

## LOW VOLTAGE 0.5Ω MAX QUAD SPDT SWITCH WITH BREAK BEFORE MAKE FEATURE

- HIGH SPEED:  
 $t_{PD} = 0.3ns$  (TYP.) at  $V_{CC} = 3.0V$   
 $t_{PD} = 0.4ns$  (TYP.) at  $V_{CC} = 2.3V$
- ULTRA LOW POWER DISSIPATION:  
 $I_{CC} = 0.2\mu A$  (MAX.) at  $T_A = 85^\circ C$
- LOW "ON" RESISTANCE  $V_{IN}=0V$ :  
 $R_{ON} = 0.5\Omega$  (MAX.  $T_A = 25^\circ C$ ) at  $V_{CC} = 2.7V$   
 $R_{ON} = 0.8\Omega$  (MAX.  $T_A = 25^\circ C$ ) at  $V_{CC} = 2.3V$   
 $R_{ON} = 3.0\Omega$  (MAX.  $T_A = 25^\circ C$ ) at  $V_{CC} = 1.8V$
- WIDE OPERATING VOLTAGE RANGE:  
 $V_{CC}$  (OPR) = 1.65V to 4.3V SINGLE SUPPLY
- 4.3V TOLERANT AND 1.8V COMPATIBLE THRESHOLD ON DIGITAL CONTROL INPUT at  $V_{CC} = 2.3$  to  $3.0V$
- LATCH-UP PERFORMANCE EXCEEDS 300mA (JESD 17)
- ESD PERFORM. (ANALOG CHAN. vs GND):  
 $HBM > 7KV$  (MIL STD 883 method 3015)

### DESCRIPTION

The STG3699 is a high-speed CMOS LOW VOLTAGE QUAD ANALOG S.P.D.T. (Single Pole Dual Throw) SWITCH or 2:1 Multiplexer/ Demultiplexer Switch fabricated in silicon gate C<sup>2</sup>MOS technology. It is designed to operate from 1.65V to 4.3V, making this device ideal for portable applications.

It offers very low ON-Resistance ( $<0.5\Omega$ ) at  $V_{CC}=3.0V$ . The  $nIN$  inputs are provided to control the switches. The switches  $nS1$  are ON (they are

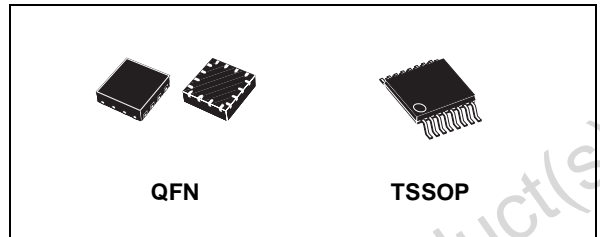


Table 1: Order Codes

PACKAGE	T & R
TSSOP	STG3699TTR
QFN	STG3699QTR

connected to common Ports  $D_n$ ) when the  $nIN$  input is held high and OFF (high impedance state exists between the two ports) when  $nIN$  is held low; the switches  $nS2$  are ON (they are connected to common Ports  $D_n$ ) when the  $nIN$  input is held low and OFF (high impedance state exists between the two ports) when  $IN$  is held high. Additional key features are fast switching speed, Break Before Make Delay Time and Ultra Low Power Consumption. All inputs and outputs are equipped with protection circuits against static discharge, giving them ESD immunity and transient excess voltage. It's available in the commercial temperature range in TSSOP and QFN3x3mm package.

Figure 1: Pin Connection

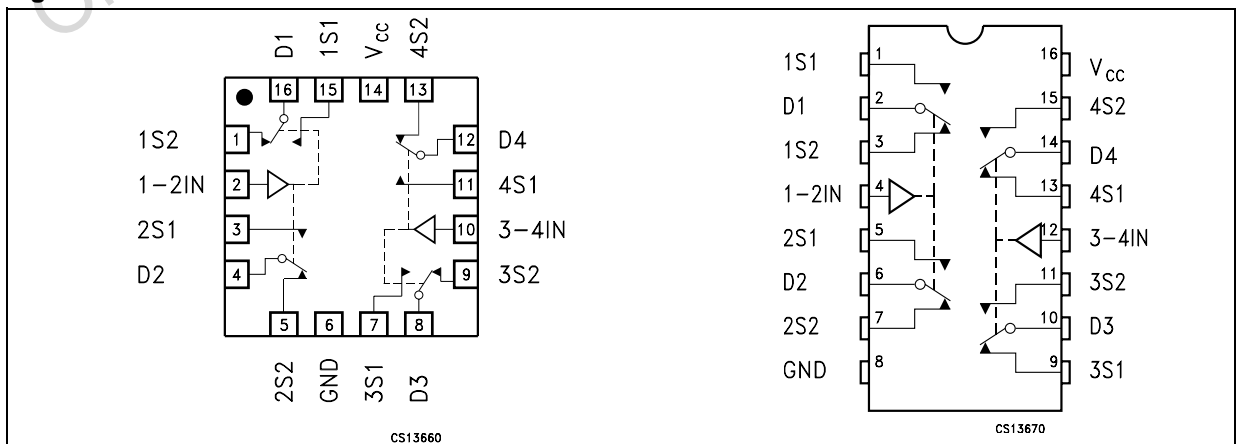


Figure 2: Input Equivalent Circuit

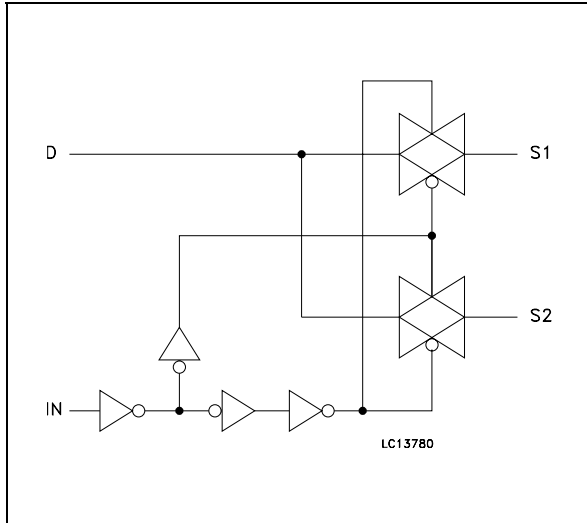


Table 2: Pin Description

TSSOP <sup>(1)</sup> PIN N°	QFN <sup>(1)</sup> PIN N°	SYMBOL	NAME AND FUNCTION
1, 5, 9, 13, 3, 7, 11, 15	15, 3, 7, 11, 1, 5, 9, 13	1S1 to 4S1, 1S2 to 4S2	Independent Channels
2, 6, 10, 14	16, 4, 8, 12	D1 to D4	Common Channels
4, 12	2, 10	1-2IN, 3-4IN	Controls
16	14	V <sub>CC</sub>	Positive Supply Voltage
8	6	GND	Ground (0V)

1. Exposed pad must be soldered to a floating plane. Do NOT connect to power or ground.

Table 3: Truth Table

IN	SWITCH S1	SWITCH S2
H	ON	OFF <sup>(1)</sup>
L	OFF <sup>(1)</sup>	ON

1. High Impedance

Table 4: Absolute Maximum Ratings

Symbol	Parameter	Value	Unit	
V <sub>CC</sub>	Supply Voltage	-0.5 to 4.6	V	
V <sub>I</sub>	DC Input Voltage	-0.5 to V <sub>CC</sub> + 0.5	V	
V <sub>IC</sub>	DC Control Input Voltage	-0.5 to 4.6	V	
V <sub>O</sub>	DC Output Voltage	-0.5 to V <sub>CC</sub> + 0.5	V	
I <sub>IKC</sub>	DC Input Diode Current on control pin (V <sub>IN</sub> < 0V)	- 50	mA	
I <sub>IK</sub>	DC Input Diode Current (V <sub>IN</sub> < 0V)	± 50	mA	
I <sub>OK</sub>	DC Output Diode Current	± 20	mA	
I <sub>O</sub>	DC Output Current	± 300	mA	
I <sub>OP</sub>	DC Output Current Peak (pulse at 1ms, 10% duty cycle)	± 500	mA	
I <sub>CC</sub> or I <sub>GND</sub>	DC V <sub>CC</sub> or Ground Current	± 100	mA	
P <sub>D</sub>	Power Dissipation at T <sub>a</sub> =70°C (1)	QFN	1120	mW
		TSSOP	500	mW
T <sub>stg</sub>	Storage Temperature	-65 to 150	°C	
T <sub>L</sub>	Lead Temperature (10 sec)	300	°C	

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions not implied.

(1) Derate above 70°C: by 18.5mW/°C for QFN package; by 5.6mW/°C for TSSOP.

Table 5: Recommended Operating Conditions

Symbol	Parameter	Value	Unit	
V <sub>CC</sub>	Supply Voltage (note 1)	1.65 to 4.3	V	
V <sub>I</sub>	Input Voltage	0 to V <sub>CC</sub>	V	
V <sub>IC</sub>	Control Input Voltage	0 to 4.3	V	
V <sub>O</sub>	Output Voltage	0 to V <sub>CC</sub>	V	
T <sub>op</sub>	Operating Temperature	-55 to 125	°C	
dt/dv	Input Rise and Fall Time Control Input	V <sub>CC</sub> = 1.65V to 2.7V	0 to 20	ns/V
		V <sub>CC</sub> = 3.0V to 4.3V	0 to 10	

1) Truth Table guaranteed: 1.2V to 4.3V.

Table 6: DC Specifications

Symbol	Parameter	Test Conditions		Value						Unit	
		V <sub>CC</sub> (V)		T <sub>A</sub> = 25°C			-40 to 85°C		-55 to 125°C		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
V <sub>IH</sub>	High Level Input Voltage	1.65-1.95		0.65V <sub>CC</sub>			0.65V <sub>CC</sub>		0.65V <sub>CC</sub>		V
		2.3-2.5		1.4			1.4		1.4		
		2.7-3.0		1.4			1.4		1.4		
		3.3		1.5			1.5		1.5		
		3.6		1.7			1.7		1.7		
		4.3		2.2			2.2		2.2		
V <sub>IL</sub>	Low Level Input Voltage	1.65-1.95				0.40		0.40		0.40	V
		2.3-2.5				0.50		0.50		0.50	
		2.7-3.0				0.50		0.50		0.50	
		3.3				0.50		0.50		0.50	
		3.6				0.50		0.50		0.50	
		4.3				1.3		1.3		1.3	
R <sub>ON</sub>	Switch ON Resistance (1)	4.3	V <sub>S</sub> =0V to V <sub>CC</sub> I <sub>S</sub> =100mA		0.40	0.50		0.60			Ω
		3.0			0.40	0.50		0.60			
		2.7			0.40	0.50		0.60			
		2.3			0.50	0.80		0.80			
		1.8			0.70	3.0		4.0			
		1.65			0.80	3.0		4.0			
ΔR <sub>ON</sub>	ON Resistance Match between channels (1,2)	2.7	V <sub>S</sub> =1.5V I <sub>S</sub> =100mA		0.06					Ω	
R <sub>FLAT</sub>	ON Resistance FLATNESS (3)	4.3	V <sub>S</sub> =1.5V I <sub>S</sub> =100mA								Ω
		3.0									
		2.7			0.07	0.15		0.15			
		2.3									
		1.65	V <sub>S</sub> =0.8V I <sub>S</sub> =100mA								
I <sub>OFF</sub>	OFF State Leakage Current (nSn), (Dn)	4.3	V <sub>S</sub> =0.3 or 4V			±10		±100		nA	
I <sub>IN</sub>	Input Leakage Current	0 - 4.3	V <sub>IN</sub> = 0 to 4.3V			±0.1		±1		μA	
I <sub>CC</sub>	Quiescent Supply Current (1)	1.65-4.3	V <sub>IN</sub> =V <sub>CC</sub> or GND			±0.05		±0.2		±1	μA

Note 1: Guaranteed by design

Note 2: ΔR<sub>ON</sub> = R<sub>ON(MAX)</sub> - R<sub>ON(MIN)</sub>

Note 3: Flatness is defined as the difference between the maximum and minimum value of on-resistance as measured over the specified analog signal ranges.

Table 7: AC Electrical Characteristics ( $C_L = 35\text{pF}$ ,  $R_L = 50\Omega$ ,  $t_r = t_f \leq 5\text{ns}$ )

Symbol	Parameter	Test Condition		Value						Unit	
		$V_{CC}$ (V)		$T_A = 25^\circ\text{C}$			$-40$ to $85^\circ\text{C}$		$-55$ to $125^\circ\text{C}$		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
$t_{PLH}$ , $t_{PHL}$	Propagation Delay	1.65-1.95	$V_I = \text{OPEN}$		0.45						ns
		2.3-2.7			0.40						
		3.0-3.6			0.30						
		3.6-4.3			0.30						
$t_{ON}$	TURN-ON time	1.65-1.95	$V_S = 0.8\text{V}$		70						ns
		2.3-2.7	$V_S = 1.5\text{V}$		30	50		60			
		3.0-3.6			30	50		60			
		3.6-4.3			30	50		60			
$t_{OFF}$	TURN-OFF time	1.65-1.95	$V_S = 0.8\text{V}$		45						ns
		2.3-2.7	$V_S = 1.5\text{V}$		25	30		40			
		3.0-3.6			25	30		40			
		3.6-4.3			25	30		40			
$t_D$	Break Before Make Time Delay	1.65-1.95	$C_L = 35\text{pF}$ $R_L = 50\Omega$ $V_S = 1.5\text{V}$								ns
		2.3-2.7			2	15					
		3.0-3.6			2	15					
		3.6-4.3			2	15					
Q	Charge injection	1.65-1.95	$C_L = 100\text{pF}$		50						pC
		2.3-2.7	$R_L = 1\text{M}\Omega$		40						
		3.0-3.6	$V_{GEN} = 0\text{V}$		35						
		3.6-4.3	$R_{GEN} = 0\Omega$		35						

Table 8: Analog Switch Characteristics ( $C_L = 5\text{pF}$ ,  $R_L = 50\Omega$ ,  $T_A = 25^\circ\text{C}$ )

Symbol	Parameter	Test Condition		Value						Unit	
		$V_{CC}$ (V)		$T_A = 25^\circ\text{C}$			$-40$ to $85^\circ\text{C}$		$-55$ to $125^\circ\text{C}$		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
OIRR	Off Isolation (1)	1.65-4.3	$V_S = 1\text{V}_{\text{RMS}}$ $f = 100\text{KHz}$		-64						dB
Xtalk	Crosstalk	1.65-4.3	$V_S = 1\text{V}_{\text{RMS}}$ $f = 100\text{KHz}$		-54						dB
THD	Total Harmonic Distortion	2.3-4.3	$R_L = 600\Omega$ $V_{IN} = 2\text{V}_{\text{PP}}$ $f = 20\text{Hz}$ to $20\text{kHz}$		0.03						%
BW	-3dB Bandwidth	1.65-4.3	$R_L = 50\Omega$		50						MHz
$C_{IN}$	Control Pin Input Capacitance				5						pF
$C_{Sn}$	Sn Port Capacitance	3.3	$f = 1\text{MHz}$		37						
$C_D$	D Port Capacitance when Switch is Enabled	3.3	$f = 1\text{MHz}$		84						

Note 1: Off Isolation =  $20\text{Log}_{10}(V_D/V_S)$ ,  $V_D$  = output.  $V_S$  = input to off switch

Figure 3: On Resistance

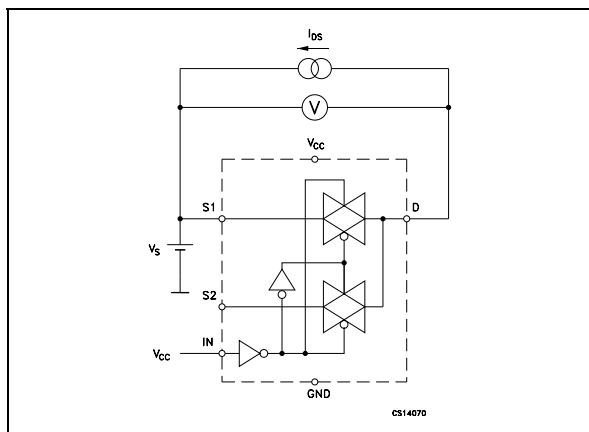


Figure 6: Bandwidth

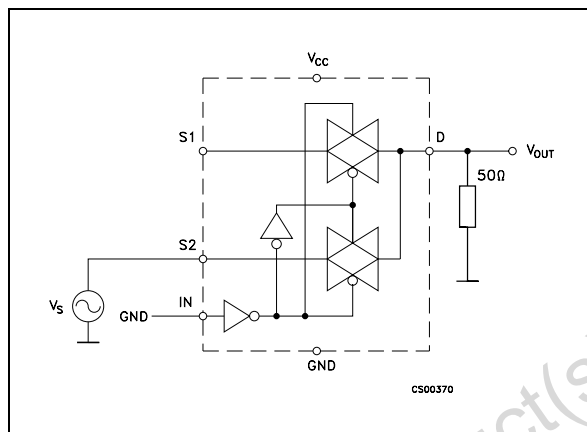


Figure 4: Off Leakage

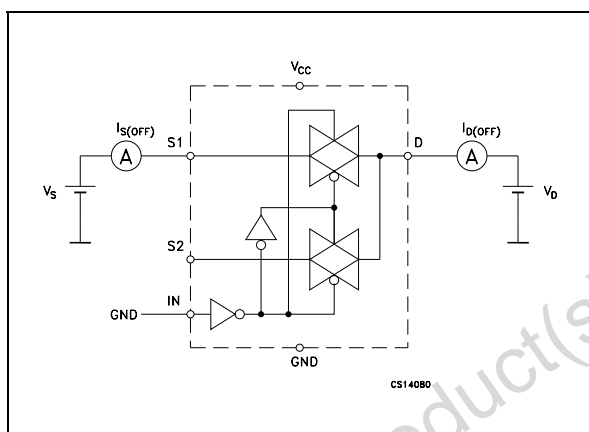


Figure 7: Channel To Channel Crosstalk

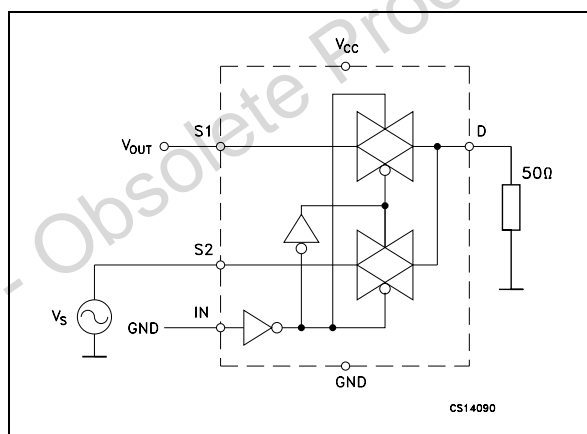


Figure 5: Off Isolation

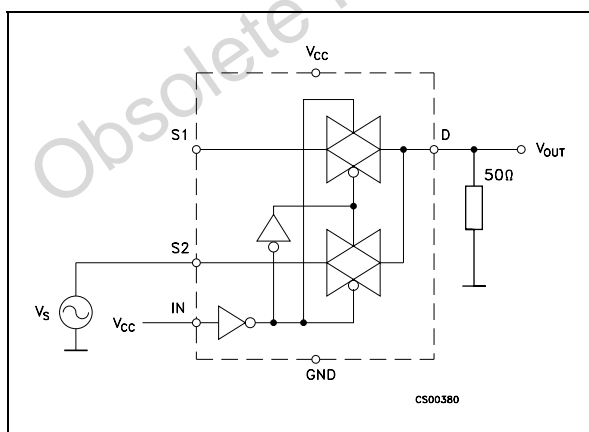
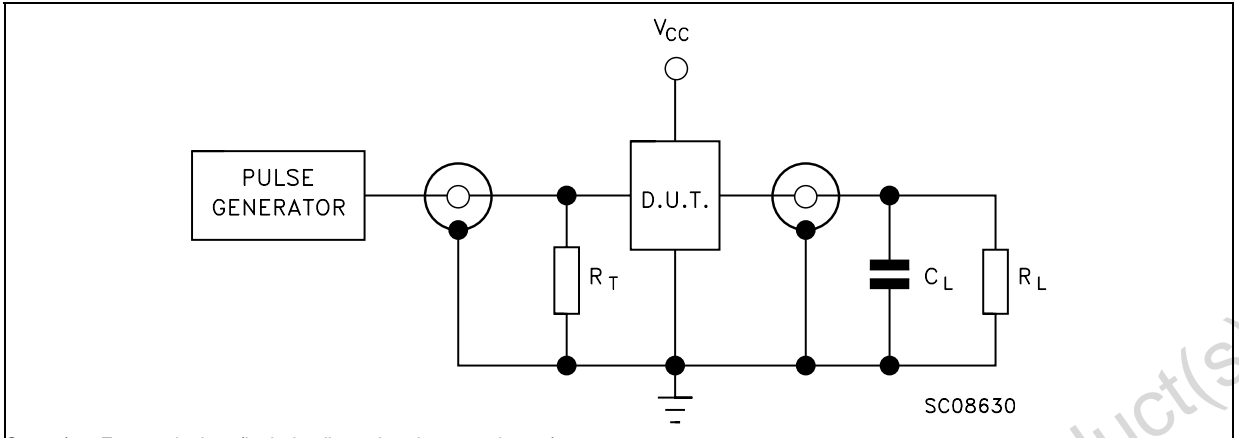


Figure 8: Test Circuit



$C_L = 5/35\text{pF}$  or equivalent (includes jig and probe capacitance)  
 $R_L = 50\Omega$  or equivalent  
 $R_T = Z_{OUT}$  of pulse generator (typically  $50\Omega$ )

Figure 9: Break Before Make Time Delay

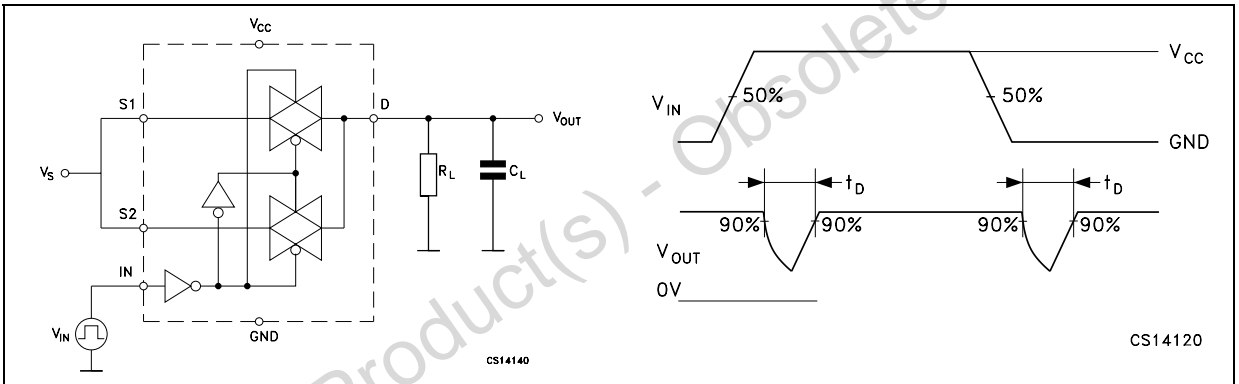


Figure 10: Charge Injection ( $V_{GEN}=0V$ ,  $R_{GEN}=0\Omega$ ,  $R_L=1M\Omega$ ,  $C_L=100\text{pF}$ )

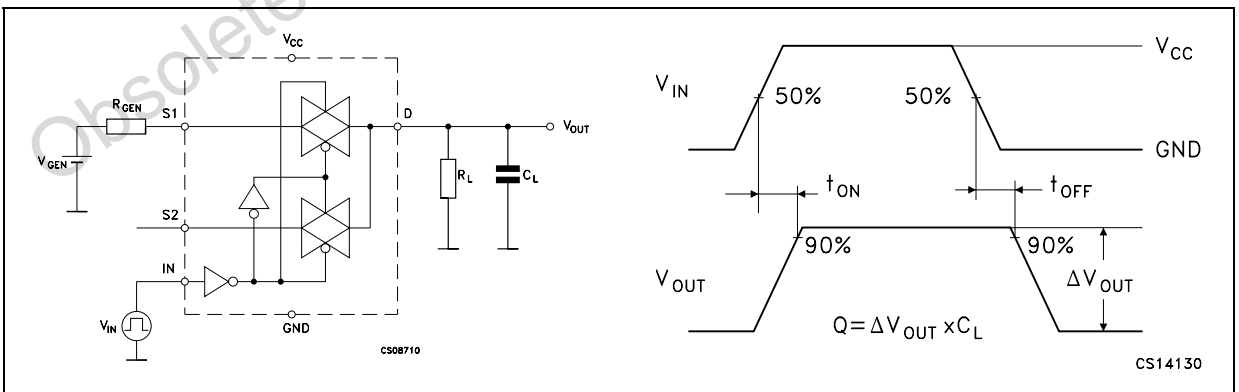
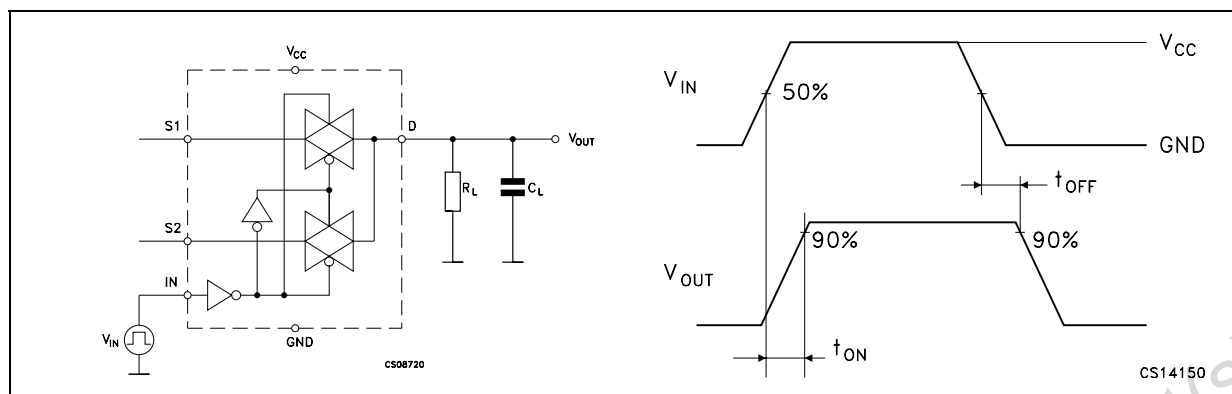
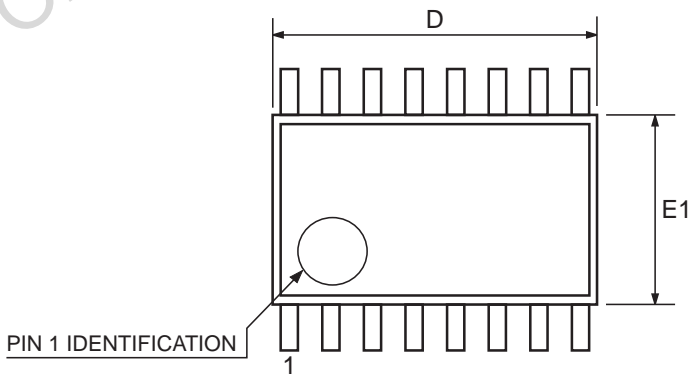
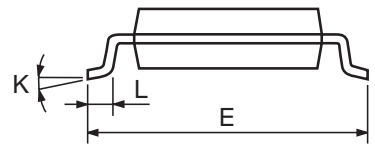
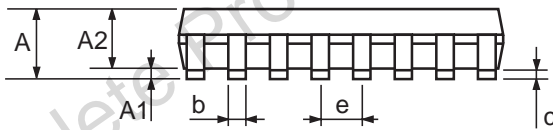


Figure 11: Turn On, Turn Off Delay Time



## TSSOP16 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.2			0.047
A1	0.05		0.15	0.002	0.004	0.006
A2	0.8	1	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.0079
D	4.9	5	5.1	0.193	0.197	0.201
E	6.2	6.4	6.6	0.244	0.252	0.260
E1	4.3	4.4	4.48	0.169	0.173	0.176
e		0.65 BSC			0.0256 BSC	
K	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030

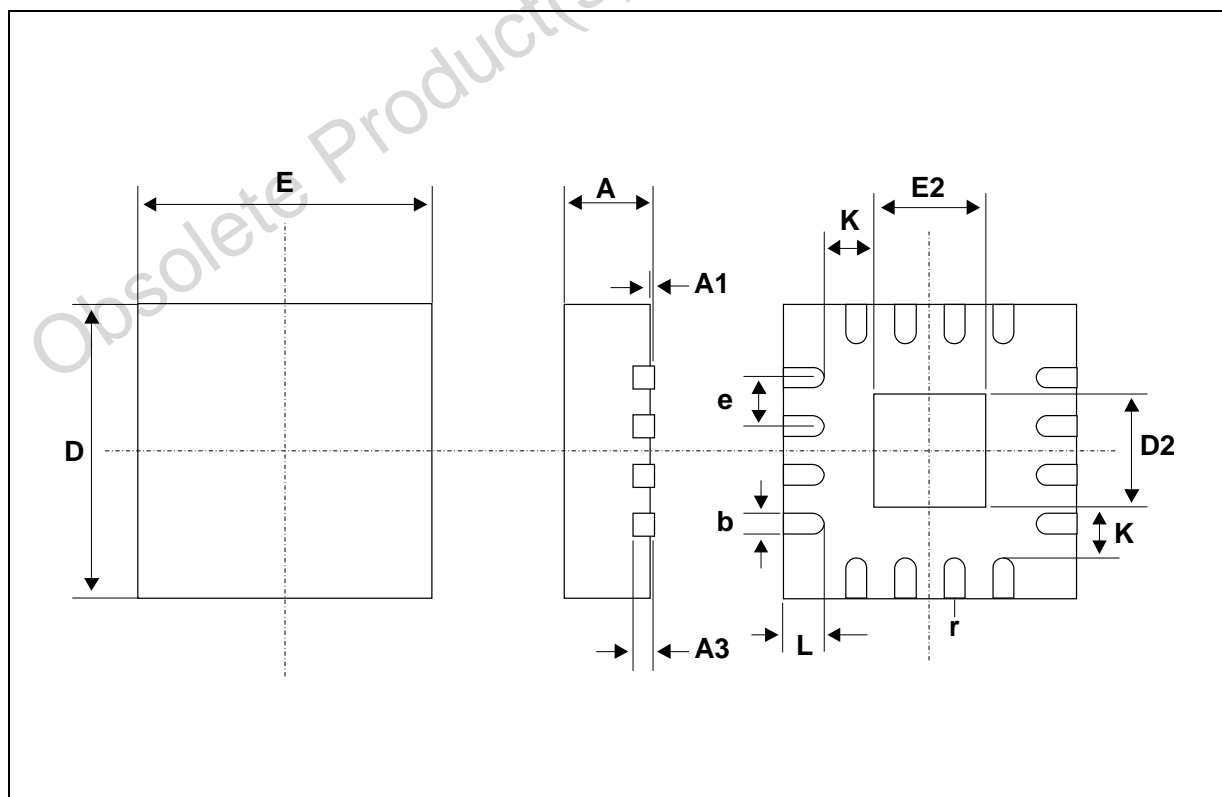


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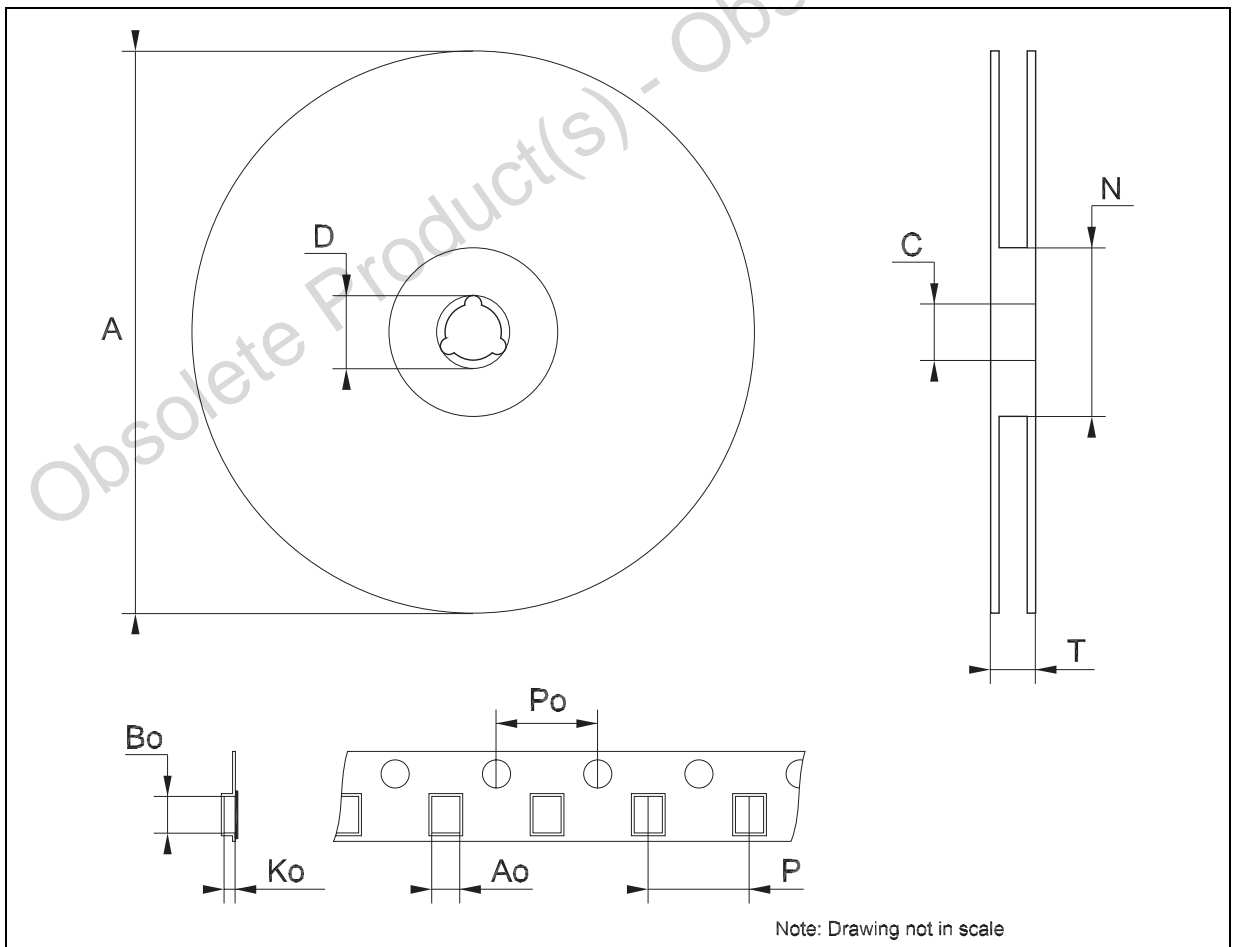
## QFN16 (3x3) MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	0.80	0.90	1.00	0.032	0.035	0.039
A1		0.02	0.05		0.001	0.002
A3		0.20			0.008	
b	0.18	0.25	0.30	0.007	0.010	0.012
D		3.00			0.118	
D2	1.55	1.70	1.80	0.061	0.067	0.071
E		3.00			0.118	
E2	1.55	1.70	1.80	0.061	0.067	0.071
e		0.50			0.020	
K		0.20			0.008	
L	0.30	0.40	0.50	0.012	0.016	0.020
r	0.09			0.006		



**Tape & Reel TSSOP16 MECHANICAL DATA**

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			330			12.992
C	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
T			22.4			0.882
Ao	6.7		6.9	0.264		0.272
Bo	5.3		5.5	0.209		0.217
Ko	1.6		1.8	0.063		0.071
Po	3.9		4.1	0.153		0.161
P	7.9		8.1	0.311		0.319



**Table 9: Revision History**

<b>Date</b>	<b>Revision</b>	<b>Description of Changes</b>
14-May-2004	3	Characteristics at $V_{CC} = 4.3$ V Added on Tables 3, 4, 5, 6 and 7.
01-Jun-2004	4	ESD Performance (Analog Channels) added on top page.
04-Jul-2005	5	The Q Values on Table 7 has been updated.

Obsolete Product(s) - Obsolete Product(s)

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