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 μs.

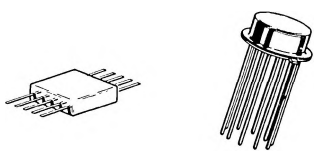
- Differential Threshold Characteristics:
  - Adjustable Threshold – 10-25 mV
  - Nominal Threshold – 17 mV @ V_6 = -6 V
  - Input Offset Voltage – 1.0 mV typical
  - Threshold Drift – -10 μV/°C typical
- Fast Response Time – 20 ns typical
- Short Recovery Time:
  - 50 ns max @ e_{in} = 1.8 V Common Mode
  - 50 ns max @ e_{in} = 400 mV Differential Mode

CORE MEMORY SENSE AMPLIFIER INTEGRATED CIRCUIT

SILICON
EPITAXIAL PASSIVATED

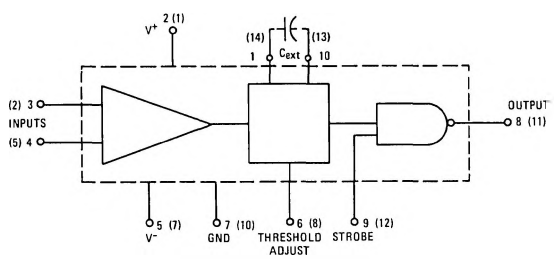
F SUFFIX
CERAMIC PACKAGE
CASE 606
TO-91

G SUFFIX
METAL PACKAGE
CASE 602B



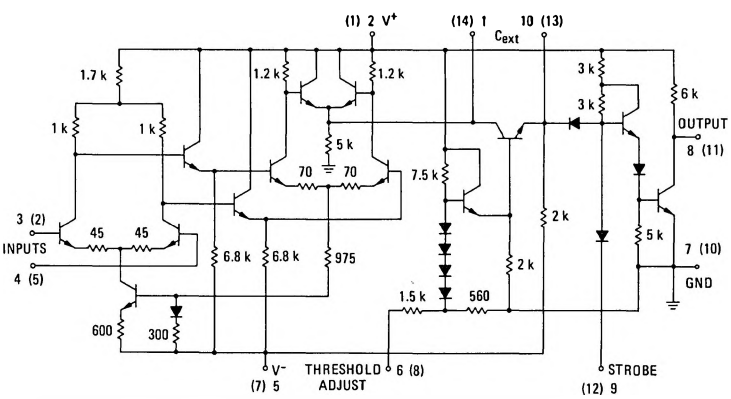
L SUFFIX
CERAMIC PACKAGE
CASE 632
TO-116

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.

See Packaging Information Section for outline dimensions.

MAXIMUM RATINGS (T_A = +25°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°C		4.6	mW/°C
Flat Package		500	mW
Derate above T_A = +25°C		3.3	mW/°C
Ceramic Dual In-Line Package		625	mW
Derate above T_A = +25°C		5.0	mW/°C
Operating Temperature Range	T_A		
MC1440F,G,L		0 to +75	°C
MC1540F,G,L		-55 to +125	
Storage Temperature Range	T_{stg}	-65 to +150	°C

ELECTRICAL CHARACTERISTICS

(V^+ = +6 Vdc ± 1%, V^- = -6 Vdc ± 1%, C_{ext} = 0.01 μF, T_A = +25°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.

			MC1540			MC1440			
Characteristic	Fig. No.	Symbol	Min	Typ	Max	Min	Typ	Max	Unit
Input Threshold Voltage		V_{th}							mV
(V_6 = -6.0 Vdc, T_A = 25°C)	1		14	17	20	12	17	24	
(V_6 = -6.0 V, T_A = T_{low}*)			12	17	24	10	17	30	
(V_6 = -6.0 V, T_A = T_{high}*)			12	17	22	10	17	30	
Input Offset Voltage	1	V_{io}	–	1.0	5.0	–	1.0	6.0	mV
Input Bias Current	2	I_b							μA
(V_3 = V_4 = 0, T_A = 25°C)			–	7.5	50	–	7.5	75	
(V_3 = V_4 = 0, T_A = T_{low}*)			–	–	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	3	V_{OL}							mVdc
(V_3 = V_4 = 0, V_{10} = +6.0 Vdc, I_8 = 6.0 mAdc)			–	–	350	–	–	400	
(V_{10} = +6.0 Vdc, I_8 = 6.0 mAdc, T_A = T_{high}*)			–	–	400	–	–	450	
Amplifier Voltage Gain (V_3 = 15 mV peak)	4	A_V	–	85	–	–	85	–	–
Strobe Load Current (V_9 = 0)	–	I_S	–	–	1.2	–	–	1.5	mAdc
Strobe Reverse Current	–	I_R							μAdc
(V_9 = +5.0 Vdc)			–	–	2.0	–	–	5.0	
(V_9 = +6.0 Vdc, T_A = T_{high}*)			–	–	25	–	–	30	
Propagation Delay									ns
Input to Amplifier Output (V_3 = 25 mV pulse, V_9 = +2.0 Vdc)	5	t_{3+10+}	–	10	15	–	10	20	
Input to Gate Output (V_3 = 25 mV pulse, V_9 = +2.0 Vdc)	5	t_{3+8-}	–	20	30	–	20	50	
Strobe to Gate Output (V_3 = V_4 = 0, V_9 = +2.0 V pulse)	6	t_{9+8-}	–	10	15	–	10	30	
Recovery Time									ns
Differential Mode (V_3 = 400 mV pulse)	7	$t_{R(dm)}$	–	20	50	–	20	90	
Common Mode (V_3 = 1.8 V pulse)	8	$t_{R(cm)}$	–	20	50	–	20	60	
Power Dissipation	–	P_D	–	120	180	–	120	250	mW

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

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 of the trailing edge of an input pulse. The device is considered recovered when the threshold after a differential overload disturbance is within 1.0 mV of the threshold value without the disturbance, or, for common-mode disturbance, when the level at pin 10 is within 100 mV of the quiescent value.

$t_{x\pm y\pm}$ 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}

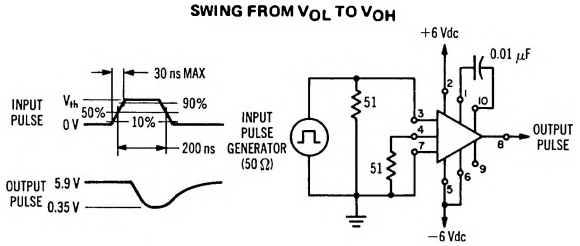


FIGURE 2 — INPUT BIAS CURRENT TEST CIRCUIT

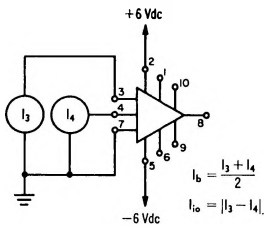


FIGURE 3 — OUTPUT VOLTAGE LEVELS

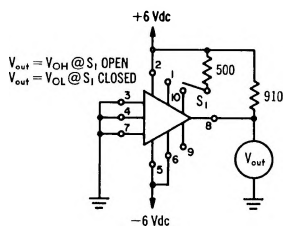


FIGURE 4 — AMPLIFIER VOLTAGE GAIN

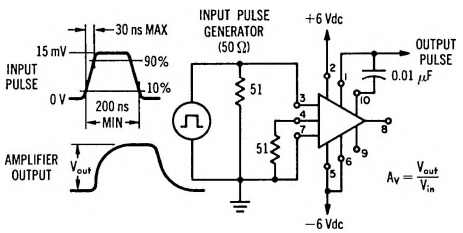


FIGURE 5 — PROPAGATION DELAY (STROBE HIGH)

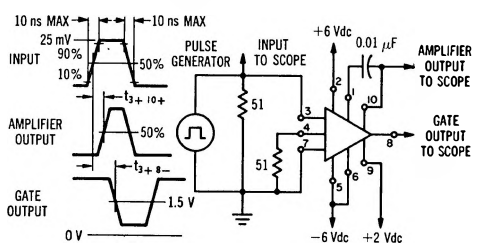


FIGURE 6 — PROPAGATION DELAY (STROBE INPUT)

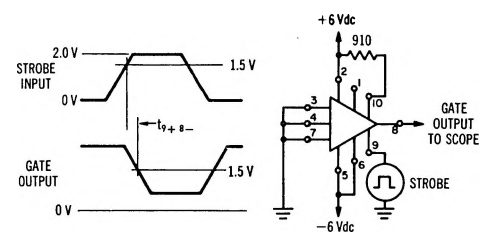


FIGURE 7 – DIFFERENTIAL MODE RECOVERY TIME TEST CIRCUIT

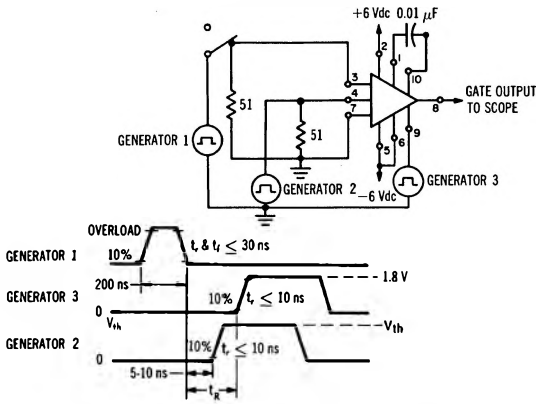
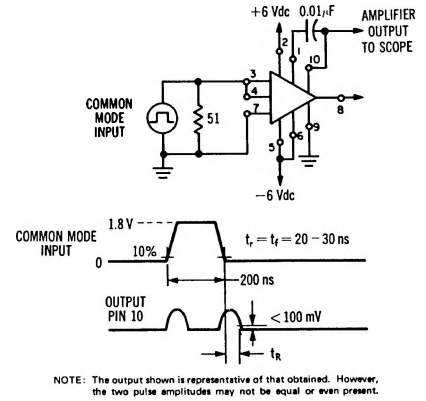


FIGURE 8 – COMMON MODE RECOVERY TIME TEST CIRCUIT



NOTE: The output shown is representative of that obtained. However, the two pulse amplitudes may not be equal or even present.

Pin numbers shown for devices in flat package and metal can. See block diagram for dual in-line package pin numbers.

FIGURE 9 – TYPICAL TRANSFER CHARACTERISTICS

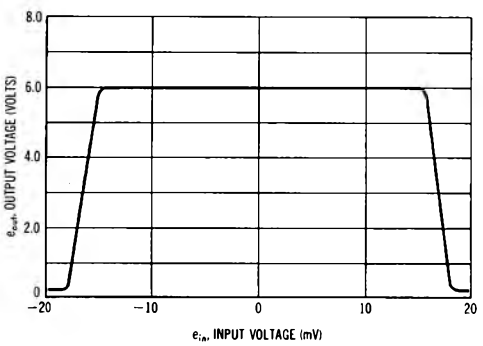


FIGURE 10 – TYPICAL THRESHOLD versus TEMPERATURE

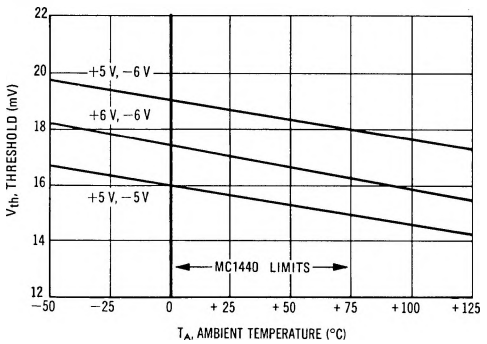


FIGURE 11 – TYPICAL THRESHOLD versus POWER SUPPLIES
T_A = +25°C (Threshold Adjust Attached to V^-)

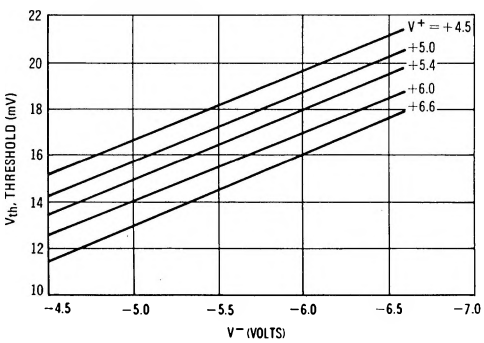
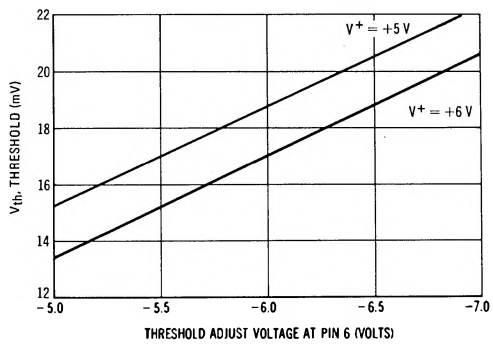


FIGURE 12 – TYPICAL THRESHOLD versus THRESHOLD VOLTAGE ADJUST FOR V^- = 6.0V



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