps) sources or any combination of High-Speed and full-/low-speed USB/UART sources to one USB 2.0 connector.

Applications

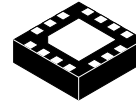
- MP3 Portable Media Players
- Cellular Phones, Smart Phones
- Netbooks, Mobile Internet Devices (MID)

Related Resources

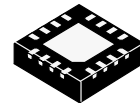
- FSUSB74 Demonstration Board
- FSUSB74 Evaluation Board

Features

| Switch Type | 4:1 |
|----------------------|---|
| USB | USB 2.0 High-Speed Compliant USB 2.0 Full-Speed Compliant |
| R _{ON} | 6.5 Ω |
| C _{ON} | 7.5 pF |
| ESD (IEC61000-4-2) | 15 kV (Air) 8 kV (Contact) |
| V _{CC} | 2.7 to 4.4 V |
| I _{CCSLP} | <1 μA |
| I _{CCACT} | 9 μA |
| Package | 16-Lead UMLP 1.80 x 2.60 x 0.55mm, 0.40mm Pitch 16-Lead MLP 3 x 3 x 0.7mm, 0.5mm Pitch |
| Ordering Information | FSUSB74UMX (UMLP) FSUSB74MPX (MLP) |

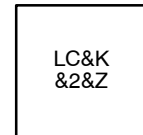
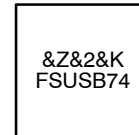


WQFN 16 3X3, 0.5P
CASE 510BS



UQFN 16 1.8X2.6, 0.6P
CASE 523BF

MARKING DIAGRAM



LC,FSUSB74 = Device Code
 &Z = Assembly Plant Code
 &2 = 2-Digit Date Code
 &K = 2-Digits Lot Run Lot Traceability Code
 FSUSB74 = Specific Device Code

ORDERING INFORMATION

| Device | Package | Shipping [†] |
|------------|----------------------|-----------------------|
| FSUSB74MPX | WQFN-16 (Pb-Free) | 3000 / Tape & Reel |
| FSUSB74UMX | UQFN-16 (Pb-Free) | 3000 / Tape & Reel |

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

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TYPICAL APPLICATION

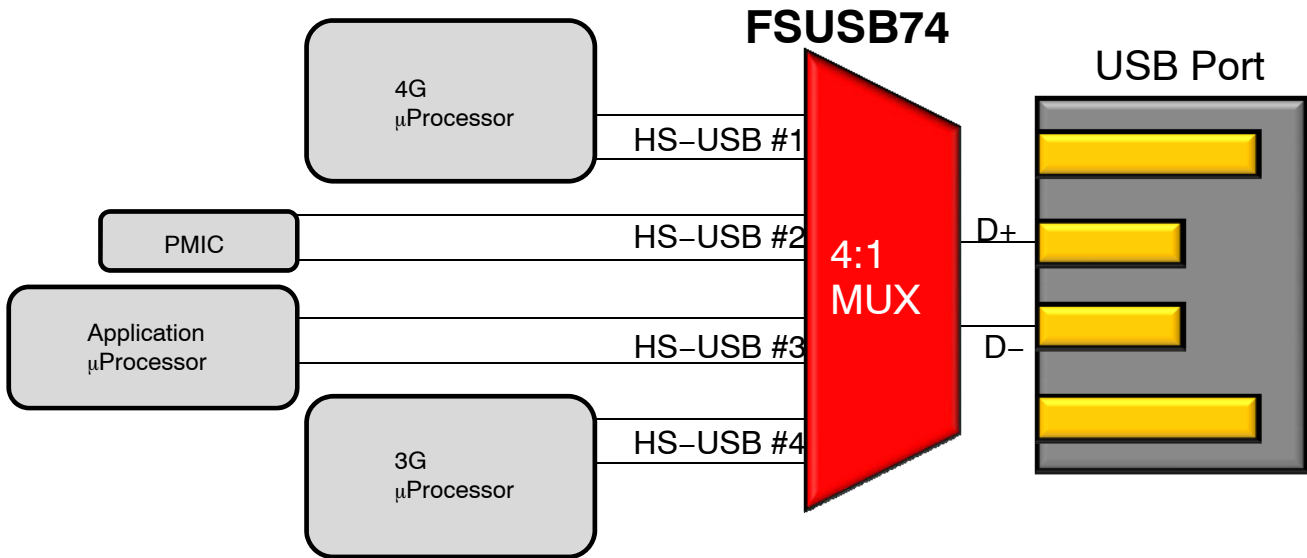


Figure 1. Mobile Phone Example

PIN CONFIGURATIONS

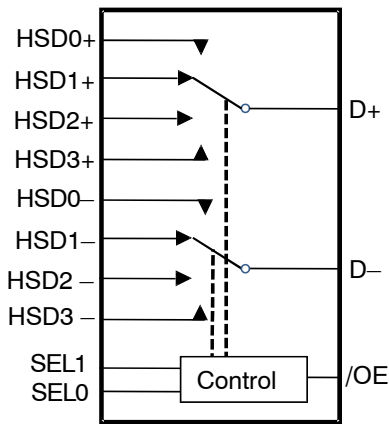


Figure 2. UMLP Analog Symbol

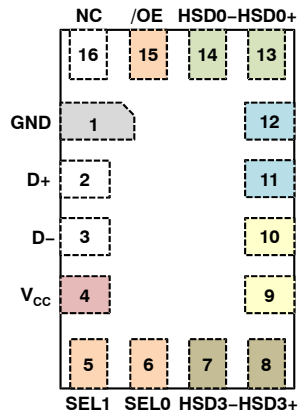


Figure 3. UMLP (Top View)

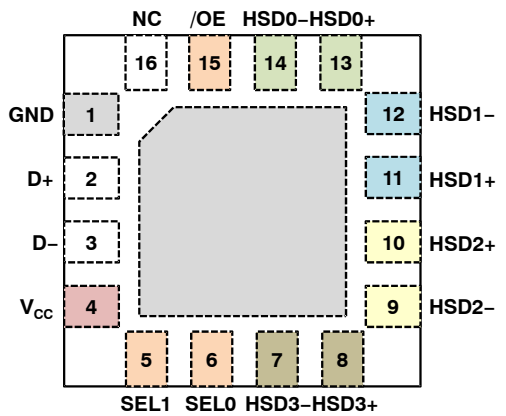


Figure 4. MLP (Top View)

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PIN DESCRIPTIONS

| Pin No. | Name | Type | Description |
|---------|-----------------|--------------|--|
| 1 | GND | Ground | Ground |
| 2 | D+ | I/O | D+ common port (HS or FS USB) |
| 3 | D- | I/O | D- common port (HS or FS USB) |
| 4 | V _{CC} | Power Supply | Supply Voltage |
| 5 | SEL1 | Input | Path Selection Control Input (see truth table below) |
| 6 | SEL0 | Input | Path Selection Control Input (see truth table below) |
| 7 | HSD3- | I/O | D- from fourth source path (HS or FS USB) |
| 8 | HSD3+ | I/O | D+ from fourth source path (HS or FS USB) |
| 9 | HSD2- | I/O | D- from third source path (HS or FS USB) |
| 10 | HSD2+ | I/O | D+ from third source path (HS or FS USB) |
| 11 | HSD1+ | I/O | D+ from second source path (HS or FS USB) |
| 12 | HSD1- | I/O | D- from second source path (HS or FS USB) |
| 13 | HSD0+ | I/O | D+ from first source path (HS or FS USB) |
| 14 | HSD0- | I/O | D- from first source path (HS or FS USB) |
| 15 | /OE | Input | D- from first source path (HS or FS USB) |
| 16 | NC | - | No Connect |

TRUTH TABLE

| /OE | SEL1 | SEL0 | Function |
|-----|------|------|--------------------------|
| 1 | X | X | D+, D- Switch Paths Open |
| 0 | 0 | 0 | D+ = HSD0 +, D- = HSD0- |
| 0 | 0 | 1 | D+ = HSD1+, D- = HSD1- |
| 0 | 1 | 0 | D+ = HSD2+, D- = HSD2- |
| 0 | 1 | 1 | D+ = HSD3+, D- = HSD3- |

ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | | Min. | Max. | Unit |
|--------------------|---|----------------|-------|-----------------|-------|
| V _{CC} | Supply Voltage | | −0.5 | 5.25 | V |
| V _{CNTRL} | DC Input Voltage (SEL1, SEL0, /OE, SELS) ⁽¹⁾ | | −0.50 | V _{CC} | V |
| V _{SW} | DC Switch I/O Voltage ⁽¹⁾ | | −0.50 | 5.25 | V |
| I _{IK} | DC Input Diode Current | | −50 | − | mA |
| T _{STG} | Storage Temperature | | −65 | +150 | °C |
| MSL | Moisture Sensitivity Level (JEDEC J−STD−020A) | | − | 1 | Level |
| ESD | IEC61000−4−2 System on USB connector pins D+ & D− | Air Gap | 15 | − | kV |
| | | Contact | 8 | − | |
| | Human Body Model, JEDEC: JESD22−A114 | D+,D− to GND | 6 | − | |
| | | Power to GND | 12 | − | |
| | | All Other Pins | 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.

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RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Min. | Max. | Unit |
|----------------------|---|------|----------|------|
| V_{CC} | Supply Voltage | 2.5 | 4.4 | V |
| V_{CNTRL} (Note 2) | Control Input Voltage (SEL1, SEL0, /OE, and SELS) | 0 | V_{CC} | V |
| V_{SW} | Switch I/O Voltage | -0.5 | 4.4 | 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.

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

DC ELECTRICAL CHARACTERISTICS (All typical values are for $V_{CC} = 3.3$ V at 25°C unless otherwise specified.)

| Symbol | Parameter | Test Conditions | V_{CC} (V) | $T_A = -40^{\circ}\text{C to } 85^{\circ}\text{C}$ | | | Unit |
|--------------------------|---|---|--------------|--|------|------|---------------|
| | | | | Min. | Typ. | Max. | |
| R_{ON} (Note 3) | HS Switch On Resistance | $V_{SW} = 0.4$ V, $I_{ON} = -8$ mA, Figure 5 | 3.3 | | 6.5 | 9.0 | Ω |
| ΔR_{ON} (Note 3) | HS Delta Ron (Note 4) | $V_{SW} = 0.4$ V, $I_{ON} = -8$ mA | 3.3 | | 0.5 | 0.5 | Ω |
| I_{IN} | Control Input Leakage | All Combinations of /OE, SEL1 & SEL0 in the Truth Table ($1 = V_{CC}$, $0 = 0$ V) | 4.4 | -1 | - | - | μA |
| I_{OZ} | Off State Leakage | $0 \leq D_n$, HSD0n, HSD1n, HSD2n, HSD3n ≤ 4.4 V | 4.4 | -1 | - | - | μA |
| I_{OFF} | Power-Off Leakage Current (All I/O Ports) | $V_{SW} = 0$ V to 4.4 V, $V_{CC} = 0$ V, Figure 6 | 0 | -1 | - | - | μA |
| I_{CCSLP} | Sleep Mode Supply Current | /OE = V_{CC} | 4.4 | - | - | - | μA |
| I_{CCACT} | Active Mode Supply Current | All Active Modes in Truth Table | 4.4 | - | 9 | 18 | μA |
| I_{CCT} | Increase in I_{CC} Current per Control Input and V_{CC} | $V_{CNTRL} = 1.8$ V | 4.4 | - | 3.3 | 4.0 | μA |
| | | $V_{CNTRL} = 1.2$ V | 4.4 | - | 4.9 | 6.0 | μA |
| V_{IK} | Clamp Diode Voltage | $I_{IN} = -18$ mA | 2.5 | - | - | -1.2 | V |
| V_{IH} | Control Input Voltage High | SEL1, SEL0, /OE | 2.5 to 4.4 | 1.0 | - | - | V |
| V_{IL} | Control Input Voltage Low | SEL1, SEL0, /OE | 2.5 to 4.4 | - | - | 0.35 | V |

3. 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).

4. Guaranteed by characterization.

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

| Symbol | Parameter | Test Conditions | V_{CC} (V) | $T_A = -40^{\circ}\text{C to } 85^{\circ}\text{C}$ | | | Unit |
|-------------|--|--|--------------|--|------|------|---------------|
| | | | | Min. | Typ. | Max. | |
| t_{ON} | Turn-On Time when Switching from One USB Path (or Disabled i.e. /OE=1) to Another USB Path | $R_L = 50$ Ω , $C_L = 35$ pF, $V_{SW} = 0.8$ V, Figure 7, Figure 8 | 2.5 to 4.4 | 126 | - | 400 | μs |
| t_{OFF} | Turn-Off Time, Turning Off Any of the USB Paths | $R_L = 50$ Ω , $C_L = 35$ pF, $V_{SW} = 0.8$ V, Figure 7, Figure 8 | 2.5 to 4.4 | - | - | 80 | ns |
| t_{PD} | Propagation Delay (Note 5) | $C_L = 5$ pF, $R_L = 50$ Ω , Figure 7, Figure 9 | 3.3 | - | 0.25 | - | ns |
| t_{RF} | Slow Turn-On/Off Switch Paths (Note 5) | $C_L = 5$ pF, Dn at 0 V or 3.6 V, 40.5 Ω in series with switch 10% to 90% | 3.3 | - | 4.5 | - | ns |
| t_{BBM} | Break-Before-Make Time (Note 5) | $R_L = 50$ Ω , $C_L = 35$ pF, $V_{SW1} = V_{SW2} = 0.8$ V, Figure 11 | 2.5 to 4.4 | 126 | - | 400 | μs |
| O_{IRR} | Off Isolation (Note 5) | $R_L = 50$ Ω , $f = 240$ MHz, Figure 13 | 2.5 to 4.4 | - | -40 | - | dB |
| X_{talk} | Channel-to-Channel Crosstalk (Note 5) | $R_L = 50$ Ω , $f = 240$ MHz, Figure 14 | 2.5 to 4.4 | - | -40 | - | dB |
| $t_{SK(P)}$ | Pulse Skew (Note 5) | $V_{SW} = 0.2$ V diff _{PP} , Figure 10, $C_L = 5$ pF | 2.5 to 4.4 | - | 25 | - | ps |
| $t_{SK(I)}$ | Skew Between Differential Signals Within a Pair (Note 5) | $V_{SW} = 0.2$ V diff _{PP} , Figure 10, $C_L = 5$ pF | 2.5 to 4.4 | - | 25 | - | ps |

5. Guaranteed by characterization.

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

| Symbol | Parameter | Test Conditions | V_{CC} (V) | Typical | Unit |
|-----------|--|---|--------------|---------|------|
| C_{IN} | Input Capacitance (Note 6) | | 0 | 3 | pF |
| C_{ON} | D+/D- On Capacitance (Note 6) | Any Switch Path Enabled, $f = 1\text{MHz}$, Figure 16 | 3.3 | 7.5 | |
| C_{OFF} | HSD0n, HSD1n, HSD2n, HSD3n Off Capacitance (Note 6) | If $V_{CC} = 3.3\text{ V}$, then $/OE = 3.3\text{ V}$; $f = 1\text{MHz}$, Figure 15 | 0 or 3.3 | 2.2 | |

6. Guaranteed by characterization.

TEST DIAGRAMS

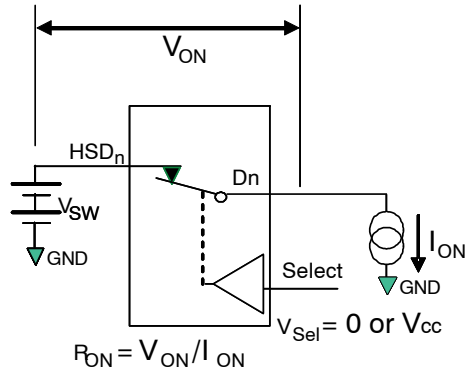
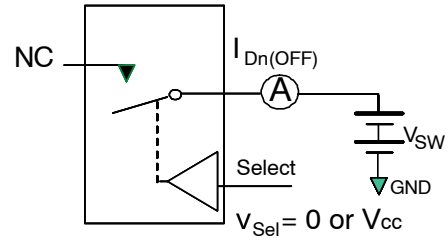


Figure 5. On Resistance



**Each switch port is tested separately

Figure 6. Off Leakage

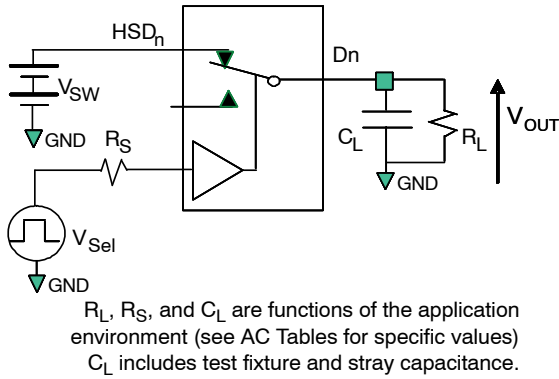


Figure 7. AC Test Circuit Load

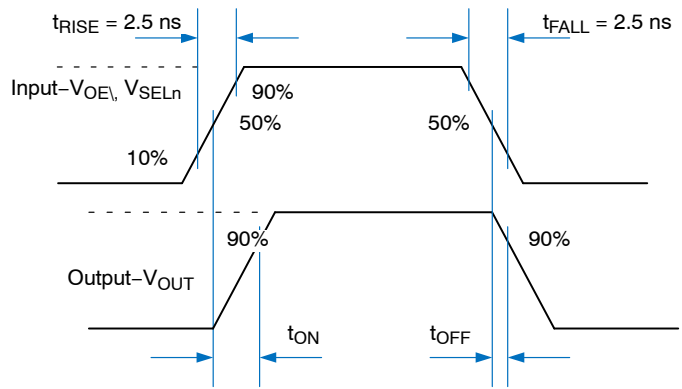


Figure 8. Turn-On / Turn-Off Waveforms

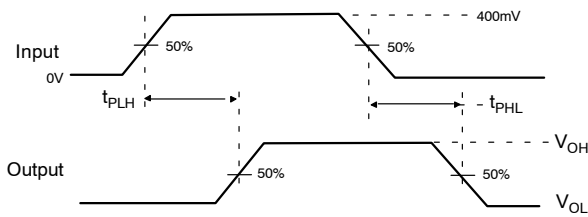


Figure 9. Propagation Delay ($t_R t_F = 500 \text{ ps}$)

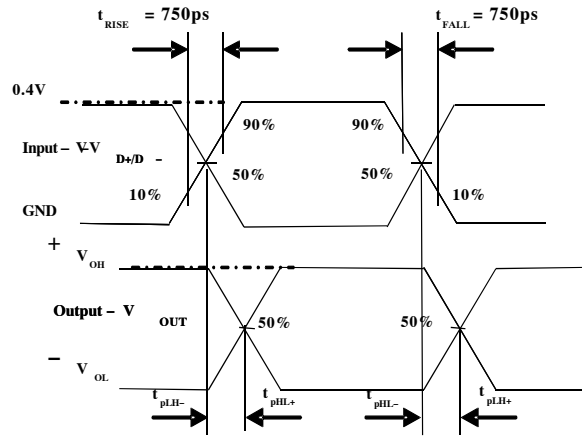


Figure 10. Skew Test Waveforms

$$t_{SK(P)} = |t_{PLH-} - t_{PHL-}| \text{ or } |t_{PLH+} - t_{PHL+}|$$

$$t_{SK(I)} = |t_{PLH-} - t_{PHL+}| \text{ or } |t_{PLH+} - t_{PHL-}|$$

TEST DIAGRAMS

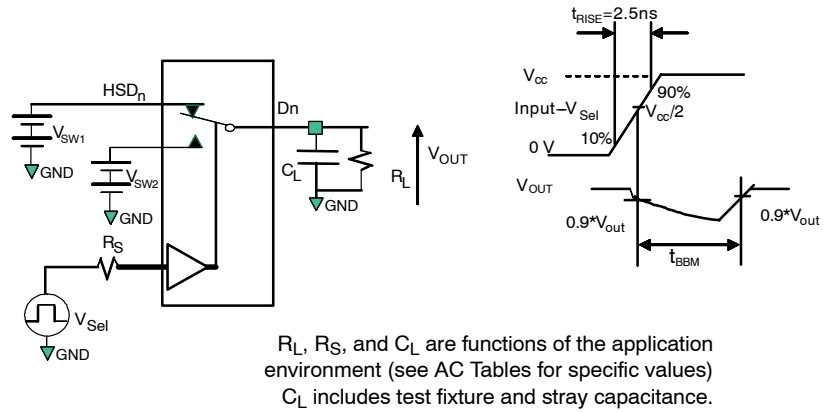


Figure 11. Break-Before-Make Interval Timing

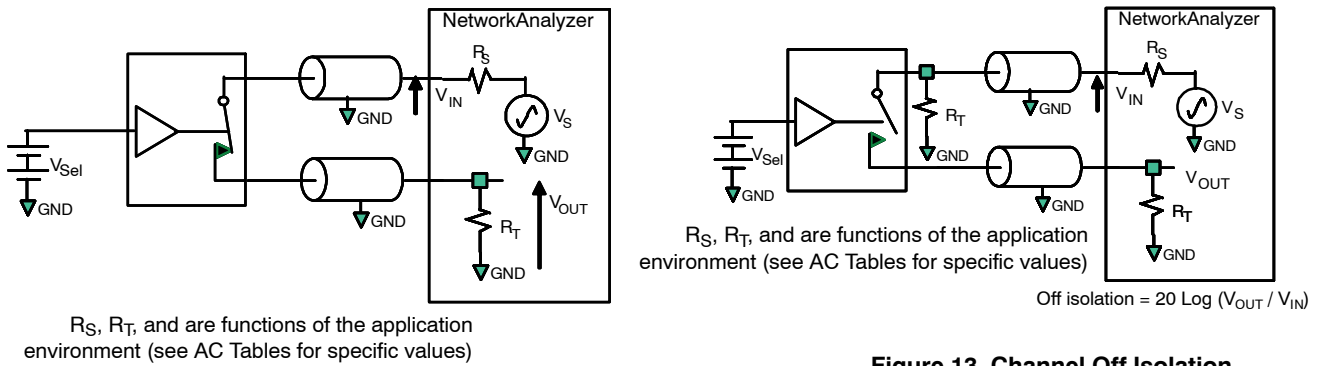


Figure 12. Bandwidth

Figure 13. Channel Off Isolation

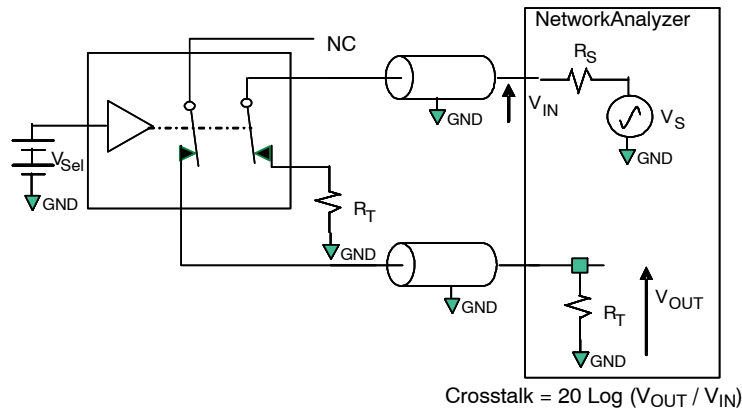


Figure 14. Non-Adjacent Channel-to-Channel Crosstalk

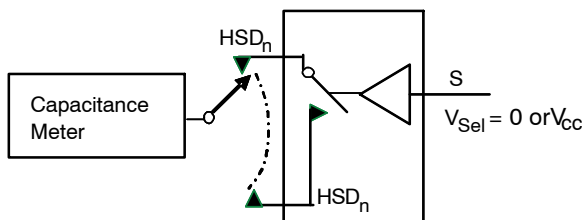


Figure 15. Channel Off Capacitance

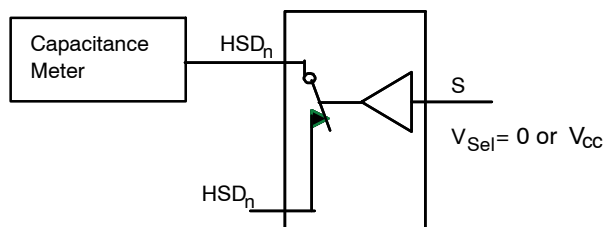
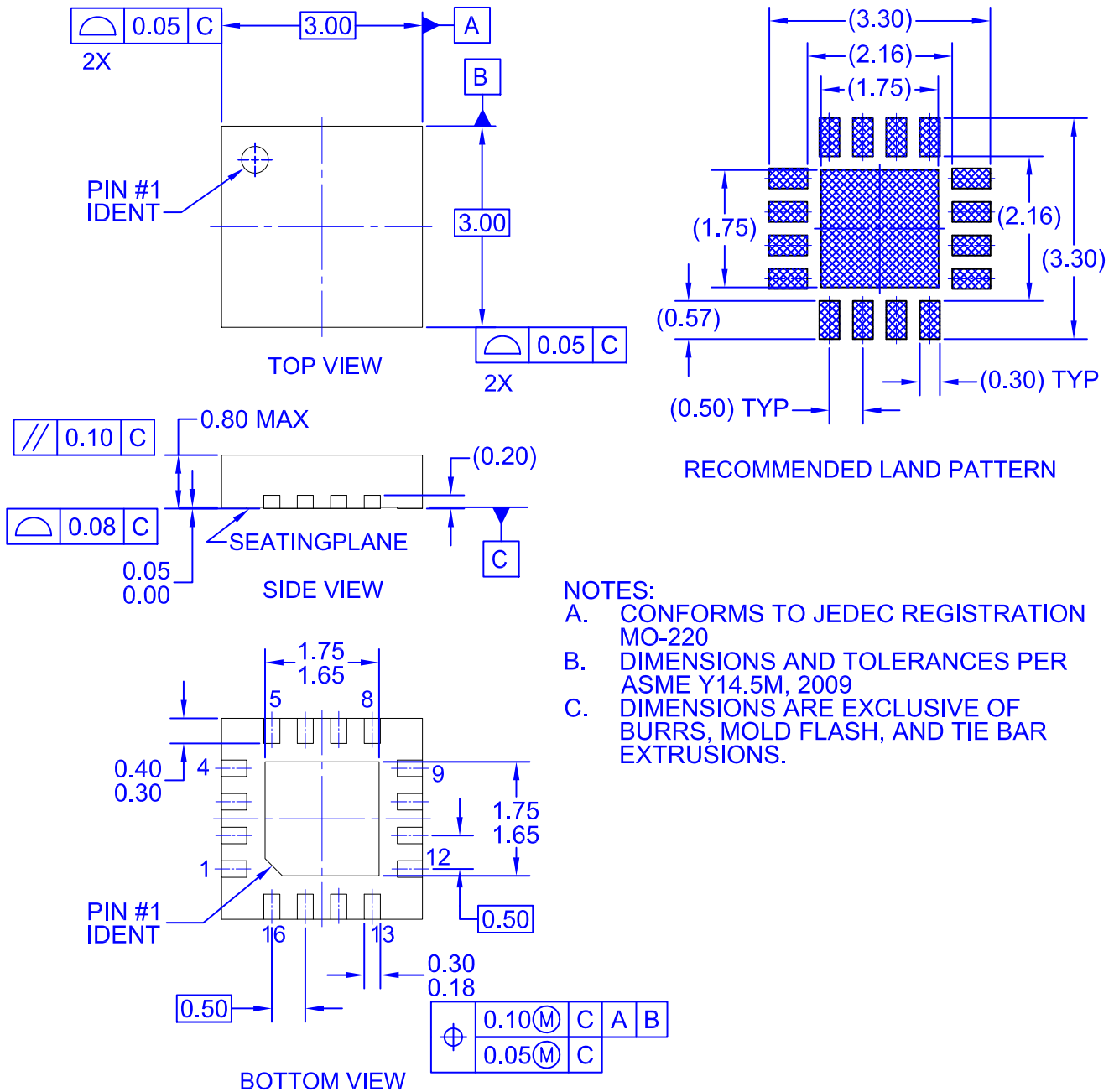


Figure 16. Channel On Capacitance

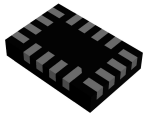
WQFN16 3x3, 0.5P
CASE 510BS
ISSUE O

DATE 31 AUG 2016

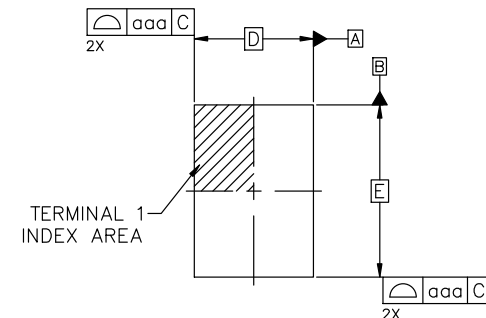


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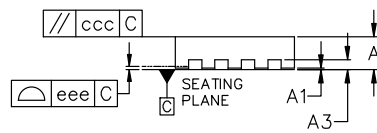
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UQFN16 1.80x2.60x0.50, 0.40P
CASE 523BF
ISSUE A

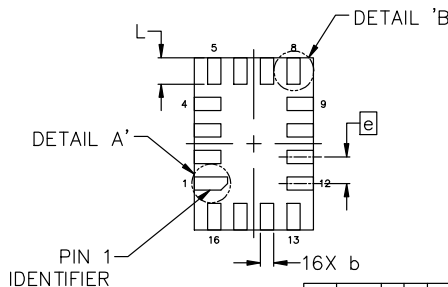
DATE 06 MAY 2024



TOP VIEW



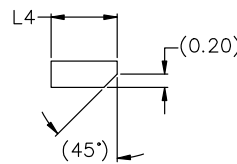
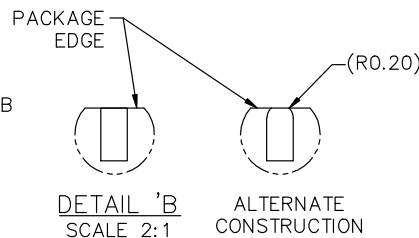
SIDE VIEW



BOTTOM VIEW

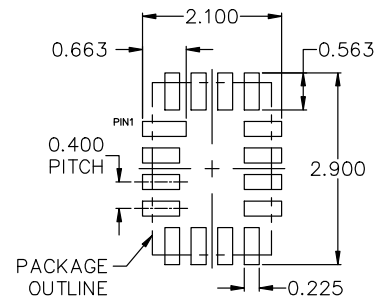
NOTES:

1. DIMENSIONING AND TOLERANCING CONFORM TO ASME Y14.5M-2018.
2. ALL DIMENSIONS ARE IN MILLIMETERS, DEGREES IN ANGLE.
3. LAND PATTERN RECOMMENDATION IS EXISTING INDUSTRY LAND PATTERN.
4. TERMINAL SHAPE MAY VARY ACCORDING TO PACKAGE SUPPLIER, SEE TERMINAL SHAPE VARIANTS.


DETAIL 'A'
SCALE 2:1

DETAIL 'B'
SCALE 2:1

ALTERNATE
CONSTRUCTION

| DIM | MILLIMETERS | | |
|--------------------------------------|-------------|------|------|
| | MIN | NOM | MAX |
| A | 0.45 | 0.50 | 0.55 |
| A1 | 0.00 | --- | 0.05 |
| A3 | 0.10 | 0.15 | 0.20 |
| b | 0.15 | 0.20 | 0.25 |
| D | 1.80 BSC | | |
| E | 2.60 BSC | | |
| e | 0.40 BSC | | |
| L | 0.35 | 0.40 | 0.45 |
| L4 | 0.45 | 0.50 | 0.55 |
| TOLERANCES FOR FEATURE CONTROL FRAME | | | |
| aaa | 0.05 | | |
| bbb | 0.10 | | |
| ccc | 0.10 | | |
| ddd | 0.05 | | |
| eee | 0.05 | | |



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