International Telecommunication Union

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Radiocommunication Sector of ITU

Recommendation ITU-R F.386-9
(02/2013)

Radio-frequency channel arrangements for fixed wireless systems operating in the 8 GHz (7 725 to 8 500 MHz) band

F Series
Fixed service

International Telecommunication Union

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***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.386-9

Radio-frequency channel arrangements for fixed wireless systems operating in the 8 GHz (7 725 to 8 500 MHz) band

(Question ITU-R 247/5)

(1963-1966-1982-1986-1992-1997-1999-2007-2013)

Scope

This Recommendation provides radio-frequency channel arrangements for fixed wireless systems operating in the 8 GHz (7 725 to 8 500 MHz) band, which may be used for high, medium and low capacity systems. The preferred radio-frequency channel arrangements are based on multiples of basic slots either of 3.5 MHz or 2.5 MHz width. Examples in various segments of the 8 GHz band are presented in Annexes 1 to 5. Annex 6 presents an arrangement for high capacity digital systems used in some countries.

The ITU Radiocommunication Assembly,

considering

a) that it may be desirable to be able to interconnect fixed wireless systems (FWSs) on international links at radio frequencies in the 8 GHz band;

b) that the availability of frequency bands in the range from 7 725 MHz to 8 500 MHz differs in various countries;

c) that, for some administrations, a frequency band, only 300 MHz wide or less, may be available in the 8 GHz range for such systems;

d) that some channel arrangements have been developed in the past based on analogue system requirements only;

e) that it is desirable to deploy in such a band digital systems of low, medium and/or high capacity. In some countries, analogue systems are still being used;

f) that digital systems are mostly designed to accommodate radio-frequency (RF) channel arrangements based on multiples of 2.5 MHz or 3.5 MHz patterns;

g) that, digital techniques such as cross-polar interference cancellers (XPIC) may significantly contribute to the cross-polar discrimination improvement factor (XIF, defined in Recommendation ITU-R F.746), thus counteracting multipath or rain propagation-induced depolarization;

h) that, when very high capacity links (e.g. twice Synchronous Transfer Mode-1 (STM-1)) are required, further economy may be achieved using system bandwidths wider than the recommended channel separation, associated to high-efficient modulation formats,

recommends

1 that the preferred RF channel arrangements be based on multiples of basic bandwidths of either 3.5 MHz or 2.5 MHz; examples in various segments of the 8 GHz band are shown in Annexes 1 to 5;

2 that, in a section over which the international connection is arranged, all the go channels should be in one half of the band, and all the return channels should be in the other half of the band;

3 that, for adjacent RF channels in the same half of the band, horizontal and vertical polarization may be used alternately, as well as co-channel arrangements, provided that sufficient adjacent channel rejection is provided;

4 that when very high capacity links are required and network coordination permits, with the agreement of the administrations concerned, the use of any two adjacent 28 or 29.65 MHz channels specified in *recommends* 1 is possible, for wider bandwidth system, with centre frequency lying in the central point of the distance between the two 28 or 29.65 MHz adjacent channels;

5 that due regard be taken of the fact that, in some countries, in the 7 725 MHz to 8 275 MHz band, another RF channel arrangement for high capacity digital systems up to 140 Mbit/s or synchronous digital hierarchy bit rates is used. A description of this RF channel arrangement is given in Annex 6. Administrations currently using channel arrangements based on the 29.65 MHz raster are encouraged, in the future, to migrate to this more efficient 28 MHz and sub-multiples channel arrangement in Annex 2.

Annex 1

RF channel arrangements for the transmission of various digital signals operating in the 7 725-8 275 MHz band, with 300 MHz duplex spacing, based on multiples of 2.5 MHz bandwidth referred to in *recommends* 1

This Annex describes an RF channel arrangement for low, medium and high capacity point-to-point FWS using digital modulation and operating in the band 7 725-8 275 MHz. Channel pairs are provided with a common transmit-receive separation of 300 MHz.

1 The RF channel arrangement is shown in Fig. 1 and is derived as follows:

Let f_0 be the frequency at the centre of the band:

$$f_0 = 8\,000 \text{ MHz}$$

f_n be the centre frequency of one RF channel in the lower half of the band (MHz);

f'_n be the centre frequency of one RF channel in the upper half of the band (MHz),

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

1.1 for systems with a 30 MHz channel bandwidth:

lower half of the band: $f_n = f_0 - 290 + 30\,n$ MHz

upper half of the band: $f'_n = f_0 + 10 + 30\,n$ MHz

where:

$n = 1, 2, 3, \dots 8;$

1.2 for systems with a 20 MHz channel bandwidth:

lower half of the band: $f_n = f_0 - 285 + 20\,n$ MHz

upper half of the band: $f'_n = f_0 + 15 + 20\,n$ MHz

where:

$n = 1, 2, 3, \dots 12;$

1.3 for systems with a 10 MHz channel bandwidth:

lower half of the band: $f_n = f_0 - 280 + 10\,n$ MHz

upper half of the band: $f'_n = f_0 + 20 + 10\,n$ MHz

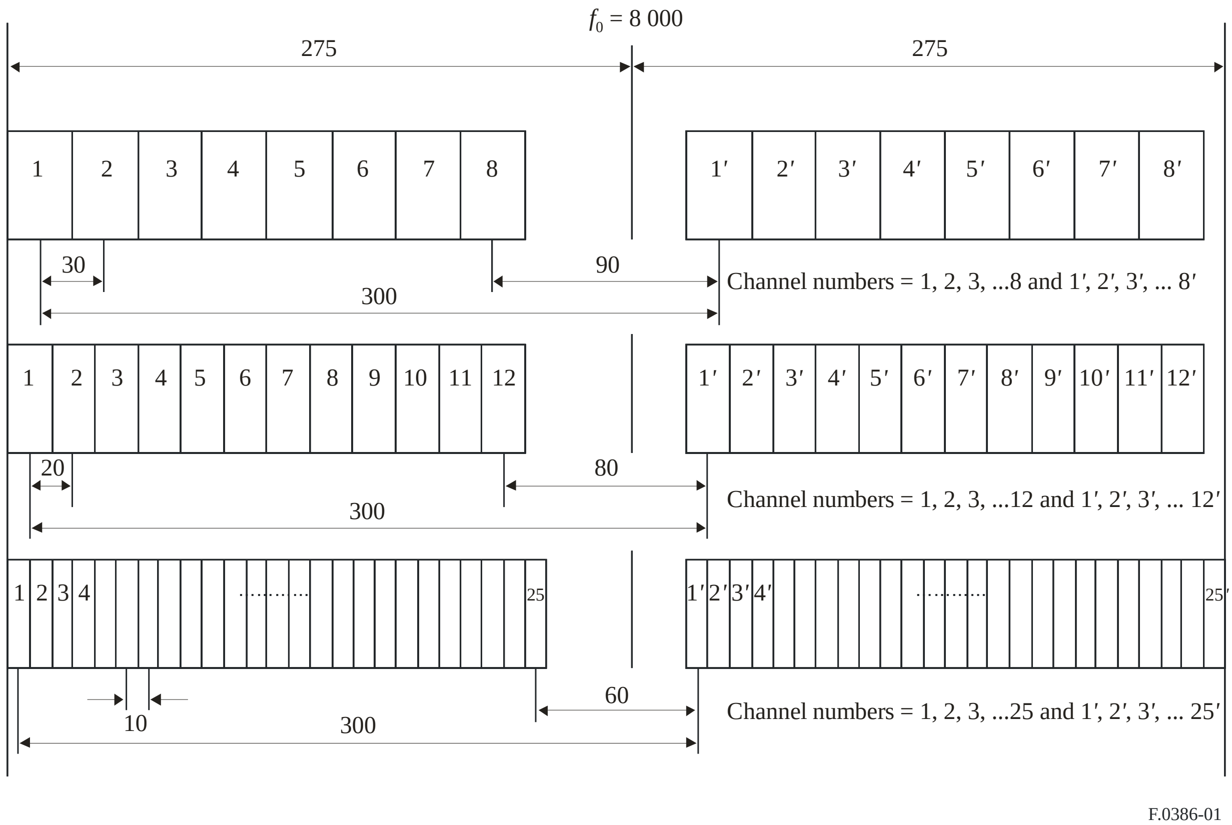
where:

$n = 1, 2, 3, \ldots 25.$

FIGURE 1

RF channel arrangements for the band 7 725-8 275 MHz

(All frequencies in MHz)



2 Low capacity systems with RF channel bandwidths of 1.25 MHz, 2.5 MHz and 5 MHz may also be utilized by subdividing the 10 MHz RF bandwidth pattern shown in Fig. 1.

Annex 2

RF channel arrangements for digital FWS operating in the 7 725-8 275 and 8 275-8 500 MHz bands based on multiples of 3.5 MHz bandwidth referred to in *recommends* 1

1 Channel arrangement in the frequency band 7 725-8 275 MHz

The RF channel arrangement, in a frequency band of ±275 MHz across the centre frequency 8 000 MHz for up to nine go and nine return channels, each accommodating high capacity digital systems operating in the 8 GHz band, is as shown in Fig. 2.

Narrower channels, 18 channels 14 MHz wide and 36 channels 7 MHz wide, can be obtained by subdivision of the 28 MHz main channels.

Channel pairs are provided with a common transmit-receive separation of 283.5 MHz.

The channels centre frequencies are derived as follows:

Let f_0 be the frequency of the centre of the band of frequencies occupied (MHz);

f_n be the centre frequency of one RF channel in the lower half of this band (MHz);

f'_n be the centre frequency of one RF channel in the upper half of this band (MHz).

The centre frequency should be:

$$f_0 = 8\,000 \text{ MHz}$$

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

1.1 28 MHz channel arrangement

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

lower half of the band: $f_n = f_0 - 281 + 28\,n$ MHz

upper half of the band: $f'_n = f_0 + 2.5 + 28\,n$ MHz

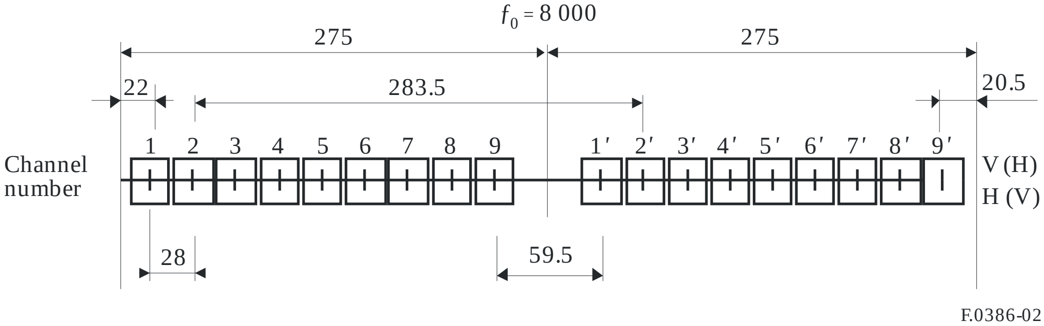
where:

$$n = 1, 2, 3, 4, 5, 6, 7, 8 \text{ or } 9.$$

FIGURE 2

RF channel arrangements for digital FWS operating in the 7 725-8 275 MHz band

(All frequencies in MHz)



1.2 14 MHz channel arrangement

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

lower half of the band: $f_n = f_0 - 274 + 14\,n$ MHz

upper half of the band: $f'_n = f_0 + 9.5 + 14\,n$ MHz

where:

$n = 1, 2, \ldots\ldots 17$ or 18.

1.3 7 MHz channel arrangement

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

lower half of the band: $f_n = f_0 - 270.5 + 7\,n$ MHz

upper half of the band: $f'_n = f_0 + 13 + 7\,n$ MHz

where:

$n = 1, 2, \ldots\ldots 35$ or 36.

2 Channel arrangement in the frequency band 8 275–8 500 MHz

The RF channel arrangements are shown in Fig. 3 (interleaved arrangements) and Fig. 4 (co-channel reusable arrangements) and are derived as follows:

Let f_0 be the frequency of the centre of the band of frequencies occupied (MHz);

f_n be the centre frequency of one RF channel in the lower half of the band (MHz);

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

The centre frequency should be:

$f_0 = 8\,387.5$ MHz;

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

2.1 Channel arrangements, based on interleaved centre frequencies

In the interleaved channel arrangement shown in Fig. 3, adjacent RF channels on the same route can be used only on different polarization.

28 MHz interleaved channel arrangement with duplex spacing of 119 MHz

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

lower half of the band: $f_n = f_0 - 108.5 + 14\,n$ MHz

upper half of the band: $f'_n = f_0 + 10.5 + 14\,n$ MHz

where:

$n = 1, 2, 3, 4, 5,$ or 6;

14 MHz interleaved channel arrangement with duplex spacing of 126 MHz

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

lower half of the band: $f_n = f_0 - 108.5 + 7\,n$ MHz

upper half of the band: $f'_n = f_0 + 17.5 + 7\,n$ MHz

where:

$n = 1, 2, 3, \ldots 12.$

2.2 Channel arrangements, based on co-channel reusable centre frequency

When a channel arrangement permitting frequency reuse is preferred, the channels should be derived from the above interleaved arrangement using only odd or even "n" indexes.

The actual resulting arrangements are shown in Figs 4a) and 4b).

FIGURE 3

RF channel arrangements for digital FWS operating in the 8 275-8 500 MHz band (interleaved pattern)

(All frequencies in MHz)

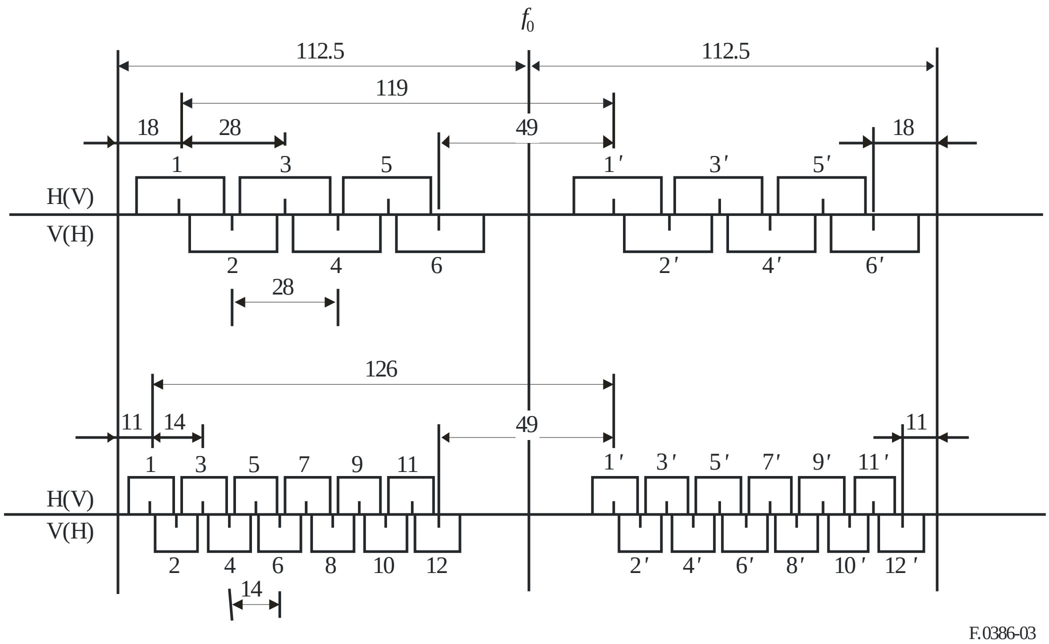
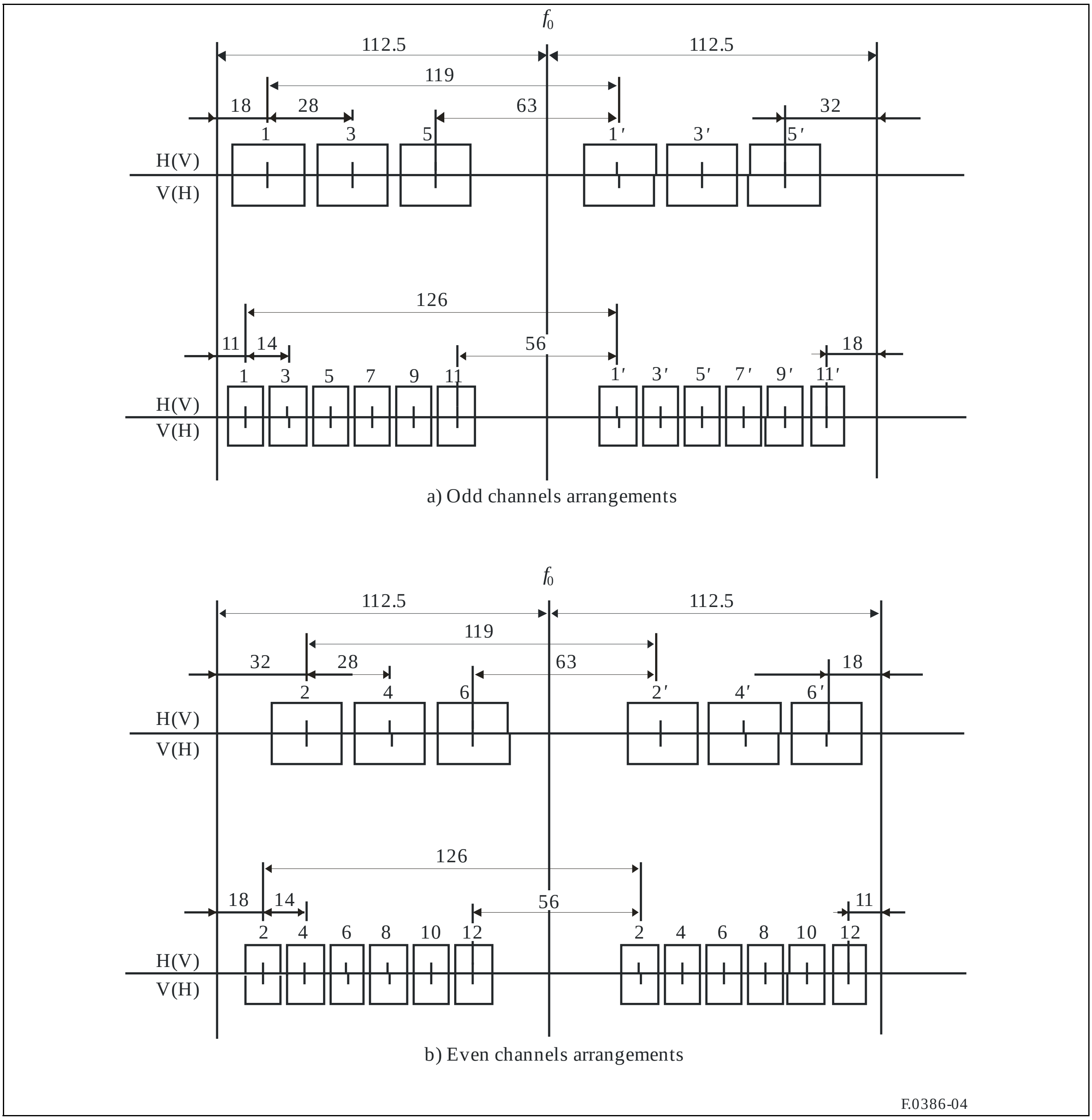


FIGURE 4

RF channel arrangements for digital FWS operating in the 8 275-8 500 MHz band (frequency reuse pattern)

(All frequencies in MHz)



NOTE 1 – When using in the same area channel 1 of the 28 MHz arrangements of the 8 275-8 500 MHz band and channel 8’ of the 29.65 MHz arrangement of the 7 725-8 275 MHz band in Annex 6, care should be taken to their separation of 26.43 MHz only, therefore, those two channels cannot be used on the same link.

Annex 3

RF channel arrangements for digital FWS up to 140 Mbit/s or synchronous digital hierarchy bit rates operating in the 7 900-8 400 MHz band, based on multiples of 3.5 MHz bandwidth referred to in *recommends* 1, with a channel separation of up to 28 MHz

1 This Annex describes a RF channel arrangement suitable for digital FWS up to 140 Mbit/s or synchronous digital hierarchy bit rates operating in the 7 900-8 400 MHz band with a channel separation up to 28 MHz, and makes provision for eight 28 MHz channels.

The RF channel arrangement is shown in Fig. 5 and is derived as follows:

Let f_0 be the frequency of the centre of the band of frequencies occupied (MHz);

f_n be the centre frequency of one RF channel in the lower half of the band (MHz);

f'_n be the centre frequency of one RF channel in the upper half of the band (MHz);

then the frequencies of individual 28 MHz channels are expressed by the following relationships,

lower half of the band: $f_n = f_0 - 259 + 28\,n$ MHz

upper half of the band: $f'_n = f_0 + 7 + 28\,n$ MHz

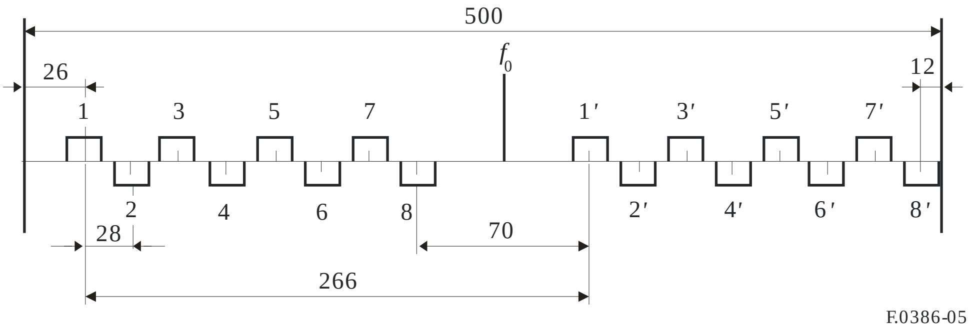
where:

$n = 1, 2, 3, \ldots 8.$

FIGURE 5

RF channel arrangement for digital FWS up to 140 Mbit/s or synchronous digital hierarchy bit rates operating in the 7 900-8 400 MHz band

(All frequencies in MHz)



2 The eight channels with a separation of 28 MHz can be split to provide 16 channels with a separation of 14 MHz or 32 channels with a separation of 7 MHz.

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

2.1 for 14 MHz channels:

lower half of the band: $f_n = f_0 - 259 + 14\,n$ MHz

upper half of the band: $f'_n = f_0 + 7 + 14\,n$ MHz

where:

$n = 1, 2, 3, \ldots 16.$

2.2 for 7 MHz channels:

lower half of the band: $f_n = f_0 - 252 + 7\,n$ MHz

upper half of the band: $f'_n = f_0 + 14 + 7\,n$ MHz

where:

$n = 1, 2, 3, \ldots 32.$

3 The centre frequency f_0 is 8 157 MHz.

Annex 4

RF channel arrangements for the transmission of various digital signals operating in the 7 725-8 275 MHz band based on multiples of 2.5 MHz bandwidth referred to in *recommends* 1

1 This Annex describes an RF channel arrangement suitable for the transmission of various digital signals operating in the 7 725-8 275 MHz band with a channel separation of 40, 20, 10 and 5 MHz.

The RF channel arrangement is shown in Fig. 6 and is derived as follows:

Let f_0 be the frequency of the centre of the band of frequencies occupied (MHz);

f_n be the centre frequency of one RF channel in the lower half of the band (MHz);

f'_n be the centre frequency of one RF channel in the upper half of the band (MHz);

a) for systems with a channel separation of 40 MHz:

lower half of the band: $f_n = f_0 - 295 + 40\,n$ MHz

upper half of the band: $f'_n = f_0 + 15 + 40\,n$ MHz

where:

$n = 1, 2, 3, \ldots 6;$

b) for systems with a channel separation of 20 MHz:

lower half of the band: $f_n = f_0 - 275 + 20\,n$ MHz

upper half of the band: $f'_n = f_0 + 35 + 20\,n$ MHz

where:

$n = 1, 2, 3, ... 11;$

c) for systems with a channel separation of 10 MHz:

lower half of the band: $f_n = f_0 - 275 + 10\,n$ MHz

upper half of the band: $f'_n = f_0 + 35 + 10\,n$ MHz

where:

$n = 1, 2, 3, ... 23;$

d) for systems with a channel separation of 5 MHz:

lower half of the band: $f_n = f_0 - 275 + 5\,n$ MHz

upper half of the band: $f'_n = f_0 + 35 + 5\,n$ MHz

where:

$n = 1, 2, 3, ... 47.$

The centre frequency f_0 is 8 000 MHz.

2 Alternatively, an effective RF channel arrangement with 20 MHz, 10 MHz, and 5 MHz may also be used by subdividing the 40 MHz RF bandwidth pattern as shown in Fig. 7.

FIGURE 6

RF channel arrangements for transmission of various signals operating with 40 MHz, 20 MHz, 10 MHz and 5 MHz channel spacing in 7 725-8 275 band

(All frequencies in MHz)

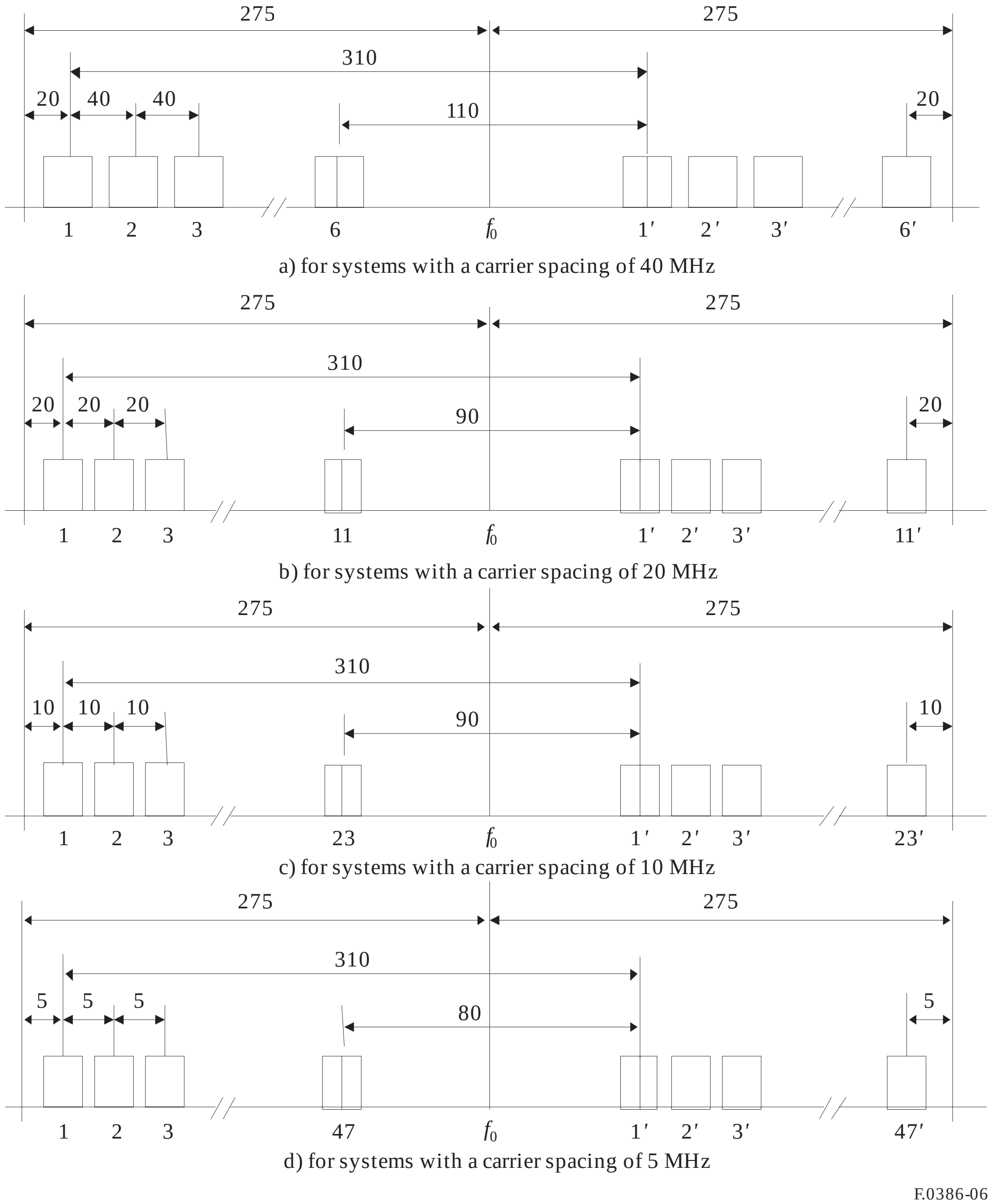
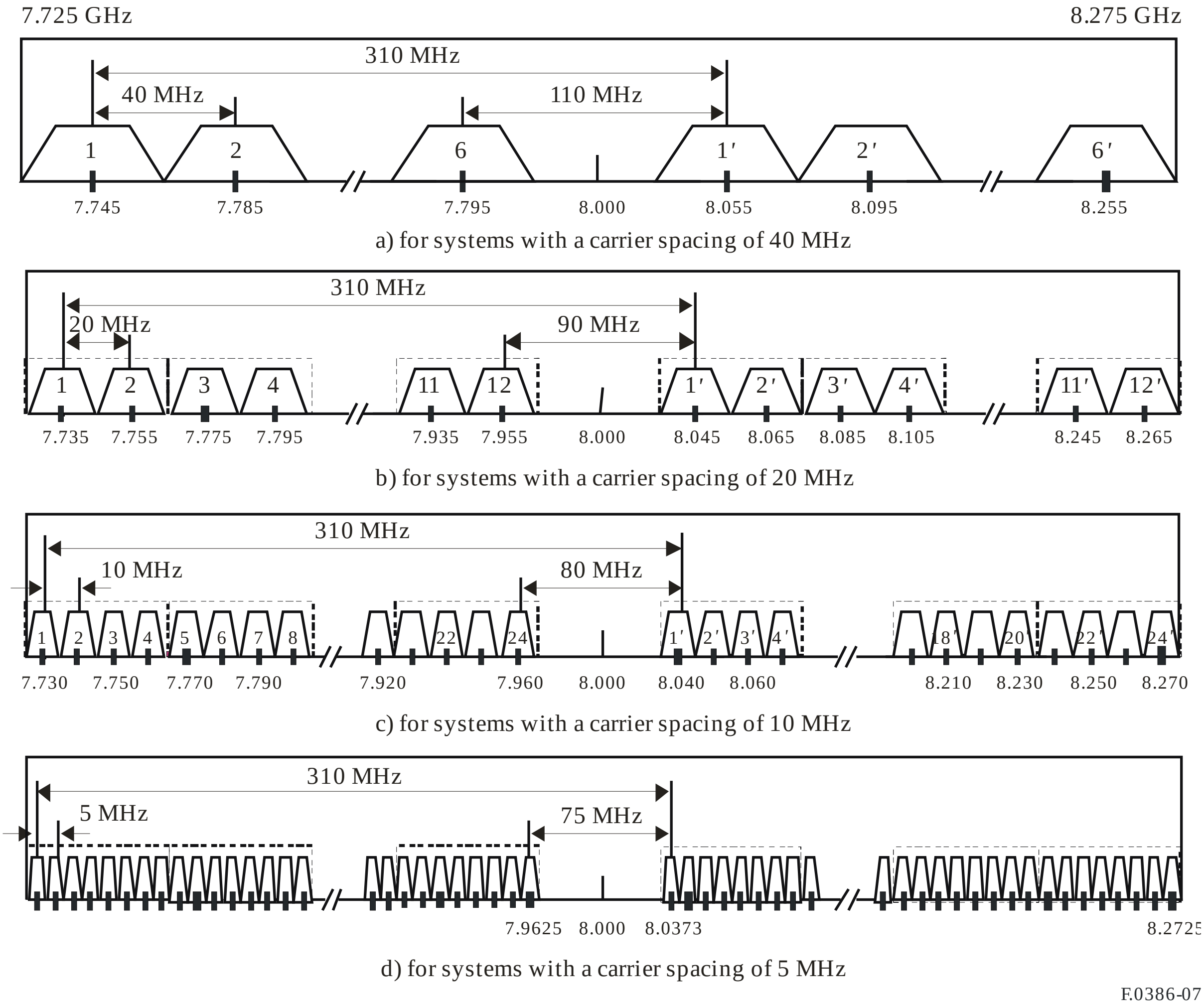


FIGURE 7

Alternative RF channel arrangements for transmission of various digital signals operating with 40 MHz, 20 MHz, 10 MHz and 5 MHz channel spacing in the band 7 725-8 275 MHz



Annex 5

RF channel arrangements for digital FWS operating in the 8 025 to 8 500 MHz band based on multiples of 3.5 MHz bandwidth referred to in *recommends* 1

This Annex describes an RF channel arrangement suitable for digital FWS operating in the 8 025-8 500 MHz band with a channel separation multiple of 3.5 MHz.

The RF channel arrangement is shown in Fig. 8 and is derived as follows:

Let f_n be the centre frequency of one RF channel in the lower half of the band (MHz);

f'_n be the centre frequency of one RF channel in the upper half of the band (MHz);

f_0 be the reference frequency (MHz),

$$f_0 = 8\,253 \text{ MHz}$$

a) for systems with a channel separation of 28 MHz (32 × 2 Mbit/s):

lower half of the band: $f_n = f_0 - 217 + 28\,n$ MHz

upper half of the band: $f'_n = f_0 - 9 + 28\,n$ MHz

where:

$n = 2, 3, \ldots 7$;

b) for systems with a channel separation of 14 MHz (16 × 2 Mbit/s):

lower half of the band: $f_n = f_0 - 210 + 14\,n$ MHz

upper half of the band: $f'_n = f_0 - 2 + 14\,n$ MHz

where:

$n = 2, 3, \ldots 14$;

c) for systems with a channel separation of 7 MHz (8 × 2 Mbit/s):

lower half of the band: $f_n = f_0 - 206.5 + 7\,n$ MHz

upper half of the band: $f'_n = f_0 + 1.5 + 7\,n$ MHz

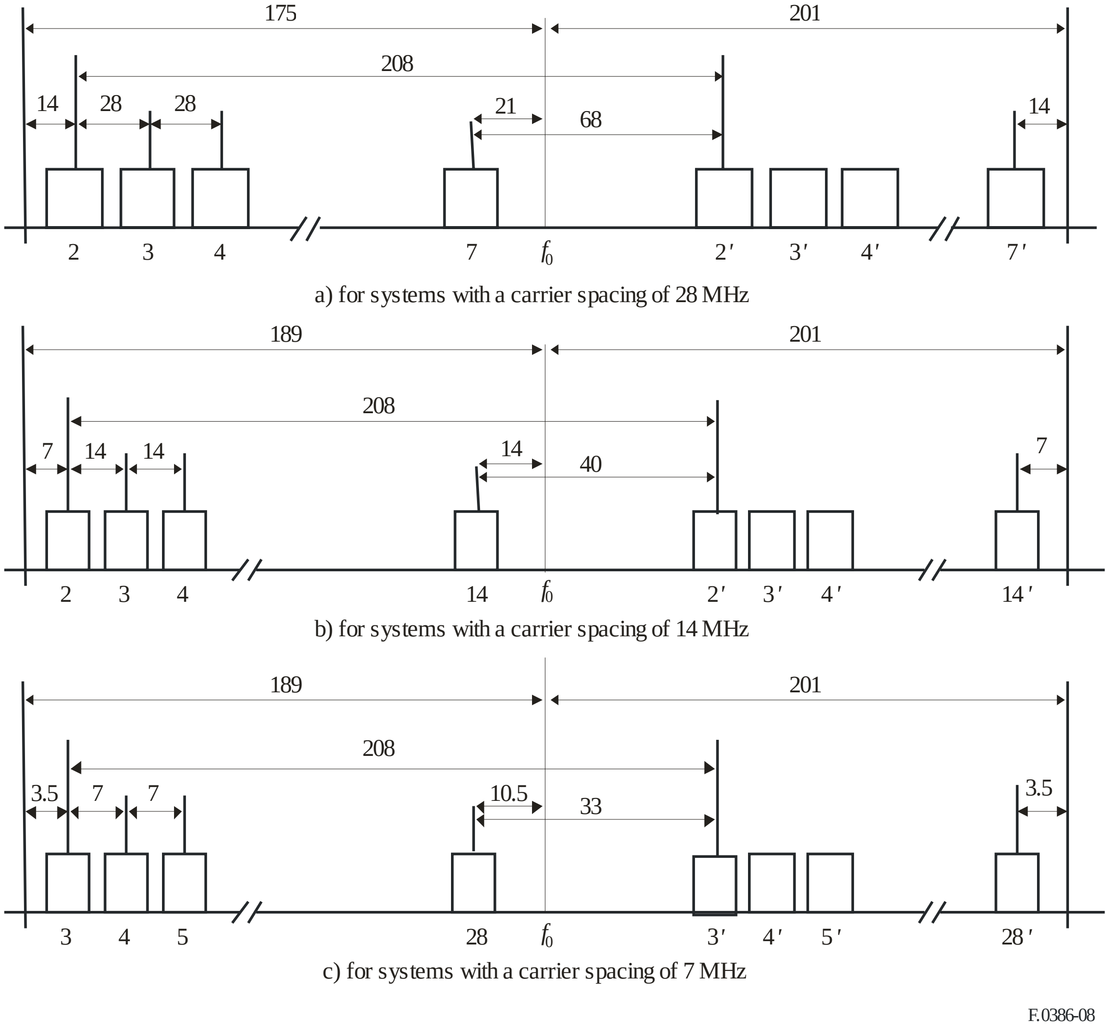
where:

$n = 3, 4, \ldots 28$.

FIGURE 8

RF channel arrangements for transmission of digital FWS operating with multiples of 3.5 MHz channel spacing in the band 8 025-8 500 MHz

(All frequencies in MHz)



Annex 6

Description of the RF channel arrangement referred to in *recommends* 5

1 The RF channel arrangement, in a frequency band of ±275 MHz across the centre frequency 8 000 MHz for up to eight go and eight return channels, each accommodating high capacity digital systems up to 140 Mbit/s or synchronous digital hierarchy bit rates operating in the 8 GHz band, is as shown in Fig. 9 and is derived as follows:

Let f_0 be the frequency of the centre of the band of frequencies occupied (MHz);

f_n be the centre frequency of one RF channel in the lower half of this band (MHz);

f'_n be the centre frequency of one RF channel in the upper half of this band (MHz);

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

lower half of the band: $f_n = f_0 - 281.95 + 29.65\, n$ MHz

upper half of the band: $f'_n = f_0 + 29.37 + 29.65\, n$ MHz

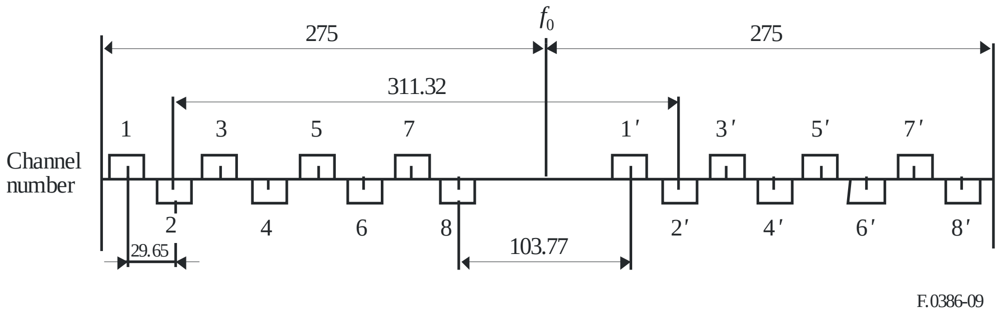
where:

$n = 1, 2, 3, 4, 5, 6, 7$ or 8.

FIGURE 9

RF channel arrangements for digital FWS with capacities up to 140 Mbit/s or synchronous digital hierarchy bit rates operating in the 7 725-8 275 MHz band

(All frequencies in MHz)



2 In a section over which the international interconnection is arranged, all the go channels should be in one half of the band, and all the return channels should be in the other half of the band.

3 The go and return channels on a given section should preferably use the polarizations shown below:

	Go	*Return*
H(V)	1 3 5 7	1′ 3′ 5′ 7′
V(H)	2 4 6 8	2′ 4′ 6′ 8′

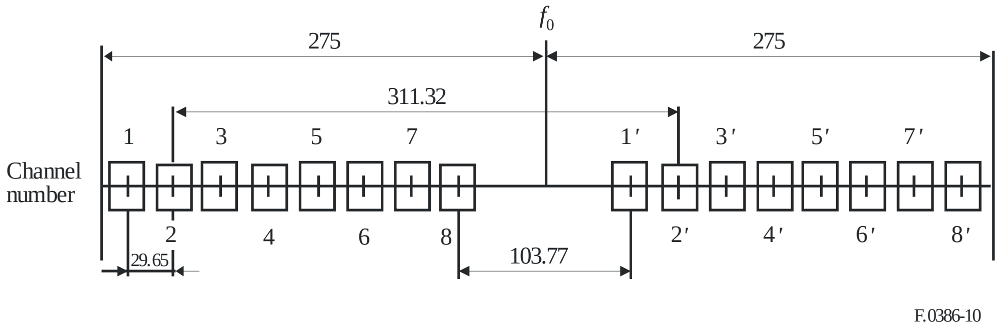
4 When additional RF channels, interleaved between those of the main pattern, are required, the values of the centre frequencies of these RF channels should be 14.825 MHz below those of the corresponding main channel frequencies.

5 In the case of digital FWS with a co-channel arrangement, the plan as shown in Fig. 10, should be used.

FIGURE 10

Co-channel arrangement for digital FWS operating in the 7 725-8 275 MHz band

(All frequencies in MHz)



6 That, for international connections, the centre frequency should be:

$$f_0 = 8\,000 \text{ MHz}$$

This value corresponds to the band 7 725-7 975 MHz in the lower half and 8 025-8 275 MHz in the upper half.

NOTE 1 – The RF channel arrangement shown in Fig. 9 overlaps that mentioned in Recommendation ITU-R F.385, for a centre frequency of 7 700 MHz, by 125 MHz between 7 725 MHz and 7 850 MHz. All due precautions to avoid mutual interference must be taken by FWS using these channel arrangements.