



Technical Specification

**Electromagnetic compatibility
and Radio spectrum Matters (ERM);
Continuous Tone Controlled Signalling System (CTCSS) and
Digitally Coded Squelch Signalling (DCSS) system**

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM).

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1 Scope

The present document contains technical requirements for Continuous Tone Controlled Signalling System (CTCSS) and Digitally Coded Squelch Signalling (DCSS).

CTCSS and DCSS systems allow the audio in a receiver to be selectively enabled/disabled on receipt of a specific tone/code. These tones/codes are transmitted continuously during the transmission so the receiver would normally implement suitable process to remove them from the wanted audio signal.

The present document specifies signalling systems that may be used with analogue FM voice equipment complying with either EN 300 086-1 [i.1]/EN 300 086-2 [i.2] or EN 300 296-1 [i.3]/EN 300 296-2 [i.4].

The present document only applies to equipment that employs frequency or phase modulation.

The scope of the present document is similar to prior national standards [i.5], [i.6] and aspects of international standards [i.7].

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

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2.1 Normative references

The following referenced documents are necessary for the application of the present document.

None.

2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] ETSI EN 300 086-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Land Mobile Service; Radio equipment with an internal or external RF connector intended primarily for analogue speech; Part 1: Technical characteristics and methods of measurement".
- [i.2] ETSI EN 300 086-2: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Land Mobile Service; Radio equipment with an internal or external RF connector intended primarily for analogue speech; Part 2: Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive".
- [i.3] ETSI EN 300 296-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Land Mobile Service; Radio equipment using integral antennas intended primarily for analogue speech; Part 1: Technical characteristics and methods of measurement".
- [i.4] ETSI EN 300 296-2: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Land Mobile Service; Radio equipment using integral antennas intended primarily for analogue speech; Part 2: Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive".

- [i.5] MPT1306: "Continuous tone controlled signalling system (CTCSS) for use in the Land Mobile Services", October 1996.
- [i.6] MPT1381: "Digitally Coded Squelch Signalling (DCSS) system for use in the Land Mobile Services", November 1996.
- [i.7] TIA-603-D: "Land Mobile FM or PM communications equipment measurement and performance standards".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

Radio Frequency channel: radio frequency carrier (RF carrier)

SINAD Meter: measurement instrument used to measure SND/ND using a band-stop filter

Squelch: circuits or functionality provided that mutes the received signal (audio) under specified conditions, e.g. the absence of a wanted signal at the input of the receiver

3.2 Symbols

For the purposes of the present document, the following symbols apply:

- f_1 lowest modulation frequency
- f_2 highest modulation frequency

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

CTCSS	Continuous Tone Controlled Signalling System
DC	Direct Current
DCS	Digitally Coded Squelch
DCSS	Digitally Coded Squelch Signalling
DUT	Device Under Test
FM	Frequency Modulation
FSK	Frequency Shift Keying
LSB	Least Significant Bit
MPFD	Maximum Permissible Frequency Deviation
MSB	Most Significant Bit
NRZ	Non Return to Zero
RF	Radio Frequency
SINAD	Received signal quality based on (Signal + Noise + Distortion)/(Noise + Distortion)

4 Overview

4.1 CTCSS

CTCSS is 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.

The CTCSS code frequency is the assigned tone frequency. The standard frequencies available for assignment are given in table 1.

Table 1: CTCSS Code Frequencies

Freq (Hz)	Freq (Hz)	Freq (Hz)	Freq (Hz)
67,0	94,8	131,8	186,2
69,3	97,4	136,5	192,8
71,9	100,0	141,3	203,5
74,4	103,5	146,2	210,7
77,0	107,2	151,4	218,1
79,7	110,9	156,7	225,7
82,5	114,8	162,2	233,6
85,4	118,8	167,9	241,8
88,5	123,0	173,8	250,3
91,5	127,3	179,9	

4.2 DCS

4.2.1 DCS codewords

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 structure of the codeword is shown in figure 1. Bits 1 to 9 are the originating DCS code and are normally expressed as a 3 digit octal number where bit 1 is the LSB. Bits 12 to 10 are fixed at 100₂. Bits 13 to 23 are check bits generated by a (23,12) cyclic Golay code.

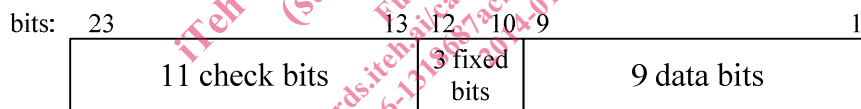


Figure 1: DCS codeword structure

The LSB is transmitted first (bit 1).

4.2.2 DCS codewords

Allowable codewords are shown in table 2. DCS codes may be separated in four groups as follows:

Group 1: codes have 3 contiguous bits (lowest frequency 22,33 Hz)

Group 2: codes have 4 contiguous bits (lowest frequency 16,75 Hz)

Group 3: codes have 5 contiguous bits (lowest frequency 13,40 Hz)

Group 4: codes have 6 contiguous bits (lowest frequency 11,17 Hz)

Table 2: DCS Codewords

Octal Code	Bit Pattern		Octal Code	Bit Pattern	
	MSB	LSB		MSB	LSB
023	11101100011100000010011		162	11010111100100001110010	
025	11010110111100000010101		165	01100011101100001110101	
026	11001011101100000010110		172	00001011111100001111010	
031	10100011111100000011001		174	00110001011100001111100	
032	10111110101100000011010		205	11011101001100010000101	
043	10110110110100000100011		223	11010001110100010010011	
047	00011111101100000100111		226	11110110000100010010110	
051	11111001010100000101001		243	10001011011100010100011	
054	11011110100100000101100		244	00111111010100010100100	
065	10111010001100000110101		245	10110001111100010100101	
071	11001111001100000111001		251	11000100111100010101001	
072	11010010011100000111010		261	00101110111100010110001	
073	01011100110100000111011		263	10111101000100010110011	
074	11101000111100000111100		265	10000111100100010110101	
114	01101011110100001001100		271	11110010100100010111001	
115	11100101011100001001101		306	00011001111100011000110	
116	11111000001100001001110		311	01110001101100011001001	
125	00001111011100001010101		315	11011000110100011001101	
131	01111010011100001011001		331	01000111110100011011001	
132	01100111001100001011010		343	01010010111100011100011	
134	01011101101100001011100		346	01110101001100011100110	
143	01101111010100001100011		351	00011101011100011101001	
152	00111101100100001101010		364	11010000101100011110100	
155	10001001101100001101101		365	01011110000100011110101	
156	10010100111100001101110		371	00101011000100011111001	
411	11101110110100100001001		606	10111011001100110000110	
412	11110011100100100001010		612	110011100011001100001010	
413	01111101001100100001011		624	00011110101100110010100	
423	10010111001100100010011		627	00000011111100110010111	
431	11011000101100100011001		631	11100101000100110011001	
432	11000101111100100011010		632	11111000010100110011010	
445	11110111000100100100101		654	10011000011100110101100	
464	01001111110100100110100		662	01001000111100110110010	
465	11000001011100100110101		664	01110010011100110110100	
466	11011100001100100110110		703	01000101011100111000011	
503	01111000110100101000011		712	00010111101100111001010	
506	01011111000100101000110		723	01110011000100111010011	
516	10000011011100101001110		731	00111100100100111011001	
532	00011100011100101011010		732	00100001110100111011010	
546	00110011110100101100110		734	00011011010100111011100	
565	00011000111100101110101		743	00101001101100111100011	
			754	01000001111100111101100	

4.2.3 DCS Modulation

DCS Modulation is a NRZ baseband FSK modulation. The polarity of the modulation shall be a negative frequency shift for a 0 and a positive frequency shift for a 1.

5 Test conditions, power sources and ambient temperatures

5.1 Normal and extreme test conditions

Testing shall be performed under normal test conditions, and also, where stated, under extreme test conditions.

The test conditions and procedures shall be as specified in clauses 5.2 to 5.5.

5.2 Test power source

During testing the power source of the equipment shall be replaced by a test power source capable of producing normal and extreme test voltages as specified in clauses 5.3.2 and 5.4.2. The internal impedance of the test power source shall be low enough for its effect on the test results to be negligible. For the purpose of tests, the voltage of the power source shall be measured at the input terminals of the equipment.

For battery operated equipment the battery shall be removed and the test power source shall be applied as close to the battery terminals as practicable.

During tests of DC powered equipment the power source voltages shall be maintained within a tolerance of $< \pm 1$ % relative to the voltage at the beginning of each test. The value of this tolerance is critical for power measurements. Using a smaller tolerance will provide better measurement uncertainty values.

5.3 Normal test conditions

5.3.1 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 %.

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

5.3.2 Normal test power source

5.3.2.1 Mains voltage

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, 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 Hz and 51 Hz.

5.3.2.2 Regulated lead-acid battery power sources used on vehicles

When the radio equipment is intended for operation from the usual types of regulated lead-acid battery power source used on vehicles the normal test voltage shall be 1,1 times the nominal voltage of the battery (for nominal voltages of 6 V and 12 V, these are 6,6 V and 13,2 V respectively).

5.3.2.3 Other power sources

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