

CHAPTER X

QUAD CABLE BASED CONTROL COMMUNICATION SYSTEM

10.1 SYSTEM:

In electrified as well as non-electrified section of Indian Railways, on important routes, OFC cable as well as six quad jelly filled cables are being laid but on non-important routes only quad cables are being laid. Wherever OFC and quad cables are being laid, control communication is provided on OFC with normal arrangements by providing STM-1 and P.D.MUX equipment at every station. Block circuits, emergency sockets and level crossings gate communication are provided on quad cable. Wherever OFC cable is not being laid and only quad cable is being laid, control as well as block communication are being provided on the quad cable itself.

10.2 SYSTEM OF WORKING OF CONTROL CIRCUITS:

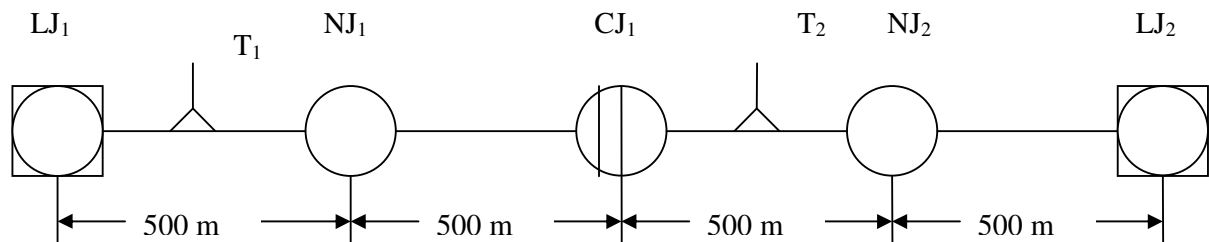
10.2.1 CONVENTIONAL SYSTEM USING REPEATERS AND LOADING AND BALANCING OF QUAD CABLE:

Earlier cable containing paper as well as polythene insulated copper quads were used. Such type of cable is now obsolete but are still in use where old installation exists. Such cable system is described in separate chapter. Now cable containing only polythene insulated quads is used. Such system is described in this chapter.

10.2.2. Repeaters are provided at less than 50 Kms to maintain proper signal level for speech and ringing at all the tapping points.

10.2.3. The repeater spacing should preferably be not less than 30 Kms to avoid by-passing and adjustment of gain of the amplifier.

10.2.4. The length of one loading section will be 2 Kms. A typical diagram showing loading joint, Condenser joint and normal joint (also called Straight through joint) and Transformer joint (2T/3T VF Transformer Assembly) in a loading section shall be as indicated below:



LEGEND

LJ1 & LJ2 : Loading Coil Joints
NJ1 & NJ2 : Normal/Straight Through joints

CJ1 : Condenser Joint
T1 & T2 : Transformer Joint

Note: To reduce number of joints, Transformer and Normal Joints should be combined wherever feasible. If the cable length in a drum is 1.0 Km., Transformer and Condenser joints can be combined with Normal joints to reduce the number of joints.

- 10.2.5. Loading coil of 118 mH shall be provided at every 2 Km. spacing.
- 10.2.6. Balancing : Balancing is to be done to obtain minimum unbalance between both limbs of any pair to earth and also between adjacent pairs.
- 10.2.7. Radio-patching : Whenever radio-patching is provided at the far end, the amplifiers at the repeaters lying between the station at which radio-patch is provided and the place of interruption to the cable will have to be reversed. Provision for remotely reversing the direction of the amplifiers is necessary to avoid manning of the stations.
- 10.2.8. Power supply requirement: The power supply unit of Repeater equipment shall normally operate at 24V DC.
- 10.2.9. Battery back up with charger shall be provided separately for charging the battery.
- 10.2.10. The power supply shall be provided with short-circuit protection of self restoring type.

10.3. AMPLIFIER EQUALISER SYSTEM:

- 10.3.1. Wherever Amplifier Equaliser systems are used, quad cable are not required to be loaded. Every station shall be provided with Amplifier Equaliser equipment to provide communication at that station and to equalize the losses in the VF band.
- 10.3.2. Balancing of various quads shall be carried out at every station by providing suitable condensers, if required.
- 10.3.3. The equipment shall be provided with the facility for radio patching from underground Quad cable media to radio communication system for normal control working or working in case of failure without reversing the direction of amplifiers.
- 10.3.4. The complete system shall comprise of the following assemblies and shall be suitable for mounting on a 19 inch rack;
 - a) Cable termination, distribution and monitoring panel.
 - b) 'U' Link Panel.
 - c) Equaliser Amplifier and VF Transformer panel.
 - d) Decoder and other PCBs.

10.3.5. ELECTRICAL PARAMETERS:

- a) Input impedance of VF Amplifier shall be 470 Ohm $\pm 10\%$.
- b) The nominal gain of the amplifier shall be 20 dB ± 1 dB when measured at a frequency of 1 KHz.
- c) The frequency response of the amplifier shall be flat within ± 3 dB in the frequency range of 300 Hz to 3.4 KHz.
- d) The amplifier shall not be overloaded for an output of +4 dBm with equalizers. The overload point is determined as that point when the input level is gradually increased and observed the wave form in the CRO, which must not clip up to an output of 4 dBm.
- e) The signal at input may be at (-)20 dBm (minimum) and the output in this case shall be 0 dBm with amplifier gain at maximum. The upper limit of input signal is determined by overload point, so that the output does not exceed +4 dBm, the overload point, without need arising for adjusting the gain of amplifier.
- f) Cross talk level of the equipment when measured after termination shall be better than -60 dB, across the amplifiers meant for same quad and adjacent quad. Frequency for the measurement for cross talk shall be 1 KHz.
- g) The Amplifier Equaliser shall have the variable slope beginning from 0 dB up to 12 dB at least in the frequency range of 300 Hz to 3.4 KHz.
- h) 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.

10.3.6. POWER SUPPLY REQUIREMENT:

- 10.3.6.1. The power supply unit of Amplifier Equaliser equipment shall normally operate at 230V AC nominal with variation from 160 V to 270 V. It should also have facility for Solar Power operation with arrangement of automatic change over from 230V AC to Solar Supply and vice versa. The charge controller for use with Solar Panel shall be provided as part of the power supply unit.
- 10.3.6.2. The power supply unit shall be fully duplicated including batteries with suitable over voltage protection (above 270 V).
- 10.3.6.3. The power supply shall be provided with short-circuit protection of self restoring type.
- 10.3.6.4. It shall be possible to by-pass automatically the way station equipment in case the battery voltage drops to threshold voltage of the amplifier to be defined by the manufacturer as per requirement of design.
- 10.3.6.5. A set of two low maintenance batteries of 12V each capable of operating the equipment for 72 hours at least shall be kept in a separate housing made of unbreakable material. The capacity of the each battery shall be minimum 40AH.

10.3.7. INTERCOM FACILITY:

- 10.3.7.1. In addition to Omnibus circuits to be provided at each station, 8-way intercom shall be provided with facility for dialing any of the subscribers by the controller.

- 10.3.7.2. Separate Cards shall be provided for 8-way intercom in the way station equipment. It shall be possible to extend these telephones up to loop resistance of 300 Ohms.
- 10.3.7.3. Intercom circuit shall be so designed that all the subscribers can talk to each other without disturbing the controller.
- 10.3.7.4. It shall be possible to call any subscriber within the group using suitable access codes.
- 10.3.7.5. The controller shall be able to call any of the subscribers using DTMF code and whenever the controller calls it, it gets disconnected from other telephones. Even when a subscriber's telephone is off-hook, it shall be possible for controller to call the subscriber and talk.
- 10.3.7.6. The subscriber shall also be in a position to call controller by dialing suitable access code.
- 10.3.7.7. There shall be facility to bar any telephone from calling the controller.
- 10.3.7.8. Facility of conference among the subscribers shall be provided.

10.3.8 REMOTE MONITORING FACILITY:

- 10.3.8.1. Remote Monitoring facility shall be provided for remote monitoring and fault localization from test room. Remote Monitoring facility for Sectional Control, Deputy Control and S&T Control Circuits shall be separately provided.
- 10.3.8.2. It shall be possible to execute following functions using remote monitoring facility;
 - i) Disconnect one side of Card of that Circuit at a particular station.
 - ii) Disconnect another side of Card of that Circuit at a particular station.
 - iii) Buffer 1 cut for Card of that Circuit at a particular station.
 - iv) Buffer 2 cut for card of that circuit at a particular station.
 - v) Battery change over.
 - vi) Connect Cards of that Circuit at a particular station.
 - vii) Monitor Power Supply Voltage.
 - viii) Monitor AC fuse, charging battery status.

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

- 10.3.8.3.. On failure of AC fuse, remote Card automatically sends fuse fail signal to Test Room Equipment along with its identity code.

10.3.8.4. Disabling and enabling of Command Codes through suitable authorization Code/Password or Key shall be desirable to prevent any unauthorized initiation.

10.4. EARTHING:

10.4.1. All non current carrying metal parts shall be bonded together and earthed. An earth terminal of suitable size shall be provided. It shall be suitably marked.

10.5. MAINTENANCE SCHEDULE FOR REPEATER AND AMPLIFIER-EQUALISER SYSTEM

EQUIPMENT	ITEM	MAINTAINER	SECTIONAL ENGINEER	SR.SECTIONAL ENGINEER
Repeater/ Amplifier- Equaliser Equipment	i) checking Power Supply voltage at the input point.	Weekly	Monthly (Every installation)	Quarterly (Every installation)
	ii) Checking of various cards in proper position.	-do-	-do-	-do-
	iii) Checking the functioning of all the circuits.	-do-	-do-	-do-
	iv) Section wise and end to end line up of all circuits.	----	----	-do-
Batteries	i) Cleaning & tightening of all connections	Weekly	Monthly (Every installation)	Quarterly (Every installation)
	ii) Measurement of voltages and gravity	-do-	-do-	-do-