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**Universal Personal Telecommunication (UPT);  
Access devices  
Dual Tone Multi Frequency (DTMF) sender for acoustical  
coupling to the microphone of a handset telephone**

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## Foreword

This Interim European Telecommunication Standard (I-ETS) was produced by the Terminal Equipment (TE) Technical Committee of the European Telecommunications Standards Institute (ETSI).

An ETSI standard may be given I-ETS status either because it is regarded as a provisional solution ahead of a more advanced standard, or because it is immature and requires a "trial period". The life of an I-ETS is limited to three years after which it can be converted into an ETS, have its life extended for a further two years, be replaced by a new version, or be withdrawn.

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## 1 Scope

This I-ETS defines the tone generating and acoustical characteristics of a one-way (sending) Universal Personal Telecommunication (UPT) access device of Dual Tone Multi Frequency (DTMF) type to be acoustically coupled to the mouthpiece of a telephone set. The characteristics specified have been chosen to conform to the transmission requirements as specified in ETS 300 001 and, therefore, to be generally acceptable for use in the Public Switched Telephone Network (PSTN) and Integrated Services Digital Network (ISDN).

The I-ETS specifies a test arrangement to verify conformance. It is not possible to standardize the physical dimensions for efficient acoustic coupling because of the wide variety of handset types in use in Europe. When using a device conforming to this I-ETS, the electrical level to the network will depend on the characteristics of the telephone set to which it is acoustically coupled. Annex B to this I-ETS indicates the variation level that could be expected. A worst case scenario is that a device conforming to this I-ETS will not ensure proper functioning.

NOTE: The specification of the functional requirements of the device is outside the scope of this I-ETS. Information about functional requirements can be found in prETS 300 391-1.

## 2 Normative references

This I-ETS incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this I-ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1] IEC 318: "An IEC artificial ear, of the wideband type, for the calibration of earphones used in audiometry".

## 3 Abbreviations

For the purposes of this I-ETS, the following abbreviations apply:

DTMF	Dual Tone Multi Frequency
ISDN	Integrated Services Digital Network
PSTN	Public Switched Telephone Network
SLR	Sending Loudness Rating
SPL	Sound Pressure Level
UPT	Universal Personal Telecommunication

## 4 Transmission requirements

### 4.1 Signalling frequencies

The 16 dual tone frequency combinations assigned to digits or special signalling characters are shown in the matrix given in table 1.

**Table 1: Signalling frequency combinations**

Low group (Hz)	High group (Hz)			
	1 209	1 336	1 477	1 633
697	1	2	3	A
770	4	5	6	B
852	7	8	9	C
941	*	0	#	D

The device shall use either 12 or 16 frequency combinations. In the case of 12 combinations the frequencies assigned to A, B, C and D shall not be used.

The accepted tolerance on the frequencies as specified in table 1 shall be 1,5 %.

Compliance shall be checked using the test described in subclause 5.2.

### 4.2 Transmission levels

The device shall not produce more than -12 dBPa Sound Pressure Level (SPL) for all the tone combinations that can be generated.

NOTE: The operation condition of the DTMF receivers may, as a signal detection condition, require that the difference in the levels of the received two signalling frequencies be less than 6 dB (see also annex B, clause B.4).

Compliance shall be checked using the tests described in subclause 5.3.

### 4.3 Duration

#### 4.3.1 Manually controlled sending

If the output signal of the sending device is manually controlled, the duration of any individual tone combination, and of the pause between the tone combinations, shall relate directly to the actuation of the pushbutton.

NOTE: If two or more buttons are pressed at the same time, only one tone combination, or no tone combination at all, should be sent to the line.

Compliance shall be checked using the test described in subclause 5.4.

#### 4.3.2 Automatic controlled sending

If the time characteristics of the sending device are controlled by the device, the duration of any individual tone combination shall be greater than 70 ms, and the pause between the tone combinations shall also be greater than 70 ms.

NOTE 1: If two or more buttons are pressed at the same time, only one tone combination, or no tone combination at all, should be sent to the line.

NOTE 2: For automatic controlled sending it is desirable that the duration of the signal and the pause length is limited. ETS 300 001, Chapter 5, subclause 5.4.7.2 gives guidelines on suitable values.

Compliance shall be checked using the test described in subclause 5.4.



#### **4.4 Unwanted frequency components**

When transmitting any tone combination, the total power level of all unwanted frequency components over the bandwidth 300 Hz to 3 400 Hz shall be at least 20 dB below the low frequency or the high-frequency component, whichever is the lowest.

Compliance shall be checked using the test described in subclause 5.5.

### **5 Test specification**

#### **5.1 General**

For all measurements, the device under test shall be placed on an artificial ear according to IEC 318 [1] fitted with a flat plate mounted on the artificial ear. The test arrangement is defined in annex A. The device is pressed tightly to the plate with the transmitter opening centered to the artificial ear. The device is then moved to find the position where the largest output signal from the artificial ear is found. The measurements shall be carried out with the device in this position.

The measurements shall be carried out with fresh batteries.

#### **5.2 Frequencies**

The frequencies shall be measured for each output signal (each character) with a suitable measuring instrument.

#### **5.3 Transmission levels**

The total signal level shall be measured for each output signal (character) with a suitable measuring instrument.

#### **5.4 Duration**

The duration of each output signal (character), and the pause between the signals, shall be measured with a suitable measuring instrument.

#### **5.5 Unwanted frequency components**

The total level of the frequency components, excluding the DTMF tone combinations, shall be measured with a suitable measuring equipment. The level of the low-frequency component and the high-frequency component shall be measured separately with a suitable measuring instrument.

Additional information about the measurement technique can be found in ETS 300 001, Chapter 5, subclause 5.4.

Annex A (normative): Test arrangement

A.1 IEC 318 coupler/flat plate arrangement

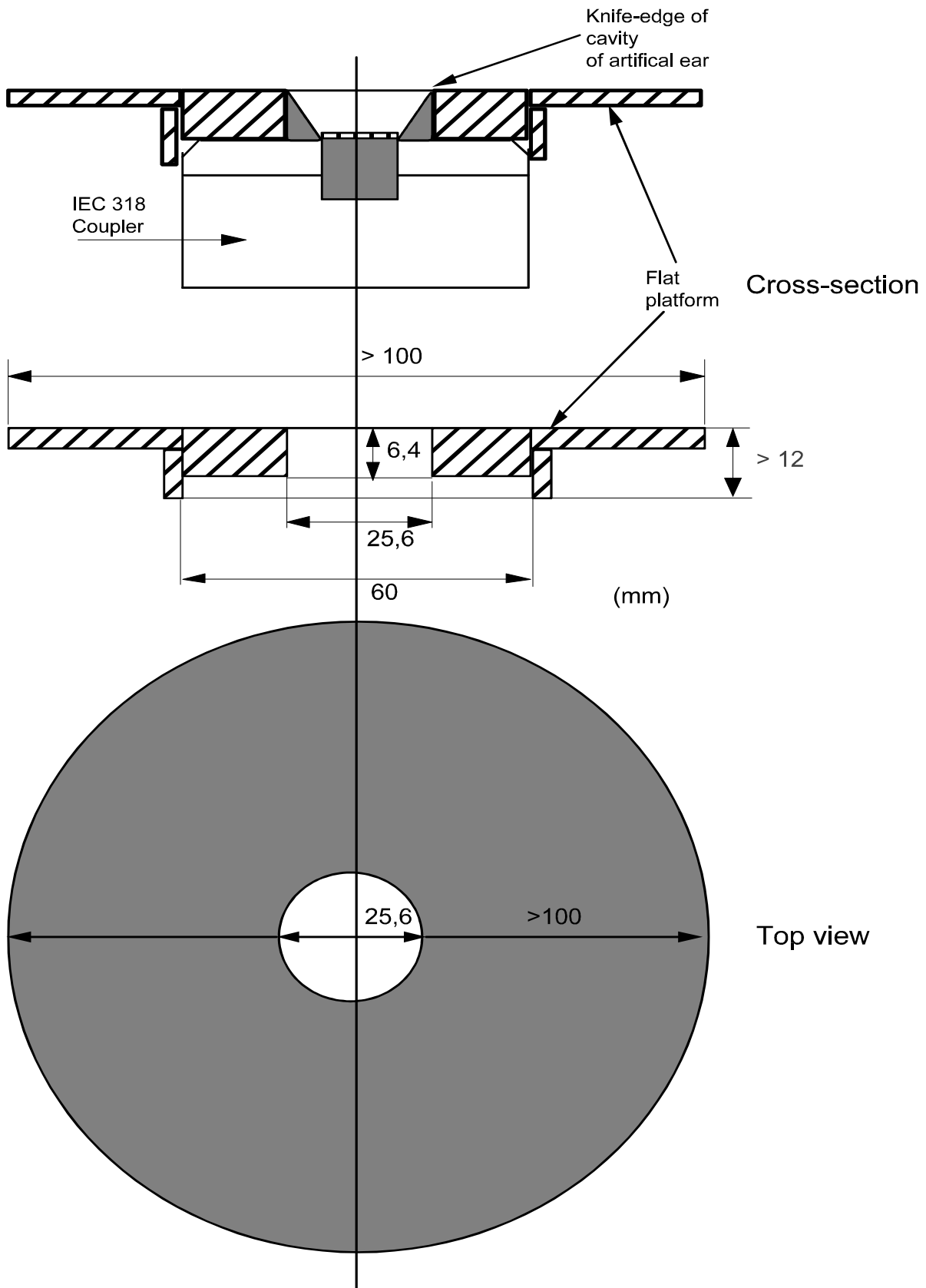


Figure A.1

## **Annex B (informative): Comments on acoustic coupling**

### **B.1 Output level**

Measurements on a number of acoustic DTMF devices connected to a number of different two piece linear telephone sets with conventional types of handsets (according to the principles set out in CCITT Recommendation P.35 ("Handset telephones")) show a total spread in output level of about 20 dB, if the telephone sets are normalised to the same sending sensitivity (Sending Loudness Rating (SLR)). The requirement in subclause 4.2 is based on the fact that the most sensitive combination acoustic device/telephone set according to these measurements gives a signal level to the line of not more than -7 dBm for SLR = -1 dB. The line level of -7 dBm corresponds to the DTMF sending level, option 1, as specified in ETS 300 001. The value SLR = -1 dB corresponds to the nominal value of the most sensitive telephone set that can be found throughout Europe.

As a consequence, the different combinations acoustic device/telephone set gives an output level to the line in the range -7 dBm to -27 dBm. If the spread in SLR between different feeding conditions and different countries also is considered, the expected range will probably be around -7 dBm to -35 dBm. If the tolerances from the nominal value for individual telephone sets also is considered the spread may even be a little bit wider.

If the specification is based on the worst case principle a variation in the output level (taking into account all possible causes of variation) from -5 dBm to -40 dBm may be expected. For telephone sets with a peculiar shape, and especially for one piece telephone sets, the output level can be even lower.

For many one piece telephone sets the hook function prevents the acoustic device from being fitted in a suitable position.

### **B.2 Unwanted signals**

There is no requirement on unwanted signals outside the speech band. The reasons are that the acoustic coupler itself probably produces reasonable low signal levels, especially at frequencies above 10 kHz, and that the telephone itself acts as a rather steep filter above approximately 4 kHz. The corresponding requirements for the DTMF function in terminals are to be found in ETS 300 001, Chapter 5, subclause 5.4.5.

### **B.3 Test setup**

The test setup, including an artificial ear with a defined cavity, is intended to be used for measurements of the receiving characteristics of circumaural earphones, and is not a perfect tool to measure the electroacoustic characteristics of a device transmitting DTMF tones.

However, practical measurements have shown that the proposed test device can give reproducible results.

The actual test device is considered to be a temporary solution until a more suitable device has been designed.

### **B.4 Level difference**

There is no requirement on the difference between the level of the high and the low frequency component. Devices giving the same difference between the two tones measured with the IEC coupler usually do not give the same difference between the tones in real use with telephone sets. However, for most couplers, it seems reasonable that the level of the low frequency tone should be 2 dB - 3 dB higher than the level of the high frequency tone (measured with the IEC 318 [1] coupler) to give the best performance for most telephone sets.

## **Annex C (informative): Bibliography**

The following documents are referenced informatively by this I-ETS:

- 1) CCITT Recommendation P.35: "Handset telephones".
- 2) prETS 300 391-1: "Universal Personal Telecommunication (UPT) - Specification of the security architecture for UPT phase 1 - Part 1: Specification".
- 3) ETS 300 001: "Attachments to Public Switched Telephone Network (PSTN) - General technical requirements for equipment connected to an analogue subscriber interface in the PSTN (Candidate NET 4)".

## History

Document history	
March 1995	First Edition
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