

RECOMMENDATION ITU-R M.1467-1*

**Prediction of sea area A2 and NAVTEX ranges and protection
of the A2 global maritime distress and safety
system distress watch channel**

(Question ITU-R 92/8)

(2000-2006)

Scope

Recommendation ITU-R M.1467 provides guidance to administrations for predicting sea area A2 and NAVTEX coverage areas by taking into account variations in the propagation conditions. These coverage areas can be confirmed by measurement. This information is provided for administrations that are upgrading, or planning to upgrade, their shore-based facilities for global maritime distress and safety system (GMDSS) operation in the A2 sea area.

The ITU Radiocommunication Assembly,

considering

- a) that the International Convention for Safety of Life at Sea (SOLAS) 1974, as amended, prescribes that all ships subject to this Convention shall be fitted for the global maritime distress and safety system (GMDSS) by 1 February 1999;
- b) that some administrations have yet to establish A2 services for the GMDSS;
- c) that Question ITU-R 92/8 identifies the need for promulgation of minimum performance criteria for the protection of the service, and guidance to accelerate the upgrade of shore-based facilities for GMDSS operation in the A2 sea area,

recommends

- 1** that administrations currently upgrading, or planning to upgrade, their shore-based facilities for GMDSS operation in the A2 sea area should base such upgrading on the information contained in Annex 1. Administrations are invited to develop appropriate software to perform the calculations described in Annex 1.

* This Recommendation should be brought to the attention of the International Maritime Organization (IMO).

Annex 1

Prediction of A2 and NAVTEX ranges

1 Overview

In order to establish a new A2 sea area it is necessary to account for variations in the propagation conditions. A2 coverage is by groundwave, which is largely stable, enabling the extent of the service area to be confirmed by measurement, as is recommended by the IMO, before committing capital expenditure.

The design criteria to be used for establishing A2 and NAVTEX sea areas are defined by the IMO in Annex 3 to their Resolution A.801(19).

2 Prediction of A2 and NAVTEX ranges

2.1 IMO performance criteria

The criteria developed by the IMO for determination of A2 and NAVTEX ranges are reproduced in Table 1 and should be used in the determination of ranges for A2 and NAVTEX services.

TABLE 1
Performance criteria for A2 and NAVTEX transmissions

Distress channel	Radiotelephony	DSC	ARQ NBDP	NAVTEX
Frequency (kHz)	2 182	2 187.5	2 174.50	490 and 518
Bandwidth (Hz)	3 000	300	300	300
Propagation	Groundwave	Groundwave	Groundwave	Groundwave
Ship's power (W)	60	60	60	
Ship's antenna efficiency (%)	25	25	25	25
RF full bandwidth signal/noise ratio (<i>S/N</i>) (dB)	9	12	18 min ⁽¹⁾	8
Mean Tx power below peak (dB)	8	0	0	0
Fading margin (dB)	3	Not stated		3
IMO reference for above	Res. A.801(19)	Res. A.804(19)	Rec. ITU-R F.339	Res. A.801(19)
Availability required (%)	95 ⁽²⁾	Not stated	Not stated	90

DSC: digital selective calling

NBDP: narrow-band direct printing

⁽¹⁾ Stated as 43 dB(Hz) under stable and 52 dB(Hz) under fading conditions with 90% traffic efficiency.

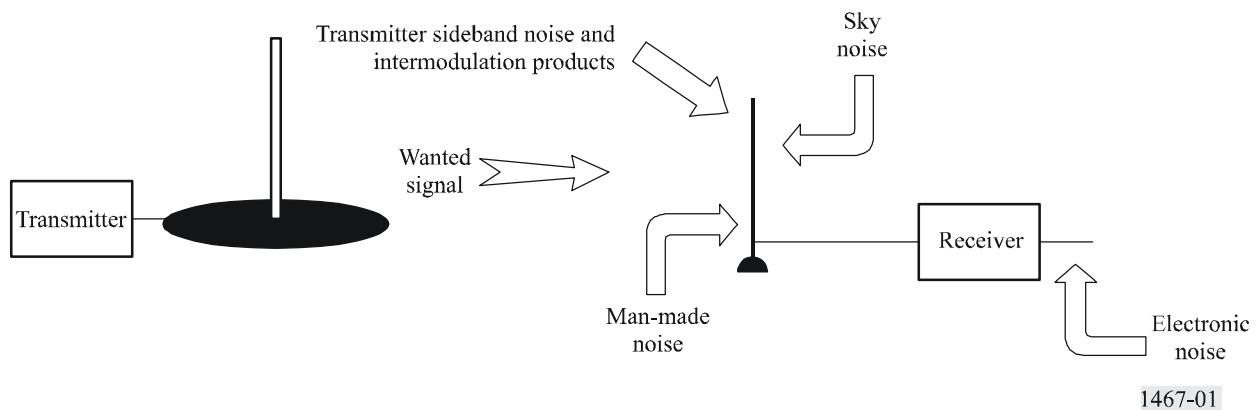
⁽²⁾ Availability can be relaxed to 90% in cases where the noise data used or performance achieved can be proven by measurement.

2.2 Achieving the required quality of signal

2.2.1 The effect of received noise

On a very quiet site, man-made noise dominates below 4 MHz and galactic noise above. These combine, at the receive antenna with seasonal levels of atmospheric noise, and also transmitter sideband noise, as shown in Fig. 1. Recommendation ITU-R P.372 should be used to account for atmospheric and normal man-made noise levels.

FIGURE 1
Determination of required carrier-to-noise ratio (C/N)



Paragraph 3.5 should be used to ensure that the levels of transmitter sideband noise and intermodulation products reaching the receive antenna by groundwave do not exceed the tolerable limit for protection of the A2 DSC watch frequency.

2.2.2 C/N required for single sideband (SSB) radiotelephony

In order to maintain the intelligibility of a received SSB radiotelephony signal it is necessary to provide the operator with a minimum AF signal/noise plus distortion ratio (SINAD), which in turn defines the RF C/N required at the receive antenna.

The capture range for an A2 receive system should be calculated assuming an RF C/N density figure of 52 dB(Hz) at the shore-based receive antenna. This will ensure that a ship's transmitter operating with a peak-to-mean ratio of 8 dB provides the shore-based operator with a 9 dB S/N in a 3 000 Hz bandwidth, as stipulated by the IMO.

The receive antenna and multicoupler should be designed to offer good linearity to minimize the risk of intermodulation products being generated on the watch frequencies. With good electronic design the noise generated within the receive system itself can be ignored below 3 MHz.

2.2.3 C/N required for NAVTEX broadcasts

The transmit range for NAVTEX broadcasts should be calculated assuming an RF C/N density figure of 35 dB(Hz) at the ship's antenna. This will ensure that the NAVTEX receiver is provided with an RF S/N of 8 dB in a 300 Hz bandwidth.

2.3 Accounting for ships topside noise

Topside noise refers to the environmental noise generated by ship-borne machinery, and other sources, and a figure is required for entry into NOISEDAT and other programs. Table 2 shows a number of published figures, and for reference purposes includes galactic and quasi-minimum noise levels, which is accepted as representing the best achievable noise floor.

TABLE 2
Naval environmental categories for topside noise

Environmental category	dB below 1 W ref. 3 MHz
DOD Cat 1 mobile platform	−137.0
IPS ship (ASAPS and GWPS)	−142.0
AGARD ship	−148.0
Quasi-minimum noise	−156.7
Noise galactic (Rec. ITU-R P.372)	−163.6

ASAPS: advanced stand alone prediction system

GWPS: groundwave prediction system

The Australian Department of Defence (DOD) and Advisory Group for Aeronautical Research and Development (AGARD) have both published relevant figures. The AGARD figure represents a naval vessel under normal cruise conditions, whilst the DOD figure represents the maximum level under battle conditions with all machinery in operation.

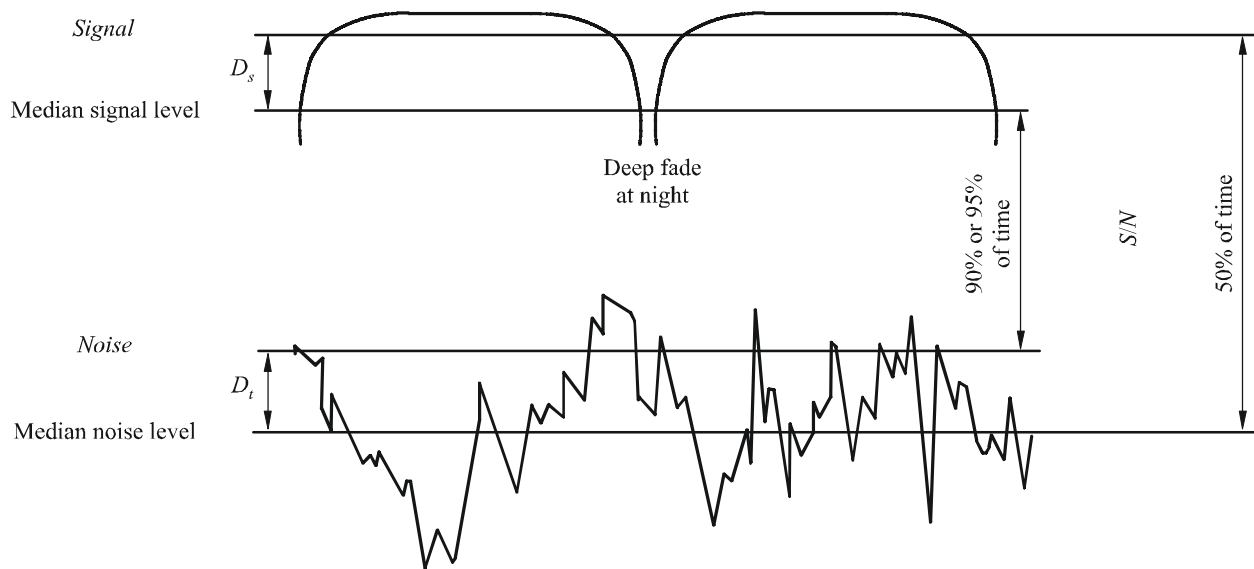
The levels of noise to be expected on commercial vessels can be expected to range between these figures. The IPS Radio and Space Services (IPS) of the Australian Department of Industry have adopted an intermediate figure in their GWPS, which is well accepted as representing the noise level encountered on container vessels, pleasure cruisers, and utility ships. This figure, −142 dBW, should be used in prediction of coverage area of shore-based GMDSS transmitters.

2.4 Determination of external noise factor, F_a , for the required availability

An A2 area in the GMDSS is defined as the area within which ship stations can alert shore stations by using DSC on MF and communicate with the shore stations using MF radiotelephony (class of emission J3E). The communications ranges for voice signals are shorter than for DSC and the IMO criteria for determination of A2 areas should therefore be based on the communication of voice signals.

The range achieved by a transmitter or a receiver depends upon the radiated power, the propagation loss, and the ability of the receiver to discriminate between the wanted signal and the unwanted noise or interference. The level of each component in the received signal will drift as the propagation conditions change with time, and therefore arrive at the receive antenna in varying proportions. The final system design should therefore ensure that the level of the signal will exceed the level of the noise by an adequate amount for an adequate proportion of the time. This proportion is called the availability, and is determined by quantifying the behaviour of the signal and the noise with time as shown in Fig. 2.

FIGURE 2



D_s : lower limit in signal level variation

D_i : upper limit in signal level variation

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Equation (1) should be used to calculate an upper value F_a for the external noise factor which corresponds to the required availability:

$$F_a = F_{am} + \sqrt{D_t^2 + D_s^2} \quad \text{dB above } k T_0 B \quad (1)$$

where:

F_{am} : median external noise factor

D_s : variation in signal level expected for the required time percentage, to which is ascribed the figure of 3 dB specified by the IMO as fading margin

D_t : variation in noise level expected for the required percentage of time.

90% availability is required for NAVTEX broadcasts, and so the upper decile value D_u should be substituted for D_t in equation (1).

95% availability is required for A2 coverage. To achieve this, substitute $D_t = D_u + 3$ dB in equation (1).

First F_{am} and D_u should be determined by running the Noise1 program, which comes with the ITU NOISEDAT package. The program requests seasons required, site location, frequency, level or category of man-made noise, and type of data output required (select F_a), local mean time, and statistical parameters required (select overall median). For prediction of external noise factor on ship stations, the reference figure of -142 dBW should be used to account for topside noise, if no better data is available.

The data is presented in seasonal blocks as shown in Table 3, the data fields being explained in Table 4.