CMOS Digital Integrated Circuits Silicon Monolithic

74VHC9363FT,74VHC9364FT

1. Functional Description

・ Dual 3-bit Schmitt trigger Buffer

74VHC9363FT:With pull-down resistor at data input terminal

74VHC9364FT:With pull-up resistor at data input terminal

2. General

The 74VHC9363FT, 74VHC9364FT are an advanced high speed CMOS Hex SCHMITT BUFFERs fabricated with silicon gate C^2MOS technology.

These are fit for use interface between microcomputer to IPU (Integrated Power Unit) at the three-phase inverter circuit, because it consists of two of 3-bit schmitt trigger buffer circuits which is controlled by three of control Inputs $\overline{Gxn}$(s).

Since outputs level can be fixed "L" level for 74VHC9363FT and "H" level for 74VHC9364FT when to disabling of output terminal with the control input which received the fail signal, it compared with the pull-down / pull-up resistor normally used, it is less affected by ambient noise and contributes to the improvement of motor operation control accuracy of IPU (Integrated Power Unit).

Each data input terminal Dxn and control terminal $\overline{Gxn}$ has a built-in pull-up resistor or pull-down resistor, it's can fixed output level even when the input is open.

・Description of terminal name: "x" is H or L, "n" is 1 to 3.

3. Features

(1) High speed: t_{pd} = 5.0 ns (typ.) at V_{CC} = 5.0 V

(2) Wide operating temperature range: T_{opr} = -40 to 125 ℃

(3) Low power dissipation: I_{CC} = 4.0 μA (max) at T_a = 25 ℃

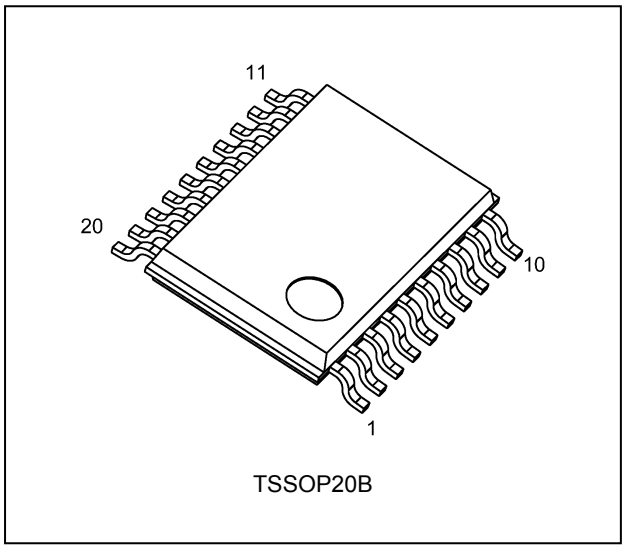
(4) Power-down protection is provided on all inputs.

(5) Balanced propagation delays: $t_{PLH} \approx t_{PHL}$

(6) Wide operating voltage range: $V_{CC(opr)}$ = 2.0 V to 5.5 V

(7) Low noise: V_{OLP} = 1.0 V (max)

4. Packaging

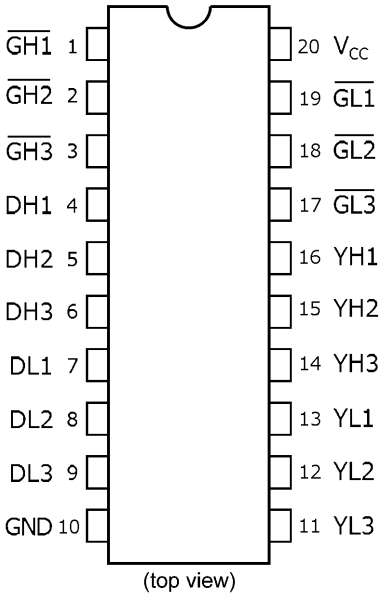


TSSOP20B

Start of commercial production

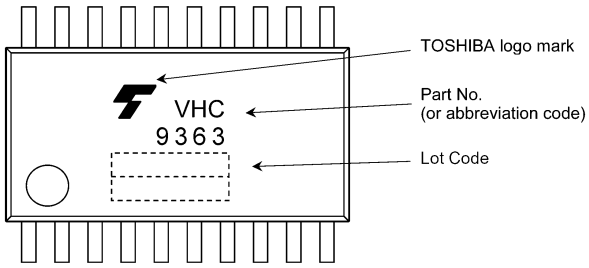
2020-01

5. Pin Assignment



6. Marking

74VHC9363FT



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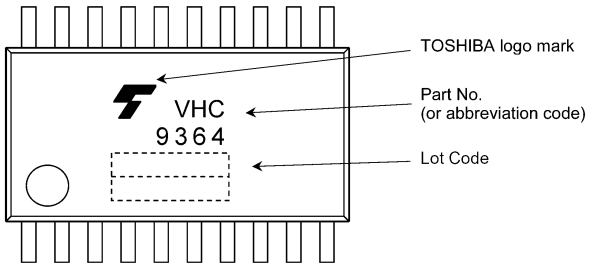
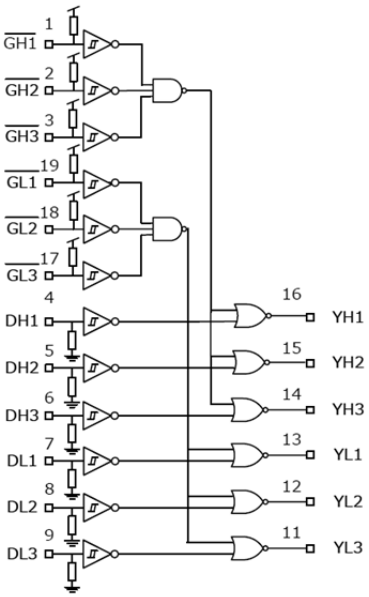
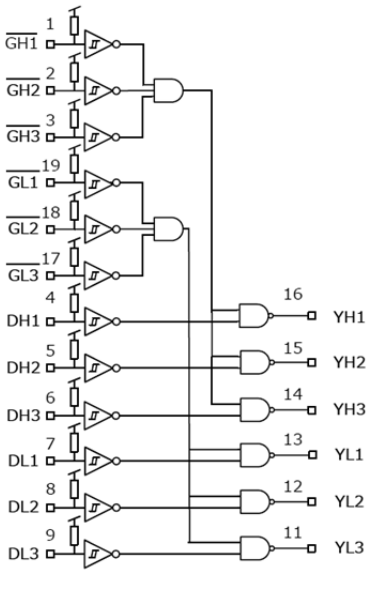


7. System Diagram

74VHC9363FT



74VHC9364FT



8. Truth Table

Inputs $\overline{GH1}$ $\overline{GL1}$	Inputs $\overline{GH2}$ $\overline{GL2}$	Inputs $\overline{GH3}$ $\overline{GL3}$	Inputs DHn DLn	Outputs YHn, YLn VHC9363	Outputs YHn, YLn VHC9364
H	X	X	X	L	H
X	H	X	X	L	H
X	X	H	X	L	H
L	L	L	L	L	L
L	L	L	H	H	H

X: Don't care

9. 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 current	I_{IN}		±1.0	mA
Input diode current	I_{IK}		-20	mA
Output diode current	I_{OK}		±20	mA
Output current	I_{OUT}		±25	mA
V_{CC}/ground current	I_{CC}		±75	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.

10. Operating Ranges (Note)

Characteristics	Symbol	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

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.

Note: All input terminal has a built-in pull-up resistor or pull-down resistor.
It is recommended that unused inputs be connected to V_{CC} or GND.

11. Electrical Characteristics

11.1. DC Characteristics (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Test Condition		V_{CC} (V)	Min	Typ.	Max	Unit
Positive threshold voltage	V_P	—		3.0	—	—	2.20	V
				4.5	—	—	3.15	
				5.5	—	—	3.85	
Negative threshold voltage	V_N	—		3.0	0.9	—	—	V
				4.5	1.35	—	—	
				5.5	1.65	—	—	
Hysteresis voltage	V_H	—		3.0	0.30	—	1.20	V
				4.5	0.40	—	1.40	
				5.5	0.50	—	1.60	
High-level output voltage	V_{OH}	V_{IN} = V_{IH} or V_{IL}	I_{OH} = -50 μA	2.0	1.9	—	—	V
				3.0	2.9	—	—	
				4.5	4.4	—	—	
			I_{OH} = -4 mA	3.0	2.58	—	—	
			I_{OH} = -8 mA	4.5	4.4	—	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 50 μA	2.0	—	—	0.1	V
				3.0	—	—	0.1	
				4.5	—	—	0.1	
			I_{OL} = 4 mA	3.0	—	—	0.36	
			I_{OL} = 8 mA	4.5	—	—	0.36	
High-level input current	$I_{IH}1$	V_{IN} = V_{CC} Applies to terminals with pull-up resistor.		0 to 5.5	—	—	±1.0	μA
	$I_{IH}2$	V_{IN} = V_{CC} Applies to terminals with pull-down resistor.		0 to 5.5	—	—	500	μA
Low-level input current	$I_{IL}1$	V_{IN} = 0 V Applies to terminals with pull-up resistor.		0 to 5.5	-500	—	—	μA
	$I_{IL}2$	V_{IN} = 0 V Applies to terminals with pull-down resistor.		0 to 5.5	—	—	±1.0	μA
Quiescent supply current	I_{CC}	V_{IN} = 0 V or Open Applies to terminals with pull-down resistor. V_{IN} = 5.5 V or Open Applies to terminals with pull-up resistor.		5.5	—	—	4.0	μA
Pull-down resistance	R_{PD}	—		5.0	11	17	23	kΩ
Pull-up resistance	R_{PU}	—		5.0	11	17	23	

11.2. DC Characteristics (Unless otherwise specified, T_a = -40 to 85 °C)

Characteristics	Symbol	Test Condition		V_{CC} (V)	Min	Max	Unit
Positive threshold voltage	V_P	—		3.0	—	2.20	V
				4.5	—	3.15	
				5.5	—	3.85	
Negative threshold voltage	V_N	—		3.0	0.9	—	V
				4.5	1.35	—	
				5.5	1.65	—	
Hysteresis voltage	V_H	—		3.0	0.30	1.20	V
				4.5	0.40	1.40	
				5.5	0.50	1.60	
High-level output voltage	V_{OH}	V_{IN} = V_{IH} or V_{IL}	I_{OH} = -50 μA	2.0	1.9	—	V
				3.0	2.9	—	
				4.5	4.4	—	
			I_{OH} = -4 mA	3.0	2.48	—	
			I_{OH} = -8 mA	4.5	3.80	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 50 μA	2.0	—	0.1	V
				3.0	—	0.1	
				4.5	—	0.1	
			I_{OL} = 4 mA	3.0	—	0.44	
			I_{OL} = 8 mA	4.5	—	0.44	
High-level input current	$I_{IH}1$	V_{IN} = V_{CC} Applies to terminals with pull-up resistor.		0 to 5.5	—	±20.0	μA
	$I_{IH}2$	V_{IN} = V_{CC} Applies to terminals with pull-down resistor.		0 to 5.5	—	690	μA
Low-level input current	$I_{IL}1$	V_{IN} = 0 V Applies to terminals with pull-up resistor.		0 to 5.5	-690	—	μA
	$I_{IL}2$	V_{IN} = 0 V Applies to terminals with pull-down resistor.		0 to 5.5	—	±20.0	μA
Quiescent supply current	I_{CC}	V_{IN} = 0 V or Open Applies to terminals with pull-down resistor. V_{IN} = 5.5 V or Open Applies to terminals with pull-up resistor.		5.5	—	40.0	μA
Pull-down resistance	R_{PD}	—		5.0	8	30	kΩ
Pull-up resistance	R_{PU}	—		5.0	8	30	

11.3. DC Characteristics (Unless otherwise specified, T_a = -40 to 125 °C)

Characteristics	Symbol	Test Condition		V_{CC} (V)	Min	Max	Unit
Positive threshold voltage	V_P	—		3.0	—	2.20	V
				4.5	—	3.15	
				5.5	—	3.85	
Negative threshold voltage	V_N	—		3.0	0.9	—	V
				4.5	1.35	—	
				5.5	1.65	—	
Hysteresis voltage	V_H	—		3.0	0.30	1.20	V
				4.5	0.40	1.40	
				5.5	0.50	1.60	
High-level output voltage	V_{OH}	V_{IN} = V_{IH} or V_{IL}	I_{OH} = -50 μA	2.0	1.9	—	V
				3.0	2.9	—	
				4.5	4.4	—	
			I_{OH} = -4 mA	3.0	2.40	—	
			I_{OH} = -8 mA	4.5	3.70	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 50 μA	2.0	—	0.1	V
				3.0	—	0.1	
				4.5	—	0.1	
			I_{OL} = 4 mA	3.0	—	0.55	
			I_{OL} = 8 mA	4.5	—	0.55	
High-level input current	$I_{IH}1$	V_{IN} = V_{CC} Applies to terminals with pull-up resistor.		0 to 5.5	—	±50.0	μA
	$I_{IH}2$	V_{IN} = V_{CC} Applies to terminals with pull-down resistor.		0 to 5.5	—	690	μA
Low-level input current	$I_{IL}1$	V_{IN} = 0 V Applies to terminals with pull-up resistor.		0 to 5.5	-690	—	μA
	$I_{IL}2$	V_{IN} = 0 V Applies to terminals with pull-down resistor.		0 to 5.5	—	±50.0	μA
Quiescent supply current	I_{CC}	V_{IN} = 0 V or Open Applies to terminals with pull-down resistor. V_{IN} = 5.5 V or Open Applies to terminals with pull-up resistor.		5.5	—	80.0	μA
Pull-down resistance	R_{PD}	—		5.0	8	36	kΩ
Pull-up resistance	R_{PU}	—		5.0	8	36	

11.4. AC Characteristics (Unless otherwise specified, T_a = 25 °C, Input: $t_r = t_f$ = 3 ns)

Characteristics	Symbol	Note	Test Condition	V_{CC} (V)	C_L (pF)	Min	Typ.	Max	Unit
Propagation delay time (Dxx-Yxx)	t_{PLH},t_{PHL}		—	3.3 ± 0.3	15	—	6.0	8.0	ns
					50	—	9.0	12.5	
				5.0 ± 0.5	15	—	5.0	5.5	
					50	—	7.0	8.5	
Propagation delay time ($\overline{G}$xx-Yxx)	t_{PLH},t_{PHL}		—	3.3 ± 0.3	15	—	8.5	11.5	ns
					50	—	13.0	17.0	
				5.0 ± 0.5	15	—	6.5	8.0	
					50	—	10.5	12.5	
Output skew	t_{osLH},t_{osHL}	(Note 1)	—	3.3 ± 0.3	50	—	—	1.5	ns
				5.0 ± 0.5	50	—	—	1.0	
Input capacitance	C_{IN}		—			—	6	10	pF

Note 1: Parameter guaranteed by design. ($t_{osLH} = |t_{PLH}m - t_{PLH}n|$, $t_{osHL} = |t_{PHL}m - t_{PHL}n|$)

11.5. AC Characteristics (Unless otherwise specified, T_a = -40 to 85 °C, Input: $t_r = t_f$ = 3 ns)

Characteristics	Symbol	Note	Test Condition	V_{CC} (V)	C_L (pF)	Min	Max	Unit
Propagation delay time (Dxx-Yxx)	t_{PLH},t_{PHL}		—	3.3 ± 0.3	15	1.0	10.0	ns
					50	1.0	15.0	
				5.0 ± 0.5	15	1.0	7.0	
					50	1.0	10.0	
Propagation delay time ($\overline{G}$xx-Yxx)	t_{PLH},t_{PHL}		—	3.3 ± 0.3	15	1.0	13.5	ns
					50	1.0	20.5	
				5.0 ± 0.5	15	1.0	9.5	
					50	1.0	15.0	
Output skew	t_{osLH},t_{osHL}	(Note 1)	—	3.3 ± 0.3	50	—	1.5	ns
				5.0 ± 0.5	50	—	1.0	
Input capacitance	C_{IN}		—			—	10	pF

Note 1: Parameter guaranteed by design. ($t_{osLH} = |t_{PLH}m - t_{PLH}n|$, $t_{osHL} = |t_{PHL}m - t_{PHL}n|$)

11.6. AC Characteristics (Unless otherwise specified, T_a = -40 to 125 °C, Input: $t_r = t_f$ = 3 ns)

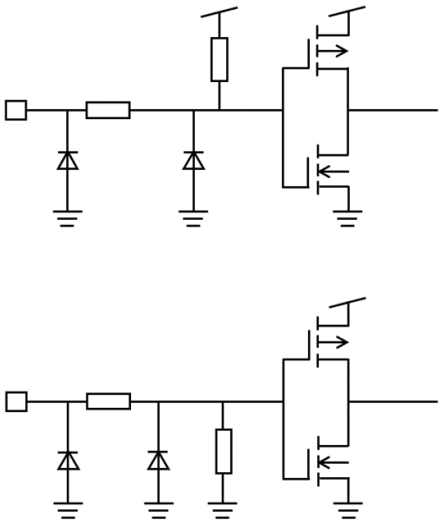
Characteristics	Symbol	Note	Test Condition	V_{CC} (V)	C_L (pF)	Min	Max	Unit
Propagation delay time (Dxx-Yxx)	t_{PLH},t_{PHL}		—	3.3 ± 0.3	15	1.0	11.5	ns
					50	1.0	17.0	
				5.0 ± 0.5	15	1.0	8.0	
					50	1.0	11.0	
Propagation delay time ($\overline{G}$xx-Yxx)	t_{PLH},t_{PHL}		—	3.3 ± 0.3	15	1.0	15.0	ns
					50	1.0	23.0	
				5.0 ± 0.5	15	1.0	10.5	
					50	1.0	17.0	
Output skew	t_{osLH},t_{osHL}	(Note 1)	—	3.3 ± 0.3	50	—	1.5	ns
				5.0 ± 0.5	50	—	1.0	
Input capacitance	C_{IN}		—			—	10	pF

Note 1: Parameter guaranteed by design. ($t_{osLH} = |t_{PLH}m - t_{PLH}n|$, $t_{osHL} = |t_{PHL}m - t_{PHL}n|$)

11.7. Noise Characteristics (Unless otherwise specified, T_a = 25 °C, Input: $t_r = t_f$ = 3 ns)

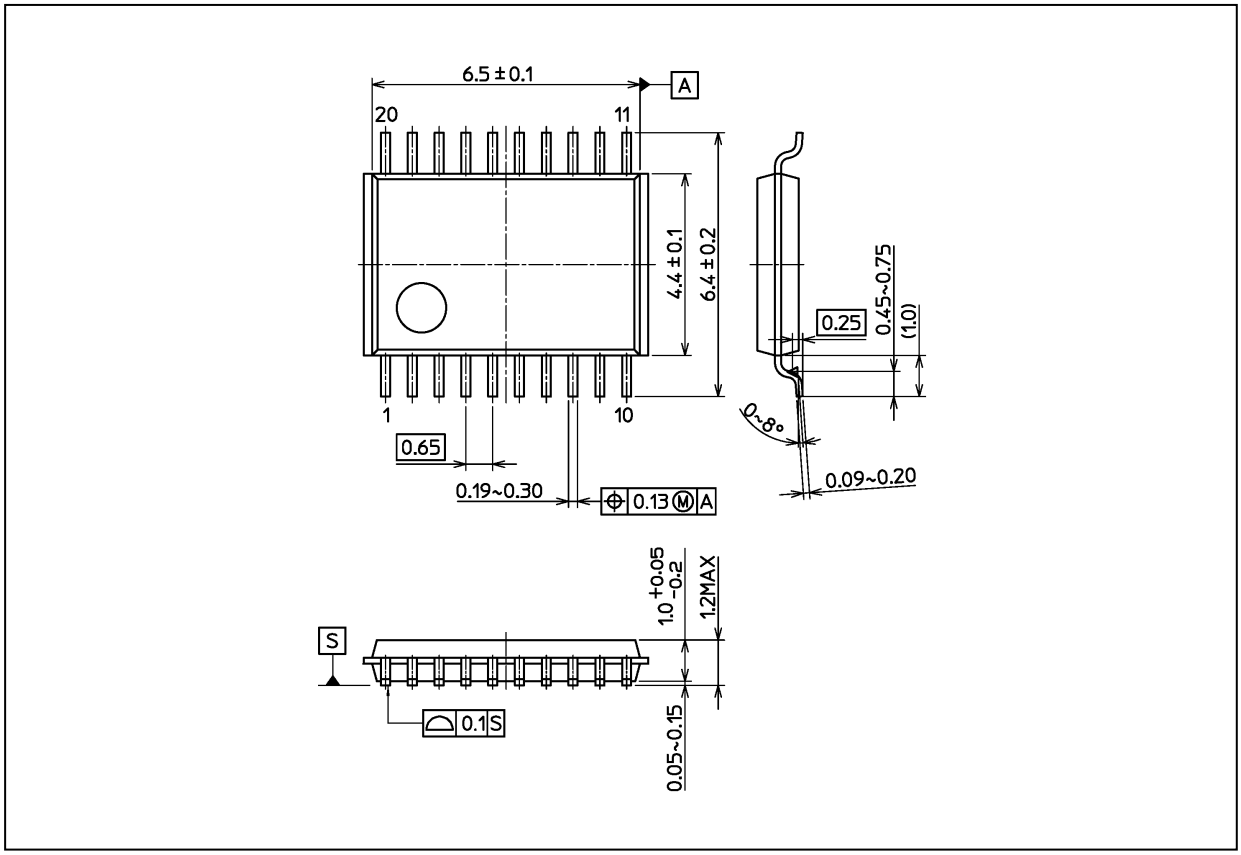
Characteristics	Symbol	Test Condition	V_{CC} (V)	Typ.	Limit	Unit
Quiet output maximum dynamic V_{OL}	V_{OLP}	C_L = 50 pF	5.0	0.7	1.0	V
Quiet output minimum dynamic V_{OL}	V_{OLV}	C_L = 50 pF	5.0	-0.7	-1.0	V
Minimum high-level dynamic input voltage	V_{IHD}	C_L = 50 pF	5.0	—	3.5	V
Maximum low-level dynamic input voltage	V_{ILD}	C_L = 50 pF	5.0	—	1.5	V

12. Internal Equivalent Circuit



Package Dimensions

Unit: mm



Weight: 0.071 g (typ.)

Package Name(s)
Nickname: TSSOP20B

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