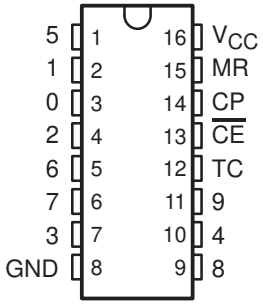
CD54HCT4017
DECADE COUNTER/DIVIDER WITH TEN DECODED OUTPUTS

SGDS012 – MAY 1999

- **4.5-V to 5.5-V Operation**
- **Fully Static Operation**
- **Buffered Inputs**
- **Common Reset**
- **Positive-Edge Clocking**
- **Balanced Propagation Delay and Transition Times**
- **Direct LSTTL Input Logic Compatibility**
  – V_{IL} = 0.8 V Maximum; V_{IH} = 2 V Minimum
- **CMOS Input Compatibility**
  – $I_I \leq 1\ \mu A$ at V_{OL}, V_{OH}
- **Packaged in Ceramic (F) DIP Packages and Also Available in Chip Form (H)**

F PACKAGE
(TOP VIEW)



description

The CD54HCT4017 is a high-speed silicon-gate CMOS 5-stage Johnson counter with ten decoded outputs. Each decoded output normally is low and sequentially goes high on the low-to-high transition of the clock (CP) input. Each output stays high for one clock period of the ten-clock-period cycle. The terminal count (TC) output transitions low to high after output ten (9) goes 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. The master reset (MR) input, when taken high, sets all the decoded outputs, except 0, to low.

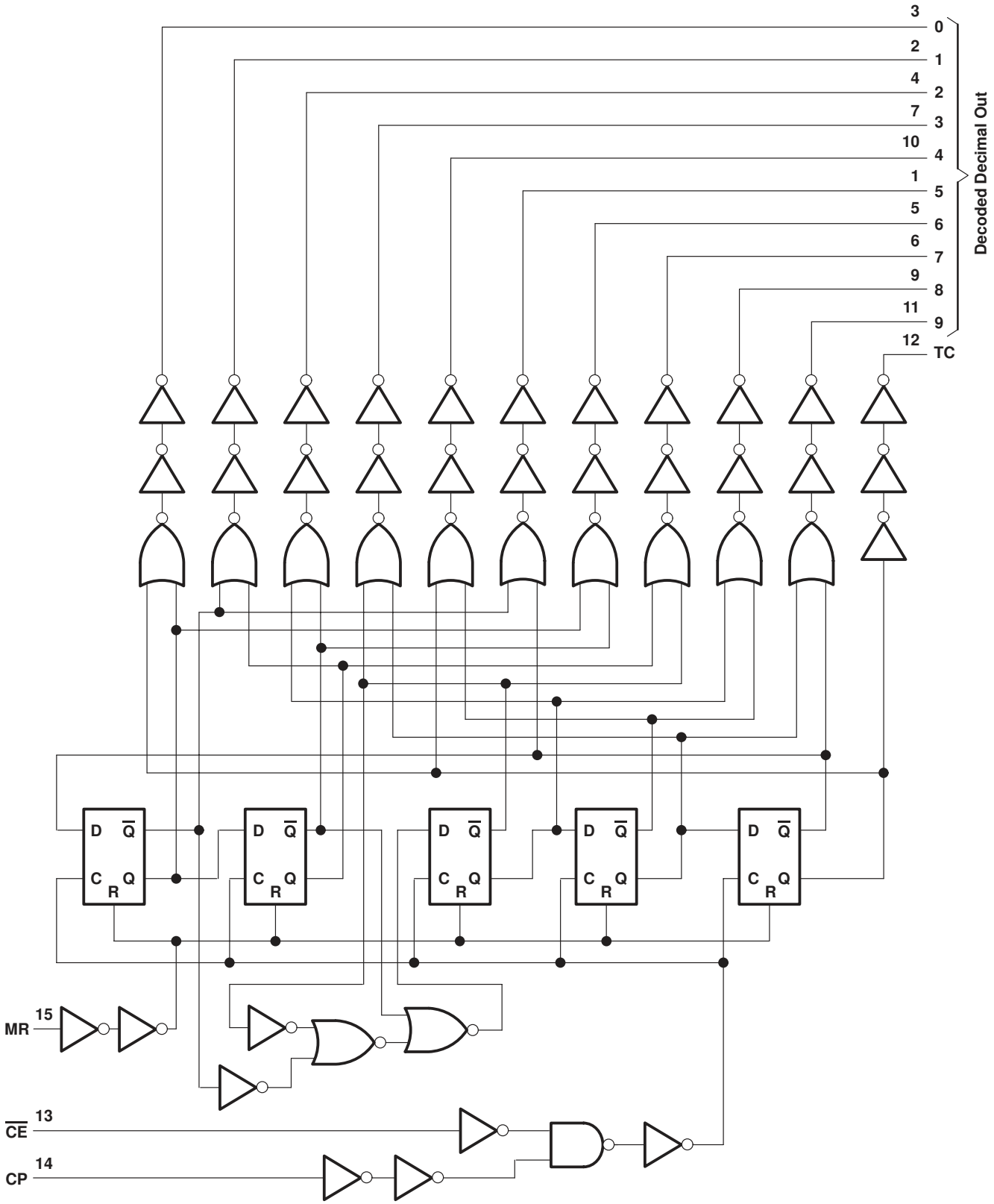
The CD54HCT4017 is characterized for operation over the full military temperature range of –55°C to 125°C.

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

† If n < 5, TC = H; otherwise, TC = L.

logic diagram (positive logic)



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

Supply voltage range, V_{CC} . . . . . –0.5 V to 7 V
Input clamp current, I_{IK} ($V_I < 0$ V or $V_I > V_{CC}$) . . . . . ±20 mA
Output clamp current, I_{OK} ($V_O < 0$ V or $V_O > V_{CC}$) . . . . . ±20 mA
Continuous output current, each output pin, I_O ($V_O > 0$ V or $V_O < V_{CC}$) . . . . . ±25 mA
V_{CC} or ground current, I_{CC} . . . . . ±50 mA
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.

recommended operating conditions (see Note 1)

			MIN	MAX	UNIT
V_{CC}	Supply voltage		4.5	5.5	V
V_{IH}	High-level input voltage	V_{CC} = 4.5 V to 5.5 V	2		V
V_{IL}	Low-level input voltage	V_{CC} = 4.5 V to 5.5 V		0.8	V
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		–55	125	°C

NOTE 1: All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to TI application report *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

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

PARAMETER		TEST CONDITIONS	V_{CC}	T_A = 25°C			MIN	MAX	UNIT
				MIN	TYP	MAX			
V_{OH}	CMOS loads	$V_I = V_{IH}$ or V_{IL}, I_O = –0.02 mA	4.5 V	4.4			4.4		V
	TTL loads	$V_I = V_{IH}$ or V_{IL}, I_O = –4 mA	4.5 V	3.98			3.7		
V_{OL}	CMOS loads	$V_I = V_{IH}$ or V_{IL}, I_O = 0.02 mA	4.5 V			0.1		0.1	V
	TTL loads	$V_I = V_{IH}$ or V_{IL}, I_O = 4 mA	4.5 V			0.26		0.4	
I_I		$V_I = V_{CC}$ to 0	5.5 V			±100		±1000	nA
I_{CC}		$V_I = V_{CC}$ or 0	5.5 V			8		160	µA
ΔI_{CC}†		$V_I = V_{CC}$ to 2.1 V, I_O = 0	4.5 to 5.5 V		100	360		490	µA
C_i						10		10	pF

† For dual-supply systems, theoretical worst case (V_I = 2.4 V, V_{CC} = 5.5 V) specification is 1.8 mA.

INPUT LOADING

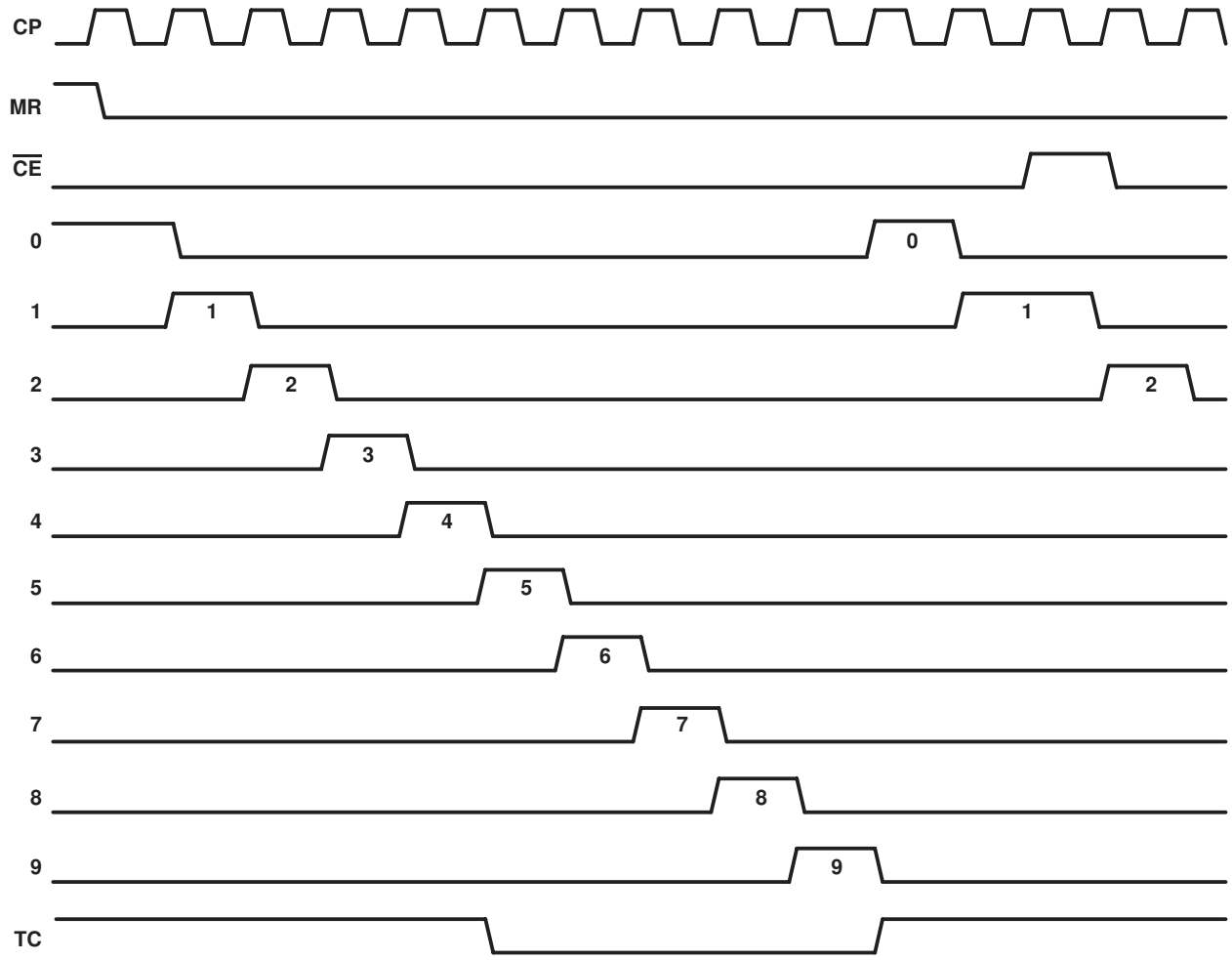
INPUT	UNIT LOAD
CP	0.15
$\overline{CE}$	0.25
MR	0.3

Unit load is ΔI_{CC} limit, e.g., 360 µA MAX at T_A = 25°C.

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

PARAMETER			V_{CC}	T_A = 25°C		MIN	MAX	UNIT
				MIN	MAX			
f_{clock}	Maximum clock frequency		4.5 V		25		17	MHz
t_w	Pulse duration	CP	4.5 V		16		24	ns
		MR	4.5 V		16		24	
t_{su}	Setup time, $\overline{CE}$ to CP		4.5 V	15		22		ns
t_h	Hold time, $\overline{CE}$ to CP		4.5 V	0		0		ns
t_{rem}	Removal time, MR		4.5 V	5		5		ns

timing requirements



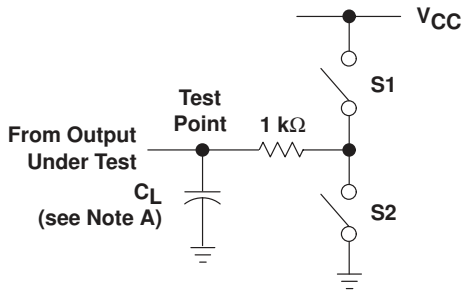
switching characteristics, C_L = 50 pF, T_A = 25°C (see Figures 1 and 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC}	T_A = 25°C		T_A = –55°C TO 125°C		UNIT
				MIN	MAX	MIN	MAX	
f_{max}			4.5 V	25		17		MHz
t_{PLH}	CP	Any output	4.5 V		46		69	ns
t_{PHL}		TC			46		69	
t_{PLH}	$\overline{CE}$	Any output	4.5 V		50		75	ns
t_{PHL}		TC			50		75	
t_{PLH}	MR	Any output	4.5 V		46		69	ns
t_{PHL}		TC			46		69	
t_{THL}		Any output	4.5 V		15		22	ns
t_{TLH}		TC			15		22	

operating characteristics

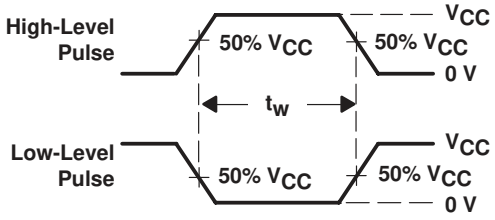
PARAMETER		TEST CONDITIONS	TYP	UNIT
C_{pd}	Power dissipation capacitance	No load	39	pF

PARAMETER MEASUREMENT INFORMATION

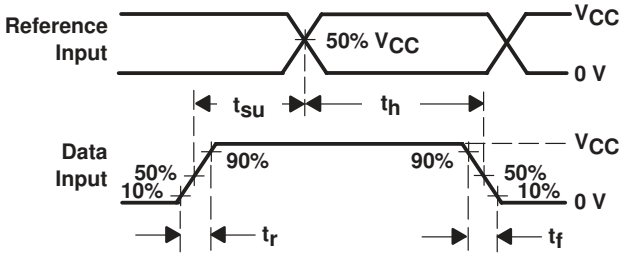


LOAD CIRCUIT

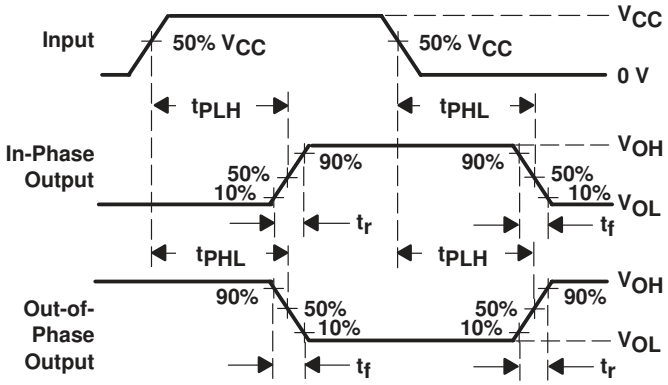
PARAMETER		S1	S2
t_{en}	t_{PZH}	Open	Closed
	t_{PZL}	Closed	Open
t_{dis}	t_{PHZ}	Open	Closed
	t_{PLZ}	Closed	Open
t_{pd} or t_t		Open	Open



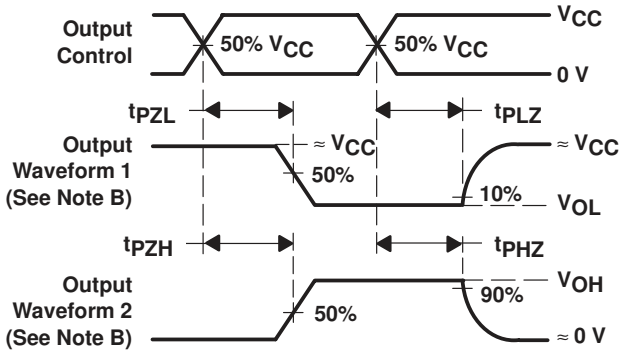
VOLTAGE WAVEFORMS
PULSE DURATIONS



VOLTAGE WAVEFORMS
SETUP AND HOLD AND INPUT RISE AND FALL TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY AND OUTPUT TRANSITION TIMES



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES FOR 3-STATE OUTPUTS

NOTES: A. C_L includes probe and test-fixture capacitance.
B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
C. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics: PRR ≤ 1 MHz, Z_O = 50 Ω, t_r = 6 ns, t_f = 6 ns.
D. The outputs are measured one at a time with one input transition per measurement.
E. t_{PLZ} and t_{PHZ} are the same as t_{dis}.
F. t_{PZL} and t_{PZH} are the same as t_{en}.
G. t_{PLH} and t_{PHL} are the same as t_{pd}.

Figure 1. Load Circuit and Voltage Waveforms

PARAMETER MEASUREMENT INFORMATION

INPUT LEVEL	V_{CC}
V_S	0.5 V_{CC}

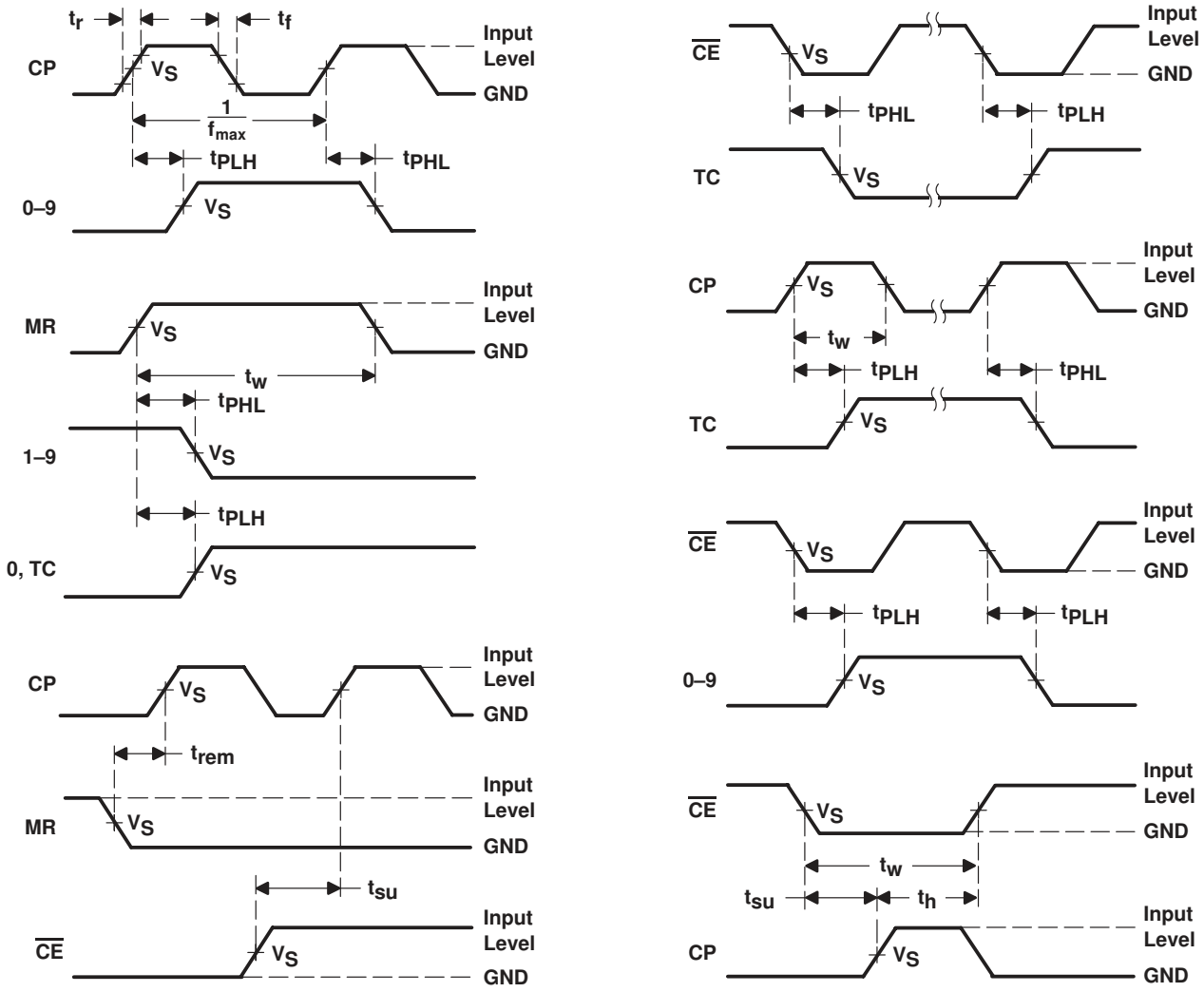


Figure 2. Voltage Waveforms

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
CD54HCT4017F3A	OBSOLETE	CDIP	J	16		TBD	Call TI	Call TI

(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.

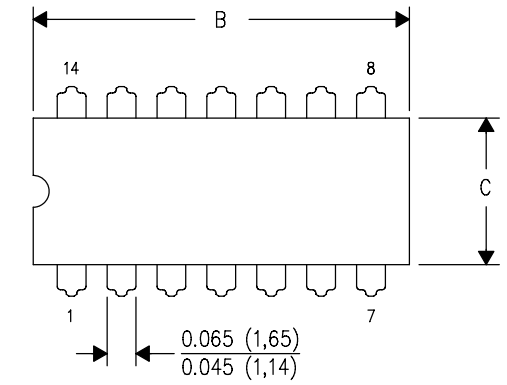
(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS) or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

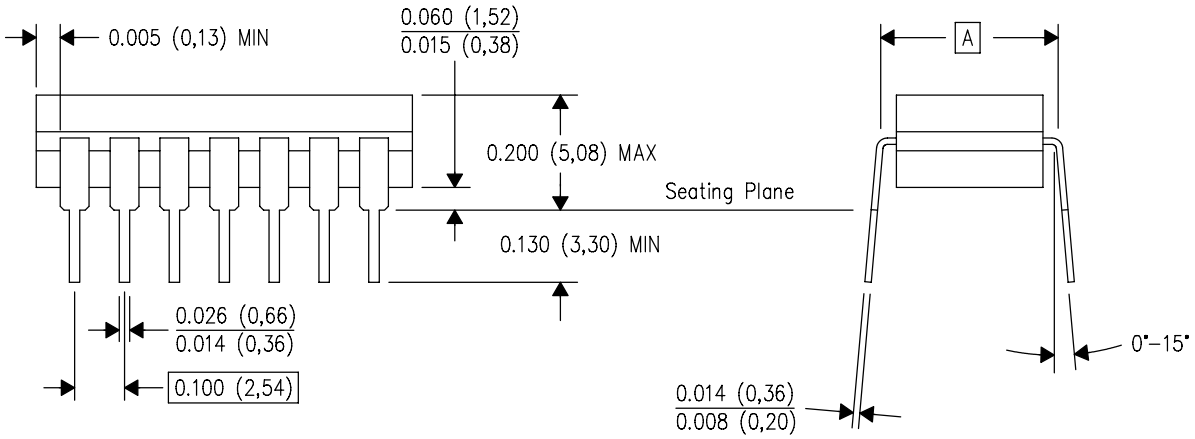
J (R–GDIP–T**)

14 LEADS SHOWN

CERAMIC DUAL IN–LINE PACKAGE



DIM \ PINS **	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



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NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package is hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
E. Falls within MIL STD 1835 GDIP1–T14, GDIP1–T16, GDIP1–T18 and GDIP1–T20.

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