Annex 3 B

Determination of the Masks Discrimination and the Net Filter Discrimination in the Fixed Service

The calculations of the masks discrimination and the net filter discrimination are based on the relation of two powers. Because these powers are represented by areas, only the areas are taken into account for the determination of the masks discrimination and the net filter discrimination.

1. Masks Discrimination – MD

The Masks Discrimination (MD) expresses the reduction (in dB) of the interference power caused by the filter shape of the transmitter spectrum density mask and the receiver selectivity mask.

MD is calculated as follows :

MD = 10 log (TX area/ overlapping area at co-channel)

1.1 calculation of the TX area

An example of a transmitter spectrum density mask is given in Figure 1. The mask can be split up into different elements. The areas of these elements are relative power portions to the transmitter power. The area within the entire mask represents the TX area.

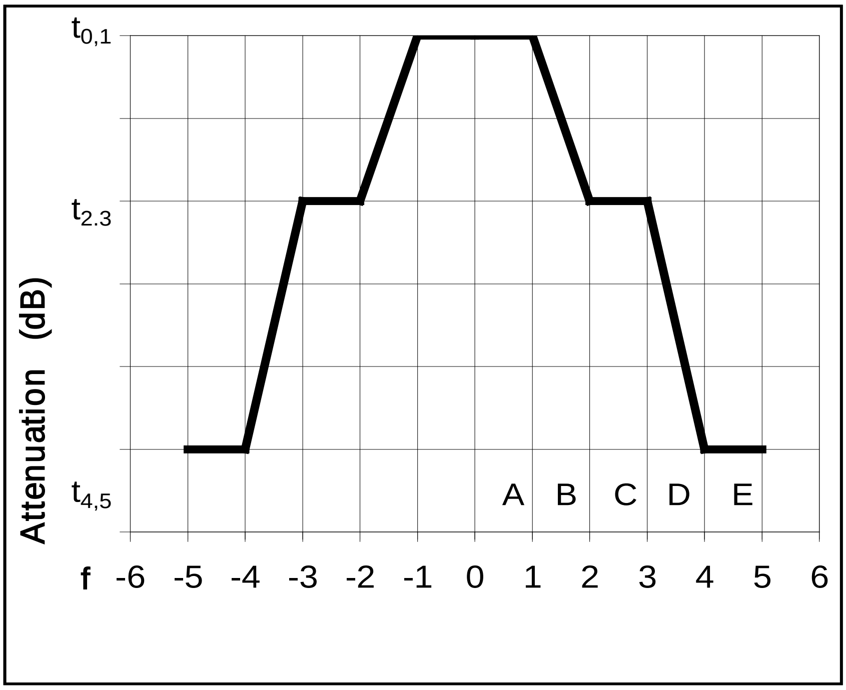

Figure 1

Flat elements have to be calculated using formula 2.1 with r_i= 0 (see below), slope elements have to be calculated using formula 2.2 with r_i= 0 (see below).

1.2 Calculation of the overlapping area at co channel

An example of the overlapping area at co channel between transmitter spectrum density mask and receiver selectivity mask is given in Figure 2.

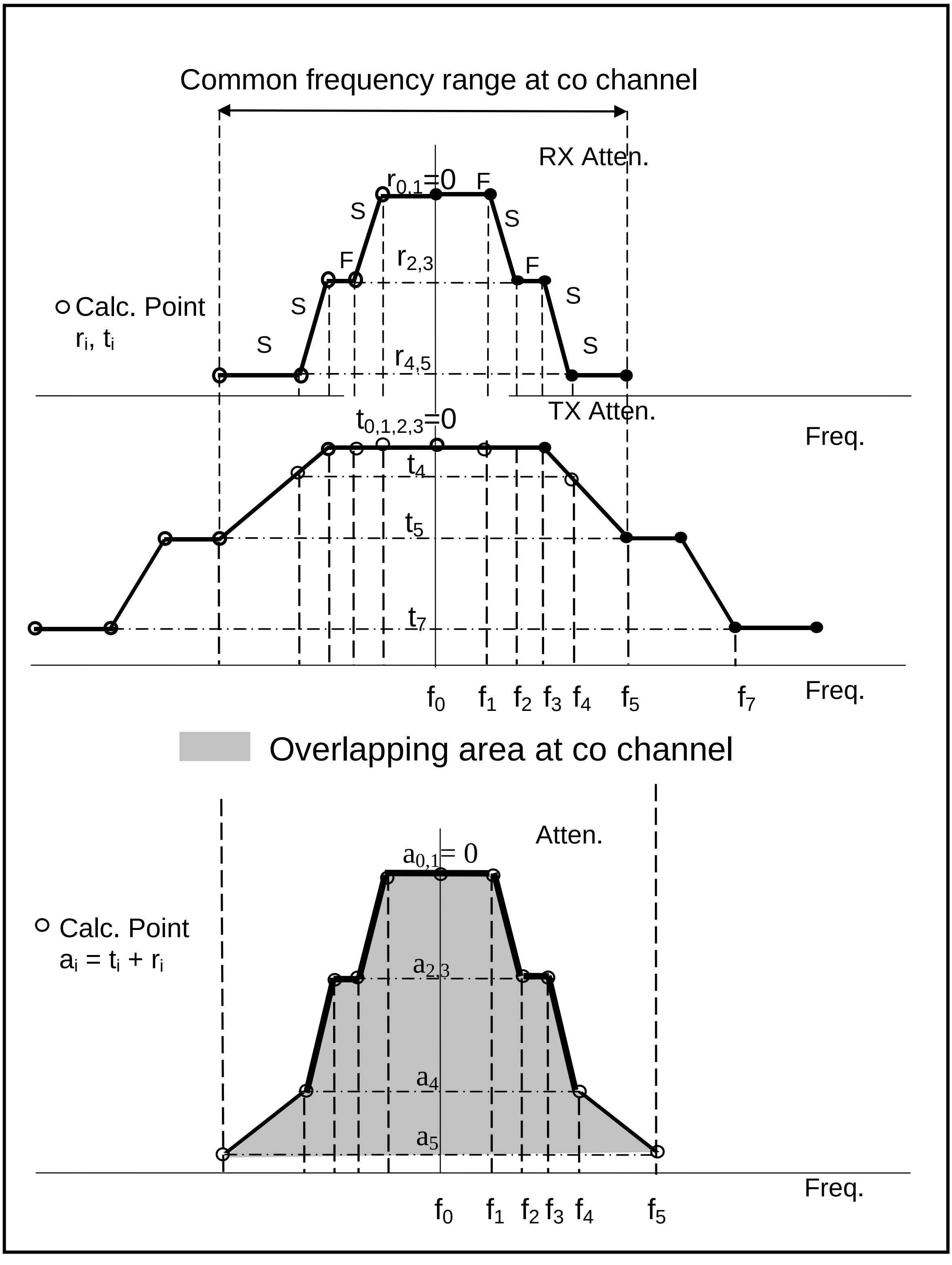

Figure 2

The common frequency range at co channel has to be split into flat and slope partial elements. Flat element (F) is a partial element where both masks are flat. Slope element (S) is a partial element where at least in one partial element a slope is detected.

Flat elements have to be calculated using formula 2.1; slope elements have to be calculated using formula 2.2.
The overlapping area is the sum of all partial elements calculated using formulas 2.1 and 2.2 in the common frequency range at co channel.

2. Net Filter Discrimination – NFD

The Net Filter Discrimination (NFD) expresses the reduction (in dB) of the interference power if the transmitter and receiver frequencies are different.

The NFD value can be determined by measurement or by calculation.

2.1 Method based on measurement

The principle of the measurement method is to plot the test channel receiver input level required for a specified BER (e.g. 10^{-3}) as a function of the signal (carrier) to interference ratio (C/I). The testing arrangement is in Figure 3.

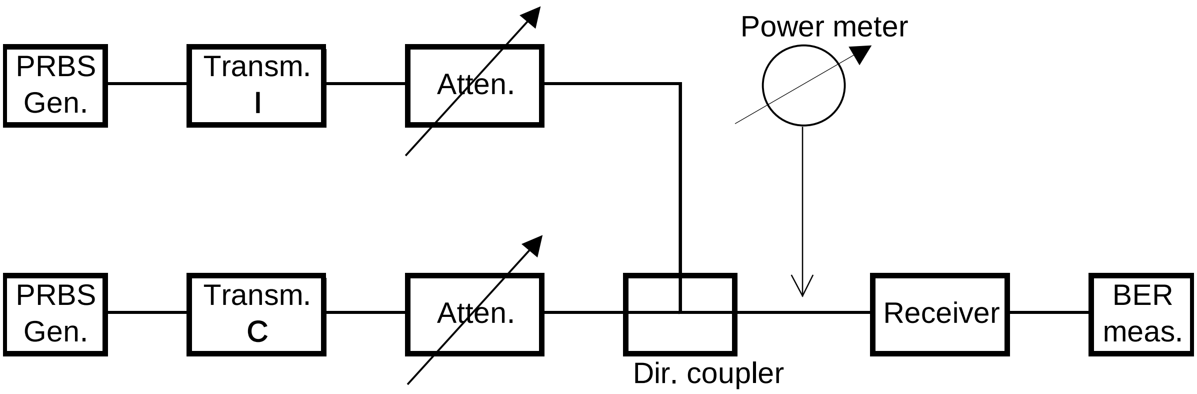

Figure 3

PRBS: Pseudo Random Bitrate Signal

By plotting two curves, one for co-channel interference and the other for the adjacent channel interference, the horizontal shift between them at the specified receiver input level (see Figure 4) is the NFD.

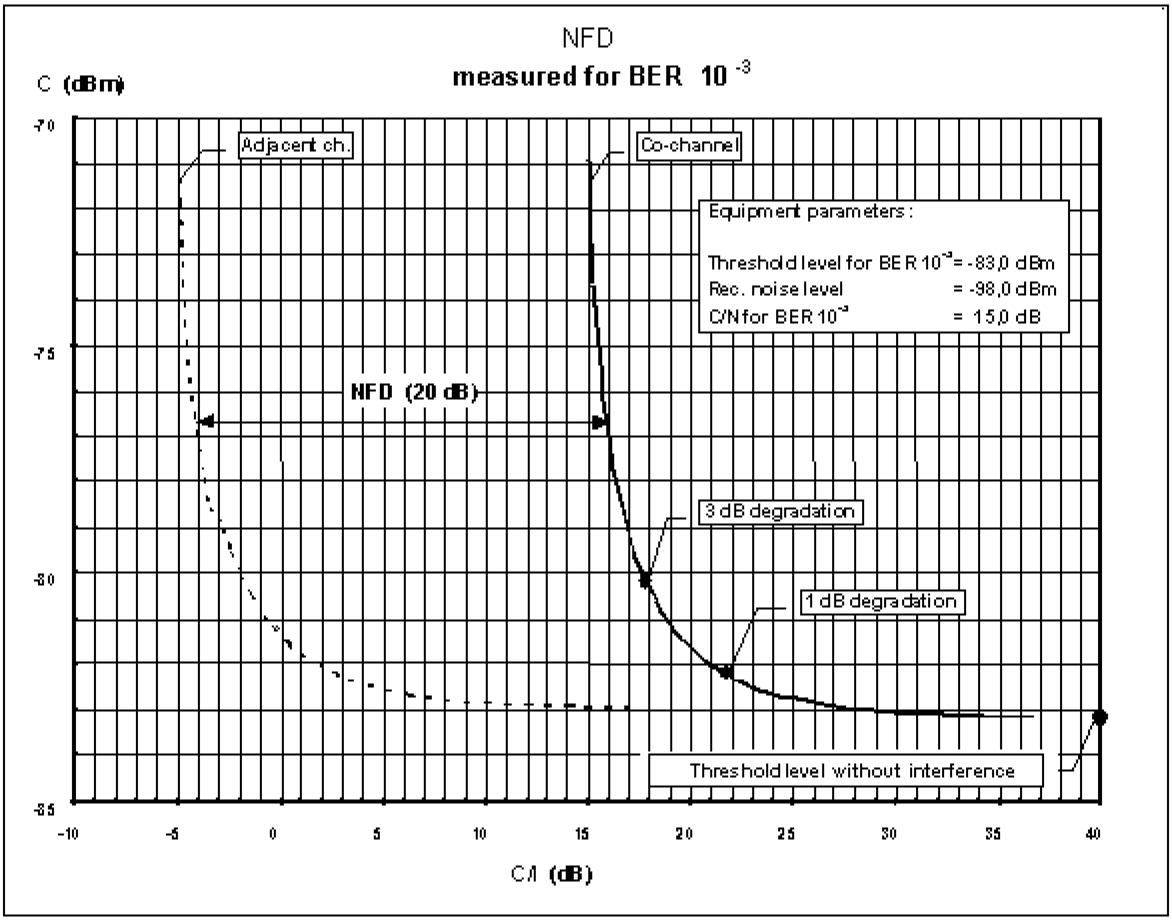

Figure 4

Using the curves, the NFD value can be determined from two points, one on each of the two curves, corresponding to a given carrier level, e.g. for the 3 dB degradation points.

2.2 Method based on calculation

The NFD is defined according to ETSI TR 101 854 as:

NFD = 10 log (Pc/Pa)

Where:
Pc is the total power received after co-channel RF, IF and base band filtering.
Pa is the total power received after offset RF, IF and base band filtering.

For calculation of the power ratio (Pc/Pa) in the common frequency case the overlapping area is considered only.

For the calculation of Pc and Pa the same transmitter power is used and therefore the formula for NFD can be

NFD = 10 log (overlapping area at co-channel / overlapping area at frequency offset)

Pc is calculated taking the overlapping area of TX spectrum density mask and RX selectivity mask at same operational frequency

An example of the overlapping area at co channel between transmitter spectrum density mask and receiver selectivity mask is given in Figure 5.

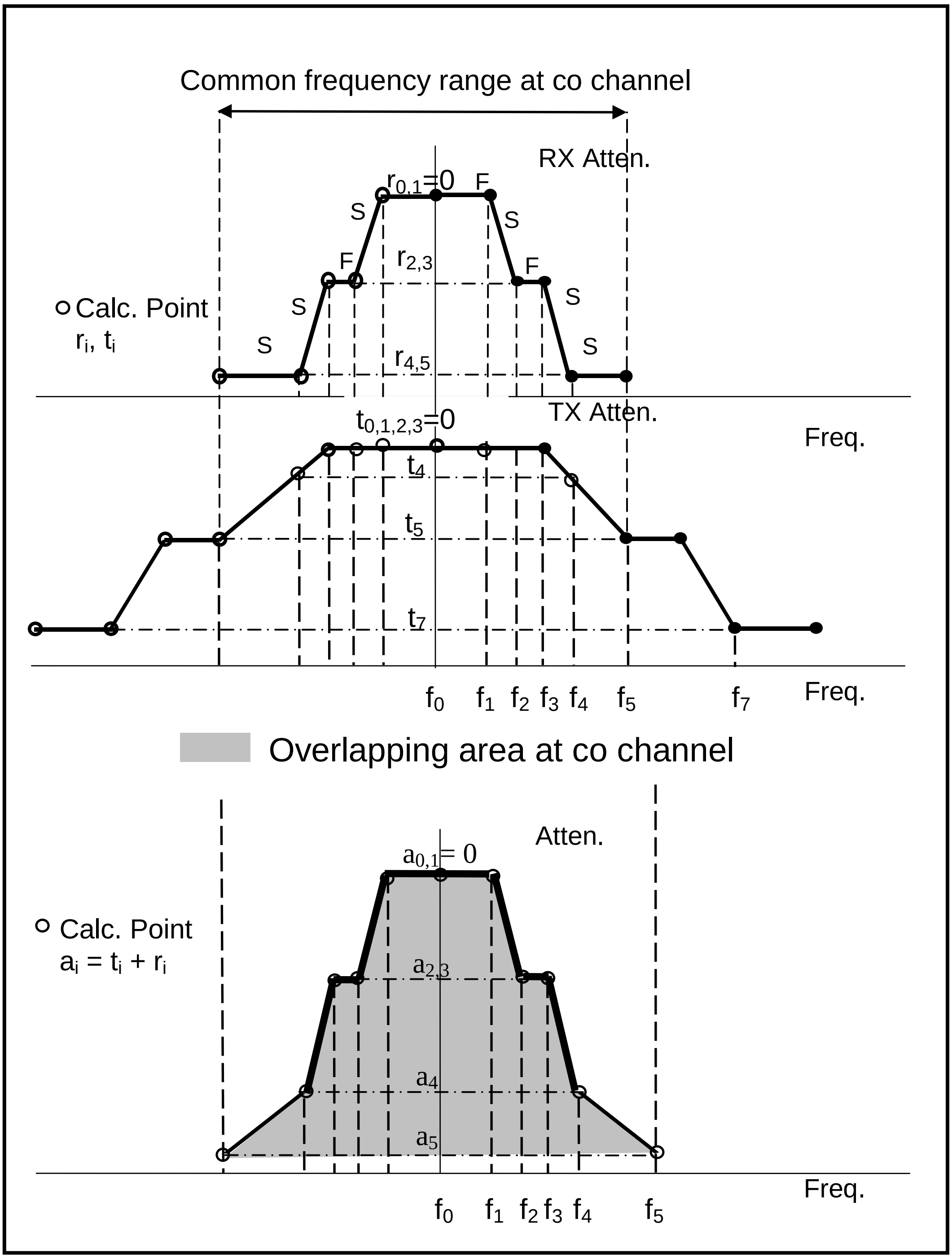

Figure 5

The calculation method is based on integration of the spectrum density of the transmitter spectrum density mask and the receiver selectivity mask in the common frequency range at co channel.

The common frequency range at co channel has to be split into flat and slope partial elements. Flat element (F) is a partial element where both masks are flat, Slope element (S) is an partial element where at least in one partial element a slope is detected.

Flat elements have to be calculated using formula 2.1, slope elements have to be calculated using formula 2.2.

The overlapping area at co channel is the sum of all partial elements calculated using formulas 2.1 and 2.2 in the common frequency range of both masks.

Pa is calculated taking the overlapping area of TX spectrum density mask and RX selectivity mask with the frequency offset:

The common frequency range is the part where both masks are overlapping each other.

An example of the common frequency range at frequency offset between transmitter spectrum density mask and receiver selectivity mask is given in Figure 6.

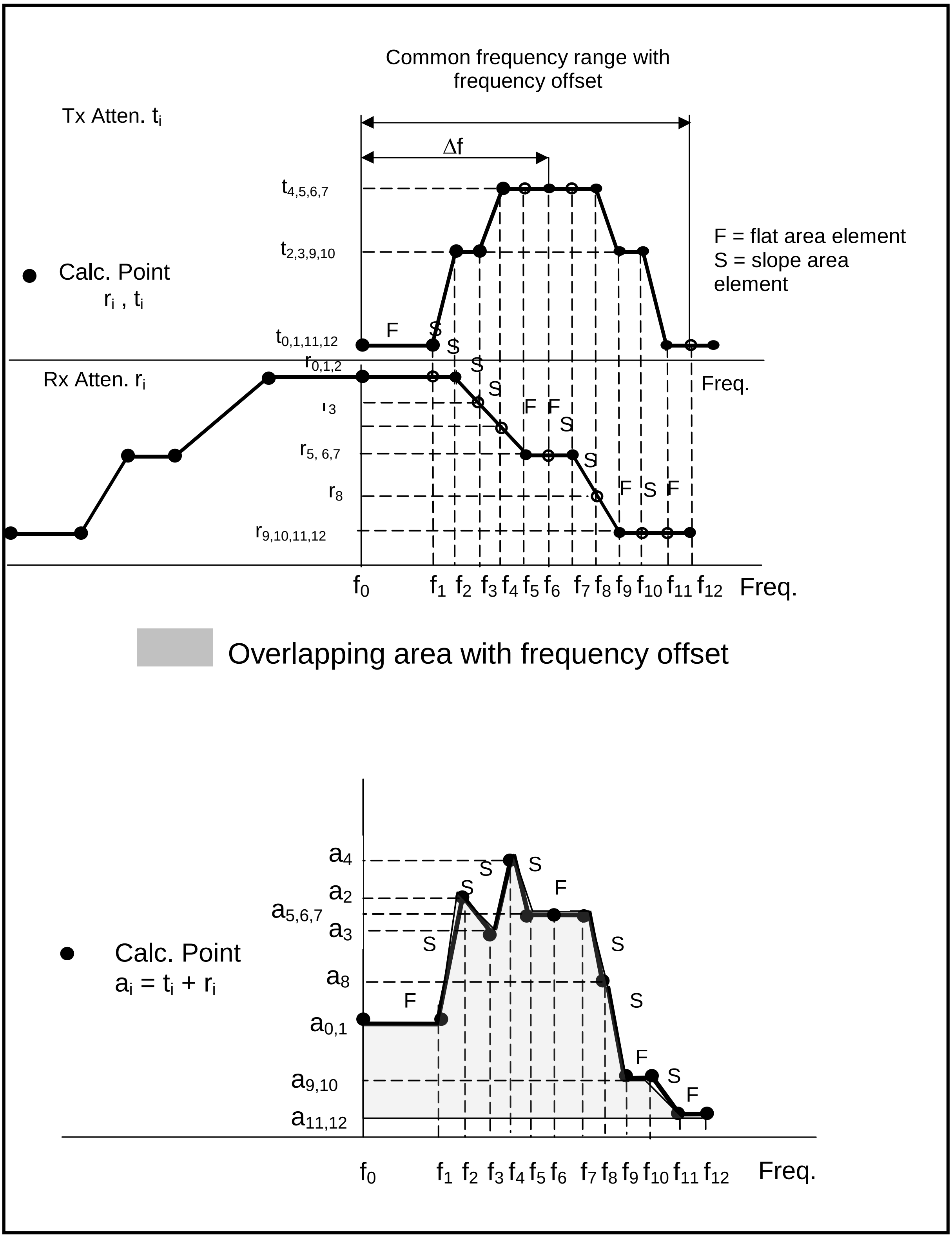

Figure 6

The calculation method is based on integration of the spectrum density of the transmitter spectrum density mask and the receiver selectivity mask in the common frequency range.

The common frequency range has to be split into flat and slope partial elements. Flat element (F) is a partial element where both masks are flat, Slope element (S) is an partial element where at least in one partial element a slope is detected.

Flat elements have to be calculated using formula 2.1, slope elements have to be calculated using formula 2.2.
The overlapping area is the sum of all partial elements calculated using formulas 2.1 and 2.2 in the common frequency range of both masks.

Flat element areas (F) can be calculated according to following formula:

$$F = \left(f_c 10^{\frac{-b}{10}} \right) \qquad (2.1)$$

where:

for the element F

$f_c = f_{i+1} - f_i$ with $f_{i+1} > f_i$ $\qquad b = t_i + r_i = t_{i+1} + r_{i+1}$

where:

b sum of the attenuation of the transmitter (t_i) and receiver (r_i) masks at the beginning or at the end of an element (dB),

f_{i+1} frequency at the end of the element (MHz),
f_i frequency at the beginning of the element (MHz),
f_c bandwidth of the element (MHz),
F partial elements areas under the spectrum masks in the common frequency range.

Slope element areas (S) can be calculated according to following formula:

$$S = \frac{10^{-\frac{b}{10}}}{\frac{\ln(10)}{10} a} \left(1 - 10^{-\frac{a}{10} f_c} \right) \qquad (2.2)^*$$

* only if a is different to 0.

For the element S $a = (t_i + r_i - b)/f_c$ $\qquad f_c = f_{i+1} - f_i$ with $f_{i+1} > f_i$ $\qquad b = t_{i+1} + r_{i+1}$

If the two corresponding elements of the masks represent inverted inclinations, the parameter a may turns to 0. When a=0, the formula (2.1) shall be applied.

where:

b sum of the attenuation of the transmitter (t_i) and receiver (r_i) masks at the end of an element (dB),
t_i transmitter mask attenuation at the beginning of an element (dB),
r_i receiver selectivity mask attenuation at the beginning of the element (dB),
f_i frequency at the beginning of the element (MHz),
f_c bandwidth of the element (MHz),

S partial elements areas under the spectrum masks in the common frequency range.

t_{i+1} transmitter mask attenuation at the end of the element (dB),
r_{i+1} receiver selectivity mask attenuation at the end of the element (dB),
f_{i+1} frequency at the end of the element (MHz),

$$F = \left(f_c 10^{\frac{-b}{10}} \right) \qquad (2.1)$$

where:

for the element F $\quad f_c = \left| f_i - f_{i+1} \right| \qquad b = t_i + r_i$

where:
b sum of the attenuation of the transmitter (t_i) and receiver (r_i) masks at the beginning of an element (dB),

f_i frequency at the beginning and at the end of the element (MHz),
f_c bandwidth of the element (MHz),
F partial elements areas under the spectrum masks in the common frequency range.

Slope element areas (S) can be calculated according to following formula:

$$S = \frac{10^{-\frac{b}{10}}}{\frac{\ln(10)}{10} a} \left(1 - 10^{-\frac{a}{10} f_c} \right) \qquad (2.2)$$

for the element S $\quad a = \frac{t_i - t_{i-1} + r_i - r_{i-1}}{f_c} \qquad f_c = \left| f_i - f_{i-1} \right| \qquad b = t_{i-1} + r_{i-1}$

where:
b sum of the attenuation of the transmitter and receiver masks at the beginning of an element (dB),
t_i transmitter mask attenuation at the beginning and at the end of an element (dB),
r_i receiver selectivity mask attenuation at the beginning and at the end of the element (dB),
f_i frequency at the beginning and at the end of the element (MHz),
f_c bandwidth of the element (MHz),

S partial elements areas under the spectrum masks in the common frequency range.

3. Necessary data for the calculation of MD and NFD

3.1 Transmitter spectrum density mask

For the calculation, the real spectrum density mask shall be used and described in Paragraph 3.3.1. If this mask is not available, the relevant ETSI transmitter mask shall be used.

3.2 Receiver selectivity mask

For the calculation, the real receiver selectivity mask shall be used and described in Paragraph 3.3.1. If this mask is not available, the relevant ETSI transmitter mask of the accompanying transmitter can be used as receiver selectivity mask.

3.3 Necessary data for the data exchange procedure

3.3.1 Up to six points but at least two points of each, the transmitter spectrum density mask and the receiver selectivity mask, have to be provided (see Figure 7).

- Each point is defined by its frequency (MHz) and its attenuation (dB).
- The first point (which is not a part of the data exchange procedure) is automatically defined as 0 MHz and 0 dB.
- The last point must be set for the attenuation of ≥ 40 dB.

3.3.2 The NFD values for the first adjacent channel, named NFD 1 (± 1 channel spacing), and the second adjacent channel, named NFD 2 (± 2 channels spacing), shall be derived from measured data, if available.

In order to use NFD1 and NFD2 values, the following conditions must be fulfilled:

- the interferer and interfered equipment must be produced by the same supplier, and have the same identification;
- the interferer and interfered frequencies must belong to the same frequency plan;
- the capacities (Mbit/s) of the interferer and interfered equipment must be the same.

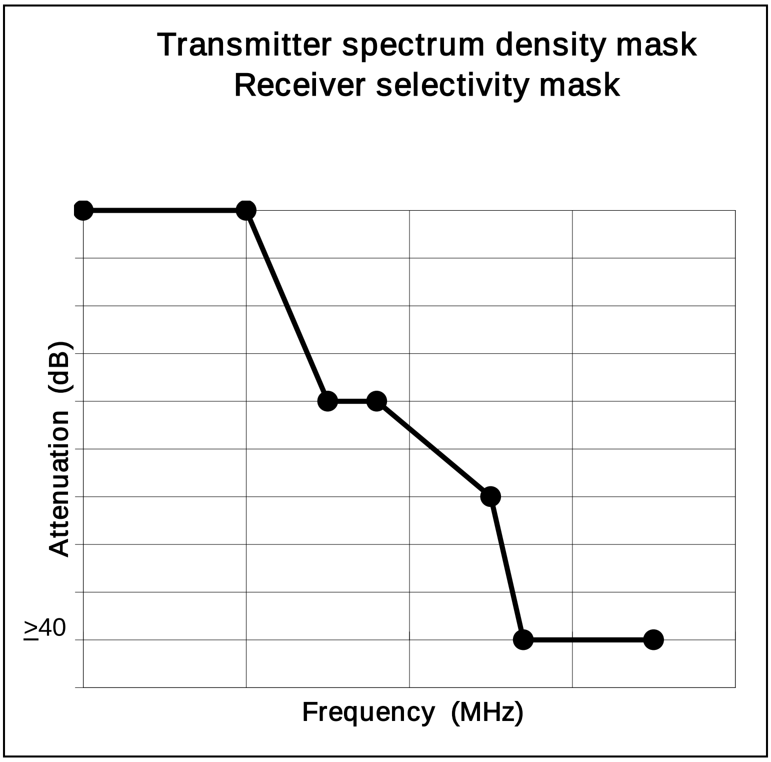
Transmitter spectrum density mask
Receiver selectivity mask
Attenuation (dB)
≥40
Frequency (MHz)

Figure 7