MPT 1381

CODE OF PRACTICE

Digitally Coded Squelch Signalling (DCSS) system for use in the Land Mobile Services

Reprinted November 1996

First published October 1994

Revised and Reprinted November 1994

Revised and Reprinted November 1996

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FOREWORD

This Code of Practice has been produced by the Radiocommunications Agency.

It may be necessary for amendments to this specification to be issued. Amendment sheets will be available from the RA Information and Library Service.

For the latest information concerning Type Approval Status and Licensing conditions, refer to the RA Information Sheet 'RA 275: Status of Land Mobile Radio Specifications (MPT 1300 series)'. This publication also contains contact names and telephone numbers for Agency staff who are able to assist you with licensing and technical enquiries and is available on a single copy basis free from the RA Information & Library Service.

This revision was required in order to allow for;

a) This document to be updated in line with the Agency's current Standard format and layout for the MPT 1300 series specifications.

The Radiocommunications Agency has a 'web site' which can be accessed on *http://www.open.gov.uk/radiocom/rahome.htm*. It is planned that all of the MPT 1300 series of specifications will be available on here.

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For further information on all radio matters please contact the Agency's 24 Hour Telephone Service: 0171 211 0211

Intellectual Property Rights

Firms intending to manufacture equipment which complies with the specification should be aware that certain features of the specification may be subject to IPR claims.

All firms are therefore advised that they should make appropriate enquiries through their Patent Agents before proceeding.

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1 INTRODUCTION

The term ‘Digital Coded Squelch’ (herein referred to as DCS) defines a system in which the radio equipment is fitted with devices which at the transmitter generate a specified digital coded signal during transmission and the receiver respond to a specific digital coded signal.

2 SCOPE

This specification 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 DCS system 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 a 'talkthrough' mode.

Equipment intended to operate on land mobile channels shall be type approved to the requirements of one or more of the following standards:

I-ETS 300 219 (1993): "Radio Equipment and Systems (RES); Land mobile service; Technical characteristics and test conditions for radio equipment transmitting signals to initiate a specific response in the receiver".

ETS 300 086: "Radio Equipment and Systems (RES); Land mobile service; Technical characteristics and test conditions for radio equipment with an internal or external RF connector intended primarily for analogue speech".

I-ETS 300 113 (1992): "Radio Equipment and Systems (RES); Land mobile service; Technical characteristics and test conditions for non-speech and combined analogue speech/non- speech equipment with an internal or external connector, intended for the transmission of data".

and for existing licensed systems to MPT 1301, MPT 1302, MPT 1303 or MPT 1304 and MPT 1326.

3 TEST CONDITIONS, ATMOSPHERIC CONDITIONS AND POWER SUPPLIES

The test conditions for any of the parameters stated in this standards shall conform to those specified in the appropriate standard(s) described in Clause 2 of this standard.

4 GENERAL CONDITIONS

4.1 DCS Codeword

4.1.1 Definition

The DCS codeword is a specific digitally coded signal transmitted continuously on the carrier frequency. The DCS codeword consists of a 23 bit frame which is transmitted at 134.4 bit/s.

The codeword is generated from a (23,12) cyclic Golay code and consists of the basic components illustrated in Figure 1.

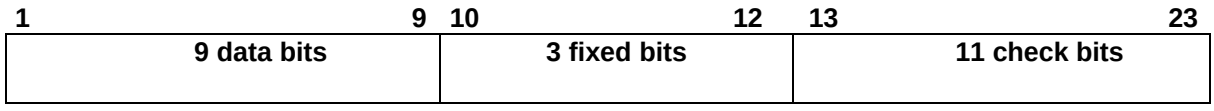

Figure 1

Bits 1 to 9 are the originating DCS code and are normally expressed as a 3 digit octal (base 8) number (where bit 1 is the least significant bit). See subclause 4.1.2.

Bits 10 to 12 are fixed at 001_2.

Bits 13 to 23 are the check bits generated by the Golay algorithm.

Bit 1 is transmitted first.

4.1.2 Standard codes

The standard codes available for assignment are shown below. The precise DCS codes from the different groups will be quoted by the Secretary of State when a licence is issued.

Table 1: Group 1

3 contiguous bits: lowest frequency 22.33 Hz	
Code	Code
212	311
243	315
246	325
252	332
255	346
266	431

Table 2: Group 2

4 contiguous bits: lowest frequency 16.75 Hz		
Code	Code	Code
114	143	226
115	145	261
122	155	343
125	156	466
131	162	565
132	165	606
134	205	654

Table 3: Group 3

5 contiguous bits: lowest frequency 13.40 Hz		
Code	Code	Code
043	072	331
053	073	371
054	074	432
065	116	624
071		

Table 4: Group 4

6 contiguous bits: lowest frequency 11.17 Hz	
Code	Code
023 025 026	031 032 036

4.2 Standard test modulation

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

4.3 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 DCS ENCODER AND ASSOCIATED TRANSMITTER

5.1 Encoder modulation

5.1.1 Definition

The encoder modulation is the modulation used to transmit the DCS signal on the carrier frequency.

5.1.2 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. See Figure 1, Annex A.

b) The measurement shall be made under normal test conditions, and repeated under extreme test conditions.

5.1.3 Limits

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

Table 5

SYSTEM	**AMPLITUDE**	**ANGLE**
Channel Spacing kHz	Modulation Depth %	Peak Deviation +/- Hz
25.0 12.5	10 to 20 10 to 20	400 - 800 200 - 400

5.2 Encoder response time

5.2.1 Definition

The encoder response time is the elapsed time from the moment the control circuit is activated at the transmitter (simultaneously when the transmitter is initiated) until the DCS modulation value of the transmitter has reached 90 % of the steady state value.

5.2.2 Method of measurement

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

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

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

d) The transmitter and its associated encoder shall be connected via a suitable load and attenuator to a modulation meter, and operated in accordance with the manufacturers instructions. The encoder shall be arranged such as to produce a DCS codeword. The output of the modulation meter shall be connected to a frequency counter and the modulation frequencies associated with the transmission of the codeword be measured. These shall be known as the steady state values.

e) The encoder response time shall be taken as the elapsed time from the enabling signal, until the envelope of the DCS modulation signal has reached 90 % of its steady state value.

f) The measurement shall be made under normal test conditions.

5.2.3 Limits

The encoder response time should not exceed 50 ms.

5.3 Encoder data rate

5.3.1 Method of measurement

a) The encoder shall be arranged to give normal operation.

b) The output from the bit rate clock, if available, shall be connected to a frequency counter and its frequency measured. If this facility is not accessible then the DCS signal shall be demodulated and the bit rate measured.

c) The measurements shall be made under normal test conditions and under extreme test conditions.

5.3.2 Limit

The encoder rate shall under all conditions be within +/-2% of the nominal bit rate (see sub-clause 4.1.1)

6 DECODER AND ASSOCIATED RECEIVER

6.1 DCS operating threshold

6.1.1 Definition

The DCS operating threshold is the minimum radio frequency level of the DCS signal at the receiver input required to operate the decoder.

6.1.2 Method of measurement

a) A test signal at the nominal frequency of the receiver, and modulated with an appropriate DCS codeword at the minimum value shown in sub clause 5.1.2 a), shall be applied to the input of the receiver.

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

c) The measurement shall be made under normal test conditions, and repeated under extreme test conditions.

6.1.3 Limits

a) The 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 DCS signal, or remain operated when such signal is removed.

b) The DCS codeword shall achieve a minimum 90 % decode success rate from a minimum 100 DCS codeword transmissions.

6.2 Response time

6.2.1 Definition

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

6.2.2 Method of measurement

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

b) The test signal shall be modulated by both standard test modulation (clause 4.2), and DCS modulation at the minimum value shown in clause 5.1.2.

c) The DCS codeword shall be taken from Group 4 in subclause 4.1.2.

d) The receiver output shall be monitored by an oscilloscope.

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

f) The decoder and receiver 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.

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

6.2.3 Limit

The response time shall be less than 350 ms.

6.3 Decoder Tolerance to Bias Distortion

6.3.1 Definition

The maximum mark or space bias distortion (expressed in percentage) that a DCS decoder can tolerate and still decode correctly.

6.3.2 Method of measurement

a) Connect the equipment as shown in Figure 1 shown in Annex B. To calibrate the pulse distorting unit, connect the square wave generator in place of the codeword generator. The square wave generator output must be symmetrical, with the mark and space duration equal in duration and each part equal to the bit length of the code from the codeword generator. The amplitude of the square wave pulses should be approximately equal to that of the code pulses.

b) While observing the output of the distorting unit on the oscilloscope, adjust the distorting unit for a mark bias distortion that produces an output wave with a mark 2.6 times as long as the space. This is equivalent to a 45 percent mark bias distortion.

c) Replace the square wave generator with a codeword generator. Set the DCS test modulation at its lowest limit. Adjust signal generator to the standard test frequency and its output voltage to the value corresponding to the level in clause 6.1. The receiver squelch must open as evidenced by receiver noise output.

Repeat the test for 45 percent space bias distortion by adjusting the distortion unit to produce an output wave with the space 2.6 times as long as the mark.

6.3.3 Limit

The DCS decoder tolerance to bias distortion shall not be less than 45 percent.

7 MEASUREMENT UNCERTAINTY

The absolute measurement uncertainties are those taken from the relevant specifications listed in clause 2 of this specification.

8 INTERPRETATION OF THE MEASUREMENT RESULTS

The interpretation of the results recorded in a test report for the measurements described in this specification be as follows.

The measured value related to the corresponding limit will be used to decide whether an equipment meets the requirement of the standard.

The measurement uncertainty value for the measurement of each parameter shall be included in the test report.

The recorded value of the measurement uncertainty shall be, for each measurement, equal or lower than those required in clause 7 of this specification.

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.

ANNEX A: ENCODER TEST DIAGRAMS

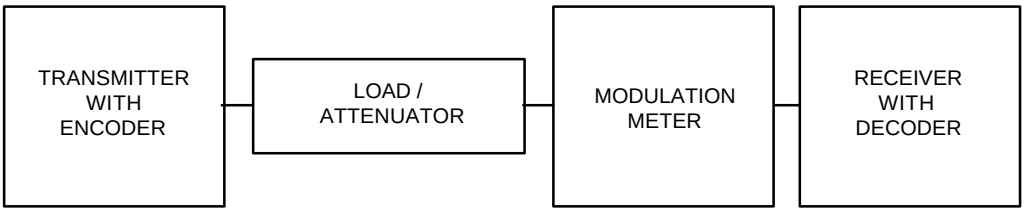

Figure A1: Encoder modulation test

ANNEX B: DECODER TEST DIAGRAMS

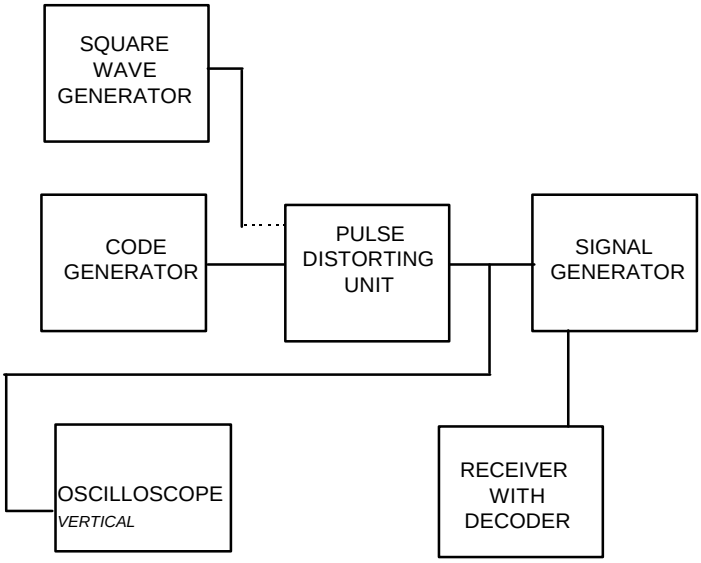

Figure B1: Decoder tolerance to bias distortion test