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TIA TELECOMMUNICATIONS SYSTEMS BULLETIN

WIRELESS COMMUNICATIONS SYSTEMS PERFORMANCE IN NOISE AND INTERFERENCE-LIMITED SITUATIONS

Part 1: Recommended Methods for Technology Independent Performance Modeling

TSB-88.1-D April 2012

TELECOMMUNICATIONS INDUSTRY ASSOCIATION
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DOCUMENT REVISION HISTORY

Version	Date	Description
TSB-88 Issue O	January 1998	Original Release
TSB-88 Issue O-1	December 1998	Added Annex F
TSB-88 Issue A	June 1999	Added Information and moved many tables from Annexes into the main body.
TSB-88 Issue A-1	January 2002	Added Annexes G & H and Corrigenda
TSB-88 Issue B	September 2004	Consolidated Annexes F, G & H into document. Updated the ACCPR modulations and methodology, ACCPR tables moved to Annex A. Modified building loss section. Added new terrain data base information and new NLCD information. Numerous editing changes and examples added. A CD with spreadsheets for each modulation is now included in a new Annex F.
TSB-88 Issue B-1	April 2005	Clarify default ENBW for analog FM receivers that are deployed in the VHF and UHF bands. Corrected editorial errors.
TSB-88.1 Issue C	February 2008	Split TSB-88B into three documents Added New Simulcast Annex G Added New Estimating Receiver Parameters Annex H Modified Square Filter Model and ACCPRUtil to split edge bins. Updated all tables and description of updated application Added Wide Band Data as data was provided Added other modulations as data was provided Added portable antenna/in-vehicle penetration values Added □/4 antenna location values Expanded ACPR Tables to start at 3.5 kHz due to 6.25 kHz FDMA offerings
TSB-88.1-C Errata	April 2008	Delete Table D-5 and replace with corrected version
TSB-88.1 Issue C-1	May 2010	Inserted new material, deleted F4FM and WB information as the FCC rules for WB changed.
TSB-88.1 Issue D	TBD	Inserted Issue C-1 additions and new information. Deleted Butterworth 10p-4c filter allowing material to be on a single page rather than 2 pages. Minimized Wide Band information due to FCC changes. Deleted old Annex E due to duplication with 88.3. Added new Annex E on Emission Designators, Moved original Annex F to Annex H. Reorganized tables for subcategories and consistency. Added H-DQPSK and H-CPM information.

FOREWORD

(This foreword is not part of this bulletin.)

Subcommittee TR-8.18 of TIA Committee TR-8 prepared and approved this document.

Changes in technology, narrowbanding between 150 MHz and 512 MHz, refarming existing frequency bands, proposed 800 MHz band reorganizations and new allocations in the 700 MHz band, plus increased reporting of interference have recently occurred. These events support keeping this document current and that it provide the methodology of modeling the various interference mechanisms to support frequency coordinators in determining the best assignments to be made for the available pool of frequencies and mixtures of technology.

This document, Part 1 includes informative Annexes A through H.

This is Part 1 of Revision D of this Bulletin and supersedes TSB-88.1-C (including addendum TSB-88.1-C1). Other parts of this Bulletin are titled as follows:

- Part 2: Propagation Modeling, including Noise
- Part 3: Performance Verification

Source Subsection in TSB-88.1-C	Superseded by Subsection in TSB-88.1-D
Annex F	Moved to Annex H

Patent Identification

The reader's attention is called to the possibility that using this document might necessitate the use of one or more inventions covered by patent rights. By publication of this document no position is taken with respect to the validity of those claims or any patent rights in connection therewith. The patent holders so far identified have, we believe, filed statements of willingness to grant licenses under those rights on reasonable and nondiscriminatory terms and conditions to applicants desiring to obtain such licenses.

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-None identified

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INTRODUCTION

This document is intended to address the following issues:

- Accommodating the design and frequency coordination of bandwidth-efficient narrowband technologies likely to be deployed as a result of the Federal Communications Commission "Spectrum Refarming". “Narrowbanding between 150 MHz and 512 MHz”, and “800 MHz Rebanding” efforts
- Assessing and quantifying the impact of new narrowband/bandwidth efficient digital and analog technologies on existing analog and digital technologies;
- Assessing and quantifying the impact of existing analog and digital technologies on new narrowband/bandwidth efficient digital and analog technologies;
- Addressing migration and spectrum management issues involved in the transition to narrowband/bandwidth efficient digital and analog technologies. This includes developing solutions to the spectrum management and frequency coordination issues resulting from the narrow banding of existing spectrum considering channel spacing from 30 and 25 kHz to 15, 12.5, 7.5, and 6.25 kHz;
- Information on new, changing and emerging Land Mobile bands such as the 700 MHz, 800 MHz and 900 MHz bands;
- Preliminary information on narrowband and limited wideband data utilizing 25 kHz and 50 kHz channel bandwidths; and
- Address the methodology of minimizing intra system interference between current or proposed Noise Limited Systems in spectral and spatial proximity to Interference Limited Systems.

The TSB-88.x-C & D series of documents was prepared partially in response to specific requests from three particular user organizations: the Association of Public Safety Communications Officials, International (APCO), the Land Mobile Communications Council (LMCC) and the National Coordination Committee (NCC).[2)]

This document, TSB-88.1-D is intended to address performance modeling and the parametric values used to accomplish that modeling within the context described above.

[2)] The National Public Safety Telecommunications Council (NPSTC) has assumed the responsibilities of the NCC which has been disbanded.

Wireless Communications Systems - Performance in Noise and Interference-Limited Situations

Part 1: Recommended Methods for Technology-Independent Performance Modeling

1. SCOPE

1.1. The TSB-88-C/D Series

The TSB-88.x-C & D series of bulletins gives guidance on the following areas:

- Establishment of standardized methodology for modeling and simulating narrowband/bandwidth efficient technologies operating in a post "Refarming" and “Narrowbanding” environment;
- Recommended datasets and propagation models that are available for improved results from modeling and simulation;
- Establishment of a standardized methodology for empirically confirming the performance of narrowband/bandwidth efficient systems operating in a post "Refarming" and “Narrowbanding” environment or in new frequency band allocations, and;
- Combining the modeling, simulation and empirical performance verification methods into a unified family of data sets or procedures which can be employed by frequency coordinators, systems engineers, system operators or software developers;

The purpose of these documents is to define and advance a standardized methodology to analyze compatibility of different technologies from a technology neutral viewpoint. They provide recommended technical parameters and procedures from which automated design and spectrum management tools can be developed to analyze proposed configurations that can temporarily exist during a “rebanding” or “narrowbanding” migration process as well as for longer term solutions involving different technologies.

As wireless communications systems evolve, it becomes increasingly complex to determine compatibility between different types of modulation, different channel bandwidths, different operational protocols, different operational geographic areas, and application usage.

Thus, spectrum managers, system designers and system maintainers have a common interest in utilizing the most accurate and repeatable modeling and simulation capabilities to determine likely system performance. With increasing spectrum allocation complexity, both in terms of modulation techniques offered, channel bandwidths available and in the number of entities involved in wireless communications systems, a standardized approach and methodology is needed for the modeling and simulation of these systems, in all frequency bands of interest.

In addition, after deployment, validation or acceptance testing is often an issue subject to much debate and uncertainty. Long after a system is in place and optimized, future interference dispute resolution demands application of an industry accepted and standardized methodology for assessing system performance and interference.

These documents contain recommendations for both public safety and non-public safety performance that are intended be used in the modeling and simulation of these systems. These documents also satisfy the need for a standardized empirical measurement methodology that is useful for routine proof-of-performance and acceptance testing and in dispute resolution of interference cases that are likely to emerge in the future.

To provide this utility necessitates that manufacturers define various performance criteria for the different capabilities and their specific implementations. Furthermore, sufficient reference information is provided so that software applications can be developed and employed to determine if the desired system performance can be realized.

Wireless system performance can be modeled and simulated with the effects of single or multiple potential distortion sources taken into account as well as the defined performance parameters and verification testing. These include:

- Performance parameters
- Co-channel users
- Off-channel users
- Internal noise sources
- External noise sources
- Equipment non-linearity
- Transmission path geometry and transmission loss modeling
- Delay spread and differential signal phase
- Over the air and network protocols
- Performance verification

Predictions of system performance can then be evaluated based on the desired RF carrier versus the combined effects of single or multiple performance degrading sources. Performance is then based on a faded environment to more accurately simulate actual usage considering all the identified parameters and potential degradation sources.

It is anticipated that these documents will serve as a recommended best practices reference for developers and suppliers of land mobile communications system design, modeling, simulation and spectrum management software and automated tools.

1.2. TSB-88.1-D

This document, Part 1 of TSB-88-D, addresses performance modeling and the parametric values used to accomplish that modeling within the context described in §1.1, limited to frequencies below 1 GHz, within the context described in §1.1.

2. REFERENCES

This Telecommunications System Bulletin contains only informative information. There are references to TIA standards which contain normative elements. These references are primarily to indicate the methods of measurement contained in those documents. At the time of publication, the edition indications were valid. All standards and bulletins are subject to revision, and parties to agreements based on this document are encouraged to investigate the possibility of applying the most recent edition of the standards or bulletins indicated in Section 3. ANSI and TIA maintain registers of currently valid national standards published by them.

3. DEFINITIONS AND ABBREVIATIONS

There is a comprehensive Glossary of Terms, Acronyms, and Abbreviations listed in Annex-A of TIA TSB-102-A. In spite of its size, numerous unforeseen terms still might have to be defined for the Compatibility aspects. The new independent sections of TSB-88.2-D and TSB-88.3-C are referenced. Additional TIA/EIA references include: TIA 603-D, Land Mobile FM or PM Communications Equipment Measurement and Performance Standards; 102.CAAA Digital C4FM/CQPSK Transceiver Measurement Methods; 102.CAAB, Digital C4FM/CQPSK Transceiver Performance Recommendations; 902.BAAB-A ,SAM Wide Band Data; 902.CBAB ,IOTA Wide Band Data; and TSB-902. Some newer documents might not have been released when this document was approved for publication. ANSI/IEEE Std 100-2009 IEEE Standard Dictionary of Electrical and Electronic Terms will also be included as applicable. Items being specifically defined for the purpose of this document are indicated as (New). All others will be referenced to their source as follows:

ANSI/IEEE 100-2009 Standard Dictionary	[IEEE]
TIA-603-D	[603]
TSB-102- A	[102/A]
TIA/EIA-102.CAAA-C	[102.CAAA]
TIA/EIA-102.CAAB-C	[102.CAAB]
Recommendation ITU-R P.1407	[ITU3]
Report ITU-R M.2014	[ITU8]
TIA-845-B	[845]
TSB-902-A	[902]
TIA-902-BAAA	[902.BAAA]
TIA-902-BAAB-A	[902.BAAB]
TIA-902-CAAB	[902.CAAB]
TIA-902-CBAB	[902.CBAB]
TSB-88.2-D	[88.2]
TSB-88.3-C	[88.3]

The preceding documents are referenced in this bulletin. At the time of publication, the editions indicated were valid. All such documents are subject to revision, and parties to agreements based on this document are encouraged to investigate the possibility of applying the most recent editions of the standards indicated above.

3.1. Definitions

For the purposes of this document, the following definitions apply:

ACIPR Adjacent Channel Interference Protection Ratio: Same as Offset Channel Selectivity [603]

ACP Adjacent Channel Power: The energy from an adjacent channel transmitter that is intercepted by prescribed bandwidth, relative to the power of the emitter. Regulatory rules determine the measurement bandwidth and offset for the adjacent channel. ACP = 1/ ACPR

ACPR Adjacent Channel Power Ratio: The ratio of the total power of a transmitter under prescribed conditions and modulation, within its maximum authorized bandwidth to that part of the output power which falls within a prescribed bandwidth centered on the nominal offset frequency of the adjacent channel. ACPR = 1/ACP

Adjacent Channel: The RF channel assigned adjacent to the licensed channel. The difference in the offset frequency is determined by the channel bandwidth.

Adjacent Channel Rejection [102.CAAA][603]: The adjacent channel rejection is the ratio of the level of an unwanted input signal to the reference sensitivity. The unwanted signal is of an amplitude that causes the BER produced by a wanted signal 3 dB in excess of the reference sensitivity to be reduced to the standard BER (or SINAD for analog). The analog adjacent channel rejection is a measure of the rejection of an unwanted signal that has an analog modulation. The digital adjacent channel rejection is a measure of rejection of an unwanted signal that has a digital modulation.

Cross analog to digital or digital to analog necessitates that the adjacent channel be modulated with its appropriate standard Interference Test Pattern modulation and that the test receiver use its reference sensitivity method.

Because it is a ratio it is commonly referred to as the Adjacent Channel Rejection Ratio (ACRR) as well..

Advanced Multi-Band Excitation Vocoder (AMBE): Newer vocoder technology requiring a lower number of bits. There are various configurations offered and performance varies based on the number of bits and the error correction coding applied.

“Area” Propagation Model: A model that predicts power levels based upon averaged characteristics of the general area, rather than upon the characteristics of individual path profiles. Cf: Point-to-point Model.

Beyond Necessary Band Emissions (BNBE) [NEW]: All unwanted emissions outside the necessary bandwidth. This differs from OOBE (*q.v.*) in that it includes spurious emissions.

Boltzmann’s Constant (k): A value 1.3805x 10^{-23} J/K (Joules per Kelvin). Room temperature is 290 K.

Bounded Area Percentage Coverage: The number of tiles within a bounded area which contain a tile margin equal or greater than that specified above the desired CPC, divided by the total number of candidate tiles within the bounded area.

BT: A key parameter in GMSK modulation to control bandwidth and interference resistance. It is referred to as the normalized bandwidth and is the product of the 3 dB bandwidth and bit interval.

C4FM [102/A]: A 4-ary FM modulation technique that produces the same phase shift as a compatible CQPSK modulation technique. Consequently, the same receiver can receive either modulation.

Channel Performance Criterion (CPC): The CPC is the specified design performance level in a faded channel. See §5.2.

Co-Channel User: Another licensee, potential interferer, on the same center frequency.

Confidence Interval: A statistical term where a confidence level is stated for the probability of the true value of something being within a given range which is the interval.

Confidence Level: also called Confidence Coefficient or Degree of Confidence, the probability that the true value lies within the Confidence Interval.

Contour Reliability: The probability of obtaining the CPC at the boundary of the Service Area. It is essentially the minimum allowable design probability for a specified performance.

Covered Area Reliability: The Covered Area Reliability is the probability of achieving the desired CPC over the defined covered area. A *tile-based area reliability* (q.v.) that is calculated by averaging the individual tile reliabilities only for those tiles that meet or exceed the minimum desired tile reliability. It can be used as a system acceptance criterion.

CQPSK [102/A]: The acronym for Compatible, Quadrature Phase Shift Keyed (QPSK) AM. An emitter that uses QPSK-c modulation that allows compatibility with a frequency discriminator detection receiver. See also C4FM.

DAQ: The acronym for Delivered Audio Quality, a reference similar to Circuit Merit with additional definitions for digitized voice and a static SINAD equivalent intelligibility when subjected to multipath fading.

Delay Spread [ITU3]: The power-weighted standard deviation of the excess delays, given by the first moment of the impulse response.

DIMRS [ITU8]: The acronym for Digital Integrated Mobile Radio Service, representing a trunked digital radio system using multi-subcarrier digital QAM modulation.

Dipole: A half wave dipole is the standard reference for fixed station antennas. The gain is relative to a half wave dipole and is expressed in *dBd*.

Doppler Frequency. The Doppler frequency is given by V/λ where V is the vehicle velocity and λ is the radio carrier wavelength (same units). Frequently this is also referred to as Doppler Shift.

Directional Height Above Average Terrain (DHAAT): The Height Above Average Terrain within a defined angular boundary. Used for determining co-channel site separations by the FCC

Effective Multicoupler Gain (EMG): The effective improvement in reference sensitivity between the input of the first amplifier stage and the reference sensitivity of the base receiver alone.

Error Function (*erf*): The normal error integral. It is used to determine the probability of values in a Normal distribution (Gaussian distribution). Many statistical calculators can perform this calculation. Many spreadsheet programs have this as a function, although enabling statistical add-ins is necessary for this function to be available. Its compliment is the *erfc*. When added together they equal 1 $(erf + erfc = 1)$.

Equivalent Noise Bandwidth (ENBW): The frequency span of an ideal filter whose area equals the area under the actual power transfer function curve and whose gain equals the peak gain of the actual power transfer function. In many cases, this value could be close to the 3 *dB* bandwidth. However, there exist situations where the use of the 3 *dB* bandwidth can lead to erroneous results. Sometimes ENBW is referred to as Effective Noise Bandwidth.

Faded Performance Threshold (FPT): Reference sensitivity minus static carrier to noise (C_S/N) plus faded carrier to noise (C_F/N).

Faded Reference Sensitivity [102.CAAA]: The faded reference sensitivity is the level of receiver input signal at a specified frequency with specified modulation which, when applied through a faded channel simulator, results in the standard BER at the receiver detector.

Gaussian Frequency Shift Keying (GFSK): A continuous phase, binary FSK modulation with a Gaussian pulse shaping function. Continuous phase means that phase continuity is maintained during the bit switching times. This FSK scheme is also known as CPFSK (Continuous Phase FSK)

Height Above Average Terrain (HAAT): The height of the radiating antenna center above the average terrain that is determined by averaging equally spaced data points along radials from the site or the tile equivalents. Average only that portion of a radial between 3 and 16 km (2 and 10 miles) inclusive.

IMBE [102/A]: The acronym for *Improved Multi Band Excitation*, a Project 25 standard vocoder per ANSI/TIA/EIA-102.BABA. "A voice coding technique based on Sinusoidal Transform Coding (analog to digital voice conversion)." There are multiple versions based on differences due to hard decoding and "soft" decoding as well as error mitigation coding.

Inferred Noise Floor: The noise floor of a receiver calculated when the Reference Sensitivity is reduced by the static C_S/N necessary for the Reference Sensitivity. This is equivalent to kT_0B + Noise Figure of the receiver.

Interference Limited: The case where the CPC is dominated by the Interference component of $C/(I+N)$.

Isotropic: An isotropic radiator is an idealized model where its energy is uniformly distributed over a sphere. Microwave point-to-point antennas are normally referenced to *dBi*.

kT_0B: kT_0B is the actual receiver thermal noise floor, where k = Boltzmann's constant (1.380622E-23 J/K), T_0 = 290*K* at the generally defined room temperature, and B is the bandwidth in Hertz. kT_0B = -174 *dBm* with ENBW in Hertz, and kT_0B = -144 *dBm* with the ENBW in KHz

Linear Modulation: Phase linear and amplitude linear frequency translation of baseband to passband and radio frequency

Lee's Method:[**7] [11]** The method of determining the number subsamples of signal power to be taken over a given number of wavelengths for a specified confidence that the overall sample is representative of the actual signal within a given confidence interval in decibels.

Local Mean: [11] The mean power level measured when a specific number of samples are taken over a specified number of wavelengths. Except at frequencies less than 300 MHz, the recommended values are 50 samples and 40λ. Note that for a lognormal distribution (typical for land mobile local shadowing), the local mean ought to result in the same value as the local median. However, the local mean calculation can produce false results if the instantaneous signal strength falls significantly below the measurement threshold of the measuring receiver.

Local Median: The median value of measured values obtained while following Lee's method to measure the Local Mean. Note that for a lognormal distribution (typical for land mobile local shadowing) the local median ought to result in the same value as the local mean. However, the local mean calculation can produce false results if the instantaneous signal strength falls significantly below the measurement threshold of the measuring receiver.

Location Variability: The standard deviation of measured power levels that exist due to the variations in the local environment such as terrain and environmental clutter density variations.

Macro Diversity: Commonly used as "voting", where sites separated by large distances are compared and the best is "voted" to be the one selected for further use by the system.

Mean Opinion Score (MOS): The opinion of a grading body that has evaluated test scripts under varying channel conditions and given them a MOS.

Measurement Error: The variability of measurements due to the measuring equipment's accuracy and stability.

Micro Diversity: Diversity reception accomplished through the placement, of receivers at the same site operating on separate antennas. These receivers are selected among or combined to enhance the overall quality of signal used by the system after this process.

Modulation Index: The modulation frequency divided by the frequency deviation. Indicated by the symbol β.

Multicast: A technique used in a land mobile radio system, wherein identical baseband information is transmitted from multiple sites on different assigned frequencies. Cf: simulcast.

Noise Gain Offset (NGO): The difference between the overall gain preceding the base receiver (Surplus Gain) and the improvement in reference sensitivity (EMG).

Noise Limited: The case where the CPC is dominated by the Noise component of $C/(I+N)$.

Number of Test Tiles: The number of uniformly distributed but randomly selected test locations used to measure the CPC. It is calculated using the Estimate of Proportions equation and the specified Area Reliability, Confidence Interval and Sampling Error.

Out of Band Emissions (OOBE) [ITU8]: Emission on a frequency or frequencies immediately outside the necessary bandwidth, which results from the modulation process, *but excluding spurious emissions.* This definition is restrictive for the purpose of this document. See Beyond Necessary Bandwidth Emissions (BNBE).

π/4 DQPSK [102/A]: The acronym for "Differential Quadrature Phase Shift Keying", "Quadrature" indicates that the phase shift of the modulation is a multiple of 90 degrees. Differential indicates that consecutive symbols are phase shifted 45 degrees ($\pi/4$) from each other.

Point-to-Point Model: A model that uses path profile data to predict path loss between points. Cf: "Area" propagation model.

Power-Density Spectrum (PDS) [IEEE]: A plot of power density per unit frequency as function of frequency.

Power Loss Exponent: The exponent of range (or distance from a signal source) that calculates the decrease in received signal power as a function of distance from a signal source, e.g. the received signal power is proportional to transmitted signal power time r^{-n} where r is the range and n is the power loss exponent.

Power Spectral Density (PSD) [IEEE]: The energy, relative to the peak or rms power per Hertz, usually given in dB units,. It is also referred to as Spectral Power Density which is utilized in this document.

Propagation Loss: The path loss between transmit and receive antennas. The loss is in dB and does not include the gain or pattern of the antennas.

Protected Service Area (PSA): That portion of a licensee's service area or zone that is to be afforded protection to a given reliability level from co-channel and off-channel interference and is based on predetermined service contours.

QPSK-c [102/A]: The acronym for the Quadrature Phase Shift Keyed family of compatible modulations, which includes CQPSK and C4FM.

Quasi-synchronous transmission: An alternate term for "simulcast", q.v.

Reference Sensitivity [603,102.CAAA]: An arbitrary signal strength value used in receiver *C/N* calculations. A given value of Reference Sensitivity doesn't specifically relate to a defined audio quality or other measurement value. If its corresponding value of *Cs/N* is known, an inferred noise floor can be determined.

Sampling Error: A percentage error; caused by not being able to measure the "true value" obtained by sampling the entire population.

Service Area: The specific user's geographic bounded area of concern. Usually a political boundary such as a city line, county limit or similar definition for the users business. Can be defined relative to site coordinates or an irregular polygon where points are defined by latitude and longitude. In some Public Safety systems the Service Area could be greater than their Jurisdictional Area. This is done to facilitate interference mitigation or allow simulcasting without violating regulatory contour regulations.

Service Area Reliability: The Service Area Reliability is the probability of achieving the desired CPC over the defined Service Area. A *tile-based area reliability* (q.v.) that is calculated by averaging the individual tile reliabilities for all tiles within the service area. It can be used as a system acceptance criterion.

SINAD: SINAD is a test bench measurement used to compare analog receiver performance specifications, normally at very low signal power levels, e.g 12 *dB* SINAD for reference sensitivity. It is defined as:

$$SINAD(dB) = 20\log_{10}[\frac{Signal + Noise + Distortion}{Noise + Distortion}]$$

Where: Signal = Wanted audio frequency signal voltage due to standard test modulation. Noise = Noise voltage with standard test modulation. Distortion = Distortion voltage with standard test modulation.

Simulcast: In a land mobile radio system, a technique in which identical baseband information is transmitted from multiple sites operating on the same assigned frequency. Quasi-synchronous transmission. Cf: multicast.

Site Isolation: The antenna port to antenna port loss in dB for receivers close to a given site. It includes the propagation loss as well as the losses due to the specific antenna gains and patterns involved.

Spectral Power Density (SPD) [IEEE]: The power density per unit bandwidth. It is also referred to as Power Spectral Density. SPD is utilized in this document.

SPD Interference Transmitter Test Pattern: The SPD digital interference transmitter test pattern is a continuously repeating 511 binary pseudo random noise sequence based on ITU-T O.153. The analog SPD Interference transmitter test pattern is two tones, one at 650 Hz at a deviation of 50% of the maximum permissible frequency deviation, and another at 2,200 Hz at a deviation of 50% of the maximum permissible frequency deviation, [603], §2.1.6 . Newer modulations could use different test patterns. The goal is to simulate normal modulation for generating adjacent channel power data. C.f.: Standard Interference Test Pattern

Standard BER [102.CAAA]: Bit Error Rate (BER) is the ratio of the received bit errors to the total number of bits transmitted, usually expressed as a percent. The value of the standard bit error rate (BER) is 5%.

Standard Deviate Unit (SDU): Also “Standard Normal Deviate.” That upper limit of a truncated normal (Gaussian) curve with zero mean and infinite lower limit which produces a given area under the curve (e.g., Z = +1.645 for Area =0.95).

Standard Interference Test Pattern: This digital test pattern is balanced to have approximately equal positive and negative signal deviations to produce symmetrical adjacent channel power [102.CAAA]**.** It is normally used to test receiver ACRR. The analog version is two tones, one at 650 Hz at a deviation of 50% of the maximum permissible frequency deviation, and another at 2,200 Hz at a deviation of 50% of the maximum permissible frequency deviation, [603], §2.1.6.

Standard SINAD [**603]:** The value of the standard signal-to-noise ratio is 12 *dB*. The standard signal-to-noise ratio (SINAD) allows comparison between different equipment when the standard test modulation is used.

Subsample: A single measured value. Part of a Test Sample.

Surplus Gain: The sum of all gains and losses from the input of the first amplified stage until the input to the base receiver.

Symbol Rate: The rate of change of symbols, symbols/sec, where each symbol represents multiple bits of binary information. Each symbol can have multiple states which correspond to the binary value represented by the symbol. The symbol rate is the bit rate divided by the number of bits per symbol.

Talk Out: From the fixed equipment outward to the "mobile" units. Also referred to as a forward-link or down-link.

Talk In: From the "mobile equipment" inbound to the fixed equipment. Also referred to as a reverse-link or up-link.

Test Grid: The overall network of tiles where random samples of the CPC are taken.

Test Location: The beginning of the Test Sample in a Test Tile.

Test Sample: A group of subsamples which are measured at a Test Tile.

Test Tile: The location where the random subsamples for CPC are to be taken.

Tile-based Area Reliability: The mean of the individual tile reliabilities over a predefined area. See §5.3.4

Tile Reliability: The tile reliability is the probability that the received local median signal strength predicted at any location with a given tile equals or exceeds the desired CPC margin. See §5.3.4.

Tile Reliability Margin: The tile reliability margin, in dB, is the difference between the predicted value of $C_F/(I+N)$ and the desired value of $C_F/(I+N)$ for the CPC. See §5.3.3.

Uncertainty Margin: An additional margin necessary due to measurement error.

Validated Service Area Reliability: The number of test locations successfully measured with the desired parametric value divided by the total number of locations tested.

Voting: The process of comparing received signals and selecting the instantaneous best value and incorporating it into the system. [See also macro diversity.]

3.2. Abbreviations

2ASK	Two Level Amplitude Shift Keying
4ASK	Four Level Amplitude Shift Keying
8ASK	Eight Level Amplitude Shift Keying
4QAM	4 point Quadrature Amplitude Modulation also QPSK
16QAM	16 point Quadrature Amplitude Modulation
64QAM	64 point Quadrature Amplitude Modulation
4CPM	4-ary (Four Level) Continuous Phase Modulation
AAR	Average Area Reliability
AMBE®	Advanced Multi-Band Excitation Vocoder
ACIPR	Adjacent Channel Interference Protection Ratio
ACK	Acknowledgement
ACP	Adjacent Channel Power (preferred by FCC)
ACPR	Adjacent Channel Power Ratio (preferred by FCC)
ACR	Adjacent Channel Rejection
ACRR	Adjacent Channel Rejection Ratio
ANSI	American National Standards Institute
APCO	Association of Public Safety Communications Officials International, Inc.
ASK	Amplitude Shift Keying
ATP	Acceptance Test Plan
BAPC	Bounded Area Percent Coverage
BER	Bit Error Rate
BDA	Bi-Directional Amplifier
BNBE	Beyond Necessary Band Emissions.
BT	3 dB bandwidth times bit interval product
C4FM	4-ary FM QPSK-C; Compatible Four Level Frequency Modulation
CAE	Counter Address Encoder
CCIPR	Co Channel Interference Protection Ratio (capture)
CCIR	International Radio Consultative Committee (Now ITU-R)
CFB	Cipher Feedback
CMRS	Commercial Mobile Radio Service
CPC	Channel Performance Criterion
$C_F/(I+N)$	Faded Carrier to Interference plus Noise ratio
C_F/N	Faded Carrier to Noise ratio
C/I	Carrier to Interference signal ratio
CQPSK	AM QPSK-C; Compatible Quadrature Phase Shift Keying

CS/N	Static Carrier to Noise ratio
CSPM	Communications System Performance Model
CTG	Composite Theme Grids
CVSD	Continuously-Variable Slope Delta modulation
DAQ	Delivered Audio Quality
dBd	Decibels relative to a half wave dipole
dBqw	Decibels relative to a quarter wave antenna
dBi	Decibels relative to an isotropic radiator
dBm	Power in decibels referenced to 1 milliWatt
$dB\mu$	Decibels referenced to 1 microvolt per meter (1 μV/m)
dBS	SINAD value expressed in decibels
DCPC	Data Channel Performance Criteria
DEM	Digital Elevation Model
DHAAT	Directional Height Above Average Terrain
DIMRS	Digital Integrated Mobile Radio Service
DLCD	Digital Land Coverage Dataset
DMA	Defense Mapping Agency (former name of NGA, National Geospatial Intelligence Agency
DMR	Digital Mobile Radio, 2 slot TDMA, ETSI, TS102 361
dPMR	digital Private Mobile Radio, 4-FSK, ETSI, TS102 658
DQPSK	Differential Quadrature Phase-Shift Keying
DVP	Digital Voice Protection
$\frac{E_b}{N_0}$	Energy per bit divided by the noise power in one Hertz bandwidth
EDACS®	Enhanced Digital Access Communication System
EMG	Effective Multicoupler Gain
ENBW	Equivalent Noise Bandwidth
erf	Error Function
erfc	Complementary Error Function *(erfc x = 1 - erf x)*
ERP_d	Effective Radiated Power, relative to a λ/2 dipole
ETSI	European Telecommunications Standards Institute
F4FM	Filtered 4-ary FM, not compatible with C4FM
F4GFSK	Filtered 4-Level Gaussian Frequency Shift Modulation
FDMA	Frequency Division Multiple Access
FM	Frequency Modulation
FPT	Faded Performance Threshold
FSA	Frequency Stability Adjustment

F-TDMA	Frequency, Time Division Multiple Access
GFSK	Gaussian Frequency Shift Keying
GMSK	Gaussian Minimum Shift Keying
GOS	Grade of Service
HAAT	Height Above Average Terrain
HAGL	Height Above Ground Leve
H-CPM	Harmonized Continuous Phase Modulation
H-DQPSK	Harmonized Differential Quadrature Phase Shift Keying
HPD	High Performance Data
HT200	Hilly Terrain, 200 km/hr
IDAS™	Trademark name for a brand of radios using NXDN® protocol
iDEN®	Integrated Digital Enhanced Network
IF	Intermediate Frequency
IIP^3	Input Third Order Intercept
IMBE	Improved Multi Band Excitation
IMR	Intermodulation Rejection
IOTA	Isotropic Orthogonal Transform Algorithm
IP^3	Third Order Intercept
ISI	Intersymbol Interference
ITU-R	International Telecommunication Union - Radiocommunication Sector
ITU-T	International Telecommunication Union Telecommunication Sector
LLC	Logical Link Control
LM	Linear Modulation
LOS	Line Of Sight
LULC	Land Usage/Land Cover
MAC	Media Access Control
MDBK	MAC data block
MHBK	MAC slot header block
MOS	Mean Opinion Score
MSR	Message Success Rate
N/A	Not Applicable
NACK	Negative Acknowledgement
NASTD	National Association of State Telecommunications Directors
NCC	National Coordination Committee
NED	National Elevation Dataset
NEXEDGE®	Trademark name for a brand of radios using NXDN® protocol

NF	Noise Factor
NF_{dB}	Noise Figure
NGDC	National Geophysical Data Center
NLCD	National Land Cover Dataset
NLOS	Non Line Of Sight
NPSPAC	National Public Safety Planning Advisory Committee
NPSTC	National Public Safety Telecommunications Council
NXDN®	Trademark for 4 Level FSK FDMA digital protocol
OHD	Okumura/Hata/Davidson Model
OIP^3	Output Third Order Intercept
OOBE	Out of Band Emissions
OpenSky®	System that uses F4GFSK
PEC	Perfect Electrical Conductor
PSA	Protected Service Area
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase-Shift Keying
QPSK-c	Quadrature Phase-Shift Keying Compatible
QQAM	Quad Quadrature Amplitude Modulation (see TSB102)
RF	Radio Frequency
RRC	Root Raised Cosine
RSSI	Receiver Signal Strength Indication
SACK	Selective Acknowledgement
SAM	Scalable Adaptable Modulation
SAR	Service Area Reliability
SINAD Ratio	Signal plus Noise plus Distortion-to-Noise plus Distortion
SPD	Spectral Power Density
TBD	To Be Determined
TCP	Transmission Control Protocol
TDMA	Time Division Multiple Access (Generic)
TDMA-N	Time Division Multiple-Access (N slots)
TIREM	Terrain Integrated Rough Earth Model
TU50	Typical Urban 50 km/hr
UDP	User Datagram Protocol
UHF	Ultra High Frequency
USGS	United States Department of the Interior, Geological Survey
VCPC	Voice Channel Performance Criteria
VHF	Very High Frequency

WAI	WEB Accessibility Initiative
Z	Standard Deviate Unit

3.3. Trademarked Names

The purpose of this Bulletin is to provide performance modeling parametric values for different modulations and channel bandwidths. Many manufacturers use trademarked names to identify their proprietary offerings. As a result it is difficult to determine the specifics for modeling without knowing the modulation and receiver characteristics.

A cross reference to known trademarks is provided to facilitate this correlation to the data provided in this Bulletin. The use of trademarks does not constitute an endorsement of the product or services. These data have been provided by the owners of their respective trademarks.

Table 1 Trademark Names Cross Reference

Trademark Owner	Trademark or Marketing Name	Annex A
EADS	TETRAPOL	§A.6.7
Icom	IDAS™	
	NXDN®	§A.6.6
Kenwood	NEXEDGE®	
	NXDN®	§A.6.6
Motorola	HPD	§A.9.1
	iDEN®	§A.8.1
	LSM	§A.6.2
	MOTOTRBO™	§A.7.1
Harris	EDACS®	§A.6.5
	OpenSky®	§A.7.2
	WCQPSK	§ A.6.3

4. TEST METHODS

Test methods listed in this section are either specific to the referenced normative TIA documents or informative recommendations.

Test methods are defined in the following subsections:

- §5.7.1.1 [603]
- §5.7.1.2 [102.CAAA]
- §5.7.1.4 [902.CAAA], [902.CBAA]
- §5.8.3 Simulcast Delay Spread Method of Measurement
- Annex F.1.2, Simulcast Delay Spread Annex [102.CAAA]

5. WIRELESS SYSTEM TECHNICAL PERFORMANCE DEFINITION AND CRITERIA

The complete definition of the user needs eventually evolves into the set of conformance criteria. Based on prior knowledge of what the User needs are and how the conformance testing is to be conducted, iterative predictions can be made to arrive at a final design. The following factors need to be defined before this process can be accomplished.

5.1. Service Area

This is the user's operational area within which a radio system is specified to provide:

- The specified Channel Performance in the defined area
- The specified CPC Reliability in the defined area

The definitions in the following sections build upon the concept of the Service Area, Channel Performance Criterion (CPC), and reliability. It is recommended that the Service Area be defined in geographic terms.

5.2. Channel Performance Criterion (CPC)

The CPC is the specified design performance level in a faded channel. Its value is dependent upon ratios of the desired signal to that of the other noise and interference mechanisms that exist within the service area. It is defined as a ratio of the Rayleigh faded carrier magnitude[3)] to the sum of all the appropriate interfering and noise sources, $C_F/(\Sigma I+\Sigma N)$ necessary to produce a defined performance level. This $C_F/(I+N)$ determines the Faded Sensitivity value. However the faded sensitivity needs an absolute power reference. The Faded Sensitivity can be determined from the known Reference Sensitivity, a static desired carrier-to-noise ratio, C_S/N, for bench testing, which provides the absolute power necessary for the C_S/N criterion. The faded sensitivity for a given CPC is then the static reference sensitivity plus $(C_F/N - C_S/N)$. For digital systems it includes an absolute value in terms of a delay spread performance factor which addresses the decrease in sensitivity which occurs at some given delay spread parameter, after which delay spread distortion occurs.

Table A-1 of Annex-A contains a tabulation of common modulations and their projected CPCs. A discussion on simulcast delay spread is in §5.8 and Annex F.

The Faded Reference Sensitivity [102.CAAA] typically corresponds to a 5% BER. This value does not provide sufficient margin for CPCs specified by Users or recommended in this Bulletin. Use the appropriate design faded sensitivity for the desired CPC. Base it on the $C_F/(\Sigma I+\Sigma N)$ needed for the signal quality desired for the particular radio service.

[3)] Constantly Rayleigh faded (e.g. 100% of the time). In the land mobile environment, the "mobile" is normally immersed in the local clutter resulting in Rayleigh fading.

5.2.1. CPC Reliability

CPC Reliability is the probability that the prescribed CPC exists at a specified location. It is computed by predicting the median signal level at a point and determining the ratio between the median (C) power level and the ($I+N$) power at the same point. Subtract the CPC design target, $C_F/(I+N)$. The magnitude of this remaining margin determines the probability of achieving the signal level needed to produce the CPC.

5.3. CPC Reliability Design Targets

The reliability of wireless communications over a prescribed area is often an issue that is misunderstood. Standardized definitions that are universally applicable are necessary and are presented in the following:

5.3.1. Contour Reliability

The concept of Contour Reliability is a method of specifying both a prescribed CPC and the probability of achieving that value, e.g., a 90% probability of achieving a prescribed C_F/N. The locus of points that meet these criteria would form a contour. Ideally that contour would follow the boundaries of the user's Service Area.

A regulatory Contour Reliability represents a specific case where the prediction model uses a single "height above the average terrain" value along each radio propagation path, radial between the site and a predicted point, such that predicted signal levels can only decrease with increased distance from the site. This is unrealistic but useful in administration of frequency reuse as it eliminates the randomness of predicted signal levels due to terrain variations, producing a "single unambiguous predicted location" along each radial that provides the specified field strength. The contour is then the locus of those points. Note that the signal strength could denote some specific CPC, but not necessarily. Historically, reuse coordination was based on a non-overlapping of contours. The existing systems desired (C) signal contour at some reliability, typically 50%, cannot be overlapped by the proposed new co-channel carrier's interference contour (I) at a specific reliability, typically 10%[4)].

[4)] The use of the 10% interfering contour method is not recommended as described in [88.2]. Modified interfering 50% contours are recommended, particularly when short separations are involved. This is especially the case for adjacent channel interfering contours due to the short spacing involved.

5.3.2. Service Area Reliability

The Service Area Reliability is the probability of achieving the desired CPC over the defined Service Area. It is calculated by averaging the individual Tile Reliabilities for all tiles within the Service Area. Tile Reliabilities are calculated by comparing the predicted signal level against the target receiver's Noise Threshold to determine the available margin. That available margin is then reduced by the CPC criterion necessary for the defined DAQ. The remaining margin determines the probability of achieving the CPC margin necessary for the defined DAQ.

Since Contour Reliability is frequently user specified, its conversion to Area Reliability is very important as confirmation testing [88.3] is based on the Area Reliability, not on the Contour Reliability. Note, however, that the area being defined is that of a bounding contour of a constant distance, not of an irregular Service Area. The design process produces the area reliability where, at a minimum, the Contour Reliability is provided throughout the Service Area.

An equation[5)] for converting Contour Reliability into Area Reliability from Reudink [1], page 127 is:

$$Fu = \frac{1}{2}\left[1 - erf\ \ a\ \ + \left\langle \exp\frac{1-2ab}{b^2} \right\rangle \left\langle erfc\left(\frac{1-ab}{b}\right)\right\rangle\right] \qquad (1)$$

where

$$erf(z) \equiv \frac{2}{\sqrt{\pi}}\int_0^z e^{-t^2}dt$$

At the contour, distance R,

$$P_{x_0}(R) = \frac{1}{2}\ erfc(a)\ = \frac{1}{2}\ 1 - erf(a) \qquad (2)$$

where

$$a = \frac{x_o - \alpha}{\sqrt{2}\sigma} = \frac{Z}{\sqrt{2}}\ where\ \frac{x_o - \alpha}{\sigma} = \frac{margin}{\sigma}$$

$$b = 10n\left(\frac{\log_{10} e}{\sqrt{2}\sigma}\right)$$

and,

α is the predicted signal power(*dBm*) reduced by the CPC criterion (*dB*)
e.g. signal power = -97 *dBm*, CPC = 17 *dB*, α = -114 *dBm*

---

5) The equation shown is modified from the source to allow using *erfc* functions. As a result a conditional requirement exists that when followed produces the correct results using the modified formula. An example in Figure 2 demonstrates the test. Mathematically, *erf(-t) = -erf(t).* Due to this, both equations (2) & (3) have conditional requirements.

x_o is the noise threshold (*dBm*) e.g. -124 *dBm*

σ is the log normal standard deviation (*dB*)

n is the power loss exponent for different range(s) i.e. power is proportional to r^{-n}

F_u is the fractional useful service area probability

Px_o is the fractional probability of x_o at the contour

Z is the standard deviate unit for the fractional reliability at the contour

The resultant solution is based on a uniform power loss exponent and a homogeneous environmental loss (smooth earth). Although it doesn't include the effects of terrain, it provides a reasonable first-order estimate.[6)]

Figure 1 shows a conversion chart between Contour Reliability and Area Reliability for a constant power loss exponent of n=3.25, a circular area, homogeneous environment and three different values of standard deviation (σ).

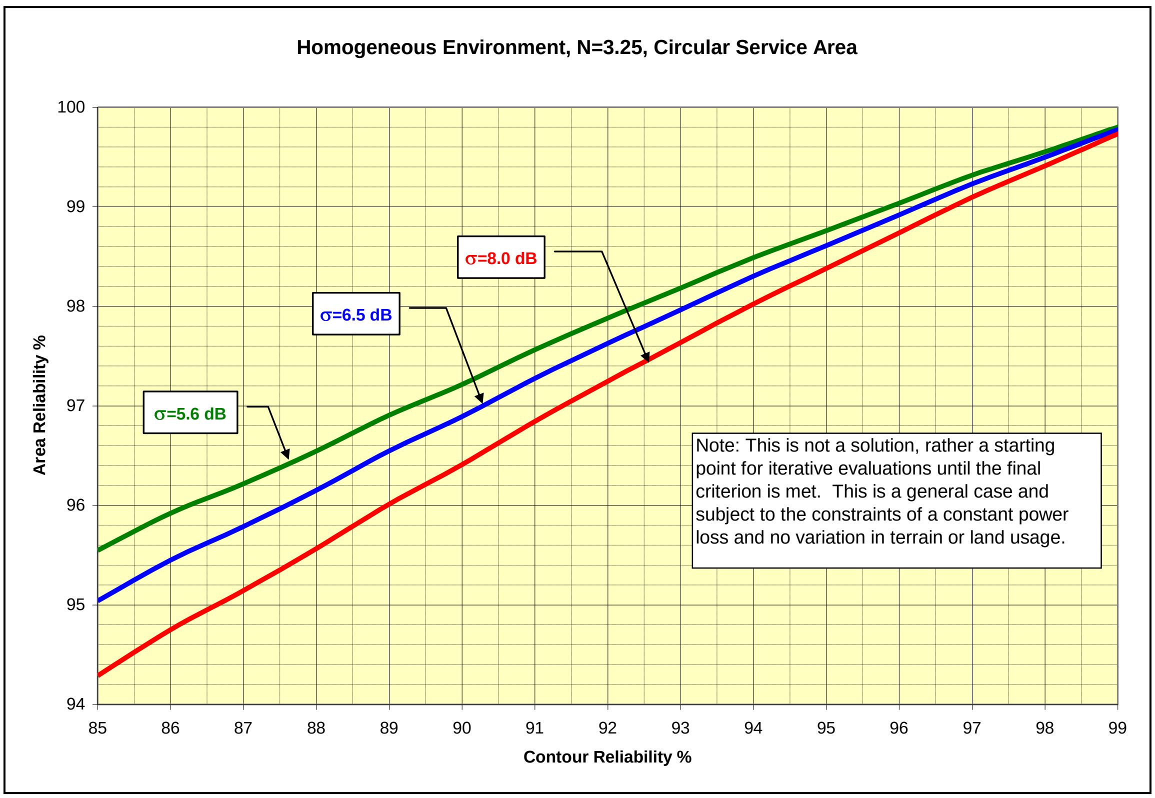

Figure 1 CPC Area Reliability vs. Contour Reliability

[6)] Because the environmental differences are not included in this model, it ought to be treated as only a beginning estimation. Even after measured data has been taken along a contour, it cannot be extrapolated to an Area reliability as insufficient data is available and the environmental differences interior to the contour are not included.

The use of the simplified contour model produces some confusion. It assumes uniform propagation loss across a smooth earth. The regulatory definition assumes the limiting case occurs at the contour. This is not useful in designing or evaluating a system as the contours do not actually exist. They were developed as an aid for frequency reuse coordination before computers and coverage models were practical for frequency coordination on an area basis rather than simple contours.

The curves in Figure 1 are slightly irregular due to the granularity in using lookup tables to compute Equation(2). A sample solution for 90% at the contour is shown in Figure 2 where n = 3.25 and σ = 5.6 *dB*. The result is an Area Reliability of 97.21%.

$$P \quad x_0 \quad R = 0.90 = \frac{1}{2} \quad 1 - erf(a)$$

$$erf(a) = (1 - 1.8) = -0.80$$

$$a = -0.905$$

The solution of "a" uses a lookup table with the conditional requirement that if $: erf(a) > 0, a, else - a.$

$$b = \frac{10(3.25)(0.4343)}{5.6\sqrt{2}} = 1.7822$$

$$Fu = \frac{1}{2}\left[+0.8 + (3.7826) erfc(1.4661)\right]$$

$$Fu = 0.9721 = 97.21\%$$

Figure 2 Sample Contour to Area Reliability Calculation

An Excel® spreadsheet automates the calculation, and an example is shown in Figure 3. In addition to calculating a circular service area, it also calculates a linear path such as a straight road or railroad track when M=1. The calculation provides both solutions if the M Factor is input as a zero. The intermediate calculations are shown to the right of the shaded instruction area.

Uses Excel *erfc* function to calculate (1-*erf*(a)) and lookup table
to calculate a when *erf*(a) is known.
See also ABRAMOWITZ & STEGUN to calculate *erf* values (7.1.26)

$erf = 1 - erfc$
$erf + erfc = 1$
e = 2.7182818246
log(e) = 0.434294481

Enter the % reliability @ contour (Px) >	90.0 %
Enter the Power Loss Exponent (2 to 5) >	3.25
Enter the Lognormal SD "Sigma" (3 to 12) >	5.6 dB
Enter the M Factor(1=circle, 0=linear) >	0
= Calculated Area Reliability-Circle, Linear >	97.21 % 98.41%

The above allows the solution of formula (2.5-10) in Jakes. By entering the contour design reliability,
the Power Loss Exponent n, n*10log d1/d2 is the difference in loss for two distances, ie
Okumura has n vary with distance, Bullington has n = 4. When n equals 4, the loss increases
12 dB/octave or 40 dB/decade. For Free Space Loss, n = 2, 6 dB/octave or 20 dB/decade.
Sigma,σ, the standard deviation of Lognormal fading varies with the variability of the terrain.
At 800 MHz Okumura uses 6.5 for Urban and 8.0 for Surburban environments.
TSB88 recommends s = 8 dB for initial coordination and 5.6 dB for cases where variables are known.
WARNING! This solution is valid only for the area within a circle or a linear configuration,
each location has equal likelyhood, and a uniform power loss.

Circle solution

erf(a)	-0.8
a =	0.905 -0.91
log e	0.434294481
b =	1.782233681
(1-ab)/b	1.466093649
erfc [(1-ab)/b]	0.038137911
(1-2ab)/bb	1.330405588
exp[(1-2ab)/bb]	3.782577246
(erfc[(1-ab)/b]*exp[(1-2ab)/bb])	0.144259593
Solution	0.972129797

Linear solution

erf(a)	-0.8
a =	0.905 -0.91
log e	0.434294481
b =	1.782233681
erfc(a)	1.8
(m+1/2b)^2	0.078706521
(m+1)a/b	-0.50778975
((m+1)/2b-a)	1.185546825
exp(j25-j26)	1.797678793
erfc(j27)	0.093617541
solve	0.984147134

$$Fu=\frac{1}{2}\left[1-erf(a)+\left(\exp\frac{(-2ab}{b^2}\right)\left(erfc\left(\frac{(-ab}{b}\right)\right)\right] \qquad b=\frac{10n\log_{10}e}{\sigma\sqrt{2}} \qquad Px=\frac{1}{2}(-erf(a)$$

In Jakes, the last variable is 1-*erf*. Since excel does *erfc*, the substitution is valid.
There is a conditional test
If *erf*(a) is negative, then a is also negative.
The lookup table works on absolute numbers so it can go below 50%
The chart is not a smooth curve due to the lookup table's granularity

Figure 3 Excel® Solution

The following definitions expand on the Area Reliability concept, using the individual tile reliabilities to calculate the Area Reliability.

5.3.3. Tile Reliability Margin

The tile reliability margin, in *dB*, is the difference between the predicted value of $C_F(I+N)$ and the necessary value of $C_F(I+N)$ for the CPC. This margin is used to predict the reliability of each individual tile.

5.3.4. Tile Reliability

The Tile Reliability is the probability that the received local median signal strength predicted at a given tile equals or exceeds the desired CPC. The fractional reliability value is calculated by dividing the total tile reliability margin minus any uncertainty margin, by the standard deviation value (σ) to obtain the standard deviate unit (Z), which can then be converted to tile reliability. For example, if the margin is 8.2 *dB*, and an uncertainty margin of 1 *dB* is included then the standard deviate unit (Z) is [8.2-1]/5.6 = 1.286 which converts[7] to a tile reliability of 90.1%.

$$\text{If } Z \geq 0, Px_0 = \frac{1}{2}\left[1 + erf\left(\frac{Z}{\sqrt{2}}\right)\right] else, \frac{1}{2}\left[erfc\left(\frac{-Z}{\sqrt{2}}\right)\right] \tag{3}$$

[7] Conversions can be found in many statistical text books. Equation (3) is an exact solution, requiring erf and erfc functions. Table 2 and Figure 4 provide some common values.

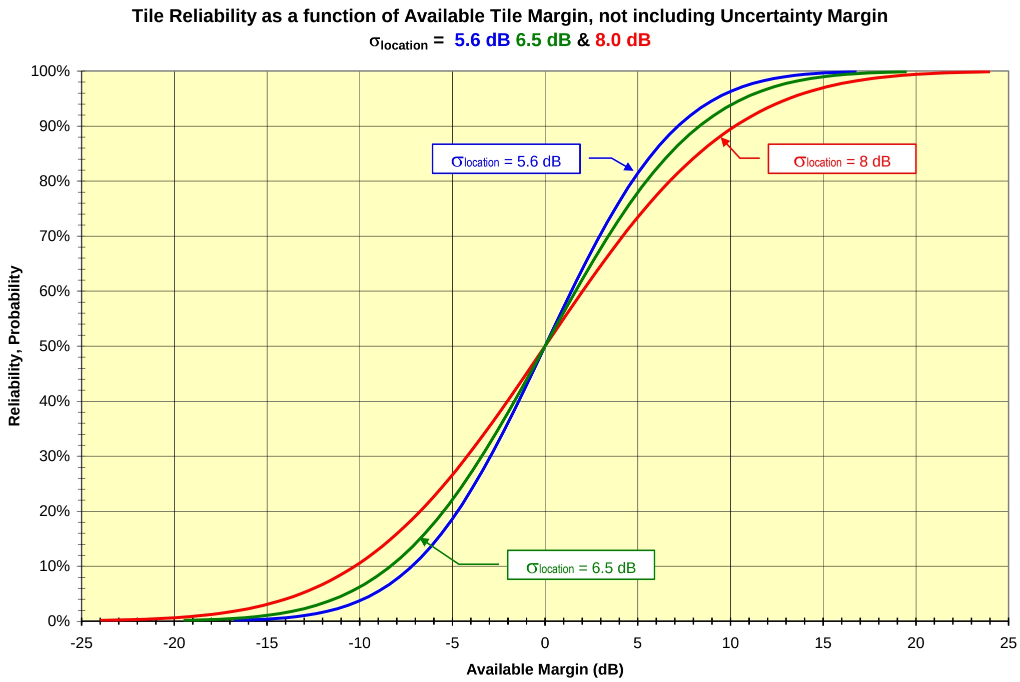

Figure 4 Reliability vs. Tile Margin

Table 2 Common Values of Standard Deviate Unit

Percentage (%)	*Z*
50	0
70	0.524
80	0.841
85	1.036
90	1.281
95	1.645
97	1.881
99	2.326

For example, if the minimum acceptable probability for any tile is a 90% probability of achieving the CPC target value, the tile reliability margin would be (1.281 × 5.6 dB)= 7.2 *dB* plus any uncertainty margin if specified. For the simple model of Table 2, the 90% would be similar to a 90% contour and would estimate an area reliability of approximately 97.4%. The exact value would be subject to an actual prediction rather than the use of the simple model of Table 2.

5.3.5. Tile-Based Area Reliability

The Tile-Based Area Reliability is the average of the individual Tile Reliabilities over a predefined area. It can be used as a system acceptance criterion. In the Land Mobile Service, it is used in the following two forms:

Covered Area Reliability is defined as the probability of achieving the desired CPC over the defined covered area. It is the average of the individual Tile Reliabilities for only those tiles that meet or exceed the minimum desired Tile Reliability.

Service Area Reliability is defined as the probability of achieving the desired CPC over the defined Service Area. It is calculated by averaging the individual Tile Reliabilities for all tiles within the Service Area.

5.3.6. Bounded Area Percent Coverage

The Bounded Area Percentage Coverage (BAPC) is defined as the number of tiles within a bounded area that contain a tile margin equal to or greater than that specified above the prescribed CPC, divided by the total number of candidate tiles within the bounded area. A candidate tile refers to the situation where certain tiles have been excluded from any evaluation so that not all tiles within the bounded area are considered. This can include enclaves (also called "exclusion zones") or specific tiles that are not accessible for acceptance testing. Thus, the candidate tiles are those tiles that have not been excluded from the evaluation. BAPC is useful as a means of numerically representing the visual information shown on a coverage map. It is not the same as, and ought <u>not</u> to be confused with, Covered Area Reliability (q.v.)! The Bounded Area Percent Coverage only shows the percentage of tiles that meet or exceed the sum of the CPC and specified reliability margin.

To demonstrate the difference, consider three different ways the same data can be represented. Using the previous example of 90% contour probability of achieving the desired CPC, the estimated circular Service Area Reliability is approximately 97.4%, using a lognormal standard deviation of 5.6 dB and no "uncertainty margin".

1. If all tiles that were predicted to be less than 90% were represented by a color, then only the area outside of the circular service area would be colored. This would represent 100% coverage to the criterion level. (i.e. BAPC = 100%). However the actual area reliability is still only 97.4%!
2. If all tiles that were predicted to be equal to or greater than 90% were represented by a color, then 100% of the circular service area would be colored. This again implies 100% coverage to the criterion level while the area reliability is still only 97.4%!
3. If all tiles that were predicted to be equal to or greater than 90% were colored distinctive colors (e.g.1% steps) additional information is represented as there would now be a series of different colored concentric rings around the site. The different colors provide the additional

information as the probability of failing to achieve the necessary signal levels is greatest at the tiles with lower reliabilities.

Bounded Area Percent Coverage ought not to be claimed as having levels higher than the actual area reliability. Under the aforementioned conditions, the acceptance of a system designed to BAPC criteria is based on the performance of a Service Area Reliability test.

The visual representation of acceptance test results is a common topic of confusion with BAPC. A Validated Service Area Reliability is directly computed by dividing the number of test tiles where the CPC specification was successfully measured by the total number of test tiles measured. Tiles are colored to represent the test results. This directly validates Service Area Reliability [88.3]. It does *not* validate the BAPC value.

5.4. Margins for CPC

Different CPCs, such as those for digital data, might need additional margins above the “standard faded sensitivity”. These additional margins are used to increase the signal levels needed to compensate for longer data messages or to compensate for the aggregated delay spread so as to achieve the appropriate $C_F/(\Sigma I+\Sigma N)$ needed for the specific modulation and applications CPC.

5.4.1. CPC Variations

There are fundamental differences between voice systems and full data systems. The CPC criterion for voice is identified as Voice Channel Performance Criterion (VCPC) and the criterion for data as Data Channel Performance Criterion (DCPC).

5.4.2. VCPC Subjective Criterion

Static SINAD equivalent intelligibility, Mean Opinion Scores (MOS) and Circuit Merit have been frequently used to define a Voice Channel Performance Criterion (VCPC). The term, Delivered Audio Quality (DAQ), was developed to facilitate mapping of analog and digital voice system performance to Circuit Merit and Static SINAD equivalent intelligibility. DAQ and its static SINAD equivalent intelligibility define a subjective evaluation based on understandability, minimizing repetition and degradation due to noise or distortion to establish scores. For the purposes of this document, DAQ values are defined in terms of static SINAD equivalent intelligibility. These are shown in Table 3, which sets out the approximate equivalency between DAQ and SINAD.

Recommendations for public safety, and non-public safety, are provided in §5.6. The values in D.3.11 are provided for situations where an incumbent’s criterion is unknown. In digital systems, the noise factor is greatly diminished and the understandability becomes the predominant factor. The final conversion is defined as the VCPC.

The goal of DAQ is to determine what median $C_F/(I+N)$ is needed to produce a subjective audio quality metric under Rayleigh multipath fading.

The reference is to a static FM analog audio SINAD equivalent intelligibility. This provides a cross-reference between the faded DAQ and static SINAD intelligibility.

The need for a static 20 dBS equivalency produces a DAQ of approximately 3.4. This value can then be used for linear interpolation of the existing criteria. Normally the VCPC DAQ is specified as a DAQ of 3, while Federal Government agencies use a DAQ of 3.4 at the boundary of a protected service area. Note that regulatory limitations could preclude providing a high probability of achieving this level of CPC for portable in-building coverage. In addition, higher infrastructure costs and lessened frequency reuse could result.

Noise/Distortion is intended to represent Analog/Digital configurations, where Noise is the predominant factor for degrading Analog DAQ, while Distortion and vocoder artifacts represent the predominant factor for degrading Digital DAQ. Repetition represents the degradation due to low intelligibility.

These values are subjective and can have variability amongst individuals as well as configurations of equipment and distractions such as high background noise, poor enunciation, or improper microphone usage. They are intended to represent the mean opinion scores of a group of individuals, thus providing a goal for evaluation. It is recommended that samples of each criterion be provided early in any design to allow calibration of user expectations and fixed design goals. Note the considerable overlapping of the static SINAD equivalent intelligibility in the right hand column due to variability of different MOS groups.

Analog performance testing using SINAD measurements is not recommended as these measurements occur in a fading environment which differs dramatically from a static environment. In a fading environment additional factors are involved such as velocity, Rayleigh fading rates and depths, Delay Spread and meter ballistics when applicable. Analog subjective testing as described in [88.3] is the recommended methodology. It is the equivalent intelligibility that is used for defining DAQ, not an absolute SINAD.

BER testing for digital radios is the recommended method using the criteria presented in Table A-1 and the methods described in [88.3].

Table 3 Delivered Audio Quality

DAQ Delivered Audio Quality	Faded Subjective Performance Description	Static SINAD equivalent intelligibility[1,2]
1	Unusable, Speech present but unreadable	<8 dB
2	Understandable with considerable effort. Frequent repetition due to Noise/Distortion	12 ± 4 dB
3	Speech understandable with slight effort. Occasional repetition necessary due to Noise/Distortion	17 ± 5 dB
3.4	Speech understandable with repetition only rarely needed. Some Noise/Distortion	20 ± 5 dB[3]
4	Speech easily understood. Occasional Noise/Distortion	25 ± 5 dB
4.5	Speech easily understood. Infrequent Noise/Distortion	30 ± 5 dB
5	Speech easily understood.	>33 dB

1) The VCPC is set to the midpoint of the range.
2) Measurement of SINAD values in fading is not recommended for analog system performance assessment.
3) The 20 dBS equivalency necessitates a DAQ of approximately 3.4. This value can then be used for linear interpolation of the existing criteria. Non public safety CPC specifications would normally request a DAQ of 3, while Federal Government agencies commonly use a DAQ of 3.4 at the boundary of a protected service area. Note that regulatory limitations could preclude providing a high probability of achieving this level of CPC for portable in-building coverage. In addition, higher infrastructure costs could be needed with potential lessened frequency reuse.

Table 3 shows the various factors needed to make a prediction for a specific VCPC.

The Thermal Noise Threshold is the noise contribution of the receiver due to thermal noise. The Thermal Noise Threshold then defines the *Inferred* or *Calculated* Noise Floor used in all subsequent calculations. It can be calculated using Boltzmann's constant and an assumed room temperature of 290 K, correcting for the receiver's Equivalent Noise Bandwidth (ENBW) and Noise Figure. This is:

$$\text{Inferred Noise Floor}_{\text{dBm}} = -144 + 10 \log (\text{ENBW}_{\text{kHz}}) + \text{NF}_{\text{dB}} \qquad (4)$$

Where: ENBW is in kHz.

It is important to note that the actual noise floor might need adjustments due to environmental noise [88.2] or interference [88.3].

The Static Threshold is the Reference Sensitivity of the receiver. It has a static carrier to noise (C_S/N) value, relative to the Inferred Noise Floor and can be expressed as an absolute power level in dBm or in μV across 50Ω.

The Faded Performance Threshold (FPT) differs slightly in definition from the Faded Reference Sensitivity as it is for a faded performance criterion. In the specific case of C4FM, the Faded Reference Sensitivity is for the standard BER (5%), § 2.1.5.1 [102.CAAA]. The Faded Performance Threshold is for a BER that provides for the specific defined VCPC. In the specific case of analog, the Faded Reference Sensitivity is for 12 *dBS.* The Faded Performance Threshold is for the signal power level that provides for the specific defined VCPC. The faded carrier to noise (C_F/N) value is associated for the VCPC performance level, see Table A-1. This C_F/N value can be evaluated as being a $C_F/(\Sigma I+\Sigma N)$.

The following example uses narrowband analog (12.5 kHz channel spacing) from Table A-1 with a C_S/N of 7*dB* and a VCPC criterion of DAQ 3.0 with a C_F/N of 23 *dB*. See Annex C for an additional example that considers noise.

- The Adjustment for “Antenna” represents the antenna efficiency of the configuration being designed for. It represents the mean losses for that antenna configuration relative to a vertically polarized λ/2 dipole. For portables it ought to include body absorption, polarization effects, and pattern variations for the average of a large number of potential users. For mobiles, it ought to include losses for gain variation for the mounting location on the vehicle, Table D 3, and coaxial cable loss.
- Mobile and portable antenna height corrections need to be included under this definition. Use the equations/programs from [88.2], e.g. Hata [4].
- User adjustment is for specific usage as necessary for determining portable reliability when operating in a vehicle or in a building with specified penetration loss(es). Some generalized values of medium building penetration loss can be found in [88.2] and [88.3]. Annex D contains some portable antenna loss values as well as vehicle loss.
- The Acceptance Test Plan (ATP) Target for a hypothetical system is then the absolute power defined by the Static Threshold plus the difference between C_F/N - C_S/N and the antenna adjustment and any usage adjustment needed. In other words, the ATP target is Faded Performance Threshold (FPT) + antenna and usage adjustment. For example if the static threshold is -116 *dBm,* the FPT is -100 *dBm* (-116 *dBm* + C_F/N - C_S/N = -116 *dBm* + *23 dB* – *7dB)*. The difference in C_F/N - C_S/N is the fading margin. In this example, the C_F/N for the desired performance level is 23 *dB* and the C_S/N is 7 *dB* (analog 12.5 *kHz* Table A-1), then the fading margin is 16 *dB*, and the FPT becomes the Static Threshold + fading margin = -116 *dBm* + 16 *dB* = -100 *dBm*. If the portable antenna has a mean gain of -10 *dBd* and a building loss of 12 *dB* is needed then the average power for the design at street level needs to be 22 *dB* greater

than -100 *dBm* (-78 *dBm*) for this example configuration. Table 3 provides the *projected*[8)] VCPC necessary for providing DAQ 3, 3.4, and 4.

- This establishes the median power, to be measured by a test receiver calibrated to offset its test antenna configuration and cable losses. For example, if the design was for a portable system and the test receiver is using a $\lambda/4$ center roof mounted antenna with 2 *dB* of cable loss then a correction factor of -1 *dBd* is applied for the antenna configuration to reference it to a $\lambda/2$ dipole. The total correction between the design configuration and testing configuration is -3 *dB*, which would modify the pass/fail criterion from -78 *dBm* to -81 *dBm*.
- The Design Target includes the necessary margins to provide for the location variability to achieve the design reliability and a “confidence factor” so that average measured values produces the VCPC. For example, if the desired minimum probability of achieving the VCPC is 90%, and a design actually produces such a condition, 50% of the tests would produce results greater than the 90% value and 50% would produce results less than the 90% value. A minor incremental increase of a 1 *dB* uncertainty margin in the design would allow the 90% design objective to be validated. The necessary correction factor varies with the system parameters as can be found in [88.2].
- The final element in the prediction involves the actual propagation model, which predicts the mean loss from the transmitter site to a specific predicted location at some probability. The specific electromagnetic wave propagation model selected is critical as the system design, simulation, and modeling accuracy versus system performance are dependent upon the validity and applicability of the selected model. Propagation and Noise [88.2] contains the recommended models and methodology. Recommendations are in §5.6. The completion of a specified ATP, where close agreement between predicted and measured values is achieved, essentially validates the specific models used. It is recommended that the specific models be employed for system coverage and for frequency reuse and interference predictions to assure consistency and long term validity.

[8)] Actual values need to be confirmed from each specific equipment manufacturer

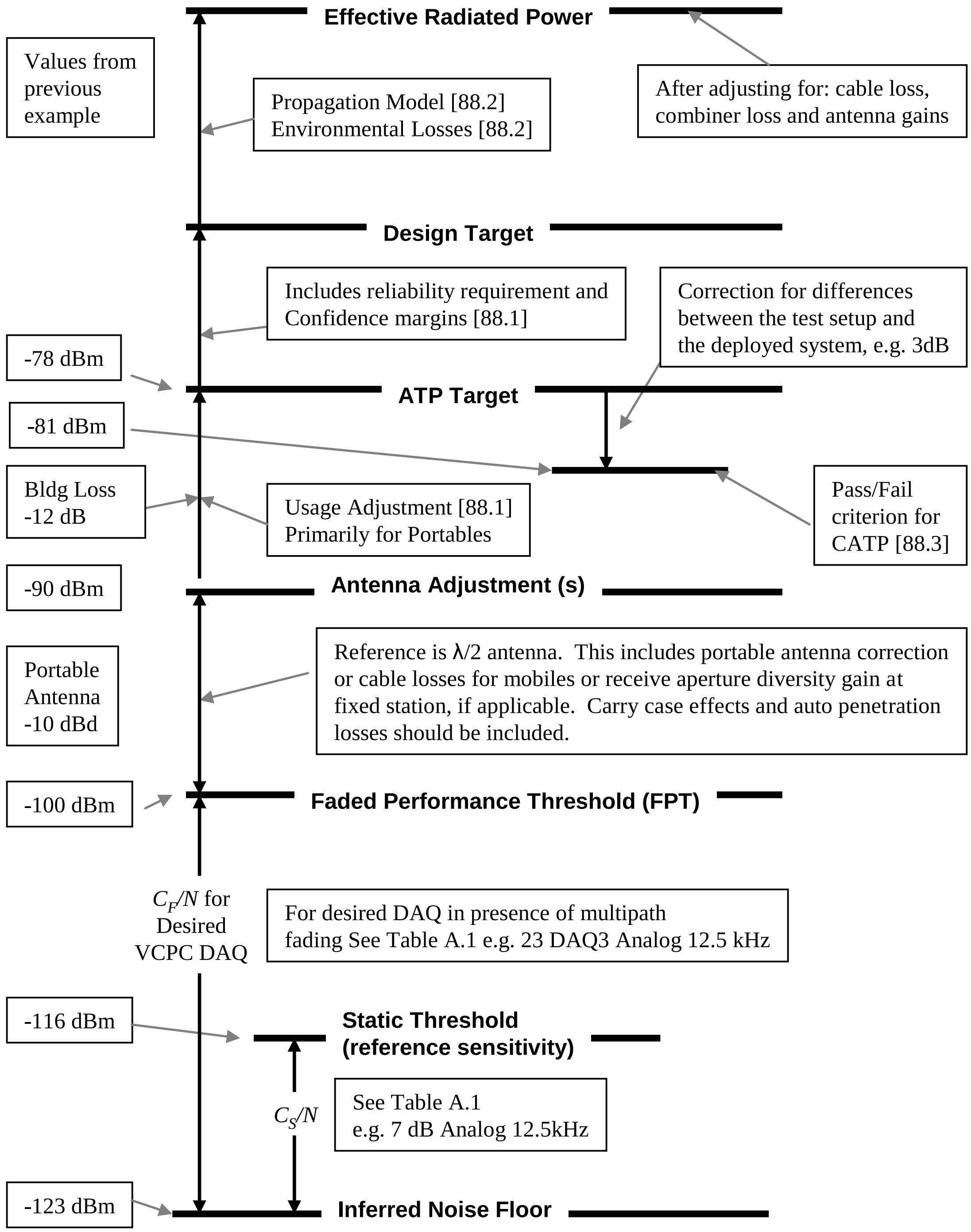

Figure 5 VCPC Prediction Factors

5.4.3. DCPC Subjective Criterion

A similar approach for data systems is presented. Data systems are considerably more complex in their definitions and simulation. Figure 6 is similar to

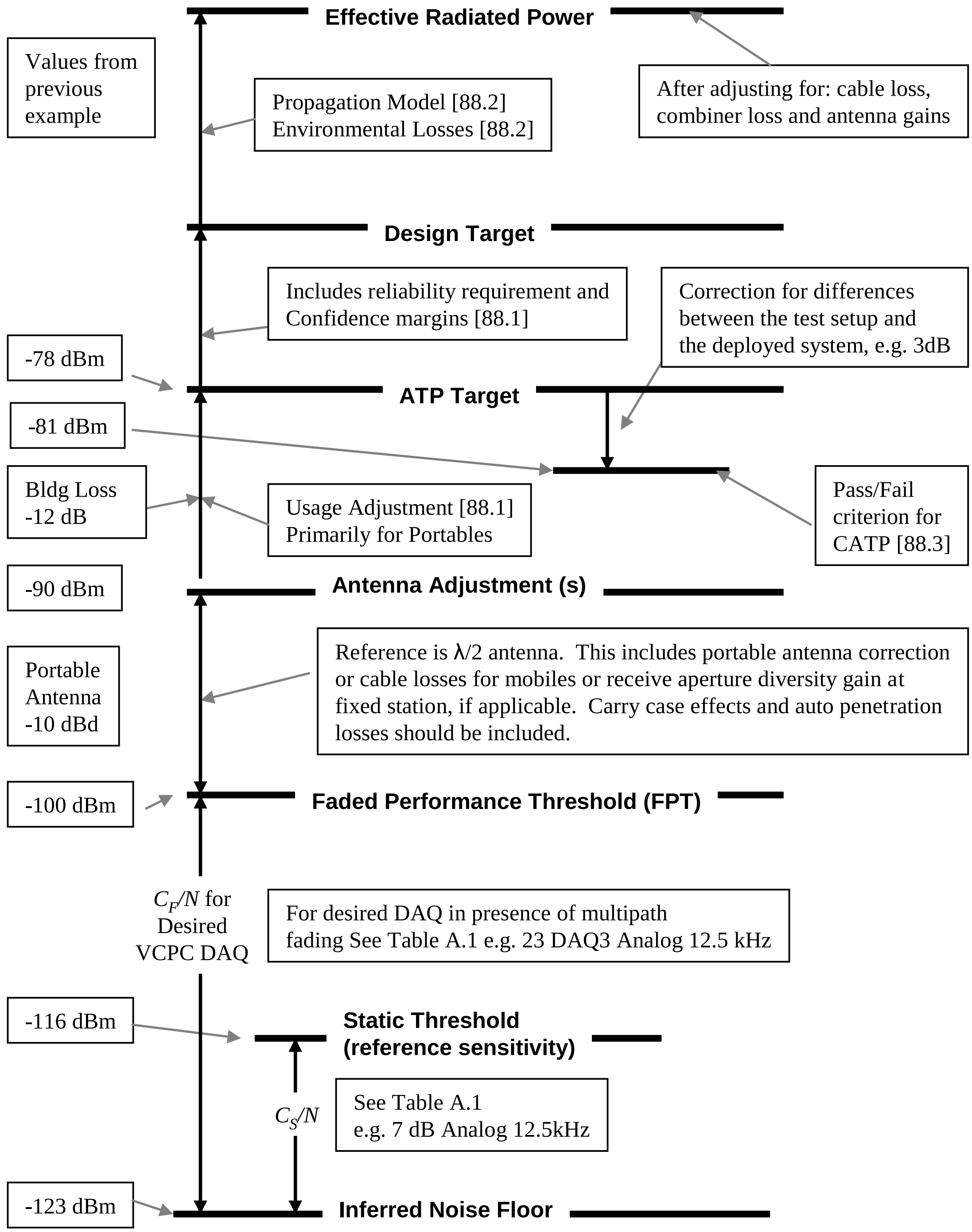

Figure **5** with the exception that specific power levels are not shown in the example. This is due to the wide variation in criteria that can be applied. The number or retries and message size are extremely critical values to have specified.

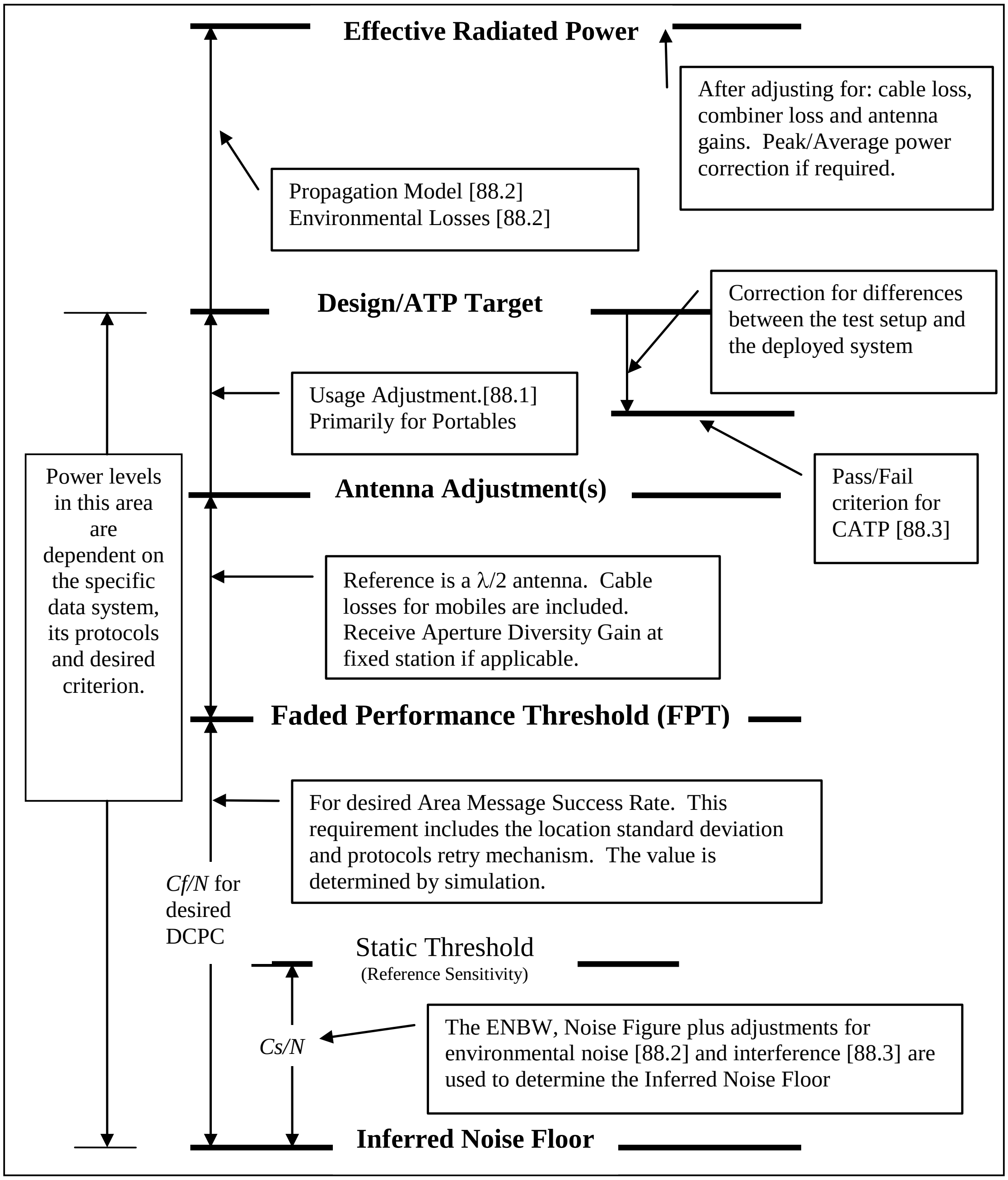

Figure 6 DCPC Example

5.4.3.1 Phased Approach to GOS

A two-phased approach is recommended for defining data grade of service (GOS). Phase A only utilizes data message reliability as the data GOS criterion, while Phase B utilizes achieved throughput as the data GOS criterion. This approach is recommended because Phase B needs industry consensus on many data protocol implementation algorithms and various data options that greatly affect throughput. Since the FCC changed the 700 MHz Wideband Data block exclusively to Broad band only minimal emphasis has been placed on how to simulate performance for this complex topic. Maximum channel bandwidths of 50 kHz have dramatically reduced interest in this type of deployment.

5.4.3.2 Phase A Simulations

This section consists of a high level description of the proposed criteria for TIA-902 wideband data systems operating in the 700 MHz band. Numerous parameters have to be agreed upon before any simulation can proceed. These parameters fall into two categories: parameters used to generate the C/N versus message success rate (MSR) protocol curves, and parameters used to calculate the area reliability.

Message success rate (MSR) is defined as the probability that a user IP datagram is delivered without any errors. This definition of success does not mean that the Logical Link Layer (TIA-902.BAAE WAI LLC Layer) ACK be successfully received by the data sender. Since the IP transport protocol (TCP or UDP) is not aware of any link layer specifics (WAI or any layer 2 bearer services actually), the layer 2 ACK is irrelevant. Additional reliability could be obtained by utilizing TCP; with an implemented transport layer acknowledgment based reliable protocol.

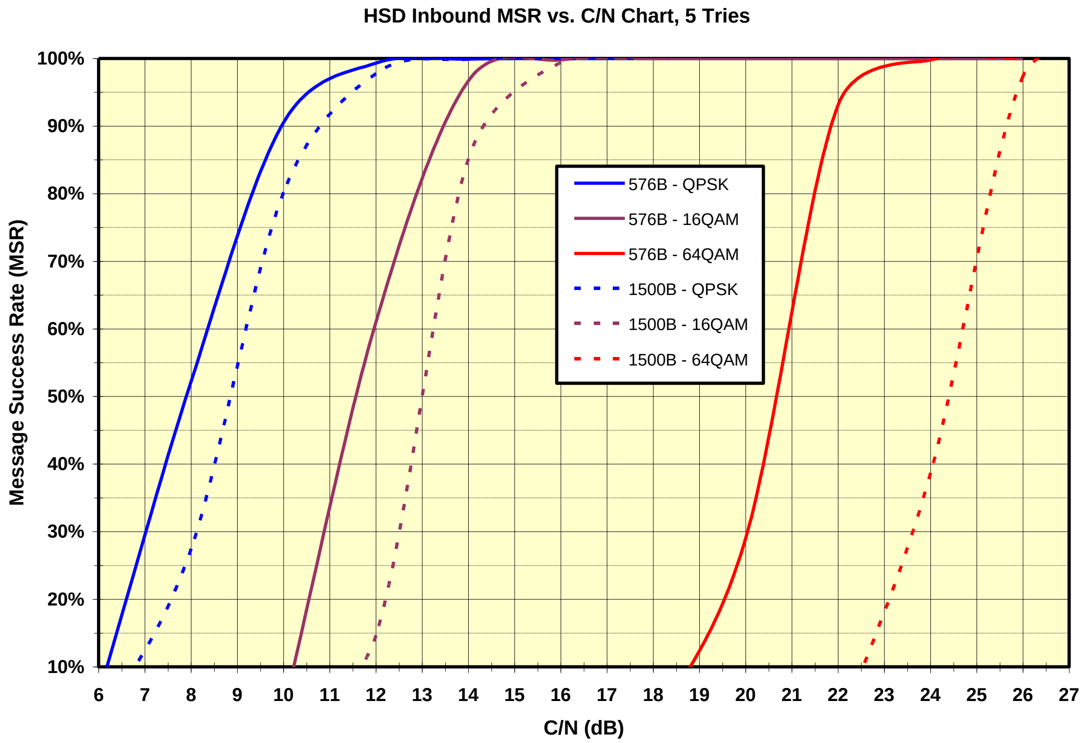

Figure 7 MSR versus *C/N* Curves for SAM 50 kHz, 5 Tries

Figure 7 shows as an example MSR performance curves for different fixed *C/N* for inbound data utilizing a 50 kHz SAM wideband data channel [902.BAAB], [902.BAAD] operating within a TU50 based channel model allowing 5 tries in total, 4 retries[9]. This does not include any location lognormal variance over the message session, which needs to be specifically accounted for in a simulation prediction of area wide analysis. In this example, inbound and outbound *C/N*s are equal and modulation/encoding is fixed. IP messages sizes of either 576 bytes or 1500 bytes were selected to show a range of typical values expected for typical IP applications. It is recommended that systems not be designed for a criterion of messages under 576 octets as this is a typical TCP operational parameter.

MSR primarily depends on the block sensitivity performance curves for the different components of a slot, e.g. the MAC slot header block (MHBK), and the payload MAC data blocks (MDBKs). The simulation also ought to take into account the reliability of MAC/LLC signaling such as MAC resource requests, slot allocation bits, and LLC selective ACKS. The RF performance curves used to generate MSR performance curves use a TU50 channel model, which is typical for an urban environment while traveling at 50 kilometers per hour.

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9) This discussion involves 50 kHz wideband data. The process is equally applicable to 25 kHz data systems.

Table 4 Reliability versus *C/N* for 50 kHz QPSK Outbound Data at 576 Bytes

C/N	1st Try	2nd Try	3rd Try	4th Try	5th Try
40	99.9%	100%	100%	100%	100%
36	99.7%	100%	100%	100%	100%
32	99.4%	100%	100%	100%	100%
28	98.4%	100%	100%	100%	100%
26					
24	95.6%	99.9%	100%	100%	100%
22					
20	86.1%	99.6%	99.9%	100%	100%
18	73.9%	98.8%	99.9%	100%	100%
16	53.3%	96.2%	99.7%	99.9%	100%
14	27.2%	87.0%	98.0%	99.7%	99.9%
12	8.0%	64.7%	89.2%	97.1%	99.3%
10	0.8%	30.5%	60.4%	80.0%	90.5%
8	0%	5.4%	19.3%	36.1%	52.2%
6	0%	0%	0.9%	2.9%	5.8%

Most systems are designed for balanced inbound and outbound signal strength so providing MSR performance curves for a balanced system is not a significant limitation. Additional MSR versus *C/N* curves could be necessary for different inbound/outbound offsets when modeling other potential system configurations. These curves are not needed for frequency coordination. Additional curves are needed for the various modulations involved so the protocol can be comprehensively modeled.

Table 5 Input Parameters Necessary for Curve Creation

	Required for Reliability Applicable to Phase A	Required for Throughput Only applicable to Phase B
Channel Bandwidth	• 50 kHz	• 50 kHz
Channel Model	• TU50	• TU50 • Other fading models
Data Protocols	• MAC • LLC	• MAC • LLC • TCP • HTTP/FTP
Coding/Modulation	• SAM • Other	• SAM • Other
Evaluation Direction	• Inbound • Outbound	• Inbound • Outbound
Data Mode	• Full Duplex	• Full Duplex • Half Duplex
Message Profile	• Inbound and Outbound Application Layer Message Lengths • Unloaded channels	• Inbound and Outbound Application Layer Protocols (HTTP. FTP, TCP) • Loaded and unloaded channels
Max Number of Attempts	• 1 to 8 (same Log Normal draw)	• 1 to 8 (Different Log Normal draws based on decorrelation)
Location (signal variations due to land clutter)	• One independent lognormal throw per test • One independent lognormal throw per interference source[1)]	• Quasi-Static • Moving • Environment • One lognormal throw per interference source
Data Type	• UDP/IP (LLC confirmed) • UDP/IP Broadcast (LLC unconfirmed)	• UDP/IP (LLC confirmed) • TCP/IP (LLC confirmed) • HTTP/IP (LLC confirmed) • FTP/IP (LLC confirmed) • Broadcast (LLC unconfirmed) • Multicast (LLC confirmed)
Tile-based Area Reliability	• Covered Area Reliability • Service Area Reliability	• Covered Area Reliability • Service Area Reliability • Others based on throughput criteria

[1)] Interference sources are co-channel, adjacent channel interferers or both.

Coverage/Reliability modeling needs defined criteria. These include:

- System design specification
    - Tile-based Reliability Selection
        - Covered Area Reliability
        - Service Area Reliability
    - Reliability Criteria
        - Covered Area reliability criterion (typically 95% - 97%)
        - Confidence level criterion (typically 90% - 95%)
- Propagation Model [88.2]
    - ERP
    - Terrain and NLCD (National Land Cover Dataset) databases
    - Shadow Loss
    - Other
        - Environmental Noise [88.2]
        - Interference [88.3]
- Service Area Subscriber Distribution
    - Uniformly Distributed Throughout Entire Service Area
    - Distributed Throughout Sub-Areas of Service Area, e.g., contour
- Frequency Issues
    - Co-channel
    - Adjacent channels

A practical consideration of how to successfully test and accept the system needs to be defined [88.3]. The use of an unloaded system is recommended for providing coverage acceptance targets. Future Phase B criterion could request testing under heavier loads and measurements of throughput.

Performance data for the specific protocol is necessary, referenced to C/N so the effect of other noise sources can be simulated.

Multiple lognormal throws are performed, from a zero median Gaussian lognormal distribution based on the location standard deviation, for each inbound or outbound tile prediction. Independent throws are made for each contributor. The same lognormal throw value is used for all data blocks, retries and responses (SACK, NACK, and ACK) for Phase A. Since wideband data retries occur so rapidly, this is not an unrealistic assumption.

It is recommend that for future Phase B and moving cases, the speed and decorrelation distance be considered based on the protocol. Multiple simulations are conducted in each tile allowing the statistics and confidence level to be computed. This does assume that the inbound/outbound RF links are reciprocal. When they are not reciprocal, this is a conservative assumption. Figure 8 represents a flow chart for this simulation.

5.4.3.3 Wideband Data Coverage Model

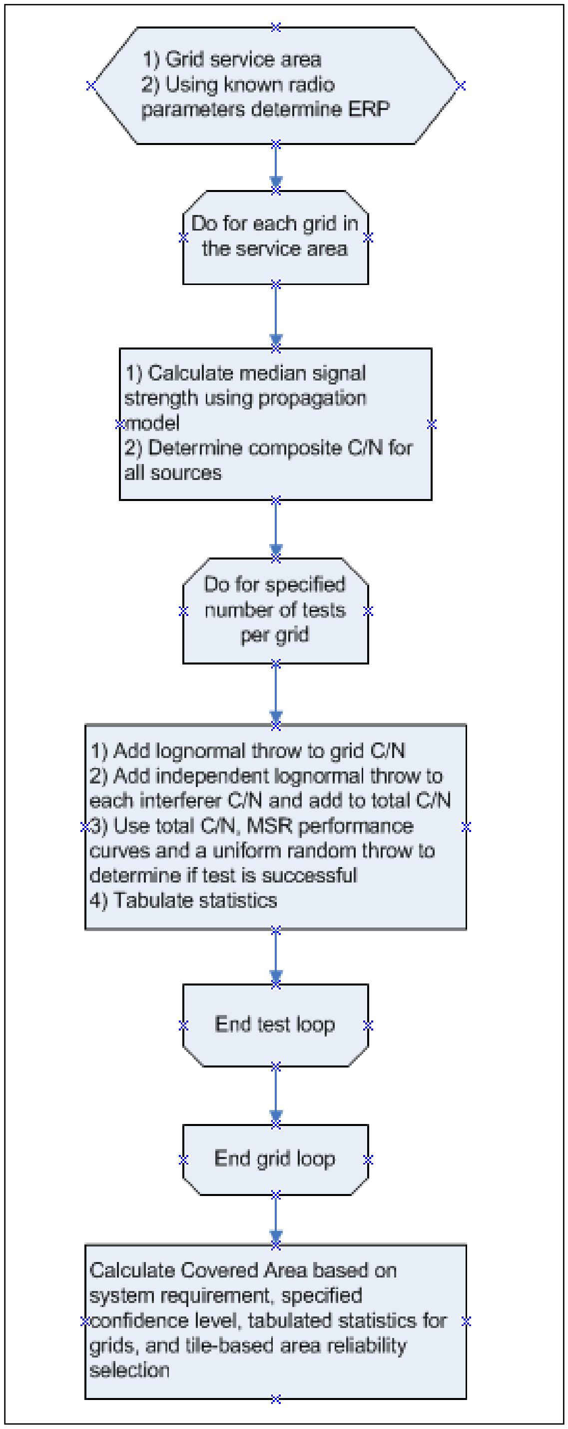


Figure 8 Coverage Model Flowchart

5.5. Parametric Values

The data provided in Table 6 were voluntarily provided by the manufacturers as "*projected*" values for system design and spectrum management. Publication of these data does not imply that either the manufacturers or TIA guarantees the conformance of any individual piece of equipment to the values provided. It is recommended that users of these parametric values validate these values with their supplier(s) to ensure applicability.

5.5.1. BER vs. E_b/N_o vs. C/N

The measurement of E_b/N_o vs. BER for both static and faded conditions is commonly made. For conventional technology implementations, this can be converted to static and faded *C/N* values with the following equation:

$$\frac{C}{N} = \frac{E_b}{N_0} + 10Log\frac{\text{Bit Rate}_{Hz}}{ENBW_{Hz}} \quad (5)$$

The C/N is the preferred method for defining receiver sensitivity as it takes into account the bit rate and receiver noise bandwidth. The reference sensitivity can then easily be determined by applying the Thermal Noise Floor from Equation (4) and the C/N from Equation(5). When the correction for ENBW is applied, a receiver with a higher E_b/N_o can have a better reference sensitivity if the narrower ENBW can support the same ratio of bit rate/ENBW. The use of C/N only needs that the ENBW be known and is supplied in the following tables.

The ENBW for a known receiver can be used, or a value can be selected from standard receiver bandwidths, to determine the faded *C/N* parameter for various CPC values. Table 6 for voice receivers and Table 7 for wideband data include the ENBW for simulating various configurations. Annex A contains detailed information for various commercial offerings.

Table 6 IF Filter Specifications for Simulating Voice Receivers

Modulation Type[1]	ENBW (kHz)	IF Filter Simulation[2),3)] See Table 9	Annex A Reference
Analog FM Radios			A.5
Analog FM (12.5 kHz) ±2.5 kHz	7.8[5)]	Butterworth 4-3	A.5.1
Analog FM (25 kHz) ±4 kHz (NPSPAC)	12.6/11.1[4)]	Butterworth 4-3	A.5.2
Analog FM (25 kHz) ±5 kHz	16.0/12.6[4)]	Butterworth 4-3	A.5.3
Digital FDMA Radios			**A.6**
C4FM (IMBE) (12.5 kHz) (P25 FDMA)	5.5[5)]	RRC, α=0.2	A.6.1
CQPSK LSM (IMBE) (12.5 kHz)	5.5	RRC, α=0.2	A.6.2
CQPSK WCQPSK (IMBE) (12.5 kHz)	6.3	RRC, α=0.2	A.6.3
CVSD (25 kHz) ±4 kHz	12.6	Butterworth 4-3	A.6.4
CVSD (25 kHz) NPSPAC	10.1	Butterworth 4-3	A.6.4
CVSD (25 kHz) 4 Level “FRED”	12.6	Butterworth 4-3	A.6.4
EDACS® (IMBE) (12.5 kHz)	6.7 / 5.4[6)]	Butterworth 5-4/ 4-3	A.6.5.1
EDACS® (IMBE) (25 kHz NPSPAC)	7.5 / 6.2[6)]	Butterworth 5-4/ 4-3	A.6.5.2
EDACS® (IMBE) (25 kHz)	8.0 / 6.9[6)]	Butterworth 5-4/ 4-3	A.6.5.3
dPMR 4.8 kb/s (AMBE+2) (6.25kHz)	3.5	RRC, α=0.2	A.6.6.1
NXDN 4.8 kb/s (AMBE+2) (6.25kHz)	3.8	RRC, α=0.2	A.6.6.2
NXDN 9.6 kb/s (AMBE+2) (12.5 kHz)	6.8	RRC, α=0.2	A.6.6.3
Tetrapol (12.5 kHz)	7.2	Butterworth, 10 - 4	A.6.7
Wide Pulse (25 kHz)	12.6/11.1[4)]	Butterworth 4-3	A.6.8
Digital TDMA Radios			**A.7**
DMR 2 slot TDMA (AMBE +2) (12.5 kHz)	7.0	RRC, α=0.2	A.7.1
F4GFSK (AMBE) OPENSKY® (25kHz)	12.4	Butterworth 4-3	A.7.2
H-DQPSK (P25 TDMA Downlink)	6.0	RRC, α=0.2	A.7.3
H-CPM (P25 TDMA Uplink)	6.0	RRC, α=0.2	A.7.4
Cellular Type Digital Radio (TDMA)			**A.8**
DIMRS-iDEN® (25 kHz)	18.0	RRC, α=0.2	A.8.1
TETRA (25 kHz)	18.0	RRC, α=0.2	A.8.2
Data Only Radios			**A.9**
HPD	18.0	RRC, α=0.2	A.9.1
RD-Lap 9.6 (25 kHz, NPSPAC, 12.5 kHz)	12.6/11.1/7.8	Butterworth 4-3	A.9.2
RD-Lap 19.2 (25 kHz)	12.6	Butterworth 4-3	A.9.3

Radios with gray shading indicate they might no longer be licensable after 1/1 2013 between 150.8 and 512 MHz.

1) Annex A and Annex G contain additional information on the various modulation types and estimating parametric values.

2) Butterworth filters. The first number indicates the number of poles, the second number, indicates the number of cascaded sections. The 4p-3c configurations are limited to older analog type radios.

3) See Table 8 and Table 9 for additional information.

4) Wideband analog radios can achieve 70 dB ACRR @ ± 25 kHz spacing with the 16 kHz ENBW IF in the 150, 450 and 800 MHz bands. The narrower ENBW is appropriate for 800 MHz band radios that also operate in the NPSPAC portion of the 800 MHz band where an Offset Channel Selectivity of 20 dB [603] is produced by ± 4 kHz deviation interferers. The 11.1 ENBW is appropriate for radios providing 20 dB from ± 5 kHz interferers offset by 12.5 kHz.

5) Narrow analog receivers can achieve 45 dB ACRR (Class A [603]) with an ENBW of 7.8 kHz. To achieve an ACRR ≥ 60 dB as might be applicable where narrow analog and C4FM are intermixed on adjacent channels, the IF similar to the C4FM digital radios is more appropriate.

6) EDACS® uses the wider ENBW for specifications, and the narrower ENBW for ACCPR determination using the 4p-3c model.

Table 7 IF Filter Specification for Simulating Wideband Data Receivers

Modulation Type[1] Channel BW	Sensitivity ENBW (kHz)	ACPR ENBW IF BW (kHz)	Number of Sub-carriers (N)	Fsc (kHz) Sub-carrier Spacing	Fsym (kHz)	IF Filter Simulation[2]
DataRadio	48.0	48.0	N/A	N/A	N/A	CH BW
HPD/iDEN	16.0[4]	17.5[5]	4	4.5	4.0	CH BW
SAM Wideband Data, 50 kHz	38.4[4]	42.6[5]	8	5.4	4.8	CH BW

1) Annex A contains additional information on the various modulation types.
2) See Table 8 and Table 9 for additional information on Receiver IF modeling.
3) IOTA ENBW = $N/2*F_{symbol}$ for both sensitivity and ACPR
4) HPD/iDEN/SAM ENBW = $N*F_{symbol}$.
5) HPD/iDEN/SAM ACPR ENBW = [(N-1)* Fsubcarrier spacing] + F_{symbol}

From the known static sensitivity and its C_S/N, the value of N, calculate the Thermal Noise floor. Based on N and the need for $C_F/(\Sigma I+\Sigma N)$ from the faded reference sensitivity for a specified CPC, the absolute value of the necessary average power is known if the various values of *I* are also known. The coverage prediction model can predict the value of I.

For example, if E_b/N_o for the reference sensitivity is 5.2 *dB* for a C4FM receiver (ENBW = 5.5 kHz, IMBE vocoder) at -116 *dBm* then the $C_S/N =$ 5.2 + 10 Log (9,600/5,500) = 7.6 *dB*. The calculated Inferred Noise Floor, equation (6) in §5.5.2, is then -123.6 *dBm*. From [102.CAAB], the faded reference sensitivity limit is -108 *dBm*. This implies a C_F/N = 15.6 *dB* for 5% BER[10]. If the specified VCPC (DAQ =3.4) desires 2% BER, then the C_F/N would be appropriately increased by its appropriate value, e.g., 15.6 dB to 17.7 *dB*. (These numbers are based on the specified minimum performance as listed in [102.CAAB] §§ 3.1.4 and 3.1.5. The increase for improving 5% BER to 2% BER is obtained from the C_F/N for DAQ=3.4 in Table 7. Thus the mean power level to provide this performance would be -123.6 *dBm* + 17.7 *dB* = -105.9 *dBm*.

10) This is not a value used for determining DAQ, rather the specified signal level for 5% BER in fading.

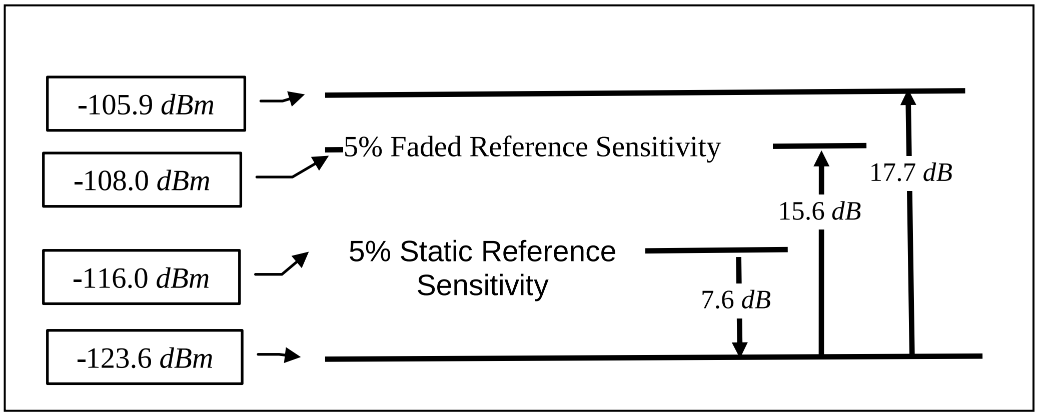


Figure 9 Adjusted Faded Sensitivity for VCPC

In a Noise Limited System, the C_F/N *of* -105.9 *dBm* would be the faded performance threshold. In an Interference Limited system, the need for a $C/(\Sigma I+\Sigma N)$, where ΣI's is, for example, >>N, would mean that the design C be 17.7 *dB* higher for the minimum probability needed to provide the CPC at the worst case location. The computer simulations recommended accurately predict this probability.

In data systems, the reference faded sensitivity varies with the complexity of the modulation. More complex modulations have a reduced sensitivity. The air protocol defines how the system handles block errors. In data systems, the message success rate is how coverage/reliability ought to be defined. The message success rate varies with block sizes and number of retries.

5.5.2. Co-Channel Rejection and VCPC/DCPC

Different modulation types and implementations have different co-channel protection ratios. The significance of Co-Channel Rejection goes beyond operation in co-channel interference: as measured per [102.CAAA]. Co-Channel Rejection is equivalent to the static IF carrier-to-noise ratio (C_S/N) needed for establishing the sensitivity criterion of the receiver under test. Therefore, a receiver's Co-Channel Rejection number can be used to determine a receiver's noise floor. This is done using equation(6):

$$\text{Noise Floor} = \text{Reference Sensitivity} - C_S / N \qquad (6)$$

The receiver noise floor is used in the interference model presented in the sections to follow.

Column 2 of Figure 9 gives Co-Channel Rejection values, i.e., static sensitivity in terms of IF C/N for the reference sensitivity listed, for many current modulation types.

5.5.3. Channel Performance Criterion

Criteria for voice channel performance of various modulations are listed in Table A 1. The VCPC criteria for DAQ 3.0, 3.4 and 4.0 are listed in the columns. The numerical values indicate BER% for digital radios and the $C_F/(I+N)$ needed to achieve that BER%. Analog radios do not utilize BER%. For values not indicated, request that the equipment manufacturer provide the necessary data.

The performance for data systems is highly dependent on the specific protocol used. See §5.4.3 DCPC Subjective Criterion for an example MSR versus C/N for a data system with two different defined message sizes and various number of tries.

5.6. Propagation Modeling and Simulation Reliability

For public safety agencies, it is recommended that the CPC be applied to 97% of the defined area of operation in the presence of noise and interference, and be designed to support the lowest effective radiated power subscriber set intended for primary usage. In most instances this will necessitate systems be designed to support handheld/portable operation. In these instances it is recommended the lowest practicable power level mobile/vehicular radio be assumed. It is recommended that talk-in power control be used, where available, to minimize system imbalance and interference potential.

For Land Mobile Radio (LMR) systems other than public safety, it is recommended that the CPC be applied to 90% of the defined area of operation in the presence of noise and interference, and be designed to support the typical effective radiated power subscriber set intended for primary usage. In most instances this necessitates that systems be designed to support mobile/vehicular operation. Handheld/portable operations are often secondary. In all instances it is recommended the lowest practicable power level mobile/vehicular radio be assumed. LMR systems that make primary use of handheld/portables are advised to prohibit mobile station operation at power levels significantly greater than the design level used for handheld/portable usage.

5.6.1. Service Area Frequency Selection

To determine suitability for assigning channels, a determination of whether the user can qualify for a Protected Service Area (PSA) is necessary. If the user does not qualify, then it is assumed that sharing can occur. The next need is whether the user can monitor the channel before transmitting so as to prevent interfering with current usage. An example using a simple weighted ordering process to select from candidate channels is provided in Table 8.

5.6.2. Proposed System Is PSA

1. Based on the defined Service Area and the appropriate licensing rules, limit the evaluation area to include only those interfering systems which can have a direct impact on the applicant's PSA.
2. Eliminate candidate channels with overlapping co-channel operational service areas.
3. Re-evaluate the remaining candidate channels by quickly evaluating potential signal(s) overlapping service areas using the following simplified prediction method: Use the recommended models, procedures, and ERP

adjustments for Adjacent Channel Power in a “coarse” mode to reduce the number of candidate channels for later detailed evaluation.

4. From the remaining candidate channels, start by calculating the Service Area CPC Reliability of the PSA under evaluation due to noise and all interference sources (co-channel and adjacent channel interference from PSAs and non-PSAs) using the “fine” mode.
5. When a candidate channel has been identified, as meeting the licensee’s needs, evaluate the incumbent channels due to the applicant to determine the interference impact to incumbents.
6. If Step 5 produces a successful assignment, the process is complete. Alternatively, it can be continued to evaluate the remaining candidate channels, looking for an optimal solution. It is anticipated that this alternative solution could involve higher fees due to the greater time and resources expended.

5.6.3. Proposed System Is Not PSA

In this scenario, adjacent channels are assumed to not be capable of being monitored before transmitting. Co-channels can be monitored if they use similar type modulation.

The assignment of a non-PSA frequency assumes that, at some time, sharing could occur. Therefore, there is no optimal solution, and any immediate solution could change in the future. Numerous tradeoffs and coordinator judgment could be necessary. For that reason, this subclause identifies some of the factors that could potentially rank candidate channels for a recommendation. Weighting factors and the way they are applied are not specified. A similar coverage evaluation process as defined in §5.6.2, in conjunction with the judgmental factors, could be applied.

1. Based on the Service Area defined and the appropriate licensing rules, limit the evaluation area to include only those interfering systems which might have a direct impact on the applicant’s Service Area.
2. Eliminate candidate channels using the following judgmental factors:
   - Number of licensees
   - Simplex base-to-base interference potential, point-to-point path
   - Number of units shown for each incumbent
   - Overlap of service areas
   - Similar size of co-channel service areas
   - Potential for adjacent channel interference due to overlapping service areas, potential of the near/far problem
   - Potential for adjacent channel interference due to signals overlapping service areas
   - Common or nearby site compatibility
   - Time of day utilization

- Competition, same type of business
- Ability to monitor before transmitting
- Compatibility of modulation to allow monitoring of “over the air audio”
- Use of encryption
- Trunked system configuration
    - Dedicated control channel
        - Location of adjacent voice channels
    - Non-dedicated control channel
- Intra System Roaming
    - Automated
    - Manual
- Data
    - Dedicated control channel
    - Non-dedicated control channel

3. Re-evaluate the remaining candidate channels by quickly evaluating potential signal(s) overlapping service areas using a simplified prediction method. Use the recommended models, procedures, and ERP adjustments for Adjacent Channel Power in a “coarse” mode to reduce the number of candidate channels for later detailed evaluation.
4. From the remaining candidate channels, start by calculating the Service Area CPC Reliability of the non-PSA under evaluation due to noise and all interference sources (co- and adjacent channel interference from PSAs and non-PSAs).
5. When a candidate channel has been identified as meeting the licensee’s needs, make an evaluation of the incumbent channels due to the applicant to determine the interference impact to incumbents.
6. Re-examine the judgmental factors of Step 2 for applicability.
7. If Step 5 produces a successful assignment, the process is complete. Alternatively, the process can be continued to evaluate the remaining candidate channels, looking for an optimal solution. It is anticipated that this alternative solution could involve higher fees due to the greater time and resources expended.

5.6.4. A Suggested Methodology for TSB-88 Pre-Analysis

1. Find likely frequencies using distance separation. Create a short list of existing transmitters requiring protection.

For each frequency:[11)]

2. Draw the inter-station radial to each existing transmitter, analyze for major interference using coarse tiles. Coarse analysis can use matrix cell sizes

[11)] Local Clutter attenuation factors are unnecessary for steps 2 and 3.

(bins) of 15, 30, 60 or some other number of seconds which is an integral multiple of the terrain data resolution[12].

- If failed (major interference predicted), go to next frequency
- Or return for editing (change proposed ERP, AGL or antenna pattern).

3. Perform coarse tile (as above) matrix analysis on all existing transmitters, sorted by most likely candidate channel first.
    - If any fail, go to next frequency or return for editing.
    - If all pass, return success and establish interference-free service area for new allocation.

    Perform a profile analysis with terrain data being retrieved at the finest resolution available so that predictions are not optimistic. Retrieve terrain data at the same resolution as used in step 4 below.

4. Apply high-resolution TSB-88 procedures.

Consider an example case with four candidates that were culled from all possible candidate channels. There is potential for two co-channel assignments and two adjacent channel assignments. Refer to Table 8 for the example.

This example is based on using Service Area Reliability (SAR) as the major point for sorting. There are numerous criteria that can be applied. The SAR is merely one such criterion and ought not to be implied as being the only way. It is beyond the scope of this document to provide specific criteria for this highly subjective matter. A final evaluation with all interfering sources included would be the preferred selection process. Additional discussion can be found in [88.2]. For data systems, message success rate probability can be applied in a similar manner.

Table 8 SAR% Selection Example

Candidate Channels #1-4		**SAR% Ranking for Candidate Channels**								**Candidate Channel Final Ranking**	
CC #	Solo SAR %	Co-1 SAR %	Rank	Co-2 SAR %	Rank	Adj-1 SAR %	Rank	Adj-2 SAR %	Rank	Rank Sums	Rank
1	95	90	2	N/A	1	92	3	93	2	8	2
2	95	85	4	91	3	90	4	92	3	14	4
3	95	92	1	92	2	93	2	N/A	1	6	1
4	95	87	3	88	4	N/A	1	90	4	12	3

[12] It is recommended that high resolution terrain data be utilized with larger evaluation tiles so that terrain obstacles are identified and part of any coarse analysis.

5.6.5. Determining Receiver Characteristics

5.6.5.1 Emission Designator Importance

Often the only information available consists of the emission designator on a current license. Since modern radios are capable of many modes, licensees frequently utilize only the largest designator possible which distorts the interpretation of the modulation as well as the ability to determine the receiver characteristics. In doing this, the essential information for determining the actual modulation can be lost making the coordination overly conservative. The FCC only places six emission designators on a certification listing others under remarks.

Annex A includes the emission designators for the most common modulations. Table 9 summarizes and cross references that data. The 99% Occupied bandwidth is based on the waveforms listed in Table A 2. These are not necessarily the recommended waveforms for type acceptance, but provide a better comparison of the emission designator and occupied bandwidth. For the analog FM Carson's rule is based on a single 3 kHz frequency causing the indicated peak deviation.

Annex F contains additional information on emission designators, how they are structured and hyperlinks to supportive documents.

Table 9 Emission Designators and Occupied Bandwidth

Modulation	Emission Designator	Annex A Reference Number	99% OBW Table A-2 waveform
Analog FM (2.5 kHz peak deviation)	11K0F3E	A.5.1.	7.34 kHz
Analog FM (4.0 kHz peak deviation)	14K0F3E	A.5.2	10.47 kHz
Analog FM (5.0 kHz peak deviation)	16K0F3E	A.5.3	12.59 kHz
C4FM (P25 FDMA)	8K10F1E	A.6.1	7.84 kHz
CQPSK LSM 9.6kbps simulcast	8K70D1W	A.6.2	8.91 kHz
CQPSK WCQPSK 9.6 kbps simulcast	9K80D1E	A.6.3	9.72 kHz
CVSD SecureNet ±4 kHz	20K0F1E	A.6.4	12.78 kHz
CVSD SecureNet ±2.4 kHz NPSPAC	16K8F1E	A.6.4	
EDACS®, 12.5 kHz channel	7K10F1E	A.6.5.1	8.34 kHz
EDACS®, 25 kHz NPSPAC channel	14K0F1E	A.6.5.2	9.91 kHz
EDACS®, 25 kHz channel	16K0F1E	A.6.5.3	10.72 kHz
dPMR 4L-FSK FDMA (6.25 kHz)	4K00F1E voice 4K00F1D data	A.6.6.1	3.47 kHz
NXDN 4L-FSK FDMA (6.25 kHz)	4K00F1E voice 4K00F1D data	A.6.6.2	3.41 kHz
NXDN 4L-FSK FDMA (12.5 kHz)	8K30F1E 8K30F1D	A.6.6.3	7.53 kHz
Tetrapol (12.5 kHz)	6K90G1E voice 6K90G1D data	A.6.7	7.91 kHz
Wide Pulse C4FM (25 kHz channel)	10K0F1E voice 10K0F1D data	A.6.8	9.34 kHz
ETSI DMR 2-slot TDMA	7K60FXE voice 7K60FXD data	A.7.1	7.66 kHz
F4GFSK OpenSky®	12K5F9W	A.7.2	12.03 kHz
H-CPM (P25 TDMA Uplink)	8K10F1W	A.7.3	8.22 kHz
H-DQPSK (P25 TDMA Downlink)	9K80D7W	A.7.4	9.78 kHz
DMIRS-iDEN®	18K3D7W	A.8.1	17.47 kHz
TETRA	23K4D7W*	A.8.2	20.91 kHz
HPD 25 kHz data	17K7D7D	A.9.1	17.47 kHz
RD-Lap 9.6 kbps 12.5 kHz channel	10K0F1D	A.9.2	8.34 kHz
RD-Lap 9.6 kbps NPSPAC channel	14K0F1D	A.9.2	
RD-Lap 9.6 kbps 25 kHz channel	16K0F1D	A.9.2	
RD-Lap 19.2 kbps 25 kHz channel	20K0F1D	A.9.3	13.28 kHz
DataRadio (50KHz channel)	28K0F1D	A.10	27.3 kHz
***** Note that that this exceeds the authorized BW			

5.6.5.2 Modeling Receiver Characteristics

It is assumed that for any modulation combination, it is valid to treat adjacent channel interference as additional noise power that enters a receiver's IF filter. Interference between different modulation types can then be calculated based on the power spectrum of the given transmitter's modulation and the IF filter selectivity and IF carrier-to-noise ratio needed for obtaining the specified CPC in a Rayleigh faded channel. The $C_F/(I+N)$ then becomes a predictor of CPC.

The $C_F/(I+N)$ for the "victim" system to meet its specified CPC, is necessary in order to determine the impact of interference levels. The subscript "F" indicates that the carrier-to-noise ratio is determined for Rayleigh *faded* conditions. When performing interference calculations, it is important to use faded carrier-to-noise values since faded conditions more accurately represent the field environment.

Columns 3-5 of Table 10 list projected CPC parameters for mainstream modulation techniques at various DAQ levels in faded conditions. For digital modulations, bit error rates associated with each CPC are listed. These can be used to determine if a given $C_F/(I+N)$ exists in an actual field test application. Static reference sensitivity (C_S/N) also is given. This value can be used to determine the receiver noise floor for interference modeling. A particular manufacturer's implementation could vary from these values somewhat, but the variation is expected to be small.

A key factor in determining adjacent channel interference is the IF selectivity of the victim receiver. There is potentially wide variation in IF selectivity between manufacturers, and definition of a standard IF selectivity is helpful in defining a reproducible test. Various IF filter configurations are given in Table 10. The filter implementations used here were selected for their ability to compactly define an explicit and reasonable implementation, not to suggest an optimum implementation for a given modulation type. Equations for use in simulations are provided in Table 10.

Table 10 Prototype Filter Characteristics

Table 10a – Butterworth Filter Equation

Attenuation = $Cx10Log_{10}\left[1+\left(\frac{\Delta f}{\Delta f_0}\right)^{2n}\right]$

C = The number of cascades

Δf = The frequency offset from the IF center frequency

Δf_o= The frequency offset of the corner frequency *

n = Number of poles

* The value of Δf_o can be determined to calculate the ENBW as follows:

- 4p3c use ≅ 0.59398 x ENBW
- 5p4c use ≅ 0.59506 x ENBW
- Other combinations can be determined using Annex H.

Table 10b – Root Raised Cosine Equations

$$M\left(f\right)=0dB;\frac{|f|}{f_0}\le 1-\alpha$$

$$M\left(f\right)=10\log_{10}\left\{\cos\left[\frac{\frac{\pi}{4}\left(\frac{|f|}{f_0}-1+\alpha\right)}{\alpha}\right]\right\}^2;1-\alpha<\frac{|f|}{f_0}\le 1+\alpha$$

$$M\left(f\right)=-\infty,\text{maximum loss};1+\alpha<\frac{|f|}{f_0}$$

f_0 = the 3 *dB* bandwidth of the filter which also is equal to ENBW/2 of the filter. α = the RRC alpha value

Table 10c – Channel Bandwidth Filter

This filter represents a perfect filter, with a bandwidth of ENBW. It is intended to calculate the ACP in the ENBW specified bandwidth.[1] *M(f)= 0dB;* $f_0-\Delta f \le f \le f_0+\Delta f$

M(f) = -∞, maximum loss; all other cases

Where:

f_0 is the filter's center frequency

$$\Delta f=\frac{ENBW}{2}$$

1) The spreadsheet implementation of this filter is modified to split the power in the edge bins to improve calculated symmetry. This is accomplished by comparing the current bin against the preceding and following bins and the start and stop frequencies of the filter. If the bin's f > start AND f ≤ stop AND if the proceeding bin < start OR if the following bin > stop then divide the power in the bin by 2 or decrease by 3 dB as appropriate for the data units.

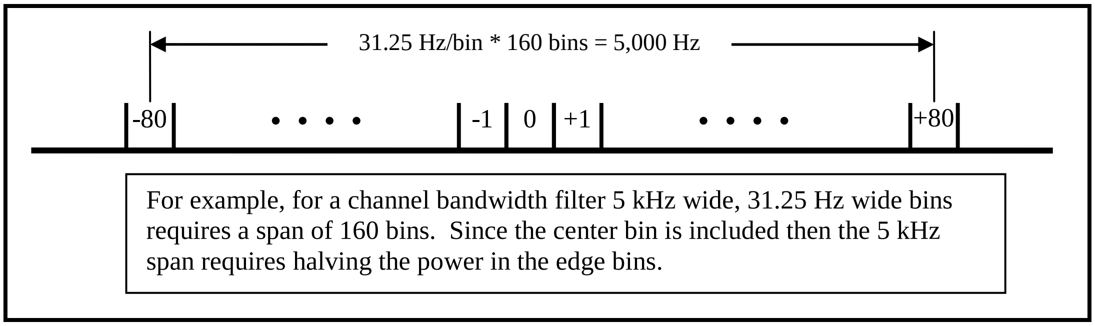


Figure 10 Half Power in edge bins

Defined receiver characteristics to use in modeling are contained in Table 11. They are also listed in Annex A. They take the form of a 9-character field where E is the ENBW, M is the model from Table 10; the letter P indicates the parameters. The result would be EEEEMPPPP[13]. Where all fields are not necessary, a pipe symbol (|) is used. The ENBW and model are indicated in Table 6 and Table 7.

Table 11 Receiver Characteristics

ENBW	Similar to FCC Emission Designator style		
	4 Characters with a magnitude symbol at the correct place		
	e.g. for C4FM at 5.5 kHz, 5K50		
Model	Channel Bandwidth	S for “Square”	4 “pipe symbols”, ||||
	Butterworth	B for “Butterworth”	XX poles, YY cascades
	Raised Root Cosine	R for “ RRC”	α. 0.XX in 0.05 steps and 2 “pipe symbols”, ||

Receiver local oscillator noise can also be a factor in interference. Since this is a function of receiver design, performance can vary greatly between various implementations, and since this type of interference does not affect co-channel or adjacent channel performance, this factor is normally not considered in the analysis. However, a receiver with very high adjacent channel attenuation in the IF filter potentially could have its selectivity limited by local oscillator noise.

Transmitter spectra have been modeled using measured or simulated spectrum power densities (SPDs). The SPDs are measured according to the procedures given in §5.7. Tables to calculate the ACPR for the various combinations of emitters, victim receivers and frequency offsets are included in Annex A. Use linear interpolation to obtain values other than ones in the tables and to apply the frequency stability correction if necessary. Spreadsheets, Listed in Annex H are provided as part of this document and allow improved accuracy for offsets not specifically listed.

13) The ENBW field includes 3 numbers plus a units symbol located so that units equal to or greater are to the left of the units symbol and any remaining units to the right, e.g. 5,500 Hz would be 5K50. See 47 CFR 2.202 for examples of the placement of the magnitude and decimal place symbol. Valid symbol values are: k for Kilohertz, M for Megahertz and G for Gigahertz. For cases requiring greater than three place accuracy, round up or down; when the last digit is a 5, round up.

5.7. Adjacent Channel Transmitter Interference Assessment

1. Obtain a calculated value of the ACPR (Annex A) for each adjacent channel transmitter within approximately 297 km (180 miles) of the station, and ± 25/30 kHz of the channel being coordinated. The calculated ACPR value is based on the receiver characteristics of the victim receiver and the specific interferer's modulation. Use each ACPR value to reduce the ERP of its respective transmitter, or alternatively change the calculated field strength value[14)].
2. Use the appropriate propagation model to calculate the various signal levels. For adjacent channel(s) use their modified transmitter ERP.
3. Sum the adjacent channel signal powers and add to the IF noise power as determined in §5.6.5 to result in the level of interference plus noise power to be overcome by the received power of the desired signal. The received power of the desired signal is determined by using the propagation model and the ERP of the desired transmitter.
4. Numerically subtract the desired signal power level in dBm from the interference power in dBm to determine the system signal to interference plus noise ratio, Compare the resulting value to the value necessary for the desired voice channel performance criterion (VCPC) for the given technology according to Table A-1. Use the difference to calculate the probability of achieving the VCPC.

5.7.1. Spectral Power-density Tables

A transmitter's emissions can be characterized by a measurement of its power-density spectrum over a specified frequency span using an adjacent channel power (ACP) analyzer or a spectrum analyzer. This type of analyzer typically presents the emission spectrum using an oscilloscopic display of a locus of discrete data points, each data point representing the amount of power measured in a "frequency bin".

The analyzer properly compensates the measured values for the characteristics of the resolution filter used for the measurement. A table of the amplitude and frequency of each data point can then be obtained via the analyzer bus, or a floppy disk interface, and subsequently formatted into a computer file which can be used for assessment analysis. This file can be normalized by integrating the power in all the bins to obtain the total power *(dBm)* of the emitter. Next the power *(dBm)* in a specified bandwidth centered at the center frequency of the adjacent channel is computed. The difference in *dB* between the total power and the value of the adjacent channel power is the adjacent channel power ratio,

To measure both on-channel and adjacent channel power it is necessary that the frequency span of the measurement be at least 3 times the channel spacing.

[14)] LMCC prefers to adjust the contour value. Others prefer to adjust the ERP.

To facilitate assessment computations, it is desirable to have only one value of frequency step, which does not exceed the resolution bandwidth. There is a 2:1 range in the frequency step size used between manufacturers and models of currently available analyzers, but most have an adjustable span.

It is recognized that the trace data output sequence, data retrieval and analyzer bus control commands, and floppy disk formats (not universally available at this time) differ between the various spectrum analyzer vendors so the captured transmitter power-density spectrum data table could need to be converted into the table format needed for performing the interference analysis via a floppy disk or Internet data transfer means.

To facilitate the generation of a data file fully compliant with the analyzing and calculating spreadsheet tools[15)] the parameters defined in Table 12 permit automated analysis of future new modulations. If instrument limitations prevent the full span of ±50 kHz, then multiple narrower spans can be combined to synthesize a full span measurement. The bin size needs to be less than the Resolution Bandwidth (RBW)[16)]. The bin size of 31.25 Hz is preferred as the spreadsheet template uses that value.

$$\text{Span}_{Hz} = \text{bin size}_{\text{Hz}} \quad N_{\text{data points-1}} \tag{7}$$

Table 12 Recommended Voice SPD Measurement Parameters (Narrow Band)

Span1	± 50 kHz (100 kHz)
Bin Size	31.25 to 50 Hz
RBW	100 to 150 Hz
Number of Data Points[3]	3,201

[1)] The span is needed to obtain data for all combinations of offset frequencies and receiver bandwidths.
[2)] 31.25 Hz is the bin size used for the spreadsheet template. Other values will obligate the submitting party to rework the spreadsheet.
[3)] To achieve the necessary number of data points, either pad the furthest away values by adding bins filled with the mean value of the last 10% of the measured span or make multiple narrower spans and merge the data file into a single file

[15)] These spreadsheet tools are included as part of this document on a separate CD.
[16)] The RBW is compensated for in the ACPR measurement procedure. This is not true in demonstrating compliance to FCC masks as RBW value affects the emission masks results.

Table 13 Recommended Data SPD Measurement Parameters (Wide Band)

Span	± 50 kHz (100 kHz)
Bin Size	31.25 to 50 Hz
RBW	100 to 150 Hz
Number of Data Points	3,201
Since Wide Band operations are now limited to 50 kHz and subject to waivers, the wider span used in TSB-88.1-C is no longer necessary and the same spreadsheet can be used for narrow as well as wide band as well as between disparate combinations.	

5.7.1.1 Spectral Power Density Table for an Analog Modulated Transmitter [603]

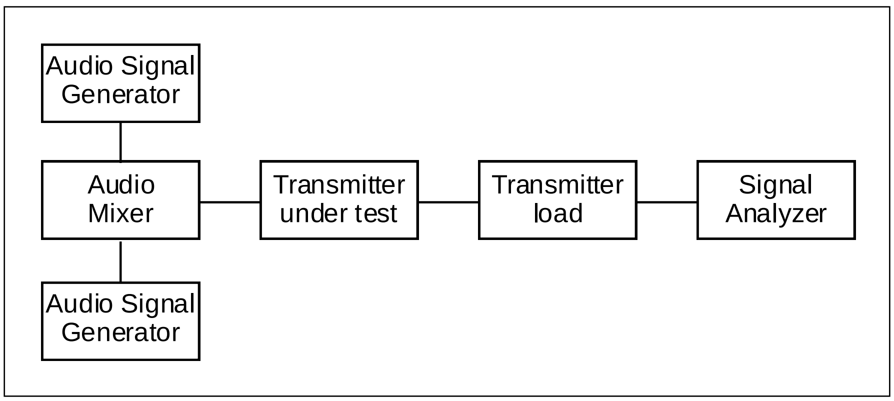


Figure 11 Two Tone Modulation Setup

1. Connect the equipment as illustrated in Figure 11, with the transmitter set to produce rated RF at the assigned frequency, and the signal analyzer set to use average power detection and the span and resolution bandwidth given in Table 12 (Note that the audio mixer can be eliminated if the audio generators are series connected).
2. Adjust the frequency of one audio generator to the lower frequency of the frequency pair given in Table A 2 of Annex-A for the modulation technology under test.
3. With the other audio generator off, modulate the transmitter with the low frequency audio tone only and adjust the generator output voltage to produce 50% of rated system modulation. Record this level, and then reduce the low frequency tone level by at least 40 dB.
4. Turn on the other audio signal generator and set its frequency to modulate the transmitter with the higher frequency tone of the frequency pair. Adjust the generator output voltage to produce 50% of rated system modulation and record this level.

5. Increase the output level of each signal generator respectively to a level 10 dB greater than the levels recorded in steps 3 and 4.
6. Capture the emission of the signal analyzer using a span no less than the appropriate span listed in Table 12. Generate a spectral power-density table by recording the center frequency of, and the power in, each frequency bin of the spectrum produced by the emission.
7. Sum (linearly, not using logarithms) the power values in each bin of the spectrum produced by the signal analyzer, then record this total power value as the transmitter power.

5.7.1.2 Voice Spectral Power-density Table for a Digitally Modulated Transmitter [102.CAAA]

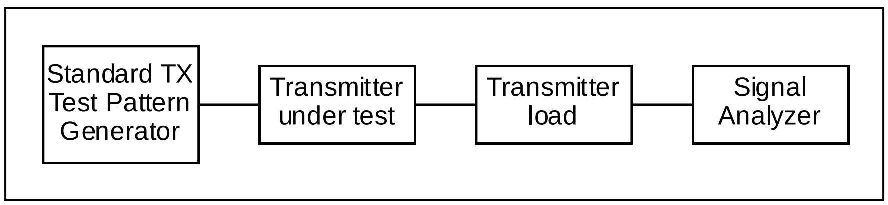


Figure 12 Digital Modulation Measurement Setup

1. Connect the equipment as illustrated in with the transmitter set to produce rated RF power at the assigned frequency, and the signal analyzer set to use average power detection with a span and resolution bandwidth per Table 12.
2. Set the test pattern generator to produce the test pattern given in Table A 2 of Annex-A at the normal modulation level plus the maximum operating variance for the modulation technology under test.
3. Capture the emission on the signal analyzer using a display span no less than the appropriate value listed in Table 12. Generate a power-density spectrum table by recording the center frequency of, and the power in, each frequency bin of the spectrum produced by the emission.
4. Sum (linearly, not using logarithms) the power values in each bin of the spectrum produced by the signal analyzer, then record this total power value as the transmitter power.

5.7.1.3 SPD Data File Utilization (Narrow Band)

The data file created in §5.7.1.1 or §5.7.1.2 has two uses. It is used to create a .SPD file to calculate the appropriate tables for the Annex A data. The same data is also used in the template spreadsheet to produce additional graphics showing the ACP as a function of offset and ENBW as well as graphics for the configuration currently being evaluated. Annex J describes the spreadsheet and the additional graphics.

	A	B	C	D	E	G
1	C4FM-TSB-88.1-C					
2		Measured Data				
3		Mag (dB)				
4	Frequency Offs	100 Hz RBW	Pwr/Bin (W)	ACP/Bin (W	ACPR= 70.6 dB	
5	-50.0000	-108.452	3.74E-15	0	-150	
6	-49.9688	-110.587	2.29E-15	0	-150	
7	-49.9375	-125.109	8.07E-17	0	-150	
8	-49.9063	-106.829	5.43E-15	0	-150	
9	-49.8750	-109.839	2.72E-15	0	-150	
10	-49.8438	-113.171	1.26E-15	0	-150	
11	-49.8125	-126.707	5.59E-17	0	-150	
12	-49.7813	-107.610	4.54E-15	0	-150	
13	-49.7500	-102.661	1.42E-14	0	-150	
14	-49.7188	-103.088	1.29E-14	0	-150	
15	-49.6875	-107.888	4.26E-15	0	-150	
16	-49.6563	-112.012	1.65E-15	0	-150	
17	-49.6250	-104.811	8.65E-15	0	-150	
18	-49.5938	-102.115	1.61E-14	0	-150	
19	-49.5625	-103.810	1.09E-14	0	-150	
20	-49.5313	-105.702	7.04E-15	0	-150	
21	-49.5000	-105.346	7.65E-15	0	-150	
22	-49.4688	-107.580	4.57E-15	0	-150	
23	-49.4375	-107.772	4.37E-15	0	-150	
24	-49.4063	-110.625	2.27E-15	0	-150	
25	-49.3750	-111.612	1.81E-15	0	-150	
26	-49.3438	-102.570	1.45E-14	0	-150	
27	-49.3125	-101.661	1.79E-14	0	-150	
28	-49.2813	-102.383	1.51E-14	0	-150	
29	-49.2500	-104.089	1.02E-14	0	-150	
30	-49.2188	-102.049	1.63E-14	0	-150	
31	-49.1875	-100.897	2.13E-14	0	-150	
32	-49.1563	-100.559	2.30E-14	0	-150	
33	-49.1250	-100.806	2.17E-14	0	-150	
34	-49.0938	-104.849	8.57E-15	0	-150	
35	-49.0625	-112.046	1.63E-15	0	-150	
36	-49.0313	-106.690	5.61E-15	0	-150	
37	-49.0000	-106.407	5.99E-15	0	-150	
38	-48.9688	-109.382	3.02E-15	0	-150	
39	-48.9375	-110.424	2.37E-15	0	-150	
40	-48.9063	-132.689	1.41E-17	0	-150	

	H	I	J	K	L	M	N
3	Carrier Frequency	150.000 MHz		Butterworth Filter Calculator*			
4	Bin Size	31.25 Hz			F ±-3dB	9.504 kHz	
5	RBW	119 Hz			# of Poles	4	
6					# of Cascades	3	
7	Signal Power	1.03 mW			IF fc Offset	-12.500 kHz	
8		0.147 dBm		*Use Goal seek to set M9 to desired value by changing M4			
9				Equivalent Noise BW		16.000 kHz	
10	Adjacent Channel Power			ACPR		18.8 dB	
11	Offset	-12.5 kHz					
12	BW	5.8 kHz		Graphed Butterworth Filter			
13					F ±3dB	3.445 kHz	
14	Start	-15.4 kHz			# of Poles	4	
15	Stop	-9.6 kHz			# of Cascades	3	
16					IF fc Offset	-12.500 kHz	
18	ACPR	70.6 dB		Equivalent Noise BW		5.800 kHz	
19				ACPR		68.2 dB	
21	Red = Entered values			RRC Filter			
22	Blue = Calculated values				Fsymbol=	5.8 ksps	
23					alpha=	0.2	
24	Enter frequency offset (kHz) & select side				Maximum	-120	
25	Offset Frequency	12.500 kHz			IF fc Offset	-12.500 kHz	
27	Low Side	High Side		Equivalent Noise BW		5.800 kHz	
28				ACPR		69.9 dB	
29	Rcvr ENBW	5.800 kHz					
30	Enter Victim's ENBW (kHz), select alternate BF2 if applicable						
31	BF 4P-3C (Normal)	BF 5P-4C			BF=4P-3C		
32	Butterworth Calculator						
33	BF2 4p-3c	3.445083922					
34	BF2 5p-4c	3.451348330					
36	Bins (1 Sided)	125					
37	% Pwr	98.99%					
38	Occupied BW	7.84 kHz					
39	Use "Goal Seek" to set I37 to desired numeric value by changing I36						

Figure 13 Sample Spreadsheet Template

To create and use the template spreadsheet;

1. Insert the measured data file into column B5 through B3205.
    a. This procedure is for manually calculating the ACPR values.
    b. Column C is the power in Watts. Calculate the power in Watts from column B if not directly available. The column B data will be used in ACPRUtil.exe, the spreadsheets sums power in Watts.
    c. Results are displayed on the Calculators sheet in the box for the identified filter configurations based on the Offset Frequency entered in cell I25 and the Receiver ENBW entered in cell I29.
    d. The calculated values are used to simultaneously drive the results of all four calculators for the manually calculated offset and ENBW. Select the frequency offset for a victim receiver that is either on the high side or low side of the interfering emitter's frequency. In addition there are 4 graphics of the filters showing the filter and the point by point integration of power to determine the ACPR. These charts are driven by the Calculator.
    e. There are two predefined Butterworth filters. The upper Butterworth Filter is available to calculate non predefined configurations using "Goal Seek" or in conjunction with the spreadsheet Butterworth auto-

calculate. The lower Butterworth Filter can be configured using the alternate filter selection button. The default or normal configuration is for 4P-3C with the option of selecting a 5P-4C which is requested by one manufacturer. The calculator only looks at the selected offset, either high or low. It does not select the worst case. This can be done manually by modeling both cases and selecting the worst value.

f. The TSB88D Data tab contains the data that is created by the ACPRUtil and drives the 4 charts that graph the ACPR over the range of offsets and ENBW values.

2. Next insert the measured data from Column B into the “modulation.spd” file template.

    a. The data has to be in specific rows for the application to properly operate as indicated in Figure 14.
    b. Save the file as “modulation.txt” using the name of the appropriate modulation. Rename the file after saving as “modulation.spd”.
    c. Place the renamed “modulation.spd” file in the same directory as the application.
    d. Execute the application as shown in Figure 15.
    e. Save the ACPR-Out-Modulation.xls file. It is recommended to create an Output file directory for storage from the output file.
    f. Insert the appropriate sections into the spreadsheet under tab “TSB88D Data” in the left hand side as shown in Figure 16 . The same results are displayed on the right hand side in the Annex A table format style.
    g. Save the template spreadsheet using a new file name to include the modulation type, e.g. C4FM TSB88-D Data.xls.
    h. Four charts are created. Be sure to edit the tabs and titles to reflect the modulation being used. The template uses XXX for ease in renaming.
    i. A recent addition is the Occupied Bandwidth Calculator. This uses “Goal Seek” to determine the percentage of power within a defined bandwidth using the SPD file.
    j. The SPD template, spreadsheet template, and all the spreadsheets and their results used to create this document are provided in the CD included as part of this document. See Annex H.

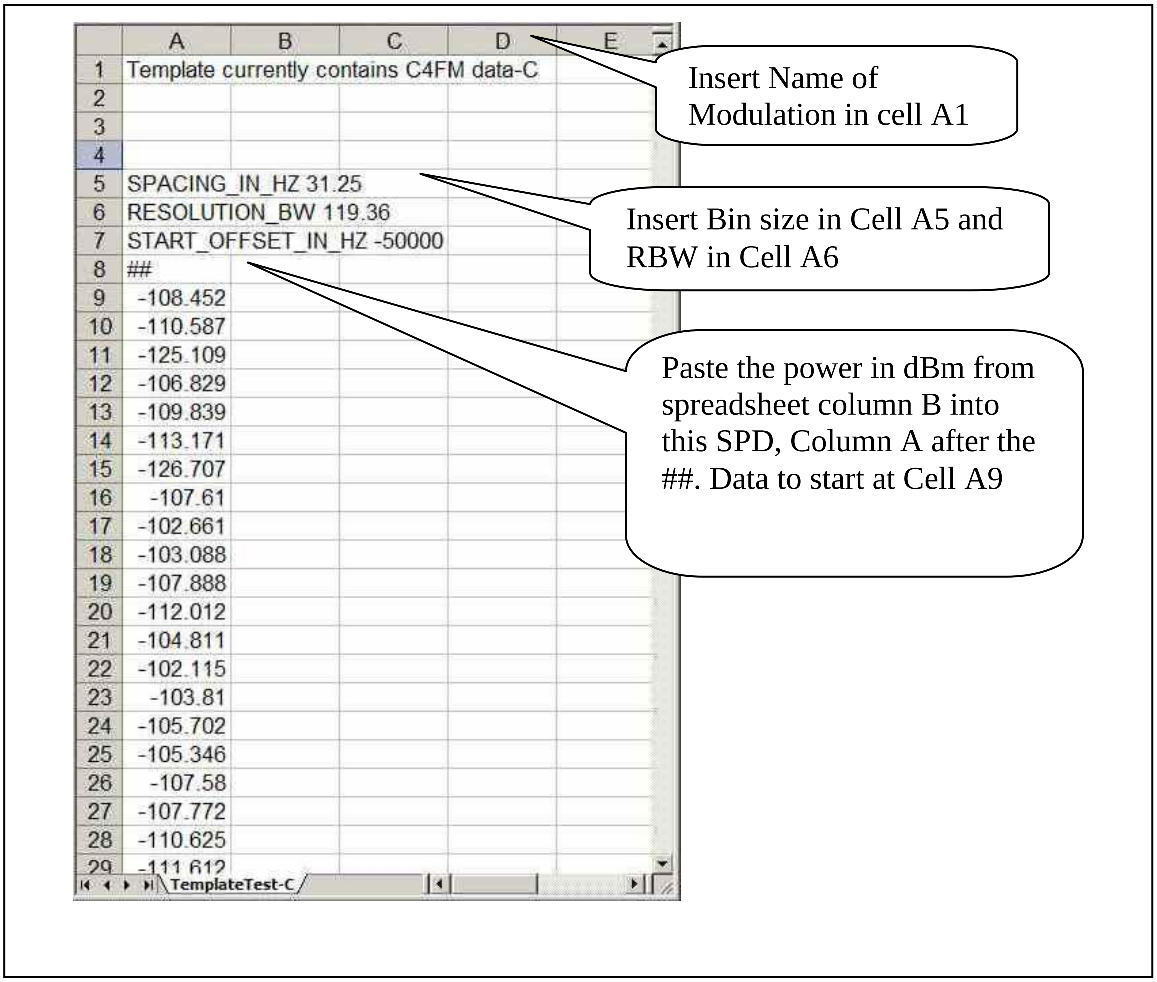


Figure 14 Create "Modulation.SPD" File

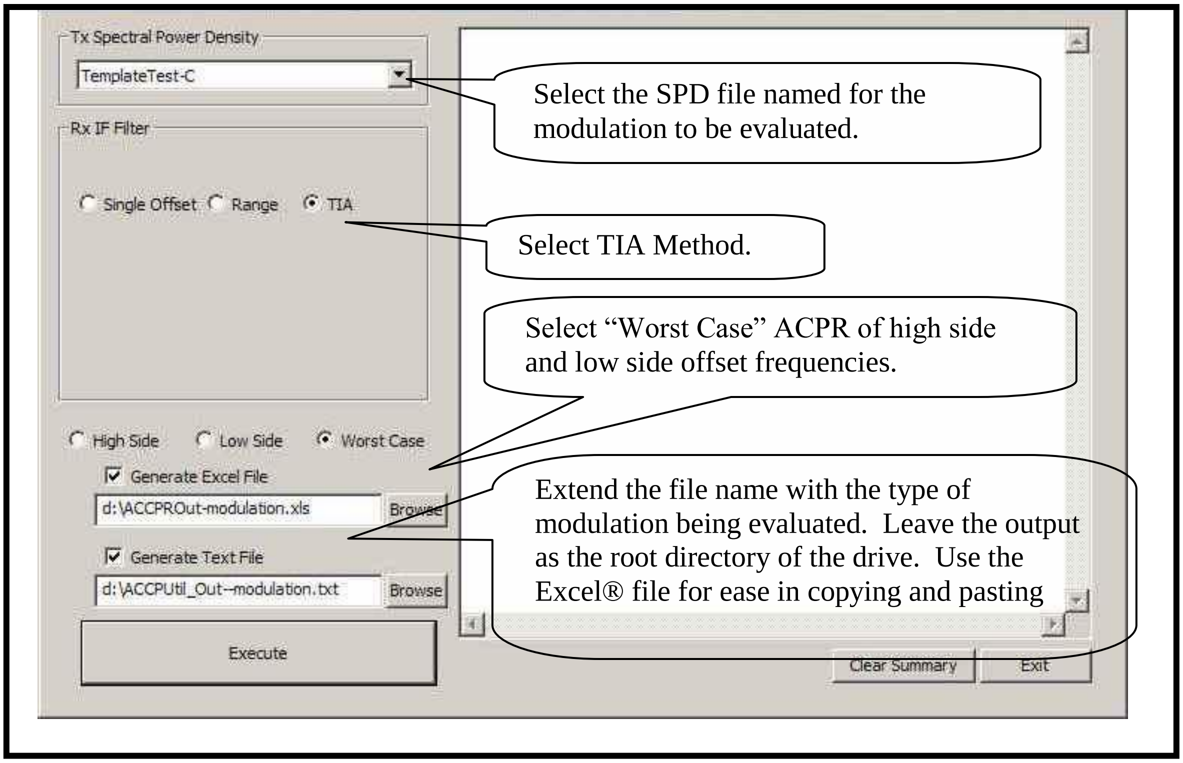
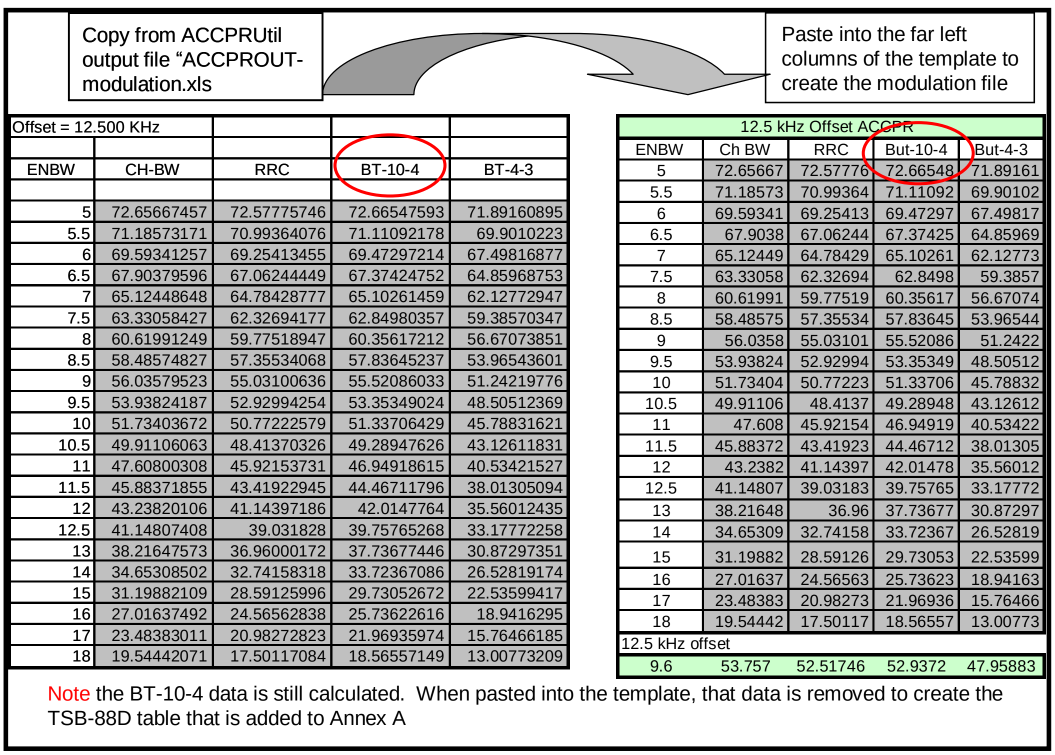


Figure 15 ACPR Calculator-ACPRUtil.exe



Offset = 12.500 KHz				
ENBW	CH-BW	RRC	BT-10-4	BT-4-3
5	72.65667457	72.57775746	72.66547593	71.89160895
5.5	71.18573171	70.99364076	71.11092178	69.9010223
6	69.59341257	69.25413455	69.47297214	67.49816877
6.5	67.90379596	67.06244449	67.37424752	64.85968753
7	65.12448648	64.78428777	65.10261459	62.12772947
7.5	63.33058427	62.32694177	62.84980357	59.38570347
8	60.61991249	59.77518947	60.35617212	56.67073851
8.5	58.48574827	57.35534068	57.83645237	53.96543601
9	56.03579523	55.03100636	55.52086033	51.24219776
9.5	53.93824187	52.92994254	53.35349024	48.50512369
10	51.73403672	50.77222579	51.33706429	45.78831621
10.5	49.91106063	48.41370326	49.28947626	43.12611831
11	47.60800308	45.92153731	46.94918615	40.53421527
11.5	45.88371855	43.41922945	44.46711796	38.01305094
12	43.23820106	41.14397186	42.0147764	35.56012435
12.5	41.14807408	39.031828	39.75765268	33.17772258
13	38.21647573	36.96000172	37.73677446	30.87297351
14	34.65308502	32.74158318	33.72367086	26.52819174
15	31.19882109	28.59125996	29.73052672	22.53599417
16	27.01637492	24.56562838	25.73622616	18.9416295
17	23.48383011	20.98272823	21.96935974	15.76466185
18	19.54442071	17.50117084	18.56557149	13.00773209

12.5 kHz Offset ACCPR				
ENBW	Ch BW	RRC	But-10-4	But-4-3
5	72.65667	72.57776	72.66548	71.89161
5.5	71.18573	70.99364	71.11092	69.90102
6	69.59341	69.25413	69.47297	67.49817
6.5	67.9038	67.06244	67.37425	64.85969
7	65.12449	64.78429	65.10261	62.12773
7.5	63.33058	62.32694	62.8498	59.3857
8	60.61991	59.77519	60.35617	56.67074
8.5	58.48575	57.35534	57.83645	53.96544
9	56.0358	55.03101	55.52086	51.2422
9.5	53.93824	52.92994	53.35349	48.50512
10	51.73404	50.77223	51.33706	45.78832
10.5	49.91106	48.4137	49.28948	43.12612
11	47.608	45.92154	46.94919	40.53422
11.5	45.88372	43.41923	44.46712	38.01305
12	43.2382	41.14397	42.01478	35.56012
12.5	41.14807	39.03183	39.75765	33.17772
13	38.21648	36.96	37.73677	30.87297
14	34.65309	32.74158	33.72367	26.52819
15	31.19882	28.59126	29.73053	22.53599
16	27.01637	24.56563	25.73623	18.94163
17	23.48383	20.98273	21.96936	15.76466
18	19.54442	17.50117	18.56557	13.00773
12.5 kHz offset				
9.6	53.757	52.51746	52.9372	47.95883

Note the BT-10-4 data is still calculated. When pasted into the template, that data is removed to create the TSB-88D table that is added to Annex A

Figure 16 Sample of File Insertions

Table 14 Sample SPD Output File

Offset = 12.500 KHz

ENBW	CH-BW	RRC	BT-10-4	BT-4-3
5	72.94528718	72.72315602	72.84768953	71.87926029
5.5	71.30921936	71.07489638	71.2230681	69.69952743
6	69.80390592	69.03588156	69.38360116	67.23076844
6.5	67.76973434	66.79621278	67.08599536	64.58100779
7	64.99525474	64.50453987	64.83753254	61.84684393
7.5	63.20177905	62.02753212	62.56115353	59.10952944
8	60.87479908	59.48118426	60.04706777	56.40077444
8.5	58.29530049	57.07416248	57.54402146	53.69901832
9	55.86962335	54.77158947	55.25239845	50.97713187
9.5	53.846591	52.6860165	53.10019538	48.24238022
10	51.57613729	50.50297798	51.09941292	45.53074629
10.5	49.85474462	48.13562527	49.02587241	42.87587358
11	48.1958027	45.62344607	46.65628929	40.2917637
11.5	45.65844238	43.14523283	44.17019148	37.77784764
12	43.1166728	40.88861326	41.73068126	35.33163745
12.5	40.98252594	38.79368788	39.50347147	32.95591758
13	38.07083523	36.75448869	37.50354533	30.65821039
14	34.85933978	32.50203785	33.61050483	26.32875732
15	31.44752724	28.34877491	29.48805717	22.38511152
16	26.87623385	24.34928272	25.50180107	18.84159846
17	23.4988975	20.82356316	21.75923258	15.70702556
18	19.43949226	17.33168202	18.43939088	12.98537169

The BT-10-4 information is no longer needed. Rather than rewrite the application no change was made and the spreadsheet handles the deletion after pasting the new information into the far left fields. The final TSB-88D table does not contain that data.

5.7.1.4 WB Data Spectral Power-density tests.

The tests for wide band data are similar to the previously described tests. For span and number of data points use. [902.CAAA] [902.CAAB] for SAM and [902.CBAA] [902.CBAB] for IOTA.

5.7.1.5 SPD Data File Utilization (Wideband)

The specific IF bandwidths only use the Channel BW filter model as indicated in Table 15.

Table 15 Wide Band Configurations

Modulation Type, Channel BW	ACPR IF BW (kHz)
IOTA Wideband Data, 50 kHz	44.0
SAM Wideband Data, 50 kHz	42.6
Channel Bandwidth, 50 kHz	50.0

The FCC reallocated the 700 MHz wideband to broadband only. As a result the wideband offerings have been dramatically reduced as the only place they can be licensed is via waiver in the 700 MHz band[17)]. The waivers are for no more than 5 years and might be granted for less time as the intent was to only facilitate some initial wideband deployments. Waivers are limited to the following cases.

1. By consolidating 700 MHz narrowband channels.
2. By incorporating in the internal guard band.
3. If 1 and 2 are unavailable the FCC might entertain waiver requests for wideband systems in the top 1.25 MHz of the broadband allocations, subject to a “very high hurdle”.

Wideband to wideband is not considered as likely. To facilitate reusing the current spreadsheet template the span for wideband data was reduced to be the same as narrowband. This simplifies the calculations due to the limited number of possibilities that might be deployed

5.7.1.6 SPD Data File Utilization (Wideband into Narrowband)

The 100 kHz wideband span is wide enough to calculate ACPR into narrowband receivers unless the narrowband receiver is so wide that the filter skirts fall outside the data. Since the 700 MHz band is all digital it is assumed that the filters will be quite sharp so that this case is not considered likely. Some concern for low power analog radios is noted if they are immediately adjacent to a wideband channel.

5.7.1.7 SPD Data File Utilization (Narrowband to Wideband)

Figure 17illustrates the possible combinations and their offsets in the first 25 kHz adjacent to a 50 kHz wideband channel. The letters indicate the frequency offset for up to four 6.25 kHz channels, or two 12.5 kHz channels or a single 25 kHz channel. The furthest away portion of the 50 kHz channel will not have data to

[17)] For details of the FCC 2nd R&O see http://fjallfoss.fcc.gov/edocs_public/attachmatch/FCC-07-132A1.doc in ¶485 - 496.

integrate, but that data ought to be very low in power so it is not a concern considering the low probability of this type of deployment.

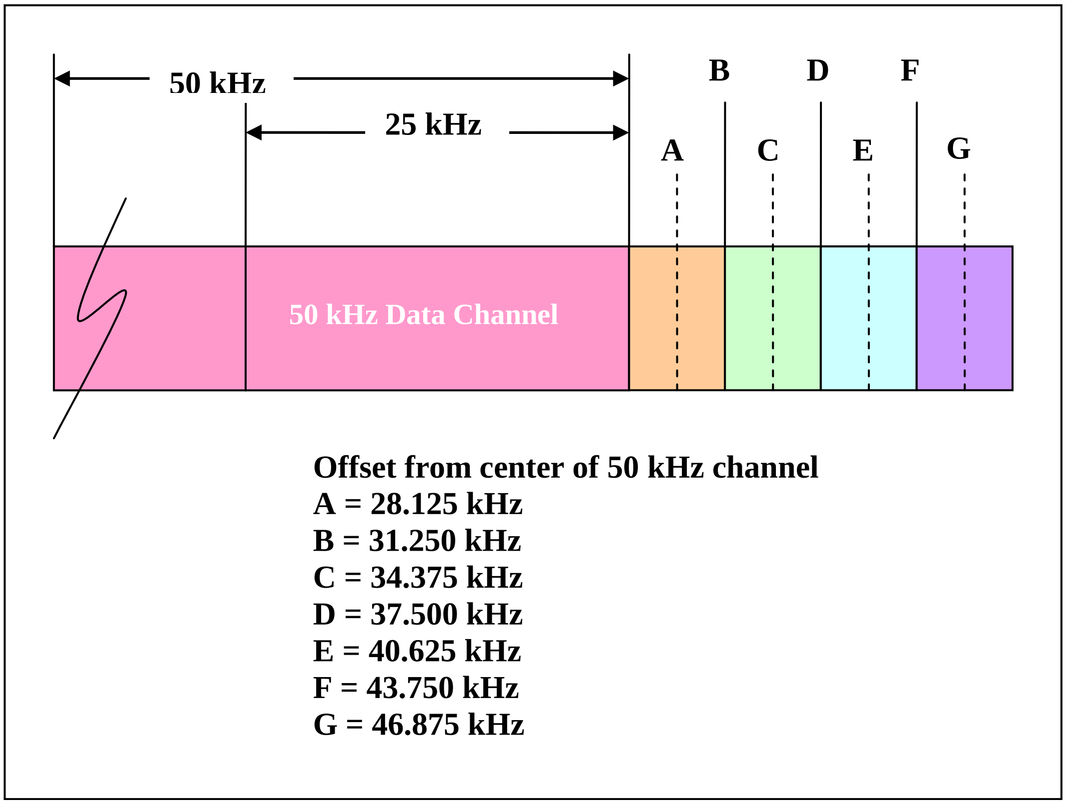


Figure 17 Narrowband and Wideband Offset Combinations

5.7.2. Frequency Stability Adjustment

It is well known that the frequency-determining elements of radio equipment are not perfectly stable. To account for instability, utilize the following procedure:

5.7.2.1 Determine Standard Deviation of Frequency Drift

Use a standard deviation (σ) of 0.4 times the individual FCC stability requirement (in Hz) for the fixed and mobile units when AFC is not utilized. At 450 MHz the 12.5 kHz channelization specification is 1.5 ppm for fixed stations and 2.5 ppm for mobile units; use Table 17 for other scenarios. The calculated independent standard deviations are:

$$\sigma_f = 0.4 \times 1.5 \times 450 = 270 \text{ Hz}$$

$$\sigma_m = 0.4 \times 2.5 \times 450 = 450 \text{ Hz}$$

$$\sigma_c = \sqrt{270^2 + 450^2} = 525 \text{ Hz}$$

The combined standard deviation, σ_C, is the square root of the sum of the squares (525 Hz).

5.7.2.2 Determine Confidence Factor

Decide on a confidence factor (e.g., 95%) and find the corresponding Z_α value from Table 16. (e.g., Z_α=1.645).

Table 16 Values for Standard Deviate Unit

Percentage (%)	Z_α	$Z_{\alpha/2}$
50	*0*	*0*
70	*0.524*	*1.036*
80	*0.841*	*1.281*
85	*1.036*	*1.439*
90	*1.281*	*1.645*
95	*1.645*	*1.960*
97	*1.881*	*2.170*
99	2.326	2.579

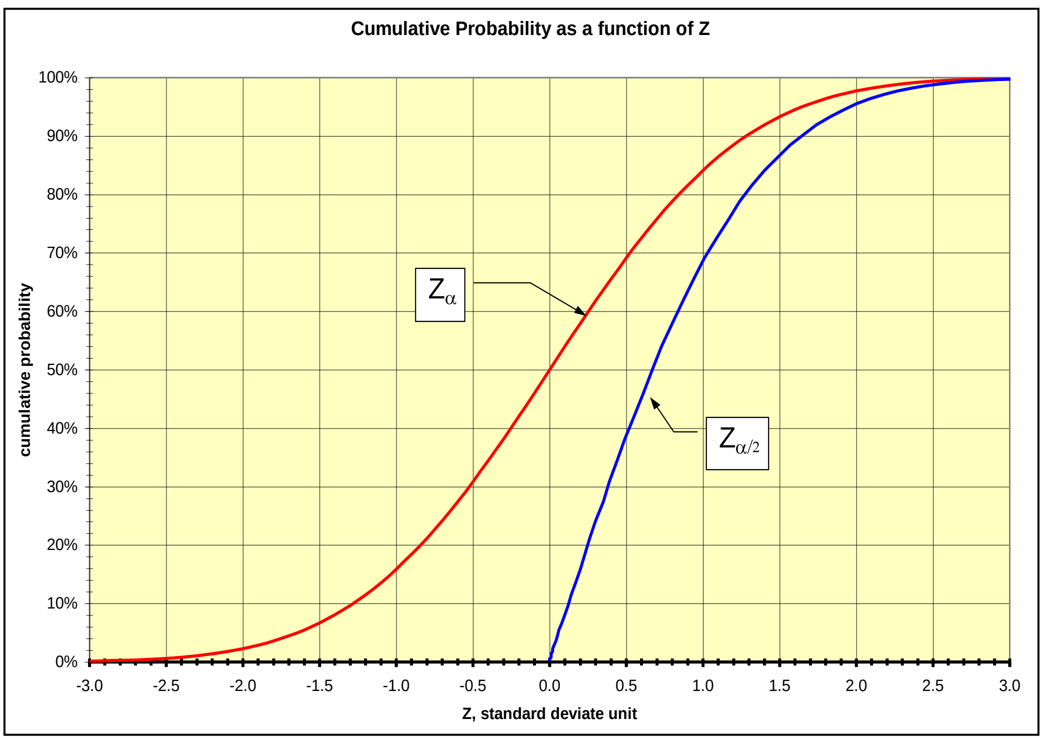


Figure 18 Cumulative Probability as a Function of Z_α and $Z_{\alpha/2}$

5.7.2.3 Frequency Stability Adjustment Calculation

The frequency stability adjustment (FSA) is the standard deviation of the frequency drift, σ_c, multiplied times the standard deviate unit, Z_α, for a given confidence level. Using the example in §5.7.2.1: FSA = 525 times 1.645 = 864 Hz. This calculation predicts that there is a 95% confidence level that the frequency error between a mobile receiver and base station transmitter is between -864 Hz and +864 Hz for a 450 MHz system using 12.5 kHz channel spacing.

5.7.3. Adjacent Channel Considerations

The adjacent channel contour can be determined by increasing the modified appropriate co-channel interference contour based on the source to victim ACPR, where the ACPR is adjusted for the frequency drift as defined in §5.7.2.3. For easy reference, the stability values in Table 17 are listed for use in the calculation.

5.7.3.1 Reduce Frequency Separation

Calculate the effect of reduced frequency separation between the adjacent channels by $\Delta f = Z_\alpha x \sigma_c$. At 450 MHz this example would be (1.645)(525) = 864 Hz offset from the normal 12.5 kHz channel separation. When using the tables in Annex A, double the offset value (1.728 kHz) and add it to the ENBW of the victim receiver.

Use the modified ENBW value to look up the ACP intercepted under the reduced frequency separation. For the spreadsheet calculator, reduce the channel offset by the frequency stability adjustment. Use Table 17 to determine the associated frequency stabilities.

The purpose of this methodology is to provide general equations for calculating the ACPR at various offsets frequencies. By doubling the FSA, the edge closest to the interferer is moved closer while the edge furthest away is moved even further away. The energy intercepted by the furthest away portion of the filter is insignificant and can be dismissed. This then provides a simple method of determining the ACPR without having the actual spreadsheet data file available.

Alternatively the spreadsheet can be used with the normal receiver ENBW but the frequency offset value is reduces by 864 Hz. Any difference between the two methods should be de minimis.

The use of 95% confidence is used in the example. Other confidence values are possible, but a minimum value of 90% is recommended.

Table 17 FCC/NTIA Stability Requirements

Assigned Frequency (MHz)	Channel Bandwidth (kHz)	Mobile Station Stability (PPM)	Base Station Stability (PPM)
25 to 50	20	20	20
138 to 174	25 & 30	5.0	5.0
	12.5 & 15	5.0	2.5
	12.5 (NTIA only)	2.5	1.5
	6.25 & 7.5	2.0	1.0
380 to 400	25	5.0	5.0
406 to 420 (NTIA only)	12.5	2.0	1.0
421 to 512	25	5.0	5.0
	12.5	2.5	1.5
	6.25	1.0	0.5
768 to 769	Guard Band[4]		
769 to 775	25	0.4 [1], 2.5 [2]	0.1
	12.5	0.4 [1], 1.5 [2]	0.1
	6.25	0.4 [1], 1.0 [2]	0.1
775 to 776	Guard Band[4]		
798 to 799	Guard Band[4]		
799 to 805	25	0.4 [1], 2.5 [2]	Not Authorized
	12.5	0.4 [1], 1.5 [2]	Not Authorized
	6.25	0.4 [1], 1.0 [2]	Not Authorized
805-806	Guard Band[4]		
806 to 809[3]	12.5	1.5	1.0
809 to 824[3]	25	2.5	1.5
851 to 854[3]	12.5	1.5	1.0
854 to 869[3]	25	2.5	1.5
896 to 901	12.5	1.5	0.1
929 to 930	25	Not Authorized	1.5
935 to 940	12.5	Not Authorized	0.1

1) When receiver AFC is locked to base station.
2) When receiver AFC is not locked to base station.
3) Channelization shown is after NPSPAC rebanding. NPSPAC criteria will only apply to the new NPSPAC blocks.
4) Guard bands after band realignment

5.7.3.2 Digital Test Pattern Generation

The digital test patterns are based on the ITU-T O.153 (formerly V.52) pseudo-random sequence. The FORTRAN procedure given below generates this pattern for binary and four level signals.

```
Function v52()
C Function produces the V.52 bit pattern called for in the digital FM
C interference measurement methodology.  Each time this function is
C called, it produces one bit of the V.52 pattern.

      Integer v52         ! The returned V.52 bit.
      Integer register    ! The shift register that holds the current
                          ! state of the LSFR.

      Data register/511/  ! The initial state of the shift register.
      Save register       ! Saving the shift register between calls.

C Returning the value in the LSB of the shift register.
      V52=and(register,1)

C Performing the EXOR and feedback function.
      If(and(register,17) .eq. 1 .or. and(register,17) .eq. 16) then
        register=register+512
      end if

C Shifting the LSFR by one bit.
      Register=rshft(register,1)
      end
```

The data from the procedure above is binary, and can be used to drive binary data systems directly. Since many modulations utilize four level symbols, the binary symbols from the O.153 sequence need to be paired into 4-level symbols. This can be done with this procedure:

```
function v52_symbol()

C Function produces a di-bit symbol based on the V.52 sequence and
C the Layer 1 translation table.


      Integer v52            ! External V.52 function.
      Integer bit_1,bit_0    ! The two bits of the di-bit pair.
      Integer v52_symbol     ! Four level V.52 symbol.
      Integer table(0:1,0:1) ! Translation table to map bits into 4-
                             ! level symbols.

C Setting up the translation table.
      Data table  /+1,+3,-1,-3/

C Making the V.52 draws and translating them to a 4-level symbol level
C with the translation table.
      Bit_1=v52()
      bit_0=v52()
      v52_symbol=table(bit_1,bit_0)
      end
```

5.8. Delay Spread Methodology and Susceptibility

A method of quantifying modulation performance in simulcast and multipath environments is desired. Hess describes such a technique [3], pp. 240-246. Hess calls the model the "multipath spread model." The model is based on the observation that for signal delays that are small with respect to the symbol time, the bit error rate (BER) observed is a function of RMS value of the time delays of the various signals weighted by their respective power levels. This reduces the entire range of multipath possibilities to a single number. The multipath spread for N signals is given by:

$$T_m = 2\sqrt{\frac{\sum_{i=1}^{N} P_i d_i^2}{\sum_{i=1}^{N} P_i} - \frac{\left[\sum_{i=1}^{N} P_i d_i\right]^2}{\left[\sum_{i=1}^{N} P_i\right]^2}} \qquad (8)$$

Since BER is affected by T_m more strongly than N, any value of N can be more simply represented as if it were due to two rays of equal signal strength, as shown below. This would be interpreted as T_m can be calculated by evaluating for two signals, where P_1 equals P_2. The value for T_m is the absolute time difference in the arrival of the two signals.

$$T_m\Big|_{N=2;P_1=P_2} = \left|d_1 - d_2\right| \qquad (9)$$

Hess describes a method where multipath spread and the total signal power necessary for given BER criteria are plotted and used in a computer program to determine coverage. Figure 19 in §5.8.1 shows the C/N for QPSK-c class modulations at 5% BER. The points above and to the left of the line on the graph represent points that have a BER ≤ 5%, and thus meet the 5% BER criterion. The points below or to the right of the line have a BER greater than 5% and thus do not meet the 5% BER criterion.

A figure of merit for delay spread is the asymptote on the multipath spread axis, which is the point at which it becomes impossible to meet the BER criterion at any signal strength. This is easily measured by using high signal strength and increasing the delay between two signals until the criterion BER is met. The two signal paths are independently Rayleigh faded. The other figure of merit for a modulation is the signal strength necessary for a given BER at T_m = 0 μs. Given these attributes, the delay performance of the candidate modulation is bounded. Note that these parameters are the figures of merit for the modulation itself; practical implementations, e.g., simulcast infrastructures or receiver performance, can change these curves[18)]. Figure 19 in §5.8.1 is an Iso-BER curve for reference sensitivity. Figure 20 in §5.8.2 shows the BER versus T_m at high signal strength for QPSK-c class modulations.

[18)] Consult the manufacturer for specific values.

5.8.1. QPSK-c Class Reference Sensitivity Delay Spread Performance (12.5 and 6.25 kHz) Digital Voice

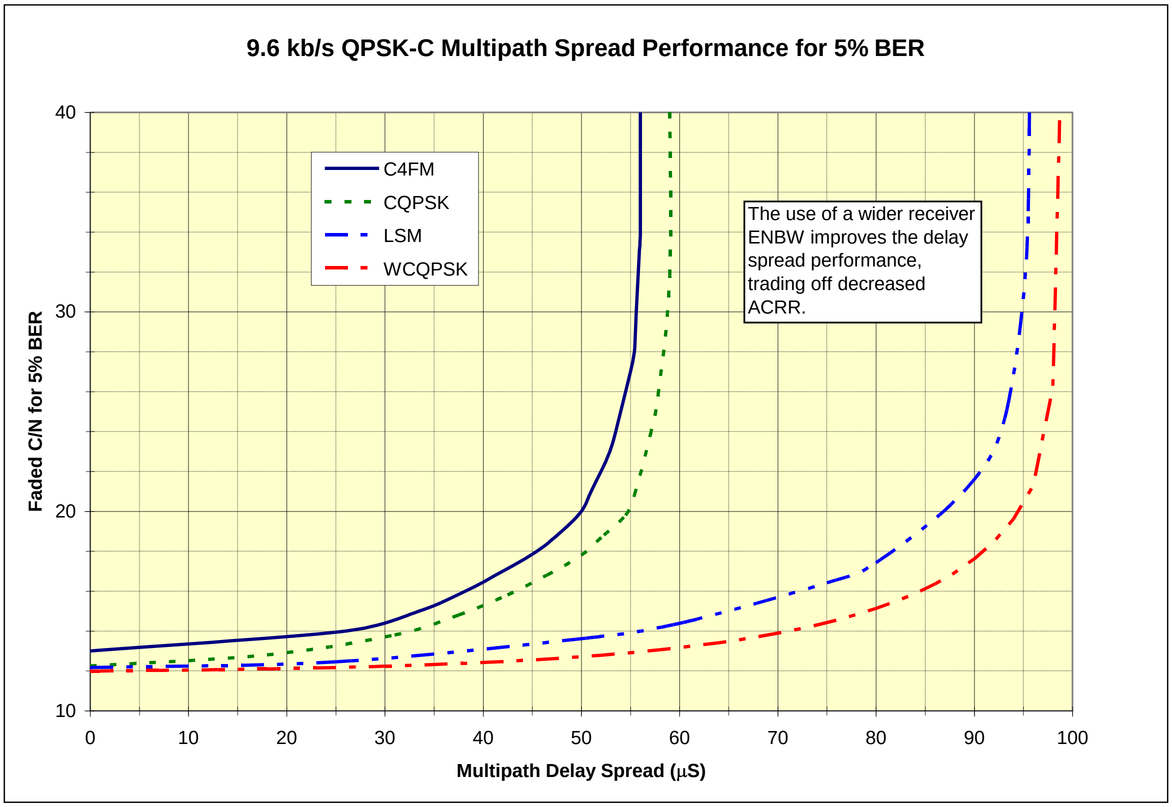


Figure 19 Multipath (Differential Phase) Spread of QPSK-c Modulations for Reference Sensitivity

The loss of reference sensitivity becomes extreme as the delay spread increases. The breakdown from delay spread can be approximated for various DAQ values from Figure 20 as being the value of T_m for the BER% needed for the specified DAQ. Performance is based on both propagation delay spread and receiver delay characteristics. Wider ENBW receivers trade off decreased ACRR for improved delay spread tolerance.

5.8.2. QPSK-c Class DAQ Delay Spread Performance (12.5 and 6.25 kHz) Digital Voice

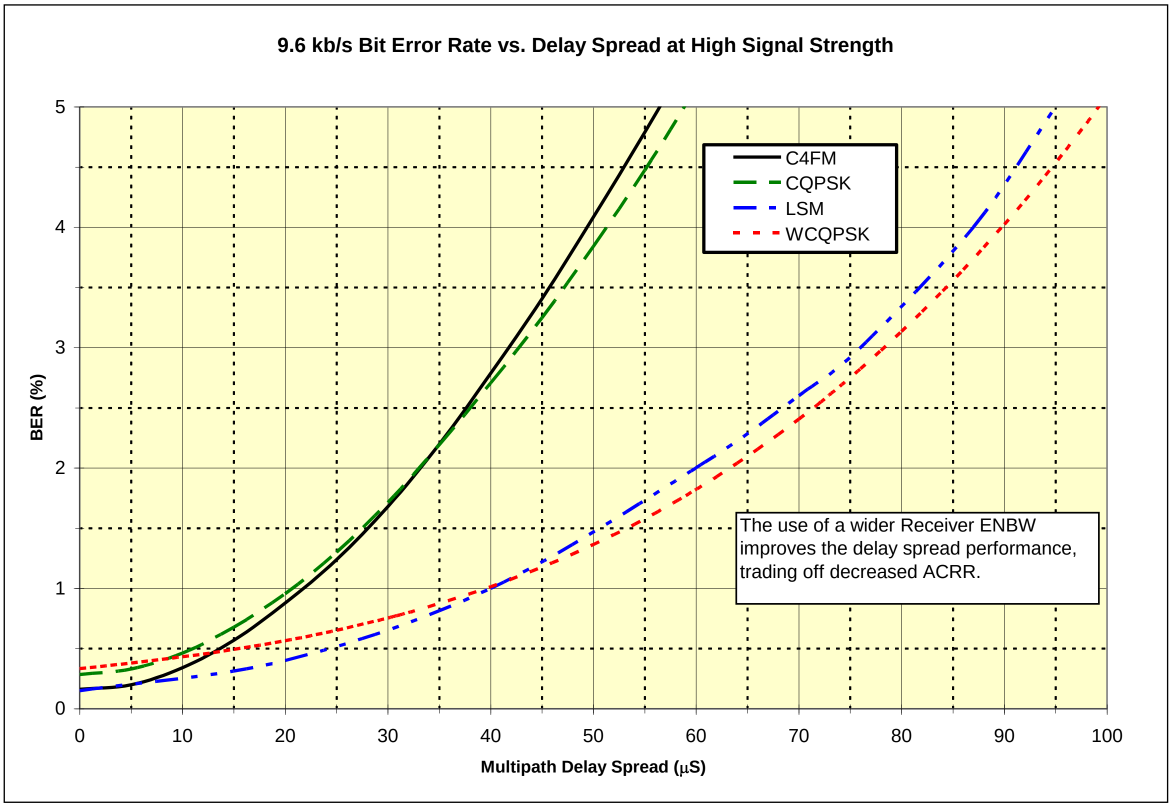


Figure 20 Simulcast Performance of CQPSK Modulations

5.8.3. Simulcast CPC

Annex F contains a discussion on how to use the type of data from Figure 19 and Figure 20 to approximate the VCPC values for various DAQs.

No information is provided for DCPC as it is not anticipated to be simulcast due to typical one to one data messaging as well as the stringent delay spread values that would apply for high speed data.

6. BIBLIOGRAPHY

The following is a list of generally applicable sources of information relevant to this document.

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ANNEX A Tables (informative)

A.1 Projected CPC Parameters for Different DAQs

Table A 1 Projected VCPC Parameters for Different DAQs

Modulation Type, (channel spacing)	Static[1]. $ref / \frac{C_s}{N}$	DAQ-3.0[2]. $BER\% / \frac{C_f}{(I+N)}$	DAQ-3.4[3]. $BER\% / \frac{C_f}{(I+N)}$	DAQ-4.0[4]. $BER\% / \frac{C_f}{(I+N)}$
Analog FM Radios				
Analog FM ± 2.5kHz (12.5 kHz)	12 dBS/7 *dB*	N/A/23 *dB*	N/A/26 *dB*	N/A/33 *dB*
Analog FM ± 4kHz (25 kHz) [5]	12 dBS/5 *dB*	N/A/19 *dB*	N/A/22 *dB*	N/A/29 *dB*
Analog FM ± 5kHz (25 kHz)	12 dBS/4 *dB*	N/A/17 *dB*	N/A/20 *dB*	N/A/27 *dB*
Digital FDMA Radios				
C4FM (IMBE) (12.5 kHz) [6]	5%/5.4 *dB*	2.6%/15.2 *dB*	2.0%/16.2 *dB*	1.0%/20.0 *dB*
C4FM (IMBE) (12.5 kHz) [7]	5%/7.6 *dB*	2.6%/16.5 *dB*	2.0%/17.7 *dB*	1.0%/21.2 *dB*
C4FM (VSELP)[*] (12.5 kHz) [7]	5%/7.6 *dB*	1.8%/17.4 *dB*	1.4%/19.0 *dB*	0.85%/21.6 *dB*
CQPSK (IMBE) LSM, 9.6 kb/s(12.5 kHz)	5%/6.5 *dB*	2.6%/15.7 *dB*	2.0%/17.0 *dB*	1.0%/20.5 *dB*
CQPSK (IMBE) WCQPSK, 9.6 kb/s (12.5 kHz)	5%/6.5 *dB*	2.6%/15.4 *dB*	2.0%/16.8 *dB*	1.0%/20.2 *dB*
CVSD "XL" CAE (25 kHz)	8.5%/4.0 *dB*	5.0%/12.0 *dB*	3.0%/16.5 *dB*	1.0%/20.5 *dB*
CVSD "XL" CAE (NPSPAC) [8]	8.5%/4.0 *dB*	5.0%/14.0 *dB*	3.0%/18.5 *dB*	1.0%/22.5 *dB*
CVSD "XL" 4 Level (25 kHz)	8.5%/4.0 *dB*	5.0%/18.0 *dB*	3.0%/21.5 *dB*	1.0%/27.0 *dB*
EDACS® Narrowband Digital	5%/7.3 *dB*	2.6%/16.7 *dB*	2.0%/17.7 *dB*	1.0%/21.2 *dB*
EDACS® NPSPAC[8] Digital	5%/6.3 *dB*	2.6%/15.7 *dB*	2.0%/16.7 *dB*	1.0%/20.2 *dB*
EDACS® Wideband Digital (25 kHz)	5%/5.3 *dB*	2.6%/14.7 *dB*	2.0%/15.7 *dB*	1.0%/19.2 *dB*
dPMR 4.8 kb/s (AMBE+2) (6.25 kHz)	5%/7.8 *dB*	2.6%/16.3 *dB*	2.0%/17.5 *dB*	1.0%/20.8 *dB*
NXDN 4.8 kb/s (AMBE+2) (6.25 kHz)	5%/7.3 *dB*	2.6%/15.7 *dB*	2.0%/17.0 *dB*	1.0%/20.2 *dB*
NXDN 9.6 kb/s (AMBE+2) (12.5 kHz)	5%/7.0 dB	2.6%/15.5 *dB*	2.0%/16.7 *dB*	1.0%/19.9 *dB*
Tetrapol	5%/4.0 *dB*	1.8%/14.0 *dB*	1.4%/15.0 *dB*	0.85%/19.0 *dB*
WidePulse C4FM (25 kHz)	5%/9.8 *dB*	2.6%/17.2 *dB*	2.0%/18.5 *dB*	1.0%/21.8 *dB*
Digital TDMA Radios				
ETSI DMR 2 slot TDMA (AMBE +2) (12.5 kHz)	5%/5.3 *dB*	2.6%/14.3 *dB*	2.0%/15.6 *dB*	1%/19.4 *dB*
F4GFSK (AMBE) OpenSky®2-slot	5%/11.0 *dB*	3.5%/17.0 *dB*	2.5%/19.0 *dB*	1.3%/22.0 *dB*
F4GFSK (AMBE) OpenSky®4-slot	5%/11.0 *dB*	1.3%/22.0 *dB*	0.9%/24.0 *dB*	0.5%/27.0 *dB*
H-DQPSK 12 kb/s (AMBE+2) (P25 TDMA DL)	5%/7.3 *dB*	3.1%/15.2 *dB*	2.4%/16.4 *dB*	1.2%/19.8 *dB*
H-CPM 12 kb/s (AMBE+2) (P25 TDMA UL)	5%/9.0 *dB*	3.3%/17.5 *dB*	2.6%/18.7 *dB*	1.4%/21.6 *dB*
Cellular Type Digital Radios (TDMA)[9]				
DIMRS – iDEN® (25 kHz) 6:1	Footnote 9	Footnote 9	Footnote 9	Footnote 9
TETRA (25 kHz) 4:1	Footnote 9	Footnote 9	Footnote 9	Footnote 9

Radios with gray shading indicate they will no longer be licensable after 1/1 2013 between 150.8 and 512 MHz.

[1] Static is the reference sensitivity of a wireless detection sub-system (receiver) and is comparable to 12 *dB* SINAD in an analog system

[2] DAQ-2.0 (not shown) is comparable to 12 dB SINAD equivalent intelligibility,
DAQ-3.0 is comparable to 17 *dB* SINAD equivalent intelligibility

[3] DAQ-3.4 is comparable to 20 *dB* SINAD equivalent intelligibility, used for minimum CPC for some public safety entities.

[4] DAQ-4.0 is comparable to 25 dB SINAD equivalent intelligibility

[5] This is a NPSPAC configuration, 25 kHz channel bandwidths, but 12.5 kHz channel spacing. 20 *dB* OCR receivers assumed (25 *dB* ACPR)

[6] A wide IF bandwidth assumed as part of a migration process

[7] A narrow IF bandwidth is assumed after migration is completed.

[8] Reduced deviation for NPSPAC regulations.

[9] Contact manufacturer as sensitivity varies by deployment configuration

These values were obtained from the manufacturers. It is recommended that they be verified with the manufacturer prior to usage

[*] VSELP values represent worst case, low speed

Receiver characteristics can be found in Table 6.

A.2 Projected Parameters for Data Systems

Data message success rates differ from voice DAQ as protocol multiple tries are employed to ensure the message is successfully delivered. These protocols can differ by manufacturer and by the type of data traffic being utilized. For two examples of the desired information necessary for throughput simulations, see Figure 7 MSR versus *C/N* Curves for SAM 50 kHz, 5 Tries" and Table 3 "Reliability versus *C/N* for 50 kHz QPSK Outbound Data at 576 Bytes". Currently no specific recommendations are provided.

Table 7 IF Filter Specification for Simulating Wideband Data Receivers contains the recommended parametric values.

A.3 Test Signals

Test signals are used to modulate each transmitter when measuring ACPR. Table A 2 summarizes the recommended test signals for voice. Consult the appropriate reference document to insure that this listing is current and correct.

Table A 2 Voice Interference Test Signals

Modulation Type	Modulation Test Signal
Analog FM (± 2.5 kHz)	650 Hz tone & 2.2 kHz tone per § 5.7.1.1
Analog FM, NPSPAC (± 4 kHz)	
Analog FM (± 5 kHz)	
C4FM (12.5 kHz) 9.6 kb/s	9.6 kb/s binary ITU-T O.153 per TIA 102.CAAA[1]
CQPSK LSM (12.5 kHz) 9.6 kb/s	
CQPSK WCQPSK (12.5 kHz) 9.6 kb/s	
CVSD – Normal (± 4 kHz)	12.0 kb/s binary ITU-T O.153 sequence
CVSD – NPSPAC (± 2.4 kHz)	
EDACS® Narrowband Digital	9.6 kb/s binary ITU-T O.153 sequence
EDACS® NPSPAC Digital	
EDACS® Wideband Digital	
dPMR 4LFSK FDMA AMBE 2+(6.25 kHz)	4.8 kb/s binary ITU-T O.153 sequence
NXDN 4LFSK FDMA AMBE 2+(6.25 kHz)	4.8 kb/s binary ITU-T O.153 sequence
NXDN 4LFSK FDMA AMBE 2+(12.5 kHz)	9.6 kb/s binary ITU-T O.153 sequence
Tetrapol	8.0 kb/s binary ITU-T O.153 sequence
ETSI DMR 2 slot TDMA (AMBE 2+)(12.5 kHz)	9.6 kb/s binary ITU-T O.153 sequence
F4GFSK (AMBE) OpenSky®	19.2 kb/s binary ITU-T O.153 sequence
H-CPM (P25 TDMA Uplink)	1031.25[2]
H-DQPSK (P25 TDMA Downlink)	1031.25[3]
DIMRS-iDEN®	[TBD]
TETRA	[TBD]

[1] The ITU-T O.153 sequence produces a slightly asymmetrical SPD file. The standard interference test pattern in [102.CAAA] §1.3.3.7 (c) uses a balanced sequence which will produce a slightly more optimistic ACPR value.
[2] TDMA inbound symmetrical test pattern per [102.CCAA] §1.6.5
[3] TDMA outbound test pattern per [102.CCAA] §1.6.1

Table A 3 Wide Data Interference Test Signals

Modulation Type	I Sample file Name	Q Sample file Name
DataRadio 50 kHz		
HPD 25 kHz		
IOTA 50 kHz, [902.CBAA]	Interference_50kHz.i	Interference_50kHz.q
SAM 50 kHz, [902.CAAA]	Interference_50kHz.i	Interference_50kHz.q

A.4 Offset Separations

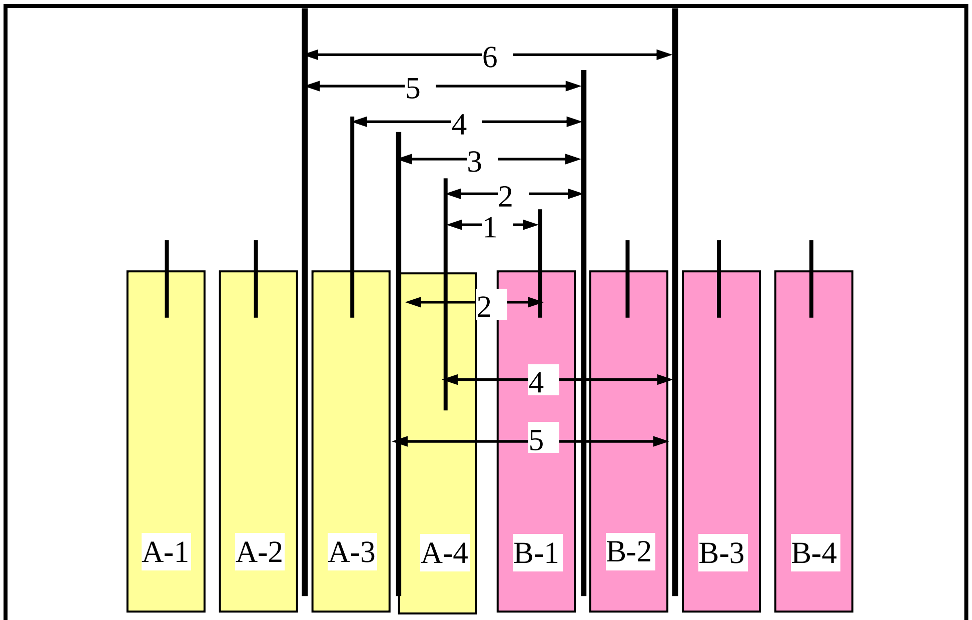
Frequency offsets vary with frequency bands and by the type of modulation being deployed. Voice channels are considered to be limited to 6.25 kHz, 12.5 kHz and 25 kHz. Wide band data channels are considered to be 25 kHz and 50 kHz. Broadband channels are currently being discussed and there is no specific bandwidth or offsets standardized at this time.

A.4.1 Narrow Band Offsets

The following tables contain data points for the different modulations based on two different channel plans. The most common plan is for dividing a 25 kHz channel into four parts. The less common approach is to divide a 30 kHz channel into four parts. The 30 kHz plan is provided for VHF High Band channels.

Channel plans are given for all possible offsets. Not all are potentially assignable, but the data is provided in case some future modulation allows closer spacing. At this time only 7.5 kHz offsets are being considered by the FCC, but the data provided indicates that this would normally be an undesirable assignment for certain modulations.

The eleven possible narrow band offset assignments are shown in Figure A 1. Cross border frequency coordination and non standard offsets can necessitate different offset frequencies than shown in Figure A 1. See Annex H for recommendations on how to utilize ACPRUtil.exe to determine ACPR values for these cases.



Case	Block A to Block B	25 kHz Plan Offsets	30 kHz Plan Offsets
1	Narrow to Narrow A(4) - B(1)	6.25 kHz	7.5 kHz
2	Narrow to Medium A(4) - B(1-2) & Medium to Narrow A(3-4) - B(1)	9.375 kHz	11.25 kHz
3	Medium to Medium A(3-4) - (B(1-2)	12.5 kHz	15.0 kHz
4	Narrow to Medium A(3) - B(1-2) & Narrow to Wide A(4) - B(1-4)	15.625 kHz	18.75 kHz
5	Medium to Wide A(3-4) - B(1-4) & Wide to Medium A(1-4) - B(1-2)	18.75 kHz	22.5 kHz
6	Wide to Wide A(1-4) - B(1-4)	25.0 kHz	30.0 kHz

Figure A 1 Narrow Band Frequency Offsets

A.4.2 Wideband Data and Narrowband Frequency Offsets

Wideband channels are limited to waivers in the US 700 MHz band, §5.7.1.5. Canada might utilize them in rural areas. Figure A 2 shows the possible alignments of various wideband and narrowband channels. (§§5.7.1.6-5.7.1.7).

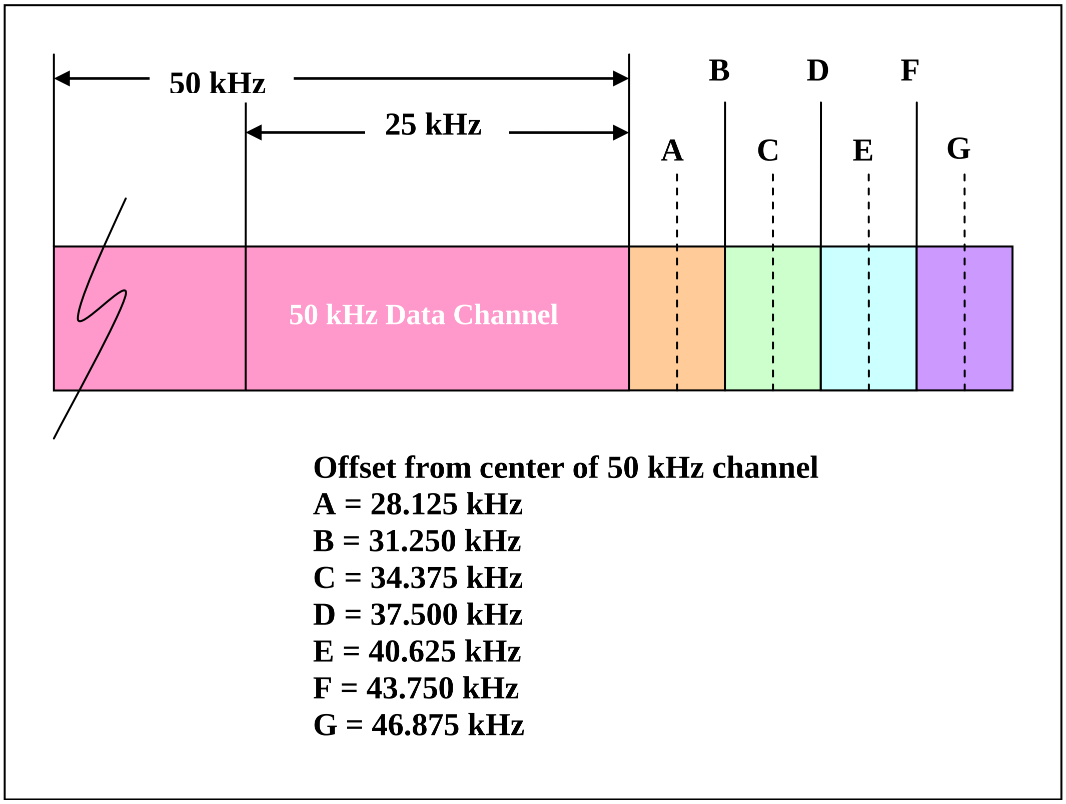


Figure A 2 Wideband Data and Narrowband Frequency Offsets

There are seven different offsets relative to a 50 kHz wideband channel

- A represents a 6.25 kHz channel offset by 28.125 kHz, 1st adjacent
- B represents a 12.5 kHz channel offset by 31.250 kHz, 1st adjacent
- C represents a 6.25 kHz channel offset by 34.375 kHz, 2nd adjacent.
- D represents a 25 kHz channel offset by 37.5 kHz, 1st adjacent.
- E represents a 6.25 kHz channel offset by 40.625 kHz, 3rd adjacent.
- F represents a 12.5 kHz channel offset by 43.75 kHz, 2nd adjacent.
- G represents a 6.25 kHz channel offset by 46.875 kHz, 4th adjacent.

As the offset exceeds 50 kHz, the SPD data file might not have data for offsets greater than 50 kHz. However the power levels at that offset are generally quite low and do not contribute to the ACPR calculation. Considering the unlikelihood of these configurations the variation in ACPR is not considered critical. If concern is expressed, the narrowband data file can be edited to retain the 100 kHz span but no longer symmetrical. This entails editing the frequency offset data and padding the extension as described in footnote 3 of Table 12.

A.4.3 Broadband Offsets

The Public Safety broadband portion of the 700 MHz band is currently in flux. It is anticipated that this will become more of a commercial configuration which will follow the deployment based on LTE.

This section will be updated as appropriate but only at a high level.

A.5 Analog FM Modulations

A.5.1 2.5 kHz Peak Deviation

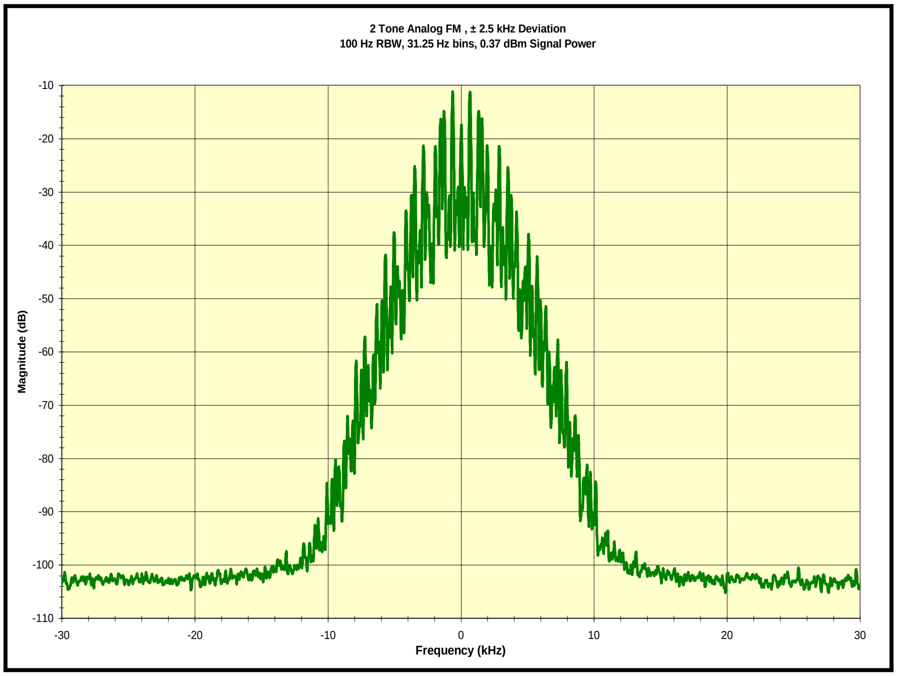


Figure A 3 Analog FM, ± 2.5 kHz Deviation

A.5.1.1 Emission Designator

11K0F3E

A.5.1.2 Typical Receiver Characteristics

5K50R20|| USA Narrowband Preferred

7K80R20|| European Version Optional

A.5.1.3 Discussion:

FM modulation normally used for narrowband radios. European versions often use a wider ENBW receiver due to greater spatial separation for adjacent channel assignments.

The analog 2 tone modulation creates a gagged line when charted using the channel bandwidth filter. This is due to the interception of individual modulation components. The other filters produce a smoother curve.

A.5.1.4 AFM, ± 2.5, 25/30 kHz Plan Offsets

Table A 4 AFM, ± 2.5, 25/30 kHz Plan Offsets

6.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	29.70	29.69	29.18
4	29.48	28.15	27.16
4.5	26.02	26.03	24.49
5	24.10	22.89	21.86
5.5	20.15	20.35	19.66
6	18.49	18.51	17.82
6.5	18.28	16.62	16.26
7	14.34	15.28	14.87
7.5	13.95	14.31	13.47
8	13.77	13.38	11.96
8.5	13.48	11.96	10.41
9	11.86	10.17	8.95
9.5	8.87	8.63	7.65
10	6.42	7.12	6.53
10.5	6.19	5.86	5.59
11	6.10	4.89	4.79
11.5	3.30	4.16	4.11
12	3.26	3.56	3.52
12.5	3.01	3.01	3.00
13	2.77	2.52	2.54
14	1.21	1.67	1.80
15	1.12	1.03	1.25
16	0.29	0.58	0.86
17	0.18	0.31	0.59
18	0.16	0.17	0.41

15.625 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	81.58	81.56	81.54
4	80.89	80.89	80.89
4.5	80.32	80.32	80.32
5	79.79	79.81	79.82
5.5	79.33	79.37	79.38
6	79.00	78.98	78.97
6.5	78.64	78.63	78.58
7	78.31	78.26	78.19
7.5	77.94	77.89	77.78
8	77.52	77.52	77.32
8.5	77.17	77.11	76.76
9	76.85	76.68	76.01
9.5	76.32	76.21	74.92
10	75.75	75.60	73.35
10.5	75.43	74.82	71.20
11	74.78	73.77	68.54
11.5	73.55	72.61	65.56
12	72.14	71.27	62.42
12.5	70.48	69.49	59.26
13	69.33	67.51	56.15
14	66.51	61.94	50.15
15	62.17	56.55	44.53
16	55.54	52.46	39.32
17	50.05	47.48	34.54
18	48.82	41.92	30.17

7.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	40.18	38.29	37.87
4	35.58	35.92	35.44
4.5	34.83	33.87	33.28
5	30.91	31.72	31.48
5.5	30.05	30.41	29.77
6	29.70	29.25	27.69
6.5	29.47	27.65	25.26
7	26.02	25.05	22.84
7.5	24.10	22.28	20.65
8	20.15	20.21	18.75
8.5	18.49	18.13	17.07
9	18.28	16.50	15.51
9.5	14.34	15.32	13.99
10	13.95	14.29	12.48
10.5	13.77	12.99	10.99
11	13.48	11.32	9.60
11.5	11.86	9.80	8.34
12	8.87	8.29	7.22
12.5	6.42	6.93	6.25
13	6.19	5.81	5.41
14	3.30	4.21	4.04
15	3.01	3.01	2.99
16	2.74	2.06	2.18
17	1.18	1.34	1.58
18	0.60	0.83	1.13

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	82.36	82.37	82.37
4	81.77	81.77	81.77
4.5	81.24	81.24	81.24
5	80.75	80.76	80.76
5.5	80.32	80.34	80.34
6	79.97	79.96	79.96
6.5	79.62	79.61	79.61
7	79.28	79.29	79.28
7.5	78.99	78.99	78.97
8	78.71	78.70	78.67
8.5	78.43	78.41	78.37
9	78.15	78.13	78.09
9.5	77.87	77.85	77.81
10	77.58	77.57	77.54
10.5	77.30	77.31	77.27
11	77.07	77.06	77.00
11.5	76.80	76.82	76.69
12	76.59	76.60	76.31
12.5	76.40	76.37	75.76
13	76.21	76.15	74.89
14	75.71	75.67	71.60
15	75.27	75.08	66.42
16	74.59	74.13	60.60
17	74.02	72.55	54.90
18	72.41	69.89	49.52

9.375 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	55.58	55.24	54.65
4	53.79	52.73	52.27
4.5	50.06	50.57	50.35
5	49.28	49.39	48.33
5.5	48.83	47.71	45.69
6	46.66	45.51	42.66
6.5	43.72	42.30	39.71
7	41.51	39.12	37.08
7.5	35.72	36.68	34.74
8	35.45	34.25	32.56
8.5	34.49	32.43	30.37
9	30.55	31.02	28.10
9.5	29.79	29.48	25.79
10	29.57	27.46	23.57
10.5	26.80	24.80	21.49
11	25.88	22.61	19.59
11.5	22.86	20.39	17.83
12	18.53	18.49	16.17
12.5	18.41	17.02	14.60
13	16.76	15.78	13.10
14	13.79	12.91	10.36
15	11.97	9.88	8.07
16	8.48	7.22	6.24
17	6.15	5.34	4.80
18	3.81	3.87	3.68

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	82.36	82.37	82.37
4	81.77	81.77	81.77
4.5	81.24	81.24	81.24
5	80.75	80.76	80.76
5.5	80.32	80.34	80.34
6	79.97	79.96	79.96
6.5	79.62	79.61	79.61
7	79.28	79.29	79.28
7.5	78.99	78.99	78.97
8	78.71	78.70	78.67
8.5	78.43	78.41	78.37
9	78.15	78.13	78.09
9.5	77.87	77.85	77.81
10	77.58	77.57	77.54
10.5	77.30	77.31	77.27
11	77.07	77.06	77.00
11.5	76.80	76.82	76.69
12	76.59	76.60	76.31
12.5	76.40	76.37	75.76
13	76.21	76.15	74.89
14	75.71	75.67	71.60
15	75.27	75.08	66.42
16	74.59	74.13	60.60
17	74.02	72.55	54.90
18	72.41	69.89	49.52

11.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	73.07	72.61	72.32
4	70.90	70.84	70.46
4.5	69.75	69.43	68.19
5	67.53	66.96	65.39
5.5	64.21	64.65	62.35
6	63.12	61.64	59.21
6.5	61.83	58.54	56.36
7	55.76	55.80	53.75
7.5	54.58	53.25	51.22
8	51.54	51.41	48.56
8.5	49.66	49.77	45.73
9	49.11	47.78	42.86
9.5	48.22	45.27	40.09
10	44.17	42.03	37.48
10.5	43.32	39.42	35.00
11	40.18	36.78	32.61
11.5	35.58	34.62	30.27
12	34.83	32.95	27.98
12.5	30.91	31.30	25.78
13	30.05	29.47	23.68
14	29.47	24.69	19.86
15	24.10	20.41	16.50
16	18.49	17.34	13.53
17	14.34	14.46	10.94
18	13.77	11.36	8.75

22.50 kHz Offset ACCCPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	82.68	82.66	82.65
4	82.04	82.04	82.05
4.5	81.51	81.52	81.54
5	81.07	81.08	81.09
5.5	80.66	80.67	80.67
6	80.30	80.29	80.28
6.5	79.94	79.93	79.93
7	79.60	79.60	79.60
7.5	79.30	79.29	79.29
8	79.01	79.00	79.00
8.5	78.73	78.73	78.73
9	78.48	78.48	78.47
9.5	78.24	78.23	78.23
10	78.00	78.00	77.99
10.5	77.78	77.78	77.77
11	77.56	77.56	77.56
11.5	77.37	77.36	77.35
12	77.16	77.16	77.16
12.5	76.97	76.97	76.97
13	76.78	76.79	76.78
14	76.46	76.46	76.41
15	76.14	76.14	75.95
16	75.86	75.83	75.12
17	75.56	75.53	73.28
18	75.23	75.23	69.88

12.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	78.59	78.60	78.57
4	77.78	77.80	77.52
4.5	77.22	76.71	76.19
5	75.16	75.32	74.60
5.5	74.32	73.67	72.82
6	72.59	71.97	70.82
6.5	70.61	70.49	68.42
7	69.53	68.57	65.58
7.5	67.40	66.32	62.52
8	64.15	63.68	59.48
8.5	63.08	60.58	56.57
9	61.80	57.77	53.74
9.5	55.75	55.03	50.92
10	54.57	52.93	48.05
10.5	51.53	51.17	45.18
11	49.66	49.17	42.36
11.5	49.11	46.90	39.65
12	48.22	43.73	37.05
12.5	44.17	41.05	34.57
13	43.32	38.36	32.17
14	35.58	34.23	27.64
15	30.91	30.71	23.51
16	29.70	25.96	19.84
17	26.02	21.61	16.58
18	20.15	18.37	13.72

25.0 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	82.51	82.51	82.52
4	81.96	81.95	81.95
4.5	81.45	81.45	81.45
5	80.98	81.01	81.01
5.5	80.63	80.62	80.62
6	80.25	80.26	80.26
6.5	79.92	79.92	79.92
7	79.60	79.61	79.61
7.5	79.33	79.32	79.32
8	79.05	79.05	79.05
8.5	78.79	78.79	78.79
9	78.54	78.55	78.55
9.5	78.34	78.32	78.32
10	78.09	78.11	78.11
10.5	77.89	77.90	77.90
11	77.72	77.71	77.71
11.5	77.53	77.52	77.52
12	77.35	77.34	77.34
12.5	77.16	77.17	77.16
13	77.00	77.00	76.99
14	76.67	76.68	76.67
15	76.38	76.38	76.35
16	76.10	76.09	76.03
17	75.82	75.81	75.62
18	75.55	75.55	74.92

25 kHz Plan

15 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	81.17	81.13	81.15
4	80.51	80.52	80.54
4.5	80.02	80.02	80.02
5	79.57	79.57	79.55
5.5	79.16	79.15	79.10
6	78.76	78.71	78.64
6.5	78.24	78.27	78.17
7	77.88	77.83	77.67
7.5	77.45	77.37	77.09
8	77.00	76.87	76.35
8.5	76.38	76.34	75.33
9	75.90	75.64	73.91
9.5	75.56	74.74	71.96
10	74.05	73.56	69.49
10.5	73.40	72.30	66.62
11	71.98	70.85	63.54
11.5	70.20	68.96	60.39
12	69.21	66.87	57.26
12.5	67.22	63.97	54.18
13	64.06	61.19	51.18
14	61.75	55.86	45.42
15	54.56	51.83	40.06
16	49.66	46.77	35.13
17	48.21	41.24	30.63
18	43.32	36.64	26.52

30 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	82.95	82.94	82.93
4	82.37	82.35	82.34
4.5	81.79	81.81	81.82
5	81.36	81.36	81.37
5.5	80.97	80.97	80.97
6	80.63	80.61	80.60
6.5	80.26	80.26	80.26
7	79.93	79.94	79.95
7.5	79.63	79.65	79.65
8	79.36	79.36	79.36
8.5	79.08	79.08	79.09
9	78.82	78.83	78.83
9.5	78.58	78.59	78.59
10	78.37	78.37	78.36
10.5	78.16	78.15	78.15
11	77.96	77.94	77.94
11.5	77.74	77.74	77.74
12	77.55	77.55	77.55
12.5	77.37	77.36	77.36
13	77.19	77.18	77.19
14	76.83	76.85	76.86
15	76.54	76.56	76.56
16	76.29	76.28	76.28
17	76.02	76.02	76.01
18	75.76	75.77	75.75

30 kHz Plan

A.5.2 4 kHz Peak Deviation

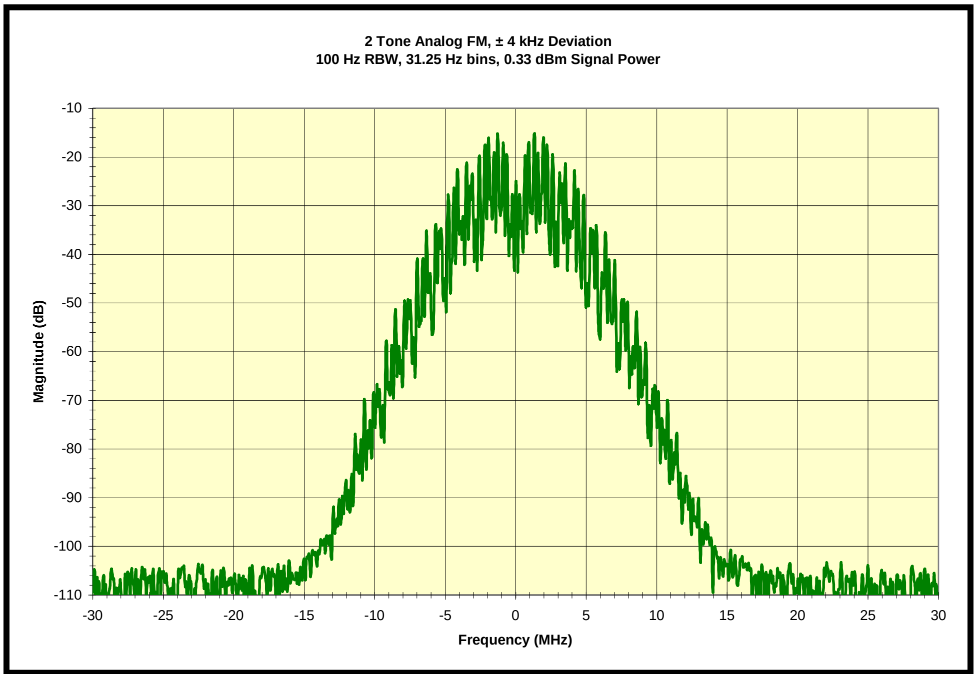


Figure A 4 Analog FM, ± 4 kHz Deviation

A.5.2.1 Emission Designator

14K0F3E

A.5.2.2 Typical Receiver Characteristics

12K6B0403, to achieve 20 dB offset channel selectivity in the 800 MHz NPSPAC band

11K1B0403, to achieve 20 dB offset channel selectivity in the entire 800 MHz band for 12.5 kHz channel spacing.

A.5.2.3 Discussion:

This modulation is used in the United States in the 800 MHz NPSPAC band. The reduced deviation is used to allow closer spacing than normal ± 5 kHz Analog FM deviation would allow. Channels are 20 kHz wide, with 12.5 kHz channel spacing. A minimum ACRR of 20 dB at 12.5 kHz offset is assumed for a “companion receiver” (configured for the same type of modulation as the radio would transmit).

A.5.2.4 AFM, ± 4, 25/30 kHz Plan Offsets

Table A 5 AFM, ± 4, 25/30 kHz Plan Offsets

25 kHz Plan

6.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	19.66	18.98	18.40
4	17.46	16.67	16.46
4.5	14.56	15.03	14.99
5	14.23	13.96	13.77
5.5	13.01	12.86	12.67
6	11.83	11.84	11.68
6.5	10.79	11.02	10.71
7	10.70	10.24	9.69
7.5	9.30	9.23	8.63
8	9.03	8.08	7.61
8.5	7.37	7.01	6.69
9	5.89	6.04	5.90
9.5	5.34	5.22	5.23
10	4.19	4.54	4.68
10.5	4.02	4.03	4.24
11	3.40	3.65	3.87
11.5	3.10	3.37	3.56
12	3.07	3.17	3.28
12.5	3.00	3.00	3.02
13	2.94	2.82	2.76
14	2.63	2.37	2.24
15	2.07	1.82	1.76
16	1.28	1.28	1.34
17	0.58	0.86	1.01
18	0.38	0.56	0.75

15.625 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	84.04	83.84	83.64
4	82.86	82.73	82.55
4.5	81.56	81.67	81.42
5	80.81	80.58	80.21
5.5	79.35	79.42	78.88
6	78.45	78.21	77.36
6.5	77.41	76.80	75.57
7	75.84	75.43	73.44
7.5	74.10	73.62	71.06
8	73.16	71.51	68.57
8.5	69.87	69.21	66.06
9	68.14	66.79	63.55
9.5	66.88	64.69	61.00
10	62.84	62.62	58.34
10.5	61.91	60.63	55.66
11	60.51	58.75	53.00
11.5	58.16	56.52	50.39
12	56.03	54.18	47.86
12.5	55.55	51.48	45.39
13	51.03	49.21	42.98
14	48.40	45.08	38.36
15	43.64	41.32	34.04
16	39.70	37.04	30.04
17	37.96	32.93	26.38
18	33.07	29.39	23.04

9.375 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	39.70	39.69	39.56
4	38.17	38.40	37.70
4.5	37.96	36.41	35.49
5	33.94	34.36	33.13
5.5	33.07	31.80	30.93
6	30.27	29.64	29.03
6.5	27.74	28.09	27.33
7	27.49	26.56	25.68
7.5	25.17	25.14	24.01
8	23.87	23.81	22.27
8.5	22.84	22.34	20.50
9	22.59	20.61	18.80
9.5	19.74	18.68	17.23
10	17.99	17.06	15.79
10.5	15.21	15.58	14.49
11	14.37	14.26	13.28
11.5	14.12	13.16	12.15
12	12.11	12.18	11.06
12.5	11.33	11.23	10.04
13	10.76	10.18	9.07
14	9.27	8.13	7.37
15	6.02	6.31	6.01
16	5.23	4.94	4.96
17	3.57	4.03	4.14
18	3.81	3.87	3.68

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	87.12	87.05	BF 4-3
4	86.56	86.52	86.46
4.5	85.95	85.94	85.87
5	85.37	85.34	85.30
5.5	84.76	84.80	84.76
6	84.34	84.29	84.24
6.5	83.84	83.79	83.76
7	83.33	83.33	83.31
7.5	82.87	82.92	82.87
8	82.55	82.54	82.43
8.5	82.26	82.18	81.92
9	81.90	81.78	81.32
9.5	81.47	81.28	80.55
10	81.04	80.72	79.53
10.5	80.29	80.04	78.16
11	79.64	79.27	76.39
11.5	79.18	78.35	74.21
12	77.95	77.29	71.71
12.5	76.94	76.08	69.02
13	76.03	74.43	66.22
14	73.56	70.33	60.51
15	68.62	66.05	55.00
16	64.43	61.98	49.79
17	61.29	57.59	44.91
18	56.92	52.47	40.38

12.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	64.53	64.45	64.15
4	62.48	62.49	62.11
4.5	61.34	60.84	60.08
5	59.10	58.78	57.96
5.5	56.93	57.09	55.61
6	55.91	54.91	53.01
6.5	54.62	52.59	50.39
7	50.61	49.92	47.94
7.5	48.90	47.37	45.66
8	44.65	45.44	43.47
8.5	43.84	43.56	41.28
9	43.52	41.75	39.04
9.5	40.97	40.05	36.79
10	38.71	38.14	34.58
10.5	38.06	36.03	32.46
11	35.50	33.65	30.44
11.5	33.79	31.67	28.51
12	31.72	29.86	26.64
12.5	27.96	28.15	24.83
13	27.51	26.65	23.08
14	24.88	23.56	19.81
15	22.76	19.99	16.90
16	19.64	16.91	14.36
17	14.55	14.40	12.13
18	13.00	12.22	10.19

25.0 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	87.18	87.12	87.19
4	86.63	86.70	86.68
4.5	86.32	86.24	86.18
5	85.73	85.71	85.71
5.5	85.13	85.25	85.30
6	84.88	84.91	84.96
6.5	84.65	84.64	84.67
7	84.44	84.40	84.40
7.5	84.13	84.15	84.14
8	83.93	83.90	83.90
8.5	83.66	83.66	83.67
9	83.45	83.44	83.45
9.5	83.23	83.23	83.25
10	83.00	83.05	83.05
10.5	82.86	82.87	82.87
11	82.73	82.70	82.69
11.5	82.57	82.53	82.50
12	82.41	82.36	82.33
12.5	82.25	82.18	82.15
13	82.01	82.00	81.97
14	81.65	81.67	81.62
15	81.34	81.35	81.19
16	81.10	81.05	80.43
17	80.77	80.77	78.75
18	80.47	80.48	75.57

30 kHz Plan

7.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	27.13	26.36	25.96
4	24.89	24.60	24.43
4.5	22.97	23.38	22.97
5	22.76	22.04	21.30
5.5	20.01	20.49	19.43
6	19.64	18.43	17.62
6.5	17.45	16.52	16.03
7	14.55	15.11	14.67
7.5	14.23	13.84	13.47
8	13.00	12.74	12.37
8.5	11.83	11.84	11.31
9	10.79	10.99	10.27
9.5	10.70	10.04	9.23
10	9.30	8.96	8.24
10.5	9.03	7.92	7.34
11	7.37	6.91	6.53
11.5	5.89	6.00	5.83
12	5.34	5.22	5.23
12.5	4.19	4.59	4.73
13	4.02	4.10	4.30
14	3.10	3.45	3.60
15	3.00	3.00	3.02
16	2.91	2.56	2.48
17	2.18	2.05	1.99
18	1.50	1.53	1.56

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	87.12	87.05	87.04
4	86.56	86.52	86.46
4.5	85.95	85.94	85.87
5	85.37	85.34	85.30
5.5	84.76	84.80	84.76
6	84.34	84.29	84.24
6.5	83.84	83.79	83.76
7	83.33	83.33	83.31
7.5	82.87	82.92	82.87
8	82.55	82.54	82.43
8.5	82.26	82.18	81.92
9	81.90	81.78	81.32
9.5	81.47	81.28	80.55
10	81.04	80.72	79.53
10.5	80.29	80.04	78.16
11	79.64	79.27	76.39
11.5	79.18	78.35	74.21
12	77.95	77.29	71.71
12.5	76.94	76.08	69.02
13	76.03	74.43	66.22
14	73.56	70.33	60.51
15	68.62	66.05	55.00
16	64.43	61.98	49.79
17	61.29	57.59	44.91
18	56.92	52.47	40.38

11.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	55.92	55.76	54.79
4	54.62	53.01	52.15
4.5	50.61	50.71	49.47
5	48.90	47.85	47.00
5.5	44.65	45.57	44.88
6	43.84	43.89	42.90
6.5	43.52	42.10	40.87
7	40.97	40.43	38.74
7.5	38.71	38.67	36.51
8	38.06	36.72	34.26
8.5	35.50	34.50	32.13
9	33.79	32.13	30.13
9.5	31.72	30.26	28.25
10	27.96	28.54	26.43
10.5	27.51	26.92	24.64
11	27.12	25.50	22.87
11.5	24.88	24.03	21.16
12	22.97	22.44	19.52
12.5	22.76	20.57	17.99
13	20.01	18.87	16.56
14	17.45	15.87	14.00
15	14.23	13.51	11.75
16	11.83	11.39	9.78
17	10.70	9.29	8.10
18	9.03	7.39	6.72

22.50 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	87.34	87.30	87.33
4	86.83	86.83	86.82
4.5	86.43	86.36	86.33
5	85.90	85.88	85.86
5.5	85.45	85.43	85.45
6	85.03	85.06	85.07
6.5	84.74	84.73	84.72
7	84.44	84.40	84.39
7.5	84.12	84.09	84.09
8	83.75	83.81	83.80
8.5	83.59	83.54	83.53
9	83.33	83.27	83.26
9.5	83.01	83.02	83.02
10	82.76	82.78	82.78
10.5	82.51	82.56	82.55
11	82.37	82.35	82.34
11.5	82.16	82.14	82.12
12	82.00	81.95	81.89
12.5	81.75	81.76	81.65
13	81.55	81.58	81.34
14	81.21	81.20	80.29
15	80.77	80.74	77.87
16	80.39	80.20	73.67
17	79.87	79.44	68.47
18	79.02	78.29	63.13

15 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	81.62	81.62	81.45
4	80.88	80.41	80.14
4.5	79.17	79.13	78.76
5	77.87	77.86	77.23
5.5	76.76	76.34	75.45
6	74.71	74.92	73.34
6.5	73.94	72.95	70.95
7	72.70	70.76	68.46
7.5	68.73	68.37	65.99
8	67.48	65.96	63.56
8.5	64.48	63.92	61.11
9	62.45	61.88	58.55
9.5	61.31	59.93	55.91
10	59.09	58.04	53.26
10.5	56.92	55.80	50.67
11	55.90	53.41	48.14
11.5	54.61	50.72	45.69
12	50.61	48.49	43.29
12.5	48.90	46.44	40.95
13	44.65	44.43	38.65
14	43.52	40.71	34.27
15	38.71	36.40	30.22
16	35.50	32.34	26.50
17	31.72	28.86	23.10
18	27.51	25.68	20.03

30 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	88.22	88.20	88.21
4	87.50	87.59	87.62
4.5	87.16	87.12	87.12
5	86.74	86.69	86.68
5.5	86.25	86.26	86.28
6	85.80	85.90	85.94
6.5	85.64	85.61	85.65
7	85.35	85.37	85.33
7.5	84.96	84.99	84.99
8	84.62	84.67	84.68
8.5	84.35	84.38	84.39
9	84.17	84.11	84.11
9.5	83.91	83.85	83.86
10	83.59	83.60	83.62
10.5	83.34	83.38	83.39
11	83.11	83.17	83.18
11.5	82.95	82.96	82.98
12	82.87	82.78	82.80
12.5	82.64	82.61	82.62
13	82.36	82.45	82.45
14	82.14	82.13	82.12
15	81.89	81.82	81.81
16	81.50	81.53	81.52
17	81.23	81.25	81.24
18	81.01	80.99	80.95

A.5.3 5.0 kHz Peak Deviation

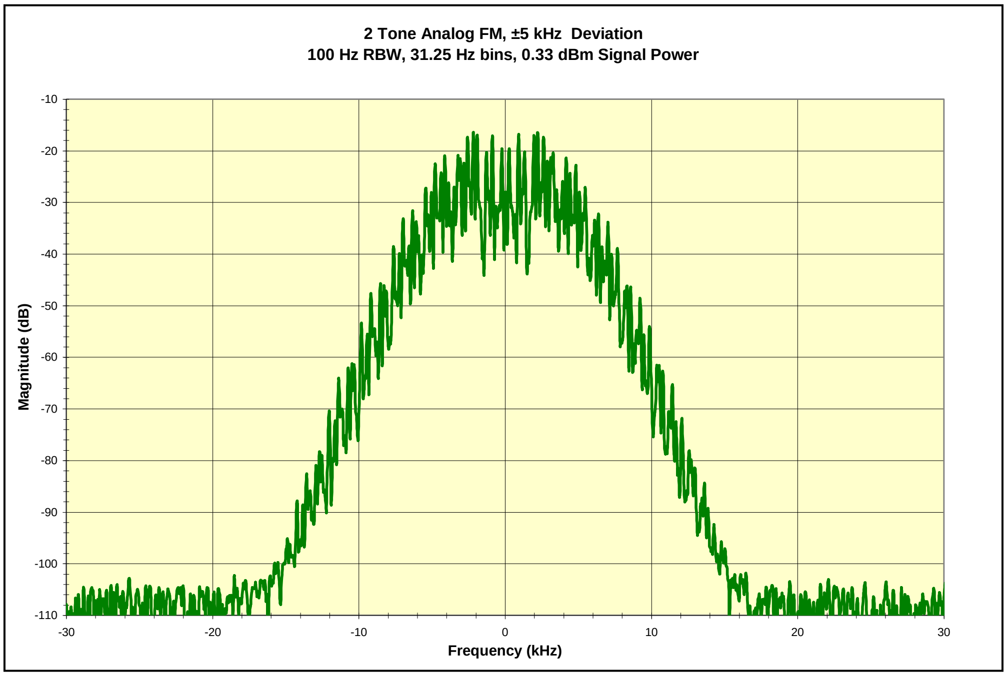


Figure A 5 Analog FM, ± 5 kHz Deviation

A.5.3.1 Emission Designator

16K0F3E

A.5.3.2 Typical Receiver Characteristics

Use 16K0B0403 for high band (150 MHz) and UHF (460 MHz) receivers and 800 MHz receivers in the 800 MHz band that do not operate in the 800 MHz NPSPAC band.

Use 12K6B0403 for receivers that operate in the 800 MHz NPSPAC band.

Use 11K1B0403, for receivers claiming 20 dB offset channel selectivity from ± 5 kHz modulation at 12.5 kHz channel spacing in the non NPSPAC portion of the 800 MHz band.

A.5.3.3 Discussion

This represents legacy analog FM modulation. Receiver characteristics vary amongst manufacturers. The typical value indicated is considered to be typical of deployed receivers. Frequency coordination is typically based on this value. Wider receiver ENBW is potentially subject to greater interference from adjacent channels but is not provided additional protection.

This type of modulation will no longer be licensable between 150 MHz and 512 MHz beginning 1/1/2013 per FCC rules. Federal Government users have migrated away from this channel bandwidth for a considerable time.

A.5.3.4 AFM, ± 5, 25/30 kHz Plan Offsets

Table A 6 AFM, ± 5, 25/30 kHz Plan Offsets

6.25 kHz Offset ACPR				15.625 kHz Offset ACPR				7.5 kHz Offset ACPR				18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3
3.5	13.79	13.58	13.48	3.5	78.31	77.99	77.34	3.5	21.16	21.08	20.71	3.5	86.61	86.67	86.63
4	12.71	12.33	12.28	4	76.26	75.66	75.27	4	20.48	19.69	19.26	4	85.96	85.91	85.91
4.5	11.07	11.28	11.39	4.5	73.67	73.85	73.44	4.5	18.04	18.20	17.64	4.5	85.20	85.28	85.30
5	10.62	10.70	10.69	5	72.81	72.38	71.57	5	16.87	16.47	16.00	5	84.84	84.79	84.74
5.5	10.42	10.19	9.95	5.5	70.98	70.53	69.55	5.5	14.36	14.88	14.51	5.5	84.36	84.29	84.16
6	9.67	9.46	9.14	6	68.75	68.86	67.37	6	13.76	13.46	13.25	6	83.76	83.72	83.53
6.5	8.50	8.60	8.27	6.5	67.44	66.81	65.00	6.5	12.69	12.25	12.21	6.5	83.10	83.13	82.80
7	7.93	7.67	7.39	7	66.70	64.86	62.56	7	11.06	11.40	11.33	7	82.68	82.43	81.94
7.5	6.63	6.74	6.59	7.5	63.08	62.45	60.16	7.5	10.61	10.73	10.50	7.5	81.92	81.69	80.89
8	6.32	5.89	5.91	8	61.81	59.98	57.87	8	10.41	10.04	9.67	8	80.94	80.78	79.59
8.5	5.19	5.25	5.36	8.5	57.91	57.98	55.62	8.5	9.67	9.31	8.82	8.5	80.32	79.73	78.03
9	4.44	4.77	4.90	9	56.18	56.05	53.35	9	8.50	8.49	7.99	9	78.88	78.43	76.23
9.5	4.41	4.39	4.52	9.5	55.83	54.22	51.04	9.5	7.93	7.56	7.21	9.5	77.84	76.85	74.22
10	4.11	4.07	4.19	10	53.45	52.43	48.71	10	6.63	6.65	6.51	10	76.69	75.31	72.02
10.5	3.99	3.81	3.90	10.5	51.37	50.50	46.41	10.5	6.32	5.91	5.90	10.5	73.97	73.68	69.65
11	3.36	3.58	3.65	11	50.39	48.47	44.17	11	5.19	5.32	5.39	11	72.81	71.97	67.16
11.5	3.34	3.36	3.42	11.5	48.51	46.09	41.99	11.5	4.44	4.83	4.95	11.5	72.13	70.23	64.61
12	3.15	3.17	3.21	12	46.07	44.01	39.87	12	4.41	4.43	4.57	12	70.16	68.29	62.04
12.5	2.99	2.99	3.00	12.5	44.66	42.07	37.79	12.5	4.11	4.10	4.24	12.5	67.67	66.26	59.49
13	2.83	2.81	2.80	13	40.54	40.24	35.76	13	3.99	3.82	3.95	13	67.21	63.81	56.96
14	2.64	2.48	2.40	14	39.17	36.93	31.86	14	3.34	3.38	3.45	14	62.78	59.54	52.01
15	2.13	2.10	2.01	15	34.98	33.25	28.24	15	2.99	2.99	3.00	15	56.80	55.66	47.25
16	1.93	1.68	1.64	16	31.71	29.51	24.91	16	2.67	2.64	2.59	16	54.43	51.72	42.76
17	1.14	1.27	1.30	17	29.31	26.33	21.86	17	2.20	2.28	2.19	17	50.50	47.21	38.55
18	0.75	0.92	1.02	18	25.00	23.54	19.10	18	1.95	1.87	1.81	18	46.22	43.20	34.62

9.375 kHz Offset ACPR				18.75 kHz Offset ACPR				11.25 kHz Offset ACPR				22.50 kHz Offset ACCCPR			
ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3
3.5	31.72	32.16	31.79	3.5	86.61	86.67	86.63	3.5	45.72	45.26	44.35	3.5	87.53	87.45	87.42
4	30.69	30.45	29.72	4	85.96	85.91	85.91	4	43.80	42.39	41.98	4	86.79	86.77	86.80
4.5	29.31	28.17	27.65	4.5	85.20	85.28	85.30	4.5	40.00	40.38	40.08	4.5	86.21	86.27	86.31
5	25.72	26.24	25.89	5	84.84	84.79	84.74	5	39.35	38.88	38.37	5	85.96	85.87	85.89
5.5	25.00	24.73	24.38	5.5	84.36	84.29	84.16	5.5	37.16	37.28	36.69	5.5	85.50	85.52	85.51
6	23.88	23.35	23.02	6	83.76	83.72	83.53	6	35.69	35.91	34.95	6	85.16	85.16	85.14
6.5	22.20	22.26	21.70	6.5	83.10	83.13	82.80	6.5	34.71	34.35	33.04	6.5	84.82	84.82	84.79
7	21.19	21.18	20.28	7	82.68	82.43	81.94	7	34.39	32.67	31.05	7	84.49	84.48	84.44
7.5	20.98	19.94	18.76	7.5	81.92	81.69	80.89	7.5	30.93	30.71	29.09	7.5	84.18	84.14	84.10
8	18.53	18.49	17.24	8	80.94	80.78	79.59	8	29.92	28.62	27.28	8	83.81	83.81	83.78
8.5	17.85	16.87	15.80	8.5	80.32	79.73	78.03	8.5	27.21	26.84	25.62	8.5	83.47	83.49	83.46
9	16.62	15.34	14.50	9	78.88	78.43	76.23	9	25.33	25.22	24.07	9	83.22	83.19	83.17
9.5	13.97	13.92	13.35	9.5	77.84	76.85	74.22	9.5	24.58	23.84	22.56	9.5	82.89	82.91	82.88
10	12.98	12.77	12.31	10	76.69	75.31	72.02	10	22.52	22.66	21.05	10	82.66	82.64	82.60
10.5	11.47	11.86	11.36	10.5	73.97	73.68	69.65	10.5	21.55	21.42	19.55	10.5	82.41	82.37	82.31
11	10.75	11.04	10.46	11	72.81	71.97	67.16	11	21.13	20.10	18.09	11	82.14	82.12	82.00
11.5	10.56	10.27	9.60	11.5	72.13	70.23	64.61	11.5	20.47	18.58	16.71	11.5	81.90	81.87	81.65
12	10.25	9.48	8.78	12	70.16	68.29	62.04	12	18.03	17.07	15.42	12	81.60	81.62	81.20
12.5	9.03	8.64	8.02	12.5	67.67	66.26	59.49	12.5	16.87	15.59	14.24	12.5	81.43	81.36	80.57
13	8.32	7.78	7.31	13	67.21	63.81	56.96	13	14.36	14.29	13.15	13	81.21	81.08	79.67
14	6.50	6.26	6.12	14	62.78	59.54	52.01	14	12.69	12.24	11.21	14	80.53	80.40	76.65
15	4.49	5.13	5.18	15	56.80	55.66	47.25	15	10.61	10.50	9.50	15	79.96	79.32	72.15
16	4.40	4.32	4.45	16	54.43	51.72	42.76	16	9.67	8.78	8.03	16	78.90	77.41	66.97
17	3.52	3.73	3.86	17	50.50	47.21	38.55	17	7.93	7.21	6.80	17	77.01	74.80	61.74
18	3.81	3.87	3.68	18	46.22	43.20	34.62	18	6.32	5.94	5.79	18	73.62	71.57	56.72

12.5 kHz Offset ACPR				25.0 kHz Offset ACPR				15 kHz Offset ACPR				30 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3
3.5	54.45	54.33	53.82	3.5	87.28	87.24	87.25	3.5	73.18	73.27	73.01	3.5	87.66	87.69	87.74
4	52.42	52.24	51.93	4	86.61	86.68	86.70	4	72.44	71.81	71.16	4	87.18	87.18	87.22
4.5	50.51	50.82	49.96	4.5	86.28	86.22	86.20	4.5	70.36	69.76	69.17	4.5	86.80	86.79	86.77
5	50.30	48.77	47.75	5	85.83	85.76	85.73	5	67.77	68.14	67.05	5	86.40	86.36	86.33
5.5	46.22	46.87	45.42	5.5	85.27	85.30	85.31	5.5	67.31	66.02	64.71	5.5	85.86	85.93	85.93
6	45.71	44.41	43.16	6	84.83	84.91	84.94	6	63.39	64.09	62.25	6	85.54	85.55	85.56
6.5	43.80	42.13	41.11	6.5	84.60	84.59	84.63	6.5	62.81	61.53	59.86	6.5	85.20	85.22	85.24
7	40.00	40.34	39.22	7	84.30	84.32	84.34	7	61.34	59.11	57.62	7	84.94	84.92	84.94
7.5	39.35	38.61	37.38	7.5	84.08	84.07	84.08	7.5	56.81	57.20	55.46	7.5	84.64	84.64	84.67
8	37.16	37.10	35.49	8	83.88	83.83	83.85	8	55.96	55.30	53.27	8	84.35	84.39	84.43
8.5	35.69	35.62	33.54	8.5	83.59	83.61	83.62	8.5	54.44	53.55	51.01	8.5	84.15	84.18	84.21
9	34.71	33.96	31.58	9	83.38	83.40	83.42	9	52.42	51.75	48.71	9	83.98	83.99	84.01
9.5	34.39	32.14	29.67	9.5	83.16	83.21	83.23	9.5	50.50	49.82	46.41	9.5	83.83	83.81	83.82
10	30.93	30.07	27.86	10	83.04	83.04	83.06	10	50.30	47.74	44.18	10	83.68	83.63	83.65
10.5	29.92	28.23	26.15	10.5	82.89	82.89	82.88	10.5	46.22	45.36	42.02	10.5	83.48	83.47	83.48
11	27.21	26.51	24.53	11	82.73	82.74	82.71	11	45.71	43.31	39.92	11	83.24	83.31	83.32
11.5	25.33	24.99	22.96	11.5	82.62	82.58	82.53	11.5	43.80	41.40	37.86	11.5	83.05	83.13	83.14
12	24.58	23.71	21.43	12	82.48	82.42	82.35	12	40.00	39.62	35.84	12	82.93	82.91	82.93
12.5	22.52	22.42	19.94	12.5	82.32	82.24	82.16	12.5	39.35	38.04	33.85	12.5	82.73	82.72	82.74
13	21.55	21.10	18.51	13	82.06	82.05	81.96	13	37.16	36.35	31.92	13	82.52	82.54	82.55
14	20.47	18.12	15.88	14	81.69	81.69	81.49	14	34.71	32.66	28.26	14	82.19	82.21	82.20
15	16.87	15.27	13.61	15	81.34	81.32	80.67	15	30.93	28.94	24.91	15	81.96	81.88	81.87
16	13.76	13.09	11.65	16	81.00	80.97	78.89	16	27.21	25.82	21.83	16	81.56	81.57	81.55
17	11.06	11.23	9.93	17	80.61	80.59	75.55	17	24.58	23.06	19.02	17	81.25	81.27	81.23
18	10.41	9.46	8.46	18	80.32	80.12	71.02	18	21.55	20.08	16.52	18	81.01	80.99	80.88
25 kHz Plan								**30 kHz Plan**							

A.6 Digital FDMA Radio Modulations

A.6.1 C4FM Modulation

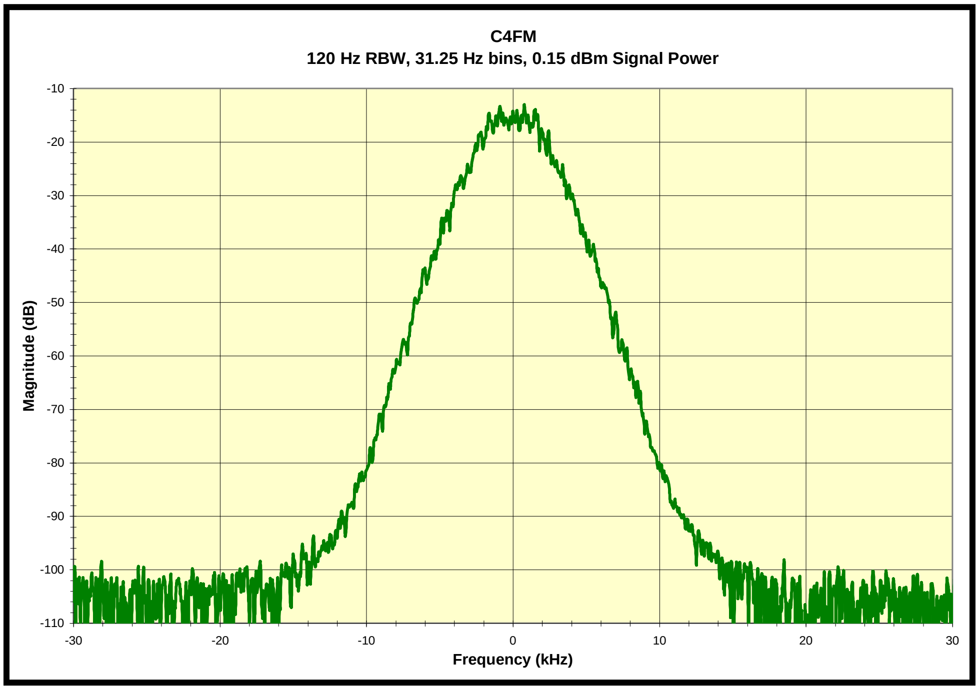


Figure A 6 C4FM

A.6.1.1 Emission Designator

8K10F1E

A.6.1.2 Typical Receive Characteristics

5K50R20||

A.6.1.3 Discussion

This is the Project 25 FDMA modulation. The modulation is a four level FM signal. The dibits are deviated ±600 Hz and ±1800 Hz. A QPSK-c receiver is compatible with C4FM, CQPSK and linear CQPSK modulations normally used for simulcast.

A.6.1.4 C4FM, 25/30 kHz Plan Offsets

Table A 7 C4FM, 25/30 kHz Plan Offsets

25 kHz Plan

6.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	26.88	26.89	26.56
4	25.50	25.15	24.53
4.5	23.50	23.11	22.48
5	21.31	21.11	20.61
5.5	19.44	19.44	18.88
6	18.26	17.98	17.18
6.5	16.79	16.49	15.45
7	15.50	14.81	13.74
7.5	13.64	13.13	12.12
8	11.76	11.55	10.63
8.5	10.52	10.06	9.29
9	9.25	8.73	8.10
9.5	7.59	7.52	7.05
10	6.54	6.45	6.14
10.5	5.72	5.55	5.34
11	4.68	4.77	4.64
11.5	4.00	4.10	4.03
12	3.53	3.52	3.48
12.5	2.99	3.01	3.00
13	2.51	2.54	2.57
14	1.75	1.76	1.86
15	1.04	1.14	1.32
16	0.49	0.69	0.93
17	0.27	0.40	0.65
18	0.12	0.22	0.45

9.375 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	52.87	52.56	52.16
4	50.58	50.62	49.99
4.5	49.23	48.73	47.56
5	46.91	46.30	44.92
5.5	44.12	43.80	42.32
6	42.09	41.22	39.89
6.5	39.35	39.01	37.61
7	37.37	37.04	35.37
7.5	35.88	35.19	33.10
8	33.90	33.20	30.82
8.5	32.19	31.07	28.57
9	30.03	29.05	26.39
9.5	27.89	27.03	24.30
10	26.06	24.97	22.29
10.5	24.57	23.03	20.37
11	22.24	21.25	18.54
11.5	20.39	19.61	16.78
12	18.86	17.94	15.12
12.5	17.48	16.23	13.57
13	16.16	14.59	12.14
14	12.76	11.48	9.64
15	9.97	8.82	7.61
16	6.97	6.71	5.98
17	5.09	5.08	4.67
18	3.81	3.87	3.68

12.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	77.46	77.37	77.04
4	75.79	75.70	75.39
4.5	74.25	74.22	73.74
5	72.95	72.72	71.88
5.5	71.31	71.07	69.70
6	69.80	69.04	67.23
6.5	67.77	66.80	64.58
7	65.00	64.50	61.85
7.5	63.20	62.03	59.11
8	60.87	59.48	56.40
8.5	58.30	57.07	53.70
9	55.87	54.77	50.98
9.5	53.85	52.69	48.24
10	51.58	50.50	45.53
10.5	49.85	48.14	42.88
11	48.20	45.62	40.29
11.5	45.66	43.15	37.78
12	43.12	40.89	35.33
12.5	40.98	38.79	32.96
13	38.07	36.75	30.66
14	34.86	32.50	26.33
15	31.45	28.35	22.39
16	26.88	24.35	18.84
17	23.50	20.82	15.71
18	19.44	17.33	12.99

15.625 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	86.35	86.35	86.30
4	85.46	85.54	85.51
4.5	84.85	84.84	84.78
5	84.30	84.17	84.08
5.5	83.48	83.50	83.38
6	82.89	82.83	82.68
6.5	82.19	82.20	81.94
7	81.61	81.50	81.12
7.5	80.85	80.72	80.18
8	80.04	79.88	79.06
8.5	79.25	79.01	77.70
9	78.36	77.95	76.02
9.5	77.44	76.72	73.97
10	76.12	75.40	71.55
10.5	74.63	73.97	68.83
11	73.41	72.35	65.90
11.5	72.06	70.42	62.89
12	70.47	68.32	59.85
12.5	68.70	66.01	56.84
13	66.22	63.51	53.89
14	62.10	58.56	48.18
15	56.95	54.07	42.82
16	52.85	49.25	37.84
17	49.23	44.29	33.24
18	44.12	39.92	29.01

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	88.46	88.49	88.55
4	88.00	88.03	88.08
4.5	87.67	87.68	87.70
5	87.43	87.39	87.34
5.5	87.13	87.05	86.94
6	86.70	86.61	86.51
6.5	86.10	86.13	86.06
7	85.65	85.69	85.63
7.5	85.30	85.28	85.20
8	84.93	84.87	84.78
8.5	84.60	84.46	84.36
9	84.04	84.06	83.93
9.5	83.66	83.65	83.50
10	83.42	83.25	83.04
10.5	82.85	82.85	82.54
11	82.54	82.45	81.93
11.5	82.15	82.03	81.13
12	81.72	81.58	80.02
12.5	81.29	81.09	78.45
13	80.86	80.54	76.36
14	79.71	79.17	70.98
15	78.30	77.25	64.97
16	76.41	74.75	59.03
17	73.77	71.25	53.41
18	71.07	66.80	48.14

25.0 kHz Offset ACPR			
ENBW	Ch BW	RRC	But-4-3
3.5	90.20	90.23	90.20
4	89.81	89.67	89.64
4.5	89.01	89.12	89.13
5	88.64	88.68	88.67
5.5	88.33	88.27	88.21
6	87.94	87.80	87.77
6.5	87.24	87.35	87.36
7	86.92	86.97	87.00
7.5	86.64	86.65	86.68
8	86.37	86.38	86.37
8.5	86.17	86.10	86.08
9	85.86	85.82	85.80
9.5	85.56	85.54	85.54
10	85.24	85.28	85.29
10.5	85.00	85.05	85.05
11	84.79	84.83	84.83
11.5	84.67	84.62	84.61
12	84.47	84.42	84.41
12.5	84.28	84.22	84.20
13	84.06	84.03	84.01
14	83.62	83.65	83.63
15	83.32	83.30	83.24
16	82.93	83.00	82.71
17	82.70	82.71	81.70
18	82.55	82.41	79.57

30 kHz Plan

7.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	36.73	36.51	36.15
4	34.86	34.74	34.18
4.5	33.10	32.92	32.04
5	31.45	30.77	29.81
5.5	28.96	28.62	27.64
6	26.88	26.71	25.51
6.5	25.49	24.74	23.46
7	23.50	22.72	21.51
7.5	21.31	20.91	19.66
8	19.44	19.28	17.87
8.5	18.26	17.73	16.11
9	16.79	16.10	14.41
9.5	15.50	14.42	12.81
10	13.64	12.82	11.34
10.5	11.76	11.26	9.99
11	10.52	9.84	8.79
11.5	9.25	8.54	7.72
12	7.59	7.39	6.77
12.5	6.54	6.38	5.94
13	5.72	5.52	5.20
14	4.00	4.10	3.97
15	2.99	3.01	2.99
16	2.17	2.14	2.23
17	1.34	1.45	1.64
18	0.78	0.93	1.19

11.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	69.93	69.65	68.97
4	67.84	67.29	66.50
4.5	65.03	65.00	63.95
5	63.22	62.69	61.28
5.5	60.88	60.16	58.61
6	58.30	57.63	56.05
6.5	55.87	55.30	53.54
7	53.85	53.12	50.99
7.5	51.58	51.14	48.36
8	49.86	48.93	45.70
8.5	48.20	46.54	43.08
9	45.66	43.98	40.54
9.5	43.12	41.57	38.08
10	40.98	39.39	35.66
10.5	38.07	37.38	33.29
11	36.73	35.37	30.97
11.5	34.86	33.26	28.71
12	33.10	31.18	26.55
12.5	31.45	29.14	24.47
13	28.96	27.05	22.49
14	25.49	23.15	18.81
15	21.31	19.70	15.55
16	18.26	16.27	12.71
17	15.50	13.04	10.31
18	11.76	10.23	8.32

15 kHz Offset ACPR			
BF 4-3	Ch BW	RRC	BF 4-3
3.5	85.25	85.21	85.16
4	84.44	84.42	84.36
4.5	83.70	83.64	83.57
5	82.91	82.93	82.78
5.5	82.33	82.17	81.95
6	81.44	81.37	81.07
6.5	80.66	80.52	80.11
7	79.78	79.63	79.04
7.5	78.89	78.71	77.72
8	77.92	77.59	76.14
8.5	76.84	76.29	74.24
9	75.42	74.92	72.00
9.5	74.00	73.45	69.44
10	72.79	71.77	66.63
10.5	71.19	69.78	63.70
11	69.72	67.64	60.71
11.5	67.72	65.29	57.73
12	64.97	62.77	54.77
12.5	63.19	60.27	51.87
13	60.87	57.85	49.02
14	55.87	53.40	43.57
15	51.58	48.57	38.47
16	48.20	43.65	33.74
17	43.12	39.32	29.40
18	38.07	34.98	25.44

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	88.46	88.49	88.55
4	88.00	88.03	88.08
4.5	87.67	87.68	87.70
5	87.43	87.39	87.34
5.5	87.13	87.05	86.94
6	86.70	86.61	86.51
6.5	86.10	86.13	86.06
7	85.65	85.69	85.63
7.5	85.30	85.28	85.20
8	84.93	84.87	84.78
8.5	84.60	84.46	84.36
9	84.04	84.06	83.93
9.5	83.66	83.65	83.50
10	83.42	83.25	83.04
10.5	82.85	82.85	82.54
11	82.54	82.45	81.93
11.5	82.15	82.03	81.13
12	81.72	81.58	80.02
12.5	81.29	81.09	78.45
13	80.86	80.54	76.36
14	79.71	79.17	70.98
15	78.30	77.25	64.97
16	76.41	74.75	59.03
17	73.77	71.25	53.41
18	71.07	66.80	48.14

22.50 kHz Offset ACCCPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	89.97	89.94	89.92
4	89.37	89.32	89.32
4.5	88.78	88.79	88.80
5	88.32	88.33	88.33
5.5	87.83	87.90	87.90
6	87.54	87.50	87.50
6.5	87.18	87.14	87.13
7	86.79	86.80	86.78
7.5	86.48	86.47	86.45
8	86.20	86.15	86.13
8.5	85.84	85.85	85.84
9	85.57	85.57	85.56
9.5	85.27	85.30	85.29
10	85.07	85.04	85.04
10.5	84.76	84.80	84.80
11	84.58	84.57	84.57
11.5	84.32	84.37	84.34
12	84.14	84.17	84.11
12.5	84.01	83.96	83.86
13	83.84	83.75	83.60
14	83.37	83.31	82.94
15	82.85	82.82	81.73
16	82.44	82.31	79.20
17	81.85	81.78	75.01
18	81.32	81.21	69.90

30 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	89.70	89.64	89.60
4	88.85	88.97	89.00
4.5	88.42	88.45	88.50
5	88.10	88.06	88.07
5.5	87.76	87.68	87.70
6	87.25	87.35	87.38
6.5	87.10	87.06	87.10
7	86.77	86.84	86.83
7.5	86.66	86.61	86.56
8	86.48	86.34	86.30
8.5	86.08	86.07	86.05
9	85.71	85.80	85.81
9.5	85.54	85.57	85.59
10	85.34	85.36	85.39
10.5	85.18	85.18	85.20
11	85.01	85.00	85.02
11.5	84.88	84.84	84.84
12	84.70	84.67	84.68
12.5	84.46	84.52	84.52
13	84.37	84.37	84.37
14	84.08	84.08	84.07
15	83.83	83.80	83.79
16	83.59	83.53	83.52
17	83.22	83.27	83.25
18	82.98	83.02	82.98

A.6.2 CQPSK LSM

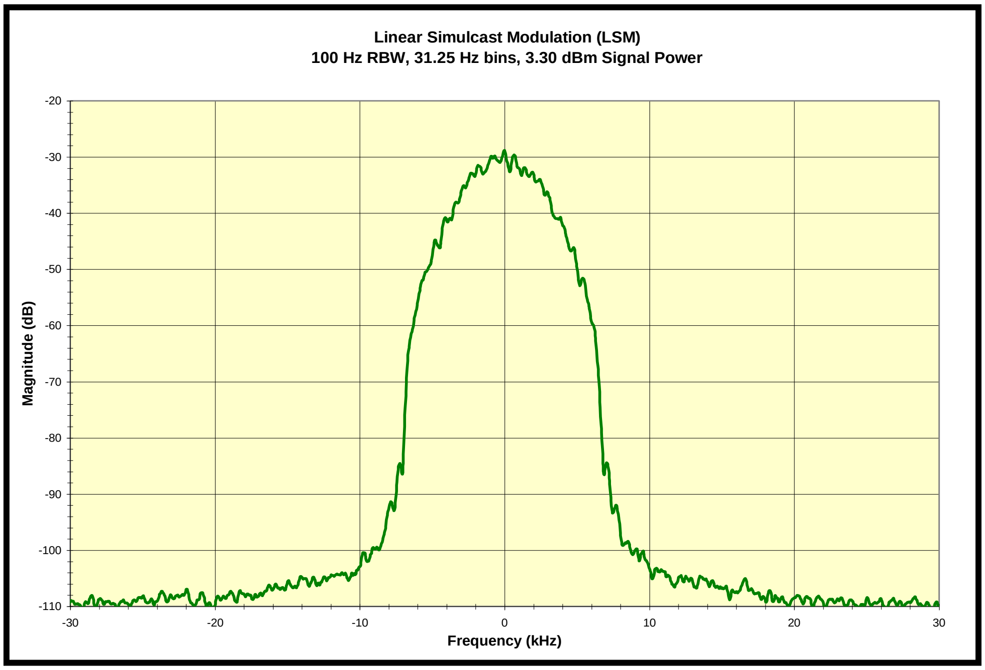


Figure A 7 CQPSK-LSM

A.6.2.1 Emission Designator

8K70D1W

A.6.2.2 Typical Receiver Characteristics

5K50R20||

A.6.2.3 Discussion

Linear Simulcast Modulation is used in the outbound direction of a P25 FDMA 9,600 b/s simulcast system. A Project 25 QPSK-c receiver is compatible with C4FM, CQPSK 6.25 kHz channel bandwidth modulations (none known to be deployed) as well as 12.5 kHz LSM and 12.5 kHz WCQPSK. The inbound, uplink, direction uses C4FM modulation.

A.6.2.4 CQPSK-LSM, 25/30 kHz Plan Offsets

Table A 8 CQPSK-LSM, 25/30 kHz Plan Offsets

25 kHz Plan

6.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	23.14	23.26	22.98
4	21.87	21.56	21.07
4.5	19.83	19.67	19.23
5	18.07	18.00	17.54
5.5	16.67	16.47	15.95
6	15.22	14.96	14.47
6.5	13.60	13.63	13.09
7	12.45	12.30	11.79
7.5	11.45	11.07	10.59
8	9.97	9.96	9.47
8.5	9.08	8.88	8.44
9	8.22	7.88	7.51
9.5	7.02	6.98	6.65
10	6.20	6.15	5.87
10.5	5.58	5.38	5.16
11	4.74	4.68	4.52
11.5	4.03	4.05	3.95
12	3.57	3.49	3.44
12.5	3.01	2.99	2.99
13	2.46	2.55	2.59
14	1.77	1.81	1.93
15	1.15	1.25	1.42
16	0.70	0.83	1.03
17	0.46	0.54	0.75
18	0.24	0.33	0.54

9.375 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	66.96	66.99	66.35
4	66.05	65.38	62.40
4.5	63.14	63.26	55.53
5	61.68	58.10	48.78
5.5	56.57	49.13	43.36
6	45.66	43.14	39.03
6.5	40.25	38.72	35.49
7	36.57	35.08	32.48
7.5	33.10	32.24	29.83
8	30.41	29.76	27.44
8.5	28.68	27.46	25.24
9	26.42	25.41	23.17
9.5	24.26	23.45	21.23
10	22.58	21.56	19.43
10.5	20.86	19.81	17.75
11	18.82	18.11	16.19
11.5	17.42	16.56	14.73
12	16.11	15.10	13.38
12.5	14.28	13.72	12.13
13	13.04	12.44	10.98
14	10.57	10.09	8.93
15	8.54	8.07	7.19
16	6.54	6.35	5.75
17	5.12	4.91	4.56
18	3.81	3.87	3.68

12.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	75.24	75.26	75.21
4	74.53	74.50	74.47
4.5	73.82	73.83	73.79
5	73.25	73.21	73.13
5.5	72.65	72.58	72.47
6	71.97	71.95	71.78
6.5	71.35	71.33	70.95
7	70.81	70.66	69.68
7.5	70.07	69.98	67.27
8	69.36	69.22	63.35
8.5	68.70	68.35	58.58
9	67.83	67.40	53.76
9.5	66.75	66.09	49.25
10	65.75	64.20	45.17
10.5	64.59	57.48	41.50
11	61.91	50.34	38.21
11.5	60.27	45.00	35.24
12	51.12	40.60	32.54
12.5	42.35	37.06	30.07
13	38.36	34.13	27.78
14	31.72	29.10	23.68
15	27.55	24.89	20.12
16	23.14	21.13	17.02
17	19.83	17.81	14.32
18	16.67	14.87	11.99

15.625 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	77.63	77.61	77.60
4	77.02	77.02	77.01
4.5	76.49	76.49	76.49
5	76.02	76.01	76.01
5.5	75.59	75.59	75.59
6	75.22	75.21	75.19
6.5	74.85	74.84	74.82
7	74.51	74.48	74.44
7.5	74.14	74.11	74.06
8	73.76	73.75	73.69
8.5	73.43	73.41	73.30
9	73.10	73.06	72.87
9.5	72.77	72.70	72.32
10	72.41	72.34	71.46
10.5	72.02	71.96	69.99
11	71.65	71.57	67.63
11.5	71.30	71.15	64.47
12	70.87	70.71	60.86
12.5	70.39	70.24	57.15
13	69.99	69.73	53.52
14	68.88	68.47	46.75
15	67.75	66.51	40.75
16	65.83	56.21	35.49
17	62.66	45.30	30.87
18	56.47	37.98	26.81

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	78.61	78.60	78.59
4	78.03	78.03	78.02
4.5	77.52	77.52	77.52
5	77.07	77.07	77.06
5.5	76.65	76.65	76.64
6	76.26	76.27	76.25
6.5	75.92	75.90	75.88
7	75.55	75.54	75.53
7.5	75.22	75.21	75.20
8	74.91	74.90	74.90
8.5	74.62	74.62	74.61
9	74.34	74.34	74.34
9.5	74.09	74.09	74.08
10	73.85	73.84	73.83
10.5	73.62	73.61	73.59
11	73.39	73.38	73.35
11.5	73.16	73.17	73.09
12	72.96	72.96	72.77
12.5	72.77	72.76	72.33
13	72.58	72.55	71.63
14	72.19	72.16	68.68
15	71.78	71.70	63.56
16	71.28	71.17	57.62
17	70.72	70.57	51.78
18	70.15	69.87	46.33

25.0 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	79.76	79.77	79.78
4	79.20	79.19	79.20
4.5	78.69	78.70	78.70
5	78.23	78.24	78.24
5.5	77.84	77.82	77.82
6	77.44	77.43	77.43
6.5	77.06	77.08	77.08
7	76.75	76.75	76.76
7.5	76.46	76.46	76.45
8	76.18	76.18	76.17
8.5	75.91	75.91	75.90
9	75.67	75.65	75.64
9.5	75.40	75.41	75.40
10	75.18	75.17	75.16
10.5	74.96	74.95	74.94
11	74.73	74.73	74.72
11.5	74.53	74.52	74.52
12	74.32	74.32	74.32
12.5	74.13	74.13	74.13
13	73.95	73.95	73.95
14	73.61	73.60	73.60
15	73.28	73.28	73.27
16	72.99	72.99	72.94
17	72.71	72.70	72.54
18	72.44	72.42	71.90

30 kHz Plan

7.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	35.01	34.48	33.71
4	31.72	31.53	30.92
4.5	29.44	29.27	28.48
5	27.55	27.07	26.21
5.5	25.23	24.95	24.11
6	23.14	23.10	22.12
6.5	21.87	21.22	20.22
7	19.83	19.45	18.45
7.5	18.07	17.81	16.81
8	16.67	16.22	15.27
8.5	15.22	14.80	13.84
9	13.60	13.43	12.51
9.5	12.45	12.13	11.28
10	11.45	10.94	10.13
10.5	9.97	9.81	9.08
11	9.08	8.76	8.12
11.5	8.22	7.79	7.23
12	7.02	6.90	6.42
12.5	6.20	6.08	5.69
13	5.58	5.33	5.03
14	4.03	4.03	3.90
15	3.01	2.99	2.99
16	2.15	2.17	2.27
17	1.39	1.54	1.71
18	0.96	1.05	1.28

11.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	73.09	73.09	73.05
4	72.25	72.27	72.19
4.5	71.56	71.48	71.33
5	70.68	70.64	70.40
5.5	69.85	69.81	69.18
6	69.09	68.89	66.88
6.5	68.14	67.86	62.63
7	66.98	66.74	57.15
7.5	65.93	65.16	51.72
8	64.73	62.53	46.85
8.5	61.98	54.48	42.61
9	60.32	47.67	38.92
9.5	51.13	42.65	35.70
10	42.35	38.50	32.83
10.5	38.36	35.21	30.24
11	35.01	32.44	27.87
11.5	31.72	29.91	25.68
12	29.43	27.66	23.64
12.5	27.55	25.57	21.73
13	25.23	23.60	19.96
14	21.87	19.95	16.77
15	18.07	16.74	14.02
16	15.22	13.91	11.64
17	12.45	11.41	9.60
18	9.97	9.25	7.86

15 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	77.28	77.27	77.28
4	76.67	76.69	76.70
4.5	76.21	76.20	76.20
5	75.72	75.73	75.72
5.5	75.29	75.28	75.26
6	74.87	74.85	74.82
6.5	74.44	74.44	74.40
7	74.06	74.05	73.99
7.5	73.70	73.67	73.58
8	73.33	73.28	73.15
8.5	72.93	72.88	72.67
9	72.54	72.48	72.04
9.5	72.11	72.07	71.04
10	71.75	71.64	69.28
10.5	71.33	71.20	66.53
11	70.82	70.72	63.00
11.5	70.35	70.21	59.14
12	69.94	69.66	55.27
12.5	69.34	69.02	51.54
13	68.74	68.30	48.01
14	67.39	66.18	41.62
15	65.49	55.12	36.08
16	61.80	44.41	31.27
17	51.11	37.25	27.06
18	38.35	31.82	23.35

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	78.61	78.60	78.59
4	78.03	78.03	78.02
4.5	77.52	77.52	77.52
5	77.07	77.07	77.06
5.5	76.65	76.65	76.64
6	76.26	76.27	76.25
6.5	75.92	75.90	75.88
7	75.55	75.54	75.53
7.5	75.22	75.21	75.20
8	74.91	74.90	74.90
8.5	74.62	74.62	74.61
9	74.34	74.34	74.34
9.5	74.09	74.09	74.08
10	73.85	73.84	73.83
10.5	73.62	73.61	73.59
11	73.39	73.38	73.35
11.5	73.16	73.17	73.09
12	72.96	72.96	72.77
12.5	72.77	72.76	72.33
13	72.58	72.55	71.63
14	72.19	72.16	68.68
15	71.78	71.70	63.56
16	71.28	71.17	57.62
17	70.72	70.57	51.78
18	70.15	69.87	46.33

22.50 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	79.45	79.44	79.44
4	78.86	78.86	78.86
4.5	78.35	78.34	78.33
5	77.88	77.87	77.86
5.5	77.43	77.43	77.42
6	77.01	77.02	77.02
6.5	76.66	76.66	76.66
7	76.32	76.32	76.32
7.5	75.99	76.01	76.01
8	75.72	75.72	75.72
8.5	75.46	75.45	75.45
9	75.19	75.19	75.20
9.5	74.95	74.96	74.96
10	74.73	74.73	74.73
10.5	74.52	74.52	74.51
11	74.33	74.31	74.30
11.5	74.12	74.12	74.10
12	73.93	73.92	73.90
12.5	73.74	73.74	73.71
13	73.56	73.55	73.52
14	73.22	73.19	73.14
15	72.86	72.85	72.68
16	72.53	72.52	71.92
17	72.22	72.20	70.26
18	71.91	71.90	67.09

30 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	80.31	80.31	80.31
4	79.73	79.73	79.73
4.5	79.20	79.21	79.21
5	78.76	78.75	78.74
5.5	78.32	78.32	78.32
6	77.94	77.93	77.92
6.5	77.57	77.57	77.56
7	77.23	77.22	77.22
7.5	76.88	76.90	76.91
8	76.59	76.60	76.62
8.5	76.32	76.34	76.36
9	76.10	76.10	76.11
9.5	75.88	75.88	75.88
10	75.67	75.66	75.66
10.5	75.46	75.45	75.45
11	75.26	75.25	75.25
11.5	75.07	75.06	75.05
12	74.87	74.87	74.87
12.5	74.67	74.69	74.69
13	74.52	74.52	74.52
14	74.20	74.20	74.20
15	73.91	73.91	73.90
16	73.63	73.63	73.62
17	73.34	73.35	73.34
18	73.09	73.08	73.06

A.6.3 CQPSK WCQPSK

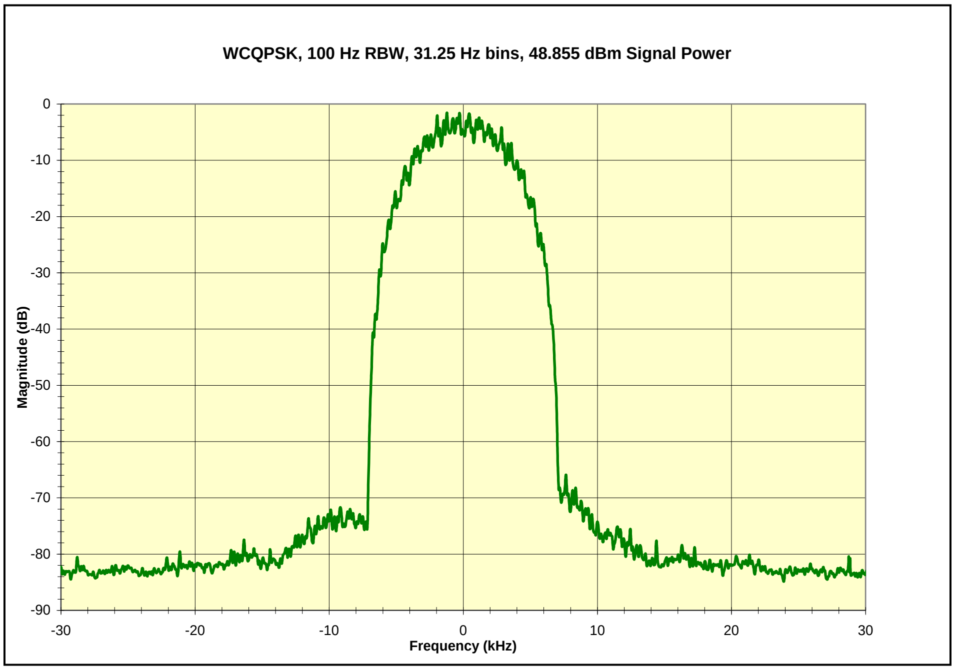


Figure A 8 CQPSK-WCQPSK Simulcast Modulation

A.6.3.1 Emission Designator

9K80D1E

A.6.3.2 Typical Receiver Characteristics

6K30R20||

A.6.3.3 Discussion

WCQPSK modulation is used in the outbound direction of a P25 FDMA 9,600 b/s simulcast system. A Project 25 QPSK-c receiver is compatible with C4FM, CQPSK 6.25 kHz channel bandwidth modulations (none known to be deployed) as well as 12.5 kHz WCQPSK and 12.5 kHz LSM. The inbound, uplink, direction uses C4FM modulation.

A.6.3.4 CQPSK-WCQPSK, 25/30 kHz Plan Offsets

Table A 9 CQPSK-WCQPSK, 25/30 kHz Plan Offsets

6.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	20.12	19.99	19.63
4	17.98	18.04	17.74
4.5	16.47	16.41	16.07
5	15.16	14.89	14.56
5.5	13.49	13.51	13.20
6	12.27	12.28	11.97
6.5	11.41	11.12	10.86
7	10.01	10.11	9.85
7.5	9.28	9.18	8.93
8	8.47	8.32	8.08
8.5	7.67	7.52	7.29
9	6.77	6.77	6.57
9.5	6.23	6.07	5.91
10	5.51	5.44	5.31
10.5	4.82	4.85	4.75
11	4.33	4.32	4.25
11.5	3.88	3.83	3.79
12	3.31	3.39	3.37
12.5	2.96	2.99	3.00
13	2.67	2.63	2.65
14	1.97	2.00	2.06
15	1.42	1.48	1.59
16	1.02	1.06	1.20
17	0.65	0.74	0.90
18	0.43	0.50	0.67

15.625 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	79.02	79.05	79.07
4	78.56	78.55	78.55
4.5	78.12	78.09	78.06
5	77.62	77.63	77.59
5.5	77.20	77.18	77.13
6	76.78	76.74	76.68
6.5	76.33	76.30	76.23
7	75.89	75.87	75.79
7.5	75.48	75.44	75.35
8	75.10	75.01	74.91
8.5	74.55	74.59	74.45
9	74.24	74.18	73.91
9.5	73.85	73.77	73.14
10	73.41	73.37	71.81
10.5	73.03	72.98	69.54
11	72.66	72.61	66.31
11.5	72.23	72.25	62.52
12	71.91	71.91	58.56
12.5	71.63	71.59	54.67
13	71.26	71.28	50.94
14	70.75	70.73	44.08
15	69.94	68.86	38.06
16	68.98	55.30	32.82
17	68.16	43.33	28.28
18	51.66	35.37	24.37

9.375 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	70.86	70.92	69.53
4	70.13	70.13	62.55
4.5	69.52	65.96	54.11
5	63.14	55.64	47.04
5.5	51.69	48.09	41.36
6	45.51	41.59	36.75
6.5	39.05	36.65	32.88
7	34.28	32.93	29.60
7.5	31.03	29.53	26.78
8	28.17	26.68	24.31
8.5	25.11	24.31	22.09
9	22.89	22.11	20.07
9.5	21.37	20.12	18.25
10	19.03	18.29	16.62
10.5	17.33	16.61	15.14
11	15.71	15.12	13.80
11.5	14.46	13.74	12.58
12	12.92	12.50	11.47
12.5	11.95	11.38	10.46
13	10.77	10.35	9.53
14	8.86	8.54	7.89
15	7.13	6.98	6.50
16	5.85	5.66	5.33
17	4.52	4.54	4.35
18	3.61	3.60	3.52

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	80.12	80.14	80.15
4	79.52	79.50	79.49
4.5	78.93	78.91	78.89
5	78.33	78.35	78.36
5.5	77.84	77.87	77.90
6	77.47	77.47	77.50
6.5	77.13	77.13	77.16
7	76.78	76.81	76.85
7.5	76.53	76.54	76.57
8	76.29	76.29	76.31
8.5	76.08	76.06	76.07
9	75.82	75.84	75.84
9.5	75.62	75.63	75.61
10	75.43	75.42	75.38
10.5	75.25	75.21	75.13
11	75.04	75.00	74.86
11.5	74.81	74.77	74.51
12	74.59	74.54	74.02
12.5	74.34	74.28	73.25
13	74.06	74.02	71.99
14	73.56	73.47	67.56
15	72.94	72.90	61.52
16	72.39	72.32	55.27
17	71.82	71.75	49.36
18	71.22	71.21	43.90

12.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	76.15	76.18	76.15
4	75.49	75.47	75.44
4.5	74.84	74.83	74.79
5	74.23	74.21	74.19
5.5	73.64	73.67	73.65
6	73.20	73.18	73.10
6.5	72.77	72.72	72.35
7	72.26	72.30	70.69
7.5	71.96	71.91	67.12
8	71.55	71.54	62.01
8.5	71.06	71.03	56.60
9	70.49	70.42	51.48
9.5	70.02	69.66	46.80
10	69.27	64.54	42.59
10.5	68.87	56.47	38.80
11	67.83	49.14	35.42
11.5	56.20	43.11	32.38
12	48.24	38.62	29.64
12.5	42.26	34.73	27.15
13	36.34	31.31	24.90
14	29.30	25.97	20.97
15	23.67	21.63	17.70
16	20.12	18.00	14.95
17	16.47	15.00	12.63
18	13.49	12.52	10.66

25.0 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	81.33	81.32	81.32
4	80.77	80.77	80.77
4.5	80.28	80.29	80.29
5	79.87	79.86	79.84
5.5	79.47	79.45	79.42
6	79.04	79.05	79.02
6.5	78.68	78.66	78.64
7	78.30	78.29	78.28
7.5	77.96	77.95	77.94
8	77.60	77.63	77.63
8.5	77.33	77.34	77.34
9	77.08	77.07	77.06
9.5	76.81	76.81	76.80
10	76.57	76.57	76.55
10.5	76.34	76.32	76.31
11	76.10	76.09	76.08
11.5	75.87	75.87	75.87
12	75.64	75.66	75.66
12.5	75.44	75.46	75.47
13	75.27	75.27	75.28
14	74.93	74.93	74.92
15	74.64	74.61	74.57
16	74.30	74.29	74.20
17	74.00	73.98	73.69
18	73.68	73.69	72.73

25 kHz Plan

7.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	32.32	32.29	31.34
4	29.30	29.12	28.07
4.5	26.61	26.11	25.31
5	23.67	23.75	22.97
5.5	22.09	21.72	20.84
6	20.12	19.72	18.86
6.5	17.98	17.88	17.09
7	16.47	16.23	15.50
7.5	15.16	14.72	14.07
8	13.49	13.40	12.78
8.5	12.27	12.15	11.61
9	11.41	11.04	10.55
9.5	10.01	10.04	9.58
10	9.28	9.11	8.69
10.5	8.47	8.25	7.87
11	7.67	7.46	7.12
11.5	6.77	6.71	6.43
12	6.23	6.04	5.80
12.5	5.51	5.41	5.22
13	4.82	4.83	4.69
14	3.88	3.83	3.76
15	2.96	3.00	3.00
16	2.24	2.31	2.37
17	1.71	1.74	1.85
18	1.17	1.28	1.43

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	80.12	80.14	80.15
4	79.52	79.50	79.49
4.5	78.93	78.91	78.89
5	78.33	78.35	78.36
5.5	77.84	77.87	77.90
6	77.47	77.47	77.50
6.5	77.13	77.13	77.16
7	76.78	76.81	76.85
7.5	76.53	76.54	76.57
8	76.29	76.29	76.31
8.5	76.08	76.06	76.07
9	75.82	75.84	75.84
9.5	75.62	75.63	75.61
10	75.43	75.42	75.38
10.5	75.25	75.21	75.13
11	75.04	75.00	74.86
11.5	74.81	74.77	74.51
12	74.59	74.54	74.02
12.5	74.34	74.28	73.25
13	74.06	74.02	71.99
14	73.56	73.47	67.56
15	72.94	72.90	61.52
16	72.39	72.32	55.27
17	71.82	71.75	49.36
18	71.22	71.21	43.90

11.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	74.03	74.03	74.03
4	73.51	73.46	73.46
4.5	72.90	72.96	72.96
5	72.57	72.53	72.41
5.5	72.14	72.12	71.25
6	71.57	71.57	67.64
6.5	70.92	70.90	61.73
7	70.41	70.25	55.41
7.5	69.60	69.03	49.64
8	69.17	61.56	44.56
8.5	68.06	53.44	40.12
9	56.22	46.34	36.25
9.5	48.25	40.68	32.87
10	42.26	36.49	29.89
10.5	36.34	32.75	27.25
11	32.32	29.53	24.86
11.5	29.30	26.87	22.71
12	26.61	24.46	20.75
12.5	23.67	22.31	18.98
13	22.09	20.32	17.37
14	17.98	16.86	14.57
15	15.16	14.00	12.23
16	12.27	11.65	10.25
17	10.01	9.66	8.57
18	8.47	7.96	7.15

22.50 kHz Offset ACCCPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	80.87	80.87	80.86
4	80.27	80.25	80.25
4.5	79.69	79.71	79.72
5	79.24	79.24	79.25
5.5	78.83	78.82	78.83
6	78.44	78.45	78.45
6.5	78.13	78.11	78.11
7	77.78	77.78	77.79
7.5	77.48	77.49	77.49
8	77.22	77.21	77.21
8.5	76.95	76.96	76.95
9	76.70	76.71	76.70
9.5	76.50	76.48	76.46
10	76.27	76.25	76.22
10.5	76.04	76.03	75.99
11	75.81	75.80	75.77
11.5	75.60	75.58	75.55
12	75.38	75.36	75.35
12.5	75.13	75.15	75.14
13	74.92	74.95	74.93
14	74.54	74.56	74.50
15	74.23	74.22	73.91
16	73.93	73.90	72.70
17	73.59	73.60	70.07
18	73.34	73.30	65.87

15 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	79.11	79.09	79.08
4	78.45	78.43	78.40
4.5	77.85	77.82	77.78
5	77.23	77.23	77.20
5.5	76.68	76.69	76.66
6	76.22	76.20	76.14
6.5	75.77	75.71	75.65
7	75.23	75.24	75.17
7.5	74.78	74.78	74.70
8	74.40	74.34	74.22
8.5	73.92	73.92	73.65
9	73.55	73.49	72.81
9.5	73.12	73.08	71.29
10	72.71	72.69	68.67
10.5	72.29	72.31	65.04
11	71.98	71.96	60.94
11.5	71.68	71.63	56.77
12	71.29	71.32	52.74
12.5	71.05	71.03	48.93
13	70.76	70.71	45.35
14	69.86	68.32	38.90
15	68.80	54.14	33.35
16	67.49	42.44	28.59
17	48.24	34.60	24.52
18	36.34	28.78	21.03

30 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	80.72	80.75	80.78
4	80.25	80.26	80.29
4.5	79.86	79.86	79.87
5	79.49	79.49	79.50
5.5	79.16	79.15	79.15
6	78.83	78.83	78.83
6.5	78.53	78.53	78.52
7	78.25	78.24	78.24
7.5	77.98	77.97	77.96
8	77.71	77.71	77.70
8.5	77.46	77.47	77.46
9	77.25	77.23	77.22
9.5	77.01	77.00	76.99
10	76.78	76.78	76.78
10.5	76.56	76.57	76.58
11	76.37	76.38	76.39
11.5	76.19	76.20	76.21
12	76.03	76.03	76.04
12.5	75.86	75.87	75.88
13	75.72	75.72	75.72
14	75.43	75.42	75.41
15	75.15	75.14	75.12
16	74.86	74.86	74.85
17	74.60	74.60	74.58
18	74.34	74.34	74.32

30 kHz Plan

A.6.4 CVSD Securenet

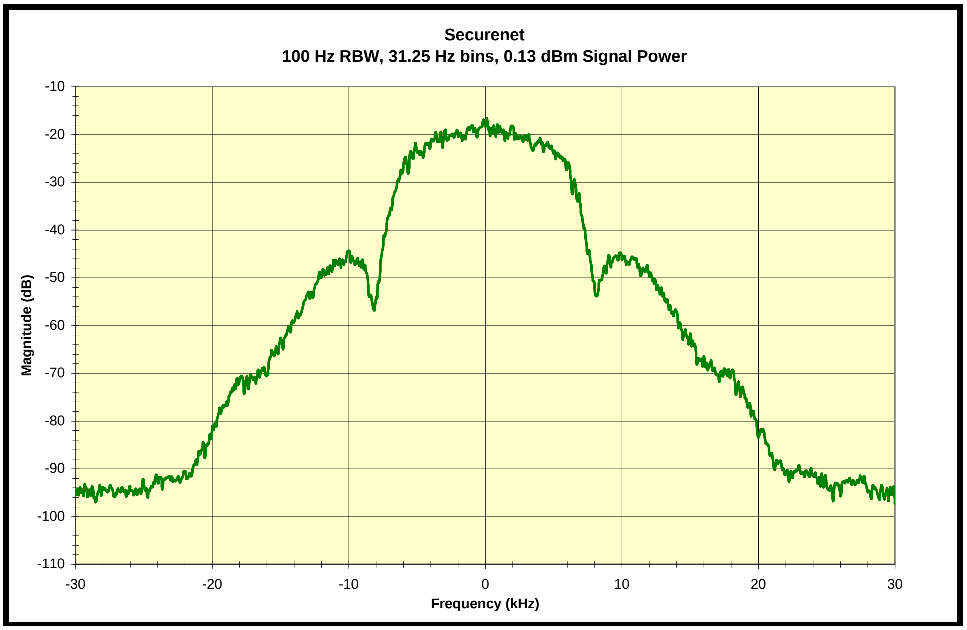


Figure A 9 CVSD Securenet (DVP)

A.6.4.1 Emission Designator

20K0F1E 25 kHz channel bandwidth

16K8F1E NPSPAC 800 MHz channels

A.6.4.2 Typical Receiver Characteristics

12K6B0403

A.6.4.3 Discussion

Encrypted Quantized Voice. Two level FM modulation at 6 kHz, ±4 kHz deviation. Known as, DVP-XL, DVI-XL, and DES-XL where the XL suffix refers to the synchronization process. The modulation is referred to as: CVSD, which describes the encoding technique of Continuous Variable Slope Delta Modulation. The NPSPAC version reduces the deviation to ±2.4 kHz. No data is provided for this version. A special simulcast version was available that used 4 level FM modulation with a deviation of ±3 kHz. No data is provided for this version.

After 1/1/2013 this modulation will not be licensable below 512 MHz. It is not available in low band.

A.6.4.4 CVSD Securenet, 25/30 kHz Plan Offsets

Table A 10 CVSD Securenet, 25/30 kHz Plan Offsets

25 kHz Plan: 6.25 kHz Offset ACPR				15.625 kHz Offset ACPR				30 kHz Plan: 7.5 kHz Offset ACPR				18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3
3.5	11.70	11.70	11.68	3.5	48.37	48.37	48.22	3.5	17.62	17.73	17.54	3.5	57.66	57.65	57.62
4	10.88	10.87	10.83	4	47.15	47.09	46.90	4	16.25	16.16	15.94	4	57.07	57.03	56.96
4.5	10.15	10.11	10.10	4.5	46.02	45.89	45.61	4.5	14.85	14.71	14.56	4.5	56.39	56.37	56.30
5	9.42	9.43	9.37	5	44.81	44.66	44.34	5	13.42	13.49	13.42	5	55.76	55.74	55.66
5.5	8.72	8.74	8.69	5.5	43.55	43.45	43.07	5.5	12.54	12.54	12.45	5.5	55.18	55.14	55.01
6	8.10	8.12	8.08	6	42.42	42.26	41.83	6	11.67	11.66	11.55	6	54.58	54.55	54.31
6.5	7.60	7.56	7.52	6.5	41.27	41.08	40.63	6.5	10.85	10.82	10.74	6.5	54.03	53.88	53.52
7	7.05	7.04	7.01	7	40.15	39.90	39.50	7	10.12	10.08	9.96	7	53.32	53.09	52.64
7.5	6.59	6.57	6.53	7.5	38.98	38.80	38.45	7.5	9.39	9.38	9.25	7.5	52.40	52.23	51.67
8	6.15	6.12	6.09	8	37.86	37.82	37.48	8	8.71	8.71	8.60	8	51.52	51.33	50.61
8.5	5.70	5.72	5.68	8.5	37.01	36.90	36.59	8.5	8.08	8.09	8.01	8.5	50.57	50.35	49.48
9	5.33	5.34	5.28	9	36.26	36.03	35.77	9	7.58	7.53	7.46	9	49.76	49.29	48.29
9.5	5.04	4.97	4.90	9.5	35.34	35.25	35.03	9.5	7.04	7.02	6.95	9.5	48.70	48.19	47.06
10	4.67	4.61	4.54	10	34.50	34.53	34.36	10	6.58	6.55	6.49	10	47.39	47.05	45.81
10.5	4.27	4.26	4.18	10.5	33.93	33.88	33.75	10.5	6.15	6.12	6.05	10.5	46.37	45.88	44.56
11	3.91	3.91	3.85	11	33.37	33.28	33.20	11	5.70	5.71	5.63	11	45.25	44.70	43.33
11.5	3.64	3.57	3.53	11.5	32.77	32.74	32.68	11.5	5.33	5.32	5.23	11.5	44.13	43.52	42.14
12	3.31	3.25	3.23	12	32.24	32.28	32.17	12	5.03	4.95	4.85	12	42.93	42.32	41.00
12.5	2.93	2.95	2.95	12.5	31.78	31.88	31.61	12.5	4.67	4.59	4.49	12.5	41.84	41.15	39.92
13	2.60	2.67	2.69	13	31.46	31.55	30.92	13	4.27	4.24	4.14	13	40.69	40.04	38.92
14	2.16	2.18	2.23	14	30.91	31.06	28.91	14	3.64	3.56	3.51	14	38.32	38.00	37.11
15	1.74	1.78	1.84	15	30.71	30.42	26.05	15	2.93	2.95	2.95	15	36.68	36.24	35.53
16	1.45	1.44	1.52	16	30.43	28.51	22.85	16	2.38	2.43	2.46	16	34.91	34.75	34.07
17	1.10	1.16	1.24	17	28.98	24.94	19.88	17	1.95	1.98	2.05	17	33.68	33.51	32.52
18	0.88	0.92	1.00	18	25.16	21.11	17.29	18	1.59	1.61	1.70	18	32.47	32.54	30.60

9.375 kHz Offset ACPR				18.75 kHz Offset ACPR				11.25 kHz Offset ACPR				22.50 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3
3.5	31.75	31.71	31.50	3.5	57.66	57.65	57.62	3.5	32.27	32.28	32.32	3.5	74.66	74.59	74.42
4	31.01	30.81	30.17	4	57.07	57.03	56.96	4	31.79	31.81	31.85	4	73.63	73.50	73.28
4.5	29.54	29.23	28.18	4.5	56.39	56.37	56.30	4.5	31.41	31.43	31.48	4.5	72.37	72.35	72.10
5	27.62	27.04	25.81	5	55.76	55.74	55.66	5	31.12	31.14	31.21	5	71.33	71.26	70.85
5.5	25.30	24.72	23.38	5.5	55.18	55.14	55.01	5.5	30.91	30.94	30.99	5.5	70.34	70.05	69.49
6	22.85	22.32	21.13	6	54.58	54.55	54.31	6	30.79	30.81	30.75	6	68.93	68.73	68.05
6.5	20.62	20.10	19.14	6.5	54.03	53.88	53.52	6.5	30.73	30.68	30.32	6.5	67.57	67.31	66.58
7	18.37	18.22	17.43	7	53.32	53.09	52.64	7	30.60	30.44	29.50	7	66.26	65.88	65.15
7.5	16.92	16.57	15.95	7.5	52.40	52.23	51.67	7.5	30.26	29.89	28.12	7.5	64.67	64.53	63.79
8	15.36	15.14	14.68	8	51.52	51.33	50.61	8	29.67	28.71	26.30	8	63.47	63.19	62.51
8.5	14.02	13.95	13.56	8.5	50.57	50.35	49.48	8.5	28.20	26.92	24.22	8.5	62.45	61.91	61.36
9	12.90	12.93	12.57	9	49.76	49.29	48.29	9	26.05	24.81	22.18	9	60.88	60.74	60.32
9.5	12.14	12.01	11.67	9.5	48.70	48.19	47.06	9.5	23.81	22.53	20.29	9.5	59.79	59.73	59.40
10	11.20	11.15	10.84	10	47.39	47.05	45.81	10	21.76	20.47	18.60	10	58.85	58.86	58.55
10.5	10.49	10.39	10.08	10.5	46.37	45.88	44.56	10.5	19.55	18.62	17.09	10.5	58.08	58.10	57.76
11	9.71	9.66	9.38	11	45.25	44.70	43.33	11	17.46	16.97	15.76	11	57.51	57.40	57.00
11.5	9.02	8.98	8.74	11.5	44.13	43.52	42.14	11.5	16.14	15.57	14.57	11.5	56.95	56.76	56.22
12	8.43	8.35	8.15	12	42.93	42.32	41.00	12	14.77	14.36	13.51	12	56.30	56.14	55.41
12.5	7.86	7.78	7.60	12.5	41.84	41.15	39.92	12.5	13.37	13.30	12.55	12.5	55.68	55.52	54.54
13	7.25	7.25	7.09	13	40.69	40.04	38.92	13	12.51	12.34	11.67	13	55.11	54.87	53.60
14	6.35	6.31	6.16	14	38.32	38.00	37.11	14	10.84	10.66	10.13	14	53.98	53.38	51.48
15	5.51	5.49	5.34	15	36.68	36.24	35.53	15	9.39	9.23	8.82	15	52.37	51.63	49.13
16	4.88	4.74	4.59	16	34.91	34.75	34.07	16	8.08	8.01	7.69	16	50.55	49.57	46.68
17	4.08	4.03	3.93	17	33.68	33.51	32.52	17	7.04	6.97	6.70	17	48.69	47.32	44.29
18	3.81	3.87	3.68	18	32.47	32.54	30.60	18	6.15	6.07	5.83	18	46.37	44.95	42.03

12.5 kHz Offset ACPR				25.0 kHz Offset ACPR				15 kHz Offset ACPR				30 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3
3.5	35.05	35.06	35.06	3.5	77.10	77.11	77.09	3.5	45.55	45.52	45.34	3.5	79.17	79.18	79.18
4	34.30	34.32	34.32	4	76.43	76.40	76.39	4	44.33	44.24	44.03	4	78.59	78.58	78.53
4.5	33.75	33.70	33.67	4.5	75.77	75.78	75.78	4.5	43.07	43.00	42.74	4.5	78.00	77.97	77.92
5	33.13	33.10	33.07	5	75.22	75.24	75.26	5	41.92	41.80	41.49	5	77.38	77.37	77.36
5.5	32.50	32.53	32.54	5.5	74.77	74.79	74.80	5.5	40.74	40.60	40.28	5.5	76.83	76.85	76.85
6	32.03	32.05	32.09	6	74.40	74.40	74.38	6	39.57	39.41	39.14	6	76.40	76.39	76.40
6.5	31.62	31.65	31.72	6.5	74.07	74.02	73.95	6.5	38.33	38.34	38.10	6.5	76.00	75.98	75.99
7	31.29	31.33	31.41	7	73.65	73.63	73.50	7	37.40	37.39	37.15	7	75.60	75.62	75.63
7.5	31.03	31.09	31.13	7.5	73.24	73.23	72.98	7.5	36.69	36.50	36.27	7.5	75.28	75.29	75.30
8	30.85	30.91	30.79	8	72.92	72.78	72.36	8	35.81	35.66	35.47	8	74.99	74.99	75.00
8.5	30.75	30.77	30.27	8.5	72.47	72.22	71.61	8.5	34.91	34.90	34.75	8.5	74.72	74.72	74.72
9	30.69	30.59	29.38	9	71.86	71.56	70.70	9	34.20	34.21	34.09	9	74.44	74.47	74.46
9.5	30.57	30.24	28.05	9.5	71.02	70.78	69.65	9.5	33.68	33.58	33.50	9.5	74.23	74.22	74.20
10	30.24	29.44	26.37	10	70.26	69.85	68.48	10	33.08	33.01	32.97	10	74.02	73.99	73.95
10.5	29.65	28.03	24.47	10.5	69.47	68.78	67.24	10.5	32.47	32.50	32.49	10.5	73.78	73.75	73.71
11	28.19	26.19	22.57	11	68.28	67.59	65.98	11	32.00	32.06	32.03	11	73.53	73.52	73.46
11.5	26.04	24.00	20.78	11.5	67.09	66.34	64.74	11.5	31.60	31.69	31.53	11.5	73.32	73.28	73.22
12	23.81	21.89	19.14	12	65.90	65.07	63.54	12	31.27	31.39	30.92	12	73.07	73.04	72.98
12.5	21.76	19.96	17.66	12.5	64.42	63.79	62.42	12.5	31.02	31.15	30.11	12.5	72.81	72.80	72.75
13	19.55	18.21	16.33	13	63.28	62.56	61.37	13	30.84	30.94	29.02	13	72.58	72.57	72.51
14	16.14	15.38	14.06	14	60.78	60.43	59.46	14	30.68	30.27	26.14	14	72.15	72.14	72.03
15	13.37	13.18	12.17	15	58.79	58.71	57.67	15	30.23	28.15	22.85	15	71.72	71.73	71.45
16	11.64	11.37	10.59	16	57.47	57.26	55.83	16	28.19	24.39	19.79	16	71.39	71.33	70.65
17	10.11	9.84	9.24	17	56.26	55.93	53.80	17	23.81	20.56	17.15	17	71.01	70.84	69.49
18	8.70	8.55	8.07	18	55.09	54.52	51.56	18	19.55	17.41	14.91	18	70.60	70.14	67.92

25 kHz Plan (first eight columns) | **30 kHz Plan** (last eight columns)

A.6.5 EDACS®

A.6.5.1 EDACS® ,12.5 kHz Channel Bandwidth (NB)

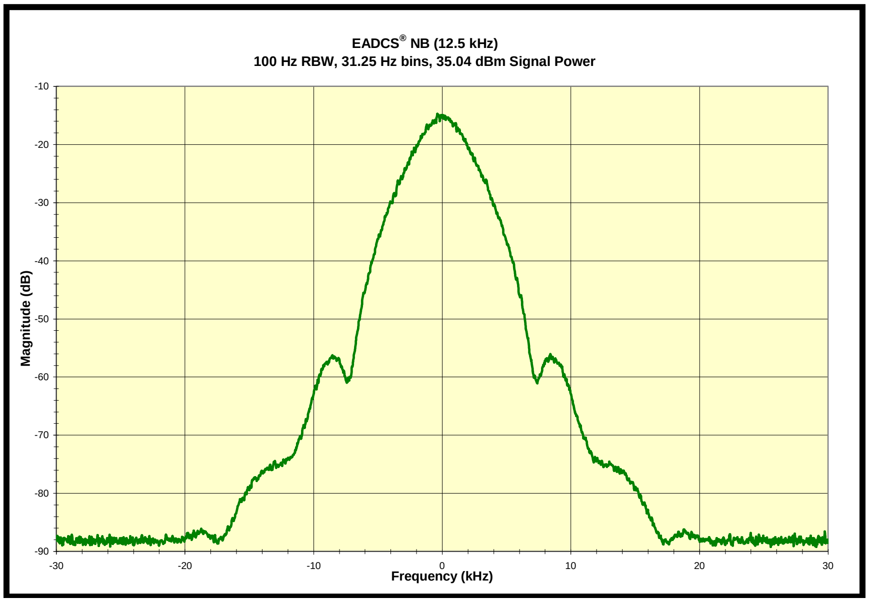


Figure A 10 EDACS®, 12.5 kHz Channel Bandwidth (NB)

A.6.5.1.1 Emission Designator

7K10F1E

A.6.5.1.2 Typical Receiver Characteristics

For frequency coordination use: 5K40B0403

For specification validation use: 6K70B0504

A.6.5.1.3 Discussion

EDACS is a registered mark of Harris Inc, formerly M/A-Com. Use of this mark does not constitute an endorsement of the product or services.

GFSK modulation is used. All digital signaling on both the trunking control and traffic channels is at 9,600 baud.

The following table defines the modulation parameters for 12.5 kHz operation where the Gaussian filter is defined by the 3 *dB* bandwidth point.

Bandwidth	**Modulation Index (h)**	Frequency deviation (f2-f1)	Bandwidth point (BT)	**Emission Mask**
12.5 kHz	0.375	3.6 kHz	0.38	90.210d

A.6.5.1.4 EDACS® NB, 25/30 kHz Plan Offsets

Table A 11 EDACS® NB, 25/30 kHz Plan Offsets

25 kHz Plan

6.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	25.43	25.32	25.00
4	23.64	23.49	23.11
4.5	21.87	21.76	21.34
5	20.32	20.16	19.66
5.5	18.83	18.58	18.03
6	17.24	17.06	16.48
6.5	15.89	15.64	15.01
7	14.52	14.28	13.60
7.5	13.22	12.97	12.25
8	11.99	11.70	10.96
8.5	10.76	10.47	9.73
9	9.60	9.28	8.57
9.5	8.45	8.15	7.50
10	7.34	7.08	6.52
10.5	6.31	6.09	5.63
11	5.39	5.18	4.84
11.5	4.51	4.36	4.14
12	3.71	3.63	3.52
12.5	3.00	3.00	2.99
13	2.40	2.45	2.53
14	1.47	1.60	1.79
15	0.87	1.02	1.27
16	0.50	0.63	0.89
17	0.28	0.38	0.63
18	0.15	0.22	0.44

15.625 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	64.87	64.87	64.84
4	64.07	64.06	64.03
4.5	63.35	63.34	63.30
5	62.69	62.67	62.64
5.5	62.06	62.07	62.04
6	61.53	61.52	61.47
6.5	61.04	61.01	60.94
7	60.55	60.52	60.39
7.5	60.07	60.04	59.80
8	59.62	59.53	59.11
8.5	59.14	58.96	58.27
9	58.53	58.28	57.25
9.5	57.84	57.46	56.05
10	57.01	56.43	54.72
10.5	56.02	55.21	53.34
11	54.83	53.82	51.97
11.5	53.38	52.35	50.66
12	51.87	50.90	49.41
12.5	50.39	49.55	48.21
13	48.89	48.34	47.01
14	46.53	46.40	44.27
15	44.83	45.05	40.73
16	43.87	43.87	36.60
17	43.41	41.84	32.39
18	42.35	38.31	28.42

9.375 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	44.03	44.06	44.10
4	43.76	43.76	43.74
4.5	43.52	43.48	43.25
5	43.17	42.99	42.35
5.5	42.42	42.03	40.83
6	41.10	40.43	38.77
6.5	39.11	38.39	36.42
7	36.95	36.16	34.00
7.5	34.81	33.84	31.61
8	32.48	31.57	29.33
8.5	30.27	29.40	27.18
9	28.23	27.35	25.16
9.5	26.35	25.42	23.24
10	24.46	23.60	21.42
10.5	22.74	21.87	19.70
11	21.09	20.22	18.07
11.5	19.59	18.64	16.52
12	17.95	17.14	15.04
12.5	16.55	15.70	13.65
13	15.19	14.33	12.33
14	12.62	11.72	9.94
15	10.18	9.32	7.89
16	7.89	7.19	6.17
17	5.82	5.36	4.77
18	3.81	3.87	3.68

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	71.94	71.94	71.91
4	71.39	71.37	71.32
4.5	70.82	70.80	70.71
5	70.24	70.21	70.08
5.5	69.64	69.57	69.40
6	68.96	68.88	68.69
6.5	68.24	68.18	67.96
7	67.56	67.46	67.21
7.5	66.84	66.72	66.46
8	66.12	65.99	65.72
8.5	65.34	65.27	65.01
9	64.67	64.57	64.33
9.5	63.99	63.90	63.68
10	63.35	63.27	63.07
10.5	62.74	62.68	62.48
11	62.19	62.13	61.90
11.5	61.65	61.61	61.33
12	61.16	61.13	60.72
12.5	60.73	60.66	60.05
13	60.29	60.20	59.28
14	59.46	59.21	57.33
15	58.55	57.88	54.87
16	57.21	55.88	52.04
17	55.33	53.26	48.93
18	52.56	50.61	45.48

12.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	58.22	58.16	57.97
4	57.05	56.96	56.64
4.5	55.82	55.63	55.14
5	54.37	54.12	53.53
5.5	52.77	52.53	51.91
6	51.20	50.94	50.38
6.5	49.66	49.45	49.02
7	48.25	48.13	47.83
7.5	47.06	46.99	46.82
8	46.05	46.03	45.97
8.5	45.19	45.26	45.22
9	44.53	44.66	44.45
9.5	44.06	44.20	43.52
10	43.75	43.80	42.25
10.5	43.53	43.34	40.57
11	43.28	42.58	38.54
11.5	42.79	41.35	36.30
12	41.78	39.65	34.01
12.5	40.19	37.61	31.76
13	38.00	35.37	29.58
14	33.64	30.92	25.53
15	29.26	26.84	21.89
16	25.38	23.19	18.63
17	21.85	19.86	15.72
18	18.83	16.83	13.13

25.0 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	72.69	72.70	72.69
4	72.12	72.11	72.11
4.5	71.59	71.59	71.59
5	71.13	71.12	71.13
5.5	70.70	70.71	70.71
6	70.33	70.33	70.34
6.5	69.99	69.99	69.99
7	69.67	69.67	69.68
7.5	69.38	69.38	69.38
8	69.11	69.11	69.10
8.5	68.86	68.85	68.84
9	68.60	68.60	68.59
9.5	68.36	68.36	68.34
10	68.14	68.13	68.11
10.5	67.90	67.90	67.88
11	67.68	67.68	67.66
11.5	67.46	67.46	67.45
12	67.26	67.25	67.24
12.5	67.06	67.05	67.04
13	66.85	66.86	66.85
14	66.49	66.51	66.47
15	66.19	66.19	66.08
16	65.92	65.86	65.61
17	65.61	65.48	65.05
18	65.23	64.98	64.35

30 kHz Plan

7.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	36.09	35.85	35.26
4	33.72	33.46	32.74
4.5	31.41	31.12	30.37
5	29.28	28.99	28.16
5.5	27.30	26.96	26.09
6	25.38	25.05	24.13
6.5	23.61	23.24	22.28
7	21.85	21.54	20.53
7.5	20.31	19.92	18.85
8	18.83	18.35	17.25
8.5	17.24	16.85	15.73
9	15.88	15.43	14.28
9.5	14.52	14.07	12.90
10	13.22	12.76	11.59
10.5	11.99	11.49	10.34
11	10.76	10.27	9.18
11.5	9.60	9.09	8.10
12	8.45	7.98	7.11
12.5	7.34	6.94	6.21
13	6.31	5.98	5.40
14	4.51	4.31	4.04
15	3.00	3.00	2.98
16	1.87	2.02	2.18
17	1.15	1.33	1.59
18	0.67	0.85	1.15

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	71.94	71.94	71.91
4	71.39	71.37	71.32
4.5	70.82	70.80	70.71
5	70.24	70.21	70.08
5.5	69.64	69.57	69.40
6	68.96	68.88	68.69
6.5	68.24	68.18	67.96
7	67.56	67.46	67.21
7.5	66.84	66.72	66.46
8	66.12	65.99	65.72
8.5	65.34	65.27	65.01
9	64.67	64.57	64.33
9.5	63.99	63.90	63.68
10	63.35	63.27	63.07
10.5	62.74	62.68	62.48
11	62.19	62.13	61.90
11.5	61.65	61.61	61.33
12	61.16	61.13	60.72
12.5	60.73	60.66	60.05
13	60.29	60.20	59.28
14	59.46	59.21	57.33
15	58.55	57.88	54.87
16	57.21	55.88	52.04
17	55.33	53.26	48.93
18	52.56	50.61	45.48

11.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	51.50	51.41	51.15
4	49.84	49.76	49.54
4.5	48.36	48.32	48.17
5	47.14	47.10	47.01
5.5	46.10	46.08	46.07
6	45.22	45.26	45.32
6.5	44.55	44.63	44.71
7	44.07	44.16	44.13
7.5	43.76	43.81	43.44
8	43.54	43.46	42.40
8.5	43.29	42.92	40.87
9	42.80	41.93	38.88
9.5	41.79	40.40	36.62
10	40.19	38.44	34.27
10.5	38.00	36.24	31.94
11	35.90	33.95	29.71
11.5	33.64	31.70	27.58
12	31.38	29.54	25.56
12.5	29.26	27.51	23.65
13	27.29	25.58	21.84
14	23.61	22.03	18.51
15	20.31	18.79	15.52
16	17.24	15.85	12.87
17	14.52	13.13	10.54
18	11.99	10.63	8.54

22.50 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	72.69	72.69	72.69
4	72.12	72.11	72.11
4.5	71.60	71.59	71.58
5	71.13	71.12	71.11
5.5	70.68	70.68	70.67
6	70.27	70.27	70.26
6.5	69.89	69.89	69.88
7	69.54	69.53	69.52
7.5	69.20	69.19	69.19
8	68.87	68.88	68.89
8.5	68.58	68.60	68.61
9	68.33	68.34	68.35
9.5	68.09	68.10	68.10
10	67.88	67.88	67.85
10.5	67.68	67.67	67.59
11	67.49	67.45	67.32
11.5	67.28	67.22	67.02
12	67.05	66.96	66.70
12.5	66.81	66.68	66.33
13	66.53	66.35	65.94
14	65.78	65.57	65.05
15	64.92	64.66	64.07
16	63.90	63.68	63.01
17	62.89	62.69	61.78
18	61.89	61.74	60.21

15 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	63.21	63.19	63.17
4	62.51	62.51	62.51
4.5	61.93	61.93	61.92
5	61.42	61.40	61.37
5.5	60.92	60.90	60.84
6	60.43	60.41	60.31
6.5	59.96	59.92	59.72
7	59.49	59.39	59.03
7.5	58.95	58.77	58.19
8	58.26	58.04	57.15
8.5	57.49	57.15	55.93
9	56.57	56.05	54.56
9.5	55.50	54.75	53.14
10	54.17	53.31	51.74
10.5	52.65	51.81	50.42
11	51.13	50.37	49.20
11.5	49.62	49.04	48.05
12	48.22	47.86	46.95
12.5	47.04	46.85	45.79
13	46.04	46.02	44.49
14	44.52	44.76	41.18
15	43.74	43.61	37.08
16	43.27	41.47	32.79
17	41.78	37.79	28.72
18	38.00	33.42	24.99

30 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	72.65	72.65	72.65
4	72.06	72.06	72.07
4.5	71.56	71.56	71.56
5	71.11	71.11	71.11
5.5	70.70	70.70	70.70
6	70.33	70.33	70.33
6.5	69.98	69.98	69.98
7	69.66	69.66	69.66
7.5	69.36	69.37	69.37
8	69.09	69.09	69.09
8.5	68.83	68.83	68.83
9	68.59	68.59	68.59
9.5	68.35	68.36	68.36
10	68.14	68.14	68.13
10.5	67.92	67.93	67.92
11	67.73	67.73	67.72
11.5	67.54	67.53	67.53
12	67.35	67.35	67.35
12.5	67.18	67.17	67.17
13	67.01	67.00	67.00
14	66.68	66.68	66.68
15	66.38	66.38	66.38
16	66.10	66.10	66.09
17	65.84	65.83	65.82
18	65.58	65.58	65.56

A.6.5.2 EDACS®, NPSPAC 25 kHz Channel Bandwidth

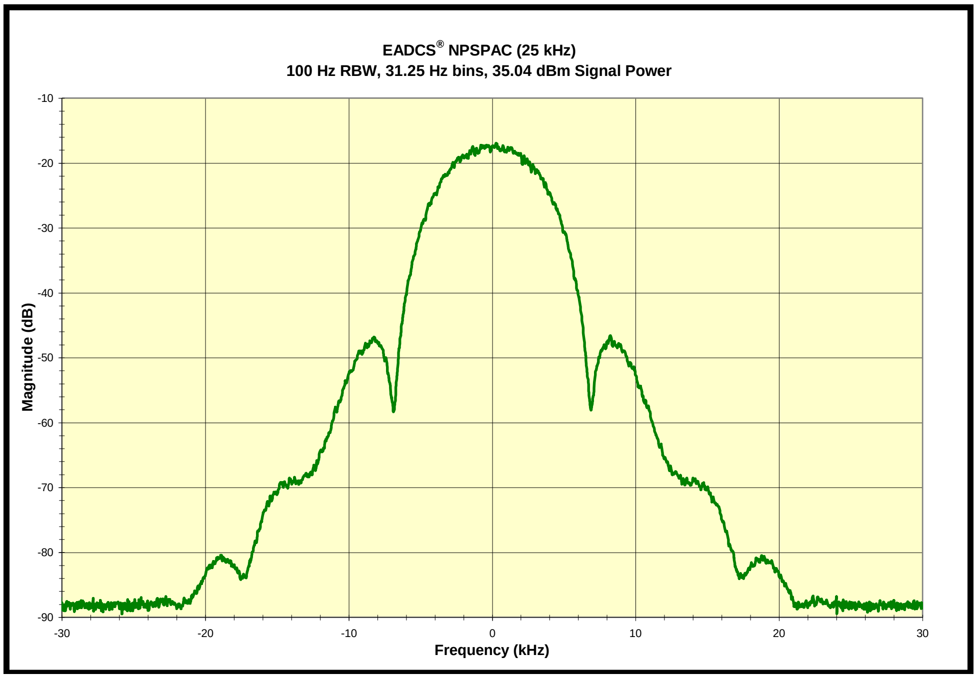


Figure A 11 EDACS®, NPSPAC 25 kHz

A.6.5.2.1 Emission Designator

14K0F1E

A.6.5.2.2 Typical Receiver Characteristics

For frequency coordination use: 6K20B0403

For specification validation use: 7K50B0504

A.6.5.2.3 Discussion

EDACS is a registered mark of Harris Inc, formerly M/A-Com. Use of this mark does not constitute an endorsement of the product or services.

Gaussian FSK modulation is used. All digital signaling on both the trunking control and traffic channels is at 9,600 baud.

The following table defines the modulation parameters for 800 MHz NPSPAC operation where the Gaussian filter is defined by the 3 *dB* bandwidth point.

Bandwidth	**Modulation Index (h)**	Frequency deviation (f2-f1)	Bandwidth point (BT)	**Emission Mask**
25 kHz	0.53	5.1 kHz	0.53	90.210h

A.6.5.2.4 EDACS®, NPSPAC, 25/30 kHz Plan Offsets

Table A 12 EDACS®, NPSPAC, 25/30 kHz Plan Offsets

6.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	19.48	19.39	19.10
4	17.71	17.60	17.31
4.5	16.09	16.02	15.72
5	14.73	14.59	14.26
5.5	13.35	13.23	12.92
6	12.10	11.99	11.71
6.5	10.97	10.88	10.63
7	9.95	9.88	9.64
7.5	9.06	8.96	8.73
8	8.15	8.10	7.90
8.5	7.37	7.33	7.15
9	6.68	6.62	6.46
9.5	6.03	5.97	5.83
10	5.38	5.36	5.24
10.5	4.82	4.81	4.71
11	4.32	4.30	4.23
11.5	3.87	3.83	3.78
12	3.41	3.40	3.37
12.5	3.00	3.01	3.00
13	2.64	2.65	2.67
14	1.98	2.02	2.08
15	1.48	1.51	1.61
16	1.04	1.10	1.23
17	0.71	0.78	0.93
18	0.46	0.53	0.69

15.625 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	56.81	56.82	56.81
4	56.19	56.19	56.18
4.5	55.65	55.64	55.60
5	55.13	55.10	55.05
5.5	54.59	54.58	54.50
6	54.10	54.07	53.91
6.5	53.59	53.52	53.26
7	53.05	52.91	52.48
7.5	52.35	52.20	51.56
8	51.64	51.37	50.47
8.5	50.78	50.39	49.22
9	49.81	49.25	47.86
9.5	48.53	47.98	46.44
10	47.27	46.62	45.02
10.5	45.99	45.21	43.64
11	44.56	43.80	42.33
11.5	43.12	42.44	41.12
12	41.79	41.14	39.99
12.5	40.53	39.94	38.96
13	39.24	38.84	37.98
14	37.19	36.99	36.03
15	35.51	35.66	33.67
16	34.43	34.76	30.60
17	33.96	33.75	27.13
18	33.82	31.51	23.69

7.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	30.46	30.24	29.56
4	28.05	27.78	26.99
4.5	25.73	25.35	24.52
5	23.35	23.08	22.25
5.5	21.28	20.99	20.19
6	19.37	19.08	18.34
6.5	17.65	17.38	16.67
7	16.05	15.83	15.15
7.5	14.71	14.41	13.76
8	13.34	13.08	12.50
8.5	12.10	11.88	11.36
9	10.96	10.79	10.33
9.5	9.95	9.80	9.38
10	9.06	8.89	8.51
10.5	8.14	8.05	7.72
11	7.37	7.28	7.00
11.5	6.68	6.58	6.33
12	6.03	5.94	5.72
12.5	5.38	5.34	5.16
13	4.82	4.79	4.65
14	3.87	3.82	3.75
15	3.00	3.01	3.00
16	2.29	2.33	2.38
17	1.71	1.77	1.87
18	1.24	1.31	1.45

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	66.85	66.83	66.78
4	66.35	66.31	66.18
4.5	65.73	65.66	65.44
5	64.98	64.86	64.53
5.5	64.06	63.88	63.50
6	62.97	62.80	62.42
6.5	61.86	61.72	61.36
7	60.81	60.68	60.36
7.5	59.83	59.69	59.43
8	58.89	58.79	58.58
8.5	58.01	57.98	57.81
9	57.31	57.26	57.11
9.5	56.63	56.61	56.46
10	56.04	56.03	55.84
10.5	55.53	55.50	55.22
11	55.07	54.99	54.57
11.5	54.58	54.49	53.84
12	54.12	53.98	53.00
12.5	53.68	53.42	52.03
13	53.18	52.79	50.94
14	51.92	51.15	48.43
15	50.28	48.93	45.76
16	47.90	46.28	43.14
17	45.25	43.55	40.63
18	42.46	41.05	38.09

9.375 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	34.55	34.58	34.65
4	34.22	34.25	34.33
4.5	34.04	34.07	34.10
5	33.96	33.95	33.80
5.5	33.87	33.74	33.18
6	33.53	33.16	31.96
6.5	32.62	31.94	30.14
7	31.01	30.13	27.96
7.5	29.00	27.97	25.67
8	26.76	25.68	23.47
8.5	24.43	23.47	21.41
9	22.28	21.40	19.53
9.5	20.32	19.50	17.81
10	18.47	17.79	16.24
10.5	16.83	16.21	14.82
11	15.38	14.77	13.52
11.5	14.01	13.44	12.33
12	12.70	12.23	11.25
12.5	11.50	11.13	10.26
13	10.44	10.12	9.35
14	8.58	8.34	7.76
15	7.01	6.85	6.41
16	5.71	5.58	5.28
17	4.57	4.50	4.32
18	3.81	3.87	3.68

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	66.85	66.83	66.78
4	66.35	66.31	66.18
4.5	65.73	65.66	65.44
5	64.98	64.86	64.53
5.5	64.06	63.88	63.50
6	62.97	62.80	62.42
6.5	61.86	61.72	61.36
7	60.81	60.68	60.36
7.5	59.83	59.69	59.43
8	58.89	58.79	58.58
8.5	58.01	57.98	57.81
9	57.31	57.26	57.11
9.5	56.63	56.61	56.46
10	56.04	56.03	55.84
10.5	55.53	55.50	55.22
11	55.07	54.99	54.57
11.5	54.58	54.49	53.84
12	54.12	53.98	53.00
12.5	53.68	53.42	52.03
13	53.18	52.79	50.94
14	51.92	51.15	48.43
15	50.28	48.93	45.76
16	47.90	46.28	43.14
17	45.25	43.55	40.63
18	42.46	41.05	38.09

11.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	41.37	41.31	41.13
4	39.97	39.95	39.81
4.5	38.82	38.76	38.63
5	37.70	37.69	37.60
5.5	36.80	36.76	36.70
6	35.94	35.94	35.95
6.5	35.20	35.26	35.35
7	34.66	34.74	34.86
7.5	34.27	34.38	34.43
8	34.04	34.14	33.91
8.5	33.93	33.95	33.11
9	33.88	33.65	31.87
9.5	33.71	33.01	30.16
10	33.12	31.81	28.16
10.5	31.86	30.06	26.06
11	29.99	27.96	23.99
11.5	27.84	25.75	22.04
12	25.64	23.60	20.22
12.5	23.31	21.58	18.54
13	21.26	19.72	17.00
14	17.65	16.46	14.29
15	14.71	13.70	12.01
16	12.10	11.40	10.08
17	9.95	9.45	8.44
18	8.14	7.81	7.06

22.50 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	72.29	72.27	72.23
4	71.57	71.56	71.50
4.5	70.88	70.85	70.77
5	70.20	70.15	70.06
5.5	69.50	69.46	69.35
6	68.82	68.78	68.68
6.5	68.18	68.13	68.06
7	67.54	67.52	67.49
7.5	66.97	66.99	66.99
8	66.50	66.52	66.56
8.5	66.09	66.12	66.17
9	65.75	65.79	65.81
9.5	65.47	65.51	65.45
10	65.24	65.25	65.07
10.5	65.03	64.98	64.62
11	64.82	64.66	64.09
11.5	64.54	64.25	63.47
12	64.14	63.72	62.76
12.5	63.60	63.05	62.01
13	62.92	62.29	61.22
14	61.14	60.61	59.65
15	59.37	58.98	58.12
16	57.71	57.54	56.60
17	56.41	56.31	54.91
18	55.35	55.22	52.89

12.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	48.44	48.37	48.13
4	46.99	46.85	46.51
4.5	45.45	45.31	44.92
5	43.96	43.80	43.40
5.5	42.53	42.38	41.96
6	41.21	41.02	40.63
6.5	39.86	39.76	39.43
7	38.74	38.62	38.35
7.5	37.64	37.60	37.41
8	36.76	36.69	36.61
8.5	35.91	35.91	35.92
9	35.19	35.28	35.32
9.5	34.65	34.79	34.72
10	34.26	34.44	34.00
10.5	34.03	34.17	33.00
11	33.92	33.90	31.64
11.5	33.87	33.42	29.93
12	33.71	32.53	28.01
12.5	33.12	31.10	26.02
13	31.86	29.21	24.06
14	27.84	24.95	20.46
15	23.31	20.96	17.34
16	19.37	17.56	14.68
17	16.05	14.67	12.42
18	13.34	12.25	10.50

25.0 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	72.65	72.65	72.65
4	72.05	72.05	72.05
4.5	71.52	71.52	71.51
5	71.03	71.03	71.03
5.5	70.59	70.60	70.61
6	70.21	70.21	70.22
6.5	69.86	69.87	69.87
7	69.56	69.56	69.54
7.5	69.27	69.26	69.22
8	68.97	68.95	68.87
8.5	68.67	68.63	68.52
9	68.35	68.30	68.15
9.5	68.02	67.94	67.77
10	67.65	67.56	67.38
10.5	67.24	67.15	66.98
11	66.82	66.74	66.60
11.5	66.41	66.33	66.23
12	65.97	65.95	65.88
12.5	65.56	65.59	65.54
13	65.22	65.27	65.20
14	64.66	64.72	64.50
15	64.25	64.23	63.64
16	63.91	63.61	62.55
17	63.35	62.66	61.25
18	62.32	61.37	59.80

15 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	55.50	55.48	55.47
4	54.94	54.94	54.91
4.5	54.44	54.42	54.36
5	53.96	53.91	53.79
5.5	53.42	53.34	53.13
6	52.80	52.69	52.35
6.5	52.08	51.93	51.41
7	51.27	51.05	50.31
7.5	50.37	49.99	49.04
8	49.25	48.80	47.65
8.5	47.95	47.48	46.21
9	46.68	46.08	44.77
9.5	45.27	44.67	43.37
10	43.85	43.26	42.05
10.5	42.47	41.91	40.83
11	41.17	40.64	39.72
11.5	39.84	39.47	38.71
12	38.73	38.40	37.77
12.5	37.63	37.45	36.88
13	36.75	36.62	35.98
14	35.18	35.38	33.82
15	34.26	34.55	30.86
16	33.92	33.52	27.34
17	33.71	31.12	23.81
18	31.86	27.29	20.57

30 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	72.71	72.71	72.71
4	72.13	72.13	72.13
4.5	71.62	71.62	71.62
5	71.15	71.16	71.16
5.5	70.75	70.75	70.75
6	70.36	70.37	70.37
6.5	70.02	70.02	70.02
7	69.71	69.70	69.70
7.5	69.40	69.40	69.40
8	69.11	69.12	69.12
8.5	68.85	68.86	68.86
9	68.61	68.61	68.61
9.5	68.38	68.38	68.38
10	68.16	68.16	68.15
10.5	67.94	67.94	67.94
11	67.74	67.74	67.74
11.5	67.54	67.54	67.54
12	67.35	67.36	67.35
12.5	67.18	67.18	67.17
13	67.01	67.00	66.99
14	66.66	66.67	66.66
15	66.35	66.36	66.33
16	66.06	66.07	66.01
17	65.80	65.78	65.67
18	65.54	65.48	65.30

25 kHz Plan (6.25, 9.375, 12.5, 15.625, 18.75 and 25.0 kHz offset tables)

30 kHz Plan (7.5, 11.25, 15, 18.75, 22.50 and 30 kHz offset tables)

A.6.5.3 EDACS®, 25 kHz Channel Bandwidth WB

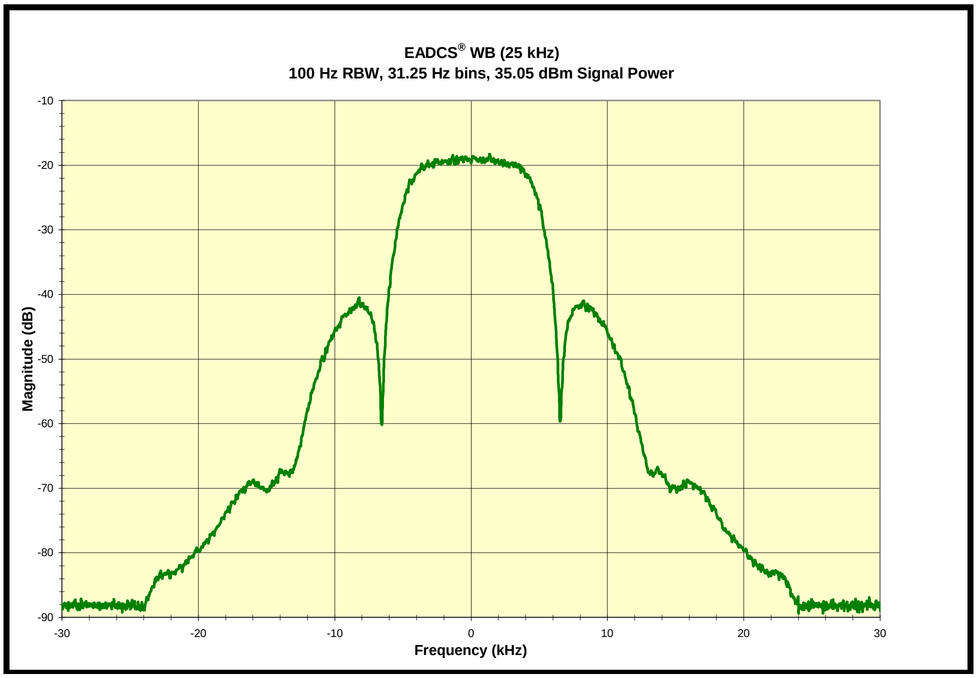


Figure A 12 EDACS®,WB

A.6.5.3.1 Emission Designator

16K0F1E

A.6.5.3.2 Typical Receiver Characteristics

For frequency coordination use: 6K90B0403

For specification validation use: 8K00B0504

A.6.5.3.3 Discussion

EDACS is a registered mark of Harris Inc, formerly M/A-Com. Use of this mark does not constitute an endorsement of the product or services.

Gaussian FSK modulation is used. All digital signaling on both the trunking control and traffic channels is at 9,600 baud. Systems can operate at either a 12.5 kHz or 25 kHz bandwidth. Systems operating at 25 kHz channel bandwidths will no longer be licensable between 150 MHz and 512 MHz after 1/1/2013.

The following table defines the modulation parameters for 25 kHz wideband operation where the Gaussian filter is defined by the 3 dB bandwidth point.

Bandwidth	**Modulation Index (h)**	Frequency deviation (f2-f1)	Bandwidth point (BT)	**Emission Mask**
25 kHz	0.625	6 kHz	0.77	90.210c & g

A.6.5.3.4 EDACS® WB, 25/30 kHz Plan Offsets

Table A 13 EDACS® WB, 25/30 kHz Plan Offsets

6.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	15.51	15.41	15.17
4	13.71	13.64	13.44
4.5	12.22	12.17	12.01
5	10.97	10.92	10.79
5.5	9.89	9.86	9.76
6	8.96	8.94	8.88
6.5	8.17	8.16	8.12
7	7.50	7.48	7.45
7.5	6.90	6.88	6.85
8	6.33	6.33	6.31
8.5	5.85	5.84	5.81
9	5.40	5.39	5.36
9.5	4.99	4.98	4.95
10	4.57	4.59	4.57
10.5	4.22	4.23	4.21
11	3.90	3.89	3.88
11.5	3.59	3.58	3.57
12	3.28	3.28	3.28
12.5	3.01	3.01	3.01
13	2.75	2.75	2.75
14	2.27	2.28	2.29
15	1.86	1.86	1.89
16	1.47	1.49	1.53
17	1.14	1.16	1.22
18	0.85	0.87	0.96

15.625 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	54.15	54.14	54.14
4	53.50	53.52	53.53
4.5	52.99	53.00	52.99
5	52.56	52.55	52.44
5.5	52.15	52.06	51.76
6	51.60	51.42	50.83
6.5	50.82	50.53	49.58
7	49.81	49.31	48.04
7.5	48.41	47.81	46.33
8	46.80	46.16	44.57
8.5	45.10	44.44	42.83
9	43.47	42.72	41.17
9.5	41.68	41.08	39.61
10	40.12	39.54	38.16
10.5	38.72	38.09	36.82
11	37.31	36.74	35.60
11.5	35.99	35.49	34.47
12	34.74	34.32	33.45
12.5	33.66	33.26	32.52
13	32.60	32.29	31.67
14	30.79	30.63	30.07
15	29.28	29.36	28.33
16	28.22	28.47	26.07
17	27.58	27.80	23.27
18	27.39	26.47	20.30

7.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	26.89	26.63	25.89
4	24.70	24.29	23.34
4.5	22.12	21.72	20.75
5	19.61	19.25	18.36
5.5	17.32	17.02	16.28
6	15.34	15.08	14.49
6.5	13.61	13.43	12.97
7	12.16	12.03	11.67
7.5	10.93	10.82	10.56
8	9.87	9.79	9.60
8.5	8.95	8.91	8.76
9	8.16	8.14	8.03
9.5	7.49	7.47	7.38
10	6.89	6.87	6.80
10.5	6.33	6.33	6.27
11	5.85	5.83	5.78
11.5	5.39	5.38	5.34
12	4.99	4.97	4.93
12.5	4.57	4.58	4.55
13	4.22	4.22	4.20
14	3.59	3.58	3.56
15	3.01	3.01	3.01
16	2.50	2.51	2.52
17	2.06	2.07	2.09
18	1.65	1.67	1.72

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	59.69	59.68	59.62
4	58.79	58.77	58.72
4.5	57.98	57.97	57.92
5	57.28	57.25	57.21
5.5	56.60	56.59	56.58
6	56.00	56.02	56.04
6.5	55.51	55.54	55.57
7	55.12	55.13	55.14
7.5	54.78	54.77	54.75
8	54.44	54.43	54.36
8.5	54.14	54.08	53.97
9	53.79	53.71	53.56
9.5	53.40	53.34	53.11
10	53.00	52.97	52.56
10.5	52.60	52.60	51.85
11	52.28	52.19	50.93
11.5	51.97	51.69	49.76
12	51.58	51.00	48.37
12.5	51.01	50.03	46.84
13	50.18	48.78	45.24
14	47.59	45.69	42.10
15	44.27	42.41	39.23
16	40.87	39.35	36.70
17	37.98	36.66	34.46
18	35.34	34.35	32.37

9.375 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	28.36	28.37	28.42
4	27.94	27.96	28.02
4.5	27.64	27.67	27.75
5	27.47	27.51	27.55
5.5	27.42	27.43	27.29
6	27.40	27.30	26.71
6.5	27.23	26.88	25.55
7	26.57	25.83	23.79
7.5	25.19	24.06	21.69
8	23.14	21.86	19.56
8.5	20.72	19.58	17.58
9	18.40	17.44	15.80
9.5	16.31	15.54	14.24
10	14.37	13.89	12.88
10.5	12.83	12.47	11.69
11	11.54	11.25	10.64
11.5	10.40	10.19	9.73
12	9.39	9.27	8.92
12.5	8.54	8.47	8.20
13	7.80	7.77	7.55
14	6.59	6.58	6.43
15	5.61	5.59	5.49
16	4.78	4.76	4.69
17	4.05	4.05	4.01
18	3.81	3.87	3.68

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	59.69	59.68	59.62
4	58.79	58.77	58.72
4.5	57.98	57.97	57.92
5	57.28	57.25	57.21
5.5	56.60	56.59	56.58
6	56.00	56.02	56.04
6.5	55.51	55.54	55.57
7	55.12	55.13	55.14
7.5	54.78	54.77	54.75
8	54.44	54.43	54.36
8.5	54.14	54.08	53.97
9	53.79	53.71	53.56
9.5	53.40	53.34	53.11
10	53.00	52.97	52.56
10.5	52.60	52.60	51.85
11	52.28	52.19	50.93
11.5	51.97	51.69	49.76
12	51.58	51.00	48.37
12.5	51.01	50.03	46.84
13	50.18	48.78	45.24
14	47.59	45.69	42.10
15	44.27	42.41	39.23
16	40.87	39.35	36.70
17	37.98	36.66	34.46
18	35.34	34.35	32.37

11.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	34.27	34.23	34.14
4	33.15	33.14	33.03
4.5	32.18	32.13	32.03
5	31.22	31.21	31.13
5.5	30.39	30.39	30.34
6	29.68	29.66	29.65
6.5	29.00	29.03	29.07
7	28.46	28.50	28.60
7.5	28.03	28.10	28.21
8	27.71	27.80	27.83
8.5	27.50	27.61	27.36
9	27.41	27.46	26.60
9.5	27.39	27.25	25.43
10	27.34	26.72	23.85
10.5	26.97	25.62	22.02
11	25.96	23.89	20.14
11.5	24.24	21.80	18.33
12	21.92	19.64	16.67
12.5	19.52	17.62	15.16
13	17.29	15.81	13.81
14	13.60	12.82	11.54
15	10.93	10.54	9.73
16	8.95	8.79	8.27
17	7.49	7.41	7.07
18	6.33	6.29	6.06

22.50 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	68.30	68.28	68.25
4	67.64	67.63	67.58
4.5	67.03	66.99	66.94
5	66.40	66.39	66.32
5.5	65.83	65.80	65.71
6	65.26	65.22	65.11
6.5	64.69	64.64	64.50
7	64.12	64.06	63.87
7.5	63.55	63.46	63.22
8	62.95	62.84	62.55
8.5	62.33	62.20	61.86
9	61.69	61.53	61.15
9.5	61.00	60.85	60.43
10	60.31	60.14	59.71
10.5	59.62	59.41	59.02
11	58.87	58.70	58.35
11.5	58.15	58.02	57.73
12	57.48	57.37	57.14
12.5	56.87	56.78	56.60
13	56.27	56.25	56.09
14	55.28	55.34	55.10
15	54.60	54.57	54.00
16	54.00	53.84	52.51
17	53.29	53.13	50.41
18	52.51	52.25	47.77

12.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	41.10	41.03	40.81
4	39.54	39.45	39.19
4.5	38.08	37.99	37.68
5	36.71	36.59	36.29
5.5	35.39	35.30	35.02
6	34.23	34.13	33.85
6.5	33.12	33.05	32.80
7	32.16	32.05	31.85
7.5	31.21	31.16	31.01
8	30.38	30.35	30.27
8.5	29.66	29.65	29.63
9	28.99	29.04	29.08
9.5	28.45	28.53	28.58
10	28.03	28.14	28.06
10.5	27.70	27.86	27.41
11	27.50	27.65	26.50
11.5	27.40	27.43	25.27
12	27.39	27.05	23.74
12.5	27.33	26.25	22.03
13	26.96	24.87	20.29
14	24.24	20.94	17.04
15	19.52	17.03	14.29
16	15.32	13.87	12.04
17	12.16	11.42	10.22
18	9.87	9.52	8.72

25.0 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	72.34	72.30	72.24
4	71.45	71.43	71.38
4.5	70.64	70.64	70.60
5	69.94	69.93	69.91
5.5	69.31	69.31	69.29
6	68.76	68.76	68.73
6.5	68.28	68.26	68.21
7	67.81	67.78	67.72
7.5	67.34	67.33	67.24
8	66.93	66.88	66.77
8.5	66.48	66.43	66.30
9	66.04	65.98	65.82
9.5	65.60	65.53	65.34
10	65.14	65.08	64.85
10.5	64.71	64.62	64.34
11	64.27	64.16	63.81
11.5	63.80	63.68	63.26
12	63.33	63.18	62.68
12.5	62.85	62.65	62.08
13	62.34	62.09	61.46
14	61.22	60.90	60.18
15	59.96	59.60	58.91
16	58.62	58.30	57.71
17	57.29	57.11	56.55
18	56.13	56.09	55.33

15 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	53.53	53.52	53.51
4	52.92	52.89	52.79
4.5	52.28	52.21	51.96
5	51.52	51.37	50.89
5.5	50.54	50.28	49.50
6	49.25	48.87	47.86
6.5	47.73	47.24	46.09
7	46.00	45.52	44.29
7.5	44.32	43.77	42.52
8	42.61	42.06	40.85
8.5	40.89	40.45	39.29
9	39.41	38.94	37.85
9.5	37.99	37.52	36.51
10	36.65	36.21	35.29
10.5	35.35	34.99	34.17
11	34.20	33.86	33.16
11.5	33.10	32.82	32.25
12	32.14	31.88	31.42
12.5	31.19	31.04	30.66
13	30.37	30.29	29.92
14	28.99	29.08	28.33
15	28.02	28.27	26.18
16	27.50	27.63	23.37
17	27.39	26.21	20.33
18	26.96	23.06	17.47

30 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	72.66	72.65	72.65
4	72.08	72.08	72.08
4.5	71.56	71.57	71.57
5	71.11	71.11	71.11
5.5	70.70	70.70	70.70
6	70.32	70.32	70.32
6.5	69.98	69.98	69.98
7	69.65	69.66	69.66
7.5	69.36	69.36	69.36
8	69.08	69.08	69.08
8.5	68.82	68.82	68.82
9	68.57	68.57	68.57
9.5	68.33	68.34	68.33
10	68.11	68.12	68.11
10.5	67.90	67.90	67.89
11	67.71	67.70	67.67
11.5	67.51	67.51	67.44
12	67.34	67.31	67.22
12.5	67.15	67.10	66.98
13	66.95	66.87	66.74
14	66.48	66.39	66.25
15	65.94	65.89	65.73
16	65.41	65.39	65.18
17	64.95	64.89	64.60
18	64.47	64.36	63.94

25 kHz Plan

30 kHz Plan

A.6.6 4L-FSK

A.6.6.1 dPMR

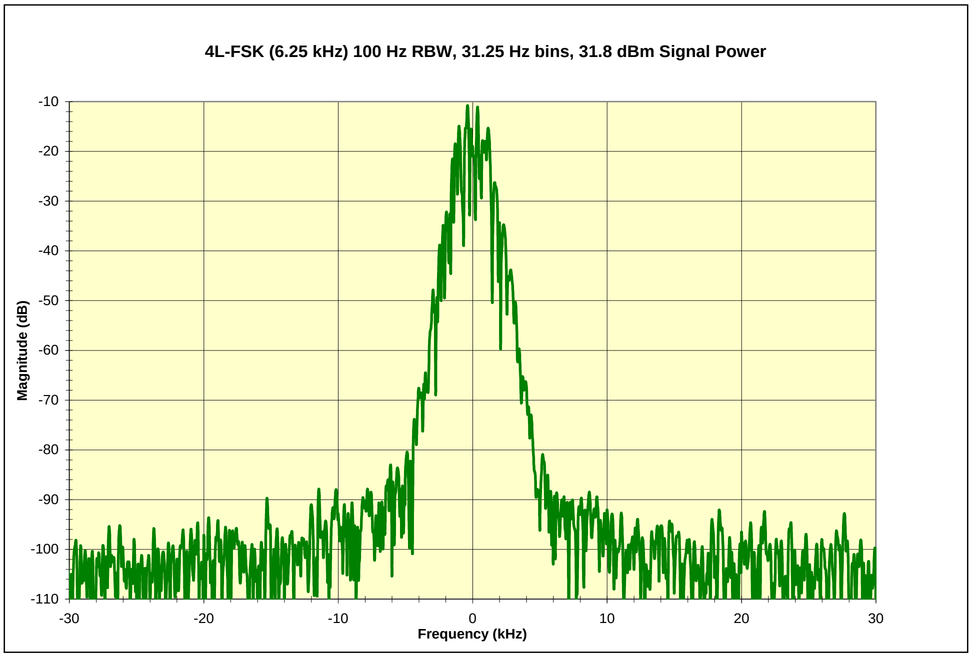


Figure A 13 dPMR (6.25 kHz Channels)

A.6.6.1.1 Emission Designator

4K00F1E Voice

4K00F1D Data

A.6.6.1.2 Typical Receiver Characteristics

3K50R20||

A.6.6.1.3 Discussion

A digital 4 level FM modulation based on ETSI TS 102 490 for 6.25 kHz channelization. The deviations are ±1050 Hz and ±350 Hz.

A.6.6.1.4 4L-FSK 6.25, dPMR, 25/30 kHz Plan Offsets

Table A 14 4L-FSK 6.25, dPMR, 25/30 kHz Plan Offsets

6.25 kHz Offset ACPR				15.625 kHz Offset ACPR				7.5 kHz Offset ACPR				18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3
3.5	69.33	68.73	66.76	3.5	81.03	80.97	80.90	3.5	72.65	72.49	72.45	3.5	80.89	80.94	80.95
4	65.78	64.87	61.85	4	80.41	80.35	80.31	4	71.46	71.63	71.61	4	80.44	80.48	80.52
4.5	61.78	60.54	55.88	4.5	79.61	79.75	79.77	4.5	71.03	70.99	70.70	4.5	80.11	80.13	80.16
5	57.57	56.89	49.26	5	79.25	79.28	79.31	5	70.28	70.17	68.91	5	79.84	79.84	79.84
5.5	54.85	51.31	43.00	5.5	78.90	78.90	78.88	5.5	69.08	69.19	64.51	5.5	79.64	79.56	79.50
6	49.71	44.59	37.37	6	78.45	78.54	78.46	6	68.58	67.01	58.38	6	79.02	79.21	79.12
6.5	43.04	39.57	32.19	6.5	78.24	78.13	78.02	6.5	65.46	63.16	51.91	6.5	78.75	78.78	78.71
7	36.63	34.50	27.36	7	77.82	77.69	77.56	7	61.65	59.45	45.75	7	78.26	78.33	78.33
7.5	34.66	30.68	22.91	7.5	77.11	77.21	77.11	7.5	57.53	54.45	40.10	7.5	77.69	77.93	77.99
8	27.86	26.62	18.95	8	76.92	76.72	76.67	8	54.83	47.87	34.92	8	77.55	77.62	77.71
8.5	26.42	22.79	15.57	8.5	76.07	76.29	76.26	8.5	49.71	42.36	30.20	8.5	77.35	77.39	77.47
9	22.15	17.53	12.75	9	75.80	75.92	75.86	9	43.03	37.20	25.90	9	77.24	77.21	77.22
9.5	18.31	13.46	10.44	9.5	75.57	75.57	75.48	9.5	36.63	32.99	22.05	9.5	77.04	76.93	76.97
10	13.03	10.66	8.55	10	75.37	75.19	75.11	10	34.66	28.96	18.65	10	76.58	76.69	76.74
10.5	8.69	8.39	6.98	10.5	75.08	74.82	74.72	10.5	27.86	25.03	15.71	10.5	76.38	76.48	76.53
11	6.94	6.64	5.68	11	74.36	74.48	74.29	11	26.42	19.93	13.18	11	76.20	76.30	76.34
11.5	6.22	5.20	4.60	11.5	73.99	74.16	73.69	11.5	22.15	15.52	11.04	11.5	76.15	76.14	76.16
12	3.35	3.97	3.71	12	73.83	73.89	72.72	12	18.31	12.45	9.23	12	76.07	75.99	75.98
12.5	2.72	3.00	2.97	12.5	73.58	73.66	71.11	12.5	13.03	9.96	7.70	12.5	75.89	75.84	75.77
13	2.48	2.22	2.37	13	73.43	73.45	68.75	13	8.69	8.01	6.40	13	75.70	75.70	75.50
14	0.77	1.13	1.50	14	73.13	73.03	62.26	14	6.22	5.05	4.38	14	75.38	75.32	74.44
15	0.15	0.51	0.94	15	72.76	72.56	55.43	15	2.72	3.01	2.96	15	74.67	74.79	72.05
16	0.01	0.19	0.59	16	72.03	72.10	48.93	16	1.05	1.68	1.98	16	74.33	74.23	67.64
17	0.00	0.06	0.38	17	71.63	71.55	42.88	17	0.51	0.87	1.32	17	73.86	73.71	62.08
18	0.00	0.01	0.24	18	71.34	70.90	37.29	18	0.06	0.40	0.88	18	73.12	73.28	56.40

9.375 kHz Offset ACPR				18.75 kHz Offset ACPR				11.25 kHz Offset ACPR				22.50 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3
3.5	75.08	75.04	75.07	3.5	80.89	80.94	80.95	3.5	76.31	76.38	76.39	3.5	81.62	81.47	81.44
4	74.40	74.36	74.43	4	80.44	80.48	80.52	4	76.01	76.01	76.02	4	80.94	80.97	80.95
4.5	73.84	73.90	73.93	4.5	80.11	80.13	80.16	4.5	75.71	75.66	75.69	4.5	80.55	80.49	80.52
5	73.59	73.52	73.44	5	79.84	79.84	79.84	5	75.33	75.39	75.38	5	80.03	80.11	80.18
5.5	73.13	73.08	72.89	5.5	79.64	79.56	79.50	5.5	75.18	75.15	75.04	5.5	79.81	79.86	79.91
6	72.66	72.46	72.24	6	79.02	79.21	79.12	6	74.99	74.79	74.62	6	79.73	79.66	79.66
6.5	71.86	71.82	71.39	6.5	78.75	78.78	78.71	6.5	74.38	74.30	74.17	6.5	79.49	79.45	79.40
7	71.14	71.18	69.80	7	78.26	78.33	78.33	7	73.70	73.79	73.72	7	79.21	79.22	79.11
7.5	70.72	70.63	65.95	7.5	77.69	77.93	77.99	7.5	73.24	73.34	73.25	7.5	79.00	78.91	78.79
8	70.06	70.09	60.46	8	77.55	77.62	77.71	8	72.97	72.97	72.60	8	78.75	78.55	78.45
8.5	69.80	69.50	54.75	8.5	77.35	77.39	77.47	8.5	72.65	72.66	71.37	8.5	78.01	78.18	78.12
9	69.01	68.53	49.28	9	77.24	77.21	77.22	9	72.40	72.30	68.86	9	77.92	77.82	77.82
9.5	68.40	66.10	44.16	9.5	77.04	76.93	76.97	9.5	72.24	71.88	64.68	9.5	77.37	77.49	77.54
10	66.89	62.67	39.40	10	76.58	76.69	76.74	10	71.56	71.41	59.93	10	77.25	77.22	77.30
10.5	63.58	58.36	35.00	10.5	76.38	76.48	76.53	10.5	70.87	70.92	55.15	10.5	76.86	77.00	77.09
11	58.96	52.14	30.95	11	76.20	76.30	76.34	11	70.57	70.42	50.53	11	76.70	76.82	76.91
11.5	56.39	46.02	27.23	11.5	76.15	76.14	76.16	11.5	69.83	69.89	46.15	11.5	76.66	76.67	76.74
12	52.45	40.86	23.85	12	76.07	75.99	75.98	12	69.58	69.22	42.01	12	76.55	76.54	76.58
12.5	45.09	36.12	20.80	12.5	75.89	75.84	75.77	12.5	69.33	67.87	38.11	12.5	76.47	76.42	76.43
13	39.23	32.13	18.06	13	75.70	75.70	75.50	13	68.27	65.14	34.45	13	76.27	76.30	76.29
14	30.90	23.22	13.49	14	75.38	75.32	74.44	14	65.20	55.80	27.86	14	76.11	76.05	75.98
15	25.58	14.93	9.96	15	74.67	74.79	72.05	15	57.48	44.14	22.21	15	75.82	75.76	75.63
16	16.49	10.00	7.29	16	74.33	74.23	67.64	16	49.70	34.95	17.47	16	75.46	75.43	75.16
17	7.65	6.67	5.28	17	73.86	73.71	62.08	17	36.63	26.22	13.58	17	75.09	75.12	74.27
18	3.81	3.87	3.68	18	73.12	73.28	56.40	18	27.86	17.23	10.45	18	74.74	74.82	72.35

12.5 kHz Offset ACPR				25.0 kHz Offset ACPR				15 kHz Offset ACPR				30 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3
3.5	78.59	78.67	78.61	3.5	83.23	83.31	83.32	3.5	80.54	80.63	80.70	3.5	83.64	83.70	83.73
4	78.41	78.16	77.92	4	82.97	82.71	82.62	4	80.39	80.37	80.33	4	83.44	83.27	83.04
4.5	77.48	77.25	77.11	4.5	81.97	82.02	81.92	4.5	79.98	79.94	79.85	4.5	82.64	82.39	82.18
5	76.24	76.36	76.37	5	81.43	81.29	81.24	5	79.48	79.45	79.32	5	81.34	81.41	81.37
5.5	75.70	75.68	75.79	5.5	80.50	80.65	80.63	5.5	78.95	78.87	78.75	5.5	80.53	80.63	80.71
6	75.10	75.23	75.35	6	80.07	80.09	80.08	6	78.32	78.28	78.17	6	80.00	80.08	80.22
6.5	74.87	74.91	75.01	6.5	79.75	79.57	79.61	6.5	77.70	77.69	77.60	6.5	79.64	79.72	79.86
7	74.70	74.67	74.71	7	79.02	79.15	79.22	7	77.40	77.10	77.08	7	79.42	79.47	79.57
7.5	74.43	74.48	74.42	7.5	78.74	78.81	78.89	7.5	76.47	76.61	76.60	7.5	79.31	79.27	79.34
8	74.31	74.25	74.09	8	78.53	78.54	78.62	8	76.12	76.21	76.16	8	79.11	79.09	79.13
8.5	74.20	73.93	73.68	8.5	78.41	78.32	78.37	8.5	75.83	75.81	75.73	8.5	78.88	78.92	78.94
9	73.68	73.56	73.07	9	78.07	78.11	78.16	9	75.74	75.39	75.33	9	78.70	78.76	78.77
9.5	73.11	73.19	71.94	9.5	77.92	77.93	77.96	9.5	75.14	74.98	74.94	9.5	78.62	78.61	78.60
10	72.68	72.86	69.83	10	77.68	77.76	77.77	10	74.37	74.61	74.56	10	78.53	78.45	78.42
10.5	72.50	72.56	66.33	10.5	77.58	77.60	77.58	10.5	74.18	74.27	74.14	10.5	78.32	78.29	78.25
11	72.33	72.24	62.16	11	77.51	77.45	77.38	11	73.91	73.99	73.56	11	78.05	78.13	78.07
11.5	72.10	71.88	57.84	11.5	77.40	77.26	77.18	11.5	73.72	73.76	72.58	11.5	77.96	77.94	77.90
12	71.89	71.48	53.60	12	77.08	77.06	76.97	12	73.54	73.55	70.91	12	77.88	77.75	77.72
12.5	71.27	71.04	49.52	12.5	76.94	76.84	76.77	12.5	73.34	73.33	68.40	12.5	77.66	77.57	77.55
13	70.58	70.58	45.62	13	76.71	76.62	76.58	13	73.25	73.09	65.10	13	77.28	77.40	77.37
14	69.59	69.52	38.40	14	76.19	76.19	76.22	14	72.69	72.58	57.98	14	77.08	77.09	77.03
15	69.10	66.41	31.95	15	75.82	75.84	75.90	15	71.91	72.09	51.05	15	76.82	76.76	76.68
16	67.75	57.94	26.26	16	75.52	75.57	75.61	16	71.68	71.51	44.59	16	76.57	76.40	76.34
17	61.51	46.12	21.32	17	75.33	75.35	75.31	17	71.34	70.82	38.63	17	75.94	76.04	76.02
18	54.80	36.64	17.11	18	75.18	75.15	74.88	18	70.19	70.02	33.18	18	75.64	75.71	75.72
25 kHz Plan								30 kHz Plan							

A.6.6.2 NXDN™ 4.8 kb/s (6.25 kHz)

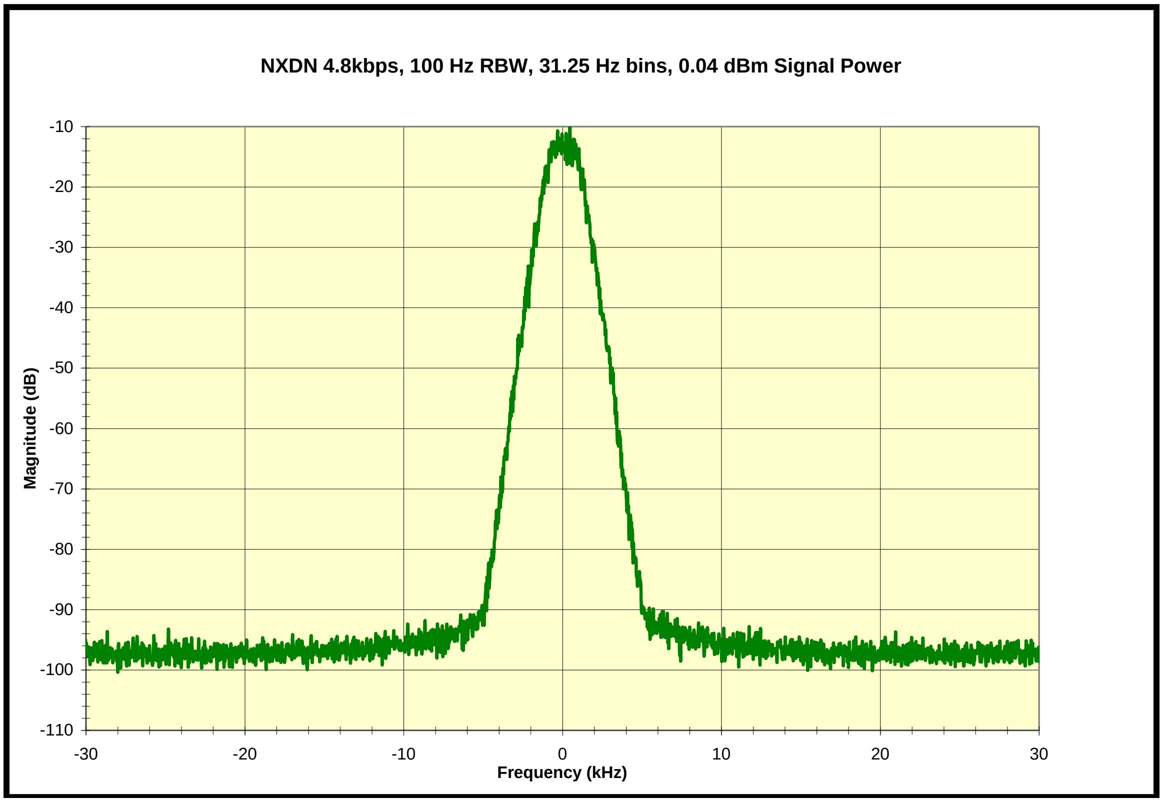


Figure A 14 NXDN™, 6.25 kHz Channel Bandwidth

A.6.6.2.1 Emission Designator

4K00F1E Voice

4K00F1D Data

A.6.6.2.2 Typical Receiver Characteristics

3K80R20||

A.6.6.2.3 Discussion

NXDN™ utilizes a 4 level frequency modulation with Nyquist characteristic. NXDN™ uses a 4.8 kb/s data rate, for use with a 6.25 kHz channel bandwidth. The dibits are deviated ±350 Hz and ±1050 Hz.

A.6.6.2.4 NXDN™ 6.25 kHz, 25/30 kHz Plan Offsets

Table A 15 NXDN™ 6.25 kHz, 25/30 kHz Plan Offsets

6.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	74.47	73.85	71.72
4	70.84	70.02	66.02
4.5	66.97	65.44	59.22
5	62.56	60.16	52.28
5.5	57.07	54.15	45.68
6	51.81	48.25	39.51
6.5	46.09	43.02	33.76
7	41.27	38.12	28.52
7.5	36.66	32.93	23.83
8	32.32	28.05	19.73
8.5	27.18	23.27	16.21
9	23.26	18.71	13.23
9.5	18.89	14.67	10.75
10	14.22	11.39	8.70
10.5	10.63	8.80	7.01
11	7.65	6.77	5.63
11.5	5.76	5.15	4.49
12	3.99	3.85	3.57
12.5	2.85	2.82	2.83
13	1.96	2.02	2.23
14	0.57	0.96	1.38
15	0.10	0.40	0.86
16	0.02	0.13	0.54
17	0.00	0.03	0.34
18	0.00	0.01	0.22

15.625 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	81.34	81.34	81.34
4	80.75	80.74	80.75
4.5	80.23	80.23	80.23
5	79.78	79.77	79.78
5.5	79.35	79.36	79.36
6	78.98	78.98	78.99
6.5	78.64	78.64	78.64
7	78.31	78.31	78.30
7.5	77.99	77.99	77.99
8	77.69	77.70	77.70
8.5	77.44	77.43	77.42
9	77.17	77.17	77.16
9.5	76.92	76.92	76.91
10	76.68	76.69	76.64
10.5	76.47	76.46	76.35
11	76.24	76.25	75.94
11.5	76.05	76.04	75.27
12	75.86	75.83	74.06
12.5	75.65	75.63	72.07
13	75.45	75.43	69.32
14	75.05	75.05	62.63
15	74.70	74.70	55.74
16	74.38	74.35	49.21
17	74.05	74.01	43.14
18	73.72	73.67	37.53

9.375 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	79.79	79.78	79.77
4	79.22	79.19	79.16
4.5	78.65	78.62	78.59
5	78.09	78.09	78.07
5.5	77.63	77.60	77.56
6	77.18	77.15	76.98
6.5	76.73	76.74	75.86
7	76.37	76.35	73.00
7.5	75.99	75.98	67.95
8	75.65	75.54	61.97
8.5	75.27	74.88	56.04
9	74.67	73.56	50.43
9.5	73.63	70.99	45.19
10	71.70	66.88	40.32
10.5	68.56	61.55	35.82
11	64.28	55.39	31.66
11.5	59.64	49.66	27.86
12	54.86	44.44	24.39
12.5	48.36	39.17	21.25
13	43.21	33.97	18.44
14	34.74	24.15	13.70
15	24.98	15.90	10.03
16	16.71	10.33	7.26
17	9.11	6.66	5.19
18	4.57	4.16	3.69

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	81.68	81.68	81.69
4	81.09	81.08	81.09
4.5	80.56	80.56	80.57
5	80.10	80.11	80.12
5.5	79.70	79.70	79.70
6	79.31	79.31	79.31
6.5	78.95	78.95	78.94
7	78.61	78.61	78.61
7.5	78.31	78.30	78.29
8	77.99	78.00	78.00
8.5	77.72	77.73	77.73
9	77.46	77.47	77.48
9.5	77.23	77.23	77.24
10	77.03	77.01	77.01
10.5	76.80	76.79	76.79
11	76.59	76.59	76.58
11.5	76.39	76.39	76.37
12	76.19	76.19	76.16
12.5	76.01	76.00	75.93
13	75.83	75.82	75.66
14	75.47	75.48	74.71
15	75.15	75.15	72.30
16	74.85	74.85	67.84
17	74.56	74.56	62.27
18	74.29	74.28	56.57

12.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	80.80	80.79	80.79
4	80.18	80.21	80.21
4.5	79.71	79.70	79.70
5	79.24	79.24	79.23
5.5	78.82	78.82	78.81
6	78.43	78.43	78.41
6.5	78.07	78.05	78.03
7	77.68	77.68	77.67
7.5	77.34	77.35	77.33
8	77.01	77.04	76.99
8.5	76.75	76.76	76.54
9	76.50	76.49	75.75
9.5	76.25	76.23	74.10
10	75.99	75.98	71.18
10.5	75.76	75.73	67.23
11	75.50	75.48	62.85
11.5	75.25	75.24	58.44
12	75.01	75.00	54.16
12.5	74.77	74.76	50.05
13	74.54	74.51	46.12
14	74.09	73.75	38.85
15	73.58	70.59	32.34
16	71.88	61.03	26.57
17	66.39	49.56	21.55
18	57.01	38.88	17.26

25.0 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	81.67	81.66	81.67
4	81.07	81.07	81.08
4.5	80.55	80.56	80.58
5	80.12	80.13	80.14
5.5	79.75	79.75	79.75
6	79.40	79.40	79.40
6.5	79.07	79.07	79.06
7	78.76	78.76	78.75
7.5	78.46	78.46	78.45
8	78.19	78.18	78.17
8.5	77.92	77.91	77.91
9	77.65	77.66	77.66
9.5	77.41	77.42	77.43
10	77.19	77.20	77.20
10.5	76.96	76.98	76.99
11	76.78	76.78	76.78
11.5	76.58	76.58	76.58
12	76.40	76.40	76.40
12.5	76.22	76.22	76.21
13	76.06	76.05	76.04
14	75.72	75.71	75.71
15	75.40	75.40	75.40
16	75.11	75.11	75.10
17	74.84	74.84	74.78
18	74.59	74.59	74.35

25 kHz Plan

7.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	78.43	78.39	78.38
4	77.78	77.75	77.64
4.5	77.18	77.13	76.50
5	76.55	76.26	73.69
5.5	75.29	74.78	68.11
6	73.63	72.13	61.15
6.5	70.46	68.23	54.20
7	66.81	63.25	47.69
7.5	62.51	57.42	41.70
8	57.05	51.35	36.22
8.5	51.81	45.88	31.25
9	46.09	40.84	26.76
9.5	41.27	35.59	22.77
10	36.66	30.57	19.25
10.5	32.32	25.72	16.18
11	27.18	21.02	13.53
11.5	23.26	16.78	11.27
12	18.89	13.27	9.35
12.5	14.22	10.46	7.73
13	10.63	8.23	6.36
14	5.76	4.97	4.27
15	2.85	2.83	2.84
16	1.15	1.51	1.87
17	0.26	0.74	1.24
18	0.03	0.32	0.82

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	81.68	81.68	81.69
4	81.09	81.08	81.09
4.5	80.56	80.56	80.57
5	80.10	80.11	80.12
5.5	79.70	79.70	79.70
6	79.31	79.31	79.31
6.5	78.95	78.95	78.94
7	78.61	78.61	78.61
7.5	78.31	78.30	78.29
8	77.99	78.00	78.00
8.5	77.72	77.73	77.73
9	77.46	77.47	77.48
9.5	77.23	77.23	77.24
10	77.03	77.01	77.01
10.5	76.80	76.79	76.79
11	76.59	76.59	76.58
11.5	76.39	76.39	76.37
12	76.19	76.19	76.16
12.5	76.01	76.00	75.93
13	75.83	75.82	75.66
14	75.47	75.48	74.71
15	75.15	75.15	72.30
16	74.85	74.85	67.84
17	74.56	74.56	62.27
18	74.29	74.28	56.57

11.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	80.52	80.52	80.51
4	79.91	79.91	79.90
4.5	79.37	79.36	79.35
5	78.84	78.86	78.86
5.5	78.40	78.41	78.42
6	78.02	78.02	78.01
6.5	77.65	77.65	77.63
7	77.31	77.30	77.25
7.5	76.97	76.97	76.77
8	76.68	76.65	75.89
8.5	76.35	76.34	73.93
9	76.04	76.03	70.39
9.5	75.76	75.74	65.74
10	75.45	75.45	60.79
10.5	75.17	75.17	55.91
11	74.94	74.88	51.24
11.5	74.68	74.50	46.81
12	74.40	73.83	42.63
12.5	74.07	72.36	38.69
13	73.33	69.44	34.99
14	69.73	58.92	28.30
15	62.38	47.62	22.54
16	51.79	37.00	17.69
17	41.27	26.99	13.70
18	32.32	18.31	10.48

22.50 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	81.74	81.75	81.75
4	81.16	81.15	81.15
4.5	80.59	80.61	80.63
5	80.13	80.16	80.18
5.5	79.76	79.77	79.78
6	79.43	79.41	79.41
6.5	79.08	79.08	79.07
7	78.77	78.76	78.75
7.5	78.45	78.46	78.45
8	78.18	78.17	78.17
8.5	77.90	77.91	77.91
9	77.65	77.66	77.66
9.5	77.42	77.42	77.42
10	77.19	77.19	77.19
10.5	76.97	76.97	76.97
11	76.77	76.77	76.76
11.5	76.58	76.57	76.57
12	76.38	76.38	76.37
12.5	76.19	76.20	76.19
13	76.03	76.02	76.01
14	75.67	75.68	75.67
15	75.37	75.37	75.33
16	75.08	75.08	74.87
17	74.79	74.80	74.04
18	74.53	74.53	72.23

15 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	81.25	81.24	81.24
4	80.67	80.67	80.68
4.5	80.15	80.15	80.16
5	79.70	79.70	79.70
5.5	79.29	79.28	79.28
6	78.88	78.89	78.89
6.5	78.53	78.53	78.53
7	78.18	78.19	78.19
7.5	77.88	77.89	77.89
8	77.60	77.60	77.60
8.5	77.33	77.33	77.33
9	77.06	77.08	77.06
9.5	76.85	76.84	76.80
10	76.63	76.61	76.49
10.5	76.40	76.38	76.08
11	76.17	76.15	75.38
11.5	75.95	75.93	74.10
12	75.71	75.72	71.97
12.5	75.51	75.51	69.03
13	75.30	75.31	65.59
14	74.94	74.93	58.35
15	74.58	74.55	51.38
16	74.21	74.19	44.89
17	73.86	73.82	38.90
18	73.50	73.36	33.42

30 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	81.67	81.67	81.66
4	81.06	81.06	81.07
4.5	80.55	80.54	80.55
5	80.06	80.08	80.09
5.5	79.67	79.67	79.67
6	79.31	79.30	79.30
6.5	78.95	78.95	78.96
7	78.63	78.64	78.65
7.5	78.36	78.35	78.36
8	78.07	78.08	78.08
8.5	77.83	77.83	77.83
9	77.60	77.59	77.58
9.5	77.36	77.36	77.35
10	77.14	77.14	77.13
10.5	76.93	76.92	76.92
11	76.72	76.72	76.72
11.5	76.53	76.53	76.53
12	76.34	76.35	76.35
12.5	76.18	76.17	76.17
13	76.01	76.00	76.00
14	75.69	75.68	75.68
15	75.38	75.37	75.37
16	75.07	75.09	75.09
17	74.83	74.83	74.82
18	74.59	74.57	74.57

30 kHz Plan

A.6.6.3 NXDN™ 9.6 kb/s (12.5 kHz)

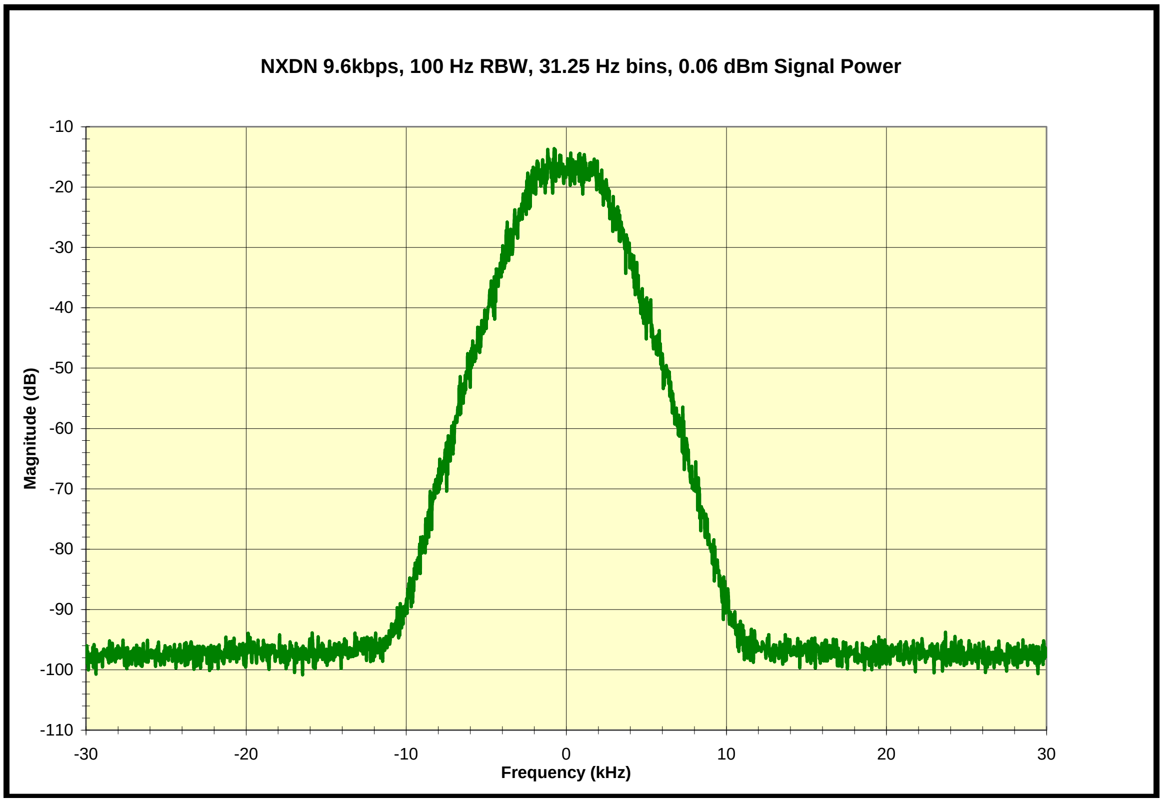


Figure A 15 NXDN™, 12.5 kHz Channel Bandwidth

A.6.6.3.1 Emission Designator

8K30F1E Voice

8K30F1D Data

A.6.6.3.2 Typical Receiver Characteristics

6K80R20||

A.6.6.3.3 Discussion

NXDN™ utilizes a 4 level frequency modulation with Nyquist characteristic. NXDN™ uses a 9.6 kb/s data rate, optimized for a 12.5 kHz channel bandwidth. The dibits are deviated ±800 Hz and ±2400 Hz.

A.6.6.3.4 NXDN™ 12.5 kHz, 25/30 kHz Plan Offsets

Table A 16 NXDN™ 12.5 kHz, 25/30 kHz Plan Offsets

6.25 kHz Offset ACPR				15.625 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3
3.5	29.64	29.23	28.51	3.5	81.43	81.42	81.41
4	27.03	26.75	25.96	4	80.84	80.84	80.84
4.5	24.70	24.34	23.52	4.5	80.33	80.33	80.34
5	22.31	22.13	21.21	5	79.90	79.90	79.90
5.5	20.41	19.99	19.03	5.5	79.52	79.51	79.50
6	18.35	18.01	16.97	6	79.15	79.14	79.13
6.5	16.54	16.12	15.02	6.5	78.79	78.79	78.77
7	14.83	14.28	13.21	7	78.46	78.45	78.43
7.5	12.92	12.54	11.56	7.5	78.14	78.13	78.09
8	11.38	10.91	10.08	8	77.83	77.82	77.74
8.5	9.87	9.42	8.79	8.5	77.54	77.52	77.34
9	8.39	8.13	7.67	9	77.26	77.22	76.81
9.5	7.04	7.02	6.70	9.5	76.93	76.87	75.97
10	6.17	6.07	5.86	10	76.61	76.48	74.62
10.5	5.33	5.26	5.13	10.5	76.21	76.01	72.56
11	4.53	4.57	4.48	11	75.79	75.34	69.83
11.5	3.97	3.97	3.92	11.5	75.16	74.42	66.66
12	3.39	3.44	3.41	12	74.41	73.14	63.30
12.5	2.95	2.97	2.96	12.5	73.23	71.48	59.90
13	2.60	2.54	2.55	13	71.77	69.38	56.55
14	1.76	1.79	1.87	14	68.11	64.56	50.15
15	1.09	1.19	1.35	15	63.33	59.07	44.22
16	0.65	0.74	0.95	16	58.74	53.60	38.76
17	0.29	0.43	0.67	17	53.05	48.06	33.78
18	0.12	0.24	0.46	18	48.79	42.89	29.25

9.375 kHz Offset ACPR				18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3
3.5	58.83	58.49	57.54	3.5	81.57	81.59	81.60
4	56.18	55.53	54.61	4	81.03	81.04	81.03
4.5	53.07	52.91	51.81	4.5	80.53	80.54	80.54
5	51.00	50.55	48.94	5	80.08	80.09	80.09
5.5	48.79	47.85	46.04	5.5	79.69	79.68	79.68
6	45.93	45.18	43.23	6	79.30	79.31	79.31
6.5	43.26	42.55	40.53	6.5	78.98	78.97	78.97
7	41.13	40.17	37.90	7	78.64	78.65	78.65
7.5	38.53	37.81	35.30	7.5	78.35	78.36	78.36
8	36.85	35.57	32.69	8	78.08	78.07	78.08
8.5	34.24	33.47	30.07	8.5	77.80	77.80	77.80
9	32.31	31.22	27.49	9	77.54	77.54	77.55
9.5	30.59	28.84	25.01	9.5	77.32	77.30	77.30
10	28.18	26.45	22.66	10	77.06	77.07	77.07
10.5	25.83	24.13	20.45	10.5	76.86	76.86	76.84
11	23.52	21.91	18.39	11	76.65	76.65	76.62
11.5	21.52	19.83	16.49	11.5	76.46	76.45	76.37
12	19.45	17.81	14.74	12	76.27	76.26	76.05
12.5	17.38	15.91	13.15	12.5	76.08	76.08	75.57
13	15.67	14.11	11.72	13	75.90	75.90	74.78
14	12.06	10.88	9.28	14	75.56	75.54	71.55
15	9.09	8.33	7.34	15	75.23	75.16	66.25
16	6.56	6.37	5.79	16	74.86	74.63	60.27
17	4.93	4.87	4.56	17	74.38	73.60	54.43
18	3.69	3.69	3.56	18	73.48	71.34	48.92

12.5 kHz Offset ACPR				25.0 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3
3.5	80.61	80.56	80.48	3.5	81.95	81.94	81.94
4	79.70	79.70	79.57	4	81.38	81.38	81.37
4.5	78.92	78.85	78.53	4.5	80.86	80.87	80.86
5	77.90	77.79	77.18	5	80.43	80.41	80.40
5.5	76.73	76.49	75.45	5.5	80.00	79.99	79.98
6	75.40	74.88	73.30	6	79.60	79.59	79.59
6.5	73.62	73.02	70.74	6.5	79.23	79.23	79.24
7	71.76	70.86	67.86	7	78.91	78.91	78.91
7.5	69.58	68.46	64.78	7.5	78.61	78.61	78.61
8	67.23	65.86	61.59	8	78.32	78.33	78.33
8.5	64.73	63.33	58.33	8.5	78.06	78.07	78.07
9	62.00	60.63	55.08	9	77.82	77.82	77.82
9.5	59.81	57.81	51.87	9.5	77.59	77.58	77.58
10	57.29	55.17	48.72	10	77.35	77.36	77.36
10.5	54.28	52.52	45.64	10.5	77.15	77.14	77.14
11	51.99	49.75	42.65	11	76.92	76.93	76.93
11.5	50.06	47.04	39.75	11.5	76.72	76.72	76.73
12	47.41	44.40	36.94	12	76.53	76.53	76.53
12.5	44.36	41.91	34.22	12.5	76.33	76.34	76.35
13	42.32	39.46	31.61	13	76.16	76.16	76.17
14	37.65	34.92	26.74	14	75.82	75.83	75.84
15	33.09	30.12	22.41	15	75.53	75.54	75.53
16	29.64	25.38	18.64	16	75.26	75.26	75.22
17	24.70	21.03	15.40	17	75.00	74.99	74.83
18	20.41	17.06	12.66	18	74.74	74.74	74.14

25 kHz Plan

7.5 kHz Offset ACPR				18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3
3.5	39.53	39.54	39.06	3.5	81.57	81.59	81.60
4	37.65	37.39	36.67	4	81.03	81.04	81.03
4.5	35.36	35.10	34.33	4.5	80.53	80.54	80.54
5	33.09	33.04	31.98	5	80.08	80.09	80.09
5.5	31.51	31.01	29.49	5.5	79.69	79.68	79.68
6	29.64	28.70	26.93	6	79.30	79.31	79.31
6.5	27.03	26.27	24.44	6.5	78.98	78.97	78.97
7	24.70	23.93	22.07	7	78.64	78.65	78.65
7.5	22.31	21.70	19.83	7.5	78.35	78.36	78.36
8	20.41	19.60	17.73	8	78.08	78.07	78.08
8.5	18.35	17.64	15.77	8.5	77.80	77.80	77.80
9	16.54	15.72	13.96	9	77.54	77.54	77.55
9.5	14.83	13.92	12.31	9.5	77.32	77.30	77.30
10	12.92	12.21	10.84	10	77.06	77.07	77.07
10.5	11.38	10.63	9.53	10.5	76.86	76.86	76.84
11	9.87	9.23	8.38	11	76.65	76.65	76.62
11.5	8.39	8.00	7.37	11.5	76.46	76.45	76.37
12	7.04	6.94	6.48	12	76.27	76.26	76.05
12.5	6.17	6.03	5.71	12.5	76.08	76.08	75.57
13	5.33	5.24	5.02	13	75.90	75.90	74.78
14	3.97	3.97	3.87	14	75.56	75.54	71.55
15	2.95	2.96	2.95	15	75.23	75.16	66.25
16	2.17	2.15	2.22	16	74.86	74.63	60.27
17	1.45	1.49	1.65	17	74.38	73.60	54.43
18	0.86	0.98	1.21	18	73.48	71.34	48.92

11.25 kHz Offset ACPR				22.50 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3
3.5	76.29	76.05	75.49	3.5	81.74	81.74	81.73
4	74.20	73.94	73.13	4	81.15	81.14	81.14
4.5	72.12	71.71	70.53	4.5	80.60	80.62	80.63
5	69.80	69.30	67.71	5	80.19	80.18	80.19
5.5	67.35	66.68	64.77	5.5	79.80	79.79	79.79
6	64.80	64.03	61.75	6	79.41	79.41	79.42
6.5	62.03	61.51	58.67	6.5	79.06	79.06	79.07
7	59.83	58.76	55.56	7	78.73	78.74	78.75
7.5	57.30	55.97	52.46	7.5	78.43	78.44	78.45
8	54.28	53.41	49.39	8	78.18	78.17	78.18
8.5	51.99	50.76	46.37	8.5	77.91	77.91	77.92
9	50.06	48.02	43.43	9	77.68	77.68	77.68
9.5	47.41	45.34	40.56	9.5	77.44	77.45	77.46
10	44.36	42.79	37.75	10	77.25	77.24	77.25
10.5	42.32	40.33	35.00	10.5	77.06	77.04	77.04
11	39.53	37.96	32.31	11	76.84	76.85	76.85
11.5	37.65	35.76	29.71	11.5	76.66	76.66	76.66
12	35.36	33.50	27.22	12	76.48	76.48	76.48
12.5	33.09	31.13	24.86	12.5	76.31	76.31	76.30
13	31.51	28.72	22.63	13	76.14	76.14	76.13
14	27.03	24.05	18.63	14	75.83	75.82	75.78
15	22.31	19.79	15.21	15	75.52	75.51	75.34
16	18.35	15.91	12.35	16	75.22	75.22	74.53
17	14.83	12.50	9.99	17	74.94	74.94	72.68
18	11.38	9.73	8.06	18	74.68	74.68	69.25

15 kHz Offset ACPR				30 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3
3.5	81.31	81.32	81.33	3.5	81.92	81.93	81.94
4	80.77	80.78	80.78	4	81.36	81.36	81.36
4.5	80.34	80.30	80.28	4.5	80.86	80.85	80.86
5	79.81	79.84	79.83	5	80.39	80.40	80.41
5.5	79.41	79.41	79.40	5.5	80.00	80.00	80.00
6	79.03	79.02	79.01	6	79.62	79.64	79.63
6.5	78.65	78.66	78.63	6.5	79.30	79.29	79.29
7	78.32	78.32	78.25	7	78.96	78.96	78.96
7.5	78.01	77.98	77.84	7.5	78.66	78.66	78.66
8	77.70	77.63	77.32	8	78.37	78.37	78.37
8.5	77.32	77.25	76.57	8.5	78.09	78.10	78.10
9	76.94	76.79	75.40	9	77.83	77.85	77.85
9.5	76.49	76.20	73.61	9.5	77.61	77.61	77.61
10	75.87	75.40	71.14	10	77.38	77.39	77.39
10.5	75.10	74.32	68.13	10.5	77.18	77.17	77.17
11	74.15	72.87	64.82	11	76.96	76.97	76.96
11.5	72.76	71.04	61.41	11.5	76.77	76.77	76.77
12	71.18	68.80	58.00	12	76.58	76.58	76.58
12.5	69.22	66.41	54.67	12.5	76.40	76.39	76.40
13	67.01	63.86	51.43	13	76.22	76.22	76.22
14	61.93	58.34	45.30	14	75.88	75.89	75.89
15	57.27	52.88	39.63	15	75.57	75.57	75.58
16	51.98	47.37	34.45	16	75.27	75.28	75.29
17	47.41	42.24	29.74	17	75.01	75.02	75.02
18	42.32	37.54	25.51	18	74.76	74.77	74.76

30 kHz Plan

A.6.7 Tetrapol

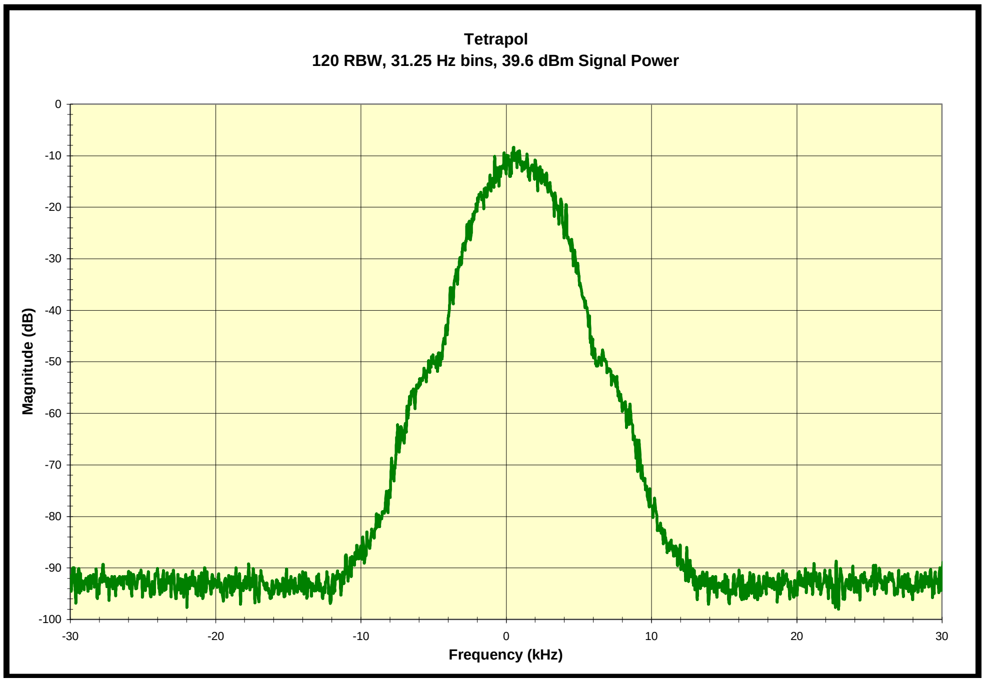


Figure A 16 Tetrapol

A.6.7.1 Emission Designator

6K90G1E Voice

6K90G1D Data

A.6.7.2 Typical Receiver Characteristics

7K20B1004

A.6.7.3 Discussion

Normally used outside the United States

Gaussian MSK modulation with BT=0.25

This modulation is used primarily with 12.5 kHz channelization, but 10 kHz channelization is sometimes used. No data is provided for the 10 kHz case. Use either the “Tetrapol spreadsheet” or the “Range Mode” in ACPRUtil.exe, Annex H, to generate the necessary information.

A.6.7.4 Tetrapol, 25/30 kHz Plan Offsets

Table A 17 Tetrapol, 25/30 kHz Plan Offsets

6.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	26.17	26.03	25.05
4	23.71	22.93	22.04
4.5	20.34	20.19	19.47
5	17.93	17.93	17.26
5.5	16.32	16.04	15.27
6	14.67	14.23	13.43
6.5	12.80	12.49	11.75
7	11.09	10.88	10.26
7.5	9.66	9.45	8.94
8	8.32	8.19	7.77
8.5	7.15	7.09	6.73
9	6.17	6.13	5.81
9.5	5.48	5.26	4.97
10	4.57	4.44	4.22
10.5	3.90	3.70	3.56
11	3.09	3.03	2.99
11.5	2.35	2.45	2.49
12	1.89	1.96	2.07
12.5	1.44	1.54	1.71
13	1.07	1.20	1.41
14	0.60	0.71	0.95
15	0.28	0.39	0.63
16	0.14	0.21	0.42
17	0.05	0.10	0.28
18	0.01	0.05	0.19

15.625 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	82.42	82.38	82.36
4	81.73	81.70	81.71
4.5	81.12	81.14	81.16
5	80.69	80.68	80.67
5.5	80.25	80.21	80.12
6	79.72	79.68	79.56
6.5	79.12	79.13	78.99
7	78.63	78.57	78.39
7.5	78.02	78.01	77.76
8	77.49	77.44	77.02
8.5	76.97	76.85	76.09
9	76.39	76.20	74.81
9.5	75.73	75.43	73.05
10	74.99	74.50	70.77
10.5	74.24	73.38	68.09
11	72.86	71.96	65.19
11.5	71.66	70.07	62.21
12	70.33	67.73	59.21
12.5	68.57	64.96	56.21
13	65.71	62.27	53.22
14	60.78	57.50	47.24
15	55.57	53.25	41.41
16	51.96	49.56	35.92
17	48.20	46.44	30.90
18	44.91	42.36	26.41

9.375 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	51.98	51.77	51.38
4	49.90	49.81	49.43
4.5	48.21	48.07	47.66
5	46.67	46.41	46.03
5.5	44.91	44.97	44.42
6	43.77	43.79	42.45
6.5	42.99	42.48	39.80
7	41.78	40.48	36.59
7.5	39.57	37.89	33.19
8	36.64	34.85	29.87
8.5	33.98	31.66	26.76
9	30.68	28.49	23.94
9.5	27.84	25.38	21.40
10	24.91	22.56	19.12
10.5	21.59	20.14	17.06
11	19.58	17.99	15.20
11.5	17.15	16.00	13.52
12	15.40	14.16	12.00
12.5	13.79	12.48	10.64
13	12.05	10.97	9.41
14	9.01	8.42	7.31
15	6.67	6.36	5.61
16	4.93	4.65	4.25
17	3.47	3.29	3.19
18	2.03	2.25	2.36

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	81.96	81.90	81.88
4	81.25	81.29	81.31
4.5	80.77	80.79	80.82
5	80.39	80.39	80.41
5.5	79.99	80.02	80.03
6	79.64	79.63	79.65
6.5	79.28	79.30	79.30
7	79.02	78.99	78.99
7.5	78.69	78.69	78.69
8	78.40	78.41	78.41
8.5	78.16	78.15	78.15
9	77.90	77.91	77.89
9.5	77.68	77.67	77.64
10	77.47	77.44	77.38
10.5	77.21	77.22	77.11
11	77.00	76.98	76.80
11.5	76.82	76.74	76.40
12	76.57	76.49	75.83
12.5	76.33	76.21	74.95
13	76.03	75.91	73.58
14	75.40	75.24	69.14
15	74.67	74.35	63.36
16	73.83	72.94	57.37
17	72.51	70.21	51.61
18	70.46	65.52	46.19

12.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	77.39	77.32	77.11
4	76.22	76.09	75.68
4.5	74.83	74.61	74.02
5	73.29	73.04	72.03
5.5	71.75	71.32	69.55
6	69.93	69.11	66.67
6.5	67.90	66.53	63.68
7	64.90	63.57	60.83
7.5	62.45	60.67	58.20
8	58.77	58.16	55.76
8.5	56.82	55.94	53.45
9	54.80	53.82	51.16
9.5	53.01	51.82	48.79
10	50.89	49.94	46.21
10.5	49.09	48.19	43.38
11	47.41	46.66	40.34
11.5	45.81	45.27	37.22
12	44.31	43.68	34.16
12.5	43.39	41.64	31.23
13	42.45	39.09	28.48
14	38.02	32.98	23.57
15	32.51	26.67	19.40
16	26.17	21.54	15.90
17	20.34	17.29	12.96
18	16.32	13.71	10.51

25.0 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	81.58	81.58	81.58
4	81.04	81.04	81.04
4.5	80.53	80.55	80.55
5	80.09	80.10	80.11
5.5	79.69	79.71	79.72
6	79.32	79.36	79.35
6.5	79.03	79.01	79.01
7	78.69	78.70	78.69
7.5	78.39	78.40	78.38
8	78.09	78.10	78.09
8.5	77.80	77.82	77.82
9	77.57	77.56	77.56
9.5	77.33	77.31	77.31
10	77.08	77.08	77.08
10.5	76.84	76.86	76.86
11	76.66	76.64	76.65
11.5	76.45	76.44	76.45
12	76.23	76.25	76.26
12.5	76.05	76.07	76.08
13	75.89	75.90	75.90
14	75.57	75.58	75.57
15	75.29	75.27	75.25
16	74.96	74.98	74.92
17	74.67	74.71	74.46
18	74.46	74.47	73.56

25 kHz Plan

7.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	40.86	40.37	39.37
4	38.02	37.63	36.28
4.5	35.31	34.71	32.90
5	32.51	31.54	29.46
5.5	29.29	28.41	26.19
6	26.17	25.29	23.20
6.5	23.71	22.35	20.57
7	20.34	19.81	18.25
7.5	17.93	17.67	16.17
8	16.32	15.72	14.29
8.5	14.67	13.90	12.59
9	12.80	12.20	11.07
9.5	11.09	10.66	9.71
10	9.66	9.29	8.49
10.5	8.32	8.08	7.41
11	7.15	7.01	6.44
11.5	6.17	6.06	5.58
12	5.48	5.18	4.80
12.5	4.57	4.38	4.11
13	3.90	3.65	3.50
14	2.35	2.46	2.51
15	1.44	1.58	1.78
16	0.83	0.97	1.25
17	0.40	0.57	0.87
18	0.20	0.32	0.61

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	81.96	81.90	81.88
4	81.25	81.29	81.31
4.5	80.77	80.79	80.82
5	80.39	80.39	80.41
5.5	79.99	80.02	80.03
6	79.64	79.63	79.65
6.5	79.28	79.30	79.30
7	79.02	78.99	78.99
7.5	78.69	78.69	78.69
8	78.40	78.41	78.41
8.5	78.16	78.15	78.15
9	77.90	77.91	77.89
9.5	77.68	77.67	77.64
10	77.47	77.44	77.38
10.5	77.21	77.22	77.11
11	77.00	76.98	76.80
11.5	76.82	76.74	76.40
12	76.57	76.49	75.83
12.5	76.33	76.21	74.95
13	76.03	75.91	73.58
14	75.40	75.24	69.14
15	74.67	74.35	63.36
16	73.83	72.94	57.37
17	72.51	70.21	51.61
18	70.46	65.52	46.19

11.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	70.12	69.91	69.01
4	68.02	67.25	66.06
4.5	64.96	64.50	62.96
5	62.48	61.39	60.03
5.5	58.78	58.62	57.45
6	56.83	56.35	55.12
6.5	54.81	54.29	52.95
7	53.01	52.27	50.88
7.5	50.89	50.35	48.88
8	49.09	48.54	46.81
8.5	47.41	46.89	44.46
9	45.81	45.48	41.71
9.5	44.31	44.15	38.61
10	43.39	42.49	35.38
10.5	42.45	40.29	32.21
11	40.85	37.56	29.21
11.5	38.02	34.47	26.42
12	35.31	31.31	23.87
12.5	32.51	28.09	21.54
13	29.29	25.10	19.42
14	23.71	20.16	15.72
15	17.93	16.07	12.66
16	14.67	12.63	10.13
17	11.09	9.84	8.04
18	8.32	7.59	6.34

22.50 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	81.63	81.64	81.64
4	81.05	81.04	81.04
4.5	80.49	80.51	80.53
5	80.06	80.07	80.08
5.5	79.71	79.68	79.67
6	79.31	79.30	79.30
6.5	78.93	78.95	78.95
7	78.61	78.62	78.63
7.5	78.33	78.33	78.34
8	78.05	78.06	78.07
8.5	77.80	77.81	77.82
9	77.60	77.58	77.59
9.5	77.36	77.36	77.38
10	77.15	77.17	77.18
10.5	76.97	76.98	76.98
11	76.81	76.80	76.80
11.5	76.62	76.63	76.62
12	76.43	76.45	76.44
12.5	76.27	76.29	76.27
13	76.13	76.12	76.10
14	75.83	75.81	75.73
15	75.52	75.51	75.18
16	75.22	75.21	74.01
17	74.93	74.93	71.43
18	74.64	74.64	67.27

15 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	82.26	82.26	82.25
4	81.67	81.63	81.57
4.5	81.05	80.99	80.91
5	80.40	80.34	80.24
5.5	79.73	79.69	79.57
6	79.13	79.04	78.88
6.5	78.47	78.38	78.17
7	77.82	77.72	77.38
7.5	77.13	77.04	76.44
8	76.53	76.30	75.21
8.5	75.74	75.42	73.54
9	74.90	74.38	71.37
9.5	73.84	73.14	68.78
10	72.57	71.57	65.94
10.5	71.24	69.53	63.03
11	69.57	67.05	60.13
11.5	67.67	64.21	57.24
12	64.78	61.52	54.34
12.5	62.38	59.09	51.42
13	58.74	56.80	48.46
14	54.79	52.61	42.52
15	50.89	48.99	36.80
16	47.41	45.91	31.53
17	44.31	41.76	26.83
18	42.45	35.93	22.70

30 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	81.13	81.14	81.17
4	80.64	80.62	80.62
4.5	80.17	80.13	80.13
5	79.67	79.68	79.68
5.5	79.28	79.28	79.27
6	78.90	78.91	78.89
6.5	78.52	78.55	78.53
7	78.20	78.20	78.19
7.5	77.86	77.87	77.88
8	77.57	77.58	77.59
8.5	77.31	77.31	77.33
9	77.06	77.07	77.08
9.5	76.84	76.84	76.85
10	76.63	76.63	76.64
10.5	76.41	76.43	76.44
11	76.23	76.24	76.25
11.5	76.06	76.06	76.07
12	75.89	75.89	75.90
12.5	75.72	75.73	75.74
13	75.56	75.57	75.59
14	75.28	75.29	75.30
15	75.03	75.02	75.04
16	74.79	74.78	74.79
17	74.54	74.55	74.56
18	74.32	74.33	74.34

30 kHz Plan

A.6.8 Wide Pulse C4FM

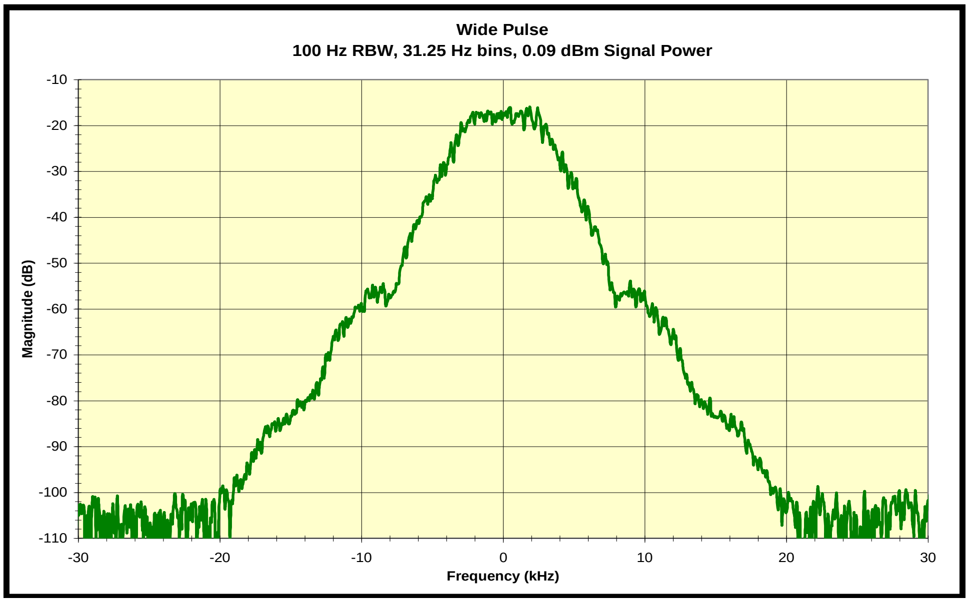


Figure A 17 Wide Pulse Simulcast Modulation

A.6.8.1 Emission Designator

10K0F1D Data channel and Control channel

10K0F1E Voice Channel

A.6.8.2 Typical Receiver Characteristics

11K1B0403 NPSPAC

12K6B0403 Normal

A.6.8.3 Discussion

Used in simulcast systems to increase delay spread tolerance. Four level C4FM modulation is used. Modified transmitter filtering allows the symbol to change state more rapidly allowing for a better probability of correctly decoding the symbol at higher levels of delay spread. Limited to 25 kHz channel bandwidths and the 12.5 kHz channel spacing of the NPSPAC 800 MHz band.

Beginning 1/1/2013 this modulation will not be licensable between 150 MHz 512 MHz due to FCC narrowbanding.

A.6.9 Wide Pulse, 25/30 kHz Plan Offsets

Table A 18 Wide Pulse, 25/30 kHz Plan Offsets

6.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	21.84	21.61	21.30
4	20.19	19.96	19.64
4.5	18.57	18.44	18.01
5	17.21	16.92	16.35
5.5	15.62	15.36	14.70
6	14.15	13.75	13.09
6.5	12.37	12.23	11.60
7	11.15	10.74	10.25
7.5	9.66	9.45	9.06
8	8.27	8.30	8.02
8.5	7.55	7.30	7.12
9	6.45	6.46	6.35
9.5	5.68	5.74	5.67
10	5.12	5.12	5.08
10.5	4.55	4.57	4.55
11	4.10	4.09	4.07
11.5	3.73	3.65	3.64
12	3.25	3.25	3.25
12.5	2.85	2.89	2.90
13	2.53	2.56	2.57
14	1.98	1.97	2.00
15	1.45	1.45	1.52
16	0.99	1.02	1.14
17	0.57	0.67	0.83
18	0.31	0.42	0.60

15.625 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	68.17	68.15	68.09
4	67.38	67.38	67.23
4.5	66.64	66.53	66.25
5	65.71	65.58	65.01
5.5	64.68	64.37	63.44
6	63.36	62.81	61.62
6.5	61.47	60.90	59.74
7	59.56	59.04	57.96
7.5	57.51	57.27	56.31
8	56.22	55.67	54.81
8.5	54.45	54.27	53.42
9	53.17	52.97	52.12
9.5	52.28	51.78	50.89
10	51.00	50.63	49.73
10.5	49.83	49.50	48.64
11	49.01	48.41	47.60
11.5	47.74	47.38	46.62
12	46.68	46.43	45.63
12.5	45.74	45.57	44.59
13	44.94	44.83	43.42
14	43.53	43.60	40.46
15	42.66	42.27	36.74
16	41.87	39.97	32.72
17	39.72	36.70	28.78
18	36.25	33.07	25.09

7.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	30.10	29.98	29.73
4	28.54	28.38	27.85
4.5	27.03	26.52	25.92
5	24.76	24.63	24.06
5.5	23.01	22.96	22.29
6	21.81	21.33	20.56
6.5	20.17	19.77	18.86
7	18.56	18.22	17.16
7.5	17.21	16.66	15.49
8	15.62	15.05	13.89
8.5	14.15	13.51	12.39
9	12.37	11.97	11.03
9.5	11.15	10.57	9.82
10	9.66	9.32	8.74
10.5	8.27	8.22	7.80
11	7.55	7.26	6.97
11.5	6.45	6.44	6.24
12	5.68	5.73	5.60
12.5	5.12	5.12	5.03
13	4.55	4.57	4.52
14	3.73	3.65	3.63
15	2.85	2.89	2.90
16	2.23	2.26	2.29
17	1.71	1.70	1.78
18	1.23	1.23	1.36

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	79.14	78.90	78.66
4	77.25	77.36	77.22
4.5	76.25	76.11	75.96
5	75.00	74.97	74.85
5.5	73.89	73.99	73.87
6	73.25	73.12	72.99
6.5	72.38	72.31	72.17
7	71.55	71.58	71.39
7.5	70.94	70.87	70.64
8	70.36	70.18	69.87
8.5	69.52	69.49	69.05
9	68.92	68.81	68.13
9.5	68.25	68.10	67.04
10	67.62	67.34	65.73
10.5	66.96	66.48	64.22
11	66.03	65.38	62.58
11.5	65.20	63.97	60.89
12	64.10	62.30	59.22
12.5	62.32	60.55	57.62
13	60.80	58.81	56.09
14	56.98	55.71	53.27
15	53.66	53.04	50.65
16	51.47	50.61	48.03
17	49.47	48.43	45.17
18	47.18	46.57	41.85

9.375 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	42.20	42.17	41.90
4	41.34	41.11	40.65
4.5	39.81	39.73	38.98
5	38.43	37.93	37.04
5.5	36.27	35.98	35.04
6	34.28	34.12	33.04
6.5	33.00	32.23	31.05
7	30.77	30.47	29.08
7.5	29.01	28.69	27.13
8	27.80	26.84	25.21
8.5	25.64	25.07	23.34
9	24.03	23.36	21.52
9.5	22.33	21.70	19.74
10	20.88	20.10	18.01
10.5	19.07	18.51	16.35
11	17.90	16.90	14.78
11.5	16.33	15.31	13.32
12	14.78	13.73	11.98
12.5	13.33	12.24	10.77
13	11.58	10.88	9.68
14	8.71	8.57	7.84
15	6.96	6.78	6.37
16	5.47	5.41	5.18
17	4.29	4.32	4.22
18	3.45	3.45	3.41

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	79.14	78.90	78.66
4	77.25	77.36	77.22
4.5	76.25	76.11	75.96
5	75.00	74.97	74.85
5.5	73.89	73.99	73.87
6	73.25	73.12	72.99
6.5	72.38	72.31	72.17
7	71.55	71.58	71.39
7.5	70.94	70.87	70.64
8	70.36	70.18	69.87
8.5	69.52	69.49	69.05
9	68.92	68.81	68.13
9.5	68.25	68.10	67.04
10	67.62	67.34	65.73
10.5	66.96	66.48	64.22
11	66.03	65.38	62.58
11.5	65.20	63.97	60.89
12	64.10	62.30	59.22
12.5	62.32	60.55	57.62
13	60.80	58.81	56.09
14	56.98	55.71	53.27
15	53.66	53.04	50.65
16	51.47	50.61	48.03
17	49.47	48.43	45.17
18	47.18	46.57	41.85

11.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	46.14	46.21	46.19
4	45.41	45.34	45.30
4.5	44.57	44.53	44.52
5	43.82	43.85	43.87
5.5	43.28	43.30	43.32
6	42.83	42.87	42.76
6.5	42.50	42.47	42.04
7	42.16	41.92	40.99
7.5	41.65	41.07	39.55
8	40.46	39.80	37.78
8.5	39.21	38.11	35.83
9	37.46	36.31	33.79
9.5	35.17	34.42	31.73
10	33.71	32.56	29.69
10.5	31.83	30.75	27.69
11	29.97	28.89	25.72
11.5	28.46	27.06	23.82
12	26.99	25.29	21.97
12.5	24.74	23.56	20.20
13	23.00	21.90	18.50
14	20.17	18.63	15.38
15	17.20	15.39	12.69
16	14.15	12.41	10.44
17	11.15	9.90	8.58
18	8.27	7.90	7.07

22.50 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	89.27	89.24	89.22
4	88.79	88.75	88.72
4.5	88.28	88.30	88.20
5	87.93	87.74	87.62
5.5	87.08	87.11	87.03
6	86.51	86.53	86.44
6.5	86.06	85.99	85.84
7	85.62	85.42	85.20
7.5	84.85	84.84	84.49
8	84.28	84.21	83.68
8.5	83.75	83.50	82.70
9	82.81	82.57	81.50
9.5	81.89	81.48	80.26
10	80.93	80.26	79.03
10.5	79.58	79.01	77.83
11	78.56	77.77	76.69
11.5	76.87	76.59	75.62
12	75.94	75.51	74.61
12.5	74.76	74.51	73.64
13	73.70	73.61	72.68
14	72.24	72.00	70.65
15	70.84	70.54	68.24
16	69.45	69.12	65.33
17	68.19	67.51	62.09
18	66.92	65.12	58.76

12.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	51.55	51.59	51.45
4	50.36	50.40	50.28
4.5	49.51	49.38	49.14
5	48.45	48.26	48.01
5.5	47.20	47.14	46.96
6	46.10	46.16	46.02
6.5	45.38	45.27	45.19
7	44.55	44.50	44.46
7.5	43.80	43.85	43.79
8	43.26	43.32	43.09
8.5	42.82	42.86	42.24
9	42.49	42.38	41.10
9.5	42.16	41.70	39.62
10	41.64	40.69	37.85
10.5	40.46	39.24	35.89
11	39.21	37.57	33.84
11.5	37.46	35.74	31.77
12	35.17	33.87	29.72
12.5	33.71	32.05	27.71
13	31.83	30.17	25.75
14	28.46	26.51	22.04
15	24.74	23.05	18.66
16	21.81	19.73	15.65
17	18.55	16.45	13.05
18	15.61	13.39	10.85

25.0 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	90.36	90.29	90.26
4	89.47	89.54	89.54
4.5	88.96	88.91	88.90
5	88.33	88.34	88.35
5.5	87.84	87.85	87.88
6	87.44	87.45	87.46
6.5	87.06	87.10	87.08
7	86.83	86.74	86.71
7.5	86.45	86.39	86.37
8	86.01	86.06	86.03
8.5	85.74	85.76	85.70
9	85.51	85.45	85.36
9.5	85.21	85.13	85.00
10	84.95	84.79	84.64
10.5	84.48	84.45	84.24
11	84.09	84.10	83.80
11.5	83.77	83.75	83.30
12	83.56	83.37	82.71
12.5	83.09	82.95	82.03
13	82.73	82.46	81.24
14	81.76	81.13	79.25
15	80.22	79.09	77.11
16	78.15	76.94	74.93
17	75.70	74.98	72.62
18	73.55	73.25	69.98

15 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	66.39	66.39	66.20
4	65.39	65.27	64.85
4.5	64.21	63.86	63.17
5	62.38	62.14	61.25
5.5	60.83	60.13	59.33
6	58.35	58.30	57.53
6.5	56.99	56.56	55.90
7	55.34	55.03	54.42
7.5	53.67	53.69	53.06
8	52.85	52.44	51.79
8.5	51.47	51.28	50.58
9	50.30	50.16	49.43
9.5	49.47	49.04	48.35
10	48.43	47.96	47.34
10.5	47.18	46.95	46.39
11	46.08	46.03	45.47
11.5	45.38	45.20	44.53
12	44.54	44.49	43.47
12.5	43.80	43.88	42.22
13	43.26	43.33	40.72
14	42.49	41.98	37.09
15	41.64	39.56	33.05
16	39.21	36.19	29.05
17	35.17	32.53	25.28
18	31.83	28.78	21.83

30 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	89.12	89.11	89.14
4	88.76	88.70	88.68
4.5	88.24	88.27	88.24
5	87.83	87.84	87.83
5.5	87.42	87.44	87.43
6	87.09	87.09	87.06
6.5	86.84	86.73	86.69
7	86.38	86.36	86.33
7.5	85.97	86.01	85.99
8	85.68	85.66	85.67
8.5	85.36	85.36	85.39
9	85.00	85.09	85.13
9.5	84.82	84.85	84.90
10	84.65	84.64	84.69
10.5	84.46	84.45	84.49
11	84.27	84.28	84.31
11.5	84.08	84.13	84.14
12	83.97	83.98	83.97
12.5	83.86	83.83	83.81
13	83.74	83.68	83.65
14	83.37	83.36	83.32
15	83.04	83.04	83.00
16	82.74	82.73	82.68
17	82.44	82.44	82.33
18	82.18	82.16	81.90

25 kHz Plan (6.25, 9.375, 12.5, 15.625, 18.75 and 25.0 kHz offset tables)

30 kHz Plan (7.5, 11.25, 15, 18.75, 22.50 and 30 kHz offset tables)

A.7 Digital TDMA Modulated Radios

A.7.1 ETSI DMR 2-slot TDMA

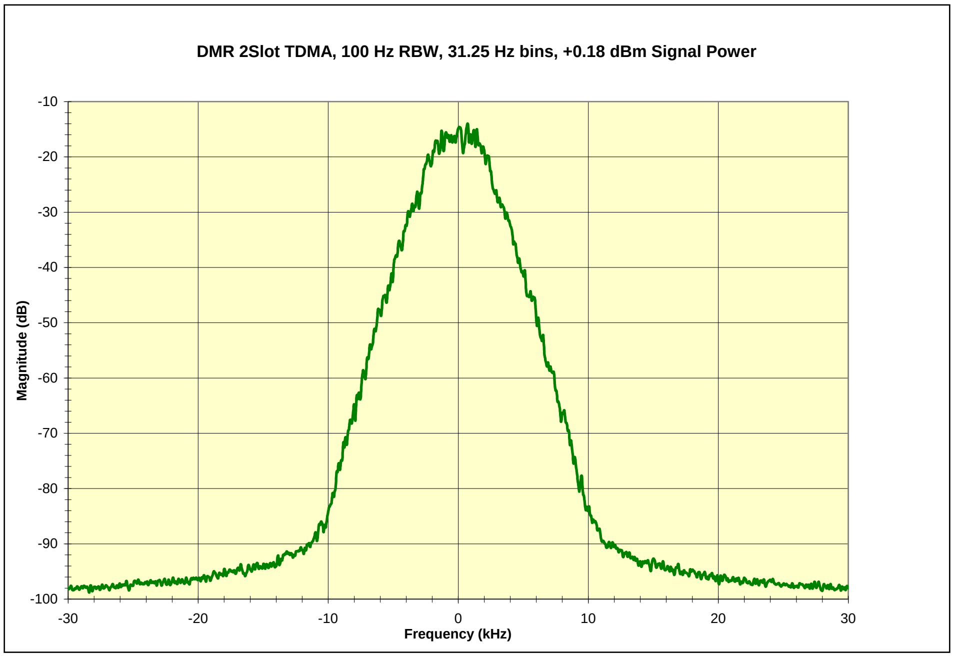


Figure A 18 ETSI DMR 2-Slot TDMA

A.7.1.1 Emission Designator

7K60 FXE Voice

7K60 FXD Data

A.7.1.2 Typical Receiver Characteristics

7K00R20||

A.7.1.3 Discussion

DMR modulation complies with the common air interface defined in ETSI TS 102 361-1. This is a 2:1 TDMA protocol for 12.5 kHz channel bandwidths utilizing a 4 level frequency modulation at 9,600 bps. It can be used in conventional as well as trunked systems.

A.7.1.4 ETSI DMR 2-Slot TDMA 25/30 kHz Plan Offsets

Table A 19 DMR 2-Slot TDMA 25/30 kHz Plan Offsets

25 kHz Plan

6.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	28.63	28.65	28.27
4	27.06	26.73	26.12
4.5	25.00	24.67	24.01
5	22.80	22.64	22.04
5.5	20.97	20.86	20.19
6	19.57	19.30	18.33
6.5	18.07	17.71	16.42
7	16.81	15.82	14.54
7.5	14.58	13.94	12.78
8	12.39	12.19	11.19
8.5	11.14	10.60	9.71
9	9.58	9.15	8.37
9.5	8.09	7.78	7.21
10	6.80	6.60	6.21
10.5	5.72	5.61	5.34
11	4.82	4.75	4.59
11.5	3.93	4.02	3.94
12	3.53	3.40	3.38
12.5	2.79	2.86	2.89
13	2.32	2.39	2.46
14	1.59	1.62	1.77
15	0.96	1.04	1.25
16	0.50	0.64	0.87
17	0.23	0.37	0.61
18	0.09	0.19	0.42

9.375 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	55.66	55.58	55.00
4	53.72	53.35	52.57
4.5	51.37	51.08	50.02
5	49.24	48.72	47.38
5.5	46.86	46.30	44.73
6	44.50	43.77	42.18
6.5	41.93	41.36	39.76
7	39.86	39.20	37.39
7.5	37.63	37.24	35.01
8	36.03	35.24	32.61
8.5	34.26	33.05	30.24
9	32.23	30.88	27.93
9.5	29.94	28.74	25.71
10	27.74	26.60	23.57
10.5	26.04	24.57	21.51
11	23.95	22.70	19.54
11.5	21.94	20.98	17.65
12	20.26	19.17	15.87
12.5	18.66	17.28	14.23
13	17.50	15.46	12.70
14	13.49	12.09	9.95
15	10.33	9.19	7.74
16	7.31	6.85	6.00
17	5.27	5.06	4.63
18	3.81	3.87	3.68

12.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	75.52	75.49	75.38
4	74.59	74.56	74.43
4.5	73.73	73.65	73.42
5	72.77	72.70	72.26
5.5	71.88	71.56	70.83
6	70.51	70.26	69.00
6.5	69.21	68.60	66.71
7	67.32	66.50	64.23
7.5	65.14	64.29	61.65
8	63.12	62.04	58.99
8.5	60.79	59.82	56.24
9	58.64	57.61	53.42
9.5	56.66	55.37	50.58
10	54.78	53.04	47.76
10.5	52.32	50.64	44.98
11	50.38	48.13	42.27
11.5	47.90	45.61	39.62
12	45.79	43.20	37.04
12.5	43.43	40.98	34.54
13	40.70	38.87	32.11
14	36.86	34.46	27.54
15	33.43	30.07	23.37
16	28.62	25.89	19.63
17	25.00	22.18	16.34
18	20.97	18.35	13.42

15.625 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	78.62	78.61	78.60
4	78.03	78.02	78.00
4.5	77.49	77.47	77.45
5	76.96	76.96	76.94
5.5	76.48	76.48	76.46
6	76.06	76.04	76.01
6.5	75.64	75.62	75.58
7	75.23	75.21	75.16
7.5	74.82	74.81	74.74
8	74.44	74.44	74.31
8.5	74.10	74.06	73.83
9	73.76	73.66	73.23
9.5	73.38	73.22	72.43
10	72.89	72.71	71.29
10.5	72.35	72.12	69.64
11	71.80	71.38	67.39
11.5	71.11	70.45	64.75
12	70.37	69.22	61.87
12.5	69.04	67.49	58.88
13	67.72	65.50	55.87
14	63.82	61.19	49.98
15	59.63	56.63	44.41
16	55.58	51.77	39.22
17	51.35	46.68	34.43
18	46.85	42.09	30.04

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	80.20	80.17	80.16
4	79.53	79.56	79.56
4.5	79.05	79.04	79.04
5	78.57	78.57	78.56
5.5	78.14	78.14	78.13
6	77.74	77.74	77.72
6.5	77.37	77.36	77.34
7	77.01	77.00	76.99
7.5	76.66	76.67	76.66
8	76.37	76.36	76.34
8.5	76.06	76.06	76.05
9	75.78	75.78	75.76
9.5	75.53	75.52	75.48
10	75.28	75.25	75.21
10.5	75.02	74.99	74.93
11	74.76	74.74	74.65
11.5	74.50	74.48	74.35
12	74.25	74.22	74.00
12.5	74.01	73.97	73.55
13	73.76	73.71	72.90
14	73.23	73.19	70.39
15	72.75	72.58	65.85
16	72.15	71.76	60.31
17	71.32	70.44	54.71
18	70.22	67.87	49.37

25.0 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	81.85	81.85	81.85
4	81.27	81.27	81.27
4.5	80.75	80.75	80.75
5	80.29	80.29	80.29
5.5	79.87	79.88	79.87
6	79.49	79.49	79.49
6.5	79.14	79.14	79.14
7	78.82	78.81	78.81
7.5	78.51	78.51	78.51
8	78.22	78.22	78.22
8.5	77.97	77.95	77.95
9	77.70	77.70	77.69
9.5	77.45	77.45	77.44
10	77.22	77.22	77.21
10.5	77.00	76.99	76.98
11	76.78	76.78	76.76
11.5	76.57	76.57	76.55
12	76.37	76.37	76.35
12.5	76.17	76.17	76.15
13	75.99	75.98	75.96
14	75.62	75.62	75.60
15	75.28	75.28	75.24
16	74.97	74.95	74.88
17	74.64	74.63	74.45
18	74.34	74.32	73.80

30 kHz Plan

7.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	38.72	38.57	38.24
4	36.86	36.72	36.20
4.5	35.21	34.92	34.02
5	33.44	32.82	31.70
5.5	31.00	30.53	29.38
6	28.63	28.43	27.13
6.5	27.06	26.35	24.97
7	25.00	24.28	22.91
7.5	22.80	22.37	20.93
8	20.97	20.66	18.98
8.5	19.57	19.03	17.06
9	18.07	17.21	15.21
9.5	16.81	15.34	13.49
10	14.58	13.56	11.91
10.5	12.39	11.88	10.43
11	11.14	10.37	9.09
11.5	9.58	8.93	7.91
12	8.09	7.62	6.87
12.5	6.80	6.51	5.97
13	5.72	5.56	5.18
14	3.93	4.02	3.89
15	2.79	2.87	2.90
16	1.94	1.99	2.14
17	1.21	1.34	1.56
18	0.71	0.86	1.13

11.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	71.14	71.05	70.72
4	69.65	69.40	68.64
4.5	67.57	67.19	66.23
5	65.29	64.92	63.75
5.5	63.20	62.63	61.28
6	60.84	60.38	58.78
6.5	58.67	58.19	56.21
7	56.68	55.99	53.56
7.5	54.79	53.76	50.82
8	52.32	51.42	48.07
8.5	50.38	49.01	45.34
9	47.90	46.49	42.69
9.5	45.80	44.00	40.09
10	43.43	41.66	37.54
10.5	40.70	39.53	35.04
11	38.71	37.46	32.59
11.5	36.86	35.29	30.21
12	35.20	33.09	27.91
12.5	33.44	30.92	25.70
13	31.00	28.74	23.60
14	27.06	24.65	19.69
15	22.80	21.01	16.23
16	19.57	17.23	13.19
17	16.81	13.73	10.59
18	12.39	10.72	8.45

15 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	78.25	78.23	78.21
4	77.57	77.58	77.57
4.5	77.01	77.01	77.00
5	76.51	76.50	76.46
5.5	76.03	76.00	75.96
6	75.54	75.52	75.48
6.5	75.07	75.07	75.02
7	74.65	74.66	74.55
7.5	74.29	74.24	74.04
8	73.91	73.79	73.44
8.5	73.42	73.28	72.67
9	72.86	72.72	71.62
9.5	72.30	72.05	70.16
10	71.62	71.23	68.11
10.5	70.95	70.20	65.61
11	69.83	68.81	62.84
11.5	68.71	66.96	59.91
12	67.00	64.89	56.92
12.5	64.96	62.72	53.93
13	63.00	60.53	50.98
14	58.60	55.96	45.29
15	54.77	51.09	39.97
16	50.37	46.02	35.04
17	45.79	41.48	30.50
18	40.70	37.00	26.37

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	80.20	80.17	80.16
4	79.53	79.56	79.56
4.5	79.05	79.04	79.04
5	78.57	78.57	78.56
5.5	78.14	78.14	78.13
6	77.74	77.74	77.72
6.5	77.37	77.36	77.34
7	77.01	77.00	76.99
7.5	76.66	76.67	76.66
8	76.37	76.36	76.34
8.5	76.06	76.06	76.05
9	75.78	75.78	75.76
9.5	75.53	75.52	75.48
10	75.28	75.25	75.21
10.5	75.02	74.99	74.93
11	74.76	74.74	74.65
11.5	74.50	74.48	74.35
12	74.25	74.22	74.00
12.5	74.01	73.97	73.55
13	73.76	73.71	72.90
14	73.23	73.19	70.39
15	72.75	72.58	65.85
16	72.15	71.76	60.31
17	71.32	70.44	54.71
18	70.22	67.87	49.37

22.50 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	81.35	81.35	81.35
4	80.76	80.75	80.76
4.5	80.23	80.24	80.24
5	79.80	79.78	79.78
5.5	79.38	79.37	79.37
6	78.99	78.99	78.98
6.5	78.63	78.63	78.62
7	78.31	78.30	78.29
7.5	77.99	77.98	77.97
8	77.69	77.68	77.67
8.5	77.41	77.40	77.39
9	77.13	77.13	77.11
9.5	76.86	76.87	76.86
10	76.63	76.62	76.61
10.5	76.39	76.38	76.37
11	76.18	76.16	76.14
11.5	75.93	75.94	75.92
12	75.73	75.73	75.70
12.5	75.53	75.52	75.49
13	75.34	75.32	75.28
14	74.95	74.93	74.87
15	74.56	74.56	74.40
16	74.21	74.20	73.66
17	73.87	73.85	72.16
18	73.54	73.50	69.23

30 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	82.59	82.58	82.58
4	81.99	82.00	82.00
4.5	81.50	81.50	81.49
5	81.04	81.03	81.03
5.5	80.61	80.62	80.62
6	80.24	80.24	80.24
6.5	79.89	79.89	79.89
7	79.58	79.57	79.57
7.5	79.27	79.27	79.27
8	78.98	78.99	78.98
8.5	78.72	78.72	78.72
9	78.47	78.47	78.47
9.5	78.23	78.23	78.23
10	78.01	78.01	77.99
10.5	77.80	77.79	77.77
11	77.59	77.57	77.56
11.5	77.38	77.37	77.35
12	77.16	77.17	77.16
12.5	76.97	76.97	76.97
13	76.79	76.79	76.79
14	76.44	76.44	76.44
15	76.13	76.12	76.12
16	75.83	75.83	75.81
17	75.55	75.54	75.52
18	75.28	75.27	75.24

A.7.2 F4GFSK (OPENSKY®)

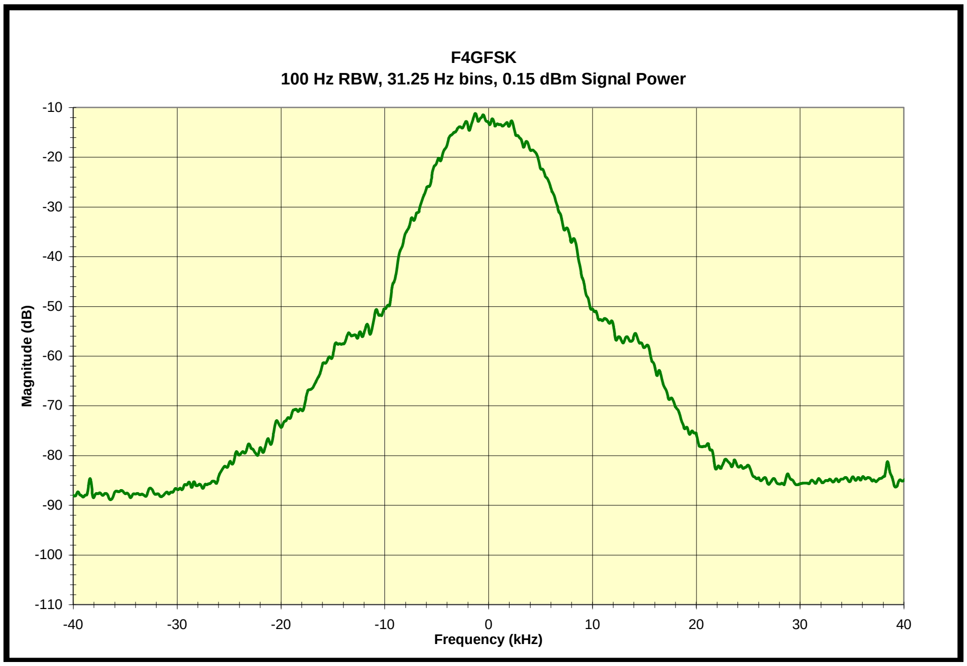


Figure A 19 F4GFSK

A.7.2.1 Emission Designator

12K5F9W

A.7.2.2 Typical Receiver Characteristics

12K4B0403

A.7.2.3 Discussion

OpenSky® is a registered mark of Harris, formerly M/A-Com Inc. Use of this mark does not constitute an endorsement of the product or services.

Filtered 4-Level Gaussian Frequency Shift Keying Modulation with AMBE vocoder (F4FGSK)

It operates at 19.2 kb/s for both 2-slot and 4-slot versions. The difference is the number of bits per channel. This affects the performance sensitivity, making the 4-slot less sensitive than the 2-slot version. Both versions require a 25 kHz channel.

A.7.2.4 F4GFSK, 25/30 kHz Plan Offsets

Table A 20 F4GFSK, 25/30 kHz Plan Offsets

25 kHz Plan

6.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	15.32	15.29	15.19
4	14.14	14.13	14.05
4.5	13.19	13.13	12.93
5	12.11	12.00	11.78
5.5	10.96	10.91	10.72
6	9.97	9.91	9.75
6.5	9.08	9.01	8.88
7	8.23	8.21	8.09
7.5	7.52	7.47	7.38
8	6.86	6.83	6.73
8.5	6.20	6.24	6.12
9	5.77	5.68	5.56
9.5	5.28	5.14	5.04
10	4.67	4.63	4.55
10.5	4.14	4.16	4.11
11	3.73	3.72	3.71
11.5	3.30	3.33	3.35
12	2.92	2.98	3.02
12.5	2.63	2.67	2.72
13	2.38	2.39	2.45
14	1.90	1.92	1.97
15	1.50	1.51	1.57
16	1.14	1.15	1.24
17	0.80	0.86	0.97
18	0.54	0.62	0.75

15.625 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	49.58	49.60	49.64
4	49.05	49.04	49.04
4.5	48.53	48.52	48.53
5	48.05	48.07	48.08
5.5	47.69	47.68	47.66
6	47.32	47.31	47.24
6.5	46.96	46.93	46.80
7	46.62	46.49	46.33
7.5	46.07	46.00	45.85
8	45.53	45.50	45.36
8.5	45.04	45.00	44.86
9	44.54	44.54	44.35
9.5	44.12	44.09	43.78
10	43.73	43.64	43.11
10.5	43.30	43.18	42.29
11	42.83	42.67	41.25
11.5	42.37	42.06	40.00
12	41.86	41.26	38.56
12.5	41.20	40.16	37.02
13	40.28	38.75	35.35
14	37.67	35.67	32.03
15	33.75	32.51	28.84
16	30.94	29.65	25.80
17	28.15	26.98	22.90
18	25.98	24.35	20.18

9.375 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	31.10	31.00	30.80
4	29.50	29.47	29.30
4.5	28.23	28.17	27.96
5	27.08	27.00	26.69
5.5	26.02	25.84	25.40
6	24.85	24.62	24.07
6.5	23.59	23.35	22.63
7	22.22	21.91	21.18
7.5	20.79	20.55	19.78
8	19.54	19.25	18.44
8.5	18.30	17.98	17.16
9	17.10	16.72	15.91
9.5	15.90	15.54	14.68
10	14.65	14.43	13.51
10.5	13.61	13.31	12.41
11	12.70	12.20	11.39
11.5	11.50	11.15	10.44
12	10.45	10.18	9.56
12.5	9.52	9.29	8.76
13	8.65	8.47	8.02
14	7.20	7.07	6.71
15	5.97	5.86	5.60
16	4.99	4.81	4.66
17	3.94	3.92	3.86
18	3.81	3.87	3.68

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	60.81	60.80	60.75
4	59.93	59.90	59.81
4.5	59.09	59.03	58.87
5	58.23	58.13	57.91
5.5	57.29	57.17	56.89
6	56.28	56.15	55.73
6.5	55.23	54.97	54.60
7	53.91	53.86	53.56
7.5	52.91	52.87	52.61
8	52.08	51.97	51.74
8.5	51.28	51.13	50.96
9	50.48	50.39	50.27
9.5	49.66	49.73	49.65
10	49.11	49.15	49.09
10.5	48.65	48.64	48.57
11	48.17	48.19	48.08
11.5	47.78	47.78	47.60
12	47.45	47.38	47.11
12.5	47.08	46.96	46.61
13	46.76	46.51	46.08
14	45.75	45.60	44.85
15	44.77	44.67	43.19
16	43.91	43.73	40.88
17	43.05	42.59	37.98
18	42.13	40.72	34.73

12.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	45.00	45.00	44.98
4	44.33	44.29	44.25
4.5	43.63	43.63	43.56
5	43.02	42.99	42.85
5.5	42.44	42.34	42.02
6	41.72	41.57	40.96
6.5	40.91	40.61	39.60
7	39.82	39.34	38.01
7.5	38.51	37.68	36.33
8	36.75	35.93	34.67
8.5	34.63	34.30	32.94
9	33.11	32.72	31.32
9.5	31.67	31.13	29.78
10	30.19	29.70	28.29
10.5	28.71	28.39	26.83
11	27.61	27.13	25.39
11.5	26.50	25.88	23.94
12	25.42	24.63	22.50
12.5	24.20	23.31	21.09
13	22.92	21.92	19.70
14	20.14	19.23	17.08
15	17.76	16.74	14.70
16	15.25	14.42	12.58
17	13.17	12.21	10.73
18	10.96	10.28	9.14

25.0 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	71.70	71.67	71.64
4	70.96	70.97	70.97
4.5	70.37	70.39	70.42
5	69.92	69.93	69.96
5.5	69.56	69.55	69.54
6	69.20	69.18	69.15
6.5	68.83	68.82	68.75
7	68.50	68.44	68.34
7.5	68.08	68.05	67.90
8	67.67	67.63	67.43
8.5	67.33	67.15	66.94
9	66.78	66.64	66.43
9.5	66.13	66.13	65.93
10	65.65	65.64	65.42
10.5	65.23	65.15	64.92
11	64.77	64.67	64.41
11.5	64.30	64.19	63.89
12	63.86	63.71	63.35
12.5	63.34	63.24	62.79
13	62.83	62.78	62.20
14	61.99	61.76	60.88
15	61.09	60.61	59.39
16	59.76	59.26	57.78
17	58.46	57.73	55.87
18	56.91	55.86	54.07

30 kHz Plan

7.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	21.54	21.47	21.29
4	20.17	20.11	19.91
4.5	18.92	18.85	18.59
5	17.77	17.63	17.29
5.5	16.45	16.37	16.03
6	15.26	15.16	14.87
6.5	14.10	14.06	13.69
7	13.17	13.01	12.54
7.5	12.10	11.89	11.46
8	10.96	10.83	10.45
8.5	9.97	9.85	9.54
9	9.08	8.97	8.71
9.5	8.23	8.17	7.95
10	7.52	7.45	7.26
10.5	6.86	6.81	6.62
11	6.20	6.21	6.03
11.5	5.77	5.64	5.48
12	5.28	5.11	4.98
12.5	4.67	4.61	4.51
13	4.14	4.14	4.09
14	3.30	3.34	3.35
15	2.63	2.68	2.74
16	2.10	2.15	2.22
17	1.69	1.71	1.79
18	1.33	1.33	1.44

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	60.81	60.80	60.75
4	59.93	59.90	59.81
4.5	59.09	59.03	58.87
5	58.23	58.13	57.91
5.5	57.29	57.17	56.89
6	56.28	56.15	55.73
6.5	55.23	54.97	54.60
7	53.91	53.86	53.56
7.5	52.91	52.87	52.61
8	52.08	51.97	51.74
8.5	51.28	51.13	50.96
9	50.48	50.39	50.27
9.5	49.66	49.73	49.65
10	49.11	49.15	49.09
10.5	48.65	48.64	48.57
11	48.17	48.19	48.08
11.5	47.78	47.78	47.60
12	47.45	47.38	47.11
12.5	47.08	46.96	46.61
13	46.76	46.51	46.08
14	45.75	45.60	44.85
15	44.77	44.67	43.19
16	43.91	43.73	40.88
17	43.05	42.59	37.98
18	42.13	40.72	34.73

11.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	42.71	42.65	42.43
4	41.66	41.51	41.11
4.5	40.34	40.15	39.46
5	38.85	38.44	37.57
5.5	36.95	36.44	35.70
6	34.74	34.61	33.99
6.5	33.17	33.04	32.24
7	31.70	31.39	30.64
7.5	30.21	29.90	29.16
8	28.71	28.57	27.75
8.5	27.62	27.35	26.36
9	26.50	26.13	24.96
9.5	25.42	24.90	23.55
10	24.20	23.65	22.09
10.5	22.92	22.23	20.67
11	21.49	20.87	19.31
11.5	20.14	19.55	17.98
12	18.90	18.24	16.69
12.5	17.76	17.00	15.46
13	16.44	15.82	14.29
14	14.10	13.54	12.15
15	12.10	11.40	10.30
16	9.96	9.56	8.72
17	8.23	8.01	7.36
18	6.86	6.68	6.20

22.50 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	68.84	68.78	68.68
4	67.94	67.89	67.82
4.5	67.04	67.07	67.05
5	66.38	66.39	66.37
5.5	65.85	65.81	65.76
6	65.28	65.25	65.17
6.5	64.72	64.70	64.60
7	64.22	64.15	64.04
7.5	63.65	63.61	63.50
8	63.10	63.10	62.95
8.5	62.63	62.62	62.39
9	62.19	62.12	61.79
9.5	61.80	61.58	61.15
10	61.25	60.99	60.45
10.5	60.54	60.35	59.70
11	59.88	59.67	58.91
11.5	59.23	58.93	58.08
12	58.54	58.15	57.23
12.5	57.80	57.33	56.19
13	56.97	56.44	55.19
14	55.10	54.37	53.35
15	52.84	52.50	51.75
16	51.24	50.93	50.36
17	49.62	49.65	49.09
18	48.63	48.61	47.78

15 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	48.44	48.46	48.48
4	47.98	47.99	48.00
4.5	47.60	47.59	47.57
5	47.20	47.20	47.14
5.5	46.85	46.79	46.68
6	46.40	46.31	46.19
6.5	45.81	45.79	45.69
7	45.31	45.27	45.19
7.5	44.80	44.79	44.70
8	44.33	44.33	44.20
8.5	43.93	43.89	43.66
9	43.54	43.44	43.02
9.5	43.06	42.97	42.23
10	42.60	42.45	41.22
10.5	42.14	41.80	39.98
11	41.54	40.94	38.54
11.5	40.79	39.75	36.99
12	39.75	38.26	35.33
12.5	38.46	36.69	33.64
13	36.72	35.14	32.00
14	33.10	31.97	28.82
15	30.19	29.15	25.79
16	27.61	26.52	22.87
17	25.42	23.88	20.13
18	22.92	21.13	17.59

30 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	75.53	75.52	75.52
4	74.94	74.95	74.95
4.5	74.46	74.45	74.44
5	73.98	73.98	73.97
5.5	73.54	73.55	73.54
6	73.15	73.16	73.15
6.5	72.81	72.79	72.78
7	72.45	72.45	72.44
7.5	72.13	72.13	72.11
8	71.83	71.82	71.79
8.5	71.54	71.52	71.47
9	71.25	71.22	71.16
9.5	70.96	70.92	70.86
10	70.64	70.62	70.56
10.5	70.33	70.33	70.28
11	70.06	70.05	70.00
11.5	69.79	69.77	69.73
12	69.54	69.51	69.47
12.5	69.26	69.25	69.21
13	69.00	69.01	68.97
14	68.55	68.55	68.49
15	68.13	68.13	68.00
16	67.69	67.61	67.30
17	67.19	67.00	66.54
18	66.58	66.32	65.71

A.7.3 H-CPM

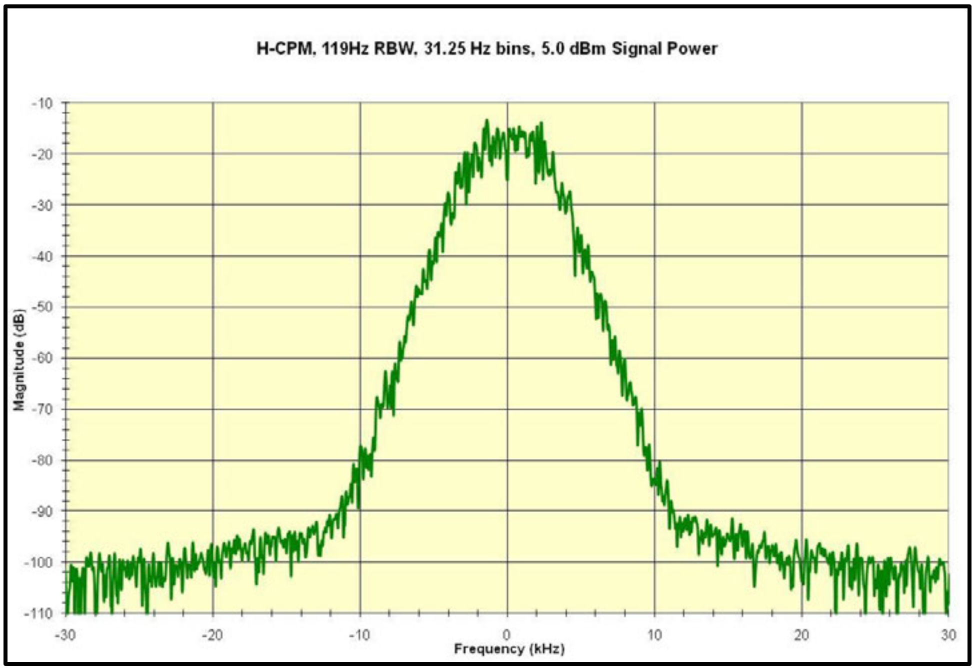


Figure A 20 H-CPM

A.7.3.1 Emission Designator

8K10F1W

A.7.3.2 Typical Receiver Characteristics

6K00R02||

A.7.3.3 Discussion

This is the P25, 12 kb/s, 2-slot TDMA uplink modulation. It uses a constant envelope modulation. The downlink utilizes H-DQPSK, a 12 kb/s modulation utilizing a linear transmitter.

A.7.3.4 H-CPM 25/30 kHz Plan Offsets

Table A 21 H-CPM 25/30 kHz Plan Offsets

25 kHz Plan

6.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	27.48	26.80	25.79
4	24.17	23.78	23.20
4.5	21.39	21.45	21.08
5	19.92	19.75	19.22
5.5	18.51	18.26	17.36
6	16.38	16.44	15.45
6.5	14.64	14.65	13.57
7	13.34	12.85	11.83
7.5	11.61	11.03	10.28
8	9.31	9.47	8.96
8.5	8.10	8.18	7.83
9	7.27	7.12	6.87
9.5	6.14	6.22	6.03
10	5.67	5.43	5.29
10.5	4.82	4.73	4.65
11	4.02	4.11	4.09
11.5	3.59	3.59	3.59
12	3.05	3.12	3.15
12.5	2.60	2.71	2.75
13	2.39	2.35	2.40
14	1.67	1.72	1.80
15	1.28	1.19	1.32
16	0.59	0.78	0.95
17	0.36	0.48	0.68
18	0.20	0.28	0.49

15.625 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	80.32	80.29	80.26
4	79.65	79.62	79.63
4.5	79.06	79.08	79.10
5	78.64	78.64	78.62
5.5	78.28	78.20	78.16
6	77.73	77.75	77.72
6.5	77.33	77.33	77.31
7	76.95	76.95	76.90
7.5	76.62	76.61	76.47
8	76.29	76.27	75.94
8.5	76.02	75.84	75.25
9	75.56	75.31	74.23
9.5	74.99	74.60	72.83
10	74.18	73.58	71.05
10.5	73.12	72.40	68.66
11	72.23	71.22	65.89
11.5	70.22	69.97	62.91
12	69.15	68.22	59.83
12.5	68.35	66.07	56.74
13	66.89	63.70	53.67
14	61.84	59.00	47.69
15	57.49	54.62	42.06
16	53.25	49.69	36.84
17	49.51	44.94	32.05
18	44.42	39.97	27.72

9.375 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	53.28	53.19	52.77
4	51.66	51.21	50.57
4.5	49.52	49.33	48.08
5	47.76	46.79	45.41
5.5	44.42	44.13	42.82
6	42.29	41.90	40.28
6.5	40.30	39.79	37.71
7	38.49	37.38	35.14
7.5	36.22	34.99	32.60
8	33.32	32.78	30.08
8.5	31.57	30.79	27.60
9	29.61	28.51	25.21
9.5	27.83	26.02	22.94
10	26.24	23.74	20.81
10.5	22.36	21.80	18.79
11	20.83	19.91	16.88
11.5	18.88	18.08	15.11
12	17.94	16.25	13.48
12.5	15.75	14.37	12.01
13	13.82	12.61	10.69
14	11.03	9.67	8.47
15	7.71	7.44	6.72
16	5.88	5.71	5.33
17	4.44	4.39	4.23
18	3.29	3.37	3.33

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	82.28	82.28	82.32
4	81.85	81.85	81.82
4.5	81.44	81.37	81.33
5	80.87	80.88	80.85
5.5	80.42	80.42	80.40
6	80.02	79.99	79.99
6.5	79.55	79.60	79.61
7	79.24	79.26	79.27
7.5	78.97	78.95	78.96
8	78.65	78.66	78.67
8.5	78.43	78.38	78.36
9	78.12	78.09	78.05
9.5	77.83	77.79	77.75
10	77.51	77.51	77.45
10.5	77.19	77.23	77.14
11	76.96	76.95	76.82
11.5	76.78	76.67	76.43
12	76.46	76.40	75.91
12.5	76.12	76.13	75.12
13	75.86	75.87	73.91
14	75.40	75.28	69.80
15	74.93	74.40	64.18
16	73.80	72.81	58.26
17	72.14	70.53	52.54
18	69.66	66.76	47.18

12.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	76.22	76.38	76.21
4	75.38	75.09	74.66
4.5	73.56	73.47	72.96
5	72.03	71.73	71.30
5.5	70.35	70.27	69.59
6	69.10	69.09	67.54
6.5	68.31	67.28	64.89
7	65.43	64.71	62.18
7.5	63.00	62.17	59.51
8	60.86	59.78	56.84
8.5	58.15	57.49	54.14
9	56.69	55.31	51.36
9.5	54.51	53.24	48.52
10	52.27	51.08	45.65
10.5	50.23	48.59	42.80
11	48.85	46.11	39.99
11.5	46.53	43.82	37.24
12	43.27	41.46	34.57
12.5	40.95	38.99	32.00
13	39.28	36.63	29.53
14	34.81	32.24	24.97
15	30.61	27.33	20.90
16	27.48	23.16	17.36
17	21.39	19.29	14.32
18	18.51	15.47	11.76

25.0 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	86.14	86.01	85.95
4	85.27	85.30	85.26
4.5	84.71	84.62	84.63
5	83.98	84.07	84.08
5.5	83.64	83.59	83.61
6	83.17	83.19	83.17
6.5	82.81	82.80	82.76
7	82.47	82.40	82.38
7.5	82.03	82.02	82.02
8	81.62	81.68	81.69
8.5	81.37	81.36	81.40
9	81.07	81.09	81.13
9.5	80.77	80.86	80.88
10	80.65	80.64	80.65
10.5	80.49	80.43	80.44
11	80.20	80.23	80.23
11.5	80.06	80.04	80.03
12	79.87	79.86	79.83
12.5	79.67	79.67	79.64
13	79.53	79.49	79.44
14	79.13	79.12	79.06
15	78.77	78.74	78.66
16	78.32	78.35	78.18
17	78.08	77.98	77.49
18	77.68	77.62	76.17

30 kHz Plan

7.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	37.29	37.11	36.33
4	34.81	34.43	33.84
4.5	32.30	32.24	31.57
5	30.61	30.28	29.28
5.5	28.62	28.48	26.82
6	27.48	25.91	24.37
6.5	24.17	23.41	22.13
7	21.39	21.32	20.07
7.5	19.92	19.62	18.10
8	18.51	17.84	16.17
8.5	16.38	16.10	14.32
9	14.64	14.28	12.61
9.5	13.34	12.42	11.09
10	11.61	10.75	9.74
10.5	9.31	9.31	8.57
11	8.10	8.12	7.56
11.5	7.27	7.08	6.67
12	6.14	6.18	5.89
12.5	5.67	5.39	5.20
13	4.82	4.71	4.59
14	3.59	3.60	3.58
15	2.60	2.73	2.76
16	2.04	2.02	2.11
17	1.44	1.45	1.59
18	0.82	0.99	1.19

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	82.28	82.28	82.32
4	81.85	81.85	81.82
4.5	81.44	81.37	81.33
5	80.87	80.88	80.85
5.5	80.42	80.42	80.40
6	80.02	79.99	79.99
6.5	79.55	79.60	79.61
7	79.24	79.26	79.27
7.5	78.97	78.95	78.96
8	78.65	78.66	78.67
8.5	78.43	78.38	78.36
9	78.12	78.09	78.05
9.5	77.83	77.79	77.75
10	77.51	77.51	77.45
10.5	77.19	77.23	77.14
11	76.96	76.95	76.82
11.5	76.78	76.67	76.43
12	76.46	76.40	75.91
12.5	76.12	76.13	75.12
13	75.86	75.87	73.91
14	75.40	75.28	69.80
15	74.93	74.40	64.18
16	73.80	72.81	58.26
17	72.14	70.53	52.54
18	69.66	66.76	47.18

11.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	69.36	69.39	69.15
4	68.52	68.16	67.06
4.5	65.56	65.40	64.24
5	63.06	62.78	61.56
5.5	60.90	60.35	59.01
6	58.17	58.03	56.54
6.5	56.70	55.82	54.07
7	54.52	53.72	51.51
7.5	52.28	51.72	48.83
8	50.24	49.49	46.07
8.5	48.85	46.95	43.31
9	46.53	44.52	40.56
9.5	43.27	42.27	37.83
10	40.95	39.91	35.15
10.5	39.29	37.46	32.53
11	37.28	35.15	30.00
11.5	34.81	33.02	27.56
12	32.30	30.83	25.24
12.5	30.61	28.33	23.05
13	28.61	25.95	20.99
14	24.17	21.90	17.25
15	19.92	18.11	14.06
16	16.38	14.35	11.39
17	13.34	11.20	9.22
18	9.31	8.75	7.45

22.50 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	84.16	84.17	84.20
4	83.73	83.68	83.68
4.5	83.13	83.20	83.22
5	82.81	82.81	82.82
5.5	82.50	82.45	82.46
6	82.06	82.13	82.14
6.5	81.86	81.83	81.84
7	81.57	81.56	81.56
7.5	81.32	81.31	81.28
8	81.03	81.01	80.99
8.5	80.64	80.67	80.66
9	80.37	80.35	80.34
9.5	80.04	80.05	80.04
10	79.83	79.77	79.76
10.5	79.43	79.51	79.50
11	79.26	79.26	79.24
11.5	79.06	79.02	78.99
12	78.85	78.78	78.74
12.5	78.54	78.55	78.51
13	78.34	78.32	78.27
14	77.87	77.88	77.74
15	77.39	77.43	77.01
16	77.06	76.99	75.60
17	76.64	76.58	72.77
18	76.18	76.17	68.46

15 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	79.66	79.68	79.69
4	79.29	79.22	79.14
4.5	78.67	78.63	78.56
5	77.98	78.04	78.02
5.5	77.50	77.52	77.53
6	77.07	77.10	77.09
6.5	76.73	76.73	76.62
7	76.42	76.36	76.08
7.5	76.06	75.88	75.39
8	75.60	75.26	74.39
8.5	74.62	74.44	73.05
9	74.00	73.30	71.38
9.5	72.62	72.03	69.33
10	71.38	70.82	66.72
10.5	69.91	69.50	63.85
11	68.77	67.66	60.86
11.5	68.06	65.39	57.81
12	65.32	62.99	54.76
12.5	62.93	60.60	51.72
13	60.82	58.30	48.73
14	56.68	53.95	42.95
15	52.27	49.01	37.56
16	48.85	44.29	32.61
17	43.27	39.34	28.11
18	39.28	34.83	24.08

30 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	86.96	86.86	86.84
4	86.27	86.30	86.26
4.5	85.76	85.73	85.71
5	85.30	85.22	85.21
5.5	84.70	84.75	84.77
6	84.30	84.36	84.39
6.5	84.01	84.03	84.05
7	83.77	83.74	83.73
7.5	83.51	83.44	83.44
8	83.14	83.16	83.17
8.5	82.83	82.90	82.92
9	82.64	82.67	82.69
9.5	82.49	82.47	82.47
10	82.32	82.27	82.26
10.5	82.09	82.08	82.05
11	81.86	81.88	81.85
11.5	81.72	81.68	81.65
12	81.50	81.48	81.46
12.5	81.27	81.29	81.27
13	81.08	81.11	81.08
14	80.74	80.76	80.72
15	80.41	80.42	80.37
16	80.15	80.07	80.02
17	79.76	79.72	79.69
18	79.33	79.39	79.36

A.7.4 H-DQPSK

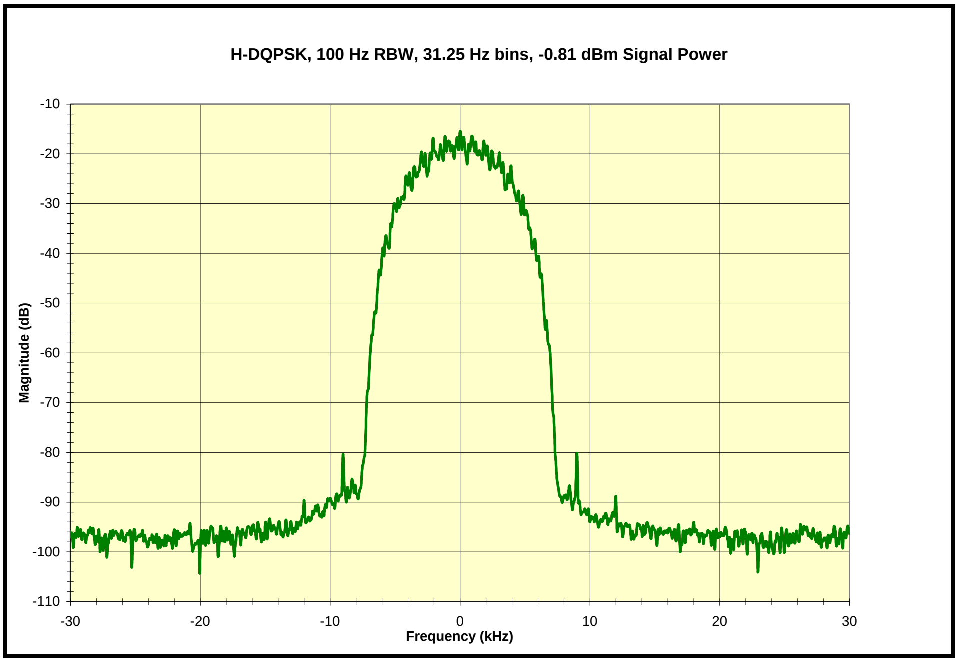


Figure A 21 H-DQPSK

A.7.4.1 Emission Designator

9K80D7W

A.7.4.2 Typical Receiver Characteristics

6K00R02||

A.7.4.3 Discussion

This is the P25, 12 kb/s, 2-slot TDMA downlink modulation. It utilizes a linear transmitter to meet the FCC mask. The uplink utilizes H-CPM, a 12 kb/s constant envelop modulation.

A.7.4.4 H-DQPSK 25/30 kHz Plan Offsets

Table A 22 H-DQPSK 25/30 kHz Plan Offsets

25 kHz Plan

6.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	19.98	19.91	19.60
4	18.49	18.16	17.76
4.5	16.47	16.39	16.10
5	14.84	14.90	14.64
5.5	13.70	13.64	13.31
6	12.61	12.42	12.10
6.5	11.31	11.25	10.99
7	10.25	10.26	9.97
7.5	9.41	9.31	9.04
8	8.62	8.42	8.17
8.5	7.55	7.60	7.38
9	6.76	6.85	6.65
9.5	6.21	6.15	5.98
10	5.68	5.51	5.36
10.5	5.00	4.93	4.80
11	4.32	4.38	4.28
11.5	3.93	3.88	3.81
12	3.50	3.42	3.38
12.5	2.96	3.00	2.99
13	2.53	2.62	2.64
14	1.98	1.97	2.04
15	1.35	1.45	1.56
16	1.01	1.04	1.18
17	0.63	0.73	0.89
18	0.42	0.49	0.66

9.375 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	72.11	71.99	68.92
4	71.06	69.56	61.03
4.5	66.09	61.58	53.19
5	56.83	53.73	46.57
5.5	50.13	47.17	41.09
6	44.95	41.16	36.61
6.5	38.79	36.44	32.84
7	34.13	32.84	29.60
7.5	30.50	29.70	26.76
8	28.37	26.74	24.26
8.5	25.43	24.22	22.04
9	22.71	22.07	20.06
9.5	20.83	20.07	18.28
10	19.13	18.26	16.68
10.5	17.35	16.65	15.22
11	15.50	15.20	13.90
11.5	14.19	13.84	12.69
12	13.06	12.62	11.58
12.5	12.13	11.51	10.56
13	10.70	10.47	9.62
14	8.88	8.64	7.96
15	7.15	7.06	6.55
16	5.93	5.73	5.36
17	4.59	4.58	4.36
18	3.79	3.61	3.52

12.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	77.48	77.49	77.49
4	76.89	76.85	76.80
4.5	76.24	76.20	76.14
5	75.54	75.56	75.51
5.5	75.00	75.00	74.88
6	74.51	74.44	74.15
6.5	73.98	73.74	73.10
7	73.05	73.03	70.99
7.5	72.27	72.41	67.02
8	71.89	71.89	61.77
8.5	71.44	71.46	56.36
9	71.06	71.00	51.28
9.5	70.80	68.85	46.65
10	70.38	62.16	42.47
10.5	69.18	55.15	38.72
11	62.29	48.44	35.35
11.5	53.33	42.80	32.32
12	47.24	38.36	29.59
12.5	41.18	34.74	27.13
13	36.02	31.41	24.89
14	29.52	25.92	21.01
15	23.83	21.57	17.77
16	19.98	18.04	15.04
17	16.47	15.09	12.73
18	13.70	12.63	10.75

15.625 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	79.48	79.51	79.52
4	79.03	79.01	79.00
4.5	78.53	78.54	78.52
5	78.10	78.08	78.07
5.5	77.67	77.67	77.65
6	77.31	77.30	77.25
6.5	76.97	76.90	76.84
7	76.56	76.50	76.44
7.5	76.05	76.10	76.05
8	75.72	75.72	75.66
8.5	75.41	75.36	75.26
9	75.06	75.03	74.75
9.5	74.68	74.70	73.93
10	74.43	74.37	72.43
10.5	74.12	74.03	69.89
11	73.74	73.68	66.43
11.5	73.35	73.30	62.50
12	73.05	72.87	58.50
12.5	72.69	72.43	54.60
13	72.34	72.00	50.87
14	71.11	71.19	44.03
15	70.47	67.44	38.03
16	69.97	54.39	32.81
17	65.49	43.06	28.30
18	50.12	35.46	24.40

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	80.20	80.22	80.23
4	79.66	79.69	79.69
4.5	79.24	79.23	79.21
5	78.81	78.78	78.76
5.5	78.36	78.36	78.35
6	77.96	77.97	77.97
6.5	77.60	77.61	77.62
7	77.29	77.30	77.30
7.5	77.02	77.00	77.00
8	76.71	76.73	76.73
8.5	76.49	76.47	76.47
9	76.21	76.22	76.22
9.5	75.99	75.99	75.98
10	75.76	75.77	75.75
10.5	75.54	75.55	75.50
11	75.34	75.33	75.22
11.5	75.12	75.11	74.88
12	74.91	74.88	74.39
12.5	74.71	74.66	73.59
13	74.50	74.43	72.26
14	73.97	73.95	67.66
15	73.54	73.47	61.53
16	73.02	72.98	55.26
17	72.60	72.45	49.35
18	72.06	71.83	43.90

25.0 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	80.76	80.77	80.79
4	80.20	80.23	80.25
4.5	79.81	79.78	79.79
5	79.38	79.38	79.37
5.5	78.97	78.99	78.97
6	78.63	78.62	78.58
6.5	78.27	78.24	78.20
7	77.86	77.87	77.85
7.5	77.51	77.52	77.52
8	77.21	77.20	77.21
8.5	76.87	76.91	76.93
9	76.62	76.66	76.67
9.5	76.42	76.43	76.43
10	76.24	76.21	76.20
10.5	76.02	75.99	75.98
11	75.81	75.78	75.76
11.5	75.58	75.57	75.56
12	75.36	75.37	75.36
12.5	75.17	75.18	75.16
13	75.01	74.99	74.97
14	74.63	74.63	74.61
15	74.29	74.30	74.27
16	73.98	73.98	73.89
17	73.69	73.68	73.39
18	73.40	73.39	72.46

30 kHz Plan

7.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	32.33	32.02	31.31
4	29.52	29.29	28.21
4.5	27.08	26.41	25.34
5	23.83	23.68	22.88
5.5	21.58	21.54	20.76
6	19.98	19.69	18.85
6.5	18.49	17.87	17.12
7	16.47	16.25	15.57
7.5	14.84	14.81	14.16
8	13.70	13.50	12.89
8.5	12.61	12.27	11.73
9	11.31	11.18	10.66
9.5	10.25	10.17	9.69
10	9.41	9.22	8.79
10.5	8.62	8.34	7.96
11	7.55	7.54	7.19
11.5	6.76	6.80	6.49
12	6.21	6.11	5.85
12.5	5.68	5.48	5.26
13	5.00	4.90	4.72
14	3.93	3.86	3.77
15	2.96	3.00	2.99
16	2.24	2.29	2.35
17	1.64	1.71	1.83
18	1.17	1.25	1.41

11.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	75.72	75.69	75.60
4	75.02	74.89	74.70
4.5	73.86	73.86	73.80
5	72.95	73.05	72.94
5.5	72.50	72.46	71.37
6	71.97	71.99	67.38
6.5	71.53	71.57	61.28
7	71.23	70.86	55.02
7.5	70.74	66.95	49.35
8	69.45	59.19	44.35
8.5	62.34	52.25	39.99
9	53.34	45.73	36.18
9.5	47.24	40.42	32.82
10	41.18	36.27	29.85
10.5	36.02	32.82	27.20
11	32.33	29.61	24.83
11.5	29.52	26.81	22.70
12	27.08	24.42	20.77
12.5	23.83	22.25	19.03
13	21.58	20.27	17.44
14	18.49	16.91	14.66
15	14.84	14.10	12.32
16	12.61	11.76	10.34
17	10.25	9.77	8.65
18	8.62	8.06	7.20

15 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	79.28	79.30	79.30
4	78.75	78.75	78.76
4.5	78.26	78.28	78.27
5	77.88	77.85	77.80
5.5	77.46	77.40	77.33
6	76.91	76.92	76.88
6.5	76.46	76.48	76.44
7	76.07	76.07	76.02
7.5	75.72	75.67	75.60
8	75.31	75.28	75.16
8.5	74.89	74.91	74.59
9	74.59	74.54	73.66
9.5	74.25	74.17	71.88
10	73.82	73.81	68.94
10.5	73.48	73.40	65.09
11	73.15	72.94	60.88
11.5	72.79	72.47	56.68
12	72.07	72.01	52.65
12.5	71.45	71.58	48.84
13	71.14	71.16	45.28
14	70.44	66.64	38.85
15	69.85	53.29	33.33
16	62.20	42.16	28.59
17	47.24	34.70	24.55
18	36.02	28.72	21.08

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	80.20	80.22	80.23
4	79.66	79.69	79.69
4.5	79.24	79.23	79.21
5	78.81	78.78	78.76
5.5	78.36	78.36	78.35
6	77.96	77.97	77.97
6.5	77.60	77.61	77.62
7	77.29	77.30	77.30
7.5	77.02	77.00	77.00
8	76.71	76.73	76.73
8.5	76.49	76.47	76.47
9	76.21	76.22	76.22
9.5	75.99	75.99	75.98
10	75.76	75.77	75.75
10.5	75.54	75.55	75.50
11	75.34	75.33	75.22
11.5	75.12	75.11	74.88
12	74.91	74.88	74.39
12.5	74.71	74.66	73.59
13	74.50	74.43	72.26
14	73.97	73.95	67.66
15	73.54	73.47	61.53
16	73.02	72.98	55.26
17	72.60	72.45	49.35
18	72.06	71.83	43.90

22.50 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	80.92	80.95	80.97
4	80.37	80.37	80.39
4.5	79.89	79.89	79.90
5	79.51	79.46	79.45
5.5	79.06	79.05	79.02
6	78.66	78.64	78.62
6.5	78.27	78.25	78.24
7	77.87	77.89	77.89
7.5	77.56	77.57	77.57
8	77.30	77.26	77.27
8.5	76.97	76.98	76.98
9	76.67	76.68	76.69
9.5	76.37	76.40	76.43
10	76.13	76.16	76.18
10.5	75.91	75.94	75.95
11	75.74	75.73	75.73
11.5	75.54	75.53	75.52
12	75.36	75.34	75.32
12.5	75.17	75.15	75.12
13	74.95	74.96	74.93
14	74.59	74.60	74.51
15	74.26	74.25	73.93
16	73.92	73.91	72.70
17	73.61	73.59	70.06
18	73.30	73.28	65.87

30 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	80.15	80.18	80.19
4	79.60	79.59	79.61
4.5	79.07	79.10	79.11
5	78.66	78.67	78.67
5.5	78.26	78.28	78.27
6	77.95	77.91	77.90
6.5	77.55	77.55	77.55
7	77.21	77.22	77.23
7.5	76.92	76.92	76.93
8	76.65	76.65	76.65
8.5	76.40	76.39	76.38
9	76.15	76.14	76.13
9.5	75.92	75.91	75.89
10	75.69	75.67	75.66
10.5	75.45	75.45	75.44
11	75.24	75.23	75.23
11.5	75.01	75.03	75.03
12	74.83	74.83	74.83
12.5	74.65	74.64	74.65
13	74.48	74.47	74.47
14	74.12	74.14	74.14
15	73.84	73.84	73.83
16	73.56	73.55	73.54
17	73.29	73.27	73.26
18	73.01	73.01	72.99

A.8 Cellular Type Digital Radio (TDMA)

A.8.1 DIMRS-iDEN®

Figure A 22 DIMRS

A.8.1.1 Emission Designator

18K3D7W

A.8.1.2 Typical Receiver Characteristics

16K0S|||| Sensitivity

17K5S|||| ACPR

A.8.1.3 Discussion

iDEN is a registered mark of Motorola, Inc. Use of this mark does not constitute an endorsement of the product or services.

A TDMA system using four sub-carriers, each modulated with a 16QAM signal providing a 64 Kbps data rate. Up to six separate conversations per carrier can be accommodated. In some cases a 3:1 selection is used to enhance interconnect DAQ. The 3:1 mode is slightly more sensitive for the same DAQ as the 6:1 mode. Vocoder performance has not been verified. Consult the manufacturer for their recommendations.

Up to four adjacent channel transmitters can be combined into a single power amplifier. To model this configuration, add the individual powers at the appropriate offset values. See the spreadsheet to view values ±50 kHz.

DIMRS is the ITU terminology for the iDEN® product line used by some CMRS carriers. It is anticipated that the 800 MHz rebanding will eliminate adjacent channel deployments.

A.8.1.4 DIMRS-iDEN®, 25 kHz Plan Offsets

Table A 23 DIMRS, 25 kHz Plan Offsets

6.25 kHz Offset ACPR				15.625 kHz Offset ACPR				7.5 kHz Offset ACPR				18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3
3.5	6.82	6.80	6.81	3.5	62.59	62.60	62.56	3.5	7.12	7.14	7.16	3.5	65.58	65.56	65.56
4	6.39	6.38	6.36	4	61.97	61.90	61.85	4	6.77	6.80	6.82	4	64.96	64.96	64.95
4.5	6.00	5.96	5.95	4.5	61.25	61.23	61.16	4.5	6.50	6.50	6.52	4.5	64.42	64.41	64.40
5	5.50	5.55	5.58	5	60.60	60.59	60.47	5	6.15	6.22	6.27	5	63.91	63.92	63.90
5.5	5.19	5.22	5.27	5.5	60.02	59.93	59.72	5.5	5.99	6.04	6.08	5.5	63.47	63.46	63.44
6	4.96	4.97	5.01	6	59.34	59.23	58.86	6	5.91	5.91	5.92	6	63.06	63.02	63.01
6.5	4.75	4.76	4.78	6.5	58.60	58.42	57.84	6.5	5.83	5.78	5.74	6.5	62.59	62.61	62.61
7	4.58	4.56	4.56	7	57.76	57.45	56.51	7	5.64	5.61	5.55	7	62.23	62.25	62.24
7.5	4.34	4.36	4.36	7.5	56.56	56.39	54.58	7.5	5.42	5.40	5.35	7.5	61.94	61.91	61.89
8	4.18	4.16	4.17	8	55.51	55.28	51.57	8	5.17	5.18	5.14	8	61.65	61.59	61.55
8.5	3.97	3.98	4.00	8.5	54.51	54.08	47.46	8.5	4.96	4.96	4.94	8.5	61.25	61.28	61.20
9	3.79	3.82	3.84	9	53.35	52.81	42.83	9	4.75	4.75	4.74	9	60.98	60.98	60.80
9.5	3.65	3.67	3.69	9.5	52.11	51.56	38.25	9.5	4.58	4.55	4.54	9.5	60.73	60.66	60.29
10	3.55	3.52	3.55	10	50.52	50.29	33.99	10	4.34	4.35	4.35	10	60.42	60.32	59.52
10.5	3.36	3.39	3.42	10.5	49.65	48.98	30.16	10.5	4.18	4.16	4.17	10.5	60.04	59.95	58.23
11	3.25	3.27	3.30	11	48.51	47.19	26.80	11	3.97	3.99	4.00	11	59.67	59.54	56.15
11.5	3.10	3.17	3.19	11.5	47.04	39.18	23.89	11.5	3.79	3.83	3.85	11.5	59.27	59.06	53.28
12	3.03	3.07	3.08	12	45.87	30.81	21.39	12	3.65	3.67	3.70	12	58.81	58.48	49.90
12.5	3.00	2.98	2.96	12.5	44.29	25.24	19.26	12.5	3.55	3.53	3.56	12.5	58.25	57.76	46.33
13	2.95	2.88	2.85	13	38.39	21.55	17.44	13	3.36	3.40	3.43	13	57.67	56.94	42.78
14	2.69	2.66	2.63	14	18.87	16.62	14.56	14	3.10	3.18	3.19	14	55.85	54.92	36.16
15	2.43	2.43	2.40	15	14.41	13.50	12.43	15	3.00	2.97	2.96	15	53.87	52.57	30.38
16	2.20	2.20	2.19	16	11.49	11.34	10.82	16	2.82	2.76	2.73	16	51.26	50.00	25.51
17	1.98	1.97	1.98	17	9.90	9.78	9.57	17	2.56	2.54	2.51	17	48.99	37.11	21.51
18	1.77	1.77	1.79	18	8.50	8.63	8.58	18	2.29	2.31	2.29	18	46.37	25.76	18.29

9.375 kHz Offset ACPR				18.75 kHz Offset ACPR				11.25 kHz Offset ACPR				22.50 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3
3.5	11.49	11.42	11.43	3.5	65.58	65.56	65.56	3.5	45.19	45.05	36.60	3.5	70.13	70.12	70.14
4	10.46	10.57	10.56	4	64.96	64.96	64.95	4	43.48	35.65	28.43	4	69.45	69.53	69.55
4.5	9.90	9.84	9.80	4.5	64.42	64.41	64.40	4.5	29.24	26.51	22.71	4.5	69.09	69.05	69.04
5	9.16	9.15	9.15	5	63.91	63.92	63.90	5	22.59	20.36	18.92	5	68.59	68.59	68.56
5.5	8.50	8.57	8.60	5.5	63.47	63.46	63.44	5.5	16.67	17.05	16.33	5.5	68.11	68.13	68.10
6	8.07	8.10	8.12	6	63.06	63.02	63.01	6	15.07	14.80	14.44	6	67.71	67.71	67.67
6.5	7.76	7.69	7.70	6.5	62.59	62.61	62.61	6.5	13.13	13.19	12.99	6.5	67.36	67.30	67.24
7	7.33	7.32	7.33	7	62.23	62.25	62.24	7	11.98	11.96	11.85	7	66.91	66.89	66.82
7.5	6.97	6.97	7.00	7.5	61.94	61.91	61.89	7.5	10.87	10.98	10.91	7.5	66.49	66.47	66.41
8	6.65	6.65	6.70	8	61.65	61.59	61.55	8	10.20	10.16	10.12	8	66.07	66.08	66.02
8.5	6.39	6.38	6.45	8.5	61.25	61.28	61.20	8.5	9.50	9.46	9.45	8.5	65.69	65.71	65.62
9	6.05	6.17	6.23	9	60.98	60.98	60.80	9	8.84	8.87	8.88	9	65.45	65.33	65.24
9.5	5.94	6.00	6.02	9.5	60.73	60.66	60.29	9.5	8.25	8.35	8.38	9.5	65.00	64.95	64.86
10	5.89	5.83	5.82	10	60.42	60.32	59.52	10	7.92	7.90	7.94	10	64.62	64.58	64.49
10.5	5.76	5.65	5.61	10.5	60.04	59.95	58.23	10.5	7.50	7.50	7.55	10.5	64.24	64.22	64.13
11	5.54	5.47	5.41	11	59.67	59.54	56.15	11	7.12	7.14	7.21	11	63.86	63.87	63.78
11.5	5.30	5.27	5.21	11.5	59.27	59.06	53.28	11.5	6.77	6.82	6.90	11.5	63.55	63.53	63.43
12	5.05	5.06	5.01	12	58.81	58.48	49.90	12	6.50	6.55	6.63	12	63.24	63.21	63.07
12.5	4.85	4.85	4.81	12.5	58.25	57.76	46.33	12.5	6.15	6.32	6.38	12.5	62.93	62.90	62.68
13	4.69	4.65	4.62	13	57.67	56.94	42.78	13	5.99	6.11	6.14	13	62.64	62.59	62.19
14	4.23	4.26	4.26	14	55.85	54.92	36.16	14	5.83	5.72	5.70	14	62.02	62.01	60.53
15	3.87	3.91	3.94	15	53.87	52.57	30.38	15	5.42	5.34	5.28	15	61.51	61.46	57.11
16	3.60	3.61	3.65	16	51.26	50.00	25.51	16	4.96	4.94	4.89	16	60.93	60.90	52.06
17	3.30	3.35	3.38	17	48.99	37.11	21.51	17	4.58	4.54	4.52	17	60.48	60.28	46.53
18	3.81	3.87	3.68	18	46.37	25.76	18.29	18	4.18	4.17	4.18	18	59.85	59.52	41.17

12.5 kHz Offset ACPR				25.0 kHz Offset ACPR				15 kHz Offset ACPR				30 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3
3.5	51.77	51.69	51.54	3.5	74.64	74.64	74.63	3.5	61.79	61.77	61.72	3.5	77.92	77.91	77.91
4	50.42	50.37	49.96	4	74.04	73.99	73.95	4	61.01	60.97	60.86	4	77.33	77.32	77.31
4.5	49.25	49.12	47.06	4.5	73.33	73.35	73.30	4.5	60.19	60.15	59.98	4.5	76.81	76.79	76.78
5	47.96	47.76	41.09	5	72.75	72.74	72.66	5	59.33	59.30	59.00	5	76.29	76.29	76.31
5.5	46.49	46.32	34.14	5.5	72.18	72.14	72.03	5.5	58.53	58.33	57.90	5.5	75.83	75.88	75.92
6	45.10	40.45	28.21	6	71.55	71.52	71.42	6	57.52	57.23	56.66	6	75.53	75.55	75.57
6.5	43.43	30.81	23.63	6.5	70.91	70.91	70.84	6.5	56.32	56.08	55.13	6.5	75.30	75.25	75.24
7	29.24	23.68	20.18	7	70.34	70.35	70.30	7	55.03	54.91	52.88	7	74.98	74.95	74.94
7.5	22.59	19.55	17.58	7.5	69.85	69.84	69.80	7.5	54.11	53.65	49.35	7.5	74.64	74.65	74.65
8	16.67	16.74	15.58	8	69.40	69.37	69.34	8	52.81	52.35	44.71	8	74.38	74.37	74.37
8.5	15.07	14.68	14.01	8.5	68.95	68.95	68.90	8.5	51.37	51.08	39.73	8.5	74.05	74.12	74.11
9	13.13	13.13	12.74	9	68.48	68.55	68.49	9	50.13	49.79	35.01	9	73.89	73.89	73.84
9.5	11.98	11.94	11.69	9.5	68.23	68.17	68.09	9.5	49.05	48.47	30.78	9.5	73.72	73.65	73.56
10	10.87	10.97	10.82	10	67.84	67.80	67.70	10	47.82	46.33	27.09	10	73.47	73.40	73.27
10.5	10.20	10.15	10.07	10.5	67.45	67.44	67.32	10.5	46.39	37.71	23.94	10.5	73.20	73.13	72.97
11	9.50	9.46	9.43	11	67.10	67.08	66.94	11	45.04	29.48	21.28	11	72.91	72.82	72.65
11.5	8.84	8.87	8.88	11.5	66.80	66.71	66.57	11.5	43.39	24.18	19.05	11.5	72.59	72.49	72.32
12	8.25	8.36	8.39	12	66.42	66.35	66.20	12	29.23	20.64	17.17	12	72.23	72.16	71.98
12.5	7.92	7.91	7.96	12.5	66.04	66.00	65.83	12.5	22.58	17.98	15.59	12.5	71.82	71.82	71.64
13	7.50	7.51	7.58	13	65.66	65.65	65.46	13	16.67	15.92	14.26	13	71.52	71.49	71.30
14	6.77	6.84	6.93	14	65.10	64.94	64.71	14	13.13	12.96	12.14	14	70.91	70.83	70.60
15	6.15	6.34	6.39	15	64.33	64.26	63.81	15	10.87	10.92	10.55	15	70.26	70.14	69.89
16	5.91	5.91	5.92	16	63.63	63.61	62.41	16	9.50	9.47	9.33	16	69.59	69.44	69.19
17	5.64	5.52	5.48	17	63.05	62.99	59.86	17	8.25	8.38	8.37	17	68.80	68.75	68.48
18	5.17	5.12	5.07	18	62.48	62.41	55.93	18	7.50	7.53	7.60	18	68.15	68.10	67.73
25 kHz Plan								**30 kHz Plan**							

A.8.2 TETRA

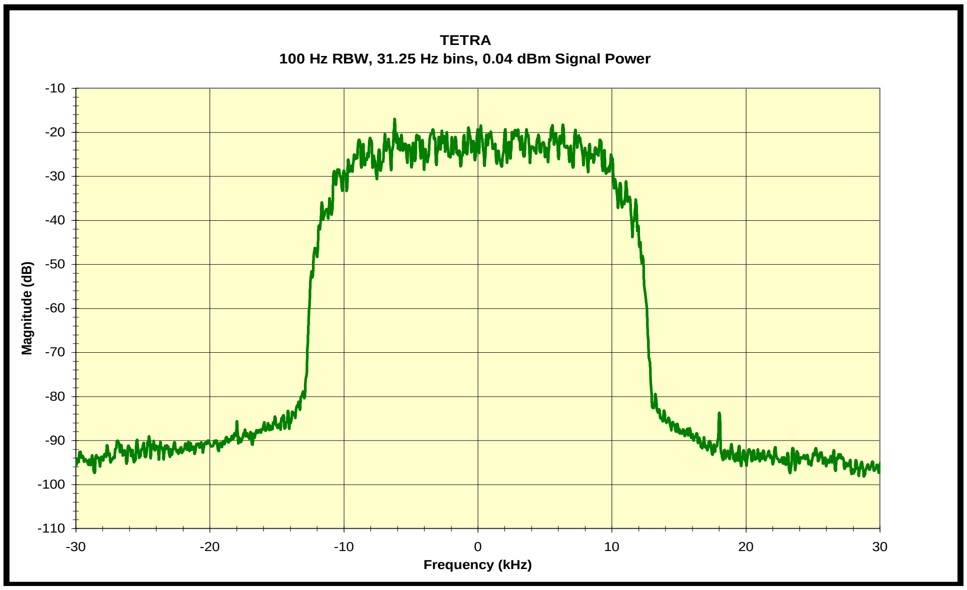


Figure A 23 TETRA

A.8.2.1 Emission Designator

23K4D7W, is used for both the up and down links.

A.8.2.2 Typical Receiver Characteristics

18K0R20||

A.8.2.3 Discussion

Normally used outside the United States. The wide band characteristics make channel spacing of less than 25 kHz difficult.

Modulation is $\pi/4$ DQPSK filtered with RRC in the transmitter with α=0.35.

Symbol rate is 18K Symbols/Sec.

E_s/N_0 = C/N as the Symbol rate and bandwidth are the same. Channel fading models include TU50/TU5, HT200 and EQ200.

Vocoder performance has not been validated. Consult the manufacturer for their recommendation.

A.8.2.4 TETRA, 25 kHz Plan Offsets

Table A 24 TETRA, 25 kHz Plan Offsets

6.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	7.01	6.99	7.01
4	6.58	6.57	6.58
4.5	6.21	6.21	6.19
5	5.90	5.83	5.80
5.5	5.41	5.44	5.43
6	5.07	5.08	5.08
6.5	4.78	4.75	4.76
7	4.43	4.44	4.49
7.5	4.11	4.19	4.26
8	3.95	3.99	4.06
8.5	3.80	3.83	3.89
9	3.67	3.71	3.74
9.5	3.60	3.59	3.60
10	3.51	3.46	3.46
10.5	3.39	3.34	3.32
11	3.19	3.20	3.18
11.5	3.05	3.06	3.05
12	2.95	2.92	2.92
12.5	2.78	2.79	2.80
13	2.65	2.66	2.68
14	2.40	2.44	2.46
15	2.22	2.25	2.26
16	2.08	2.07	2.07
17	1.94	1.89	1.89
18	1.71	1.71	1.71

9.375 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	10.98	10.90	10.82
4	10.13	10.10	10.12
4.5	9.37	9.51	9.57
5	9.10	9.11	9.10
5.5	8.79	8.72	8.65
6	8.39	8.26	8.19
6.5	7.74	7.80	7.74
7	7.42	7.35	7.33
7.5	7.00	6.93	6.96
8	6.44	6.58	6.63
8.5	6.24	6.29	6.35
9	6.06	6.04	6.09
9.5	5.85	5.83	5.85
10	5.59	5.63	5.63
10.5	5.44	5.43	5.41
11	5.28	5.23	5.19
11.5	5.05	5.02	4.99
12	4.85	4.81	4.78
12.5	4.67	4.60	4.59
13	4.41	4.40	4.41
14	3.97	4.04	4.07
15	3.67	3.75	3.77
16	3.55	3.49	3.49
17	3.28	3.23	3.23
18	3.02	2.98	2.98

12.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	25.30	25.20	24.76
4	22.93	22.76	22.57
4.5	20.90	21.05	20.97
5	19.90	19.84	19.65
5.5	18.73	18.77	18.35
6	17.75	17.35	16.86
6.5	16.45	15.89	15.56
7	14.45	14.63	14.47
7.5	13.50	13.63	13.56
8	12.83	12.85	12.78
8.5	12.15	12.21	12.07
9	11.65	11.58	11.41
9.5	11.15	10.95	10.79
10	10.44	10.36	10.22
10.5	9.68	9.83	9.69
11	9.26	9.32	9.19
11.5	8.98	8.85	8.71
12	8.61	8.39	8.27
12.5	7.96	7.94	7.86
13	7.56	7.53	7.48
14	6.70	6.80	6.81
15	6.15	6.22	6.24
16	5.74	5.74	5.74
17	5.35	5.30	5.29
18	4.90	4.88	4.88

15.625 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	71.47	71.42	71.29
4	70.73	70.67	69.53
4.5	69.91	69.84	64.03
5	69.00	68.72	56.35
5.5	67.95	61.22	49.34
6	61.89	51.95	43.45
6.5	49.61	45.63	38.80
7	43.09	39.19	35.12
7.5	38.26	35.13	32.14
8	32.37	31.95	29.65
8.5	30.92	29.38	27.34
9	28.20	27.37	25.21
9.5	25.79	25.18	23.35
10	24.10	23.23	21.70
10.5	21.68	21.63	20.22
11	20.48	20.23	18.79
11.5	19.35	18.92	17.47
12	18.20	17.44	16.29
12.5	16.91	16.12	15.24
13	15.46	15.00	14.31
14	13.11	13.23	12.70
15	11.99	11.76	11.36
16	10.90	10.55	10.20
17	9.34	9.50	9.21
18	8.79	8.53	8.34

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	74.36	74.37	74.38
4	73.83	73.82	73.80
4.5	73.29	73.29	73.26
5	72.80	72.78	72.75
5.5	72.31	72.29	72.26
6	71.84	71.84	71.80
6.5	71.41	71.41	71.33
7	71.04	71.01	70.72
7.5	70.62	70.62	69.53
8	70.28	70.26	66.96
8.5	69.89	69.90	62.84
9	69.59	69.54	57.86
9.5	69.25	69.16	53.04
10	68.86	68.72	48.61
10.5	68.46	67.40	44.62
11	67.95	60.25	41.05
11.5	67.24	52.82	37.87
12	65.93	46.14	35.04
12.5	54.47	40.82	32.50
13	46.35	36.98	30.17
14	34.26	31.21	26.13
15	29.32	26.73	22.79
16	25.30	23.11	19.92
17	20.90	20.14	17.51
18	18.73	17.34	15.50

25.0 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	76.68	76.65	76.64
4	75.99	76.03	76.06
4.5	75.56	75.55	75.57
5	75.15	75.14	75.16
5.5	74.77	74.78	74.78
6	74.44	74.44	74.45
6.5	74.13	74.13	74.14
7	73.84	73.85	73.85
7.5	73.59	73.58	73.58
8	73.35	73.33	73.32
8.5	73.10	73.08	73.07
9	72.87	72.84	72.82
9.5	72.60	72.60	72.59
10	72.36	72.38	72.36
10.5	72.17	72.16	72.14
11	71.95	71.95	71.92
11.5	71.75	71.75	71.69
12	71.57	71.55	71.45
12.5	71.38	71.34	71.15
13	71.18	71.14	70.75
14	70.73	70.74	69.14
15	70.37	70.35	65.54
16	70.00	69.97	60.29
17	69.65	69.59	54.59
18	69.26	69.20	49.15

25 kHz Plan

7.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	7.73	7.77	7.76
4	7.05	7.09	7.15
4.5	6.56	6.62	6.70
5	6.30	6.30	6.35
5.5	6.02	6.04	6.07
6	5.81	5.80	5.82
6.5	5.56	5.58	5.59
7	5.39	5.37	5.36
7.5	5.22	5.16	5.14
8	4.91	4.95	4.92
8.5	4.77	4.73	4.71
9	4.56	4.50	4.50
9.5	4.27	4.29	4.31
10	4.02	4.10	4.14
10.5	3.90	3.94	3.98
11	3.75	3.80	3.84
11.5	3.64	3.68	3.70
12	3.58	3.56	3.56
12.5	3.50	3.44	3.43
13	3.39	3.31	3.29
14	3.05	3.05	3.04
15	2.78	2.79	2.80
16	2.56	2.56	2.57
17	2.31	2.35	2.36
18	2.17	2.16	2.17

11.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	17.75	17.56	17.31
4	16.45	16.09	15.84
4.5	14.45	14.63	14.59
5	13.50	13.57	13.62
5.5	12.83	12.82	12.85
6	12.15	12.22	12.17
6.5	11.65	11.66	11.52
7	11.15	11.03	10.89
7.5	10.44	10.38	10.30
8	9.68	9.82	9.76
8.5	9.26	9.33	9.26
9	8.98	8.86	8.78
9.5	8.61	8.42	8.32
10	7.96	7.98	7.90
10.5	7.56	7.54	7.50
11	7.19	7.14	7.14
11.5	6.70	6.78	6.81
12	6.30	6.47	6.51
12.5	6.15	6.20	6.24
13	5.94	5.95	5.98
14	5.52	5.52	5.51
15	5.20	5.11	5.08
16	4.76	4.69	4.69
17	4.27	4.31	4.33
18	3.90	3.99	4.00

15 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	70.19	70.08	66.58
4	69.00	68.52	58.00
4.5	67.15	58.89	50.21
5	54.54	49.90	43.67
5.5	46.36	43.89	38.59
6	41.39	37.62	34.75
6.5	34.26	33.87	31.74
7	31.73	30.88	29.27
7.5	29.32	28.48	27.00
8	26.52	26.62	24.85
8.5	25.30	24.37	22.99
9	22.93	22.51	21.36
9.5	20.90	20.99	19.90
10	19.90	19.67	18.48
10.5	18.73	18.36	17.15
11	17.75	16.87	15.98
11.5	16.45	15.60	14.94
12	14.45	14.54	14.02
12.5	13.50	13.65	13.20
13	12.83	12.86	12.45
14	11.65	11.46	11.14
15	10.44	10.30	10.00
16	9.26	9.27	9.02
17	8.61	8.32	8.17
18	7.56	7.51	7.43

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	74.36	74.37	74.38
4	73.83	73.82	73.80
4.5	73.29	73.29	73.26
5	72.80	72.78	72.75
5.5	72.31	72.29	72.26
6	71.84	71.84	71.80
6.5	71.41	71.41	71.33
7	71.04	71.01	70.72
7.5	70.62	70.62	69.53
8	70.28	70.26	66.96
8.5	69.89	69.90	62.84
9	69.59	69.54	57.86
9.5	69.25	69.16	53.04
10	68.86	68.72	48.61
10.5	68.46	67.40	44.62
11	67.95	60.25	41.05
11.5	67.24	52.82	37.87
12	65.93	46.14	35.04
12.5	54.47	40.82	32.50
13	46.35	36.98	30.17
14	34.26	31.21	26.13
15	29.32	26.73	22.79
16	25.30	23.11	19.92
17	20.90	20.14	17.51
18	18.73	17.34	15.50

22.50 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	76.39	76.40	76.39
4	75.80	75.74	75.73
4.5	75.13	75.15	75.16
5	74.63	74.65	74.67
5.5	74.24	74.22	74.24
6	73.80	73.84	73.85
6.5	73.52	73.50	73.49
7	73.20	73.17	73.14
7.5	72.86	72.85	72.80
8	72.56	72.51	72.47
8.5	72.24	72.18	72.15
9	71.82	71.86	71.84
9.5	71.53	71.57	71.54
10	71.31	71.29	71.22
10.5	71.03	71.04	70.82
11	70.80	70.81	70.19
11.5	70.60	70.58	69.10
12	70.38	70.35	67.28
12.5	70.17	70.12	64.67
13	69.93	69.89	61.53
14	69.46	69.42	54.74
15	68.97	68.94	48.33
16	68.50	68.43	42.60
17	68.06	66.02	37.57
18	67.48	53.22	33.16

30 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	79.16	79.14	79.12
4	78.53	78.53	78.51
4.5	77.99	77.97	77.97
5	77.46	77.49	77.47
5.5	77.09	77.05	77.00
6	76.67	76.58	76.54
6.5	76.08	76.12	76.11
7	75.68	75.72	75.73
7.5	75.36	75.37	75.39
8	75.04	75.06	75.07
8.5	74.78	74.78	74.77
9	74.53	74.51	74.49
9.5	74.24	74.24	74.22
10	74.01	73.99	73.97
10.5	73.79	73.73	73.72
11	73.46	73.49	73.49
11.5	73.25	73.27	73.27
12	73.03	73.05	73.07
12.5	72.87	72.86	72.87
13	72.66	72.67	72.68
14	72.33	72.33	72.33
15	72.02	72.02	71.99
16	71.74	71.71	71.64
17	71.42	71.42	71.19
18	71.15	71.14	70.40

30 kHz Plan

A.9 Digital Only Radios (25 kHz)

A.9.1 HPD 25 kHz

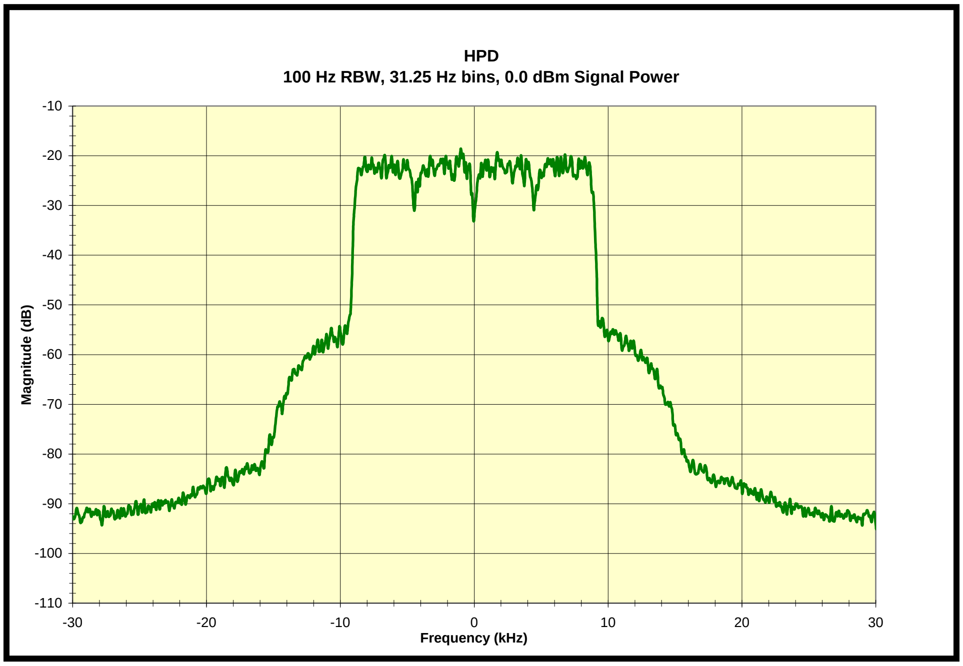


Figure A 24 HPD

A.9.1.1 Emission Designator

17K7D7D

A.9.1.2 Typical Receiver Characteristics

16K0S|||| Sensitivity

17K5S|||| ACPR

A.9.1.3 Discussion

HPD is a four sub-carrier TDMA data system. Three different modulations are utilized, with dynamic selection based on channel performance. The data provided herein is based on 16QAM. Only minor differences exist in the power spectral density for the other modulations

- QPSK
- 16QAM
- 64QAM

A.9.1.4 HPD, 25 kHz Plan Offsets

Table A 25 HPD, 25 kHz Plan Offsets

25 kHz Plan

6.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	6.96	6.96	6.94
4	6.52	6.48	6.45
4.5	5.99	5.98	6.00
5	5.51	5.58	5.62
5.5	5.25	5.27	5.32
6	5.00	5.02	5.07
6.5	4.79	4.82	4.85
7	4.67	4.64	4.65
7.5	4.46	4.47	4.46
8	4.31	4.29	4.27
8.5	4.13	4.10	4.09
9	3.91	3.92	3.92
9.5	3.72	3.75	3.76
10	3.58	3.59	3.62
10.5	3.44	3.44	3.48
11	3.25	3.32	3.36
11.5	3.14	3.21	3.24
12	3.01	3.09	3.12
12.5	2.98	3.00	3.01
13	2.95	2.90	2.89
14	2.76	2.69	2.65
15	2.41	2.45	2.42
16	2.22	2.20	2.19
17	1.97	1.97	1.98
18	1.73	1.76	1.79

15.625 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	58.03	57.94	57.61
4	56.19	56.17	55.86
4.5	54.69	54.56	54.28
5	53.19	53.15	52.88
5.5	51.97	51.87	51.61
6	50.81	50.71	50.45
6.5	49.66	49.67	49.38
7	48.87	48.69	48.36
7.5	47.87	47.75	47.32
8	46.91	46.88	46.07
8.5	46.14	46.08	44.21
9	45.40	45.33	41.39
9.5	44.76	44.61	37.78
10	44.07	43.94	33.92
10.5	43.35	43.31	30.22
11	42.74	42.67	26.88
11.5	42.27	39.42	23.95
12	41.74	31.77	21.43
12.5	41.07	25.79	19.28
13	39.34	21.69	17.46
14	19.74	16.56	14.59
15	13.68	13.49	12.47
16	11.35	11.39	10.87
17	9.89	9.86	9.62
18	8.71	8.69	8.63

9.375 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	11.35	11.38	11.41
4	10.67	10.68	10.63
4.5	9.89	9.96	9.92
5	9.37	9.30	9.28
5.5	8.71	8.73	8.72
6	8.21	8.22	8.22
6.5	7.74	7.77	7.77
7	7.38	7.35	7.37
7.5	6.96	6.97	7.02
8	6.59	6.65	6.73
8.5	6.33	6.40	6.48
9	6.13	6.20	6.27
9.5	6.01	6.04	6.06
10	5.95	5.88	5.86
10.5	5.81	5.71	5.67
11	5.54	5.52	5.47
11.5	5.38	5.32	5.27
12	5.13	5.12	5.08
12.5	4.88	4.93	4.89
13	4.73	4.73	4.70
14	4.38	4.36	4.34
15	4.03	4.00	4.01
16	3.65	3.68	3.71
17	3.37	3.41	3.44
18	3.07	3.18	3.18

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	69.59	69.58	69.57
4	68.93	68.94	68.95
4.5	68.41	68.40	68.41
5	67.92	67.93	67.90
5.5	67.54	67.50	67.37
6	67.10	67.00	66.60
6.5	66.48	66.27	65.55
7	65.62	65.31	64.22
7.5	64.64	64.01	62.69
8	63.25	62.53	61.05
8.5	61.42	60.98	59.37
9	60.08	59.35	57.72
9.5	58.49	57.71	56.12
10	57.04	56.14	54.59
10.5	55.28	54.67	53.06
11	53.79	53.30	51.44
11.5	52.61	52.06	49.60
12	51.33	50.92	47.41
12.5	50.23	49.85	44.84
13	49.23	48.85	41.97
14	47.39	47.08	35.97
15	45.68	45.50	30.37
16	44.43	44.11	25.54
17	43.02	37.66	21.54
18	42.04	26.01	18.32

12.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	44.55	44.52	44.46
4	43.76	43.76	43.70
4.5	43.06	43.09	42.68
5	42.56	42.53	39.91
5.5	42.06	41.96	34.45
6	41.36	40.47	28.67
6.5	40.79	32.22	23.93
7	34.10	24.57	20.30
7.5	23.34	19.83	17.59
8	17.28	16.70	15.54
8.5	14.63	14.54	13.97
9	12.93	13.03	12.74
9.5	11.64	11.89	11.72
10	11.00	10.99	10.87
10.5	10.35	10.23	10.14
11	9.61	9.57	9.51
11.5	8.96	8.99	8.95
12	8.48	8.46	8.45
12.5	8.02	7.98	8.01
13	7.59	7.56	7.63
14	6.76	6.87	6.98
15	6.24	6.37	6.44
16	5.98	5.95	5.97
17	5.68	5.57	5.54
18	5.25	5.19	5.14

25.0 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	75.48	75.48	75.48
4	74.89	74.89	74.89
4.5	74.37	74.37	74.37
5	73.91	73.92	73.91
5.5	73.50	73.50	73.48
6	73.13	73.10	73.07
6.5	72.73	72.72	72.68
7	72.36	72.34	72.29
7.5	71.99	71.97	71.92
8	71.61	71.61	71.55
8.5	71.28	71.26	71.20
9	70.95	70.91	70.85
9.5	70.58	70.57	70.50
10	70.29	70.24	70.17
10.5	69.91	69.92	69.84
11	69.63	69.60	69.52
11.5	69.34	69.29	69.20
12	69.02	68.98	68.89
12.5	68.73	68.68	68.57
13	68.42	68.39	68.25
14	67.85	67.83	67.49
15	67.36	67.27	66.28
16	66.79	66.73	63.99
17	66.24	66.15	60.28
18	65.76	65.27	55.73

30 kHz Plan

7.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	7.18	7.17	7.18
4	6.76	6.78	6.81
4.5	6.43	6.47	6.52
5	6.24	6.24	6.30
5.5	6.06	6.09	6.13
6	5.98	5.98	5.97
6.5	5.90	5.83	5.79
7	5.68	5.66	5.60
7.5	5.44	5.45	5.40
8	5.25	5.23	5.20
8.5	5.00	5.02	5.01
9	4.79	4.83	4.81
9.5	4.67	4.64	4.63
10	4.46	4.46	4.44
10.5	4.31	4.27	4.26
11	4.13	4.09	4.09
11.5	3.91	3.92	3.93
12	3.72	3.75	3.77
12.5	3.58	3.59	3.63
13	3.44	3.45	3.49
14	3.14	3.22	3.24
15	2.98	3.00	3.00
16	2.87	2.80	2.76
17	2.57	2.56	2.53
18	2.29	2.32	2.30

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	69.59	69.58	69.57
4	68.93	68.94	68.95
4.5	68.41	68.40	68.41
5	67.92	67.93	67.90
5.5	67.54	67.50	67.37
6	67.10	67.00	66.60
6.5	66.48	66.27	65.55
7	65.62	65.31	64.22
7.5	64.64	64.01	62.69
8	63.25	62.53	61.05
8.5	61.42	60.98	59.37
9	60.08	59.35	57.72
9.5	58.49	57.71	56.12
10	57.04	56.14	54.59
10.5	55.28	54.67	53.06
11	53.79	53.30	51.44
11.5	52.61	52.06	49.60
12	51.33	50.92	47.41
12.5	50.23	49.85	44.84
13	49.23	48.85	41.97
14	47.39	47.08	35.97
15	45.68	45.50	30.37
16	44.43	44.11	25.54
17	43.02	37.66	21.54
18	42.04	26.01	18.32

11.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	41.68	41.72	37.19
4	41.00	37.88	29.35
4.5	34.13	27.90	23.24
5	23.35	21.10	19.09
5.5	17.28	17.13	16.28
6	14.63	14.62	14.34
6.5	12.93	12.98	12.93
7	11.64	11.87	11.84
7.5	11.00	11.00	10.96
8	10.35	10.25	10.20
8.5	9.61	9.60	9.54
9	8.96	9.00	8.97
9.5	8.48	8.47	8.45
10	8.02	7.99	8.00
10.5	7.59	7.55	7.60
11	7.18	7.17	7.25
11.5	6.76	6.84	6.94
12	6.43	6.57	6.67
12.5	6.24	6.34	6.42
13	6.06	6.14	6.19
14	5.90	5.77	5.76
15	5.44	5.40	5.35
16	5.00	5.02	4.96
17	4.67	4.63	4.59
18	4.31	4.26	4.25

22.50 kHz Offset ACCCPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	73.93	73.93	73.92
4	73.28	73.27	73.25
4.5	72.68	72.68	72.65
5	72.15	72.12	72.09
5.5	71.56	71.59	71.57
6	71.12	71.11	71.08
6.5	70.70	70.66	70.62
7	70.23	70.23	70.19
7.5	69.83	69.81	69.78
8	69.43	69.42	69.39
8.5	69.02	69.05	69.01
9	68.72	68.71	68.65
9.5	68.40	68.38	68.30
10	68.10	68.04	67.94
10.5	67.76	67.72	67.56
11	67.43	67.39	67.14
11.5	67.08	67.08	66.61
12	66.79	66.76	65.93
12.5	66.49	66.43	64.92
13	66.24	66.05	63.63
14	65.54	64.61	60.23
15	64.04	62.27	55.95
16	61.14	59.32	51.10
17	58.35	56.34	45.99
18	55.21	53.67	40.94

15 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	53.96	53.93	53.78
4	52.73	52.58	52.41
4.5	51.41	51.34	51.18
5	50.29	50.22	50.06
5.5	49.27	49.23	49.03
6	48.48	48.27	48.05
6.5	47.42	47.35	47.11
7	46.57	46.50	46.11
7.5	45.70	45.73	44.74
8	45.16	45.00	42.44
8.5	44.44	44.30	38.98
9	43.69	43.65	34.90
9.5	43.03	43.03	30.86
10	42.54	42.36	27.20
10.5	42.04	38.33	24.03
11	41.34	30.46	21.33
11.5	40.78	24.69	19.07
12	34.10	20.75	17.18
12.5	23.34	17.93	15.60
13	17.28	15.85	14.28
14	12.93	12.95	12.18
15	11.00	10.97	10.61
16	9.61	9.54	9.39
17	8.48	8.44	8.43
18	7.59	7.59	7.65

30 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	76.87	76.86	76.87
4	76.25	76.28	76.29
4.5	75.82	75.80	75.80
5	75.37	75.36	75.36
5.5	74.96	74.96	74.95
6	74.58	74.58	74.58
6.5	74.24	74.24	74.22
7	73.93	73.91	73.89
7.5	73.61	73.59	73.57
8	73.29	73.28	73.26
8.5	72.98	72.98	72.97
9	72.69	72.70	72.70
9.5	72.43	72.44	72.44
10	72.21	72.20	72.19
10.5	71.99	71.97	71.96
11	71.75	71.75	71.73
11.5	71.54	71.53	71.52
12	71.34	71.33	71.30
12.5	71.13	71.12	71.10
13	70.94	70.92	70.90
14	70.54	70.55	70.51
15	70.18	70.18	70.12
16	69.86	69.83	69.73
17	69.53	69.47	69.31
18	69.15	69.09	68.80

A.9.2 RD-LAP 9.6

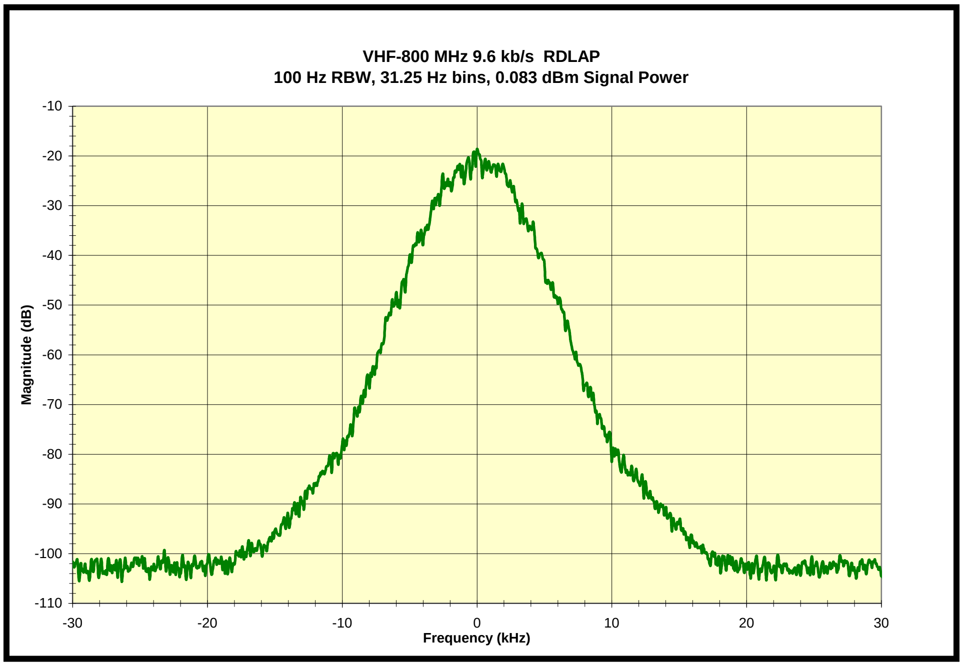


Figure A 25 RD-LAP 9.6

A.9.2.1 Emission Designator

16K0F1D	25 kHz wide channels	± 3.9 kHz Deviation VHF & 800 MHz
14K0F1D	NPSPAC channels	± 3.9 kHz Deviation 800 MHz
10K0F1D	12.5 kHz channels	± 2.5 kHz Deviation 450 & 900 MHz

A.9.2.2 Typical Receiver Characteristics

12K6B0403	25 kHz wide channels
11K1B0403	NPSPAC channels
7K8B0403	12.5 kHz channels

A.9.2.3 Discussion

Four level FSK modulation produces 9,600 bps. This product is recommended for frequencies above 400 MHz. Channels below 400 MHz can be used. However, performance could be degraded due to the relatively longer multipath fades and higher RF interference levels in lower frequency bands. The ACPR tables for VHF are provided with the understanding of the above caveat.

The data provided is for the 25 kHz version only which will be not licensable below 512 MHz beginning on 1/1/2013 due to FCC narrowbanding in those frequency bands.

A.9.2.4 RD-LAP 9.6, 25 kHz Plan Offsets (VHF & 800 MHz)

Table A 26 RD-LAP 9.6, 25 kHz Plan Offsets (VHF & 800 MHz)

6.25 kHz Offset ACPR				15.625 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3
3.5	24.99	24.83	24.56	3.5	75.07	75.01	74.95
4	23.09	23.02	22.81	4	74.11	74.12	74.07
4.5	21.65	21.58	21.22	4.5	73.38	73.33	73.24
5	20.19	19.98	19.53	5	72.67	72.58	72.42
5.5	18.68	18.46	17.81	5.5	71.88	71.80	71.57
6	17.08	16.89	16.06	6	71.12	70.96	70.70
6.5	15.49	15.21	14.41	6.5	70.22	70.10	69.81
7	14.06	13.56	12.89	7	69.28	69.23	68.94
7.5	12.20	12.10	11.34	7.5	68.54	68.38	68.08
8	10.90	10.69	9.93	8	67.67	67.58	67.22
8.5	9.66	9.26	8.70	8.5	66.86	66.80	66.34
9	8.11	8.03	7.62	9	66.22	66.03	65.40
9.5	6.98	6.99	6.67	9.5	65.43	65.25	64.36
10	6.13	6.10	5.83	10	64.76	64.43	63.17
10.5	5.41	5.32	5.08	10.5	63.88	63.53	61.76
11	4.70	4.61	4.41	11	63.05	62.56	60.12
11.5	4.05	3.94	3.81	11.5	62.21	61.47	58.23
12	3.57	3.33	3.27	12	61.05	60.28	56.05
12.5	2.77	2.79	2.81	12.5	59.98	58.91	53.65
13	2.16	2.32	2.40	13	58.73	57.43	51.15
14	1.42	1.58	1.75	14	55.99	54.25	46.05
15	1.00	1.05	1.26	15	52.70	50.57	41.08
16	0.57	0.69	0.90	16	49.34	46.10	36.40
17	0.34	0.43	0.64	17	45.90	41.63	32.06
18	0.16	0.26	0.46	18	41.21	37.67	28.06

9.375 kHz Offset ACPR				18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3
3.5	49.43	49.40	48.99	3.5	81.00	80.96	80.93
4	47.87	47.58	46.90	4	80.24	80.22	80.21
4.5	45.93	45.64	44.52	4.5	79.58	79.59	79.59
5	44.10	43.24	42.01	5	79.06	79.04	79.03
5.5	41.21	40.76	39.64	5.5	78.51	78.55	78.53
6	39.01	38.48	37.48	6	78.12	78.10	77.98
6.5	36.84	36.58	35.42	6.5	77.61	77.52	77.36
7	35.07	34.89	33.33	7	77.02	76.91	76.73
7.5	33.77	33.19	31.17	7.5	76.32	76.29	76.10
8	32.05	31.26	28.99	8	75.72	75.69	75.46
8.5	30.46	29.14	26.89	8.5	75.16	75.08	74.81
9	28.12	27.01	24.88	9	74.59	74.47	74.15
9.5	25.98	25.09	22.97	9.5	73.98	73.85	73.47
10	23.87	23.40	21.12	10	73.35	73.22	72.77
10.5	22.26	21.78	19.33	10.5	72.70	72.59	72.04
11	20.84	20.11	17.62	11	72.12	71.93	71.27
11.5	19.39	18.44	15.94	11.5	71.53	71.24	70.46
12	17.97	16.75	14.35	12	70.85	70.51	69.60
12.5	16.28	15.11	12.88	12.5	70.13	69.76	68.66
13	14.67	13.63	11.52	13	69.35	68.99	67.61
14	11.51	10.68	9.17	14	67.74	67.47	64.94
15	8.73	8.27	7.25	15	66.33	65.94	61.22
16	6.60	6.38	5.70	16	64.86	64.25	56.60
17	5.03	4.82	4.45	17	63.34	62.25	51.62
18	3.86	3.56	3.44	18	61.44	59.72	46.71

12.5 kHz Offset ACPR				25.0 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3
3.5	65.44	65.50	65.41	3.5	81.90	81.87	81.86
4	64.66	64.59	64.45	4	81.25	81.25	81.27
4.5	63.67	63.67	63.43	4.5	80.76	80.75	80.78
5	62.87	62.66	62.32	5	80.33	80.34	80.35
5.5	61.62	61.58	61.10	5.5	79.99	79.98	79.97
6	60.65	60.41	59.73	6	79.65	79.63	79.62
6.5	59.50	59.15	58.20	6.5	79.28	79.29	79.29
7	58.06	57.74	56.51	7	78.99	78.99	78.99
7.5	56.88	56.17	54.68	7.5	78.69	78.70	78.70
8	55.12	54.58	52.59	8	78.46	78.44	78.43
8.5	53.49	52.92	50.34	8.5	78.19	78.19	78.18
9	51.78	51.16	47.95	9	77.96	77.95	77.93
9.5	50.24	49.34	45.48	9.5	77.72	77.71	77.69
10	48.68	47.32	43.00	10	77.50	77.48	77.46
10.5	46.77	45.02	40.57	10.5	77.26	77.25	77.24
11	44.96	42.65	38.18	11	77.04	77.03	77.02
11.5	42.55	40.41	35.85	11.5	76.81	76.82	76.82
12	40.00	38.42	33.57	12	76.61	76.63	76.62
12.5	37.74	36.55	31.35	12.5	76.43	76.45	76.43
13	35.91	34.64	29.21	13	76.28	76.27	76.24
14	32.86	30.49	25.18	14	75.96	75.92	75.86
15	29.27	26.54	21.48	15	75.61	75.56	75.46
16	24.98	23.06	18.07	16	75.24	75.19	75.01
17	21.65	19.58	15.05	17	74.84	74.82	74.42
18	18.68	16.25	12.44	18	74.46	74.43	73.38

25 kHz Plan

7.5 kHz Offset ACPR				18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3
3.5	34.52	34.43	34.10	3.5	81.00	80.96	80.93
4	32.86	32.80	32.24	4	80.24	80.22	80.21
4.5	31.35	30.99	30.10	4.5	79.58	79.59	79.59
5	29.27	28.86	27.87	5	79.06	79.04	79.03
5.5	27.17	26.64	25.77	5.5	78.51	78.55	78.53
6	24.98	24.62	23.87	6	78.12	78.10	77.98
6.5	23.09	22.93	22.09	6.5	77.61	77.52	77.36
7	21.65	21.45	20.33	7	77.02	76.91	76.73
7.5	20.19	19.79	18.56	7.5	76.32	76.29	76.10
8	18.68	18.25	16.83	8	75.72	75.69	75.46
8.5	17.08	16.58	15.19	8.5	75.16	75.08	74.81
9	15.49	14.89	13.59	9	74.59	74.47	74.15
9.5	14.06	13.32	12.06	9.5	73.98	73.85	73.47
10	12.20	11.94	10.66	10	73.35	73.22	72.77
10.5	10.90	10.43	9.41	10.5	72.70	72.59	72.04
11	9.66	9.09	8.30	11	72.12	71.93	71.27
11.5	8.11	7.94	7.31	11.5	71.53	71.24	70.46
12	6.98	6.94	6.43	12	70.85	70.51	69.60
12.5	6.13	6.07	5.65	12.5	70.13	69.76	68.66
13	5.41	5.28	4.94	13	69.35	68.99	67.61
14	4.05	3.90	3.75	14	67.74	67.47	64.94
15	2.77	2.79	2.82	15	66.33	65.94	61.22
16	1.80	1.95	2.10	16	64.86	64.25	56.60
17	1.22	1.33	1.56	17	63.34	62.25	51.62
18	0.75	0.88	1.15	18	61.44	59.72	46.71

11.25 kHz Offset ACPR				22.50 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3
3.5	60.90	60.80	60.59	3.5	81.92	81.94	81.95
4	59.67	59.48	59.15	4	81.43	81.40	81.39
4.5	58.16	58.11	57.59	4.5	80.90	80.89	80.86
5	56.93	56.54	55.89	5	80.41	80.38	80.36
5.5	55.16	54.87	54.13	5.5	79.89	79.91	79.91
6	53.51	53.29	52.20	6	79.50	79.50	79.51
6.5	51.79	51.53	50.11	6.5	79.12	79.13	79.15
7	50.24	49.77	47.84	7	78.81	78.81	78.82
7.5	48.69	47.94	45.43	7.5	78.49	78.52	78.52
8	46.78	45.83	42.97	8	78.25	78.25	78.23
8.5	44.96	43.46	40.58	8.5	78.00	77.99	77.95
9	42.55	41.08	38.25	9	77.76	77.72	77.67
9.5	40.00	38.92	35.98	9.5	77.49	77.45	77.39
10	37.74	37.02	33.73	10	77.19	77.18	77.11
10.5	35.91	35.22	31.51	10.5	76.94	76.90	76.83
11	34.50	33.33	29.34	11	76.67	76.63	76.56
11.5	32.86	31.29	27.24	11.5	76.38	76.36	76.29
12	31.35	29.16	25.23	12	76.11	76.10	76.01
12.5	29.27	27.15	23.31	12.5	75.86	75.85	75.72
13	27.16	25.32	21.47	13	75.61	75.60	75.41
14	23.09	21.91	17.98	14	75.18	75.03	74.57
15	20.19	18.48	14.84	15	74.41	74.27	73.52
16	17.08	15.22	12.14	16	73.66	73.41	72.06
17	14.06	12.21	9.85	17	72.78	72.47	69.85
18	10.90	9.61	7.95	18	71.77	71.40	66.64

15 kHz Offset ACPR				30 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3	ENBW	Ch BW	RRC	BF 4-3
3.5	73.30	73.29	73.23	3.5	82.15	82.15	82.16
4	72.51	72.46	72.35	4	81.58	81.58	81.61
4.5	71.64	71.61	71.45	4.5	81.10	81.13	81.14
5	70.79	70.71	70.52	5	80.76	80.72	80.72
5.5	69.88	69.81	69.61	5.5	80.32	80.34	80.32
6	69.01	68.92	68.72	6	79.99	79.96	79.96
6.5	68.09	68.07	67.86	6.5	79.60	79.61	79.62
7	67.35	67.27	67.01	7	79.26	79.26	79.28
7.5	66.58	66.50	66.15	7.5	78.92	78.95	78.98
8	65.94	65.73	65.24	8	78.66	78.67	78.70
8.5	65.04	64.94	64.24	8.5	78.43	78.43	78.46
9	64.42	64.10	63.10	9	78.18	78.21	78.23
9.5	63.46	63.18	61.78	9.5	78.01	78.00	77.99
10	62.71	62.17	60.25	10	77.79	77.76	77.75
10.5	61.52	61.05	58.49	10.5	77.49	77.53	77.53
11	60.58	59.82	56.47	11	77.27	77.32	77.33
11.5	59.45	58.42	54.18	11.5	77.11	77.12	77.13
12	58.02	56.90	51.74	12	76.96	76.93	76.94
12.5	56.85	55.35	49.21	12.5	76.80	76.75	76.76
13	55.11	53.67	46.67	13	76.59	76.58	76.59
14	51.78	49.96	41.65	14	76.25	76.26	76.27
15	48.68	45.45	36.89	15	75.96	75.97	75.98
16	44.96	41.02	32.45	16	75.70	75.70	75.70
17	40.00	37.10	28.36	17	75.47	75.45	75.44
18	35.91	32.94	24.57	18	75.22	75.21	75.19

30 kHz Plan

A.9.3 RD-LAP 19.2

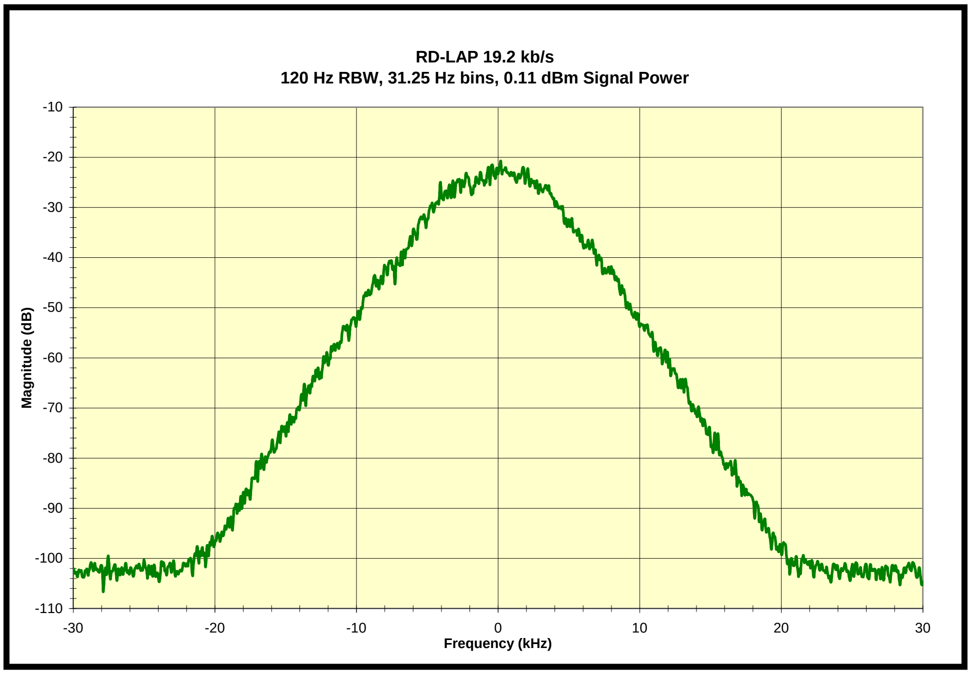


Figure A 26 RD-LAP 19.2

A.9.3.1 Emission Designator

20K0F1D   ± 5.6 kHz Deviation

A.9.3.2 Typical Receiver Characteristics

12K6B0403

A.9.3.3 Discussion:

Four-level FSK modulation produces 19,200 bps. This product is recommended for frequencies above 400 MHz. Channels below 400 MHz can be used. However, performance could be degraded due to the relatively longer multipath fades and higher RF interference levels in lower frequency bands. The ACPR tables for VHF are provided with the understanding of the above caveat.

A.9.3.4 RD-LAP 19.2, 25 kHz Plan Offsets

Table A 27 RD-LAP 19.2, 25 kHz Plan Offsets

25 kHz Plan

6.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	14.45	14.41	14.29
4	13.42	13.30	13.14
4.5	12.10	12.19	12.08
5	11.26	11.22	11.14
5.5	10.46	10.39	10.29
6	9.71	9.63	9.51
6.5	9.02	8.90	8.78
7	8.21	8.21	8.11
7.5	7.59	7.55	7.50
8	6.99	6.98	6.94
8.5	6.38	6.48	6.44
9	6.02	6.03	5.93
9.5	5.43	5.48	5.39
10	5.00	4.97	4.88
10.5	4.56	4.50	4.42
11	4.13	4.05	3.99
11.5	3.69	3.63	3.59
12	3.28	3.24	3.23
12.5	2.83	2.87	2.90
13	2.52	2.55	2.61
14	1.92	2.01	2.11
15	1.54	1.60	1.70
16	1.23	1.26	1.36
17	0.86	0.94	1.07
18	0.61	0.68	0.82

15.625 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	54.27	54.14	53.93
4	52.67	52.76	52.57
4.5	51.60	51.52	51.25
5	50.48	50.29	49.95
5.5	49.20	49.05	48.67
6	47.93	47.87	47.41
6.5	47.01	46.67	46.15
7	45.67	45.48	44.90
7.5	44.59	44.31	43.67
8	43.39	43.18	42.44
8.5	42.29	42.03	41.23
9	41.36	40.89	40.01
9.5	40.08	39.78	38.79
10	38.88	38.70	37.55
10.5	38.07	37.65	36.29
11	36.93	36.54	35.02
11.5	36.04	35.37	33.75
12	35.09	34.14	32.51
12.5	33.73	32.91	31.30
13	32.40	31.73	30.13
14	29.89	29.47	27.86
15	28.15	27.45	25.64
16	26.01	25.65	23.38
17	24.51	23.83	21.10
18	22.80	21.81	18.86

9.375 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	26.14	26.13	26.12
4	25.21	25.26	25.23
4.5	24.56	24.52	24.42
5	23.87	23.77	23.56
5.5	22.82	22.77	22.56
6	21.81	21.80	21.58
6.5	20.97	20.90	20.47
7	20.05	19.90	19.30
7.5	19.15	18.74	18.14
8	17.77	17.62	16.99
8.5	16.65	16.54	15.86
9	15.86	15.48	14.77
9.5	14.66	14.42	13.73
10	13.77	13.38	12.74
10.5	12.82	12.40	11.82
11	11.60	11.49	10.96
11.5	10.76	10.64	10.16
12	9.97	9.84	9.43
12.5	9.27	9.10	8.75
13	8.61	8.41	8.11
14	7.32	7.23	6.98
15	6.21	6.23	5.93
16	5.18	5.17	4.94
17	4.33	4.22	4.10
18	3.47	3.41	3.39

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	68.45	68.47	68.26
4	67.12	67.00	66.84
4.5	65.82	65.75	65.54
5	64.74	64.58	64.29
5.5	63.57	63.42	63.06
6	62.39	62.28	61.83
6.5	61.39	61.10	60.61
7	60.12	59.94	59.39
7.5	58.96	58.81	58.16
8	58.01	57.72	56.90
8.5	56.85	56.62	55.60
9	55.96	55.43	54.26
9.5	54.84	54.18	52.90
10	53.48	52.93	51.54
10.5	52.19	51.66	50.18
11	51.02	50.41	48.83
11.5	49.78	49.17	47.49
12	48.54	47.95	46.16
12.5	47.47	46.73	44.84
13	46.28	45.54	43.52
14	43.99	43.19	40.89
15	41.80	40.90	38.26
16	39.45	38.68	35.65
17	37.49	36.34	33.09
18	35.58	33.90	30.62

12.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	39.55	39.56	39.49
4	38.59	38.50	38.37
4.5	37.52	37.47	37.27
5	36.55	36.46	36.14
5.5	35.60	35.39	34.91
6	34.50	34.16	33.63
6.5	33.05	32.90	32.34
7	31.89	31.61	31.11
7.5	30.61	30.44	29.94
8	29.41	29.35	28.84
8.5	28.55	28.30	27.79
9	27.58	27.29	26.78
9.5	26.59	26.37	25.81
10	25.49	25.52	24.82
10.5	24.89	24.70	23.80
11	24.15	23.87	22.74
11.5	23.42	22.98	21.63
12	22.27	22.02	20.49
12.5	21.34	20.97	19.34
13	20.63	19.88	18.19
14	18.45	17.68	15.99
15	16.30	15.50	13.96
16	14.24	13.45	12.15
17	12.02	11.61	10.55
18	10.42	9.99	9.16

25.0 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	81.85	81.83	81.83
4	81.27	81.24	81.24
4.5	80.71	80.73	80.73
5	80.30	80.27	80.26
5.5	79.85	79.85	79.83
6	79.47	79.45	79.40
6.5	79.06	79.05	78.99
7	78.71	78.64	78.58
7.5	78.26	78.24	78.18
8	77.86	77.86	77.78
8.5	77.49	77.49	77.37
9	77.18	77.11	76.95
9.5	76.82	76.72	76.49
10	76.39	76.31	75.99
10.5	75.96	75.88	75.42
11	75.57	75.41	74.77
11.5	75.11	74.87	74.02
12	74.55	74.28	73.17
12.5	74.04	73.61	72.20
13	73.31	72.87	71.13
14	71.80	71.11	68.74
15	70.13	68.97	66.12
16	67.77	66.69	63.35
17	65.45	64.37	60.48
18	63.36	62.05	57.52

30 kHz Plan

7.5 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	19.80	19.74	19.55
4	18.56	18.46	18.28
4.5	17.24	17.27	17.10
5	16.34	16.21	15.98
5.5	15.28	15.17	14.88
6	14.26	14.14	13.80
6.5	13.30	13.07	12.77
7	12.02	12.06	11.81
7.5	11.21	11.15	10.92
8	10.43	10.33	10.10
8.5	9.69	9.56	9.35
9	9.01	8.84	8.65
9.5	8.20	8.16	8.01
10	7.59	7.53	7.42
10.5	6.99	6.98	6.87
11	6.37	6.48	6.37
11.5	6.02	6.01	5.83
12	5.43	5.47	5.31
12.5	5.00	4.96	4.82
13	4.56	4.48	4.37
14	3.69	3.62	3.58
15	2.83	2.88	2.92
16	2.18	2.28	2.37
17	1.73	1.81	1.93
18	1.37	1.43	1.56

18.75 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	68.45	68.47	68.26
4	67.12	67.00	66.84
4.5	65.82	65.75	65.54
5	64.74	64.58	64.29
5.5	63.57	63.42	63.06
6	62.39	62.28	61.83
6.5	61.39	61.10	60.61
7	60.12	59.94	59.39
7.5	58.96	58.81	58.16
8	58.01	57.72	56.90
8.5	56.85	56.62	55.60
9	55.96	55.43	54.26
9.5	54.84	54.18	52.90
10	53.48	52.93	51.54
10.5	52.19	51.66	50.18
11	51.02	50.41	48.83
11.5	49.78	49.17	47.49
12	48.54	47.95	46.16
12.5	47.47	46.73	44.84
13	46.28	45.54	43.52
14	43.99	43.19	40.89
15	41.80	40.90	38.26
16	39.45	38.68	35.65
17	37.49	36.34	33.09
18	35.58	33.90	30.62

11.25 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	34.62	34.46	34.23
4	33.12	33.08	32.86
4.5	31.93	31.79	31.55
5	30.64	30.54	30.33
5.5	29.42	29.45	29.21
6	28.56	28.43	28.14
6.5	27.59	27.41	27.13
7	26.60	26.44	26.18
7.5	25.49	25.57	25.27
8	24.89	24.77	24.35
8.5	24.15	23.99	23.38
9	23.42	23.12	22.34
9.5	22.27	22.15	21.24
10	21.34	21.22	20.10
10.5	20.63	20.13	18.94
11	19.60	19.02	17.79
11.5	18.45	17.91	16.66
12	17.18	16.82	15.57
12.5	16.30	15.73	14.52
13	15.25	14.66	13.52
14	13.29	12.67	11.71
15	11.21	10.90	10.13
16	9.69	9.35	8.76
17	8.20	8.04	7.57
18	6.99	6.93	6.51

22.50 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	80.73	80.74	80.72
4	80.06	80.04	79.96
4.5	79.36	79.30	79.20
5	78.60	78.56	78.45
5.5	77.86	77.85	77.71
6	77.21	77.15	76.96
6.5	76.55	76.45	76.16
7	75.78	75.70	75.30
7.5	75.12	74.88	74.37
8	74.19	74.00	73.35
8.5	73.34	73.07	72.25
9	72.40	72.11	71.07
9.5	71.38	71.06	69.83
10	70.53	69.90	68.54
10.5	69.40	68.67	67.23
11	67.98	67.45	65.92
11.5	66.78	66.23	64.60
12	65.58	65.05	63.28
12.5	64.55	63.88	61.94
13	63.43	62.71	60.59
14	61.30	60.41	57.83
15	58.91	58.13	54.98
16	56.83	55.70	52.09
17	54.82	53.19	49.21
18	52.18	50.67	46.35

15 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	51.13	51.06	50.87
4	49.84	49.77	49.56
4.5	48.57	48.52	48.28
5	47.49	47.35	47.03
5.5	46.30	46.16	45.78
6	45.04	44.97	44.55
6.5	44.00	43.80	43.33
7	42.80	42.69	42.13
7.5	41.80	41.55	40.93
8	40.84	40.41	39.74
8.5	39.45	39.31	38.54
9	38.53	38.25	37.32
9.5	37.49	37.20	36.07
10	36.53	36.09	34.80
10.5	35.58	34.91	33.53
11	34.49	33.67	32.29
11.5	33.05	32.44	31.09
12	31.88	31.26	29.93
12.5	30.61	30.13	28.80
13	29.41	29.03	27.71
14	27.58	27.06	25.52
15	25.49	25.29	23.29
16	24.15	23.48	21.01
17	22.27	21.44	18.76
18	20.63	19.29	16.61

30 kHz Offset ACPR			
ENBW	Ch BW	RRC	BF 4-3
3.5	82.35	82.36	82.37
4	81.77	81.78	81.78
4.5	81.28	81.26	81.26
5	80.76	80.79	80.80
5.5	80.36	80.38	80.39
6	79.98	80.00	80.01
6.5	79.66	79.66	79.66
7	79.36	79.34	79.33
7.5	79.02	79.03	79.03
8	78.73	78.75	78.74
8.5	78.48	78.48	78.47
9	78.24	78.22	78.22
9.5	77.97	77.97	77.97
10	77.71	77.74	77.74
10.5	77.50	77.52	77.51
11	77.30	77.31	77.30
11.5	77.12	77.10	77.10
12	76.92	76.91	76.90
12.5	76.72	76.72	76.72
13	76.53	76.54	76.53
14	76.20	76.21	76.17
15	75.91	75.89	75.80
16	75.61	75.56	75.38
17	75.29	75.21	74.86
18	74.88	74.81	74.14

A.10 Data Radios (>25 kHz)

A.10.1 DataRadio 50 kHz Data

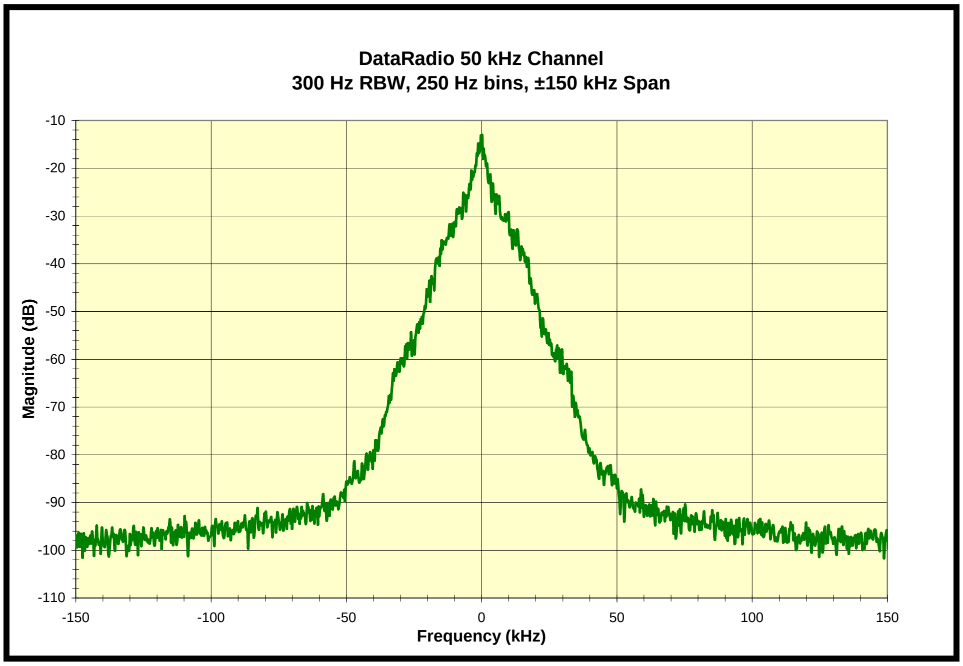


Figure A 27 DataRadio, 50 kHz

A.10.1.1 Emission Designator

28K0F1D

A.10.1.2 Typical Receiver Characteristics

48K0S||||. ENBW =**48kHz.** Based on Carson rule:. = 2(max dev+max freq) = 2(8kHz+16kHz) =48kHz.

A.10.1.3 Discussion

There are 16 levels of frequency shift keying for 50 kHz channelization producing 128kbps. Lower rates of 96 and 64 kbps provide increased sensitivity.

A.10.1.4 DataRadio WB Data, 700 MHz Offsets

Table A 28 DataRadio, 50 kHz Plan Offsets

ACPR, 50 kHz WB source					
ENBW ⮛ Offset ⮚	50 kHz	75 kHz	100 kHz	125 kHz	150 kHz
42.6 kHz	46.32 dB		70.92 dB		73.15 dB
44.0 kHz	45.13 dB		70.77 dB		72.97 dB
50.0 kHz	41.63 dB		70.16 dB		72.42 dB
85.8 kHz		51.88 dB		69.03 dB	
90.0 kHz		48.09 dB		68.75 dB	
94.0 kHz		45.12 dB		68.51 dB	
100.0 kHz		41.62 dB		68.14 dB	
129.0 kHz			57.97 dB		
135.0 kHz			52.49 dB		
144.0 kHz			45.11 dB		
150.0 kHz			41.62 dB		

Note this data was developed for TSB-88.1-C when it was envisioned that half the public safety 700 MHz band allocation would be used for wideband deployments. It is retained for general information.

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ANNEX B RECOMMENDED DATA ELEMENTS (informative)

B.1 Recommended Data Elements for Automated Modeling, Simulation, and Spectrum Management of Wireless Communications Systems

The following information is necessary to facilitate Spectrum Management. Sufficient information is needed to calculate the Effective Radiated Power (ERP_d) relative to a half wave dipole and the necessary signal levels for the minimum reliability for the appropriate Channel Performance Criterion (CPC) over the Protected Service Area. Define the existing systems so that a bi-directional evaluation can be performed. The existing system(s) are comprised of co-channel licensees, adjacent channel(s) and potentially alternate and second alternate channels for cases where a wide bandwidth channel is being utilized against narrow bandwidth channels.

Table B 1 Parameters of the Transmitter, [proposed]

1.1	**Site Latitude dd, mm, ss N/S**	
1.1.1	**Site Longitude ddd, mm, ss W/E**	
1.2	**Power supplied to the antenna**	**dBm**
1.3	**Antenna model and manufacturer**	
1.3.1	**Maximum Antenna Gain**	**dBd**
1.3.2	**Azimuth of directional gain if applicable**	**º from True North**
1.3.3	**Maximum Effective Radiated Power**	**dBmd**
1.3.4	**Maximum ERP at Horizon**	**dBmd**
1.3.5	**Tilt Angle below Horizon if applicable**	**º**
1.4	**Antenna Height Above Ground Level**	**(m) HAGL**
1.5	**Site Elevation, Height Above Mean Sea Level**	**(m) HAMSL**
1.6	**Tower Height**	**m**
1.7	**Modulation Type**	**Table A-1 or A-2**
1.7.1	**Vocoder type**	
1.8	**Bandwidth**	**kHz**
1.9	**Frequency**	**MHz**

Antenna Pattern - Provide manufacturer and model number so that an antenna pattern can be obtained. Leaving 1.3.2 blank implies omni-directional and eliminates the need for a horizontal antenna pattern. Leaving 1.3.5 blank implies no mechanical or electrical tilt.

Table B 2 Parameters of the Receiver [proposed]

2.1	**Reference Static Sensitivity relative to 12 dBS or 5% BER**	***dBm***
2.2	**Receiver Characteristics,** Error! Reference source not found. **and nnex A**	
2.3	**Channel Performance Criterion, faded DAQ or % BER**	**Table A-1 or A-2**
2.3.1	**Usage Losses (in car or in building loss)**	***dB***
2.4	**Antenna Gain (include pattern and polarization losses)**	***dBd***
2.4.1	**Antenna Gain at Horizon (as above)**	***dBd***
2.4.2	**Cable Loss**	***dB***
2.5	**Antenna Height Above Ground Level (HAGL)**	**m**
2.6	**Minimum Reliability for CPC at Service Area boundary**	**%**
2.7	**Frequency**	**MHz**
2.8	**Service Area definition**	
2.9	**Voting or Diversity? V(voting), DX (x branches)**	
2.10	**Simplex operation of mobile units? Y/N**	

Simplex operation impacts adjacent channel reuse distance because of mobile-to-mobile and base-to-base interference.

Table B 3 Parameters for the Transmitter [existing]

3.1	**Site Latitude dd, mm, ss N/S**	
3.1.1	**Site Longitude ddd, mm, ss W/E**	
3.2	**Power supplied to the antenna**	***dBm***
3.3	**Antenna model and manufacturer**	
3.3.1	**Maximum Antenna Gain**	***dBd***
3.3.2	**Azimuth of directional gain if applicable**	**º from True North**
3.3.3	**Maximum Effective Radiated Power**	dBm_d
3.3.4	**Maximum ERP at Horizon**	dBm_d
3.3.5	**Tilt Angle below Horizon if applicable**	**º**
3.4	**Antenna Height Above Ground Level**	**(m) HAGL**
3.5	**Site Elevation, Height Above Mean Sea Level**	**(m) HAMSL**
3.6	**Tower Height**	**m**
3.7	**Modulation Type**	**Table A-1 or A-2**
3.7.1	**Vocoder type**	
3.8	**Bandwidth**	**kHz**
3.9	**Frequency**	**MHz**

Antenna Pattern - Provide manufacturer and model number so that an antenna pattern can be obtained. Leaving 3.3.2 blank implies omni-directional. Leaving 3.3.5 blank implies no mechanical or electrical tilt.

Table B 4 Parameters of the Receiver [existing]

4.1	**Reference Static Sensitivity relative to 12 dBS or 5% BER**	***dBm***
4.2	**Receiver Characteristics**, Error! Reference source not found. **and nnex A, ENBW**	
4.3	**Criterion Channel Performance, faded DAQ or % BER**	**Table A-1 or A-2**
4.3.1	**Usage Losses (in car or in building loss)**	***dB***
4.4	**Antenna Gain (include pattern and polarization losses)**	***dBd***
4.4.1	**Antenna Gain at Horizon (as above)**	***dBd***
4.4.2	**Cable Loss**	***dB***
4.5	**Antenna Height Above Ground Level (HAGL)**	**m**
4.6	**Minimum Reliability for CPC at Service Area boundary**	**%**
4.7	**Frequency**	**MHz**
4.8	**Service Area Definition**	
4.9	**Voting or Diversity? V(voting), DX (x branches)**	
4.10	**Simplex operation of mobile units? Y/N**	

Service area definition is needed to determine where the mobile radios operate. It can be defined by:

- A radius around the site or a specific latitude/longitude.
- A rectangle with the opposite corners defined by latitude/longitude.
- Political boundary such as: city, county, state.
- A political boundary plus an additional distance of “X” miles.
- A set of latitude/longitudes ordered in a counter clockwise direction so that when the points are connected, the resulting irregular polygon defines the service area.
- If none of the above is available, use the method of Annex-D. This applies to existing stations only.
- Simplex operation impacts adjacent channel reuse distance because of base-to-base as well as mobile-to-mobile potential interference.

It is recommended that the evaluation bi-directional, proposed to existing and existing to proposed, in the talk-out direction only, utilizing the worst case based on service area definitions.

Table B 5 Protected Service Area (PSA)

5.1	**Existing station protected availability (0 for unprotected)**	**nn.n % inbound**	**nn.n % outbound**
5.2	**Proposed station protected availability (0 for unprotected)**	**nn.n % inbound**	**nn.n % outbound**

The following field widths are recommended:

Table B 6 Field Widths

Sections		Input Data	Output Data
1.1	3.1	nn◊nn◊nn◊h (DMS)	±nn.nnnn (decimal degrees, not DMS)
1.1.1	3.1.1	nnn◊nn◊nn◊h (DMS)	±nnn.nnnn (decimal degrees, not DMS)
1.2	3.2	nn.n	nn.n
1.3	3.3	Mfr: 8 alpha char Model: 25 alpha char	Mfr: 8 alpha char Model: 25 alpha char
1.3.1	3.3.1	±nn.n	±nn.n
1.3.2	3.3.2	nnn	nnn
1.3.3	3.3.3	nn.n	nn.n
1.3.4	3.3.4	nn.n	nn.n
1.3.5	3.3.5	±nn.n	±nn.n
1.4	3.4	nnnn	nnnn
1.5	3.5	±nnnnn	±nnnnn
1.6	3.6	nnnn	nnnn
1.7	3.7	26 alpha char	26 alpha char
1.7.1	3.7.1	15 alpha char	15 alpha char
1.8	3.8	nn.nn	nn.nn
1.9	3.9	nnnn.nnnn	nnnn.nnnn
2.1	4.1	-nnn.n	-nnn.n
2.2	4.2	9 alpha char	9 alpha char
2.3	4.3	nn.n	nn.n
2.4	4.4	±nn.n	±nn.n
2.4.1	4.4.1	±nn.n	±nn.n
2.4.2	4.4.2	-nn.n	-nn.n
2.5	4.5	nnnn	nnnn
2.6	4.6	nn.n	nn.n
2.7	4.7	nnnn.nnnn	nnnn.nnnn
2.8	4.8	110 alpha characters	See Note 1
2.9	4.9	2 alpha characters	2 alpha characters
2.10	4.10	1 alpha character	1 alpha character
5.1	5.2	nn.n	nn.n

1 If the Service Area definition is in terms of a political boundary or a distance from a political boundary, the output data will consist of numerous pairs of latitude/longitude points. If the latitudes and longitudes are expressed in accordance with the RIGHT column for 1.1/3.1 and 1.1.1/3.1.1, each point needs 8 characters for each latitude and 9 for each longitude, excluding space characters between them. Political boundaries on coastlines or rivers can have numerous (possibly thousands of) points.

2 Spaces need to be included between fields (◊) for clarity.

3 Determine sign from the hemisphere of outputs latitude and longitude. N & E are positive; S & W are negative. In the United States of America, latitudes are always positive and longitudes are generally negative. Some of the Aleutian Islands are in the Eastern Hemisphere.

Table B 6 LEGEND:

h	=	hemisphere (N/S/E/W)
n	=	a numeric character
-	=	a minus sign (inserted for clarity)
±	=	a plus sign, a minus sign, or a blank (implying plus)
◊	=	a space (inserted for clarity)
.	=	a decimal point

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ANNEX C SPECTRUM MANAGEMENT (informative)

C.1 Simplified Explanation of Spectrum Management Process

The following explanation is provided as an example of the process.

C.2 Process Example

For this example, a C4FM receiver is used. Reference sensitivity is -119 dBm. Receiver parameters can be found in Annex A, others are derived. See Figure 5 for an analog example.

C.2.1. Pull site elevation (AMSL) and antenna HAGL

C.2.2. Calculate ERP_d at the horizon [Xmtr P_0 cable losses filtering losses + antenna gain[19] at the horizon (dB_d)]. See Table D 1.

> e.g., 50 *dBm* - 2 *dB* - 4 *dB* + 8 *dB* = **52 *dBm*** (158.5 Watts)

C.2.3. Use methods defined in this document to calculate the field strength at all points on the edge of the Service Area. If the field strength at any point on the edge of the Service Area exceeds 37 $dB\mu$ in the 150 MHz band, 38 $dB\mu$ in the 220 MHz band, 39 $dB\mu$ in the 450 MHz band, or 40 $dB\mu$ in the 700, 800 and 900 MHz bands, reduce the ERP before proceeding. See [88.2].

C.2.4. Calculate Receiver power levels for CPC from reference sensitivity, in *dBm* or µV, Table A 1.

a) Faded Performance Threshold

FPT = Ref Sensitivity - C_S/N + C_F/N (for CPC to produce DAQ 3.0, Table A 1)

> e.g., for C4FM (-119 *dBm* -7.6 *dB* + 16.5 *dB* (DAQ 3) = -110.1 *dBm*

b) Calculate the Noise-Adjusted Faded Performance Threshold without consideration of antennas:

$$NF_{dB} = \text{Sens}_{\text{Ref}} - (C_S/N) - kT_0B$$

$$NF = \text{antilog}(\text{NF}_{\text{dB}}/10)$$

$$N_r = \text{antilog}(\text{N}_{rdB}/10)$$

Where N_r = environmental noise relative to kT_0B, expressed in linear (not *dB*) units

$$\text{Adjustment} = 10 \log_{10}(1 + (N_r / NF))$$

$$\text{FPT}_{\text{Adj}} = \text{FPT} + \text{Adjustment}$$

Where N_r and N_{rdB} are as defined in [88.2].

---

19) If the antenna is directional apply the pattern variations in the appropriate directions.

e.g., for f = 160 MHz, environment = Residential (Cat 11) in Rural Area, and B = 5. 5 kHz:

N_{rdB} = 12.1 $dB_{kTB,}$ N_r=16.2, $N_{dBm1kHz}$ = -131.9 dBm_{1kHz} (from [88.2])

NF_{dB} = -119 dBm – 7.6 dB – (-144 + 10 $\log_{10}$ (5.5)) = 10.0 dB *Noise Factor* = 10.0

Adjustment = 10 $\log_{10}$(1 + 16.2/10) = 4.2 dB

FPT = -110.1 dBm from previous example

FPT_{Adj} = *FPT* + *Adjustment* = -110.1 dBm + 4.2 dB = -105.9 dBm *Data from §5.2.1 was used in preference to §5.2.2 because it is thought to be more reliable.

c) Calculate the Noise-Adjusted Faded Performance Threshold with consideration of environmental noise and antenna/line effects. Calculate the ATP Target and ATP Pass/Fail Criterion by adjusting for antenna gain, cable losses, building penetration margins, etc. See Table D 2, Table D 4, Table D 5 and Building loss values, if applicable, in [88.2] and [88.3]. For this example, C4FM is assumed. The ATP Target in this example is for illustrative purposes, and BER testing for digital radios is the recommended objective acceptance test method using the criteria presented in Table A-1 [88.3, Table 4 VCATP Test Matrix]. If an analog signal strength test is performed, a test configuration adjustment would need to be applied to the ATP Target to determine the ATP pass/fail criteria.

Mobile Example:

e.g., mobile with λ/4 antenna (-1.0 *dBd*) and 0.8 *dB* cable loss, for *f* = 160 MHz, environment = Residential (Cat 11) in Rural Area, and *B* = 5. 5 kHz:

Given:

ENBW	5.50 kHz
Noise Figure	10.00 dB
Noise Factor	10.00
Reference Sensitivity	-119.00 dBm
Cs/N	7.60 dB
Cf/N	16.50 dB

Environmental Noise (Nr) from Table [88.2]	-131.90 dBm(kHz)
adjust for ENBW	7.40 dB
External Noise	-124.50
Ant/cable loss	1.80 dBd
Adjusted External Noise	-126.30 dBm
Internal Noise	-126.60 dBm
Combined	-123.44 dBm
Cf/N	16.50 dB
FPT Adjusted	-106.94 dBm
ATP Target	-105.14 dBm
Test Configuration Adjustment	0.00 dB
ATP Pass/Fail Criterion	-105.14 dBm

Environmental Noise (Nr) from Table [88.2]	12.10 dB(kTB)	16.22
Ant/cable loss	1.80 dBd	
Nr adjusted	10.30 dB(kTB)	10.72
Nr & Internal		11.79
Unadj FPT	-110.10 dBm	
Adjustment to FPT		3.16 dB
FPT Adjusted	-106.94 dBm	
ATP Target	-105.14 dBm	
Test Configuration Adjustment	0.00 dB	
ATP Pass/Fail Criterion	-105.14 dBm	

Conversions

$Nr_{(dBm/kHz)} = -144 + Nr_{dB}$

$Nr_{dB} = 10\text{^}(Nr_{(dBkTB)}/10)$

$Nr_{(dBkTB)} = 10 * Log(Nr_{dB})$

There is no test configuration adjustment in this example because the mobile antenna system is the antenna system to be used in the coverage acceptance test.

Portable Example:

e.g., portable with antenna gain = -8 *dBd*, outdoor coverage, for *f* = 160 MHz, environment = Residential (Cat 11) in Rural Area, and *b* = 5. 5 kHz:

Given:

ENBW	5.50 kHz
Noise Figure	10.00 dB
Noise Factor	10.00
Reference Sensitivity	-119.00 dBm
Cs/N	7.60 dB
Cf/N	16.50 dB

Environmental Noise (Nr) from Table [88.2]	-131.90 dBm(kHz)
adjust for ENBW	7.40 dB
External Noise	-124.50
Ant/cable loss	8.00 dBd
Adjusted External Noise	-132.50 dBm
Internal Noise	-126.60 dBm
Combined	-125.61 dBm
Cf/N	16.50 dB
FPT Adjusted	-109.11 dBm
ATP Target	-101.11 dBm
Test Configuration Adjustment	-1.80 dB
ATP Pass/Fail Criterion	-102.91 dBm

Environmental Noise (Nr) from Table [88.2]	12.10 dB(kTB)	16.22
Ant/cable loss	8.00 dBd	
Nr adjusted	4.10 dB(kTB)	2.57
Nr & Internal		1.81
Unadj FPT	-110.10 dBm	
Adjustment to FPT		0.99 dB
FPT Adjusted	-109.11 dBm	
ATP Target	-101.11 dBm	
Test Configuration Adjustment	-1.80 dB	
ATP Pass/Fail Criterion	-102.91 dBm	

Conversions

$Nr_{(dBm/kHz)} = -144 + Nr_{dB}$

$Nr_{dB} = 10\hat{}(Nr_{(dBkTB)}/10)$

$Nr_{(dBkTB)} = 10 * \mathrm{Log}(Nr_{dB})$

An Excel® Tool, *Noise Adjusted Performance Example C24.xls* has been provided with this document.

C.2.5 Calculate coverage reliability for the site independent of interference, noise only.

a) Pull Radial(s) from terrain data base for each point being evaluated within the service area. At each point, calculate propagation loss (L_l) for Open,. Be sure to correct for loss relative to $\lambda/2$ antennas as the referenced programs calculate the loss in *dBi*. The correction is 4.3 *dB*. See Table D 2.

b) Pull Environmental Loss from NLCD or LULC cross reference (L_2) in [88.2]. Use tables in [88.2] to determine the correct classification.

c) Sum $L_l + L_2$ = Propagation Loss (example values)

128 *dB* + 14 *dB* (160 MHz residential) = 142 *dB*.

d) Calculate **Median Signal Level** = ERP_d - Propagation Loss

e.g., 52 *dBm* -142 *dB* = ***-90 dBm.***

e) **Margin** = Median Signal Level ATP Target

e.g., 14.1/5.6 =2.518

f) Z = Margin/σ (See [88.2] for determining σ).

g) Calculate Noise-only Reliability (See §5.3.4, Equation (3) for converting Z to a percentage

e.g., Z =2.518 ⇨ **99.41%.**

h) Store and continue iterating until PSA calculations are complete.

e.g., (-90 -(-104.1) =14.1 ***dB***

C.2.6. Calculate the ACPR from each potential emitter into each victim receiver at the frequency offset being evaluated.

a) For a proposed transmitter use the process in this Annex to determine the power intercepted by the victim receiver based on one Watt ERP. Use the emission designator to determine the type of modulation. For the victim receiver, use either the Receiver Characteristics, Table 6 or Annex A to determine the appropriate ENBW and receiver model to use.

e.g. Proposed transmitter is C4FM, by its emission designator of 8K10F1E, §A.6.1.1.

Incumbent transmitter is Analog FM ± 5 kHz deviation based on its emission designator of 16K0F3E, §A.5.3.1.

Frequency to be evaluated is 12.5 kHz offset.

DAQ 3.0 needs a CPC of $C_F/(I+N)$ = 16.5 *dB* per Table A1 for the proposed C4FM system.

Lognormal standard deviation (σ) = 5.6

The calculated interfering signal level from AFM at a point being evaluated is -40 *dBm*.

Use the proposed C4FM victim's ENBW to determine the ACPR. From §A.6.1.2 or Table 6, the proposed C4FM victim's receiver has an ENBW of 5.5 kHz and is modeled by the RRC filter.

From §A.5.3.4, AFM, ± 5, at the offset of 12.5 kHz, the existing analog ACPR for the proposed victim's receiver is found to be -46.87 *dB* below the analog transmitter's power. Therefore the ACPR to the proposed C4FM victim is -86.87 *dBm*.

To achieve 90% probability of having a DAQ =3 necessitates that the desired C4FM signal be above the -86.87 *dBm* interfering AFM signal by 16.5 *dB* plus the interference margin of 10.1 *dB*, σ = 5.6 *dB*, a -60.27 *dBm* median signal level. The actual reliability can be determined based on the margin that is actually available. See [88.2] for more information on interference margin and the probability of CPC in the presence of interference.

The reverse pair needs to be evaluated as well. See §5.6 Propagation Modeling and Simulation Reliability for other issues that need to be evaluated.

b) For an existing transmitter, if the information needed in C.2.6. a) is available use it, if not:

   i) Use the emission designator to estimate the type of modulation. Many frequency coordinators change the designator to the maximum bandwidth possible for the channel. If the last portion of the emission designator is F3 assume it is analog FM and use the bandwidth to determine which type. If the last portion is F1, assume Project 25 C4FM.

   ii) For applicants who have not yet selected specific equipment, or at the frequency coordinator's discretion, select a modulation to define the applicant's modulation and receiver characteristics. This could necessitate using a worst-case selection and limit potential assignments for narrower bandwidth equipment. For cases with difficulty obtaining frequencies, contact with current licensees can prove helpful in minimizing worst-case assumptions

c) If the receiver's IF response is known, use it for determining the ACPR from the possible interfering transmitters. Even if the receiver exists, it's IF response might be unknown. Use the values in Table 6 or Annex A. If these values are not considered appropriate, use the specified minimum values in [603] §3.2.14, Table 30 or 102.CAAB] §3.1.7.1, Table 3-5, Adjacent Channel Rejection, as appropriate to determine the adjacent channel rejection. Add the Cs/N to the ACRR to estimate the ACPR and apply this ACPR value uniformly across the entire adjacent channel. Assume zero on-channel rejection[20)].

d) If it is desired to allow for frequency stability degradation, follow the method of §5.7.2; otherwise, assume no frequency error.

e) The ACPR is the intercepted power of the victim receivers IF, relative to average power intercepted if the interferer was considered to be a co-channel emitter. Reduce the ERP_d of the interferer by this value for the simulation prediction. Alternatively, decrease the desired interference contour by the ACPR.

C.2.7. Evaluate co-channel and adjacent-channel impact

a) Determine which sites to evaluate.

   i) Find all existing sites on the frequency under consideration and both adjacent channels within 297 km. [297 km is the sum of the 113 km protection distance plus line-of-sight for k=1.33 for a 2,000 m HAAT mountain].

   ii) After the distance sorting process in Step C.2.7a) i) above, the initial decision on whether to consider an interfering station further can be done

[20)] The exact value of ACPR might not be the same as would result from an actual measurement due to minor differences in detectors. However this calculation is accurate for Analog FM and C4FM. At most a 2 to 3 dB differential might be applicable, but these values are highly conservative so it is reasonable to apply the adjustment regardless of the modulation and companion detector.

using an analysis along the inter-station radial between the desired station and the interfering station. First, determine the distance to the desired station coverage area boundary using the propagation method in [88.2]. At the intersection of the inter-station radial and the designed station coverage area boundary, the magnitude of the interfering station signal is calculated, again using the model in [88.2]. If the calculated interfering signal level at this intersection point is below the environmental noise level, this station need not be considered further as an interferer. For co-channel stations, if the desired median signal level at this point is 15 *dB* higher than the median interfering signal level plus the *C/(I*+*N*) allowance for CPC, then sufficient margin exists for adequate service and the interfering station need not be considered further as an interferer. For adjacent channel stations, if the desired median signal level at this point is 15 *dB* higher than the sum of the interfering median signal level minus the adjacent channel protection ratio plus the *C/(I*+*N)* allowance for CPC, then sufficient margin exists for adequate service and the interfering station need not be considered further as an interferer. For example if the median adjacent channel power is -50 *dBm* the ACPR = 60 *dB*, and CPC = 17 *dB*, then the interfering power would be -110 *dBm.* If the median desired is ≥ -78 *dBm* the interfering station need not be considered further,

(-110 *dBm* + 17 *dB* (CPC parametric) + 15 *dB* (probability margin) = -78*dBm*).

b) If the ratio of the desired station to interfering signal levels fall below the above criteria, or if the interferer is within the desired station coverage area further analysis of the interfering station is recommended. Voice systems can be subjected to either of the methods of Equivalent Interferer Method [88.2] or the preferred Monte Carlo Simulation Method [88.2] If the results of the two methods conflict, the Monte Carlo Simulation is considered to be the more accurate, provided that the number of samples run is at least 5000. Because of “re-try” considerations, it is not practical to use the Simplified Estimate method for Data Systems. Thus, only the Monte Carlo method is recommended for data systems.

c) Calculate the interference potential using the methods of Equivalent Interferer or Monte Carlo Simulation [88.2].

C.2.8. If current evaluation was for a proposed transmitter to an existing receiver and the existing transmitter to proposed receiver evaluation hasn't yet been done, do that now by looping to step C.2.2.

C.2.9. Next configuration to evaluate. Loop to step C.2.1.

C.2.10. Continue to develop short list. Then evaluate short list in greater detail to determine the best recommendation.

C.2.11. The Tables and Figures in Annex A are provided for various modulations. They were generated using measured SPD data files of sources modulated with interference test signals. Considerable information is provided for each modulation.

a) For very small offsets, possibly eliminate some of the receiver models as the ACPR values have little variation due to the selected model.

b) For the larger offsets, possibly eliminate some of the receiver models as ACPR values have little variation due to the selected model.

c) For the intermediate offsets, there is considerable divergence in the various models

d) For older analog receivers, the Butterworth model of 4-poles, 3-cascaded sections is valid for ENBWs greater than 10 kHz. Annex A contains tables for ENBWs up to 18 kHz. In Table 6 the 4p-3c configuration is provided for specific models for the sole purpose of determining ACPR so that additional models are not necessary.

e) For newer digital receivers, the filtering is more appropriately modeled using the RRC filter. See Annex A.

f) The channel bandwidth filter is more appropriate for showing compliance to specifications that are defined as being measured by specialized test equipment.

g) The application in §5.7.1.3 can be used to provide the data for configurations not included in this document using the methods described in § 5.7.

The CD provided with this document contains all the spreadsheets and the application and the appropriate data files the application utilizes. See Annex H for a list of files included.

ANNEX D SERVICE AREA (informative)

D.1 Methodology for Determining Service Area for Existing Land Mobile Licensees Between 30 and 940 MHz

The following contains an approach and methodology which, when used in conjunction with the overall modeling and simulation methodology advanced in the body of this document and [88.2], enables the determination of a service area for most scenarios.

D.2 Information

It is possible to generalize a service area if certain basic elements are known or derived from the existing licenses which include:

- File or Reference Number
- Licensee Name
- Licensee Address (Mailing)
- Licensee Address (Physical)
- Latitude and Longitude Coordinates
- Ground Elevation AMSL
- Antenna Height AGL
- Fixed Station Class
- Mobile Station Class
- Fixed Station Transmitter Power Output
- Radio Service using current nomenclature, i.e., Police, Land Transportation, etc
- Fixed Station Transmitter ERP (ref. half wave dipole). If ERP is not known, ERP can be assumed as follows:

Table D 1 Recommended Values for Estimating ERP

Frequency Range	Assumed Fixed Station ERP (Watts)
30-50 MHz	0.7 x Transmitter Output Power
136-174 MHz	2.5 x Transmitter Output Power
220-222 MHz	2.5 x Transmitter Output Power
380-512 MHz	4.0 x Transmitter Output Power
746-940 MHz	10 x Transmitter Output Power

.

D.3 General Assumptions

The Modeling and Simulation Methodology employed can be modified by the assumptions and predicates presented in this annex.

D.3.1. Units and measures are consistently applied.

D.3.2. The modulation employed is identified by the emission designator or manufacturers model numbers. Annex A contains typical emission designators for identified modulations.

D.3.3. The fixed station and mobile receiver performance meets [603] or [102.CAAB] concerning adjacent channel performance.

D.3.4. The fixed station and mobile transmitter BNBE spectrum is represented by data in Annex A.

D.3.5. Typical configurations of transmitter spectrum (ACP) intercepted by various receiver configurations are tabulated in Annex A.

D.3.6. Omni-directional fixed station antenna is used.

D.3.7. The mobile units operating with the associated base station/mobile relay operate within the coverage area of the base station/mobile relay.

D.3.8. Mobile antenna are normally referenced to a quarter wave antenna. Unless additional information is known, assume the gain is for a quarter wave whip. The correction values for converting various antenna types is shown in Table D 2. If the gain is known, make the correction to use a half wave dipole for any calculations.

Table D 2 Antenna Corrections

Specific Antenna	Isotropic	Antenna Reference $\lambda/2$ half-wave dipole	$\lambda/4$ quarter-wave
Isotropic	0 dBi	-2.15 dBd	-1.15 $dB_{\lambda/4}$
$\lambda/4$ quarter-wave	1.15 dBd	-1.0 dBd	0 $dB_{\lambda/4}$
$\lambda/2$ half-wave dipole	2.15 dBd	0 dBd	1 $dB_{\lambda/4}$

Table D 3 compares quarter wave antennas to half wave dipole antennas at the same radiation center heights for various locations. The values indicated are for the average gain as there are definite pattern variations

Table D 3 Measured Location Gain

Antenna Location	$\lambda/4$ Antenna Gain vs. Frequency *				
	30 MHz	50 MHz	155 MHz	455 MHz	830 MHz
Rooftop Center	-1.5 dBd	-0.5 dBd	-1.0 dBd	-1.0 dBd	-1.0 dBd
Left Front Cowl	-3.2 dBd	-3.1 dBd	-2.9 dBd	-4.5 dBd	-4.5 dBd
Trunk Lip			-3.5 dBd	-4.5 dBd	
Left Rear Deck		-3.7 dBd			
Trunk Lid Center			-2.5 dBd	-4.8 dBd	-4.3 dBd
* Older data from 1973 VTG Conference paper, 73CH0817-7VT-B-3, D.W. Horn					

D.3.9. Where handheld/portable units are licensed portable/handheld usage is assumed to be primary and the appropriate handheld/portable antenna correction factor be applied.

D.3.10. If known[21], apply the manufacturer's handheld/portable antenna correction factor. Otherwise use Table D 4 or as appropriate:

Table D 4 Estimated Portable Antenna Correction Factors

Frequency Band	Handheld/Portable Antenna Correction Factor
30-50 MHz	-15 *dBd*
136-174 MHz	-10 *dBd*
220 -222 MHz	-10 *dB*
380-512 MHz	-6 *dB*
700 MHz band	-5 *dBd*
800 MHz band	-5 *dB*
900 MHz band	-5 *dB*
Note: Reference is a half wave dipole.	

Some measured values for various portable antenna types by frequency and for both outside a vehicle and inside a vehicle are offered in Table D 5[10]. The underlined value is the average of different radios and their type of antenna in the open. The lower value represents the average of different radios and their type of antenna in-side a vehicle. The difference is the vehicle penetration loss. Other accessories can affect these values. Speaker microphones result in radios remaining on the hip during transmission, lower effective height. The size of the user causes body loss to vary. The different carrying options affect the overall antenna loss due to placing the antenna closer to the user's body. Other accessories carried on the belt, such as key rings and revolvers can also cause these values to vary.

[21] Different manufacturers frequently use different correction factors. The value used ought to include the antenna efficiency, polarization losses and body absorption losses. The values shown are for head level. When radios are "on the hip" then the method of securing it there ought to be considered. Additional body absorption occurs due to the proximity and orientation of the antenna to the users' body. Typically the talk-out range is affected by the location of the radio before establishing "head level" usage. Portables in cars need additional margins due to additional losses, particularly if a portable in "on hip: and the user is seated with the portable antenna obstructed.

Table D 5 Median Portable Antenna Loss Outside & Inside Vehicle

Height (Head/Side)	Head Level				Swivel Case on hip				Belt Case on hip			
Frequency (MHz)	150	450	800	900	150	450	800	900	150	450	800	900
Helical Antenna Loss (dB) *	11.3 16.6	6.1 12.3			17.6 24.0	12.6 22.0			22.8 31.9	17.2 25.4		
λ/4 whip Antenna Loss (dB)*		4.6 12.0	8.6 12.2	9.9 13.1		11.1 22.6	15.4 22.5	14.8 23.4		13.2 24.7	14.3 24.1	15.4 25.4
Coaxial Dipole Antenna Loss (dB)*			4.5 8.5	5.2 9.7			8.5 17.5	9.9 18.5			10.3 21.3	12.1 21.1
Height	**Shoulder Level**											
Shoulder Mount Antenna Loss (dB)*		12.7 23.2	7.5 16.1									
*Portable antenna median loss relative to a half-wave dipole [10] Top value is Antenna Loss outside a vehicle, lower value is Antenna Loss inside a vehicle												

D.3.11. Coverage reliability is assumed as a function of radio service. The recommended values are as follows:

Table D 6 Estimated Area Coverage Reliability

Radio Service	Area Coverage Reliability
Public Safety	95%
LMR	90%

D.3.12. Average levels of ambient RF noise, referred to as kT_0B, and are assumed. This equates to a 6 dB derating value for 132-174 MHz and a 3 dB derating value for 380-512 MHz. The RF noise level is defined in Environmental RF Noise Data [88.2]. In the 700 MHz band, CMRS noise levels are assumed to cause 3 dB of degradation.

D.3.13. For tower top amplifier configurations, assume that the improvement in reference sensitivity is equivalent to +3 dB or to -119 dBm, whichever creates the worst sensitivity. Eliminate all other losses between the tower top amplifier input and the victim receiver. Note, take high site or external noise into consideration if known.

For receiver multicoupler cases, assume that there is no change in sensitivity, but all losses and gains between the multicoupler input and the victim receiver are zero.

D.3.14. CPC is assumed as a function of radio service. The values are as follows:

Table D 7 Assumed CPC

Radio Service	CPC
Public Safety	DAQ -3.4[1] Equivalent
LMR	DAQ -3.0[2] Equivalent

[1] DAQ-3.4 is defined as 20 dB SINAD equivalent intelligibility (Table 2)
[2] DAQ-3 is defined as 17 dB SINAD equivalent intelligibility (Table 2)

Sometimes FCC field strength limitations might preclude the higher DAQ values at the edge of the service area, e.g. portable coverage into high loss buildings without using an ancillary hardware system.

D.4 Discussion

This methodology assumes *a priori* that the information contained on the license is accurate and that the licensee is currently operating the station within the licensed parameters. However, when the parameters are evaluated in context of the overall modeling and simulation methodology proposed, a coverage area in the form of an irregular polygon can be determined for any existing licensed station.

In the event an existing licensee desired additional consideration above and beyond that provided by the above predicates, such a licensee could provide all of the information of a new applicant. With more complete information a more finely tuned service area can be determined.

Regulations could limit the ERP and tower heights making high levels of DAQ unachievable.

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ANNEX E Emission Designators (informative)

E.1 General

The purpose of this Bulletin is to provide a method for examining potential frequency selections to minimize the potential interference between disparate modulations utilizing disparate channel bandwidths during frequency coordination. The use of the emission designator is essential to identifying the modulations being used and their associated receiver parameters. Annex A contains the recommended emission designators for each documented modulation. Manufacturers publish their emission designators on specification sheets. Unfortunately today's radios are often capable of multiple waveforms (modulations) and it is common for a licensee to use a single worst case (widest) modulation to cover all cases on their license. In doing this, the essential information for determining the actual modulation is lost making the coordination process less efficient.

The FCC, NTIA and ITU provide rules and methodology for determining the appropriate emission designator. A discussion of these follows.

E.2 Bandwidth Definitions

There are four different definitions of bandwidth commonly used. It is important to use the appropriate one.

Channel Spacing BW, represents the actual channelization being used. This also describes the frequency separation to the adjacent channel's assignment for a similar channel bandwidth. The channel bandwidths for land mobile radio users include: 30 kHz, 25 kHz, 15 kHz, 12.5 kHz, 7.5 kHz and 6.25 kHz.

Authorized BW, essentially a reduction in the Channel Spacing BW indicating the maximum bandwidth that the modulation is allowed to occupy, as shown in Table E1 below.

Occupied BW, 47CFR2.202(a) & 47CFR2.1049, represents the bandwidth between the upper and lower frequency limits where each equals 0.5% of the emissions total mean power. This represents 99% of the total mean power falling inside this bandwidth

Necessary BW, 47CFR2.202(b) represents the three numbers and one letter of the first four characters of the emission designator. Historically this bandwidth has been obtained by formula. However with more complex modulations the 99% occupied bandwidth is recommended using defined modulation waveforms.

Table E 1 Channel Spacing vs. Authorized Bandwidth

Channel Spacing[1]	30 kHz	25 kHz	15 kHz	12.5 kHz	7.5 kHz	6.25 kHz
Authorized Bandwidth	20 kHz	20 kHz	11.25 kHz	11.25 kHz[2]	6.0 kHz	6.0 kHz

[1] 47CFR90.209(b)(5)
[2] In the 900 MHz band, the authorized bandwidth is 13.6 kHz

E.3 Emission Designator References

E.3.1 FCC

47CFR2.201 *Emission, modulation, and transmission characteristics*

47CFR2.202 *Bandwidths*

47CFR 2.1049 *Occupied bandwidth measurement*

47CFR 90.207 *Types of emissions*

47CFR 90.209 *Bandwidth limitations*

47CFR 90.210 *Emission masks*

47CFR 90.213 *Frequency stability*

47CFR 90.233 *Base/mobile non-voice operations*

E.3.2 NTIA Manual of Regulations and Procedures for Federal Radio Frequency Management (Jan 2008), with current modifications

§5.1.5 *Terminology*

§6.3 *Emission Designators*

§9.8.1 -16. EMS—Emission Designator

Annex J Guidance for Determination of Necessary Bandwidth

E.3.3 ITU-R Spectrum Management [SM] (Subscription service required for these documents)

ITU-R SM.328-11 *Spectra and Bandwidth of Emissions*

ITU-R SM 853.-1 *Necessary Bandwidth*

ITU-R SM.1138-2 *Determination of Necessary Bandwidths. Including examples for their calculation and associated examples for the designation of emissions.*

ITU-R SM [RR(2008)] *Radio Regulations*

E.4 Emission Designator Format

E.4.1 1st through 4th Characters

These characters indicate the necessary or occupied bandwidth, to three places, using a unit magnitude letter to indicate the equivalency of a decimal point. For LMR the letter is normally K for kilo. Other magnitude indicators include:

- Between 0.001 and 999 Hz are expressed in Hz (**H**)
- Between 1.00 and 999 MHz are expressed in MHz (**M**)
- Between 1.00 and 999 GHz are expressed in GHz (**G**).

E.4.2 First Symbol (Modulation Type)

F = Frequency Modulation: (Allows including phase modulation, rather than using the Symbol G)

D = Combination of amplitude and phase modulation: Typical examples include linear transmitters such as: LSM, WCQPSK and H-DQPSK.

W = Multiple: The FCC prefers only F or D but some manufacturers use W.

47 CFR 2.201 Emission, modulation, and transmission characteristics.

(c) First Symbol—types of modulation of the main carrier:

(1) Emission of an unmodulated carrier……………………………………………N
(2) Emission in which the main carrier is amplitude-modulated (including cases where sub-carriers are angle-modulated):
- Double-sideband……………………………………………………………… A
- Single-sideband, full carrier…………………………………………………H
- Single-sideband, reduced or variable level carrier………………………R
- Single-sideband, suppressed carrier …………………………………….. J
  - Independent sidebands …………………………………………..B
  - Vestigial sideband ……………………………………………......……C

(3) Emission in which the main carrier is angle-modulated:
  - Frequency modulation ……………………………………………F
  - Phase modulation ………………………………………………….G

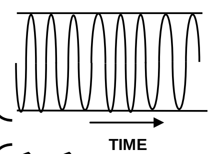
  Note: Whenever frequency modulation "F" is indicated, phase modulation "G" is also acceptable.

(4) Emission in which the main carrier is amplitude and angle-modulated either simultaneously or in a pre-established sequence……………………D
(5) Emission of pulses:[1)]
  - Sequence of unmodulated pulses ………………………………P
  - A sequence of pulses
    - Modulated in amplitude ……………………………………….K
    - Modulated in width/duration ………………………………….L
    - Modulated in position/phase …………………………………..M
    - In which the carrier is angle-modulated during the period of the pulse…………………………………………………..Q
    - Which is a combination of the foregoing or is produced by other means ……………………………….V

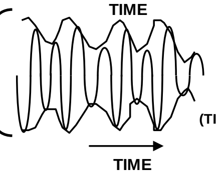
(6) Cases not covered above, in which an emission consists of the main carrier modulated, either simultaneously or in a pre-established sequence, in a combination of two or more of the following modes: amplitude, angle, pulse ……………………………………………………………. W
(7) Cases not otherwise covered ……………………………………………………. X

[1)] Emissions where the main carrier is directly modulated by a signal which has been coded into quantized form (e.g. pulse code modulation) should be designated under (2) or (3).

Part 90 Land Mobile narrowband MODULATION most likely to be " F " or " D "



F = CONSTANT ENVELOPE FREQUENCY/PHASE MODULATION



D = "LINEARIZED" FREQUENCY/PHASE MODULATION (TIME VARYING AMPLITUDE ADDED)

TDMA modulation in Land Mobile subscribers, where a transmitter turns on/off to send TDMA packets, treat as normal "F" or "D" modulation rather than as PULSE modulation.

Figure E 1 First Symbol (Modulation Type)

E.4.3 Second Symbol (Signal Type)

1 = Digital: (single conversation or sub-carrier) e.g. C4FM, dPMR

2 = Non Voice Data

3 = Analog : (a single conversation) Examples include the three analog modulations currently being deployed

7 = TDMA: (multiple conversations or sub-carriers) Examples include multi-slot TDMA such as DMR and H-DQPSK

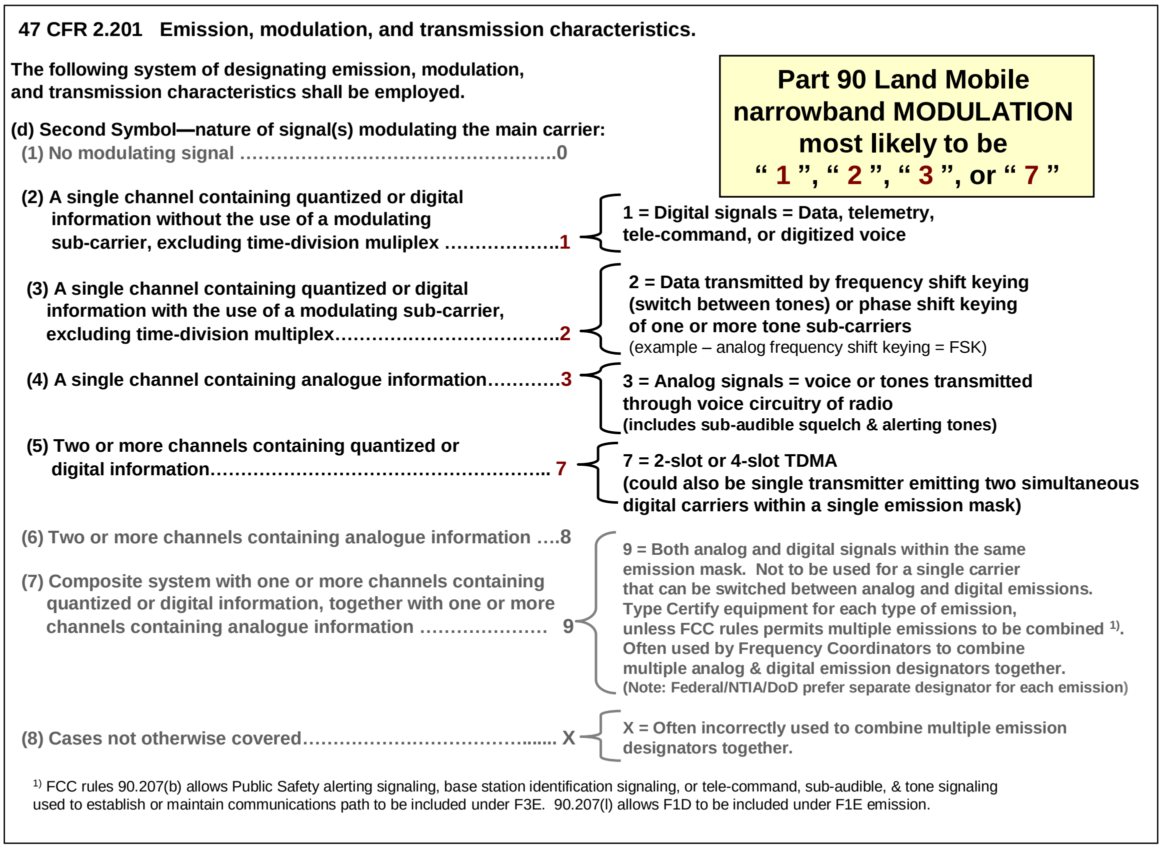


Figure E 2 Second Symbol (Signal Type)

E.4.4 Last Symbol: (Type of Information) *FCC latitude §90.207(l)

D = Data: (data, telecommand, telegraphy and/or telemetry) Example includes SCADA systems

E = Voice: (Can include telecommand, control signaling if it is used to establish or maintain a voice path) Example includes CTCSS, CDCSS, trunking LSD.

W = Multiple: (voice plus items listed under D = data) Examples include multi-slot TDMA systems.

47 CFR 2.201 Emission, modulation, and transmission characteristics.

The following system of designating emission, modulation, and transmission characteristics shall be employed.

(e) Third Symbol—type of information to be transmitted:[1)]

(1) No information transmitted	N
(2) Telegraphy—for aural reception	A
(3) Telegraphy—for automatic reception	B
(4) Facsimile	C
(5) Data transmission, telemetry, telecommand	**D**
(6) Telephony (including sound broadcasting)	**E**
(7) Television (video)	F
(8) Combination of the above	**W**
(9) Cases not otherwise covered	X

Part 90 Land Mobile narrowband MODULATION most likely to be " D ", " E ", or " W "

D = Digital information = Data, telemetry, tele-command, data transmitted by FSK

E = Analog information = voice or tones transmitted through voice circuitry of radio
(under 90.207(b)&(l) might includes sub-audible squelch, PS alerting, BSID, or tele-command)

W = Used mostly for TDMA, where both voice and data may be transmitted, separately, or at the same time.
W rarely used for non-TDMA since 90.207(l) allows F1D emissions if transmitter Type Certified for F1E emission (could also be used for single transmitter emitting two simultaneous digital carriers within a single emission mask, where either carrier might be used for voice or data)

[1)] In this context the word "information" does not include information of a constant, unvarying nature such as is provided by standard frequency emissions, continuous wave and pulse radars, etc.

Figure E 3 Last Symbol: (Type of Information)

E.5 Additional Discussion

For additional discussion on emission designators, see §5.6.5.1 Emission Designator Importance.

E.6 Project 25 FDMA C4FM Modulation Discussion

The emission designator for C4FM FCC Certification* is based upon actual emission measurements, which is slightly less than the ~8.1 kHz calculated by either the analog or digital formulas.

Some P25 FDMA (C4FM) radios use an internally generated calibration signal and a reference deviation (2.83 kHz). As long as the reference deviation is set correctly, the modulation fits within the 8K10F1E emission designator and the appropriate mask.

Note: When observing the emission on a scope, there might be peaks of up to 20% above the 2.83 kHz calibration deviation level. This slight 'over-shoot' helps reduce transmitter side-band emissions. In addition, digital transmitters have more filtering than analog-only transmitters, so digital emissions appear to more completely fill the FCC emission mask. Single analog audio tone emissions appeared well inside the emission mask producing discrete frequencies based on the modulation index.

P25 CAI Necessary Bandwidth Calculation

Carson's Rule

- Used for analog FM
- Uses calibration deviation

[ASTRO radios generate test pattern to set deviation using "calibration deviation"]

$$
\begin{aligned}
B_{n(\text{P25 CAI})} &= (2M + 2D) \\
&= (2M + 2D_{cal}) \\
&= 2x1.20_{kHz} + 2x2.83_{kHz} \\
&= 8.060 \text{ kHz}
\end{aligned}
$$

The maximum deviation = 2.83 kHz is associated with the Standard Transmitter Symbol Rate test pattern (aka High Deviation TP). The Standard Transmitter TP (O.153) can produce peak deviations on the order of 3.5 kHz

Digital Formula

$$B_{n(\text{P25 CAI})} = (3.86xD + hxR)$$

D = deviation = 1800 Hz

h = deviation index = 0.25

R = channel data rate = 4800 Sym/sec

$$
\begin{aligned}
&= (3.86x1.8_{kHz} + 0.25x4.8_{kHz}) \\
&= 8.148 \text{ kHz}
\end{aligned}
$$

Figure E 4 Example P25 FDMA Necessary Bandwidth Calculation

* Effective 10/05/98 the terms 'type acceptance', 'certification', and 'notification' have been replaced in 47 CFR Part 2, Subpart J - "Equipment Authorization Procedures" by the single term 'certification'.

ANNEX F Transceiver Measurements and Methods Simulcast Parameters (informative)

F.1 Signal Delay Spread Capability

F.1.1 Definition

The signal delay spread capability is the amount of delay between two independently faded equal amplitude signals that can be tolerated, when the standard input signal is applied through a faded channel simulator that will result in the standard BER at the receiver detector. The channel simulator provides a composite signal of two, equal amplitude, independently faded rays, the last of which is a delayed version of the first.

F.1.2 Method of Measurement[22)]

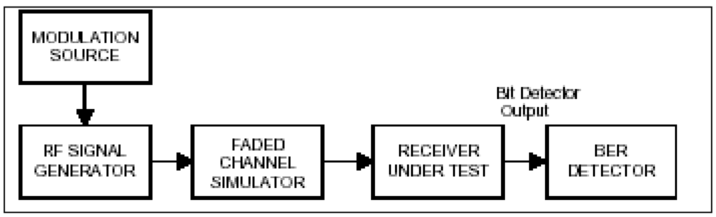


Figure F 1 Delay Spread Test Setup

a) Connect the equipment as illustrated.
b) Apply a standard input signal to the receiver input terminals, with the standard test pattern, through a faded channel simulator
c) Adjust the faded channel simulator to provide a two equal ray composite signal with independent Rayleigh fading corresponding to 8 km/h.
d) Connect a bit error rate detector to the bit detector output of the receiver.
e) Adjust the delay between the two rays to achieve the various DAQ criteria as well as sufficient additional bit error rates to be able to graph a family of bit error rates when measured over a time interval of at least t seconds, where t is defined by the following:

   $t = 180{,}000 / ((F_{MHz}) (S_{km/h}))$

   Where:

   F_{MHz} is the receiver operating frequency in MHz

   $S_{km/h}$ is the vehicle speed in km/h.
f) Record the delay between the two rays.

[22)] The definition and method of measurement is the same as TIA -102.CAAA-B § 2.1.6 “Signal Delay Spread Capability” with the addition of steps h) and i) to provide the additional data needed for this process.

g) Repeat step e) for the channel simulator adjusted for 100 km/h.
h) The smaller of the delays recorded in steps e) and f) for each bit error rate is the signal delay spread capability for that bit error rate.
i) Create a table of the values from step h).
j) Plot the results as a continuous curve from 0.2% bit error rate to 8% bit error rate.

F.1.2.1 Scaling Method Discussion

By measuring this data, the asymptotes for different delay spread criteria become known. From the C_F/N for the various DAQ criteria, the faded sensitivity at a delay spread of zero is known, Table A-1. The delay spread curves for the various DAQ values can then be scaled from a single known curve. The recommended known curve value is 5% BER, Figure F 3.

One known curve is needed to develop the scaling. An example is shown in Figure F 2 for C4FM. This curve is the result of a large number of simulations, enough to produce a smooth curve. A table of the final values used to create the curve is critical so that unnecessary interpolation of a curve is not necessary. During the simulations, the signal power of both equal signals ought to be 3 *dB* less than the signal level used to compute the C_f/N. For example to simulate a 40 *dB C/N*, each signal would be 37 *dB* above the noise floor, combining to produce a 40 *dB C/N*.

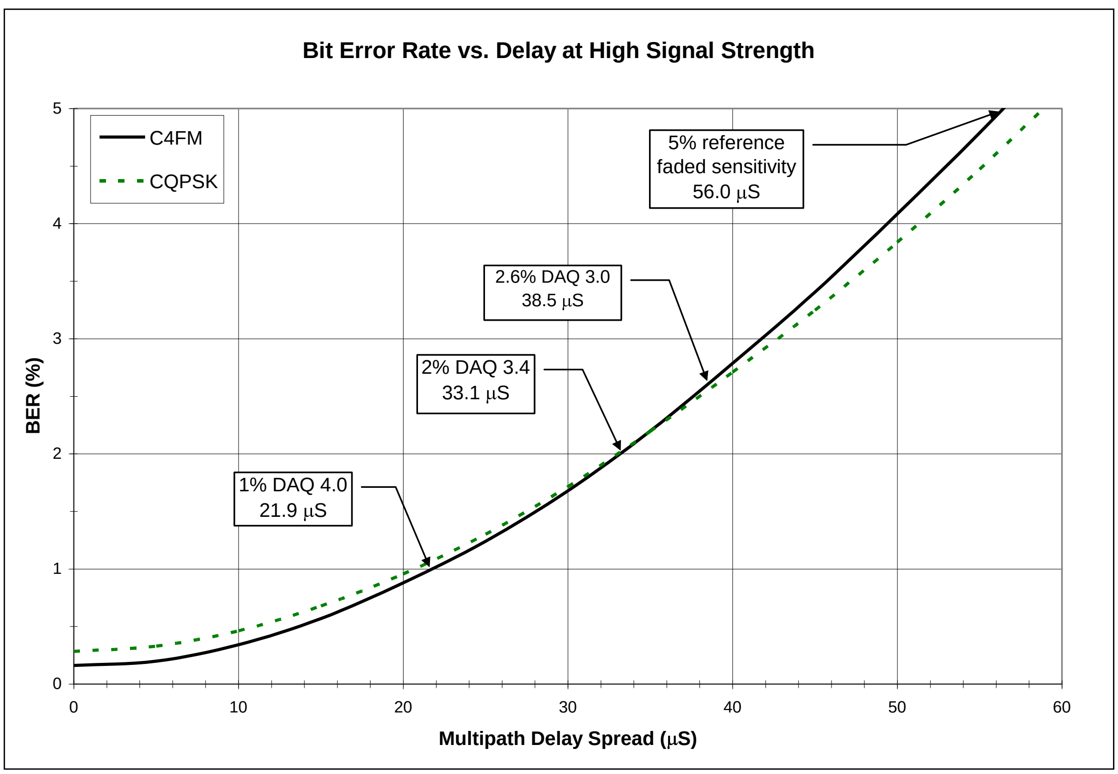


Figure F 2 C4FM BER% vs. Delay at Standard Signal Strength Example

Note that the 5% BER occurs at *Tm* = 56 µS for C4FM. The other DAQ values can be found in Figure F 2 or Table A 1. The asymptote value is the same as the two equal standard signal levels for the different BER% criteria.

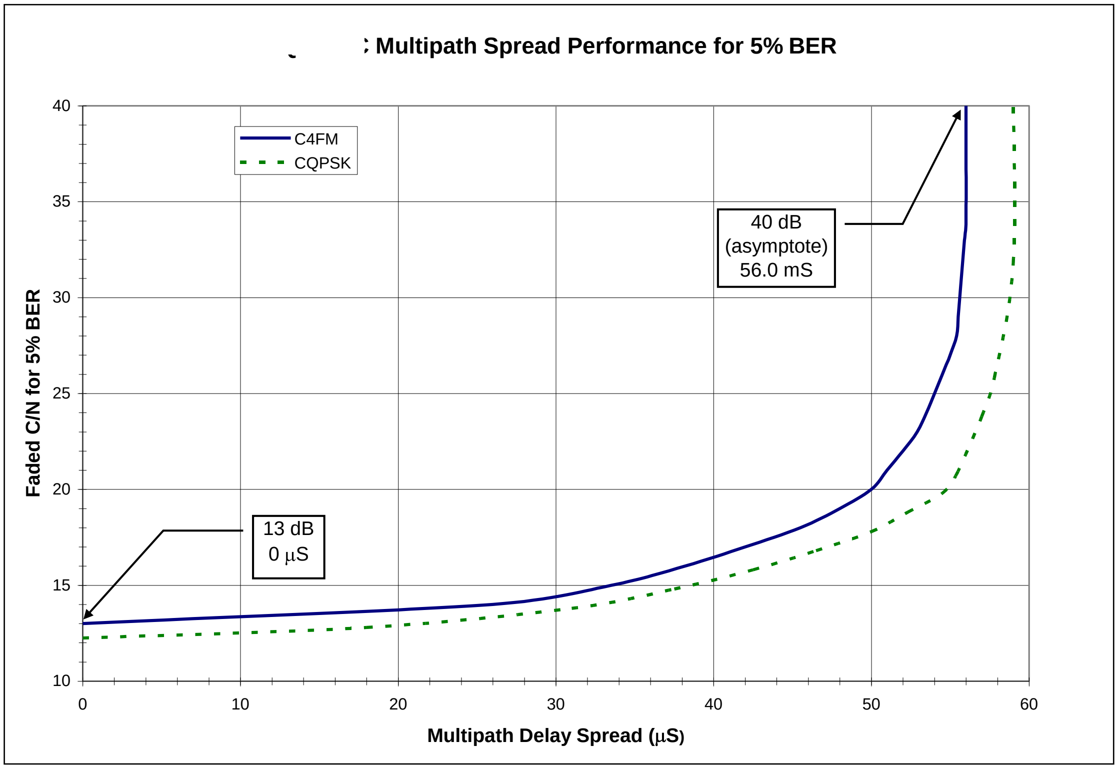


Figure F 3 Delay Spread vs. $C_{F/}N$ *for 5%* BER Sensitivity

The data in Figure F 3 was scaled and the ratio of *Tm/ Tm (max)* computed. For each DAQ, the ratio was multiplied by *Tm (max)* for that DAQ. The C_f/N values for the different DAQs are available in Figure F 2 for this example or Table A-1 for other modulations.

In Table F1, column 1 lists the 1 *dB* steps of sensitivity reduction and the corresponding value of *Tm* in column 3. Column 2 is the loss of reference sensitivity relative to the sensitivity at *Tm* = 0. Column 4 is the value of the delay spread at each recorded value divided by the asymptote value, which is listed at the top of that column.

The adjacent columns 5, 7 and 9 list the sensitivity from the BER% at *Tm*=0, incremented by the same 1 dB steps as in the column 2. The asymptote value is recorded at the top of columns 6, 8 and 10. The *Tm* for each case is then computed by multiplying the *Tm(max)* for a given criteria by its associated *Tm/Tm(max)* in column 4. For example, for DAQ=3, and the loss of sensitivity at 4 *dB* (20.5 dB -16.5 *dB*), from column 4 the value of *Tm(max)* is 0.75 so the corresponding value for DAQ=3 with a 4 *dB* loss of sensitivity for 2.6% BER is 38.50 *0.75 = 28.88 µS.

The results are plotted in Figure F 4 and compared to measured data for 1% and 2% BER. The agreement is well within the precision of the scaling.

Table F 1 C4FM Scaling Example

1	2	3	4	5	6	7	8	9	10
Scale Master from 5%		Tm Max =	56.00 uS	Tm(max) = **38.50 uS**		Tm(max) = **33.10 uS**		Tm(max) = **21.89 uS**	
ref	Δ C/N	Tm	Tm/Tm(max)	**DAQ = 3.0**		**DAQ = 3.4**		**DAQ = 4.0**	
13 dB	0 dB	0.0 uS	0	**16.5 dB**	0.00 uS	**17.7 dB**	0.00 uS	**21.2 dB**	0.00 uS
14 dB	1 dB	26.0 uS	0.46428571	17.5 dB	17.88 uS	18.7 dB	15.37 uS	22.2 dB	10.16 uS
15 dB	2 dB	33.5 uS	0.59821429	18.5 dB	23.03 uS	19.7 dB	19.80 uS	23.2 dB	13.09 uS
16 dB	3 dB	38.2 uS	0.68214286	19.5 dB	26.26 uS	20.7 dB	22.58 uS	24.2 dB	14.93 uS
17 dB	4 dB	42.0 uS	0.75	20.5 dB	28.88 uS	21.7 dB	24.83 uS	25.2 dB	16.42 uS
18 dB	5 dB	45.5 uS	0.8125	21.5 dB	31.28 uS	22.7 dB	26.89 uS	26.2 dB	17.79 uS
19 dB	6 dB	48.0 uS	0.85714286	22.5 dB	33.00 uS	23.7 dB	28.37 uS	27.2 dB	18.76 uS
20 dB	7 dB	50.0 uS	0.89285714	23.5 dB	34.38 uS	24.7 dB	29.55 uS	28.2 dB	19.54 uS
21 dB	8 dB	51.0 uS	0.91071429	24.5 dB	35.06 uS	25.7 dB	30.14 uS	29.2 dB	19.94 uS
22 dB	9 dB	52.0 uS	0.92857143	25.5 dB	35.75 uS	26.7 dB	30.74 uS	30.2 dB	20.33 uS
23 dB	10 dB	52.9 uS	0.94464286	26.5 dB	36.37 uS	27.7 dB	31.27 uS	31.2 dB	20.68 uS
24 dB	11 dB	53.5 uS	0.95535714	27.5 dB	36.78 uS	28.7 dB	31.62 uS	32.2 dB	20.91 uS
25 dB	12 dB	54.0 uS	0.96428571	28.5 dB	37.13 uS	29.7 dB	31.92 uS	33.2 dB	21.11 uS
26 dB	13 dB	54.5 uS	0.97321429	29.5 dB	37.47 uS	30.7 dB	32.21 uS	34.2 dB	21.30 uS
27 dB	14 dB	55.0 uS	0.98214286	30.5 dB	37.81 uS	31.7 dB	32.51 uS	35.2 dB	21.50 uS
28 dB	15 dB	55.4 uS	0.98928571	31.5 dB	38.09 uS	32.7 dB	32.75 uS	36.2 dB	21.66 uS
29 dB	16 dB	55.5 uS	0.99107143	32.5 dB	38.16 uS	33.7 dB	32.80 uS	37.2 dB	21.69 uS
30 dB	17 dB	55.6 uS	0.99285714	33.5 dB	38.23 uS	34.7 dB	32.86 uS	38.2 dB	21.73 uS
31 dB	18 dB	55.7 uS	0.99464286	34.5 dB	38.29 uS	35.7 dB	32.92 uS	39.2 dB	21.77 uS
32 dB	19 dB	55.8 uS	0.99642857	35.5 dB	38.36 uS	36.7 dB	32.98 uS	40.2 dB	21.81 uS
33 dB	20 dB	55.9 uS	0.99821429	36.5 dB	38.43 uS	37.7 dB	33.04 uS	41.2 dB	21.85 uS
34 dB	21 dB	56.0 uS	1	37.5 dB	38.50 uS	38.7 dB	33.10 uS	42.2 dB	21.89 uS
40 dB	27 dB	56.0 uS	1	40.0 dB	38.50 uS	40.0 dB	33.10 uS		

The spreadsheet shown in Table F1 is included in the CD that accompanies this document.

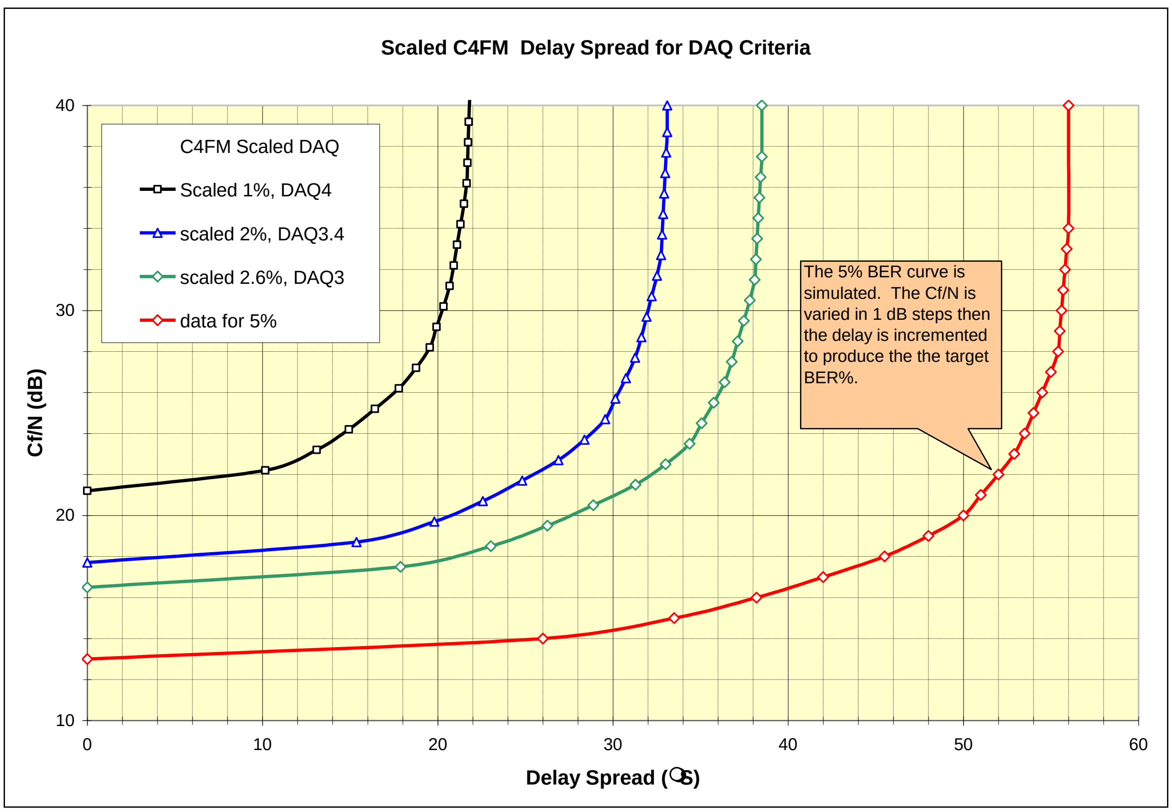


Figure F 4 Example of Scaling Other DAQ values from the 5% BER data

Other digital modulations ought to have similar shapes and be subject to similar scaling. Manufacturers are expected to supply the necessary data for this process. Even so, the entire deployment has to be considered as indicated in §F.2

The same process applied to LSM is shown in Figure F 5 and for WCQPSK in Figure F 6 . The WCQPSK data used a 6 kHz ENBW.

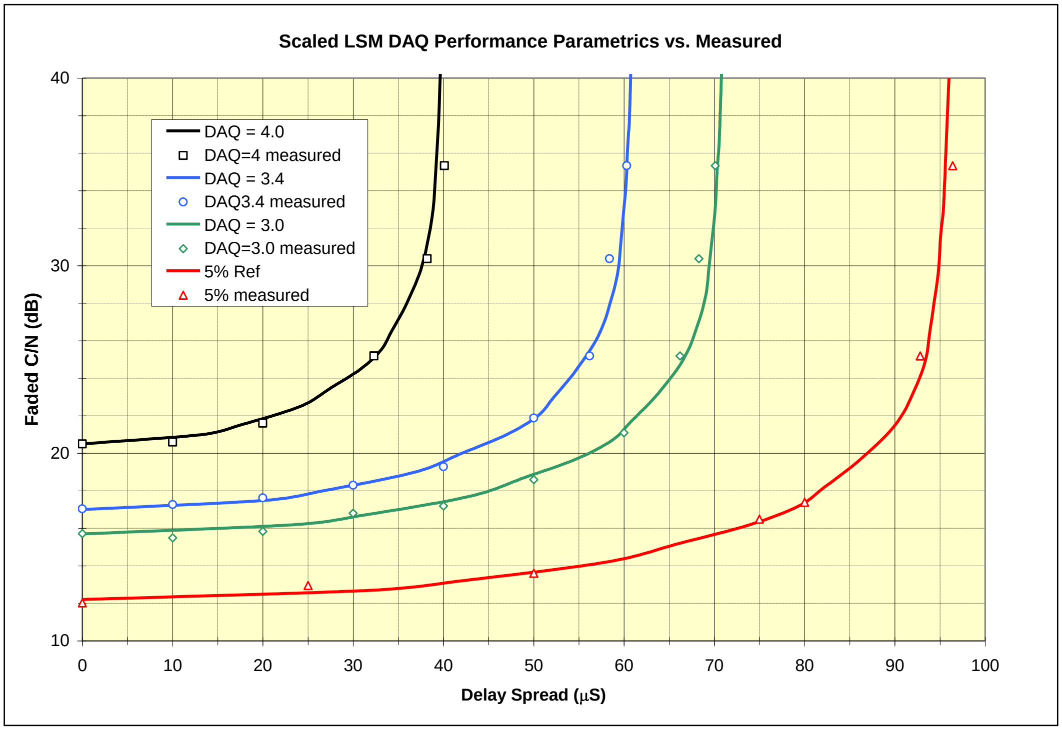


Figure F 5 LSM Scaled DAQ Parameters

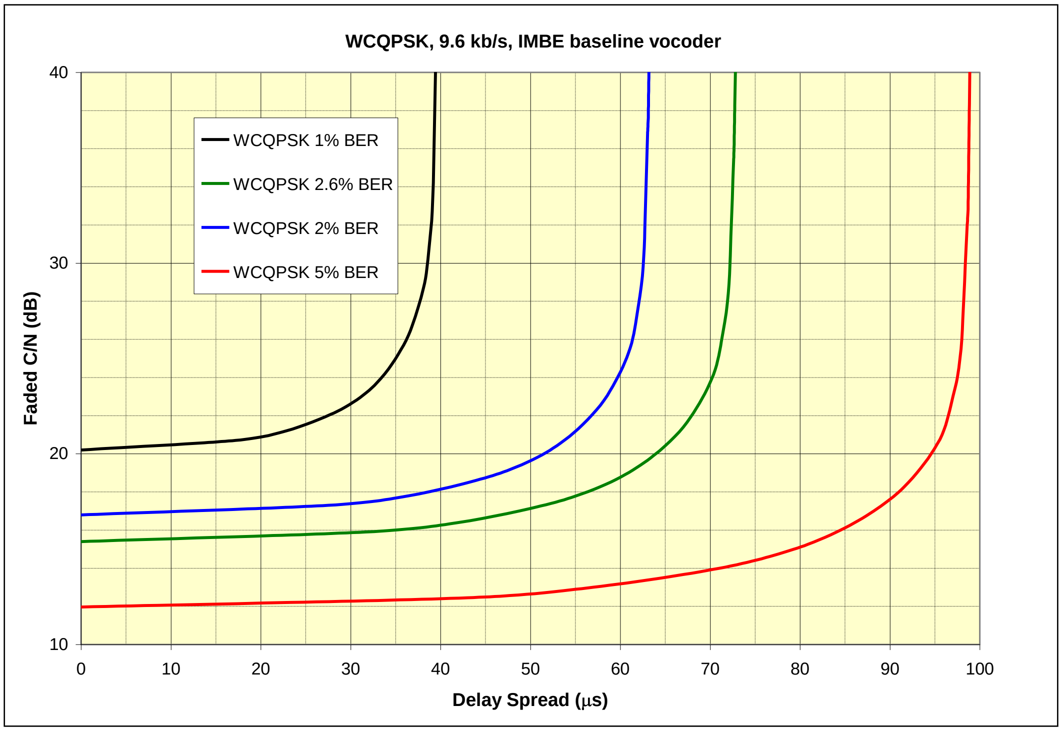


Figure F 6 WCQPSK Scaled DAQ Parameters

F.1.2.2 Analog Simulcast

This process is not being recommended for analog FM simulcast. Analog is more difficult to predict as there are no specific BER% to target, subjective testing only. As analog systems are currently being phased out by the introduction of digital modulations and narrower channel bandwidths it is not considered an efficient use of resources to develop.

F.2 Hardware Considerations

F.2.1 RF Frequency Stability

The infrastructure hardware has a definite impact on the performance of a simulcast system. "Amplitude, frequency and phase equalization are important parameters that it is recommended be controlled tightly in a simulcast system. Contact specific manufacturers for their recommended values and frequency standards performance." Meeting the delay spread values without also providing the appropriate infrastructure hardware does not assure meeting the DAQ associated with the VCPC. The delay spread measurement, §F.1.2 itself does not introduce any additional parameters that affect DAQ as only one modulation is used, split, faded independently and recombined. Therefore there is no RF frequency offset or amplitude variation in the measurement.

Infrastructure transmitter frequency differences produce deviation spikes as the phase of the carriers cancel. These noise spikes occur at the difference in frequency rate, beat frequency. Absolute synchronization essentially eliminates the deviation spikes even when the carriers are at the same level.[12][23). When there are frequency differences, the amplitude of the spike is a function of differences in the signal frequency and modulation amplitude. Increased differences in carrier frequency necessitate larger differences in carrier levels to minimize the deviation spikes. Therefore high frequency stability is recommended. Currently there are various methods to achieve the desired stability. Oscillators/synthesizers normally use atomic standards as a frequency reference. Some common sources of the atomic standards include:

- Local Cesium standard
- Local Rubidium standard
- Reference signal from GPS satellites atomic standard
- WWV reference signals[24)]

Doppler shift might seem to create frequency differences that would aggravate deviation spikes. However the received signal from a single source consists of multiple reflected waves; Rayleigh fading. Movement in this complex field consisting of multiple signals coming from different directions produces only a slight broadening of the received signal's spectrum and not a specular Doppler [1] [12].

Table F 2 indicates the affects of frequency stability on the amplitude of noise/deviation spikes produced as a function of the RF Signal difference [12].

Table F 2 Audio Noise Spike S/N vs. Differences in Carrier Frequency & RF Signal

Carrier Frequency Difference (Hz)	RF Signal Ratio for 35 *dB* Audio S/N	RF Signal Ratio for 20 *dB* Audio S/N
2	0.1 dB	0.05 dB
10	0.55 dB	0.2 dB
25	1.4 dB	0.55 dB
50	2.8 dB	1.15 dB
100	6.4 dB	2.55 dB

F.2.2 Amplitude Equalization

Digital multiplex and microwave are preferred to analog versions for amplitude equalization.

F.2.3 Simulcast DAQ Optimization

The optimization of a system's DAQ is an iterative process. Propagation predictions are conducted with initial design parameters and the results evaluated against the design criterion. Changes to parametric parameters can then be made to optimize the DAQ over the entire service area. Specific locations that fail to

---

[23)] The reference was written in 1982 when the predominant form of modulation was FM analog.

[24)] Atmospheric disruptions and antenna sizes need to be considered for this source.

meet the criteria are the primary focus of changes. The concept is to make changes that improve the performance in poor performing areas while not significantly reducing the DAQ in other areas. This involves some tradeoffs to achieve the desired DAQ over the entire service area.

Three variables are the focus of an optimization process.

- Selection of specific sites from a list of candidate sites
- Selection of antenna patterns to control relative signal levels
- Selection of site launch delays to control relative delay

There is a high degree of interaction between these variables. A successful solution involves the repetitive process of conducting computer predictions and comparing them against each other and the user's specification until a final solution is achieved. Details on simulating simulcast propagation predictions are presented in [88.2].

F.2.3.1 Site Selection

In most cases multiple candidate sites are available. Selection of an optimal combination can be achieved by comparison of various combinations. As a general rule, the greater the number of sites, the more complex is the optimization process due to the increased number of interfaces and number of variables.

F.2.3.2 Antenna Pattern Selection

The purpose of antenna pattern selection is to control the relative signal powers from different sites to improve DAQ in areas that potentially have low DAQ due to high delay spread values. Delay spread is a weighted average of the time delay differences with weights proportional to the power levels, § 5.8. The relative median signal level at various locations can be varied by adjusting the antenna pattern from a site. There are various ways this can be achieved. Selection of specific patterns, side mounted antenna tower spacing and tilt angles are all potential methods. Site launch delay selection is frequently necessary as part of this process.

F.2.3.3 Site Launch Delay Optimization

The purpose of site launch delay optimization is to purposely add delays to some sites to control the resulting time delay differences and improve DAQ in areas that would potentially have low DAQ due to high delay spread values. Delay spread is a weighted average of the time delay differences with weights proportional to the power levels, § 5.8. Site Launch delay steps ought to be available in sufficient number and small enough increments for the specific modulation's performance. Consider and compensate alternate paths when applicable. Signal levels can also be changed to control the delay spread. Antenna pattern selection is frequently necessary as part of this process.

F.2.3.4 Optimization Interactions

Figure F 7 shows the combined *C/N* of two signals. The combined *C/N* is shown in the figure as compared to the *C/N* of the dominant signal alone. Thus, if $P_1 = P_2$, the ratio of the signals is 0 *dB*, and the combined *C/N* is doubled, or incremented +3 *dB*. If the dominant signal is about 6 *dB* stronger than the other, then the combined *C/N* is increased by only 1 *dB*. The increase in *C/N* will normally lead to improved DAQ. The amount of improvement is a function of the specific modulation and absolute signal power levels.

Figure F 7 *C/N* Enhancement vs. Power Level Difference (2 ray)

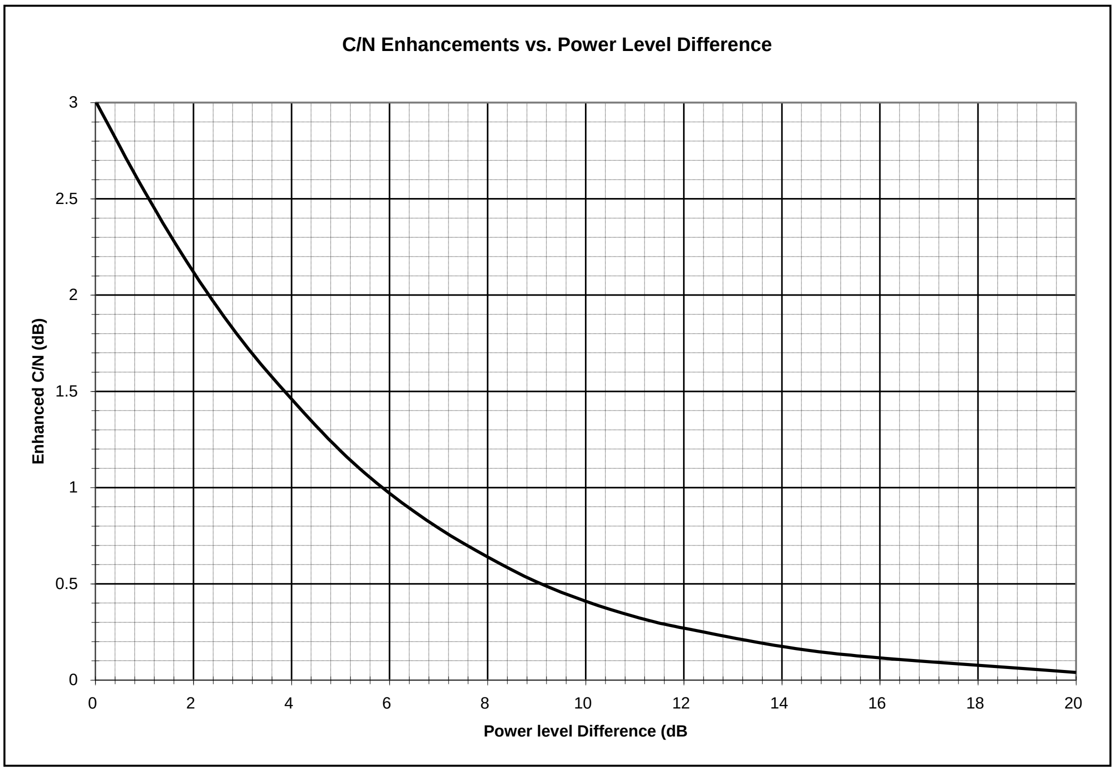
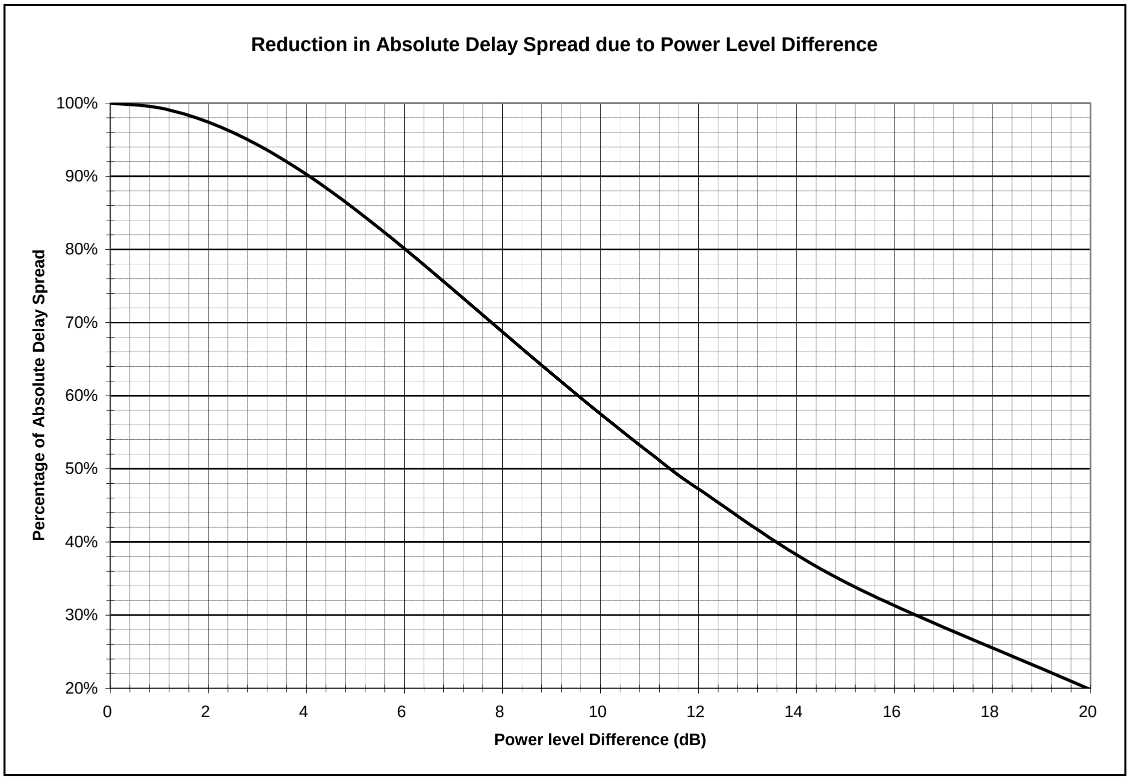


Figure F 8 shows the normalized delay spread as a function of the power ratio of two signals. The normalized delay spread is given as the ratio of the time delay difference of the two rays. Thus, if $P_1 = P_2$, the ratio is 0 *dB*, and the delay spread is 100 percent of the time delay difference of the two rays. If P_1 is about 11.5 *dB* stronger than P_2, then the delay spread is about half of the time delay difference between the two rays. The amount of DAQ improvement is a function of the specific modulation its delay spread tolerance and signal level differences. The Excel® tool, *Delay Spread Calculator.xls*, provided as part of this document can be used to calculate the 2 ray delay spread for more than 2 rays using the equations in § 5.8.

Figure F 8 Reduction in Absolute *Tm* vs. Power Level Difference (2-ray)



F.2.4 Receiver Delay Equalizers

Receiver equalizers have been discussed to increase delay spread tolerance. At this time there are no specific recommendations as availability is unknown. Issues involved include:

- Performance variations at low delay spread values
- Non linear scaling for different DAQ values
- Compatibility for interoperability involving units not equipped

F.2.5 General Recommendations

- Utilize high performance parameters for :
    - Frequency Stability
    - Amplitude Equalization
    - Audio Phase Equalization
    - Signal Delay Equalization
- Adjust ERP, HAAT and antenna patterns for Signal Delay Equalization
- Do not mix transmitter types on any given frequency of a system, i.e.

Different manufacturer

Same manufacturer, different model

ANNEX G Estimating Receiver Parameters (informative)

G.1 Overview

The ability to accurately estimate the ENBW of a victim receiver is critical in the process of determining its susceptibility to adjacent channel interference. This is especially critical in cases where non standard offset frequencies are involved such as along territorial borders and different frequency blocks with differing rule sets.

The purpose of this Annex is to provide users guidelines for estimating the ENBW and IF shape factor for different types of receivers using the application provided as part of this document.

The graphics and tables provided in the spreadsheets are based on predefined offset frequencies for the recommended model IFs. The application ACPRUtil.exe has additional capabilities to generate the ACPR for any predefined IF for a span of frequencies at some incremental step in frequency. From that information if multiple IFs are modeled then the specified ACRR of a victim receiver can be converted to an ACPR and compared to the data and an appropriate ENBW determined.

With the increasing number of receivers that can have multiple modes, there are additional considerations that could affect the ENBW. General comments are made to assist in this determination.

G.2 Application ACPRUtil.exe

Table G 1 shows the user interface for operating in the “Range Mode”. This mode allows the selection of a span and a step size within the span for a specifically identified IF. In this case the Butterworth 4-3 is used. The Corner Frequency needs to be adjusted to the desired ENBW.

Table G 1 Butterworth Filter Corrections

Filter Designator (poles-cascades)	Multiplication Factor
4-3	0.59398
5-4	0.59506

The correction (multiplication factor) used with the typical Butterworth filters recommended is given in Table G 1. The listed multiplication factor, times the desired ENBW, will calculate the input ENBW. In this case the desired ENBW is 7.8 kHz. The input is then 7,800 Hz x 0.59398 = 4,633 Hz. For cases not listed iterative runs (execute) will calculate and show the ENBW Value.

The spreadsheet “Butterworth Auto Calculate” allows a simple method of obtaining the correction factor which can be pasted directly into the working spreadsheet.

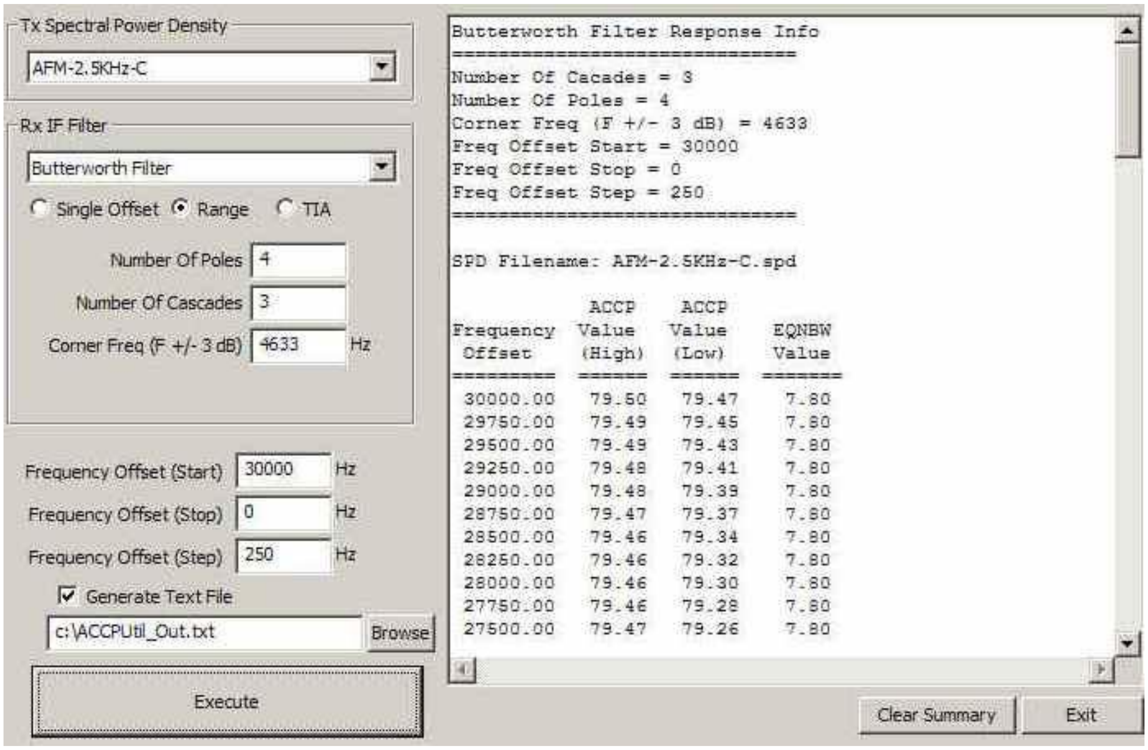


Figure G 1 ACPRUtil.exe in "Range Mode"

G.3 Graphical Views

The text file can be copied and pasted into an Excel® spreadsheet. All the data will be in one column. The data can be parsed into separate columns by using menu - Data - Text to Columns - Fixed Width to separate into 4 distinct columns. In inserting a new column between the Frequency Offset column and High ACPR[25] value. Then a simple test can be run on the high and low side values to select only the worst case.

$$\text{Worst Case} = IF(B_x \geq C_x, C_x, B_x) \qquad (10)$$

The unused columns can be eliminated so only the Offset Frequency and ACPR remain. Continue the process for different IF configurations which might be applicable. The column numbers will change for the subsequent test configurations.

The resultant data can be charted and displayed as shown in Figure G 3 through Figure G 5.

The ACPR can be converted to ACRR by subtraction the *C/N* for static reference sensitivity[26]. Table A 1 in Annex A provides this value.

[25] The application was written for TSB-88B. Since then some of the notation used has changed. ACCPR is no longer used and has been replaced by ACPR.

[26] This is generally true. Some demodulation processes provide some additional filtering that the modeling does not take into consideration.

The manufacturers' ACRR or the TIA minimum specifications can then be used to indicate the particular ENBW and configuration necessary to produce the ACPR for its companion modulation. Companion modulation is the same modulation as the receiver is configured to receive. In this example it would be narrow analog FM as the interferer to determine the IF ENBW for a narrow analog FM receiver.

$$ACRR = ACPR - \frac{C_S}{N} \qquad (11)$$ [27]

For narrow analog FM (±2.5kHz) Cs/N = 7 *dB*.

For wide analog FM (±5kHz) Cs/N = 4 *dB.*

For NPSPAC analog FM (±4kHz) C_S/N = 5 *dB.*

For P25 FDMA C4FM C_S/N = 7.6 *dB*.

See Table A 1 Annex A for other modulations.

Figure G 2 contains the minimum TIA requirements for a P25 FDMA digital radio (C4FM) at 12.5 kHz offset as well as analog FM radios for different offset frequencies [102] [603].

• Digital 12.5 kHz

Radio Application	Mobile	Portable	Base Station
Class A	60 dB	60 dB	60 dB
Class B	60 dB	50 dB	60 dB

• Receiver ENBW ≤ 6 kHz to achieve Class A specification

•Analog

Channel Bandwidth	Fixed Station	Mobile Station	Portable Station
≥ 20.0 kHz	75 dB (class A) 70 dB (class B)	75 dB (class A) 70 dB (class B)	70 dB (class A) 60 dB (class B)
15.0 kHz	65 dB (class A) 60 dB (class B)	65 dB (class A) 60 dB (class B)	65 dB (class A) 60 dB (class B)
12.5 kHz	45 dB(class A) 40 dB (class B)	45 dB (class A) 40 dB (class B)	45 dB (class A) 40 dB (class B)

•NPSPAC Analog (Special Case) 25 kHz channel, 12.5 kHz spacing

•20 dB Offset Channel Selectivity (@ ± 12.5 kHz)

•IF ENBW to meet Analog ≥ 25 kHz "A" = 16 kHz (B-4-3)

Figure G 2 P25 C4FM Digital and TIA analog ACRR Requirements

[27] For some digital modulations this equation is only an approximation as the demodulation process could provide some minor additional filtering.

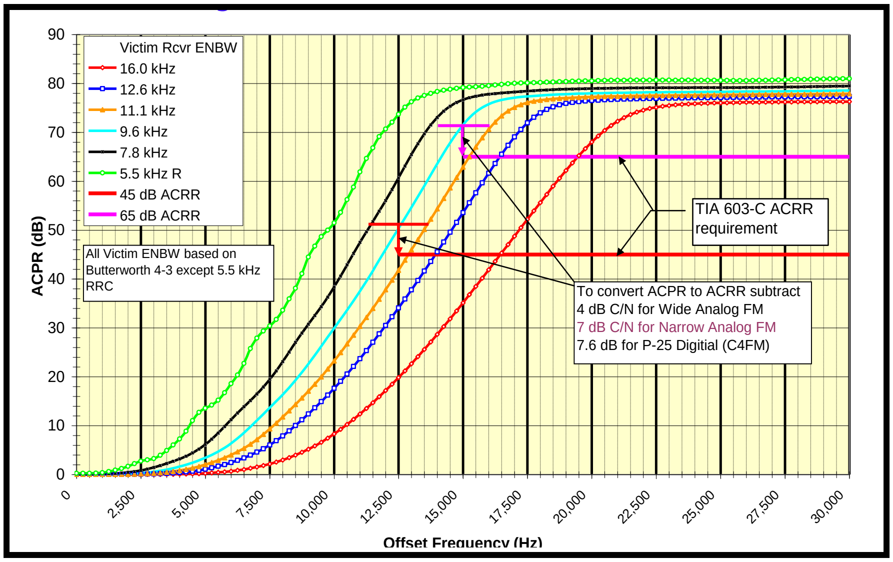


Figure G 3 Narrow Analog Chart for various IF ENBWs

The conversions for 12.5 kHz and 15.0 kHz indicate that a receiver approximately 9.6 kHz ENBW would produce the TIA minimum specification, but with little margin for frequency stability. As a result most manufacturers use a narrower IF ENBW for the narrow analog FM receivers.

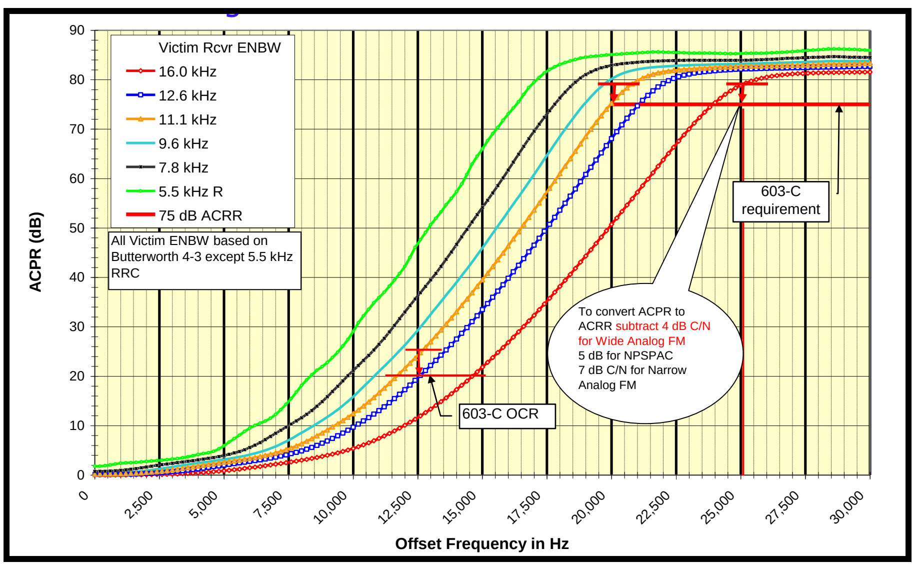


Figure G 4 Wide (±5 kHz) Analog Chart for various IF ENBWs

Figure G 4 confirms that wide analog FM needs a 16.0 kHz Butterworth 4-3 to meet the 75 *dB* ACRR TIA minimum. A special case might occur where a radio is specified with a 20 *dB* OCR therefore a narrower IF ≤ 11.1 kHz is used unless reduced deviation as in the NPSPAC portion of the band is provided.

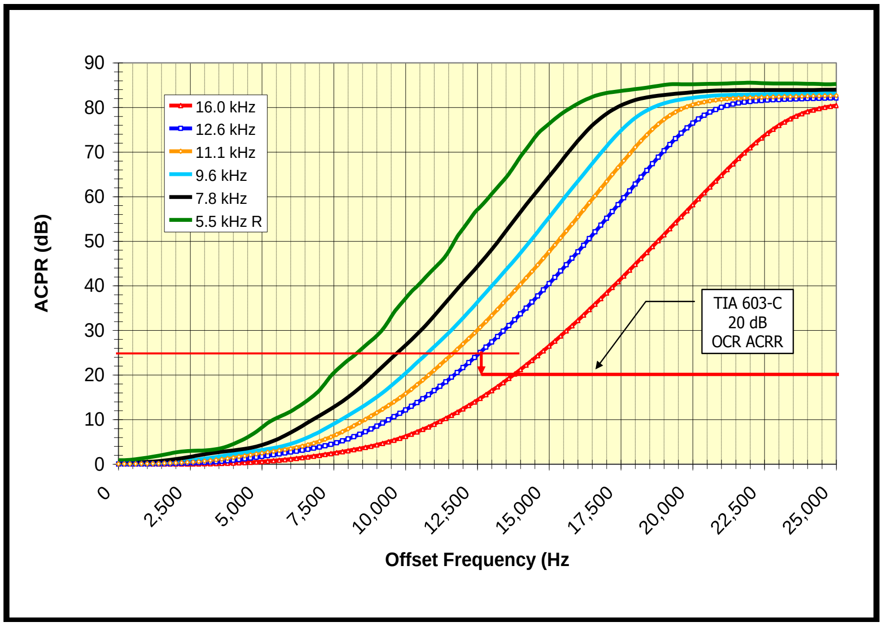


Figure G 5 NPSPAC (±4 kHz) Analog Chart for various IF ENBWs

Figure G 5 demonstrates that the lower deviation used in the NPSPAC channels allows an IF ENBW ≤ 12.6 kHz, slightly wider than the 11.1 kHz that would be needed if a radio claims 20 *dB* OCR in both the NPSPAC and the other portions of the 800 MHz band.

G.4 General Comments

This process provides a reasonable method for estimating the ENBW of a victim receiver. However, there are numerous variations that can be employed that make this a more difficult parameter to estimate. Currently only four different configurations are provided. Manufacturer's specifications can use different configurations consisting of combinations of crystal filters, Digital Signal Processor (DSP) filtering or Zero IF chips sets. Consult specific manufacturers for more detailed modeling information if desired.

G.4.1 Mixed Analog and Digital

- Radios providing P25 Digital FDMA have an ENBW less than 6 kHz.
- Narrow Analog FM receivers can tolerate wider ENBW than P25 FDMA C4FM digital radios
- Radios that provide both capabilities need the P25 FDMA C4FM ENBW

G.4.2 Wide Analog and NPSPAC operation

- Legacy Wide Analog FM (±5 kHz) receivers generally meet TIA minimum ACRR with a 16 kHz ENBW.
- NPSPAC receivers use a narrower ENBW, depending on the peak deviation utilized.

G.4.3 Mixed Wide and Narrow Analog

- Analog radios that can operate as both 25 kHz channelization and 12.5 kHz channelization could use a compromise IF ENBW to meet the more stringent TIA standards.
- Analog radios that can operate as both 25 kHz channelization and 12.5 kHz channelization could switch IF ENBW to maximize performance.

G.4.4 Class A vs. Class B ACRR

The determination of Class A or Class B specifications changes the ENBW values listed. Class A operation has been utilized in all recommendations.

G.4.5 Recommended ENBW Summary

Figure G 6 contains estimated values of ENBW that could be appropriate to use based on ACRR values from manufacturer's published catalog sheets.

Wide Analog (± 5 kHz Peak Deviation) 25 kHz Channel						
	ACRR (dB)	ENBW	ACRR (dB)	ENBW		
12.5 kHz	<8	16.0 kHz	15>25	12.4-9.4 kHz		
15.0 kHz	<18	16.0 kHz	30>40	12.4-9.4 kHz		
25 kHz	≥75	16.0 kHz	≥78	12.4-9.4 kHz		

NPSPAC Analog (± 4 kHz Peak Deviation) 25 kHz Channel						
	ACRR (dB)	ENBW	ACRR (dB)	ENBW		
12.5 kHz	20 dB OCR	12.6 kHz	≥25	11.1 kHz		
15.0 kHz	N/A					
25 kHz	≥75	16.0 kHz	≥77	≤12.6 kHz		

Narrow Analog (± 2.5 kHz Peak Deviation) 12.5 kHz Channel						
	ACRR (dB)	ENBW	ACRR (dB)	ENBW	ACRR (dB)	ENBW
12.5 kHz	45	9.4 kHz	≥50	≤7.8 kHz	≥60	<6.0 kHz
15.0 kHz	65	9.4 kHz	≥70	≤7.8 kHz	≥72	<6.0 kHz
25 kHz						

P-25 Digital (C4FM) 12.5 kHz Channel						
	ACRR (dB)	ENBW				
12.5 kHz	≥60	<6.0 kHz				
15.0 kHz	≥70	<6.0 kHz				
25 kHz	≥80	<6.0 kHz				

• Red values are TIA requirements, based on TIA methods of measurement and B 4-3 filter characteristics (conservative).
• ENBW values may be lower than the minimums shown.
• Values of ACRR >75 dB are less useful due to limited dynamic range of measured data files.

Figure G 6 Estimated ENBW Values Based On Published ACRR

ANNEX H Compact Disk (Informative)

H.1 Compact Disk Organization

Included is a CD which contains the spreadsheets referred to in the document which are the source of the data in Annex A. In addition there is the utility for building the data files that are included in Annex A and additional analysis as indicated in Annex G. These files are also available on the internet for those who selected the PDF version of TSB-88.1-D.

H.2 Root Directory

The document, *SPD Spreadsheet Instructions.PDF,* contains instructions for using the template and describes the contents of the spreadsheets. There are two folders, one containing the spreadsheets and another with the application *ACCPRUtil.exe* and its supporting files. A copy of this Annex is included in the root directory with the title README.doc

H.3 Spreadsheets Folder

The spreadsheets folder contains 25 spreadsheets.

Analog FM Radios

Analog FM ±2.5 kHz Peak Deviation (AFM 2.5kHz Dev-88_1-D.xls)

Analog FM ±4.0 kHz NPSPAC (AFM 4kHz Dev-88_1-D.xls)

Analog FM ±5.0 kHz Peak Deviation (AFM 5kHz Dev-88_1-D.xls)

Digital FDMA Radios

C4FM FDMA Project 25 (C4FM-88_1-D.xls)

dPMR-4 Level FSK FDMA (6.25 kHz) (dPMR-6.25-88_1-D.xls)

NXDN-4 Level FSK FDMA (6.25 kHz) (NXDN-6.25-88_1-D.xls)

NXDN-4 Level FSK FDMA (12.5 kHz) (NXDN-12.5-88_1-D.xls)

EDACS® Narrow Band (EDACS-NB-88_1-D.xls)

EDACS® Narrow Band (EDACS-NPSPAC-88_1-D.xls)

EDACS® Narrow Band (EDACS-WB-88_1-D.xls)

Linear Simulcast Modulation (LSM-88_1-D.xls)

Securenet, 12 kbits/sec CVSD (Securenet-88_1-D.xls)

Tetrapol (Tetrapol-88_1-D.xls)

WCQPSK (WCQPSK-88_1-D.xls)

Widepulse, (Widepulse-88_1-D.xls)

Digital TDMA Radios

DataRadio 50 kHz CH Data (DataRadio 50-88_1-D.xls)

DMR 2-Slot TDMA (DMR 2-Slot TDMA-88_1-D.xls)

F4GFSK OpenSky® (F4GFSK-88_1-D.xls)

H-CPM – P25 TDMA UL (HCPM-88_1-D.xls)
H-DQPSK – P25 TDMA DL (HDQPSK-88_1-D.xls
HPD 25 kHz Data (HPD-88_1-D.xls)
RD-LAP 9.6 Data (RD-Lap 9.6-88_1-D.xls)
RD-Lap 19.2 Data (RD-Lap 19.2-88_1-D.xls)

Cellular Type Digital Radios (TDMA)

DIMRS-iDEN® (DIMRS-iDEN-88_1-D.xls)
TETRA (Tetra-88_1-D.xls)

Other

Butterworth Auto Calculate,xls

Template for creating SPD spreadsheets (Template-88_1-D.xls)

TIA Area Coverage Estimator (TIA COV-Area.xls)

Each spreadsheet, except Wide Band Data sheets, has 9 tabs, listed left to right. The modulation abbreviation is included on each tab. For this listing “modulation” will be used instead of a specific modulation. These spreadsheets are “protected” but do not need a password to “unprotect”. Users are cautioned when making changes to the spreadsheets.

“Modulation”-ACP. This sheet is driven by the Calculator Sheet. It charts the results for a “perfect” band pass filter of bandwidth ENBW. This is useful to model FCC requirements.

“Modulation” ACPR-RRC. Driven by the Calculator, charts the configuration for the Root Raised Cosine band pass filter with a bandwidth of ENBW and a roll off factor of alpha (α). Alpha is fixed at 0.2 in all the spreadsheets.

“Modulation” ACPR-BF. Driven by the Calculator, charts the configuration for a Butterworth band pass filter with 4 poles and 3 cascaded sections or alternatively by a special case of 5 poles and 4 cascaded sections as recommended for the EDACS® modulation for a bandwidth of ENBW. See Table 6 IF Filter Specifications for Simulating Voice Receivers. The legend indicates which configuration of poles and cascaded sections is being charted, driven by the selection in the Calculator.

25-small. This is a chart of data from the TSB88D data sheet. Each chart contains three of the possible offset frequency values using a 25 kHz frequency plan with theoretical channel splits. Not all combinations are assignable, but are provided for completeness. The small offset assignments are 6.25 kHz, 9.375 kHz and 12.5 kHz. See Annex A, Figure A-1. The legend reflects the magnitude of ACPR in order of: Channel BW, RRC and But 4p-3c, corresponding to lessening selectivity. The curves are driven by the data tables in Tab TSB88D Data.

25-large. This is a chart of data from the TSB88D data sheet. Each chart contains three of the possible offset frequency values using a 25 kHz frequency plan with theoretical channel splits. The large offset assignments are 15.625 kHz, 18.75 kHz and 25.0 kHz. See Annex A, Figure A-1. The curves are driven by the data tables in Tab TSB88D Data.

30-small. This is a chart of data from the TSB88D data sheet. Each chart contains three of the possible offset frequency values using a 30 kHz frequency plan with theoretical channel splits. The small offset assignments are 7.5 kHz, 11.25 kHz and 15.0 kHz. See Annex A, Figure A-1. The curves are driven by the data tables in Tab TSB88D Data.

30-large. This is a chart of data from the TSB88D data sheet. Each chart contains three of the possible offset frequency values using a 30 kHz frequency plan with theoretical channel splits. The large offset assignments are 18.75 kHz, 22.5 kHz and 30.0 kHz. Note that the 18.75 kHz offset is also possible in a 25 kHz plan. See Annex A, Figure A-1. The curves are driven by the data tables in Tab TSB88D Data.

TSB88D Data. This sheet contains the data from ACPRUtil.exe (see § 5.7.1.3 for information on the application) and is the source data for the charts on sheets 4 through 7 described above. The data from ACPRUtil.exe can be pasted into the appropriate tables on the left hand side of this sheet. The left hand side tables drive the tables further to the right creating the figures that are presented in Annex A for the modulation being evaluated. Note that the utility provides information for a 10p-4c configuration which is no longer utilized. However the data sheets eliminates that information allowing ACPRUtil.exe to be utilized without modification.

Calculator. This sheet provides complete flexibility to calculate any offset value for any ENBW band pass value for the four filters. A feature allows the calculation of the bandwidth occupied by a requested percentage of the waveform's power is included. The selection of high or low offset frequencies and the selection of which defined Butterworth Filter is provided in sheet 3. There is a separate Butterworth calculator which can be used to evaluate other filter configurations An additional spreadsheet is included which allows numerous predefined Butterworth filters to be modeled and the results can be pasted from that sheet into the calculator cell M4 to determine the resulting ACPR for the ENBW desired.

H.4 ACPR Utility Folder

This folder contains the utility ACPRUtil.exe and the data files necessary to support the application for that modulation. Place the data files in the same directory (folder) for the utility to properly access them. In addition a sub folder "acprout" contains the output files that were used to create the TSB88D Data files in the spreadsheets.

H.5 Additional Applications

The following spreadsheet tools are available on the CD or available to download from the internet.

TIA Area Coverage Estimator (TIA COV-Area.xls)

Butterworth Auto Calculate (Butterworth Auto Calculate.xls)

Noise Adjusted Performance (Noise Adjusted Performance Example C24.xls)

[END OF DOCUMENT]

THE TELECOMMUNICATIONS INDUSTRY ASSOCIATION

TIA represents the global information and communications technology (ICT) industry through standards development, advocacy, tradeshows, business opportunities, market intelligence and world-wide environmental regulatory analysis. Since 1924, TIA has been enhancing the business environment for broadband, wireless, information technology, cable, satellite, and unified communications.

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