

# THE ISM BAND – A REVIEW OF THE ESSENTIALS

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ISM stands for:

Industrial

Scientific

Medical

A SET OF UNLICENSED FREQUENCIES  
ALLOWED IN MOST COUNTRIES BETWEEN  
902 MHZ to 5.925 GHZ.



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## HISTORY

In 1985 the Federal Communications Commission issued rules permitting “intentional radiators” to use the “Industrial, Scientific and Medical (ISM) Bands (902-928, 2400-2483.5, 5725-5850 Mhz) at power levels of up to one Watt without end-user licenses.

Originally these bands had been reserved for unwanted, but unavoidable emissions from industrial and other processes, but They also supported a few (often military) communications users. The new rules led to the development of a large number of consumer and professional products and is considered to be an important step towards the development of wireless computing or multimedia applications.

Applications in the ISM band include, wireless LANs, short range links for advanced traveller systems (electronic toll collection), garage door openers, home audio distribution, cordless phones, private point to point links, remote control, wireless telemetric systems (e.g. electrical power consumption monitoring) etc. Applications seem to be limited by the imagination rather than technology.

A drawback of the ISM band is lack of any protection against interference. In particular microwave ovens limit the useful range of such communications devices



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## UNLICENSED FREQUENCIES

Country	Frequency	Notes	Standards
US	2.400 – 2.483.5 Ghz	ISM Band ( Max 4W EIRP)	802.11x
	902-928 Mhz	ISM Band ( Used by GSM in most countries)	
	5.800-5.925 Ghz	ISM Band	
	5.15 – 5.25 Ghz	U – NII ( Unlicensed – National Information Infrastructure) Max 200mW EIRP	802.11a
	5.25 – 5.35 Ghz	U – NII Max 1 W EIRP	802.11a
	5.725 – 5.825 Ghz	U – NII Max 4W EIRP	802.11a



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## DEFACTO STANDARDS

- Little Standards Activity, except for the Wireless LAN standardization work in the European Telecommunications Standardization Institute ( ETSI), the 802.11 and Blue Tooth?
- Little or no emphasis on interoperability
- Great Diversity in products, and in the traffic they generate
- Interference limited ( as opposed to noise limited) system design
- Little focus on co-existence



## THE EUROPEAN SITUATION

In Europe ISM – type regulations exist in similar bands, except that The 900 Mhz frequencies are part of the GSM allocation. This implies that 900 Mhz ISM equipment ( illegally ) imported from the US, Asia or South Africa causes and suffers substantial interference.

CEPT recommendation TR/01-04 allows for low powered ( ERP < 10mW) devices to operate in the 433.05 – 434.79 Mhz band. Manufacturers are free to select their own modulation method, carrier frequency and transmit bandwidth. Type approval using ETSI norm ETS 300 220 is required.



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## FCC RULES FOR ISM BAND WIRELESS EQUIPMENT

In the US, FCC regulates and manages the electromagnetic spectrum. FCC regulations appear in title 47 of the United States Code of Federal Regulations (47CFR) and radio spectrum issues are the subject of part 15 of the FCC rules, or 47CFR15 in brief.

Consult FCC Website at <http://www.fcc.gov> for a lot of material online including FCC rules ( 47CFR)



## FCC RULES FOR ISM BAND WIRELESS EQUIPMENT

FCC Rules applicable to ISM – SS Radios:

FCC	Conducted Emissions including AC line
FCC	Unintentional Radiation
FCC	Restricted bands of operation
FCC	Conducted emissions from intentional radiators
FCC	Radiated emissions limits, general requirements
FCC	ISM Band Communications Equipment

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### Summary of Power output rules for ISM bands

- 1.0 Maximum transmitter output is 1 Watt ( 30 dBm) (47CFR15.247.b.1).
- 2.0 Maximum EIRP is 4 Watt ( 36 dBm) (47CFR15.247.b.3) i.e. for every dB of antenna gain above 6dBi, the transmitter output must be reduced by 1 dBm; per this rule, a 24 dBi antenna limits the output power to 12 dBm which is 16 mW.
- 3.0 For fixed point to point operation in ISM2.4, peak output need only be reduced by 1 dBm for every 3 dBi of antenna gain above 6 ( 47CFR15.247.b.3.i) i.e per this rule, a 24 dBi antenna may be fed by a 24 dBm or 250 mW.
- 4.0 In ISM5.8, you can apply all the antenna gain you want(47CFR15.247.b.3.ii) with no reduction in output power.

The responsibility of staying within these limits falls on the operator ( or, if professionally installed on the installer).



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### SEMICONDUCTOR TECHNOLOGIES FOR ISM BAND PRODUCTS

- 0.6um Si-Ge Process – XFAB
- 0.35 um CMOS Process- XFAB
- 0.18 um RF CMOS process – TSMC/UMC

among others. The requirement on the technology is that it should be fairly well characterized either by the supplier or the user. Technology is freely available both in MPW form and MLM form for prototypes and test chips before volume fabrication.

Some additional design tools may be required as well as custom built routines. Packaging and board interactions are very important as are the noise/interference issues. FCC compliance testing is an added requirement ( compared to simple probe tests and package tests for low frequency devices).





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## MARKET FOR ISM BAND PRODUCTS

- Market is very large and growing
- Present day products are based on 802.11/Bluetooth Standards.
- HOMERF and other applications are being addressed.
- Wireless is rapidly becoming the technology of choice for interconnect.
- ISM band security products are being identified.
- RFID is a major application area and is growing

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