



Recommendation ITU-R M.2068-0
(02/2015)

**Characteristics of and protection criteria for
systems operating in the mobile service in
the frequency range 14.5-15.35 GHz**

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

Foreword

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Series	Title
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BR	Recording for production, archival and play-out; film for television
BS	Broadcasting service (sound)
BT	Broadcasting service (television)
F	Fixed service
M	Mobile, radiodetermination, amateur and related satellite services
P	Radiowave propagation
RA	Radio astronomy
RS	Remote sensing systems
S	Fixed-satellite service
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.2068-0

Characteristics of and protection criteria for systems operating in the mobile service in the frequency range 14.5-15.35 GHz

(2014)

Scope

This Recommendation specifies the characteristics of and protection criteria for systems operating in the mobile service in the frequency range 14.5-15.35 GHz. These technical and operational characteristics should be used in analyzing compatibility between systems operating in the mobile service with systems in other services.

Keywords

Mobile service, technical characteristics, protection criteria.

Abbreviations/Glossary

BPSK	Binary phase shift keying
FET	Field effect transistor
FSK	Frequency shift keying
QPSK	Quadrature phase shift keying
RF	Radio frequency

The ITU Radiocommunication Assembly,

considering

- a)* that mobile systems in the 14.5-15.35 GHz frequency range are used for a variety of purposes including land mobile ground-to-ground data links used to convey voice, data, and/or video;
- b)* that antenna, signal propagation, and large bandwidth characteristics of mobile systems to achieve their functions and requirements are optimum in certain frequency bands;
- c)* that the technical characteristics of systems operating in the mobile service in this frequency range are determined by the purpose of the system and vary widely;
- d)* that representative technical and operational characteristics of systems operating in frequency bands allocated to the mobile service are required to determine the feasibility of introducing new types of systems as well as conducting sharing studies;
- e)* that procedures and methodologies are needed to analyse compatibility between systems operating in the mobile service and systems in other services;
- f)* that administrations conducting ITU-R sharing or compatibility studies addressing new allocation proposals in any part of the frequency band 14.5-15.35 GHz should take into account operations of incumbent services in the band, including mobile service,

recognizing

that the authorization and operation of these systems should comply with applicable national spectrum policies and the ITU Radio Regulations,

noting

- a) that the frequency range 14.5-15.35 GHz is allocated worldwide on a primary basis to the mobile service and the fixed service;
- b) that the frequency band 14.5-14.8 GHz is allocated worldwide on a primary basis to the fixed-satellite service (Earth-to-space) limited by RR No. **5.510** to feeder links for the broadcasting satellite service for countries outside Europe;
- c) that the frequency range 14.5-15.35 GHz is allocated worldwide on a secondary basis to the space research service,

recommends

- 1 that the technical and operational characteristics of the systems operating in the mobile service described in Annex 1 should be considered representative of those operating in the frequency band 14.5-15.35 GHz;
- 2 that the technical and operational characteristics of the systems operating in the mobile service as described in Annex 1 should be used for sharing and compatibility studies involving the mobile service and other services in the frequency band 14.5-15.35 GHz;
- 3 that the criterion of interfering signal power to mobile system receiver noise power level, I/N , of -6 dB should be used as the required protection level for the mobile systems in the frequency range 14.5-15.35 GHz, and that this protection level is for aggregate interference if multiple interferers are present.

Annex 1

Technical and operational characteristics of systems operating in the mobile service in the frequency range 14.5-15.35 GHz

1 Introduction

In the frequency range 14.5-15.35 GHz mobile systems support a variety of useful functions including reliable transmission of large amounts of data for land mobile to land mobile voice, data, and video wideband links.

2 Technical characteristics of mobile systems in the frequency band 14.5-15.35 GHz

The technical parameters of representative mobile systems operating in the frequency range 14.5-15.35 GHz are presented in Table 1.

TABLE 1
Mobile system characteristics in the band 14.5-15.35 GHz

Characteristics	System 1	System 2	System 3	System 4	System 5	System 6	Units
Frequency range	14.5-15.35	14.5-15.35	14.5-15.35	14.5-15.0	14.5-15.30	14.6-15.35	GHz
Platform type	Land-mobile vehicle	Handheld	Land-mobile vehicle	Land-mobile vehicle	Land-mobile vehicle	Land-mobile vehicle	
Modulation	8-QAM, QPSK	BPSK	FSK	FSK	BPSK/OQPSK	BPSK/QPSK/QAM	
Emission designator	50M0G1D	18M5F9W	4M60F9W	20M0G7W	2M46G1D	40M0G7W	
Transmitter output power*	15 (peak)	5 (peak)	25 (peak)	18 (peak)	40 (mean)	0.5 (mean)	W
Maximum data rate	140	10	5	19	1.024/3.072	108	Mbit/s
Output device	Solid State	FET	FET	FET	FET	Gallium Arsenide Field Effect Transistor	
Antenna pattern type	Directional	Hemispherical	Directional	Directional	Directional	Directional	
Antenna type	Electronically scanned circular array	Stacked microstrip patch	Stacked microstrip patch	Stacked microstrip patch	Stacked microstrip patch	Phased-array	
Antenna polarization	Right-hand circular	Linear	Linear	Linear	Horizontal and vertical	Left hand circular	
Antenna gain	18	4	23	25	24	28	dBi
Antenna pattern model	ITU-R F.1336 ($k = 0$)	Omni directional	ITU-R F.1336 ($k = 0$)	ITU-R F.1336 ($k = 0$)	ITU-R F.1336 ($k = 0$)	ITU-R F.1336 ($k = 0$)	
Antenna horizontal beamwidth	10	360	3	2.1	2.2	1.9	Degrees
Antenna vertical beamwidth	15	40	3	2.1	2.2	1.9	Degrees
Antenna height	4-18	2	4-14	4-13	4-15	4-17	m

TABLE 1 (*end*)

Characteristics	System 1	System 2	System 3	System 4	System 5	System 6	Units
Receiver IF –3 dB bandwidth	55	21	4	23	3	35	MHz
Receiver noise figure	4	3	3	4	4	5	dB
Minimum sensitivity	–93	–98	–105	–97	–106	–94	dBm
Transmitter RF emission bandwidth: –3 dB/–20 dB	30/55	10/20	3/6	12/22	1.5/2.4	20/38	MHz

* NOTE – The maximum power level at the input to the antenna is limited to 10 dBW in the 14.5-14.8 GHz frequency range by RR Article **21.5**.

3 Characteristics of mobile systems in the frequency range 14.5-15.35 GHz

3.1 Introduction

Technology advancements in signal processing, complex modulations, antenna design, and solid-state components are enabling the design and manufacture of communication systems in the 14.5-15.35 GHz frequency range that are intended to be used as hand-held devices, e.g. Table 1, System 2, or on ground-based mobile vehicles, e.g. Table 1, System 1 and System 3 – System 6, that can inter-operate with other similar ground-based vehicles while one or both of the vehicles are in motion or stationary. The hand-held devices can communicate with each other or with the vehicular systems. Some Administrations use this band for mobile ground data links that convey voice, data, and/or video, for example, in situations where there is a need to establish and maintain wideband communication among mobile vehicles and personnel providing relief and public safety to an area subjected to a catastrophic natural disaster. Platforms equipped with these data links can be deployed anywhere within a country whose Administration has authorized their use.

The wide available bandwidth and relative ease of propagation when obstacle-free conditions exist in this frequency range allow mobile systems with data rates up to many 10's of Mbit/s.

Largely because of these mission requirements, the mobile systems using or planned to use the band 14.5-15.35 GHz tend to possess the following general characteristics:

- they typically use solid-state power-amplifier transmitters that are usually able to tune through the frequency band and use digital modulations;
- an increasing number of these systems have antenna main beams that are steerable in both azimuth and elevation using electronic beam steering techniques.

Table 1 summarizes technical characteristics of representative mobile systems deployed or planned to be deployed in the whole or portions of the band 14.5-15.35 GHz. This information is sufficient for general calculations to assess the compatibility between these mobile systems and other systems. Some or all of the mobile systems whose characteristics are presented in Table 1 possess the properties above, although they do not illustrate the full repertoire of attributes that might appear in future systems.

3.2 Transmitters

The mobile systems operating or planned to operate in the 14.5-15.35 GHz band typically use digital modulations. A given transmitter may be capable of radiating more than one waveform and solid-state power amplifier output devices are typically used in the transmitters. The trend towards use of solid-state transmitters in new mobile systems will continue for the foreseeable future due to the wide bandwidth, low level of generated spurious emissions, low power consumption, and reliability of these devices.

Typical transmitter RF emission (3 dB) bandwidths of mobile systems operating or planned to operate in the band 14.5-15.35 GHz range from about 4 MHz to 50 MHz. Current transmitter peak output powers range from 5 W (37 dBm) to 25 W (44 dBm). Advances in solid state modules will enable systems in the near future to generate peak power outputs of 70 W – 130 W in this frequency range. However, the maximum power level at the input to the antenna is limited to 10 dBW in the 14.5-14.8 GHz frequency range by RR No. **21.5**.

3.3 Receivers

The newer-generation mobile systems in the 14.5-15.35 GHz use digital modulations to enhance system performance.

The signal processing in the newer generation of mobile systems use digital phase, frequency, or amplitude modulation techniques.

3.4 Antennas

A variety of different types of antennas are used by systems in the 14.5-15.35 GHz band. Antennas in this band are generally of a variety of sizes and thus are of interest for applications where mobility and lightweight are important. The directional antenna pattern for mobile systems must be able cover 360° in the horizontal plane either electronically or mechanically. Sectored horn or circular phased arrays may be used to obtain 360 degree horizontal coverage. Flat-plate electronically steered antennas may require several facets or sub-antennas to achieve 360° horizontal coverage. Both horizontal and vertical polarizations are used. No current ITU-R Recommendation adequately addresses the antenna pattern for mobile systems in the 14.5-15.35 GHz frequency range. However, as an interim measure, the analytical procedures contained in Recommendation ITU-R F.1336, with a suggested “k-factor” of 0, can be used to model the directional antenna pattern for the vehicular antennas for use in compatibility studies and sharing analyses.

Typical antenna heights for ground-based mobile vehicle systems range from 4 m to 15 m above ground level. The 4 m height is typical for operations when the antenna is configured in a stowed or retracted position while the vehicle is in motion. The 13-18 m height is typical when the vehicle is halted and an antenna mast can be extended.

Operations while the antenna is in the stowed position while the vehicle is on the move may limit the signal strength of the desired signal due to its propagation along non-line of sight paths with various obstructions. In this frequency range selection of antenna locations on elevated terrain is desirable to mitigate the effects of, e.g. foliage and buildings, etc., on electromagnetic propagation to maximize communication distances when the vehicle is operating when halted.

4 Protection criteria

Under noise-limited conditions, a protection criteria of $I/N = -6$ dB limits the increase in the noise level in the receiver to about 1 dB and corresponds to an $(I + N)/N$ ratio of 1.26. The 1 dB increase in the noise level could be manifested as, e.g. a decrease in the available fade margin, a decrease in the effective coverage area where a maximum given bit error rate must be maintained, or receiver desensitization, which would constitute significant degradation for digital receivers that must operate with very low bit error rates. The 1 dB increase represents the aggregate effect of multiple interferers, when present; the received level of interference from an individual interferer depends on the interferer geometry and other factors, and needs to be assessed in the course of analysis of a given scenario. The specified tolerable I/N ratio is referenced to the mobile receiver input and requires taking in to account all sources of interference. If a single interference source is present, protection of the mobile systems requires that this criterion is not exceeded due to the interference from the single source. If multiple interference sources are present, protection of the mobile systems requires that this criterion is not exceeded due to the aggregate interference from the multiple sources.
