

CD40174BMS

CMOS Hex 'D'-Type Flip-Flop

Rev X.00
Jan 13, 2017

Features

- High Voltage Type (20V Rating)
- 5V, 10V and 15V Parametric Ratings
- Standardized, Symmetrical Output Characteristics
- 100% Tested for Quiescent Current at 20V
- Maximum Input Current of 1 μ A at 18V Over Full Package Temperature Range, 100nA at 18V and +25°C
- Noise Margin (Over full Package Temperature Range):
 - 1V at VDD = 5V
 - 2V at VDD = 10V
 - 2.5V at VDD = 15V
- Meets All Requirements of JEDEC Tentative Standard No. 13A, "Standard Specifications for Description of 'B' Series CMOS Devices"

Applications

- Shift Registers
- Buffer/Storage Registers
- Pattern Generators

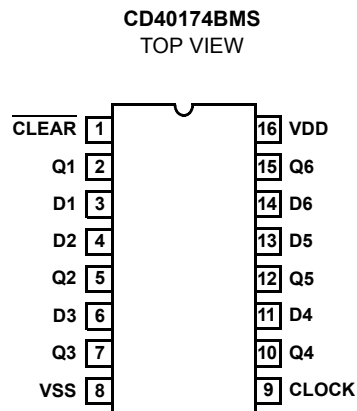
Description

CD40174BMS consists of six identical 'D'-Type flip-flops having independent DATA inputs. The CLOCK and CLEAR inputs are common to all six units. Data is transferred to the Q outputs on the positive going transition of the clock pulse. All six flip-flops are simultaneously reset by a low level on the CLEAR input.

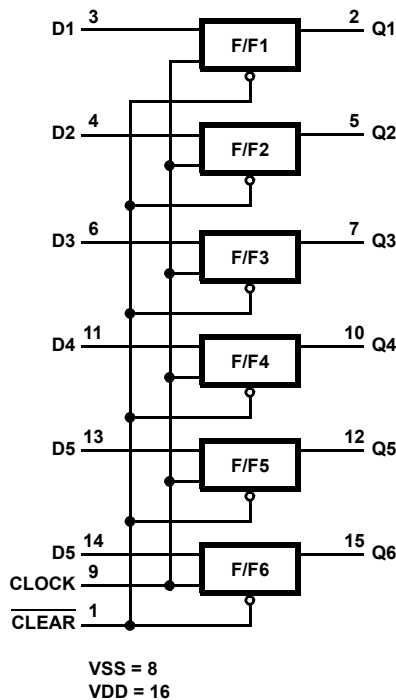
The CD40174BMS is supplied in these 16 lead outline packages:

| | |
|------------------|-----|
| Braze Seal DIP | H4T |
| Frit Seal DIP | H1E |
| Ceramic Flatpack | H6W |

Pinout



Functional Diagram



Absolute Maximum Ratings

DC Supply Voltage Range, (VDD) -0.5V to +20V
 (Voltage Referenced to VSS Terminals)
 Input Voltage Range, All Inputs -0.5V to VDD +0.5V
 DC Input Current, Any One Input ±10mA
 Operating Temperature Range -55°C to +125°C
 Package Types D, F, K, H
 Storage Temperature Range (TSTG) -65°C to +150°C
 Lead Temperature (During Soldering) +265°C
 At Distance 1/16 ± 1/32 Inch (1.59mm ± 0.79mm) from case for
 10s Maximum

Reliability Information

Thermal Resistance θ_{ja} θ_{jc}
 Ceramic DIP and FRIT Package 80°C/W 20°C/W
 Flatpack Package 70°C/W 20°C/W
 Maximum Package Power Dissipation (PD) at +125°C
 For TA = -55°C to +100°C (Package Type D, F, K) 500mW
 For TA = +100°C to +125°C (Package Type D, F, K) Derate
 Linearity at 12mW/°C to 200mW
 Device Dissipation per Output Transistor 100mW
 For TA = Full Package Temperature Range (All Package Types)
 Junction Temperature +175°C

TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS

| PARAMETER | SYMBOL | CONDITIONS (NOTE 1) | | GROUP A SUBGROUPS | TEMPERATURE | LIMITS | | UNITS |
|-----------------------------|--------|------------------------------------|-----------|----------------------|----------------------|----------------|----------------|-------|
| | | | | | | MIN | MAX | |
| Supply Current | IDD | VDD = 20V, VIN = VDD or GND | | 1 | +25°C | - | 2 | µA |
| | | | | 2 | +125°C | - | 200 | µA |
| | | VDD = 18V, VIN = VDD or GND | | 3 | -55°C | - | 2 | µA |
| Input Leakage Current | IIL | VIN = VDD or GND | VDD = 20 | 1 | +25°C | -100 | - | nA |
| | | | VDD = 18V | 2 | +125°C | -1000 | - | nA |
| | | | | 3 | -55°C | -100 | - | nA |
| Input Leakage Current | IIH | VIN = VDD or GND | VDD = 20 | 1 | +25°C | - | 100 | nA |
| | | | VDD = 18V | 2 | +125°C | - | 1000 | nA |
| | | | | 3 | -55°C | - | 100 | nA |
| Output Voltage | VOL15 | VDD = 15V, No Load | | 1, 2, 3 | +25°C, +125°C, -55°C | - | 50 | mV |
| Output Voltage | VOH15 | VDD = 15V, No Load (Note 3) | | 1, 2, 3 | +25°C, +125°C, -55°C | 14.95 | - | V |
| Output Current (Sink) | IOL5 | VDD = 5V, VOUT = 0.4V | | 1 | +25°C | 0.53 | - | mA |
| Output Current (Sink) | IOL10 | VDD = 10V, VOUT = 0.5V | | 1 | +25°C | 1.4 | - | mA |
| Output Current (Sink) | IOL15 | VDD = 15V, VOUT = 1.5V | | 1 | +25°C | 3.5 | - | mA |
| Output Current (Source) | IOH5A | VDD = 5V, VOUT = 4.6V | | 1 | +25°C | - | -0.53 | mA |
| Output Current (Source) | IOH5B | VDD = 5V, VOUT = 2.5V | | 1 | +25°C | - | -1.8 | mA |
| Output Current (Source) | IOH10 | VDD = 10V, VOUT = 9.5V | | 1 | +25°C | - | -1.4 | mA |
| Output Current (Source) | IOH15 | VDD = 15V, VOUT = 13.5V | | 1 | +25°C | - | -3.5 | mA |
| N Threshold Voltage | VNTH | VDD = 10V, ISS = -10µA | | 1 | +25°C | -2.8 | -0.7 | V |
| P Threshold Voltage | VPTH | VSS = 0V, IDD = 10µA | | 1 | +25°C | 0.7 | 2.8 | V |
| Functional | F | VDD = 2.8V, VIN = VDD or GND | | 7 | +25°C | VOH > VDD/2 | VOL < VDD/2 | V |
| | | VDD = 20V, VIN = VDD or GND | | 7 | +25°C | | | |
| | | VDD = 18V, VIN = VDD or GND | | 8A | +125°C | | | |
| | | VDD = 3V, VIN = VDD or GND | | 8B | -55°C | | | |
| Input Voltage Low (Note 2) | VIL5 | VDD = 5V, VOH > 4.5V, VOL < 0.5V | | 1, 2, 3 | +25°C, +125°C, -55°C | - | 1.5 | V |
| Input Voltage High (Note 2) | VIH5 | VDD = 5V, VOH > 4.5V, VOL < 0.5V | | 1, 2, 3 | +25°C, +125°C, -55°C | 3.5 | - | V |
| Input Voltage Low (Note 2) | VIL15 | VDD = 15V, VOH > 13.5V, VOL < 1.5V | | 1, 2, 3 | +25°C, +125°C, -55°C | - | 4 | V |
| Input Voltage High (Note 2) | VIH15 | VDD = 15V, VOH > 13.5V, VOL < 1.5V | | 1, 2, 3 | +25°C, +125°C, -55°C | 11 | - | V |

NOTES: 1. All voltages referenced to device GND, 100% testing being implemented. 2. Go/No Go test with limits applied to inputs. 3. For accuracy, voltage is measured differentially to VDD. Limit is 0.050V max.

TABLE 2. AC ELECTRICAL PERFORMANCE CHARACTERISTICS

| PARAMETER | SYMBOL | CONDITIONS (Note 1, 2) | GROUP A SUBGROUPS | TEMPERATURE | LIMITS | | UNITS |
|--------------------------------------|----------------|----------------------------|----------------------|---------------|----------|-----|-------|
| | | | | | MIN | MAX | |
| Propagation Delay Clock to Output | TPHL1 TPLH1 | VDD = 5V, VIN = VDD or GND | 9 | +25°C | - | 300 | ns |
| | | | 10, 11 | +125°C, -55°C | - | 405 | ns |
| Propagation Delay CLEAR to Output | TPHL2 | VDD = 5V, VIN = VDD or GND | 9 | +25°C | - | 200 | ns |
| | | | 10, 11 | +125°C, -55°C | - | 270 | ns |
| Transition Time | TTHL TTLH | VDD = 5V, VIN = VDD or GND | 9 | +25°C | - | 200 | ns |
| | | | 10, 11 | +125°C, -55°C | - | 270 | ns |
| Maximum Clock Input Frequency | FCL | VDD = 5V, VIN = VDD or GND | 9 | +25°C | 3.5 | - | MHz |
| | | | 10, 11 | +125°C, -55°C | 3.5/1.35 | - | MHz |

NOTES:

1. CL = 50pF, RL = 200K, Input TR, TF < 20ns.
2. -55°C and +125°C limits guaranteed, 100% testing being implemented.

TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS

| PARAMETER | SYMBOL | CONDITIONS | NOTES | TEMPERATURE | LIMITS | | UNITS |
|-------------------------|--------|-----------------------------|-------|-------------------------|--------|-------|-------|
| | | | | | MIN | MAX | |
| Supply Current | IDD | VDD = 5V, VIN = VDD or GND | 1, 2 | -55°C, +25°C | - | 1 | μA |
| | | | | +125°C | - | 30 | μA |
| | | VDD = 10V, VIN = VDD or GND | 1, 2 | -55°C, +25°C | - | 2 | μA |
| | | | | +125°C | - | 60 | μA |
| | | VDD = 15V, VIN = VDD or GND | 1, 2 | -55°C, +25°C | - | 2 | μA |
| +125°C | - | | | 120 | μA | | |
| Output Voltage | VOL | VDD = 5V, No Load | 1, 2 | +25°C, +125°C, -55°C | - | 50 | mV |
| Output Voltage | VOL | VDD = 10V, No Load | 1, 2 | +25°C, +125°C, -55°C | - | 50 | mV |
| Output Voltage | VOH | VDD = 5V, No Load | 1, 2 | +25°C, +125°C, -55°C | 4.95 | - | V |
| Output Voltage | VOH | VDD = 10V, No Load | 1, 2 | +25°C, +125°C, -55°C | 9.95 | - | V |
| Output Current (Sink) | IOL5B | VDD = 5V, VOUT = 0.4V | 1, 2 | +125°C | 0.36 | - | mA |
| | | | | -55°C | 0.64 | - | mA |
| Output Current (Sink) | IOL10 | VDD = 10V, VOUT = 0.5V | 1, 2 | +125°C | 0.9 | - | mA |
| | | | | -55°C | 1.6 | - | mA |
| Output Current (Sink) | IOL15 | VDD = 15V, VOUT = 1.5V | 1, 2 | +125°C | 2.4 | - | mA |
| | | | | -55°C | 4.2 | - | mA |
| Output Current (Source) | IOH5A | VDD = 5V, VOUT = 4.6V | 1, 2 | +125°C | - | -0.36 | mA |
| | | | | -55°C | - | -0.64 | mA |
| Output Current (Source) | IOH5B | VDD = 5V, VOUT = 2.5V | 1, 2 | +125°C | - | -1.15 | mA |
| | | | | -55°C | - | -2.0 | mA |
| Output Current (Source) | IOH10 | VDD = 10V, VOUT = 9.5V | 1, 2 | +125°C | - | -0.9 | mA |
| | | | | -55°C | - | -1.6 | mA |

TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS (Continued)

| PARAMETER | SYMBOL | CONDITIONS | NOTES | TEMPERATURE | LIMITS | | UNITS |
|--------------------------------------|----------------|----------------------------------|------------|-------------------------|--------|------|-------|
| | | | | | MIN | MAX | |
| Output Current (Source) | IOH15 | VDD = 15V, VOUT = 13.5V | 1, 2 | +125°C | - | -2.4 | mA |
| | | | | -55°C | - | -4.2 | mA |
| Input Voltage Low | VIL | VDD = 10V, VOH > 9V, VOL < 1V | 1, 2 | +25°C, +125°C, -55°C | - | 3 | V |
| Input Voltage High | VIH | VDD = 10V, VOH > 9V, VOL < 1V | 1, 2 | +25°C, +125°C, -55°C | +7 | - | V |
| Propagation Delay Clock to Output | TPHL1 TPLH1 | VDD = 10V | 1, 2, 3 | +25°C | - | 140 | ns |
| | | VDD = 15V | 1, 2, 3 | +25°C | - | 100 | ns |
| Propagation Delay CLEAR to Output | TPHL2 | VDD = 10V | 1, 2, 3 | +25°C | - | 100 | ns |
| | | VDD = 15V | 1, 2, 3 | +25°C | - | 80 | ns |
| Transition Time | TTHL TTLH | VDD = 10V | 1, 2, 3 | +25°C | - | 100 | ns |
| | | VDD = 15V | 1, 2, 3 | +25°C | - | 80 | ns |
| Maximum Clock Input Frequency | FCL | VDD = 10V | 1, 2, 3 | +25°C | 6 | - | MHz |
| | | VDD = 15V | 1, 2, 3 | +25°C | 8 | - | MHz |
| Minimum Data Setup Time | TS | VDD = 5V | 1, 2, 3 | +25°C | - | 40 | ns |
| | | VDD = 10V | 1, 2, 3 | +25°C | - | 20 | ns |
| | | VDD = 15V | 1, 2, 3 | +25°C | - | 10 | ns |
| Minimum Data Hold Time | TH | VDD = 5V | 1, 2, 3 | +25°C | - | 80 | ns |
| | | VDD = 10V | 1, 2, 3 | +25°C | - | 40 | ns |
| | | VDD = 15V | 1, 2, 3 | +25°C | - | 30 | ns |
| Minimum Clock Pulse Width | TW | VDD = 5V | 1, 2, 3 | +25°C | - | 130 | ns |
| | | VDD = 10V | 1, 2, 3 | +25°C | - | 60 | ns |
| | | VDD = 15V | 1, 2, 3 | +25°C | - | 40 | ns |
| Maximum Clock Rise and Fall Time | TRCL TFCL | VDD = 5V | 1, 2, 3, 4 | +25°C | 15 | - | μs |
| | | VDD = 10V | 1, 2, 3, 4 | +25°C | 15 | - | μs |
| | | VDD = 15V | 1, 2, 3, 4 | +25°C | 15 | - | μs |
| Minimum CLEAR Removal Time | TREM | VDD = 5V | 1, 2, 3 | +25°C | - | 0 | ns |
| | | VDD = 10V | 1, 2, 3 | +25°C | - | 0 | ns |
| | | VDD = 15V | 1, 2, 3 | +25°C | - | 0 | ns |
| Minimum CLEAR Pulse Width | TW | VDD = 5V | 1, 2, 3 | +25°C | - | 100 | ns |
| | | VDD = 10V | 1, 2, 3 | +25°C | - | 50 | ns |
| | | VDD = 15V | 1, 2, 3 | +25°C | - | 40 | ns |
| Input Capacitance | CIN | CLEAR | 1, 2 | +25°C | - | 40 | pF |
| | | All others | 1, 2 | +25°C | - | 7.5 | pF |

NOTES:

- All voltages referenced to device GND.
- The parameters listed on Table 3 are controlled via design or process and are not directly tested. These parameters are characterized on initial design release and upon design changes which would affect these characteristics.
- CL = 50pF, RL = 200K, Input TR, TF < 20ns.
- If more than one unit is cascaded, TRCL should be made less than or equal to the sum of the transition time and the fixed propagation delay of the output of the driving stage for the estimated capacitive load.

TABLE 4. POST IRRADIATION ELECTRICAL PERFORMANCE CHARACTERISTICS

| PARAMETER | SYMBOL | CONDITIONS | NOTES | TEMPERATURE | LIMITS | | UNITS |
|---------------------------|--------|-----------------------------|------------|-------------|-------------|--------------------|-------|
| | | | | | MIN | MAX | |
| Supply Current | IDD | VDD = 20V, VIN = VDD or GND | 1, 4 | +25°C | - | 7.5 | µA |
| N Threshold Voltage | VNTH | VDD = 10V, ISS = -10µA | 1, 4 | +25°C | -2.8 | -0.2 | V |
| N Threshold Voltage Delta | ΔVTN | VDD = 10V, ISS = -10µA | 1, 4 | +25°C | - | ±1 | V |
| P Threshold Voltage | VTP | VSS = 0V, IDD = 10µA | 1, 4 | +25°C | 0.2 | 2.8 | V |
| P Threshold Voltage Delta | ΔVTP | VSS = 0V, IDD = 10µA | 1, 4 | +25°C | - | ±1 | V |
| Functional | F | VDD = 18V, VIN = VDD or GND | 1 | +25°C | VOH > VDD/2 | VOL < VDD/2 | V |
| | | VDD = 3V, VIN = VDD or GND | | | | | |
| Propagation Delay Time | TPHL | VDD = 5V | 1, 2, 3, 4 | +25°C | - | 1.35 x +25°C Limit | ns |
| | TPLH | | | | | | |

NOTES: 1. All voltages referenced to device GND. 2. CL = 50pF, RL = 200K, Input TR, TF < 20ns. 3. See Table 2 for +25°C limit. 4. Read and Record

TABLE 5. BURN-IN AND LIFE TEST DELTA PARAMETERS +25°C

| PARAMETER | SYMBOL | DELTA LIMIT |
|-------------------------|--------|--------------------------|
| Supply Current - MSI-1 | IDD | ± 0.2µA |
| Output Current (Sink) | IOL5 | ± 20% x Pre-Test Reading |
| Output Current (Source) | IOH5A | ± 20% x Pre-Test Reading |

TABLE 6. APPLICABLE SUBGROUPS

| CONFORMANCE GROUP | MIL-STD-883 METHOD | GROUP A SUBGROUPS | READ AND RECORD |
|-------------------------------|--------------------|---------------------------------------|------------------------------|
| Initial Test (Pre Burn-In) | 100% 5004 | 1, 7, 9 | IDD, IOL5, IOH5A |
| Interim Test 1 (Post Burn-In) | 100% 5004 | 1, 7, 9 | IDD, IOL5, IOH5A |
| Interim Test 2 (Post Burn-In) | 100% 5004 | 1, 7, 9 | IDD, IOL5, IOH5A |
| PDA (Note 1) | 100% 5004 | 1, 7, 9, Deltas | |
| Interim Test 3 (Post Burn-In) | 100% 5004 | 1, 7, 9 | IDD, IOL5, IOH5A |
| PDA (Note 1) | 100% 5004 | 1, 7, 9, Deltas | |
| Final Test | 100% 5004 | 2, 3, 8A, 8B, 10, 11 | |
| Group A | Sample 5005 | 1, 2, 3, 7, 8A, 8B, 9, 10, 11 | |
| Group B | Subgroup B-5 | 1, 2, 3, 7, 8A, 8B, 9, 10, 11, Deltas | Subgroups 1, 2, 3, 9, 10, 11 |
| | Subgroup B-6 | Sample 5005 | 1, 7, 9 |
| Group D | Sample 5005 | 1, 2, 3, 8A, 8B, 9 | Subgroups 1, 2, 3 |

NOTE: 1. 5% Parametric, 3% Functional; Cumulative for Static 1 and 2.

TABLE 7. TOTAL DOSE IRRADIATION

| CONFORMANCE GROUPS | MIL-STD-883 METHOD | TEST | | READ AND RECORD | |
|--------------------|--------------------|-----------|------------|-----------------|------------|
| | | PRE-IRRAD | POST-IRRAD | PRE-IRRAD | POST-IRRAD |
| Group E Subgroup 2 | 5005 | 1, 7, 9 | Table 4 | 1, 9 | Table 4 |

TABLE 8. BURN-IN AND IRRADIATION TEST CONNECTIONS

| FUNCTION | OPEN | GROUND | VDD | 9V ± -0.5V | OSCILLATOR | |
|---------------------------|---------------------|------------------------------|-------------------------------|---------------------|------------|---------------------|
| | | | | | 50kHz | 25kHz |
| Static Burn-In 1 (Note 1) | 2, 5, 7, 10, 12, 15 | 1, 3, 4, 6, 8, 9, 11, 13, 14 | 16 | | | |
| Static Burn-In 2 (Note 1) | 2, 5, 7, 10, 12, 15 | 8 | 1, 3, 4, 6, 9, 11, 13, 14, 16 | | | |
| Dynamic Burn-In (Note 1) | - | 8 | 1, 16 | 2, 5, 7, 10, 12, 15 | 9 | 3, 4, 6, 11, 13, 14 |
| Irradiation (Note 2) | 2, 5, 7, 10, 12, 15 | 8 | 1, 3, 4, 6, 9, 11, 13, 14, 16 | | | |

NOTE:

- Each pin except VDD and GND will have a series resistor of 10K ± 5%, VDD = 18V ± 0.5V
- Each pin except VDD and GND will have a series resistor of 47K ± 5%; Group E, Subgroup 2, sample size is 4 dice/wafer, 0 failures, VDD = 10V ± 0.5V

Logic Diagram

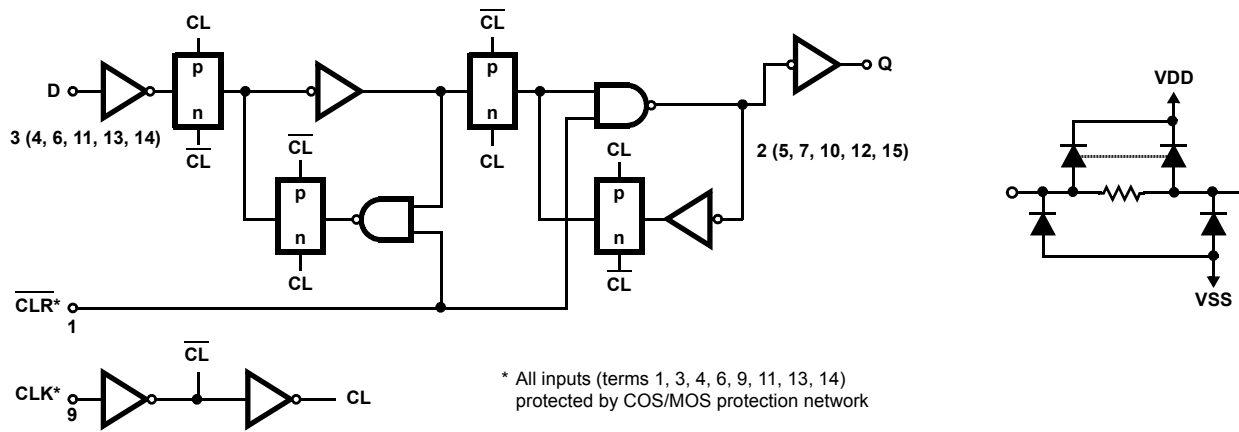


FIGURE 1. 1 OF 6 FLIP-FLOPS

TRUTH TABLE FOR 1 OF 6 FLIP-FLOPS

| INPUTS | | | OUTPUT |
|--------|------|-------|--------|
| CLOCK | DATA | CLEAR | Q |
| | 0 | 1 | 0 |
| | 1 | 1 | 1 |
| | X | 1 | NC |
| X | X | 0 | 0 |

1 = High Level
2 = Low Level

X = Don't Care
NC = No Change

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Typical Performance Curves

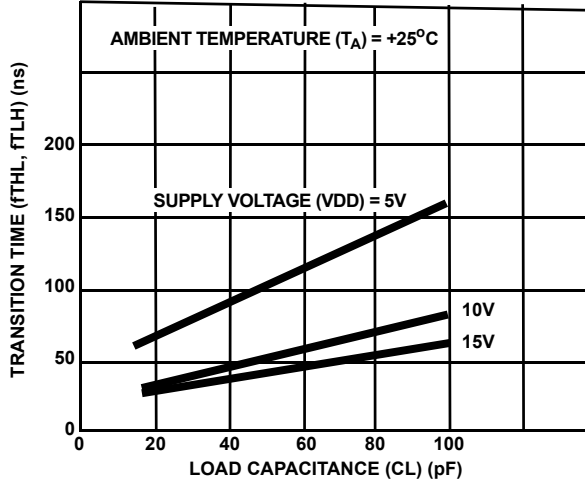


FIGURE 2. TYPICAL TRANSITION TIME AS A FUNCTION OF LOAD CAPACITANCE

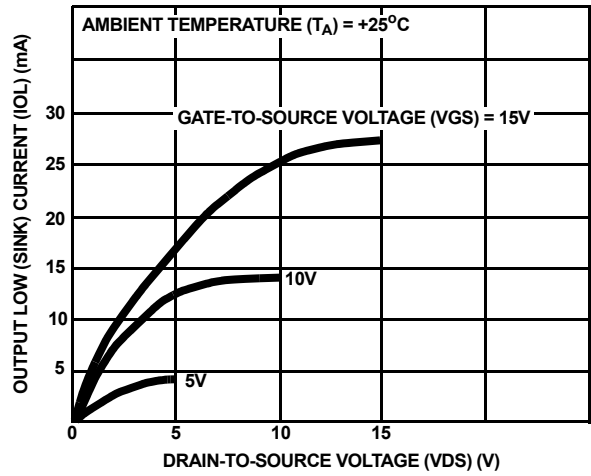


FIGURE 3. TYPICAL OUTPUT LOW (SINK) CURRENT CHARACTERISTICS

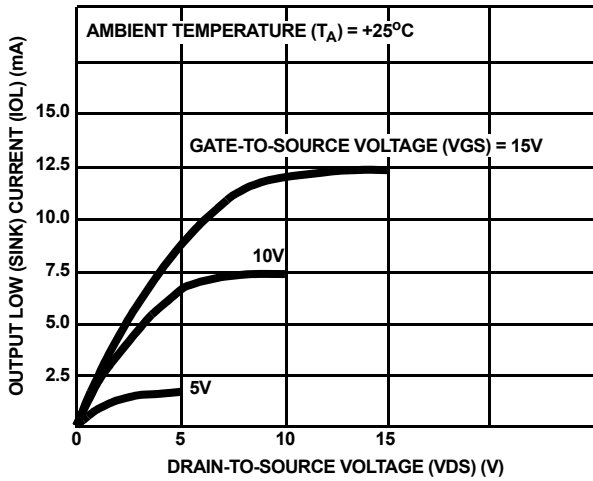


FIGURE 4. MINIMUM OUTPUT LOW (SINK) CURRENT CHARACTERISTICS

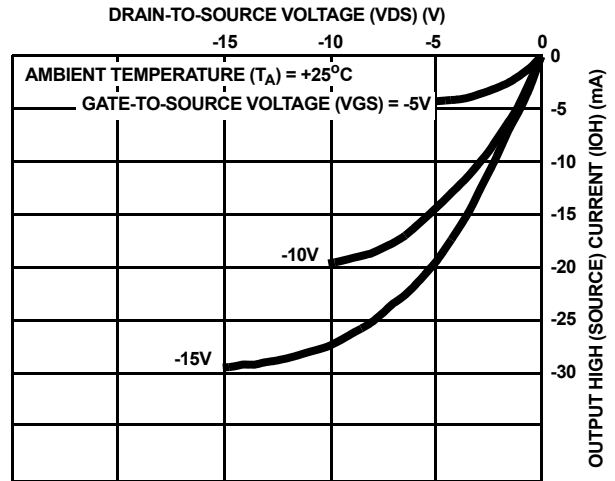


FIGURE 5. TYPICAL OUTPUT HIGH (SOURCE) CURRENT CHARACTERISTICS

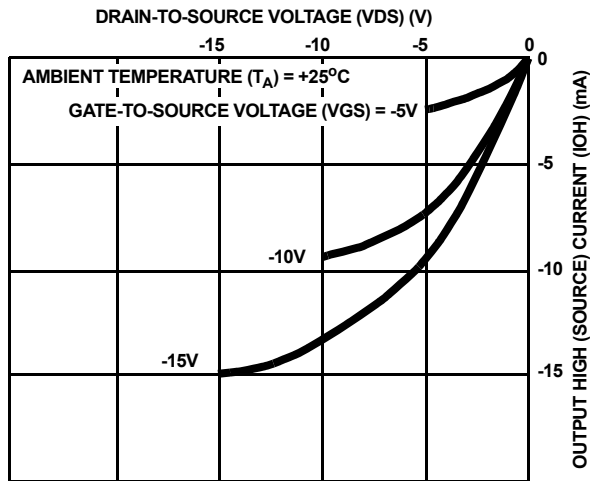


FIGURE 6. MINIMUM OUTPUT HIGH (SOURCE) CURRENT CHARACTERISTICS

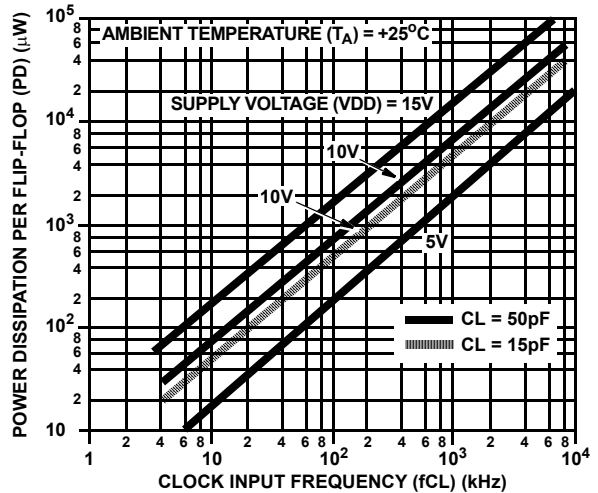


FIGURE 7. TYPICAL DYNAMIC POWER DISSIPATION AS A FUNCTION OF CLOCK FREQUENCY

Typical Performance Curves (Continued)

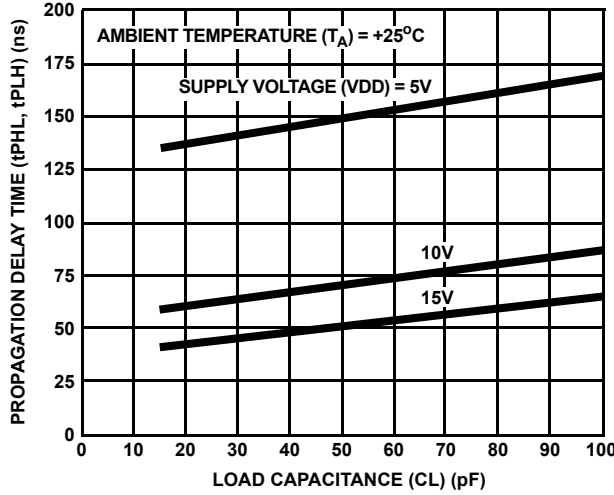


FIGURE 8. TYPICAL PROPAGATION DELAY TIME (CLOCK TO OUTPUT) AS A FUNCTION OF LOAD CAPACITANCE

Waveform

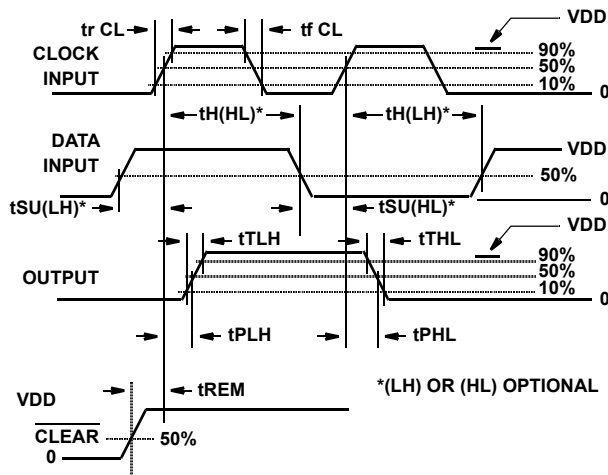
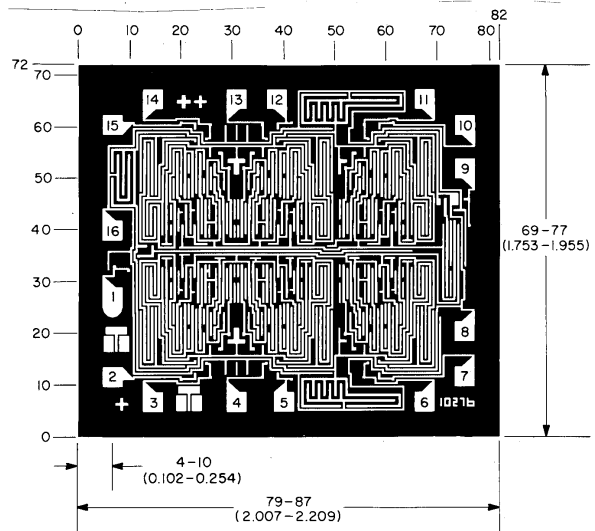


FIGURE 9. DEFINITION OF SETUP, HOLD, PROPAGATION DELAY, AND REMOVAL TIMES

Pad Layout



DIMENSIONS AND PAD LAYOUT FOR CD40174BMSH

The photographs and dimensions of each CMOS chip represent a chip when it is part of the wafer. When the wafer is separated into individual chips, the angle of cleavage may vary with respect to the chip face for different chips. The actual dimensions of the isolated chip, therefore, may differ slightly from the nominal dimensions shown. The user should consider a tolerance of -3 mils to +16 mils applicable to the nominal dimensions shown.

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

METALLIZATION: Thickness: $11\text{k\AA} - 14\text{k\AA}$, AL.

PASSIVATION: $10.4\text{k\AA} - 15.6\text{k\AA}$, Silane

BOND PADS: 0.004 inches X 0.004 inches MIN

DIE THICKNESS: 0.0198 inches - 0.0218 inches