

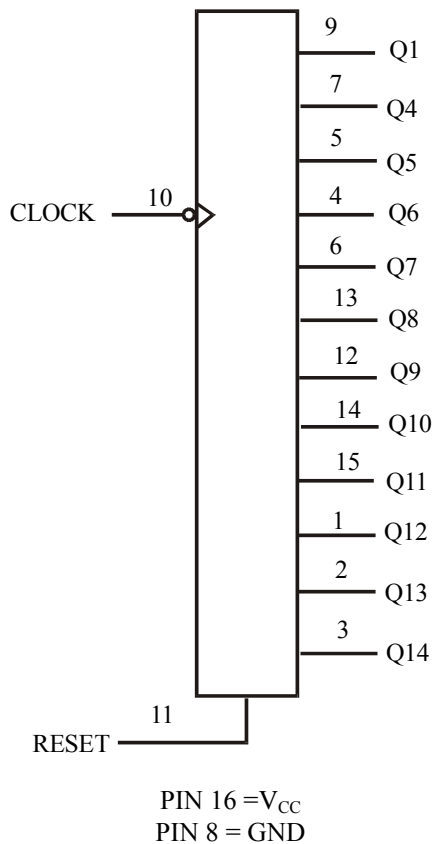
IW4020B

14 Stage Ripple-Carry Binary Counter/Divider
High-Voltage Silicon-Gate CMOS

The IW4020B is ripple-carry binary counter. All counter stages are master-slave flip-flops. The state of a counter advances one count on the negative transition of each input pulse; a high level on the RESET line resets the counter to its all zeros state. Schmitt trigger action on the input-pulse line permits unlimited rise and fall times.

- Operating Voltage Range: 3.0 to 18 V
- Maximum input current of 1 μ A at 18 V over full package-temperature range; 100 nA at 18 V and 25°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



N SUFFIX
PLASTIC DIP

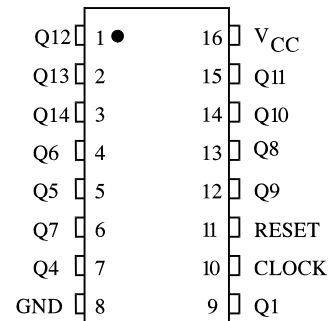
D SUFFIX
SOIC

ORDERING INFORMATION

IW4020BN Plastic DIP
IW4020BD SOIC

T_A = -55° to 125° C for all packages

PIN ASSIGNMENT



FUNCTION TABLE

| Inputs | | Output |
|--------|-------|-----------------------|
| Clock | Reset | Output state |
| | L | No change |
| | L | Advance to next state |
| X | H | All Outputs are low |

H= high level
 L = low level
 X=don't care

MAXIMUM RATINGS*

| Symbol | Parameter | Value | Unit |
|------------------|--|------------------------------|------|
| V _{CC} | DC Supply Voltage (Referenced to GND) | -0.5 to +20 | V |
| V _{IN} | DC Input Voltage (Referenced to GND) | -0.5 to V _{CC} +0.5 | V |
| V _{OUT} | DC Output Voltage (Referenced to GND) | -0.5 to V _{CC} +0.5 | V |
| I _{IN} | DC Input Current, per Pin | ±10 | mA |
| P _D | Power Dissipation in Still Air, Plastic DIP+ SOIC Package+ | 500* ¹ | mW |
| P _{tot} | Power Dissipation per Output Transistor | 100 | mW |
| T _{stg} | Storage Temperature | -65 to +150 | °C |
| T _L | 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.

*¹ For T_A=-55 to 100°C (package plastic DIP), for T_A=-55 to 65°C (package SOIC)

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

RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Min | Max | Unit |
|------------------------------------|--|-----|-----------------|------|
| V _{CC} | DC Supply Voltage (Referenced to GND) | 3.0 | 18 | V |
| V _{IN} , V _{OUT} | DC Input Voltage, Output Voltage (Referenced to GND) | 0 | V _{CC} | V |
| T _A | 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_{IN} and V_{OUT} should be constrained to the range GND ≤ (V_{IN} or V_{OUT}) ≤ V_{CC}.

Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or V_{CC}). Unused outputs must be left open.

DC ELECTRICAL CHARACTERISTICS (Voltages Referenced to GND)

| Symbol | Parameter | Test Conditions | V _{CC} V | Guaranteed Limit | | | Unit |
|-----------------|--|--|----------------------|------------------|-------|-------|------|
| | | | | -55°C | 25°C | 125°C | |
| V _{IH} | Minimum High-Level Input Voltage | V _{OUT} =0.5 V or V _{CC} - 0.5 V V _{OUT} =1.0 V or V _{CC} - 1.0 V V _{OUT} =1.5 V or V _{CC} - 1.5 V | 5.0 | 3.5 | 3.5 | 3.5 | V |
| | | | 10 | 7.0 | 7.0 | 7.0 | |
| | | | 15 | 11.0 | 11.0 | 11.0 | |
| V _{IL} | Maximum Low -Level Input Voltage | V _{OUT} =0.5 V or V _{CC} - 0.5 V V _{OUT} =1.0 V or V _{CC} - 1.0 V V _{OUT} =1.5 V or V _{CC} - 1.5 V | 5.0 | 1.5 | 1.5 | 1.5 | V |
| | | | 10 | 3.0 | 3.0 | 3.0 | |
| | | | 15 | 4.0 | 4.0 | 4.0 | |
| V _{OH} | Minimum High-Level Output Voltage | V _{IN} = GND or V _{CC} | 5.0 | 4.95 | 4.95 | 4.95 | V |
| | | | 10 | 9.95 | 9.95 | 9.95 | |
| | | | 15 | 14.95 | 14.95 | 14.95 | |
| V _{OL} | Maximum Low-Level Output Voltage | V _{IN} = GND or V _{CC} | 5.0 | 0.05 | 0.05 | 0.05 | V |
| | | | 10 | 0.05 | 0.05 | 0.05 | |
| | | | 15 | 0.05 | 0.05 | 0.05 | |
| I _{IN} | Maximum Input Leakage Current | V _{IN} = GND or V _{CC} | 18 | ±0.1 | ±0.1 | ±1.0 | µA |
| I _{CC} | Maximum Quiescent Supply Current (per Package) | V _{IN} = GND or V _{CC} | 5.0 | 5 | 5 | 150 | µA |
| | | | 10 | 10 | 10 | 300 | |
| | | | 15 | 20 | 20 | 600 | |
| | | | 20 | 100 | 100 | 3000 | |
| I _{OL} | Minimum Output Low (Sink) Current | V _{IN} = GND or V _{CC} U _{OL} =0.4 V U _{OL} =0.5 V U _{OL} =1.5 V | 5.0 | 0.64 | 0.51 | 0.36 | mA |
| | | | 10 | 1.6 | 1.3 | 0.9 | |
| | | | 15 | 4.2 | 3.4 | 2.4 | |
| I _{OH} | Minimum Output High (Source) Current | V _{IN} = GND or V _{CC} U _{OH} =2.5 V U _{OH} =4.6 V U _{OH} =9.5 V U _{OH} =13.5 V | 5.0 | -2.0 | -1.6 | -1.15 | mA |
| | | | 5.0 | -0.64 | -0.51 | -0.36 | |
| | | | 10 | -1.6 | -1.3 | -0.9 | |
| | | | 15 | -4.2 | -3.4 | -2.4 | |

AC ELECTRICAL CHARACTERISTICS ($C_L=50$ pF, $R_L=200$ k Ω , $t_r=t_f=20$ ns)

| Symbol | Parameter | V _{CC} V | Guaranteed Limit | | | Unit |
|-------------------------------------|--|----------------------|-------------------|-------------------|-------------------|------|
| | | | -55°C | 25°C | 125°C | |
| f _{max} | Maximum Clock Frequency (Figure 1) | 5.0 10 15 | | 3.5 8 12 | | MHz |
| t _{PLH} , t _{PHL} | Maximum Propagation Delay, Clock to Q1 (Figure 1) | 5.0 10 15 | 720 320 260 | 360 160 130 | 720 320 260 | ns |
| t _{PLH} , t _{PHL} | Maximum Propagation Delay, Q _n to Q _{n+1} (Figure 2) | 5.0 10 15 | 660 160 120 | 330 80 60 | 660 160 120 | ns |
| t _{PHL} | Maximum Propagation Delay, Reset to Any Q (Figure 3) | 5.0 10 15 | 560 240 200 | 280 120 100 | 560 240 200 | ns |
| t _{TLH} , t _{THL} | Maximum Output Transition Time, Any Output (Figure 1) | 5.0 10 15 | 400 200 160 | 200 100 80 | 400 200 160 | ns |
| C _{IN} | Maximum Input Capacitance | - | | 7.5 | | pF |

TIMING REQUIREMENTS ($C_L=50$ pF, $R_L=200$ k Ω , $t_r=t_f=20$ ns)

| Symbol | Parameter | V _{CC} V | Guaranteed Limit | | | Unit |
|---------------------------------|---|----------------------|-------------------|-------------------|-------------------|------|
| | | | -55°C | 25°C | 125°C | |
| t _w | Minimum Pulse Width, Clock (Figure 1) | 5.0 10 15 | 280 120 80 | 140 60 40 | 280 120 80 | ns |
| t _w | Minimum Pulse Width, Reset (Figure 3) | 5.0 10 15 | 400 160 120 | 200 80 60 | 400 160 120 | ns |
| t _{rem} | Minimum Removal Time, Reset(Figure 3) | 5.0 10 15 | 700 300 200 | 350 150 100 | 700 300 200 | ns |
| t _r , t _f | Maximum Input Rise and Fall Times, Clock (Figure 1) | 5.0 10 15 | Unlimited | | | ns |

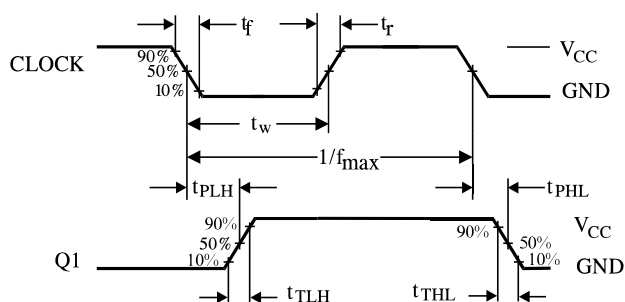


Figure 1. Switching Waveforms

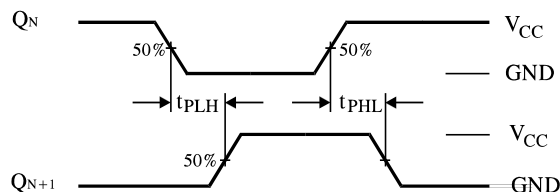


Figure 2. Switching Waveforms

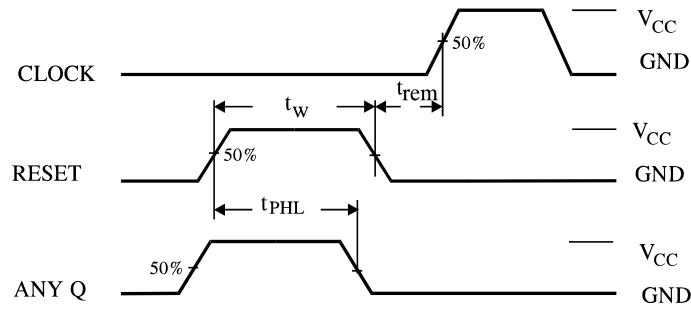
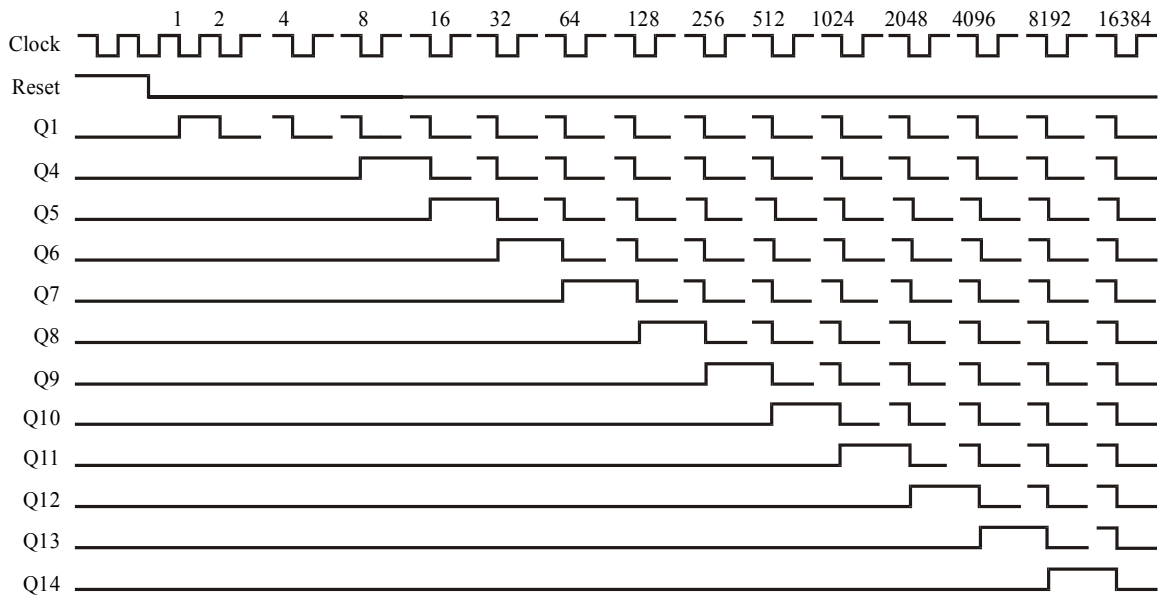
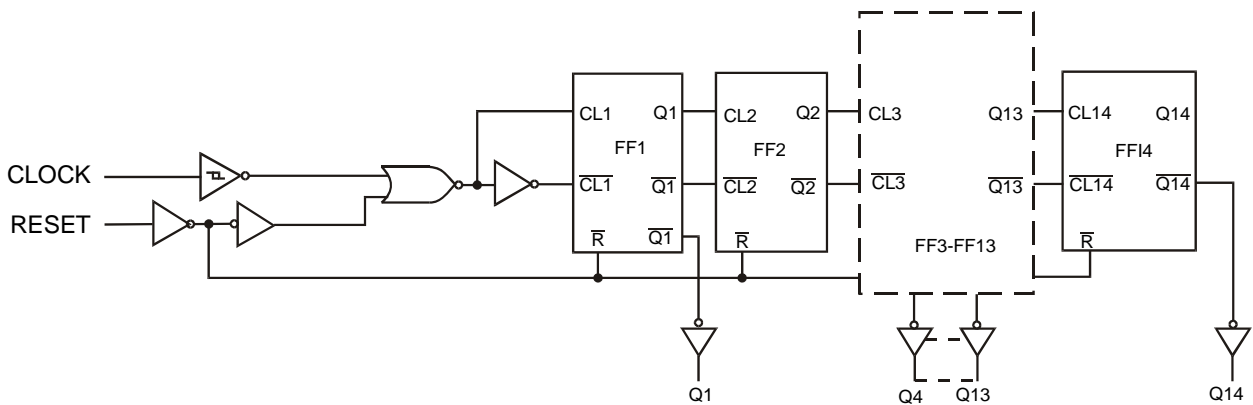


Figure 3. Switching Waveforms

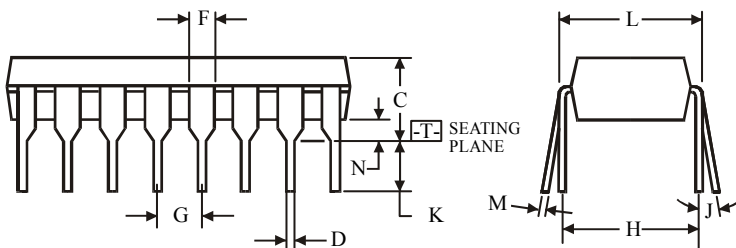
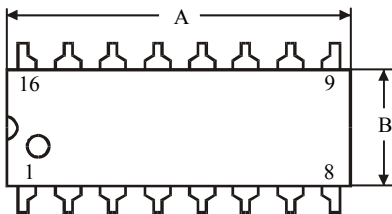
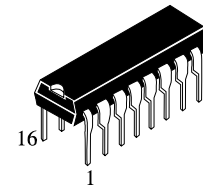
TIMING DIAGRAM



EXPANDED LOGIC DIAGRAM



**N SUFFIX PLASTIC
(MS - 001BB)**



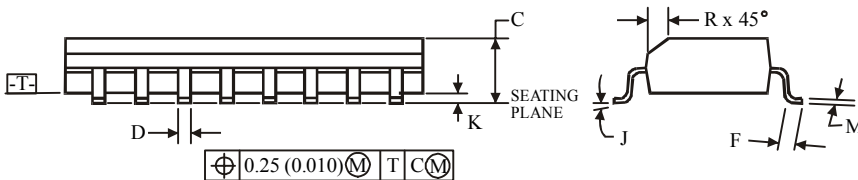
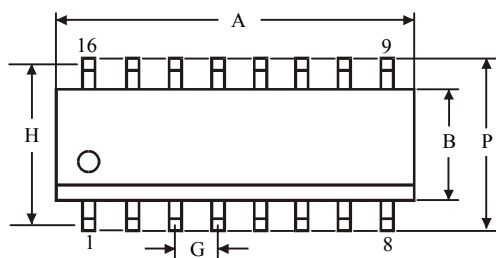
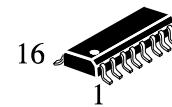
$\text{⌀} 0.25 (0.010) \text{Ⓜ} \text{ T}$

| Symbol | Dimensions, mm | |
|--------|----------------|-------|
| | MIN | MAX |
| A | 18.67 | 19.69 |
| B | 6.10 | 7.11 |
| C | | 5.33 |
| D | 0.36 | 0.56 |
| F | 1.14 | 1.78 |
| G | 2.54 | |
| H | 7.62 | |
| J | 0° | 10° |
| K | 2.92 | 3.81 |
| L | 7.62 | 8.26 |
| M | 0.20 | 0.36 |
| N | 0.38 | |

NOTES:

- Dimensions "A", "B" do not include mold flash or protrusions. Maximum mold flash or protrusions 0.25 mm (0.010) per side.

**D SUFFIX SOIC
(MS - 012AC)**



$\text{⌀} 0.25 (0.010) \text{Ⓜ} \text{ T CⓂ}$

| Symbol | Dimensions, mm | |
|--------|----------------|------|
| | MIN | MAX |
| A | 9.80 | 10.0 |
| B | 3.80 | 4.00 |
| C | 1.35 | 1.75 |
| D | 0.33 | 0.51 |
| F | 0.40 | 1.27 |
| G | 1.27 | |
| H | 5.72 | |
| J | 0° | 8° |
| K | 0.10 | 0.25 |
| M | 0.19 | 0.25 |
| P | 5.80 | 6.20 |
| R | 0.25 | 0.50 |

NOTES:

- Dimensions A and B do not include mold flash or protrusion.
- Maximum mold flash or protrusion 0.15 mm (0.006) per side for A, for B - 0.25 mm (0.010) per side.