DEPARTMENT OF THE AIR FORCE
Headquarters US Air Force
Washington DC  20330-1680

Air Force Job Qualification
Standard 2E1X1-215N
2E1X1-215.14
1 October 1999

AN/FRC-181 (V)1,2,3 MILSTAR TERMINAL
(Satellite/Wideband Communications Systems Journeyman/Craftsman)

**SECTION A:  GENERAL**

1.    This Air Force Job Qualification Standard (AFJQS) and attached Air Force Qualification Training Package (AFQTP) standardize on-the-job training (OJT) tasks and constitute an approved training program for the AN/FRC-181 (V)1,2,3 MILSTAR Terminal.  The AFJQS and AFQTP are used by unit training managers, supervisors, trainers, trainees, and other training functions to plan, conduct, and document OJT on this equipment.

2.    Maintain the AFJQS IAW AFI 36-2201, AFI 36-2233, and AFMAN 36-2247.  Routine changes will be accomplished via page changes and urgent changes will be disseminated via message.  Enter additional local tasks in the blank areas on the AFJQS or add forms.  Develop Task Training Guides for added tasks; they should be consistent in content and format with those in the AFQTP. Submit recommended AFJQS/AFQTP improvements/corrections to the 81 TRSS Qualification Training Flight (81 TRSS/TSQS), 601 D Street, Keesler AFB MS 39534-2229.

3.    Review Air Force publishing bulletins and AFIND8 to identify available training materials.  Use this AFJQS in conjunction with other applicable JQSs or the Career Field Education and Training Plan (CFETP) and locally assigned tasks to identify work center duty positions.  Also, use this AFJQS along with other applicable JQSs and the CFETP to evaluate newly assigned personnel and identify individual training requirements.

4.    Tasks listed on the AFJQS have been selected IAW the Instructional System Development (ISD) process and are the minimum, mandatory AF training requirements for this equipment.  The "X" code in the Core Task column of the AF Form 797 is used to indicate that the individual must be trained and certified on that particular task.   The "X*" code identifies tasks that may not be common to all equipment configurations; however, the task must be trained if it is assigned to the individual's duty position. The "—" code is used to indicate that training on this task is a local determination while ensuring 100% task coverage within the work center.

5.    Trainees must accurately perform each assigned task unassisted IAW Technical References (TR) prior to being certified.  To qualify for skill-level upgrade, trainees must be certified on assigned tasks, satisfactorily complete career knowledge training, and meet mandatory specialty qualifications IAW AFI 36-2101, AFI 36-2201, and AFMAN 36-2108.  After upgrade, assign individuals to other work center duty positions and continue qualification training.

_____

**SECTION B:  DOCUMENTATION**

1.    AFJQS/CFETP tasks will be compiled in an automated training management system, such as the Core Automated Maintenance System (CAMS), if available.  The system must contain each AFJQS/CFETP title line with appropriate AFJQS/CFETP numbers, titles, and dates.   AFJQS/CFETP and automated documentation requirements are listed below.  The alphanumeric AFJQS number is converted to a dotted decimal number for use in CAMS.  Alphanumeric numbers have been converted by retaining the 200 series number and changing the alpha character to the corresponding number, i.e., -200B becomes -200.2 and -201LB becomes -201.12.2.

        a.    Load applicable tasks in the automated training system or identify training requirements by circling the task numbers on each individual's AFJQS/CFETP.

        b.    If task statements contain more than one noun or action verb which precludes certification on the entire task, load/circle the noun or verb to indicate the individual is being trained only on that portion of the task.

        c.    When training is started on a task, enter the start date in the appropriate place.  When training is complete, document training and task certification IAW local certification procedures.

2.    The identification blocks listed below are to be used when the trainer is other than the trainee's immediate supervisor.

| TRAINEE'S NAME: | INITIALS: | SSN: |
|---|---|---|
| TRAINER'S NAME, INITIALS, DATE: | | |
| TRAINER'S NAME, INITIALS, DATE: | | |
| TRAINER'S NAME, INITIALS, DATE: | | |
| TRAINER'S NAME, INITIALS, DATE: | | |
| TRAINER'S NAME, INITIALS, DATE: | | |

BY ORDER OF THE SECRETARY OF THE AIR FORCE

OFFICIAL                                              JOHN W. HANDY, Lieutenant General, USAF
                                                             Deputy Chief of Staff/Installations and Logistics


                                                             4 Atch
                                                             1.  AF Form 797
                                                             2.  Trainer's Guide
                                                             3.  Skill Training Material
                                                             4.  Knowledge Evaluation Pamphlet

# JOB QUALIFICATION STANDARD CONTINUATION/COMMAND JQS

| TASKS, KNOWLEDGE, AND TECHNICAL REFERENCES | CORE TASK | CERTIFICATION | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| | | START DATE | COMPLETE DATE | TRAINEE'S INITIALS | TRAINER'S INITIALS | CERTIFYING OFFICIAL'S INITIALS |
| 215.14.1  AN/FRC-181(V)1,2,3 POWER UP AND POWER DOWN PROCEDURES | | | | | | |
| 215.14.1.1  Power up/reset terminal<br>TR:  31R2-2FRC181-51, Figure 4-27; 31R2-2FRC181-61, Figure 4-18 | X | | | | | |
| 215.14.1.2  Power down the terminal<br>TR:  31R2-2FRC181-51, Figure 4-39; 31R2-2FRC181-61, Figure 4-29 | X | | | | | |
| 215.14.2  Perform Preventive Maintenance Inspections (PMI)<br>TR:  31R2-2TRC194-6WC-1, Cards 1-001 thru 1-010 and 4-001 | X | | | | | |
| 215.14.3  FAULT ISOLATION | | | | | | |
| 215.14.3.1  Modify message routing<br>TR:  MILSTAR Positional Handbook, Procedure 3.6.1 | X | | | | | |
| 215.14.3.2  Initiate a non-disruptive test<br>TR:  MILSTAR  Positional Handbook, Procedure 4.6.1 | — | | | | | |
| 215.14.3.3  Initiate a disruptive test<br>TR:  MILSTAR Positional Handbook, Procedure 4.7.1 | — | | | | | |
| 215.14.3.4  Isolate faults<br>TR:  31R2-2FRC181-51, Chapter 6-4, Figures 6-2 and 6-7 thru 6-25;<br>31R2-2FRC181-61, Chapter 6-4, Figures 6-2 and 6-7 thru 6-24 | — | | | | | |
| 215.14.4  Remove and Replace Major Line Replaceable Units (LRU)<br>TR:  31R2-2FRC181-51, Chapter 6-5 or 31R2-2FRC181-61, Chapter 6-5 | — | | | | | |

| TRAINEE NAME *(Last, First, MI)* | CFETP/JQS NUMBER<br>2E1X1-215N | PAGE NO<br>1 |
| --- | --- | --- |
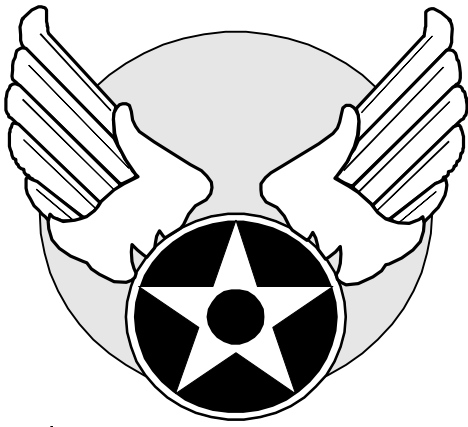
**AF FORM 797, FEB 99** *(EF-V1)*  PREVIOUS EDITIONS ARE OBSOLETE

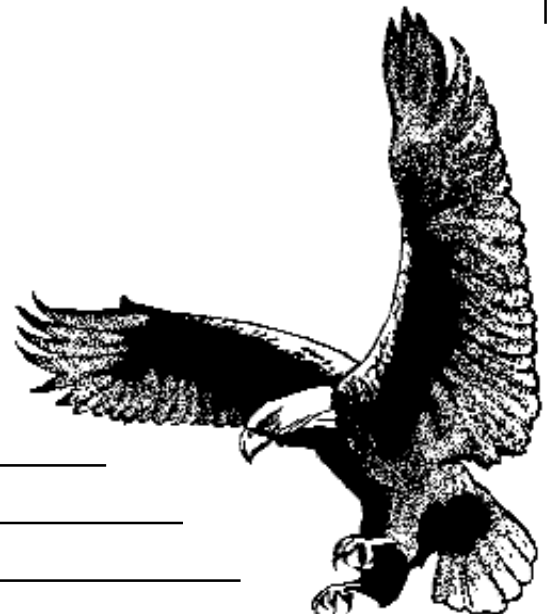# AIR FORCE QUALIFICATION TRAINING PACKAGE

## *2E1X1-215N*

PART OF AFJQS 2E1X1-215N

# AN/FRC-181 (V)1,2,3 MILSTAR TERMINAL

## TRAINER'S GUIDE

**1 OCTOBER 1999**

**SUPERSEDES AFJQS 2E1X1-215N**
**DATED 26 AUGUST 1998**

**FOR OJT USE ONLY**

# TRAINER'S GUIDE

## CONTENTS

## ABOUT THIS TRAINING PACKAGE

This training package was originally developed by SSgt Daniel Ouellette and revised by SrA Jason Woods, 81 TRSS Qualification Training Flight, Keesler AFB, MS. The Training and Education Specialist was Mr. Tom Vuncannon. SSgt Tom Wilcox, 338 TRS/Det 1, Ft. Gordon, GA, was consulted as Subject Matter Expert.

For more information on the 81 TRSS Qualification Training Flight and a list of other products that are available, feel free to visit our home page at http://www.keesler.af.mil/81trss/qflight.

### IMPORTANT INFORMATION

The following training guidance is intended for use by qualified trainers. It is highly recommended that inexperienced trainers complete Air Force Training Course J4AJS3S2X1-00X, available on computer disk through your wing/unit training manager, before attempting to train anyone on this material.

This training package was developed with four objectives in mind.
- Standardize on-the-job training.
- Reduce training time while maintaining proficiency standards.
- Provide trainers and trainees with a logically organized training plan which yields immediate and measurable feedback.
- Provide a standard to measure task knowledge and performance during personnel evaluations.

## HOW TO USE THIS TRAINING PACKAGE

### PACKAGE DESCRIPTION

This training package consists of
- an AF Form 797 that lists all tasks performed during development of OJT material that require structured training and certification.
- a Trainer's Guide that provides the trainer with instructions on how to effectively conduct on-the-job training using this training package. The Trainer's Guide includes Task Training Guides (TTG) and covers every task listed on the AF Form 797. The task evaluation checklists reflect the major areas of a task which must be performed satisfactorily before certification. A Training Completion Certification is attached.

- Skill Training Material (STM) which contains training modules, review questions, performance procedures, and a review question confirmation key.
- a Knowledge Evaluation Pamphlet (KEP) which contains a test for each module. Keep the pamphlet separate until you are ready to administer the tests. Detach and store the KEP Key and Answer Sheet(s) in a secure place to ensure the KEP is not compromised.

## INSTRUCTIONS FOR USING THIS TRAINING PACKAGE

- Review the trainee's training record (AF Form 623) and determine the trainee's previous training and certification.
- Assign the trainee to a duty position and develop the trainee's individual training plan (ITP) (see Figure 1 for an example of a computer-generated plan). Using the ITP, select the first task for training and review the applicable TTG.
- Ensure all training references are available and all prerequisites for that task are met.
- Discuss with trainee the task objective(s) and training steps. Assign corresponding STM module for the trainee to complete.
- When you are satisfied with the trainee's knowledge of the material, administer the Knowledge Evaluation Pamphlet. (Normally, the trainee is NOT permitted to use TRs but if TR use is permitted, it will be stated at the beginning of each KEP test and a score of 100% required. Otherwise, the trainee must score a minimum of 70% on the KEP tests.) Check the trainee's answers against the KEP Confirmation Key and review missed questions with trainee to ensure understanding of the material. If the score is less than what is required, have the trainee restudy the module and retake the test. Using TRs and the Task Evaluation Checklist as guidance, explain the task performance procedures to the trainee. Demonstrate the task procedures to the trainee and answer any questions. Have the trainee practice and explain the task procedures to you.
- Have the trainee perform the task procedures unassisted. Using the Task Evaluation Checklist, evaluate the trainee's performance. Should the trainee fail, determine the cause of unsatisfactory performance. Reevaluate the trainee when you are satisfied the task can be performed unassisted. When the trainee performs the task at the desired level of proficiency without assistance, document training and task certification IAW local certification procedures.

- Using the ITP, assign additional tasks until the trainee completes the requirements for the duty position.  If, before completing this training package, the trainee is reassigned to another location which has a need for this training, we recommend you forward the training material to the gaining work center.
- Schedule periodic evaluations after the trainee is task certified.  You may use the performance procedures, task evaluation checklists, or the KEP.
- When training is completed, remove the attached Training Completion Certification and give it to the trainee so he/she may make recommendations, suggestions, or offer corrections to the training package in the comments section.  Mail the completed Training Completion Certification to the address specified.  Upon receipt of a properly completed training certification, a Certificate of Training will be forwarded through channels to the trainee.

| INDIVIDUAL TRAINING PLAN | | | | |
|---|---|---|---|---|
| TRAINEE: Amn Smith     TRAINER: SSgt Jones | | | | |
| AFJQS NUMBER/ TASK NUMBER | ESTIMATED TRAINING TIME | ESTIMATED START TIME | DATE TRAINING COMPLETED | REMARKS |
| XXXXX-XXXX   /1 | 2 days | 21 Jun 97 | 23 Jun 97 | |
| /2 | 4 hours | 24 Jun 97 | 25 Jun 97 | |

**EXAMPLE**                                    **EXAMPLE**

This Individual Training Plan is an example only.  It does not reflect accurate training times.

Figure 1.  Individual Training Plan

# POWER UP/POWER DOWN THE AN/FRC-181 (V)1,2,3 TASK TRAINING GUIDE

**TRAINEE'S NAME** _____

**AFJQS TASK NUMBERS** 215.14.1.1 and 215.14.1.2

**ESTIMATED TASK TRAINING TIME** _____

## TRAINING REFERENCES

- TO 31R2-2FRC181-51

- TO 31R2-2FRC181-61

- MILSTAR Positional Handbook

- AFQTP Module 1

## PREREQUISITES

- Test equipment to be used:  None

- Downtime/user release is required.

## TRAINING OBJECTIVES

- OBJECTIVE 1: Given TO 31R2-2FRC181-51 or TO 31R2-2FRC181-61, power up/reset the terminal IAW Figure 4-27 of the -51 TO or Figure 4-18 of the –61 TO.

- OBJECTIVE 2: Given TO 31R2-2FRC181-51 or TO 31R2-2FRC181-61, power down the terminal IAW Figure 4-39 of the -51 TO or Figure 4-29 of the –61 TO.

## INITIAL TRAINING STEPS  (check when completed)

Discuss the objective for the task, including the work center speed and accuracy standards for performing the task.  Also discuss the conditions under which it is normally performed.

Assign AFQTP Module 1.

Discuss the review questions and answers with the trainee.

Administer the KEP.

Check the KEP answers and review missed questions.

## OBJECTIVE 1 TRAINING STEPS

Using technical references and the checklist in the Task Evaluation below as guidance, discuss the task steps for achieving objective 1 with trainee. Ensure all Notes, Cautions, and Warnings listed in the TO for each step are covered. Brief the trainee on all safety precautions and local procedures that apply.

Demonstrate correct task performance.

Review task steps with trainee and answer any questions.

Have trainee practice steps and assist as necessary.

## TASK 215.14.1.1 EVALUATION

- Have trainee perform task steps unassisted and evaluate performance IAW the following checklist. (Return to OBJECTIVE 1 TRAINING STEPS if evaluation is unsatisfactory.)

Powered up/reset the terminal.

Trainee is ready to be certified on this AFJQS task. Follow local certification procedures.

## OBJECTIVE 2 TRAINING STEPS

Using technical references and the checklist in the Task Evaluation below as guidance, discuss the task steps for achieving objective 2 with trainee. Ensure all Notes, Cautions, and Warnings listed in the TO for each step are covered. Brief the trainee on all safety precautions and local procedures that apply.

Demonstrate correct task performance.

Review task steps with trainee and answer any questions.

Restore system to normal operating configuration.

Have trainee practice steps and assist as necessary.

## TASK 215.14.1.2 EVALUATION

- Have trainee perform task steps unassisted and evaluate performance IAW the following checklist.  (Return to OBJECTIVE 2 TRAINING STEPS if evaluation is unsatisfactory.)

Powered down the terminal.

Restored system to normal operating configuration.

Trainee is ready to be certified on this AFJQS task.  Follow local certification procedures.

Assign the next task for training.

# PERFORM PREVENTIVE MAINTENANCE INSPECTIONS (PMI) TASK TRAINING GUIDE

**TRAINEE'S NAME**  _____

**AFJQS TASK NUMBER**  215.14.2

**ESTIMATED TASK TRAINING TIME**  _____

**TRAINING REFERENCE**

- TO 31R2-2TRC194-6WC-1

**PREREQUISITES**

- Test equipment to be used:  None

- Downtime/user release is required.

- Ensure trainee has completed AFQTP Module 1.

**TRAINING OBJECTIVE**

- Given TO 31R2-2TRC194-6WC-1, perform PMIs on the AN/FRC-181(V)1,2,3 IAW cards 1-001 through 1-010 and 4-001.

**INITIAL TRAINING STEPS  (check when completed)**

Discuss the objective for the task, including the work center speed and accuracy standards for performing the task.  Also discuss the conditions under which it is normally performed.

Assign trainee to read the material listed in the objective.

Discuss the reading assignment with trainee to ensure the trainee understands the material.

## OBJECTIVE TRAINING STEPS

Using technical references and the checklist in the Task Evaluation below as guidance, discuss the task steps for achieving the objective with trainee.  Ensure all Notes, Cautions, and Warnings listed in the TO for each step are covered. Brief the trainee on all safety precautions and local procedures that apply.

Demonstrate correct task performance.

Review task steps with trainee and answer any questions.

Restore system to normal operating configuration.

Have trainee practice steps and assist as necessary.

## TASK 215.14.2 EVALUATION

- Have trainee perform task steps unassisted and evaluate performance IAW the following checklist.  (Return to OBJECTIVE TRAINING STEPS if evaluation is unsatisfactory.)

Performed Daily PMI.

Performed 7-Day PMI.

Performed 28-Day PMI.

Performed 56-Day PMI.

Performed 336-Day PMI.

Performed time replacement of the TFS.

Trainee is ready to be certified on this AFJQS task.  Follow local certification procedures.

Assign the next task for training.

# FAULT ISOLATION
# TASK TRAINING GUIDE

**TRAINEE'S NAME** _____

**AFJQS TASK NUMBERS** 215.14.3.1, 215.14.3.2, 215.14.3.3, and 215.14.3.4

**ESTIMATED TASK TRAINING TIME** _____

**TRAINING REFERENCES**

- TO 31R2-2FRC181-51

- TO 31R2-2FRC181-61

- MILSTAR Positional Handbook

- AFQTP Module 2

**PREREQUISITES**

- Test equipment to be used: None

- Downtime/user release is not required.

- Ensure trainee has completed AFQTP Module 1.

**TRAINING OBJECTIVE(S)**

- OBJECTIVE 1: Given the MILSTAR Positional Handbook, modify message routing IAW procedure 3.6.1.

- OBJECTIVE 2: Given the MILSTAR Positional Handbook, initiate a non-disruptive test IAW procedure 4.6.1.

- OBJECTIVE 3: Given the MILSTAR Positional Handbook, initiate a disruptive test IAW procedure 4.7.1.

- OBJECTIVE 4: Given TO 31R2-2FRC181-51 or TO 31R2-2FRC181-61, isolate faults IAW Chapter 6-4 and Figures 6-2 and 6-7 through 6-25 of the –51 TO, or Figures 6-2 and 6-7 through 6-24 of the –61 TO.

## INITIAL TRAINING STEPS  (check when completed)

Discuss the objective for the task, including the work center speed and accuracy standards for performing the task.  Also discuss the conditions under which it is normally performed.

Assign AFQTP Module 2.

Discuss the review questions and answers with the trainee.

Administer the KEP.

Check the KEP answers and review missed questions.

## OBJECTIVE 1 TRAINING STEPS

Using technical references and the checklist in the Task Evaluation below as guidance, discuss the task steps for achieving objective 1 with trainee.  Ensure all Notes, Cautions, and Warnings listed in the TO for each step are covered. Brief the trainee on all safety precautions and local procedures that apply.

Demonstrate correct task performance.

Review task steps with trainee and answer any questions.

Have trainee practice steps and assist as necessary.

## TASK 215.14.3.1 EVALUATION

- Have trainee perform task steps unassisted and evaluate performance IAW the following checklist.  (Return to OBJECTIVE 1 TRAINING STEPS if evaluation is unsatisfactory.)

Modified message routing.

Trainee is ready to be certified on this AFJQS task.  Follow local certification procedures.

## OBJECTIVE 2 TRAINING STEPS

Using technical references and the checklist in the Task Evaluation below as guidance, discuss the task steps for achieving objective 2 with trainee.  Ensure all Notes, Cautions, and Warnings listed in the TO for each step are covered. Brief the trainee on all safety precautions and local procedures that apply.

Demonstrate correct task performance.

Review task steps with trainee and answer any questions.

Restore system to normal operating configuration.

Have trainee practice steps and assist as necessary.

## TASK 215.14.3.2 EVALUATION

- Have trainee perform task steps unassisted and evaluate performance IAW the following checklist. (Return to OBJECTIVE 2 TRAINING STEPS if evaluation is unsatisfactory.)

Initiated a non-disruptive test.

Restored system to normal operating configuration.

Trainee is ready to be certified on this AFJQS task. Follow local certification procedures.

## OBJECTIVE 3 TRAINING STEPS

Using technical references and the checklist in the Task Evaluation below as guidance, discuss the task steps for achieving objective 3 with trainee. Ensure all Notes, Cautions, and Warnings listed in the TO for each step are covered. Brief the trainee on all safety precautions and local procedures that apply.

Demonstrate correct task performance.

Review task steps with trainee and answer any questions.

Restore system to normal operating configuration.

Have trainee practice steps and assist as necessary.

## TASK 215.14.3.3 EVALUATION

- Have trainee perform task steps unassisted and evaluate performance IAW the following checklist. (Return to OBJECTIVE 3 TRAINING STEPS if evaluation is unsatisfactory.)

Initiated a disruptive test.

Restored system to normal operating configuration.

Trainee is ready to be certified on this AFJQS task.  Follow local certification procedures.

## OBJECTIVE 4 TRAINING STEPS

Using technical references and the checklist in the Task Evaluation below as guidance, discuss the task steps for achieving objective 4 with trainee.  Ensure all Notes, Cautions, and Warnings listed in the TO for each step are covered.  Brief the trainee on all safety precautions and local procedures that apply.

Demonstrate correct task performance.

Review task steps with trainee and answer any questions.

Restore system to normal operating configuration.

Have trainee practice steps and assist as necessary.

## TASK 215.14.3.4 EVALUATION

- Have trainee perform task steps unassisted and evaluate performance IAW the following checklist.  (Return to OBJECTIVE 4 TRAINING STEPS if evaluation is unsatisfactory.)

Isolated faults.

Restored system to normal operating configuration.

Trainee is ready to be certified on this AFJQS task.  Follow local certification procedures.

Assign the next task for training.

# REMOVE AND REPLACE MAJOR LINE REPLACEABLE UNITS (LRU) TASK TRAINING GUIDE

**TRAINEE'S NAME**  _____

**AFJQS TASK NUMBER**  215.14.4

**ESTIMATED TASK TRAINING TIME**  _____

**TRAINING REFERENCES**

- TO 31R2-2FRC181-51

- TO 31R2-2FRC181-61

**PREREQUISITES**

- Test equipment to be used:  None

- Downtime/user release is not required.

**TRAINING OBJECTIVE(S)**

- Given TO 31R2-2FRC181-51 or 31R2-2FRC181-61, remove and replace major LRUs IAW Chapter 6-5.

### NOTE

Select an appropriate LRU or LRUs to train on from Table 6-3.

## INITIAL TRAINING STEPS  (check when completed)

Discuss the objective for the task, including the work center speed and accuracy standards for performing the task.  Also discuss the conditions under which it is normally performed.

Assign trainee to read the material listed in the objective.

Discuss the reading assignment with trainee to ensure the trainee understands the material.

## OBJECTIVE TRAINING STEPS

Using technical references and the checklist in the Task Evaluation below as guidance, discuss the task steps for achieving the objective with trainee.  Ensure all Notes, Cautions, and Warnings listed in the TO for each step are covered. Brief the trainee on all safety precautions and local procedures that apply.

Demonstrate correct task performance.

Review task steps with trainee and answer any questions.

Restore system to normal operating configuration.

Have trainee practice steps and assist as necessary.

## TASK 215.14.4 EVALUATION

- Have trainee perform task steps unassisted and evaluate performance IAW the following checklist.  (Return to OBJECTIVE TRAINING STEPS if evaluation is unsatisfactory.)

Removed LRU.

Replaced LRU.

Restored system to normal operating configuration.

Trainee is ready to be certified on this AFJQS task.  Follow local certification procedures.

TRAINING COMPLETION CERTIFICATION FOR
AFJQS/AFQTP 2E1X1-215N
AN/FRC-181 (V)1,2,3 MILSTAR TERMINAL


I certify that _____

**(Please print trainee's full name and rank)**

completed all requirements for the above AFJQS/AFQTP.

_____

SUPERVISOR'S NAME, RANK, DUTY TITLE, DSN **(Please Print)**

_____

UNIT MAILING ADDRESS, INCLUDING ZIP CODE  **(Please Print)**

_____

E-MAIL ADDRESS **(Please Print)**

_____

SUPERVISOR'S SIGNATURE

**Please complete the above information, attach the completed and graded KEP answer sheet(s), and submit to 81 TRSS/TSQS, 601 D Street, Keesler AFB MS 39534-2229 (or FAX your answer sheet(s) to 597-9043).**


TRAINER/TRAINEE:  You have completed an AFJQS/AFQTP, and we need your feedback.  Please fill out the following survey.  If you found any errors or have suggestions for improvements, please tell us.  Take advantage of this opportunity to express your ideas directly to the AFJQS/AFQTP development teams.  List the errors you discovered in as much detail as possible.  If you have product improvement suggestions, describe your ideas clearly and in a logical order.  Thank you for your time and interest.

In the space provided, indicate your preference by placing the number corresponding to the following scale:

*1. STRONGLY AGREE  2. AGREE   3. UNCERTAIN 4.  DISAGREE  5.  STRONGLY DISAGREE*

TRAINEE

1. **Training Material**
    a.  The objectives were easy to understand.                                    ____

    b.  The instructions were easy to understand.                                  ____

    c.  The review and test questions reinforced the objective statement.          ____

    d.  This is a high quality training package.                                   ____

**2. <u>Training Material Presentation</u>**
a. I have easy access to a computer in my workplace. ____

b. Material was easy to read and presented in a logical sequence. ____

**3. <u>In my opinion</u>**
a. The Q Flight web page helps me stay current with training issues. ____

b. This training package accurately reflects my job requirements. ____

c. This package will help me be proficient in my career field. ____

d. After completing this package, I can do my job better. ____

## TRAINER

**1. <u>Training Material</u>**
a. Instructions in the Trainer's Guide were clear and concise. ____

b. The objectives in this package were clear and attainable. ____

c. I have all the technical references listed for this package. ____

d. The figures, diagrams, and flowcharts helped student understanding. ____

e. The KEP questions measured the attainment of the objective. ____

**2. <u>In my opinion</u>**
a. This training package accurately reflects trainee job requirements. ____

b. This package helped make trainees proficient in their career field. ____

c. The Q Flight web page helps me stay current with training issues. ____

d. After completing this package, trainees can do their job better. ____

e. QTPs meet training needs. ____

**3. <u>In general</u>**
a. How do you receive our products?
    QMAIL
    Web Page
    Other (Specify)
b. Which method of delivery do you prefer?
    Electronic
    Hard copy

**<u>OTHER COMMENTS OR SUGGESTIONS FOR IMPROVEMENT:</u>**

*AIR FORCE
QUALIFICATION
TRAINING
PACKAGE
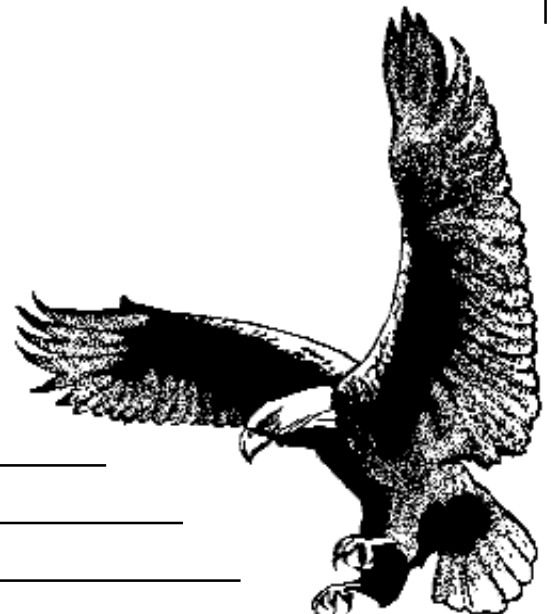2E1X1-215N*
PART OF AFJQS 2E1X1-215N

# AN/FRC-181 (V)1,2,3 MILSTAR TERMINAL

## SKILL TRAINING MATERIAL

**1 OCTOBER 1999**

**SUPERSEDES AFJQS 2E1X1-215N
DATED 26 AUGUST 1998**

**FOR OJT USE ONLY**

# SKILL TRAINING MATERIAL

## CONTENTS

## ABOUT THIS TRAINING PACKAGE

The purpose of this Air Force Qualification Training Package (AFQTP) is to

- standardize on-the-job training.
- reduce training time while maintaining proficiency standards.
- provide individuals with a logically organized training plan which yields immediate and measurable feedback.
- provide a standard to measure task knowledge and performance during personnel evaluations.

This training package was originally developed by SSgt Daniel Ouellette and revised by SrA Jason Woods, 81 TRSS Qualification Training Flight, Keesler AFB, MS.  The Training and Education Specialist was Mr. Tom Vuncannon.  SSgt Tom Wilcox, 338 TRS/Det 1, Ft. Gordon, GA, was consulted as a Subject Matter Expert.

For more information on the 81 TRSS Qualification Training Flight and a list of other products that are available, feel free to visit our home page at http://www.keesler.af.mil/81trss/qflight.

## HOW TO USE THIS TRAINING PACKAGE

### INSTRUCTIONS FOR THE TRAINEE

- Ensure your trainer explains how to complete this training package.
- As you read each section in the module, answer the review questions pertaining to that section.  You may use the module and technical references to answer the questions.  You'll find the answers to these review questions at the end of each module.
- When you finish the module, your trainer will administer the Knowledge Evaluation Pamphlet (KEP).  Answer all KEP questions and give the answer sheet to your trainer for grading.  Your trainer will discuss any incorrect answers with you.
- When you complete the AFQTP, your trainer should give you the Training Completion Certification so you may make any recommendations, suggestions, or offer corrections to the training package in the comments section.  Your inputs provide us with valuable feedback which enables us to give our customers the best possible training materials.

# MODULE 1
# AN/FRC-181 (V)1,2,3 SYSTEM THEORY

## ABOUT THIS MODULE

The MILSTAR system is a satellite communications system capable of secure communications in the EHF/SHF and UHF ranges.  This module covers the different system configurations, their purpose, theory of EHF/SHF and UHF communications environments, and finally the system components, their purpose, and how they are grouped.

## OBJECTIVES

- Explain the MILSTAR terminal system configurations.
- Explain the theory of the EHF/UHF communications environments.
- Explain the functional operation of the system components.

## TRAINING REFERENCES

TO 31R2-2FRC181-51
TO 31R2-2FRC181-61
MILSTAR Positional Handbook

## SYSTEM CONFIGURATIONS

### EHF/UHF GROUND COMMAND POST (GNDCP)

The EHF/UHF GNDCP is a ground-based terminal capable of secure communications in the EHF/SHF, and UHF frequency ranges.  It provides command, control, and secure communications through a satellite network to other compatible terminals.  It provides worldwide communications capability for SIOP, CINCNET operations, in both peace and wartime, and US Military environments.  It provides EHF uplink and SHF downlink capabilities and UHF uplink/downlink capabilities.  It supports strategic Command Post communications requirements using both UHF satellite assets [DSCS-III (SCT), SDS, PACKAGE D1 (AFSATCOM-1), and MILSTAR UHF], and the EHF/SHF satellite assets MILSTAR and FEP/FLTSATCOM.

### EHF GROUND COMMAND POST/FORCE ELEMENT (GNDCP/FE)

The EHF GNDCP/FE is a ground terminal capable of secure communications in the EHF and SHF frequency ranges.  When the terminal is configured as a command post terminal, it provides command, control, and secure communications through a satellite network to other compatible terminals.  It's able to enter the communications system and provide command, control, and communications functions required to operate with the constellation of MILSTAR EHF communications satellites which include FLEETSAT EHF Package (FEP).  Table 1-3 in TO 31R2-2FRC181-61 lists equipment supplied for the terminal.

?

*1.    What are the uplink and downlink frequency ranges for an EHF satellite network?*

## THEORY OF EHF/UHF COMMUNICATIONS ENVIRONMENTS

### OVERVIEW OF AN EHF SATELLITE NETWORK ENVIRONMENT

The AN/FRC181 (V)1,2,3 terminal communicates with other terminals through a satellite link in the EHF/SHF range.  The terminal supports uplink communications in the EHF range and downlink in the SHF range.

**DOWNLINK**

Downlink (DL) communication channels use Time Division Multiple Access (TDMA) which divides the downlink channels among many terminals.  A downlink is created when acquisition (synchronization) occurs between the satellite and terminal.  It is at a frequency of approximately 20GHz (without alteration from the frequency hoping process).

**UPLINK**

Uplink (UL) communications use Frequency Division Multiple Access (FDMA) and TDMA processes.  This gives users an assigned frequency channel within the transmission spectrum.

FDMA allows many data channels to be transmitted simultaneously using different frequency channels.  UL signals are encrypted before transmission.  The signals are transmitted at a frequency of about 44GHz which employs the techniques of frequency hopping.  Frequency hopping changes the frequency band allocated for a transmission channel in a given time period.  The hopping rate of change and hopping band frequencies are classified.  This technique minimizes jamming and excludes unwanted listeners.

## CROSSLINK COMMUNICATIONS

Crosslinks are made between satellites to extend the transmission distance between the initial transmitter and final receiver.  Crosslink is done at an EHF frequency higher than the uplink frequency.

## ACQUISITION AND TRACKING

Satellite ephemeris data for up to eight satellites is stored within the terminal.  This data along with terminal location information is used to determine pointing data so the terminal can find the satellite.  A satellite's position data is integrated with the terminal and a synchronization procedure is invoked.  Once locked onto the satellite, the terminal performs a fine resolution frequency and time base synchronization process.  Once the two are aligned in time, time tracking is accomplished by recognizing frequency shifts caused by changes in the satellite to terminal distance.

## OVERVIEW OF UHF COMMUNICATIONS ENVIRONMENT

The EHF/UHF GNDCP terminal in the UHF communications mode utilizes FDMA uplink channels and TDMA downlink channels on each MILSTAR satellite to configure Demand Assignment Multiple Access (DAMA) networks according to the UHF networking scheme.  The terminal can function as a network controller, alternate network controller, and a network member.  Terminal UHF operation includes both UHF-UHF operation and EHF/UHF-UHF/SHF operation.  UHF-UHF operation is defined as UHF only operation, and EHF/UHF-UHF/SHF operation is defined as participation in a MILSTAR UHF network through EHF uplink and SHF downlink.

## UHF-UHF OPERATION

All MILSTAR UHF operation is coordinated through the UHF modems and operation is in the UHF frequency range only.

**EHF/UHF-UHF/SHF OPERATION**

The terminal provides for operation and control of one MILSTAR UHF network with EHF uplink and SHF downlink. The MILSTAR UHF Computer Program Component (CPC) of the TAC interfaces with the EHF modem for an EHF uplink and SHF downlink.  In this mode, the MILSTAR satellite implements crossbanding operation.  This causes the satellite to route the selected EHF uplink channel to the UHF downlink for transmission on the selected UHF TDM.  The crossbanding also causes the selected FDM UHF uplink channel from the selected satellite to be routed over to the EHF portion of the satellite for SHF downlink.

**UHF UPLINK ACQUISITION AND COMMUNICATION**

The terminal implementing MILSTAR UHF mode automatically adjusts the uplink data and command signals to be time and frequency synchronized with the MILSTAR satellite receiver.  The terminal first acquires the downlink and pre-corrects its time and frequency by monitoring the downlink. The terminal measures time and frequency errors on the downlink and translates errors to the uplink timing and frequency generators.  The terminal initiates uplink probing and reprobing when instructed by the operator.

**UHF DOWNLINK ACQUISITION, CROSSLINK, AND COMMUNICATIONS**

The terminal provides time and frequency acquisition and tracking to allow the terminal to synchronize to a MILSTAR UHF downlink.  Each MILSTAR crosslink adds path delay between network controller and network member.  To adjust for this, the modem determines the number of crosslinks, and stores crosslink delay parameters in memory as part of the terminal database.

<span style="color:red; font-size:2em">❓</span>

*2.    Which type of multiplexing is used in the downlink communications channels?*

*3.    What is the purpose of frequency hopping?*

*4.      What is EHF/UHF-UHF/SHF communication?*

*5.      How is UHF uplink timing acquired?*

## FUNCTIONAL OPERATION

The AN/FRC181 (V)1,2,3 terminals can be divided into six functional groups: Operator and monitor group, processing subsystem, timing reference subsystem, EHF subsystem, UHF subsystem, and terminal interface group.

### OPERATOR AND MONITOR GROUP

The operator and monitor group provides an interactive interface between the operator and terminal equipment.  It allows the operator to control, monitor, and communicate with the terminal.  Operator control includes power turn on/off by the use of the control panel and menu driven system operation via display and keyboard.  Operator monitoring is done using the control panel, display, and printer.  Operator communication consists of voice communication through the Advanced Narrowband Digital Voice Terminal (ANDVT) and data communications through the use of the keyboard, the plasma display, and printer units.  The operator and monitor group also provides BIT functions for control and testing of various terminal line replaceable units (LRU).

### CONTROL PANEL

The control panel is the prime operator interface for power-up of the terminal.  The control is powered by one phase voltage (primary power) from the Power Distribution Unit (PDU).  The control panel ON/OFF push-button uses this primary power to control power control relays on the PDU.  The PDU in-turn transfers power to the equipment.  The control panel also interfaces alarm and some terminal system control signals to the Terminal Access Controller (TAC) and Baseband Processor (BBP).  The panel receives TAC, BBP FAULT/EAM ALARM signals from the TAC to drive the EAM alarms and indicator lamps on the control panel.  The switches also initiate the ALARM RESET, TEST, and SYSTEM RESET signals to the TAC.

### LARGE DISPLAY

The large display is a plasma display monitor that provides the display of terminal status, information provided by the BBP, and operator keyboard inputs.  Terminal readouts at the BIT function also appear on the display.  The large display is controlled by the BBP; display data from the TAC is transferred to the BBP then to the display.  The large display interfaces with the keyboard through the Red J-Box.  The large display accepts data (KYBD DATA) from the keyboard and permits on-screen editing when needed, it then passes unaltered KYBD DATA to the BBP.

### KEYBOARD

The keyboard transfers keystroke signals (KYBD DATA) to the BBP via the large display.  The keyboard receives power and clock signals (KYBD TIMING/PWR) from the BBP and large display, respectively.  The timing signals synchronize keyboard operation with the terminal.

### HIGH SPEED PRINTER (HSP)

The HSP is a thermal process non-impact printer.  Terminal status and informational data to be printed is contained in the PRINT DATA/CONTROL signal inputs from the BBP and TAC via the Red J-Box.

### STATUS PANEL

The status panel monitors the transfer of facility primary power to the LRUs.  Three indicators monitor the console/processor rack blower (C/P RACK BLOWER FAULT), HPA blower (BLOWER FAULT), and antenna anti-ice fault summary (ECU STATUS).

## PROCESSING SUBSYSTEM

The processor group consists of two digital computer processor LRUs: Terminal Access Controller (TAC) and Baseband Processor (BBP).  This group is responsible for controlling terminal functions and processing information transfers associated with transmit (TX) and receive (RX) functions.

### BASEBAND PROCESSOR (BBP)

The BBP provides terminal management, message handling and processing, satellite command processing, report back processing, and operator interaction.  The Baseband Processor

(BBP) provides the I/O capability to compose and edit messages from the keyboard.  The BBP also controls the large display.  In addition the BBP accomplishes Red/Black Interface (RBI) for the terminal.  The red side interfaces with the equipment items that handle plain language information, such as the large display.  The black side interfaces with equipment items that handle encrypted information and unclassified control signals; the TAC and its associated I/O devices are on the black side.  There are 19 user I/O interfaces in the BBP.  Sixteen of the interfaces support red serial I/O devices that are compatible with Automatic Send/Receive (ASR) units and encryption/decryption devices.  Three parallel receive interfaces are provided for message logging on high-speed printers.  Five BBP functions are briefly discussed in the following paragraphs.

### Terminal KGV-11A Traffic Management

The BBP provides KG DATA from the KGV-11A (TRANSEC) module, mounted on its front panel, to the EHF modem.  The BBP uses its RBI circuit card assemblies and the installed KGV-11A to send uplink transmit data (TX DATA) to the EHF modem and receive downlink data (RX DATA) from the EHF modem.  KG DATA sent from the BBP provide encoding and decoding instructions to the EHF modem.

### Control Subsystem Interactions

The BBP sends keyboard timing (KYBD TIMING) to the large display for use by the keyboard, RX DATA for display, and PRINT DATA/CONTROL to the HSP for printing.  The BBP receives KYBD DATA through the large display, STATUS from the large display, and PRINTER STATUS from the printer.

### Message Handling

The BBP periodically polls data of TX/RX channels.  It also handles queuing, sending of messages, and KGV-11A traffic routing.

### Monitoring Functions

These functions involve the BBP functioning as a security monitor, performing EAM initialization and report back routines, as well as the building and formatting of EAMs.

### Processing Functions

The BBP handles command processing, time division multiplexing, link control, message processing and formatting, as well as the building and formatting of Emergency Action Messages (EAMs).

### TERMINAL ACCESS CONTROLLER (TAC)

The TAC controls and coordinates terminal equipment to accomplish EHF/UHF satellite communication, message processing, antenna tracking and pointing, and operator interaction through the control panel, monitor, and keyboard equipment.  A battery pack mounted on the front panel of the TAC supplies 30 days of BTRY BACKUP for TAC Nonvolatile RAM (NVRAM) and 10 minutes of BTRY BACKUP for the KGV-11A unit, during power interruptions.  The TAC also performs system status and BIT monitoring for the terminal. The TAC sends TAC and BBP FAULT/EAM ALARM signals to the control panel.  The TAC provides a power supply inhibit (PS INHIBIT) to disable power generation circuits when an unsafe condition occurs.

### TIMING REFERENCE SUBSYSTEM

The timing group consists of a Time Frequency Standard (TFS) and a Hand Held Module (HHM).  This group is responsible for timing synchronization between airborne and ground-based terminals, and between the satellite networks and terminals.

### TFS

The TFS provides timing base frequencies for timing synchronization throughout the terminal.  The TFS distributes TERMINAL TIMING (1PPS) to the EHF modem, 5MHz to the Receiver Synthesizer Unit (RSU), and STATUS/SUMMARY FAULT data to the TAC.  The TFS receives system control signals from the TAC.

### HHM

The HHM provides timing updates to the TFS and stores timing data during terminal shutdown.  In addition, the HHM stores satellite ephemeris data used to initialize the terminal.  When the terminal is powered up, the HHM transfers its timing and ephemeris data to the terminal.  Each terminal has an HHM that is programmed with timing standards and ephemeris data unique to that terminal.

### TERMINAL INTERFACE GROUP

Terminal interface devices are those ancillary devices for the operational configuration.  They include the KGV-11A, KG-84A, Advanced Narrowband Digital Voice Terminal (ANDVT) units, ANDVT call box, ANDVT junction box (J-Box), Red J-Box, and Black/Mission Control Element (MCE) J-Box.

### KGV-11A

The KGV-11A provides secure transmitting and receiving capabilities (COMSEC and TRANSEC) for terminal communications.  The KGV-11A is controlled by the EHF modem but is located with the BBP.

### KG-84A

The KG-84A provides interoperability with agencies other than the Air Force.  RX ENCRYPTED DATA from the EHF group is sent to the TAC then to the KG-84A and the KG-84A sends RX DECRYPTED DATA to the BBP.  In TX mode, the KG-84A receives TX DECRYPTED DATA and sends TX ENCRYPTED DATA to the processing group and finally to the EHF group.

### ANDVT

The ANDVT provides an analog-to-digital interface for voice communications between the operator and terminal.  In TX mode, the ANDVT digitizes TX VOICE DATA, and in the RX mode it converts the digital RX VOICE DATA to an analog signal.

### ANDVT CALL BOX

The ANDVT call box provides audible and visual indications of incoming calls.

### ANDVT J-BOX

The ANDVT J-Box channels all the signals from the ANDVT and ANDVT call box to the TAC.  It also provides the capability to install additional ANDVT and ANDVT call boxes.

### RED J-BOX

These J-Boxes breakout and separate the serial port outputs of the terminal into separate port connectors to meet user I/O and installation requirements.

### BLACK/MCE J-BOX

The MCE J-Box channels all two-way data and control signals between the MCE and TAC.  It also allows for additional MCE units.

## EHF GROUP

The EHF group supports communications in the EHF and SHF range.  It consists of the High Power Amplifier (HPA), High Voltage Power Supply (HVPS), Receiver Synthesizer Unit, EHF Modem, Receiver Front End (RFE), EHF Antenna/Pedestal Assembly (A/PA), and Antenna Positioning Control Unit (APCU).

### HPA

The HPA performs frequency upconversion by mixing an upconverted signal from the RSU with the wideband SHF signal to generate an EHF TX signal from 43.5 to 45.5GHz.  The HPA also provides high power amplification for the EHF TX signal through an EHF Traveling Wave Tube (TWT).

### HVPS

The HVPS generates the HIGH/LOW DC VOLTAGES required to operate the HPA, provides HPA control functions (HPA CONTROL/RESET) as commanded by the TAC, and provides automatic and fault isolation for itself by BIT.  The filament and cathode voltages (HIGH/LOW DC VOLTAGES) for the HPA are remotely selected by REFERENCE CODES from the HPAs TWT circuits.  The TAC controls the operating state of the HVPS.  The HVPS reports detected faults to the TAC.

### RSU

The RSU provides downconversion, IF amplification and frequency generation along with TX/RX frequency hopping which is commanded by the EHF modem.  The RSU filters, downconverts and amplifies the dehoppped receive IF signal from the RFE.  The RSU uses RX HOP WORDS to generate an RX LO frequency to the RFE and to produce the signal bearing IF.  It also provides a hopped LO signal (TX HOP-SWITCHED HPA LO) to the HPA.  The RSU also generates 70MHz LO and 60MHz LO frequencies used by the EHF modem.

### EHF MODEM

The EHF modem provides the operational functions that interface the BBP and TAC with the EHF group.  In the UL direction, TX DATA from the BBP and TAC is processed by the modem to produce TX/RX HOP WORDS (digital words containing the data to be transmitted and frequency hopping instructions) for use by the RSU.  The EHF modem also receives KG DATA from the BBP for TRANSEC processing.  In the DL direction, IF data from the RSU is demodulated and decoded by the modem for transfer to the TAC and BBP as RX DATA.  Timing for the modem is derived from the TERMINAL TIMING, which comes from the TFS, and a 60MHz signal from the RSU.

### RFE

The RFE is mounted on the EHF antenna assembly and provides SHF RF bandpass filtering, low noise amplification, and downconversion/dehopping functions to an IF signal.

### A/PA

The EHF A/PA is an electromechanical/microwave assembly that radiates in the MILSTAR EHF band and receives in the MILSTAR SHF band.  The A/PA is able to position itself to a satellite through the use of a rotary joint, polarizer, torque motors, position resolvers, and reflector.  The A/PA receives its control from the APCU.

### APCU

The APCU provides the processing to stabilize antenna positioning.  The APCU doesn't compensate for changes in satellite position; the TAC does this.  The TAC computes the required antenna pointing data from the satellite ephemeris data and the platform location and passes this information to the APCU which maintains that pointing direction.  The APCU also controls the speed and phase of rotation of the reflection used to scan the antenna beam for tracking purposes; it ensures the rotation is locked to a CONSCAN sync pulse received from the EHF modem.

## UHF GROUP

The UHF group contains the equipment needed for terminal UHF communications.  It contains the UHF modem, KI-36, KI-36 control, receiver/transmitter (R/T), diplexer, UHF antenna,

transmit test coupler, test translator, divider/combiner, preamplifier, and distribution amplifier.

## UHF MODEM

The UHF modem is a full-duplex FSK modem that provides modulation/demodulation for the UHF subsystem.

## KI-36

The KI-36 provides TRANSEC cover and address generation for transmit and receive frequency hop words.

## KI-36 CONTROL.

The KI-36 control provides control for operate or standby mode of the KI-36.

## R/T

The R/T is a full-duplex receiver transmitter operating in the frequency range of 225.000 through 399.995MHz. For transmit it receives the IF from the modem and upconverts it to an UHF TX signal and amplifies it to 100 watts. The receive side amplifies the UHF RCV signals and converts them to an IF signal.

## DIPLEXER

The diplexer is a fixed-tuned filter network that interconnects one transmit and one receive channel to a single antenna.

## UHF ANTENNA

The UHF antenna provides directional coverage within the upper hemisphere. The antenna is mounted on the antenna drive, and an antenna control provides the operator a means of moving the antenna.

## TRANSMIT TEST COUPLER

The transmit test coupler is a directional coupler that provides the signal a direct path to an RF load. Signals are applied to the transmit test coupler through a coaxial relay that is controlled by the test translator.

## TEST TRANSLATOR

The test translator provides testing for receivers tuned to the downlink signal in loopback test mode. The test translator

downconverts the sampled RF uplink signal to the downlink signal within the receive bandpass filter.

### DIVIDER/COMBINER

The divider/combiner as a combiner connects outputs of different transmit test couplers to different receiver-transmitters to provide a common input to the test translator.  As a divider, the output of the test translator and the input of receive test couplers are connected to different R/Ts.

### PREAMPLIFIER

The preamplifier provides low-noise amplification of the UHF receive signals.

### DISTRIBUTION AMPLIFIER

The distribution amplifier provides six identical UHF signal outputs from a single input.

<span style="color:red; font-size:2em;">?</span>

6.   *Which group is responsible for controlling terminal functions and processing information transfers associated with transmit and receive functions?*


7.   *Which functions do the BBP provide?*


8.   *Which functions do the TAC provide?*


9.   *Where is the satellite ephemeris data stored and what is it used for?*


10.   *Which LRU controls the operating state of the HVPS?*


11.   *Where is the frequency upconversion for an EHF TX signal accomplished?*


12.   *What is the power output on the TX side of the R/T?*

## SUMMARY

The AN/FRC-181 (V)1,2,3 is a ground-based terminal capable of secure communications in EHF/UHF frequency ranges.  In the EHF mode, downlink communications use TDMA multiplexing, and the uplink uses FDMA and TDMA multiplexing.  Crosslinks are performed between satellites to extend the transmission distance.  The UHF communications mode uses FDMA uplink channels and TDMA downlink channels.  A terminal implementing MILSTAR UHF mode automatically adjusts the uplink data and command signals to be in time and frequency synchronization with the satellite receiver.  The terminal provides time and frequency acquisition and tracking to allow the terminal to synchronize to a MILSTAR UHF downlink.

The operator and monitor group of the AN/FRC-181(V)1,2,3 consists of the control panel, large display, keyboard, HSP, and the status panel.  Together, they provide an interface between the operator and the terminal equipment.  The processing group consists of the BBP and the TAC and is responsible for controlling terminal functions and information transfers associated with transmit and receive functions.  The BBP provides terminal management, message handling and processing, satellite command processing, report back processing, and operation interaction.  The TAC controls and coordinates terminal equipment to accomplish EHF/UHF satellite communications, message processing, antenna tracking and pointing, and operator interaction.  The timing reference subsystem consists of the TFS and the HHM and is responsible for timing synchronization between airborne and ground-based terminals, and between the satellite networks and terminals.  Terminal interface devices are those ancillary devices for the operational configuration.  They include the KGV-11A, KG-84A, Advanced Narrowband Digital Voice Terminal (ANDVT) units, ANDVT call box, ANDVT junction box (J-Box), Red J-Box, and Black/Mission Control Element (MCE) J-box.  The EHF group supports communications in the EHF and SHF range.  It consists of the High Power Amplifier (HPA), High Voltage Power Supply (HVPS), Receiver Synthesizer Unit, EHF Modem, Receiver Front End (RFE), EHF Antenna/Pedestal Assembly (A/PA), and Antenna Positioning Control Unit (APCU).  The UHF group contains the equipment needed for terminal UHF communications.  It contains the UHF modem, KI-36, KI-36 control, receiver/transmitter (R/T),

diplexer, UHF antenna, transmit test coupler, test translator, divider/combiner, preamplifier, and distribution amplifier.

## ADDITIONAL INSTRUCTIONS

Compare your responses to the review questions with the confirmation key in the back of this module.  Your responses do not have to match word-for-word, but should convey the same basic meaning.  Review the applicable portions of this module for all missed questions.  When ready, ask your trainer to administer the KEP questions for this module.  This is a closed-book test and you must score 70% or more.  Your trainer will check your answers and review any incorrectly answered questions with you. When you have achieved the KEP standard, your trainer will assign the next module.

## REVIEW QUESTIONS CONFIRMATION KEY

1. EHF Uplink,  SHF Downlink
2. Time Division Multiple Access (TDMA)
3. Minimize outside interference and exclude unwanted listeners
4. It is a UHF terminal operation that provides for operation of one MILSTAR UHF network with EHF uplink and UHF downlink.
5. The terminal first acquires the downlink and pre-corrects its time and frequency by monitoring the downlink. The terminal measures time and frequency errors on the downlink and translates errors to the uplink timing and frequency generators.
6. The processor group
7. Terminal management, message handling and processing, satellite command processing, report back processing, operator interaction, compose and edit messages from the keyboard, controls the large display, and accomplishes Red/Black Interface (RBI) for the terminal
8. Controls and coordinates terminal equipment to accomplish EHF/UHF satellite communication, message processing, antenna tracking and pointing, and operator interaction through the control panel, monitor, and keyboard equipment
9. In the HHM; it's used during initiation of the terminal.
10. TAC
11. In the HPA; it's mixed with an upconverted signal from the RFE with the wideband SHF signal to generate an EHF TX signal.
12. 100 watts

# MODULE 2
# FAULT ISOLATION

## ABOUT THIS MODULE

Module 2 examines terminal menus, displays, and controls and indicators.  Further, this module explains the theory of and procedures for fault isolation.

## PREREQUISITES

Must have completed Module 1 of this AFQTP.

## OBJECTIVE

Given TO 31R2-2FRC181-51 or TO 31R2-2FRC181-61, isolate faults IAW Chapter 6-4 and Figures 6-2 and 6-7 through 6-25 of the -51TO, or Figures 6-2 and 6-7 through 6-24 of the –61 TO. (AFJQS Task 215.14.3.4)

- Explain the use of menus in terminal operation.
- Explain the use of the display in terminal operation.
- Explain the use of the terminal controls and indicators.
- Explain the theory of fault isolation.
- Explain the procedures for fault isolation.

## TRAINING REFERENCE(S)

TO 31R2-2FRC181-51
TO 31R2-2FRC181-61
MILSTAR Positional Handbook

## MENUS

The terminal is controlled through a series of menus.  The menu updates as selections are made.  In most cases the operator is presented with a set of predefined options.  If text needs to be entered, the terminal prompts the operator to enter the appropriate input.

## DISPLAY

The display for the system is divided into four areas: system status, main display area, prompt area, and option display area.  Refer to -51 TO, Figure 4-28 or -61 TO, Figure 4-19, for a diagram of the display.  The system status area is the top area on the display.  It displays the current date and time and any alarm

or advisory messages such as advising of EAM reception, system fault, or other critical condition.  The main display area is the next area from the top.  It displays the menus for the different functions available to the operator.  The prompt area is a small area under the main display area.  It displays requests for operator inputs.  Each menu display, except message display/edit, has a set of prompts associated with it.  The options display area, the bottom area, displays up to eight option boxes that contain available options based on what is in the prompt area.  If more options are needed, select the eighth box labeled "More Options".  When selected, the remaining options are displayed.  A classification label is always displayed in the middle of the system status area and between prompt and options areas.  This label shows the highest classification of information that is on the screen.

The main operator input for the system is by keyboard, and for the most part, it operates the same as any computer keyboard.

**NOTE**

For more information on the keyboard inputs, read TO 31R2-2FRC181-51, para 4-5.3, or -61 TO, para 4-4.3.  Return here when finished.

?

*1.  What are the main display areas?*

*2.  Where are advisory messages displayed?*

*3.  What is contained in the main display area?*

*4.  What is the purpose of the prompt area?*

*5.  What is the purpose of the options display area?*

*6.  If a prompt requires the display area to display twelve options, how are the options displayed?*

*7.  Where are classification labels displayed?*

## OPERATOR CONTROLS

The operator controls the MILSTAR terminal through inputs
from the keyboard and display.  Prior to terminal initialization,
the operator may change the default parameters.  These include
selection of initialization mode and data source, entry of time-
of-day, date, terminal latitude and longitude, cryptographic
keys, adaptation data, ephemeris data, and pointing data.
Following terminal initialization, the operator may make
changes to message and data recording.  The operator can
perform actions that affect the COMSEC and TRANSEC crypto
keys, such as printing, loading, storing and deleting keys, and
key mode selection.  The operator can also call up a spot beam
pointing map; here the operator can change map parameters,
query, and move the beam.

## CONTROLS AND INDICATORS

Along with inputs from menus and the keyboard, the system has
controls and indicators located on control panels and all of the
LRUs.  The TO covers all of these controls and their purposes.

### STOP

Read TO 31R2-2FRC181-51 or -61, paragraph
4-2.  When finished, return here.

## FAULT ISOLATION THEORY

Organizational maintenance for the AN/FRC181(V)1,2,3
consists of fault isolation to a single Line Replaceable Unit
(LRU) or to a group of no more than three LRUs.  The BIT
function is used to isolate faults in the terminal.  BIT
continuously monitors terminal hardware and software
operation.  If a fault is detected, the operating status of the
terminal is examined and the fault is validated by comparison
against a set of system performance parameters.  The severity of
a validated fault is organized by its effect on system operation
into one of three categories: alarm, advisory, or log only.  Faults
that result in the inoperability of the terminal are displayed in
the Status Display area as alarm messages.  If the fault causes
partial loss of capability, an advisory message is displayed in the
Status Display area.  A fault that doesn't affect mission
performance is logged into the fault log for repair during routine
maintenance.

The validated fault is categorized in one of the following
equipment groups: Common, EHF, UHF, Red I/O, or Black I/O.

The common group consists of the plasma display, keyboards, printers, Terminal Access Controller (TAC) and Baseband Processor (BBP) (except as specifically listed under other groups), Time Frequency Standard (TFS) and related time distribution, and Hand Held Module (HHM).  The EHF group includes the EHF modem, Receiver Synthesizer Unit (RSU), EHF High Voltage Power Supply (HVPS), EHF High Power Amplifier (HPA), Antenna Position Control Unit (APCU), EHF Antenna/Pedestal Assembly (A/PA), Receiver Front End (RFE), Antenna Reference Unit (ARU), KGV-11A, and KG-84A. Also included in the EHF group are the following TAC Input/Output (I/O) interfaces: EHF modem data, EHF modem control, EHF HA System Control Interface (SCI), RSU SCI, KG-84 data, and APCU SCI.  The following BBP I/O interfaces are also included in the EHF group: Key Generator Controller (KGC), Red buffer, and KG-84A data.  The UHF group consists of two UHF Receiver/Transmitters (R/Ts), two UHF modems, UHF switching KG-33s, and the KI-36.  The following TAC I/O interfaces are also included in the UHF group: KG-33 data, UHF modem A data, and UHF modem B data.  In addition, the following BBP I/O interfaces are included in the UHF group: UHF modem A data, UHF modem B data, and KG-33 data. The Red I/O group includes the Red (BBP connected) I/O ports and related devices not listed above.  The Black I/O group consists of the Black (TAC connected) I/O ports and related devices not listed above.

When a fault is displayed, the operator can display the fault summary table by selecting the BIT option at the MAIN MENU. The fault summary table displays the fault status of all equipment groups, any recommended operator-initiated tests, and the present fault status message (as shown on the fault log printout).  The fault summary table allows the operator to access the group status display for the faulted equipment group(s):

- isolate the fault to a faulty LRU or group of LRUs

- select various disruptive tests to further isolate faults when more than one LRU is faulted

- select fault log options

Table 6-2 in TO 31R2-2FRC181-51 or -61 shows a sequence of events using BIT to isolate a fault.

The ON-LINE STATUS option on the fault summary table presents the operator with the ability to select the various group status displays.  These displays list each of the LRUs in the selected group, the BIT status of each LRU, and isolation (if

possible).  From here the operator can display the status of on-line BIT tests of equipment group.  The DISRUPTIVE TEST option terminates terminal operation and then the operator can select any of the disruptive tests needed to isolate a fault.  Table 6-1 lists the disruptive test options and the tests that can be performed in each.  Each option provides the operator with individual LRU and interface tests to isolate faults to a single unit.  The FAULT LOG options are also accessed through the fault summary table; here the operator may choose one of the following options: PRINT LOG, PRINT ON DEMAND (print fault log on demand or when full), PRINT IMMEDIATELY, or DELETE PRINT LOG.  The fault log printout is a list of all faults identified by terminal BIT.  It is important to mention that you must modify the message routing to ensure that all messages are routed to the HSP.

?

*8.  Which functions of the terminal are used for fault isolation?*

*9.  If a fault cases partial loss of capability, in which category is it  included?*

*10.  Where is a fault that does not affect mission performance logged?*

*11.   Which group contains the HHM?*

*12.  What is displayed in the fault summary table?*

*13.  Which option in the fault summary table presents the operator with the ability to select group status displays?*

## FAULT ISOLATION PROCEDURES

**CAUTION**

Hazardous voltages exist in equipment when power is applied.  Ensure power to equipment has been removed prior to performing continuity checks on cables.  Failure to heed this warning may result in personal injury or death.

This section provides procedures for fault isolation where more than one LRU may be the cause.  These procedures use on-line, disruptive, and manual testing to isolate a fault to a specific LRU.  Figure 6-2 provides a general flowchart for isolating faults by using BIT.  Table 6-2, in the TO, provides an index of procedures to be used in isolating faults; it lists fault codes (from fault log), describes the fault, and points to a fault isolation flow diagram to be used.  The isolation flow diagrams are Figures 6-9 through 6-25 of the -51 TO, or Figures 6-9 through 6-24 in the -61 TO.  If a fault code is not listed in the table, refer to Figure 6-7, *General Fault Isolation Flow Diagram*.  Figure 6-8 is a flow chart for LRU power fault isolation.

**STOP**

Read and review Chapter 6-4, Figure 6-2 and 6-7 through 6-25 of the -51 TO or 6-7 through 6-24 of the -61 TO.  Return here when finished.

**?**

*14.  Name three methods used in fault isolation.*

*15.  What is an easy way to verify power to an LRU?*

*16.  The fault log shows fault BBP:10  --.  What is the fault description?  What is the first step in troubleshooting the fault?*

*17.  A fault in the fault log is not listed in Table 6-2 of the TO. How do you proceed?*

## SUMMARY

Terminal operation uses a series of menus to display options, and when an option is selected, it adjusts to the chosen option with a new set of options.  The system display is divided into

four display areas: system status, main display, prompt, and option display areas.  Also displayed is a classification label that shows the highest classification of information that is on the screen.  The main operator input to the system is through the keyboard.  The system also accepts input from various controls located on control panels and LRUs.  The operator must also be aware of the information presented by the system's various indicators.

Organizational maintenance for the AN/FRC-181(V)1,2,3 consists of fault isolation to a single LRU or a group of no more than three LRUs through the use of BIT.  Validated faults are categorized in one of the following equipment groups: common, EHF, UHF, Red I/O, or Black I/O.  The operator can then access the fault summary table, which displays the status of all equipment groups.  Also, from the ON-LINE STATUS option the operator can select various group status displays.

Fault isolation procedures include the use of on-line, disruptive, and manual testing.  Through the use of fault tables and flow diagrams in the TO, the maintainer is able to isolate faults in the system.

## ADDITIONAL INSTRUCTIONS

Compare your responses to the review questions with the confirmation key in the back of this module.  Your responses do not have to match word-for-word, but should convey the same basic meaning.  Review the applicable portions of this module for all missed questions.  When ready, ask your trainer to administer the KEP questions for this module. You are permitted to use all available technical references and must score 100%.  Your trainer will check your answers and review any incorrectly answered questions with you.  When you have achieved the KEP standard, proceed to the performance procedures.

## PERFORMANCE PROCEDURES

Your trainer will demonstrate fault isolation.  Following the demonstration, you will be given an opportunity to practice the procedure. When you feel comfortable with the procedure, you will be evaluated on the following:

Isolate various faults.

After you complete this procedure, your trainer will review your work.  When you are proficient in performing the procedure, you may be certified on the AFJQS.

## REVIEW QUESTIONS CONFIRMATION KEY

1. System status, main display, prompt, and option display areas
2. System status area
3. The menu displays for the different functions available to the operator.
4. It displays requests for operator inputs.
5. It displays option boxes that contain available options based on what is in the prompt area.
6. The first seven are displayed on the first screen and the eighth box displays More Options.  Options 8-12 are displayed on the second screen when More Options is chosen.
7. In the system status and between the prompt and options areas
8. BIT (Built In Test)
9. Advisory
10. Fault log
11. Common group
12. Fault status of all equipment groups, any recommended operator-initiated tests, and the present fault status message
13. ON-LINE STATUS
14. On-line, disruptive, and manual testing
15. By viewing the timing flag in the Elapsed Time Meter (ETM), it should appear approximately every 6 seconds.
16. 6MHz clock fault, as listed in Figure 6-10, the first step is to run EHF modem test.
17. Proceed by using the *General Purpose Fault Isolation Flow Diagram*, Figure 6-7.