

### GENERAL DESCRIPTION

The MP2735/MP2736 are low voltage, low on-resistance, dual single-pole, double-throw (SPDT) monolithic CMOS analog switches designed for high performance switching of analog signals. Combining low-power, high speed, low on-resistance, and small package size, the MP2735/MP2736 are ideal for portable and battery power applications.

The MP2735/MP2736 have an operation range from 1.65V to 5.5V single supply. The MP2735 has two separate control pins and two separate SPDT switches. The MP2736 includes an  $\overline{EN}$  pin. All switches are at high impedance mode when the  $\overline{EN}$  is high.

The MP2735/MP2736 are guaranteed 1.65V logic compatible for  $V+ < 3.3V$ , allowing the easy interface with low voltage DSP or MCU control logic and ideal for one cell Li-ion battery direct power.

The switch conducts signals within power rails equally well in both directions when on, and blocks up to the power supply level when off. Break-before-make is guaranteed.

The MP2735/MP2736 are offered in a QFN10 package.

### FEATURES

- Low Voltage Operation (1.65V to 5.5V)
- Low On-Resistance -  $R_{ON}$ : 0.45Ω at 2.7V
- Fast Switching:  $T_{ON}$  = 29ns at 2.7V
- $T_{OFF}$  = 23ns at 2.7V
- Latch-Up Current >300mA (JESD78)
- 1.4mm x 1.8mm QFN10 Package
- ESD Human-Body Model  $\pm 4000V$

### APPLICATIONS

- Cellular Phones
- Speaker Headset Switching
- Audio and Video Signal Routing
- PCMCIA Cards
- Battery Powered Systems
- Portable Media Player
- Handheld Test Instruments

### TRUTH TABLE

|               | IN1/2 | $\overline{EN}$ | NC1/2 | NO1/2 |
|---------------|-------|-----------------|-------|-------|
| <b>MP2735</b> | 0     | -               | ON    | OFF   |
|               | 1     | -               | OFF   | ON    |
| <b>MP2736</b> | 0     | 1               | OFF   | OFF   |
|               | 1     | 1               | OFF   | OFF   |
|               | 0     | 0               | ON    | OFF   |
|               | 1     | 0               | OFF   | ON    |

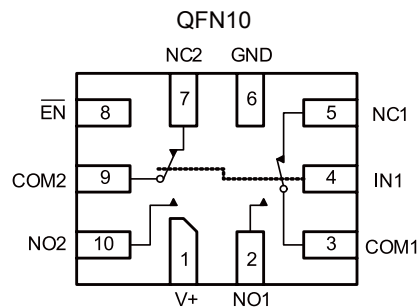
"MPS" and "The Future of Analog IC Technology" are Registered Trademarks of Monolithic Power Systems, Inc..

### FUNCTIONAL BLOCK DIAGRAM PIN CONFIGURATION

**MP2735DQG**



**MP2736DQG**



### ORDERING INFORMATION

| Part Number* | Package                 | Top Marking     | Free Air Temperature (T <sub>A</sub> ) |
|--------------|-------------------------|-----------------|--|
| MP2735DQG    | QFN10<br>(1.4mm x1.8mm) | $\overline{2T}$ | -40°C to +85°C                         |
| MP2736DQG    |                         | $\overline{AM}$ |  |

\* For Tape & Reel, add suffix -Z (e.g. MP2735DQG-Z).  
 For RoHS compliant packaging, add suffix -LF (e.g. MP2735DQG-LF-Z)

### PACKAGE REFERENCE



### ABSOLUTE MAXIMUM RATINGS

V+ Supply Voltage .....-0.3V to +6V  
 IN/COM/NC/NO Voltage <sup>(1)</sup> ... -0.3V to V+ + 0.3V  
 Current  
 (Any terminal except NO, NC or COM) .....  
 ..... 30mA  
 Continuous Current (NO, NC or COM) .....  
 ..... ±250mA  
 Peak Current  
 (Pulsed at 1ms, 10% duty cycle) ..... ±500mA  
 Storage Temperature..... -65°C to +150°C  
 Power Dissipation (QFN10 <sup>(2)</sup> <sup>(3)</sup>) ..... 208mW

#### Notes:

- 1) Signals on NC, or COM or IN exceeding V+ will be clamped by internal diodes. Limit forward diode current to maximum current ratings.
- 2) Derate 4.0mW/°C above 70°C.
- 3) All leads welded or soldered to PC Board.

## ELECTRICAL CHARACTERISTICS

V+=3V, ±10%, V<sub>IN</sub>=0.4 or 1.65V, unless otherwise noted.

| Parameter                  | Symbol                               | Condition   | Min                             | Typ                      | Max  | Units |
|----------------------------|--------------------------------------|---|---------------------------------|--------------------------|------|-------|
| <b>Analog Switch</b>       |                                      |   |                                 |                          |      |       |
| Analog Signal Range        | V <sub>analog</sub>                  | r <sub>DS(on)</sub> , T <sub>A</sub> = -40°C to +85°C               | 0                               |                          | V+   | V     |
| On-Resistance              | r <sub>DS(on)</sub>                  | V+=2.7V, I <sub>NO/NC</sub> =100mA, V <sub>COM</sub> =0.5V          | T <sub>A</sub> = +25°C          | 0.28                     | 0.45 | Ω     |
|                            |                                      | V+=2.7V, I <sub>NO/NC</sub> =100mA, V <sub>COM</sub> =1.5V          |                                 |                          |      |       |
|                            |                                      | V+=2.7V, I <sub>NO/NC</sub> =100mA, V <sub>COM</sub> =0.5V          | T <sub>A</sub> = -40°C to +85°C | 0.30                     |      |       |
|                            |                                      | V+=2.7V, I <sub>NO/NC</sub> =100mA, V <sub>COM</sub> =1.5V          |                                 |                          |      |       |
|                            |                                      | V+=5.5V, I <sub>NO/NC</sub> =100mA, V <sub>COM</sub> =0.9V          | T <sub>A</sub> = +25°C          | 0.20                     | 0.30 |       |
|                            |                                      | V+=5.5V, I <sub>NO/NC</sub> =100mA, V <sub>COM</sub> =2.5V          |                                 | 0.18                     |      |       |
|                            |                                      | V+=5.5V, I <sub>NO/NC</sub> =100mA, V <sub>COM</sub> =0.9V          | T <sub>A</sub> = -40°C to +85°C | 0.25                     |      |       |
|                            |                                      | V+=5.5V, I <sub>NO/NC</sub> =100mA, V <sub>COM</sub> =2.5V          |                                 |                          |      |       |
| r <sub>ON</sub> Match      | Δr <sub>on</sub>                     | V+=2.7V, I <sub>NO/NC</sub> =100mA, V <sub>COM</sub> =0.5V/1.5V     | T <sub>A</sub> = +25°C          | 0.01                     | 0.02 |       |
|                            |                                      | V+=5.5V, I <sub>NO/NC</sub> =100mA, V <sub>COM</sub> =0.9V/2.5V     |                                 |                          |      |       |
| r <sub>ON</sub> Flatness   | r <sub>ON</sub> Flatness             | V+=2.7V, I <sub>NO/NC</sub> =100mA, V <sub>COM</sub> =0.5V/1.5V     |                                 |                          | 0.15 |       |
| Switch Off Leakage Current | I <sub>NO/NC(off)</sub>              | V+=5.5V, V <sub>NO/NC</sub> =0.3V/4.0V, V <sub>COM</sub> =4.0V/0.3V | T <sub>A</sub> = +25°C          | -40                      | 40   | nA    |
|                            |                                      |   | T <sub>A</sub> = -40°C to +85°C | -100                     | 100  |       |
|                            | T <sub>A</sub> = +25°C               |   | -40                             | 40                       |      |       |
|                            | T <sub>A</sub> = -40°C to +85°C      |   | -100                            | 100                      |      |       |
| Channel-On Leakage Current | I <sub>COM(on)</sub>                 | V+=5.5V, V <sub>NO/NC</sub> =V <sub>COM</sub> =4.0V/0.3V            | T <sub>A</sub> = +25°C          | -40                      | 40   |       |
|                            |                                      |   | T <sub>A</sub> = -40°C to +85°C | -150                     | 150  |       |
| <b>Digital Control</b>     |                                      |   |                                 |                          |      |       |
| Input High Voltage         | V <sub>INH</sub>                     |   | T <sub>A</sub> = -40°C to +85°C | 1.65                     |      | V     |
| Input Low Voltage          | V <sub>INL</sub>                     |   |                                 |                          | 0.4  |       |
| Input Capacitance          | C <sub>IN</sub>                      |   |                                 | 6                        |      | pF    |
| Input Current              | I <sub>INL</sub> or I <sub>INH</sub> |   |                                 | V <sub>IN</sub> =0 or V+ | -1   | 1     |

**ELECTRICAL CHARACTERISTICS (continued)**
**V+=3V, ±10%, V<sub>IN</sub>=0.4 or 1.65V, unless otherwise noted.**

| Parameter  | Symbol               | Condition  | Min                             | Typ                                      | Max | Units |    |
|--|----------------------|--|---------------------------------|--|-----|-------|----|
| <b>Dynamic Characteristics</b>                         |                      |  |                                 |  |     |       |    |
| Break-Before-Make Time                                 | t <sub>BBM</sub>     | V+=3.6V, V <sub>NO</sub> /V <sub>NC</sub> =1.5V, R <sub>L</sub> =50Ω, C <sub>L</sub> =35pF | T <sub>A</sub> = +25°C          |  | 10  |       | ns |
| Turn-On Time   | t <sub>ON</sub>      |  |                                 |  | 24  | 36    |    |
| Turn-Off Time  | t <sub>OFF</sub>     |  | T <sub>A</sub> = -40°C to +85°C |  |     | 40    |    |
|  |                      |  | T <sub>A</sub> = +25°C          |  | 20  | 30    |    |
| Enable Turn-On Time MP2736 ( $\overline{\text{EN}}$ )  | t <sub>ON(EN)</sub>  |  | T <sub>A</sub> = -40°C to +85°C |  |     | 35    |    |
|  |                      |  | T <sub>A</sub> = +25°C          |  | 24  | 36    |    |
| Enable Turn-Off Time MP2736 ( $\overline{\text{EN}}$ ) | t <sub>OFF(EN)</sub> |  | T <sub>A</sub> = -40°C to +85°C |  |     | 40    |    |
|  |                      |  | T <sub>A</sub> = +25°C          |  | 20  | 30    |    |
| Off-Isolation <sup>(4)</sup>                           | OIRR                 | R <sub>L</sub> =50Ω, C <sub>L</sub> =5pF, f=100kHz   | T <sub>A</sub> = +25°C          |  | -70 |       | dB |
| Crosstalk <sup>(4)</sup>                               | XTALK                |  |                                 |  | -70 |       | dB |
| 3dB Bandwidth  |                      |  |                                 | R <sub>L</sub> =50Ω, C <sub>L</sub> =5pF |     | 50    |    |
| NO, NC Off Capacitance <sup>(4)</sup>                  | C <sub>NO(off)</sub> | V <sub>IN</sub> =0V, or V+, f=1MHz   | T <sub>A</sub> = +25°C          |  | 55  |       | pF |
|  | C <sub>NC(off)</sub> |  |                                 |  | 55  |       |    |
| Channel On Capacitance <sup>(4)</sup>                  | C <sub>NO(on)</sub>  |  |                                 |  | 130 |       |    |
|  | C <sub>NC(on)</sub>  |  |                                 |  | 130 |       |    |
| <b>Power Supply</b>                                    |                      |  |                                 |  |     |       |    |
| Power Supply Range                                     | V+                   |  |                                 | 1.65                                     |     | 5.5   | V  |
| Power Supply Current                                   | I+                   | V <sub>IN</sub> =0 or V+   | T <sub>A</sub> = -40°C to +85°C | -1                                       |     | 1     | μA |

**Note:**

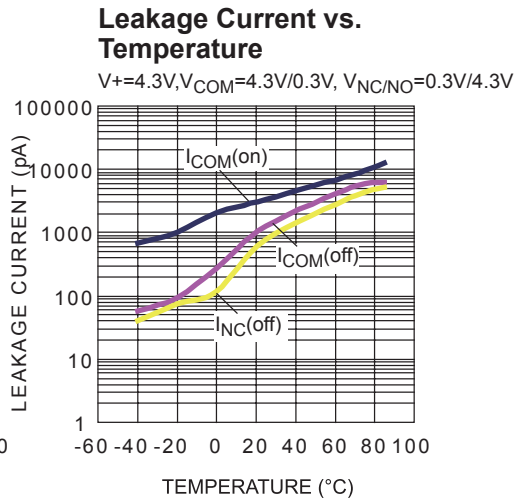
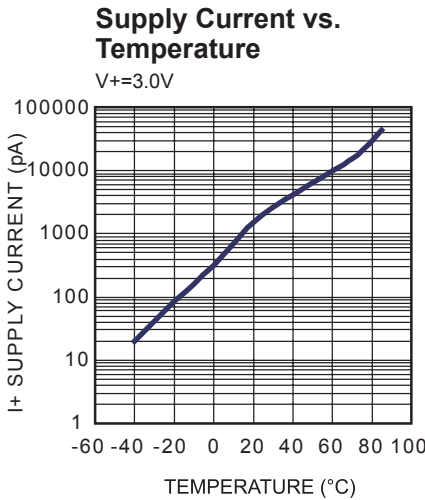
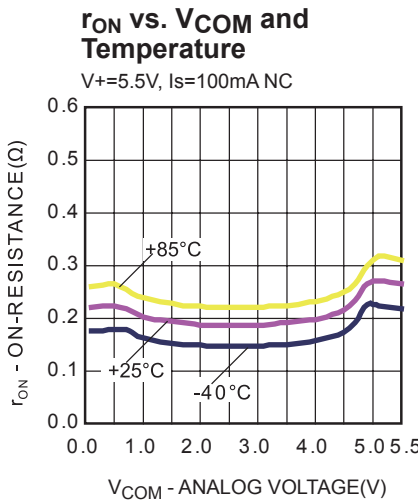
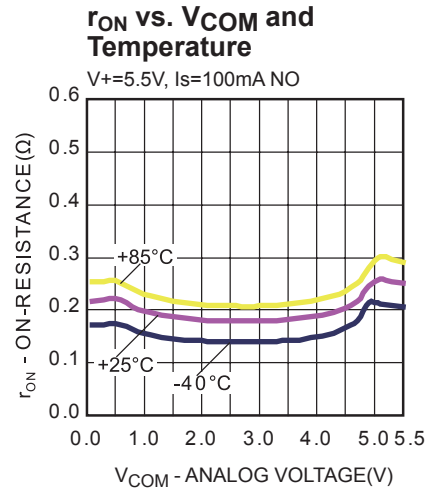
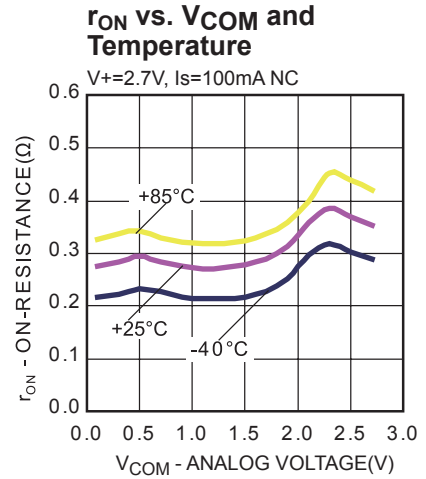
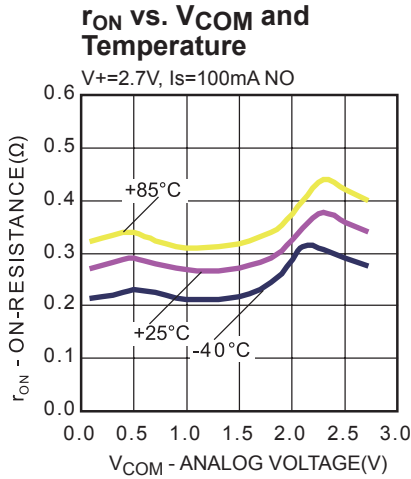
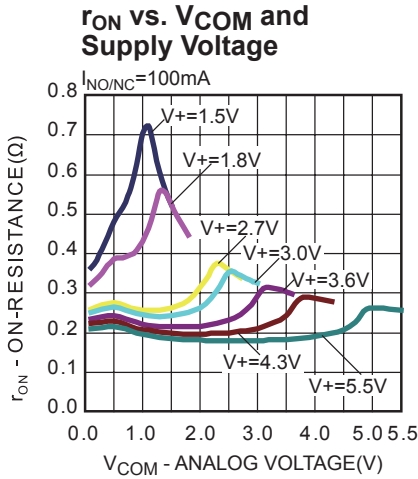
- 4) Guarantee by design, not subjected to production test.

## PIN FUNCTIONS

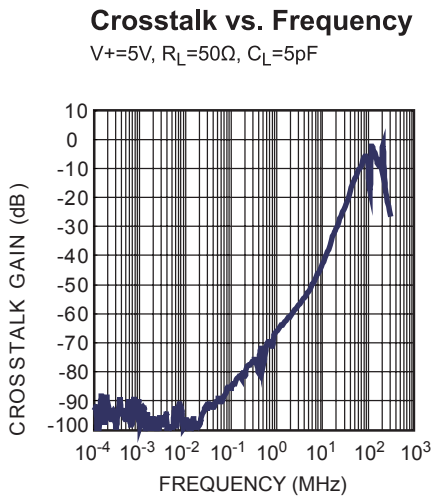
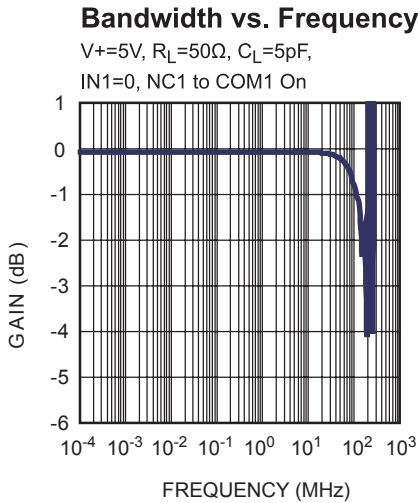
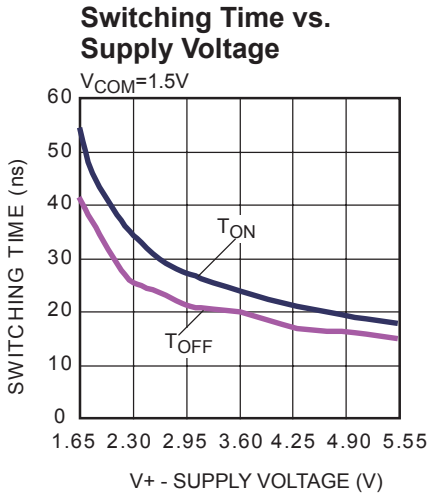
| ( MP2735DQG)<br>Pin # | ( MP2736DQG)<br>Pin # | Name                   | Description  |
|-----------------------|-----------------------|------------------------|--|
| 1                     | 1                     | V+                     | Supply Voltage   |
| 2                     | 2                     | NO1                    | Normally open I/O port of switch1  |
| 3                     | 3                     | COM1                   | Common I/O port for NC and NO channels of switch1  |
| 4                     | 4                     | IN1                    | Channel select signal for switch1. IN1 high, NO1 channel is selected. Otherwise, NC1 channel is selected in default. For MP2736, IN1 controls both switch1 and switch2 |
| 5                     | 5                     | NC1                    | Normally closed I/O port of switch1  |
| 6                     | 6                     | GND                    | Ground   |
| 7                     | 7                     | NC2                    | Normally closed I/O port of switch2  |
| 8                     |                       | IN2                    | Channel select signal for switch2. IN2 high, NO2 channel is selected. Otherwise, NC2 channel is selected in default  |
|                       | 8                     | $\overline{\text{EN}}$ | Enable for two channels, active low  |
| 9                     | 9                     | COM2                   | Common I/O port for NC and NO channels of switch2  |
| 10                    | 10                    | NO2                    | Normally open I/O port of switch2  |

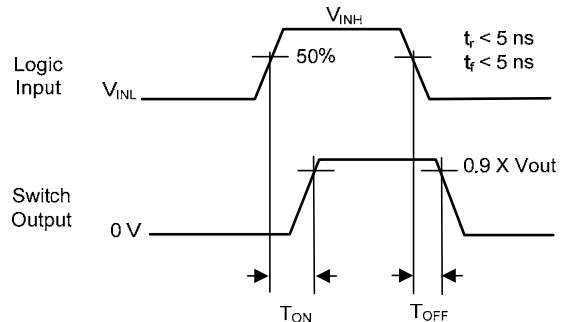
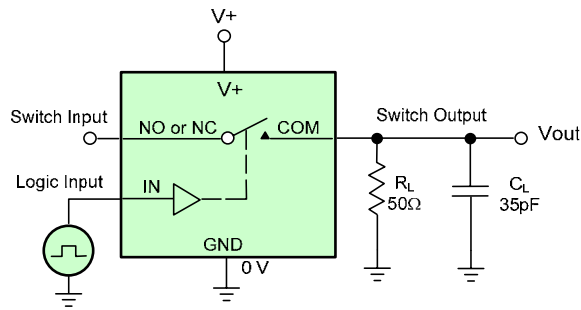
## TYPICAL PERFORMANCE CHARACTERISTICS

$T_A = +25^\circ\text{C}$ , unless otherwise noted.



**TYPICAL PERFORMANCE CHARACTERISTICS (continued)**

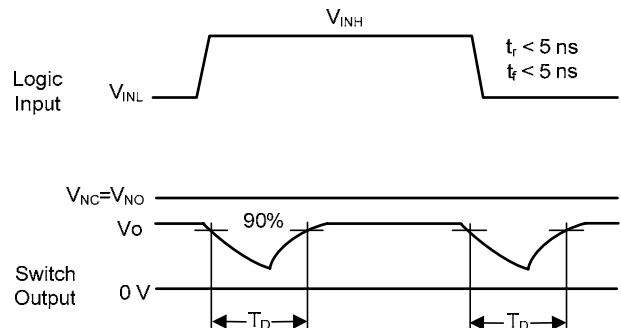
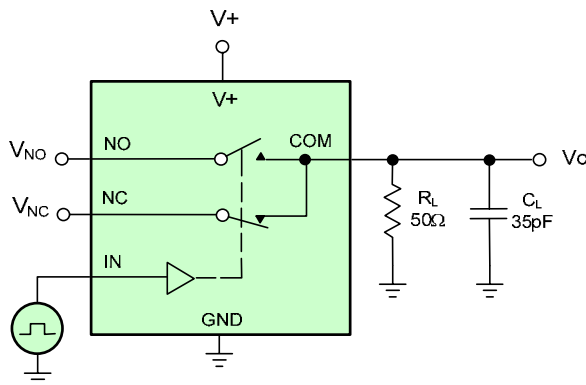
 T<sub>A</sub> = +25°C, unless otherwise noted.


**TEST CIRCUITS**


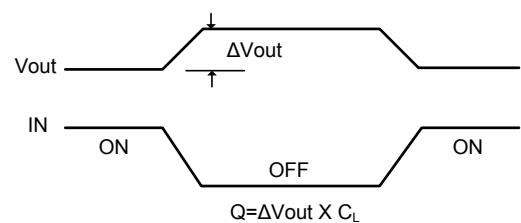
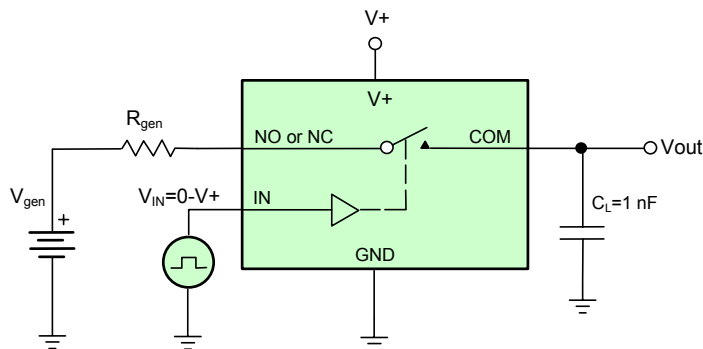
$C_L$  (includes fixture and stray capacitance)

$$V_{out} = V_{COM} \left( \frac{R_L}{R_L + R_{ON}} \right)$$

Logic "1" = Switch on  
Logic input waveforms inverted for switches that have the opposite logic sense.

**Figure 1 — Switching Time**


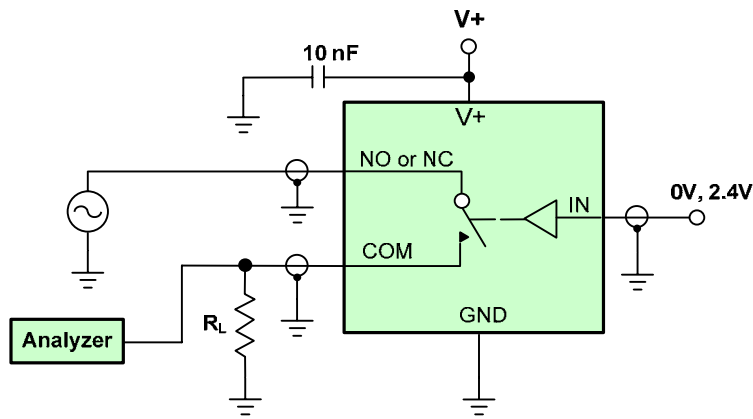
$C_L$  (includes fixture and stray capacitance)

**Figure 2 — Break-Before-Make Interval**


IN depends on switch configuration: input polarity determined by sense of switch.

**Figure 3 — Charge Injection**





$$\text{Off Isolation} = 20 \log \frac{V_{\text{COM}}}{V_{\text{NO/NC}}}$$

Figure 4 — Off-Isolation

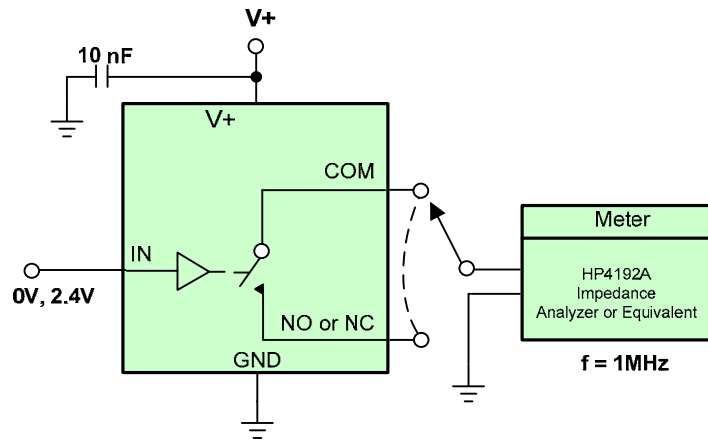
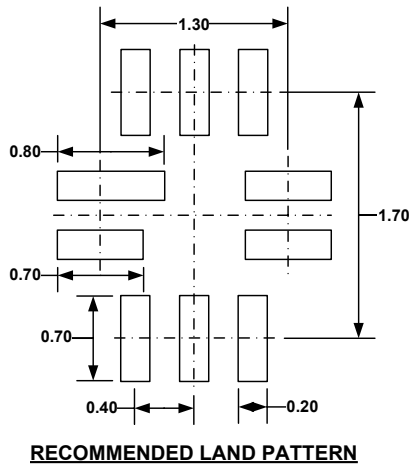
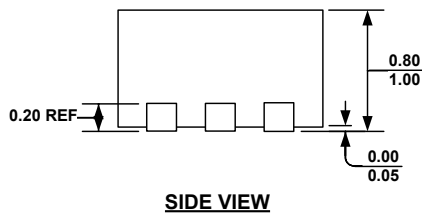
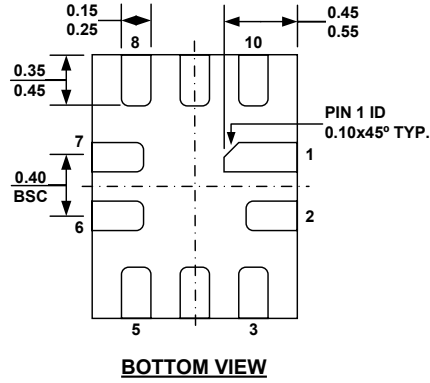
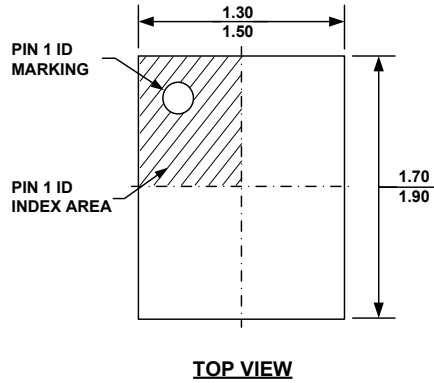


Figure 5 — Channel Off/On Capacitance

## PACKAGE INFORMATION

### PACKAGE OUTLINE DRAWING FOR 10L FCQFN (1.4x1.8mm) MF-PO-D-0084 revision 0.0



**NOTE:**

- 1) ALL DIMENSIONS ARE IN MILLIMETERS.
- 2) EXPOSED PADDLE SIZE DOES NOT INCLUDE MOLD FLASH.
- 3) LEAD COPLANARITY SHALL BE 0.10 MILLIMETER MAX.
- 4) JEDEC REFERENCE IS MO-220.
- 5) DRAWING IS NOT TO SCALE.

**NOTICE:** The information in this document is subject to change without notice. Please contact MPS for current specifications. Users should warrant and guarantee that third party Intellectual Property rights are not infringed upon when integrating MPS products into any application. MPS will not assume any legal responsibility for any said applications.