11C58

VOLTAGE CONTROLLED MULTIVIBRATOR

11C00 SERIES

GENERAL DESCRIPTION – The 11C58 is an ECL astable multivibrator utilizing current mode circuitry and having emitter follower buffers to provide ECL output levels. Operating frequency is determined by an applied voltage V_{CX} in conjunction with an external timing capacitor C_X.

The circuit is designed to accommodate a V_{CX} dynamic range of 2 V, which causes a frequency change of typically four to one for a given C_X value. Operating frequency ranges from typically 155 MHz with 5 pF C_X to low frequencies determined only by practical limits on capacitor size.

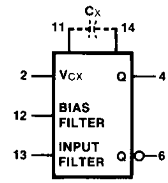
Noise on the analog input signal can be decoupled by connecting a bypass capacitor from the Input Filter terminal to ground. Similarly, a bypass capacitor from the Bias Filter to ground helps eliminate ripple on the output signal at high frequencies.

- **BROAD FREQUENCY RANGE — DC TO 155 MHz**
- **TRUE AND COMPLEMENT OUTPUTS**
- **50 Ω DRIVE CAPABILITY**
- **USES STANDARD TTL OR ECL POWER SUPPLY**
- **ONLY ONE TIMING CAPACITOR REQUIRED**

FUNCTIONS

V_{CX}	Applied Control Voltage
Bias Filter	For Ripple Elimination
Input Filter	For Input Noise Decoupling
C_X	External Timing Capacitor
Q, $\overline{Q}$	Outputs

LOGIC SYMBOL

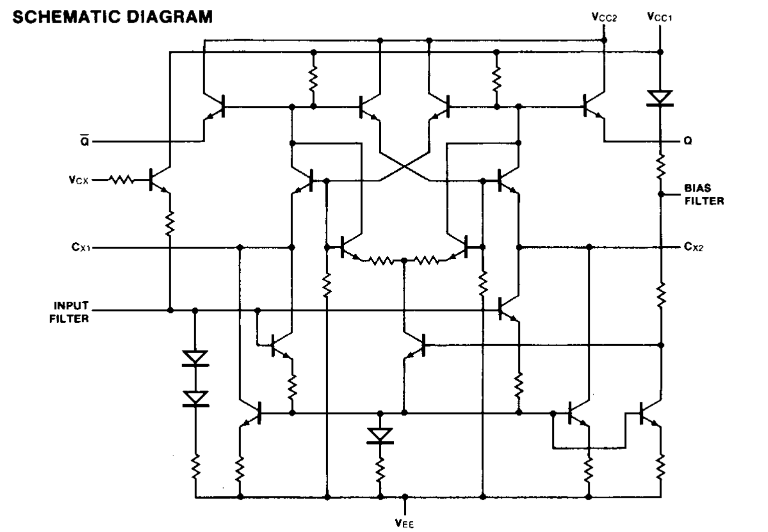


V_{CC1} = Pin 1

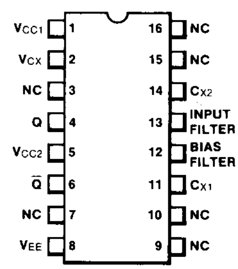
V_{CC2} = Pin 5

V_{EE} = Pin 8

SCHEMATIC DIAGRAM



CONNECTION DIAGRAM
DIP (TOP VIEWO)



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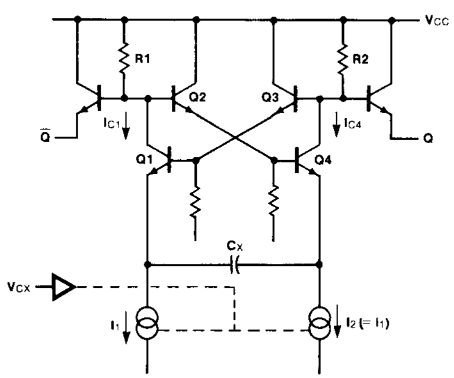
FUNCTIONAL DESCRIPTION — The simplified schematic and waveforms of *Figure 1* highlight basic operation of the 11C58. Q1 and Q4 turn on and off alternately, while Q2 and Q3 serve as level shifting buffers. C_X is alternately charged in different directions by the voltage controlled current sources I_1 and I_2 acting in conjunction with Q1 and Q4. To follow through a cycle of operation, assume that Q1 has just turned on, causing a positive voltage step at its emitter and a negative step at its collector. Since the voltage across C_X cannot change instantaneously, the positive step also appears at Q4 emitter. Simultaneously the negative step is applied through Q2 to the base of Q4. Thus Q4 is turned off and Q1 supplies the current required to satisfy I_1 and I_2. Since I_2 must flow through C_X, the voltage across C_X starts decreasing linearly. During the time that Q1 is on, the base-emitter voltages of Q3 and Q1 in series hold V_{11} constant at about 2 V_{BE} below V_{CC}. With V_{11} constant and C_X discharging linearly, Q4 emitter voltage is a negative going ramp, as indicated by the V_{14} waveform sketch.

This negative ramp eventually reaches a point where the base-emitter junction of Q4 becomes forward biased. Thus Q4 starts turning on and its collector current I_{C4} causes a negative going voltage drop across R2 which is applied by Q3 to the base of Q1. This reduces I_{C1}, which decreases the voltage drop across R1. The resultant positive going voltage at the base of Q2 is applied to Q4, which accelerates the turn-on of Q4. The circuit reaction is thus regenerative and produces a negative going voltage step at the Q4 collector and a positive step at the Q4 emitter. The negative step is applied by Q3 to Q1 base while the positive step is applied through C_X to the Q1 emitter. Q1 is thus turned off and I_1 starts charging C_X in the opposite direction, producing the negative going ramp shown on the V_{11} waveform. At the end of this ramp Q1 is again turned on and the circuit returns to the conditions assumed for the starting point of this analysis.

The full schematic shows that I_1 and I_2 each consists of a fixed current source in parallel with a variable current source controlled by the applied voltage V_{CX}. The useful range of V_{CX} is from V_{CC} to (V_{CC} - 2 V). From a given operating point within this range, making V_{CX} more positive increases the charging current and thus increases the operating frequency. For a given value of V_{CX}, operating frequency and C_X are inversely proportional, as indicated in the graph of *Figure 2*. Note that stray capacitances tend to predominate when C_X is small. The product of frequency and C_X is plotted in *Figure 3* as a function of V_{CX}. Note that V_{CC} is taken as the ground reference for the V_{CX} scale.

The total current switched through R1 and R2 is maintained constant, in spite of changes in charging current, by a pair of transistors with their bases and collectors connected in common with those of Q1 and Q4. This pair of transistors functions as a simple current switch operating in synchronism with Q1 and Q4. The current supplied to the emitters of this switching pair is automatically adjusted by internal circuitry to offset any changes in the charging current. By thus maintaining a constant total current through R1 or R2, the output voltage swing is made independent of V_{CX}.

SIMPLIFIED SCHEMATIC AND WAVEFORMS



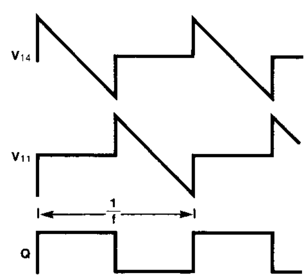


Figure 1

The net voltage across C_X changes from a peak of approximately 0.8 V of one polarity at the beginning of a ramp to 0.8 V in the opposite polarity at the end of the same ramp. The capacitor chosen for C_X should thus be capable of withstanding 1 V in either direction; for waveform symmetry its capacitance-vs-voltage characteristic should be linear over this range.

The power supply for the 11C58 can have its negative side designated as the bround reference, as is commonly done with TTL/DTL circuits, or the positive terminal can be designated as ground as is usually done in an ECL system. This latter configuration is preferable for incoming test purposes and is assumed as a condition for the specifications given in the dc test table. Notice that the ac test arrangement uses split power supplies to offset V_{CC} above scope ground by +2.0 V. This offset allows the 50 Ω terminations built into the sampling scope inputs to act as the specified standard loads for the 11C58 outputs. This in turn allows direct connection of the circuit to the scope using coaxial cables, thereby eliminating high impedance probes and possible problems of improper loading, impedance mismatch, improper compensation, bandwidth limitations and unequal channel delay.

The 11C58 can be operated from the same +5.0 V ±5% supply with TTL circuits, provided that good rf bypassing is used to prevent the effects of TTL current spikes from affecting 11C58 operation. These spikes create noise on both the positive and negative sides of the supply and are most effectively limited by capacitors placed close to the TTL packages.

TYPICAL CHARACTERISTICS

OUTPUT FREQUENCY vs CAPACITANCE FOR VARIOUS VALUES OF INPUT VOLTAGE

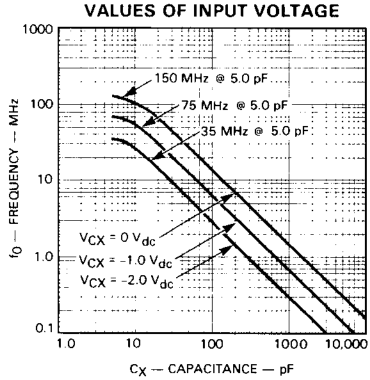


Figure 2

FREQUENCY-CAPACITANCE PRODUCT vs CONTROL VOLTAGE (V_{CX}) FOR C_X > 10 pF

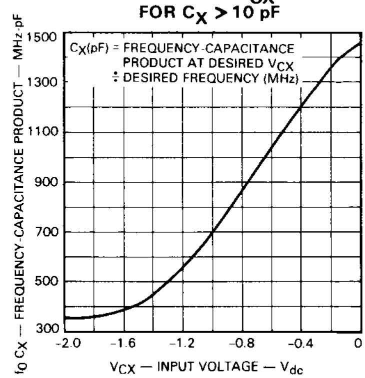


Figure 3

DC CHARACTERISTICS: $V_{EE} = -5.2$ V, $V_{CC1} = V_{CC2} =$ GND

SYMBOL	CHARACTERISTIC	LIMITS		UNITS	T_A	CONDITIONS
		A	B			
V_{OH}	Output Voltage HIGH	-1000 -960 -900	-840 -810 -720	mV	0°C 25°C 75°C	Note 1 for Pin 6; Note 2 for Pin 4 $V_{CX} = -1.0$ V Loading is 50 Ω to -2 V
V_{OL}	Output Voltage LOW	-1870 -1850 -1850	-1620 -1620 -1595	mV	0°C 25°C 75°C	Note 2 for Pin 6; Note 1 for Pin 4 $V_{CX} = -1.0$ V Loading is 50 Ω to -2 V
I_{IH}	Input Current HIGH		350	µA	25°C	V_{CX} = Gnd Note 2
I_{IL}	Input Current LOW	-0.5		µA	25°C	$V_{CX} = -2.0$ V Note 2
I_{EE}	Power Supply Current	-32		mA	25°C	Note 1 or Note 2

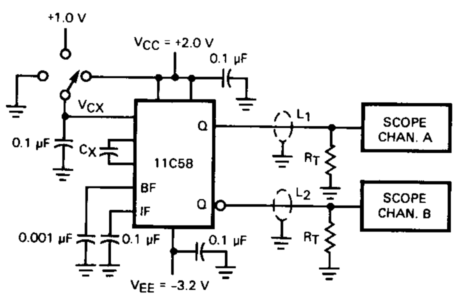
NOTES:

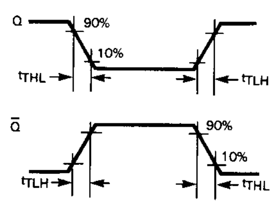
1. Connect germanium or Schottky diode 
2. Connect germanium or Schottky diode 

AC CHARACTERISTICS: $V_{EE} = -3.2$ V, $V_{CC1} = V_{CC2} = +2.0$ V, $T_A = 25°C$

SYMBOL	CHARACTERISTIC	LIMITS			UNITS	CONDITIONS	
		A	TYP	B			
t_{TLH}, t_{THL}	Transition Time (10%–90%) or (90%–10%)			3.0	ns	$V_{CX} = +2.0$ V	$C_X = 5$ pF
				4.6	ns	$V_{CX} = +1.0$ V	
				8.5	ns	V_{CX} = Gnd	
f_{OSC1}	Oscillation Frequency	130	155	175	MHz	$V_{CX} = +2.0$ V, $C_X = 5$ pF	
f_{OSC2}	Oscillation Frequency	78	90	100	MHz	$V_{CX} = +2.0$ V, $C_X = 10$ pF	
TR	Tuning Ratio Test	3.1	4.5			$TR = \frac{f_{OSC} @ V_{CX} = +2.0\text{ V}}{f_{OSC} @ V_{CX} = \text{Gnd}}$	$C_X = 10$ pF

SWITCHING CIRCUIT AND WAVEFORMS





L_1 and L_2 = equal length 50 Ω impedance lines
R_T = 50 Ω termination of scope