Experiment # 3 : FM and Demodulation

Object:-

(a) Generate three FM signals of different modulation indices taking square wave as a modulating signal, using FM Kit model CS-1204. Calculate the modulation index of each.

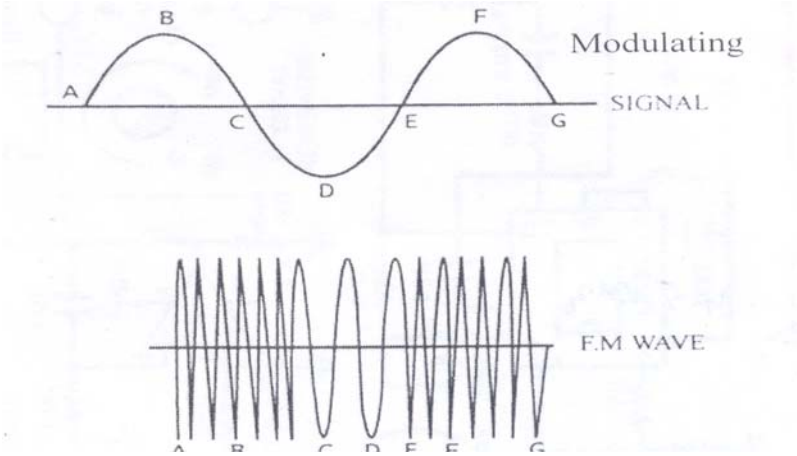
(b) Using sine-wave as a modulating signal, generate an FM signal and demodulate it to recover the original modulating signal.

Apparatus Used:-

1. FM kit, Trinity model CS-1204
2. 20 MHz dual channel CRO
3. An AF square-wave signal Generator

Brief Theory and Description of the Kit:-

In frequency modulation, the frequency of the high frequency sinusoidal signal, called "Carrier", is made to vary in accordance with the instantaneous value of the amplitude of the low frequency sinusoidal signal, called "message or modulating signal". The Frequency Modulation may be represented in the following diagram:-



The modulation index of FM signal = (maximum freq deviation)/(message freq)

i.e., $m_f = \delta f / f_m$, where $\delta f = (f_{max} - f_{min})$ & fm = freq. of the modulating signal.

Experimental Procedure:-

1. Switch ON the experimental kit.
2. Observe carrier signal at the FM modulator output, without connecting any signal to it, and measure its amplitude and frequency.
3. Observe modulating signal at the AF signal output; its frequency is fixed but its amplitude is variable from 0 to +12 Volts p-p.
4. Connect an AF square-wave signal obtained from an external signal generator, to the modulator's input, and observe the modulating signal on one channel and FM signal (at FM output) on other channel of the CRO. Trigger the CRO with ch-1 and adjust amplitude of the AF signal to get undistorted FM output. The maximum frequency deviation in the FM output is directly proportional to the modulating signal amplitude.

5. Calculate the maximum frequency and the minimum frequency from the FM output and calculate the modulation index of the FM wave.
6. Change the amplitude of the modulating signal and calculate the modulation index of the FM wave for new value of the modulating signal amplitude.
7. Now, replace the square-wave by a sine-wave of similar amplitude & frequency, and connect the FM wave output to the input of the FM Demodulator and observe the recovered message signal at the demodulator's output. Observe sine-wave input on one channel and the demodulator's output on the other channel of the CRO.
8. Adjust the modulating signal amplitude (sine-wave) to get undistorted output signal at the demodulator's output.
9. Report the maximum amplitude of the modulating signal, that can be recovered after demodulation without any distortion and verify that it is around 1.0 Vp-p for the given kit.

Observations:-

Modulating signal = Square-wave ;
Modulating signal Amplitude (A_m) = ……V_{p-p} & its frequency (f_m) = ……. KHz
Carrier signal : Amplitude (Ac) = ……Vp-p & its frequency (f_c) = ……. KHz
FM Signal : maximum frequency, f_{max} = …….., KHZ.
minimum frequency, f_{min} = …….. , KHz

Calculation:-

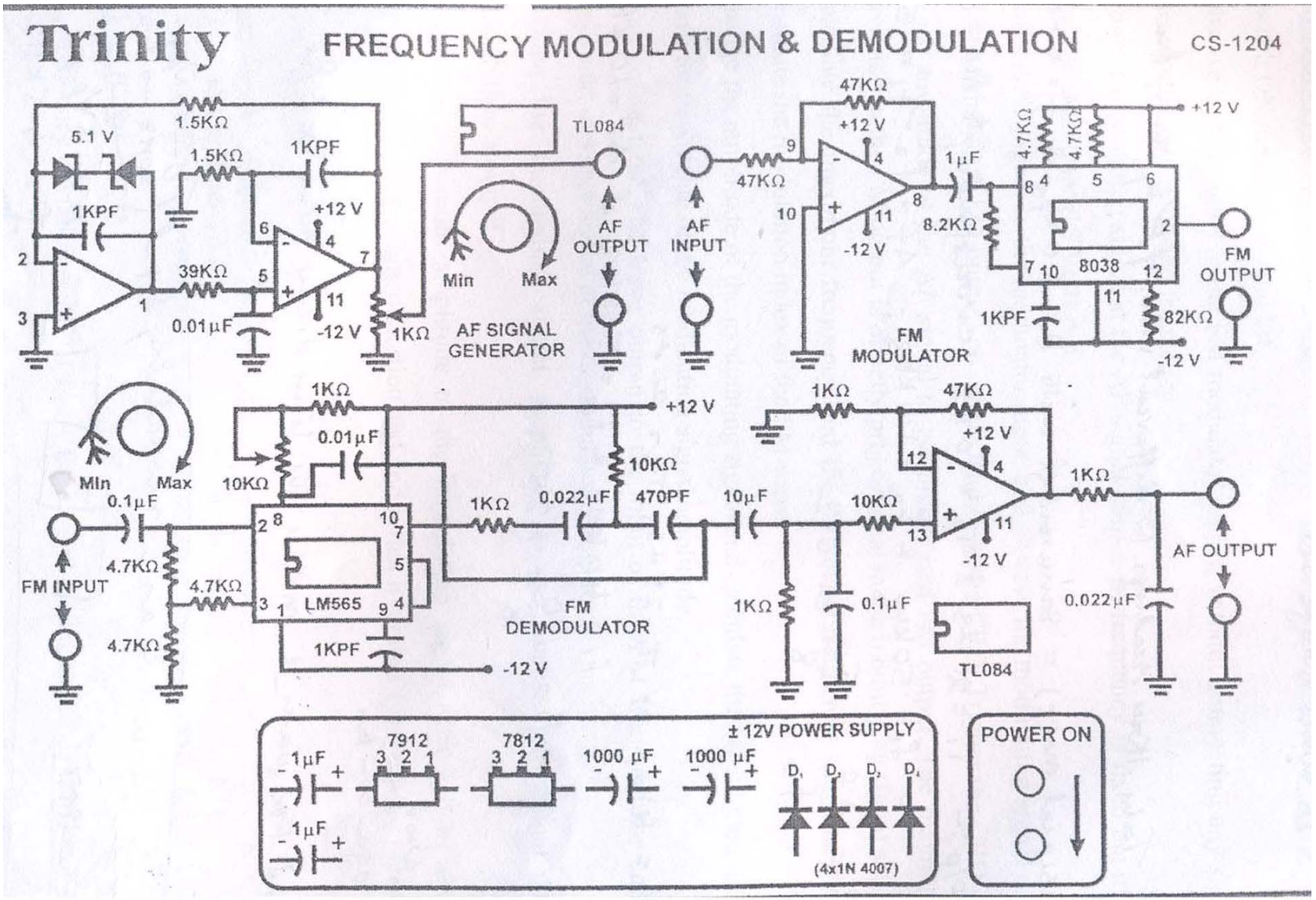
Maximum frequency deviation = $\delta f = (f_{max} - f_{min})$;
and modulation index, $m_f = (\delta f) / fm$

Result:-

Reference:-

1. Carlson : Communication Systems
2. Manual of the Trinity Frequency Modulation and Demodulation Trainer kit model CS-1202

The kit used in this experiment is shown in the layout diagram on the following page:-


Trinity
FREQUENCY MODULATION & DEMODULATION
CS-1204
AF SIGNAL GENERATOR
FM MODULATOR
FM DEMODULATOR
LM565
TL084
8038
AF OUTPUT
AF INPUT
FM OUTPUT
FM INPUT
Min
Max
± 12V POWER SUPPLY
7912
7812
POWER ON
(4x1N 4007)