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# FSSD06 — SD/SDIO and MMC Two-Port Multiplexer

## Features

- On Resistance Typically 4Ω,  $V_{DDH}=2.7V$
- $f_{toggle} > 120MHz$
- Low On Capacitance: 9pF Typical
- Low Power Consumption: 1μA Maximum
- Conforms to Secure Digital (SD), Secure Digital I/O (SDIO), and Multimedia Card (MMC) Specifications
- Supports 1-Bit / 4-Bit Host Controllers ( $V_{DDH}=1.65V$  to 3.6V) Communicating with High-Voltage (2.7-3.6V) and Dual-Voltage Cards (1.65-1.95V, 2.7-3.6V)
  - $V_{DDH}=1.65$  to 3.6V,  $V_{DDC1/C2}=V_{DDH}$  to 3.6V
- 24-Lead MLP (3.5 x 4.5mm) and UMLP Packages

## Description

The FSSD06 is a two-port multiplexer that allows Secure Digital (SD), Secure Digital I/O (SDIO), and Multimedia Card (MMC) host controllers to be expanded out to multiple cards or peripherals. This configuration enables the CMD, CLK, and D[3:0] signals to be multiplexed to dual-card peripherals. It is optimized for 1-bit / 4-bit SD / MMC applications.

The architecture includes the necessary bi-directional data and command transfer capability for single high-voltage cards or dual-voltage supply cards. The clock path for the FSSD06 is a uni-directional buffer with an integrated pull-up for high-impedance mode.

Typical applications involve switching in portables and consumer applications: cell phones, digital cameras, home theater monitors, portable GPS units, and printers.

## Applications

- Cell Phone, PDA, Digital Camera, Portable GPS
- LCD Monitor, Home Theater PC/TV, All-in-One Printer

## Analog Symbol Diagram

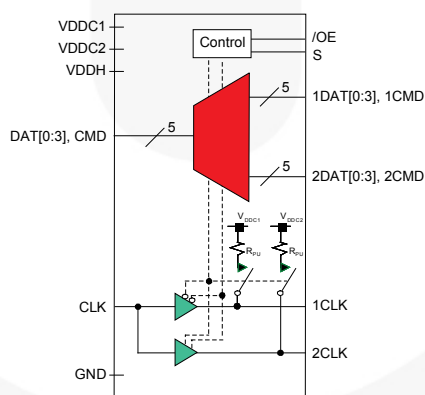


Figure 1. Analog Symbol Diagram

## Ordering Information

| Part Number | Operating Temperature Range | Package Description                                              | Packing Method |
|-------------|-----------------------------|------------------------------------------------------------------|----------------|
| FSSD06BQX   | -40°C to +85°C              | 24-Lead Molded Leadless Package (MLP), JEDEC MO-220, 3.5 x 4.5mm | Tape & Reel    |
| FSSD06UMX   | -40°C to +85°C              | 24-Lead Ultrathin Molded Leadless Package (UMLP)                 | Tape & Reel    |

## Pin Configuration

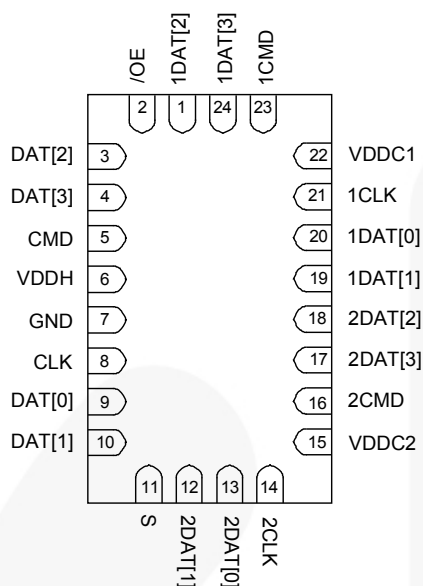


Figure 2. MLP Pin Assignments

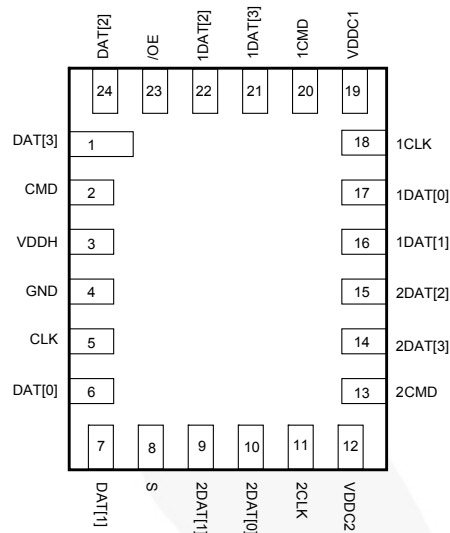


Figure 3. UMLP Pin Assignments

## Pin Definitions

| Name                             | Description                               |
|----------------------------------|-------------------------------------------|
| VDDH                             | Power Supply (Host ASIC)                  |
| VDDC1, VDDC2                     | Power Supply (SDIO Peripheral Card Ports) |
| /OE                              | Output Enable (Active Low)                |
| S                                | Select Pin                                |
| 1DAT[3:0], 2DAT[3:0], 1CMD, 2CMD | SDIO Card Ports                           |
| DAT[3:0], CMD                    | SDIO Common Ports                         |
| CLK, 1CLK, 2CLK                  | Clock Path Ports                          |

## Truth Table

| /OE  | S    | Function                                                                                    |
|------|------|---------------------------------------------------------------------------------------------|
| LOW  | LOW  | CMD, CLK, DAT[3:0] connected to 1CMD, 1CLK, 1DAT[3:0]; 2CLK pulled HIGH via R <sub>PU</sub> |
| LOW  | HIGH | CMD, CLK, DAT[3:0] connected to 2CMD, 2CLK, 2DAT[3:0]; 1CLK pulled HIGH via R <sub>PU</sub> |
| HIGH | X    | All Ports High Impedance; 1CLK, 2CLK pulled HIGH via R <sub>PU</sub>                        |

## Typical Application Diagram

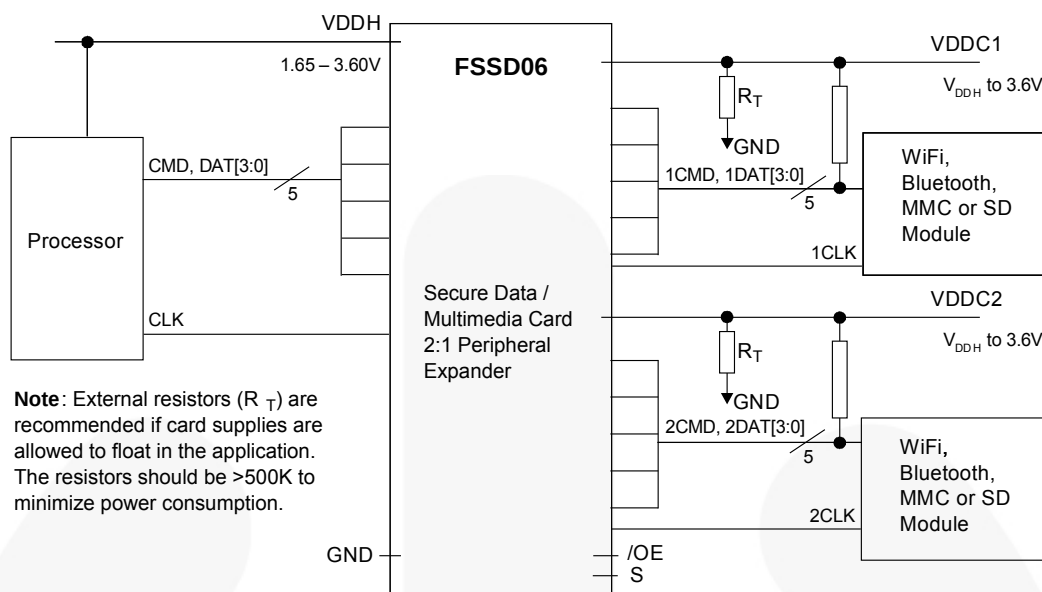


Figure 4. Typical Application Diagram

## Functional Description

The FSSD06 enables sharing the ASIC/baseband processor SDIO port(s) to two peripheral cards, providing bi-directional support for dual-voltage SD/SDIO or MMC cards available in the marketplace. Each SDIO port of the FSSD06 has its own supply rail, allowing peripheral cards with different supplies to be interfaced to the host. The peripheral card supplies must be equal or greater than the host to minimize power consumption. The independent  $V_{DDH}$ ,  $V_{DDC1}$ , and  $V_{DDC2}$  are defined by the supplies connected from the application Power Management ICs (PMICs) to the FSSD06. The clock path is a uni-directional buffered path rather than a bi-directional switch port.

### CMD, DAT Bus Pull-ups

The 1CMD, 2CMD, 1DAT[3:0], and 2DAT[3:0] ports do not have, internally, the system pull-up resistors as defined in the MMC or SD card system bus specifications. The system bus pull-up must be added external to the FSSD06. The value, within the specific specification limits, is a function of the individual application and type of card or peripheral connected. For SD card applications, the  $R_{CMD}$  and  $R_{DAT}$  pull-ups should be between  $10k\Omega$  and  $100k\Omega$ . For MMC applications, the  $R_{CMD}$  pull-ups should be between  $4.7k\Omega$  and  $100k\Omega$  and the  $R_{DAT}$  pull-ups between  $50k\Omega$  and  $100k\Omega$ . The card-side 1CMD, 2CMD, 1DAT[3:0], and 2DAT[3:0] outputs have a circuit that facilitates incident wave switching, so the external pull-up resistors ensure retention of the output high level.

The /OE pin can be used to place the 1CMD, 2CMD, 1DAT[3:0] and 2DAT[3:0] into high-impedance mode when the system enters IDLE state (see *IDLE State CMD/DAT Bus "Parking"*).

### CLK Bus

The 1CLK and 2CLK outputs are bi-state buffer architectures, rather than a switch I/O, to ensure 52MHz incident wave switching. When there is no communication on the bus (IDLE), the FSSD06 can be disabled with the /OE pin. When this pin is pulled HIGH, the nCLK outputs are also pulled HIGH. Along with nCMD, nDAT[3:0] goes high-impedance to ensure that the CLK path between the FSSD06 and the peripheral does not float.

### IDLE State CMD/DAT Bus "Parking"

The SD and MMC card specifications were written for a direct point-to-point communication between host controller and card. The introduction of the FSSD06 in that path, as an expander, requires that the functional operation and system latency not be impacted by the FSSD06 switch characteristics. Since there are various card formats, protocols, and configurable controllers, a /OE pin is available to facilitate a fast IDLE transition for the nCMD/nDAT[3:0] outputs. Some controllers, rather than simply placing CMD/DAT into high-impedance mode, may pull their outputs HIGH for a clock cycle prior to going into high-impedance mode (referred to as "parking" the output). Some legacy controllers pull their outputs HIGH versus high impedance.

If the /OE pin is left LOW and the controller places the CMD/DAT[3:0] outputs into high impedance, the nCMD/nDAT[3:0] output rise time is a function of the RC time constant through the switch path. It is recommended that the host controller pull CMD and DAT[3:0] HIGH for one cycle before pulling /OE HIGH. This facilitates parking all nCMD/nDAT[3:0] outputs HIGH before putting the switch I/Os in high impedance.

## Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

| Symbol               | Parameter                                 | Conditions                                   | Min. | Max.                                     | Unit |
|----------------------|-------------------------------------------|----------------------------------------------|------|------------------------------------------|------|
| $V_{DDH}$            | Supply Voltage                            |                                              | -0.5 | 4.6                                      | V    |
| $V_{DDC1}, V_{DDC2}$ | Supply Voltage                            |                                              | -0.5 | 4.6                                      | V    |
| $V_{SW}^{(1)}$       | Switch I/O Voltage                        | 1DAT[3:0], 2DAT[3:0], 1CMD, 2CMD Pins        | -0.5 | $V_{DDX}^{(2)} + 0.3V$<br>(4.6V maximum) | V    |
|                      |                                           | DAT[3:0], CMD Pins                           | -0.5 | $V_{DDX}^{(2)} + 0.3V$<br>(4.6V maximum) | V    |
| $V_{CNTRL}^{(1)}$    | Control Input Voltage                     | S, /OE                                       | -0.5 | 4.6                                      | V    |
| $V_{CLKI}^{(1)}$     | CLK Input Voltage                         | CLK                                          | -0.5 | 4.6                                      | V    |
| $V_{CLKO}^{(1)}$     | CLK Output Voltage                        | 1CLK, 2CLK                                   | -0.5 | $V_{DDX}^{(2)} + 0.3V$<br>(4.6V maximum) | V    |
| $I_{INDC}$           | Input Clamp Diode Current                 |                                              |      | -50                                      | mA   |
| $I_{SW}$             | Switch I/O Current                        | SDIO Continuous                              |      | 50                                       | mA   |
| $I_{SWPEAK}$         | Peak Switch Current                       | SDIO Pulsed at 1ms Duration, <10% Duty Cycle |      | 100                                      | mA   |
| $T_{STG}$            | Storage Temperature Range                 |                                              | -65  | +150                                     | °C   |
| $T_J$                | Max Junction Temperature                  |                                              |      | +150                                     | °C   |
| $T_L$                | Lead Temperature                          | Soldering, 10 Seconds                        |      | +260C                                    | °C   |
| ESD                  | Human Body Model (JEDEC: JESD22-A114)     | I/O to GND                                   |      | 8                                        | kV   |
|                      |                                           | Supply to GND                                |      | 9                                        |      |
|                      |                                           | All Other Pins                               |      | 5                                        |      |
|                      | Charged Device Model (JEDEC: JESD22-C101) |                                              |      | 2                                        | kV   |

### Notes:

1. The input and output negative ratings may be exceeded if the input and output diode current ratings are observed.
2.  $V_{DDX}$  references the specific SDIO port  $V_{DD}$  rail (i.e.  $V_{DDC1}$ ,  $V_{DDC2}$ ,  $V_{DDH}$ ).

## Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to Absolute Maximum Ratings.

| Symbol               | Parameter                              | Minimum   | Maximum    | Unit |
|----------------------|----------------------------------------|-----------|------------|------|
| $V_{DDH}$            | Supply Voltage - Host Side             | 1.65      | 3.6V       | V    |
| $V_{DDC1}, V_{DDC2}$ | Supply Voltage - SDIO Cards            | $V_{DDH}$ | 3.6V       | V    |
| $V_{CNTRL}$          | Control Input Voltage - $V_S, V_{/OE}$ | 0         | $V_{DDH}$  | V    |
| $V_{CLKI}$           | Clock Input Voltage - $V_{CLKI}$       | 0         | $V_{DDH}$  | V    |
| $V_{SW}$             | Switch I/O Voltage - CMD, DAT[3:0]     | 0         | $V_{DDH}$  | V    |
|                      | Switch I/O Voltage - 1CMD, 1DAT[3:0]   | 0         | $V_{DDC1}$ | V    |
|                      | Switch I/O Voltage - 2CMD, 2DAT[3:0]   | 0         | $V_{DDC2}$ | V    |
| °C                   | Operating Temperature                  | -40       | +85        | °C   |
| $\theta_{JA}$        | Thermal Resistance (free air), MLP24   |           | 50         | °C/W |

**DC Electrical Characteristics at 1.8V  $V_{DDH}$** All typical values are for  $V_{DDH}=1.8V$  at 25°C unless otherwise specified.

| Symbol                 | Parameter                                             | $V_{DDC1} / V_{DDC2} (V)$ | Conditions                                                                                                   | $T_A = -40^{\circ}C$ to $+85^{\circ}C$ |      |      | Unit       |
|------------------------|-------------------------------------------------------|---------------------------|--------------------------------------------------------------------------------------------------------------|----------------------------------------|------|------|------------|
|                        |                                                       |                           |                                                                                                              | Min.                                   | Typ. | Max. |            |
| <b>Common Pins</b>     |                                                       |                           |                                                                                                              |                                        |      |      |            |
| $V_{IK}$               | Clamp Diode Voltage                                   | 2.7                       | $I_{IK} = -18mA$                                                                                             |                                        |      | -1.2 | V          |
| $V_{IH}$               | Control Input Voltage High                            | 2.7                       | $V_{DDH} = 1.65V$                                                                                            | 1.3                                    |      |      |            |
| $V_{IL}$               | Control Input Voltage Low                             | 2.7                       |                                                                                                              |                                        |      | 0.5  |            |
| $I_{IN}$               | S, /OE Input High Current                             | 3.6                       | $V_{DDH} = 1.95V$ , $V_{CNTRL} = 0V$ to $V_{DDH}$                                                            | -1                                     |      | 1    | $\mu A$    |
| $I_{OZ}$               | Off Leakage, Current of all ports                     | 3.6                       | $V_{DDH} = 1.95V$ , $V_{SW} = 0V$ to $V_{DDX}$                                                               | -1.0                                   | 0.5  | 1.0  | $\mu A$    |
| $I_{PU}$               | CLK Pull-up Current                                   | 3.6                       | $V_{CLKI} = V_{DDH}$ , $V_{CLKO} = 0V$ ,<br>/OE = $V_{DDH}$                                                  |                                        |      | 35   | $\mu A$    |
| $V_{OHC}$              | CLK Output Voltage High                               | 2.7                       | $I_{OH} = -2mA$                                                                                              | 2.4                                    |      |      | V          |
| $V_{OLC}$              | CLK Output Voltage Low                                | 3.6                       | $I_{OL} = -2mA$                                                                                              |                                        |      | 90   | mV         |
| $R_{PU}$               | CLK Pull-up Resistance <sup>(3)</sup>                 |                           |                                                                                                              | 50                                     | 100  |      | k $\Omega$ |
| $R_{ON}$               | Switch On Resistance <sup>(4)</sup>                   | 2.7                       | $V_{CMD, DAT[3:0]} = 0V$ , $I_{ON} = -2mA$ ,<br>See Figure 5                                                 |                                        | 4    | 6    | $\Omega$   |
| $\Delta R_{ON}$        | Delta On Resistance <sup>(4, 5)</sup>                 | 2.7                       | $V_{CMD, DAT[3:0]} = 0V$ , $I_{ON} = -2mA$                                                                   |                                        | 0.8  |      | $\Omega$   |
| <b>Power Supply</b>    |                                                       |                           |                                                                                                              |                                        |      |      |            |
| $I_{CC(VDDH)}$         | Quiescent Supply Current (Host)                       | 0                         | $V_{DDH} = 1.95V$ , $V_{SW} = 0$ or $V_{DDH}$ ,<br>$I_{OUT} = 0$                                             |                                        |      | 1    | $\mu A$    |
| $I_{CC(VDDC1, VDDC2)}$ | Quiescent Supply Current (SDIO Cards)                 | 3.6                       | $V_{SW} = 0$ or $V_{DDX}$ , $I_{OUT} = 0$ ,<br>$V_{CLKI} = V_{DDH}$ , $V_{CLKO} = \text{Open}$ ,<br>/OE = 0V |                                        |      | 1    | $\mu A$    |
| $\Delta I_{CARD}$      | Delta $I_{CC(VDDC1, VDDC2)}$ for One Card Powered Off | 3.6V / 0V                 | $V_{SW} = 0$ or $V_{DDX}$ , $I_{OUT} = 0$ ,<br>$V_{CLKI} = V_{DDH}$ , $V_{CLKO} = \text{Open}$ ,<br>/OE = 0V |                                        |      | 1    | $\mu A$    |

**Notes:**

- Guaranteed by characterization, not production tested.
- On resistance is determined by the voltage drop between the switch I/O pins at the indicated current through the switch.
- $\Delta R_{ON} = R_{ON \max} - R_{ON \min}$  measured at identical  $V_{CC}$ , temperature, and voltage.

**DC Electrical Characteristics at 2.7V  $V_{DDH}$** All typical values are for  $V_{DDH}=2.7V$  at 25°C unless otherwise specified.

| Symbol                 | Parameter                                             | $V_{DDC1} / V_{DDC2} (V)$ | Conditions                                                                                               | $T_A = -40^{\circ}C$ to $+85^{\circ}C$ |      |      | Unit       |
|------------------------|-------------------------------------------------------|---------------------------|----------------------------------------------------------------------------------------------------------|----------------------------------------|------|------|------------|
|                        |                                                       |                           |                                                                                                          | Min.                                   | Typ. | Max. |            |
| <b>Common Pins</b>     |                                                       |                           |                                                                                                          |                                        |      |      |            |
| $V_{IK}$               | Clamp Diode Voltage                                   | 2.7                       | $I_{IK} = -18mA$                                                                                         |                                        |      | -1.2 | V          |
| $V_{IH}$               | Control Input Voltage High                            | 2.7                       | $V_{DDH} = 2.7V$                                                                                         | 1.8                                    |      |      |            |
| $V_{IL}$               | Control Input Voltage Low                             | 2.7                       |                                                                                                          |                                        |      | 0.8  |            |
| $I_{IN}$               | S, /OE Input High Current                             | 3.6                       | $V_{DDH} = 3.6V$ , $V_{CNTRL} = 0V$ to $V_{DDH}$                                                         | -1                                     |      | 1    | $\mu A$    |
| $I_{OZ}$               | Off Leakage Current of all ports                      | 3.6                       | $V_{DDH} = 3.6V$ , $V_{SW} = 0V$ to $V_{DDX}$                                                            | -1.0                                   | 0.5  | 1.0  | $\mu A$    |
| $I_{PU}$               | CLK Pull-up Current                                   | 3.6                       | $V_{CLKI} = V_{DDH}$ , $V_{CLKO} = 0V$ , $/OE = V_{DDH}$                                                 |                                        |      | 50   | $\mu A$    |
| $V_{OHC}$              | CLK Output Voltage High                               | 2.7                       | $I_{OH} = -2mA$                                                                                          | 2.4                                    |      |      | V          |
| $V_{OLC}$              | CLK Output Voltage Low                                | 3.6                       | $I_{OL} = -2mA$                                                                                          |                                        |      | 90   | mV         |
| $R_{PU}$               | CLK Pull-up Resistance <sup>(6)</sup>                 |                           |                                                                                                          | 50                                     | 100  |      | k $\Omega$ |
| $R_{ON}$               | Switch On Resistance <sup>(7)</sup>                   | 2.7                       | $V_{CMD, DAT[3:0]} = 0V$ , $I_{ON} = -2mA$<br>See Figure 5                                               |                                        | 2.5  | 6.0  | $\Omega$   |
| $\Delta R_{ON}$        | Delta On Resistance <sup>(7,8)</sup>                  | 2.7                       | $V_{CMD, DAT[3:0]} = 0V$ , $I_{ON} = -2mA$                                                               |                                        | 0.8  |      | $\Omega$   |
| <b>Power Supply</b>    |                                                       |                           |                                                                                                          |                                        |      |      |            |
| $I_{CC(VDDH)}$         | Quiescent Supply Current (Host)                       | 0                         | $V_{DDH} = 3.6V$ , $V_{SW} = 0$ or $V_{DDH}$ , $I_{OUT} = 0$                                             |                                        |      | 1    | $\mu A$    |
| $I_{CC(VDDC1, VDDC2)}$ | Quiescent Supply Current (SDIO Cards)                 | 3.6                       | $V_{SW} = 0$ or $V_{DDX}$ , $I_{OUT} = 0$ , $V_{CLKI} = V_{DDH}$ , $V_{CLKO} = \text{Open}$ , $/OE = 0V$ |                                        |      | 1    | $\mu A$    |
| $\Delta I_{CARD}$      | Delta $I_{CC(VDDC1, VDDC2)}$ for One Card Powered Off | 3.6V/0V<br>0V/3.6V        | $V_{SW} = 0$ or $V_{DDX}$ , $I_{OUT} = 0$ , $V_{CLKI} = V_{DDH}$ , $V_{CLKO} = \text{Open}$ , $/OE = 0V$ |                                        |      | 1    | $\mu A$    |

**Notes:**

6. Guaranteed by characterization, not production tested.
7. On resistance is determined by the voltage drop between the switch I/O pins at the indicated current through the switch.
8.  $\Delta R_{ON} = R_{ON \max} - R_{ON \min}$  measured at identical  $V_{CC}$ , temperature, and voltage.

**AC Electrical Characteristics at 1.8V  $V_{DDH}$** 

All typical values are for  $V_{DDH}=1.8V$  at 25°C unless otherwise specified.

| Symbol       | Parameter                                        | $V_{DDC1} / V_{DDC2}$ (V) | Conditions                                                          | $T_A = -40^{\circ}\text{C to } +85^{\circ}\text{C}$ |      |      | Unit |
|--------------|--------------------------------------------------|---------------------------|---------------------------------------------------------------------|-----------------------------------------------------|------|------|------|
|              |                                                  |                           |                                                                     | Min.                                                | Typ. | Max. |      |
| $t_{ON1}$    | Turn-On Time,<br>S, /OE to CMD, DAT[3:0]         | 2.7 to 3.6                | $V_{SW}=0V$ , $R_L=1k\Omega$ , $C_L=30pF$<br>See Figure 7, Figure 8 |                                                     | 10   | 24   | ns   |
| $t_{OFF1}$   | Turn-Off Time,<br>S, /OE to CMD, DAT[3:0]        | 2.7 to 3.6                | $V_{SW}=0V$ , $R_L=1k\Omega$ , $C_L=30pF$<br>See Figure 7, Figure 8 |                                                     | 7    | 22   | ns   |
| $t_{PD}$     | Switch Propagation<br>Delay <sup>(9)</sup>       | 2.7 to 3.6                | See Figure 9                                                        |                                                     | 1    |      | ns   |
| $t_{SKEW}$   | Switch Skew <sup>(9, 10)</sup><br>CMD, DAT[3:0]  | 2.7 to 3.6                | $R_L=1k\Omega$ , $C_L=30pF$                                         |                                                     | 2    |      | ns   |
| $t_{ON2}$    | Turn-On Time,<br>S, /OE to 1CLK, 2CLK            | 2.7 to 3.6                | $V_{SW}=0V$ , $R_L=1k\Omega$ , $C_L=30pF$<br>See Figure 7, Figure 8 |                                                     | 17   | 35   | ns   |
| $t_{OFF2}$   | Turn-Off Time<br>S, /OE to 1CLK, 2CLK            | 2.7 to 3.6                | $V_{SW}=0V$ , $R_L=1k\Omega$ , $C_L=30pF$<br>See Figure 7, Figure 8 |                                                     | 10   | 28   | ns   |
| $t_{PDCLK}$  | Clock Propagation Delay                          | 2.7 to 3.6                | $R_L=1k\Omega$ , $C_L=30pF$<br>See Figure 11                        |                                                     | 3.0  | 5.5  | ns   |
| $O_{IRR}$    | Off Isolation <sup>(9)</sup>                     | 2.7 to 3.6                | $f=10\text{MHz}$ , $R_T=50\Omega$ , $C_L=30pF$ ,<br>See Figure 12   |                                                     | -60  |      | dB   |
| Xtalk        | Non-Adjacent Channel<br>Crosstalk <sup>(9)</sup> | 2.7 to 3.6                | $f=10\text{MHz}$ , $R_T=50\Omega$ , $C_L=30pF$ ,<br>See Figure 13   |                                                     | -60  |      | dB   |
| $f_{toggle}$ | Clock Frequency <sup>(9)</sup>                   | 2.7 to 3.6                | $C_L=30pF$                                                          |                                                     | 120  |      | MHz  |

**Notes:**

9. Guaranteed by characterization, not production tested.

10. Skew is determined by  $|T_{PLH} - T_{PHL}|$  for worst-case temperature and  $V_{DDX}$ .

**AC Electrical Characteristics at 2.7V  $V_{DDH}$** 

All typical values are for  $V_{DDH}=2.7V$  at 25°C unless otherwise specified.

| Symbol       | Parameter                                      | $V_{DDC1}/V_{DDC2}$ (V) | Conditions                                                          | $T_A = -40^{\circ}C$ to $+85^{\circ}C$ |      |      | Unit |
|--------------|------------------------------------------------|-------------------------|---------------------------------------------------------------------|----------------------------------------|------|------|------|
|              |                                                |                         |                                                                     | Min.                                   | Typ. | Max. |      |
| $t_{ON1}$    | Turn-On Time<br>S, /OE to CMD, DAT[3:0]        | 2.7 to 3.6              | $V_{SW}=0V$ , $R_L=1k\Omega$ , $C_L=30pF$<br>See Figure 7, Figure 8 |                                        | 8    | 17   | ns   |
| $t_{OFF1}$   | Turn-Off Time<br>S, /OE to CMD, DAT[3:0]       | 2.7 to 3.6              | $V_{SW}=0V$ , $R_L=1k\Omega$ , $C_L=30pF$<br>See Figure 7, Figure 8 |                                        | 6    | 13   | ns   |
| $t_{PD}$     | Switch Propagation Delay <sup>(11)</sup>       | 2.7 to 3.6              | See Figure 9                                                        |                                        | 1    |      | ns   |
| $t_{SKEW}$   | Switch Skew <sup>(12)</sup><br>CMD, DAT[3:0]   | 2.7 to 3.6              | $R_L=1k\Omega$ , $C_L=30pF$                                         |                                        | 1.5  |      | ns   |
| $t_{ON2}$    | Turn-On Time<br>S, /OE to 1CLK, 2CLK           | 2.7 to 3.6              | $V_{SW}=0V$ , $R_L=1k\Omega$ , $C_L=30pF$<br>See Figure 7, Figure 8 |                                        | 15   | 25   | ns   |
| $t_{OFF2}$   | Turn-Off Time<br>S, /OE to 1CLK, 2CLK          | 2.7 to 3.6              | $V_{SW}=0V$ , $R_L=1k\Omega$ , $C_L=30pF$<br>See Figure 7, Figure 8 |                                        | 10   | 25   | ns   |
| $t_{PDCLK}$  | Clock Propagation Delay                        | 2.7 to 3.6              | $R_L=1k\Omega$ , $C_L=30pF$<br>See Figure 11                        |                                        | 1.5  | 3.0  | ns   |
| $O_{IRR}$    | Off Isolation <sup>(11)</sup>                  | 2.7 to 3.6              | $f=10MHz$ , $R_T=50\Omega$ , $C_L=30pF$<br>See Figure 12            |                                        | -60  |      | dB   |
| Xtalk        | Non-Adjacent Channel Crosstalk <sup>(11)</sup> | 2.7 to 3.6              | $f=10MHz$ , $R_T=50\Omega$ , $C_L=30pF$<br>See Figure 13            |                                        | -60  |      | dB   |
| $f_{toggle}$ | Clock Frequency <sup>(11)</sup>                | 2.7 to 3.6              | $C_L=30pF$                                                          |                                        | 120  |      | MHz  |

**Notes:**

11. Guaranteed by characterization, not production tested.

12. Skew is determined by  $|T_{PLH} - T_{PHL}|$  for worst-case temperature and  $V_{DDX}$ .

**Capacitance**

| Symbol                | Parameter                                             | Conditions                                                                                                 | $T_A = -40^{\circ}C$ to $+85^{\circ}C$ |      |      | Unit |
|-----------------------|-------------------------------------------------------|------------------------------------------------------------------------------------------------------------|----------------------------------------|------|------|------|
|                       |                                                       |                                                                                                            | Min.                                   | Typ. | Max. |      |
| $C_{IN(S, /OE, CLK)}$ | Control and CLK Pin Input Capacitance                 | $V_{DDH}=0V$                                                                                               |                                        | 2.5  |      | pF   |
| $C_{ON}$              | Common Port On Capacitance<br>( $C_{DAT[3:0], CMD}$ ) | $V_{DDH}=1.8V$ , $V_{DDC1}=V_{DDC2}=2.7V$ ,<br>$V_{/OE}=0V$ , $V_{bias}=0V$ , $f=1MHz$<br>See Figure 15    |                                        | 9.0  |      |      |
| $C_{OFF}$             | Input Source Off Capacitance                          | $V_{DDH}=1.8V$ , $V_{DDC1}=V_{DDLH2}=2.7V$ ,<br>$V_{/OE}=3.3V$ , $V_{bias}=0V$ , $f=1MHz$<br>See Figure 14 |                                        | 4.0  |      |      |

# Test Diagrams

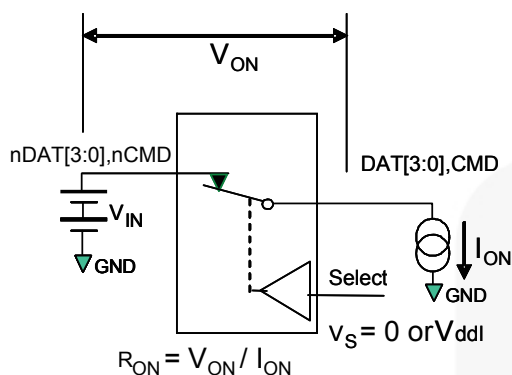


Figure 5. On Resistance

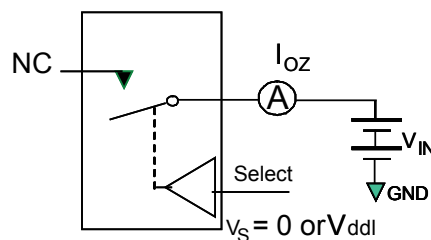
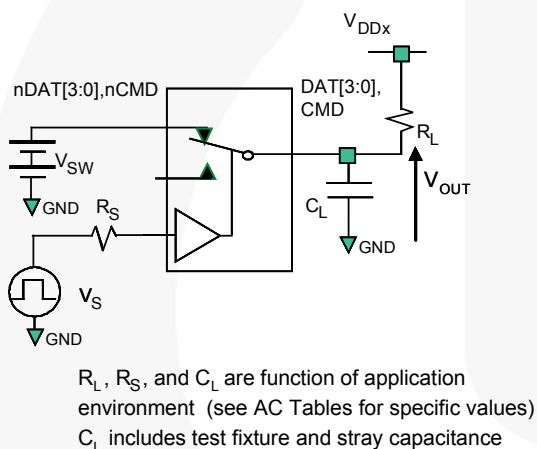


Figure 6. Off Leakage (Each Switch Port is Tested Separately)



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

Figure 7. AC Test Circuit Load

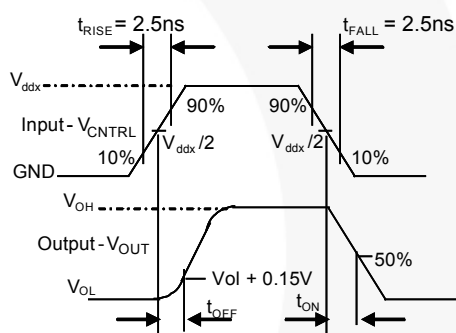


Figure 8. Turn On/Off Time Waveforms

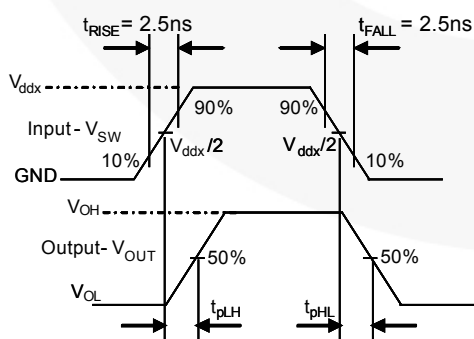
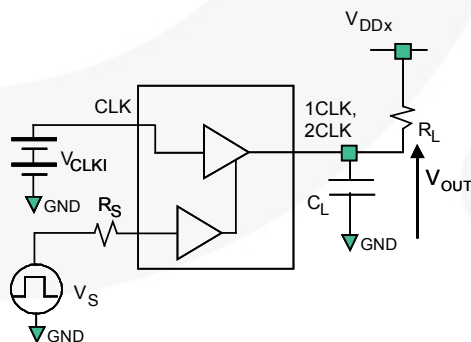


Figure 9. Switch Propagation Delay Waveform



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

Figure 10. AC Test Circuit Load (CLK)

# Test Diagrams (Continued)

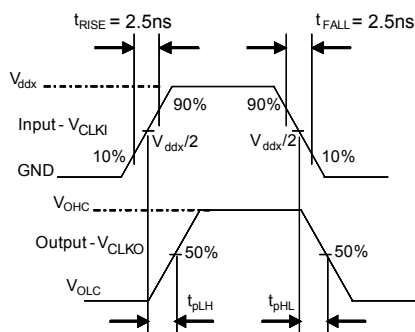


Figure 11. CLK Propagation Delay Waveforms

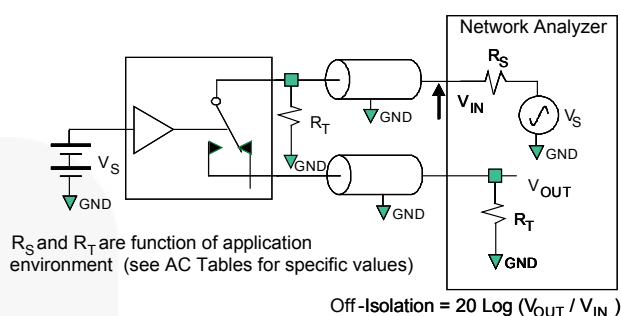


Figure 12. Channel Off Isolation

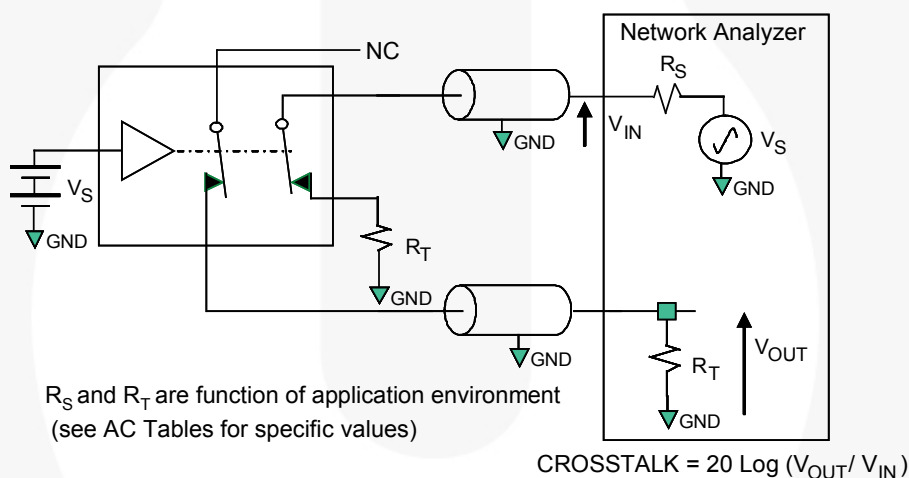


Figure 13. Channel-to-Channel Crosstalk

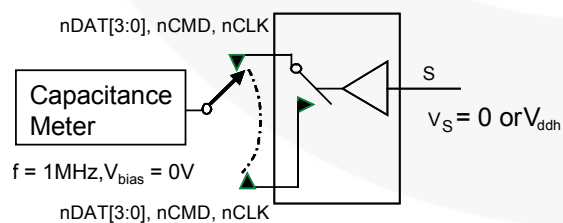


Figure 14. Channel Off Capacitance

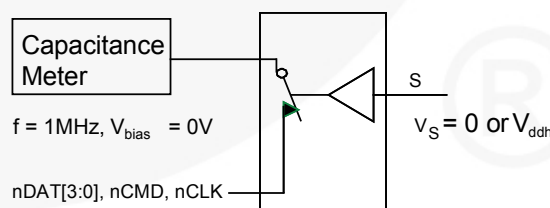


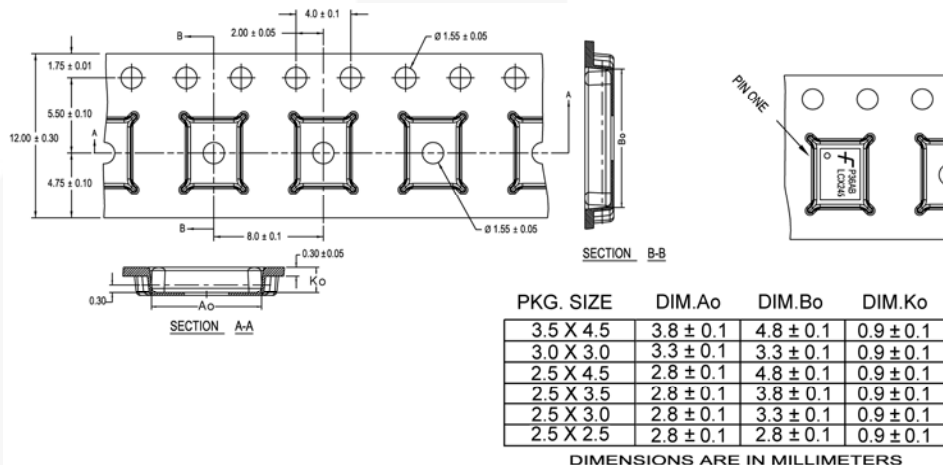
Figure 15. Channel On Capacitance

## Tape and Reel Specifications

| Package Designator | Tape Selection     | Number Cavities | Cavity Status | Cover Tape Status |
|--------------------|--------------------|-----------------|---------------|-------------------|
| MPX                | Leader (Start End) | 125 (Typical)   | Empty         | Sealed            |
|                    | Carrier            | 3000            | Filled        | Sealed            |
|                    | Trailer (Hub End)  | 75 (Typical)    | Empty         | Sealed            |

## Tape Dimensions

Dimensions are in millimeters unless otherwise noted.

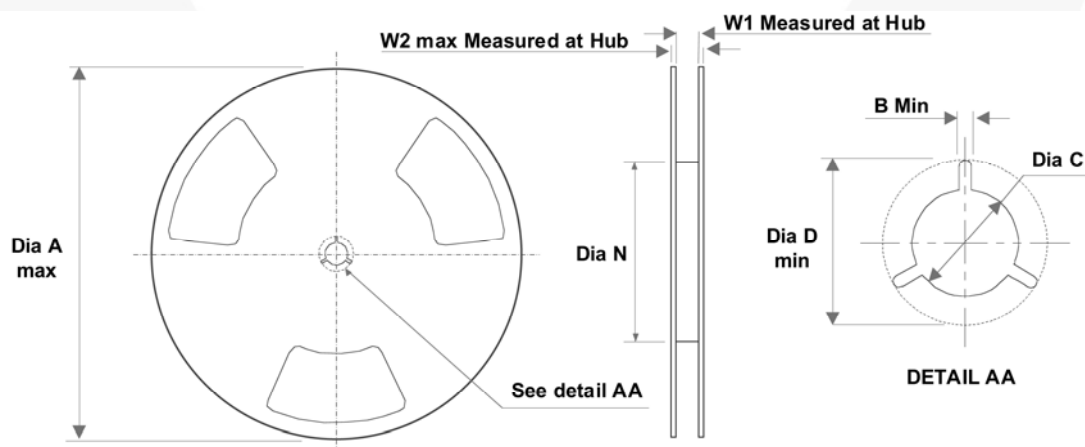


NOTES: unless otherwise specified

1. Cumulative pitch for feeding holes and cavities (chip pockets) not to exceed 0.008[0.20] over 10 pitch span.
2. Smallest allowable bending radius.
3. Thru hole inside cavity is centered within cavity.
4. Tolerance is ±0.002[0.05] for these dimensions on all 12mm tapes.
5. A<sub>o</sub> and B<sub>o</sub> measured on a plane 0.120[0.30] above the bottom of the pocket.
6. K<sub>o</sub> measured from a plane on the inside bottom of the pocket to the top surface of the carrier.
7. Pocket position relative to sprocket hole measured as true position of pocket. Not pocket hole.
8. Controlling dimension is millimeter. Dimension in inches rounded.

## Reel Dimensions

Dimensions are in inches (millimeters) unless otherwise noted.

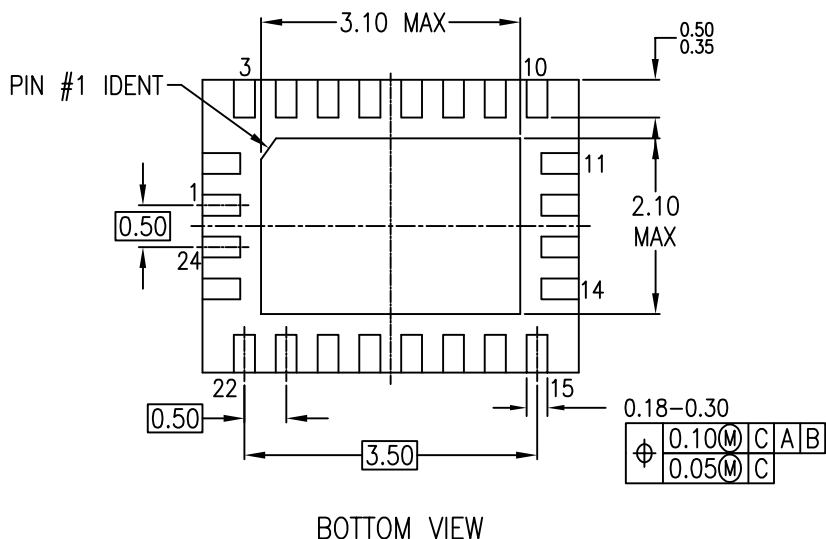
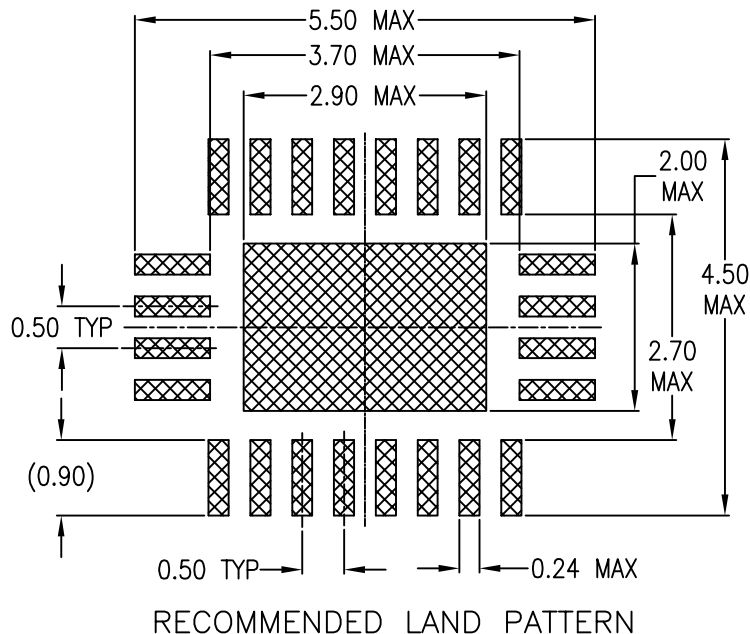
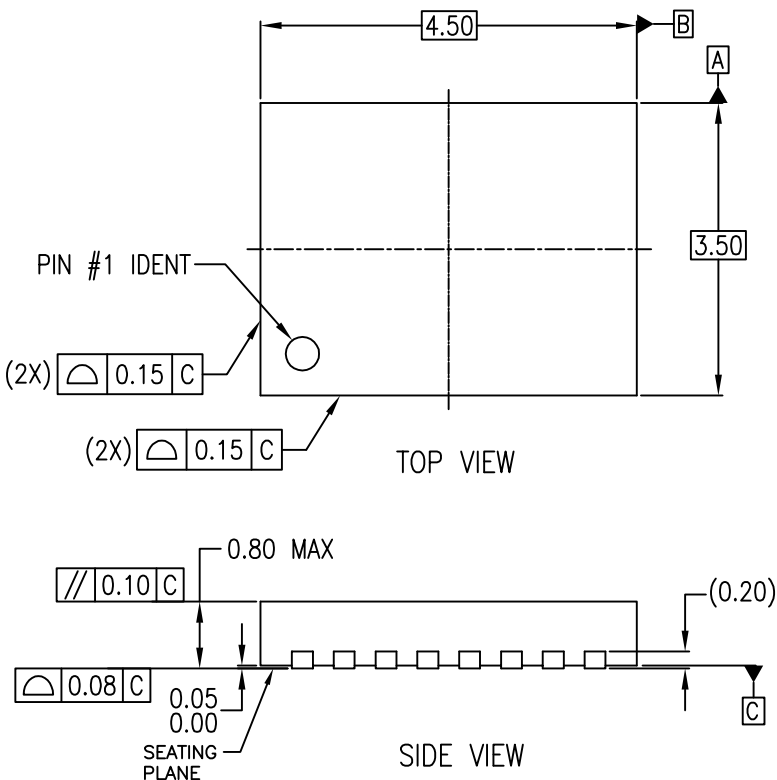


| Tape Size | A        | B      | C       | D       | N       | W1      | W2      |
|-----------|----------|--------|---------|---------|---------|---------|---------|
|           | 13.000   | 0.059  | 0.512   | 0.795   | 2.165   | 0.488   | 0.724   |
| (12.00mm) | (330.00) | (1.50) | (13.00) | (20.00) | (55.00) | (12.40) | (18.40) |

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# REVISIONS

| LTR | DESCRIPTION                                                                                                   | EDCN | DATE        | BY/APP'D |
|-----|---------------------------------------------------------------------------------------------------------------|------|-------------|----------|
| A   | RELEASE TO DOCUMENT CONTROL                                                                                   |      | 7-4-2003    | FEITAN   |
| B   | REVISE DWG NAME AND NOTE 1.                                                                                   |      | 12-11-2003  | FEITAN   |
| C   | CORRECTED PIN NUMBERING AND DAP DIM REMOVED LAND PATTERN NUMBERING. REVISED NOTE 1. TOP VIEW ADDED PIN #1 DOT |      | 17-11-2003  | HALLEN   |
| 4   | CORRECTED THE LEAD LENGTH FROM 0.35~0.75 TO 0.35~0.50                                                         |      | 26 JAN 2007 | CHIPKING |

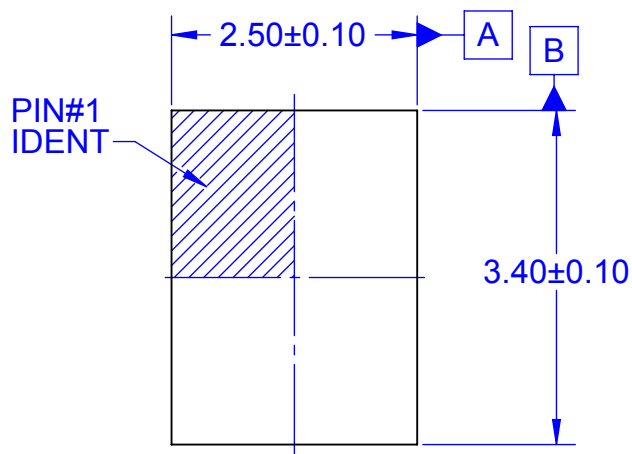


## NOTES:

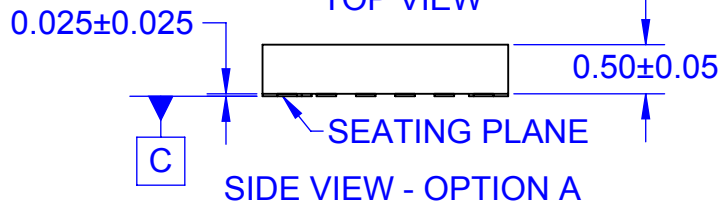
- CONFORMS TO JEDEC REGISTRATION MO-220, VARIATION WFSD-2 FOR DIMENSIONS ONLY. PIN NUMBERING DOES NOT COMPLY.
- DIMENSIONS ARE IN MILLIMETERS.
- DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994

MLP24Brev4

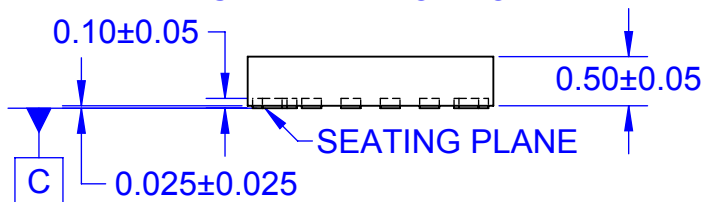
|                            |        |                                                                              |      |                |     |
|----------------------------|--------|------------------------------------------------------------------------------|------|----------------|-----|
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| DRAWN                      | FEITAN |                                                                              |      |                |     |
| DFTG. CHK.                 |        | 24LD, MLP, QUAD, JEDEC<br>MO-220, 3.5x4.5 MM                                 |      |                |     |
| ENGR. CHK.                 |        |                                                                              |      |                |     |
| PROJECTION<br>INCH<br>[MM] |        | SCALE                                                                        | SIZE | DRAWING NUMBER | REV |
|                            |        | N/A                                                                          | N/A  | MKT-MLP24B     | 4   |
| DO NOT SCALE DRAWING       |        |                                                                              |      | SHEET 1 of 1   |     |



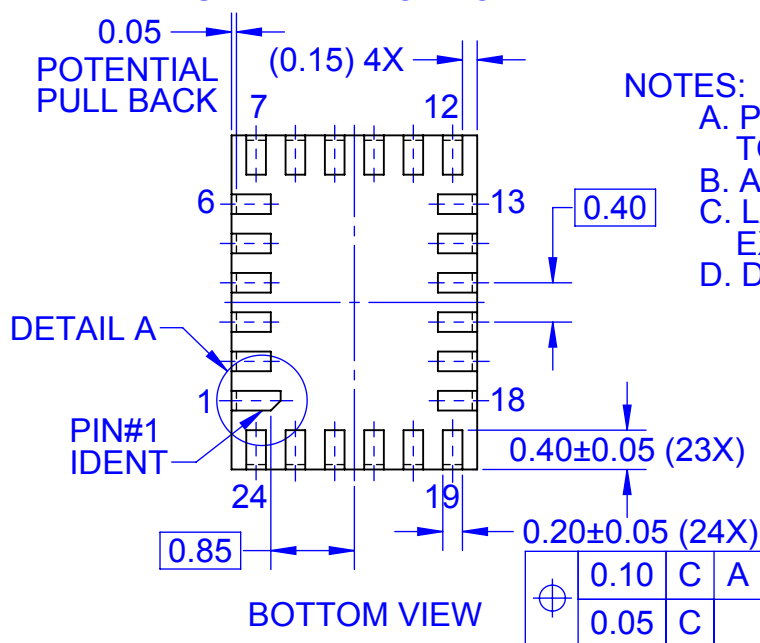
TOP VIEW



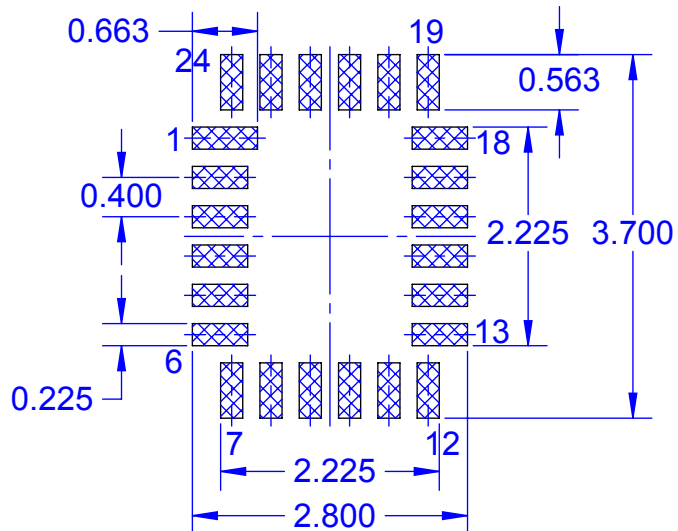
SIDE VIEW - OPTION A



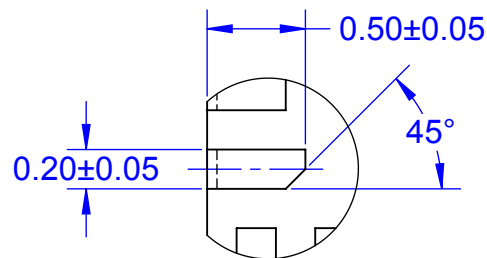
SIDE VIEW - OPTION B



BOTTOM VIEW



LAND PATTERN RECOMMENDATION



DETAIL A  
SCALE 2:1

NOTES:

- A. PACKAGE DOES NOT FULLY CONFORM TO JEDEC STANDARD
- B. ALL DIMENSIONS ARE IN MILLIMETERS
- C. LAND PATTERN RECOMMENDATION IS EXISTING INDUSTRY LAND PATTERN
- D. DRAWING FILENAME: MKT-UMLP24ArevE

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