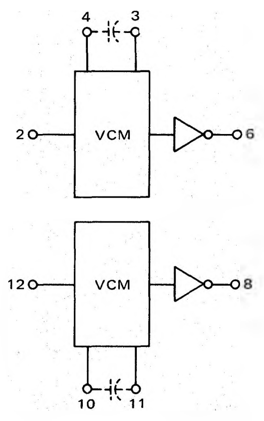
DUAL
VOLTAGE-CONTROLLED
MULTIVIBRATOR

MC4324F, L*
MC4024F, L, P*



The MC4324/4024 voltage-controlled multivibrator provides appropriate level shifting to produce an output compatible with MTTL logic levels. Frequency control is accomplished through the use of voltage-variable current sources which control the slew rate of a single capacitor. Variation of the output frequency over a 3.5 to 1 range is possible with an input dc control voltage of +1.0 to +5.0 volts.

Voltage-controlled multivibrators are used in phase-locked loops for digital frequency control. They may also be used for some types of A to D converters.

V_{CC}: VCM = 1, 13
Output Buffer = 14

GND: VCM = 5, 9
Output Buffer = 7

External Capacitor for
Frequency Range Determination

Output Loading Factor = 7

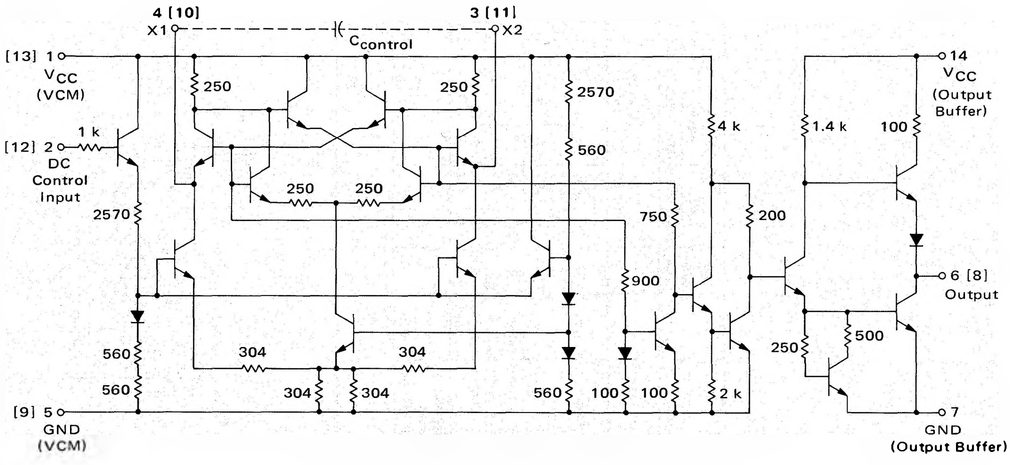
Power Dissipation = 150 mW typ/pkg

Maximum Operating Frequency = 30 MHz typ

CIRCUIT SCHEMATIC

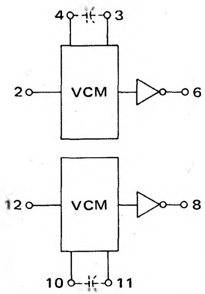
1/2 OF CIRCUIT SHOWN

(Numbers in brackets are pin numbers for other half.)



*F suffix = TO-86 ceramic flat package (Case 607).
L suffix = TO-116 ceramic dual in-line package (Case 632).
P suffix = TO-116 plastic dual in-line package (Case 605).

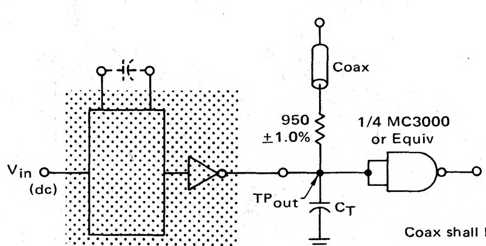
ELECTRICAL CHARACTERISTICS

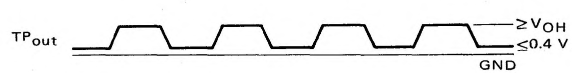


@ Test Temperature		I_{OL1} (mA)	I_{OL2} (mA)	I_{OH} (mA)	V_{IH} (Volts)	V_{CC} (Volts)	V_{CCL} (Volts)	V_{CCH} (Volts)
MC4324	-55°C	9.8	11.2	-1.6	5.0	5.0	4.5	5.5
	+25°C	9.8	11.2	-1.6	5.0	5.0	4.5	5.5
	+125°C	9.8	11.2	-1.6	5.0	5.0	4.5	5.5
MC4024	0°C	9.8	11.2	-1.6	5.0	5.0	4.75	5.25
	+25°C	9.8	11.2	-1.6	5.0	5.0	4.75	5.25
	+75°C	9.8	11.2	-1.6	5.0	5.0	4.75	5.25

Characteristic	Symbol	Pin Under Test	MC4324 Test Limits -55°C Min	-55°C Max	+25°C Min	+25°C Max	+125°C Min	+125°C Max	MC4024 Test Limits 0°C Min	0°C Max	+25°C Min	+25°C Max	+75°C Min	+75°C Max	Unit	TEST CURRENT/VOLTAGE APPLIED TO PINS LISTED BELOW: I_{OL1}	I_{OL2}	I_{OH}	V_{IH}	V_{CC}	V_{CCL}	V_{CCH}	Gnd
Input Forward Current	I_{in}	2	—	40	—	40	—	40	—	40	—	40	—	40	µAdc	—	—	—	2	—	—	14	5,7,9
		12	—	40	—	40	—	40	—	40	—	40	—	40	µAdc	—	—	—	12	—	—	14	5,7,9
Output Output Voltage	V_{OL}	6	—	0.4	—	0.4	—	0.4	—	0.4	—	0.4	—	0.4	Vdc	6	—	—	2	—	1,4,14	—	5,7,9
		8	—	↓	—	↓	—	↓	—	↓	—	↓	—	↓	↓	8	—	—	12	—	10,13,14	—	↓
		6	—	↓	—	↓	—	↓	—	↓	—	↓	—	↓	↓	—	6	—	2	—	—	1,4,14	↓
		8	—	↓	—	↓	—	↓	—	↓	—	↓	—	↓	↓	—	8	—	12	—	—	10,13,14	↓
	V_{OH}	6	2.4	—	2.4	—	2.4	—	2.5	—	2.5	—	2.5	—	Vdc	—	—	6	2	—	1,3,14	—	5,7,9
		8	2.4	—	2.4	—	2.4	—	2.5	—	2.5	—	2.5	—	Vdc	—	—	8	12	—	11,13,14	—	5,7,9
Short-Circuit Current	I_{SC}	6	-40	-100	-40	-100	-40	-100	-40	-100	-40	-100	-40	-100	mAdc	—	—	—	2	1,3,14	—	—	5,6,7,9
		8	-40	-100	-40	-100	-40	-100	-40	-100	-40	-100	-40	-100	mAdc	—	—	—	12	11,13,14	—	—	5,7,8,9
Power Requirements (Total Device) Power Supply Drain	I_{PD}	1,3,14	—	—	—	37	—	—	—	—	—	37	—	—	mAdc	—	—	—	2,4,10,12	1,13,14	—	—	5,7,9

AC TEST CIRCUIT AND WAVEFORMS





Coax shall be CT-070-50 or equivalent.

C_T = 25 pF = total parasitic capacitance, which includes probe, wiring, and load capacitances.

AC TEST LIMITS

TEST	SYMBOL	CONDITIONS	LIMITS Min
Maximum Operating Frequency	f_{max}	$C_{control}$ = 10 pF, V_{in} = 5.0 Vdc Frequency Ratio = 3.5:1	25 MHz
Ratio of Frequency of Oscillation over Specified Input Voltage Range	$\frac{f_{high}}{f_{low}}$	$C_{control}$ = 100 pF, V_{in} high = 5.0 Vdc, V_{in} low = 1.0 Vdc	3.5:1.0

OPERATING CHARACTERISTICS

The operating frequency range of this multivibrator is controlled by the value of an external capacitor that is connected between X1 and X2. Either of the two equations shown below may be used to define the value of $C_{control}$:

$$C_{control} = \frac{500}{f_{max}}\ \mu F, \quad \text{or} \quad C_{control} = \frac{100}{f_{min}}\ \mu F,$$

with f given in Hz. The maximum operating frequency of this device is typically 30 MHz.

Three power supply and three ground connections are provided in this circuit. Each multivibrator has a separate power supply and ground connection. The output buffers have a common power supply and ground pin. This provides isolation between VCM's and minimizes the effect of output buffer transients on the multivibrators in critical applications. This separation of power supply and ground lines also provides the capability of disabling one VCM by disconnecting its V_{CC} pin. All grounds must always be connected to insure substrate grounding and proper isolation.

The output buffer transforms the logic levels of the VCM to MTTL logic levels.

FIGURE 1 — INPUT VOLTAGE versus OUTPUT FREQUENCY (15 pF FEEDBACK CAPACITOR)

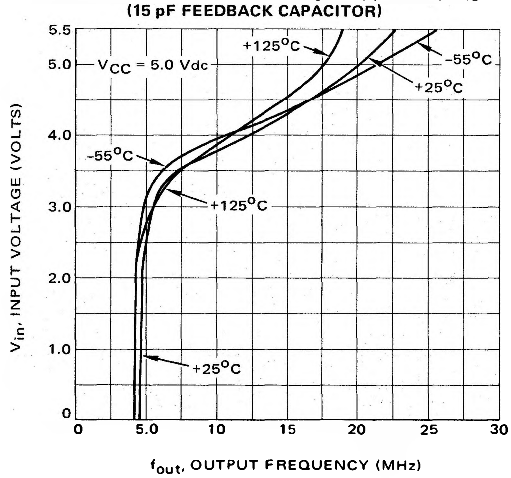


FIGURE 2 — INPUT VOLTAGE versus OUTPUT FREQUENCY (100 pF FEEDBACK CAPACITOR)

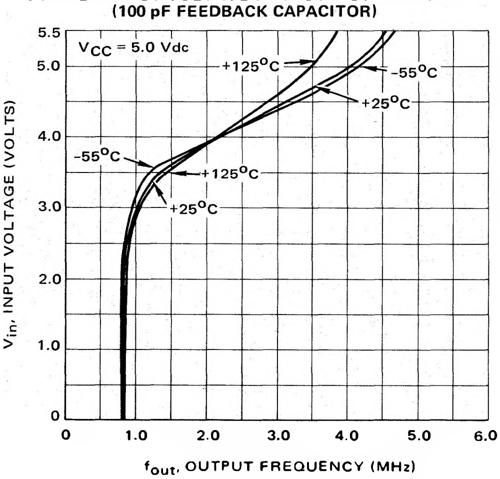
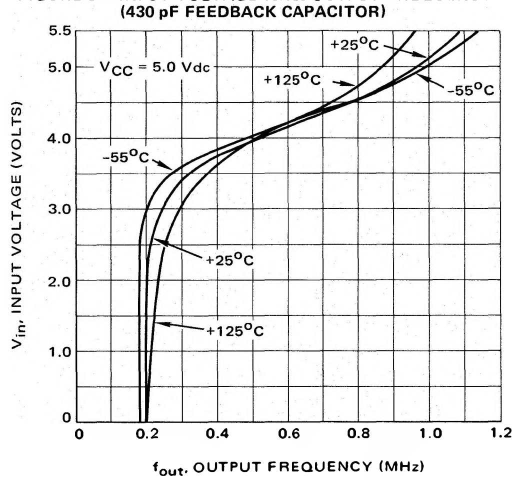


FIGURE 3 — INPUT VOLTAGE versus OUTPUT FREQUENCY (430 pF FEEDBACK CAPACITOR)



APPLICATIONS INFORMATION

The basic frequency synthesizer loop shown in Figure 4 consists of five basic components: the reference oscillator, the phase detector, the low-pass filter, the voltage controlled multivibrator/oscillator, and the divide by N counter.

This loop achieves a stable state when $f_{VCM} = N\ f_{ref}$. When this condition does not exist the VCM searches through its frequency spectrum until it finds the frequency at which the stable state occurs. At this point the loop locks. This system allows the generation of many discrete frequencies from a single, highly stable source (f_{ref}). A system such as this has many useful applications in communications (frequency control systems), computer systems (for synchronizing data tracks and clocking systems), in instruments (frequency synthesizers and counters) and filter networks.

In addition to its function in the phase-locked loop, the VCM may be used as a fixed oscillator (plug crystal into capacitor pins and ground control input), in simple A to D converter systems, and as an FM modulator.

FIGURE 4 – PHASE-LOCKED, FREQUENCY SYNTHESIZER LOOP