



Licensed Devices General Technical Requirements

(Detailed Update October 2005)

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**Federal Communications Commission
Office of Engineering & Technology**

October, 2005

➤ **TCB Workshop**

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Sessions for licensed devices intended to give an overview of FCC Processes & Rules, not to show limits for every type of device. The information covered is mainly related to equipment authorization of the transmitting equipment and not the licensing of the station.

Overview



- **General Information**
- **How to find information at the FCC**
- **Creating a Grant**
- **Organizing a Report**
- **Licensed Device Checklist**

This session will cover general information related to the FCC rules and technical requirements for licensed devices.

Assumption is that everyone is familiar with testing equipment so test setup and equipment settings will not covered.

The approval process for these types of equipment was previously called Type Acceptance or Notification. Now all methods of equipment approval are called Certification.

This information generally applies to all Radio Service Rules for scopes B1 through B4.

General Information



➤ Understanding how FCC rules for licensed equipment are written and how FCC operates

- ▶ The FCC rules are Title 47 of the Code of Federal Regulations
- ▶ 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.)
- ▶ All material covered in this training is either in these rules or based on these rules

There are about 15 different radio service rule Parts which require equipment to be authorized before an operators license can be obtained.

The various radio service rule parts are each developed by different groups at the FCC for the purpose of allowing different types of operations at various frequency bands across the frequency spectrum. Each rule part may have unique technical requirements which need to be addressed in each application.

The hard copy version of the rules are updated as of October 1 every year. Any rules adopted after October 1 can be found on the FCC website under e-filing and then clicking EDOCS link. A Report and Order number or Docket number is needed.

EDocs link:

http://hraunfoss.fcc.gov/edocs_public/SilverStream/Pages/edocs.html

General Information II



- **FCC TCB process divides all Licensed Radio Service Rules into four scopes of authorization.**
- **Not all equipment which is approved by the FCC may be approved by a TCB**
 - ▶ 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

As new technology evolves the FCC will develop test procedures to allow TCB's to approve the equipment.

RF exposure issues will be addressed by Tim and Martin.

TCB Radio Service Rules Scopes



- **Scope B1- Personal mobile radio Services**
 - ▶ 47 CFR Parts 22(cellular),24,25,27
- **Scope B2- General mobile radio services**
 - ▶ 47 CFR Parts 22(non-cellular),73,74,90,95,& 97
- **Scope B3- Maritime & Aviation Radio Services**
 - ▶ 47 CFR Parts 80 & 87
- **Scope B4- Microwave Radio Services**
 - ▶ 47 CFR Parts 27,74, & 101

All licensed equipment is organized into four scopes.

Broadcast services where Certification is required or allowed is included in the General mobile radio services scope B2

2002/2003

B1 57% of licensed devices

B2 39% of licensed devices

B3 2 % of licensed devices

B4 2 % of licensed devices

FCC Testing



➤ 47 CFR Parts 2.1046 - 2.1055 Tests required for all Licensed 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

The testing requirements are described under FCC Rule sections 2.1046 through 2.1055 are very basic. What they provide is a general requirement to test certain technical parameters. They don't provide a complete description of how to perform all tests

These Rule sections don't specify the limit which must be met. The specific limits are called out in each Radio Service rule part.

The frequency stability tests are done with respect voltage and temperature variation.

Example: For a Part 90 device go to Part 2 to find the general tests required such as maximum and minimum temperature range for frequency stability tests are from -30 to +50 degrees centigrade and then go to part 90 to see that the limit is 2.5 ppm.

47 CFR Parts 2.1046 - 2.1055



- **These tests are generally required for all licensed devices**
- **In some case the Radio Service Rules will have special or unique requirements which will add additional tests to be performed**
- **FCC recognizes ANSI/TIA/EIA 603-2003 as a document generally suitable to meet the minimum testing requirements in these sections**

There are some tests which 603 doesn't cover and some tests are done over a different range than the FCC Rules call out. When the FCC rules call out a specific value or test method, the FCC rules take precedent.

If the radio service rule section has more specific requirements than 2.1046-2.1055 then the radio service rules take precedent over Part 2.

Purpose of Measurements



- **The purpose of performing tests is to establish compliance with the technical requirements contained in the Radio Service Rules**
 - ▶ Common problem with applications is that tests are performed exactly as described in the 603 document but not enough information is provided to show compliance with the rules. The test report and supporting information submitted should show how the device complies with the Radio Service Rules and requirements

Example of problem with 603 - for the modulation limiting test, a test performed per 603 for a unit which is voice modulated. The 603 test calls out a maximum frequency range of 3 kHz where the FCC rules call out a minimum frequency range of 5 kHz.

2.1046 - RF Power Output



- **Form 731 Power always listed in Watts**
- **For units with antenna connector power is always conducted measurement**
- **For units with built-in/integral antenna 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
- **Power listed on grant-normally mean power**
 - ▶ Example of exception- Single sideband transmitters require peak envelope power and RADAR transmitters are peak values

Some of the Radio Service rules may get more specific about how the power output should be measured. When the radio service rules are more specific than Part 2, the radio service rules should be followed.

2.1046 - RF Power Output



- **Power listed on grant is based on measurement data and supplied in the report. Manufacturers ratings should 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”**

In many cases RF exposure evaluation test results determine the maximum power that can be listed on the grant.

Production tolerance never defined by rules.

2.1046 Power Out Special Cases



- **Amplifiers and other devices with multiple signals at output terminals**
 - ▶ 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
- **Part 101.113 (c) (1) spectral power density specifications are an example of a non typical power output on grant**
- **Part 80.959 (c) (1) requirement of minimum power output after 10 minutes of operation**

When the radio service rules have unique or special cases for power measurement the test report should be clearly describe how the test was performed.

Examples of special cases:

Amplifiers with multiple outputs may also be listed by total composite power on grant and providing maximum carrier and loading de-rating in grant remarks.

80.959 power measurement after 10 minutes conflicts with 5 minute cutoff requirement of 80.203(c)

2.1047 (a) Frequency Response

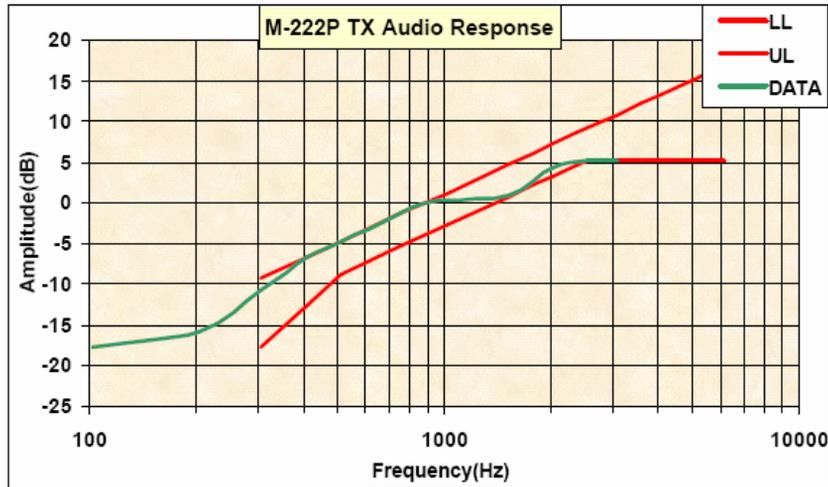


- **For voice modulated equipment a frequency response plot over the range 100 - 5000 Hz should be provided**
 - ▶ EIA/TIA 603 shows a different range but since the FCC rules are specific, the above range should be shown
- **For units with extended audio frequency response (wireless microphones) the response should be measured up to 15 KHz since up to 15KHz can be used a in typical broadcast operation**

Part 74 units are typically done with a 15kHz response.

Part 90 voice units typical response rolls off about 3KHz.

Audio Frequency Response Plot



This is a plot of the audio frequency response for a voice modulated FM transmitter. This transmitter has pre-emphasis or the plot would be flatter. The plot shows the peak response to be at 3 kHz.

2.1047 (b) Modulation Limiting



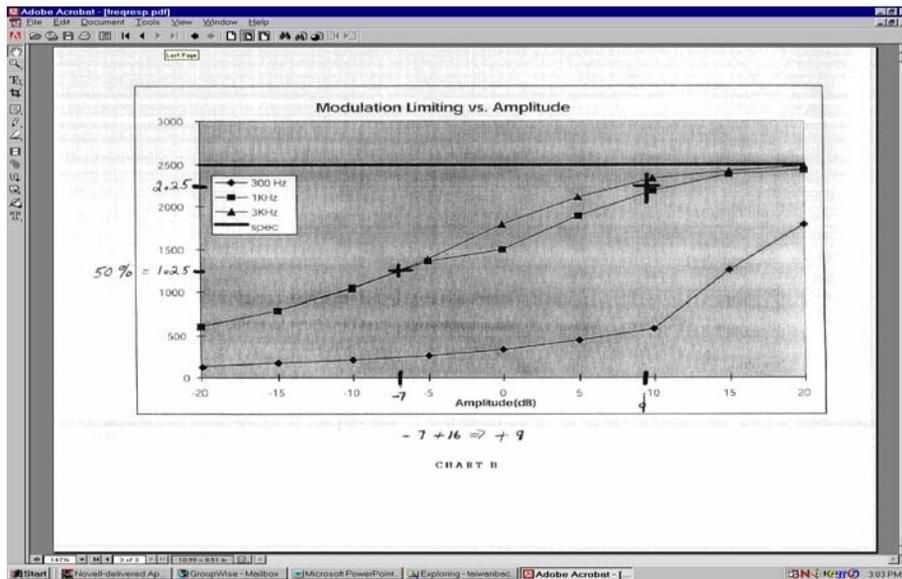
➤ A plot of modulation level (%) as a function of increasing modulation input

- ▶ A “family” of curves should be provided. Most test procedures for typical radio telephone use recommend the frequencies of 300, 1000, and 3000 Hz be used. These are acceptable but 2500 Hz audio frequency is also recommended since this is the frequency normally used in the occupied bandwidth test
- ▶ The audio input level should be increased to at least the level used for the occupied bandwidth test.
- ▶ Do not follow the 603 document for this test as it doesn't provide the required information

For Single sideband radios a family of curves should be plotted using peak envelope power versus audio input level.

Other special cases are for CB Units where a test of modulation keying transients is required and for part 90 units where a transient frequency response test is required under 90.214

Modulation Limiting Plot



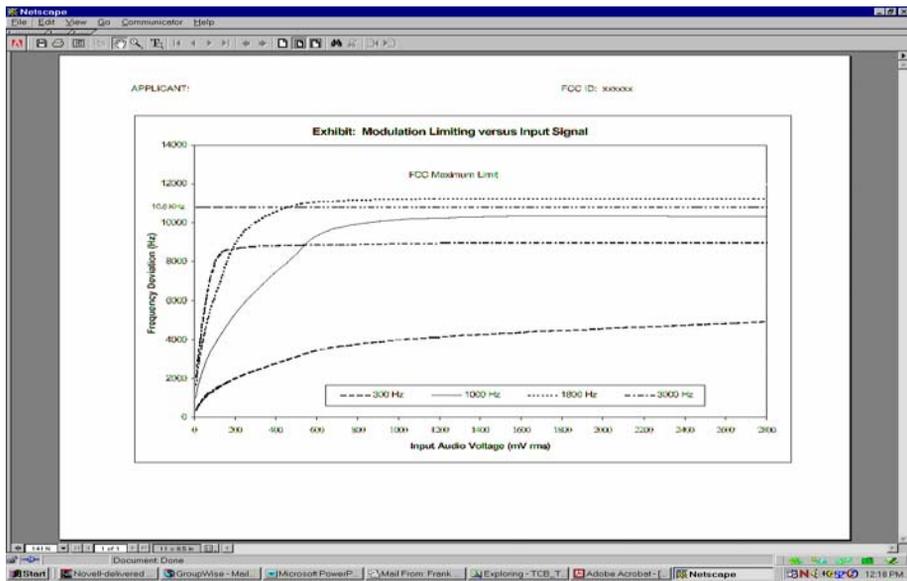
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This is a typical plot showing modulation limiting for a voice modulated unit. The plot should show at least 16 dB greater than that which is necessary to produce 50% modulation. The plot shows the modulation limited to 2.5 kHz. 50% of the attainable modulation level is 1.25 kHz for a frequency of 3 kHz. From the plot this occurs at an input level of -7dB (relative amplitude). The modulation input level of 16 dB higher than -7 dB is +9 dB. At this level the expected modulation level for a 2.5 kHz input is extrapolated to be 2.5 kHz.

Modulation Limiting Example



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This is an example of a modulation limiting plot for a device with a higher deviation level than the previous example.

2.1047 (d) Additional Tests



- **Some rule parts call for specific additional tests.**
 - ▶ An example of an additional test is the Transient Frequency Behavior test under Part 90.214

When new types of modulation or variations of current modulation types are developed, sometimes new tests or test methods are required to show compliance with the rules.

2.1049 Occupied Bandwidth



- **Occupied BW is the portion of the spectrum which contains 99% of the emitted energy (.5% of the remaining is above and .5% is below the occupied BW)**
 - ▶ The FCC uses these test results to compare the modulated spectrum with the emissions masks in the various radio service rule parts
 - ▶ The occupied bandwidth may not exceed the authorized bandwidth in the radio service rules
 - ▶ The occupied bandwidth test should be performed for each type of emission listed on the grant

For a 25 KHz land mobile radio Part 90.209 lists the authorized bandwidth as 20 kHz. 20 kHz is also the maximum acceptable necessary bandwidth. The bandwidth justification using Carson's rule can't exceed 20 kHz. Normally a typical frequency modulated voice emission has a maximum modulating frequency of 3 kHz and a peak deviation of 5 kHz which give a necessary bandwidth of 16 kHz which is well within the allowed 20 kHz.

Superimposing the emissions mask is helpful in making the review faster.

2.1049 Occupied Bandwidth II



- ▶ The emissions mask is normally applied with the Zero dB 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
 - ▶ A Bessel function analysis of the spectrum is performed for FM modulation
- ▶ 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

When the radio service rules don't specify a resolution bandwidth setting the guideline used is 1% of the occupied bandwidth. The video bandwidth setting should not be less than the resolution bandwidth setting.

Part 90 devices in the re-farming bands typically specify a bandwidth setting.

Re-farming Bands 150-174, 421-512 MHz.

2.1049 Occupied Bandwidth III



➤ Amplifiers and similar units

- ▶ These are devices which reproduce the modulated input signal
 - ▶ A test to show a comparison of a properly modulated input signal with the output signal. The output should show compliance with the emission limitations mask
- ▶ Multiple channel units should be tested with multiple channels for each emission type to show inter-modulation products

Some examples of similar units are: boosters, repeaters, and extenders.

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 at a specific time
- **Channel Bandwidth**
- **Other Bandwidth terms**

The various terms for bandwidth can cause confusion. Necessary bandwidth should be listed on the Form 731.

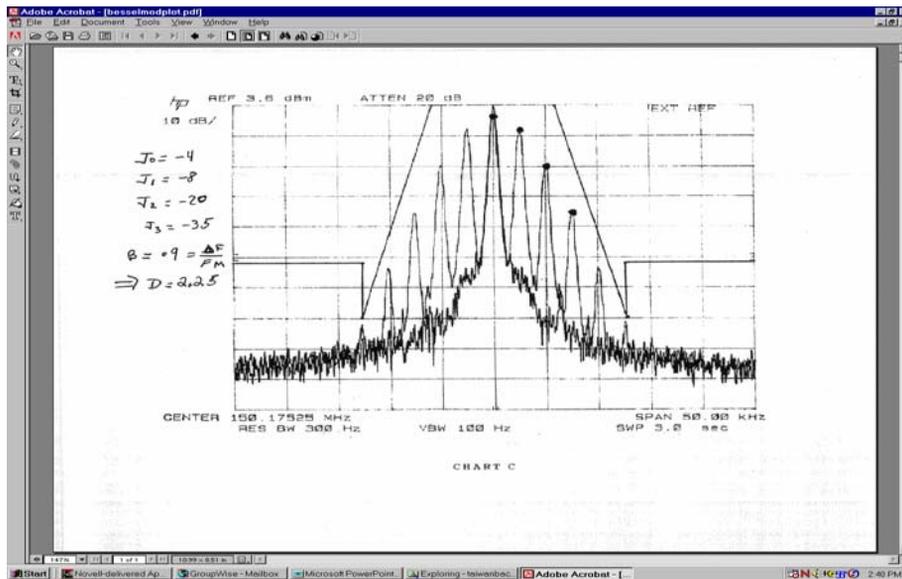
Occupied bandwidth and emission designator justifications should be consistent with the necessary bandwidth.

Channel bandwidth normally indicates the spacing specified by the FCC licensing bureau.

Other bandwidth terms - as new technologies are developed so are new terms. Listed are the most common terms

The rules are written by different personnel in different FCC Bureaus for a wide variety of operations and occasionally a new term for bandwidth will get into the Rules.

Bessel Function Analysis



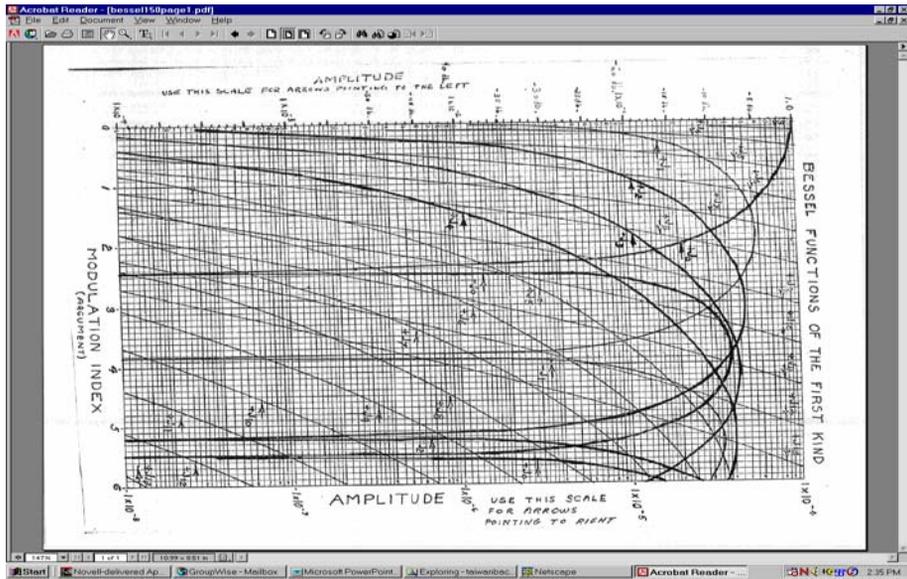
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A Bessel function analysis is used when possible to determine if a device was modulated properly during testing. This is an occupied bandwidth plot of a narrow-band Part 90 voice modulated transmitter. The sidebands are marked and their values shown on the left column. This voice modulated equipment should have a modulating frequency of 2.5 kHz and a deviation of about 2.5 kHz. The modulating frequency is shown by the spacing between sidebands to be about 2.5 kHz. To calculate the Bessel function Beta (modulation index) the level of the sidebands below the unmodulated carrier is noted and then the beta value determined from the Bessel plot on the next page.

Bessel Function Chart



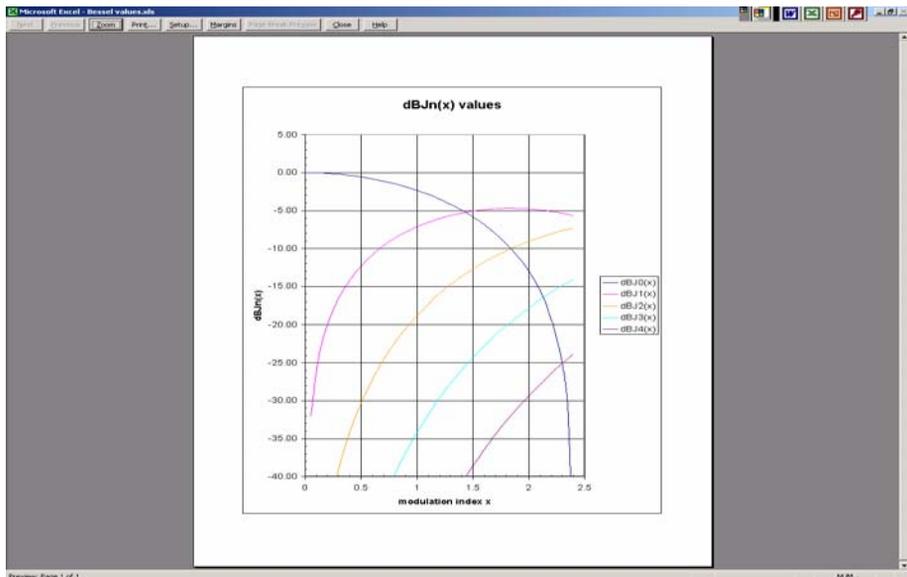
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This slide shows an image of a Bessel function chart taken from an RF engineering reference manual. This isn't a very clear image but is just to show roughly what the plot looks like. Each of the lines on the plot represent the side lobes of the transmitted signal. This plot is rotated sideways to fit on the page.

Bessel Function Chart



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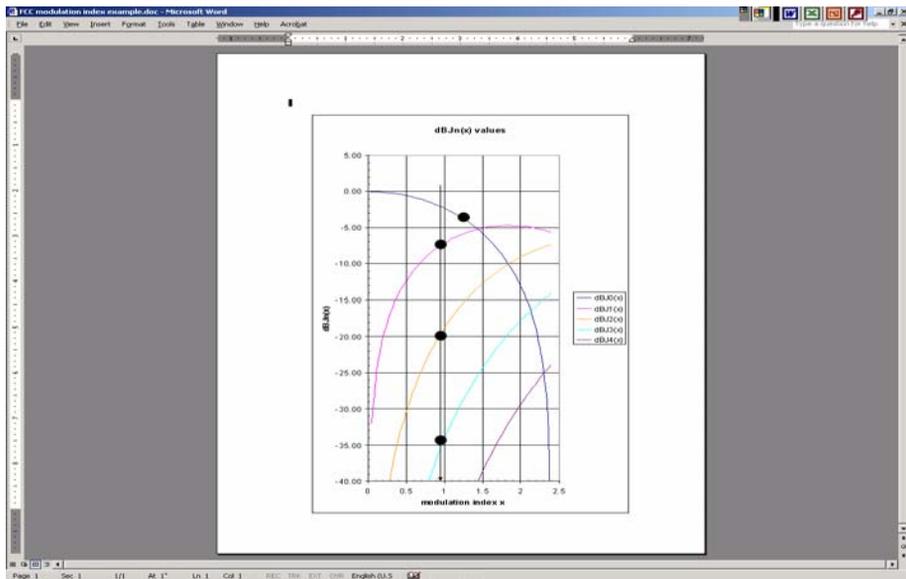
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This slide shows a clearer image of a Bessel function with the points of the previous slide plugged into a Microsoft Excel file and plotted. By plotting the level that the side lobes are below the unmodulated carrier and drawing a line between them, the modulation index can be determined. This can be used along with the modulation frequency to determine the deviation on a plot.

Data entered and plotted by R. Gubisch.

Bessel Function Beta



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This is the same plot as before with the levels of the side lobes shown and a line drawn through the plotted points to determine the modulation index (beta). Beta is calculated to be about .9. $\text{Beta} = \text{deviation}/\text{modulation}$. Plugging in the modulation and beta shows the deviation to be about 2.25 kHz. This value is then compared with the audio frequency response plots to verify the device is operating with the proper modulation during testing.

This point shows that the level of the fundamental is slightly off but the 1st thru 3rd sidebands line up properly.

2.1051 Conducted Spurious



➤ Measurements of the emissions at the antenna terminal

- ▶ This test is to determine emissions conducted through the antenna terminal. If the device doesn't have an antenna connector the data is obtained at the base of the antenna terminal
- ▶ The highest frequency measured is specified in 2.1057 of the rules
- ▶ The emission limits specified are an extension of the occupied bandwidth limits which are listed in the radio service rules measured up to the highest frequency specified in 2.1057

For units with integral antennas conducted spurious is not normally required. There are a few exceptions to this where the FCC rules call out limits at the base of the antenna whether or not the antenna is integral.

Emissions more than 20 dB below the limit do not need to be reported.

Conducted Spurious tests are performed with the equipment modulated.

2.1053 Radiated Spurious



- **This test is to determine emissions radiated from the cabinet, chassis, and associated wiring**
 - ▶ The emission limits specified are an extension of the occupied bandwidth limits which are listed in the radio service rules measured up to the highest frequency specified in 2.1057
 - ▶ Use Signal Substitution method described in EIA 603
 - ▶ All emission radiated relative to a half wave dipole
 - ▶ Power should be referenced to a dipole antenna
 - ▶ Method used because it standardizes the process and eliminates measurement uncertainties due to site characteristics, attenuation and path loss

For equipment with an antenna connector, this test normally performed with the EUT terminated.

When the equipment has an integral antenna, the test for radiated spurious should be made with the antenna attached to the unit. The test should be made with a signal substitution method per EIA/TIA 603. Note “measurements are referenced to dipole”.

Transmit and receive antennas don't need to be dipoles but measurement results should be converted to be equivalent to a dipole.

For radiated spurious test equipment is unmodulated during the test.

2.1055(a) Frequency Stability



➤ Frequency Stability versus Temperature

- ▶ Test is normally performed from -30 to +50 degrees centigrade
- ▶ Data is normally provided in 10 degree C increments
- ▶ Some radio service rules specify different frequency ranges. 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
- ▶ EIA/TIA 603 has less detail than the FCC rules and should not be followed for 2.1055 tests

Additional example of a difference is FRS radios where temperature is measured from -20 degrees to + 50 degrees.

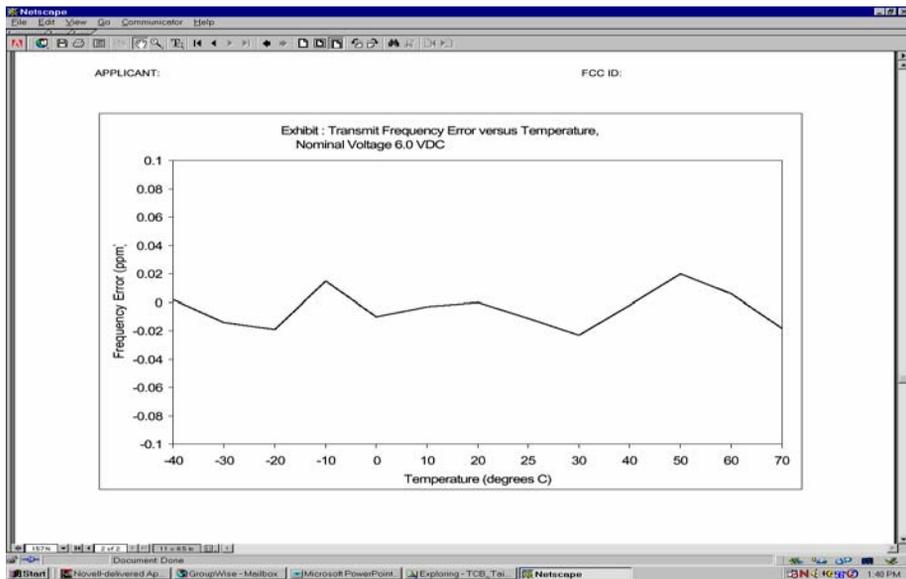
2.1055(d) Frequency Stability



➤ Frequency Stability versus Voltage

- ▶ For AC powered equipment the primary supply voltage should be from 85 to 115 % of the nominal value
 - ▶ If the equipment has an automatic shutoff before it gets to these levels, the device should be tested to the shutoff point
- ▶ For battery operated equipment the stability should be tested to the battery endpoint specified by the manufacturer
- ▶ EIA/TIA 603 has less detail than the FCC rules and should not be followed for 2.1055 tests

Frequency versus Temperature



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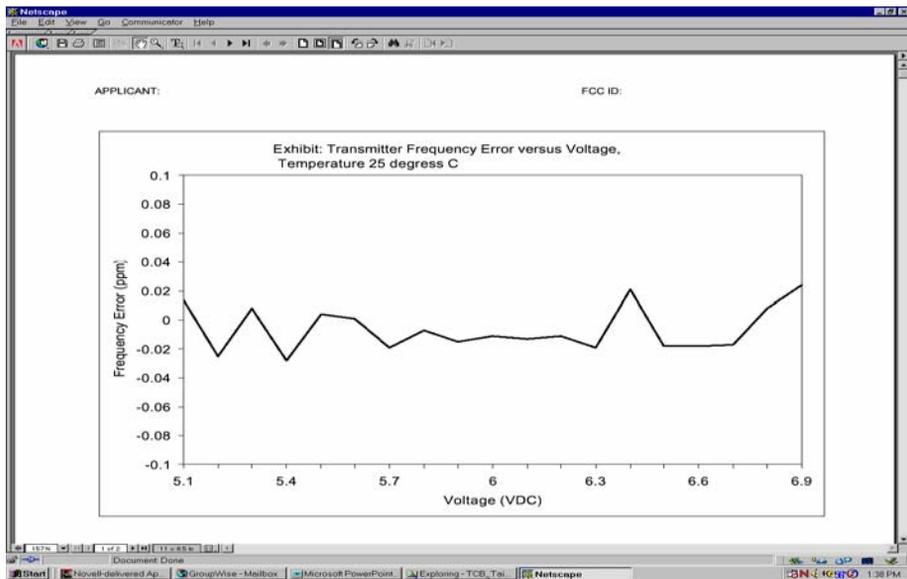
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This is an example of a frequency stability versus temperature plot. The plot shows the temperature measurements performed over a larger span than the FCC rules require.

Typical range is -30 to +50

Frequency versus Voltage



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This is an example plot showing the frequency stability versus voltage for a battery operated device.

Intermodulation



> INTERMOD TEST

- ▶ 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. (Does not demodulate the signal and retransmit. If the signal is demodulated the device would be classified as a transmitter.)
 - Extender - A bi-directional Booster or Repeater

Amplifier Definition- A device that takes incoming RF signal and retransmits the signal without demodulating.

For multi channel devices show a single channel comparison of input and output signal and also perform the three tone intermodulation test.

This is a conducted measurement. In most cases the equipment is modulated during the test. In some cases, such as FM, the signal is unmodulated.

For units where a power reduction is required at the band edges, the test only needs to be done at the first channels at each edge of the band with maximum power.

Intermodulation (continued)



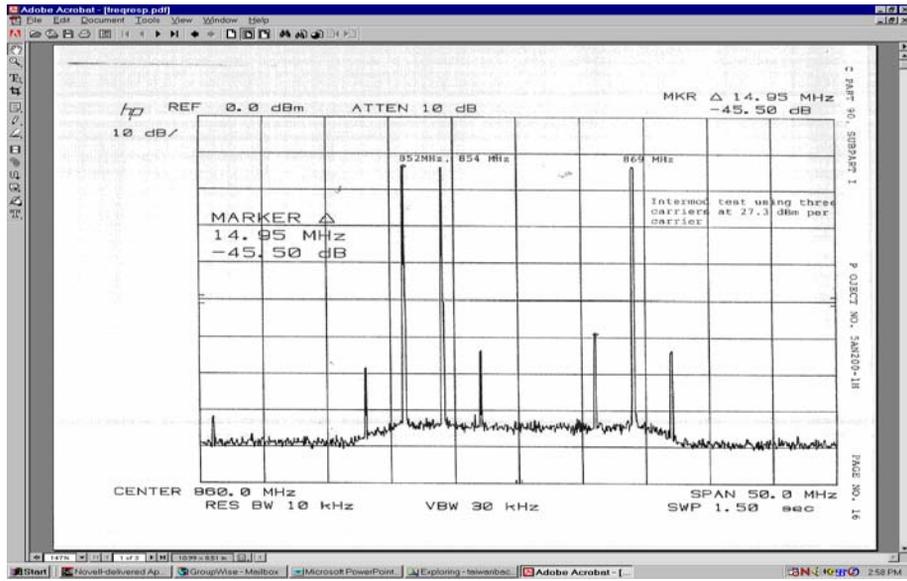
- ▶ Intermodulation products are spurious emissions which must meet the emissions mask in each Radio Service rule part
- ▶ Test Procedure - Should be tested at highest rated output level
 - ▶ Three Signal Test – requires only one test
 - two near to each other at one edge of passband
 - other signal alone at other edge of passband
 - ▶ Two Signal Test - requires the test be done twice
 - Once with two signals at upper edge of passband
 - Once with two signals at lower edge of passband

Three signals of equal magnitude at their highest rated output level should be tested for each type of modulation.

The two channels near each other should be separated by at least one operating channel width.

The two tone test is also accepted but must be performed twice, one time at each end of the operating band.

Intermodulation Plot



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This is a plot of a three tone Intermod test for an 850 - 870 MHz transmitter. The three highest signals are the three channel test. The two lower channels are separated by at least one channel.

This plot clearly shows the three intermod signals but not the intermod products which would be just off the screen. When the first and third tones beat against each other they will product emissions just outside the range shown on the plot.

The raised noise floor indicates the operating band of the device.

Test Procedures



➤ FCC Rules and Regulations

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

➤ EIA/TIA 603-2003

- ▶ FM Land Mobile Transmitter Test Methods

➤ EIA/TIA TSB102.CAAA

- ▶ Digital transceiver measurements

➤ ANSI C63.4 -2001

➤ Other industry accepted test procedures

- ▶ Many test procedures available from Global Engineering Documents - <http://global.ihs.com> 800-854-7179 or 303-397-7956

When the FCC is testing a device, the FCC rules are reviewed first to see what guidance they provide about performing the test. This includes a careful review of Part 2 and the specific radio service rules.

In some cases the the specific radio service rules may not provide any guidance but another radio service rule may have an applicable test procedure. For example the device being tested may be a Part 95 family radio service transmitter but Part 95 doesn't provide much detail about the power output test. In this case the device is required to have an integral antenna and the power output test should be done using the ERP method of signal substitution in which Part 15 of the rules provides some guidance.

If the FCC rules don't address a test procedure, the FCC looks for an industry adopted standard which applies.

EIA/TIA 603-1992 is a procedure for FM Land Mobile transmitters which provides useful information for testing and is a good supplement in many cases. There are some cases where 603 doesn't apply. Through out the presentation I'll try to indicate where 603 should not be used.

EIA/TIA TSB102 is based on 603 but used for digitally modulated devices.

C63.4 is basically for use with Part 15 devices but can be used in certain cases. Pending ET Docket 95-19 is considering adoption of C63.4 – 2001.

Information Requests



- **The FCC lab handles all information requests related to electronic filing and the equipment authorization process.**
- **The specific FCC Bureaus handle information requests related to licensing and interpretations of the radio service rules and technical requirements.**
 - ▶ Index for Wireless Telecommunications Bureau
Websites: <http://wireless.fcc.gov/services>

Questions related to the best way to file something or for how a test should be performed should be sent to the FCC Lab at btaube@fcc.gov or tcbinfo@fcc.gov respectively.

Questions related to rule makings and rule changes should be addressed to the responsible bureau.

The internet site listed is a good reference by service name for services regulated by the Wireless Telecommunications Bureau.

Contact Information



➤ **Rule Interpretations & Test Procedure Questions**

- ▶ Search Rule Interpretation Database by clicking on link on electronic filing pages
- ▶ Before contacting the FCC search the FCC Internet site for similar equipment previously granted
- ▶ Email questions to fccinfo@fcc.gov

➤ **Licensing and Rule Changes for Licensed devices**

- ▶ Check main FCC website: www.fcc.gov/labhelp
- ▶ Contact FCC Bureau which is responsible for rules
Most licensing questions are handled at Gettysburg Office

Quickest way to find a test procedure question is to look for similar types of equipment which have already been granted. All files received after April 15, 1998 are in electronic format on the Internet. Prior to that, a list of grants for all types of licensed equipment was published in the Radio equipment list. Also, the FCC Equipment Authorization Branch can be contacted and can usually find an example of a good application which is similar.

When rules change related to equipment authorization or when Radio Service Rules change which will have significant impact on equipment authorization process, OET will normally put a message on the electronic filing Internet sites but these messages won't appear until the new rules are about to go into effect. To see proposed rule makings each of the licensing bureaus Internet sites should be checked regularly and the Public Notices also should be checked. Note that the printed CFR's contain changes through October 1 of the year listed. Rule changes more recent than the date listed are not contained in the printed CFR's.

FCC licensing bureaus can be contacted by calling 1-800-call-fcc or by going to their web site as discussed in later slides.

When the licensing bureaus site lists a rulemaking by Docket number, the text of the rulemaking can be found at the EDOC's FCC website:

http://hraunfoss.fcc.gov/edocs_public/SilverStream/Pages/edocs.html

Example Applications



➤ **A good resource for how to test and which rule parts apply to a device is to look at previously granted devices**

- ▶ Part 74 Base Station FCCID:E5M-LEDR400S-74
- ▶ Part 74 H FCCID: AK8WRT822A
- ▶ Part80/87 Single Sideband Tx FCCID:BZ6SEA245
- ▶ Part 90 Land Mobile TNF FCCID: ABZ99FT4056
- ▶ Part 95 FRS TNF FCCID: K7GD54XX
- ▶ Part 95 A&B GMRS/FRS FCCID:G9H3-5822

Example applications are not perfect but are a good example to base an application on.



Tips for quicker response

- **Provide as much detail as possible about how the equipment in question operates**
- **Ask specific questions**
- **Specify which Rule Part(s) applies and what your interpretation of that rule section is**
- **Specify all other pertinent information**
- **Only send request to one individual at FCC**
 - ▶ If that person can't answer the question or needs to coordinate the response with someone else they will handle getting it to the person who can respond

Bureau Contacts



Part 90 - Land Mobile	Brian Marengo	202-418-0838
Part 97 – Amateur	David Roberts	202-418-1618
Part 25 – Satellite	Tom Tycz	202-418-0735
Part 101 – Fixed Microwave	Mike Pollak	202-418-1682
Part 21 (MDS) & 74 (ITFS)	Keith Larson	202-418-2600
Parts 22,24,26,& 27	Jay Jackson	202-418-1309

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These are the current contacts but they do change occasionally.

MDS - Multi-point distribution systems

ITFS - Instructional Television Fixed service

Part 22 Cellular Radio telephone equipment.

Part 24 PCS - Personal Communications Systems Devices

Part 26 General Wireless Communications Service 4 GHz band

Part 27 Wireless Communications Service 2.3 GHz band

Emails for specific individuals at the FCC follow a standard naming scheme. First letter of first name followed by first seven characters of last name. My address is gtannahi@fcc.gov. This standard is in the process of changing to george.tannahill@fcc.gov. Emails sent to the old address will be forwarded.

Bureau Contacts (continued)



Part 73 & 74 Remote Pickup	Clay Pendarvis	202-418-1635
Parts 80 & 87	Jim Shaffer or Tim Maquire	202-418-0687 202-418-2155
Part 90 Public Safety	Jeanne Kowalski	202-418-1897
Part 95	Bill Cross	202-418-0680
Part 95 F 218-219 MHz	Keith Fickner	202-418-7308
Part 95 G LPRS & MURS	Brian Marengo	202-418-0838

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Part 73 & 74 Broadcast Services

Part 80 Maritime Services

Part 87 Aircraft Services

Part 90 Land Mobile Services

Part 95 Personal Radio services

MURS - Multi use radio service - Personal or business short range private 2 way voice/data/image communications service 156 MHz, unlicensed, 11.25 kHz bandwidth, 2 watts.

These contacts do change occasionally.

For Part 95 Bill Cross handles the CB, FRS, GMRS, MURS and Radio Control services.

Purpose of Grant



- **To define the capability and ratings of a transmitter for the FCC and other equipment users to show the equipment is “Acceptable for Licensing” and what that use is**
- **A Grant of Equipment authorization signifies that the device has been properly tested and may be marketed**

If the grant isn't correct or clear then there may be issues getting user/site license when the end user attempts to operate the device.

Compliance report should clearly state all modes of operation, which modes were tested and which were worst case.

Uses of Grant



- **FCC licensing bureaus use the grant information to issue licenses to equipment users/stations**
 - ▶ Incorrect information on the grant can lead to significant problems obtaining a license
- **The public regularly checks the details of a grant before purchasing a product**
- **US Customs reviews grant information when products are imported into the United States**
- **Many other countries will allow products to be imported based on the FCC approval and information on the grant**

An example of how a licensing bureau would use the information on the grant would be when a user buys a marine VHF radio for a ship or boat and applies for a user license under Part 80 of the rules. The licensing bureau would check the power output, frequency tolerance and operating frequency to determine if the device was eligible for both a ship station and a coast station license and then compare that with what the person requesting the license requested.

The public checks grants to determine if a product can be licensed in the service which they want to use the device and also to compare multiple products they are considering purchasing.

Creating A Good Grant



- **The information on the Grant is based on the information entered on the Form 731**
 - ▶ In order to correct a grant, the information on the 731 must be modified
- **Understanding all operating modes of a device and which rule parts it will be operated under is necessary to properly test the device and issue an correct grant**

The users manual is normally how the FCC determines how a product is used.

Parts of Grant/Form 731



> Scope of Equipment

- ▶ For TCB applications for licensed equipment Scopes B1 through B4 apply

> Equipment Class

- ▶ Three character code defined by FCC

> Line entry/equipment specification

- ▶ Includes grant notes, rule parts, frequency range, power output, frequency tolerance, and emission designator

> Other parts of grant

- ▶ Description of device & remarks

The scope of equipment is entered on the first page of the Form 731. In order to limit potential errors, the selection of the scope effects which rule parts may be selected in section II of the Form 731. The scope descriptions were provided earlier.

The equipment class is selected on the second page of the Form 731. Selection of the equipment class limits, as much as possible, the rule parts and frequencies which may be selected in section II of the Form 731. The equipment class is a three character code defined by the FCC which is used to define a type of equipment and the radio service it is used in. In many case the rule part and type of operation (i.e. portable, mobile, base station, handheld, etc) can be determined from the equipment class.

Some equipment classes available through the FCC Certification process are not available in the TCB process. Most common reasons are new technology and/or no developed test procedure.

Line entry is most important part of grant

Description of device example: CB radio or remote control airplane transmitter.

Remarks - Special notes which are specific to the device which further help to define the capability of the device.

Equipment Class Examples



- **TNB- Non broadcast transmitter. Base station equipment and non standard equipment**
- **TNF-Non broadcast transmitter. Equipment held to face**
- **TNT-Non broadcast transmitter. Equipment held to body**
- **TNE- Non broadcast transmitter. Equipment held to ear**
- **PCB- Licensed Personal Communications System Part 24 base station**
- **AMP- Amplifier, booster, repeater, extender**

TNB is the catch all category for non broadcast devices which don't fit into any other groups.

In the definition of TNB the "non broadcast" means that the device isn't used in a broadcast service such as Part 73 & 74.

The AMP equipment class is different from the other classes in that it can be submitted without a frequency tolerance. Since the tolerance is based on the unit driving the amplifier it isn't necessary to list a tolerance for these types of devices or provide frequency stability data.

Equipment Specifications



- This is also referred to as the line entry
- **Parts of Equipment Specifications**
 - ▶ Grant Notes
 - ▶ Rule Parts
 - ▶ Frequency Range
 - ▶ Power Output
 - ▶ Frequency Tolerance
 - ▶ Emission Designator

Most common problem for Licensed devices is incorrect line entry.

Emission designator being incorrectly entered or not supported by the rest of the application.

When the purchaser of the equipment applies for a station license, the licensing bureau looks at the rule part to match the station requirements/limitations to the capability of the unit

Grant Notes



- ▶ Many notes which are used to define, the capability of a device in greater detail, that are used repeatedly on grants, are entered in the system so that they don't have to be retyped each time they are used. The codes are two characters long and made up of letters and numbers
 - ▶ **Examples:**
 - Show minimum power setting on adjustable device. "BC = The output power is continuously variable from the value listed in this entry to 5%-10% of the value listed."
 - Show Coast or Ship station for Marine radio. "CO = Transmitter meets technical requirements only for use at coast stations."
 - ▶ **A handout of all current Notes codes is attached**

The most commonly used note codes are the ones which address the power reduction capability of devices. Examples of these are BC which means the power is continuously variable to 5-10% of the listed value, BD 10-15%, BE 15-20%, etc.

Rule Parts



- **Various categories of FCC Service rules which have equipment authorization requirements**
- **Multiple rule parts may go on a grant as long as the device complies with all listed parts**
 - ▶ Example - A grant in the UHF band is listed for rule parts 22,74, & 90
- **Having the rule part listed on the grant indicates that there is a least one section of that rule part in which the equipment is capable of operating**
 - ▶ It does not indicate that the device complies with all sections of the rule part

Rule Parts are also referred to as Radio Service Rules.

Part 15 should not be listed in the line entry or rule parts for a licensed transmitter.

Frequency Range



➤ The rated operating range of the device listed in MHz

- ▶ A listing of 450-512 MHz indicates the device is capable of operating over that range but not that the user can get a license on all of those frequencies
 - ▶ The Radio Service Rules have varying station use requirements/limitations that must be satisfied
 - ▶ Example - Under Part 90 a Tx could be listed 806-824 MHz but not 806-849 MHz since 824-849 MHz is a Part 22 Cellular band with different technical requirements

In many cases the frequency listed on the grant may go beyond the frequency range allowed in the Radio Service Rule Part. This normally occurs when a manufacturer wants to show a rating for other than FCC purposes, such as importing a equipment to a foreign country. As long as the rating doesn't conflict with another FCC rule part this practice is acceptable. Compliance with other radio service rule parts should be checked before listing the band on the grant.

Frequency Range (continued)



- ▶ An individual unit may not actually be capable of operating over the entire rated frequency range
 - ▶ For example: the rating may be from 450-512 MHz but the units may be produced with band splits such as 450-470, 470-500, 500-512
 - ▶ These units must be tested in each band and “worst case data provided. The FCC licensing rule parts don’t have guidelines for the number of tests to be performed over a frequency range for licensed equipment but Part 15.31 addresses a common method

Power Output



- **Power output is listed on the grant in Watts**
 - ▶ For units with an output/antenna connector, this is the average/mean power into a dummy load
 - ▶ For units with a built in antenna(s) this is ERP or EIRP as specified by the Radio Service Rules Part(s), made using the substitution method
- **The value listed on the grant should be consistent with the rest of the application and supported by the test data**

There are some exceptions to the average power where the Radio Service rules call for a different measurement. The most common is Radar transmitters where a peak power is listed.



Frequency Tolerance

- **Frequency tolerance is a rating of the unit listed in percent, parts per million (PPM) or Hertz (Hz).**
- **The units should be the same as those specified in the Radio Service rules**
- **Amplifiers**
 - ▶ Equipment classified as an amplifier, booster, or repeater doesn't require a tolerance to be listed since the tolerance is based on the unit which is driving amplifier equipment
- **The test report and all information provided must be consistent**

Licensed Devices – Class II Permissive Changes



- **Provide a list of modifications**
- **Justify Class II permissive changes and provide data as necessary to justify changes**
- **Class II Remeasurement Tolerance for fundamental frequencies**
 - ▶ Conducted Power: +/- 0.5 dB
 - ▶ Radiated Power (ERP/EIRP): +/- 3 dB for test site and antenna variations as specified in TIA-603-A Annex B.1.1
- **Power on Class II Grant remains the same as power listed on the Original Grant**

Note: Class II measurement tolerance not intended for host-to-host variation in multi-host filings

Emission Designator



➤ A seven character description of the devices modulation. Sections 2.201 & 2.202

- ▶ The first four characters are the necessary bandwidth with a letter for the units (K for Kilohertz, M for Megahertz) in place of the decimal point
 - ▶ 16K0 represents 16.0 Kilohertz necessary bandwidth.
 - ▶ Normally calculated using Carson's Rule $2M+2D$ where M is the maximum modulation and D is the peak deviation
- ▶ Second three characters are the emission classification from 2.201 and describe the modulation signal used
 - ▶ F3E is Frequency modulated single channel telephony

The emission classification is made up of three symbols. The first symbol identifies the type of modulation such as "F" for Frequency modulation. The second symbol identifies the nature of the modulating signal (or process). "1" would represent a single channel containing quantized or digital information without the use of a modulating sub-carrier, excluding time division multiplex. The third symbol identifies the type of information to be transmitted (or content). "E" represents "telephony" which includes sound broadcasting.

More examples of emissions designators are provided in sections 2.201 and 2.202.

Emission Designator (continued)



- **Necessary Bandwidth is listed on Grant**
- **In cases where Carson's Rule doesn't give accurate results, a justification is required, and a 99% bandwidth measurement is accepted**
- **Additional information can be found at:**
 - ▶ **Necessary Bandwidth -**
http://www.ntia.doc.gov/osmhome/redbook/annex_J.pdf
 - ▶ **Emission Classification -**
<http://www.apco911.org/frequency/emission.html>

The necessary or occupied bandwidth may not exceed authorized bandwidth listed in Radio Service Rule parts.

Common Problem Designators



➤ **For consistency the following commonly used emission designators have been defined:**

- ▶ 40K0F8W - Cellular Voice & Signaling tone.
- ▶ 40K0F1D - Cellular wide-band data.
- ▶ 14K2G2B - Digital Selective Calling(DSC).
- ▶ F9W - CDMA
- ▶ DXW - pi/4DQPSK - TDMA - NADC
- ▶ GXW - GSM - iDen
- ▶ FXW - Cellular Digital Packet Data (CDPD)
- ▶ D7W - QAM
- ▶ W7D - OFDM or COFDM

CDMA – Code Division Multiple Access

TDMA – Time Division Multiple Access

DQPSK – Digital Quadrature Phase Shift Keying

NADC - North American Digital Cellular

GSM – Global Systems for Mobile Communications

iDen - A Motorola system using TDMA modulation. Only TDMA in land mobile service

QAM - Quadrature amplitude modulation

OFDM - Orthogonal frequency division multiplexing

COFDM - Coded-Orthogonal frequency division multiplexing

Note that GSM and CDPD signals use the same type of modulation, GMSK, we identify them using different classifications which makes them easier to identify when searching the FCC database on the Internet.

Other Parts of Grant



➤ These include the following:

- ▶ **Microprocessor Model**
 - ▶ This is on the grant for computers and peripherals. It is not used for licensed devices
- ▶ **Description of Device/Grant Comments/Remarks**
 - ▶ Any special operating conditions or requirements should be addressed here. For Example:
 - Antenna installation requirements
 - Power output for multi channel amplifiers
 - ▶ Special conditions are entered in Item 14 of the TCB Form 731



Common Issues to avoid

- **Conflicting information**
 - ▶ Grant requests voice emission but report and user manual only describes digital transmission
- **Requesting Rule parts which don't have any licensable frequencies in the requested operating band or power output**
- **Testing not performed with all emission designators which Form 731 requests**
 - ▶ Emission designators requested on grant but not addressed in report

Examples:

Requesting Part 22 Cellular Rule parts on the grant for a radio which is described by the users manual and report as a land mobile Part 90 radio.

Requesting a power output on the grant of 5 watts but the test report shows the device was tested at 2 watts.

Common Issues to avoid (cont.)



- **Amplifier power output levels not clearly described or shown properly on grant**
 - ▶ The maximum power output per channel or composite should be clearly described along with total number of channels and any loading requirements which apply
- **Permissive Change applications:**
 - ▶ Only listing new emissions and not showing all previous emissions which are still applicable
- **RF Exposure:**
 - ▶ Approving equipment which isn't allowed by a TCB
 - ▶ Incorrect RF exposure grant conditions

When applying for a class II permissive change, the filing should include all grant conditions and line entry information from the original application.

Example of incorrect RF Exposure grant comment could be to say it is a base station and testing must be done at licensing when the unit is a mobile unit.

Second example could be to quote the MPE rules when SAR is required.

Organizing a Report



- **All information received for all types of applications falls into one of 14 exhibit types**
 - ▶ Organizing TCB information in a similar way reduces confusion and simplifies the review process
 - ▶ All 14 exhibit types are not required for every application. The required exhibit types are based on the equipment class and application type
 - ▶ Submit as few attachments as possible
 - ▶ Confidential material must be in a separate file from non confidential material and justification letter should be in cover letter exhibit type

Application type is original grant, permissive change, alternate FCCID.

Normally for licensed equipment 8 of the exhibit types are required.

For permissive change applications a cover letter describing the changes and data supporting compliance for any changed information is required.

For an alternate FCCID the required exhibits are photos, ID label, and cover letter explaining application.



Exhibit Types

- > 1. ID Label/Location Info
- > 2. Attestation Statements
- > 3. External Photos
- > 4. Block Diagram
- > 5. Schematics
- > 6. Test report
- > 7. Test Setup Photos
- > 8. User's Manual
- > 9. Internal photos
- > 10. Parts List/Tune up Info
- > 11. RF Exposure Info
- > 12. Operational Description
- > 13. Cover Letters
- > 14. SDR Executable Files

For an original grant typically item 1,3,5,6,8,9,10,12 are always required.

A block diagram isn't required but can be helpful in describing the devices operation.

RF Exposure information is required based on the operating frequency and power of the device.

Licensed Equipment Checklist I



- **FCCID:**
- **Test Firm:**
- **Functional Description**
- **Administrative Information**
 - ▶ Associated Pending Application?
 - ▶ Confidentiality Request?
 - ▶ Properly requested?
 - ▶ Any special requirements?
 - ▶ Inter agency requirements(US Coast Guard or FAA)

The licensed equipment check list is a handout provided. The FCC uses a similar checklist to reduce the possibility of Items being overlooked.

Any waivers pending or approved filed with Licensing Bureaus or any other agency should be submitted.

Licensed Equipment Checklist II



➤ Technical Information

- ▶ Rule Parts:
- ▶ Frequency Range:
- ▶ Power Output:
 - ▶ Levels - switched or variable
 - ▶ Antenna Connector or Integral.
- ▶ Frequency Tolerance:
- ▶ Emissions:
 - ▶ Necessary bandwidth Justified?
 - ▶ Emissions Types Justified?

Licensed Checklist Part III



➤ Descriptive Information

- ▶ Instruction manual:
- ▶ DC voltages & currents:
- ▶ Tune up procedure:
- ▶ Circuit diagram/block diagram:
- ▶ Photographs:
 - ▶ Internal:
 - ▶ External:

Licensed Checklist Part IV



➤ Technical Report-Compare with Radio Service rules for compliance

- ▶ Power Output(ERP or Conducted)?
- ▶ Audio Frequency Response $M = \underline{\hspace{2cm}}$
- ▶ Modulation Limiting $D = \underline{\hspace{2cm}}$
- ▶ Audio low pass filter response plot?
- ▶ Transient Frequency Behavior(90.214) or Attack time for CB Radios Part 95
- ▶ Occupied Bandwidth - Plot for each emission?
 - ▶ VBW & ResBW = $\underline{\hspace{2cm}}$ Hz
 - ▶ Properly modulated?

Checklist Part IV(cont)



- ▶ Conducted Spurious
- ▶ Radiated Spurious
- ▶ Frequency Stability vs Voltage(+/- 15% or battery endpoint)
- ▶ Frequency Stability vs Temperature(-30 to +50 C)

➤ **Notes** _____

➤ **Comments** _____



Scope B1 Personal Mobile Radio Services

**Federal Communications Commission
OET Laboratory**

The information in this session relates to the Equipment authorization requirements only. Most devices require an equipment authorization and users station license before the equipment can be operated. The station licensing requirements are not addressed.

The intent of this presentation is to familiarize TCB's with rules and how to read and interpret the rules. It is not intended to provide specific limits for every type of device.

Scope B1



➤ Personal Mobile Radio Service Scope B1 includes:

- ▶ Part 22 - Cellular Radiotelephone Service
- ▶ Part 24 - Personal Communications Service (PCS)
- ▶ Part 25 - Satellite Communications
- ▶ Part 27 - Wireless Communications Service (WCS)

These are Radio Service Rule parts which fall under scope B1. This presentation will cover as many types of devices as possible and will highlight the more common applications.

These radio service rule parts are all developed for different purposes to provide different services. Each may have unique requirements.

Part 22 has several radio services other than the Cellular Radio telephone service. The other services are in Scope B2

Part 26 is a new radio service rule part which allows licensed operation in the 4.6 gigahertz frequency band.

Part 27 is also a new radio service rule part which allows licensed operation in the 746 - 794 MHz and 2.3 gigahertz frequency bands.

Scope B1 Excluded Devices



- **Devices with no FCC approved test procedure**
- **Devices which use new technology**
- **Devices subject to RF Exposure Evaluation**
 - ▶ Exclusion lists are available on the Interpretations database The list that is applicable depends on the training the TCB has received
 - ▶ July 17, 2002 Exclusion List
http://hraunfoss.fcc.gov/eas_public/SilverStream/Pages/Fpg_html_fts_res.html?letter=1290
 - ▶ November 15, 2000 Exclusion List
http://hraunfoss.fcc.gov/eas_public/SilverStream/Pages/Fpg_html_fts_res.html?letter=1103

RF exposure was covered in a little more detail in the General Licensed devices presentation. Specifics about RF exposure evaluation will be covered by Tim and Martin.

Part 22 H Cellular Radio Service



➤ **Operating Frequency Bands:**

- ▶ Mobile 824-849 MHz
- ▶ Base Station 869-894 MHz

➤ **General Technical Requirements:**

- ▶ 22.355 - Frequency Stability
- ▶ 22.913 - Power Output (ERP)
- ▶ 22.915 - Modulation requirements
 - ▶ (b) deviation limit 10% tolerance
 - ▶ (d)(1) SAT notch filter
- ▶ 22.917 - Emissions Limits
 - ▶ (f) emission in base station band requirements

This is a general overview of 47 CFR Part 22 Subpart H, the Cellular radiotelephone service. The rule sections above list the primary rule sections and highlight some of the unique requirements specifically for 22.915 and 22.917.

22.915 requires the modulation level for each type of modulation to remain within +/- 10 % of the specified value. The TIA standard doesn't agree with cellular standard (IS-19-B) modulation level.

22.917 Mobile emissions in base frequency bands must be attenuated to at least -80 dBm.

Part 22 H Cellular Radio Service



➤ Special Requirements:

- ▶ 22.919 Electronic Serial Number Protection
- ▶ 22.921 Dial 911 - Call processing
- ▶ 22.933 Cellular System Compatibility
 - ▶ References OET Bulletin 53(for AMP's system)
- ▶ 22.381 Auxiliary test stations
- ▶ 22.901(d) Alternative Technologies
 - ▶ Used for non-Amps operation
 - ▶ Emission limits apply only outside band edges
- ▶ MPE or SAR evaluation require per 2.1091 & 2.1093
- ▶ SAR value(s) listed on grant

This slide addresses issues that are unique to the Cellular radio service.

Some of these requirements are in the process of being phased out per FCC 02-229.

The ESN is a 32 bit binary number which uniquely identifies a cellular mobile transmitter to any cellular system.

Dial 911 call processing is requirement that a cellular phone can communicate with either cellular provider in any given service area when making a 911 emergency call.

OET Bulletin 53 is the cellular compatibility protocols. It defines standard protocols so that all cellular units can communicate.

A statement(s) attesting to the compliance of ESN, 911 call processing and system compatibility should be in each application in the "attestation statements" exhibit type.

Part 22 H Cellular Radio Service



➤ **Special Interpretations:**

- ▶ Power output for units with built in antennas is listed as an ERP value
- ▶ Maximum ERP level listed on Grant
- ▶ Tests performed at one operating frequency at maximum power output
 - ▶ Exception is antenna terminal measurements which are done at highest and lowest power output levels

This slide shows some special interpretations of the rules that are based on the special requirements listed on the previous slide.

Part 22 H Common Cellular Modes



- **AMP - American mobile phone standard (voice)**
- **SAT - Supervisory Audio Tone**
- **ST - Signaling Tone**
- **Wideband Data**
- **CDPD - Cellular digital packet data**
- **NAMPS - Narrowband American Mobile Phone Standard**
- **CDMA - Code division multiple access**
- **TDMA (DQPSK) - Time division multiple access**
- **GSM - Global Mobile System**

Data should be provided for all modes of operation. All types of emissions should be tested.

The AMPS mode is normally listed on the grant as 22 Subpart H. Other “alternate technologies” are listed on the grant as 22.901(d).

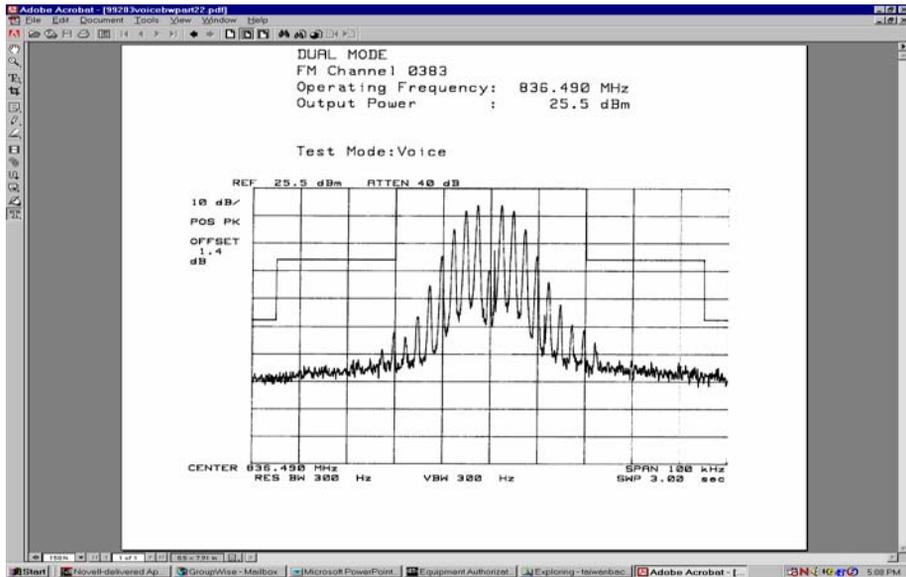
Supervisory audio tones are transmitted by the base station and used to control the communication between the mobile and base station

Signaling tones are 10 kHz control tones transmitted by the mobile unit to control the communication between the mobile and base station.

GSM is European standard not very common on US Cellular phones but more common on PCS phones.

The next few slides show plots of some of these modulation types.

Example Voice OBW Plot



October, 2005

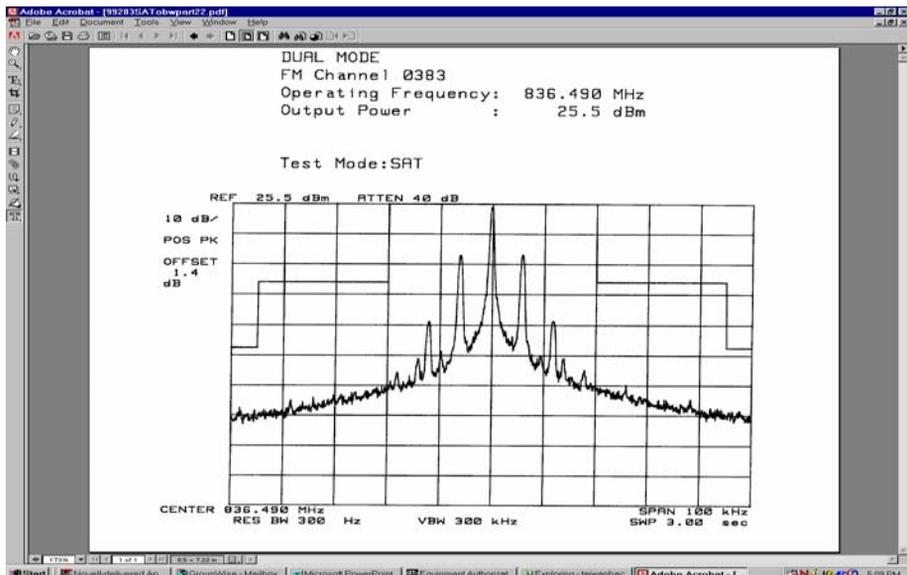
➤ TCB Workshop

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This slide shows a plot of a typical voice modulated occupied bandwidth plot with the emission mask shown.

The unmodulated carrier level is the top of the screen.

Example SAT OBW Plot



October, 2005

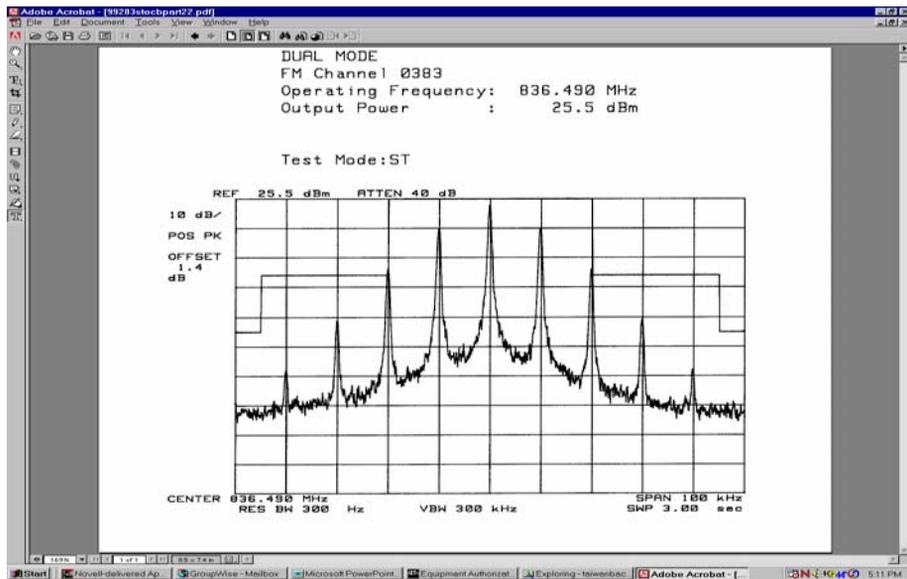
>TCB Workshop

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This slide shows a plot of a typical Supervisory Audio Tone (SAT) occupied bandwidth plot with the emission mask shown.

The SAT signal is a control signal from a cellular base station to a mobile unit.

Example ST OBW Plot



October, 2005

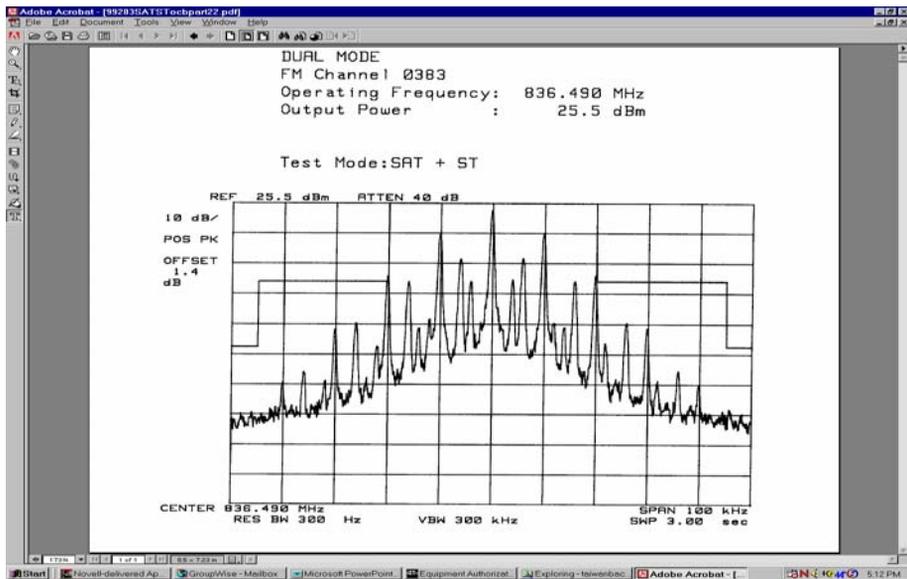
>TCB Workshop

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This slide shows a plot of a typical signaling tone (ST) occupied bandwidth plot with the emission mask shown.

The ST signal is a control signal from the mobile station to the base station.

Example SAT & ST OBW Plot



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This slide shows a plot of a typical signaling tone and supervisory audio tone occupied bandwidth plot with the emission mask shown.

Part 22 H Cellular Emission Designators



- **40K0F8W - Cellular voice & signaling tone**
- **40K0F1D - Cellular wideband data**
- **1M25F9W - CDMA**
- **30K0DXW - North American digital cellular - TDMA**
- **30K0GXW - GSM**
- **28K0FXW - CDPD**

These are the most commonly used emission designators for cellular radiotelephones. These designations are found in 2.201 and 2.202 of the FCC rules. Both sections include examples of what a proper emission designator looks like.

Emission Designator Calculation



➤ Emission Designator

- ▶ 40K0F8W - Voice & SAT signal
 - ▶ Voice (M=2.5k, D=12k), SAT (M=6k, D=2k)
 - ▶ Pick highest frequency and add deviations and apply Carson's Rule $2M+2D$
 - ▶ $2(6k) + 2(12k+2k) = 12+28 = 40$ kHz
- ▶ 40K0F8W - Signaling Tone (ST) & SAT
 - ▶ ST (M=10k, D=8k), SAT (M=6k, D=2k)
 - ▶ $2(10k) + 2(8k+2k) = 20+20 = 40$ kHz
- ▶ 40K0F1D - Wideband Data
 - ▶ Data (M=10k, D=8k), SAT (M=6k, D=2k)
 - ▶ $2(10k) + 2(8+2) = 20+20 = 40$ kHz

This slide shows some sample necessary bandwidth calculations for some of the more common cellular emissions.

For 40K0F8W the highest value of modulating frequency is selected. 6 kHz for the SAT is the M value for the voice and SAT signal. 10 kHz for the SAT & ST combined signals and 10 kHz for the wideband data.

No example of signaling tone & voice is provided because the two are not transmitted at the same time.

Cellular Phone Measurements



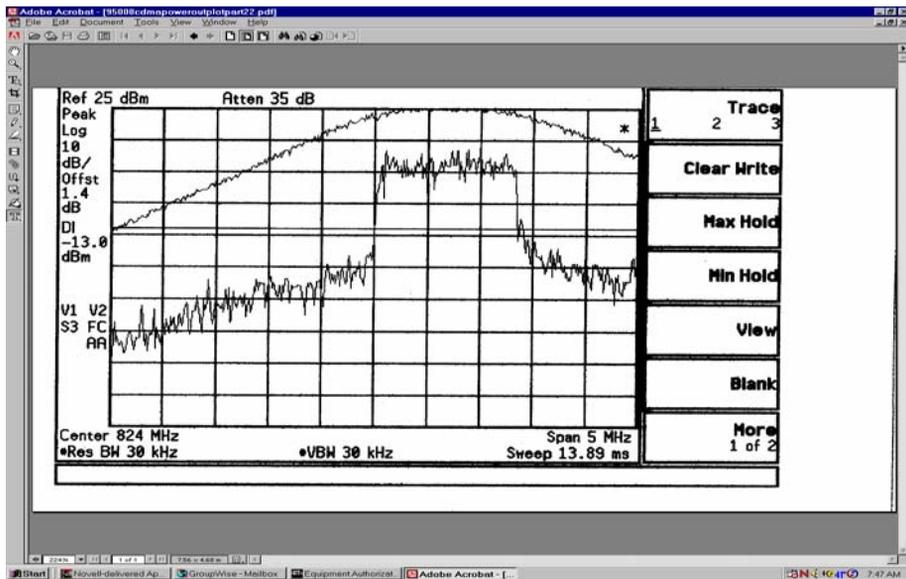
➤ **Modulation Limiting deviation levels per 22.915b**

- ▶ Voice = 12 kHz +/- 10%
- ▶ SAT = 2 kHz +/- 10%
- ▶ ST = 8 kHz +/- 10%
- ▶ WBD = 8 kHz +/- 10%

Cellular deviation limits are mentioned here because they are different than the typical 2.5 or 5 kHz in other Radio Service rules.

When reviewing an application, FCC reviewers cross check the modulation limiting levels with the levels displayed in the occupied bandwidth test using the Bessel function analysis described earlier.

CDMA Power Output



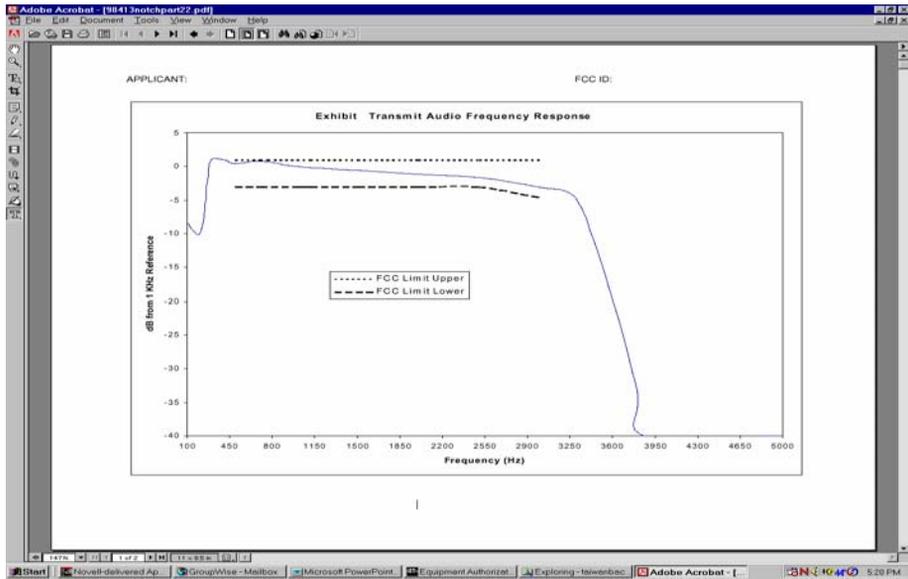
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>TCB Workshop

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For CDMA units, there is no carrier which means the power output test has to be performed slightly differently. This plot shows a power measurement with the spectrum analyzer bandwidth opened up to 30 kHz. The analyzer is set on max hold to obtain the zero dB reference level so that compliance at the band edge can be determined. The peak emissions on this plot are very close to the top scale of the analyzer. Be careful the signal isn't out of the analyzers operating dynamic range.

Audio Frequency Response



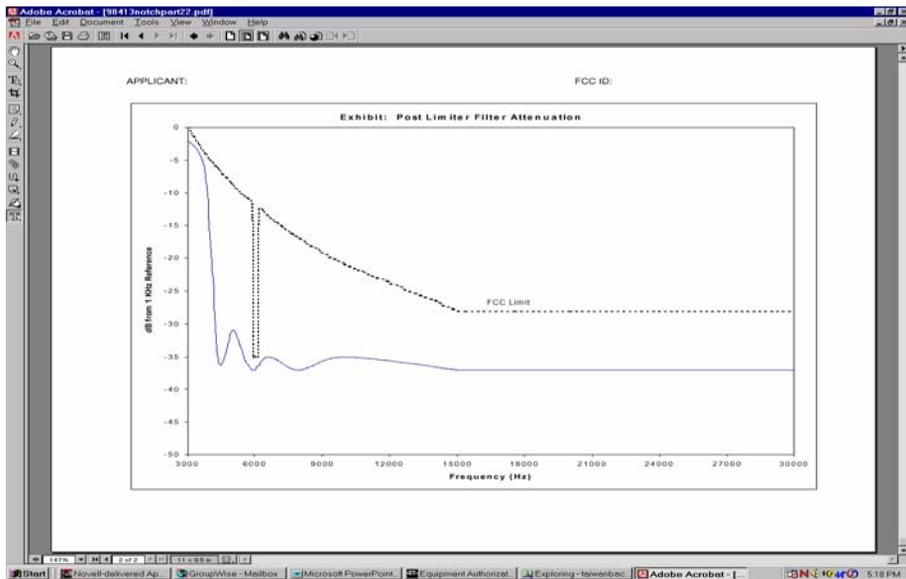
October, 2005

> TCB Workshop

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This plot shows a typical Audio Frequency Response plot for a cellular unit. Notice how the response rolls off before it reaches 6 kHz.

SAT Notch Requirement



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> TCB Workshop

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The SAT notch filter is a unique requirement of Cellular phones. In order for the 6 kHz Supervisory Audio Tone signal to operate properly, the transmitted voice or data signal must roll off before 6 kHz. This allows the SAT tone transmitted by the base station to be properly received by the mobile unit. This is a plot of what an audio frequency response which rolls off by 6 kHz looks like. The limit with the SAT Notch is shown as the upper line.

Example Grant Part 22 H



Adobe Acrobat - [grantexample22hnanamp.PDF]

FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D.C. 20554

COPY **COPY**

**GRANT OF EQUIPMENT AUTHORIZATION
Certification**

Company Name
Company Address

Date of Grant:
Application Dated: 06/28/2000

Attention:
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.

NOT TRANSFERABLE

FCC IDENTIFIER
Name of Grantee

Equipment Class: Licensed Non-Broadcast
Transmitter Held to Ear

Notes: 800 MHz CDMA/AMPS
Cellular Phone

Grant Notes	FCC Rule Parts	Frequency Range (MHz)	Output Watts	Frequency Tolerance	Emission Designator
BC	22(H)	824 - 849	0.33	1.1 PM	40K0F8W
BC	22(H)	824 - 849	0.33	1.1 PM	40K0F1D
	22.901(d)	824 - 849	0.217	1.1 PM	1M25F9W

Power output listed is ERP. For AMPS mode operations, units produced must not exceed the conducted output levels tested on the channels for head SAR compliance. SAR compliance for body-worn operating configurations is limited to the specific leather case/belt-clip tested for this filing. End-users must be informed of the body-worn operating requirements for satisfying RF exposure compliance. The highest reported SAR values are - Head: 1.50 W/kg; Body-worn: 0.36 W/kg.

BC: The output power is continuously variable from the value listed in this entry to 5%-10% of the value listed.

Start | Novell-delivered | GroupWise - Mail | Equipment Author | Microsoft PowerPoint | FCC OET Electron | Adobe Acrobat | 8:24 AM

October, 2005

>TCB Workshop

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This grant image is intended to show a typical Part 22 handheld dual mode cellular radio telephone grant which incorporates AMPS voice technology and 22.901(d) alternate technology. This application required RF exposure evaluation and would only have been approvable by a TCB that had the 22/24 handset training.

On the grant the first two designators represent the AMPS technology and the third represents the CDMA technology which is the alternate mode of operation.

The grant note addresses how the power output was measured and the RF exposure levels of the unit.

All of the grants shown have been modified to remove company names and FCCID's.

Example Grant Part 22 H Amplifier



Adobe Acrobat - [grantexamplepart22h.PDF]

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WASHINGTON, D. C. 20554

COPY **COPY**

**GRANT OF EQUIPMENT AUTHORIZATION
Type Acceptance**

Company Name
Company Address

Date of Grant: 01/23/1996
Application Dated: 12/01/1995

Attention: **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
Name of Grantee

Equipment Class: Licensed Non-Broadcast
Station Transmitter

Notes: Power output listed is
maximum total. Unit may
transmit up to 21 channels.
Power output per channel
decreases with loading

<u>Grant Notes</u>	<u>FCC Rule Parts</u>	<u>Frequency Range (MHZ)</u>	<u>Output Watts</u>	<u>Frequency Tolerance</u>	<u>Emission Designator</u>
	22(H)	869 - 894	1	Amp	F1D
	22(H)	869 - 894	1	Amp	F8W

Start Novell-delivered Ap... GroupWise - Mailbox Equipment Authorizat... Microsoft PowerPoint... FCC OET Electronic... Adobe Acrobat - L... 8:13 AM

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This example is intended to show a grant of Part 22 Subpart H amplifier. Note that there is a grant comment about how the power output is measured and there is no listed frequency tolerance or necessary bandwidth. Frequency tolerance and necessary bandwidth are not listed on amplifiers, boosters, repeaters or extenders.

Example Grant 22.901(d)



Adobe Acrobat - [grantexample22901d.PDF]

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COPY **COPY**

**GRANT OF EQUIPMENT AUTHORIZATION
Certification**

Company Name _____ Date of Grant: 07/09/1999
Company Address _____ Application Dated: 12/10/1998

Attention: **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 _____
Name of Grantee

Equipment Class: Licensed Non-Broadcast
 Station Transmitter

Notes: **MODULAR TRANSMITTER**

<u>Grant Notes</u>	<u>FCC Rule Parts</u>	<u>Frequency Range (MHZ)</u>	<u>Output Watts</u>	<u>Frequency Tolerance</u>	<u>Emission Designator</u>
	22.901(d)	834.03 - 839.49	0.5	2.5 PM	36K0F1D

Mobile
The output power listed is conducted - at the antenna terminals. The gain of the antenna to be used shall not exceed 0 dBi. Maximum duration of transmission is limited to 200 ms. Maximum transmission rate is once per hour. Final product must limit antenna proximity to humans to not less than 20 cm to satisfy Mobile classification.

Mail To: _____

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This page is intended to show an example of a typical Part 22.901(d) grant. Note the special conditions on the grant about the antenna and transmission requirements that must be met in order for the device to comply. This grant also lists RF exposure requirements but was issued before the FCC started to add specific base station notes and the SAR values to the grants. Any grants issued now for a base station will have a more generic note related to RF exposure compliance. For handheld and mobile device the measured SAR values are all listed on all new grants. This grant is for a mobile device and would only be eligible for TCB approval by a TCB which had 22/24 handset training.

Common Cellular Problems



- **Part 22 H – E911 Requirements not addressed or complied with**
- **Part 22.919 – ESN requirements not clearly addressed**
- **Part 22.921 – OET 53/Amps mode requirements/compliance not addressed**
- **Part 22/24 – Handsets not tested in all modes, in all operating configurations. Especially with regard to RF exposure and belt clips/holsters**
- **Part 22/24 – Label on removable battery cover**
- **Part 22/24 – Incorrect use of AMP Equipment Class**

This slide shows some of the most common problems for Part 22/24 devices.

Example of incorrect use of AMP equipment class: An in building distribution system for a Cellular, PCS or Land Mobile system. The building has receiver on the roof and distributes the signal via fiber optic to multiple transmitters inside the building. The transmitters in the building would not be classified as amplifiers, boosters, extenders or repeaters because their input isn't RF, they are generating the modulated signal.

Part 22 Recent Rulemakings



➤ FCC 01-256

- ▶ Allocates spectrum below 3 GHz for new wireless services

➤ FCC 02-229

- ▶ Changes Rules over next 5 years to allow for design flexibility
 - ▶ Eliminates AMPS mode requirements
 - ▶ Eliminates OET 53 requirements
 - ▶ Eliminates ESN requirements
 - ▶ Eliminates channelization requirements

➤ FCC 02-247

- ▶ Modifies 22.901 to eliminate unnecessary regulations and modernize requirements

Part 24 D - Narrowband PCS



- **Operating Frequency Bands:**
 - ▶ 930 - 931MHz and 940 - 941MHz
- **General Technical Requirements:**
 - ▶ 24.131 - Authorized bandwidth
 - ▶ 24.132 - Power Output (ERP)
 - ▶ 24.133 - Emissions Limits
 - ▶ 24.135 - Frequency Stability
- **Special requirements**
 - ▶ MPE or SAR evaluation required for portable and mobile units per 2.1091 & 2.1093.
 - ▶ SAR value(s) listed on grant

This slide provides a general overview of 47 CFR Part 24 Subpart D. Narrowband Personal Communications Systems.

Part 24 D - Narrowband PCS



➤ **Special Interpretations**

- ▶ Power output for units with built in antennas is listed as an ERP value
- ▶ Maximum ERP level listed on Grant
- ▶ Tests performed at one operating frequency at maximum power output
 - ▶ Exception is antenna terminal measurements which are done at highest and lowest power output levels
- ▶ Maximum level for SAR compliance listed on Grant if it is higher than ERP on line entry

These requirements are the same as the Part 22 Subpart H Cellular radio telephone service special interpretations.

Part 24 E - Broadband PCS



- **Operating Frequency Bands:**
 - ▶ Blocks from 1850 - 1990 MHz
- **General Technical Requirements:**
 - ▶ 24.232 - Power Output (EIRP)
 - ▶ 24.235 - Frequency Stability
 - ▶ 24.238 - Emission Limits
- **Special requirements**
 - ▶ MPE or SAR evaluation required for portable and mobile units per 2.1091 & 2.1093
 - ▶ SAR value(s) listed on grant

This slide shows a general overview of 47 CFR Part 24 E. The Broadband Personal Communications Systems Service.

EIRP is effective isotropic radiated power is defined as the radiated power output relative to an antenna with no gain.

Part 24 E - Broadband PCS



➤ **Special Interpretations**

- ▶ Power output for units with built in antennas is listed as an EIRP value
- ▶ Maximum EIRP level listed on Grant
- ▶ Tests performed at one operating frequency at maximum power output
 - ▶ Exception is antenna terminal measurements which are done at highest and lowest power output levels

These testing requirements are the same as the Part 22 Subpart H Cellular radio telephone service special interpretations with the exception that the power output is an EIRP measurement.

Part 24 PCS Emission Designators



➤ Part 24E

- ▶ 1M25F9W – CDMA
- ▶ 4M20F9W – WCDMA
- ▶ 30K0DXW – TDMA
- ▶ 300KGXW – GSM
- ▶ 300KG7W - EDGE

CDMA – Code Division Multiple Access

W-CDMA – Wideband Code Division Multiple Access

TDMA – Time Division Multiple Access

GSM – Global Systems for Mobile Communications

EDGE – Enhanced Data Rates for GSM Evolution

Example Grant Part 24



Adobe Acrobat - [grantexamplepart24.PDF]

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WASHINGTON, D.C. 20554

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**GRANT OF EQUIPMENT AUTHORIZATION
Certification**

Company Name _____ Date of Grant: _____
Company Address _____ Application Dated: 01/26/2001

Attention: **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 _____
Name of Grantee _____

Equipment Class: Part 24 Licensed Portable
transmitter held to ear

Notes: Single Band PCS Phone
(CDMA)

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
	24E	1851.25 - 1908.75	0.372	2.5 PM	1M25F9W

Output is EIRP. SAR compliance for body-worn operating configurations is limited to the specific configuration tested for this filing. Body-worn operations are restricted to belt-clips, holsters or similar accessories that have no metallic component in the assembly and must provide at least 1.5 cm separation between the device, including its antenna whether extended or retracted, and the user's body. End-users must be informed of the body-worn operating requirements for satisfying RF exposure compliance. The highest reported SAR values are - Head: 1.28 W/kg; Body-worn: 1.05 W/kg.

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This slide is intended to show a typical Part 24 Broadband PCS grant for a single band CDMA PCS phone. Note the SAR requirements/restrictions on the grant. The unit is a handheld unit. The grant note describes how the power output was measured and the highest value of SAR measured.

Example Grant Part 24 E Amplifier



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GRANT OF EQUIPMENT AUTHORIZATION
Certification

Company Name: _____ Date of Grant: _____
Company Address: _____ Application Dated: 08/25/1999

Attention: **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: _____
Name of Grantee: _____

Equipment Class: **Amplifier**
Notes: **REPEATER**

Grant Notes	FCC Rule Parts	Frequency Range (MHz)	Output Watts	Frequency Tolerance	Emission Designator
	24(E)	1850 - 1910	2.5		F9W
	24(E)	1850 - 1910	10		GXW
	24(E)	1850 - 1910	5		DXW
	24(E)	1930 - 1990	2.5		F9W
	24(E)	1930 - 1990	10		GXW
	24(E)	1930 - 1990	5		DXW

The power output listed is the composite of all operating channels. Per - channel output level varies with loading.

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This slide shows a grant for a Part 24 Subpart E broadband PCS repeater. Since its equipment class is “amp” which is for amplifier it allows the grant to not have a frequency tolerance or necessary bandwidth. Also note the grant clarification of how the power operates for a multi channel device.

Part 25 Satellite Communication



➤ **Operating Frequency Bands:**

- ▶ 1610 - 1626.5 MHz Up-link
- ▶ 149 - 149.9 MHz & 399.9 - 400.05 MHz (non-voice)

➤ **General Technical Requirements:**

- ▶ 25.200 - Interim requirements for authorization

➤ **Special Requirements**

- ▶ Certification is optional.
- ▶ Units need ITU GMPCS - MoU Registry
- ▶ Power output for units with built in antennas is listed as EIRP on the Grant

Part 25 has only mobile and portable devices which require equipment authorization.

Certification is optional for these devices per the rule making which is Gen Docket No. 98-68. 98-68 was adopted as FCC 01-141. Also see FCC 02-134.

The acronym ITU - GMPCS - MoU stands for International Telecommunications Union Global Mobile Personal Communication by Satellite Memorandum of Understanding

Part 25 Satellite Communication



➤ **Special Requirements (continued)**

- ▶ MPE or SAR evaluation required for portable and mobile units per 2.1091 & 2.1093
- ▶ SAR measured value listed on grant

➤ **Part 25 Recent Rulemakings**

- ▶ FCC 02-134 – GMPCS MoU– Global Mobile Personal Communications by Satellite Memorandum of Understanding
 - ▶ Establishes emissions limits for mobile and portable earth stations

Example Grant Part 25



Adobe Acrobat - [grantexamplepart25.PDF]

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WASHINGTON, D.C. 20554

COPY **COPY**

**GRANT OF EQUIPMENT AUTHORIZATION
Certification**

Company Name _____ Date of Grant: 1999
Company Address _____ Application Dated: 08/06/1999

Attention: **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 _____
Name of Grantee _____

Equipment Class: Licensed Non-Broadcast
Station Transmitter

Notes:

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
	25	1616 - 1626.5	0.6	1 PM	41K7Q7W

Power output listed is conducted average with 9.2% duty cycle. Used with 5 dBi antenna. This is an interim Grant of Certification based on compliance with all relevant portions of Parts 1, 2 and 25 as specified in the NPRM for GEN Docket 98 - 68 adopted on May 14, 1998. We are granting this interim approval on the basis that final approval must satisfy the requirements and procedures adopted in our future GMPCS - MoU implementation proceeding, including the specific spurious and out - of - band emission limits adopted in the proceeding.

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This slide is intended to show a typical Part 25 mobile unit. Note the interim grant note for Part 25 equipment. The rule making which the device is authorized under is under consideration to be changed.

The NPRM 98-68 listed on the grant was adopted as FCC 01-141.

Part 27 Wireless Communication



- **Wireless Communications Service (WCS)**
- **Operating Frequency Bands:**
 - ▶ 746 - 794 MHz and 2305 - 2360 MHz
- **General Technical Requirements:**
 - ▶ 27.50 Power Output (EIRP)
 - ▶ 27.53 Emission Limits
 - ▶ 27.54 Frequency Stability
- **Special Requirements:**
 - ▶ MPE or SAR evaluation required for portable and mobile units per 2.1091 & 2.1093
 - ▶ SAR measured values listed on Grant

This slide provides a general overview of the wireless communications service. This Radio Service rule is available for any type of operation in the band which meets the technical requirements.

Example Grant Part 27



Adobe Acrobat - [grantexamplepart27.PDF]

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GRANT OF EQUIPMENT AUTHORIZATION
Type Acceptance

COPY

Company Name
Company Address

Date of Grant:
Application Dated: 10/10/1997

Attention:

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
Name of Grantee

Equipment Class: Licensed Non-Broadcast Station Transmitter

Notes:

Grant Notes	FCC Rule Parts	Frequency Range (MHz)	Output Watts	Frequency Tolerance	Emission Designator
	27	2305 - 2317.5	2	0.001 %	1M25D7W
	27	2347.5 - 2360	2	0.001 %	1M25D7W

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This slide shows an example of a Part 27 Grant. Since almost any type of operation is allowed in the frequency band, to call this a typical grant may not be accurate.

Common Problems to Avoid



- ▶ Don't submit data for Part 15 Verified portions of the device
- ▶ For conventional Cellular (AMPS) units the proper Part 22 rule section to list on the grant is 22 H
- ▶ For non-AMPS emission modes the proper rule section to list is 22.901(d)
- ▶ The power output on the grant needs to be consistent with the test report and user manual
- ▶ The frequency stability listing on the grant is not in compliance with the Radio Service rule
 - ▶ Be careful of footnotes in the Rules

Comparable Applications



- ▶ Submitting new application types:
 - ▶ Highly recommended that previous FCC Grants be viewed for comparison purposes
- ▶ Finding Similar Applications:
 - ▶ Go to either FCC Equipment Authorization filing site or TCB filing site and click on “generic search” link
 - ▶ Enter search criteria and pick a good example from the returned results
 - All applications since 4/15/1998 have all attachments on the Internet. Newer files are recommended because they are generally smaller in size
 - Search can be limited by rule part, equipment class, date, FCC/TCB Approval, and/or frequency range etc.

When a TCB is submitting equipment under an equipment class which they haven't done before, it is highly recommended that a previous grant from a similar application be reviewed to see how the test was done and what requirements the device was tested too.

Searching advice:

Change “show 10 results” from 10 to 200 before searching.

Start with limited search and then expand when no results found.

Use newer applications as basic applications.

Use applications which were granted by the FCC.

Don't use too specific of a search

e.g. if 90.217(b) doesn't return enough results, try 90.217, and then try 90

Some rule parts such as 22, 90, 95 have large numbers of equipment authorizations but rule part 26 and 27 don't. For the rule parts with large numbers of equipment authorizations a more specific search is required.



Scope B2 General Mobile Radio Services

**Federal Communications Commission
OET Laboratory**

October, 2005

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This presentation covers equipment authorization requirements and not station licensing requirements. It is intended to familiarize TCB's with the technical equipment rules but not specify the limits for every type of device.

For licensed devices scope B1 gets the most submissions closely followed by scope B2.

Scope B2



➤ General Mobile Radio and Broadcast Services

Scope B2 Includes:

- ▶ Part 22 Non Cellular Services
- ▶ Part 73 Broadcast Services
- ▶ Part 74 Auxiliary Broadcast Service
- ▶ Part 90 Private Land Mobile Radio Service
- ▶ Part 95 Personal Radio Services
- ▶ Part 97 Amateur Radio Service

These Radio service rules are each written for different purposes for different types of operations. Each Radio Service rule has some unique requirements. The FCC laboratory can make interpretations in these rules for issues related to testing for equipment authorization but the bureau/office has the final word. Any issues related to rule changes or licensing must be handled by the bureau/office responsible for that radio service rule.

Scope B2 Excluded Devices



➤ Devices subject to RF Exposure Evaluation

- ▶ Exclusion lists are available on the Interpretations database. The list that is applicable depends on the training the TCB has received:
 - ▶ July 17, 2002 Exclusion List
http://hraunfoss.fcc.gov/eas_public/SilverStream/Pages/Fpg_html_fts_res.html?letter=1290
 - ▶ November 15, 2000 Exclusion List
http://hraunfoss.fcc.gov/eas_public/SilverStream/Pages/Fpg_html_fts_res.html?letter=1103

This was covered in more detail in the General licensed presentation.

Multiple Rule Part Applications



General Land Mobile Devices

	150-174 MHz	220-222 MHz	421-512 MHz	806-940 MHz
Part 22 E,F,G	x		x	x
Part 74 D			x	
Part 90	x	x	x	x
Part 95 A			x	

Wireless Microphones

	150-174 MHz	174-216 MHz
Part 90.217	x	
Part 90.265	x	
Part 74.861		x

This slide shows a comparison of which devices commonly operate across multiple frequency bands and rule parts. Note that a 450 to 470 MHz transmitter is eligible to operate in at least four rule parts.

The most common land mobile frequency bands are shown in the chart above.

The boxes with an "x" in them indicate that there is a portion of the listed frequency band that the device can operate in. Operation in the band is dependant on the emission designator.

Wireless Microphones are usually authorized in three bands depending on where they are used. Broadcast quality equipment operates in the rule part 74.861. Land mobile wireless microphones operate under 90.217 and 90.265. All three radio service rules require the equipment user to obtain a users station license before operating the equipment.

Part 22 - Non Cellular Services



➤ Operating Frequency Bands

▶ Subpart E

- ▶ Paging: 152 - 159 MHz, 454 - 459 MHz.
- ▶ Point to Point: 72 - 76 MHz, 488 - 494 MHz

▶ Subpart F

- ▶ Rural Radio 152 - 158 MHz, 454 - 460 MHz
- ▶ BETRS 816 - 821 MHz, 861 - 866 MHz
 - Basic exchange telephone radio system

▶ Subpart G

- ▶ Air to Ground 454 - 460 MHz

This slide shows operating frequencies available in 47 CFR Part 22

Part 22 - Non Cellular Services



➤ General Technical Requirements Subpart C

- ▶ 22.355 Frequency Tolerance
- ▶ 22.357 Emission Types
- ▶ 22.359 Emission Masks

➤ Technical Requirements Subpart G Air to Ground Service

- ▶ 22.809 Power Output
- ▶ 22.861 Emission Limitations
- ▶ 22.863 Frequency Tolerance

The requirements of Subpart C apply to all other subparts unless the Subpart has specifications listed.

The Subpart G Air to Ground Service has the most exceptions

Part 73 Broadcast Services



➤ AM Stereo Transmitters & Exciters

- ▶ Operating Frequency Bands
 - ▶ 0.54 - 1.6 MHz
- ▶ General Technical Requirements
 - ▶ 73.44 - AM Transmission System Emission Limitations
 - ▶ 73.128 - AM Stereophonic Broadcasting
 - ▶ 73.1545(a) - Carrier Frequency Departure Tolerances

Most of the Broadcasting equipment (i.e. AM, FM, and TV Transmitters) is verified under Part 73 but some of it is not. Since there isn't a significant amount of equipment authorized under these parts I'll only mention it briefly.

AM stereo is under Subpart A with some general requirements under Subpart H. Section 73.1545 is mentioned just to list an example of Subpart H general information.

Part 73 Subpart H contains requirements which generally apply to all Part 73 equipment. When Subpart A doesn't address a requirement then the standards in Subpart H apply.

Most Subpart H requirements are related to licensing but there are some technical requirements.

Most of the equipment in this rule part is verified.

Example Grant Part 73



Adobe Acrobat - [grantexample73amstereo.pdf]

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WASHINGTON, D.C. 20554

COPY **COPY**

GRANT OF EQUIPMENT AUTHORIZATION
Type Acceptance

Company Name _____ Date of Grant: _____
Company Address _____ Application Dated: 11/22/1997

Attention: **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 _____
Name of Grantee _____

Equipment Class: Licensed Broadcast Station Transmitter

Notes: Audio input signal must be filtered in accordance with NRSC-1 standard.

<u>Grant Notes</u>	<u>FCC Rule Parts</u>	<u>Frequency Range (MHZ)</u>	<u>Output Watts</u>	<u>Frequency Tolerance</u>	<u>Emission Designator</u>
BC	73	0.525 - 1.705	500	20 Hz	20K0L7E

BC: The output power is continuously variable from the value listed in this entry to 5%-10% of the value listed.

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This is a typical AM Stereo grant under part 73. The power of this device can be reduced to 5% of 500 watts per the grant note BC.

The grant note also specifies the standard the equipment was tested too. NRSC-1 is ANSI/EIA-549-1998 AM Pre-emphasis/De-emphasis and broadcast transmission bandwidth specification which is referenced in 73.128(c)(1). The standards for filtering were adopted by the FCC in order to protect the adjacent channels of the transmitter.

This is an older grant because there aren't many AM Stereo grants.

Part 74 Auxiliary Broadcast



➤ Operating Frequency Bands

- ▶ Subpart D - Remote Pickup 450 - 456 MHz
- ▶ Subpart E - Aural Broadcast Auxiliary 944 - 952 MHz
 - ▶ Studio Transmitter Link - STL
- ▶ Subpart G - Low Power TV, TV Translator and Booster
 - ▶ VHF (Channels 2-13) 54-216 MHz
 - ▶ UHF (Channels 14-69 (except 37)) 470-806 MHz
 - Channel 37 608-614 MHz
- ▶ Subpart H - Low Power Auxiliary Stations
 - ▶ 26.1-26.48, 54-72, 161.625-161.775, 174-216, 450-451, 455-456, 470-608, 614-806, 944-952 MHz.
- ▶ Subpart L FM Translators & Boosters 88-108 MHz

This slide shows the operating frequency bands available in 47 CFR Part 74. Channel 37 608-614 MHz is reserved for Radio Astronomy

A change has been proposed in Part 74 to allow television remote broadcasting of digital television signals in the 2 GHz band. The changes are under consideration by the Media Bureau. More details can be found on their Internet site.

Example of remote pickup device is voice link from mobile station back to broadcast studio. This service is moving to microwave services due to video transmissions.

Aural broadcast auxiliary frequencies for STL are for voice link from studio to transmitter when the studio and transmitter are not at the same location.

Part 74 Auxiliary Broadcast



➤ General Technical Requirements

- ▶ Subpart D - Remote Pickup
 - ▶ 74.461 Power Limitations
 - ▶ 74.462 Emission & Bandwidth
 - ▶ 74.464 Frequency Tolerance
- ▶ Subpart E - Aural Broadcast Auxiliary
 - ▶ 74.534 Power Limitations
 - ▶ 74.535 Emission & Bandwidth
 - ▶ 74.561 Frequency Tolerance
- ▶ Subpart G - LPTV, TV Translator & TV Booster
 - ▶ 74.733 - UHF Translator signal boosters
 - ▶ 74.735 - Power limitations

This slide shows the General technical requirements for 47 CFR subparts of the Auxiliary Broadcast Service.

In addition to the requirements listed above for Part 74 Subpart D, modulation requirements are addressed in 74.463.

TV translators and TV Boosters Subparts are for extending the range of TV transmitter into areas with poor coverage.

Part 74 Auxiliary Broadcast



- ▶ Subpart G (continued)
 - ▶ 74.736 - Emission & Bandwidth
 - ▶ 74.750 - Transmission System Facilities
 - ▶ 74.761 - Frequency Tolerance
- ▶ Subpart H - Low Power Auxiliary Stations
 - ▶ 74.861 - Technical Requirements
- ▶ Subpart L - FM Translators & Boosters
 - ▶ 74.1234 - Unattended Operation
 - ▶ 74.1235 - Power Limitations & Antenna Systems
 - ▶ 74.1236 - Emission & Bandwidth
 - ▶ 74.1250 - Transmitters & Associated Equipment
 - ▶ 74.1261 - Frequency Tolerance

Part 74 Auxiliary Broadcast



➤ Special Requirements

- ▶ Subpart E
 - ▶ Verification applies to units used at fixed stations.
- ▶ Subpart G
 - ▶ Automatic gain control requirement for some devices
- ▶ Subpart H
 - ▶ Wireless microphones for BROADCAST ONLY use. Occupied Bandwidth test done at lesser of maximum modulation frequency or 15 kHz.
- ▶ Subpart L
 - ▶ Standard AM, FM, and TV transmitters under Part 73 and boosters under Part 74 do not need Certification but a manufacturer may request it, if desired.

Part 74 Subpart H wireless microphones may only be used in broadcast type uses and not for Part 90 land mobile operation.

Part 74 Subpart L equipment was deregulated several years ago but due to numerous requests from manufacturers who were having problems selling the equipment with no FCCID, the FCC has allowed (but not required) the devices to receive Certification if all of the information required for Certified devices is provided.

Part 90 Private Land Mobile



➤ Operating Frequency Bands 1.6 - 940 MHz

- ▶ **Special Operating Frequency Bands:**
 - ▶ 173.075 MHz Lo-Jack - 90.20(e)(6)
 - ▶ 764-806 MHz - Public Safety Interoperability
 - ▶ 902-928 MHz Subpart M, Location & Monitoring
 - ▶ 1427-1435 MHz - 90.259 (Public Safety Pool)
 - ▶ 2450-2500 MHz – Non-channelized frequencies
 - ▶ 3650-3700 MHz – Wireless Broadband Service
 - ▶ 4940-4990 MHz – Public Safety
 - ▶ 8400-8500 MHz - Subpart Q, Developmental

This slide shows some special operating frequency bands allowable for Part 90 operation.

The land mobile band has frequencies covering the entire RF frequency spectrum.

2450-2500 band is typically used for video transmission. It is one of the few parts of Part 90 where there is a allowable authorized bandwidth greater than 25 kHz.

Part 90 Private Land Mobile



➤ General Technical Requirements

- ▶ Subpart I - General
 - ▶ 90.205 - Power Limitations
 - ▶ 90.207 - Types of Emissions
 - ▶ 90.209 - Bandwidth Limitations
 - ▶ 90.210 - Emissions Masks
 - ▶ 90.211 - Modulation Requirements
 - ▶ 90.212 - Scrambling Devices & Digital Voice Modulation
 - ▶ 90.213 - Frequency Stability
 - ▶ 90.214 - Transient Frequency Behavior
 - ▶ 90.217 - Exemption from Technical Standards
 - ▶ 90.219 - Signal boosters

The general requirements of subpart I apply to all other parts unless the specific rule part being applied under specifies a requirement

90.217 exempts low power devices from many of the other rules but requires the devices to meet the specifications listed in the section.

Part 90 Private Land Mobile



➤ General Technical Requirements

- ▶ Subpart F - Radio-location Service
 - ▶ 90.103 - Technical Standards
- ▶ Subpart J - Non voice & other specialized operations
 - ▶ 90.241 - Radio Call Box Operation
 - ▶ 90.242 - Travelers Information Stations
 - ▶ 90.259 - Telemetry
- ▶ Subpart K - Special Frequency Bands
 - ▶ 90.265(b) - Wireless Microphones for Business uses.
- ▶ Subpart S - SMR Operation
 - ▶ 90.669 - Emission Limit for 896-901/935-940 MHz MTA
 - ▶ 90.691 - Emission Mask for 806-821/851-866 MHz EA

This slide shows the subparts of the 47 CFR Private Land Mobile Radio Service.

Subpart F radio-locations service is used mainly for radar equipment.

Wireless microphones approved under 90.265 generally are rated at a modulation frequency of up to 3 kHz and not up to 15 kHz necessary bandwidth as in Part 74. Note that part 2 requires the bandwidth be tested to 5 kHz.

For 90.259 telemetry operations none of the general technical standards apply.

MTA & EA represent the different types of service areas the equipment operates under.

Part 90 Private Land Mobile



➤ General Technical Requirements

- ▶ Subpart R – Public Safety Interoperability
 - ▶ 90.531 – Interoperability Channels Operation
 - ▶ 90.535 – Spectrum Efficiency Requirement
 - ▶ 90.543 – Adjacent Channel Power
 - ▶ 90.548 – P25 Interoperability Standards
- ▶ Subpart Y – Public Safety
 - ▶ 90.1213 – Channel Band Plan
 - ▶ 90.1217 – RF Exposure Requirement
- ▶ Subpart Z – Wireless Broadband Service
 - ▶ 90.1307 - licensed on the basis of non-exclusive nationwide licenses
 - ▶ 90.1319 - 3650–3700 MHz band must employ a contention-based protocol (based on 90.7)
 - ▶ 90.1321 - Power and antenna limits
 - ▶ 90.1323 - Emission limits

This slide shows the subparts of the 47 CFR Private Land Mobile Radio Service.

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For 90.259 telemetering operations none of the general technical standards apply.

MTA & EA represent the different types of service areas the equipment operates under.

Part 90 Private Land Mobile



➤ Special Requirements:

- ▶ 2.1091 & 2.1093 – RF Exposure requirements apply to some devices
 - ▶ Portable & Mobile units operating from 806-940 MHz for EA and MTA operation under Subpart S.
 - ▶ UHF units operating from 450-512 MHz that are non push to talk and may be connected to the switched telephone network.
- ▶ 90.203 channel programming restrictions.
- ▶ 90.203 Narrowband & Efficiency standards in re-farming bands.
- ▶ 90.214 Transient behavior testing.
- ▶ 406 MHz band requirement.

The TCB exclusion list should be checked before approving Part 90 devices, especially higher frequency, higher power equipment.

90.203 channel programming restrictions address frequency tuning capability of the external controls of equipment.

90.214 transient frequency test is done using the EIA/TIA 603 test method. TSB102.CAAA covers digital modulation. This section of the rules was added several years ago in a rulemaking known as “re-farming”. The channel spacing and data rate requirements were modified to reduce the channel spacing from 25 kHz to 12.5 kHz eventually to 6.25 kHz. Due to the additional channels in the same amount of frequency spectrum, the 90.214 tests were instituted to make sure the equipment came up on frequency fast enough not to cause interference with adjacent channels.

Land Mobile use of the 406 MHz band is prohibited in the FCC rules per NOAA and NASA to protect satellite transmissions.

Part 90 Private Land Mobile



➤ Special Requirements (continued):

- ▶ 90.103 Subpart F - Radio-location service
 - ▶ Entire frequency band assigned. There is no authorized bandwidth value
 - ▶ From general technical specifications, only out of band emissions limit applies
 - ▶ Bandwidth listed on grant is normally occupied bandwidth
 - ▶ Subpart allows un-modulated CW signals to be transmitted
 - ▶ Peak power listed on grant

90.103 different in that most of Part 90 has 25 kHz channel bands

The out of band emission limit is $43 + 10 \log(p)$.

The peak power of a radar transmitter is defined as maximum level during interrogation pulse. Calculated as $P = P(\text{avg})/(\text{pulse width} \times \text{Rep rate})$.

OET Bulletin 37 on Doppler Radars applies to 24 GHz units. Available from FCC Warehouse @ 800-418-3676 but not online.

Part 90 Common Problems

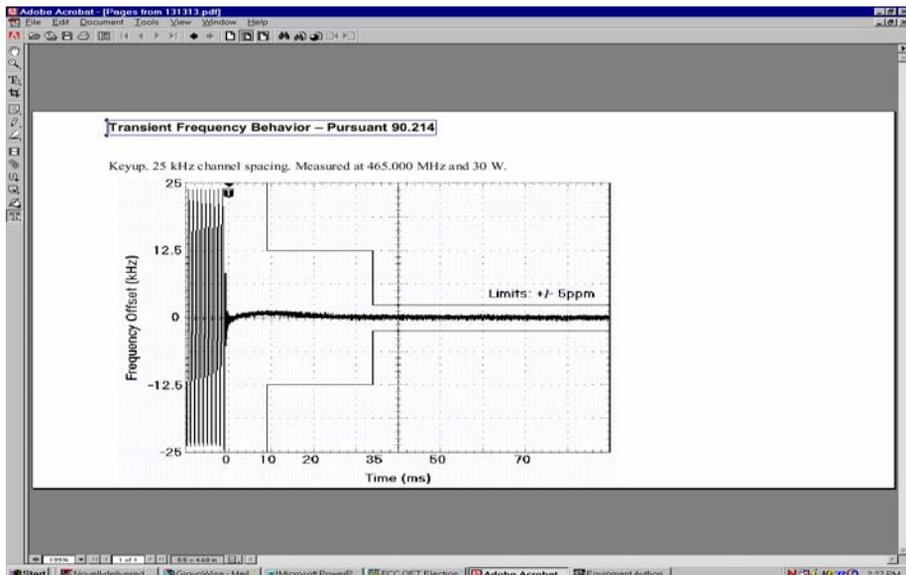


- ▶ 90.217 Applications
 - ▶ Application requests 90.217(b) and 90.217(c) One or the other must be selected
- ▶ 90.213 Frequency Tolerance
 - ▶ Application requests a tolerance which is greater than allowed by the rules
 - ▶ Application shows inconsistency between reported tolerance value and value listed on grant
- ▶ 90.203(j) Minimum data rate requirements
 - ▶ Application doesn't indicate that data rate complies
- ▶ 90.203(e) Channel programming restrictions
 - ▶ Application doesn't indicate requirements met

90.217 equipment is either designed for 12.5 kHz operation or 6.25 kHz but not both.

Minimum Data rate is 4800 bps per 6.25 kHz of channel spacing.

Example Plot 90.214 25 kHz



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This slide shows a typical plot for a 25 kHz voice modulated unit transient frequency response test. The response shown is for the turn on transient.

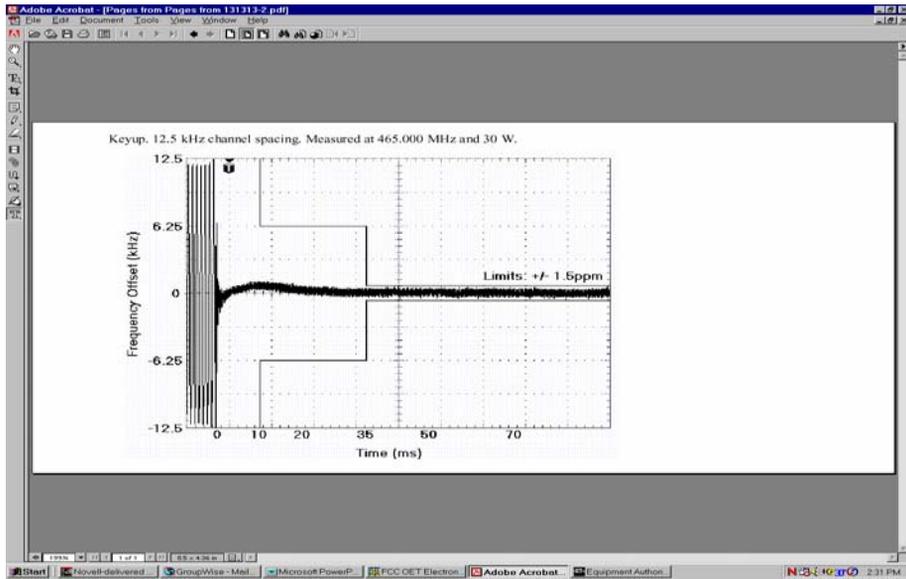
On this plot the frequency stability requirements of 90.213 apply after time period T2.

Standard intended to prevent interference at time of turn on/off to adjacent channels.

From left to right is reference signal(-25 to 0 ms), turn on (around 0 ms), signal on and frequency stability (from 0 to left edge)

Reference signal is 1 KHz modulation and 25 KHz deviation.

Example Plot 90.214 12.5 kHz



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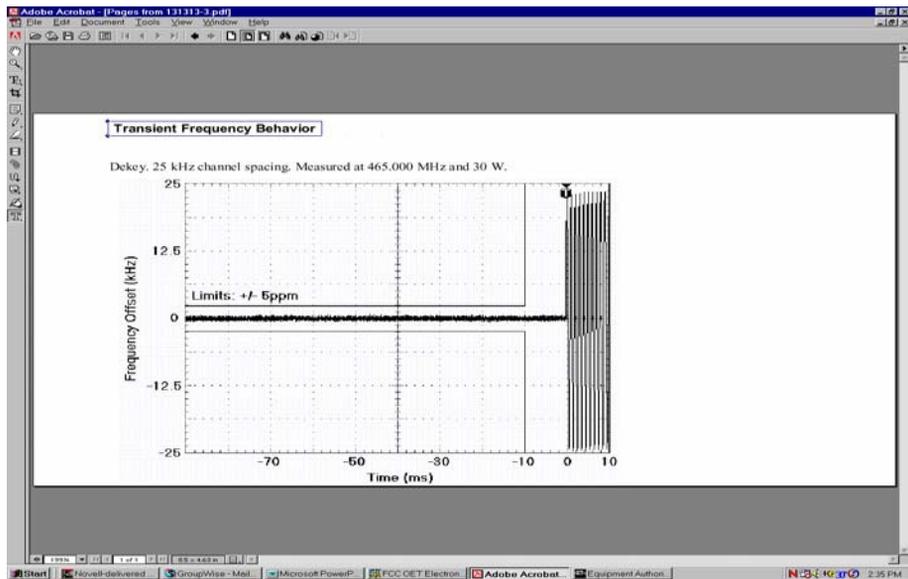
>TCB Workshop

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This slide shows a typical 90.214 turn on transient response plot for 12.5 kHz operation of a voice modulated device.

On this plot the frequency stability requirements of 90.213 apply after time period T2.

Example Plot 90.214 25 kHz



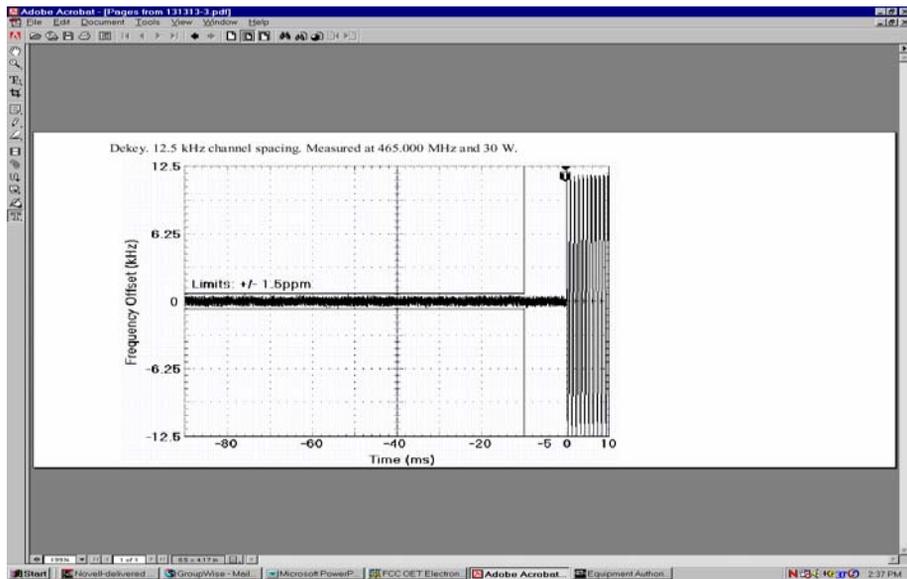
October, 2005

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This slide shows the 90.214 transient frequency response at turn off for a 25 kHz voice modulated unit.

Example Plot 90.214 12.5 kHz



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This slide shows the 90.214 transient frequency response for a 12.5 kHz voice modulated unit at turn off.

Part 95 Personal Radio Services



➤ Part 95 Includes:

- ▶ Subpart A – General Mobile Radio Service (GMRS)
- ▶ Subpart B - Family Radio Service (FRS)
- ▶ Subpart C - Radio Control (R/C) Radio Service
- ▶ Subpart D - Citizens Band (CB) Radio Service
- ▶ Subpart F - 218 - 219 MHz Service
- ▶ Subpart G - Low Power Radio Service (LPRS)
- ▶ Subpart H - Wireless Medical Telemetry Communications Service (WMTS)
- ▶ Subpart I - Medical Implant Communications Service (MICS)
- ▶ Subpart J - Multi-Use Radio Service (MURS)

This slide shows an overview of the Subparts of 47 CFR Part 95.

Part 95 is unique in that some of its Subparts don't require a station license. These Subparts which require equipment approval but not operator license are the family radio service, radio control service, citizens band service and multi-use radio service.

Background of Part 95 is that originally included devices which all required licenses. Over time some of the license requirements were dropped as the technology became more stable. Then some additional subparts were added which required equipment authorization but no licenses.

Part 95 Personal Radio Services



➤ Subpart A - General Mobile (GMRS)

- ▶ Operating Frequency Bands:
 - ▶ 462.55-462.725 MHz & 467.55-467.725 MHz
- ▶ General Technical Requirements
 - ▶ 95.621 - Frequency Tolerance
 - ▶ 95.631(a), (e), & (f) - Emission Types
 - ▶ 95.633 - Emission Bandwidth(s)
 - ▶ 95.635 - Unwanted radiation
 - ▶ 95.637 - Modulation Standards
 - ▶ 95.639 - Maximum Transmitter Power
 - ▶ 95.655 - Frequency Capability

This slide shows an overview of 47 CFR part 95 Subpart A General mobile radio service. An operators license is required to use this equipment.

For GMRS Sections 95.29 and 95.621 show available channels.

Part 95 Personal Radio Services



➤ Subpart B - Family Radio Service (FRS)

- ▶ Operating Frequency Band: 462.5625-467.7125 MHz
- ▶ General Technical Requirements
 - ▶ 95.193 - Types of Communication (voice/"tones")
 - ▶ 95.627(b) - Frequency Tolerance
 - ▶ 95.631 - Emission Types
 - ▶ 95.633 - Emission Bandwidth
 - ▶ 95.635 - Unwanted Radiation
 - ▶ 95.637 - Modulation Standards
 - ▶ 95.639 - Maximum Transmitter Power
 - ▶ 95.647 - Transmitter Antenna
 - ▶ 95.649 - Power Capability

This slide shows an overview of 47 CFR Part 95 Subpart B Family Radio Service. An operator license is not required for the operation of this equipment. For FRS units sections 95.627(a) shows available channels

Part 95 Personal Radio Services



➤ Subpart B - Family Radio Service (FRS)

- ▶ **Special Requirements:**
 - ▶ Integral Antenna is required
 - ▶ See applicable Exclusion list
 - ▶ FCC 03-26 New rulemaking
 - GPS Data transmission.

➤ Subpart C - Radio Control Service (R/C)

- ▶ **Operating Frequency Bands:**
 - ▶ 26.995 - 27.255 MHz
 - ▶ 72.01 - 72.99 MHz
 - ▶ 75.41 - 75.99 MHz

New rules for FRS per docket FCC 03-26 allowing GPS data transmission. Previously only voice transmission is allowed.

47 CFR Part 95 Subpart C is the Radio Control Radio Service. No operator license is required to use this type of equipment.

For the R/C service sections 95.207 and 95.623 address the available channels

Part 95 Personal Radio Services



➤ Subpart C - Radio Control Service (R/C)

- ▶ **General Technical Requirements:**
 - ▶ 95.623 - Frequency Tolerance
 - ▶ 95.631 - Emission Types
 - ▶ 95.633 - Emission Bandwidth
 - ▶ 95.635 - Unwanted Radiation
 - ▶ 95.639 - Maximum Transmitter Power
 - ▶ 95.645 - Control Accessibility (Crystals)
 - ▶ 95.647 - Transmitter Antenna
 - ▶ 95.649 - Power Capability
 - ▶ 95.651 - Crystal Control Required

In addition to the emission types requirements addressed in 95.631, also see 95.211 and 95.212.

In addition to the power output requirements addressed in 95.639, also see 95.210.

Section 95.603(b) provides an exemption from Certification for crystal controlled 26-27 MHz transmitters

Part 95 Personal Radio Services



➤ Subpart C - Radio Control Service (R/C)

- ▶ **Special Requirements:**
 - ▶ Integral Antenna required.
 - ▶ External crystal access prohibited.

➤ Subpart D - Citizens Band Radio Service (CB)

- ▶ **Operating Frequency Band:**
 - ▶ 26.965 - 27.405 MHz
- ▶ **General Technical Requirements:**
 - ▶ 95.625(b) - Frequency Tolerance
 - ▶ 95.631 - Emission Types
 - ▶ 95.633 - Emission Bandwidth
 - ▶ 95.635 - Unwanted Radiation

47 CFR Part 95 Subpart D is the Citizens Band Radio Service. No operators license is required to use CB equipment.

For the CB service sections 95.407 and 95.625 address available channels. Additional information about 95.631 emission types is available in 95.412 and 95.413.

Part 95 Personal Radio Services



➤ Subpart D - Citizens Band Radio Service (CB)

- ▶ **General Technical Standards:**
 - ▶ 95.637 - Modulation Standards
 - ▶ 95.639 - Maximum Transmitter Power
 - ▶ 95.649 - Power Capability
 - ▶ 95.655 - Frequency Capability
 - ▶ 95.667 - CB Transmitter Power
 - ▶ 95.669 - External Controls
 - ▶ 95.671 - Serial Number
- ▶ **Special Requirements:**
 - ▶ Final output stage has a 10 W power dissipation limit.
 - ▶ Serial number must be engraved on TX Chassis.

Power requirements are also addressed in 95.410 and 95.411.

Part 95 Personal Radio Services



➤ Subpart F - 218-219 MHz Service

- ▶ Operating Frequency Bands:
 - ▶ 218 218.5 MHz and 218.501-219
- ▶ General Technical Requirements:
 - ▶ 95.853 - Frequency Segments
 - ▶ 95.855 - Transmitter ERP
 - ▶ 95.859 - Antennas
- ▶ Special Requirements
 - ▶ CTS & RTU Stations

47 CFR Part 95 Subpart F contains the 218-219 MHz band.

The 218-219 MHz band was formerly known as the Interactive Video and Data Service. Operation in this band requires a license.

This is an open band for any type of operation which meets the technical requirements.

For more information on this service see the Wireless Telecommunications Bureau rulemaking WT docket 98-169 on the Internet

RTU-Response Transmitter Unit

CTS-Cell Transmitter Station

Part 95 Personal Radio Services



➤ Subpart G - Low Power Radio Service (LPRS)

- ▶ Operating Frequency Bands:
 - ▶ 216 - 217 MHz
- ▶ General Technical Requirements:
 - ▶ 95.629 - Channel Bandwidths
 - ▶ 95.629 - Frequency Stability
 - ▶ 95.631 - Emission Types
 - ▶ 95.633 - Emission Bandwidth
 - ▶ 95.635 (c) - Unwanted Radiation
 - ▶ 95.639 - Maximum Transmitter Power

47 CFR Part 95 Subpart G contains the LPRS. An operator license is required to operate in this band.

Operating frequency information is addressed in 95.629

One type of device authorized in this band is hearing aid or auditory assistance devices.

Part 95 Personal Radio Services



➤ Subpart G - Low Power Radio Service (LPRS)

- ▶ **Special Requirements:**
 - ▶ 95.1009 - Permissible Communications
 - ▶ 95.1013 - Antennas
 - ▶ 95.1015 - Disclosure Policies
 - ▶ 95.1017 - Labeling Requirements

➤ Subpart H - Wireless Medical Telemetry Service (WMTS)

- ▶ **Operating Frequency Bands**
 - ▶ 608 - 614 MHz
 - ▶ 1395 - 1400 MHz
 - ▶ 1429 - 1432 MHz

Part 95 Personal Radio Services



➤ Subpart H - Wireless Medical Telemetry Service (WMTS)

- ▶ General Technical Requirements
 - ▶ 95.1115 - Technical Requirements
 - ▶ 95.1117 - Types of Communication
- ▶ Special Requirements
 - ▶ Voice & video Transmission prohibited.
 - ▶ RF Exposure evaluation is required for portable devices.

For addition information on the WMTS see ET Docket 99-255 which is a follow up of PR Docket 92-235. ET stands for Office of Engineering and Technology. PR was the Private Radio Bureau which is now part of the Wireless Bureau.

Part 95 Personal Radio Services



➤ Subpart I - Medical Implant Communications Service (MICS)

- ▶ Operating Frequency Bands:
 - ▶ 402-405 MHz
- ▶ General Technical Requirements:
 - ▶ 95.628 - MICS Transmitter
 - ▶ 95.631(l) - Emission Types
 - ▶ 95.633(f) - Emission Bandwidth
 - ▶ 95.635(d) - Unwanted Radiation
 - ▶ 95.639(g) - Maximum Transmitter Power
 - ▶ 95.649 - Power Capability
 - ▶ 95.651 - Crystal Control Required

MICS service for devices implanted in body.

95.628 contains requirements for Frequency monitoring for MICS transmitters.

For additional information see WT Docket 99-66

These devices are currently not eligible for TCB approval.

Part 95 Personal Radio Services



➤ Subpart J - Multi-Use Radio Service (MURS)

- ▶ Operating Frequency Band:
 - ▶ 151.82, 151.88, 151.94, 154.57, & 154.6 MHz
- ▶ General Technical Standards:
 - ▶ 95.631 - Emission Types
 - ▶ 95.632 - Operating Frequency, bandwidth, and frequency stability.
 - ▶ 95.633 - Emission Bandwidth
 - ▶ 95.635 - Unwanted Radiation
 - ▶ 95.639 - Maximum Transmitter Power
 - ▶ 95.649 - Power Capability
 - ▶ 95.651 - Crystal Control required

The MURS service is a private, two way, short distance voice, data or image communications service for personal or business use.

Maximum Power for MURS equipment is 2 watts. Initially this power output was ERP but a recent rule making FCC02-139 changed this to a conducted limit and also prohibited the filing of combination FRS devices.

The frequencies in this service were formerly in Part 90 but moved to part 95 when the licensing requirement was eliminated.

Part 95 Common Problems



- ▶ 95.645(b) Crystal Access
 - ▶ Application doesn't contain statement about accessibility of crystal.
- ▶ 95.669 CB External Controls
 - ▶ CB Radio Application isn't clear on how it complies with external controls requirements.

95.645(b) applies to the radio control service only.

Part 95 New Issues



➤ Combined GMRS/FRS Devices

- ▶ Different RF exposure requirements
- ▶ Power Restrictions on shared channels
 - ▶ FRS maximum power 0.5 Watts
 - ▶ GMRS maximum power 5 Watts
- ▶ License Issues
 - ▶ FRS requires no users license
 - ▶ GMRS requires users license
- ▶ Bandwidth
 - ▶ FRS Maximum 12.5 KHz
 - ▶ GMRS 20KHz or 12.5KHz
- ▶ Integral Antenna Requirements

Due to the power differences between services the RF exposure requirements are different. Due to the potential different user groups, FRS are used by anyone, GMRS can be restricted to trained personnel which allows for higher exposure levels for GMRS

FRS radios must have integral antennas but GMRS don't have this requirement. A combo device FRS/GMRS must have an integral antenna.

Power output for these devices must be limited based on the mode of operation. When operating on FRS channels the maximum power must be 0.5 Watts ERP

Issues related to combining operations of this type are handled by the Wireless Telecommunication Bureau on a case by case basis. Currently FRS/GMRS and FRS/Part 80 VHF(156-163MHz) combos are permitted.

Part 95 New Services



➤ Subpart K - Personal Locator Beacons

- ▶ 95.1400 – 95.1403
- ▶ For use for individuals participating in outdoor activities in remote areas
- ▶ Effective July 1,2003
- ▶ WT Docket 99-366 adopted as FCC 02-271

Policy regarding TCB approval is under consideration.

Part 97 - Amateur Radio Service



- ▶ Operating Frequency Band:
 - ▶ < 144 MHz for amplifiers subject to Certification
- ▶ General Technical Requirements:
 - ▶ 97.307 - Emission Standards
 - ▶ 97.313(b) - Transmitter Power Standards
 - ▶ 97.317 - Standards for Certification
- ▶ Special Requirements
 - ▶ 2.1060 - Guidelines for kits for amateur service

For more information about amplifier Certification see 97.315

For part 97 equipment only amplifiers operating below 144 MHz require Certification.

In the Amateur service the operator is required to be licensed but the equipment does not require Certification with the exception of Amplifiers operating below 144 MHz.

Grant Example Multi Rule Part



Adobe Acrobat - [grantexample99multirulepart.PDF]

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WASHINGTON, D.C. 20554

GRANT OF EQUIPMENT AUTHORIZATION
Certification

Company name
Company Address

Date of Grant:
Application Dated: 02/05/1999

Attention: **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 [REDACTED]
Name of Grantee [REDACTED]

Equipment Class: Licensed Non-Broadcast Station Transmitter

Notes: M1225 Low Power Mobile

<u>Grant Notes</u>	<u>FCC Rule Parts</u>	<u>Frequency Range (MHz)</u>	<u>Output Watts</u>	<u>Frequency Tolerance</u>	<u>Emission Designator</u>
	22.74.90,95A	450 - 474	30	2.5 PM	16K0F3E
	22.74.90.210,95A	450 - 474	30	2.5 PM	11K0F3E
	22.74.90,95A	450 - 474	10	2.5 PM	16K0F3E
	22.74.90.210,95A	450 - 474	10	2.5 PM	11K0F3E

Single channel mode.

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➤ TCB Workshop

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This grant is a typical part 90 re-farming band mobile transmitter with 25 kHz and 12.5 kHz channel operation. The grant has a note “single channel mode” to show that the equipment meets the 12.5 kHz data rate requirements. The channels which meet the efficiency standard are also note in the rule part column with 90.210 instead of the typical 90. The grant also shows this unit has a power output which is switchable between 30 W and 10 W.

Grant Example Multi Rule Part



Adobe Acrobat - [grantexamplemulti-ruletwo.PDF]

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WASHINGTON, D.C. 20554

COPY

GRANT OF EQUIPMENT AUTHORIZATION
Type Acceptance

Company Name _____ Date of Grant: _____
Company Address _____ Application Dated: 12/16/1997

Attention: **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
Name of Grantee _____

Equipment Class: Licensed Non-Broadcast
Station Transmitter

Notes:

Grant Notes	FCC Rule Parts	Frequency Range (MHz)	Output Watts	Frequency Tolerance	Emission Designator
	22,74,90	148 - 174	5	0.00015 %	16K0F3E
	22,74,90	148 - 174	5	0.00015 %	19K6F3D
	22,74,90.210	148 - 174	5	0.00015 %	11K0F3E
	22,74,90	148 - 174	1	0.00015 %	16K0F3E
	22,74,90	148 - 174	1	0.00015 %	19K6F3D
	22,74,90.210	148 - 174	1	0.00015 %	11K0F3E

Single channel mode.

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> TCB Workshop

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This grant shows another part 90 refarming band transmitter which has a power output switchable from 5 watts to 1 watt. This unit is in a different frequency band and doesn't include part 95. It also has an F3D emission with a larger necessary bandwidth of greater than 16 kHz.

Grant Example Narrowband



Adobe Acrobat - [grantexamplearrow90.PDF]

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COPY **COPY**

**GRANT OF EQUIPMENT AUTHORIZATION
Certification**

Company name: _____ Date of Grant: _____
Company Address: _____ Application Dated: 10/06/1998

Attention: **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 _____
Name of Grantee _____

Equipment Class: Licensed Non-Broadcast
Station Transmitter

Notes:

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
	90.210	403 - 470	5	2.5 PM	11K0F1D
	90.210	136 - 174	5	2.5 PM	11K0F1D

Single channel mode.

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This grant is a typical example of a Part 90 Narrowband data transmitter which meets the re-farming efficiency standard

Grant Example 90.217



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GRANT OF EQUIPMENT AUTHORIZATION Certification

Company Name _____ Date of Grant: _____
Company Address _____ Application Dated: 05/14/1999

Attention: **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
Name of Grantee _____

Equipment Class: Licensed Non-Broadcast Transmitter Worn on Body
Notes: Audio Intelligence Module

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
MM	90.217(b)	150 - 174	0.12	5 PM	54K7F3E

MM: Type accepted in accordance with Section 90.217.

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This slide shows a typical 90.217(b) grant. The necessary bandwidth for this unit is 54.7 kHz. Note the “note code” MM which is placed on grants issued in this rule section.

MM “Type Accepted in accordance with 90.217” is no longer used since all approvals called Certification.

Example Grant 90.265(b)



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**GRANT OF EQUIPMENT AUTHORIZATION
Certification**

Company name: _____ Date of Grant: _____
Company Address: _____ Application Dated: 10/23/1998

Attention: **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: _____
Name of Grantee: _____

Equipment Class: Licensed Non-Broadcast
Transmitter Worn on Body

Notes:

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
MJ	90.265(b)	169 - 172	0.045	0.02 %	54K0F3E

MJ: Type accepted in accordance with Section 90.265(b).

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This slide shows a typical grant for a 90.265 wireless microphone. The necessary bandwidth for this device is 54 kHz and the note code MJ is listed on the grant for devices in this rule part.

MJ "Type Accepted in accordance with 90.265(b)" is no longer used since all approvals called Certification.

Grant Example SMR Part 90



Adobe Acrobat - [grantexample90smr.PDF]

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COPY GRANT OF EQUIPMENT AUTHORIZATION **COPY**
Certification

Company Name _____ Date of Grant: _____
Company address _____ Application Dated: 04/01/1999

Attention: **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 _____
Name of Grantee _____

Equipment Class: Licensed Non-Broadcast
Station Transmitter
Notes: Wireless Data Modem

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
BH	90	896 - 901	2	1.5 PM	12K8F1D

Power output listed is measured at the antenna terminals. MPE evaluation covers operation up to 2.25 W. Unit is approved for use with the following antennas: Larsen NMO 3E 900B with 3 dBd gain, Austin 200160 500V with 0 dBd gain and Eclipse II Magnet Mount with 3 dBd gain - all used with 6 ft (or longer, 1 dB loss) cable. Minimum separation from antenna to user required for MPE compliance is 23 cm for Larsen antenna and 20 cm for both Austin and Eclipse II antennas. A corresponding Warning statement must be included in the user manuals for the final product.

BH: The output power is continuously variable from the value listed in this entry to 30%-35% of the value listed.

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This slide shows a grant for a Part 90 Specialized Mobile Radio service unit. This unit requires RF Exposure evaluation. Note the RF Exposure remark on the grant. This unit also has an adjustable power level indicated by the note BH.

Example Grant 95 B



Adobe Acrobat - [grantexample95b.PDF]

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WASHINGTON, D.C. 20554

COPY **COPY**

**GRANT OF EQUIPMENT AUTHORIZATION
Certification**

Company Name
Company Address

Date of Grant:
Application Dated: 12/13/2000

Attention: **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
Name of Grantee

Equipment Class: Part 95 Family Radio Face
Held Transmitter

Notes: Face Held Family Radio

<u>Grant Notes</u>	<u>FCC Rule Parts</u>	<u>Frequency Range (MHZ)</u>	<u>Output Watts</u>	<u>Frequency Tolerance</u>	<u>Emission Designator</u>
	95B	462.5625 - 467.7125	0.47	0.00025 %	11k0F3E

Power is ERP. This device is authorized to operate at a duty factor not to exceed 50%. End-users must be informed of operating requirements accepted for satisfying RF exposure compliance. The belt clip is for storage purposes only and is not to be used for body-worn configuration to transmit.

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This slide shows a typical Family Radio service grant. Note the RF exposure evaluation comment on the grant.

Example Grant Part 97



Adobe Acrobat - [grantexample97.PDF]

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WASHINGTON, D.C. 20554

COPY **COPY**

**GRANT OF EQUIPMENT AUTHORIZATION
Certification**

Company Name: _____ Date of Grant: _____
Company Address: _____ Application Dated: 04/12/1999

Attention: Krassimir Petkov

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: _____
Name of Grantee: _____

Equipment Class: Amplifier
Notes: Automatic HF
Linear Amplifier

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
	97	1.8 - 21.45	1500	Amp	A1A
	97	1.8 - 21.45	1500	Amp	A3E
	97	1.8 - 21.45	1500	Amp	J3E

Emissions per Section 97.305

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This slide shows a typical Part 97 Amateur band amplifier grant. Since this is an amplifier the grant doesn't list a frequency tolerance or necessary bandwidth.



Scope B3 Maritime & Aviation Services And Scope B4 Microwave Radio Services

**Federal Communications Commission
OET Laboratory**

This presentation covers the equipment authorization requirements of devices and not the licensing requirements. It is intended to give a general overview of rules and not address the specific requirements for every type of device.

Overview



➤ Maritime & Aviation Services Scope B3

- ▶ Part 80 - Maritime Services
- ▶ Part 87 - Aviation Services

➤ Microwave Radio Services Scope B4

- ▶ Part 27 – Misc. Wireless Communications
 - ▶ Broadband Radio Service (BRS)
 - ▶ Educational Broadband Service (EBS)
- ▶ Part 74 – Program Distribution Services
 - ▶ Television Broadcast Auxiliary Service
- ▶ Part 101 - Fixed Microwave Services

This presentation covers scopes B3 and B4 which are the Maritime and Aviation Services of 47 CFR parts 80 & 87 and the Microwave Radio Services of Parts 21,74, 101.

Scope B3 & B4 Exclusions



➤ Devices subject to RF Exposure Evaluation

- ▶ Exclusion lists are available on the Interpretations database and is emailed to all TCB's when it is modified. The list that is applicable depends on the training the TCB has received.
 - ▶ July 17, 2002 Exclusion List
http://hraunfoss.fcc.gov/eas_public/SilverStream/Pages/Fpg_html_fts_res.html?letter=1290
 - ▶ November 15, 2000 Exclusion List
http://hraunfoss.fcc.gov/eas_public/SilverStream/Pages/Fpg_html_fts_res.html?letter=1103

Scope B3 Maritime Services



➤ Part 80 - Maritime Services

- ▶ Operating Frequency Bands:
 - ▶ MF - 100 kHz to 4 MHz
 - ▶ HF - 4 MHz to 27.5 MHz
 - ▶ VHF
 - 72-76 MHz
 - 156 - 162 MHz
 - 216 - 220 MHz
 - ▶ UHF
 - 456 - 468 MHz
 - 1626.5 - 1646.5 MHz Ship Earth Stations
 - ▶ SHF
 - 2920 - 3100, 9320 - 9500 MHz Radars

47 CFR Part 80 covers the maritime services. This slide shows the available frequency bands.

MF medium frequency - 0.3 to 3 MHz

HF high frequency - 3 to 30 MHz

VHF very high frequency - 30 to 300 MHz

UHF ultra high frequency - 300 to 3000 MHz

SHF super high frequency - 3 to 30 GHz

Many of the regulations in this rule part are developed by international treaty and this can lead to some complex regulations.

Scope B3 Maritime Services



- ▶ **General Technical Requirements:**
 - ▶ 80.205 - Authorized Bandwidth Listings
 - ▶ 80.207 - Allowable Emissions
 - ▶ 80.209 - Frequency Tolerances
 - ▶ 80.211 - Emission Limitations
 - ▶ 80.213 - Modulation Requirements
 - ▶ 80.215 - Transmitter Power
- ▶ **Special Requirements:**
 - ▶ **VHF**
 - ▶ 80.203(b) - Frequency programming & capability
 - ▶ 80.203(c) - Transmit timer & Indicator(also 80.959(c)(1))
 - ▶ 80.203(n) - DSC requirement(also 80.225)

The general technical standards of Part 80 apply when the specific subpart a device operates in doesn't address a technical standard. When the specific subpart lists a standard, that standard takes precedence over the general standards.

More detail related to 80.203(b) can be found in 80.871.

DSC Digital Selective Calling

Scope B3 Maritime Services



- ▶ **Special Requirements:**
 - ▶ **EPIRBS - Emergency Position Indicating Radio Beacon**
 - Subpart V - Must meet RTCM requirements
 - ▶ Operating Frequencies 121.5 MHz, 243 MHz, 156.7-156.8 MHz, and 406 - 406.1 MHz.
 - ▶ Part 2 Subpart N requirements for 121.5 & 243 MHz units.
 - ▶ **Other Special Categories:**
 - ▶ Alarm Receiver
 - ▶ Watch Receiver
 - ▶ Survival Craft
 - ▶ Subpart R - Compulsory Installations (vessels > 300 GT)
 - ▶ Subpart S - Compulsory Installations (small passenger boats)
 - ▶ Subpart T - Great Lakes requirements
 - ▶ Subpart U - Bridge to Bridge requirements
 - ▶ Subpart W - GMDSS Categories

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121.5 and 243 MHz EPIRBs must also meet the requirements of Part 2 Subpart N which applies to Class A, B & S EPIRBs

121.5/243 MHz units are slowly being phased out. Newer units operate 121.5/406 MHz and may eventually only operate on 406 MHz

RTCM - Radio Technical Committee for Maritime Services is an international group which develops standards.

Subpart W GMDSS Global Maritime Distress and Safety System units normally require compliance with certain additional IMO, IEC, ISO, CCIR, and CCITT standards

Some of the standards listed in the FCC Part 80 Rules may be obsolete. When the listed part 80 standard is obsolete the application should indicate compliance with specific current requirements (in addition to those contained in the FCC Part 80 Radio Service Rules.

Prior US Coast Guard approval is required for certain devices

IMO - International Maritime Organization

IEC - International Electrotechnical Commission

ISO - International Organization for Standardization

CCIR - International Radio Consultative Committee

CCITT - International Telegraph and Telephone Consultative Committee

Scope B3 Maritime Services



- ▶ Special Requirements (continued):
 - ▶ RADAR transmitters - Power output is normally measured as an average/ mean power. For Radar units the power listed on the grant is peak power. Peak denotes the maximum level during the interrogation pulse. Calculated as $P = P(\text{avg}) / (\text{pulse width} \times \text{Rep Rate})$.

During typical operation a radar unit pulses on and off very quickly making it difficult to measure peak power. Therefore, an average power measurement is taken and the peak power calculated from that.

Scope B3 Maritime Services



- ▶ International/US Operating Modes
 - ▶ For units which need to switch between International and domestic frequencies, the channels available in the domestic mode may consist only of those listed in 47 CFR 80.371(a) & 90.373(f) with the following exception:
 - Marine VHF channel numbers 3,21,23,61,64,81,82,& 83 also may be included in the domestic mode because they may be used in certain instances. If they are included the radio or manual must make clear that these simplex channels are not for use by the general public in US waters.
 - Marine VHF channel numbers 2,4,60 & 62 may not be included in the group of accessible channels under the domestic mode of operation.

Channels 3,21,23,61,64,81,82,83 are for use by the US Coast Guard.

Channels 2,4,60, & 62 are Land mobile channels and not authorized for use in the marine bands

Part 80 Example Grant



Adobe Acrobat - [grantexample88.PDF]

FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D.C. 20554

COPY **COPY**

GRANT OF EQUIPMENT AUTHORIZATION
Type Acceptance

Raytheon Marine Company Date of Grant: 08/28/1997
Application Dated: 07/11/1997

Attention: **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: ASLRAY106-VHF520
Name of Grantee: Raytheon Marine Company

Equipment Class: Licensed Non-Broadcast Station Transmitter

Notes:

Grant Notes	FCC Rule Parts	Frequency Range (MHz)	Output Watts	Frequency Tolerance	Emission Designator
CS VP	80	156 - 157.5	1	0.001 %	16K0F3E
CS VP	80	156 - 157.5	3	0.001 %	16K0F3E
CS VP	80	156 - 157.5	6	0.001 %	16K0F3E

CS: Transmitter meets technical requirements only for use at ship stations.
VP: Transmitter portion meets technical requirements for use as a portable unit permanently associated with a vessel pursuant to the Vessel Bridge-to-Bridge Radiotelephone Act.

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This is an example of a grant for a 47 CFR Part 80 Application. This is an older grant that was issued while the process was still called type acceptance. The grant is for a voice modulated ship station with a three level power adjustment. Also notice the special condition about the device meeting the requirements of the Vessel Bridge to bridge radiotelephone act.

Part 80 New Services



➤ Automatic Identification Systems

- ▶ Effective July 2002
- ▶ Docket DA 02-1362 & DA 02-1499
- ▶ Test procedure under development so currently not TCB approvable

Scope B3 Aviation Service



➤ **Part 87 - Aviation Services**

▶ **Operating Frequency Bands:**

- ▶ LF - 90 - 500 kHz
- ▶ MF - 510.525 - 3494 kHz
- ▶ HF - 4125 - 26621.5 kHz
- ▶ VHF - 72.02-75.98, 108-117.95, 118-136.975, 143.75-148.15, 156.3-157.425, 328-334.7, 960-1215, 1300-1660.5, 2310-2390, 2700-2900, 4200-4400 MHz.

▶ **General Technical Requirements:**

- ▶ 87.131 - Power output and emissions (also 87.137)
- ▶ 87.135 - Bandwidth of Emissions (also 87.137)
- ▶ 87.137 - Authorized Bandwidth

This slide shows an overview of 47 CFR Part 87

Scope B3 Aviation Service



- ▶ General Technical Requirements (continued):
 - ▶ 87.139 - Emission Limitations
 - ▶ 87.141 - Modulation Requirements
- ▶ Special Requirements:
 - ▶ ELT - Emergency Locator Transmitters
 - Operating Frequencies
 - ▶ 121.5 & 243 MHz - Units must meet FAA TSO-C91a requirements.
 - ▶ 406 - 406.1 MHz - These units are approved through the Verification process and not Certification.
 - 87.147(d)(2) requires prior coordination with FAA for units operating on certain frequencies.
 - VHF Channel spacing 25 kHz-waiver for 8.33kHz units.
 - Operation above 136.975 - FAA/WTB VHF waiver

FAA TSO - C91a Federal Aviation Administration Technical Standards Order.

121.5/243 MHz units are slowly being phased out. Newer units operate 121.5/406 MHz and may eventually only operate on 406 MHz

Units operating with an 8.33 kHz channel spacing require a waiver from the Wireless Telecommunications Bureau.

For Part 87 units to operate above 136.975 MHz a letter from the FAA is required in addition to a waiver of the rules from the Wireless Telecommunications Bureau.

87.147 is currently under consideration for changes by the FAA and FCC. Due to electronic filing the process described in the rules is being changed.

87.299 is another example of special requirements. Flight test station transmitters are in Part 87 Subpart J

Part 87 Example Grant



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WASHINGTON, D.C. 20554

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GRANT OF EQUIPMENT AUTHORIZATION
Type Acceptance

Rockwell Collins Inc Date of Grant: 02/12/1998
Application Dated: 06/13/1997

Attention: **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 AJK8221046
Name of Grantee Rockwell Collins Inc

Equipment Class: Licensed Non-Broadcast
Station Transmitter

Notes: Emission 5K00A3E is listed
pursuant to waiver of
Section 87.173(b).

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
	87	118 - 137	25	0.003 %	6K00A3E
	87	118 - 137	25	0.003 %	5K00A3E
	87	118 - 137	25	0.003 %	10K0A3D

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This slide shows an example of a 47 CFR typical Part 87 grant. This is an older grant that was issued while the process was called Type Acceptance. The note on it indicates that a waiver was issued of 87.173(b) of the rules to allow the unit to operate with a channel spacing of less than 25 kHz. The narrowband emission is indicated on the grant by the 5K00A3E emission.

Scope B3 Common Problems



- ▶ FAA & US Coast Guard Coordination letters are not submitted.
- ▶ GMDSS compliance statements are not addressed.
 - ▶ 80.1101
- ▶ Channel programming restrictions not addressed.
 - ▶ 80.203
- ▶ Permissive Changes submitted only showing new emission designators.
- ▶ Power output adjustments not clearly described.
- ▶ Illegal channels listed in manual.

A copy of the FAA reply should be included with the application to FCC

Scope B4 Microwave Radio



➤ **Part 27 Subpart M - BRS**

- ▶ **Operating Frequency Band:**
 - ▶ 2150 - 2168 MHz

- ▶ **General Technical Requirements:**
 - ▶ 27.54 - Frequency Tolerance
 - ▶ 27.50 - Transmitter Power
 - ▶ 27.53 - Emissions and Bandwidth
 - ▶ 27.1220 - Transmission Standards
 - ▶ 27.50 - Signal Booster Stations

Scope B4 Microwave Radio



➤ **Part 27 Subpart M – EBS**

- ▶ **Operating Frequency Band:**
 - ▶ 2500 - 2686 MHz

- ▶ **General Technical Requirements:**
 - ▶ 27.50 - Power Limitations
 - ▶ 27.53 - Emissions & Bandwidth
 - ▶ 27.54 - Frequency Tolerance
 - ▶ 27.1220 – Transmission Standards
 - ▶ 27.50 - Signal Booster Stations

Scope B4 Microwave Radio



➤ Part 74 Subpart F - Television Broadcast Auxiliary

- ▶ Operating Frequency Bands:
 - ▶ 1990 - 2483.5 MHz
 - ▶ 6875 - 7125 MHz
 - ▶ 12700 - 13250 MHz
- ▶ General Technical Requirements:
 - ▶ 74.636 - Power Limitations
 - ▶ 74.637 - Emissions & Emission Limitations
 - ▶ 74.661 - Frequency Tolerance
 - ▶ 74.663 - Modulation Limits

This slide shows an overview of 47 CFR Part 74 F.

A typical use is for sending television video signals over a microwave link from a studio to the broadcast transmitter when the transmitter and studio are at different locations.

74.637 lists some additional frequencies available which may be used for digital modulated signals. They are 6425 - 6525, 17700 - 19700 and 31000 - 31300 MHz.

The band 1990 - 2500 MHz doesn't currently allow digital modulation but is being modified to allow digital modulation. This is related to High definition television operation.

Scope B4 Microwave Radio



➤ Part 101 Subpart C-General Technical Standards

- ▶ Operating Frequency Band
 - ▶ 928 - 960 MHz (101.101, 101.147)
- ▶ General Technical Requirements
 - ▶ 101.107 - Frequency Tolerance
 - ▶ 101.109 - Bandwidth (Authorized)
 - ▶ 101.111 - Emission Limitations
 - ▶ 101.113 - Transmitter Power Limitations
 - ▶ 101.131 - Transmitter Construction
- ▶ Special Requirements
 - ▶ 101.151 - Use of Signal Boosters

47 CFR Part 101 Subpart C contains the general technical standards. Multiple Address Systems Service (MAS), are not fixed microwave services even though it is in the fixed microwave radio service rule part. When the individual subparts of Part 101 don't address as standard then the standards in Subpart C apply.

At least one reconsideration petition for Part 101 has been filed and proposals to move LMDS equipment into verification are being considered.

Scope B4 Microwave Radio



➤ Part 101 Subpart G - Digital Electronic Message Service (DEMS)

- ▶ Operating Frequency Band
 - ▶ 18870 - 19260 MHz (101.505 & 101.147)
- ▶ General Technical Standards
 - ▶ 101.507 - Frequency Stability
 - ▶ 101.513 - Transmitter Power (see 101.113)
 - ▶ 101.515 - Emissions & Bandwidth (see 101.109 & 101.111)
- ▶ Special Requirements
 - ▶ 101.141 - Microwave modulation (minimum data rate)

Recently revised in Docket WT 99-327

http://hraunfoss.fcc.gov:8835/edocs_public/attachmatch/FCC-01-151A1.pdf

Part 101G should be listed on the grants for these devices

Scope B4 Microwave Radio



➤ Part 101 Subpart J - Local Television Transmission Service

- ▶ Operating Frequency Band
 - ▶ 6425 - 6525 MHz
 - ▶ 11700 - 12200 MHz
 - ▶ 13200 - 13250 MHz
 - ▶ 14200 - 14400 MHz
 - ▶ 21200 - 22000 MHz
 - ▶ 22000 - 23000 MHz
 - ▶ 31000 - 31300 MHz

Scope B4 Microwave Radio



➤ Part 101 Subpart J - Local Television Transmission Service

- ▶ General Technical Requirements
 - ▶ 101.107 - Frequency Tolerance
 - ▶ 101.807 - Transmitter Power
 - ▶ 101.809 - Bandwidth & Emission Limitations (also see 101.109 & 101.111)
 - ▶ 101.811 - Modulation Requirements
- ▶ Special Requirements
 - ▶ 101.141 - Microwave Modulation (minimum data rate)

Scope B4 Microwave Radio



➤ Part 101 Subpart L - Local Multi-point Distribution Service (LMDS)

- ▶ Operating Frequency Bands(101.1005)
 - ▶ 27500 - 28350 MHz
 - ▶ 29100 - 29250 MHz
 - ▶ 31075 - 31225 MHz
 - ▶ 31225 - 31300 MHz
- ▶ General Technical Requirements
 - ▶ 101.107 - Frequency Tolerance
 - ▶ 101.109 - Authorized Bandwidth
 - ▶ 101.111 - Emission Limitations
 - ▶ 101.113 - Transmitter Power Limitations

This is a point to multi-point distribution service usually line of site. Typical bandwidths allow for up to 45 MB/sec and a transmission range of about 2 miles. Usually used by large business's in urban areas.

Scope B4 Microwave Radio



➤ Part 101 Subpart L - Local Multi-point Distribution Service (LMDS)

▶ Special Requirements

- ▶ 101.113(c)(1) Spectral Power Density specification.
- ▶ Automatic Transmitter Power Control (ATPC) guidelines are contained in TIA TSB 10.
- ▶ Authorized bandwidth values shown in Section 101.109 are the same as the assigned frequency blocks so that the emissions mask is applied on the basis of the total band.

TIA TSB - Telecommunications Industry Association Telecommunications Systems Bulletin.

The special interpretation related to the bandwidth in section 101.109 relates to the 27500 - 28350 MHz band where the authorized bandwidth is 850 MHz. This covers the entire band. Since the entire band is used the band edge requirements are difficult for these broadband units to meet. This requires the devices to reduce their bandwidth to comply usually by not operating on the highest and lowest channel in the band.

Part 101 Example Grant



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GRANT OF EQUIPMENT AUTHORIZATION Certification

Nortel Networks Inc. Date of Grant: 01/31/2001
Application Dated: 11/14/2000

Attention: 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: ABGCTR2808M
Name of Grantee: Nortel Networks Inc.

Equipment Class: Licensed Non-Broadcast Station Transmitter
Notes: LMDS CPE Transceiver

Grant Notes	FCC Rule Parts	Frequency Range (MHz)	Output Watts	Frequency Tolerance	Emission Designator
	101	27853.5 - 27996.5	0.063	0.001 %	4M43D7W
	101	27857.25 - 27993.75	0.063	0.001 %	8M86D7W
	101	27852.4 - 27997.6	0.063	0.001 %	2M18D7W
	101	27854.05 - 27995.95	0.063	0.001 %	4M36D7W
	101	27853.5 - 27996.5	0.063	0.001 %	5M50D7W
	101	27857 - 27993	0.063	0.001 %	12M4D7W

Power output listed is composite levels measured at the antenna connector. This device operates with a 38.8 dBi parabolic antenna as an integral part of this transmitter. It is to be fix-mounted on outdoor permanent structures and RF exposure compliance must be addressed at the time of licensing, including co-location requirements of 1.1307(b)(3). An RF exposure label, as described for this filing, should be placed on the antenna of subscriber units, visible to all persons in the vicinity of the transmitter exposed to the antenna, for satisfying RF exposure requirements.

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This slide shows a typical grant for a Part 101 fixed microwave unit. Since the unit has multi channel output the power out is described as composite. The grant note also addresses the antenna and RF exposure requirements for this unit.