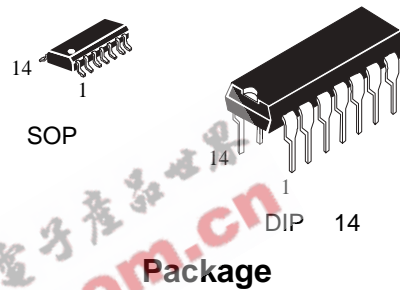


## Description

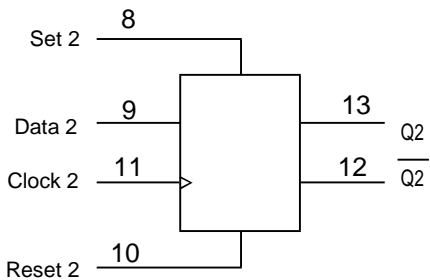
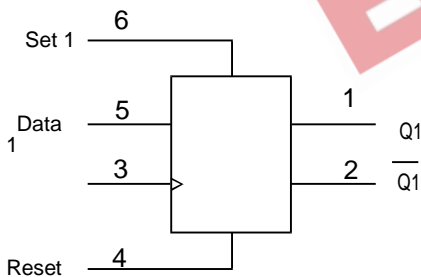
The IW4013B consists of two identical, independent data-type flip-flops. Each flip-flop has independent data, set, reset, and clock inputs and Q and  $\bar{Q}$  outputs. These devices can be used for shift register applications, and, by connecting Q output to the data input, for counter and toggle applications. The logic level present at the Input is transferred to the Q output during the positive-going Transition of the clock pulse. Setting or resetting is independent of clock and is accomplished by a high level on the set or reset line, respectively.

## Features

- Operating Voltage Range: 3.0 to 18 V
- Maximum input current of 1  $\mu$ A at 18 V over full package-temperature range ;100 nA at 18 V and 25  $^{\circ}$ C
- Noise margin (over full package temperature range):  
 1.0 V min @ 5.0 V supply  
 2.0 V min @ 10.0 V supply  
 2.5 V min @ 15.0 V supply

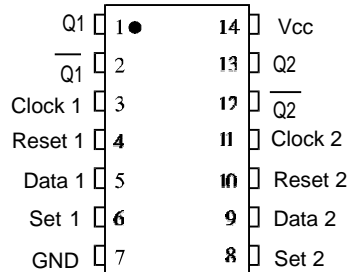


## Logic Diagram



PIN 14 =  
 $\overline{0V}$

## Pin Assignment



## Function Table

Inputs				Outputs	
Clock	Data	Reset	Set	Q	$\bar{Q}$
	L	L	L	L	H
	H	L	L	H	L
	X	L	L	Q	$\bar{Q}$
X	X	H	L	L	H
X	X	L	H	H	L
X	X	H	H	H	H

X = don't care

## Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	DC Supply Voltage (Referenced to GND)	-0.5 to +20	V
V <sub>IN</sub>	DC Input Voltage (Referenced to GND)	-0.5 to V <sub>CC</sub> +0.5	V
I <sub>IN</sub>	DC Input Current, per Pin	±10	mA
P <sub>D</sub>	Power Dissipation in Still Air, Plastic DIP, SOIC Package	500	mW
P <sub>tot</sub>	Power Dissipation per Output Transistor	100	mW
T <sub>stg</sub>	Storage Temperature	-65 to +150	°C
T <sub>L</sub>	Lead Temperature, 1 mm from Case for 10 Seconds (Plastic DIP or SOIC Package)	260	°C

Maximum Ratings are those values beyond which damage to the device may occur. Functional operation should be restricted to the Recommended Operating Conditions.

\*\*Derating - Plastic DIP from -55 to +100°C

- SOIC Package from -55 to +65°C
- Plastic DIP: -12 mW/°C from +100 to +125°C
- SOIC Package: -7 mW/°C from +65 to +125°C

## Recommended Operating Conditions

Symbol	Parameter	Min	Max	Unit
V <sub>CC</sub>	DC Supply Voltage (Referenced to GND)	3.0	18	V
V <sub>IN</sub>	DC Input Voltage (Referenced to GND)	0	V <sub>CC</sub>	V
T <sub>A</sub>	Operating Temperature, All Package Types	-55	+125	°C

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation V<sub>IN</sub> should be constrained to the range GND ≤ V<sub>IN</sub> ≤ V<sub>CC</sub>.

Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or V<sub>CC</sub>). Unused outputs must be left open.

## DC Electrical Characteristics

(Voltages Referenced to GND)

Symbol	Parameter	Test Conditions	V <sub>CC</sub> V	Guaranteed Limit			Unit
				-55°C	25°C	125°C	
V <sub>IH</sub>	Minimum High-Level Input Voltage	V <sub>OUT</sub> =0.5 V or V <sub>CC</sub> - 0.5 V	5.0	3.5	3.5	3.5	V
		V <sub>OUT</sub> =1.0 V or V <sub>CC</sub> - 1.0 V	10	7	7	7	
		V <sub>OUT</sub> =1.5 V or V <sub>CC</sub> - 1.5 V	15	11	11	11	
V <sub>IL</sub>	Maximum Low - Level Input Voltage	V <sub>OUT</sub> =0.5 V or V <sub>CC</sub> - 0.5 V	5.0	1.5	1.5	1.5	V
		V <sub>OUT</sub> =1.0 V or V <sub>CC</sub> - 1.0 V	10	3	3	3	
		V <sub>OUT</sub> =1.5 V or V <sub>CC</sub> - 1.5 V	15	4	4	4	
V <sub>OH</sub>	Minimum High-Level Output Voltage	V <sub>IN</sub> =GND or V <sub>CC</sub>	5.0	4.95	4.95	4.95	V
			10	9.95	9.95	9.95	
			15	14.95	14.95	14.95	
		V <sub>IL</sub> =1.5V, V <sub>IH</sub> =3.5V, I <sub>o</sub> =-1μA	5.0	4.5	4.5	4.5	
		V <sub>IL</sub> =3.0V, V <sub>IH</sub> =7.0V, I <sub>o</sub> =-1μA	10	9.0	9.0	9.0	
V <sub>OL</sub>	Maximum Low-Level Output Voltage	V <sub>IN</sub> =GND or V <sub>CC</sub>	5.0	0.05	0.05	0.05	V
			10	0.05	0.05	0.05	
			15	0.05	0.05	0.05	
		V <sub>IL</sub> =1.5V, V <sub>IH</sub> =3.5V, I <sub>o</sub> =1μA	5.0	0.5	0.5	0.5	
		V <sub>IL</sub> =3.0V, V <sub>IH</sub> =7.0V, I <sub>o</sub> =1μA	10	1.0	1.0	1.0	
I <sub>IN</sub>	Maximum Input Leakage Current	V <sub>IN</sub> = GND or V <sub>CC</sub>	18	± 0.1	± 0.1	± 1.0	uA
I <sub>CC</sub> Quiescent	Maximum Supply Current (per Package)	V <sub>IN</sub> = GND or V <sub>CC</sub>	5.0	1	1	30	uA
			10	2	2	60	
			15	4	4	120	
			20	20	20	600	
	Low (Sink) Current	V <sub>IN</sub> = GND or V <sub>CC</sub>					mA
		U <sub>OL</sub> =0.4 V	5.0	0.64	0.51	0.36	
		U <sub>OL</sub> =0.5 V	10	1.6	1.3	0.9	
I <sub>OH</sub>	Minimum Output High (Source) Current	V <sub>IN</sub> = GND or V <sub>CC</sub>					mA
		U <sub>OH</sub> =2.5 V	5.0	-2.0	-1.6	-1.15	
		U <sub>OH</sub> =4.6 V	5.0	-0.64	-0.51	-0.36	
		U <sub>OH</sub> =9.5 V	10	-1.6	-1.3	-0.9	
		U <sub>OH</sub> =13.5 V	15	-4.2	-3.4	-2.4	

**AC Electrical Characteristics**

 (C<sub>E</sub>=50pF, R<sub>E</sub>=200 kΩ, Input t<sub>r</sub>=t<sub>f</sub>=20 ns)

Symbol	Parameter	V <sub>CC</sub> V	Guaranteed Limit			Unit
			≥ -55°C	25°C	≤ 125°C	
f <sub>max</sub>	Maximum Clock Frequency (Figure 1)	5.0 10 15	3.5 8 12	3.5 8 12	3.0 6 10	MHz
t <sub>PLH</sub> , t <sub>PHL</sub>	Maximum Propagation Delay, Clock to Q or $\bar{Q}$ (Figure 1)	5.0 10 15	300 130 90	300 130 90	450 200 150	ns
t <sub>PLH</sub>	Maximum Propagation Delay, Set to Q or $\bar{Q}$	5.0 10 15	300 130 90	300 130 90	450 200 150	ns
t <sub>PHL</sub>	Maximum Propagation Delay, Set to $\bar{Q}$ or Reset	5.0 10 15	400 170 120	400 170 120	600 250 150	ns
t <sub>TLH</sub> , t <sub>THL</sub>	Maximum Output Transition Time, Any Output (Figure 1)	5.0 10 15	200 100 80	200 100 80	250 150 100	ns
C <sub>IN</sub>	Maximum Input Capacitance	5.0		7.5		pF

**Timing**

 (C<sub>E</sub>=50pF, R<sub>E</sub>=200 kΩ, Input t<sub>r</sub>=t<sub>f</sub>=20 ns)

Symbol	Parameter	V <sub>CC</sub> V	Guaranteed Limit			Unit
			≥ -55°C	25°C	≤ 125°C	
t <sub>w</sub>	Minimum Pulse Width, Clock (Figure 1)	5.0 10 15	140 60 40	140 60 40	200 80 50	ns
t <sub>w</sub>	Minimum Pulse Width, Set or Reset (Figure 2)	5.0 10 15	180 80 50	180 80 50	250 120 80	ns
t <sub>su</sub>	Minimum Setup Time, Data to Clock (Figure 3)	5.0 10 15	40 20 15	40 20 15	40 20 15	ns
t <sub>h</sub>	Minimum Hold Time, Clock to Data (Figure 3)	5.0 10 15	5 5 5	5 5 5	8 5 5	ns
t <sub>r</sub> , t <sub>f</sub>	Maximum Input Rise or Fall Time, Clock (Figure 1)	5.0 10 15	500 30 6	500 30 6	500 30 6	μs

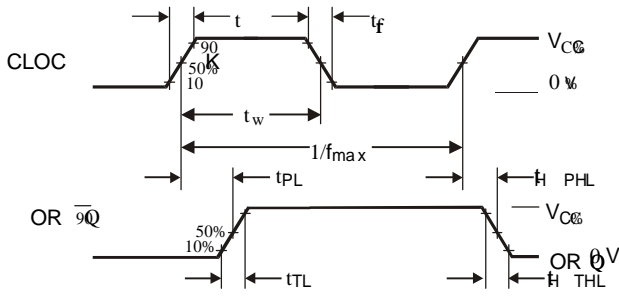


Figure 1. Switching Waveforms

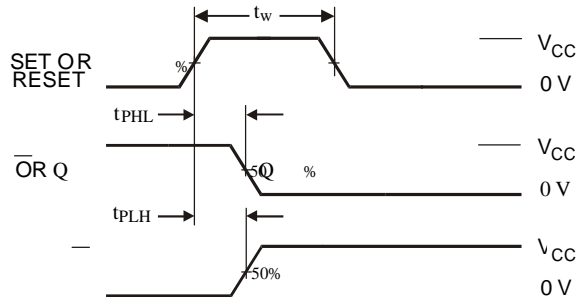


Figure 2. Switching Waveforms

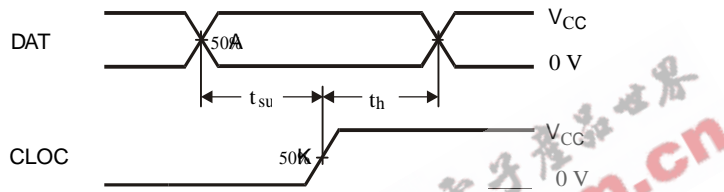
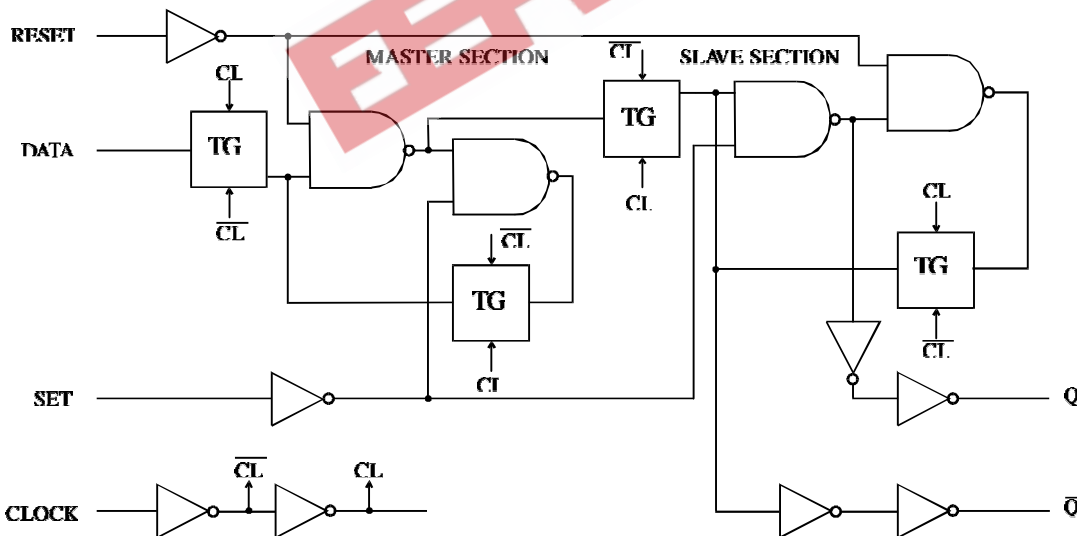


Figure 3. Switching Waveforms

## Expanded Logic Diagram (1/2 of the Device)



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