

## CD40106BM/CD40106BC Hex Schmitt Trigger

### General Description

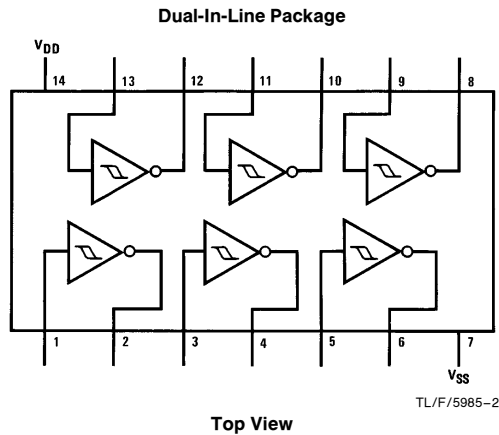
The CD40106B Hex Schmitt Trigger is a monolithic complementary MOS (CMOS) integrated circuit constructed with N and P-channel enhancement transistors. The positive and negative-going threshold voltages,  $V_{T+}$  and  $V_{T-}$ , show low variation with respect to temperature (typ 0.0005V/°C at  $V_{DD} = 10V$ ), and hysteresis,  $V_{T+} - V_{T-} \geq 0.2 V_{DD}$  is guaranteed.

All inputs are protected from damage due to static discharge by diode clamps to  $V_{DD}$  and  $V_{SS}$ .

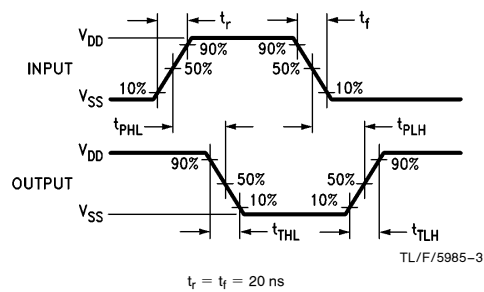
### Features

- Wide supply voltage range 3V to 15V
- High noise immunity  $0.7 V_{DD}$  (typ.)
- Low power Fan out of 2 driving 74L or 1 driving 74LS
- TTL compatibility  $0.4 V_{DD}$  (typ.)
- Hysteresis  $0.2 V_{DD}$  guaranteed
- Equivalent to MM54C14/MM74C14
- Equivalent to MC14584B

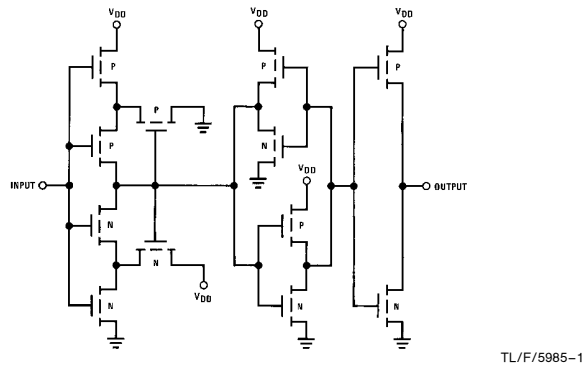
### Connection Diagram



### Switching Time Waveforms



### Schematic Diagram



**Absolute Maximum Ratings** (Notes 1 & 2)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

DC Supply Voltage ( $V_{DD}$ )	-0.5 to +18 $V_{DC}$
Input Voltage ( $V_{IN}$ )	-0.5 to $V_{DD}$ + 0.5 $V_{DC}$
Storage Temperature Range ( $T_S$ )	-65°C to +150°C
Power Dissipation ( $P_D$ )	
Dual-In-Line	700 mW
Small Outline	500 mW
Lead Temperature ( $T_L$ )	
(Soldering, 10 seconds)	260°C

**Recommended Operating Conditions** (Note 2)

DC Supply Voltage ( $V_{DD}$ )	3 to 15 $V_{DC}$
Input Voltage ( $V_{IN}$ )	0 to $V_{DD}$ $V_{DC}$
Operating Temperature Range ( $T_A$ )	
CD40106BM	-55°C to +125°C
CD40106BC	-40°C to +85°C

**DC Electrical Characteristics** CD40106BM (Note 2)

Symbol	Parameter	Conditions	-55°C		+25°C			+125°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
$I_{DD}$	Quiescent Device Current	$V_{DD} = 5V$ , $V_{IN} = V_{DD}$ or $V_{SS}$		1.0			1.0		30	$\mu A$
		$V_{DD} = 10V$ , $V_{IN} = V_{DD}$ or $V_{SS}$		2.0			2.0		60	$\mu A$
		$V_{DD} = 15V$ , $V_{IN} = V_{DD}$ or $V_{SS}$		4.0			4.0		120	$\mu A$
$V_{OL}$	Low Level Output Voltage	$ I_O  < 1 \mu A$ $V_{DD} = 5V$		0.05			0.05		0.05	V
		$V_{DD} = 10V$		0.05			0.05		0.05	V
		$V_{DD} = 15V$		0.05			0.05		0.05	V
$V_{OH}$	High Level Output Voltage	$ I_O  < 1 \mu A$ $V_{DD} = 5V$	4.95		4.95	5		4.95		V
		$V_{DD} = 10V$	9.95		9.95	10		9.95		V
		$V_{DD} = 15V$	14.95		14.95	15		14.95		V
$V_{T-}$	Negative-Going Threshold Voltage	$V_{DD} = 5V$ , $V_O = 4.5V$	0.7	2.0	0.7	1.4	2.0	0.7	2.0	V
		$V_{DD} = 10V$ , $V_O = 9V$	1.4	4.0	1.4	3.2	4.0	1.4	4.0	V
		$V_{DD} = 15V$ , $V_O = 13.5V$	2.1	6.0	2.1	5.0	6.0	2.1	6.0	V
$V_{T+}$	Positive-Going Threshold Voltage	$V_{DD} = 5V$ , $V_O = 0.5V$	3.0	4.3	3.0	3.6	4.3	3.0	4.3	V
		$V_{DD} = 10V$ , $V_O = 1V$	6.0	8.6	6.0	6.8	8.6	6.0	8.6	V
		$V_{DD} = 15V$ , $V_O = 1.5V$	9.0	12.9	9.0	10.0	12.9	9.0	12.9	V
$V_H$	Hysteresis ( $V_{T+} - V_{T-}$ )	$V_{DD} = 5V$	1.0	3.6	1.0	2.2	3.6	1.0	3.6	V
		$V_{DD} = 10V$	2.0	7.2	2.0	3.6	7.2	2.0	7.2	V
		$V_{DD} = 15V$	3.0	10.8	3.0	5.0	10.8	3.0	10.8	V
$I_{OL}$	Low Level Output Current (Note 3)	$V_{DD} = 5V$ , $V_O = 0.4V$	0.64		0.51	0.88		0.36		mA
		$V_{DD} = 10V$ , $V_O = 0.5V$	1.6		1.3	2.25		0.9		mA
		$V_{DD} = 15V$ , $V_O = 1.5V$	4.2		3.4	8.8		2.4		mA
$I_{OH}$	High Level Output Current (Note 3)	$V_{DD} = 5V$ , $V_O = 4.6V$	-0.64		-0.51	-0.88		-0.36		mA
		$V_{DD} = 10V$ , $V_O = 9.5V$	-1.6		-1.3	-2.25		-0.9		mA
		$V_{DD} = 15V$ , $V_O = 13.5V$	-4.2		-3.4	-8.8		-2.4		mA
$I_{IN}$	Input Current	$V_{DD} = 15V$ , $V_{IN} = 0V$		-0.10		$-10^{-5}$	-0.10		-1.0	$\mu A$
		$V_{DD} = 15V$ , $V_{IN} = 15V$		0.10		$10^{-5}$	0.10		1.0	$\mu A$

**Note 1:** "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the devices should be operated at these limits. The table of "Recommended Operating Conditions" and "Electrical Characteristics" provides conditions for actual device operation.

**Note 2:**  $V_{SS} = 0V$  unless otherwise specified.

**Note 3:**  $I_{OH}$  and  $I_{OL}$  are tested one output at a time.

## DC Electrical Characteristics CD40106BC (Note 2)

Symbol	Parameter	Conditions	-40°C		+25°C			+85°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
I <sub>DD</sub>	Quiescent Device Current	V <sub>DD</sub> = 5V V <sub>DD</sub> = 10V V <sub>DD</sub> = 15V		4.0 8.0 16.0			4.0 8.0 16.0		30 60 120	μA μA μA
V <sub>OL</sub>	Low Level Output Voltage	I <sub>O</sub>   < 1 μA V <sub>DD</sub> = 5V V <sub>DD</sub> = 10V V <sub>DD</sub> = 15V		0.05 0.05 0.05			0.05 0.05 0.05		0.05 0.05 0.05	V V V
V <sub>OH</sub>	High Level Output Voltage	I <sub>O</sub>   < 1 μA V <sub>DD</sub> = 5V V <sub>DD</sub> = 10V V <sub>DD</sub> = 15V	4.95 9.95 14.95		4.95 9.95 14.95	5 10 15		4.95 0.95 14.95		V V V
V <sub>T-</sub>	Negative-Going Threshold Voltage	V <sub>DD</sub> = 5V, V <sub>O</sub> = 4.5V V <sub>DD</sub> = 10V, V <sub>O</sub> = 9V V <sub>DD</sub> = 15V, V <sub>O</sub> = 13.5V	0.7 1.4 2.1	2.0 4.0 6.0	0.7 1.4 2.1	1.4 3.2 5.0	2.0 4.0 6.0	0.7 1.4 2.1	2.0 4.0 6.0	V V V
V <sub>T+</sub>	Positive-Going Threshold Voltage	V <sub>DD</sub> = 5V, V <sub>O</sub> = 0.5V V <sub>DD</sub> = 10V, V <sub>O</sub> = 1V V <sub>DD</sub> = 15V, V <sub>O</sub> = 1.5V	3.0 6.0 9.0	4.3 8.6 12.9	3.0 6.0 9.0	3.6 6.8 10.0	4.3 8.6 12.9	3.0 6.0 9.0	4.3 8.6 12.9	V V V
V <sub>H</sub>	Hysteresis (V <sub>T+</sub> - V <sub>T-</sub> ) Voltage	V <sub>DD</sub> = 5V V <sub>DD</sub> = 10V V <sub>DD</sub> = 15V	1.0 2.0 3.0	3.6 7.2 10.8	1.0 2.0 3.0	2.2 3.6 5.0	3.6 7.2 10.8	1.0 2.0 3.0	3.6 7.2 10.8	V V V
I <sub>OL</sub>	Low Level Output Current (Note 3)	V <sub>DD</sub> = 5V, V <sub>O</sub> = 0.4V V <sub>DD</sub> = 10V, V <sub>O</sub> = 0.5V V <sub>DD</sub> = 15V, V <sub>O</sub> = 1.5V	0.52 1.3 3.6		0.44 1.1 3.0	0.88 2.25 8.8		0.36 0.9 2.4		mA mA mA
I <sub>OH</sub>	High Level Output Current (Note 3)	V <sub>DD</sub> = 5V, V <sub>O</sub> = 4.6V V <sub>DD</sub> = 10V, V <sub>O</sub> = 9.5V V <sub>DD</sub> = 15V, V <sub>O</sub> = 13.5V	-0.52 -1.3 -3.6		-0.44 -1.1 -3.0	-0.88 -2.25 -8.8		-0.36 -0.9 -2.4		mA mA mA
I <sub>IN</sub>	Input Current	V <sub>DD</sub> = 15V, V <sub>IN</sub> = 0V V <sub>DD</sub> = 15V, V <sub>IN</sub> = 15V		-0.30 0.30		-10 <sup>-5</sup> 10 <sup>-5</sup>	-0.30 0.30		-1.0 1.0	μA μA

## AC Electrical Characteristics\*

T<sub>A</sub> = 25°C, C<sub>L</sub> = 50 pF, R<sub>L</sub> = 200k, t<sub>r</sub> and t<sub>f</sub> = 20 ns, unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t <sub>PHL</sub> or t <sub>PLH</sub>	Propagation Delay Time from Input to Output	V <sub>DD</sub> = 5V V <sub>DD</sub> = 10V V <sub>DD</sub> = 15V		220 80 70	400 200 160	ns ns ns
t <sub>THL</sub> or t <sub>TLH</sub>	Transition Time	V <sub>DD</sub> = 5V V <sub>DD</sub> = 10V V <sub>DD</sub> = 15V		100 50 40	200 100 80	ns ns ns
C <sub>IN</sub>	Average Input Capacitance	Any Input		5	7.5	pF
C <sub>PD</sub>	Power Dissipation Capacity	Any Gate (Note 4)		14		pF

\*AC Parameters are guaranteed by DC correlated testing.

**Note 1:** "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed; they are not meant to imply that the devices should be operated at these limits. The table of "Recommended Operating Conditions" and "Electrical Characteristics" provides conditions for actual device operation.

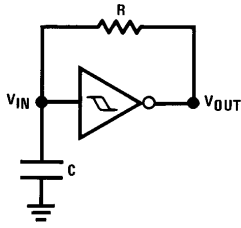
**Note 2:** V<sub>SS</sub> = 0V unless otherwise specified.

**Note 3:** I<sub>OH</sub> and I<sub>OL</sub> are tested one output at a time.

**Note 4:** C<sub>PD</sub> determines the no load ac power consumption of any CMOS device. For complete explanation see 54C/74C Family Characteristics Application Note, AN-90.

## Typical Applications

### Low Power Oscillator



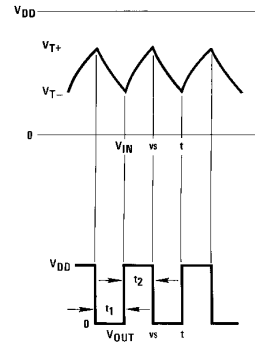
$$t_1 \approx RC \ln \frac{V_{T+}}{V_{T-}}$$

$$t_2 \approx RC \ln \frac{V_{DD} - V_{T-}}{V_{DD} - V_{T+}}$$

$$f \approx \frac{1}{RC \ln \frac{V_{T+}(V_{DD} - V_{T-})}{V_{T-}(V_{DD} - V_{T+})}}$$

Note: The equations assume  $t_1 + t_2 \gg t_{pHL} + t_{pLH}$

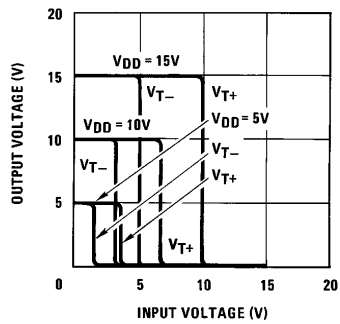
TL/F/5985-4



TL/F/5985-5

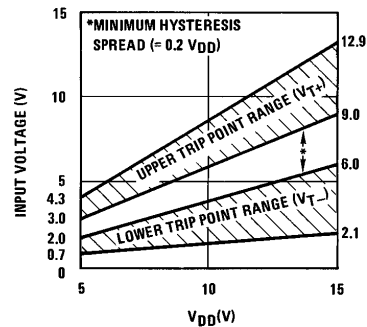
## Typical Performance Characteristics

### Typical Transfer Characteristics

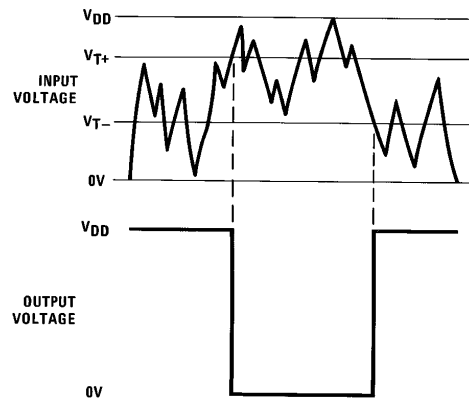


TL/F/5985-6

### Guaranteed Trip Point Range

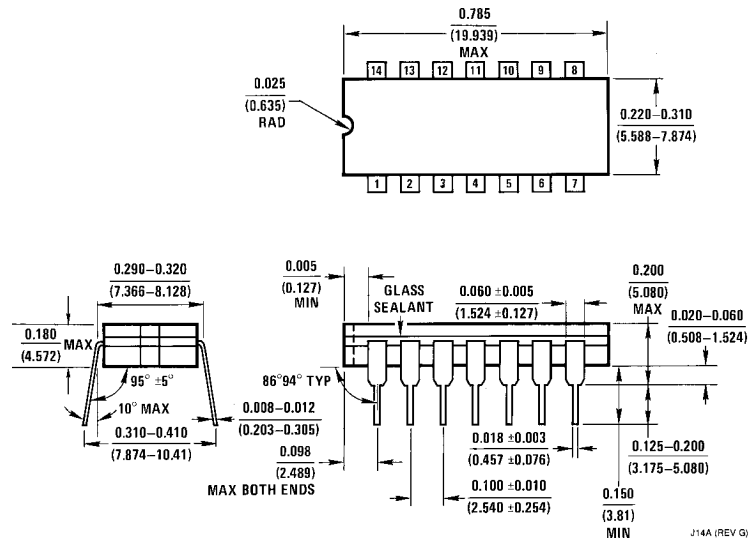


TL/F/5985-7



TL/F/5985-8

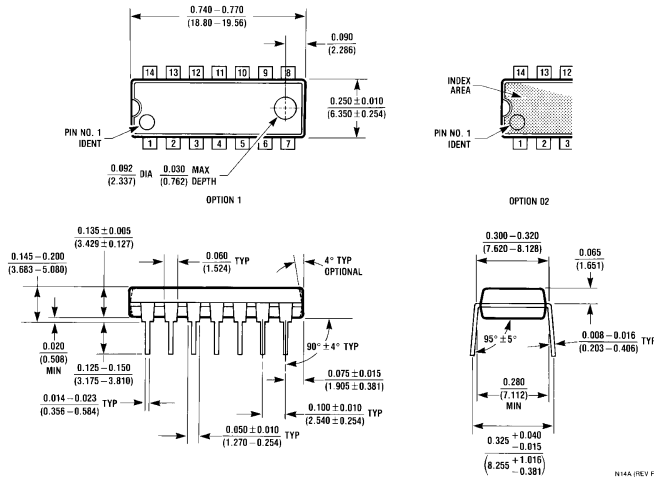
**Physical Dimensions** inches (millimeters)



**Ceramic Dual-In-Line Package (J)**  
**Order Number CD40106BMJ or CD40106BCJ**  
**NS Package Number J14A**

J14A (REV G)

**Physical Dimensions** inches (millimeters) (Continued)



**Molded Dual-In-Line Package (N)**  
**Order Number CD40106BMN or CD40106BCN**  
**NS Package Number N14A**

**LIFE SUPPORT POLICY**

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

 <p><b>National Semiconductor Corporation</b>          1111 West Bardin Road          Arlington, TX 76017          Tel: 1(800) 272-9959          Fax: 1(800) 737-7018</p>	<p><b>National Semiconductor Europe</b>          Fax: (+49) 0-180-530 85 86          Email: cnjwge@tevm2.nsc.com          Deutsch Tel: (+49) 0-180-530 85 85          English Tel: (+49) 0-180-532 78 32          Français Tel: (+49) 0-180-532 93 58          Italiano Tel: (+49) 0-180-534 16 80</p>	<p><b>National Semiconductor Hong Kong Ltd.</b>          19th Floor, Straight Block,          Ocean Centre, 5 Canton Rd.          Tsimshatsui, Kowloon          Hong Kong          Tel: (852) 2737-1600          Fax: (852) 2736-9960</p>	<p><b>National Semiconductor Japan Ltd.</b>          Tel: 81-043-299-2309          Fax: 81-043-299-2408</p>
--	--	---	---

National does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and National reserves the right at any time without notice to change said circuitry and specifications.