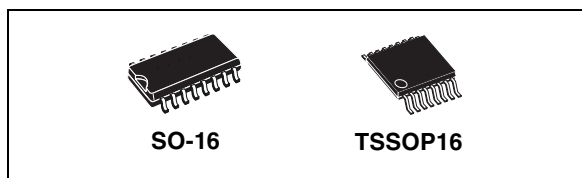


## Single 8-channel analog MUX/DEMUX with injection current protection

Datasheet – production data

### Features

- Low power dissipation
  - $I_{CC} = 2 \mu\text{A}$  (max.) at  $T_A = 25 \text{ }^\circ\text{C}$
- Injection current protection
  - $V_{\Delta\text{OUT}} < 1 \text{ mV}$  at  $V_{CC} = 5 \text{ V}$ ,  $I_{IN} \leq 1 \text{ mA}$
  - $R_S \leq 3.9 \text{ k}\Omega$
- “ON” resistance at  $T_A = 25 \text{ }^\circ\text{C}$ 
  - $215 \text{ }\Omega$  typ. ( $V_{CC} = 3.0 \text{ V}$ )
  - $160 \text{ }\Omega$  typ. ( $V_{CC} = 4.5 \text{ V}$ )
  - $150 \text{ }\Omega$  typ. ( $V_{CC} = 6 \text{ V}$ )
- Fast switching
  - $t_{pd} = 8.6 \text{ ns}$  (typ.) at  $T_A = 25 \text{ }^\circ\text{C}$ ,  $V_{CC} = 4.5 \text{ V}$
- Wide operating supply voltage range
  - $V_{CC} = 2 \text{ V}$  to  $6 \text{ V}$
- High noise immunity
  - $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (min.)
- Pin and function compatible with series 4051, 4851
- Latch-up performance exceeds  $500 \text{ mA}$ 
  - (JESD 17)
- ESD performance
  - HBM:  $2000 \text{ V}$
  - MM:  $200 \text{ V}$
  - CDM:  $1000 \text{ V}$



### Applications

- Automotive
- Computer
- Consumer
- Industrial

### Description

The M74HC4851 device is a single 8-channel analog multiplexer/demultiplexer manufactured with silicon gate C<sup>2</sup>MOS technology.

It features injection current effect control which makes the device particularly suited for use in automotive applications where voltages in excess of normal logic voltages are common. The injection current effect control allows signals at disabled input channels to exceed the supply voltage range or go down to ground without affecting the signal of the enabled analog channel.

This eliminates the need for external diode-resistor networks typically used to keep the analog channel signals within the supply voltage range.

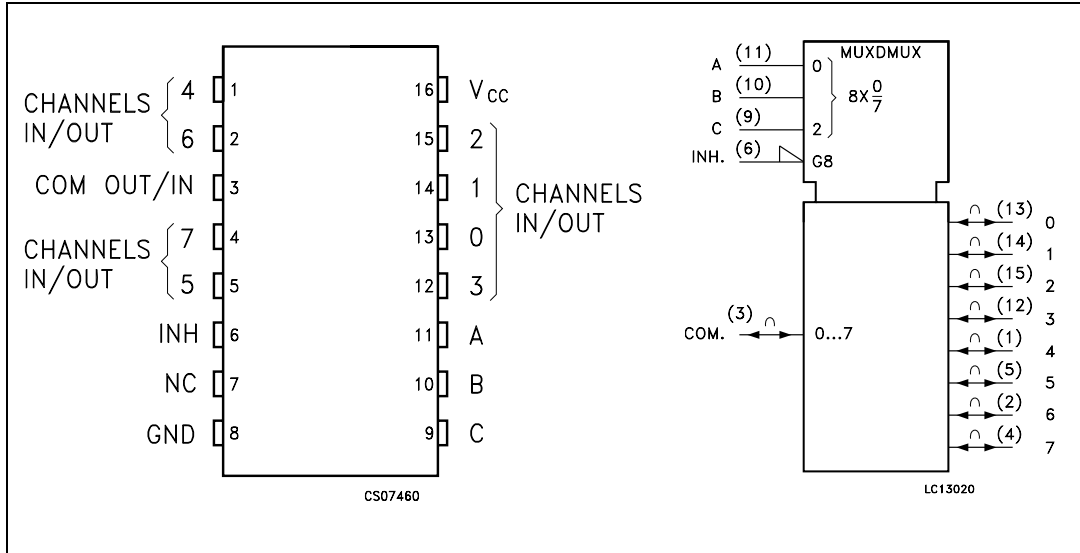
**Table 1. Device summary**

| Order code                      | Temperature range | Package                    | Packaging     | Marking   |
|---------------------------------|-------------------|----------------------------|---------------|-----------|
| M74HC4851YRM13TR <sup>(1)</sup> | -40/+125 °C       | SO-16 (automotive grade)   | Tape and reel | 74HC4851Y |
| M74HC4851RM13TR                 | -55/+125 °C       | SO-16                      | Tape and reel | 74HC4851  |
| M74HC4851YTTR <sup>(1)</sup>    | -40/+125 °C       | TSSOP16 (automotive grade) | Tape and reel | HC4851Y   |
| M74HC4851TTR                    | -55/+125 °C       | TSSOP16                    | Tape and reel | HC4851    |

1. Qualification and characterization according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 and Q002 or equivalent.

# 1 Pin connections

**Figure 1. Pin connections and IEC logic symbols**



**Table 2. Pin descriptions**

| Pin number                    | Symbol          | Name and function         |
|-------------------------------|-----------------|---------------------------|
| 3                             | COM OUT/IN      | Common output/input       |
| 6                             | INH             | INHIBIT input             |
| 7                             | NC              | Not connected             |
| 11, 10, 9                     | A, B, C         | Select inputs             |
| 13, 14, 15,<br>12, 1, 5, 2, 4 | 0 to 7          | Independent input/outputs |
| 8                             | GND             | Ground (0 V)              |
| 16                            | V <sub>CC</sub> | Positive supply voltage   |

Table 3. Truth table

| Input state |   |   |   | On channel |
|-------------|---|---|---|------------|
| INH         | C | B | A |            |
| L           | L | L | L | 0          |
| L           | L | L | H | 1          |
| L           | L | H | L | 2          |
| L           | L | H | H | 3          |
| L           | H | L | L | 4          |
| L           | H | L | H | 5          |
| L           | H | H | L | 6          |
| L           | H | H | H | 7          |
| H           | X | X | X | NONE       |

Note: X: don't care.

Figure 2. Control input equivalent circuit

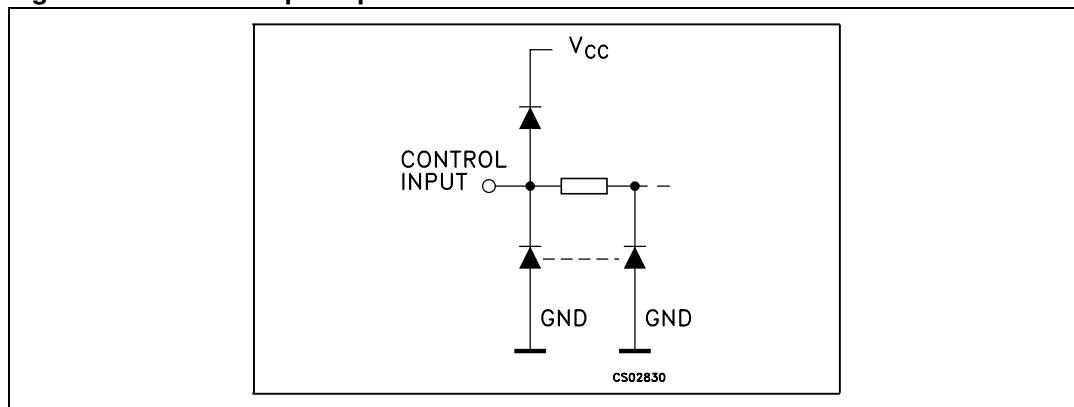


Figure 3. I/O equivalent circuit

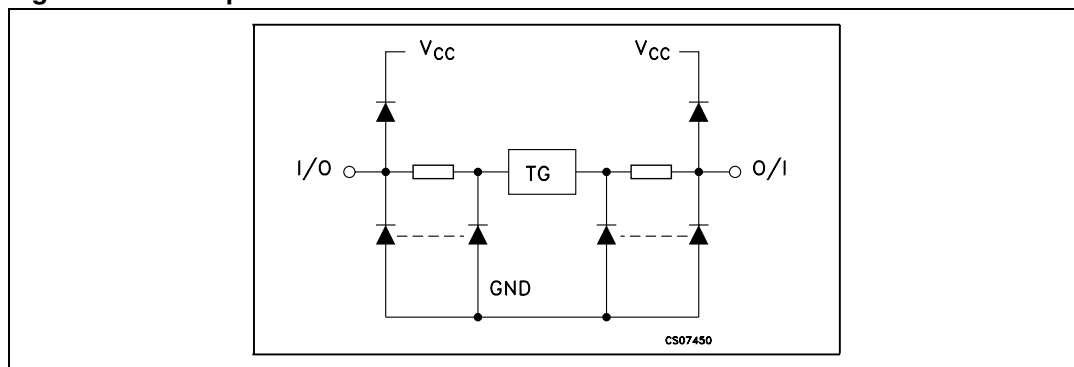
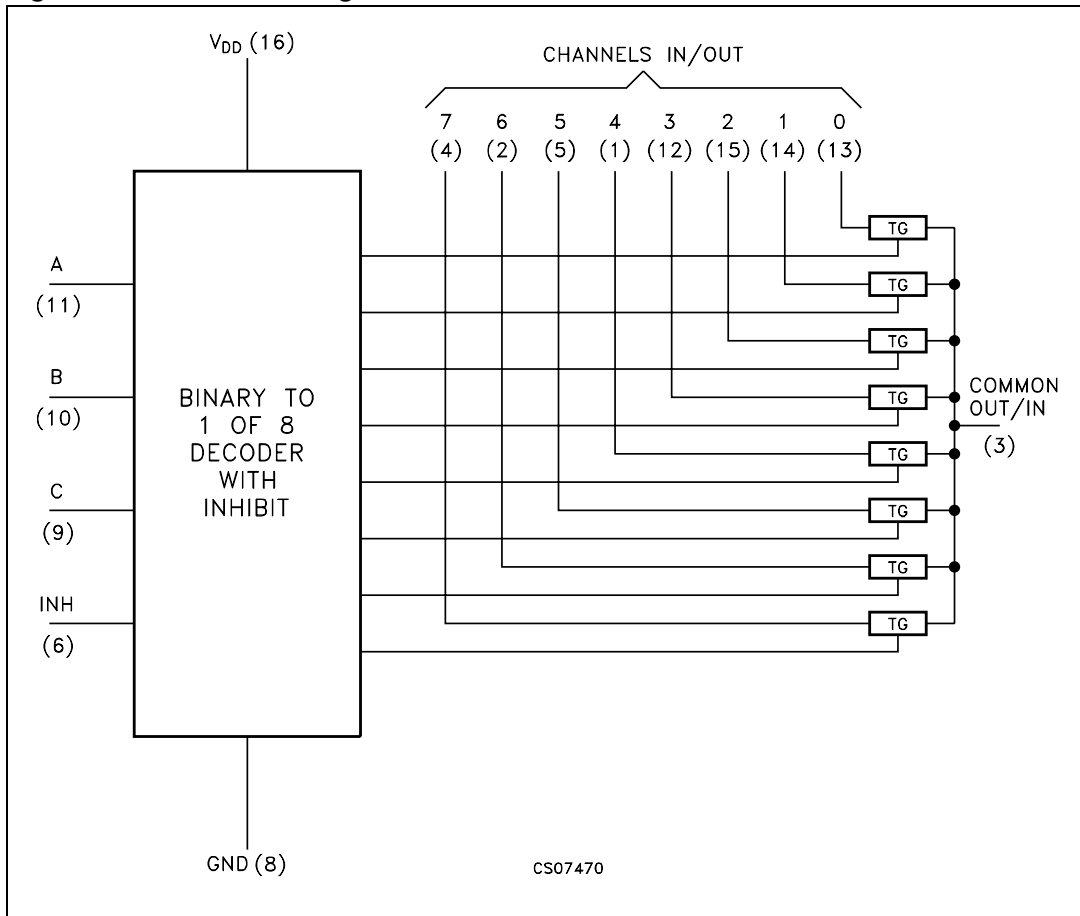


Figure 4. Functional diagram



## 2 Absolute maximum ratings and operating conditions

*Note:* Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.

**Table 4. Absolute maximum ratings**

| Symbol           | Parameter                     |         | Value                  | Unit |
|------------------|-------------------------------|---------|------------------------|------|
| $V_{CC}$         | Supply voltage                |         | -0.5 to +7             | V    |
| $V_{IN}$         | Control input voltage         |         | -0.5 to $V_{CC} + 0.5$ | V    |
| $V_{I/O}$        | Switch I/O voltage            |         | -0.5 to $V_{CC} + 0.5$ | V    |
| $I_{CK}$         | Control input diode current   |         | $\pm 25$               | mA   |
| $I_{I/OK}$       | I/O diode current             |         | $\pm 25$               | mA   |
| $I_{CC}$         | DC $V_{CC}$ or ground current |         | $\pm 50$               | mA   |
| $P_D$            | Power dissipation             | SO-16   | 500 <sup>(1)</sup>     | mW   |
|                  |                               | TSSOP16 | 450 <sup>(1)</sup>     | mW   |
| $T_{stg}$        | Storage temperature           |         | -65 to +150            | °C   |
| $T_L$            | Lead temperature (10 sec.)    |         | 300                    | °C   |
| ESD<br>(JEDEC22) | Human body model (HBM)        |         | 2000                   | V    |
|                  | Machine model (MM)            |         | 200                    | V    |
|                  | Charged device model (CDM)    |         | 1000                   | V    |

1. Power dissipation at 65 °C. Derating from 65 °C to 125 °C: SO package -7 mW/°C; TSSOP package -6.1 mW/°C.

**Table 5. Recommended operating conditions**

| Symbol     | Parameter   |                                   | Value         | Unit |
|------------|---|-----------------------------------|---------------|------|
| $V_{CC}$   | Supply voltage  |                                   | 2 to 6        | V    |
| $V_{I/O}$  | Input output voltage  |                                   | 0 to $V_{CC}$ | V    |
| $V_{I/O}$  | Static or dynamic voltage across switch <sup>(1)</sup>                            |                                   | 0 to 1.2      | V    |
| $V_{IN}$   | Control input voltage   |                                   | 0 to $V_{CC}$ | V    |
| $T_{op}$   | Operating temperature   | SO-16, TSSOP16                    | -55 to +125   | °C   |
|            |   | SO-16, TSSOP16 (automotive grade) | -40 to +125   | °C   |
| $t_r, t_f$ | Input rise and fall time <sup>(2)</sup><br>(channel select or enable inputs only) | $V_{CC} = 2.0$ V                  | 0 to 1000     | ns   |
|            |   | $V_{CC} = 3.0$ V                  | 0 to 800      |      |
|            |   | $V_{CC} = 3.3$ V                  | 0 to 700      |      |
|            |   | $V_{CC} = 4.5$ V                  | 0 to 500      |      |
|            |   | $V_{CC} = 6.0$ V                  | 0 to 400      |      |

1. For voltage drops across the switch greater than 1.2 V (switch on), excessive  $V_{CC}$  current may be drawn; i.e., the current out of the switch may contain both  $V_{CC}$  and switch input components. The reliability of the device is unaffected unless the maximum ratings are exceeded.

2.  $V_{IN}$  from 30% to 70%  $V_{CC}$  of channel selected or enable inputs.

Table 6. DC specifications

| Symbol           | Parameter  | Test condition      |  | Value  |      |      |             |      |              | Unit |      |
|------------------|--|---------------------|--|--|------|------|-------------|------|--------------|------|------|
|                  |  | V <sub>CC</sub> (V) |  | T <sub>A</sub> = 25 °C   |      |      | Up to 85 °C |      | Up to 125 °C |      |      |
|                  |  |                     |  | Min.   | Typ. | Max. | Min.        | Max. | Min.         |      | Max. |
| V <sub>IHC</sub> | High level input voltage                                   | 2.0                 |  | 1.5  |      |      | 1.5         |      | 1.5          |      | V    |
|                  |  | 3.0                 |  | 2.1  |      |      | 2.1         |      | 2.1          |      |      |
|                  |  | 3.0                 |  | 2.3  |      |      | 2.3         |      | 2.3          |      |      |
|                  |  | 4.5                 |  | 3.15   |      |      | 3.15        |      | 3.15         |      |      |
|                  |  | 6.0                 |  | 4.2  |      |      | 4.2         |      | 4.2          |      |      |
| V <sub>ILC</sub> | Low level input voltage                                    | 2.0                 |  |  |      | 0.5  |             | 0.5  |              | 0.5  | V    |
|                  |  | 3.0                 |  |  |      | 0.9  |             | 0.9  |              | 0.9  |      |
|                  |  | 3.3                 |  |  |      | 1.0  |             | 1.0  |              | 1.0  |      |
|                  |  | 4.5                 |  |  |      | 1.35 |             | 1.35 |              | 1.35 |      |
|                  |  | 6.0                 |  |  |      | 1.8  |             | 1.8  |              | 1.8  |      |
| R <sub>ON</sub>  | ON resistance  | 2.0                 | I <sub>S</sub> = 2 mA                    |  | 500  | 650  |             | 670  |              | 700  | Ω    |
|                  |  | 3.0                 | I <sub>S</sub> ≤ 2 mA                    | V <sub>IN</sub> = V <sub>IHC</sub> or V <sub>ILC</sub><br>V <sub>IS</sub> = V <sub>CC</sub> to GND | 215  | 280  |             | 320  |              | 360  |      |
|                  |  | 3.3                 |  |  | 210  | 270  |             | 305  |              | 345  |      |
|                  |  | 4.5                 |  |  | 160  | 210  |             | 240  |              | 270  |      |
|                  |  | 6.0                 |  |  | 150  | 195  |             | 220  |              | 250  |      |
| ΔR <sub>ON</sub> | Difference of ON resistance between switches               | 2.0                 | I <sub>S</sub> = 2 mA                    |  | 4    | 10   |             | 15   |              | 20   | Ω    |
|                  |  | 3.0                 | I <sub>S</sub> ≤ 2 mA                    | V <sub>IN</sub> = V <sub>IHC</sub> or V <sub>ILC</sub><br>V <sub>IS</sub> = V <sub>CC</sub> /2     | 2    | 8    |             | 12   |              | 16   |      |
|                  |  | 3.3                 |  |  | 2    | 8    |             | 12   |              | 16   |      |
|                  |  | 4.5                 |  |  | 2    | 8    |             | 12   |              | 16   |      |
|                  |  | 6.0                 |  |  | 3    | 9    |             | 13   |              | 18   |      |
| I <sub>OFF</sub> | Input/output leakage current (switch off) (any channel)    | 6.0                 | V <sub>IN</sub> = V <sub>CC</sub> or GND |  |      | ±0.1 |             | ±0.5 |              | ±1.0 | μA   |
| I <sub>OFF</sub> | Input/output leakage current (switch off) (common channel) | 6.0                 |  |  |      | ±0.2 |             | ±2   |              | ±4   | μA   |
| I <sub>ON</sub>  | Switch input leakage current (switch on, output open)      | 6.0                 | V <sub>IN</sub> = V <sub>CC</sub> or GND |  |      | ±0.1 |             | ±0.5 |              | ±1   | μA   |

Table 6. DC specifications (continued)

| Symbol          | Parameter                | Test condition         |   | Value                  |      |      |             |      |              | Unit |      |
|-----------------|--------------------------|------------------------|---|------------------------|------|------|-------------|------|--------------|------|------|
|                 |                          | V <sub>CC</sub><br>(V) |   | T <sub>A</sub> = 25 °C |      |      | Up to 85 °C |      | Up to 125 °C |      |      |
|                 |                          |                        |   | Min.                   | Typ. | Max. | Min.        | Max. | Min.         |      | Max. |
| I <sub>IN</sub> | Control input current    | 6.0                    | V <sub>IN</sub> = V <sub>CC</sub> or GND                                  |                        |      | ±0.1 |             | ±0.1 |              | ±1   | μA   |
| I <sub>CC</sub> | Quiescent supply current | 6.0                    | V <sub>IN</sub> = V <sub>CC</sub> or GND<br>V <sub>IN(analog)</sub> = GND |                        |      | 2    |             | 20   |              | 40   | μA   |

Table 7. AC electrical characteristics (C<sub>L</sub> = 50 pF, input t<sub>r</sub> = t<sub>f</sub> = 6 ns)

| Symbol   | Parameter  | Test condition         |                | Value                  |      |      |             |      |              | Unit |      |
|--|--|------------------------|----------------|------------------------|------|------|-------------|------|--------------|------|------|
|  |  | V <sub>CC</sub><br>(V) | Test circuit 1 | T <sub>A</sub> = 25 °C |      |      | Up to 85 °C |      | Up to 125 °C |      |      |
|  |  |                        |                | Min.                   | Typ. | Max. | Min.        | Max. | Min.         |      | Max. |
| t <sub>PHL</sub> , t <sub>PLH</sub>  | Propagation delay time, analog input to analog output          | 2.0                    |                |                        | 19.5 | 25   |             | 29   |              | 32   | ns   |
|  |  | 3.0                    |                |                        | 12   | 15.5 |             | 17.5 |              | 19.5 |      |
|  |  | 3.3                    |                |                        | 11   | 14.5 |             | 16.5 |              | 18.5 |      |
|  |  | 4.5                    |                |                        | 8.6  | 11.5 |             | 12.5 |              | 13.5 |      |
|  |  | 6.0                    |                |                        | 8    | 10   |             | 11   |              | 12   |      |
| t <sub>PHL</sub> , t <sub>PLH</sub>  | Propagation delay time channel-select to analog output         | 2.0                    |                |                        | 23   | 30   |             | 35   |              | 40   | ns   |
|  |  | 3.0                    |                |                        | 13.5 | 17.5 |             | 20   |              | 23   |      |
|  |  | 3.3                    |                |                        | 12.5 | 16.5 |             | 19   |              | 22   |      |
|  |  | 4.5                    |                |                        | 10   | 13   |             | 15   |              | 17   |      |
|  |  | 6.0                    |                |                        | 9.5  | 12.5 |             | 14.5 |              | 16.5 |      |
| t <sub>PHZ</sub> , t <sub>PZH</sub><br>t <sub>PLZ</sub> , t <sub>PZL</sub> | Enable disable time, enable or channel-select to analog output | 2.0                    |                |                        |      | 95   |             | 105  |              | 115  | ns   |
|  |  | 3.0                    |                |                        |      | 90   |             | 100  |              | 110  |      |
|  |  | 3.3                    |                |                        |      | 85   |             | 95   |              | 105  |      |
|  |  | 4.5                    |                |                        |      | 80   |             | 90   |              | 100  |      |
|  |  | 6.0                    |                |                        |      | 78   |             | 80   |              | 80   |      |
| C <sub>IN</sub>  | Input capacitance (digital pins)                               |                        |                |                        | 3.5  | 10   |             | 10   |              | 10   | pF   |
| C <sub>IN</sub>  | Input capacitance (switches off, any single analog pins)       |                        |                |                        | 6.7  | 15   |             | 15   |              | 15   | pF   |

**Table 7. AC electrical characteristics ( $C_L = 50 \text{ pF}$ , input  $t_r = t_f = 6 \text{ ns}$ ) (continued)**

| Symbol   | Parameter  | Test condition |                | Value                             |      |      |                                   |      |                                    | Unit |      |
|----------|--|----------------|----------------|-----------------------------------|------|------|-----------------------------------|------|------------------------------------|------|------|
|          |  | $V_{CC}$ (V)   | Test circuit 1 | $T_A = 25 \text{ }^\circ\text{C}$ |      |      | Up to $85 \text{ }^\circ\text{C}$ |      | Up to $125 \text{ }^\circ\text{C}$ |      |      |
|          |  |                |                | Min.                              | Typ. | Max. | Min.                              | Max. | Min.                               |      | Max. |
| $C_{IN}$ | Input capacitance (switches off, any common analog pins) |                |                |                                   | 22   | 40   |                                   | 40   |                                    | 40   | pF   |
| $C_{PD}$ | Power dissipation capacitance <sup>(1)</sup>             | 3.3            |                |                                   | 24   |      |                                   |      |                                    |      | pF   |
|          |  | 5.0            |                |                                   | 28   |      |                                   |      |                                    |      |      |

1.  $C_{PD}$  is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load (refer to [Figure 5](#)). The average operating current can be obtained by the following equation:  
 $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/8$ .

**Table 8. Injection current coupling specification ( $T_A = -55^\circ\text{C}$  to  $+125^\circ\text{C}$ )**

| Symbol           | Parameter   | Test condition |   | Value               |      | Unit |
|------------------|---|----------------|---|---------------------|------|------|
|                  |   | $V_{CC}$ (V)   | Test circuit 2  | Typ. <sup>(1)</sup> | Max. |      |
| $V_{\Delta OUT}$ | Shift of output voltage of enabled analog channel | 3.3            | $I_{IN} \leq 1 \text{ mA}, R_S \leq 3.9 \text{ k}\Omega$  | 0.050               | 1.0  | mV   |
|                  |   | 5.0            |   | 0.100               | 1.0  |      |
|                  |   | 3.3            | $I_{IN} \leq 10 \text{ mA}, R_S \leq 3.9 \text{ k}\Omega$ | 0.345               | 5.0  |      |
|                  |   | 5.0            |   | 0.067               | 5.0  |      |
|                  |   | 3.3            | $I_{IN} \leq 1 \text{ mA}, R_S \leq 20 \text{ k}\Omega$   | 0.050               | 2.0  |      |
|                  |   | 5.0            |   | 0.110               | 2.0  |      |
|                  |   | 3.3            | $I_{IN} \leq 10 \text{ mA}, R_S \leq 20 \text{ k}\Omega$  | 0.050               | 20   |      |
|                  |   | 5.0            |   | 0.024               | 20   |      |

1. Typical values are measured at  $T_A = 25 \text{ }^\circ\text{C}$ . They are calculated as the difference from  $V_{OUT}$  without injection current and  $V_{OUT}$  with injection current.  $I_{IN}$  = total current injected into any other disabled channels, one at time.



Figure 5. Test circuit 1

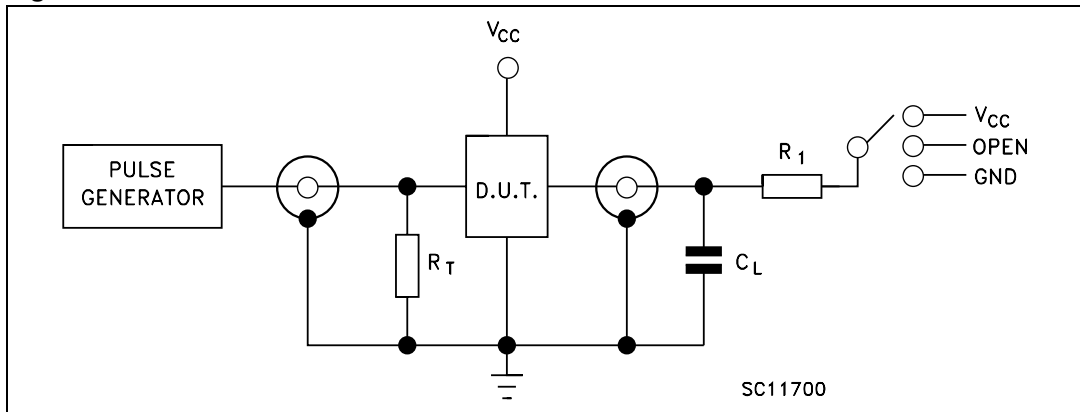


Table 9. Test circuit 1 - switch configuration table

| Test                  | Switch   |
|-----------------------|----------|
| $t_{PLH}$ , $t_{PHL}$ | Open     |
| $t_{PZL}$ , $t_{PLZ}$ | $V_{CC}$ |
| $t_{PZH}$ , $t_{PHZ}$ | GND      |

Note:  $C_L = 50 \text{ pF}$  or equivalent (includes jig and probe capacitance).  
 $R_L = R_1 = 10 \text{ k}\Omega$  or equivalent.  
 $R_T = Z_{OUT}$  of pulse generator (typically  $50 \Omega$ ).

Figure 6. Test circuit 2

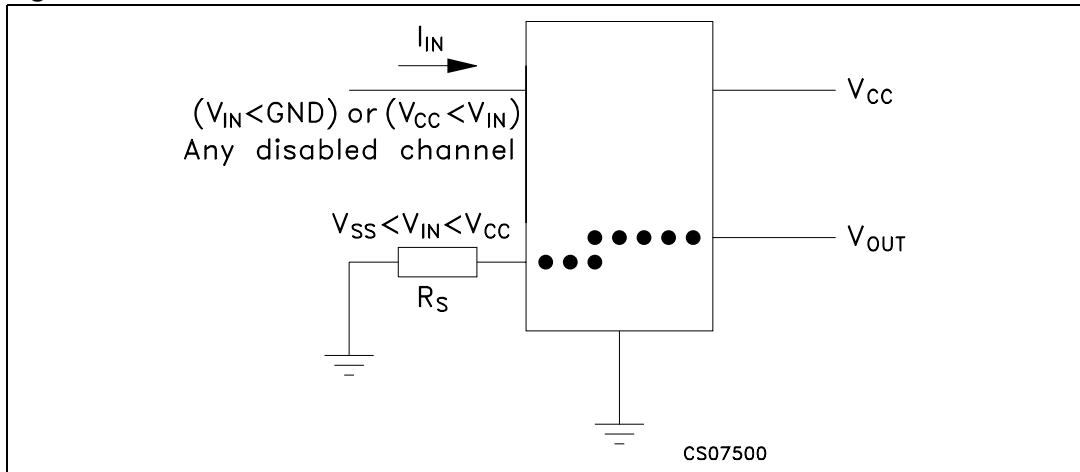


Figure 7. Enable and disable time

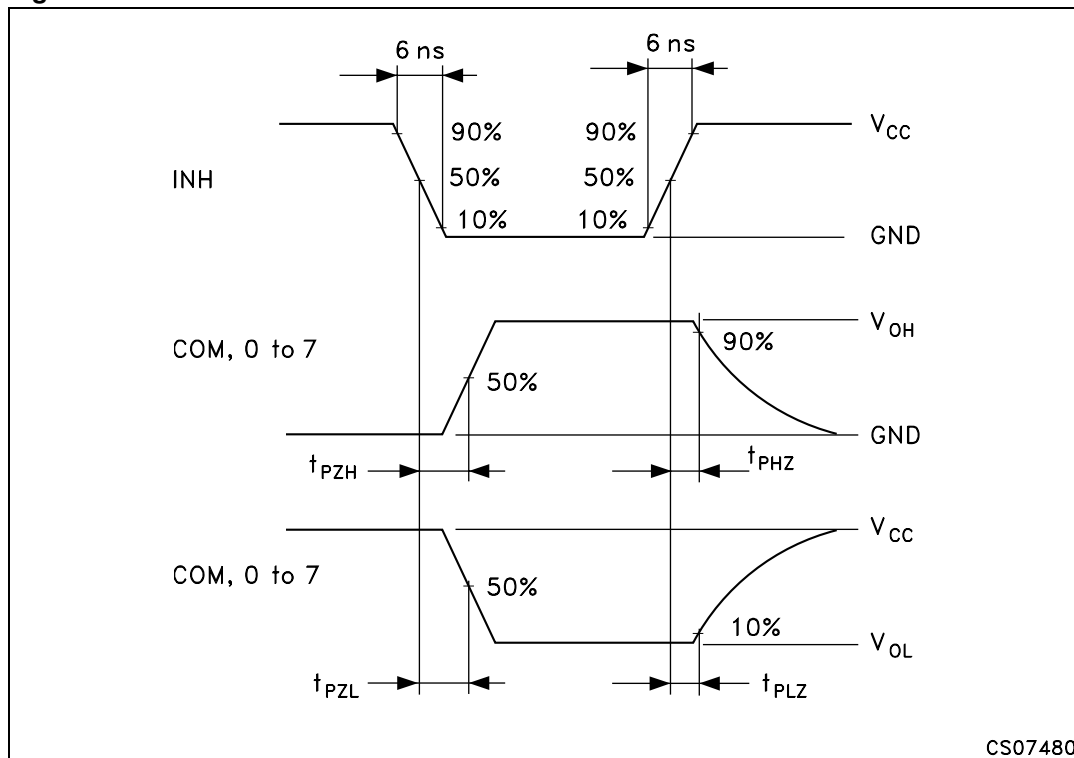
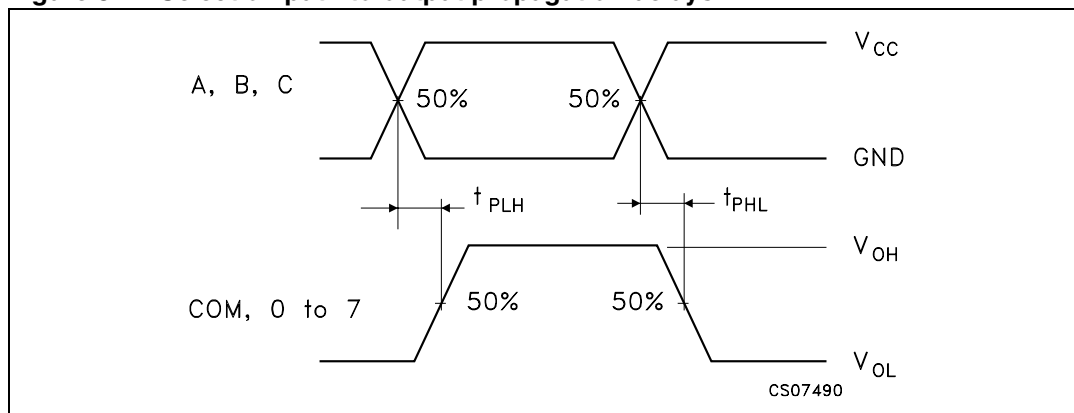
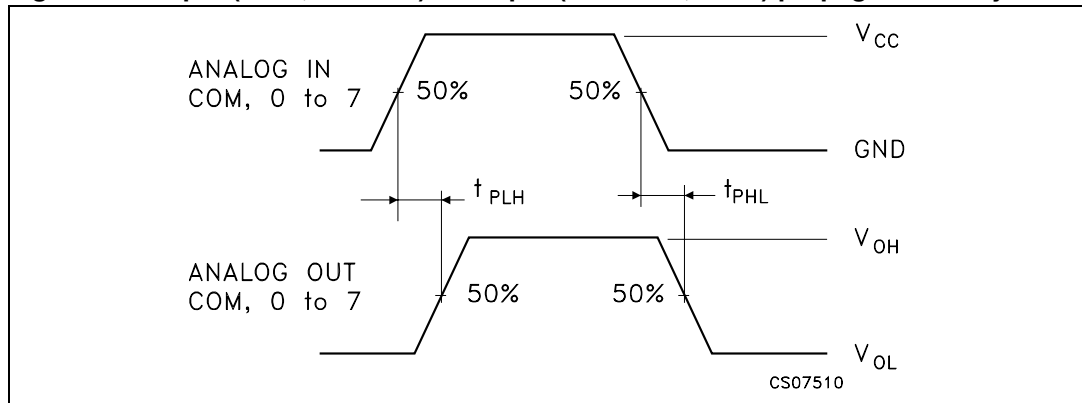


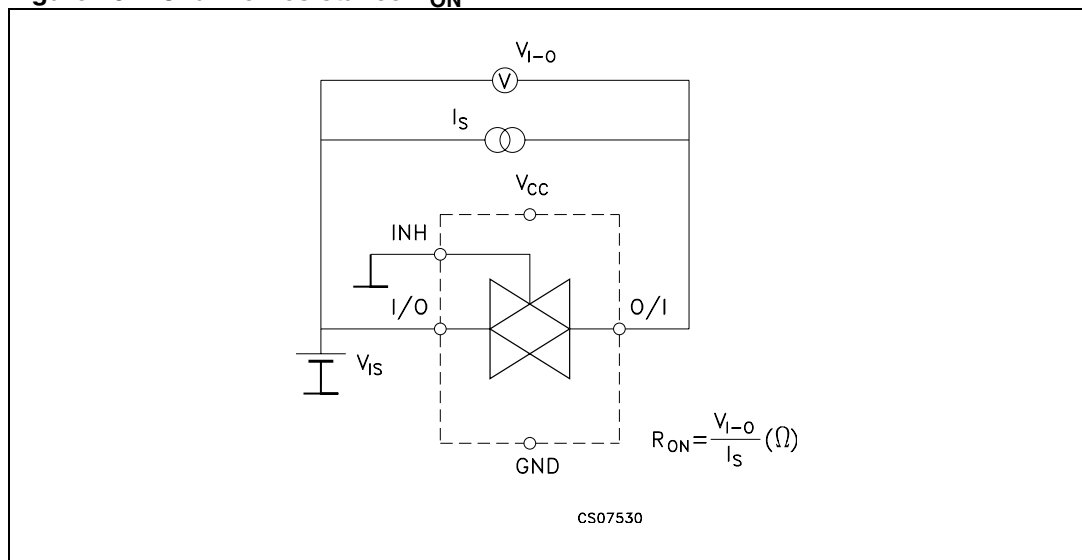
Figure 8. Selection path to output propagation delays



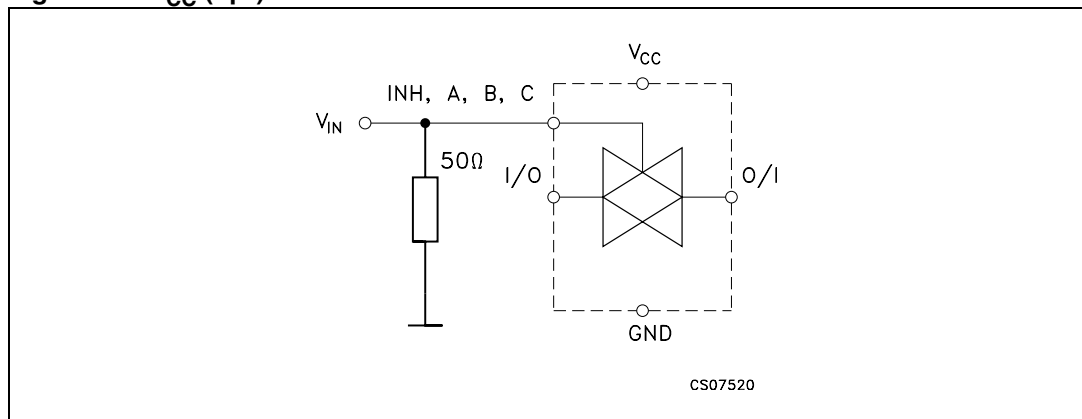
**Figure 9. Input (COM, 0 to 7 in) to output (0 to 7 out, COM) propagation delays**



**Figure 10. Channel resistance  $R_{ON}$**



**Figure 11.  $I_{CC}$  (opr)**



### 3 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.

### 3.1 SO-16 package information

Figure 12. SO-16 package outline

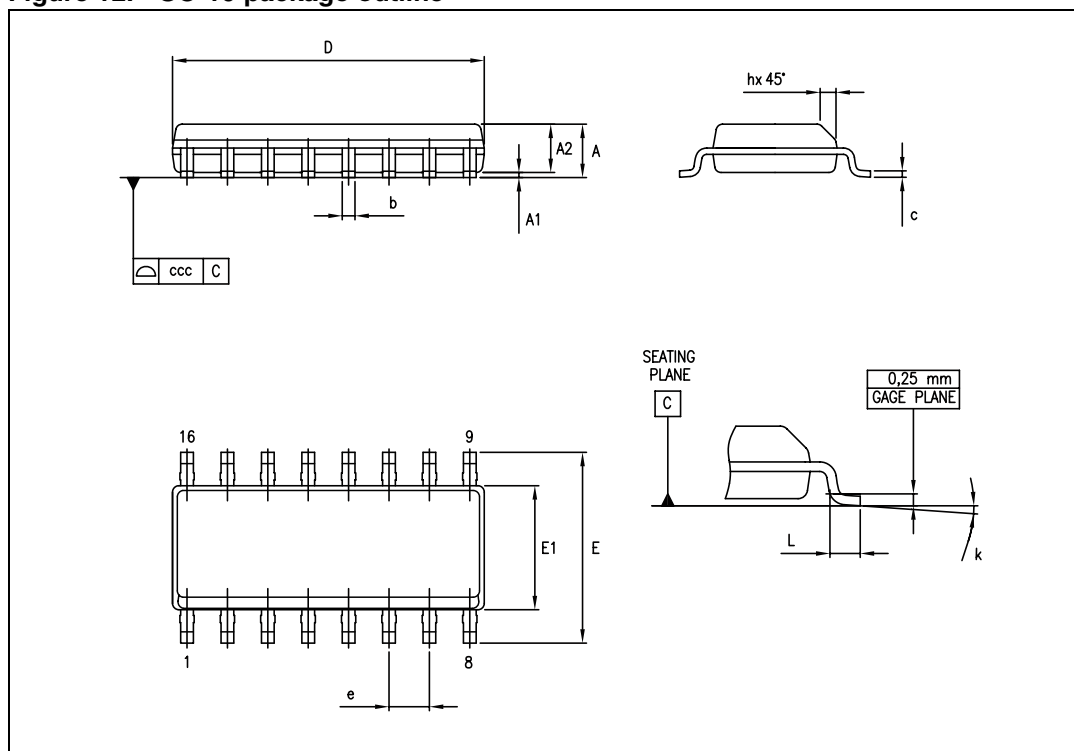


Table 10. SO-16 mechanical data

| Symbol | Dimensions  |      |       |        |       |       |
|--------|-------------|------|-------|--------|-------|-------|
|        | Millimeters |      |       | Inches |       |       |
|        | Min.        | Typ. | Max.  | Min.   | Typ.  | Max.  |
| A      |             |      | 1.75  |        |       | 0.069 |
| A1     | 0.10        |      | 0.25  | 0.004  |       | 0.010 |
| A2     | 1.25        |      |       | 0.049  |       |       |
| b      | 0.31        |      | 0.51  | 0.012  |       | 0.020 |
| c      | 0.17        |      | 0.25  | 0.007  |       | 0.010 |
| D      | 9.80        | 9.90 | 10.00 | 0.386  | 0.390 | 0.394 |
| E      | 5.80        | 6.00 | 6.20  | 0.228  | 0.236 | 0.244 |
| E1     | 3.80        | 3.90 | 4.00  | 0.150  | 0.154 | 0.157 |
| e      |             | 1.27 |       |        | 0.050 |       |
| h      | 0.25        |      | 0.50  | 0.010  |       | 0.020 |
| L      | 0.40        |      | 1.27  | 0.016  |       | 0.050 |
| k      | 0           |      | 8     |        |       |       |
| ccc    |             |      | 0.10  |        |       | 0.004 |

### 3.2 TSSOP16 package information

Figure 13. TSSOP16 package outline

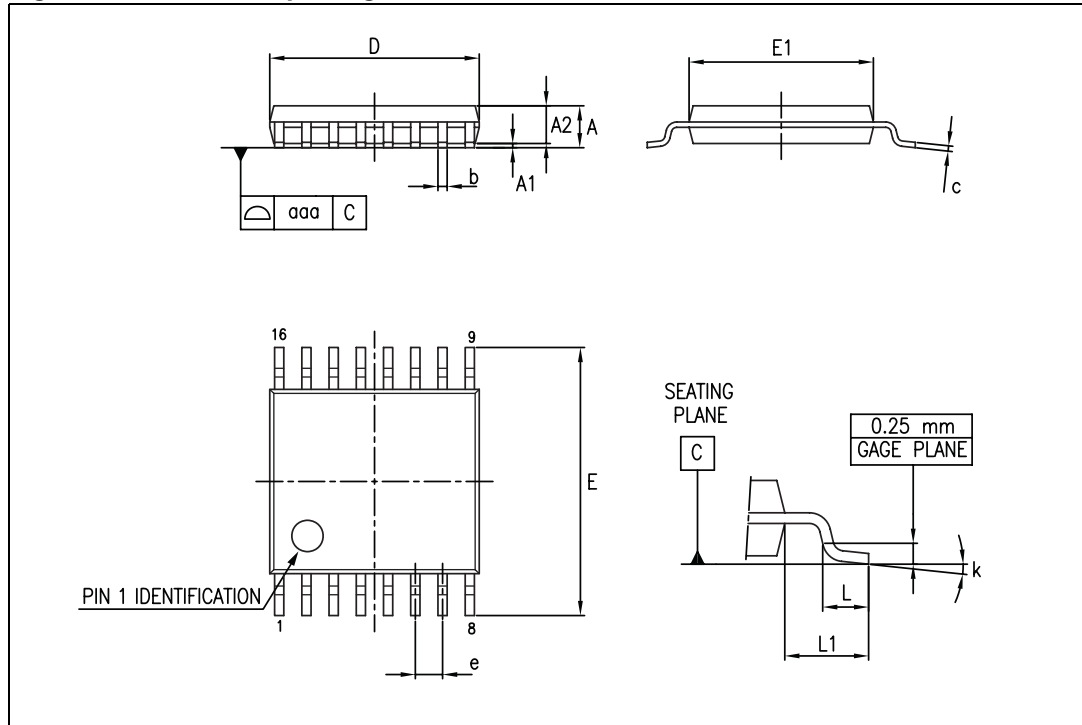


Table 11. TSSOP16 mechanical data

| Symbol | Dimensions  |      |      |        |        |       |
|--------|-------------|------|------|--------|--------|-------|
|        | Millimeters |      |      | Inches |        |       |
|        | Min.        | Typ. | Max. | Min.   | Typ.   | Max.  |
| A      |             |      | 1.20 |        |        | 0.047 |
| A1     | 0.05        |      | 0.15 | 0.002  |        | 0.006 |
| A2     | 0.80        | 1.00 | 1.05 | 0.031  | 0.039  | 0.041 |
| b      | 0.19        |      | 0.30 | 0.007  |        | 0.012 |
| c      | 0.09        |      | 0.20 | 0.004  |        | 0.008 |
| D      | 4.90        | 5.00 | 5.10 | 0.193  | 0.197  | 0.201 |
| E      | 6.20        | 6.40 | 6.60 | 0.244  | 0.252  | 0.260 |
| E1     | 4.30        | 4.40 | 4.50 | 0.169  | 0.173  | 0.177 |
| e      |             | 0.65 |      |        | 0.0256 |       |
| k      | 0°          |      | 8°   | 0°     |        | 8°    |
| L      | 0.45        | 0.60 | 0.75 | 0.018  | 0.024  | 0.030 |
| L1     |             | 1.00 |      |        | 0.039  |       |
| aaa    |             |      | 0.10 |        |        | 0.004 |

## 4 Revision history

**Table 12. Document revision history**

| Date        | Revision | Changes  |
|-------------|----------|--|
| 05-Apr-2012 | 4        | <ul style="list-style-type: none"> <li>– Document reformatted.</li> <li>– Added ESD charged device model feature on cover page.</li> <li>– Added ESD values to <a href="#">Table 4: Absolute maximum ratings</a>.</li> <li>– Modified <a href="#">Chapter 3: Package information</a>.</li> <li>– Modified <a href="#">Chapter 4: Ordering information</a>.</li> </ul>  |
| 11-May-2012 | 5        | <ul style="list-style-type: none"> <li>– Added automotive-grade part number M74HC4851YRM13TR to <a href="#">Table 12.: Order codes</a>.</li> <li>– Added <a href="#">Table 1.: Device summary</a> and Modified <a href="#">Description</a> text on coverpage.</li> </ul>   |
| 15-Jun-2012 | 6        | <ul style="list-style-type: none"> <li>– Updated <a href="#">Table 1: Device summary</a> and <a href="#">Table 12: Order codes</a>.</li> <li>– Corrected ON resistance values in <a href="#">Features on page 1</a></li> <li>– Updated T<sub>op</sub> in <a href="#">Table 5: Recommended operating conditions</a></li> <li>– Added footnote <a href="#">1</a> to <a href="#">Table 1: Device summary</a></li> </ul> |
| 26-Oct-2012 | 7        | <p>Updated ESD values in <a href="#">Features</a>.</p> <p>Updated <a href="#">Table 1</a> (added packaging and marking, updated note <a href="#">1</a>.)</p> <p>Removed <a href="#">Table 12: Order codes</a> (<a href="#">Section 4: Ordering information</a>).</p> <p>Minor corrections throughout document.</p>   |

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