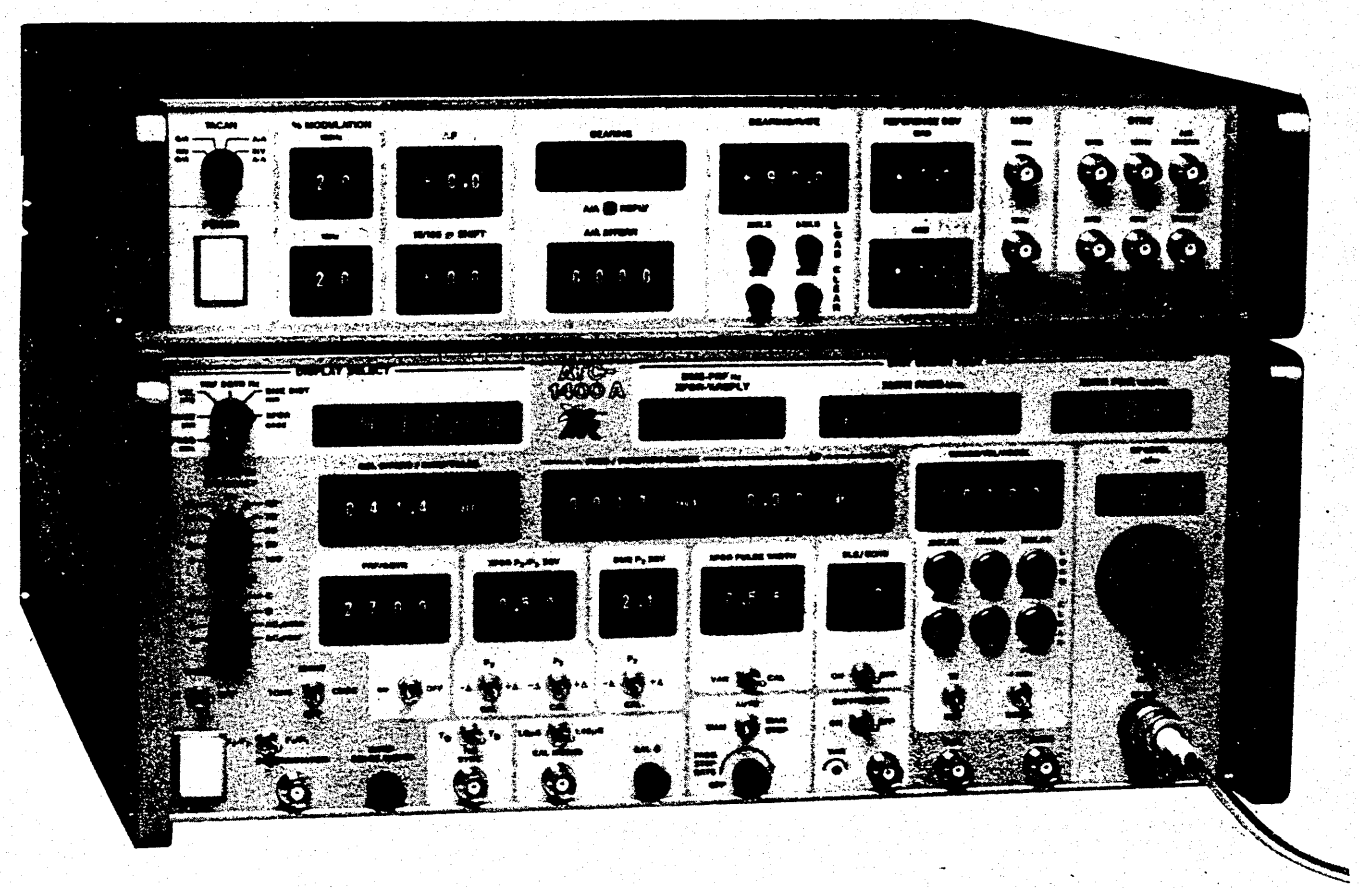
OPERATION

T-1401



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1002-7101-000

SECTION 1 - DESCRIPTION

1. General Description and Features

The T-1401 is a TACAN simulator used to test TACAN receiver/transmitters. It is designed to be used with an ATC-1400A. The T-1401 can be operated as a desk-top unit or it can be installed in a rack. All test controls are on the front panel. Those on the rear panel are usually only for setup (before starting a test). Usually, the T-1401 is operated and controlled via the ATC-1400A with the T-1401 mounted on top of, and strapped to, the ATC-1400A.

The mode of operation is determined primarily by control settings on the front panel of the T-1401. In the absence of an ATC-1400A, the T-1401 will operate with X Mode pulse spacing. Identification and Equalizer pulse pairs are enabled when the G/A Mode has been selected. Mode information is also received from the ATC-1400A when the two are connected via the IFR Bus. This information includes Identification On/Off, Equalizer On/Off, X/Y Mode and P1 to P2 pulse spacing deviation.

The T-1401 weighs 17.5 pounds (7.95 kg) and is 16 7/8 inches (42.86 cm) wide, 16 inches (40.64 cm) deep less handles, and 3 1/4 inches (8.25 cm) high. See figure 1. Removal of the top cover gives access to three PC Board Assemblies (Analog, Computer, and TACAN) mated with connectors on the Motherboard PC Board Assembly. The Power Supply Assembly, containing two PC Board Assemblies, and the Line Supply Assembly with PC Board are mounted on the left side (viewed from the front). Two PC Board Assemblies, Switch and Display, are attached to the back of the front panel. Mode of operation is determined by switch settings on the front panel.

2. Functional Capabilities

The T-1401/ATC-1400A set is capable of complete simulation of G/A X, G/A Y, A/A X, A/A Y, INVERSE G/A X, INVERSE G/A Y, INVERSE A/A X and INVERSE A/A Y Modes of operation. Nominal pulse spacings, modulation signals and channel pairings are automatically selected for each mode. Convenient front panel controls give a continuous display of each parameter of the TACAN signal and provide for varying each parameter from its nominal value.

Channel cross-references are given in Appendix D. For a complete description of the functional capabilities, refer to Section 3.

1. TACAN TEST SYSTEM SPECIFICATIONS

These specifications supersede ATC-1400A and T-1401 specifications whenever the T-1401 is mated to the ATC-1400A. Refer to Section 1-3-1 of either the ATC-1400A or T-1401 Operation/Maintenance Manual (as appropriate) for specifications not listed in this section.

A. Mode Characteristics

1. Bearing

Range:	0 to 359.9 degrees in 0.1 degree increments.
Accuracy:	G/A Mode, 135 Hz ±0.05 degrees G/A Mode, 15 Hz ±0.10 degrees A/A Mode, 15 Hz ±0.10 degrees INV Mode, 15 Hz ±0.30 degrees.

2. Bearing Rate

Range:	0 to ±39 degree(s) per second in 1 degree increments.
Accuracy:	±0.1 degree per second.

3. TACAN Modulation

Range:	0 to 39% in 1% increments. 15 Hz and 135 Hz separately adjustable.
Accuracy:	±1%
Distortion:	<2.0% of either tone.

4. 15 Hz Phase Shift

Range:	0 to ±39 degree(s) in 1 degree increments.
Accuracy:	±0.2 degree.

5. TACAN Reference Frequency

Range:	±3.9% of nominal in 0.1% steps.
Accuracy:	±0.01%

6. Main Reference Burst

Control:	Selectable ON/OFF on REFERENCE DEV MRB Thumbwheels (7).
Length:	12 pulse pairs nominal in G/A X mode; 13 single pulses nominal in G/A Y mode; 10 single pulses nominal in A/A X or Y mode (May be adjusted for -1, -2, +1 or +2).
Spacing:	30.0 µs nominal (May be adjusted for ±3.9 µs in 0.1 µs increments).
Accuracy:	±0.1 µs

7. Auxiliary Reference Burst

Length:	6 pulse pairs in G/A X Mode; 13 single pulses nominal in G/A Y mode; Adjustable +1, +2, -1 or -2.
Spacing:	24.0 µs in G/A X mode, 15.0 µs in G/A Y mode. Adjustable ±3.9 µs in 0.1 µs increments.
Position:	The first ARB following MRB may be disabled.
Accuracy:	±0.1 µs.

8. A/A Interrogations

Average Rate:	0 to 3999 per second, selectable in 1 Hz steps.
Accuracy:	1%
Distribution:	Period is random in discrete steps. Minimum period is approx.: $\frac{1}{2 \times rate}$. The minimum period at any setting is 100 µs. Maximum period is approx.: $\frac{23}{2 \times rate}$.

9. Ident

Position:	740 ±50 µs after reference burst.
Code interval:	37 seconds (typical).

10. Pulse Characteristics (ATC-1400A)

Spacing	12.0 µs (±0.1 µs) X Channel DME and TACAN replies;
	30.0 µs (±0.1 µs) Y Channel DME and TACAN replies;
	12.0 µs (±0.1 µs) X Channel A/A TACAN interrogation;
	24.0 µs (± 0.1 µs) Y Channel A/A TACAN interrogation.

11. UUT A/A Reply Delay Measurement

Definition:	Measured from the 50% point of the leading edge of P1 of the interrogation to the 50% point of the leading edge of the reply.
Range:	25.0 to 89.9 µs in 0.1 µs steps.
Accuracy:	±0.1 µs.
Decoder Window position:	X Channel centered at 62.0 µs. Y Channel centered at 74.0 µs.
Accept:	<±0.5 µs
Reject:	>±1.0 µs
	If the reply delay is outside of window, an "F" will precede reply delay reading.
Error Conditions:	If no reply occurs within 89.9 µs of P1 or A/A mode is not selected, "DDD.D" will be displayed.

12. UUT Pulse Interrogation Spacing Detector

Position:	12.0 µs for X Channel G/A and A/A TACAN 24.0 µs for Y Channel A/A TACAN 36.0 µs for Y Channel G/A TACAN
Accuracy:	Measured from the 50% point of P1 to 50% point of P2.
Windows:	
Narrow:	Accept: <±0.5 µs Reject: >±1.0 µs

Wide: Accept: <±2.0 µs
Reject: >±3.0 µs

13. SCOPE SYNC

15 Hz: 27.0 µs before the positive going zero crossing of the 15 Hz sine wave modulation.

135 Hz: 2.5 µs before the positive going zero crossing of the 8th 135 Hz sine wave modulation after the 15 Hz positive going zero crossing.

MRB: 3.0 µs before the first pulse of the Main Reference Burst.

ARB: 3.0 µs before the first pulse of each Auxiliary Reference Burst.

A/A INTERR: 3.0 µs before the first pulse of each A/A Interrogation pulse pair.

INV TACAN Sync: Leading Edge is coincident with negative going zero crossing of the 15 Hz sine wave with 180 degrees bearing selected.

Polarity: Internally selectable, standard setting is negative.

Width: 70 µs (±18.0 µs)

14. External Interrogations

J10010 Enable: Enables J10011, and gates off all other interrogations including reference bursts and Ident pairs as long as ENABLE is active.

Polarity: Active low

Level: TTL

J10011 TRIGGER: Triggers modulator when enabled by J10010.

Polarity: Negative edge

Level: TTL

B. Power Characteristics

AC Input: 105 to 120 VAC or 210 to 250 VAC, 50 to 400 Hz, power consumption is less than 150 watts.

WARNING:

HIGH VOLTAGE EQUIPMENT

THIS EQUIPMENT CONTAINS CERTAIN CIRCUITS AND/OR COMPONENTS OF EXTREMELY HIGH VOLTAGE POTENTIALS, CAPABLE OF CAUSING SERIOUS BODILY INJURY OR DEATH. WHEN PERFORMING ANY OF THE PROCEDURES CONTAINED IN THIS MANUAL, HEED ALL APPLICABLE SAFETY PRECAUTIONS.

RESCUE OF SHOCK VICTIMS

1. DO NOT ATTEMPT TO PULL OR GRAB THE VICTIM
2. IF POSSIBLE, TURN OFF THE ELECTRICAL POWER.
3. IF YOU CANNOT TURN OFF ELECTRICAL POWER, PUSH, PULL OR LIFT THE VICTIM TO SAFETY USING A WOODEN POLE, A ROPE OR SOME OTHER DRY INSULATING MATERIAL.

FIRST AID

1. AS SOON AS VICTIM IS FREE OF CONTACT WITH SOURCE OF ELECTRICAL SHOCK, MOVE VICTIM A SHORT DISTANCE AWAY FROM SHOCK HAZARD.
2. SEND FOR DOCTOR AND/OR AMBULANCE.
3. KEEP VICTIM WARM, QUIET AND FLAT ON HIS/HER BACK.
4. IF BREATHING HAS STOPPED , ADMINISTER ARTIFICIAL RESUSCITATION. STOP ALL SERIOUS BLEEDING.

CAUTION

INTEGRATED CIRCUITS AND SOLID STATE DEVICES SUCH AS MOS FET'S, ESPECIALLY CMOS TYPES, ARE SUSCEPTIBLE TO DAMAGE BY ELECTROSTATIC DISCHARGES RECEIVED FROM IMPROPER HANDLING, THE USE OF UNGROUNDED TOOLS, AND IMPROPER STORAGE AND PACKAGING. ANY MAINTENANCE TO THIS UNIT MUST BE PERFORMED WITH THE FOLLOWING PRECAUTIONS:

1. BEFORE USING IN A CIRCUIT, KEEP ALL LEADS SHORTED TOGETHER EITHER BY THE USE OF VENDOR-SUPPLIED SHORTING SPRINGS OR BY INSERTING LEADS INTO A CONDUCTIVE MATERIAL.

2. WHEN REMOVING DEVICES FROM THEIR CONTAINERS, GROUND THE HAND BEING USED WITH A CONDUCTIVE WRISTBAND.

3. TIPS OF SOLDERING IRONS AND/OR ANY TOOLS USED MUST BE GROUNDED.

4. DEVICES MUST NEVER BE INSERTED INTO NOR REMOVED FROM CIRCUITS WITH POWER ON.

5. PC BOARDS, WHEN TAKEN OUT OF THE SET, MUST BE LAID ON A GROUNDED CONDUCTIVE MAT OR STORED IN A CONDUCTIVE STORAGE BAG.

NOTE

Remove any built-in power source, such as a battery, before laying PC Boards on conductive mat or storing in conductive bag.

6. PC BOARDS, IF BEING SHIPPED TO THE FACTORY FOR REPAIR, MUST BE PACKAGED IN A CONDUCTIVE BAG AND PLACED IN A WELL-CUSHIONED SHIPPING BOX.

THE USE OF SIGNAL GENERATORS FOR MAINTENANCE AND OTHER ACTIVITIES CAN BE A SOURCE OF ELECTROMAGNETIC INTERFERENCE TO COMMUNICATION RECEIVERS, WHICH CAN CAUSE DISRUPTION AND INTERFERENCE TO COMMUNICATION SERVICE OUT TO A DISTANCE OF SEVERAL MILES.

USERS OF THIS EQUIPMENT SHOULD SCRUTINIZE ANY OPERATION WHICH RESULTS IN RADIATION OF A SIGNAL (DIRECTLY OR INDIRECTLY) AND SHOULD TAKE NECESSARY PRECAUTIONS TO AVOID POTENTIAL COMMUNICATION INTERFERENCE PROBLEMS.

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INTRODUCTION - TACAN TEST SYSTEM

This manual contains instructions for operating and maintaining the Tacan Test System, which is composed of the T-1401 and ATC-1400A, and is to be used in conjunction with the ATC-1400A Operation/Maintenance Manual.

It is recommended that the operator and maintenance technicians be familiar with the Description of Controls, 1-2-2, and Troubleshooting, 2-2-1, before operating or performing maintenance on the equipment.

The T-1401 simulates all the parameters of a TACAN modulation signal necessary to test TACAN receiver/transmitters. It is designed to be used with an ATC-1400A. The T-1401 can be operated as a bench-top unit or it can be installed in a rack.

The contents of the manual are in three chapters: Operation, Maintenance, and Illustrated Parts List. There are four appendices.

NOTE: Throughout the text, all controls, indicators and connectors are identified by parenthesized item numbers. These numbers correspond to item numbers in the following figures: Figures 3 and 4 of 1-2-2, T-1401 Front and Rear Panel Controls and Indicators and Figure 6 of 1-2-2, ATC-1400A Front and Rear Panels (See ATC-1400A Operation/Maintenance Manual).

CHAPTER 1

TACAN TEST SYSTEM

OPERATION/MAINTENANCE MANUAL W/ILLUSTRATED PARTS LIST

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CHAPTER 1

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SECTION 1 - DESCRIPTION

1. General Description and Features

The T-1401 is a TACAN simulator used to test TACAN receiver/transmitters. It is designed to be used with an ATC-1400A. The T-1401 can be operated as a desk-top unit or it can be installed in a rack. All test controls are on the front panel. Those on the rear panel are usually only for setup (before starting a test). Usually, the T-1401 is operated and controlled via the ATC-1400A with the T-1401 mounted on top of, and strapped to, the ATC-1400A.

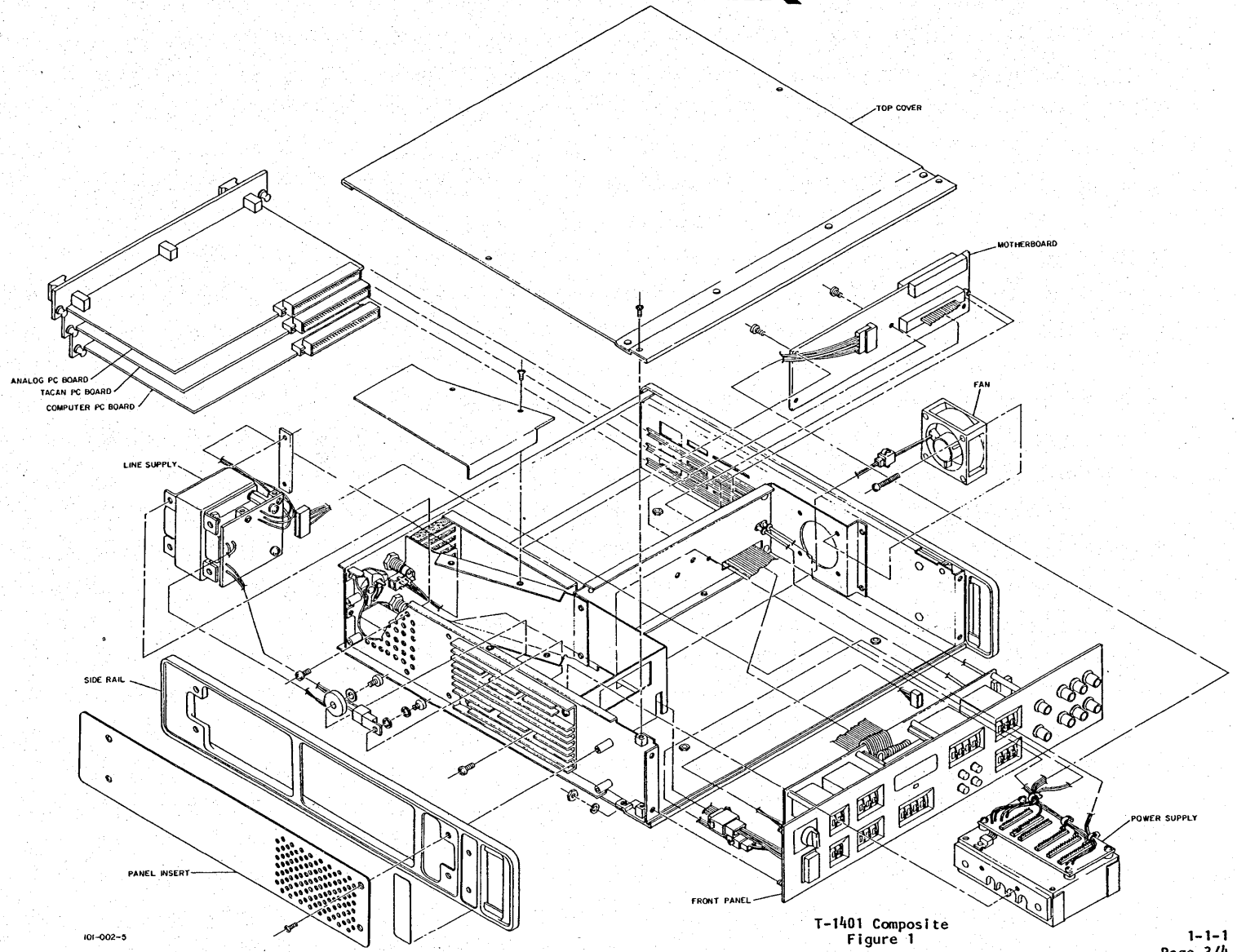
The mode of operation is determined primarily by control settings on the front panel of the T-1401. In the absence of an ATC-1400A, the T-1401 will operate with X Mode pulse spacing. Identification and Equalizer pulse pairs are enabled when the G/A Mode has been selected. Mode information is also received from the ATC-1400A when the two are connected via the IFR Bus. This information includes Identification On/Off, Equalizer On/Off, X/Y Mode and P1 to P2 pulse spacing deviation.

The T-1401 weighs 17.5 pounds (7.95 kg) and is 16 7/8 inches (42.86 cm) wide, 16 inches (40.64 cm) deep less handles, and 3 1/4 inches (8.25 cm) high. See figure 1. Removal of the top cover gives access to three PC Board Assemblies (Analog, Computer, and TACAN) mated with connectors on the Motherboard PC Board Assembly. The Power Supply Assembly, containing two PC Board Assemblies, and the Line Supply Assembly with PC Board are mounted on the left side (viewed from the front). Two PC Board Assemblies, Switch and Display, are attached to the back of the front panel. Mode of operation is determined by switch settings on the front panel.

2. Functional Capabilities

The T-1401/ATC-1400A set is capable of complete simulation of G/A X, G/A Y, A/A X, A/A Y, INVERSE G/A X, INVERSE G/A Y, INVERSE A/A X and INVERSE A/A Y Modes of operation. Nominal pulse spacings, modulation signals and channel pairings are automatically selected for each mode. Convenient front panel controls give a continuous display of each parameter of the TACAN signal and provide for varying each parameter from its nominal value.

Channel cross-references are given in Appendix D. For a complete description of the functional capabilities, refer to Section 3.



T-1401 Composite
Figure 1

SECTION 2 - OPERATION

1. INSTALLATION

Installation of the T-1401 Test Auxiliary is a simple procedure which consists primarily of:

Setting instrument into an operating position.

Furnishing electrical power to test set by connecting AC power cable to available power source (either 105 to 120 VAC or 210 to 250 VAC, 50 to 400 Hz).

Also included in this section are recommendations regarding installation/operating safety, equipment inspection, power requirements, required installation tools and bench/rack installations.

A. Safety Precautions

Listed below are several important precautions which must be observed during all phases of system installation and operation. IFR Systems, Inc., assumes no liability for customer's failure to comply with any of the safety precautions outlined in this manual.

(1) Complying with Instructions

Installation/operating personnel should not attempt to install or operate system without reading and complying with all instructions contained in this manual. All procedures contained in this manual must be performed in exact sequence and manner described.

(2) Grounding Requirements

To minimize shock hazard, all equipment chassis and cabinets must be connected to electrical ground. For this purpose, all IFR Systems, Inc., test sets are equipped with a standard three-prong power cable which must be connected to a properly grounded three-prong wall receptacle. To summarize, it is customer's responsibility to:

Have a qualified electrician check wall receptacle(s) for proper grounding.

Replace any standard two-prong wall receptacle(s) with properly grounded three-prong receptacle(s).

WARNING: DUE TO POTENTIAL SAFETY HAZARDS, USE OF A THREE-PRONG TO TWO-PRONG ADAPTER PLUG IS NOT RECOMMENDED.

(3) Operating Safety

Due to presence of potentially lethal voltages within test equipment, operating personnel must not remove test equipment covers at any time. Component replacement and internal adjustments must be made by qualified maintenance personnel only.

(4) Observing "CAUTION" and "WARNING" Labels

Extreme care should be exercised when performing any operations preceded by a "CAUTION" or "WARNING" label. "CAUTION" labels appear where possibility of damage to equipment exists, while "WARNING" notes are used to denote a condition where a shock hazard exists, exposing personnel to possible bodily injury.

B. Equipment Inspection

All IFR Systems, Inc., test sets are carefully inspected for material defects and are subjected to a thorough performance check prior to leaving the factory. All sets are shipped to customer in excellent mechanical/electrical condition. Upon receipt of shipment, receiving personnel should:

Account for presence of all equipment and accessories as listed on packing slip.

Inspect all equipment for visible or concealed damage which may have occurred in transit. If damage is apparent, see "RECEIVING INSPECTION/UNPACKING" sticker affixed to shipping container for "Damage Claim" procedure.

C. Power Requirements

The T-1401 power supply can operate over a voltage range of 105 to 120 or 210 to 250 VAC. No internal wiring changes are required prior to applying AC power to the test auxiliary. To select between 120 VAC and 220 VAC, ensure LINE Switch (35) setting on rear panel matches input line voltage. Instantaneous surge current at power up is less than 50 Amps. Input current varies to maintain constant power over the input voltage range (approximately 10 W), so it is important that the fuse selected has the correct rating for proper operation. The recommended fuse ratings are listed below:

INPUT VOLTAGE	F1 - AC IN FUSE	F2 - AC OUT VOLTAGE
105 to 120 VAC	3.0A 250V Fast Blo	0.5A 250V Med Blo
220 to 250 VAC	3.0A 250V Fast Blo	0.25A 250V Med Blo

D. Installation Equipment

All electrical connections required to ready the instrument for operation can be easily made by hand, without using special tools.

E. Installation Procedure

The T-1401 and ATC-1400A are shipped in separate containers. To prepare the units for operation, proceed as follows:

STEP	PROCEDURE
1.	Remove both the T-1401 and ATC-1400A Test Sets from their respective containers.
2.	Place the T-1401 on top of the ATC-1400A.
3.	Connect the two 25-pin type D ribbon cables, SMB-to-SMB coax cable, two power cables and attaching hardware to test sets as shown in Figure 1.
4.	Calibrate the TACAN Test System per Section 2-2-2 Paragraph I, System Calibration. The System must be calibrated any time the T-1401 is replaced.

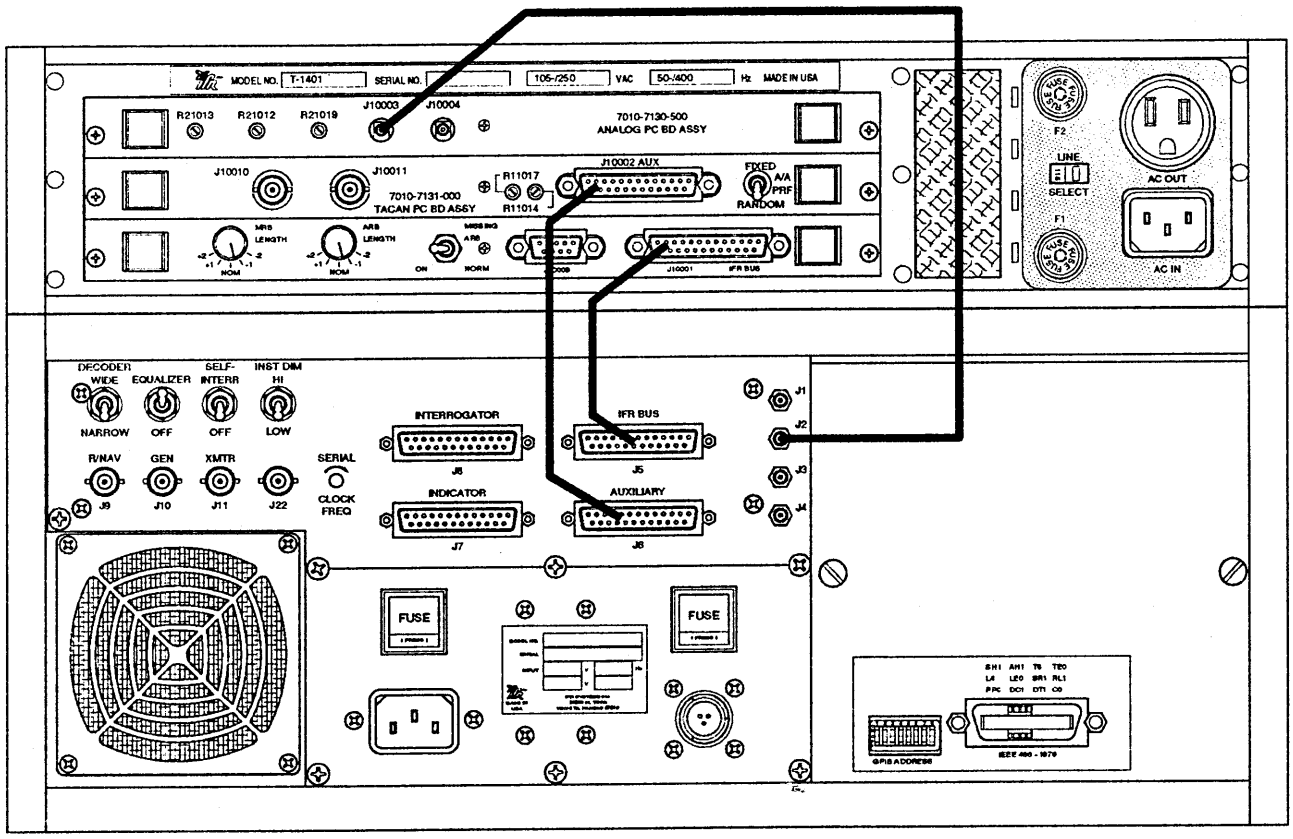


Figure 1 - T-1401/ATC-1400A Interface

The T-1401, when interfaced with the ATC-1400A, can be installed in either a bench-top or rack-mount fashion. All IFR Systems, Inc., test sets are normally shipped from factory with plastic feet installed for a bench-top installation.

Installation Kit	Instrument	IFR Systems Part Number
Rack Mount	ATC-1400A	7001-7636-800
	T-1401	7001-6740-800
Bench/Stack Mount	ATC-1400A	7005-6743-000
	T-1401	One kit per system.

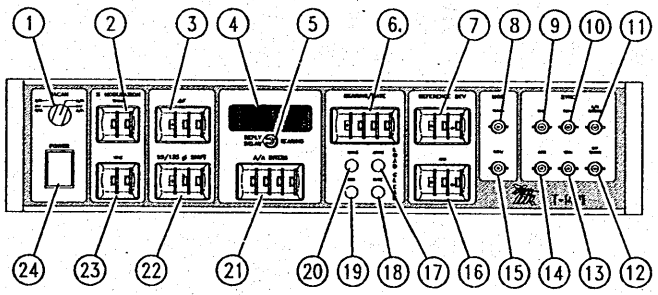
CAUTION: SPECIAL CARE MUST BE TAKEN TO AVOID RESTRICTION OF AIR FLOW TO INTAKE VENT, WHEN INSTALLING INSTRUMENT IN EITHER A BENCH-TOP OR RACK-MOUNT FASHION.

F. Power-up Procedure

Remove 3 conductor AC power cable from T-1401 shipping container and connect female end to POWER RECEPTACLE (32) on rear panel of T-1401. Connect 3-pin grounded plug on opposite end of AC power cable to standard 3-pin grounded receptacle.

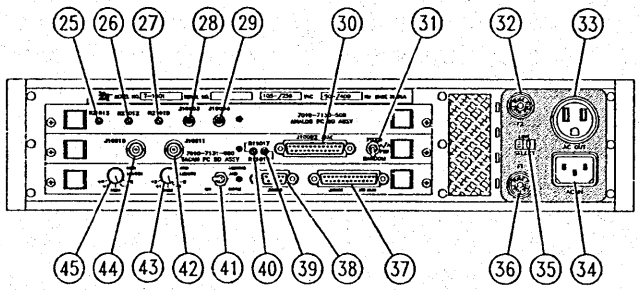
Place Power Switch to "ON" Position to energize test set and verify Power Switch is illuminated.

2. Description of Controls Item numbers in parentheses correspond to numbered items called out in figures 3 and 4.



(1) TACAN CONTROL
(2) 135 Hz %MODULATION Thumbwheels
(3) ΔF Thumbwheels
(4) BEARING/REPLY DELAY Display
(5) DISPLAY SELECT Switch
(6) BEARING RATE Thumbwheels
(7) REFERENCE DEV MRB Thumbwheels
(8) 135 Hz MOD Connector (J15003)
(9) MRB SYNC Connector
(10) 135 Hz SYNC Connector (J15007)
(11) A/A INTERR SYNC Connector (J15009)
(12) INV TACAN SYNC Connector (J15010)
(13) 15 Hz SYNC Connector (J15008)
(14) ARB SYNC Connector (J15006)
(15) 15 Hz MOD Connector (J15004)
(16) REFERENCE DEV ARB Thumbwheels
(17) LOAD RATE Pushbutton
(18) CLEAR RATE Pushbutton
(19) CLEAR BRG Pushbutton
(20) LOAD BRG Pushbutton

T-1401 Front Panel Controls and Indicators
Figure 3



(21) A/A INTERR Thumbwheels
(22) 15/135 Ø SHIFT Thumbwheels
(23) 15 Hz % MODULATION Thumbwheels
(24) POWER Switch
(25) 135 Hz LEVEL Adjust (R21013)
(26) 15 Hz LEVEL Adjust (R21012)
(27) COMP MOD OFFSET Adjust (R21019)
(28) COMP MOD Connector (J10003)
(29) EXT Connector (J10004)
(30) AUX Connector (J10002)
(31) A/A RATE SELECT Switch
(32) F2 Fuse
(33) AC OUT Connector
(34) AC IN Connector
(35) LINE SELECT Switch
(36) F1 Fuse
(37) IFR BUS Connector
(38) TEST Connector
(39) A/A Y Adjust (R11014)
(40) EQUALIZER Adjust (R11017)
(41) MISSING ARB Switch
(42) ENABLE INPUT Connector (J10011)
(43) ARB LENGTH Switch
(44) TRIGGER INPUT Connector
(45) MRB LENGTH Switch

T-1401 Rear Panel Control and Indicators
Figure 4

A. T-1401 Front Panel

(1) TACAN Control

INV G/A Position - Sets the T-1401 to the INVERSE GROUND-TO-AIR Mode of operation.

G/A Position - Sets the T-1401 to the GROUND-TO-AIR Mode of operation.

A/A Position - Sets the T-1401 to the AIR-TO-AIR Mode of operation.

INV A/A Position - Sets the T-1401 to the INVERSE AIR-TO-AIR Mode of operation.

(2) 135 Hz % MODULATION Thumbwheels

Programs the percent modulation of the 135 Hz component of the TACAN modulation between 0% and 39% in 1% steps.

(3) ΔF Thumbwheels

Adjusts the TACAN timing reference oscillator from -3.9% to +3.9% of nominal value in 0.1% steps.

NOTE: The Delta F and Bearing Rate functions are mutually selective. Selecting a non-zero Delta F in the presence of a Bearing Rate will result in an Error code being displayed

on the BEARING/REPLY DELAY Display (4). Refer to Chapter 1, Section 2, Subject 6 for an explanation of the Error Codes.

(4) BEARING/REPLY DELAY Display

Normally displays the currently simulated bearing or reply delay output. If the T-1401 detects an error condition or the operator has selected an incompatible parameter value, an appropriate message will be displayed in place of the current value until the problem is resolved. Refer to Chapter 1, Section 2, Subject 6 for an explanation of the error messages.

(5) DISPLAY SELECT Switch

BEARING/REPLY DELAY Display (4) displays either bearing or reply delay based upon the position of this switch.

(6) BEARING/RATE Thumbwheels

Desired value of bearing and bearing rate is set in degrees for bearing and degrees per second for bearing rate.

SELECTION	RANGE	THUMBWHEEL SETTING
Bearing	000.0 to 359.9	0000 to 3599
Bearing Rate	-39.0 to +39.0	-39X to +39X

(7) REFERENCE DEV MRB Thumbwheels

G/A X Mode - Adjusts the deviation between the pairs of pulses that make up the Main Reference Burst. Adjustment is from -3.9 us to +3.9 us from the nominal value.

G/A Y Mode, A/A X Mode, A/A Y Mode - Adjusts the deviation between the single pulses that make up the Main Reference Burst. Adjustment is from -3.9 us to +3.9 us from the nominal value.

INV G/A and INV A/A Modes - Main Reference Burst not present.

OFF (DOT) Position - Disables the Main Reference Burst in all modes.

(8) 135 Hz MOD Connector (J15003)

A sample of the 135 Hz modulation signal is output at this connector. The level is adjusted from 0 V pp to 3.0 V pp as the 135 Hz % MODULATION Thumbwheels are set from 00% to 39%.

(9) MRB SYNC Connector (J15005)

A negative-going oscilloscope sync pulse, whose falling edge occurs immediately prior to the first pulse of the Main Reference Burst, is output at this connector.

(10) 135 Hz SYNC Connector (J15007)

A negative-going oscilloscope sync pulse, whose falling edge occurs at the positive-going zero crossing of the 135 Hz modulation signal, is output at this connector.

(11) A/A INTERR SYNC Connector (J15009)

A negative-going oscilloscope sync pulse, whose falling edge occurs immediately prior to the first pulse of an A/A Interrogation pulse pair, is output at this connector.

(12) INV TACAN SYNC Connector (J15010)

A positive-going North Reference Trigger pulse is output at this connector. The 15 Hz bearing in INV Mode is determined by the time delay between the rising edge of this pulse to the negative-going zero crossing of the 15 Hz modulating signal. This sync pulse is output only when INV G/A or INV A/A Modes have been selected on the TACAN Control (1).

(13) 15 Hz SYNC Connector (J15008)

A negative-going oscilloscope sync pulse, whose falling edge occurs at the positive-going zero crossing of the 15 Hz modulation signal, is output at this connector.

(14) ARB SYNC Connector (J15006)

A negative-going oscilloscope sync pulse whose falling edge occurs immediately prior to the first pulse of the Auxiliary Reference Burst, is output at this connector.

(15) 15 Hz MOD Connector (J15004)

A sample of the 15 Hz modulation signal is output at this connector. The level is adjusted from 0 V pp to 3.0 V pp as the 15 Hz % MODULATION Thumbwheels are set from 00% to 39%.

(16) REFERENCE DEV ARB Thumbwheels

G/A X Mode - Adjusts the deviation between the pairs of pulses that make up the Auxiliary Reference Burst. Adjustment is from -3.9 us to +3.9 us from the nominal value.

G/A Y Mode - Adjusts the deviation between the single pulses that make up the Auxiliary Reference Burst. Adjustment is from -3.9 us to +3.9 us from the nominal value.

A/A X Mode, A/A Y Mode, INV G/A and INV A/A Modes - Auxiliary Reference Burst not present.

OFF (DOT) Position -Disables the Auxiliary Reference Burst in all modes.

(17) LOAD RATE Pushbutton

Programs a bearing rate from -39.0 degrees per second to +39.0 degrees per second as selected on the BEARING/RATE Thumbwheels (6).

NOTE: The Delta F and Bearing Rate functions are mutually exclusive. Selecting a Bearing Rate in the presence of a non-zero Delta F will result in an Error code being displayed on the BEARING/REPLY DELAY Display (4). Refer to Chapter 1, Section 2, Subject 6 for an explanation of the Error Codes.

(18) CLEAR RATE Pushbutton

Clears the previously loaded bearing rate information to 00.0 degrees per second.

(19) CLEAR BRG Pushbutton

Clears the previously loaded bearing information to 000.0 degrees.

(20) LOAD BRG Pushbutton

Programs a bearing from 000.0 degrees to +359.9 degrees as selected on the BEARING/RATE Thumbwheels (6).

(21) A/A INTERR Thumbwheels

Programs an A/A interrogation rate from 0000 interrogations per second to 3999 interrogations per second in one interrogation per second steps when in the A/A or INV A/A Modes.

(22) 15/135 Ø SHIFT Thumbwheels

Programs the phase shift between the 15 Hz and 135 Hz modulating signals from -39 degrees to +39 degrees in one degree steps.

(23) 15 Hz % MODULATION Thumbwheels

Programs the percent modulation of the 15 Hz component of TACAN modulation between 0% and 39% in 1% steps.

(24) POWER Switch

Applies external ac power to the T-1401 and to the ATC-1400A when it is connected to the AC OUT Connector (33) on the rear of the T-1401.

B. T-1401 Rear Panel (see figure 4)

(25) 135 Hz LEVEL Adjust (R21013)

Calibration adjustment for the level of the 135 Hz component of the composite modulation output voltage.

(26) 15 Hz LEVEL Adjust (R21012)

Calibration adjustment for the level of the 15 Hz component of the composite modulation output voltage.

(27) COMP MOD OFFSET Adjust (R21019)

Calibration adjustment for the dc offset of the composite modulation output voltage.

(28) COMP MOD Connector (J10003)

15/135 Hz composite modulation output from the T-1401 to the ATC-1400A.

(29) EXT F Connector (J10004)

Input for external frequency source for the TACAN signal timing reference (enabled through the GPIB bus).

(30) AUXILIARY Connector (J10002)

Connects the T-1401 to the ATC-1400A to provide discrete signal interconnect.

(31) A/A RATE SELECT Switch

Selects between Random A/A and Fixed Rate interrogations. This selection is not GPIB controlled.

(32) F2 Fuse

Fuses the power to the AC OUT Connector. Refer to Paragraph 1-2-1C for appropriate rating.

(33) AC OUT Connector

Convenience outlet used to power the ATC-1400A.

(34) AC IN Connector

Power receptacle for applying either 115 VAC or 230 VAC single phase power to the T-1401. LINE SELECT Switch (35) must be set to the correct position before applying power.

(35) LINE SELECT Switch

Selects the line voltage that will be applied to the T-1401.

(36) F1 Fuse

Fuses the power to the T-1401 and the AC OUT Connector. Refer to Paragraph 1-2-1C for appropriate rating.

(37) IFR BUS Connector (J10001)

Connects the T-1401 to the ATC-1400A so that information may be exchanged between the two units.

(38) TEST Connector (J10009)

RS-232 connector used for factory test.

(39) A/A REPLY DELAY Adjust (R11014)

Calibration adjustment for the A/A Reply Delay counters.

(40) EQUALIZER Adjust (R10017)

Calibration adjustment for the position of the Ident equalizing pulse pairs.

(41) MISSING ARB Switch

Deletes the first Auxiliary Reference Burst following the Main Reference Burst when set to the ON position.

(42) $\overline{\text{ENABLE}}$ INPUT Connector (J10011)

External input that gates off all other pulses including Ident and Reference bursts when active.

(43) ARB LENGTH Switch

Controls the number of pulse pairs in G/A X mode or single pulses in G/A Y Mode in the Auxiliary Reference Burst. One or two pulse pairs (single pulses) may be added or subtracted from the nominal value.

(44) $\overline{\text{TRIGGER}}$ INPUT Connector (J10010)

External input that triggers ATC-1400A Modulator whenever ENABLE INPUT Connector (J10011) is active.

(45) MRB LENGTH Switch

Controls the number of pulse pairs in G/A X or single pulses in G/A Y Mode, A/A X Mode, and A/A Y Mode in the main reference burst. One or two pulse pairs (single pulses) may be added from the nominal value.

3. T-1401 Performance Evaluation

A. General. This section contains step-by-step test procedures for assessing the performance of the T-1401. When the operating condition of the T-1401 is in question, these procedures should be relied upon as the first step in the troubleshooting/maintenance process.

B. Pre-operational Considerations. For maximum benefit of all operating procedures, it is strongly recommended that personnel:

(1) Read and understand thoroughly all steps of the procedure to be performed, prior to its completion.

(2) Be familiar with the circuit or unit under test so some idea is perceived as to the power, frequency, and waveform to be expected at each test point. This knowledge will aid personnel in performing the test procedure logically and efficiently.

C. Test Equipment Requirements. Appendix B at the rear of this manual contains a comprehensive list of test equipment suitable for performing any of the procedures in this manual. Any other equipment meeting the specifications listed in the appendix may be substituted for the recommended models.

NOTE: For certain procedures in this manual, the equipment listed in Appendix B may exceed the minimum required specifications.

D. Corrective Maintenance Procedures. The performance checks in this section will aid the operator/technician in determining whether the T-1401 is functioning properly or if a failure exists. A failure will normally be reflected as either a calibration error or a malfunction. A calibration error is defined as a measurement or reading (relating to the unit being tested) that is not within prescribed tolerance. In this condition, the set may appear to be functioning properly, despite the presence of a calibration error. A malfunction is a defective condition in which a signal may be totally absent, grossly out of tolerance, or where the unit is obviously not working properly. If a failure or calibration error is confirmed, the technician should take appropriate action to return the set to its normal operating condition.

E. Initial Control Settings. Before any performance evaluation, the T-1401 controls shall be set in accordance with table 1.

CONTROL	SETTING
TACAN Control (1, Fig.3, Chapter1, Section 2)	G/A
135 Hz % MODULATION Thumbwheels (2)	0.0
Δ F Thumbwheels (3)	+0.0
BEARING/RATE Thumbwheels (6)	000.0
REFERENCE DEV MRB Thumbwheels (7)	+0.0
REFERENCE DEV ARB Thumbwheels (16)	+0.0
A/A INTERR Thumbwheels (21)	0000
15/135 Ø SHIFT Thumbwheels (22)	+00
15 Hz % MODULATION Thumbwheels (23)	00
MRB LENGTH Switch (43, Fig.14, Chapter 1, Section 2)	NOM
ARB LENGTH Switch (41)	NOM
MISSING ARB Switch (39)	NORM

ATC-1400A Initial Control Settings
Table 1

F. T-1401 Performance Evaluation. Refer to the calibration and/or troubleshooting sections if the T-1401 fails any step in the performance evaluation.

(1) Equipment Required.

Oscilloscope

(2) Procedure.

(a) Set T-1401 controls to settings listed in Table 1.

(b) Energize T-1401.

(c) Connect oscilloscope channel A to 15 Hz MOD Connector (15, Fig. 3, Chapter 1, Section 2).

(d) Set 135 Hz % MODULATION Thumbwheels (2) to 00.

(e) Set 15 Hz % MODULATION Thumbwheels (23) to 20.

(f) Oscilloscope shall indicate a 15 Hz sine wave whose magnitude is 1.44 to 1.64 volts peak-to-peak.

(g) Set 15 Hz % MODULATION Thumbwheels (23) to 00.

(h) Set 135 Hz % MODULATION Thumbwheels (2) to 20.

(i) Connect oscilloscope channel A to 135 Hz MOD Connector (8).

(j) Oscilloscope shall indicate a 135 Hz sine wave whose magnitude is 1.44 to 1.64 volts peak-to-peak.

(k) Set TACAN Control (1) to A/A.

(l) Oscilloscope shall indicate 0.00 volts.

(m) Set TACAN Control (1) to INV A/A.

(n) Oscilloscope shall indicate 0.00 volts.

(o) Set TACAN Control (1) to G/A.

(p) Connect oscilloscope channel A to 135 Hz SYNC Connector (10).

(q) Connect oscilloscope channel B to 15 Hz SYNC Connector (13).

(r) Set 15/135 Ø SHIFT Thumbwheels (22) to +39.

(s) Oscilloscope shall indicate 14.55 to 14.65 millisecond delay between sync signal on channel A and sync signal on channel B.

(t) Connect oscilloscope channel A to MRB SYNC Connector (9).

(u) Connect oscilloscope channel B to 15 Hz MOD Connector (15).

(v) Set 15/135 Ø SHIFT Thumbwheels (22) to 00.

(w) Set BEARING/RATE Thumbwheels (6) to 000.0.

(x) Press LOAD BRG Pushbutton (20).

(y) BEARING Display (4) shall indicate 000.0.

(z) Oscilloscope channel B 0.1 degree tick mark on 15 Hz sine wave shall be 140 to 160 microseconds behind channel A MRB SYNC signal.

(aa) Press CLEAR BRG Pushbutton (19).

(ab) Set BEARING/RATE Thumbwheels (6) to -01.0.

(ac) Press LOAD RATE Pushbutton (17).

(ad) BEARING Display (4) shall indicate a bearing rate change of -1 degree per second.

(ae) Press CLEAR RATE Pushbutton (18).

(af) BEARING Display (4) shall stop at current bearing.

(ag) Set 15 Hz % MODULATION Thumbwheels (23) to 00.

(ah) Connect oscilloscope channel A to MRB SYNC Connector (9).

(ai) Remove the cable interconnecting T-1401 AUXILIARY Connector (30) and ATC-1400A J6.

(aj) Connect oscilloscope channel B to AUXILIARY Connector (30) pin 5.

(ak) Set TACAN Control (1) to G/A.

(al) Oscilloscope shall indicate 12 pulse pairs.

(am) Oscilloscope shall indicate leading edge of P2 occurring 11.9 to 12.1 microseconds after leading edge of P1 in each pulse pair.

(an) Set REFERENCE DEV MRB Thumbwheels (7) to 0.0 (OFF).

(ao) Oscilloscope shall indicate no main reference burst.

(ap) Set REFERENCE DEV MRB Thumbwheels (7) to +0.0.

(aq) Set TACAN Control (1) to A/A.

(ar) Oscilloscope shall indicate that main reference burst consists of 10 single pulses.

(as) Set TACAN Control (1) to G/A.

(at) Connect oscilloscope channel A to ARB SYNC Connector (14).

(au) Set ARB LENGTH Switch (41, fig. 4, Chapter 1, Section 2) to NOM.

(av) Oscilloscope shall indicate Auxiliary Reference Burst containing 6 pulse pairs.

(aw) Set REFERENCE DEV ARB Switch (16, fig. 3, Chapter 1, Section 2) to 0.0 (OFF).

(ax) Oscilloscope shall indicate no Auxiliary Reference Burst.

(ay) Connect oscilloscope channel A to A/A INTERR SYNC Connector (11).

(az) Connect oscilloscope channel B to AUXILIARY Connector (30) pin 10.

(ba) Set TACAN Control (1) to G/A.

(bb) Set A/A INTERR Thumbwheels (21) to 1000.

(bc) Oscilloscope shall indicate no A/A interrogations on channel B.

(bd) Set TACAN Control (1) to A/A.

(be) Set REFERENCE DEV MRB Thumbwheels (7) to 0.0 (OFF).

(bf) Oscilloscope shall indicate A/A SYNC signals every 1 millisecond.

(bg) Connect oscilloscope channel A to INV TACAN SYNC Connector (12).

(bh) Connect oscilloscope channel B to 15 Hz SYNC Connector (13).

(bi) Set TACAN Control (1) to INV A/A.

(bj) Oscilloscope shall indicate inverse TACAN signal is 60 to 80 microseconds long.

(bk) Oscilloscope shall indicate time delay between falling edge of 15 Hz SYNC signal and the rising edge of INV TACAN SYNC signal is 33.0 to 33.7 microseconds.

(bl) Set TACAN Control (1) to G/A.

(bm) Set REFERENCE DEV MRB Thumbwheels (7) to +0.0.

(bn) Connect oscilloscope external trigger input to MRB SYNC Connector (9).

(bo) Connect oscilloscope channel A to AUXILIARY Connector (30) pin 5.

(bp) Oscilloscope shall indicate P1 of identification pulse pair occurring 690 to 790 microseconds after P1 of each reference burst.

(bq) Oscilloscope shall indicate P1 of equalizer pulse pair occurring 90 to 110 microseconds after P1 of identification pulse pair.

(br) Set TACAN Control (1) to A/A.

(bs) Oscilloscope shall indicate no equalizer nor identification pulse pairs are present.

(bt) Connect oscilloscope channel A to AUXILIARY Connector (30) pin 5.

(bu) Connect oscilloscope channel B to AUXILIARY Connector (30) pin 7.

(bv) Connect oscilloscope external trigger input to MRB SYNC Connector (9).

(bw) Set TACAN Control (1) to G/A.

(bx) Oscilloscope shall indicate MRB pulses on channel A bracketed by priority pulses on channel B.

(by) Set TACAN Control (1) to A/A.

(bz) Set A/A INTERR Thumbwheels (21) to 1350.

(ca) Connect oscilloscope external trigger input to A/A INTERR SYNC Connector (11).

(cb) Connect oscilloscope channel A to AUXILIARY Connector (30) pin 10.

(cc) Connect oscilloscope channel B to AUXILIARY Connector (30) pin 2.

(cd) Oscilloscope shall indicate interrogation pulses on channel A bracketed by priority pulses on channel B.

(ce) Disconnect oscilloscope.

(cf) Reconnect the cable from T-1401 AUXILIARY Connector (30) to ATC-1400A J6.

4. GENERAL OPERATING PROCEDURES

This section contains operating instructions relating to local control (front panel) operation of the TACAN Test System. Paragraph 1-2-5 contains operating instruction for remote (GPIB) operation.

NOTE: The procedures contained within this section are general procedures, identifying the Controls, Connectors and Indicators used for the individual test functions. Specific UUT Test Procedures have to be addressed in the UUT Manuals.

LOCAL CONTROL (Front Panel) OPERATION

The T-1401 Test Auxiliary, when interfaced with the ATC-1400A Transponder/DME Test Set, has four distinct test functions of operation as listed below:

Paragraph	Test Function	Page No.
2-4-A	Ground-to-Air (G/A) Test Function	2
2-4-B	Inverse Ground-to-Air (G/A) Test Function	14
2-4-C	Air-to-Air (A/A) Test Function	26
2-4-D	Inverse Air-to-Air (A/A) Test Function	36

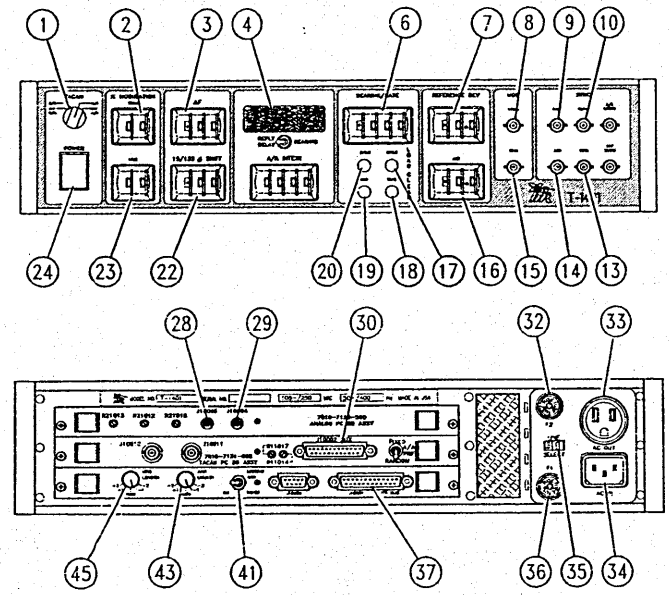
The ATC-1400A provides the DME test function including: interrogation PRF, frequency and power, controlling frequency, pulse spacing, range, velocity, acceleration, reply efficiency and RF output level. For a more complete definition, refer to Chapter 1-2-4, ATC-1400A Operation/Maintenance Manual.

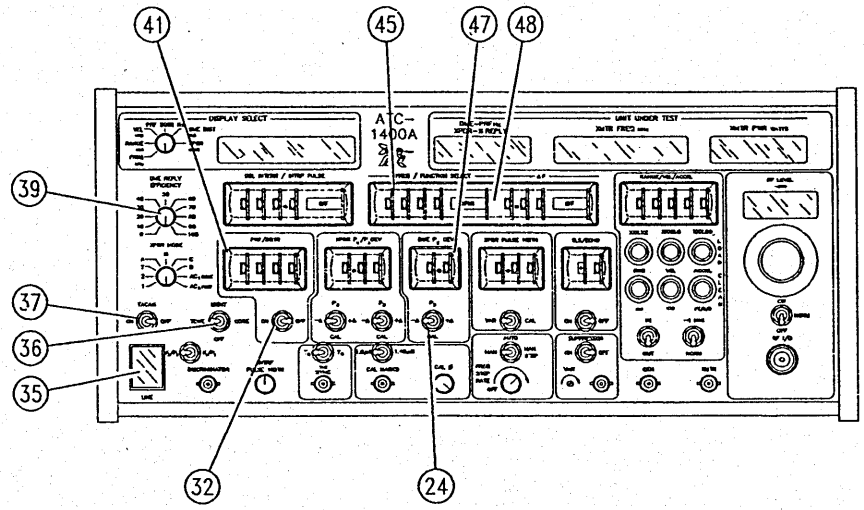
For purposes of clarity and ease of understanding, the description of controls, connectors and indicators for only those controls (with nominal settings), as well as hook-up diagrams and timing charts will be shown for the test function of operation discussed in that paragraph.

REMOTE CONTROL (GPIB) OPERATION

Refer to Paragraph 1-2-5 for descriptions and commands associated with GPIB operations.

A. Ground-to-Air (G/A) Test Function





(1) TACAN CONTROL
(2) 135 Hz %MODULATION Thumbwheels
(3) ΔF Thumbwheels
(4) BEARING/REPLY DELAY Display
(6) BEARING/RATE Thumbwheels
(7) REFERENCE DEV MRB Thumbwheels
(8) 135 Hz MOD Connector (J15003)
(9) MRB SYNC Connector (J15005)
(10) 135 Hz SYNC Connector (J15007)
(13) 15 Hz SYNC Connector (J15008)
(14) ARB SYNC Connector (J15006)
(15) 15 Hz MOD Connector (J15004)
(16) REFERENCE DEV ARB Thumbwheels
(17) LOAD RATE Pushbutton
(18) CLEAR RATE Pushbutton
(19) CLEAR BRG Pushbutton
(20) LOAD BRG Pushbutton
(22) 15/135 Ø SHIFT Thumbwheels
(23) 15 Hz % MODULATION Thumbwheels
(24) POWER Switch
(28) COMP MOD Connector (J10003)
(29) EXT Connector (J1004)
(30) AUX Connector (J10002)
(32) F2 Fuse
(33) AC OUT Connector
(34) AC IN Connector
(35) LINE SELECT Switch
(36) F1 Fuse
(37) IFR BUS Connector
(41) MISSING ARB Switch
(43) ARB LENGTH Switch
(45) MRB LENGTH Switch

(24) DME DEV P2/CAL Switch
(32) PRF/SQTR ON/OFF Switch
(35) LINE Switch
(37) TACAN ON/OFF Switch
(39) DME REPLY EFFICIENCY Control
(41) PRF/SQTR Thumbwheels
(45) FREQ/FUNCTION SELECT Thumbwheels
(47) DME P2 DEV Thumbwheels
(48) ΔF Thumbwheels

T-1401 and ATC-1400A Front and Rear Panel Controls, Connectors and Indicators used in G/A Test Operation

Figure 1

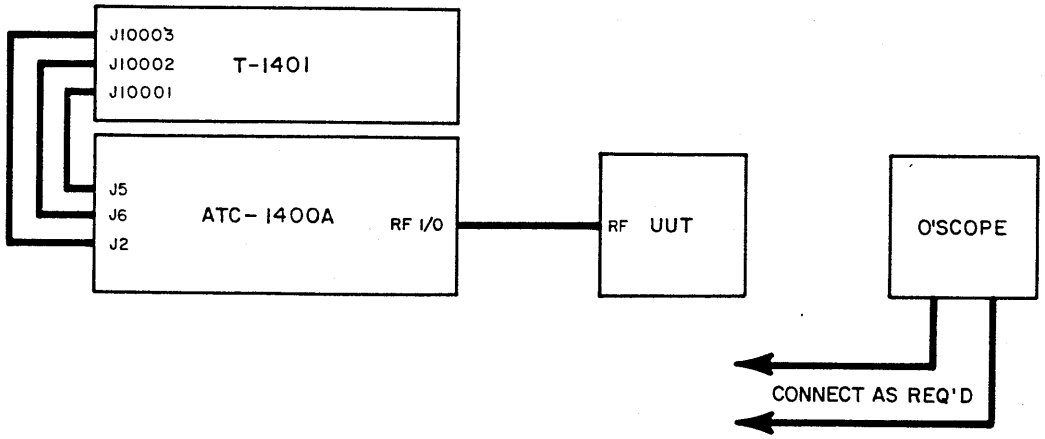
(1) T-1401 Description of Controls, Connectors, and Indicators Used in G/A Test Function

A complete description of the T-1401 Test Auxiliary Controls, Connectors and Indicators, used in conjunction with the ATC-1400A, while performing the G/A Test Function is described in this paragraph.

A complete description of the ATC-1400A Controls, Connectors and Indicators, used in conjunction with the T-1401, while performing the G/A Test Function is described in Paragraph 2-4-A(2).

In the G/A Test Mode, which is the primary mode of operation, the T-1401 provides the 15 Hz Modulation, 135 Hz Modulation, Main Reference Bursts and Auxiliary Reference Bursts. (Refer to Figure 17 for a description of the main and auxiliary reference groups).

NOTE: Beacon G/A Mode can effectively be selected by turning OFF the MRBs, ARBs, 15 Hz Modulation and 135 Hz modulation.



G/A Test Function Hook-up Diagram
Figure 2

ITEM	NAME	DESCRIPTION

1. TACAN Control

G/A Position - Sets the T-1401 to the GROUND-TO-AIR Mode of Operation.

NOMINAL SETTING - "G/A" Position

ITEM NAME DESCRIPTION

2. 135 Hz % Modulation Thumbwheels

Programs the percent modulation of the 135 Hz component of the TACAN modulation between 0% and 39% in 1% steps.

NOMINAL SETTING - "20%" Position

3. DELTA F Thumbwheels

Adjusts the TACAN timing reference oscillator from -3.9% to +3.9% of nominal value in 0.1% steps.

NOMINAL SETTING - "+0.0" Position

4. BEARING/REPLY DELAY Display

Normally displays the currently simulated bearing or reply delay output. If the T-1401 detects an error condition or the operator has selected an incompatible parameter value, an appropriate message will be displayed in place of the current value until the problem is resolved. Refer to Section 1-2-6 for an explanation of the error messages.

6. BEARING/RATE Thumbwheels

Desired value of bearing and bearing rate is set in degrees for bearing and degrees per second for bearing rate.

SELECTION	RANGE	THUMBWHEEL SETTING
Bearing	000.0 to 359.9	0000 to 3599
Bearing Rate	-39.0 to +39.0	-39X to +39X

7. REFERENCE DEV MRB Thumbwheels

G/A X Mode - Adjusts the deviation between the pairs of pulses that make up the Main Reference Burst. Adjustment is from -3.9 μs to +3.9 μs from the nominal value.

NOMINAL SETTING - "+0.0" Position

ITEM	NAME	DESCRIPTION

G/A Y Mode,
A/A X Mode,
A/A Y Mode - Adjusts the deviation between the single pulses that make up the Main Reference Burst. Adjustment is from -3.9 µS to +3.9 µS from the nominal value.

8. 135 Hz MOD Connector

A sample of the 135 Hz modulation signal is output at this connector. The level is adjusted from 0 V p-p to 3.0 V p-p as the 135 Hz % MODULATION Thumbwheels are set from 00% to 39%.

9. MRB SYNC Connector

A negative going oscilloscope sync pulse whose leading edge occurs immediately prior to the first pulse of the Main Reference Burst is output at this connector.

10. 135 HZ SYNC Connector

A negative going oscilloscope sync pulse whose leading edge occurs at the positive going zero crossing of the 135 Hz eight cycle of the modulation signal following the first pulse of the MRB is output at this connector.

13. 15 HZ SYNC Connector

A negative going oscilloscope sync pulse whose leading edge occurs at the positive going zero crossing of the 15 Hz modulation signal is output at this connector.

14. ARB SYNC Connector

A negative going oscilloscope sync pulse whose leading edge occurs immediately prior to the first pulse of the Auxiliary Reference Burst is output at this connector.

ITEM	NAME	DESCRIPTION

15. 15 HZ MOD Connector

A sample of the 15 Hz modulation signal is output at this connector. The level is adjusted from 0 V p-p to 3.0 V p-p as the 15 HZ % MODULATION Thumbwheels are set from 00% to 39%.

16. REFERENCE DEV ARB Thumbwheels

G/A X Mode - Adjusts the deviation between the pairs of pulses that make up the Auxiliary Reference Burst. Adjustment is from -3.9 µS to +3.9 µS from the nominal value.

G/A Y Mode - Adjusts the deviation between the single pulses that make up the Auxiliary Reference Burst. Adjustment is from -3.9 µS to +3.9 µS from the nominal value.

NOMINAL SETTING: "+0.0" Position

17. LOAD RATE Pushbutton

Programs a bearing rate from -39.0 degrees per second to +39.0 degrees per second as selected on the BEARING/RATE Thumbwheels (6).

18. CLEAR RATE Pushbutton

Clears the previously loaded bearing rate information to 00.0 degrees per second.

19. CLEAR BRG Pushbutton

Clears the previously loaded bearing information to 000.0 degrees.

20. LOAD BRG Pushbutton

Programs a bearing from 000.0 degrees to +359.9 degrees as selected on the BEARING/RATE Thumbwheels (6).

22. 15/135 Ø SHIFT Thumbwheels

Programs the phase shift between the 15 Hz and 135 Hz modulating signals from -39 degrees to +39 degrees in 1 degree steps.

ITEM	NAME	DESCRIPTION

NOMINAL SETTING - "00" Position

23. 15 Hz % MODULATION Thumbwheels

Programs the percent modulation of the 15 Hz component of TACAN modulation between 0% and 39% in 1% steps.

NOMINAL SETTING: "20%" Position

24. POWER Switch

Applies external AC power to the T-1401 and to the ATC-1400A when it is connected to the AC OUT (33) convenience outlet on the rear of the T-1401.

28. COMP MOD Connector

15/135 Hz Composite modulation output from the T-1401 to the ATC-1400A.

29. EXT F Connector

Input for external frequency source for the TACAN signal timing reference.

NOTE: Input is enabled through the IFR BUS.

30. AUXILIARY Connector

Connects the T-1401 to the ATC-1400A to provide discrete signal interconnect.

32. F2 Fuse

Fuses the power to the AC OUT connector. Refer to Paragraph 1-2-1c for appropriate rating.

33. AC OUT Connector

Convenience outlet normally used to power the ATC-1400A.

ITEM	NAME	DESCRIPTION

34. AC IN Connector

Power receptacle for applying either 115 VAC or 230 VAC single phase power to the T-1401. LINE SELECT Switch (35) must be set to the correct position before applying power.

35. LINE SELECT Switch

Selects the line voltage that will be applied to the T-1401.

36. F1 Fuse

Fuses the power to the T-1401 and the AC OUT Connector. Refer to Paragraph 1-2-1C for appropriate rating.

37. IFR BUS Connector

Connects the T-1401 to the ATC-1400A so that information may be exchanged between the two units.

41. MISSING ARB Switch

Deletes the first Auxiliary Reference Burst following the Main Reference Burst when set to the ON position.

NOMINAL SETTING - "OFF" Position

43. ARB LENGTH Switch

Controls the number of pulse pairs in G/A X mode or single pulses in G/A Y mode in the Auxiliary Reference Burst. One or two pulse pairs (single pulses) may be added or subtracted from the nominal value.

NOMINAL SETTING - "NOM" Position

ITEM	NAME	DESCRIPTION

45. MRB LENGTH Switch

Controls the number of pulse pairs in G/A X mode or single pulses in G/A Y mode, A/A X mode, and A/A Y mode in the Main Reference Burst. One or two pulse pairs (single pulses) may be added or subtracted from the nominal value.

NOMINAL SETTING - "NOM" Position

(2) ATC-1400A Description of Controls, Connectors and Indicators Used in G/A Test Function

24. DME DEV P_2/CAL Switch (DME)

"CAL" Position - P_2 pulse remains in nominal position. DME DEV P_2/CAL Thumbwheels (47) have no effect on deviating P_2 pulses.

NOMINAL SETTING - "CAL" Position

32. PRF/SQTR ON/OFF Switch

Two position toggle switch which when placed in OFF position, will inhibit squitter.

NOMINAL SETTING - "ON" Position

35. LINE Switch

Applies external AC Power to ATC-1400A Test Set.

36. IDENT TONE/OFF/CODE Switch (DME)

"CODE" Position - Modulates 1350 Hz tone with Morse code "IFR". Repeated every 30 seconds.

NOMINAL SETTING - "CODE" Position

37. TACAN ON/OFF Switch (DME)

"ON" Position - Simulates a TACAN ground station. Enables TACAN signals from the T-1401.

NOMINAL SETTING - "ON" Position

ITEM NAME DESCRIPTION

39. DME REPLY EFFICIENCY Control (DME)

Range replies are produced only in response to a valid interrogation (i.e., P_1 to P_2 spacing is 12 µS for G/A X Mode and 36 µS for G/A Y Mode). Selection of any position of this control selects ATC-1400A reply efficiency rate (i.e., "50" position equals 50% reply rate and "100" position equals 100% reply rate).

NOMINAL SETTING: "70%" Position

41. PRF/SQTR Thumbwheels

DME Function - Select the mean squitter rate in Hz. ATC-1400A Squitter is defined as nominal level pulse pairs of random spacing generated at a mean squitter rate, as selected by thumbwheel setting.

NOMINAL SETTING: "2700 Hz" Position

45. FREQ/FUNCTION SELECT Thumbwheels

Select function of operation and frequency of test set. Numbers in MHz relate to function viewed in the window. Function and frequency is listed as follows:

WINDOW DISPLAY	OPERATION FUNCTION	RANGE	THUMBWHEEL RANGE
XPDR	TRANSPONDER	962 MHz-1213 MHz	0962-1213
TAC Y	DME-Y Ch	Channel 1-Channel 126	0001-0126
TAC X	DME-X Ch	Channel 1-Channel 126	0001-0126
5 VOR PAIR	DME-Y Ch	108.05 MHz-117.95 MHz	1080-1179
0 VOR PAIR	DME-X Ch	108.00 MHz-117.90 MHz	1080-1179
MHz Y	DME-Y Ch	962 MHz-1213 MHz	0962-1213
MHz X	DME-X Ch	962 MHz-1213 MHz	0962-1213

NOTE: Selection of XPDR function disables the TACAN Test Auxiliary and "OFF" is displayed in the T-1401 BEARING Display (4).

ITEM	NAME	DESCRIPTION

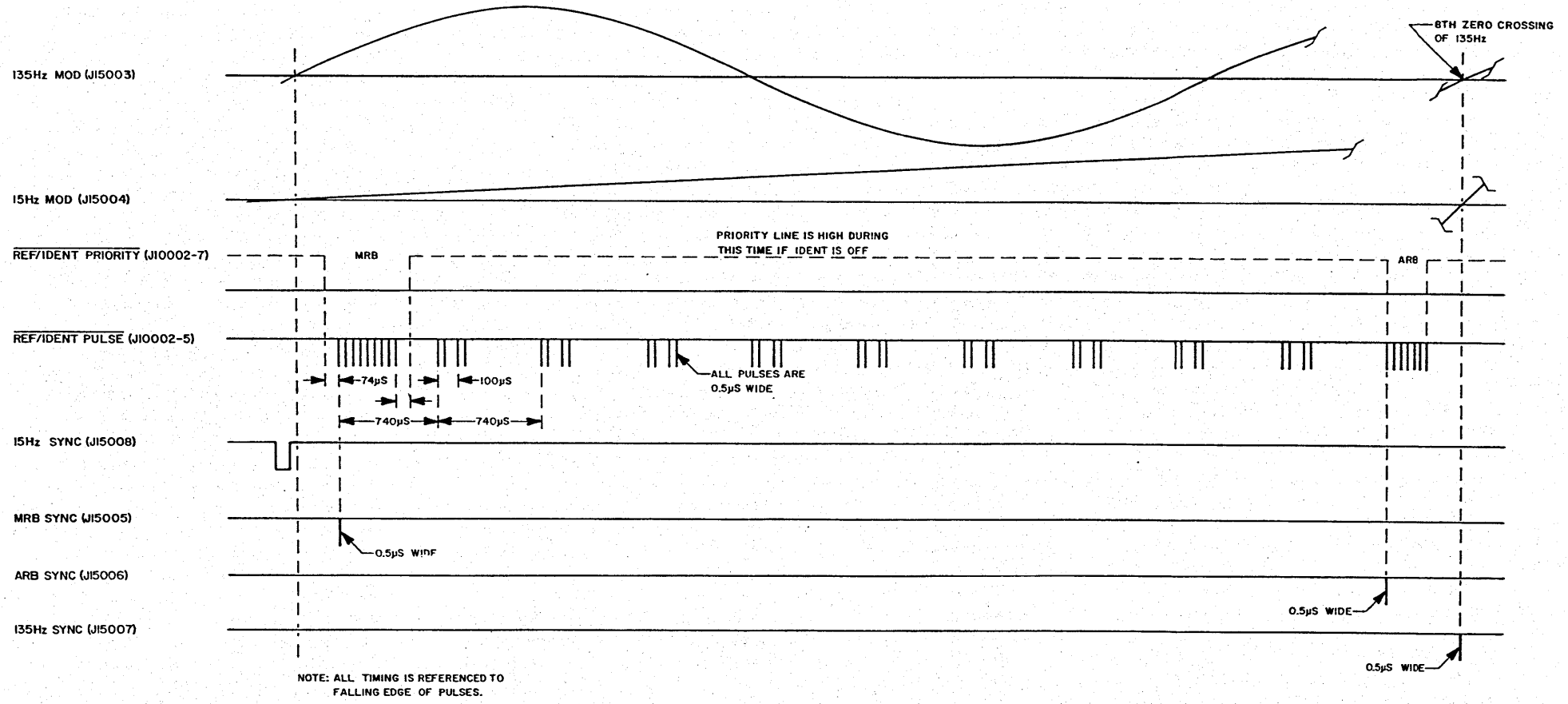
47. DME P_2 DEV Thumbwheels (DME)

Position of the P_2 pulse can be deviated from nominal position by value selected on thumbwheel switches in microseconds.

NOTE: Controls P_2 pulse deviation for the reference burst, as well as squitter and range replies.

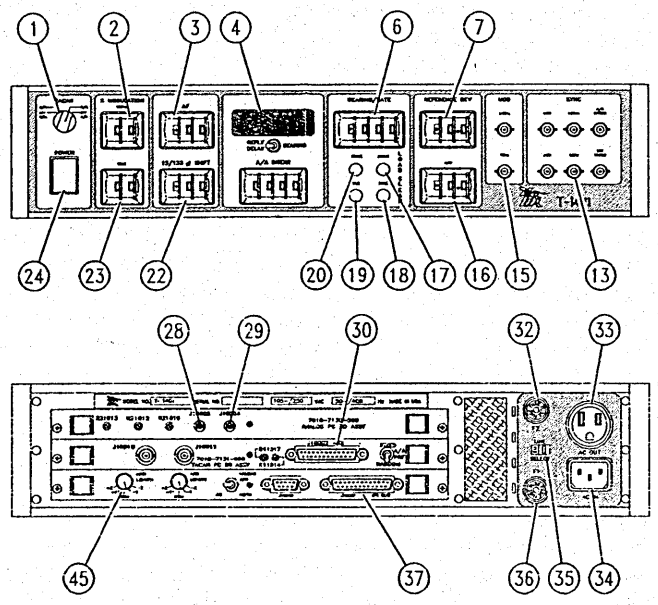
48. ΔF Thumbwheels

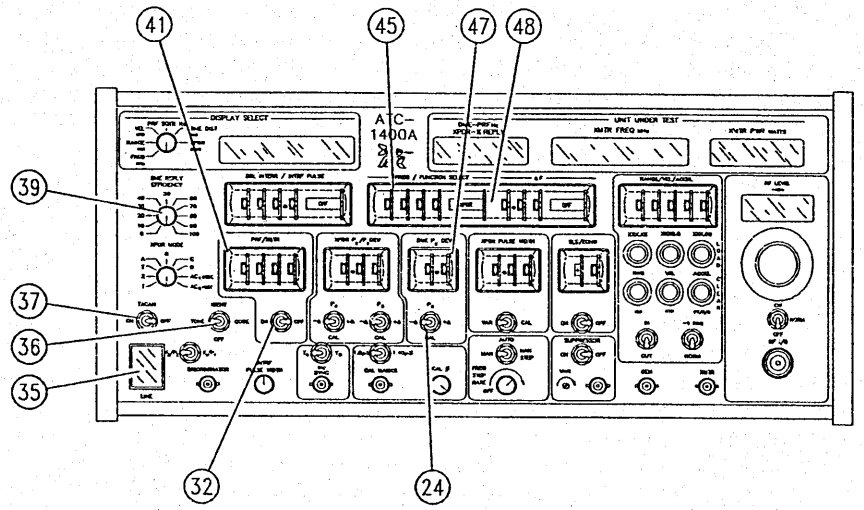
Deviates generator frequency from -9.99 MHz to +9.99 MHz. Frequency range is increased from 952.01 MHz to 1222.99 MHz. The ΔF switch has no effect on X or Y channel selection or 2 out of 5 code output at the INTERROGATOR Connector J8 (66).



Ground-To-Air Test Function
Timing Chart
Figure 3

B. Inverse Ground-To-Air (G/A) Test Function





(1) TACAN CONTROL
(2) 135 Hz %MODULATION Thumbwheels
(3) ΔF Thumbwheels
(4) BEARING/REPLY DELAY Display
(6) BEARING/RATE Thumbwheels
(7) REFERENCE DEV MRB Thumbwheels
(13) 15 Hz SYNC Connector (J15008)
(15) 15 Hz MOD Connector (J15004)
(16) REFERENCE DEV ARB Thumbwheels
(17) LOAD RATE Pushbutton
(18) CLEAR RATE Pushbutton
(19) CLEAR BRG Pushbutton
(20) LOAD BRG Pushbutton
(22) 15/135 Ø SHIFT Thumbwheels
(23) 15 Hz % MODULATION Thumbwheels
(24) POWER Switch
(28) COMP MOD Connector (J10003)
(29) EXT Connector (J1004)
(30) AUX Connector (J10002)
(32) F2 Fuse
(33) AC OUT Connector
(34) AC IN Connector
(35) LINE SELECT Switch
(36) F1 Fuse
(37) IFR BUS Connector
(45) MRB LENGTH Switch

(24) DME DEV P2/CAL Switch
(32) PRF/SQTR ON/OFF Switch
(35) LINE Switch
(37) TACAN ON/OFF Switch
(39) DME REPLY EFFICIENCY Control
(41) PRF/SQTR Thumbwheels
(45) FREQ/FUNCTION SELECT Thumbwheels
(47) DME P2 DEV Thumbwheels
(48) ΔF Thumbwheels

T-1401 and ATC-1400A Front and Rear Panel Controls, Connectors and Indicators used in Inverse G/A Test Operation

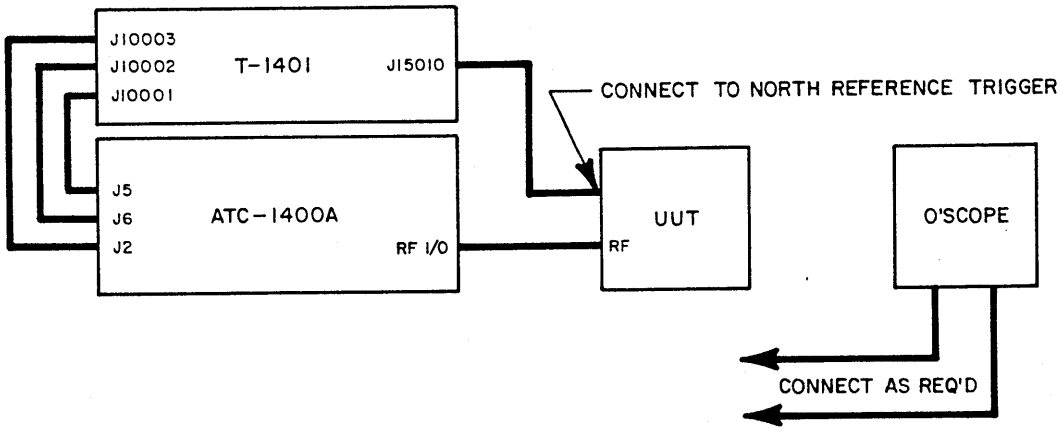
Figure 4

(1) T-1401 Description Of Controls, Connectors, and Indicators Used In Inverse G/A Test Function

A complete description of the T-1401 Test Auxiliary Controls, Connectors and Indicators, used in conjunction with the ATC-1400A, while performing the INVERSE G/A Test Function is described in this paragraph.

A complete description of the ATC-1400A Controls, Connectors and Indicators, used in conjunction with the T-1401, while performing the INVERSE G/A Test Function is described in Paragraph 2-4-B(2).

In the Inverse G/A Test Mode, the Airborne TACAN Beacon is equipped with a rotating antenna to provide both bearing and distance information. The DME reply information (Squitter, Ident. and Range Replies) is modulated with a 15 Hz Envelope. An inverse SYNC Signal is a 15 Hz envelope. An inverse SYNC signal is generated coincident with the negative going zero crossing of the 15 Hz modulated signal to simulate the antenna at zero degrees bearing. ARB and MRB pulses are inhibited.



INVERSE G/A Test Function Hook-up Diagram
Figure 5

ITEM NAME DESCRIPTION

1. TACAN Control

INV G/A Position - Sets the T-1401 to the INVERSE GROUND-TO-AIR Mode of Operation.

NOMINAL SETTING - "INV G/A" Position

2. 135 Hz % Modulation Thumbwheels

Programs the percent modulation of the 135 Hz component of the TACAN modulation between 0% and 39% in 1% steps.

NOMINAL SETTING - "00%" Position

3. DELTA F Thumbwheels

Adjusts the TACAN timing reference oscillator from -3.9% to +3.9% of nominal value in 0.1% steps.

NOMINAL SETTING - "0.0" Position

4. BEARING/REPLY DELAY Display

Normally displays the currently simulated bearing or reply delay output. If the T-1401 detects an error condition or the operator has selected an incompatible parameter value, an appropriate message will be displayed in place of the current value until the problem is resolved. Refer to Section 1-2-6 for an explanation of the error messages.

6. BEARING/RATE Thumbwheels

Desired value of bearing and bearing rate is set in degrees for bearing and degrees per second for bearing rate.

SELECTION	RANGE	THUMBWHEEL SETTING
Bearing	000.0 to 359.9	0000 to 3599
Bearing Rate	-39.0 to +39.0	-39X to +39X

ITEM	NAME	DESCRIPTION

7. REFERENCE DEV MRB Thumbwheels

G/A X Mode - Adjusts the deviation between the pairs of pulses that make up the Main Reference Burst. Adjustment is from -3.9 µS to +3.9 µS from the nominal value.

NOMINAL SETTING: "•0.0" (OFF) Position (Disables MRB)

G/A Y Mode,
A/A X Mode,
A/A Y Mode - Adjusts the deviation between the single pulses that make up the Main Reference Burst. Adjustment is from -3.9 µS to +3.9 µS from the nominal value.

13. 15 HZ SYNC Connector

A negative going oscilloscope sync pulse whose leading edge occurs at the positive going zero crossing of the 15 Hz modulation signal is output at this connector.

15. 15 HZ MOD Connector

A sample of the 15 Hz modulation signal is output at this connector. The level is adjusted from 0 V p-p to 3.0 V p-p as the 15 HZ % MODULATION Thumbwheels are set from 00% to 39%.

16. REFERENCE DEV ARB Thumbwheels

G/A X Mode - Adjusts the deviation between the pairs of pulses that make up the Auxiliary Reference Burst. Adjustment is from -3.9 µS to +3.9 µS from the nominal value.

G/A Y Mode - Adjusts the deviation between the single pulses that make up the Auxiliary Reference Burst. Adjustment is from -3.9 µS to +3.9 µS from the nominal value.

NOMINAL SETTING: "•0.0" (OFF) Position (Disables ARB)

ITEM	NAME	DESCRIPTION

17. LOAD RATE Pushbutton

Programs a bearing rate from -39.0 degrees per second to +39.0 degrees per second as selected on the BEARING/RATE Thumbwheels (6).

18. CLEAR RATE Pushbutton

Clears the previously loaded bearing rate information to 00.0 degrees per second.

19. CLEAR BRG Pushbutton

Clears the previously loaded bearing information to 000.0 degrees.

20. LOAD BRG Pushbutton

Programs a bearing from 000.0 degrees to +359.9 degrees as selected on the BEARING/RATE Thumbwheels (6).

22. 15/135 Ø SHIFT Thumbwheels

Programs the phase shift between the 15 Hz and 135 Hz modulating signals from -39 degrees to +39 degrees in 1 degree steps.

NOMINAL SETTING: "00" Position

23. 15 HZ % MODULATION Thumbwheels

Programs the percent modulation of the 15 Hz component of TACAN modulation between 0% and 39% in 1% steps.

NOMINAL SETTING: "20%" Position

24. POWER Switch

Applies external AC power to the T-1401 and to the ATC-1400A when it is connected to the AC OUT (33) convenience outlet on the rear of the T-1401.

28. COMP MOD Connector

15/135 Hz Composite modulation output from the T-1401 to the ATC-1400A.

ITEM	NAME	DESCRIPTION

29. EXT F Connector

Input for external frequency source for the TACAN signal timing reference.

NOTE: Input is enabled through the IFR BUS.

30. AUXILIARY Connector

Connects the T-1401 to the ATC-1400A to provide discrete signal interconnect.

32. F2 Fuse

Fuses the power to the AC OUT connector. Refer to Paragraph 1-2-1C for appropriate rating.

33. AC OUT Connector

Convenience outlet normally used to power the ATC-1400A.

34. AC IN Connector

Power receptacle for applying either 115 VAC or 230 VAC single phase power to the T-1401. LINE SELECT Switch (35) must be set to the correct position before applying power.

35. LINE SELECT Switch

Selects the line voltage that will be applied to the T-1401.

36. F1 Fuse

Fuses the power to the T-1401 and the AC OUT Connector. Refer to Paragraph 1-2-1C for appropriate rating.

ITEM	NAME	DESCRIPTION

37. IFR BUS Connector

Connects the T-1401 to the ATC-1400A so that information may be exchanged between the two units.

45. MRB LENGTH Switch

Controls the number of pulse pairs in G/A X mode or single pulses in G/A Y mode, A/A X mode and A/A Y mode in the Main Reference Burst. One or two pulse pairs (single pulses) may be added or subtracted from the nominal value.

NOMINAL SETTING - "NOM" Position

(2) ATC-1400A Description of Controls, Connectors and Indicators Used in INVERSE G/A Test Function

ITEM	NAME	DESCRIPTION

24. DME DEV P_2/CAL Switch (DME)

"CAL" Position - P_2 pulse remains in nominal position. DME DEV P_2/CAL Thumbwheels (47), have no effect on deviating P_2 pulses.

NOMINAL SETTING: "CAL" Position

32. PRF/SQTR ON/OFF Switch

Two position toggle switch which when placed in OFF position, will inhibit squitter.

NOMINAL SETTING: "ON" Position

35. LINE Switch

Applies external AC Power to ATC-1400A Test Set.

36. IDENT TONE/OFF/CODE Switch (DME)

"OFF Position - Inhibits both continuous and code tones.

NOMINAL SETTING: "OFF" Position

37. TACAN ON/OFF Switch (DME)

"ON" Position - Simulates a TACAN ground station. Enables TACAN signals from T-1401.

NOMINAL SETTING: "ON" Position

39. DME REPLY EFFICIENCY Control (DME)

Range replies are produced only in response to a valid interrogation (i.e., P_1 to P_2 spacing is 12 µS for G/A X Mode and 36 µS for G/A Y Mode). Selection of any position of this control selects ATC-1400A reply efficiency rate (i.e., "50" position equals 50% reply rate and "100" position equals 100% reply rate).

NOMINAL SETTING: "70%" Position

ITEM NAME DESCRIPTION

41. PRF/SQTR Thumbwheels

DME Function - Select the mean squitter rate in Hz. ATC-1400A Squitter is defined as nominal level pulse pairs of random spacing generated at a mean squitter rate, as selected by thumbwheel setting.

NOMINAL SETTING: "2700 Hz" Position

45. FREQ/FUNCTION SELECT Thumbwheels

Select function of operation and frequency of test set. Numbers in MHz relate to function viewed in the window. Function and frequency is listed as follows:

WINDOW DISPLAY	OPERATION FUNCTION	RANGE	THUMBWHEEL RANGE
XPDR	TRANSPONDER	962 MHz-1213 MHz	0962-1213
TAC Y	DME-Y Ch	Channel 1-Channel 126	0001-0126
TAC X	DME-X Ch	Channel 1-Channel 126	0001-0126
5 VOR PAIR	DME-Y Ch	108.05 MHz-117.95 MHz	1080-1179
0 VOR PAIR	DME-X Ch	108.00 MHz-117.90 MHz	1080-1179
MHz Y	DME-Y Ch	962 MHz-1213 MHz	0962-1213
MHz X	DME-X Ch	962 MHz-1213 MHz	0962-1213

NOTE: Selection of XPDR function disables the TACAN Test Auxiliary and "OFF" is displayed in the T-1401 BEARING Display (4).

47. DME P_2 DEV Thumbwheels (DME)

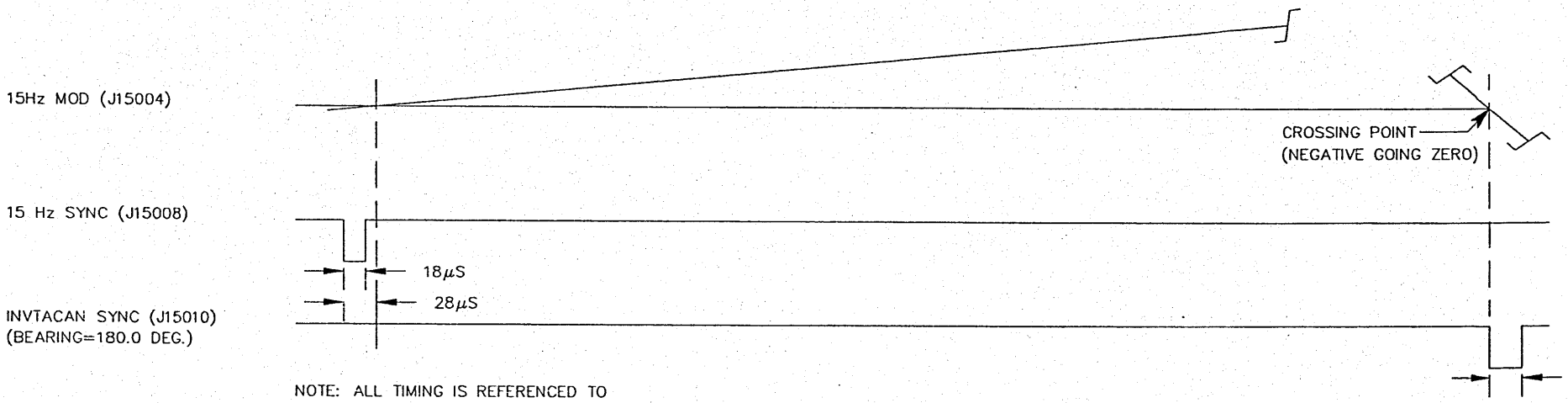
Position of the P_2 pulse can be deviated from nominal position by value selected on thumbwheel switches in microseconds.

NOMINAL SETTING: "+0.0" Position

ITEM	NAME	DESCRIPTION

48. ΔF Thumbwheels

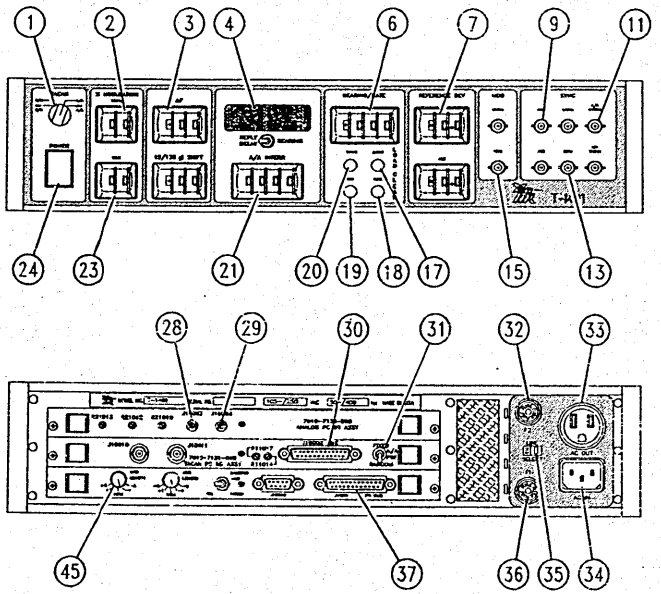
Deviates generator frequency from -9.99 MHz to +9.99 MHz. Frequency range is increased from 952.01 MHz to 1222.99 MHz. The ΔF switch has no effect on X or Y channel selection or 2 out of 5 code output at the INTERROGATOR Connector J8 (67).

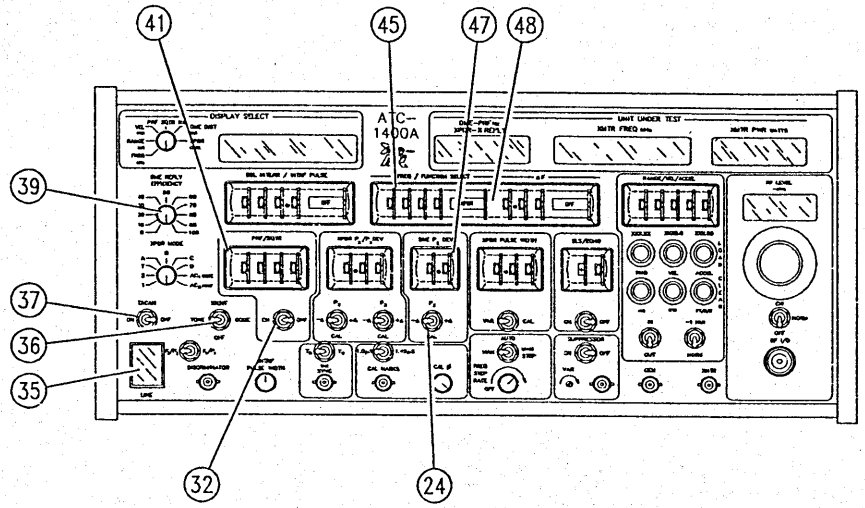


NOTE: ALL TIMING IS REFERENCED TO FALLING EDGE OF PULSES.

INVERSE G/A Test Function
Timing Chart
Figure 6

C. Air-to-Air (A/A) Test Function





(1) TACAN CONTROL
(3) ΔF Thumbwheels
(4) BEARING/REPLY DELAY Display
(6) BEARING/RATE Thumbwheels
(7) REFERENCE DEV MRB Thumbwheels
(9) MRB SYNC Connector (J15005)
(11) A/A INTERR SYNC Connector (J15009)
(13) 15 Hz SYNC Connector (J15008)
(15) 15 Hz MOD Connector (J15004)
(17) LOAD RATE Pushbutton
(18) CLEAR RATE Pushbutton
(19) CLEAR BRG Pushbutton
(20) LOAD BRG Pushbutton
(21) A/A INTERR Thumbwheels
(23) 15 Hz % MODULATION Thumbwheels
(24) POWER Switch
(28) COMP MOD Connector (J10003)
(29) EXT Connector (J10004)
(30) AUX Connector (J10002)
(31) A/A RATE SELECT Switch
(32) F2 Fuse
(33) AC OUT Connector
(34) AC IN Connector
(35) LINE SELECT Switch
(36) F1 Fuse
(37) IFR BUS Connector
(45) MRB LENGTH Switch

(24) DME DEV P2/CAL Switch
(32) PRF/SQTR ON/OFF Switch
(35) LINE Switch
(37) TACAN ON/OFF Switch
(39) DME REPLY EFFICIENCY Control
(41) PRF/SQTR Thumbwheels
(45) FREQ/FUNCTION SELECT Thumbwheels
(47) DME P2 DEV Thumbwheels
(48) ΔF Thumbwheels

T-1401 and ATC-1400A Front and Rear Panel Controls, Connectors and Indicators used in A/A Test Operation

Figure 7

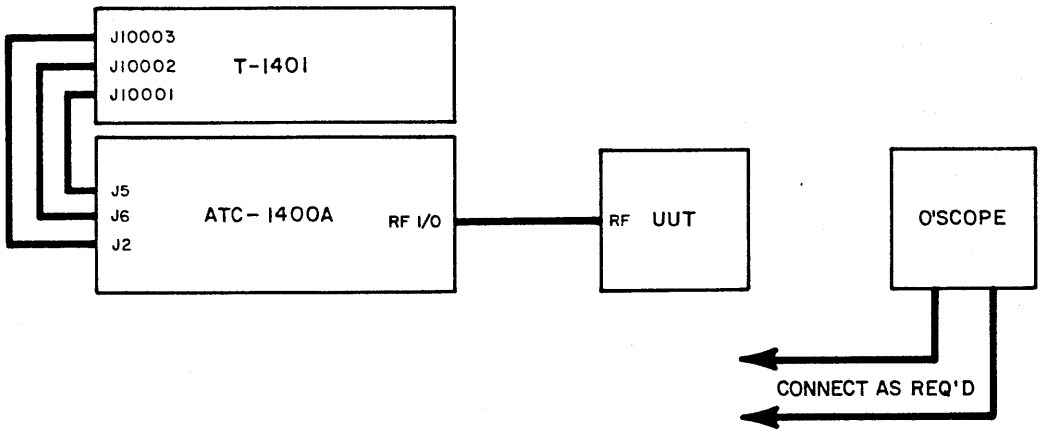
(1) T-1401 Description Of Controls, Connectors, and Indicators Used In A/A Test Function

A complete description of the T-1401 Test Auxiliary Controls, Connectors and Indicators, used in conjunction with the ATC-1400A, while performing the A/A Test Function is described in this paragraph.

A complete description of the ATC-1400A Controls, Connectors and Indicators, used in conjunction with the T-1401, while performing the A/A Test Function is described in Paragraph 2-4-B(2).

In the A/A Test Mode, the bearing information consists only of 15 Hz modulation and Main Reference Bursts (MRB). The MRB consists of 10 signal pulses spaced at 30 µS apart in both X and Y Modes. Range replies and squitter are single pulses. The test set generates signal pulse squitter and single pulse range replies. The test set also generates pulse interrogations and decodes the UUT range replies after a nominal delay of 62 µS in X Channel and 74 µS in Y Channel.

NOTE: Beacon A/A Mode can effectively be selected by turning OFF the MRBs, ARBs, 15 Hz Modulation and 135 Hz Modulation.



A/A Test Function Hook-up Diagram
Figure 8

ITEM NAME DESCRIPTION

1. TACAN Control

A/A Position - Sets the T-1401 to the AIR-TO-AIR Mode of Operation.

NOTE: When in the AIR-TO-AIR Mode of operation, the 135 Hz % MODULATION Thumbwheels (2), and REFERENCE DEV ARB Thumbwheels (16), ATC-1400A IDENT TONE/OFF/CODE Switch (36) and EQUALIZER/OFF Switch (64) are disabled.

NOMINAL SETTING - "A/A" Position

3. DELTA F Thumbwheels

Adjusts the TACAN timing reference oscillator from -3.9% to +3.9% of nominal value in 0.1% steps.

NOMINAL SETTING - "+0.0" Position

4. BEARING/REPLY DELAY Display

Normally displays the currently simulated bearing or reply delay output. If the T-1401 detects an error condition or the operator has selected an incompatible parameter value, an appropriate message will be displayed in place of the current value until the problem is resolved. Refer to Section 1-2-6 for an explanation of the error messages.

5. A/A REPLY Annunciator

Annunciates the reception of valid A/A replies from the UUT.

6. BEARING/RATE Thumbwheels

Desired value of bearing and bearing rate is set in degrees for bearing and degrees per second for bearing rate.

SELECTION	RANGE	THUMBWHEEL SETTING
Bearing	000.0 to 359.9	0000 to 3599
Bearing Rate	-39.0 to +39.0	-39X to +39X

ITEM	NAME	DESCRIPTION

7. REFERENCE DEV MRB Thumbwheels

G/A X Mode - Adjusts the deviation between the pairs of pulses that make up the Main Reference Burst. Adjustment is from -3.9 µS to +3.9 µS from the nominal value.

G/A Y Mode,
A/A X Mode,
A/A Y Mode - Adjusts the deviation between the single pulses that make up the Main Reference Burst. Adjustment is from -3.9 µS to +3.9 µS from the nominal value.

NOMINAL SETTING: "•0.0" (OFF) Position (Disables MRB)

9. MRB SYNC Connector

A negative going oscilloscope sync pulse whose leading edge occurs immediately prior to the first pulse of the Main Reference Burst is output at this connector.

11. A/A INTERR SYNC Connector

A negative going oscilloscope sync pulse whose leading edge occurs immediately prior to the first pulse of an A/A Interrogation pulse pair is output at this connector.

13. 15 HZ SYNC Connector

A negative going oscilloscope sync pulse whose leading edge occurs at the positive going zero crossing of the 15 Hz modulation signal is output at this connector.

15. 15 HZ MOD Connector

A sample of the 15 Hz modulation signal is output at this connector. The level is adjusted from 0 V p-p to 3.0 V p-p as the 15 Hz % MODULATION Thumbwheels are set from 00% to 39%.

ITEM	NAME	DESCRIPTION

17. LOAD RATE Pushbutton

Programs a bearing rate from -39.0 degrees per second to +39.0 degrees per second as selected on the BEARING/RATE Thumbwheels (6).

18. CLEAR RATE Pushbutton

Clears the previously loaded bearing rate information to 00.0 degrees per second.

19. CLEAR BRG Pushbutton

Clears the previously loaded bearing information to 000.0 degrees.

20. LOAD BRG Pushbutton

Programs a bearing from 000.0 degrees to +359.9 degrees as selected on the BEARING/RATE Thumbwheels (6).

21. A/A INTERR Thumbwheels

Programs an A/A interrogation rate from 0000 interrogations per second to 3999 interrogations per second in 1 interrogation per second steps when in the A/A mode.

NOMINAL SETTING: "0030" Position

23. 15 HZ % MODULATION Thumbwheels

Programs the percent modulation of the 15 Hz component of TACAN modulation between 0% and 39% in 1% steps.

NOMINAL SETTING: "20%" Position

24. POWER Switch

Applies external AC power to the T-1401 and to the ATC-1400A when it is connected to the AC OUT (33) convenience outlet on the rear of the T-1401.

ITEM	NAME	DESCRIPTION

28. COMP MOD Connector

    15/135 Hz Composite modulation output from the T-1401 to the ATC-1400A.

29. IFR BUS Connector

    Connect the T-1401 to the ATC-1400A so that information may be exchanged between the two units.

30. AUXILIARY Connector

    Connects the T-1401 to the ATC-1400A to provide discrete signal interconnect.

31. A/A RATE SELECT Switch

    Selects between Random and Fixed Rate interrogations. This selection is not GPIB controlled.

32. F2 FUSE

    Fuses power to the AC OUT connector. Refer to Paragraph 1-2-1C for appropriate rating.

33. AC OUT Connector

    Convenience outlet normally used to power the ATC-1400A.

34. AC IN Connector

    Power receptacle for applying either 115 VAC or 230 VAC single phase power to the T-1401. LINE SELECT Switch (32) must be set to the correct position before appying power.

35. LINE SELECT Switch

    Selects the line voltage that will be applied to the T-1401.

ITEM NAME DESCRIPTION

36. F1 Fuse

Fuses the power to the T-1401 and the AC OUT Connector. Refer to Paragraph 1-2-1C for appropriate rating.

37. IFR BUS Connector

Connect the T-1401 to the ATC-1400A so that information may be exhanged between the two units.

45. MRB LENGTH Switch

Controls the number of pulse pairs in G/A X mode or single pulses in G/A Y mode, A/A X mode, A/A Y mode in the Main Reference Burst. One or two pulse pairs (Single pulses) may be added or subtracted from the nominal value.

(2) ATC-1400A Description of Controls, Connectors and Indicators Used in A/A Test Function

24. DME DEV P2/CAL Switch (DME)

"CAL" Position - P_2 pulse remains in nominal position. DME DEV P_2/CAL Thumbwheels (47) have no effect on deviating P_2 pulses.

NOMINAL SETTING - "CAL" Position

32. PRF/SQTR ON/OFF Switch

Two position switch which, placed in OFF position, will inhibit squitter in DME mode and interrogations in transponder mode.

35. LINE Switch

Applies external AC Power to ATC-1400A Test Set.

ITEM	NAME	DESCRIPTION

37. TACAN ON/OFF Switch (DME)

"ON" Position - Simulates a TACAN ground station. The bearing is fixed at 180°. A 15 Hz sync is provided for observing the TACAN modulation at the SYNC Connector (29).

NOMINAL SETTING: "ON" Position

39. DME REPLY EFFICIENCY Control (DME)

Range replies are produced only in response to a valid interrogation (i.e., P_1 to P_2 spacing is 12 µS for A/A X Mode and 36 µS for A/A Y Mode. Selection of any position of this control selects ATC-1400A reply efficiency rate (i.e., "50" position equals 50% reply rate and "100" position equals 100% reply rate).

NOMINAL SETTING: "70%" Position

41. PRF/SQTR Thumbwheels

DME Function - Select the mean squitter rate in Hz. ATC-1400A Squitter is defined as nominal level pulse pairs of random spacing generated at a mean squitter rate, as selected by thumbwheel setting.

NOMINAL SETTING: "1300" Position

45. FREQ/FUNCTION SELECT Thumbwheels

Select function of operation and frequency of test set. Numbers in MHz relate to function viewed in the window. Function and frequency is listed as follows:

ITEM NAME DESCRIPTION

WINDOW DISPLAY	OPERATION FUNCTION	RANGE	THUMBWHEEL RANGE
XPDR	TRANSPONDER	962 MHz-1213 MHz	0962-1213
TAC Y	DME-Y Ch	Channel 1-Channel 126	0001-0126
TAC X	DME-X Ch	Channel 1-Channel 126	0001-0126
5 VOR PAIR	DME-Y Ch	108.05 MHz-117.95 MHz	1080-1179
0 VOR PAIR	DME-X Ch	108.00 MHz-117.90 MHz	1080-1179
MHz Y	DME-Y Ch	962 MHz-1213 MHz	0962-1213
MHz X	DME-X Ch	962 MHz-1213 MHz	0962-1213

NOTE: Selection of XPDR function disables the TACAN Test Auxiliary and "OFF" is displayed in the T-1401 BEARING Display (4).

NOTE: A/A RF Frequency pairs always use Y Mode pair.

EXAMPLE: Channel 0001X uses channel 0001Y frequency pair, but pulse spacing remains the same for X Channel.

47. DME P_2 DEV Thumbwheels (DME)

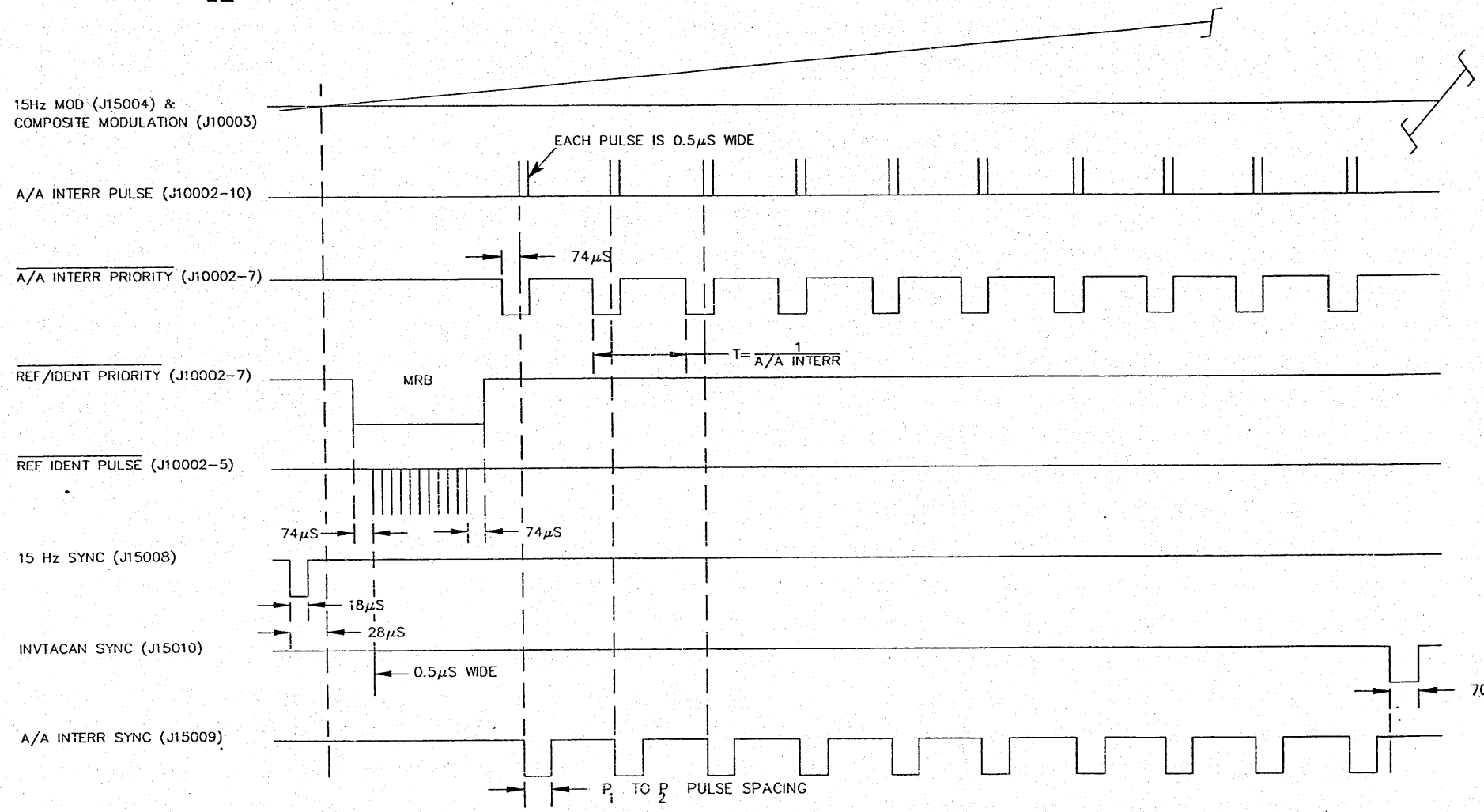
Position of the P_2 pulse can be deviated from nominal position by value selected on thumbwheel switches in microseconds.

NOTE: Controls the spacing for A/A Interrogation pulse pairs as well as MRB.

NOMINAL SETTING: "+0.0" Position

48. ΔF Thumbwheels

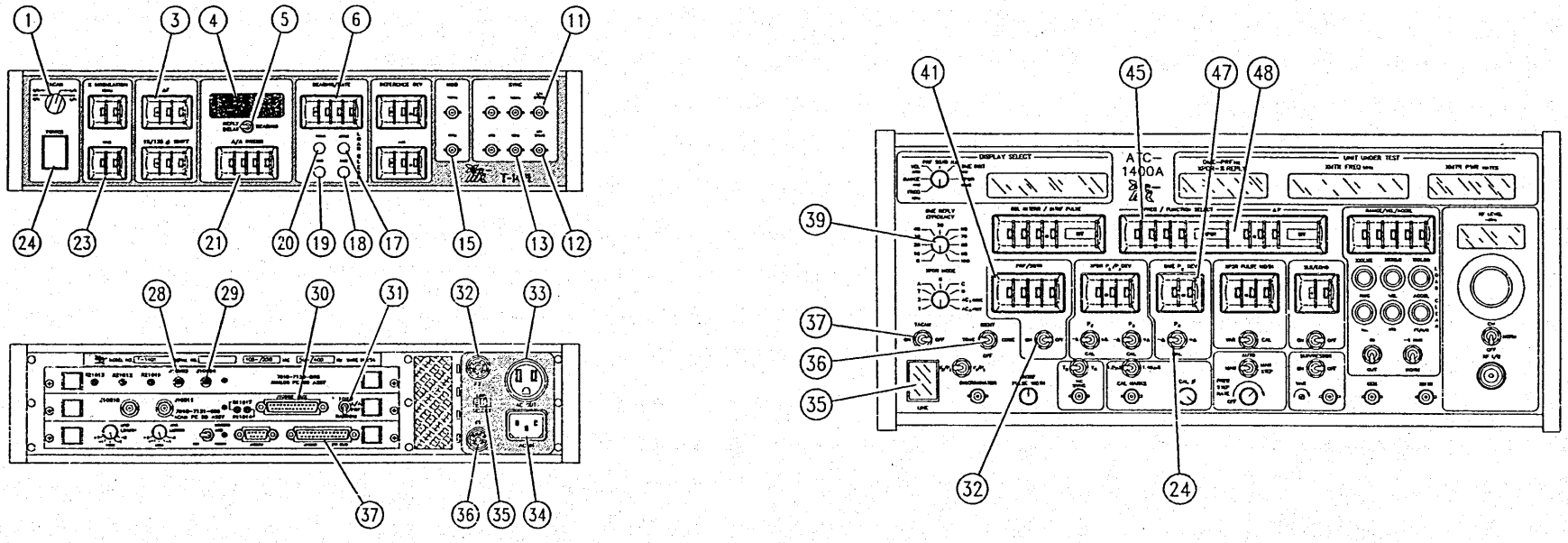
Deviates generator frequency from -9.99 MHz to +9.99 MHz. Frequency range is increased from 952.01 MHz to 1222.99 MHz. The ΔF Switch has no effect on X or Y channel selection or 2 out of 5 code output at the INTERROGATOR Connector J8 (67).



NOTE: ALL TIMING IS REFERENCED TO FALLING EDGE OF PULSES EXCEPT FOR A/A INTERR PULSE.

Air-to-Air Test Function
Timing Chart
Figure 9

D. Inverse Air-to-Air (A/A) Test Function



(1) TACAN CONTROL
(3) ΔF Thumbwheels
(4) BEARING/REPLY DELAY Display
(5) DISPLAY SELECT Switch
(6) BEARING/RATE Thumbwheels
(11) A/A INTERR SYNC Connector (J15009)
(12) INV TACAN SYNC Connector (J15010)
(13) 15 Hz SYNC Connector (J15008)
(15) 15 Hz MOD Connector (J15004)
(17) LOAD RATE Pushbutton
(18) CLEAR RATE Pushbutton
(19) CLEAR BRG Pushbutton
(20) LOAD BRG Pushbutton
(21) A/A INTERR Thumbwheels
(23) 15 Hz % MODULATION Thumbwheels
(24) POWER Switch
(28) COMP MOD Connector (J10003)
(29) EXT Connector (J10004)
(30) AUX Connector (J10002)
(31) A/A RATE SELECT Switch
(32) F2 Fuse
(33) AC OUT Connector
(34) AC IN Connector
(35) LINE SELECT Switch
(36) F1 Fuse
(37) IFR BUS Connector

(24) DME DEV P2/CAL Switch
(32) PRF/SQTR ON/OFF Switch
(35) LINE Switch
(37) TACAN ON/OFF Switch
(39) DME REPLY EFFICIENCY Control
(41) PRF/SQTR Thumbwheels
(45) FREQ/FUNCTION SELECT Thumbwheels
(47) DME P2 DEV Thumbwheels
(48) ΔF Thumbwheels

T-1401 and ATC-1400A Front and Rear Panel Controls, Connectors and Indicators used in Inverse A/A Test Operation

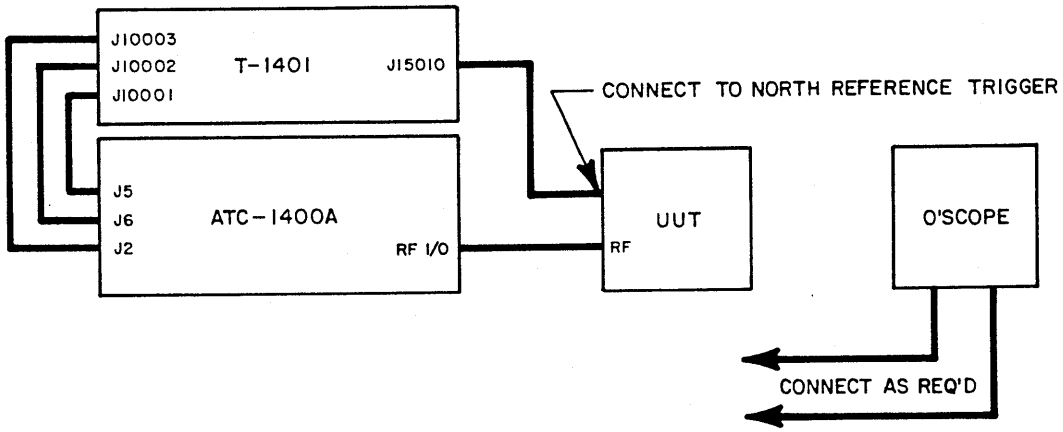
Figure 10

(1) T-1401 Description Of Controls, Connectors, and Indicators Used In INVERSE A/A Test Function

A complete description of the T-1401 Test Auxiliary Controls, Connectors and Indicators, used in conjunction with the ATC-1400A, while performing the INVERSE A/A Test Function is described in this paragraph.

A complete description of the ATC-1400A Controls, Connectors and Indicators, used in conjunction with the T-1401, while performing the INVERSE A/A Test Function is described in Paragraph 2-4-D(2).

In Inverse A/A Test Mode, the Airborne TACAN Beacon may determine the bearing to an airborne TACAN receiver/transmittter. In this case, a single pulse squitter generates timing between the negative going zero crossing of the 15 Hz modulated signal. An inverse SYNC Signal is generated coincident with the negative going zero crossing of the 15 Hz modulated signal to determine bearing to the ground station. ARB and MRB pulses are inhibited.



INVERSE A/A Test Function Hook-up Diagram
Figure 11

ITEM	NAME	DESCRIPTION

1. TACAN Control

INV A/A Position - Sets the T-1401 to the INVERSE A/A Mode of Operation.

NOMINAL SETTING: "INV A/A" Position

ITEM NAME DESCRIPTION

3. DELTA F Thumbwheels

Adjusts the TACAN timing reference oscillator from -3.9% to +3.9% of nominal value in 0.1% steps.

NOMINAL SETTING - "+0.0" Position

4. BEARING/REPLY DELAY Display

Normally displays the currently simulated bearing or reply delay output. If the T-1401 detects an error condition or the operator has selected an incompatible parameter value, an appropriate message will be displayed in place of the current bearing until the problem is resolved.

6. BEARING/RATE Thumbwheels

Desired value of bearing and bearing rate is set in degrees for bearing and degrees per second for bearing rate.

SELECTION	RANGE	THUMBWHEEL SETTING
Bearing	000.0 to 359.9	0000 to 3599
Bearing Rate	-39.0 to +39.0	-39X to +39X

11. A/A INTERR SYNC Connector

A negative going oscilloscope sync pulse whose leading edge occurs immediately prior to the first pulse of an A/A interrogation pulse pair is output at this connector.

12. INV TACAN SYNC Connector

A positive-going North Reference Trigger pulse is output at this connector. The 15 Hz bearing in INV Mode is determined by the time delay between the rising edge of this pulse to the negative-going zero crossing of the 15 Hz modulating signal. This sync pulse is output only when INV G/A or INV A/A Modes have been selected on TACAN Control (1).

13. 15 Hz SYNC Connector

A negative going oscilloscope sync pulse whose leading edge occurs at the positive going zero crossing of the 15 Hz modulation signal is output at this connector.

ITEM NAME DESCRIPTION

15. 15 HZ MOD Connector

A sample of the 15 Hz modulation signal is output at this connector. The level is adjusted from 0 V p-p to 2.5 V p-p as the 15 HZ % MODULATION Thumbwheels are set from 00% to 39%.

17. LOAD RATE Pushbutton

Programs a bearing rate from -39.0 degrees per second to +39.0 degrees per second as selected on the BEARING/RATE Thumbwheels (6).

18. CLEAR RATE Pushbutton

Clears the previously loaded bearing rate information to 00.0 degrees per second.

19. CLEAR BRG Pushbutton

Clears the previously loaded bearing information to 000.0 degrees.

20. LOAD BRG Pushbutton

Programs a bearing from 000.0 degrees to +359.9 degrees as selected on the BEARING/RATE Thumbwheels (6).

21. A/A INTERR Thumbwheels

Programs an A/A interrogation rate from 0000 interrogations per second to 3999 interrogations per second in 1 interrogation per second steps when in the A/A mode.

NOMINAL SETTING: "0030" Position

23. 15 HZ % MODULATION Thumbwheels

Programs the percent modulation of the 15 Hz component of TACAN modulation between 0% and 39% in 1% steps.

NOMINAL SETTING: "20%" Position

24. POWER Switch

Applies external AC power to the T-1401 and to the ATC-1400A when it is connected to the AC OUT (33) convenience outlet on the rear of the T-1401.

ITEM	NAME	DESCRIPTION

28. COMP MOD Connector

    15/135 Hz Composite modulation output from the T-1401 to the ATC-1400A.

29. EXT F Connector

    Input for external frequency source for the TACAN signal timing reference.

    NOTE: Input is enabled through the IFR BUS.

30. AUXILIARY Connector

    Connects the T-1401 to the ATC-1400A to provide discrete signal interconnect.

31. A/A RATE SELECT Switch

    Selects between Random and Fixed Rate interrogations. This selection is not GPIB controlled.

32. F2 Fuse

    Fuses the power to the AC OUT Connector. Refer to Paragraph 1-2-1C for appropriate rating.

33. AC OUT Connector

    Convenience outlet normally used to power the ATC-1400A.

34. AC IN Connector

    Power receptacle for applying either 115 VAC or 230 VAC signal phase power to the T-1401. LINE SELECT Switch (35) must be set to the correct position before applying power.

35. LINE SELECT Switch

    Selects the line voltage that will be applied to the T-1401.

36. F1 Fuse

    Fuses the power to the T-1401 and the AC OUT Connector. Refer to Paragraph 1-2-1C for appropriate rating.

ITEM	NAME	DESCRIPTION

37 IFR BUS Connector

Connects the T-1401 to the ATC-1400A so that information may be exchanged between the two units.

(2) ATC-1400A Description of Controls, Connectors and Indicators Used in INVERSE A/A Test Function

ITEM	NAME	DESCRIPTION

24. DME DEV P_2/CAL Switch (DME)

"CAL" Position - P_2 pulse remains in nominal position. DME DEV P_2/CAL Thumbwheels (47) have no effect on deviating P_2 Pulses.

NOMINAL SETTING: "CAL" Position

32. PRF/SQTR ON/OFF Switch

Two position toggle switch which when placed in OFF position, will inhibit squitter.

35. LINE Switch

Applies external AC Power to ATC-1400A Test Set.

37. TACAN ON/OFF Switch (DME)

"ON" Position - Simulates a TACAN ground station. Enables TACAN signals from T-1401.

NOMINAL SETTING: "ON" Position

39. DME REPLY EFFICIENCY Control (DME)

Range replies are produced only in response to a valid interrogation (i.e., P_1 to P_2 spacing is 12 µS for A/A X Mode and 36 µS for A/A Y Mode). Selection of any position of this control selects ATC-1400A reply efficiency rate and "100" position equals 100% reply rate).

NOMINAL SETTING: "70%" Position

ITEM NAME DESCRIPTION

41. PRF/SQTR Thumbwheels

DME Function - Select the mean squitter rate in Hz. ATC-1400A Squitter is defined as nominal level pulse pairs of random spacing generated at a mean squitter rate, as selected by thumbwheel setting.

NOMINAL SETTING: "2700" Position

45. FREQ/FUNCTION SELECT Thumbwheels

Select function of operation and frequency of test set. Numbers in MHz relate to function viewed in the window. Function and frequency is listed as follows:

WINDOW DISPLAY	OPERATION FUNCTION	RANGE	THUMBWHEEL RANGE
XPDR	TRANSPONDER	962 MHz-1213 MHz	0962-1213
TAC Y	DME-Y Ch	Channel 1-Channel 126	0001-0126
TAC X	DME-X Ch	Channel 1-Channel 126	0001-0126
5 VOR PAIR	DME-Y Ch	108.05 MHz-117.95 MHz	1080-1179
0 VOR PAIR	DME-X Ch	108.00 MHz-117.90 MHz	1080-1179
MHz Y	DME-Y Ch	962 MHz-1213 MHz	0962-1213
MHz X	DME-X Ch	962 MHz-1213 MHz	0962-1213

NOTE: Selection of XPDR function disables the TACAN Test Auxiliary and "OFF" is displayed in the T-1401 BEARING Display (4).

NOTE: A/A RF Frequency pairs always use Y Mode pair.

EXAMPLE: Channel 0001X uses channel 0001Y frequency pair, but pulse spacing remains the same for X Channel.

47. DME P_2 DEV Thumbwheels (DME)

Position of the P_2 pulse can be deviated from nominal position by value selected on thumbwheel switches in microseconds.

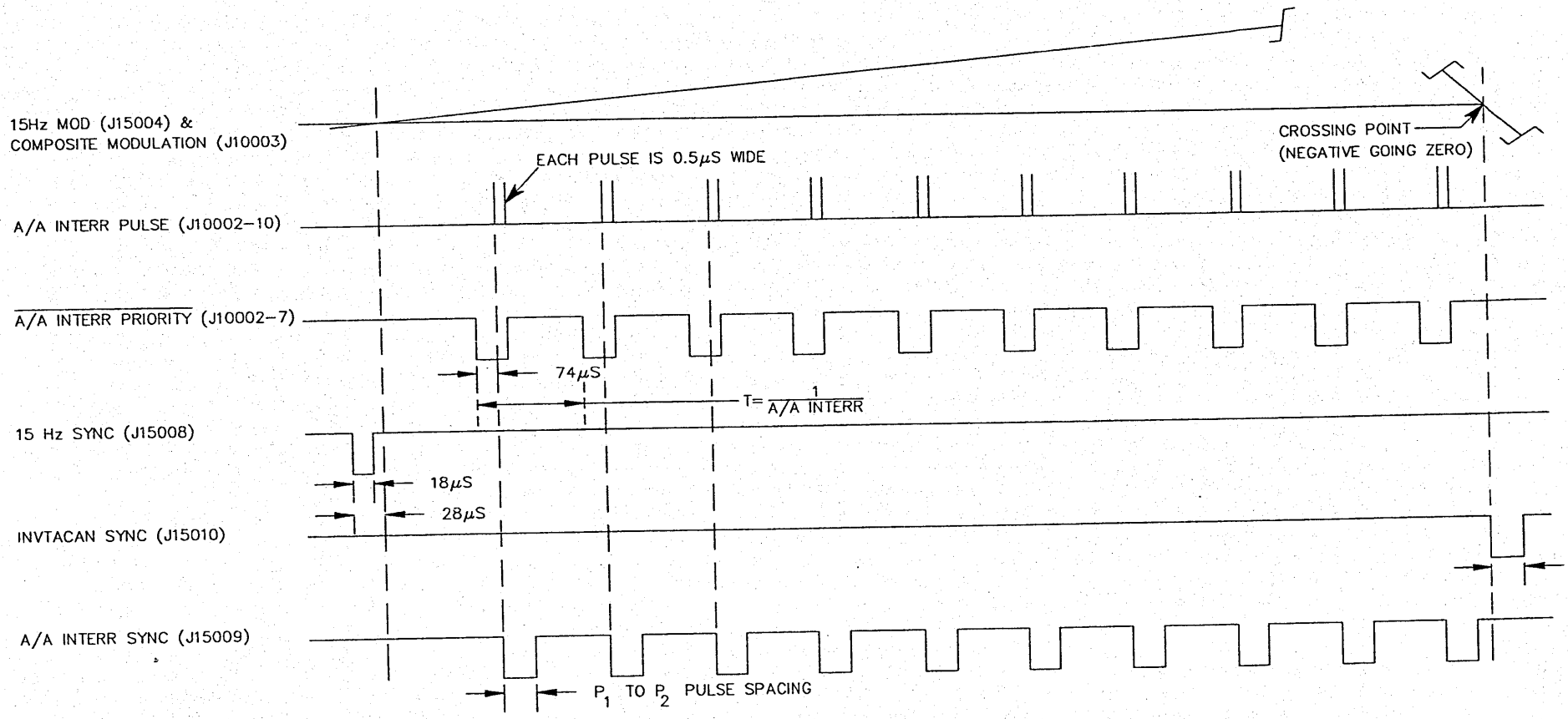
ITEM	NAME	DESCRIPTION

NOTE: Controls the spacing for A/A interrogation pulse pairs.

NOMINAL SETTING: "+0.0" Position

48. ΔF Thumbwheels

Deviates generator frequency from -9.99 MHz to +9.99 MHz. Frequency range is increased from 952.01 MHz to 1222.99 MHz. The ΔF switch has no effect on X or Y channel selection or 2 out of 5 code output at the INTERROGATOR Connector J8 (67).



NOTE: ALL TIMING IS REFERENCED TO FALLING EDGE OF PULSES EXCEPT FOR A/A INTERR PULSE.

INVERSE Air-to-Air Test Function
Timing Chart
Figure 12

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5. Remote (GPIB) Operations

The GPIB Commands contained within this paragraph apply to all T-1401 Test Units when interfaced with the ATC-1400A, and should be used in conjunction with the commands listed in the ATC-1400A Operation Manual.

Remote communication with the TACAN Test System is provided by use of the General Purpose Interface Bus (GPIB), which conforms to IEEE Standard 488-1978. All communication with the TACAN Test System over the GPIB is implemented with ASCII encoded character strings.

A. Remote (GPIB) Operating Procedures

Remote communication with the T-1401 is provided by use of the General Purpose Interface Bus (GPIB) via the ATC-1400A which conforms to the latest IEEE standard 488-1978. The ATC-1400A performs the following IEEE-488 subsets: SH1, AH1, T8, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1 and C0. These subsets mean the ATC-1400A is a talker, listener, primary address only and has remote and local capability, device clear capability, device trigger capability or controller capability.

All communication with the T-1401 over the GPIB bus is implemented with ASCII encoded character strings via the ATC-1400A GPIB hardware. That is, the T-1401 does not have the actual GPIB bus hardware, and relies on the ATC-1400A to do the job. T-1401 GPIB commands are passed to the ATC-1400A which in turn will acknowledge the GPIB command is for the T-1401 and will forward the T-1401 GPIB command string over the T-1401 via the IFR BUS. Likewise, if the T-1401 needs to transmit a GPIB command, it will send the string to the ATC-1400A via the IFR Bus, which will in turn, pass it on to the GPIB BUS.

When the ATC-1400A receives the first command, the T-1401 will lock out all front panel controls and display "AAAA" in the Bearing/Reply Delay window. The AAAA display will remain until the T-1401 is instructed to display Bearing or Reply Delay or returns to "Local" mode.

B. Command and Data Structure

All communication with ATC-1400A/T-1401 is done with uppercase ASCII character strings, which are designed to replace the front panel controls. There is a one-for-one correspondence between the ASCII commands and ATC-1400A/ T-1401 front panel switches and displays with the exception of a few functions with which the data ranges are increased. The front panel switches can be used to program the initial condition or local state of the ATC-1400A/T-1401. The device clear message (GPIB DCL) will also reset the ATC-1400A/T-1401 to the current front panel conditions.

C. ASCII Input Commands

The T-1401 receives GPIB commands from the ATC-1400A. The ATC-1400A transmits GPIB command strings to the T-1401 which the ATC-1400A receives from two sources. Input commands to the interpreter will be one of four types: (1) Set a value (using '='), (2) Set/Reset Boolean types, (3) Acquire a specified value (using '?'), or (4) Enable (execute) a command (using '.').

D. GPIB Input Command Sources

One source of ASCII GPIB commands originate from the talker of the GPIB BUS with a directed destination to the T-1401. The ATC-1400A recognizes the ASCII string is destined for the T-1401 (sees the "AX1=") command prefix and passes remaining ASCII string to T-1401 via the IFR BUS without massaging any of the remaining string.

E. ASCII Commands from the ATC-1400A

The other origination of GPIB ASCII command strings occurs from within the ATC-1400A itself. The ATC-1400A passes the T-1401 GPIB commands transparent to the GPIB user. The T-1401 processes these commands as though the commands originated from the GPIB talker. These commands usually occur when the GPIB bus requests (in hardware) special functions. Device clear and go to local (DCL and GTL) commands are examples of such requests.

F. GPIB ASCII Command Syntax and Format

All ASCII commands sent to the ATC-1400A with the command line prefix "AX1=" will be passed to the T-1401 via the IFR BUS. When the ASCII string begins with these four characters, the characters are stripped and the remaining string will be sent on to the T-1401. This means that an IEEE programmer must not send a command intended for the ATC-1400A unit to process in this string. The GPIB transfer can only occur if, and only if, the IFR BUS communication has been previously established.

The command string sent to the ATC-1400A may be up to sixty-four characters (including the AX1= characters and spaces) with spaces being optional, as they are ignored internally. The commands may be packed together in random order within the ASCII string separated with command delimiters.

The command delimiter used in the T-1401 system is the ":" colon character. GPIB commands that use "?" and "." in them do not require the colon delimiter after them prior to another GPIB command. For example, GPIB commands "AX1=B?AA" and "AX1=B?:AA" would both be valid syntax.

G. ASCII Input Command Format

The commands and their variable formats and ranges are explained in detail in paragraph K. In general, variables programmed greater than the allowable range are set to the maximum limit and variables less than the allowable range are set to the minimum limit. Invalid commands and data are ignored. The T-1401 GPIB commands: "GA, B=25, A1, B?, AAR?" could be transmitted to the T-1401 as shown below:

"AX1=GA:B=25:A1:B?AAR?" or
"AX1=GA: B=25: A1: B?" AAR?"

H. GPIB ASCII Output Data

Command instructions which pass data from the T-1401 to the GPIB are handled also via the IFR BUS. Resulting data from all measurements are stored in a buffer, one measurement at a time, separated with the delimiter, in the order requested. If a syntax error occurred in the received GPIB command string, the T-1401 will place "?" in the buffer. After data is placed in this buffer, a flag is set to indicate a GPIB transmit is desired, where later the IFR BUS task will transmit the string to the ATC-1400A.

Once the GPIB application has made measurement requests, no new measurements should be requested until all previous results have been returned, as this action will destroy the data remaining to be transmitted.

I. ASCII INPUT Command Format Examples

(1) Valid Command Syntax Example

The following example illustrates a proper request from the GPIB application to put the T-1401 into Ground-to-Air TACAN Mode, bearing measurement, and request to see if the TACAN unit is receiving valid Air-to-Air replies.

Transmit request:
"AX1=GA: B=25: A1: B?: AAR?"

Reply response:
"1:25.0:1:"

Receiving valid Air-to-Air replies
Measured bearing is 25 degrees

(2) Invalid Command Syntax Example

The following example illustrates how the T-1401 handles an error within the received GPIB command. Example 1-2-6I(1) above is used with an error inserted in two places.

Transmit request:
"AX1=GA1, BZ=25: A1 B": AAR?

No terminator used
Invalid command

Reply response:
1:?:1:"

(3) GPIB Command Syntax Omitting Unneeded Terminators

The T-1401 GPIB command interpreter allows omission of the terminator between commands. The interpreter will allow the GPIB application to omit the colon (":") terminator after "?" or "." commands. These commands are assumed to be complete by the interpreter and will be processed accordingly. An example is illustrated as follows:

Valid transmit request with terminators: "AX1=GA: B=25: A1: B?" AAR?"

Reply response: "1:25.0:1:"

Receiving valid Air-to-Air replies
Measured bearing is 25 degrees

Valid transmit request without non-required terminators:

"AX1=GA: B=25: A1: B?: AAR?" or
"AX1=GA:B=25:A1:B?AA?"

Reply response: "1:25.01:1:"

Receiving valid Air-to-Air replies
Measured bearing is 25 degrees

Invalid transmit request without required terminators:
"AX1=GA B=25 A1 B? AAR?"

Interpreter delimits see AAR? Terminator required.

Reply response:
"1:?:1:"

Receiving valid Air-to-Air replies
Interpreter did not know "GAB=25A1B?"

J. Quick Reference ASCII Command Table

An alphabetical listing of the GPIB ASCII commands used in remote control operation of the T-1401 is listed in 1-2-5J(a). The listing is as seen from the GPIB application. A definition of the list is as follows:

1. All commands are in ASCII code

2. All T-1401 auxiliary unit GPIB command strings will begin with "AX1=".

3. Data listed under the Data List column reflects input/output data of the T-1401. Data shown in parentheses is input data, that not enclosed in parentheses is output data, and a dash is used for commands having no input/output data.

4. A brief description of the commands are listed under the instruction column.

COMMAND	DATA	INSTRUCTION
AAI=	XXXX	Set Air-to-Air interrogation (Ø to 3999)
AA	--	Select Air-to-Air TACAN Mode
AAR?	(X)	Get Air-to-Air reply state (Ø/1)
A=	+/-X.X	Set ARB deviation (-3.9 to +3.9)
AØ	--	Set Auxiliary Reference Bursts OFF
A1	--	Set Auxiliary Reference Bursts ON
ADP=	+/-X	Set ARB delta pulse (-2 to +2)
AMISSØ	--	Allow first ARB after MRB
AMISS1	--	Remove first ARB after MRB
B=	XXX.X	Set Bearing degree (Ø to 359.9)
B?	(XXX.X)	Get measured Bearing (Ø to 359.9)
BR=	+/-XX.X	Set Bearing Rate (-39 to +39)
DF=	+/-X.X	Set delta frequency (-3.9 to +3.9)

Table 1 - GPIB ACSII Command Listing

COMMAND	DATA	INSTRUCTION
DISPB.	——	Display Bearing
DISPRD.	——	Display Air-to-Air Reply Delay
GA	--	Select Ground-to-Air TACAN Mode
INVGA	——	Select Inverse G/A TACAN Mode
INVAA	——	Select Inverse A/A TACAN Mode
M=	+/-X.X	Set MRB deviation (-3.9 to +3.9)
MØ	--	Turn Main Reference Bursts OFF
M1	--	Turn Main Reference Bursts ON
MDP=	+/-X	Set MRB delta pulse (-2 to +2)
MOD15=	XX	Set percent 15 Hz modulation (0 to 39)
MOD135=	XX	Set percent 135 Hz modulation (0 to 39)
PH=	+/-XX	Set 15/135 Hz phase shift (-39 to +39)
RD?	(XXX.X)	Get Air-to-Air Reply Delay

Table 1 (Cont'd) - GPIB ACSII Command Listing

K. Explanation of Codes for Common Commands

In the following paragraphs [(a) to (z)] is a detailed description of the ASCII commands used in the function of operation of the T-1401, as seen from the GPIB application.

1. All Commands are in ASCII code.

2. Data listed under the data list column reflects input/output data of the T-1401. Data shown enclosed in parentheses is input data, that not enclosed in parentheses is output data, and "None" indicates no input/output data flow.

(a)--------- COMMAND: AAI=XXXX ------

INSTRUCTION FORMAT:
ASCII command - AAI=
Data list - XXXX

COMMAND DEFINITION: Instructs the T-1401 Air-to-Air interrogations to be fixed at XXXX PRF.

DATA LIST DEFINITION: A maximum of four digits are output to the T-1401, with a range of 0 to 3999 PRF.

EXAMPLE: ASCII character string "AX1=AAI=2525" instructs the T-1401 to produce Air-to-Air interrogation pulses at a 2525 PRF.

ERROR CONDITION: Data value >3999 PRF

ERROR CONDITION RESPONSE: Defaults to 3999 PRF

(b)--------- COMMAND: AA ---------

INSTRUCTION FORMAT:
ASCII command - AA
Data list - None

COMMAND DEFINITION: Selects T-1401 Air-to-Air TACAN Mode. The T-1401 has four (4) possible TACAN Modes: Ground-to-Air, Air-to-Air, Inverse G/A and Inverse A/A. (GA, AA, INVGA, INVAA commands respectively). Only one TACAN Mode can be active at any given time.

DATA LIST DEFINITION: No input/output data.

EXAMPLE:ASCII character string "AX1= AA" sets the T-1401 in Air-to-Air TACAN Mode.

ERROR CONDITION: N/A

ERROR CONDITION RESPONSE: N/A

(c) -------- COMMAND: AAR?----------

INSTRUCTION FORMAT:
ASCII command - AAR?
Data list - (X)

COMMAND DEFINITION: Instructs the T-1401 to read the Air-to-Air reply delay value and determine if reply is valid, then transfer the results to the GPIB when the ATC-1400A is addressed to talk.

DATA LIST DEFINITION: Data sent from the T-1401 of the Air-to-Air reply status is one character. The returned value corresponds with Boolean values 0 or 1 indicating TRUE or FALSE respectively.

EXAMPLE: ASCII string "AX1=AAR?"

ERROR CONDITION: Data value out of range.

ERROR CONDITION RESPONSE: Value defaults to FALSE.

(d) -------- COMMAND: A=+/-X.X --------

INSTRUCTION FORMAT:
ASCII command - A=
Data list - +/-X.X

COMMAND DEFINITION: Instructs the T-1401 to set Auxiliary Reference Bursts' reference deviation setting to +/-X.X microseconds. This command works in conjunction with the "AØ" and "A1" commands.

DATA LIST DEFINITION: A maximum of four (4) digits including the decimal point are output to the T-1401, with a range of -3.9 to +3.9 microseconds.

EXAMPLE: ASCII character string "AX1=A=2.5" instructs the T-1401 to deviate the ARB's 2.5 μs from the nominal.

ERROR CONDITION: Data value out of range.

ERROR CONDITION RESPONSE: Defaults to negative maximum limit if data value is under range and defaults to positive maximum limit if data value is over range.

(e) ------- COMMAND: AØ ----------

INSTRUCTION FORMAT: ASCII command - AØ
Data list - None

COMMAND DEFINITION: Instructs T-1401 to select Auxiliary Reference Bursts to an OFF state.

DATA LIST DEFINITION: No input/output data.

EXAMPLE: ASCII character string "AX1= AØ" turns off the Auxiliary Reference bursts.

ERROR CONDITION: N/A

ERROR CONDITION RESPONSE: N/A

(f) ---------- COMMAND: A1 ----------

INSTRUCTION FORMAT:
ASCII command - A1
Data list - None

COMMAND DEFINITION: Instructs the T-1401 to select the Auxiliary Reference Bursts to an ON state.

DATA LIST Definition: No input/output data.

EXAMPLE: ASCII character string "AX1=A1" turns on the Auxiliary Reference bursts.

ERROR CONDITION: N/A

ERROR CONDITION RESPONSE: N/A

(g) ---------- COMMAND: ADP=+/-X ----------

INSTRUCTION FORMAT:
ASCII command - ADP=
Data list - +/-X

COMMAND DEFINITION: Instructs T-1401 to set the Auxiliary Reference Bursts' pulse quantity to +/-X from the nominal amount.

DATA LIST DEFINITION: A maximum of two ASCII digits are output to the T-1401, with a range of -2 to +2 pulses.

EXAMPLE: ASCII character string "AX1= ADP= -2" instructs the T-1401 to subtract 2 pulses (or pairs of pulses) from the Auxiliary Reference Bursts.

ERROR CONDITION: Data value out of range.

ERROR CONDITION RESPONSE: Defaults to zero.

(h) ---------- COMMAND: AMISSØ ----------

INSTRUCTION FORMAT:
ASCII command - AMISSØ
Data list - None

COMMAND DEFINITION: Instructs the T-1401 to enable the first Auxiliary Reference Burst after the Main Reference Burst.

DATA LIST DEFINITION: No input/output data.

EXAMPLE: AX1= AMISS1"

ERROR CONDITION: N/A

ERROR CONDITION RESPONSE: N/A

(i) ---------- COMMAND: AMISS1 ----------

INSTRUCTION FORMAT:
ASCII command - AMISS1
Data list - None

COMMAND DEFINITION: Removes the first Aux. Reference Burst after the Main Reference Burst.

DATA LIST DEFINITION: No input/output data.

EXAMPLE: "AX1= AMISS1"

ERROR CONDITION: N/A

ERROR CONDITION RESPONSE: N/A

(j) ---------- COMMAND: B=XXX.X ----------

INSTRUCTION FORMAT:
ASCII command - B=
Data list - XXX.X

COMMAND DEFINITION: Instructs T-1401 selected bearing to be fixed at XXX.X degrees.

DATA LIST DEFINITION: Maximum of five characters are output with a range of 0 to 359.9 degrees.

EXAMPLE: "AX1=B=350.5" instructs the T-1401 to generate a bearing of 350.5 degrees.

ERROR CONDITION: Data value out of range.

ERROR CONDITION RESPONSE: Defaults to 0 degrees

(k) -------- COMMAND: B? ----------

INSTRUCTION FORMAT:
ASCII command - B?
Data list - (XXX.X)

COMMAND DEFINITION: Samples and measure the actual bearing and transfer this value.

DATA LIST DEFINITION: Data input from T-1401 in response to the "B?" command consists of 5 characters.

EXAMPLE: AX1= B?"

ERROR CONDITION: N/A

ERROR CONDITION RESPONSE: N/A

(l) -------- COMMAND: BR=+/-XX -------

INSTRUCTION FORMAT:
ASCII command - BR=
Data list - +/-XX

COMMAND DEFINITION: Sets the Bearing Rate to +/-XX degrees per second. This command puts the T-1401 in speed mode and operates with the "DF=+/-X.X" command.

The T-1401 does not allow both speed mode and Delta Freq. mode at the same time, thus if the T-1401 is in Delta Freq. mode prior to the "BR=+/-XX" command, the unit will leave Delta Freq. mode and enter speed mode. Speed mode can be stopped by programming the bearing rate to zero degrees/sec.

DATA LIST DEFINITION: Outputs a maximum of 3 ASCII characters from -39 to +39 degrees/second.

EXAMPLE: Character string "AX1=BR=+25" will ignore prior "DF=+/-X.X" command, set T-1401 to speed mode, and program Bearing Rate generator for 25 degrees/second.

The commands "AX1=BR=0" or "AX1=BR=" tells the T-1401 to exit speed mode and stop the bearing rate generator.

ERROR CONDITION: Data value out of range.

ERROR CONDITION RESPONSE: If the bearing rate programmed is less than the minimum allowed data range, the T-1401 defaults to the lower bearing rate limit of -39. If the bearing rate programmed is greater than the maximum allowed data range, the T-1401 defaults to the upper bearing rate limit of +39.

(m) ---------- COMMAND: DF=+/-X.X ----------

INSTRUCTION FORMAT:
ASCII commands - DF=
Data list - +/-X.X

COMMAND DEFINITION: Instructs the T-1401 to vary the 15 Hz and 135 Hz frequency +/-X.X percent. Upon the T-1401 accepting this command, the unit is placed in the Delta Freq. mode. Hardware limitations will not allow the unit to be in Delta Freq. mode and speed mode at the same time. Thus the unit will go from speed mode to Delta Freq. mode.

DATA LIST DEFINITION: Outputs a maximum of four (4) decimal ASCII characters from -3.9 to +3.9 percent. If no value follows the command ("DF=" or "DF=0"), then the unit will leave the Delta Freq. mode, thus clearing any previously stored data.

EXAMPLE: ASCII character string "AX1=DF=1.0" instructs the T-1401 t select Delta Freq. and alter the 15 Hz and 135 Hz signals 1 percent.

ASCII character string "AX1= or DF=0" instructs the T-1401 to leave Delta Freq. mode and ignore any previously stored values for delta frequency.

ERROR CONDITION: Data value Lower limit (-3.9)
Data Upper limit (+3.9)

ERROR CONDITION RESPONSE: If the delta frequency is programmed with a value less than the minimum allowed lower limit, then the T-1401 will instruct a delta frequency value equal to the lower range. If the delta frequency is programmed with a value greater than the maximum allowed upper limit, the T-1401 will instruct a delta frequency value equal to the upper range.

(n) ---------- COMMAND: GA ----------

INSTRUCTION FORMAT:
ASCII command - GA
Data list - None

COMMAND DEFINITION: Select T-1401 Ground-to-Air TACAN mode. The T-1401 has four (4) possible TACAN modes of operation; Ground-to-Air, Air-to-Air, and Inverse G/A and Inverse A/A, (GA, AA, INVGA, INVAA respectfully). Only one TACAN mode can be active at any given time.

DATA LIST DEFINITION: No input/output data.

EXAMPLE: ASCII character string "AX1=GA" sets the T-1401 in Ground to Air TACAN mode.

ERROR CONDITION: N/A

ERROR CONDITION RESPONSE: N/A

(o) ---------- COMMAND: INVGA ----------

INSTRUCTION FORMAT:
ASCII command - INVGA
Data list - None

COMMAND DEFINITION: Selects T-1401 Inverse G/A TACAN mode of operation. The T-1401 has four (4) possible TACAN modes of operation; Ground-to-Air, Air-to-Air, Inverse G/A and Inverse A/A, (GA, AA, INVGA, INVAA commands respectively). Only one TACAN mode of operation can occur at any given time.

DATA LIST DEFINITION: No input/output data.

EXAMPLE: ASCII character string "AX1= INVGA" will instruct the T-1401 to select Inverse G/A TACAN mode of operation.

ERROR CONDITION: N/A

ERROR CONDITION RESPONSE: N/A

(p) ---------- COMMAND: INVAA ----------

INSTRUCTION FORMAT:
ASCII Command - INVAA
Data List - None

COMMAND DEFINITION: Selects T-1401 Inverse A/A TACAN mode of operation. The T-1401 has four (4) possible TACAN modes of operation; Ground-to-Air, Air-to-Air, Inverse G/A and Inverse A/A (GA, AA, INVGA, INVAA commands respectively). Only one TACAN mode of operation can occur at any given time.

DATA LIST DEFINITION: No input/output data.

EXAMPLE: ASCII character string "AX1=INVAA" will instruct the T-1401 to select Inverse A/A TACAN mode of operation.

ERROR CONDITION: N/A

ERROR CONDITION RESPONSE: N/A

(q) ---------- COMMAND: M=+/-X.X ----------

INSTRUCTION FORMAT:
ASCII command - M=
Data list - +/-X.X

COMMAND DEFINITION: Instructs the T-1401 to set the Main Reference Bursts' reference deviation setting to +/=X.X Microseconds. This command works in conjunction with the "MØ" and "M1" commands.

DATA LIST DEFINITION: A maximum of four (4) decimal ASCII commands including the decimal point are output to the T-1401, with a range of -3.9 to +3.9 microseconds.

EXAMPLE: ASCII character string "AX1=M=2.5" instructs the T-1401 to deviate the MRB's +2.5 μs from the nominal value. ASCII command "AX1= M=" will cause the T-1401 to reset back to the nominal value.

ERROR CONDITION: Data value out of range.

ERROR CONDITION RESPONSE: Defaults to negative minimum limit if data value is under range and defaults to positive maximum range if data value is over range.

(r) ---------- COMMAND: MØ ----------

INSTRUCTION FORMAT:
ASCII command - MØ
Data list - None

COMMAND DEFINITION: Instructs the T-1401 to select Main Reference Bursts to an OFF state.

DATA LIST DEFINITION: No input/output data

EXAMPLE: ASCII character string "AX1= MØ" turns off the Main Reference Bursts.

ERROR CONDITION: N/A

ERROR CONDITION RESPONSE: N/A

(s) ---------- COMMAND: M1 ----------

INSTRUCTION FORMAT:
ASCII command - M1
Data list - None

COMMAND DEFINITION: Instructs the T-1401 to set the Main Reference Bursts to an on state.

DATA LIST DEFINITION: No input/output data.

EXAMPLE: ASCII character string "AX1=M1" instructs the T-1401 to turn on the Main Reference Bursts.

ERROR CONDITION: N/A

ERROR CONDITION RESPONSE: N/A

(t) ------- COMMAND: MDP=+/-X --------

INSTRUCTION FORMAT:
ASCII command - MDP=
Data list - +/-X

COMMAND DEFINITION: Instructs T-1401 to set the Main Reference Bursts pulse (or pulse pair) quantities to +/-X for the nominal amount.

DATA LIST DEFINITION: A maximum of two ASCII characters.

EXAMPLE: ASCII character string "AX1= MDP=2" instructs the T-1401 to add 2 pulses (or pulse pairs) to the Main Reference Bursts.

ERROR CONDITION: Data value out or range.

ERROR CONDITION RESPONSE: Defaults to zero.

(u) ------- COMMAND: MOD15=XX --------

INSTRUCTION FORMAT:
ASCII command - MOD15=
Data list - XX

COMMAND DEFINITION: Instructs T-1401 to modify the 15 Hz component of the composite signal by a percentage.

DATA LIST DEFINITION: A maximum of two (2) decimal ASCII characters, with a range of 0 to 39.

EXAMPLE: ASCII character string "AX1= MOD15=25" instructs the unit to modify the 15 Hz component to 25%. ASCII character string "AX1= MOD15=" or "AX1= MOD15=Ø" will turn the 15 Hz component OFF.

ERROR CONDITION: Data value out of range.

ERROR CONDITION RESPONSE: Value defaults to maximum.

(v) ---------- COMMAND: MOD135=XX ----------

INSTRUCTION FORMAT:
ASCII command - MOD135=
Data list - XX

COMMAND DEFINITION: Instructs T-1401 to modify the 135 Hz component of the composite signal by a percentage.

DATA LIST DEFINITION: A maximum of two (2) decimal ASCII characters, with a range of 0% to 39%.

EXAMPLE: ASCII character string "AX1= MOD135=25" instructs the unit to modify the 135 Hz component to 25%. ASCII character string "AX1= MOD135=" or "AX1= MOD135=Ø" will turn the 135 Hz component signal OFF.

ERROR CONDITION: Data value out of range.

ERROR CONDITION RESPONSE: Value defaults to maximum.

(w) ---------- COMMAND: PH=+/-XX ----------

INSTRUCTION FORMAT:
ASCII command - PH=
Data list - +/-XX

COMMAND DEFINITION: Instructs the T-1401 to select the phase shift between 15 Hz and 135 Hz sinusoids between -XX degrees and +XX degrees.

DATA LIST DEFINITION: Outputs a maximum of three (3) decimal ASCII digits between -39 degrees and +39 degrees.

EXAMPLE: ASCII character string "AX1= PH=32" instructs the T-1401 to select a phase shift of 32 degrees.

ERROR CONDITION: Data value out of range.

ERROR CONDITION RESPONSE: Value defaults to zero (Ø).

(x) ------- COMMAND: DISPB. ---------

INSTRUCTION FORMAT:
ASCII command - DISPB.
Data list - None

COMMAND DEFINITION: Instructs the T-1401 to display measured bearing. T-1401 generates bearing and bearing rate regardless whether or not bearing is displayed.

DATA LIST DEFINITION: N/A

EXAMPLE: ASCII character string "AX1=DISPB." instructs the T-1401 to display measured bearing.

ERROR CONDITION: N/A

ERROR CONDITION RESPONSE: N/A

(y) ------- COMMAND: DISPRD. ---------

INSTRUCTION FORMAT:
ASCII command - DISPRD.
Data list - None

COMMAND DEFINITION: Instructs the T-1401 to display measured reply delay in μs. T-1401 measure reply delay regardless whether or not it is displayed.

DATA LIST DEFINITION: N/A

EXAMPLE: ASCII character string "AX1=DISPRD." instructs the T-1401 to display measured reply delay.

ERROR CONDITION: If reply delay is out of tolerance, an "F" will precede reply delay reading. If reply delay is 89 μs, or A/A mode is not selected, "DDD.D" will be displayed.

ERROR CONDITION RESPONSE: None

(z) ------- COMMAND: RD? ----------

INSTRUCTION FORMAT:
ASCII command - RD?
Data list - (XXX.X)

COMMAND DEFINITION: Instructs the T-1401 to get measured reply delay in μs and return the value when the ATC-1400A is addressed to talk.

DATA LIST DEFINITION: Data input from the T-1401 in response to the "RD?" command consists of up to five ASCII characters including the decimal point with a range of 0.1 to 89.9 μs.

EXAMPLE: ASCII character string "AX1=RD?" instructs the T-1401 to get reply delay measurement and return value when ATC-1400A is addressed to talk.

ERROR CONDITION: If reply delay is out of tolerance, an "F" will precede reply delay reading. If reply delay is >89.9 μs, or A/A mode is not selected, "DDDD" will be returned.

ERROR CONDITION RESPONSE: None

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6. Error Codes

The error codes which may appear on the T-1401 BEARING/REPLY DELAY Display (4) are defined as follows:

EC01 Invalid bearing rate. The operator has selected a bearing rate outside of the range of 39.0 deg/sec.

EC02 Delta F mode invalid. The operator has selected non-zero frequency deviation during a non-zero bearing rate.

EC03 Bearing rate mode invalid. The operator has selected non-zero bearing rate during a non-zero frequency deviation.

The following error code (EC04) may occur only when the T-1401 is connected to an ATC-1400A via the IFR bus.

EC04 RF mode selection is invalid. The operator has selected a VOR frequency pair on the ATC-1400A when in the A/A or INV A/A Mode.

DDD.D Invalid Reply Delay (when DISPLAY SELECT Switch [5] is in REPLY DELAY position). The Reply Delay reading is >89.9 μs, or A/A mode is not selected.

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