



# Sense Amplifiers

## LM5520/LM7520 series dual core memory sense amplifiers general description

The devices in this series of dual core sense amplifiers convert bipolar millivolt-level memory sense signals to saturated logic levels. The design employs a common reference input which allows the input threshold voltage level of both amplifiers to be adjusted. Separate strobe inputs provide time discrimination for each channel. Logic inputs and outputs are DTL/TTL compatible. All devices of the series have identical preamplifier configurations, while various logic connections are provided to suit the specific application.

The LM5520/LM7520 has output latch capability and provides sense, strobe, and memory function for two sense lines. The LM5522/LM7522 contains a single open collector output which may be used to expand the number of inputs of the LM5520/LM7520, or to drive an external Memory Data Register (MDR). Intended for small memories, the two channels of the LM5524/LM7524 are independent with two separate outputs. The LM5534/LM7534 is similar to the LM5524/LM7524 but has uncommitted, wire-ORable outputs. The LM5528/LM7528 has the same logic configuration of the LM5524/LM7524 and in addition provides separate low impedance Test Points at each preamplifier output. A similar device having uncommitted, wire-ORable outputs is the LM5538/LM7538.

### features

- High speed
- Guaranteed narrow threshold uncertainty over temperature

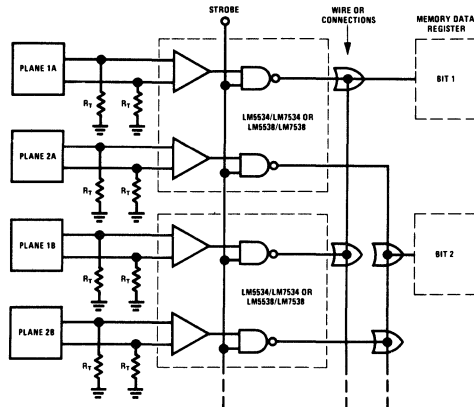
- Adjustable input threshold voltage
- Fast overload recovery times
- Two amplifiers per package
- Molded or cavity dual-in-line package
- Six logic configurations

The part number ending with an even number (e.g., LM5520) designates a tighter guaranteed input threshold uncertainty than the subsequent odd number ending (e.g., LM5521). The remaining specifications for the two are identical. All devices meet or exceed the specifications for the corresponding device (where applicable) in the SN5520/SN7520 series and are pin-for-pin replacements.

### absolute maximum ratings

Supply Voltage	±7V
Differential or Reference Input Voltage	±5V
Logic Input Voltage	+5.5V
Operating Temperature Range	
LM55XX	-55°C to +125°C
LM75XX	0°C to +70°C
Storage Temperature Range	-65°C to +150°C

### typical application



Expanded Small Memory System

## LM5520/LM7520 and LM5521/LM7521 electrical characteristics

LM5520/LM5521: The following apply for  $-55^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$

PARAMETER	MIN	TYP	MAX	UNIT	TEST CONDITIONS (EACH AMPLIFIER)							LOGIC OUTPUT (NOTE 3)	SUPPLY VOLT.	COMMENTS
					DIFF. INPUT	REF. INPUT	STROBE INPUT	GATE Q INPUT	GATE $\bar{Q}$ INPUT					
Differential Input Threshold Voltage ( $V_{TH}$ ) (Note 2)	10(8)	15	20(22)	mV	$\pm V_{TH}$	15 mV	+5V	+5V			+16 mA(Q)	$\pm 5V$	Logic Output <0.4V Logic Output >2.4V Logic Output <0.4V Logic Output >2.4V	
	35(33)	15		mV	$\pm V_{TH}$	15 mV	+5V	+5V			-400 $\mu\text{A}$ (Q)	$\pm 5V$		
		40	mV	$\pm V_{TH}$	40 mV	+5V	+5V			+16 mA(Q)	$\pm 5V$			
		40	mV	$\pm V_{TH}$	40 mV	+5V	+5V			-400 $\mu\text{A}$ (Q)	$\pm 5V$			
Differential & Reference Input Bias Current		30	100	$\mu\text{A}$	0V	0V	+5.25V	+5.25V	+5.25V		$\pm 5.25V$			

LM7520/LM7521: The following apply for  $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$

Differential Input Threshold Voltage ( $V_{TH}$ ) (Note 4)	11(8)	15	19(22)	mV	$\pm V_{TH}$	15 mV	+5V	+5V			+16 mA(Q)	$\pm 5V$	Logic Output <0.4V Logic Output >2.4V Logic Output <0.4V Logic Output >2.4V
	36(33)	15		mV	$\pm V_{TH}$	15 mV	+5V	+5V			-400 $\mu\text{A}$ (Q)	$\pm 5V$	
		40	mV	$\pm V_{TH}$	40 mV	+5V	+5V			+16 mA(Q)	$\pm 5V$		
		40	mV	$\pm V_{TH}$	40 mV	+5V	+5V			-400 $\mu\text{A}$ (Q)	$\pm 5V$		
Differential & Reference Input Bias Current		30	75	$\mu\text{A}$	0V	0V	+5.25V	+5.25V	+5.25V		$\pm 5.25V$		

LM5520/LM5521: The following apply for  $-55^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$

LM7520/LM7521: The following apply for  $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$

Differential Input Offset Current		0.5		$\mu\text{A}$	0V	0V	+5.25V	+5.25V	+5.25V		$\pm 5.25V$		
Logic "1" Input Voltage (Strobes)	2			V	40 mV	20 mV	+2V	+4.75V			-400 $\mu\text{A}$ (Q)	$\pm 5V$	Logic Output >2.4V Logic Output <0.4V Logic Output <0.4V
				V	40 mV	20 mV	0V	+2V			+16 mA(Q)	$\pm 5V$	
				V	40 mV	20 mV	0V	0V	+2V		+16 mA(Q)	$\pm 5V$	
Logic "0" Input Voltage (Strobes)			0.8	V	40 mV	20 mV	+0.8V	+4.75V			+16 mA(Q)	$\pm 5V$	Logic Output <0.4V Logic Output >2.4V Logic Output >2.4V
			0.8	V	40 mV	20 mV	0V	+0.8V			-400 $\mu\text{A}$ (Q)	$\pm 5V$	
			0.8	V	40 mV	20 mV	0V	0V	+0.8V		+16 mA(Q)	$\pm 5V$	
Logic "0" Input Current	-1	-1.6		mA	40 mV	20 mV	+0.4V	+0.4V	+0.4V		$\pm 5.25V$	Each Input	
Logic "1" Input Current (Strobe & Gate Q)	5	40		$\mu\text{A}$	0V	20 mV	+2.4V	+5.25V	+2.4V		$\pm 5.25V$	Each Input Each Input	
		02	1	mA	0V	20 mV	+5.25V	+5.25V	+5.25V		$\pm 5.25V$		
		5	40	$\mu\text{A}$	40 mV	20 mV	+5.25V	+2.4V			$\pm 5.25V$		
		02	1	mA	40 mV	20 mV	+5.25V	+5.25V			$\pm 5.25V$		
Logic "1" Output Voltage (Strobe)	2.4	3.9		V	40 mV	20 mV	+2.0V	+5.25V			-400 $\mu\text{A}$ (Q)	$\pm 4.75V$	$\pm 4.75V$ $\pm 4.75V$ $\pm 4.75V$
				V	40 mV	20 mV	0V	+0.8V			-400 $\mu\text{A}$ (Q)	$\pm 4.75V$	
				V	40 mV	20 mV	+4.75V	0V	+0.8V		-400 $\mu\text{A}$ (Q)	$\pm 4.75V$	
Logic "0" Output Voltage (Strobe)		0.25	0.40	V	40 mV	20 mV	+0.8V	+4.75V			+16 mA(Q)	$\pm 4.75V$	$\pm 4.75V$ $\pm 4.75V$ $\pm 4.75V$
				V	0V	20 mV	0V	+2V			+16 mA(Q)	$\pm 4.75V$	
				V	0V	20 mV	0V	0V	+2V		+16 mA(Q)	$\pm 4.75V$	
Q Output Short Circuit Current	-3	-4	-5	mA	0V	20 mV	0V	0V	0V		0 V(Q)	$\pm 5.25V$	
$\bar{Q}$ Output Short Circuit Current	-2.1	-2.8	-3.5	mA	0V	20 mV	0V	0V	0V		0 V(Q)	$\pm 5.25V$	
V+ Supply Current		21	35	mA	0V	20 mV	0V	0V	0V		$\pm 5.25V$		
V- Supply Current		-13	-18	mA	0V	20 mV	0V	0V	0V		$\pm 5.25V$		

**Note 1:** For  $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$  operation, electrical characteristics for LM5520 and LM5521 are guaranteed the same as LM7520 and LM7521, respectively.

**Note 2:** Limits in parentheses pertain to LM5521, other limits pertain to LM5520.

**Note 3:** Q or  $\bar{Q}$  in parentheses indicate Q or  $\bar{Q}$  logic output, respectively.

**Note 4:** Limits in parentheses pertain to LM7521, other limits pertain to LM7520.

**Note 5:** Positive current is defined as current into the referenced pin.

**Note 6:** Pin 1 to have  $\geq 100$  pF capacitor connected to ground.

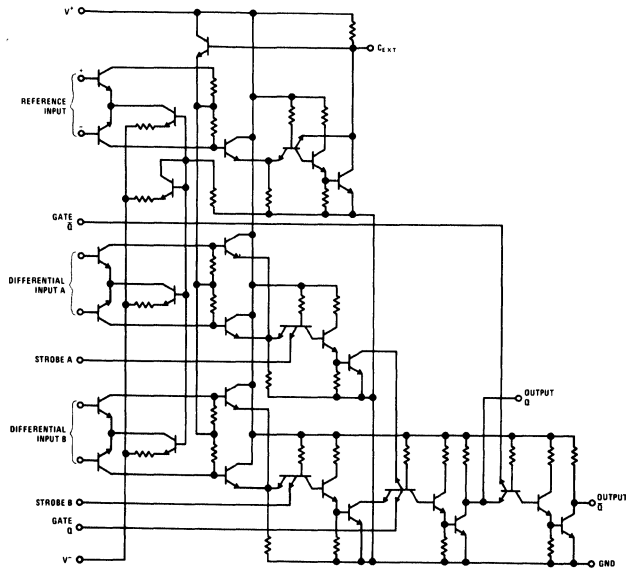
## LM5520/LM7520 and LM5521/LM7521 electrical characteristics

LM5520/LM5521 and LM7520/LM7521: The following apply for  $T_A = 25^\circ\text{C}$ ,  $V^+ = 5\text{V}$ ,  $V^- = -5\text{V}$

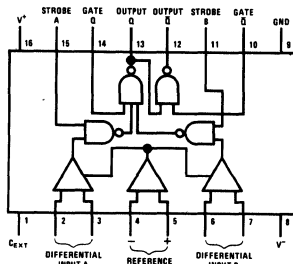
PARAMETER	MIN	TYP	MAX	UNIT	TEST CONDITIONS				
					DIFF. INPUT	REF. INPUT	STROBE AND GATE INPUTS	Q LOGIC OUTPUT	AC TEST CIRCUIT
AC Common-Mode Input Firing Voltage		±2.5		V	PULSE	20 mV	+5V	SCOPE	
Propagation Delays									
Differential Input to Logical "1" Q Output		20	40	ns		20 mV			1
Differential Input to Logical "0" Q Output		28		ns		20 mV			1
Differential Input to Logical "1" $\bar{Q}$ Output		36		ns		20 mV			1
Differential Input to Logical "0" $\bar{Q}$ Output		28	55	ns		20 mV			1
Strobe Input to Logical "1" Q Output		10	30	ns		20 mV			1
Strobe Input to Logical "0" Q Output		20		ns		20 mV			1
Strobe Input to Logical "1" $\bar{Q}$ Output		33		ns		20 mV			1
Strobe Input to Logical "0" $\bar{Q}$ Output		16	55	ns		20 mV			1
Gate Q Input to Logical "1" Q Output		12	20	ns		20 mV			2
Gate Q Input to Logical "0" Q Output		6		ns		20 mV			2
Gate Q Input to Logical "1" $\bar{Q}$ Output		17		ns		20 mV			2
Gate Q Input to Logical "0" $\bar{Q}$ Output		19	30	ns		20 mV			2
Gate $\bar{Q}$ Input to Logical "1" $\bar{Q}$ Output		12		ns		20 mV			2
Gate $\bar{Q}$ Input to Logical "0" $\bar{Q}$ Output		6	20	ns		20 mV			2
Diff. Input Overload Recovery Time		10		ns					
Common-Mode Input Overload Recovery Time		5		ns					
Min. Cycle Time		200		ns					

# LM5520/LM7520 and LM5521/LM7521

## schematic diagram



## connection diagram



TOP VIEW

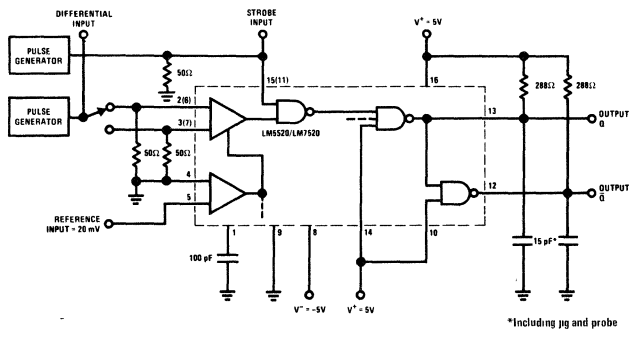
Order Number LM5520J or LM7520J  
See Package 17

Order Number LM7520N  
See Package 23

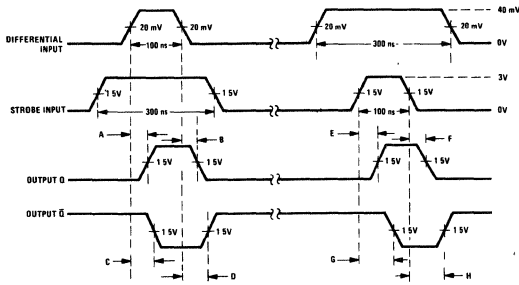
Order Number LM5521J or LM7521J  
See Package 17

Order Number LM7521N  
See Package 23

# LM5520/LM7520 and LM5521/LM7521 AC test circuit (1)

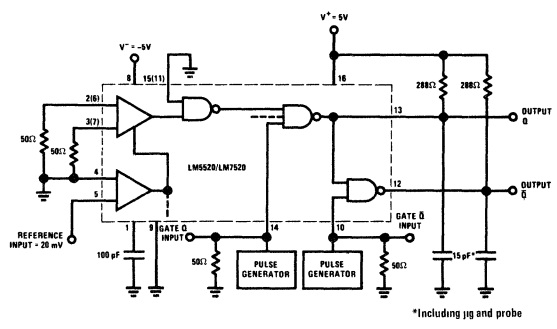


## voltage waveforms (1)

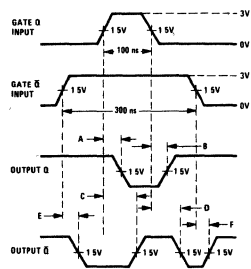


- Pulse generator characteristics  
 $Z_{OUT} = 50\Omega$ ,  $t_r = 15 \pm 5$  ns, PRR = 1 MHz
- Propagation delays  
 A = Differential input to logical "1" output Q  
 B = Differential input to logical "0" output Q  
 C = Differential input to logical "1" output Q-bar  
 D = Differential input to logical "0" output Q-bar  
 E = Strobe input to logical "1" output Q  
 F = Strobe input to logical "0" output Q  
 G = Strobe input to logical "0" output Q-bar  
 H = Strobe input to logical "1" output Q-bar

## AC test circuit (2)



## voltage waveforms (2)



- Pulse generator characteristics  
 $Z_{OUT} = 50\Omega$ ,  $t_r = 15 \pm 5$  ns, PRR = 1 MHz
- Propagation delays  
 A = Gate Q input to logical "0" output Q  
 B = Gate Q input to logical "1" output Q  
 C = Gate Q input to logical "1" output Q-bar  
 D = Gate Q input to logical "0" output Q-bar  
 E = Gate Q-bar input to logical "0" output Q  
 F = Gate Q-bar input to logical "1" output Q



## LM5522/LM7522 and LM5523/LM7523 electrical characteristics

LM5522/LM5523: The following apply for  $-55^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$  (Note 1)

PARAMETER	MIN	TYP	MAX	UNIT	TEST CONDITIONS (EACH AMPLIFIER)						COMMENTS
					DIFF. INPUT	REF. INPUT	STROBE INPUT	GATE INPUT	LOGIC OUTPUT	SUPPLY VOLT.	
Differential Input Threshold Voltage ( $V_{TH}$ ) (Note 2)	10(8)	15		mV	$\pm V_{TH}$	15 mV	+5V	+5V	-400 $\mu\text{A}$	$\pm 5\text{V}$	Logic Output >2.4V Logic Output <0.4V Logic Output >2.4V Logic Output <0.4V
		15	20(22)	mV	$\pm V_{TH}$	15 mV	+5V	+5V	+16 mA	$\pm 5\text{V}$	
	35(33)	40		mV	$\pm V_{TH}$	40 mV	+5V	+5V	-400 $\mu\text{A}$	$\pm 5\text{V}$	
		40	45(47)	mV	$\pm V_{TH}$	40 mV	+5V	+5V	+16 mA	$\pm 5\text{V}$	
Differential & Reference Input Bias Current		30	100	$\mu\text{A}$	0V	0V	+25V	+25V		$\pm 5.25\text{V}$	

LM7522/LM7523: The following apply for  $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$

Differential Input Threshold Voltage ( $V_{TH}$ ) (Note 3)	11(8)	15		mV	$\pm V_{TH}$	15 mV	+5V	+5V	-400 $\mu\text{A}$	$\pm 5\text{V}$	Logic Output >2.4V Logic Output <0.4V Logic Output >2.4V Logic Output <0.4V
		15	19(22)	mV	$\pm V_{TH}$	15 mV	+5V	+5V	+16 mA	$\pm 5\text{V}$	
	36(33)	40		mV	$\pm V_{TH}$	40 mV	+5V	+5V	-400 $\mu\text{A}$	$\pm 5\text{V}$	
		40	44(47)	mV	$\pm V_{TH}$	40 mV	+5V	+5V	+16 mA	$\pm 5\text{V}$	
Differential & Reference Input Bias Current		30	75	$\mu\text{A}$	0V	0V	+25V	+25V		$\pm 5.25\text{V}$	

LM5522/LM5523: The following apply for  $-55^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$

LM7522/LM7523: The following apply for  $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$

Diff. Input Offset Current		0.5		$\mu\text{A}$	0V	0V	+25V	+25V		$\pm 5.25\text{V}$	
Logic "1" Input Voltage (Strobes) (Gate)	2			V	40 mV	20 mV	+2V	+4.75V	+16 mA	$\pm 5\text{V}$	Logic Output <0.4V Logic Output >2.4V
				V	40 mV	20 mV	0V	+2V	-400 $\mu\text{A}$	$\pm 5\text{V}$	
Logic "0" Input Voltage (Strobes) (Gate)			0.8	V	40 mV	20 mV	+0.8V	+4.75V	-400 $\mu\text{A}$	$\pm 5\text{V}$	Logic Output >2.4V Logic Output <0.4V
			0.8	V	40 mV	20 mV	0V	+0.8V	+16 mA	$\pm 5\text{V}$	
Logic "0" Input Current		-1	-1.6	mA	40 mV	20 mV	+0.4V	+0.4V		$\pm 5.25\text{V}$	Each Input
Logic "1" Input Current (Strobes) (Gate)				$\mu\text{A}$	0V	20 mV	+2.4V	+5.25V		$\pm 5.25\text{V}$	
				1	mA	0V	20 mV	+5.25V	+5.25V	$\pm 5.25\text{V}$	
				40	$\mu\text{A}$	40 mV	20 mV	+5.25V	+2.4V	$\pm 5.25\text{V}$	
				1	mA	40 mV	20 mV	+5.25V	+5.25V	$\pm 5.25\text{V}$	
Logic "1" Output Voltage	2.4	3.9		V	40 mV	20 mV	+0.8V	+2V	-400 $\mu\text{A}$	$\pm 4.75\text{V}$	
Logic "0" Output Voltage (Strobes) (Gate)		0.25	0.40	V	40 mV	20 mV	+2V	+4.75V	+16 mA	$\pm 4.75\text{V}$	Tie Pins 10 and 12
		0.25	0.40	V	40 mV	20 mV	0V	+0.8V	+16 mA	$\pm 4.75\text{V}$	Tie Pins 10 and 12
Output Short Circuit Current	-2.1	-2.8	-3.5	mA	40 mV	20 mV	0V	+5.25V	0V	$\pm 5.25\text{V}$	Tie Pins 10 and 12
Output Leakage Current		0.01	250	$\mu\text{A}$	0V	20 mV	0V	+2V	+5.25V	$\pm 4.75\text{V}$	
V <sup>+</sup> Supply Current		23	36	mA	0V	20 mV	0V	0V		$\pm 5.25\text{V}$	
V <sup>-</sup> Supply Current		-13	-18	mA	0V	20 mV	0V	0V		$\pm 5.25\text{V}$	

LM5522/LM5523 and LM7522/LM7523: The following apply for  $T_A = 25^{\circ}\text{C}$ ,  $V^+ = 5\text{V}$ ,  $V^- = -5\text{V}$

AC Common Mode Input Firing Voltage		$\pm 2.5$		V	PULSE	20 mV	+5V	+5V	SCOPE		
Propagation Delays Differential Input to Logical "1" Output		26		ns		20 mV					AC Test Circuit
Differential Input to Logical "0" Output		21	45	ns		20 mV					AC Test Circuit
Strobe Input to Logical "1" Output		22		ns		20 mV					AC Test Circuit
Strobe Input to Logical "0" Output		12	40	ns		20 mV					AC Test Circuit
Gate Input to Logical "1" Output		4		ns		20 mV					AC Test Circuit
Gate Input to Logical "0" Output		15	25	ns		20 mV					AC Test Circuit
Differential Input Overload Recovery Time		10		ns							
Common Mode Input Overload Recovery Time		5		ns							
Min. Cycle Time		200		ns							

**Note 1:** For  $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$  operation, electrical characteristics for LM5522 and LM5523 are guaranteed the same as LM7522 and LM7523, respectively.

**Note 2:** Limits in parentheses pertain to LM5523, other limits pertain to LM5522.

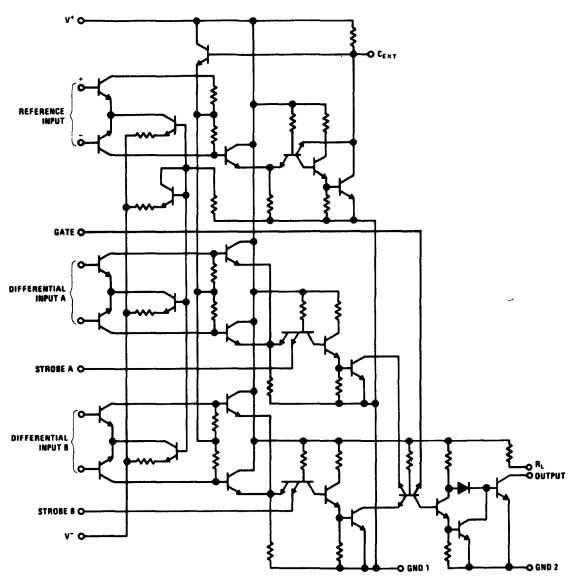
**Note 3:** Limits in parentheses pertain to LM7523, other limits pertain to LM7522.

**Note 4:** Positive current is defined as current into the referenced pin.

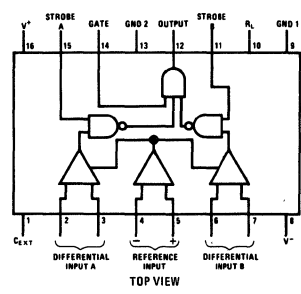
**Note 5:** Pin 1 to have  $\geq 100\text{ pF}$  capacitor connected to ground.

# LM5522/LM7522 and LM5523/LM7523

## schematic diagram

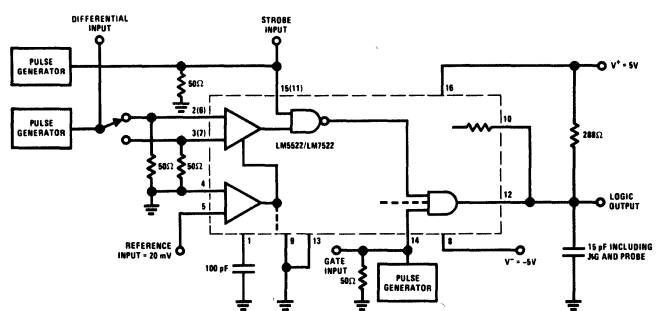


## connection diagram

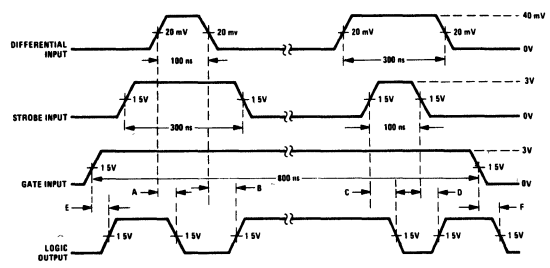


Order Number LM5522J or LM7522J  
See Package 17  
Order Number LM7522N  
See Package 23  
Order Number LM5523J or LM7523J  
See Package 17  
Order Number LM7523N  
See Package 23

## AC test circuit



## voltage waveforms



- One strobe is grounded when the other side is being tested
- Pulse generator characteristics:  
 $Z_{OUT} = 50\Omega$ ,  $t_r = t_f = 15 \pm 5$  ns, PRR = 1 MHz
- Propagation delays:  
A = Differential input to logical "0" output  
B = Differential input to logical "1" output  
C = Strobe input to logical "0" output  
D = Strobe input to logical "1" output  
E = Gate input to logical "1" output  
F = Gate input to logical "0" output



## LM5524/LM7524 and LM5525/LM7525 electrical characteristics

LM5524/LM5525: The following apply for  $-55^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$  (Note 1)

PARAMETER	MIN	TYP	MAX	UNIT	TEST CONDITIONS (EACH AMPLIFIER)					COMMENTS
					DIFF. INPUT	REF. INPUT	STROBE INPUT	LOGIC OUTPUT	SUPPLY VOLT.	
Differential Input Threshold Voltage ( $V_{TH}$ ) (Note 2)	10(8)	15		mV	$\pm V_{TH}$	15 mV	+5V	+16 mA	$\pm 5V$	Logic Output < 0.4V Logic Output > 2.4V Logic Output < 0.4V Logic Output > 2.4V
		15	20(22)	mV	$\pm V_{TH}$	15 mV	+5V	-400 $\mu\text{A}$	$\pm 5V$	
		40		mV	$\pm V_{TH}$	40 mV	+5V	+16 mA	$\pm 5V$	
		40	45(47)	mV	$\pm V_{TH}$	40 mV	+5V	-400 $\mu\text{A}$	$\pm 5V$	
Differential & Reference Input Bias Current		30	100	$\mu\text{A}$	0V	0V	+5 25V		$\pm 5 25V$	

LM7524/LM7525: The following apply for  $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$

Differential Input Threshold Voltage ( $V_{TH}$ ) (Note 3)	11(8)	15		mV	$\pm V_{TH}$	15 mV	+5V	+16 mA	$\pm 5 15\%$	Logic Output < 0.4V Logic Output > 2.4V Logic Output < 0.4V Logic Output > 2.4V
		15	19(22)	mV	$\pm V_{TH}$	15 mV	+5V	-400 $\mu\text{A}$	$\pm 5 15\%$	
		40		mV	$\pm V_{TH}$	40 mV	+5V	+16 mA	$\pm 5 15\%$	
		40	44(47)	mV	$\pm V_{TH}$	40 mV	+5V	-400 $\mu\text{A}$	$\pm 5 15\%$	
Differential & Reference Input Bias Current		30	75	$\mu\text{A}$	0V	0V	+5 25V		$\pm 5 25V$	

LM5524/LM5525: The following apply for  $-55^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$

LM7524/LM7525: The following apply for  $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$

Diff Input Offset Current		0.5		$\mu\text{A}$	0V	0V	+5 25V		$\pm 5 25V$	
Logic "1" Input Voltage	2			V	40 mV	20 mV	+2V	-400 $\mu\text{A}$	$\pm 5V$	Logic Output > 2.4V Logic Output < 0.4V
Logic "0" Input Voltage			0.8	V	40 mV	20 mV	+0.8V	+16 mA	$\pm 5V$	
Logic "0" Input Current		-1	-1.6	mA	40 mV	20 mV	+0.4V		$\pm 5 25V$	
Logic "1" Input Current		5	40	$\mu\text{A}$	0V	20 mV	+2.4V		$\pm 5 25V$	
		0.02	1	mA	0V	20 mV	+5.25V		$\pm 5 25V$	
Logic "1" Output Voltage	2.4	3.9		V	40 mV	20 mV	+2.0V	-400 $\mu\text{A}$	$\pm 4 75V$	
Logic "0" Output Voltage		0.25	0.40	V	40 mV	20 mV	+0.8V	+16 mA	$\pm 4 75V$	
Output Short Circuit Current	-2.1	-2.8	-3.5	mA	40 mV	20 mV	+5 25V	0V	$\pm 5 25V$	
$V^+$ Supply Current		29	40	mA	0V	20 mV	0V		$\pm 5 25V$	
$V^-$ Supply Current		-13	-18	mA	0V	20 mV	0V		$\pm 5 25V$	

LM5524/LM5525 and LM7524/LM7525: The following apply for  $T_A = 25^{\circ}\text{C}$ ,  $V^+ = 5V$ ,  $V^- = -5V$

AC Common-Mode Input Firing Voltage		$\pm 2.5$		V	PULSE	20 mV	+5V	SCOPE		
Propagation Delays										
Differential Input to Logical "1" Output	20		40	ns		20 mV				AC Test Circuit
Differential Input to Logical "0" Output	28			ns		20 mV				AC Test Circuit
Strobe Input to Logical "1" Output	10		30	ns		20 mV				AC Test Circuit
Strobe Input to Logical "0" Output	20			ns		20 mV				AC Test Circuit
Differential Input Overload Recovery Time	10			ns						
Common-Mode Input Overload Recovery Time		5		ns						
Min Cycle Time	200			ns						

**Note 1:** For  $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$  operation, electrical characteristics for LM5524 and LM5525 are guaranteed the same as LM7524 and LM7525 respectively.

**Note 2:** Limits in parentheses pertain to LM5525, other limits pertain to LM5524.

**Note 3:** Limits in parentheses pertain to LM7525, other limits pertain to LM7524.

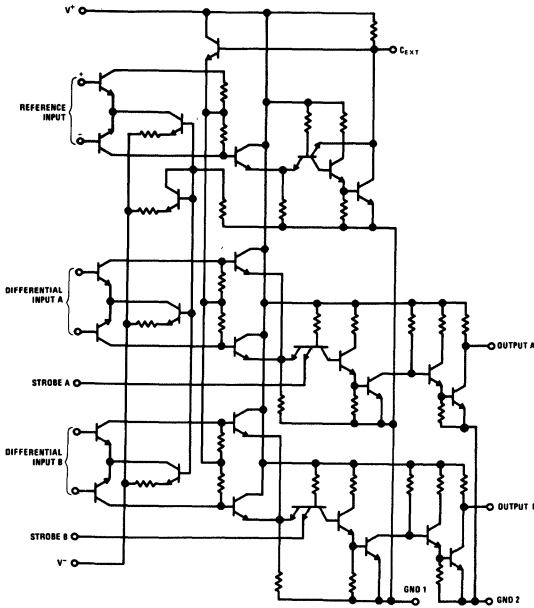
**Note 4:** Positive current is defined as current into the referenced pin.

**Note 5:** Pin 1 to have  $\geq 100$  pF capacitor connected to ground.

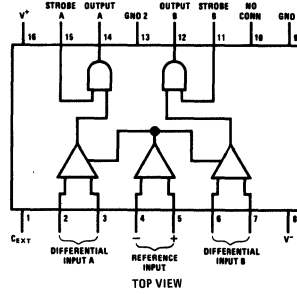


# LM5524/LM7524 and LM5525/LM7525

## schematic diagram

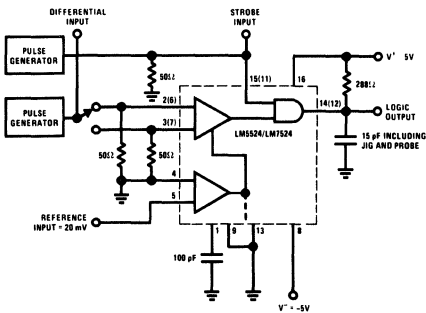


## connection diagram

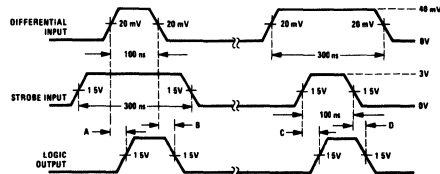


- Order Number LM5524J or LM7524J  
See Package 17
- Order Number LM7524N  
See Package 23
- Order Number LM5525J or LM7525J  
See Package 17
- Order Number LM7525N  
See Package 23

## AC test circuit



## voltage waveforms



1. Pulse generator characteristics:  
 $Z_{OUT} = 50\Omega$ ,  $t_r = t_f = 15 \pm 5$  ns, PRR = 1 MHz
2. Propagation delays:  
A = Differential input to logical "1" output  
B = Differential input to logical "0" output  
C = Strobe input to logical "1" output  
D = Strobe input to logical "0" output

## LM5528/LM7528 and LM5529/LM7529

### electrical characteristics

LM5528/LM5529: The following apply for  $-55^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$  (Note 1)

PARAMETER	MIN	TYP	MAX	UNIT	TEST CONDITIONS (EACH AMPLIFIER)					COMMENTS
					DIFF. INPUT	REF. INPUT	STROBE INPUT	LOGIC OUTPUT	SUPPLY VOLT.	
Differential Input Threshold Voltage ( $V_{TH}$ ) (Note 2)	10(8)	15	20(22)	mV	$\pm V_{TH}$	15 mV	+5V	+16 mA	$\pm 5V$	Logic Output <0.4V
	35(33)	15		mV	$\pm V_{TH}$	15 mV	+5V	-400 $\mu\text{A}$	$\pm 5V$	
		40	45(47)	mV	$\pm V_{TH}$	40 mV	+5V	+16 mA	$\pm 5V$	Logic Output <0.4V
	40	mV		$\pm V_{TH}$	40 mV	+5V	-400 $\mu\text{A}$	$\pm 5V$	Logic Output >2.4V	
Differential & Reference Input Bias Current		30	100	$\mu\text{A}$	0V	0V	+5.25V			$\pm 5.25V$

LM7528/LM7529: The following apply for  $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$

Differential Input Threshold Voltage ( $V_{TH}$ ) (Note 3)	11(8)	15	19(22)	mV	$\pm V_{TH}$	15 mV	+5V	+16 mA	$\pm 5V$	Logic Output <0.4V
	36(33)	15		mV	$\pm V_{TH}$	15 mV	+5V	-400 $\mu\text{A}$	$\pm 5V$	
		40	44(47)	mV	$\pm V_{TH}$	40 mV	+5V	+16 mA	$\pm 5V$	Logic Output <0.4V
	40	mV		$\pm V_{TH}$	40 mV	+5V	-400 $\mu\text{A}$	$\pm 5V$	Logic Output >2.4V	
Differential & Reference Input Bias Current		30	75	$\mu\text{A}$	0V	0V	+5.25V			$\pm 5.25V$

LM5528/LM5529: The following apply for  $-55^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$

LM7528/LM7529: The following apply for  $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$

Diff. Input Offset Current		0.5		$\mu\text{A}$	0V	0V	+5.25V		$\pm 5.25V$	
Logic "1" Input Voltage	2			V	40 mV	20 mV	+2V	-400 $\mu\text{A}$	$\pm 5V$	Logic Output >2.4V
Logic "0" Input Voltage			0.8	V	40 mV	20 mV	+0.8V	+16 mA	$\pm 5V$	
Logic "0" Input Current		-1	-1.6	mA	40 mV	20 mV	+0.4V		$\pm 5.25V$	
Logic "1" Input Current		5	40	$\mu\text{A}$	0V	20 mV	+2.4V		$\pm 5.25V$	
		0.02	1	mA	0V	20 mV	+5.25V		$\pm 5.25V$	
Logic "1" Output Voltage	2.4	3.9		V	40 mV	20 mV	+2.0V	-400 $\mu\text{A}$	$\pm 4.75V$	
Logic "0" Output Voltage		0.25	0.40	V	40 mV	20 mV	+0.8V	+16 mA	$\pm 4.75V$	
Output Short Circuit Current	-2	-2.8	-3.5	mA	40 mV	20 mV	+5.25V	0V	$\pm 5.25V$	
$V^+$ Supply Current		29	40	mA	0V	20 mV	0V		$\pm 5.25V$	
$V^-$ Supply Current		-13	-18	mA	0V	20 mV	0V		$\pm 5.25V$	

LM5528/LM5529 and LM7528/LM7529: The following apply for  $T_A = 25^{\circ}\text{C}$ ,  $V^+ = 5V$ ,  $V^- = -5V$

AC Common-Mode Input Firing Voltage		$\pm 2.5$		V	PULSE	20 mV	+5V	SCOPE		
Propagation Delays										
Differential Input to Logical "1" Output		20	40	ns		20 mV				AC Test Circuit
Differential Input to Logical "0" Output		28		ns		20 mV				AC Test Circuit
Strobe Input to Logical "1" Output		10	30	ns		20 mV				AC Test Circuit
Strobe Input to Logical "0" Output		20		ns		20 mV				AC Test Circuit
Differential Input Overload Recovery Time		10		ns						
Common-Mode Input Overload Recovery Time		5		ns						
Min. Cycle Time		200		ns						

**Note 1:** For  $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$  operation, electrical characteristics for LM5528 and LM5529 are guaranteed the same as LM7528 and LM7529 respectively.

**Note 2:** Limits in parentheses pertain to LM5529, other limits pertain to LM5528.

**Note 3:** Limits in parentheses pertain to LM7529, other limits pertain to LM7528.

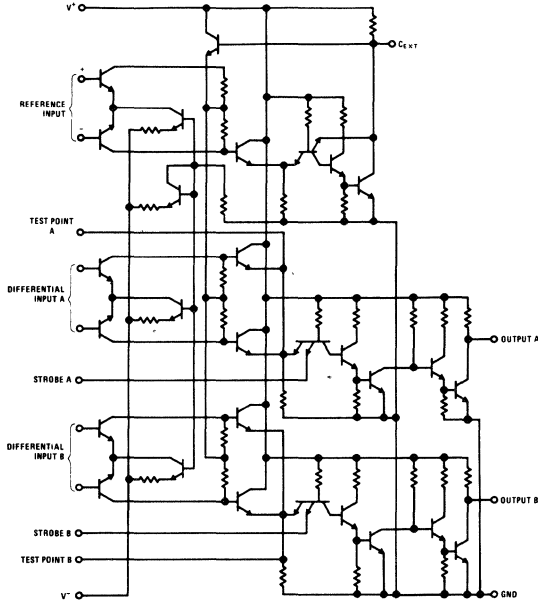
**Note 4:** Positive current is defined as current into the referenced pin.

**Note 5:** Pin 1 to have  $\geq 100$  pF capacitor connected to ground.

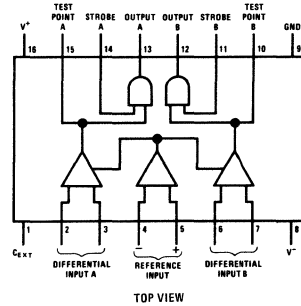
**Note 6:** Each test point to have  $\leq 15$  pF capacitive load to ground.

# LM5528/LM7528 and LM5529/LM7529

## schematic diagram



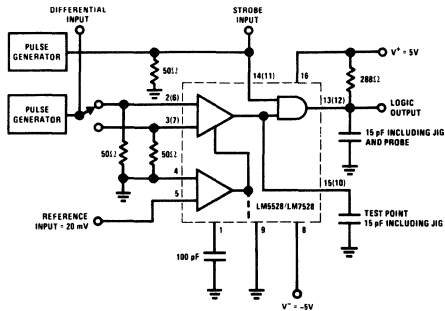
## connection diagram



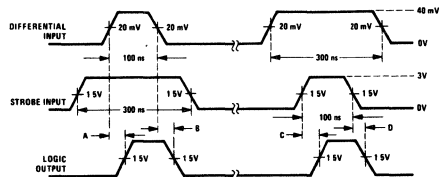
TOP VIEW

- Order Number LM5528J or LM7528J  
See Package 17
- Order Number LM7528N  
See Package 23
- Order Number LM5529J or LM7529J  
See Package 17
- Order Number LM7529N  
See Package 23

## AC test circuit



## voltage waveforms



- 1 Pulse generator characteristics  
 $Z_{OUT} = 50\Omega$ ,  $t_r = t_f = 15 \pm 5$  ns, PRR = 1 MHz
- 2 Propagation delays:  
A = Differential input to logical "1" output  
B = Differential input to logical "0" output  
C = Strobe input to logical "1" output  
D = Strobe input to logical "0" output



## LM5534/LM7534 and LM5535/LM7535 electrical characteristics

LM5534/LM5535: The following apply for  $-55^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$  (Note 1)

PARAMETER	MIN	TYP	MAX	UNIT	TEST CONDITIONS (EACH AMPLIFIER)					COMMENTS
					DIFF. INPUT	REF. INPUT	STROBE INPUT	LOGIC OUTPUT	SUPPLY VOLT.	
Differential Input Threshold Voltage ( $V_{TH}$ ) (Note 2)	10(8)	15		mV	$\pm V_{TH}$	15 mV	+5V	+5 25V	$\pm 5V$	Logic Output <250 $\mu\text{A}$ Logic Output <0.4V Logic Output <250 $\mu\text{A}$ Logic Output <0.4V
	35(33)	15	20(22)	mV	$\pm V_{TH}$	15 mV	+5V	+20 mA	$\pm 5V$	
		40		mV	$\pm V_{TH}$	40 mV	+5V	+5 25V	$\pm 5V$	
		40	45(47)	mV	$\pm V_{TH}$	40 mV	+5V	+20 mA	$\pm 5V$	
Differential & Reference Input Bias Current		30	100	$\mu\text{A}$	0V	0V	+5 25V		$\pm 5 25V$	

LM7534/LM7535: The following apply for  $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$

Differential Input Threshold Voltage ( $V_{TH}$ ) (Note 3)	11(8)	15		mV	$\pm V_{TH}$	15 mV	+5V	+5.25V	$\pm 5V$	Logic Output <250 $\mu\text{A}$ Logic Output <0.4V Logic Output <250 $\mu\text{A}$ Logic Output <0.4V
	36(33)	15	19(22)	mV	$\pm V_{TH}$	15 mV	+5V	+20 mA	$\pm 5V$	
		40		mV	$\pm V_{TH}$	40 mV	+5V	+5 25V	$\pm 5V$	
		40	44(47)	mV	$\pm V_{TH}$	40 mV	+5V	+20 mA	$\pm 5V$	
Differential & Reference Input Bias Current		30	75	$\mu\text{A}$	0V	0V	+5 25V		$\pm 5 25V$	

LM5534/LM5535: The following apply for  $-55^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$

LM7534/LM7535: The following apply for  $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$

Diff. Input Offset Current		0.5		$\mu\text{A}$	0V	0V	+5 25V		$\pm 5 25V$	
Logic "0" Input Voltage			0.8	V	40 mV	20 mV	+0.8V	+5.25V	$\pm 5V$	Logic Output <250 $\mu\text{A}$ Logic Output <0.4V
Logic "1" Input Voltage	2.0			V	40 mV	20 mV	+2.0V	+20 mA	$\pm 5V$	
Logic "0" Input Current		-1	-1.6	mA	40 mV	20 mV	+0.4V		$\pm 5.25V$	
Logic "1" Input Current		5	40	$\mu\text{A}$	0V	20 mV	+2.4V		$\pm 5 25V$	
Current		0.02	1	mA	0V	20 mV	+5 25V		$\pm 5 25V$	
Logic "0" Output Voltage		0.25	0.40	V	40 mV	20 mV	+2V	+20 mA	$\pm 4.75V$	
Output Leakage Current		0.01	250	$\mu\text{A}$	40 mV	20 mV	+0.8V	+5 25V	$\pm 4 75V$	
$V^+$ Supply Current		28	38	mA	0V	20 mV	0V		$\pm 5 25V$	
$V^-$ Supply Current		-13	-18	mA	0V	20 mV	0V		$\pm 5 25V$	

LM5534/LM5535 and LM7534/LM7535: The following apply for  $T_A = 25^{\circ}\text{C}$ ,  $V^+ = 5V$ ,  $V^- = -5V$

AC Common-Mode Input Firing Voltage		$\pm 2.5$		V	PULSE	20 mV	+5V	SCOPE		
Propagation Delays										
Differential Input to Logical "1" Output		24		ns		20 mV				AC Test Circuit
Differential Input to Logical "0" Output		20	40	ns		20 mV				AC Test Circuit
Strobe Input to Logical "1" Output		16		ns		20 mV				AC Test Circuit
Strobe Input to Logical "0" Output		10	30	ns		20 mV				AC Test Circuit
Differential Input Overload Recovery Time		10		ns						
Common-Mode Input Overload Recovery Time		5		ns						
Min. Cycle Time		200		ns						

**Note 1:** For  $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$  operation, electrical characteristics for LM5534 and LM5535 are guaranteed the same as LM7534 and LM7535 respectively

**Note 2:** Limits in parentheses pertain to LM5535, other limits pertain to LM5534.

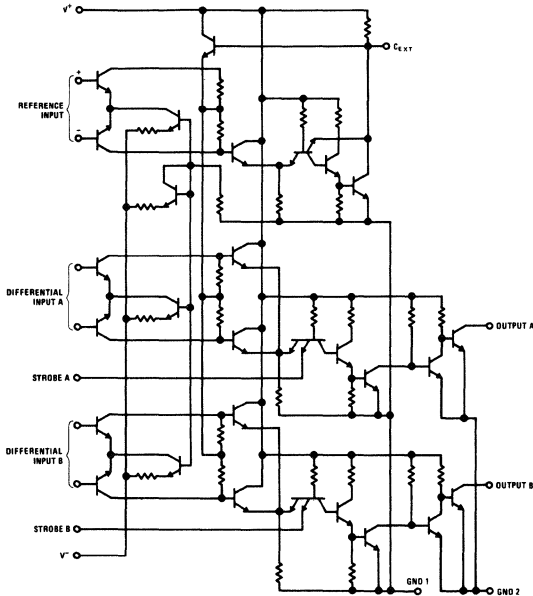
**Note 3:** Limits in parentheses pertain to LM7535, other limits pertain to LM7534.

**Note 4:** Positive current is defined as current into the referenced pin.

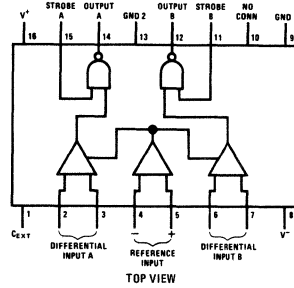
**Note 5:** Pin 1 to have  $\geq 100$  pF capacitor connected to ground.

LM5534/LM7534 and LM5535/LM7535

schematic diagram

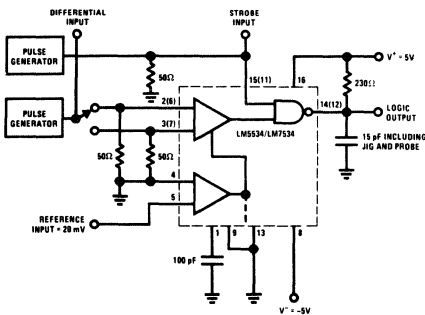


connection diagram

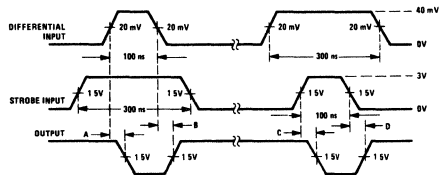


Order Number LM5534J or LM7534J  
See Package 17  
Order Number LM7534N  
See Package 23  
Order Number LM5535J or LM7535J  
See Package 17  
Order Number LM7535N  
See Package 23

AC test circuit



voltage waveforms



- Pulse generator characteristics  
 $Z_{OUT} = 50\Omega$ ,  $t_r = 15 \pm 5$  ns, PRR = 1 MHz
- Propagation delays.  
A = Differential input to logical "0" output  
B = Differential input to logical "1" output  
C = Strobe input to logical "0" output  
D = Strobe input to logical "1" output

## LM5538/LM7538 and LM5539/LM7539 electrical characteristics

LM5538/LM5539: The following apply for  $-55^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$  (Note 1)

PARAMETER	MIN	TYP	MAX	UNIT	TEST CONDITIONS (EACH AMPLIFIER)					
					DIFF. INPUT	REF. INPUT	STROBE INPUT	LOGIC OUTPUT	SUPPLY VOLT.	COMMENTS
Differential Input Threshold Voltage ( $V_{TH}$ ) (Note 2)	10(8)	15		mV	$\pm V_{TH}$	15 mV	+5V	+5.25V	$\pm 5V$	Logic Output $< 250 \mu\text{A}$ Logic Output $< 0.4V$ Logic Output $< 250 \mu\text{A}$ Logic Output $< 0.4V$
		15	20(22)	mV	$\pm V_{TH}$	15 mV	+5V	+20 mA	$\pm 5V$	
		40		mV	$\pm V_{TH}$	40 mV	+5V	+5.25V	$\pm 5V$	
		40	45(47)	mV	$\pm V_{TH}$	40 mV	+5V	+20 mA	$\pm 5V$	
Differential & Reference Input Bias Current		30	100	$\mu\text{A}$	0V	0V	+5.25V		$\pm 5.25V$	

LM7538/LM7539: The following apply for  $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$

Differential Input Threshold Voltage ( $V_{TH}$ ) (Note 3)	11(8)	15		mV	$\pm V_{TH}$	15 mV	+5V	+5.25V	$\pm 5V$	Logic Output $< 250 \mu\text{A}$ Logic Output $< 0.4V$ Logic Output $< 250 \mu\text{A}$ Logic Output $< 0.4V$
		15	19(22)	mV	$\pm V_{TH}$	15 mV	+5V	+20 mA	$\pm 5V$	
		40		mV	$\pm V_{TH}$	40 mV	+5V	+5.25V	$\pm 5V$	
		40	44(47)	mV	$\pm V_{TH}$	40 mV	+5V	+20 mA	$\pm 5V$	
Differential & Reference Input Bias Current		30	75	$\mu\text{A}$	0V	0V	+5.25V		$\pm 5.25V$	

LM5538/LM5539: The following apply for  $-55^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$

LM7538/LM7539: The following apply for  $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$

Diff. Input Offset Current		0.5		$\mu\text{A}$	0V	0V	+5.25V		$\pm 5.25V$	
Logic "1" Input Voltage	2			V	40 mV	20 mV	+2V	+20 mA	$\pm 5V$	Logic Output $< 0.4V$ Logic Output $< 250 \mu\text{A}$
Logic "0" Input Voltage			0.8	V	40 mV	20 mV	+0.8V	+5.25V	$\pm 5V$	
Logic "0" Input Current		-1	-1.6	mA	40 mV	20 mV	+0.4V		$\pm 5.25V$	
Logic "1" Input Current		5	40	$\mu\text{A}$	0V	20 mV	+2.4V		$\pm 5.25V$	
		0.02	1	mA	0V	20 mV	+5.25V		$\pm 5.25V$	
Logic "0" Output Voltage		0.25	0.40	V	40 mV	20 mV	+2.0V	+20 mA	$\pm 4.75V$	
Output Leakage Current		0.01	250	$\mu\text{A}$	40 mV	20 mV	+0.8V	+5.25V	$\pm 4.75V$	
$V^+$ Supply Current		28	38	mA	0V	20 mV	0V		$\pm 5.25V$	
$V^-$ Supply Current		-13	-18	mA	0V	20 mV	0V		$\pm 5.25V$	

LM5538/LM5539 and LM7538/LM7539: The following apply for  $T_A = 25^{\circ}\text{C}$ ,  $V^+ = 5V$ ,  $V^- = -5V$

AC Common-Mode Input Firing Voltage		$\pm 2.5$		V	PULSE	20 mV	+5V	SCOPE		
Propagation Delays										
Differential Input to Logical "1" Output		24		ns		20 mV				AC Test Circuit
Differential Input to Logical "0" Output		20	40	ns		20 mV				AC Test Circuit
Strobe Input to Logical "1" Output		16		ns		20 mV				AC Test Circuit
Strobe Input to Logical "0" Output		10	30	ns		20 mV				AC Test Circuit
Differential Input Overload Recovery Time		10		ns						
Common-Mode Input Overload Recovery Time		5		ns						
Min. Cycle Time		200		ns						

**Note 1:** For  $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$  operation, electrical characteristics for LM5538 and LM5539 are guaranteed the same as LM7538 and LM7539 respectively.

**Note 2:** Limits in parentheses pertain to LM5539, other limits pertain to LM5538.

**Note 3:** Limits in parentheses pertain to LM7539, other limits pertain to LM7538.

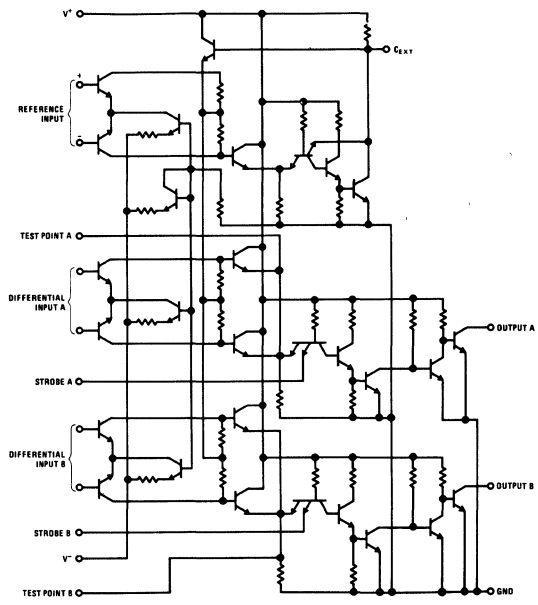
**Note 4:** Positive current is defined as current into the referenced pin.

**Note 5:** Pin 1 to have  $\geq 100$  pF capacitor connected to ground.

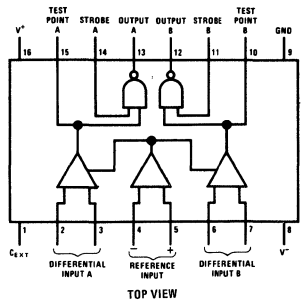
**Note 6:** Each test point to have  $\leq 15$  pF capacitive load to ground.

# LM5538/LM7538 and LM5539/LM7539

### schematic diagram

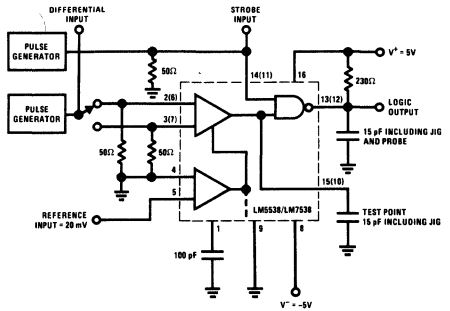


### connection diagram

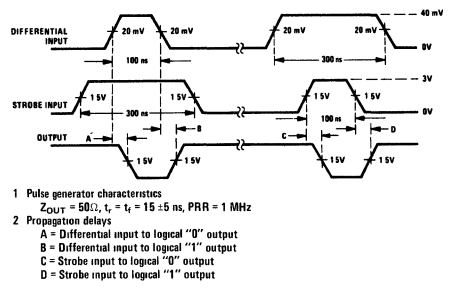


- Order Number LM5538J or LM5538J See Package 17
- Order Number LM7538N See Package 23
- Order Number LM5539J or LM7539J See Package 17
- Order Number LM7539N See Package 23

### AC test circuit



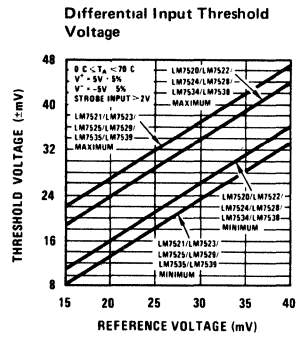
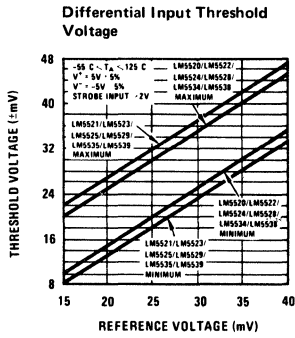
### voltage waveforms



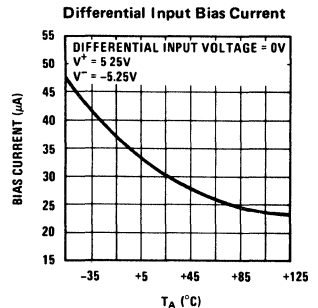
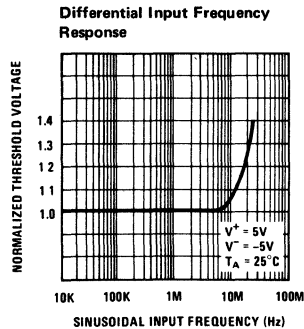
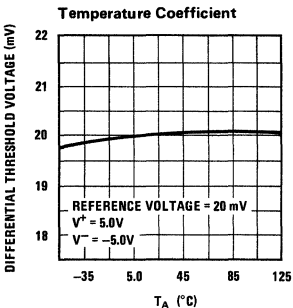
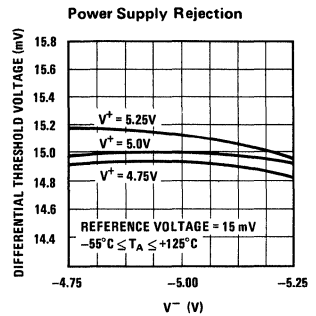
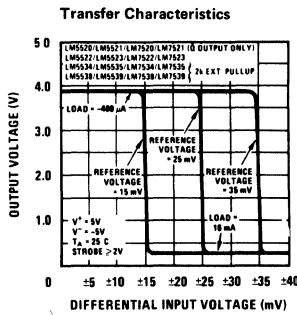
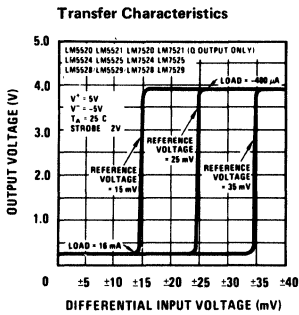
- 1 Pulse generator characteristics  
 $Z_{out} = 50\Omega$ ,  $t_r = t_f = 15 \pm 5$  ns,  $PRR = 1$  MHz
- 2 Propagation delays  
  - A = Differential input to logical "0" output
  - B = Differential input to logical "1" output
  - C = Strobe input to logical "0" output
  - D = Strobe input to logical "1" output



## guaranteed performance characteristics



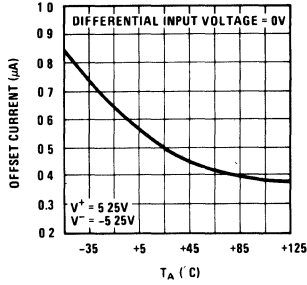
## typical performance characteristics



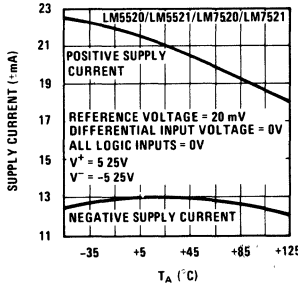


typical performance characteristics (cont.)

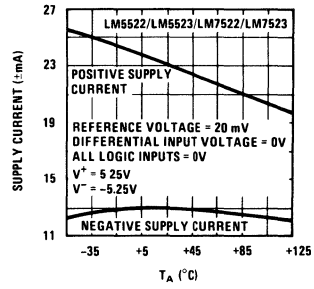
Differential Input Offset Current



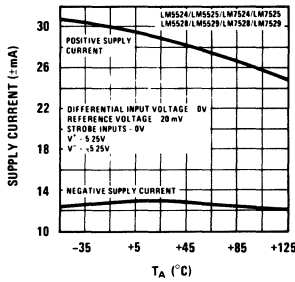
Power Supply Currents



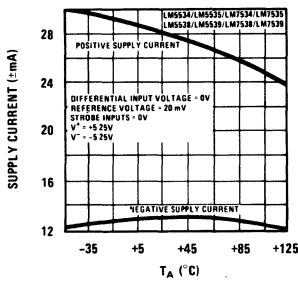
Power Supply Currents



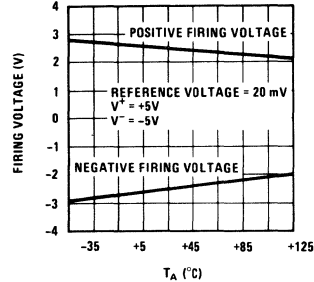
Power Supply Currents



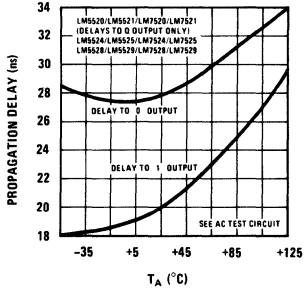
Power Supply Currents



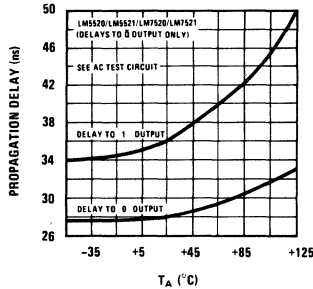
AC Common-Mode Firing Voltage



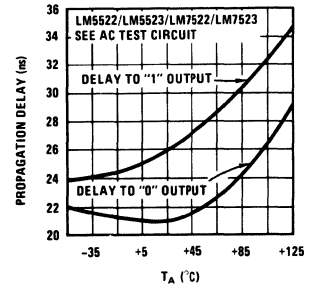
Differential Input to Output Propagation Delays



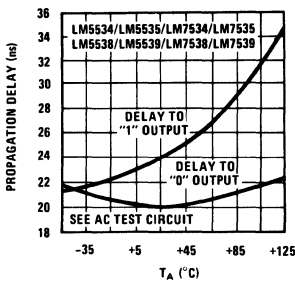
Differential Input to Output Propagation Delays



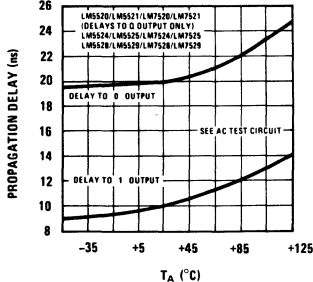
Differential Input to Output Propagation Delays



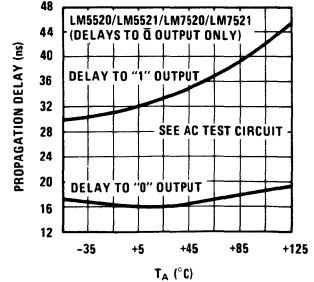
Differential Input to Output Propagation Delays



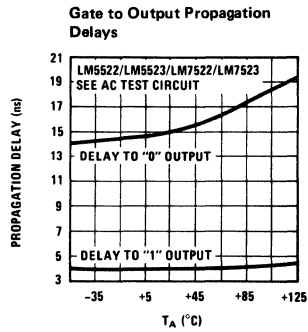
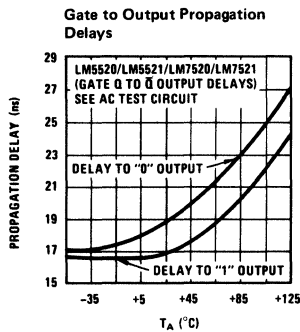
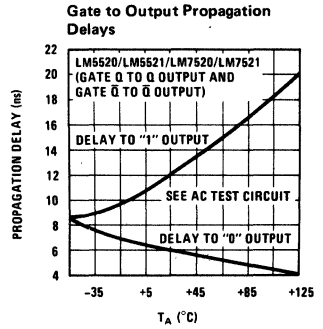
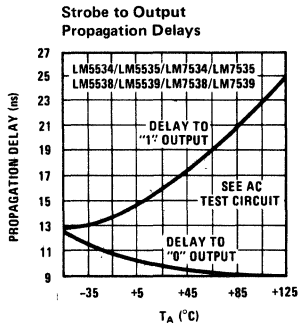
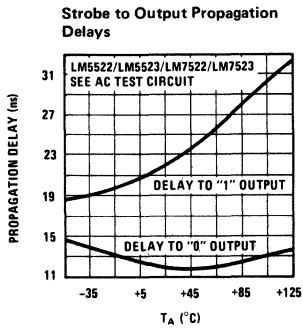
Strobe to Output Propagation Delays



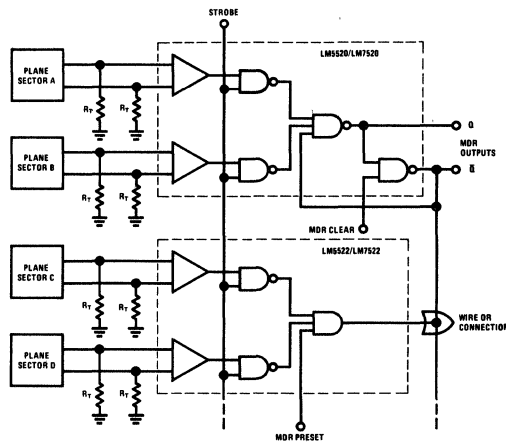
Strobe to Output Propagation Delays



typical performance characteristics (cont.)

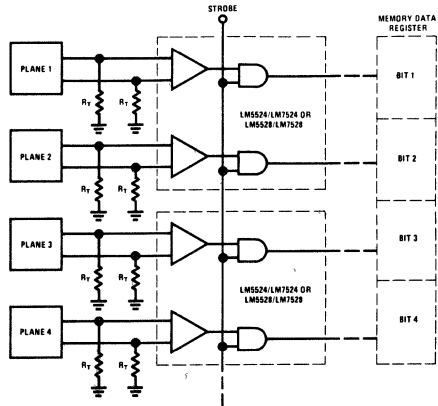


typical applications

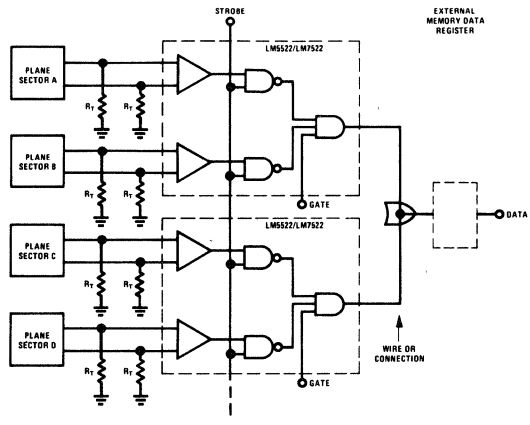


Large Memory System with Sectored Core Planes

typical applications (cont.)



Small Memory System



Large Memory System