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TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74HC4020AP, TC74HC4020AF TC74HC4040AP, TC74HC4040AF

TC74HC4020AP/AF 14-Stage Binary Counter

TC74HC4040AP/AF 12-Stage Binary Counter

The TC74HC4020A/TC74HC4040A are high speed CMOS BINARY COUNTER/DIVIDERS fabricated with silicon gate C²MOS technology.

They achieve the high speed operation similar to equivalent LSTTL while maintaining the CMOS dissipation.

The TC74HC4020A is a 14-STAGE BINARY COUNTER, and the TC74HC4040A is a 12-STAGE BINARY COUNTER.

Setting CLR to high resets the counter to low.

A negative transition on the CK input brings one increment into the counter.

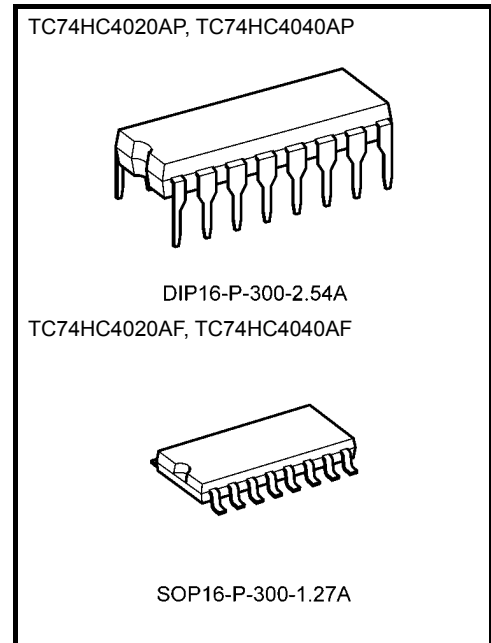
The TC74HC4020A provides 12 divided outputs: 1'st stage and stage 4 thru stage 14. At Q14, a 1/16384 divided frequency will be output.

The TC74HC4040A provides all divided output stages, and at Q12, a 1/4096 divided frequency will be output.

All inputs are equipped with protection circuits against static discharge or transient excess voltage.

Features

- High speed: $f_{max} = 73$ MHz (typ.) at $V_{CC} = 5$ V
- Low power dissipation: $I_{CC} = 4$ μ A (max) at $T_a = 25^\circ$ C
- High noise immunity: $V_{NIH} = V_{NIL} = 28\%$ V_{CC} (min)
- Output drive capability: 10 LSTTL loads
- Symmetrical output impedance: $|I_{OH}| = I_{OL} = 4$ mA (min)
- Balanced propagation delays: $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range: $V_{CC} (opr) = 2$ to 6 V
- Pin and function compatible with 4020B/4040B



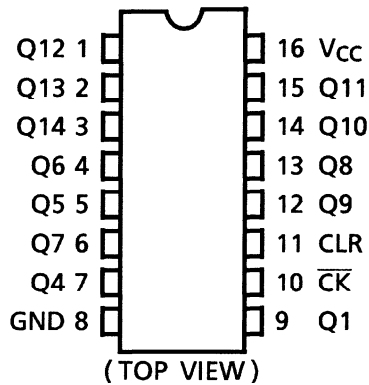
Weight

DIP16-P-300-2.54A : 1.00 g (typ.)
SOP16-P-300-1.27A : 0.18 g (typ.)

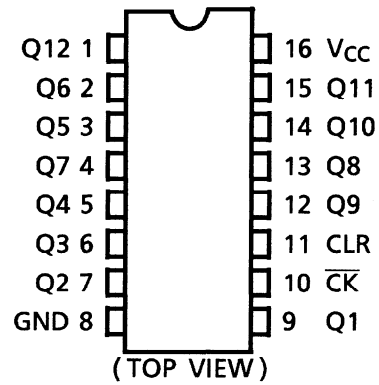
Start of commercial production
1988-05

Pin Assignment

TC74HC4020A

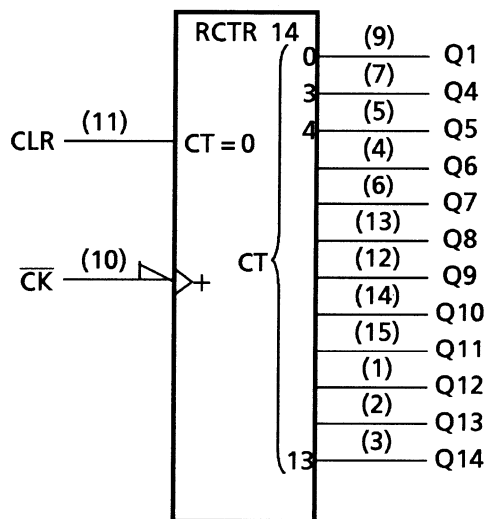


TC74HC4040A

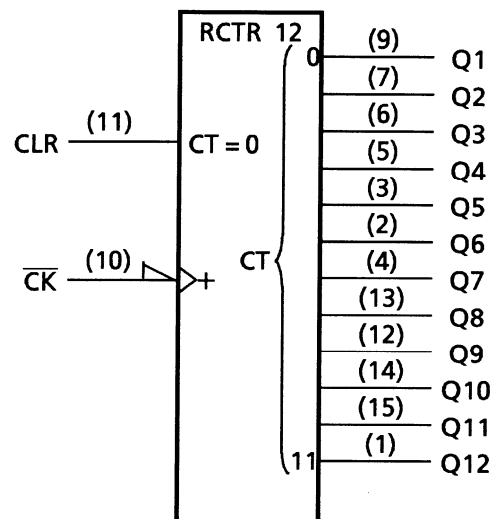


IEC Logic Symbol

TC74HC4020A



TC74HC4040A



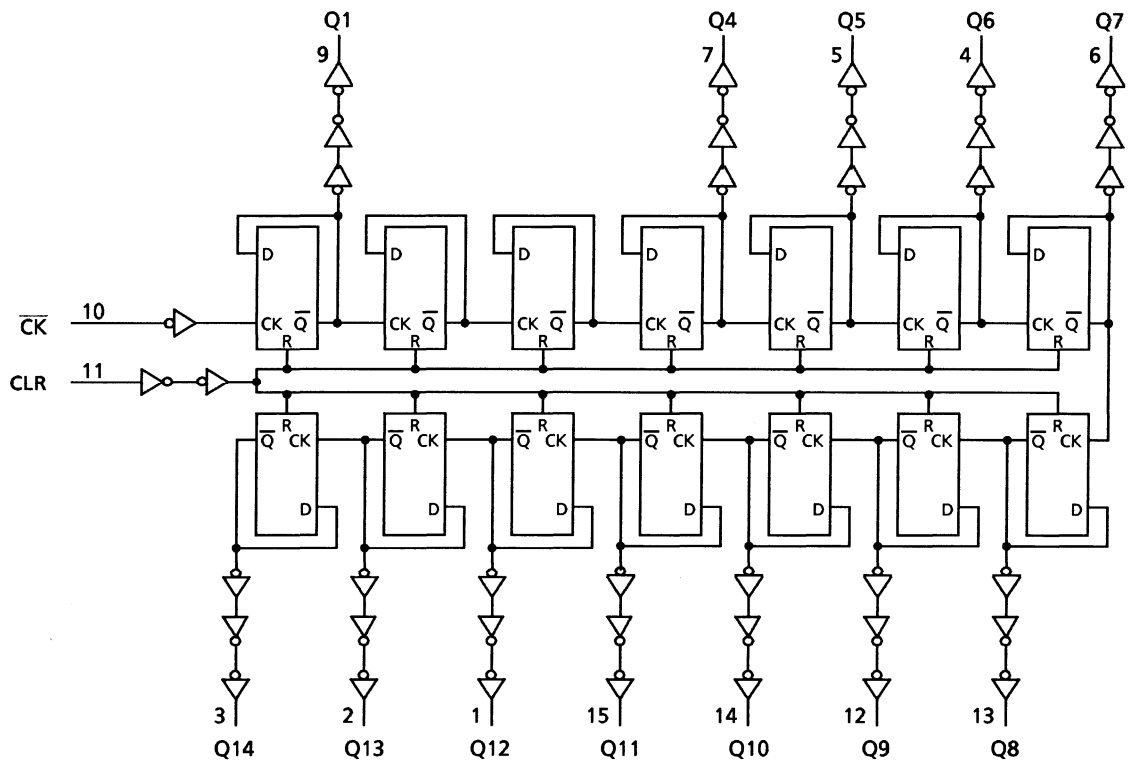
Truth Table

\overline{CK}	CLR	Output State
X	H	All Output = "L"
	L	No Change
	L	Advance to Next State

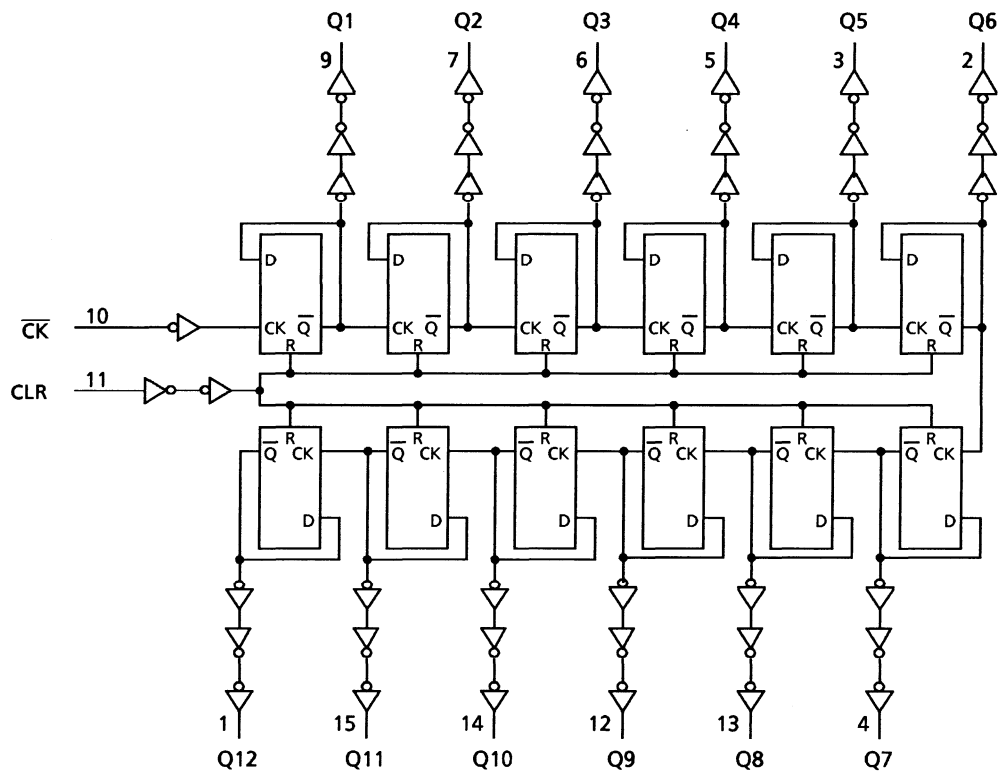
X: Don't care

System Diagram

TC74HC4020A



TC74HC4040A



Absolute Maximum Ratings (Note 1)

Characteristics	Symbol	Rating	Unit
Supply voltage range	V_{CC}	-0.5 to 7	V
DC input voltage	V_{IN}	-0.5 to $V_{CC} + 0.5$	V
DC 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
DC output current	I_{OUT}	± 25	mA
DC V_{CC} /ground current	I_{CC}	± 50	mA
Power dissipation	P_D	500 (DIP) (Note 2)/180 (SOP)	mW
Storage temperature	T_{stg}	-65 to 150	$^{\circ}\text{C}$

Note 1: 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 2: 500 mW in the range of $T_a = -40$ to 65°C . From $T_a = 65$ to 85°C a derating factor of -10 mW/ $^{\circ}\text{C}$ shall be applied until 300 mW.

Operating Ranges (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage	V_{CC}	2 to 6	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 85	$^{\circ}\text{C}$
Input rise and fall time	t_r, t_f	0 to 1000 ($V_{CC} = 2.0$ V) 0 to 500 ($V_{CC} = 4.5$ V) 0 to 400 ($V_{CC} = 6.0$ V)	ns

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.

Electrical Characteristics

DC Characteristics

Characteristics	Symbol	Test Condition		Ta = 25°C			Ta = -40 to 85°C		Unit	
				V _{CC} (V)	Min	Typ.	Max	Min		Max
High-level input voltage	V _{IH}	—		2.0	1.50	—	—	1.50	—	V
				4.5	3.15	—	—	3.15	—	
				6.0	4.20	—	—	4.20	—	
Low-level input voltage	V _{IL}	—		2.0	—	—	0.50	—	0.50	V
				4.5	—	—	1.35	—	1.35	
				6.0	—	—	1.80	—	1.80	
High-level output voltage	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = -20 μA	2.0	1.9	2.0	—	1.9	—	V
				4.5	4.4	4.5	—	4.4	—	
				6.0	5.9	6.0	—	5.9	—	
			I _{OH} = -4 mA	4.5	4.18	4.31	—	4.13	—	
				6.0	5.68	5.80	—	5.63	—	
				I _{OH} = -5.2 mA	4.5	4.18	4.31	—	4.13	
Low-level output voltage	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 20 μA	2.0	—	0.0	0.1	—	0.1	V
				4.5	—	0.0	0.1	—	0.1	
				6.0	—	0.0	0.1	—	0.1	
			I _{OL} = 4 mA	4.5	—	0.17	0.26	—	0.33	
				6.0	—	0.18	0.26	—	0.33	
				I _{OL} = 5.2 mA	4.5	—	0.17	0.26	—	
6.0	—	0.18	0.26	—	0.33					
Input leakage current	I _{IN}	V _{IN} = V _{CC} or GND		6.0	—	—	±0.1	—	±1.0	μA
Quiescent supply current	I _{CC}	V _{IN} = V _{CC} or GND		6.0	—	—	4.0	—	40.0	μA

Timing Requirements (input: t_r = t_f = 6 ns)

Characteristics	Symbol	Test Condition		Ta = 25°C		Ta = -40 to 85°C		Unit
				V _{CC} (V)	Typ.	Limit	Limit	
Minimum pulse width (\overline{CK})	t _W (L) t _W (H)	—		2.0	—	75	95	ns
				4.5	—	15	19	
				6.0	—	13	16	
Minimum pulse width (CLR)	t _W (H)	—		2.0	—	75	95	ns
				4.5	—	15	19	
				6.0	—	13	16	
Minimum removal time	t _{rem}	—		2.0	—	25	30	ns
				4.5	—	5	6	
				6.0	—	5	5	
Clock frequency	f	—		2.0	—	6	5	MHz
				4.5	—	30	24	
				6.0	—	35	28	

AC Characteristics ($C_L = 15 \text{ pF}$, $V_{CC} = 5 \text{ V}$, $T_a = 25^\circ\text{C}$, 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 ($\overline{\text{CK}} - Q1$)	t_{pLH} t_{pHL}	—	—	16	24	ns
Propagation delay time ($Q_n - Q_{n+1}$)	Δt_{pd}	—	—	5	14	ns
Propagation delay time (CLR)	t_{pHL}	—	—	14	24	ns
Maximum clock frequency	f_{max}	—	33	73	—	MHz

AC Characteristics ($C_L = 50 \text{ pF}$, input: $t_r = t_f = 6 \text{ ns}$)

Characteristics	Symbol	Test Condition	$T_a = 25^\circ\text{C}$			$T_a = -40 \text{ to } 85^\circ\text{C}$		Unit
			$V_{CC} \text{ (V)}$	Min	Typ.	Max	Min	
Output transition time	t_{TLH} t_{THL}	—	2.0	—	30	75	—	ns
			4.5	—	8	15	—	
			6.0	—	7	13	—	
Propagation delay time ($\overline{\text{CK}} - Q1$)	t_{pLH} t_{pHL}	—	2.0	—	70	145	—	ns
			4.5	—	20	29	—	
			6.0	—	17	25	—	
Propagation delay time ($Q_n - Q_{n+1}$)	Δt_{pd}	—	2.0	—	20	75	—	ns
			4.5	—	6	15	—	
			6.0	—	4	13	—	
Propagation delay time (CLR)	t_{pHL}	—	2.0	—	55	140	—	ns
			4.5	—	17	28	—	
			6.0	—	14	24	—	
Maximum clock frequency	f_{max}	—	2.0	6	17	—	5	MHz
			4.5	30	66	—	24	
			6.0	35	78	—	28	
Input capacitance	C_{IN}	—	—	5	10	—	10	pF
Power dissipation capacitance	CPD (Note)	TC74HC4020A	—	27	—	—	—	pF
		TC74HC4040A	—	37	—	—	—	

Note: C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

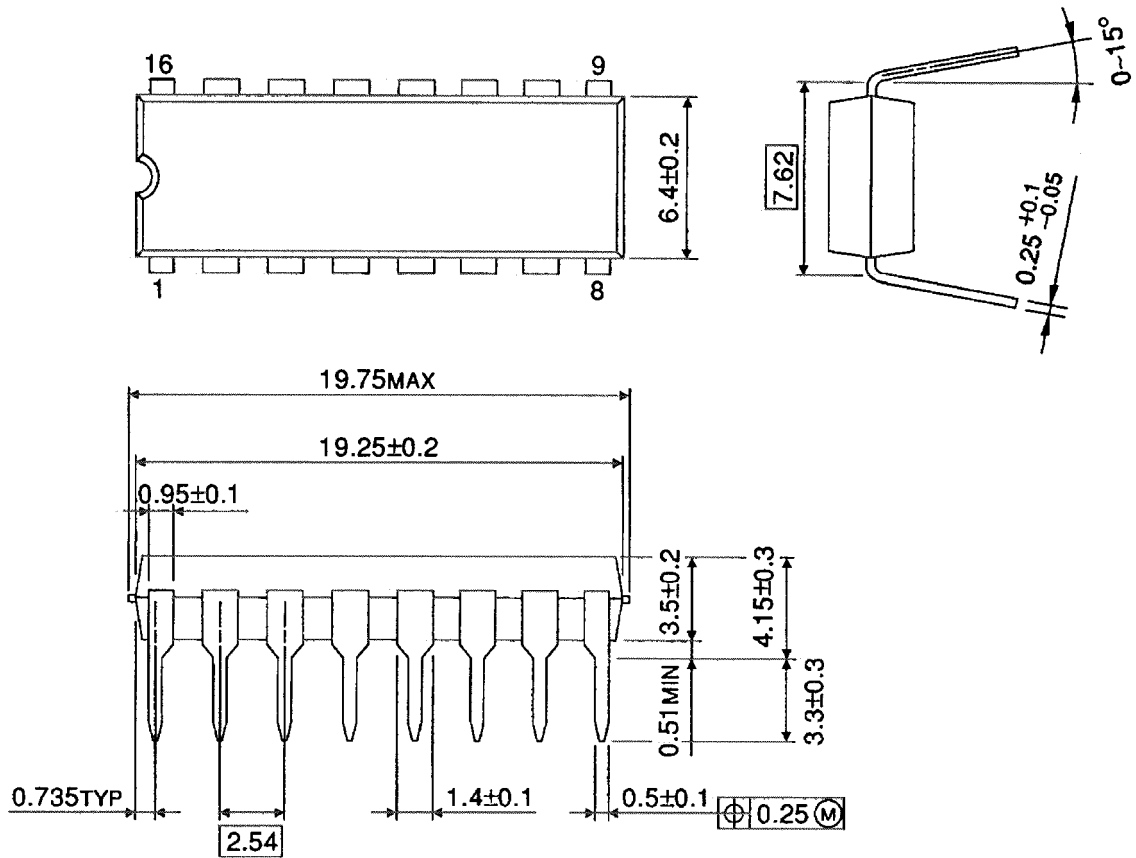
Average operating current can be obtained by the equation:

$$I_{CC}(\text{opr}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$

Package Dimensions

DIP16-P-300-2.54A

Unit : mm

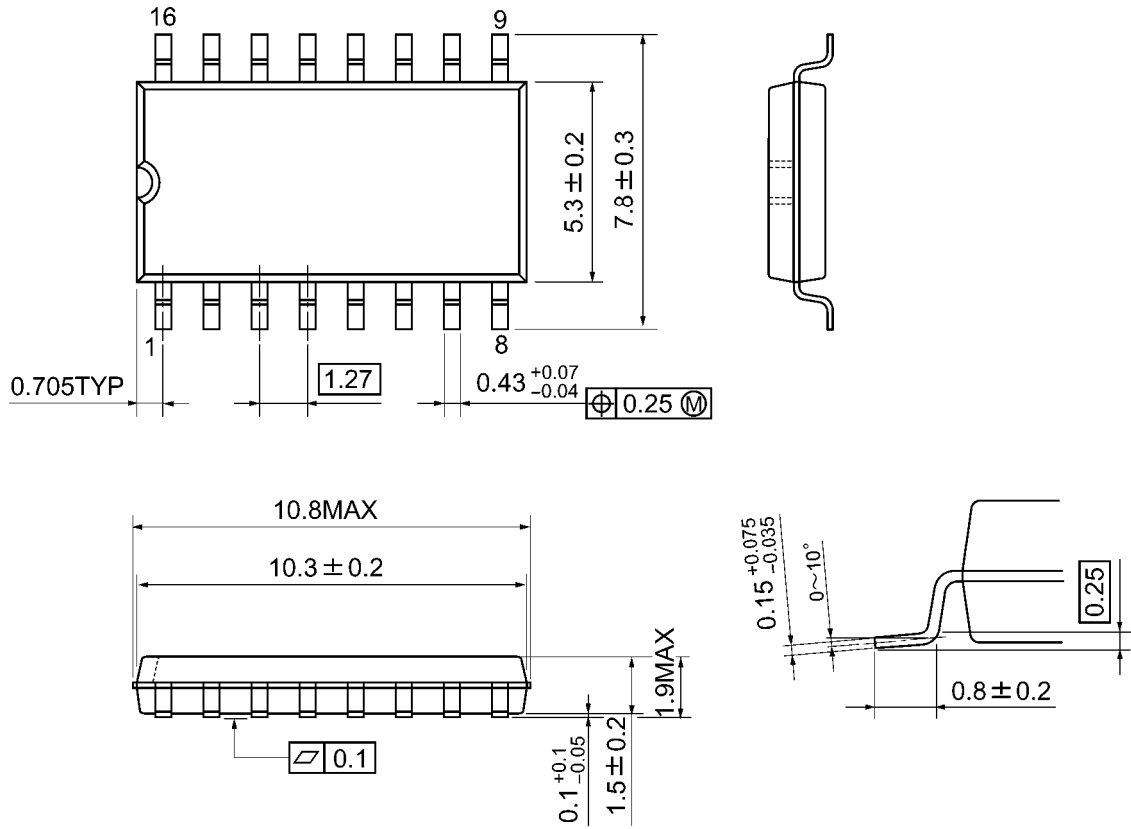


Weight: 1.00 g (typ.)

Package Dimensions

SOP16-P-300-1.27A

Unit: mm



Weight: 0.18 g (typ.)

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