

Annex 9

Threshold Degradation in the Fixed Service

Permissible Threshold Degradation

1 Definition of Threshold Degradation (TD)

The Threshold of a radio receiver is defined as the level of the wanted signal received for a given Bit Error Rate (BER).

In presence of an interfering signal (I), the level of the received wanted signal must be increased to preserve the same BER.

For a given BER, the difference between the increased threshold level value due to interference, and the threshold value without interference, is the Threshold Degradation (TD).

TD is assumed to be equivalent to the noise level increase, due to the interfering signal at the input of the receiver.

2 Permissible Threshold Degradation

The Permissible Threshold Degradation caused to one fixed-link receiver by one foreign fixed-link transmitter must not exceed 1 dB.

3 Calculation of Threshold Degradation

The calculation of TD is a two-step process.

First, the interfering power level (I) at the input of the receiver must be calculated.

Then, the TD due to this interfering signal is calculated and compared to the 1 dB permissible value.

Figure 1 illustrates the mechanism of the interference caused by transmitter X on receiver U.

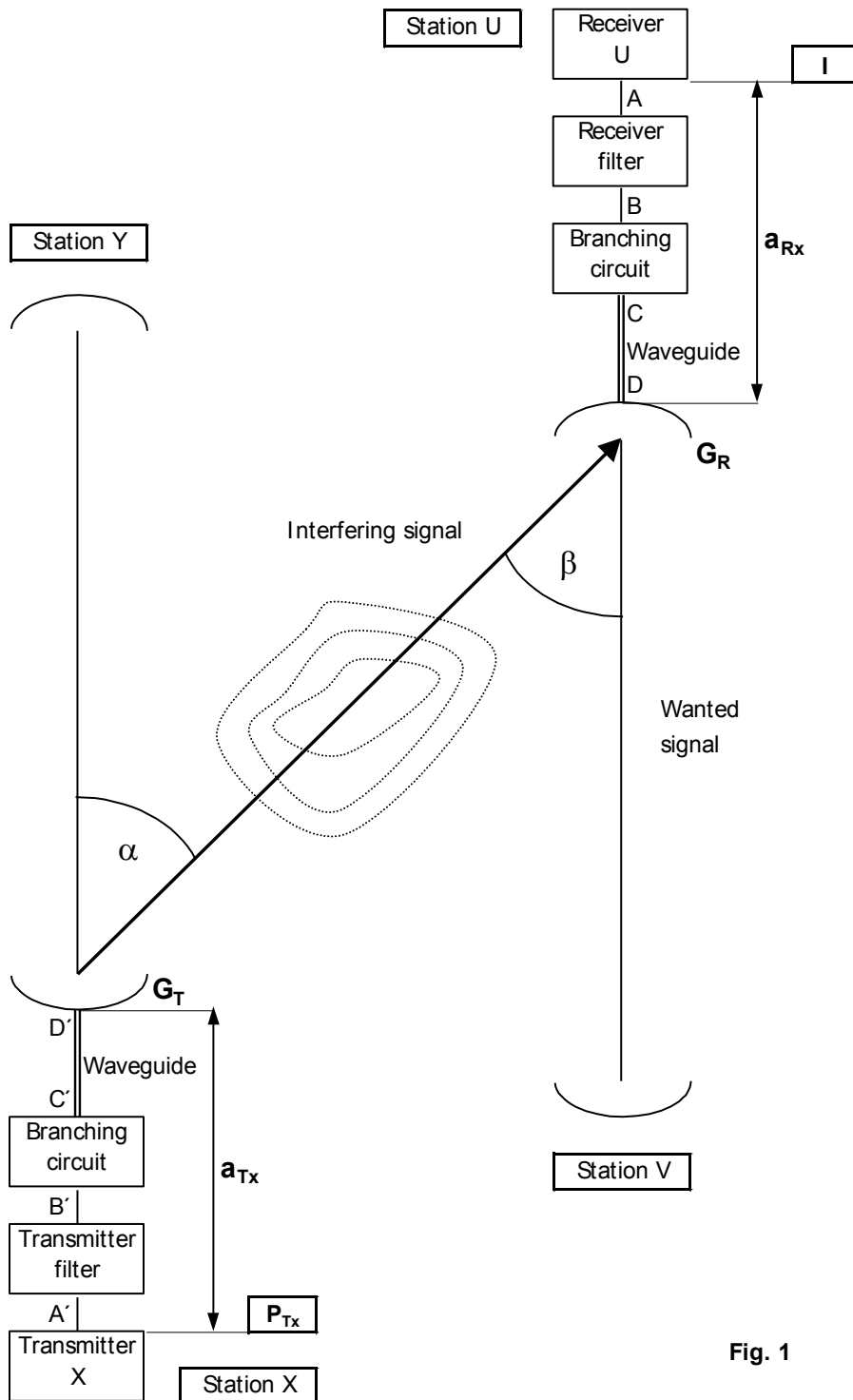


Fig. 1

3.1 Calculation of the interfering power level I

a) The technical data necessary for the calculation of different intermediate parameters, and finally the interfering signal power level (I) at the input of an interfered receiver, are listed below:

Interfered receiver:

- f_{Rx} (MHz) : receiver frequency
- geographical coordinates
- terrain height (m) above sea level
- antenna height (m) above terrain level
- main beam direction of the antenna
- G_R (dB) : receiver antenna gain
- a_{Rx} (dB) : receiver attenuation between points D and A (all losses between the antenna flange and the input of the receiver)
- co-polar and cross polar receiver antenna radiation pattern
- receiver selectivity mask (possibly assumed, see Annex 3 B)
- polarisation

Interfering transmitter:

- f_{Tx} (MHz) : transmitter frequency
- P_{Tx} (dBW) : transmitter power level
- geographical coordinates
- terrain height (m) above sea level
- antenna height (m) above terrain level
- main beam direction of the antenna
- G_T (dB) : transmitter antenna gain
- a_{Tx} (dB) : transmitter attenuation between points D' and A' (all losses between the antenna flange and the output of the transmitter)
- Co-polar and cross polar transmitter antenna radiation pattern
- Transmitter spectrum mask (see Annex 3 B)
- ATPC (dB) : dynamic range of automatically transmitter power control (when applicable)
- polarisation

b) The interfering power level (I) at the receiver input at the station U can be determined using:

$$I = P_{Tx} - a_{tot} \quad (\text{dBW}) \quad (1.1)$$

where

a_{tot} [dB] total attenuation between transmitter output (point A') and receiver input (point A)

$$a_{\text{tot}} = a_{\text{Tx}} - G_{\text{Tx}} + a_{\text{prop}} - G_{\text{Rx}} + a_{\text{Rx}} + a_{\text{ant}} + \text{MD} + \text{NFD} + \text{ATPC} \quad (\text{dB}) \quad (1.2)$$

where

NFD (dB) Net Filter Discrimination (see Annex 3B for calculation)

MD (dB) Masks Discrimination (see Annex 3B for calculation)

a_{prop} [dB] propagation attenuation between antennas that can be calculated on the basis of the results of calculation covered in the Annex 10, in conformity with the type of path.

a_{ant} [dB] attenuation which is a function of both antenna radiation patterns and polarisation discrimination

The aggregated antennas attenuation a_{ant} due to both antenna radiation patterns and polarisation discriminations can be determined using the following formula:

$$a_{\text{ant}} = a_{\text{antH}} - 10 \log \left(1 + 10^{\frac{a_{\text{antH}} - a_{\text{antV}}}{10}} \right) \quad (\text{dB}),$$

where:

a_{antH} aggregated antennas (transmitting and receiving) attenuation for signal of H polarisation,

a_{antV} aggregated antennas attenuation for signal of V polarisation.

a_{antH} and a_{antV} for different configuration of antennas polarisation can be determined by formulas given in the Table 1 where the following notation is applied:

$a_{\text{T}_{\text{H-H}}}$ attenuation of the transmitter antenna of polarisation H relating to the signal of H polarisation in the direction of the receiver,

$a_{\text{T}_{\text{V-V}}}$ attenuation of the transmitter antenna of polarisation V relating to the signal of V polarisation in the direction of the receiver,

$a_{\text{T}_{\text{H-V}}}$ attenuation of the transmitter antenna of polarisation H relating to signal with V polarisation in the direction of the receiver,

$a_{\text{T}_{\text{V-H}}}$ attenuation of the transmitter antenna of polarisation V relating to signal with H polarisation in the direction of the receiver,

$a_{\text{R}_{\text{H-H}}}$ attenuation of the receiver antenna of polarisation H relating to the signal of H polarisation in the direction of the transmitter,

$a_{\text{R}_{\text{V-V}}}$ attenuation of the receiver antenna of polarisation V relating to the signal of V polarisation in the direction of the transmitter,

$a_{\text{R}_{\text{H-V}}}$ attenuation of the receiver antenna of polarisation H relating to the signal of V polarisation in the direction of the transmitter,

$a_{\text{R}_{\text{V-H}}}$ attenuation of the receiver antenna of polarisation V relating to the signal of H polarisation in the direction of the transmitter,

Table 1 a_{antH} and a_{antV} for different configuration of antennas polarisation

Transmitter antenna Polarisation	Receiver antenna polarisation	
	H	V
H	$a_{\text{antH}} = aT_{\text{H-H}} + aR_{\text{H-H}}$ $a_{\text{antV}} = aT_{\text{H-V}} + aR_{\text{H-V}}$	$a_{\text{antH}} = aT_{\text{H-H}} + aR_{\text{V-H}}$ $a_{\text{antV}} = aT_{\text{H-V}} + aR_{\text{V-V}}$
V	$a_{\text{antH}} = aT_{\text{V-H}} + aR_{\text{H-H}}$ $a_{\text{antV}} = aT_{\text{V-V}} + aR_{\text{H-V}}$	$a_{\text{antH}} = aT_{\text{V-H}} + aR_{\text{V-H}}$ $a_{\text{antV}} = aT_{\text{V-V}} + aR_{\text{V-V}}$

3.2 Calculation of TD due to I**a) Input data**

I (dBW) : interfering power level at the receiver input coming from one interfering source (see 3.1.b).

FkTB or N (dBW) : noise power level in the interfered receiver bandwidth.

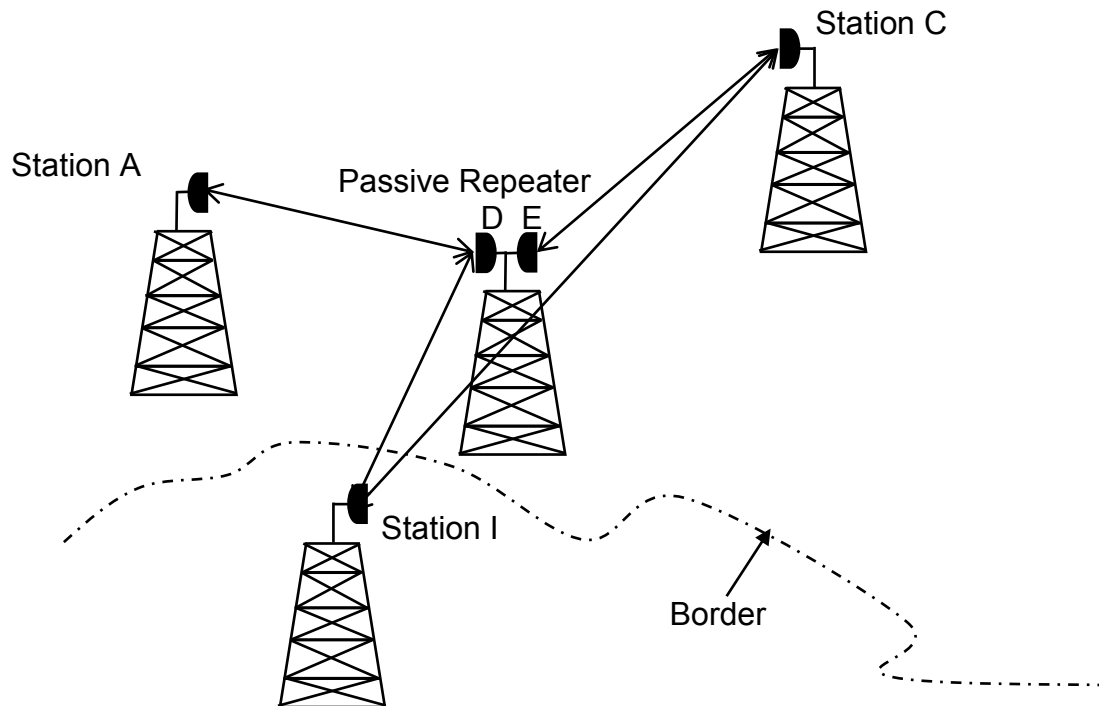
b) Calculation:

TD (dB) , threshold degradation of the interfered receiver

$$TD = 10 \log (1 + 10^{(I-N)/10}) \quad (1.3)$$

3.3 Calculation method for radio relays with passive repeaters

3.3.1 Back to Back antenna type



Victim: link ADEC

Interferer: station I

Fig 1

The calculation method of the threshold degradation is based on the method described below.

The mechanism of the interference caused by the transmitter I on the receiver C is illustrated in Fig. 2. The total interfering power can be split up into two parts, resulting from the sum of the interference power caused by the transmitter I on the direct path and the power interference contribution due to the back to back repeater.

For the calculation with the back to back passive repeater type, it is necessary to change only the formula for the total attenuation between transmitter output and receiver input (formula (12)).

$$a_{\text{tot}} = a_{\text{Tx}} - G_{\text{Tx}} + a_{\text{propID}} - G_{\text{D}} + a_{\text{antID}} + a_{\text{DE}} - G_{\text{E}} + a_{\text{propEC}} - G_{\text{C}} + a_{\text{antEC}} + a_{\text{Rx}} + \text{MD} + \text{NFD} + \text{ATPC}$$

where

- a_{propID} [dB]** propagation attenuation between antennas I and D that can be calculated on the basis of the result of calculation covered in Annex 10. In conformity with the type of path.
- a_{propEC} [dB]** propagation attenuation between antennas E and C that can be calculated on the basis of the result of calculation covered in Annex 10. In conformity with the type of path.
- a_{antID} [dB]** attenuation which is a function of antennas I and D radiation patterns and polarisation discrimination.
- a_{antEC} [dB]** attenuation which is a function of antennas E and C radiation patterns and polarisation discrimination.
- a_{DE} [dB]** attenuation between antennas D and E (wave guide attenuation).

3.3.2 Plane reflector

Interference at the reflector only needs to be considered if it arrives from the same direction as the wanted signal. Consequently, plane reflectors have to be taken into account in the national coordination process, but can be neglected during international coordination.