RADIOMETRIX

Hartcran House, 231 Kenton Lane, Harrow, HA3 8RP England
Tel: +44 (0) 20 8909 9595, Fax: +44 (0) 20 8909 2233

Letter of the law

Myk Dormer, Senior RF Design Engineer at Radiometrix Ltd

First published in Electronics World magazine, January 2009

SHORT-RANGED, low-power wireless devices are usable throughout Europe − and much of the rest of the world − without the specific installation licensing that PMR systems relatives require, and without the certified operator training of marine and amateur radio services.

TR1M Transceiver

This is only permissible because every SRD has to conform to a specification very carefully written to minimise its potential to cause interference to other services. Limitations are placed on permitted frequencies of operation (the 'ISM bands'), on maximum RF output power and on the level of any off-channel spurii, or harmonics. Frequently, the modulation mode, occupied bandwidth and transmitter on-time are also restricted.

In Europe the governing spec for short range low-power radio devices is EN300-220, currently in its v2.1.1 release. This specification is, in common with others of the type, not easy 'bedtime reading'. It needs to be very exacting in its definition of terms, methods and test procedures, but this in turn can make it difficult to extract the actual radio performance requirements from it. Refer to Note 1 for a synopsis (and Note 2 if you wish to download and read it in its entirety).

The specification concentrates on the transmitter (as, beyond its local oscillator leakage, a receiver is not a source of potential interference) and sets fairly practical performance targets. A transmitter complying with EN300-220 will not swamp the ISM band with wideband noise and overmodulation 'splatter', or put a spurious output on a broadcast channel, or an airband frequency.

But a problem can be seen when we consider the receiver parameters. For all but the safety critical (Class 1) receivers, the only requirement is that no emitted spurii exceeds 2nW. For ordinary "Class 3" receivers the rest of the performance parameters are undefined. It is entirely possible for an unscrupulous manufacturer to sell a "compliant to EN300-220 receiver" that has no chance of working in the real-world.

Continued on page 2...

Of course, no supplier will ever really attempt to sell a unit that actually won't receive anything at all, but there are a good number of module and chip manufacturers who do sell products where, although the sensitivity is good enough to pass on-the-bench tests, the spurious rejection (adjacent channel, image, blocking) and large signal performance can be so poor that the device fails to function when connected to a real aerial and is used on a congested band.

By specifying a Class 2 (or even Class 1) receiver performance the user can be a little more certain that the module has at least a usable level of sensitivity, and filter stopband performance good enough to match it, but unfortunately, the actual definitions of the receiver classes have been in something of a state of flux, and very few receivers being sold today are capable of meeting the current Class 1 requirements (see Note 3).

The conclusion here turns out to be a very common one: "Let the buyer beware!". Compliance to the 300-220 specification is mandatory, but is only the tip of the iceberg. Carefully inspect the manufacturer's datasheet and look for the parameters not covered by the basic spec compliance (most of the receiver measurements, in most cases). There ought to be quoted specifications for sensitivity, image rejection, spurious responses, blocking and adjacent channel. (And, for example, if a narrowband radio has a spurious rejection or adjacent channel figure worse than 60dB, or a blocking spec under 80dB then "inadequate design" alarm bells should ring.) If a parameter is not quoted at all, then suspect a very poor spec.

Lastly, remember that there is no substitute for attaching the aerial to your radio and going out into the field and doing some tests. Good luck!

NOTE 1: SYNOPSIS OF EN300-220 RADIO SPECIFICATIONS:

Operating temperature	-20 to +55 degrees	(general usage)
	-10 to +55	(mobile)
	+5 to +35	(indoor use only)
Frequency stability:	wideband (> 200kHz channels)	±100ppm
	25kHz channels, 300-500MHz	±2KHz

Refer to Table 6a on page 27 of EN300-220 for a complete listing (various channel spacings 6.25-200kHz, frequencies 25-1000MHz)

TRANSMITTER	spurii / harmonics	-36dBm	(up to 1GHz)
		-30dBm	(over 1GHz)
		-54dBm	(forbidden bands)
	"standby" spurious output	-57dBm	(up to 1GHz)
		-47dBm	(over 1GHz)

(forbidden bands are 47-74MHz, 87.5-118MHz, 174-230MHz, 470-862MHz)

	adjacent channel power	10uW	(< 20kHz channels)
		200nW	(≥ 25kHz channels)
RECEIVER	spurious emissions	-57dBm	(up to 1GHz)
		-47dBm	(above 1GHz)

(Measurements are made up to 4GHz for radios operating below 470MHz and up to 12.75GHz for radios operating above 470MHz).This is just a very basic extraction of the primary radio spec limits. The transmitter tests also include transient spurious emission tests and the receiver testing can (for Class 1 and 2 radios) also include sensitivity and several spurious response and large-signal tests.There are also various sub-clauses dealing with band or application-specific tests, dealing with limited duty cycles, listen-before-talk or spread spectrum operation.

NOTE 2: SPECIFICATION DOCUMENTS:
Overall short ranged device band allocation document:
http://www.erodocdb.dk/Docs/doc98/official/pdf/REC7003E.PDF
Current release of the main EN300-220 spec.
http://www.radiometrix.co.uk/test_report/radio/en_30022001v020101p.pdf
NOTE 3: CLASS 1 RECEIVER PERFORMANCE REQUIREMENTS
The EN300-220 provides for a more stringently tested sub-group of receivers, intended for safety critical applications. Receivers conforming to the Class 1 (and to a lesser extent, Class 2) groups must have adequately good spurious rejection and large signal handling specs. Referring to the specification: *"4.1.1 Receiver classification. The receivers used in short range radio devices are divided into three classes of receivers, each having its own set of minimum performance criteria. This classification is based upon the impact on persons in case the equipment does not operate above the specified minimum performance level.*
Class 1 Safety critical SRD communication media; i.e. for devices serving systems where failure may result in a physical risk to a person.
Class 2 Function-critical SRD communication media; i.e. when a failure to operate correctly causes loss of function but does not constitute a safety hazard.
Class 3 Non-critical SRD communication media whose failure to operate correctly causes loss of function which can be overcome by parallel means."
Unfortunately, over time, the various versions of the EN300-220 spec have changed the actual requirements for Class 1 receivers, to the point that a receiver compliant to the spec in 2007 has little chance of complying in 2008, while appearing somewhat over designed when compared to the forthcoming 2009 requirements. In fact, the current stringent Class 1 standard expects a low-cost SRD receiver to meet specifications as stringent as expensive PMR Class receivers complying with EN 300 086 or 300-113. Comparing the performance requirements (the actual testing methods have changed between v1.3.1 and v2.1.1, making direct comparisons a little difficult. I have re-worded the measurements into commonly understood relative-to-carrier values):

EN 300 220-1 V1.3.1	(2000-09) was valid until 31 December 2007: 60dB Adjacent Channel Selectivity, 84dB Blocking.
EN 300 220-1 V2.1.1	(2006-04) current issue: 60dB Adjacent Channel Selectivity, 84dB Blocking, 65dB Intermodulation
EN 300 220-1 V2.2.1	(2008-04) Future standard, implemented 2009: 54dB Adjacent Channel Selectivity, 4dB Blocking (at ±2MHz only). No intermodulation measurement.

A 65dB intermodulation level is the same as that required by the exacting 300-086 and 300-113 land mobile radio specifications.
ETSI appears to be have realised the implications of demanding such a stringent high standard from a low-cost SRD receiver. Therefore, they are working on the new v2.2.1 standard for R&TTE Directive Article 3.2 requirement. This new Class 1 requirement is scheduled to be published on 27 January 2009.
http://webapp.etsi.org/workProgram/Report_WorkItem.asp?wki_id=27107
http://webapp.etsi.org/workProgram/Report_Schedule.asp?WKI_ID=27107

About Radiometrix

Established in 1985 and headquartered in London, Radiometrix continues to be recognised as the leading global developer of narrow and wideband radio communication modules. Our diverse product range is suitable for a wide variety of licensed and licence-exempt ISM/SRD wireless applications, and is available worldwide through our global sales and distribution network.

For more information on the company, please visit our website:
www.radiometrix.com

Contact Radiometrix
Editorial queries can be sent to press@radiometrix.com
Sales queries can be directed to the sales department: sales@radiometrix.com

Radiometrix Ltd,
Hartcran House,
231 Kenton Lane,
Harrow, Middlesex,
HA3 8RP,
UK.
Tel: +44 (0) 208-909-9595

Limitation of liability

The information furnished by Radiometrix Ltd is believed to be accurate and reliable. Radiometrix Ltd reserves the right to make changes or improvements in the design, specification or manufacture of its subassembly products without notice. Radiometrix Ltd does not assume any liability arising from the application or use of any product or circuit described herein, nor for any infringements of patents or other rights of third parties which may result from the use of its products. This data sheet neither states nor implies warranty of any kind, including fitness for any particular application. These radio devices may be subject to radio interference and may not function as intended if interference is present. We do NOT recommend their use for life critical applications. The Intrastat commodity code for all our wireless radio modules is: 8542 6000.