



# FSHDMI04

## Wide-Bandwidth Differential Signaling HDMI Switch

### Features

- 1.65 Gbps throughput
- 8kV ESD protection
- -26dB non-adjacent channel crosstalk at 825MHz
- Isolation ground between channels
- Low skew
  - Inter-pair skew <150ps
  - Intra-pair skew <90ps
- Fast turn on/off time
- Low power consumption (1µA maximum)
- Control input: TTL compatible

### Applications

- UXGA and 1080p DVI and HDMI video source selection

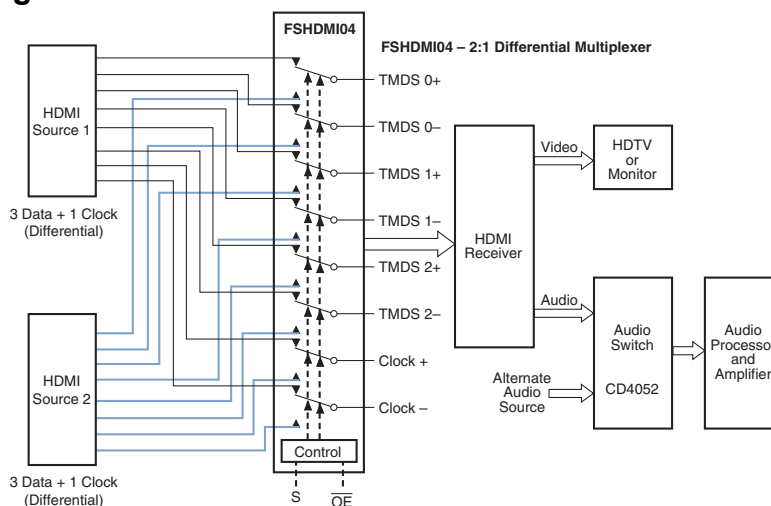
### General Description

The FSHDMI04 is a wide bandwidth switch for routing HDMI Link Data and Clock signals. This device supports data rates up to 1.65Gbps per channel for UXGA resolution. It can also be used to switch TMDS-based DVI digital video streams. Possible applications include LCD TV, DVD, Set-Top Box, notebook computers and other designs with multiple digital video interfaces. The FSHDMI04 switch allows the passage of HDMI link signals with low non-adjacent channel crosstalk and superior OFF-Isolation. This performance is critical to minimize ghost images between active video sources in video applications. The wide bandwidth of this switch allows the high speed differential signal to pass through the switch with minimal additive skew and phase jitter.

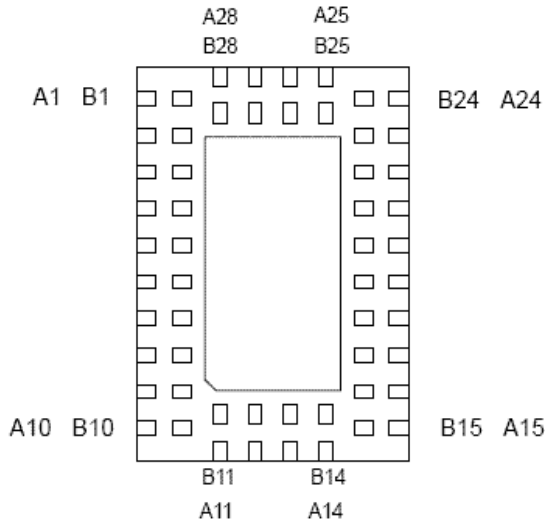
### Ordering Information

| Order Number              | Package Number | Package Description   |
|---------------------------|----------------|---|
| FSHDMI04QSPX              | MQA48A         | 48-Lead Quarter Size Very Small Outline Package (QVSOP), JEDEC MO-154, 0.150inches Wide |
| FSHDMI04MTDX              | MTD48          | 48-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide             |
| FSHDMI04BQX (Preliminary) | MLP56          | 56-Lead Molded Leadless Package (MLP), 5x7mm Wide                                       |

### Applications Diagram



### Pin Assignments



| Pin | Function | Pin | Function | Pin | Function |
|-----|----------|-----|----------|-----|----------|
| A1  | NC       | A21 | C1-      | B13 | NC       |
| A2  | 2C0-     | A22 | C1+      | B14 | C3-      |
| A3  | 1C1+     | A23 | VCC      | B15 | GND      |
| A4  | 1C1-     | A24 | NC       | B16 | C3+      |
| A5  | 2C1-     | A25 | GND      | B17 | VCC      |
| A6  | GND      | A26 | VCC      | B18 | GND      |
| A7  | 1C2+     | A27 | Vcc      | B19 | NC       |
| A8  | 1C2-     | A28 | GND      | B20 | NC       |
| A9  | GND      | B1  | 2C0+     | B21 | GND      |
| A10 | NC       | B2  | 1C0-     | B22 | GND      |
| A11 | 2C3-     | B3  | GND      | B23 | C0-      |
| A12 | GND      | B4  | 2C1+     | B24 | GND      |
| A13 | VCC      | B5  | NC       | B25 | C0+      |
| A14 | GND      | B6  | NC       | B26 | NC       |
| A15 | NC       | B7  | 2C2+     | B27 | NC       |
| A16 | GND      | B8  | 2C2-     | B28 | 1C0+     |
| A17 | C2-      | B9  | 1C3+     |     |          |
| A18 | C2+      | B10 | 2C3+     |     |          |
| A19 | OE       | B11 | 1C3-     |     |          |
| A20 | S        | B12 | NC       |     |          |

Figure 1. MLP Pin Assignments

### Pin Assignments

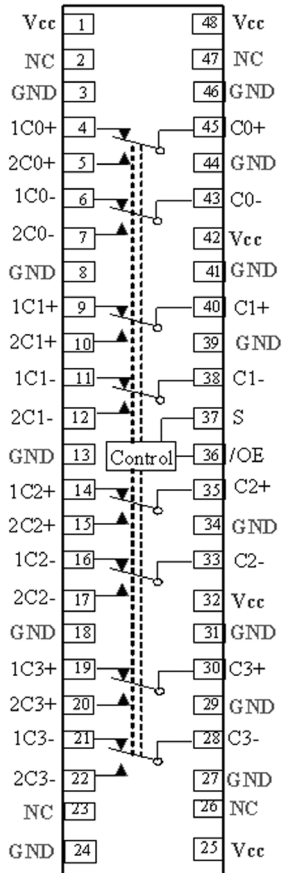


Figure 2. QVSOP and TSSOP Pin Assignments

### Truth Table

| S | $\overline{OE}$ | Function     |
|---|-----------------|--------------|
| X | H               | Disconnected |
| L | L               | $1C_n = C_n$ |
| H | L               | $2C_n = C_n$ |

### Pin Descriptions

| Pin Name                             | Description       |
|--------------------------------------|-------------------|
| $\overline{OE}$                      | Bus Switch Enable |
| S                                    | Select Input      |
| $1C_n, 2C_n, C0_n, C1_n, C2_n, C3_n$ | Data Ports        |

## Absolute Maximum Ratings

The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table defines the conditions for actual device operation.

| Symbol    | Parameter                       | Rating                   |
|-----------|---------------------------------|--------------------------|
| $V_{CC}$  | Supply Voltage                  | -0.5V to +4.6V           |
| $V_S$     | DC Switch Voltage               | -0.5V to $V_{CC} + 0.05$ |
| $V_{IN}$  | DC Input Voltage <sup>(1)</sup> | -0.5V to +4.6V           |
| $I_{IK}$  | DC Input Diode Current          | -50 mA                   |
| $I_{OUT}$ | DC Output Sink Current          | 128 mA                   |
| $T_{STG}$ | Storage Temperature Range       | -65°C to +150°C          |
|           | ESD, Human Body Model           | 8,000V                   |

## Recommended Operating Conditions<sup>(2)</sup>

| Symbol   | Parameter              | Rating         |
|----------|------------------------|----------------|
| $V_{CC}$ | Power Supply Operating | 3.0V to 3.6V   |
| $V_{IN}$ | Control Input Voltage  | 0V to $V_{CC}$ |
|          | Switch Input Voltage   | 0V to $V_{CC}$ |
| $T_A$    | Operating Temperature  | -40°C to 85°C  |

## DC Electrical Characteristics

All typical values are for  $V_{CC} = 3.3V @ 25^\circ C$  unless otherwise specified.

| Symbol         | Parameter                                    | Conditions   | $V_{CC}$ (V) | $T_A = -40^\circ C$ to $+85^\circ C$ |      |           | Units    |
|----------------|--|--|--------------|--------------------------------------|------|-----------|----------|
|                |  |  |              | Min.                                 | Typ. | Max.      |          |
| $V_{IK}$       | Clamp Diode Voltage                          | $I_{IN} = -18mA$   | 3.0          |                                      |      | -1.2      | V        |
| $V_{IH}$       | Input Voltage HIGH                           |  | 3.0-3.6      | 2.0                                  |      |           | V        |
| $V_{IL}$       | Input Voltage LOW                            |  | 3.0-3.6      |                                      |      | 0.8       | V        |
| $I_{IN}$       | Control Input Leakage                        | $V_{IN} = 0$ to $V_{CC}$                                 | 3.6          |                                      |      | $\pm 1.0$ | $\mu A$  |
| $I_{OZ}$       | OFF-STATE Leakage                            | $0 \leq nC_n, C_n \leq V_{CC}$                           | 3.6          |                                      |      | $\pm 1.0$ | $\mu A$  |
| $R_{ON}$       | Switch On Resistance <sup>(3)</sup>          | $V_{IN} = V_{CC} - 0.6$ to $V_{CC}$ ,<br>$I_{ON} = 10mA$ | 3.0          |                                      | 12.0 | 19.0      | $\Omega$ |
| $R_{ON(FLAT)}$ | Switch On Resistance Flatness <sup>(4)</sup> | $V_{IN} = V_{CC} - 0.6$ to $V_{CC}$ ,<br>$I_{ON} = 10mA$ | 3.0          |                                      | 1.0  |           | $\Omega$ |
| $I_{CC}$       | Quiescent Supply Current                     | $V_{IN} = 0$ or $V_{CC}$ , $I_{OUT} = 0$                 | 3.6          |                                      |      | 1.0       | $\mu A$  |

### Notes:

1. The input and output negative voltage ratings may be exceeded if the input and output diode current ratings are observed.
2. Unused control inputs must be held HIGH or LOW. They may not float.
3. Measured by the voltage drop between A and B pins at the indicated current through the switch. On resistance is determined by the lower of the voltages on the two (A or B) pins.
4. Flatness is defined as the difference between the maximum and minimum value on resistance over the specified range of conditions.

## AC Electrical Characteristics

All typical values are for  $V_{CC} = 3.3V$  @  $25^{\circ}C$  unless otherwise specified.

| Symbol                                | Parameter   | Conditions  | $V_{CC}$ (V) | $T_A = -40^{\circ}C$ to $+85^{\circ}C$ |       |       | Units | Figure Number         |
|---------------------------------------|---|---|--------------|--|-------|-------|-------|-----------------------|
|                                       |   |   |              | Min.                                   | Typ.  | Max.  |       |                       |
| $t_{ON}$                              | Turn ON Time S,<br>$\overline{OE}$ -to-Output                       | $V_{IN} = V_{CC} - 0.5$ ,<br>$R_{PU} = 50\Omega$ , $C_L = 5pF$                  | 3.0 to 3.6   |  | 4.0   | 6.0   | ns    | Figure 7<br>Figure 8  |
| $t_{OFF}$                             | Turn OFF Time S,<br>$\overline{OE}$ -to-Output                      | $V_{IN} = V_{CC} - 0.5$ ,<br>$R_{PU} = 50\Omega$ , $C_L = 5pF$                  | 3.0 to 3.6   |  | 2.0   | 4.0   | ns    | Figure 7<br>Figure 8  |
| $t_{BBM}$                             | Break-Before-Make<br>Time   | $V_{IN} = V_{CC} - 0.5$ ,<br>$R_{PU} = 20\Omega$ , $C_L = 5pF$                  | 3.0 to 3.6   |  | 3.0   |       |       | Figure 14             |
| $t_{PD}$<br>( $t_{PLH}$ , $t_{PHL}$ ) | Switch Propagation<br>Delay   | $R_{PU} = 50\Omega$ , $C_L = 5pF$   | 3.0 to 3.6   |  |       | 250   | ps    | Figure 7<br>Figure 13 |
| $T_{JITTER}$                          | Total Jitter (DJ + RJ)  | $f = 165MHz$ Clock with<br>50% Duty Cycle,<br>$R_{PU} = 50\Omega$ , $C_L = 5pF$ | 3.0 to 3.6   |  | 55.0  |       | ps    | Figure 7              |
| $T_{RATIO}$                           | Duty Cycle Ratio  |   |              |  | 50.0  |       | %     |                       |
| $T_{SK1}$                             | Intra-Pair Skew<br>$C_{n+}$ to $C_{n-}$ <sup>(5)</sup>              | $f = 1.65Gbps$ , $2^{23}-1$ PRBS<br>$R_{PU} = 50\Omega$ , $C_L = 5pF$           | 3.0 to 3.6   |  | 55.0  | 90.0  | ps    | Figure 7<br>Figure 13 |
| $T_{SK2}$                             | Inter-Pair Skew <sup>(5)</sup><br>(Between any two<br>switch paths) | $f = 1.65Gbps$ , $2^{23}-1$ PRBS<br>$R_{PU} = 50\Omega$ , $C_L = 5pF$           | 3.0 to 3.6   |  | 90.0  | 150.0 | ps    | Figure 7<br>Figure 13 |
| $O_{IRR}$                             | OFF-Isolation   | $R_T = 50\Omega$ , $f = 370MHz$   | 3.0 to 3.6   |  | -35.0 |       | dB    | Figure 9              |
|                                       |   | $R_T = 50\Omega$ , $f = 825MHz$   | 3.0 to 3.6   |  | -25.0 |       |       |                       |
| $X_{talk}$                            | Non-Adjacent Channel<br>Crosstalk                                   | $R_T = 50\Omega$ , $f = 370MHz$   | 3.0 to 3.6   |  | -30.0 |       | dB    | Figure 10             |
|                                       |   | $R_T = 50\Omega$ , $f = 825MHz$   | 3.0 to 3.6   |  | -26.0 |       |       |                       |
| $f_{MAX}$                             | Maximum Throughput  |   | 3.3          |  | 1.65  |       | Gbps  |                       |

### Notes:

5. Guaranteed by characteristics and design.

## Capacitance

| Symbol    | Parameter                     | Conditions      | $T_A = -40^{\circ}C$ to $+85^{\circ}C$ |      |      | Units |
|-----------|-------------------------------|-----------------|--|------|------|-------|
|           |                               |                 | Min.                                   | Typ. | Max. |       |
| $C_{IN}$  | Control Pin Input Capacitance | $V_{CC} = 0V$   |  | 1.1  |      | pF    |
| $C_{ON}$  | $nC_n$ ON Capacitance         | $V_{CC} = 3.3V$ |  | 6.0  |      | pF    |
| $C_{OFF}$ | Port $C_n$ OFF Capacitance    | $V_{CC} = 3.3V$ |  | 2.5  |      | pF    |

## Typical Characteristics

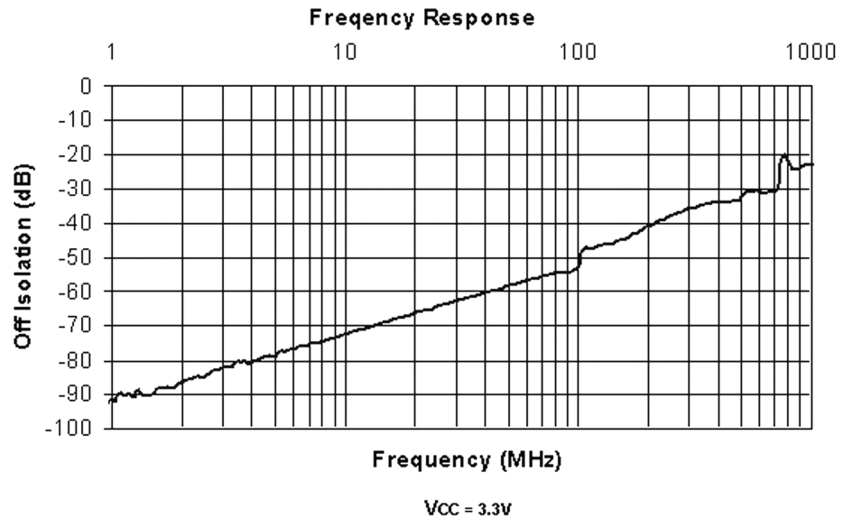


Figure 3. Off- Isolation, V<sub>CC</sub> = 3.3V

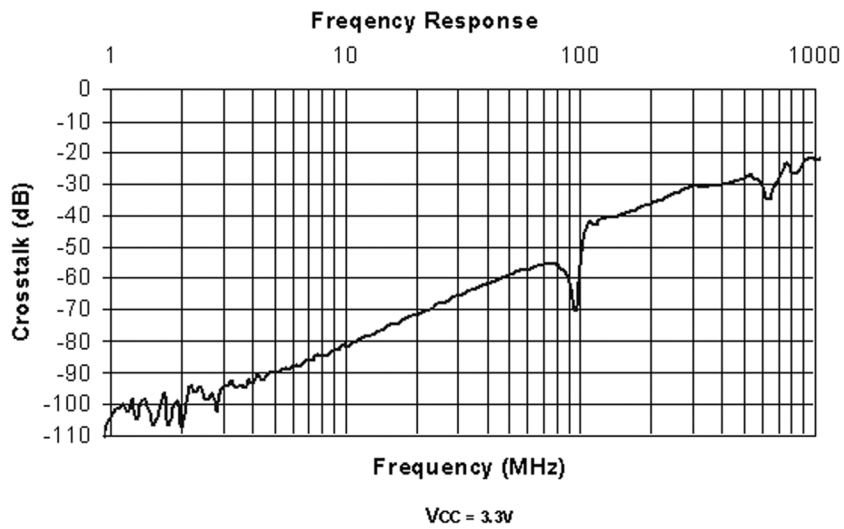
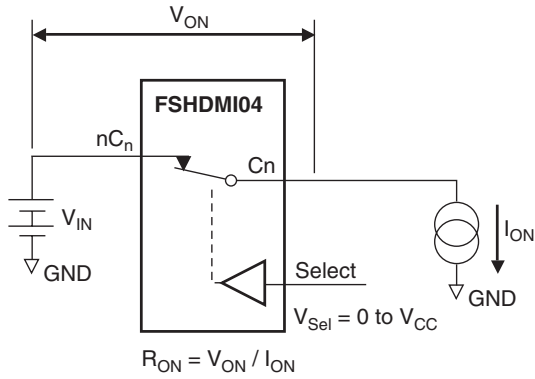
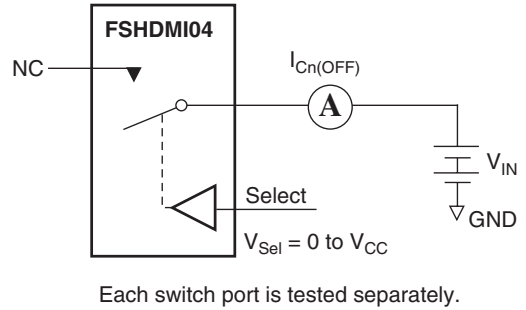


Figure 4. Crosstalk, V<sub>CC</sub> = 3.3CV

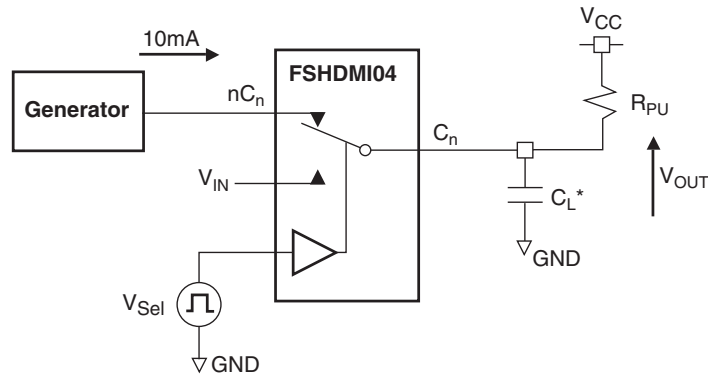
## Test Diagrams



**Figure 5. On Resistance**



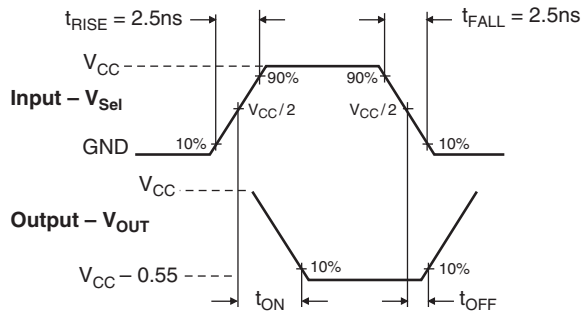
**Figure 6. OFF Leakage**



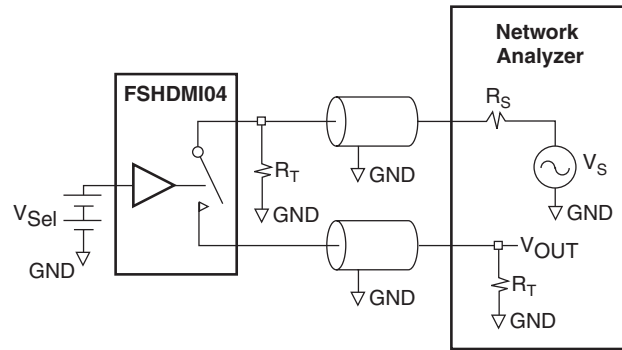
$R_{PU}$  and  $C_L$  are functions of application environment (see AC/DC Tables for values of  $C_L$  and  $R_{PU}$ )  
 \* $C_L$  includes fixture and stray capacitance

**Figure 7. AC Test Circuit Load**

**Test Diagrams (Continued)**

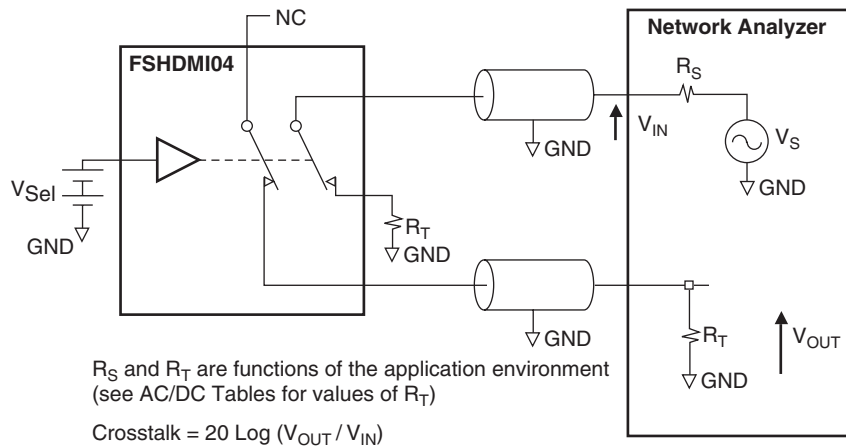


**Figure 8. Turn ON / Turn OFF Waveforms**



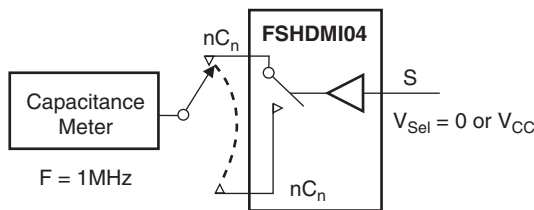
$R_S$  and  $R_T$  are functions of the application environment (see AC/DC Tables for values of  $R_T$ )  
 OFF-Isolation =  $20 \text{ Log } (V_{OUT} / V_{IN})$

**Figure 9. Channel OFF-Isolation**

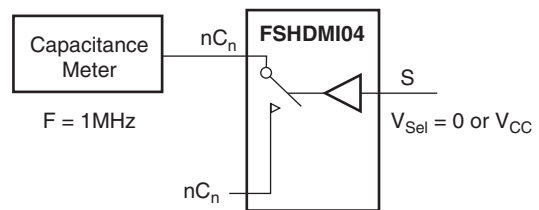


$R_S$  and  $R_T$  are functions of the application environment (see AC/DC Tables for values of  $R_T$ )  
 Crosstalk =  $20 \text{ Log } (V_{OUT} / V_{IN})$

**Figure 10. Non-adjacent Channel-to-Channel Crosstalk**

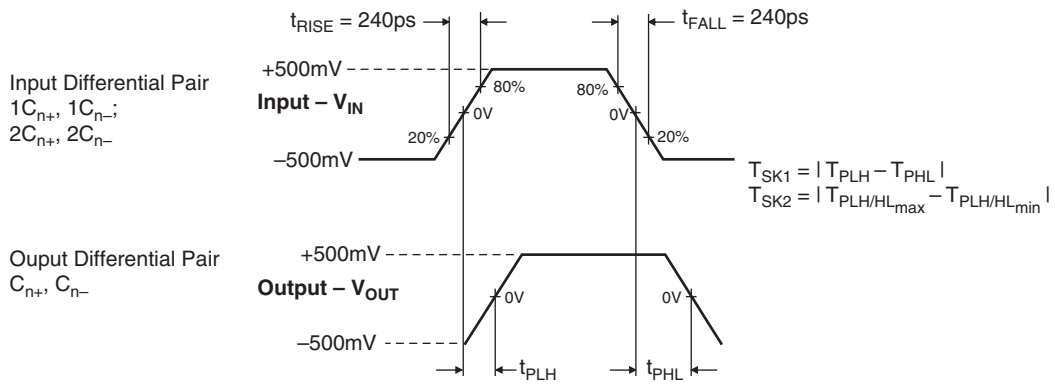


**Figure 11. Channel OFF-Capacitance**

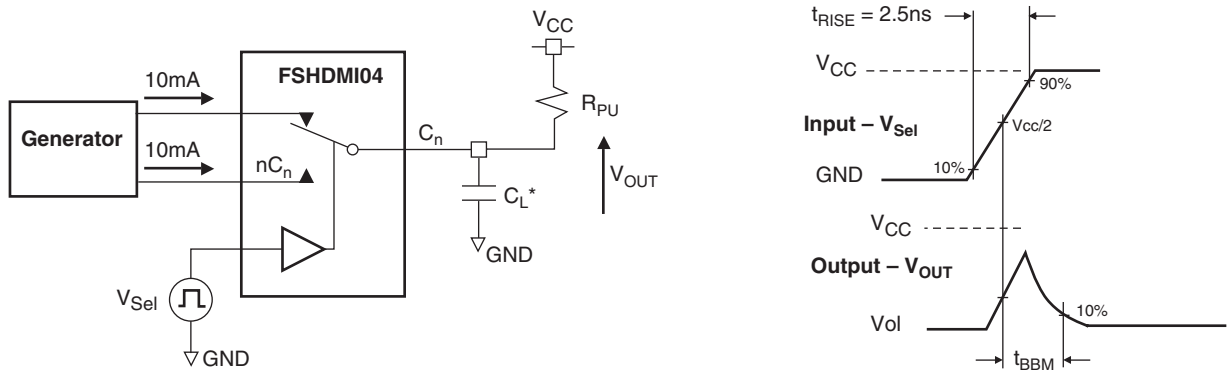


**Figure 12. Channel ON-Capacitance**

**Test Diagrams (Continued)**



**Figure 13. Intra- and Inter-Pair Skew,  $t_{PD}$**



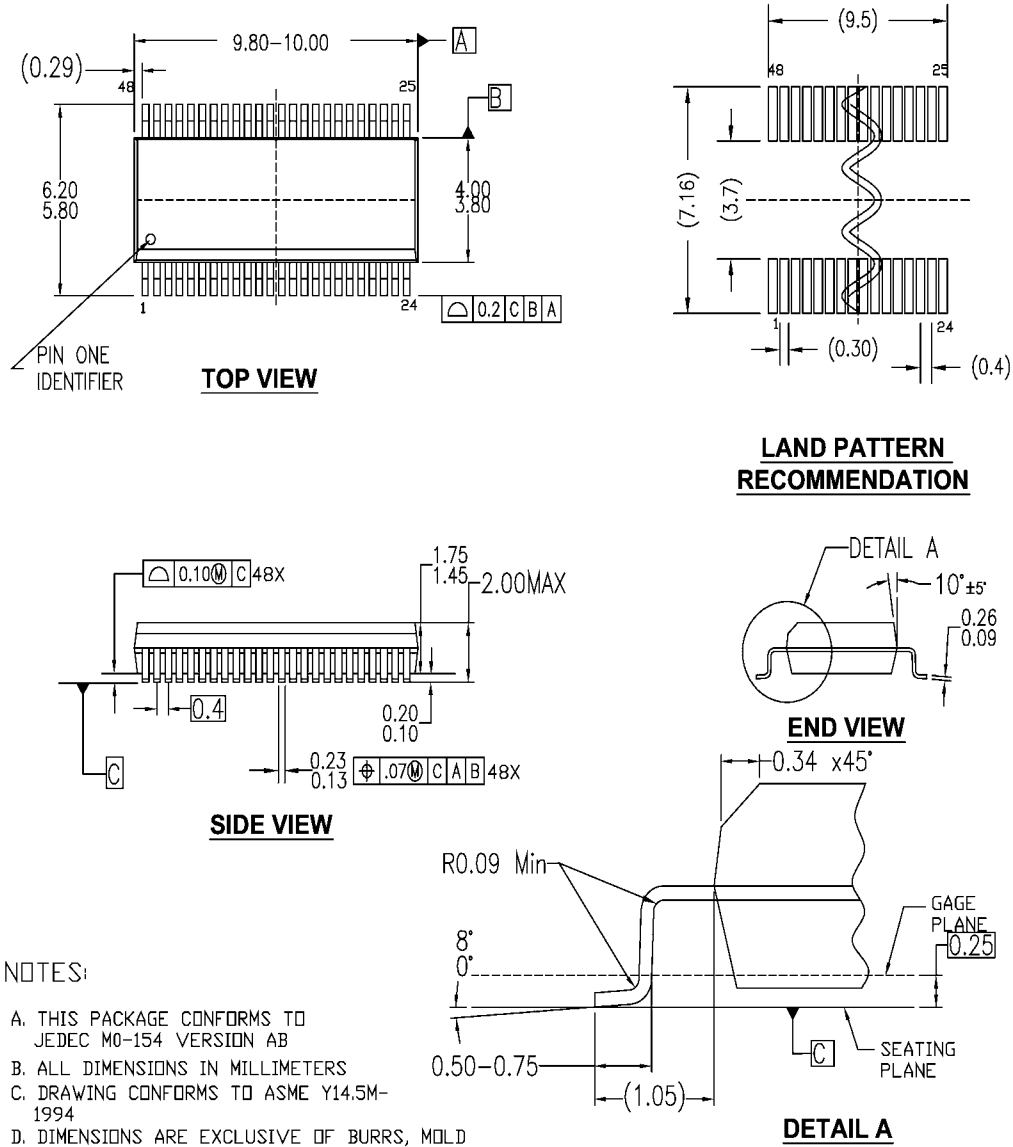
$R_{PU}$  and  $C_L$  are functions of application environment (see AC/DC Tables for values of  $C_L$  and  $R_{PU}$ )  
 $*C_L$  includes fixture and stray capacitance

**Figure 14. Break-Before-Make**



## Physical Dimensions

Dimensions are in millimeters unless otherwise noted.

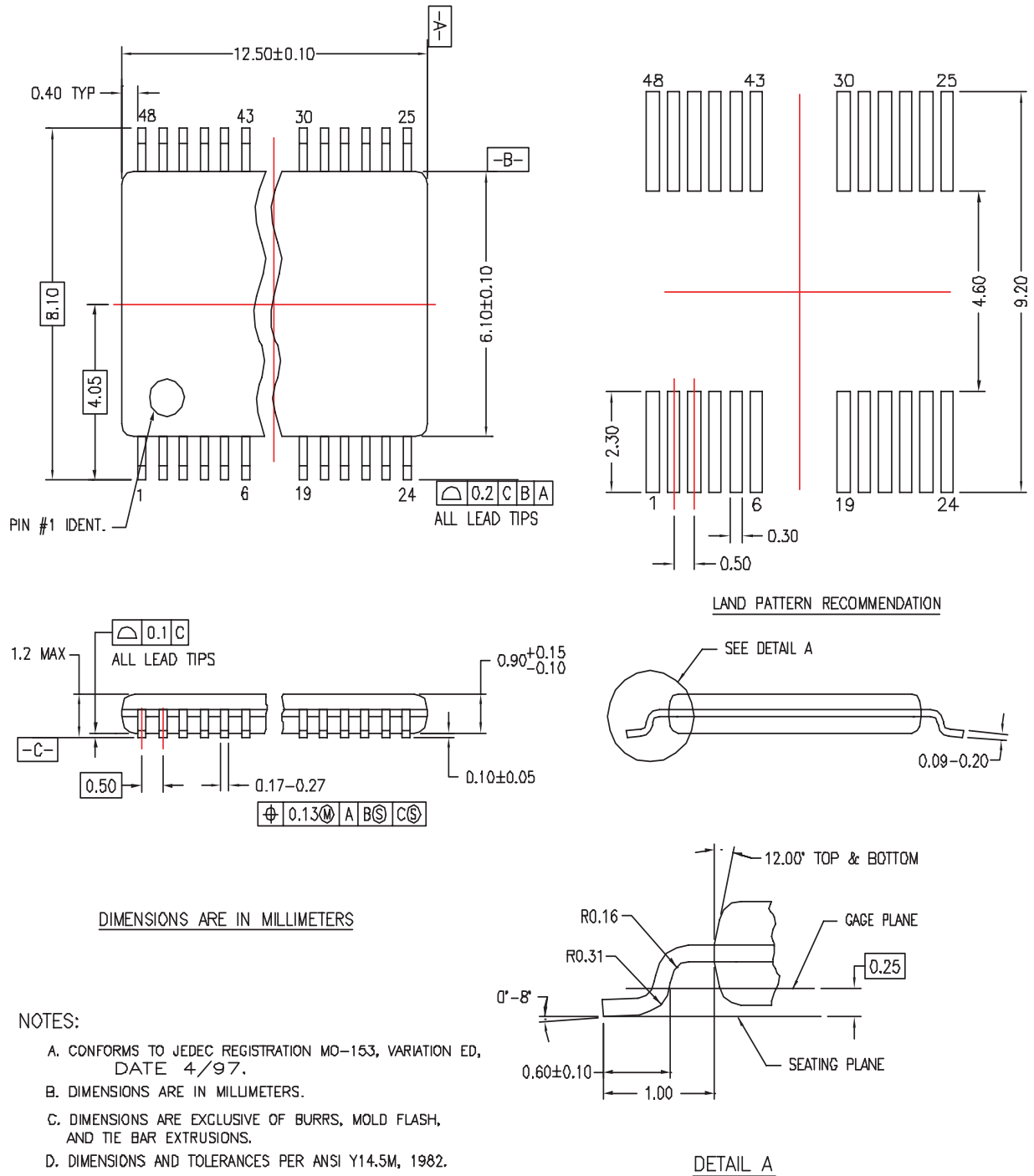


MQA48AREVA

Figure 15. 48-Lead Quarter Size Very Small Outline Package (QVSOP), JEDEC MO-154, 0.150inches Wide

### Physical Dimensions (Continued)

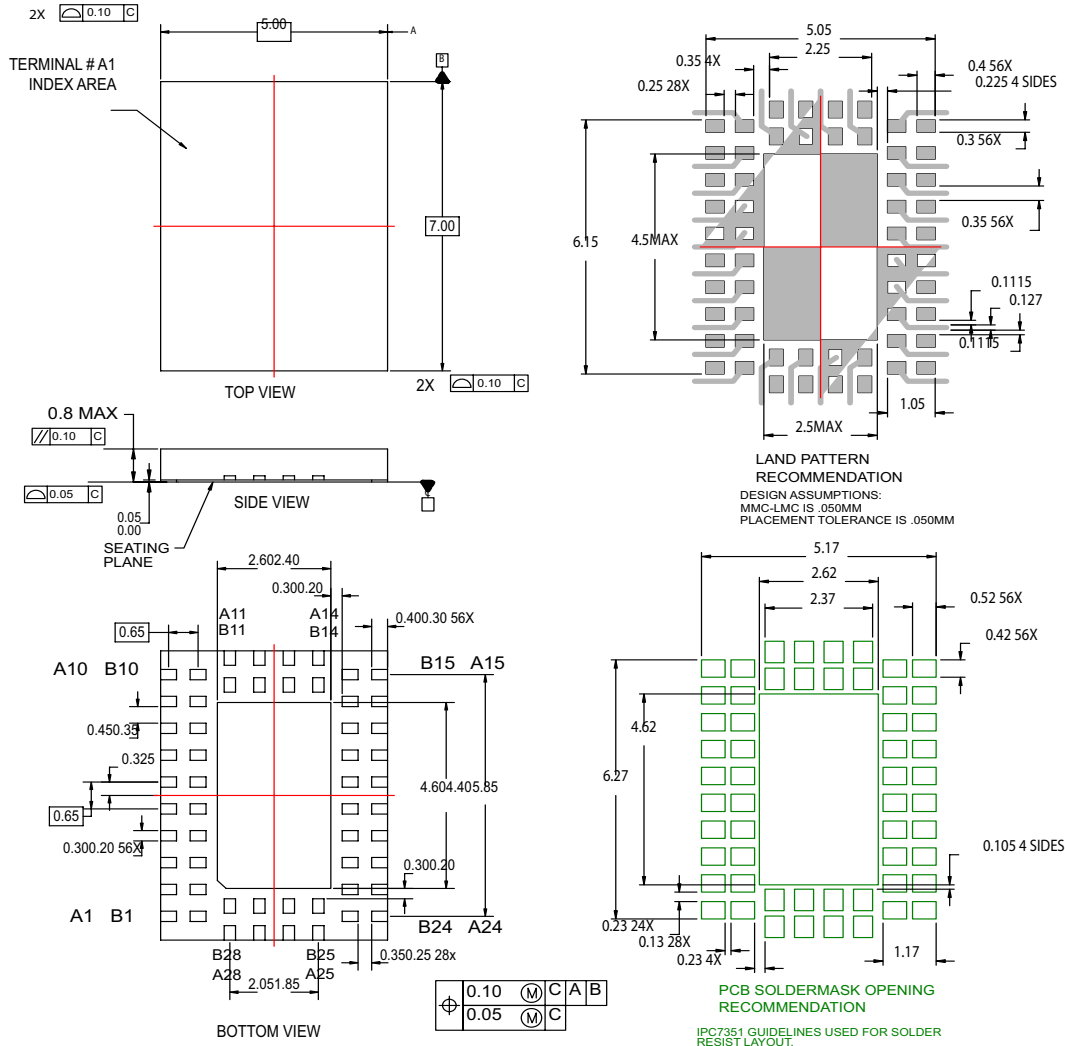
Dimensions are in millimeters unless otherwise noted.



**Figure 16. 48-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide**

## Physical Dimensions (Continued)

Dimensions are in millimeters unless otherwise noted.



**NOTES:**

- A. NOT CURRENTLY REGISTERED WITH ANY STANDARDS BODY.
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994
- D. PRELIMINARY DRAWING SUBJECT TO REVISION.

MLP56Arev2

**Figure 17. 56-Lead Molded Leadless Package (MLP) 5x7mm**

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| Build it Now <sup>™</sup>                        | HiSeC <sup>™</sup>              | OPTOPLANAR <sup>™</sup>         | Stealth <sup>™</sup>         | Wire <sup>™</sup>     |
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|--------------------------|------------------------|--|
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