

Dual A/D Converter

The MC1650 and the MC1651 are very high speed comparators utilizing differential amplifier inputs to sense analog signals above or below a reference level. An output latch provides a unique sample-hold feature. The MC1650 provides high impedance Darlington inputs, while the MC1651 is a lower impedance option, with higher input slew rate and higher speed capability.

The clock inputs (\bar{C}_A and \bar{C}_B) operate from MECL III or MECL 10,000 digital levels. When \bar{C}_A is at a logic high level, Q_0 will be at a logic high level provided that $V_1 > V_2$ (V_1 is more positive than V_2). \bar{Q}_0 is the logic complement of Q_0 . When the clock input goes to a low logic level, the outputs are latched in their present state.

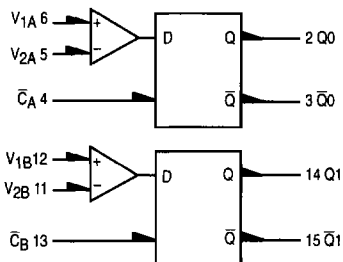
Assessment of the performance differences between the MC1650 and the MC1651 may be based upon the relative behaviors shown in Figures 4 and 7.

MC1650
MC1651



L SUFFIX
CERAMIC PACKAGE
CASE 620-10

LOGIC DIAGRAM



$V_{CC} = +5.0 \text{ V} = \text{PIN } 7, 10$
 $V_{EE} = -5.2 \text{ V} = \text{PIN } 8$
 $\text{GND} = \text{PIN } 1, 16$

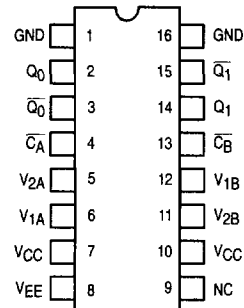
- $P_D = 330 \text{ mW typ/pkg (No Load)}$
- $t_{pd} = 3.5 \text{ ns typ (MC1650)}$
 $= 3.0 \text{ ns typ (MC1651)}$
- Input Slew Rate = $350 \text{ V}/\mu\text{s (MC1650)}$
 $= 500 \text{ V}/\mu\text{s (MC1651)}$
- Differential Input Voltage: $5.0 \text{ V (-30}^\circ\text{C to +85}^\circ\text{C)}$
- Common Mode Range:
 $-3.0 \text{ V to +2.5 V (-30}^\circ\text{C to +85}^\circ\text{C (MC1651)}$
 $-2.5 \text{ V to +3.0 V (-30}^\circ\text{C to +85}^\circ\text{C (MC1650)}$
- Resolution: $\leq 20 \text{ mV (-30}^\circ\text{C to +85}^\circ\text{C)}$
- Drives 50Ω lines

Number at end of terminal denotes pin number for L package (Case 620).

TRUTH TABLE

| \bar{C} | V_1, V_2 | Q_{0n+1} | \bar{Q}_{0n+1} |
|-----------|-------------|------------|------------------|
| H | $V_1 > V_2$ | H | L |
| H | $V_1 < V_2$ | L | H |
| L | X X | Q_{0n} | \bar{Q}_{0n} |

PIN ASSIGNMENT



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MC1650 MC1651

ELECTRICAL CHARACTERISTICS

| Characteristic | Symbol | Test Limits | | | | | | Unit | |
|-----------------------------|----------------------|-------------------|--------|--------|--------|-------------|--------|--------|-----------|
| | | -30°C | | +25°C | | +85°C | | | |
| | | Min | Max | Min | Max | Min | Max | | |
| Power Supply Drain Current | Positive Negative | I_{CC} I_E | | | | 25* 55* | | | mAdc |
| Input Current | MC1650 MC1651 | I_{in} | | | | 10 40 | | | μ Adc |
| Input Leakage Current | MC1650 MC1651 | I_R | | | | 7.0 10.0 | | | μ Adc |
| Clock Input Current | | I_{inH} | | | | 350 | | | |
| Output Voltage | Logic 1 | V_{OH} | -1.045 | -0.875 | -0.960 | -0.810 | -0.890 | -0.700 | Vdc |
| Output Voltage | Logic 0 | V_{OL} | -1.890 | -1.650 | -1.850 | -1.620 | -1.830 | -1.575 | Vdc |
| Threshold Voltage (Note 2.) | Logic 1 | V_{OHA} | -1.065 | | -0.980 | | -0.910 | | Vdc |
| Threshold Voltage (Note 2.) | Logic 0 | V_{OLA} | | -1.630 | | -1.600 | | -1.555 | Vdc |

1. All data is for 1/2 MC1650 or MC1651, except data marked (*) which refers to the entire package.
2. These tests are done in order indicated. See Figure 5.
3. Maximum Power Supply Voltages (beyond which device life may be impaired): $|V_{EE}| + |V_{CC}| \geq 12$ Vdc.

| All Temperature | V_{A3} | V_{A4} | V_{A5} | V_{A6} |
|-----------------|----------|----------|----------|----------|
| MC1650 | +3.0 | +2.98 | -2.5 | -2.48 |
| MC1651 | +2.5 | +2.48 | -3.0 | -2.98 |

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ELECTRICAL CHARACTERISTICS (continued)

| ⊗ Test Temperature | | TEST VOLTAGE VALUES (Volts) | | | | | | | | | | V_{CC}^3 | V_{EE}^3 | | | |
|---------------------------------|------------------|-------------------------------------------|-------------|-------------|-------------|-------------|------------------------------|----------------------|--------------|--------------|--------------|----------------------------------------------------------------------------------|----------------------------------------------------------------------------------|------------------------|------|--|
| | | V_{IHmax} | V_{ILmin} | V_{IHmin} | V_{ILmax} | V_{A1} | V_{A2} | V_{A3} | V_{A4} | V_{A5} | V_{A6} | | | | | |
| | | -30°C | -0.875 | -1.890 | -1.180 | -1.515 | +0.02 | +0.02 | See Note 4. | | | | | +5.0 | -5.2 | |
| | | +25°C | -0.810 | -1.850 | -1.095 | -1.485 | +0.02 | +0.02 | | | | | | +5.0 | -5.2 | |
| +85°C | -0.700 | -1.830 | -1.025 | -1.440 | +0.02 | +0.02 | +5.0 | -5.2 | | | | | | | | |
| Characteristic | Symbol | TEST VOLTAGE APPLIED TO PINS LISTED BELOW | | | | | | | | | | $(V_{CC})_{Gnd}$ | | | | |
| | | V_{IHmax} | V_{ILmin} | V_{IHmin} | V_{ILmax} | V_{A1} | V_{A2} | V_{A3} | V_{A4} | V_{A5} | V_{A6} | | | | | |
| Power Supply Drain Current | Pos Neg | I_{CC} I_E | 4,13 | 4,13 | | | 6,12 6,12 | | | | | | | 1,5,11,16 1,5,11,16 | | |
| Input Current | MC1650 MC1651 | I_{in} | 4 | 13 | | | 12 | | 6 | | | | | 1,5,11,16 | | |
| Input Leakage Current | MC1650 MC1651 | I_R | 4 | 13 | | | 12 | | | 6 | | | | 1,5,11,16 | | |
| Clock Input Current | | I_{inH} | 4 | 13 | | | 6,12 | | | | | | | 1,5,11,16 | | |
| Output Voltage | Logic 1 | V_{OH} | 4,13 | | | | 6,12 5,11 6,12 5,11 | 5,11 6,12 5,11 | 5,11 6,12 | 5,11 6,12 | 5,11 6,12 | 6,12 5,11 | 1,5,11,16 1,6,12,16 1,16 1,16 1,5,11,16 1,6,12,16 1,16 1,16 | | | |
| Output Voltage | Logic 0 | V_{OL} | 4,13 | | | | 5,11 6,12 5,11 | 6,12 5,11 6,12 | 5,11 6,12 | 6,12 5,11 | 6,12 5,11 | 1,5,11,16 1,6,12,16 1,16 1,16 1,5,11,16 1,6,12,16 1,16 1,16 | | | | |
| Threshold Voltage Note 2. | Logic 1 | V_{OHA} | | 13 | 4 4 4 | 4 4 4 | 6 6 6 | 6 6 6 | | | | | 1,5,16 | | | |
| Threshold Voltage Note 2. | Logic 0 | V_{OLA} | | 13 | 4 4 4 | 4 4 4 | 6 6 6 | 6 6 6 | | | | | 1,5,16 | | | |

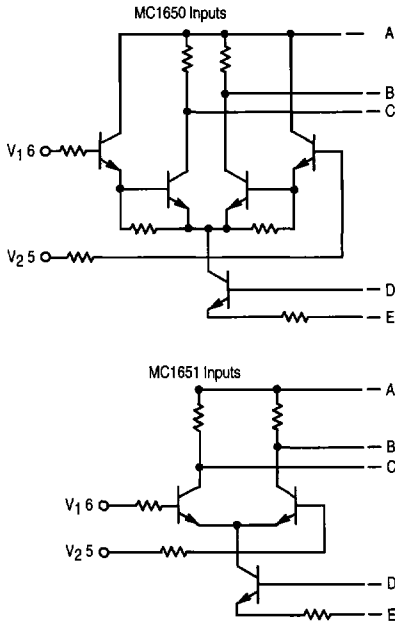
- All data is for 1/2 MC1650 or MC1651, except data marked (*) which refers to the entire package.
- These tests are done in order indicated. See Figure 5.
- Maximum Power Supply Voltages (beyond which device life may be impaired): $|V_{EE}| + |V_{CC}| \geq 12$ Vdc.

| All Temperature | V_{A3} | V_{A4} | V_{A5} | V_{A6} |
|-----------------|----------|----------|----------|----------|
| MC1650 | +3.0 | +2.98 | -2.5 | -2.48 |
| MC1651 | +2.5 | +2.48 | -3.0 | -2.98 |

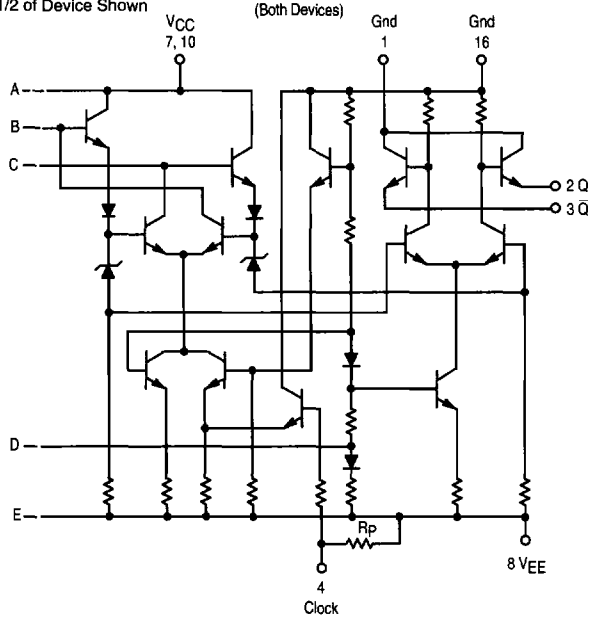
Each MECL 10,000 series circuit has been designed to meet the dc specifications shown in the test table, after thermal equilibrium has been established. The circuit is in a test socket or mounted on a printed circuit board and transverse air flow greater than 500 linear fpm is maintained. Outputs are terminated through a 50-ohm resistor to -2.0 volts. Test procedures are shown for only one gate. The other gates are tested in the same manner.

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MC1650 MC1651



CIRCUIT SCHEMATIC
1/2 of Device Shown



SWITCHING TEST VOLTAGE VALUES

| Test Temperature | (Volts) | | | | | | |
|------------------|-----------------|-----------------|-----------------|----------------|-----------------|------------------------------|------------------------------|
| | V _{R1} | V _{R2} | V _{R3} | V _X | V _{XX} | V _{CC} ¹ | V _{EE} ¹ |
| -30°C | +2.0 | See Note 4 | | +1.04 | +2.0 | +7.0 | -3.2 |
| +25°C | +2.0 | | | +1.11 | +2.0 | +7.0 | -3.2 |
| +85°C | +2.0 | | | +1.19 | +2.0 | +7.0 | -3.2 |

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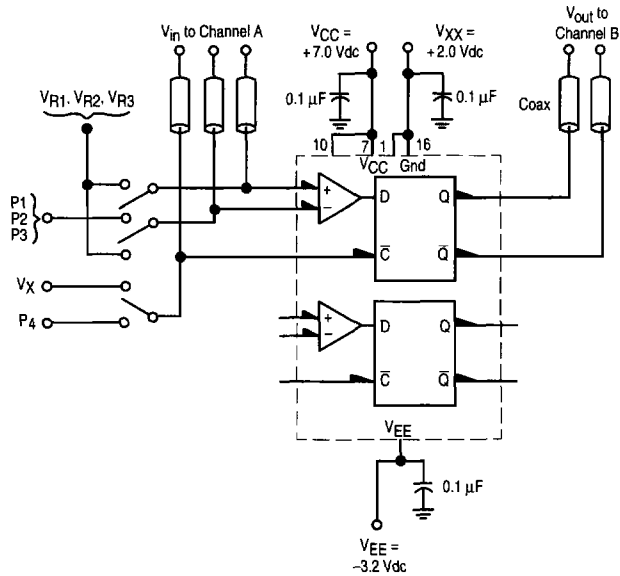
| Characteristic | Symbol | -30°C | | +25°C | | +85°C | | Unit | Conditions (See Figures 1-3) | | | | | | |
|----------------------------------------|--------------------|-------|-----|-------|-----|-------|-----|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | | Min | Max | Min | Max | Min | Max | | | | | | | | |
| Switching Times | t _{pd} | 2.0 | 5.0 | 2.0 | 5.0 | 2.0 | 5.7 | ns | V _{R1} to V ₂ , V _X to Clock, P ₁ to V ₁ , or, V _{R2} to V ₂ , V _X to Clock, P ₂ to V ₁ , or, V _{R3} to V ₂ , V _X to Clock, P ₃ to V ₁ . | | | | | | |
| Propagation Delay (50% to 50%) V-Input | | | | | | | | | 2.0 | 4.7 | 2.0 | 4.7 | 2.0 | 5.2 | V _{R1} to V ₂ , P ₁ to V ₁ and P ₄ to Clock, or, V _{R1} to V ₁ , P ₁ to V ₂ and P ₄ to Clock. |
| Clock ² | | | | | | | | | | | | | | | |
| Clock Enable ³ | t _{setup} | — | — | 2.5 | — | — | — | ns | V _{R1} to V ₂ , P ₁ to V ₁ , P ₄ to Clock | | | | | | |
| Clock Aperture ³ | t _{ap} | — | — | 1.5 | — | — | — | ns | | | | | | | |
| Rise Time (10% to 90%) | t ₊ | 1.0 | 3.5 | 1.0 | 3.5 | 1.0 | 3.8 | ns | V _R to V ₂ , V _X to Clock, P ₁ to V ₁ . | | | | | | |
| Fall Time (10% to 90%) | t ₋ | 1.0 | 3.0 | 1.0 | 3.0 | 1.0 | 3.3 | ns | | | | | | | |

NOTES:

- Maximum Power Supply Voltages (beyond which device life may be impaired:
V_{CC} + |V_{EE}| ≥ 12 Vdc.
- Unused clock inputs may be tied to ground.
- See Figure 3.

| All Temperatures | V _{R2} | V _{R3} |
|------------------|-----------------|-----------------|
| MC1650 | +4.9 | -0.4 |
| MC1651 | +4.4 | -0.9 |

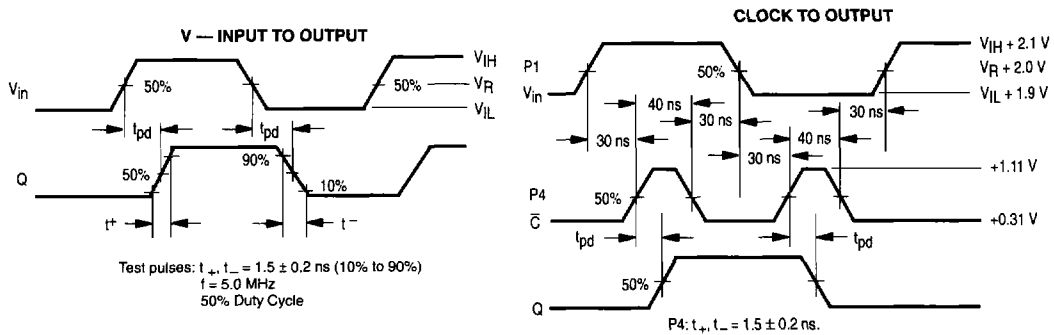
FIGURE 1 — SWITCHING TIME TEST CIRCUIT @ 25°C



Note: All power supply and logic levels are shown shifted 2.0 volts positive.
 50 ohm termination to ground located in each scope channel input.
 All input and output cables to the scope are equal lengths of 50 ohm coaxial cable.

FIGURE 2 — SWITCHING AND PROPAGATION WAVEFORMS @ 25°C

The pulse levels shown are used to check ac parameters over the full common-mode range.

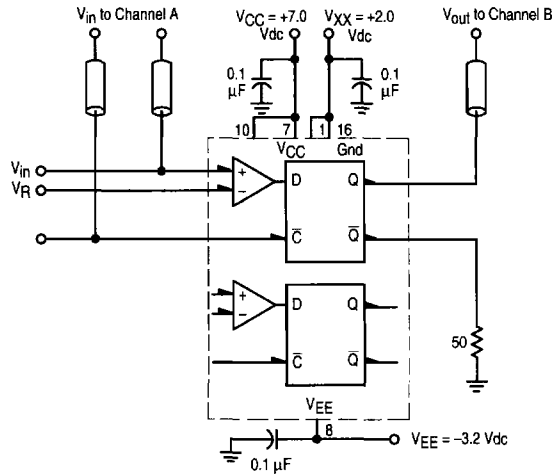


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TEST PULSE LEVELS

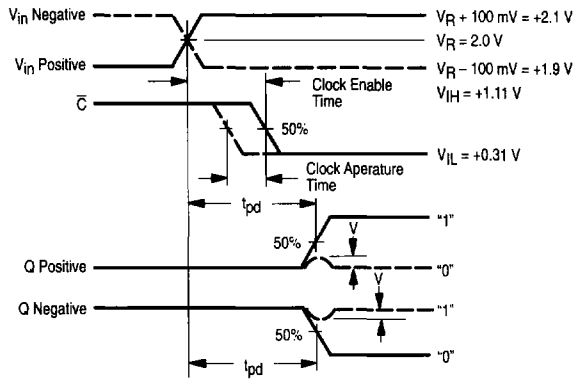
| | P1 | | P2 | | P3 | |
|-----------------|--------|--------|--------|--------|--------|--------|
| | MC1650 | MC1651 | MC1650 | MC1651 | MC1650 | MC1651 |
| V _{IH} | +2.1 V | +2.1 V | +5.0 V | +4.5 V | -0.3 V | -0.8 V |
| V _R | +2.0 V | +2.0 V | +4.9 V | +4.4 V | -0.4 V | -0.9 V |
| V _{IL} | +1.9 V | +1.9 V | +4.8 V | +4.3 V | -0.5 V | -1.0 V |

FIGURE 3 — CLOCK ENABLE AND APERTURE TIME TEST CIRCUIT AND WAVEFORMS @ 25°C



50 ohm termination to ground located in each scope channel input.
All input and output cables to the scope are equal lengths of 50 ohms coaxial cable.

ANALOG SIGNAL POSITIVE AND NEGATIVE SLEW CASE

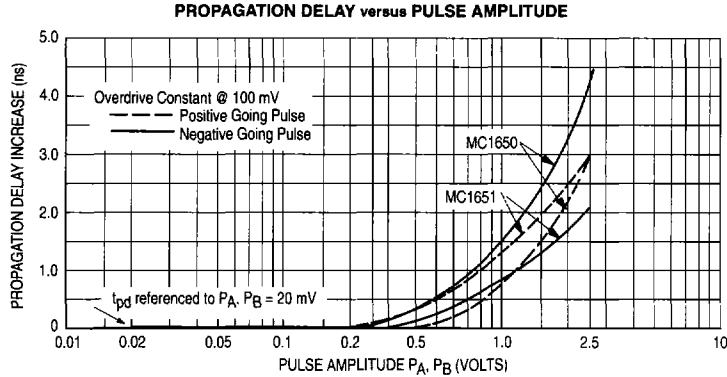
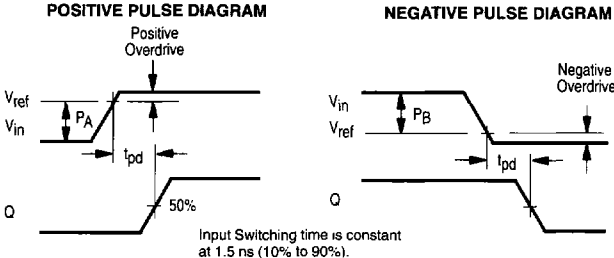
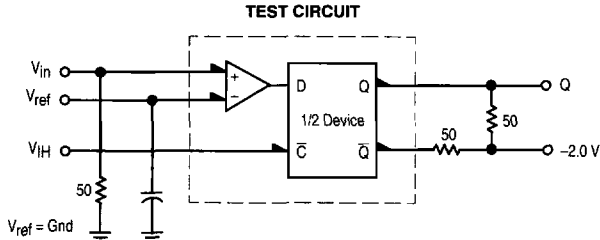


- Clock enable time = minimum time between analog and clock signal such that output switches, and t_{pd} (analog to Q) is not degraded by more than 200 ps.
- - - - - Clock aperture time = time difference between clock enable time and time that output does not switch and V is less than 150 mV.

Note: All power supply and logic levels are shown shifted 2.0 volts positive.

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FIGURE 4 — PROPAGATION DELAY (t_{pd}) versus INPUT PULSE AMPLITUDE AND CONSTANT OVERDRIVE



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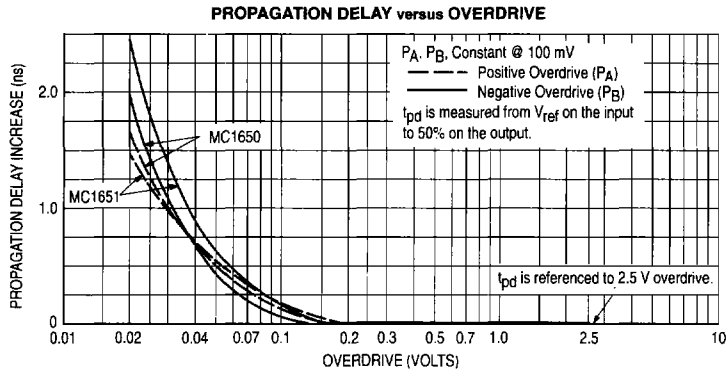


FIGURE 5 — LOGIC THRESHOLD TESTS (WAVEFORM SEQUENCE DIAGRAM)

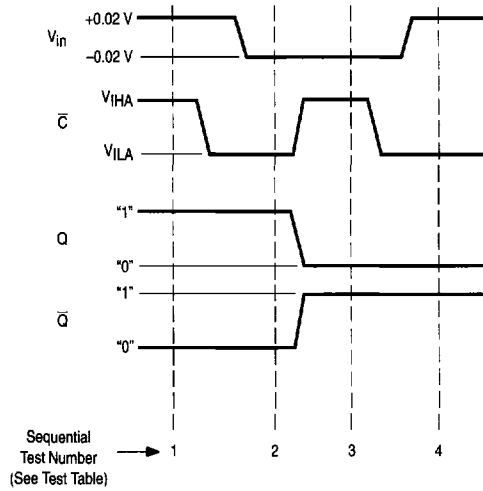
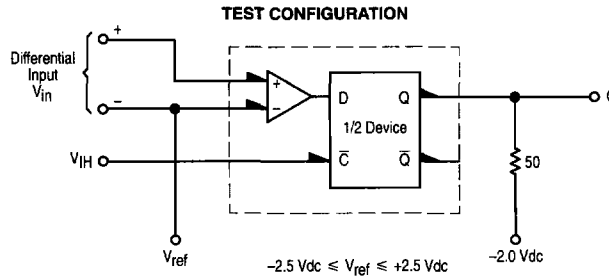


FIGURE 6 — TRANSFER CHARACTERISTICS (Q versus V_{in})



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TYPICAL TRANSFER CURVES

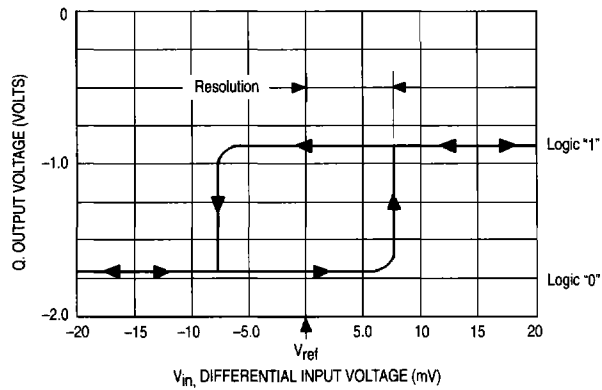
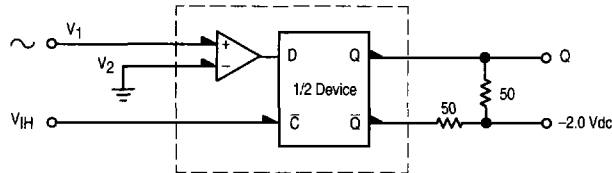
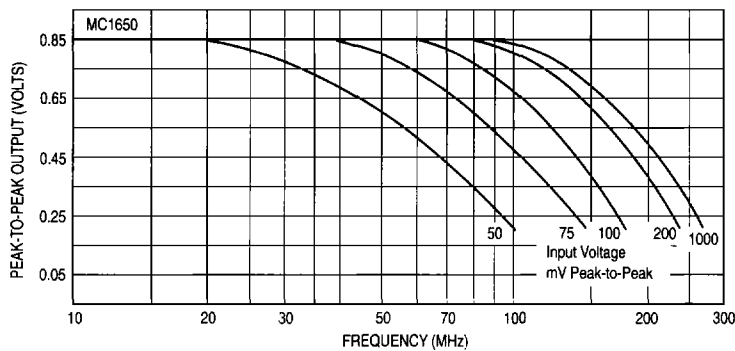
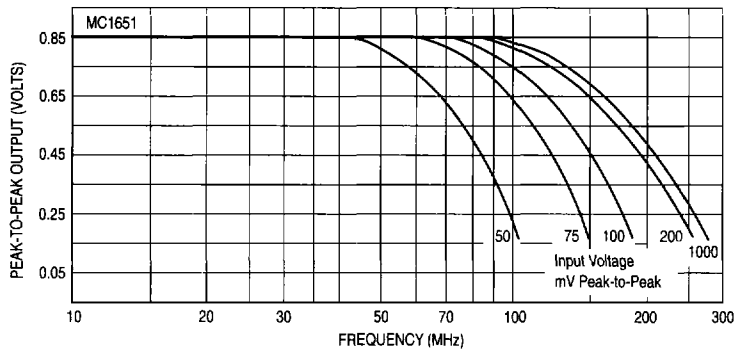


FIGURE 7 — OUTPUT VOLTAGE SWING versus FREQUENCY

(A) TEST CIRCUIT



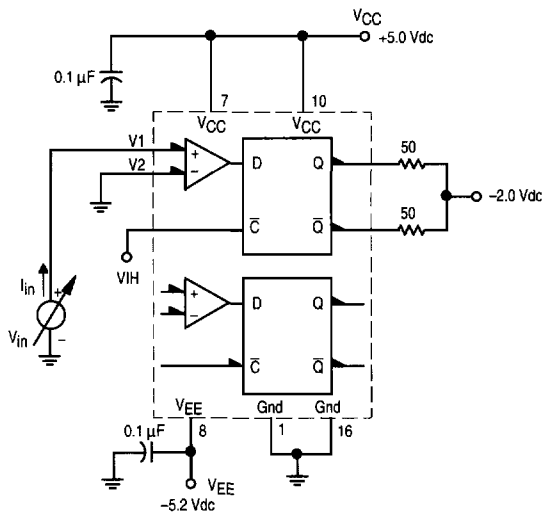
(B) TYPICAL OUTPUT LOGIC SWING versus FREQUENCY



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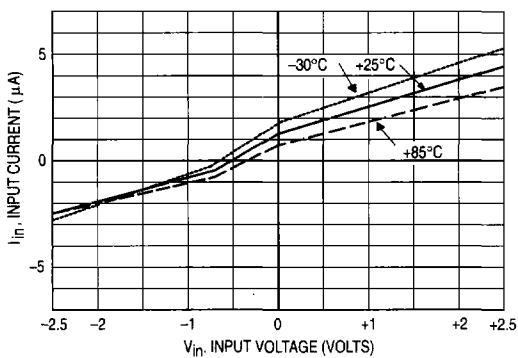
FIGURE 8 — INPUT CURRENT versus INPUT VOLTAGE

TEST CIRCUIT



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Typical MC1650 (Complementary Input Grounded)



Typical MC1651 (Complementary Input Grounded)

