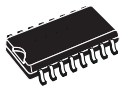
M74HC4851

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

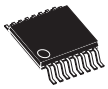
Datasheet – production data

Features

- Low power dissipation
  - I_{CC} = 2 µA (max.) at T_A = 25 °C
- Injection current protection
  - $V_{\Delta OUT}$ < 1 mV at V_{CC} = 5 V, $I_{IN} \leq$ 1 mA
  - $R_S \leq$ 3.9 kΩ
- "ON" resistance at T_A = 25 °C
  - 215 Ω typ. (V_{CC} = 3.0 V)
  - 160 Ω typ. (V_{CC} = 4.5 V)
  - 150 Ω typ. (V_{CC} = 6 V)
- Fast switching
  - t_{pd} = 8.6 ns (typ.) at T_A = 25 °C, V_{CC} = 4.5 V
- Wide operating supply voltage range
  - V_{CC} = 2 V to 6 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 mA
  - (JESD 17)
- ESD performance
  - HBM: 2000 V
  - MM: 200 V
  - CDM: 1000 V



SO-16



TSSOP16

Applications

- Automotive
- Computer
- Consumer
- Industrial

Description

The M74HC4851 device is a single 8-channel analog multiplexer/demultiplexer manufactured with silicon gate C^2MOS 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(1)	-40/+125 °C	SO-16 (automotive grade)	Tape and reel	74HC4851Y
M74HC4851RM13TR	-55/+125 °C	SO-16	Tape and reel	74HC4851
M74HC4851YTTR(1)	-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

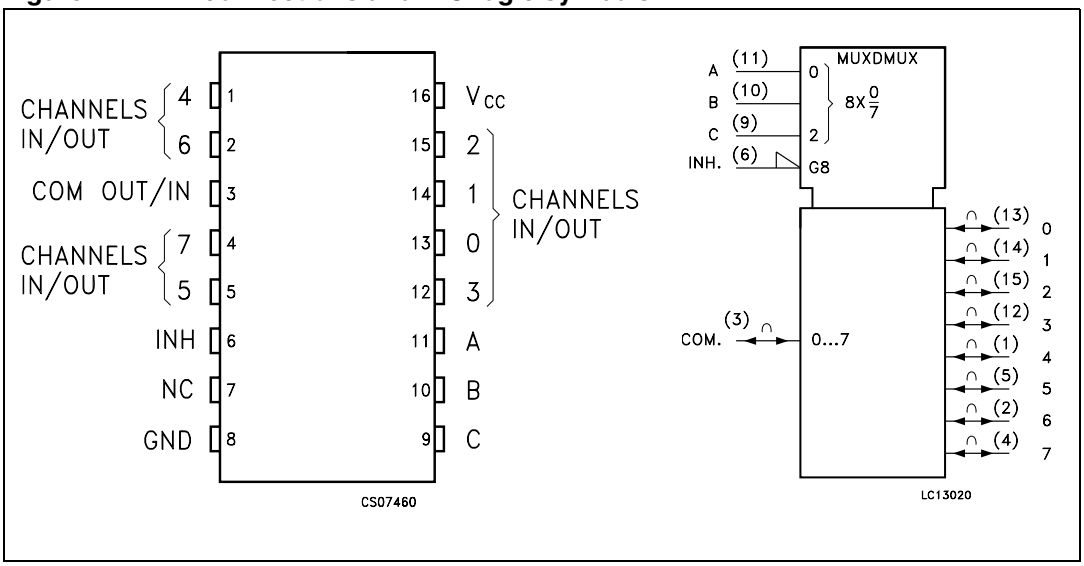


Table 2. Pin descriptions

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, 12, 1, 5, 2, 4	0 to 7	Independent input/outputs
8	GND	Ground (0 V)
16	V_{CC}	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

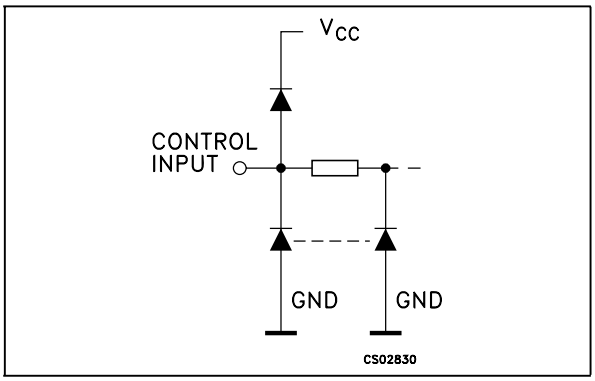


Figure 3. I/O equivalent circuit

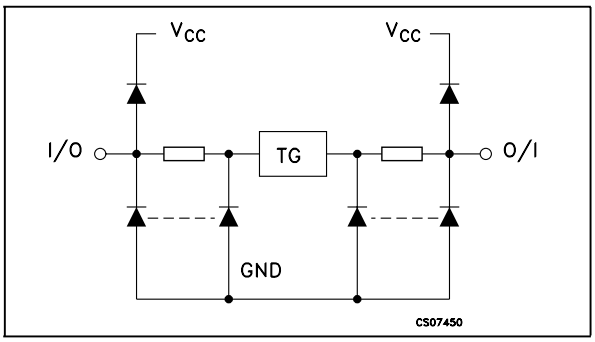
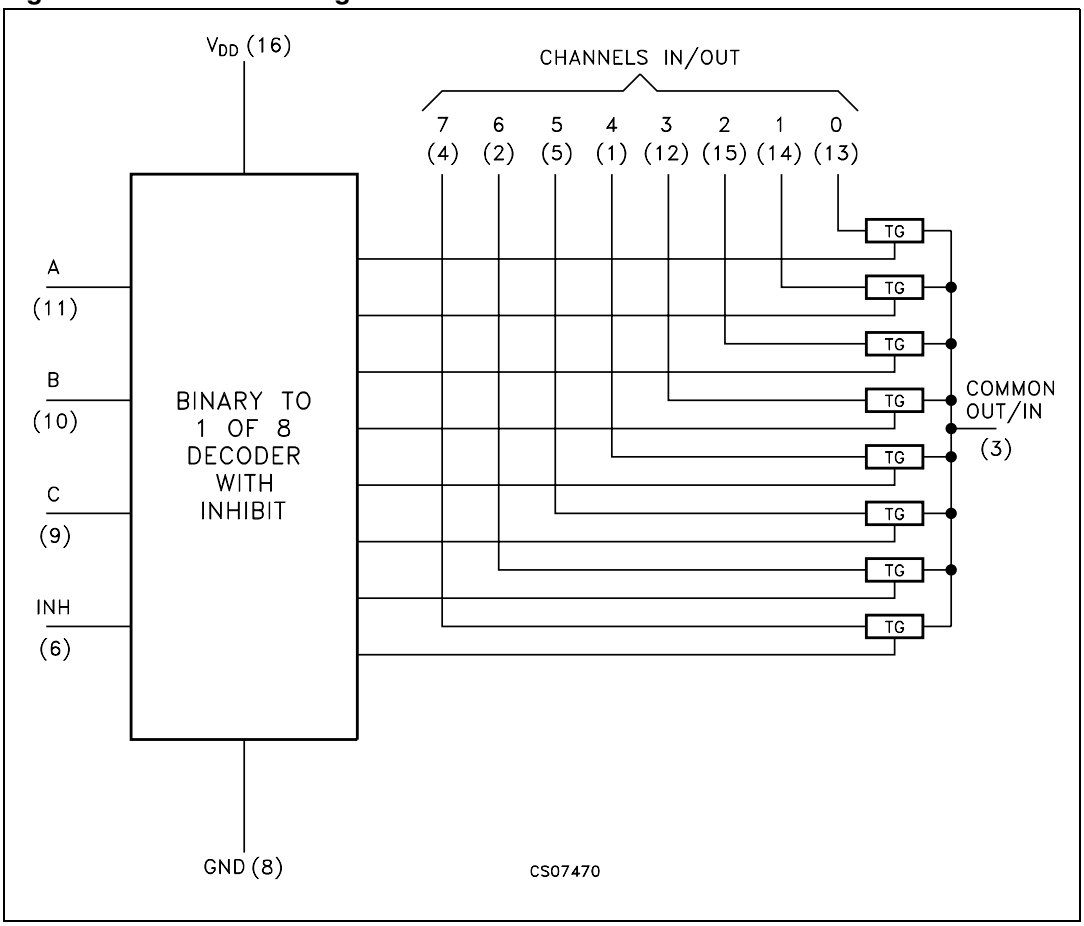


Figure 4. Functional diagram



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		± 25	mA
I_{IOK}	I/O diode current		± 25	mA
I_{CC}	DC V_{CC} or ground current		± 50	mA
P_D	Power dissipation	SO-16	500(1)	mW
		TSSOP16	450(1)	mW
T_{stg}	Storage temperature		-65 to +150	°C
T_L	Lead temperature (10 sec.)		300	°C
ESD (JESD22)	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(1)		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(2) (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_{CC} (V)			T_A = 25 °C			Up to 85 °C		Up to 125 °C		
					Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
V_{IHC}	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_{ILC}	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_{ON}	ON resistance	2.0	I_S = 2 mA	V_{IN} = V_{IHC} or V_{ILC} V_{IS} = V_{CC} to GND		500	650		670		700	Ω
		3.0	$I_S \leq$ 2 mA			215	280		320		360	
		3.3				210	270		305		345	
		4.5				160	210		240		270	
		6.0				150	195		220		250	
ΔR_{ON}	Difference of ON resistance between switches	2.0	I_S = 2 mA	V_{IN} = V_{IHC} or V_{ILC} V_{IS} = V_{CC}/2		4	10		15		20	Ω
		3.0	$I_S \leq$ 2 mA			2	8		12		16	
		3.3				2	8		12		16	
		4.5				2	8		12		16	
		6.0				3	9		13		18	
I_{OFF}	Input/output leakage current (switch off) (any channel)	6.0	V_{IN} = V_{CC} or GND				±0.1		±0.5		±1.0	µA
I_{OFF}	Input/output leakage current (switch off) (common channel)	6.0	V_{IN} = V_{CC} or GND				±0.2		±2		±4	µA
I_{ON}	Switch input leakage current (switch on, output open)	6.0	V_{IN} = V_{CC} or GND				±0.1		±0.5		±1	µA

Table 6. DC specifications (continued)

Symbol	Parameter	Test condition		Value							Unit
		V_{CC} (V)		T_A = 25 °C			Up to 85 °C		Up to 125 °C		
				Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
I_{IN}	Control input current	6.0	V_{IN} = V_{CC} or GND			±0.1		±0.1		±1	µA
I_{CC}	Quiescent supply current	6.0	V_{IN} = V_{CC} or GND $V_{IN(analog)}$ = GND			2		20		40	µA

Table 7. AC electrical characteristics (C_L = 50 pF, input t_r = t_f = 6 ns)

Symbol	Parameter	Test condition		Value							Unit
		V_{CC} (V)	Test circuit 1	T_A = 25 °C			Up to 85 °C		Up to 125 °C		
				Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
t_{PHL}, t_{PLH}	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_{PHL}, t_{PLH}	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_{PHZ}, t_{PZH} t_{PLZ}, t_{PZL}	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_{IN}	Input capacitance (digital pins)				3.5	10		10		10	pF
C_{IN}	Input capacitance (switches off, any single analog pins)				6.7	15		15		15	pF

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

Symbol	Parameter	Test condition		Value							Unit
		V_{CC} (V)	Test circuit 1	T_A = 25 °C			Up to 85 °C		Up to 125 °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(1)	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°C to +125°C)

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

1. Typical values are measured at T_A = 25 °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

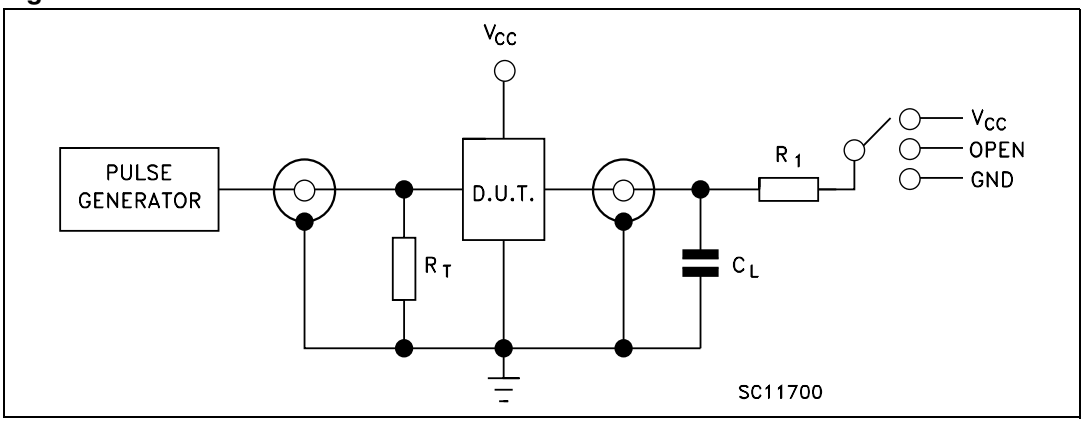


Table 9. Test circuit 1 - switch configuration table

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

Note: *C_L = 50 pF or equivalent (includes jig and probe capacitance).*
R_L = R1 = 10 kΩ or equivalent.
$R_T = Z_{OUT}$ of pulse generator (typically 50 Ω).

Figure 6. Test circuit 2

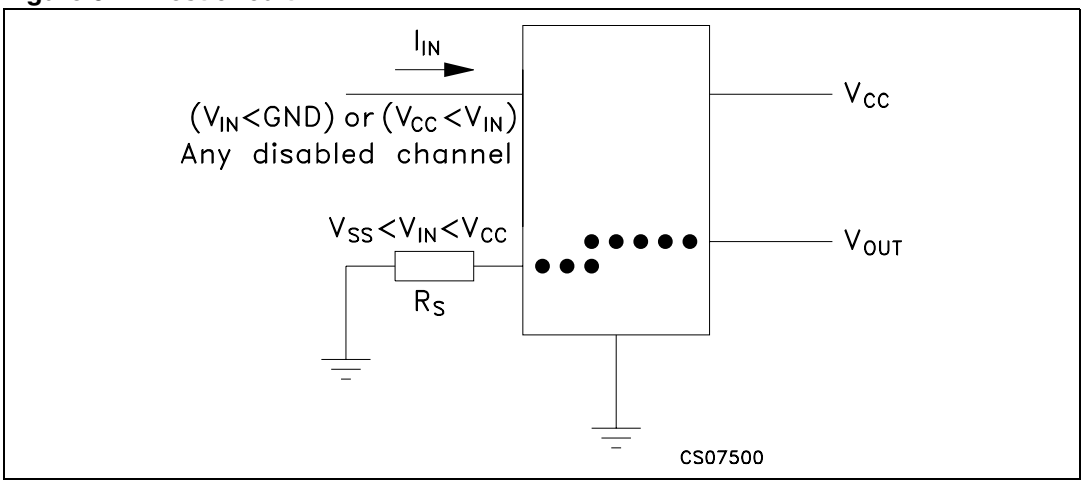


Figure 7. Enable and disable time

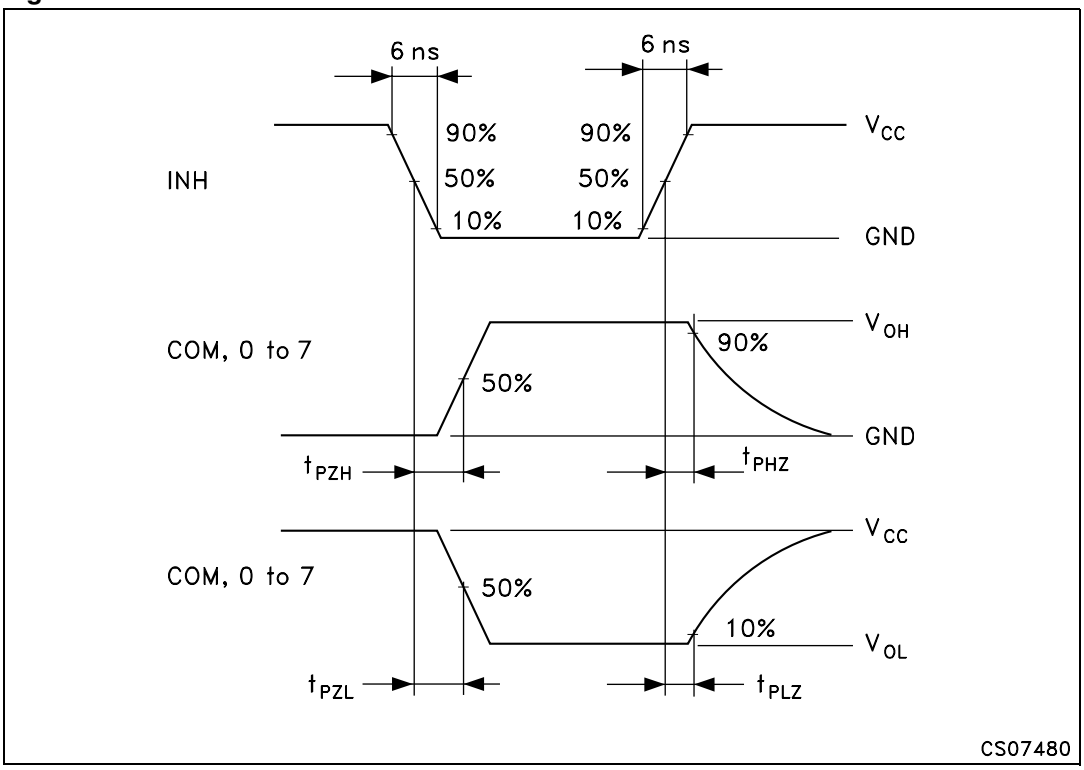


Figure 8. Selection path to output propagation delays

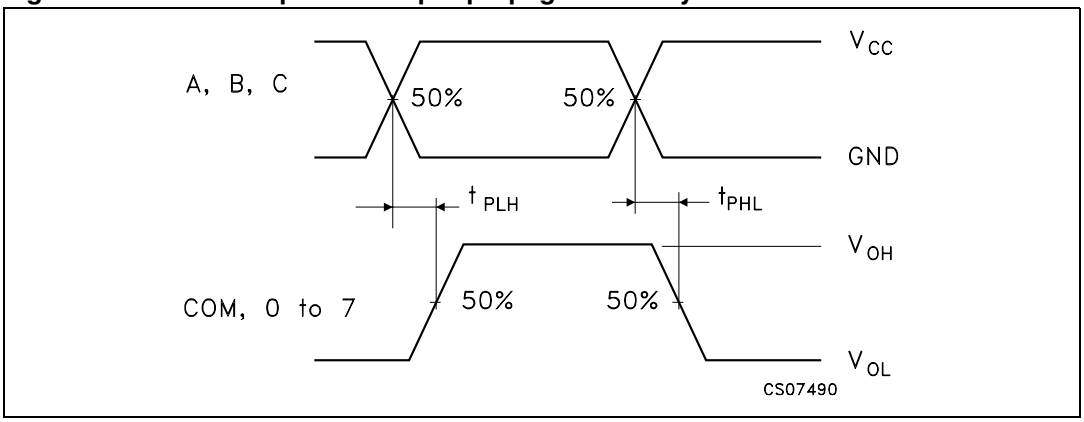


Figure 9. Input (COM, 0 to 7 in) to output (0 to 7 out, COM) propagation delays

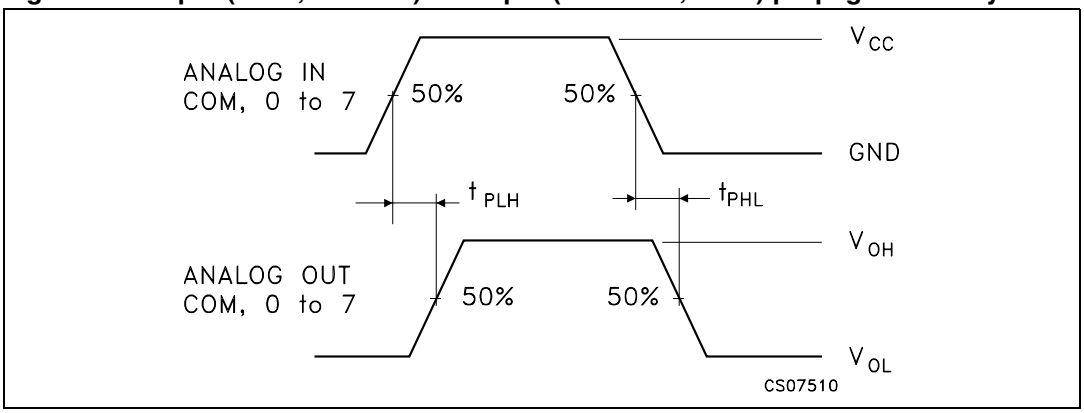


Figure 10. Channel resistance R_{ON}

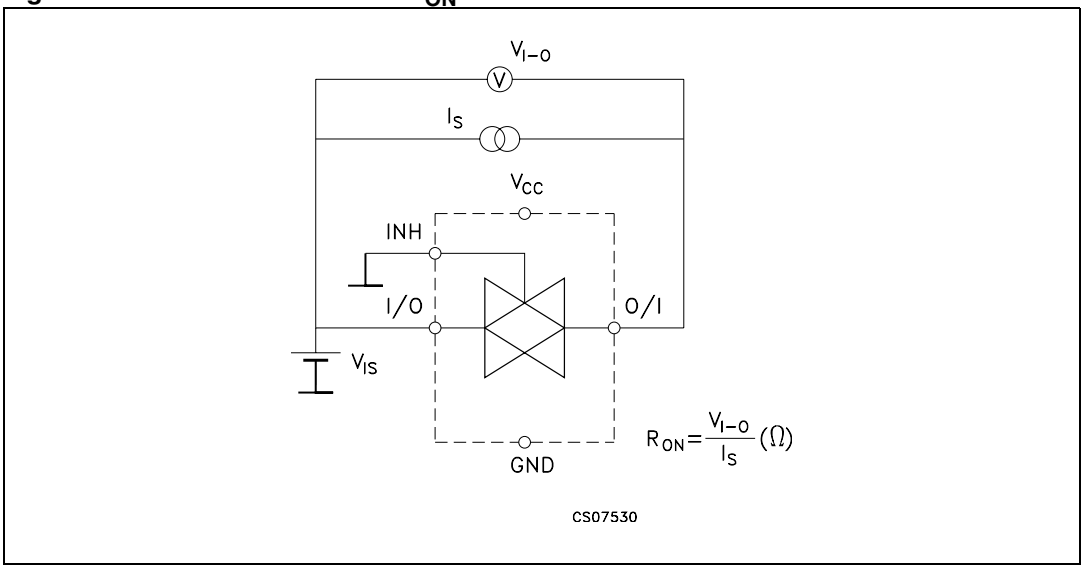
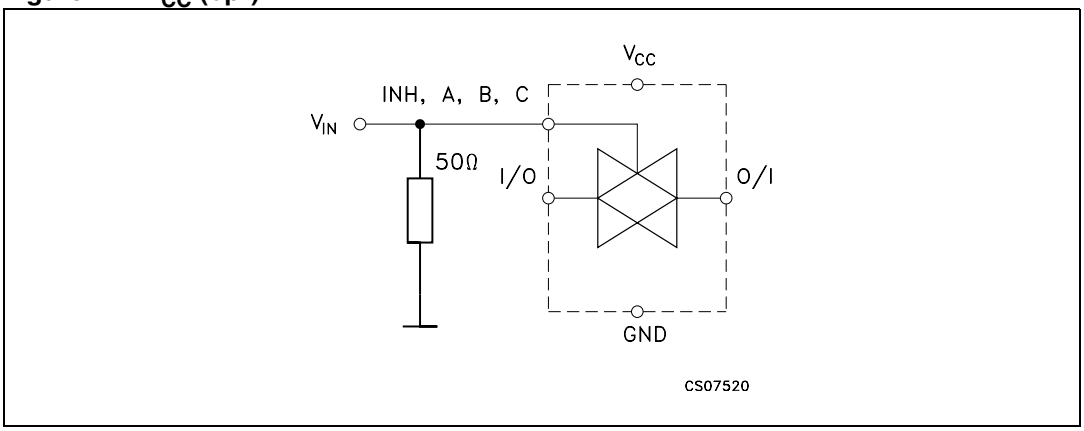


Figure 11. I_{CC} (opr)



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*. ECOPACK is an ST trademark.

3.1 SO-16 package information

Figure 12. SO-16 package outline

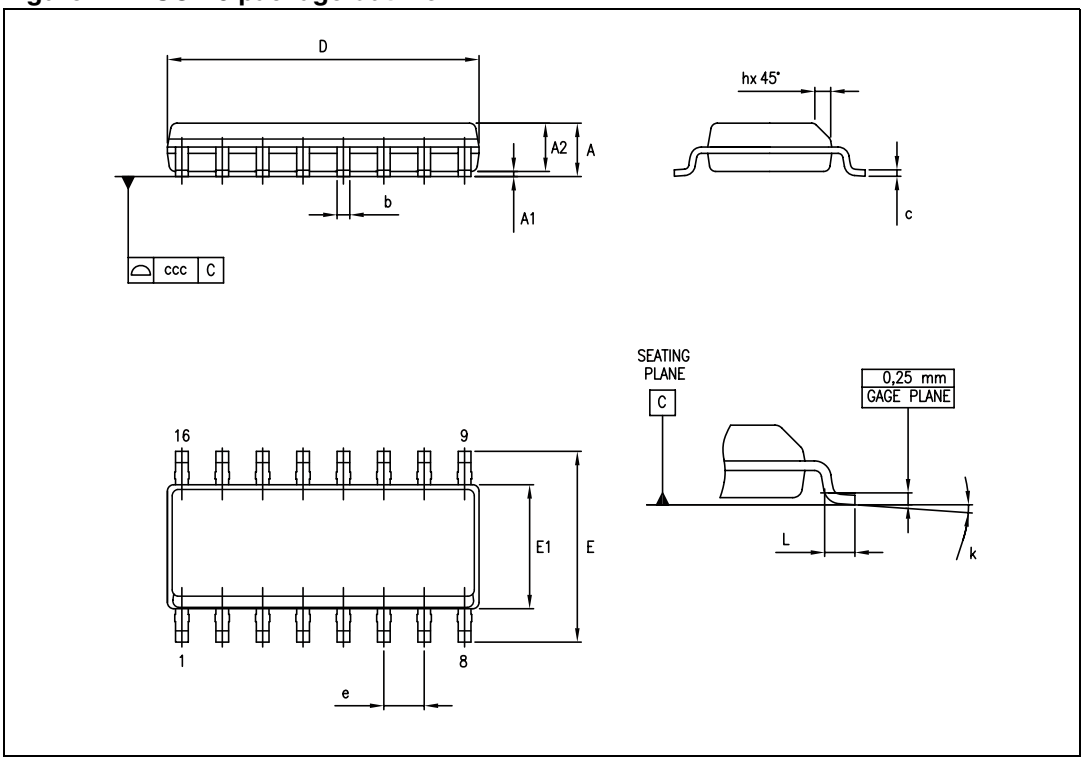


Table 10. SO-16 mechanical data

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

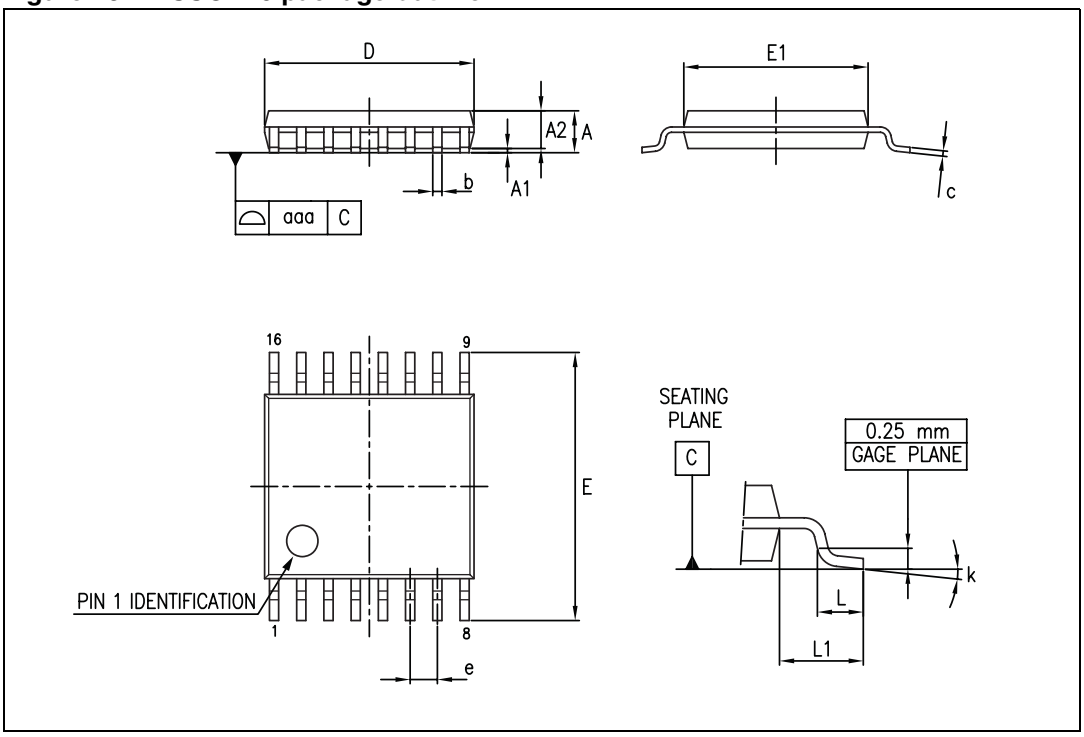


Table 11. TSSOP16 mechanical data

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	– Document reformatted. – Added ESD charged device model feature on cover page. – Added ESD values to *Table 4: Absolute maximum ratings*. – Modified *Chapter 3: Package information*. – Modified *Chapter 4: Ordering information*.
11-May-2012	5	– Added automotive-grade part number M74HC4851YRM13TR to *Table 12.: Order codes*. – Added *Table 1.: Device summary* and Modified *Description* text on coverpage.
15-Jun-2012	6	– Updated *Table 1: Device summary* and *Table 12: Order codes*. – Corrected ON resistance values in *Features on page 1* – Updated T_{op} in *Table 5: Recommended operating conditions* – Added footnote *1* to *Table 1: Device summary*
26-Oct-2012	7	Updated ESD values in *Features*. Updated *Table 1* (added packaging and marking, updated note *1*.) Removed *Table 12: Order codes* (*Section 4: Ordering information*). Minor corrections throughout document.