UIC CODE 751-1

4th edition, July 2002

Translation

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Railway radio equipment - Fixed and mobile units - General technical considerations

Equipement radioélectrique du chemin de fer - Postes fixes et mobiles - Considérations techniques générales
Ortsfeste und mobile Funkeinrichtungen für Eisenbahnen - Allgemeine Technische Bedingungen

UNION INTERNATIONALE DES CHEMINS DE FER
INTERNATIONALER EISENBAHNVERBAND
INTERNATIONAL UNION OF RAILWAYS

Leaflet to be classified in Volume :

VII - Way and Works

Application :

With effect from 1 January 1985
All members of the International Union of Railways

Record of updates

3rd edition, July 1985

4th edition, July 2002	Retyped in FrameMaker. Important: the articles (points) in this leaflet have been renumbered in the new edition. The first digit of each point has been increased by one (i.e. 0 becomes 1, 1 becomes 2, and so on). Please take account of this when using cross-references from other leaflets. Addition of the sentence on GSM-R in point 1.1.

The person responsible for this leaflet is named in the UIC Code

Contents

Summary

This leaflet sets out general technical considerations applicable to the radio service links covered in *UIC Leaflet 750*, with the exception of ground-to-train radio. Key points handled include modes of operation and choice of frequencies. The leaflet also contains technical requirements for the minimum reception voltage, transmitting power and rules for the aerials of fixed and mobile units. Different radio network structures are described: single frequency (with selective call function in some cases), multi-frequency, combined, fixed unit networks working in relay and monitored links. Finally, a technical solution is specified for closing off discrete networks working on the same radio frequency.

1 - General

1.1 - Scope of application

This leaflet sets out a number of technical considerations to be borne in mind when the service links by radio dealt with in *UIC Leaflet 750* (see Bibliography - page 9) are being established.

This leaflet does not deal with continuous radio links between control units and moving trains. These are contained in *UIC Leaflet 751-3* (see Bibliography - page 9).

GSM-R will be dealt with in a new separate leaflet.

1.2 - Mode of operation

The network may use fixed, mobile or portable units.

Links are generally made in simplex mode and conversations are held alternately; voice is used to call a unit and conversations are not confidential.

This mode of operation requires strict discipline on the part of users.

NB : The half-duplex or duplex mode of operation is used for special networks in which the radio link can be switched to the telephone network.

2 - Choice of frequency

The choice of frequency depends firstly on availability. In some countries, mobile facilities have already been developed to such an extent that the allocation of additional frequencies is seriously limited. Thus, it is strongly recommended that care be taken to ensure well in advance that frequencies are available.

In general terms, radio networks are currently set up in the following frequency bands, depending on how the network is used:

- 76 MHz band: local links between portable units or fixed and portable units for track work;

- 160 MHz band: local links between fixed, mobile and portable units for shunting operations in stations;

- 460 MHz band: continuous links along railway lines of the ground-train type. This frequency band is also used for local links in areas where radio propagation is difficult.

There is a move towards higher frequencies (900 MHz) in certain networks.

3 - Technical requirements

3.1 - Technical characteristics of the equipment

These are described in *UIC Leaflet 751-2* (see Bibliography - page 9).

3.2 - Minimum reception voltage

Good radio coverage of an area requires the received voltage to reach 2 μV over 95% of the range and 95% of the time.

In simple cases, e.g. when operating safety is not at risk, networks may accept a lower probability for the reception level than that defined above.

3.3 - Fixed unit aerial

In open terrain, all types of aerial with vertical polarisation can be used. Choice of characteristics for the aerials (e.g. omnidirectional, slightly or very directional) depends on the topography of the area to be served.

3.4 - Mobile unit aerial

3.4.1 - In open terrain, aerials should have omnidirectional radiation characteristics and a gain equal to or greater than 0 dB as compared with a λ/4 aerial.

They should be mounted on the roofs of locomotives in such a way as to obtain vertical polarisation and to prevent, wherever possible, reflection and refraction caused by roof superstructures. The loss of gain may be as high as 9 dB under unfavourable mounting conditions.

3.4.2 - In order to protect staff from dangerous over-voltages in the case of accidental contact with components under high voltage or with the contact wire, the aerials should be bonded to the chassis of the tractive unit (i.e. rail potential).

They may also be protected by an insulating sheath made of synthetic material.

3.4.3 - Aerials should be mounted in such a way as to comply with vehicle gauges.

3.5 - Transmitting power

The nominal transmitting power is generally between 1 and 6 watts.

Standards of national postal or telecommunications authorities should be complied with in all cases.

4 - Radio-wave propagation

Radio-wave propagation on railway locations has been studied in recent years by Specialists' Committee A 133. The ORE[1] has published the results of this study in the form of a guide enabling the value of the radio signal to be estimated in most of the configurations generally encountered on railway locations.

1. ORE became ERRI (European Rail Research Institute) in January 1992.

5 - Radio-network layout

5.1 - Single-frequency networks

Generally speaking, this type of network has a fixed station and one or several mobile or portable units operating on a single frequency.

The fixed station is normally situated at the centre of the network's area of operation, in a clear location sheltered from interference.

When the operator is some distance away because of local circumstances, he should have a control box linked to the fixed station by means of a telephone line used for voice communication and controlling transmit/receive switching. This switching may be controlled via a separate pair or by means of a characteristic frequency superimposed on the voice signal.

If the number of participants increases but operation on a single frequency is nevertheless desirable, it is possible to use selective calls to the units. The advantage of this solution is that units not called do not hear the conversation being held.

Principle of selective calls

A transmitter, e.g. a fixed unit, is equipped with a tone generator per user group. This generator is triggered briefly by pressing a call button. Reception of the tone by the receivers of the relevant group activates their audio-frequency circuit. This remains active for the duration of the conversation.

This procedure can be used to call different groups selectively from the fixed unit, or to call an operator at the fixed unit from the mobile or portable units.

5.2 - Multi-frequency networks

!f a single frequency is insufficient in networks with several units, it is better to use several and to group the units rationally. Depending on requirements, the apparatus will operate on one or several frequencies: however, it is important to remember that it is generally designed only for a radio-frequency bandwidth of 0,8 to 1,2 MHz. The frequency needs to be changed to make contact with groups operating on different frequencies.

5.3 - Combined networks

It may be useful to create combined networks with voice-frequency switching if there are a certain number of units belonging to radio and telegraphic networks.

Communication between two units operating on the same frequency can be made directly. However, communication between units operating on different channels and communication with the telegraphic networks take place at voice frequency via a switching centre.

The great advantage of this system is that it permits connections between radio units operating on different channels, even if they belong to different frequency bands.

5.4 - Fixed-unit networks operating in relay

In order to extend the range of the network, links can be established via a fixed station in automatic relay. In this case, access to a duplex channel is required: the portable and mobile units operate in dual-frequency simplex; the fixed station operates in duplex.

5.5 - Monitored links

In some cases, it becomes necessary to monitor the functioning of a link, so that any failure results in predefined measures being triggered.

In such cases, a clearly defined frequency should be allocated to each of these links, whatever the status of the network.

6 - Closed networks

In order to prevent confusion between two separate networks with the same frequency, one possibility is to modulate the carrier wave permanently by an audio-frequency signal lower than 250 Hz which is a characteristic of the relevant network. This characteristic signal unblocks the relevant receiver and is filtered before it becomes audible.

A closed network, is thereby created.

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Warning

Printed by the International Union of Railways (UIC)
16, rue Jean Rey 75015 Paris - France, July 2002
Dépôt Légal July 2002

ISBN 2-7461-0436-9 (French version)
ISBN 2-7461-0437-7 (German version)
ISBN 2-7461-0438-5 (English version)