

**DRAFT SPECIFICATION
FOR
VOICE FREQUENCY COMMUNICATION SYSTEM
FOR UNDERGROUND QUAD CABLE**

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Abstract This document specifies technical specifications of Voice Frequency Communication System for Underground Quad Cable.		

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ABBREVIATIONS:

1	CACT	Component Approval Centre Telecommunication
2	dB	Decibel
3	DC	Direct Current
4	DIP	Dual Inline Package
5	DTMF	Dual Tone Multi Frequency
6	EC	Emergency Control Circuit
7	FAD	Frequency Attenuation Distortion
8	Hz	Hertz
9	IC	Integrated Circuit
10	IR	Insulation Resistance
11	IRS	Indian Railway Specification
12	IS	Indian Standards
13	KHz	Kilo Hertz
14	Km.	Kilometre
15	LCD	Liquid Crystal Display
16	LCSO	Electronic Components Standardization Organization
17	LD	Lightning Discharger
18	LED	Light Emitting Diode
19	MOV	Metal Oxide Varistor
20	PCB	Printed Circuit Board
21	PET	Polyethylene
22	PIJF	Polyethylene Insulated Jelly Filled
23	PSU	Power Supply Unit
24	RH	Relative Humidity
25	RMS	Root Mean Square
26	Rx.	Receive
27	S/N Ratio	Signal to Noise Ratio
28	SPN	Specification
29	SMPS	Switch Mode Power Supply
30	TC	Telecom
31	Tx	Trans
32	VF	Voice Frequency

SECTION-1

GENERAL

1.0. Introduction:

This document covers the technical requirements, constructional features, electrical characteristics, and provisions of tests & inspection of Voice Frequency Communication System for Underground Quad Cable for use over Indian Railways and is issued under the serial No. **RDSO/SPN/34/2002**.

1.1. This specification requires reference to the following Indian Railway Standards/Indian Standards/Joint Services Standards specifications -

- IRS:S-23 Electrical Signalling and Interlocking equipment.
- IRS: TC 38-97 4 Wire Way Station Control Telephone.
- IRS: TC 60 /93 4Wire/2Wire Train Traffic Control Equipment with DTMF Signalling.
- IRS: TC 61 /93 Emergency Control Room Equipment.
- IS: 9000(Series) Basic environmental testing procedures for electronic and electrical items.

GR/TEL-02/04.SEP 2002

Electronic Telephone Equipment, issued by
Telecommunication Engineering Centre. New Delhi

Wherever in this specification any of the above mentioned specification is referred, it shall refer to the latest issue of the specification, otherwise, the particular year of the issue has to be taken as reference.

1.2. This specification is intended chiefly to cover the technical provisions and does not include all the necessary provisions of a contract.

1.3. Terminology

1.3.1. For the purpose of this specification, terminology as given in **IRS: S- 23** shall be applicable.

1.3.2. The terms referred to in the specification but not covered in **IRS:S-23** are defined below.

1.3.2.1. **Lot:** A lot is constituted by Voice Frequency Communication System for Underground Quad Cable of the same type manufactured in the same factory during the same period using the same process and materials.

1.4. Brief System Description

Here the function of principle system components is briefly described, to provide a general idea of their working. For a comprehensive understanding the detailed description of each of the system components (and its sub-components) and optional components may be refer to.

1.4.1 Principle System Components

The control communication system has three principle system components:

- 1) Control Room Equipment
- 2) Test Room Equipment
- 3) Way station Equipment

These are powered by a power supply system with double power supply configuration with battery back-up.

1.4.1.1 A short description of these three important system components and power supply system is given below.

1) Control Room Equipment :

The Control Room equipment is a table top equipment used by the controller. This has a microphone, loudspeaker, handset, alphanumeric keyboard and display. This is used by the controller to call the station by dialling a two/three digit number. The controller is able to converse on the control circuit with the help of the microphone and loudspeaker or he may use the handset to do so. The power to run this equipment is provided by Test Room. The Control Room equipment is connected to the Test Room equipment on 2 pairs of telecom wires for Trans and Receive signals. The Control Room equipment caters to only one control circuit.

2) Test Room Equipment :

The Test Room Equipment is a 19” rack mountable equipment used by the Test Room staff. This equipment functions as an interface for Control Room equipment and Way station Equipment. It has a control panel for remote measurements of way station equipment’s vital parameters and for control actions through remote commands and for occasional calling of way stations. A handset and a monitor speaker is available on this equipment for the staff to use when they wish to converse on line. A LCD/LED display to show the status and action in progress is also provided. The Test Room equipment caters to 4 control circuits viz. Section control, Dy. Control, S&T control and Emergency Control or as decided by Railway.

3) Way station Equipment :

The equipment at the way station is designed to cater to four control circuits. The equipment amplifies and equalizes the VF signal in either direction, and also distributes it for local use. It also provides the VF signal for Reverse/Mid patching purpose. All this is done with the help of a multiway amplifier which provides equal signal distribution with impedance isolation characteristic. The VF signal is locally used by the DTMF decoder, station telephones and local telephones (intercom). The station telephones are 4 Wire control telephone to Spec No. IRS: TC 38-97 or modified version of it with in-built decoder or even standard 2 wire auto telephone. It also has an Intercom Equipment. The Intercom Equipment caters to eight Local Telephones. The telephone instrument used as Local Telephone is a desk

type instrument working on two wire and conform to TEC standards. These telephones are installed within the station vicinity. The Intercom equipment is nominated to a control circuit, on which the Local Telephone will gain accesses. The nomination of this equipment to a particular control circuit is optional, so is the facility to gain access to it. The Way station Rack has only one such equipment. Control Room Equipment has facility to call these Local Telephones.

Power Supply System :

The power supply system of the Way station Equipment and Test Room Equipment works on mains supply with a battery backup in 100% standby mode. The option of solar power is also available.

1.4.2 Facilities available with the various equipments:

1.4.2.1 The under mentioned facilities are available on a particular control circuit :-

- a) Controller can call any Station Telephone by dialling a 2 digit Station Code number.
- b) Controller can call a Group of Station Telephones by dialling a Group number.
- c) Controller can call any Local Telephone by dialling a 3 digit number.
- d) Test room can call any Station Telephone or any Local Telephone.
- e) Where option of auto telephone as Station Telephone is exercised the Station Telephone can call any other Station Telephone by dialling a 2 digit number. Facility is also provided to bar the Station Telephone from calling other Station Telephones.
- f) Where option of auto telephone as Station Telephone is exercised the Station Telephone, its trans output is isolated from control circuit after a pre-determine time of lifting the hand-set in order to prevent unwanted local sound to enter into control circuit. This can be restored by tapping cradle switch. In other options this feature is achieved through PTT switch.
- g) Local Telephone can call any other Local Telephone within the station group of 8 telephones.
- h) Local Telephone can patch, by dialling a code, on to the assigned control circuit. Facility is provided to bar any particular Local Telephone from patching onto a control circuit.
- i) In addition to the calling facilities described above, certain line plant alteration commands and remote maintenance features is also provided as described at appropriate places.

SECTION- 2

GENERAL REQUIREMENTS

2.0. SCOPE

- 2.1. This section covers the general requirements of Voice Frequency Communication System at way stations & Test room over Underground Quad Cable in all type of territories.
- 2.2. The control circuit shall normally work on underground PET Quad cable of 0.9mm diameter with characteristic impedance of 470 Ohms as per spec. no. IRS-TC-30/05, which may be referred for other parameters such as frequency response, FAD, impedance variation with respect to frequency of signal etc. It shall also work on similar type of cables with slightly varying parameters with adjusted performance.
- 2.3. The PET Quad will not be loaded and to compensate uneven attenuation over voice frequency band, every station will be provided with Voice Frequency Communication Equipment to provide communication at that station and to equalize the losses in the VF range.
- 2.4. If required, balancing of various quads will be carried out at every station by providing suitable condensers on control end only.
- 2.5. It shall be possible to avail the facility of end patching or mid patching from underground quad cable media to radio /other communication system for normal control working or working in case of failure without reversing the direction of amplifiers. This shall be applicable to all control circuits including Emergency Control circuit. The Emergency Control circuit shall also work from Emergency Sockets provided at every Kilometre in the block sections in case of end patching or mid patching. If required the Emergency Control Circuit cards may be different or additional card may be used to achieve this and in such case these cards should be marked in distinguishable manner.
 - 2.5.1. There shall be a provision to automatically isolate the local circuit if any card pertaining to that circuit of the system is taken out and in case of failure of power supply at a station that station shall be automatically bypassed. The system should automatically restore if the card / power supply is restored.
 - 2.5.2. The reference signal shall be 0 dBm at 1 kHz unless stated otherwise for all tests, configurations and measurements.
 - 2.5.3. The features desired by the railways to be incorporated in future versions of specifications are given in Annexure V. Manufacturers are advised to take up development of the same to keep abreast with the latest specifications.

2.6. SYSTEM CONFIGURATION

- 2.6.1. The Test Room Equipment and Way Station Equipment shall consist of -
 - (i) Power Supply Unit/Module/Card, and
 - (ii) The following assemblies -
 - a) Cable termination, distribution & monitoring panel.
 - b) U Link panel

- c) KRONE termination
- d) Equalizer Amplifier and VF transformer panel.
- e) Decoder card panel.
- f) Remote monitoring & management panel.

Alternatively some of the above functions may be combined onto one card.

OR

- g) A Single PCB can be used per Quad for each control circuit.

2.6.2. Emergency Socket: - One emergency socket shall be provided on equipment connecting the emergency circuit (EC) through one buffer amplifier for communication from Station to Control office during emergency.

2.6.3. Phantom Circuit- 2 phantom circuits derived from emergency circuit pairs shall be terminated on the equipment at appropriate places and labelled 'PHANTOM CKT CONTROL END' and 'PHANTOM CKT FAR END'. A magneto telephone when connected to these terminals shall facilitate communication with maintenance staff at emergency socket equipped with phantom terminals and magneto telephone connected to these phantom terminals or to the adjacent station equipped with similar equipment.

2.6.4. Monitoring Loud Speaker shall be provided at a convenient location.

2.6.5. U LINK PANEL -

2.6.5.1. Two rows of U links of adequate size & nos. shall be used to facilitate isolation, measurement, monitoring and patching the arrangement shall be as per Annexure VI.

2.6.5.2. U links shall be of good quality and shall be of reputed make.

2.6.6. KRONE terminal arrangement

2.6.6.1 KRONE terminal arrangement shall be used for terminating underground cable quads and telephone and radio patch lead cable pairs and providing connection of these to the equipment through U link panel.

2.7. LAYOUT AND TECHNICAL REQUIREMENTS OF THE EQUIPMENT: -

2.7.1. Unless otherwise specified, all exposed surfaces /parts shall be plated, painted and protected from corrosion.

2.7.2. The general requirements of workmanship, limits, fits and rejections shall be in accordance with IRS: S-23 to the extent applicable.

2.7.3. The connectors and vital components used shall be LCSO/CACT approved as far as possible otherwise industrial grade component from reputed sources shall be used as per manufacturer's discretion.

2.7.4. The complete system shall be housed in a standard 19' rack with maximum height of 1000mm. Cabinet shall be made of Mild Steel sheet/ Aluminium Alloy having minimum thickness of 1.2mm in case of MS

sheet and minimum thickness of 1.6mm in case of Aluminium Alloy sheet.

The strength of cabinet shall be adequate to bear the load of fully housed equipments inside it with a safety factor of at least 2.5. It shall be of such a design that all the equipments /cards are easily accessible for maintenance and operation purposes.

2.7.5. The cabinet shall be wall mounting type or floor mounting type as specified by the purchaser.

2.7.6. If wall mounting type –

2.7.6.1 It shall be mounted on a steel frame grouted on the wall.

2.7.6.2 It shall be capable of swinging 90° horizontally on the frame in case rear panel/door has to be opened for maintenance purpose.

2.7.6.3 The wall-mounting frame shall be made of MS flats/angles of suitable size to carry load of the equipment and shall be powder coated.

2.7.6.4 Rack shall be provided with suitable bolting arrangement over the frame for resting in normal position.

2.7.6.5 Rack & frame combination shall be so designed to avoid any ingress of water due to seepage from the wall.

2.7.7 If floor mounting type, the clearance of the lowest shelf of the cabinet from floor level shall be minimum 450mm. Alternatively a suitable MS stand with durable plastic / rubber pads on legs shall be provided for the cabinet. This space may be utilised to keep batteries in separate housing.

2.7.8 The doors shall be dust proof. The front door shall be provided with a window covered with a clear polycarbonate sheet /toughened glass to see indications provided on the panel without need of opening the front panel.

2.7.9 The front door shall be provided with knurled screw Bakelite knob of suitable size at top and bottom of one side of panel for easy opening. The other side shall be provided with hinges, unless the door panel has to be fully separated from the cabinet when open.

2.7.10 The cable entry holes shall be provided on the top or bottom of rack with rubber grommet or other suitable protection against entry of rodents/reptiles/insects.

2.7.11 For power supply and battery wiring, PVC insulated multi-strand wires of suitable size to withstand the load requirement of the equipment shall be used.

2.7.12 PCBs shall be made of fire-retardant gloss epoxy and coated with epoxy base anti-fungal varnish to provide protection against dust, humidity and mechanical abuse. The gloss epoxy PCBs of 1.6mm minimum thickness with tolerance of +/-0.1mm shall be used.

2.7.13 PCB shall be fitted with suitable good quality connector and female part shall be used in the motherboard.

2.7.14 In order to reduce wiring inside the rack, all cards shall be provided on motherboard and it shall be possible to plug PCB in the desired slots to achieve the configuration at any station.

2.7.15 Suitable arrangements shall be made to prevent insertion of wrong cards in the motherboard.

2.7.16 All wiring on the PCB cards shall be from the back side for the ease of maintenance

2.7.17 Electro-mechanical relays, if used in the circuits shall be of sealed type.

2.7.18 Preferably I.C. technology shall be used which has got all advantages like high reliability, compactness, low power consumption and easy maintenance.

2.7.19 All cards / PCBs shall be subjected to Burn-in test for 72 hours at 50°C prior to being used in manufacturing and manufacturer shall keep records of this quality check to be produced on demand.

2.7.20 All the equipments shall be in a pre-wired rack to minimize the installation and maintenance time and to increase reliability of the system.

2.7.21 Components used from sources other than those mentioned in this specification, if any, have to be from a reputed manufacturer and these sources shall have to be got approved from RDSO at the time of type approval.

2.7.22 Lock & Key Arrangement: - Lock & Key arrangement shall be provided on the front door of the equipment, different for Test Room and way station. The locks must have duplicate keys.

2.7.23 Sealing Arrangement: - Arrangement for sealing by railway official with spiral sealing wire and sealing tablet as per railway practice should be provided on all openings other than the front door.

2.7.24 Use of potentiometers or other analogue trimming devices including methods of setting that cannot be selected in steps are not acceptable except for such factory settings, which need not be changed in field for any purpose. The settings should relate to circuit/section length or should be in dB and details of the same should be displayed within the equipment at a convenient location.

2.7.25 Equipment must be so pre-wired that no inside wiring or soldering at site shall be required except for balancing capacitors.

2.8. EARTHING:-

2.8.1 All non-current carrying metal parts shall be bonded together and earthed. An earth terminal of suitable conspicuous size shall be provided with facility to connect with installation earth and clearly marked.

2.9. MARKING AND LABELING: -

- 2.9.1. Each electrical component should be easily possible to locate on the PCB by the layout/circuit drawings. Main components may be marked as a block in the layout/circuit diagram.
- 2.9.2. Fuse holder identification shall include details of the fuse rating and type. In case of fuses on PCBs, the rating shall be either on the fuse or on PCB.
- 2.9.3. A cabling diagram, screen printed or any other better arrangement ensuring better life expectancy shall be placed in the inside of the front door or any other convenient place for ready reference of the maintenance staff.
- 2.9.4. Procedure for adjustment of main parameters (required to be adjusted in the field) shall be displayed (by printing or by other means with better life expectancy) at a convenient location inside the equipment for ready reference of maintenance staff.

2.10. VISUAL EXAMINATION: -

- 2.10.1. The 4 Wire VF repeater station equipment shall be visually inspected for checking conformity with the requirements of the Clause 2.6 to 2.9, Clause 2.15 to Clause 2.17, clause 3.1 and clause 4.0 of the specification.

2.11. PERFORMANCE TESTS: -

These tests shall be done with output ports terminated at 470 ohm resistance.

2.11.1. Performance Tests for circuits other than Emergency control circuit

- 2.11.1.1 A signal of 0 dBm, 1 KHz is fed to the buffer input from link panel and output at Trans. output, Receive output and at other buffer output shall be measured. It shall be $0 \text{ dBm} \pm 1 \text{ dBm}$.
- 2.11.1.2 A signal of - 10dBm at 1 KHz is fed to Amplifier/ Equaliser Trans input from link panel and levels at trans output and at buffer outputs shall be measured which shall match with each other within $\pm 1 \text{ dBm}$. The same test shall be repeated with receive circuit.

2.11.2. Performance Tests for Emergency control circuit

The gain of the Amplifier/ Equaliser shall be set to 10 dB by feeding a signal of - 10dBm at 1 KHz to Trans input from link panel and adjusting gain so that levels at Trans output becomes 0 dBm. Similarly Receive side shall be adjusted. Keeping this gain fixed following tests shall be carried out.

- 2.11.2.1 A signal of - 10dBm at 1 KHz is fed to Amplifier/ Equaliser Receive output port from link panel and levels at trans output and at Radio Patch buffer output (and Telephone end buffer output if used) shall be measured. It shall be $-5 \text{ dBm} \pm 2 \text{ dBm}$. At all other input and output ports the measured level shall be less than -60 dBm.

2.11.2.2 A signal of - 10dBm at 1 KHz is fed to Amplifier/ Equaliser Receive input port from link panel and levels at Receive output, Trans input and at Radio Patch buffer output (and Telephone end buffer output if used) shall be measured. It shall be 0 dBm \pm 2 dBm. At all other input and output ports the measured level shall be less than -60 dBm.

2.11.2.3 A signal of 0 dBm at 1 KHz is fed to Amplifier/ Equaliser Radio Patch input port (and Telephone end buffer input port if used) from link panel and levels at Receive output, Trans input and at Trans output shall be measured. It shall be 0 dBm \pm 2 dBm. At all other input and output ports the measured level shall be less than -60 dBm.

2.11.2.4 A signal of - 10dBm at 1 KHz is fed to Amplifier/ Equaliser Trans input from link panel and levels at Trans output and at Radio Patch buffer output (and Telephone end buffer output if used) shall be measured which shall match with each other within \pm 2 dBm.

2.12. APPLIED HIGH VOLTAGE TEST: -

The 4W V.F. repeater station equipment shall withstand without any damage a test voltage of 1 KV AC RMS, 50 Hz when applied between the body and all current carrying terminals at distribution panel looped together with all U links removed for a period of one minute. No breakdown or abnormal temperature rise shall occur.

2.13. INSULATION RESISTANCE TEST: -

The insulation resistance measured with 100V DC between body and all current carrying terminals looped together shall be as per table given below -

Value of Insulation Resistance at different temperature and relative humidity

R.H.	25° C	30° C	35° C	40° C
60%	>100 Mega Ohms	>100 Mega Ohms	>100 Mega Ohms	>100 Mega Ohms
65%	100"	90"	85 "	80"
70%	80"	70"	65 "	60"
75%	60 "	53"	47"	43"
80%	42"	36"	33"	30"
85%	29"	25"	22"	18"
90%	20"	16"	13"	10"
95%	15"	10"	7 "	5"
100%	10"	6"	3"	1 "

2.14. CLIMATIC AND ENVIRONMENTAL TESTS: -

2.14.1. DRY HEAT TEST:-

This test shall be carried out at 55 \pm 2°C for duration of 16 hours as per IS: 9000 (Part-III, Section-3) - 1977 or latest. The equipment shall be kept energized inside the chamber during this test. On completion of duration of test, the equipment shall be taken out from the chamber and all tests for electrical parameters of amplifier equaliser and VF transformer panel as mentioned in Clause 4.2, test of decoder as mentioned in Clause 5.2 and power supply unit as per Clause 6.0 to 6.7 shall be performed. The variation in different parameters shall be within \pm 5% (+0.42 dB / -0.45 dB) of initial

readings. The equipment shall further be visually inspected to check that no part is damaged or cracked.

2.14.2. DAMP HEAT (ACCELERATED) TEST: -

This test shall be carried out at $55 \pm 2^{\circ}\text{C}$, relative humidity of 90-95% for duration of 24 hours (1 cycle) as per IS: 9000 (Part-V, Section-2)-1981 or latest. The equipment shall not be energized during this test in the chamber. On completion of above cycle, the equipment shall be taken out and shall be wiped with dry cloth to remove condensed water if any, from the surface. The equipment shall then be kept in the recovery chamber at 27°C , 65% RH for 6 Hrs. The insulation resistance as per clause 2.13 and performance test as per Clause 2.11 shall be performed. The IR value shall not be less than 10 mega ohms.

2.14.3. COLD TEST:-

This test shall be carried out at -10°C for 2 (Two) hours as per IS-9000 (Part-II: Section-3)-1977 or latest. The performance tests shall be conducted keeping the equipment inside the chamber. The electrical parameters of amplifier equaliser and VF transformer panel as mentioned in Clause 4.2, test of decoder as mentioned in Clause 5.2 and power supply unit as per Clause 6.0 to 6.7 shall be performed after recovery period of at least 6 hours from the time after removing the equipment from the chamber. The variation in different parameters shall be within $\pm 5\%$ ($+0.42 \text{ dB} / -0.45 \text{ dB}$) of initial readings.

2.14.4. VIBRATION TEST:-

The equipment shall be subjected to vibration test as per IS: 9000 (Part-VIII).

Sl. No.	Parameter	Value of Parameter for test conditions
1.	Frequency Range	: 10 Hz to 55 Hz
2.	Vibration Amplitude	: 0.35 mm
3.	Duration of Endurance for Sweep	: 20 Sweep Cycles (10Hz-55Hz-10Hz)
4.	No. of Axes	: 3 Coordinate axes
5.	Duration at Resonant frequency	: 30 minutes \pm 1 minute
6.	Value of 'g'	: 1 'g'

After vibration test the equipment shall pass the performance test as per clause 2.11.

2.15. NAME PLATE: -

2.15.1. A name plate etched / engraved / anodized or any other better arrangement ensuring better life expectancy shall be suitably fixed on each rack and contain following information:

- 1 Indian Railways
- 2 Name of equipment
- 3 Specification No.
- 4 Unit Serial No.
- 5 Manufacturer's Name and Identification.
- 6 Year of manufacture.

2.16. INSTALLATION AND MAINTENANCE MANUAL:-

- 2.16.1. Two copies of the Instruction Manual shall be supplied along with each type of unit. The manual has to include dimensioned layout drawings, detailed circuit and schematic diagrams; PCB layouts and detailed interconnecting drawings of modules and other arrangements. Details of testing and adjustment procedures, initial checks on receipt at site, detailed installation & commissioning procedures, maintenance procedure, proposed routine maintenance tests, detailed troubleshooting chart shall be outlined in the manual. A softcopy of the Installation and Maintenance Manual has to be supplied on a Floppy Disk/CD also.
- 2.16.2. Instruction Manual has to be prepared using good quality paper with clear and crisp printing. All the drawings in clear print shall be attached to the handbook binding. One set of flow chart drawings necessary for troubleshooting shall be provided with lamination for each manual. The handbook shall have a thick polythene sheet cover with plastic/wire spiral binding or wire-comb binding.
- 2.16.3. The manufacturer shall submit warranty certificate for the satisfactory performance of the equipment for 12 months at least. During the warranty period, any defect should be repaired free of cost.

2.17. PACKING:-

- 2.17.1. Equipments complete shall be packed in suitable boxes / crates, strong enough to prevent damage or loss to the unit during transit. Loose space inside the box / crate shall be filled up with suitable packing material.
- 2.17.2. Each box shall be legibly marked at one end with code numbers, contents, quantity and name of manufacturer /supplier.
- 2.17.3. Batteries, if supplied, shall be transported dry i.e. without electrolyte filled-in and charging shall be done at site as per battery manufacturers instructions.

2.18. INSPECTION:-

- 2.18.1. The inspection and tests shall be carried out to the satisfaction of the purchaser or his nominee.
- 2.18.2. The purchaser or his nominee shall have the right to be present during all stages of manufacture and shall be accorded all reasonable /complete facilities to satisfy himself that the equipment are being manufactured in accordance with the terms and conditions of the specification. The purchaser or his nominee shall have the right to reject any material that fails to conform to the specification.
- 2.18.3. When inspection is carried out during the manufacture, manufacturer shall supply the material and samples required for testing free of charge, and shall at his own cost prepare and furnish the necessary test pieces and appliances for such testing as may be carried out at his own premises in accordance with the specification. Failing to provide facilities at his own works for conducting the prescribed tests, manufacturer shall bear the cost of carrying out the tests at an approved test laboratory.

SECTION- 3**CABLE TERMINATION, DISTRIBUTION & MONITORING PANEL****3.0. GENERAL REQUIREMENTS:**

- 3.1. It shall consist of Krone connectors to terminate incoming and outgoing cables and all other connections for wayside equipments, radio patching etc. On all the incoming and outgoing cables, Krone connectors shall be provided with IPM (Integrated protection module) consisting of LDs, poly-switches (self resetting fuses), and MOV /Zener diodes. For monitoring circuits a loud speaker with amplifier and a tone generator of 1 KHz \pm 100 Hz at 0 dBm \pm 1 dBm output at 470 ohm shall be provided. Links shall be provided to patch the loudspeaker amplifier in required circuit and similar arrangements shall be provided for tone generator.

3.2. TECHNICAL REQUIREMENTS:-

- 3.2.1. This panel shall be used for monitoring VF circuits on a loudspeaker. Two terminals shall be provided on the cable termination panel for connection using a patch cord in the circuit to be monitored.
- 3.2.2. The system shall work on 12V DC (nominal)
- 3.2.3. A loudspeaker amplifier shall be provided to monitor the incoming or outgoing speech.
- 3.2.4. The loudspeaker amplifier shall be capable to deliver min. 200 mW power across non-inductive resistance of 4/8 ohms.
- 3.2.5. Loudspeaker of reputed make shall be used.
- 3.2.6. On the distribution panel, two terminals shall be provided for extending Tx. or Rx. output to speaker through patch cord.
- 3.2.7. On the distribution panel, provision shall be made for extending power supply to monitor card.
- 3.2.8. Tone Generator: A sinusoidal tone of 0 \pm 1 dBm, 1 KHz \pm 100 Hz shall be generated and provided for testing different circuits. The output shall be provided on two terminals in distribution panel so that it can be connected to any circuit using patch cord.

SECTION- 4**EQUALIZER AMPLIFIER AND VF TRANSFORMER PANEL****4.0. GENERAL REQUIREMENTS:-**

It shall consist of one amplifier equalizer card suitable for 4 wire, 4-way system and second card for isolation transformers consisting of 8 Nos. of VF transformers (4 Nos. for main cable, and 4 Nos. for two buffer circuits). These two cards shall cater to one control circuit. Alternatively all the abovementioned PCBs can be accommodated on a single PCB with minimum interconnections between cards.

This panel should cater for 4 control circuits

4.1. TECHNICAL REQUIREMENTS:-

- 4.1.1. The 4 Wire, V.F. amplifier equalizer is intended to make good the loss of the speech level at way station due to cable attenuation, insertion loss of the transformers and due to bridging loss of the tapping transformers. The equipments may be spaced at an interval as decided by the purchaser. These shall be preferably at all stations of the control section.
- 4.1.2. The gain of the amplifier with reference to 1 KHz signal shall be adjustable in steps of 1 dB or 2 dB by DIP-switch. This may be done either independent of equalizer settings or in conjunction with it. Preferably the gain settings at 1 KHz should be independent of equalizer settings.
- 4.1.3. Trans and receive amplifiers shall be identical. The trans amplifier and the receive amplifier may be located on separate areas if on the same PCB. The trans and receive pair of the equipment, wherever referred to, will be with reference to the controller.
- 4.1.4. Input and output of the amplifier shall be provided with isolation transformers.
- 4.1.5. Surge protection shall be provided at input and output of each amplifier.
- 4.1.6. Each amplifier equalizer card shall be provided with presettable equalizer to compensate the slope of cable attenuation in the frequency range of 300Hz to 3.4 kHz. The number of frequency bands for equalization shall, however be based on the design criteria of the manufacturer. Auto equalization is desirable, and if provided, it has to be over the same voice frequency band and the characteristic response graph should be displayed on inside cover of the equipment.
- 4.1.7. The equalizer circuit shall consist of single or multiple profile filters to compensate attenuation characteristic. In case of manual equalisation it shall be possible to select a particular characteristic by selecting DIP-switch position depending upon the sectional length for compensation.
- 4.1.8. Multi-way Branch: Each way station equipment shall be provided with 4 way full conference circuit as per block diagram given as Annexure-I. These 4 ways will be as under: -
 - a) Control end way.

- b) Far end way.
- c) Radio-patch way.
- d) Control telephones way.

In Emergency Control circuit the Control telephones way may be not required.

- 4.1.9. In order to reduce noise due to external interference the trans and the receive amplifiers shall be provided with band pass filters having centre frequencies 250 Hz and 4 KHz and 20 dB/ octave or more attenuation.

4.2. ELECTRICAL PARAMETERS:-

All measurements to be made with equipment energized at rated voltage.

- 4.2.1. Input impedance of the V.F amplifier shall be more than or equal to 470 ohm $\pm 10\%$.
- 4.2.2. The nominal gain of the amplifier shall be 20dB ± 1 dB when measured at a frequency of 1 KHz.
- 4.2.3. The frequency response of the amplifier shall be flat within ± 3 dB in the frequency range of 300Hz to 3.4 kHz, reference point at 1 kHz.
- 4.2.4. The amplifier shall not overload for an output of + 4dBm with equalizers. The overload point is determined as that point when the input level is gradually increased and the waveform observed in CRO, which must not clip up to an output of 4dBm.
- 4.2.5. The signal at input may be -20dBm (minimum) & the output in this case shall be 0 dBm ± 1.0 dBm with amplifier gain at maximum. The upper limit on input signal is determined by overload point, so that the output does not exceed +4dBm, the overload point, without need arising for adjusting the gain of amplifier.
- 4.2.6. Cross talk level of the equipment when measured after termination shall be better than -60 dB, across the trans and receive direction amplifiers of same quad. Frequency for the measurement of cross talk shall be 1 kHz.
- 4.2.7. The Amp/Equalizers shall have the variable slope beginning from 0 dB up to 12dB at least, in the frequency range of 300Hz to 3.4 kHz.
- 4.2.8. Harmonic distortion at 1 kHz shall not exceed 3% when the gain of the amplifier is set to its maximum and output is properly loaded.

4.3. ALIGNMENT AT SITE

- 4.3.1. The equalizer shall be so aligned that frequency attenuation distortion (FAD) characteristics of any one-equalizer amplifier equipment effective between any two stations shall be within the mask indicated in as per **Annexure II** or better so as to comply with the limits prescribed in **Annexure III** for entire control section from end to end.

SECTION -5**DECODER****5.0. GENERAL REQUIREMENTS:**

It shall consist of two Nos. of DTMF decoder circuits, preferably on single PCB for use in one control circuit. There shall be provision for two more similar decoder PCBs for use in other control circuits for any additional requirement at site as per requirement of the purchaser.

Alternatively the DTMF decoder circuits may be provided inside the 4 wire control telephone itself.

5.1. TECHNICAL REQUIREMENTS OF DECODER -

5.1.1. 4-Wire, DTMF decoder shall be provided in decoder panel for Communication between control office and way side stations.

5.1.2 Two decoder circuits shall be provided (preferably in one card) suitable to connect two nos. way side telephones. It shall be possible to talk from one telephone to the other.

When decoder circuit is provided inside the 4 wire control telephone itself the second way side telephone may be connected to the unused other buffer port (Radio Patch port, if not used) of the Amplifier Equalizer card to get facility to talk from one telephone to the other.

5.1.3. Each card shall have provision to connect 4 Wire control telephone to Spec No. IRS: TC 38-97 as default choice. However, standard PSTN telephone as per TEC spec. no.'GR/TEL-02/04,SEP 2002 or latest' shall be used if opted by user railway specifically in the ordering information. With this option the functions of decoding and extension of standard ringing voltage shall be provided. Also with this option the trans output of the PSTN telephone shall be isolated from control circuit after a pre-determine time of lifting the hand-set in order to prevent unwanted local sound to enter into control circuit. This can be restored by taping cradle switch.

5.1.4. The decoder shall be capable of decoding at least 99 sets of DTMF codes and 4 group codes. The code shall be set by 5 DIP switches provided on PCB and shall be properly marked for Tele-I and Tele-II for 1st digit and 2nd digit of each telephone and one DIP switch for common group code. In case DTMF decoder circuit is provided inside the 4 wire control telephone itself then it shall be provided with 3 DIP switches one each for common group code, 1st digit and 2nd digit. Alternatively code setting may be executed using keypad and software arrangement but in this case provision of display for set codes shall be provided.

5.2. ELECTRICAL PARAMETERS OF DECODER: -

- 5.2.1. The DTMF decoder shall faithfully decode all the station codes, group codes & general code when the receive level is between -2 dBm to -25 dBm. It shall be possible to work the decoder reliably even under noisy channel conditions so long as the channel noise remains 15dB below the signal. The signal shall be taken as DTMF code frequencies under test and noise as the frequencies other than DTMF codes.

SECTION-6

POWER SUPPLY UNIT (PSU)

- 6.0. The Power Supply Unit shall normally operate at 230 Volt AC nominal with minimum variation from 160V to 270V. It should also have facility for Solar Power operation with arrangement of automatic change over from 230 Volt AC to Solar supply and vice-versa. The charge controller shall invariably be provided as part of the Power Supply Unit for use with Solar Power panel which may be ordered by the user with PSU or separately. The 230 Volt AC supply may be the preferred source or Solar supply may work in parallel with 230 Volt AC supply in such a way that the battery charging current is optimum i.e. neither undercharging nor overcharging.
- 6.1. Power Supply Unit (PSU) shall be fully duplicated including batteries with suitable over voltage (above 270V) protection.
- 6.2. Short Circuit Protection: Power Supply shall be provided with short circuit protection of self-restoring type.
- 6.3. Reverse polarity protection shall also be provided in the module.
- 6.4. Load protection through fuse of appropriate rating shall be provided.
- 6.5. It shall be possible to by-pass automatically the way station equipment in case voltage of the battery bank drops to threshold voltage of the amplifier. The manufacturer as per requirement of design shall define threshold voltage/ Cut-off voltage, which shall be 10.8 volts or above.
- 6.6. **Power Supply Management:** Out of two power supply units, one shall remain as standby and shall be automatically connected to battery charging system whenever main unit fails. One battery shall be connected to load while the other shall be connected to the power supply unit for charging. If the voltage across the battery on-load drops down to 11.5 volt, changeover between the two batteries should take place automatically. Changeover of battery shall also be possible through remote operation as well as manually (locally).

The changeover should stop, if due to any reason, both the batteries go below 11.5 Volts. An audio-visual alarm to this effect shall be generated in the test room with station code. However, the changeover process should again begin once command for battery changeover is given locally or from Remote Monitoring Facility. Also, in this condition if any battery voltage picks-up and becomes more than 12V the system should changeover to this battery automatically. If both batteries remains under 11.5V changeover shall again take place automatically when voltage of the battery on load drops down to the threshold voltage/ Cut-off voltage.
- 6.7. The power supply unit shall be suitable to charge the batteries at the rate of C/10. It should be constant current /constant voltage device and it shall be configured for charge- discharge mode.

- 6.8. The AC power cord shall be provided with 3 pin 5 A plug at wall outlet side and Mains ON indicator LED shall be provided on the equipment rack. Mains protection shall be provided by fuse of appropriate rating.
- 6.9. Battery on charge/ Battery on load indication shall be provided.
- 6.10. A set of 02 (two) low maintenance batteries of 12 volt each, jointly capable of operating the equipment for 72 hours at least shall be kept in a separate housing made of wooden/ fibre / plastic material of adequate strength. The batteries shall be sourced from reputed manufacturers against performance guarantee of 24 months minimum. The capacity of each battery shall be minimum 40 AH. Charging process for this low maintenance battery shall be carried out at site of installation where it shall be transported dry, i.e. without electrolyte filled in.

SECTION -7**INTERCOM FACILITY****7.0. 8WAY INTERCOM:-**

- 7.1. Intercom facility has been planned to provide some communication to the Supervisory staff of various departments headquartered at stations which neither have telephone exchange nor are connected to the Divisional office by any other means other than the control communication. This requirement is optional and shall be specified by the Railways separately depending on their specific requirement at various stations.
- 7.2. The Intercom Equipment shall support eight telephones instruments conforming to TEC specification No. GR/TEL-02/04.SEP-2002 for desk telephones. Each of these eight telephone instruments, denoted as Local Telephones, shall be connected on two wires having a maximum dc loop impedance of 300 ohms.
- 7.3. All the connections of these subscriber telephones shall be brought to Krone connectors.
- 7.4. All eight Local Telephone shall have a 2 digit number assigned to them, preferably 21 to 28.
- 7.5. The intercom circuit shall be so designed that all the subscribers can call and talk to each other without disturbing the controller by dialling 2 digit number.
- 7.6. Facility of conferencing among the subscribers shall be provided.
- 7.7. The controller shall be able to call and talk to any of the subscribers using 3 digit DTMF codes. The first 2 digits shall be station address code and last digit shall be Local Telephone number ignoring its first digit.
- 7.8. Numbering scheme of station telephone and intercom/ local telephones-

Planning of telephone numbers for station telephones and intercom telephones shall be done by railway judiciously to avoid unintended ringing. It is suggested to keep the numbers 80 to 99 or 90 to 99 (10 to 20 numbers based on the number of stations to be provided with intercom) reserved for intercom telephones station address and these numbers may not be used for station telephones numbering. Since the number of stations which may be required to be provided with intercom may be 10 or 20 only the above scheme would be a suitable trade off.
- 7.9. The ring pattern initiated by a call from the Headquarters shall be different from the ring pattern from a call initiated from other Local Telephone.
- 7.10. It shall be possible to assign one of the control circuits to this Intercom Equipment, so that whenever any one of the Local Telephone user wishes to link to the control circuit, he shall be linked on to the assigned control circuit by dialling an access code.

Assignment of the Intercom Equipment to a control circuit shall be carried while installation. Facility shall also exist to locally disconnect the Intercom from the assigned control circuit.

- 7.11. The controller shall be able to call and talk to any of the subscribers using 3 digit DTMF codes, even when the intercom telephone is Off-Hook or busy. Whenever controller calls it, intercom shall get disconnected from other telephones following a tone indication to the intercom subscribers. The ringing patterns for local call and for Headquarters call shall be different.
- 7.12. It shall be possible to enable and disable the control access facility of all eight Local Telephones from the Test Room. It shall be possible for the Test Room to restore back to the previous settings assigned to the Local Telephones.

SECTION-8

CONTROL ROOM EQUIPMENTS

8.0. DTMF HEADQUARTER CONTROL OFFICE EQUIPMENT:

- 8.1. V.F. Amplifier Equaliser System shall be able to interface with DTMF Headquarter Control Room Equipment designed as per RDSO Specification No. IRS: TC 60 /93 with following modifications-
 - 8.1.1. To suit Quad cable of 470 ohm characteristic impedance, &
 - 8.1.2. Three digit / two digit dialling mode selectable using suitable access codes from dial itself.
- 8.2. Otherwise, an alternative DTMF Headquarter Control Room Equipment may be adopted to cater to needs of data and command transmission and intercom working.

8.3. EMERGENCY CONTROL ROOM EQUIPMENT: -

- 8.3.1. V.F. Amplifier Equaliser System shall be able to interface with Emergency Control Room Equipment designed as per RDSO Specification No. IRS: TC 61/93 to suit Quad cable of 470 ohm characteristic impedance.
- 8.3.2. Alternatively, the control room equipment should be able to functionally work as an Emergency Control room equipment as per spec. no. IRS: TC-61/93 in addition to working as headquarter control equipment as per spec. no. IRS: TC-60/93; suited for 470 ohms characteristic impedance.
- 8.4. It shall have the following working features: -
 - 8.4.1. Controller should be able to call a way station telephones using a 2 digit code number.
 - 8.4.2. Controller should be able to call a group of way station telephones using a 2 digit group number.
 - 8.4.3. Controller should be able to call any intercom telephone using a 3 digit intercom telephone number.

SECTION – 9

TEST ROOM EQUIPMENT

- 9.0. The Test Room equipment shall have preferably similar and interchangeable cards for common features in use as in the way station equipment. Test room equipment shall have following additional features -
- 9.1. The Test Room Equipment shall be provided in the test room. It should have provision for one additional card to generate 4 buffer channels to connect required number of non-ringing telephones in non-conferencing mode. The loading of this channel shall not affect the level of main channel.
- 9.1.1. It shall have a control panel with a numeric keyboard and backlit LCD or LED display. This will be used for internal and remote maintenance operation as well as calling any station or subscriber on the control section. Normally all operations shall be done from control desk of the test room. The remote monitoring facility shall be provided on control desk of test room including its power supply, numeric keyboard, LCD/LED display unit and a handset; in addition to its provision on the equipment.
- 9.1.2. In addition to remote operations as specified in the way station equipment, facility to re-set the controller's equipment from test room equipment shall be provided.
- 9.1.3. Test telephone along with monitoring speaker shall be provided on the equipment.
- 9.1.4. Test Room equipment shall not have 8-way intercom.
- 9.2. **REMOTE MONITORING & MANAGEMENT SYSTEM:-**
- 9.2.1. Remote monitoring & management facility shall be provided for remote monitoring and fault localization from test room. Remote monitoring & management facility for section control, Deputy Control & S&T control circuits shall be separately provided.
- 9.2.2. For this purpose remote monitoring & management cards shall be installed in way station and test room equipments. These cards may be of same or different types for the way station and test room equipments.
- 9.2.3. This system shall utilise DTMF tones for coding commands and responses which shall be decoded and acted upon at appropriate places. For transmission of these codes one control circuit preferably S&T control shall be assigned.
- 9.2.4. It shall be possible to execute the following minimum functions using remote monitoring facility except emergency control -
- i. Disconnect control side of a circuit at a particular station,
 - ii. Disconnect far end side of a circuit at a particular station,

- iii. Disconnect Buffer 1(Radio patch) of a circuit at a particular station,
- iv. Disconnect Buffer 2 (Telephones end) of a circuit at a particular station,
- v. Reconnect all sides of a circuit at a particular station,`
- vi. Battery changeover.
- vii. Monitor power supply status at a particular station,
- viii. Monitor Mains status and battery status (including battery voltage) at a particular station. The Battery voltage measuring resolution shall be 100 mV or better.

These commands with relevant access codes shall be displayed on the equipment in addition to being displayed at control desk in test room.

- 9.2.5. Remote Card automatically sends LOW BATTERY signal to Test Room Equipment along with station identity code. It shall initiate a display of these information along with an alarm buzzer in control room. The alarm buzzer may be resettable by acknowledgement.
- 9.2.6. Disabling and enabling of command codes through suitable authorization code/password or key shall be desirable to prevent any unauthorized initiation.
- 9.2.7. Test room should be able to call any way station telephone or intercom telephone using their respective code numbers.

SECTION - 10**TESTS AND MEASUREMENTS**

10.0. Unless otherwise specified, all the tests shall be carried out under prevalent ambient atmospheric conditions.

10.1. TYPE TESTS:-

10.1.1. One sample each of way station equipment & test room equipment shall be type tested.

10.1.2. The following shall constitute type tests. A complete wired rack is required for type tests.

- | | | |
|----|------------------------------|--------------------------|
| a) | Visual Inspection | (Cl. No. 2.10) |
| b) | Applied High Voltage Test | (Cl. No. 2.12) |
| c) | Insulation Resistance Test | (Cl. No. 2.13) |
| d) | Electrical Parameters | (Cl. No. 4.2 & 5.2) |
| e) | Power supply tests | (Cl. No. 6.0 to 6.10) |
| f) | Performance tests | (Cl. No. 2.11) |
| g) | Climatic Tests | (Cl. No. 2.14) |
| h) | Tests on Intercom facility | (Cl. No. 7.0) |
| i) | Tests on Test Room Equipment | (Cl. No. 9.0, 9.1 & 9.2) |
| j) | Vibration test | (Cl. No. 2.14.4) |

10.1.3. Clause by clause compliance or otherwise (along with detailed technical justification for changes suggested) of the specification shall be submitted by the manufacturer or his authorized representative before offering the equipment for type test.

10.1.4. As decided by the competent authority, the RDSO/ Rly. Officials may witness manufacturing & in process testing of the product at the manufacturer's premises/works.

10.2. ACCEPTANCE TESTS: -

10.2.1. Acceptance Tests shall be carried out on 20% of the lot subject to minimum of 5 equipments and 100% in case of lot consisting of 5 nos. of equipment or less.

10.2.2. The following shall constitute the acceptance test and shall be carried out in the sequence given below: -

- | | | |
|----|------------------------------|--------------------------|
| a) | Visual Inspection | (Cl. No. 2.10) |
| b) | Applied High Voltage Test | (Cl. No. 2.12) |
| c) | Insulation Resistance Test | (Cl. No. 2.13) |
| d) | Electrical Parameters | (Cl. No. 4.2 & 5.2) |
| e) | Power Supply test | (Cl. No. 6.0 to 6.10) |
| f) | Performance tests | (Cl. No. 2.11) |
| g) | Tests on Intercom facility | (Cl. No. 7.0) |
| h) | Tests on test room Equipment | (Cl. No. 9.0, 9.1 & 9.2) |

10.2.3. Any other tests as required by the inspecting authority to ensure that equipment is in conformity with the requirements of the specification.

10.3. ROUTINE TESTS:-

10.3.1 The following shall constitute routine tests on 100% of the equipments. These tests shall be carried out by the manufacturer or his authorized representative at the manufacturer's works/premises & results submitted before offering the equipment to RDSO/Railway official for type tests/acceptance tests. These results shall also be produced at the time of inspection.

- a) Visual Inspection (Cl. No. 2.10)
- b) Applied High Voltage Test (Cl. No. 2.12)
- c) Insulation Resistance Test (Cl. No. 2.13)
- d) Electrical Parameters (Cl. No. 4.2 & 5.2)
- e) Power Supply test (Cl. No. 6.0 to 6.5)
- f) Performance Test (Cl. No. 2.11)
- g) Tests on Intercom facility (Cl. No. 7.0)
- h) Tests on test room Equipment (Cl. No. 9.0, 9. 1 & 9.2)

10.3.2 Any other tests as required by the manufacturer to ensure that equipment is in conformity with the requirement of the specification may be carried out by them and advised to RDSO/Railways.

SECTION - 11**TESTING PROCEDURES****11.0. TESTING OF AMPLIFIER EQUALIZER: -**

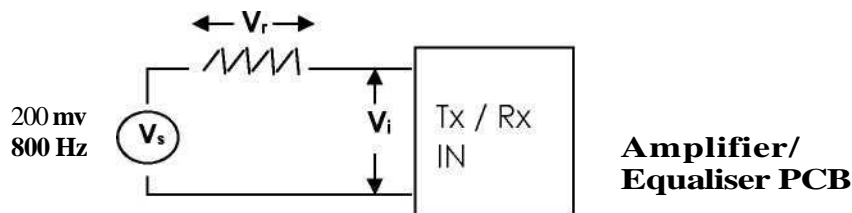
These amplifier equalizers are required to compensate the losses of speech signals at different frequencies in V.F. range between two stations. The purpose of test is to ascertain the requirement of Input impedance, Gain, Harmonic distortion and Frequency response etc.

11.1. EQUIPMENT REQUIRED FOR TESTING: -

1. Low distortion audio oscillator.
2. dB meter with -60 dB to +20 dB range.
3. C.R.O. with a bandwidth of 20 MHz.
4. Distortion factor meter.
5. Loading resistance of 470 Ohms $\pm 1\%$.

11.2. INPUT IMPEDANCE MEASUREMENT: -

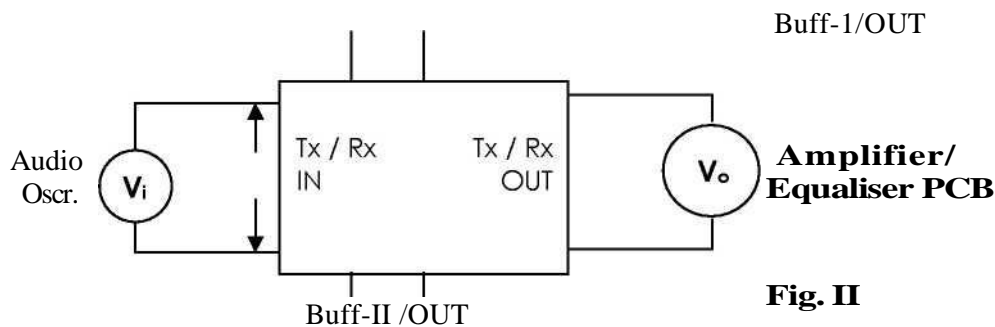
Test Set Up - Test set-up will be as given in Fig. I below -

**Fig. I**

Connect 12 Volt DC to the PCB at specified pins and measure the voltage across R_s resistance. Measure the voltages V_j & V_r . Calculate the input impedance of the amplifier as under:

$$Z_i = (V_i/V_r) \times R_s$$

It shall be 470 Ohm $\pm 10\%$. With same setup, measure the input impedance for buffer I and buffer II. It shall be 1.5 K Ohm $\pm 10\%$.

11.3. GAIN, HARMONIC DISTORTION & FREQUENCY RESPONSE MEASUREMENT: - Test set-up will be as given in Fig. II below**11.3.1. GAIN****Fig. II**

Test Procedure : Set the frequency of the oscillator to 1 kHz and feed -20 dB level to the input of Tx circuit. Measure output at -

- (1) Tx/out (2) Buff-I/out (3) Buff-II/out

Difference of output dB level to input dB level is the gain and $= V_o - V_j$. It should be 20dB ± 1 dB. The output level at Tx./out, Buff-I/out and Buff-II/out shall be within ± 1 dB.

Repeat the same measurements for Receive circuit.

11.3.2. HARMONIC DISTORTION

Measure the Harmonic distortion for both Tx. & Rx. circuits at output terminals and buffer output terminals. It shall be less than 3 %.

11.3.3. FREQUENCY RESPONSE

Manufacturer shall submit readings of this test and graph plot of the same, for verification.

Set all the equaliser DIP-switches at their respective values identified for equalisation of a typical section of maximum permissible length to which this equipment caters. Record the length targeted. Adjust the gain for the section length. Henceforth no changes shall be made to the gain or equaliser settings throughout the test.

Feed signal at -20 dB level at the frequencies of 300Hz, 500Hz, 800Hz, 1kHz, 1.2kHz, 1.4 kHz, 1.6 kHz, 2kHz, 2.4KHz, 3kHz and 3.4kHz respectively at Tx/in and measure Tx/out level. Record the gain (Tx/out -Tx/in) at all these frequencies. This constitutes frequency response of the equipment and It should be within ± 1 dB w.r.t data provided by manufacturer for this setting.

11.4. AMPLIFIER OVERLOADING MEASUREMENT: -

In the setup of Fig 2, feed input at Tx./in and measure output at Tx./out. Slowly increase the input level and observe the waveform in CRO, the waveform must not clip up to an output of 4dBm. The same must hold good for receive circuit.

11.5. CROSS TALK MEASUREMENT:

A signal of 1 KHz frequency shall be fed from the link panel at the input of one channel keeping its output as 0dBm and output of the adjacent channel shall be measured. The channels shall be terminated with 470 ohm characteristic impedance both at input and at output.

11.6. FUNCTIONAL TEST:

The test room & wayside equipment should be wired for all circuits and telephones provided on all decoders. The wayside equipment should be connected to test room & HQ control room equipment through 10dB pad simulating lines losses. Functional tests for voice, ringing & remote monitoring functions shall be carried out.

11.7. TESTING OF DECODERS UNDER NOISY CONDITIONS:

Discretion for selection of signal frequencies is left to the inspecting officials except that one round of this test must always be carried out for the code "AA" used as signal frequencies.

Signal shall be generated from the dialler with levels so adjusted that its level is -12dBm and noise frequencies shall be simulated from audio oscillator adjusted at -27dBm i.e. 15dB below the signal.

The signal and noise shall be combined and fed at the input of the decoder.

TEST:

Whenever code "AA" is pressed, it should be reliably decoded. This test should be repeated for various noise frequencies fed from the audio oscillator.

The test may be carried out for other signal frequencies also, in the range of 300 Hz to 3.4 kHz, if desired by the inspecting official.

SECTION - 12**INFORMATION TO BE SUPPLIED BY THE PURCHASER**

1. The specification covers some variation/ options which are summarised below for ready reference:-
2. The Way Station Equipment and Test Room Equipment of different manufacturers may differ in the type of station telephones connected with control circuits as following three types of telephone equipments may be used as station telephones -
 - a. 4W Control Telephone to spec. IRS: TC 38-97
 - b. Modified 4W Control Telephone with in-built decoder
 - c. DoT type 2-wire telephone
3. The default type is Way Station Equipment and Test Room Equipment suitable for 4W Control Telephone to spec. IRS: TC 38-97. If other types are desired this should be clearly mentioned in the tender documents and accordingly the required type and quantity of station telephones may be mentioned in the ordering information table furnished below.
4. By default the Way Station Equipment is equipped with one no. decoder card which is sufficient for 2 nos. station telephones connected to one control circuit. If other control circuits are required to be equipped with station telephones two more such decoder cards may be connected with two other control circuits which may be ordered as required.
5. 8 Way Intercom equipment is also optional. This interfaces with DoT type 2-wire telephone only. Local telephones connected to 8 Way Intercom equipment can be dialled by Modified HQ Control Room Equipment with 2/3 digit dialling feature only. Therefore if Intercom equipment is opted then Modified DTMF HQ Control Room Equipment with 2/3 digit dialling feature may also be opted.

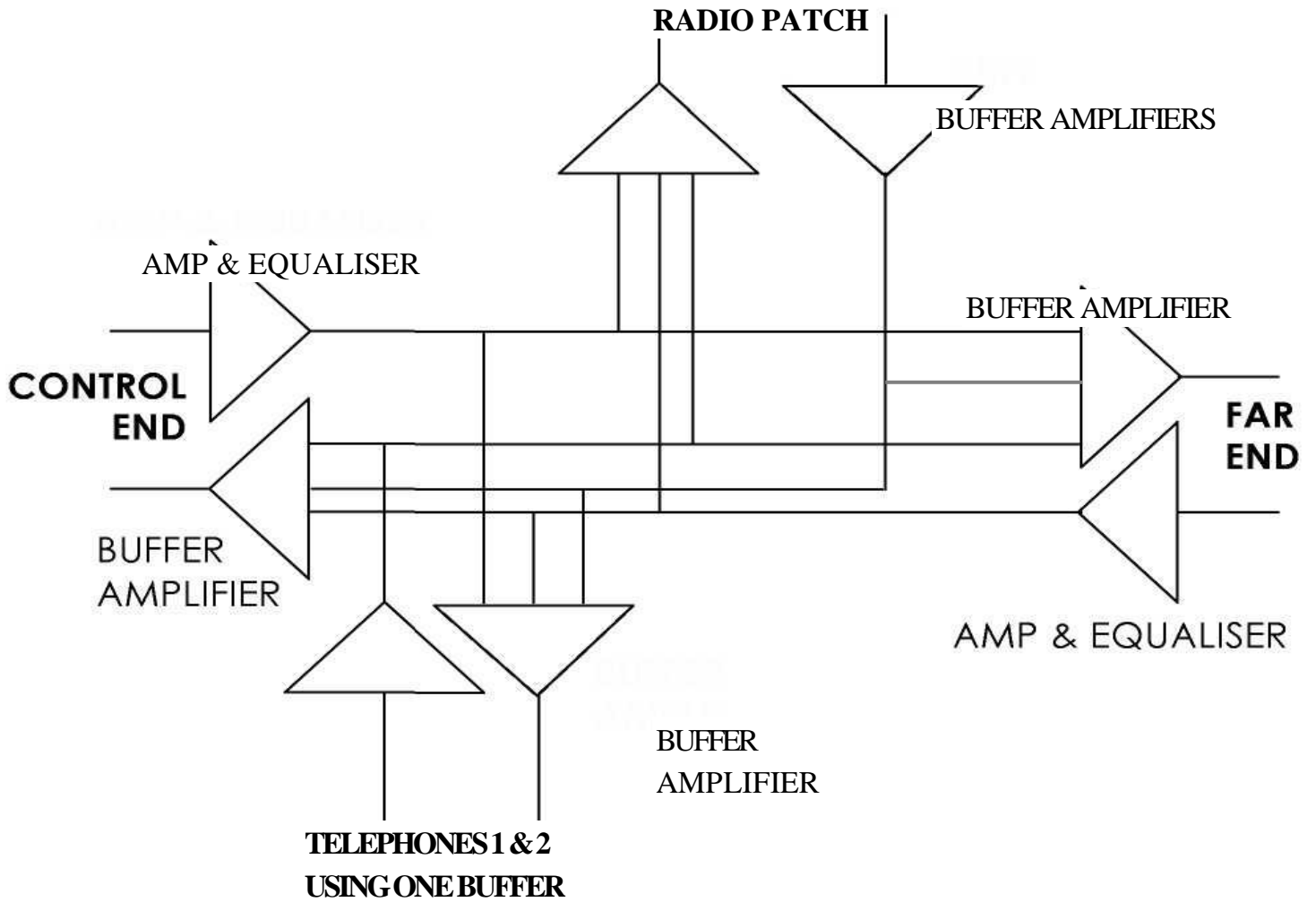
1. Details of equipments required: -

	TYPE OF EQUIPMENT	SPEC. NO.	QTY.
1	a) DTMF HQ Control Room Equipment or b) Modified DTMF HQ Control Room Equipment with 2/3 digit dialling feature	IRS: TC 60/93 RDSO/SPN/TC/34/2002 Ver.4	
2	Emergency Control room Equipment	IRS: TC 61 /93	
3	DTMF control room equipment with Emergency Control Room Equipment working and 2/3 digit dialling features.	RDSO/SPN/TC/34/2002 Ver.4	
4	Test Room Equipment	RDSO/SPN/TC/34/2002 Ver.4	

5	a) Way Station Equipment suitable for 4W Control Telephone to spec. IRS: TC 38-97 or b) Way Station Equipment suitable for Modified 4W Control Telephone with in-built decoder or c) Way Station Equipment suitable for DoT type 2-wire telephone	RDSO/SPN/TC/34/2002 Ver.4 RDSO/SPN/TC/34/2002 Ver.4 RDSO/SPN/TC/34/2002 Ver.4	
6	a) 4W Control Telephone or b) Modified 4W Control Telephone with in-built decoder	IRS: TC 38-97 RDSO/SPN/TC/34/2002 Ver.4	
8	DoT type 2-wire telephone	TEC spec. no. GR/TEL-02/04 SEP 2002 or latest	
9	8 Way Intercom equipment	RDSO/SPN/TC/34/2002 Ver.4	
10	Additional Dual decoder card	RDSO/SPN/TC/34/2002 Ver.4	
11	Type of mounting required on way station /test room equipment- wall/floor mounting	RDSO/SPN/TC/34/2002 Ver.4	

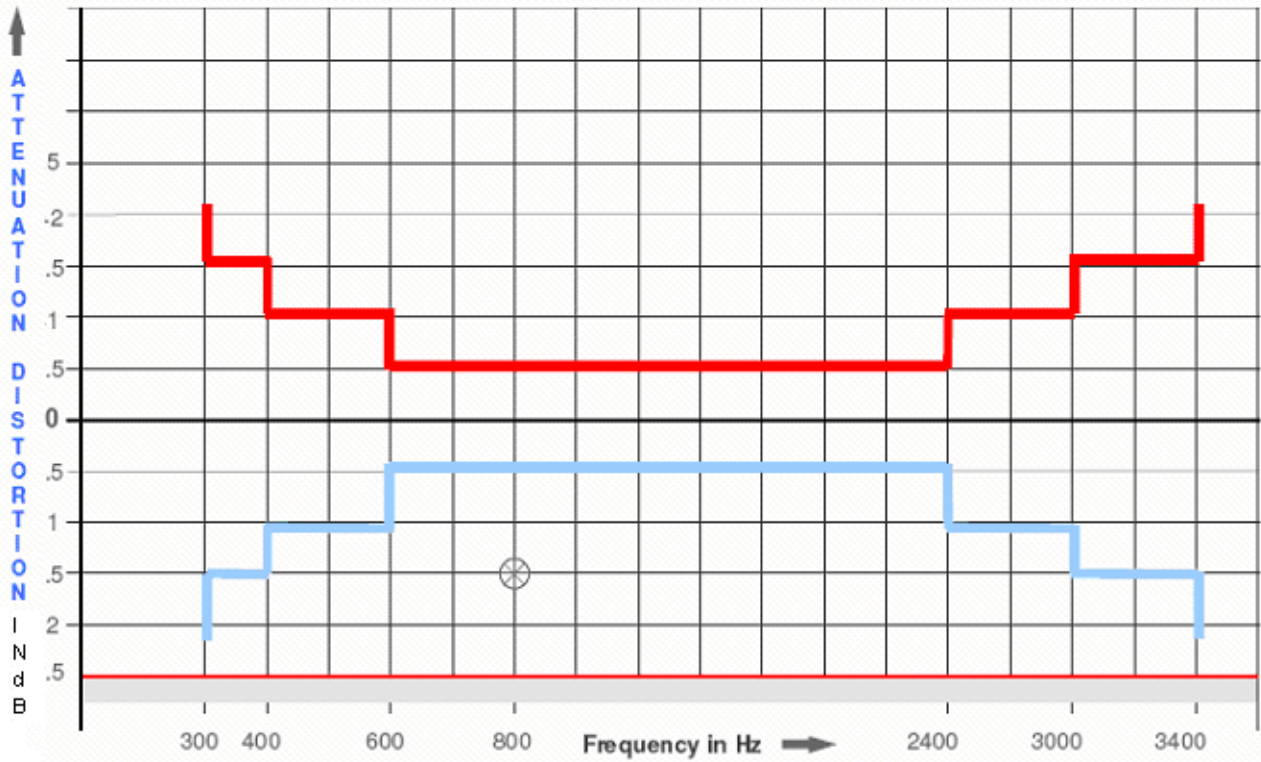
- 2 Typical layout of the entire control section including sectional control tapping chart to assess configuration requirements.
- 3 Attenuation characteristics between two stations for all sections for equalization purpose. If these attenuation characteristics are not available, joint measurements for the same with the supplier/ manufacturer must be recorded.
- 4 Optional requirements (if any)
- 5 Balancing requirements.
- 6 Any other information.

ANNEXURE - I



BLOCK DIAGRAM FOR 4 WAY CONFERENCE

ANNEXURE-II

Frequency Attenuation Distortion (FAD) For One Station

PERMISSIBLE ATTENUATION DISTORTION MASK over VF band for one Way Station / Test Room Equipment

ANNEXURE-III

Frequency Attenuation Distortion (FAD) END to END for A Section

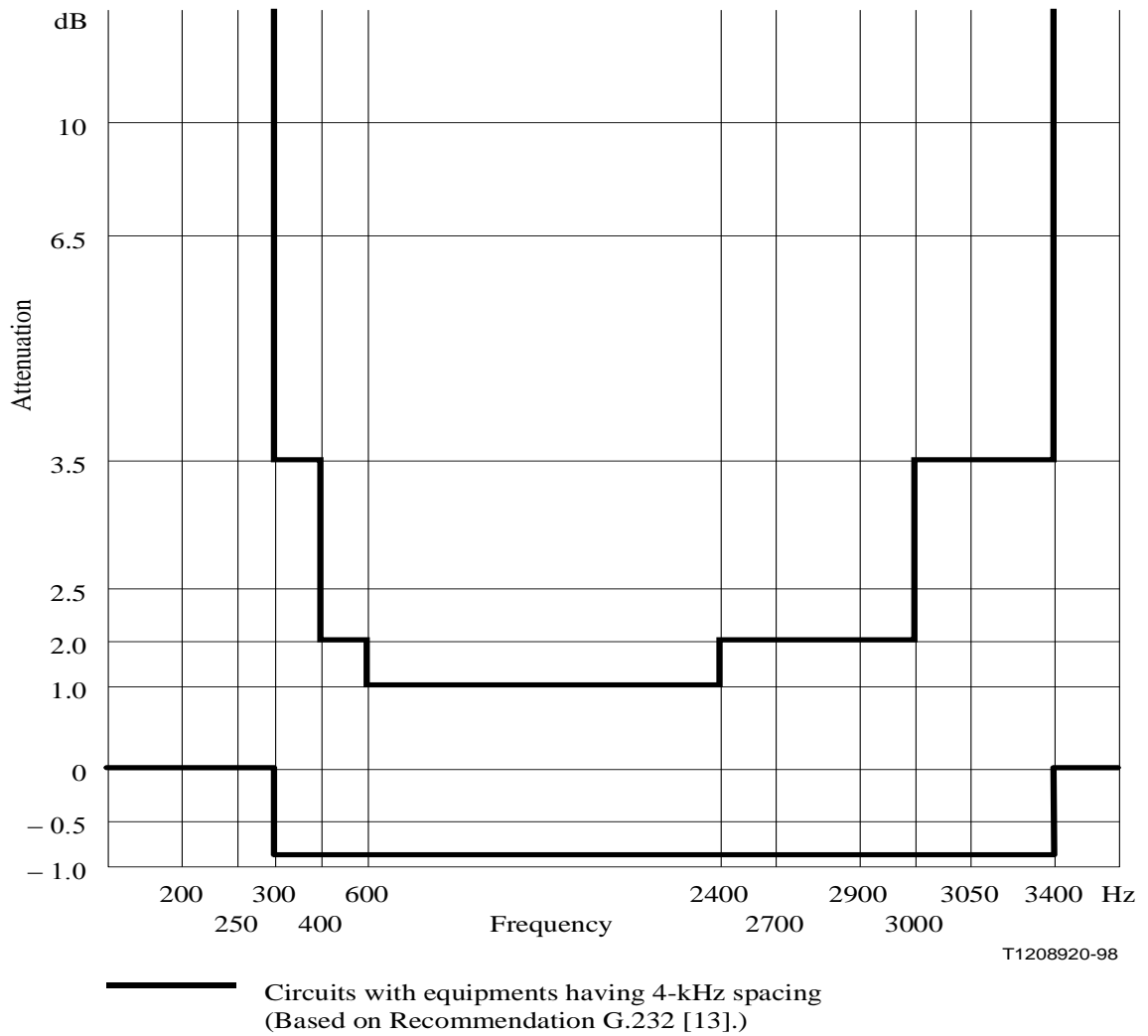


Figure 1/G.120 – Line-up limits of circuits with 4-kHz channel equipment

ANNEXURE-IV

SECTIONAL DETAILS TABLE

Details of Section : Station Distance and other details on the control section.

Serial No.	Station Name	Station code	Km from HQ	Section Span Km Cable Length (Note 1)	Mains Power or Solar Power	Number of Station Telephones on Section CNL circuit	Number of Station Telephone son Dy CNL circuit	Number of Station Telephone on S&T CNL circuit	Number of Dummy Control Circuits	Number of Local (Intercom) Telephones
1					Mains	2	0	0		1
2					Mains	2	0	1		3
3					Solar	2	1	0		5
4					Mains	2	1	1		8

Note 1: The Station Span length will be the actual cable length to be laid between stations kilometres with a 100 meters resolution.

ANNEXURE V

FEATURES IDENTIFIED FOR FUTURE DEVELOPMENT

The following features are desired by the railways to be incorporated in future versions of specifications. Manufacturers are advised to take up development of the same to keep abreast with the latest specifications.

1. Adaptive / Auto Equalisation
2. Automatic Gain Control
3. Data logging with telemetering, predictive maintenance and failure report generation features at Test Room
4. Inclusion of Emergency control Railway/DOT phone extension equipment as a module
5. Feasibility to provide Facility for 10/100 MBPS Ethernet working with TCP-IP & VOIP features on idle quad in 6-Quad cable.

Annexure -VI

Arrangement of U- Link Panel

