14-stage Ripple-carry Binary Counter/Divider and Oscillator

Features:

- Wide supply voltage range from 3V to 15V
- Tolerant of slow clock rise and fall times
- Fully static operation
- 5V, 10V, and 15V parametric ratings
- Standardized symmetrical output characteristics
- Inputs and outputs are protected against electrostatic effects
- Specified from -40℃ to +125℃
- Packaging information: DIP-16 /SOP-16 / TSSOP-16 / QSOP-16 / QFN-16


DIP-16


SOP-16


TSSOP-16


QSOP-16


QFN-16

Ordering Information

DEVICE	Package Type	MARKING	Packing	Packing Qty
74HC4060N	DIP-16	74HC4060	TUBE	1000pcs/box
74HC4060M/TR	SOP-16	74HC4060	REEL	2500pcs/reel
74HC4060MT/TR	TSSOP-16	HC4060	REEL	2500pcs/reel
74HC4060MS/TR	QSOP-16	HC4060	REEL	2500pcs/reel
74HC4060LQ/TR	QFN-16 3*3	HC4060	REEL	5000pcs/reel

General Description

74HC4060 is a 14-stage ripple-carry binary counter/divider and oscillator with three oscillator terminals (RS,REXT and CEXT), ten buffered outputs (Q3 to Q9 and Q11 to Q13) and an overriding asynchronous master reset input (MR).

The oscillator configuration allows design of either RC or crystal oscillator circuits. The oscillator may be replaced by an external clock signal at input RS. The counter advances on the negative-going transition of RS. A HIGH level on MR resets the counter (Q3 to Q9 and Q11 to Q13=LOW), independent of other input conditions.

It operates over a recommended V_{DD} power supply range of 3V to 15V referenced to V_{SS} (usually ground). Unused inputs must be connected to V_{DD}, V_{SS}, or another input.

Block Diagram And Pin Description

Block Diagram

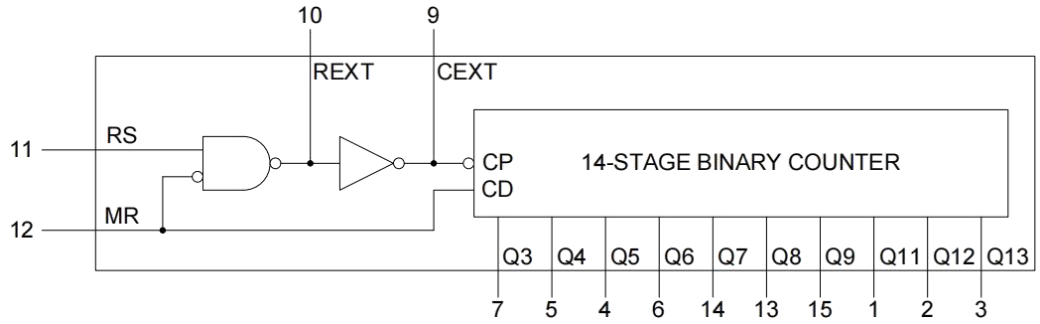


Figure 1. Functional diagram

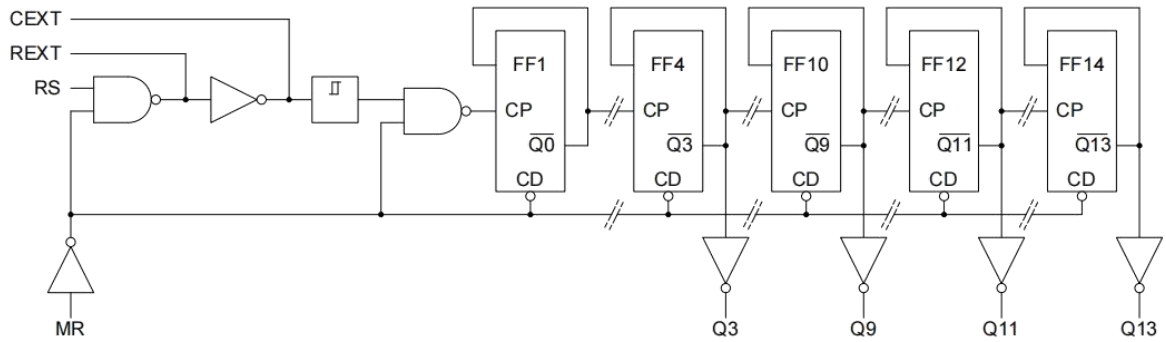


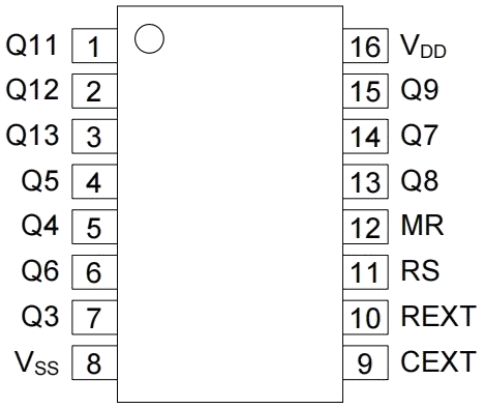
Figure 2. Logic diagram

Function Table

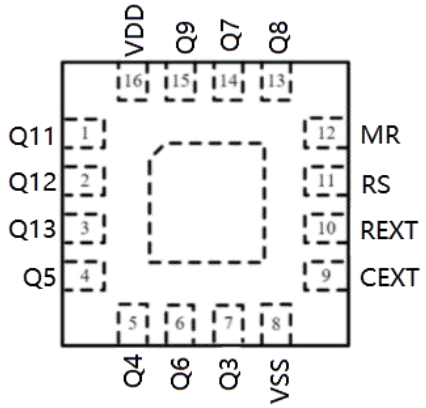
Input		Output
RS	MR	Q3 to Q9 and Q11 to Q13
↑	L	no change
↓	L	count
X	H	L

Note: H=HIGH voltage level; L=LOW voltage level; X=don't care; ↑=LOW-to-HIGH clock transition.

Pin Configurations



DIP-16/SOP-16/TSSOP-16/QSOP-16



QFN-16 3*3

Pin Description

Pin No.	Pin Name	Description
1	Q11	counter output
2	Q12	counter output
3	Q13	counter output
4	Q5	counter output
5	Q4	counter output
6	Q6	counter output
7	Q3	counter output
8	V_{SS}	ground (0V)
9	CEXT	external capacitor connection
10	REXT	oscillator pin
11	RS	clock input/oscillator pin
12	MR	master reset
13	Q8	counter output
14	Q7	counter output
15	Q9	counter output
16	V_{DD}	supply voltage

Electrical Parameter

Absolute Maximum Ratings

(Voltages are referenced to V_{SS} (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Max.	Unit
supply voltage	V_{DD}	-	-0.5	+18	V
DC input current	I_{IK}	any one input	-	±10	mA
input voltage	V_I	all inputs	-0.5	V_{DD}+0.5	V
storage temperature	T_{stg}	-	-65	+150	℃
total power dissipation	P_{tot}	-	-	500	mW
device dissipation	P	per output transistor	-	100	mW
soldering temperature	T_L	10s	260		℃

Note: Stress greater than those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions outside those indicated in the operational sections of this specification are not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

Recommended Operating Conditions

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
supply voltage	V_{DD}	-		3	-	15	V
ambient temperature	T_{amb}	in free air		-40	-	+125	℃
input pulse width	t_w	f=100kHz	V_{DD}=5V	100	-	-	ns
			V_{DD}=10V	40	-	-	ns
			V_{DD}=15V	30	-	-	ns
input pulse rise and fall time	t_{rIN}, t_{fIN}	V_{DD}=5V		unlimited			-
		V_{DD}=10V					-
		V_{DD}=15V					-
input pulse frequency	f_{RS}	external pulse source	V_{DD}=5V	-	-	3.5	MHz
			V_{DD}=10V	-	-	8	MHz
			V_{DD}=15V	-	-	12	MHz
reset pulse width	t_{wR}	V_{DD}=5V		120	-	-	ns
		V_{DD}=10V		60	-	-	ns
		V_{DD}=15V		40	-	-	ns

Electrical Characteristics

DC Characteristics 1

(T_{amb}=25℃, voltages are referenced to V_{SS} (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions (V)			Tamb=25℃			Unit
		V_O	V_{IN}	V_{DD}	Min.	Typ.	Max.	
supply current	I_{DD}	-	0, 5	5	-	-	5	uA
		-	0, 10	10	-	-	10	uA
		-	0, 15	15	-	-	20	uA
LOW-level output current	I_{OL}	0.4	0, 5	5	0.51	1	-	mA
		0.5	0, 10	10	1.3	2.6	-	mA
		1.5	0, 15	15	3.4	6.8	-	mA
HIGH-level output current	I_{OH}	4.6	0, 5	5	-0.51	-1	-	mA
		2.5	0, 5	5	-1.6	-3.2	-	mA
		9.5	0, 10	10	-1.3	-2.6	-	mA
		13.5	0, 15	15	-3.4	-6.8	-	mA
LOW-level output voltage	V_{OL}	-	0, 5	5	-	0	0.05	V
		-	0, 10	10	-	0	0.05	V
		-	0, 15	15	-	0	0.05	V
HIGH-level output voltage	V_{OH}	-	0, 5	5	4.95	5	-	V
		-	0, 10	10	9.95	10	-	V
		-	0, 15	15	14.95	15	-	V
LOW-level input voltage	V_{IL}	0.5, 4.5	-	5	-	-	1.5	V
		1, 9	-	10	-	-	3	V
		1.5, 13.5	-	15	-	-	4	V
HIGH-level input voltage	V_{IH}	0.5, 4.5	-	5	3.5	-	-	V
		1, 9	-	10	7	-	-	V
		1.5, 13.5	-	15	11	-	-	V
input leakage current	I_I	-	0, 15	15	-	-	±1	uA

DC Characteristics 2

(T_{amb}=-40℃ to +85℃, voltages are referenced to V_{SS} (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions (V)			T_{amb}=-40℃		T_{amb}=+85℃		Unit
		V_O	V_{IN}	V_{DD}	Min.	Max.	Min.	Max.	
supply current	I_{DD}	-	0, 5	5	-	5	-	150	uA
		-	0, 10	10	-	10	-	300	uA
		-	0, 15	15	-	20	-	600	uA
LOW-level output current	I_{OL}	0.4	0, 5	5	0.61	-	0.42	-	mA
		0.5	0, 10	10	1.5	-	1.1	-	mA
		1.5	0, 15	15	4	-	2.8	-	mA
HIGH-level output current	I_{OH}	4.6	0, 5	5	-0.61	-	-0.42	-	mA
		2.5	0, 5	5	-1.8	-	-1.3	-	mA
		9.5	0, 10	10	-1.5	-	-1.1	-	mA
		13.5	0, 15	15	-4	-	-2.8	-	mA
LOW-level output voltage	V_{OL}	-	0, 5	5	-	0.05	-	0.05	V
		-	0, 10	10	-	0.05	-	0.05	V
		-	0, 15	15	-	0.05	-	0.05	V
HIGH-level output voltage	V_{OH}	-	0, 5	5	4.95	-	4.95	-	V
		-	0, 10	10	9.95	-	9.95	-	V
		-	0, 15	15	14.95	-	14.95	-	V
LOW-level input voltage	V_{IL}	0.5, 4.5	-	5	-	1.5	-	1.5	V
		1, 9	-	10	-	3	-	3	V
		1.5, 13.5	-	15	-	4	-	4	V
HIGH-level input voltage	V_{IH}	0.5, 4.5	-	5	3.5	-	3.5	-	V
		1, 9	-	10	7	-	7	-	V
		1.5, 13.5	-	15	11	-	11	-	V
input leakage current	I_I	-	0, 15	15	-	±1	-	±1	uA

DC Characteristics 3

(T_{amb}=-40℃ to +125℃, voltages are referenced to V_{SS} (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions (V)			T_{amb}=-40℃		T_{amb}=+125℃		Unit
		V_O	V_{IN}	V_{DD}	Min.	Max.	Min.	Max.	
supply current	I_{DD}	-	0, 5	5	-	5	-	150	uA
		-	0, 10	10	-	10	-	300	uA
		-	0, 15	15	-	20	-	600	uA
LOW-level output current	I_{OL}	0.4	0, 5	5	0.61	-	0.36	-	mA
		0.5	0, 10	10	1.5	-	0.9	-	mA
		1.5	0, 15	15	4	-	2.4	-	mA
HIGH-level output current	I_{OH}	4.6	0, 5	5	-0.61	-	-0.36	-	mA
		2.5	0, 5	5	-1.8	-	-1.15	-	mA
		9.5	0, 10	10	-1.5	-	-0.9	-	mA
		13.5	0, 15	15	-4	-	-2.4	-	mA
LOW-level output voltage	V_{OL}	-	0, 5	5	-	0.05	-	0.05	V
		-	0, 10	10	-	0.05	-	0.05	V
		-	0, 15	15	-	0.05	-	0.05	V
HIGH-level output voltage	V_{OH}	-	0, 5	5	4.95	-	4.95	-	V
		-	0, 10	10	9.95	-	9.95	-	V
		-	0, 15	15	14.95	-	14.95	-	V
LOW-level input voltage	V_{IL}	0.5, 4.5	-	5	-	1.5	-	1.5	V
		1, 9	-	10	-	3	-	3	V
		1.5, 13.5	-	15	-	4	-	4	V
HIGH-level input voltage	V_{IH}	0.5, 4.5	-	5	3.5	-	3.5	-	V
		1, 9	-	10	7	-	7	-	V
		1.5, 13.5	-	15	11	-	11	-	V
input leakage current	I_I	-	0, 15	15	-	±1	-	±1	uA

AC Characteristics 1

(T_{amb}=25℃, V_{SS}=0V, t_r , t_f=20ns, C_L=50pF, R_L=200kΩ, unless otherwise specified.)

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
propagation delay time	t_{PHL}, t_{PLH}	RS to Q3 out; see Figure 4	V_{DD}=5V	-	370	740	ns
			V_{DD}=10V	-	150	300	ns
			V_{DD}=15V	-	100	200	ns
		Q_n to Q_{n+1}; see Figure 4	V_{DD}=5V	-	100	200	ns
			V_{DD}=10V	-	50	100	ns
			V_{DD}=15V	-	40	80	ns
		MR to Qn; see Figure 4	V_{DD}=5V	-	180	360	ns
			V_{DD}=10V	-	80	160	ns
			V_{DD}=15V	-	50	100	ns
transition time	t_t	see Figure 4	V_{DD}=5V	-	100	200	ns
			V_{DD}=10V	-	50	100	ns
			V_{DD}=15V	-	40	80	ns
pulse width	t_W	minimum width; f=100kHz; RS HIGH;	V_{DD}=5V	-	50	100	ns
			V_{DD}=10V	-	20	40	ns
			V_{DD}=15V	-	15	30	ns
		minimum width; MR HIGH; see Figure 4	V_{DD}=5V	-	60	120	ns
			V_{DD}=10V	-	30	60	ns
			V_{DD}=15V	-	20	40	ns
input pulse rise and fall time	t_{rIN}, t_{fIN}	-	V_{DD}=5V	unlimited			-
			V_{DD}=10V				-
			V_{DD}=15V				-
maximum clock frequency	f_{max}	input RS; see Figure 4	V_{DD}=5V	3.5	7	-	MHz
			V_{DD}=10V	8	16	-	MHz
			V_{DD}=15V	12	24	-	MHz
input capacitance	C_I	any input		-	5	7.5	pF

Note: t_t is the same as t_{TLH} and t_{THL}.

AC Characteristics 2

(RC Operation, T_{amb}=25℃, V_{SS}=0V, t_r , t_f=20ns, C_L=50pF, R_L=200kΩ, unless otherwise specified.)

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
variation of frequency (unit to unit)	-	C_X=200pF R_S=560kΩ R_X=50kΩ	V_{DD}=5V	-	23±10%	-	kHz
			V_{DD}=10V	-	24±10%	-	kHz
			V_{DD}=15V	-	25±10%	-	kHz
variation of frequency with voltage change (same unit)	-	C_X=200pF R_S=560kΩ R_X=50kΩ	5V to 10V	-	1.5	-	kHz
			10V to 15V	-	0.5	-	kHz
R_X max	-	C_X=10uF, V_{DD}=5V		-	-	20	MΩ
		C_X=50uF, V_{DD}=10V		-	-	20	MΩ
		C_X=10uF, V_{DD}=15V		-	-	10	MΩ
C_X max	-	R_X=500kΩ, V_{DD}=5V		-	-	1000	uF
		R_X=300kΩ, V_{DD}=10V		-	-	50	uF
		R_X=300kΩ, V_{DD}=15V		-	-	50	uF
Maximum oscillator frequency	-	C_X=15pF R_S=30kΩ R_X=15kΩ	V_{DD}=10V	530	650	810	kHz
			V_{DD}=15V	690	800	940	kHz
drive current at CEXT (for oscillator design)	I_{OL}	V_O=0.4V, V_{DD}=5V		0.16	0.35	-	mA
		V_O=0.5V, V_{DD}=10V		0.42	0.8	-	mA
		V_O=1.5V, V_{DD}=15V		1	2	-	mA
	I_{OH}	V_O=4.6V, V_{DD}=5V		-0.16	-0.35	-	mA
		V_O=9.5V, V_{DD}=10V		-0.42	-0.8	-	mA
		V_O=13.5V, V_{DD}=15V		-1	-2	-	mA

Note: RC oscillator applications are not recommended at supply voltages below 7V for R_X<50kΩ.

Testing Circuit

AC Testing Circuit

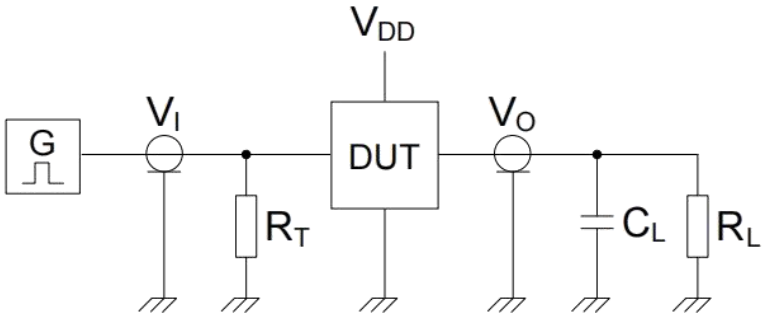


Figure 3. Test circuit for switching times

Definitions for test circuit:

DUT=Device Under Test.

C_L=Load capacitance including jig and probe capacitance.

R_T=Termination resistance should be equal to the output impedance Z_o of the pulse generator.

R_L= Load resistance.

AC Testing Waveforms

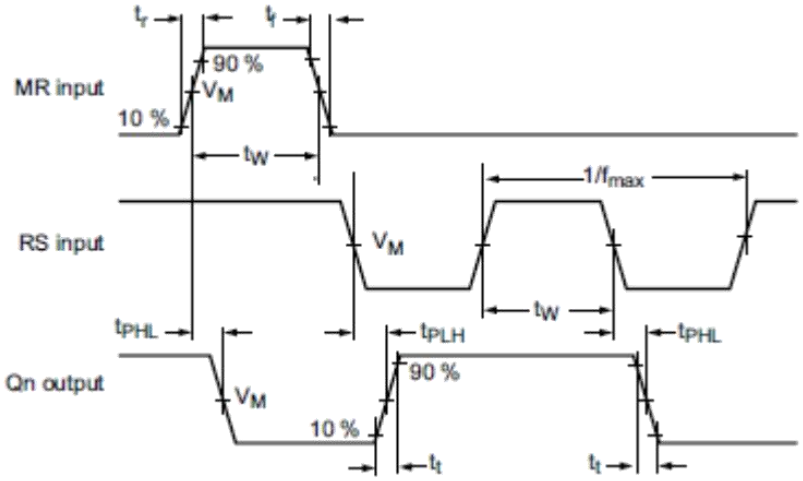


Figure 4. Waveforms showing propagation delays

Measurement Points

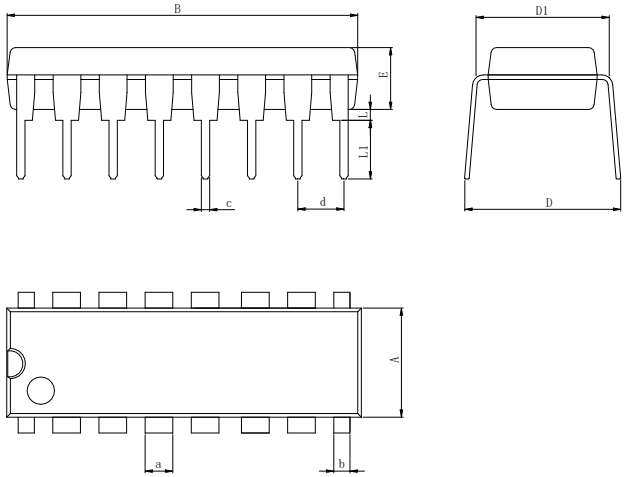
Supply voltage	Input	Output
V_{DD}	V_M	V_M
5V to 15V	0.5×V_{DD}	0.5×V_{DD}

Test Data

Supply voltage	Input		Load
V_{DD}	V_I	t_r , t_f	C_L
5V to 15V	V_{SS} or V_{DD}	≤ 20ns	50pF

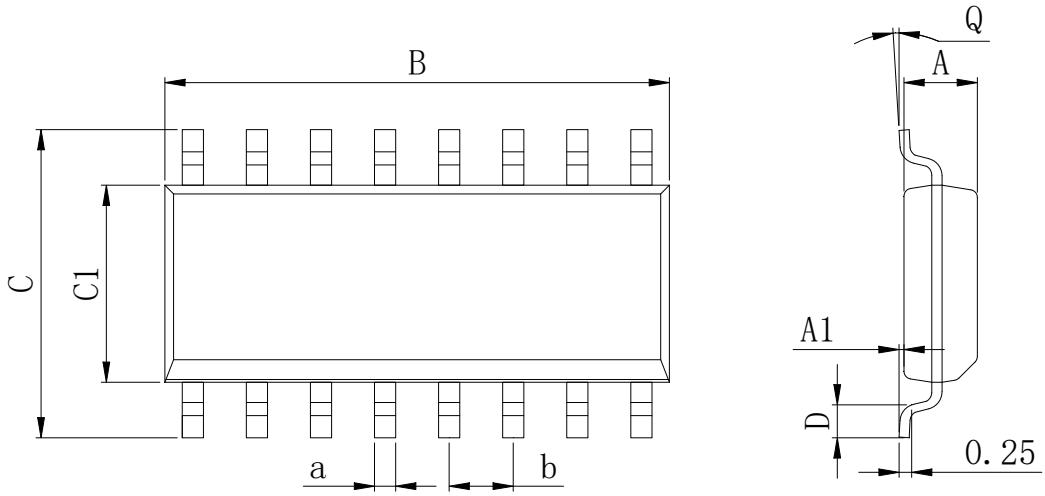
Physical Dimensions

DIP-16



Dimensions In Millimeters(DIP-16)											
Symbol:	**A**	**B**	**D**	**D1**	**E**	**L**	**L1**	**a**	**b**	**c**	**d**
Min:	6.10	18.94	8.10	7.42	3.10	0.50	3.00	1.50	0.85	0.40	2.54 BSC
Max:	6.68	19.56	10.9	7.82	3.55	0.70	3.60	1.55	0.90	0.50	

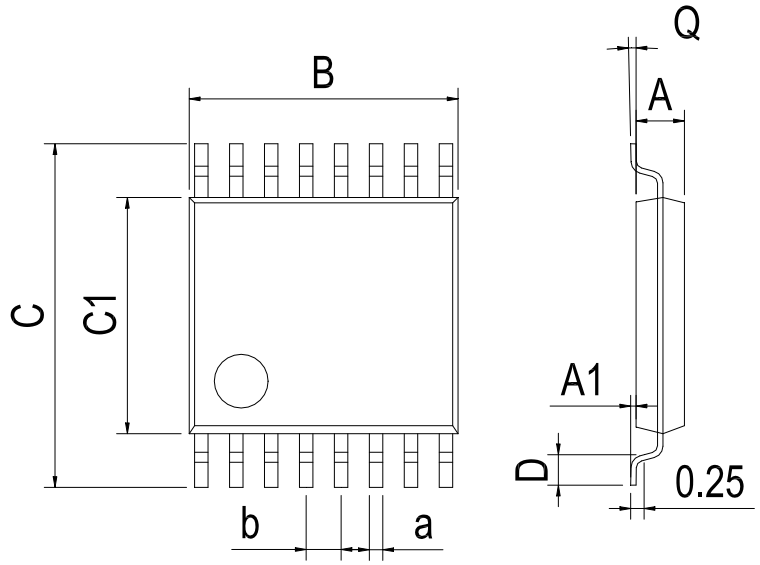
SOP-16



Dimensions In Millimeters(SOP-16)									
Symbol:	**A**	**A1**	**B**	**C**	**C1**	**D**	**Q**	**a**	**b**
Min:	1.35	0.05	9.80	5.80	3.80	0.40	0°	0.35	1.27 BSC
Max:	1.55	0.20	10.0	6.20	4.00	0.80	8°	0.45	

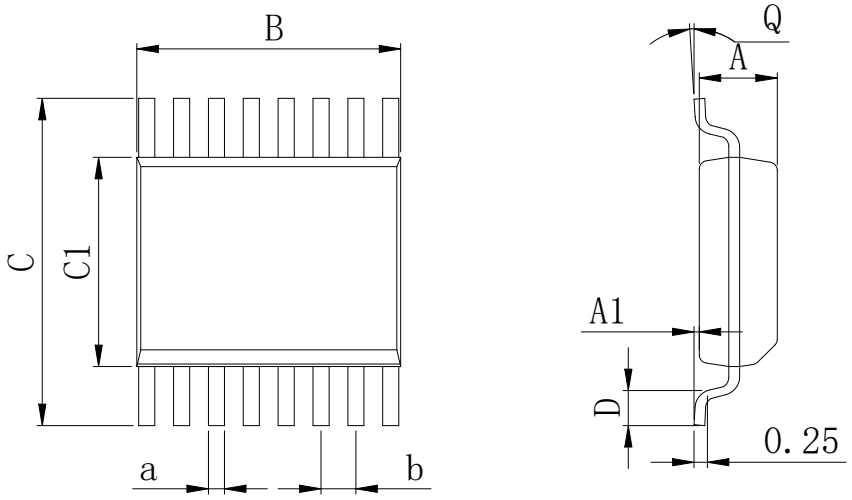
Physical Dimensions

TSSOP-16



Dimensions In Millimeters(TSSOP-16)									
Symbol:	**A**	**A1**	**B**	**C**	**C1**	**D**	**Q**	**a**	**b**
Min:	0.85	0.05	4.90	6.20	4.30	0.40	0°	0.20	0.65 BSC
Max:	0.95	0.20	5.10	6.60	4.50	0.80	8°	0.25	

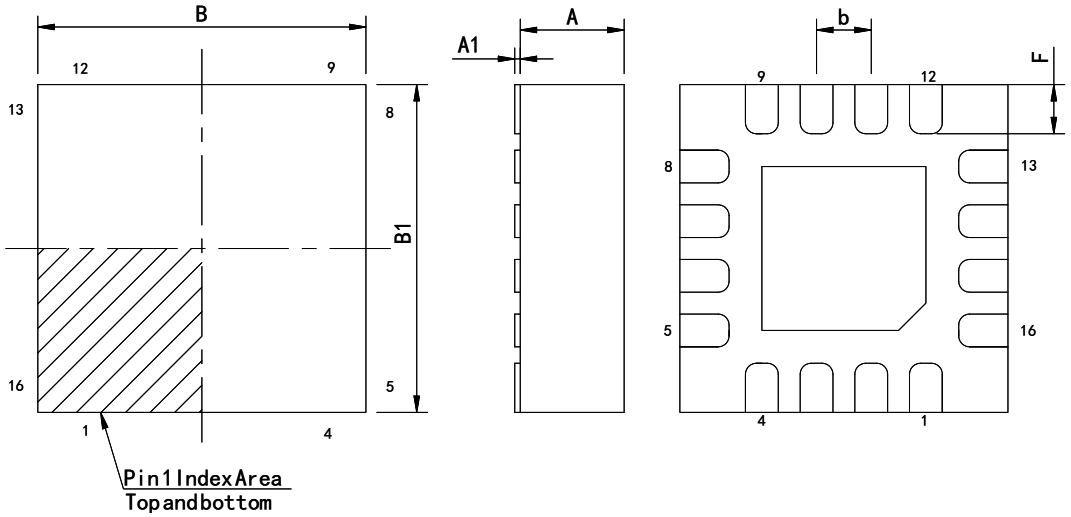
QSOP-16



Dimensions In Millimeters(QSOP-16)									
Symbol:	**A**	**A1**	**B**	**C**	**C1**	**D**	**Q**	**a**	**b**
Min:	1.35	0.05	4.80	5.80	3.80	0.40	0°	0.20	0.635 BSC
Max:	1.55	0.20	5.10	6.20	4.00	0.80	8°	0.25	

Physical Dimensions

QFN-16 3*3



Dimensions In Millimeters(QFN-16 3*3)								
Symbol:	**A**	**A1**	**B**	**B1**	**E**	**F**	**a**	**b**
Min:	0.85	0	2.90	2.90	0.15	0.25	0.18	0.50TYP
Max:	0.95	0.05	3.10	3.10	0.25	0.45	0.30	

Revision History

REVISION NUMBER	DATE	REVISION	PAGE
V1.0	2019-11	New	1-15
V1.0	2025-4	Document Reformatting	1-15

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