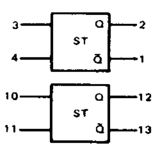
MC1035
MC1235

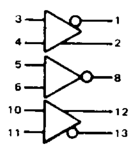
Three differential amplifiers with emitter-follower outputs and a bias driver. This device is designed for use as a dual Schmitt trigger or a level translator, as well as for many linear applications.

POSITIVE LOGIC

DUAL SCHMITT TRIGGER



TRIPLE DIFFERENTIAL AMPLIFIER



TRUTH TABLE

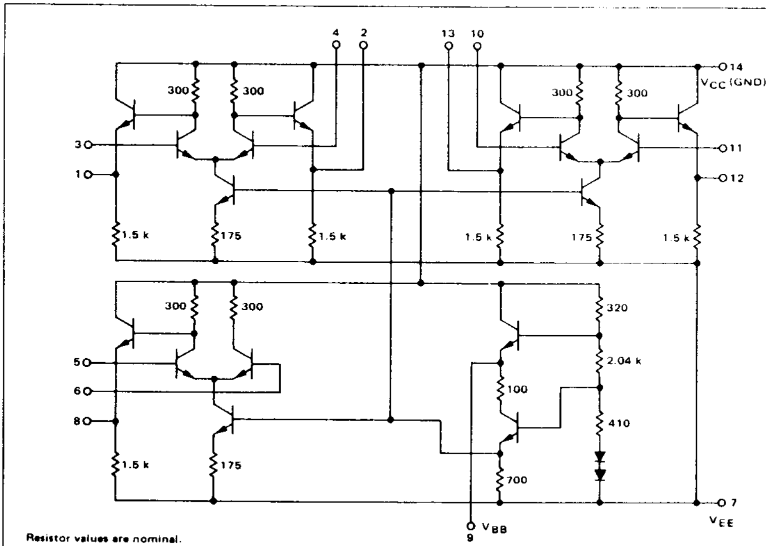
Inputs		Outputs	
3	4	1	2
5	6	8	-
10	11	13	12
H	V_{BB}	L	H
L	V_{BB}	H	L
V_{BB}	H	H	L
V_{BB}	L	L	H

☐ OR ▒ NOR

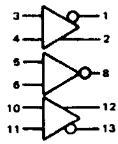
DC Input Loading Factor = 1
DC Output Loading Factor = 25
Power Dissipation = 140 mW typical

The output polarities shown in the logic diagrams above are true only when V_{BB} is applied on Pins 4, 6 and 11.

CIRCUIT SCHEMATIC



Resistor values are nominal.



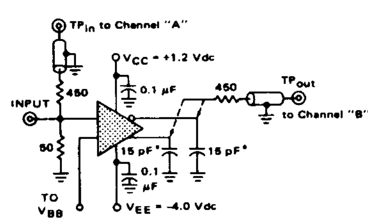
ELECTRICAL CHARACTERISTICS

The output polarity shown in the logic diagram at the right is true only when V_{BB} is applied on pins 4, 6, and 11.

Characteristic	Symbol	Pin Under Test	MC1235 Test Limits −55°C Min	−55°C Max	+25°C Min	+25°C Max	+125°C Min	+125°C Max	Unit	MC1035 Test Limits 0°C Min	0°C Max	+25°C Min	+25°C Max	+75°C Min	+75°C Max	Unit
Power Supply Drain Current	I_E	7	-	-	-	33	-	-	mAdc	-	-	-	33	-	-	mAdc
Input Current	I_{in}	3	-	-	-	100	-	-	µAdc	-	-	-	100	-	-	µAdc
		4	-	-	-	↓	-	-	↓	-	-	-	↓	-	-	↓
		5	-	-	-	↓	-	-	↓	-	-	-	↓	-	-	↓
		6	-	-	-	↓	-	-	↓	-	-	-	↓	-	-	↓
		10	-	-	-	↓	-	-	↓	-	-	-	↓	-	-	↓
		11	-	-	-	↓	-	-	↓	-	-	-	↓	-	-	↓
Input Leakage Current	I_R	3	-	-	-	0.2	-	1.0	µAdc	-	-	-	0.2	-	1.0	µAdc
		4	-	-	-	↓	-	↓	↓	-	-	-	↓	-	↓	↓
		5	-	-	-	↓	-	↓	↓	-	-	-	↓	-	↓	↓
		6	-	-	-	↓	-	↓	↓	-	-	-	↓	-	↓	↓
		10	-	-	-	↓	-	↓	↓	-	-	-	↓	-	↓	↓
		11	-	-	-	↓	-	↓	↓	-	-	-	↓	-	↓	↓
"NOR" Logical "1" Output Voltage‡	V_{OH}‡	1	-0.990	-0.825	-0.850	-0.700	-0.700	-0.530	Vdc	-0.895	-0.740	-0.850	-0.700	-0.775	-0.615	Vdc
		8	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
		13	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
"NOR" Logical "0" Output Voltage	V_{OL}	1	-1.890	-1.580	-1.800	-1.500	-1.720	-1.380	Vdc	-1.830	-1.525	-1.800	-1.500	-1.760	-1.435	Vdc
		8	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
		13	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
"OR" Logical "1" Output Voltage‡	V_{OH}‡	2	-0.990	-0.825	-0.850	-0.700	-0.700	-0.530	Vdc	-0.895	-0.740	-0.850	-0.700	-0.775	-0.615	Vdc
		8	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
		12	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
"OR" Logical "0" Output Voltage	V_{OL}	2	-1.890	-1.580	-1.800	-1.500	-1.720	-1.380	Vdc	-1.830	-1.525	-1.800	-1.500	-1.760	-1.435	Vdc
		8	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
		12	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
Bias Driver Output Voltage	V_{BB} ①	9	-1.35	-1.20	-1.26	-1.10	-1.11	-0.98	Vdc	-1.28	-1.14	-1.26	-1.10	-1.19	-1.04	Vdc
Switching Times			Typ	Max	Typ	Max	Typ	Max		Typ	Max	Typ	Max	Typ	Max	
Propagation Delay	t_{3+1-}	1	4.0	8.0	5.0	8.0	6.0	9.0	ns	4.0	8.0	5.0	8.0	5.0	8.5	ns
	t_{3-1+}	1	↓	7.0	4.0	7.0	5.0	8.0	↓	↓	7.0	4.0	7.0	4.0	7.5	↓
	t_{3+2+}	2	↓	7.0	4.0	7.0	5.5	8.0	↓	↓	7.0	4.0	7.0	4.0	7.5	↓
	t_{3-2-}	2	↓	8.0	5.0	8.0	6.0	9.0	↓	↓	8.0	5.0	8.0	5.0	8.5	↓
Rise Time	t_{1+}	1	↓	7.0	4.0	7.0	5.0	8.0	↓	↓	7.0	4.0	7.0	4.0	7.5	↓
	t_{2+}	2	↓	7.0	4.0	7.0	5.0	8.0	↓	↓	7.0	4.0	7.0	4.0	7.5	↓
Fall Time	t_{1-}	1	5.0	9.0	6.0	9.0	8.0	11	↓	5.0	9.0	6.0	9.0	7.0	10	↓
	t_{2-}	2	5.0	9.0	6.0	9.0	8.0	11	↓	5.0	9.0	6.0	9.0	7.0	10	↓

① V_{BB} supplied from pin 9, and is applicable from a load of 0 mA to -1.0 mA. ‡ V_{OH} limits apply from no load (0 mA) to full load (-2.5 mA).

SWITCHING TIME TEST CIRCUIT @ 25°C



*Load Corresponds to a Fan-Out = 3.

Input Pulse t_r and t_f = 5.0 ± 0.5 ns

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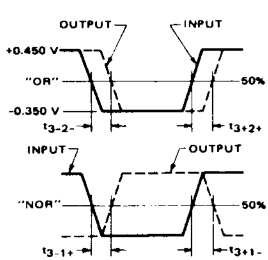
@Test Temperature		$V_{IL\,min}$ to $V_{IL\,max}$	$V_{IH\,min}$ to $V_{IH\,max}$	$V_{IH\,max}$	V_{EE}	V_{BB}	I_L
		TEST VOLTAGE/CURRENT VALUES Vdc ±1.0%					mAdc
MC1235	−55°C	-5.2 to -1.405	-1.165 to -0.825		-5.2	1	-2.5
	+25°C	-5.2 to -1.325	-1.025 to -0.700	-0.700	-5.2	1	-2.5
	+125°C	-5.2 to -1.205	-0.875 to -0.530	-	-5.2	1	-2.5
MC1035	0°C	-5.2 to -1.350	-1.070 to -0.740	-	-5.2	1	-2.5
	+25°C	-5.2 to -1.325	-1.025 to -0.700	-0.700	-5.2	1	-2.5
	+75°C	-5.2 to -1.260	-0.950 to -0.615		-5.2	1	-2.5

TEST VOLTAGE/CURRENT APPLIED TO PINS LISTED BELOW:

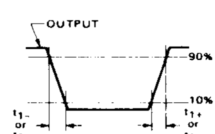
Characteristic	Symbol	Pin Under Test	$V_{IL\,min}$ to $V_{IL\,max}$	$V_{IH\,min}$ to $V_{IH\,max}$	$V_{IH\,max}$	V_{EE}	V_{BB}	I_L	V_{CC} (Gnd)
Power Supply Drain Current	I_E	7	-	-	-	7	3,5,10		14
Input Current	I_{in}	3	-	-	3	6,7,11	4,5,10		14
		4	-	-	4	6,7,11	3,5,10	-	
		5	-	-	5	4,7,11	3,6,10	-	
		6	-	-	6	4,7,11	3,5,10	-	
		10	-	-	10	4,6,10	3,5,11	-	
		11	-	-	11	4,6,11	3,5,10	-	↓
Input Leakage Current	I_R	3	-	-	-	3,6,7,11	4,5,10	-	14
		4	-	-	-	4,6,7,11	3,5,10	-	
		5	-	-	-	4,5,7,11	3,6,10	-	
		6	-	-	-	4,6,7,11	3,5,10	-	
		10	-	-	-	4,6,7,10	3,5,11		
		11	-	-	-	4,6,7,11	3,5,10	-	↓
"NOR" Logical "1" Output Voltage‡	V_{OH}‡	1	3	-	-	5,7,10	4,6,11	1	14
		8	5	-	-	3,7,10		8	
		13	10	-	-	3,5,7	↓	13	↓
"NOR" Logical "0" Output Voltage	V_{OL}	1	-	3	-	5,7,10	4,6,11	-	14
		8	-	5	-	3,7,10		-	
		13	-	10	-	3,5,7	↓	-	↓
"OR" Logical "1" Output Voltage‡	V_{OH}‡	2	-	3	-	6,7,10	4,5,11	2	14
		8	-	6	-	3,7,10		8	
		12	-	10	-	3,6,7	↓	12	↓
"OR" Logical "0" Output Voltage	V_{OL}	2	3	-	-	6,7,10	4,5,11	-	14
		8	6	-	-	3,7,10		-	
		12	10	-	-	3,6,7	↓	-	↓
Bias Driver Output Voltage	V_{BB} ①	9	-	-	-	7	3,5,10	-	14
Switching Times			Pulse In	Pulse Out					(+1.2 V)
Propagation Delay	t_{3+1-}	1	3	1	-	6,7,10	4,5,11	-	14
	t_{3-1+}	1		1	-			-	
	t_{3+2+}	2		2	-			-	
	t_{3-2-}	2		2	-			-	
Rise Time	t_{1+}	1		1	-			-	
	t_{2+}	2		2	-			-	
Fall Time	t_{1-}	1		1	-			-	
	t_{2-}	2	↓	2	-	↓	↓	-	↓

SWITCHING TIME WAVEFORMS

PROPAGATION DELAY



RISE AND FALL TIME



Switching waveforms shown for pulse in on pin 3 and pulse out on pins 1 and 2, however, all other input-output combinations will meet the limits specified.

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APPLICATIONS INFORMATION

The MC1035/MC1235 is a dual Schmitt trigger/triple differential amplifier designed for interfacing into a MECL system. Signals with very slow rise and fall times and with low voltage swings can be converted to MECL signal levels with MECL rise and fall times to operate flip-flops and gates (see Figures 1 and 2). The circuit also acts as a triple level translator from negative power supply logic circuits, such as those used in PNP discrete component systems and MOS systems, to MECL levels (Figure 3).

The differential inputs allow a threshold of V_{BB} (obtained by connecting the internal V_{BB} reference voltage available at pin 9 to one side of the differential pair) or some other value (externally generated) to be set for the switching point. The externally-generated reference should lie between −0.5 Vdc and a value no more negative than 1.7 volts above V_{EE}. This permits a 3.0-volt range over which the input voltage may vary without affecting the characteristics of the device when using the nominal supply voltage of −5.2 Vdc.

Some of the general properties of the MC1035/MC1235 for each of the three amplifiers are:

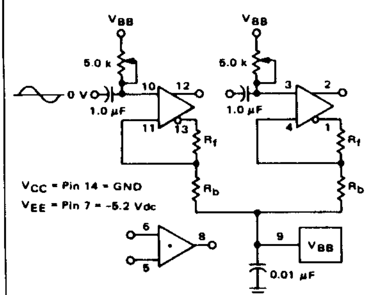
- Voltage gain – 6.0 V/V (single-ended) or 12 V/V (differential)
- Bandwidth (at the 3.0 dB point) – 45 to 50 MHz
- Useful gain – to 100 MHz
- Common mode rejection ratio – ≈ 80 dB

The amplifiers may be cascaded in various combinations for different gains. A typical gain of 60 dB with an overall bandwidth of 40 MHz can be realized by cascading amplifiers. This makes it useful as an RF/IF amplifier and limiter as shown in Figure 4, or as a wideband video amplifier as shown in Figures 5 and 6. The common-mode rejection ratio in this configuration is typically 80 dB due to the active current source for each amplifier.

The active current source in the differential-pair emitters reduces the effects of saturation so that input levels more positive than maximum MECL logic "1" levels can be applied before saturation occurs. This effect can be seen in Figure 7. Notice also in Figure 7 that the "NOR" logic "0" transfer characteristics do not exhibit the normal droop as the input is made more positive.

Figures 8 through 12 illustrate additional applications for the MC1035/MC1235 as an A/D comparator (Figure 8), a zero crossing detector (Figure 9), a low-current power supply buffer amplifier (Figure 10), and a V_{BB} buffered supply (Figures 11 and 12).

FIGURE 1 – DUAL SCHMITT TRIGGER



Ratio of R_b/R_f adjusts hysteresis of the Schmitt trigger (See Figure 2 for curves). Hysteresis is adjustable from about 20 mV to 600 mV. Useful to 50 MHz.

*May be used as an amplifier for the input waveform to decrease effective hysteresis, or as an extra unbuffered Schmitt trigger.

FIGURE 2 – HYSTERESIS CURVES FOR DUAL SCHMITT TRIGGER

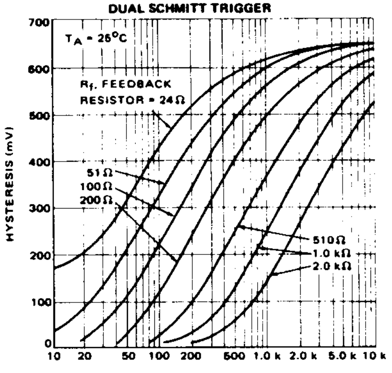
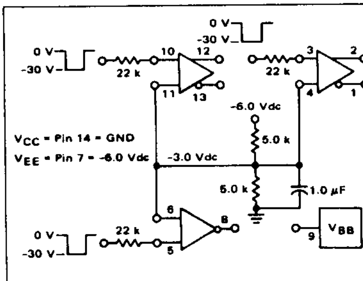


FIGURE 3 – TRIPLE MOS-TO-MECL TRANSLATOR



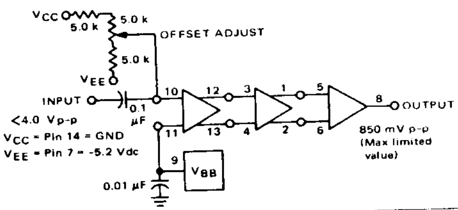
The voltage at the MC1035/MC1235 input is clamped at −6.8 V due to the substrate diodes turning on.

The threshold is set at −3.0 V by the resistor network.

Bipolar devices may also be used to drive the inputs.

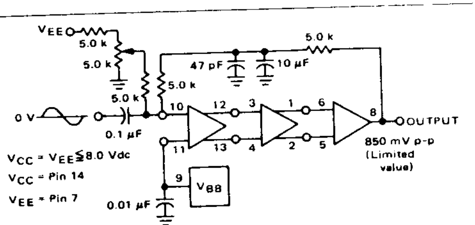
APPLICATIONS INFORMATION (continued)

FIGURE 4 – RF AMPLIFIER/FM AMPLIFIER-LIMITER



- Gain ≈ 800 V/V (May be decreased by connecting pins 4 and/or 5 to V_{BB}, resulting in single ended gain).
- Gain ≈ 60 dB with about 70 dB of limiting.
- Effective input noise at gain of 800 ≈ 35 µV (Similar to that caused by 2.5 kΩ resistor)
- Negative feedback may be applied to increase bias stability.
- Output phasing may be reversed 180° by interchanging inputs.

FIGURE 5 – WIDEBAND VIDEO AMPLIFIER WITH BIAS FEEDBACK



- Voltage gain ≈ 800 V/V
- 3.0 dB down point ≈ 40 MHz @ gain = 800 V/V
- Single-ended gain ≈ 6.0 V/V per stage @ bandwidth = 45 MHz
- Double ended gain ≈ 12 V/V per stage @ bandwidth = 45 MHz
- Negative feedback or fewer stages may be employed to reduce gain and increase bandwidth.
- See Figure 6 for response characteristics.

FIGURE 6 – VIDEO AMPLIFIER RESPONSE CHARACTERISTICS

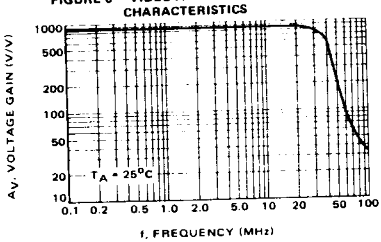


FIGURE 7 – MC1035/MC1235 TRANSFER CHARACTERISTICS

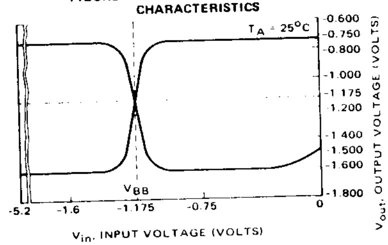
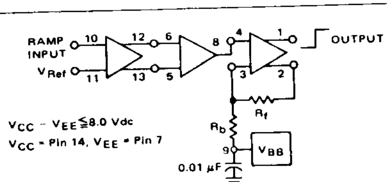


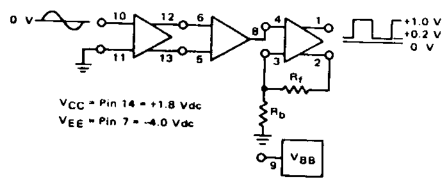
FIGURE 8 – A/D COMPARATOR



- Ratio of R_b/R_f adjusts hysteresis of the Schmitt trigger (See Figure 2 for curves).
- Effective voltage gain > 200 V/V
- Delay time ≈ 15 ns
- Useful to 50 MHz
- Offset voltage (pins 10-11) typically 2.0 to 3.0 mV

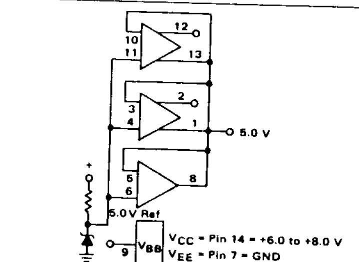
APPLICATIONS INFORMATION (continued)

FIGURE 9 – ZERO CROSSING DETECTOR



Ratio of R_b/R_f adjusts hysteresis of the Schmitt trigger (See Figure 2 for curves).
Effective voltage gain > 200 V/V
Delay time ≈ 15 ns
Useful to 50 MHz
Output will drive a discrete NPN transistor.

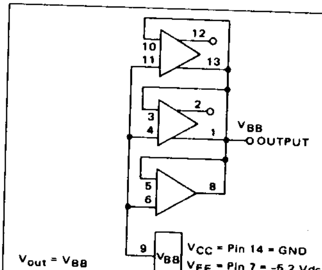
FIGURE 10 – LOW CURRENT POWER SUPPLY-BUFFER AMPLIFIER



V_{out} = 5.0 V
Z_{out} = 0.5 ohms

This circuit can be used as a buffer regulator with output current to 60 mA. This circuit permits the output voltage to be the same as the reference voltage for loads from 0 to 60 mA.

FIGURE 11 – V_{BB} BUFFERED SUPPLY



V_{out} = V_{BB}
Z_{out} = 0.5 ohms

This circuit can be used as a V_{BB} source or sink supply for the "party-line" distribution technique shown for the MC1020/MC1220 line receiver. (See MC1020/MC1220 data sheet). See Figure 12 for load characteristics.

FIGURE 12 – BUFFERED V_{BB} SUPPLY versus LOADING