# CHAPTER : V

## STUDY OF RESPONSE OF THE CIRCUIT WITH VARIATION OF CENTER FREQUENCY '$F_0$'

# CHAPTER : V

## STUDY OF RESPONSE OF THE CIRCUIT WITH VARIATION OF CENTER FREQUENCY '$F_o$'

### 5.1 CIRCUIT AND EXPERIMENTAL STUDY :-

The circuit was designed using commonly available IC 741 operational amplifier. The analysis of circuit shows that the most important operational amplifier parameter is the gain bandwidth product GB. The GB value for number of operational amplifiers was obtained experimentally in the laboratory and the operational amplifiers with almost equal GB value ($2\pi$ x 7.8 x$10^5$) rad/sec. were chosen for assembly of the circuit.

Every care was taken during the assembly to avoid the effects of stray capacitances.

The new active R filter circuit discussed in previous chapter is studied with variation of center frequency 'Fo'. Calculations are made using eq. 4.7, 4.8 and 4.9.

For practical realization the value of resistance must be positive. Hence there is an upper limit on Q. From $eq^n$ (4.10) we have

$$Q < \frac{1}{2} \sqrt{\frac{R_1}{A}}$$

Different to values are assumed and various resistances are calculated. The values are shown in table No.(5.1)

## 5.2 RESULTS AND DISCUSSION :-

Using these values the circuit was assembled. The observed responses of the circuit are studied and following conclusions are made about the various outputs.

### A) LOW PASS RESPONSE :-

The Low Pass response is shown in fig.(5.1). It is observed that the gain decreases in the pass band as design frequency increases. It is also noted that the design frequency agrees well with observed values. For 'Fo' above 50 Khz a slight peaking is observed near 100 KHz. The overall response is quite satisfactory. A theoratical curve is also included for Fo = 30 KHz. Above 10 KHz the response shows the gain roll-off 40 dB/decade. It is seen that therotical curve shows some peaking where as the observed is smooth in the pass band. The cut off frequency is about 12 KHz instead of 30. The gain is high (80 dB for 30 KHz).

There is no overshoot, good agreement of center frequency with designed value for 70 KHz and 120 KHz.

B) **HIGH PASS RESPONSE :-**

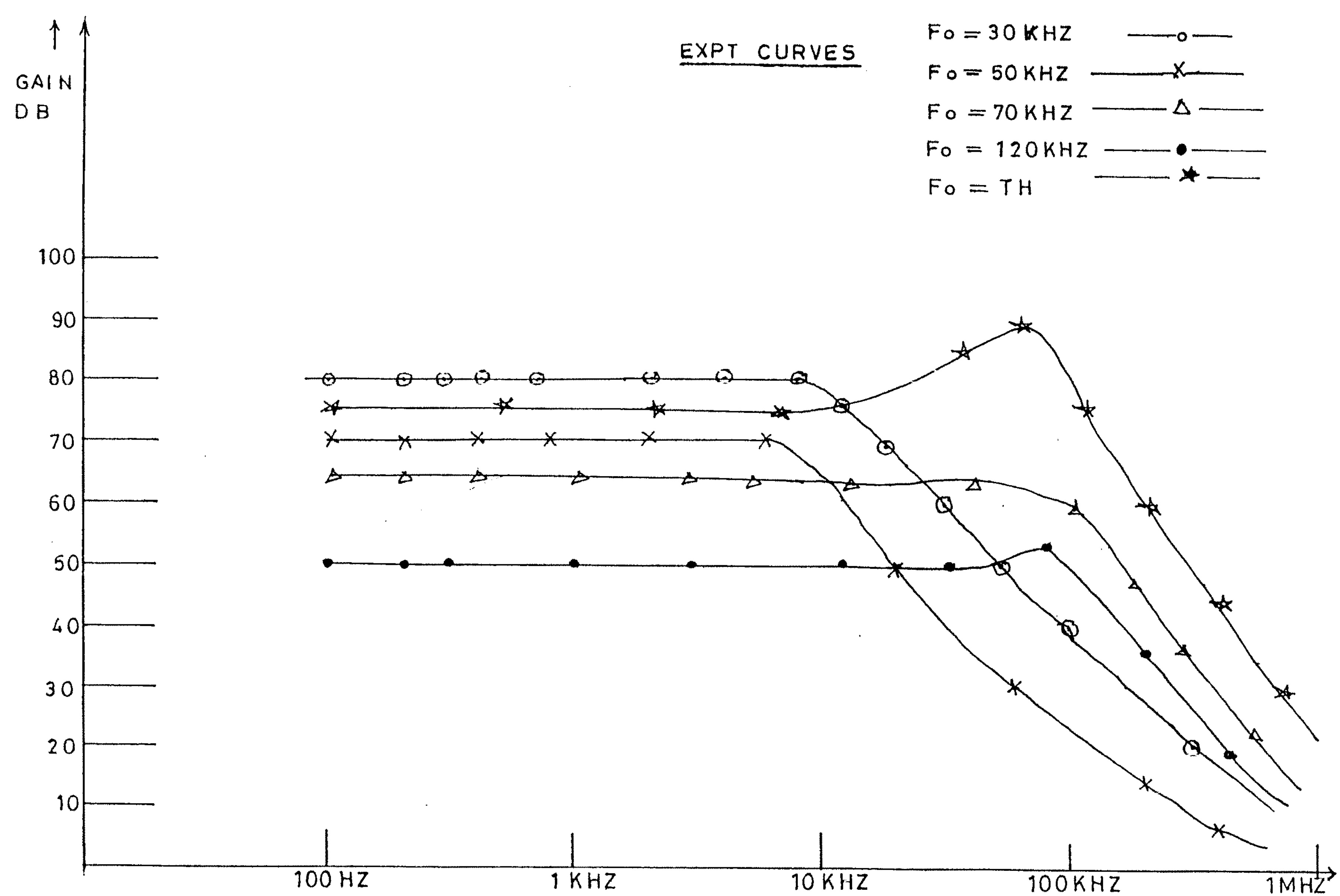
The high pass response is shown in fig.(5.2). It is seen that overall response is satisfactory and design value of Fo matches with the observed value. in this case a slight peaking is observed for Fo =50KHz onwards. A theorotical curve is also inclued for Fo = 30 KHz, for comparision. It is observed that in the pass band there is a good agreement between theorotical and observed resonses. However, a theorotical curve shows a slight peaking at Fo = 20 KHz and shows higher rejection below 10 KHz.

C) **BAND PASS RESPONSE :-**

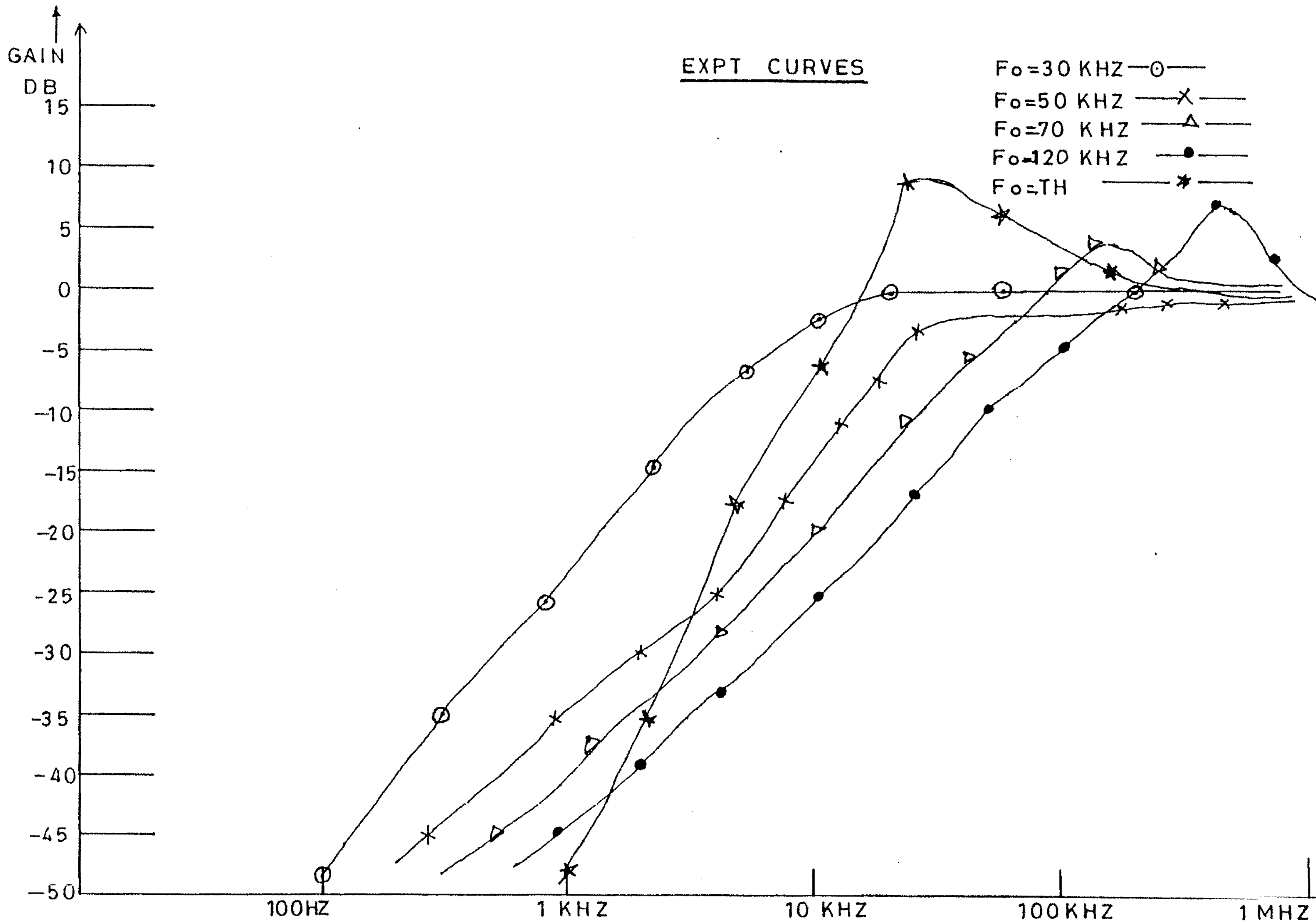
The band pass curve is shown in fig.(5.3). It is observed that the response is similar to resonant circuit with Q Values.

For Fo = 30 KHz, the peak is observed at 10KHz. The theorotical curve also has the similar shape, but peak is observed near 2 KHz. The maximum gain however almost equal. The gain decreases slowly with increasing Fo values. The design value and peak value agreed as Fo increases.

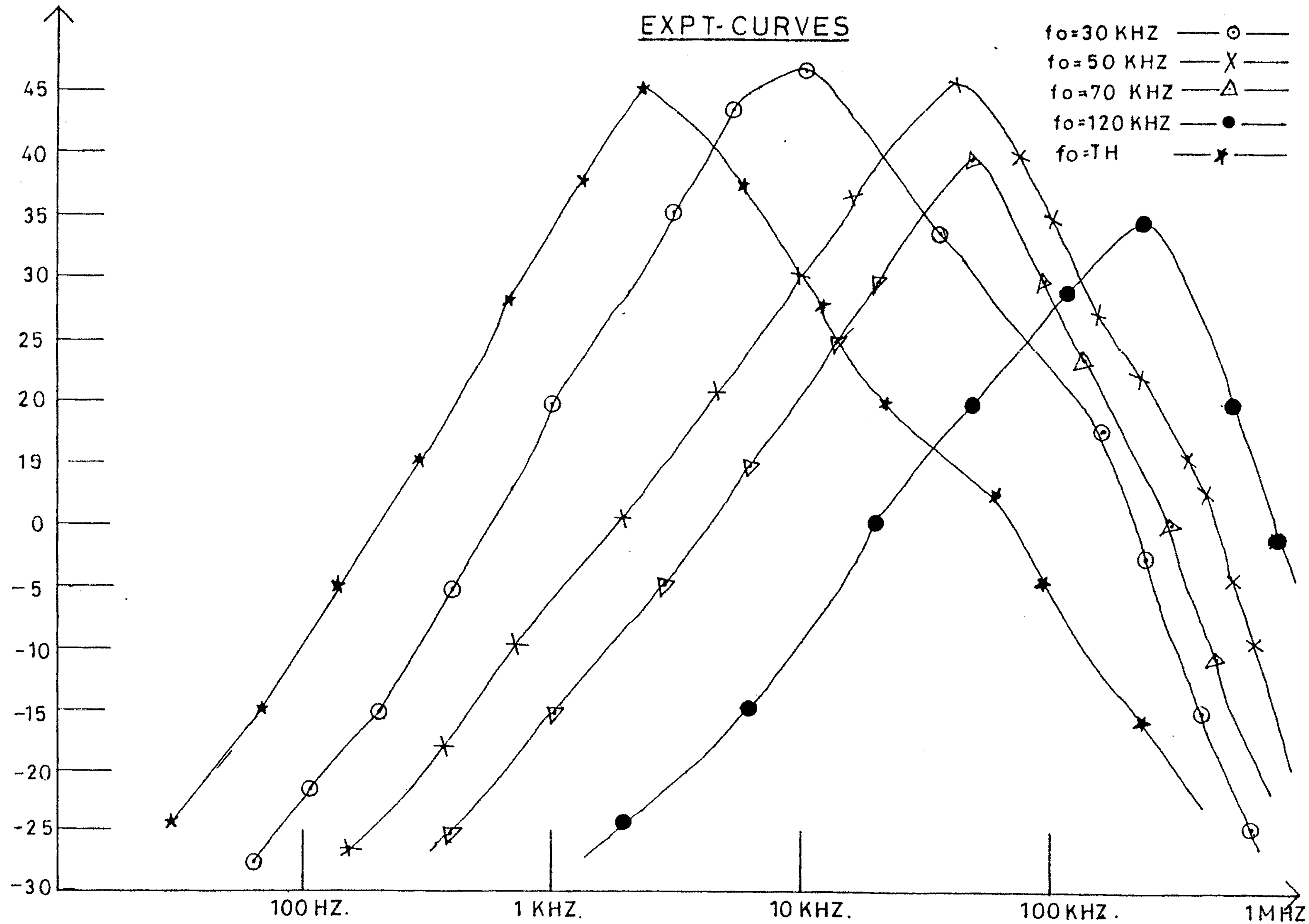
The all over response is satisfactory.



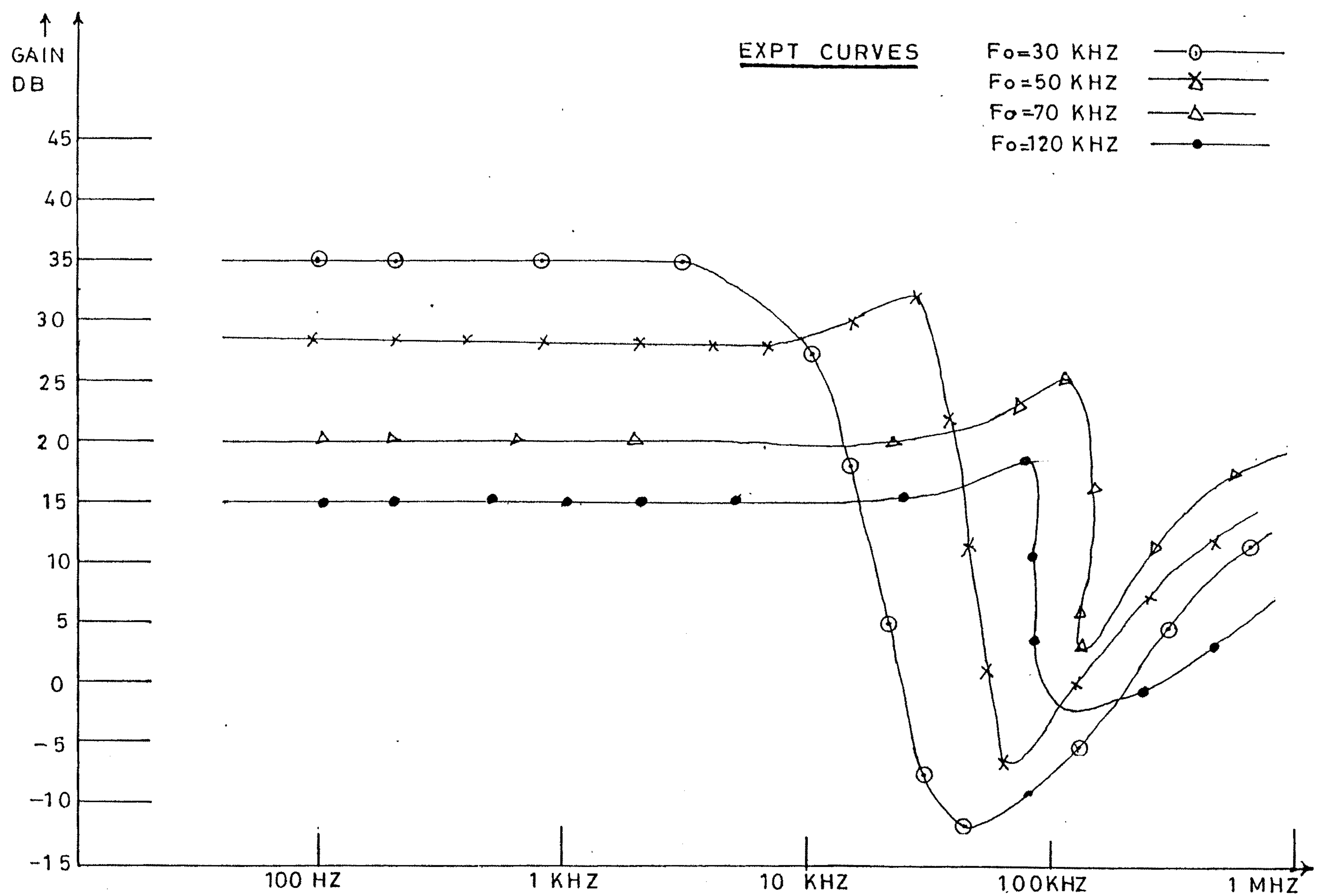

(FIG 5.1) LOW PASS RESPONSE FOR Q=1 AND DIFFRENT Fo A=0.5




(FIG·5·2) HIGH PASS RESPONSE FOR Q=1 AND DIFFERENT Fo. A=0·5




(• Fig 5.3) BAND PASS RESPONSE FOR Q=1 & DIFFERENT Fo A=0.5




(Fig 5.4) BAND STOP RESPONSE FOR Q=1 AND VARIOUS Fo=KHZ A=0.5

D) **BAND STOP RESONSE :-**

The band stop response is shown in Fig.(5.4). It is seen that the band stop response is some-what similar to the low pass response. However a pronounced deep is observed in high frequency region. For low values of Fo the response decreases vary rapidly.

As Fo increases, the deep becomes less and less pronounced. From the curve it is seen that as 'Fo' increases the frequency of rejection point increases and gain decreases.

## 5.3 CONCLUSIONS :-

The new Active R circuit is quite satisfactory as for as low pass, high pass and band pass responses are concerned.

In the case of low pass filter in the gain decreases in pass band as designed frequency (Fo) increases.

In high pass response the theorotical curve shows slight peaking near Fo = 30 KHz. Band pass response shows peaks at frequencies equal to the design values of 'Fo.'

The agreement between theorotical and observed results is moderate for LP, HP and BP functions.

| Fo (KHz) | Tapping Point A | Q | Designed Value | | | Experimental Value | | |
|---|---|---|---|---|---|---|---|---|
| | | | $R_3$ | $R_2$ | $R_1$ | $R_3$ | $R_2$ | $R_1$ |
| 30 | 0.5 | 1 | 12.00 K | 130.2 K | 101 Ω | 12.20 K | 130.00 K | 100 Ω |
| 50 | 0.5 | 1 | 4.9 K | 4.9 K | 104 Ω | 4 K | 53 K | 100 Ω |
| 70 | 0.5 | 1 | 2.5 K | 25 K | 100 Ω | 3 K | 29 K | 100 Ω |
| 120 | 0.5 | 1 | 2 K | 8.6K | 101 Ω | 2.1K | 8.2K | 100 Ω |

Table : (5.1) The Designed and Experimental Values of Resistances.