Quad D-Type Flip-Flop

74VHC175

General Description

The VHC175 is an advanced high-speed CMOS device fabricated with silicon gate CMOS technology. It achieves the high-speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

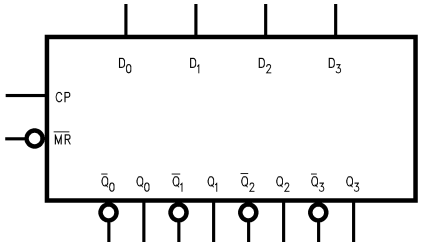
The VHC175 is a high-speed quad D-type flip-flop. The device is useful for general flip-flop requirements where clock and clear inputs are common. The information on the D inputs is stored during the LOW-to-HIGH clock transition. Both true and complemented outputs of each flip-flop are provided. A Master Reset input resets all flipflops, independent of the Clock or D inputs, when LOW.

An input protection circuit insures that 0 V to 5.5 V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5 V to 3 V systems and two supply systems such as battery backup. This circuit prevents device destruction due to mismatched supply and input voltages.

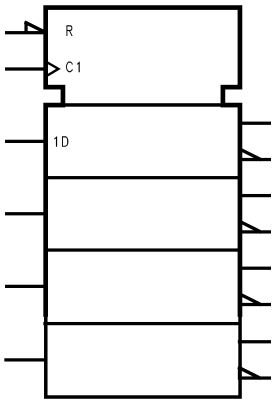
Features

- High Speed: f_{MAX} = 210 MHz (Typ.) at V_{CC} = 5 V
- Low Power Dissipation: I_{CC} = 4 μA (Max.) at T_A = 25 °C
- High Noise Immunity: $V_{NIH} = V_{NIL}$ = 28% V_{CC} (Min.)
- Power Down Protection is Provided On All Inputs
- Low Noise: V_{OLP} = 0.8 V (Max.)
- Pin and Function Compatible with 74HC157
- This Device is Halide Free and Pb-Free

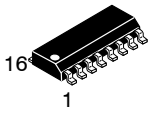
LOGIC SYMBOLS



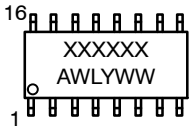
IEEE/IEC

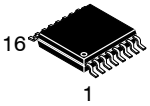


MARKING DIAGRAMS

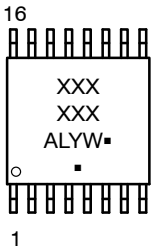


SOIC-16, 150 mils
CASE 751BG





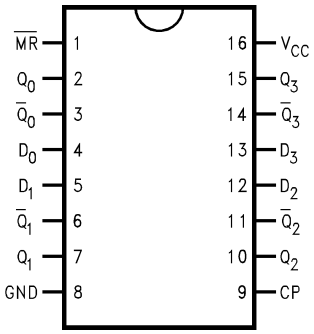
TSSOP-16
CASE 948AH



A	= Assembly Location
WL, L	= Wafer Lot
Y	= Year
WW, W	= Work Week
G or ▪	= Pb-Free Package

(Note: Microdot may be in either location)

CONNECTION DIAGRAM



PIN DESCRIPTION

Pins	Function
D_0–D_3	Data Inputs
CP	Clock Pulse Input
MR	Master Reset Input
Q_0–Q_3	True Outputs
$\overline{Q}_0$–$\overline{Q}_3$	Complement Outputs

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 4 of this data sheet.

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Functional Description

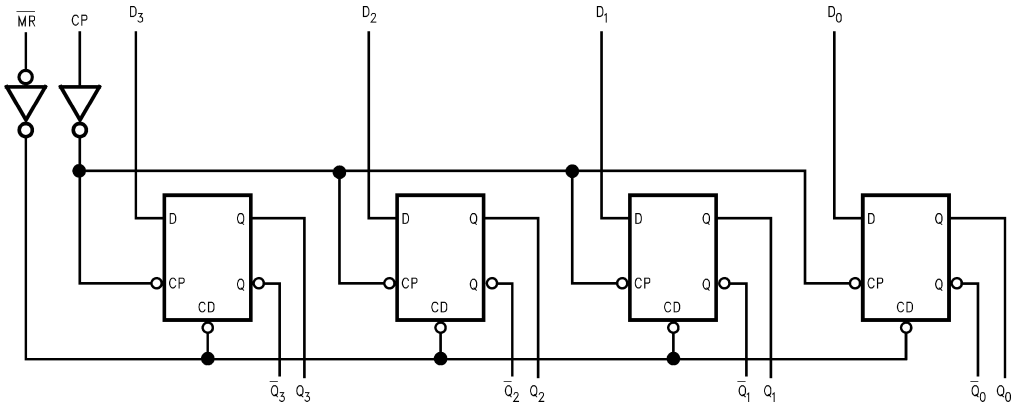
The VHC175 consists of four edge-triggered D flip-flops with individual D inputs and Q and $\overline{Q}$ outputs. The Clock and Master Reset are common. The four flip-flops will store the state of their individual D inputs on the LOW-to-HIGH clock (CP) transition, causing individual Q and $\overline{Q}$ outputs to follow. A LOW input on the Master Reset ($\overline{MR}$) will force all Q outputs LOW and $\overline{Q}$ outputs HIGH independent of Clock or Data inputs. The VHC175 is useful for general logic applications where a common Master Reset and Clock are acceptable.

TRUTH TABLE

Inputs @ t_n, $\overline{MR}$ = H	Outputs @ t_{n+1}	
D_n	Q_n	$\overline{Q}_n$
L	L	H
H	H	L

H = HIGH Voltage Level
L = LOW Voltage Level
t_n = Bit Time Before Clock Pulse
t_{n+1} = Bit Time After Clock Pulse

LOGIC DIAGRAM



Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

MAXIMUM RATINGS

Symbol	Parameter		Value	Unit
V_{CC}	DC Supply Voltage		−0.5 to +6.5	V
V_{IN}	DC Input Voltage		−0.5 to +6.5	V
V_{OUT}	DC Output Voltage		−0.5 to V_{CC} +0.5	V
I_{IN}	DC Input Current, per Pin		±20	mA
I_{OUT}	DC Output Current, per Pin		±25	mA
I_{CC}	DC Supply Current, V_{CC} and GND Pins		±50	mA
I_{IK}	Input Clamp Current		−20	mA
I_{OK}	Output Clamp Current		±20	mA
T_{STG}	Storage Temperature Range		−65 to +150	°C
T_L	Lead Temperature, 1 mm from Case for 10 secs		260	°C
T_J	Junction Temperature Under Bias		+150	°C
θ_{JA}	Thermal Resistance (Note 2)	SOIC-16 TSSOP-16	126 159	°C/W
P_D	Power Dissipation in Still Air at 25 °C	SOIC-16 TSSOP-16	995 787	mW
MSL	Moisture Sensitivity		Level 1	–
F_R	Flammability Rating	Oxygen Index: 28 to 34	UL 94 V-0 @ 0.139 in	–
V_{ESD}	ESD Withstand Voltage (Note 3)	Human Body Model Charged Device Model	2000 N/A	V

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Applicable to devices with outputs that may be tr-stated.
2. Measured with minimum pad spacing on an FR4 board, using 76mm-by-114mm, 2-ounce copper trace no air flow per JESD51-7.
3. HBM tested to EIA / JESD22-A114-A. CDM tested to JESD22-C101-A. JEDEC recommends that ESD qualification to EIA/JESD22-A115A (Machine Model) be discontinued.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter		Min	Max	Unit
V_{CC}	DC Supply Voltage		2.0	5.5	V
V_{IN}	DC Input Voltage (Note 4)		0	5.5	V
V_{OUT}	DC Output Voltage (Note 4)		0	V_{CC}	V
T_A	Operating Temperature		–40	+85	°C
t_r, t_{fc}	Input Rise or Fall Rate	V_{CC} = 3.0 V to 3.6 V V_{CC} = 4.5 V to 55 V	0 0	100 20	ns/V

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

4. Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or V_{CC}). Unused outputs must be left open.

DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Conditions		V_{CC} (V)	T_A = 25°C			T_A = –40°C to +85°C		Unit
					Min	Typ	Max	Min	Max	
V_{IH}	HIGH Level Input Voltage			2.0 3.0 – 5.5	1.50 0.7 x V_{CC}	–	–	1.50 0.7 x V_{CC}	–	V
V_{IL}	LOW Level Input Voltage			2.0 3.0 – 5.5	–	–	0.50 0.3 x V_{CC}	–	0.50 0.3 x V_{CC}	V
V_{OH}	HIGH Level Output Voltage	V_{IN} = V_{IH} or V_{IL}	I_{OH} = –50 μA	2.0 3.0 4.5	1.9 2.9 4.4	2.0 3.0 4.5	– – –	1.9 2.9 4.4	– – –	V
			I_{OH} = –4 mA I_{OH} = –8 mA	3.0 4.5	2.58 3.94	– –		2.48 3.80	– –	V
V_{OL}	LOW Level Output Voltage	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 50 μA	2.0 3.0 4.5	– – –	0.0 0.0 0.0	0.1 0.1 0.1	– – –	0.1 0.1 0.1	V
			I_{OH} = 4 mA I_{OH} = 8 mA	3.0 4.5	– –	– –	0.36 0.36	– –	0.44 0.44	V
I_{IN}	Input Leakage Current	V_{IN} = 5.5 V or GND		0 – 5.5	–	–	±0.1	–	±1.0	μA
I_{CC}	Quiescent Supply Current	V_{IN} = V_{CC} or GND		5.5	–	–	4.0	–	40.0	μA

NOISE CHARACTERISTICS

Symbol	Parameter	Conditions	V_{CC} (V)	T_A = 25°C		Unit
				Typ	Limits	
V_{OLP}	Quiet Output Maximum Dynamic V_{OL} (Note 5)	CL = 50 pF	5.0	0.4	0.8	V
V_{OLV}	Quiet Output Minimum Dynamic V_{OL} (Note 5)	CL = 50 pF	5.0	–0.4	–0.8	V
V_{IHD}	Minimum HIGH Level Dynamic Input Voltage (Note 5)	CL = 50 pF	5.0	–	3.5	V
V_{ILD}	Maximum LOW Level Dynamic Input Voltage (Note 5)	CL = 50 pF	5.0	–	1.5	V

5. Parameter guaranteed by design.

AC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Conditions	V_{CC} (V	T_A = 25 °C			T_A = –40 °C to +85 °C		Unit
				Min	Typ	Max	Min	Max	
f_{MAX}	Maximum Clock Frequency	C_L = 15 pF	3.3 ± 0.3	90	140	–	75	–	MHz
		C_L = 50 pF		50	75	–	45	–	
		C_L = 15 pF	5.0 ± 0.5	150	210	–	125	–	MHz
		C_L = 50 pF		85	115	–	75	–	

AC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Conditions	V_{CC} (V	T_A = 25 °C			T_A = −40 °C to +85 °C		Unit
				Min	Typ	Max	Min	Max	
t_{PLH}, t_{PHL}	Propagation Delay Time, (CP to Q_n or $\overline{Q}_n$)	C_L =15 pF	3.3 ± 0.3	–	7.5	11.5	1.0	13.5	ns
		C_L = 50 pF		–	10.0	15.0	1.0	17.0	
		C_L = 15 pF	5.0 ± 0.5	–	4.8	7.3	1.0	8.5	ns
		C_L = 50 pF		–	6.3	9.3	1.0	10.5	
t_{PLH}, t_{PHL}	Propagation Delay Time, ($\overline{MR}$ to Q_n or $\overline{Q}_n$)	C_L = 15 pF	3.3 ± 0.3	–	6.3	10.1	1.0	12.0	ns
		C_L = 50 pF		–	8.8	13.6	1.0	15.5	
		C_L = 15 pF	5.0 ± 0.5	–	4.3	6.4	1.0	7.5	ns
		C_L = 50 pF		–	5.8	8.4	1.0	9.5	
t_{OSLH}, t_{OSHL}	Output to Output Skew (Note 6)	C_L = 50 pF	3.3 ± 0.3	–	–	1.5	–	1.5	
		C_L = 50 pF	5.0 ± 0.5	–	–	1.0	–	1.0	
C_{IN}	Input Capacitance	V_{CC} = Open		–	4	10	–	10	pF
C_{PD}	Power Dissipation Capacitance (Note 7)			–	44	–	–	–	pF

6. Parameter guaranteed by design. $t_{OSLH} = |t_{PLH\ max} - t_{PLH\ min}|$; $t_{OSHL} = |t_{PHL\ max} - t_{PHL\ min}|$
7. C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation: I_{CC} (opr.) = $C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/4$ (per F/F),and the total C_{PD} when n pcs of the Flip−Flop operate can be calculated by the following equation: C_{PD} (total) = 30 + 14 · n

AC OPERATING REQUIREMENTS

Symbol	Parameter	V_{CC} (V) (Note 8)	T_A = 25 °C	T_A = −40 °C to +85 °C		Unit
			Typ	Guaranteed Minimum		
t_W(L), t_W(H)	Minimum Pulse Width (CP)	3.3	–	5.0	5.0	ns
		5.0	–	5.0	5.0	
t_W(L)	Minimum Pulse Width ($\overline{MR}$)	3.3	–	5.0	5.0	ns
		5.0	–	5.0	5.0	
t_S	Minimum Setup Time (Dn to CP)	3.3	–	5.0	5.0	ns
		5.0	–	4.0	4.0	
t_H	Minimum Hold Time (Dn to CP)	3.3	–	1.0	1.0	ns
		5.0	–	1.0	1.0	
t_{REC}	Minimum Removal Time ($\overline{MR}$)	3.3	–	5.0	5.0	ns
		5.0	–	5.0	5.0	

8. V_{CC} is 3.3 ±0.3 V or 5.0 ±0.5V

ORDERING INFORMATION

Device	Marking	Package	Shipping†
74VHC175MX	VHC175G	SOIC-16	2500 Units / Tape & Reel
74VHC175MTCX	VHC 175	TSSOP-16	2500 Units / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

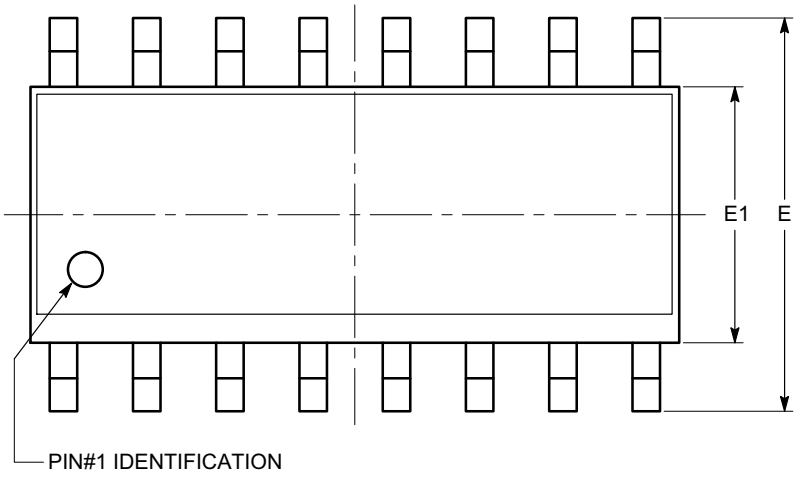
REVISION HISTORY

Revision	Description of Changes	Date
1	Converted the Data Sheet to **onsem**i format with the updates in Ordering Information Table, Recommended Operating Table, Maximum Rating Table.	9/23/2025

This document has undergone updates prior to the inclusion of this revision history table. The changes tracked here only reflect updates made on the noted approval dates.

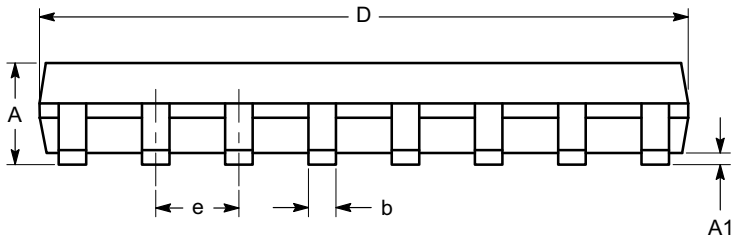
SOIC−16, 150 mils
CASE 751BG
ISSUE O

DATE 19 DEC 2008

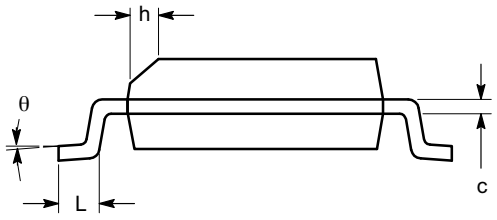


TOP VIEW

SYMBOL	MIN	NOM	MAX
A	1.35		1.75
A1	0.10		0.25
b	0.33		0.51
c	0.19		0.25
D	9.80	9.90	10.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27 BSC		
h	0.25		0.50
L	0.40		1.27
θ	0º		8º



SIDE VIEW



END VIEW

Notes:
(1) All dimensions are in millimeters. Angles in degrees.
(2) Complies with JEDEC MS-012.

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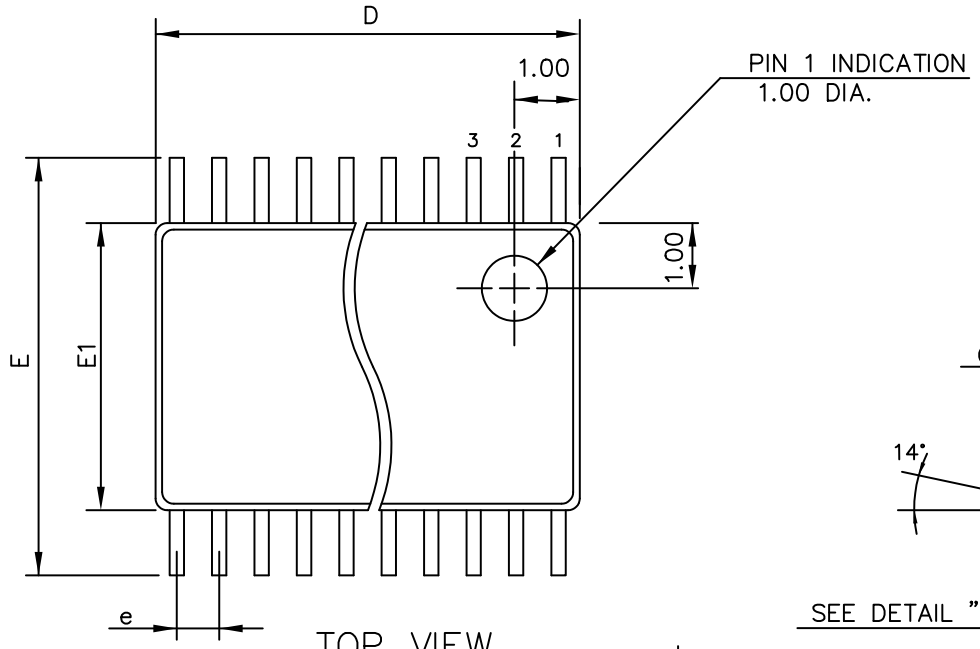
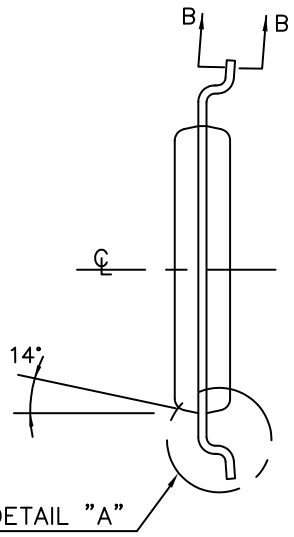
TSSOP 16
CASE 948AH
ISSUE O

DATE 19 SEP 2008



TOP VIEW



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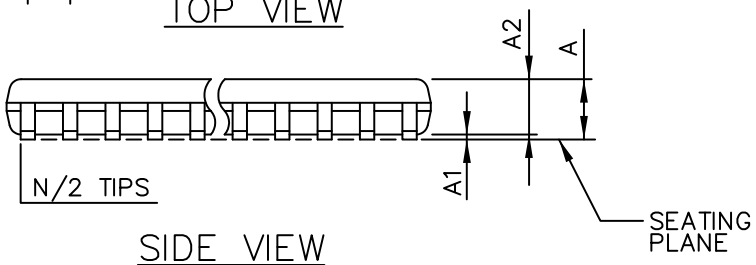

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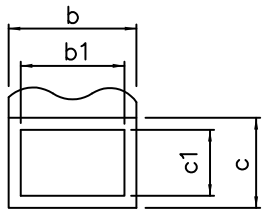
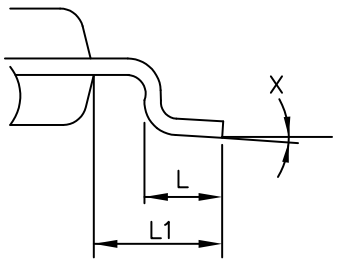


SECTION "B–B"

THIS TABLE FOR 0.65mm PITCH

SYMBOL	COMMON DIMENSIONS		
	MIN.	NOM.	MAX.
A	——	——	1.10
A_1	0.05	——	0.15
A_2	0.85	0.90	0.95
b	0.19	–	0.30
b1	0.19	0.22	0.25
c	0.09	–	0.20
c1	0.09	0.127	0.16
D	SEE VARIATIONS		
E1	4.30	4.40	4.50
e	0.65 BSC		
E	6.40 BSC		
L	0.50	0.60	0.70
L1	1.00 REF		
N	SEE VARIATIONS		
X	0°	——	8°

NOTE VARIATIONS	D	N
AA/AAT	3.00 BSC	8
AB–1/ABT	5.00 BSC	14
AB/ABT	5.00 BSC	16
AD/ADT	7.80 BSC	24



DETAIL 'A'

ALL DIMENSIONS IN MILLIMETERS

MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15mm ON D PER SIDE

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