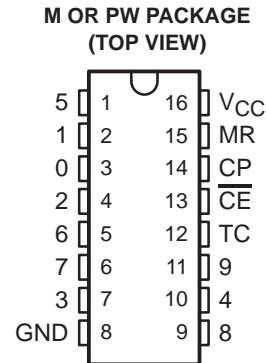


CD74HC4017-EP HIGH-SPEED CMOS LOGIC DECADE COUNTER/DIVIDER WITH 10 DECODED OUTPUTS

SCLS550 – DECEMBER 2003

- **Controlled Baseline**
 - One Assembly/Test Site, One Fabrication Site
- **Extended Temperature Performance of –40°C to 125°C**
- **Enhanced Diminishing Manufacturing Sources (DMS) Support**
- **Enhanced Product-Change Notification**
- **Qualification Pedigree†**
- **Fully Static Operation**
- **Buffered Inputs**
- **Common Reset**
- **Positive Edge Clocking**
- **Typical $f_{max} = 60$ MHz at $V_{CC} = 5$ V, $C_L = 15$ pF, $T_A = 25^\circ\text{C}$**
- **Fanout (Over Temperature Range)**
 - Standard Outputs . . . 10 LSTTL Loads
 - Bus Driver Outputs . . . 15 LSTTL Loads
- **Balanced Propagation Delay and Transition Times**
- **Significant Power Reduction Compared to LSTTL Logic ICs**
- **V_{CC} Voltage = 2 V to 6 V**
- **High Noise Immunity N_{IL} or $N_{IH} = 30\%$ of V_{CC} , $V_{CC} = 5$ V**

† Component qualification in accordance with JEDEC and industry standards to ensure reliable operation over an extended temperature range. This includes, but is not limited to, Highly Accelerated Stress Test (HAST) or biased 85/85, temperature cycle, autoclave or unbiased HAST, electromigration, bond intermetallic life, and mold compound life. Such qualification testing should not be viewed as justifying use of this component beyond specified performance and environmental limits.



description/ordering information

The CD74HC4017 is a high-speed silicon-gate CMOS 5-stage Johnson counter with ten decoded outputs. Each of the decoded outputs normally is low and sequentially goes high on the low-to-high transition clock period of the ten-clock-period cycle. The carry (TC) output transitions low to high after output 9 goes from high to low and can be used in conjunction with the clock enable (\overline{CE}) input to cascade several stages. \overline{CE} disables counting when in the high state. A master reset (MR) input also is provided that, when taken high, sets all the decoded outputs, except output 0, to low.

The device can drive up to ten low-power Schottky equivalent loads.

ORDERING INFORMATION

T _A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 125°C	SOIC – M	Tape and reel	CD74HC4017QM96EP	HC4017E
	TSSOP – PW	Tape and reel	CD74HC4017QPWREP	HC4017E

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.



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CD74HC4017-EP HIGH-SPEED CMOS LOGIC DECADE COUNTER/DIVIDER WITH 10 DECODED OUTPUTS

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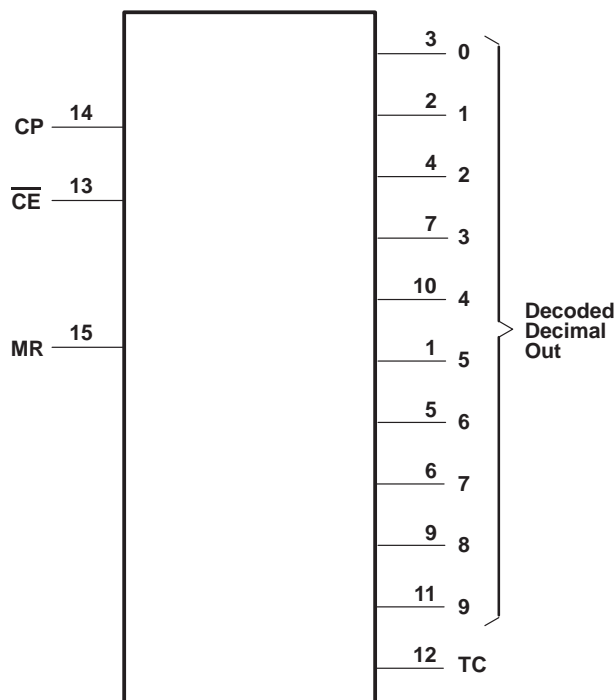
FUNCTION TABLE

INPUTS			OUTPUT STATE†
CP	\overline{CE}	MR	
L	X	L	No change
X	H	L	No change
X	X	H	0 = H, 1–9 = L
↑	L	L	Increments counter
↓	X	L	No change
X	↑	L	No change
H	↓	L	Increments counter

NOTE: H = high voltage level, L = low voltage level,
X = don't care, ↑ = transition from low to high
level, ↓ = transition from high to low level

† If $n < 5$, TC = H, otherwise TC = L

logic diagram (positive logic)



CD74HC4017-EP HIGH-SPEED CMOS LOGIC DECADE COUNTER/DIVIDER WITH 10 DECODED OUTPUTS

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absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage range, V_{CC} (see Note 1)	–0.5 V to 7 V
Input clamp current, I_{IK} ($V_I < -0.5$ V or $V_I > V_{CC} + 0.5$ V)	±20 mA
Output clamp current, I_{OK} ($V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V)	±20 mA
Source or sink current per output pin, I_O ($V_O > -0.5$ V or $V_O < V_{CC} + 0.5$ V)	±25 mA
Continuous current through V_{CC} or GND	±50 mA
Package thermal impedance, θ_{JA} (see Note 2): M package	73°C/W
PW package	108°C/W
Maximum junction temperature, T_J	150°C
Lead temperature (during soldering):	
At distance $1/16 \pm 1/32$ inch ($1,59 \pm 0,79$ mm) from case for 10 s max	300°C
Storage temperature range, T_{stg}	–65°C to 150°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES: 1. All voltages referenced to GND unless otherwise specified.
2. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions (see Note 3)

		MIN	MAX	UNIT	
V_{CC}	Supply voltage	2	6	V	
V_{IH}	High-level input voltage	$V_{CC} = 2$ V	1.5	V	
		$V_{CC} = 4.5$ V	3.15		
		$V_{CC} = 6$ V	4.2		
V_{IL}	Low-level input voltage	$V_{CC} = 2$ V	0.5	V	
		$V_{CC} = 4.5$ V	1.35		
		$V_{CC} = 6$ V	1.8		
V_I	Input voltage	0	V_{CC}	V	
V_O	Output voltage	0	V_{CC}	V	
t_t	Input transition (rise and fall) time	$V_{CC} = 2$ V	0	1000	ns
		$V_{CC} = 4.5$ V	0	500	
		$V_{CC} = 6$ V	0	400	
T_A	Operating free-air temperature	–40	125	°C	

NOTE 3: All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

CD74HC4017-EP
HIGH-SPEED CMOS LOGIC DECADE COUNTER/DIVIDER
WITH 10 DECODED OUTPUTS

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electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS		I _O (mA)	V _{CC}	T _A = 25°C		MIN	MAX	UNIT
					MIN	MAX			
V _{OH}	V _I = V _{IH} or V _{IL}	CMOS loads	-0.02	2 V	1.9	1.9	V		
			-0.02	4.5 V	4.4	4.4			
			-0.02	6 V	5.9	5.9			
		TTL loads	-4	4.5 V	3.98	3.7			
			-5.2	6 V	5.48	5.2			
V _{OL}	V _I = V _{IH} or V _{IL}	CMOS loads	0.02	2 V	0.1	0.1	V		
			0.02	4.5 V	0.1	0.1			
			0.02	6 V	0.1	0.1			
		TTL loads	4	4.5 V	0.26	0.4			
			5.2	6 V	0.26	0.4			
I _I	V _I = V _{CC} or GND		6 V	±0.1	±1	μA			
I _{CC}	V _I = V _{CC} or GND	0	6 V	8	160	μA			
C _{IN}	C _L = 50 pF			10	10	pF			

timing requirements over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1)

PARAMETER			V _{CC}	T _A = 25°C		MIN	MAX	UNIT
				MIN	MAX			
f _{max}	Maximum clock frequency		2 V	6	4	MHz		
			4.5 V	30	20			
			6 V	35	23			
t _w	Pulse duration	CP	2 V	80	120	ns		
			4.5 V	16	24			
			6 V	14	20			
		MR	2 V	80	120			
			4.5 V	16	24			
			6 V	14	20			
t _{su}	Setup time	\overline{CE} to CP	2 V	75	110	ns		
			4.5 V	15	22			
			6 V	13	19			
		MR inactive	2 V	5	5			
			4.5 V	5	5			
			6 V	5	5			
t _h	Hold time, \overline{CE} to CP	2 V	0	0	ns			
		4.5 V	0	0				
		6 V	0	0				



CD74HC4017-EP HIGH-SPEED CMOS LOGIC DECADE COUNTER/DIVIDER WITH 10 DECODED OUTPUTS

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switching characteristics over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	V _{CC}	T _A = 25°C			MIN	MAX	UNIT
					MIN	TYP	MAX			
t _{pd}	CP	Decade out	C _L = 50 pF	2 V		230		345	ns	
				4.5 V		46		69		
				6 V		39		59		
		TC	C _L = 15 pF	5 V		19				
				C _L = 50 pF	2 V		230			345
					4.5 V		46			69
	6 V		39			59				
	MR	Decade out	C _L = 50 pF	2 V		250		375		
				4.5 V		50		75		
				6 V		43		64		
		TC	C _L = 15 pF	5 V		21				
				C _L = 50 pF	2 V		250			375
					4.5 V		50			75
	6 V		43			64				
	MR	Decade out	C _L = 50 pF	2 V		230		345		
				4.5 V		46		69		
				6 V		39		59		
		TC	C _L = 15 pF	5 V		19				
C _L = 50 pF				2 V		230		345		
				4.5 V		46		69		
	6 V		39		59					
t _t		TC, Decade out	C _L = 50 pF	2 V		75		110	ns	
				4.5 V		15		22		
				6 V		13		19		
f _{max}	CP		C _L = 15 pF	5 V		60			MHz	

operating characteristics, V_{CC} = 5 V, T_A = 25°C, input t_r, t_f = 6 ns, C_L = 15 pF

PARAMETER	TYP	UNIT
C _{pd} Power dissipation capacitance (see Note 4)	39	pF

NOTE 4: C_{pd} is used to determine the dynamic power consumption per package.

$$P_D = (C_{pd} \times V_{CC}^2 \times f_i) + \Sigma(C_L \times V_{CC}^2 \times f_o)$$

f_i = input frequency

f_o = output frequency

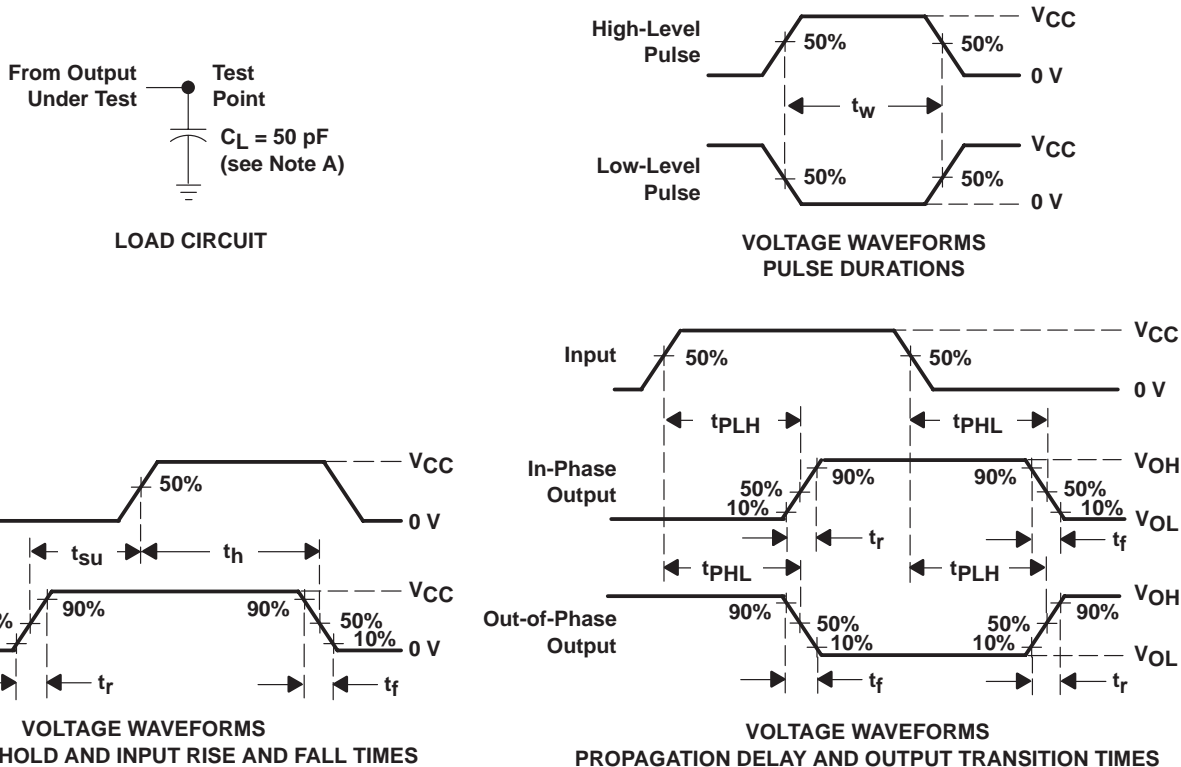
C_L = output load capacitance

V_{CC} = supply voltage

CD74HC4017-EP HIGH-SPEED CMOS LOGIC DECADE COUNTER/DIVIDER WITH 10 DECODED OUTPUTS

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PARAMETER MEASUREMENT INFORMATION



- NOTES:
- A. C_L includes probe and test-fixture capacitance.
 - B. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics: $PRR \leq 1 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r = 6 \text{ ns}$, $t_f = 6 \text{ ns}$.
 - C. For clock inputs, f_{max} is measured when the input duty cycle is 50%.
 - D. The outputs are measured one at a time with one input transition per measurement.
 - E. t_{PLH} and t_{PHL} are the same as t_{pd} .

Figure 1. Load Circuit and Voltage Waveforms

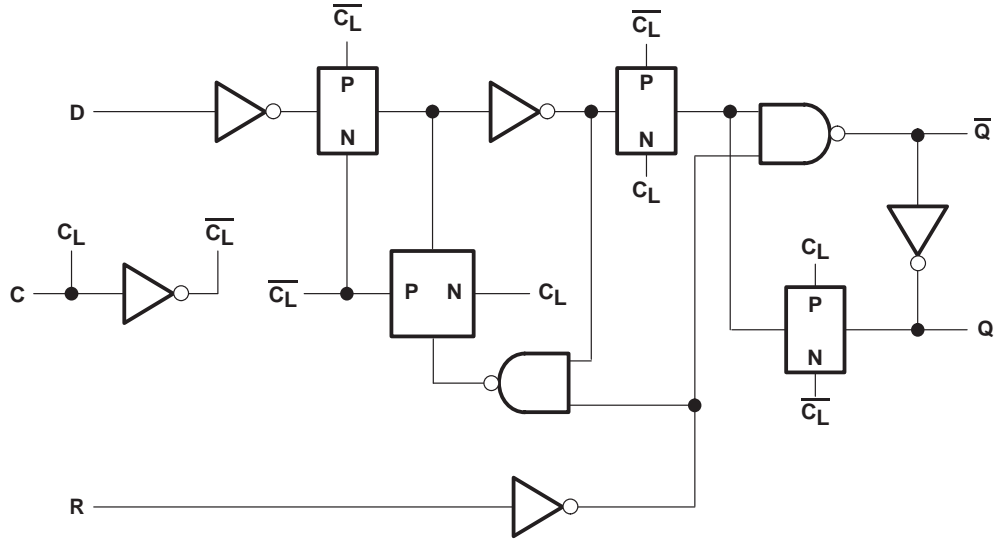


Figure 2. Flip-Flop Detail

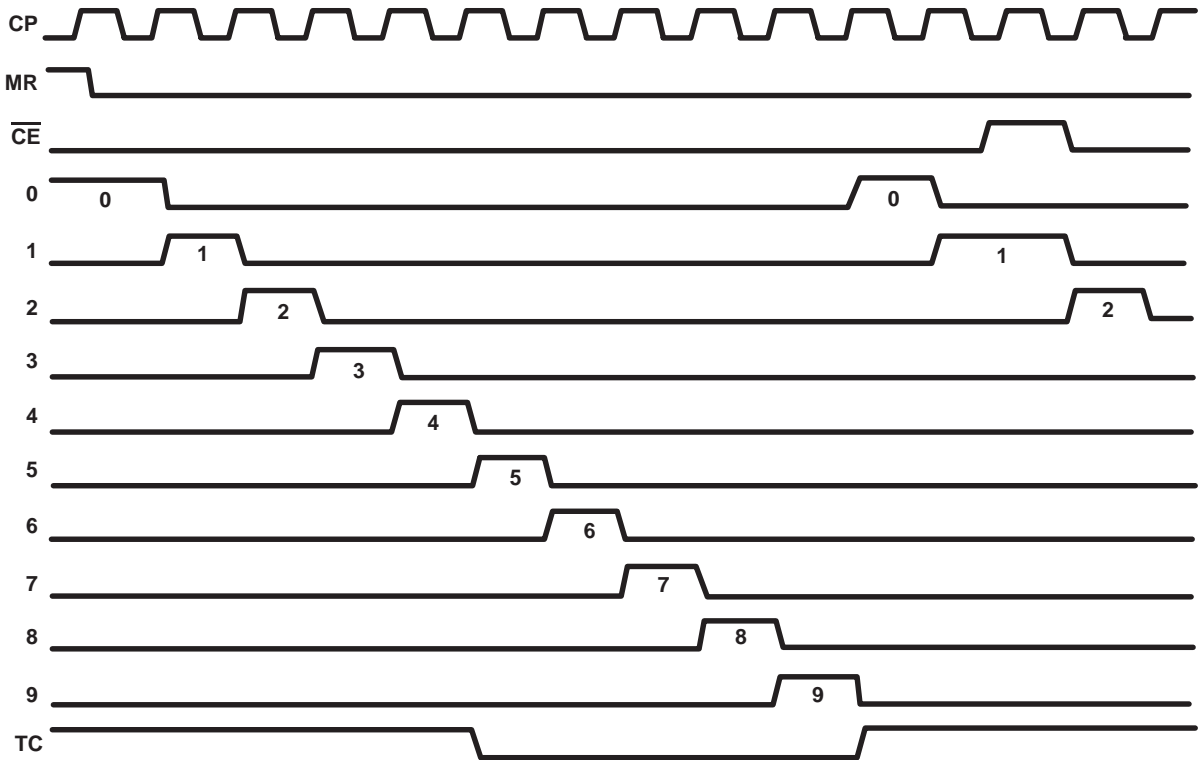


Figure 3. Timing Diagram

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
CD74HC4017QM96EP	ACTIVE	SOIC	D	16	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HC4017E	Samples
CD74HC4017QPWREP	ACTIVE	TSSOP	PW	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HC4017E	Samples
V62/04703-01XE	ACTIVE	SOIC	D	16	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HC4017E	Samples
V62/04703-01YE	ACTIVE	TSSOP	PW	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HC4017E	Samples

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "-" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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OTHER QUALIFIED VERSIONS OF CD74HC4017-EP :

- Catalog: [CD74HC4017](#)
- Automotive: [CD74HC4017-Q1](#)
- Military: [CD54HC4017](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects
- Military - QML certified for Military and Defense Applications

TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
CD74HC4017QM96EP	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
CD74HC4017QPWREP	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CD74HC4017QM96EP	SOIC	D	16	2500	340.5	336.1	32.0
CD74HC4017QPWREP	TSSOP	PW	16	2000	853.0	449.0	35.0

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



4040047-6/M 06/11

- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 -  C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
 -  D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 - E. Reference JEDEC MS-012 variation AC.

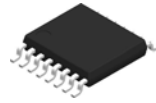
D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Publication IPC-7351 is recommended for alternate designs.
 - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

PW0016A



PACKAGE OUTLINE

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153.

EXAMPLE BOARD LAYOUT

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



SOLDER MASK DETAILS

4220204/A 02/2017

NOTES: (continued)

- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 10X

4220204/A 02/2017

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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