

Testing Automatic Link Establishment High Frequency Radios Using Compact Disc Technology Part I: Clean Tones

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CONTENTS

	Page
GLOSSARY	v
ABSTRACT.....	1
1. OVERVIEW	1
2. BACKGROUND ON HF RADIOS AND ALE	2
3. HISTORY OF STANDARDIZED ALE TESTING.....	3
4. USING AUDIO CDS FOR INTEROPERABILITY TESTING	6
5. METHOD OF GENERATING TEST FILES	8
6. INITIAL TESTING	12
7. SUMMARY AND FUTURE DIRECTIONS.....	12
8. ACKNOWLEDGMENTS	13
9. REFERENCES	14
APPENDIX A: ALECALL PROGRAM.....	15
APPENDIX B: FTSC TEST PLAN FOR INTEROPERABILITY AND PERFORMANCE OF ALE RADIOS	25
APPENDIX C: APPENDIX I TO ALE TEST PLAN - SUGGESTED FORMAT OF STANDARD TEST AUDIO COMPACT DISC.....	41
APPENDIX D: APPENDIX II TO ALE TEST PLAN - LOG SHEETS FOR RECORDING TEST DATA WHEN USING THE STANDARD TEST AUDIO COMPACT DISC	61
APPENDIX E: AUDIO COMPACT DISC LAYOUT TO IMPLEMENT THE HF ALE RADIO TEST PLAN	69
APPENDIX F: USING THE COMPACT DISC	73

CONTENTS (cont'd.)

	Page
APPENDIX G: NARRATION FOR TRACK 1 ON THE AUDIO CD.....	97
APPENDIX H: ACQUIRING THE SOFTWARE.....	101
APPENDIX I: EVALUATION FORM FOR NTIA AUDIO COMPACT DISC 01A ALE CLEAN TONES FOR FED-STD-1045A AND 1046/1	107

GLOSSARY

ALE: Automatic Link Establishment; a set of protocols defining the capability of an HF radio to link with another HF radio without operator assistance, under processor control.

allcalls: general broadcasts that do not request a response; can include automatic message display (AMD) messages.

anycalls: calls that request responses without designating specific addresses; can include link quality analysis and automatic message display calls.

automatic message display (AMD): short orderwire message using an expanded 64-character ASCII subset of the full 128-character ASCII.

clear channel: pure ALE tones with no degradations from noise, multipath, or fading.

command line arguments: arguments or parameters that are passed to the program; when invoking the program, they are typed after the program name at the computer prompt before pressing <ENTER>; in ALECALL, command line arguments include the filenames of input files and switches that invoke different modes of operation.

data text message (DTM): orderwire message transmissions that can be full ASCII or binary data; includes an acknowledgement request in the kd4 bit.

data word: the part of the basic ALE word that is described by the 3-bit preamble that precedes it; the data word consists of three 7-bit characters.

degraded conditions: the addition of noise, multipath, and/or fading, making the signal less clear.

group call: a call made to several stations without prearrangement.

interoperability: implies that two or more different systems, regardless of vendor, can effectively exchange information.

link quality analysis (LQA): used to rank channel quality; LQA is an exchange of information on the quality of the link between the radios, including bit error ratio (BER) and signal-plus-noise-plus-distortion to noise-plus-distortion ratio (SINAD).

NFM: noise, fading, or multipath (degraded tone) condition.

NFM parameters: input variables within the protocol file defining noise, fading, or multipath, set by the user as follows:

```
#
#a '*' defines a time delay or pause in integer Trw's (n * 0.392 s)
#a '!' defines total silence in integer Trw's (n * 0.392 s)
#
# $ SEQUENTIAL          # add Noise/Multipath in sequence it appears
#                       # in the *.pro file; default: Multipath
#                       # first, Gaussian noise second
# INITIALIZE            0 # Random seed; range: 0-65535;
#                       # default: 0 = use time of day
# LEVELSCALE            0.25 # default: 0.25 for full program, 0.50 for
#                       # Gaussian only program; range: 0.0 to 1.0
# fading
# FADEBANDWIDTH         1.0 # Hz; default: 0.0; range: 0.1 to 10.0
# multipath
# DELAY                 .6 # ms; default: 0.0; range: 0.1 to 9.9
# SCALINGRATIO          1.0 # default: 1.0; range: 0.1 to 1.0
# Gaussian noise
# NOISEBANDWIDTH        3000 # Hz; default: 0; range: 200 to 9900
# S/N                   10 # dB; default: 99.9; range: -20.0 to +80.0
# NFM                   ON # add degradation; default:OFF; range:ON, OFF
#
```

preamble: the part of the basic ALE word that describes the data word that follows; there are eight possible 3-bit preambles: THRU (represented by 001 in binary), TO (010), FROM (100), COMMAND (110), DATA (000), THIS IS or TIS (101), THIS WAS or TWAS (011), REPEAT (111).

protocol file: the first part of the ALE tone generation; it is the input file to ALECALL program; it represents the basic ALE call with an easily read and understood ASCII format; an ALE preamble with the accompanying data word is represented by one line of the ALE protocol file; the line also contains an L or R leading character designating whether this ALE word is to be recorded on the left or right channel of the sound file; the last item on a line of the protocol file is a number indicating how many times this ALE word will be repeated before the next ALE word begins; the pause or silence between ALE words is represented by a "*" (or a "!") and an integer; this integer represents the duration of the pause or silence in multiples of redundant word time (T_{rw}) of 392 ms.

sound file: the output of the ALECALL program, digitized at a sample rate of 44.1 kHz, in either wave format for the sound card, or digital audio (DA) format for the CD.

sounds: unilateral broadcast transmissions that are used by receiving stations to determine optimal channels.

star netcalls: a prearranged collection of member stations in a network.

T_{rw} : the transmission time for the three repetitions of the 49-bit ALE words, 392 ms.; redundant word time.

T_w: the transmission time for a single 49-bit ALE word, one-third of a T_{rw} ($1 * T_{rw} = 3 * T_w$) or approximately 130.7 ms; this unit is useful for calculating the wait times for replies and slotwidth times of the time slots in group calls.

time slot: the time allotted to a radio responding to a star netcall within which it must respond; the time slots are designated on the right channel of the test disc.

tone file: an octal representation of the ALE frequency tones (8-fsk modulation) that result from word encoding and interleaving, transmitted by the radio; the tone file is an output of ALECALL in normal mode. The tone file is also input to ALECALL in another mode to generate calibration files of one or more of the 8 ALE frequencies.

UUT: unit under test; the radio being tested in an interoperability test.

Testing Automatic Link Establishment High Frequency Radios Using Compact Disc Technology Part I: Clean Tones

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A method of high frequency (HF) radio interoperability testing in accordance with Federal Standards 1045A and 1046/1 is now available on a compact disc (CD) created by engineers at the National Telecommunications and Information Administration, Institute for Telecommunication Sciences. This report describes both the use of the CD and the software that created the sound files recorded on the CD. The sound files, which can be recreated by the program on a personal computer and played through a PC sound card, were recorded on a compact disc and packaged with the executable software for distribution to the public. The use of the CD for interoperability testing is explained, and tools are provided to simplify testing, such as data log sheets and additional utility software.

Key words: FED-STD-1045A; FED-STD-1046/1; automatic link establishment; ALE; interoperability; compact disc; CD; high frequency (HF) radio

1. OVERVIEW

Automatic Link Establishment (ALE) is a cornerstone in the growing trend of automation and ease in operation of high frequency (HF) radios. Federal Standard FED-STD-1045, the first in the family of automated and adaptive HF radio standards, and Military Standard MIL-STD-188-141A define minimum features required in an ALE radio procured by a U.S. Government agency. The goal of the U.S. Government is over-the-air interoperability for all agencies citing these standards in their procurement. The National Telecommunications and Information Administration, Institute for Telecommunication Sciences (NTIA/ITS) has conducted performance and interoperability tests on HF ALE radios. This testing typically has been a costly and time-consuming process. In an effort to simplify performance and interoperability testing, NTIA/ITS has produced the first audio compact disc (CD) that implements standard reference tones of ALE radio calls. This production was in response to an HF Industry Association (HFIA) request for a "standard" test tape of tones that encodes key specific functions of the Government standards. In addition, a companion floppy

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computer disk provides listings of the protocols used in generating the CD. A prototype CD was provided free of charge in November 1993, to all members of the HFIA and interested U.S. Government agencies. The CD provides an easy-to-use and documented implementation of FED-STD-1045A and FED-STD-1046/1. Users of the CD provided suggestions for improving the CD and the standardized test procedures and protocols. The final version of the ALE Clean Tones CD (CD-01a) was produced in December 1994.

This document describes the background and gives an overview of the software method used to create the digital audio sound files for the CD. The primary software for producing the sound files is a DOS program written in "C" called ALECALL. Details of the software structure and use of the CD are in the Appendices. Appendix A includes several flowcharts that describe the software, including an ALECALL Structure Chart; logic flowcharts for several key modules; and the Data Flow Diagram. Appendix B contains all of the documentation from the computer floppy disk that accompanies the CD. The test plans, details of software use, and test setup are included in Appendix B.

The ALE Clean Tone audio compact disc and the tone files that make up the collection of audio sounds used for testing the FED-STD-1045A and FED-STD-1046/1 HF radios are copyrighted (c) 1994 by the U.S. Department of Commerce. This collection of tones, or audio information, is referred to as NIST Special Database 17.

2. BACKGROUND ON HF RADIOS AND ALE

Due to the automation and ease of operation of ALE radios, HF radio communications are now available to anyone, regardless of experience and training. The ALE HF transceiver has embedded computer-controlled sounding, channel scanning, and adaptive channel-selection techniques. These techniques are dictated by the variable HF propagation environment and formerly required an experienced radio operator. The task of operating an HF radio is much easier with ALE because channel selection, sounding, and scanning are automated. The soundings are used to rank the channel frequencies assigned to the radio. Each time a channel is evaluated, it is ranked based on signal strength and on recent past performance. Later, when the transceiver is placing a call, the channels are selected according to their respective rank until a link is established. This link is accomplished by a three-way handshake (Figure 1). Typically, an unoccupied ALE radio returns to the scan or listening mode. When it receives an initial call, it returns a response to the originating radio, which in turn sends back an acknowledgment, thus completing the link establishment.

Federal Standards define all of the protocols that comprise ALE radio operations. FED-STD-1045A describes the minimum ALE features required in an ALE radio procured by a Federal agency, such as single- and multiple-channel individual (station-to-station) calls and single- and multiple-channel sounding. Some optional features in FED-STD-1045A are required in FED-STD-1046/1 (Table 1). These features include orderwire link quality analysis (LQA), used to rank channel quality; orderwire message transmission such as automatic message display (AMD) for short orderwire ASCII

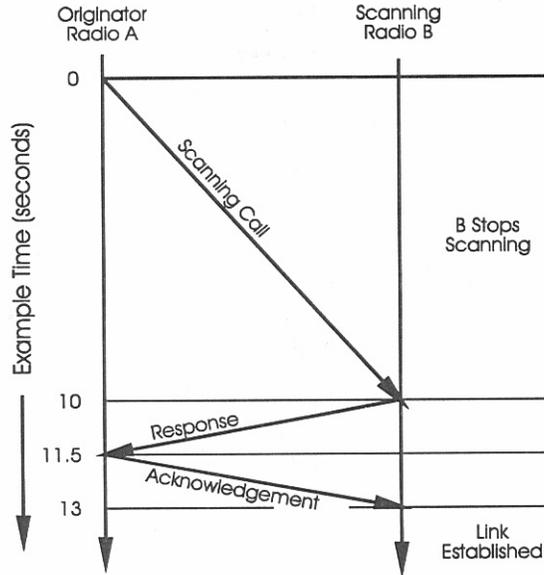


Figure 1. Example of a three-way handshake used by HF ALE radios to establish a link.

messages; data text message (DTM) for ASCII or binary data transmission; and cyclic redundancy check (CRC), which is used to assure data integrity on any form of message [1]. ALE radios also have the ability to link with multiple stations in prearranged groups, called star nets, or groups that have not been prearranged; these protocols are also defined in these standards.

3. HISTORY OF STANDARDIZED ALE TESTING

Federal agencies procuring HF ALE radios have used laboratory and field testing to ensure interoperability and performance of the units under test (UUT) as specified in the Federal standards. Interoperability implies that two different systems, regardless of vendor, can effectively exchange information. Testing the candidate radios to verify that they meet the mandatory requirements of FED-STD-1045 and FED-STD-1046/1 ensures that all of the ALE radios purchased by a Federal agency will interoperate. Unfortunately, testing has typically been an arduous and costly process.

The interoperability testing and performance evaluation techniques initially used by the Government were complex and required transporting either test equipment to the manufacturer's location, or the radios to the Government laboratories and field test sites. After rigorously checking the functionality of two identical systems, the probability of linking was measured in the lab under various simulated atmospheric conditions using portable, narrowband, propagation channel simulators (Watterson model; [2]). Because performance is measured between two radio systems and because the ALE protocol uses the three-way handshake, two identical HF propagation channel simulators were required for this phase of the testing. Vendors were required to demonstrate over-the-air interoperability with the other vendors' radios at various sites to complete the testing process [3].

Table 1. Summary of the Basic Functions of the FED-STD-1045A Family of HF ALE Radio Standards (M = Mandatory, O = Optional, Blank = not addressed)

Functions	FS-1045	FS-1045A	FS-1046/1 & proposed FS-1046, Sections				
	1/24/90	10/18/93	1 10/93	1A	2	3	4
INDIVIDUAL CALLS							
Single Channel	M	M	M	M	M	M	M
Multiple Channel	M	M	M	M	M	M	M
SOUNDING							
Single Channel	M	M	M	M	M	M	M
Multiple Channel	M	M	M	M	M	M	M
ORDERWIRE - LQA							
LQA - SINAD	O	M	M	M	M	M	M
LQA - BER	M	M	M	M	M	M	M
LQA - Multipath				M	M	M	M
ORDERWIRE - MESSAGES							
AMD	M	M	M	M	M	M	M
CRC	O	O	M	M	M	M	M
Message - DTM: Basic & Extended	O	O	M	M	M	M	M
Message - DBM: Basic & Extended	O	O	O	M	M	M	M
MULTIPLE STATIONS							
Star Net	M	M	M	M	M	M	M
Star Group		O	M	M	M	M	M
Allcalls	M	M	M	M	M	M	M
Anycalls		O	M	M	M	M	M
Multipoint Net				M	M	M	M
Multipoint Group				M	M	M	M
Wildcard Calls			M	M	M	M	M

These interoperability tests must be performed more than once in some cases. As each new adaptive radio standard is issued, at least two more sets of tests must be performed: proof-of-concept testing prior to the release of the Standard and interoperability and performance testing. Although the Standards were intended to describe basic ALE requirements, some functions were interpreted differently by the vendors. Thus, two radios from different vendors, each allegedly complying with the Standard, may not interoperate due to subtle differences in implementation.

After the first testing for Government procurement was performed in 1990, a need for improved, standardized testing was recognized [4]. A standardized test media could facilitate the testing process and clearly illustrate expectations for an ALE radio procured by a Federal agency. This need prompted the High Frequency Industry Association (HFIA), in conjunction with the Armed Forces Communications and Electronics Association (AFCEA), to propose twelve types of tests that cover all of the mandatory features of the two Government ALE radio standards (Federal and Military). The HFIA proposed that a Government agency create a standardized tape or audio compact disc that would support all of the suggested tests. Since the standards also specify performance requirements, the test plan included procedures for using both high quality clear channel tones and degraded tones (that would occur due to noise, multipath, and fading). The degraded tones would simulate ionospheric propagation conditions as defined by the International Radio Consultative Committee (CCIR) Recommendation 520-1 [5,6].

The format for a standardized test includes all the mandatory and optional features in FED-STD-1045 and mandatory features in FED-STD-1046/1 (Table 2; [1]). The HFIA-suggested test plan was modified and adopted by the Federal Telecommunication Standards Committee (FTSC) and is included in Appendix B. The ALE features to be tested are:

- 1) Sounds—unilateral broadcast transmissions—are used by receiving stations to determine optimal channels. The test plan calls for various combinations of characters to form the sounder's address.
- 2) Allcalls—general broadcasts that do not request a response—include both simple allcalls, with and without automatic message display (AMD) messages, and selective allcalls to demonstrate proper and improper addressing.
- 3) Individual calls—calls made to specific addresses—include LQA and AMD. The LQA is an exchange of information on the quality of the link between the radios and is used by the radios to rank the channels. This information includes bit error ratio (BER), the ratio of errored bits to received bits, and signal-plus-noise-plus-distortion to noise-plus-distortion ratio (SINAD).
- 4) The ALE standard also requires the capability to set up a prearranged collection of member stations in a network. These star netcalls consist of simple calls and calls with LQA and AMD.
- 5) A group call is a call made to several stations without prearrangement and is tested as are star netcalls. In the same manner, anycalls—calls that request responses without designating specific addresses—are tested as simple, LQA and AMD calls, and also include calls to demonstrate proper and improper addressing.
- 6) Wildcard calls—calls made using an address with one or more of the special wildcard character (the “?” symbol)—are tested with three- and six-character-length addresses [7].

Table 2. HFIA-suggested Format for a Standard Test Tape or CD

Section	Type of Call	Comments
1	Sounds	Many addresses using all characters in the allowed set
		Noise added at three signal-to-noise levels for a selected address
2	100 Quick Sounds	Mix of long and short addresses
3	Allcall	Simple and with AMD
4	Selective Allcall	With known and foreign address
5	Individual Calling	With four levels of LQA in acknowledgement
6	Star Netcalls	Simple and with LQA and AMD
7	Star Group Calls	Simple and with LQA and AMD
8	Anycalls	Simple and with LQA and AMD
9	Selective Anycalls	With known and foreign address
10	Wildcard Calls	With length of three and six characters
11	AMD	90-character message in response section of a call
12	Performance Tests with Allcall & AMD	100 calls for each of the 12 sets of conditions in FED-STD-1045 matrix

4. USING AUDIO CDS FOR INTEROPERABILITY TESTING

The “clear channel” test CD contains all of the calls described in the above section. The HFIA-suggested test plan is the basis for the functions implemented on the audio CD test disc, described herein. The development of a standardized test disc greatly facilitates the interoperability and performance tests. This inexpensive test disc allows U.S. Government agencies and HF radio developers and vendors to test and verify HF radio interoperability and compliance with the Federal standards using a common set of reference tones.

Traditionally, a radio has demonstrated interoperability by first successfully accepting, as the receiving radio, all of these test calls from a standard ALE radio (transceiver and ALE controller) and then by reversing the process and correctly transmitting the same calls to a standard radio. To use the ALE CD, a CD with a transceiver is substituted for the ALE controller in the first part of the testing process. The performance tests are completed by executing a simple call 100 times for each condition of clear channel and the suite of degraded channel conditions of noise, multipath, and fading. The probability-of-linking statistics are compiled from this suite of 100 calls.

The ALE waveform consists of an 8-ary frequency-shift keying (FSK) modulation containing eight orthogonal tones, each of which represents three bits of data. The bits are first encoded and interleaved to constitute a word; this word is 8-ary FSK modulated, transmitted, and then decoded at the receive station. A computer program emulates an ALE radio by encoding the various calls into ALE tones [8]. The ALE tones are located on the left stereo channel of the CD; timing, example responses, and verbal information to assist the test operator are on the right channel. When testing ALE radios in the laboratory, a transmit radio and a receive radio are required. The ALE tone files can be played through an ordinary audio CD player, replacing the ALE controller in the first phase of the laboratory testing. The ALE tone files may also be played through a sound card on a PC; this is discussed in Appendix C.

The ALE tones are sent, after impedance-and level- matching, through the microphone input (VOX) line of an HF radio transceiver (Figure 2). The right channel is played through an audio amplifier and speaker. Radio #2 transceiver antenna port output is passed through a 50-ohm RF load and attenuators into radio transceiver #1. The signal, which can be fed through the HF channel simulator for degraded ionospheric propagation conditions, is received by the ALE Controller #1, the UUT. If the signal is not degraded by the channel simulator, then the resulting clean tones can be used to ascertain the receive/decode level of interoperability of the UUT. Degraded ionospheric propagation conditions, either digitally added to a test CD or added with an HF channel simulator, test the

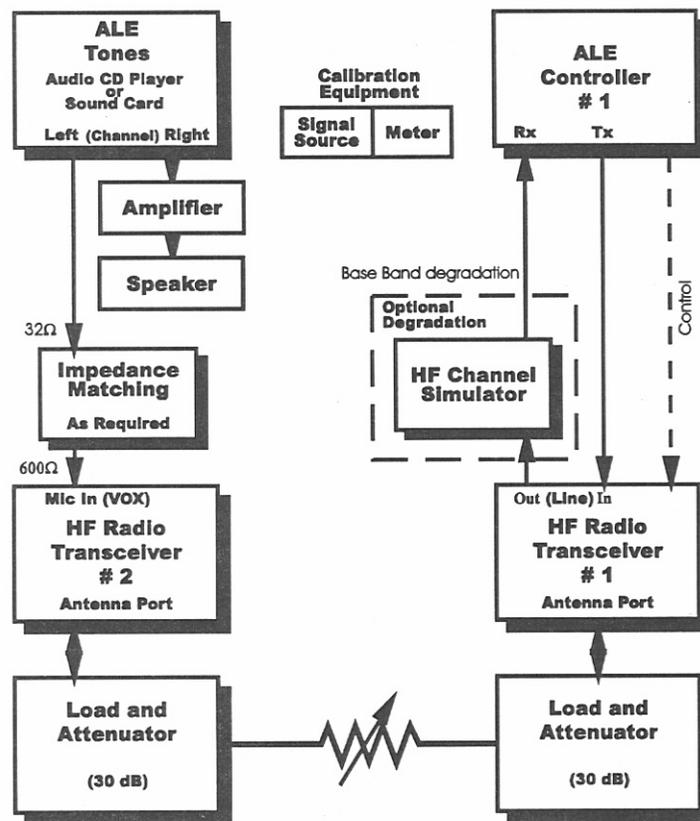


Figure 2. Equipment setup for one-way radio testing.

performance of the radio under adverse conditions. In this manner, a CD can be used for both interoperability and performance testing. The test calls, thus automated, can be consistently repeated as needed. If the UUT can indicate linking status, and if the CD player is set in repeat mode, then tedious and repetitious testing can be automated.

Interoperability testing cannot be performed completely using an audio CD because the CD player is a one-directional device. It will continue to play the proper responses and acknowledgements regardless of whether it is sent a correct signal. Thus, it can only be used to test the receive functions of an HF ALE radio, in the first phase of testing. Transmit functions are tested in the second phase, after the receive functions are successfully tested (Figure 3). The transmit function tests repeat the first phase tests and must be executed by another UUT radio that is substituted for the CD player/radio module. The UUT that has completed the receive tests would remain in place and receive the same calls as in the first phase, this time transmitted by the second UUT. Thus the CD test disc serves as a representation of the Federal standards for the first phase of interoperability testing. The digitally recorded tone files greatly improve the testing procedure by defining and clarifying the Federal standards, and by offering a consistent, easily repeatable and inexpensive test medium.

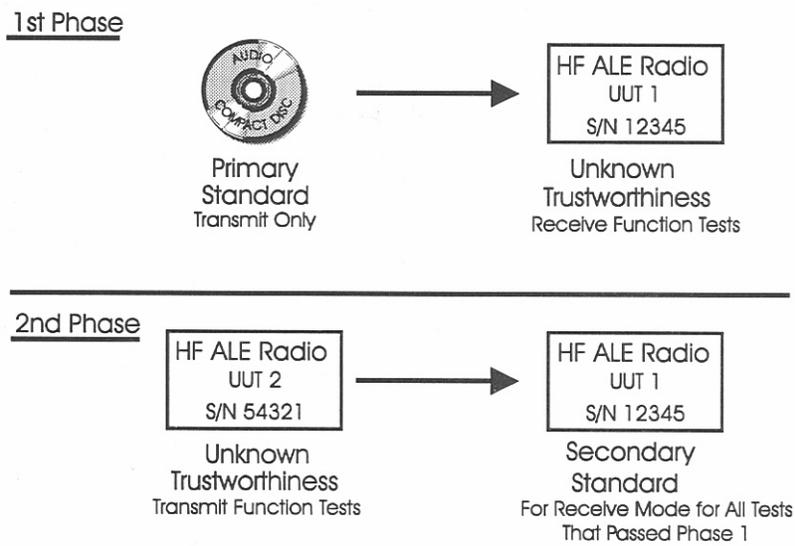


Figure 3. Two-step process for interoperability testing with an audio CD.

5. METHOD OF GENERATING TEST FILES

Because it is not feasible to manually decipher the digitally recorded ALE sounds or binary representations in the sound file, it is essential that the method of generating the ALE tone test files includes a complete audit trail of input protocol, encoded tones, and the output sound file tones. Three files are used to track the operation of the program that generates the calls (Figure 4):

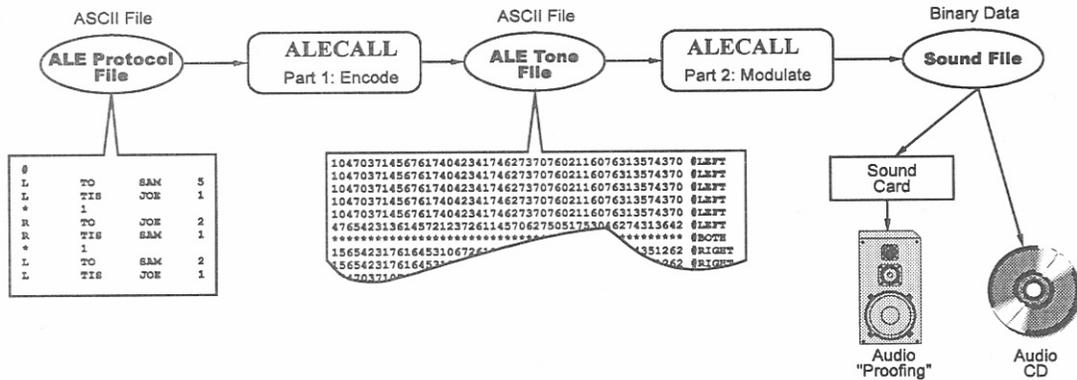


Figure 4. Software technique for generating sound files that contain ALE tones.

- 1) The ALE protocol file: the actual ALE words defined in FED-STD-1045.
- 2) The ALE tone file: an octal representation of the ALE frequency tones transmitted by a radio; they are the result of the word-encoding and interleaving.
- 3) The sound file: the resultant sounds digitized at a sample rate of 44.1 kHz, in either wave format for the sound card, or digital audio (DA) format for the CD.

This three-part process has been developed as a computer program, "ALECALL," at NTIA/ITS. This program created the sound files for the first "clean tones" CD Beta test disc (recorded in August 1993) and the final version CD-01a Clean Tones Disc. The program also can add degraded channel conditions to the test calls to indicate radio performance.

The basic ALE call is represented by an ALE protocol file in ASCII format that is easy to understand. The basic ALE word consists of a 3-bit preamble and a data word of three 7-bit characters, resulting in a total of 24 bits. There are eight possible preambles, such as TO (represented in binary by 010), FROM (100), COMMAND (110), and DATA (000) that describe the data word. A preamble with the accompanying data word appears as one line of the ALE protocol file (Figure 4). This line begins with an L or R, designating whether this ALE word is recorded on the left or right channel of the sound file. The line ends with a number indicating how many times this ALE word will be repeated before the next ALE word begins. A pause or silence between ALE words is represented by a "*" (or a "!"). An integer value of the duration in redundant word time (T_{rw}) is also included ($1 T_{rw} = 392$ ms). This ALE protocol file is the input to the ALECALL program that encodes the ALE words as described in FED-STD-1045A and produces the tone file and the sound file.

During an ALE radio call, each ALE word is divided into two 12-bit halves. These are Golay-encoded into two 24-bit words and are interleaved to form a 48-bit word. An additional stuff bit is added to produce a 49-bit word. This word is transmitted three times to overcome the effects of environmental conditions. The transmission time for the three 49-bit words is 392 ms, or one T_{rw} .

The receiving station then performs a 2-out-of-3 majority vote, bit by bit on the three redundant words, and completes the decoding process.

The ALECALL program, using the ALE encoding modules from the HF Automatic Link Establishment Simulator program [5] encodes each ALE word as described above. The three 49-bit ALE words, when converted into octal format, represent the ALE 8-ary FSK frequencies since each of the eight ALE tones represents 3 bits of data. These 49 octal digits are recorded in an ASCII ALE tone file as part of the audit trail created by the program (Figure 4). Also recorded is the channel designation: right, left, or both. Periods of silence are represented in the tone file by a “*”. A radio responding to a star netcall must respond within a designated time slot, as described in FED-STD-1045. The right channel of the test disc has time-ticks that mark the slot width times for the ALE netcall responses. Using these time-ticks, the test operator can determine if the UUT responded to the Star netcall during the correct time slot, as defined by ALE protocols in FED-STD-1045A. A “T” designates a time-tick in the tone file, followed by the appropriate number of asterisks (*) for silence. This tone file, created by the ALECALL program, records this additional information on the right channel. The tone file also records the ALE tone representation of the call on the left channel and, as such, is a frequency representation of the modulation that an ALE radio would make.

Sound files, created from the tone files, can be played either through a sound card or a CD player. Each ALE tone transmission is 8 ms long (a transmission rate of 125 tones per second). Since each ALE tone represents 3 bits, the transmitted bit rate is 375 bps. The standard sampling rate of a CD is 44.1 kHz, so each tone is represented by a cosine wave of approximately 353 samples. The elapsed time, used to calculate the cosine waves, facilitates the smooth transitioning between the 8-ms frequencies. The sample values of the cosine waves, with 16-bit sampling, can range from $+ [2^{15} - 1]$ to $- [2^{15} - 1]$. The time-ticks, which mark the star netcall slot widths, sound like a noise pop on the CD. The ticks are created with a 8-ms duration, 1000-Hz signal followed by silence to fill the slot-width duration.

The ticks can also be produced another way, demonstrated by the following example. Files were prerecorded of an ITS staff member speaking each number from 1 to 16 and a few words such as “start” and “stop.” Instead of inserting the 8-ms duration, 1000-Hz noise pop, the appropriate word or number was added in each slot. Thus, “start” was recorded in slot 0, “one” in slot one, “two” in slot two, and so forth to the last slot. Each sample, whether a tick, a cosine wave or silence, was written to the sound file in binary format.

The wave file played through a sound card has been an invaluable tool for software development and demonstrations at the NTIA/ITS laboratories. Any ALE call can be created and tested in a few minutes. Questions on radio functions can be instantly tested and answered. As Federal standards are interpreted and implemented through the protocol file, the call can be created and perfected quickly and easily. Using commercially available software, the wave files or parts of the wave files can be visually examined and analyzed with such tools as the Fast Fourier Transform (FFT). The ALECALL software could also be used by developers to create test calls as needed. As a further aid to industry, NTIA/ITS released in 1994 the floppy disk containing the ALECALL executable

software, also available to the public via the internet. Thus industry has a valuable development tool for prototyping new features that may be incorporated into later issuances of the Federal and Military standards. All of the documentation files that support use of ALECALL and CD-01a are in the Appendices and are described in Table 3.

Table 3. ALECALL Documentation Files from the CD-01A Companion Floppy Disk

Documentation Title	Floppy Disk Filename	Appendix	Purpose
FTSC Test Plan for Interoperability and Performance of ALE Radios	ftip-man.*	B	the basis of the project
Appendix I to ALE Test Plan - Suggested Format of Standard Test Audio Compact Disc	ftip-ap1.*	C	modified and implementable adaptation of the FTSC Test Plan; directly corresponds to tracks on CD-01a
Appendix II to ALE Test Plan - Log Sheets for Recording Test Data When Using the Standard Test Audio Compact Disc	cdlog01a.xls, cdlogx.xls, sounds.xls, read-log.txt	D	provided to facilitate testing with CD-01a; they directly correspond to the disc
Audio Compact Disc Layout to Implement the HF Radio Test Plan	cd-layout.*	E	shows the CD track listing
CD-Info Information for Users of the ALE Clean Tones Compact Disc 01a	cd-info.*	F	explains the software usage and the protocol files that are read by the program to determine the ALE call parameters; test equipment setup is also outlined
ALE Clean Tones on Compact Disc 01a	readme.1st	F	describes all of the files on the floppy disc
Calculations for Slot Widths on Compact Disc 01a	slotwidth.wp5	F	worksheet for calculating the slot widths for net and group calls
Narration for Track 1 on the Audio CD	cd-intro.wp	G	text of CD Track 1 narration
How To Receive ALECALL Software Package Via FTP	readme.too	H	contains instructions for the Anonymous FTP of the software
Request for NTIA ALE Software and Documentation	ale-wan2.*	H	used by ITS personnel to track software requests
Evaluation Form for NTIA Audio Compact Disc 01a	evaluate.*	I	a form for software and CD suggestions and comments

* Indicates a file that is available under three file types and extensions: .wp for Word Perfect files, .ps for PostScript files (or .eps for Encapsulated PostScript), and .txt for ASCII files.

Instructions for obtaining the software are included in Appendix H. Basic program operations and specific information on the protocol and tone file formats are described in Appendix F, CD-INFO Information for Users of the ALE Clean Tones Compact Disc 01a.

6. INITIAL TESTING

The Beta version of the clean tones ALE test CD was distributed to various vendors and Government agencies in November 1993. Most of the Beta test users were enthusiastic about the possibilities of using an audio CD for testing. A clear example of how all the basic functions of an ALE radio are expected to perform is now available to all vendors through the CD.

Initial use and analysis uncovered a few errors in the Beta release; some were protocol file errors in the creation of the CD and were easily corrected on the final release in December 1994. Some of the errors, however, indicate problems with either the HFIA-suggested test plan or with the vendors' interpretation of the Federal and Military standards. Some of these problems required consensus by the HFIA user community on the correct protocol. Others had to be resolved by the FTSC. Thus, the ALE Clean Tones CD-01a was instrumental in both the transfer of technology to industry and in fine-tuning the Government standards.

The ALECALL program has also been used successfully in the laboratory to quickly analyze an apparent interoperability problem uncovered by a Federal agency. The agency was testing two different brands of HF ALE radios. They discovered that after linking between the two radios the first brand (vendor X) could send an AMD message to the second brand (vendor Y), but vendor Y could not send the AMD message to vendor X. Using the ALECALL program through a sound card on a PC, NTIA/ITS personnel created a suite of tests to analyze the various implementations of AMD messaging used by the vendors. Eight different calls were created, each testing a slightly different protocol variation in an ALE AMD call. It was discovered that one of the ALE radios had implemented a required feature of the standard, while the other radio had not. This resulted in two different implementations of AMD messaging and noninteroperability for that specific function. The ability of a laboratory to quickly recreate each of the vendors' protocol implementations and pinpoint the exact nature of the problem demonstrates the power and value of the ALECALL software in the laboratory.

7. SUMMARY AND FUTURE DIRECTIONS

The Federal standards for HF ALE radios specify expected linking performance under simulated atmospheric conditions of Gaussian noise, and CCIR Good and Poor channels at various signal-to-noise ratios. CCIR Good is defined as a fading bandwidth of 0.1 Hz and a multipath delay of 0.5 ms; CCIR Poor has a 1.0-Hz fading bandwidth and a 2.2-ms multipath delay (modified from CCIR Recommendation 520-1) [6]. Both are invoked at various Gaussian signal-to-noise ratios. The next iteration of the ALE test CD will incorporate signal degradation caused by noise, multipath, and

fading using the Watterson channel model [2]. A simple ALE call will be repeated under the matrix of simulated atmospheric conditions. A set of 12 CDs, one for each atmospheric condition at a given signal-to-noise ratio, will be produced; each CD will have 100 calls. With these CDs, a vendor that cannot afford to purchase an expensive propagation channel simulator can test HF ALE radio performance under the degraded conditions specified in the Federal standard. The techniques used to produce CD-01a could also be used to create tests with other ionospheric models.

NTIA/ITS periodically conducts radio interoperability and performance tests of HF ALE radios using the Federal standards. The ALE test CD is currently being used on a supplemental basis with these tests. As the viability of the test results from the CD is demonstrated, it is expected that the CD will be utilized for a major portion of this testing.

The ALE test CD is a versatile, inexpensive tool that has already proven to be invaluable in testing ALE radio interoperability and performance in accordance with the Federal standards. Developers and purchasers of ALE radio equipment now have a clear, primary standard for uniformly evaluating HF radios. The ALECALL software is an equally useful tool in ALE radio development. The software can be used to interpret and implement new and proposed ALE features. Using either the CD or the software, the features of the ALE Federal standards can be demonstrated easily and quickly. NTIA/ITS, through the CD-01a and the ALECALL software, has made the Federal standards, and thus, the Federal procurement process, available to all HF ALE radio vendors and operators.

8. ACKNOWLEDGMENTS

Contributing behind the scenes to the implementation and production of the CD was M. Bielkiewicz, a student employee. The sponsor of the ALE tones on Compact Disc is the National Communications System (NCS.) The points of contact at NCS are D. Bodson and S. Karty:

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NCS - NT
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703-607-6204 (Group Secretary)
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karty@cc.ims.disa.mil (E-mail)

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APPENDIX A: ALECALL PROGRAM

This appendix contains both general and detailed software charts of the ALECALL program. The charts describe the logic flow of the program and of key modules, the modular structure of the program, and the data flow. The ALECALL overview logic flowchart explains the ALECALL program execution (Figure A-1). The program is executed with command line arguments. The switches that invoke the various modes of operation are explained in the help menu which may be accessed by typing "alecall" without any other command line arguments. No switches are used to run the program in normal mode; switches are used to change the expected input format, output file, or add debugging, or chimes. The name(s) of the input protocol files to be made into sound files must be designated on the command line for the program to run. Wildcard designations for the file names, such as "*" or "?", may be used. Typing "alecall filename.pro" invokes the program in normal mode. The program initializes its variables and structures, parses the command line to set the mode of operation, and opens the first protocol file on the command line. It reads each line in the protocol file, ignoring comments. The noise, fading, or multipath (NFM) input parameters are stored until an initialize command is read, at which point the degraded conditions are set and the filters are made. Degraded conditions can be turned on and off anywhere in the protocol file. ALECALL modulates the ALE word into the 49 ALE tones. The ASCII octal representation of the 49 tones is recorded in a tone file named filename.ton and the tones are converted to 16-bit, 44.1-kHz sampled cosine waves. These waves are written to the sound file after any specified NFM conditions are added to the signal. The process is repeated for the ALE word as many times as designated in the line of the protocol file. When all the repetitions are written to a file, the next line is read and processed, until the end of the file is reached. The file handling procedure is repeated, reading each protocol file specified on the command line, until all of the protocol files have been converted to tone and sound files.

The ALECALL structure chart (Figure A-2) shows the different modules of the program and the calling hierarchy (which procedures are called and by whom). Main parses the command line and calls make_it, which does most of the work of the program, to process each input file. The last overview chart is the high level data flow diagram (Figure A-3). Flowcharts for the most important program modules follow. There are three logic flowcharts: the main module (Figure A-4), the NFM module (Figure A-5), and the make_it module (Figure A-6). The main module logic flowchart shows the flow of the main body of the program. The NFM module explains the procedure for turning NFM conditions on and off. It also shows when new conditions are saved or used. The make_it flowchart describes how each line of the input file is parsed and converted into a sound file representing an ALE call.

The ALECALL program has several modes of operation. It can directly convert a tone file into a sound file. This is the way the two calibration tracks on the Clean Tone CD-01a were created: the second track 1,000-Hz tone and the third track stair-step of all 8 ALE tones. The tone file must be in the exact format as that of a tone file produced by the program. The process is a truncated version of the normal execution, beginning at the point where the ALE tones are converted to cosine waves; it is invoked with a command line switch. The program reads the input tone file and converts the octal representations of the ALE tones into the 16-bit, 44.1-kHz sampled cosine waves and writes

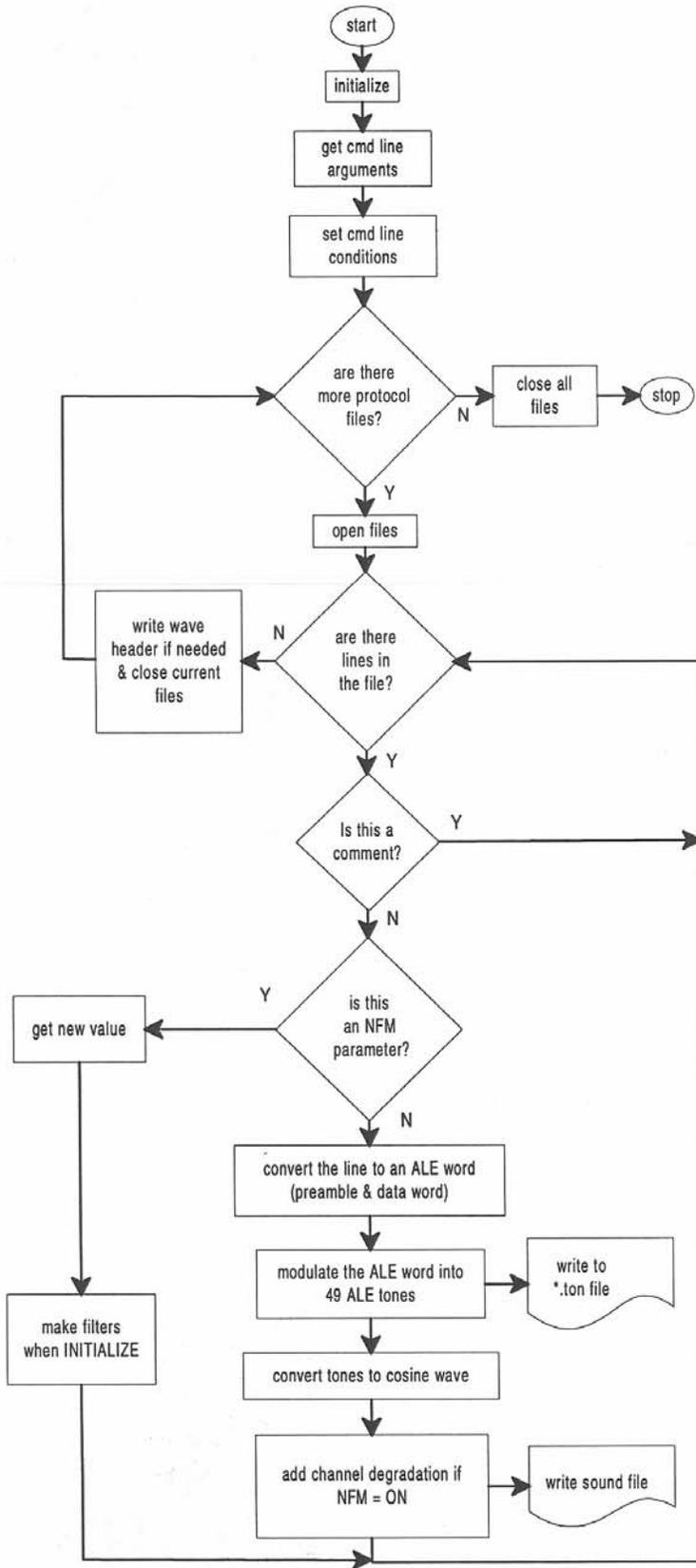
the samples to the sound file. Only clean tone files may be created since the channel degradation conditions are specified in the protocol file. Because the first part of the ALE conversion process (building the tone file) is already accomplished before the program begins and channel degradation is not added, this mode is the fastest method of producing the sound files.

The ALECALL program can also be run to produce only tone files. In this mode the input protocol files are quickly converted to tone files. Although NFM parameters can be specified in the protocol file, they will be ignored since the tone file contains no NFM information. Another operating mode, the verbose mode, may be run concurrently with any of the others. This mode provides additional information on the computer screen to assist and inform the user of the program operations.

Four utility programs are included with the ALECALL program. These programs facilitate the use of the ALECALL software by either encoding difficult features of ALE or providing information on playing the sound files. ALETIME uses the input protocol files to compute the running times of the sound files. The protocol files to be computed are specified on the command line when the program is invoked. The program writes, to the computer screen, the running times of each individual file and the total running time.

The other three utility programs, C-AMD, C-DTM, and C-LQA, assist the user in preparing the protocol file with the following ALE call features: AMD messaging, DTM messaging, and LQA transmissions and requests. Protocol files produced by the utility programs can be read by ALECALL. C-AMD encodes the AMD message specified on the command line and writes it to a protocol file. The command line parameters include the call signs of the sender and the receiver, and either the message in single quotes or the name of the file containing the message. C-DTM is invoked in exactly the same manner with the addition of the kd4 [1] specification: "1" for acknowledgement request or "0" for no acknowledgement request. C-LQA also uses the call signs of the sender and receiver as input parameters. In addition, a control bit, the SINAD, BER, and debug mode may be specified if desired. If an LQA response is chosen, the SINAD and BER are not included. The help screens for these utility programs are in Appendix F, CD-INFO Information for Users of the ALE Clean Tones Compact Disc 01a or may be invoked by typing the program name with no other command line parameters.

Figure A-1. ALECALL overview logic flowchart for normal execution.



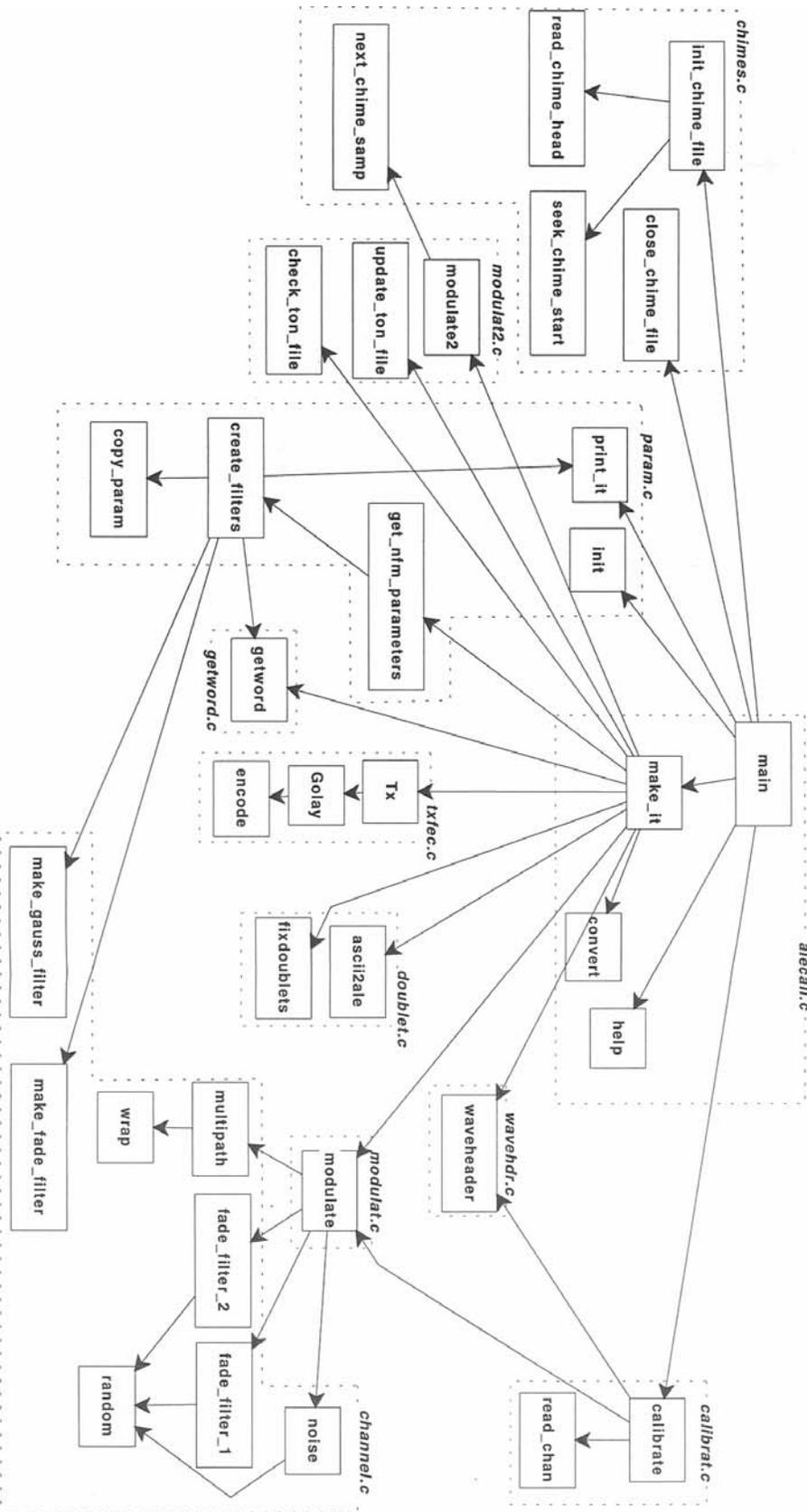


Figure A-2. ALECALL structure chart.

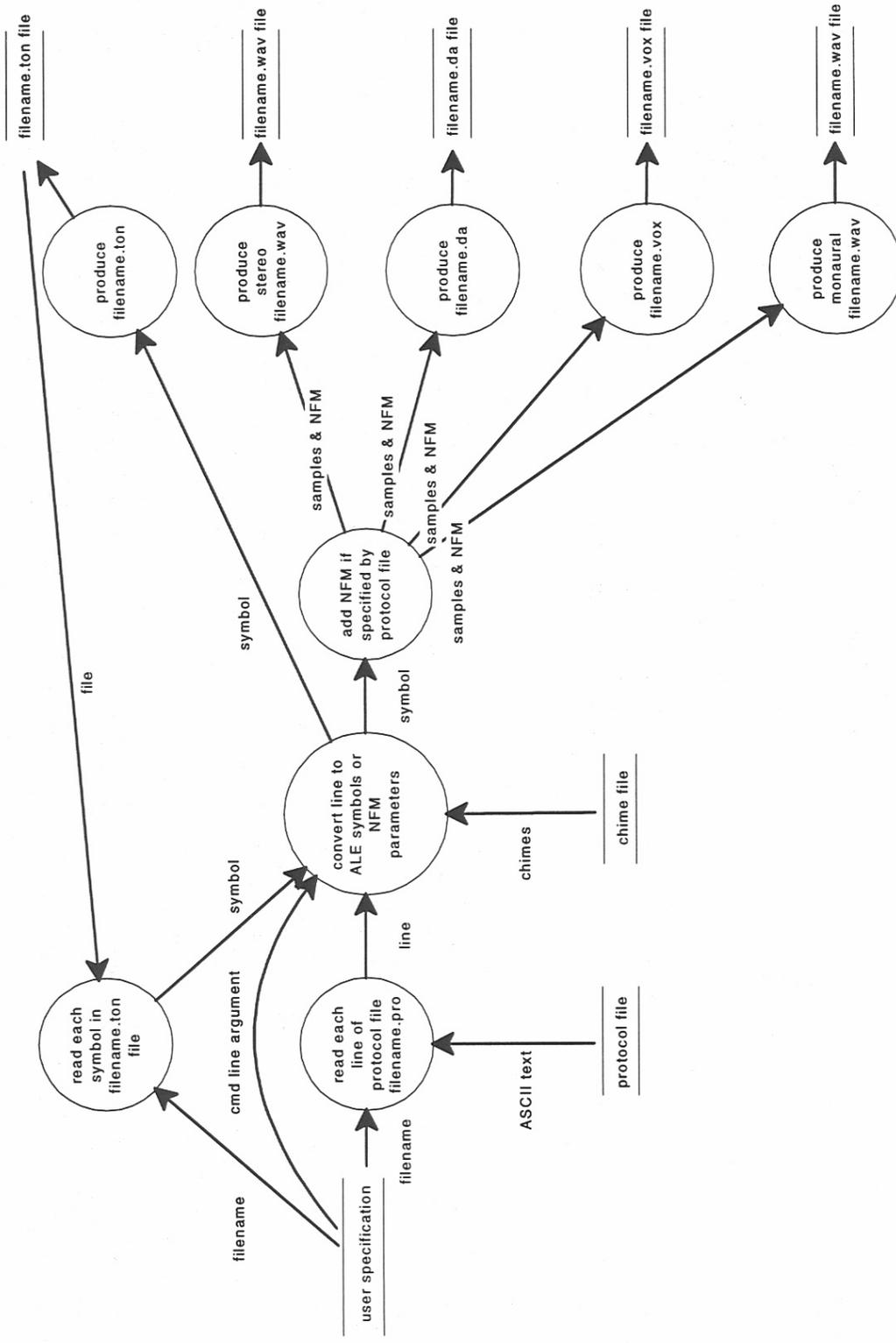


Figure A-3. ALECALL high level data flow diagram.

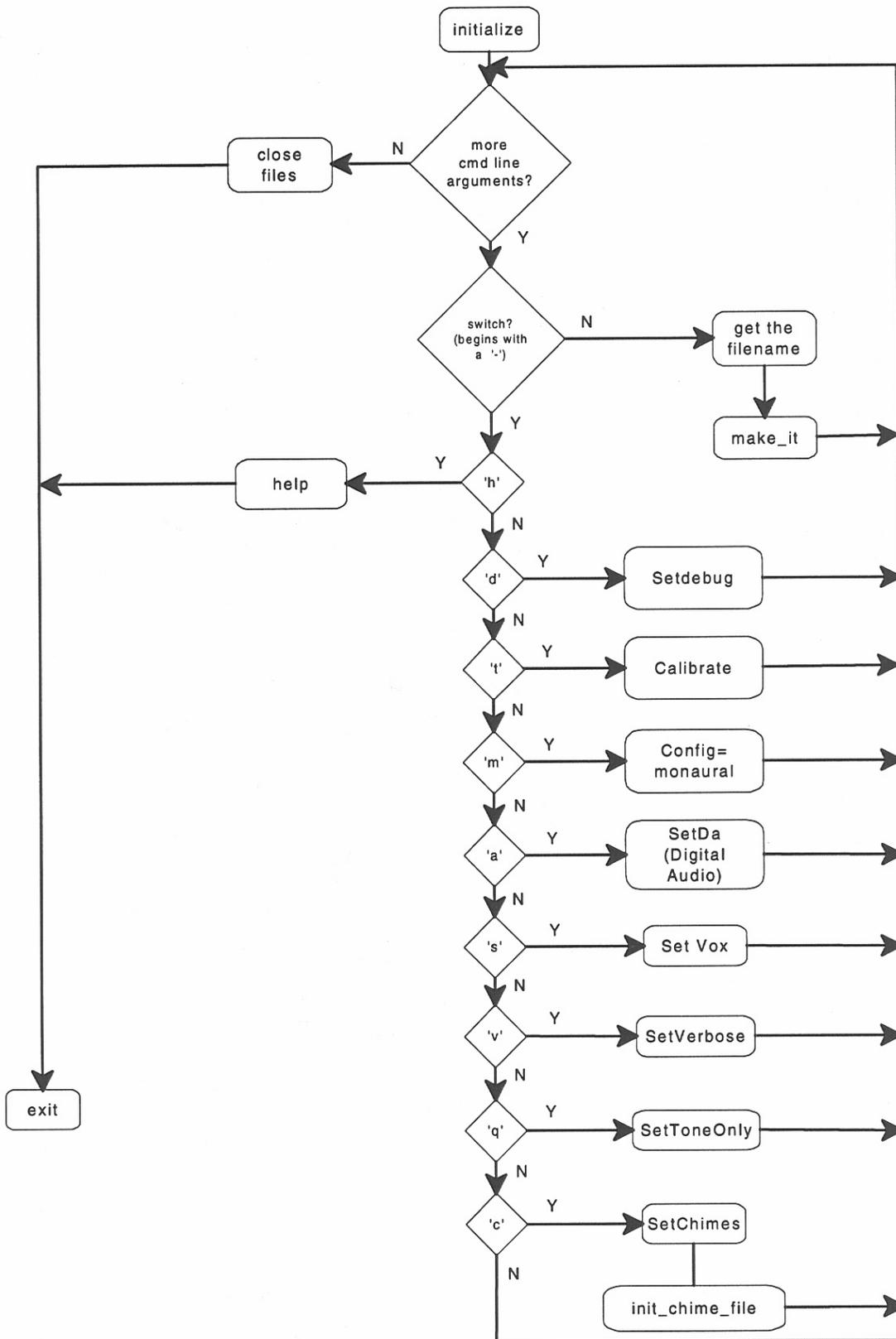


Figure A-4. ALECALL logic flowchart - Main module.

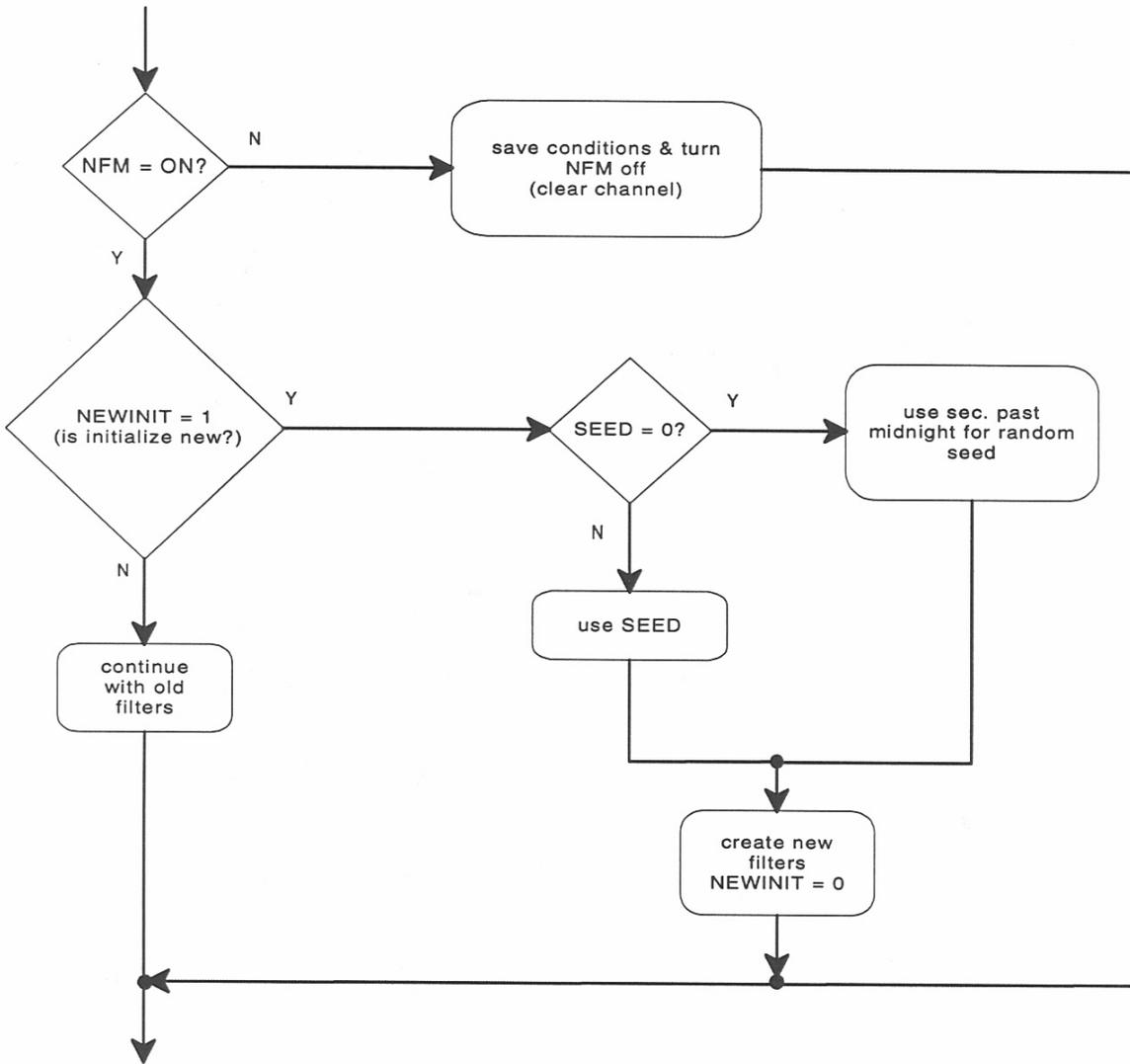


Figure A-5. ALECALL logic flowchart - NFM module.

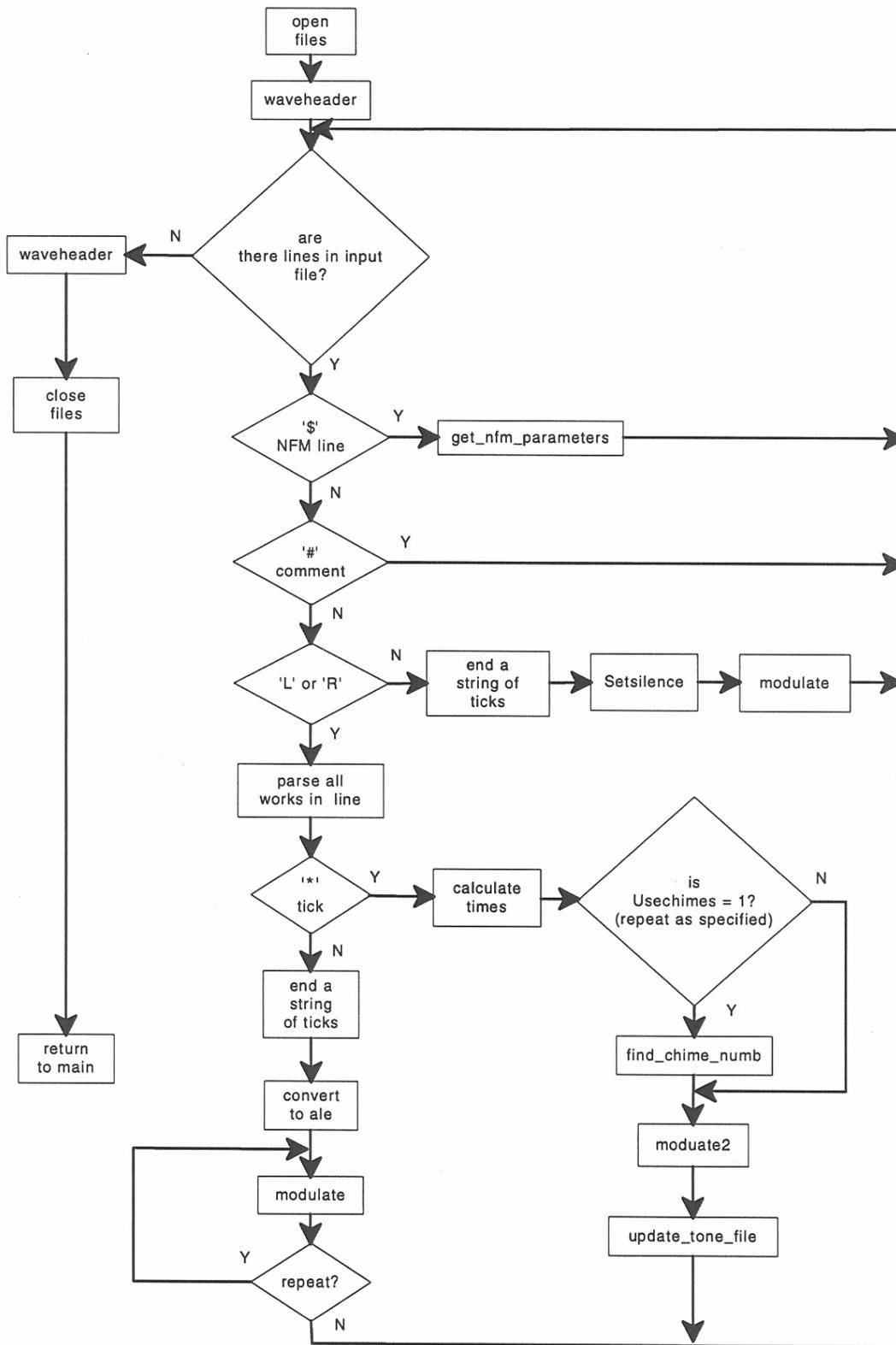


Figure A-6. ALECALL logic flowchart - Make_it module.

**APPENDIX B:
FTSC TEST PLAN FOR INTEROPERABILITY AND PERFORMANCE
OF ALE RADIOS**

FTSC TEST PLAN
FOR INTEROPERABILITY AND PERFORMANCE
OF HF ALE RADIOS
APPROVED FEBRUARY 9, 1995

Based upon the
HFIA TEST ACCEPTANCE PLAN
OF RECOMMENDED TEST PROCEDURES
FOR HF ALE RADIOS

January, 1993

Note: This FTSC Test Plan follows the numbering scheme found in FED-STD-1045A & FED-STD-1046/1.

FTSC TEST PLAN FOR INTEROPERABILITY AND PERFORMANCE OF HF ALE
RADIOS

(Proposed FTIP for ALE: minor modifications in the 1st page by NTIA, Oct 15, 1993)
Received 9-13-93 from Gene Teggatz

The following outline is a list of items that must be tested to demonstrate that the ALE implementation is in accordance with the interoperability and performance requirements of FED-STD-1045A and FED-STD-1046/1. (It is recognized by many in industry that these standards are a mixture of minimum essential requirements and other requirements that may not be essential.)

It is further proposed that a test tape (or a CD disc) be developed by some government agency which contains a number of linking tests including one-way tests for both compatibility testing and acquisition probability testing. (The percentages in Table 1 need to be adjusted for one-way testing if so used.) This validated test tape will be used to verify a number of test conditions.

The goal of this test plan and ultimate procedure is to develop a document that can be used by a procuring agency to determine the capabilities of the purchased ALE equipment. This list of tests addresses the paragraphs as numbered in FED-STD-1045A.

This initial document identifies the individual tests that we believe are necessary to demonstrate some level of compliance to the ALE standard. This list of objectives, which may be modified in the future, can then expanded to a more formal procedure.

It is anticipated that individual vendors will have to write vendor specific procedures to test each requirement listed in the test plan, rather than having one common procedure that can be used on all equipments.

TEST SET UP: For acquisition testing, it is recommended that the test tape signal be converted to RF by use of a balanced modulator and a local RF signal generator. This approach generates a double sideband signal, of which only one sideband should be used. For all other tests, the test set up can be similar or it can run the tape audio into the mike input of a conventional radio, keying both the radio and enabling the tape audio together.

During the test procedures, there are numerous times when a test signal from the tape is being used to determine the proper UUT response. Only during the acquisition testing is it required that the percentage of linking be recorded. For all other testing, it is recognized that periodically, a unit may miss the desired call and the test may be repeated to demonstrate compliance with the procedure.

<u>para:</u>	<u>title</u>	<u>Test tape sequence proven</u>
1.	SCOPE	n/a
2.	APPLICABLE DOCUMENTS	n/a
3.	DEFINITIONS	n/a
4.	GENERAL REQUIREMENTS	n/a
4.1.	SYSTEM TEST PERFORMANCE	
	1 While scanning at 2 channels per second, verify that the unit will meet the performance requirements of Table I (modified for one way). Uses test tape for acquisition testing. (Assuming that a one way test using ALLCALLS is an acceptable alternative approach.)	
	2 Verify that the link up time between two units on the bench as set up per the requirements of paragraph 4.1 do not exceed 14 seconds. The test set up shall be per Figure 1, System Performance Measurements Test Setup, FED-STD-1045A.	
4.2	CHANNEL MEMORY	
	Verify that the ALE unit can store, use and retrieve information on 100 channels, including recovery from a power down condition.	
4.3	SCANNING	
	1 Verify that the UUT will scan at both 2 and 5 channels per second.	
	2 Verify that while the UUT is scanning at 5 channels per second, it will meet the performance requirements of Table I (modified for one way). Use test tape for acquisition testing.	
	3 Verify that the unit will stop scanning upon entry of a stop scan input.	
4.4	SELF ADDRESS MEMORY	
	1 Verify that the ALE unit can store, use and retrieve information on 20 self addresses, including 20 NET self addresses. The NET addressing information includes (for each net member self address, as necessary) the net address and present slot wait time.	
4.5	OTHER ADDRESS MEMORY	
	1 Verify that the ALE unit can store, retrieve and use information at least 100 different sets of information concerning the addresses of other stations and nets. (Addresses can be manually loaded or loaded via the reception of the 100 sounds from the test tape.)	
4.6	CONNECTIVITY AND LQA MEMORY	
	1 Demonstrate that the product of the number of addresses present times the number of channels that an address can be logged in on is at least 4000.	
	2 Using an appropriately addressed second station, demonstrate that bi-lateral LQA's can be stored and retrieved in the first and last address locations on the first and last channel.	
	3 Verify that the LQA's are retained through a power cycle.	

- 4 Verify that the stored LQA includes an age indicator or an algorithm for automatically reducing the weight of data with time, to compensate for changing propagation conditions. (either by listing the LQA with a time indicator, or as part of a calling routine).
5. **WAVEFORM**

Section 5 is considered to be definitions and therefore, non-testable. These items are indirectly tested during the protocol testing in section 5.3 and during the performance testing in section 4.
- 5.1.1 **INTRODUCTION**
- 5.1.2 **TONES**
- 5.1.3 **TIMING**
- 5.1.4 **ACCURACY**
- 5.2 **SIGNAL STRUCTURE**

The signal structure is similar to the waveform and will not be directly tested. Unless otherwise noted, all requirements of this section will be indirectly tested during the testing to demonstrate the protocol in sections 5.3 and 5.4. (Exceptions are paragraphs 5.2.5.4.3 ALLCALLS, 5.2.5.4.4 ANYCALLS and 5.2.5.4.5 WILDCARDS. These paragraphs are really protocol and will be tested as part of section 5.3) The specific paragraphs are validated when the specified test tape sequences are used.

<u>para:</u>	<u>title</u>	<u>Test tape sequence proven</u>
5.2	SIGNAL STRUCTURE	n/a
5.2.1	INTRODUCTION	n/a
5.2.2	WORD FORMAT	n/a
5.2.2.1	STRUCTURE	1
5.2.2.2	WORD TYPES	1,2,3,4,5,6,7
5.2.2.3	PREAMBLES	n/a
5.2.2.3.1	THRU	5
5.2.2.3.2	TO	1,3,4
5.2.2.3.3	COMMAND	3
5.2.2.3.4	FROM	3
5.2.2.3.5	THIS IS	3
5.2.2.3.6	THIS WAS	3
5.2.2.3.7	DATA	3
5.2.2.3.8	REPEAT	3
5.2.2.3.9	VALID SEQUENCES	1,2,3,4,5,6,7,8
5.2.2.4	CHARACTERS	n/a
5.2.2.4.1	GENERAL	n/a
5.2.2.4.2	BASIC 38 ASCII SUBSET	1
5.2.2.4.3	EXPANDED 64 ASCII SUBSET	3
5.2.2.4.4	FULL 128 ASCII AND BINARY DATA (DTM)	n/a
5.2.3	CODING	n/a
5.2.3.1	INTRODUCTION	n/a
5.2.3.2	FORWARD ERROR CORRECTION (FEC)	1
5.2.3.2.1	ENCODING	1
5.2.3.2.2	DECODING	1
5.2.3.3	INTERLEAVING AND DEINTERLEAVING	1
5.2.3.4	REDUNDANT WORDS	1
5.2.4	WORD FRAMING AND SYNCHRONIZATION	1
5.2.4.1	GENERAL	3
5.2.4.2	FRAMING	3
5.2.4.2.1	CALLING CYCLE	3
5.2.4.2.2	MESSAGE	3
5.2.4.2.3	CONCLUSION	3
5.2.4.2.4	BASIC FRAME STRUCTURE EXAMPLES	n/a
5.2.4.3	SYNCHRONIZATION	3
5.2.4.3.1	TRANSMIT MODULATOR	3
5.2.4.3.2	RECEIVE DEMODULATOR	3
5.2.4.3.3	SYNCHRONIZATION CRITERIA	3
5.2.5	ADDRESSING	n/a
5.2.5.1	INTRODUCTION	n/a

5.2.5.2	INDIVIDUAL STATION	1
5.2.5.2.1	BASIC	1
5.2.5.2.2	EXTENDED	1
5.2.5.3	MULTIPLE STATION	4,5,6
5.2.5.3.1	NET	4
5.2.5.3.2	GROUP	5
5.2.5.4	SPECIAL MODES “@” AND “?”	4,7,8
5.2.5.4.1	GENERAL	n/a
5.2.5.4.2	STUFFING	1
5.2.5.4.3	ALLCALLS (Note: HFIA exceptions)	(Tested after 5.3)
5.2.5.4.4	ANYCALLS	(Tested after 5.3)
5.2.5.4.5	WILDCARDS	(Tested after 5.3)
5.2.5.4.6	SELF ADDRESS (Note: HFIA exceptions)	
5.2.5.4.7	NULL ADDRESS	4,5
5.2.6	LINK QUALITY ANALYSIS (LQA)	par. 80.2.1 and par. 80.2.2
5.2.6.1	GENERAL	“
5.2.6.2	BASIC BIT ERROR RATIO (BER)	“
5.2.6.3	SIGNAL PLUS NOISE PLUS DISTORTION TO NOISE PLUS DISTORTION RATIO	“
5.2.6.4	MULTIPATH (MP)	n/a
5.2.7	CHANNEL SELECTION	n/a
5.2.7.1	GENERAL	n/a
5.2.7.2	SINGLE-STATION CHANNEL SELECTION	par. 5.3.4.3
5.2.7.3	MULTIPLE STATION CHANNEL SELECTION	par. 5.3.6.2

5.3 PROTOCOLS n/a

In section 50 and 5.2, a number of items were defined. Proof of the implementation is the successful completion of the remainder of the tests.

A feature or performance capability is proven in detail in one test sequence. It is used in several tests during the course of the testing sequence to verify that it operates within the general protocol. It should be observed to work the same in all cases even though not measured to the same detail.

5.3.1 INTRODUCTION n/a

5.3.2 MANUAL OPERATION n/a

5.3.2.1 OPERATOR CONTROL

Verify that operator can take manual control of the radio.

5.3.2.2 PUSH-TO-TALK OPERATION

Verify that operator has normal PTT control when in non-ALE manual or channel mode or when linked in ALE mode.

5.3.3 ALE OPERATIONAL RULES

Purpose: This test verifies that the implementation complies with the specified rules necessary for an ALE implementation.

- 1 Verify that if another ALE protocol is present in the unit, the ALE protocol specified in this section is also enabled when the unit is active.
- 2 Verify that when other ALE traffic is present on the channel, the UUT will not automatically sound or make a call on the busy channel.

5.3.4 INDIVIDUAL CALLING

n/a

5.3.4.1 INTRODUCTION

n/a

5.3.4.2 SINGLE CHANNEL

(All single channel capabilities are also supported with paragraph 5.3.4.3, Multiple Channels. Therefore, all testing will be done in paragraph 5.3.4.3 MULTIPLE CHANNELS.)

5.3.4.3 MULTIPLE CHANNELS

PURPOSE: The purpose of this test is to determine that the UUT can operate in the scanning mode and make and receive ALE calls. The addresses used are optional. (Use addresses _____ and _____.)

- 1 Verify that the UUT will respond and link without any other commands or messages enabled in the call.
- 2 Verify that UUT will link and exchange LQA scores when so requested while in the scanning mode.
- 3 Verify that UUT will receive (and transmit) command AMD traffic as part of the individual linking protocol.
- 4 Verify that the UUT generates an alert when the two units are linked.
- 5 Verify that the input/output audio paths are enabled to the radio when the unit is linked and that user PTT actions cause input audio signals to be transmitted.
- 6 Verify that the UUT remains linked if user PTT activity is periodically present and occurs more often than the automatic link disconnect time out.
- 7 Verify that without PTT activity or after PTT activity ceases, the UUT returns to scanning upon expiration of the disconnect time out.
- 8 Verify that the speaker audio is muted upon returning to scanning. (NOTE: Many systems have an operator enable/disable of the mute function which allows the operator to disable all muting. This test would apply when the operator has enabled muting as the normal mode.)
- 9 Use the test tape, section 1. Record the LQA values for the last four sounds (all with address DEF) on four different channels. Verify that

the calling algorithm will call address DEF in the order of best channels first.

- 5.3.5 SOUNDING n/a
- 5.3.5.1 INTRODUCTION n/a
(Note the HFIA exceptions)
- 5.3.5.2 SINGLE CHANNEL
(Single channel sounding is addressed as part of paragraph 5.3.5.3 MULTIPLE CHANNELS.)
- 5.3.5.3 MULTIPLE CHANNELS
PURPOSE: The purpose of this test is to verify that the UUT can receive and log sounds automatically while scanning as well as periodically transmit the sounds.
- 1 Verify that the UUT will copy the signals from the test tape, section 1 and log sounds for 6 different addresses. The LQA scores are recorded while the UUT is scanning.
 - 2 Program a second UUT with the same address. Verify that the UUT will log a sound in a similar manner from the local unit as it did from the test tape (LQA scores maybe different). Repeat for each of the 6 addresses listed for the tape.
 - 3 Verify that UUT will automatically transmit a sound (if enabled) on a channel at periodic intervals and for a programmable duration when enabled. (Sounding intervals and the sounding duration are vendor determined functions. They may be directly set by the operator or they may be indirectly determined by the unit based upon other operator inputs.)
 - 4 Verify that if the UUT broadcasts the sound with a THIS IS conclusion and is in the scanning mode, that it remains on channel for at least 2 seconds to allow remote stations time to establish a link on that channel.
- 5.3.5.4 OPTIONAL HANDSHAKE optional
- 5.3.6 MULTIPLE STATIONS OPERATIONS N/A
- 5.3.6.1 GENERAL N/A
- 5.3.6.2 STAR NET

short net and long net addressing

PART 1: The test tape (section #6, part 1) will generate a NET call with various configurations. The local UUT responds and links accordingly. There are four types of NET calls recorded.

PURPOSE: The purpose of this test is to verify that the receiving UUT will link with the test tape test signal in a variety of ways. The test can be either run twice using the first and then the last address on the net list, or two units can be used. (Slow tuning radios may use another slot besides the first slot to demonstrate NET call operation.)

- 1 Verify that the UUT can link on the first (and last) address slot available using the first NET call.
- 2 Verify that the UUT can link on the first (and last) address slot available and correctly computes the slot size when a command LQA is included in the call using the second NET call.
- 3 Verify that the UUT can hear an AMD message and a command LQA in the initial call and respond in the first (and last) address slot available when using the third NET call.
- 4 Verify that the UUT hears the “disconnect” transmission from the test tape and immediately returns to scanning using the third NET call. (Disconnect is approximately 50 seconds after the NET call acknowledgment.)
- 5 Verify that the UUT can hear a command LQA in the initial call and correctly responds in the first (and last) address slot available and that it will correctly copy the AMD message included in the Acknowledgment transmission when using the fourth NET call.

PART 2: The second part of the test is to have a second UUT generate the same calling sequence to verify that the UUT can also source the calls.

- 6 With the second UUT programmed to generate the same NET call, verify that the UUT will link with the first (and last) address slot available.
- 7 Verify that the second UUT can generate the NET call with the command LQA and that the receiving unit can respond in the first (and last) address slot available. Also verify that the NET calling station does log the exchanged command LQA scores correctly.
- 8 Verify the second UUT can generate a NET call with both a command LQA and command AMD as part of the call. (AMD location is vendor optional.) Observe that the receiving UUT can respond in the first (and last) address slot available.

5.3.6.3 STAR GROUP (Optional in FS-1045A, mandatory in FS-1046/1)

5.3.6.3.1 STAR GROUP CALL

PURPOSE: The purpose of this test is to verify that the receiving UUT will link with the test signal in a variety of ways. The test can be either run twice using the first and then the last address on the group list, or two units can be used.

PART 1: The test tape (SECTION 7) will generate GROUP calls with various configurations. The UUT responds and links accordingly.

Note: HFIA exception to multiple address responses. (Industry does not feel that a unit should respond multiple times)

- 1 Verify that the UUT can link on the first (and last) address slot available using the first GROUP call. (Note which address is to be in Slot 1.)
- 2 Verify that the UUT can link on the first (and last) address slot available and correctly computes the slot size when a command LQA is included in the call using the second GROUP call.
- 3 Verify that the UUT can hear an AMD message and a command LQA in the initial GROUP call and respond in the first (and last) address slot available using the third GROUP call.

PART 2: The second part of the test is to have a second UUT generate the same calling sequence to verify that the unit will also source the calls.

- 4 With the second UUT programmed to generate the same GROUP call, verify that the UUT will link with the first (and last) address slot available.
- 5 Verify that the second UUT can generate the GROUP call with the command LQA and that the receiving unit can respond in the first (and last) address slot available. Also verify that the group calling station does log the exchanged LQA scores in correctly.
- 6 Verify the second UUT can generate a GROUP call with both a command LQA and command AMD as part of the call. (AMD location is vendor optional.) Observe that the receiving UUT can respond in the first (and last) address slot available.

5.2.5.4.3 ALLCALLS INCLUDING SELECTIVE (Tested after 5.3)

PURPOSE: The purpose of this test is to verify that the UUT will link with the general ALLCALL with various configurations and protocol options enabled (simple ALLCALL, ALLCALL with embedded command AMD and ALL CALL with embedded command AMD and terminated with a THIS WAS conclusion).

PART 1: Test tape SECTION 3 will be used for all ALLCALL testing.

- 1 Verify that the receiving UUT will link with the generic ALL call as recorded as the first ALLCALL.
- 2 Verify that the receiving UUT un-mutes the speaker when linking with the ALLCALL. (ALLCALL # 1)
- 3 Verify that the receiving UUT will time out and return to scanning if no PTT activity is initiated within the disconnect time out.
- 4 Verify that the receiving unit will copy an embedded AMD message and links with the generic ALLCALL. (ALLCALL # 2)
- 5 Verify that the message received contains the ASCII 64 characters per Table in the standard. (ALLCALL # 3)

- 6 Verify that the QUICK ID (FROM MODE) does not impair operation when copying the long AMD message.
- 7 Verify that the message received contains 90 characters and that the UUT returns to scanning immediately upon receipt of the THIS WAS conclusion. (ALLCALL # 4)

PART 2: The second part of the test is to have a second UUT generate the same calling sequence to verify that the unit will also source the calls.

- 8 Verify that the second UUT can be used to generate and transmit the ALLCALL signals such that the receiving UUT again satisfies all of the requirements of one through four.
- 9 Verify that the receiving unit can disable the reception of the incoming ALLCALL.

PART 3: Selective ALLCALLS are demonstrated using the test tape, SECTION 4.

- 10 Verify that the UUT will link with the SELECTIVE ALLCALL signal only if its self address ends in "A". (Selective ALLCALL is to any station address ending in "A".)
- 11 Verify that the UUT will not link with the second SELECTIVE ALLCALL signal if the UUT's self address ends in "A" and not "Z". (Selective ALLCALL on tape is to any station address ending in "Z".)

PART 4: The fourth part of the test is to have a local UUT programmed to source the same signals that are present on the tape and verify that the receiving UUT can inter-operate with them.

- 12 Verify that the second UUT can be used to generate and transmit the ALLCALL signals such that the receiving UUT again satisfies all of the requirements of ten through eleven.

5.2.5.4.4 ANYCALLS INCLUDING SELECTIVE (Optional in FS-1045A, mandatory in FS-1046/1) (Tested after 5.3)

Purpose: The purpose of the ANYCALL test is to verify that the receiving unit can recognize the ANYCALL addressing. It also tests different types of ANYCALLS to validate the UUT's ability to adjust the slot timing for the different calling conditions.

PART 1: Use the test tape, SECTION 8 to generate the ANYCALL signals.

- 1 Verify that the UUT will respond within any slot upon hearing the ANYCALL signal when using the first ANYCALL. It will only enter the linked state if the UUT self address is one of the three self addresses included in the acknowledgment.
- 2 Verify that the UUT will respond within any slot upon hearing the ANYCALL signal with the embedded command LQA when using the second ANYCALL. (The slot width for this call is wider to accommodate the Command LQA included in the responses.)
- 3 Verify that the UUT copies the Command AMD message included as part of the ANYCALL and that it also responds in any of the slots when using the third ANYCALL. (Note that the slot width is also wider to accommodate the command LQA in the responses.)
- 4 Verify that when a self address is other than any of the three provided for in the Acknowledgment, the responding unit will stop, respond and eventually depart when it does not hear its address in the acknowledgment using the first ANYCALL.

PART 2: Program a second local UUT to generate the ANYCALL signals. Note: The locally generated ANYCALL will only acknowledge those stations that it has heard. Therefore, the acknowledgment will be different.

- 5 Verify that the first UUT responds in a similar fashion when the second UUT places an ANYCALL.

SELECTIVE ANYCALLING (Optional in FS-1045A, mandatory in FS-1046/1)

Purpose: The purpose of the selective ANYCALL is to demonstrate that a unit will respond properly to the selective ANYCALL broadcast. The test shall include both a test to see that the properly addressed unit responds and that non-properly addressed units does not respond.

PART 3: Use the test tape, SECTION 9 to generate the selective ANYCALL signals. Note that the stations being acknowledged in the two calls are different.

- 6 Verify that the UUT will respond to the Selective ANYCALL when it is using a self address ending in an "A" and using the first SELECTIVE ANYCALL. It will also enter the linked state if the self address is one of the three self addresses included in the Acknowledgment.
- 7 Verify that the UUT will not respond to the Selective ANYCALL when it is using a self address ending in any character other than a "Z" and using the second SELECTIVE ANYCALL. (The UUT will momentarily stop to decode the call and then return to scanning.

PART 4: Program a second local UUT to generate the selective ANYCALL signals.

Note: The acknowledgment will consist of only those stations that respond to the selective ANYCALL, not those listed in the test tape.

- 8 Verify that the UUT responds in a similar fashion by repeating tests six and seven.
- 9 Verify that reception of the ANYCALL (or selective ANYCALL can be disabled by the UUT.

5.2.5.4.5 WILDCARDS (FS-1046/1) (Tested after 5.3)

Purpose: The purpose of this test is; To demonstrate that the UUT will link with a station which is broadcasting a WILDCARD call using an address that is properly programmed into the unit; To demonstrate that the responses are in one of the 16 slots, randomly selected by the UUT; To demonstrate that a non-acknowledged station will not link; And to demonstrate that several stations may stop and listen to the full scanning call, but depart when they hear the full leading call.

PART 1: Use the test tape SECTION 10 to generate the WILDCARD call signals. The address being called is "TR?".

- 1 Verify that the receiving UUT responds in any slot when its self address is a 3 character address beginning with "TR" and using the first WILDCARD call.
- 2 Observe that a link is completed if the UUT address is either TR1, TR9 or TRA. In all other cases, the will UUT will not link and resume scanning upon hearing the acknowledgment (using the first WILDCARD call).

PART 2: Using test tape sequence 9, second call, verify that the UUT will link with the station calling when the responding unit address is one of the two acknowledged addresses.

- 3 Verify that the receiving UUT responds in any slot and links when it hears its address in the acknowledgment.
- 4 Verify that the UUT will respond, but not link if the address is a match for the call, but is not acknowledged.
- 5 Observe that all stations (irrespective of address if 3 or more characters) will stop and listen to the full scanning call. (A one or two character addressed station will briefly pause and then continue.)
- 6 Observe that any responding station remains on channel for the acknowledgment and departs when it does not hear its' address in the acknowledgment.

PART 3: Program a second local UUT to generate the WILDCARD signals. Note: The locally generated WILDCARD call will only acknowledge those stations that it has heard. Therefore, the acknowledgment will be shortened and different.

- 7 Verify that the first UUT will respond in a similar manner to the locally generated WILDCARD as observed in Part 1 and 2.

5.4 ORDERWIRE MESSAGES

5.4.1 INTRODUCTION

5.4.2 LINK QUALITY ANALYSIS (LQA)

5.4.2.1 BIT ERROR RATIO (BER) (Verified in par. 5.3.4.3)

5.4.2.2 SIGNAL PLUS NOISE PLUS DISTORTION TO NOISE PLUS DISTORTION RATIO (SINAD) (mandatory) (Verified in Par. 5.3.4.3)

5.4.2.3 MULTIPATH (MP) RESERVED

5.4.3 AUTOMATIC MESSAGE DISPLAY (AMD) MODE

Purpose: The requirements of the AMD message function have been demonstrated during ALL, individual, Group and Net call testing except the ability to copy the AMD message in the response part of a calling protocol. This test will demonstrate only that part of the AMD message requirement.

PART 1: Using the test tape, SECTION 11, demonstrate that when a station's response includes an AMD message, the calling station will copy the AMD message and report it to the operator.

(Note: The UUT is programmed to have the respective addresses listed for SECTION 11. The calling UUT can be operating either channel or scanning mode. To allow non-critical test operator times, the remote station tune time allowed should be long. Upon completion of the call on a channel, the taped response message can be transmitted back to the UUT by enabling first the transmit path and then enabling the tape.)

- 1 Verify that the UUT will accept the incoming response and link with the station.
- 2 Verify that the AMD message included with the response is received correctly. (It includes all 64-ASCII subset characters valid for the AMD message.)

**APPENDIX C:
APPENDIX I TO ALE TEST PLAN - SUGGESTED FORMAT OF
STANDARD TEST AUDIO COMPACT DISC**

LIST OF TESTS**SECTION 1 SOUNDS, 6 ADDRESSES**

- A A
- B BC
- C GHIJK
- D LMNOPQRSTUVWXYZ
- E 1234567890
- F DEF (Clean Tones)
- G DEF (15 db signal to noise)
- H DEF (10 db signal to noise)
- I DEF (5 db signal to noise)

SECTION 2 100 SOUNDS FOR CHANNEL RECORDING VARIOUS LENGTHS**SECTION 3 ALL CALL -THIS IS <GEORGE>**

- A SIMPLE ALL CALL
- B ALL call with short AMD message
- C ALL call with 64 char. AMD message
- D ALL call with a QUICK ID, 90 char. AMD message, and THIS WAS conclusion
- E SIMPLE ALL CALL at scan rate of 5 channels/sec (cps)
- F ALL call with short AMD message at scan rate of 5 cps

SECTION 4 SELECTIVE ALL CALLS

- A SELECTIVE ALL call to "A"
- B SELECTIVE ALL call to "Z"

SECTION 5 INDIVIDUAL CALLING - THIS IS <TOM>

- A SIMPLE LINKING CALL (to BOB)
- B SIMPLE LINKING CALL WITH RETURN TO SCAN
- C-F INDIVIDUAL CALL WITH command LQA report in the acknowledgment

SECTION 6 STAR NET CALLS (with 3 character addresses - THIS IS <IKE>)

- A Simple Star NET call w/3 char addresses
- B Star NET call with command LQA (with 6 character addresses - THIS IS <GEORGE>)
- C Star NET call with command LQA and AMD message (including disconnect after 15 seconds)
- D Star NET call with command LQA and an AMD message in the acknowledgment.
- E Simple Star NET call (same as A) , and responses in slots 1 and 8
- F Star NET call (same as C) w/6 char addresses, and responses in slot 1 and 8
- G Simple Star NET call with a 2-word net name address

- H Star NET call (same as F) with a slot 0 response
 - J Star NET call (same as F) with “garbage” in slot 0
- SECTION 7 STAR GROUP CALLS - THIS IS <RONNIE> (& <RON>)
- A Simple GROUP call
 - B GROUP call with command LQA
 - C GROUP call with command LQA in the call & AMD in ACK
 - D Simple 3-slot GROUP call from RON
 - E GROUP call with actual responses in slot 1 and 4
 - F GROUP call with NULL address in slot 2 of 4
- SECTION 8 ANY CALLS - THIS IS <DOC> (HFIA changed from DOOM)
- A Simple ANY call
 - B ANY call with command LQA
 - C ANY call with command LQA and AMD message
Note: Addresses Acknowledged on CD: TRA, 123DEF, GEORGE.
- SECTION 9 SELECTIVE ANY CALLS - THIS IS <DOC> or <DOOM>
- A Selective ANY call to “A”
Note: Addresses ACKnowledged on CD: TRA, AAA, CBA. The calling source is “DOC”.
 - B-C Selective ANY call to “Z”
Note: Addresses ACKnowledged on CD: TRZ, UVWXYZ, ZZZ.
Calling source is <DOC> or <DOOM>.
- SECTION 10 WILD CARD CALLS - THIS IS <DUM> OR <DUMB>
- A WILD CARD call to “TR?” Calling source is <DUMB>
Note: Addresses ACKnowledged on CD: TRA, TR1, TR9.
 - B WILD CARD call to “??DEF” Calling source is <DUM>
Note: Addresses ACKnowledged on CD: 123DEF, ABCDEF.
 - C Illegal WILD CARD call to “??DEF” from <DUMB>
Note: No responses are allowed.
- SECTION 11 AMD CALLS AND PLACEMENT
- A IN THE RESPONSE PART OF A CALL
 - B SENDING AN AMD AFTER LINKING
- SECTION 12 DESCRIPTION OF PERFORMANCE CHECK - Four ALLCALLS
- A Each with 6 character AMD scan, the first has no noise, the last three have Gaussian noise added at 30, 10 and -1.5 dB S/N.

SECTION 13 DTM IN THE RESPONSE PART OF A CALL

- A BASIC DTM WITH KD4=0
- B BASIC DTM WITH KD4=1
- C DTM message only for debugging purposes
- D DTM message only for debugging purposes

SECTION 14 CALL ACCEPTANCE SOUNDING

- A TOM Sounds, BOB (UUT1) calls TOM.

FORMAT OF THE STANDARD COMPACT DISC (CD)

Based on the HFIA Test Plan, approved January 1993

=== Audio Compact Disc 01a ===

NTIA Revised 1-9-95

To simplify the recording of test results, a set of data log sheets are provided as Appendix II.

SECTION 1. SOUNDS

General purpose: The purpose of the sounds is to verify that the UUT can correctly decode various combinations of addresses. Correct reception of these addresses validates the unit's ability to receive all of the valid address characters in the address, that it correctly positions the stuff characters, and that it can correctly decode the DATA and REPEAT words when used in addresses.

Disc details: The test disc will include six sounds generated using the addresses below. Each sound will be 30 seconds long and will be concluded with THIS WAS. The sounding disc will also contain three additional copies of the sound of DEF. One copy will be at 15 dB signal-to-noise, another at 10 dB, and the final copy at 5 dB. (The four copies of DEF at different SNR may be used to test the UUT's channel ranking algorithm if transmitted on four different channels.)

ADDRESSES USE ALL 36 VALID CHARACTERS PLUS THE STUFF CHARACTER

1	A	4	GHIJK
2	BC	5	LMNOPQRSTUVWXYZ
3	DEF	6	1234567890

SECTION 2. ADDRESSES (100 sounds of unique addresses)

General purpose: This section of disc provides 100 addresses in an easy to visibly verify sequence. The sounds are random combinations of characters.

Disc details: The disc will include 100 different unique sounds, each no shorter than 3 TRW's. The sounds can only be copied while the system is listening on a single channel. The gap between sounds is approximately one second. The address lengths are varied with random combinations of valid characters. (The disc may be played multiple times if an address is missed.) Difficult address combinations, and company and individual names will be included

ADDRESSES USED FOR THE 100 SOUNDS

Note: This page has been added by NTIA/ITS for the 100 sounds

A: 1	SYD	35	MACKAY	69	USPS
2	ROCKWELLCOLLINS	36	USDA	70	MTR
3	HI17	37	CEDARRAPIDS	71	AIRFORCE
4	123	38	JOE	72	MIT
5	P64	39	SYE	73	MOT
6	SY4	40	FREDERICK	74	HARRIS
7	MISSISSIPPI	41	SYF	75	NORTH CAROLINA
8	LOST	42	MTG	-----	
9	P66	43	FTHUACHUCA	F: 76	BAS
10	CO9	44	FBI	77	ITS
11	SY9	45	NTIA	78	NEWYORK
12	MCA	-----		79	NCS
13	IDAHO	D: 46	OHIO	80	NKS
14	MIAMI	47	NBJ	81	NMS
15	MLA	48	MIL	82	NOSC
-----		49	ALL15CHARACTERS	83	MASSACHUSETTS
B: 16	MTA	50	HI	84	NIST
17	SYA	51	CALIFORNIA	85	MAT
18	NOAA	52	SY1	86	NET
19	UTAH	53	COLORADO	87	UST
20	TRANSWORLD	54	NEVADA	88	UUT
21	5MB	55	NAVY	89	UUT3
22	BOB	56	IBM	90	JITC
23	ILLINOIS	57	KANSAS	-----	
24	COLLINS	58	SAM	G: 91	MOTOROLA
25	MLB	59	NEWMEXICO	92	MITRE
26	SYB	60	TOM	93	OSU
27	SUNAIR	-----		94	COMMERCE
28	DOC	E: 61	FEMA	95	SAMMY
29	STC	62	USMC	96	WSU
30	SCHAUMBURG	63	USMINT	97	BOULDER
-----		64	SAMUEL	98	TEXAS
C: 31	SYC	65	ARMY	99	KEY
32	USC	66	USN	100	SY Y
33	USCG	67	DENVER		
34	ROCHESTER	68	NIO		

100 ADDRESSES, VARIOUS LENGTHS AND CHARACTER COMBINATIONS

Address length	Percentage each
3 char.	50
4 to 6	30
7 to 9	10
10 to 12	6
13 to 15	4

SECTION 3. ALLCALL CALLING

General purpose: The purpose of the Allcall testing is to demonstrate that the unit will link in the Allcall mode and copy the respective traffic. Additional purposes are to verify that the 64 ASCII characters that can appear in the AMD message are correctly implemented, and that the unit correctly decodes the mode words of FROM and THIS WAS. As a general note, all of the calls on the CD assume a scan rate of two channels per second, with the exception of 3E and 3F.

Disc Details: The test disc includes 3 versions of the Allcall.

- A The first Allcall is a simple all call signed with a THIS IS conclusion.
 - B The second Allcall includes a short command AMD message.
 - C The third Allcall includes the 64 characters in a Command AMD message.
 - D The fourth Allcall includes the QUICK ID (FROM mode) as part of the call. It also includes a 90 character command AMD message and terminates with a THIS WAS conclusion.
 - E The fifth call is identical to A, with the scan rate set at 5 channels per second. This test must be performed 3 times with a linking success each time.
 - F The sixth call is identical to B, with the scan rate set at 5 channels per second.
- Calling source: GEORGE

SECTION 4. SELECTIVE ALL CALLING

General purpose: The purpose of the selective Allcall is to demonstrate that a unit will link properly to the selective Allcall broadcast. The test shall include both a test to see that the properly addressed unit responds and that the improperly addressed unit does not respond.

Disc details: The test disc includes two versions of the standard selective ALL call.

- A The initial Allcall is a simple selective All call using the selective address of “A” (@A@), with no additional commands. (Only units with an address ending in “A” will link.)
- B The second selective Allcall is a simple selective Allcall using the selective address of “Z” (@Z@), with no additional commands. (Units with an address ending in “Z” will link, but those ending in “A” or any other character except “Z” must not link with this call.) Since the units are not programmed with an address ending in “Z”, there should be no connection.

Calling source: GEORGE

SECTION 5. INDIVIDUAL CALLING Test A & B added by NTIA, August 1993

General purpose: The purpose of the simple linking call is to verify that the UUT will perform a three-way handshake. Two different calls are included. The first call leaves the UUT linked. The second call terminates the link after approximately eight seconds.

Disc details:

- A The first call includes a three-way handshake (TOM to BOB).
- B The second call includes a three-way handshake, then breaks the link with a THIS_WAS (TWAS) after about 8 seconds.

Address being called: BOB

Calling source: TOM

General purpose: The second purpose of the INDIVIDUAL calling section is to verify that the UUT will accept an incoming individual call, respond and then properly copy the LQA handshake included in the acknowledgment. The primary purpose of this test is to verify that the UUT can copy the command LQA in the acknowledgment and that the command LQA bits are properly located in the transferred LQA scores. (Since the recorded signal has no way of time synchronizing itself with the target radio, the test operator may have to pause the playing disc to allow the recorded acknowledgment to be properly timed.)

Disc details: The test disc consists of a series of individual calls and acknowledgments. The time between the call and acknowledgment should be set for a channel type with no tuning of the transceiver required.

- C-F Four different LQA values are sent ranging from the maximum to minimum.

Address being called: BOB

Calling source: TOM

SECTION 6. STAR NET CALLING

General purpose: The purpose of the NET call section is to verify that the receiving unit can recognize the net address and from preprogrammed information determine when it must respond. It also includes different types of net calls to validate the UUT's ability to adjust the slot timing for the different calling conditions.

Disc details: The test disc includes four versions of the standard net call. As an aid to determining the slot boundaries, the test disc will **include time ticks at each slot boundary**, allowing testers to determine if the responses are correctly placed. NTIA included some of the key responses from other net members in the appropriate slots as suggested by HFIA members. These were placed on the **left** channel to simulate an incoming signal from the other net stations (to be received by the UUT).

- A The initial NET call is a simple NET call, with no additional commands.
NET address configuration is

Name of net: NT1

Slot 0	(reserved)
Slot 1	ABC <== Test 6E response on left chan
Slot 2	DEF
Slot 3	GHI
Slot 4	JKL
Slot 5	MNO
Slot 6	PQR
Slot 7	STU
Slot 8	WXY <== Text 6E response on left chan
Slot 9	Z12 <== Reserved for UUT1 response

Calling source: IKE

- B The second NET call includes a command LQA in the call, thus causing each slot to be 392 ms longer. (Same addresses as in A.)
- C The third NET call includes both a command LQA (in the calling section) and command AMD, respectively. (Call includes a NET disconnect approximately 15 seconds after the acknowledgment and uses the following 6 character addresses.)
- (Note that the command AMD begins with a REPEAT mode word, since it is a sequential command word.)

NET address configuration is

Name of net:	NT2 (Name changed by NTIA 8/93)
Slot 0	(reserved)
Slot 1	ABCDEF <== Test 6F response on left chan
Slot 2	GHIJKL
Slot 3	MNOPQR
Slot 4	STUVWX
Slot 5	YZ1234
Slot 6	567890
Slot 7	123456
Slot 8	789ABC <== Test 6F response on left chan
Slot 9	DEFGHI <== Reserved for UUTI response

Calling source: GEORGE

- D The fourth NET call includes a command LQA in the call and a command AMD in the Acknowledgment. (It uses the addresses described in C.)
- E The fifth NET call is identical to the first (Test 6A using NT1), except the test CD has actual responses of ABC in slot 1 and WXY in slot 8 on the left channel.
- F The sixth NET call is identical to the third (Test 6C using NT2), except the test CD has actual responses of ABCDEF in slot 1 and 789ABC in slot 8 on the left channel.
- G The seventh NET call includes the same NET address configuration as Test 6A. The difference is that the name of the net is changed from NT1 to NET1 to demonstrate network capability with networks that have addresses greater than three characters. Note: The Beta Test CD-01 issued on August 30, 1993, had an error in the caller's address: it was changed from GEORGE to IKE on the current CD. This was test 14A on the August 30 CD.
- H The eighth NET call is identical to the third (Test 6C using NT2), except the test CD has an emergency response in slot 0 from JAMES, and actual responses of ABCDEF in slot 1 and 789ABC in slot 8, all on the left channel.
- J The ninth NET call is identical to the third (Test 6C using NT2), except the test CD has a "garbage" response in slot 0, and actual responses of ABCDEF in slot 1 and 789ABC in slot 8, all on the left channel.

SECTION 7. STAR GROUP CALLING

General purpose: The purpose of the GROUP call section is to verify that the receiving unit can recognize the GROUP addressing and from the embedded information determine when it must respond. It also includes different types of GROUP calls to validate the UUT's ability to adjust the slot timing for the different calling conditions.

Disc details: The test disc includes three versions of the standard GROUP call. As an aid to determining the slot boundaries, the test disc will **include time ticks at each slot boundary**, allowing testers to determine if the response was correctly placed. The actual responses are on the **left** channel of the test CD for some of the calls.

- A The initial GROUP call is a simple GROUP call.
- B The second GROUP call includes a command LQA in the call, thus causing each slot to be 392 ms longer.
- C The third GROUP call includes a command LQA (in the calling section) and command AMD (in the ACK section).

GROUP addresses used for the call are

Name of GROUP: GROUP (not used over the air.)

Slot 1: ABC <== Response #1 in Test 07E on CD

Slot 2: DEF

Slot 3: GHIJ

Slot 4: 456789DEF <== Response #2 in Test 07E on CD

Slot 5: GHIJKLMNOPSTUVW <== Response of UUTI

Calling source: RONNIE

- D The fourth GROUP call is a simple 3 slot GROUP call similar to the first (Test 7A), except the calling source is "RON", and only the stations responding in the first three slots in the table above are used.

GROUP addresses used for the call are

Name of GROUP: GROUP (not used over the air.)

Slot 1: ABC <== Response #1 in Test 07D on CD

Slot 2: DEF

Slot 3: 123DEF <== Response of UUTI

Calling source: RON

- E The fifth GROUP call is identical to the first (Test 7A), except the test CD has actual responses of ABC and 456789DEF in slots 1 and 4 respectively on

the left channel. UUT1 is expected to respond in slot 5 with the address of GHIJKLMNOPSTUVW.

- F The sixth GROUP call is a simple four-slot GROUP call similar to Test 7D, using “RON” as the calling source, and inserting a NULL address in slot 2. The stations responding in the four slots will be “ABC”, NULL, “DEF”, and “123DEF” respectively in slots 1 to 4.

GROUP addresses used for the call.

Name of GROUP: GROUP (not used over the air.)

Slot 1: ABC

Slot 2: @@@

Slot 3: DEF

Slot 4: 123DEF <== Response of UUTI

Calling source: RON

Note: ACK includes all addresses.

SECTION 8. ANY CALLING

General purpose: The purpose of the ANY call test is to verify that the receiving unit can recognize the ANY call addressing. It also includes different types of ANY calls to validate the UUT’s ability to adjust the slot timing for the different calling conditions.

Disc details: The test disc includes three versions of the standard ANY call. As an aid to determining the slot boundaries, the test disc will include time chimes and a verbal slot count at each slot boundary, allowing testers to determine if the responses are correctly placed.

- A The initial ANY call is a simple ANY call, with no additional commands.
- B The second ANY call includes a command LQA in the call, thus causing each slot to be 392 ms longer.
- C The third ANY call includes a command AMD (in the calling section) and command LQA.

Note: The following addresses are ACKnowledged: TRA. (123DEF & GEORGE)
Calling source: DOC (Changed from DOOM" 9/93)

SECTION 9. SELECTIVE ANY CALLING

General purpose: The purpose of the selective ANY call is to demonstrate that a unit will respond properly to the selective ANY call broadcast. The test shall include both a test to see that the properly addressed unit responds and that improperly addressed units do not respond.

Disc Details: The test disc includes two versions of the standard selective ANY call. As an aid to determining the slot boundaries, the test disc will **include time chimes and a verbal slot count at each slot boundary**, allowing testers to determine if the response was correctly placed.

- A The initial ANY call is a simple selective ANY call using the selective address of "A" (@@A), with no additional commands. (Unit with addresses ending in "A" respond.)
Note: The following addresses are ACKnowledged: TRA. (AAA & CBA)
Calling source: DOC (Changed from "DOOM" 9/93)

- B The second selective any call is a simple selective ANY call using the selective address of "Z" (@@Z), with no additional commands. (Units with address ending in "A" or any other character except "Z" must not respond. Only units ending in "Z" must respond.)
Note: The following addresses are ACKnowledged: TRZ, ZZZ and UVWXYZ.
Calling source: DOC (Changed from "DOOM" 9/93)

- C The third selective any call is a simple selective ANY call using the selective address of "Z" (@@Z), with no additional commands. (Unit with address ending in "A" or any other character except "Z" must not respond. Only one-word address units ending in "Z" may respond.)
Note: The following addresses are ACKnowledged: TRZ, ZZZ.
Calling source: "DOOM". UVWXYZ is NOT allowed.

SECTION 10. WILDCARD CALLING

General purpose: The purpose of the WILDCARD call is to demonstrate that a unit will respond and link when a call is made using an address that matches by character count and by the specified ASCII 36 characters. (The use of the question mark is identical to the DOS command of "?", as used in a DIRectory command.)

Disc details: The test disc includes two versions of the standard WILDCARD call. As an aid to determining the slot boundaries, the test disc will **include time chimes and a verbal slot count at each slot boundary**, allowing testers to determine if the response was correctly placed.

- A The initial WILDCARD call is a simple WILDCARD call using the address of “TR?” with no additional commands. (The call is to any address of three characters with the first two characters being “TR”.)
Note: The following addresses are ACKnowledged: TRA, TR1 and TR9.
Calling source: DUMB
- B The second call is a WILDCARD call using the address of “???DEF” and no additional commands.
Note: The following addresses are ACKnowledged: ABCDEF and 123DEF.
Calling source: DUM (Changed from “DUMB” 9/93)
- C The third call is a WILDCARD call using the address of “???DEF” and no additional commands.
Note: Because the calling source is “DUMB”, an address length of 2 T_{rw} , this is a bogus call; units must return to Scanning mode. The following addresses should **not** be ACKnowledged (but **are** on the CD): ABCDEF and 123DEF.

Note from NTIA/ITS: The HFIA TAP had an error using “DUMB” as the source for the two word WILDCARD call. This is not permitted in FED-STD-1046/1. The Beta Test CD-01 had the address “DUMB”; it was decided to correct the error and put both good and bad calls in the final release.

SECTION 11. AMD CALLS AND PLACEMENT (TEST MESSAGE IN RESPONSE)

General purpose: The first purpose is to test the ability of the radio to receive an AMD message after a link-up. The second purpose of this sequence is to provide a test message that can be used as a response to a call. The response includes an AMD message (max length).

Disc details: The first call is to demonstrate that the UUT can send/receive AMD messages with another station after being linked. The test verifies that the UUT is **always listening**, and that it will **always use the three-way handshake**. The AMD is from the original caller (TOM). The original caller terminates the link approximately six seconds after the AMD.

The second call in this sequence on the disc contains the response only, which includes a command AMD message of 90 characters and a conclusion. The CD player must be placed in the “PAUSE” mode at the beginning of the tones in this track, and started when the UUT completes the scanning “CALL”. The tune-up time for the UUT should be set for several seconds to prevent missing the CD tones.

- A The call includes a three-way handshake. After linking, another three-way handshake exchanges an AMD in the acknowledgement. This test is a mandatory feature of the ALE Standards, added by NTIA in March 1994.
Address called: BOB
Calling source: TOM
- B Responding stations address: AMDINRESP (this station), Calling station address: PROVEAMDINRESP

The AMD message of Test 07B: The test message of all 64 legal ASCII characters plus duplications to make it a full 90 character message.

SECTION 12. DESCRIPTION OF PERFORMANCE CHECK

Disc details: The acquisition testing will be performed using a broadcast call consisting of the ALLCALL plus an included AMD message of six characters. (The message can be unique for each test.) While this type of broadcast call can provide a good qualitative evaluation of the UUT performance, it is not intended to be a replacement for the system performance linking probability test (three-way handshake) required by FS-1045A.

The test disc will have 100 calls for each of the respective conditions. The disc output will be modulated to RF via a radio (or a balanced modulator and a signal generator), where a scanning receiver will hear the signals. Following each call in the simulated conditions, there will be a clean tone disconnect signal transmitted after approximately five seconds to return the UUT to scanning.

NOTE: The time between the disconnect and the next call will randomly vary from three to 12 seconds. Otherwise the units will always be in a certain part of the scan cycle for each new call.

Assume about 30 seconds per test
or 3000 seconds for a set of 100 calls (50 minutes)
or 600 minutes for all 12 tests (10 hours)
or 20 hours to do it at 2 and 5 channels per sec.

Disc 01a has four calls, the first with clean tones and the other three with Gaussian noise added to the tones at signal-to-noise ratios of 30, 10 and -1.5 dB, respectively. The signal level is 1/2 of the signal level of all the other calls on this disc, necessitated by the wide excursions of amplitude when noise, multipath and fading are added. See note at end of this document about the degraded tones on the CDs for FY 95.

SECTION 13. OPTIONAL BASIC DTM CALLS -- Added by NTIA, August 1993

General purpose: The purpose of this sequence is to demonstrate that a unit has DTM capability.
 Disc details: The DTM BASIC mode is used for all DTM calls provided on the CD. The first two calls include a DTM message in the response portion of a three-way handshake. The second two calls send the DTM as a stand-alone message. This is NOT allowed in the FED-STD, but provided merely as an example. Examples of the EXTENDED DTM are not provided. The compact disc includes four versions of the standard DTM call. The control bit KD4 is set to "0" for ACK, and "1" for NAK.

- A The DTM message is included in the response portion of a three-way handshake. (KD4 = 0)
- B The DTM message is included in the response portion of a three-way handshake. (KD4 = 1)
- C Stand-alone DTM message: KD4 = 0. (for debug purposes)
- D Stand-alone DTM message: KD4 = 1. (for debug purposes)
 Address called: BOB.
 Calling source: GEORGE
 The last two tests (Test C & D) are not valid calls by themselves.

SECTION 14. OPTIONAL CALL ACCEPTANCE -- Added by G. Harrison, October 1993

General purpose: The purpose of call acceptance sounding is to allow a station to link with any system that issues the sound, immediately after the sound has ended.

Disc details:

- A The CD issues the sound (THIS_IS TOM). The UUT (ID = BOB) responds with three-way linking call to TOM.

Calling source (sound): TOM
 Calling source (call): BOB (UUT1)
 Address called: TOM

=== Audio Compact Discs 02 - 13 ===
Not currently funded

The next 12 discs will each contain approximately 50 minutes of the degraded signals for each of the 12 conditions (four each S/N and three types of channel conditions) according to the HF ALE Standards. The tests will follow the protocol outlined in Section 12.

Even if the funding is not obtained for reproduction of these 12 audio CDs, NTIA/ITS intends to release the software and protocol files which generate the large audio sound files. These may be used with a high quality (DSP based) sound card to perform the tests. The software package, when complete, will be placed on the Internet.

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The ALE Clean Tone audio compact disc and the tone files that make up the collection of audio sounds (notes) used for testing the FED-STD-1045A and FED-STD-1046/1 HF ALE Radios are Copyrighted (c) 1994. This collection of tones, or audio information, shall hereafter be referred to as NIST Special Database 17.

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The authors and maintainers of the ALE Clean Tone Database are with the National Telecommunications and Information Administration (NTIA), the Institute for Telecommunication Sciences (ITS) in Boulder, Colorado. Specifically the Wireless Networks Group (ITS.N1) developed the Special Database of ALE tones under the sponsorship of the National Communications System (NCS), Office of Technology and Standards (NT).

Quick Reference Guide for ALE Programming of First Unit Under Test (UUT1)

Provided by NTIA for use with Audio Compact Disc 01a

Self Addresses

TRA
BOB
Z12
DEFGHI
GHIJKLMNOPSTUVW
123DEF
PROVEAMDINRESP

Others

DOOM, DUMB
TOM, GEORGE
IKE
GEORGE
RONNIE, RON
DUM, DOC, RON
AMDINRESP

Nets/Slots

Net Name: NT1 Call initiated by IKE

Slots:

Slot 0 (reserved)
Slot 1 ABC #
Slot 2 DEF
Slot 3 GHI
Slot 4 JKL
Slot 5 MNO
Slot 6 PQR
Slot 7 STU
Slot 8 WXY #
Slot 9 Z12 *

Net Name: NET1 Call initiated by IKE

Slots:

Slot 0 (reserved)
Slot 1 ABC
Slot 2 DEF
Slot 3 GHI
Slot 4 JKL
Slot 5 MNO
Slot 6 PQR
Slot 7 STU
Slot 8 WXY
Slot 9 Z12 *

Net Name: NT2 Call initiated by GEORGE

Slots:

Slot 0 (reserved)
Slot 1 ABCDEF #
Slot 2 GHIJKL
Slot 3 MNOPQR
Slot 4 STUVWX
Slot 5 YZ1234
Slot 6 567890
Slot 7 123456
Slot 8 789ABC #
Slot 9 DEFGHI *

* Self addresses used above for UUT 1 to respond in slot shown.

Simulated 3rd party responses in selected tests

Quick Reference Guide for ALE Programming of Second Unit Under Test (UUT2)

For use with UUT2 after UUT1 has been tested with Audio Compact Disc 01a

Self Addresses	Others
TOM	BOB
IKE	Z12
DUM	123DEF
RON	GHIJ
AMDINRESP	PROVEAMDINRESP
GEORGE	DEFGHI
RONNIE	GHIJKLMNOSTUVW
DOC	
DOOM	
DUMB	

Nets/Slots

Net Name: NT1 Self ID = IKE

Slots:

Slot 0 (reserved)
 Slot 1 ABC
 Slot 2 DEF
 Slot 3 GHI
 Slot 4 JKL
 Slot 5 MNO
 Slot 6 PQR
 Slot 7 STU
 Slot 8 WXY
 Slot 9 Z12 *

Net Name: NET1 SELF ID = IKE

Slots:

Slot 0 (reserved)
 Slot 1 ABC
 Slot 2 DEF
 Slot 3 GHI
 Slot 4 JKL
 Slot 5 MNO
 Slot 6 PQR
 Slot 7 STU
 Slot 8 WXY
 Slot 9 Z12 *

Net Name: NT2 Self ID = GEORGE

Slots:

Slot 0 (reserved)
 Slot 1 ABCDEF
 Slot 2 GHIJKL
 Slot 3 MNOPQR
 Slot 4 STUVWX
 Slot 5 YZ1234
 Slot 6 567890
 Slot 7 123456
 Slot 8 789ABC
 Slot 9 DEFGHI *

* Expected response slot from UUT 1 when programmed with these addresses used above.

**APPENDIX D:
APPENDIX II TO ALE TEST PLAN - LOG SHEETS FOR RECORDING
TEST DATA WHEN USING THE STANDARD TEST AUDIO COMPACT
DISC**

Log Sheets for Recording Test Data

The following spreadsheets are provided with the CD-01a documentation floppy disk to aid the tester during a test. The first set of sheets, comprised of four pages, lists each track on the CD. Information such as the channel through which the CD's calls should be transmitted, the call signs of the sender and receiver, and whether or not the unit should link, return to scan or receive an AMD is provided in a check-list format as a guide to the tester. The last sheet is to be used by the tester to record any unusual activity that the UUT displays.

**ALE Interoperability Test Data Log
CD-01a**

Compact Disc to UUT1 ()
UUT2 to UUT1 ()

Page _____ of _____

Testers: (name & signature) _____

Date _____
Location _____
Radio _____
Model _____
Options _____

UUT1 S/N _____
UUT2 S/N _____

Track Test	Call type	CD/UUT2 channel	UUT1	Additional	From	To	Link	AMD	RefmScan	Expected Outcome	OK?
4 01A	Sound	1 *	Scan		A					Receive sound	
5 01B	Sound	10 **	Scan		BC					Receive sound	
6 01C	Sound	5	Scan		GHIJK					Receive sound	
7 01D	Sound	5	Scan		LMNOPQRSTUVWXYZ					Receive sound	
8 01E	Sound	5	Scan		1234567890					Receive sound	
9 01F	Sound	5	Scan	Clean Tone	DEF					Receive sound, Best channel score	
10 01G	Sound	7	Scan	SNR = 16dB, BW = 3kHz	DEF					Receive sound, Channel score	
11 01H	Sound	2	Scan	SNR = 10dB, BW = 3kHz	DEF					Receive sound, Channel score	
12 01J	Sound	6	Scan	SNR = 5dB, BW = 3kHz	DEF					Receive sound, Worst channel score	
N/A	Call from UUT1 to CD	Local	Auto		Z12	DEF				Channel order: 5, 7, 2, 6	
13 02A	15 Quick Sounds	5	5		See Attached List					Receive sounds	
14 02B	15 Quick Sounds	5	5		See Attached List					Receive sounds	
15 02C	15 Quick Sounds	5	5		See Attached List					Receive sounds	
16 02D	15 Quick Sounds	5	5		See Attached List					Receive sounds	
17 02E	15 Quick Sounds	5	5		See Attached List					Receive sounds	
18 02F	15 Quick Sounds	5	5		See Attached List					Receive sounds	
	* Channel 1 is low extreme in frequency										
	** Channel 10 is high extreme in frequency										
19 02G	10 Quick Sounds	5	5		See Attached List					Receive sounds	
20 03A	Allcall	5	Scan		GEORGE	@?@				Link	
21 03B	Allcall w/AMD	5	Scan	THIS IS AMD	GEORGE	@?@				Link + AMD	

Certified Correct by _____

NTIA: CDLOG01A.XLS
1/26/95

ALE Interoperability Test Data Log
CD-01a

Compact Disc to UUT1 ()
UUT2 to UUT1 ()

Track	Test	Call Type	CD/UUT2	UUT1	Additional	From	To	Link	AMD	ReImScan	Expected Outcome	OK?
22	03C	Allcall w/AMD	5	Scan	"#S%&0*+<->%A /0123456789;<->%A BCDEFGHIJKLMNO PQRSTUWXYZ\ `	GEORGE	@?@				Link + AMD	
23	03D	Allcall w/AMD BACK TO SCAN	5	Scan	"#S%&0*+<->%A /0123456789;<->%A BCDEFGHIJKLMNO PQRSTUWXYZ\ ` "#S%&0*+<->%A /01234567	GEORGE	@?@				Link + AMD, Scan	
24	03E	## Allcall	5	Scan		GEORGE	@?@				Link	
25	03F	## Allcall w/AMD	5	Scan	THIS IS AMD	GEORGE	@?@				Link + AMD	
26	04A	Allcall, selective	5	Scan		GEORGE	@A@				TRA, Link	
27	04B	Allcall, selective	5	Scan		GEORGE	@Z@				No address is recognized, unit continues to scan	
28	05A	Ind Call - Linking	5	Scan		TOM	BOB				Link, Scan	
29	05B	Ind Call - Linking BACK TO SCAN	5	Scan		TOM	BOB				Link, Scan	
30	05C	Ind Call - Linking	5	Scan	LQA	TOM	BOB				Link w/SINAD = 30	
31	05D	Ind Call - Linking	5	Scan	LQA	TOM	BOB				Link w/SINAD = 20	
32	05E	Ind Call - Linking	5	Scan	LQA	TOM	BOB				Link w/SINAD = 10	
33	05F	Ind Call - Linking	5	Scan	LQA	TOM	BOB				Link w/SINAD = 0	
34	06A	Net call - Linking	5	Scan		IKE	NT1				Z12 in slot 9, Link	
35	06B	Net call - Linking	5	Scan	LQA Request	IKE	NT1				Z12 in slot 9, Link	
36	06C	Net call - Linking w/AMD BACK TO SCAN	5	Scan	LQA THIS IS AMD	GEORGE	NT2				DEFGHI in slot 9, Link, Scan 15 sec. later	
37	06D	Net call - Linking w/AMD	5	Scan	LQA Request THIS IS AMD	GEORGE	NT2				DEFGHI in slot 9, Link + AMD in ACK	
38	06E	Net call - Linking	5	Scan		IKE	NT1				Same as 6A (Track 34) with some responses on left channel in slots 1.	
39	06F	Net call - Linking w/AMD BACK TO SCAN	5	Scan	LQA THIS IS AMD	GEORGE	NT2				Same as 6C (Track 36) with some responses on left channel in slots 1, 8, Scan	
40	06G	Net call - Linking	5	Scan		IKE	NET1				Z12 in slot 9, Link	

Certified Correct by _____

Compact Disc to UUT1 ()

ALE Interoperability Test Data Log
CD-01a

Track Test	Call Type	CD/UUT2	UUT1	Additional	From	To	Link	AMD	RetrnScan	Expected Outcome	OK?
41 0xH	Net call - Linking w/AMD BACK TO SCAN	5	Scan	LQA THIS IS AMD	GEORGE	NT2				Same as 6C (Track 36) with some responses on left channel in slots 1, 8 & emergency response from JAMES in slot 0. Scan	
42 0xJ	Net call - Linking w/AMD BACK TO SCAN	5	Scan	LQA THIS IS AMD	GEORGE	NT2				Same as 6C (Track 36) with some responses on left channel in slots 1, 8 & garbage in slot 0	
43 07A	Star Group - Linking	5	Scan		RONNIE	Group (5)				GHUJIKLMNOPSTUVW in slot 5, Link	
44 07B	Star Group - Linking	5	Scan	LQA Request	RONNIE	Group (5)				GHUJIKLMNOPSTUVW in slot 5, Link	
45 07C	Star Group - Linking w/AMD	5	Scan	LQA Request THIS IS AMD in ack	RONNIE	Group (5)				GHUJIKLMNOPSTUVW in slot 5, Link + LQA in call, AMD in ack	
46 07D	Star Group - Linking	5	Scan		RON	Group (3)				123DEF in slot 3, with a response in slot 1. Link	
47 07E	Star Group - Linking	5	Scan		RONNIE	Group (5)				Same as 7A (Track 43) with some responses on left channel in slots 1, 8 & emergency response from JAMES in slot 0. Scan	
48 07F	Star Group - Linking	5	Scan		RON	Group (4)				123DEF in slot 4 with a NULL address in slot 2. Link	
49 08A	Anycall - Linking	5	Scan		DOC	@@?				TRA in any slot 1 - 16, Link, Time=17x23Tw(44.1s)	
50 08B	Anycall - Linking	5	Scan	LQA	DOC	@@?				TRA in any slot 1 - 16, Link, Time=17x23Tw(51.1s)	
51 08C	Anycall - Linking w/AMD	5	Scan	LQA in call THIS IS AMD	DOC	@@?				TRA in any slot 1 - 16, Link, Time=17x23Tw(51.1s)	
52 09A	Anycall - Linking	5	Scan		DOC	@@A				TRA, Link	
53 09B	Anycall	5	Scan		DOC	@@Z				No response, continues to scan	
54 09C	Anycall	5	Scan		DOOM	@@Z				No response, continues to scan	
55 10A	Wildcard - Linking	5	Scan		DUMB	TR?				TRA, Link	
56 10B	Wildcard - Linking	5	Scan		DUM	??DEF				123DEF, Link	
57 10C	Wildcard (bogus)	5	Scan		DUMB	??DEF				Illegal call, unit continues to scan	
58 11A	Receiving AMD after linked. BACK TO SCAN	5	Scan	WOW	TOM TOM TOM	BOB				TOM links with BOB TOM sends AMD to BOB TOM breaks link, Scan	
59 11B	** Call from UUT1 to CD w/AMD	5	Call on 5	!#%&'()*+,-./0123456789:;<=>?@A BCDEFGHIJKLMNO PQRSTUWXYZ[\]^_`{ }~!#%&'()*+,-./01234567	PROVEAMINDINRESP	AMDIR				Link + AMD received on UUT1	
60 12A	Alicall w/ AMD BACK TO SCAN (increase audio gain)	5	Scan	P99001 (SN = 0.0 dB) Q30002 (SN = 30 dB) Q10003 (SN = 10 dB) Q1004 (SN = -1.5)	TOM	@@?				Link + AMD, Scan Link + AMD, Scan Link + AMD, Scan Link (50%) + AMD, Scan	
#61 13A	Ind Call - Linking w/DIM	5	Scan	Control bit KD4 = 0	GEORGE	BOB				Link	
#62 13B	Ind Call - Linking w/DIM	5	Scan	Control bit KD4 = 1	GEORGE	BOB				Link	

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ALE Interoperability Test Data Log
CD-01a

Compact Disc to UUT1 ()
 UUT2 to UUT1 ()

Track Test	Call Type	CD/UUT2	UUT1	Additional	From	To	Link	AMD	Reinscan	Expected Outcome	OK?
#61 13A	Ind Call - Linking w/DIM	5	Scan	Control bit KD4 = 0	GEORGE	BOB				Link	
#62 13B	Ind Call - Linking w/DIM	5	Scan	Control bit KD4 = 1	GEORGE	BOB				Link	
#63 13C	DTM message	5			GEORGE	BOB				Should not receive, optional test for debuzzing only	
#64 13D	DTM message	5			GEORGE	BOB				Should not receive, optional test for debuzzing only	
#65 14A	** Call acceptance sound - Linking	5	5		BOB	TOM				UUT1 (BOB) calls TOM after TOM issues sound, Link	
	** UUT1 initiates call										
	# OPTIONAL										

**APPENDIX E:
AUDIO COMPACT DISC LAYOUT TO IMPLEMENT THE HF ALE
RADIO TEST PLAN**

Audio Compact Disc Layout to Implement the HF ALE Radio Test Plan

CD-01a: Interoperability Clean Tone Tests

Revised: 12-30-94, NTIA/ITS

Track HFIA No. No.	Contents of Track/Index	Playing Time Min:Sec
01 00A	Introduction, NTIA voice narrative	04:18
02 00B	Calibration Tone, 1000.000 Hz, 30 s	00:33
03 00C	Calibration Tones, all 8 ALE Tones: 750-2500 Hz	00:18
04 01A	Sound by A - CLEAN TONE	00:35
05 01B	Sound by BC	00:35
06 01D	Sound by LMNOPQRSTUVWXYZ	00:36
08 01E	Sound by 1234567890	00:36
09 01F	Sound by DEF, Clean tone (No noise added)	00:35
10 01G	Sound by DEF, 15 dB S/N (Gaussian noise, BW=3kHz)	00:35
11 01H	Sound by DEF, 10 dB S/N (Gaussian noise, BW=3kHz)	00:35
12 01J	Sound by DEF, 5 dB S/N (Gaussian noise, BW=3kHz)	00:35
13 02A	15 Quick Sounds - 1st min	01:00
14 02B	15 Quick Sounds - 2nd min	01:02
15 02C	15 Quick Sounds - 3rd min	01:04
16 02D	15 Quick Sounds - 4th min	01:05
17 02E	15 Quick Sounds - 5th min	01:04
18 02F	15 Quick Sounds - 6th min	00:59
19 02G	10 Quick Sounds - 7th part	00:44
20 03A	Allcall, simple (@?@) with TIS GEORGE	00:13
21 03B	Allcall, with short AMD	00:15
22 03C	Allcall, with all 64 characters in AMD	00:22
23 03D	Allcall, with QUICK ID (FROM) and 90 char AMD, TWAS GEORGE	00:26
24 03E	Allcall, simple (@?@) with TIS GEORGE, Scan rate 5 channels/sec	00:10
25 03F	Allcall, with short AMD, Scan rate 5 channels/sec	00:12
26 * 04A	Selective Allcall, (address @A@, TIS GEORGE)	00:11
27 * 04B	Selective Allcall, (address @Z@, TIS GEORGE)	00:13
28 05A	Simple linking call (TO BOB, TIS TOM)	00:17
29 05B	Simple linking call, SCAN after 8s (TO BOB, TIS TOM; TWAS)	00:26
30 05C	Individual Call w/LQA v=max in Ackn (TO BOB, TIS TOM)	00:18
31 05D	Individual Call w/LQA v=mid in Ackn (TO BOB, TIS TOM)	00:18
32 05E	Individual Call w/LQA v=low in Ackn (TO BOB, TIS TOM)	00:18
33 05F	Individual Call w/LQA v=min in Ackn (TO BOB, TIS TOM)	00:18
34 06A	Star Net Call, simple (TO NT1, TIS IKE)	00:32
35 06B	Star Net Call, LQA in call (TO NT1, TIS IKE)	00:36
36 06C	Star Net Call, LQA+AMD in call (TO NT2, TIS GEORGE; TWAS)	01:07
37 06D	Star Net Call, LQA in call, AMD in Ack (TO NT2, TIS GEORGE)	00:50
38 06E	Star Net Call, simple, responses: 1,8 (TO NT1, TIS IKE)	00:32
39 06F	Star Net Call, LQA+AMD, responses: 1,8 (TO NT2, TIS GEORGE; TWAS)	01:07
40 06G	Star Net Call, simple (TO NET1, TIS IKE)	00:34
41 06H	Star Net Call, simple, responses: 0,1,8 (TO NT2, TIS GEORGE; TWAS)	01:07
42 06J	Star Net Call, simple, responses: 0,1,8 (TO NT2, TIS GEORGE; TWAS)	01:07
43 * 07A	Star Group Call, simple (TO GROUP, TIS RONNIE)	00:52
44 * 07B	Star Group Call, LQA in call (TO GROUP, TIS RONNIE)	00:54
45 * 07C	Star Group Call, LQA in call, AMD in Ack (TO GROUP, TIS RONNIE)	00:56
46 * 07D	Star Group Call, simple, response: 1 (TO GROUP, TIS RON)	00:27
47 * 07E	Star Group Call, simple, responses: 1,4 (TO GROUP, TIS RONNIE)	00:52
48 * 07F	Star Group Call, simple w/NULL address (TO GROUP, TIS RON)	00:31
49 * 08A	Anycall, simple (TO @@?, TIS DOC)	01:02
50 * 08B	Anycall, LQA in call (TO @@?, TIS DOC)	01:09

51 *	08C	Anycall, LQA+AMD in call	(TO @@?, TIS DOC)	01:10
52 *	09A	Anycall, selective	(TO @@A, TIS DOC)	01:00
53 *	09B	Anycall, selective	(TO @@Z, TIS DOC)	00:59
54 *	09C	Anycall, selective	(TO @@Z, TIS DOOM)	00:59
55 *	10A	Wildcard call	(TO TR?, TIS DUMB)	01:01
56 *	10B	Wildcard call	(TO ???DEF, TIS DUM)	01:02
57 *	10C	Wildcard call (illegal call)	(TO ???DEF, TIS DUMB)	01:02
58	11A	AMD sent after linking call	(TO BOB, TIS TOM; TWAS)	00:35
59	11B	90 char AMD in response	(TO AMDINRESP, TIS PROVEAMDINRESP (UUT))	00:21
60	12A	4 Calls ALLCALL+AMD,SCAN (clean & degraded tones: TO @?@, TWAS TOM)		01:38
61 #	13A	Link call, DTM in response-KD4=0	(TO BOB, TIS GEORGE)	00:24
62 #	13B	Link call, DTM in response-KD4=1	(TO BOB, TIS GEORGE)	00:24
63 #	13C	DTM message, KD4=0	(TO BOB, TIS GEORGE)	00:13
64 #	13D	DTM message, KD4=1	(TO BOB, TIS GEORGE)	00:13
65 #	14A	Call Acceptance Sounding; TOM sounds; (TO TOM, TIS BOB (UUT))		00:18
		Total Playing Time		46:53

Note: Tests with * are FED-STD-1046/1; # are optional tests; all others not marked are required tests for FED-STD-1045A radios. The word "TIS" denotes "originator" of call.

**APPENDIX F:
USING THE COMPACT DISC**

CD-INFO Information for Users of the ALE Clean Tones Compact Disc 01a**TABLE OF CONTENTS**

1.	Protocol Files for Generating ALE Calls	F-3
2.	ASCII Text Protocol Files Representing All 128 Characters	F-4
3.	Creating a Protocol File for an ALE Encoding (FED-STD-1045A)	F-5
4.	Tone Files	F-7
5.	Output Level	F-8
6.	Test Set Up	F-8
7.	Disc Specifics - Audio Compact Disc 01a	F-8
8.	Why an Audio CD Was Chosen over a CD-ROM	F-9
9.	Executable Software Programs	
9.1	ALECALL	F-10
9.2	ALETIME	F-11
9.3	C-AMD	F-12
9.4	C-LQA	F-14
9.5	C-DTM	F-15
10.	Bug List and Fixes for the Audio Clean Tones Compact Disc 01a	F-18
11.	ALE Clean Tones on Compact Disc 01a Readme File	F-19
12.	Calculations for Slot Widths on Compact Disc 01a	F-22

1. Protocol Files for Generating ALE Calls

Protocol files are ASCII text files that describe the particular type of call and data that are used by a FED-STD 1045A/MIL-STD 188-141A HF ALE controller. The protocol file is a simple representation of the call, understandable by those who use the ALE equipment, but also used by the computer software to generate the actual call. The protocol is read by the ALECALL software program which generates an ASCII tone sequence file and a digitized binary sound file to be placed on a Compact Disc or played through a high quality sound card. The sound file is produced in one of several formats: the default is a Microsoft Wave file for use with a sound card, or the PCM or DA digital audio file is created for recording onto audio compact discs. An example of a simple call in which JOE calls SAM to establish a link is shown.

```
# ALE Protocol file for 1045 Radios
# Developed by Dave Wortendyke at NTIA/ITS.N1 on 10-26-92
# This is a comment line
# 1st character in each line defines type of line, ie
#   a '#' defines a comment line
#   a '*' defines a time delay or pause in integer Trw's (n*0.392 s)
#   a '!' defines total silence in integer Trw's (n * 0.392 s)
#   an 'L' means the Left or Originate radio tones
#   an 'R' means the Right or Called radio tones
# 2nd word is either one of the 8 FED-STD 1045 preamble codes/commands
#   or a '*' for a tick mark for net calls
# 3rd word is the information/data word of exactly 3 characters
#   or a fraction like 14/3 Trw's representing spacing of net slots
# 4th word is a number telling how many times the line will be used
# The scanning call duration in this test is based upon the UUT set to
#   scan 10 channels at 2 channels/sec., for a total of 5 seconds.
#
L   TO   SAM   15
L   TIS  JOE   1
*   2
R   TO   JOE   2
R   TIS  SAM   1
*   2
L   TO   SAM   2
L   TIS  JOE   1
```

A time delay is represented in the simple example above by a "* 2". This equals two T_{rw} s or $2 * .392$ seconds. Later, when one advances to more complex calls, such as net and group calls, the protocol for time delays is extended to include not only the T_{rw} (392 ms) but the T_w timing (392/3 ms). The format of a fractional T_{rw} becomes

```
*   L   2/3           # Time delay of 2 Tw = 2/3 Trw
```

A more realistic example where the two protocol files are different, might be when JOE calls SAMMY and sends an AMD in the acknowledgment.

```
# Protocol File -----
L TO SAM 14
L DATA MY@ 1
L TO SAM 1
L DATA MY@ 1
L TIS JOE 1
* 2
R TO JOE 2
R TIS SAM 1
R DATA MY@ 1
* 2
L TO SAM 1
L DATA MY@ 1
L TO SAM 1
L DATA MY@ 1
L COMMAND HEL 1
L DATA LO^` 1
L REPEAT THE 1
L DATA RE^` 1
L TIS JOE 1
```

In the above protocol file, the two-ALE-word, 5-character "HELLO" must be padded by a blank character. Since the blank character (ASCII 32) is a nonprintable character in the ASCII set, a different method of representing the space (and other nonprintable characters) had to be found. This technique is described in Section 2 which follows.

2. ASCII Text Protocol Files Representing All 128 Characters

The purpose of creating an ASCII text protocol file is to provide the user of a software program that controls various hardware functions with a file that can be changed with a simple text editor, and then printed on a standard printer using only the 95 printable ASCII characters. Normally the protocol file should contain only the standard 95 printable characters, but sometimes it is necessary to use control characters, or the full 128 ASCII set. The method below describes a technique to represent all 128 characters with the 95 printable ones.

The ground rules are as follows.

All the **printable** characters will be printed as single characters **as normal** except for the backslash and the up-arrow. The backslash "\" (ASCII 92) and up-arrow "^" (ASCII 94) will be printed as doublets using the backslash as the leading character. The DEL (ASCII 127) will be represented by the doublet backslash and the printable character "@".

The normal control character set and space will be printed using a doublet sequence with the up arrow (ASCII 94) as the lead character, and the printable ASCII character whose value is 64 more than the control character.

Examples:

Character	ASCII decimal	Printed	Doublet ASCII Values
NUL	0	^@	94, 64
SOH	1	^A	94, 65
STX	2	^B	94, 66
:	:	:	
RS	30	^^	94, 94
US	31	^_	94, 95
space	32	^`	94, 96
!	33	!	n/a
:	:	:	
Z	90	Z	n/a
[91	[n/a
\	92	\\	92, 92
]	93]	n/a
^	94	^^	92, 94
_	95	_	n/a
:	:	:	
}	125	}	n/a
~	126	~	n/a
DEL	127	\@	92, 64

3. Creating a Protocol File for an ALE Encoding (FED-STD IO45A)

For simple calls one merely follows the rules provided as comments in the sample protocol files. It is necessary to use all upper case characters for the eight types of preambles. One may use the entire word, but only the first three characters are significant. They are as follows.

Type	Word Type	Code
DAT	DATA	0
THR	THRU	1
TO	TO	2
COM	COMMAND	3
FRO	FROM	4
TIS	THIS_IS	5
TWA	THIS_WAS, TWAS	6
REP	REPEAT	7

The address or data word is always three contiguous characters that are case sensitive. In some situations where a control or special character is used, a doublet character is required to represent the single character. (All control or special characters start with "\" or "^".)

Many of the powerful features of the ALE coding utilize information at the bit level, which makes the generation of the protocol file difficult if done manually. The package includes a series of software modules or programs to automatically provide the translation. The various command functions and preprocessors are named as follows.

Type	Cmd Code letter	Routine Name
AMD	n/a	c-amd
LQA	a	c-lqa
DTM	d	c-dtm (Basic DTM only, not extended)

An example for the LQA preprocessor is provided. The desired function is a scanning call with LQA information:

Left COMmand a-C-M-S-B

where lower case 'a' denotes an "Analysis," i.e., LQA function,
 the C is a control bit, 1 = return LQA, 0 = no return LQA,
 the M is an octal value for Multipath (0-7),
 the S is a 5 bit number for SINAD (0-9, A-V or other method for 0-31),
 the B is a 5 bit number for BER (0-9, A-V or other method for 0-31).

The output of the "c-lqa" module is shown.

```
input:   Left   COMmand   a-1-7-K-5   (note: K=21= 10101, 5= 00101)
          a    1  7    K    5           a    }    %
word= 110 1100001 1 111 10101 00101 => 110 1100001 1111101 0100101

output:  LEFT    COMMAND   a}%
```

If we change the request for LQA to suppress the return LQA then we get:

```
input:   Left   COMmand   a-0-7-K-5   (note: K= 10101, 5= 00101)
          a    0  7    K    5           a    =    %
word= 110 1100001 0 111 10101 00101 => 110 1100001 0111101 0100101

output:  LEFT    COMMAND   a=%   (note the '}' became '=')
```

4. Tone Files

These files describe the audio tones that will modulate a high frequency radio signal transmission. They carry address and data information in a precise format specified by FED-STD-1045.

The tone files are produced as an intermediate step in the generation of the audio sound files by the ALECALL program. Basically, the data in the file specifies what "goes over the air," in which direction, and when. The first word of each line of the ASCII tone file contains the encoded data. It normally consists of octal digits, or a "*". A "#" anywhere in the line denotes comments or information that is not really part of the tone database. ASCII characters "T" and "\$" are also allowed. The octal digits (0,1,2..7) and the "*" each represent one ALE baud or 8 ms of information. They are defined as:

Character	Meaning	Length (Cycles)	Time (ms)
0	Cosine wave of 750 Hz	6.000	8.000
1	Cosine wave of 1000 Hz	8.000	8.000
2	Cosine wave of 1500 Hz	12.000	8.000
3	Cosine wave of 1250 Hz	10.000	8.000
4	Cosine wave of 2500 Hz	20.000	8.000
5	Cosine wave of 2250 Hz	18.000	8.000
6	Cosine wave of 1750 Hz	14.000	8.000
7	Cosine wave of 2000 Hz	16.000	8.000
*	Silence of 8 ms	n/a	8.000

The tick mark "T", is used on the right stereo channel for all calls that require a response in a time slot. It is either a 4-ms cosine wave of 1000 Hz followed by silence, or a chime and a verbal indication of the number position of the current slot followed by silence. For example, at the start of the fifteenth slot, one would hear a chime and the word "fifteen." The chime is used on a few calls with 16 response slots. The duration of the tick (or chime) and silence is determined by the word time (T_w) given in the protocol control file and never exceeds the slotwidth. If the total redundant word time ($T_{rw} = 3 * T_w$) is not an integer for the slots described in the record of the protocol control file, the silence marks ("*") end with a "\$" as a warning flag to an incomplete ALE word boundary.

The tone file described above may include additional information preceded by a "#". Each of the fields or following words must have "white space" as separators between them. The first word after the "#" is the stereo channel: LEFT, RIGHT, or BOTH. The next word is "time=" and the last word represents the total elapsed time in seconds since the start of the ALE call described in the protocol file.

The ALECALL program (command line option -t FILENAME) reads tone files (*.TON) to produce a sound file that could be used for calibration and to check levels and frequencies. The calibration tone file must follow the format of the ALECALL tone file output, except that there can be any number of tones per line on the calibration tone file (rather than exactly 49 as produced by ALECALL.)

5. Output Level

The default output level is currently set at $0.5 * 2^{16}$ bits; this is 6 dB below the maximum voltage. This value represents 15 bits of the A-D converter. The generation software, ALECALL, varies this level at file generation time if so specified by the user. Call 12A on CD-01A has half of the default level ($0.25 * 2^{16}$) another 6 dB below the output level of the remainder of the CD. This was necessary due to the wide excursions of amplitude of the output that has Gaussian noise added.

6. Test Set Up

We have used with equal success the output of both very inexpensive and very good quality compact disc players (price range: \$125 - 650) from the variable head phone output to drive the VOX input of a transceiver. The audio output of a low quality CD player is noticeably inferior to the human ear, but an eight digit frequency counter gives the same frequency and stability for both players. There is a wide variance in output frequency for some brands of CD players. Both the CD players we use have better than 10 ppm accuracy when the 1000.000-Hz tone is played (i.e. $1000.000 \pm \Delta f$, where $\Delta f < 0.010$ Hz). The 32-Ohm output of the CD player is coupled via an audio transformer to the 600-Ohm balanced VOX audio input on the transceiver. The transceiver is set to one of the channels which the ALE UUT is scanning. The two radios are coupled with two 30-dB power attenuators and a small pad usually set at 40 dB. Our experience has shown it is very important to:

1. First transformer couple or use a passive bridge to match impedances between the CD phone output and the transceiver.
2. Then adjust the CD player output level and the transceiver VOX gain to a proper level, monitoring the SINAD or channel score until the maximum is reached.

Failure to perform the above steps may cause distortion that will affect the performance testing portion of the test plan (degraded tones CDs.) We were able to drop the LQA scores from a maximum of 30 to 18-22 by setting the output level either too low or too high on the CD player.

7. Disc Specifics - Audio Compact Disc 01a

The first track on CD-01a was recorded in an on-site laboratory with a microphone hooked directly to a computer disk. It is meant to be an informative introduction, and the quality of the track is of no concern, since the rest of the disc was produced totally from computer software and has the best S/N ratio that a CD player can produce. All test data (ALE tones) are on the left channel. Some new net and group calls on the final CD-01a disc have a few responses in the net response slots which are also on the left channel. The right channel is reserved for information and tick marks (for net calls, group calls, etc.). These simulate other stations which are responding to the net call. The CD track layout sheet marks those tests that are optional in FED-STD-1045 with an "*". Those tests are required for FED-STD-1046/1. Tests numbered 13 and higher are marked with a "#" and are optional because ITS included them without verification against the Federal Standard.

8. Why an Audio CD Was Chosen over a CD-ROM

The audio CD is identical to the music CDs sold in stores for \$5 - \$15 each that are played on a home audio CD stereo player. Audio CDs are now so popular that there are portable CD players and automobile CD players. The disc can hold 60 to 70 minutes of audio recording (i.e., stereo music, voice, or sound tracks.) Using a calibrated square wave on a test/demonstration audio CD or our own 1000-Hz cosine wave calibration track two, the accuracy of several home CD players varied from 7 parts per million (ppm) to 108 ppm when measured with an 8-digit frequency counter. Data for the audio tracks is transferred to an ISO optical compact disc writer from the computer disk drive. The writer must run nonstop, which records at a rate of approximately 10 Mbytes/minute. The prototype CD thus produced is sent to a CD manufacturer after testing in the laboratory. A master CD and submasters are made from the prototype, so the copies may be pressed out from a reverse image submaster.

The other CD popular format is the CD-ROM, which is more like an extremely high capacity floppy disk. (Note the spelling: disks are magnetic media, discs are optical media.) There are several formats that could be used for the CD-ROM, including ISO 9660 and Rockridge formats. Most CD-ROMs have the dual function of being able to be used as a slow disk drive for programs and data files, and with special software as a playback for audio CDs. The CD-ROM is not intended for use as an audio CD player, but will work. Note an accuracy of 84 ppm was measured when an audio CD was played in a good CD-ROM unit. By using a high quality DSP sound card (price = \$380) a very good playback frequency accuracy can be obtained from 80486 computers. We measured 15 ppm accuracy using a 486/33 computer. Use of a lesser computer is not recommended. Thus, a disadvantage of choosing the CD-ROM over the audio CD format is that the equipment requirements for the user would be greater than those for the audio CD. An added advantage of the CD-ROM is that all the documentation and sample protocol files could be stored on the same CD with the digital sound files. Another disadvantage is the higher cost to produce a master CD. The cost would be about 80% more than the audio CD for the master and 200 - 300 discs. We decided against producing CD-ROMs due to the added expense of production and the additional equipment requirement of the user.

In summary, there are good reasons to favor each technology, the sound card, the CD-ROM, and audio CD. The biggest advantage of using an accurate sound card is that the users and testers can generate a new digital file (different than that provided on the CD) with a different set of station addresses for their unique application, using the ALECALL software provided on the floppy disk. The best reason for using an audio CD is that everyone who tests ALE radios will have the same set of tests used by others, and the disc reproduction is relatively inexpensive. For our development effort, we use the quality sound card, but for everyday testing the audio CD is very convenient and inexpensive. A combination obviously provides the best and most flexible test combination.

9. Executable Software Programs

9.1 ALECALL

ALECALL software program for generating ALE Clean Tones was released in January 1995. It was developed by NTIA/ITS in Boulder, Colorado. This version of the program will generate the ALE pure (clean) tones and tones with Gaussian noise.

At the request of the HFIA representatives, this program is being released to all organizations that request it or obtain it via the Internet. The software is not in final form, but in an initial release version with clean tones and tones with Gaussian noise. This software release has several purposes:

1. It provides a means of producing sound (Wave) files that may be played on a high quality sound card. We used the audio output from the sound card to test each protocol of the final issue of CD-01A before recording it to a CD. It is likely that the industry providers may quickly set up and verify the operation of their radios against the sound files. This would benefit both the Government and industry by identifying either mistakes in the CD, mistakes in the vendors' ALE DSP coding, or misunderstood sections of the Federal and military Standards for HF ALE radios. All of this can be accomplished in the privacy of each vendor's test laboratory.
2. It provides a sneak preview of the more sophisticated ALECALL software program to be released in the future. That final software release will include a full Watterson model software simulator to degrade the ALE modem tones. Noise, fading, and multipath (NFM) will be specified in the protocol files (*.PRO) and will include the full range of CCIR conditions to produce GOOD, MODERATE, and POOR channel conditions.
3. It provides the HF industry a chance to provide final comments on the content and organization of the Official ALE Clean Tone compact disc published in January 1995.

===== Using ALECALL program =====

Usage: ALECALL ale-014a.pro To invoke the software

Files made: ALE-014a.ton The output tone (*.TON) file
 ALE-014a.wav The Wave sound file

--- OR---

Usage: ALECALL -t ale-014a.ton To invoke the software with a .TON file

Files made: ALE-014a.wav The Wave sound file

===== **ALECALL help screen** =====

ALECALL -- NTIA/ITS, Boulder, CO
Version 3.51; Jan, 1995 (tgs, gps)

A program to generate ALE tones from a Standard Usage: alecall [-arguments]
filename(s) arguments:

? ,h -> This help screen
a -> Write Digital Audio formatted output (.DA)
t -> Read the input as a .TON file
c -> Insert chimes instead of ticks
(TICKS.DAT must be in directory)
v -> Verbose mode: Display extra status information
q -> Quick mode: Only generate .TON files

Defaults:

input files: ASCII Protocol File (*.PRO)
output files: Wave file (.WAV)

You must be in the same directory as the .pro files!
Only Gaussian and Level NFM parameters in protocol files
are accepted in this version

Default level for this version is 0.50 (15 bits)

===== **Hardware for ALECALL** =====

Equipment required:

CPU 80486/33 (80386 and slower machines work, but take too long.)

Disk 10 to 40 MB free space

Sound card Good quality, with on board CPU and DSP chip

Warning: The *.WAV files accumulate at the rate of slightly over 10 Mbytes per minute of playing time. Check your free disk space.

9.2 ALETIME

ALETIME software program computes playing time from the protocol files. This program was essential for creating a CD track list. It is provided as an aid to test and disk space planning.

===== **Using ALETIME program** =====

Usage: ALETIME ale-07?.pro To invoke the software

Sample output:

Trk#	File Name	Playing	Total Trw's Time	Elapsed Time	
				seconds	min:sec
1	ALE-07A.PRO	48.608	124.	48.608	0:48.608
2	ALE-07B.PRO	50.960	130.	99.568	1:39.568
3	ALE-07C.PRO	52.528	134.	152.096	2:32.096
4	ALE-07D.PRO	23.912	61.	176.008	2:56.008
5	ALE-07E.PRO	48.608	124.	224.616	3:44.616
6	ALE-07F.PRO	27.440	70.	252.056	4:12.056
6	TOTALS		643.00	252.056	4:12.056

Note: most CD recorders add 2 sec per track as a buffer, hence the calculated time shown above may be 12 sec less than the actual recorded time.

===== **ALETIME help screen** =====

```
*****
*      ALETIME program to compute running times      *
*      of protocol (.pro) files for CD                *
*      U.S. Department of Commerce                   *
*      NTIA/ITS.N1                                    *
*      December 1994                                  *
*      Version 1.2                                     *
*****
```

```
Use: ALETIME [- arguments] filename(s)
arguments:
    ?,h      : This help screen
    a        : To add 2 seconds per track
              (To compensate for most CD writers)
filename(s):
    One or more protocol (.pro) files
    (A wildcard may be used, i.e., *.pro)
```

9.3 C-AMD

C-AMD software program creates a protocol file with an AMD message. C-AMD facilitates building protocol files with AMD messages since the AMD command codes include nonprintable characters. (See Section 2 of this appendix for details on nonprintable characters or FED-STD-1045A for information on AMD messaging.)

===== **C-AMD help screen** =====

```
***** C-AMD.C *****
Written by Chris Riddle, ITS.N1
Version 1.0

Usage: c-amd <to> <from> <message.file>
       or: c-amd <to> <from> 'put message in single quotes'
       Output is ale-amd.pro which contains the correct protocol
       file for the given AMD message.
```

===== **Using C-AMD program** =====

Usage: C-AMD BOB DOC 'this is a message' To invoke the software

--- OR ---

Usage: C-AMD BOB DOC MESSAGE.TXT To invoke the software

Sample input file: MESSAGE.TXT
Hello, this is a sample AMD for your review! "(12345*&%)

Sample output file: ALE-AMD.PRO

```

# ALE Protocol file for 1045 Radios
# Developed by Dave Wortendyke at NTIA/ITS.N1 on 10-26-92
# This is a comment line
# 1st character in each line defines type of line, ie
#   a '#' defines a comment line
#   a '*' defines a time delay or pause in integer Trw's (n *0.392 s)
#   a '!' defines total silence in integer Trw's (n * 0.392 s)
#   an 'L' means the Left or Originate radio tones
#   an 'R' means the Right or Called radio tones
# 2nd word is one of the 8 FED-STD 1045 preamble codes/commands
# 3rd word is the information/data word of exactly 3 characters
# 4th word is a number telling how many times the line will be used
# The scanning call duration in this test is based upon the UUT set to
#   scan 10 channels at 2 channels/second for a total of 5 seconds.
#
# This file generated by c-amd.c
# AMD message
#
# to BOB
# from DOC
# the message is from the file message.txt
L   TO     BOB     16
L   TO     BOB     1
L   TIS    DOC     1
*   4
R   TO     DOC     1
R   TO     DOC     1
R   TIS    BOB     1
*   3
L   TO     BOB     1
L   TO     BOB     1
# the AMD message follows...
L   COMMAND Hel    1
L   DATA   lo,    1
L   REPEAT  ^`th   1
L   DATA   is^`   1
L   REPEAT  is^`   1
L   DATA   a^`s   1
L   REPEAT  amp    1
L   DATA   le^`   1
L   REPEAT  AMD    1
L   DATA   ^`fo   1
L   REPEAT  r^`y   1
L   DATA   our    1
L   REPEAT  ^`re   1
L   DATA   vie    1
L   REPEAT  w^a^`  1
L   DATA   " (1   1
L   REPEAT  234    1
L   DATA   5*&   1
L   REPEAT  %)^`   1
#
L   TIS    DOC     1
*   1

```

9.4 C-LQA

C-LQA software program creates a protocol file with an LQA. As with AMD, the nonprintable characters are used in the command LQA. (See Section 3 of this appendix and FED-STD-I045A for details on LQA encoding.)

===== **C-LQA help screen** =====

```

***** C-LQA.C *****
Written by Chris Riddle, ITS.N1
Revised by Teresa Sparkman
Version 2.1

Usage: c-lqa <to> <from> <control bit> [[<SINAD> <BER>]] R] [Debug]
Output is ale-lqa.pro which contains the correct protocol
file for the given LQA message.
R - for LQA request, SINAD & BER undefined
control bit: 1 = return LQA, 0 = don't return LQA
SINAD: 0 - 30
BER: 0 - 30
NOTE: The maximum BER or SINAD value is 30

```

===== **Using C-LQA program** =====

Usage: C-LQA KAT DOC 1 R To invoke the software

Sample output file: ALE-LQA.PRO

```

# This file generated by c-lqa.c
#
# to KAT
# from DOC
# control bit = 1
# LQA request
# SINAD = N/A
# BER = N/A
# address the called station...
L    TO    KAT    15
L    TO    KAT    1
L    COMMAND    a/@/@ 1
L    TIS    DOC    1
*    5
R    TO    DOC    1
R    TO    DOC    1
R    TIS    KAT    1
*    2
L    TO    KAT    2
L    TIS    DOC    1
*    1

```

--- OR ---

Usage: C-LQA KATHREEN DOC 1 30 30 To invoke the software

Sample output file: ALE-LQA.PRO

```
# This file generated by c-lqa.c
#
# to KATHREEN
# from DOC
# control bit = 1
# SINAD = 30
# BER = 30
# address the called station...
L   TO           KAT   15
L   DATA        HRE   1
L   REPEAT       EN@   1
L   TO           KAT   1
L   DATA        HRE   1
L   REPEAT       EN@   1
L   COMMAND      a/@/^ 1
L   TIS          DOC   1
*   5
R   TO           DOC   1
R   TO           DOC   1
R   TIS          KAT   1
R   DATA        HRE   1
R   REPEAT       EN@   1
*   2
L   TO           KAT   2
L   DATA        HRE   1
L   REPEAT       EN@   1
L   TIS          DOC   1
*   1
```

9.5 C-DTM

C-DTM software program creates a protocol file with a DTM message. As with LQA and AMD, this program facilitates the encoding of the DTM nonprintable command characters. (See FED-STD-I045A for details on DTM encoding.)

===== **C-DTM help screen** =====

```
***** C-DTM.C *****
Written by Chris Riddle, ITS.N1
Version 2.1

Usage: c-dtm <to> <from> <kd4> <message.file>
       or: c-dtm <to> <from> <kd4> 'put message in single quotes'
           kd4 = 1 -> ACK request, kd4 = 0 -> no ACK request

Output is ale-dtm.pro which contains the correct protocol
file for the given DTM message.
```

===== Using C-DTM program =====

Usage: C-DTM JASON DOC 0 'this is a sample message' To invoke the software

Sample output file: ALE-DTM.PRO

```
# This file generated by c-dtm.c
# The COMMAND DTM is in one long block
# This assumes the receiving station has DTM capability
#
# to JASON
# from DOC
# message file temp.msg
# kd4 = 0
L    TO    JAS    16
L    DATA ON@    1
L    TO    JAS    1
L    DATA ON@    1
L    TIS   DOC    1
*    4
R    TO    DOC    1
R    TO    DOC    1
R    TIS   JAS    1
R    DATA ON@    1
*    3
L    TO    JAS    1
L    DATA ON@    1
L    TO    JAS    1
L    DATA ON@    1
# the DTM follows...
L    COMMAND d6$    1
L    DATA   thi    1
L    REPEAT  s^`i    1
L    DATA   s^`a    1
L    REPEAT  ^`sa    1
L    DATA   mpl    1
L    REPEAT  e^`m    1
L    DATA   ess    1
L    REPEAT  age    1
L    DATA   ^M^J@   1
L    COMMAND z;i    1
L    TIS    DOC    1
*    1
```

--- OR ---

Usage: C-DTM JASON DOC 1 TEST.MSG To invoke the software

Sample input file: TEST.MSG
this is a test of orderwire

Sample output file: ALE-DTM.PRO

```
# This file generated by c-dtm.c
# The COMMAND DTM is in one long block
# This assumes the receiving station has DTM capability
#
# to JASON
# from DOC
# message file test.msg
# kd4 = 1
L TO JAS 16
L DATA ON@ 1
L TO JAS 1
L DATA ON@ 1
L TIS DOC 1
* 4
R TO DOC 1
R TO DOC 1
R TIS JAS 1
R DATA ON@ 1
* 3
L TO JAS 1
L DATA ON@ 1
L TO JAS 1
L DATA ON@ 1
# the DTM follows...
L COMMAND dv' 1
L DATA thi 1
L REPEAT s^`i 1
L DATA s^`a 1
L REPEAT ^`te 1
L DATA st^` 1
L REPEAT of^` 1
L DATA ord 1
L REPEAT erw 1
L DATA ire 1
L REPEAT ^M^J@ 1
L COMMAND yF( 1
L TIS DOC 1
* 1
```

10. Bug List and Fixes for the Audio ALE Clean Tones Compact Disc 01a

***** Entries for ALE Clean Tones CD-01 (Beta test) *****

1. 9-21-93, Test 14A, D. Wortendyke, Incorrectly coded protocol, corrected for next release. The intent of Test 14A was to have a two-word net address, and a one word caller address, named IKE. Somehow GEORGE got into the file, and so the net slot time of 20 Tw's was too short. CD-01A will use IKE as the caller. Ignore this test on the Beta Disc.
2. 9-8-93, Test 10B, D. Wortendyke & G Teggatz, bogus test, changed test address of caller to DUM. The test plan calls for a two-word calling address and two-word caller address. This violates the length in the STD. The next release will use the caller address of DUM. It was found that some radios can decode the bogus call and respond, and some correctly ignore the call and immediately return to scan.
3. 3-20-94, Several Star NET & GROUP calls contained slot width errors and inconsistencies. These have been changed for the CD-01A, and are incorporated on the attached floppy disk.

***** Entries for ALE Clean Tones CD-01a *****

1. 6-28-94, D. Wortendyke, Summary of changes in the CD-01A release. Since the Beta test CD in August 1993, the following tests have been revised or are new: 6E, F, G, H, J, 7A, B, C, D, E, F, 14A, 12A. Several other tests created by ITS on the Beta test CD, have been merged into companion or associated tests on this CD.

11. ALE Clean Tones On Compact Disc 01a Readme File NTIA/ITS, Boulder, CO - January 1995

The files on this floppy disk and the zipped Internet package provide information for the proper use of the proposed audio Compact Disc (CD-01a). The purpose of Compact Disc 01a titled "ALE HF Radio Clean Tones for Interoperability Testing per FED-STD-1045A" is to provide an accurate, reliable, cost-effective method to test Adaptive HF radios for interoperability with Federal Standards 1045A and 1046/1. The MIL-STD-188-141A, Change #2 also contains these functions.

To get started, there are several files which must be printed. Each primary documentation file is provided in three forms. The file extension identifies the type of file. Text files end in ".TXT;" PostScript files end in ".PS;" and Word Perfect 5.x files end in ".WP5." You may choose which to use, depending upon your printing capabilities. The Word Perfect files use a PostScript printer. This file, README.1ST, and all the computer input/output files that have an extension of ".PRO" and ".TON" are only provided in ASCII text versions. A file extension of "xxx" implies that all three versions are provided on the floppy. ASCII text versions be printed in 12 chars/inch (elite).

FILES ON FLOPPY AND THE ZIPPED INTERNET PACKAGE:

1. FTIP-MAN.xxx and FTIP-AP1.xxx are the set of ALE test procedures derived from a Test Acceptance Plan (TAP) approved by the High Frequency Industries Associates (HFIA) during their meeting in San Diego, January 1993. Gene Teggatz, Rockwell, made a few corrections to the procedures to eliminate some problems encountered during early testing with a prototype CD by ITS in August 1993. The revised HFIA test document was received by ITS September 13, 1993. Only a few editorial changes have been made in the TAP to obtain the body of the FTIP-MAN.xxx document. The second portion of the TAP is Appendix I which describes the actual tests performed by the test tape or compact disc. ITS has modified the FTIP-AP1.xxx Appendix and tailored it to match the CD calls as of January 1995. The combined FTIP-MAN.xxx and FTIP-AP1.xxx document was approved by the FTSC HF as the test procedure for ALE radios with the ITS produced audio compact disc of ALE tones.
2. CDLAYOUT.xxx is the CD track listing. It also shows the correspondence between the CD track number and the test section number in Appendix I of the ALE Test Plan - Suggested Format of Standard Test Audio Compact Disc (Appendix C of this report.)
3. EVALUATE.xxx is the evaluation form you may use to provide user comments, evaluation, suggestions, and feedback about the CD and the concept for testing ALE HF radios. If preferred, you may write a letter on your letterhead with your evaluation of the CD. Although this is the final version of the files for the interoperability test disc, we welcome comments and suggestions. It will be assumed that persons or organizations that do not respond at all have not used or do not have a use for the CD, and may be dropped from future mailing lists.

4. *.PRO files found in the PRO subdirectory are the ALE protocol files from which the digital sound files were created. The problems found with the prototype Beta Test CD have been documented in both the FTIP-API Appendix and the protocol files (*.pro). If you think there is a mistake in any of the protocols, we urge you to document your understanding of the correct interpretation of the call, and notify us by e-mail, FAX, or letter. The file names of the protocol files are ALE-*nn*.PRO, where *nn* = the section number found in Appendix I to the ALE Test Plan - Suggested Format of Standard Test Audio Compact Disc (Appendix C of this report.) The numbers range from 01 to 14 including the additional tests added by ITS. The letter "a" = the segment of the test, such as A, B, C, etc.. Many of the net and group calls have been modified since the Beta CD.
5. The four sample *.TON files found in the TON subdirectory are representative of the over-the-air encoded tones that are found on the audio CD. Each of the 8-ary tones is represented by an octal number (0-7) representing the gray-scaled ALE frequencies according to the table on page 15, Section 5.1.2, of FED-STD-1045. (0=750Hz, 1=1000Hz, 2=1500Hz, etc.) Each line of the *.TON files has 49 tones, or exactly one ALE word of 392 ms. The file names correspond exactly with the ALE-*nn*.* names in the PRO subdirectory. The two files that represent ALE calls are for tests 5A and 6A. The other two are calibration tone files. They may have any length line and were chosen to have 50 tones equal to 0.4 seconds. They are named ALE-00B.TON and ALE-00C.TON.
6. D-INFO.xxx file is a set of documentation explaining how the audio disc was built from the FED-STD-1045A and FED-STD 1046/1 protocols and addresses. Additional information about the CD and future plans may be found here. This is a very important file that includes equipment set-up for running the tests on the CD.
7. *.EXE, executable binary programs have been added. Five programs are included on this disk: ALECALL.EXE which generates the sound files from the *.PRO protocol files, ALETIME.EXE which computes the playing time of the protocol files, and three other utility programs that build protocol files for the user. They are: C-AMD.EXE to build calls with AMD messages, C-DTM.EXE for DTM messages, and C-LQA.EXE to add LQA exchange to a call. These are in the subdirectory "exe" on the floppy disk. The ALECALL software will generate only clean tones, ignoring commands in the protocol files to generate noise, fading, and multipath.

Authorship, sponsor, and additional information:

The work to produce audio Compact Disc 01a was performed by:

Wireless Networks Group	303-497-5116 (Group Secretary)
US Department of Commerce	303-497-6982 (FAX)
NTIA/ITS.N1	tsparkman@its.bldrdoc.gov (E-mail)
325 Broadway	
Boulder, CO 80303-3328	

Additional information about the research, development, and applications of the ALE Compact Disc may be found in:

QEX (ARRL Experimenter's Exchange), "The Growing Family of Federal Standards for HF Radio ALE, Part II: A Compact Disc for Testing HF ALE Radios," by D. Wortendyke, C. Riddle, and D. Bodson, pp. 9 - 14, August 1993.

E-Mail questions, evaluations, criticism, and suggestions should be sent to: ale-cd@its.bldrdoc.gov or FAXed to "ALE-CD" 303-497-6982

***** WARNING *****

Information pertaining to use of Compact Disc 01a should be directed to NTIA/ITS or NCS at the above addresses. The CD represents a working implementation of a Federal Standard, and adheres to the 10 ppm accuracy required by FED-STD-1045. The civilian and military standards upon which this audio Compact Disc was based are under the control of the U.S. Government and its authorized Agencies. The Federal Government reserves the right to change the audio disc or standard at any time, and will notify all known recipients of the current compact disc of the availability of the newly revised audio compact disc.

The ALE Clean Tone audio compact disc and the tone files that make up the collection of audio sounds used for testing the FED-STD-1045A and FED-STD-1046/1 HF radios are copyrighted (c) 1994. This collection of tones, or audio information, is referred to as NIST Special Database 17. The tone files are not provided on the floppy so that the disk may be freely copied. You may generate the tone files for all the CD using the software and protocol files provided but they are for local use only. The sound files and the tone files make up the copyrighted database.

The ALE Clean Tone Database is maintained by NTIA/ITS in Boulder, Colorado. Specifically the Wireless Networks Group (ITS.N1) developed the Special Database of ALE tones under the sponsorship of NCS, Office of Technology and Standards, (c) 1994 copyright by the U.S. Department of Commerce on behalf of the United States. All rights reserved. No part of this database may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, or otherwise, without the prior written permission of the distributor. This copyright is assigned to the Standard Reference Data Program, National Institute of Standards and Technology (NIST).

12. Calculations for Slot Widths on Compact Disc 01a

Star Net Calls (06), Revised: 6-16-94

Test#	Slot#	Caller, # of words- Trw	Responder, #of words-Trw *	LQA (or AMD)	Guard Tw	Values $3(2*C+R+L)+5$	Width-Tw
06A	0	"IKE" = 1	R=C=1	0	5	$3*(2*1+1+0)+5$	14
	1	1	"ABC" = 1	0	5	ditto	14
	etc	1	1	0	5	ditto	14
06B	0	"IKE" = 1	R=C=1	1	5	$3*(2*1+1+1)+5$	17
	1	1	"ABC" = 1	1	5	ditto	17
	etc	1	1	1	5	ditto	17
06C	0	2	R=C=2	1	5	$3*(2*2+2+1)+5$	26
	1	2	2	1	5	ditto	26
	etc				5		
06D	same	as test	#06C		5		26
06E	same	as test	#06A		5		14
06F	same	as test	#06C		5		26
06G	same	as test	#06A		5		14

* For SLOT 0, set R = C

Star GroupCalls (07), Revised: 6-16-94

Test#	Slot#	Caller, # of words- Trw	Responder, #of words-Trw *	LQA (or AMD)	Guard Tw	Values $3(2*C+R+L)+5$	Width. Tw
07A	0	"RONNIE"=2	R = C = 2	0	5	$3*(2*2+2+0)+5$	23
	1	2	"ABC" = 1	0	5	$3*(2*2+1+0)+5$	20
	2	2	"DEF" = 1	0	5	ditto	20
	3	2	"GHIJ" = 2	0	5	$3*(2+2+2+0)+5$	23
	4	2	"456789DEF" = 3	0	5	$3*(2*2+3+0)+5$	26
	5	2	5	0	5	$3*(2*2+5+0)+5$	32
07B	0	2	2	1	5	$3*(2*2+2+1)+5$	26
	1	2	"ABC" = 1	1	5	$3*(2*2+ 1 +0)+5$	23
	2	2	"DEF" = 1	1	5	ditto	23
	3	2	2	1	5	$3*(2*2+1+1)+5$	26
	4	2	3	1	5	$3*(2*2+2+1)+5$	29
	5	2	5	1	5	$3*(2*2+5+1)+5$	35
07C	same	as test	#07B		5		
07D	0	"RON"= 1	R = C = 1	0	5	$3*(2*1+1+0)+5$	14
	1	1	"ABC" = 1	0	5	ditto	14
	2	1	"DEF" = 1	0	5	ditto	14
	3	1	"GHIJ"= 2	0	5	$3*(2*1+2+0)+5$	17
07E	0	"RON"= 1	R=C=1	0	5	$3*(2*1+1+0)+5$	14
	1	1	"ABC"= 1	0	5	ditto	14
	2	1	Null slot	0	5	ditto	14
	3	1	"DEF"= 1	0	5	ditto	14
	4	1	"GHIJ"= 2	0	5	$3*(2*1+2+0)+5$	17

* For SLOT 0, set R = C

**APPENDIX G:
NARRATION FOR TRACK 1 ON THE AUDIO CD**

Narration for Track 1 on the NTIA ALE Clean Tone Audio CD

December 20, 1994

Note: L = Left channel, R = Right channel, B = both channels

- L Short scanning call (8 TRW's): TO BOB (8), TIS TOM (1)
- R Response: TO TOM (2), TIS BOB (1)
- L Acknowledgement TO BOB (2), TIS TOM (1)

- R The modem tones you just heard are the exchanges between two adaptive high frequency radios, using an eight-tone waveform. This new breed of radio is controlled by a smart computer box or circuit card known as an Automatic Link Establishment controller, commonly referred to as ALE. This all-digital audio Compact Disc provides a comprehensive set of ALE tones which can be used to test the Federal Standard 1045 protocols, functions, and addresses.

The Institute for Telecommunication Sciences, located in Boulder, Colorado, leads the development and publication of Telecommunication Standards for the Federal Government. As part of the National Telecommunications & Information Administration, under the U.S. Department of Commerce, we are proud to present technology of the new standards in a cost-effective manner. This Compact Disc may be played in a simple home CD player. Our goal is to provide an inexpensive means and fast method for industry and Government users to test and verify equipment interoperability with the Government ALE Standard.

This audio Compact Disc is provided under the sponsorship of the National Communications System in Washington, DC. It is accompanied by a 3.5 inch high density floppy disk, for use in portable computers running under IBM PC-DOS or Microsoft DOS. It is necessary to read the "README.1ST" file in the root directory of the 3.5 inch Floppy Disk before using this CD.

Manufacturers of ALE radios formed a group called the High Frequency Industry Association, known as HFIA. This industry group developed and approved a test plan in January 1993, which is included on the floppy disk. Additional documentation includes the PROTOCOL files used to make the audio disc. The complete layout of the compact disc, including the correspondence between the text files and CD tracks, is provided on the floppy disk.

The Institute hopes you will find this compact disc useful. We would appreciate your comments by completing the evaluation form found on the floppy disk.

Before you get started with this Compact Disc, here are some helpful technical tips.

Tip 1: Track 1 contains this narration on the right stereo channel only. The right channel of this CD provides information such as the tick mark time boundaries for net calls or the expected responses from the ALE radio being tested. The left channel on this CD is reserved for the tones from the originating radio. Normally the left channel output is routed to a voice actuated microphone input of a high frequency radio transceiver. The RF output is attenuated and coupled to the ALE radio system under test.

Tip 2: Track 2 contains a 30-second calibration tone of 1000 Hz. With a properly adjusted CD player, the frequency of this tone should measure better than 10 parts per million. Track 3 continues with all eight ALE tones in a step sequence.

Tip 3: Tracks 4 through 57 implement the approved HFIA test plan. Track 58 has a short sequence of degraded tone calls for Section 12 in the test plan. In Fiscal Year 1995, we plan to produce a complete set of compact discs with degraded tones as described in the Test Plan. The discs will test the relative performance of the HF ALE radios for a wide variety of simulated channel conditions.

We have added some optional tests beginning at track 59. These optional tests are simple Data Text Messages, and a call acceptance sound.

This compact disc of clean ALE tones for interoperable testing has been copyrighted by the U.S. Department of Commerce under the Standard Reference Data Program of the National Institute of Standards and Technology.

**APPENDIX H:
ACQUIRING THE SOFTWARE**

To Receive the ALECALL Software Package via the Internet

- Step 1. Log onto your internet account.
- Step 2. At the prompt type "ftp nita.its.blrdoc.gov" and press <ENTER>.
- Step 3. Login as "ftp" and press <ENTER>.
- Step 4. Type your complete e-mail address at the password prompt (ex. "ale-cd@its.blrdoc.gov") and press <ENTER>.
- Step 5. Type "cd dist/ale-cd" and press <ENTER> to change to the ale-cd directory.
- Step 6. Type "bin" and press <ENTER> to change to binary transfer mode of FTP.
- Step 7. Type "get ale-1230.exe" (or the name of the desired file) and press <ENTER>. This will copy ale-1230.exe to your internet account. Be patient, as it may take a few moments to transfer the file which is about 1/3 Megabyte in length.
- Step 8. Type "quit" from FTP ("logout" from your account prompt) or whatever you usually do to exit. Press <ENTER> to log off the system and return to your internet account.

How to extract the ALECALL software

- Step 1. Copy ALE-1230.EXE to the directory on your DOS system where you would like to keep the ALECALL software. NOTE: The fully extracted software requires 4.3 MB of space! It will not fit on a high capacity 1.44 MB floppy.
- Step 2. At the DOS prompt, type "ale-1230 -d" and press <ENTER>. Failure to use the "-d" option will extract all files into your current directory. The following files will be extracted into your current directory if you use the "-d" option to create subdirectories:

COREL50	<DIR>	02-27-92	5:12p	
EXE	<DIR>	02-16-95	10:00a	
LOGSHEET	<DIR>	02-16-95	10:00a	
PRO	<DIR>	02-16-95	10:00a	
TON	<DIR>	02-16-95	10:00a	
ALE-WAN2	PS	42,238	02-24-95	5:47p
ALE-WAN2	TXT	1,680	02-24-95	5:46p
ALE-WAN2	WP5	2,837	02-24-95	5:45p
CD-INFO	PS	260,880	02-15-95	3:38p
CD-INFO	TXT	33,918	02-17-95	5:01p
CD-INFO	WP5	52,507	02-07-95	10:12a
CD-INTRO	PS	76,246	02-15-95	4:09p
CD-INTRO	TXT	4,140	02-17-95	5:11p
CD-INTRO	WP	5,527	02-07-95	8:52a
CDLAYOUT	PS	42,808	02-15-95	3:34p
CDLAYOUT	TXT	5,918	02-17-95	5:23p
CDLAYOUT	WP5	14,895	01-20-95	4:49p
EVALUATE	PS	40,131	02-15-95	3:39p
EVALUATE	TXT	1,810	02-15-95	3:39p
EVALUATE	WP5	2,796	01-10-95	2:28p
FTIP-AP1	PS	101,150	02-15-95	3:31p
FTIP-AP1	XT	36,060	02-15-95	3:30p
FTIP-AP1	WP5	39,306	01-26-95	4:00p
FTIP-MAN	PS	260,583	02-15-95	3:28p
FTIP-MAN	TXT	30,444	02-15-95	3:26p
FTIP-MAN	WP5	33,274	02-15-95	3:20p
README	1ST	8,721	02-23-95	6:00p
README	TOO	4,172	02-27-95	5:17p
SLOTWIDTH	PS	182,665	02-15-95	3:45p
SLOTWIDTH	WP5	30,014	06-29-94	1:23p

The README.1ST file should be printed and read first. The other files are documentation, and *normally* exist in three forms: Word Perfect 5.1 (*.wp5), Adobe Post Script for copying directly to a PostScript printer (*.ps), and an ASCII text version (*.txt). A few files do *not* exist in all 3 formats.

The "exe" directory contains the executable files (alecall.exe, aletime.exe, etc).

The "ton" directory contains the sample tone files (*.ton).

The "logsheet" directory contains the test log sheets which are Microsoft Excel files, version 4.0a. (*.xls), and PostScript versions (*.ps).

The "pro" directory contains the ALE protocol files (*.pro). These files are used as the source for the "alecall" program to generate the sound files.

The "corel50" directory contains Corel version 5.0 drawings. They are **not** essential and are provided only as supplementary information for those who have the Corel program.

In the current directory, WordPerfect 5.1 files are *.wp5, ASCII text files are *.txt, and PostScript files are *.ps.

****Please read the "readme.1st" file for the most recent updates.**

**APPENDIX I:
EVALUATION FORM FOR NTIA AUDIO COMPACT DISC 01A ALE
CLEAN TONES FOR FED-STD-1045A AND 1046/1**

5. Would you like to see any tests added/deleted/modified?

6. Would any other media or format be better than an audio CD for your use?

7. Are you interested in getting additional releases of this same “Interoperability Clean ALE Tone Compact Disc”?

8. Would you be interested in a set of CDs that have the tones degraded by using a digital model of the Watterson Channel Simulator? If so, what would your application be?

9. The software program ALECALL for generating your own calls with a sound card is included on the floppy disk. Will this be a useful tool? How?

10. This space (and separate page) for any additional comments/evaluation.

BIBLIOGRAPHIC DATA SHEET

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		13.	
14. SUPPLEMENTARY NOTES			
15. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.) A method of high frequency (HF) radio interoperability testing in accordance with Federal Standards 1045A and 1046/1 is now available on a compact disc (CD) created by engineers at the National Telecommunications and Information Administration, Institute for Telecommunication Sciences. This report describes both the use of the CD and the software that created the sound files recorded on the CD. The sound files, which can be recreated by the program on a personal computer and played through a PC sound card, were recorded on a compact disc and packaged with the executable software for distribution to the public. The use of the CD for interoperability testing is explained, and tools are provided to simplify testing, such as data log sheets and additional utility software.			
16. Key Words (Alphabetical order, separated by semicolons) FED-STD-1045A; FED-STD-1046/1; automatic link establishment; ALE; interoperability; compact disc; CD; high frequency (HF) radio			
17. AVAILABILITY STATEMENT <input checked="" type="checkbox"/> UNLIMITED. <input type="checkbox"/> FOR OFFICIAL DISTRIBUTION.		18. Security Class. (This report) unclassified	20. Number of pages 117
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