

# ETSI TS 100 392-15 V1.4.1 (2010-03)

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*Technical Specification*

## **Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 15: TETRA frequency bands, duplex spacings and channel numbering**

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Reference

RTS/TETRA-03205

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Keywords

radio, TETRA, V+D

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## Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Terrestrial Trunked Radio (TETRA).

The present document is part 15 of a multi-part deliverable covering Voice plus Data (V+D), as identified below:

- EN 300 392-1: "General network design";
- EN 300 392-2: "Air Interface (AI)";
- EN 300 392-3: "Interworking at the Inter-System Interface (ISI)";
- ETS 300 392-4: "Gateways basic operation";
- EN 300 392-5: "Peripheral Equipment Interface (PEI)";
- EN 300 392-7: "Security";
- EN 300 392-9: "General requirements for supplementary services";
- EN 300 392-10: "Supplementary services stage 1";
- EN 300 392-11: "Supplementary services stage 2";
- EN 300 392-12: "Supplementary services stage 3";
- ETS 300 392-13: "SDL model of the Air Interface (AI)";
- ETS 300 392-14: "Protocol Implementation Conformance Statement (PICS) proforma specification";
- TS 100 392-15: "TETRA frequency bands, duplex spacings and channel numbering";**
- TS 100 392-16: "Network Performance Metrics";
- TR 100 392-17: "TETRA V+D and DMO specifications";
- TS 100 392-18: "Air interface optimized applications".

NOTE: Part 13 (SDL) and part 14 (PICS) of this multi-part are of status "historical" and will not be updated according to this version of the standard.

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# 1 Scope

The present document defines TETRA frequency bands, duplex spacings and channel numbering for the Terrestrial Trunked Radio (TETRA) system supporting Voice plus Data (V+D).

The informative annex A gives an example of the radio channel definition.

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# 2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific.

- For a specific reference, subsequent revisions do not apply.
- Non-specific reference may be made only to a complete document or a part thereof and only in the following cases:
  - if it is accepted that it will be possible to use all future changes of the referenced document for the purposes of the referring document;
  - for informative references.

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NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

## 2.1 Normative references

The following referenced documents are indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

- [1] ETSI EN 300 392-2: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 2: Air Interface (AI)".

## 2.2 Informative references

The following referenced documents are not essential to the use of the present document but they assist the user with regard to a particular subject area. For non-specific references, the latest version of the referenced document (including any amendments) applies.

- [i.1] CEPT T/R 25-08: "Planning criteria and coordination of frequencies in the land mobile service in the range 29.7-960 MHz".

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# 3 Definitions and abbreviations

## 3.1 Definitions

For the purposes of the present document, the terms and definitions given in EN 300 392-2 [1] apply.

## 3.2 Abbreviations

For the purposes of the present document, the abbreviations given in EN 300 392-2 [1] apply.

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# 4 Carrier frequencies and radio channel numbers

TETRA can support multiple carrier frequency requirements such as different offsets from multiples of 25 kHz. If the same frequency band will be allocated in different countries using different variants, the same base frequency of the frequency band is used and the migrating MS shall carefully study SYSINFO broadcast to find out the applied offset and duplex spacing values.

In the clause 21.4.4.1 in EN 300 392-2 [1] the main carrier frequency is defined as:

- downlink main carrier frequency = base frequency + (main carrier × 25 kHz) + offset kHz; and

in the clause 21.5.2 in EN 300 392-2 [1] the carrier number is defined as:

- downlink carrier frequency = base frequency + (carrier number × 25 kHz) + offset kHz.

For the purpose of the TETRA carrier frequency definition the base frequency shall be equal to the reference frequency for the band. The reference frequency need not coincide with the band edge frequency. The main carrier (or carrier number) is the carrier number (N).

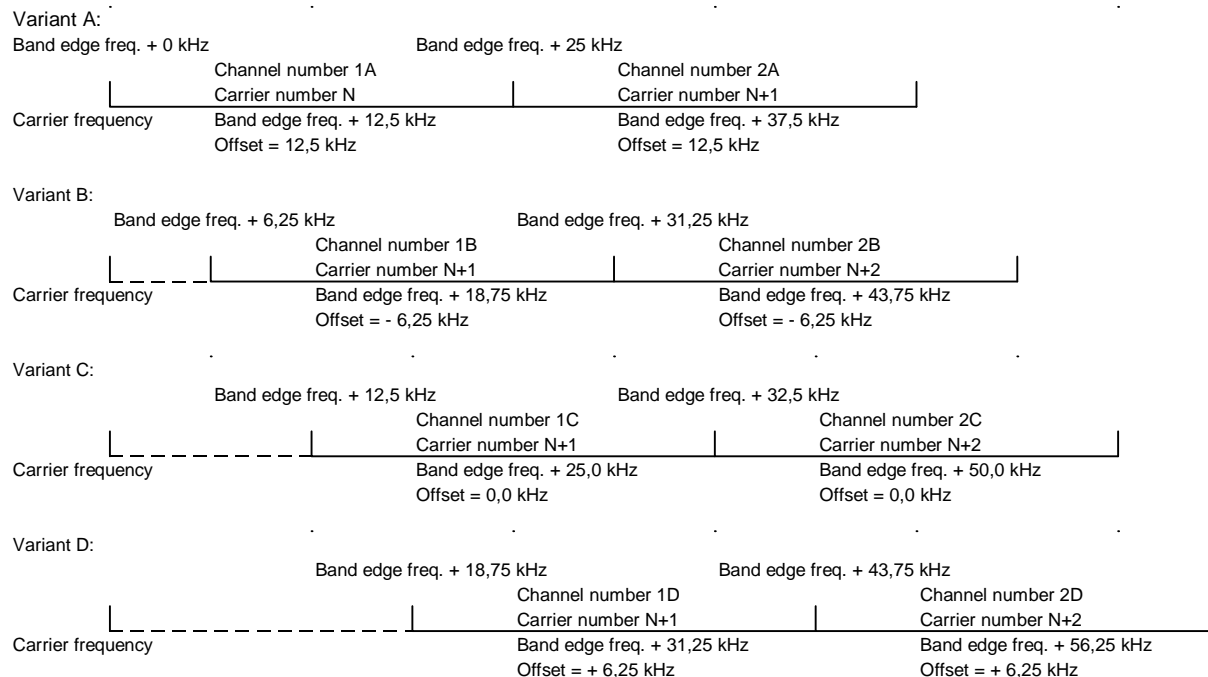
The carrier frequency offsets defined in clause 21.4.4.1 in EN 300 392-2 [1] allow values:

- a) -6,25 kHz;
- b) 0 kHz;
- c) +6,25 kHz; and
- d) +12,5 kHz.

With those values up to four different radio carrier frequency allocations are possible as shown in figure 1. The number of the first whole radio channel is always "1". The radio channel numbers for different allocations are marked by a letter A, B, C or D. That marking of radio channels by additional letter allows to keep channel numbers running 1, 2, 3 etc. If there is only one region (country) wide allocation variant in use, as for the band 380 MHz to 400 MHz in Europe, then the letter can be left out.

The possible variants are shown in the figure 1 where the band edge frequency is the reference frequency + the band position. Both the reference frequency and the band position values are assumed to be even numbers of form XXX,000 MHz. The band position is not transferred over the air interface protocol as a separate information element but it is included into the carrier number N.

**NOTE:** The radio channel number is intended for human purposes and it normally starts with value "1" for the lowest radio channel. The main carrier (carrier number) is defined for the MAC layer protocol purposes to be used in the air interface signalling. The numerical values of the radio channel number and the carrier number are normally different for the same radio channel. The radio channel number values are outside the scope of the present document.



**Figure 1: Channel allocation possibilities**

The radio channel number is what a user may see especially in direct mode operation and may be defined in the frequency band allocation documentation. It is proposed to define radio channel numbers starting from the band edge independently whether radio channels allocated for TETRA usage starting from band edge so that the radio channel numbers will be same in all countries.

The carrier number N is a TETRA radio protocol internal number, which is used in the radio carrier definition. Both the radio channel number and the associated carrier number are the same for both base station and mobile station and the difference in transmitter frequencies is defined by the duplex spacing and the normal/reverse information elements.

Most probably only variants A and B will be applied for TETRA frequency allocations in Europe. As a regulatory issue the radio channel centre frequency (offset) allocations are outside the scope of the present document.

## 5 TETRA frequency bands

The frequency band information element values generally and for the current defined bands for TETRA in Europe shall be encoded as defined in table 1. The frequency band information element value is valid for the whole indicated frequency range although it may not be allocated totally for TETRA service. The reference and base frequency is defined by the frequency band of the BS transmitter.

As a regulatory issue the frequency band allocations are outside the scope of the present document and the indicated band pairs are for information to indicate the information element encoding for those bands.

Table 1: TETRA frequency bands

Frequency band of the MS transmitter	Frequency band of the BS transmitter	Reference and base frequency	Value of the Frequency band element	Value of the Reverse operation element
100 MHz (see note 1)	100 MHz (see note 1)	100,000 MHz	0001 <sub>2</sub>	0 <sub>2</sub> (Normal) (see note 2)
200 MHz (see note 1)	200 MHz (see note 1)	200,000 MHz	0010 <sub>2</sub>	0 <sub>2</sub> (Normal) (see note 2)
300 MHz (see note 1)	300 MHz (see note 1)	300,000 MHz	0011 <sub>2</sub>	0 <sub>2</sub> (Normal) (see note 2)
380 MHz to 390 MHz	390 MHz to 400 MHz	300,000 MHz	0011 <sub>2</sub>	0 <sub>2</sub> (Normal)
400 MHz (see note 1)	400 MHz (see note 1)	400,000 MHz	0100 <sub>2</sub>	0 <sub>2</sub> (Normal) (see note 2)
410 MHz to 420 MHz	420 MHz to 430 MHz	400,000 MHz	0100 <sub>2</sub>	0 <sub>2</sub> (Normal)
450 MHz to 460 MHz	460 MHz to 470 MHz	400,000 MHz	0100 <sub>2</sub>	0 <sub>2</sub> (Normal)
500 MHz (see note 1)	500 MHz (see note 1)	500,000 MHz	0101 <sub>2</sub>	0 <sub>2</sub> (Normal) (see note 2)
600 MHz (see note 1)	600 MHz (see note 1)	600,000 MHz	0110 <sub>2</sub>	0 <sub>2</sub> (Normal) (see note 2)
700 MHz (see note 1)	700 MHz (see note 1)	700,000 MHz	0111 <sub>2</sub>	0 <sub>2</sub> (Normal) (see note 2)
800 MHz (see note 1)	800 MHz (see note 1)	800,000 MHz	1000 <sub>2</sub>	0 <sub>2</sub> (Normal) (see note 2)
870 MHz to 876 MHz	915 MHz to 921 MHz	900,000 MHz	1001 <sub>2</sub>	0 <sub>2</sub> (Normal)
900 MHz (see note 1)	900 MHz (see note 1)	900,000 MHz	1001 <sub>2</sub>	0 <sub>2</sub> (Normal) (see note 2)
NOTE 1: For this frequency band only the reference frequency is defined and the actual band limits will be defined by regulatory bodies. It is preferred that the lowest possible radio channel in all areas where this band is available is numbered to be "1" independently whether it is actually available for TETRA usage.				
NOTE 2: Also reverse operation may be used in some frequency allocation.				

NOTE 1: The air interface protocol is independent of the actual frequency bands as the reference/base frequency (a multiple of 100 MHz) and the carrier number with the offset, duplex spacing and reverse operation information elements alone define as a mathematical equation the real carrier frequency.

NOTE 2: In future more frequency bands may be defined or more details added to the TETRA frequency bands.



## 6 Duplex spacing

The duplex spacing values are defined without any mathematical rule. The duplex spacing shall be reference/base frequency dependent as defined in table 2. The 0,000 MHz duplex value may be needed for direct mode operation and is included here for completeness.

**Table 2: Duplex spacing as function of the reference/base frequency**

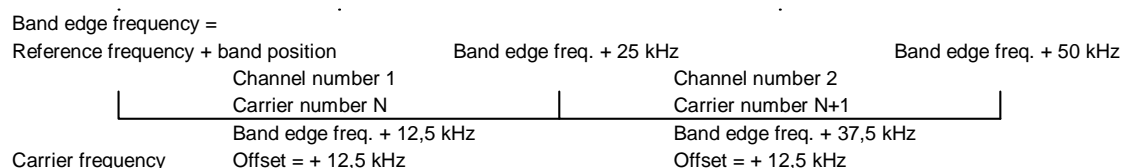
Frequency band	Base/reference frequency	Duplex spacing information element value (next row) and corresponding duplex spacing (other rows; in MHz)							
		000 <sub>2</sub>	001 <sub>2</sub>	010 <sub>2</sub>	011 <sub>2</sub>	100 <sub>2</sub>	101 <sub>2</sub>	110 <sub>2</sub>	111 <sub>2</sub>
0000 <sub>2</sub>	note 1	note 1	note 1	0	note 1	note 1	note 1	note 1	note 1
0001 <sub>2</sub>	100 MHz	1,6	4,5	0	note 1	note 1	note 1	note 1	note 1
0010 <sub>2</sub>	200 MHz	10	note 1	0	note 1	note 1	note 1	note 1	note 1
0011 <sub>2</sub>	300 MHz	10	36 (see note 2)	0	8 (see note 2)	18 (see note 2)	note 1	note 1	note 1
0100 <sub>2</sub>	400 MHz	10	7 (see note 2)	0	8 (see note 2)	5 (see note 2)	9,5 (see note 2)	note 1	note 1
0101 <sub>2</sub>	500 MHz	10	note 1	0	note 1	note 1	note 1	note 1	note 1
0110 <sub>2</sub>	600 MHz	10	note 1	0	note 1	30, (see note 2)	note 1	note 1	note 1
0111 <sub>2</sub>	700 MHz	note 1	note 1	0	note 1	30 (see note 2)	note 1	note 1	note 1
1000 <sub>2</sub>	800 MHz	note 1	45	0	18 (see note 2)	note 1	note 1	note 1	note 1
1001 <sub>2</sub>	900 MHz	note 1	45	0	18 (see note 2)	39 (see note 2)	note 1	note 1	note 1
1010 <sub>2</sub>	note 1	note 1	note 1	0	note 1	note 1	note 1	note 1	note 1
1011 <sub>2</sub>	note 1	note 1	note 1	0	note 1	note 1	note 1	note 1	note 1
1100 <sub>2</sub>	note 1	note 1	note 1	0	note 1	note 1	note 1	note 1	note 1
1101 <sub>2</sub>	note 1	note 1	note 1	0	note 1	note 1	note 1	note 1	note 1
1110 <sub>2</sub>	note 1	note 1	note 1	0	note 1	note 1	note 1	note 1	note 1
1111 <sub>2</sub>	note 1	note 1	note 1	0	note 1	note 1	note 1	note 1	note 1

NOTE 1: The value is reserved for future standardization.  
 NOTE 2: These values are not in accordance with CEPT T/R 25-08 [i.1] and hence the use of these values is subject to a specific frequency allocation from individual National Regulatory Authorities.

## Annex A (informative): Examples

### A.1 Frequency band 380 MHz to 400 MHz

CEPT/SE has defined for TETRA frequency band 380 MHz to 400 MHz channel numbers as shown in figure A.1, which shows only two first radio channels of that frequency band. The reference/base frequency is 300 MHz and for base station transmitter the band position value is 90 MHz so that the base station band starts from 390 MHz. The duplex spacing is 10 MHz with normal band allocation (no reverse operation) so that that the mobile station transmitter is 10 MHz below the base station transmitter. The offset is +12,5 kHz so that the band edge frequency and the lower edge of the first radio channel coincide. The lowest possible base station radio channel 1 has carrier number 3 600, refer to table A.1.



**Figure A.1: Radio channel arrangement and radio channel numbering on 380 MHz to 400 MHz**

As an example the carrier frequencies 380,0125 MHz to 390,0125 MHz of the first radio channel on the 380 MHz to 400 MHz band are indicated in the TETRA protocol by information elements as shown in table A.1.

**Table A.1: The first radio channel on the band 380 MHz to 400 MHz**

Information element	Value of the information element	Remark
Radio channel number	-	1
Frequency band	0011 <sub>2</sub>	300 MHz reference frequency
Main carrier/Carrier number	3 600	(390 000 - 300 000) / 25
Offset	11 <sub>2</sub>	+12,5 kHz
Duplex spacing	000 <sub>2</sub>	10 MHz
Reverse operation	0 <sub>2</sub>	normal

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## Annex B (informative): Change requests

The present document contains change requests as listed in table B.1 since version 1.2.1.

No	CR vers.	Standard Version	Clauses affected	Title	CR Status
101	APP	1.2.1	6	36 MHz duplex spacing added for 300 MHz base frequency	EPT approved 040224
102	11	1.3.1	6	9,5 MHz duplex spacing added for 400 MHz base frequency	WG3 approved 091013

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## History

<b>Document history</b>		
V1.1.1	October 2000	Publication
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V1.4.1	March 2010	Publication