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FAIRCHILD SEMICONDUCTOR®

August 2009

# FSA2367 — Low $R_{ON}$ (0.75Ω) Triple-SPDT, Negative-Swing Audio Source Switch

## Features

- 10µA Maximum $I_{CCT}$ Current Over Expanded Control Voltage Range ($V_{IN}$=2.6V, $V_{CC}$=4.3V)
- On Capacitance 55pF Typical ($C_{ON}$)
- 0.75Ω Typical On Resistance ($R_{ON}$)
- Common Ports 1A, 2A, 3A with Negative Swing Audio to -2V
- -3db Bandwidth: >150 MHz
- Low Power Consumption (1µA Maximum)
- Power-Off Feature for 1A/2A/3A Pin ($I_{IN}$ < 2µA)
- Packaged in Pb-Free 14-Pin TSSOP and DQFN

## Applications

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

## Description

The FSA2367 is a triple Single-Pole Double-Throw (SPDT) switch that multiplexes three sources of data or audio under independent control pins. The FSA2367 has special circuitry on the 1A, 2A, 3A pins that allows a power-off feature. With the $V_{CC}$ supply removed and a voltage on the 1A/2A/3A pins, there is minimal leakage current into the 1A/2A/3A data pins. In addition, the FSA2367 also features very low quiescent current to extend battery life. The low quiescent current allows mobile handset applications direct interface with the baseband processor general-purpose I/Os. Typical applications involve switching in portables and consumer applications such as cell phones, digital cameras, and notebooks with hubs or controllers.

## IMPORTANT NOTE:

For additional information, please contact analogswitch@fairchildsemi.com.

## Ordering Information

| Part Number | Top Mark | Eco Status | Package |
|---|---|---|---|
| FSA2367BQX | 2367 | Green | 14-Terminal Depopulated very thin Quad Flat-pack No leads (DQFN) 2.5 x 3.0mm, JEDEC MO-241 |
| FSA2367MTCX | FSA2367 | RoHS | 14-Lead Thin Shrink Small Outline Package (TSSOP), 4.4mm Wide, JEDEC MO-153 |

*For Fairchild's definition of Eco Status, please visit: http://www.fairchildsemi.com/company/green/rohs_green.html.*

## Analog Symbol

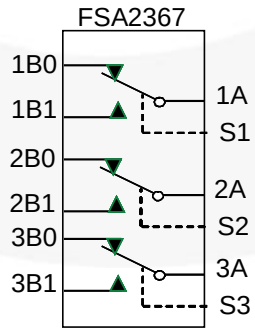



**Figure 1. Analog Symbol**

## Pin Assignments

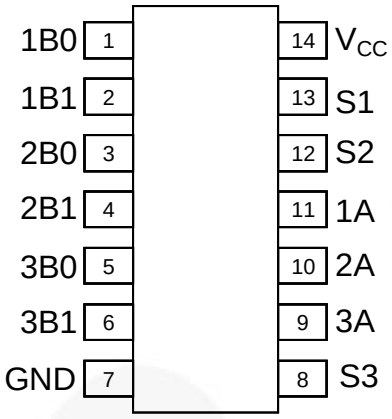



**Figure 2. Pin Assignment TSSOP-14 (Top View)**

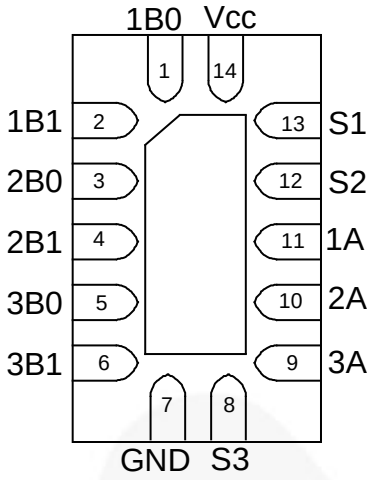



**Figure 3. Pad Assignment DQFN-14 (Top View)**

## Pin Descriptions

| Pin Name | Description |
|---|---|
| S1, S2, S3 | Switch Control Selects |
| 1A, 2A, 3A | A Data Bus (Common) |
| 1Bn, 2Bn, 3Bn | Multiplexed Source inputs |

## Truth Table

| S1, S2, S3 | Function |
|---|---|
| LOW | 1B0=1A; 2B0=2A; 3B0=3A |
| HIGH | 1B1=1A; 2B1=2A; 3B1=3A |

## 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 |
|---|---|---|---|---|---|
| $V_{CC}$ | Supply Voltages | | -0.5 | 6.0 | V |
| $V_{SW}$ | Switch I/O Voltage[1] | 1Bn, 2Bn Pins | $V_{CC}$-5.5V | $V_{CC}$-0.3V | V |
| | | 1A, 2A Pins | $V_{CC}$-5.5V | $V_{CC}$-0.3V | V |
| $V_{CNTRL}$ | Control Input Voltage[1] | S0, S1 | -0.5 | 6.0 | V |
| | Input Clamp Diode Current | | -50 | | mA |
| | Switch I/O Current | Continuous | | 350 | mA |
| | Peak Switch Current | Pulsed at 1ms duration, <10% Duty Cycle | | 500 | mA |
| $P_D$ | Power Dissipation at 85ºC | DQFN14 package | | 2.5 | µW |
| | | TSSOP14 package | | 2.5 | µW |
| $T_{STG}$ | Storage Temperature Range | | -65 | +150 | °C |
| $T_J$ | Maximum Junction Temperature | | | +150 | °C |
| $T_L$ | Lead Temperature | Soldering, 10 seconds | | +260 | °C |
| ESD | Human Body Model (JEDEC: JESD22-A114) | All Pins | | 5500 | kV |
| | | I/O to GND | | 8000 | |
| | | VCC to GND | | 8000 | |
| | Charged Device Model (JEDEC-JESD22-C101) | | | 2000 | kV |

**Note:**

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

## 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 | Min. | Max. | Unit |
|---|---|---|---|---|
| $V_{CC}$ | Supply Voltages | 2.7 | 4.3 | V |
| $V_{S0:S1}$ | Control Input Voltage | 0 | $V_{CC}$ | V |
| $V_{SW}$ | Switch I/O Voltage | $V_{CC}$ -5.5 | $V_{CC}$-0.3 | V |
| $T_A$ | Operating Temperature | -40 | +85 | ºC |
| $\theta_{JA}$ | Thermal Resistance (free air) | | 145 | ºC/W |

## DC Electrical Characteristics

All typical values are at 25°C unless otherwise specified.

| Symbol | Parameter | Conditions | Vcc (V) | $T_A$=- 40°C to +85°C | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| | Analog Signal Range | | | Vcc-5.5 | | Vcc | V |
| $V_{IK}$ | Clamp Diode Voltage | $I_{IN}$=-18mA | 3.0 | | | -1.2 | V |
| $V_{IH}$ | Input Voltage High | | 2.7 to 3.6 | 1.2 | | | V |
| | | | 3.6 to 4.3 | 1.5 | | | |
| $V_{IL}$ | Input Voltage Low | | 2.7 to 3.6 | | | 0.5 | V |
| | | | 3.6 to 4.3 | | | 0.7 | |
| $I_{IN}$ | Control Input Leakage | $V_{IN}$=0 to $V_{cc}$ | 4.3 | | | ±1 | µA |
| $I_{OFF}$ | Power-Off Leakage Current (Common Port Only 1A, 2A) | Common Port (1A, 2A), $V_{SW=}$0 to 4.3V, $V_{CC}$=0V | 0V | | | ±10 | µA |
| $I_{NO(0FF)}$ | Off-Leakage Current of Port 1Bn, 2Bn | 1Bn, 2Bn=0.5V, $V_{CC}$ - 0.5V or Floating 1A, 2A=0.5V, $V_{CC}$ – 0.5V Figure 8 | 4.3 | -250 | 10 | 250 | nA |
| $I_{NC(0N)}$ | On-Leakage Current of Port 1Bn, 2Bn | 1Bn, 2Bn=Floating 1A, 2A=0.5V, $V_{CC}$ – 0.5V Figure 10 | 4.3 | -250 | 10 | 250 | nA |
| $R_{ON}$ | Switch On Resistance[2] | 1Bn or 2Bn=0V, 0.7V, 2.0V,2.7V, $I_{ON=}$-100m Figure 9 | 2.7 | | 0.75 | 2.00 | Ω |
| $\Delta R_{ON}$ | Delta $R_{ON}$[3] | 1Bn or 2Bn=0.7V , $I_{ON=}$-100mA | 2.7 | | 0.5 | | Ω |
| $R_{FLAT(ON)}$ | On Resistance Flatness[4] | 1Bn or 2Bn=0V, 0.7V, 2.0V,2.7V, $I_{ON=}$-100mA | 2.7 to 4.3 | | 0.23 | 0.40 | Ω |
| $I_{CC}$ | Quiescent Supply Current | $V_{SW=}$0 or $V_{CC}$, $I_{OUT}$=0 | 4.3 | | | 500 | nA |
| $I_{CCT}$ | Increase in $I_{CC}$ Current per Control Voltage and $V_{CC}$ | $V_{CNTRL=}$2.6V | 4.3 | | 2.2 | 10.0 | µA |
| | | $V_{CNTRL=}$1.8V | 4.3 | | 6.5 | 15.0 | |

**Notes:**

2. Measured by the voltage drop between the 1Bn (2Bn, 3Bn) and 1A (2A, 3A) pins at the indicated current through the switch. On resistance is determined by the lower voltage on the two.
3. Guaranteed by characterization; not tested in production.
4. Flatness is defined as the difference between minimum and maximum on resistance over the specified range.

## AC Electrical Characteristics

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

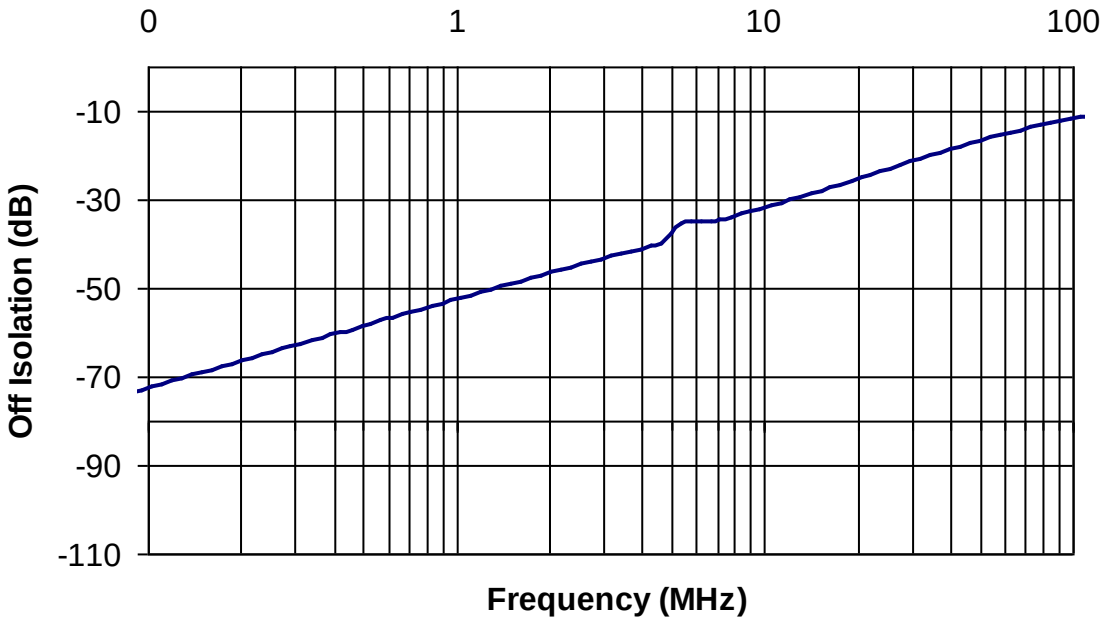
| Symbol | Parameter | Conditions | Vcc (V) | $T_A$=- 40ºC to +85ºC | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| $t_{ON}$ | Turn-On Time, S to Output | $V_{Bn}$=1.5V, $R_L$=50Ω, $C_L$=35pF<br>Figure 10, Figure 12 | 2.7 to 4.3 | | 45 | 60 | ns |
| $t_{OFF}$ | Turn-Off Time, S to Output | $V_{Bn}$=1.5V, $R_L$=50Ω, $C_L$=35pF<br>Figure 10, Figure 12 | 2.7 to 4.3 | | 25 | 45 | ns |
| $t_{PD}$ | Propagation Delay(5) | $R_L$=50Ω, $C_L$=5pF<br>Figure 10, Figure 13 | 3.3 | | 0.25 | | ns |
| $t_{BBM}$ | Break-Before-Make(5) | $R_L$=50Ω, $C_L$=35pF<br>$V_{IN1=}V_{IN2=}V_{IN3=}$1.5V<br>Figure 11 | 2.7 to 4.3 | 1 | 6 | | ns |
| Q | Charge Injection | $R_{GEN=}$0Ω, $C_L$=100pF, $R_L$=OPEN; $V_{GEN=}$0V<br>Figure 14 | 2.7 to 4.3 | | 9 | | pC |
| $O_{IRR}$ | Off-Isolation | f=100 kHz, $R_L$=50Ω<br>Figure 4, Figure 16 | 2.7 to 4.3 | | -70 | | dB |
| Xtalk | Non-Adjacent Channel Crosstalk | f=100 kHz, $R_L$=50Ω<br>Figure 5, Figure 17 | 2.7 to 4.3 | | -100 | | dB |
| THD | Total Harmonic Distortion | $R_L$=600Ω, $V_{SW=}$0.5$V_{pp}$, f=20 Hz to 20kHz<br>Figure 20 | 2.7 to 4.3 | | 0.01 | | % |
| BW | -3db bandwidth | $R_L$=50Ω, $C_L$=0, 5pF<br>Figure 6, Figure 15 | 2.7 to 4.3 | | 150 | | MHz |

**Note:**
5. Guaranteed by characterization; not tested in production.

## Capacitance

| Symbol | Parameter | Conditions | $T_A$=- 40ºC to +85ºC | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| $C_{IN}$ | Control Pin Input Capacitance | $V_{CC}$=0V | | 2.5 | | pF |
| $C_{ON}$ | A/B On Capacitance | $V_{CC}$=3.3, f=1MHz<br>Figure 19 | | | 55 | |
| $C_{OFFB}$ | Port 1Bn, 2Bn,3Bn Off Capacitance | $V_{CC}$=3.3, f=1MHz<br>Figure 18 | | | 16 | |
| $C_{OFFA}$ | Port 1A, 2A,3A Off Capacitance | $V_{CC}$=3.3, f=1MHz<br>Figure 18 | | | 20 | |

## Typical Performance Characteristics




**Vcc = 3.3V**

**Figure 4. Off Isolation $V_{CC}$=3.3V, $C_L$=0pF**

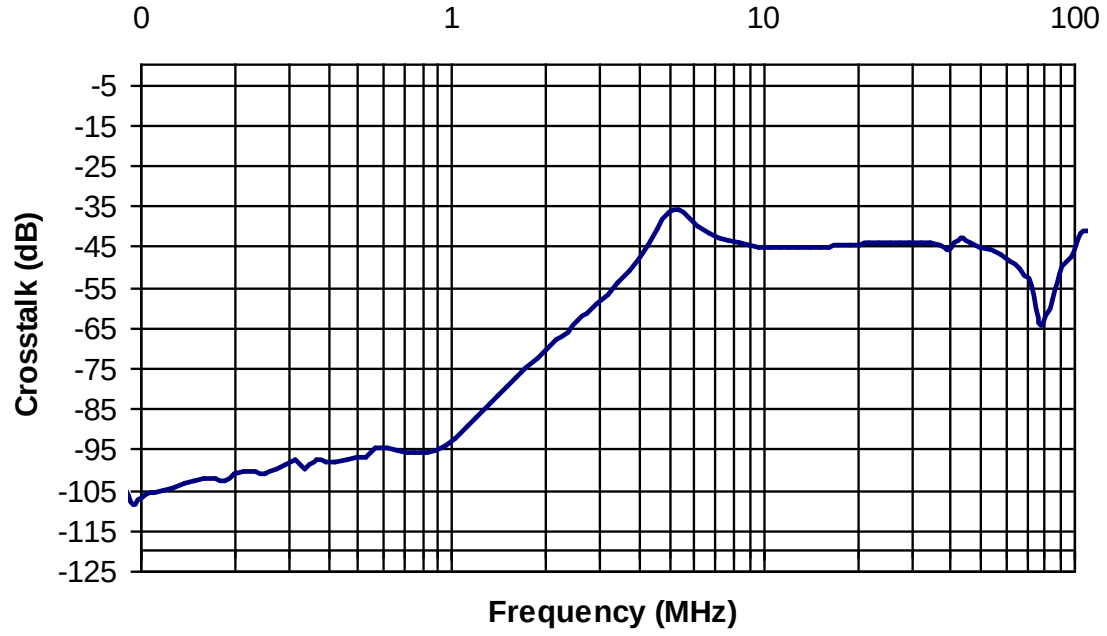



**Figure 5. Non-Adjacent Crosstalk $V_{CC}$=3.3, $C_L$=0pF**

## Typical Performance Characteristics (Continued)

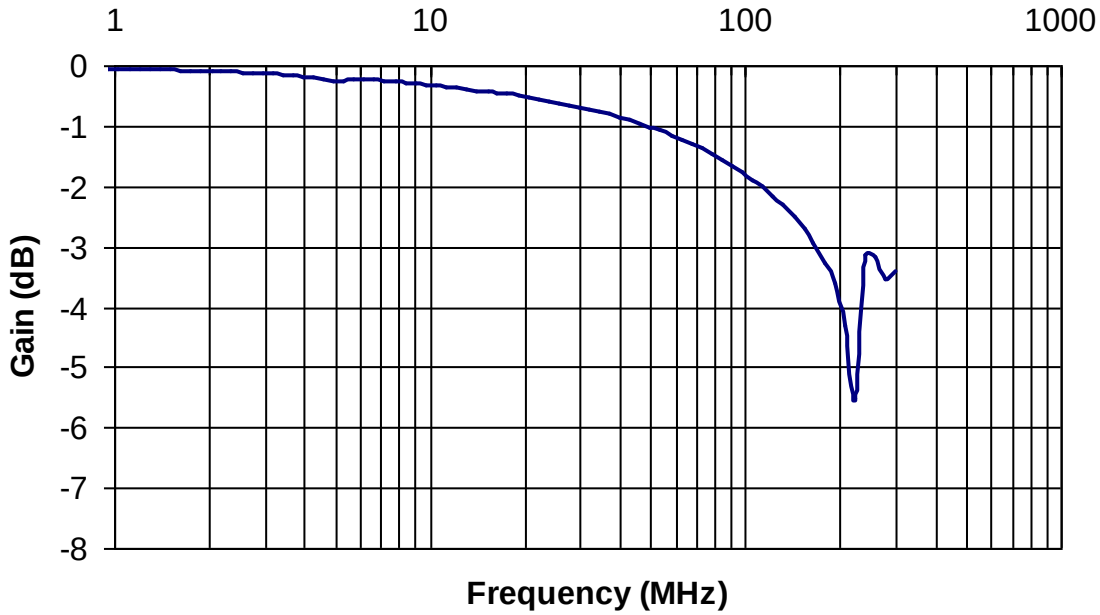



**Figure 6. Bandwidth Characterization, Frequency Response at $V_{CC}$=3.3V, $C_L$=0pF**

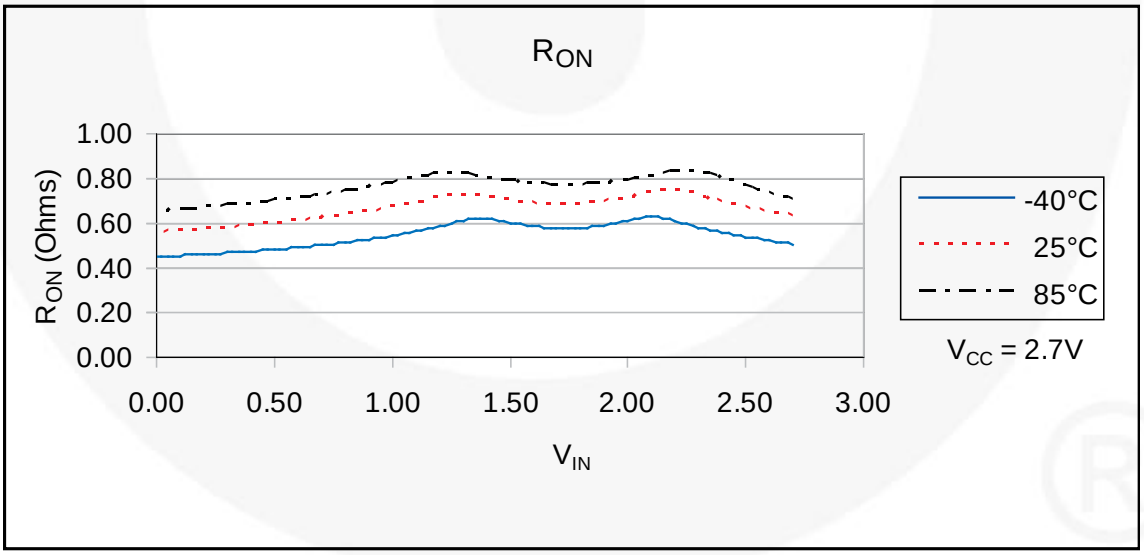
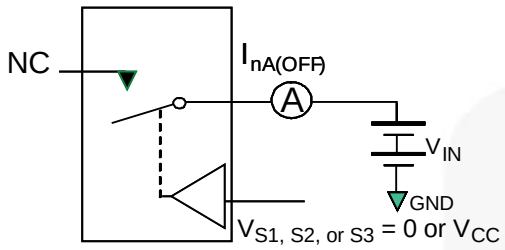



**Figure 7. On Resistance**

## Test Diagrams




**Each switch port is tested separately

**Figure 8. Off Leakage**

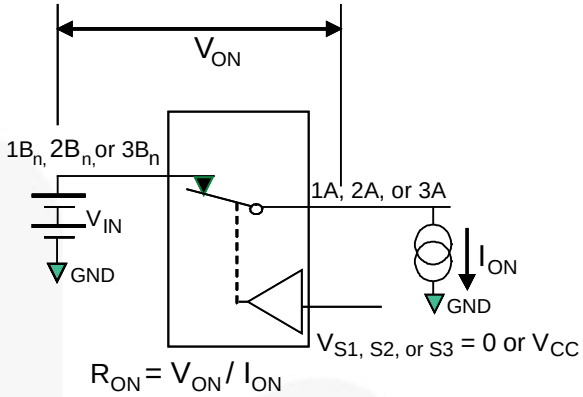
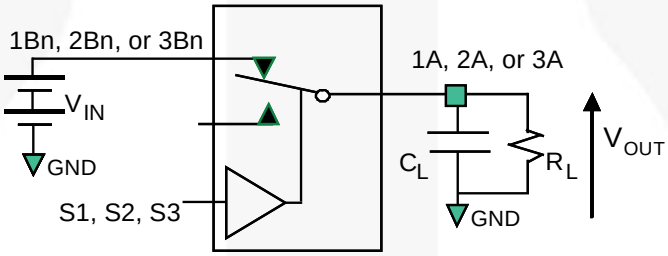
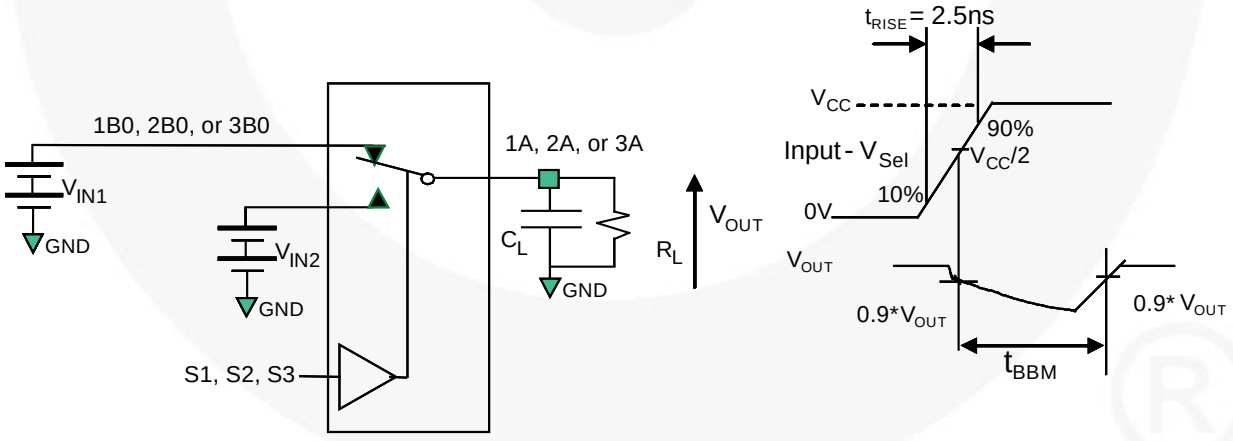



**Figure 9. On Resistance**




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

**Figure 10. AC Test Circuit Load**




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

**Figure 11. Break-Before-Make Interval Timing**

## Test Diagrams (Continued)

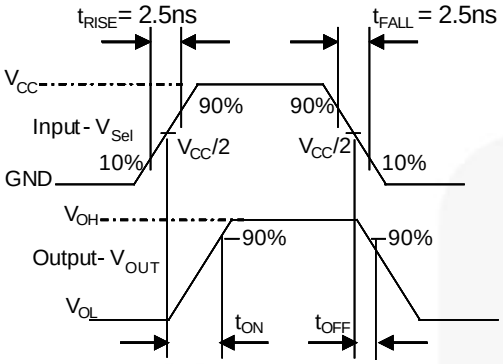



**Figure 12. Turn-On / Turn-Off Waveforms**

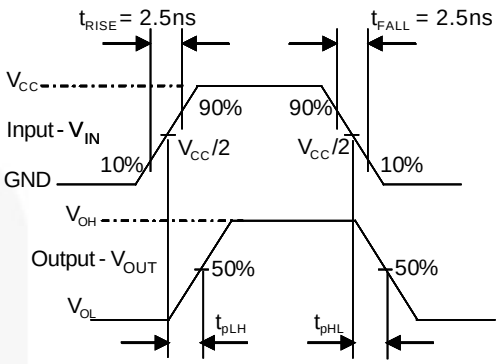



**Figure 13. Switch Propagation Delay Waveforms**

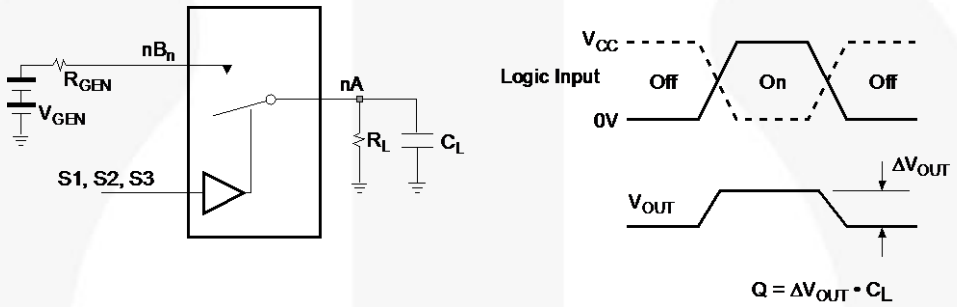
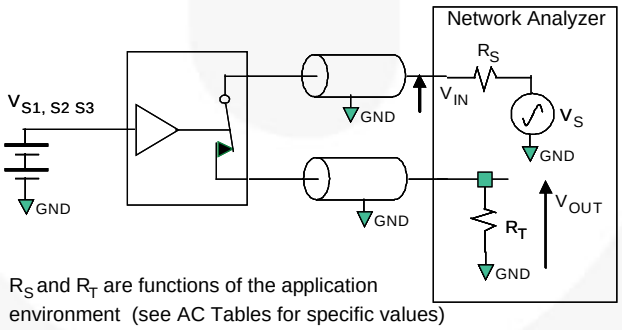
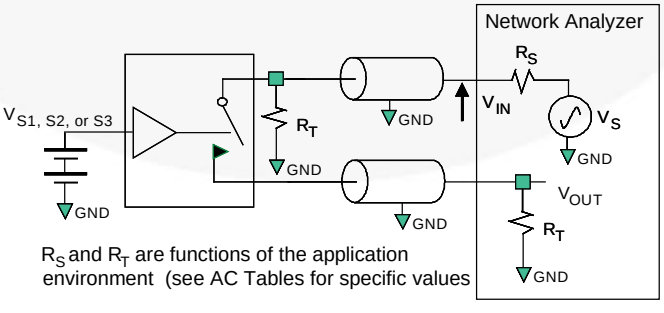



**Figure 14. Charge Injection Test ($Q=\Delta V_{OUT} * C_L$)**




$R_S$ and $R_T$ are functions of the application environment (see AC Tables for specific values)

**Figure 15. Bandwidth**




$R_S$ and $R_T$ are functions of the application environment (see AC Tables for specific values

Off -Isolation = 20 Log ($V_{OUT}$ / $V_{IN}$ )

**Figure 16. Channel Off Isolation**

## Test Diagrams (Continued)

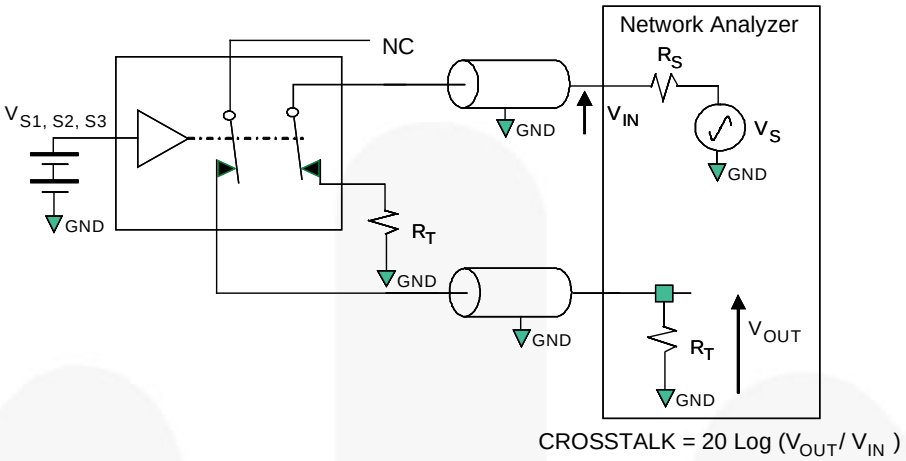



**Figure 17. Non-Adjacent Channel-to-Channel Crosstalk**

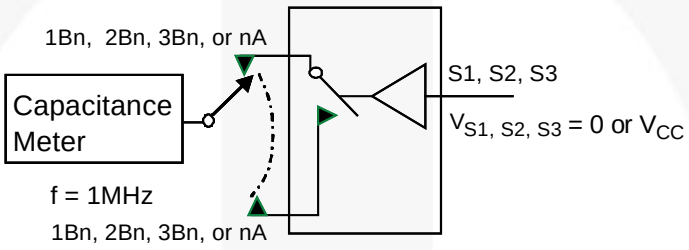



**Figure 18. Channel Off Capacitance**

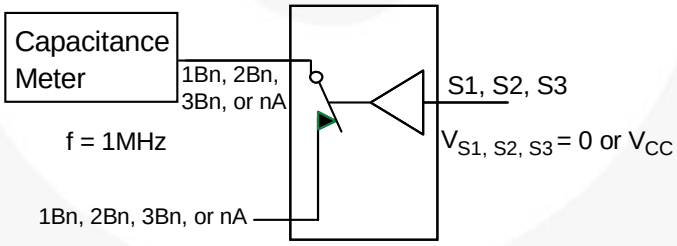



**Figure 19. Channel On Capacitance**

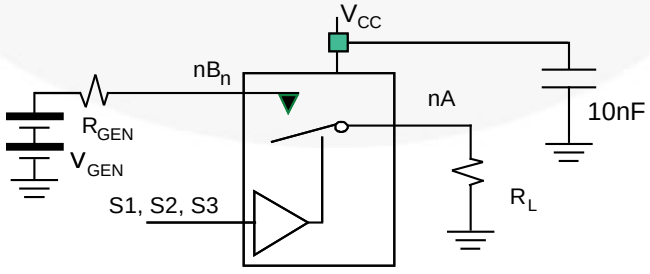
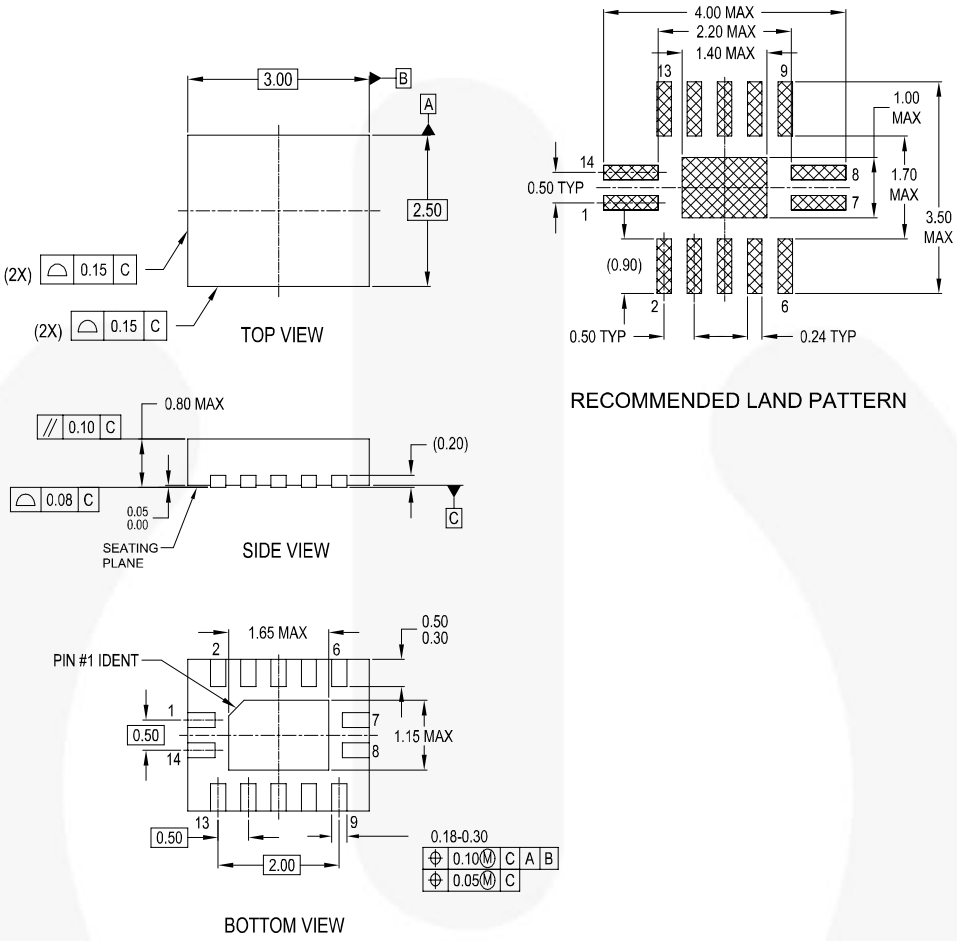



**Figure 20. Total Harmonic Distortion**

## Physical Dimensions




NOTES:

A. CONFORMS TO JEDEC REGISTRATION MO-241, VARIATION AA

B. DIMENSIONS ARE IN MILLIMETERS

C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994

MLP14ArevA

**Figure 21. 14-Terminal Depopulated very thin Quad Flat-pack No leads (DQFN)**

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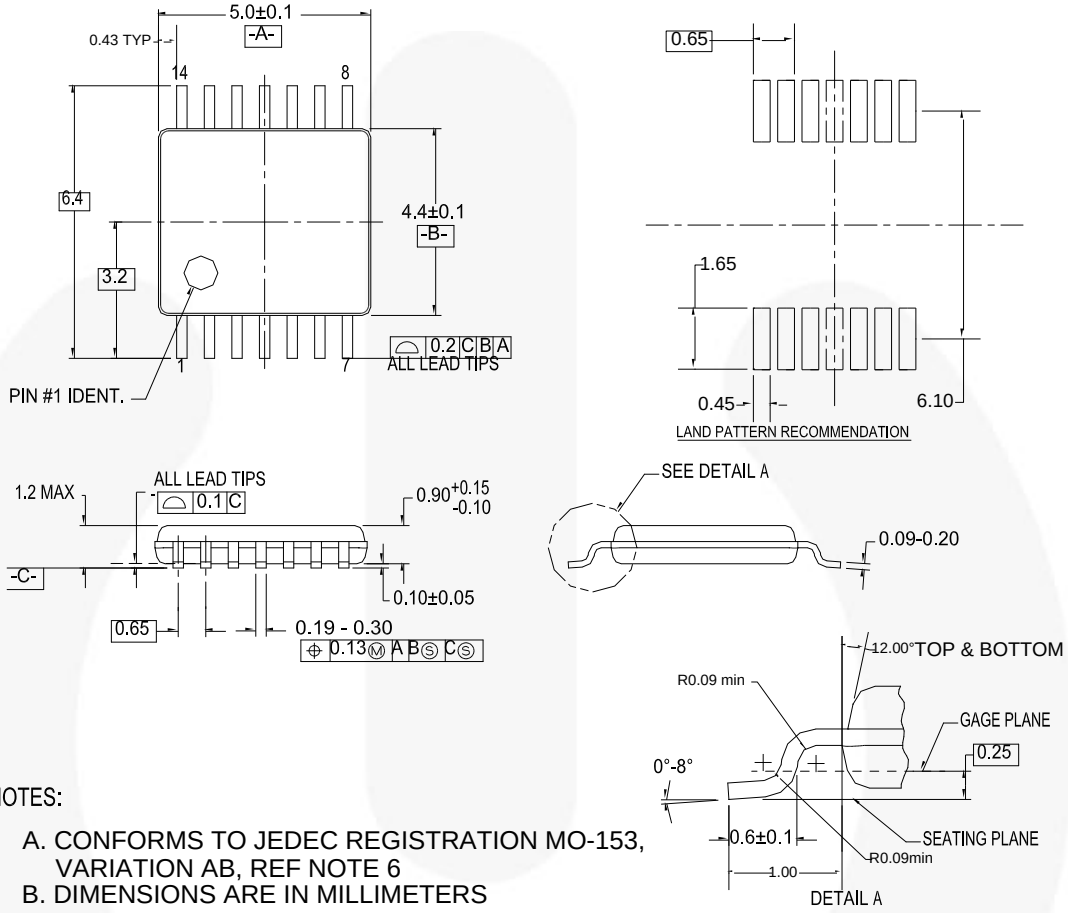
## Physical Dimensions (Continued)




NOTES:

A. CONFORMS TO JEDEC REGISTRATION MO-153, VARIATION AB, REF NOTE 6

B. DIMENSIONS ARE IN MILLIMETERS

C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS

D. DIMENSIONING AND TOLERANCES PER ANSI Y14.5M, 1982

E. LANDPATTERN STANDARD: SOP65P640X110-14M

F. DRAWING FILE NAME: MTC14REV6

**Figure 22. 4-Lead Thin Shrink Small Outline Package (TSSOP)**

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SuperSOT™-6
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