



EUROPEAN
COMMISSION

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ANNEX

ANNEX

to the

Commission Implementing Decision

on the harmonised use of the paired frequency bands 874.4-880.0 MHz and 919.4-925.0 MHz and of the unpaired frequency band 1900-1910 MHz for Railway Mobile Radio

ANNEX

PART A: TECHNICAL CONDITIONS FOR GSM-R IN 874.4-880.0 MHz and 919.4-925.0 MHz bands

For GSM-R, the following parameters apply:

GSM-R Downlink centre frequency $f_{DL} = 921 \text{ MHz} + n \times 0.2 \text{ MHz}^1$ where $\{n \in \mathbb{Z} \mid -7 \leq n \leq 19\}$

GSM-R Uplink centre frequency $f_{UL} = f_{DL} - 45 \text{ MHz}$

GSM-R channel bandwidth is 200 kHz

Table 1

In-block requirements for GSM-R Base Stations in 919.4-921 MHz uncoordinated deployment

GSM-R channel bandwidth	Maximum e.i.r.p.
200 kHz	$= 70.5 \text{ dBm} + (f_{DL} - 921) \times 40/3 \text{ dB}$

f_{DL} is the centre frequency in MHz

There is no e.i.r.p. restriction on GSM-R Base Stations transmitting in the 921-925 MHz frequency band. Formula applicable to $f_{DL} \leq 921 \text{ MHz}$. To allow higher e.i.r.p, the implementation of a coordination procedure or other mitigation measures must be applied.

PART B: TECHNICAL CONDITIONS FOR A SINGLE WIDEBAND RMR CARRIER IN 874.4-880.0 MHz and 919.4-925.0 MHz bands

Technical conditions for RMR Base Stations using wideband technologies

The technical conditions defined in this section are in the form of a block-edge mask (BEM) applicable to wideband RMR Base Stations. The technical conditions defined in this section are valid for a single RMR carrier using wideband technologies. The BEM is developed on the basis that detailed coordination and cooperation agreements would not be required to be in place prior to network deployment. To allow multiple carriers or higher e.i.r.p. for RMR BS than stated in the harmonised technical conditions, the implementation of a coordination procedure or other mitigation measures must be applied. Base Stations using active antenna systems are prohibited.

For radio access technologies other than GSM-R, the following parameters apply:

- The lower edge of the lowest Resource Block shall be $\geq 919.6 \text{ MHz}$.

¹ GSM-R channel raster of 200 kHz

Table 2
General in-block requirement - not mandatory

RMR channel bandwidth	Maximum e.i.r.p.
For any channel bandwidth	The following value may be used in case an upper bound is desired: = Min {65 dBm/channel, Maximum e.i.r.p. specific to the channel bandwidth}

Table 3
Specific in-block requirements for 5.6 MHz and 5 MHz channels mandatory for uncoordinated deployment

RMR channel bandwidth	Maximum e.i.r.p.
5.6 MHz	= 62 dBm/5.6 MHz
5 MHz	= 64.5 dBm/5 MHz + $(f_{DL} - 922.1) \times 40/3$ dB

f_{DL} is the centre frequency in MHz.

NB-IoT in-band operation mode without power boost is allowed. NB-IoT guard-band operation mode and in-band operation mode with power boost are not allowed.

Table 4
Specific in-block requirements for 1.4 MHz and 200 kHz channels mandatory for uncoordinated deployment

RMR channel bandwidth	Maximum e.i.r.p.
1.4 MHz	= 56 dBm/1.4 MHz + $(f_{DL} - 920.2) \times 40/3$ dB (Note 1)
200 kHz (Note 2)	= 70.5 dBm/200 kHz + $(f_{DL} - 921) \times 40/3$ dB (Note 3)

f_{DL} is the centre frequency in MHz.

Note 1: Formula applicable to $f_{DL} \leq 921.7$ MHz. No specific e.i.r.p. restriction above.
 Note 2: Applicable to NB-IoT standalone operation mode, which is made of one Resource Block.
 Note 3: Formula applicable to $f_{DL} \leq 921.0$ MHz. No specific e.i.r.p. restriction above.

Table 5
Out-of-band requirements

MHz from block edge (919.4-925 MHz)	e.i.r.p. limit
$0 \leq \Delta f < 0.2$	32.5 dBm/200 kHz
$0.2 \leq \Delta f < 1$	14 dBm/800 kHz
$1 \leq \Delta f < 10$	5 dBm/MHz

On a case-by-case basis, at a national level, higher out-of-band limits may be applied.

Table 6
Baseline requirement

Frequency range	e.i.r.p. limit
880-915 MHz	-49 dBm/5 MHz

This requirement prevails over out-of-band requirements.

Technical conditions for RMR cab-radio using wideband technologies

For radio access technologies other than GSM-R, the following parameters apply:
 Maximum output power: higher than 23 dBm and up to 31 dBm;
 ACLR²: 37 dB minimum;
 Uplink power control is mandatory and shall be activated.

² ACLR: Adjacent Channel Leakage power Ratio

Technical conditions for RMR terminals other than cab-radios, using wideband technologies

For radio access technologies other than GSM-R, the following parameters apply:

Maximum output power: 23 dBm;

ACLR: 30 dB minimum;

Uplink power control is mandatory and shall be activated.

Technical conditions for RMR receivers using wideband technologies

The band can be accessed if techniques to access spectrum and mitigate interference that provide an appropriate level of receiver performance to comply with the essential requirements of Directive 2014/53/EU are used. Where relevant techniques are described in harmonized standards or parts thereof the references of which have been published in the Official Journal of the European Union in accordance with Directive 2014/53/EU, performance at least equivalent to the performance level associated with those techniques shall be ensured.

Table 7

Requirements on wideband RMR Base Station receiver characteristics

Parameter	Value
Level of the wanted signal	RefSens + 3 dB
Maximum interfering signal in 870-874.4 MHz (Note 1)	-34 dBm

The antenna connector of the radio module is the reference point. The reference sensitivity (RefSens) is the minimum mean power received at the antenna connector at which a specified minimum performance shall be met.

These requirements cover both blocking and third-order intermodulation.

Note 1: A bandwidth of 200 kHz for the interfering signal is assumed.

Table 8

Requirements only for wideband RMR cab-radio receiver characteristics³

³ Requirements for RMR terminal receiver other than cab-radio are not covered in this table

Parameter	Value
Level of the wanted signal	RefSens + 3 dB
Maximum interfering signal in 880-918.9 MHz (Note 1)	-26 dBm
Maximum continuous wave interfering signal in 925.6-927 MHz	-13 dBm
Maximum continuous wave interfering signal in 927-960 MHz	-10 dBm
Maximum 5 MHz LTE interfering signal (lowest carrier at 927.6 MHz)	-13 dBm

The antenna connector of the radio module is the reference point. The reference sensitivity (RefSens) is the minimum mean power received at the antenna connector at which a specified minimum performance shall be met.

These requirements cover both blocking and third-order intermodulation.

Note 1: A bandwidth of 400 kHz for the RFID interfering signal is assumed.

PART C: TECHNICAL CONDITIONS FOR WIDEBAND RMR IN 1900-1910 MHz (TDD) band

Technical conditions for RMR Base Stations using wideband technologies

The technical conditions defined in this section are in the form of a block-edge mask (BEM) applicable to wideband RMR BS. The BEM is developed on the basis that detailed coordination and cooperation agreements would not be required to be in place prior to network deployment. Base Stations with active antenna systems are prohibited.

The following parameters apply:

Table 9

General in-block requirement mandatory for uncoordinated deployment

RMR channel bandwidth	Maximum e.i.r.p.
10 MHz	= 65 dBm/10 MHz (Note 1)

Note 1: Member States may allow a higher e.i.r.p. level, subject to national coordination

or other mitigation measures.

Table 10
Baseline requirement

Frequency range	e.i.r.p. limit
1920-1980 MHz	-43 dBm/5 MHz

Technical conditions for RMR cab-radio using wideband technologies

The following parameters apply:

Maximum output power: 31 dBm;

ACLR: 37 dB minimum;

Unwanted output power in 1920-1980 MHz:

-25 dBm/MHz maximum in 1920-1925 MHz,

-30 dBm/MHz maximum in 1925-1980 MHz;

Uplink power control is mandatory and shall be activated.

Technical conditions for RMR terminals other than cab-radios, using wideband technologies

The following parameters apply:

Maximum output power: 23 dBm;

ACLR: 30 dB minimum;

Uplink power control is mandatory and shall be activated.

Technical conditions for RMR receivers using wideband technologies

The band can be accessed if techniques to access spectrum and mitigate interference that provide an appropriate level of receiver performance to comply with the essential requirements of Directive 2014/53/EU are used. Where relevant techniques are described in harmonized standards or parts thereof the references of which have been published in the Official Journal of the European Union in accordance with Directive 2014/53/EU, performance at least equivalent to the performance level associated with those techniques shall be ensured.

Table 11
Requirements on wideband RMR Base Stations receiver characteristics

Parameter	Value
Level of the wanted signal	RefSens + 3 dB
Maximum 5 MHz LTE interfering signal in 1805-1880 MHz	-20 dBm

The antenna connector of the Base Station receiver is the reference point. The reference sensitivity (RefSens) is the minimum mean power received at the antenna connector at which a specified minimum performance shall be met.
These requirements cover both blocking and third-order intermodulation.

Table 12
Requirements only for wideband RMR cab-radio receiver characteristics⁴

Parameter	Value
Level of the wanted signal	RefSens + 3 dB
Maximum 5 MHz LTE interfering signal in 1805-1880 MHz	-13 dBm
Maximum 5 MHz LTE interfering signal in 1920-1980 MHz	-39 dBm

The antenna connector of the Base Station receiver is the reference point. The reference sensitivity (RefSens) is the minimum mean power received at the antenna connector at which a specified minimum performance shall be met.
These requirements cover both blocking and third-order intermodulation.

⁴ Requirements for RMR terminal receiver other than cab-radio are not covered in this table