INSTRUCTION MANUAL
FOR
FREUENCY MODULATION & DEMODULATION

Frequency modulation & demodulation has been designed to study the frequency modulation & demodulation.

The instrument comprises of following built-in parts.

1. Fixed output DC regulated power supply ±12 volts

2. Built in audio frequency generator of 2Khz & 4Khz, 3 volts peak –peak amplitude.

3. Circuit diagrams for modulator & demodulator are printed on the front panel & component are soldered behind the front panel.

THEORY

In frequency modulation the frequency of carrier wave is alerted in such way by a low frequency modulating wave to transmit the information from one side to other through air.

The advantage of frequency modulation is that there is no change in its amplitude from outer world interfaces and particularly a wider bandwidth, which makes very faithfully receptions of music signals, generally called the high fidelity transmission. The frequency modulation is defined by a useful parameter called the "frequency deviation" which determines the bandwidth of the signal. In laboratory practical narrowband FM is generated by reactance modulator or by voltage controlled oscillators. This narrowband frequency modulated signal when goes through frequency multiplier it from wideband FM signal. The power contents in FM signal derived by "Parseval" theorem which states that the total power of the signal is equal to the sums of the power of individual component presented in it. As FM signal has same amplitude in modulator or un-modulated from thus it is find out that the power is same in both cases, bandwidth of FM signals depends upon the modulation index which is equal to total deviation in frequency/frequency of modulating signal.

$$mF = \Delta F/Fm$$

From the modulation index Bessel function can be determine which helps to plot the frequency modulation spectrum. The modulator efficiency is calculated as.

$$\text{Modulator efficiency } KF = \Delta F/VFm \qquad \text{Hz/Volt}$$

Where Vfm is the amplitude of the input modulating signal.

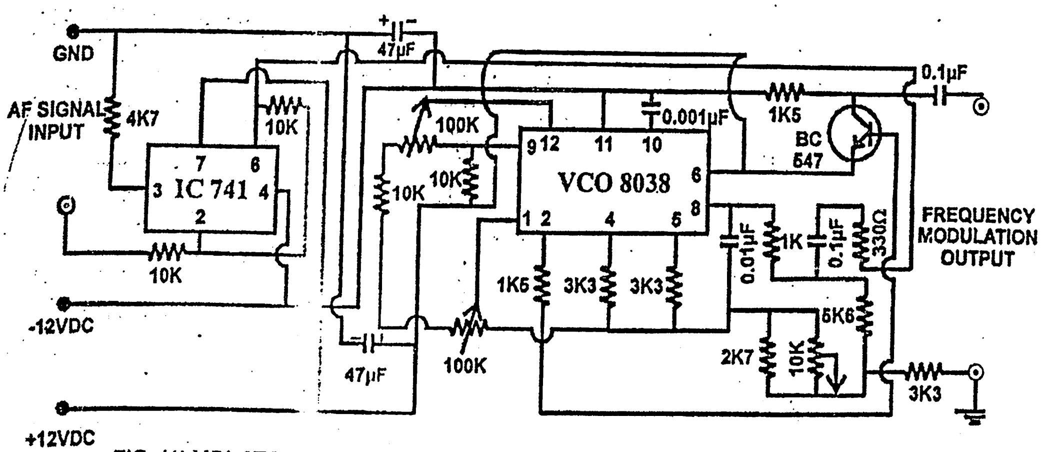


FIG. (1) VOLATGE ONTROLLED OSCILLATOR ICL 8038 AS FM MODULATOR

For Modulation:-

In fig. (1) Given VCO chip IC8038 circuit shown where it perform the function of frequency modulator. The 8038, is basically used for waveform generation. The gebnerated frequency is determine primarily by the timing resistor RT (3K3) the timing capacitor Ct (0.001mF) anf the (DC) bias voltage at FM input in present circuit resistor R2 in conjunction with R1 and voltage divider (R1 K & R5 K) determine the free run frequency, which may be consider as carrier frequency. External modulating signal can be inserted at appropriate input through dc blocking capacitor .1µF. The free run frequency (carrier) of the VCO changes in rhythm of input signal polarity and amplitude hence frequency modulation achieved. The obtained signal is further amplified by an amplifier and terminated of FM output socket though dc blocking capacitor 0.1 µF.

The Signal Source:-

As stated earlier that VCO its generate the free run frequency called carrier. Addition to that the board has built in 2 & 4Khz (approximate 0 phase synchronized AF generated (MOD SIG) with amplitude 0-3 Vpp approx.. The output impendence of the modulator is 1KΩ.
A synchronization signal is given to trigger CRO in external trigger mode.

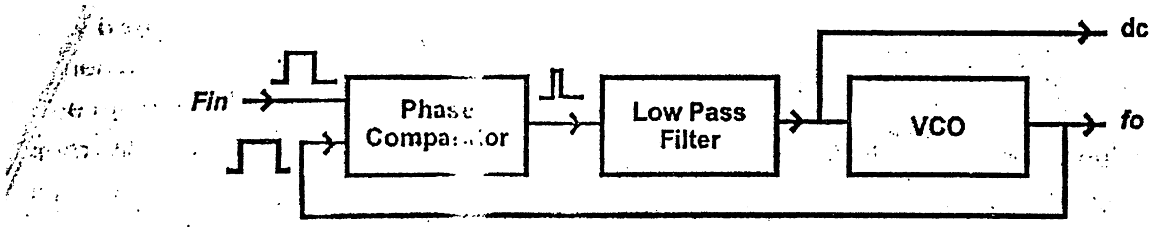


Fig. (2) Phase Lock Loop System

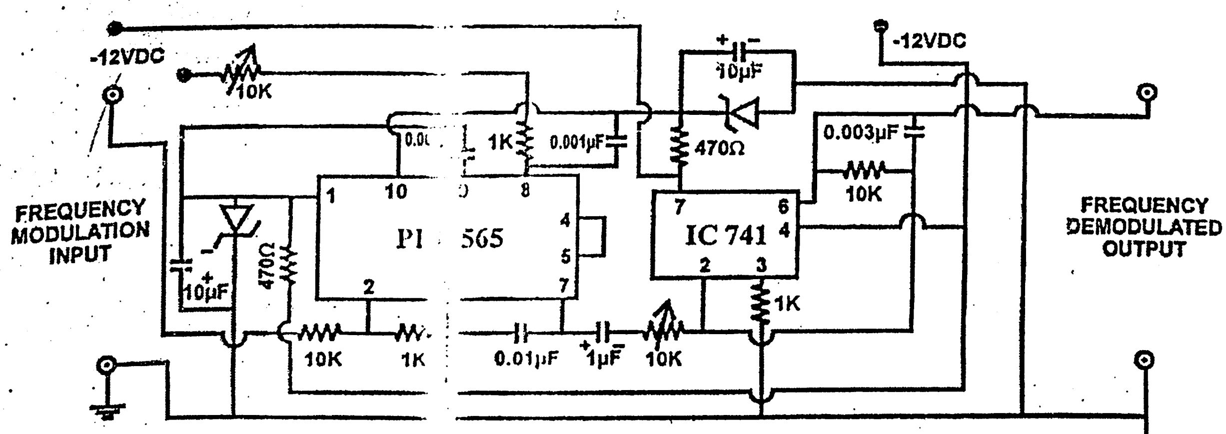


FIG. (3) PHASE LOCK LOOP IC NE 565 AS FM DEMODULATOR

For Demonstration:-

The phase lock loop (PLL) consists of a free run voltage controlled oscillator (VCO) and a digital phase comparator circuit. The prime aim of it to generate a signal of such frequency (f0) which has same frequency (fin) at the phase cooperate input. Let see the fig. (2), where basic block diagram of such PLL is shown. The VCO free run signal is connected back to one input of phase comparator. The phase comparator given an output pulse, the width of which is the different between two signal pulse one from outside (fin) and other from VCO(f0). The output signal is passed though low pass filter to form dc voltage which is used to control free run frequency of VCO. This process of tracking is continued (called capture process) till both fin and fo'hold' same phase lock loop to demodulation the frequency modulated signal. In fig. (3), the circuit of frequency demodulator using IC NE565 is shown. The NE 565 has inbuilt voltage controlled oscillator (the free run frequency of which depends upon control voltage from PC OUT (pin no. 7) the timing resistor (RT 10K 56) and timing capacitor CT (.001μF) a phase comparator an amplifier and input 3.6K ohm resistor connected between VCO sig in and PC out. In present circuit 10KΩ (p) to bring VCO free run frequency close to carrier frequency for proper tracking. The PC out is filtred by two 0.01, 1μF capacitors and further amplifier to recover the modulating signal.

The frequency demodulation by PLL:-

When un-modulated carrier is fused to PLL signal input and RT (P) assumed to adjusted fro same free run frequency as input the PC out has no pulse since fin=f0, the output at is assumed zero. When modulated signal is feed at input the PC output has has different width of pulses, since the input signal is continues/deviating. The deviating dc voltage at PC out is used to track VCO and same is amplified by passing through LPF to recover the modulating signal. The capture range of 565 has ratio 1:3 ratio of free run frequency thus at 60Khz carrier it demonstration ± 10 Khz deviated signal only.

PROCEDURE

1. Connect the AF signal socket with the AF signal input modulator circuit. Keep amplitude control at minimum. Select mod sig frequency 2 Khz.

2. Connect CRO with the frequency modulation output socket and ground. Display the signal upon CRO which is carrier wave and measure its un-modulated frequency (1/T) with calibrated time base of CRO (about….KHz).

3. Now connect AF signal output socket to the AF signal input of the modulator circuit. Adjust amplitude control of modulating signal. Trigger CRO with this signal.

4. Observe the modulating signal. Trace it upon paper. Measure the maximum frequency deviation by using X magnification (easy to measure at –ve slop of modulating signal).

5. Now from the observations:-

   a) Unmodulated carrier frequency ..KHz

   b) Modulated and deviated carrier frequency …KHz (at -ve slop of mod signal)

   The frequency deviation is) $\Delta f = (a) - (b)$ … KHz

   Total deviation of both slopes f mod signal is2) Δf in … ±KHz

   The modulating signal fm … KHz

   The mod index modulation factor) $mF = 2\Delta F/Fm$

   The mod signal amplitude Ain…Vpp

   The modulator efficiency $kF = 2\Delta F/A$ in KHz/Vpp

6. Now change the mod signal to 4 KHz. Measure the frequency deviation as before while the amplitude must be same as before (3Vpp).

7. Complete the result from observation from observation it is found that mf is changes with fm, but Δf is not change. The Δf is a function of fm amplitude.

For Demodulation:-

1. Connect frequency modulated output to the input of the demodulator section. Remain the CRO with the AF signal output as earlier.

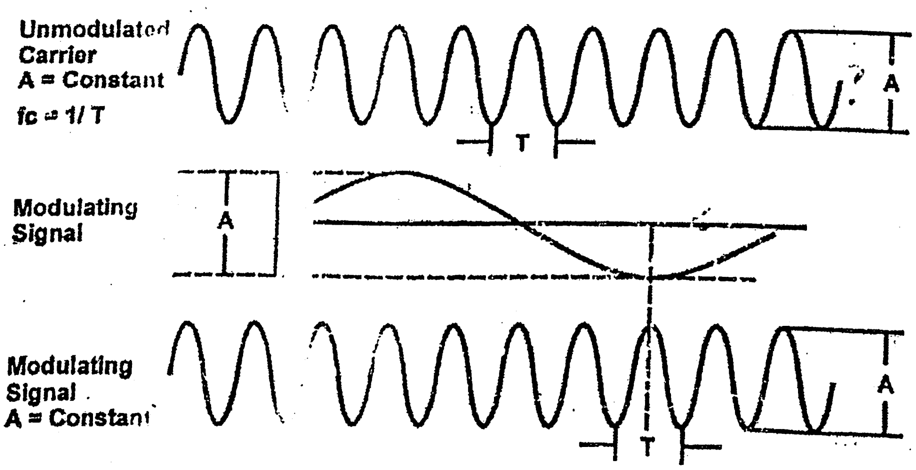
2. Connect the CRO with frequency demodulated output socket. Keep the mod signal amplitude at minimum position. Select fm = 2KHz.

3. Keep P near center. Trigger CRO. Now bring the frequency modulation by applying 3 Vpp signal at the mod signal observe the demodulation signal.

4. Adjust P control to obtained maximum amplitude signal.

5. Change the Fm to 4KHz the demodulated output has small amplitude then 2KHz due to frequency roll off presented by low pass filter.

For CRO External Trigger mod:- To observe the modulating and modulated signal trigger CRO with modulating signal otherwise trigger it with SYNC. Signal connecting it with external trigger input of CRO.



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