

CHAPTER V

TRAIN TRAFFIC CONTROL

5.1 GENERAL

5.1.1 RAILWAY CONTROL CIRCUITS: Railway Control Circuits are omnibus telephone circuits which provide communication with each train working point, thus facilitating efficient train operation. They should provide satisfactory and reliable communication between the controller and the various way-side stations, important signal cabins, loco sheds, yard offices etc. There should be provision of Voice Data Logger/ Monitor for Control Circuits

5.1.2. TYPE OF CONTROL SYSTEM: According to traffic requirements and to cater to the needs of Electric Traction area, a section may be provided with one or more Railway Control Circuits as detailed below :

- a) SECTION CONTROL / TRAIN CONTROL: This is provided for communication between the Section/Train Controller in the control office and way-side stations, junction station, block cabins, loco sheds and yards in a division for the control of train movements and effective utilisation of section capacity.
- b) DEPUTY CONTROL: If required by division, this is provided for communication between the Deputy Controller in the control office and important stations, junctions & terminal stations, yard master's offices, loco sheds and important signal cabins in a division for supervisory control of traffic operation in general.
- c) TRACTION POWER CONTROL: Provided between traction power controller and SM's Office, FPs/SPs/SSPs for maintenance of OHE system.
- d) Remote Control for Supervisory Control and Data Acquisition System: SCADA is provided between traction power controller and FPs/SPs/SSPs for various data acquisition and remote control of OHE energisation/de-energisation etc. purpose.
- e) EMERGENCY CONTROL: Provided from selected points along the track route for establishing communication between train crew (in case of emergency), traction and permanent way staff with traction power controller and with section controller in non-RE area if control office does not have traction power controller . The emergency sockets are provided at an interval of 1 Km (Max.) along the route. They are also provided at FP/SP/SSPs, isolators in yards, LC gates and both sides of major bridges. Emergency control can be dispensed with specific approval of the Railway Board wherever any other form of emergency communication (MTRC etc.) is commissioned and put into use.

- i) EMERGENCY WIRELESS CONTROL COMMUNICATION: The following equipments can also be utilized for emergency wireless communication where such system exists:-
 - a. Handsets for Mobile Train Radio Communication (MTRC) in sections.
 - b. Handsets (Official or Private) for Cellular Mobile Communication in sections.
 - c. Walkie-Talkie sets in sections where VHF communication from train to control office has been provided in lieu of any physical medium or MTRC.

Any other form of emergency wireless communication shall have the specific approval of the Railway Board.

5.1.3 REQUIREMENTS FOR TRAIN TRAFFIC CONTROL SYSTEM :

Train Control systems shall fulfill the following requirements :-

- a) Facilities should be provided to section controllers for selectively calling one or a group of stations or all stations.
- b) Push buttons of non-locking type or soft keys/tabs/buttons in case of touch screen based dialling equipment shall be provided for selective calling of any station by the controller.
- c) The station masters shall lift their control phone and it should be possible to directly talk to the section controller with no dialing or minimum dialing. The control phone shall have a non-lockable type press-to-talk switch for enabling the speech transmission of the station master so as to minimise background noise while in listening-only mode.
- d) Means shall be provided to automatically inform the section controller whenever the bell/buzzer at the station rings in response to the call initiated by him.
- e) The signalling used for selective calling shall not hamper normal telephone conversation on the line.
- f) Feature of prolonged ringing of any way-station shall be provided.
- g) The equipment should be rugged and capable of intensive use.
- h) The equipment should work satisfactorily within allowable margins of line characteristics without frequent critical adjustments.
- i) The system should be capable of progressive expansion without any replacement.
- j) Earth return circuits shall not be retained on AC traction and all Telecom circuits shall work on metallic return or OFC.
- k) Facility shall be provided in the control office for transferring/conferencing Emergency Control(whenever exists) to the Section Control circuit.

- l) No overhead Railway telecom alignment is permitted over Indian Railway. However in unavoidable cases local Railway administration can give permission for temporary overhead telecom alignment for a temporary period not exceeding 3 months which may be extendable by further 3 months period.
- m) Provisions must be made to record the control communication with time stamps.
- n) Multiple protection paths with route & service provider diversities shall be provided to ensure high reliability of control communication circuits,

5.1.4 INTERCOMMUNICATION BETWEEN LOCAL TELEPHONE AND CONTROL CIRCUIT

- a) It is also desirable to make provision of an approved type to interconnect the local telephone exchange with important control circuits to enable important officials served by the local telephone exchange to gain access to such control circuits with or without the assistance of an operator.
- b) Such a provision shall not affect the performance of the control circuits from the point of view of signalling or speech.
- c) Whenever interconnection is made through an operator, the manual board shall be provided with necessary supervisory facilities so that the telephone connected to the exchange is disconnected from the control circuit as soon as the conversation is over.
- d) It should be ensured that only important officials have access to control circuits in this manner.

5.1.5 TYPES: In one control section, only one type of equipment should be provided to ensure ease of maintenance and inventory management. Traffic Control Equipment shall be of the following or any other approved type.

- a) **DUAL TONE MULTIFREQUENCY SYSTEM:** In this system two frequencies are being transmitted simultaneously as per the standard DTMF Frequencies plan given in Annexure-I with 2 digit code to call either one station at a time or a nominated group at a time or all at the same time.
- b) **CCEO:** Control Communication Equipment for OFC System (CCEO) is being used for Control Communication between Control office and way stations. This system permits working of voice communication and signaling through an Optical Fibre Communication System and also works through quad cable with some changes of input and output impedances.
- c) **VoIP Based Train Control Communication System:** Voice over internet protocol based train control communication is to make use of the standard, modern and widely proven Internet Protocol technology as a platform. This enables use of common infrastructure for voice and data services. This system provides many additional features such as caller ID, call logs, different ringtones etc.

5.1.6 INTERCOMMUNICATION EQUIPMENT: All controllers in a control office shall be provided with an intercommunication system covering local requirements with facilities for each controller to call any other controller, including Deputy Controller, Chief Controller and the Technician/JE/SSE(Tele) on duty.

5.2 DUAL TONE MULTI FREQUENCY CALLING SYSTEM.

5.2.1 (a) This system for train traffic control equipment with voice frequency signaling using Dual Tone Multi Frequency(DTMF) signals for 4 Wire and 2 Wire operation is known as DTMF Calling System.

(b) The control office equipment is normally designed for 4 Wire operation which can be converted into 2 Wire operation by provision of hybrid attachment. The way station equipment shall be different for 4 Wire and 2 Wire working.

5.2.2 CONTROLLERS EQUIPMENT: The control office equipment consists of an operating console with DTMF code generator and voice communication equipment.

(i) The operating console with code generator has following facilities :

- a. Standard 16 key DTMF KeyPad for calling 99 stations with two push button operation alongwith
- b. Station group code buttons A, B, C, D. and some additional buttons (4). Some buttons are used for Special Functions such as –
- c. Push button (marked 'G') for general call for calling stations simultaneously.
- d. Push button LR for extending long ring at way stations.
- e. Special push button 'RT' - for repeating last transmitted station code.'RS' - to reset the system 'RC' - for row/column frequency check. 'DL' - for cancellation of code.
- f. Visual indications for “System O.K”., “Display of station code” and “power ON” indication.

(ii) The communication equipment consists of loudspeaker/microphone with amplifiers and hand micro telephone and controllers headset.

5.2.3 WAY STATION EQUIPMENT: The way station equipment shall consist of DTMF decoder which can be assigned any DTMF station code/group code selectable with DIP switches, voice communication equipment and 2-Wire/4-Wire desk type control telephone.

5.3 CCEO System:

5.3.1 The CCEO (Control Communication Equipment for OFC) is an advanced equipment connected to traditional control communication system on OFC as per RDSO Specification No. RDSO/SPN/TC/66/2007. The main equipment is kept in OFC hut itself and it works only on standard telecom supply (-48 V DC). No other DC power supply is required for normal PSTN analog handset.

5.3.2 Components of the CCEO system

S.No.	Name of the Segment or Unit	Part of
1.	Control Room Equipment (CRE)	Headquarters Equipment
2.	Test Room Equipment (TRE)	
3.	Local Telephone Equipment (LTE)	
4.	Multi Telephone Way station Equipment (MTWE)	Way station Equipment at OFC hut.
5.	Three Way Amplifier (TWA)	
6.	Remote Patching Equipment (RPE)	
7.	Two-Wire Dialing Control Telephone (TDCT)	Way station equipment with the ASM.

5.3.3 Control Room Equipment (CRE): This equipment is provided on the controller's desk. Using this equipment the controller can selectively call any way station or any local telephone, TDCT (Two wire Dialing Control Telephone), of any way station and can speak to it.

5.3.4 Test Room Equipment (TRE): This unit is provided in the test room for carrying out maintenance and testing functions on way station equipment.

5.3.5 Local Telephone Equipment (LTE): The LTE is used to provide 20 local telephones at Head Quarter.

5.3.6 Multi Telephone Way station Equipment (MTWE): This unit is provided at every way station and it is connected to the VF channel from the PD Mux on OFC system by a 4-wire cable. It gives a facility to connect maximum 4 control telephones at a way station.

5.3.7 Three Way Amplifier (TWA): The TWA unit is used when the number of telephones required at a way station is more than four which is the maximum capacity of a MTWE unit. By using TWA one more MTWE can be provided at a way station.

5.3.8 Two-Wire Dialing Control Telephone (TDCT): The Two-wire Dialing Control Telephone (TDCT) is the standard telephone instrument with a handset and a numeric dial. Each TDCT is connected to MTWE with a twisted pair having a loop resistance of less than 1200 Ohm.

5.3.9 Remote Patching Equipment (RPE): The function of RPE is to provide patching between the two 4-wire VF control circuits available on the OFC system. The patching can be effected locally from the way station where the RPE is provided, or remotely from the test room.

5.4 **VoIP based Train Control Communication System**

5.4.1 VoIP Based TCCS is the latest among the various control communication systems being used in Indian Railways. It leverages open standard IP technology to provide control communication thereby reducing dependence on railway specific equipment/technology which limits market driven innovation. It provides the benefit of economy of scale and open market competition using common network infrastructure for voice, video and data

5.4.2 The VoIP based TCCS has three major components:

1. Control Communication network (CCN).
2. HQ equipment/servers for control communication
3. Waystation equipment including control phones.

5.4.3 It is desirable that the Control Communication Network be kept logically separate from other networks for performance and security. It may be devised using traditional IP components or can be designed as a L3 VPN on Railways MPLS/SDH infrastructure.

5.4.4 CCN should be designed in such a way that it has sufficient OFC paths available either in the Railways OFC or through other service providers network. This shall provide very high redundancy.

5.4.5 OSPF shall be used as the routing protocol.

5.4.6 All Equipment of VoIP based TCCS shall be monitored through an NMS and it is desirable to monitor through mobile dash-boards also.

5.4.7 It is important that the system is secure, easy to configure and maintain. Hence, it is desirable that all the VoIP equipment used in this system are remotely manageable and capable of picking their configuration from a central location.

5.4.8 One communication server shall be used for all the control Boards of the division along with redundant server. It is desirable to keep them at separate networks/locations in the division.

5.4.9 The communication server shall be connected to the Railway exchange using a suitable interface. It must be possible for the controller to dial a railway number and make the subscriber a part of the control conference.

5.4.10 CCN may be used to provide railway auto phones at stations.

5.4.11 Divisions may use either IP control phones or PSTN analog phones at way stations with suitable interface. However, the controller should have a touch screen panel based dialing arrangement for ease of operation.

5.4.12 Time in all the IP equipment in the CCN shall be synchronized with the communication server. The control communication server may also work as NTP server and shall provide timing information to all the VoIP/IP equipment in the CCN.

5.7 INSTRUCTIONS FOR INSTALLATION

5.7.1 LAYOUT OF CONTROL OFFICE :

- a) Control offices and the attached test rooms shall be air-conditioned.
- b) The layout of the control office shall, as far as possible, conform to the layout shown in Annexure II. They should be located, as far as possible, in the ground floor.
- c) Control offices, especially the controller's booths, shall be acoustically treated to eliminate disturbing noises, echoes, etc., to enable use of microphones and loudspeakers. The reverberation constant of the booth shall not be more than 0.4 seconds.
- d) All equipment except those required for operation by the controllers, especially equipment producing noise during operation, shall be located in a different room outside the control office.
- e) Batteries, especially secondary cells, shall be located in a separate room outside the control office.
- f) The test room shall be located as close to the control office as possible to enable the test room staff to attend to any fault promptly.
- g) The test room shall have enough floor area to accommodate the test panel and maintenance spares required for the various equipment. It shall also accommodate tables and chairs for the maintenance staff to carry out overhauling, repairs and maintenance.
- h) While planning a control office, space required for future additions and alterations should be kept in view.
- i) Adequate space should also be earmarked for stationery and filing cases.

5.7.2 INSIDE WIRING IN CONTROL OFFICE:

- a) Wire runs to the controller's table shall be terminated on a terminal strip of approved type, fixed at a suitable place in the rear. The terminal strip shall be protected by a suitable cover.
- b) Separate conduits or runways shall be provided for communication and high voltage electric wires.

- c) Before constructing a building for a control office, distributing systems for communication wires shall be included in the building specifications.
- d) Facilities for provision of communication wire should be made during construction of the building to enable concealment of cables and wires, thereby improving the general appearance of the control office.
- e) Mechanical protection should, as far as possible, be provided for cables and wires to achieve trouble-free service.
- f) Terminal and junction boxes should be located suitable to enable maximum flexibility while carrying out additions or alterations.
- g) All incoming line wires underground cables shall be terminated in the test room before extending them to the control office.
- h) Where direct termination in the test room is not possible, they should be terminated on a termination box of approved type and extended to the test room in a duct or a conduit through the wall.
- i) It should be ensured that the entrance cable is not susceptible to damage due to proximity of water pipes, steam pipes, engine exhausts, electric light or power circuits, elevator shafts, storage dumps or inflammable materials, etc.
- j) The entry should be planned so that it is not objectionable from the standpoint of appearance.
- k) All line wires/communication cables entering the building from outside and all inside wiring shall be terminated in the test room with facilities for cross-connection and distribution.
- l) Test rooms shall be free from overhead piping and the walls should be fire-proof.
- m) Provision of outlets for soldering iron and portable lights shall be made in test rooms.
- n) The area surrounding the test room shall be dry and clear and shall be constructed so that there is no possibility of the basement getting flooded.
- o) Provision of fire detection and suppression should be ensured to protect vital telecom equipment of the test room and control office.
- p) Where loudspeakers and microphones are provided for the controller, the loudspeaker shall be provided with the volume control easily accessible to the controller. The microphone shall be fitted on an adjustable bracket on the arm.
- q) Cable tray/rack(s), if any, shall be made of longitudinal strips iron or angle iron with horizontal cross pieces of light material. The size of the material shall be decided on the basis of the ultimate weight that the rack is expected to carry.

- r) Cable tray/rack(s) shall be located so as to be accessible and laid out for the shortest practicable runs between the various units.

5.8 INSTRUCTIONS FOR MAINTENANCE :

5.8.1 DUAL TONE MULTI FREQUENCY CALLING SYSTEM

CONTROL OFFICE EQUIPMENT

- a) For equipment with DTMF signalling proper functioning of the following keys shall be checked.
 - i) Group codes A, B, C and D
 - ii) Long ring LR
 - iii) General call
 - iv) Special purpose keys
 - Reset - RS
 - Delete - DL
 - Repeat - RT
- b) All visual indications provided on equipment shall be checked.
- c) Quarterly Maintenance: The following shall be checked:
 - 1. Proper functioning of all station codes including special codes shall be checked.
 - 2. DTMF signalling code level shall be between 0 dBm to - 7dBm across a load of 600 ohms.
 - 3. Row/column DTMF frequency shall be checked by pressing the 'RC' button and shall be within the specified limits.

WAY STATION EQUIPMENT

- a) Monthly Maintenance: The following shall be covered :
 - 1. Proper decoding of the set code of the equipment and actuation of buzzer/ loudspeaker Ring back and LED on the control telephone.
 - 2. LED indication on the telephone shall clear after the handset is lifted of the cradle.
 - 3. Correct fitting of fuses and their rating.
 - 4. Cleaning and proper termination of wires on the terminals on the rosette and CT box.
 - 5. Telephone cord is in good condition and connected properly.
 - 6. Cleaning of battery terminals and vent plugs.

5.9 TESTING OF CONTROL CIRCUITS FROM CONTROL OFFICE

- 5.9.1 For ease of operation, testing and management, NMS along with associated equipment (STM, PDMUX etc) should be provided in telecom control room in control office
- 5.9.2 TEST PANEL: A test panel of approved type should be installed in all control offices for the use of the maintenance staff to facilitate the following :

- a) Disconnection of control office equipment to enable independent testing of control circuits with either the way station equipment or the control office equipment.
- b) Patching facilities for substitution by radio patch, of deputy control or spare lines to restore communication on interrupted circuits.
- c) Monitoring of all circuits without interruption to the normal working of circuits.
- d) Provision for a universal calling device to call any station on any circuit.
- e) Provision for calling attention of the maintenance staff by the controllers.

5.9.3 TEST OSCILLATOR: A standard line test oscillator with a dB meter should be provided to carry out measurement of line transmission loss and equipment insertion loss.

5.9.4 MEGGER: A 100 volt megger should be provided to carry out insulation tests on internal wiring and external lines.

5.9.5 PERIODIC TESTS:

- a) All control circuits should be periodically tested by the inspector incharge to check the condition of inside wiring in control offices and way-stations, external line and cables, and control office and wayside station equipment. Voice logger has to be checked periodically for working of channels and recording.
- b) Circuits transmission loss should be measured once every year.
- c) Line loop resistance should also be measured once every year. The loop resistance and disparity between each limb shall not exceed 5% of normal calculated value.
- d) Result of such tests should be entered in a register maintained separately at each sectional inspector's headquarters and in the office of DSTE/Sr.DSTE.
- e) Any defects noticed during such tests should be rectified on the spot and the circuit retested before proceeding with further tests. Defects and their rectification should be recorded in periodic test.
- f) All loss measurements should be carried out by means of a test set provided with an audio oscillator giving a variable output from -10 dB to +10 dB with reference to 1 milliwatt across 600 ohms, between 300 and 3000 Hz. The dB meter should have a sensitivity of -30 dB with reference to 1 milliwatt across 600 ohms.
- g) All tests should preferably be carried out for the smallest subsections.
- h) All Protection path for Control Circuits of BSNL/RAILTEL to be Checked daily and its parameters should be tested monthly. Joint testing of Long Haul network protection path with NOC (Railtel) once in three months.

5.10 CONTROL INTERRUPTIONS

5.10.1 PROCEDURE

- a) As soon as interruption such as complete ringing failure, very low speech, hum, noise or heavy induction on a control circuit for more than 10 minutes, the Section controller on duty shall localise the faulty section with the help of the way station operating staff.
- b) Technical staff in the control office and way-station may be called upon to assist in the localisation whenever any technical difficulty arises.
- c) As soon as the faulty section is localised, the matter should be brought to the notice of the Technician/JE/SSE(tele) on duty, who will confirm the faulty section.
- d) After confirming the faulty section, Technician/JE/SSE(tele) on duty will restore it by utilising the alternate path/circuits available for protection purpose. They shall inform to field telecom staff/Railtel staff/Railtel NOC if there is equipment failures/ 6 quad cable or OFC cut /damage in the section.
- e) An additional facility of single touch multi key phone (Railway/BSNL/ FCT) should be provided to avoid discontinuity in control communication in case of failure of section controller HQ equipment.

5.11 INSPECTION RECORDS AND REPORTS

5.11.1 RECORD AND REPORTS BY INSPECTORS: The SSE/JE incharge of the control office shall:

- a) Keep a record of all interruptions on the control line as well as failure of way station and control office equipment.
- b) Prepare a monthly line interruption and failure report and submit it to the Sr. Divisional Signal & Telecommunication Engineer in duplicate.

5.11.2 RECORD AND REPORTS BY DSTE/Sr.DSTE.

The Sr. Divisional Signal & Telecommunication Engineer/DSTE shall

- a) Forward one copy of the report to the PCSTE for his information after scrutiny of the line interruption and failure reports and reports of periodical test.
- b) Maintain record of control interruptions, preferably graphically, showing
 - i) The total number of interruptions and their duration, and
 - ii) The efficiency of line operation.

The efficiency is calculated as under:

$$\text{Efficiency} = \frac{A-B}{A} \times 100$$

Where A = Total working hours in a month

B = Total working hours lost on account of line interruptions.

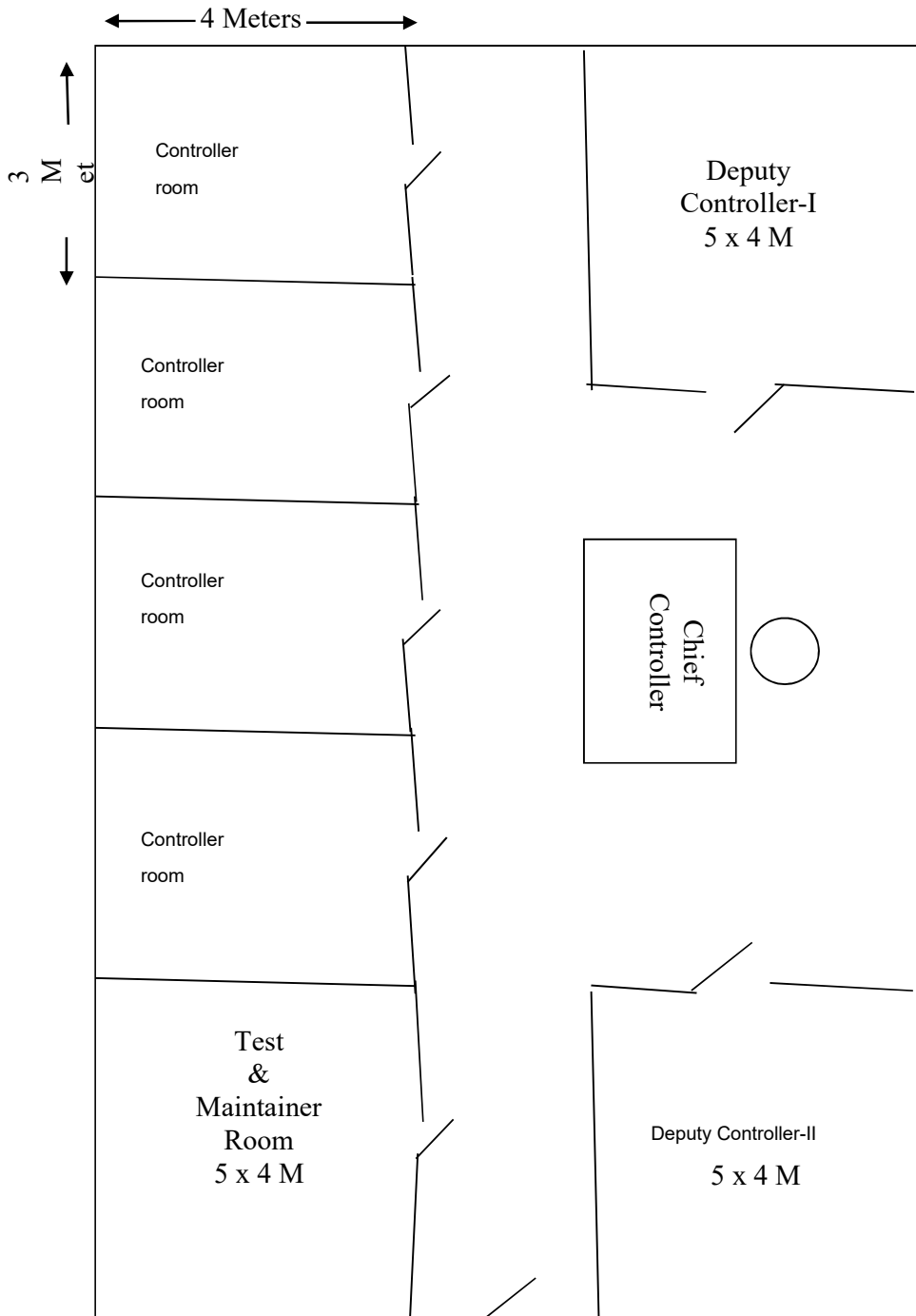
STANDARD DTMF FREQUENCY

RS	DL	RT	RC		
1	2	3	A	697	LOW GROUP FREQUENCY (Hz)
4	5	6	B	770	
7	8	9	C	852	
G	0	LR	D	941	
	1209	1336	1447	1633	

HIGH GROUP FREQUENCY (Hz)

- Note :**
1. The frequency tolerance is $\pm 1.5\%$
 2. ABCD For Group Calling
 3. LR For Long Ring
 4. G For General Call
 5. RS Reset
 6. DL Cancel
 7. RT Last Code Repeat
 8. RC Row/Column Frequency

Typical layout of a control office



Note: Power plant room shall be located outside