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**ITU-R**  
Radiocommunication Sector of ITU

**Recommendation ITU-R F.637-5**  
(02/2022)

**Radio-frequency channel arrangements  
for fixed wireless systems operating  
in the 21.2-23.6 GHz band**

**F Series**  
**Fixed service**

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<b>SNG</b>	Satellite news gathering
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<b>V</b>	Vocabulary and related subjects

*Note: This ITU-R Recommendation was approved in English under the procedure detailed in Resolution ITU-R 1.*

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## RECOMMENDATION ITU-R F.637-5

**Radio-frequency channel arrangements for fixed wireless systems  
operating in the 21.2-23.6 GHz band**

(Question ITU-R 247-1/5)

(1986-1992-1994-1999-2012-2022)

**Scope**

This Recommendation provides radio-frequency (RF) channel arrangements for fixed wireless systems (FWS) operating in the 21.2-23.6 GHz band. The main text of this Recommendation presents RF channel arrangements based on the homogeneous patterns with channel separations of 2.5 and 3.5 MHz. Annexes 1 to 4 present example arrangements of these homogeneous patterns used in some countries.

**Keywords**

Fixed service, point-to-point, channel bandwidth, channel arrangement, 23 GHz

**Abbreviations / Glossary**

BSS	Broadcasting-satellite service
CEPT	European Conference of Postal and Telecommunications Administrations
ENG/OB	Electronic news gathering / outside broadcast
FS	Fixed service
FWS	Fixed wireless systems
IMT	International Mobile Telecommunications
SAP/SAB	Services ancillary to production / services ancillary to broadcasting
RF	Radio-frequency
WARC	World Administrative Radio Conference

**Related ITU Recommendations and Reports**

Recommendation ITU-R F.746 – Radio-frequency arrangements for fixed service systems

The ITU Radiocommunication Assembly,

*considering*

- a) that the band 21.2-23.6 GHz is allocated to the fixed and other services;
- b) Resolution **525** of the World Administrative Radio Conference (WARC) for Dealing with Frequency Allocations in Certain Parts of the Spectrum (Malaga-Torremolinos, 1992);
- c) that the band is used for differing applications by various administrations and that these applications may require different radio-frequency (RF) channel arrangements;
- d) that several types of service with various capacities may be in simultaneous use in this frequency band;
- e) that the band allocated to each service or even to each administration may vary from one country to another;
- f) that the applications in this frequency band may require differing channel bandwidth;

g) that a high degree of compatibility between RF channels of different arrangements can be achieved by selecting all channel centre frequencies from a homogeneous basic pattern;

h) that the continuously capacity growing request to radio links, especially as part of the mobile network evolution to IMT-2020, has been increasingly addressed in recent years,

*recognizing*

that Recommendation ITU-R SM.1540 provides guidelines for managing the unwanted emissions in the out-of-band domain falling into adjacent allocated bands,

*recommends*

**1** that RF channel arrangements for the band 21.2-23.6 GHz should be based on a homogeneous pattern;

**2** that the homogeneous pattern with a preferred 3.5 MHz interval be defined by the relation:

$$f_p = f_r + 3.5 + 3.5 p$$

where:

$$1 \leq p \leq 685$$

$f_r$ : reference frequency of the homogeneous pattern;

**3** that the homogeneous pattern with a preferred 2.5 MHz interval be defined by the relation:

$$f_p = f_r + 4 + 2.5 p$$

where:

$$1 \leq p \leq 959$$

$f_r$ : reference frequency of the homogeneous pattern;

**4** that the reference frequency of the homogeneous pattern for international connections should be:

$$f_r = 21\,196 \quad \text{MHz}$$

other reference frequencies may be agreed by the administrations concerned;

**5** that in each bidirectional link all go channels should be in one half of any band, and all return channels in the other;

**6** that the channel spacings,  $XS$ , the centre gap,  $YS$ , and the distance to the lower and upper band limits,  $Z_1S$  and  $Z_2S$ , should be agreed by the administrations concerned, dependent on the application and channel capacity envisaged (see Recommendation [ITU-R F.746](#) for definitions of  $XS$ ,  $YS$  and  $ZS$ ).

NOTE 1 – Examples of channel arrangements based on this Recommendation are described in Annexes 1, 2, 3 and 4.

NOTE 2 – Due regard has to be taken that, in certain countries, a 3.5 MHz homogeneous pattern, interleaved by 1.75 MHz from that referred in § 2, is used in conjunction with the main pattern.

## Annex 1

### RF channel arrangements in the band 21.2-23.6 GHz used in some countries in accordance with *recommends 2*

The use of the band 21.2-23.6 GHz is based on a homogeneous 3.5 MHz frequency pattern. Various channel spacings from 3.5 MHz to 224 MHz are accommodated as shown in Fig. 1 and interleaved patterns are also used for the various spacings. In some applications, additional channels can be added in the edge and central guardbands using the homogeneous pattern.

The duplex separation is 1 232 MHz

Let  $f_r$  be the reference frequency of the homogeneous pattern 21 196 MHz;

$f_n$  be the centre frequency of a radio-frequency channel in the lower half of the band (MHz);

$f'_n$  be the centre frequency of a radio-frequency channel in the upper half of the band (MHz);

then the frequencies of individual channels are expressed by the following relationships:

a) for systems with carrier spacing of 224 MHz in interleaved arrangement:

$$\text{lower half of the band: } f_n = f_r + 28 + 112 n \quad \text{MHz}$$

$$\text{upper half of the band: } f'_n = f_r + 1\,260 + 112 n \quad \text{MHz}$$

where:

$$n = 1, \dots, 9$$

b) for systems with carrier spacing of 112 MHz:

$$\text{lower half of the band: } f_n = f_r - 28 + 112 n \quad \text{MHz}$$

$$\text{upper half of the band: } f'_n = f_r + 1\,204 + 112 n \quad \text{MHz}$$

where:

$$n = 1, \dots, 10$$

c) for systems with a carrier spacing of 56 MHz:

$$\text{lower half of the band: } f_n = f_r + 56 n \quad \text{MHz}$$

$$\text{upper half of the band: } f'_n = f_r + 1\,232 + 56 n \quad \text{MHz}$$

where:

$$n = 1, \dots, 20$$

d) for systems with a carrier spacing of 28 MHz:

$$\text{lower half of the band: } f_n = f_r + 14 + 28 n \quad \text{MHz}$$

$$\text{upper half of the band: } f'_n = f_r + 1\,246 + 28 n \quad \text{MHz}$$

where:

$$n = 1, \dots, 40$$

e) for systems with a carrier spacing of 14 MHz:

$$\text{lower half of the band: } f_n = f_r + 21 + 14 n \quad \text{MHz}$$

$$\text{upper half of the band: } f'_n = f_r + 1\,253 + 14 n \quad \text{MHz}$$

where:

$$n = 1, \dots, 80$$

f) for systems with a carrier spacing of 7 MHz:

$$\text{lower half of the band: } f_n = f_r + 24.5 + 7n \quad \text{MHz}$$

$$\text{upper half of the band: } f'_n = f_r + 1256.5 + 7n \quad \text{MHz}$$

where:

$$n = 1, \dots, 160$$

g) for systems with a carrier spacing of 3.5 MHz:

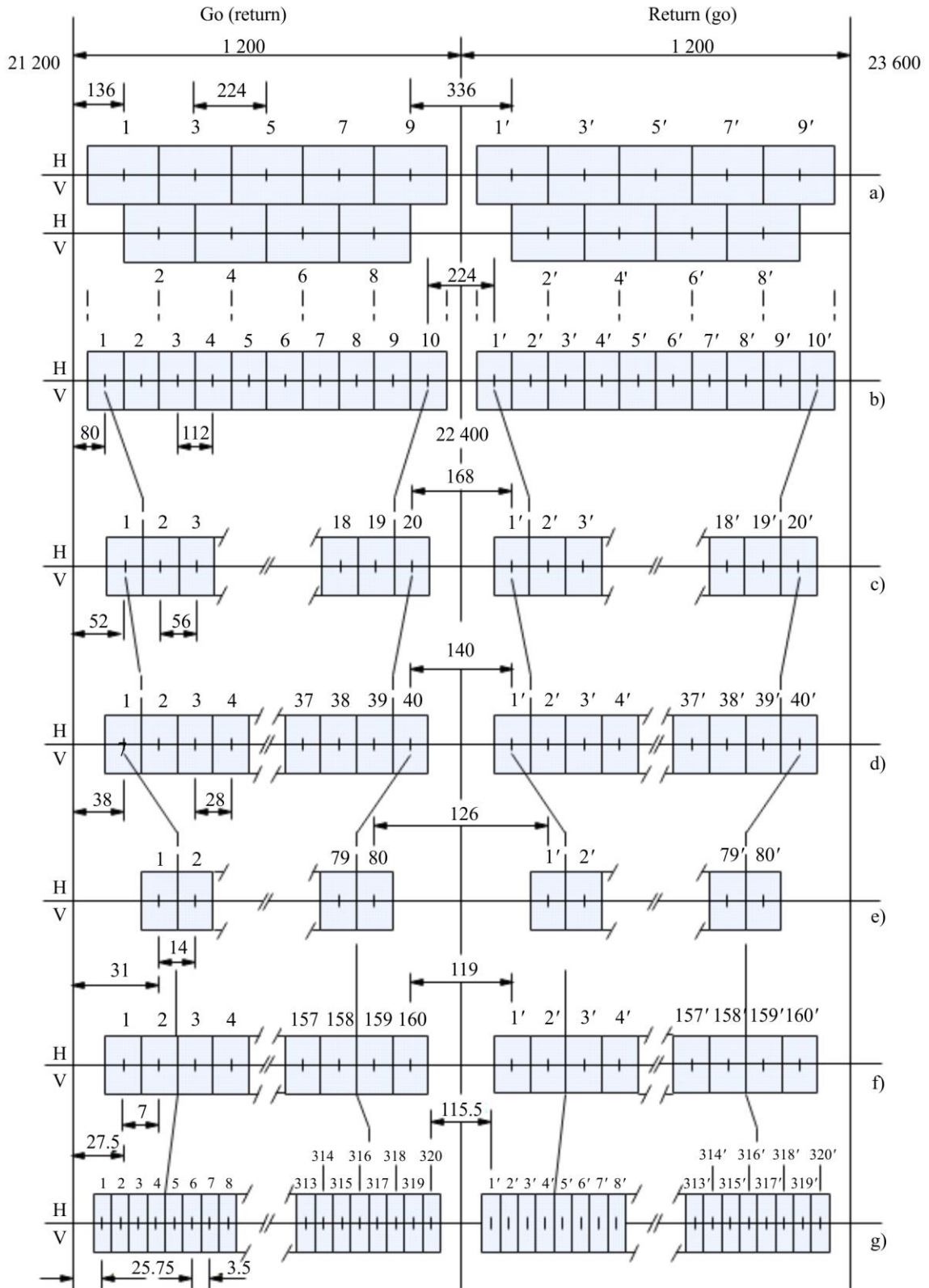
$$\text{lower half of the band: } f_n = f_r + 26.25 + 3.5n \quad \text{MHz}$$

$$\text{upper half of the band: } f'_n = f_r + 1258.25 + 3.5n \quad \text{MHz}$$

where:

$$n = 1, \dots, 320.$$

FIGURE 1  
**Radio-frequency channel arrangements for digital and analogue FWS  
operating in the 21.2-23.6 GHz band**  
(All frequencies in MHz)



NOTE 1 – The RF channel arrangements of Fig. 1g) are derived by the use of carriers interleaved between those of the homogeneous pattern of *recommends 2*.

NOTE 2 – Figure 1a) shows the channel arrangement of 224 MHz channel spacing with interleaved arrangement by granularity of 112 MHz.

## Annex 2

### Radio-frequency channel arrangements for some CEPT<sup>1</sup> administrations in the band 22.0-23.6 GHz in accordance with *recommends 2*

#### 1 Frequency bands 22.0-22.6 GHz paired with 23.0-23.6 GHz

An example of radio-frequency channel arrangements in the band 22.0-22.6 GHz paired with 23.0-23.6 GHz for carrier spacings of 224 MHz, 112 MHz, 56 MHz, 28 MHz, 14 MHz, 7 MHz and 3.5 MHz is derived as follows:

The duplex separation is 1 008 MHz.

Let  $f_r$  be the reference frequency of the homogeneous pattern 21 196 MHz;

$f_n$  be the centre frequency of a radio-frequency channel in the lower half of the band (MHz);

$f'_n$  be the centre frequency of a radio-frequency channel in the upper half of the band (MHz);

then the frequencies of individual channels are expressed by the following relationships:

a) for systems with a carrier spacing of 224 MHz in an interleaved pattern:

$$\text{lower half of the band : } f_n = f_r + 826 + 112 n \quad \text{MHz}$$

$$\text{upper half of the band : } f'_n = f_r + 1 834 + 112 n \quad \text{MHz}$$

where:

$$n = 1, \dots 4$$

b) for systems with a carrier spacing of 112 MHz:

$$\text{lower half of the band: } f_n = f_r + 770 + 112 n \quad \text{MHz}$$

$$\text{upper half of the band: } f'_n = f_r + 1 778 + 112 n \quad \text{MHz}$$

where:

$$n = 1, \dots 5$$

c1) for systems with a carrier spacing of 56 MHz providing 9 channels:

$$\text{lower half of the band: } f_n = f_r + 826 + 56 n \quad \text{MHz}$$

$$\text{upper half of the band: } f'_n = f_r + 1 834 + 56 n \quad \text{MHz}$$

where:

$$n = 1, \dots 9$$

c2) for systems with a carrier spacing of 56 MHz providing 10 channels:

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<sup>1</sup> European Conference of Postal and Telecommunications Administrations.



$$\text{lower half of the band: } f_n = f_r + 784 + 56 n \quad \text{MHz}$$

$$\text{upper half of the band: } f'_n = f_r + 1792 + 56 n \quad \text{MHz}$$

where:

$$n = 1, \dots, 10$$

d) for systems with a carrier spacing of 28 MHz:

$$\text{lower half of the band: } f_n = f_r + 798 + 28 n \quad \text{MHz}$$

$$\text{upper half of the band: } f'_n = f_r + 1806 + 28 n \quad \text{MHz}$$

where:

$$n = 1, \dots, 20$$

e) for systems with a carrier spacing of 14 MHz:

$$\text{lower half of the band: } f_n = f_r + 805 + 14 n \quad \text{MHz}$$

$$\text{upper half of the band: } f'_n = f_r + 1813 + 14 n \quad \text{MHz}$$

where:

$$n = 1, \dots, 41$$

f) for systems with a carrier spacing of 7 MHz:

$$\text{lower half of the band: } f_n = f_r + 808.5 + 7 n \quad \text{MHz}$$

$$\text{upper half of the band: } f'_n = f_r + 1816.5 + 7 n \quad \text{MHz}$$

where:

$$n = 1, \dots, 83$$

g) for systems with a carrier spacing of 3.5 MHz:

$$\text{lower half of the band: } f_n = f_r + 805 + 3.5 n \quad \text{MHz}$$

$$\text{upper half of the band: } f'_n = f_r + 1813 + 3.5 n \quad \text{MHz}$$

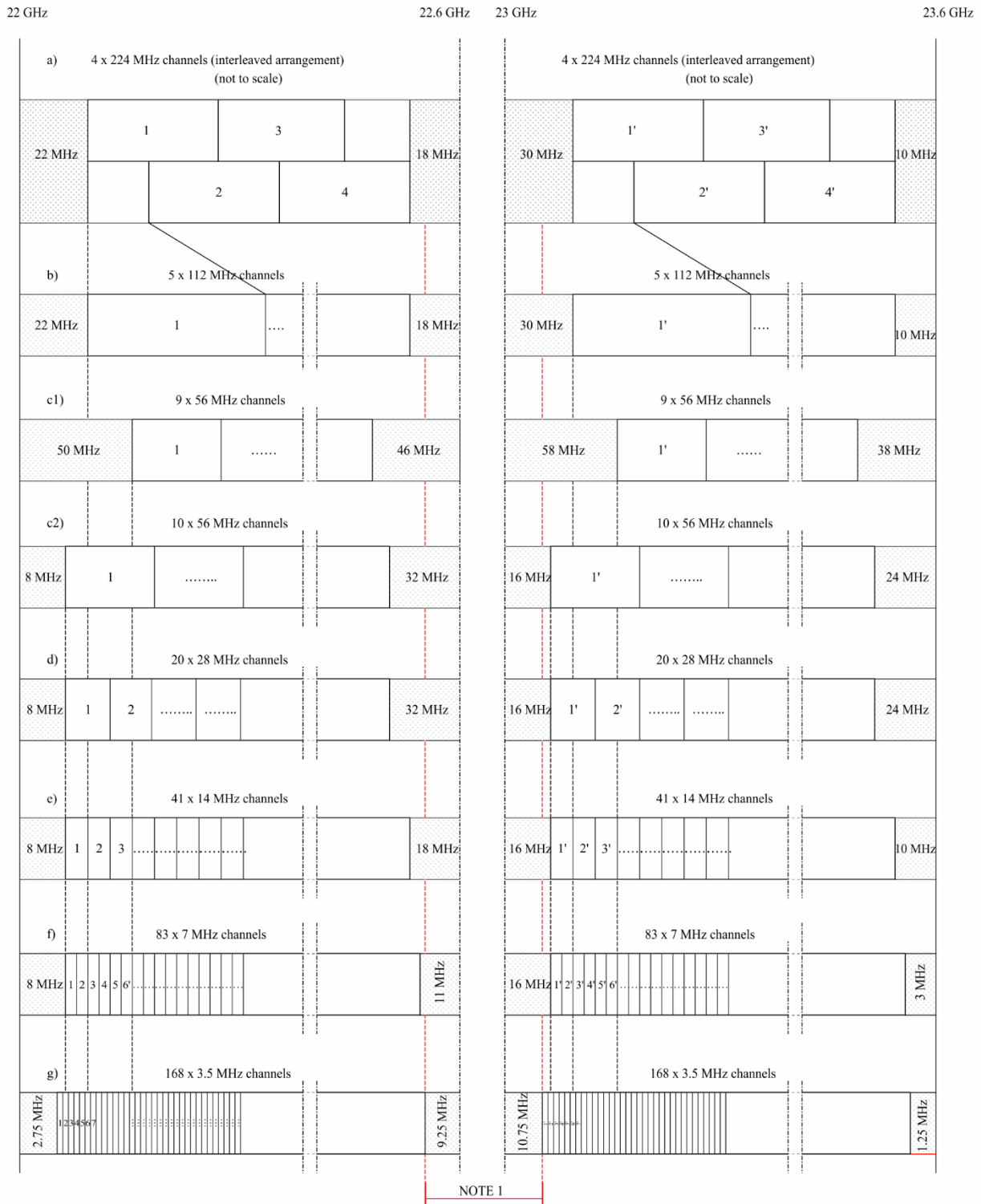
where:

$$n = 1, \dots, 168.$$

NOTE 1 – The radio-frequency channel arrangements of a) to g) above use channel centre frequencies  $f_n$  and  $f'_n$  selected from the homogeneous pattern of *recommends 2*.

NOTE 2 – Figure 2 gives occupied spectrum in the 22.0-23.6 GHz band.

FIGURE 2  
Radio-frequency channel arrangement in the band 22.0-22.6 GHz paired with 23.0-23.6 GHz



NOTE 1 – For the centre-gap channel arrangements, see §§ 2 and 3 of this Annex.

## 2 Frequency bands 22.590 75-22.758 75 GHz paired with 22.842 75-23.010 75 GHz

These bands are portions of the centre-gap of the channel arrangement shown in § 1, combined with the innermost guardbands of the 3.5 MHz arrangement (see Fig. 3).

The preferred radio-frequency channel arrangement for digital point-to-point FWS for carrier spacings of 28 MHz, 14 MHz, 7 MHz and 3.5 MHz should be derived as follows:

Let  $f_r$  be the reference frequency of the homogeneous pattern 21 196 MHz;

$f_n$  be the centre frequency of the radio-frequency channel in the lower half of the band (MHz);

$f'_n$  be the centre frequency of the radio-frequency channel in the upper half of the band (MHz);

TX/RX duplex separation = 252 MHz;

centre gap = 84 MHz;

then the frequencies of individual channels (Note 1) are expressed by the following relationships:

a) for systems with a carrier spacing of 28 MHz:

$$\text{lower half of band: } f_n = (f_r + 1\ 380.75 + 28\ n) \quad \text{MHz}$$

$$\text{upper half of band: } f'_n = (f_r + 1\ 632.75 + 28\ n) \quad \text{MHz}$$

where:

$$n = 1, \dots 6$$

b) for systems with a carrier spacing of 14 MHz:

$$\text{lower half of band: } f_n = (f_r + 1\ 387.75 + 14\ n) \quad \text{MHz}$$

$$\text{upper half of band: } f'_n = (f_r + 1\ 639.75 + 14\ n) \quad \text{MHz}$$

where:

$$n = 1, \dots 12$$

c) for systems with a carrier spacing of 7 MHz:

$$\text{lower half of band: } f_n = (f_r + 1\ 391.25 + 7\ n) \quad \text{MHz}$$

$$\text{upper half of band: } f'_n = (f_r + 1\ 643.25 + 7\ n) \quad \text{MHz}$$

where:

$$n = 1, \dots 24$$

d) for systems with a carrier spacing of 3.5 MHz:

$$\text{lower half of band: } f_n = (f_r + 1\ 393 + 3.5\ n) \quad \text{MHz}$$

$$\text{upper half of band: } f'_n = (f_r + 1\ 645 + 3.5\ n) \quad \text{MHz}$$

where:

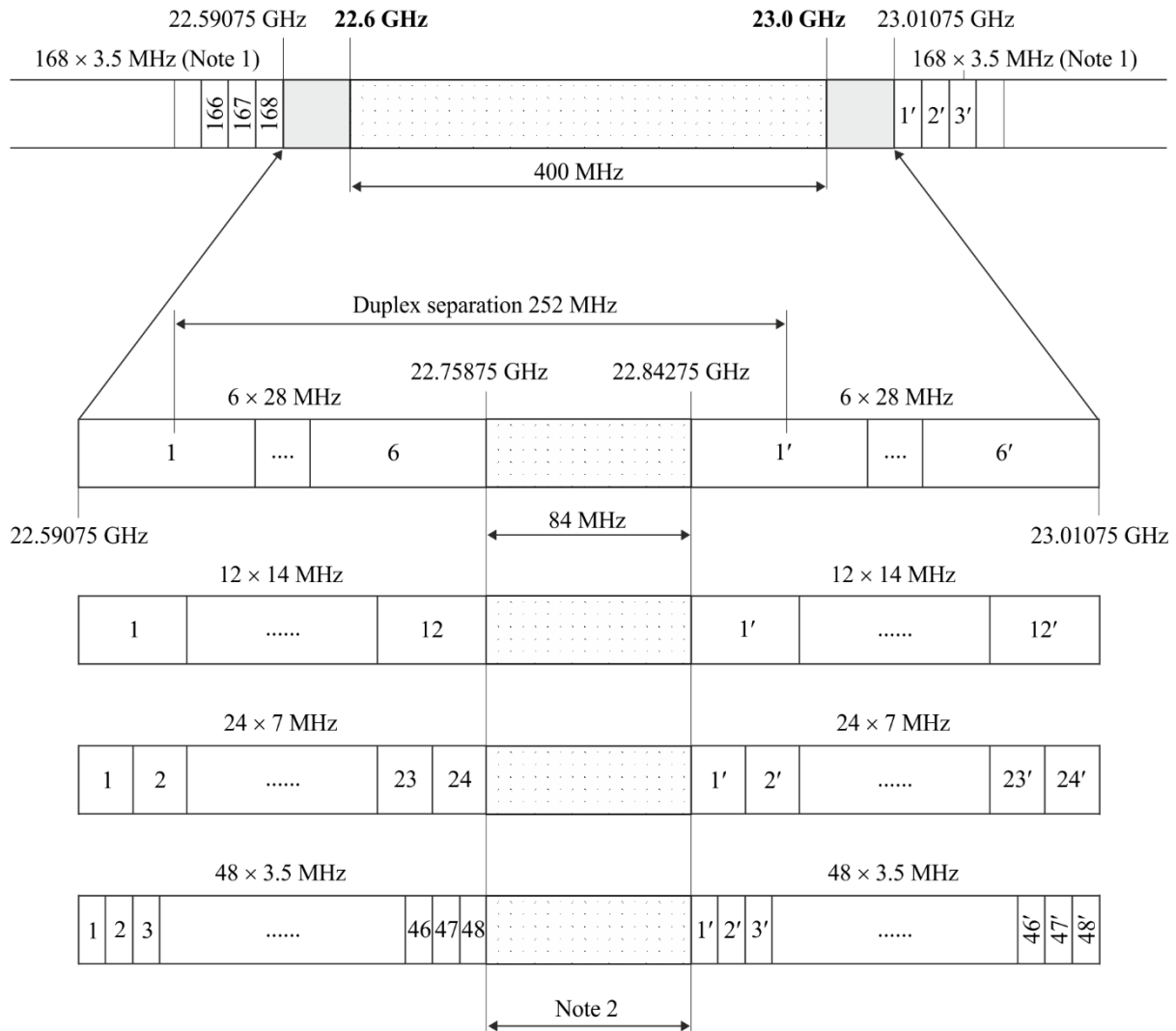
$$n = 1, \dots 48$$

NOTE 1 – The channels are shown as paired; however, administrations may envisage unpaired use of those channels according to the national need (e.g. for ENG/OB- and/or SAP/SAB-applications). Some administrations may also wish to pair some of the channels in the lower half within the 22.6-23.0 GHz band with those in 21.2-21.4 GHz band referred in Annex 4.

NOTE 2 – Figure 3 gives occupied spectrum in the band 22.590 75-22.758 75 GHz paired with the 22.842 75-23.010 75 GHz band.

FIGURE 3

Radio-frequency channel arrangement in the band 22.590 75-22.758 75 GHz paired with 22.842 75-23.010 75 GHz



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NOTE 1 – This is the 3.5 MHz channel arrangement according to § 1 of this Annex.

NOTE 2 – For the centre-gap channel arrangement, see § 3 of this Annex.

### 3 Frequency band 22.758 75-22.842 75 GHz

This band is the centre-gap of the channel arrangement in § 2 (see Fig. 3), which may be used for unpaired channels.

The preferred radio-frequency channel arrangement for digital and analogue point-to-point FWS for carrier spacings of 28 MHz, 14 MHz, 7 MHz and 3.5 MHz should be derived as follows:

Let  $f_0$  be a reference frequency of 22 757 MHz;

$f_n$  be the centre frequency (MHz) of a radio-frequency channel;

then the frequencies of individual channels are expressed by the following relationships:

a) for systems with a carrier spacing of 28 MHz:

$$f_n = (f_0 - 12.25 + 28 n) \text{ MHz}$$

where:

$$n = 1, 2, 3$$

b) for systems with a carrier spacing of 14 MHz:

$$f_n = (f_0 - 5.25 + 14 n) \text{ MHz}$$

where:

$$n = 1, 2, \dots 6$$

c) for systems with a carrier spacing of 7 MHz:

$$f_n = (f_0 - 1.75 + 7 n) \text{ MHz}$$

where:

$$n = 1, 2, \dots 12$$

d) for systems with a carrier spacing of 3.5 MHz:

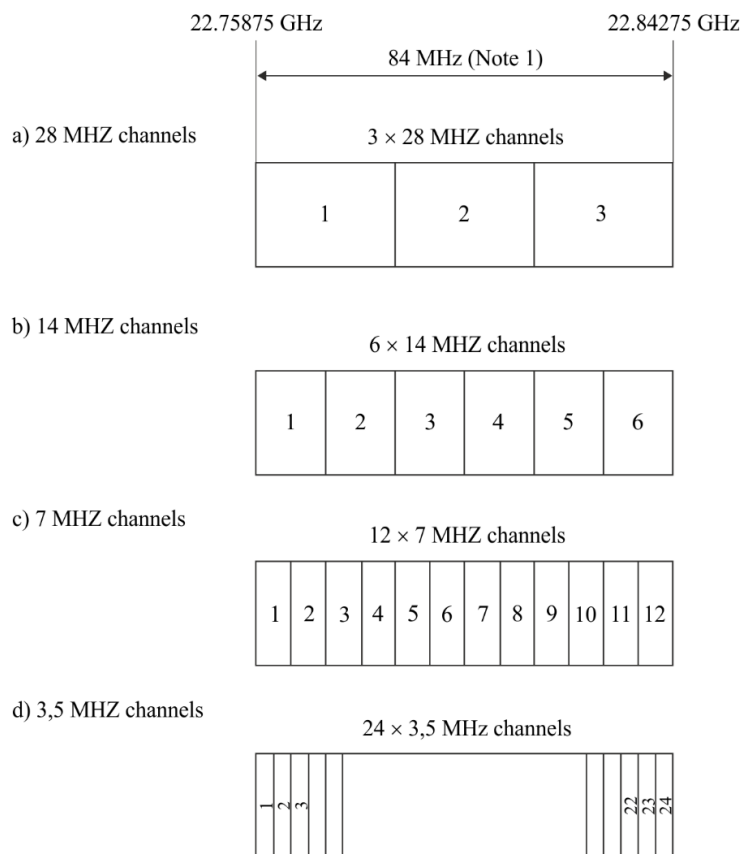
$$f_n = (f_0 + 3.5 n) \text{ MHz}$$

where:

$$n = 1, 2, \dots 24$$

NOTE – Figure 4 gives occupied spectrum in the 22.758 75-22.842 75 GHz band.

FIGURE 4  
Radio-frequency channel arrangement in the band 22.758 75-22.842 75 GHz



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NOTE 1 – This is the centre-gap of the channel arrangement in § 2 (see Fig. 3).

### Annex 3

#### Description of the radio-frequency channel arrangements in the band 21.2-23.6 GHz in accordance with *recommends 3* (North America)

In the United States of America, the most widespread use of the 21.2-23.6 GHz band is in the 21.8-22.4 GHz and 23.0-23.6 GHz portions for which a frequency pattern with 50 MHz channels has been adopted. The same pattern is being used in the remainder of the 21.2-23.6 GHz band as usage is spreading. Accordingly, a homogeneous pattern is in use, based on *recommends 3* and given by:

$$f_n = f_r - 21 + 50 n$$

where:

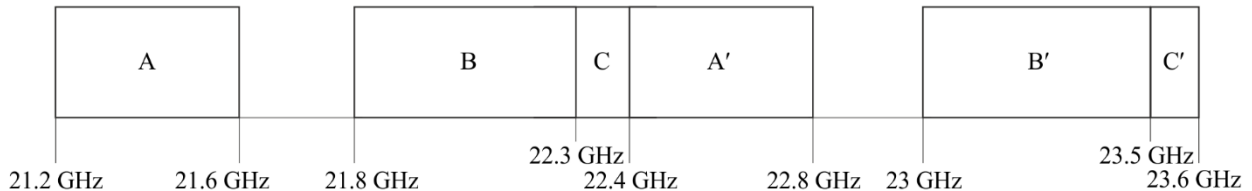
$$n = 1, 2, 3, \dots 48$$

$$f_r \text{ (reference frequency) } = 21\,196 \text{ MHz.}$$

For two-way operation, the go-return separation is about 1 200 MHz. Typical systems in use include digital transmission at data rates between about 1.5 and 8 Mbit/s, and a variety of analogue video systems.

In Canada, the RF channel arrangements for FWS in the band 21.2-23.6 GHz is shown in Fig. 5.

FIGURE 5  
Band plan for the band 21.2-23.6 GHz (Canada)



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The above channel arrangement contains three paired blocks: Blocks A/A', Blocks B/B', and Blocks C/C'. In all three blocks, each paired channel has a frequency separation of 1 200 MHz. The channel widths in each block are as follows:

A/A': 50 MHz channels (8 in each block).

B/B': Five available channel widths: 10 MHz, 15 MHz, 20 MHz, 40 MHz and 50 MHz.

C/C': Three available channel widths: 2.5 MHz, 5 MHz and 7.5 MHz.

**Annex 4**

**Radio-frequency channel arrangements in the band 21.2-23.6 GHz  
in accordance with *recommends 2* (Germany)**

Taking into account the fact, that:

- WARC-92 has allocated the band 21.4-22.0 GHz to the broadcasting-satellite service (BSS) on a primary basis in Regions 1 and 3;
- many individual reception units for the BSS are expected to be used and interference from the fixed service (FS) should be minimized;

the operational use of FWS in the sub-band 21.4-22.0 GHz should be avoided.

The band plan based on WARC-92 decisions is shown in Fig. 6.

FIGURE 6  
Band plan for the band 21.2-23.6 GHz based on WARC-92 decisions

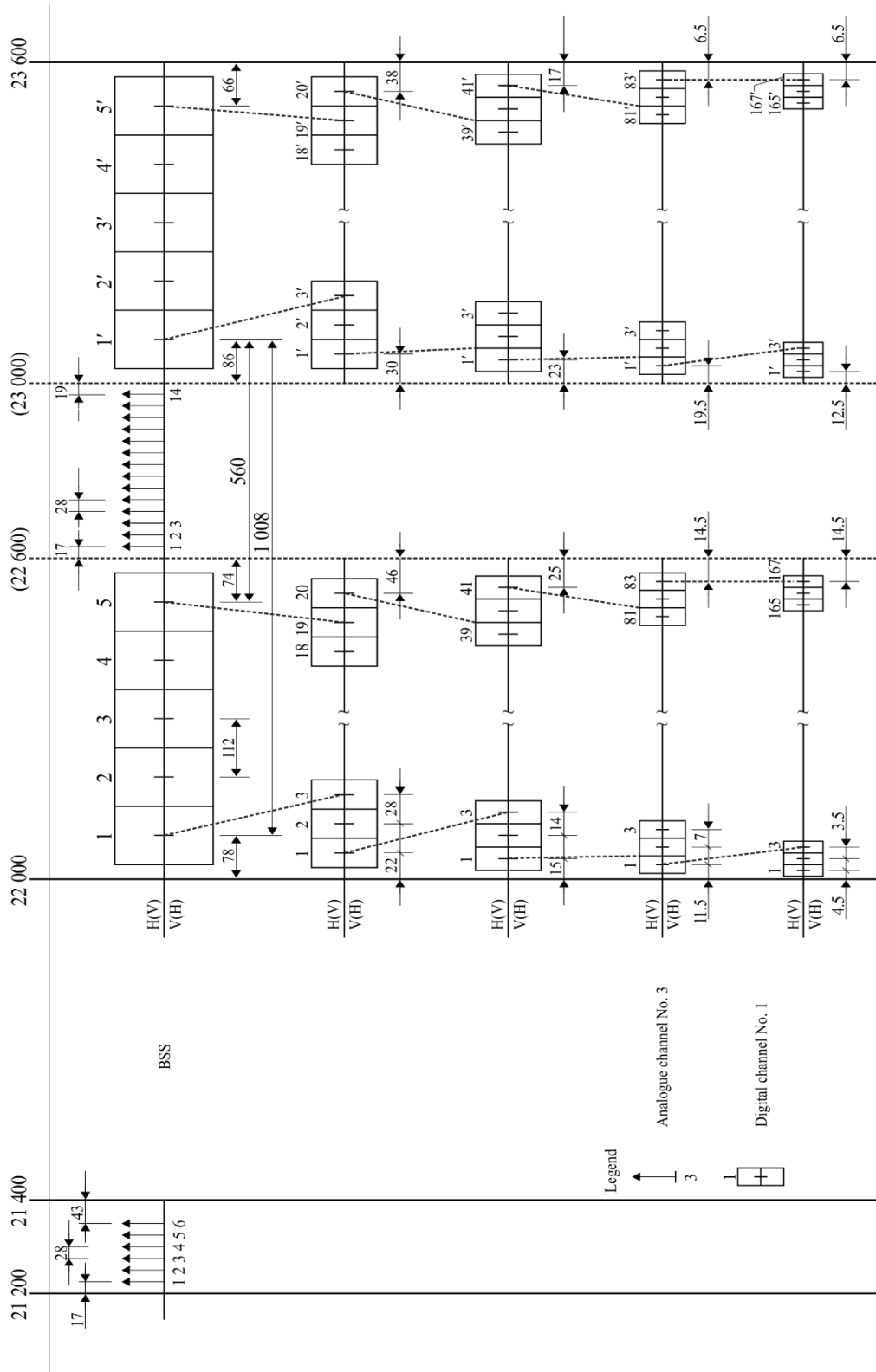
FS simplex TV	Broadcasting- satellite service	FS duplex Go (Return)	FS simplex	FS duplex Return (Go)	
21.2	21.4	22.0	22.6	23.0	23.6

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An application of the band plan (Fig. 6) for analogue and digital FWS (2 Mbit/s to 155 Mbit/s) is described in detail in Fig. 7.

NOTE – In Fig. 7 the radio-frequency channel arrangements in the bands 22.0-22.6 GHz paired with 23.0-23.6 GHz are equal to the corresponding ones in § 1 of Annex 2.

FIGURE 7  
 Radio-frequency channel arrangements for digital and analogue FWS  
 operating in the band 21.2-23.6 GHz based on WARC-92 decisions  
 (All frequencies in MHz)



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