

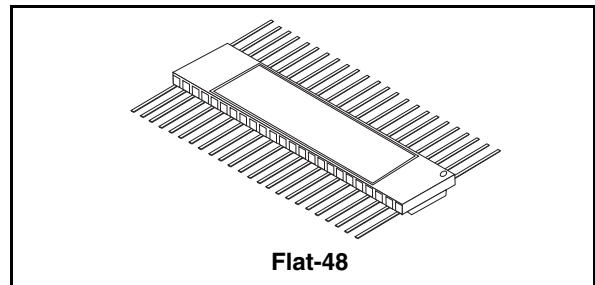


54VCXH162374

Rad hard low voltage CMOS 16-bit D-type Flip-Flop (3-state)
with 3.6V tolerant inputs and outputs

Features

- 1.65 to 3.6V inputs and outputs
- High speed:
 - $t_{PD} = 3.4\text{ns}$ (Max) at $V_{CC} = 3.0$ to 3.6V
 - $t_{PD} = 4.8\text{ns}$ (Max) at $V_{CC} = 2.3$ to 2.7V
- Symmetrical impedance outputs:
 - $|I_{OH}| = I_{OL} = 12\text{mA}$ (Min) at $V_{CC} = 3.0\text{V}$
 - $|I_{OH}| = I_{OL} = 8\text{mA}$ (Min) at $V_{CC} = 2.3\text{V}$
- Power down protection on inputs and outputs
- 26Ω serie resistors in outputs
- Operating voltage range:
 - $V_{CC}(\text{Opr}) = 1.65\text{V}$ to 3.6V
- Pin and function compatible with 54 SERIES H162374
- Bus hold provided on both sides
- Cold spare function
- Latch-up performance exceeds 300mA (JESD 17)
- ESD performance:
 - $\text{HBM} > 2000\text{V}$
(MIL STD 883 method 3015); $\text{MM} > 200\text{V}$
- 300KRad Mil1019.6 Condition A, (RHA QML qualification extension undergone)
- No SEL, no SEU under $72\text{Mev/cm}^2/\text{mg}$ LET heavy ions irradiation
- QML qualified product
- Device fully compliant with DSCC SMD 5962-05212



Description

The 54VCXH162374 is a low voltage CMOS 16 bit d-type Flip-Flop with 3 state outputs non inverting fabricated with sub-micron silicon gate and five-layer metal wiring C²MOS technology. It is ideal for low power and very high speed 1.65 to 3.6V applications; it can be interfaced to 3.6V signal environment for both inputs and outputs.

These 16 bit D-TYPE flip-flops are controlled by two clock inputs ($n\text{CK}$) and two output enable inputs ($n\overline{\text{OE}}$).

On the positive transition of the ($n\text{CK}$), the $n\text{Q}$ outputs will be set to the logic state that were setup at the $n\text{D}$ inputs.

While the ($n\overline{\text{OE}}$) input is low, the 8 outputs ($n\text{Q}$) will be in a normal state (HIGH or LOW logic level) and while high level the outputs will be in a high impedance state.

Any output control does not affect the internal operation of flip flops; that is, the old data can be retained or the new data can be entered even while the outputs are OFF.

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1 Logic symbols and I/O equivalent circuit

Figure 1. IEC logic symbols

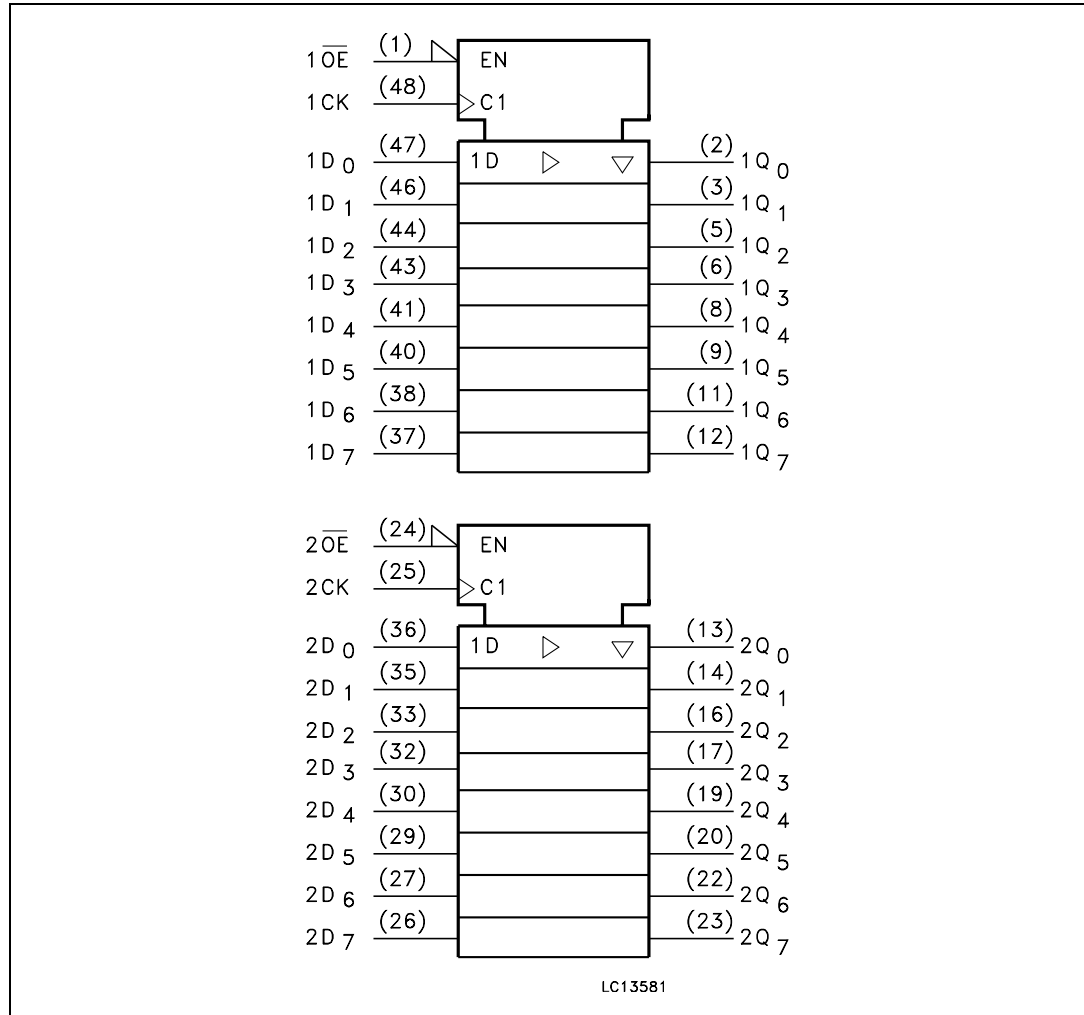


Figure 2. Input and output equivalent circuit

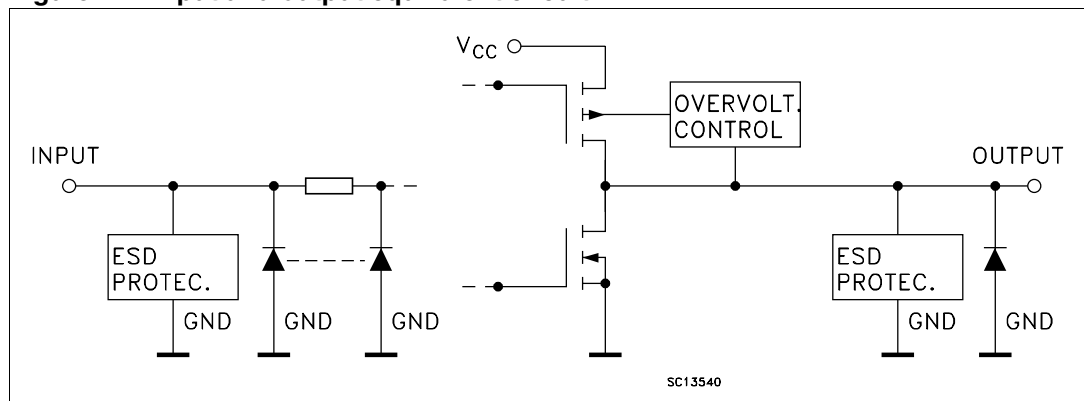
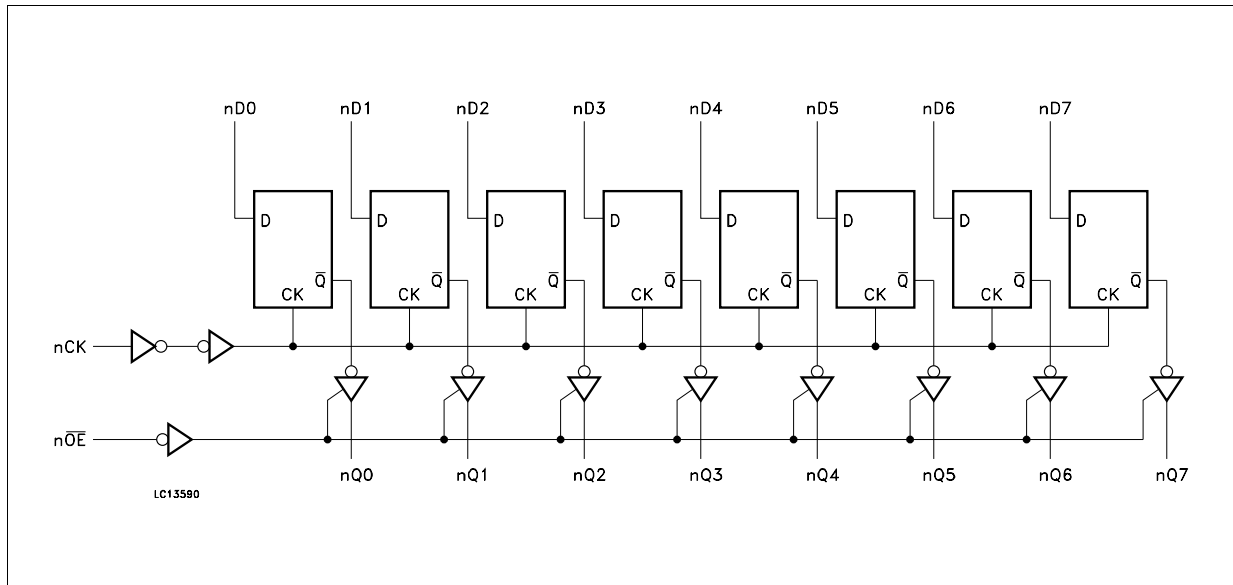


Figure 3. Logic diagram

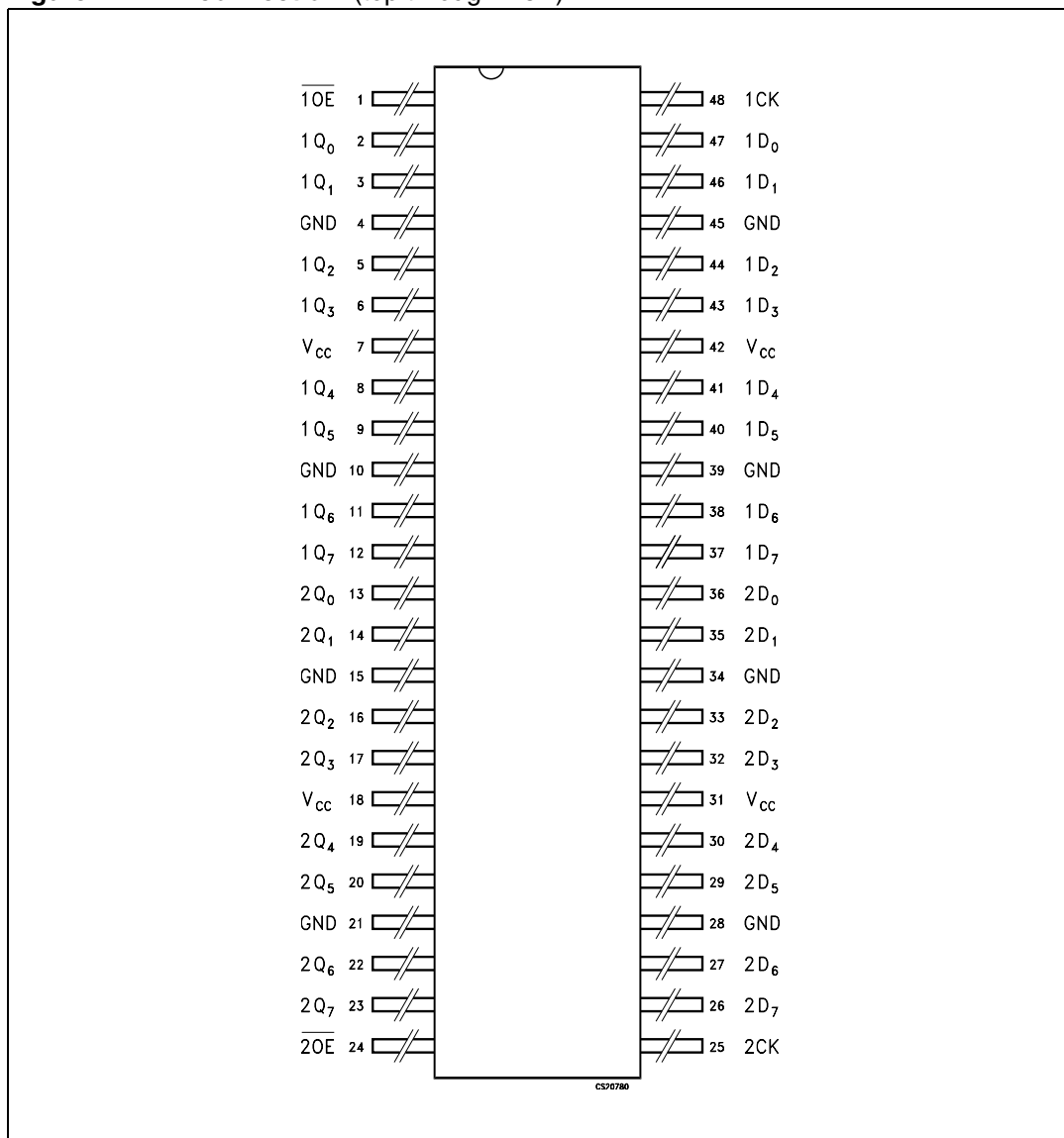


Note: This logic diagram has not to be used to estimate propagation delays

2 Pin settings

2.1 Pin connection

Figure 4. Pin connection (top through view)



2.2 Pin description

Table 1. Pin description

Pin N°	Symbol	Name and function
1	$1\overline{OE}$	3 state output enable input (Active LOW)
2, 3, 5, 6, 8, 9, 11, 12	1Q0 to 1Q7	3-state outputs
13, 14, 16, 17, 19, 20, 22, 23	2Q0 to 2Q7	3-state outputs
24	$2\overline{OE}$	3 state output enable input (Active LOW)
25	2CK	Clock input
36, 35, 33, 32, 30, 29, 27, 26	2D0 to 2D7	Data inputs
47, 46, 44, 43, 41, 40, 38, 37	1D0 to 1D7	Data inputs
48	1CK	Clock input
4, 10, 15, 21, 28, 34, 39, 45	GND	Ground (0V)
7, 18, 31, 42	V _{CC}	Positive supply voltage

2.3 Truth table

Table 2. Truth table

Inputs			Output
OE	LE	D	Q
H	X	X	Z
L	$\overline{\text{L}}$	X	No change ⁽¹⁾
L	L	L	L
L	L	H	H

1. Q outputs are latched at the time when the LE input is taken low logic level.

Note: X = Do not care; Z = High Impedance

3 Maximum rating

Stressing the device above the rating listed in the “Absolute Maximum Ratings” table may cause permanent damage to the device. These are stress ratings only and operation of the device at these or any other conditions above those indicated in the Operating sections of this specification is not implied. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability. Refer also to the STMicroelectronics SURE Program and other relevant quality documents.

Table 3. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage	-0.5 to +4.6	V
V_I	DC input voltage	-0.5 to +4.6	V
V_O	DC output voltage (OFF State)	-0.5 to +4.6	V
V_O	DC output voltage (High or Low State) ⁽¹⁾	-0.5 to $V_{CC} + 0.5$	V
I_{IK}	DC input diode current	- 50	mA
I_{OK}	DC output diode current ⁽²⁾	- 50	mA
I_O	DC output current	± 50	mA
I_{CC} or I_{GND}	DC V_{CC} or ground current per supply pin	± 100	mA
P_D	Power dissipation	400	mW
T_{stg}	Storage temperature	-65 to +150	°C
T_L	Lead temperature (10 sec)	260	°C

1. I_O absolute maximum rating must be observed

2. $V_O < GND$, $V_O > V_{CC}$

3.1 Recommended operating conditions

Table 4. Recommended operating conditions

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage	1.8 to 3.6	V
V_I	Input voltage	-0.3 to 3.6	V
V_O	Output voltage (OFF state)	0 to 3.6	V
V_O	Output voltage (High or Low State)	0 to V_{CC}	V
I_{OH} , I_{OL}	High or low level output current ($V_{CC} = 3.0$ to $3.6V$)	± 12	mA
I_{OH} , I_{OL}	High or low level output current ($V_{CC} = 2.3$ to $2.7V$)	± 8	mA
T_{op}	Operating temperature	-55 to 125	°C
dt/dv	Input rise and fall time ⁽¹⁾	0 to 10	ns/V

1. V_{IN} from 0.8V to 2V at $V_{CC} = 3.0V$

4 Electrical characteristics

Table 5. DC specifications ($2.7V < V_{CC} \leq 3.6V$ unless otherwise specified)

Symbol	Parameter	Test condition		Value		Unit
		V _{CC} (V)		-55 to 125°C		
				Min	Max	
V _{IH}	High level input voltage	2.7 to 3.6		2.0		V
V _{IL}	Low level input voltage				0.8	
V _{OH}	High level output voltage	2.7 to 3.6	I _O =-100 μA	V _{CC} -0.2		V
		2.7	I _O =-6 mA	2.2		
		3.0	I _O =-8 mA	2.4		
			I _O =-12 mA	2.2		
V _{OL}	Low level output voltage	2.7 to 3.6	I _O =100 μA		0.2	V
		2.7	I _O =6 mA		0.4	
		3.0	I _O =8 mA		0.55	
			I _O =12 mA		0.8	
I _I	Input leakage current	2.7 to 3.6	V _I = 0 to 3.6V		± 5	μA
I _{I(HOLD)}	Input hold current	3.0	V _I = 0.8V	75		μA
			V _I = 2V	-75		
		3.6	V _I = 0 to 3.6V		± 500	
I _{off}	Power Off leakage current	0	V _I or V _O = 0 to 3.6V		10	μA
I _{OZ}	High impedance output leakage current	2.7 to 3.6	V _I = V _{IH} or V _{IL} V _O = 0 to 3.6V		± 10	μA
I _{CC}	Quiescent supply current	2.7 to 3.6	V _I = V _{CC} or GND		20	μA
			V _I or V _O = V _{CC} to 3.6V		± 20	
ΔI _{CC}	I _{CC} incr. per Input	2.7 to 3.6	V _{IH} = V _{CC} - 0.6V		750	μA

Table 6. DC specifications ($2.3V < V_{CC} \leq 2.7V$ unless otherwise specified)

Symbol	Parameter	Test condition		Value			Unit
		V _{CC} (V)		-55 to 125 °C			
				Min	Max		
V _{IH}	High level input voltage	2.3 to 2.7		1.6		V	
V _{IL}	Low level input voltage				0.7		
V _{OH}	High level output voltage	2.3 to 2.7	I _O =-100 μA	V _{CC} -0.2		V	
			I _O =-4 mA	2.0			
		2.3	I _O =-6 mA	1.8			
			I _O =-8 mA	1.7			
V _{OL}	Low level output voltage	2.3 to 2.7	I _O =100 μA		0.2	V	
			I _O =6 mA		0.4		
		2.3	I _O =8 mA		0.6		
I _I	Input leakage current	2.3 to 2.7	V _I = V _{CC} or GND		± 5	μA	
I _{I(HOLD)}	Input hold current	2.3	V _I = 0.7V	45		μA	
			V _I = 1.7V	-45			
I _{off}	Power Off leakage current	0	V _I or V _O = 0 to 3.6V		10	μA	
I _{OZ}	High impedance output leakage current	2.3 to 2.7	V _I = V _{IH} or V _{IL} V _O = 0 to 3.6V		± 10	μA	
I _{CC}	Quixent	2.3 to 2.7	V _I = V _{CC} or GND		20	μA	
			V _I or V _O = V _{CC} to 3.6V		± 20		

Table 7. Dynamic switching characteristics(T_A = 25°C, Input t_r = t_f = 2.0ns, C_L = 30pF, R_L = 500Ω)

Symbol	Parameter	Test condition		Value			Unit
		V _{CC} (V)		T _A = 25 °C			
				Min	Typ	Max	
V _{OLV}	Dynamic valley low voltage quiet output (1) (2)	2.5	V _{IL} = 0V		0.25		V
		3.3	V _{IH} = V _{CC}		0.35		
V _{OHV}	Dynamic valley high voltage quiet output (2) (3)	2.5	V _{IL} = 0V		-0.25		V
		3.3	V _{IH} = V _{CC}		-0.35		
V _{OHV}	Dynamic valley high voltage quiet output (2) (3)	2.5	V _{IL} = 0V		2.05		V
		3.3	V _{IH} = V _{CC}		2.65		

- Number of outputs defined as "n". Measured with "n-1" outputs switching from HIGH to LOW or LOW to HIGH. The remaining output is measured in the LOW state.
- Parameters guaranteed by design.
- Number of outputs defined as "n". Measured with "n-1" outputs switching from HIGH to LOW or LOW to HIGH. The remaining output is measured in the HIGH state.

Table 8. AC electrical characteristics ($C_L = 30\text{pF}$, $R_L = 500\Omega$, Input $t_r = t_f = 2.0\text{ns}$)

Symbol	Parameter	Test condition		Value		Unit
		V_{CC} (V)		-55 to 125 °C		
				Min	Max	
t_{PLH} t_{PHL}	Propagation delay time Dn to Qn	2.3 to 2.7		1.0	5.5	ns
		3.0 to 3.6		0.8	4.5	
t_{PLH} t_{PHL}	Propagation delay time LE to Qn	2.3 to 2.7		1.0	6.2	ns
		3.0 to 3.6		0.8	4.5	
t_{PZL} t_{PZH}	Output enable time	2.3 to 2.7		1.0	5.1	ns
		3.0 to 3.6		0.8	4.6	
t_{PLZ} t_{PHZ}	Output disable time	2.3 to 2.7		1.0		ns
		3.0 to 3.6		1.0		
t_s	Setup time, HIGH or LOW level Dn to LE	2.3 to 2.7		1.5		ns
		3.0 to 3.6		1.5		
t_h	Hold time High or LOW level Dn to LE	2.3 to 2.7		1.5		ns
		3.0 to 3.6		1.5		
t_w	LE pulse width, HIGH	2.3 to 2.7		190		ns
		3.0 to 3.6		235		
t_{OSLH} t_{OSHL}	Output to output skew time (1) (2)	2.3 to 2.7			0.5	ns
		3.0 to 3.6			0.5	

1. Skew is defined as the absolute value of the difference between the actual propagation delay for any two outputs of the same device switching in the same direction, either HIGH or LOW ($t_{OSLH} = |t_{PLHm} - t_{PLHn}|$, $t_{OSHL} = |t_{PHLm} - t_{PHLn}|$)

2. Parameter guaranteed by design

Table 9. Capacitive characteristics

Symbol	Parameter	Test condition		Value			Unit
		V_{CC} (V)		$T_A = 25\text{ °C}$			
				Min	Typ	Max	
C_{IN}	Input capacitance	2.5 or 3.3	$V_{IN} = 0$ or V_{CC}		6		pF
C_{OUT}	Output capacitance	2.5 or 3.3	$V_{IN} = 0$ or V_{CC}		7		pF
C_{PD}	Power dissipation capacitance (1)	2.5 or 3.3	$f_{IN} = 10\text{MHz}$ $V_{IN} = 0$ or V_{CC}		20		pF

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 Test Circuit). Average operating current can be obtained by the following equation. $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/16$ (per circuit)

5 Test circuit

Figure 5. Test circuit

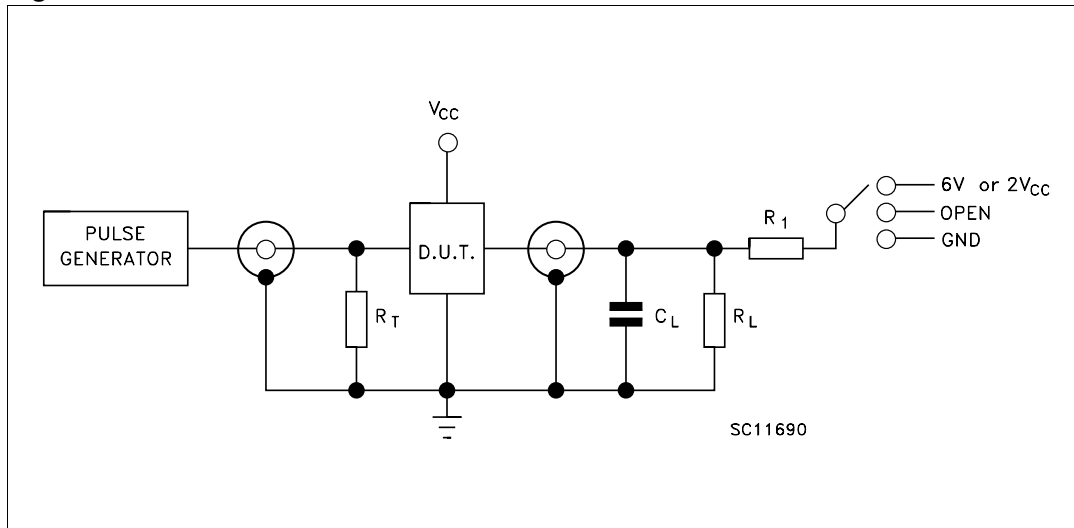


Table 10. Test circuit

Test	Switch
t_{PLH} , t_{PHL}	Open
t_{PZL} , t_{PLZ} ($V_{CC} = 3.0$ to $3.6V$)	6V
t_{PZL} , t_{PLZ} ($V_{CC} = 2.3$ to $2.7V$)	$2V_{CC}$
t_{PZH} , t_{PHZ}	GND

$C_L = 30pF$ or equivalent (includes jig and probe capacitance)

$R_L = R_1 = 500\Omega$ or equivalent

$R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

6 Waveforms

Table 11. Waveform symbol value

Symbol	V _{CC}	
	3.0 to 3.6V	2.3 to 2.7V
V _{IH}	2.7V	V _{CC}
V _M	1.5V	V _{CC} /2
V _X	V _{OL} + 0.3V	V _{OL} + 0.15V
V _Y	V _{OH} - 0.3V	V _{OH} - 0.15V

Figure 6. Waveform - nCK TO Qn propagation delays, nCK maximum frequency, Dn TO nCK setup and hold times (f = 1MHz; 50% duty cycle)

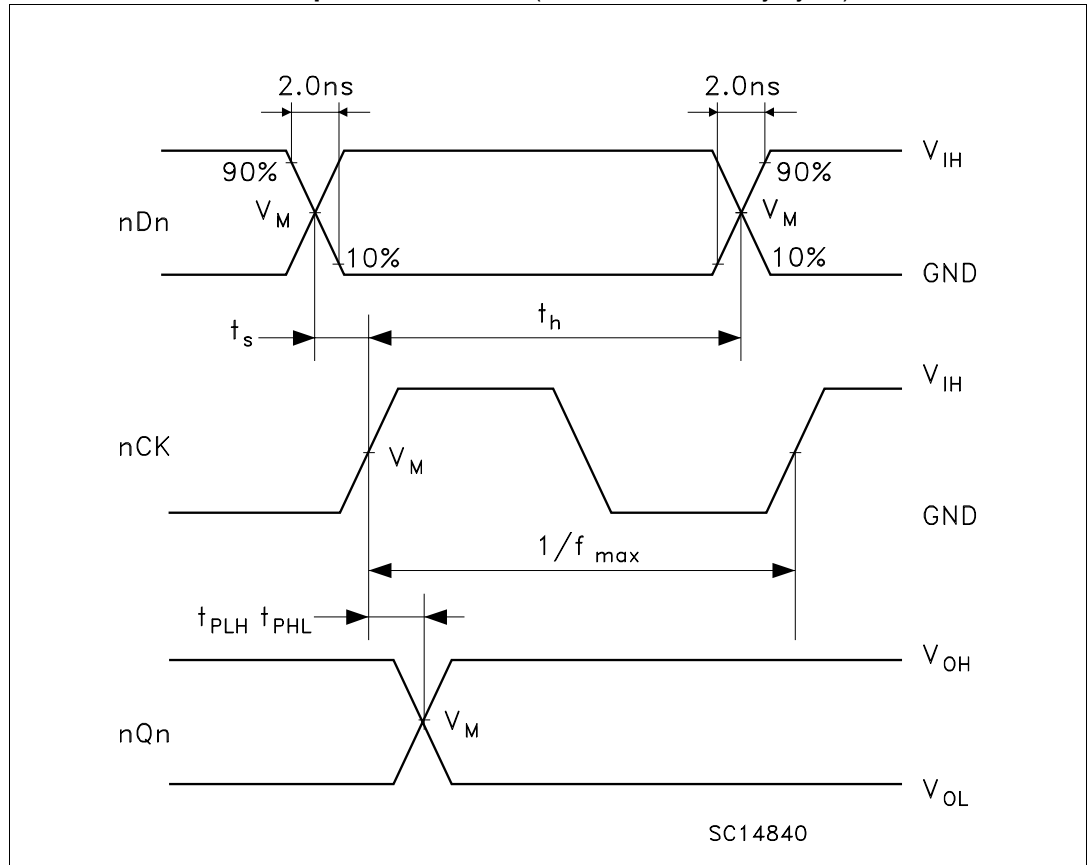


Figure 7. Waveform - output enable and disable time (f = 1MHz; 50% duty cycle)

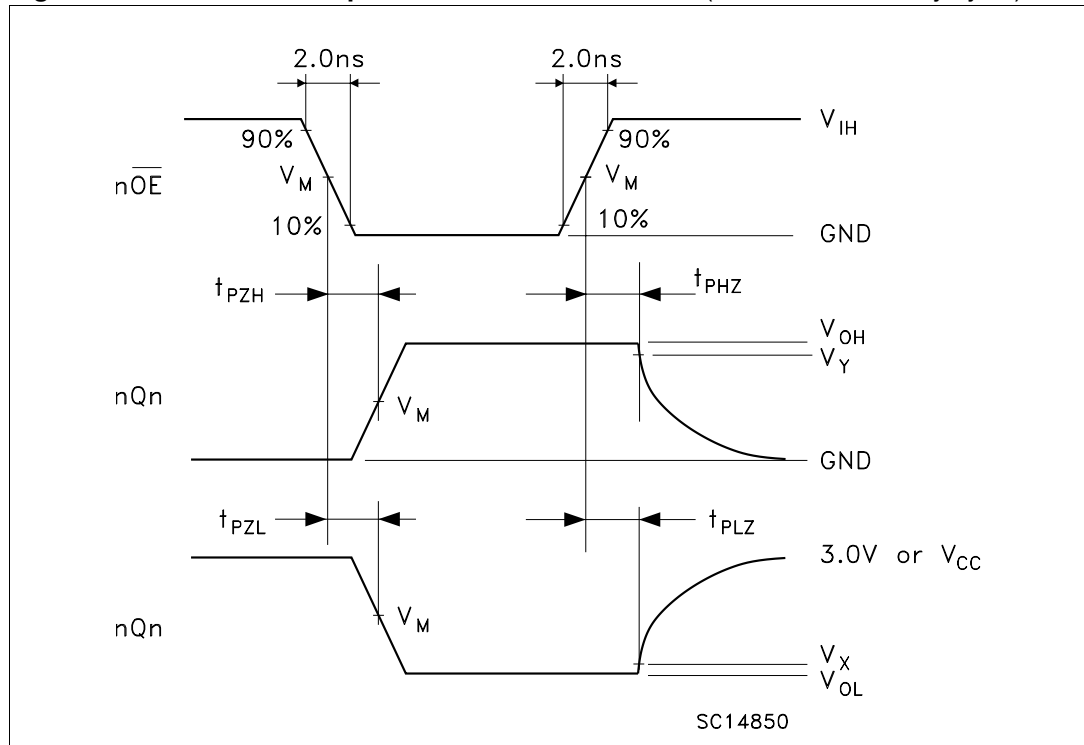
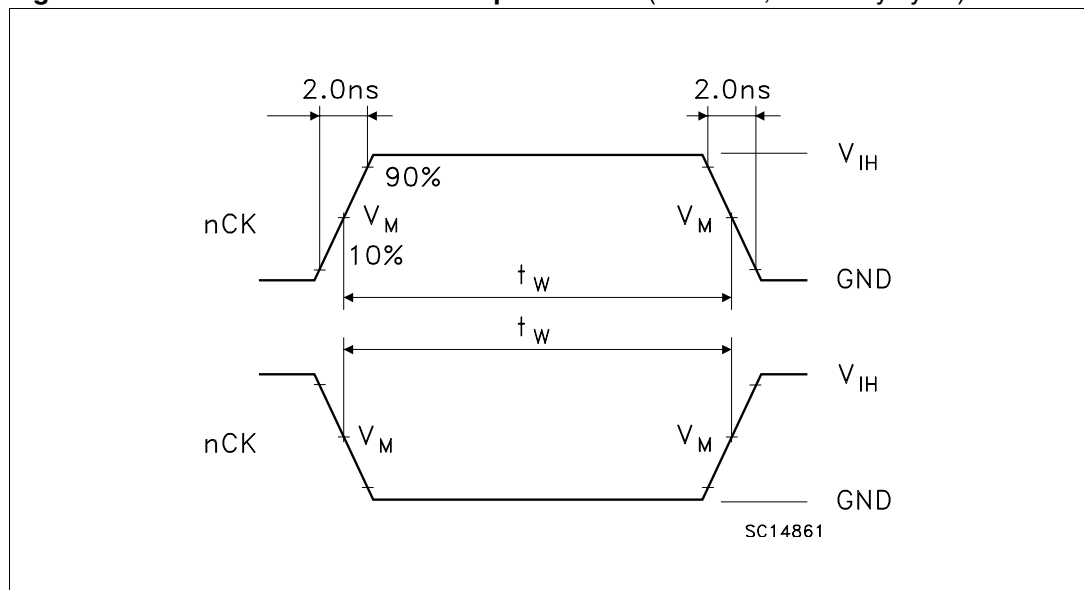


Figure 8. Waveform - nCK minimum pulse width (f = 1MHz; 50% duty cycle)



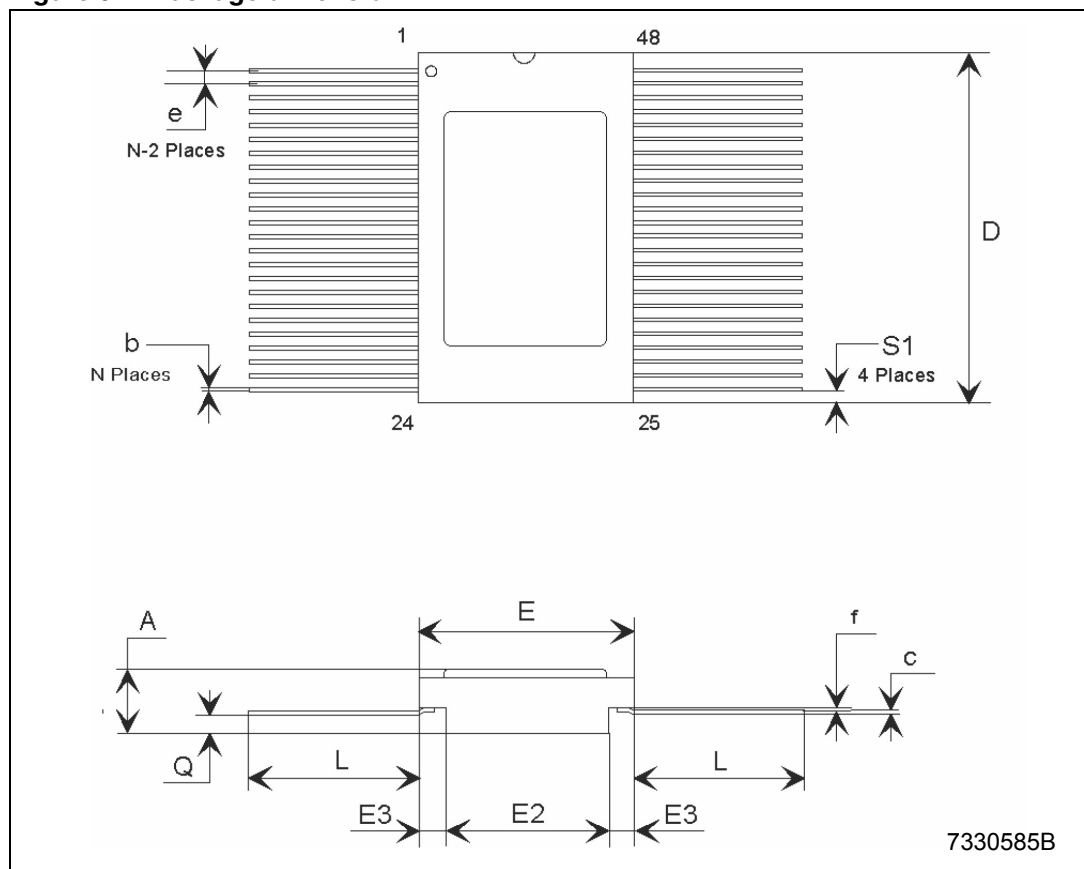
7 Package mechanical data

54VCXH162374 Products are supplied into ceramic body / metal lid hermetic Flat 48-pin space package

Table 12. Flat-48 (MIL-STD-1835) mechanical data

Dim.	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	2.18	2.47	2.72	0.086	0.097	0.107
b	0.20	0.254	0.30	0.008	0.010	0.012
c	0.12	0.15	0.18	0.005	0.006	0.007
D	15.57	15.75	15.92	0.613	0.620	0.627
E	9.52	9.65	9.78	0.375	0.380	0.385
E2	6.22	6.35	6.48	0.245	0.250	0.255
E3	1.52	1.65	1.78	0.060	0.065	0.070
e		0.635			0.025	
f		0.20			0.008	
L	6.85	8.38	9.40	0.270	0.330	0.370
Q	0.66	0.79	0.92	0.026	0.031	0.036
S1	0.25	0.43	0.61	0.010	0.017	0.024

Figure 9. Package dimension



8 Order code

Table 13. Order code

Package	Lead finish	Radiation level	Flight model		Engineering model
			QML-V	QML-Q	
Flat-48	Gold	300kRad	RHFXH162374K-01V	RHFXH162374K-01Q	RHRXH162374K1
	Gold	100kRad	RHRXH162374K-01V	RHRXH162374K-01Q	RHRXH162374 K1
	Solder dip	100kRad	RHRXH162374K-02V	RHRXH162374K-02Q	Use the above one

9 Revision history

Table 14. Revision history

Date	Revision	Changes
09-Jul-2004	1	First release.
17-May-2005	2	SMD qualified.
19-Jun-2006	3	300Krad bullet updated, new template, mechanical data updated
30-Jul-2007	4	Typo in Table 12 on page 14 .

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