Maritime (Part 80) and Aviation (Part 87) Radio Services - Details

October 2005
TCB Workshop

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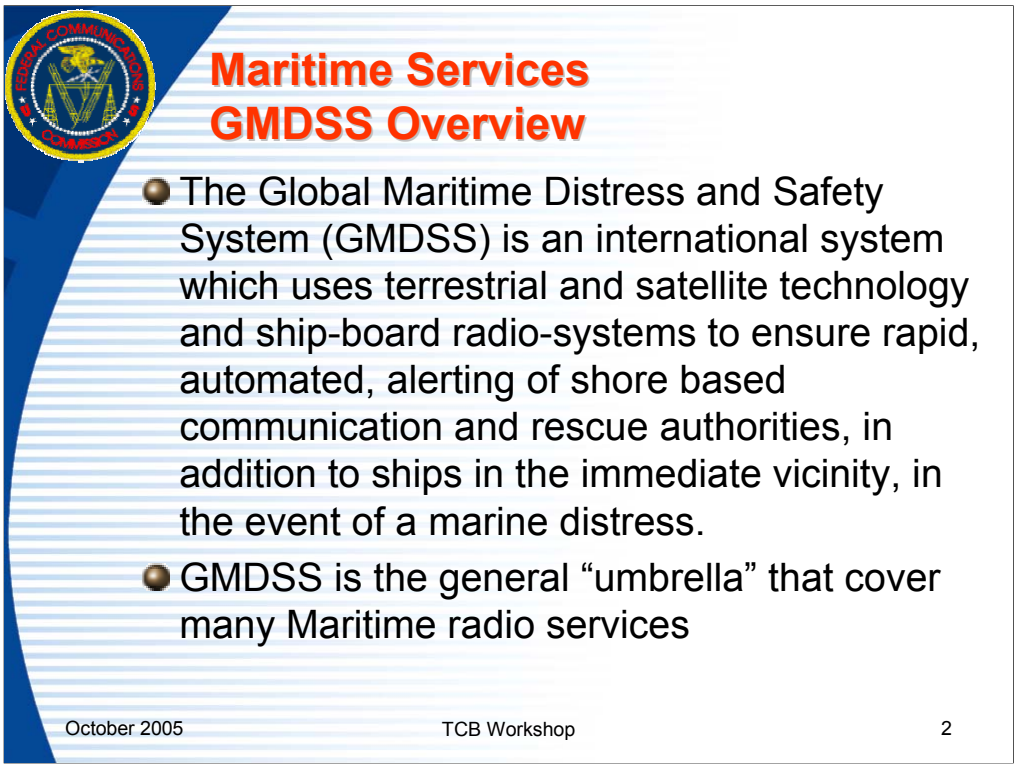
Equipment Authorization Branch

Federal Communications Commission
Office of Engineering and Technology
Laboratory Division

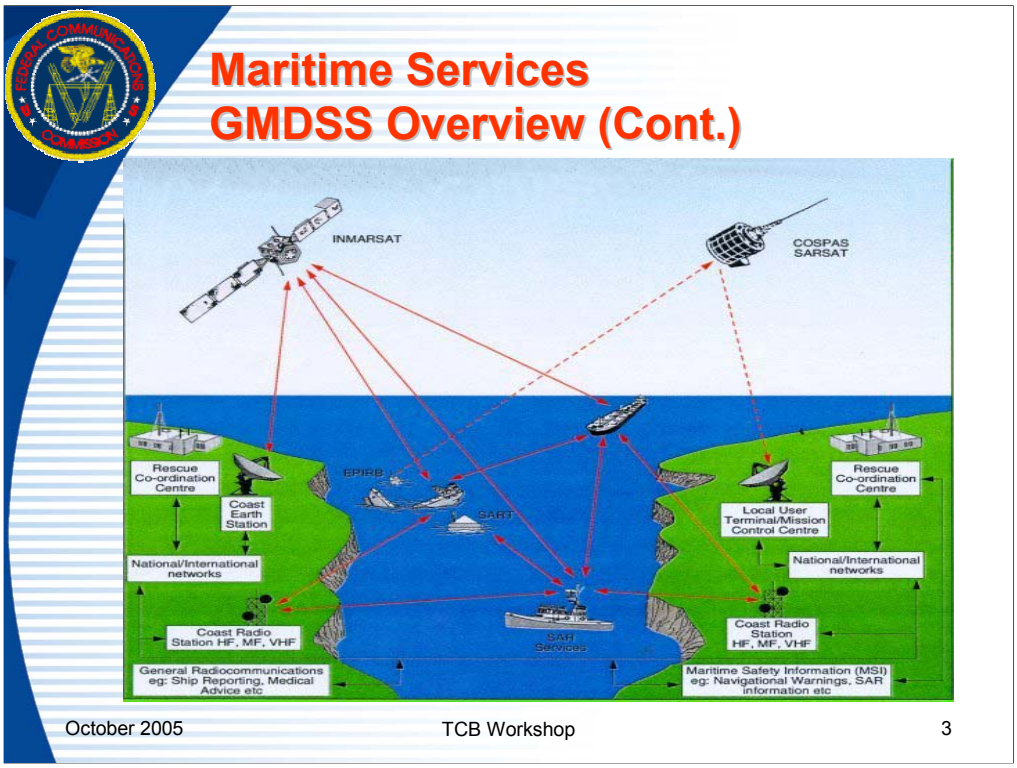


Global maritime distress and safety system (GMDSS). An International Maritime Organization (IMO) worldwide coordinated maritime distress system designed to provide the rapid transfer of distress messages from vessels in distress to units best suited for giving or coordinating assistance. The system includes standardized equipment and operational procedures, unique identifers for each station, and the integrated use of frequency bands and radio systems to ensure the transmission and reception of distress and safety calls and messages at short, medium and long ranges.

MF (including DSC) – 2 MHz Band

HF (including DSC and telex) – 4, 6, 12,16, 18, 22, and 25 MHz Bands

VHF (including DSC) – 156 to 162 MHz



GMDSS Geographic Configuration

Applies to cargo vessels >300 gross tons & passenger ships carrying more than 12 passengers when traveling on international waters or in the open sea.

Depends on the sea area of which the ship will trade:

http://www.navcen.uscg.gov/marcomms/gmdss/area.htm

Sea area A1 is within VHF range of a coast station

Sea area A2 is within MF range of a coast station

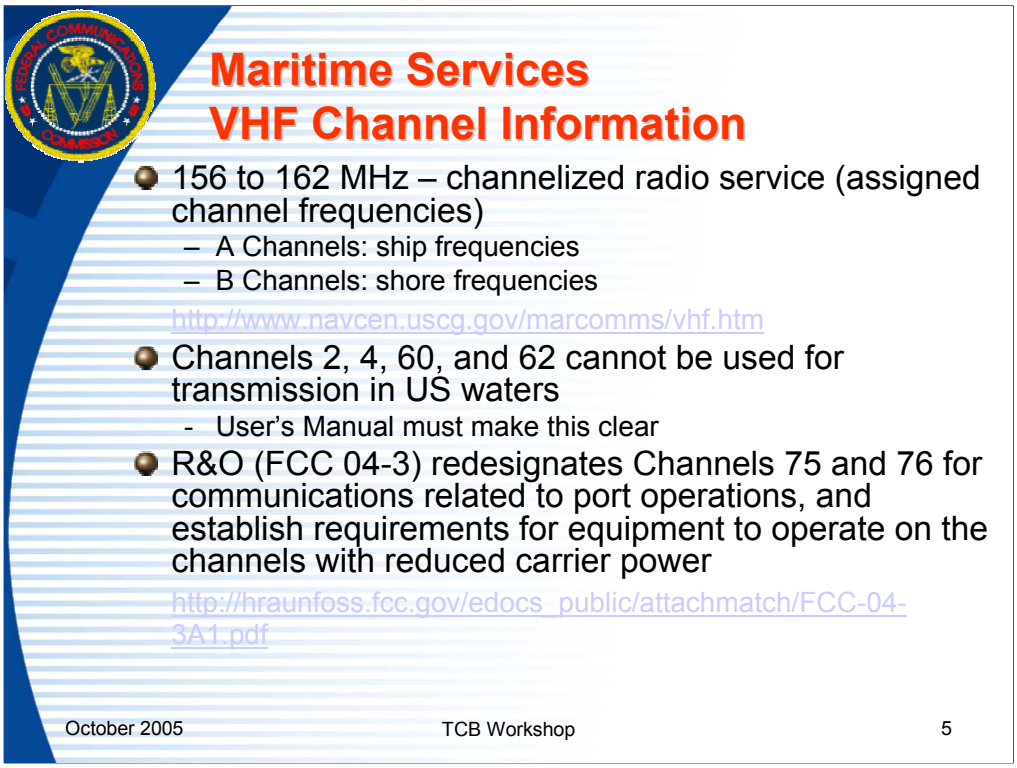
Sea area A3 is within Inmarsat Satellite System coverage

Sea area A4 is world-wide and within HF range of a coast station (Including the Polar Regions)

Maritime Services

Digital Selective Calling (DSC) Overview

- Replacement for the radiotelephone and radiotelegraph (Morse) alarm signal
- Information transmitted:
  - the priority of the call - DISTRESS, URGENCY, SAFETY or ROUTINE;
  - the address - ie: all ships or a single ship/station
  - the identification of the ship in distress
  - the position of the ship in distress
  - the nature of the distress
- MF/HF DSC Distress and Safety Channels:
  2187.5, 4207.5, 6312.0, 8414.5, 12577.0, and 16804.5 kHz
- VHF DSC Distress and Safety Channel:
  Marine channel 70 (156.525 MHz)
- DSC Classifications:
  http://www.navcen.uscg.gov/marcomms/gmdss/dsc.htm



Second R&O, Sixth R&O, and Second FNPRM (FCC 04-3)

redesignate Channels 75 and 76 for communications related to port operations, and establish requirements for equipment to operate on the channels with reduced carrier power;

establish a new emission mask in Part 80 to accommodate a wide range of data services

Maritime Services

VHF User's Manual - Frequency Table

Channel number			Frequency (MHz)	
USA	INT	CAN	Transmit	Receive
	01	01	156.050	160.650
01A			156.050	156.050
	02	02	156.100	160.700
	03	03	156.150	160.750
03A			156.150	156.150
	04		156.200	160.800
		04A	156.200	156.200
	05		156.250	160.850
05A		05A	156.250	156.250
06	06	06	156.300	156.300
	07		156.350	160.950
07A		07A	156.350	156.350
08	08	08	156.400	156.400
09	09	09	156.450	156.450
10	10	10	156.500	156.500
11	11	11	156.550	156.550
12	12	12	156.600	156.600
13[*2]	13	13[*1]	156.650	156.650
14	14	14	156.700	156.700
15[*2]	15[*1]	15[*1]	156.750	156.750
16	16	16	156.800	156.800
17[*1]	17	17[*1]	156.850	156.850
	18		156.900	161.500
18A		18A	156.900	156.900
	19		156.950	161.550

Channel number			Frequency (MHz)	
USA	INT	CAN	Transmit	Receive
19A		19A	156.950	156.950
20	20	20[*1]	157.000	161.600
20A			157.000	157.000
	21	21	157.050	161.650
21A		21A	157.050	157.050
		21b	Rx only	161.650
	22		157.100	161.700
22A		22A	157.100	157.100
	23	23	157.150	161.750
23A			157.150	157.150
24	24	24	157.200	161.800
25	25	25	157.250	161.850
		25b	Rx only	161.850
26	26	26	157.300	161.900
27	27	27	157.350	161.950
28	28	28	157.400	162.000
		28b	Rx only	162.000
	60	60	156.025	160.625
	61		156.075	160.675
61A		61A	156.075	156.075
	62		156.125	160.725
		62A	156.125	156.125
	63		156.175	160.775
63A			156.175	156.175
	64	64	156.225	160.825

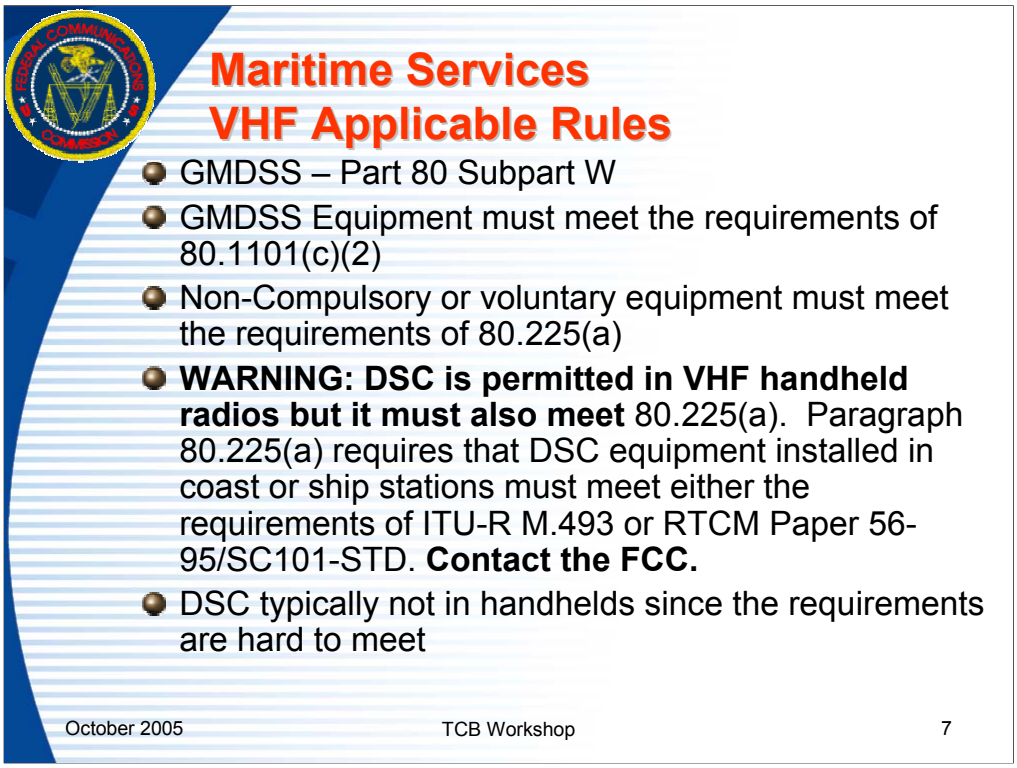
Channel number			Frequency (MHz)	
USA	INT	CAN	Transmit	Receive
64A		64A	156.225	160.825
	65		156.275	160.875
65A	65A	65A	156.275	156.275
	66		156.325	160.925
66A	66A	66A[*1]	156.325	156.325
67[*2]	67	67	156.375	156.375
68	68	68	156.425	156.425
69	69	69	156.475	156.475
70[*3]	70[*3]	70[*3]	156.525	156.525
71	71	71	156.575	156.575
72	72	72	156.625	156.625
73	73	73	156.675	156.675
74	74	74	156.725	156.725
77[*1]	77	77[*1]	156.875	156.875
	78		156.925	161.525
78A		78A	156.925	156.925
	79		156.975	161.575
79A		79A	156.975	156.975
	80		157.025	161.625
80A		80A	157.025	157.025
	81		157.075	161.675
81A		81A	157.075	157.075
	82		157.125	161.725
82A		82A	157.125	157.125
	83	83	157.175	161.775

Channel number			Frequency (MHz)	
USA	INT	CAN	Transmit	Receive
83A		83A	157.175	157.175
		83b	Rx only	161.775
84	84	84	157.225	161.825
84A			157.225	157.225
85	85	85	157.275	161.875
85A			157.275	157.275
86	86	86	157.325	161.925
86A			157.325	157.325
87	87	87	157.375	161.975
87A			157.375	157.375
88	88	88	157.425	162.025
88A			157.425	157.425

WX channel	Frequency (MHz)	
	Transmit	Receive
1	RX only	162.550
2	RX only	162.400
3	RX only	162.475
4	RX only	162.425
5	RX only	162.450
6	RX only	162.500
7	RX only	162.525
8	RX only	161.650
9	RX only	161.775
10	RX only	163.275

[*1]Low power only. [*2]Momentary high power. [*3]DSC operation only

NOTE: Simplex channels, 3, 21, 23, 61, 64, 81, 82 and 83 **CANNOT** be lawfully used by the general public in U.S.A. waters.



Technical Standards

DC Voltage & Current into Final Device 2.1033(C)(8)
RF Output Power 2.1046 (Typically conducted power)
Modulation Characteristics (Audio Roll-off) 2.1047 & 80.213
Modulation Characteristics (Audio Frequency Response) 2.1047
Modulation Characteristics (Modulation Limiting) 2.1047
Occupied Bandwidth 2.1049(c)(1) & 80.211
Spurious & Harmonic Emission at Antenna Terminal 2.1051
Field Strength of Spurious & Harmonic Radiation 2.1053
Frequency Stability (Temperature) 2.1055 & 80.209
Frequency Stability (Voltage) 2.1055 & 80.209
Receiver radiated spurious emissions 80.217(b)
DC Voltage & Current into Final Device 2.1033(C)(8)

§ 80.207 Classes of emission

updated chart of Part 80 emissions designators

§ 80.213 Modulation requirements

156-162 and 216-220 MHz bands freq. deviation cannot exceed +/- 5 kHz

§ 80.215 Transmitter power

non portable ship station in the 156-162 MHz band must be between 8 and 25 Watts

§ 80.275 AIS US Coast Guard

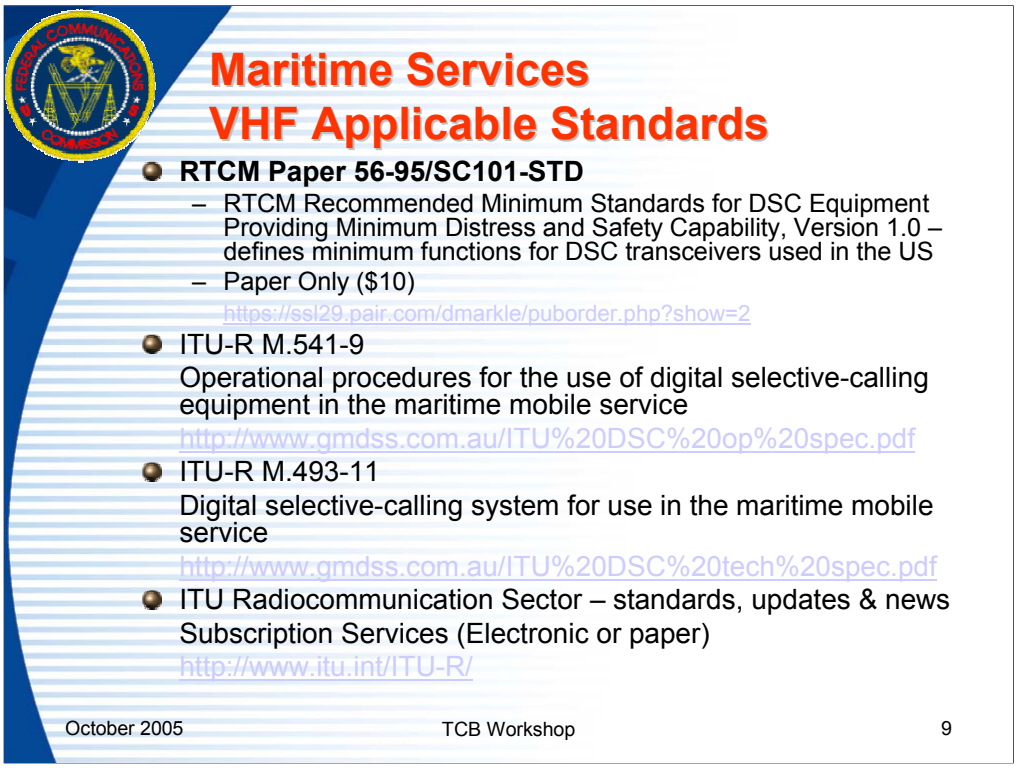
approval requirements defined

§ 80.373 Private communications frequencies

updated frequency use table for 156–162 MHz Band

Maritime Services
VHF Applicable Rules (Cont.)

- Section 80.1101(b)…must be tested in accordance with the applicable testing standards listed
- Section 80.1101(c)(2) – lists applicable standards
  - IMO Resolution A.803(19) Performance Standards for Shipborne VHF Radio Installations Capable of Voice Communication and Digital Selective Calling
  - ITU-R Recommendation M.493–10 Digital Selective-calling System for Use in the Maritime Mobile Service
  - ITU-R Recommendation M.541-8 Operational Procedures for the use of Digital Selective-Calling Equipment in the Maritime Mobile Service



(4) *MF/HF radio equipment:* (i) IMO Resolution A.806(19), "Performance Standards for Shipborne MF/HF Radio Installations Capable of Voice Communication, Narrow-Band Direct Printing and Digital Selective Calling," with Annex, adopted 23 November 1995, as amended by IMO Resolution MSC.68(68), "Adoption of Amendments to Performance Standards for Shipborne Radiocommunication Equipment," GMDSS terrestrial communications—1.3(c), adopted 6 June 1997.

(ii) ITU-R Recommendation M.493–10, "Digital Selective-calling System for Use in the Maritime Mobile Service," with Annexes 1 and 2, 2000, and ITU-R Recommendation M.541–8, "Operational Procedures for the Use of Digital Selective-Calling Equipment in the Maritime Mobile Service," with Annexes, 1997.

(iii) ITU-R Recommendation M.625–3, "Direct-Printing Telegraph Equipment Employing Automatic Identification in the Maritime Mobile Service," with Annex, 1995, ITU-R Recommendation M.493–10, "Digital Selective-calling System for Use in the Maritime Mobile Service," with Annexes 1 and 2, 2000. Equipment may conform to ITU-R Recommendation M.476–5, "Direct-Printing Telegraph Equipment in the Maritime Mobile Service," with Annex, 1995, in lieu of ITU-R Recommendation M.625–3 with Annex, 1995, where such equipment was installed on ships prior to February 1, 1993.

(iv) IMO Resolution A.700(17), "Performance Standards for Narrow-band Direct-printing Telegraph Equipment for the Reception of Navigational and Meteorological Warnings and Urgent Information to Ships (MSI) by HF," adopted 6 November 1991.

Maritime Services
VHF Equipment Authorization

- Equipment Class
  - GVH: Part 80 VHF Transmitter (GMDSS) Base Station
  - TNB (Base Station) or TNF (Handheld): Part 80 VHF transmitters without GMDSS/DSC
- For devices with DSC (Base Station)
  - CS “Transmitter meets technical requirements for ship stations”.
  - GM “This unit meets requirements for GMDSS as contained in Subpart W of Part 80”.
  - Handhelds - no Note Code required
- Modulations
  - VHF Marine: 16K0F3E and/or 16K0G3E
  - DSC: 16K0G2B (Requires separate line item)

Maritime Services
VHF Equipment Authorization (Cont.)

- Modulation Characteristics (Audio Roll-off) 2.1047 & 80.213
  - FCC limits:
    - 3 kHz - 15 kHz: -40 log (F/3) dB
    - >20kHz : At least -28 dB
- Modulation Characteristics (Audio Frequency Response) 2.1047
  - FCC limits: 300 - 3000 Hz: 6dB/octave roll-off (+1/-3 dB)
- Modulation Characteristics (Modulation Limiting) 2.1047
  - FCC limits: +/-5 kHz deviation

Maritime Services
VHF Equipment Authorization (Cont.)

- Occupied Bandwidth 2.1049(c)(1) & 80.211
  - a) -25dB (50 - 100% of assigned frequency)
  - b) -35dB (100 - 250% of assigned frequency)
  - c) 43 + 10log (RF output power in Watts) dB or 80dB, whichever is lesser attenuation for more than 250% of assigned frequency
- Spurious & Harmonic Emission at Antenna Terminal 2.1051
  - FCC limits: 43 + 10log (RF output power in Watts) dB
- Field Strength of Spurious & Harmonic Radiation 2.1053
  - FCC limit = 43 + 10log P(Watts) dB
  - P(dBm) = -30 + 10 log P(Watts) therefore Limit = -13 dBm

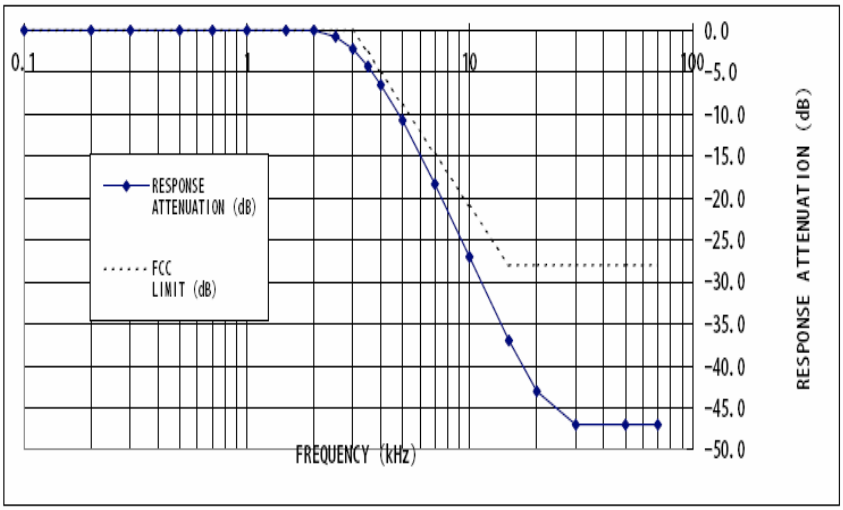
    X axis is dBm

Maritime Services
VHF Equipment Authorization (Cont.)

- Frequency Stability (Temperature) 2.1055 & 80.209
  - From -20 °C to +50 °C at intervals of 10°C
  - FCC limits: +/-0.0005%
- Frequency Stability (Voltage) 2.1055 & 80.209
  - 85% to 115% of the nominal voltage
  - FCC limits: +/-0.0005%
- Typically test a low and high channel
- If the device has a switchable high/low power setting test at both high and low power. If the power is variable test at high power setting only.
- **US Coast Guard approval letter or MRA approval not required for VHF radios**

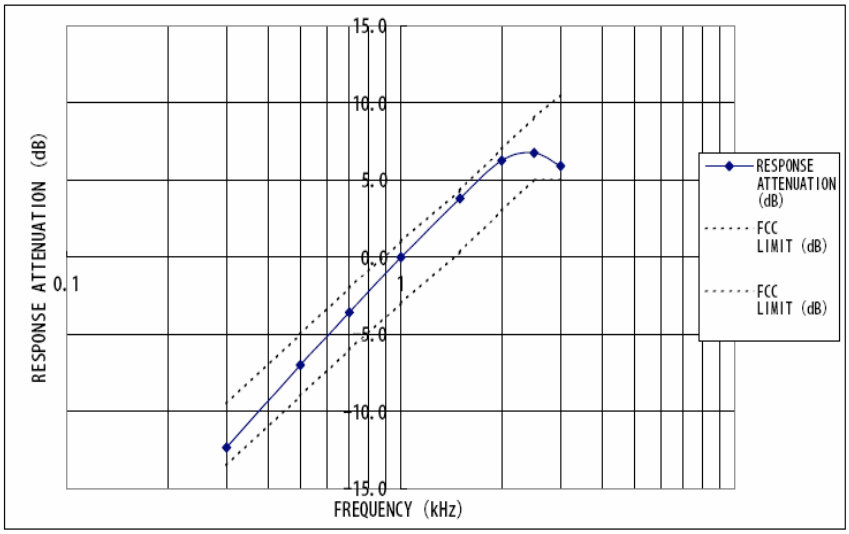
Maritime Services

Modulation Characteristics (Audio Roll-off)



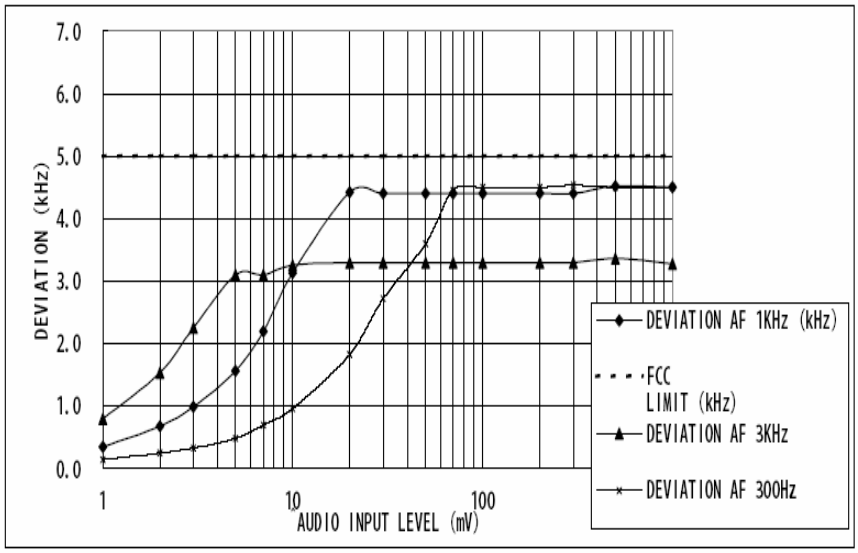
Maritime Services

Modulation Characteristics (Audio Frequency Response)

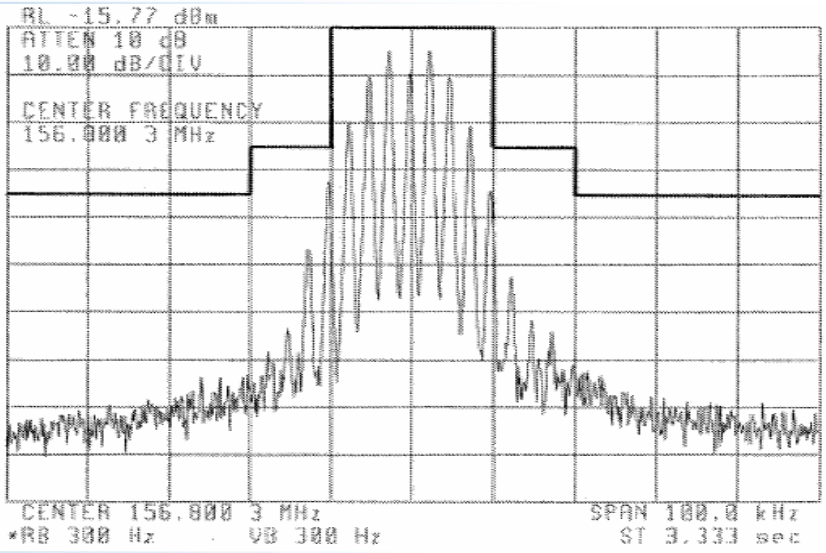


Maritime Services

MODULATION CHARACTERISTICS (MODULATION LIMITING)

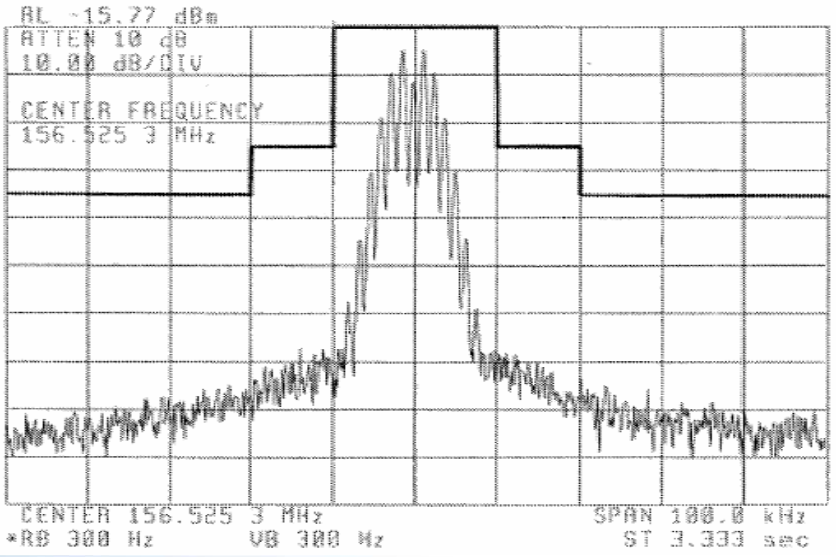


Maritime Services
F3E (Channel 16) Occupied BW



Maritime Services

DSC (G2B Modulation, Channel 70) Occupied BW



Maritime Services
VHF Handheld PTT RF Exposure

- Categorically excluded: Section 1.1307(b)(2)
- Option 1 (Portables): Occupational Limits
  - Submit Occupational training material
  - Special exemption from the July 02 Exclusion List
  - SAR Report is not required
- Option 2 (Portables): General Population Limits
  - SAR Report required
- If Portable power > 7 Watts contact the FCC before proceeding for both Occupational and General Population limits

Maritime Services
VHF Handheld PTT RF Exposure (Cont.)

- If applicant chooses to submit SAR - TCBs cannot review the application
  - Submitted to the FCC
  - No standard SAR procedures for 150 MHz devices
- RF exposure training instructions and labeling information is required for portables and mobiles
  - To determine mobile separation distance an MPE exhibit is required if separation distance not equal to 20 cm

Maritime Services
VHF Base Station RF Exposure

- Categorically excluded: Section 1.1307(b)(2)
- RF exposure training instructions and labeling information is required since these are mobiles
- To determine mobile separation distance an MPE exhibit is required

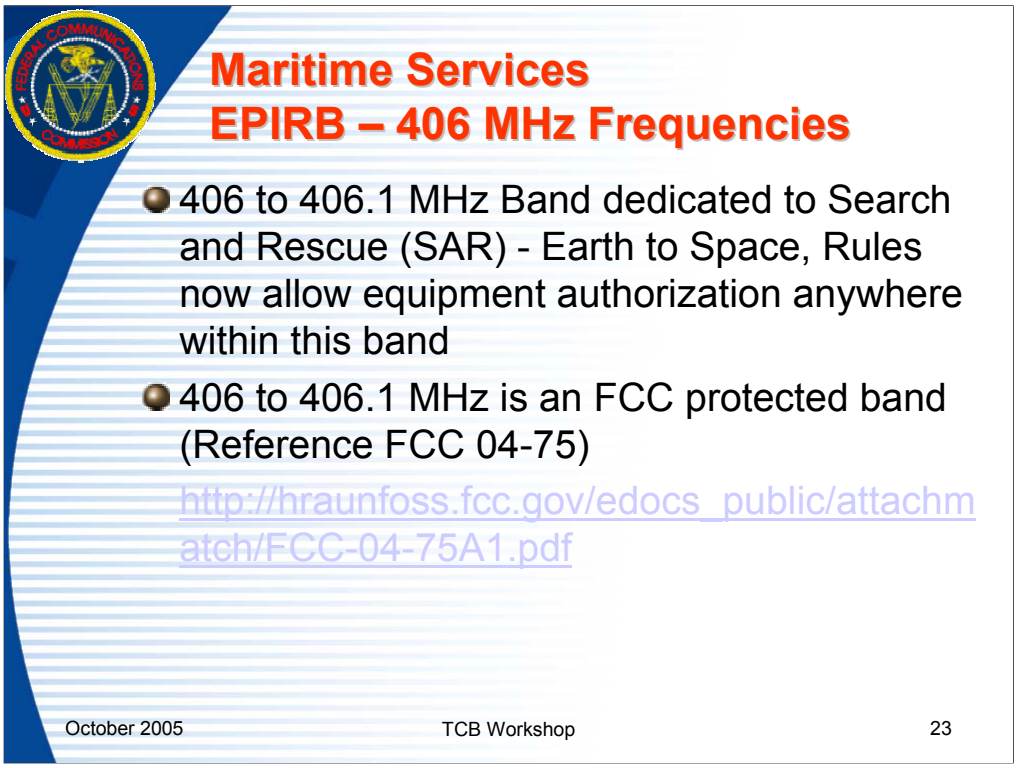
Maritime Services
VHF Example Grant

Equipment Class : Part 80 VHF Transmitter (GMDSS)
Notes: VHF FM Marine Transceiver

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
CS GM	80.1101(c)(4)	156.025 - 157.425	1	7 PPM	16K0G3E
CS GM	80.1101(c)(4)	156.025 - 157.425	25	7 PPM	16K0G3E
CS GM	80.1101(c)(4)	156.025 - 157.425	1	7 PPM	16K0G2B
CS GM	80.1101(c)(4)	156.025 - 157.425	25	7 PPM	16K0G2B

Power listed is conducted. This device must not exceed a maximum transmitting duty factor of 50%. All qualified end-users of this device must have the knowledge to control their exposure conditions and/or duration, and the exposure conditions and/or duration of their passengers and bystanders, to comply with the General Population/Controlled MPE limit and requirements. Users must be provided with the training information, antenna installation and transmitter operating conditions for satisfying RF exposure compliance. The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 60cm from all persons and must not exceed an antenna gain of 0 dBi.
"Includes integral DSC modem in conformity with ITU-R M.493.8"

CS: Transmitter meets technical requirements only for use at ship stations.
GM: This unit meets requirements for GMDSS use as contained in Subpart W of Part 80.

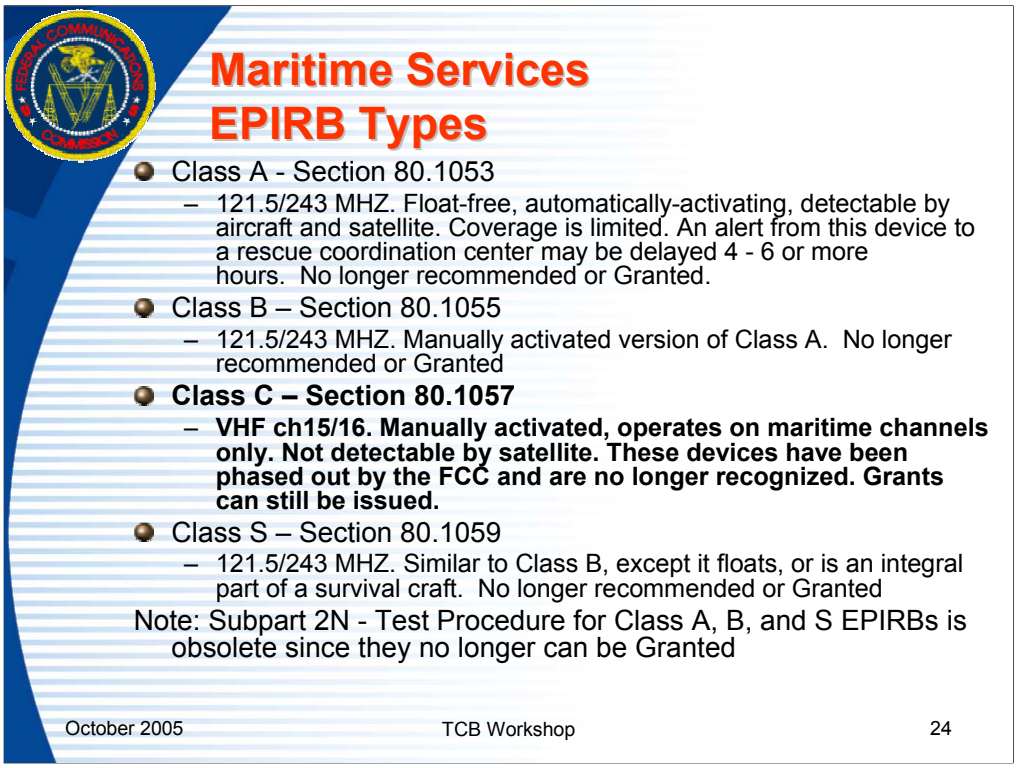


International Digital Emergency and Distress Frequencies

As noted by RTCM and SARSAT, 406.025 MHz is no longer the sole international digital distress frequency. According to the COSPAS-SARSAT 406 MHz Frequency Management Plan the International Telecommunication Union (ITU) has allocated the frequency band 406.0 – 406.1 MHz for the use of low power satellite position-indicating radio beacons.[1] COSPAS-SARSAT has divided this frequency band into channels to ensure that the distress beacon traffic does not exceed the system's capacity.[2] Channels are opened as beacon production demands increase and the beacon population grows. According to the 406 MHz channel assignment table, the window for type approval of new beacon models at 406.025 MHz (channel B) closed on January 1, 2002. The next frequency, 406.028 MHz or channel C, opened on January 1, 2000, and is scheduled to close on January 1, 2006. Opening dates for frequencies 406.037 MHz and 406.040 MHz have also already been assigned (January 1, 2004 and January 1, 2008 respectively). The frequencies on which it is possible for beacons to operate range from 406.025 MHz to 406.076 MHz.

[1] *COSPAS-SARSAT 406 MHz Frequency Management Plan,* C/S T.012, Issue 1 - October 2002 at H-2.

[2] *Id.* at 4-5.



Inmarsat E-EPIRB (1.4 GHz) to discontinue operation after December 1, 2004

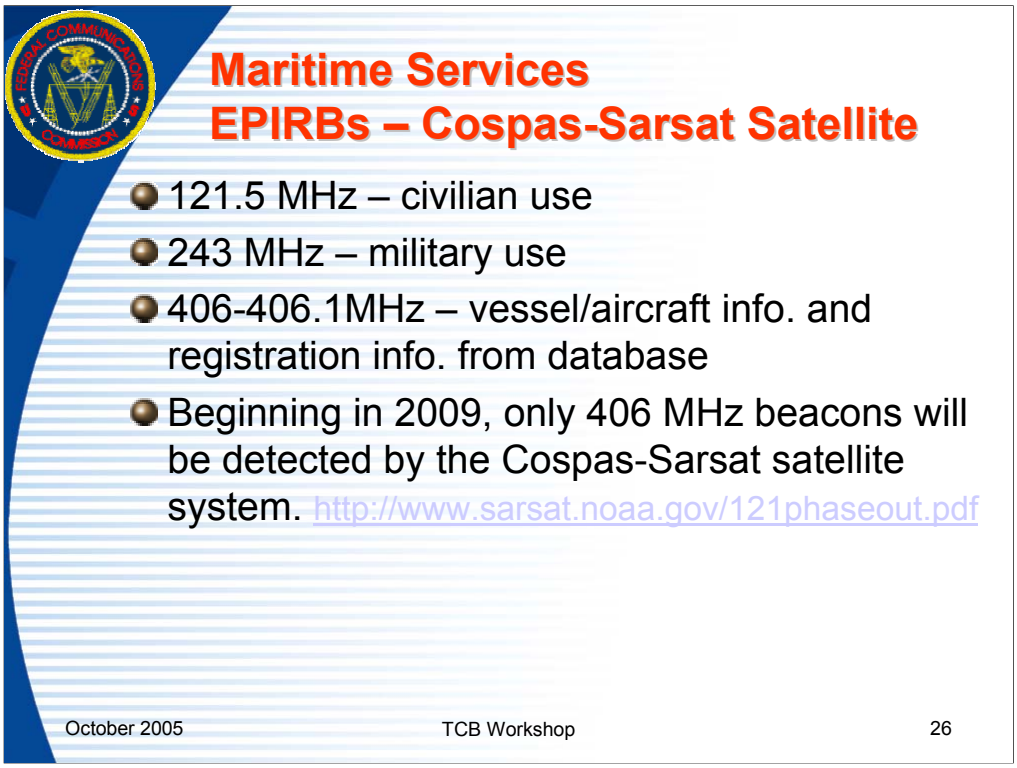
After 8 years of service only 100 L-Band EPIRBSs fitted to GMDSS ships and less than 1300 L-Band EPIRBs fitted worldwide

Inmarsat L-Band maintenance contracts expire

Other Inmarsat service not affected

Maritime Services EPIRB Categories

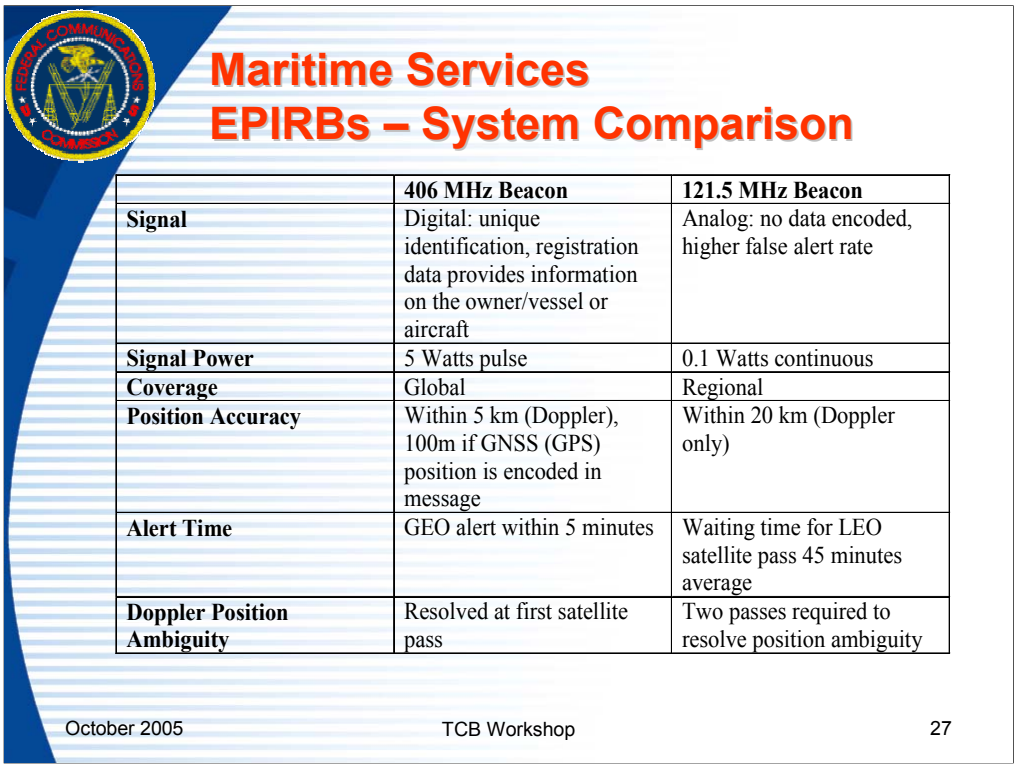
- Category II
  - 406/121.5 MHZ. Similar to Category I, except is manually activated. Some models are also water activated.
- Category I
  - 406/121.5 MHZ. Float-free, automatically activated EPIRB. Detectable by satellite anywhere in the world. Recognized by GMDSS.
- Include Bracket information for Category I/II in Grant condition



Phase out - This affects all maritime beacons (EPIRBs), all aviation beacons (ELTs) and all personal beacons (PLBs).

This decision has been made by the international organization that controls the satellites to reduce false alarms. About 97 per cent of all 121.5 MHz analogue beacon detections are false alarms and this is placing an unnecessary strain on the global search and rescue system. The change has been made to ensure that scarce search and rescue assets needed for a genuine emergency are not caught up chasing false alerts.

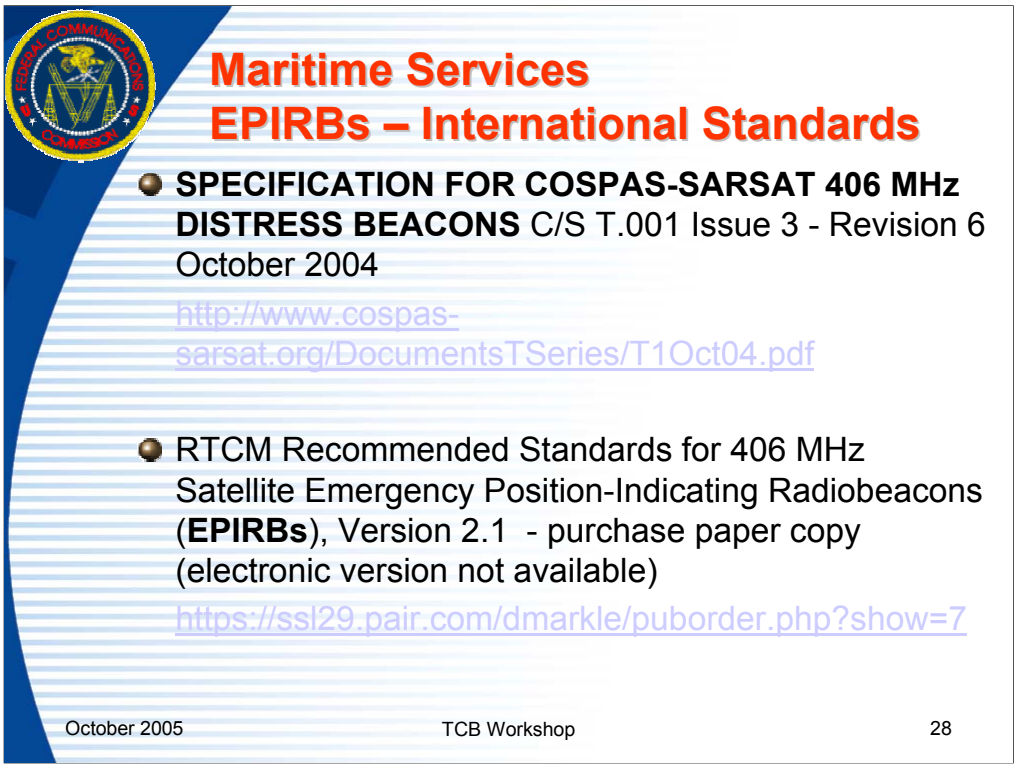
False alarms from digital 406 MHz beacons can be resolved with a phone call as these devices transmit an identity code that can be cross-referenced with an ownership database.



	406 MHz Beacon	121.5 MHz Beacon
Signal	Digital: unique identification, registration data provides information on the owner/vessel or aircraft	Analog: no data encoded, higher false alert rate
Signal Power	5 Watts pulse	0.1 Watts continuous
Coverage	Global	Regional
Position Accuracy	Within 5 km (Doppler), 100m if GNSS (GPS) position is encoded in message	Within 20 km (Doppler only)
Alert Time	GEO alert within 5 minutes	Waiting time for LEO satellite pass 45 minutes average
Doppler Position Ambiguity	Resolved at first satellite pass	Two passes required to resolve position ambiguity

With a 121.5 MHz beacon, only one alert out of every 50 alerts is a genuine distress situation. This has a significant effect on the resources of search and rescue (SAR) services. With 406 MHz beacons, false alerts have been considerably reduced (about one alert in 17 is genuine) and when properly registered can normally be resolved with a telephone call to the beacon owner using the encoded beacon identification. Consequently, real alerts can receive the attention they deserve.

When a 406 MHz beacon signal is received, SAR authorities can retrieve information from a registration database. This includes beacon owner contact information, emergency contact information, and vessel/aircraft identifying characteristics. Having this information allows SAR services to respond appropriately. Make sure your 406 MHz beacon is properly and accurately registered!



Section 80.1061(a) - Notwithstanding the provisions in paragraph (b) of this section, 406.0–406.1 MHz EPIRBs must meet all the technical and performance standards contained in the Radio Technical Commission for Maritime Services document entitled RTCM Paper 77–02/SC110–STD, “RTCM Recommended Standards for 406 MHz Satellite Emergency Position-Indicating Radiobeacons (EPIRBs),” Version 2.1, dated June 20, 2002 (RTCM Recommended Standards).

IMO Resolution A.810(19), “Performance Standards for Float-free Satellite Emergency Position-indicating Radio Beacons (EPIRBs) Operating on 406 MHz,” with Annex, adopted 23 November 1995, and IMO Resolution A.812(19), “Performance Standards for Float-free Satellite Emergency Position-indicating Radio Beacons Operating Through the Geostationary INMARSAT Satellite System on 1.6 GHz,” with Annex, adopted 23 November 1995.

ITU-R Recommendation M.633–2, “Transmission Characteristics of a Satellite Emergency Position-indicating Radiobeacon (Satellite EPIRB) System Operating Through a Low Polar-orbiting Satellite System in the 406 MHz Band,” 2000.

Maritime Services
EPIRBs – Equip. Authorization

- All standards data required, even if not applicable for equipment authorization. Legal requirement.
- Approved Test Laboratories
  - Indoor tests – no TX to satellite
  - Outdoor tests – functional test w/ TX to satellite
  - Important to check application for approved test lab for 406 MHz devices. List available:
    http://www.cospas-sarsat.org/Beacons/beaconTypeApprovalLabs.htm

Maritime Services
EPIRBs – Equip. Authorization

- Equipment Class – GEP 406 MHz EPIRB
- Note Code – "GM" for GMDSS compliance
- Use 80.1101(c)(5) on 121.5 and 406 MHz line items
- Section 80.1101(c)(5) *406.0–406.1 MHz EPIRBs:*
  - (i) IMO Resolution A.810(19), "Performance Standards for Float-free Satellite Emergency Position-indicating Radio Beacons (EPIRBs) Operating on 406 MHz," with Annex, adopted 23 November 1995, and IMO Resolution A.812(19), "Performance Standards for Float-free Satellite Emergency Position-indicating Radio Beacons Operating Through the Geostationary INMARSAT Satellite System on 1.6 GHz," with Annex, adopted 23 November 1995.

Maritime Services
EPIRBs – Equip. Authorization

- (iii) ITU-R Recommendation M.633-1, "Transmission Characteristics of a Satellite Emergency Position-indicating Radiobeacon (Satellite EPIRB) System Operating Through a Low Polar-orbiting Satellite System in the 406 MHz Band," 1990.
- (iv) The 406.0-406.1 MHz EPIRBs must also comply with 80.1061.

- No RF Exposure Exhibit required – low duty factor

Maritime Services
EPIRBs – Approval Letter Exhibits

- All EPIRBs require US Coast Guard approval letter
- COSPAS – SARSAT Certificate

Maritime Services
EPIRBs – Example certificate

COSPAS SARSAT

COSPAS-SARSAT
TYPE APPROVAL CERTIFICATE

For a 406 Megahertz Distress Beacon
for use with the Cospas-Sarsat Satellite System

WHEREAS, ***Jotron Electronics a.s.***, of ***Tjodalyng, Norway***, the manufacturer of a 406 Megahertz Distress Beacon packaged as an ***EPIRB***, and identified as Model: ***TRON 40 GPS*** has submitted test data and had said beacon tested in ***October 2000*** at a facility accepted by Cospas-Sarsat at ***Intespace, Toulouse, France***, to demonstrate that said beacon meets the applicable technical requirements for use with the Cospas-Sarsat Satellite System, as defined in documents C/S T.001", Issue 3 - Rev. 3, October 1999, and C/S T.007 "Cospas-Sarsat 406 MHz Distress Beacon Type Approval Standard", Issue 3 - Rev. 6 October 1999,*
for frequency channel ***406.025*** MHz;

WHEREAS, the Cospas-Sarsat Council has determined, following a review of the test results, that the said beacon meets the Cospas-Sarsat Class 2 requirements and is rated for operating over the temperature range of ***-20 °C to +55 °C,*****
with battery:

Saft
Lithium Thionyl Chloride ($LiSOCl_2$, 4 D-cells LSH20) and

WHEREAS, said manufacturer has certified that all other units of the same type will meet said technical requirements in a similar manner to the unit subjected to test, which incorporated the following features:

- ***121.5 MHz Auxiliary radio locating device (20 dBm ±3dB, continuous)***
- ***Internal navigation device (GPS):*** *manufacturer:* ***Connexant***
  model: ***Jupiter I.P***
- ***Automatic activation***
- ***Strobe light (0.85 cd, 21 flashes/min)***
- ***Self-test mode (one burst:*** ***520 ms, format flag bit = "1", long message;***
  440 ms, format flag bit = "0", short message)

* *beacon is approved for use with standard location protocol, short standard location protocol and user-location protocol*
** *specified operating lifetime 48 hours*

NOW, THEREFORE, in reliance upon the following, the Cospas-Sarsat Council does hereby certify that the 406 MHz Distress Beacon Model identified herein is compatible with the Cospas-Sarsat System as of the date of this Certificate.

Certificate No: ***122***

Date: ***8 November 2000***

Signed by:

D. Levesque
Head of Cospas-Sarsat Secretariat

NOTE, HOWEVER:

1. This certificate does not authorize the operation or sale of any 406 MHz distress beacon. Such authorization may require type acceptance by national administrations in countries where the beacon will be distributed, and may also be subject to national licensing requirements.

2. This certificate is intended only as a formal notification to the above identified manufacturer that the Cospas-Sarsat Council has determined, on the basis of test data of a beacon submitted by the manufacturer, that 406 MHz distress beacons of the type identified herein meet the standards for use with the Cospas-Sarsat System. This certificate is not a warranty and Cospas-Sarsat hereby expressly disclaims any and all liability arising out of or in connection with the issuance, use, or misuse of this certificate.

3. This certificate is subject to revocation by the Cospas-Sarsat Council should the beacon type for which it is issued cease to meet the Cospas-Sarsat specification. A new certificate may be issued after satisfactory corrective action has been taken and correct performance demonstrated in accordance with to the Cospas-Sarsat Type Approval Standard.

Maritime Services
EPIRB – 406 MHz Frequencies

- The frequency change from 406.025 MHz to 406.028 MHz was allowed as an option of the manufacturer, but will be mandatory for new beacon models presented for certification and approved by COSPAS/SARSAT after January 1, 2002. New Grants must list the new frequency.
- 406.028 MHz required to prevent saturation of satellites at the old frequency (406.025 MHz). Reference FCC 02-102.

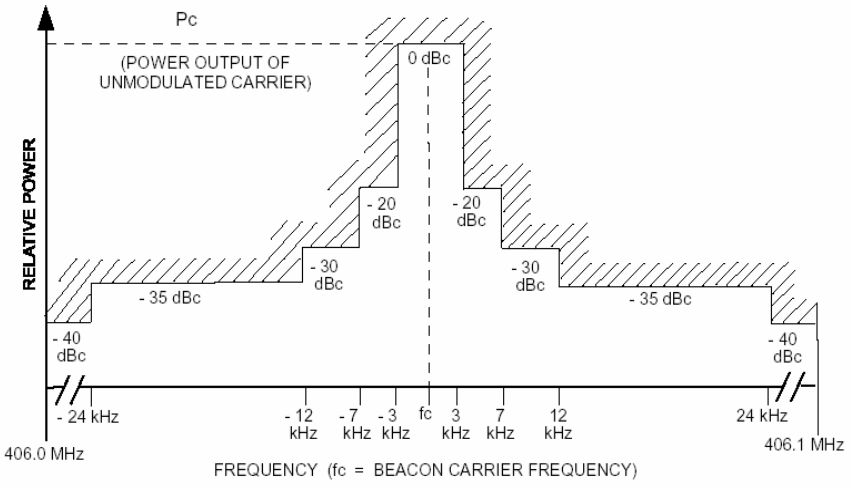
  http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-02-102A1.pdf

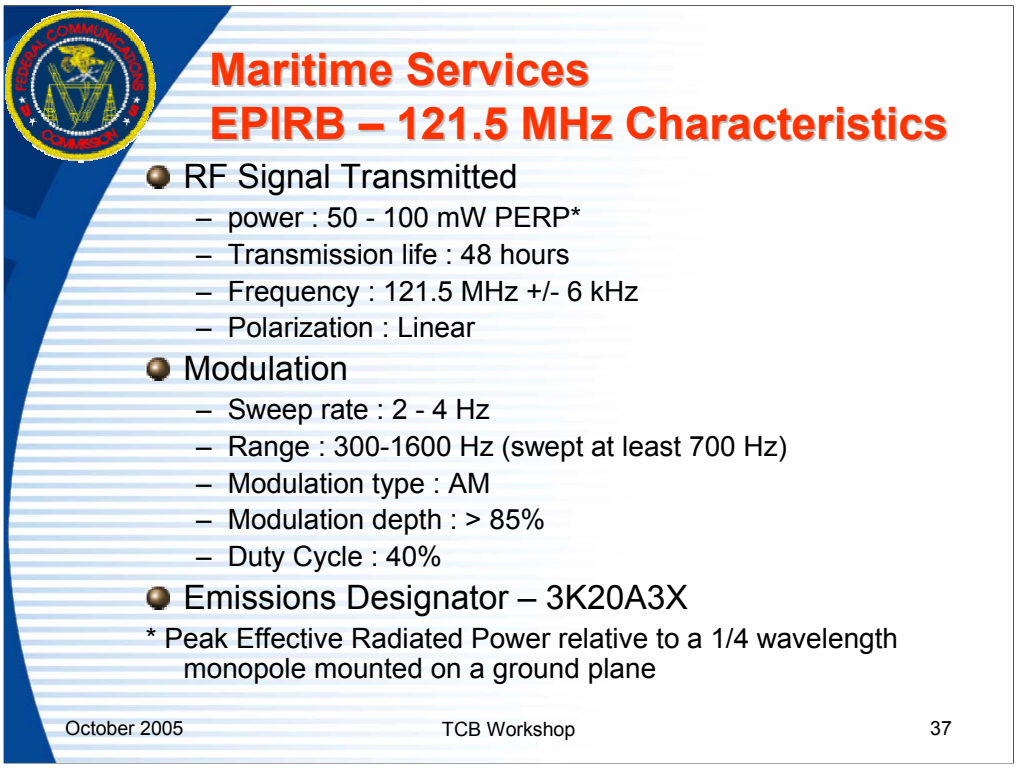
Maritime Services
EPIRBs – 406 MHz Characteristics

- **Frequency Tolerance**: short-term variations 2 ppm in 100 ms. Long-term variations +2 kHz /-5 kHz from 406.028 MHz in 5 years.
- **Power Output**: 5 W + 2 dB (35 to 39 dBm)
- **Maximum Continuous Transmission**: maximum of 45 seconds
- **Emissions Designator** – 16K0G1D

Maritime Services
EPIRBs – 406 MHz Mask

The in-band spurious emissions shall not exceed the levels specified by the signal mask in Figure 2.3, when measured in a 100 Hz resolution bandwidth.





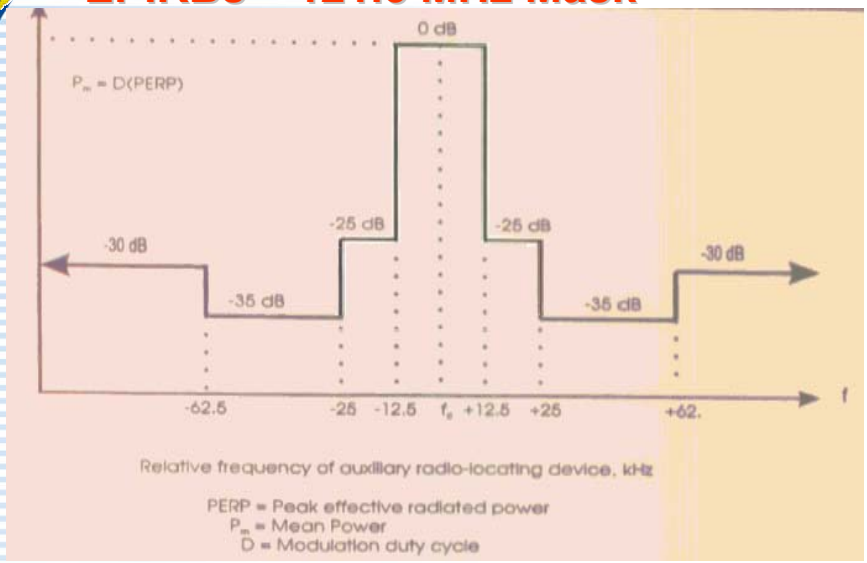
It is estimated that there are almost 700,000 121.5 MHz beacons in use world-wide. The list below gives typical 121.5 MHz beacon signal characteristics. Most of these units are used aboard aircraft and are required to meet national specifications based on ICAO standards.

Transmission characteristics of 121.5 MHz beacons are given in ITU Radio-Regulations Appendix 37-A, and included in ITU Recommendation ITU-R M.690-1.

The initial ICAO standards were not established with the aim of satellite reception of 121.5 MHz signals. The 121.5 MHz Cospas-Sarsat system was designed to serve the existing type of beacons, even though system performance is constrained by their characteristics. Parameters such as system capacity (number of simultaneous transmissions in the field of view of the satellite which can be processed by LEOLUTs) and location accuracy are limited. No information is usually provided about the operator's identity, although a morse coding of the signal is included in some models; however, these data are not processed automatically by Cospas-Sarsat LEOLUTs. Despite the limitations described above, the efficiency of 121.5 MHz beacons has been greatly enhanced by the use of satellite detection and Doppler location techniques.

121.5 MHz beacons carried aboard aircraft can usually be activated both manually and automatically by shock (using a crash sensor or G switch). This latter feature has led to numerous false alerts when a beacon is mounted in an aircraft with insufficient care or when an aircraft makes a "hard landing". By providing the location of transmitting beacons, Cospas Sarsat can be instrumental in the quick processing of false alerts.

Maritime Services
EPIRBs – 121.5 MHz Mask



Maritime Services
EPIRBs – Labeling Requirements

- FCC ID and Section 80.1103(e)
  - "The owner of this 406.0–406.1 MHz EPIRB must register the NOAA identification code contained on this label with the National Oceanic and Atmospheric Administration (NOAA) whose address is: NOAA, NOAA/SARSAT Beacon Registration, E/SP3, Federal Building 4, Room 3320, 5200 Auth Road, Suitland, MD 20746–4304." Vessel owners shall advise NOAA in writing upon change of vessel or EPIRB ownership, transfer of EPIRB to another vessel, or any other change in registration information. NOAA will provide registrants with proof of registration and change of registration postcards."
- RTCM Label
  - "USE ONLY DURING SITUATIONS OF GRAVE AND IMINENT DANGER"

Maritime Services
EPIRBs – Grant Example

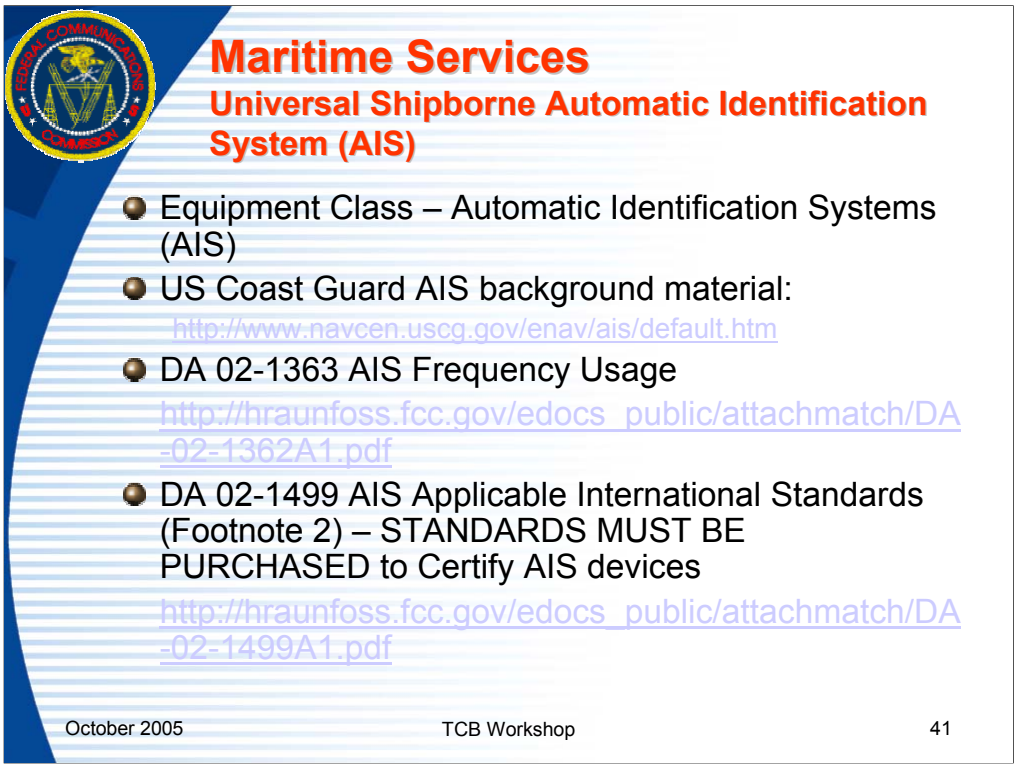
Equipment Class : 406 MHz EPIRB

Notes: EPIRB Class A FLOAT FREE

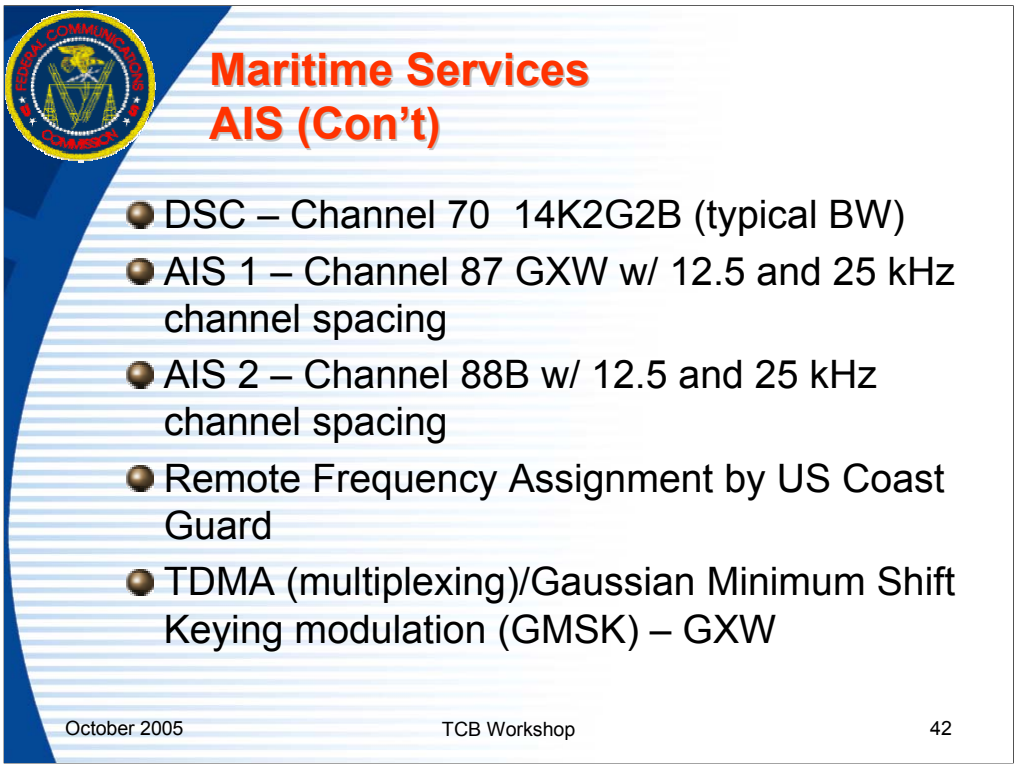
Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
GM	80.1101(c)(5)	406.025	5	2 PPM	16K0G1D
GM	80.1101(c)(5)	121.5	0.1	10 PPM	3K20A3X

Approved for RTCM Category 1 (Float Free) when used with bracket FB4 or FBH4.
Approved for RTCM Category 2 (Manual) when used with bracket MB4.

GM: This unit meets requirements for GMDSS use as contained in Subpart W of Part 80.



Certification of AIS equipment in the United States In June 2002, the FCC released a Notice entitled "Applications For Equipment Authorization Of Universal Shipborne Automatic Identification Systems To be Coordinated with U.S. Coast Guard To Ensure Homeland Security". Pending completion of FCC rulemaking, the FCC Laboratory will coordinate review of applications for certification of AIS equipment with the United States Coast Guard to ensure that the equipment meets all applicable international standards and requirements. Essentially, AIS manufacturers must meet the requirements of the FCC's regulations for equipment authorization, 47 CFR 2 Subpart J (beginning 2.901), and the Coast Guard's Navigational and Vessel Inspection Circular (NVIC) 8-01, Approval of Navigation Equipment for Ships. NVIC 8-01 describes the certification process for AIS and other navigation equipment described under the newly adopted SOLAS V. The Federal Communications Commission has requested comments on how its rules should be amended to accommodate AIS certification, in a further Notice of Proposed Rulemaking under Docket PR 92-257. Until these FCC rules are finally adopted, the procedures described in the FCC Notice and the NVIC should apply.



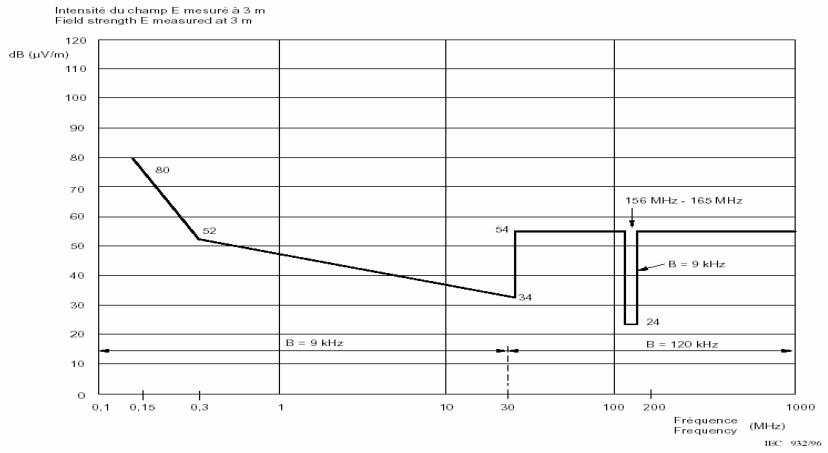
[2] The International standards and requirements identified are: IMO Resolutions A.694(17) and MSC.74(69), Annex 3; ITU-R 1371-1; IEC standards IEC 60945, IEC 61162 and IEC 61993-2.

OBW must be derived from the mask spectral plots (typically -26 dB BW) since this information is not typically provided by AIS applicants

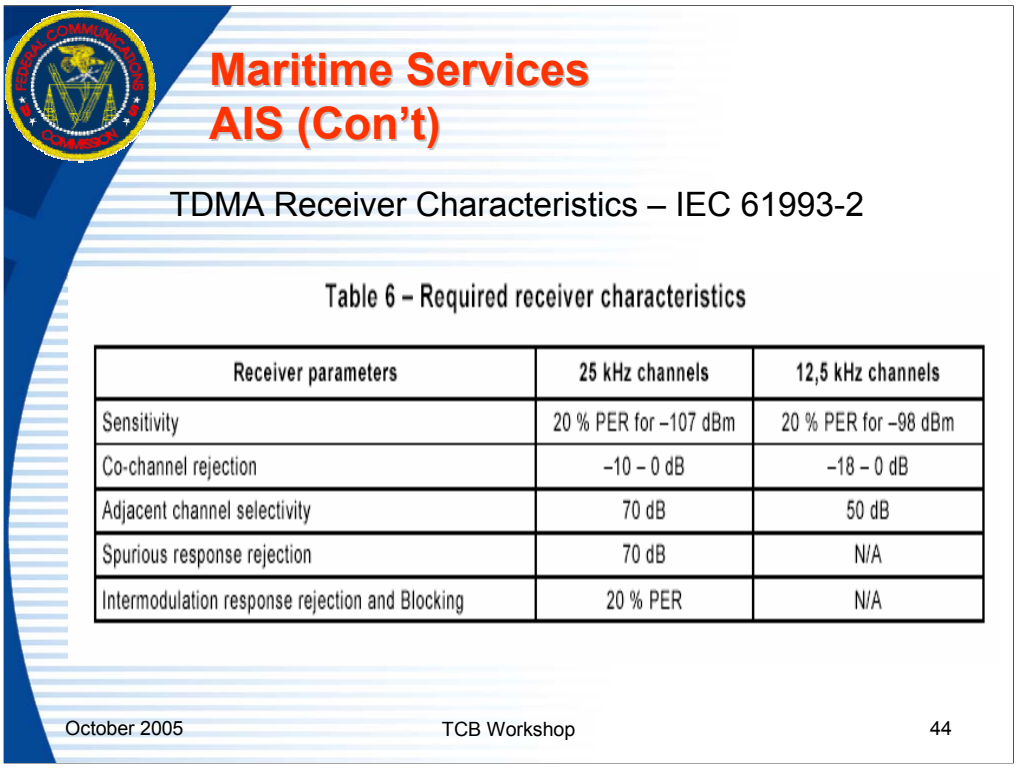
Questions concerning AIS standards may be directed to Tim Maguire of the Wireless Telecommunications Bureau at tim.maguire@fcc.gov and concerning equipment authorization to Andrew Leimer at andrew.leimer@fcc.gov.

Maritime Services
AIS (Con't)

Radiated Emissions Limits – IEC 945



B = bande passante du récepteur de mesure
B = measuring receiver bandwidth



Problems with Receiver Standards – US Coast Guard can issue an approval letter for the following non-compliant standards with a rationale for recommending certification. Grant can be issued under there conditions.

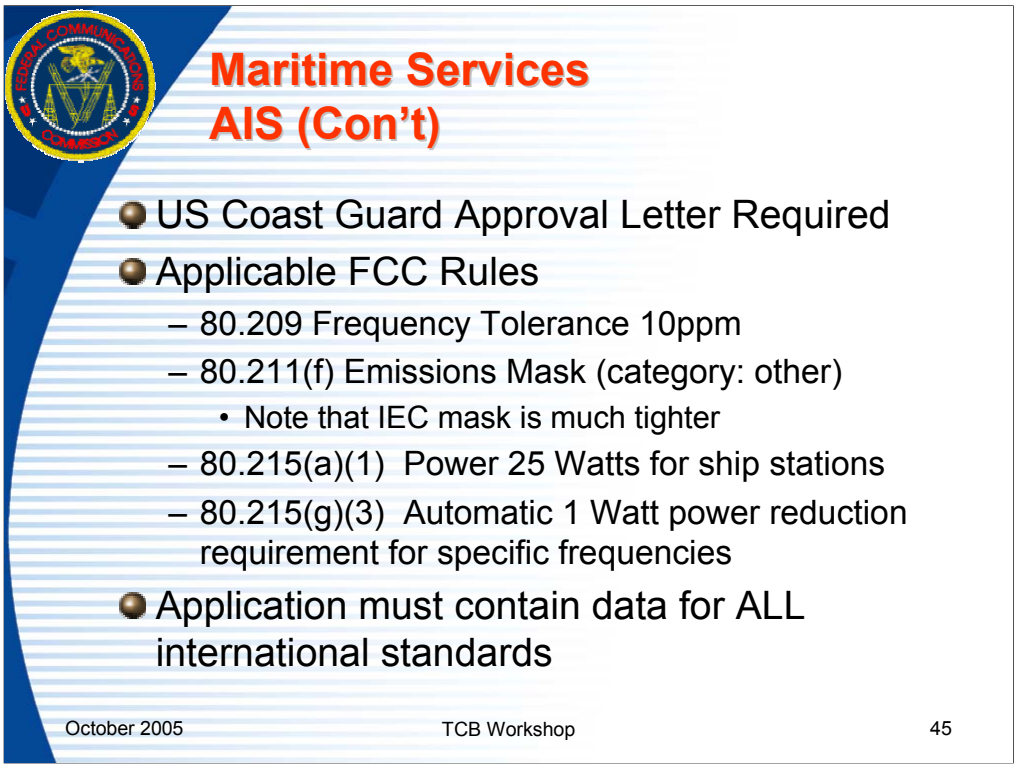
15.3.4 - Co-channel rejection - 25 kHz operation

15.3.5 - Co-channel rejection – 12.5 kHz operation

15.3.6 - Adjacent channel selectivity - 25 kHz operation

15.3.7 - Adjacent channel selectivity – 12.5 kHz operation

15.3.9 - Intermodulation response rejection and blocking



Note: application must include data for all international standards even though some of the standards are not applicable for FCC Certification and will not be reviewed. This is a legal requirement.

Maritime Services AIS (Con't)

Standard AIS Grant Example

Equipment Class : Automatic Identification Systems

Notes: Shipboum Automatic Identification System (AIS)

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
	80	156 - 163	12.5	150 Hz	15K0GXW
	80	156 - 163	12.5	150 Hz	11K5GXW
	80	156.525	12.5	150 Hz	14K2G2B

The device operates on AIS 1 - Channel 87 (161.975 MHz) and AIS 2 - Channel 88B (162.025 MHz) with remote frequency assignment capability. This device also has DSC capability.

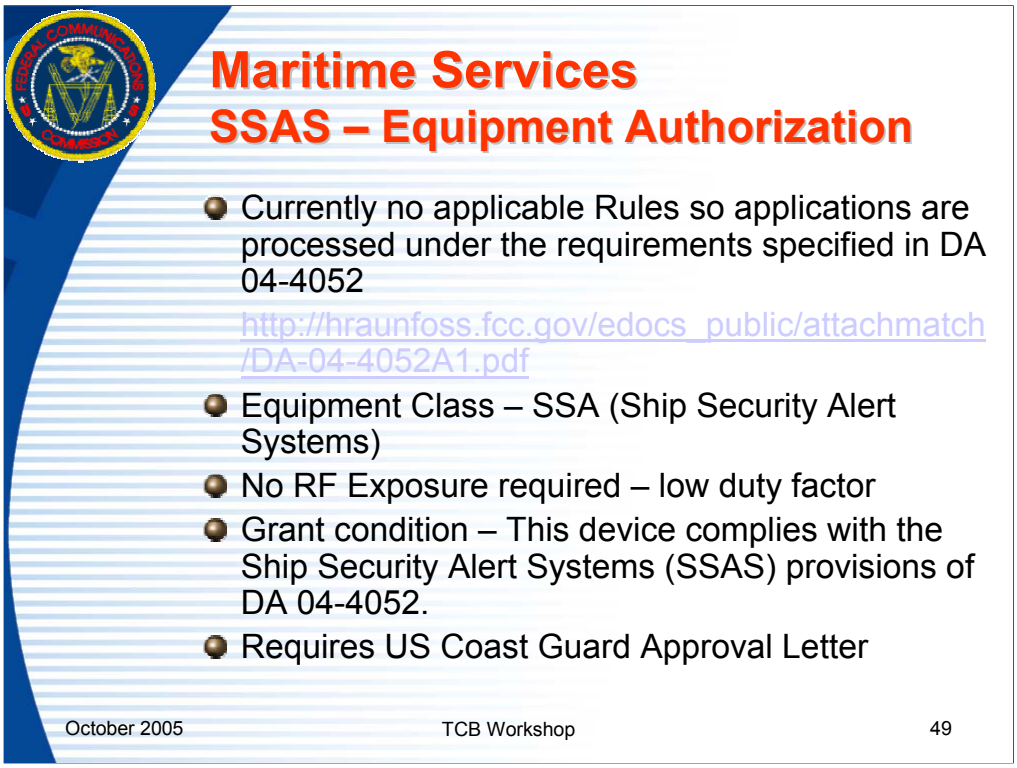
Maritime Services
AIS (Con't)

- Previously Automatic Identification Equipment (AIS) required a US Coast Guard approval letter
- U.S. / European Community Mutual Recognition Agreement on Marine Equipment - July 1st, 2004
  http://www.uscg.mil/hq/g-m/mse4/mra.htm
- AIS requires EC Accrediting Body Certificate – needs "Wheelmark" and a USCG Approval Number (Issued by EC Notification Body) on the Label Exhibits

Maritime Services
Ship Security Alert Systems (SSAS)

- Homeland Security directive
- 406 MHz SOSPAS-SARSAT system without 121.5 MHz homing beacon so messages are covert. Transmitter is essentially a modified 406 MHz EPIRB.

  http://www.cospas-sarsat.org/FirstPage/ssas.htm



DA 04-4052

Released: December 28, 2004

Review of Applications for Equipment Authorization of Ship Security Alerting Systems (SSAS) Using the COSPAS/SARSAT Satellite System

On July 1, 2004, Chapter XI-2, Regulation 6, *Revised Performance Standards for a Ship Security Alert System (SSAS)*, of the Safety of Life at Sea Convention, to which the United States is a signatory, went into effect. The SSAS provides a means for certain ships to transmit a covert security alert to shore to indicate that the security of the ship is under threat or has been compromised. The U.S. Coast Guard will assure that required vessels meet SSAS requirements during its inspection of vessels.

The Commission's Part 80 rules governing stations in the Maritime Service require certification for various radio transmitters used on board ships and by coast stations. The IMO Resolution recommended only functional requirements for the SSAS, not technical standards. Certain equipment meeting current Part 80 requirements may be utilized to meet SSAS requirements. In addition, there is equipment that meets the RTCM Recommended Standard for SSAS, but does not meet the current Part 80 requirements.[1] The Commission issued a *Notice of Proposed Rule Making* in PR Docket 00-48 that addresses the SSAS and seeks comment on certification requirements for the equipment.[2] During the pendency of the rulemaking proceeding, for SSAS equipment not meeting all current Part 80 requirements, the FCC Laboratory will review applications for certification under the RTCM recommended standard for SSAS equipment.

Questions concerning SSAS standards may be directed to Jim Shaffer of the Wireless Telecommunications Bureau at James.Shaffer@fcc.gov, and questions concerning equipment authorization may be directed to Andrew Leimer of the Office of Engineering and Technology at Andrew.Leimer@fcc.gov.

[1] *See* RTCM Recommended Standards for Ship Security Alerting Systems (SSAS) Using the COSPAS/SARSAT Satellite System, Version 1.0, June 4, 2004.

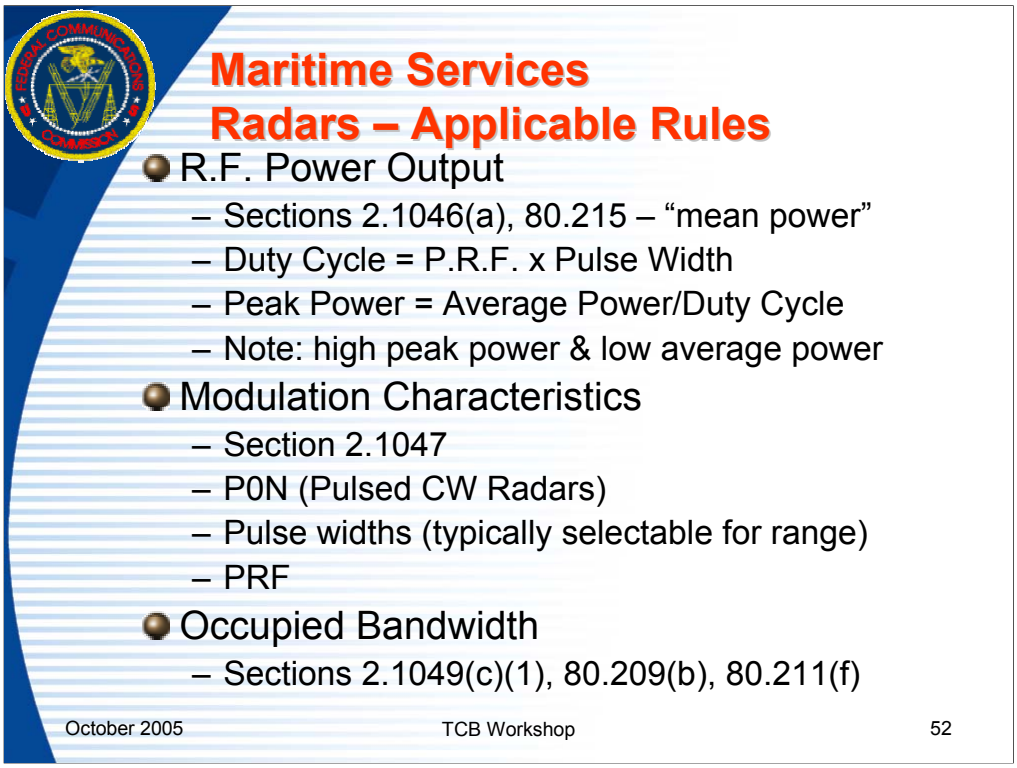
[2] *See* Amendment of Parts 13 and 80 of the Commission's Rules Concerning Maritime Communications, *Second Report and Order, Sixth Report and Order, and Second Further Notice of Proposed Rule Making*, PR Docket 00-48, 19 FCC Rcd 3120, 3163-64 ¶ 85 (2004).

Maritime Services
SSAS – International Standards

- Interim COSPAS-SARSAT Type Acceptance Procedures for SSAS
  http://www.cospas-sarsat.org/DocumentsTSeries/095-enclosure.pdf
- Final COSPAS-SARSAT Standards approved June 4, 2004
  - RTCM Paper 110-2004/SC110-STD
  - Currently not available on the Internet – contact COSPAS-SARSAT for a copy

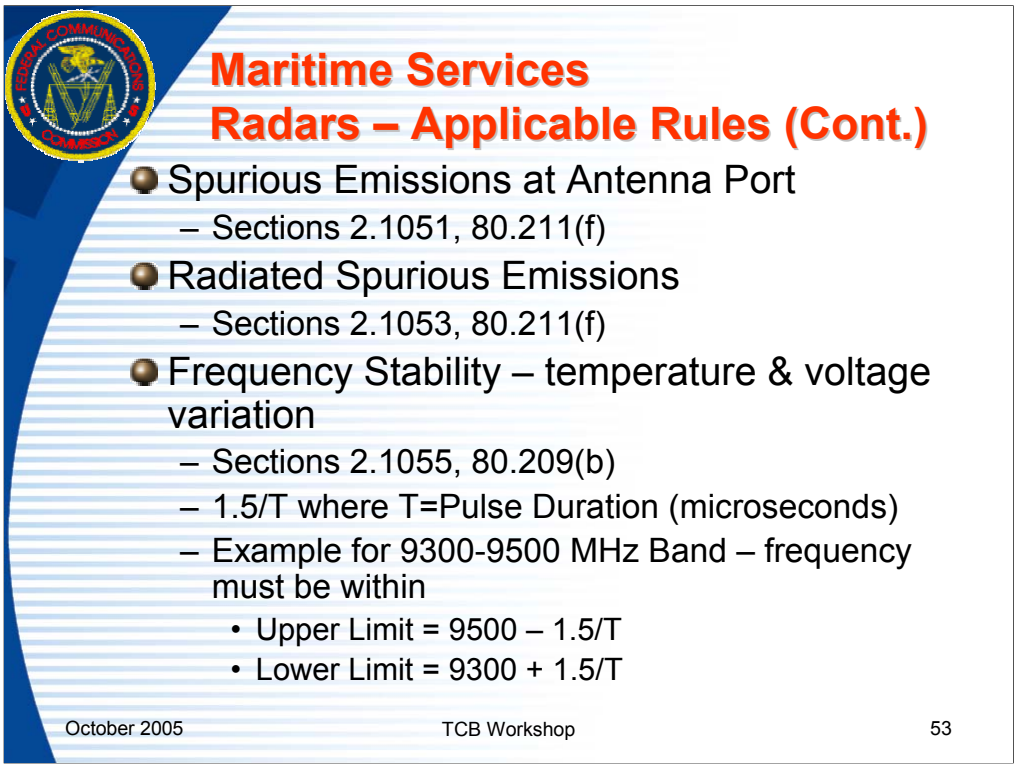
Maritime Services
Radars – Frequency Bands

- Frequency Bands
  - 2450–2500 MHz
  - 2900–3100 MHz
  - 5460–5650 MHz
  - **9300–9500 MHz**
  - 14.00–14.05 GHz
- This presentation focuses on the 9300-9500 MHz band since the majority of new devices only use this band



80.213(g) Radar stations operating in the bands above 2.4 GHz may use any type of modulation consistent with the bandwidth requirements in §80.209(b).

80.213(h) Radar transponder coast stations using the 2900–3100 MHz or 9300–9500 MHz band must operate in a variable frequency mode and respond on their operating frequencies with a maximum error equivalent to 100 meters. Additionally, their response must be encoded with a Morse character starting with a dash. The duration of a Morse dot is defined as equal to the width of a space and 1/3 of the width of a Morse dash. The duration of the response code must not exceed 50 microseconds. The sensitivity of the stations must be adjustable so that received signals below −10 dBm at the antenna will not activate the transponder. Antenna polarization must be horizontal when operating in the 9300–9500 MHz band and either horizontal or both horizontal and vertical when operating in the 2900–3100 MHz band. Racons using frequency agile transmitting techniques must include circuitry designed to reduce interference caused by triggering from radar antenna sidelobes.



80.211(f) The mean power when using emissions other than those in paragraphs (a), (b), (c) and (d) of this section:

(1) On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB;

(2) On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 dB; and

(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus 10log10 (mean power in watts) dB.

80.209(b) When pulse modulation is used in land and ship radar stations operating in the bands above 2.4 GHz the frequency at which maximum emission occurs must be within the authorized bandwidth and must not be closer than 1.5/T MHz to the upper and lower limits of the authorized bandwidth where “T” is the pulse duration in microseconds. In the band 14.00–14.05 GHz the center frequency must not vary more than 10 MHz from 14.025 GHz.

80.273(a)(1) Radar installed on or after July 1, 1988, on ships of 500 gross tons and upwards that were constructed on or after September 1, 1984, must comply with the provisions of RTCM Paper 133–87–SC 103–33 including Appendix A. Title: "RTCM Recommended Performance Specification for a General Purpose Navigational Radar Set for Oceangoing Ships of 500 Gross Tons and Upwards for New Radar Installations." Title of Appendix A: "General Purpose Shipborne Navigational Radar Set for Oceangoing Ships Design and Testing Specifications." Document originally approved by RTCM August 15, 1985 and revised May 15, 1987.

80.273(a)(2) Radar installed on ships of 1,600 gross tons and upwards on or before April 27, 1981, must comply with the provisions of Volume II of RTCM Special Committee No. 65 Final Report; Part II. Title: "Performance Specification for a General Purpose Navigational Radar Set for Oceangoing Ships of 1,600 Tons Gross Tonnage and Upwards for Ships Already Fitted." Document approved by RTCM July 18, 1978; effective as FCC requirement on April 27, 1981.

80.273(a)(3) Radar installed on ships of 1,600 gross tons and upwards after April 27, 1981 and before July 1, 1988, must comply with the provisions of Volume II of RTCM Special Committee No. 65 Final Report with Change 1 entered; Part I including Appendix A. Title: "Performance Specification for a General Purpose Navigational Radar Set for Oceangoing Ships of 1,600 Tons Gross Tonnage and Upwards for New Radar Installations." Title of Appendix A: "General Purpose Shipborne Navigational Radar Set for Oceangoing Ships Design and Testing Specifications." Document approved by RTCM July 18, 1978; effective as FCC requirement on April 27, 1981.

80.273(a)(4) Ships between 500 and 1,600 gross tons constructed on or after September 1, 1984, with radar installed before July 1, 1988, must comply with Regulation 12, Chapter V of the Safety Convention and with the provisions of Inter-Governmental Maritime Consultative Organization (IMCO) [now International Maritime Organization] Resolution A.477 (XII). Title: "Performance Standards for Radar Equipment," with Annex. Adopted by IMCO November 19, 1981.

Maritime Services

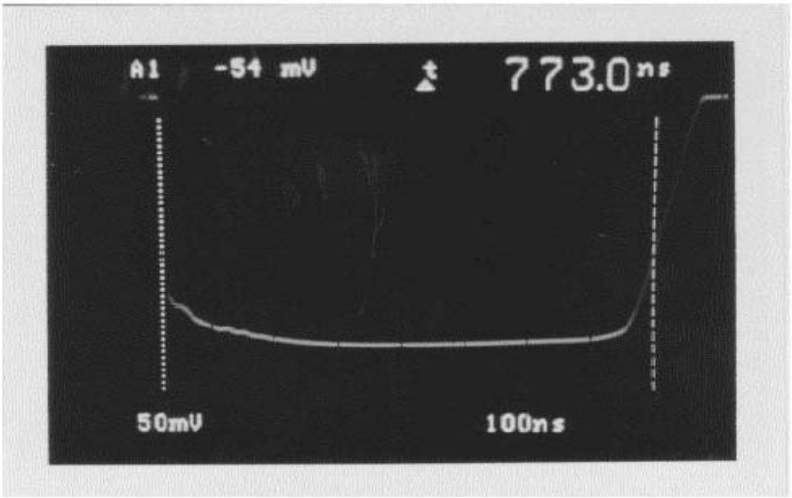
Radars – Typical Measurement Procedure

- The average power, pulse widths, pulse rise and decay times, and the interval between successive output pulses are measured (1/2 Voltage PW)
- The pulse repetition frequency (PRF) is then calculated from the reciprocal of the interval
- The duty cycle is calculated from the product of the P.F.R. and the pulse width
- The average power is corrected for attenuation
- The peak power is calculated by dividing the average power by the duty cycle
- The spurious and harmonic radiation characteristics, the occupied bandwidth and the receiver radiation are measured

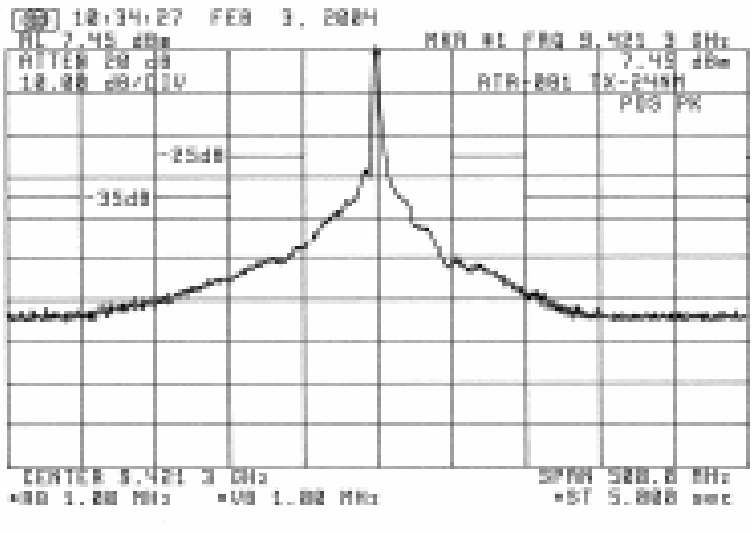
Maritime Services
Radars – Equipment Authorization

- Equipment Class – MRD (Marine Radar)
- Can list entire band on Grant but must have operational frequencies and frequencies parameters (Hopping, etc.) in the Operational Description
- Modulation P0N (Not PON)
- Necessary BW is typically several MHz
- Measure all PW and OBW – preferable to include plots in the Test Report
- Conducted spurious radiation
- Case radiated measurements
  - Antenna terminated
- No RF Exposure requirements

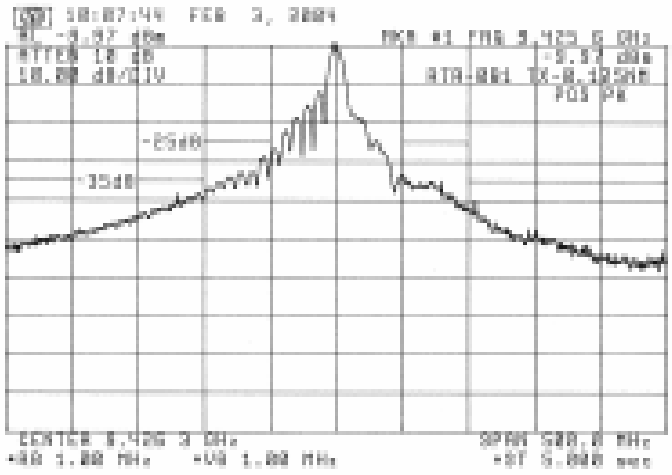
Maritime Services
Radars – Measured PW



Maritime Services
Radars – OBW RW #1



Maritime Services
Radars – OBW PW#2



Maritime Services
Radars – Grant Example

- Equipment Class – MRD
- List entire 9300-9500 MHz band
- Output Power – manufacturers rated peak power
- Frequency Tolerance – leave blank (must comply)
- No RF Exposure Conditional Requirements Necessary

Equipment Class : Marine Radar
Notes: Marine Radar RA41C

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
	80	9300 - 9500	4000		54M4P0N

Aviation Services
VHF Rules

- 118-137 MHz (Equipment Class – TNB)
- R&O and FNPRM - FCC 03-238 (Docket 01-289) – in effect as of 9/13/04
  http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-03-238A1.pdf
- Requires FAA Coordination Prior to FCC Filing
- Removes waiver requirement for equipment with 8.33 KHz channel spacing
- Allows for dual spacing transceivers (i.e 25/8.33 KHz)
  - 8.33 KHz operation not allowed in US

Aviation Services Radars

- Similar to Marine (Part 80) Radars
- Equipment Class – SRT
- 9300-9500 MHz
- Very Few Grants
- FAA Approval – Not Required

Aviation Services
Emergency Location Transmitter (ELTs)

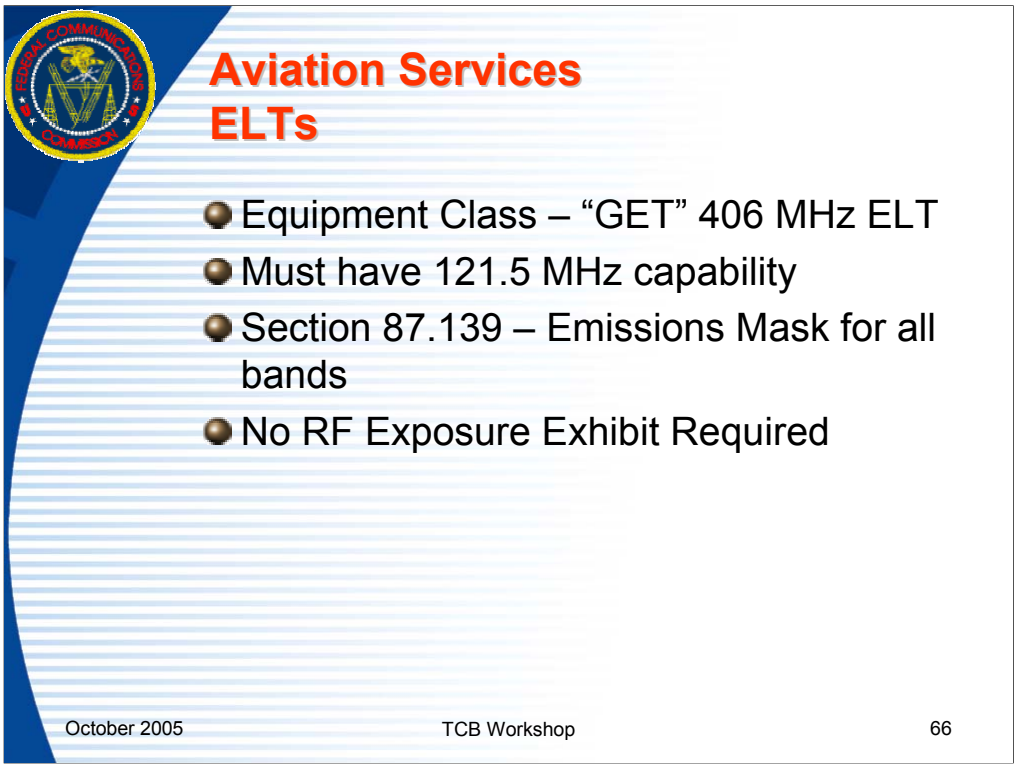
- 121.5/406 MHz beacons carried aboard aircraft can usually be activated both manually and automatically by shock (using a crash sensor or G switch). False alerts w/G switch.
- Section 87.197 – ELT Test Procedures
- Section 87.199 – Special Requirements
- COSPAS/SARSAT approved test facility required

Aviation Services
ELTs - Standards

- FAA Standard TSO – C91A
  http://www.airweb.faa.gov/Regulatory_and_Guidance_Library/rgTSO.nsf/0/e2b1e589c98200f886256dc900695b8c/$FILE/C91a.pdf
- Radio Technical Commission for Aeronautics document titled “Minimum Operational Performance Standards 406 MHz Emergency Locator Transmitters (ELT)” Document No. RTCA/DO–204 dated September 29, 1989.

Aviation Services
ELTs – Approval Letter Exhibits

- FAA Approval
  - Section 87.149(d)(2) for 121.5 MHz
  - Section 87.149(e) for 406 MHz
- COSPAS – SARSAT Certificate



87.139(h): For ELTs operating on 121.500 MHz, 243.000 MHz and 406.0–406.1 MHz the mean power of any emission must be attenuated below the mean power of the transmitter (pY) as follows:

(1) When the frequency is moved from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth the attenuation must be at least 25 dB;

(2) When the frequency is removed from the assigned frequency by more than 100 percent of the authorized bandwidth the attenuation must be at least 30 dB.

Questions and Answers

Thanks!