Telecommunications Standards Advisory Committee (TSAC)

Technical Specification

Land Mobile Radio Equipment

IMDA TS LMR
Issue 1, 1 October 2016

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Acknowledgement

The Info-communications Media Development Authority (IMDA) would like to acknowledge the following members of the Telecommunications Standards Advisory Committee (TSAC) for their invaluable contributions towards the publication of this Technical Specification.

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Technical Specification for Land Mobile Radio Equipment

1 Scope

1.1 This Specification defines the minimum technical requirements for radio equipment to be used in Land Mobile Radio (LMR) services. LMR equipment shall operate in one of the authorised frequency bands or frequencies, and transmit within the corresponding output power levels given in Table 1.

1.2 LMR equipment may be base stations used in fixed locations, mobile stations used in vehicles or as transportable stations, or handheld portable stations that come with an external antenna or an integral antenna (generally termed “LMR” in this Specification). Applications may include speech and/or data communication, and may be using digital radio technologies such as the Integrated Digital Enhanced Network (iDEN), Terrestrial Trunked Radio (TETRA), Digital Mobile Radio (DMR) or NXDN technology (see Table 1).

2 References

For the technical requirements captured in this Specification, reference has been made to the following standards. Where versions are not indicated, implementation of this Specification shall be based on current and valid versions of these standards published by the respective Standards Development Organisations.

ETSI EN 300 086-1	Electromagnetic compatibility and Radio spectrum Matters (ERM); Land Mobile Service; Radio equipment with an internal or external RF connector intended primarily for analogue speech; Part 1: Technical characteristics and methods of measurement
ETSI EN 300 296-1	Electromagnetic compatibility and Radio spectrum Matters (ERM); Land Mobile Service; Radio equipment using integral antennas intended primarily for analogue speech; Part 1: Technical characteristics and methods of measurement
FCC Part 90	Federal Communications Commission, Part 90 Private Land Mobile Radio Services
ETSI EN 300 113-1	Electromagnetic compatibility and Radio spectrum Matters (ERM); Land Mobile Service; Radio equipment intended for the transmission of data (and/or speech) using constant or non-constant envelope modulation and having an antenna connector; Part 1: Technical characteristics and methods of measurement
ETSI EN 301 166-1	Electromagnetic compatibility and Radio spectrum Matters (ERM); Land Mobile Service; Radio equipment for analogue and/or digital communication (speech and/or data) and operating on narrow band channels and having an antenna connector; Part 1: Technical characteristics and methods of measurement
ETSI EN 300 390-1	Electromagnetic compatibility and Radio spectrum Matters (ERM); Land Mobile Service; Radio equipment intended for the transmission of data (and/or speech) and using an integral antenna; Part 1: Technical characteristics and methods of measurement
ETSI EN 300 394-1	Terrestrial Trunked Radio (TETRA); Conformance Testing Specification; Part 1: Radio
ETSI EN 300 396-2	Terrestrial Trunked Radio (TETRA); Technical requirements for Direct Mode Operation (DMO); Part 2: Radio aspects

ETSI EN 300 392-2	Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 2: Air Interface (AI)
ETSI EN 301 489-1	Electromagnetic Compatibility (EMC) standard for radio equipment and services; Harmonised Standard covering the essential requirements of article 3.1(b) of the Directive 2014/53/EU and the essential requirements of article 6 of the Directive 2014/30/EU; Part 1: Common technical requirements
ETSI EN 301 489-5	Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 5: Specific conditions for Private land Mobile Radio (PMR) and ancillary equipment (speech and non-speech) and Terrestrial Trunked Radio (TETRA); Harmonised Standard covering the essential requirements of article 3.1(b) of the Directive 2014/53/EU
ETSI EN 303 035-1	Terrestrial Trunked Radio (TETRA); Harmonised EN for TETRA equipment covering essential requirements under article 3.2 of the R&TTE Directive; Part 1: Voice plus Data (V+D)
ETSI EN 303 035-2	Terrestrial Trunked Radio (TETRA); Harmonised EN for TETRA equipment covering essential requirements under article 3.2 of the R&TTE Directive; Part 2: Direct Mode Operation (DMO)
ETSI TS 102 361-1	Electromagnetic compatibility and Radio spectrum Matters (ERM);Digital Mobile Radio (DMR) Systems; Part 1: DMR Air Interface (AI) protocol
ETSI TS 102 361-2	Electromagnetic compatibility and Radio spectrum Matters (ERM);Digital Mobile Radio (DMR) Systems; Part 2: DMR voice and generic services and facilities
ETSI TS 102 361-3	Electromagnetic compatibility and Radio spectrum Matters (ERM);Digital Mobile Radio (DMR) Systems; Part 3: DMR data protocol
ETSI TS 102 361-4	Electromagnetic compatibility and Radio spectrum Matters (ERM);Digital Mobile Radio (DMR) Systems; Part 4: DMR trunking protocol
IEC CISPR 32	Electromagnetic compatibility of multimedia equipment – Emission requirements Note: Validity of the IEC CISPR 22 (2008), EMC standard for information technology equipment, will lapse by 31 March 2017, in sync with IEC's timeline for withdrawing this CISPR standard and replacing it with the CISPR 32 standard.
IEC CISPR 24	Information technology equipment – Immunity characteristics – Limits and methods of measurement
IEC 60950-1	Information technology equipment – Safety – Part 1: General requirements
IEC 62368-1	Audio/video, information and communication technology equipment – Part 1: Safety requirements
ISO 7637-2	Road vehicles - Electrical disturbances from conduction and coupling - Part 2: Electrical transient conduction along supply lines only
ITU-T K.116	EMC requirements and test methods for radio telecommunication terminal equipment

3 General Requirements

3.1 Design of Land Mobile Radio (LMR)

LMR shall be designed such that it does not have any external or readily accessible control which permits the adjustment of its operation in a manner that is inconsistent with this Specification.

3.2 Radiation Safety

3.2.1 Where applicable, the LMR shall comply with the International Commission on Non-Ionising Radiation Protection (ICNIRP) guidelines for limiting exposure to time-varying EMFs in the frequency range up to 300 GHz.

3.2.2 It should be noted that compliance with any radiation safety standard does not by itself confer immunity from legal obligations and requirements imposed by national health or safety authorities.

3.3 Power Supply

The LMR may be AC powered or DC powered. For an AC powered equipment, the Specification shall be complied with when operating from an AC mains supply of voltage, 230V ± 10% and frequency, 50 Hz ± 2%. Where external power supply is used, e.g. power adaptor or charger, it shall not affect the capability of the equipment to meet the requirements of this Specification.

3.4 Electromagnetic Compatibility (EMC) and Safety Requirements

3.4.1 EMC assessment

For EMC assessment, the LMR and/or ancillary equipment shall be classified as equipment for fixed use; vehicular use (i.e. mobile terminal connected with vehicular charger or DC supply); or portable/mobile use (i.e. powered by its integral battery). This equipment classification is used to determine the applicability of the EMC (emission and immunity) testing requirements based on §5.5 and §7 of ETSI EN 301 489-1; or §7.5 and §9 of ITU-T K.116. The ETSI EN 301 489-1 standard shall be used in conjunction with the ETSI EN 301 489-5 standard for Private land Mobile Radio (PMR) and ancillary equipment (speech and non-speech) and Terrestrial Trunked Radio (TETRA), where applicable.

3.4.1.1 EMI or emission measurements

(a) Radiated emissions from associated ancillary equipment not incorporated in the LMR shall be measured to Class B requirements defined in §4 and Tables A.4 and A.5 of IEC CISPR 32.

(b) Conducted emission at the DC power port of the LMR intended for vehicular use, shall be measured to Class B requirements defined in §4 and Table A10 of IEC CISPR 32.

(c) Conducted emission at the AC mains port shall be measured for LMR with dedicated charger or adapter to Class B requirements defined in §4 and Table A.10 of IEC CISPR 32. Equipment with DC power port which is powered by a dedicated AC/DC power converter is defined as AC mains powered equipment (§3.1.1 [9]).

Note 1: If LMR is a module intended to be marketed and sold separately from a host, it shall be assessed with at least one representative host system. Modules may be internal, mounted, plug-in or external (§6.2 of IEC CISPR 32).

Note 2: Emission measurements performed to FCC Part 15 Subpart B for unintentional radiators (§15.109) may be acceptable as an alternative to IEC CISPR 32.

3.4.1.2 EMS or immunity testing

The following immunity tests may be performed on the LMR to requirements defined in IEC CISPR 24, §11 of ITU-T K.116 or §9 of ETSI EN 301 489-1, where applicable:

(a) RF electromagnetic field (80 MHz to 1 GHz and 1.4 GHz to 6 GHz) at the enclosure of the equipment

(b) Electrostatic discharge at the enclosure of the equipment

(c) Fast transients (common mode) at DC power and AC main power ports that have cables longer than 3 m

(d) RF common mode 0.15 MHz to 80 MHz at DC power and AC mains power ports that have cables longer than 3 m

(e) Transients and surges (vehicular environment) on nominal 12V and 24V DC supply voltage input ports of mobile terminal and ancillary equipment intended also for mobile use in vehicles [ISO 7637-2]

(f) Voltage dips and interruptions at AC mains power port of mobile or portable terminal with dedicated charger/power adapter

(g) Surges, common and differential mode at AC mains power port of mobile or portable terminal with dedicated charger/power adapter

3.4.2 Equipment safety testing

3.4.2.1 Equipment safety testing or assessment shall be performed to requirements defined in IEC 60950-1 or IEC 62368-1, based on the following assumptions:

(a) LMR is powered by a dedicated external power supply (charger/power adapter); and

(b) LMR operates with SELV in environments where overvoltage from telecommunication networks is not possible. SELV refers to voltages not exceeding 42.4 V peak or 60 V DC.

3.4.2.2 For LMR safety assessment performed with the hazard-based approach, the processes defined in IEC 62368-1 shall be used:

(a) Identify energy sources in the LMR;

(b) Classify energy sources (effect on the body or combustible material, e.g. possibility of injury or ignition);

(c) Identify safeguards for protection against energy sources; and

(d) Consider the effectiveness of safeguards with respect to compliance criteria or requirements defined in the IEC 62368-1 standard.

4 Technical Requirements

4.1 The LMR shall comply with the RF output power and spurious emissions given in Table 1 of this Specification, operating in its intended frequency band or frequencies. It shall fulfil the relevant requirements of this Specification on all the permitted frequencies which it is intended to operate.

4.2 The LMR shall be tested for compliance with the applicable technical requirements stipulated in Table 1 of this Specification. Measurement methods and conditions shall be with reference to one of the standards given in §2, whichever is applicable for the equipment under test (refer to Table 1 for guidance).

Table 1: Technical Requirements for Radio Equipment to be used in Land Mobile Radio Services

<table>
<tr><th>Item No.</th><th>Operating Frequencies</th><th>Channel Spacing</th><th>Max RF Power Output</th><th>Spurious Emissions</th><th>Test Reference</th><th>Applications</th><th>Additional Requirements</th></tr>
<tr><td rowspan="4">1</td><td>80 MHz</td><td rowspan="3">12.5 kHz</td><td rowspan="4">Base/Mobile: 25 W ERP Note 1
Portable: 5 W ERP Note 1</td><td rowspan="4">< 20 nW</td><td rowspan="4">ETSI EN 300 086-1 for radio equipment with an internal or external RF connector;
ETSI EN 300 296-1 for radio equipment with integral antenna; or
FCC Part 90 for Private Land Mobile Radio Services</td><td rowspan="4">Base, mobile or portable equipment for analogue speech</td><td rowspan="3">▪ Suppliers registering equipment for use in Private Radio Network operation are required to first seek the approval of IMDA on the frequencies to be used.

▪ Suppliers registering equipment for use in Public Radio Data Communication Networks are advised to check with Network Operations on the exact operating frequencies used.

▪ Operation under this provision requires IMDA licensing.

▪ Provision does not apply to equipment with special function such as tone coded squelch, selective calling decoders or encoders, which shall be disabled during testing.</td></tr>
<tr><td>150 MHz</td></tr>
<tr><td>450 MHz</td></tr>
<tr><td>900 MHz</td><td>25 kHz</td></tr>
<tr><td>2</td><td>Mobile Tx:
415 – 417 MHz
Base Tx:
425 – 427 MHz</td><td>12.5 kHz/ 25 kHz</td><td rowspan="2">Base: 25 W ERP Note 1
Mobile: 25 W ERP Note 1
Portable: 5 W ERP Note 1</td><td rowspan="2">43 + 10log(P) where P = Rated carrier power in Watts</td><td rowspan="2">ETSI EN 300 113-1 for radio equipment with antenna connector;
ETSI EN 300 390-1 for radio equipment with integral antenna; or
FCC Part 90 for Private Land Mobile Radio Services</td><td rowspan="2">Base, mobile or portable equipment for data</td></tr>
<tr><td></td><td>Mobile Tx:
806 – 818 MHz
Base Tx:
851 – 863 MHz</td><td>25 kHz</td></tr>
</table>

Note 1 Effective Radiated Power (ERP) refers to radiation of a half wave tuned dipole, which is used for frequencies below 1 GHz.

Table 1: Technical Requirements for Radio Equipment to be used in Land Mobile Radio Services

(Continued)

Item No.	Operating Frequencies	Channel Spacing	Max RF Power Output	Spurious Emissions	Test Reference	Applications	Additional Requirements
3	446.3250 – 446.4750 MHz	12.5 kHz	1 W ERP [Note 1]	< 2 nW	ETSI EN 300 296-1 for radio equipment with integral antenna	Multi-channel portable radio equipment for analogue speech (localised use)	▪ Operation above 500 mW ERP under this provision requires IMDA licensing. ▪ Frequencies specified in this provision are to be used on non-interference, non-protected and shared basis. ▪ Provision does not apply to equipment with special function such as tone coded squelch, selective calling decoders or encoders, which shall be disabled during testing. ▪ Repeaters and amplifiers are not allowed to be used with the multi-channel portable radio equipment to extend the range of coverage. ▪ Equipment shall use integral antenna only, and be designed to ensure that no antenna other than that furnished by the responsible party shall be used. ▪ Equipment shall be equipped with the Continuous Tone Code Sub-audible Squelch (CTCSS) capability with a minimum number of 10 distinct tones out of 32 as specified in Annex A of this Specification.

[Note 1] Effective Radiated Power (ERP) refers to radiation of a half wave tuned dipole, which is used for frequencies below 1 GHz.

Table 1: Technical Requirements for Radio Equipment to be used in Land Mobile Radio Services

(Continued)

Item No.	Operating Frequencies	Channel Spacing	RF Power Output	Spurious Emissions	Test Reference	Applications	Additional Requirements
4	446.00 – 446.10 MHz	12.5 kHz	500 mW ERP Note 1	< 2 nW	ETSI EN 300 296-1 for radio equipment with integral antenna	Portable radio equipment for analogue speech (localised use)	▪ Frequencies specified in this provision are to be used on non-interference, non-protected and shared basis. ▪ Provision does not apply to equipment with special function such as tone coded squelch, selective calling decoders or encoders, which shall be disabled during testing. ▪ Repeaters and amplifiers are not allowed to be used with the multi-channel portable radio equipment to extend the range of coverage. ▪ Equipment shall use integral antenna only, and be designed to ensure that no antenna other than that furnished by the responsible party shall be used.

Note 1 Effective Radiated Power (ERP) refers to radiation of a half wave tuned dipole, which is used for frequencies below 1 GHz.

Table 1: Technical Requirements for Radio Equipment for use in Land Mobile Radio Services

(Continued)

Item No.	Operating Frequencies	Channel Spacing	Max RF Power Output	Spurious Emissions	Test Reference	Applications	Additional Requirements
5	Tx: 806 – 825 MHz Rx: 851 – 870 MHz	25 kHz	Base/Mobile: 25 W ERP Note 1 Portable: 5 W ERP Note 1	43 + 10log(P) where P = Rated carrier power in Watts	FCC Part 90 for Private Land Mobile Radio Services	Base, mobile and portable equipment for digital radio mobile system such as iDEN trunked mobile radio system	▪ Operation under this provision requires IMDA licensing. ▪ If the radio equipment supports connection to the public mobile radio network, suppliers shall demonstrate that equipment has been tested and certified to comply with the relevant requirements given in IMDA TS CMT. ▪ If the radio equipment supports WLAN mode, suppliers shall demonstrate that equipment has been tested and certified to comply with the relevant requirements for WLAN given in the IMDA TS SRD.
6	380 – 400 MHz	25 kHz	25 W ERP Note 1	-36 dBm in 100 kHz bandwidth in frequency range 9 kHz to 1 GHz -30 dBm in 1 MHz bandwidth in frequency range 1 to 4 GHz	Conformity assessment requirements: ETSI EN 300 394-1, EN 300 396-2 and EN 300 392-2 Testing Requirements: ETSI EN 303 035-1 and EN 303 035-2.	Base and mobile stations for digital radio mobile system such as TETRA trunked mobile radio system	▪ Operation under this provision requires IMDA licensing.

Note 1 Effective Radiated Power (ERP) refers to radiation of a half wave tuned dipole, which is used for frequencies below 1 GHz.

Table 1: Technical Requirements for Radio Equipment for use in Land Mobile Radio Services

(Continued)

Item No.	Operating Frequencies	Channel Spacing	Max RF Power Output	Spurious Emissions	Test Reference	Applications	Additional Requirements
7	136 – 174 MHz 400 – 410 MHz 430 – 450 MHz	6.25 kHz or equivalent/ 12.5 kHz	Base/Mobile: 25 W ERP Note 1 Portable: 5 W ERP Note 1	43 + 10log(P) where P = Rated carrier power in Watts	ETSI EN 300 113-1 for radio equipment with antenna connector; ETSI EN 301-166-1 for radio equipment operating at narrowband channel with antenna connector; ETSI EN 300 390-1 for radio equipment with integral antenna; or FCC Part 90 for Private Land Mobile Radio Services	Base, mobile and portable equipment for digital conventional or trunked mobile radio system such as DMR, NXDN or equivalent	▪ Operation under this provision requires IMDA licensing. ▪ If the radio equipment supports connection to the public mobile radio network, suppliers shall demonstrate that equipment has been tested and certified to comply with the relevant requirements given in IMDA TS CMT. ▪ If the radio equipment supports WLAN mode, suppliers shall demonstrate that equipment has been tested and certified to comply with the relevant requirements for WLAN given in the IMDA TS SRD.

Note 1 Effective Radiated Power (ERP) refers to radiation of a half wave tuned dipole, which is used for frequencies below 1 GHz.

Annex A

Continuous Tone Code Sub-audible Squelch (CTCSS) Code Frequency

The standard frequencies (in Hz) available for assignment are shown below.

67.0	110.9	146.2	192.8
71.9	114.8	151.4	203.5
77.0	118.8	156.7	210.7
82.5	123.0	162.2	218.1
88.5	127.3	167.9	225.7
94.8	131.8	173.8	233.6
103.5	136.5	179.9	241.8
107.2	141.	186.2	250.3

Annex B

Corrigendum / Addendum

Revised TS		Items Changed	Date of Issue
Page	Section		
Changes to IDA TS LMR, Issue 1 Rev 5, June 2014			
6	§3	The IMDA TS LMR Issue 1 (October 2016) has replaced the IDA TS LMR Issue 1 Rev 7 (April 2013). Changes are largely editorial to provide updates and clarity in the application of EMC and safety requirements, in line with standards development that has taken place in the Standards Development Organisations concerned.	1 Oct 16

Changes to IDA TS LMR, Issue 1, Rev 4, June 11			
Page	**TS Ref.**	**Items Changed**	**Effective Date**
7	Table 1 (3)	The use of the frequency band 477 – 477.25 MHz has been migrated to the frequency band 446.3250 – 446.4750 MHz with the maximum RF Power output increased to 1 W ERP.	23 Jun 14

Changes to IDA TS LMR, Issue 1, Rev 3, May 11			
Page	**TS Ref.**	**Items Changed**	**Effective Date**
9, 10	Table 1 (5, 7)	Editorial changes to the column, 'Additional Requirements' – Reference to IDA TS GSM-MT was changed to IDA TS CMT	17 Jun 11

Changes to IDA TS LMR, Issue 1, Rev 2, Feb 11			
Page	**TS Ref.**	**Items Changed**	**Effective Date**
		Change of IDA's address at cover page to Mapletree Business City.	1 May 11

Changes to IDA TS LMR, Issue 1, Rev 1, Aug 06			
Page	**TS Ref.**	**Items Changed**	**Effective Date**
10	Table 1(7)	Provision of services operating with 6.25 kHz channel spacing is intended for improving the spectrum efficiency of equipment operating in the following frequency bands: a. 136.00 – 174.00 MHz b. 400.00 – 410.00 MHz c. 430.00 – 450.00 MHz	Feb 11

Changes to IDA TS LMR, Issue 1, Jul 05			
Page	**TS Ref.**	**Items Changed**	**Effective Date**
6 and 7	Table 1(3) and 1(4)	Provisions have been aligned with the Schedule to the Telecommunications (Exemption from sections 33, 34(1)(b) and 35) (Amendment) Notification 2006: d. 477.00 – 477.25 MHz frequency band, output power up to 500 mW ERP e. 446.00 – 446.10 MHz frequency band, output power up to 500 mW ERP	Jun 06

Changes to IDA TS 101, 102, 107, 108, 111, 112, 115 and TETRA			
Page	**TS Ref.**	**Items Changed**	**Effective Date**
—	—	This Specification supersedes the following IDA Type Approval Specifications: a. IDA TS 101 Issue 1 Rev 4 b. IDA TS 102 Issue 1 Rev 4 c. IDA TS 107 Issue 1 Rev 3 d. IDA TS 108 Issue 1 Rev 3 e. IDA TS 111 Issue 1 Rev 3 f. IDA TS 112 Issue 1 Rev 3 g. IDA TS 115 Issue 1 h. IDA TS TETRA Issue 1 Rev 1	21 Jul 05
—	—	Title of Specification has been renamed as “Technical Specification for Land Mobile Radio Equipment” (IDA TS LMR Issue 1). Changes are mainly editorial in nature. The essential technical requirements for conformity assessment remain unchanged.	21 Jul 05