2023-SC101-0331 Rev.3
15 April 2024

AIS receiver blocking by separate VHF radio on same vessel

Antennas horizontally separated

Rohde & Schwarz Field Strength Estimator: Power received by AIS from VHF radiotelephone

VHF RT / AIS antenna separation: ***5 m***

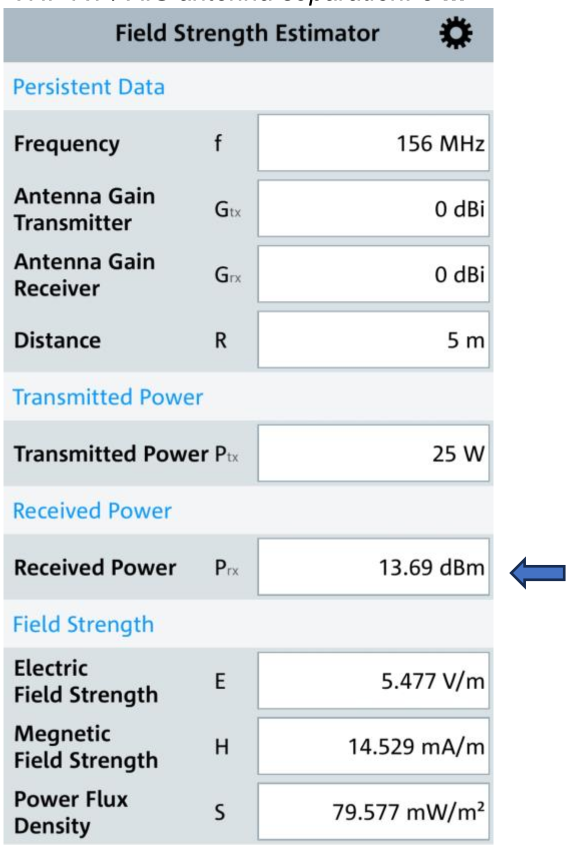

Figure 1

VHF RT / AIS antenna separation: ***136 m***

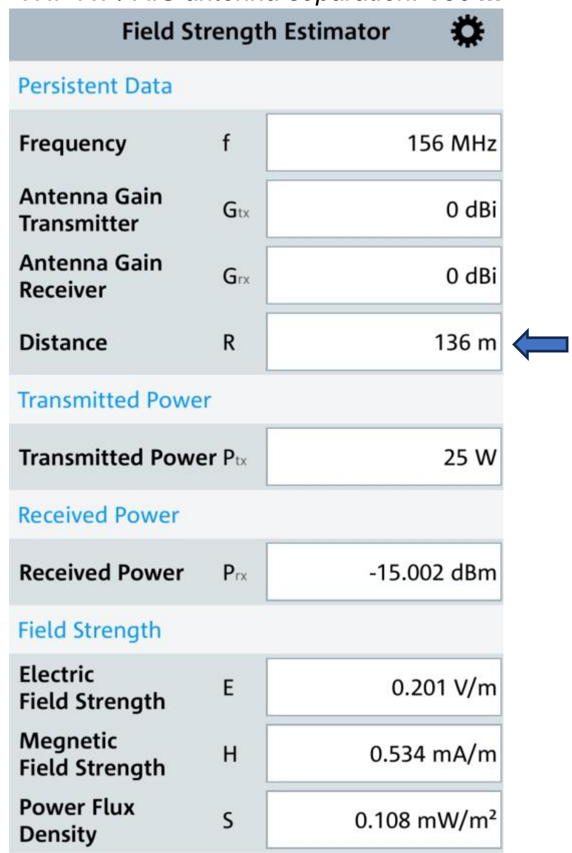

Figure 2

AIS (all Classes) receiver blocking and desensitization specification (ITU-R M.1371-5):

-15 dBm (>5 MHz)

Power received into AIS antenna from VHF radiotelephone when antennas are horizontally separated by 5 metres, in accordance with COMSAR.1/Circ.32/Rev.2 § 5.2.8 (see Figure 1):

13.7 dBm, **exceeding the power specified to block AIS receiver by 28.7 dB**

VHF radiotelephone / AIS antenna horizontal separation necessary to avoid AIS blocking (see Figure 2):

≥**136 metres**

NOTE: Revision 3 corrects the 26km distance calculation at the end of page 3. Free space valid for calculating VHF propagation distances less than a kilometer only. ITU-R P.1546-6 is used instead.

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Antennas vertically separated

Characteristics for vertical whip antennas based on ITU-R F.1336

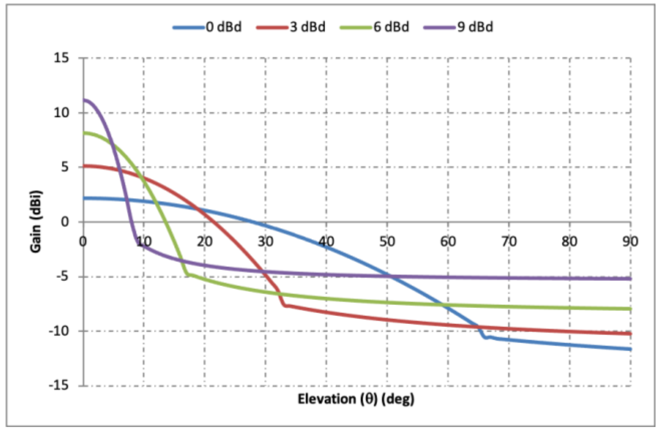

Figure 3

0 dBd VHF and AIS antennas vertically (90 deg elevation) separated by 2 metres in accordance with COMSAR.1/ Circ.32/Rev.2 § 5.2.8 (see Figure 3):

VHF RT -12 dBi
AIS -12 dBi

VHF RT / AIS vertical antenna separation: ***2 m***

Field Strength Estimator		
Persistent Data		
Frequency	f	156 MHz
Antenna Gain Transmitter	G_{tx}	-12 dBi
Antenna Gain Receiver	G_{rx}	-12 dBi
Distance	R	2 m
Transmitted Power		
Transmitted Power	P_{tx}	25 W
Received Power		
Received Power	P_{rx}	-2.351 dBm
Field Strength		
Electric Field Strength	E	3.44 V/m
Megnetic Field Strength	H	9.124 mA/m
Power Flux Density	S	31.381 mW/m²

Figure 4

Power received into AIS antenna from VHF radiotelephone when antennas are vertically separated by 2 metres, in accordance with COMSAR.1/Circ.32/Rev.2 § 5.2.8 (see Figure 4):

-2.4 dBm, 12.6 dB above the AIS receiver blocking specification.

Note: Reflections from the ship's superstructure would reduce the 24 dB isolation achieved by vertical separation, thereby worsening the situation.

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Mitigating the problem without modifying ITU-R receiver requirements

It may be possible to mitigate this problem without changing the receiver blocking and desensitization specification. One means of doing so might be to include an automated (e.g. signal strength-enabled) local-distance switch, which would attenuate the receive signal a fixed (or variable) amount whenever the received signal exceeded -15 dBm.

An example of the effect an automatically-activated local/distance switch employed on AIS receivers would have on shipboard antenna installations is shown in figure 5.

VHF RT / AIS horizontal antenna separation of 2.5 m with 35 dB automatically-activated local/distance switch

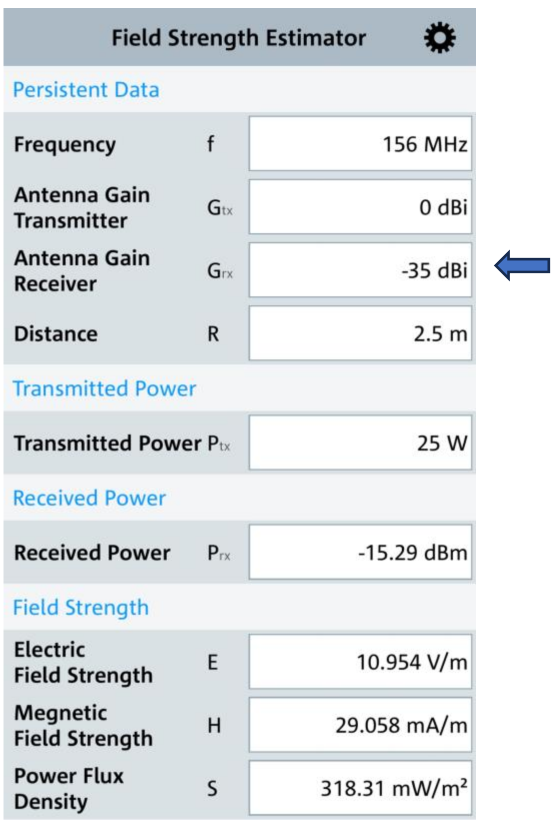

Figure 5

Calculated detection range of Class B(CS) AIS while 35 dB local/distance switch is activated

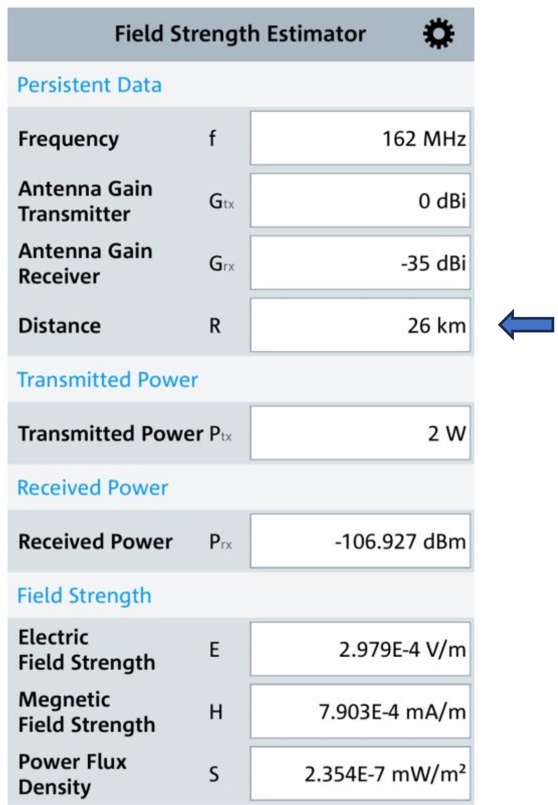

Figure 6

In this example, a VHF radio antenna could be installed as close as 2.5 metres horizontally from the AIS antenna without causing the AIS receiver to be blocked. If the AIS received signal exceeded – 15 dBm due to the keying of that of that or any nearby VHF radio, 35 dB of AIS front end attenuation would be activated while VHF is keyed. While activated, Class B(CS) AIS line-of-sight free space detection range is calculated in figure 6 to be 26 km. Since free space is not a valid means of predicting propagation range at VHF for distances above a kilometer, the actual range using ITU-R P.1546-6 Figure 4 is shown as 4.2 km (2.3 nm). Normal Class B detection range is 28 km (15nm).

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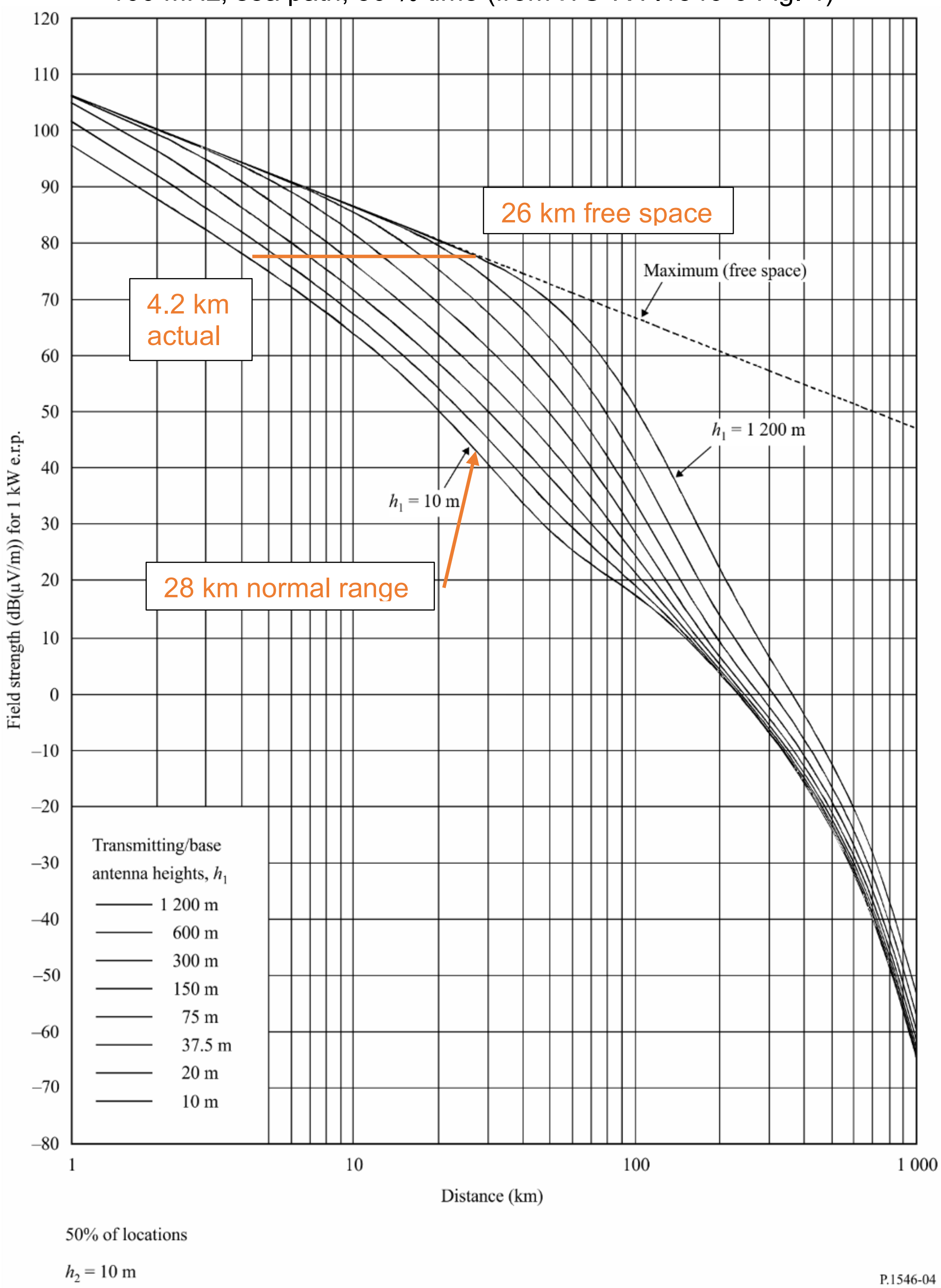
100 MHz, sea path, 50 % time (from ITU-R P.1546-6 Fig. 4)



AIS receiver blocking by separate VHF radio on same vessel

Calculating field strength necessary to receive Class B AIS based upon Recommendation ITU-R P.1546-6

Frequency = 162 MHz
Receiver sensitivity = -107 dBm
Antenna gain = 0 dBi *(assumed by RTCM 2023-SC101-0331)*
Tx antenna height = 10 m
Rx antenna height = 10 m *(height assumed by ITU-R P.1546-6)*
AIS power = 2 w
Assumed attenuation necessary to prevent receiver saturation = 35 dB

$E_{dB\mu V/m} = AF_{dB/m} + V_{dB\mu V}$

$AF_{50\Omega} = 20 \log_{10} f_{MHz} - 10 \log_{10} G - 29.7707$, where

$G = 1.64$ for the 0 dBd AIS antenna

$AF_{50\Omega} = 44.19 - 0 - 29.7707 = 14.42$ dB/m

$V_{dB\mu V} = P_{dBm} + 107 = 0$ dBµV

$E_{dB\mu V/m} = AF_{dB/m} + V_{dB\mu V} = 14.42 + 0 = 14.42$ dBµV/m

$E_{dB\mu V/m}$ *reference to 1KW* $= 10 \log \left(\frac{1000}{2}\right) + 14.42 = 41.4$ dBµV/m

$E_{dB\mu V/m}$ *reference to 1KW with 35 dB attenuator* $= 41.4 + 35 = 76.4$ dB µV/m

Using the ITU-R P.1546-6 chart on Figure 4:

Normal AIS detection range is = 28 km = 15.1 nm

AIS detection with 35 dB attenuator is = 4.2 km = 2.3 nm