



## PC Card (PCMCIA) Interface Switch—12-V Suspend Capability

### FEATURES

- Programmable  $V_{CC}$  Ramp
- Smart Switching
- 12-V Sleepmode Compatible
- Extremely Low  $R_{ON}$
- Reverse Blocking Switches
- $V_{PP}$  Programmable to 0, 12-V or  $V_{CC}$
- Safe Power-Up
- Low Power Consumption
- PC Card 3-V/5-V Compatible
- Logic Compatible Inputs
- Single SO-16 Package

### DESCRIPTION

The Si9712 combines low on-resistance with slow ramp time and smart switching for overall best performance in integrated PC Card interface switches.

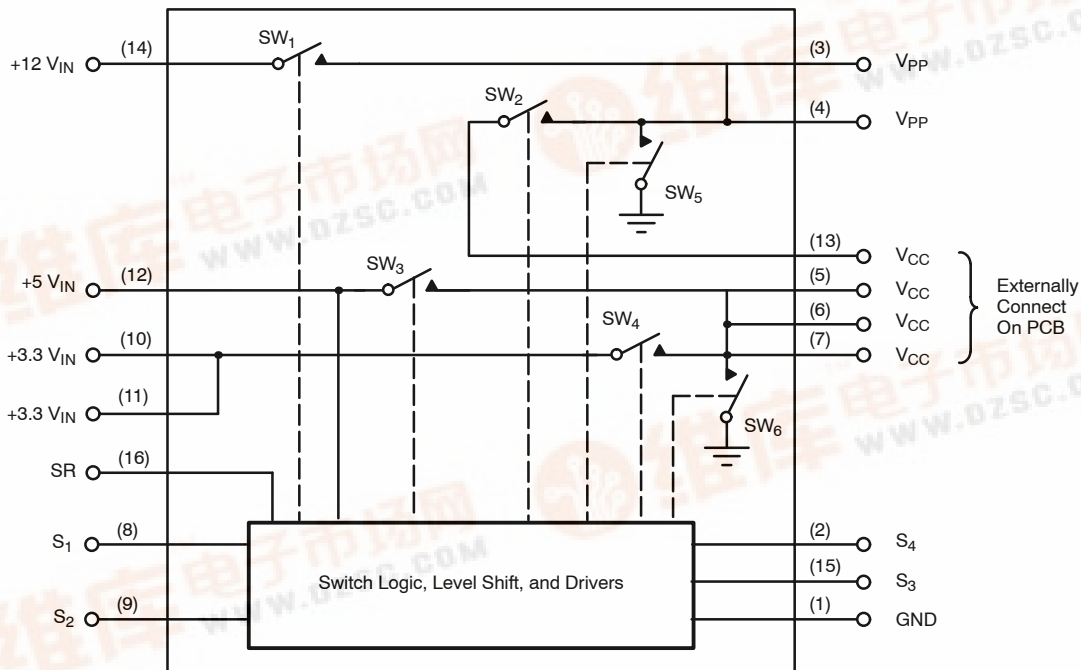
The Si9712 operates off the 5-V supply and has built-in level shifting for gate drive. Internal logic protects against an external control input error that would short 5 V to the 3.3-V supply. This protection logic also allows the Si9712 to be configured for positive or negative control logic for compatibility with a variety of PC Card controllers. These control inputs are CMOS logic compatible and can be driven to 3.3 V or 5 V.

The Si9712 complies with the release of the PC Card standard by supplying 0 V, 12 V, and  $V_{CC}$  to the  $V_{PP}$  output and 0 V, 3.3 V, and 5 V to the  $V_{CC}$  output. The  $V_{CC}$  ramp time is user programmable with an external capacitor connected to the SR pin.

The PC Card switch is packaged in a narrow body SO-16 package and is rated over the industrial temperature range  $-40$  to  $85^{\circ}\text{C}$ .

The Si9712 is available in both standard and lead (Pb)-free packages.

### FUNCTIONAL BLOCK DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

Voltages Referenced to Ground

|                                                     |        |
|-----------------------------------------------------|--------|
| +12 V <sub>IN</sub>                                 | 15 V   |
| +5 V <sub>IN</sub>                                  | 7 V    |
| +3.3 V <sub>IN</sub> <sup>c</sup>                   | 7 V    |
| S <sub>1</sub> through S <sub>4</sub> (CMOS Inputs) | 7 V    |
| I <sub>OUT</sub> V <sub>PP</sub> <sup>a</sup>       | 300 mA |
| All Pins                                            | -0.5 V |
| I <sub>OUT</sub> V <sub>CC</sub> <sup>b</sup>       | 4 A    |

|                                 |         |
|---------------------------------|---------|
| PD Max: (T <sub>A</sub> = 25°C) | 2.5 W   |
| (T <sub>A</sub> = 85°C)         | 1.0 W   |
| Junction Temperature            | 125°C   |
| Thermal Rating—R <sub>ΘJA</sub> | 40 °C/W |

### Notes

- Pins 3, 4 connected together externally.
- Pins 5, 6, 7, 13 connected together externally.
- Pins 10, 11 connected together externally.

## RECOMMENDED OPERATING CONDITIONS

|                                               |                 |
|-----------------------------------------------|-----------------|
| +12 V <sub>IN</sub>                           | 0 or 12 V ± 10% |
| +5 V <sub>IN</sub> (must be present)          | 5 V ± 10%       |
| +3.3 V <sub>IN</sub> <sup>c</sup>             | 3.3 V ± 10%     |
| C <sub>SR</sub>                               | 33 nF           |
| I <sub>OUT</sub> V <sub>PP</sub> <sup>a</sup> | 150 mA          |
| I <sub>OUT</sub> V <sub>CC</sub> <sup>b</sup> | 2 A             |

|                                  |            |
|----------------------------------|------------|
| V <sub>PP</sub> Load Capacitance | 10 μF Max  |
| V <sub>CC</sub> Load Capacitance | 150 μF Max |

### Notes

- Pins 3, 4 connected together externally.
- Pins 5, 6, 7, 13 connected together externally.
- Pins 10, 11 connected together externally.

## SPECIFICATIONS

| Parameter                           | Symbol         | Test Conditions<br>Unless Otherwise Specified<br>$C_{SR} = 33\text{ nF}$ , $+12\text{ V}_{IN} = 12\text{ V}$ , $+5\text{ V}_{IN} = 5\text{ V}$<br>$+3.3\text{ V}_{IN} = 3.3\text{ V}$ , Low $\leq 0.8\text{ V}$ , High $\geq 2.2\text{ V}$ |                          | Limits<br>-40 to 85°C |                  |                  | Unit             |
|-------------------------------------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|-----------------------|------------------|------------------|------------------|
|                                     |                |                                                                                                                                                                                                                                            |                          | Min <sup>a</sup>      | Typ <sup>b</sup> | Max <sup>a</sup> |                  |
| Switch 1                            |                |                                                                                                                                                                                                                                            |                          |                       |                  |                  |                  |
| On-Resistance                       | $R_{ON}$       | $I = 120\text{ mA}$ , $+12\text{ V}_{IN} = 11.4\text{ V}$<br>$S_3 = S_1 = \text{High}$<br>$S_2 = S_4 = \text{Low}$                                                                                                                         | $T_A = 25^\circ\text{C}$ |                       |                  | 120              | $\text{m}\Omega$ |
|                                     |                |                                                                                                                                                                                                                                            | $T_A = 85^\circ\text{C}$ |                       |                  | 145              |                  |
| Off Current ( $+12\text{ V}_{IN}$ ) | $I_{OFF}$      | $+12\text{ V}_{IN} = 12.6\text{ V}$<br>$S_1 = \text{Low}$                                                                                                                                                                                  | $T_A = 25^\circ\text{C}$ |                       |                  | 1                | $\mu\text{A}$    |
|                                     |                |                                                                                                                                                                                                                                            | $T_A = 85^\circ\text{C}$ |                       |                  | 10               |                  |
| Switching Time                      | $t_{SW1(on)}$  | $S_2 = S_4 = \text{Low}$ , See Figure 1<br>$S_3 = \text{High}$                                                                                                                                                                             |                          | 50                    | 200              | 350              | $\mu\text{s}$    |
|                                     | $t_{SW1(off)}$ |                                                                                                                                                                                                                                            |                          |                       | 1.0              | 10               |                  |
| Delay Time                          | $t_{d(on)}$    | See Figure 3<br>$S_2 = S_4 = \text{Low}$                                                                                                                                                                                                   |                          | 1.0                   | 6                | 20               | $\text{ms}$      |
|                                     | $t_{d(off)}$   |                                                                                                                                                                                                                                            |                          | 0.1                   | 2.9              | 10               |                  |
| Rise Time                           | $t_{SW1(on)}$  | $S_2 = S_4 = \text{Low}$ , $S_3 = \text{High}$ , See Figure 2                                                                                                                                                                              |                          | 50                    | 150              | 300              | $\mu\text{s}$    |
| Switch 2                            |                |                                                                                                                                                                                                                                            |                          |                       |                  |                  |                  |
| On-Resistance                       | $R_{ON}$       | $I = 120\text{ mA}$ , $S_2 = S_3 = \text{High}$<br>$S_1 = S_4 = \text{Low}$                                                                                                                                                                | $T_A = 25^\circ\text{C}$ |                       |                  | 150              | $\text{m}\Omega$ |
|                                     |                |                                                                                                                                                                                                                                            | $T_A = 85^\circ\text{C}$ |                       |                  | 180              |                  |
| Switching Time                      | $t_{SW2(on)}$  | $S_1 = S_4 = \text{Low}$ , $S_3 = \text{High}$ , See Figure 1                                                                                                                                                                              |                          | 50                    | 200              | 350              | $\mu\text{s}$    |
|                                     | $t_{SW2(off)}$ |                                                                                                                                                                                                                                            |                          |                       | 1.0              | 10               |                  |
| Delay Time                          | $t_{d(on)}$    | $S_1 = S_4 = \text{Low}$ , See Figure 3                                                                                                                                                                                                    |                          | 1.0                   | 6                | 20               | $\text{ms}$      |
|                                     | $t_{d(off)}$   |                                                                                                                                                                                                                                            |                          | 0.1                   | 1.7              | 10               |                  |
| Rise Time                           | $t_{SW2(on)}$  | $S_1 = S_4 = \text{Low}$ , $S_3 = \text{High}$ , See Figure 2                                                                                                                                                                              |                          | 50                    | 150              | 300              | $\mu\text{s}$    |
| Switch 3                            |                |                                                                                                                                                                                                                                            |                          |                       |                  |                  |                  |
| On-Resistance                       | $R_{ON}$       | $I = 500\text{ mA}$ , $S_3 = \text{High}$<br>$S_1 = S_2 = S_4 = \text{Low}$                                                                                                                                                                | $T_A = 25^\circ\text{C}$ |                       |                  | 70               | $\text{m}\Omega$ |
|                                     |                |                                                                                                                                                                                                                                            | $T_A = 85^\circ\text{C}$ |                       |                  | 95               |                  |
| Off Current ( $V_{CC}$ )            | $I_{OFF}$      | $+5\text{ V}_{IN} = 5.5\text{ V}$ , $V_{CC} = 0\text{ V}$<br>$S_1 = S_2 = S_3 = \text{Low}$<br>$S_4 = \text{High}$<br>$+3.3\text{ V}_{IN} = \text{Open Circuit}$                                                                           | $T_A = 25^\circ\text{C}$ |                       |                  | 1                | $\mu\text{A}$    |
|                                     |                |                                                                                                                                                                                                                                            | $T_A = 85^\circ\text{C}$ |                       |                  | 10               |                  |
| Rise Time                           | $t_{SW3(on)}$  | $S_1 = S_2 = S_4 = \text{Low}$ , See Figure 2                                                                                                                                                                                              |                          | 0.1                   | 1.7              | 10               | $\text{ms}$      |
| Fall Time                           | $t_{SW3(off)}$ |                                                                                                                                                                                                                                            |                          | 3                     | 30               | 50               |                  |



| SPECIFICATIONS                          |                       |                                                                                                                                                                                                                                                     |                          |                  |                  |      |                  |
|-----------------------------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|------------------|------------------|------|------------------|
| Parameter                               | Symbol                | Test Conditions<br>Unless Otherwise Specified<br>$C_{SR} = 33 \text{ nF}$ , $+12 \text{ V}_{IN} = 12 \text{ V}$ , $+5 \text{ V}_{IN} = 5 \text{ V}$<br>$+3.3 \text{ V}_{IN} = 3.3 \text{ V}$ , Low $\leq 0.8 \text{ V}$ , High $\geq 2.2 \text{ V}$ | Limits<br>–40 to 85°C    |                  |                  | Unit |                  |
|                                         |                       |                                                                                                                                                                                                                                                     | Min <sup>a</sup>         | Typ <sup>b</sup> | Max <sup>a</sup> |      |                  |
| Switch 4                                |                       |                                                                                                                                                                                                                                                     |                          |                  |                  |      |                  |
| On-Resistance                           | $R_{ON}$              | $I = 500 \text{ mA}$ , $S_4 = \text{High}$<br>$S_1 = S_2 = S_3 = \text{Low}$                                                                                                                                                                        | $T_A = 25^\circ\text{C}$ |                  |                  | 50   | $\text{m}\Omega$ |
|                                         |                       |                                                                                                                                                                                                                                                     | $T_A = 85^\circ\text{C}$ |                  |                  | 70   |                  |
| Off Current ( $+3.3 \text{ V}_{IN}$ )   | $I_{OFF}$             | $+3.3 \text{ V}_{IN} = 3.6 \text{ V}$ ,<br>$S_1 = S_2 = S_3 = S_4 = \text{Low}$                                                                                                                                                                     | $T_A = 25^\circ\text{C}$ |                  |                  | 1    | $\mu\text{A}$    |
|                                         |                       |                                                                                                                                                                                                                                                     | $T_A = 85^\circ\text{C}$ |                  |                  | 10   |                  |
| Rise Time                               | $t_{SW4(\text{on})}$  | $S_1 = S_2 = S_3 = \text{Low}$ , See Figure 2                                                                                                                                                                                                       |                          | 0.1              | 0.9              | 10   | $\text{ms}$      |
| Fall Time                               | $t_{SW4(\text{off})}$ |                                                                                                                                                                                                                                                     |                          | 3                | 20               | 40   |                  |
| Switch 5                                |                       |                                                                                                                                                                                                                                                     |                          |                  |                  |      |                  |
| On-Resistance                           | $R_{ON}$              | $I = 2 \text{ mA}$ , $S_1 = S_2 = \text{Low}$                                                                                                                                                                                                       | $T_A = 25^\circ\text{C}$ |                  | 235              | 400  | $\Omega$         |
|                                         |                       |                                                                                                                                                                                                                                                     | $T_A = 85^\circ\text{C}$ |                  | 325              | 550  |                  |
| Switch 6                                |                       |                                                                                                                                                                                                                                                     |                          |                  |                  |      |                  |
| On-Resistance                           | $R_{ON}$              | $I = 2 \text{ mA}$ , $S_3 = S_4 = \text{Low}$                                                                                                                                                                                                       | $T_A = 25^\circ\text{C}$ |                  | 140              | 400  | $\Omega$         |
|                                         |                       |                                                                                                                                                                                                                                                     | $T_A = 85^\circ\text{C}$ |                  | 200              | 500  |                  |
| Power Supply                            |                       |                                                                                                                                                                                                                                                     |                          |                  |                  |      |                  |
| $+5 \text{ V}_{IN}$ Current Input (on)  | $I_{+5VIN(1)}$        | $S_1 = S_4 = 0 \text{ V}$ , $S_2 = S_3 = 3 \text{ V}$                                                                                                                                                                                               |                          |                  | 20               | 50   | $\mu\text{A}$    |
|                                         | $I_{+5VIN(2)}$        | $S_1 = S_4 = 3 \text{ V}$ , $S_2 = S_3 = 0 \text{ V}$                                                                                                                                                                                               |                          |                  | 20               | 50   |                  |
| $+5 \text{ V}_{IN}$ Current Input (off) | $I_{+5VIN(3)}$        | $S_1 = S_2 = S_3 = S_4 = 0 \text{ V}$                                                                                                                                                                                                               |                          |                  | <1               | 10   | $\mu\text{A}$    |
| Switch Control Inputs                   |                       |                                                                                                                                                                                                                                                     |                          |                  |                  |      |                  |
| Input Voltage High                      | $V_{I(H)}$            | $+5 \text{ V}_{IN} = 5.5 \text{ V}$                                                                                                                                                                                                                 |                          | 2.2              | 1.8              |      | $\text{V}$       |
|                                         |                       | $+5 \text{ V}_{IN} = 4.5 \text{ V}$                                                                                                                                                                                                                 |                          | 2.2              | 1.6              |      |                  |
| Input Voltage Low                       | $V_{I(L)}$            | $+5 \text{ V}_{IN} = 5.5 \text{ V}$                                                                                                                                                                                                                 |                          |                  | 1.6              | 0.8  |                  |
|                                         |                       | $+5 \text{ V}_{IN} = 4.5 \text{ V}$                                                                                                                                                                                                                 |                          |                  | 1.4              | 0.8  |                  |
| Input Current High                      | $I_{I(H)}$            | $S_1$ through $S_4 = 5 \text{ V}$                                                                                                                                                                                                                   |                          |                  |                  | 1.0  | $\mu\text{A}$    |
| Input Current Low                       | $I_{I(L)}$            | $S_1$ through $S_4 = \text{GND}$                                                                                                                                                                                                                    |                          | –1.0             |                  |      |                  |

Notes

- a. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum.  
b. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.

## TIMING WAVEFORMS

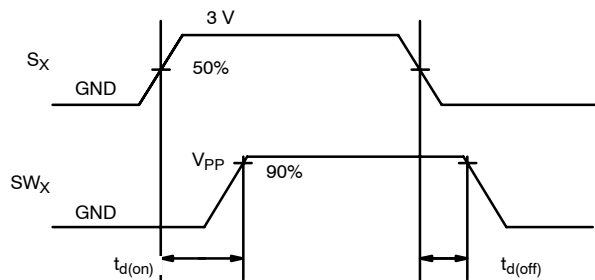
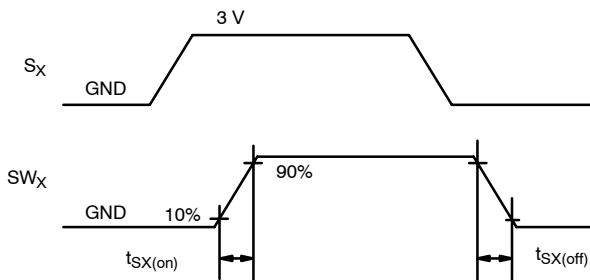
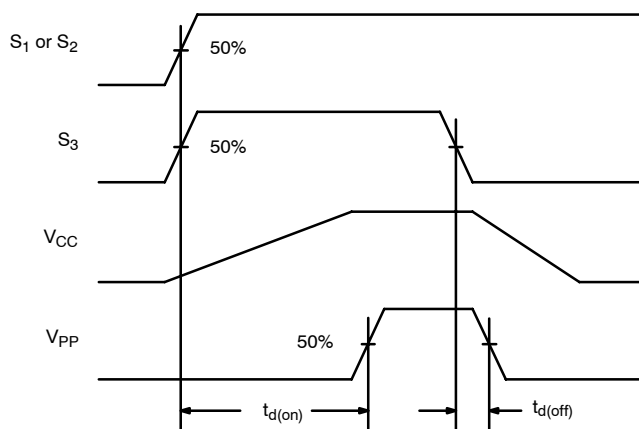
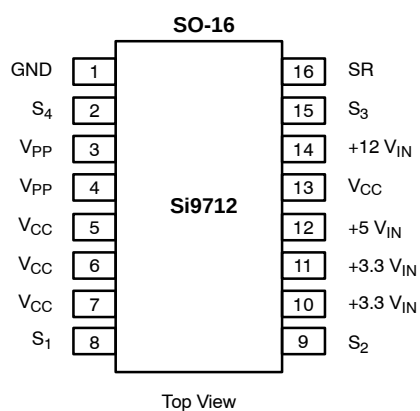
FIGURE 1.  $V_{PP}$  Switch Delay

FIGURE 2. Switch Ramp

FIGURE 3. Delay from  $S_1$  or  $S_2$  to  $V_{PP}$  Power-up

## PIN CONFIGURATION AND DESCRIPTION



Note: Pins 5, 6, 7, and 13 must be connected in the PCB for correct operation.

| Pin Number  | Function      | Description                                                                                                     |
|-------------|---------------|-----------------------------------------------------------------------------------------------------------------|
| 1.          | GND           | Ground connection.                                                                                              |
| 2           | $S_4$         | Control input for selecting +3.3 $V_{IN}$ to $V_{CC}$ . The PC Card terminology for this pin is $V_{CC\_EN0}$ . |
| 3, 4        | $V_{PP}$      | Program and peripheral voltage to PC Card slot.                                                                 |
| 5, 6, 7, 13 | $V_{CC}$      | Supply voltage to slot.                                                                                         |
| 8           | $S_1$         | Control input for selecting +12 $V_{IN}$ to $V_{PP}$ . The PC Card terminology for this pin is $V_{PP\_EN1}$ .  |
| 9           | $S_2$         | Control input for selecting $V_{CC}$ to $V_{PP}$ . The PC Card terminology for this pin is $V_{PP\_EN0}$ .      |
| 10, 11      | +3.3 $V_{IN}$ | +3.3-V supply.                                                                                                  |
| 12          | +5 $V_{IN}$   | +5-V supply.                                                                                                    |
| 14          | +12 $V_{IN}$  | +12-V supply.                                                                                                   |
| 15          | $S_3$         | Control input for selecting +5 $V_{IN}$ to $V_{CC}$ . The PC Card terminology for this pin is $V_{CC\_EN1}$ .   |
| 16          | SR            | Slew rate control pin, capacitor to GND defines programmable ramp time.                                         |



ORDERING INFORMATION

| Part Number    | Temperature Range | Package |
|----------------|-------------------|---------|
| Si9712DY       | -40 to 85°C       | SOIC-16 |
| Si9712DY-T1    |                   |         |
| Si9712DY-T1—E3 |                   |         |

TRUTH TABLE<sup>b</sup>

| S <sub>1</sub> | S <sub>2</sub> | S <sub>3</sub> | S <sub>4</sub> | Switch 1 <sup>a</sup> | Switch 2 <sup>a</sup> | Switch 3 | Switch 4 | Switch 5 | Switch 6 |
|----------------|----------------|----------------|----------------|-----------------------|-----------------------|----------|----------|----------|----------|
| 0              | 0              | 0              | 0              | Off                   | Off                   | Off      | Off      | On       | On       |
| 0              | 0              | 0              | 1              | Off                   | Off                   | Off      | On       | On       | Off      |
| 0              | 0              | 1              | 0              | Off                   | Off                   | On       | Off      | On       | Off      |
| 0              | 0              | 1              | 1              | Off                   | Off                   | Off      | Off      | On       | On       |
| 0              | 1              | 0              | 0              | Off                   | Off                   | Off      | Off      | On       | On       |
| 0              | 1              | 0              | 1              | Off                   | On                    | Off      | On       | Off      | Off      |
| 0              | 1              | 1              | 0              | Off                   | On                    | On       | Off      | Off      | Off      |
| 0              | 1              | 1              | 1              | Off                   | Off                   | Off      | Off      | On       | On       |
| 1              | 0              | 0              | 0              | Off                   | Off                   | Off      | Off      | On       | On       |
| 1              | 0              | 0              | 1              | On                    | Off                   | Off      | On       | Off      | Off      |
| 1              | 0              | 1              | 0              | On                    | Off                   | On       | Off      | Off      | Off      |
| 1              | 0              | 1              | 1              | Off                   | Off                   | Off      | Off      | On       | On       |
| 1              | 1              | 0              | 0              | Off                   | Off                   | Off      | Off      | On       | On       |
| 1              | 1              | 0              | 1              | On                    | Off                   | Off      | On       | Off      | Off      |
| 1              | 1              | 1              | 0              | On                    | Off                   | On       | Off      | Off      | Off      |
| 1              | 1              | 1              | 1              | Off                   | Off                   | Off      | Off      | On       | On       |

Notes

- a. Turn on of switch 1 and 2 are internally delayed until after V<sub>CC</sub> is valid. See Figure 3.  
b. Shaded lines are error conditions for PC Card applications, however, switches default to the states shown.

TIMING DIAGRAM

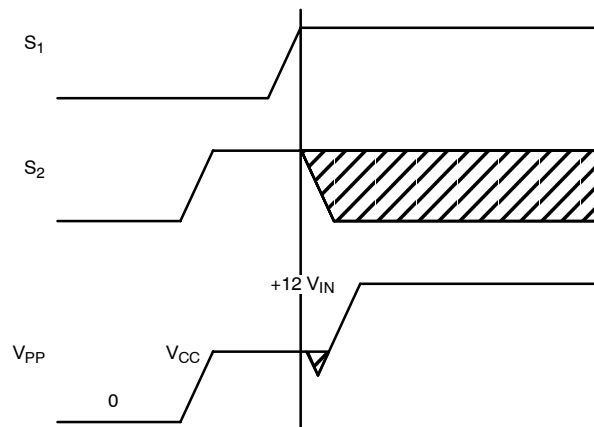
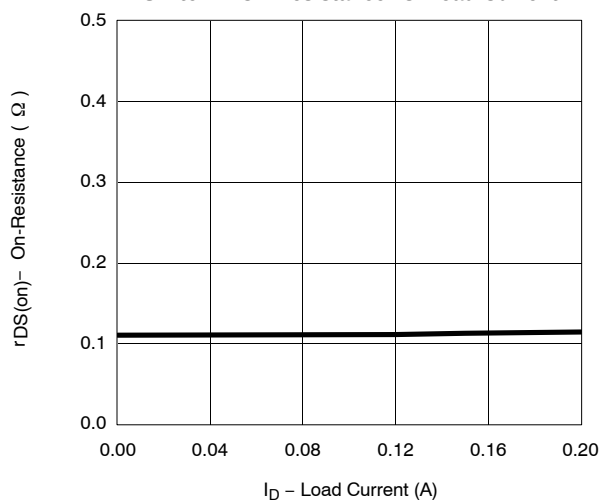
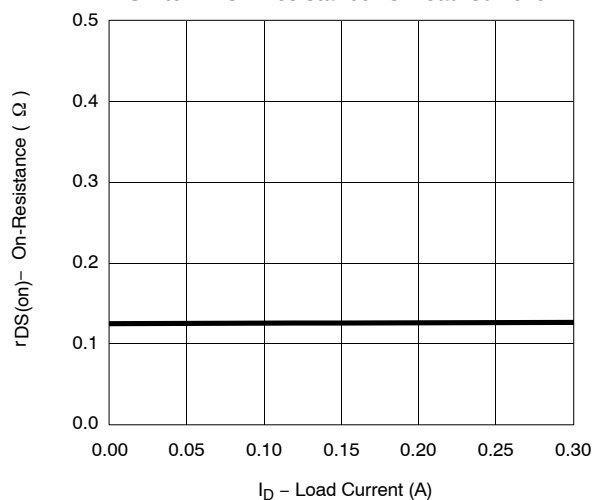
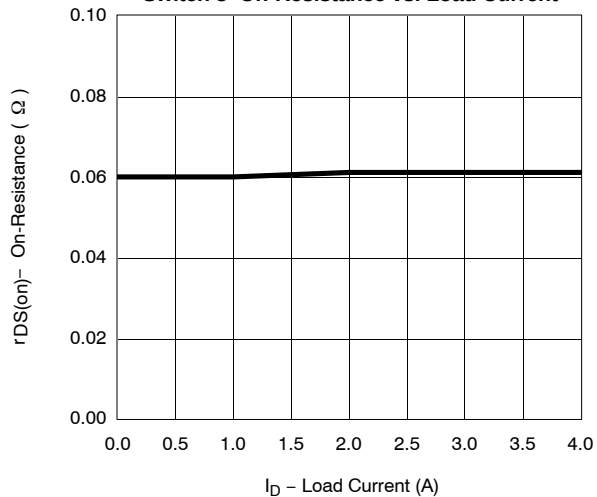
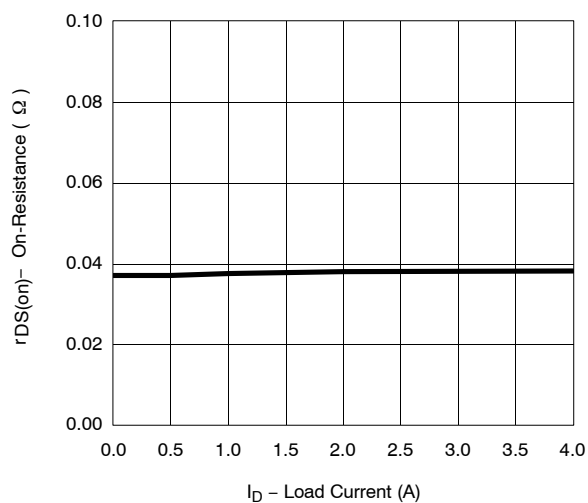
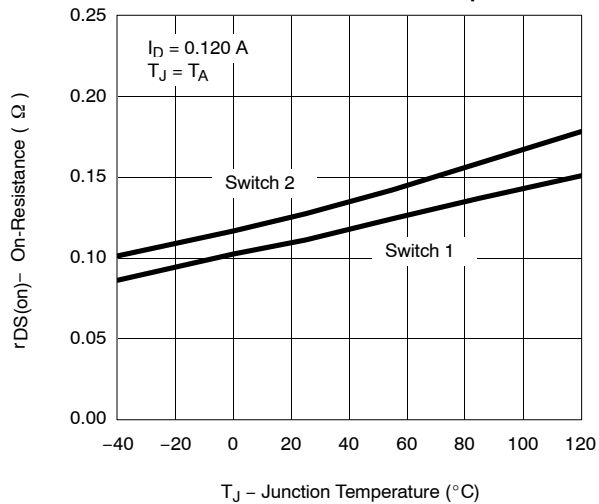
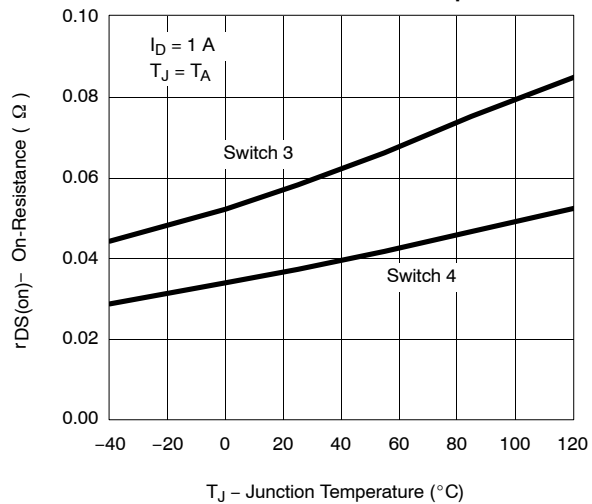
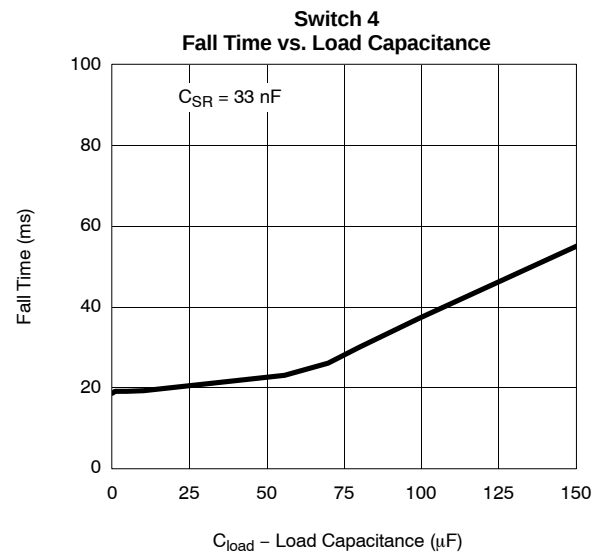
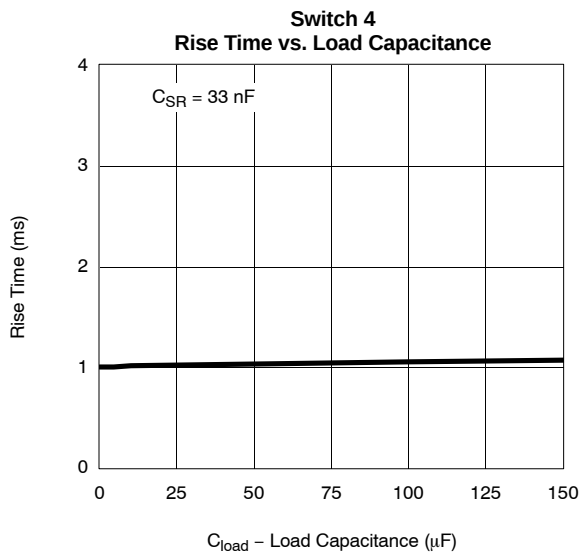
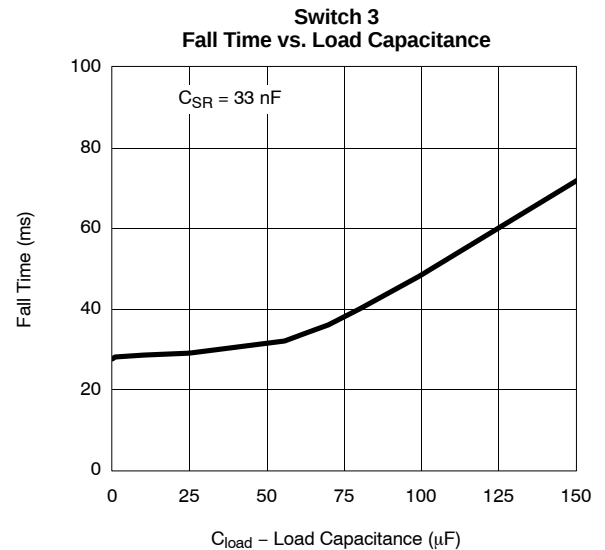
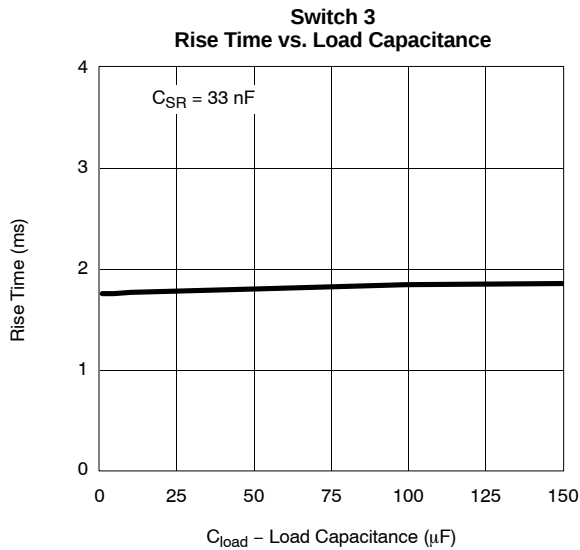
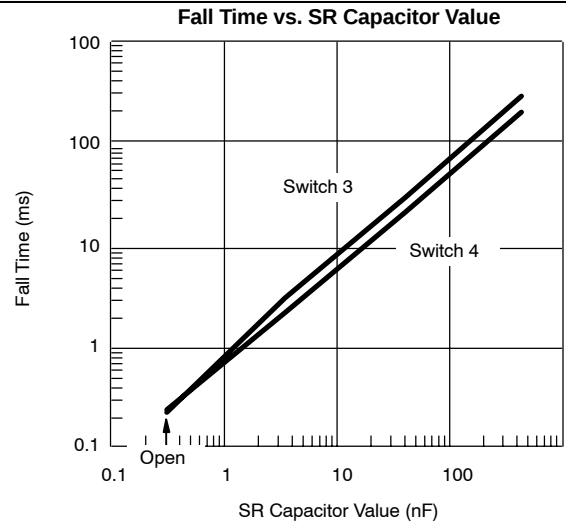
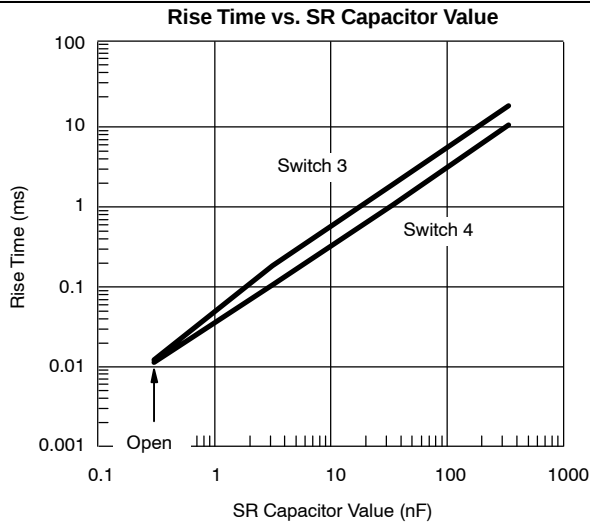


FIGURE 4. Break-Before-Make of SW<sub>1</sub> and SW<sub>2</sub>

**TYPICAL CHARACTERISTICS (25 °C UNLESS OTHERWISE NOTED)**
**Switch 1–On-Resistance vs. Load Current**

**Switch 2–On-Resistance vs. Load Current**

**Switch 3–On-Resistance vs. Load Current**

**Switch 4–On-Resistance vs. Load Current**

**On-Resistance vs. Junction Temperature**

**On-Resistance vs. Junction Temperature**




**TYPICAL CHARACTERISTICS (25°C UNLESS OTHERWISE NOTED)**



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