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नियंत्रण प्रयोगशाला
प्रयोग नं: सी टी 1

IRISET

CONTROL LABORATORY

EXPERIMENT NO : CT- 1

नाम
Name : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

अनुक्रमांक
Roll No : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

पाठ्यक्रम
Course : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

दिनांक
Date : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

प्राप्त अंक
Marks Awarded:

अनुदेशक का अधाक्षर
Instructor Initial:

EXPERIMENT No. CT -1

Study of DTMF Headquarter(Controller)'s Equipment

Objective: To study the features and working of the Head quarters equipment used in railway control communication.

Function: The function of this equipment is to provide

- Control telephone facility to the Section Controllers and
- A means for selective calling of any way station along the track

Description: This equipment consists of two parts to meet the above two requirements

- Speech part and
- Signaling part

The **speech part** of the equipment consists of **two op-amps** used for **trans** and **receive** speech amplification.

The **signaling part** of this equipment is a solid-state digital circuitry using the microcontroller 8749 as CPU. It employs DTMF signaling, for calling way stations. DTMF signaling, in compliance with the ITU-T (previously CCITT) recommendations, uses 8 different tones(or frequencies) which are within the VF range and also harmonically unrelated.

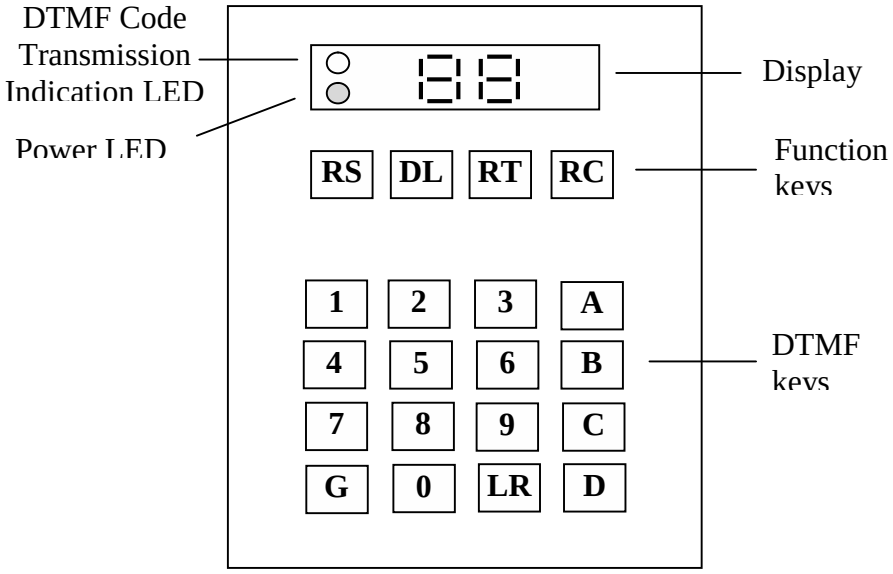
The Technical Features of the Equipment:

1) Uses 8749 Microcontroller
2) It employs a 4x4 matrix DTMF key board
3) There are total 8 tone frequencies
   (a) 4 row frequencies - **697, 770, 852, 941 Hz** and
   (b) 4 column frequencies - **1209, 1336, 1477, 1633 Hz**

4) Each key or digit on DTMF key board is represented by two tones ie., ***one row frequency*** and **one *column frequency***.

5) A 2-digit code is used for each way station. This gives a total of **99** way station codes.

6) The transmission duration for each digit-tones is for 200ms and the pause duration between the two digits is 100ms



Front Panel of DTMF Head quarter's Equipment

Key	Function	Description
RS	Reset	System is reset
DL	Delete	Deletes the previous key board entry
RT	Repeat	Retransmits the last entered 2- digit station code
RC	Row / column tones	Row & column tone frequencies are sent to Tx lines for measurement purpose for maintenance
0 to 9	Numeric Keys	Station code Transmission
A,B,C & D	Group code keys	Group code Transmission
G	General call	General call transmission to all stations at time
LR	Long Ring	When kept pressed sends the last called station code repeatedly for every 4. 5 seconds

Table showing the function of keys

Working Features:

1) It is designed to assign *two-digit* codes for way stations

2) The dual tone transmission for the code digits starts only after pressing the second digit of the way station code

3) The second digit of the code should be pressed within *4 sec* after pressing

the first digit. Otherwise the first digit becomes invalid and goes off the display.

4) Code transmission is completed in 500ms
5) Entered two- digit code is shown on the 7-segment LED display.
6) During code digit transmission an LED on the extreme left of the display flickers indicating code transmission.

Special Features:

1) It is a most versatile system suitable for both RE and Non-RE sections
2) The controller's equipment as it is designed for 4 wire working. For 2 wire working in non-RE just one 4-wire to 2-wire conversion unit is required additionally
3) Calling of way stations is possible in case poor line condition ie., noisy and distorted condition.
4) At -25dB of DTMF signal level also the calling of way stations is possible. This is the minimum level for the signal.

Specifications: (of M/s Tummala's make Equipment)

1) DTMF Signaling :

Frequency stability	: ± 1%
Output Level	: 0dB to -7dB

2) Speech :

Trans:

Nominal output level	: 0dB
Level adjustment	:15dB from max. level)

Receive:

Input Signal	: Min. -20dB & Max. +12dB
Level adjustment	: 15dB from max. level
AGC range	: -15dB to +10dB

3) Power Supply : 12V DC ± 10% @ Current 400mA (max)

NOTE: A 12 V dc power supply unit with charger and a built -in 12V maintenance-free battery is provided with system.

Review Questions

1) Mention two main advantages of DTMF signaling.
2) What does controller need to dial if he wants to call the **Group- B** stations?
3) Is it possible to ring a way station if 00 is allotted as its station code ?
4) Mention the dual tones assigned to LR key and are the same tones transmitted on the line when LR is pressed?
5) Do you think that ringing of the way stations can be possible if an Auto-telephone is used in place of the controller's equipment?

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CONTROL LABORATORY

EXPERIMENT NO : CT- 2

नाम
Name : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

अनुक्रमांक
Roll No : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

पाठ्यक्रम
Course : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

दिनांक
Date : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

प्राप्त अंक
Marks Awarded:

अनुदेशक का अधाक्षर
Instructor Initial:

EXPERIMENT No. CT -2

Study of DTMF Way Station Equipment

Objective : To study the features and working of the Way Station Equipment used in railway control communication.

Function : The function of this equipment is to provide

- DTMF 2-digit code detection and buzzer operation
- Control telephone facility to the SM/ASM etc.

Description: The DTMF way station equipment comprises of

- The DTMF selective call decoder and buzzer
- The control Telephone and
- Power supply unit.

The DTMF Selective Call (code) Decoder

It is a solid state digital circuit using CMOS ICs. It consists of the following components: (Ref. M/s Tummala Equipment)

1) Two Matching Transformers TR1 & TR2.

TR1 - This connects controller's speech on Tx pair to way station Receive and
TR2 - This connects way station speech Trans onto controller's Rx pair.

2) IC 8870 - DTMF Tone decoder.

This converts the digit information received in Dual Tone- form into 4-bit binary.

3) IC 4514 - 4 bit Decoder.

This converts the 4 bit binary value from 8870 into discrete form and outputs onto one of the 16 output lines.

4) Two DIP switches (10 -way)

The 2 digit way station code (viz., 01 through 99) is set by using these two DIP switches, one for each digit. The first 10 outputs of IC 4514 are connected to both of these switches in parallel.

5) IC 4538 / 74C221 – Dual Mono-shot

The decoded first digit signal of the received station code, from IC 4514, is connected to the Trig- input of one of these Mono-shots through the closed contact of the First-digit (FD) DIP switch. This gives a time delay of nearly 0.5 seconds.

6) IC 4027 Dual J-K Flip-flop or 4013- Dual D Flip-Flop.

The decoded First -digit (FD) signal in the form of Mono-shot outputs, Q and $\overline{Q}$ of IC 4538, is connected respectively to the J & K inputs of one J-K Flip-flop in this IC . The decoded second digit signal , from IC 4514, is connected through the closed contact of the Second-digit (SD) DIP switch to the Clock-in of the same J-K Flip-flop as clock pulse for setting the flip-flop.

Similarly, a 2 digit Group-call code (viz., AA, BB, CC and DD) through a single 4-way DIP switch or the 2 digit General-call code (GG) ,directly, is applied to the second pair of Mono-shot and J-K flip-flop in the ICs 4538 and 4027.

The Q outputs of the two J-K flip-flops in IC 4027, are diode- OR-ed and connected to a mono in another IC4538. The Q output of this mono gives a timing pulse of 3 to 5 seconds for ringing a Buzzer and also for enabling an RBT(ring back tone) for the controller and its $\overline{Q}$ output resets the J-K flip –flops.

7) IC 4093 – Quad 2-input NAND Gate.

This is used as an RBT (ring back tone) generator

8) LM 386 – Dual Op-amp.

One each of these Op-amps is for both Tx and Rx speech amplification.

9) IC 7805 – 5V DC Regulator.

Provides 5V DC for all ICs except for LM386, which uses 12VDC

10) Relay 12 V DC

This relay operates when PTT switch, on the handset of the way station Control Telephone, is pressed and connects SM's speech to Controller's Rx pair. In Tummala make equipment it is a miniature DIP relay.

NOTE : If more than one contact is ON in any DIP switch

- The code becomes invalid and ringing does not take place in M/s Tummala make equipment.
- But, in case of other makes the ringing takes place with both the codes

Way Station DTMF Decoder Circuit

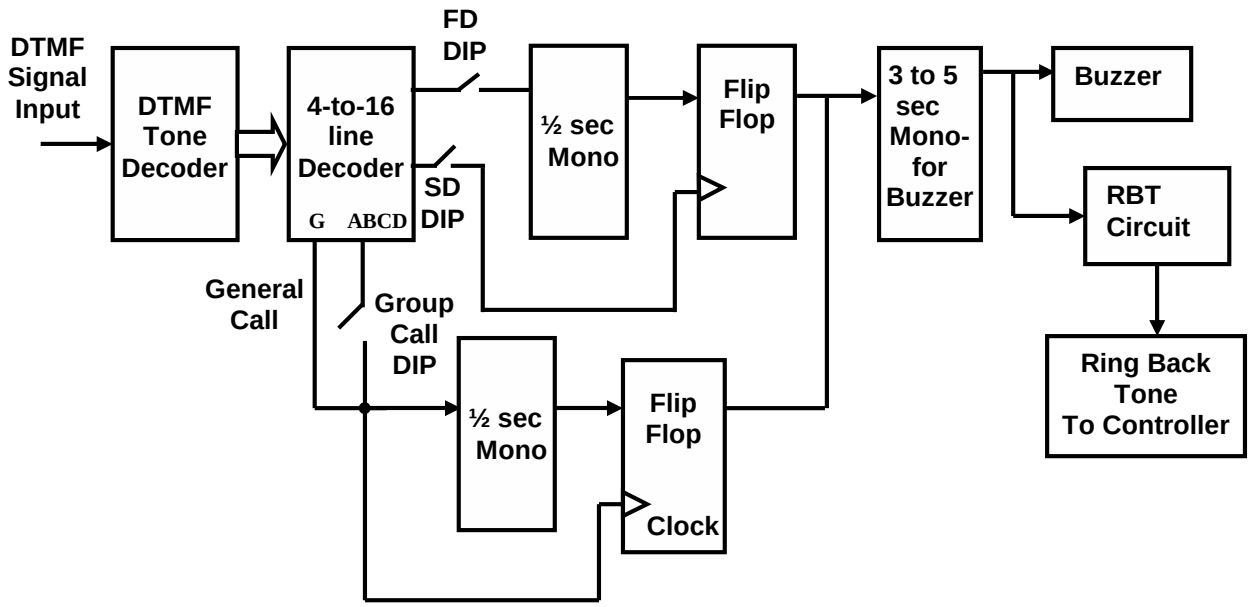

Fig.1 - Block Diagram of Way Station DTMF Decoder Circuit

The Way Station Control Telephone

This telephone instrument consists of

1) A Handset with
   - (a) a *Carbon microphone* for Transmitter and
   - (b) a *Split armature* type Receiver
2) A telephone unit with
   - (a) a Piezo buzzer and
   - (b) an LED for visual indication

In case of a call from the controller in addition to the audible buzzer there is a visual indication of either

- (a) a **flashing** *LED* as in Tummala make or
- (b) a **steady light** *LED* as in Epsilon make

In Tummala make for providing flashing indication a circuit with 555 timer and an SCR is used , inside the telephone

NOTE: Both these units ie., the way station DTMF signaling decoder and Control telephone can be either 2w or 4w type

Power Supply Unit

This provides 12 V DC @ 100 mA . It consists a rectifier and charger with a built-in 12 V maintenance-free battery. On the front panel indications are provided for

1) AC mains
2) Charging of battery and
3) Battery low

Specifications of Way Station Equipment

1) Operating Voltage : 12 V DC ±10%
2) Operating Current : 20 – 60 mA
3) Signaling : Standard DTMF Signaling
4) Code Setting : Using two DIP switches
5) Min. Detectable signal level : -25 dBm

Speech characteristics

1) Trans output : 0 dBm (nominal)
2) Trans gain variation : 12 dB from nominal
3) Insertion Loss (Trans) : 2.0 dB max.
4) Receive min. level : - 30 dBm
5) Receive max. level : + 10 dBm
6) Rec. Level adjustment : 12 dB from nominal
7) Insertion Loss (Rec) : Less than 0.5 dB

Exercise:

1) Call a way station with a Group-Code and observe
   (a) Whether ringing at the way station takes place only on receiving the first digit of group code ? If not explain why when there is only one DIP switch used for both FD and SD digits, in the group call circuit?

Review Questions

2) What is need of mono-shots in the way station DTMF decoder unit?
3) Why RBT signal is required in the way station equipment?
4) Suppose an SM wants more ringing period in his control telephone, can you provide it ? If yes how ? and if no why ?

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प्रयोग नं: सी टी 3

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CONTROL LABORATORY

EXPERIMENT NO : CT- 3

नाम
Name : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

अनुक्रमांक
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दिनांक
Date : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

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Marks Awarded:

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Instructor Initial:

EXPERIMENT No. CT -3

Tests On DTMF Equipment

Objective: To perform different tests to know the performance of the DTMF system.

Tests on Controller's Equipment

1) DTMF Frequency Measurements:

The Row and Column frequencies can be measured individually as below:

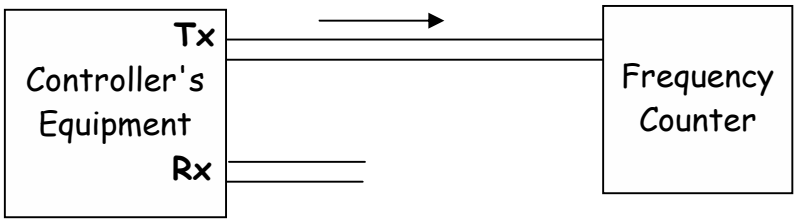

Fig.1 - Setup For Frequency Measurement

Connect a Frequency counter to Tx lines of the Controller's equipment as shown above.

a) Press ' **RC** ' key on the key board of Controller's equipment.

b) On the display of Cont. Equip. ' r1 ' is displayed.

c) This stands for ' 1st row frequency ' and it is available directly on Tx lines of Controller's equipment. The frequency counter measures and displays this frequency. Record it in table-1.

d) Now press ' **RC** ' key again. Cont. Equip. display shows ' **r2** ' and this stands for 2nd row frequency. Its value is measured by the frequency counter already

connected to Tx lines.

e) Similarly ' **r3** ' and ' **r4** ' are measured. On the next press of ' **RC** ' after ' **r4** ' a ' **c1** ' is displayed indicating 1st column frequency.

f) Like this all the **eight** DTMF frequencies ' **r1**' to ' **c4** ' are measured and record them in the table-1

S.No	Row Frequencies(Hz)		Column Frequencies(Hz)	
	Standard value	**Measured value**	**Standard value**	**Measured value**
1	697		1209	
2	770		1336	
3	852		1477	
4	941		1633	

Table-1

2) Speech Amplifiers Gain Measurement :

The Trans and Receive amplifiers Gains in the Controller's speech circuit are to be measured. Make connections as shown below

a) Measuring Tx Amplifier Gain

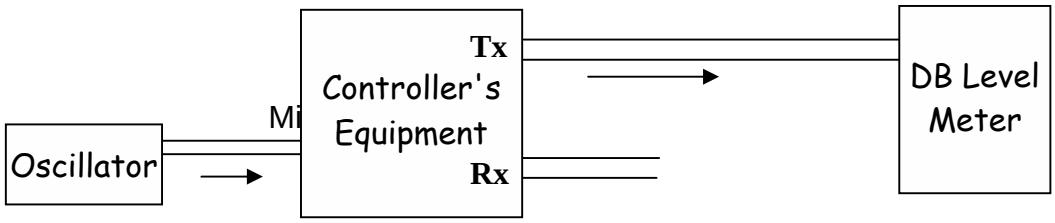

Fig.2 Set Up For Measuring Tx Amplifier Gain And Frequency Response

1) Make connections as shown above
2) Set the Oscillator for 800 Hz at -20dB
3) Feed this to the Microphone input lines
4) Measure the level on the dB meter
5) Record this in the table-2
6) Compute the gain of Tx amplifier and record in the table

b) Finding Tx Amplifier Frequency Response

1) Keeping the same set up.
2) Now vary the frequency on Oscillator from 300Hz to 3400Hz
3) Observe variation in the gain on the DB meter.
4) This should be within 3dB

c) Measuring Rx Amplifier Gain

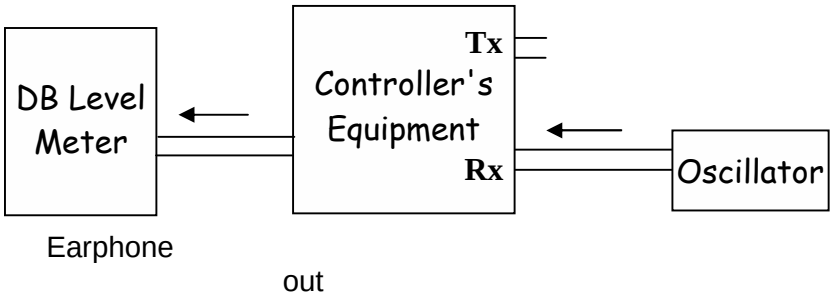

Fig.3 - Set up for measuring Rx amplifier gain and frequency response

1) Connect Oscillator to Rx line and DB meter to Earphone-out line as shown above
2) Set the Oscillator for 800 Hz at -20dB
3) Feed this onto the Rx line on the back of Controller's equipment
4) Keep the controller's speaker volume control in max. position
5) Measure the level on the dB level meter
6) Record this in the table
7) Compute the gain of Rx Amplifier and record in the table.

d) Finding Rx Amplifier Frequency Response

1) Keeping the same set up.
2) Now vary the frequency of Oscillator from 300Hz to 3400Hz
3) Observe variation in the gain on the DB meter.
4) This should be within 3dB

Test	Tx Amplifier			Rx Amplifier		
	Tx -In	Tx-Out	Gain	Rx-In	Rx-Out	Gain
Gain Measurement						
Frequency Response						

Review Questions

What is the acceptable drift in DTMF frequencies? Do the measured DTMF values lie within this limit?

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प्रयोग नं: सी टी 4

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CONTROL LABORATORY

EXPERIMENT NO : CT- 4

नाम
Name : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

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Date : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

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Instructor Initial:

EXPERIMENT No. CT - 4

Common Faults in Control Equipment

Objective : In this lab session you will learn different types of common faults that occur frequently in control equipment and their localization procedures.

The Common Faults in Control Equipment can be Categorized into :

1. Faults in **Head quarters equipment** and
2. Faults in **Way Station Equipment**

Common Faults In Head Quarters Equipment

1. One Way Speech To Controller:

a) No Trans from Controller :

This means way stations do not receive controller speech.

Causes: The causes for this problem can be

1) Microphone or mouth piece may be defective or got disconnected
2) Trans amplifier gain may be very low or amplifier IC may be defective
3) Disconnection between amplifier output and the terminal strip on the back of the equipment
4) Disconnection in trans cable-pair
5) U-links may not be put through or may be open in the test room panel

Procedure for locating the Fault:

1) Check for the connections of microphone and mouth piece; if disconnected reconnect it and check whether speech is through to way stations. If not
2) Measure trans amplifier gain by feeding a tone of 800Hz using TMS kit. If gain is low increase it with **preset**. Still no improvement check components for short or open . If components are OK replace amplifier IC
3) Ensure the output of amplifier is extended up to the terminal strip
4) Take **loop test** between **controller equipment** and **test room panel** for ensuring the trans pair continuity.
5) And finally check the U-links

b) <u>No Receive to Controller</u> from any station:

This means that controller does not receive speech of any way stations.

Causes: This problem may be due to

1) Disconnected or defective earphone or loud speaker
2) Receive amplifier gain may be very low or amplifier IC may be defective
3) Disconnection between amplifier output to the terminal strip on the back of the equipment
4) Disconnection in receive cable-pair
5) U-links are not put through or defective U-links in test room panel

Procedure for locating the Fault:

1) Check for the connectivity of earphone or loud speaker; if found disconnected, reconnect it and check whether speech is through from way stations. If not
2) Measure receive amplifier gain by feeding a tone of 800Hz using TMS kit. If gain is low increase it with **preset**. Still no improvement replace amplifier IC
3) Ensure the output of amplifier is extended on to the terminal strip
4) Take loop test from controller equipment to test room panel for ensuring the receive pair connectivity.
5) And finally check the U-links

2. Both Way Speech Loss at Controller:

There is no speech in either direction

Causes:

1) Controller equipment problem or
2) Disconnection in quad between controller and test room

Procedure for locating the Fault:

1) Check power supply to the equipment

2) Feed tone to both the trans and receive amplifiers and measure outputs
3) If amplifiers outputs are present check for the trans amplifier tone at test room panel

Common Faults In The Way Station Equipment

1. **No Ringing :**
   a) At one or two way stations
   b) At all way stations beyond a point
   c) At all way stations in the entire section.

a) No Ringing At One Or Two Way Stations

Causes:

1) Wrong setting of station code at that particular way station or stations. This means more than one contact may be made ON in either **First digit DIP** switch or **Second digit DIP** switch.
2) Or any IC in the decoder circuit may be faulty
3) Power supply may not be extended
4) Problem may be in the piezo buzzer itself
5) Disconnection in the receive pair

Procedure for locating the Fault:

1) Check for the correctness of the above mentioned things one by one till the fault is located and problem is solved.

b) No Ringing At All The Way Stations Beyond A Point

Causes:

1) The main cause of this problem can be a **break** or **short** in the **Trans pair** beyond this point.
2) Or if all these stations are located immediately after a repeater, that particular repeater output signal may not be present.

Procedure for locating the Fault:

1) Check for the above mentioned faults and rectify the fault.

c) No Ringing At All Way Stations In The Entire Section

Causes:

1) The main cause can be the controller equipment. That is
   (a) No DTMF signal output from it or
   (b) Its DTMF signal level may be very low or
   (c) Tone sending relay may not be operating

2) The problem can also be in the test room. This may occur due to

(a) Break in the test room panel board
(b) Or no output from terminal repeater in the test room.

Procedure for locating the Fault:

1) Using DTMF **Test Jig** in the test room send different way station codes. If the stations are ringing the fault is confirmed to be with the Controller's equipment only. If this also didn't work then

2) The fault is in the Terminal Repeater. This can be confirmed by taking tone test with the help of TMS kit. Feed any tone in VF range at –10 dB level to the input of repeater trans amplifier and measure its output. This should be between –1dB to + 14 dB. (Because amplifier gain is +24dB and selectable attenuation is between 0dB to –15dB.)

Exercise :

1. With the knowledge of the fault locating methods studied above find out the given fault in the system and write down below, in sequence, the steps you followed to locate it.

नाम
Name : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

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पाठ्यक्रम
Course : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

दिनांक
Date : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

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Marks Awarded:

अनुदेशक का अधाक्षर
Instructor Initial:

EXPERIMENT No. CT -5

Study of Repeater Amplifiers

Objective : In this lab session you will learn the features and specifications of Repeater Amplifiers used in railway control communication system

Purpose of Repeater Amplifiers: It provides the required amplification in both the direction of a control channel to compensate for the attenuation due to cable pairs. One pair of amplifiers is required for every control circuit or channel. One Trans amplifier and one Receive amplifier is provided in each quad. The repeater equipment consists of as many no. of amplifier pairs as the no. of control circuits. The types of amplifier cards provided in a repeater bay are

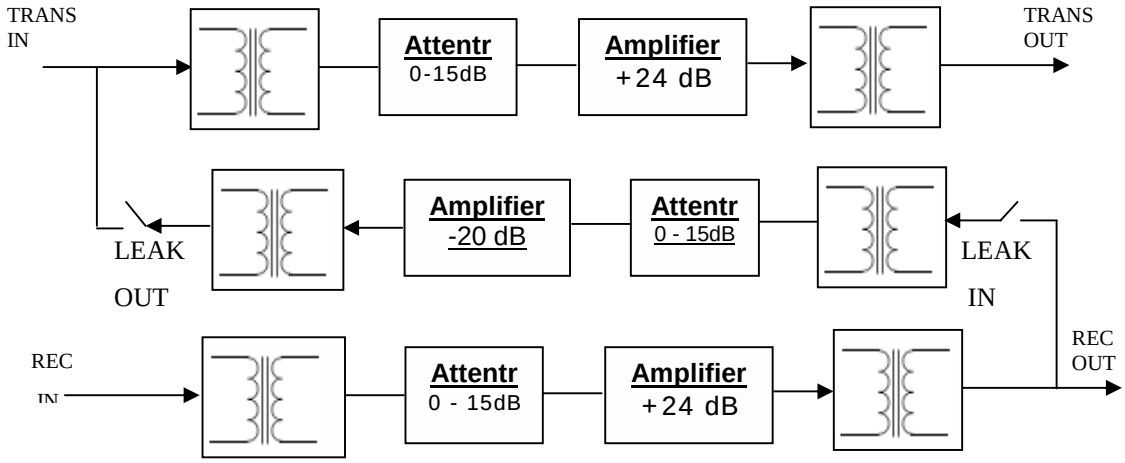
1. **VFL Card** - VF Repeater Amplifiers card with a Leak amplifier
2. **VFR Card** - VF Repeater Amplifiers card without leak amplifier
3. **Buffer Card** - Buffer Amplifiers for branching monitoring and communication purpose.

Generally, **4 VFL** cards and **4 VFR** cards and one buffer card are provided with every repeater bay. Each of these cards contains one Trans Amplifier and one Receive Amplifier. The VFL additionally contains one ***Leak amplifier*** *which is to be* ***connected*** *between Rx-out and Tx-in*. This cross connection facilitates the way stations to speak with one another.

VFL Card:

It houses two VF amplifiers, one for **trans** direction and another for **receive** direction. The gain of each amplifier is +24dB. In addition to **Trans** and **Receive**

amplifiers there is also one more amplifier called **Leak Amplifier** on the VFL card. The purpose of leak amplifier is to provide communication facility among the way stations. Each control circuit uses two pairs of a quad on the telecom cable. One pair is for trans of controller and another pair is for the receive of controller. Suppose, two way stations need to talk with each other. The voice output (or trans) of both these stations travels on the same **receive pair** of controller. *The way stations control telephone receiver is connected to trans pair of the controller*. This means that any way station can hear the voice of other way station only if that speech signal is available on the trans pair. For this reason leak amplifier is used to leak the way stations' speech signals from controller's receive pair to his trans pair and thus enabling intercommunication among way stations.



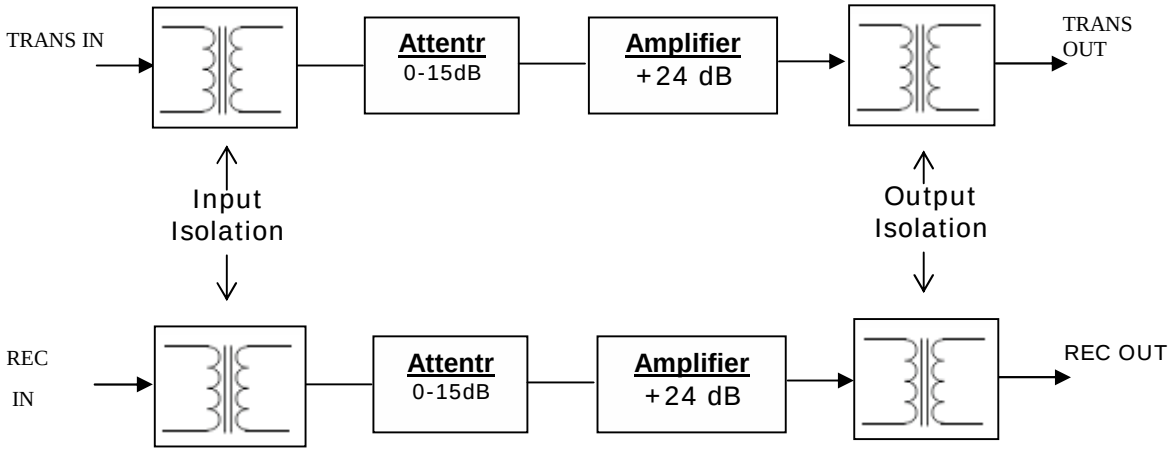
Block diagram of VFL

Circuits Requiring Leak Amplifiers:

All omnibus control circuits like Section control, Dy. Control, Traction Loco Control, Traction Power Control, Engineering Control, Maintenance Order Wire (MOW) and Emergency Control require Leak Amplifiers at every alternate repeaters along the cable route. If leak amplifier is connected to a control circuit at every repeater station instead of at alternate ones, the gain on the control circuit increases and singing or whistling takes place rendering conversation not possible.

VFR Card:

The circuitry on the VFR card is the same like that on VFL card. But there is one difference. That is, there is no Leak Amplifier on VFR card. Otherwise, it has the same VF amplifier circuits, one for trans and another for receive, with same gain, that is a gain of +24dB. The block diagram of VFR card is shown on the next page.



Block diagram of VFR

A variable attenuator is also provided with each VF amplifier in both **VFL** and **VFR** cards. The purpose of this attenuator is to adjust the gain of a VF amplifier to a required level, below +24dB. The attenuation range offered is between 0dB to – 15 dB which is selected by DIP switches. The switch settings for different attenuation values can be seen in Annexure-I. For Trans and Receive gain settings **DIP-SW3** and **DIP-SW-1** are used respectively.

BUFFER Card:

On this card also two VF amplifiers with +24dB gain are provided. These amplifiers are mainly used for branching of control circuits and then monitoring of speech on communication purpose.

The following DIP switches are provided on VFL, VFR and Buffer cards

VFR & VFL Cards:

Gain adjustment:

DIP Switch – 1 for adjusting **Receive** gain
DIP Switch – 3 for adjusting **Trans** gain

Equaliser setting:

DIP Switch - 2 for adjusting **Receive** slope
DIP Switch - 4 for adjusting **Trans** slope

Leak Amplifier setting: (only on VFL card)

DIP Switch - 5 for adjusting attenuation of Leak Amplifier
DIP Switch - 6 for connecting Leak Amplifier

BUFFER Card:

Gain adjustment:

DIP Switch – 1 for adjusting **Receive** gain
DIP Switch – 2 for adjusting **Trans** gain

TECHNICAL SPECIFICATIONS

V.F. Amplifiers (VFR & VFL)

Operating Voltage-	**24 V**olt nominal (21 Volts to 30 Volts)	
Input current	-	less than **30mA** each PCB.
Gain	-	24dB ± 0.5 dB
Input Impedance -	1120 ohm ± 2%	
Output Impedance	-	1120 ohm ± 2%
Frequency Response to 3.4 KHz	-	Flat within ± 0.1 dB for 300 Hz

Attenuators : Four Active Attenuators of **1dB, 2dB, 4dB, 8dB**
Total Attenuation level = **15dB,** selection by DIP switches.

Note*: Initially all Attenuators and Equalizers are not connected in the circuit.*

LEAK AMPLIFIER (provided only on VFL Card)

Gain	-	**-** 20dB ± 0.5dB (only attenuation)
Input shunting loss	-	< 1.5dB
Output shunting loss	-	< 1.5 dB
Frequency Response -	Flat with in ± 0.75 dB for 0. 3 to 3.4 KHz	

Attenuators: Four Attenuators for - **1 dB, 2dB, 4dB, 8dB**
Max. Attenuation - 15dB (selection by DIP switches).

Leak Amplifier is connected in the circuit by **SW – 6**

To connect all the **four** switches should be **ON**

To disconnect all the **four** switches should be **OFF**.

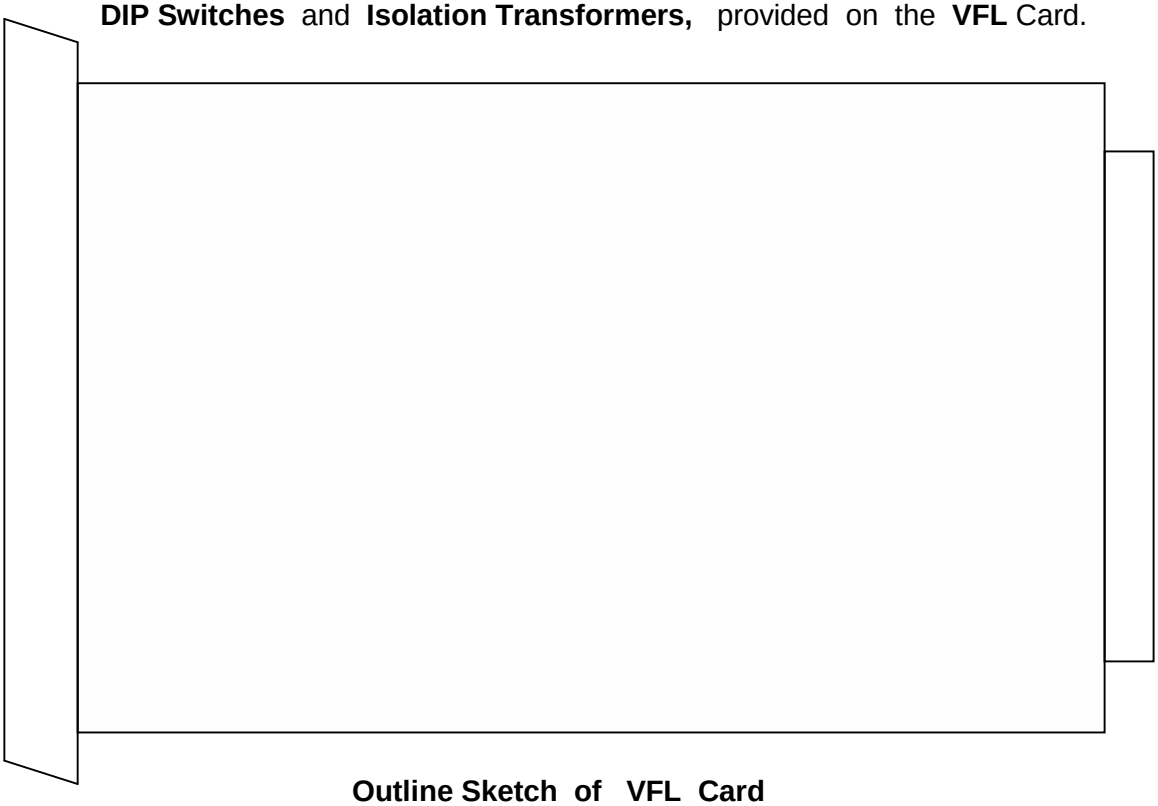
BUFFER AMPLIFIER :

Gain	-	24 dB ±0.5dB
Input Impedance Trans	-	High
Output Impedance Trans	-	1120ohm ± 5%
Input Impedance Receive	-	1120 ohm ± 5%
Output Impedance Receive	-	High
Shunting loss	-	Better than 1. 5dB
Frequency Response	-	Flat within ± 0.2 dB

Attenuators: (5 attenuators) - of **1dB, 2dB, 4dB, 8dB, 16dB** are provided with tolerance of ± 0.2dB. (Selection by **DIP SW2 –** for Trans & **DIP SW1 –** for Receive)

EXERCISE

1. Mention circuits which do not require leak amplifier.
2. What happens if leak amplifier is included in a circuit where it is not required?
3. Identify and show on the below given card outline sketch the positions of all **DIP Switches** and **Isolation Transformers,** provided on the **VFL** Card.



Outline Sketch of VFL Card

The DIP switch settings for selecting different Gain and Attenuation values of VF Amplifiers is given on the next page

1. *DIP Switch Settings for VFL & VFR Cards*

TRANS						RECEIVE					
DIP SWITCH SW – 3						DIP SWITCH SW – 1					
1	**2**	**3**	**4**	**ATTN**	**GAIN**	**1**	**2**	**3**	**4**	**ATTN**	**GAIN**
OFF	ON	ON	OFF	0dB	24dB	OFF	ON	ON	OFF	0dB	24dB
ON	ON	ON	OFF	1dB	23dB	ON	ON	ON	OFF	1dB	23dB
OFF	OFF	ON	OFF	2dB	22dB	OFF	OFF	ON	OFF	2dB	22dB
ON	OFF	ON	OFF	3 dB	21dB	ON	OFF	ON	OFF	3 dB	21dB
OFF	ON	OFF	OFF	4 dB	20dB	OFF	ON	OFF	OFF	4 dB	20dB
ON	ON	OFF	OFF	5 dB	19dB	ON	ON	OFF	OFF	5 dB	19dB
OFF	OFF	OFF	OFF	6 dB	18dB	OFF	OFF	OFF	OFF	6 dB	18dB
ON	OFF	OFF	OFF	7 dB	17dB	ON	OFF	OFF	OFF	7 dB	17dB
OFF	ON	ON	ON	8 dB	16dB	OFF	ON	ON	ON	8 dB	16dB
OFF	OFF	ON	ON	10dB	14dB	OFF	OFF	ON	ON	10dB	14dB
OFF	ON	OFF	ON	12dB	12dB	OFF	ON	OFF	ON	12dB	12dB
ON	OFF	OFF	ON	15dB	9dB	ON	OFF	OFF	ON	15dB	9dB

2. *DIP Switch Settings for BUFFER Card*

TRANS (SW- 2) & RECEIVE (SW-1)						
1	**2**	**3**	**4**	**5**	**ATTN**	**GAIN**
ON	OFF	ON	ON	OFF	0	24
OFF	OFF	ON	ON	OFF	1	23
ON	ON	ON	ON	OFF	2	22
OFF	ON	ON	ON	OFF	3	21
ON	OFF	OFF	ON	OFF	4	20
OFF	OFF	OFF	ON	OFF	5	19
ON	ON	OFF	ON	OFF	6	18
OFF	ON	OFF	ON	OFF	7	17
ON	OFF	ON	OFF	OFF	8	16
ON	ON	ON	OFF	OFF	10	14
ON	OFF	OFF	OFF	OFF	12	12
ON	OFF	ON	ON	ON	16	8
ON	OFF	ON	OFF	ON	24	0

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नियंत्रण प्रयोगशाला

प्रयोग नं: सी टी 6

IRISET

CONTROL LABORATORY

EXPERIMENT NO : CT-6

नाम
Name : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

अनुक्रमांक
Roll No : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

पाठ्यक्रम
Course : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

दिनांक
Date : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

प्राप्त अंक
Marks Awarded:

अनुदेशक का अधाक्षर
Instructor Initial:

EXPERIMENT No. CT -6

Repeater Amplifiers Gain Measurements

Objective : In this lab session you will learn the Gain and Attenuation measurements on Repeater Amplifiers used in Control communication system.

VFL Card Gain Measurements

PROCEDURE

1. Pull out VFL card from the repeater bay (rack) and locate SW-1 and SW-3 DIP switches. Note down their existing settings in **table-1**
2. Referring to tables in **Annexure -A** for switch settings, note down the specified gain and attenuation for the existing switch settings for both SW-3 and SW-1 in table-1. In this table the switches setting for **maximum Gain** and **zero attenuation** is shown as a sample case.

TRANS & RECEIVE DIP Switch settings							
Switch settings for Max Gain		1	2	3	4	ATTN	GAIN
		OFF	ON	ON	OFF	0dB	24dB
Existing Switch Settings	SW-1						
	SW-3						

Table-1

3. Re-insert the card in to the bay slot.

On the U link panel:

TX-IN-I, RX-IN-I, TX-OUT-I, RX-OUT-I are terminations of VFL card

and TX-IN-II, RX-IN-II, TX-OUT-II, RX-OUT-II are terminations of VFR card.

Trans Amplifier Gain Measurement

4. On the U link panel remove the links on TX-IN - I and TX-OUT – I.
5. Take a TMS kit and set its both impedance switches to 1120Ω.
6. Feed an 800 Hz tone from the oscillator of TMS kit at different levels as given in table-2, to trans amplifier at TX-IN and measure its output level at TX-OUT.
7. Note down these values in table-2 given below and calculate the gain in each case.

TX-IN	TX-OUT	Amplifier Gain
0 dB		
-10 dB		
-20 dB		

Table-2

Review Question: Now specify out of the three gain values which is not the correct one and why?

Answer:

Receive Amplifier Gain Measurement

8. Remove the U links on RX-IN - I and RX-OUT – I.
9. Feed an 800 Hz tone from the oscillator of TMS kit at different levels as shown in table-3, to receive amplifier RX-IN and measure its output level at RX-OUT.
10. Note down these values in table-3 given below. Calculate the gain in each case.

RX-IN	RX-OUT	Amplifier Gain
-10 dB		
-20 dB		

Table-3

Leak Amplifier Gain Measurement

PROCEDURE

1. Pull out VFL card once again and set all switches in the DIP switch 6 (SW-6) to ON.

2. Check for setting on DIP SW-5 should be OFF, ON, ON, OFF (For 0dB attenuation)
3. Re-insert the card back into its slot.
4. Feed 800 Hz signal at RX- OUT at the levels shown below and measure output at TX-IN and record in the table below and calculate the gain

Input level at RX-OUT	**Output at TX-IN**	**Amplifier Gain**
-10 dB		
-20 dB		

Table-4

5. The gain of leak amplifier should be –26dB (max). Actually leak amplifier simply introduces attenuation not gain.
6. Now re-insert all the U links back in to the panel.

VFR & Buffer Amplifiers Gain Measurements

Follow the same procedure as that you followed for **VFL** (except for Leak, because there is no leak amplifier in VFR and Buffer cards which you know already) and find out their gains and record in the below table.

VFR	**Trans Amp Gain**	**Receive Amp Gain**
BUFFER	**Trans Amp Gain**	**Receive Amp Gain**

Table-5

DIP Switches Settings for Adjusting Trans & Receive Amplifiers Gain

Table-1

TRANS GAIN						RECEIVE GAIN					
DIP SWITCH SW – 3						DIP SWITCH SW – 1					
1	**2**	**3**	**4**	**ATTN**	**GAIN**	**1**	**2**	**3**	**4**	**ATTN**	**GAIN**
OFF	ON	ON	OFF	**0dB**	**24dB**	OFF	ON	ON	OFF	**0dB**	**24dB**
OFF	ON	ON	ON	**1dB**	**23dB**	OFF	ON	ON	ON	**1dB**	**23dB**
OFF	ON	OFF	OFF	**2dB**	**22dB**	OFF	ON	OFF	OFF	**2dB**	**22dB**
OFF	ON	OFF	ON	**3 dB**	**21dB**	OFF	ON	OFF	ON	**3 dB**	**21dB**
OFF	OFF	ON	OFF	**4 dB**	**20dB**	OFF	OFF	ON	OFF	**4 dB**	**20dB**
OFF	OFF	ON	ON	**5 dB**	**19dB**	OFF	OFF	ON	ON	**5 dB**	**19dB**
OFF	OFF	OFF	OFF	**6 dB**	**18dB**	OFF	OFF	OFF	OFF	**6 dB**	**18dB**
OFF	OFF	OFF	ON	**7 dB**	**17dB**	OFF	OFF	OFF	ON	**7 dB**	**17dB**
ON	ON	ON	OFF	**8 dB**	**16dB**	ON	ON	ON	OFF	**8 dB**	**16dB**
ON	ON	OFF	OFF	**10dB**	**14dB**	ON	ON	OFF	OFF	**10dB**	**14dB**
ON	OFF	ON	OFF	**12dB**	**12dB**	ON	OFF	ON	OFF	**12dB**	**12dB**
ON	OFF	OFF	ON	**15dB**	**9dB**	ON	OFF	OFF	ON	**15dB**	**9dB**

Review Questions:

1. What are the minimum and maximum gain and attenuation values that can be set for each amplifier on the amplifier cards?
2. What difference did you observe between VFL and VFR cards?
3. What is the use of buffer amplifier in a repeater station ?
4. **Carefully think and answer:** what would be the normal input level for the Tx and Rx amplifiers in the real field conditions of railways?

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IRISET

CONTROL LABORATORY

EXPERIMENT NO : CT- 7

नाम
Name : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

अनुक्रमांक
Roll No : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

पाठ्यक्रम
Course : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

दिनांक
Date : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

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Marks Awarded:

अनुदेशक का अधाक्षर
Instructor Initial:

EXPERIMENT No. CT –7

Study of Isolation Transformers Bay and Loading Coil Assembly

Objective : In this lab session you will learn the features and uses of the following equipments used in railway control communication system.

- **Isolation Transformers Bay**
- **Loading Coil Assembly**

1. Isolation Transformer Bay

Introduction

The Isolation Transformer Bay consists of number of Isolation Transformers to be used with VF circuits working on under ground telecom cable. The 25 KV AC traction voltage used in RE sections longitudinally induces voltages or EMFs in telecom cable wires which are part of VF circuits. This is due to the parallelism of telecom cable with the catenary and the track rails. It is considered that a normal field strength of **87.5** V/ KM exists in the vicinity of telecom cable. This induces a voltage of **8.75 V** per kilometer in each wire of cable, because its screening factor is 0.1. As the cable length increases this voltage also increases proportionately. If this longitudinally induced voltage exceeds 150 V the safety of staff and equipment becomes hazardous as per the recommendations of ITU –T.

Hence it is very essential to isolate all the control circuits from this **induced voltage** so that its value will not rise above the 150 V limit, to ensure safety for staff and equipment. Dividing 150V by the per-kilometer-induced-value (8.75V/km) of the cables, gives 17km of maximum permissible uninterrupted length for cable circuits. This means that there must be a break in cable length every 17 km. This is

achieved by inserting an isolation transformer in every pair of control circuits at every 17 km. By doing this the accumulation of induced voltages on the cable pairs is brought to zero value on the other side of the isolation transformer that is the secondary side, because the same amount of voltage is induced on both the wires of a pair.

This is the reason behind the provision of a **Cable Hut** after every 17km on a cable route. An **Isolation Transformer bay** is placed in every Cable Hut with enough no. of VF transformers for the purpose of isolating all the control circuits on the cable.

Note: *Presently the practice in railways is that the isolation transformer bays are placed in the station buildings itself instead of constructing cable huts specifically for this purpose in mid sections of track, but without exceeding the 17km norm.*

EXERCISE

1) Go near the transformer bay and open its door
2) Observe different items available in the bay
3) Write the names of these items, category wise, in the below space

   (a)

   (b)

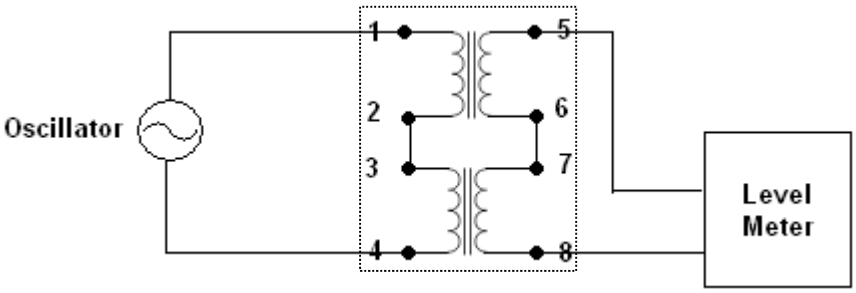
   (c)
4) Take a Multimeter and trace the connections between different points numbered as 1,2,3,….8 in a VF transformer.
5) Draw a diagram showing these connection details along with the color of wires used , in the below given space.

6) Count the total no. of such transformers provided in the bay and write the count below.

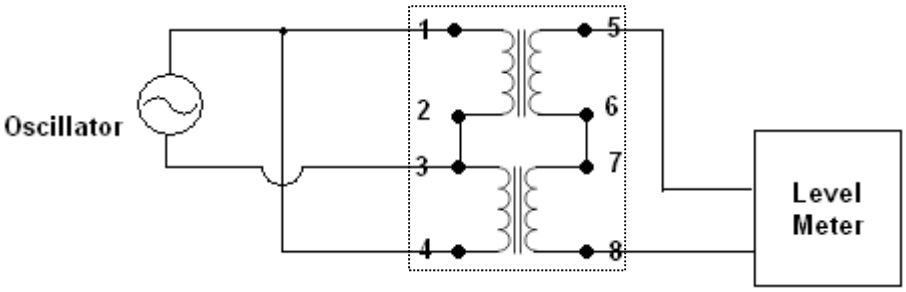
7) Trace the connections made through U links between different items of the transformer bay and show these with a diagram in the space on next page.

8) **Conduct the following tests** to know 'H*ow the induced voltages are suppressed by the isolation transformers?'*

(a) Feed an AC signal of 800 Hz to the primary winding of the VF transformer as shown in figure below. Measure the signal level on the secondary winding and note down its value.



(b) Now connect the same AC signal of 800 Hz to the primary winding of the VF transformer as shown in figure below and measure the signal level on the secondary winding and note down this value too.



9) Now mention which one of the above two arrangements could suppress the induced voltages. Explain how?

2. Loading Coil Assembly

Objective: To study the physical structure of **Loading Coil Assembly** and the response of its coils to VF frequencies.

Introduction

Every transmission line is assumed to be consisting of distributed parameters like Resistance, Inductance, Capacitance and Conductance. . For loss-less condition of the line, these parameter values should obey the follow equation.

$$LG = RC$$

But practically no line would satisfy this condition. This is true even with the telecom cable used for control communication. Let us think of the ways to bring about this balanced condition between the four parameters of the line.

R - The **resistance** of the line and is usually very high due to the thin size

of the conductors

C - The **capacitance**. It is also high because in the cable conductors are placed very close to each other.

L - the **inductance** offered by the line to VF frequencies

G - the **conductance** or **leakance**. This is very small because of good insulation between cable conductors

This means that the term **RC** is always **high** compared to **LG** in a telecom cable.

i.e., **RC > LG**

And there is no means to reduce either R or C values in a cable which is rigidly constructed with fixed physical sizes for the conductor wires and the cable as a whole. Then the only choice is to increase the value of LG. In this also G can not be increased because increasing G means reducing insulation between the lines which is undesirable. The only alternative is to increase the value of L. This is done by adding inductors of required values in series with the cable conductors. This external addition of inductances to equalize cable parametric values is called LOADING of the cable. After loading we achieve

RC = LG

The value of the inductor to be added depends on the type of cable used. This is as shown in the table given below.

Cable Type	Value of Loading Coil to be added
Paper insulated Quad Cable	**88** mH
PVC insulated 4/6 Quad Cable	**118** mH

All control circuits meant for speech communication are loaded by adding external inductors. But there are some circuits which shall not be loaded. These are

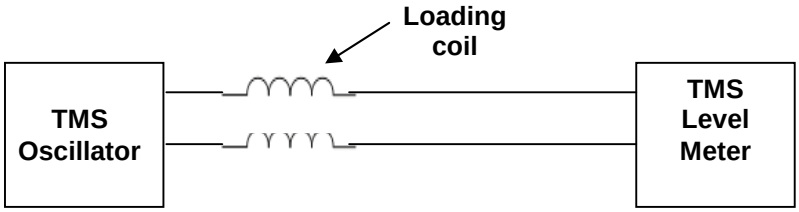
- Block circuits
- Data circuits - like Data Logger and PRS terminal link up at a way station
- IBS circuit - if provided through PET quad of RE cable

EXERCISE

1. Using a Multimeter find out the no. of coils available in the given assembly.

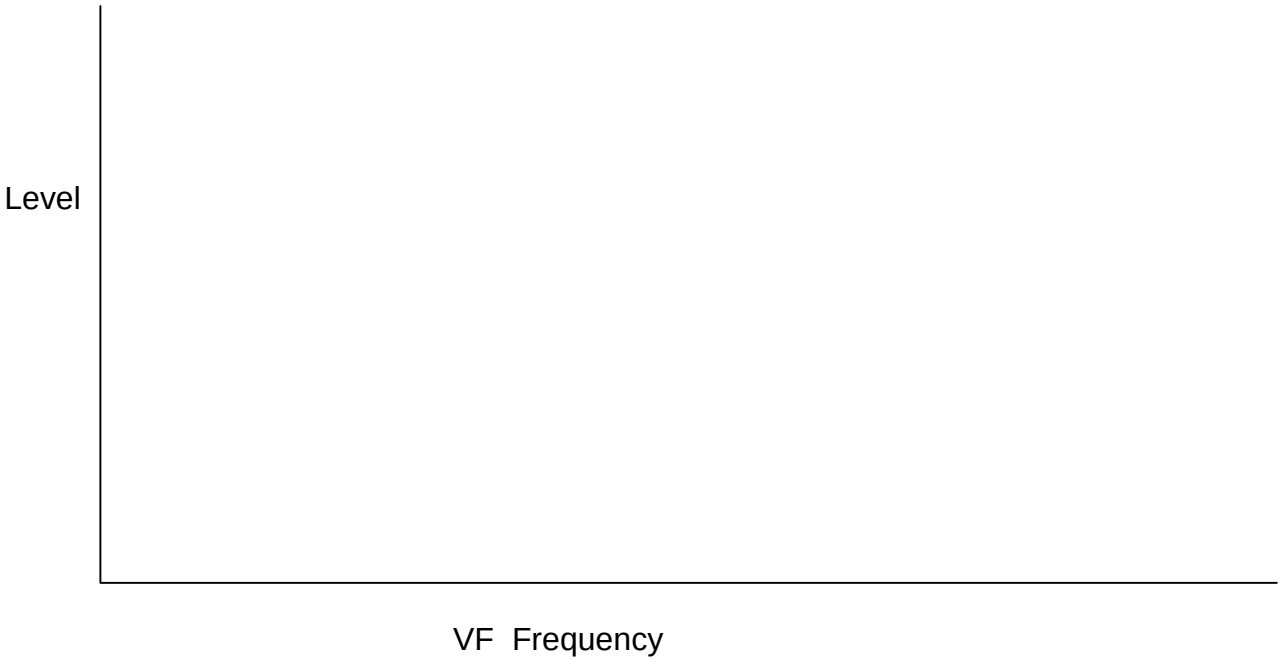
2. Draw a diagram, in the given space below, to show coils with their terminal **wire color details** and also give **serial numbering** for each coil.

3. Set the TMS oscillator for 400Hz at 0 dB level.
4. Connect any two coils of the given loading coil assembly between TMS oscillator and level meter as shown below.
5. Feed 400Hz tone and measure its level. Repeat this for all frequencies given in table. Now plot a line using this data. This line shows the response of loading coils to VF frequencies.



Tone (Hz)	**400**	**800**	**1000**	**1200**	**1600**	**1800**	**2400**	**3000**	**3500**
Level									

Plot the response line in the Graph below



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प्रयोग नं: सी टी 8

IRISET

CONTROL LABORATORY

EXPERIMENT NO : CT- 8

नाम
Name : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

अनुक्रमांक
Roll No : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

पाठ्यक्रम
Course : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

दिनांक
Date : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

प्राप्त अंक
Marks Awarded:

अनुदेशक का अधाक्षर
Instructor Initial:

EXPERIMENT No. CT -8

Study of Auto Dialing System

Objective : In this lab session you will learn the features and working of Auto Dialing System provided through Emergency Control circuit.

Description: This system is designed for providing **Auto Telephone facility,** over the Emergency Control channel, from any point in the mid section of the railway line. It is mainly used during emergencies like accidents etc. The total system is made up of the following two types of equipment.

- **Base Unit**
- **Way side unit** (or Field Portable Telephone)

Base Unit: This unit or equipment is placed at headquarters office in the Test Room. Two **auto telephone** lines – **one DOT** line and **one Railway** line – and the **Emergency Control** 4-wire line are terminated on the back of this equipment. The main units in this equipment are

- A 12-digit 7-segment LED display
- Loudspeaker Amplifier with Volume Control facility
- Handset for communication, if needed
- Line indication LEDs – DOT and RLY

Exercise-1: Draw the **front panel view of Base unit** in the space given below.

Dialed telephone number from the way station unit is display on the 12-digit display. Loudspeaker amplifier is for speech monitoring purpose if required and the hand set is for conversation either with the **way station unit** or with its **dialed party** on the headquarters side, if at all need arises. The two LEDs are for indicating which of the auto telephone lines is in use when a call is established.

On the back side of the unit the following terminations are provided on terminal strips

- DOT line
- Railway line
- 4-wire Emergency circuit line
- 2-wire EC line (normally not used but terminated with 600 ohms)
- +12V DC power supply

Exercise-2: Draw the **back panel view of Base unit** with connection details, in

the space given below

The system is designed around Intel's Micro controller of 8051 family. The functions of this unit are to

- Extend **dial tone** of either DOT or RLY exchanges to the way station unit upon receiving either a '*****' or '#' characters respectively.
- Display which line is in use
- Display the **telephone number** that is being dialed from way station
- Provide speech monitoring facility while a call is in progress
- Provide speaking facility through handset at the Test Room, if required

Way station Unit: This unit is also designed around the same 8051 family of micro controller. The total circuit of this unit is kept inside a telephone instrument. It works on 12V DC derived either from AC mains or from a back up power source of 12V rechargeable battery provided with this unit along with a built in charger. The telephone instrument and the charger–cum-battery are paced inside two separate compartments of a metal box.

PROCEDURE

1. Inter connect both units through a two pair cable or emergency control circuit
2. Connect both DOT and RLY telephone lines to Base unit
3. Terminate 2 wire line of Base unit with 600 ohms resistor
4. Extend 12 V DC supply to the base unit and mains to the way station unit
5. Switch on both the units
6. Lift the handset and press * button on the way side unit
7. RLY LED glows and dial tone of railway exchange is heard
8. Now one can dial any subscriber of railway auto exchange. Dial a required a telephone number
9. This number is displayed on the base unit
10. After connection is established, talk with the dialed subscriber
11. Monitor this conversation at the base unit
12. After conversation, to disconnect press the same * button once again.
13. LED indication goes off and call is disconnected.
14. Replace the hand set back on the hook
15. Now again lift the hand set and press # button on the way station unit
16. Now DOT LED glows and dial tone of DOT exchange is heard
17. Dial any required telephone number of DOT exchange
18. This number is displayed on the base unit
19. Next steps are same as earlier
20. To disconnect call press # button once again.
21. Replace the hand set back on hook

Review Questions:

1. How do you select a Railway telephone line and what is the color of its indication LED on base unit?

2. How do you select a DOT telephone line and what is the color of its indication LED on base unit?

3. Check whether it is possible to talk from base unit with both ends - **way station** and **the dialed party** - after a call is already established. Write down your observation below.

4. Check whether it is possible to make a call from the base unit both on DOT and RLY lines and record your observation below

5. Immediately after finishing a call on **one line** can you make a call on **the other line,** without replacing the hand set back on the hook ?

6. Draw a diagram showing the interconnections between base unit, EC socket and wayside unit. Allot any optional telephone numbers to the two auto phone lines coming from exchanges.

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CONTROL LABORATORY

EXPERIMENT NO : CT-9

नाम
Name : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

अनुक्रमांक
Roll No : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

पाठ्यक्रम
Course : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

दिनांक
Date : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

प्राप्त अंक
Marks Awarded:

अनुदेशक का अधाक्षर
Instructor Initial:

EXPERIMENT No. CT -9

Study of Equalizer Amplifier Type Control System

Objective:

In this lab session you will learn the features and working of Equalizer Amplifier type Control Communication System used with 4/6 Quad jelly filled PET cable.

Overview of the system:

Equalizer Amplifier type Control Communication system is an **alternative to** the **conventional type** control communication system. In this system there are no repeaters amplifiers separately. But every station has equalizer amplifiers offering the function of repeater amplifiers in conventional type system. The comparison between both the systems is given below

S.No	Equalizer Amplifier Type System	Conventional Type System
1	Loading of the cable is not needed.	Loading of cable is very essential in this system
2	Balancing is done in the way station equipment itself, but not directly on the cable	Balancing of the cable is provided through balancing joints directly on the cable
3	No separate repeaters stations & cable huts are required at any place along the cable route	Provision of repeaters at fixed intervals & cable huts is required along the entire cable route
4	Remote monitoring and controlling of way stations is possible	No remote monitoring and controlling of way stations is possible
5	Auto-bypassing of way station, in case of any fault in the Equ. Amplifier circuit, is available	No such feature is available
6	Local 8-line Intercom facility can be provided, optionally, at way stations.	No such provision is possible in this system
7	Cost of way station equipment is very high	Cost of way station equipment is very low
8	This system offers maximum FOUR control circuits only	This system can offer more number of control circuits.

Generally, any control communication system is invariably made up of the following types of equipment. Even this new system also accommodates the same.

1. Controller's Equipment
2. Test room Equipment
3. Way station Equipment

Controller's Equipment

It is the communication set provided to the controller and is the same as that used in conventional type of control system except for an extra 3-digit code dialing facility. It consists of a micro controller or microprocessor based unit with a 4x4 matrix DTMF keypad, a 7-segment LED 2-digit display, an hand set, and a table-top microphone for speaking and a loud speaker for monitoring. The way stations are called by 2-digit station codes and local intercom phones at way stations are called by 3-digit codes.

Test Room Equipment

Test room equipment plays vital role in the equalizer type control communication system. It performs the general maintenance functions like sending way station codes for checking up the ringing of way stations, in case of complaint speech level measurement, fault localization and restoration etc. In addition to this it also performs **remote operations** on way station equipment. Controller equipment is connected to the quad cable through the test room equipment. It consists of the following circuits

1. DTMF Keypad & Display
2. DTMF Tone Transceiver
3. Test room Communication & loud speaker circuit
4. Remote Monitoring & Battery Management unit (master)
5. Equalizer Amplifier
6. Isolation Transformers
7. Power supply unit

Way Station Equipment

This equipment is also provided in a mini rack. In earlier DTMF system the way station equipment comprised of only the DTMF decoder and the control telephone. But the new system is different from this and it contains not only the DTMF decoder and control telephone but also repeater amplifiers which eliminate the need for separate repeater amplifier equipment to be installed at fixed intervals. Unlike the conventional repeater amplifiers these new amplifiers are provided with equalization circuits to **eliminate** the need for cable **loading**. In addition to the equalizer amplifiers the way station has some more modules. The total list of all these modules is

1. Equalizer Amplifier
2. Isolation Transformers
3. DTMF Decoder
4. Remote Monitoring & Battery Management Card (slave)

5. Power supply unit
6. A local intercom facility with a mini telephone exchange of 8 lines (auto telephones) and
7. A Control Telephone for SM / ASM

Exercise-1:

1. Switch on all the three equipment
2. Dial assigned 2-digit station codes from controller's equipment
3. Observe whether way stations are ringing
4. Repeat steps 2 and 3 from Test Room equipment also
5. Record your observations in the table below

Station Code (to be Dialed)	Indications At Way Stations							
	Station - A				**Station - B**			
	Buzzer On?	**Duration of Buzzer**	**LED On?**	**Duration of LED**	**Buzzer On?**	**Duration of Buzzer**	**LED On?**	**Duration of LED**
36								
63								

Table 1

Exercise-2:

1) (a) Write down the names of different types of modules or cards provided in **Test Room** & **Way Station** equipments and also mention their functions.

S.No.	**In Test Room Equipment**	**In Way station Equipment**	**Function**
1			
2			
3			
4			
5			
6			
7			

Table 2

(b) How many controls circuits can be provided with existing cards.

2) Mention the details of indications & controls available on the front panel of RMT BTMN card.

3) What are the **voltage** and **current ratings** of the **power supply** units provided in Way Station equipment and the Test Room Equipment ?

4) What is the **voltage** and **AH capacity** of the **batteries** provided with both the equipment ?

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EXPERIMENT No. CT -10

Study of Equalizer Amplifier Module

Objective : **In this lab session you will learn** the features of Equalizer Amplifier Card and its TX, RX and Buffer amplifiers' gain measurements.

Equalization

Railway control circuits are working on very long distance cables spanning over a few hundreds of kilometers. The frequency response of these long distance cables is not flat over the entire VF (voice frequency) range. High frequencies are more attenuated than low frequencies, as a result of which the signal levels of higher end frequencies in VF band get reduced. *To correct for or to boost the reduced levels of high frequencies* **Equalization** is used.

Equaliser Amplifier

The function of an equalizer amplifier is to provide **equalization** along with **amplification** of VF frequencies .This amplifier performs the role of a **repeater amplifier** of the conventional system.

Equalizer Amplifier Card / Module

This module or card accommodates **two equalizer amplifiers** one for **trans** direction and another for **receive** direction. Each of these amplifiers is designed to give a max. gain of +20dB and this gain can be varied through DIP switches using an attenuator of 0 -10dB. Each amplifier is a combination of the following circuit sections

- Equalizer

- VF filter
- Attenuator
- Amplifier
- Adder or combiner

In addition to these circuits the equalizer amplifier card also accommodates **two Buffer circuits**. With the help of these **four circuits**, ie., two amplifiers and two buffers, it provides a facility for **4-way connectivity** at every way side station as shown below.

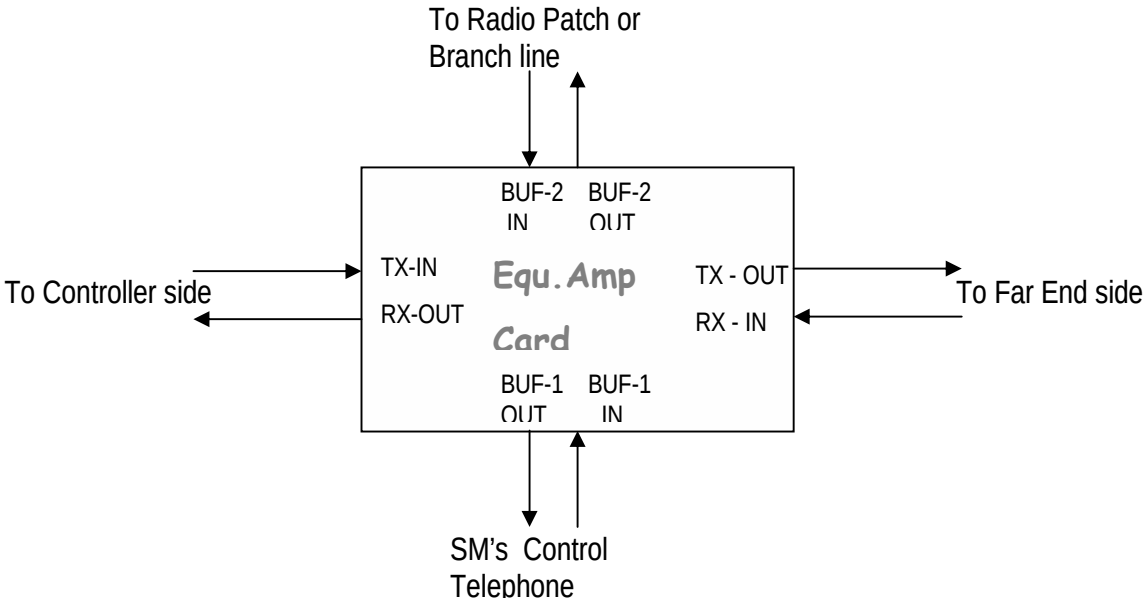


Fig - The 4-way connectivity of an Equalizer Amplifier Card

In conventional type control communication system **Loading** of the quad cable is done, by adding small value of inductors separately on to each limb of quads. Loading compensates for the voice signal level loss at high frequencies. The same benifit is obtained by equalization in the new system of control communication. It means the process of **equalization eliminates the need for loading** the quad cable.

The gain, attenuation and equalization of both trans and receive amplifiers are selected using the following DIP switches.

Gain Setting :

DIP Switch – 3	for adjusting **Receive** gain
DIP Switch – 7	for adjusting **Trans** gain

Attenuation Setting:

DIP Switch – 4	for adjusting **Receive** attenuation
DIP Switch – 8	for adjusting **Trans** attenuation

DIP Switch Settings for Gain & Attenuation of Equaliser Amplifiers

DIP Sw -7 TRANS Gain

(DIP Sw -3 REC Gain)

1	2	Amp Gain
OFF	ON	5dB
ON	ON	10 dB
OFF	OFF	15 dB
ON	OFF	20 dB

DIP Sw - 8 TRANS Attenuation

(DIP Sw - 4 REC Attenuation)

1	2	3	4	Amp Attenuation
ON	ON	ON	ON	0 dB
OFF	ON	ON	ON	1 dB
OFF	OFF	ON	ON	2 dB
OFF	OFF	OFF	ON	3 dB
OFF	OFF	OFF	OFF	4 dB

Equalizer Slope Selection:

DIP Switch – 1 & 2 for adjusting **Receive** slope
DIP Switch – 5 & 6 for adjusting **Trans** slope

Four miniature **relays** are also provided on this card for **bypassing or isolating** the **equipment from the cable** through **remote commands**. These functional details of the relays is as given below.

Relay Name	Bypasses / Isolates	Name of Remote function performed
Relay-1	**Far end cable** from **TX-OUT & RX-IN**	West cut
Relay-2	Buffer-1	Buffer-1 cut
Relay-3	Buffer-2	Buffer-2 cut
Relay-4	**Controller end cable** from **TX-IN & RX-OUT**	East cut

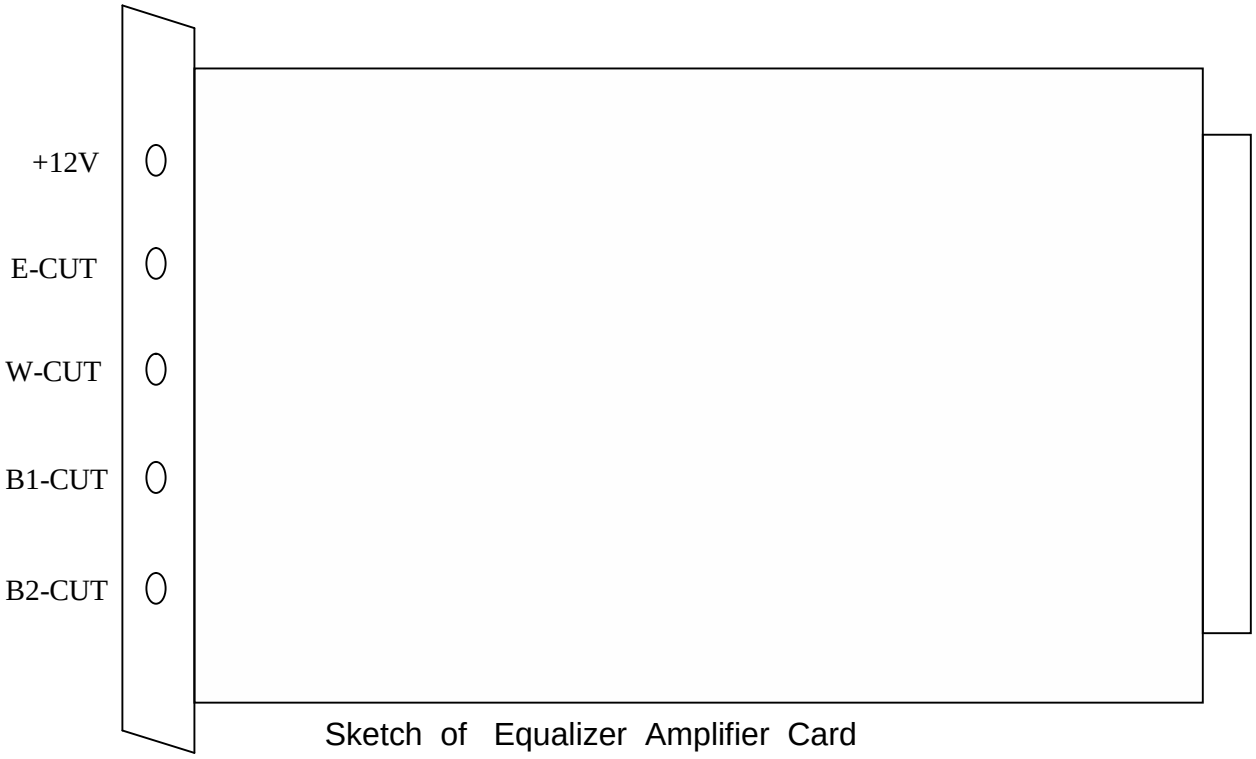
Procedure for Gain Measurements

1) Feed a tone of **800Hz @ -10dB** level from TMS kit at points TX-IN and RX-IN one after the other measure for the output levels at TX-OUT, RX-OUT, BUF1-OUT and BUF2-OUT. Record these in the below table.

800Hz @-10dB fed to	TX-OUT Level	RX-OUT Level	BUF1-OUT Level	BUF2-OUT Level
TX-IN				
RX-IN				

2) Similarly, feed tone at BUF1-IN and BUF2-IN one after the other and measure levels at TX-OUT, RX-OUT, BUF1-OUT and BUF2-OUT and record in the below table.

800Hz @ -10dB fed to	TX-OUT Level	RX-OUT Level	BUF1-OUT Level	BUF2-OUT Level
BUF1-IN				
BUF2-IN				



Sketch of Equalizer Amplifier Card

Exercise:

1. Pull out the equalizer amplifier module from the system Rack
2. Locate different DIP switches on the Equalizer Amplifier Card
3. Show their locations on the card sketch given above.
4. Similarly, search for and identify the four relays provided, and show their relative locations on the card sketch
5. Write the meaning of each visual indication provided on the module.

Review Questions

1) Write in brief what is your conclusion from the above two measurements.
2) What benefits can we get from the 4-way connectivity of Equalizer Amplifier?

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CONTROL LABORATORY

EXPERIMENT NO : CT- 11

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EXPERIMENT No. CT -11

Checking of Equalization Slopes

Objective : **In this lab session you will check for** (or find out) the presently selected equalization slopes for both TX and RX amplifiers on Equalizer Amplifier Card

Procedure:

Follow the given steps to find out the set equalization slopes of both TX and RX amplifiers

1. Checking Equalization Slope for Trans Amplifier

1. Pull out the Equalizer amplifier card from the rack
2. Note down the equalizer switches - SW5 and SW6 - settings existing on the card for Trans amplifier, and record them in the table-1 shown below
3. Similarly, note down the equalizer switches – SW1 and SW2 - settings existing on the card for Receive amplifier, and record them in the table-2 below
4. Reinsert the card into the rack
5. First feed **300 Hz tone at 0 dBm level** to the TX-IN and measure the output level at TX-OUT and record the same in the table-1
6. Then feed 400 Hz at the same level and record its output level in the table
7. Repeat this for all the frequencies shown in the table one after the other
8. With all these output values **plot the slope line** in the graph shown

TRANS Amplifier Slope setting									
DIP switch	**SW6**				**SW5**				
Contact No.	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	
Switch position									
Frequency in Hz	**300**	**400**	**700**	**1000**	**1500**	**2000**	**2500**	**3000**	**3400**
Equalizer output									
Trans Equalizer Slope									

Table-1

2. Checking Equalization Slope for Receive Amplifier

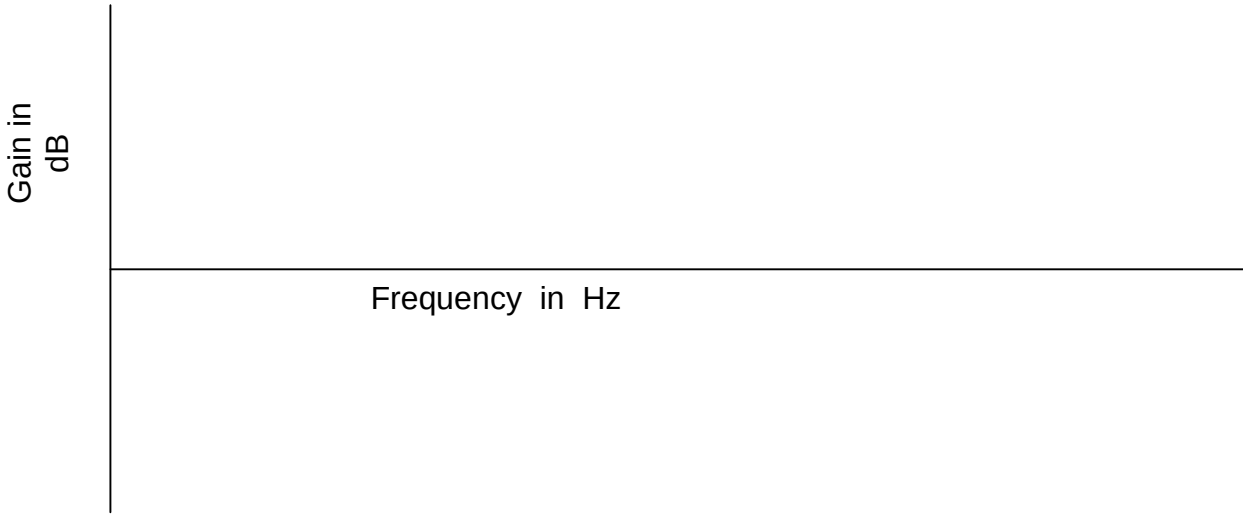
1. First feed 300 Hz tone at 0 dBm level to the RX-IN and measure the output level at RX-OUT and record the same in the table-2
2. Then feed 400 Hz at the same level and record its output level in the table
3. Repeat this for all the frequencies shown in the table-2 one after the other
4. Plot the slope line with these readings for the RX amplifier in the same graph

REC Amplifier Slope setting									
DIP switch	**SW2**				**SW1**				
Contact No.	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	
Switch position									
Frequency in Hz	**300**	**400**	**700**	**1000**	**1500**	**2000**	**2500**	**3000**	**3400**
Equalizer output									
Receive Equalizer Slope									

Table-2

Exercise:

1. Plot equalization **Slope Lines** for both TX and RX amplifiers on this graph



2. What do you understand from slope lines ? Give your comments in brief.

Some Sample Equalizer Slope Settings

DIP Switches	**SW2** (Rec) **/ SW6** (Trans)				**SW1** (Rec) **/ SW6** (Trans)			
Contact numbers	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Sw position	OFF	OFF	OFF	ON	ON	ON	ON	ON

Freq in Hz	**300**	**400**	**700**	**1000**	**1500**	**2000**	**2500**	**3000**	**3400**
Equalizer output	-5.56	-5.07	-3.31	-1.52	1.06	3.13	4.79	6.16	7.09

SLOPE obtained with this switch - setting is **12.65**

Sw position	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF

Freq in Hz	**300**	**400**	**700**	**1000**	**1500**	**2000**	**2500**	**3000**	**3400**
Equalizer output	-8.22	-7.86	-6.56	-5.23	-3.39	-2.08	-1.16	-0.51	-0.12

SLOPE obtained with this switch - setting is **8.09**

Sw position	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF

Freq in Hz	**300**	**400**	**700**	**1000**	**1500**	**2000**	**2500**	**3000**	**3400**
Equalizer output	-6.63	-6.05	-5.34	-4.20	-3.25	-2.54	-2.01	-1.68	-6.63

SLOPE obtained with this switch - setting is **5.09**

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CONTROL LABORATORY

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Instructor Initial:

EXPERIMENT No. CT -12

Remote Monitoring System & Its Functions

Objective : **In this lab session you will learn** the working and features of Remote Monitoring System provided with equalizer type control communication system.

Description:

A Remote monitoring facility is provided with equalizer type of control communication system. This facility offers remote monitoring , controlling and battery management of way station equipments in the entire control section from the control **test room** in the headquarters office. This feature is provided with the help of two types of modules one of which is installed in the test room equipment and the other in every way station equipment. These two cards are

1) **Remote Monitoring - (RMT BTMN) Master card** (at Test Room)
2) **Remote Monitoring - (RMT BTMN) Slave card** (at every way station)

Remote Monitoring Master Card:

This card performs the following functions

1) It **sends remote operation codes** to way stations to perform the following
   - to effect cutting or isolation between cable and the equipment at way stations
   - to change over batteries on load and charge
2) Collects data from way station remote slave cards regarding
   - Load Voltage (voltage of the Battery on load)
   - **Status** of the **three Power Sources** - ie., whether Ac mains voltage present or not and the two batteries voltages are normal or low
   - Receives SOS codes sent by way station in case of supply failures

Remote Monitoring Slave Card:

Every way station equipment is provided with the remote monitoring cum battery management slave card – RMT BTMN slave. Each slave card is identified by its own **2-digit Station-code**, set by DIP switches provided on the card. This code is separate from the 2 digit way station code used by the controller for calling way stations. The slave card performs the following functions on receipt remote commands from master

- Operates relays provided on equalizer amplifier card - REP-CD4 - to effect cutting or isolation
- Collects load voltage and sends to master
- Collects power supplies status and sends to master
- Also sends SOS signals in case of supply failures

The **master card** is provided **in the test room equipment**. It sends **control commands** to any way station **slave unit** to perform the following operations at that way station

- To **cut** or **disconnect** the line and the equipment
- To restore or **reconnect** the disconnected line
- To **change over** of batteries
- To read the **power supply voltage** to the equipment
- To know the **status** of the mains supply and the two battery supplies
- To send a tone
- And to **reset** all remote control cards

All these operations can be performed on any of the control circuits given below

- Section control
- Emergency control
- 3rd or 4th control

Remote Commands

The master card employs **4 digit Remote Codes** for performing the above operations. The remote code pattern is

C O R R

C - First digit – represents the **control** circuit on which the operations are performed. This digit is either A, B or C to represent

A - Section control
B - Emergency control and
C - 3rd or 4th control

O - 2nd digit – indicates the **operation** or function to be performed. To perform different remote functions at way stations different digits are used. These are as given below

0 - Reset all Remote Slave Cards

1 - East side (or controller side) cut between cable and equipment
2 - West side (or far side) cut or isolation of cable and equipment
3 - Buffer 1 cut or isolation
4 - Buffer 2 cut or isolation
5 - Remote change over of battery at way station
6 - Reconnect or normalize all
7 - send power supply voltage
8 - send the Status of power supplies at the way station.

On receipt of the remote code to get **power supply status** at a way station, its slave card sends to the test room equipment (to master card) a 3 digit information, representing the present power supply status at that way station, in the format given below

M B_1 B_2

M – Mains voltage
B_1 – 1st Battery voltage
B_2 – 2nd Battery voltage

If , M = 1 means - Mains voltage present, or if
= 0 means - Mains voltage not present

B_1, B_2 = 1 Normal battery voltage, if
= 0 Low battery voltage

Example: If received data is 0 1 1 then it tells **mains supply is not available** and **battery voltages are normal**

R R – **3rd &4th digits** - represent the **2-digit Remote Code** of **a way station** set in the **remote slave card** of that way station

Example: A **remote command** to be sent for knowing **power supply voltage** at a station with a remote code 45 is **A745**

Exercise-1

1. Press RS button in the Test Room equipment
2. Send the remote command **A 0 RR** to a way station
3. Send all the remote codes to any way station as given in the below table, one by one and observe the effect. Note down your observations in the table-1.

S.No	Remote Command sent	Remote Operation performed
1	A1 RR	
2	A2 RR	
3	A0 RR	
4	A3 RR	
5	A4 RR	
6	A6 RR	
7	A7 RR	
8	A5 RR	
9	A7 RR	
10	A8 RR	
11	A9 RR	

Table-1

SOS Codes

In case of a **Power Supply Failure** at any way station the remote monitoring slave card of that station sends SOS codes to the Test Room Equipment. These SOS codes are in a format of **N RR**. In this N = 1/2/3/4 and RR is way station remote code.

If	N	= 1	indicates	both batteries low (<11.3V)
		= 2	means	battery fuse failed
		= 3	means	PSU1 fail or AC fuse fail
		= 4	means	PSU2 fail or AC fuse fail

These codes can be verified by manually creating a supply failure at a way station. Follow the procedure given below

Exercise- 2

1. Switch off AC mains at way station and observe the effect
2. Record the SOS code received at Test room
3. Remove fuse of one power supply unit (PSU1 or 2) at the way station and observe the SOS code received and record it in table-2.

S.No	Fault simulated at way station	SOS code received
1	AC mains Switched Off	
2	Battery fuse removed	
3	Power supply 1 fuse removed	
4	Power supply 2 fuse removed	

Table-2

Review Questions

1) What is the difference between a Remote Command code and a SOS code?
2) Do you think the remote cards of way station equipment are interchangeable?
3) Can the Remote Master and Slave cards be interchanged?

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EXPERIMENT No. CT -13

Study of Gf400 System

Gf400 System

Gf400 system (M/s Marvel make) is designed as per the RDSO specifications No. RDSO/SPN/66/2007 for CCEO, **Control Communication Equipment for OFC,** which is meant for providing an omnibus control circuit for communication between the Control Office and way side stations, utilizing one speech channel from OFC network. Gf400 consists of the following categories of equipment.

1. Headquarters Equipment

The Headquarters equipment has two main units –

(a) Control Room Equipment – CRE - Module No. Gf466.

(b) Test Room Equipment – TRE - Module No. Gf464.

2. Way Station Equipment

It consists of the following two modules

(a) MTWE – Multi Telephone Way station Equipment - Module No. Gf446.

(b) 2-wire Control Telephones with dialing facility (TDCT)

3. Additional Equipment

(a) TWA - Three Way Amplifier - Module No. Gf432.

(b) RPE - Remote Patching Equipment - Module No. Gf463

Control Room Equipment (CRE) :

It is a desktop model unit. It is provided with the **Controller** for **speech communication** with **way stations** as well as with **local telephones** in the headquarters office, extended from Test Room Equipment. It is identified by the TRE as **DEC** (Desktop Equipment for Controller) and its number for dialing is **99.** The CRE front panel consists of the following keys –

1) 40 push button key pad - for calling the Way Stations
2) 10 Numeric keys - for local telephones calling and
3) Special function keys -
    a) **Shift -** facilitates to call another set of 40 way stations and 10 local telephones.
    b) **Program -** used to assign (program) way station codes to each of the 40 keys so that every way station can be called only with **single key** press.
    c) **LT cut -** used to disconnect a local telephone temporarily.
    d) **General -** used to give general call to all way stations.

Exercise-1 : (i) Press each of the 40 keys and observe the assigned way station codes on the display. Also identify telephone numbers of the way station phones available. (ii) Next try the 10 numeric keys. Repeat (i) and (II) in combination with **Shift** key. Mention what can be the total way station calling capacity of CRE.

Test Room Equipment (TRE):

It is the main equipment in the system and performs the role of overall controller of the system. The Test Room Equipment consists of the following two units:

1. **Control Unit & Line Interfacing (Gf464):** As the name indicates it has two functions. One as **Central Controller** for the total system which is used to control the connectivity with all other units in the system and also to change gain settings. Control unit can be called by dialing **98**. The other function is **Line Interface**. There are three types of line interfaces -
    i. **Two 4wire Control Circuit interfaces** – one is connected to a VF channel on 30-channel MUX for working of control and the other is used for radio patching arrangement through Patching Equipment (Refer Fig.13.2 below).

ii. **8-line interface** with CRE
iii. **20-pair line interface** with Local telephones.

- It is provided with a **handset**, **loud speaker** with **volume control**, a **keypad** and an **LCD display** to facilitate calling, monitoring and controlling operations.
- Two LED bar indicators to show trans and receive levels.

2. **Local Telephone Interface Unit- LTI (Gf468):** It facilitates to connect 20 local telephones (normal auto telephones) on 2-wire lines up to 2km distance using even 0.6mm dia cable.
   i. These Local Telephones are **not provided with dialing facility**.
   ii. The **controller** and the **test room** can call these LTs but the way stations cannot.

Exercise-2 : Call local telephones from TRE and CRE. Similarly try to call TRE or CRE from any one of local telephones and record your observations below.

Way Station Equipment (MTWE) :

It is known as multi telephone way station equipment **(MTWE)**

- It gives facility to connect FOUR control telephones on one control circuit. (see Fig.13.1)
- These are auto telephones with dialing facility to call other way station telephones.

Three Way Amplifier (TWA):

TWA facilitates the connection of one more MTWE for use at a way station when more than four telephones are needed at that station and also the TWA facilitates connection with Remote Patching Equipment (RPE) at way stations. The Figures 13.1 & 13.2 show these two instances of the **three way amplifier** usage.

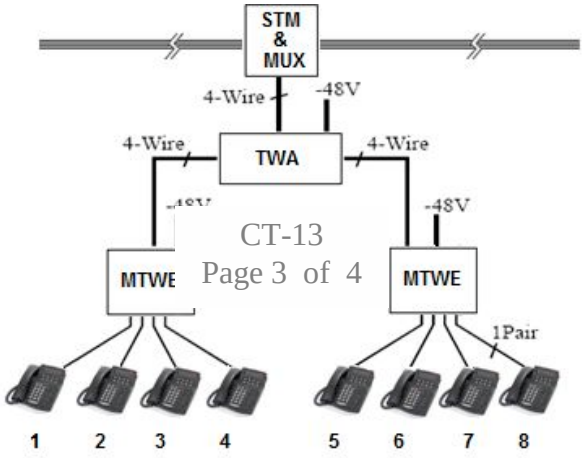

Fig.13.1 - Using TWA for Connecting One More Way Station Equipment

Exercise-3: Interchange the directions (3-ways) of connectivity on TWA and record the effect on its working.

Remote Patching Equipment or Unit (RPE/RPU): This unit is used to provide patching facility with an alternative system of communication like a **Microwave** link or a **BSNL** network or any other compatible system in case of disconnection or damage to the OFC. Every RPE in the system has an identification number between 1- 9. The TRE uses these ID numbers while switching paths through RPEs.

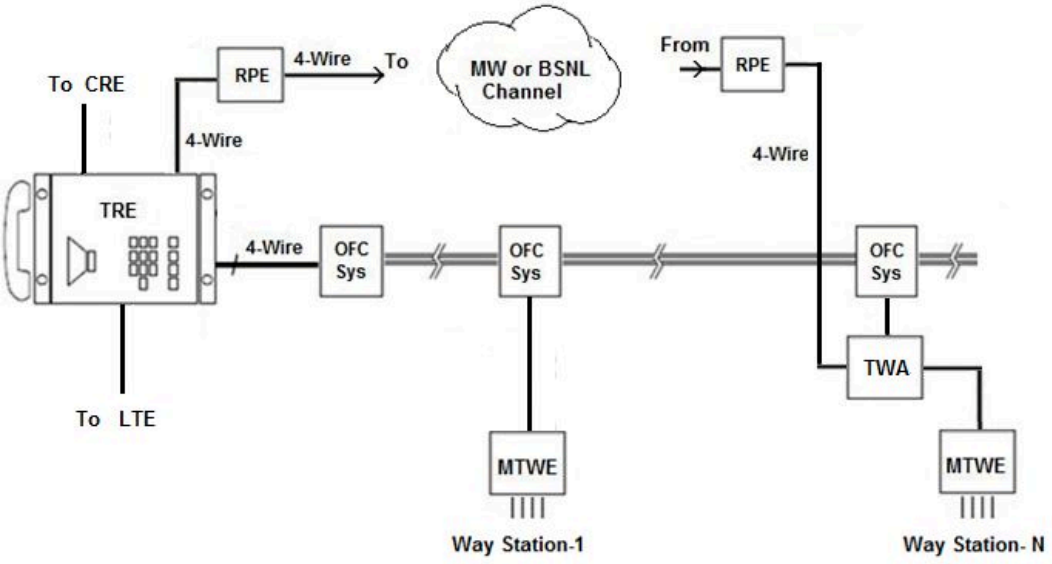

Fig. 13.2 - Patching Arrangement Through Remote Patching Equipment

Exercise-4:

1) Study and draw in the space given below the connection scheme of RPE in the lab system. Then perform the following exercises.

2) From TRE keypad try to **make** and **break** the path through RPU.
3) Give ring to way station phones connected in the path extended by the RPU.
4) Try to call the same way stations after disconnecting the RPU path.
5) Call from CRE and TRE all the way stations in both conditions of RPU.
6) Record your observations and comments below.

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Name : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

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EXPERIMENT No. CT -14

Configuration of Gf400 System

Introduction

After installation of Gf400 system all its units except TWA are needed to be configured (programmed) first by selecting different parameter values before using the system for control communication. The individual units in the system are using circuitry based on 8051 microcontroller. Let us see how to configure each unit of the system.

SYSTEM CONFIGURATION

1. Way Station Equipment (MTWE) Configuration

Following is the procedure for configuring the way station equipment, MTWE.

Procedure:

1. Switch off power to MTWE by power switch.
2. Insert a **thin screw driver** or rod into the small hole -**Prog**- provided above the display, keep the **Program button** inside the hole pressed and then switch on power.
3. Letters **PrG** appear on the display. Now it is possible to configure MTWE for all its parameters settings as well as to view existing settings.
4. For this purpose the 1st control telephone connected to ST1 line on MTWE can only be used.
5. Pressing digits on ST1 Control Telephone keypad in the sequence shown in the Table 2.1, way station equipment parameters can be either **viewed** or **set**.

a) Procedure to View or Set MTWE Parameters

SNo	To View or Set	Digits to be dialed from ST1 Telephone						Options
		To View (starting 5, 2)						
		To Set (starting 5, 1)						
1	Tx gain	5	2/1	0	1	0	0/1/2	Low / Normal / High
2	Rx gain	5	2/1	0	2	0	0/1/2	Low / Normal / High
3	DTMF Tx gain	5	2/1	0	3	0	0/1/2	Low / Normal / High
4	DTMF Rx gain	5	2/1	0	4	0	0/1/2	Low / Normal / High
5	Load Default Settings*	5	2/1	0	5	0	0	Sets Normal gain, 4 min timeout, no dialing, .. etc.
6	Handset Timeout	5	2/1	1/2/3/4	0	0	1/2/3	4 min/ 8 min / infinite
7	Way station Telephone Number	5	2/1	1/2/3/4	1	0-9	0-9	1/2/3/4 to represent ST1- 4 0-9 to enter telephone no.
8	Way station Group Code	5	2/1	1/2/3/4	2	0	1-9	1/2/3/4 to represent ST1- 4 1-9 to enter Group Code no.
9	Ring Pattern	5	2/1	1/2/3/4	3	0	1-4	1-4 for ring pattern
10	Ring Duration	5	2/1	1/2/3/4	4	0	0-9	Duration can be set 10-225s
11	Dialing Permission	5	2/1	1/2/3/4	5	0	0/1/2	To dial: **Nil / 4/ All** phones

Table-2.1

b) Default Settings For Way Station Equipment

The following table shows the default settings that are loaded to a way station equipment when it is programmed with **'Load default Settings'** option.

SNo	***Parameter***	****Default Settings Loaded***				***Default Value***
1	*All Tx & Rx gains*	*1*				*Normal Gain (0dB)*
		ST 1	***ST 2***	***ST 3***	***ST 4***	
5	*Handset Timeout*	*1*	*1*	*1*	*1*	*4 Minute Duration*
6	*Way station Telephone Number*	*12*	*13*	*14*	*15*	*WS codes- 12,13,14 & 15*
7	*Way station Group Code*	*1*	*1*	*1*	*1*	*group code -11 for all 4*
8	*Ring Pattern*	*1*	*2*	*3*	*4*	*4 different ring sounds*
9	*Ring Duration*	*0*	*0*	*0*	*0*	*10 sec*
10	*Dialing Permission*	*0*	*0*	*0*	*0*	*No dialing facility*

Table-2.2

Exercise-1:

1. Assign telephone numbers C31 and D71 to control telephones connected to ST1 and ST2 of first MTWE.
2. Call these numbers from TRE. Record your observation.

2. CRE- Control Room Equipment Configuration

This process involves assigning way station codes to each of 40 keys on CRE front panel using the following procedure.

Procedure:

1) Switch off CRE by **Turning Off** its power switch.

2) **Press** and **hold PROGRAM** button and then **Turn On Power** to CRE again.

3) Letters **' PrG'** appear on the display indicating the **Program mode** of CRE

4) Release **PROGRAM** push button.

5) With **Mic** button, select **C** for DTMF type code

(NOTE: Type of codes possible: C-Classic means **DTMF; d- DASSFO; CG-DTMF group code; dG- DASSFO group code)**

6) Next select code 31 by pressing numeral keys.

7) Then press **PROGRAM** push button.

8) Three beeps are heard. Before the beeps stop, press the first key of the 40 keys.

9) A long beep is heard indicating successful programming of the key.

10) By this process, the way station code 31 is assigned to 1st key of 40 keys.

11) Now using **Mic** button select **d** for DASSFO type code.

12) Then enter code 71 using numeral keys.

13) Press in sequence, keys **Program**, **Shift** and then the same 1st key of the 40 keys.

14) With this way station codes C31 and D71 are assigned to the first key.

(NOTE: Each key of 40 keys can be programmed for any two types of codes only)

15) Switch off CRE and then switch it on without pressing **Program** button.

16) Now press 1st key and observe code on the display; it should be **C.31**.

17) Press **Shift** then 1st key and observe on the display; it should be **d.71**

18) Like this each of the 40 buttons can be programmed for two different way station codes.

Exercise-2:

1. Using the 1st button on CRE keypad call telephone numbers C31 and D71 and observe whether the way station phones ring. Record your observation.

3. TRE- Test Room Equipment Configuration

Unlike CRE and MTWE, there is no separate programming mode for TRE. Instead, it can be used in normal working mode itself to view, as well as to set configuration of different line interfaces and parameters. These are - Line ***make*** *or* ***break***, adjust- ***Tx & Rx level*** and ***Ring Duration***, ***Switch*** RPEs, ***Read*** *or* ***Load*** CRE configuration etc.

Procedure:

To carry out the above mentioned functions, follow the menu sequences shown below through TRE keypad.

1. ↵ → **SETTING** → **TOOLS** → **VIEW** / EDIT →

LINE A	■	DEC	■
LINE B	□	LT	■
DTMF DASSFO	■	HS	■
DTMF CLASSIC	■	LS	■

■ Indicates ‘’ Line is **Through**”

□ Indicates “ Line is **Cut ”**

2. ↵ → **SETTING** → **TOOLS** → **VIEW** / **EDIT** → **LINE A** →

a) LINE A (LINE B/ DEC / LT/ CLASSIC / DASSFO)
Tx LEVEL
Rx LEVEL

b) LINE A (LINE B / DEC / LT/ CLASSIC / DASSFO/ HS / LS)

MAKE
BREAK

c) RING DURATION
d) DEC SETTINGS - READ /LOAD DEC

3. ↵ → **SETTING** → **REMOTE OPERATION** → **MAKE BREAK STATUS**

Exercise-3:

1. Verify present status of different line interfaces on TRE and record it below.
2. Verify and mention what are the other functions that can be performed from TRE.

3. Read the present status of RPE and switch it to **Through** state. Call way stations in the path connected through RPE. Also try to call them keeping RPE in **Cut** state.