

**MPT 1306**

**CODE OF PRACTICE**

**Continuous tone controlled signalling  
system (CTCSS) for use in the  
Land Mobile Services**

**Revised and reprinted October 1996**



© Crown Copyright 1996

First published 1978

Revised and Reprinted May 1993

Revised and reprinted October 1996

Blank page

3.1 General .....	7
3.2 Test power source .....	7
3.3 Normal test conditions .....	7
3.3.1 Normal temperature and humidity .....	7
3.3.2 Normal test source voltage .....	8
3.4 Extreme test conditions .....	8
3.4.1 Extreme temperatures .....	8
3.4.2 Extreme test source voltages .....	8
3.5 Procedure for tests at extreme temperatures .....	9
3.5.1 General .....	9
3.5.2 Test procedure .....	9
4 GENERAL CONDITIONS .....	9
4.1 Selective signalling code format .....	9
4.1.1 Definition .....	9
4.1.2 Standard frequencies .....	9
4.2 Standard test modulation .....	10
4.3 Monitoring facility .....	10
4.4 Arrangements for test signals applied to the receiver input .....	10
5 TONE ENCODER AND ASSOCIATED TRANSMITTER .....	10
5.1 Encoder frequency .....	10
5.1.1 Method of measurement .....	10
5.1.2 Limits .....	11
5.2 Encoder modulation .....	11
5.2.1 Method of measurement .....	11
5.2.2 Limits .....	11
5.3 Encoder response time .....	11
5.3.1 Definition .....	11
5.3.2 Method of measurement .....	11
5.3.3 Limits .....	11
6 DECODER AND ASSOCIATED RECEIVER .....	12
6.1 Tone squelch threshold .....	12
6.1.1 Definition .....	12
6.1.2 Method of measurement .....	12
6.1.3 Limits .....	12
6.2 Code frequency selectivity .....	12
6.2.1 Definition .....	12
6.2.2 Method of measurement .....	12
6.2.3 Limit .....	12
6.3 Decoder response time .....	12
6.3.1 Definition .....	12
6.3.2 Method of measurement .....	13
6.3.3 Limit .....	13
7 ACCURACY OF MEASUREMENT .....	13
8 INTERPRETATION OF THIS CODE OF PRACTICE .....	14

Blank page

## 1 INTRODUCTION

The term 'continuous tone controlled signalling system' (herein referred to as CTCSS) defines a system in which the radio equipment is fitted with devices which at the transmitter generate a specified continuous tone during transmission and at the receiver respond to a specific continuous tone.

## 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 frequencies. It does not necessarily include all the characteristics which may be required by a user.

It applies to any CTCSS operated in the land mobile services with radio equipment using amplitude or angle modulation where the purpose of the system is typically to facilitate channel sharing by more than one user or to enable base station equipments to be selectively operated in the "talk through" mode.

## 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). The tests will normally be carried out with the CTCSS operated with representative radio equipment, and in the event that any clause in the appropriate radio equipment performance specification concerning extreme test conditions 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 3.2 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  $\pm 3\%$  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  $\pm 10\%$ . 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 from 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.

#### **3.5.2 Test procedure**

##### **3.5.2.1 Equipment designed for continuous operation**

For tests at the upper temperature, after thermal balance has been attained (Clause 3.5.1), the equipment shall be switched on in the transmit condition for half an hour, after which the appropriate tests shall be carried out. For tests at the lower temperature, after thermal balance has been attained (Clause 3.5.1), the equipment shall be switched on in the standby or receive condition for one minute, after which the appropriate tests shall be carried out. <sup>1</sup>

##### **3.5.2.2 Equipment designed for intermittent operation only**

The procedure shall be as described in Clause 3.5.2.1, except that at the upper temperature, the half hour transmit condition shall be replaced by one minute in the transmit condition followed by four minutes in the receive condition before measurements are made.

## **4 GENERAL CONDITIONS**

### **4.1 Selective signalling code format**

#### **4.1.1 Definition**

The CTCSS code frequency (or tone) in Hz is the assigned audio frequency.

#### **4.1.2 Standard frequencies**

The standard frequencies available for assignment are shown below. The precise CTCSS code frequency will be quoted by the Secretary of State when a licence is issued.<sup>2</sup>

---

<sup>1</sup> Note: If the equipment contains temperature stabilisation circuits designed to operate continuously, the equipment may be switched on for 15 minutes before measurements are made.

<sup>2</sup> Note: On any one radio channel, assignments are normally only made from one group.

**Table 1 - Tone Table**

<b>Tone</b>	<b>Grp</b>	<b>Tone</b>	<b>Grp</b>	<b>Tone</b>	<b>Grp</b>	<b>Tone</b>	<b>Grp</b>
67.0	A	110.9	B	146.2	B	192.8	B
71.9	B	114.8	A	151.4	A	203.5	A
77.0	A	118.8	B	156.7	B	210.7	B
82.5	B	123.0	A	162.2	A	218.1	A
88.5	A	127.3	B	167.9	B	225.7	B
94.8	B	131.8	A	173.8	A	233.6	A
103.5	B	136.5	B	179.9	B	241.8	B
107.2	A	141.3	A	186.2	A	250.3	A

#### **4.2 Standard test modulation**

Standard test modulation shall be in accordance with that laid down in the relevant performance specification for the associated radio equipment.

#### **4.3 Monitoring facility**

A means should be provided on all receiving equipment fitted with CTCSS for the operator to monitor the channel for a period sufficiently long to determine that it is free before transmitting a call.

#### **4.4 Arrangements for test signals applied to the receiver input**

Sources of test signals for application to the receiver input shall be connected in such a way that the impedance presented to the receiver is 50 ohms.

The levels of the test signals shall be expressed in terms of the emf presented to the receiver input terminals.

### **5 TONE ENCODER AND ASSOCIATED TRANSMITTER**

#### **5.1 Encoder frequency**

##### **5.1.1 Method of measurement**

- a) The transmitter and its associated encoder unit shall be connected via a suitable load and attenuator to a modulation meter, and operated in accordance with the manufacturer's instructions.
- b) The output of the modulation meter shall be connected to a frequency counter and the frequency of the CTCSS modulation measured.
- c) The measurement shall be made under normal test conditions (Clause 3.3), and repeated under extreme test conditions (Clauses 3.4.1 and 3.4.2 applied simultaneously).

### 5.1.2 Limits

The measured CTCSS frequency should under all test conditions be within  $\pm 0.75\%$  of the standard frequency.

## 5.2 Encoder modulation

### 5.2.1 Method of measurement

The equipment shall be arranged as in Clause 5.1.1a, and the CTCSS modulation level shall be measured.

The measurement shall be made under normal test conditions (Clause 3.3, and repeated under extreme test conditions (Clauses 3.4.1 and 3.4.2 applied simultaneously)).

### 5.2.2 Limits

The CTCSS modulation should, under all test conditions be within the following limits:

**Table 2**

System	Amplitude	Angle
Channel spacing kHz	Modulation depth %	Peak deviation $\pm$ Hz
25	10 to 20	400 to 800
12.5	10 to 20	200 to 400

## 5.3 Encoder response time

### 5.3.1 Definition

The encoder response time is the elapsed time from the moment the control circuit is activated at the transmitter until the CTCSS modulation value of the transmitter has reached 90 % of the steady state value.

### 5.3.2 Method of measurement

The transmitter and its associated encoder unit shall be connected via a load and an attenuator to a suitable demodulator.

The output of the demodulator shall be monitored by an oscilloscope.

A suitable synchronising pulse, for the calibrated horizontal scan of the oscilloscope, shall be derived from the signal that enables the encoder and transmitter.

The encoder response time shall be taken as the elapsed time from the enabling signal, until the envelope of the demodulated signal has reached 90 % of its steady state value.<sup>3</sup>

The measurement shall be made under normal test conditions (Clause 3.3).

### 5.3.3 Limits

The encoder response time should not exceed 50 ms.

In the case of transmitters where the radio-frequency rise time is appreciable, this rise time may be added to the above limit.

---

<sup>3</sup> The rise time of the demodulator should not affect the result

## **6 DECODER AND ASSOCIATED RECEIVER**

### **6.1 Tone squelch threshold**

#### **6.1.1 Definition**

The tone squelch threshold is the minimum radio frequency level of the CTCSS signal at the receiver input required to operate the decoder.

#### **6.1.2 Method of measurement**

A test signal at the nominal frequency of the receiver, and modulated with the appropriate CTCSS code frequency at the minimum value shown in Clause 5.2.2, shall be applied to the input of the receiver.

The level of the test signal shall be adjusted to find the minimum level at which the decoder just operates.

The measurement shall be made under normal test conditions (Clause 3.3), and repeated under extreme test conditions (Clauses 3.4.1 and 3.4.2 applied simultaneously).

#### **6.1.3 Limits**

The tone squelch threshold should be less than the maximum usable sensitivity limit of the relevant mandatory receiver specification, under all test conditions. Under all test conditions, the decoder should not operate in the absence of a CTCSS signal, or remain operated when such signal is removed.

### **6.2 Code frequency selectivity**

#### **6.2.1 Definition**

Code frequency selectivity is the ability of the CTCSS decoder to reject signals operating on the same radio frequency channel having the alternate CTCSS code frequencies.

#### **6.2.2 Method of measurement**

A test signal at the nominal frequency of the receiver and at a level 60 dB above the tone squelch threshold (Clause 6.1) shall be applied to the input of the receiver.

The test signal shall be modulated at the maximum value shown in Clause 5.2.2, by the alternate CTCSS code frequencies as appropriate (e.g. 107.2 Hz and 123.0 Hz for a decoder code frequency of 114.8 Hz).

The measurement shall be made under normal test conditions (Clause 3.3) and repeated under extreme test conditions (Clauses 3.4.1 and 3.4.2 applied simultaneously).

#### **6.2.3 Limit**

The decoder should not be operated by either of the alternate CTCSS code frequencies, under all conditions of test.

### **6.3 Decoder response time**

#### **6.3.1 Definition**

The decoder response time is the elapsed time from the application of a CTCSS signal modulated with both standard test modulation and the minimum CTCSS modulation at the receiver input, to the time when the receiver output voltages reaches 75 % of the steady state level.

### 6.3.2 Method of measurement

A test signal at the nominal frequency of the receiver and at a level of 20 dB above the tone squelch threshold (Clause 6.1), shall be applied to the input of the receiver.

The test signal shall be modulated by both standard test modulation (Clause 4.2), and CTCSS modulation at the minimum value shown in Clause 5.2.2.

The CTCSS tone frequency shall be the lowest usable in the particular equipment as stated by the manufacturer.

The receiver output shall be monitored by an oscilloscope.

A suitable synchronising pulse for the calibrated horizontal scan of the oscilloscope shall be derived from the input signal source.

The decoder response time shall be measured as the elapsed time from the application of the test signal to the receiver input terminals, until the envelope of the receiver output voltage has reached 75 % of its steady state level.

The measurement shall be made under normal test conditions (Clause 3.3).

### 6.3.3 Limit

The decoder response time should be less than 250 ms.

## 7 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	± 0.001 %
* Distortion, noise etc. of audio frequency generators	1 %
* Radio frequency voltage	± 2 dB
* Impedance of artificial loads, cables, plugs attenuators etc.	± 5 %
* Radio frequency carrier power (erp)	± 2 dB
* Impedance of artificial loads, combining units, cables, plugs, attenuators etc.	± 5 %
* Source impedance of generators	± 10 %
* Temperature	± 1 °C
* Humidity	± 5 %

## **8 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.