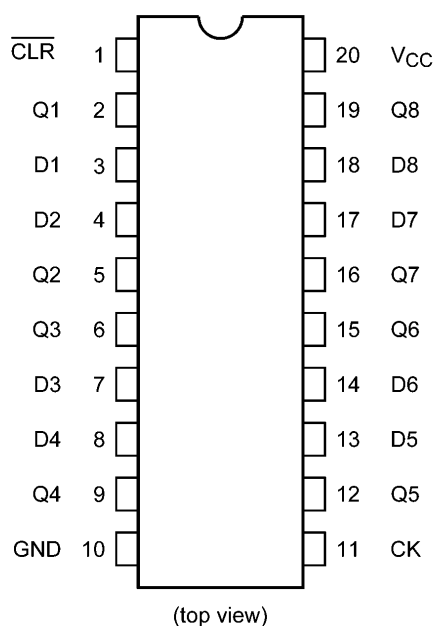
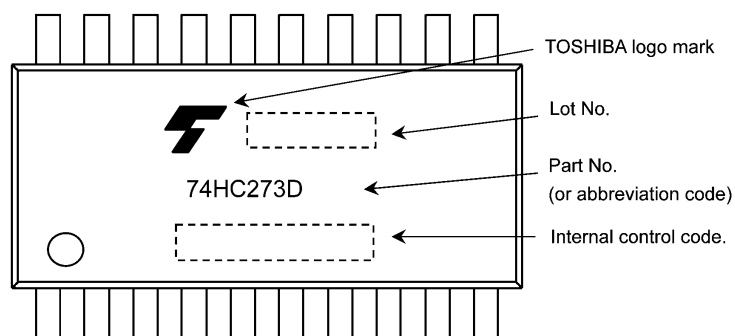


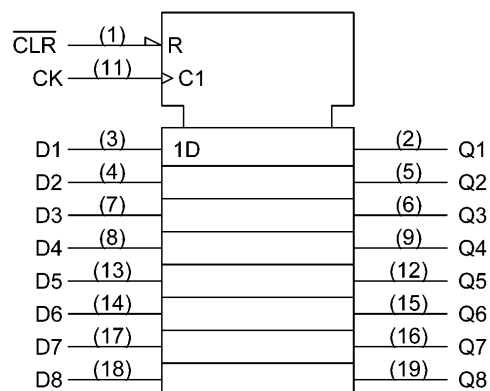
5. Pin Assignment



6. Marking



7. IEC Logic Symbol

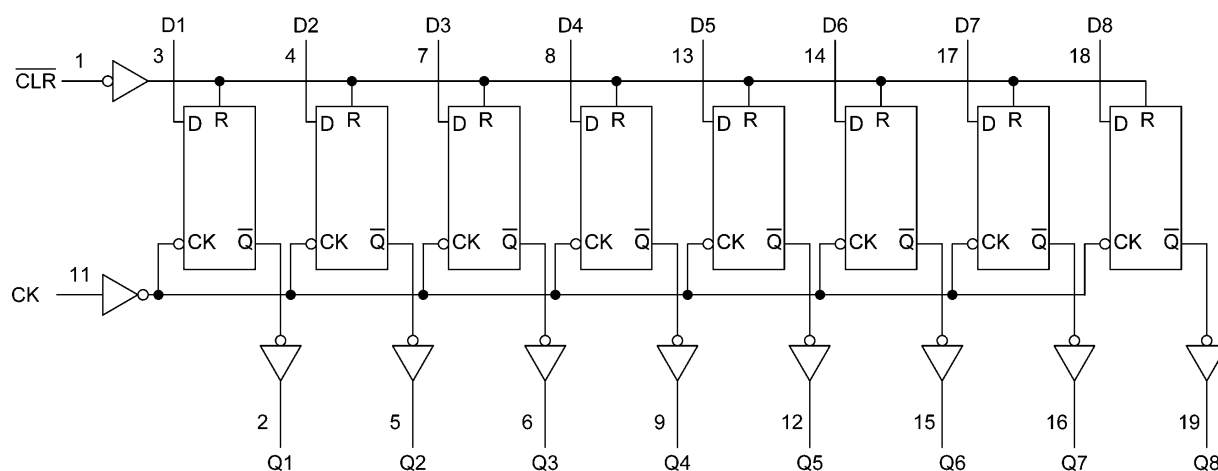


8. Truth Table

Inputs			Output	Function
$\overline{\text{CLR}}$	D	CK	Q	
L	X	X	L	Clear
H	L	\uparrow	L	—
H	H	\uparrow	H	—
H	X	\downarrow	Q _n	No Change

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 $V_{CC} + 0.5$	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}		± 20	mA
Output current	I_{OUT}		± 25	mA
V_{CC} /ground current	I_{CC}		± 50	mA
Power dissipation	P_D	(Note 1)	500	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: P_D derates linearly with -8 mW/°C above 85°C

11. Operating Ranges (Note)

Characteristics	Symbol	Test Condition	Rating	Unit
Supply voltage	V_{CC}	—	2.0 to 6.0	V
Input voltage	V_{IN}	—	0 to V_{CC}	V
Output voltage	V_{OUT}	—	0 to V_{CC}	V
Operating temperature	T_{opr}	—	-40 to 125	°C
Input rise and fall times	t_r, t_f	—	0 to 50	μs

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.

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
				4.5	3.15	—	—	
				6.0	4.20	—	—	
Low-level input voltage	V_{IL}	—		2.0	—	—	0.50	V
				4.5	—	—	1.35	
				6.0	—	—	1.80	
High-level output voltage	V_{OH}	$V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OH} = -20\text{ }\mu\text{A}$	2.0	1.9	2.0	—	V
				4.5	4.4	4.5	—	
				6.0	5.9	6.0	—	
			$I_{OH} = -4\text{ mA}$	4.5	4.18	4.31	—	
			$I_{OH} = -5.2\text{ mA}$	6.0	5.68	5.80	—	
Low-level output voltage	V_{OL}	$V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OL} = 20\text{ }\mu\text{A}$	2.0	—	0.0	0.1	V
				4.5	—	0.0	0.1	
				6.0	—	0.0	0.1	
			$I_{OL} = 4\text{ mA}$	4.5	—	0.17	0.26	
			$I_{OL} = 5.2\text{ mA}$	6.0	—	0.18	0.26	
Input leakage current	I_{IN}	$V_{IN} = V_{CC} \text{ or } GND$		6.0	—	—	± 0.1	μA
Quiescent supply current	I_{CC}	$V_{IN} = V_{CC} \text{ or } GND$		6.0	—	—	4.0	μA

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
				4.5	3.15	—	
				6.0	4.20	—	
Low-level input voltage	V_{IL}	—		2.0	—	0.50	V
				4.5	—	1.35	
				6.0	—	1.80	
High-level output voltage	V_{OH}	$V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OH} = -20\text{ }\mu\text{A}$	2.0	1.9	—	V
				4.5	4.4	—	
				6.0	5.9	—	
			$I_{OH} = -4\text{ mA}$	4.5	4.13	—	
			$I_{OH} = -5.2\text{ mA}$	6.0	5.63	—	
Low-level output voltage	V_{OL}	$V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OL} = 20\text{ }\mu\text{A}$	2.0	—	0.1	V
				4.5	—	0.1	
				6.0	—	0.1	
			$I_{OL} = 4\text{ mA}$	4.5	—	0.33	
			$I_{OL} = 5.2\text{ mA}$	6.0	—	0.33	
Input leakage current	I_{IN}	$V_{IN} = V_{CC} \text{ or } GND$		6.0	—	± 1.0	μA
Quiescent supply current	I_{CC}	$V_{IN} = V_{CC} \text{ or } GND$		6.0	—	40.0	μA

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
				4.5	3.15	—	
				6.0	4.20	—	
Low-level input voltage	V_{IL}	—		2.0	—	0.50	V
				4.5	—	1.35	
				6.0	—	1.80	
High-level output voltage	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -20\text{ }\mu\text{A}$	2.0	1.9	—	V
				4.5	4.4	—	
				6.0	5.9	—	
			$I_{OH} = -4\text{ mA}$	4.5	3.7	—	
			$I_{OH} = -5.2\text{ mA}$	6.0	5.2	—	
Low-level output voltage	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 20\text{ }\mu\text{A}$	2.0	—	0.1	V
				4.5	—	0.1	
				6.0	—	0.1	
			$I_{OL} = 4\text{ mA}$	4.5	—	0.4	
			$I_{OL} = 5.2\text{ mA}$	6.0	—	0.4	
Input leakage current	I_{IN}	$V_{IN} = V_{CC}$ or GND		6.0	—	± 1.0	μA
Quiescent supply current	I_{CC}	$V_{IN} = V_{CC}$ or GND		6.0	—	160.0	μA

12.4. Timing Requirements (Unless otherwise specified, $T_a = 25^\circ\text{C}$, Input: $t_r = t_f = 6\text{ ns}$)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Limit	Unit
Minimum pulse width (CK)	$t_{w(L)}, t_{w(H)}$	—	2.0	75	ns
			4.5	15	
			6.0	13	
Minimum pulse width (CLR)	$t_{w(L)}$	—	2.0	75	ns
			4.5	15	
			6.0	13	
Minimum setup time	t_s	—	2.0	75	ns
			4.5	15	
			6.0	13	
Minimum hold time	t_h	—	2.0	0	ns
			4.5	0	
			6.0	0	
Minimum removal time (CLR)	t_{rem}	—	2.0	50	ns
			4.5	10	
			6.0	9	
Clock frequency	f	—	2.0	6	MHz
			4.5	30	
			6.0	35	

12.5. Timing Requirements (Unless otherwise specified, $T_a = -40$ to 85°C , Input: $t_r = t_f = 6\text{ ns}$)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Limit	Unit
Minimum pulse width (CK)	$t_{w(L)}, t_{w(H)}$	—	2.0	95	ns
			4.5	19	
			6.0	16	
Minimum pulse width (CLR)	$t_{w(L)}$	—	2.0	95	ns
			4.5	19	
			6.0	16	
Minimum setup time	t_s	—	2.0	95	ns
			4.5	19	
			6.0	16	
Minimum hold time	t_h	—	2.0	0	ns
			4.5	0	
			6.0	0	
Minimum removal time (CLR)	t_{rem}	—	2.0	65	ns
			4.5	13	
			6.0	11	
Clock frequency	f	—	2.0	5	MHz
			4.5	24	
			6.0	28	

12.6. Timing Requirements(Unless otherwise specified, $T_a = -40$ to $125\text{ }^{\circ}\text{C}$, Input: $t_r = t_f = 6\text{ ns}$)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Limit	Unit
Minimum pulse width (CK)	$t_{w(L)}, t_{w(H)}$	—	2.0	120	ns
			4.5	24	
			6.0	20	
Minimum pulse width (CLR)	$t_{w(L)}$	—	2.0	120	ns
			4.5	24	
			6.0	20	
Minimum setup time	t_s	—	2.0	120	ns
			4.5	24	
			6.0	20	
Minimum hold time	t_h	—	2.0	0	ns
			4.5	0	
			6.0	0	
Minimum removal time (CLR)	t_{rem}	—	2.0	75	ns
			4.5	15	
			6.0	13	
Clock frequency	f	—	2.0	4	MHz
			4.5	20	
			6.0	24	

12.7. AC Characteristics(Unless otherwise specified, $C_L = 15\text{ pF}$, $V_{CC} = 5\text{ V}$, $T_a = 25\text{ }^{\circ}\text{C}$, Input: $t_r = t_f = 6\text{ ns}$)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Output transition time	t_{TLH}, t_{THL}	—	—	4	8	ns
Propagation delay time (CK-Q)	t_{PLH}, t_{PHL}	—	—	15	25	ns
Propagation delay time (CLR-Q)	t_{PHL}	—	—	16	27	ns
Maximum clock frequency	f_{MAX}	—	40	67	—	MHz

12.8. AC Characteristics(Unless otherwise specified, $C_L = 50 \text{ pF}$, $T_a = 25 \text{ }^\circ\text{C}$, Input: $t_r = t_f = 6 \text{ ns}$)

Characteristics	Symbol	Note	Test Condition	V_{CC} (V)	Min	Typ.	Max	Unit
Output transition time	t_{TLH}, t_{THL}		—	2.0	—	25	75	ns
				4.5	—	7	15	
				6.0	—	6	13	
Propagation delay time (CK-Q)	t_{PLH}, t_{PHL}		—	2.0	—	54	145	ns
				4.5	—	18	29	
				6.0	—	15	25	
Propagation delay time (CLR-Q)	t_{PHL}		—	2.0	—	60	160	ns
				4.5	—	20	32	
				6.0	—	17	27	
Maximum clock frequency	f_{MAX}		—	2.0	6	18	—	MHz
				4.5	30	56	—	
				6.0	36	66	—	
Input capacitance	C_{IN}		—	—	—	3	—	pF
Power dissipation capacitance	C_{PD}	(Note 1)	—	—	—	11	—	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.

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

12.9. AC Characteristics(Unless otherwise specified, $C_L = 50 \text{ pF}$, $T_a = -40 \text{ to } 85 \text{ }^\circ\text{C}$, Input: $t_r = t_f = 6 \text{ ns}$)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Min	Max	Unit
Output transition time	t_{TLH}, t_{THL}	—	2.0	—	95	ns
			4.5	—	19	
			6.0	—	16	
Propagation delay time (CK-Q)	t_{PLH}, t_{PHL}	—	2.0	—	180	ns
			4.5	—	36	
			6.0	—	31	
Propagation delay time (CLR-Q)	t_{PHL}	—	2.0	—	200	ns
			4.5	—	40	
			6.0	—	34	
Maximum clock frequency	f_{MAX}	—	2.0	5	—	MHz
			4.5	24	—	
			6.0	28	—	

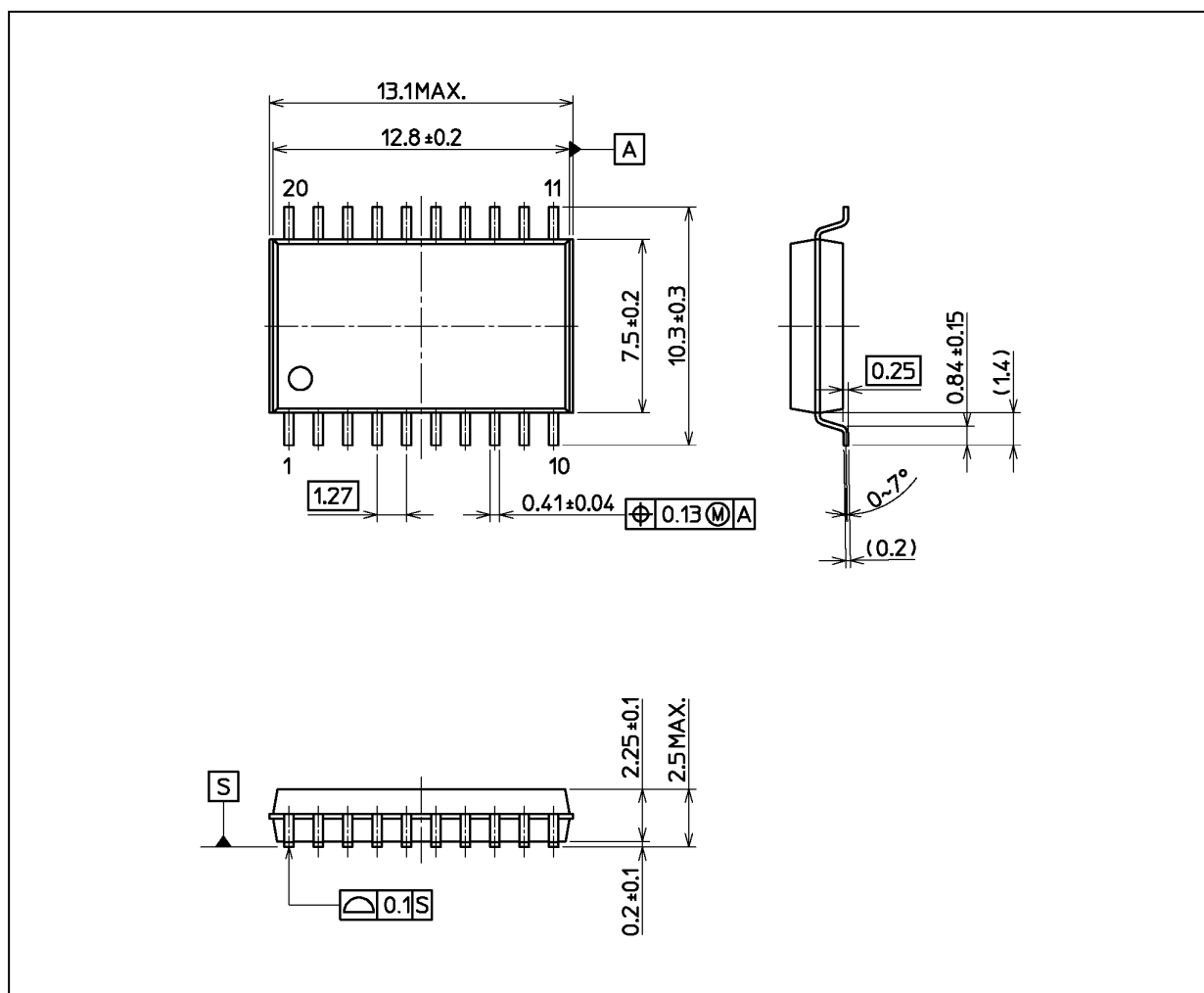
12.10. AC Characteristics

(Unless otherwise specified, $C_L = 50 \text{ pF}$, $T_a = -40 \text{ to } 125 \text{ }^\circ\text{C}$, Input: $t_r = t_f = 6 \text{ ns}$)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Min	Max	Unit
Output transition time	t_{TLH}, t_{THL}	—	2.0	—	110	ns
			4.5	—	22	
			6.0	—	19	
Propagation delay time (CK-Q)	t_{PLH}, t_{PHL}	—	2.0	—	225	ns
			4.5	—	45	
			6.0	—	38	
Propagation delay time (CLR-Q)	t_{PHL}	—	2.0	—	225	ns
			4.5	—	45	
			6.0	—	38	
Maximum clock frequency	f_{MAX}	—	2.0	4	—	MHz
			4.5	20	—	
			6.0	24	—	

Package Dimensions

Unit: mm



Weight: 0.51 g (typ.)

Package Name(s)
Nickname: SOIC20

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