

14-stage ripple carry binary counter/divider and oscillator

Datasheet — production data

Features

- Medium speed operation
- Common reset
- Fully static operation
- Buffered inputs and outputs
- Quiescent current specified up to 20 V
- 5 V, 10 V and 15 V parametric ratings
- Input leakage current
 - $I_I = 100 \text{ nA}$ (max.) at $V_{DD} = 18 \text{ V}$, $T_A = 25 \text{ }^\circ\text{C}$
- 100% tested for quiescent current
- Meets all requirements of JEDEC JESD13B “Standard specifications for description of B series CMOS devices”
- ESD performance
 - HBM: 2000 V
 - MM: 200 V
 - CDM: 1000 V

Applications

- Automotive
- Industrial
- Computer
- Consumer

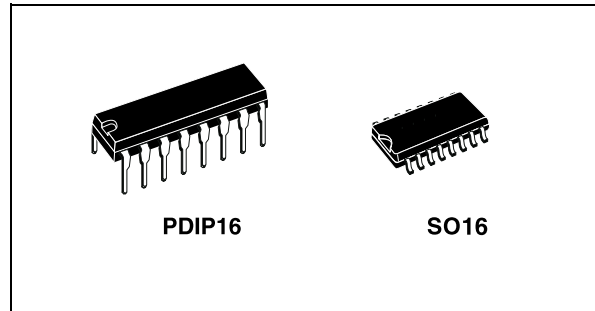


Figure 1. Pin connection

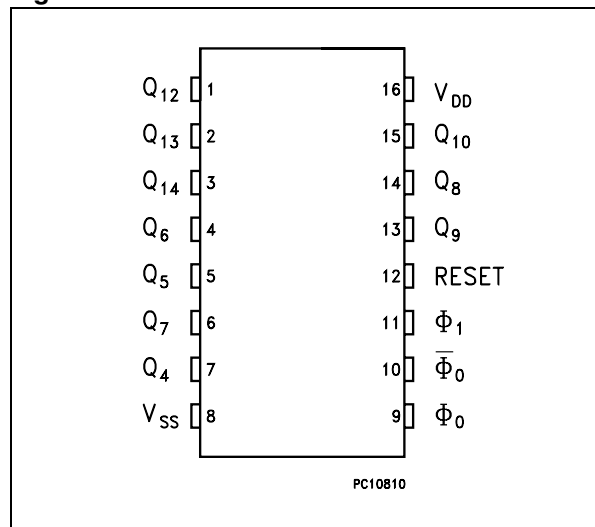


Table 1. Device summary

Order code	Temperature range	Package	Packaging	Marking
HCF4060M013TR	-55/+125 °C	SO16	Tape and reel	HCF4060
HCF4060YM013TR ⁽¹⁾	-40/+125 °C	SO16 (automotive version)	Tape and reel	HCF4060Y
HCF4060BEY	-55/+125 °C	PDIP16	Tube	HCF4066BE

1. Qualification and characterization according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 and Q002 or equivalent.

1 Description

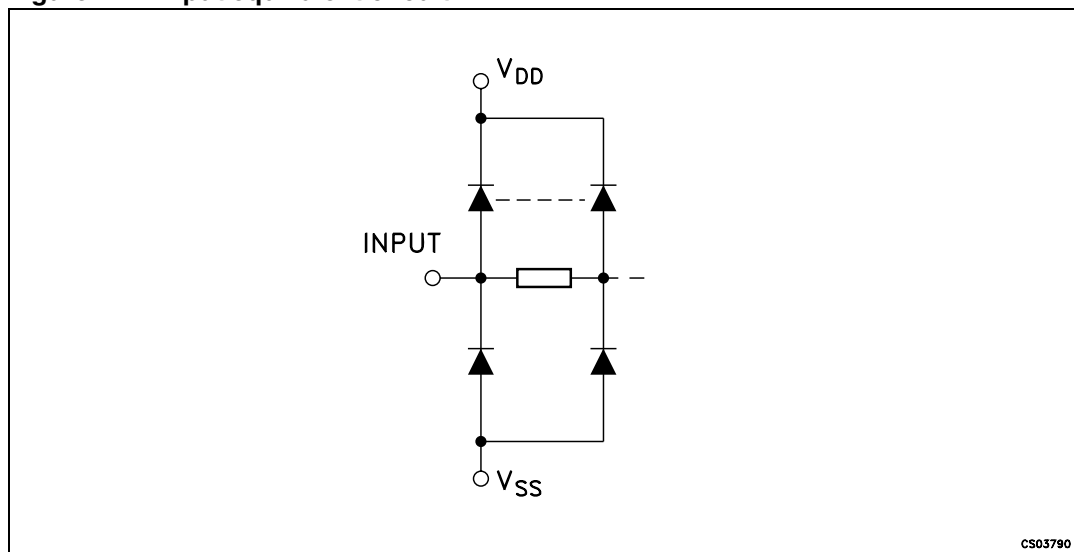
The HCF4060 device is a monolithic integrated circuit fabricated in MOS (metal oxide semiconductor) technology available in SO16 and PDIP16 packages.

The HCF4060 device consists of an oscillator section and 14 ripple carry binary counter stages.

The oscillator configuration allows design of either RC or crystal oscillator circuits. A RESET input is provided which reset the counter to the all 0's state and disable oscillator. A high level on the RESET line accomplishes the reset function. All counter stages are master slave flip-flops. The state of the counter is advanced one step in binary order on the negative transition of ϕ_1 (and ϕ_0). All inputs and outputs are fully buffered. Schmitt trigger action on the clock pin permits unlimited clock rise and fall time.

2 Input equivalent circuit

Figure 2. Input equivalent circuit



3 Pin settings

Table 2. Pin description

Pin no.	Symbol	Name and function
1, 2, 3, 4, 5, 6, 7, 13, 14, 15	$Q_{12}, Q_{13}, Q_{14}, Q_6, Q_5, Q_7, Q_4, Q_9, Q_8, Q_{10}$	Outputs
9, 10, 11	$\Phi_0, \bar{\Phi}_0, \Phi_1$	Oscillator input
12	RESET	Reset
8	V_{SS}	Negative supply voltage
16	V_{DD}	Positive supply voltage

Figure 3. Functional diagram

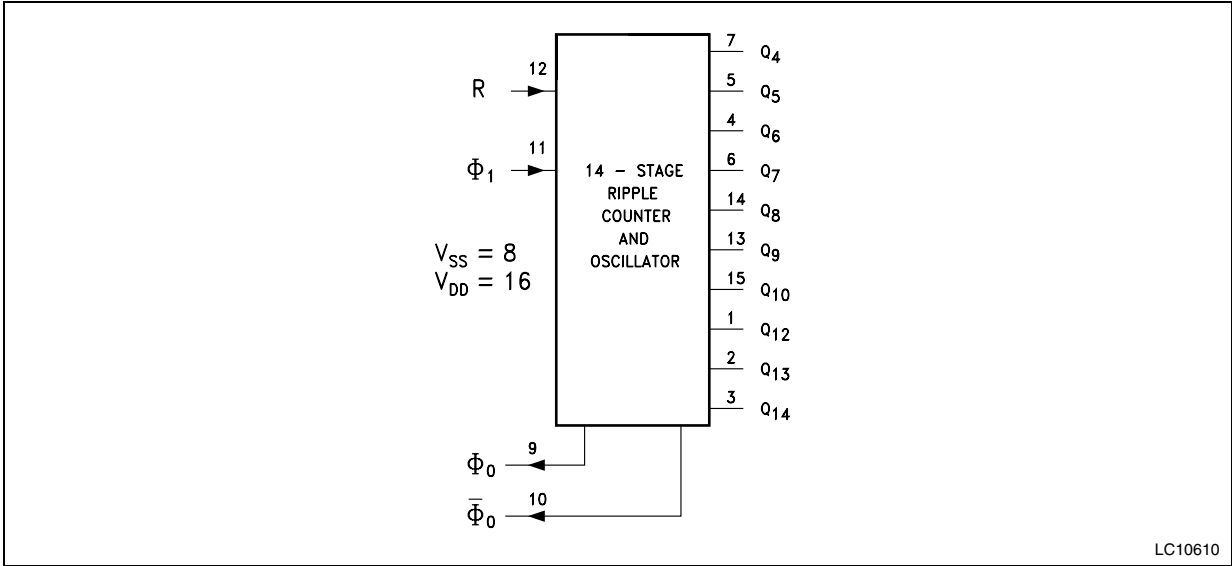
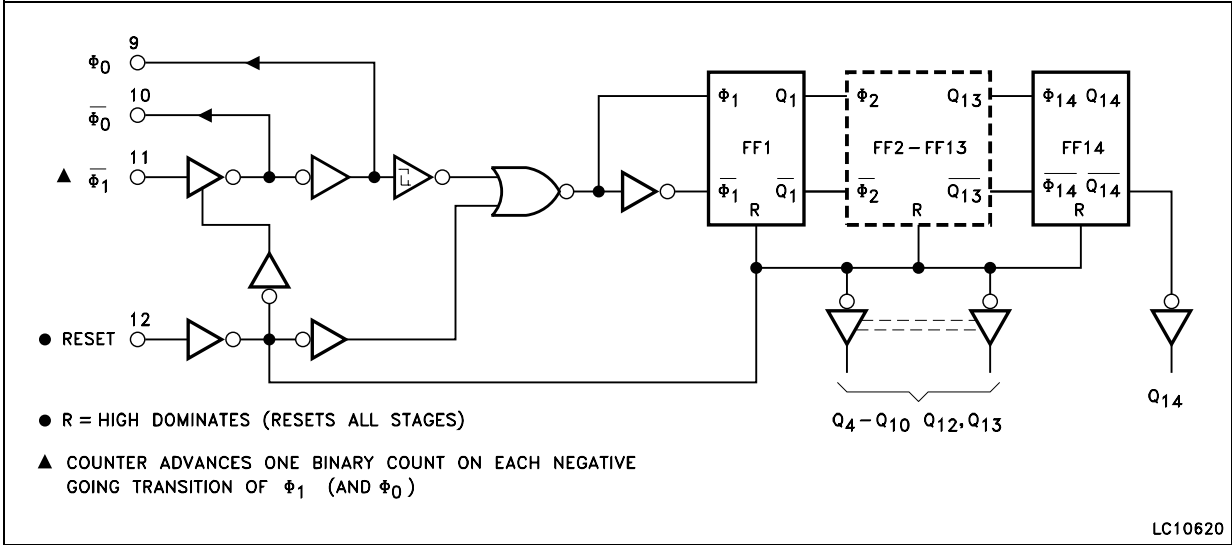


Figure 4. Logic diagram



4 Maximum ratings

Table 3. Absolute maximum ratings^{(1), (2)}

Symbol	Parameter	Value	Unit
V_{DD}	Supply voltage	-0.5 to +22	V
V_I	DC input voltage	-0.5 to $V_{DD} + 0.5$	V
I_I	DC input current	± 10	mA
P_D	Power dissipation per package	200	mW
	Power dissipation per output transistor	100	mW
T_{op}	Operating temperature	-55 to +125	°C
T_{stg}	Storage temperature	-65 to +150	°C

1. Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.
2. All voltage values are referred to V_{SS} pin voltage.

Table 4. Recommended operating conditions

Symbol	Parameter	Value	Unit
V_{DD}	Supply voltage	3 to 20	V
V_I	Input voltage	0 to V_{DD}	V
T_{op}	Operating temperature	-55 to 125	°C

5 Electrical characteristics

Table 5. DC specifications⁽¹⁾

Symbol	Parameter	Test condition				Value							Unit
		V _I (V)	V _O (V)	I _{Ol} (μA)	V _{DD} (V)	T _A = 25 °C			-40 to 85 °C		-55 to 125 °C		
						Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
I _L	Quiescent current	0/5			5		0.04	5		5		150	μA
		0/10			10		0.04	10		10		300	
		0/15			15		0.04	20		20		600	
		0/20			20		0.08	100		100		3000	
V _{OH}	High level output voltage	0/5		<1	5	4.95			4.95		4.95		V
		0/10		<1	10	9.95			9.95		9.95		
		0/15		<1	15	14.9 5			14.9 5		14.9 5		
V _{OL}	Low level output voltage	5/0		<1	5		0.05			0.05		0.05	V
		10/0		<1	10		0.05			0.05		0.05	
		15/0		<1	15		0.05			0.05		0.05	
V _{IH}	High level input voltage		0.5/4.5	<1	5	3.5			3.5		3.5		V
			1/9	<1	10	7			7		7		
			1.5/13.5	<1	15	11			11		11		
V _{IL}	Low level input voltage		4.5/0.5	<1	5			1.5		1.5		1.5	V
			9/1	<1	10			3		3		3	
			13.5/1.5	<1	15			4		4		4	
I _{OH}	Output drive current	0/5	2.5	<1	5	-1.36	-3.2		-1.15		-1.1		mA
		0/5	4.6	<1	5	-0.44	-1		-0.36		-0.36		
		0/10	9.5	<1	10	-1.1	-2.6		-0.9		-0.9		
		0/15	13.5	<1	15	-3.0	-6.8		-2.4		-2.4		
I _{OL}	Output sink current	0/5	0.4	<1	5	0.44	1		0.36		0.36		mA
		0/10	0.5	<1	10	1.1	2.6		0.9		0.9		
		0/15	1.5	<1	15	3.0	6.8		2.4		2.4		
I _I	Input leakage current	0/18	Any input		18		±10 ⁻⁵	±0.3		±0.3		±1	μA
C _I	Input capacitance		Any input				5	7.5					pF

1. The noise margin for both "1" and "0" level is: 1 V min. with V_{DD} = 5 V, 2 V min. with V_{DD} = 10 V, 2.5 V min. with V_{DD} = 15 V.

Table 6. Dynamic electrical characteristics
($T_{amb} = 25\text{ }^{\circ}\text{C}$, $C_L = 50\text{ pF}$, $R_L = 200\text{ K}\Omega$, $t_r = t_f = 20\text{ ns}$)

Symbol	Parameter	Test condition		Value ⁽¹⁾			Unit
		V _{DD} (V)		Min.	Typ.	Max.	
t _{TLH} , t _{THL}	Output transition time	5			100	200	ns
		10			50	100	
		15			40	80	
t _{PLH} , t _{PHL}	Propagation delay time (ϕ to Q ₄ out)	5			370	740	ns
		10			150	300	
		15			100	200	
t _{PLH} , t _{PHL}	Propagation delay time (Q _n to Q _{n+1})	5			100	200	ns
		10			50	100	
		15			40	80	
t _W	Input pulse width	5	f = 100 KHz		50	100	ns
		10			20	40	
		15			15	30	
t _r , t _f	Input pulse rise and fall time	5		Unlimited			μs
		10					
		15					
f _{max}	Maximum clock input frequency	5		3.5	7		MHz
		10		8	16		
		15		12	24		
Reset operation							
t _{PHL}	Propagation delay time	5			180	360	ns
		10			80	160	
		15			50	100	
t _W	Input pulse width	5			60	120	ns
		10			30	60	
		15			20	40	
RC operation							
	Variation of frequency (unit-to-unit)	5	C _x = 200 pF, R _s = 560 KΩ, R _x = 50 KΩ	18	21.5	25	KHz
		10		20	23	26	
		15		21.1	24	27	
	Variation of frequency with voltage change (the same unit)	5 to 10	C _x = 200 pF, R _s = 560 KΩ, R _x = 50 KΩ			2	KHz
		10 to 15				1	

Table 6. Dynamic electrical characteristics
($T_{amb} = 25\text{ }^{\circ}\text{C}$, $C_L = 50\text{ pF}$, $R_L = 200\text{ K}\Omega$, $t_r = t_f = 20\text{ ns}$) (continued)

Symbol	Parameter	Test condition		Value ⁽¹⁾			Unit
		V_{DD} (V)		Min.	Typ.	Max.	
R_X		5	$C_X = 10\text{ }\mu\text{F}$			20	$\text{M}\Omega$
		10	$C_X = 50\text{ }\mu\text{F}$			20	
		15	$C_X = 10\text{ }\mu\text{F}$			10	
C_X		5	$R_X = 500\text{ K}\Omega$			1000	μF
		10	$R_X = 300\text{ K}\Omega$			50	
		15	$R_X = 300\text{ K}\Omega$			50	
	Maximum oscillator frequency ⁽²⁾	10	$R_X = 5\text{ K}\Omega$, $C_X = 15\text{ pF}$	530	650	810	pF
		15		690	800	940	

1. Typical temperature coefficient for all V_{DD} values is $0.3\text{ }^{\circ}\text{C}/^{\circ}\text{C}$, all input rise and fall times = 20 ns.

2. RC oscillator applications are not recommended at supply voltages below 7 V for $R_X = 50\text{ K}\Omega$.

6 Test circuits

Figure 5. Detail of typical flip-flop stage

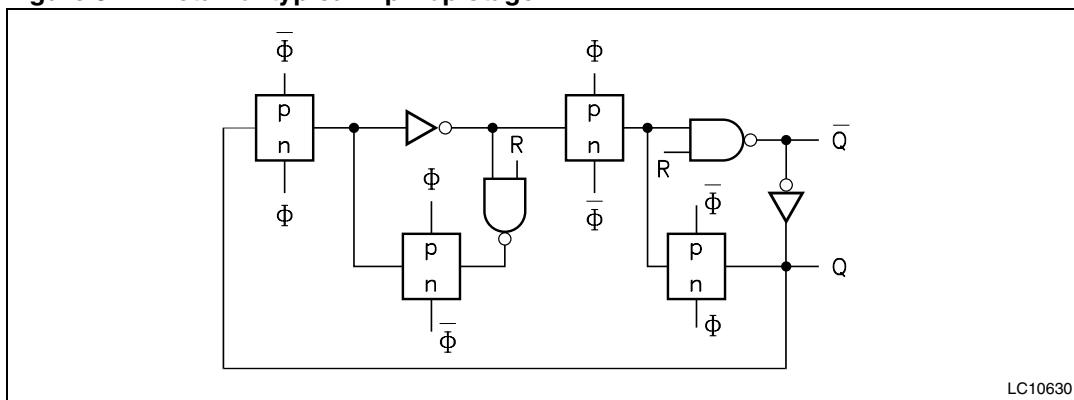


Figure 6. Typical RC oscillator circuit

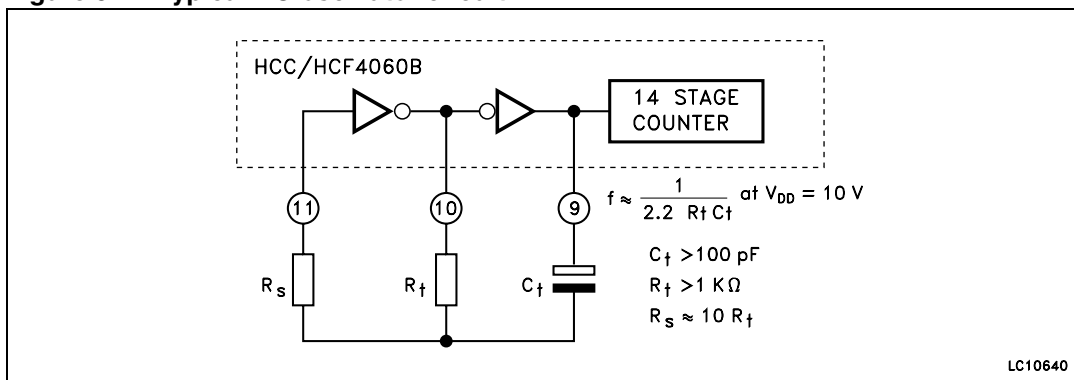
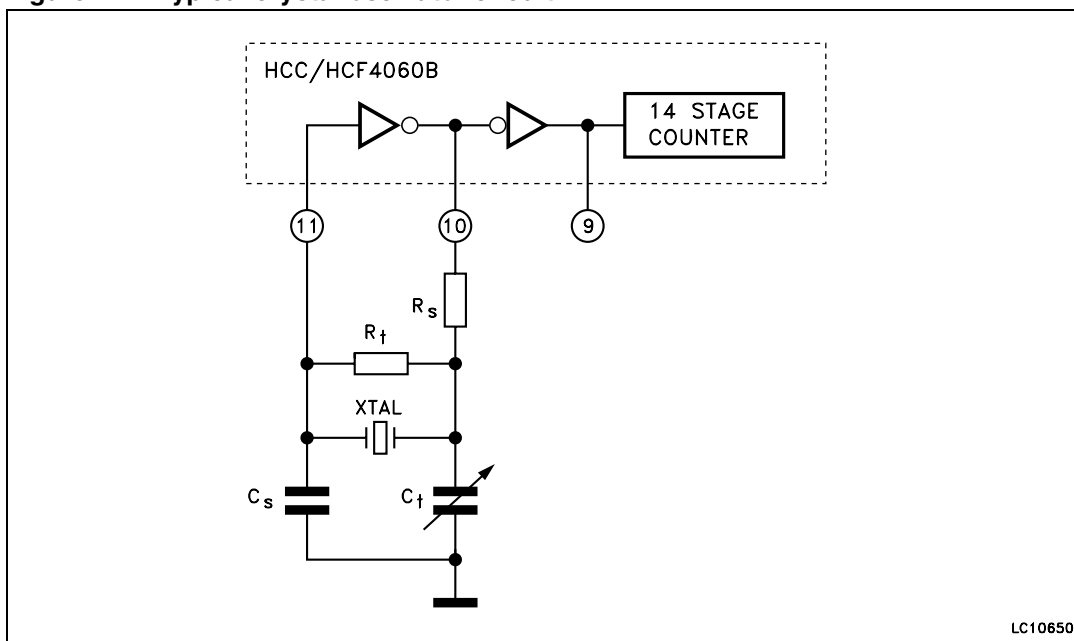


Figure 7. Typical crystal oscillator circuit



7 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

Figure 8. Plastic PDIP16 (0.25) package outline

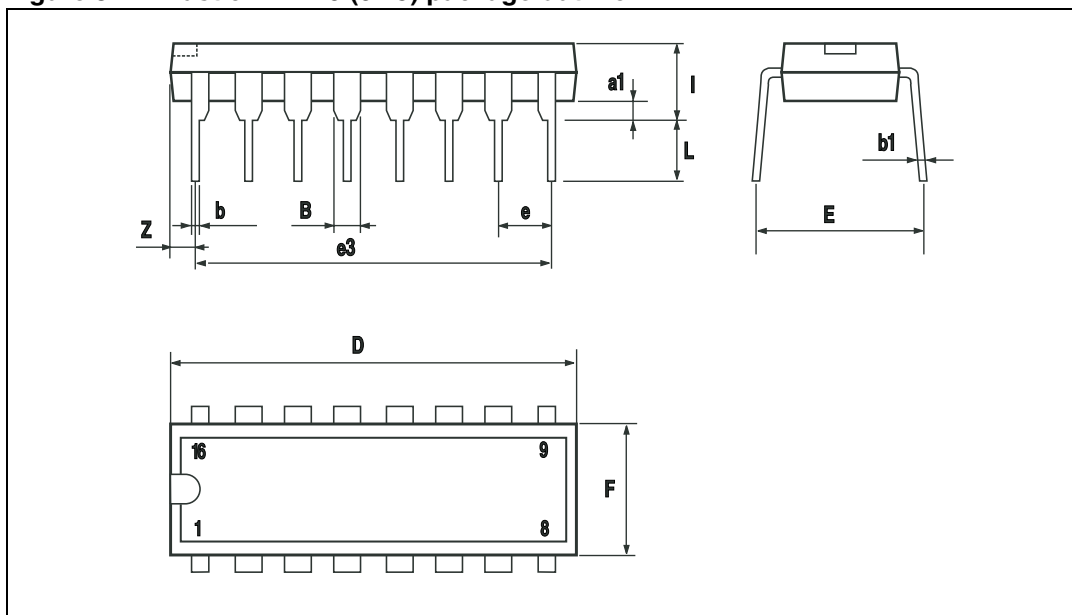


Table 7. Plastic PDIP16 (0.25) package mechanical data

Symbol	Dimensions					
	mm			inch		
	Min.	Typ.	Max.	Min.	Typ.	Max.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050

Figure 9. SO16 package outline

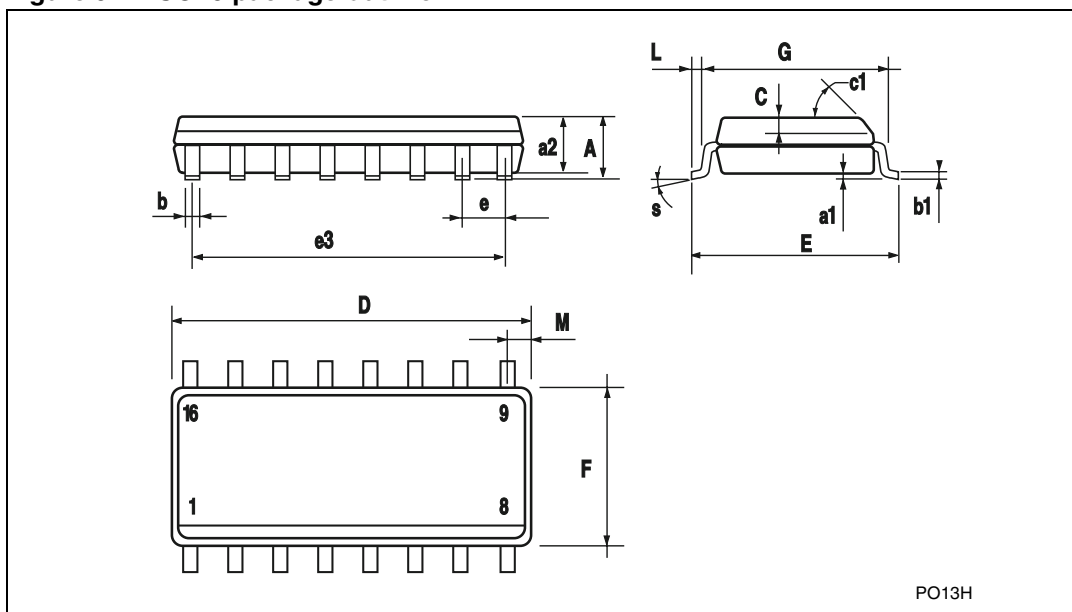


Table 8. SO16 package mechanical data

Symbol	Dimensions					
	mm			inch		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.068
a1	0.1		0.2	0.004		0.008
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	9.8		10	0.385		0.393
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.62			0.024
S	8° (max.)					

8 Revision history

Table 9. Document revision history

Date	Revision	Changes
29-Oct-2012	5	Updated Features (added ESD values), added Applications . Updated Table 1 (reformatted table, added order codes, temperature range, marking, updated package and packaging, added note 1.). Moved Description to page 2, updated Description (unified part numbers and package names). Updated Section 2 to Section 7 (added titles and numbering). Reformatted Section 7 (added ECOPACK text, Figure 8 , Figure 9 , Table 7 and Table 8 , unified package names). Minor corrections throughout document.

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