Wireless Approvals

Mike Violette, P.E.
American Certification Body, Inc
Washington Laboratories, Ltd

FCC, IC and EU Regulations

Agenda

Overview – Part I

- Background: EMC
- Definitions
- Regulatory Overview
- Technical Requirements
- General Measurements
- Compliance Procedures

Agenda

Overview – Part II

- FCC and IC Permissive Changes
- Measurement Techniques
- Modular Approvals
- European Requirements
- Japan Certification
- Q&A

Washington Labs & ACB

EMC, Environmental, Product Safety & Radio Frequency Expertise

Commercial

Consumer

Defense & Aerospace

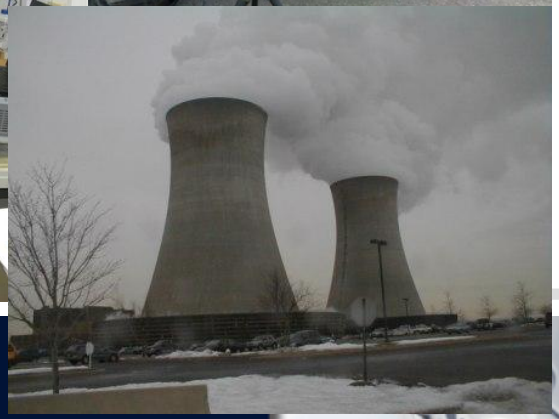
Energy

Wireless Certifications

WL Project Experience

Over 10,000 projects since 1989

- NASA
- US Army, Air Force & Navy
- General Electric
- Westinghouse
- Hughes Network System
- Applied Physics Laboratory
- Exelon
- 35+ Nuclear Power Plants
- Research Universities
- Hospital/Medical Facilities
- Industrial Environments
- Municipalities



FCC, IC and EU Regulations

American Certification Body

Operations in

- North America
- European Union (UK & Netherlands)
- Beijing, Shanghai & Shenzhen
- Taiwan

Perform ~ 1400 Certifications yearly

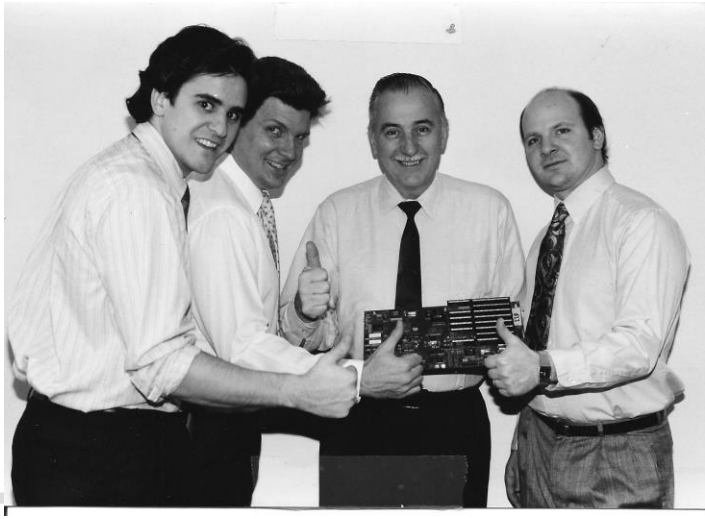
European: NB1588

US EPA: EnergyStar®

Japan: CB for MIC

My Background

EMC



Compliance Definitions

EMC: Electromagnetic Compatibility

Emissions: Unwanted radiated and conducted electrical energy

Immunity: Undesirable response to external electrical energy

EMI: Electromagnetic Interference

- Effect on equipment of an EM disturbance

RFI: Radio Frequency Interference

Product Safety

Protection from Electrical, Mechanical, Fire and Chemical Hazards

ROHS

Restriction on Hazardous Substances

Regulatory Requirements

North America

- EMC: FCC & Industry Canada Requirements
  - Intentional and Unintentional
  - Licensed and Unlicensed
- Safety: NEC & OSHA
- Medical: FDA 510(k) Premarket Notification
  - CDRH compiled case histories (hundreds of incidents)

European:

- EMC: EMC Directive
- Safety: Low Voltage Directive
- Medical Device Directive
- Machinery Directive
- Radio & Telecommunications Terminal Equipment Directive

US Regulations

- Code of Federal Regulations Title 47:
  - Part 2: General Requirements
    - » § 2.1091, § 2.1093
  - Part 15, Unlicensed
  - Part 22, 24: Licensed
    - » Cellular devices
  - Part 87, 90: Licensed
    - » Marine, Land-Mobile
  - SAR: ANSI C95.1-1991: Non-ionizing Radiation Hazards

Canada

Industry Canada Requirements

- ICES-CS03: Unintentional Emitters
  - Digital Apparatus
- RSS-GEN: Overall
- RSS-119: Licensed
  - Land mobile
- RSS-210: Unlicensed
  - Short range, low power

- “Most” technical requirements harmonized with FCC

EUROPE

Directives:

- EMC Directive
- Low Voltage Directive
- Medical Device Directive
- Machinery Directive
- Radio and Telecommunications Terminal Equipment Directive

Self-Declaration allowed for many products

- “Essential Requirements”

Notified Body for certain classes (notably medical and some telecom and some machinery)

FCC, IC

EUROPEAN DIRECTIVES

Low Voltage (73/23/EEC) Amended by 93/68/EEC
Simple Pressure Vessels (87/404/EEC) Amended by 90/488/EEC
Toy Safety (88/378/EEC) Amended by 93/68/EEC
Construction Products (89/106/EEC) Amended by 93/68/EEC
***EMC (2004/108/EC)**
***Machinery (89/392/EEC) Amended by 93/68/EEC**
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Hot Water Boilers (92/42/EEC) Amended by 93/68/EEC
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Recreational Craft (94/25/EEC)
Automatic EMC 72/245/EEC (>3 wheels)
2 or 3 wheeled Vehicles 97/24/EEC
***Active Implantable Medical Devices (90/385/EEC)**
***Radio and Telecommunications Terminal Equipment Directive (1995/5/EC)**
WEEE/ROHS Directive (2002/95/EC)

FCC, IC and EU Regulations *** Contain EMC Provisions**

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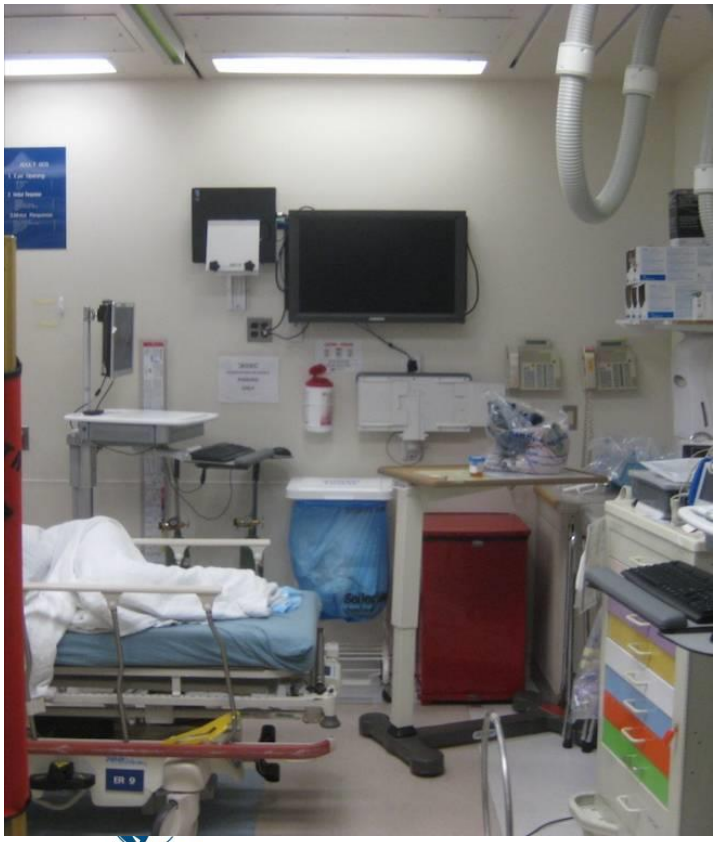
*Contain EMC

FCC, IC and EU Regulations *** Contain EMC Provisions**

You can meet all the regulations….

But…

Interference to XRAY System



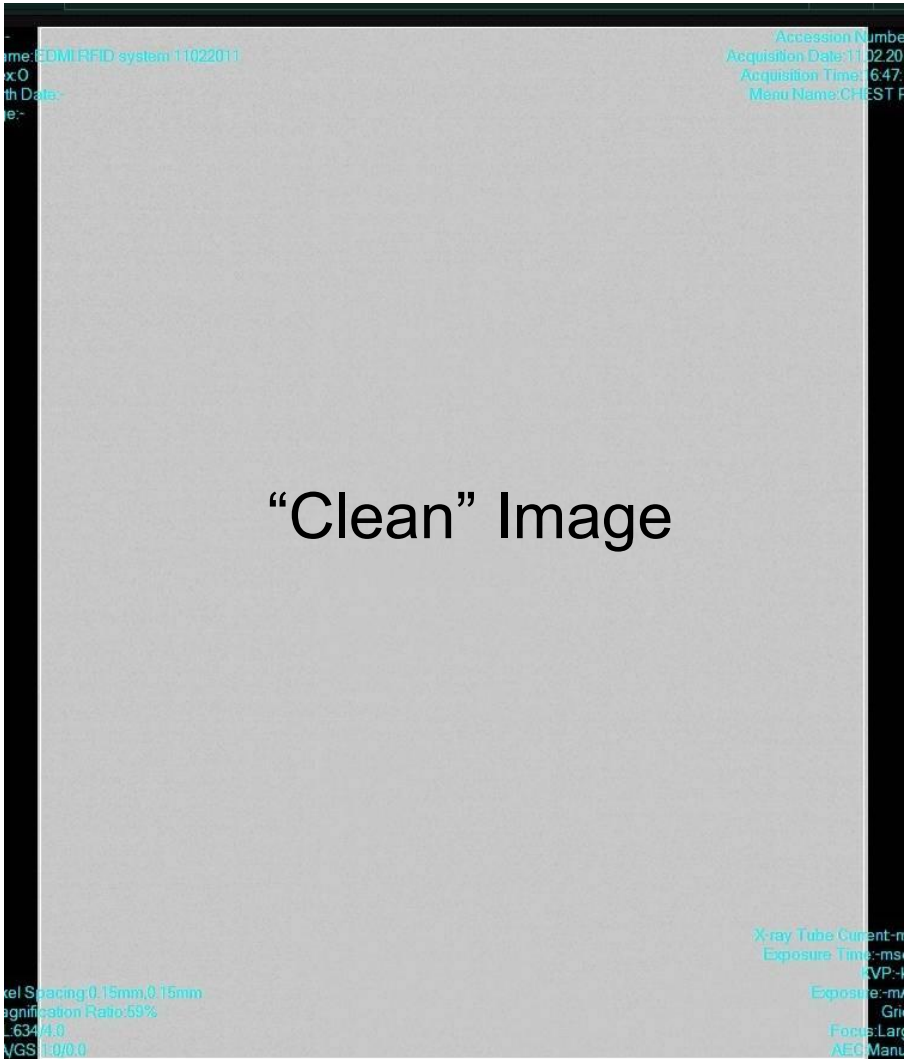
Emergency Room in Urban Hospital

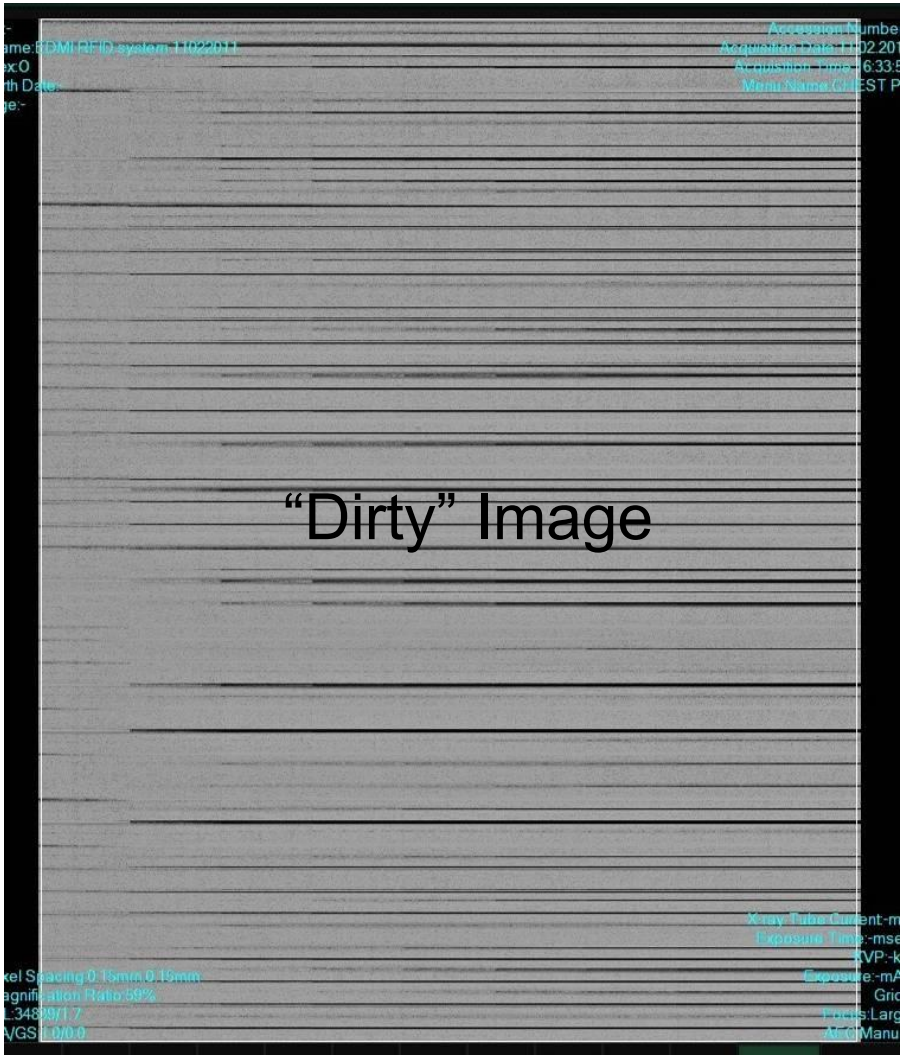
XRAY System exhibited interference

Spatially-dependent (worse towards the south wall of room)

X-RAY Cassette

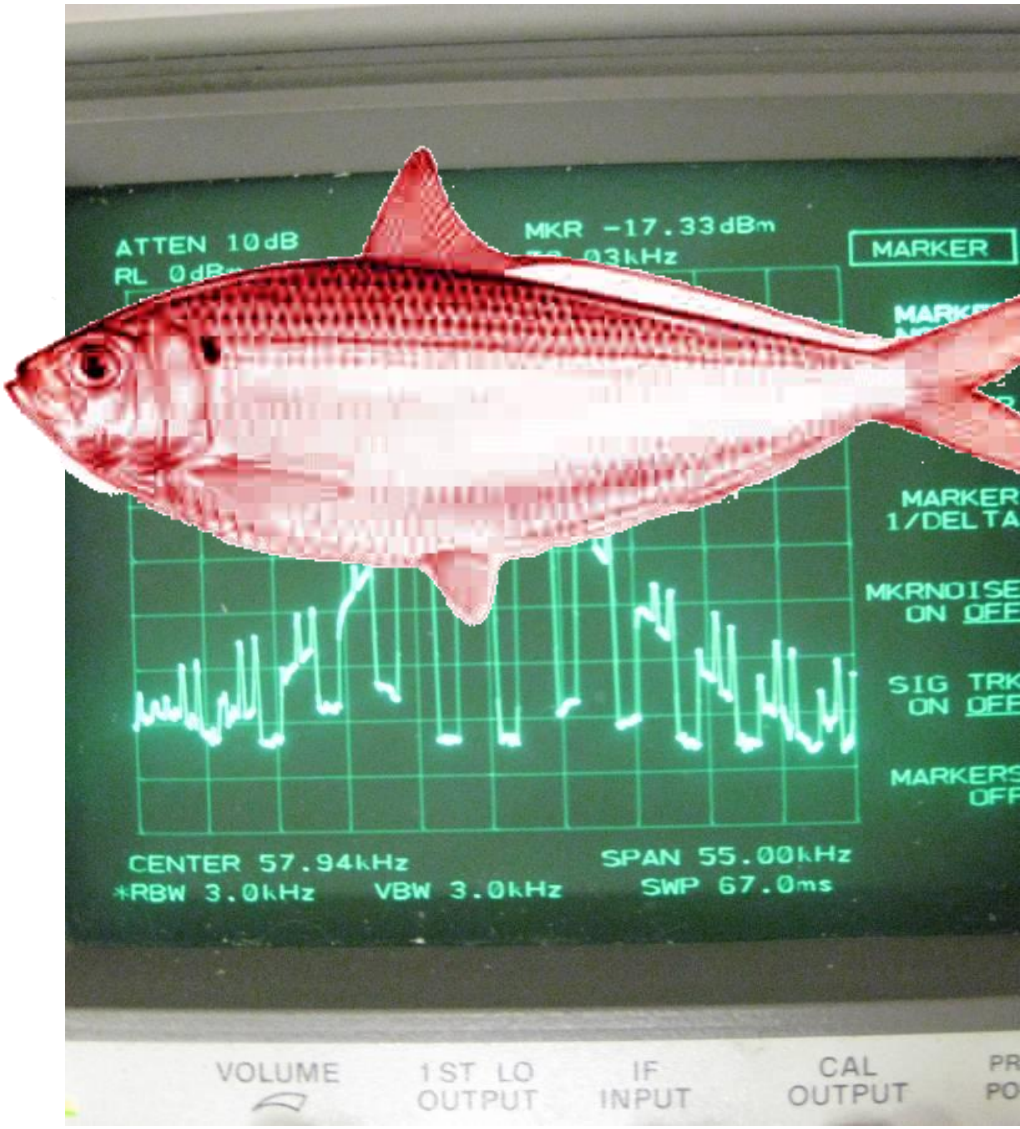
Interference to XRAY System





Measurements

- Strong 60 kHz field against South Wall
  - Indeterminate source
- Rest of spectrum “well-behaved”
  - Electric field measurements
- XRAY System met usual regulatory requirements for immunity



Interference Source

RFID Inventory Control Pedestal

13.56 MHz Source

Magnetic Field

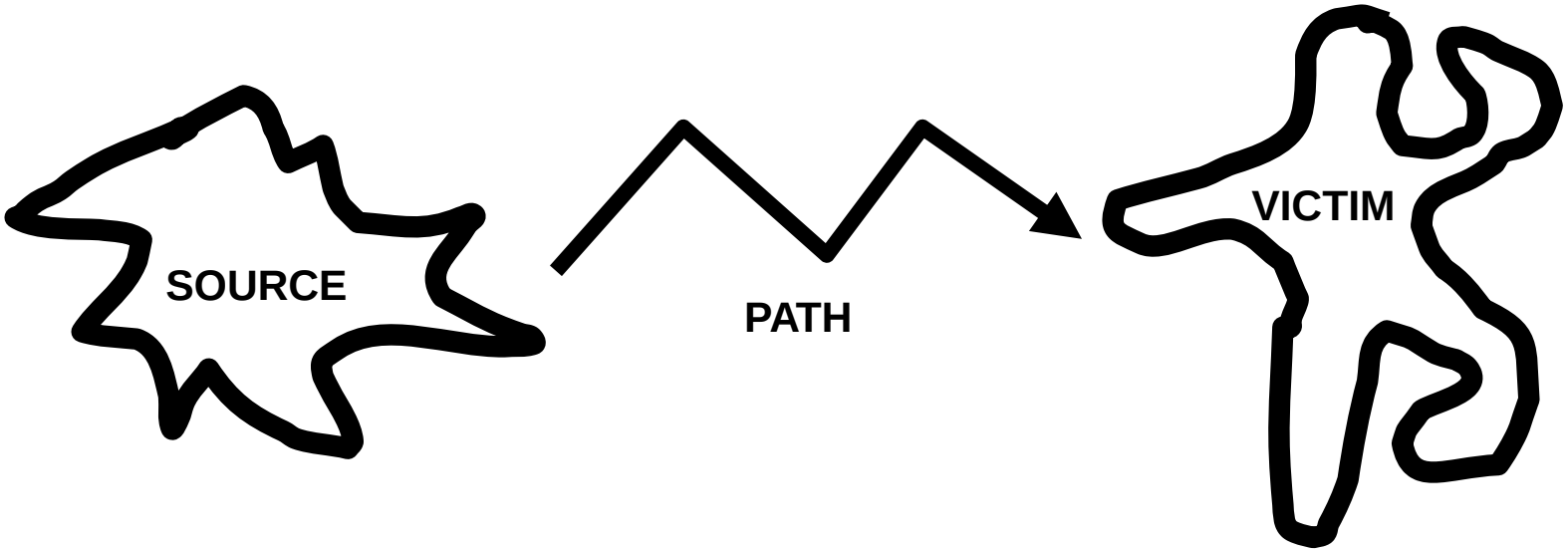
System located ~3 m outside South wall of ER

Effect would NOT have been assessed during EMC Testing

Radiated Immunity > 26MHz

Only E-Field is specified

Three Elements of an EMI Situation



Source: “Culprit”

Coupling Method: “Path”

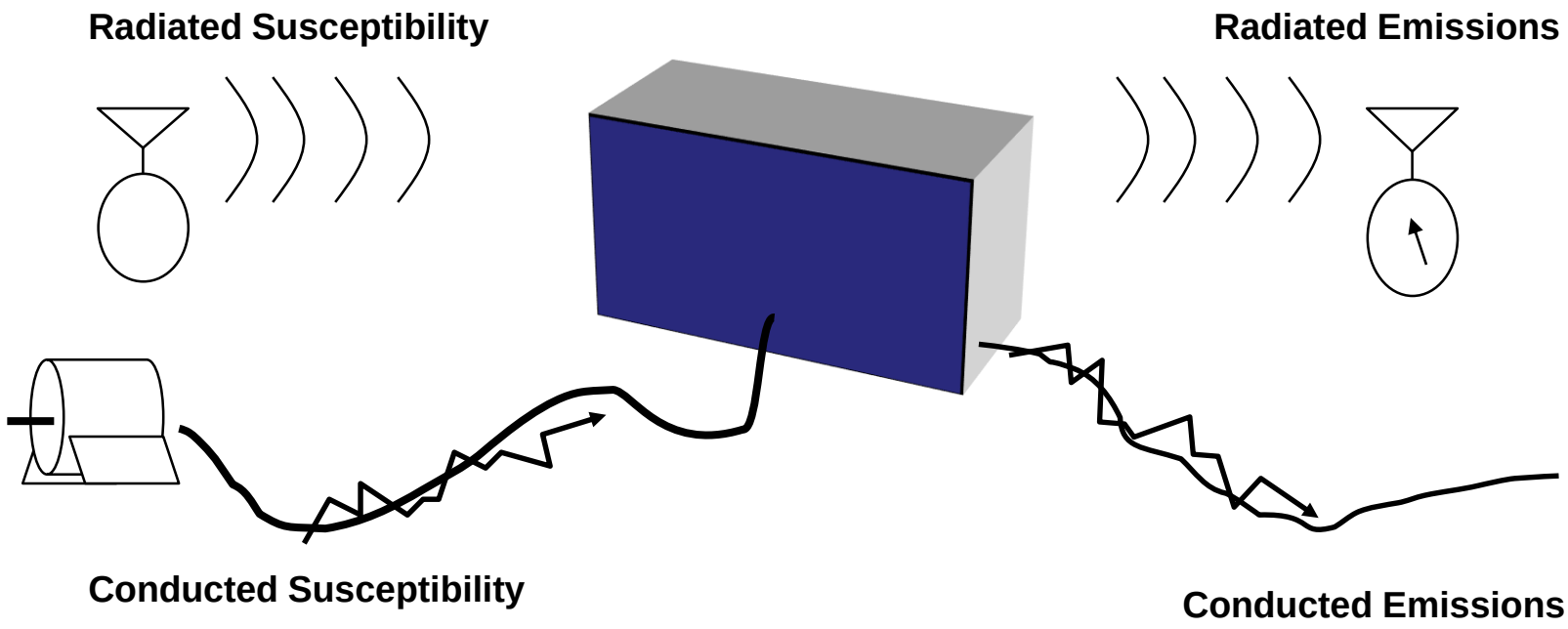
Sensitive Device: “Victim”

Coupling Paths

FOUR MODES:

Conduction: Voltage and Current via Wiring

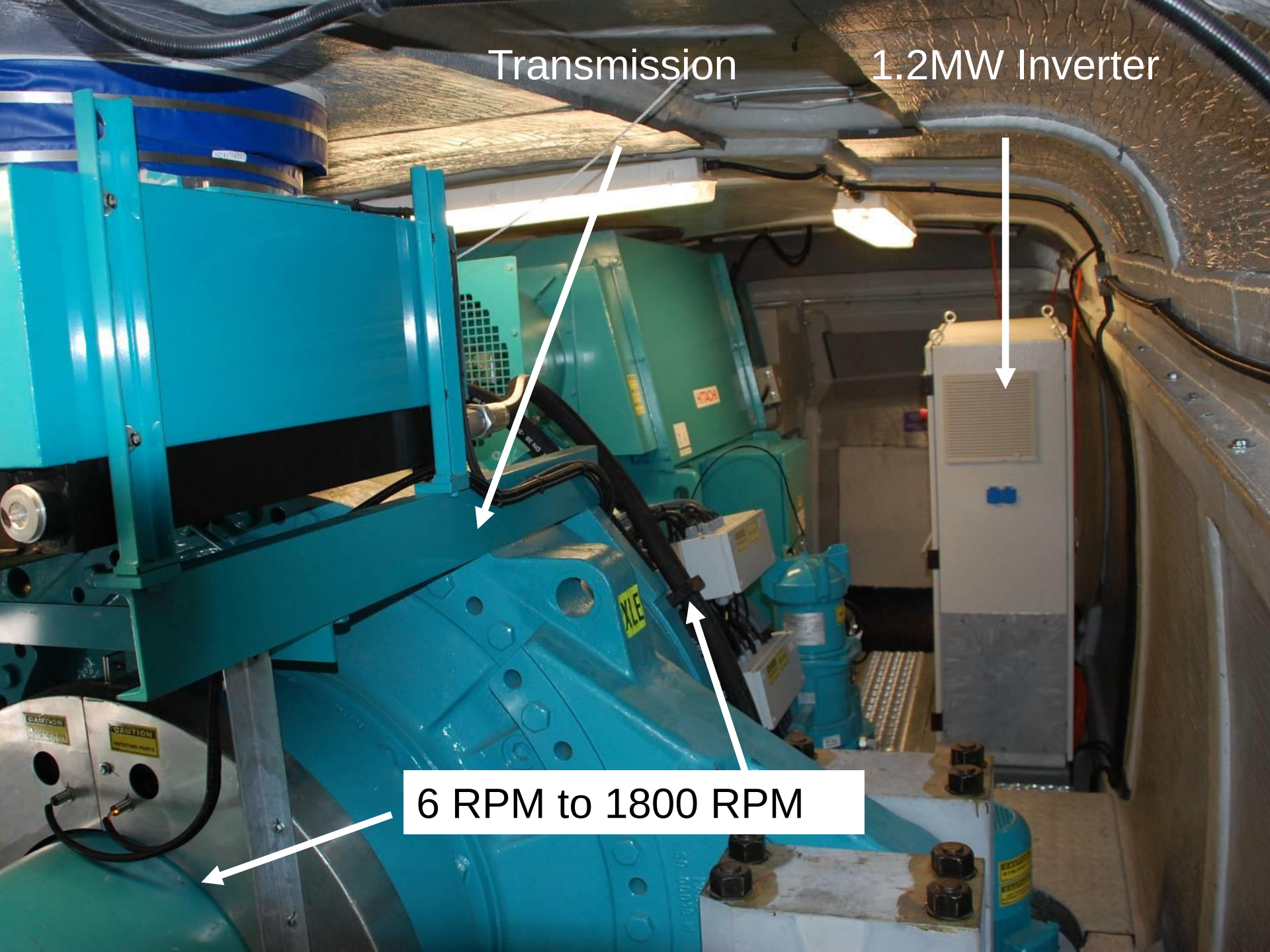
Radiation: Field Coupling via Wiring and Enclosures



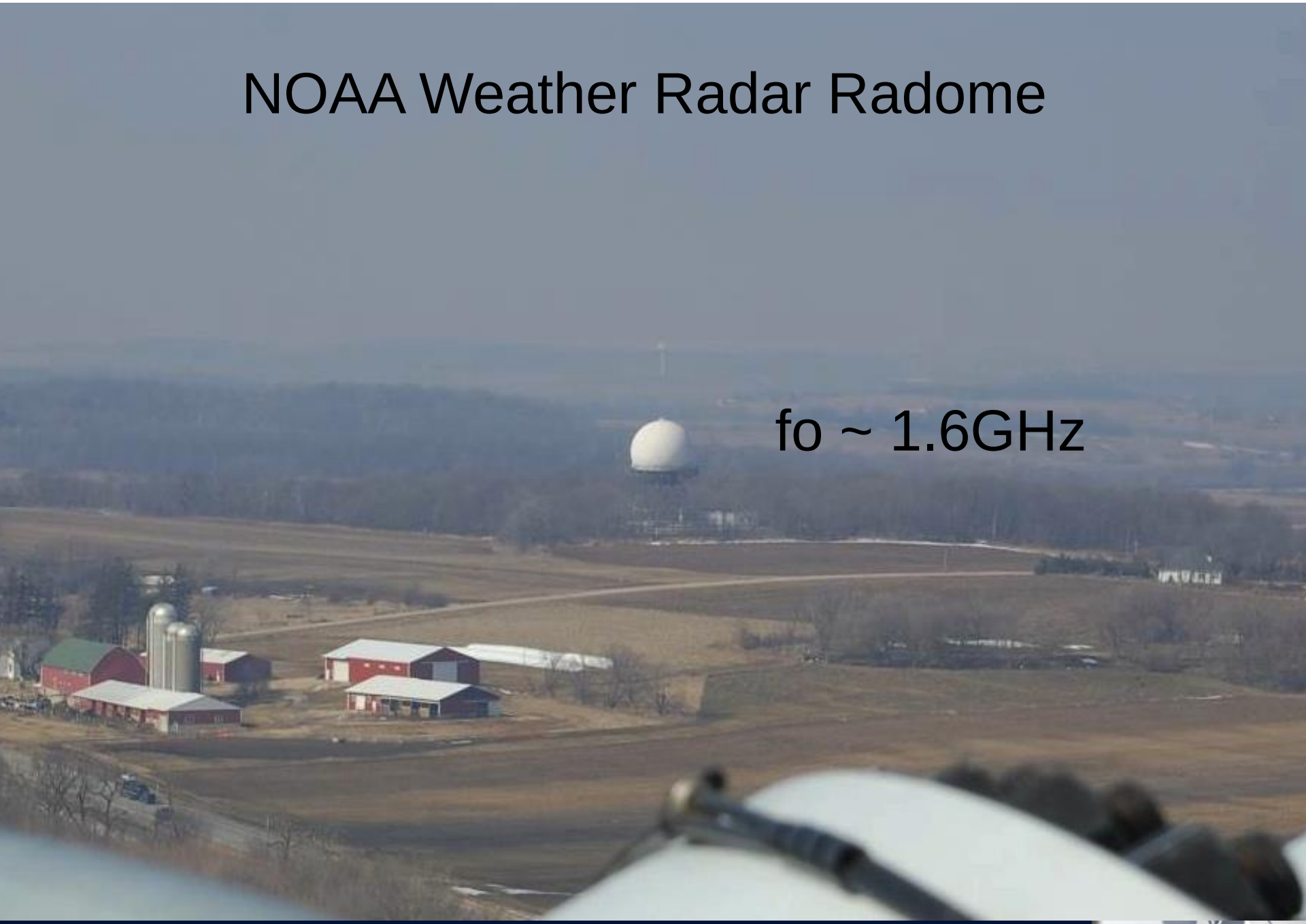
WI Wind Farm Case Study

~25% of 30 Wind Turbines

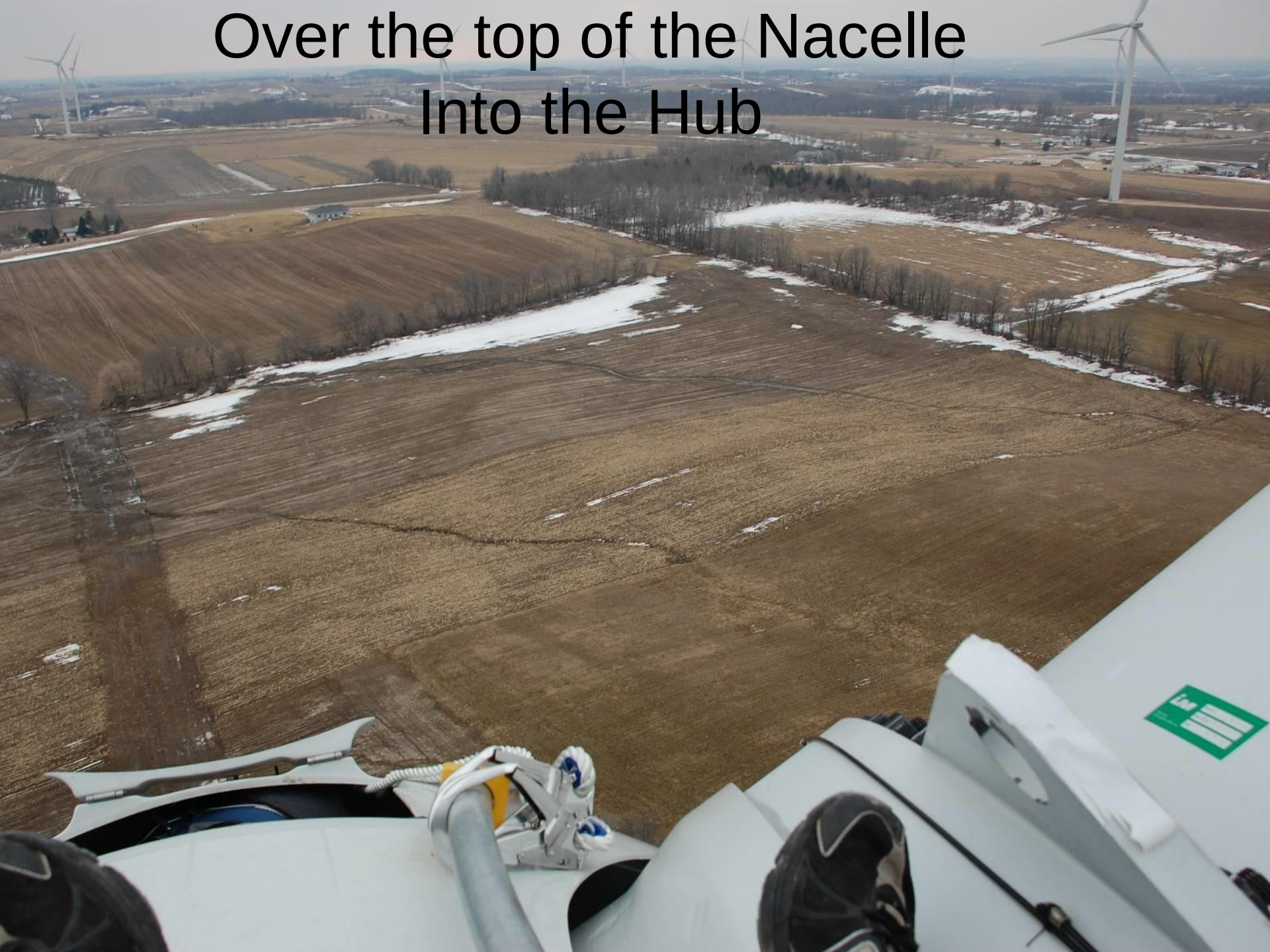
Unusable


Transmission
1.2MW Inverter
6 RPM to 1800 RPM

NOAA Weather Radar Radome



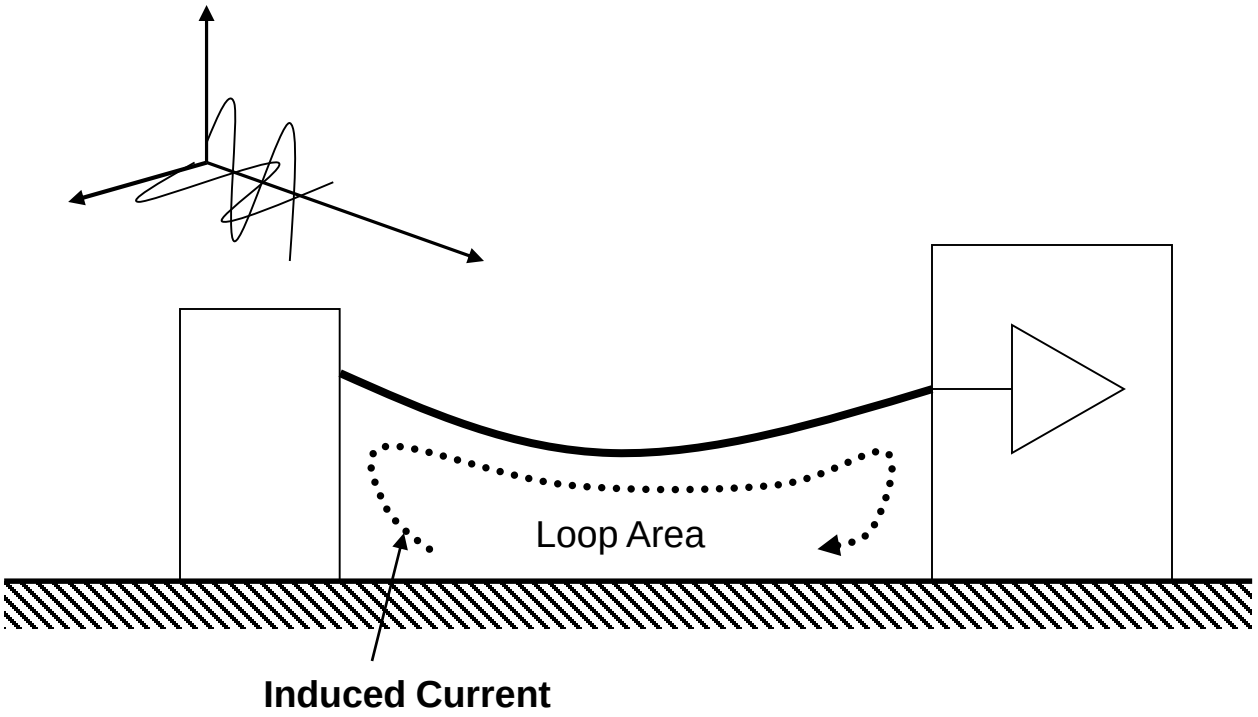
Over the top of the Nacelle Into the Hub




Pitch Control Signal Cable
in Liquidtight Conduit

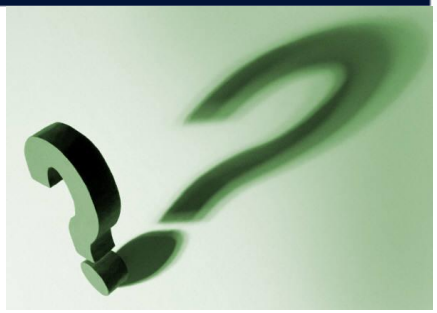
Radiated Coupling

Electromagnetic Wave: E/H Field



Coupling proportional to: E/H Field, Loop Area, Frequency

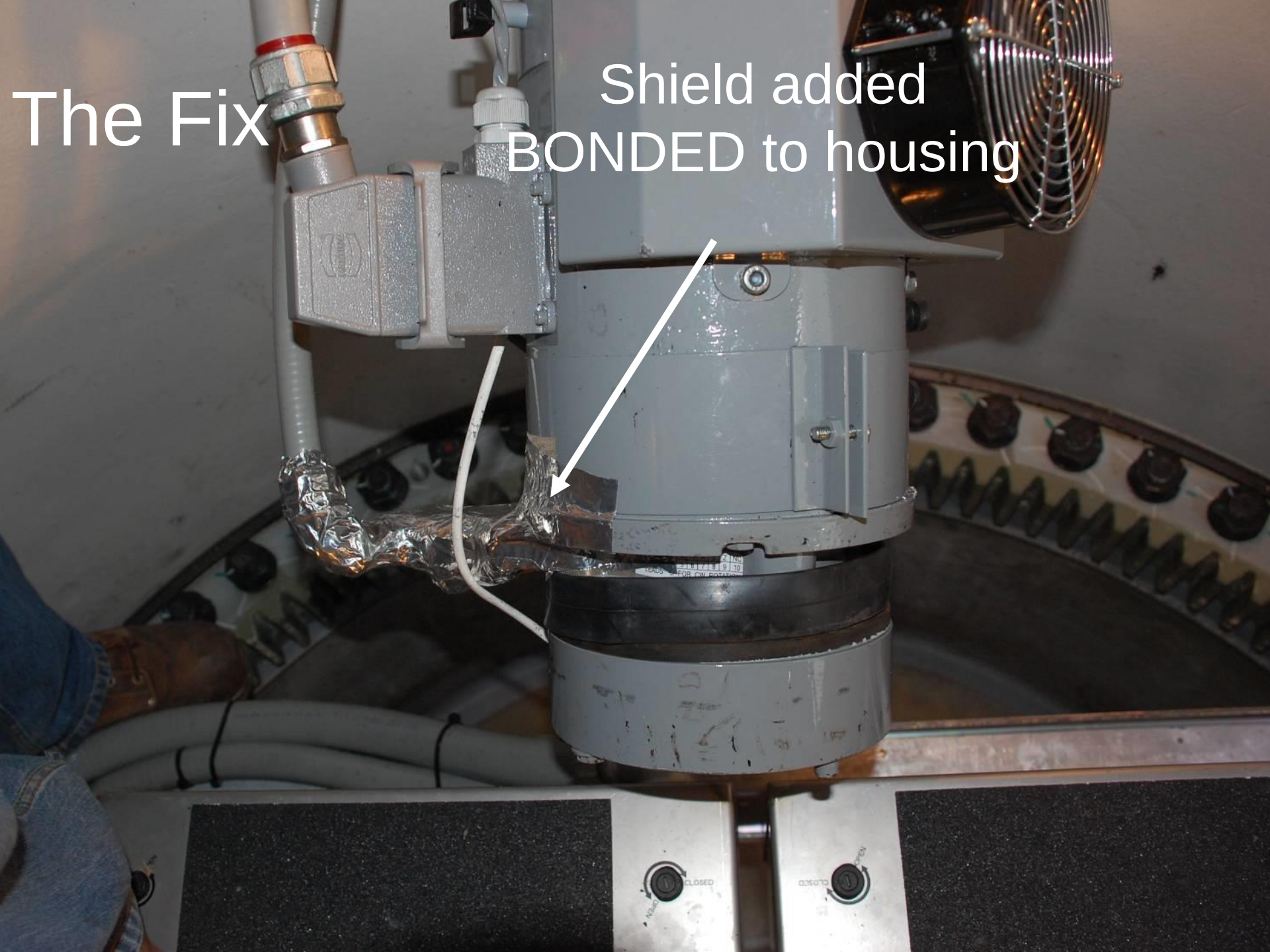
Radiated Coupling



Options?

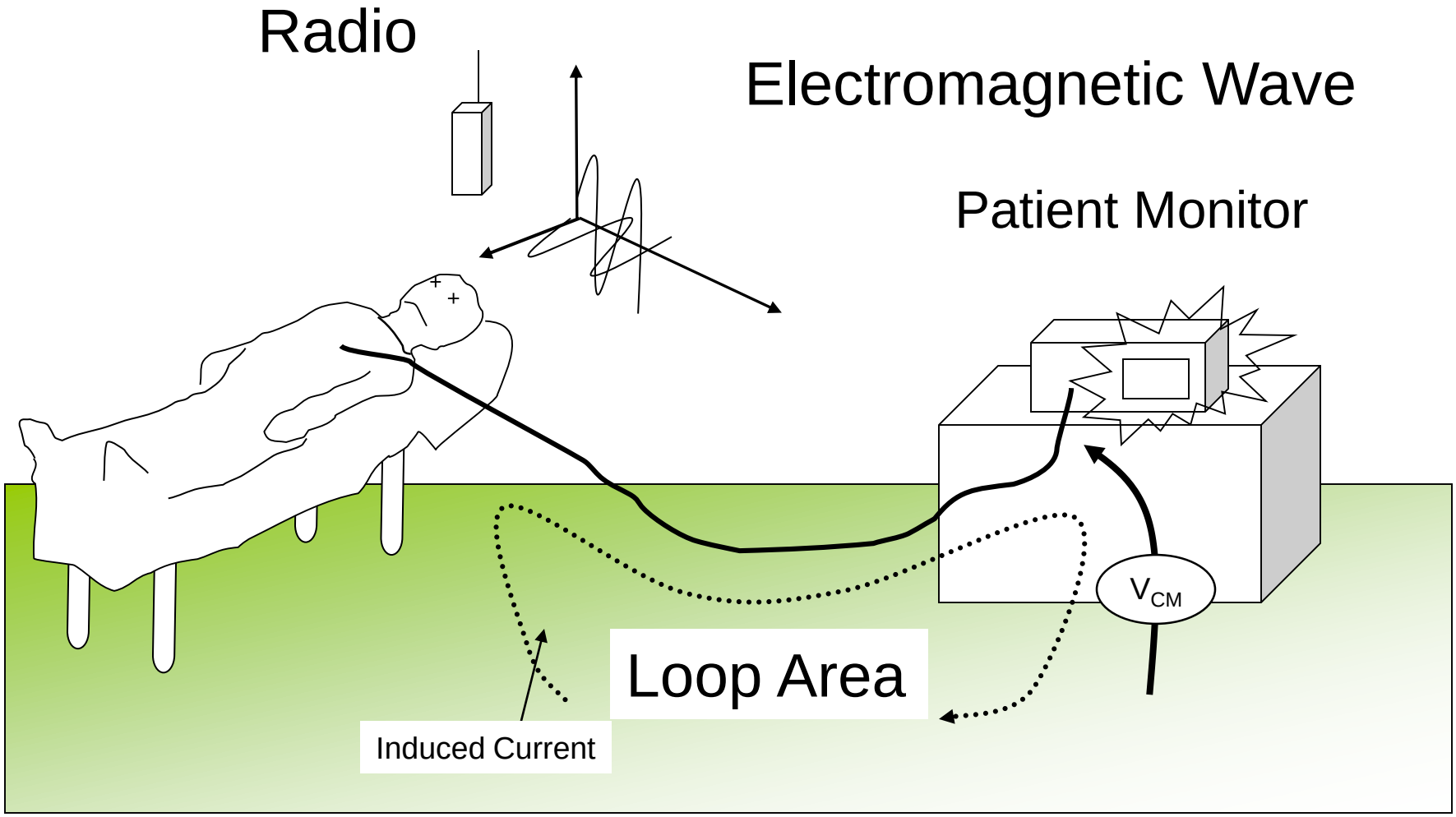
- **Suppress the Source**
- **Reduce the Coupling Path**
- **Replace the Technology?**

Harden the Victim


The Fix
Shield added
BONDED to housing

Radiated Coupling: Field to Cable

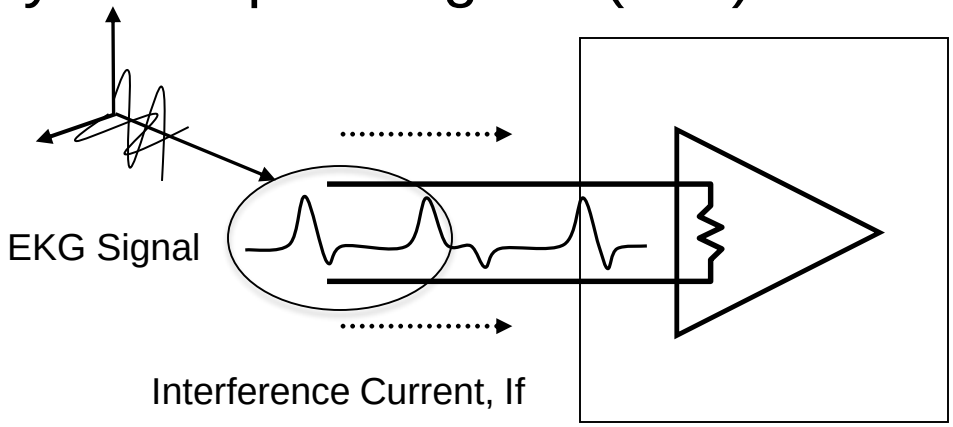
Medical Devices Require Immunity Testing: FDA and MDD

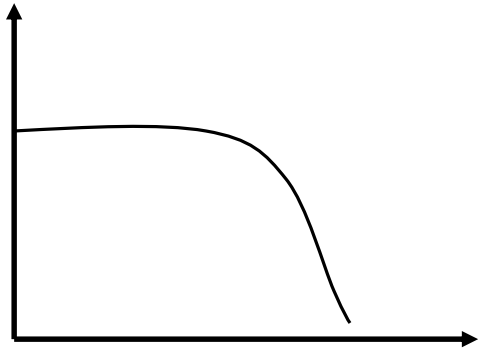


Radiated Coupling: iPhone to VW

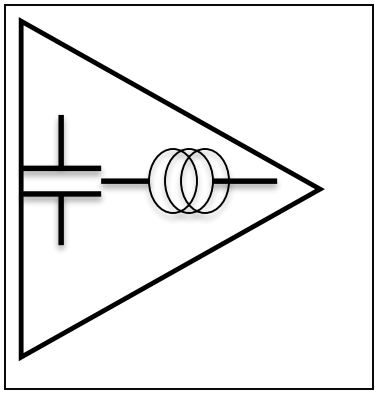
Interference to Instrumentation

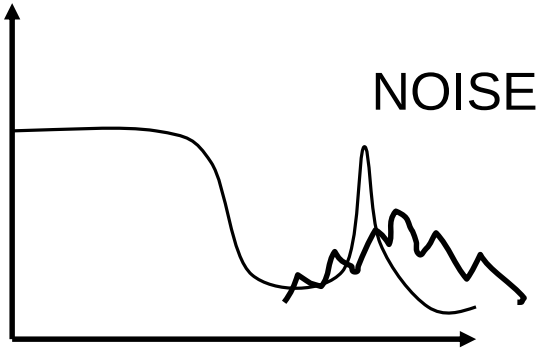
How does a signal at many MEGAHERTZ affect a system operating the (one) HERTZ range ?





Ideal Response

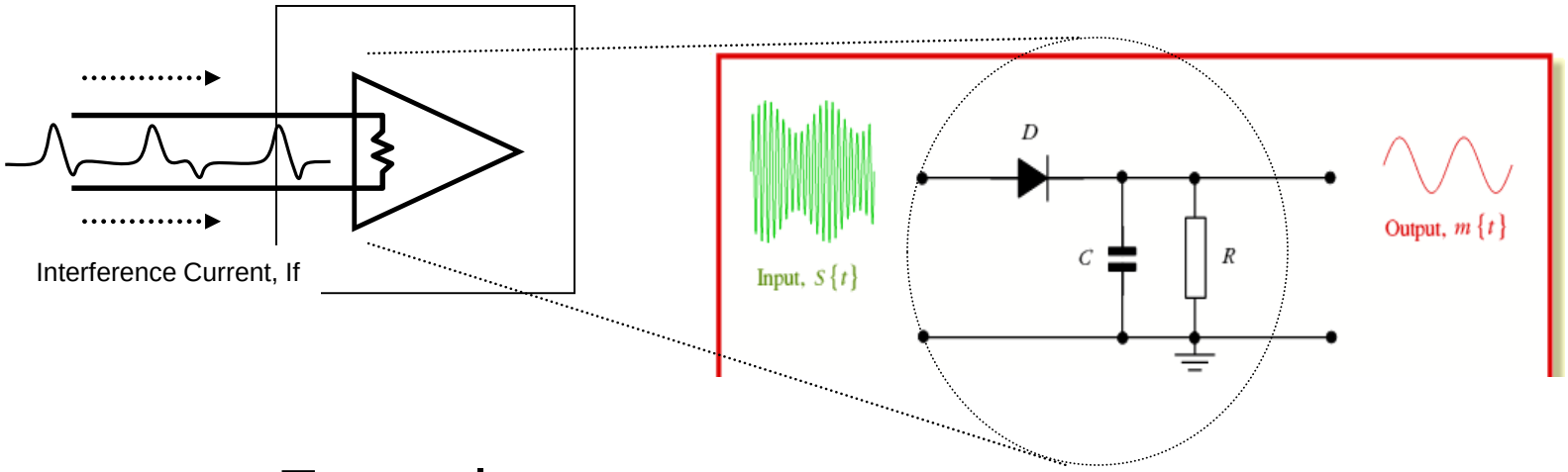




Real Response

Effect of Modulation

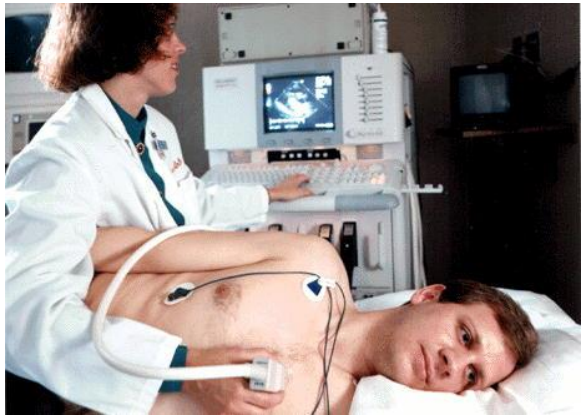
AMPLITUDE MODULATION AMPLITUDE MODULATION AMPLITUDE MODULATION

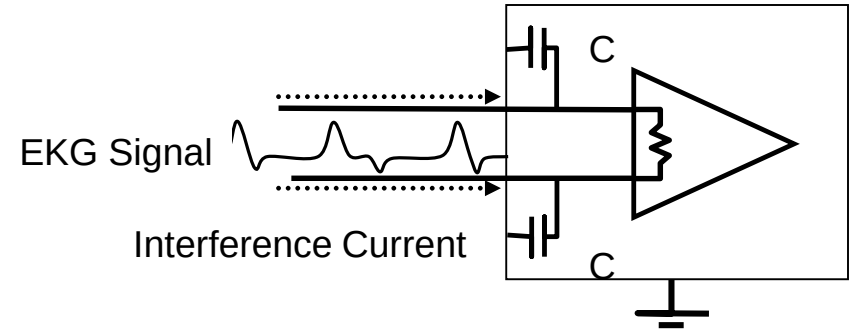


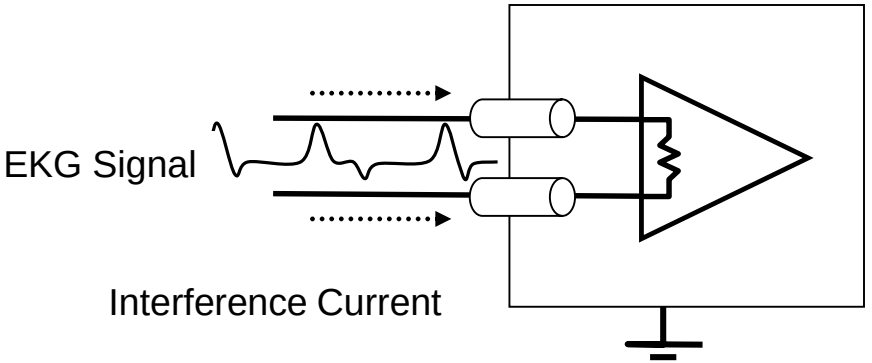
Examples:

- Patient monitoring
- Wind Turbines
- Electric-powered wheelchairs
- What everyday occurrence?

Filtering

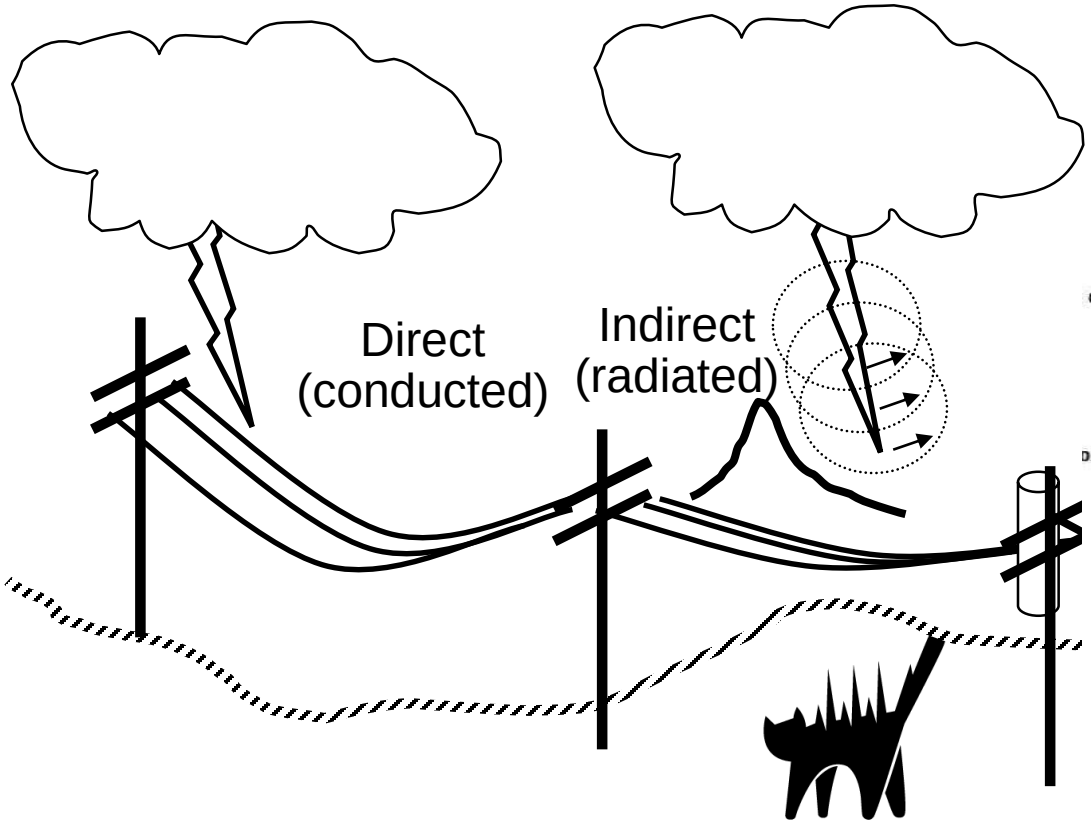



C
EKG Signal
Interference Current
C


EKG Signal
Interference Current

Direct & Field Coupling

Lightning and pulse sources cause high-energy transients into power and data cables



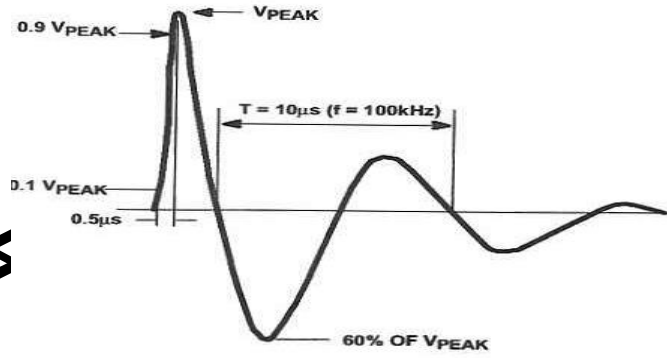
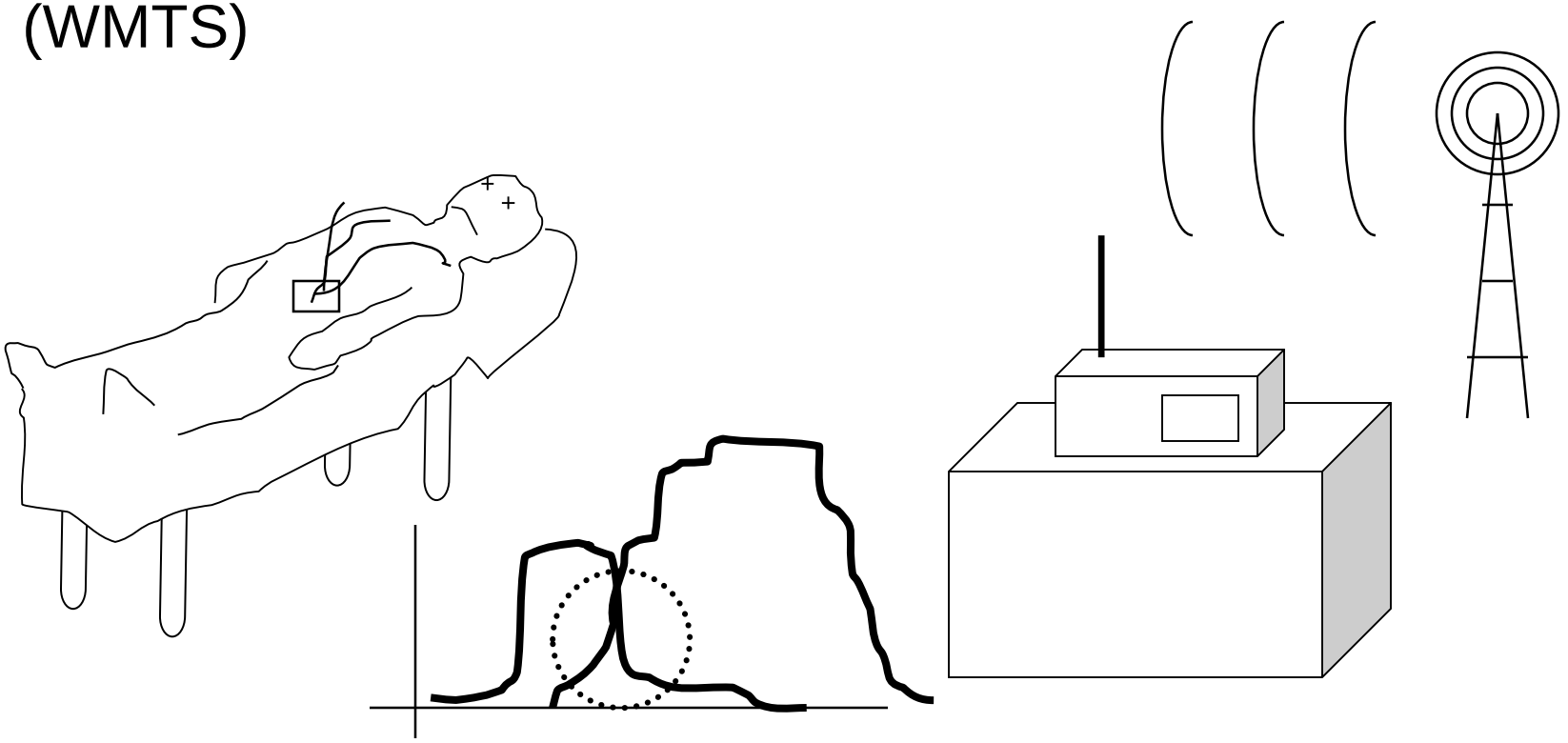


FIGURE 2. 0.5µs - 100kHz RING WAVE (OPEN CIRCUIT VOLTAGE)

Example: In-band Interference

Problem: Medical Telemetry Systems operating on secondary basis (TV Channels 7-46) experience interference from HDTV

Resolution: FCC allocated additional spectrum (WMTS)



EM Environment

Natural and Human Sources

Enter the Regulators

FCC, IC and EU Regulations

Compliance For Wireless Equipment

Three Main Areas

- Conducted and Radiated Emissions
  - (FCC, IC, RTTE)
- Conducted and Radiated Immunity (RTTE)
- Safety (US, Canada, EU)

Network connection protocols for Mobile Devices

- CTIA, PTCRB

(Cellular Telecommunications Industry Assn
PCS Type Certification Review Board)

Compliance For Wireless Equipment

EMC Covers

- Spectrum Management
- Device Operation (EU-immunity)
- Protection of $ervices

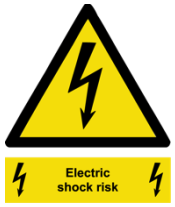
Compliance For Wireless Equipment

Safety Issues

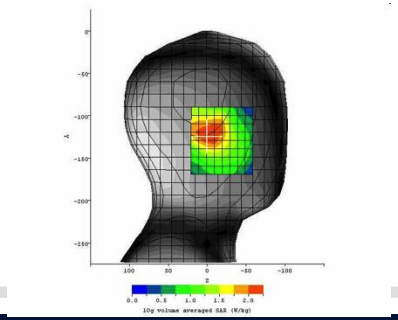
Electrical Safety

IEC/EN60950 UL1950 is dominant standard for IT

(For RTTE, no low-voltage limit)



SAR & MPE (OET Supplement C, IEEE 1528, IEC 62209)



RF Exposure

Authority: National Environmental Policy Act of 1969

SAR threshold of 4W/kg whole-body basis for “potentially harmful effects”

Safety Factors => 0.4W/kg & 0.08W/kg

Depends on frequency

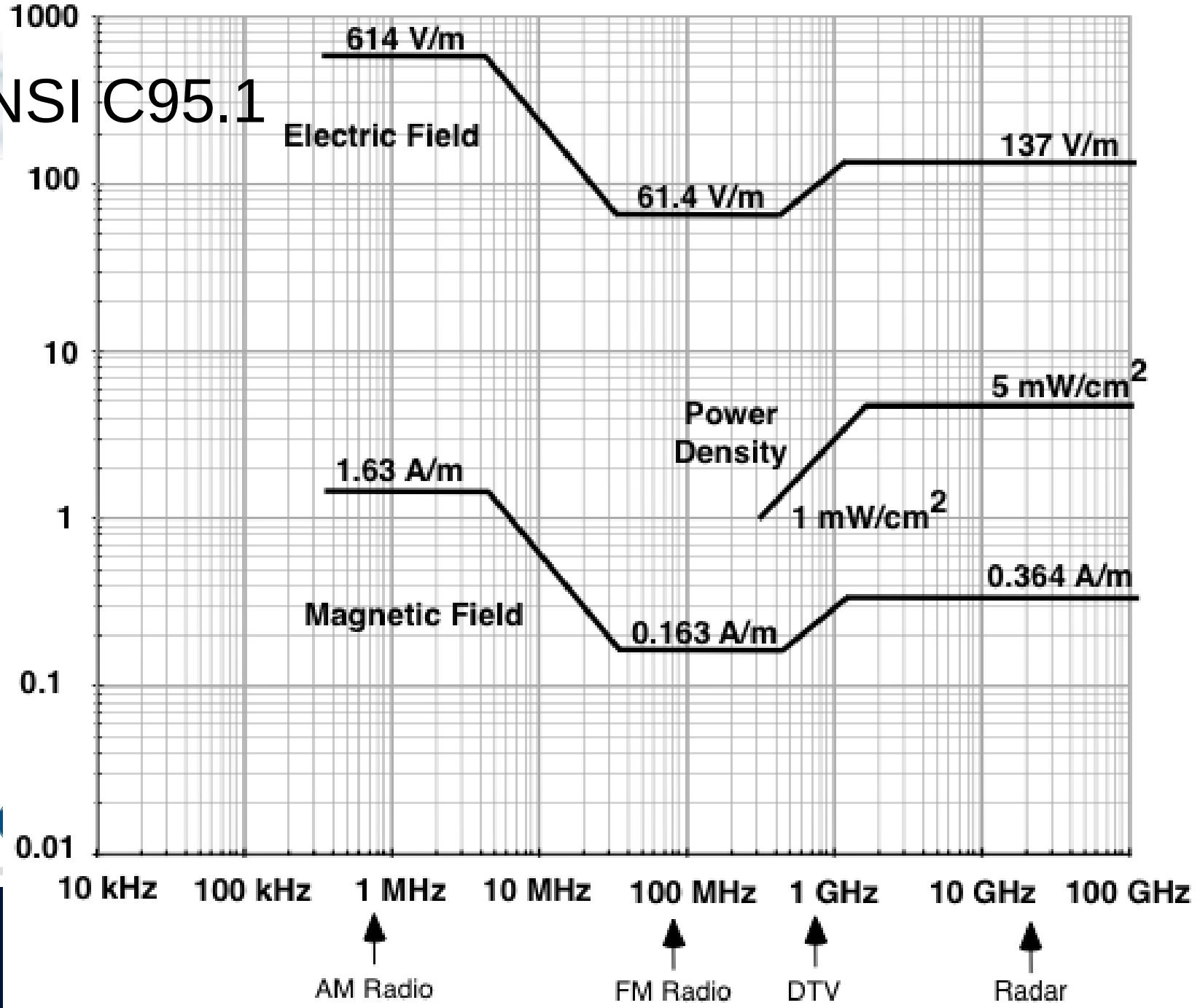
Federal Communications Commission
Office of Engineering & Technology

Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields

OET Bulletin 65
Edition 97-01

August 1997

ANSI C95.1


1000
100
10
1
0.1
0.01
614 V/m
Electric Field
61.4 V/m
137 V/m
5 mW/cm2
Power
Density
1 mW/cm2
1.63 A/m
Magnetic Field
0.163 A/m
0.364 A/m
10 kHz
100 kHz
1 MHz
10 MHz
100 MHz
1 GHz
10 GHz
100 GHz
AM Radio
FM Radio
DTV
Radar

RF Safety Issues Human Exposure

OET 65

OET 65-C

FCC Part 1.1037

FCC Part 2.1091 Mobile Devices

FCC Part 2.1093 Portable Devices

FCC Part 15.247 (b) (4)

Back To Wireless

FCC, IC and EU Regulations

And God said

$$\oint \mathbf{E} \cdot d\mathbf{A} = q / \varepsilon_0$$

$$\oint \mathbf{B} \cdot d\mathbf{A} = 0$$

$$\oint \mathbf{E} \cdot d\mathbf{S} = -d\Phi_B / dt$$

$$\oint \mathbf{B} \cdot d\mathbf{S} = \mu_0 i + \mu_0 \varepsilon_0 d\Phi_E / dt$$

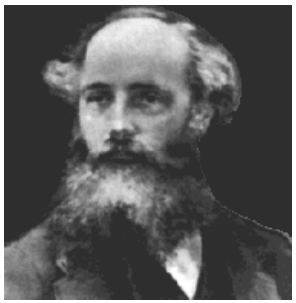
and THEN there was light.

Let's see how this all got started

Electromagnetic Field Theory

Heinrich Hertz (1857-1894) clarified and expanded on James Clerk Maxwell's Electromagnetic Theory

- "Maxwell's Equations"



Maxwell

Hertz

$$\oint \vec{E} \cdot d\vec{A} = \frac{q}{\varepsilon_0}$$

Charge

$$\oint \vec{B} \cdot d\vec{A} = 0$$

Magnetic Field

$$\oint \vec{E} \cdot d\vec{s} = -\frac{d\Phi_B}{dt}$$

Induction

$$\oint \vec{B} \cdot d\vec{s} = \mu_0 i + \frac{1}{c^2}\frac{\partial}{\partial t}\int \vec{E} \cdot d\vec{A}$$

Displacement Current

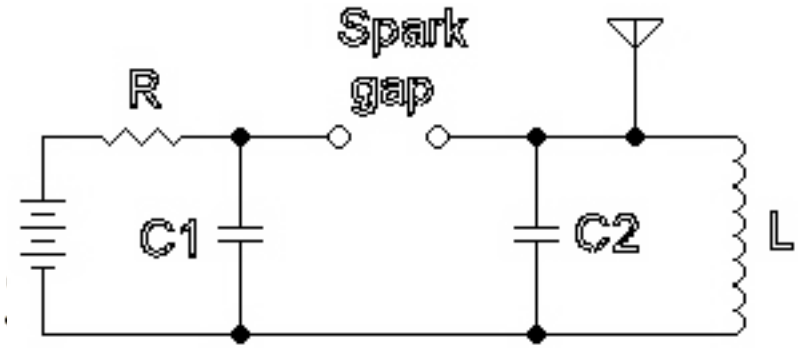
Guglielmo Marconi: first use & patent

Marconi

"Every day sees humanity more victorious in the struggle with space and time."

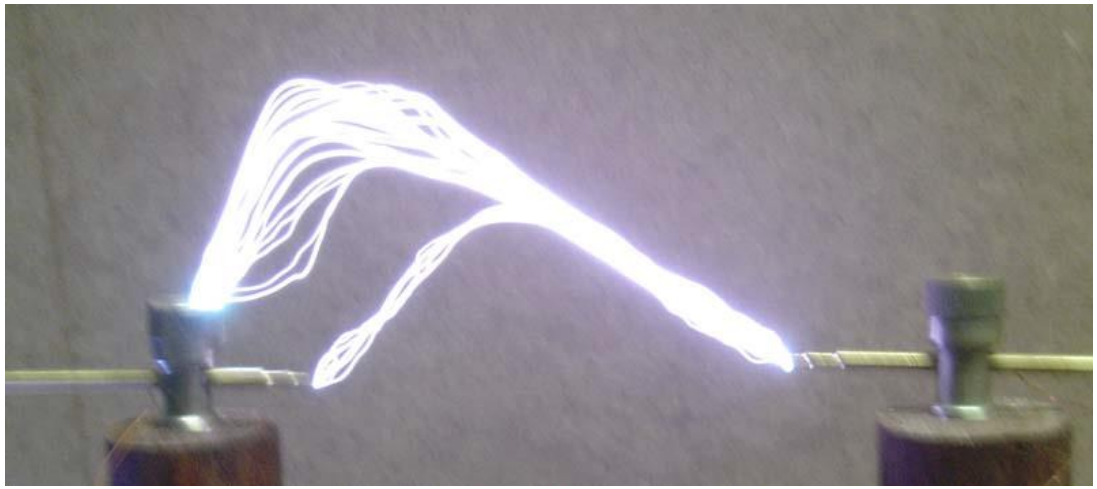
Let's see how this all got started

Spark Devices



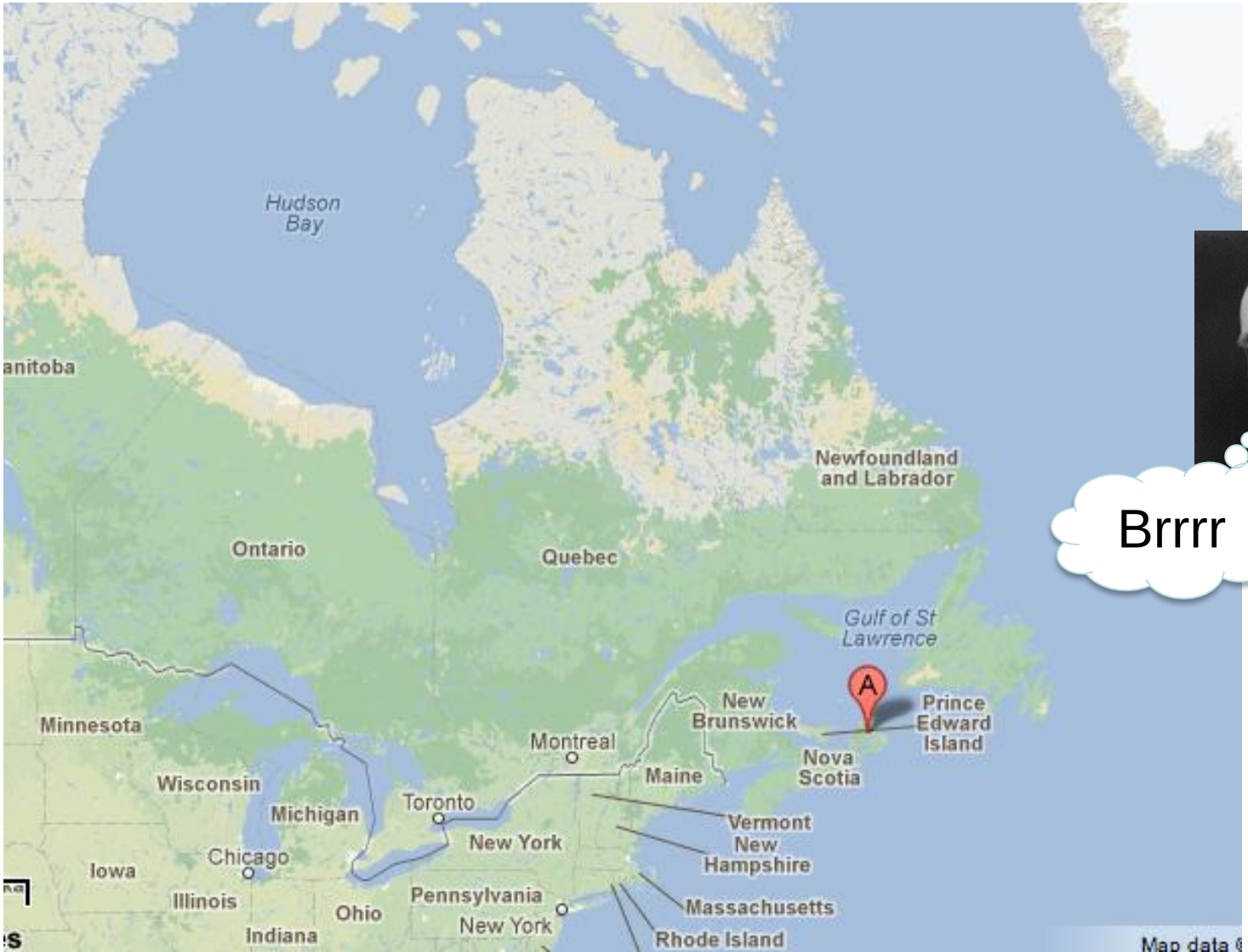
Bandwidth?

Spark Transmitters no longer authorized…UWB?



First Transatlantic Transmissions

Cape Breton Isle, Nova Scotia. Dec 17, 1902

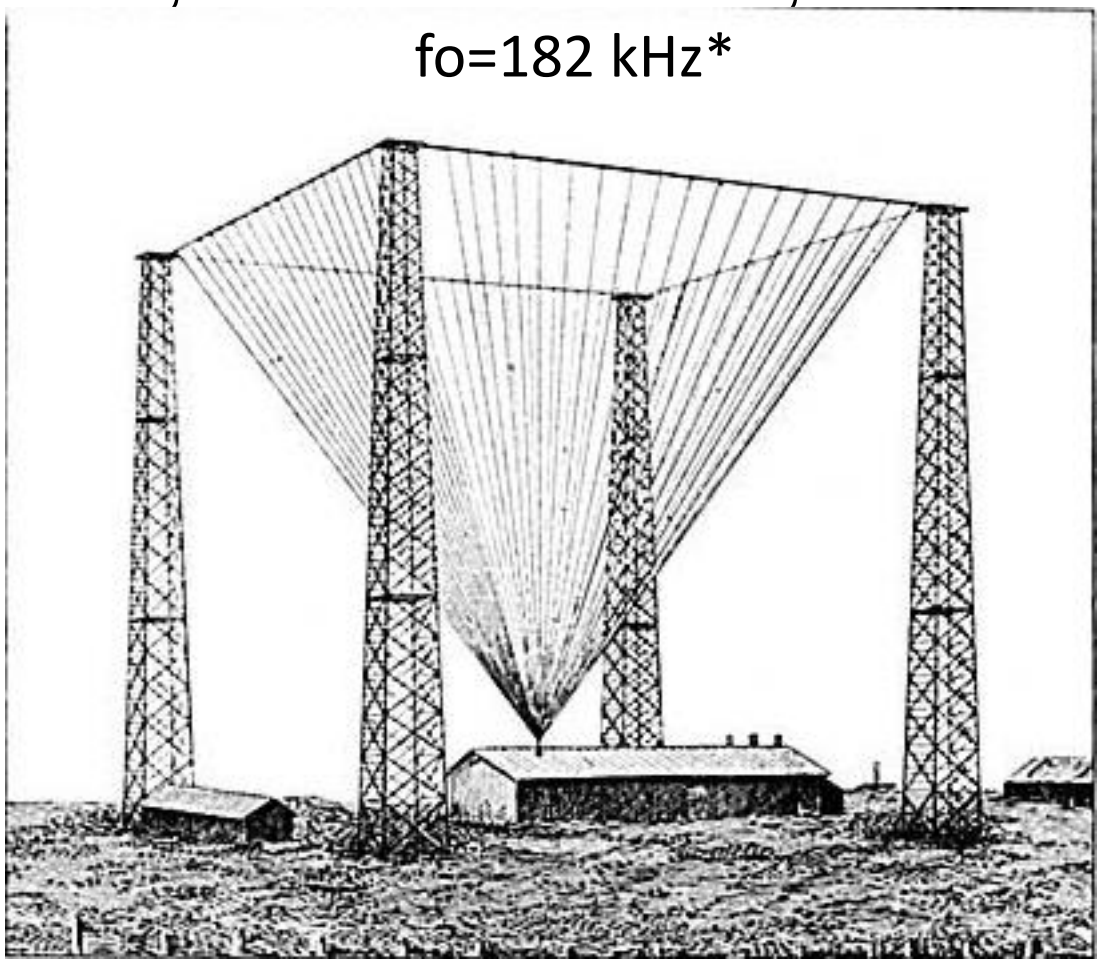


First Transatlantic Transmissions

Cape Breton Is, Nova Scotia. Dec 17, 1902

fo=182 kHz*

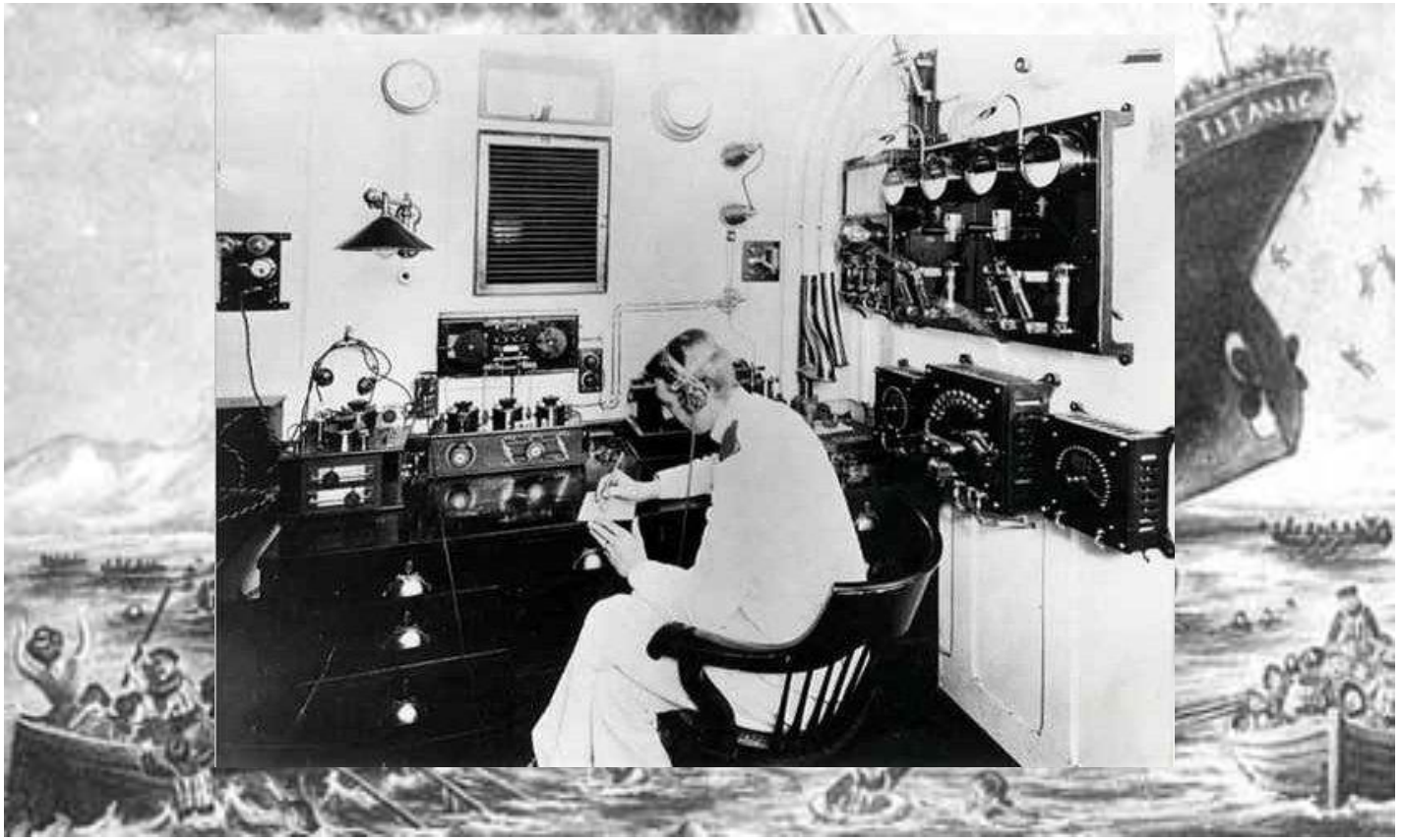
~61 m



*λ=1650 m

not real efficient, but it did radiate fields

Wireless in Maritime History

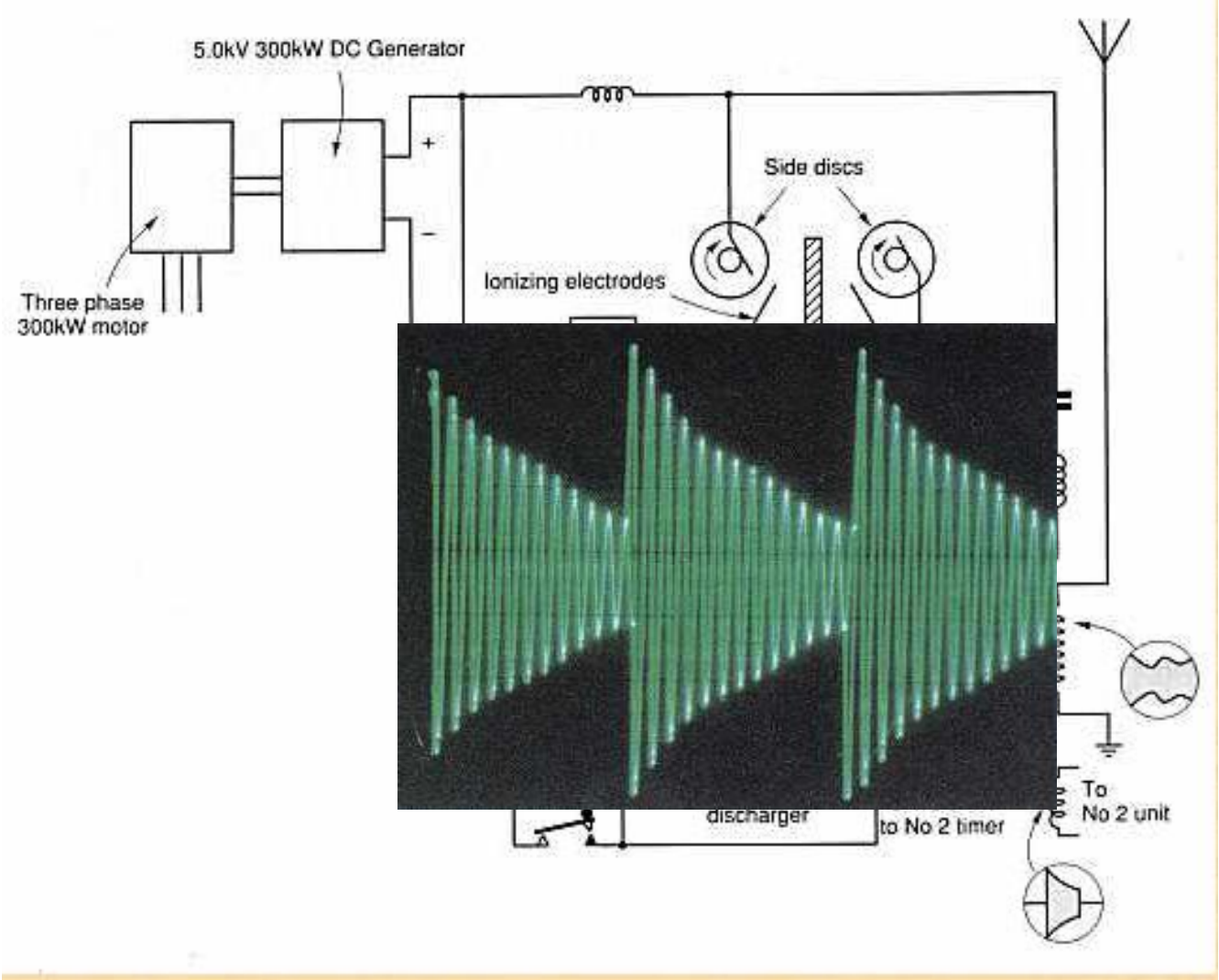


April 15, 1912: 1-45 a.m.

Last signals heard from Titanic by Carpathia: "Come as quickly as possible old man: the engine-room is filling up to the boilers"

Marconi's Most Power Transmitter

200 kW Caernarvon Transmitter (1921)



Early Adopters: Broadcast and Hams

FCC, IC and EU Regulations

One Hundred Years On

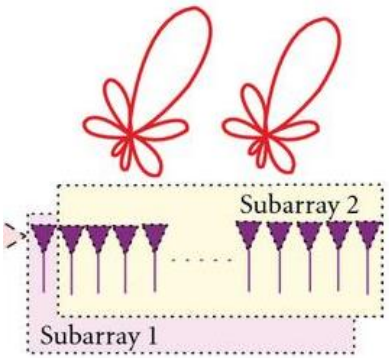
Wireless Evolution

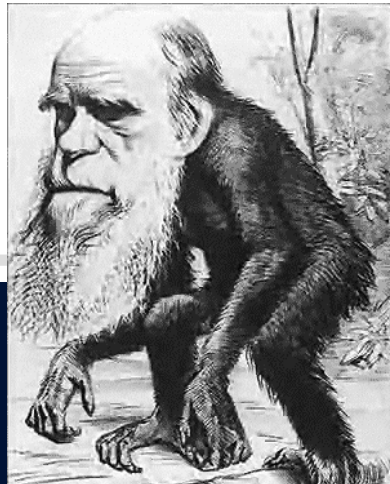
- Cellular/GSM
- BPL: Broadband over Power Line
- RFID: Radio Frequency Identification
- UWB: Ultrawideband
- WiFi
  - 802.11n: MIMO
- UNII: (Dynamic Frequency Selection)
- WiMax
- 3G, 4G, LTE
- SDR: Software Defined Radio

802.11 Evolution

802.11 protocol	Release[6]	Freq. (GHz)	Bandwidth (MHz)	Data rate per stream (Mbit/s)[7]	Allowable MIMO streams	Modulation
—	Jun 1997	2.4	20	1, 2	1	DSSS, FHSS
a	Sep 1999	5 3.7[A]	20	6, 9, 12, 18, 24, 36, 48, 54	1	OFDM
b	Sep 1999	2.4	20	1, 2, 5.5, 11	1	DSSS
g	Jun 2003	2.4	20	6, 9, 12, 18, 24, 36, 48, 54	1	OFDM, DSSS
n	Oct 2009	2.4/5	20	7.2, 14.4, 21.7, 28.9, 43.3, 57.8, 65, 72.2[B]	4	OFDM
			40	15, 30, 45, 60, 90, 120, 135, 150[B]		
ac (DRAFT)	Dec 2012	5	20	up to 87.6[9]	8	
			40	up to 200[9]		
			80	up to 433.3[9]		
			160	up to 866.7[9]		
ad	~Feb 2014	2.4/5/60		up to 7000		

- MIMO Issues
- “Smart” Antennas
- Phase Arrays





FCC, IC and EU Regulations

MIMO Issues: Rev to KDB 662911 D01

Concerns about SAR & OFDM Signals “peaking”

FCC limits apply to total emissions across all outputs

Directional gain = individual antenna gain + array gain

For mutually uncorrelated signals (e.g., pure spatial multiplexing):

Array gain = 0 dB

For correlated signals (e.g., beamforming, cyclic delay diversity [CDD], or combination of correlated and uncorrelated):

Array gain = 10 log(NANT) dB, where NANT = number of transmit antennas.

Big-A** Phased Array

- 1.2 MW Over the Horizon Radar

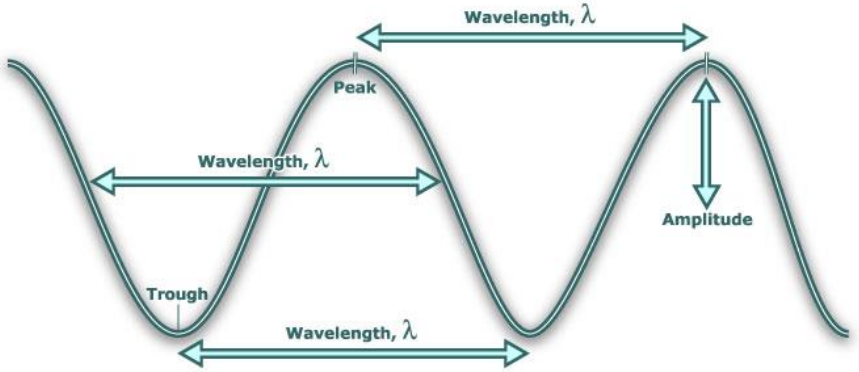
Agenda

Overview

- Background: EMC
- Definitions
- Regulatory Overview
- Technical Requirements
- Measurements
- Compliance

Definitions

Wavelength: distance between same points of amplitude and phase on a sine wave



$\lambda m = c/f$

c = speed of light = 3X10E8 m/s

f = frequency in hertz

for Frequency in MHz (10E6):

$\lambda m = 3*E8/3*10E6 = 300/fMHz$

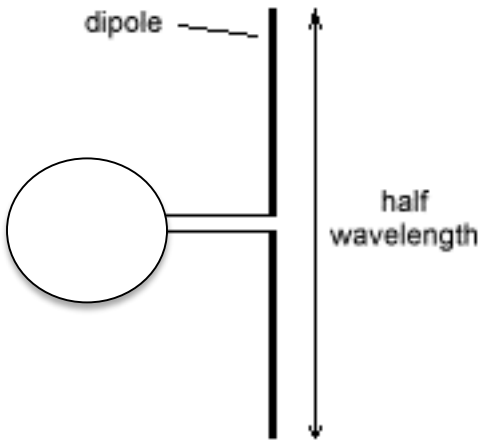
$$\lambda m = 300/fMHz$$

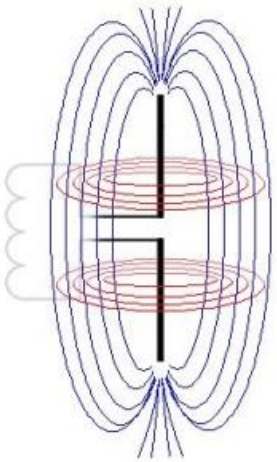
Definitions

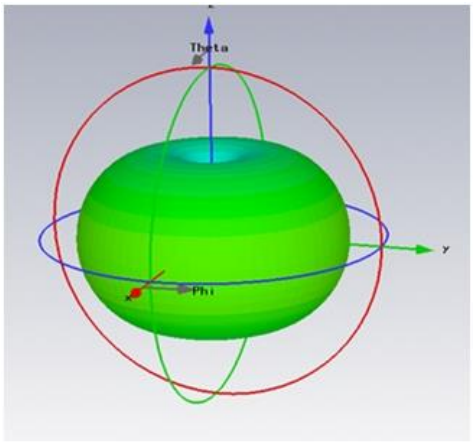
Resonance

Tendency of a system to oscillate at some frequency(ies)

Resonance (and efficient radiation) occurs when a conductor reaches ½ wavelength in dimension







Gain Pattern of ½ dipole

Definitions

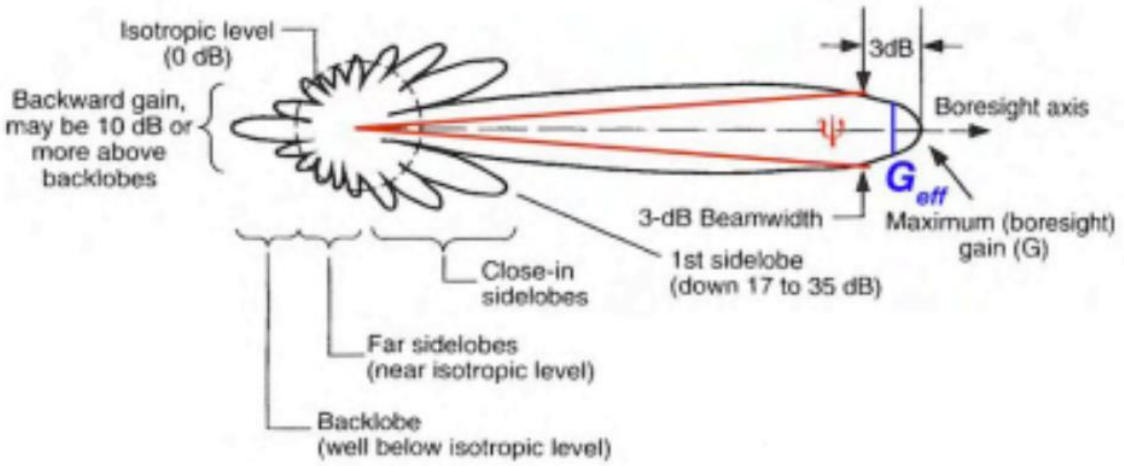
Gain

Ability of an antenna to direct power, at a certain efficiency, into a given direction

Effective gain (Tx or Rx):

$$G_{eff} = \frac{4\pi A_{eff}}{\lambda^2}$$

A*eff* is the effective aperture m^2

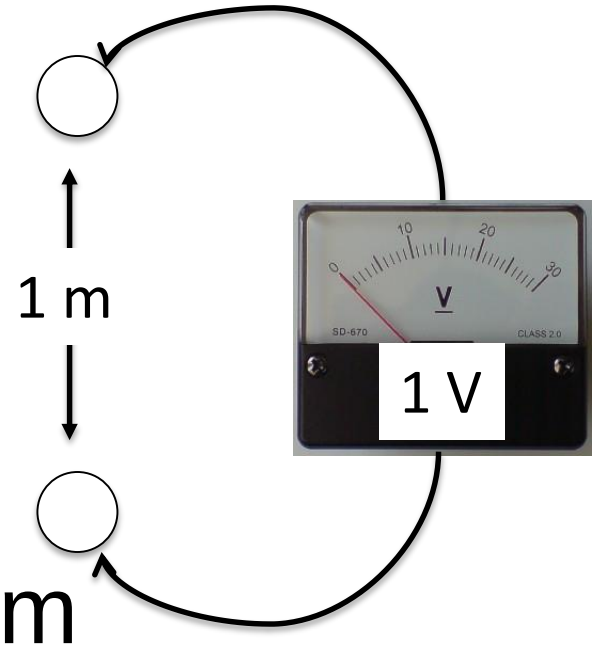


Definitions

Electric Field is the voltage across two points in space 1 meter apart

Volt-per-meter (N/C)*

$$\vec{E} = \vec{F}/q$$



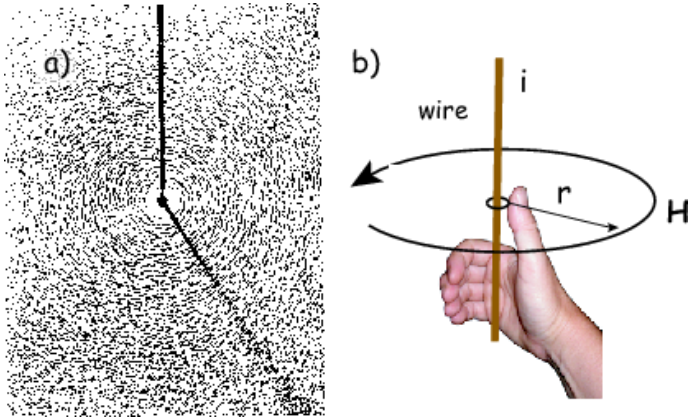
Common expressions:

V/m, mV/m, uV/m, dBuV/m

*a true Force Field

Definitions

Magnetic Field is the result of the movement of electric charge



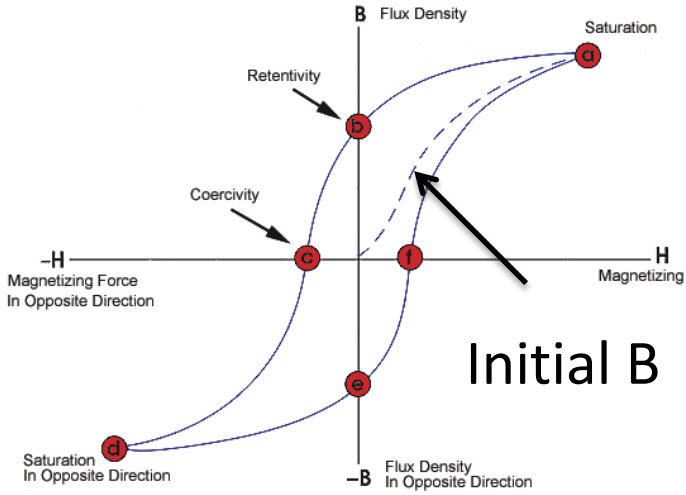
Ampere's Law:

H = I/2πr amperes/meter

- Right Hand Rule (Vector)

Flux density: B = μH

- μ = permeability of material
- Hysteresis curve
  - What does air look like?



Definitions

Magnetic Field Units

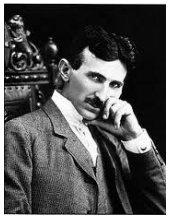
Amperes-per-meter (A/m)

Tesla (flux density)

Gauss (1T = 10,000G)

Webers (1 Wm^2 = 1 T)

Ørsted (CGS system)



Wilhelm Weber
(1804-1891)

Definitions

Time-Varying Fields

$$\nabla \cdot \boldsymbol{B} = 0, \quad \nabla \times \boldsymbol{E} = -\frac{\partial \boldsymbol{B}}{\partial t}$$

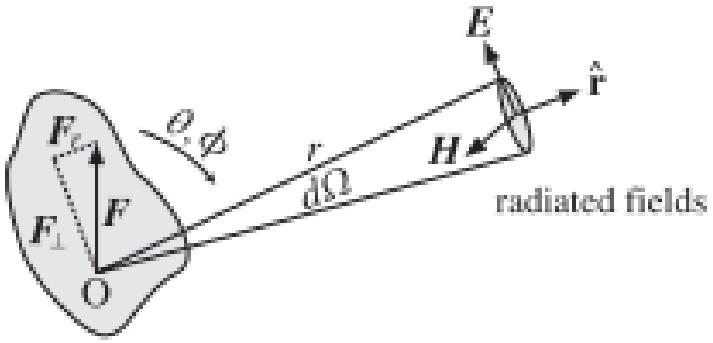
JC

Mike

E and H are inter-related

Movement of electric charge induces B

Rate of change of B-field raises E



Definitions

Accurate Measurements: Near & Far Field

Normal test ranges (3, 10 m) may not offer far-field conditions at low frequencies

Near field E-field is particularly messy (3 “r”s)

$$E_\theta = \frac{I*l*\beta^3}{4*\pi*\omega*\varepsilon_0}\left[\frac{j*1}{\beta*r}+\frac{1}{(\beta*r)^2}+\frac{-j}{(\beta*r)^3}\right]*\sin(\theta)*e^{-j*\beta*r}\ \text{V/m}, \quad (1)$$

Magnetic field, not pretty, but “better-behaved”

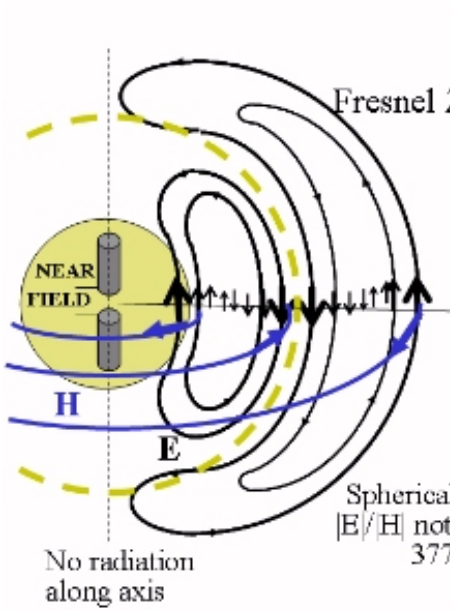
$$H\phi = \frac{I*l*\beta^2}{4*\pi}\left[\frac{-1}{j*\beta*r}+\frac{1}{(\beta*r)^2}\right]*\sin(\theta)*e^{-j*\beta*r}\ \text{A/m}, \quad (2)$$

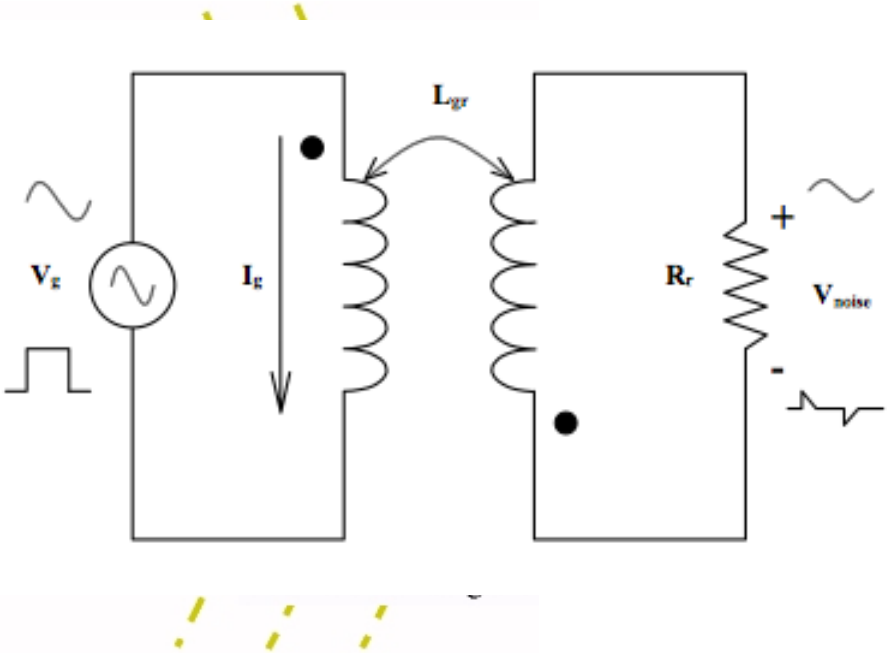
30 MHz, loop antennas used for compliance

Definitions

Near & Far Field

Z = Impedance of EM Wave: 3 regions





For Near E-fields, Z > 120π

For Near H-field, Z < 120π

For Plane-Wave, Z =120π

Why do we use E-Field Antennas in (most) Compliance Testing?

Interference Source

RFID Inventory Control Pedestal

13.56 MHz Source

Magnetic Field

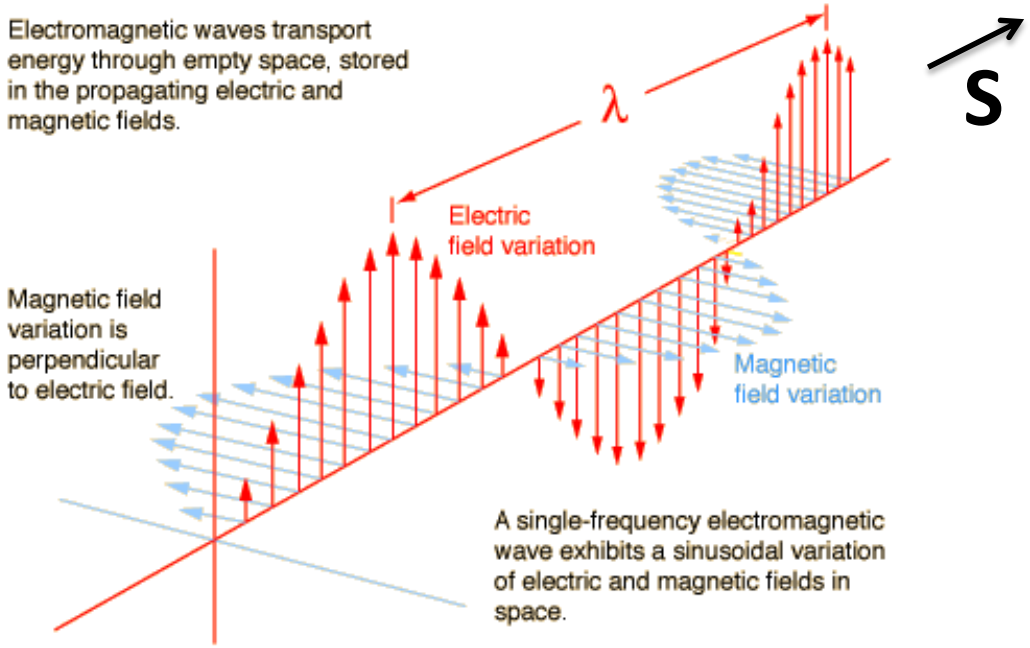
System located ~3 m outside South wall of ER

Effect would NOT have been assessed during EMC Testing of the XRAY

Nor did I notice the 13.56 MHz RFID signal because I was using E-Field Survey Antennas

Definitions

Far Field E = Z*H = 120πH = 377H



Poynting Vector: **S = E X H** W/m^2

- In the direction of propagation
- What do we have here?

$$E_\theta = \frac{I*l*\beta^3}{4*\pi*\omega*\varepsilon_0}\left[\frac{-j*1}{\beta*r}+\frac{1}{(\beta*r)^2}+\frac{-j}{(\beta*r)^3}\right]*\sin(\theta)*e^{-j*\beta*r}\ \text{V/m}\ ,$$

Definitions

Power Quantities

$$P = VI$$

- RMS
- Average
- Peak
- Maximum

Various power units/methods are referenced

Measurements are tricky with complex modulations

Definitions

Power Measurements

- Thermistor
- Thermocouple
- Diode

All methods tend to give same result for CW

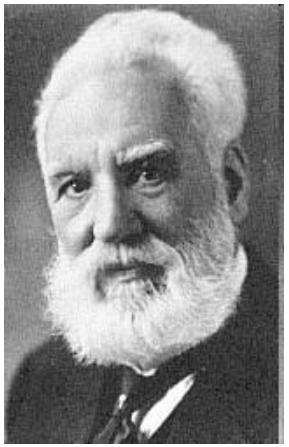
Thermistor and Thermocouple methods too slow for "peaky" signals (OFDM)

Diode methods require many samples

Definitions

dB: deciBel (one-tenth of a BEL):

Logarithmic ratio that compresses large amplitude variations into easily-managed numbers (converts multiples and quotients into addition and subtraction)



Power Ratio: 10 Log (P2/P1)

Voltage Ratio: 20 Log (V2/V1) *why 20*?

P1, V1 are *reference units*

Watts, mW, uW

Volts, mV, uV

dB Compression

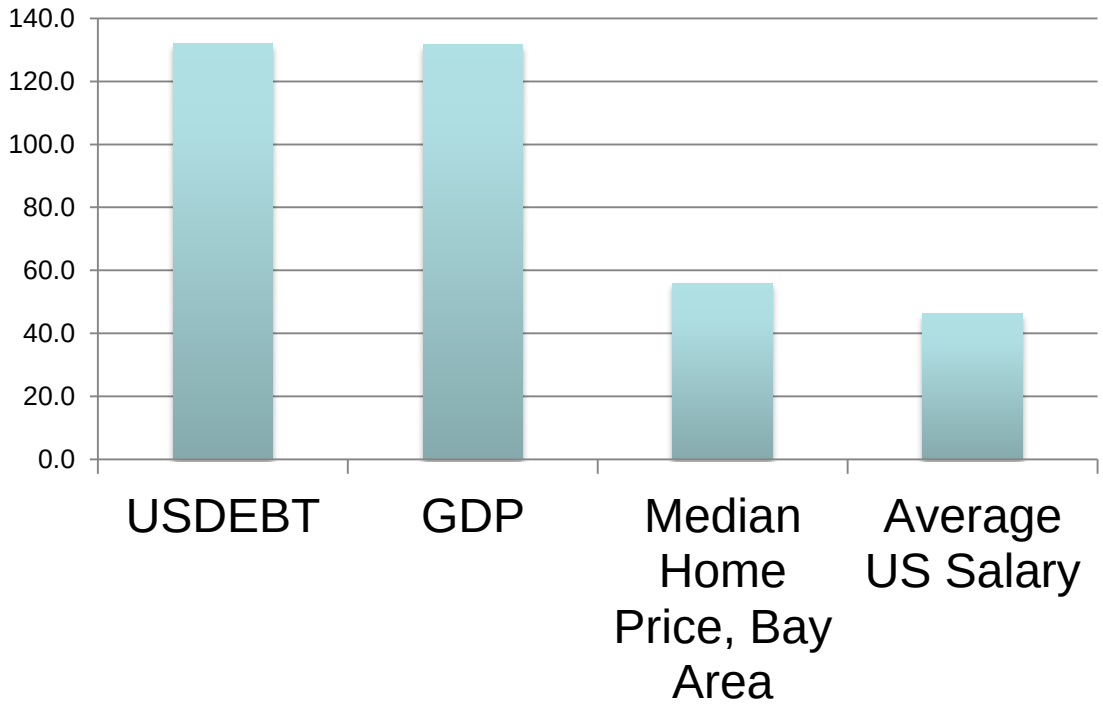
National Debt: $16T = $16E12

Debt, dB$ = 10 Log (16E12) =

132dB$

dB Compression

dB$



dB Compression-electrical units

Microvolts 10E-6

uV	dBuV	Phenomenon
1.00	0	Radio Receiver Sensitivities
10.00	20	
100.00	40	
1,000.00	60	Physiological potentials
10,000.00	80	Analog
100,000.00	100	
1,000,000.00	120	Digital logic circuits
10,000,000.00	140	
100,000,000.00	160	AC power

We use dB a LOT

Agenda

Overview

- Background: EMC
- Definitions
- Regulatory Overview
- Technical Requirements
- Measurements
- Compliance

FCC Authorizations

FCC has authority over radio spectrum since 1934 “to make available…a rapid, efficient, nationwide, and worldwide wire and radio communication service…for the purpose of the national defense…”

Federal Communications Commission

- Responsible for integrity of the airwaves
- Use of spectrum
- Licensing and operation of RF systems
- Certification
- Database of thousands of products:
  - Frequency
  - Power
  - Limitations on Use
  - Responsible Party
- RF Safety

Federal Communications Commission

- Rules evolve over time
- Regulations have expanded with technology

FCC Equipment Authorizations

- Verification: least-interfering equipment
  - Class A Digital Devices
  - Radio receivers
- Declaration of Conformity (DOC)
  - Class B Digital Devices (computers & peripherals)
- Certification
  - Intentional Transmitters (unlicensed and licensed)

IC Authorization

- Industry Canada has overview Authority on Spectrum
  - Similar technical limits and rules
  - “Verification” for digital devices
  - Certification for radio transmitters

Wireless Explosion

FCC Certifications in 2000: 4,011 devices

FCC (+TCB) Certifications in 2012: 15,000 devices

Power levels from mW to hundreds of watts

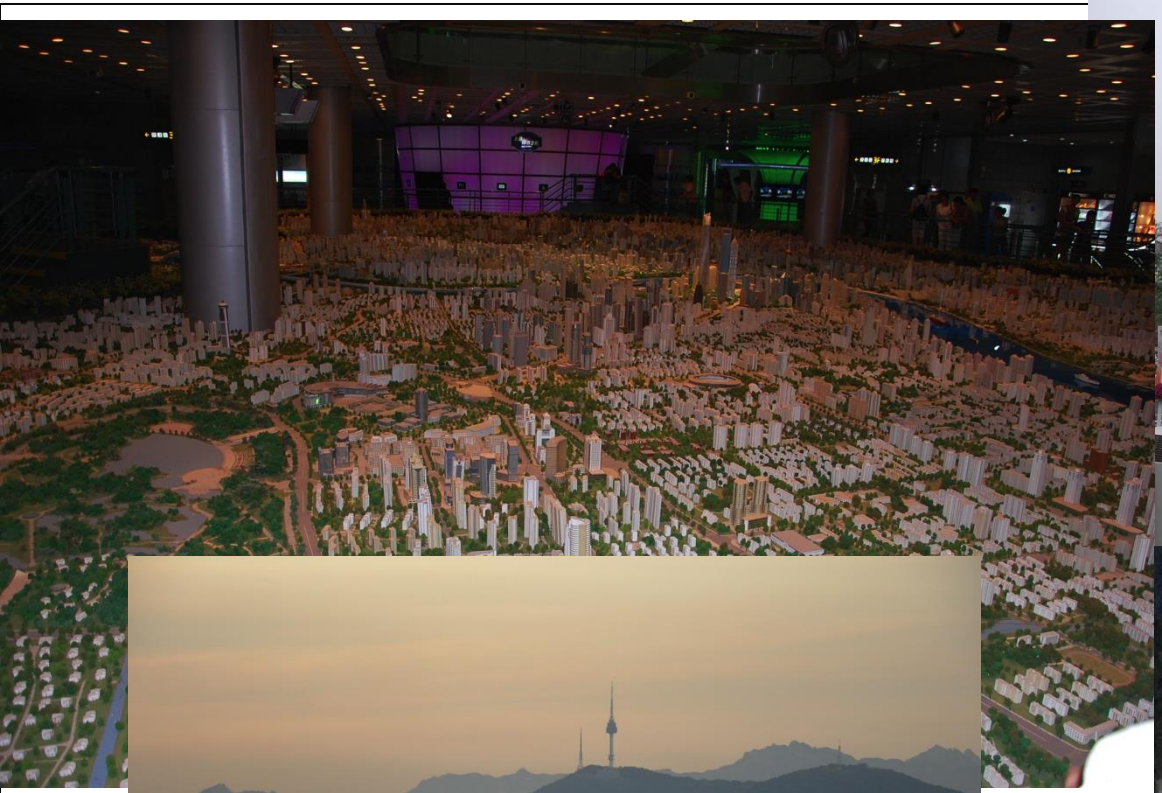
Unlicensed low power proliferating

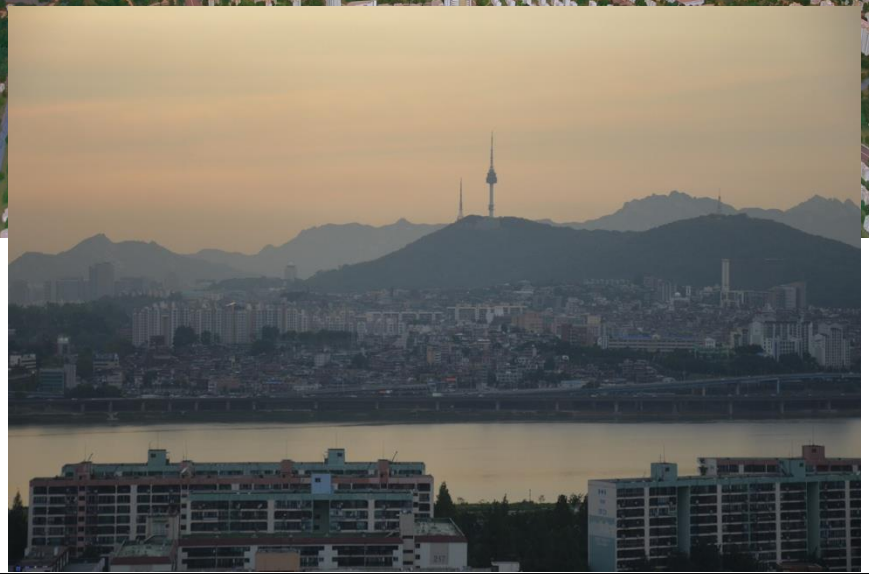
Broadband technologies expanding

Frequency Allocations expanding

Wireless Explosion

The Effect of Asia





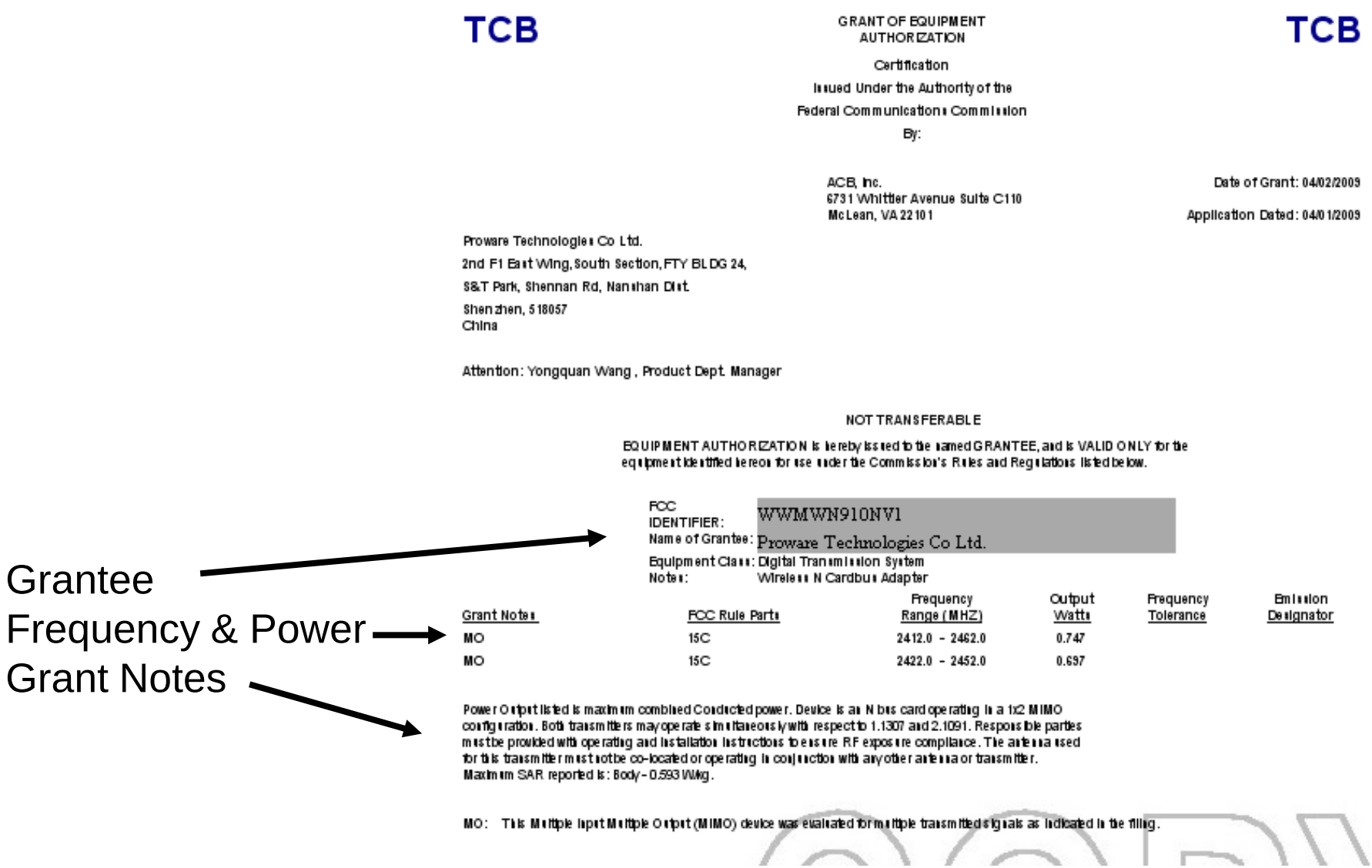
Wireless Explosion

TCB (US) Program initiated in 2000

FCB (Canada) Program shortly after

95%+ of Certifications performed by private sector

Grant of Equipment Authorization



TCB

GRANT OF EQUIPMENT AUTHORIZATION

Certification

Issued Under the Authority of the

Federal Communications Commission

By:

TCB

ACB, Inc.
6731 Whittier Avenue Suite C110
McLean, VA 22101

Date of Grant: 04/02/2009

Application Dated: 04/01/2009

Proware Technologies Co Ltd.
2nd Fl East Wing, South Section, FTY BLDG 24,
S&T Park, Shennan Rd, Nanshan Dist.
Shenzhen, 518057
China

Attention: Yongquan Wang , Product Dept. Manager

NOT TRANSFERABLE

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

FCC IDENTIFIER: WWMWN910NV1
Name of Grantee: Proware Technologies Co Ltd.
Equipment Class: Digital Transmission System
Notes: Wireless N Cardbus Adapter

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
MO	15C	2412.0 - 2462.0	0.747		
MO	15C	2422.0 - 2452.0	0.697		

Power Output listed is maximum combined Conducted power. Device is an N bus card operating in a 1x2 MIMO configuration. Both transmitters may operate simultaneously with respect to 1.1307 and 2.1091. Responsible parties must be provided with operating and installation instructions to ensure RF exposure compliance. The antenna used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. Maximum SAR reported is: Body - 0.593 W/kg.

MO: This Multiple Input Multiple Output (MIMO) device was evaluated for multiple transmitted signals as indicated in the filing.

Grantee

Frequency & Power

Grant Notes

Grant of Equipment Authorization

TCB

GRANT OF EQUIPMENT AUTHORIZATION

Certification

Issued Under the Authority of the

Federal Communications Commission

By:

TCB

ACB, Inc.
6731 Whittier Avenue Suite C110
McLean, VA 22101

Date of Grant: 06/07/2012

Application Dated: 06/05/2012

LG Electronics USA
1000 Sylvan Avenue
Englewood Cliffs, NJ 07632

Attention: Jacob Cho , Director, Standards & Compliance

NOT TRANSFERABLE

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

FCC IDENTIFIER: BEJIPS277LY
Name of Grantee: LG Electronics USA
Equipment Class: Part 15 Class B Computing Device Peripheral
Notes: Part15 Subpart B-LCD Monitor

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
20	15B	-			

Maximum Resolution: 1920x1080 @60Hz

20: All electrical and mechanical devices employed for spurious radiation suppression, including any modifications made during certification testing, must be incorporated in each unit marketed.

Grantee
Rule Part
Grant Notes

FCC ID Provides Device Details

FCC ID: AAAnnnnnnnnnnnn

AAA: is Grantee Code from FCC. Identifies the responsible party (Grantee)

nnnnnnnnnnnnn: is from Manufacturer

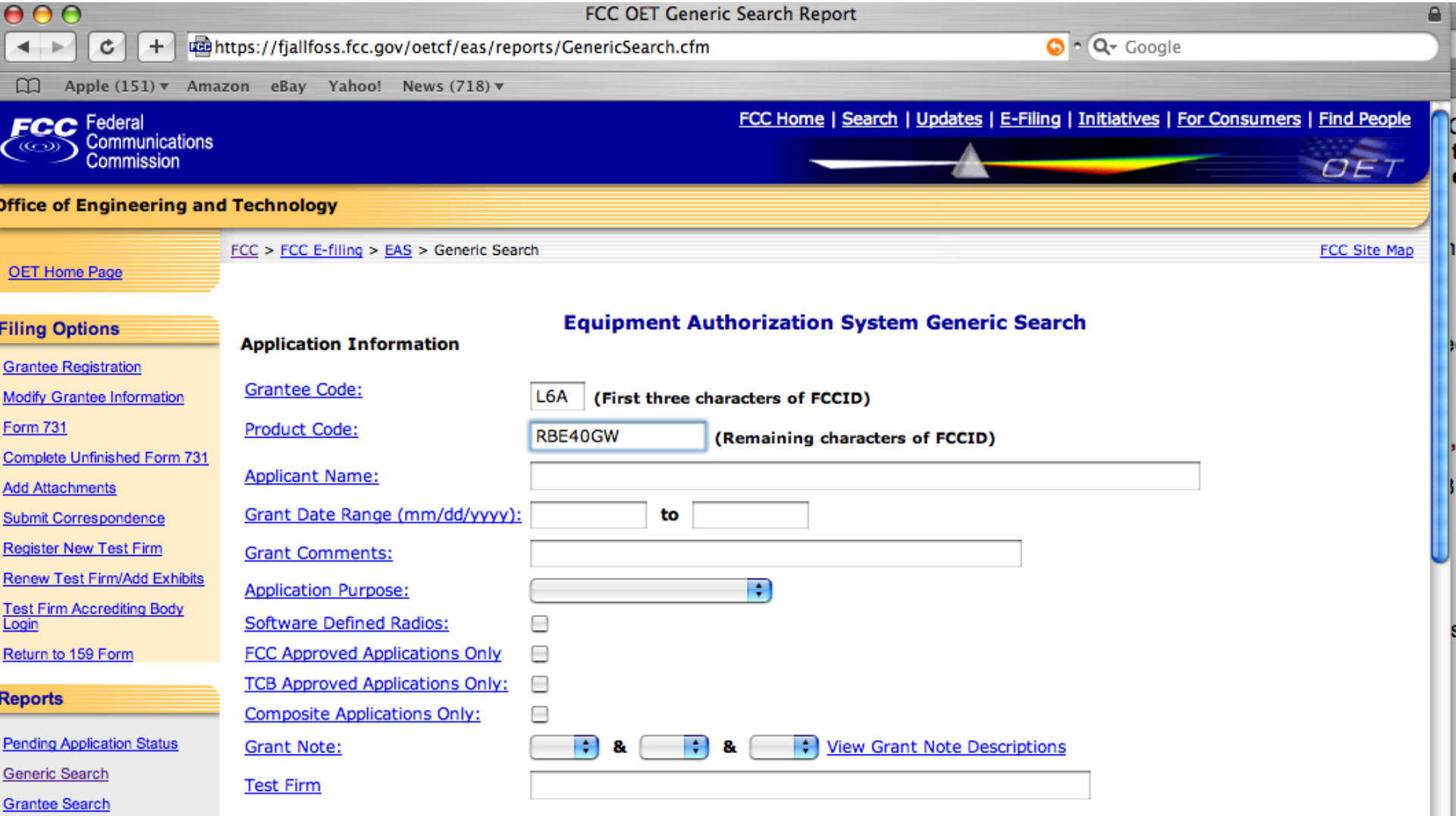
Look up information on transmitter on FCC Web Site

MORE CODES COMING

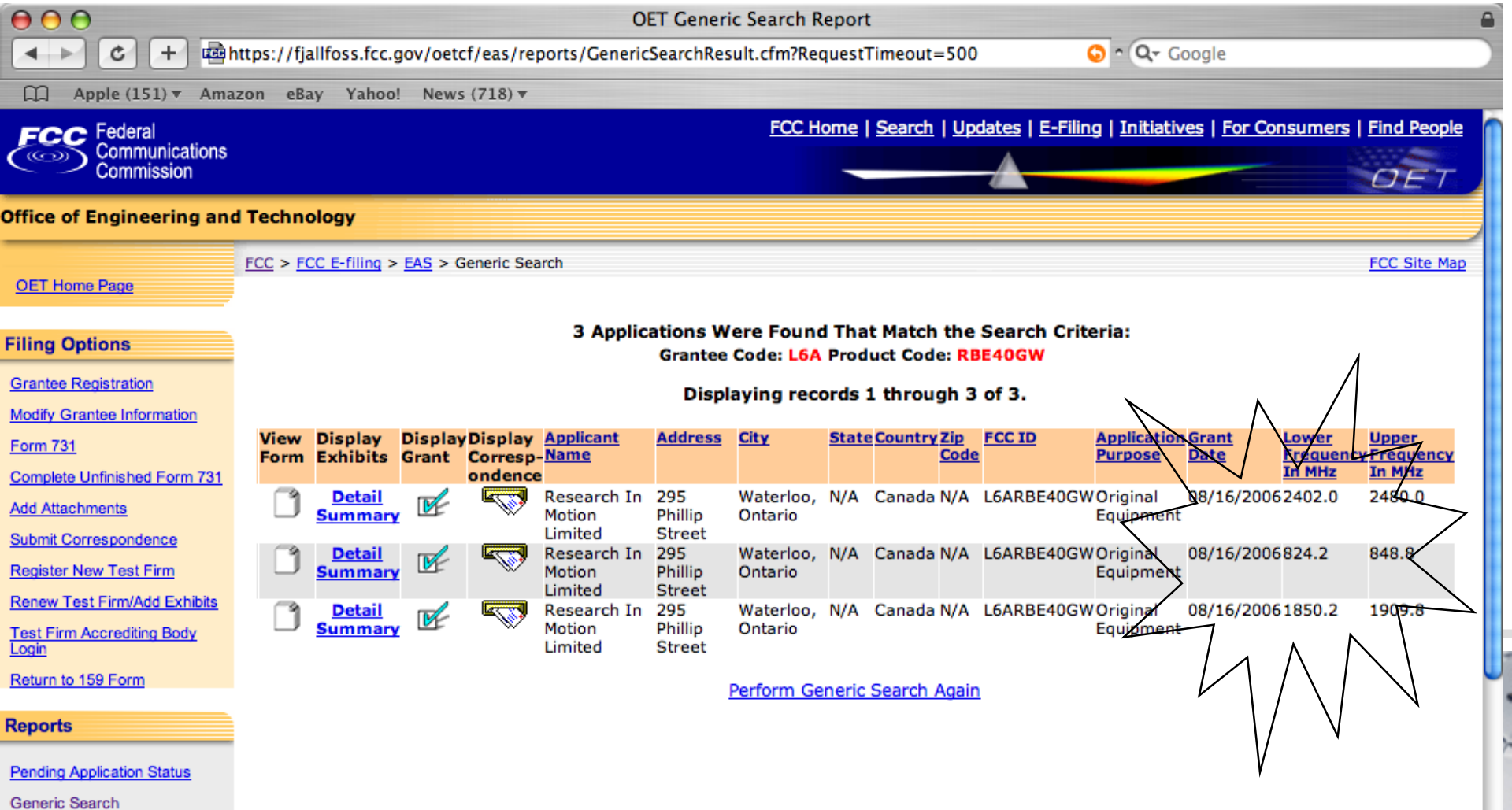
https://fjallfoss.fcc.gov/oetcf/eas/reports/GenericSearch.cfm

Example Look-up

https://fjallfoss.fcc.gov/oetcf/eas/reports/GenericSearch.cfm



Multiple Transmitter Devices
Bluetooth, Cellular & PCS



FCC CFR 47 Regulations

http://www.gpoaccess.gov/ecfr/

Part 2 General Requirements

Part 5 Experimental Radio Service

Part 15 Subpart C, D, and E Unlicensed Low Power Transmitters

Part 20 Common Carrier

Part 21 Domestic Public Service

Part 22 Public Mobile Service

Part 24 Licensed PCS

FCC CFR 47 Regulations

Part 25 Satellite Communication Services

Part 26 General Wireless services

Part 27 Miscellaneous Wireless Services

Part 68 Telecom Services

Part 73 Education Services

Part 74 Television Broadcast

Part 80 Maritime Service

FCC CFR 47 Regulations

Part 87 Aviation

Part 90 Private Land Mobile

Part 95 Personal Radio Service

Part 97 Amateur Radio

Part 100 Digital Satellite Broadcast (Eliminated and now requirements are in Part 25)

Part 101 Fixed Microwave

KDB

FCC's Knowledge Database system

- Most topics have some sort of guidance or KDB written about them https://apps.fcc.gov/oetcf/kdb/index.cfm
- IC accepts guidance from most of these KDBs
- KDB system is used to ask the FCC about any non-standard test methods

Permit But Ask (PBA)

PBA: Typically “New Technologies”

If your device is on the PBA list

- If guidance is clear, such as confidentiality of a photo or user manual, then TCB can guide
- If the PBA is due to test procedures, you will typically need to contact the FCC through the KDB system to resolve all testing issues before testing begins
- Submit your KDB communication with the FCC, to the TCB at the time of Certification

Permit But Ask (PBA)

Customer Request:

LTE cat4

VoLTE

HSDPA Cat24

WLN 802.11ac

Hotspot power back off version 2011

VoLTE / WIFI voice

3GPP release 9

European Wireless Regulations: R&TTE Directive

R&TTED Scope

- Radio Equipment
  - Transmitters
  - Transceivers
  - Some receivers
    - Broadcast receivers (sound/video) excluded
- Telecommunication Terminal Equipment
  - (Not covered by this presentation)

European Wireless Regulations: R&TTE Directive

Declaration of Conformity (DoC)

NOT Certification

Self-Declaration

Good news: Manufacturer has all responsibility

Bad news: Manufacturer has all responsibility

Putting the device on the market or into service

European Wireless Regulations: R&TTE Directive

- Essential Requirements
  - Health, Safety, EMC, Radio
    - In some cases, interoperability

- R&TTE Directive does not give test limits
  - Standards by ETSI or CENELEC
    - Standards may be used to demonstrate compliance with essential requirements
  - Frequency allocation tables (National) may limit power limits and/or usage

European Wireless Regulations: R&TTE Directive

Radio Spectrum (Tx/Rx/TRx)

- construction to effectively use spectrum
- operate within allocated spectrum to avoid interference with other users

Network Interoperability (TTE)

- operates on network
- does not harm/degrade network
- allows access to emergency services
- privacy of personal data

European Wireless Regulations: R&TTE Directive

EMC Directive

The product does not interfere
The product will operate when subjected to interference (Immunity)

European Wireless Regulations: R&TTE Directive

Safety: LOW VOLTAGE DIRECTIVE

Adequate protection for persons, domestic animals and property
Protection against hazards caused by external influences
RF exposure safety
Acoustic safety

European Wireless Regulations: R&TTE Directive

Harmonised Frequencies

Class 1 Equipment:
A frequency band that every country (in EU) has agreed to use for a specific operation.

Limitations on:

- Power
- Bandwidth
- Type of operation

European Wireless Regulations: R&TTE Directive

Non-Harmonized Frequencies

Class 2 Equipment:

Country Notifications may be required
Notified Body, Alert symbol on product

European Wireless Regulations: R&TTE Directive

19	40.660-40.700 MHz	Non Specific Short Range Devices
20	433.05-434.79 MHz	Non Specific Short Range Devices
21	2400-2483.5 MHz	Non Specific Short Range Devices
*)22	2400-2454 MHz	Wideband Data Transmission Systems incl RLANs
24	13.553-13.567 MHz	Inductive applications
25	26.995 MHz, 27.045 MHz, 27.145 MHz, 27.195 MHz	Non Specific Short Range Devices
26	2446-2454 MHz	Movement Detection
27	24.15-24.175 GHz	Movement Detection
28	868.0-868.6 MHz	Non-Specific Short Range Device
29	868.7-869.2 MHz	Non-Specific Short Range Device
30	869.4-869.65 MHz	Non-Specific Short Range Device
31	869.7-870 MHz	Non-Specific Short Range Device

Frequency Bands

ERC Report 25, frequency allocation table
All frequency bands in Europe
www. cept.org/ecc

EFIS, frequency information system
Search for specific band and information
http://www.efis.dk/

REC 70-03
Short range devices
www. cept.org/ecc

European Wireless Regulations: R&TTE Directive

Test Standards

ETSI/EN for Spectrum
EN for EMC
EN for Safety

European Wireless Regulations: R&TTE Directive

Notified Body Opinion

When non-Harmonized standards are applied
When non-Harmonized frequencies are used
When Market asks for it….

Notified Body Statement of Opinion

The TCF listed below has been evaluated to the requirements of the European R&TTE Directive 1999/5/EC

Applicant name:	Manufacturer
EUT:	GSM/GPRS Dual bands mobile phone
Model:	Phone 5000
Frequency bands:	880 MHz to 915 MHz 1710 MHz to 1785 MHz
TCF Number:	TCF
ACB Project Number:	ATCBNNNNNN

ACB is designated as a Notified Body under the U.S.-EU Mutual Recognition Agreement

ACB, Inc.
Notified Body Number 1588
6731 Whittier Avenue, Suite C110
McLean, VA 22101, USA

In the opinion of ACB the examination of the technical construction file presented demonstrates the requirements of Directive 1999/5/EC have been met. The product listed above and in Annex 1 of this document, is in conformity with Annex IV and the essential requirements of Articles 3.1a, 3.1b and 3.2 of Directive 1999/5/EC. This statement of opinion relates only to the documents provided to ACB. A list of documentation forming the basis for the examination is provided in Annex 2 of this document.

Notified Body: Michael Violette, P.E.

22 February, 2012
Date

The device under evaluation was a Mobile Phone.
It used GSM with GPRS technology in the E-GSM 900 MHz and GSM 1800 MHz bands.
It also had an FM Radio Receiver in the 88 MHz to 108 MHz band.

Use of this device is only considered acceptable and harmonized (Class 1) if the device complies with the network control requirements of EU sub-class 9.

Details of operation:

Description of service:	GSM 900 MHz
Transmit Frequency:	880 MHz to 915 MHz
Receive Frequency:	925 MHz to 960 MHz
Modulation type:	GMSK
Power Class	Class 4
Transmit power:	GSM: 32.8 dBm, Conducted

Description of service:	GSM 1800 MHz
Transmit Frequency:	1710 MHz to 1785 MHz
Receive Frequency:	1805 MHz to 1880 MHz
Modulation type:	GMSK
Power Class	Class 1
Transmit power:	GSM: 30.7 dBm, Conducted

1	Test Report:	Report number:	Dated:
	EMC	2012TAE028	16 February 2012
	EMC	E1102WT8888-0198-02-Y	4 March 2011
	EMC (travel charger)	SZ11010143E01	16 February 2011
	Radio (GSM)	2012FTA043R	17 February 2012
	RF Safety	2012SAR00015	16 February 2012
	Electrical Safety	2012SAF0025	16 February 2012
	Acoustic Safety	2012TAR090	16 February 2012

2	Technical Documentation provided:		
	Antenna Details	Assembly Drawing	Block Diagram
	Schematic/Circuit Diagram	External Photographs	Internal Photographs
	Label Drawing	Parts List / Bill of Material	PCB layout
	Technical Description	Test Reports	Test Photographs
	User Manual	Operational Description	Declaration of Conformity

3	Conformity documentation:	Signed and Dated:
	Declaration of Conformity	Yes

4	Standards used to show conformity to 1999/5/EC:		
	Radio Spectrum :	EN 301 511 V9.0.2	
	EMC :	EN 301 489-1 V1.8.1	EN 301 489-7 V1.3.1
		EN 301 489-34 V1.1.1	
	RF Safety:	EN 50360: 2001	
		EN 62209-1: 2006	EN 62209-2: 2010
	Acoustic Safety	EN 50332-1: 2000	EN 50332-2: 2003
	Electrical Safety:	EN 60950-1: 2006/ A11: 2009	

5	Standard used in Non-R&TTE test reports included in the TCF:		
		EN 55020: 2007	EN 55013: 2001 + A2: 2006

6	Other Relevant Essential Requirements	
	Art 6.3 Information to user provided:	Yes
	Art 6.4 Alert Symbol required:	No
	Art 12 CE Marking appropriate:	Yes

7. Further information:

This is a Class 1 device, if the device satisfactorily meets the requirements of EU sub-class 9.
The FM Radio Receiver is excluded from the scope of the R&TTE Directive.
The appropriate conformity information, CE Mark and Notified Body number (1588) must be clearly displayed on the equipment label, the user's manual and the packaging.
A statement of compliance with Directive 1999/5/EC or a copy of the Declaration of Conformity must be provided with each device.

8. Contact information:

For contact with ACB or questions regarding this Statement of Opinion:
Web: www.acb.com; e-mail: customerservice@acbcert.com; Tel.: (+1) 703 847 4700

CE 1588

European Wireless Regulations: R&TTE Directive

Use of the CE Marking

Label
User's Manual
Packaging

Use of CE Marking infers that ALL Directives have been met

1. Compliance, R&TTE

Declaration of Conformity (DoC)

- Create the DoC
- Sign and date
  - Authority should be able to contact signatory for compliance issues
- Provide a copy of the DoC (or a statement of compliance and a link to the DoC) with every device
- DoC in each language must be available if requested
  - Minimum requirement is compliance statement, in local language

European Wireless Regulations: R&TTE Directive

Multiple Directives?

Each Directive may have different process

For example

- FM Radio Receiver is EMC Directive, DoC
- Car harness connection is Automotive Directive, not DoC
- Wireless Toys, Toy Safety Directive

European Wireless Regulations: R&TTE Directive

Harmonised Standards

The European Commission releases the “Official Journal”

http://ec.europa.eu/enterprise/rtte/harstand.htm

http://ec.europa.eu/enterprise/policies/european-standards/documents/harmonised-standards-legislation/list-references/

Updated regularly

When a standard is superseded, the device should meet the new version of the standard to stay compliant. There are transition periods.

European Wireless Regulations: R&TTE Directive

No harmonised standards?

- The main reason for not using a harmonised standard is that the technology is new and no standard exists yet
- Work with the Notified Body to decide a test plan or a non-harmonised standard to use
- Perform the tests and get an opinion on the test results

Break!

Agenda

Overview

- Background: EMC
- Definitions
- Regulatory Overview
- Technical Requirements
- Measurements
- Compliance

Technical Requirements

FCC, IC and EU Regulations

Applies to ALL Devices

Unlicensed versus Licensed

Licensed devices are more regulated and are protected

Unlicensed devices are unprotected. Some historical basis in the Industrial Scientific and Medical (ISM) Bands (13.56 MHz, 2.4 GHz, e.g.,)

Unlicensed Examples

WAP

Bluetooth

Cordless phones

Remote control devices (most)

UWB devices

Spread Spectrum

UNII

Unlicensed use is UNPROTECTED

Licensed Devices

Land mobile radio

Cellular telephones (blanket license)

Broadcast transmitters (*Docket 20780 ca 1979)

Business radio applications

Radars

Licensed Use is PROTECTED

General Rules (CFR 47)

Part 2 of the FCC Rules covers general regulations & Filing procedures which apply to all other rule parts

- Technical standards for licensed equipment are found in the various radio service rule parts (e.g. Part 22, Part 24, Part 25, Part 80, and Part 90, etc.)
- Technical standards for unlicensed equipment are found in Part 15
- About 15 different radio service rule Parts which require equipment authorization

General Rules

Rule parts are developed by different groups at the FCC for the purpose of allowing differ types of op atio frequency ban oss the f

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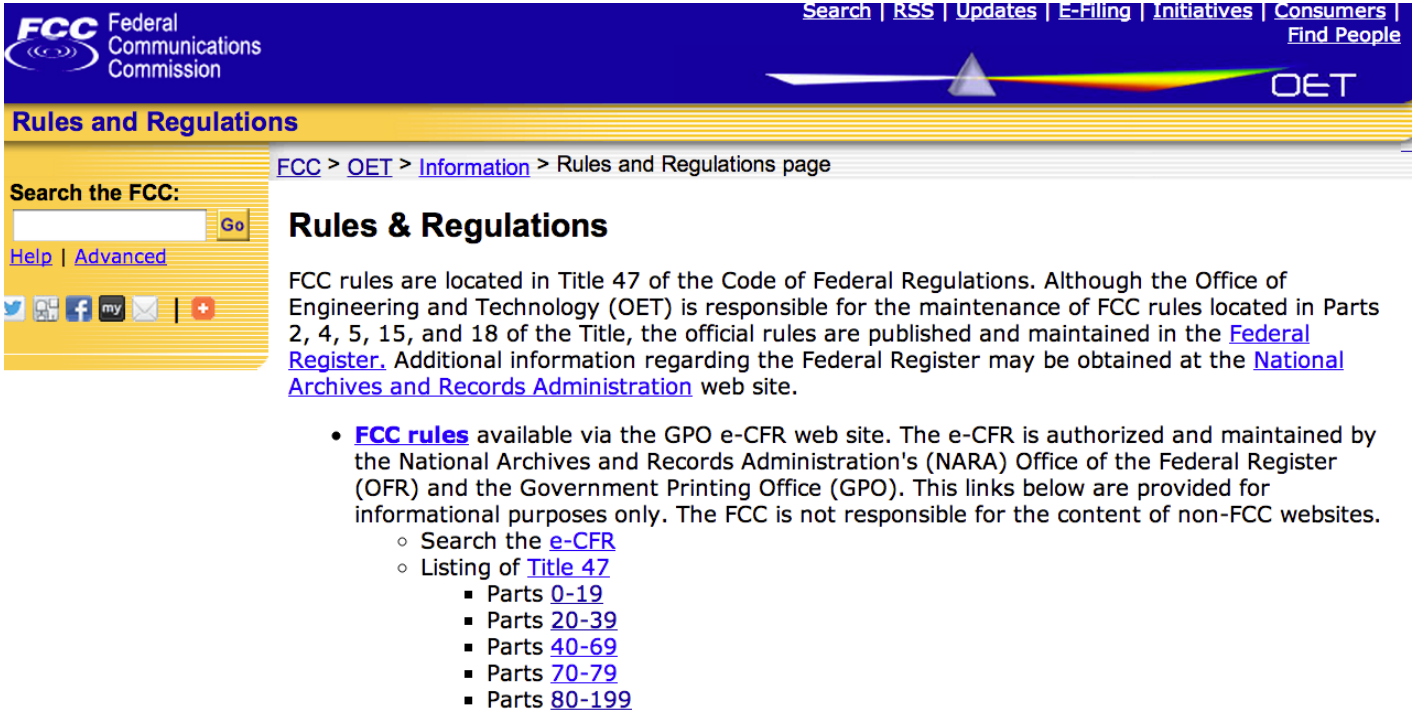
General Rules

Best place to find up-to-date Rules

FCC OET - http://transition.fcc.gov/oet/info/rules/



General Rules

FCC Scopes:

- Unlicensed scopes: A1-A4
- Licensed scopes: B1-B4

Exclusion List (KDB 628591)

- New technology must be approved by the FCC
- Technology where there is no developed test procedure must be approved by the FCC
- Equipment which requires RF exposure evaluation may be approved only if the Exclusion list requirements are met and the TCB has attended the proper training

General Rules

47 CFR Parts 2.1046 - 2.1055

Tests required for all Devices*

- 2.1046 - RF power output
- 2.1047 - Modulation Characteristics
- 2.1049 - Occupied Bandwidth
- 2.1051 - Conducted Spurious Emissions
- 2.1053 - Radiated Spurious Emissions
- 2.1055 - Frequency Stability: Temperature & Voltage

*unless the specific Rule part doesn't call these out

For example, there are no limits for Stability in Part 15

IC Radio Standard Specifications

RSS GEN

RSS 102: RF Exposure

RSS 210: License Free

RSS 220: UWB

Forty Titles in all

http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/h_sf06129.html

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Measurement Standards

ANSI C63.4–2009/2003: “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz”

ANSI C63.10—2009: “Standard for testing Unlicensed Wireless Devices”

TIA-603D: “Land Mobile FM Or PM Communications Equipment Measurement And Performance Standards”

FCC Rules, Regulations and special procedures

DTS, UNII, MMWave, FHSS procedures etc,

- FCC e-mail service for publications and notices. subscribe@info.fcc.gov

(ANSI C63.26: Draft: Licensed Devices)

General Rules

2.1046 to 2.1055 are the basic minimum requirements that apply to ALL Rule Parts

Specifies data required, GENERAL LIMITS found in Specific Rule Part

Example: Part 90 device, Part 2 specifies frequency stability vs voltage and temperature from -30 to +50C
Part 90 specifies limit at 2.5 ppm

2.1046 RF Power Output

Unless specifically stated in rule part, Power always listed in Watts

For units with antenna connector power is always conducted measurement (i.e. removable antenna)

For units with built-in/integral antenna (i.e. non-removable or permanent) power is measured as Effective Radiated Power (ERP) unless otherwise specified

- Example of exception is Part 24 PCS 1900 MHz band where Effective Isotropic Radiated Power is required
- Part 15.231 devices specify Field Strength Limits

2.1046 RF Power Output

Power listed on grant is normally mean power

Exception: SSB and RADAR (peak)

Power listed on grant is generally based on measurement data from the report.

Some rule parts (primarily Part 90) allow manufacturer's rated power, within tolerance.

Manufacturers ratings should closely agree with listed power

The FCC has no official tolerance for power output listing for Equipment Authorization. Some Radio Service Rules have station license tolerances and Part 2.931 allows for "production tolerances"

2.1046 RF Power Output

Amplifiers and multiple output signals

The maximum power output per carrier should be listed.

Grant should note maximum number of carriers and rated maximum composite power output.

If the maximum power output must decrease with channel loading, this should be noted on grant

2.1047(a) Frequency Response

For voice modulated equipment a frequency response plot over the range 100 - 5000 Hz should be provided

(EIA/TIA 603 shows a different range but since the FCC rules are specific, the above range should be shown)

For units with extended audio frequency response (wireless microphones) the response should be measured up to 15kHz since up to 15kHz can be used in a typical broadcast operation

2.1047(b) Modulation Limiting

Modulation (%) vs Input Level

A “family” of curves should be provided:
300, 1000, 2500 and 3000 Hz are typical

The audio input level should be increased to at least the level used for the occupied bandwidth test.

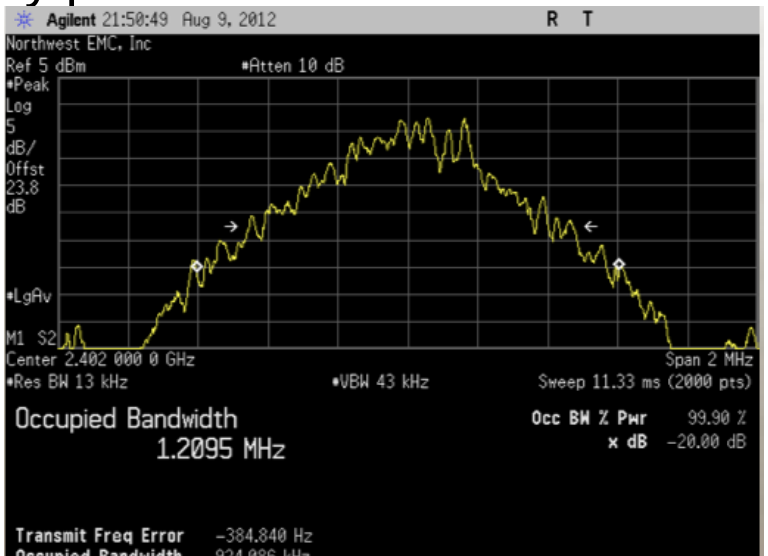
Some rule parts require specific additional tests (i.e transient frequency response)

2.1049 Occupied Bandwidth

Occupied BW is the portion of the spectrum which contains 99% of the emitted energy (20dB BW)

(0.5% of the remaining is above and 0.5% is below the occupied BW)

- Compares the modulated spectrum with the emissions masks
- The occupied bandwidth may not exceed the **authorized bandwidth**
- The occupied bandwidth test is performed for each type of emission listed on the grant—for multi-mode OFDM products: many plots~



2.1049 Occupied Bandwidth

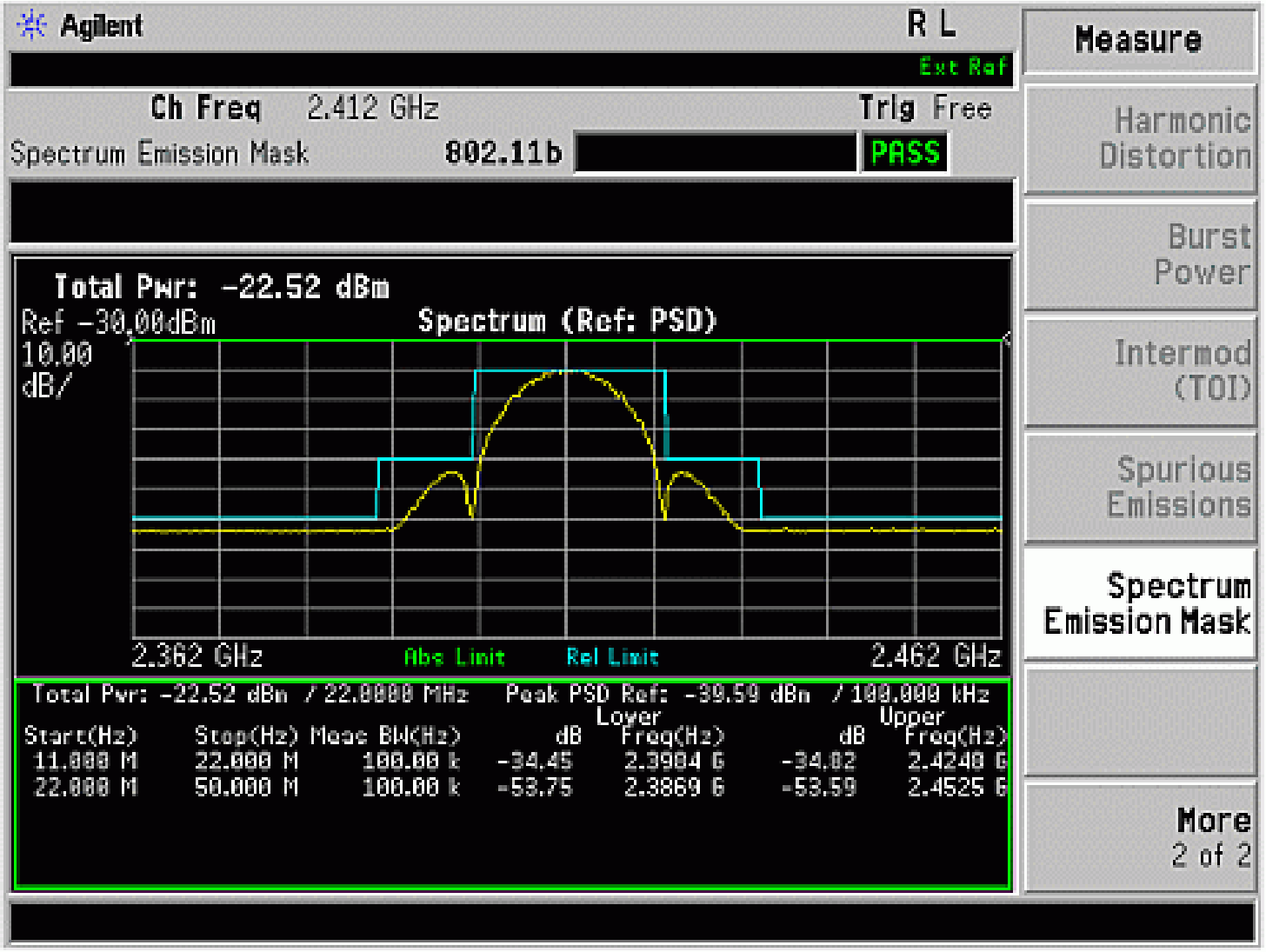
Emissions Masks

The emissions mask is normally applied with the 0dB level equal to the level of the un-modulated carrier or equivalent composite power level.

- The test results are also used to confirm the modulation level used for the occupied BW test
- In some cases the Radio Service Rules specify a spectrum analyzer resolution bandwidth setting
- The proper emissions “mask” from each Radio Service Rule part must be applied to the spectrum display
- Typically, unless otherwise disallowed, use a RBW of 1% of the occupied bandwidth
- For amplifiers, tests must show comparison of the input and output with the output in compliance to the rules.

2.1049 Occupied Bandwidth

Emissions Masks



Bandwidth Terminology

Authorized Bandwidth

The maximum bandwidth the specific radio service rule section allows

Necessary Bandwidth*

The maximum bandwidth a specific device requires to operate in the devices worst case mode

Occupied Bandwidth

The bandwidth of a specific device, usually either the 20dBc or 26dBc points

Channel Bandwidth

The bandwidth in which the energy of a communications signal is concentrated around a center frequency.

*Forms an element of Emission Designator

Emissions Designators

AAAAXNY

AAAA: Necessary Bandwidth, in shorthand form
12.5kHz => 12K5, 10 MHz => 10M6

X: Type of Modulation (FM, AM, PM)

N: Nature of signal modulating the carrier (Analog, Digital)

Y: Type of information (Audio, Data, Video)
Channel Bandwidth

2.1051 Conducted Spurious Emissions

Measurements of the emissions at the antenna terminal.

This test is to determine emissions conducted through the antenna terminal.

The highest frequency measured is specified in 2.1057 of the rules.

2.1053 Radiated Spurious Emissions

Radiated from the cabinet, chassis, and associated wiring.

Extension of the occupied bandwidth limits

Use **Signal Substitution method** described in EIA603

Pre-calibrated field method has been approved

2.1055(a) Frequency Stability

Frequency Stability versus Temperature

Test is normally performed from -30C to +50C, 10C increments (some exceptions, Part 80 and Part 73)

Auto shut-off OK. Must verify operation

When more specific requirements are listed, the more specific requirements should be followed
Example - Some Part 80 Maritime rules specify -20 to +50 degrees centigrade
Example - Some Part 73 Broadcast Service rules specify 0 to 50 degrees centigrade

2.1055(d) Frequency Stability

Frequency Stability versus Voltage

AC: 85 to 115 % of the nominal value

Auto shut-off OK, must verify

Battery: Test to endpoint specified by the manufacturer

Intermodulation Test

Intermodulation

Transmitters and amplifiers designed to handle multiple channels must be tested with multiple carriers for each emission type to show intermodulation products

Amplifiers include**:**

Booster - Device with antenna input – receives and amplifies on the same frequency – in one direction.

Repeater - Device with antenna input – receives, amplifies and retransmits on a different frequency.

Extender - A bi-directional Booster or Repeater

*Do not demodulate the signal and retransmit. If the signal is demodulated, the device would be classified as a transmitter.

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Unlicensed Devices (a closer look)

FCC Part 15

https://apps.fcc.gov/oetcf/eas/

Year 2011 Grants:

- 4412 digital transmission (DTS)
- 2514 spread spectrum (DSS)
- 1761 low power communications (DXX)

About 1/3 of the total Authorizations (20,360)

…Let's look at the unlicensed requirements…

FCC Part 15.1/RSS-210: Scope

Regulations under which an intentional, unintentional, or incidental radiator may be operated without an individual license.

Includes technical specifications, administrative requirements and other conditions relating to the marketing of unlicensed devices.

FCC Part 15.15: Technical Requirements

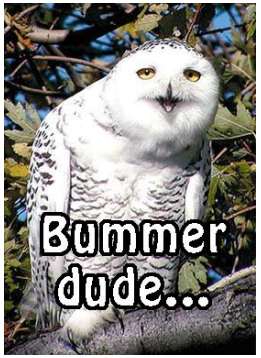
Good Design. Emanations < Limits

No adjustments by user

Operators of Part 15 devices must cease operation if interference is caused to authorized users

Operators must “accept” interference

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, *including interference that may cause undesired operation*.



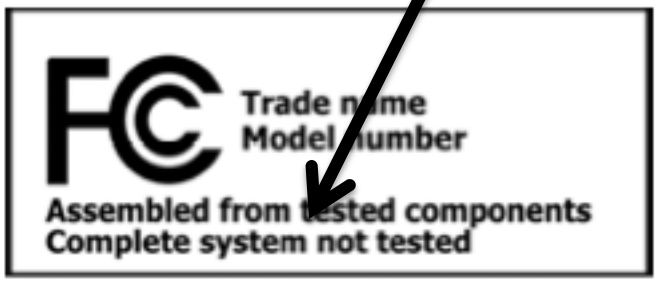
Part 15 labeling (KDB 784748)

- Verification: Section 2.954 Unique Identifier (name) and one of three compliance statements in 15.19(a).
- Certification: 2.925 FCC ID and compliance statement in 15.19(a)
  - Size Matters: Device smaller than palm of hand: Compliance statement may go in Manual. FCC ID required.
  - If device is “unquestionably small” to read FCC ID (<6 pts), FCC ID may go in Manual
  - Electronic labeling OK for 15.212 modules and SDRs (display or to conveyed to host electronically)

Part 15 labeling (KDB 784748)

Declaration of Conformity: Section 15.19(b)

FCC Logo, Trade Name and Model number must be on device



Part 15 labeling (KDB 784748)

The label or statement shall be etched, engraved, stamped, indelibly printed, or permanently affixed to a permanently attached part of the equipment, and be visible at the time of purchase on the exterior of the equipment enclosure.

Cannot be located on removable part (battery cover, for example)

FCC Application Process

The device is certified to the FCC rule part

Collect all the technical documents required for certification and submit them to a TCB

- (or directly to the FCC)

TCB reviews the application and uploads all the documentation to the FCC website

FCC Grant received from the TCB

- A copy of the FCC Grant shown on the FCC site

FCC Application Process

Check the TCB Exclusion List

- Some products cannot be certified by a TCB

Permit But Ask List

- Some products require permission from the FCC

Certification types:

- New Certification for a final product
- Modular Approval
- Limited Modular Approval

FCC Application Process

- Form 731
- Cover Letters may be necessary
- Confidentiality request letter
  - Permanent and Short Term confidentiality
- Agent authorization
  - All other documents as requested under FCC Part 2.1033

Application Items

- Cover Letters (e.g., Agent Authorization)
- Request for Confidentiality (if desired)
- Test Report from Lab
- Modifications Performed During the Testing
- User's Manual
- Theory of Operation, Schematics and Block Diagram
- Test Setup Photograph &
- Internal/External Photograph
- FCC ID Label Artwork & Position on Device
- Attestation Statements (such as conditions of installation)

IC Application Process

Apply the right RSS

Collect all the technical documents required for certification and submit them to a CB

CB reviews the application and uploads all the documentation to the IC website

CB's own Certificate received from the CB

- IC places details of the certification on their own website, after they have completed their review
- Radio Equipment List (REL)

IC Application Process

There is no CB Exclusion List

There is no Permit But Ask List for IC

Certification types:

- New Certification for a final product
- Modular Approval
- Limited Modular Approval

Permit But Ask process

TCB (FCC only)

- Application to the TCB
- TCB reviews application and resolves issues
  - TCB assesses application with KDB guidance
- TCB completes assessment and asks FCC
- FCC gives permission for final Grant
- TCB completes the Certification process
- This can add considerable time to a project

Hearing Aid Compatibility

Mobile Phone Requirements

Cell phone providers are obligated to provide a certain portion of their product line that satisfy HAC requirements

Two or fewer models: Not required.

Three of more: Offer at least one

Beginning September 8, 2012, Big guys must offer one

ANSI C63.19

New Version

Non-Wireless Communications

Telephone attachment requirements

US: ACTA Part 68

DOC Process

Canada: CS-03 Testing and DC-01 (DOC) procedure

Both systems require Registration of the device

Break!

Wireless Approvals
Part II

Mike Violette, P.E.
American Certification Body, Inc
Washington Laboratories, Ltd

FCC, IC and EU Regulations

Agenda

Overview

- FCC and IC Permissive Changes
- Measurement Techniques
- Modular Approvals
- Updates from TCB Training
- Q&A


Changes
NEXT EXIT

Permissive Changes

If you change the transmitter, you need a new authorization, perhaps a new Certification

If you change the supporting electronics or other aspects of the device, you may consider a **Permissive Change**

- Class I Permissive Change: Changes that WILL not affect the RF characteristics
- Class II Permissive Change: Changes that MAY affect the RF characteristics

Permissive Changes

KDB178919: New Certifications:

"Changes to the basic **frequency determining** and **stabilizing circuitry** (including clock and data rates), frequency multiplication stages, basic modulator circuit or maximum power or field strength ratings…

will always require a new FCC ID and a new equipment authorization application."

Permissive Changes

Class I: EMC performance does not change

- Just keep the details on record

Class II: EMC performance “degrades”

- This requires an application (FCC/TCB or CB/IC)

https://apps.fcc.gov/kdb/GetAttachment.html?id=ZIDEh0DKnjkZmV2QXZxJPw%3D%3D

KDB 178919

Permissive Changes

Degradation:

Any increase in the fundamental emission for output power rated devices authorization under a new FCC ID.

Spurious emissions - an increase of up to 3 dB from the original authorization is allowed, if the emission level is compliant.

KDB 178919

Permissive Changes

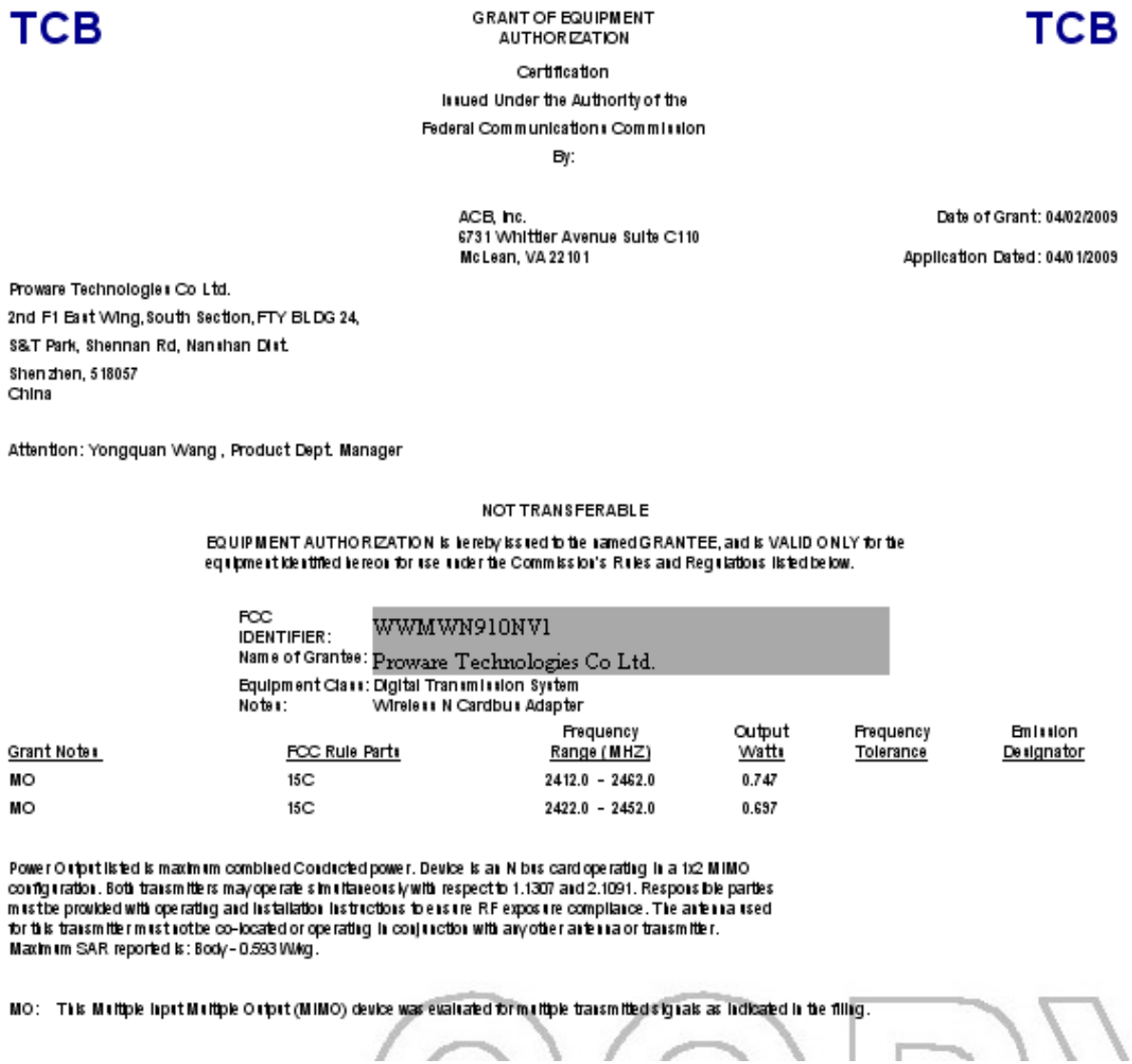
Class I: Change in non-RF portion of circuitry that doesn't affect output characteristics or **conditions** on the GRANT

- Power Regulator
- Baseband digital circuit
- Housing change that doesn't affect shielding
- Software change (depends)

Class II:

- Software changes adding frequencies
- Additional antenna (possibly)
- Filter/layout change on output
- Layout change in RF portion of board

Grant of Equipment Authorization



TCB

GRANT OF EQUIPMENT AUTHORIZATION

Certification

Issued Under the Authority of the

Federal Communications Commission

By:

TCB

ACB, Inc.
6731 Whittier Avenue Suite C110
McLean, VA 22101

Date of Grant: 04/02/2009

Application Dated: 04/01/2009

Proware Technologies Co Ltd.
2nd Fl East Wing, South Section, FTY BLDG 24,
S&T Park, Shennan Rd, Nanshan Dist.
Shenzhen, 518057
China

Attention: Yongquan Wang , Product Dept. Manager

NOT TRANSFERABLE

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

FCC IDENTIFIER: WWMWN910NV1
Name of Grantee: Proware Technologies Co Ltd.
Equipment Class: Digital Transmission System
Notes: Wireless N Cardbus Adapter

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
MO	15C	2412.0 - 2462.0	0.747		
MO	15C	2422.0 - 2452.0	0.697		

Power Output listed is maximum combined Conducted power. Device is an N bus card operating in a 1x2 MIMO configuration. Both transmitters may operate simultaneously with respect to 1.1307 and 2.1091. Responsible parties must be provided with operating and installation instructions to ensure RF exposure compliance. The antenna used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. Maximum SAR reported is: Body - 0.593 W/kg.

MO: This Multiple Input Multiple Output (MIMO) device was evaluated for multiple transmitted signals as indicated in the filing.

Frequency & Power Grant Notes

Permissive Changes

Software Changes allowed under Class II:

- No hardware changes have been made.
- There is no increase in the output power rating on new frequencies.
- The Equipment Class remains the same. (Changes that require a new Equipment Class code require a new FCC ID, except for SDR approvals.)
- RF exposure changes must be addressed.
- Only the original equipment manufacturer may implement the new frequencies
- Change Grant Frequency Range

Permissive Changes

Antenna Changes: Same type of lower gain than original filing

No filing EXCEPT:

- Part 15 Subpart B (UPSC) and E require filing in case of lower gain antennas
  - UPSC: Detecting lowest energy above noise floor
  - UNII: Detecting radars according to DFS requirements
- UWB Antenna affect all emissions, must file.
- Transmitters subject to power density limits
- Portable devices subject to SAR evaluations

Permissive Changes

Hardware Changes (replacements) Allowed

- The new chip component is pin-for-pin compatible.
- The new chip has the same basic function as the old chip, from an external perspective (internal circuitry may differ).
- No change in radio parameters has occurred.
- The same conditions apply when a small are(approximately the same area as the chip) of the PCB is replaced with an equivalent chip.

Permissive Changes

Hardware Changes Not Allowed

- Versions of a device with different internal active hardware components (e.g., amplifiers and crystals) that result in different radio parameters (e.g., output power, frequency) or that result in the device not being electrically identical
- Adding or subtracting an on-board amplifier component (except exact replacements)
- Depopulated version of transmitter

New FCC ID Required

Permissive Changes

Class III: Software Defined Radios (2.1043(b)(3))

Modifications to the software of a software defined radio transmitter that change the frequency range, modulation type or maximum output power (either radiated or conducted) outside the parameters previously approved, or that change the circumstances under which the transmitter operates in accordance with Commission rules.

Commission approves Class III changes.

Agenda

Overview

- FCC and IC Permissive Changes
- Measurement Techniques
- Updates from TCB Training
- Q&A

Test Equipment

- Spectrum Analyzer to 10X Transmit Frequency (max 40 GHz @ 5.8 GHz)
- Power meter with peak head adapter
- Extremely low loss cables
- Pre-amp
- High Pass & Notch Filters
- Horn antenna
- Signal Generator
- Oscilloscope
- Diode Detector
- Attenuators
- Adapters, miscellaneous

Emissions Measurements

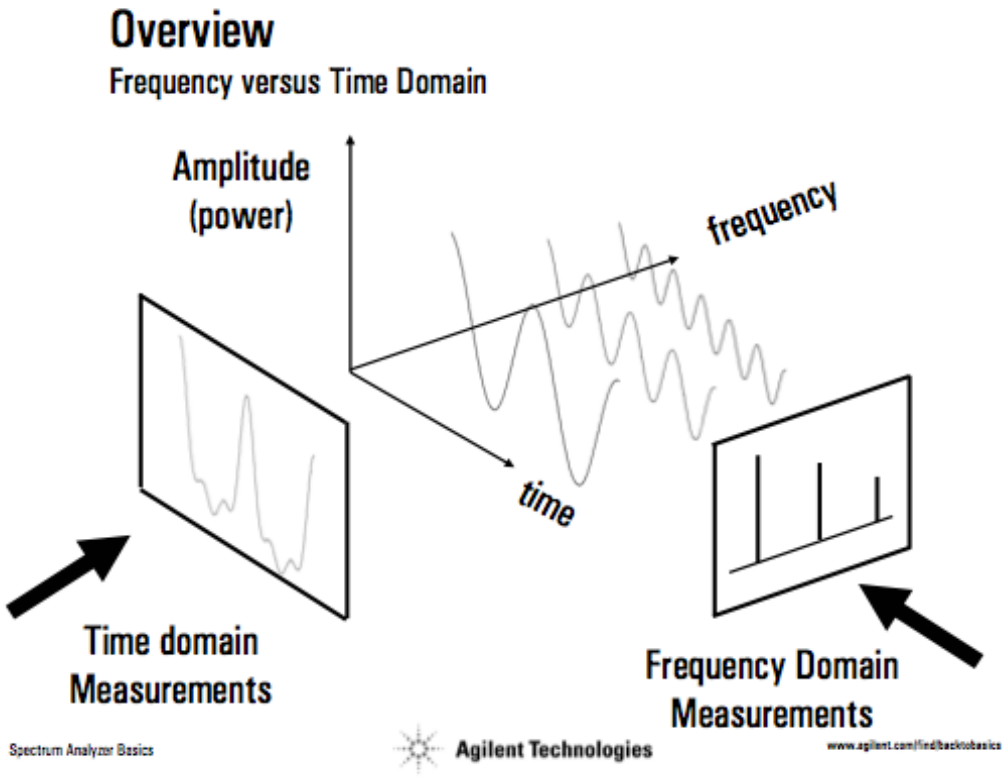
Use Spectrum Analyzers, Radio Receivers

Contain Logarithmic sections that convert *linear* to *decibel-equivalent* quantities

Defined measurement bandwidths

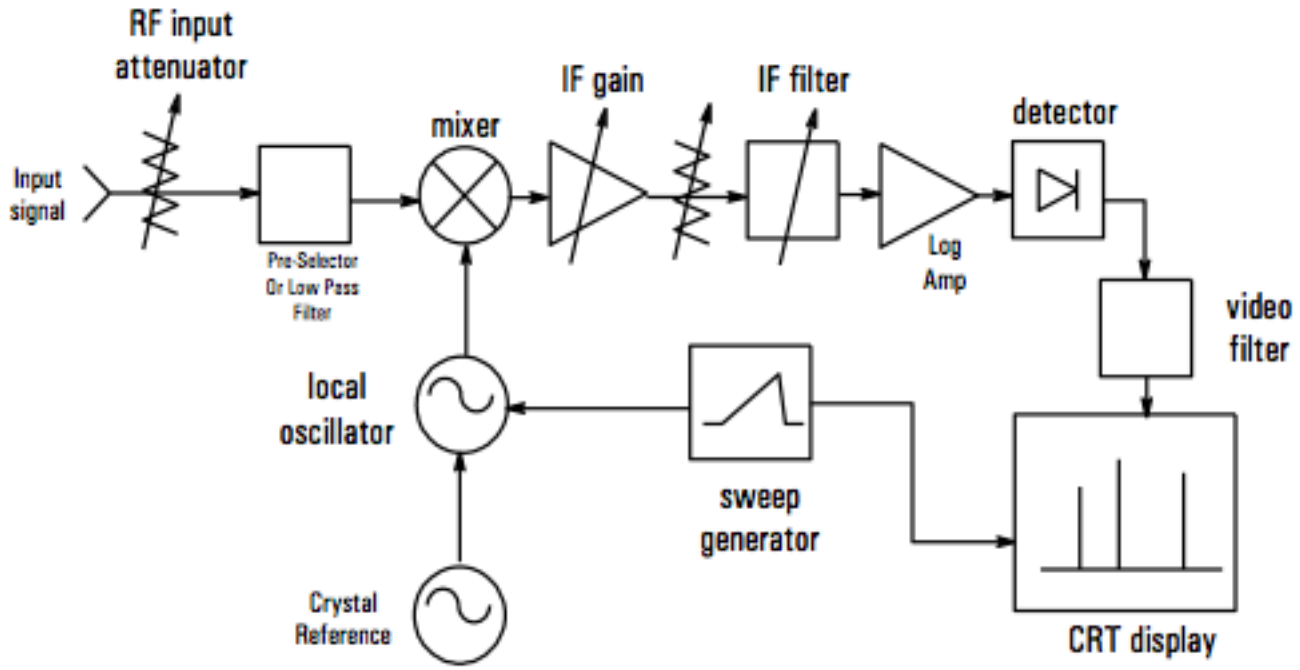
Limits vary according to specification

Spectrum Analysis



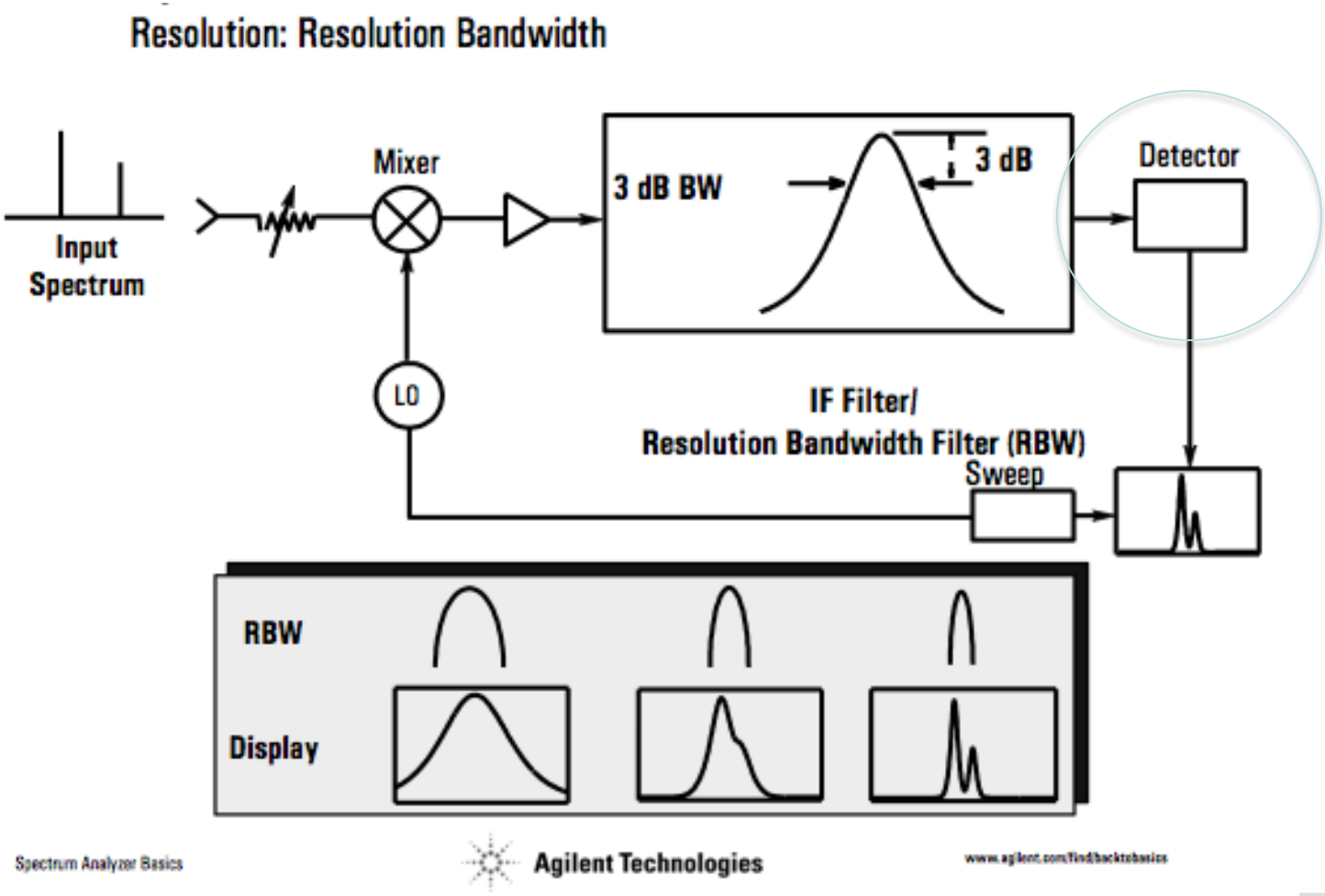
FCC, IC and EU Regulations

Spectrum Analysis



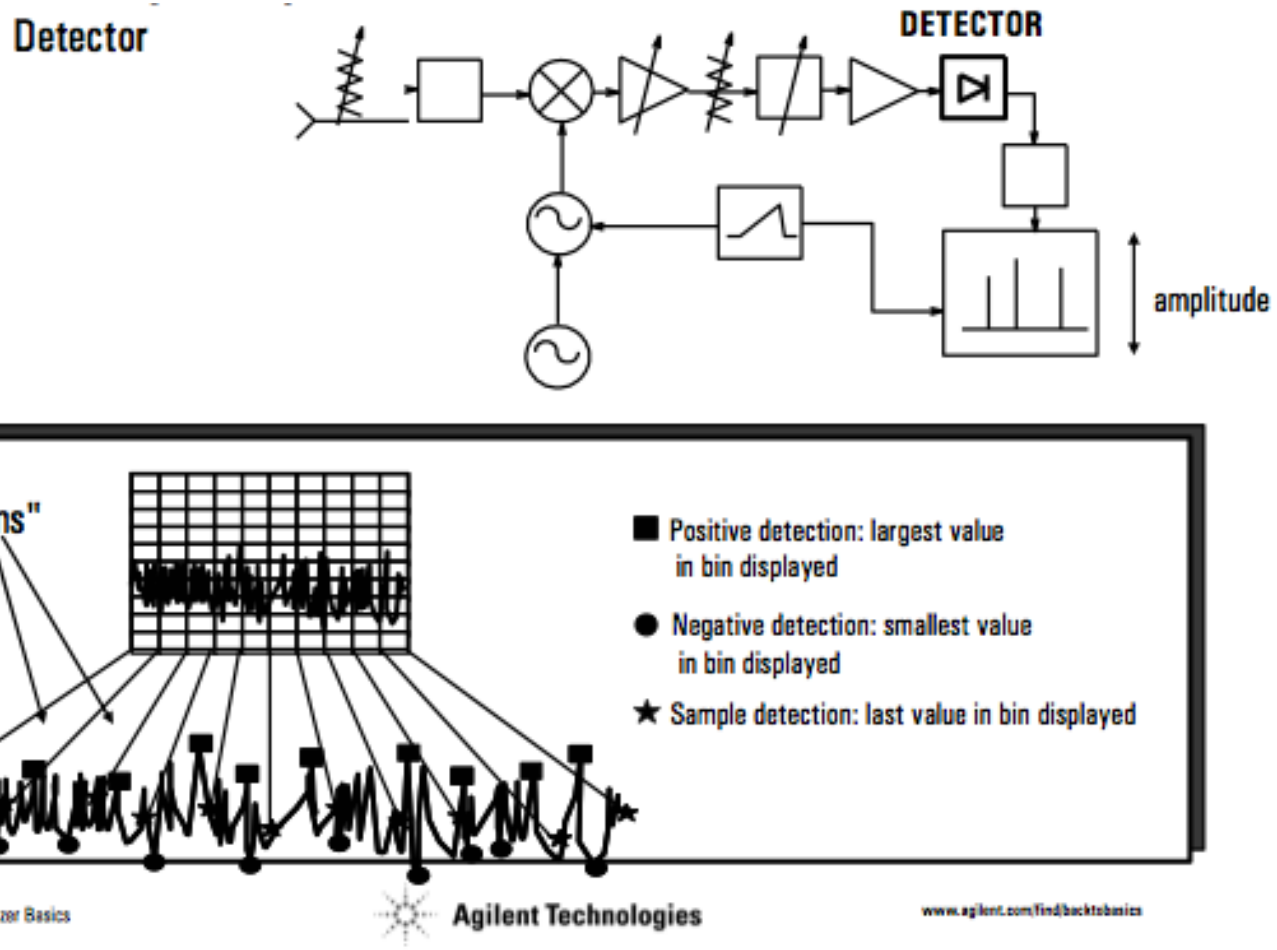
FCC, IC and EU Regulations

Spectrum Analysis



FCC, IC and EU Regulations

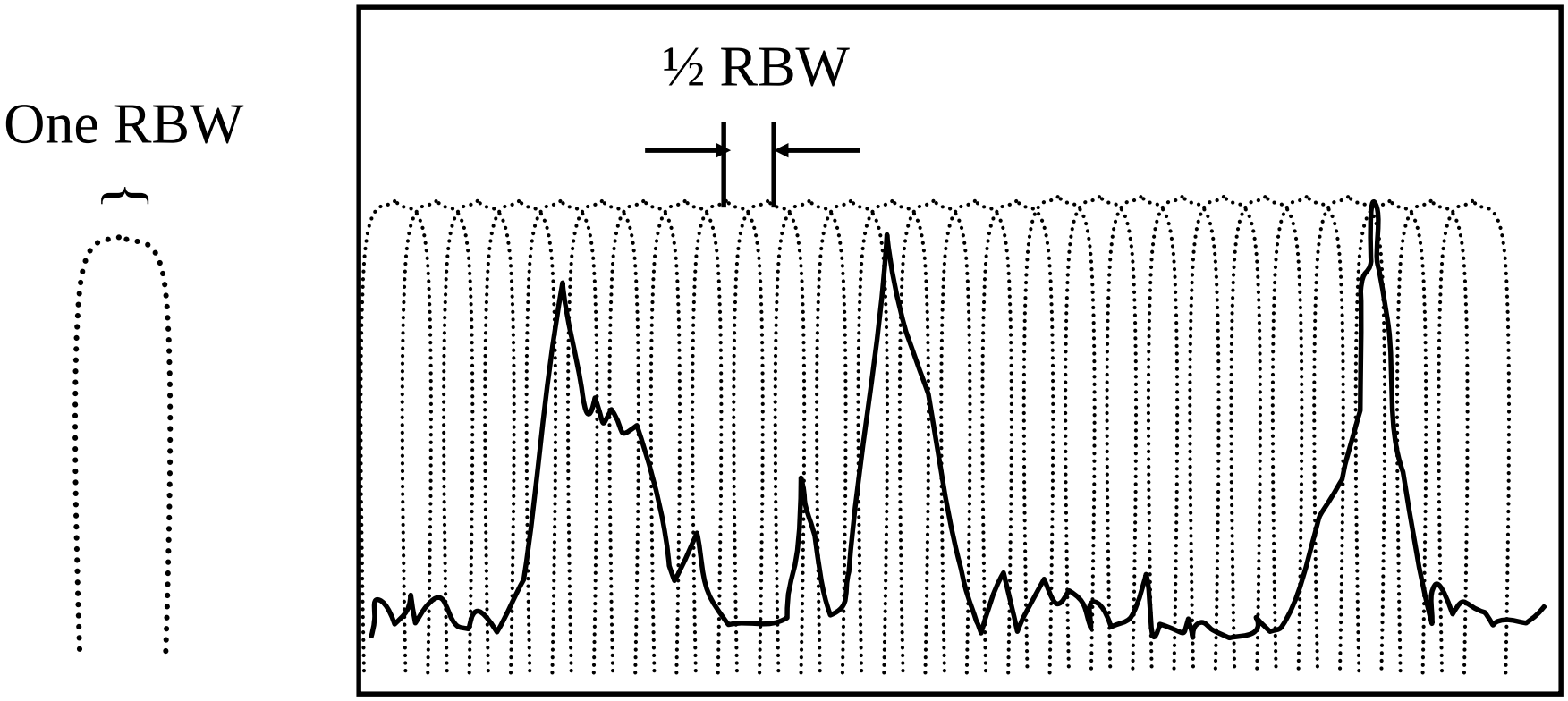
Spectrum Analysis



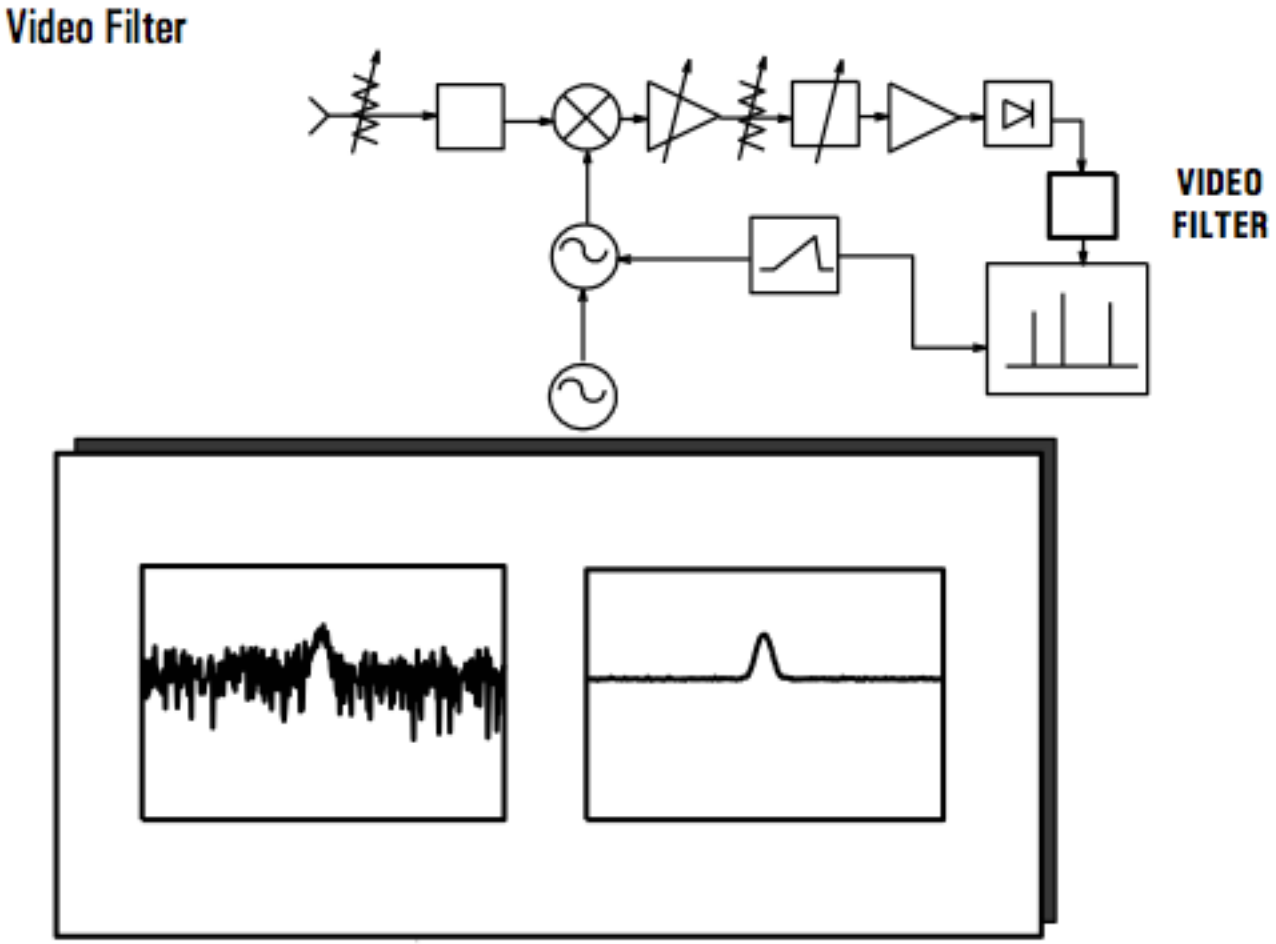
FCC, IC and EU Regulations

Frequency scanning

Sweep of filter across frequency spectrum



Spectrum Analysis

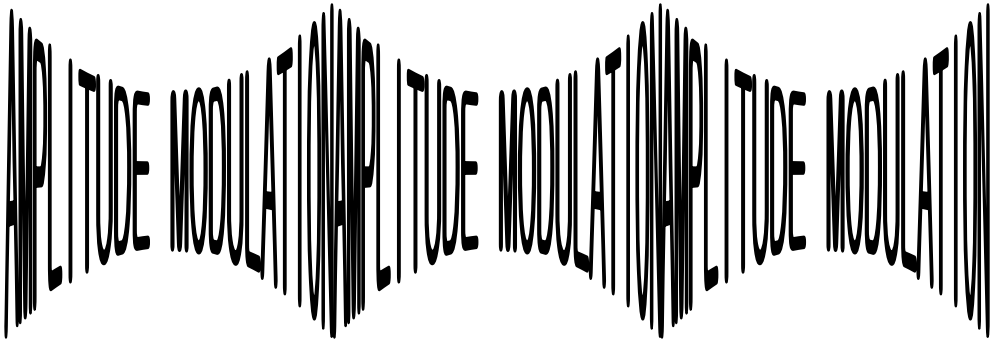


FCC, IC and EU Regulations

Detectors

The detector is after the Radio Signal is converted to a “baseband” signal

Result depends on the nature of the modulating signal and detector design



Emissions Measurements Quantities

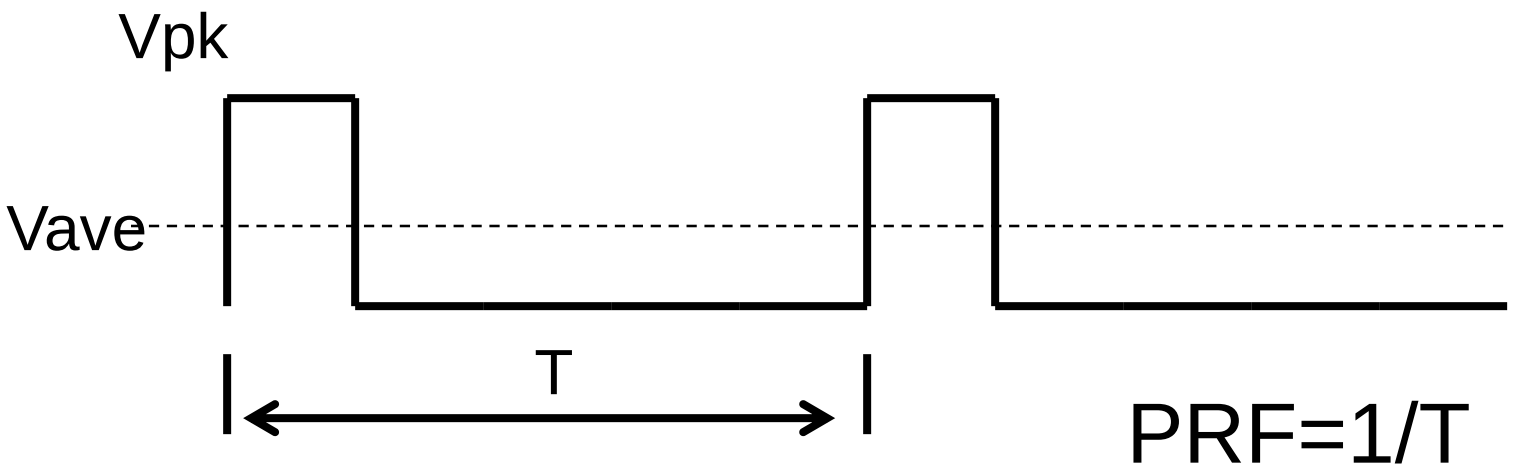
Peak

Average

Quasi-Peak (QP)

RMS

Peak vs Quasi-Peak Detectors

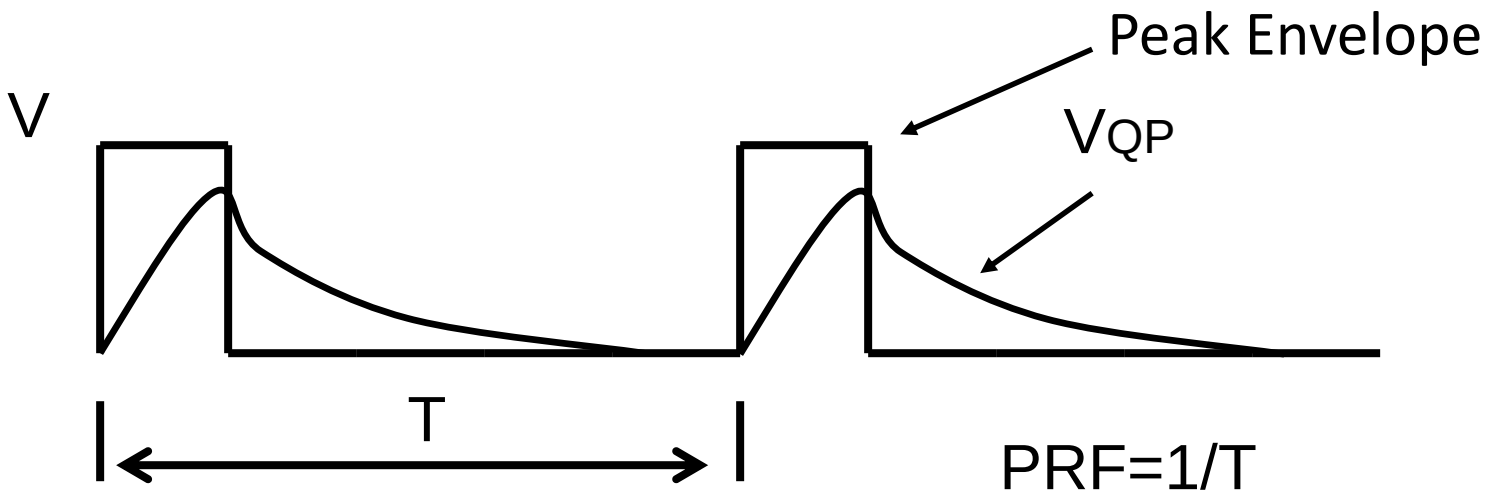


A PEAK Detector will indicate Vpk

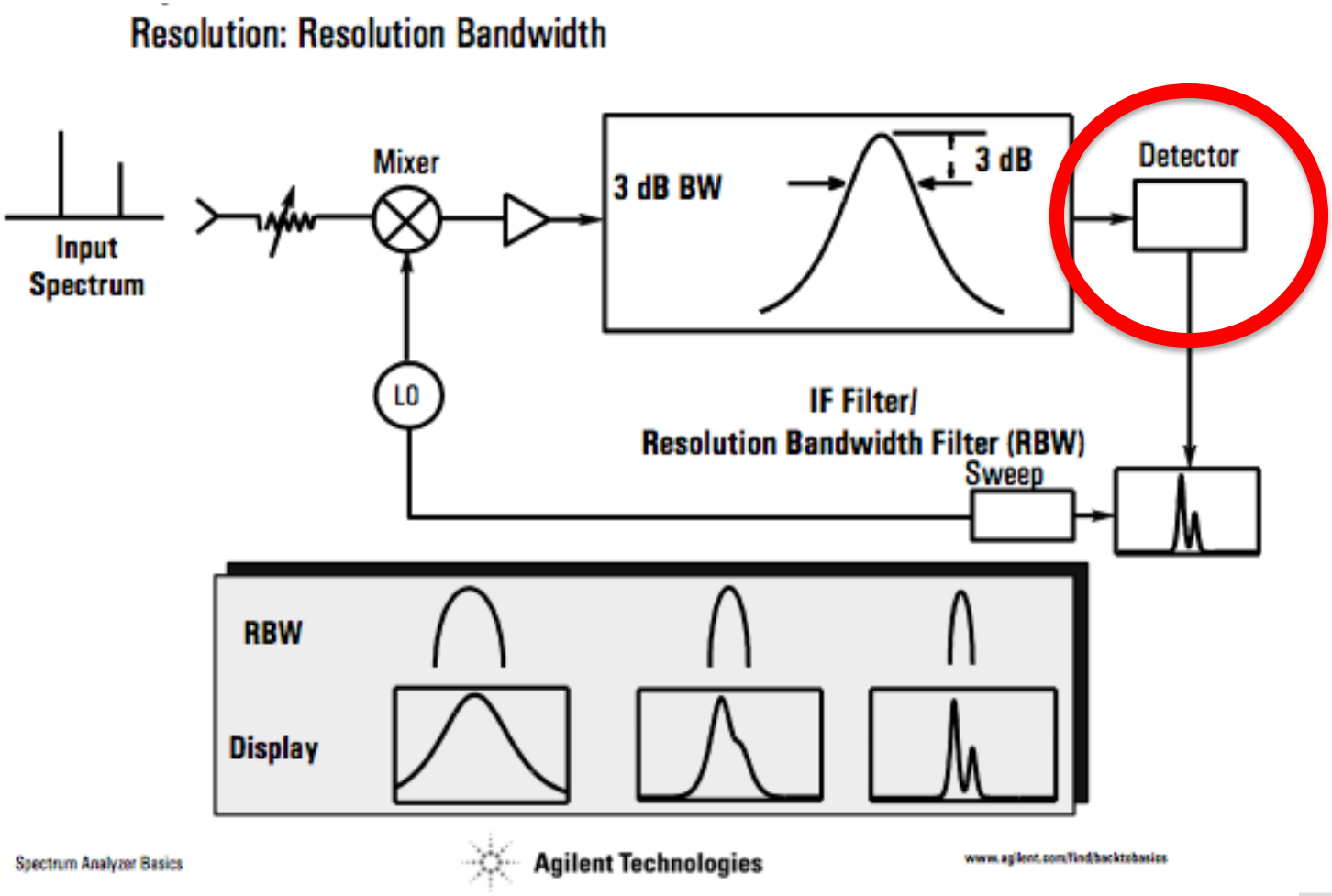
A QUASI-PEAK will indicate a voltage **proportional** to PRF

Average will depend on the duty cycle

Peak vs Quasi-Peak Detectors

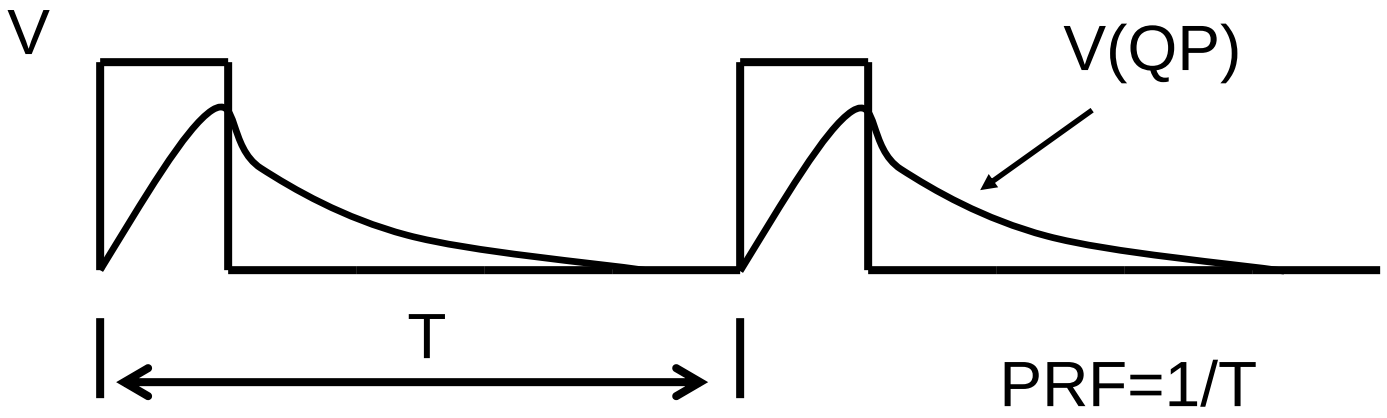


Spectrum Analysis



FCC, IC and EU Regulations

Peak vs Quasi-Peak Detectors



“the dynamics are chosen to reflect the sensitivity of human hearing to brief sounds”
(Peculiar to commercial standards. MIL, Aero standards specify Peak Detection.)

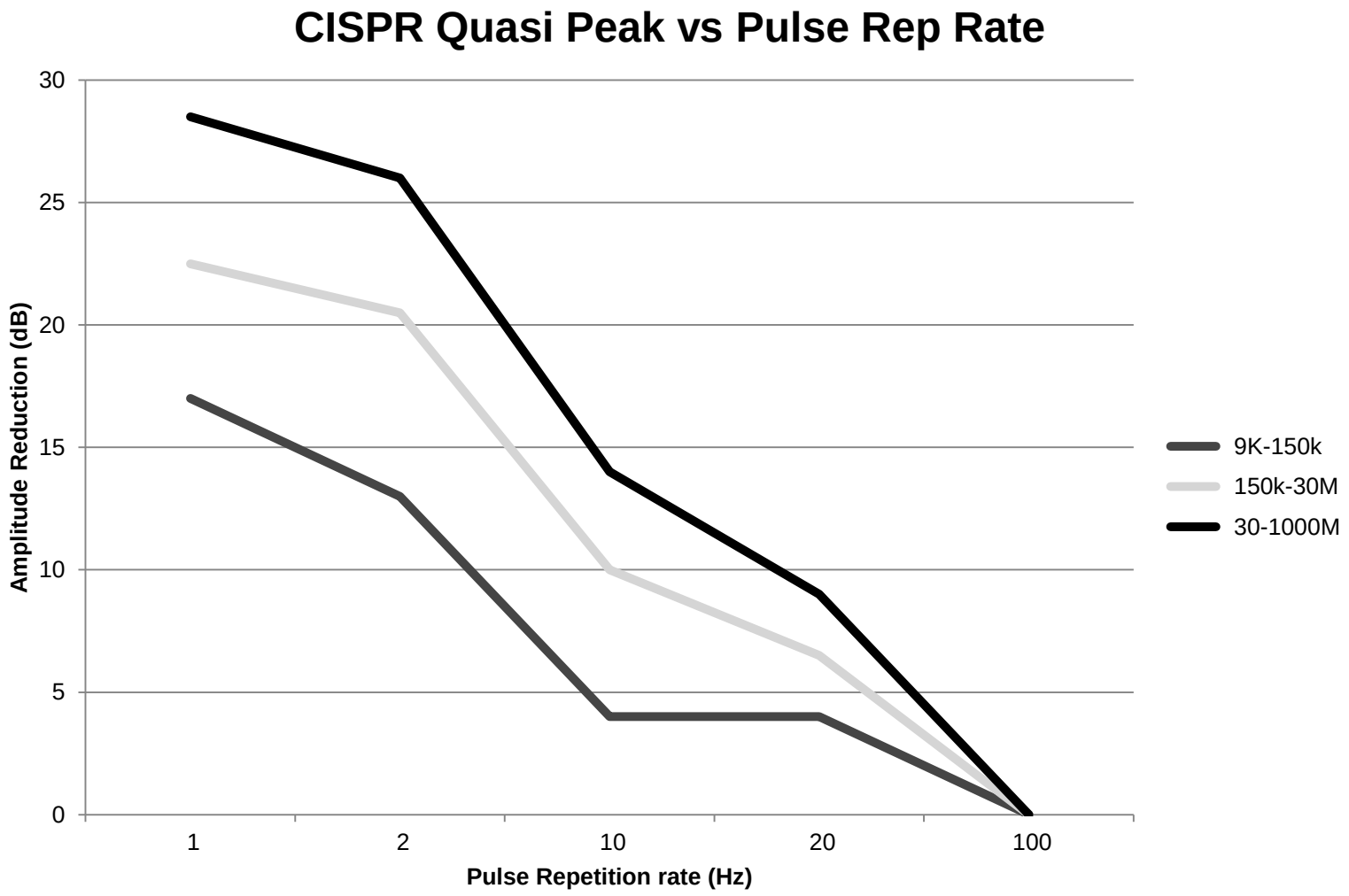
Quasi-Peak Receiver

QP Defined by CISPR 16

Three measurement bandwidths, depending on frequency range of measurement:

- 9 kHz – 150 kHz: 200 Hz (rarely used)
- 150 kHz – 30 MHz: 9 kHz (conducted)
- 30 MHz – 1GHz: 120 kHz (radiated)

Quasi-Peak “Relaxation” vs PRF



15C Intentional Radiators

General Requirements:

FCC 15.207: AC Conducted Emissions

FCC 15.209: General Radiated Emissions

http://www.ecfr.gov/cgi-bin/text-idx?&c=ecfr&tpl=/ecfrbrowse/Title47/47tab_02.tpl

15C Intentional Radiators

§15.217	Operation in the band 160-190 kHz.	
§15.219	Operation in the band 510-1705 kHz.	
§15.221	Operation in the band 525-1705 kHz.	
§15.223	Operation in the band 1.705-10 MHz.	
§15.225	Operation within the band 13.110-14.010 MHz.	RFID
§15.227	Operation within the band 26.96-27.28 MHz.	
§15.229	Operation within the band 40.66-40.70 MHz.	
§15.231	Periodic operation in the band 40.66-40.70 MHz and above 70 MHz.	Remote Control
§15.233	Operation within the bands 43.71-44.49 MHz, 46.60-46.98 MHz, 48.75-49.51 MHz and 49.66-50.0 MHz.	
§15.235	Operation within the band 49.82-49.90 MHz.	
§15.237	Operation in the bands 72.0-73.0 MHz, 74.6-74.8 MHz and 75.2-76.0 MHz.	
§15.239	Operation in the band 88-108 MHz.	FM Radio
§15.240	Operation in the band 433.5-434.5 MHz.	RFID
§15.241	Operation in the band 174-216 MHz.	
§15.242	Operation in the bands 174-216 MHz and 470-668 MHz.	
§15.243	Operation in the band 890-940 MHz.	
§15.245	Operation within the bands 902-928 MHz, 2435-2465 MHz, 5785-5815 MHz, 10500-10550 MHz, and 24075-24175 MHz.	
§15.247	Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.	Bluetooth, 802.11
§15.249	Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHZ, and 24.0-24.25 GHz.	
§15.250	Operation of wideband systems within the band 5925-7250 MHz.	
§15.251	Operation within the bands 2.9-3.26 GHz, 3.267-3.332 GHz, 3.339-3.3458 GHz, and 3.358-3.6 GHz.	Vehicle ID
§15.252	Operation of wideband vehicular radar systems within the bands 16.2-17.7 GHz and 23.12-29.0 GHz.	
§15.253	Operation within the bands 46.7-46.9 GHz and 76.0-77.0 GHz.	Vehicle Radar
§15.255	Operation within the band 57-64 GHz.	
§15.257	Operation within the band 92-95 GHz.	

15D UPCS

Subpart D--UNLICENSED PERSONAL COMMUNICATIONS SERVICE DEVICES

§15.301	Scope.
§15.303	Definitions.
§15.305	Equipment authorization requirement.
§15.307	Coordination with fixed microwave service.
§15.309	Cross reference.
§15.313	Measurement procedures.
§15.315	Conducted limits.
§15.317	Antenna requirement.
§15.319	General technical requirements.
§15.321	[Reserved]
§15.323	Specific requirements for devices operating in the 1920-1930 MHz band.

15E UNII

Subpart E--UNLICENSED NATIONAL INFORMATION INFRASTRUCTURE DEVICES

§15.401	Scope.
§15.403	Definitions.
§15.405	Cross reference.
§15.407	General technical requirements.

15F UNII

Subpart F--ULTRA-WIDEBAND OPERATION

§15.501	Scope.
§15.503	Definitions.
§15.505	Cross reference.
§15.507	Marketing of UWB equipment.
§15.509	Technical requirements for ground penetrating radars and wall imaging systems.
§15.510	Technical requirements for through D-wall imaging systems.
§15.511	Technical requirements for surveillance systems.
§15.513	Technical requirements for medical imaging systems.
§15.515	Technical requirements for vehicular radar systems.
§15.517	Technical requirements for indoor UWB systems.
§15.519	Technical requirements for hand held UWB systems.
§15.521	Technical requirements applicable to all UWB devices.
§15.523	Measurement procedures.
§15.525	Coordination requirements.

15G Access BPL

Subpart G--ACCESS BROADBAND OVER POWER LINE (ACCESS BPL)

§15.601	Scope.
§15.603	Definitions.
§15.605	Cross reference.
§15.607	Equipment authorization of Access BPL equipment.
§15.609	Marketing of Access BPL equipment.
§15.611	General technical requirements.
§15.613	Measurement procedures.
§15.615	General administrative requirements.

15H Television Band Devices

Subpart H--TELEVISION BAND DEVICES

§15.701	Scope.
§15.703	Definitions.
§15.705	Cross reference.
§15.706	Information to the user.
§15.707	Permissible channels of operation.
§15.709	General technical requirements.
§15.711	Interference avoidance methods.
§15.712	Interference protection requirements.
§15.713	TV bands database.
§15.714	TV bands database administration fees.
§15.715	TV bands database administrator.
§15.717	TVBDs that rely on spectrum sensing.

15.33 Frequency Range

Intentional Emitters:

- f < 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
- 10 GHz ≤ f < 30 GHz: fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.
- f >: fifth harmonic of the highest fundamental frequency or to 200 GHz, whichever is lower, unless specified otherwise elsewhere in the rules.

15.33 Frequency Range

Unintentional Emitters

Highest frequency generated or used in the device or on which the device operates or Upper frequency of tunes (MHz) measurement range (MHz)

Below 1.705.....30

1.705-108.....1000

108-500..... 2000

500-1000.....5000

Above 1000.....5th harmonic or 40 GHz, whichever is lower

15.33(b)(2) See exceptions for CB radios

15.203 Antenna Requirements

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

- Unique connector
- Permanently affixed and/or
- Professional Installation*

*Attestation and Justification

Unique Connectors?

Unique (non-standard) antenna connector

Standard antenna connector - Any antenna connector found in an electronic parts catalogue is not unique and, therefore, prohibited by Section 15.203 Examples of standard connectors that are prohibited: BNC, TNC, N, SMA, SMX, and F type connectors.

Unique antenna connectors

– Standard connectors with a left-handed thread

– Reverse polarity connectors

– Standard connectors with non-standard thread gauge or physical dimensions

– Screw-type connectors typically used by cordless phones

15.205 Restricted Bands

Bands are generally US Government, military bands, Biomedical Telemetry

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in § 15.209.

Basis for all radiated “band edge” requirements (i.e. 2483.5MHz).

Caution: Restricted Bands change over time

15.207 AC Conducted Limits

- Unless specified elsewhere, all Intentional Radiators must meet 15.207 limits anywhere outside of their allotted frequency band
- Required if it connects directly or indirectly to AC mains
- Conducted emissions not required for battery powered devices

15.209 General RE Limits

- Unless specified elsewhere, all Intentional Radiators must meet 15.209 limits anywhere outside of their allotted frequency band
- Test set-up per ANSI C63.4
- Limits identical to FCC Class B. Tighter limits apply at all band edges
- Specific rules may apply for the device.
- Intentional radiators must generally be measured to the 10th Harmonic

Testing

Radio testing done in stages

Lab bench testing for all conducted tests

Open field test site or Anechoic Chamber for all radiated tests.

Test Setup: Antenna Port

Frequency stability

Occupied bandwidth and Band-edge

Output power

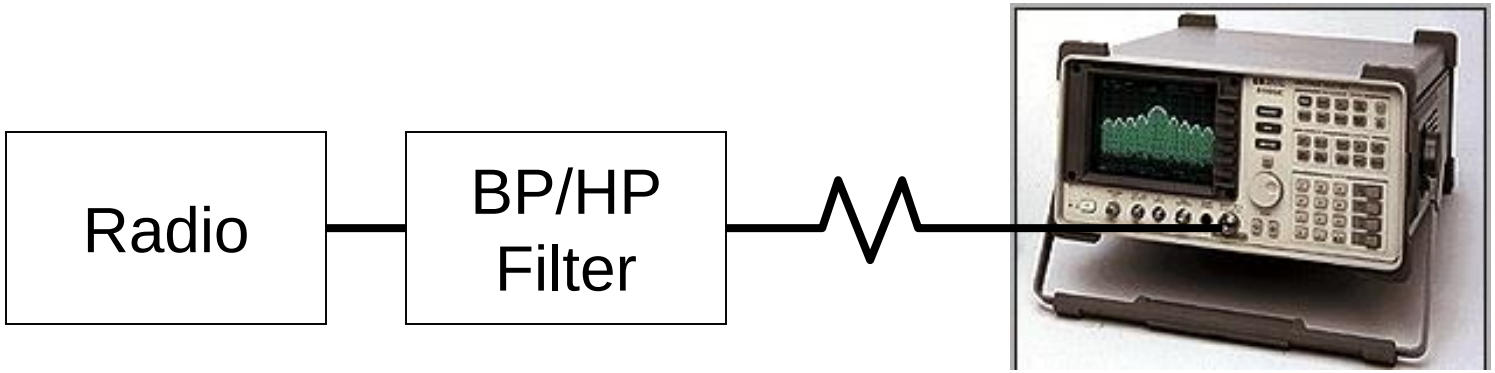
Power spectral density

Frequency hopping device parameters

If a direct connection can’t be made, radiated measurement methods can be used.

Test Setup

General Setup



In-Band Conducted Measurements

Transmit Power

Occupied Bandwidth

Power Spectral Density

Transmit Power

Measured at the RF output terminals after the tune-up procedure, or measured as EIRP using substitution method.

Power meter, spectrum analyzer, or RF detector diode.

If using a spectrum analyzer, the resolution bandwidth should be greater than the 6dB bandwidth of the modulated fundamental emission.

Power Spectral Density

DTS and Hybrid devices under FCC 15.247 & 15.407

Use the method specified for the particular rule part and emission type.

For example, for FCC 15.247 DTS the spectrum analyzer is set as follows:

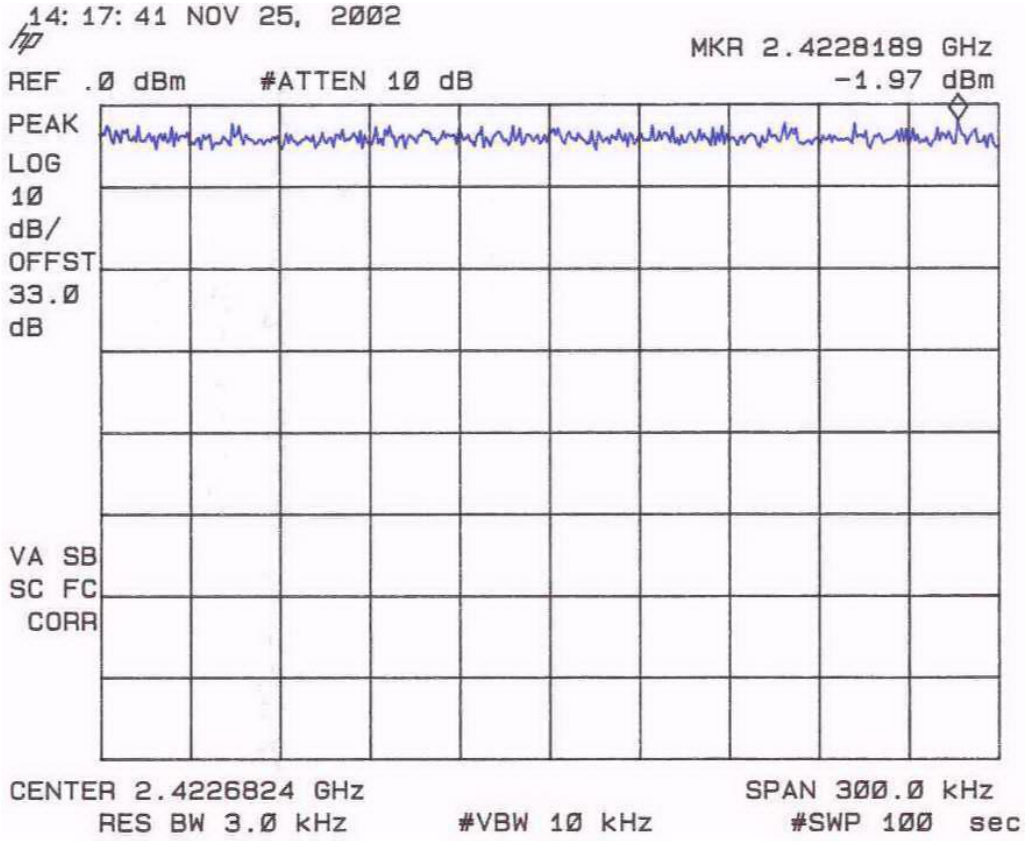
The emission peak was located and zoomed in on within the pass band.

RBW = 3 kHz, VBW =10kHz, SPAN=300kHz, SWEEP = 100s

MAX HOLD

The 1 Hz Marker Noise function on the analyzer is used. The data are corrected to 3 kHz by adding 34.8 dB to the reading (10Log 3kHz/1Hz)

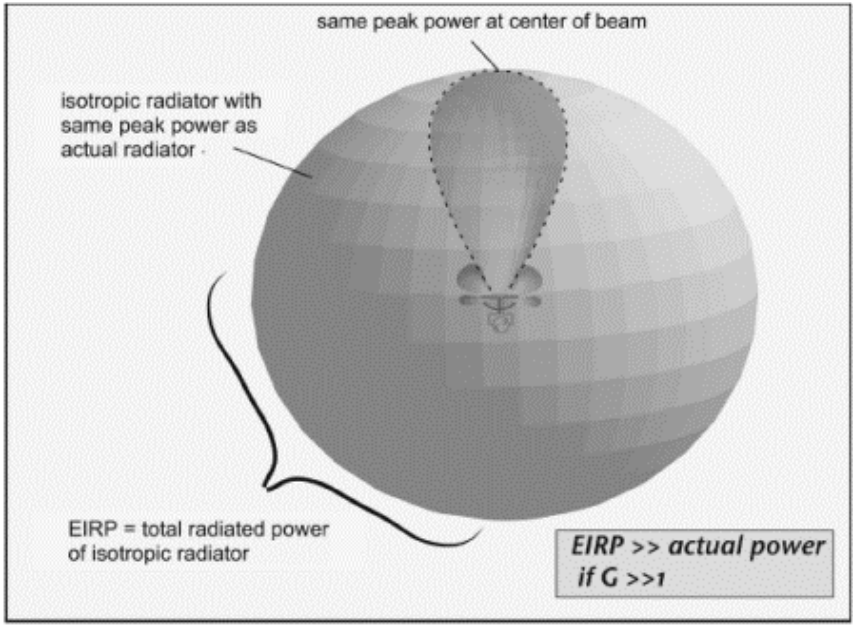
Power Spectral Density



EIRP and ERP

Equivalent/Effective Isotropic Radiated Power:

Power emitted by an isotropic antenna to produce the peak power density observed in the direction of maximum antenna gain.

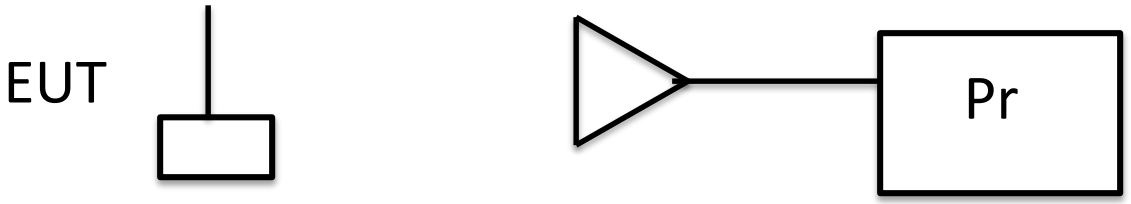


EIRP = Pt * GtdBi

G, relative to 0dBi

EIRP Measurement: Substitution

Measure received power



Replace EUT with Sig Gen and Antenna with known gain

Adjust Sig Gen Power to achieve Pr at the receiver

$$EIRP = Pt * Gt\ dBi$$

EIRP and ERP

Effective Radiated Power:

Power supplied to an antenna multiplied by the antenna gain in a given direction, usually in the direction of maximum gain.

ERP = Pt * Gt dBd

G, relative to 0dBd

dBd = dBi – 2.15dB

Electromagnetic Monopole

Occupied Bandwidth

Video bandwidth (VBW) at least 3 times greater than the resolution bandwidth (RBW).

Span 2 – 5 times the occupied bandwidth (OBW)

Unless otherwise specified, the RBW 1% to 5% of the OBW

Measure the specified bandwidth of the modulated carrier:

- 6 dB for DTS devices under 15.247 (RBW = 100 kHz)
- 20 dB for FHSS devices under 15.247
- 26 dB for UNII devices under 15.407

Measure the modulated carrier

In-Band Conducted Measurements

Occupied Bandwidth

99.9% of transmitted power

10 Log(0.01) = 20dB

RBW of 1% of the OBW

Agenda

Overview

- FCC and IC Permissive Changes
- Measurement Techniques
- Modular Approvals
- Updates from TCB Training
- Q&A

What is a Modular Approval?

- Approval of modular transmitter circuitry that could be used in a variety of devices without requiring those devices to obtain subsequent and separate FCC approvals.
- To afford relief to equipment manufacturers by eliminating the requirement for a new FCC ID when the same transmitter is installed in a new device.

Modular Approvals

The initial modular approval process began with DA001407 (June 2000).

Subsequent inclusion and modification into the rules under 15.212

Modular Approvals

The module is certified for the operation shown in the application

Module Grantee or Certificate holder **remains responsible for module compliance**

Host device must reference the certified module and its ID or Certification Number

"Contains FCC ID: ABCnnnnnnnnn"

Full Modular Approval

Tested alone for use in any host

- FCC Certification to Part 15.212
- IC Certification to RSS-GEN, section 3.2

Must meet 8 important criteria:

- RF Shielding
- Voltage Regulator(s)
- Data Buffers
- Antenna requirements
- Correct Labelling
- RF Exposure requirements
- Tested Stand-Alone
- Comply with rule part or RSS

Limited Modular Approval

Tested with a host

This is used if the device does not meet one of the 8 requirements and therefore cannot achieve Modular Approval, however it can be used with specific host(s) listed at certification

Installation is controlled (usually own host)

- Often used by manufacturers to deal with variations in products

Limited Modular Approval

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
	15C	902.5 - 927.35	0.933		

Limited Modular Approval (LMA). Output Power listed is conducted. Professional installation of this device is required. This Grant is valid only when this transmitter is installed by the Grantee into his products. Installation by other OEMs is expressly prohibited. Compliance of this device in all final host configurations is the responsibility of the Grantee. The antenna(s) used for this device must be installed to provide a separation distance of at least 20 cm from all persons, and must not be co-located or operating in conjunction with any other antenna or transmitter except in accordance with FCC multi-transmitter product procedures. Installers must be provided with antenna installation instructions and transmitter operating conditions for satisfying RF exposure compliance.

Modular Approvals Requirements

The modular transmitter must comply with the antenna requirements of Section 15.203 and 15.204(c).

- The antenna must either be permanently attached or employ a “unique” antenna coupler (at all connections between the module and the antenna, including the cable).
- Any antenna used with the module must be approved with the module, either at the time of initial authorization or through a Class II permissive change. The “professional installation” provision of Section 15.203 may not be applied to modules.

The modular transmitter must be tested in a stand-alone configuration, i.e., the module must not be inside another device during testing.

- This is intended to demonstrate that the module is capable of complying with Part 15 emission limits regardless of the device into which it is eventually installed.
- Unless the transmitter module will be battery powered, it must comply with the AC line conducted requirements found in Section 15.207. AC or DC power lines and data input/output lines connected to the module must not contain ferrites, unless they will be marketed with the module (see Section 15.27(a)). The length of these lines shall be length typical of actual use or, if that length is unknown, at least 10 centimeters to insure that there is no coupling between the case of the module and supporting equipment.
- Any accessories, peripherals, or support equipment connected to the module during testing shall be unmodified and commercially available (see Section 15.31(i)).

Modular Approvals Requirements

The modular transmitter must be labeled with its own FCC ID number.

- if the FCC ID is not visible when the module is installed inside another device, then the host device must contain the FCC ID number with the statement such as the following: “Contains Transmitter Module FCC ID: XYZMODEL1” or “Contains FCC ID: XYZMODEL1.”

The modular transmitter must comply with any specific rule or operating requirements applicable to the transmitter and the manufacturer must provide adequate instructions along with the module to explain any such requirements.

- A copy of these instructions must be included in the application for equipment authorization.

The modular transmitter must comply with any applicable RF exposure requirements.

- FCC Rules in Sections 2.1091, 2.1093 or any specific RF exposure requirements of part 15.

RF Exposure and Modules

Modular devices MUST always consider RF exposure.

What category for RF exposure is the device

- Mobile
- Portable

The grantee of the modular approval is responsible for RF exposure of the module in any host device.

RF Exposure and Modules

Mobile RF exposure

Mobile RF exposure is any device typically or normally used at least 20cm from the body (2.1091(b)).

A modular approval will allow any host device that is of a mobile category to use the module in an unrestricted manner as long as the separation distance requirements and other limitations of the grant are met.

For part 15 modular approvals, MPE is calculated except as specified in 2.1091(c).

- Generally this MPE calculation applies to devices in 15.247 , 15.407 or rule sections where the device output limit is rated in power (watts etc)
- If power exceeds that listed in 2.1091(c), MPE must be measured not calculated.

RF Exposure and Modules

Portable RF exposure

- Any device host that places the radiating elements of a module within 20cm of the body is classified as portable RF category. (2.1091(b)).
- SAR is used to show compliance to RF exposure if the output power is basically greater than 60/fGHz (i.e. 24-25mW at 2.4GHz).
- However, some devices require SAR (routine evaluation) regardless of power (2.1091(c)).
- Both conducted and radiated power should be considered.
  - Many device types at certain frequencies and over certain erp/eirp levels require SAR to be measured – thus both conducted and radiated power need to be evaluated.
- In portable RF configurations ALL antennas are required to be tested, even if of a lower gain than one already tested
- ALL RF portable category modular approvals requiring SAR are Limited Modular Approvals.
  - Recently KDB8447498 D01 allows modular approval for use in any host devices where Stand alone SAR of the module is less than 0.4w/kg or where power is $\leq$60/fGHz and there is NO simultaneous transmission.

RF Exposure and Modules

Portable Limited modular Approval

15.212 states “Limited modular approval also may be granted in those instances where compliance with RF exposure rules is demonstrated only for particular product configurations. **The applicant for certification must state how control of the end product into which the module will be installed will be maintained** such that full compliance of the end product is always ensured.”

Simply put – the original module grantee must control how the module is used in a final host configuration.

RF Exposure and Modules

Portable Limited modular Approval

- If SAR in the host is required (i.e. does not meet KDB8447498(2)(a) requirements), the modular approval is always Limited Modular Approval in a specific Host
  - Reason – SAR is considered host dependent.
  - Compliance responsibility cannot be transferred to the Host manufacturer.
  - The module manufacturer must remember that they are the ones responsible for compliance of their module in **any final host configuration**.

RF Exposure and Modules

Modular Approval scenarios must consider all appropriate KDB (Knowledge Data Base) entries listed on the FCC website.

- Some of the KDBs involved are:
  - KDB248227, KDB447498, KDB616217, KDB648474, KDB844149
- Others may also apply – the grantee needs to make sure testing is done to proper KDB procedures etc.

Licensed Modules

Licensed modular transmitters are not the same as a part 15 Modular Approval.

While having many items in common, licensed modules are not specifically subject to the Modular Approval rules in 15.212 nor DA001407.

These are licensed transmitters and are not subject to the restrictions of part 15 but to the specific licensed rule part.

Licensed Modules

The FCC has issued a guidance document for Licensed Modular transmitters in Oct 2006.

- No significant changes have occurred in this document
- Licensed Modular approval guidance is incorporated in KDB996369 section III

Licensed Modules

Licensed modular transmitter requirements per KDB996369:

- Split-modular approvals or limited split-modular approvals are not permitted for licensed modular devices;
- The applicant may use Section 15.212 provisions for additional guidelines for good engineering practice. In this case, the modular approval cover letter must also include an itemized list documenting compliance with analogous conditions (see Section II A of this document);
- The grantee is required to provide to other parties (e.g., Original Equipment Manufacturers (OEM)) and end users, clear documented instructions to define all the conditions for installing and using the module for the licensed services. This includes clear instructions describing the other party's responsibility to obtain station licensing. These specific instructions are required in the exhibit attachments for a certification application;
- The grantee is responsible for full compliance;

Licensed Modules

Licensed modular grant conditions shall be listed on the grant:

- The maximum antenna gain to ensure compliance with rules, such as EMC (e.g. EIRP, PPSD limits),
- RF exposure requirements and
- Host product limitations;

– An electronic display of the FCC ID is acceptable for licensed modules;

– A licensed module must have a FCC ID label on the module itself - even if the device uses an electronic display. The FCC ID label must be visible through a window or it must be visible on an access panel, door or cover that is easily removed. If neither of the above is possible, a second label must be placed on the outside of the device that contains the following text: Contains FCC ID: XXXNNNNNN;

– Licensed modular devices must be compliant to all specific applicable licensed radio service rules.

Licensed Modules

Licensed modules intended for end-user installation in notebook and tablet computers or similar devices, with pre-installed antennas which would operate in portable RF exposure conditions, must utilize some type of bidirectional authentication function to ensure that only combinations for which SAR routine evaluation has been performed are used together

- Bios Lock Function is OK
- Any other method must be preapproved by the FCC before filing.

Permissive Changes and Modules

When does a module need a PC2?

Basic instructions found in KDB178919

- Antenna changes
- Printed Circuit Board (PCB) and Hardware changes
- Enclosure changes
- Software changes
- Miscellaneous changes

Permissive Changes and Modules

Any portable configuration modular approval or limited modular approval requiring SAR must have a PC2 for any antenna used (higher or lower gain)

- Antenna gain is a far field value and it may not be known what happens to a specific antenna in the near field SAR environment

A module that has a no collocation statement on the grant needs a PC2 in order to collocate with any other transmitter (exceptions may be BT devices or very low power devices. In some instances a PC2 may only need be done on the dominant transmitter)

LMA approvals need a PC2 for any new host not considered electrically and mechanically equal/identical to the host already approved

Modular Approval Problems

The biggest problems are:

- Understanding the 8 requirements
- Understanding that the original grantee is always responsible for the module in the final host.
  - Compliance of the module in any device (host) into which it is installed remains the responsibility of the module grant holder, not the host device manufacturer.
  - Consequently, original grant holder of the module must be able to have control over how it is installed in any host device.

Finally……

You have received your FCC Grant and your IC Certificate…..

FCC: Start shipping to the USA, once you have taken care of any other authorisations

IC: Watch the IC website for your certification to appear, then you can proceed with shipping

Telecommunication Certification Bodyt

TCBC: TCB Council

Semi-Annual Training

Industry – FCC – Market Partners

March & October: Baltimore, MD

TCB Training Update

Market Surveillance: US

Fraudulent Test Reports allegedly found

FCC taking action through TCBs

Market Surveillance WG: EU

Issues and Goals:

- How to deal with non-compliant products over the internet
- How to do more with less resources?
- Establish global cooperation
- Improve cooperation between industry, NBs, customs
- Education industry and consumers

TCB Training Update

FCC Issues:

New Grantee Codes being assigned

Old codes not being changed

New Grantee Code Process

- Grantee code = 5 characters
- Product code = maximum of 14 characters #GGGGPPPPPPPPPPPPPP

10 million new grantee codes

Expect implementation by first quarter 2013

TCB Training Update

Following Draft KDBs published after receiving many comments:

KDB 447498 – General RF Exposure Policy

KDB 616217 – SAR for Laptops

KDB 648474 – SAR for Handsets

KDB 865664 – SAR Measurement Procedures

KDB 941225 – SAR for LTE devices

Establish transition period during which old and new guidance may be used

TCB Training Update

More KDBs

KDB 628591 – TCB Exclusion List

KDB 388624 – Permit-but-Ask List

KDB 178919 – Permissive Change guidance

KDB 442812 – SDR Guidance

KDB 594280 – Software Configuration Policy

KDB 690783 – SAR Grant Listing Policy

KDB 579009 – VHF/UHF Narrowbanding

TCB Training Update

Topics:

NIST MRA Updates

Industry Canada Updates

Market Surveillance

FCC Issues

Power Measurement

RF Exposure Topics

Wireless Charging

RTTE & EMC Directive Updates

TCB Training Update

Draft KDB 865664: 100MHz-6 GHz

- SAR Probe Calibration
- Tissue Dielectric Parameters
- SAR Measurement Requirements
- Simultaneous Transmission SAR
- Enlarged Zoom Scan and Volume Scan Post-Processing
- Measurement Variability and Uncertainty
- SAR System Validation
- SAR System Verification

TCB Training Update

- Draft KDB 648474: SAR for Handsets with Multiple Transmitters and Antennas
- Simultaneous Voice and Data
- Power Reduction Considerations
- NFC (near-field coupling) and Wireless Charging
- VoIP Support
- SAM Phantom Limitations

TCB Training Update

Draft KDB 941225: SAR for LTE Devices

Revisions of LTE

Standlone SAR Requirements

Simultaneous Transmission SAR

TCB Training Update

PBA List

- Dynamic antenna tuning; except for fixed table look-up implementations that result in static tuning conditions
- Power reduction; except for single fixed level table look-up implementations triggered by single operating mode and event or power reduction is not for SAR compliance and SAR is tested at maximum full power
- Proximity sensor; except when published RF exposure KDB procedures can be applied to the specific implementation
- Channel and carrier aggregation and wide band transmissions exceeding SAR probe calibration or tissue dielectric requirements
- Wireless charging applications; except when published RF exposure KDB procedures are available for the specific implementation; for example, certain WPC implementations on cellphone battery covers

TCB Training Update

Topics:

NIST MRA Updates

Industry Canada Updates

Market Surveillance

FCC Issues

Power Measurement

RF Exposure Topics

Wireless Charging

RTTE & EMC Directive Updates

TCB Training Update

Wireless Charging

TCB Training Update

Wireless Charging

- May be approved under Part 15, Part 18 or both Rule Parts
- Chargers and clients are generally approved separately, however they should satisfy compliance in both standalone and as a system
- Part 18 Authorization for the charger and clients
  - Load and power management must be integral to wireless operation
  - May NOT communicate information NOT related to power management
  - Locally generated and used energy (Part 18)
  - Other communications authorized under Part 15

TCB Training Update

Wireless Charging

- RF Exposure must be evaluated
  - Determined for charging under worst case
  - Portable and mobile considerations
  - However, frequencies for SAR evaluation > 100 MHz
- PBA!

Break!

Japan Wireless Certification

Overview

- Background
- Overview of Process
- Standards and Technical Requirements
  - Lab requirements
- Example Filing
- Documentation for Filing

Who are the players??

Ministry of Internal Affairs and Communications **(MIC)** Regulators

Telecommunications Engineering Center **(TELEC)** runs the certification program for MIC

Association of Radio Industries and Business (ARIB): Writes Specifications

Mutual Recognition Agreement

- Allows formation of Recognized Certification Bodies (RCBs) in the US for Japan Certification
- Took several years to develop

  (EU/Japan MRA in place since Jan 2002)

Section IV: Regulatory Authority

UNITED STATES	JAPAN
Federal Communications Commission (FCC) or an authority succeeding this commission	Ministry of Internal Affairs and Communications or an authority succeeding this ministry

US Japan MRA

Entered into force January 2008

Effectively Implemented with first RCBs in the United States in late 2010

A2LA and ANSI accredit to the Japanese Specifications

Scopes of US-Japan MRA

Equipment Scopes

A1/A2: Terminal Equipment

B1/B2/B3: Radio Equipment

CAB/RCB must have capability to certify all classes of equipment covered under each scope (All of B1, for example).

Overview of Process

Radio Approvals Mandatory

Four main classes of products:

1. License-free (very low power)
2. Unlicensed (BT, cordless phones, WLAN)
3. Licensed
4. Special*

*Only MIC can approve

Regulations and Specifications

Japan Radio Law (Number 131):

Procedure (akin to Part 2 of FCC)

http://www.soumu.go.jp/main_sosiki/joho_tsusin/eng/Resources/laws/2003RL.pdf

Ordinances

Technical Requirements

Regulation 18: http://www.tele.soumu.go.jp/resource/e/equ/tech/orre.pdf

Telec

Summary of Technical Requirements

Association of Radio Industries and Businesses (ARIB)

Procedures

Overview of Transmitter Certification

1. **Chapter 3 of Radio Law: Regulations and Conformity Assessment Processes**
2. **Ordinances 18 (Regulations) and 37 (Procedure)**
3. **Reference or RF Data Base: Summary of Requirements**
4. **ARIB Standards: Methods**
5. **Assessment performed by CAB (Japan) or RCB (Foreign)**
6. **Issuance of Number by the CAB/RCB**
7. **Notification to MIC (equipment, type and number)**

Excerpt from Article 38-2:
Specified Radio Equipment

Specified Categories

Print

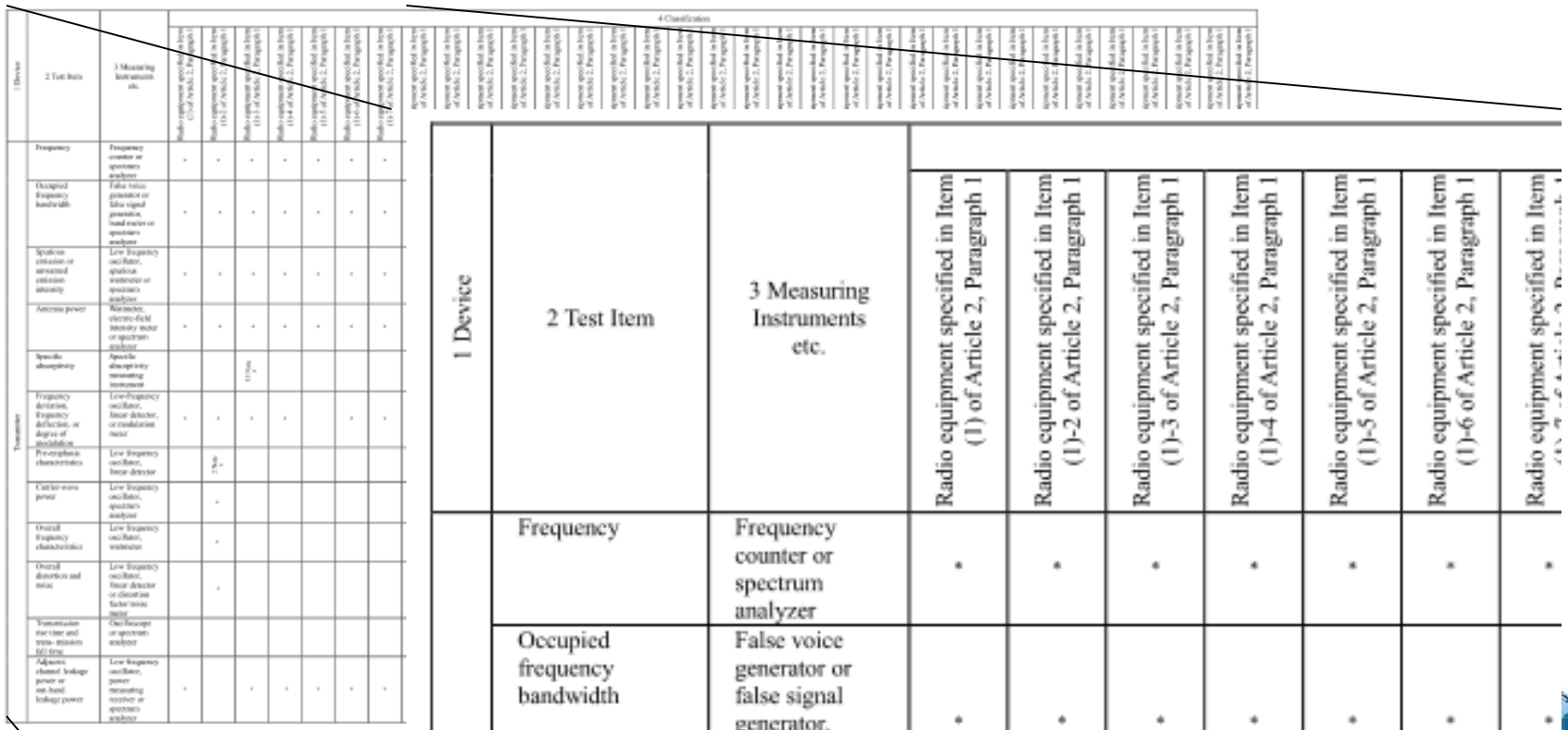
- 1.Specified Radio Equipment specified in Article 38-2, paragraph 1, item 1 of the Radio Law
- 2.Specified Radio Equipment specified in Article 38-2, paragraph 1, item 2 of the Radio Law
- 3.Special Specified Radio Equipment
- 4.Specified Radio Equipment specified in Article 38-2, paragraph 1, item 3 of the Radio Law

1.Specified Radio Equipment specified in Article 38-2, paragraph 1, item 1 of the Radio Law

Specified Radio Equipment	Ordinance of MPT No.37, 1981 (*)	Mark
Citizen radio	Article 2 paragraph 1 item (3)	O
Cordless telephone	Article 2 paragraph 1 item (7)	L
Specified low power radio equipment	Article 2 paragraph 1 item (8)	Y
Low power security system	Article 2 paragraph 1 item (13)	AZ
Low power data communications system in the 2.4GHz band	Article 2 paragraph 1 item (19)	WW
Low power data communications system in the 2.4GHz band (for radio control model aircraft, 2400-2483.5MHz)	Article 2 paragraph 1 item (19)-2-2	UV
Low power data communications system in the 2.4GHz band (for radio control model aircraft, 2471-2497MHz)	Article 2 paragraph 1 item (19)-2-3	VV

Requirements (Ordinance 37)

Table 1



1 Device	2 Test Item	3 Measuring Instruments etc.	4 Classification: Radio equipment specified in Item (1) of Article 2, Paragraph 1	Radio equipment specified in Item (1)-2 of Article 2, Paragraph 1	Radio equipment specified in Item (1)-3 of Article 2, Paragraph 1	Radio equipment specified in Item (1)-4 of Article 2, Paragraph 1	Radio equipment specified in Item (1)-5 of Article 2, Paragraph 1	Radio equipment specified in Item (1)-6 of Article 2, Paragraph 1	Radio equipment specified in Item
Transmitter	Frequency	Frequency counter or spectrum analyzer	*	*	*	*	*	*	*
	Occupied frequency bandwidth	False voice generator or false signal generator, band meter or spectrum analyzer	*	*	*	*	*	*	*
	Spurious emission or unwanted emission intensity	Low frequency oscillator, spurious wattmeter or spectrum analyzer	*	*	*	*	*	*	*

FCC,

Summary Requirements

Equipment		Transmitter													Receiver	
	No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Test items / Classification of Radio Equipment		Frequency	Occupied Bandwidth	Spurious Emission Intensity	Antenna Power	SAR (Specific Absorption Ratio)	Degree of modulation or Frequency Deviation or Shift	Pre-emphasis Characteristics	Carrier Power	Overall Frequency Response	Overall Distortion and Noise	Transmission Rise and Fall time	Adjacent Channel Leakage Power or Out-band Leakage Power	Leakage Power at no-carrier transmission	Transmission Rate	Limit of secondary radiated emissions (Spurious Emissions)	Sensitivity '
Land mobile station for MC-CDMA cellular radio telephone		★	★	★	★	★							★	★	★	★	
Base station, etc. for DS-CDMA cellular radio telephone		★	★	★	★								★		★	★	
2.4GHz band wide band low-power data communication system		★	★	★	★											★	
INMARSAT portable mobile earth station		★	★	★	★										★	★	

Classification of Radio Equipment:

http://www.telec.or.jp/ENG/E-002.HTM: Good Summary

Classification of radio equipment for certification

	Short title of radio equipment (Certification Ordinance)	Description of radio equipment
1)	MCA (Item 1-4of Article 2 Paragraph 1)	Radio equipment for land mobile or command station used for MCA land mobile communications (antenna power: 50W or less)
2)	Airport MCA (Item 1-8 of Article2 Paragraph 1)	Radio equipment for land mobile station used for airport radio telephone communications (antenna power: 50W or less)
3)	SSB (Item 1-9 of Article 2 Paragraph 1)	Radio equipment for land mobile or portable station that uses single-sideband radio waves (antenna power: 50W or less)
4)	Digital radio (Item 1-10 of Article 2 Paragraph 1)	Radio equipment for land mobile or portable station that uses an F1B, F1C, F1D, F1E, F1F, F1N, F1X, G1B, G1C, G1D, G1E, G1F, G1N or G1X radio wave, excluding the equipment specified in Item 1), 2) and 4) (antenna power: 50W or less)
5)	F3E radio etc (Item 1-11 of Article 2 Paragraph 1)	Radio equipment for land mobile or portable station that uses an F2A, F2B, F2C, F2D, F2N, F2X or F3E radio wave, excluding the equipment specified in Item 1), 2) and 3) (antenna power: 50W or less)
6)	Specified radio microphone (Item 1-12 of Article 2 Paragraph 1)	Specified radio microphone with antenna power of 0.01W or less
7)	Maritime DSB (Item 1-13 of Article 2 Paragraph 1)	Radio equipment for maritime mobile radio station using an A3E radio wave of 26.1 - 28 MHz, 29.7 - 41 MHz or 146 - 162.0375 MHz (antenna power: 50W or less)
8)	SSB	Radio equipment for radio station that uses a single-sideband radio

104 Items……

Technical Specifications:
http://www.telec.or.jp/ENG/E_T203.html

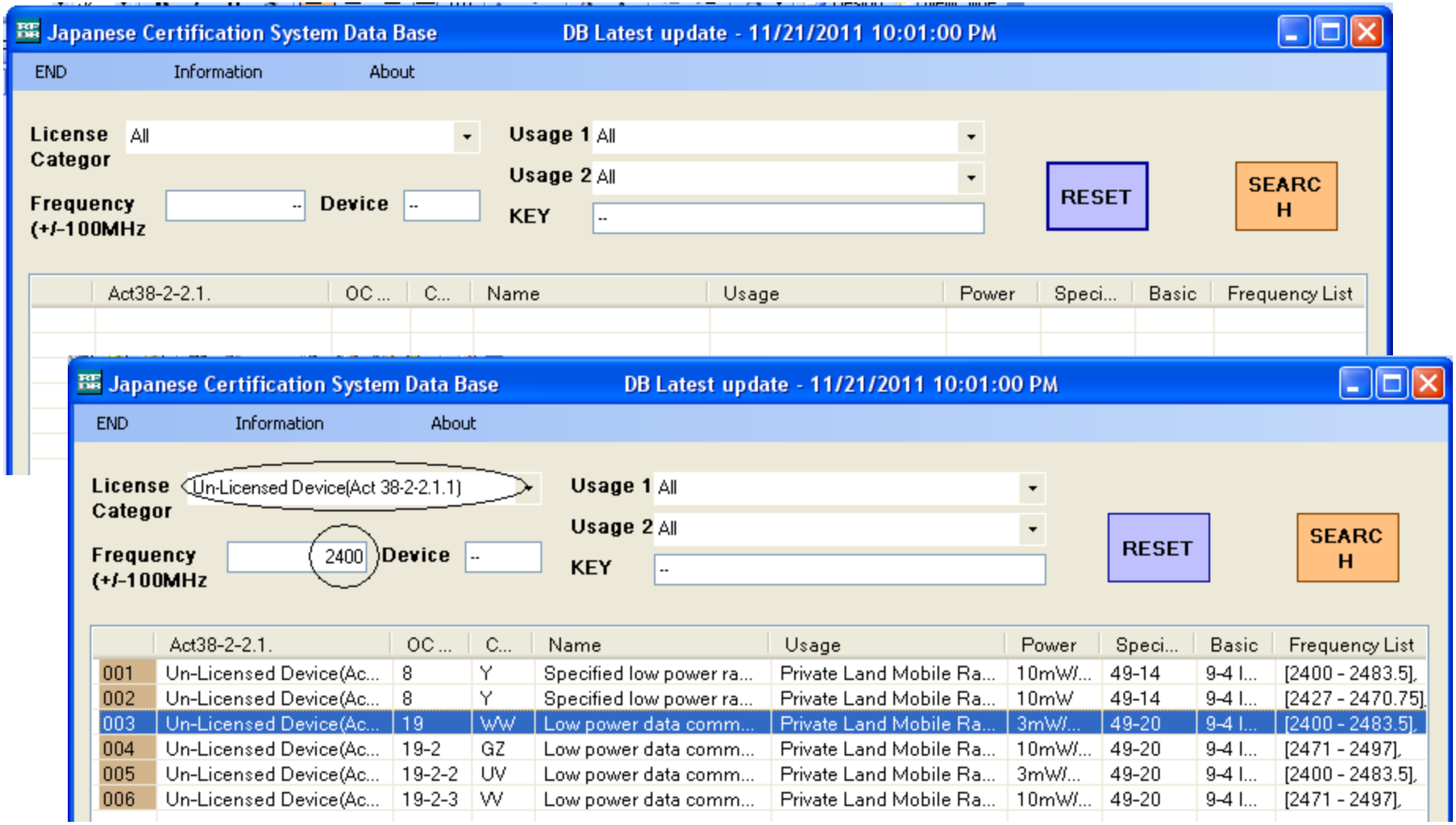
Example: MCA (Mobile Comm Services on Aircraft)

MCA (Item 1-4 of Article 2 Paragraph 1 of Certification Ordinance)

Short title of rad (Certification (
1) MCA (Item 1-4of Artic
2) Airport MCA (Item 1-8 of Arti
3) SSB (Item 1-9 of Arti
4) Digital radio (Item 1-10 of Ar 1)
5) F3E radio etc (Item 1-11 of Ar 1)
6) Specified radio n (Item 1-12 of Ar 1)
7) Maritime DSB (Item 1-13 of Ar

Test items		Technical standards
		Narrow-band
Class of emissions		F2 CDFX F3 CDEFX
Assigned frequency or designated frequency		905.0125 - 914.9875MHz
Number of channels and channel separation		1597 6.25kHz interleave
Tolerance of frequency ($\times 10^{-6}$)		2
Tolerance of occupied bandwidth		8.5kHz
Tolerance of spurious and unwanted emission intensity	1W or less	25μW
	Over 1W	-60dB (and 1mW for spurious)
Antenna power	Designated value	30W or less
	Tolerance	+20%, -50%
Maximum frequency deviation or shift		±2.5kHz
Tolerance of adjacent channel leakage power		-60dB
		Antenna power reduction Frequency selection

Third-Party Resource:
“RF Database” DSP Research



RF Database

Low power data communications system in the 2.4GHz band

RF Act Un-Licensed Device(Act 38-2-2.1.1)

Radio Equipment Name Low power data communications system in the 2.4GHz band

Usage Private Land Mobile Radio Services/for Data Communication/Wireless LAN, Bluetooth, ZigBee, Ant

Ordinance concerning Technical Regulations Conformity Certification etc. of Specified

Article 2, Para 1, Item 19 **Category Code** W

Ordinance regulating Radio Equipment(OT)

Basic

Article 5 Frequency Tolerance
Article 6 Occupied Bandwidth
Article 7 Spurious & Unwanted Emission Intensity
Article 14 Tolerance for Antenna Power
Article 15 Condition for Frequency Stabilization
Article 24 Secondary Radiated Emissions
Article 9-4 Interference Prevention Function

Specific Article 49-20

Output 3mW/MHz (FH, FH+DS, FH+OFDM method, except using frequency between 2427 - 2470.75MHz)10mW/MHz (DS method and except above method)10mW/MHz (OFDM method of OBW less than 26MHz)5mW/MHz (OFDM method of OBW between 26 - 38MHz)10mW (except above methods)

Frequency List(MHz)

[2400 - 2483.5],

RF Database

Article 2 Paragraph 1 of Certification Ordinance	Item 19	Category code	WW
Radio Equipment Name	Low Power Data Communication System in the 2.4GHz band (2400 - 2483.5MHz)		
Usage	Private Land Mobile Radio Services, Data Communication, Wireless LAN, Bluetooth, ZigBee		

Items	Technical Requirement			Quotation
Communication Method	One-way, Simplex, Half-Duplex, Duplex			OT : Article49-20
Modulation Method	SS			OT : Article49-20
	DSSS	FHSS (Compound method with DSSS or OFDM)		
Frequency Allocation	2400MHz – 2483.5MHz	2400MHz - 2483.5MHz	2427MHz – 2470.75MHz	OT : Article49-20
Frequency Tolerance	±50ppm			OT : Article5 OT : Annex1 7-12
Output Power	10mW/MHz	3mW/MHz	10mW/MHz	OT : Article49-20
Output Power Tolerance	+20% -80%			OT : Article14 7
Spreading Bandwidth	500kHz or more			OT : Article49-20
Occupied Bandwidth	26MHz	83.5MHz		OT : Article6 OT : Annex2 30
Spurious Emission/ Unwanted Emission Strength, Spurious area	30MHz - 2387MHz ; 2.5uW/MHz 2387MHz – 2400MHz ; 25uW/MHz 2483.5MHz – 2496.5MHz ; 25uW/MHz 2496.5MHz – 12.5GHz ; 2.5uW/MHz			OT : Article7 OT : Annex3 26

RF Database

E.I.R.P	12.14dBm/MHz - 22.14dBm/MHz	6.91dBm/MHz - 16.91dBm/MHz	12.14dBm/MHz - 22.14dBm/MHz	OT : Article49-20
Secondary Radiated Emission Strength	< 1GHz ; 4nW 1GHz≤ ; 20nW			OT : Article24 2
Antenna Absolute Gain	12.14dBi or less （When an EIRP is less than a limit, the shortage shall be compensated for by the gain of the transmitting antenna.）			OT : Article49-20
Half Power Beam Angle.	HPBA (degree) = 360 / A A = EIRP / (2.14dBi + Output Power(10mW/MHz, 3mW/MHz)) Shall be 1 when A is lower than 1.			OT : Article49-20
Carrier Sensing Function	—			—
Spreading Factor	5 or more			OT : Article49-20
Dwell Time (Integrated dwell time)	—	0.4sec. or less (0.4sec. or less *Except compound method)		OT : Article49-20

Housing requirements	The hig shall nc	
Interference Prevention Function	Chiefly, wireles	
Condition for Frequency Stabilization — Voltage fluctuation	1. In t The po 2. Oth The po can be machi source	
Condition for Frequency Stabilization — Environment	—	
Condition for Frequency Stabilization — Vibration	—	
Other Requirement	OT : th RL : Re	

Carrier Sensing Function	Required	—	OT : Article49-20
Spreading Factor	—		—
Dwell Time	—		—
Housing requirements	The radio equipment shall be housed in a single cabinet, and the cabinet shall not be capable of being opened easily. (except for the antenna system)		OT : Article49-20
Interference Prevention Function	Chiefly, the one automatically to transmit and to receive identification code with the wireless equipment of the wireless station used in the same premises.		OT : Article9-4 9 RL : Article6-2 3
Condition for Frequency Stabilization — Voltage fluctuation	1. In the case of a characteristic test in the technical regulations conformity certification The power supply supplies the voltage rating. 2. Other cases The power supply supplies the voltage rating and the voltage rating ±10%. However, when it can be confirmed that the change of the input voltage to the wireless part circuit of the testing machine is ±1% or less when the input voltage to the testing machine from the external source changes at ±10%, examines it only by the voltage rating.		OT : Article15 1
Condition for Frequency Stabilization — Environment	—		
Condition for Frequency Stabilization — Vibration	—		
Other Requirement	OT : the ordinance regulating radio equipment RL : Regulations for Enforcement of the Radio Law		

RF Database

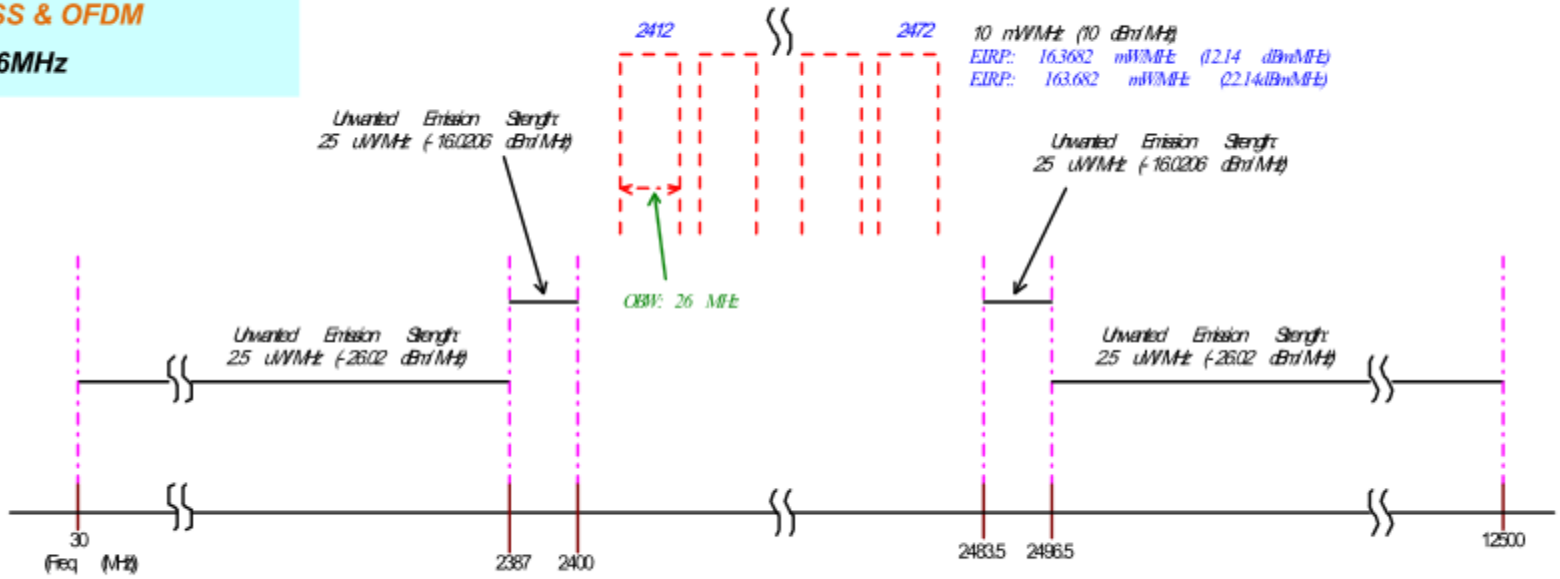
Items	Technical Requirement			Quotation
Communication Method	One-way, Simplex, Half-Duplex, Duplex			OT : Article49-20
Modulation Method	OFDM		Other Digital Methods	OT : Article49-20
Frequency Allocation	2400MHz – 2483.5MHz			OT : Article49-20
Frequency Tolerance	±50ppm			OT : Article5 OT : Annex1 7-12
Output Power	5mW/MHz	10mW/MHz	10mW	OT : Article49-20
Output Power Tolerance	+20% -80%			OT : Article14 7
Spreading Bandwidth	—			—
Occupied Bandwidth	38MHz	26MHz		OT : Article6 OT : Annex2 30
Spurious Emission/ Unwanted Emission Strength, Spurious area	30MHz - 2387MHz ; 2.5uW/MHz 2387MHz – 2400MHz ; 25uW/MHz 2483.5MHz – 2496.5MHz ; 25uW/MHz 2496.5MHz – 12.5GHz ; 2.5uW/MHz			OT : Article7 OT : Annex3 26
E.I.R.P	9.13dBm/MHz - 19.13dBm/MHz	12.14dBm/MHz - 22.14dBm/MHz	12.14dBm – 22.14dBm	OT : Article49-20
Secondary Radiated Emission Strength	< 1GHz ; 4nW 1GHz≤ ; 20nW			OT : Article24 10
Antenna Absolute Gain	12.14dBi or less (When an EIRP is less than a limit, the shortage shall be compensated for by the gain of the transmitting antenna.)			OT : Article49-20
Half Power Beam Angle.	HPBA (degree) = 360 / A A = EIRP / (2.14dBi + Output Power(10mW/MHz, 5mW/MHz, 10mW)) Shall be 1 when A is lower than 1.			OT : Article49-20

FCC, IC and EU Regulations

RF Database

Type DSSS & OFDM

/OBW≤ 26MHz



Type FHSS

46 Entries around 900 MHz (+/-100MHz)

Japanese Certification System Data Base DB Latest update - 11/21/2011 10:01:00 PM

END Information About

License Categor: All Usage 1: All Usage 2: All KEY: -- Frequency (+/-100MHz): 900 Device: -- RESET SEARCH

	Act38-2-2.1.	OC ...	C...	Name	Usage	Power	Speci...	Basic	Frequer
001	Un-Licensed Device(Act 38-2-2.1.1)	8	Y	Specified low power ra...	Private Land Mobile Ra...	1mW (...	49-14	9-4 l...	[950.8 -
002	Un-Licensed Device(Act 38-2-2.1.1)	8	Y	Specified low power ra...	Private Land Mobile Ra...	10mW	49-14	9-4 l...	[806.125
003	Un-Licensed Device(Act 38-2-2.1.1)	8	Y	Specified low power ra...	Private Land Mobile Ra...	10mW	49-14	9-4 l...	[952 - 95
004	Blanket-Licensed Device(Act 38-2-2.1.2)	1-4	M	MCA (Land Mobile Stati...	Private Land Mobile Ra...	10W	49-7		[905 - 91
005	Blanket-Licensed Device(Act 38-2-2.1.2)	1-4	N	MCA (Land Mobile Stati...	Private Land Mobile Ra...	10W	49-7		[905 - 91
006	Blanket-Licensed Device(Act 38-2-2.1.2)	10	VT	Mobile Relay Station/L...	Public Telecommunicat...	40mW ...	49-6		[815 - 85
007	Blanket-Licensed Device(Act 38-2-2.1.2)	10-2	W	TDMA cellular phone	Public Telecommunicat...	5W	49-6-2	14-2 ...	[940 - 95
008	Blanket-Licensed Device(Act 38-2-2.1.2)	10-2	W	TDMA cellular phone	Public Telecommunicat...	5W	49-6-2	14-2 ...	[940 - 95
009	Blanket-Licensed Device(Act 38-2-2.1.2)	11	XZ	CDMA cellular phone (...	Public Telecommunicat...	1W	49-6-3	14-2 ...	[815 - 85
010	Blanket-Licensed Device(Act 38-2-2.1.2)	11-3	XY	WCDMA cellular phone...	Public Telecommunicat...	24dBm	49-6-4	14-2 ...	[815 - 85
011	Blanket-Licensed Device(Act 38-2-2.1.2)	11-7	MW	DS-CDMA (HSDPA) cel...	Public Telecommunicat...	24dBm	49-6-5	14-2 ...	[815 - 85
012	Blanket-Licensed Device(Act 38-2-2.1.2)	11-8	NX	CDMA2000 (1xEV-DO) ...	Public Telecommunicat...	24dB...	49-6-5	14-2 ...	[815 - 85
013	Blanket-Licensed Device(Act 38-2-2.1.2)	11-8-2	XU	CDMA2000 (3xEV-DO) ...	Public Telecommunicat...	24dB...	49-6-5	14-2 ...	[815 - 85
014	Blanket-Licensed Device(Act 38-2-2.1.2)	11-19	HU	SC-FDMA (LTE) FDD c...	Public Telecommunicat...	23dBm	49-6-9	14-2 ...	[815 - 85
015	Blanket-Licensed Device(Act 38-2-2.1.2)	11-23	LU	OFDMA (UMB) FDD cel...	Public Telecommunicat...	23dBm	49-6-11	14-2 ...	[815 - 85
016	Blanket-Licensed Device(Act 38-2-2.1.2)	20-2	VX	Digital MCA (800MHz b...	Private Land Mobile Ra...	2W	49-7-3		[905.025
017	Licensed Device(Act 38-2-2.1.3)	1-4	M	MCA (except for land m...	Private Land Mobile Ra...	10,v	49-7		[905 - 91
018	Licensed Device(Act 38-2-2.1.3)	1-4	N	MCA (except for land m...	Private Land Mobile Ra...	10W	49-7		[905 - 91
019	Licensed Device(Act 38-2-2.1.3)	1-10	D	Angle-modulation syste...	Private Land Mobile Ra...	50W	57-3		[54 - 76]
020	Licensed Device(Act 38-2-2.1.3)	1-12	B	Specified radio microp...	Private Land Mobile Ra...	10mW	49-16		[779 - 78
021	Licensed Device(Act 38-2-2.1.3)	1-12	B	Specified radio microp...	Private Land Mobile Ra...	10mW	49-16		[779 - 78
022	Licensed Device(Act 38-2-2.1.3)	1-12-2	CU	Specified digital radio ...	Private Land Mobile Ra...	50mW	49-16-2		[770 - 80
023	Licensed Device(Act 38-2-2.1.3)	4	R	Convenience radio (90...	Private Land Mobile Ra...	5W	54-1-4		[903.012
024	Licensed Device(Act 38-2-2.1.3)	4	U	Convenience radio (90...	Private Land Mobile Ra...	5W	54-1-4		[903.012
025	Licensed Device(Act 38-2-2.1.3)	4-7	WU	Convenience radio (95...	Private Land Mobile Ra...	0.25W	54-1-5		[952 - 95
026	Licensed Device(Act 38-2-2.1.3)	6	A	Premises radio/UHF Ba...	Private Land Mobile Ra...	1W	49-9		[952 - 95
027	Licensed Device(Act 38-2-2.1.3)	6-2	PV	Premises radio (950M...	Private Land Mobile Ra...	1W	49-9		[952 - 95

Equipment Categories

Category 1: **Unlicensed station: 17 classes**

(Specified Radio Equipment specified in Article 38-2, paragraph 1, item 1 of the Radio Act)

Category 2: **Licensed station (Blanket License): 31 classes (i.e., mobile phones)**

(Specified Radio Equipment specified in Article 38-2, paragraph 1, item 2 of the Radio Act)

Category 3: **Licensed station (Others): 75 classes (*subject to simplified licensing procedure or registration)* (i.e., basestations)**

(Specified Radio Equipment specified in Article 38-2, paragraph 1, item 3 of the Radio Act)

Core Review Items

1. Transmitter
   - Rated output power
   - Available type of emissions and frequency range
   - Oscillation
   - Modulation
2. Device Information
   - Manufacturer's name
   - Model name
3. Antenna
   - Model name and configuration
   - Gain
4. Information on associated/ancillary equipment
5. Drawings
   - System diagram

References & Supporting Documentation

Types of W-LAN in Japan

Low power data communications system in the 2.4GHz band (2,400 - 2,483.5MHz)

Low power data communications system in the 2.4GHz band (2,471 - 2,497MHz)

Low power data communications system in the 5.2, 5.3GHz band

Low power data communications system in the 5.6GHz band

Technical Standards: 2,400 - 2,483.5MHz

1. **Frequency Range:** 2,400MHz to 2,483.5MHz
2. **Tolerance of frequency (Hz):** 50 x 10^{-6} (-20C to +70C)
3. **Occupied bandwidth (occupancy band)**

FH	83.5MHz
FH+DS	83.5MHz
FH+OFDM	83.5MHz
OFDM	38MHz
Others	26MHz

4. **Unwanted emission intensity (out of band emissions)**

(1) 2,387MHz or less	2.5μW/MHz
(2) 2,387MHz to 2,400MHz	25μW/MHz
(3) 2,483.5MHz to 2,496.5MHz	25μW/MHz
(4) 2,496.5MHz or more	2.5μW/MHz

Technical Standards: 2,400 - 2,483.5MHz

5. Antenna power

(1) FH, FH+DS, FH+OFDM: 3mW/MHz (2427 - 2470.75MHz)

(2) Other than (1) of DS: 10mW/MHz

(3) Other than (1) of OFDM:

Occupied bandwidth ≤ 26MHz: 10mW/MHz

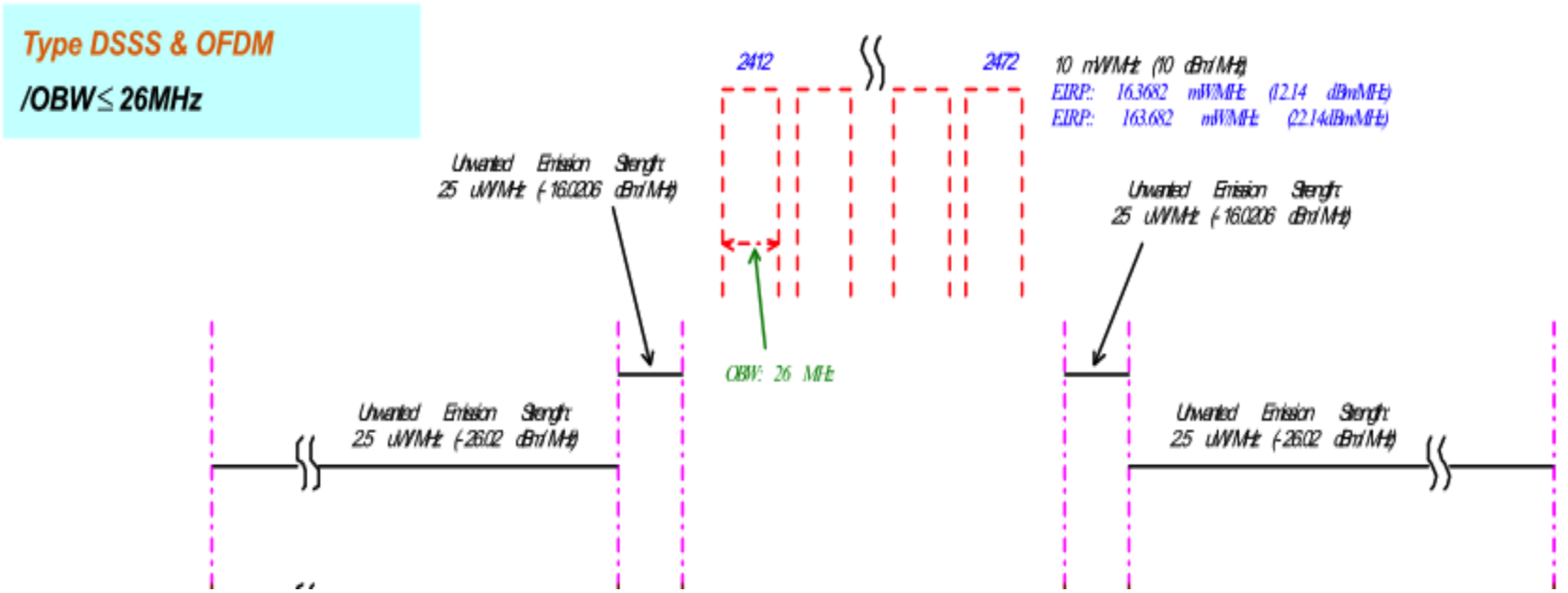
26MHz < Occupied bandwidth ≤ 38MHz: 5mW/MHz

Other than (1), (2) & (3): 10mW

Antenna Power Tolerance: **+20% -80%**

Spreading bandwidth: **DS, FH, FH + DS, FH + OFDM 500KHz or more**

2400-2483.5 MHz Limits



FCC, IC and EU Regulations

Technical Standard: 2,400 - 2,483.5MHz

6. Holding time of hopping frequency

FH+DS, FH+OFDM: 0.4s or less

FH : The total sum of holding time at arbitrary frequencies within the time multiplied 0.4 sec by the spreading ratio shall be 0.4sec or less.

7. Limit of secondary radiated emissions

(1) 1GHz or less: 4nW or less
(2) 1GHz to 10GHz: 20nW or less
(3) 10GHz or more: 20nW or less

8. Interference prevention function

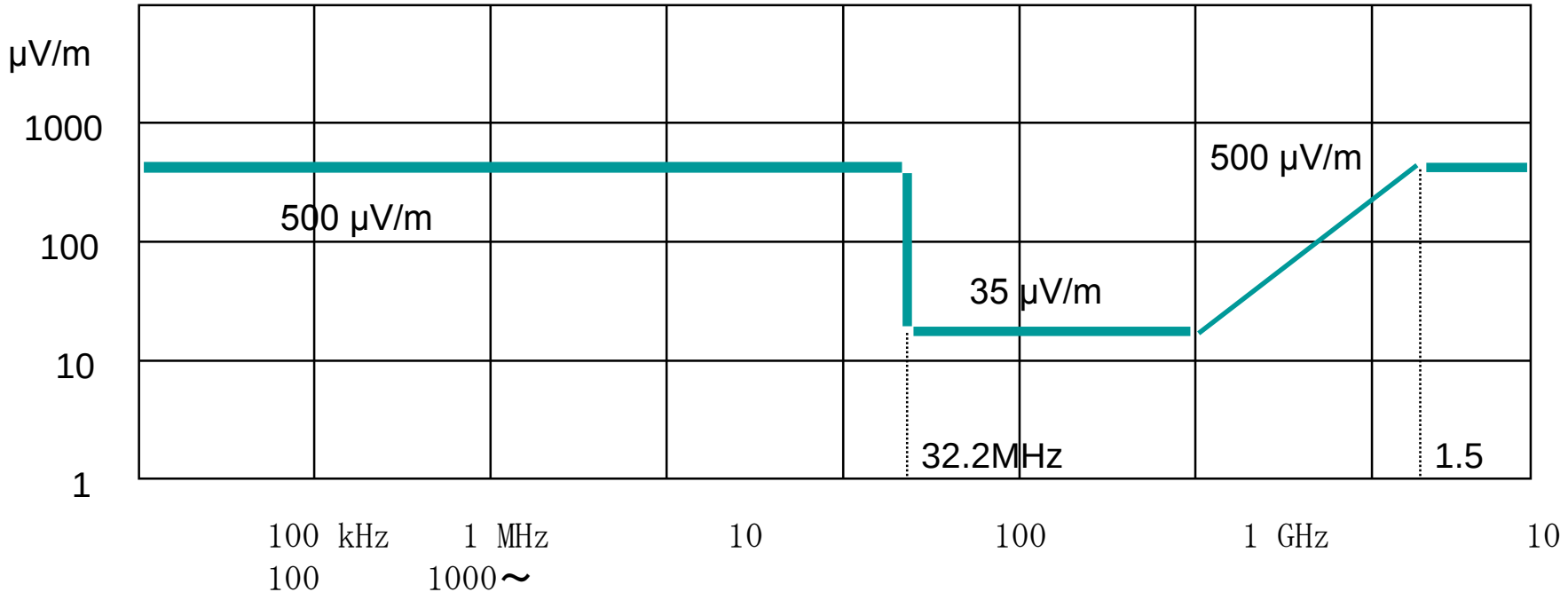
Shall have the function of automatic transmission or reception of identification code.

Example: RFID Technologies

135KHz or less (passive)
13.56MHz band (passive)
Inductive reading and writing radio communication equipment
433MHz band (active)
For international transportation data transmission
950MHz band
For Identification of Moving Objects (passive)
For Telemeter, Tele-control and Data transmission (active)
2.45GHz band (passive & active)

Very Low Power Transmitters

License-exempt, certification exempt



Test Method: http://www.tele.soumu.go.jp/j/material/dwn/kouzi2.pdf (in Japanese only)

Modular Approvals: “Independent of Host’

Modular type device can be approved under the following conditions:

1. Equipment must have:
    1. Antenna, high frequency section, modulation section, auxiliary equipment (indicator, etc) and a control section (including power supply).
    2. The control section may include external equipment which is supposed to be connected to the control part under certain interface conditions.
2. If the equipment is supposed to be installed in a host, it must be “easily disconnected”

Accreditation Requirements

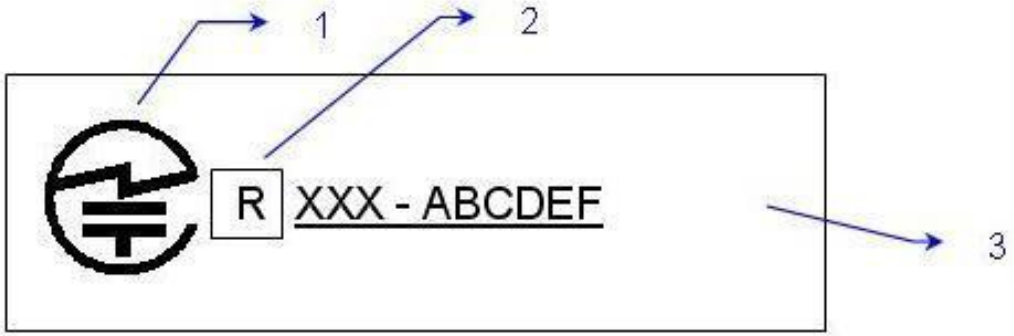
- ISO 17025 is not common practice in Japan
- The “kyoruko” practice is prevalent in society, not unlike the original radio days of FCC Type Acceptance and Type Approval
- Individual competence is rated
- Stumbling block for NIST during implementation discussions

Essentials

Measurement Methods: Must be same or "equivalent" to MIC-accepted methods

Data Acceptance: Our process mandates data from a 17025 accredited lab, however, a "confidence factor" is part of the Japanese regimen

Labeling



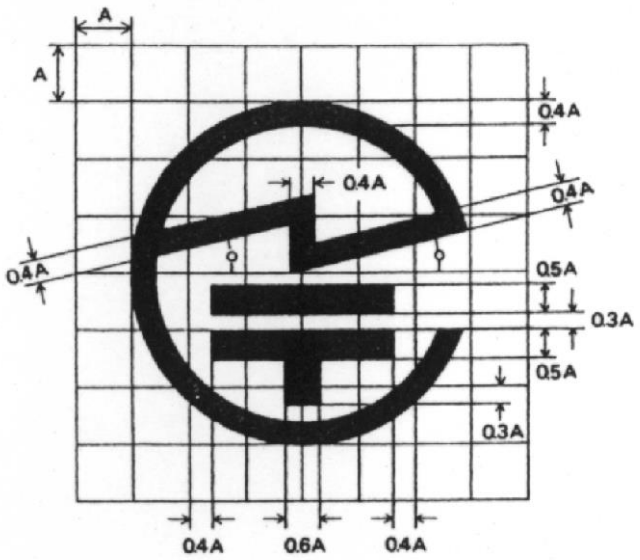
1. GITEKI (MIC) Mark
The diameter of the mark must be 5 mm or greater. (If the volume of certified equipment is less than 100 cc, the diameter of the mark may be 3 mm or greater).

2. Symbol of Radio Certification
Put 'R' in the square as it is shown above

3. Certified Type Number
Certified Type Number specific to this device. Details of this number are given below.

Labeling

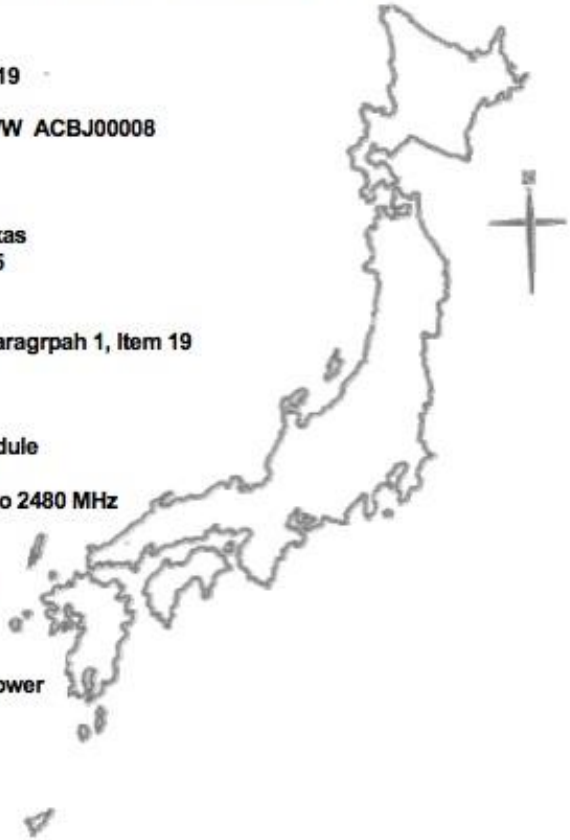
Mark Details



1) Diameter of the mark shall be > 5 mr
2) If volume of the equipment is 100 cc or less, the diameter shall be 3 mm or more.

American Certification Body Inc.
6731 Whittier Ave, Suite C110, McLean, VA 22101
Ph: (703) 847-4700, Fax: (703) 847-6888

JAPAN CERTIFICATE OF CONSTRUCTION TYPE



CERTIFICATION No.	►	**ATCB011119**
RADIO LABEL MARKING	►	**R 209 WW ACBJ00008**
ISSUED TO	►	**Austin, Texas USA, 78735**
CLASSIFICATION OF SPECIFIED RADIO EQUIPMENT	►	**article 2, Paragrpah 1, Item 19**
MODEL / NAME OF EQUIPMENT	►	**Zigbee Module**
FREQUENCY RANGE	►	**2405 MHz to 2480 MHz**
EMISSION DESIGNATION	►	**2M93F1D**
R.F. POWER RATING	►	**2.92mW Antenna power**

This is to Certify that the above Type Certification has been granted in accordance with the provisions of Article 38-24 Paragraph 1 of the Radio Law.

ORIGINAL DATE OF ISSUE: Oct 1, 2011
REVISED DATE OF ISSUE: N/A

FCC, IC

QUESTIONS

Thank you!

THANK YOU!

Mike Violette

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