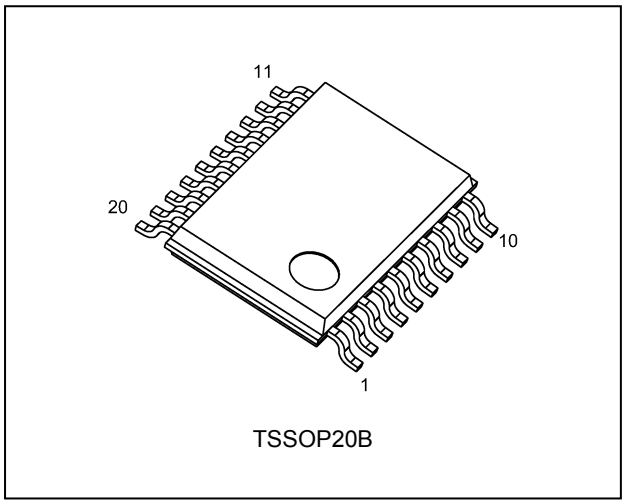
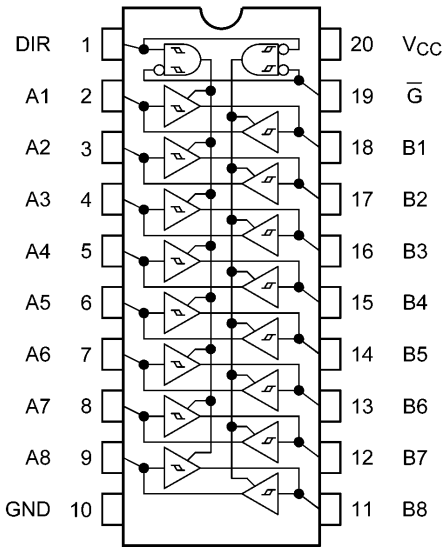
4. Packaging



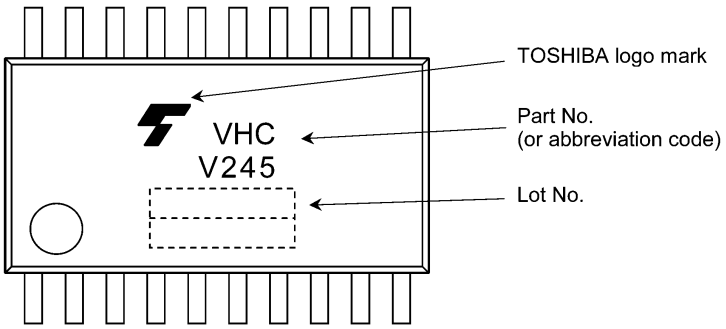
TSSOP20B

5. Pin Assignment



(top view)

6. Marking



7. Truth Table

Inputs $\overline{G}$	Inputs DIR	Function A Bus	Function B Bus	Output
L	L	Output	Input	A = B
L	H	Input	Output	B = A
H	X	Z	Z	Z

X: Don't care
Z: High Impedance

8. Absolute Maximum Ratings (Note)

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	V_{CC}		-0.5 to 7.0	V
Input voltage(DIR,$\overline{G}$)	V_{IN}		-0.5 to 7.0	V
Bus I/O voltage	$V_{I/O}$	(Note 1)	-0.5 to 7.0	V
		(Note 2)	-0.5 to V_{CC} + 0.5	
Input diode current	I_{IK}		-50	mA
Output diode current	I_{OK}	(Note 3)	±50	mA
Output current	I_{OUT}		±50	mA
Power dissipation	P_D	(Note 4)	180	mW
V_{CC}/ground current	I_{CC}/I_{GND}		±100	mA
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: OFF state.
Note 2: High (H) or Low (L) state. I_{OUT} absolute maximum rating must be observed.
Note 3: V_{OUT} < GND, V_{OUT} > V_{CC}
Note 4: 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.

9. Operating Ranges (Note)

Characteristics	Symbol	Test Condition	Note	Rating	Unit
Supply voltage	V_{CC}	—		1.8 to 5.5	V
Input voltage(DIR,$\overline{G}$)	V_{IN}	—		0 to 5.5	V
Bus I/O voltage	$V_{I/O}$	—	(Note 1)	0 to 5.5	V
			(Note 2)	0 to V_{CC}	
Operating temperature	T_{opr}	—		-40 to 125	°C
Input rise and fall times	dt/dv	V_{CC} = 3.3 ± 0.3 V		0 to 20	ms/V
		V_{CC} = 5.0 ± 0.5 V		0 to 1	

Note: The operating ranges must be maintained to ensure the normal operation of the device.
Unused inputs and bus inputs must be tied to either V_{CC} or GND. Please connect both bus inputs and the bus outputs with V_{CC} or GND when the I/O of the bus terminal changes by the function. In this case, please note that the output is not short-circuited.

Note 1: OFF state.
Note 2: High (H) or Low (L) state.

10. Electrical Characteristics

10.1. 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	—		1.8	—	—	1.65	V
				2.3	—	—	1.85	
				3.0	—	—	2.20	
				4.5	—	—	3.15	
				5.5	—	—	3.85	
Negative threshold voltage	V_N	—		1.8	0.15	—	—	V
				2.3	0.45	—	—	
				3.0	0.90	—	—	
				4.5	1.35	—	—	
				5.5	1.65	—	—	
Hysteresis voltage	V_H	—		1.8	0.15	—	1.05	V
				2.3	0.20	—	1.10	
				3.0	0.30	—	1.20	
				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	1.8	1.7	1.8	—	V
				3.0	2.9	3.0	—	
				4.5	4.4	4.5	—	
			I_{OH} = -8 mA	3.0	2.58	—	—	
			I_{OH} = -16 mA	4.5	3.94	—	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 50 μA	1.8	—	0.0	0.1	V
				3.0	—	0.0	0.1	
				4.5	—	0.0	0.1	
			I_{OL} = 8 mA	3.0	—	—	0.36	
			I_{OL} = 16 mA	4.5	—	—	0.44	
3-state output OFF-state leakage current	I_{OZ}	V_{IN} = V_{IH} or V_{IL} V_{OUT} = 0 to 5.5 V		1.8 to 5.5	—	—	±0.5	μA
Power-OFF leakage current	I_{OFF}	V_{IN}/V_{OUT} = 5.5 V		0	—	—	0.5	μA
Input leakage current	I_{IN}	V_{IN} = 5.5 V or GND		0 to 5.5	—	—	±0.1	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND		5.5	—	—	2.0	μA

10.2. 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	—		1.8	—	1.65	V
				2.3	—	1.85	
				3.0	—	2.20	
				4.5	—	3.15	
				5.5	—	3.85	
Negative threshold voltage	V_N	—		1.8	0.15	—	V
				2.3	0.45	—	
				3.0	0.90	—	
				4.5	1.35	—	
				5.5	1.65	—	
Hysteresis voltage	V_H	—		1.8	0.15	1.05	V
				2.3	0.20	1.10	
				3.0	0.30	1.20	
				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	1.8	1.7	—	V
				3.0	2.9	—	
				4.5	4.4	—	
			I_{OH} = -8 mA	3.0	2.48	—	
			I_{OH} = -16 mA	4.5	3.80	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 50 μA	1.8	—	0.1	V
				3.0	—	0.1	
				4.5	—	0.1	
			I_{OL} = 8 mA	3.0	—	0.44	
			I_{OL} = 16 mA	4.5	—	0.55	
3-state output OFF-state leakage current	I_{OZ}	V_{IN} = V_{IH} or V_{IL} V_{OUT} = 0 to 5.5 V		1.8 to 5.5	—	±5.0	μA
Power-OFF leakage current	I_{OFF}	V_{IN}/V_{OUT} = 5.5 V		0	—	5.0	μA
Input leakage current	I_{IN}	V_{IN} = 5.5 V or GND		0 to 5.5	—	±1.0	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND		5.5	—	20.0	μA

10.3. 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	—		1.8	—	1.65	V
				2.3	—	1.85	
				3.0	—	2.20	
				4.5	—	3.15	
				5.5	—	3.85	
Negative threshold voltage	V_N	—		1.8	0.15	—	V
				2.3	0.45	—	
				3.0	0.90	—	
				4.5	1.35	—	
				5.5	1.65	—	
Hysteresis voltage	V_H	—		1.8	0.15	1.05	V
				2.3	0.20	1.10	
				3.0	0.30	1.20	
				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	1.8	1.7	—	V
				3.0	2.9	—	
				4.5	4.4	—	
			I_{OH} = -8 mA	3.0	2.40	—	
			I_{OH} = -16 mA	4.5	3.70	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 50 μA	1.8	—	0.1	V
				3.0	—	0.1	
				4.5	—	0.1	
			I_{OL} = 8 mA	3.0	—	0.55	
			I_{OL} = 16 mA	4.5	—	0.65	
3-state output OFF-state leakage current	I_{OZ}	V_{IN} = V_{IH} or V_{IL} V_{OUT} = 0 to 5.5 V		1.8 to 5.5	—	±20.0	μA
Power-OFF leakage current	I_{OFF}	V_{IN}/V_{OUT} = 5.5 V		0	—	20.0	μA
Input leakage current	I_{IN}	V_{IN} = 5.5 V or GND		0 to 5.5	—	±2.0	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND		5.5	—	40.0	μA

10.4. 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	t_{PLH},t_{PHL}		—	2.5 ± 0.2	15	—	5.9	13.0	ns
					50	—	8.7	15.9	
				3.3 ± 0.3	15	—	4.6	8.4	
					50	—	6.9	11.9	
				5.0 ± 0.5	15	—	3.8	5.5	
					50	—	5.4	7.5	
3-state output enable time	t_{PZL},t_{PZH}		R_L = 1 kΩ	2.5 ± 0.2	15	—	7.0	19.9	ns
					50	—	9.6	22.7	
				3.3 ± 0.3	15	—	5.3	13.2	
					50	—	7.4	16.7	
				5.0 ± 0.5	15	—	4.1	8.5	
					50	—	5.7	10.6	
3-state output disable time	t_{PLZ},t_{PHZ}		R_L = 1 kΩ	2.5 ± 0.2	50	—	15.0	23.1	ns
				3.3 ± 0.3	50	—	11.6	15.8	
				5.0 ± 0.5	50	—	9.3	9.7	
Output skew	t_{osLH},t_{osHL}	(Note 1)	—	2.5 ± 0.2	50	—	—	2.0	ns
				3.3 ± 0.3	50	—	—	1.5	
				5.0 ± 0.5	50	—	—	1.0	
Input capacitance	C_{IN}		DIR, $\overline{G}$			—	4	10	pF
Bus I/O capacitance	$C_{I/O}$		An, Bn			—	6	—	pF
Power dissipation capacitance	C_{PD}	(Note 2)	—			—	26	—	pF

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

Note 2: 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.

$I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/8$ (per bit)

10.5. 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	t_{PLH},t_{PHL}		—	2.5 ± 0.2	15	1.0	15.0	ns
					50	1.0	18.0	
				3.3 ± 0.3	15	1.0	10.0	
					50	1.0	13.5	
				5.0 ± 0.5	15	1.0	6.5	
					50	1.0	8.5	
3-state output enable time	t_{PZL},t_{PZH}		R_L = 1 kΩ	2.5 ± 0.2	15	1.0	22.0	ns
					50	1.0	26.0	
				3.3 ± 0.3	15	1.0	15.5	
					50	1.0	19.0	
				5.0 ± 0.5	15	1.0	10.0	
					50	1.0	12.0	
3-state output disable time	t_{PLZ},t_{PHZ}		R_L = 1 kΩ	2.5 ± 0.2	50	1.0	25.0	ns
				3.3 ± 0.3	50	1.0	18.0	
				5.0 ± 0.5	50	1.0	11.0	
Output skew	t_{osLH},t_{osHL}	(Note 1)	—	2.5 ± 0.2	50	—	2.0	ns
				3.3 ± 0.3	50	—	1.5	
				5.0 ± 0.5	50	—	1.0	
Input capacitance	C_{IN}		DIR, $\overline{G}$			—	10	pF

Note 1: Parameter guaranteed by design. ($t_{osLH} = |t_{PLHm} - t_{PLHn}|$, $t_{osHL} = |t_{PHLm} - t_{PHLn}|$)

10.6. 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	t_{PLH},t_{PHL}		—	2.5 ± 0.2	15	1.0	16.5	ns
					50	1.0	19.5	
				3.3 ± 0.3	15	1.0	11.5	
					50	1.0	15.0	
				5.0 ± 0.5	15	1.0	7.5	
					50	1.0	9.5	
3-state output enable time	t_{PZL},t_{PZH}		R_L = 1 kΩ	2.5 ± 0.2	15	1.0	23.5	ns
					50	1.0	28.5	
				3.3 ± 0.3	15	1.0	17.5	
					50	1.0	21.0	
				5.0 ± 0.5	15	1.0	11.5	
					50	1.0	13.5	
3-state output disable time	t_{PLZ},t_{PHZ}		R_L = 1 kΩ	2.5 ± 0.2	50	1.0	26.5	ns
				3.3 ± 0.3	50	1.0	20.0	
				5.0 ± 0.5	50	1.0	12.5	
Output skew	t_{osLH},t_{osHL}	(Note 1)	—	2.5 ± 0.2	50	—	2.0	ns
				3.3 ± 0.3	50	—	1.5	
				5.0 ± 0.5	50	—	1.0	
Input capacitance	C_{IN}		DIR, $\overline{G}$			—	10	pF

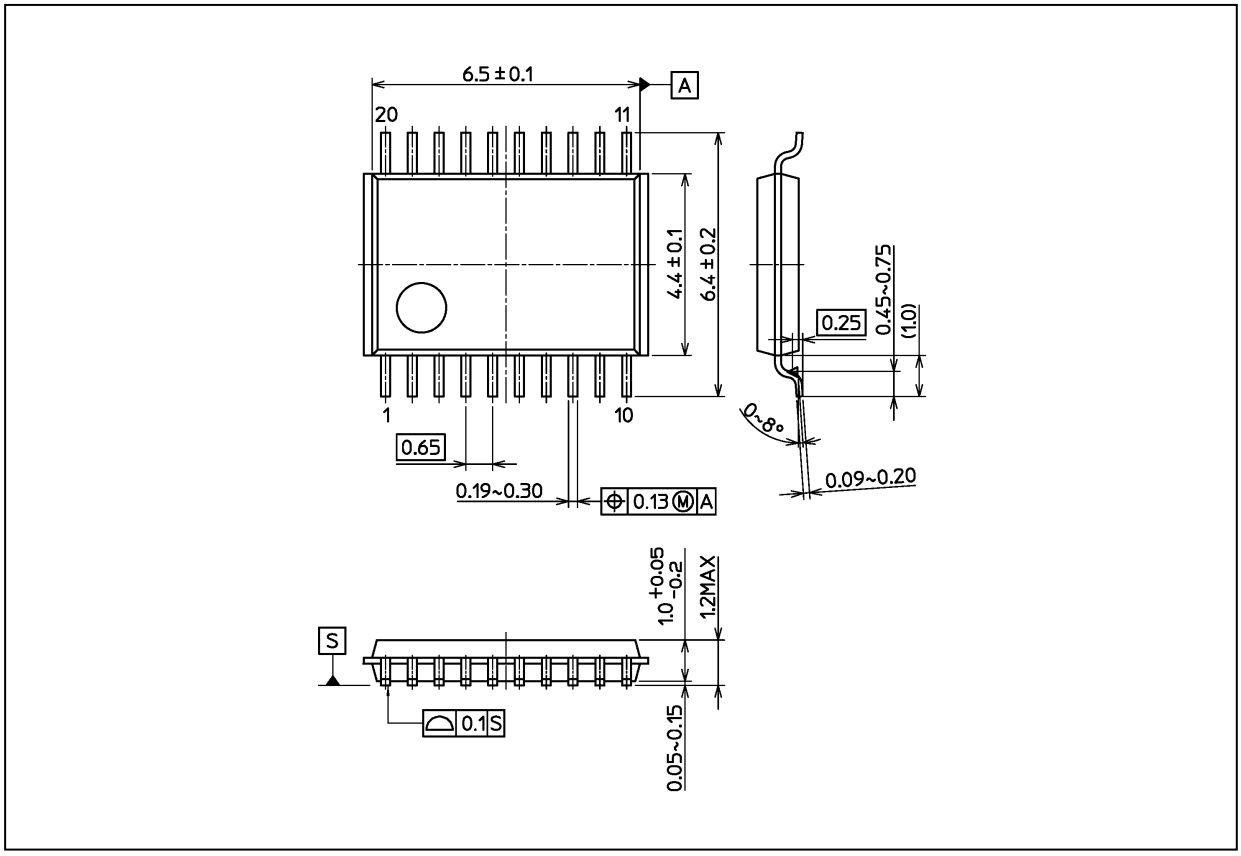
Note 1: Parameter guaranteed by design. ($t_{osLH} = |t_{PLHm} - t_{PLHn}|$, $t_{osHL} = |t_{PHLm} - t_{PHLn}|$)

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

Characteristics	Symbol	Test Condition	V_{CC} (V)	Typ.	Max	Unit
Quiet output maximum dynamic V_{OL}	V_{OLP}	C_L = 50 pF	3.3	0.5	—	V
			5.0	1.0	—	
Quiet output minimum dynamic V_{OL}	V_{OLV}	C_L = 50 pF	3.3	-0.1	—	V
			5.0	-0.3	—	
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

Package Dimensions

Unit: mm



Weight: 0.071 g (typ.)

Package Name(s)
Nickname: TSSOP20B

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