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

October 2005
TCB Workshop

Andy Leimer
Equipment Authorization Branch

Federal Communications Commission
Office of Engineering and Technology
Laboratory Division
The Global Maritime Distress and Safety System (GMDSS) is an international system which uses terrestrial and satellite technology and ship-board radio-systems to ensure rapid, automated, alerting of shore based communication and rescue authorities, in addition to ships in the immediate vicinity, in the event of a marine distress.

GMDSS is the general “umbrella” that cover many Maritime radio services.

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 identifiers 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
<table>
<thead>
<tr>
<th>Channel number</th>
<th>Frequency (MHz)</th>
<th>Channel number</th>
<th>Frequency (MHz)</th>
<th>Channel number</th>
<th>Frequency (MHz)</th>
<th>Channel number</th>
<th>Frequency (MHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>156.525</td>
<td>04</td>
<td>156.200</td>
<td>08</td>
<td>156.300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>01</td>
<td>156.525</td>
<td>05</td>
<td>156.200</td>
<td>09</td>
<td>156.300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>02</td>
<td>156.525</td>
<td>06</td>
<td>156.300</td>
<td>10</td>
<td>156.525</td>
<td></td>
<td></td>
</tr>
<tr>
<td>03</td>
<td>156.525</td>
<td>07</td>
<td>156.300</td>
<td>11</td>
<td>156.525</td>
<td></td>
<td></td>
</tr>
<tr>
<td>04</td>
<td>156.200</td>
<td>08</td>
<td>156.300</td>
<td>12</td>
<td>156.525</td>
<td></td>
<td></td>
</tr>
<tr>
<td>05</td>
<td>156.200</td>
<td>09</td>
<td>156.300</td>
<td>13</td>
<td>156.525</td>
<td></td>
<td></td>
</tr>
<tr>
<td>06</td>
<td>156.300</td>
<td>10</td>
<td>156.525</td>
<td>14</td>
<td>156.700</td>
<td></td>
<td></td>
</tr>
<tr>
<td>07</td>
<td>156.300</td>
<td>11</td>
<td>156.525</td>
<td>15</td>
<td>156.700</td>
<td></td>
<td></td>
</tr>
<tr>
<td>08</td>
<td>156.300</td>
<td>12</td>
<td>156.525</td>
<td>16</td>
<td>156.800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>09</td>
<td>156.300</td>
<td>13</td>
<td>156.525</td>
<td>17</td>
<td>156.800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>156.525</td>
<td>14</td>
<td>156.700</td>
<td>18</td>
<td>156.900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>156.525</td>
<td>15</td>
<td>156.700</td>
<td>19</td>
<td>156.900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>156.525</td>
<td>16</td>
<td>156.800</td>
<td>20</td>
<td>156.900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>156.525</td>
<td>17</td>
<td>156.800</td>
<td>21</td>
<td>156.900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>156.700</td>
<td>18</td>
<td>156.900</td>
<td>22</td>
<td>156.900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>156.700</td>
<td>19</td>
<td>156.900</td>
<td>23</td>
<td>156.900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>156.800</td>
<td>20</td>
<td>156.900</td>
<td>24</td>
<td>156.900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>156.800</td>
<td>21</td>
<td>156.900</td>
<td>25</td>
<td>156.900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>156.900</td>
<td>22</td>
<td>156.900</td>
<td>26</td>
<td>156.900</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Low power only. *Momentary high power.

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

October 2005

TCB Workshop
Maritime Services
VHF Applicable Rules

- GMDSS – Part 80 Subpart W
  GMDSS Equipment must meet the requirements of 80.1101(c)(2)
- Non-Compulsory or voluntary equipment must meet the requirements of 80.225(a)

**WARNING:** DSC is permitted in VHF handheld radios but it must also meet 80.225(a). Paragraph 80.225(a) requires that DSC equipment installed in coast or ship stations must meet either the requirements of ITU-R M.493 or RTCM Paper 56-95/SC101-STD. **Contact the FCC.**

- DSC typically not in handhlds since the requirements are hard to meet

### 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
Maritime Services
VHF Applicable Standards

RTCM Paper 56-95/SC101-STD
- RTCM Recommended Minimum Standards for DSC Equipment Providing Minimum Distress and Safety Capability, Version 1.0 – defines minimum functions for DSC transceivers used in the US
- Paper Only ($10)

ITU-R M.541-9
Operational procedures for the use of digital selective-calling equipment in the maritime mobile service

ITU-R M.493-11
Digital selective-calling system for use in the maritime mobile service

ITU Radiocommunication Sector – standards, updates & news
Subscription Services (Electronic or paper)
  http://www.itu.int/ITU-R/

October 2005 TCB Workshop 9


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)

[Graph showing modulation characteristics with various lines indicating deviations at 1kHz, 3kHz, and 10kHz.]
Maritime Services
F3E (Channel 16) Occupied BW
Maritime Services
DSC (G2B Modulation, Channel 70) Occupied BW

[Graph showing frequency and modulation characteristics]
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 Maritime Transceiver

<table>
<thead>
<tr>
<th>Grant Notes</th>
<th>FCC Rule Part</th>
<th>Frequency (Range MHz)</th>
<th>Output Watts</th>
<th>Frequency Tolerance</th>
<th>Emission Designator</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS GM</td>
<td>00.1101(c)(4)</td>
<td>156.025 - 156.025</td>
<td>1</td>
<td>7 PPM</td>
<td>16KR6G3E</td>
</tr>
<tr>
<td>CS GM</td>
<td>00.1101(c)(4)</td>
<td>156.025 - 157.425</td>
<td>25</td>
<td>7 PPM</td>
<td>16KR6G3E</td>
</tr>
<tr>
<td>CS GM</td>
<td>00.1101(c)(3)</td>
<td>156.025 - 157.425</td>
<td>1</td>
<td>7 PPM</td>
<td>16KR6G2B</td>
</tr>
<tr>
<td>CS GM</td>
<td>00.1101(c)(4)</td>
<td>156.025 - 157.425</td>
<td>25</td>
<td>7 PPM</td>
<td>16KR6G2B</td>
</tr>
</tbody>
</table>

Power listed is conducted. This device must not exceed a maximum transmitting duty factor of 69%. All qualified end-users of this device must have the responsibility 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 dB.

*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.

October 2005  TCB Workshop  22
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.


[2] Id. at 4-5.
Maritime Services

EPIRB Types

Class A – Section 80.1053
  - 121.5/243 MHZ. Float-free, automatically-activating, detectable by aircraft and satellite. Coverage is limited. An alert from this device to a rescue coordination center may be delayed 4 - 6 or more hours. No longer recommended or Granted.

Class B – Section 80.1055
  - 121.5/243 MHZ. Manually activated version of Class A. No longer recommended or Granted

Class C – Section 80.1057
  - VHF ch15/16. Manually activated, operates on maritime channels only. Not detectable by satellite. These devices have been phased out by the FCC and are no longer recognized. Grants can still be issued.

Class S – Section 80.1059
  - 121.5/243 MHZ. Similar to Class B, except it floats, or is an integral part of a survival craft. No longer recommended or Granted

Note: Subpart 2N - Test Procedure for Class A, B, and S EPIRBs is obsolete since they no longer can be Granted

Inmarsat E-EPIRB (1.4 GHz) to discontinue operation after December 1, 2004
  - After 8 years of service only 100 L-Band EPIRBs 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.
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).


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](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
Maritime Services
EPIRBs – Equip. Authorization


– (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
COSPAS-SARSAT TYPE APPROVAL CERTIFICATE

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

WHEREAS, the Cospsar Council has determined, following a review of the test results, that the said beacon meets the Cospsar Search and Rescue requirements and is suitable for operation over the temperature range of -20°C to +50°C, with battery:

- Automatic activation
- S band (10995 - 11290 MHz)
- EPIRB mode
- 406 MHz (140 - 1480 MHz)
- L/R channel (156 MHz)
- Battery life: 5 years

THEREFORE, Cospsar Council hereby certifies that the said EPIRB is compatible with the Cospas-Sarsat System as of the date of this Certificate.

Certificate No.: 132
Date: 8 September 2000

Signed by:
Head of Cospsar Search and Rescue

NOTE: HOWEVER:
1. This certificate does not authorize the operation of any 406 MHz distress beacon in Antarctica or any area where its operation may interfere with other telecommunications services, or in areas where its beacon will be disseminated, and may also be subject to national licensing requirements.

2. This certificate is intended only as a formal confirmation of the above identified EPIRB's conformance with the Cospsar Search and Rescue requirements as defined in the COSPAR Search and Rescue Standard. This certificate is not a warranty and Cospsar Search and Rescue expressly disclaims any and all liability arising out of or in connection with the issuance, use, or omission of this certificate.

3. This certificate is subject to revocation by the Cospsar Search and Rescue when it is no longer capable of meeting the Cospsar Search and Rescue specifications. A new certificate may be issued when an operator's station has been certified and continues to meet the Cospsar Search and Rescue specifications.
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.

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.

October 2005 TCB Workshop 36
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

<table>
<thead>
<tr>
<th>Grant Notes</th>
<th>FCC Rule Parts</th>
<th>Frequency Range (MHz)</th>
<th>Output Watts</th>
<th>Frequency Tolerance</th>
<th>Emission Designator</th>
</tr>
</thead>
<tbody>
<tr>
<td>GM</td>
<td>80.1101(c)(5)</td>
<td>406.025</td>
<td>5</td>
<td>2 PPM</td>
<td>16K01G1D</td>
</tr>
<tr>
<td>GM</td>
<td>80.1101(c)(5)</td>
<td>121.5</td>
<td>0.1</td>
<td>10 PPM</td>
<td>3K20A3X</td>
</tr>
</tbody>
</table>

Approved for RTCM Category 1 (Float Free) when used with bracket FE4 or FB4.
Approved for RTCM Category 2 (Manual) when used with bracket MB4.

GM: This unit meets requirements for GMDS 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.
Radiated Emissions Limits – IEC 945

B = bande passante du récepteur de mesure
D = 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 these 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

---

**Table 6 – Required receiver characteristics**

<table>
<thead>
<tr>
<th>Receiver parameters</th>
<th>25 kHz channels</th>
<th>12.5 kHz channels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>20 % PER for −107 dBm</td>
<td>20 % PER for −98 dBm</td>
</tr>
<tr>
<td>Co-channel rejection</td>
<td>−10 − 0 dB</td>
<td>−10 − 0 dB</td>
</tr>
<tr>
<td>Adjacent channel selectivity</td>
<td>70 dB</td>
<td>50 dB</td>
</tr>
<tr>
<td>Spurious response rejection</td>
<td>70 dB</td>
<td>N/A</td>
</tr>
<tr>
<td>Intermodulation response rejection and blocking</td>
<td>20 % PER</td>
<td>N/A</td>
</tr>
</tbody>
</table>
US Coast Guard Approval Letter Required

Applicable FCC Rules
- 80.209 Frequency Tolerance 10ppm
- 80.211(f) Emissions Mask (category: other)
  • Note that IEC mask is much tighter
- 80.215(a)(1) Power 25 Watts for ship stations
- 80.215(g)(3) Automatic 1 Watt power reduction requirement for specific frequencies

Application must contain data for ALL international standards

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

<table>
<thead>
<tr>
<th>Grant Notes</th>
<th>FCC Rule Parts</th>
<th>Frequency Range (MHz)</th>
<th>Output Power (Watts)</th>
<th>Frequency Tolerance (Hz)</th>
<th>Emission Designator</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>156 - 163</td>
<td>12.5</td>
<td>150Hz</td>
<td>15K90XKXW</td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>156 - 163</td>
<td>12.5</td>
<td>150Hz</td>
<td>1K50XKXW</td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>156.525</td>
<td>12.5</td>
<td>150Hz</td>
<td>14K2626</td>
<td></td>
</tr>
</tbody>
</table>

The device operates on AIS 1 - Channel 07 (156.575 MHz) and AIS 2 - Channel 088 (162.025 MHz) with remote frequency assignment capability. This device also has DSC capability.

October 2005  TCB Workshop  46
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.

[External Link: http://www.cospas-sarsat.org/FirstPage/ssas.htm]
Maritime Services
SSAS – Equipment Authorization

Currently no applicable Rules so applications are processed under the requirements specified in DA 04-4052

Equipment Class – SSA (Ship Security Alert Systems)
No RF Exposure required – low duty factor
Grant condition – This device complies with the Ship Security Alert Systems (SSAS) provisions of DA 04-4052.
Requires US Coast Guard Approval Letter

October 2005 TCB Workshop 49

DA 04-4052
Released: December 28, 2004


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.

Maritime Services
SSAS – International Standards

Interim COSPAS-SARSAT Type Acceptance Procedures for SSAS

Final COSPAS-SARSAT Standards approved June 4, 2004
– 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.
Maritime Services
Radars – Applicable Rules

- **R.F. Power Output**
  - Sections 2.1046(a), 80.215 – “mean power”
  - Duty Cycle = P.R.F. x Pulse Width
  - Peak Power = Average Power/Duty Cycle
  - Note: high peak power & low average power

- **Modulation Characteristics**
  - Section 2.1047
  - P0N (Pulsed CW Radars)
  - Pulse widths (typically selectable for range)
  - PRF

- **Occupied Bandwidth**
  - Sections 2.1049(c)(1), 80.209(b), 80.211(f)

---

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.
Maritime Services
Radars – Applicable Rules (Cont.)

- Spurious Emissions at Antenna Port
  - Sections 2.1051, 80.211(f)
- Radiated Spurious Emissions
  - Sections 2.1053, 80.211(f)
- Frequency Stability – temperature & voltage variation
  - Sections 2.1055, 80.209(b)
  - 1.5/T where T=Pulse Duration (microseconds)
  - Example for 9300-9500 MHz Band – frequency must be within
    - Upper Limit = 9500 – 1.5/T
    - Lower Limit = 9300 + 1.5/T

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)(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.


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 – 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

<table>
<thead>
<tr>
<th>Grant Notes</th>
<th>FCC Rule Parts</th>
<th>Frequency Range (MHz)</th>
<th>Output Watts</th>
<th>Frequency Tolerance</th>
<th>Emission Designator</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>80</td>
<td>9300 - 9500</td>
<td>4000</td>
<td></td>
<td>5AM4P0N</td>
</tr>
</tbody>
</table>

October 2005

TCB Workshop

60
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
- 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
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

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!