SCHERING BRIDGE

(Model No : VSB - 07)

User Manual

Version 1.0

Technical Clarification /Suggestion :

✍ / ☎

Technical Support Division,

Vi Microsystems Pvt. Ltd.,

Plot No :75, Electronics Estate,

Perungudi, Chennai - 600 096, INDIA.

Ph: 91- 44-24961842, 91-44-24961852

Mail : service@vimicrosystems.com,

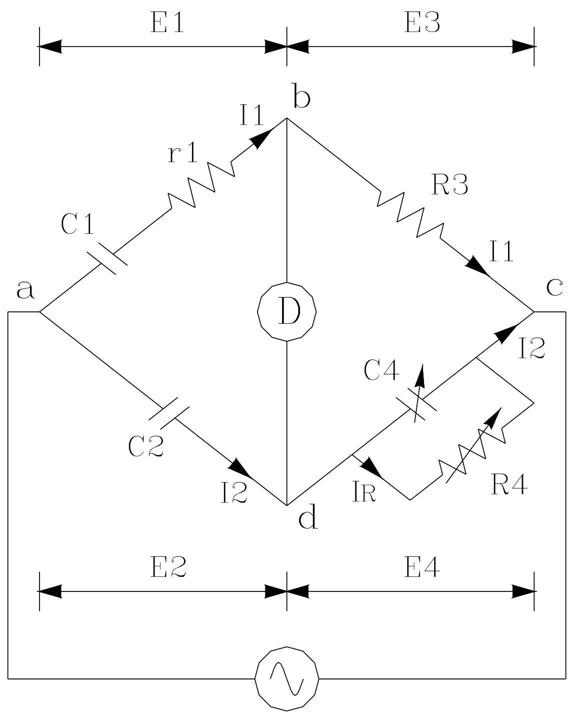
Web : www.vimicrosystem

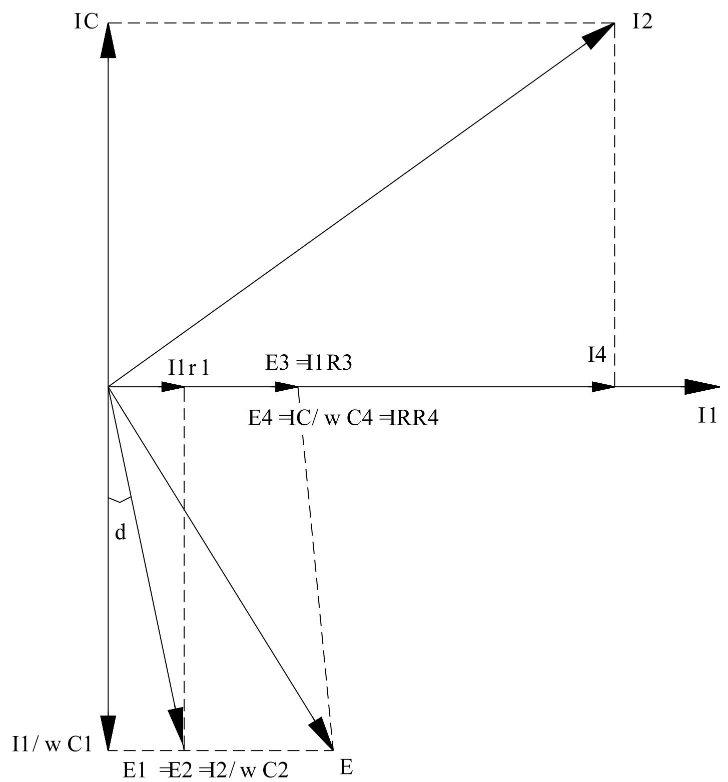
INTRODUCTION

Alternating current bridges are of outstanding importance for measurement of electrical quantities. Measurement of inductance, capacitance etc may be made conveniently and accurately by employing AC bridge networks. An AC bridge is an improved version of the wheatstone bridge and consists of a source of excitation and a detector sensitive to small alternating potential differences. The schering bridge is one such type of AC bridge used for the measurement of capacitances.

SCHERING BRIDGE

The schering bridge unlike the other bridges consists of four arms. One arm has a range selection is provided so as to select the correct point of balance of the bridge. This arm provides the point to select the range between which the bridge can be balanced. The other arm consists of a fixed capacitor connected in parallel to a variable resistance which is used as one of the variable arm of the bridge. The third arm has a standard variable resistance which is varied along with the other variable resistance to obtain exact balanced point. The circuit diagram and the phasor diagram of the bridge are as shown below,





The balance condition for the bridge is as shown below

Let C1 = Capacitor whose capacitance is to be measured
r1 = a series resistance representing the loss in the capacitor C1
C2 = a standard capacitor
R3 = a non - inductive resistance
C4 = a variable capacitor
R4 = a variable non-inductive resistance in parallel with variable capacitor C4

Therefore now at balanced condition,

$$\left[r_1 + \frac{1}{j\omega\ C_1}\right]\left[\frac{R_4}{1 + j\omega C_4\ R_4}\right] = \frac{1}{j\omega C_2}\ .\ R_3$$

$$\left[r_1 + \frac{1}{j\omega\ C_1}\right] R_4 = \frac{R_3}{j\omega C_2} \left(1 + j\omega C_4\ R_4\right)$$

$$r_1\ R_4 - \frac{jR_4}{\omega C_1} = -\frac{jR_3}{\omega C_2} + \frac{R_3\ R_4\ C_4}{C_2}$$

Equating real and imaginary terms, we get

$$r_1 = \frac{R_3\ C_4}{C_2}$$

$$and\ C_1\ \frac{C_2\ R_4}{R_3}$$

Two independent balance equations are obtained if C4 and R4 are chosen as the variable elements.

Dissipation factor

$$D_1 = \tan\delta = \omega C_1\ r_1$$

$$= \omega \left(\frac{C_2\ R_4}{R_3}\right) \times \left(\frac{R_3\ C_4}{C_2}\right) = \omega\ C_4\ R_4$$

Therefore values of capacitance C1 and its dissipation factor are obtained from the values of bridge elements at balance permanently setup schering bridges are sometimes arranged so that balancing is done by adjustment of R2 and C4 with C2 and R4 remaining fixed. Since R3 appears in both the balance equations and therefore there is some difficulty in obtaining balance but that will have same advantages as explained below.

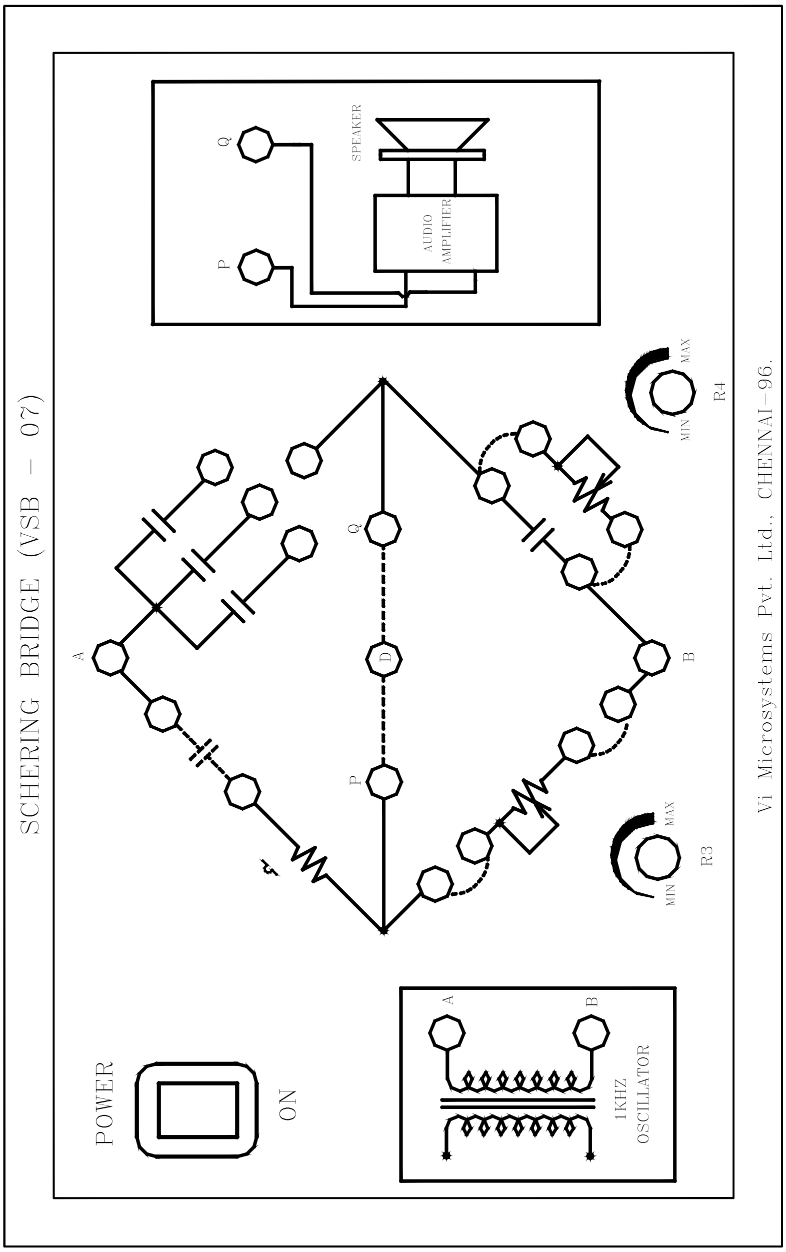
The equation of the capacitance is

$$C_x = \left(\frac{R_4}{R_3}\right) C_2$$

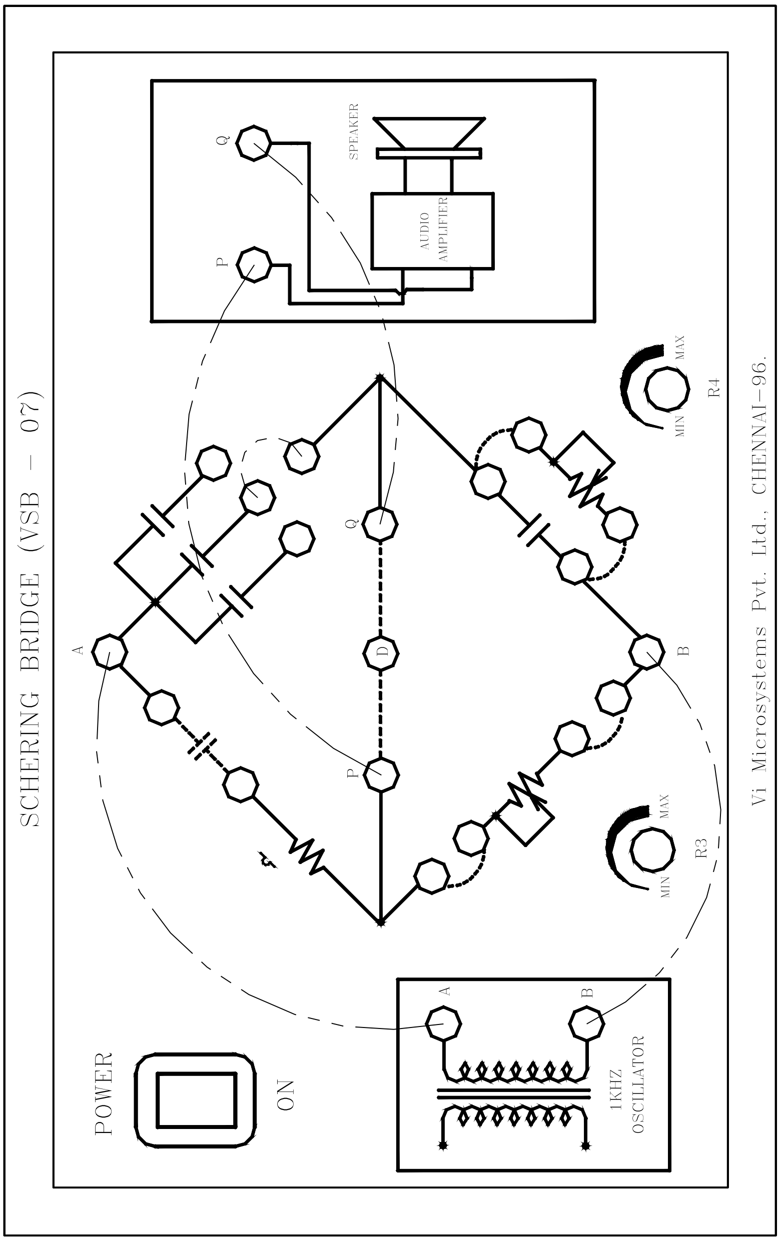
and since R_4 & C_2 are fixed the dial resistor R3 may be calibrated to read the capacitance directly. Dissipation factor $D_1 = \omega C_4 R_4$ and in case the frequency is fixed, the dial capacitor C4 can be calibrated to read the dissipation factor directly. It should however be understood that the calibration for dissipation factor holds good for one particular frequency, but may be used at another frequency if correction is made by multiplying by the ratio of frequencies

The unit VSB - 07 has an inbuilt 1KHz oscillator circuit for giving input to the bridge and an audio amplifier with a speaker to detect the output. The speaker produces either no sound or least sound possible at the point of balance.

FRONT PANEL DIAGRAM



CONNECTION DIAGRAM



EXPERIMENT

AIM

To find the value of unknown capacitance using a schering bridge.

REQUIREMENT

1. VSB - 07 Trainer Kit.
2. Decade Capacitance box.
3. Multimeter.
4. CRO.
5. Patch chords.

FORMULA USED

$$C_x = C_2 \left(\frac{R_4}{R_3} \right)$$

PROCEDURE - I

1. Connections are made as per the connection diagram shown above.
2. Connect the unknown capacitance at the Cx (unknown) point.
3. Keep R4, R3 in minimum position.
4. Connect the CRO across P and Q.
5. Switch ON the unit.
6. Vary resistance R3 to some extent. (above 2K is suggested).
7. Choose C2, such that you can obtain a maximum variation of output.

8. Vary the potentiometer R4 such that the amplitude of sine wave will decrease and at one point it will obtain a minimum of zero amplitude and then it will start increasing at that point stop the tuning and vary R3. Here also the amplitude of sine wave will decrease and at one point it will obtain a minimum of zero amplitude and then it will start increasing at that point stop the tuning.

9. Repeat the above step such that you will obtain minimum amplitude or zero amplitude.

10. Remove the patching at R4 and R3, find the resistance using multimeter and note down the reading according to the table given below and calculate the value of unknown capacitance.

11. One can verify the balancing condition by connecting the bridge output (P & Q) to the input (P & Q) of audio power amplifier and you can hear a minimum noise or no noise. If you vary the potentiometer R4 you can hear a maximum noise.

PROCEDURE - II

1. Connections are made as per the connection diagram shown above.

2. Connect the unknown capacitance at the Cx (unknown) point.

3. Keep R4, R3 in minimum position.

4. Connect the multimeter across P and Q (AC mode).

5. Switch ON the unit.

6. Vary resistance R3 to some extent. (above 2K is suggested).

7. Choose C2, such that you can obtain a maximum variation of output.

8. Vary the potentiometer R4 such that the output voltage will decrease and at one point it will obtain a minimum voltage or zero voltage and then it will start increasing at that point stop the tuning and vary R3. Here also the voltage will decrease and at one point it will obtain a minimum voltage or zero voltage and then it will start increasing at that point stop the tuning.

9. Repeat the above step such that you will obtain minimum voltage or zero voltage.

10. Remove the patching at R4 and R3, find the resistance using multimeter and note down the reading according to the table given below and calculate the value of unknown capacitance.

11. One can verify the balancing condition by connecting the bridge output (P & Q) to the input (P & Q) of audio power amplifier and you can hear a minimum noise or no noise. If you vary the potentiometer R4 you can hear a maximum noise.

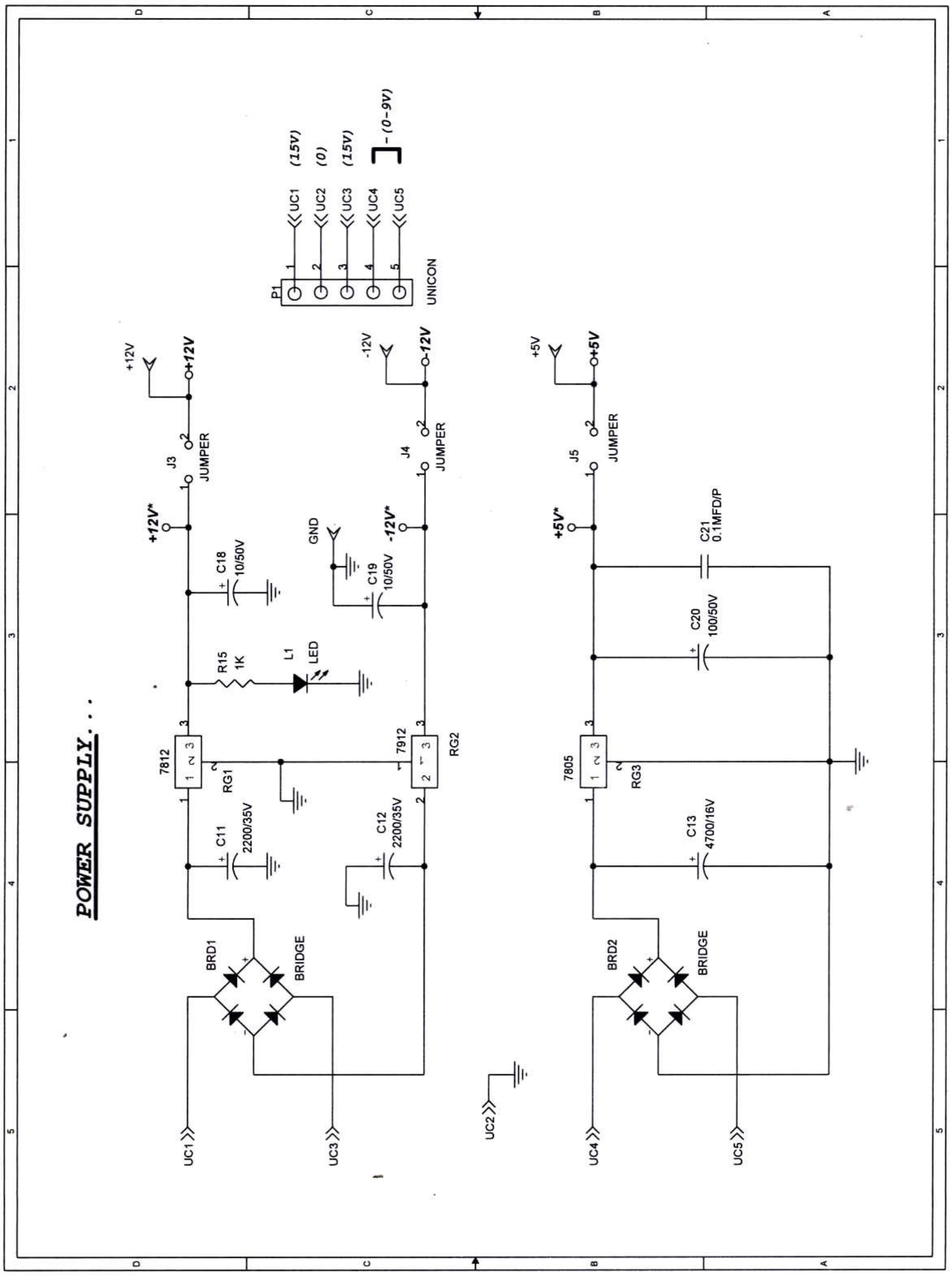
TABULATION

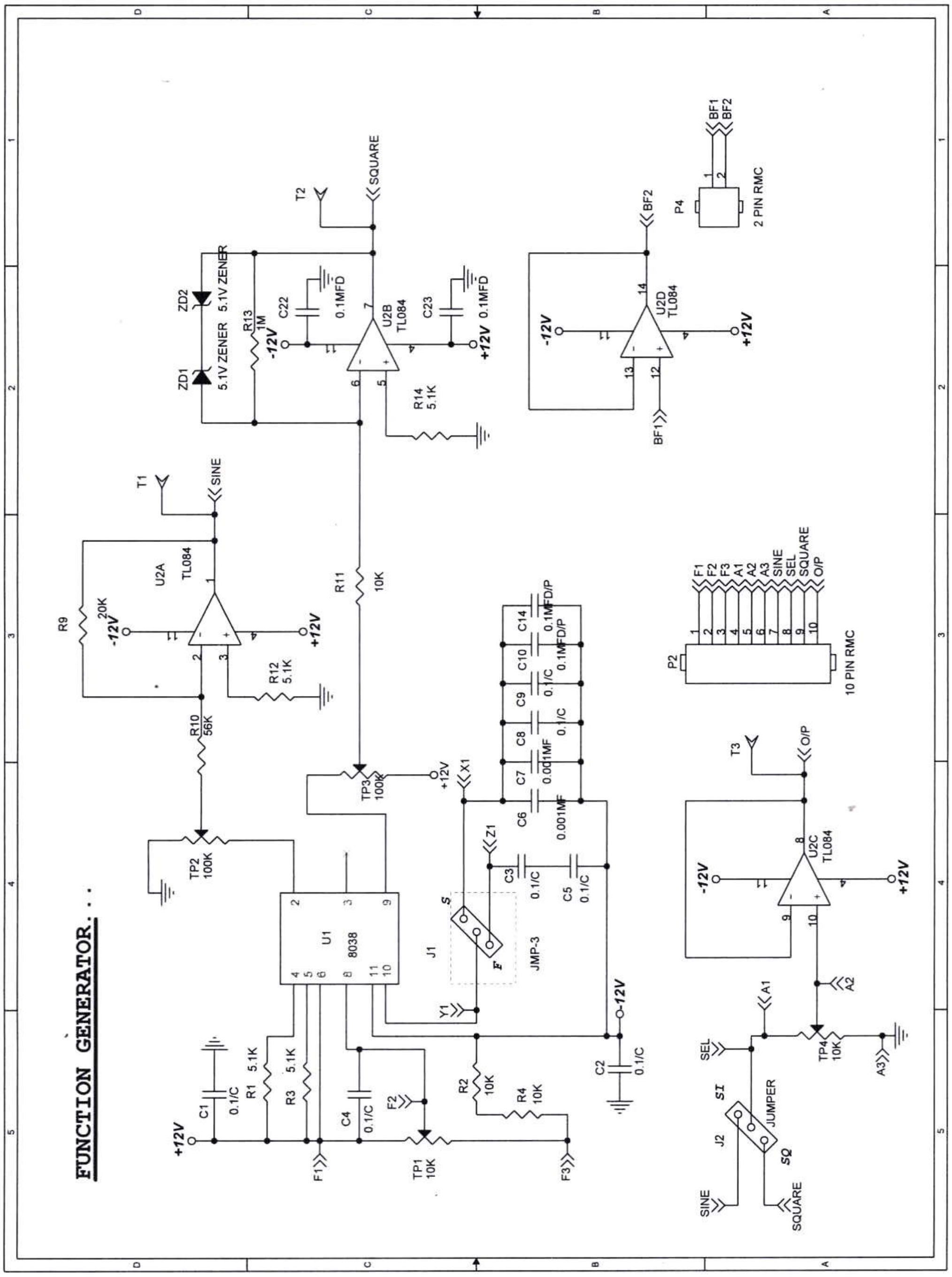
S. No	C2 (μF)	R3 (Ohms)	R4 (Ohms)	Cx (Theoritical)	Cx (Practical)

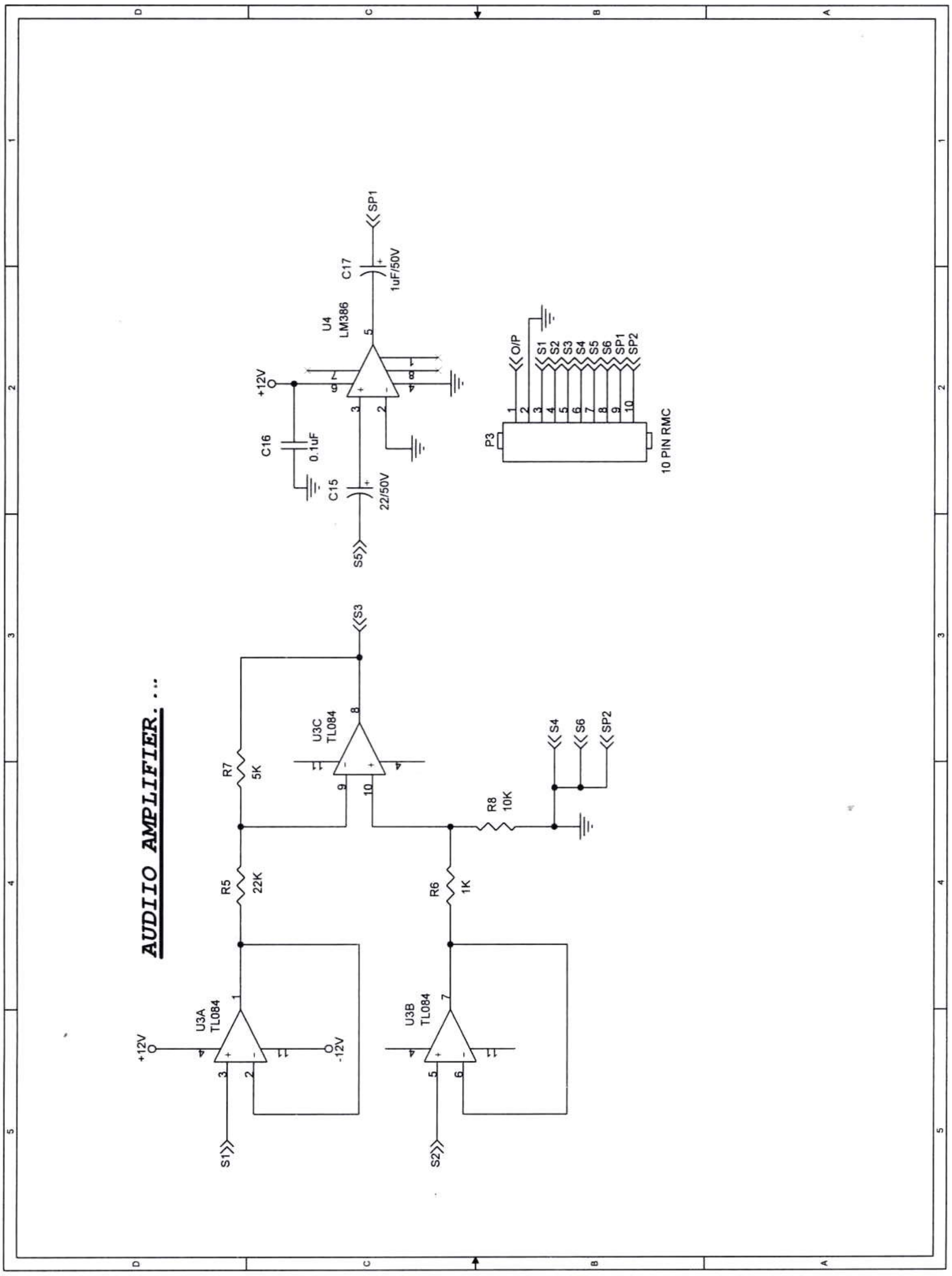
RESULT

Thus the value of unknown capacitance was measured using a Schering Bridge.

CIRCUIT DIAGRAM:




FUNCTION GENERATOR. . .
SINE
SQUARE
T1
T2
T3
U2A
U2B
U2C
U2D
TL084
R9
20K
R10
56K
R11
10K
R12
5.1K
R13
1M
R14
5.1K
ZD1
ZD2
5.1V ZENER
C22
C23
0.1MFD
TP2
100K
TP3
100K
TP1
10K
TP4
10K
U1
8038
J1
JMP-3
J2
JUMPER
R1
R2
R3
R4
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C14
0.1/C
0.001MF
0.1MFD/P
+12V
-12V
P2
10 PIN RMC
P4
2 PIN RMC
BF1
BF2
F1
F2
F3
A1
A2
A3
SEL
O/P
X1
Y1
Z1


AUDIO AMPLIFIER.:
U3A
TL084
U3B
TL084
U3C
TL084
U4
LM386
R5
22K
R6
1K
R7
5K
R8
10K
C15
22/50V
C16
0.1uF
C17
1uF/50V
+12V
-12V
S1
S2
S3
S4
S5
S6
SP1
SP2
O/P
P3
10 PIN RMC