

Data sheet acquired from Harris Semiconductor SCHS042C – Revised July 2003

# CD4045B Types

## **CMOS 21-Stage Counter**

High-Voltage Types (20-Volt Rating)

■ CD4045B is a timing circuit consisting of 21 counter stages, two output-shaping flip-flops, two inverter output drivers, and input inverters for use in a crystal oscillator. The CD4045B configuration provides 21 flip-flop counting stages, and two flip-flops for shaping the output waveform for a 3.125% duty cycle. Push-pull operation is provided by the inverter output drivers.

The first inverter is intended for use as a crystal oscillator/amplifier. However, it may be used as a normal logic inverter if desired. A crystal oscillator circuit can be made less sensitive to voltage-supply variations by the use of source resistors. In this device, the sources of the p and n transistors have been brought out to package terminals. If external resistors are not required, the sources must be shorted to their respective substrates (Sp to VDD, Sn to VSS). See Fig. 1. The first inverter in conjunction with an outboard inverter, such as 1/6 CD4069, and R<sub>X</sub>, C<sub>X</sub>, and RS can also be used to construct an RC oscillator. The following data is supplied as a guide in the selection of values for RX, R<sub>S</sub>, and C<sub>X</sub> used in Fig. 11:

- 1.  $R_X$  max = 10  $M\Omega$  with  $R_S$  = 10  $M\Omega$ and  $C_X$  = 50 pF
- 2.  $C_X$  max = 25  $\mu$ F with  $R_S$  = 560  $k\Omega$  and  $R_X$  = 50  $k\Omega$

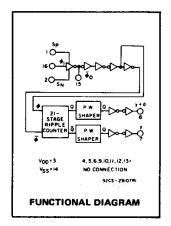
The CD4045B types are supplied in 16-lead dual-in-line plastic packages (E suffix), 16-lead small-outline package (NSR suffix), and 16-lead thin shrink small-outline packages (PW and PWR suffixes).

#### Applications:

- Digital equipment in which ultra-low dissipation and/or operation using a battery source is required.
- Accurate timing from a crystal oscillator for timing applications such as wall clocks, table clocks, automobile clocks, and digital timing references in any circuit requiring accurately timed outputs at various intervals in the counting sequence.
- Driving miniature synchronous motors, stepping motors, or external bipolar transistors in push-pull fashion.

#### Features:

- Very low operating dissipation . . . . . <1 mW (typ.) © VDD = 5 V,  $f\phi$  = 1 MHz
- Output drivers with sink or source capability . . . . . 7 mA (typ.) @ V<sub>DD</sub> = 5 V
- Medium speed (typ.) . . .  $f\phi = 25 \text{ MHz} @ V_{DD} = 10 \text{ V}$
- 100% tested for quiescent current at 20 V
- 5-V, 10-V, and 15-V parametric ratings
- Meets all requirements of JEDEC Tentative Standard No. 13B, Standard Specifications for Descripiton of 'B' Series CMOS Devices"



#### MAXIMUM RATINGS, Absolute-Maximum Values:

LEAD TEMPERATURE (DURING SOLDERING):

DC SUPPLY-VOLTAGE RANGE, (V <sub>DD</sub> )	
Voltages referenced to V <sub>SS</sub> Terminal)	0.5V to +20V
INPUT VOLTAGE RANGE, ALL INPUTS	0.5V to V <sub>DD</sub> +0.5V
DC INPUT CURRENT, ANY ONE INPUT	±10mA
POWER DISSIPATION PER PACKAGE (PD):	
For T <sub>A</sub> = -55°C to +100°C	500mW
For T <sub>A</sub> = +100°C to +125°C	Perate Linearity at 12mW/°C to 200mW
DEVICE DISSIPATION PER OUTPUT TRANSISTOR	
FOR TA = FULL PACKAGE-TEMPERATURE RANGE (All Package Type	pes) 100mW
OPERATING-TEMPERATURE RANGE (TA)	55°C to +125°C
STORAGE TEMPERATURE RANGE (Tsig)	65°C to +150°C

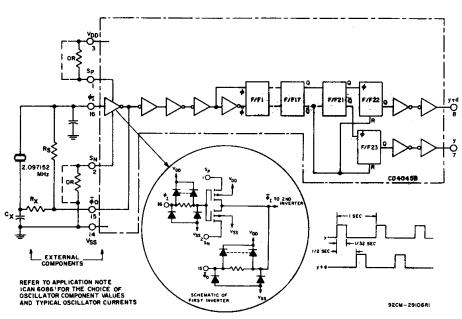


Fig. 1 - CD4045B and outboard components in a typical 21-stage counter application.

## CD4045B Types

### **STATIC ELECTRICAL CHARACTERISTICS**

CHARACTERISTIC	CONE	ITIO	NS	LIMITS AT INDICATED TEMPERATURES (°C)					PC)	U N	
	٧o	VIN	۷ <sub>DD</sub>						+25		Т
	(v)	(V)	(V)	-55	-40	+85	+125	Min.	Тур.	Max.	s
Quiescent Device	_	0,5	5	5	5	150	150	_	0.04	5	
Current, IDD Max.	<u> </u>	0,10	10	. 10	10.	300	300	_	0.04	10	
		0,15	15	20	20	600	600		0.04	20	μΑ
	_	0,20	20	100	100	3000	3000		0.08	100	<u>l</u>
Output Low (Sink)	0.4	0,5	5	4.5	4.3	2.9	2.5	3.6	7	1	
Current IOL Min.	0.5	0,10	10	11.2	10.5	7.7	6.3	9.1	18	_	
	1.5	0,15	15	29.4	28	19.6	16.8	23.8	47	-	mA
Output High (Source)	4.6	0,5	5	-4.5	-4.3	-2.9	-2.5	-3.6	-7	_	]''''^
Current, IOH Min.	9.5	0,10	10	-11.2	-10.5	-7.7	-6.3	-9.1	-18	-	]
<u> </u>	13.5	0,15	15	-29.4	-28	-19.6	-16.8	-23.8	-47	_	1
Pin 15 Output	15 Output 0.4,4.6 0,5 5 -					±0.1	±0.18				
Low and High	0.5,9.5	0,10	10					±0.2	±0.3	_	mΑ
Current, IOL, IOH	1.5,13.5	0,15	15	_			±0.5	±1	_		
Output Voltage:		0,5	5		_ =	0.05		-	_	0.05	
Low-Level,	-	0,10	10	:		0.05		_	_	0.05	
VOL Max.		0,15	15		- (	0.05		_	_	0.05	v
Output Voltage:		0,5	5			4.95		4.95	. 5	_	"
High-Level,		0,10	10			9.95		9.95	10	_	
V <sub>OH</sub> Min.	-	0,15	15	14.95			14.95	15	_	1	
Input Low	0.5,4.5	1	5			1.5		-	-	1.5	Г
Voltage	1,9	1	10	3			_	-	3		
V∣∟ Max.	1.5,13.5	1	15	4			_		4	V	
Input High	0.5,4.5	-	5	3.5			3.5	_	_	<b>"</b>	
Voltage,	1,9	1	10	. 7			7	_	_		
V <sub>IH</sub> Min.	1.5,13.5	-	15	11			11		_	1	
Input Current I <sub>IN</sub> Max.	-	0,18	18	±0.1	±0.1	±1	±1	-	±10-5	±0.1	μΑ

## RECOMMENDED OPERATING CONDITIONS

For maximum reliability, nominal operating conditions should be selected so that operation is always within the following ranges

CHARACTERISTIC	V <sub>DD</sub>	LIN			
— — — — — — — — — — — — — — — — — — —	(v)	Min.	Max.	UNITS	
Supply-Voltage Range (For T <sub>A</sub> = Full Package- Temperature Range)	_	3	18	٧	
Minimum Input-Pulse Width, tw	5 10 15	- - -	100 50 40	ns	
Maximum Input-Pulse Frequency, fφ (External Pulse Source)	5 10 15	5 12 15		MHz	

## CD4045B Types

# DYNAMIC ELECTRICAL CHARACTERISTICS at T\_A = 25°C; input $t_r,\,t_f$ = 20 ns, C\_L = 50 pF, R\_L = 200 $k\Omega$

	TEST	_					
CHARACTERISTIC	CONDITIONS	V <sub>DD</sub>	Min.	Тур.	Max.	UNITS	
Propagation Delay Time:		5	_	2.2	5.5		
$\phi_{\parallel}$ to y or y+d out		10	_	0.9	2.7	μs	
<sup>t</sup> PHL <sup>, t</sup> PLH	1	15	-	0.65	2	~	
Transition Time:		5	_	25	50		
		10	_	13	25		
<sup>t</sup> THL <sup>, t</sup> TLH	<u> </u>	15		10	20	ns	
Minimum Input-Pulse Width		5	_	50	100	113	
		10	-	25	50		
tw		15	-	20	40		
Input-Pulse Rise or Fall Time:		5	_		500		
		10		-	500	μs	
$t_r \phi$ , $t_f \phi$		15		_	500		
Maximum Input-Pulse		5	5	10	_		
Frequency:		10	12	25		MHz	
(External Pulse Source) f <sub>φ</sub>		15	15	30	-		
Input Capacitance, C <sub>IN</sub>	Any Input			5	7.5	pF	
Variation of Output Frequency		5	_	0.05	_		
(Unit-to-Unit)	f = 5 MHz	10	_	0.03	-	%	
		15	_	0.1			
RC Oscillator Operation							
Maximum Oscillator Frequency	$R_X = 50 k\Omega$ ,	5	45	60	75		
(See Fig. 11)	$R_S^2 = 560 \mathrm{k}\Omega$ ,	10	45	60	75	kHz	
fosc	$C_X = 50 pF$	15	45	60	75		

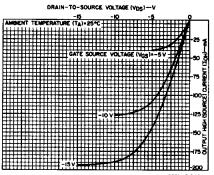


Fig. 4 — Typical output high (source) current characteristics.

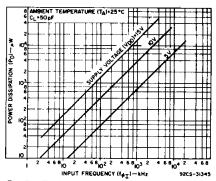
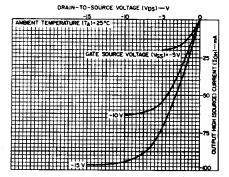


Fig. 7 — Typical power dissipation as a function of input frequency (21 counting stages).



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Fig. 5 — Minimum output high (source)

characteristics.

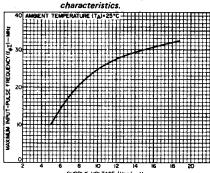


Fig. 8 — Typical maximum input-pulse frequency as a function of supply voltage.

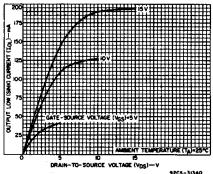


Fig. 2 — Typical output low (sink) current characteristics.

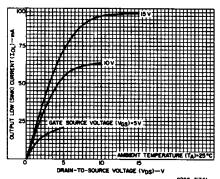


Fig. 3 – Minimum output low (sink) current cherecteristics.

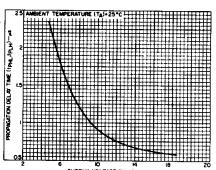


Fig. 6 — Typical propagation delay time as a function of supply voltage ( $\phi_1$  to y or y + d out vs.  $V_{DD}$ ).

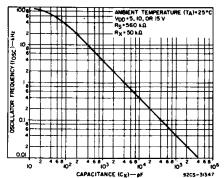


Fig. 9 — Typical RC oscillator frequency as a function of capacitance (C<sub>X</sub>), See Fig. 11.

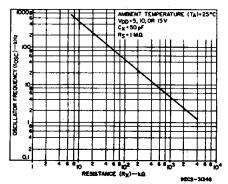


Fig. 10 — Typical RC oscillator frequency as a function of resistance (R<sub>X</sub>),
See Fig. 11.

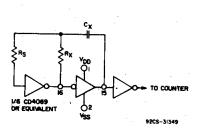


Fig. 11 - Typical RC circuit.

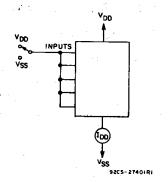


Fig. 12 - Quiescent-device-current test circuit.

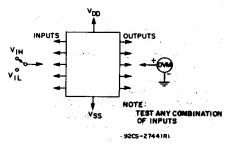


Fig. 13 - Noise-immunity test circuit.

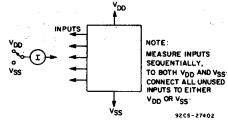


Fig. 14 - Input-leakage-current test circuit.

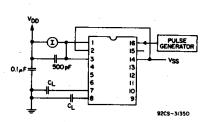
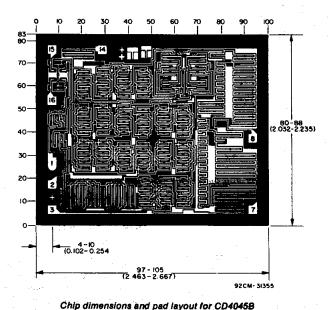


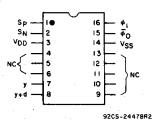
Fig. 15 - Dynamic power dissipation test circuit.



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Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated. Grid graduations are in mils ( $10^{-3}$  inch).

# TERMINAL DIAGRAM Top View



NC - NO CONNECTION

NOTE Observe power-supply terminal connections, V<sub>DD</sub> is terminal No. 3 and V<sub>SS</sub> is terminal No. 14 (not 16 and 8 respectively, as in other CD40008 Series 16-lead devices).

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### PACKAGING INFORMATION

Orderable part number	Status	Material type	Package   Pins	Package qty   Carrier	<b>RoHS</b> (3)	Lead finish/ Ball material	MSL rating/ Peak reflow	Op temp (°C)	Part marking (6)
CD4045BE	Active	Production	PDIP (N)   16	25   TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD4045BE
CD4045BE.A	Active	Production	PDIP (N)   16	25   TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD4045BE

<sup>(1)</sup> Status: For more details on status, see our product life cycle.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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<sup>(3)</sup> RoHS values: Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

<sup>(4)</sup> Lead finish/Ball material: Parts 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.

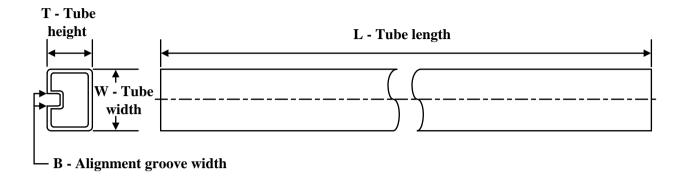
<sup>(5)</sup> MSL rating/Peak reflow: The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

<sup>(6)</sup> Part marking: There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

# **PACKAGE MATERIALS INFORMATION**

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## **TUBE**



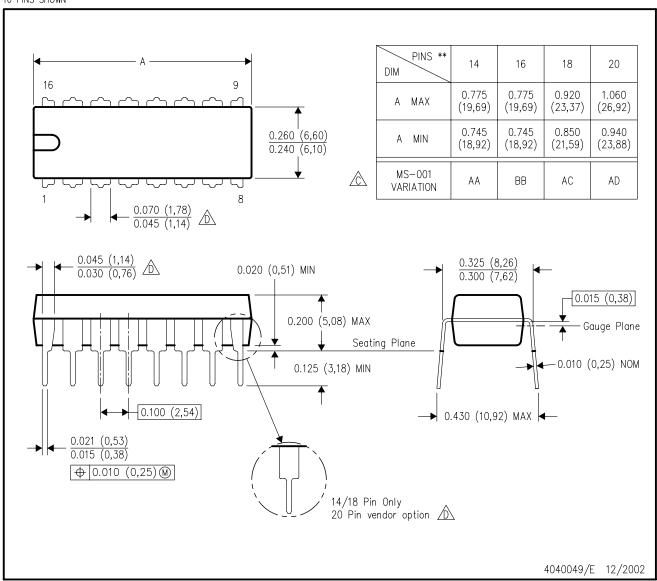
\*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
CD4045BE	N	PDIP	16	25	506	13.97	11230	4.32
CD4045BE	N	PDIP	16	25	506	13.97	11230	4.32
CD4045BE.A	N	PDIP	16	25	506	13.97	11230	4.32
CD4045BE.A	N	PDIP	16	25	506	13.97	11230	4.32

# N (R-PDIP-T\*\*)

## PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



NOTES:

- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
- The 20 pin end lead shoulder width is a vendor option, either half or full width.



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