

# 74VHC157FT

## 1. Functional Description

- Quad 2-Channel Multiplexer

## 2. General

The 74VHC157FT is an advanced high speed CMOS QUAD 2-CHANNEL MULTIPLEXER fabricated with silicon gate C<sup>2</sup>MOS technology.

It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

It consists of four 2-input digital multiplexers with common select and strobe inputs.

When the  $\overline{ST}$  input is held "H" level, selection of data is inhibited and all the outputs become "L" level.

The SELECT decoding determines whether the A or B inputs get routed to their corresponding Y outputs.

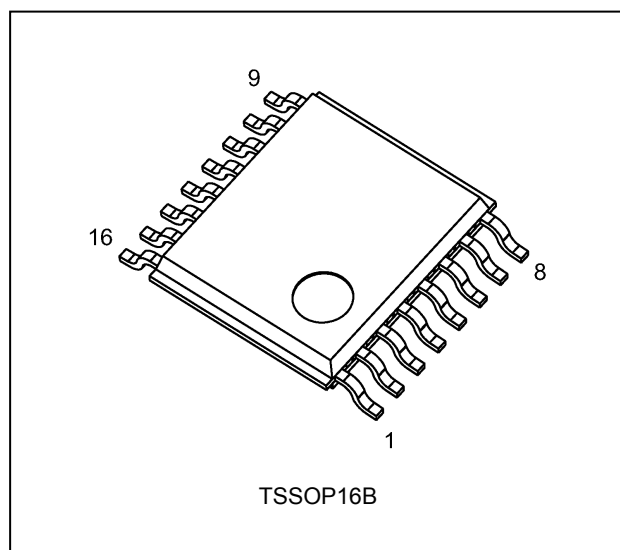
An Input protection circuit ensures that 0 to 5.5 V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5 V to 3 V systems and on two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input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

## 3. Features

- (1) AEC-Q100 (Rev. H) (Note 1)
- (2) Wide operating temperature:  $T_{opr} = -40$  to  $125\text{ }^{\circ}\text{C}$
- (3) High speed:  $t_{pd} = 4.1\text{ ns}$  (typ.) at  $V_{CC} = 5\text{ V}$
- (4) Low power dissipation:  $I_{CC} = 4.0\text{ }\mu\text{A}$  (max) at  $T_a = 25\text{ }^{\circ}\text{C}$
- (5) High noise immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (min)
- (6) Power down protection is provided on all inputs.
- (7) Balanced propagation delays:  $t_{PLH} \approx t_{PHL}$
- (8) Wide operating voltage range:  $V_{CC(opr)} = 2.0\text{ V}$  to  $5.5\text{ V}$
- (9) Low noise:  $V_{OLP} = 0.8\text{ V}$  (max)
- (10) Pin and function compatible with the 74 serie (AC/HC/AHC/LV etc.) 157 type.

Note 1: This device is compliant with the reliability requirements of AEC-Q100. For details, contact your Toshiba sales representative.

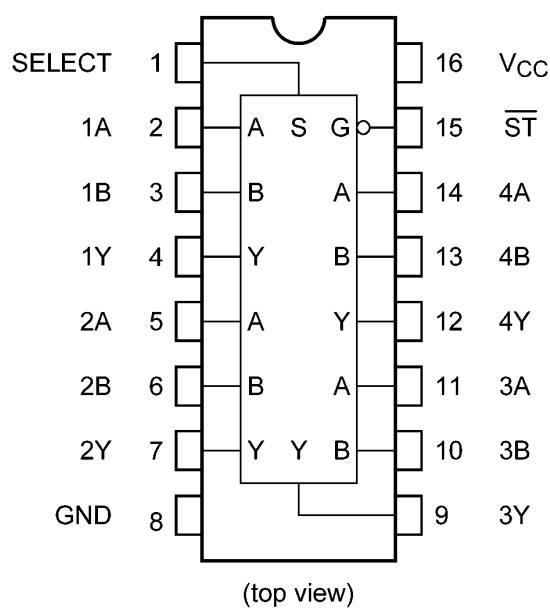
## 4. Packaging



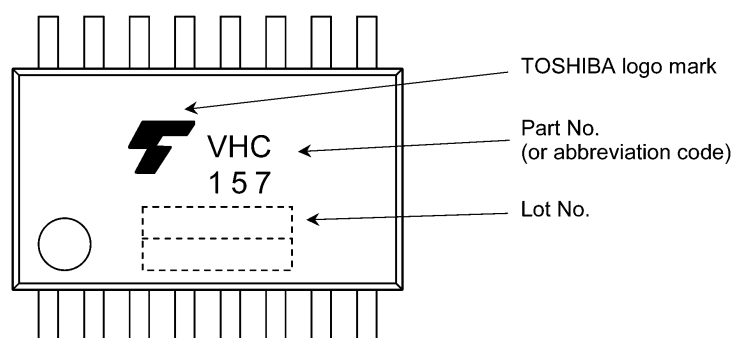
Start of commercial production

2014-01

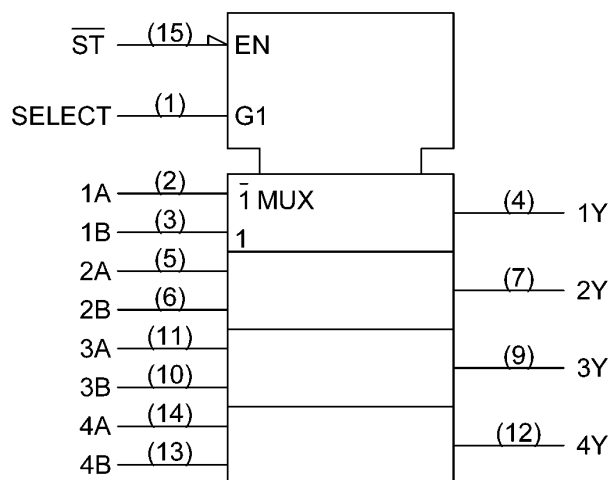
## 5. Pin Assignment



## 6. Marking



## 7. IEC Logic Symbol

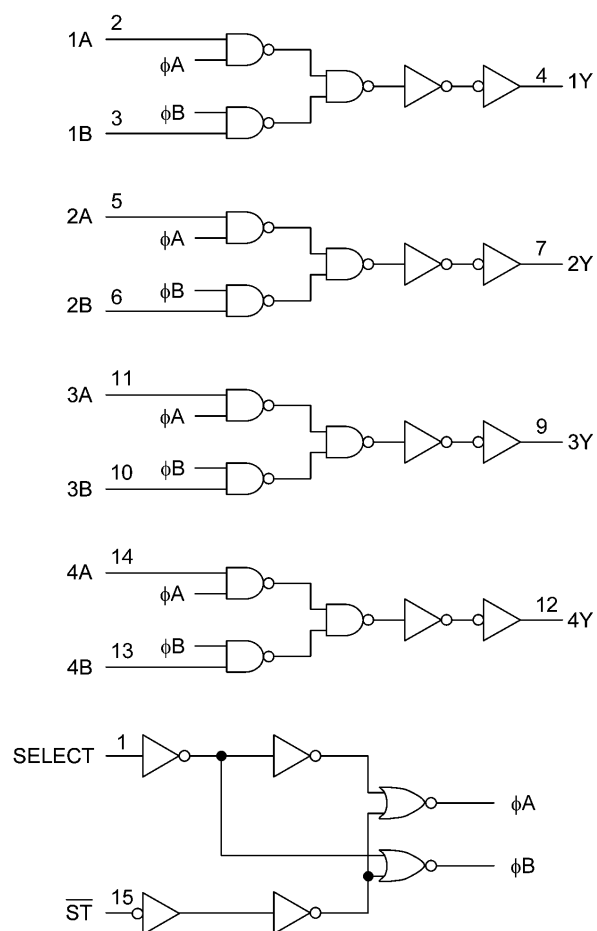


## 8. Truth Table

Inputs ST	Inputs SELECT	Inputs A	Inputs B	Output Y
H	X	X	X	L
L	L	L	X	L
L	L	H	X	H
L	H	X	L	L
L	H	X	H	H

X: Don't care

## 9. System Diagram



## 10. Absolute Maximum Ratings (Note)

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	$V_{CC}$		-0.5 to 7.0	V
Input voltage	$V_{IN}$		-0.5 to 7.0	V
Output voltage	$V_{OUT}$		-0.5 to $V_{CC} + 0.5$	V
Input diode current	$I_{IK}$		-20	mA
Output diode current	$I_{OK}$		$\pm 20$	mA
Output current	$I_{OUT}$		$\pm 25$	mA
$V_{CC}$ /ground current	$I_{CC}$		$\pm 50$	mA
Power dissipation	$P_D$	(Note 1)	180	mW
Storage temperature	$T_{stg}$		-65 to 150	°C

Note: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 1: 180 mW in the range of  $T_a = -40$  to  $85$  °C. From  $T_a = 85$  to  $125$  °C a derating factor of  $-3.25$  mW/°C shall be applied until 50 mW.

## 11. Operating Ranges (Note)

Characteristics	Symbol	Test Condition	Rating	Unit
Supply voltage	$V_{CC}$		2.0 to 5.5	V
Input voltage	$V_{IN}$		0 to 5.5	V
Output voltage	$V_{OUT}$		0 to $V_{CC}$	V
Operating temperature	$T_{opr}$		-40 to 125	°C
Input rise and fall times	$dt/dv$	$V_{CC} = 3.3 \pm 0.3$ V	0 to 100	ns/V
		$V_{CC} = 5 \pm 0.5$ V	0 to 20	

Note: The operating ranges must be maintained to ensure the normal operation of the device.

Unused inputs must be tied to either  $V_{CC}$  or GND.

## 12. Electrical Characteristics

12.1. DC Characteristics (Unless otherwise specified,  $T_a = 25\text{ }^{\circ}\text{C}$ )

Characteristics	Symbol	Test Condition		$V_{CC}$ (V)	Min	Typ.	Max	Unit
High-level input voltage	$V_{IH}$	—		2.0	1.50	—	—	V
				3.0 to 5.5	$V_{CC} \times 0.7$	—	—	
Low-level input voltage	$V_{IL}$	—		2.0	—	—	0.50	V
				3.0 to 5.5	—	—	$V_{CC} \times 0.3$	
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OH} = -50\text{ }\mu\text{A}$	2.0	1.9	2.0	—	V
				3.0	2.9	3.0	—	
				4.5	4.4	4.5	—	
			$I_{OH} = -4\text{ mA}$	3.0	2.58	—	—	
			$I_{OH} = -8\text{ mA}$	4.5	3.94	—	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OL} = 50\text{ }\mu\text{A}$	2.0	—	0.0	0.1	V
				3.0	—	0.0	0.1	
				4.5	—	0.0	0.1	
			$I_{OL} = 4\text{ mA}$	3.0	—	—	0.36	
			$I_{OL} = 8\text{ mA}$	4.5	—	—	0.36	
Input leakage current	$I_{IN}$	$V_{IN} = 5.5\text{ V or GND}$		0 to 5.5	—	—	$\pm 0.1$	$\mu\text{A}$
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC} \text{ or GND}$		5.5	—	—	4.0	$\mu\text{A}$

12.2. DC Characteristics (Unless otherwise specified,  $T_a = -40\text{ to }85\text{ }^{\circ}\text{C}$ )

Characteristics	Symbol	Test Condition		$V_{CC}$ (V)	Min	Max	Unit
High-level input voltage	$V_{IH}$	—		2.0	1.50	—	V
				3.0 to 5.5	$V_{CC} \times 0.7$	—	
Low-level input voltage	$V_{IL}$	—		2.0	—	0.50	V
				3.0 to 5.5	—	$V_{CC} \times 0.3$	
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OH} = -50\text{ }\mu\text{A}$	2.0	1.9	—	V
				3.0	2.9	—	
				4.5	4.4	—	
			$I_{OH} = -4\text{ mA}$	3.0	2.48	—	
			$I_{OH} = -8\text{ mA}$	4.5	3.80	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OL} = 50\text{ }\mu\text{A}$	2.0	—	0.1	V
				3.0	—	0.1	
				4.5	—	0.1	
			$I_{OL} = 4\text{ mA}$	3.0	—	0.44	
			$I_{OL} = 8\text{ mA}$	4.5	—	0.44	
Input leakage current	$I_{IN}$	$V_{IN} = 5.5\text{ V or GND}$		0 to 5.5	—	$\pm 1.0$	$\mu\text{A}$
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC} \text{ or GND}$		5.5	—	40.0	$\mu\text{A}$

12.3. DC Characteristics (Unless otherwise specified,  $T_a = -40$  to  $125\text{ }^\circ\text{C}$ )

Characteristics	Symbol	Test Condition		$V_{CC}$ (V)	Min	Max	Unit
High-level input voltage	$V_{IH}$	—		2.0	1.50	—	V
				3.0 to 5.5	$V_{CC} \times 0.7$	—	
Low-level input voltage	$V_{IL}$	—		2.0	—	0.50	V
				3.0 to 5.5	—	$V_{CC} \times 0.3$	
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -50\text{ }\mu\text{A}$	2.0	1.9	—	V
				3.0	2.9	—	
				4.5	4.4	—	
		$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -4\text{ mA}$	3.0	2.40	—	
			$I_{OH} = -8\text{ mA}$	4.5	3.70	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 50\text{ }\mu\text{A}$	2.0	—	0.1	V
				3.0	—	0.1	
				4.5	—	0.1	
		$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 4\text{ mA}$	3.0	—	0.55	
			$I_{OL} = 8\text{ mA}$	4.5	—	0.55	
Input leakage current	$I_{IN}$	$V_{IN} = 5.5\text{ V}$ or GND		0 to 5.5	—	$\pm 2.0$	$\mu\text{A}$
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND		5.5	—	80.0	$\mu\text{A}$

12.4. AC Characteristics (Unless otherwise specified,  $T_a = 25\text{ }^\circ\text{C}$ , Input:  $t_r = t_f = 3\text{ ns}$ )

Characteristics	Symbol	Note	$V_{CC}$ (V)	$C_L$ (pF)	Min	Typ.	Max	Unit
Propagation delay time (A, B - Y)	$t_{PLH}, t_{PHL}$		$3.3 \pm 0.3$	15	—	6.2	9.7	ns
				50	—	8.7	13.2	
			$5.0 \pm 0.5$	15	—	4.1	6.4	
				50	—	5.6	8.4	
Propagation delay time (SELECT - Y)	$t_{PLH}, t_{PHL}$		$3.3 \pm 0.3$	15	—	8.4	13.2	ns
				50	—	10.9	16.7	
			$5.0 \pm 0.5$	15	—	5.3	8.1	
				50	—	6.8	10.1	
Propagation delay time ( $\overline{\text{ST}}$ - Y)	$t_{PLH}, t_{PHL}$		$3.3 \pm 0.3$	15	—	8.7	13.6	ns
				50	—	11.2	17.1	
			$5.0 \pm 0.5$	15	—	5.6	8.6	
				50	—	7.1	10.6	
Input capacitance	$C_{IN}$				—	4	10	pF
Power dissipation capacitance	$C_{PD}$	(Note 1)			—	20	—	pF

Note 1:  $C_{PD}$  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.

$$I_{CC(\text{opr})} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC} / 4 \text{ (per bit)}$$

## 12.5. AC Characteristics

(Unless otherwise specified,  $T_a = -40$  to  $85\text{ }^\circ\text{C}$ , Input:  $t_r = t_f = 3\text{ ns}$ )

Characteristics	Symbol	$V_{CC}$ (V)	$C_L$ (pF)	Min	Max	Unit
Propagation delay time (A, B - Y)	$t_{PLH}, t_{PHL}$	$3.3 \pm 0.3$	15	1.0	11.5	ns
			50	1.0	15.0	
		$5.0 \pm 0.5$	15	1.0	7.5	
			50	1.0	9.5	
Propagation delay time (SELECT - Y)	$t_{PLH}, t_{PHL}$	$3.3 \pm 0.3$	15	1.0	15.5	ns
			50	1.0	19.0	
		$5.0 \pm 0.5$	15	1.0	9.5	
			50	1.0	11.5	
Propagation delay time (ST - Y)	$t_{PLH}, t_{PHL}$	$3.3 \pm 0.3$	15	1.0	16.0	ns
			50	1.0	19.5	
		$5.0 \pm 0.5$	15	1.0	10.0	
			50	1.0	12.0	
Input capacitance	$C_{IN}$			—	10	pF

## 12.6. AC Characteristics

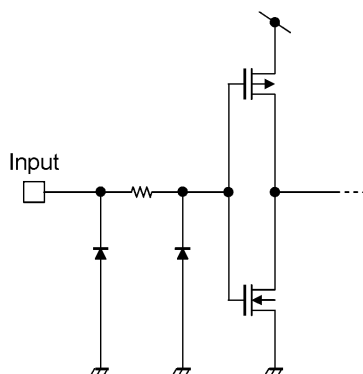
(Unless otherwise specified,  $T_a = -40$  to  $125\text{ }^\circ\text{C}$ , Input:  $t_r = t_f = 3\text{ ns}$ )

Characteristics	Symbol	$V_{CC}$ (V)	$C_L$ (pF)	Min	Max	Unit
Propagation delay time (A, B - Y)	$t_{PLH}, t_{PHL}$	$3.3 \pm 0.3$	15	1.0	13.0	ns
			50	1.0	16.5	
		$5.0 \pm 0.5$	15	1.0	8.5	
			50	1.0	10.5	
Propagation delay time (SELECT - Y)	$t_{PLH}, t_{PHL}$	$3.3 \pm 0.3$	15	1.0	17.5	ns
			50	1.0	21.0	
		$5.0 \pm 0.5$	15	1.0	11.0	
			50	1.0	13.0	
Propagation delay time (ST - Y)	$t_{PLH}, t_{PHL}$	$3.3 \pm 0.3$	15	1.0	18.0	ns
			50	1.0	21.5	
		$5.0 \pm 0.5$	15	1.0	11.5	
			50	1.0	13.5	
Input capacitance	$C_{IN}$			—	10	pF

12.7. Noise Characteristics (Unless otherwise specified,  $T_a = 25\text{ }^\circ\text{C}$ , Input:  $t_r = t_f = 3\text{ ns}$ )

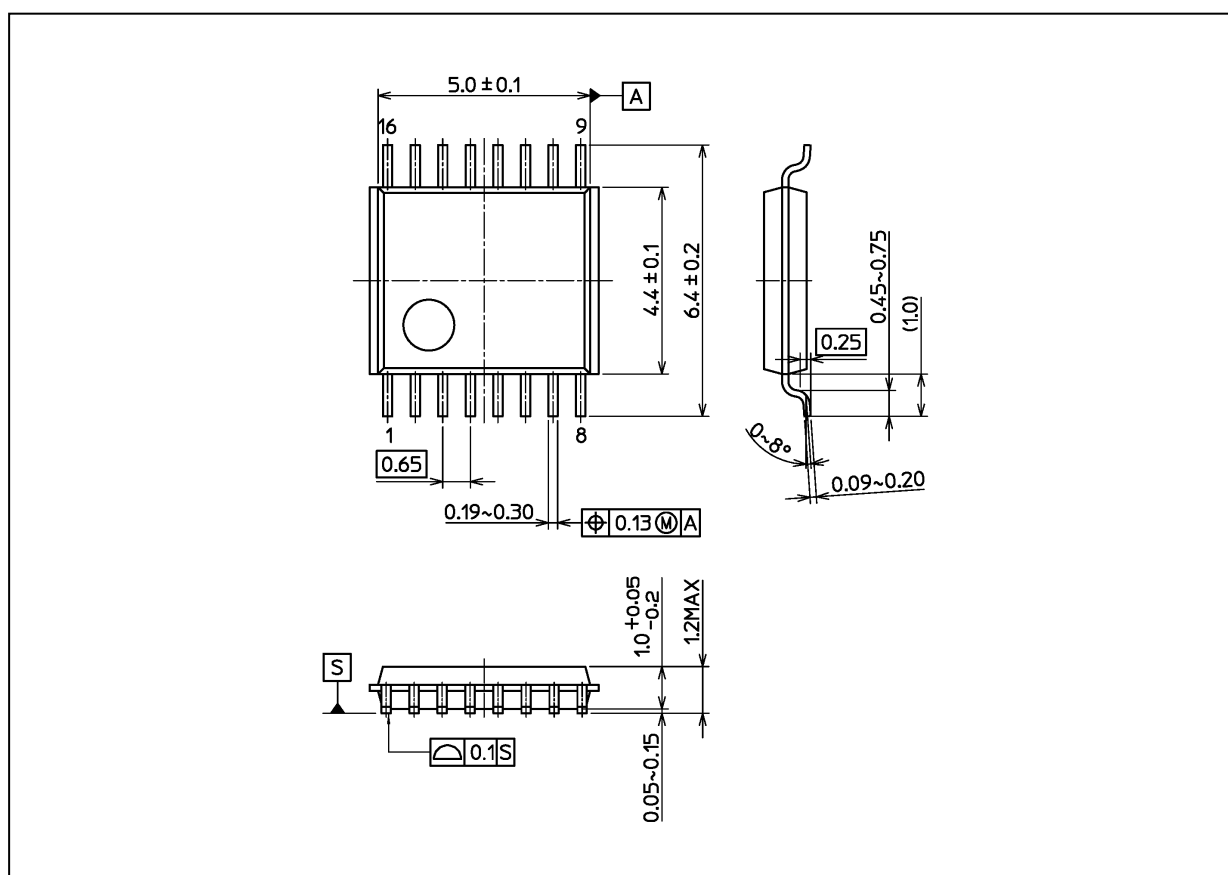
Characteristics	Symbol	Test Condition	$V_{CC}$ (V)	Typ.	Limit	Unit
Quiet output maximum dynamic $V_{OL}$	$V_{OLP}$	$C_L = 50\text{ pF}$	5.0	0.3	0.8	V
Quiet output minimum dynamic $V_{OL}$	$V_{OLV}$	$C_L = 50\text{ pF}$	5.0	-0.3	-0.8	V
Minimum high-level dynamic input voltage	$V_{IHD}$	$C_L = 50\text{ pF}$	5.0	—	3.5	V
Maximum low-level dynamic input voltage	$V_{ILD}$	$C_L = 50\text{ pF}$	5.0	—	1.5	V

# 13. Input Equivalent Circuit



## Package Dimensions

Unit: mm



Weight: 0.055 g (typ.)

Package Name(s)
Nickname: TSSOP16B



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