

CMOS 4-Bit Magnitude Comparator

High Voltage Types (20-Volt Rating)

■ CD4585B is a 4-bit magnitude comparator designed for use in computer and logic applications that require the comparison of two 4-bit words. This logic circuit determines whether one 4-bit word (Binary or BCD) is "less than", "equal to", or "greater than" a second 4-bit word.

The CD4585B has eight comparing inputs (A3, B3, through A0, B0), three outputs (A < B, A = B, A > B) and three cascading inputs (A < B, A = B, A > B) that permit systems designers to expand the comparator function to 8, 12, 16.....4N bits. When a single CD4585B is used, the cascading inputs are connected as follows: (A < B) = low, (A = B) = high, (A > B) = high.

Cascading these units for comparison of more than 4 bits is accomplished as shown in Fig. 13.

The CD4585B types are supplied in 16-lead hermetic dual-in-line ceramic packages (D and F suffixes), 16-lead dual-in-line plastic packages (E suffix), and in chip form (H suffix). This device is pin-compatible with low-power TTL type 7485 and the CMOS types MC14585 and 40085.

Features:

- Expansion to 8,12,16.....4N bits by cascading units
- Medium-speed operation: compares two 4-bit words in 180 ns (typ.) at 10 V
- 100% tested for quiescent current at 20 V
- Standardized symmetrical output characteristics
- 5-V, 10-V, and 15-V parametric ratings
- 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 (full package temperature range) = 1 V at $V_{DD} = 5$ V
2 V at $V_{DD} = 10$ V
2.5 V at $V_{DD} = 15$ V
- Meets all requirements of JEDEC Tentative Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices"

Applications:

- Servo motor controls
- Process controllers

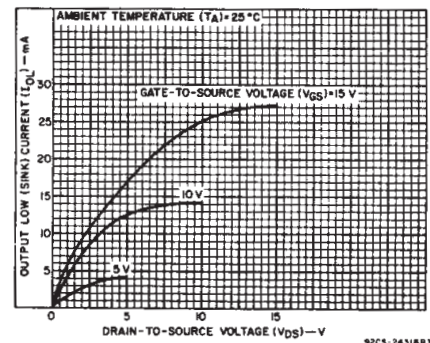
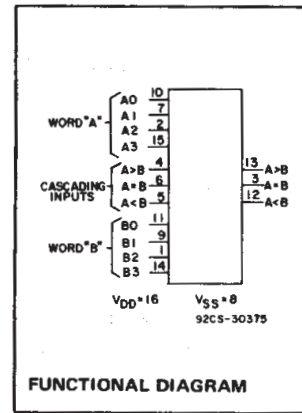


Fig. 1 - Typical output low (sink) current characteristics.

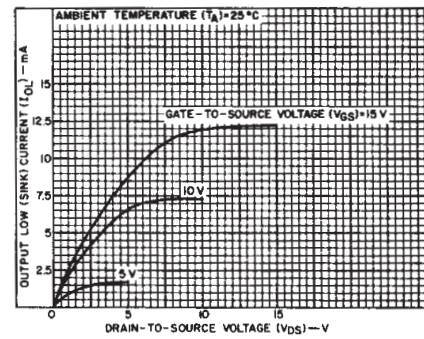


Fig. 2 - Minimum output low (sink) current characteristics.

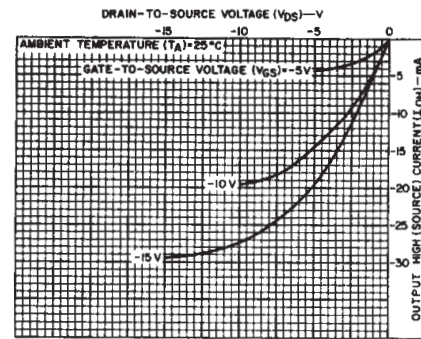


Fig. 3 - Typical output high (source) current characteristics.

MAXIMUM RATINGS, Absolute-Maximum Values:

DC SUPPLY-VOLTAGE RANGE, (V_{DD})

Voltages referenced to V_{SS} Terminal -0.5V to +20V

INPUT VOLTAGE RANGE, ALL INPUTS -0.5V to $V_{DD} + 0.5$ V

DC INPUT CURRENT, ANY ONE INPUT ± 10 mA

POWER DISSIPATION PER PACKAGE (P_D):

For $T_A = -55^\circ\text{C}$ to $+100^\circ\text{C}$ 500mW

For $T_A = +100^\circ\text{C}$ to $+125^\circ\text{C}$ Derate Linearly at 12mW/ $^\circ\text{C}$ to 200mW

DEVICE DISSIPATION PER OUTPUT TRANSISTOR

FOR $T_A = \text{FULL PACKAGE-TEMPERATURE RANGE (All Package Types)}$ 100mW

OPERATING-TEMPERATURE RANGE (T_A) -55°C to $+125^\circ\text{C}$

STORAGE TEMPERATURE RANGE (T_{stg}) -65°C to $+150^\circ\text{C}$

LEAD TEMPERATURE (DURING SOLDERING):

At distance $1/16 \pm 1/32$ inch (1.59 ± 0.79 mm) from case for 10s max $+265^\circ\text{C}$

RECOMMENDED OPERATING CONDITIONS

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

| CHARACTERISTIC | LIMITS | | UNITS |
|---|--------|------|-------|
| | Min. | Max. | |
| Supply-Voltage Range (For $T_A = \text{Full Package-Temperature Range}$) | 3 | 18 | V |

CD4585B Types

TRUTH TABLE

| INPUTS | | | | CASCADING | | | OUTPUTS | | |
|-----------|---------|---------|-----------|-----------|-------|---------|---------|-------|-------|
| COMPARING | | | CASCADING | | | OUTPUTS | | | |
| A3, B3 | A2, B2 | A1, B1 | A0, B0 | A < B | A = B | A > B | A < B | A = B | A > B |
| A3 > B3 | X | X | X | X | X | 1 | 0 | 0 | 1 |
| A3 = B3 | A2 > B2 | X | X | X | X | 1 | 0 | 0 | 1 |
| A3 = B3 | A2 = B2 | A1 > B1 | X | X | X | 1 | 0 | 0 | 1 |
| A3 = B3 | A2 = B2 | A1 = B1 | A0 > B0 | X | X | 1 | 0 | 0 | 1 |
| A3 = B3 | A2 = B2 | A1 = B1 | A0 = B0 | 0 | 0 | 1 | 0 | 0 | 1 |
| A3 = B3 | A2 = B2 | A1 = B1 | A0 = B0 | 0 | 1 | X | 0 | 1 | 0 |
| A3 = B3 | A2 = B2 | A1 = B1 | A0 = B0 | 1 | 0 | X | 1 | 0 | 0 |
| A3 = B3 | A2 = B2 | A1 = B1 | A0 < B0 | X | X | X | 1 | 0 | 0 |
| A3 = B3 | A2 = B2 | A1 < B1 | X | X | X | X | 1 | 0 | 0 |
| A3 = B3 | A2 < B2 | X | X | X | X | X | 1 | 0 | 0 |
| A3 < B3 | X | X | X | X | X | X | 1 | 0 | 0 |

X = Don't Care

Logic 1 = High Level

Logic 0 = Low Level

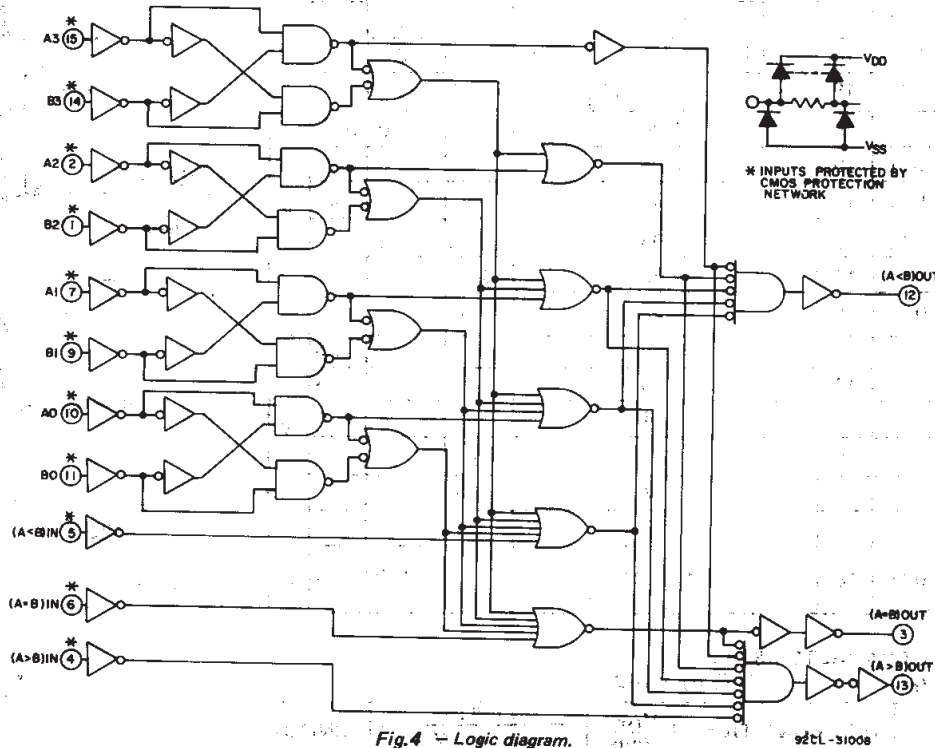


Fig. 4 - Logic diagram.

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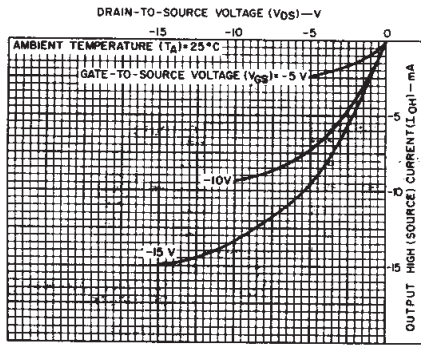


Fig. 5 - Minimum output high (source) current characteristics.

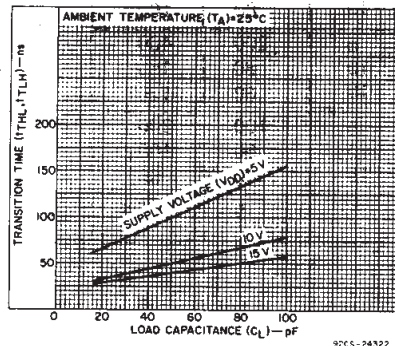


Fig. 6 - Typical transition time as a function of load capacitance.

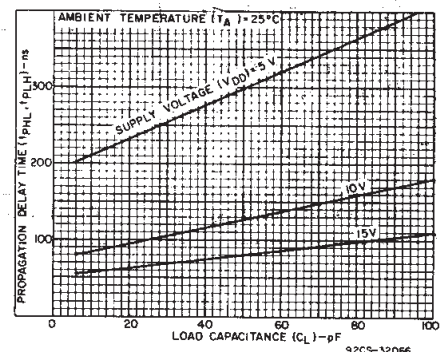


Fig. 7 - Typical propagation delay time ("comparing inputs" to outputs) as a function of load capacitance.

CD4585B Types

STATIC ELECTRICAL CHARACTERISTICS

| CHARACTERISTIC | CONDITIONS | | | LIMITS AT INDICATED TEMPERATURES (°C) | | | | | | | UNITS |
|--|--------------------|---------------------|---------------------|---------------------------------------|-------|-------|-------|-------|-------------------|------|-------|
| | V _O (V) | V _{IN} (V) | V _{DD} (V) | -55 | -40 | +85 | +125 | +25 | | | |
| | | | | | | | | Min. | Typ. | Max. | |
| Quiescent Device Current, I _{DD} Max. | — | 0,5 | 5 | 5 | 5 | 150 | 150 | — | 0,04 | 5 | μA |
| | — | 0,10 | 10 | 10 | 10 | 300 | 300 | — | 0,04 | 10 | |
| | — | 0,15 | 15 | 20 | 20 | 600 | 600 | — | 0,04 | 20 | |
| | — | 0,20 | 20 | 100 | 100 | 3000 | 3000 | — | 0,08 | 100 | |
| Output Low (Sink) Current I _{OL} Min. | 0,4 | 0,5 | 5 | 0,64 | 0,61 | 0,42 | 0,36 | 0,51 | 1 | — | mA |
| | 0,5 | 0,10 | 10 | 1,6 | 1,5 | 1,1 | 0,9 | 1,3 | 2,6 | — | |
| | 1,5 | 0,15 | 15 | 4,2 | 4 | 2,8 | 2,4 | 3,4 | 6,8 | — | |
| Output High (Source) Current, I _{OH} Min. | 4,6 | 0,5 | 5 | -0,64 | -0,61 | -0,42 | -0,36 | -0,51 | -1 | — | mA |
| | 2,5 | 0,5 | 5 | -2 | -1,8 | -1,3 | -1,15 | -1,6 | -3,2 | — | |
| | 9,5 | 0,10 | 10 | -1,6 | -1,5 | -1,1 | -0,9 | -1,3 | -2,6 | — | |
| Output Voltage: Low-Level, V _{OL} Max. | — | 0,5 | 5 | 0,05 | | | — | 0 | 0,05 | — | V |
| | — | 0,10 | 10 | 0,05 | | | — | 0 | 0,05 | — | |
| | — | 0,15 | 15 | 0,05 | | | — | 0 | 0,05 | — | |
| Output Voltage: High-Level, V _{OH} Min. | — | 0,5 | 5 | 4,95 | | | — | 4,95 | 5 | — | V |
| | — | 0,10 | 10 | 9,95 | | | — | 9,95 | 10 | — | |
| | — | 0,15 | 15 | 14,95 | | | — | 14,95 | 15 | — | |
| Input Low Voltage V _{IL} Max. | 0,5,4,5 | — | 5 | 1,5 | | | — | — | 1,5 | — | V |
| | 1,9 | — | 10 | 3 | | | — | — | 3 | — | |
| | 1,5,13,5 | — | 15 | 4 | | | — | — | 4 | — | |
| Input High Voltage, V _{IH} Min. | 0,5,4,5 | — | 5 | 3,5 | | | — | 3,5 | — | — | V |
| | 1,9 | — | 10 | 7 | | | — | 7 | — | — | |
| | 1,5,13,5 | — | 15 | 11 | | | — | 11 | — | — | |
| Input Current I _{IN} Max. | — | 0,18 | 18 | ±0,1 | ±0,1 | ±1 | ±1 | — | ±10 ⁻⁵ | ±0,1 | μA |

DYNAMIC ELECTRICAL CHARACTERISTICS

At T_A = 25°C; Input t_r, t_f = 20 ns, C_L = 50 pF, R_L = 200 kΩ

| CHARACTERISTIC | TEST CONDITIONS | V _{DD} Volts | LIMITS | | UNITS |
|--|-----------------|-----------------------|--------|------|-------|
| | | | Typ. | Max. | |
| Propagation Delay Time: Comparing Inputs to Outputs, t _{PHL} , t _{PLH} | | 5 | 300 | 600 | ns |
| | | 10 | 125 | 250 | |
| | | 15 | 80 | 160 | |
| Cascading Inputs to Outputs, t _{PHL} , t _{PLH} | | 5 | 200 | 400 | ns |
| | | 10 | 80 | 160 | |
| | | 15 | 60 | 120 | |
| Transition Time, t _{THL} , t _{TLH} | | 5 | 100 | 200 | ns |
| | | 10 | 50 | 100 | |
| | | 15 | 40 | 80 | |
| Input Capacitance, C _{IN} | Any Input | | 5 | 7,5 | pF |

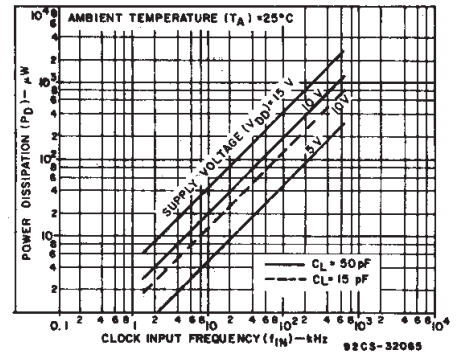


Fig. 8 — Typical dynamic power dissipation as a function of clock input frequency (see Fig. 9—dynamic power dissipation test circuit).

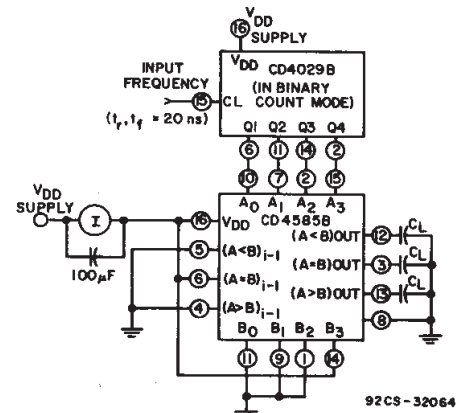


Fig. 9 — Dynamic power dissipation test circuit.

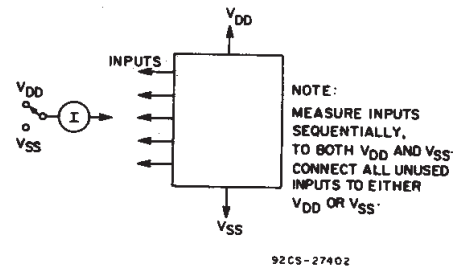


Fig. 10 — Input current test circuit.

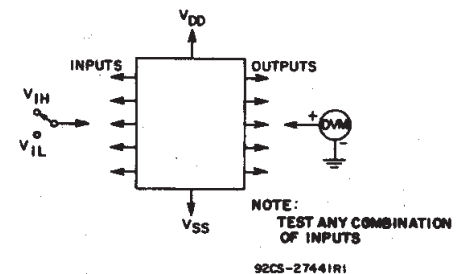


Fig. 11 — Input-voltage test circuit.

CD4585B Types

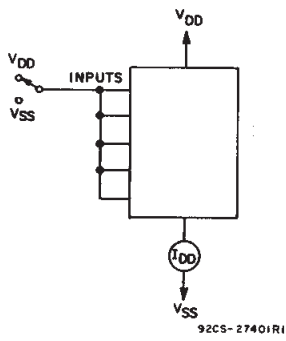
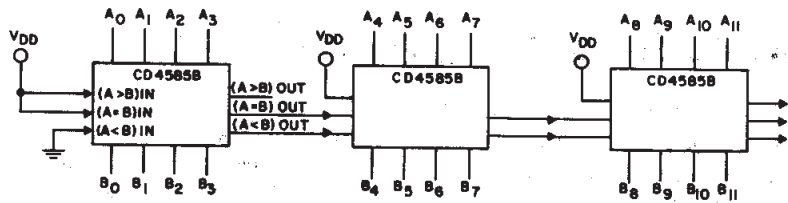


Fig. 12 — Quiescent-device-current test circuit.



$$t_p \text{ TOTAL} = t_p \text{ (COMPARE INPUTS)} + 2 \times t_p \text{ (CASCADE INPUTS)}, \text{ AT } V_{DD} = 10V$$

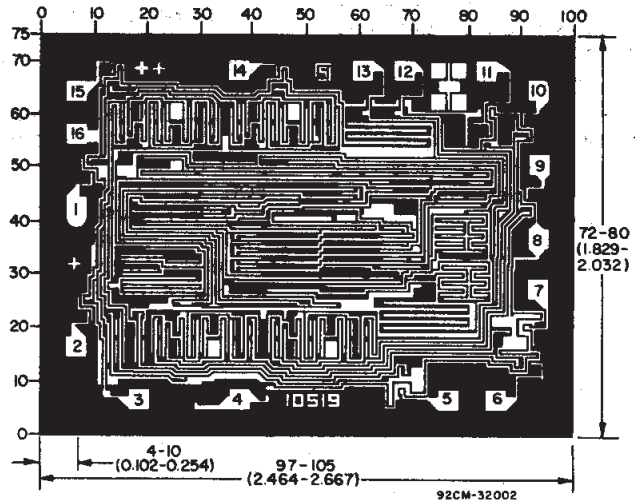
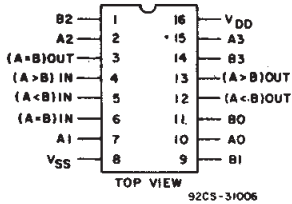
(3 STAGES)

$$= 120 + 2(80) = 280 \text{ ns (TYP.)}$$

92CM-31007R1

Fig. 13 — Typical speed characteristics of a 12-bit comparator.

TERMINAL ASSIGNMENT



Dimensions and Pad Layout for CD4585BH

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

3
COMMERCIAL CMOS
HIGH VOLTAGE ICs

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