

MC 1540 MC 1440

SENSE AMPLIFIERS

MONOLITHIC SENSE AMPLIFIER

... consisting of a wideband differential amplifier, a dc restoration circuit which also incorporates facilities to externally adjust the threshold, and an MDTL output gate which is strobed from saturated logic. It is designed to detect bipolar differential signals derived by a core memory with cycle times as low as 0.5 μ s.

- Differential Threshold Characteristics:
Adjustable Threshold – 10–25 mV
Nominal Threshold – 17 mV @ $V_G = -6$ V
Input Offset Voltage – 1.0 mV typical
Threshold Drift – -10μ V/ $^{\circ}$ C typical
- Fast Response Time – 20 ns typical
- Short Recovery Time:
50 ns max @ $e_{in} = 1.8$ V Common Mode
50 ns max @ $e_{in} = 400$ mV Differential Mode

CORE MEMORY SENSE AMPLIFIER INTEGRATED CIRCUIT

SILICON
EPITAXIAL PASSIVATED

F SUFFIX
CERAMIC PACKAGE
CASE 606
TO-91

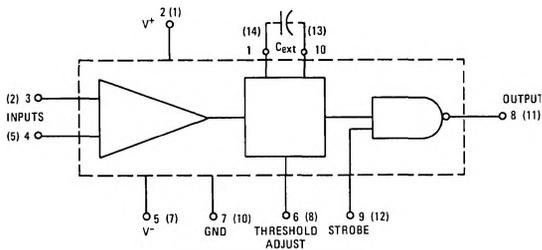
G SUFFIX
METAL PACKAGE
CASE 6028



L SUFFIX
CERAMIC PACKAGE
CASE 632
TO-116

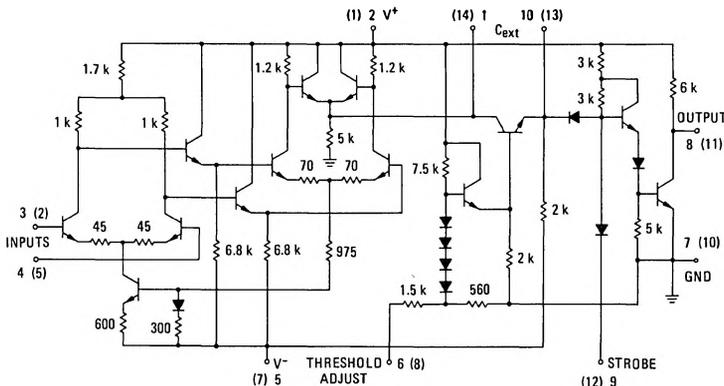


MC1540/MC1440 BLOCK DIAGRAM



Number at end of terminal represents pin number for devices in flat package and metal can. Number in parenthesis represents pin number for dual in-line package.

CIRCUIT SCHEMATIC



Number at end of terminal represents pin number for devices in flat package and metal can. Number in parenthesis represents pin number for ceramic dual in-line package.

MC1540, MC1440 (continued)

MAXIMUM RATINGS ($T_A = +25^\circ\text{C}$ unless otherwise noted)

| Rating | Symbol | Value | Unit |
|--|----------------------------|-------------------------|----------------------|
| Power Supply Voltage | V^+ | +10 | Vdc |
| | V^- | -10 | Vdc |
| Differential Input Signal | V_{in} | ± 5.0 | Vdc |
| Common Mode Input Voltage | CMV_{in} | ± 5.0 | Vdc |
| Load Current | I_L | 25 | mA |
| Power Dissipation (Package Limitation) | P_D | | |
| Metal Can | | 680 | mW |
| Derate above $T_A = +25^\circ\text{C}$ | | 4.6 | mW/ $^\circ\text{C}$ |
| Flat Package | | 500 | mW |
| Derate above $T_A = +25^\circ\text{C}$ | | 3.3 | mW/ $^\circ\text{C}$ |
| Ceramic Dual In-Line Package | | 625 | mW |
| Derate above $T_A = +25^\circ\text{C}$ | | 5.0 | mW/ $^\circ\text{C}$ |
| Operating Temperature Range | T_A | | $^\circ\text{C}$ |
| | MC1440F,G,L MC1540F,G,L | 0 to +75 -55 to +125 | |
| Storage Temperature Range | T_{stg} | -65 to +150 | $^\circ\text{C}$ |

ELECTRICAL CHARACTERISTICS

($V^+ = +6\text{ Vdc} \pm 1\%$, $V^- = -6\text{ Vdc} \pm 1\%$, $C_{ext} = 0.01\ \mu\text{F}$, $T_A = +25^\circ\text{C}$ unless otherwise noted)

Pin number references are for devices in flat package and metal can.

See block diagram for dual in-line package pin numbers.

| Characteristic | Fig. No. | Symbol | MC1540 | | | MC1440 | | | Unit |
|--|----------|-------------|--------|-----|-----|--------|-----|-----|-----------------|
| | | | Min | Typ | Max | Min | Typ | Max | |
| Input Threshold Voltage ($V_6 = -6.0\text{ Vdc}$, $T_A = 25^\circ\text{C}$) ($V_6 = -6.0\text{ V}$, $T_A = T_{low}^*$) ($V_6 = -6.0\text{ V}$, $T_A = T_{high}^*$) | 1 | V_{th} | 14 | 17 | 20 | 12 | 17 | 24 | mV |
| | | | 12 | 17 | 24 | 10 | 17 | 30 | |
| | | | 12 | 17 | 22 | 10 | 17 | 30 | |
| Input Offset Voltage | 1 | V_{io} | - | 1.0 | 5.0 | - | 1.0 | 6.0 | mV |
| Input Bias Current ($V_3 = V_4 = 0$, $T_A = 25^\circ\text{C}$) ($V_3 = V_4 = 0$, $T_A = T_{low}^*$) | 2 | I_b | - | 7.5 | 50 | - | 7.5 | 75 | μA |
| | | | - | - | 100 | - | - | 100 | |
| Input Offset Current | 2 | I_{io} | - | 2.0 | 10 | - | 2.0 | 15 | μA |
| Output Voltage High ($V_3 = V_4 = 0$) | 3 | V_{OH} | 5.9 | - | - | 5.8 | - | - | Vdc |
| Output Voltage Low ($V_3 = V_4 = 0$, $V_{10} = +6.0\text{ Vdc}$, $I_g = 6.0\text{ mAdc}$) ($V_{10} = +6.0\text{ Vdc}$, $I_g = 6.0\text{ mAdc}$, $T_A = T_{high}^*$) | 3 | V_{OL} | - | - | 350 | - | - | 400 | mVdc |
| | | | - | - | 400 | - | - | 450 | |
| Amplifier Voltage Gain ($V_3 = 15\text{ mV peak}$) | 4 | A_V | - | 85 | - | - | 85 | - | - |
| Strobe Load Current ($V_g = 0$) | - | I_S | - | - | 1.2 | - | - | 1.5 | mAdc |
| Strobe Reverse Current ($V_g = +5.0\text{ Vdc}$) ($V_g = +6.0\text{ Vdc}$, $T_A = T_{high}^*$) | - | I_R | - | - | 2.0 | - | - | 5.0 | μAdc |
| | | | - | - | 25 | - | - | 30 | |
| Propagation Delay | 5 | t_{3+10+} | - | 10 | 15 | - | 10 | 20 | ns |
| | | | - | 20 | 30 | - | 20 | 50 | |
| | 6 | t_{g+8-} | - | 10 | 15 | - | 10 | 30 | |
| Recovery Time | 7 | $t_R(dm)$ | - | 20 | 50 | - | 20 | 90 | ns |
| | 8 | $t_R(cm)$ | - | 20 | 50 | - | 20 | 60 | |
| Power Dissipation | - | P_D | - | 120 | 180 | - | 120 | 250 | mW |

* $T_{low} = -55^\circ\text{C}$ for MC1540 or 0°C for MC1440, $T_{high} = +125^\circ\text{C}$ for MC1540 or $+75^\circ\text{C}$ for MC1440.

MC1540, MC1440 (continued)

- A_V** Amplifier Voltage Gain — the ratio of output voltage at pin 1 to the input voltage at pin 3 or 4
- I_b** Input Bias Current — the average input current defined as $(I_3 + I_4)/2$
- I_{io}** Input Offset Current — the difference between input current values, $|I_3 - I_4|$
- I_R** Strobe Reverse Current — leakage current when the strobe input is high
- I_S** Strobe Load Current — amount of current drain from the circuit when the strobe pin is grounded
- P_D** Power Dissipation — amount of power dissipated in the unit as defined by $|I_2 \times V^+| + |I_5 \times V^-|$
- t_R** Recovery Time — The time that is required for the device to recover from the specified differential and common-mode overload inputs prior to strobe as reference to the 10% point

- t_{x±y±}** Propagation Delay — The time that is required for the output pulse at pin y to achieve 50% of its final value or the 1.5 V level referenced to 50% of the input pulse at pin x. (The + and - denote positive and negative-going pulse transition.)
- V_{OH}** Output Voltage High — high-level output voltage when the output gate is turned off
- V_{OL}** Output Voltage Low — low-level output voltage when the output gate is turned on
- V_{th}** Input Threshold — input pulse amplitude that causes the output to begin saturation
- V_{io}** Input Offset Voltage — the difference in V_{th} at each input

FIGURE 1 — INPUT THRESHOLD AT OUTPUT VOLTAGE SWING FROM V_{OL} TO V_{OH}

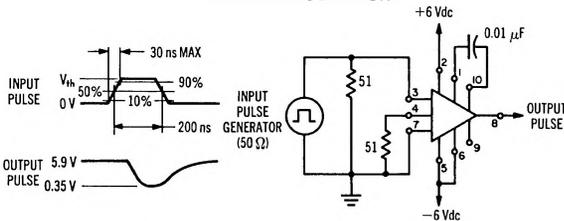


FIGURE 3 — OUTPUT VOLTAGE LEVELS

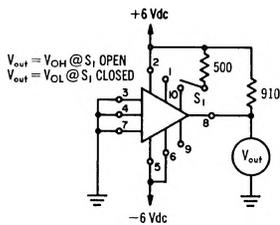


FIGURE 5 — PROPAGATION DELAY (STROBE HIGH)

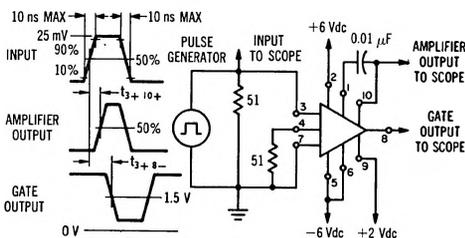


FIGURE 2 — INPUT BIAS CURRENT TEST CIRCUIT

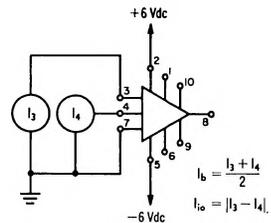


FIGURE 4 — AMPLIFIER VOLTAGE GAIN

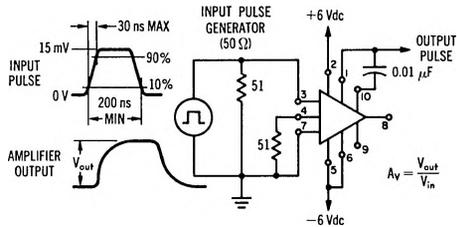
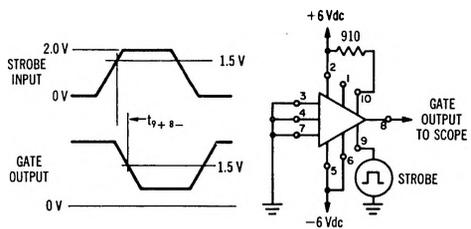


FIGURE 6 — PROPAGATION DELAY (STROBE INPUT)



MC1540, MC1440 (continued)

FIGURE 7 - DIFFERENTIAL MODE RECOVERY TIME TEST CIRCUIT

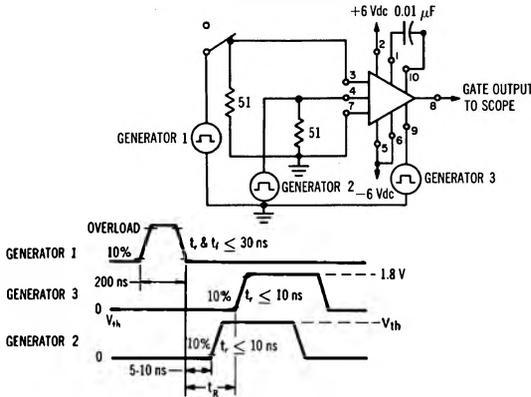


FIGURE 8 - COMMON MODE RECOVERY TIME TEST CIRCUIT

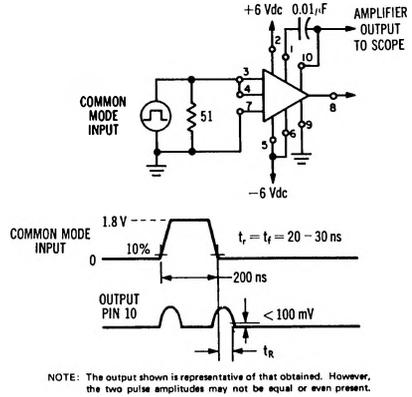


FIGURE 9 - TYPICAL TRANSFER CHARACTERISTICS

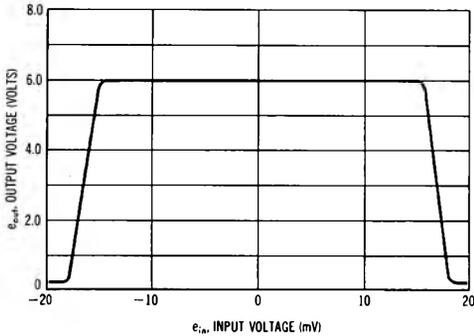


FIGURE 10 - TYPICAL THRESHOLD versus TEMPERATURE

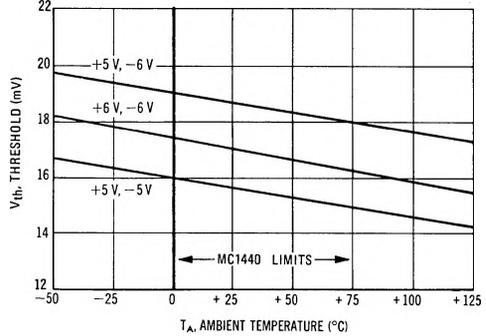


FIGURE 11 - TYPICAL THRESHOLD versus POWER SUPPLIES
 $T_A = +25^\circ\text{C}$ (Threshold Adjust Attached to V^-)

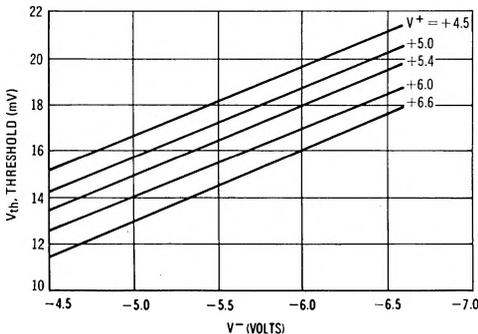
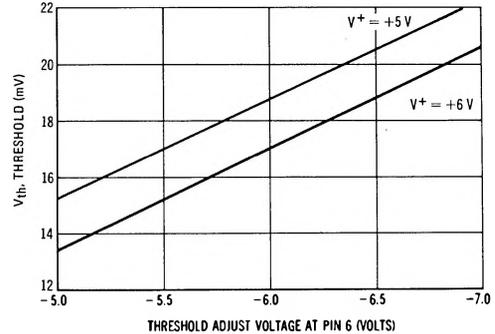


FIGURE 12 - TYPICAL THRESHOLD versus THRESHOLD VOLTAGE ADJUST FOR $V^- = 6.0\text{V}$



For a more detailed discussion regarding application of sense amplifiers, see Motorola Application Note AN-245. "The MC1540 - An Integrated Core Memory Sense Amplifier."