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 I 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 then 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.

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

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.

para:	title	Test tape sequence proven
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)
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 then 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 setable 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 an self address is other then 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 then 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.)