MPT 1315

CODE OF PRACTICE

Requirements for duplex operation in the Land Mobile Services

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1 INTRODUCTION

The term duplex operation defines a system in which the radio equipment is fitted with devices which enable transmission to take place simultaneously in both directions. This Code of Practice is also applicable to semi-duplex operation which is simplex at one end of the circuit and duplex at the other.

Duplex operation is required for reverse frequency control or talk-through operation, see Appendix A.

2 APPLICATION OF THIS CODE OF PRACTICE

This code of practice covers the minimum performance considered necessary in order to make the best use of the available radio spectrum. It does not necessarily include all the characteristics which may be required by a user. It applies to any duplex system in the land mobile services with radio equipment using amplitude or angle modulation.

Duplex radio equipment submitted to an MPT or ETS Specifications should meet the requirements of this code of practice in as much as they apply to the radio equipment, as required by the relevant MPT or ETS Specification.

3 TEST CONDITIONS: ATMOSPHERIC CONDITIONS AND POWER SUPPLIES

3.1 General

Tests shall be made under normal test conditions (Clause 3.3) and also, where stated, under extreme test conditions (Clause 3.4). In the event that any clause in the appropriate radio equipment performance specification concerning extreme test conditioned differs from the relevant clause in this code of practice, the clause for the radio equipment may be applied as an alternative. Otherwise, the test conditions and procedures shall be as specified in Clauses 3.3 to 3.5.

3.2 Test power source

During tests, the power supply for the equipment may be replaced by a test power source, capable of producing normal and extreme test voltages as specified in Clauses 3.3.2 and 3.4.2. The internal impedance of the test power source shall be low enough for its effects on the test results to be negligible.

For the purpose of tests, the supply voltage shall be measured at the input terminals of the equipment. If the equipment is provided with a permanently connected power cable, the test voltage shall be measured at the point of connection of the power cable to the equipment.

During the tests the power source voltage shall be maintained within a tolerance of ± 3 % relative to the voltage at the beginning of each test.

In equipment in which batteries are incorporated, the test power source shall be applied as close to the battery terminals as practicable.

3.3 Normal test conditions

3.3.1 Normal temperature and humidity

The normal temperature and humidity conditions for tests shall be any convenient combination of temperature and humidity within the following ranges:

Temperature	+ 15°C to + 35°C
Relative humidity	20 % to 75 %

NOTE: When it is impracticable to carry out the tests under the conditions stated above, a note to this effect, stating the actual temperature and relative humidity during the tests, shall be added to the test report.

3.3.2 Normal test source voltage

3.3.2.1 Mains voltage

The normal test source voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of this code of practice, the nominal voltage shall be the declared voltage or any of the declared voltages for which the equipment was designed.

The frequency of the test power source corresponding to the AC mains shall be between 49 and 51 Hz.

3.3.2.2 Regulated lead-acid battery power sources

When the equipment is intended for operation from the usual type of regulated lead-acid battery source, the normal test source voltage shall be 1.1 times the nominal voltage of the battery (6 volts, 12 volts, etc.).

3.3.2.3 Other power sources

For operation from other power sources or types of battery, either primary or secondary, the normal test source voltage shall be that declared by the equipment manufacturer.

3.4 Extreme test conditions

3.4.1 Extreme temperatures

For tests at extreme temperatures, measurements shall be made in accordance with the procedures specified in Clause 3.5, at an upper value of + 55°C and at a lower value of - 10°C.

3.4.2 Extreme test source voltages

3.4.2.1 Mains voltage

The extreme test source voltages for equipment to be connected to an AC mains source shall be the nominal mains voltage ± 10 %. The frequency of the test power source shall be between 49 and 51 Hz

3.4.2.2 Regulated lead-acid battery power sources

When the equipment is intended for operation from the usual type of regulated lead-acid power source the extreme test voltages shall be 1.3 and 0.9 times the nominal voltage of the battery.

3.4.2.3 Other power sources

The lower extreme test voltage for equipment with power sources using primary batteries shall be as follows:

For Leclanche type of battery; 0.85 times the nominal voltage of the battery.
For mercury type of battery; 0.9 times the nominal voltage of the battery.
For other types of primary batteries; End point voltage declared by the equipment manufacturer.

For equipment using other power sources or capable of being operated form a variety of power sources the extreme test voltages shall be those agreed between the equipment manufacturer and the testing authority and shall be recorded with the test results

3.5 Procedure for tests at extreme temperatures

3.5.1 General

Before making measurements, the equipment shall be placed in a temperature controlled chamber for a period of one hour or for such period as may be judged necessary for thermal balance to be attained. The equipment shall be switched off during the temperature stabilisation period. The sequence of tests shall be chosen and the humidity content in the test chamber shall be controlled so that excessive condensation does not occur.

4 ELECTRICAL TEST CONDITIONS

Where applicable the electrical tests shall be carried out in accordance with the appropriate MPT or ETS performance specification.

5 TRANSMITTER

5.1 Carrier Power

The carrier power shall, under all test conditions, be within the limits laid down in the appropriate MPT or ETS performance specification.

5.2 Spurious emissions

The power of any spurious emission, within the specified range of frequencies, shall not exceed the value laid down in the appropriate MPT or ETS performance specification.

6 RECEIVER

6.1 Receiver desensitisation with simultaneous transmission and reception

6.1.1 Definition

The desensitisation is the degradation of the sensitivity of the receiver resulting from the transfer of power from the transmitter to the receiver due to coupling effects. It is expressed as the difference in dB of the maximum usable sensitivity levels with simultaneous transmission and without.

6.1.2 Method of measurement

The transmitter and the receiver are connected to the duplex filter, the antenna terminals being connected to an artificial load through a coupling device. Where the equipment does not include a duplex filter, the transmitter shall be connected to the input of the receiver via a 30 dB attenuator.

A signal generator with normal test modulation is connected to the coupling device so that it does not affect the impedance matching. The transmitter is put into operation with 400 Hz modulation to give 30 % amplitude modulation or 60 % of maximum permissible frequency deviation, whichever is applicable.

The receiver sensitivity is then measured in accordance with the requirements of the relevant performance specification. The test signal input level under these conditions is the maximum usable sensitivity for simultaneous transmission and reception.

6.1.3 Limits

The desensitisation is expressed as the difference in dB of the maximum usable sensitivity levels with simultaneous transmission and without. The desensitisation shall not exceed 3 dB.

6.2 Receiver spurious response rejection

6.2.1 Definition

The spurious response rejection is a measure of the capability of the receiver to discriminate between a wanted modulated signal at the nominal frequency and an unwanted signal at any other frequency.

6.2.2 Method of measurement

When carrying out this measurement care must be taken to avoid power from the transmitter entering the signal generators and causing their outputs to contain intermodulation products.

The receiver spurious response rejection is measured as laid down in the relevant equipment performance specification with the equipment arranged as in Clause 6.1.2 except that the transmitter shall be unmodulated.

6.2.3 Limits

At any frequency separated from the nominal frequency of the receiver by more than one channel spacing, the spurious response rejection ratio shall be not less than the value laid down in the appropriate Home Office performance specification.

7 ENGINEERING CONSIDERATIONS

7.1 Duplex filters

Duplex filters are included in systems to provide the high degree of isolation required between transmitter and receiver. A system utilising a duplex filter can employ a common antenna which will provide the same coverage areas for both transmitter and receiver. For a base station this will also result in a saving of antenna space on the mast. The following precautions should be observed when dealing with systems incorporating duplex filters.

7.1.1 Power rating

Duplex filters are constructed to handle a given maximum power level. If this power level is exceeded, detuning, electrical breakdown and mechanical damage may occur.

7.1.2 Frequency adjustments

The adjustment of duplex filters requires the use of specialised knowledge and test equipment to ensure that optimum performance is achieved. Once duplex filters have been adjusted steps should be taken to prevent subsequent maladjustment by unqualified staff.

7.2 Antenna feeders

In general the antenna of a radio system is connected to the radio equipment by means of a coaxial cable having a characteristic impedance equal to the output impedance of the equipment. If excessive RF leakage occurs from one of a number of coaxial cables routed in close proximity, the result could be interference, possibly of the intermodulation product type, introduced into radio equipments connected to the other cables. This type of problem can be avoided by use of coaxial cables with solid outer sheaths and careful planning of the cable runs. Coaxial cables should be matched carefully to the transmitter and antenna to ensure that a low value of SWR is obtained, this will ensure that there is a minimum level of RF radiation from the cable.

7.3 Antennae

Where separate antennae are employed for transmit and receive, they should be spaced such as to give a minimum isolation of typically 30 dB measured at the input of the equipment.

7.4 Receiver input protection

Where a single antenna is employed for a duplex system there may be, under antenna fault conditions, an excessive input level applied to the receiver. It will be necessary to protect the receiver from damage under such conditions.

7.5 Frequency planning

Where more than one duplex radio system is operated in the same frequency band on a communal transmitting site, care should be taken to avoid interference due to intermodulation products arising from the common transmit/receive separation used in the systems.

7.6 Use of filters

Where in a particular situation the required isolation cannot be obtained by normal duplexing arrangement, additional band-stop or band-pass filters may be added in both transmitter and receiver feeders to obtain the required isolation.

8 ACCURACY OF MEASUREMENT

The tolerance for the measurement of the following parameters shall be as given below:

*	DC voltage	± 3 %
*	AC mains voltage	± 3 %
*	AC mains frequency	± 0.5 %
*	Audio frequency voltage, power etc.	± 0.5 dB
*	Audio frequency	± 1 %
*	Distortion, noise etc. of audio frequency generators	1 %
*	Radio frequency voltage	± 2 dB
*	Impedance of artificial loads, cables, plugs attenuators etc.	± 5 %
*	Source impedance of generators	± 10 %
*	Temperature	± 1 °C
*	Humidity	± 5 %

9 INTERPRETATION OF THIS CODE OF PRACTICE

In cases of doubt about the interpretation of this code of practice, the methods of carrying out the tests and the validity of statements made by the manufacturers of the equipment, the decision of the Radiocommunications Agency shall be final.

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ANNEX A: GLOSSARY OF TERMS FOR DUPLEX OPERATION

A.1 Duplex operation

Operating method in which transmission is possible simultaneously in both directions.

A.2 Semi-Duplex operation

Operating method which is simplex at one end of the circuit and duplex at the other. In practice semi-duplex operation requires the use of two frequencies, and it is normally the base station that operates in the duplex mode.

A.3 Talk-Through operation (Repeater operation)

Operating method whereby two land-mobile stations may communicate with one another via a base station. Talk-Through operation is a specific form of semi-duplex operation.

A.4 Reverse Frequency operation

Operating method of a two frequency system in which a control station communicates with the land-mobile stations by relaying through the base station. This mode of operation is similar to talk-through, the difference being that the control station (using vehicle mobile equipment usually with a directional antenna), operates from a fixed location.