

ITU-R

Radiocommunication Sector of ITU

Recommendation ITU-R M.2013
(01/2012)

Technical characteristics of, and protection criteria for non-ICAO aeronautical radionavigation systems, operating around 1 GHz

M Series

**Mobile, radiodetermination, amateur
and related satellite services**



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Foreword

The role of the Radiocommunication Sector is to ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including satellite services, and carry out studies without limit of frequency range on the basis of which Recommendations are adopted.

The regulatory and policy functions of the Radiocommunication Sector are performed by World and Regional Radiocommunication Conferences and Radiocommunication Assemblies supported by Study Groups.

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Series	Title
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P	Radiowave propagation
RA	Radio astronomy
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SA	Space applications and meteorology
SF	Frequency sharing and coordination between fixed-satellite and fixed service systems
SM	Spectrum management
SNG	Satellite news gathering
TF	Time signals and frequency standards emissions
V	Vocabulary and related subjects

Note: This ITU-R Recommendation was approved in English under the procedure detailed in Resolution ITU-R 1.

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RECOMMENDATION ITU-R M.2013

Technical characteristics of, and protection criteria for non-ICAO aeronautical radionavigation systems, operating around 1 GHz

(2012)

Scope

This Recommendation describes the technical characteristics of, and protection criteria for, non-International Civil Aviation Organisation (ICAO) aeronautical radionavigation service (ARNS) systems operating around 1 GHz for use in compatibility studies. It concerns with non-ICAO ARNS systems operating in countries referred to in RR No. **5.312** and TACAN systems.

The ITU Radiocommunication Assembly,

considering

- a)* that the tactical air navigation system (TACAN) is an aeronautical radionavigation system used on a national basis and operates in the frequency band 960-1 215 MHz;
- b)* that the TACAN system is used by both civil and state aircraft;
- c)* that when used by civil aviation, TACAN functionally is equivalent to the ICAO standardized distance measuring equipment (DME);
- d)* that the TACAN system provides additional functionality to that of DME, i.e. obtaining bearing information;
- e)* that this additional functionality results in technical characteristics that differ from those of DME and may require additional consideration in future compatibility studies,
- f)* that the use of TACAN also includes shipborne and air-to-air applications,

noting

- a)* that according to Resolution 417 (WRC-07) precedence must be given to the ARNS operating in the frequency band 960-1 164 MHz;
- b)* that ITU-R studies have shown that following the introduction of aeronautical mobile (route) service (AM(R)S) in the frequency band 960-1 164 MHz, more detailed site-specific compatibility studies between TACAN and AM(R)S systems need to be performed,

recommends

that for compatibility studies the characteristics and protection criteria in the annexes should be used.

Annex 1

Tactical air navigation system

TACAN is an aeronautical radionavigation system used on a national basis operating between 960 and 1 215 MHz. A TACAN system consists of an interrogator on-board an aircraft and a beacon which gives the replies. In most cases the TACAN beacons are fixed ground based installations but there are maritime mobile and aeronautical mobile beacons in use as well. Depending on the generated e.i.r.p. and design of the interrogator slant ranges up to 400 nm (740 km) can be achieved but in practice the range is limited to the maximum radio line-of-sight (RLOS). The aircraft unit transmits regular pulse pairs, so-called interrogation pulses which are received by ground based installations (beacons). The TACAN pulses have a pulse width of 3.5 μ s at the 50% amplitude points. The spacing between the pulses of an interrogation pulse pair is 12 μ s (X channel) or 36 μ s (Y channel). After receiving an interrogator pulse pair a ground station will test the pulse shape and spacing. If these fall within the acceptance limits, it will respond by transmitting a reply after a fixed delay with a ± 63 MHz frequency offset from the interrogation frequency depending on selected channel on pulse code. The beacon has a spacing between the reply pulses of 12 μ s (X channel) and 30 μ s (Y channel). After receipt of the reply, the interrogator will calculate the momentary slant range distance to the beacon from the time elapsed between transmitting interrogation and receiving reply pulse pairs.

The beacon will receive interrogations from many aircraft and therefore will send out many replies. Each interrogator creates a unique pattern by varying, within certain limits, the time between the pulse pairs to avoid generation of synchronic replies. By this principle each platform is able to recognize among all pulse pairs the replies that are initiated by its own interrogator.

For identification purposes, a TACAN beacon transmits a Morse ID code. The ID tone is used at the airborne interrogators to verify if the range readouts are provided by the correct beacon. Besides the pulse responses, proper reception of the ID tone is also an important condition for TACAN interrogators to properly function.

In addition to the range measurements TACAN also offers azimuth bearing information. The bearing information is provided by applying a modulation in the amplitude of the pulses transmitted by the ground beacon. This pulse amplitude modulation (PAM) is created using either a mechanically or electronically scanning beacon antenna. The variation in the azimuth pattern in the form of 15 Hz and 135 Hz antenna lobes at the maximum allowable modulation index of 55% will reduce the signal level of the reply pulses by up to 10.7 dB below the maximum e.i.r.p. level of pulses without PAM. In order for the interrogator to decode the orientation of the antenna pattern in reference to north from the PAM, an additional 900 pulse pairs, consisting of a north-reference-pulse-group (NRPG) and additional fine reference pulse groups (RPG) are transmitted by the beacon. In order to obtain accurate bearing information and be able to reply to at least 100 aircraft with 70% reply efficiency a constant number of at least 3 600 pulse pairs have to be transmitted.

The TACAN system is used for aeronautical navigation for both state aircraft as well as civil aviation. When used by civil aviation, the TACAN equipment is functionally equivalent to the ICAO standardized DME. TACAN characteristics are given in Table 1.