Blocking (Receiver Susceptibility) Derivation in:
Seamcat
ERC Report 68
ERC Report 101

**Preliminary**

The equation used to calculate the blocking in SEAMCAT are derived from ERC Report 68 and ERC Report 101.

ERC Report 68 provides to theoretical background to conduct Monte-Carlo Simulations. ERC Report 68 assumes that Monte-Carlo studies are performed for a 3dB desensitisation, i.e. N=I\_MAX. Therefore, the equation from ERC Report 68 is only valid for this target environment but may require adaptation for other target desensitisations.

ERC Report 101 compares the minimum coupling loss, the enhanced minimum coupling loss and the Monte-Carlo methods for compatibility analysis.

**ERC Report 68**

iRSSblocking interfering Received Signal Strength due to blocking (in dBm)

ERC Report 68 provides the following equation for the derivation of iRSSblocking



For a single receiver, iRSS can be simplified as

iRSSblocking = (pitsupplied + gitPC + git->vr(fit) - plit->vr - gvr->it (fit)) - avr

where:

(pitsupplied + gitPC + git->vr(fit) - plit->vr - gvr->it (fit)) is simply the interfering power at the receiver’s antenna connector, which will be specified in the following as IOOB.

avr is defined as ‘*receiver susceptibility characteristic is expressed as a ratio between interfering signal levels producing unacceptable receiver performance and is n as a function of frequency separation between the two signals*’, while avr (fit,fvr) is defined as the attenuation of the victim receiver.





It is assumed in the following that avr is the Blocking Response which can be defined as either:

* The receiver filter attenuation of signals outside of receiver’s channel/band, in dB.
* The ratio between the power of an interfering blocking signal (interfering signal outside of the receiver’s bandwidth) and the equivalent in band interfering signal corresponding to this interfering blocking signal, in dB.

ERC Report 68 indicates three possible ways to calculate the Blocking Response:

*Case 1*

This is a user defined mode and ERC Report 68 states that:

*Case 1: avr is provided by the user,*

Obviously no problem as long as the user inputs the right parameter

*Case 2*

Case 2 applies to technologies standard that specify the Blocking limit as an interference ratio. ERC Report 68 indicates that:

*Case 2: Blocking is given in terms of Blocking attenuation of protection ratio. For a wanted signal 3dB above the sensitivity, the attenuation avr can be derived from the following equation:*

*avr=f(C/(N+I), Blockatt)=3+C/(N+I)+Blockatt(fit,fvr)*

The equation clearly combines terms expressed in the linear and logarithmic domain. However, one can transpose the whole equation in the linear domain by substituting C- 10.log10[10^N/10 + 10^I/10] for C/(N+I).

It is also unclear which interference signal is referred to with this I. In the following, we will assume that [C/(N+I)] is actually the performance criteria input by the user in the simulator, where I refers to IIB, the equivalent in band interference from the IOOB.

The definition of Blockatt(fit,fvr) is:

Blockatt(fit,fvr)= IOOB-Standard - Cstandard

It should be noted here that the specification of [C/(N+I)] entered by the user and Blockatt(fit,fvr)= C/IOOB taken together indirectly define the Blocking Response of the receiver (Blockabs(fit,fvr)).

The definitions of iRSSblocking and avr combined provide the following equality:

iRSSblocking = IOOB - avr

= IOOB – (3+ [C/(N+I)] +Blockatt(fit,fvr))

= IOOB - 3 - [C/(N+I)] – IOOB-Standard + Cstandard

= (IOOB-IOOB-Standard) + Cstandard - 3 – [C/(N+I)]

Let’s derive IIB to be able to compare iRSSblocking and IIB.

IIB-STANDARD=IOOB-STANDARD – IOOB-STANDARD + CSTANDARD - CSTANDARD + IIB-STANDARD

= IOOB-STANDARD – Blockatt(fit,fvr) - CSTANDARD + IIB-STANDARD

= IOOB-STANDARD – Blockatt(fit,fvr) - CSTANDARD + IIB-STANDARD

= IOOB-STANDARD – Blockatt(fit,fvr) - (CSTANDARD - IIB-STANDARD)

In order to obtain the IIB corresponding to a given IOOB, a further assumption is required. Let’s assume that:

IIB-IIB-STANDARD=IOOB-IOOB-STANDARD

which corresponds to the hypothesis that the receiver provides a constant attenuation to the interfering signal, i.e. the receiver remains in the linear domain and does not become saturated.

We can then derive:

IIB =IOOB-IOOB-STANDARD + IIB-STANDARD

IIB =(IOOB-IOOB-STANDARD)+ IOOB-STANDARD – Blockatt(fit,fvr) - (CSTANDARD - IIB-STANDARD)

IIB =(IOOB-IOOB-STANDARD)+ CSTANDARD - (CSTANDARD - IIB-STANDARD)

It is now easy to compare iRSSblocking and IIB. We have:

IIB = (IOOB-IOOB-STANDARD)+ CSTANDARD - (CSTANDARD - IIB-STANDARD)

iRSSblocking = (IOOB-IOOB-Standard) + CSTANDARD - 3 – [C/(N+I)]

Therefore, it is clear that iRSSblocking = IIB if and only if

CSTANDARD - IIB-STANDARD = 3 + [C/(N+I)].

This is obviously the case for standards where IIB-STANDARD = N, provided the user has ensured that [C/(N+I)] is consistent with the standard’s definition.

However, in general, iRSSblocking is not necessarily equal to IIB. We have:

iRSSblocking = IIB + [(CSTANDARD - IIB-STANDARD) – (3 + [C/(N+I)] ) ] = IIB + K

where K is a constant value for each simulation setup.

Please note that this is entirely consistent with Appendix 7 of ERC Report 68 which states that the report is based on an assumption of blocking parameters defined for a 3dB desensitisation, i.e.

3 + (C/N+I) = C - I = CSTANDARD - IIB-STANDARD

*Case 3*

Case 3 applies to technologies standard that specify the Blocking limit as an absolute limit (limit in dBm). ERC Report 68 indicates that:

*Case 3: Blocking is given in terms of absolute levels of blocking.*

*avr=f(C/(N+I), blockabs)=C/(N+I)+Blockabs(fit,fvr)-sensvr*

The equation clearly combines terms expressed in the linear and logarithmic domain. However, one can transpose the whole equation in the linear domain by substituting C- 10.log10[10^N/10 + 10^I/10] for C/(N+I).

It is also unclear which interference signal is referred to with this I. In the following, we will assume that [C/(N+I)] is actually the performance criteria input by the user in the simulator, where I refers to IIB, the equivalent in band interference from the IOOB.

The definition of Blockabs(fit,fvr) is:

Blockabs(fit,fvr)= IOOB-Standard

ERC Report 68 defines sensvr as:

sensvr = sensitivity of victim receiver (in dBm)

 The sensitivity is usually defined in standard in absence of interfering signal.

The definitions of iRSSblocking and avr combined provide the following equality:

iRSSblocking = IOOB - avr

= IOOB – ( [C/(N+I)] + Blockabs(fit,fvr) - sensvr)

= (IOOB-IOOB-Standard) + sensvr – [C/(N+I)]

In order to obtain the IIB corresponding to a given IOOB, an assumption is required. Let’s assume that:

IIB-IIB-STANDARD=IOOB-IOOB-STANDARD

which corresponds to the hypothesis that the receiver provides a constant attenuation to the interfering signal, i.e. the receiver remains in the linear domain and does not become saturated.

We can then derive:

IIB =IOOB-IOOB-STANDARD + IIB-STANDARD

It is now easy to compare iRSSblocking and IIB. We have:

IIB = (IOOB-IOOB-STANDARD)+ IIB-STANDARD

iRSSblocking = (IOOB-IOOB-Standard) + sensvr – [C/(N+I)]

Therefore, it is clear that iRSSblocking = IIB if and only if

IIB-STANDARD = sensvr – [C/(N+I)].

This is obviously the case for standards where CSTANDARD = sensvr + 3dB, which also means that IIB-STANDARD=N and [C/(N+I)] + 3 dB = CSTANDARD - IIB-STANDARD, provided the user has ensured that [C/(N+I)] is consistent with the standard’s definition.

However, in general, iRSSblocking is not necessarily equal to IIB. We have:

iRSSblocking = IIB + [ sensvr – [C/(N+I)] - IIB-STANDARD ] = IIB + K

where K is a constant value for each simulation setup.

Please note that this is entirely consistent with Appendix 7 of ERC Report 68 which states that the report is based on an assumption of blocking parameters defined for a 3dB desensitisation, i.e.

CSTANDARD = sensvr + 3dB

N = IIB

**ERC Report 101**

The report 101 also assumes from the beginning of the report that any MCL analysis should be conducted for a 3 dB desensitisation:

*The most important characteristics of the MCL method are:*

* *[…]*
* *the victim receiver is assumed to be operating 3 dB above reference sensitivity […]*

ERC Report 101 does not discuss how the standards blocking parameters are specified, but simply recommend to take them ‘as is’, i.e. regarding the effect of the desensitisation implicitly specified by the standard for the definition/testing of blocking parameters.

**SEAMCAT Manual**

The SEAMCAT manual defines/discussed the receiver attenuation in Annex A.6.3, A.6.4 and A.6.5.

The manual uses exactly the same equations as ERC Report 68 and refers explicitly to the assumption that standards define blocking parameters for a 3 dB desensitisation.

Therefore, similarly as for ERC Report 68, SEAMCAT provides an erroneous result for any standard defining blocking parameters for a desensitization other than 3 dB.