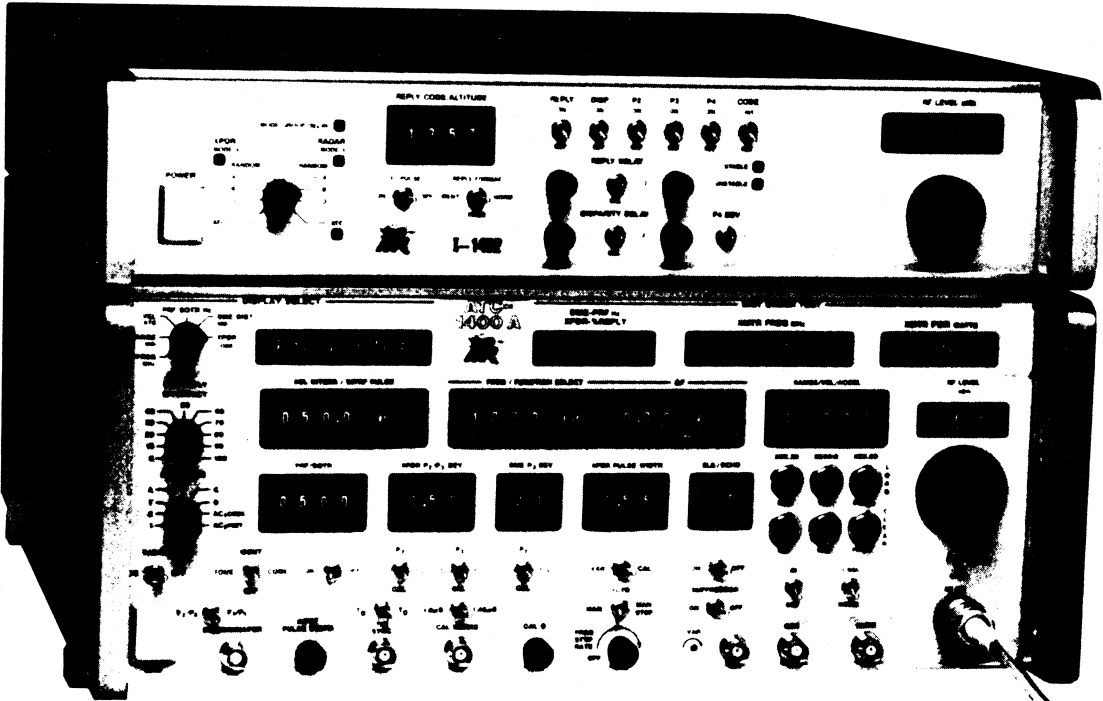




OPERATION MANUAL

MODE 4 TEST SYSTEM



10200 West York Street / Wichita, Kansas 67215 U.S.A. / (316) 522-4981 / FAX (316) 524-2623

1002-6701-100
EMC



**OPERATION MANUAL
MODE 4 TEST SYSTEM**

**PUBLISHED BY
IFR SYSTEMS, INC.
Wichita, Kansas**

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OPERATION MANUAL
MODE S TEST SYSTEM

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.



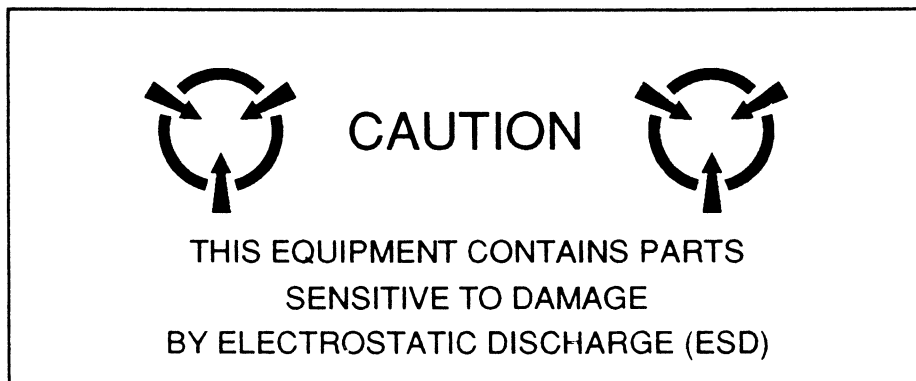
OPERATION MANUAL
MODE S TEST SYSTEM

CAUTION: INTEGRATED CIRCUITS AND SOLID STATE DEVICES SUCH AS MOS FETS, 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:

- BEFORE USE 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.
- WHEN REMOVING DEVICES FROM THEIR CONTAINERS, GROUND THE HAND BEING USED WITH A CONDUCTIVE WRISTBAND.
- TIPS OF SOLDERING IRONS AND/OR ANY TOOLS USED MUST BE GROUNDED.
- DEVICES MUST NEVER BE INSERTED INTO NOR REMOVED FROM CIRCUITS WITH POWER ON.
- PC BOARDS, WHEN TAKEN OUT OF THE SET, MUST BE LAID ON A GROUNDED CONDUCTIVE MAT OR STORED IN A CONDUCTIVE STORAGE BAG. REMOVE ANY BUILT-IN POWER SOURCE, SUCH AS A BATTERY, BEFORE LAYING PC BOARDS ON A CONDUCTIVE MAT OR STORING IN A CONDUCTIVE BAG.
- PC BOARDS, IF BEING SHIPPED TO THE FACTORY FOR REPAIR, MUST BE PACKAGED IN A CONDUCTIVE BAG AND PLACED IN A WELL-CUSHIONED SHIPPING CONTAINER.

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

CAUTION: USERS OF THIS EQUIPMENT SHOULD SCRUTINIZE ANY OPERATION WHICH RESULTS IN RADIATION OF A SIGNAL (DIRECTLY OR INDIRECTLY) AND ENSURE COMPLIANCE WITH INSTRUCTIONS IN FAA CIRCULAR AC 170-6C, DATED FEBRUARY 19, 1981.



Cable Statement:

For continued EMC compliance, double shielded and properly terminated external interface cables must be used with this equipment when interfacing with the TEST, IFR BUS and/or AUXILIARY Connectors.

Test System Statement:

For continued EMC compliance, the Mode 4 Test System requires an I-1402-1 Test Auxiliary correctly mated with an ATC-1400A-1.

Nomenclature Statements:

The I-1402-1 Test Auxiliary is the official nomenclature for the EMC compliant I-1402 Test Auxiliary. In this manual the I-1402, I-1402 Test Auxiliary, I-1402 Test Unit, Test Auxiliary or Test Set refers to the I-1402-1 Test Auxiliary.

The ATC-1400A-1 Transponder/DME Test Set is the official nomenclature for the EMC compliant ATC-1400A Transponder/DME Test Set. In this manual the ATC-1400A, ATC-1400A Transponder/DME Test Set, ATC-1400A Test Set or ATC-1400A Test Unit refers to the ATC-1400A-1 Transponder/DME Test Set.

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INTRODUCTION - MODE 4 TEST SYSTEM

This manual contains the information necessary to install and operate the MODE 4 Test System. It is designed to be used in conjunction with the ATC-1400A Operation/Maintenance Manual. The I-1402 Test Auxiliary, when interfaced with the ATC-1400A Transponder/DME Test Set, forms the MODE 4 Test System. The additional GPIB commands required for both ATC and Mode 4 testing, are listed in Section 1-2-4 of this manual.

It is strongly recommended that personnel be thoroughly familiar with the contents of this manual, along with contents of the ATC-1400A Operation/Maintenance Manual, before attempting to operate or service this equipment.

ORGANIZATION

This manual is divided into the following Chapters and Sections:

CHAPTER/SECTION

- 1-1 DESCRIPTION - A brief introduction to the MODE 4 Test System, explaining its functions, and including an I-1402 composite drawing for module identification.
- 1-2 OPERATION - Contains detailed instructions for:
 - INSTALLATION - Procedures to set up the MODE 4 Test System for testing both ATC and Mode 4 transponders as well as RADAR interrogators, and instructions for interfacing the I-1402 to the ATC-1400A.
 - CONTROLS - Description of all Controls, Connectors, and Indicators for MODE 4 Test System.
 - SYSTEM OPERATION - General Setup Procedures and Test Sequence for each test function of operation.
 - REMOTE (GPIB) OPERATION - Complete description of commands required to operate MODE 4 Test System, utilizing IEEE-488 Bus connected to the ATC-1400A.
 - CALIBRATION/VERIFICATION - Complete procedures to verify and calibrate the Mode 4 Test System.
- 1-3 SPECIFICATIONS - Contains a detailed list of specifications for the I-1402 Test Auxiliary, categorized by test function of operation.
- 1-4 SHIPPING - Provides procedures to be used for repacking for shipment.



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CHAPTER/SECTION

1-5 STORAGE - Provides instructions to be followed for storage during extended periods.

APPENDICES - Contains useful supplementary maintenance and operational data.



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SECTION 1 - DESCRIPTION

1. General Description and Capabilities

A. Description

The I-1402 Test Auxiliary provides additional pulse code modulation when interfaced with the ATC-1400A Transponder/DME Test Set, for the purpose of testing both ATC and Mode 4 Transponders, as well as RADAR Interrogators in ATC modes A, C and 4. It can be operated manually using front panel controls and switches, or remotely by ATE (Automatic Test Equipment) control through the GPIB (General Purpose Interface Bus).

All necessary test signals and their variations are generated within the I-1402 and ATC-1400A Test Sets. Only an oscilloscope is required as peripheral equipment.

B. Functional Capabilities

The I-1402 Test Auxiliary monitors all inputs in a round robin fashion, including the IFR BUS input; processes this information, and sends output to all devices, including the IFR BUS output.

A vernier control provides 0.1 dB steps in all modes. An encoder with octal thumbwheels provides reply pulses to drive a modulator.

The I-1402 Test Auxiliary, when interfaced with the ATC-1400A Transponder/DME Test Set, performs the following test functions:

XPDR ATC Test Function

XPDR Mode 4 Test Function (Internal)(For Use Without KIT Encryption Device)

XPDR Mode 4 Test Function (External) (For Use With KIT Encryption Device)

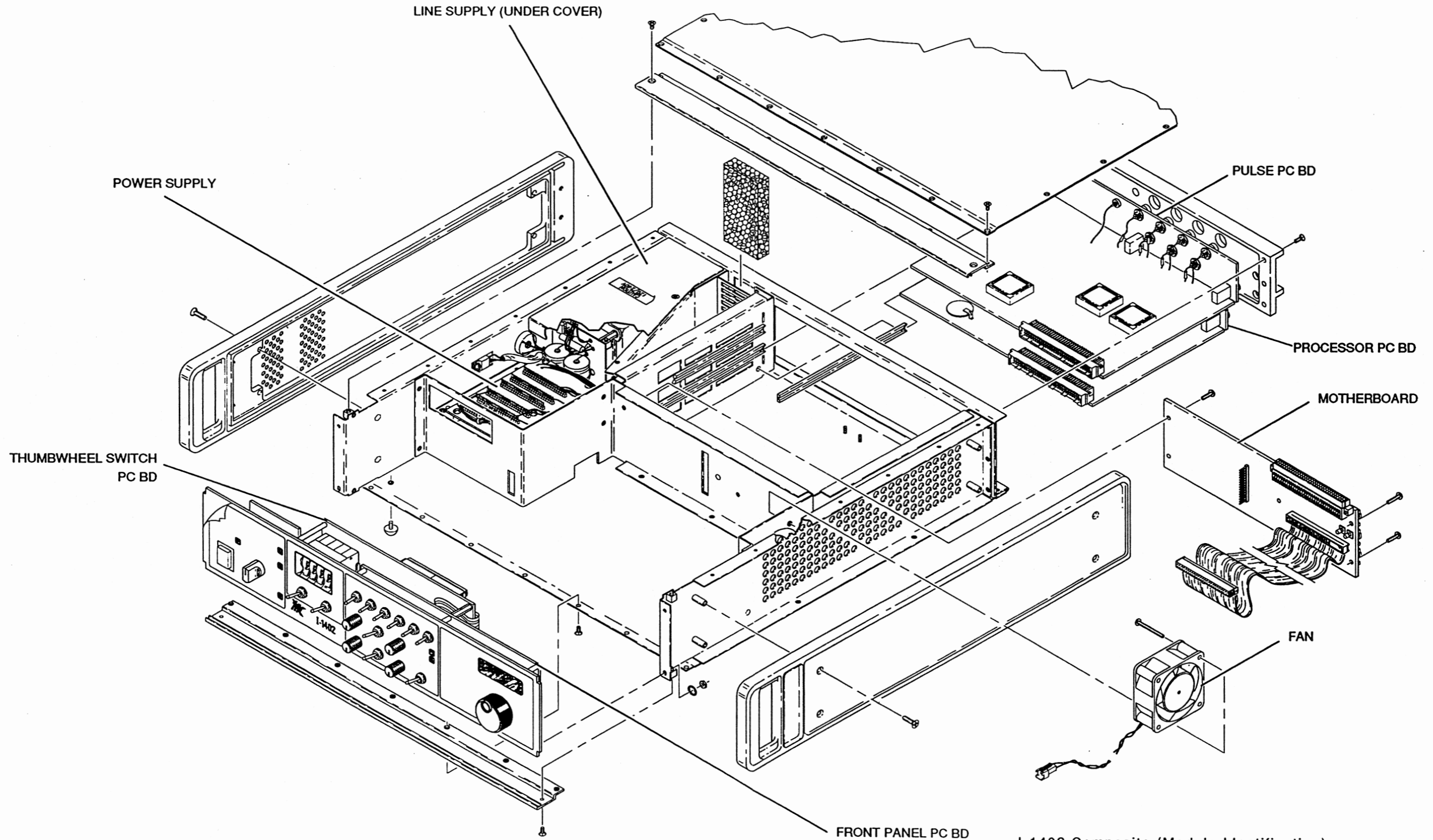
RADAR ATC Test Function

RADAR Mode 4 Test Function (Internal) (For Use Without KIR Encryption Device)

RADAR Mode 4 Test Function (External) (For Use With KIR Encryption Device)



C. Composite



I-1402 Composite (Module Identification)
Figure 1

6707001



SECTION 2 - OPERATION

1. Installation

Installation of the I-1402 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 220 to 250 VAC, 45 to 440 Hz).

NOTE: As illustrated in the Test Hook-up Diagrams in Section 1-2-3, accessory test equipment required for testing XPDR and RADAR Systems consists of an oscilloscope.

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 that must be connected to a properly grounded three-prong wall receptacle. It is the 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: DO NOT USE A THREE-PRONG TO TWO-PRONG ADAPTER PLUG. DOING SO CREATES A SHOCK HAZARD BETWEEN THE CHASSIS AND ELECTRICAL GROUND.



(3) Operating Safety

Due to potential for electrical shock within the test equipment, personnel should not remove test equipment covers except for the Calibration/Verification in 1-2-5. 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 I-1402 power supply can operate over a voltage range of 105 to 250 VAC. No internal wiring changes are required prior to applying AC power to the test set. To select between 120 VAC and 220 VAC, insure LINE SELECT Switch (Ref. Fig. 3) setting on rear panel matches input line voltage. Instantaneous surge current at power up is less than 50 A. The recommended fuse rating for the input voltage is listed below:

INPUT VOLTAGE	F1	F2
105 to 120 VAC	3.0A 250V Med Blo	0.5A 250V Med Blo
220 to 250 VAC	1.5A 250V Med Blo	0.25A 250V Med Blo

D. Installation Equipment

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



E. Installation Procedure

Refer to 1-2-1, Figure 1.

<u>STEP</u>	<u>PROCEDURE</u>
1.	Remove the I-1402 Test Auxiliary and ATC-1400A Test Set from the shipping containers.
2.	Place the I-1402 on top of the ATC-1400A.
3.	Connect the two 25 Pin D style ribbon cables, one to the I-1402 and ATC-1400A IFR BUS Connectors and the other to the I-1402 and ATC-1400A AUXILIARY Connectors.
4.	Connect the SMB-SMB coaxial cable to the I-1402 LEVEL OUTPUT Connector and ATC-1400A RF LEVEL INPUT Connector.
5.	Connect ATC-1400A power cable to the I-1402 AC OUT Connector and ATC-1400A AC INPUT Connector.

NOTE: The I-1402 and ATC-1400A are calibrated together as a system. If either Test Set is replaced, the SLEW Control calibration in 1-2-5(2) must be performed.

The I-1402, when interfaced with the ATC-1400A, can be installed in either a bench-top or rack-mount fashion. IFR Systems, Inc. test sets are normally shipped from the factory with plastic feet installed for a bench-top installation. Conversion from bench-top to rack-mount installation is possible by ordering the following rack-mount kits:

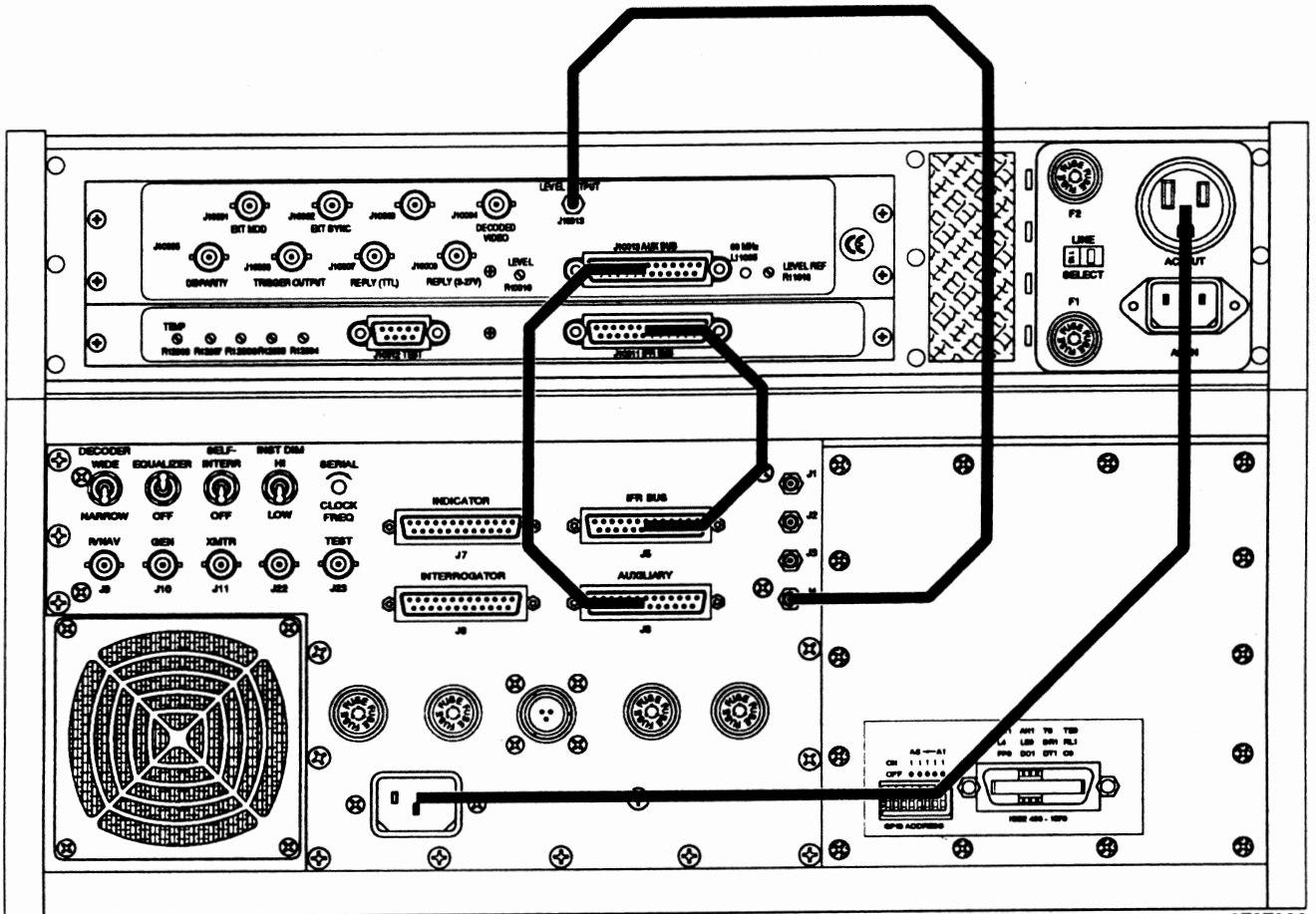
NOTE: One kit is required per test set.

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

<u>TEST SET:</u>	<u>IFR SYSTEMS PART NO.</u>
ATC-1400A	7001-7636-800
I-1402	7001-6740-800



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6707006

I-1402 to ATC-1400A Interface
Figure 1

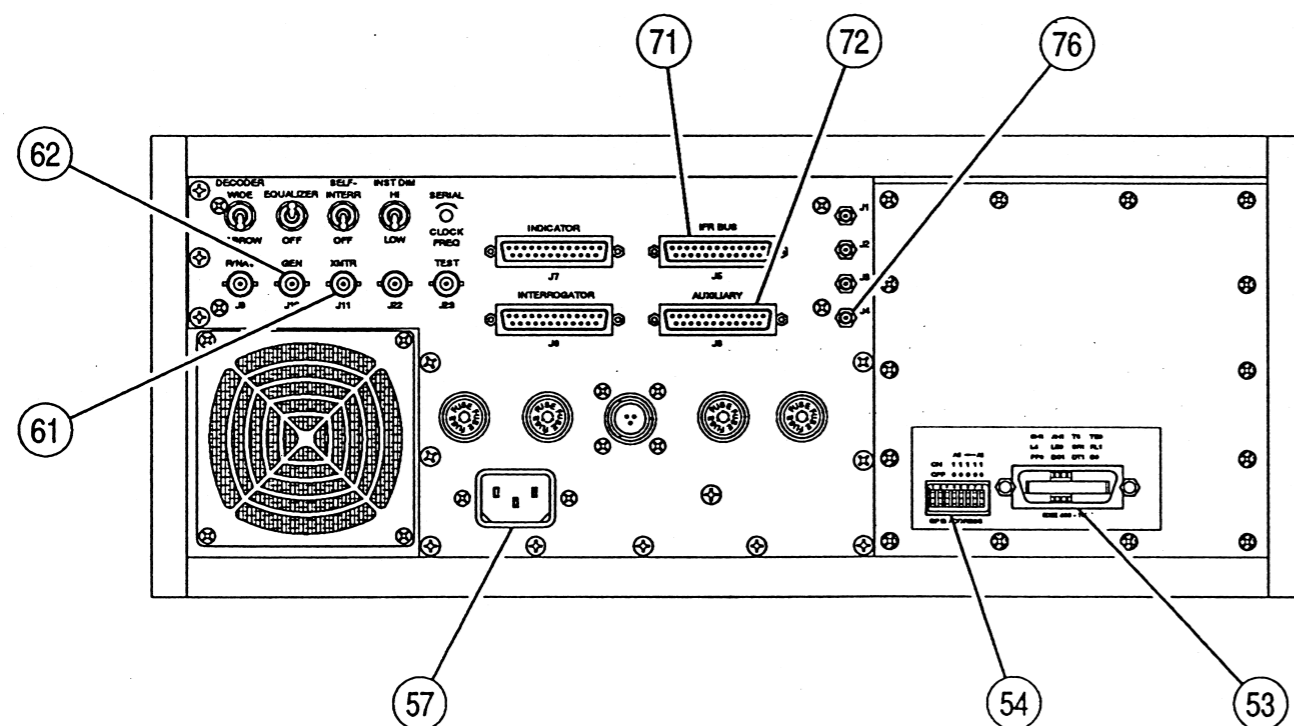
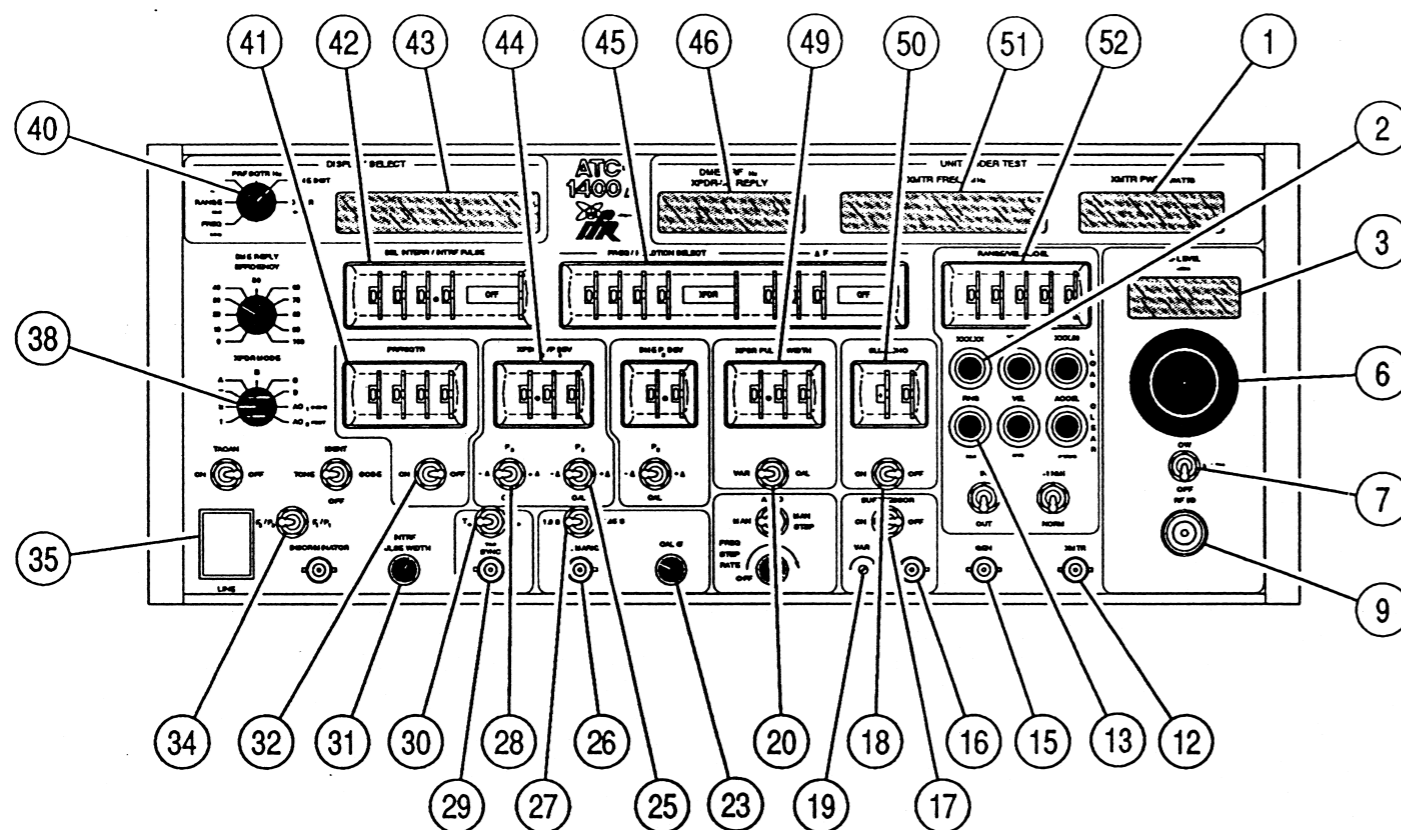
F. Power-up Procedure

With female end of AC power cable connected to AC IN connector on I-1402 rear panel, connect opposite end of AC power cable to standard 3-pin grounded receptacle.

Place I-1402 POWER Switch (R) to "ON" position to energize test system and verify that POWER Switch is illuminated.

Place ATC-1400A LINE Switch (35) to "ON" position and allow a five-minute warm-up period.

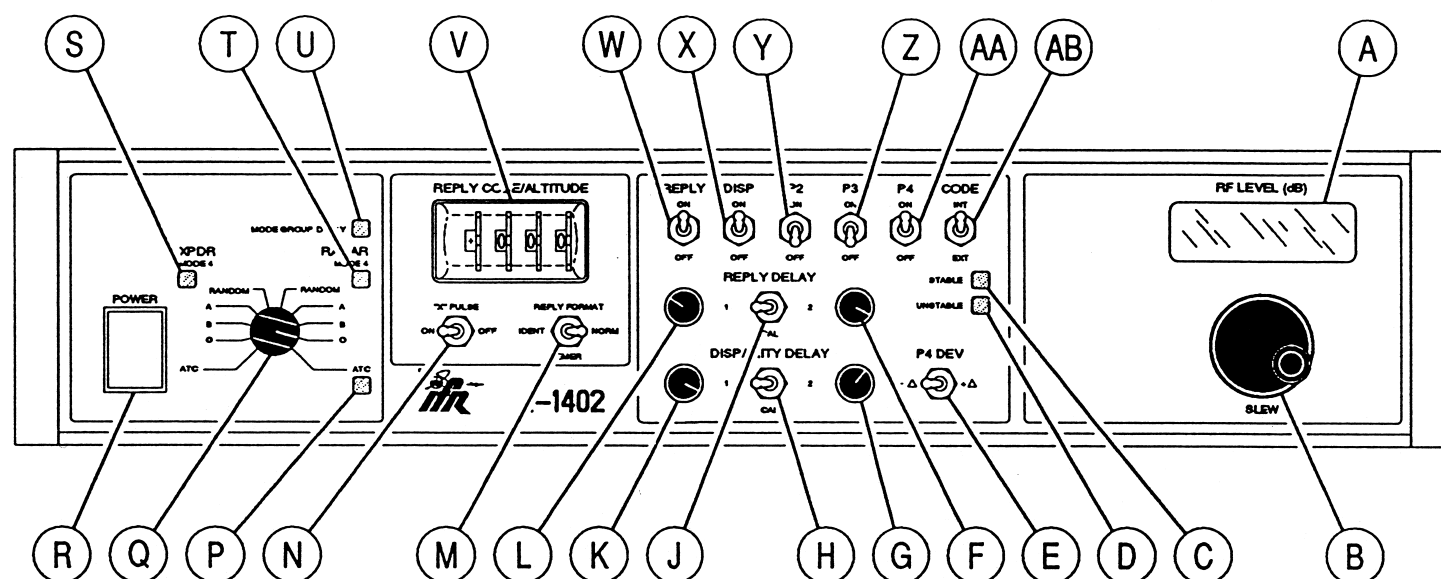
2. Description of Controls, Connectors, and Indicators



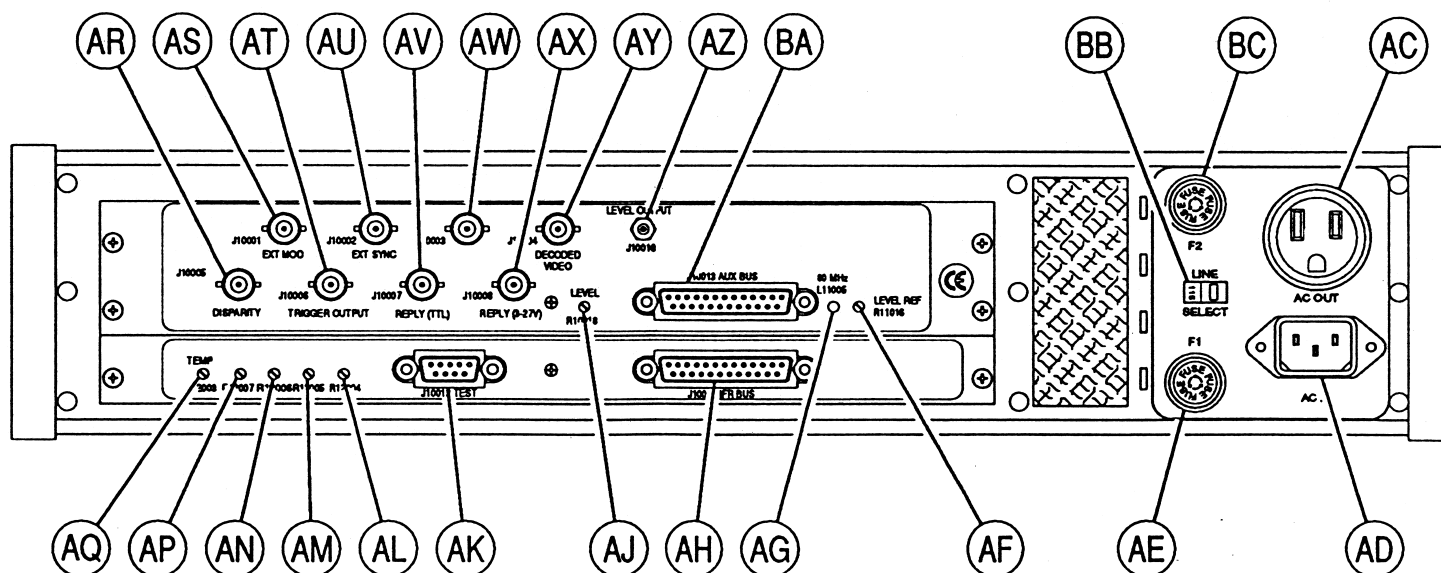
- 1 XMTR PWR WATTS Display
- 2 LOAD RANGE Pushbutton Switch
- 3 RF LEVEL -dBm Display
- 6 RF LEVEL Control
- 7 CW/NORM/OFF Switch
- 9 RF I/O Connector
- 12 XMTR Connector
- 13 CLEAR RNG Pushbutton Switch
- 15 GEN Connector
- 16 SUPPRESSOR OUTPUT Connector
- 17 SUPPRESSOR ON/OFF Switch
- 18 SLS/ECHO ON/OFF Switch
- 19 SUPPRESSOR VAR Adjustment
- 20 XPDR PULSE WIDTH VAR/CAL Switch
- 23 CAL Ø Control
- 25 XPDR DEV P₃/CAL Switch
- 26 CAL MARKS Connector (J1019)
- 27 1.0 µs/1.45 µs Switch
- 28 XPDR DEV P₂/CAL Switch
- 29 SYNC Connector (J1020)
- 30 T₀/TAC/T_D Switch
- 31 INTRF PULSE WIDTH Control
- 32 PRF/SQTR ON/OFF Switch
- 34 F₂/P₂ F₁/P₁ Switch
- 35 LINE Switch
- 38 XPDR MODE Control
- 40 DISPLAY SELECT Control
- 41 PRF/SQTR Thumbwheels
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- 44 XPDR P₂/P₃ DEV Thumbwheels
- 45 FREQ/FUNCTION SELECT Thumbwheels
- 46 DME-PRF Hz XPDR - % REPLY Display
- 49 XPDR PULSE WIDTH Thumbwheels
- 50 SLS/ECHO Thumbwheels
- 51 XMTR FREQ MHz Display
- 52 RANGE/VEL/ACCEL Thumbwheels
- 53 GPIB Connector
- 54 GPIB ADDRESS Dip Switches
- 57 AC INPUT Connector
- 61 XMTR Connector (J11)
- 62 GEN Connector (J10)
- 71 IFR BUS Connector (J5)
- 72 AUXILIARY Connector (J6)
- 76 RF LEVEL INPUT Connector (J4)

ATC-1400A Front and Rear Panels
Figure 2

6707003



- A RF LEVEL (dB) Display
- B SLEW Control
- C STABLE Indicator
- D UNSTABLE Indicator
- E P4 DEV Switch
- F REPLY DELAY 2 Control
- G DISPARITY DELAY 2 Control
- H DISPARITY DELAY Switch
- J REPLY DELAY Switch
- K DISPARITY DELAY 1 Control
- L REPLY DELAY 1 Control
- M REPLY FORMAT Switch
- N "X" PULSE Switch
- P ATC Indicator
- Q MODE SELECT Control
- R POWER Switch
- S XPDR MODE 4 Indicator
- T RADAR MODE 4 Indicator
- U MODE GROUP DELAY Indicator
- V REPLY CODE/ALTITUDE Thumbwheels
- W REPLY ON/OFF Switch
- X DISP ON/OFF Switch
- Y P2 ON/OFF Switch
- Z P3 ON/OFF Switch
- AA P4 ON/OFF Switch
- AB CODE INT/EXT Switch
- AC AC OUT Connector
- AD AC IN Connector
- AE F1 AC LINE IN Fuse
- AF LEVEL REFERENCE Adjust (R11016)
- AG 80 MHz Adjust (L11005)
- AH IFR BUS Connector (J10011)
- AJ LEVEL Adjust (R10018)
- AK TEST Connector (J10012)
- AL SPARE 4 (R12004)
- AM SPARE 3 (R12005)
- AN SPARE 2 (R12006)
- AP SPARE 1 (R12007)
- AQ TEMPERATURE Adjust (R12003)
- AR DISPARITY Connector (J10005)
- AS EXT MOD Connector (J10001)
- AT TRIGGER OUTPUT Connector (J10006)
- AU EXT SYNC Connector (J10002)
- AV REPLY (TTL) Connector (J10007)
- AW Reserved for future use (J10003)
- AX REPLY (3-27 V) Connector (J10008)
- AY DECODED VIDEO Connector (J10004)
- AZ LEVEL OUTPUT Connector (J10013)
- BA AUXILIARY Connector (J10010)
- BB LINE SELECT Switch
- BC F2 AC LINE OUT Fuse



6707002

I-1402 Front and Rear Panels
Figure 3



A. I-1402 Description of Controls, Connectors, and Indicators

Refer to Figure 3.

ITEM	NAME	DESCRIPTION
------	------	-------------

A. RF LEVEL (dB) Display

Displays value of vernier RF level in 0.1 dB steps, as selected by the SLEW Control (B) or remote control (GPIB). (Displayed level is added to the ATC-1400A RF level generator output.)

B. SLEW Control

Adjusts vernier RF level ± 3.0 dB, as displayed on RF LEVEL Display (A).

C. STABLE Indicator (LED)

Illuminates when pulse repetition jitter, as measured from pre-trigger to decode video, is less than 0.45 μ s.

D. UNSTABLE Indicator (LED)

Illuminates when pulse repetition jitter, as measured from pre-trigger to decode video, is greater than 0.65 μ s.

NOTE: When pulse jitter is between 0.45 μ s and 0.65 μ s, either STABLE Indicator (C) or UNSTABLE Indicator (D) may be illuminated.

E. P4 DEV Switch

Use in Mode 4 (Internal) Test Functions.

- Δ - Advances position of P4 Pulse by value selected on ATC-1400A P2/P3 DEV Thumbwheels (44), in microseconds.

CAL - P4 Pulse remains in nominal position (6 μ s from leading edge of P1). ATC-1400A P2/P3 DEV Thumbwheels (44) have no effect on deviating P4 pulse.

+ Δ - Delays position of P4 Pulse by value selected on ATC-1400A P2/P3 Thumbwheels (44), in microseconds.

F. REPLY DELAY 2 Control

Varies position of Reply Pulses when position "2" is selected on REPLY DELAY Switch (J). Refer to Table 1.



ITEM	NAME	DESCRIPTION
G.	DISPARITY DELAY 2 Control	Varies position of Disparity or GTC Trigger Pulse, depending on test function, when position "2" is selected on DISPARITY DELAY 2 Switch (H). Refer to Table 2.
H.	DISPARITY DELAY Switch	
1	-	Varies position of Disparity or ISLS Pulse by DISPARITY DELAY 1 Control (K). Refer to Table 2.
CAL	-	Pulse remains at a calibrated setting shown in Table 2.
2	-	Varies position of Disparity or GTC Pulse by DISPARITY DELAY 2 Control (G). Refer to Table 2.
J.	REPLY DELAY Switch	
1	-	Varies position of Reply Pulses as listed in Table 1 by REPLY DELAY 1 Control (L).
CAL	-	Pulses remain at calibrated setting, as selected by test function and word format on MODE SELECT Control (Q). Calibrated settings are listed in Table 1.
2	-	Varies position of Reply Pulses listed in Table 1 by REPLY DELAY 2 Control (F).
K.	DISPARITY DELAY 1 Control	Varies position of Disparity or ISLS Pulse, depending on test function, when position "1" is selected on DISPARITY DELAY Switch (H). Refer to Table 2.
L.	REPLY DELAY 1 Control	Varies position of Reply Pulses when position "1" is selected on REPLY DELAY Switch (J). Refer to Table 1.



TEST FUNCTION	CALIBRATED REPLY DELAY	VARIABLE REPLY DELAYS 1 and 2
XPDR ATC	3 μ s	0 to 12 μ s
XPDR Mode 4	A: 200 μ s, B: 260 μ s, O: 230 μ s, RANDOM: 200 μ s to 260 μ s	180 to 280 μ s
RADAR ATC	3 μ s + range delay	1.0 to 12 μ s
RADAR Mode 4	A: 202 μ s, B: 262 μ s, O: 232 μ s, RANDOM: 202 μ s to 262 μ s	180 to 280 μ s

All ATC reply delays are measured from nominal P4 position.
All Mode 4 reply delays are measured from nominal P3 position.
RANDOM varies in quasi-random fashion.

Reply Delay Control
Table 1

TEST FUNCTION	CALIBRATED DISPARITY DELAY	VARIABLE DISPARITY DELAY 1	VARIABLE DISPARITY DELAY 2
XPDR ATC	Not Used	Not Used	Not Used
XPDR Mode 4	198 μ s following P4	180 to 280 μ s	0 to 100 μ s
RADAR ATC	Not Used	Not Used	Not Used
RADAR Mode 4	(ISLS) 5.9 μ s following P1	(GTC) 360 to 384 μ s following EXT SYNC Pulse	(ISLS) -6.1 to 17.9 μ s following P1

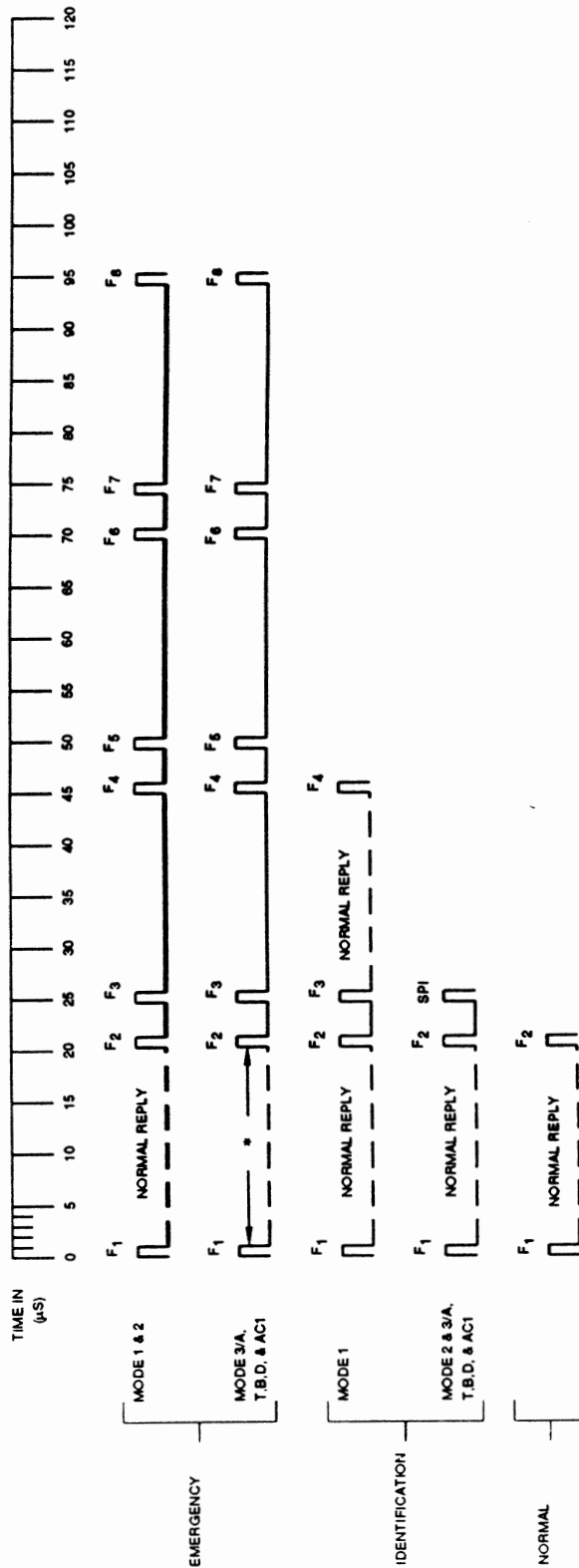
Disparity Delay Control
Table 2



ITEM	NAME	DESCRIPTION
M.	REPLY FORMAT Switch	
	XPDR ATC	
	NORM	- Selects normal reply format for Modes 1, 2, 3/A, T, B, C, D, AC1, and AC2 as selected by XPDR MODE Control (38). Reply format description is shown in Figure 4.
	EMER	- Selects emergency reply format for Modes 1, 2, 3/A, T, B, D, and AC1 as selected by XPDR MODE Control (38). Reply format description is shown in Figure 4.
	NOTE:	7700 should be selected on REPLY CODE/ALTITUDE Thumbwheels (V) when using Emergency Reply Format.
	IDENT-	Selects identification reply format for Modes 1, 2, 3/A, T, B, D, and AC1 as selected by XPDR MODE Control (38). Reply format description is shown in Figure 4.
	RADAR ATC	
	NORM	- Disables SPI Pulse.
	IDENT-	Enables the SPI Pulse. The REPLY CODE generated is selected by REPLY CODE/ALTITUDE Thumbwheels (V). Signal definition is shown in 1-2-3, Figure 12.
	EMER	- Enables SPI Pulse. Generates the 7700 code and overrides the REPLY CODE/ALTITUDE Thumbwheel (V) setting.
N.	"X" PULSE Switch (X pulse is used to simulate unmanned aircraft.)	
	ON	- Enables "X" pulse into the IDENT reply code. Position for "X" pulse is shown in 1-2-3, Figures 6 and 12.
	OFF	- Disables "X" Pulse generated by I-1402 Test Auxiliary.
P.	ATC RADAR MODE Indicator	
		Illuminates to indicate RADAR ATC Test function is selected on MODE SELECT Control (Q).



OPERATION MANUAL
MODE 4 TEST SYSTEM



Reply Code Format Timing Chart
Figure 4



OPERATION MANUAL
MODE 4 TEST SYSTEM

ITEM	NAME	DESCRIPTION
Q.	MODE SELECT Control	Selects Test Function mode, and in Mode 4, interrogation word format (A, B, O, or RANDOM).
R.	POWER Switch	Applies external AC power to the I-1402 Test Auxiliary and AC OUT Connector (AC)
S.	XPDR MODE 4 Indicator	Illuminates to indicate XPDR Mode 4 is selected on MODE SELECT Control (Q).
T.	RADAR MODE 4 Indicator	Illuminates to indicate RADAR Mode 4 is selected on MODE SELECT Control (Q).
U.	MODE GROUP DELAY Indicator	Indicates ATC-1400A DBL INTERR/INTRF Thumbwheels (42) are set to Double Interrogation at the same time the SUPPRESSOR ON/OFF Switch (17) is ON. When this happens, the first interrogation is omitted. Delay between the mutual suppression pulse and second interrogation is controlled by DBL INTERR/INTRF PULSE Thumbwheels (42).
V.	REPLY CODE/ALTITUDE Thumbwheels	Selects either one of 4096 reply IDENT codes, from 0000 to 7777 (octal) for modes 1, 2, or 3/A; or altitude from -0010 (represented as 9010) to 1267 (decimal), in hundreds of feet (30.48 meters/100 ft), for Mode C. NOTE: All 12 bits of the reply code are active regardless of the XPDR mode selected. Mode 1 only uses digits "A" and "B" (first six bits). Digits "C" and "D" (last six bits), the two least significant digits on the thumbwheel switch, should be set to zero, (e.g., select 1100 to 7700).
W.	REPLY ON/OFF Switch	ON - Enables all Reply Pulses, not otherwise controlled, to be sent to UUT. OFF - Inhibits all Reply Pulses within I-1402.



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MODE 4 TEST SYSTEM

ITEM	NAME	DESCRIPTION
X.	DISP ON/OFF Switch	
	ON	- Enables Disparity, ISLS, or GTC Pulse; depending on test function and DISPARITY DELAY Switch (H) position. Refer to Table 3.
	OFF	- Disables any pulse controlled by DISPARITY DELAY Switch (H).
Y.	P2 ON/OFF Switch	
	ON	- Enables a nominal 0.5 μ s P2 pulse in Mode 4 interrogation preamble. Pulse position is variable from nominal (2 μ s following P1) ± 1.95 μ s in 0.05 μ s steps using the ATC-1400A XPDR DEV P2/CAL Switch (28) and XPDR P2/P3 DEV Thumbwheels (44).
	OFF	- Disables P2 pulse.
Z.	P3 ON/OFF Switch	
	ON	- Enables a nominal 0.5 μ s P3 pulse in Mode 4 interrogation preamble. Pulse position is variable from nominal (4 μ s following P1) ± 1.95 μ s in 0.05 μ s steps using the ATC-1400A XPDR DEV P3/CAL Switch (25) and XPDR P2/P3 DEV Thumbwheels (44).
	OFF	- Disables P3 pulse.
AA.	P4 ON/OFF Switch	
	ON	- Enables a nominal 0.5 μ s P4 pulse in Mode 4 interrogation preamble. Pulse position is variable from nominal (6 μ s following P1) ± 1.95 μ s in 0.05 μ s steps using the P4 DEV Switch (E) and ATC-1400A XPDR P2/P3 DEV Thumbwheels (44).
	OFF	- Disables P4 pulse.
AB.	CODE INT/EXT Switch	
		Selects Interrogation word (P6 through P37)
	INT	- For Mode 4 (Internal), I-1402 generates interrogation word format O, A, B, or Random depending on MODE SELECT Control (Q) position. See Appendix B for formats.
	EXT	- For Mode 4 (External), interrogation word format is generated by an optional external encryption device.



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MODE 4 TEST SYSTEM

ITEM	NAME	DESCRIPTION
AC.	AC OUT Connector	Provides AC output voltage for ATC-1400A or ancillary test equipment.
AD.	AC IN Connector	Power receptacle for applying either 105 to 120 VAC or 220 to 250 VAC single phase power, at 50 to 400 Hz, to the I-1402. Line SELECT Switch (BB) must be set to the correct position before applying power.
AE.	F1 AC LINE IN Fuse	Fuses power to the I-1402 and AC OUT Connector (AC). When LINE SELECT Switch (BB) is in the 115 VAC position, F1 should be a 3.0 A Med Blow fuse. When LINE SELECT Switch (BB) is in the 230 VAC position, F1 should be a 1.5 A Med Blow fuse.
AF.	LEVEL REFERENCE Adjust (R11016)	
AG.	80 MHz Adjust (L11005)	
AH.	IFR BUS Connector (J10011)	25-pin female connector used to provide communication between the I-1402 and ATC-1400A IFR BUS Connector (71). (See Appendix A for pin assignments)
AJ.	LEVEL Adjust (R10018)	
AK.	TEST Connector (J10012)	
AL.	SPARE 4 (R12004)	
AM.	SPARE 3 (R12005)	
AN.	SPARE 2 (R12006)	
AP.	SPARE 1 (R12007)	
AQ.	TEMPERATURE Adjust (R12003)	
AR.	DISPARITY Connector (J10005)	Output to UUT Disparity Input, providing Disparity, ISLS, or GTC trigger in lieu of an encryption device.
AS.	EXT MOD Connector (J10001)	Signal received from the optional encryption device, at this connector, is used to modulate the ATC-1400A RF generator. Signal definitions are shown in 1-2-3, Figures 10 and 16.



ITEM	NAME	DESCRIPTION
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AT. TRIGGER OUTPUT Connector (J10006)

Output provides particular trigger pulse. Refer to Table 3.

TEST FUNCTION	TRIGGER PULSE
XPDR ATC	Not used
XPDR Mode 4 (Internal)	Oscilloscope Trigger 194 μ s following P4
XPDR Mode 4 (External)	Pre-trigger sent to KIR to start Mode 4 Interrogation process
RADAR ATC	coincides with end of range delay following P3
RADAR Mode 4 (Internal)	Simulating a KIR sending Time-Decoded Video to UUT
RADAR Mode 4 (External)	Enable trigger to KIT

Trigger Pulse Output
Table 3

AU. EXT SYNC Connector (J10002)

Input from RADAR UUT to initiate interrogation, to be used in lieu of an encryption device. Signal definition is shown in 1-2-3, Figure 14

AV. REPLY (TTL) Connector (J10007)

Output to UUT provides external pulse modulation for simulating an encryption device in Mode 4 or use with ATCRBS transponders requiring external encoding. Signal definition is shown in 1-2-3, Figures 6, 8, and 14.

AW. Reserved for future use (J10003)

AX. REPLY (3-27 V) Connector (J10008)

Output to UUT provides external pulse modulation for simulating an encryption device in Mode 4 or use with ATCRBS transponders requiring external encoding.



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MODE 4 TEST SYSTEM

ITEM	NAME	DESCRIPTION
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AY. DECODED VIDEO Connector (J10004)

Signal received from optional encryption device, at this connector, is used to determine reply jitter for STABLE Indicator (C) or UNSTABLE Indicator (D). Signal definition is shown in 1-2-3, Figure 10.

AZ. LEVEL OUTPUT Connector (J10013)

Vernier RF level output at this connector is controlled by SLEW Control (B) and sent to ATC-1400A through RF LEVEL INPUT Connector, J4 (76).

BA. AUXILIARY Connector (J10010)

25-pin female connector used to interconnect logic and timing signals between the I-1402 and ATC-1400A AUXILIARY Connector (72). (See Appendix A for pin assignments).

BB. LINE SELECT Switch

Selects a line voltage of either 115 VAC or 230 VAC.

BC. F2 AC LINE OUT Fuse

Fuses the power to the I-1402. When LINE VOLTAGE SELECT Switch (BB) is in the 115 VAC position, F2 should be 0.5 A Med Blow. When LINE VOLTAGE SELECT Switch (BB) is in the 230 VAC position, F2 should be 0.25 A Med Blow.

B. Description of ATC-1400A Controls, Connectors, and Indicators used in MODE 4 Test System

Descriptions listed below supersede descriptions listed in the ATC-1400A Operation/Maintenance Manual. Refer to Figure 2.

ITEM	NAME	DESCRIPTION
------	------	-------------

1. XMTR PWR WATTS Display

Provides a continuous visual display of peak pulse power of the UUT.

2. LOAD RANGE Pushbutton Switch

Programs a fixed range distance as selected on RANGE/VEL/ACCEL Thumbwheels (52).

NOTE: Maximum range used in MODE 4 Test System Test Functions is 200 nautical miles.



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MODE 4 TEST SYSTEM

ITEM	NAME	DESCRIPTION
3.	RF LEVEL -dBm Display	Displays the programmed peak RF power of the generator in dB below 1 mW.
6.	RF LEVEL Control	Adjusts RF generator level (Interrogation Transmission in XPDR Test Functions and Reply Transmission in RADAR Test Functions).
7.	CW/NORM/OFF Switch	Controls the signal through the RF I/O Connector (9). CW - Supplies continuous wave signal (RF signal with no modulation) at the frequency selected by the FREQ/FUNCTION SELECT Thumbwheels (45). CW setting is used for testing the Mode 4 Test System. NORM- Supplies modulated RF signal and is the normal setting during operation. OFF - Disables output.
9.	RF I/O Connector (J1015)	Connects all interrogation and reply RF pulses to the Antenna Connector of UUT.
12.	XMTR Connector (J1016)	RF pulses transmitted by UUT are detected by the ATC-1400A and presented at this connector.
13.	CLEAR RNG Pushbutton Switch	Clears previously selected range information.
15.	GEN Connector (J1017)	RF output pulses from generator are detected and presented at this connector, to enable viewing transponder interrogations and interference pulses.
16.	SUPPRESSOR OUTPUT Connector (J1018)	Provides mutual suppression pulses.
17.	SUPPRESSOR ON/OFF Switch	Enables/disables mutual suppression pulses.



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MODE 4 TEST SYSTEM

ITEM NAME DESCRIPTION

18. SLS/ECHO ON/OFF Switch

ON - When testing radars, echo replies are generated. When testing transponders, side-lobe suppression pulses (P2 for ATC Modes and P5 for Mode 4) are enabled.

OFF - Echo replies and side-lobe suppression pulses are inhibited.

19. SUPPRESSOR VAR Adjustment

Adjusts amplitude level of the mutual suppression pulses

20. XPDR PULSE WIDTH VAR/CAL Switch

VAR - Selects variable pulse width, as read from the XPDR PULSE WIDTH Thumbwheels (49).

CAL - Selects nominal pulse width depending on test function. See Table 4.

TEST FUNCTION	PULSES AFFECTED	NOMINAL WIDTH
XPDR ATC	P1, P2	0.8 μ s
XPDR Mode 4	P1, P2, P3, P4	0.5 μ s
RADAR ATC	F2	0.45 μ s
RADAR Mode 4	P1, P2, P3, P4	0.5 μ s

Pulse Width Control
Table 4

23. CAL \emptyset Control

Adjusts the phase of calibration (timing) pulses.

25. XPDR DEV P3/CAL Switch

- Δ - Advances position of P3 pulse from nominal, by value selected on XPDR P2/P3 DEV Thumbwheels (44), in microseconds.

CAL - P3 pulse remains in nominal position. XPDR P2/P3 DEV Thumbwheels (44) have no effect on deviating P3 pulses.

+ Δ - Delays position of P3 pulse from nominal, by value selected on XPDR P2/P3 DEV Thumbwheels (44), in microseconds.



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MODE 4 TEST SYSTEM

ITEM	NAME	DESCRIPTION
26.	CAL MARKS Connector (J1019)	Provides an output for the calibration pulses set by the 1.0 μ S/1.45 μ S Switch (27) and aligned by the CAL \emptyset Control (23).
27.	1.0 μ S/1.45 μ S Switch	Sets calibration pulses through CAL MARKS Connector (26). 1.45 μ S setting is used to verify ATC reply pulses.
28.	XPDR DEV P ₂ /CAL Switch	<p>-Δ - Advances position of P₂ pulse (F₂ pulse in RADAR ATC Test Function) from nominal; by value selected on the XPDR P₂/P₃ DEV Thumbwheels (44), in microseconds.</p> <p>CAL - Pulse remains in nominal position. XPDR P₂/P₃ DEV Thumbwheels (44) have no effect on deviating P₂ or F₂ pulses.</p> <p>+Δ - Delays position of pulse from nominal, by value selected on the XPDR P₂/P₃ DEV Thumbwheels (44), in microseconds.</p>
29.	SYNC Connector (J1020)	Provides active low Oscilloscope sync pulse set by T ₀ /TAC/T _D Switch (30).
30.	T ₀ /TAC/T _D Switch	Controls sync pulse position through the SYNC Connector (29).
	T ₀	- Positions sync pulse for viewing interrogation or ATC reply pulses on Oscilloscope.
	TAC	- Not used by the Mode 4 Test System.
	T _D	- Positions sync pulse for viewing second interrogations or Mode 4 replies on Oscilloscope.
31.	INTRF PULSE WIDTH Control	Adjusts width of interference pulse.
32.	PRF/SQTR ON/OFF Switch	Two-position toggle switch, when set to OFF, will inhibit interrogations. OFF is displayed on DISPLAY SELECT Readout (43) when PRF/SQTR ON/OFF Switch (32) is set to OFF.



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MODE 4 TEST SYSTEM

ITEM	NAME	DESCRIPTION
34.	F2/P2 F1/P1 Switch	Measures UUT frequency and power of F1 or F2 reply pulse. For MODE 4 Test System functions, switch should be set to F1/P1.
35.	LINE Switch	Applies external ac Power to ATC-1400A Test Set.
38.	XPDR MODE Control	Selects nominal P3 pulse position for XPDR ATC interrogation modes and determines start time for range delay by referencing to P3 spacing for RADAR ATC interrogation modes. NOTE: In RADAR ATC Test Function, set control to same mode position as the RADAR UUT.
40.	DISPLAY SELECT Control	DISPLAY SELECT Readout (43) displays a particular test condition for the control setting listed as follows: a. FREQ MHz Displays Mode 4 Test System transmit frequency in MHz. b. RANGE NMi (Not used in MODE 4 Test System) c. VEL KTS (Not used in MODE 4 Test System) d. PRF/SQTR Hz Displays number of interrogations per second, as selected on PRF/SQTR Thumbwheels (41). e. DME DIST NMi (Not used in MODE 4 Test System) f. XPDR CODE Displays Mode A identification replies (IDENT Code) and Mode C altitude replies from UUT in XPDR ATC Test Function.
41.	PRF/SQTR Thumbwheels	Selects the interrogation rate in Hz. When double interrogation rate is selected, interrogation rate is twice the thumbwheel value. When XPDR MODE Control (38) is set to AC1 or AC2, the rate of A or C interrogations is half the thumbwheel value.



ITEM	NAME	DESCRIPTION
------	------	-------------

42. DBL/INTERR/INTRF Thumbwheels

Selects either a double interrogation or an interference pulse. Numbers, in microseconds, represent the distance from the leading edge of P1 in the regular interrogation to the interference pulse or P1 in the extra interrogation, depending on the function selected. This feature will override normal transponder mode of operation.

NOTE: I-1402 MODE GROUP DELAY Indicator (U) illuminates whenever double interrogation and suppressor (17) are selected simultaneously.

43. DISPLAY SELECT Readout

Displays information selected on DISPLAY SELECT Control (40).

44. XPDR P2/P3 DEV Thumbwheels

Deviates pulses, as shown in Table 5, from nominal position by value selected on the thumbwheel switches, in microseconds.

TEST FUNCTIONS	PULSE/(CONTROL SWITCH)
XPDR ATC	P2/(28), P3/(25)
XPDR Mode 4	P2/(28), P3/(25), P4/(E)
RADAR ATC	F2/(28)
RADAR Mode 4	P2/(28), P3/(25), P4/(E)

Pulse Deviation Control
Table 5

45. FREQ/FUNCTION SELECT Thumbwheels

Must be set to "XPDR" position for MODE 4 Test System Functions. Selects transmitting frequency of Test System. 1030 MHz is nominal for interrogator transmissions (XPDR Test Functions) while 1090 MHz is nominal for transponder transmissions (RADAR Test Functions).

46. DME-PRF Hz XPDR - % REPLY Display

Continuously displays ratio of transponder replies to MODE 4 Test System interrogations.



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ITEM	NAME	DESCRIPTION
49.	XPDR PULSE WIDTH Thumbwheels	Selects, in microseconds, pulse width of pulses shown in Table 4 when XPDR PULSE WIDTH VAR/CAL Switch (20) is in the "VAR" position.
50.	SLS/ECHO Thumbwheels	Selects amplitude of side-lobe suppression pulses (P2 for XPDR ATC and P5 for XPDR Mode 4), interference pulses for XPDR Test Functions, and echo replies for RADAR Test Functions.
51.	XMTR FREQ MHz Display	Continuously displays average frequency of UUT RF pulses as measured between 50% amplitude points.
52.	RANGE/VEL/ACCEL Thumbwheels	Simulates range in nautical miles. NOTE: The maximum range used in MODE 4 Test System Test Functions is 200 nautical miles.
53.	GPIB Connector	24-pin female connector conforming to IEEE standard 488-1978 for interface of general purpose programmable instrumentation.
54.	GPIB ADDRESS Dip Switches	Eight segment DIP switch used for setting IEEE-488 bus address for remote control mode of operation.
57.	AC INPUT Connector	Connects ac power from I-1402 to ATC-1400A.
61.	XMTR Connector (J9111)	Video output of RF pulses from the UUT (reply pulses in XPDR Test Functions and interrogation pulses in RADAR Test Functions) are at this connector. In Mode 4 External Test Functions, this connector is used to transmit pulses to encryption devices (KIR in XPDR Test and KIT in RADAR Test).
62.	GEN Connector (J9110)	Provides the TTL-compatible signal which modulates ATC-1400A generator output.



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ITEM	NAME	DESCRIPTION
71.	IFR BUS Connector (J9105)	25-pin female connector for exchanging microprocessing data between the ATC-1400A and I-1402 (J10011 [AH]).
72.	AUXILIARY Connector (J9106)	25-pin female connector for exchanging signal, video, and timing data between the ATC-1400A and I-1402 (J10010 [BA]).
76.	RF LEVEL INPUT Connector (J9104)	Used for additional ± 3 dB level control of RF Output from I-1402 LEVEL OUTPUT Connector (J10013 [AZ]).



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3. General Operating Procedures

There are many variable controls on both the I-1402 and ATC-1400A test units. An understanding of how these controls affect test functions and how both units interact to carry out these test functions is important. This section provides a general description of controls, connectors, and indicators used in MODE 4 Test System functions. A brief overview of how the units interact is included in this paragraph. Changing I-1402 controls affecting ATC-1400A output is accomplished as the I-1402 sends commands to the ATC-1400A. The I-1402 monitors ATC-1400A control settings and reacts accordingly to any changes. In XPDR ATC, the ATC-1400A produces interrogation pulses and the I-1402 produces simulated reply video used to test XPDR UUT encoder inputs. In all other modes, the I-1402 controls all pulse functions, except interference pulses, through the Auxiliary Bus.

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 are addressed in the UUT Manuals.

LOCAL CONTROL (FRONT PANEL) OPERATION

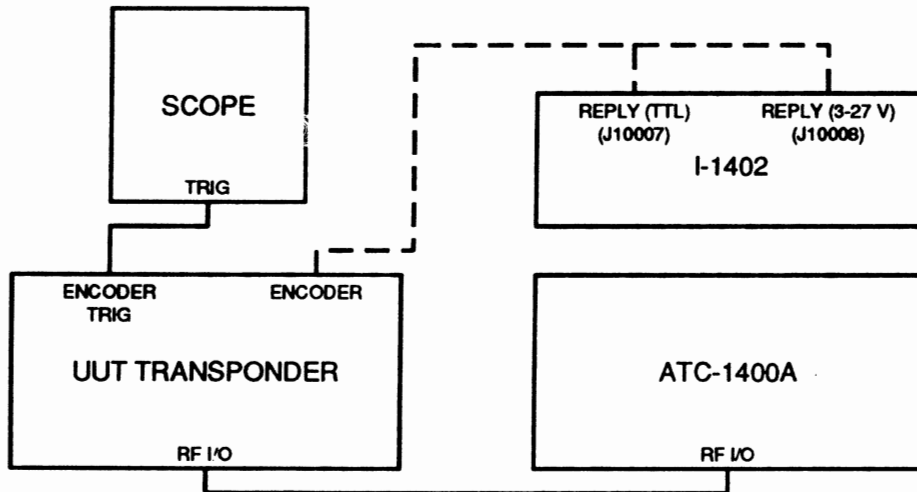
The MODE 4 Test System has six (6) distinct functions of operation listed as follows:

Paragraph	Test Function	Page No.
3A	XPDR ATC Test Function	2
3B	XPDR Mode 4 (Internal) Test Function (For Use Without KIT Encryption Device)	7
3C	XPDR Mode 4 External) Test Function (For Use With KIT Encryption Device)	13
3D	RADAR ATC Test Function	17
3E	RADAR Mode 4 (Internal) Test Function (For Use Without KIR Encryption Device)	21
3C	XPDR Mode 4 External) Test Function (For Use With KIR Encryption Device)	25



A. XPDR ATC Test Function

The XPDR ATC Test Function verifies the accuracy of a transponder in transmitting altitude and identification codes. The I-1402 Test Auxiliary provides this input information.



06703001

XPDR ATC Test Hook-up Diagram
Figure 5

(1) Setup and Controls

STEP	PROCEDURE
1.	Set up MODE 4 Test System according to XPDR ATC Test Hook-up Diagram, Figure 5.
2.	Set the ATC-1400A FREQ/FUNCTION SELECT Thumbwheels (45) to "XPDR" at 1030 MHz.
3.	Set I-1402 MODE SELECT Control (Q) to XPDR ATC (fully counterclockwise).
4.	Set ATC-1400A XPDR MODE Control (38) to desired interrogation mode.
5.	Set ATC-1400A DISPLAY SELECT Control (40) to "XPDR CODE".



STEP PROCEDURE

6. Variable parameters are controlled as follows:

RF Frequency is varied through ATC-1400
FREQ/FUNCTION SELECT Thumbwheels (45).

RF Level is adjusted by using I-1402 RF LEVEL
(dB) Display (A) with SLEW Control (B) and
ATC-1400A RF LEVEL -dBm Display (3) with RF
LEVEL Control (6).

Interrogation Pulse Repetition Frequency is
controlled through the ATC-1400A PRF/SQTR
Thumbwheels (41).

Interrogation Pulse Width Control is
accomplished through ATC-1400A PULSE WIDTH
VAR/CAL Switch (20) and XPDR PULSE WIDTH
Thumbwheels (49).

Interrogation Pulse Deviation is accomplished
through ATC-1400A XPDR DEV P3/CAL Switch (25),
XPDR DEV P2/CAL Switch (28), and XPDR P2/P3 DEV
Thumbwheels (44).

Suppression is controlled through ATC-1400A
SLS/ECHO ON/OFF Switch (18) along with SLS/ECHO
Thumbwheels (50) for Side-Lobe Suppression and
ATC-1400A SUPPRESSOR OUTPUT Connector (16),
SUPPRESSOR ON/OFF Switch (17), and SUPPRESSOR
VAR Adjustment for Mutual Suppression.

Double Interrogations and Interference pulses
are controlled through ATC-1400A DBL
INTERR/INTRF PULSE Thumbwheels (42) and INTRF
PULSE WIDTH Control (31).

Reply Format and content is varied through
I-1402 REPLY ON/OFF Switch (W), REPLY
CODE/ALTITUDE Thumbwheels (V), REPLY FORMAT
Switch (M), and "X" PULSE Switch (N).

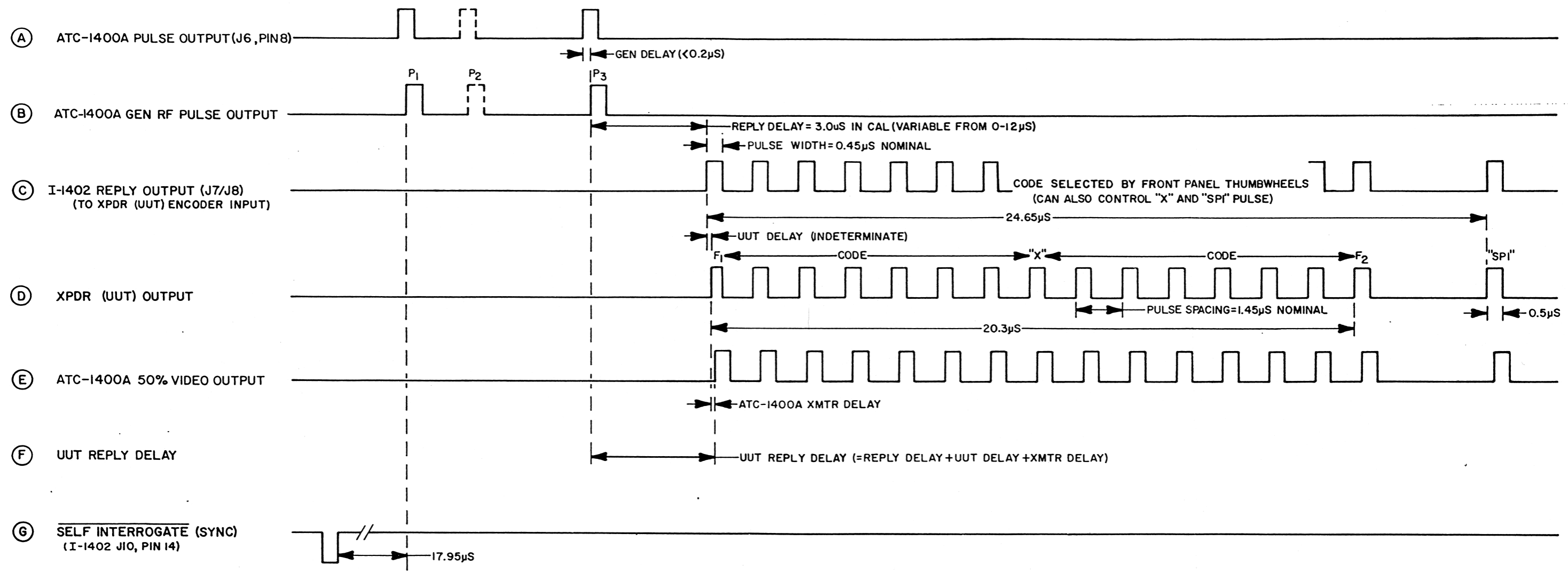
Reply Delay is controlled through I-1402 REPLY
DELAY Switch (J), REPLY DELAY 1 Control (L),
and REPLY DELAY 2 Control (F).

7. Reply percentage is verified by ATC-1400A DME-PRF
Hz XPDR - % REPLY Display (46).
8. Transponder frequency is verified by ATC-1400A
XMTR FREQ MHz Display (51).
9. Transponder power level is verified by ATC-1400A
XMTR PWR WATTS Display (1).



(2) General Test Sequence

STEP	ACTION/TEST
1.	ATC-1400A sends operator controlled ATCRBS interrogation (TTL signal) to I-1402 Test Auxiliary as a timing reference for generating the reply code (Ref. line A, Figure 6).
2.	ATC-1400A sends ATCRBS interrogation (RF signal) to UUT (Ref. line B, Figure 6).
3.	I-1402 sends operator controlled reply to transponders requiring externally encoded input (Ref. line C, Figure 6).
4.	UUT sends reply to MODE 4 Test System (Ref. lines D and E, Figure 6). Detected Video can be seen by connecting an oscilloscope to ATC-1400A XMTR Connector (12).
5.	UUT Reply Delay is measured using GPIB command (Ref. last command, 1-2-4, Table 6).



NOTES:

- A PULSE INPUT (I-1402, J10, PIN 8).
- B ATC-1400A GENERATES INTERROGATION.
- C FOLLOWING SELECTED REPLY DELAY, I-1402 TRANSMITS ALTITUDE OR IDENT CODE DIRECTLY TO UUT.
- D FOLLOWING AN INDETERMINATE DELAY, UUT TRANSMITS REPLY DIRECTLY BACK TO ATC-1400A.

- E FOLLOWING ATC-1400A DELAY ($< 0.1 \mu S$) UUT RESPONSE IS OBSERVED AT 50% VIDEO OUTPUT (ATC-1400A, J6, PIN 11).
- F UUT REPLY DELAY IS MEASURED FOR GPIB OUTPUT.

XPDR ATC Test Function
Timing Chart
Figure 6



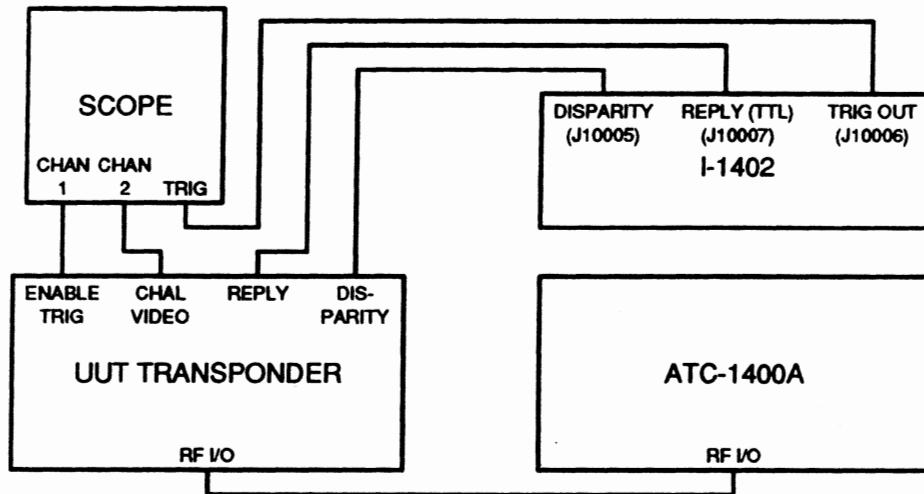
OPERATION MANUAL
MODE 4 TEST SYSTEM

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B. XPDR Mode 4 (Internal) Test Function

The XPDR Mode 4 (Internal) Test Function verifies ability of a transponder to correctly transmit Mode 4 reply pulses. The I-1402 Test Auxiliary supplies data, simulating encrypted interrogations and decoded replies. Testing is carried out by controlling several variables (SLS, Disparity delay, Pulse widths, Pulse spacings, Interrogation frequency, Interference, RF level) and ensuring the UUT reply pulses remain consistently correct.



06703002

XPDR Mode 4 (Internal) Test Hook-up Diagram
Figure 7

(1) Setup and Controls

STEP	PROCEDURE
1.	Set up MODE 4 Test System according to XPDR Mode 4 (Internal) Test Hook-up Diagram, Figure 7.
2.	Set the ATC-1400A FREQ/FUNCTION SELECT Thumbwheels (45) to "XPDR" at 1030 MHz.
3.	Set I-1402 MODE SELECT Control (Q) to desired XPDR MODE 4 position, selecting interrogation word format A, B, O, or RANDOM. (XPDR MODE 4 Indicator [S] is illuminated.)
4.	Set I-1402 CODE INT/EXT Switch (AB) to "INT" position.



STEP PROCEDURE

5. Variable parameters are controlled as follows:

RF Frequency is varied through ATC-1400 FREQ/FUNCTION SELECT Thumbwheels (45).

RF Level is adjusted by using I-1402 RF LEVEL (dB) Display (A) with SLEW Control (B) and ATC-1400A RF LEVEL -dBm Display (3) with RF LEVEL Control (6).

Interrogation Pulse Repetition Frequency is controlled through the ATC-1400A PRF/SQTR Thumbwheels (41).

Interrogation Pulse Width Control is accomplished through ATC-1400A PULSE WIDTH VAR/CAL Switch (20) and XPDR PULSE WIDTH Thumbwheels (49).

Interrogation Pulse Deviation is accomplished through I-1402 P4 DEV Switch (E), P2 ON/OFF Switch (Y), P3 ON/OFF Switch (Z), P4 ON/OFF Switch (AA); and ATC-1400A XPDR DEV P3/CAL Switch (25), XPDR DEV P2/CAL Switch (28), and XPDR P2/P3 DEV Thumbwheels (44).

Side-Lobe Suppression is controlled through ATC-1400A SLS/ECHO ON/OFF Switch (18) along with SLS/ECHO Thumbwheels (50).

Double Interrogations and Interference pulses are controlled through ATC-1400A DBL INTERR/INTRF PULSE Thumbwheels (42) and INTRF PULSE WIDTH Control (31). (Ref. lines A, G, and I; Figure 8.)

Disparity control is accomplished through I-1402 DISP ON/OFF Switch (X), DISPARITY DELAY Switch (H), DISPARITY DELAY 1 Control (K), and DISPARITY DELAY 2 Control (G).

Reply Delay is controlled through I-1402 REPLY DELAY Switch (J), REPLY DELAY 1 Control (L), and REPLY DELAY 2 Control (F).

6. Reply percentage is verified by ATC-1400A DME-PRF Hz XPDR - % REPLY Display (46).

7. Transponder frequency is verified by ATC-1400A XMTR FREQ MHz Display (51).

8. Transponder power level is verified by ATC-1400A XMTR PWR WATTS Display (1).



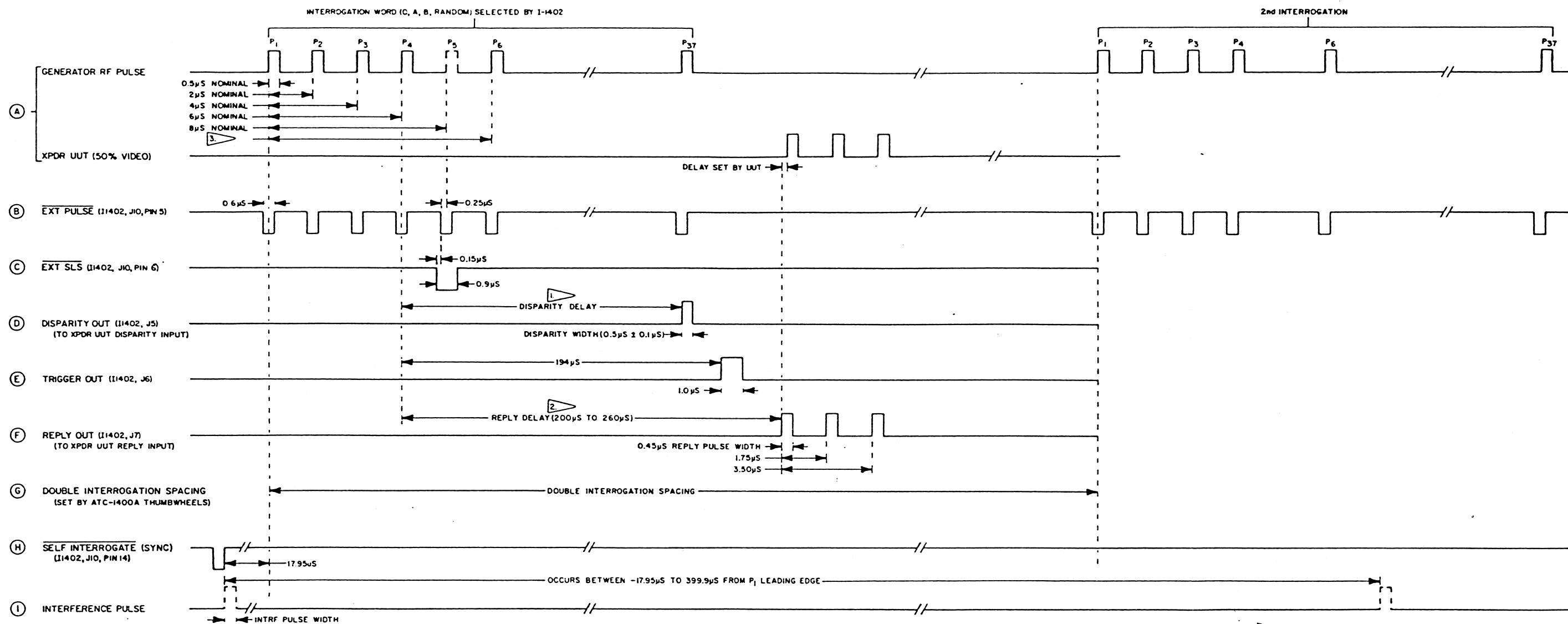
(2) General Test Sequence

STEP	ACTION/TEST
1.	MODE 4 Test System sends interrogations to UUT (Ref. line A, Figure 8). This output is controlled by external pulse data from I-1402 (Ref. lines B and C, Figure 8).
2.	UUT sends an enable trigger followed by Challenge Video to oscilloscope (Ref. Figure 7).
3.	MODE 4 Test System, simulating a KIT encryption device, sends disparity pulse or reply to UUT (Ref. lines D and F, Figure 8).
4.	UUT sends reply to MODE 4 Test System (Ref. line A, Figure 8). Detected Video can be seen by connecting oscilloscope to ATC-1400A XMTR Connector (12).



OPERATION MANUAL
MODE 4 TEST SYSTEM

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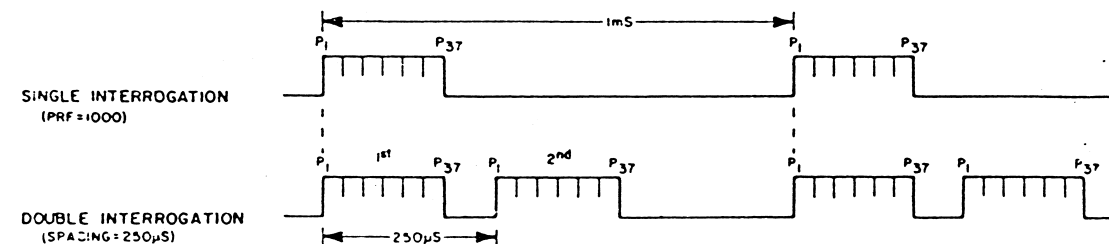


NOTES:

- (A) ATC-1400A GENERATES P₁ THRU P₄. I-1402 ADDS SELECTED INTERROGATION WORD.
- (B) EXT PULSE DATA SENT TO ATC-1400A RF GEN.
- (C) EXT SLS IS ENABLED BY I-1402 0.15 μS BEFORE EXT PULSE. THE EXT SLS PULSE IS APPROX. 0.9 μS WIDE. EXT PULSE DATA WILL PRECEDE GENERATOR OUTPUT BY APPROX. 0.25 μS.
- (D) OUTPUT DISPARITY TO XPDR UUT
- (E) OUTPUT TRIGGER TO OSCILLOSCOPE AT 194 μS FROM P₄
- (F) OUTPUT REPLY, FOLLOWING REPLY DELAY.

- (H) SELF-INTERROGATE (SYNC) PULSE WILL OCCUR 17.95 μS PRIOR TO P₁.
- (I) INTRF PULSE (ATC-1400A INTERFERENCE PULSE) IS CONTROLLED BY ATC-1400A DBL INTER/INTERF THUMBWHEEL (CAN OCCUR BETWEEN -17.95 μS TO 399.9 μS). PULSE WIDTH IS ADJUSTABLE BY FRONT PANEL CONTROL ON ATC-1400A.

EXAMPLE: DOUBLE INTERROGATION



- 1. TIMED FROM P₄ IN CAL POSITION. (CAL=198μS, CONTROL #1= 0-100μS, CONTROL #2 = 180 to 280μS).
- 2. CAL: A=200μS, B=260μS, O=230μS, CONTROL #1 & #2=180 to 280μS.
- 3. 9μS OR 10μS DEPENDING ON INFORMATION WORD SELECTED (O, A OR B). 9μS IS THE FIRST ANTI-INTERFERENCE PULSE (WORDS O OR A) AND 10μS IS THE FIRST INFORMATION PULSE (WORD B).

XPDR Mode 4 (Internal)
Test Function Timing Chart
Figure 8



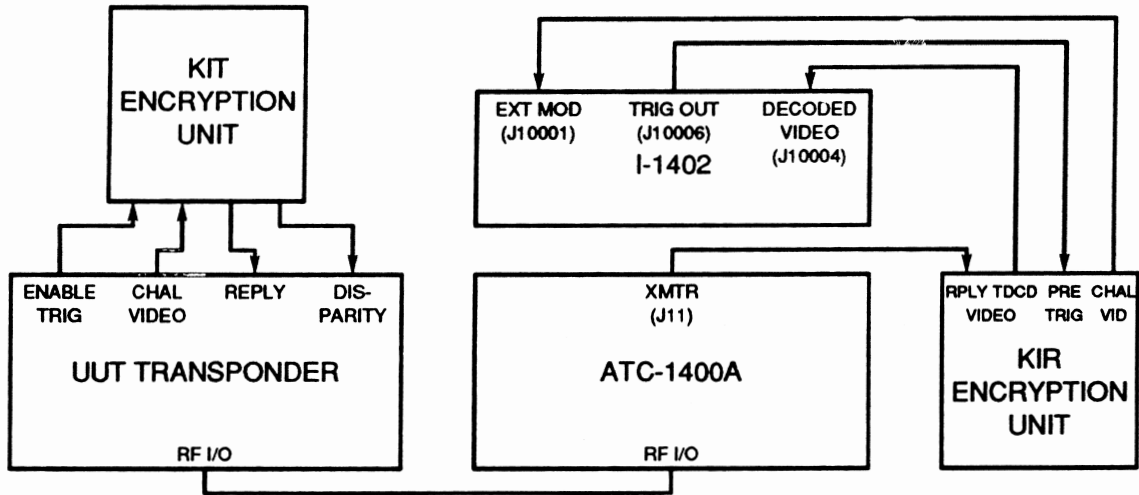
OPERATION MANUAL
MODE 4 TEST SYSTEM

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C. XPDR Mode 4 (External) Test Function

The XPDR Mode 4 (External) Test Function verifies a transponder's ability to receive an IFF interrogation and transmit a consistent reply. This test utilizes two encryption devices. A KIT encryption unit is used with transponder to decode interrogations and encrypt replies. A KIR encryption unit is used with test system for encrypting interrogations and decoding replies.



06703003

XPDR Mode 4 (External) Test Hook-up Diagram
Figure 9

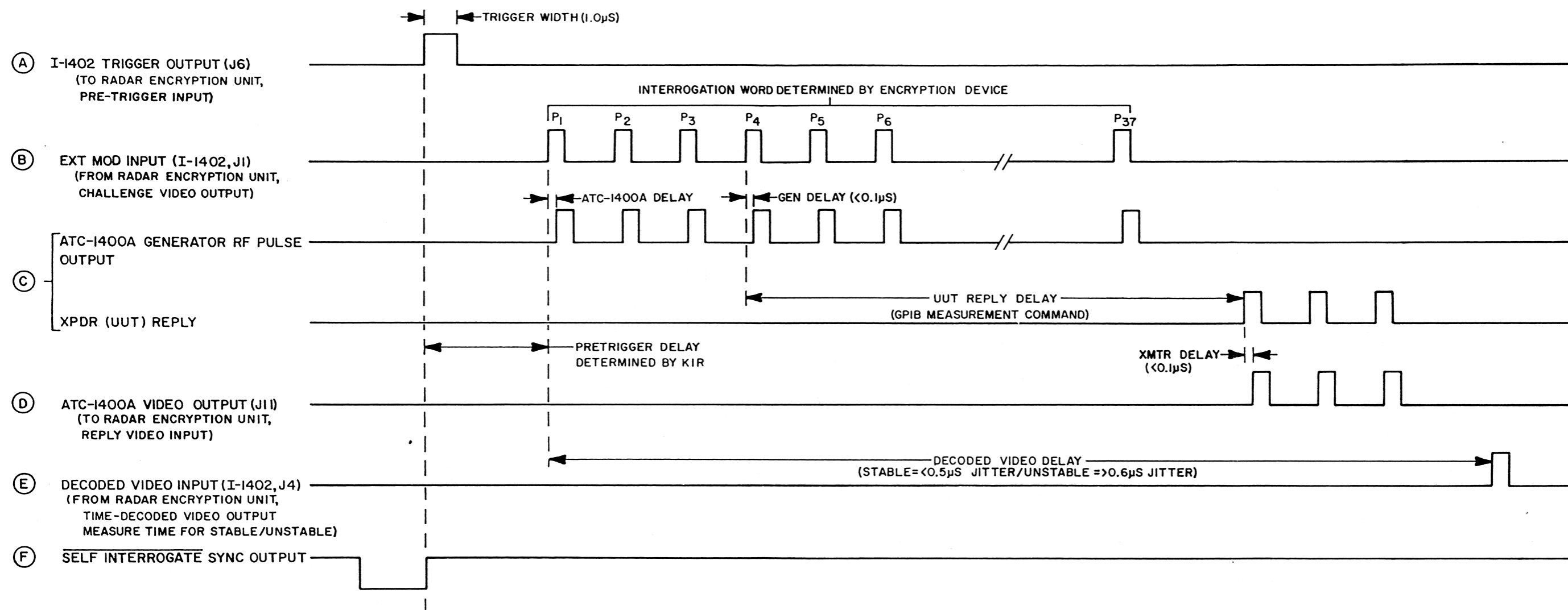
(1) Setup and Controls

STEP	PROCEDURE
1.	Set up MODE 4 Test System according to XPDR Mode 4 (External) Test Hook-up Diagram, Figure 9.
2.	Set the ATC-1400A FREQ/FUNCTION SELECT Thumbwheels (45) to "XPDR" at 1030 MHz.
3.	Set I-1402 MODE SELECT Control (Q) to any XPDR MODE 4 position. (XPDR MODE 4 Indicator [S] is illuminated.)
4.	Set I-1402 CODE INT/EXT Switch (AB) to "EXT" position.



(2) General Test Sequence

STEP	ACTION/TEST
1.	MODE 4 Test System triggers KIR encryption device (Ref. line A, Figure 10).
2.	KIR sends interrogation, Challenge Video, to MODE 4 Test System (Ref. line B, Figure 10).
3.	MODE 4 Test System sends interrogation to UUT (Ref. line C, Figure 10).
4.	UUT sends enable trigger to KIT encryption device, to enable KIT to receive interrogation (Ref. Figure 9).
5.	UUT sends interrogation, Challenge Video, to KIT (Ref. Figure 9).
6.	If interrogation is accepted, KIT sends reply to UUT (Ref. Figure 9). If interrogation is not accepted, KIT sends Disparity Pulse to UUT (Ref. Figure 9).
7.	UUT sends reply to MODE 4 Test System (Ref. line C, Figure 10). MODE 4 Test System measures reply delay through GPIB command (Ref. 1-2-4, table 6)
8.	MODE 4 TEST SYSTEM sends reply to KIR (Ref. line D, Figure 10).
9.	KIR sends time-decoded video to MODE 4 Test System (Ref. line E, Figure 10). Check jitter stability. STABLE Indicator (C) or UNSTABLE Indicator (D) is illuminated on I-1402.



NOTES:

- A TRIGGER OUTPUT TO KIR. USES ATC-1400A PRF GEN AND SELF INTERR WITH P1, P2, P3, AND P4 DISABLED.
- B KIR TRANSMITS MODULATION TO I-1402 EXT MOD INPUT.
- C ATC-1400A TRANSMITS INTERROGATION TO XPDR (UUT) WHICH IS CONNECTED TO KIT.
- D XPDR REPLY AND ATC-1400A OUTPUT IS SENT TO KIR.
- E KIR RETURNS TIME-DECODED VIDEO TO I-1402 WITHIN SAME INTERVAL EVERY TIME FOR STABLE INDICATION.
- F SELF INTERROGATE SYNC OUTPUT, FROM ATC-1400A PRF GEN (ATC-1400A, J6, PIN 14).

XPDR Mode 4 (External)
Test Function Timing Chart
Figure 10



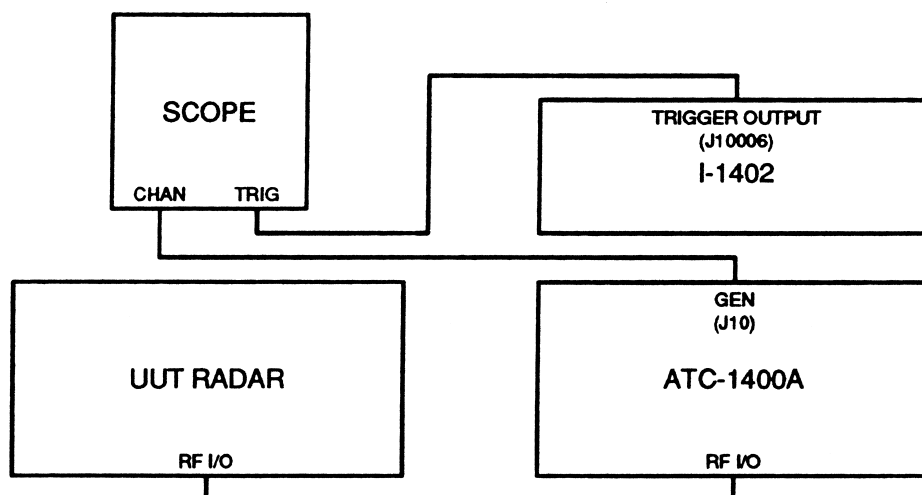
OPERATION MANUAL
MODE 4 TEST SYSTEM

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D. RADAR ATC Test Function

The RADAR ATC Test Function verifies a radar's ability to correctly interpret replies to Mode 3/A and Mode C interrogations. The I-1402 Test Auxiliary provides variable altitude and IDENT codes while the ATC-1400A varies range and simulates echo replies.



06703004

RADAR ATC Test Hook-up Diagram
Figure 11

(1) Setup and Controls

STEP	PROCEDURE
1.	Set up MODE 4 Test System according to RADAR ATC Test Hook-up Diagram, Figure 11.
2.	Set the ATC-1400A FREQ/FUNCTION SELECT Thumbwheels (45) to "XPDR" at 1090 MHz.
3.	Set I-1402 MODE SELECT Control (Q) to RADAR ATC (fully clockwise). (ATC Indicator [P] is illuminated on I-1402.)
4.	Set ATC-1400A XPDR MODE Control (38) to correct interrogation mode.

NOTE: The MODE 4 Test System does not interpret interrogation pulse spacing to determine what to reply. Instead, interrogation is referenced internally, triggered off P1 from UUT and controlled by XPDR MODE Control (38). Therefore, the XPDR MODE Control (38) must be in the same mode as the UUT to get accurate readings.



STEP **PROCEDURE**

5. Variable parameters are controlled as follows:

RF Frequency is varied through ATC-1400 **FREQ/FUNCTION SELECT** Thumbwheels (45).

RF Level is adjusted by using I-1402 **RF LEVEL (dB) Display (A)** with **SLEW Control (B)** and ATC-1400A **RF LEVEL -dBm Display (3)** with **RF LEVEL Control (6)**.

Range is simulated through ATC-1400A **LOAD RANGE Pushbutton Switch (2)** and **RANGE/VEL/ACCEL Thumbwheels (52)**.

Reply Delay is controlled through I-1402 **REPLY DELAY Switch (J)**, **REPLY DELAY 1 Control (L)**, and **REPLY DELAY 2 Control (F)**.

Reply Format and content is varied through I-1402 **REPLY ON/OFF Switch (W)**, **REPLY CODE/ALTITUDE Thumbwheels (V)**, **REPLY FORMAT Switch (M)**, and **"X" PULSE Switch (N)**.

F2 Reply Pulse Width Control is accomplished through the **PULSE WIDTH VAR/CAL Switch (20)** and **XPDR PULSE WIDTH Thumbwheels (49)** on ATC-1400A.

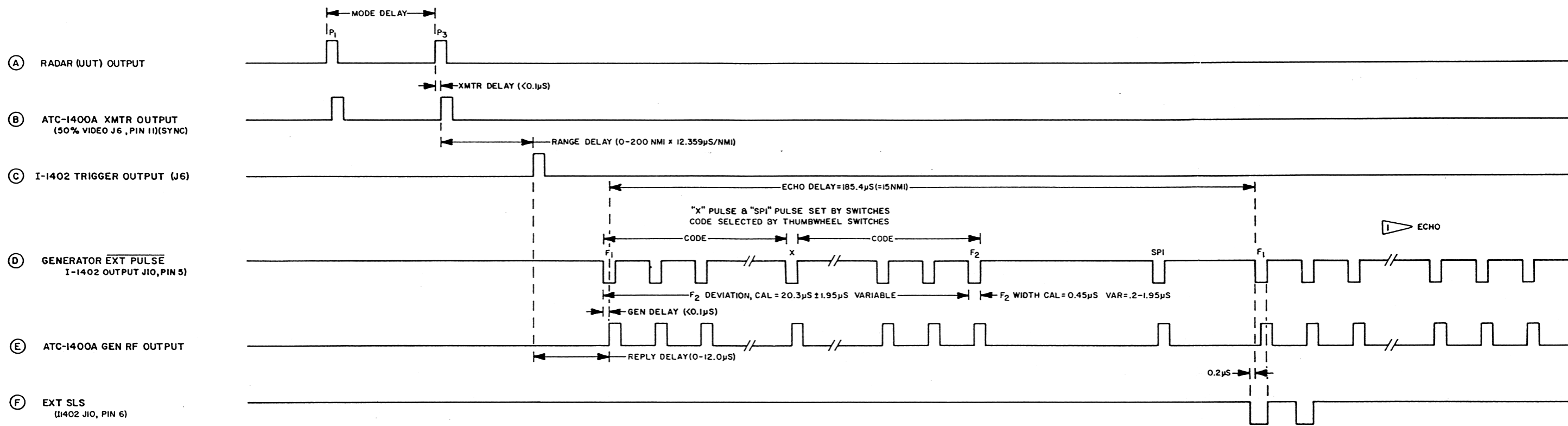
F2 Reply Pulse Deviation is accomplished through ATC-1400A **XPDR DEV P2/CAL Switch (28)** and **XPDR P2/P3 DEV Thumbwheels (44)**.

Echo Replies are controlled through ATC-1400A **SLS/ECHO ON/OFF Switch (18)** along with **SLS/ECHO Thumbwheels (50)**.

(2) **General Test Sequence**

STEP **ACTION/TEST**

1. UUT sends interrogation to ATC-1400A (Ref. line A, Figure 12).
2. ATC-1400A sends interrogation to I-1402 (Ref. line B, Figure 12).
3. I-1402 sends a trigger pulse to oscilloscope for accurate range delay to compare with UUT (Ref. line C, Figure 12).
4. MODE 4 Test System sends reply to UUT (Ref. line E, Figure 12). This output is controlled by external pulse data from I-1402 (Ref. lines D and F, Figure 12).



I ECHO SETS RANGE & VARIES AMPLITUDE THRU SLS/ECHO THUMBWHEELS. (F₁ STARTS AT 185.4μS PLUS RANGE DELAY & REPLY DELAY)

NOTES:

- A RADAR UNIT TRANSMITS P1 AND P3.
- B SYNC ON 50% VIDEO (ATC-1400A, J6, PIN 11).
- C I-1402 TRANSMITS TRIGGER PULSE FOLLOWING RANGE DELAY.
- D FOLLOWING VARIABLE REPLY DELAY, CODE IS SENT THROUGH EXT PULSE CONNECTOR. WHEN ECHO IS ENABLED (ATC-1400A SLS/ECHO SWITCH), REPEAT OF GENERATOR RF IS TRANSMITTED, STARTING AT 15 NMI PLUS REPLY AND RANGE DELAYS. F2 DEVIATION AND WIDTH IS CONTROLLED BY P2 CONTROLS ON ATC-1400A.
- E OUTPUT IS OBSERVED ON GEN OUTPUT (EQUIVALENT TO PULSE) (ATC-1400A, J10).
- F EXT SLS IS ENABLED FOR EACH PULSE OF THE ECHO, SO ECHO LEVEL CAN BE CONTROLLED.

RADAR ATC Test Function
Timing Chart
Figure 12



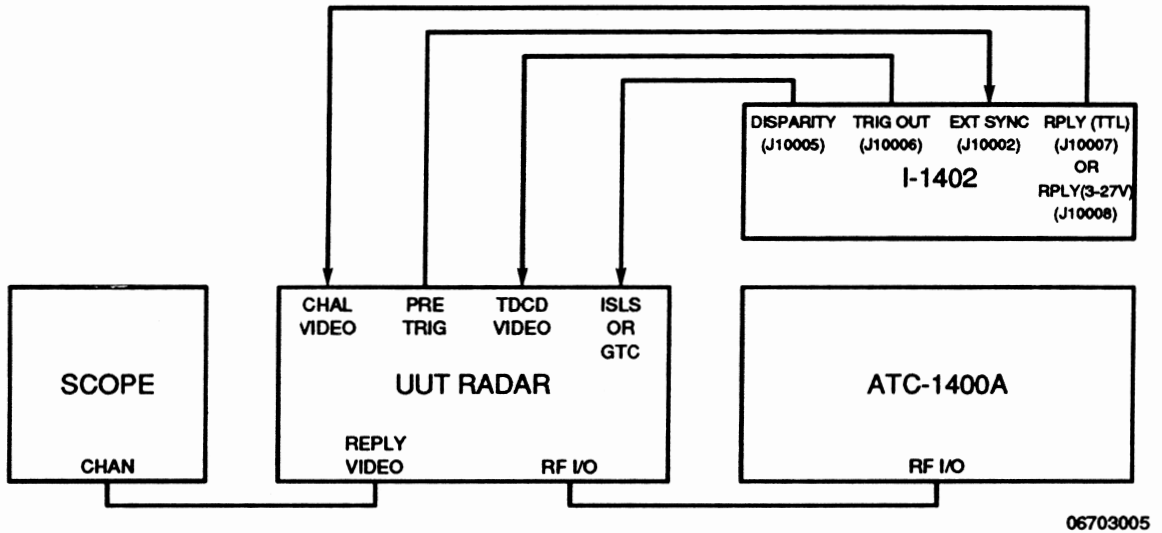
OPERATION MANUAL
MODE 4 TEST SYSTEM

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E. RADAR Mode 4 (Internal) Test Function

The RADAR Mode 4 (Internal) Test Function verifies ability of radars to transmit IFF interrogations and correctly respond to replies. The I-1402 Test Auxiliary provides input data, simulating encrypted interrogations and decoded replies.



RADAR Mode 4 (Internal) Test Hook-up Diagram
Figure 13

(1) Setup and Controls

STEP	PROCEDURE
1.	Set up MODE 4 Test System according to RADAR Mode 4 (Internal) Test Hook-up Diagram, Figure 13.
2.	Set the ATC-1400A FREQ/FUNCTION SELECT Thumbwheels (45) to "XPDR" at 1090 MHz.
3.	Set I-1402 MODE SELECT Control (Q) to desired RADAR MODE 4 position, selecting interrogation word format A, B, O, or RANDOM. (RADAR MODE 4 Indicator [T] is illuminated.)
4.	Set I-1402 CODE INT/EXT Switch (AB) to "INT" position.



STEP PROCEDURE

5. Variable parameters are controlled as follows:

RF Frequency is varied through ATC-1400 FREQ/FUNCTION SELECT Thumbwheels (45).

RF Level is adjusted by using I-1402 RF LEVEL (dB) Display (A) with SLEW Control (B) and ATC-1400A RF LEVEL -dBm Display (3) with RF LEVEL Control (6).

Range is simulated through ATC-1400A LOAD RANGE Pushbutton Switch (2) and RANGE/VEL/ACCEL Thumbwheels (52).

Reply Delay is controlled through I-1402 REPLY DELAY Switch (J), REPLY DELAY 1 Control (L), and REPLY DELAY 2 Control (F).

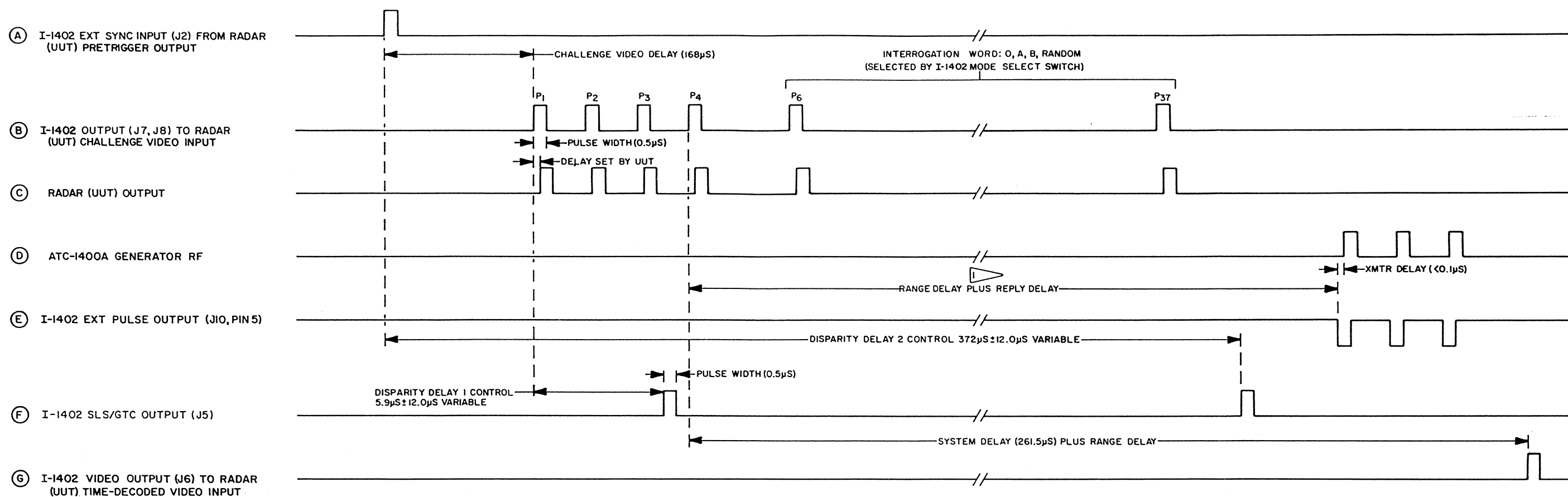
Disparity control, used to simulate ISLS and GTC Pulses, is accomplished through I-1402 DISP ON/OFF Switch (X), DISPARITY DELAY Switch (H), DISPARITY DELAY 1 Control (K), and DISPARITY DELAY 2 Control (G) (Ref. line F, Figure 14).

Echo Replies are controlled through ATC-1400A SLS/ECHO ON/OFF Switch (18) along with SLS/ECHO Thumbwheels (50).

(2) General Test Sequence

STEP ACTION/TEST

1. UUT sends pretrigger to I-1402, simulating a KIR encryption device (Ref. line A, Figure 14).
2. I-1402 sends interrogation, Challenge Video, to UUT (Ref. line B, Figure 14).
3. UUT interrogates MODE 4 Test System (Ref. line C, Figure 14).
4. MODE 4 Test System sends reply back to UUT (Ref. line D, Figure 14). This output is controlled by external pulse data from I-1402 (Ref. line E, Figure 14).
5. UUT sends reply to oscilloscope, simulating send to KIR encryption device (Ref. Figure 13).
6. I-1402, simulating a KIR, sends Time-Decoded Video to UUT (Ref. line G, Figure 14).



NOTES:

- A SYNC FROM I-1402 EXT SYNC INPUT (J2).
- B CHALLENGE VIDEO IS GENERATED IN I-1402 AND SENT TO RADAR (KIR SIMULATION) 168 µS FOLLOWING PRE-TRIGGER.
- C RADAR INTERROGATED ATC-1400A.
- D REPLY VIDEO IS TRANSMITTED TO UUT THROUGH EXT PULSE FOLLOWING REPLY PLUS RANGE DELAYS.
- E REPLY PULSE CONTROL IS SENT TO ATC-1400A.
- F I-1402 TRANSMITS ISLS WITH DELAY 1 CONTROL (SUPPRESSION) OR GTC TRIGGER, WITH DELAY 2 CONTROL

- G I-1402 SIMULATES TIME-DECODED VIDEO OUTPUT AT A FIXED SYSTEM DELAY OF 261.5 µS PLUS RANGE DELAY (FOR PPI DISPLAY).

1 ▷ REPLY DELAY IN "CAL" POSITION DEPENDS ON INTERROGATION WORD SELECTED (0 = 232 µS, A = 202 µS, B = 262 µS, RANDOM AUTOMATICALLY VARIES FROM 202 TO 262 µS), OR IT IS MANUALLY VARIABLE IN THE "1" OR "2" POSITION FROM 180 TO 280 µS. RANGE DELAY IS COMPUTED BY MULTIPLYING ATC-1400A FRONT PANEL RANGE SWITCHES BY 12.359 µS/NMI.

RADAR Mode 4 (Internal)
Test Function Timing Chart
Figure 14



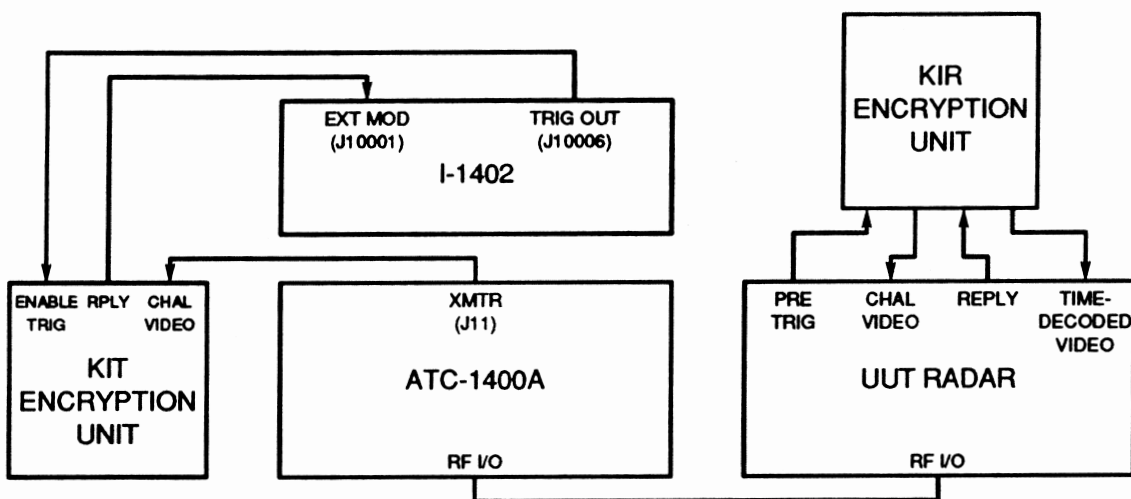
OPERATION MANUAL
MODE 4 TEST SYSTEM

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F. RADAR Mode 4 (External) Test Function

The RADAR Mode 4 (External) Test Function confirms radar's ability to transmit an IFF interrogation and receive the reply. This test utilizes two encryption devices. A KIR encryption unit for encrypting interrogations and decoding replies is used with radar UUT. A KIT encryption unit for decoding interrogations and encrypting replies is used with test system.



06703006

RADAR Mode 4 (External) Test Hook-up Diagram
Figure 15

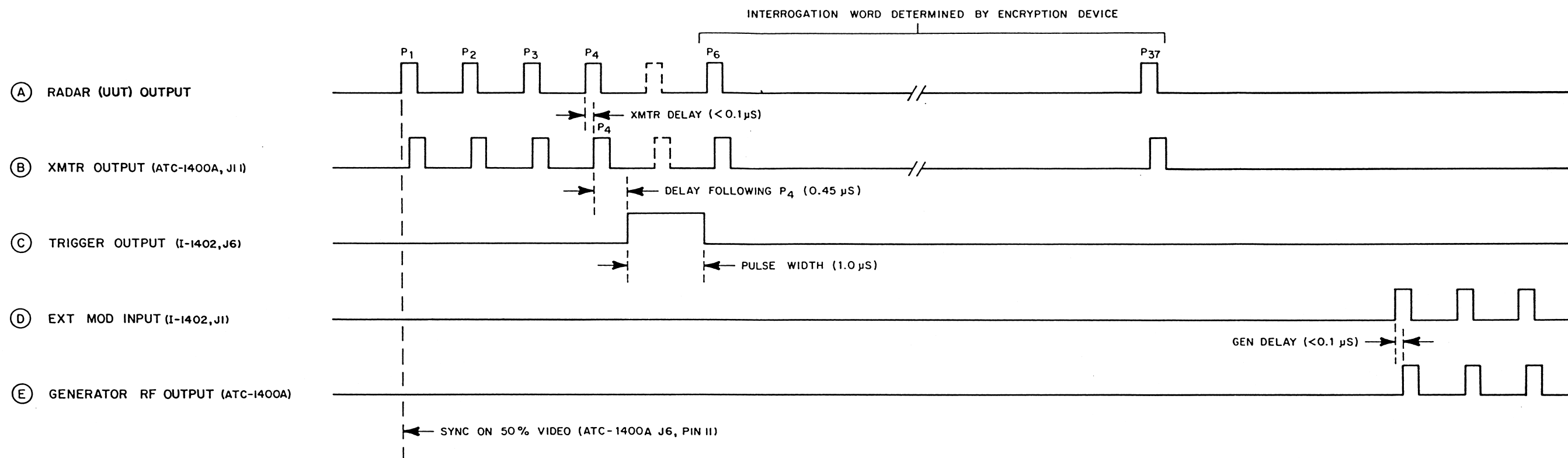
(1) Setup and Controls

STEP	PROCEDURE
1.	Set up MODE 4 Test System according to RADAR Mode 4 (External) Test Hook-up Diagram, Figure 15.
2.	Set the ATC-1400A FREQ/FUNCTION SELECT Thumbwheels (45) to "XPDR" at 1090 MHz.
3.	Set I-1402 MODE SELECT Control (Q) to any RADAR MODE 4 position. (RADAR MODE 4 Indicator [T] is illuminated.)
4.	Set I-1402 CODE INT/EXT Switch (AB) to "EXT" position.



(2) General Test Sequence

STEP	ACTION/TEST
1.	UUT triggers KIR encryption device (Ref. Figure 15).
2.	KIR sends interrogation, Challenge Video, to UUT (Ref. Figure 15).
3.	UUT sends interrogation to MODE 4 Test System (Ref. line A, Figure 16).
4.	MODE 4 Test System sends enable trigger to KIT encryption device (Ref. line C, Figure 16).
5.	MODE 4 Test System sends interrogation to KIT (Ref. line B, Figure 16).
6.	KIT sends reply to MODE 4 Test System (Ref. line D, Figure 16).
7.	MODE 4 Test System sends reply to UUT (Ref. line E, Figure 16).
8.	UUT sends reply to KIR (Ref. Figure 15).
9.	KIR decodes and verifies reply, then sends time-decoded video to UUT (Ref. Figure 15).



(THIS TEST SET-UP DOES NOT SIMULATE RANGE DELAY)

NOTES:

- A RADAR (UUT) TRANSMITS P1 THROUGH P37.
- B XMTR OUTPUT IS SENT TO KIT ENCRYPTION UNIT, CHALLENGE VIDEO INPUT.
- C ENABLE TRIGGER IS SENT, $0.45 \mu\text{s}$ FOLLOWING P4 TO ENABLE KIT ENCRYPTION UNIT (ENABLE TRIGGER INPUT).
- D KIT SENDS REPLY TO EXT MOD INPUT, MODULATING THE ATC-1400A GENERATOR THROUGH THE I-1402 EXT PULSE OUTPUT (J10, PIN 5).
- E ATC-1400A SENDS REPLY TO UUT.

RADAR Mode 4 (External)
Test Function Timing Chart
Figure 16



OPERATION MANUAL
MODE 4 TEST SYSTEM

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4. GPIB Operating Procedures

This section contains operating instructions relating to remote control (GPIB) operation of the Mode 4 Test System.

REMOTE CONTROL (GPIB) OPERATION

Remote communication with the Mode 4 Test System is provided by use of the General Purpose Interface Bus (GPIB) which conforms to IEEE Standard 488-1978. All communication with the Mode 4 Test System over the GPIB is implemented with ASCII encoded character strings.

Remote Control (GPIB) Commands

The GPIB Commands contained within this paragraph apply to all I-1402 Test Auxiliaries when interfaced with the ATC-1400A, and should be used in conjunction with the commands listed in the ATC-1400A Operation/Maintenance Manual. Refer to Paragraphs 1-2-4D through 1-2-4E(5) of the ATC-1400A Operation/Maintenance Manual for a complete explanation on remote communication with the Mode 4 Test System.

I-1402 Command Set

Table 6 defines the ASCII Commands used to control the I-1402 under GPIB operation. Delimiters for each command are used throughout the Table to define different command types:

"=" represents a "set value to" operation for that command.

"?" represents a "get value" operation for that command.

"." represents an "enable" operation.

Items listed under the range column reflect data entered into or retrieved from the I-1402. Data shown in parentheses is data retrieved from the unit. Data not enclosed in parentheses is data being sent to the I-1402.

NOTE: All commands and data entries must be numeric, one of the assigned delimiters, or an alphabetic (UPPERCASE or lowercase) character.

Command lines to be sent to the MODE 4 unit must be preceded with the qualifier "AX2=" as in: AX2=[COMMAND 1]: [COMMAND 2] ... [COMMAND n]. Commands may be grouped together on the same line using the ":" as a separator ("?" and "." are also separators for commands which normally use these).



COMMAND	RANGE	DEFINITION
AX2=RLCD=	If <u>Mode C</u> : -10 to 1267 (Decimal); <u>Otherwise</u> : 0000 to 7777 (Octal)	If in Mode C, set an altitude in the range of -1 to 1267 hundred feet; otherwise, set Reply Code with four octal digits.
AX2=RLCD?	If <u>Mode C</u> : -10 to 1267 (Decimal); <u>Otherwise</u> : 0000 to 7777 (Octal)	Return Reply Code or Altitude.
AX2=PULS=	ON/OFF	Set "X" Pulse ON or OFF.
AX2=PULS?	(ON/OFF)	Return "X" Pulse status.
AX2=RLFM=	IDENT/NORM/EMER	Set reply format to IDENT, NORM or EMER.
AX2=RLFM?	(IDENT/NORM/EMER)	Return reply format status; IDENT, NORM or EMER.
AX2=RPLY=	ON/OFF	Enable/Disable Reply Pulses.
AX2=RPLY?	(ON/OFF)	Return Reply status.
AX2=RLDL=	CAL/DELAY1/DELAY2	Select Reply Delay from: CAL, Control 1 or Control 2.
AX2=RLDL?	(CAL/DELAY1/DELAY2)	Return Reply Delay status: Control 1, Control 2, or CAL.
AX2=RLD1=	<u>Mode 4</u> : 180 to 280 μ s (0.1 μ s steps) <u>Mode ATC</u> : 0 to 12 μ s (50 ns steps)	Set Reply Delay for Control 1.
AX2=RLD1?	<u>Mode 4</u> : 180 to 280 μ s (0.1 μ s steps) <u>Mode ATC</u> : 0 to 12 μ s (50 ns steps)	Return Reply Delay for Control 1.
AX2=RLD2=	<u>Mode 4</u> : 180 to 280 μ s (0.1 μ s steps) <u>Mode ATC</u> : 0 to 12 μ s (50 ns steps)	Set Reply Delay for Control 2.

MODE 4 GPIB Command and Instruction Set
Table 6



OPERATION MANUAL
MODE 4 TEST SYSTEM

COMMAND	RANGE	DEFINITION
AX2=RLD2?	Mode 4: 180 to 280 μ s (0.1 μ s steps) Mode ATC: 0 to 12 μ s (50 ns steps)	Return Reply Delay for Control 2.
AX2=DISP=	ON/OFF	Enable/Disable Disparity Pulse.
AX2=DISP?	(ON/OFF)	Return Disparity status.
AX2=DSDL=	CAL/DELAY1/DELAY2	Select Disparity Delay from: CAL, Control 1 or Control 2.
AX2=DSDL?	(CAL/DELAY1/DELAY2)	Return Disparity Delay status: Control 1, Control 2, or CAL.
AX2=DSD1=	XPDR-M4: 0 to 100 μ s (0.1 μ s steps) RADAR-M4: -6.1 μ s to +17.9 μ s (0.1 μ s steps)	Set Disparity Delay for Control 1 based on test mode.
AX2=DSD1?	XPDR-M4: 0 to 100 μ s (0.1 μ s steps) RADAR-M4: -6.1 μ s to +17.9 μ s (0.1 μ s steps)	Return Disparity Delay for Control 1.
AX2=DSD2=	XPDR-M4: 180 to 280 μ s (0.1 μ s steps) RADAR-M4: 360 to 384 μ s (0.1 μ s steps)	Set Disparity Delay for Control 2 based on test mode.
AX2=DSD2?	XPDR-M4: 180 to 280 μ s (0.1 μ s steps) RADAR-M4: 360 to 384 μ s (0.1 μ s steps)	Return Disparity Delay for Control 2.
AX2=P2=	ON/OFF	Set P2 pulse ON or OFF.
AX2=P2?	(ON/OFF)	Return P2 pulse status.
AX2=P3=	ON/OFF	Set P3 pulse ON or OFF.
AX2=P3?	(ON/OFF)	Return P3 pulse status.
AX2=P4=	ON/OFF	Set P4 pulse ON or OFF.
AX2=P4?	(ON/OFF)	Return P4 pulse status.

MODE 4 GPIB Command and Instruction Set
Table 6 (Cont'd)



OPERATION MANUAL
MODE 4 TEST SYSTEM

COMMAND	RANGE	DEFINITION
AX2=CODE=	INT/EXT	Select INT or EXT Code Source: INT = No Encryption Device. EXT = Encryption Device present.
AX2=CODE?	(INT/EXT)	Return Encryption Mode status.
AX2=P4D=	CAL/-/+	Selects P4 pulse deviation.
AX2=P4D?	(CAL/-/+)	Return P4 pulse deviation status.
AX2=RFLV=	-3.0 to +3.0 dB (0.1 dB steps)	Set RF level
AX2=RFLV?	-3.0 to +3.0 dB (0.1 dB steps)	Return RF Level status.
AX2=MODE=	XATC, XM4-RANDOM, XM4-A, XM4-B, XM4-Ø, RATC, RM4-RANDOM, RM4-A, RM4-B, RM4-Ø	Select Test Mode: Transponder ATC, Mode 4, (RANDOM A, B, or Ø); RADAR ATC, Mode 4 (RANDOM A, B, or Ø).
AX2=MODE?	(XATC, XM4-RANDOM, XM4-A, XM4-B, XM4-Ø, RATC, RM4-RANDOM, RM4-A, RM4-B, RM4-Ø)	Return Test Mode status.
AX2=STAB?	(X1 to X2 µs or "OVER")	Return stability time (Decoded Video Pulse).
AX2=UUTD?	(X1 to X2 µs or "OVER")	Return UUT Reply Delay status.

MODE 4 GPIB Command and Instruction Set
Table 6 (Cont'd)



5. Calibration/Verification

A. General

(1) The Calibration/Verification procedures should be performed as a result of one or more of the following conditions:

- **Failure to Meet Specifications**

If, during the course of normal operation, the Mode 4 Test System or any major function thereof fails to meet the performance specifications in 1-3-1, the Calibration/Verification Procedures should be performed.

- **Module/Assembly Replacement**

If one or more of the Mode 4 Test System modules/assemblies are replaced, the Calibration/Verification Procedures should be performed

- **Annual Calibration/Verification**

IFR Systems, Inc. recommends an annual Calibration/Verification on the Mode 4 Test System to maintain proper testing standards.

(2) **Controls, Connectors and Indicators**

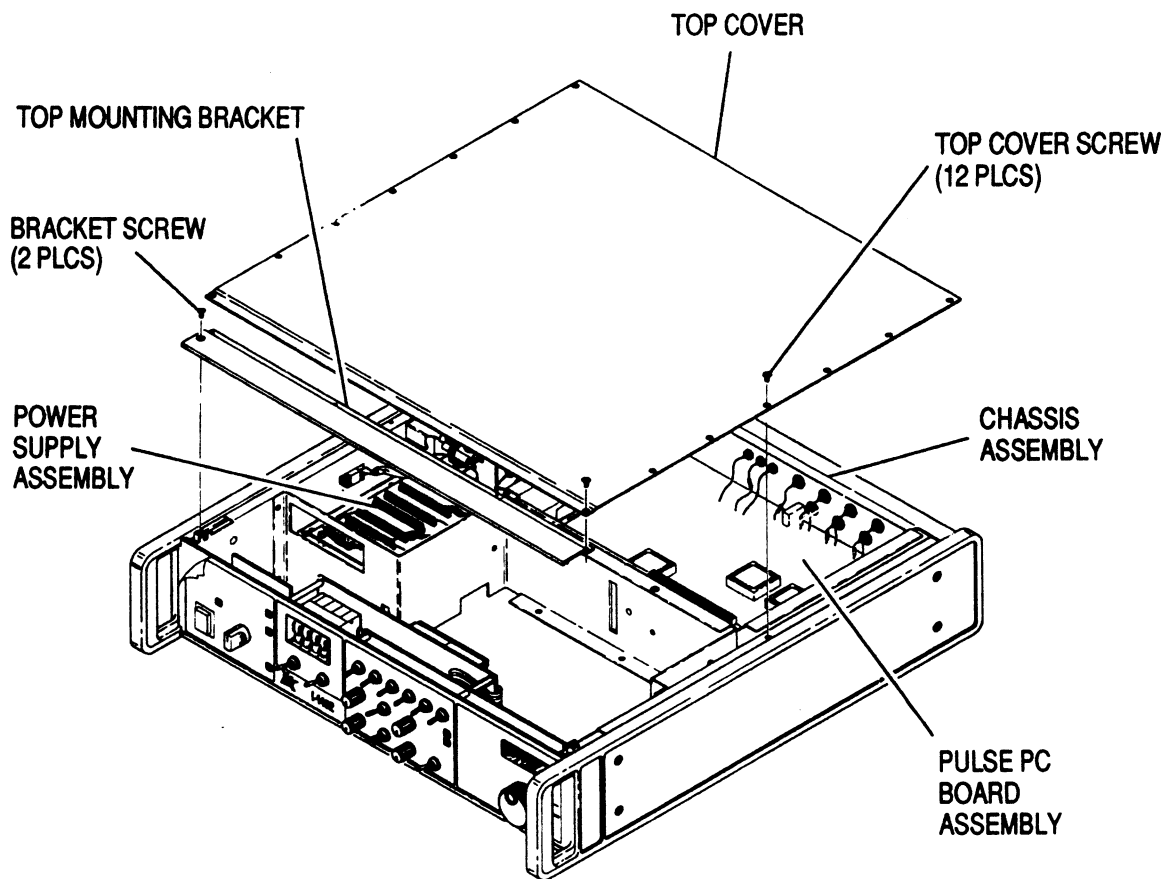
Refer to 1-2-2, Figure 3 for I-1402 controls, connectors and indicators (alphabetic character identifiers). Refer to 1-2-2, Figure 2 in for ATC-1400A controls, connectors and indicators (numeric character identifiers).

(3) **Disassembly Requirements**

Remove the ATC-1400A top cover according to 2-3-1D in the ATC-1400A Maintenance Manual. Refer to 1-2-5, Figure 17 and remove the I-1402 top cover as follows:

STEP	PROCEDURE
-------------	------------------

-
1. Remove power from I-1402.
 2. Remove ten top cover screws and two bracket screws.
 3. Lift top cover with top mounting bracket from Chassis Assembly.



6707004

Top Cover Removal
Figure 17



<u>CALIBRATION/VERIFICATION PROCEDURE</u>	<u>PAGE</u>
Power Supply	4
XPDR ATC	6
XPDR Mode 4	12
RADAR ATC	19
RADAR Mode 4	23

B. Performance Requirements

It is strongly recommended that personnel thoroughly read and understand all steps of the procedures to be performed and be familiar with the circuit under test. Knowledge of what power, frequency and waveform to be expected at each test point is recommended.

NOTE: When one circuit provides the same pulse characteristic for different pulses, it is necessary to test the specifications for that characteristic only once.

C. Test Equipment Requirements

Appendix G contains a comprehensive list of test equipment suitable for performing any procedure contained in this manual. Other equipment meeting specifications listed in Appendix G may be substituted in place of recommended models.

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

D. Preliminary Operations

(1) Safety Precautions

WARNING: REMOVE ALL JEWELRY OR OTHER COSMETIC APPAREL BEFORE PERFORMING ANY CALIBRATION/VERIFICATION PROCEDURE INVOLVING LIVE CIRCUITS.

WARNING: WHEN WORKING WITH LIVE CIRCUITS OF HIGH POTENTIAL, KEEP ONE HAND IN POCKET OR BEHIND BACK TO AVOID SERIOUS SHOCK HAZARD.

WARNING: USE ONLY INSULATED TROUBLESHOOTING TOOLS WHEN WORKING WITH LIVE CIRCUITS.

WARNING: FOR ADDED INSULATION, PLACE RUBBER BENCH MAT UNDERNEATH ALL POWERED BENCH EQUIPMENT, AS WELL AS A RUBBER MAT UNDERNEATH TECHNICIAN'S CHAIR.

WARNING: HEED ALL WARNINGS AND CAUTIONS CONCERNING MAXIMUM VOLTAGES AND POWER INPUTS.



OPERATION MANUAL
MODE 4 TEST SYSTEM

CAUTION: THE MODE 4 TEST SYSTEM CONTAINS PARTS SENSITIVE TO DAMAGE BY ELECTROSTATIC DISCHARGE (ESD). ALL PERSONNEL PERFORMING CALIBRATION/VERIFICATION PROCEDURES SHOULD HAVE KNOWLEDGE OF ACCEPTED ESD PRACTICES AND/OR BE ESD CERTIFIED.

(2) Environmental Considerations

For best results, the calibration/verification environmental conditions should be identical to the environmental conditions at the normal operating location.

E. Test Record

A Calibration/Verification Data Sheet is provided for recording the results obtained while performing the Calibration/Verification Procedures.

NOTE: It is recommended the technician reproduce copies of the Calibration/Verification Data Sheet, rather than use the copy in this manual.

F. Calibration/Verification Procedures

NOTE: Pulse spacings are measured from leading edge to leading edge at the 50% amplitude points. Pulse widths are measured from leading edge to trailing edge at the 50% amplitude points.

(1) Power Supply (Refer to 1-2-5, Figure 18.)

PREREQUISITES: None

TEST EQUIPMENT: 1 Digital Multimeter

STEP PROCEDURE

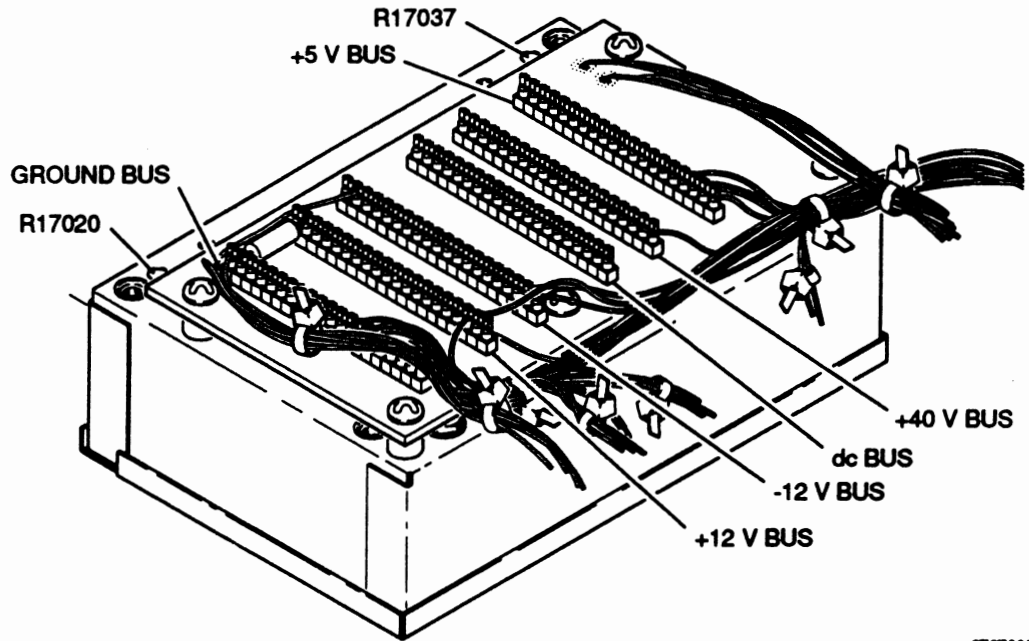
1. Use Digital Multimeter to verify resistance between Ground Bus and test points on Power Distribution PC Board as follows:

<u>TEST POINT</u>	<u>RESISTANCE</u>	<u>WIRE COLOR</u>
dc Bus	20 k Ω	Blue
+5 V Bus	200 Ω	Orange
+12 V Bus	300 Ω	Red
-12 V Bus	400 Ω	Yellow
+40 V Bus	20 k Ω	Violet

2. Apply power to I-1402.



STEP PROCEDURE



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Power Supply Test Points
Figure 18

3. Use Digital Multimeter to verify voltage between Ground Bus and test points on Power Distribution PC Board Assembly as follows:

TEST POINT	VOLTAGE	ADJUSTMENT
dc Bus	+18 Vdc (-2.0 V, +6.0 V)	
+5 V Bus	+5.1 Vdc (± 0.2 V)	R17037
+12 V Bus	+12 Vdc (± 0.3 V)	R17020
-12 V Bus	-12 Vdc (± 0.3 V)	R17020
+40 V Bus	+37.5 Vdc (± 2.5 V)	R17020

Make adjustments as necessary.

4. Refer to 1-2-5, Figure 19 and use Digital Multimeter to verify voltage across C11017 on I-1402 Pulse PC Board Assembly is +5 Vdc (± 0.2 V). Adjust R17037, if necessary.
5. Repeat Steps 3 and 4 until no adjustments are needed.
6. Verify ac power is present at AC OUT Connector (AD).
7. Remove power from I-1402.



OPERATION MANUAL
MODE 4 TEST SYSTEM

(2) XPDR ATC

PREREQUISITES: Calibrated ATC-1400A
1-2-5G(1) Power Supply

TEST EQUIPMENT: 1 Digital Multimeter
1 Heterodyne Monitor
1 Oscilloscope
1 RF Power Meter
1 RF Signal Generator

STEP PROCEDURE

1. Connect I-1402 to ATC-1400A according to 1-2-1E.

2. Apply power to Mode 4 Test System.

NOTE: Use I-1402 POWER Switch (R) to control power to Mode 4 Test System.

3. Set Front Panel Controls as follows:

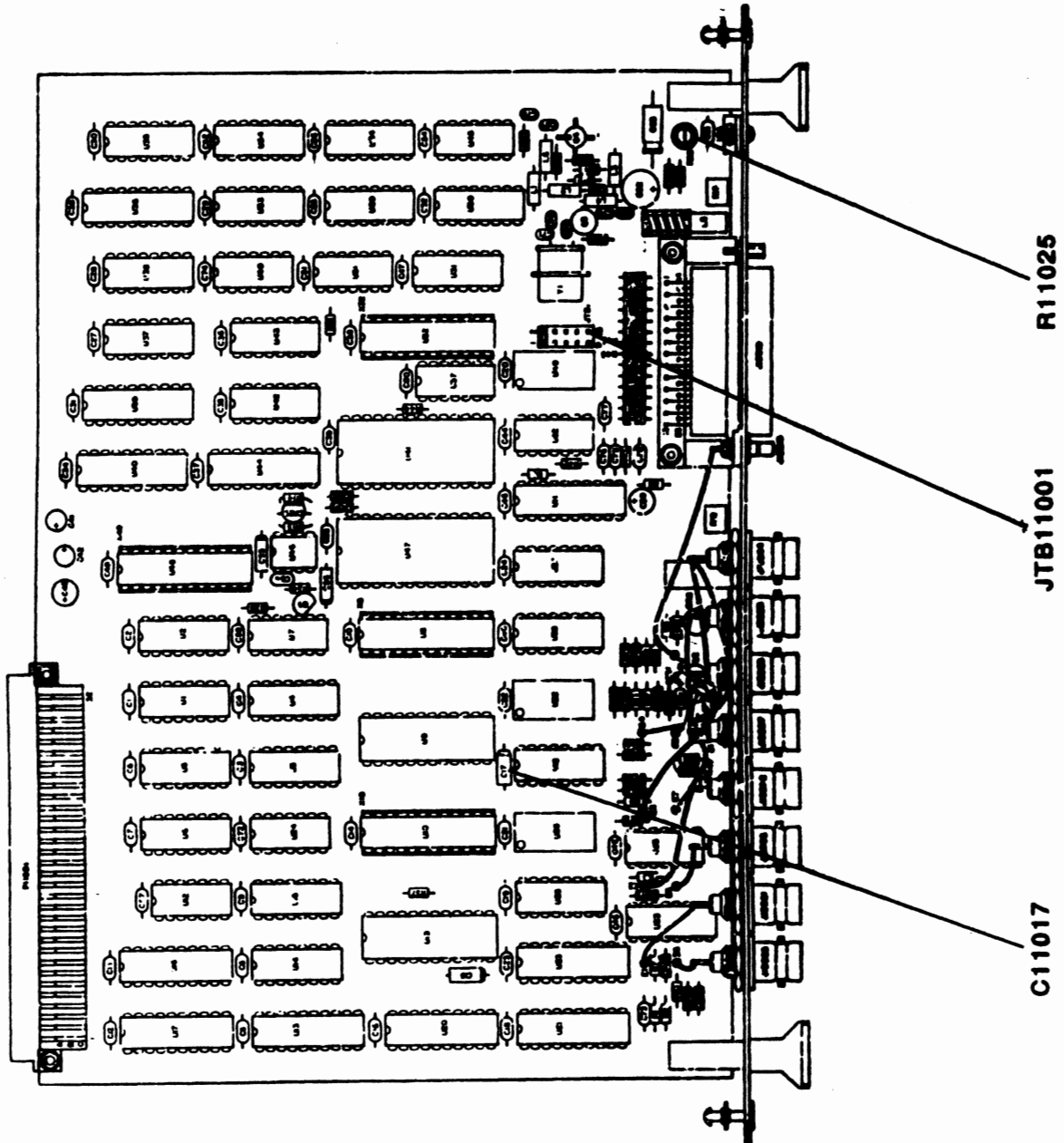
<u>CONTROL</u>	<u>SETTING</u>
(J) REPLY DELAY Switch	CAL
(M) REPLY FORMAT Switch	NORMAL
(N) "X" PULSE Switch	OFF
(Q) MODE SELECT Control	XPDR ATC
(V) REPLY CODE/ALTITUDE Thumbwheels	0000
(W) REPLY ON/OFF Switch	ON
(7) CW/NORM/OFF Switch	NORM
(18) SLS/ECHO ON/OFF Switch	OFF
(25) XPDR DEV P ₃ /CAL Switch	CAL
(28) XPDR DEV P ₂ /CAL Switch	CAL
(30) T ₀ /TAC/T _D Switch	T ₀
(32) PRF/SQTR ON/OFF Switch	ON
(38) XPDR MODE Control	A
(40) DISPLAY SELECT Control	PRF/SQTR Hz
(41) PRF/SQTR Thumbwheels	1000
(42) DBL INTERR/INTRF PULSE Thumbwheels	OFF
(45) FREQ/FUNCTION SELECT Thumbwheels	1030 XPDR
(52) RANGE/VEL/ACCEL Thumbwheels	0000

NOTE: All other ATC-1400A controls are set to normal positions.

NORMAL REPLY

4. Connect Oscilloscope channel 1 to J10007 (AV) and SYNC Connector (29) to Oscilloscope external trigger.

5. Verify time interval between F₁ and F₂ pulses is 20.3 μ s (\pm 10 ns). Refer to 1-2-3, Figure 6.



Pulse PC Board Assembly Calibration Points
Figure 19



STEP PROCEDURE

6. Adjust REPLY CODE/ALTITUDE Thumbwheels (V) and verify pulse positions as follows:

CODE	POSITION
0000	0 0 0 0 0 0 X 0 0 0 0 0 0
1111	1 1 0 0 0 0 X 1 1 0 0 0 0
2222	0 0 1 1 0 0 X 0 0 1 1 0 0
3333	1 1 1 1 0 0 X 1 1 1 1 0 0
4444	0 0 0 0 1 1 X 0 0 0 0 1 1
5555	1 1 0 0 1 1 X 1 1 0 0 1 1
6666	0 0 1 1 1 1 X 0 0 1 1 1 1
7777	1 1 1 1 1 1 X 1 1 1 1 1 1

NOTE: Ones represent positions where pulses occur.

7. Verify pulses are spaced 1.45 μ s (± 10 ns) apart. F₁ pulse precedes code and F₂ pulse follows code. Refer to 1-2-3, Figure 6.

NOTE: Access reference signal with pulses 1.45 μ s apart by connecting Oscilloscope channel 2 to CAL MARKS Connector (26) and switching 1.0 μ s/1.45 μ s Switch (27) to 1.45 μ s. Use CAL \emptyset Control (23) to align signals.

"X" PULSE

8. Set "X" PULSE Switch (N) to ON. Verify "X" Pulse appears in seventh position, 1.45 μ s (± 10 ns) from pulses on each side.
9. Set "X" PULSE Switch (N) to OFF.

EMERGENCY REPLY

10. Set REPLY FORMAT Switch (M) to EMER.
11. Set REPLY CODE/ALTITUDE Thumbwheels (V) to 0000.
12. Set XPDR MODE Control (38) to 1, 2, T, 3/A, B, D and AC₁. For each setting, verify Oscilloscope displays pulse timing according to Emergency Code Format in 1-2-2, Figure 4.



STEP	PROCEDURE
IDENTIFICATION REPLY	
13.	Set REPLY FORMAT Switch (M) to IDENT.
14.	Set XPDR MODE Control (38) to 1.
15.	Verify Oscilloscope displays pulse timing according to Identification Code Format Mode 1 in 1-2-2, Figure 4.
16.	Set XPDR MODE Control (38) to 2, T, 3/A, B, D and AC ₁ . For each setting, verify Oscilloscope displays pulse timing according to Identification Code Format; Modes 2, 3/A, T, B, D and AC ₁ ; in 1-2-2, Figure 4.
17.	Verify F ₁ to SPI pulse spacing is 24.65 μ s (\pm 10 ns).
18.	Verify SPI pulse width is 0.5 μ s (\pm 10 ns).
REPLY DELAY	
19.	Connect Oscilloscope channel 2 to Heterodyne Monitor IF output connector.
20.	Connect RF I/O Connector (9) to Heterodyne Monitor RF input connector.
21.	Connect RF Signal Generator to Heterodyne Monitor LO input connector.
22.	Set RF Signal Generator for 1030 MHz.
23.	Set RF LEVEL Control (6) to read -10 dBm on RF LEVEL -dBm Display (3).
24.	Set REPLY FORMAT Switch (M) to NORM.
25.	Set REPLY DELAY Switch (J) to CAL.
26.	Verify reply delay (P ₃ to F ₁ pulse spacing) is 3 μ s (\pm 50 ns). Refer to 1-2-3, Figure 6.
27.	Set REPLY DELAY Switch (J) to 1.
28.	Adjust REPLY DELAY 1 Control (L) from limit to limit. Verify reply delay varies from 0 to 12 μ s in 50 ns increments.
29.	Set REPLY DELAY Switch (J) to 2.
30.	Adjust REPLY DELAY 2 Control (F) from limit to limit. Verify reply delay varies from 0 to 12 μ s in 50 ns increments.



STEP	PROCEDURE
	REPLY PULSE WIDTH
31.	Verify pulse widths are 0.45 μ s (\pm 10 ns). Refer to 1-2-3, Figure 6.
32.	Verify pulses are at positive TTL level.
	REPLY PULSE OUTPUT
33.	Disconnect Oscilloscope channel 1 from J10007 (AV).
34.	Connect 1 k Ω resistor in parallel and Oscilloscope channel 1 to J10008 (AX).
35.	Verify pulse width is 0.45 μ s, (\pm 100 ns). Refer to 1-2-3, Figure 6.
36.	Refer to 1-2-5, Figure 19 and adjust R11025 from limit to limit. Verify positive pulse amplitude varies from 3 to 27 V.
37.	Readjust R11025 to set pulse amplitude to 4.5 V.
38.	Disconnect equipment.
	SLEW CONTROL
39.	Set RF LEVEL Control (6) to read -20 dBm on RF LEVEL -dBm Display (3).
40.	Set CW/NORM/OFF Switch (7) to CW.
41.	Connect RF Power Meter to RF I/O Connector (9).
42.	Disconnect coax cable at J10013 (AZ).
43.	Verify RF level is -20 dBm (\pm 2.0 dB). Note RF level for reference.
44.	Reconnect coax cable to J10013 (AZ).
45.	Set SLEW Control (B) to read 0.0 dB on RF LEVEL (dB) Display (A).
46.	Adjust R11016 (AF) until RF Power Meter reading equals reference level in Step 43.
47.	Set SLEW Control (B) to read +3.0 dB on RF LEVEL (dB) Display (A).
48.	Adjust R11018 (AJ) until RF Power Meter reading is +3.0 dB above reference level in Step 43.



- | STEP | PROCEDURE |
|----------------------|---|
| 49. | Adjust SLEW Control (B) in 0.1 dB steps from +3.0 dB to -3.0 dB. Verify each corresponding setting is within 10% of relative reference level. |
| 50. | Set Slew Control (B) to read 0.0 dB on RF LEVEL (dB) Display (A). |
| 51. | Disconnect coax cable at J10013 (AZ). |
| 52. | Verify change in dB displayed on RF LEVEL (dB) Display (A) is <0.05 dB. |
| 53. | Reconnect coax cable at J10013 (AZ). |
| 54. | Disconnect RF Power Meter. |
| 55. | Set CW/NORM/OFF Switch (7) to NORM. |
| MODE GROUP INDICATOR | |
| 56. | Set SUPPRESSOR ON/OFF Switch (17) to ON. |
| 57. | Set DBL INTERR/INTRF PULSE Thumbwheels (42) to 050.0 DOUBLE. |
| 58. | Verify MODE GROUP DELAY Indicator (U) illuminates. |
| 59. | Return SUPPRESSOR ON/OFF Switch (17) and DBL INTERR/INTRF PULSE Thumbwheels (42) to OFF. |
| 60. | Disconnect equipment. |



OPERATION MANUAL
MODE 4 TEST SYSTEM

(3) XPDR Mode 4

TEST EQUIPMENT: 1 Function Generator
1 Heterodyne Monitor
1 Oscilloscope
1 Pulse Generator
1 RF Signal Generator

STEP PROCEDURE

1. Connect I-1402 to ATC-1400A according to 1-2-1E.

2. Apply power to Mode 4 Test System.

NOTE: Use I-1402 POWER Switch (R) to control power to Mode 4 Test System.

3. Set Front Panel Controls as follows:

<u>CONTROL</u>	<u>SETTING</u>
(B) SLEW Control	0.0
(H) DISPARITY DELAY Switch	CAL
(Q) MODE SELECT Control	XPDR ATC
(W) REPLY ON/OFF Switch	ON
(X) DISP ON/OFF Switch	ON
(Y) P2 ON/OFF Switch	ON
(Z) P3 ON/OFF Switch	ON
(AA) P4 ON/OFF Switch	ON
(AB) CODE INT/EXT Switch	INT
(18) SLS/ECHO ON/OFF Switch	ON
(30) To/TAC/Tp Switch	To
(50) SLS/ECHO Thumbwheels	-0

NOTE: All other ATC-1400A controls are set to normal positions.

4. Connect SYNC Connector (29) to Oscilloscope external trigger.

5. Connect Oscilloscope channel 1 to Heterodyne Monitor IF output connector.

6. Connect RF I/O Connector (9) to Heterodyne Monitor RF input connector.

7. Connect RF Signal Generator to Heterodyne Monitor LO input connector.

8. Set RF Signal Generator for 1030 MHz.

P1-P5 INTERROGATION SEQUENCE

9. Adjust Oscilloscope to center rising edge of P1 across major vertical and use as reference.

10. Set MODE SELECT Control (Q) to XPDR MODE 4/A.



OPERATION MANUAL
MODE 4 TEST SYSTEM

- | STEP | PROCEDURE |
|------|---|
| 11. | Verify XPDR MODE 4 Indicator (S) illuminates. |
| 12. | Refer to 1-2-5, Figure 19 and set JTB11001 so P ₁ pulse position in XPDR Mode 4 is coincident (± 5 ns) with P ₁ pulse position in XPDR ATC referenced in Step 9. |
| 13. | Verify P ₁ through P ₃₇ pulse widths are 0.5 μ s (± 10 ns). Note P ₂ pulse width for reference. |
| 14. | Verify P ₁ to P ₂ pulse spacing is 2.0 μ s (± 10 ns). |
| 15. | Verify P ₁ to P ₃ pulse spacing is 4.0 μ s (± 10 ns). |
| 16. | Verify P ₁ to P ₄ pulse spacing is 6.0 μ s (± 10 ns). |
| 17. | Verify P ₁ to P ₅ pulse spacing is 8.0 μ s (± 10 ns). |
| 18. | Set MODE SELECT Control (Q) to XPDR MODE 4/Random. |
| 19. | Verify P ₅ pulse is followed by a randomly changing pulse sequence containing up to 32 pulses. |
| 20. | Set SLS/ECHO ON/OFF Switch to OFF. |
| 21. | Set XPDR P ₂ /CAL Switch (28), XPDR P ₃ /CAL Switch (25) and P ₄ DEV Switch (E) to + Δ . |
| 22. | Set XPDR P ₂ /P ₃ DEV Thumbwheels (44) to 1.95. |
| 23. | Verify P ₁ to P ₂ pulse spacing is 3.95 μ s (± 10 ns). |
| 24. | Verify P ₁ to P ₃ pulse spacing is 5.95 μ s (± 10 ns). |
| 25. | Verify P ₁ to P ₄ pulse spacing is 7.95 μ s (± 10 ns). |
| 26. | Set XPDR P ₂ /CAL Switch (28), XPDR P ₃ /CAL Switch (25) and P ₄ DEV Switch (E) to - Δ . |
| 27. | Verify P ₁ with P ₂ merged pulse width is 0.05 μ s + P ₂ pulse width referenced in Step 13 (± 10 ns). Actual P ₁ to P ₂ pulse spacing is measured value minus P ₂ pulse width. |
| 28. | Verify P ₁ to P ₃ pulse spacing is 2.05 μ s (± 10 ns). |
| 29. | Verify P ₁ to P ₄ pulse spacing is 4.05 μ s (± 10 ns). |
| 30. | Set XPDR P ₂ /CAL Switch (28), XPDR P ₃ /CAL Switch (25) and P ₄ DEV Switch (E) to CAL. |
| 31. | Set XPDR PULSE WIDTH VAR/CAL Switch (20) to VAR. |
| 32. | Set P ₃ ON/OFF Switch (Z) to OFF. |



- | STEP | PROCEDURE |
|-----------------------------|--|
| 33. | Adjust XPDR PULSE WIDTH Thumbwheels (49) from 0.2 to 1.90 μ s. Verify P ₂ pulse width varies accordingly. |
| 34. | Set P ₃ ON/OFF Switch (Z) to ON. |
| 35. | Set P ₄ ON/OFF Switch (AA) to OFF. |
| 36. | Adjust XPDR PULSE WIDTH Thumbwheels (49) from 0.2 to 1.90 μ s. Verify P ₃ pulse width varies accordingly. |
| 37. | Set P ₄ ON/OFF Switch (AA) to ON. |
| 38. | Adjust XPDR PULSE WIDTH Thumbwheels (49) from 0.2 to 1.0 μ s. Verify P ₄ pulse width varies accordingly. |
| 39. | Set XPDR PULSE WIDTH VAR/CAL Switch (20) to CAL. |
| 40. | Set SLS/ECHO ON/OFF Switch to ON. |
| 41. | Adjust SLS/ECHO Thumbwheels from -19 to +6 dB. Verify P ₅ pulse amplitude varies accordingly. |
| XPDR MODE 4/A | |
| 42. | Set MODE SELECT Control (Q) to XPDR MODE 4/A. |
| 43. | Connect Oscilloscope channel 2 to GEN Connector (15). |
| 44. | Verify pulses P ₆ through P ₃₇ conform to A Word Format in Appendix B. |
| XPDR MODE 4/B | |
| 45. | Set MODE SELECT Control (Q) to XPDR MODE 4/B. |
| 46. | Verify pulses P ₆ through P ₃₇ conform to B Word Format in Appendix B. |
| XPDR MODE 4/0 | |
| 47. | Set MODE SELECT Control (Q) to XPDR MODE 4/0. |
| 48. | Verify pulses P ₆ through P ₃₇ conform to 0 Word Format in Appendix B. |
| DOUBLE INTERROGATION | |
| 49. | Set DBL INTERR/INTRF Thumbwheels (42) to 072.0 DOUBLE. |
| 50. | Verify second interrogation P ₁ pulse occurs 72 μ s (\pm 50 ns) after first interrogation P ₁ . |



STEP	PROCEDURE
51.	Verify P ₅ is missing from second interrogation.
52.	Adjust DBL INTERR/INTRF Thumbwheels (42) from 72 to 399.9 μ s. Verify first interrogation P ₁ to second interrogation P ₁ spacing varies accordingly (\pm 50 ns).
53.	Set DBL INTERR/INTRF Thumbwheels (42) to OFF.
	DISPARITY DELAY
54.	Disconnect Oscilloscope channel 2 from GEN Connector (15).
55.	Connect Oscilloscope channel 2 to J10005 (AR).
56.	Verify time from Generator RF Pulse P ₄ to Disparity Out Pulse is 198 μ s (\pm 50 ns) as shown in 1-2-3, Figure 8.
57.	Verify Disparity Out Pulse is 0.5 μ s (\pm 10 ns) wide and at positive TTL level.
58.	Set DISPARITY DELAY Switch (H) to 1.
59.	Adjust DISPARITY DELAY 1 Control (K) from limit to limit. Verify time from Generator RF Pulse P ₄ to Disparity Out Pulse varies from 0 μ s to 100 μ s in 500 ns steps.
60.	Set DISPARITY DELAY Switch (H) to 2.
61.	Adjust DISPARITY DELAY 2 Control (G) from limit to limit. Verify time from Generator RF Pulse P ₄ to Disparity Out Pulse varies from 180 to 280 μ s in 500 ns steps.
62.	Set DISPARITY DELAY Switch (H) to CAL.
	TRIGGER OUT DELAY
63.	Disconnect Oscilloscope channel 2 from J10005 (AR).
64.	Connect Oscilloscope channel 2 to J10006 (AT).
65.	Verify time from Generator RF Pulse P ₄ to Trigger Out Pulse is 194 μ s (\pm 50 ns) as shown in 1-2-3, Figure 8.
66.	Verify Trigger Out Pulse is 1.0 μ s (\pm 10 ns) wide and at positive TTL level.



STEP PROCEDURE

REPLY DELAY

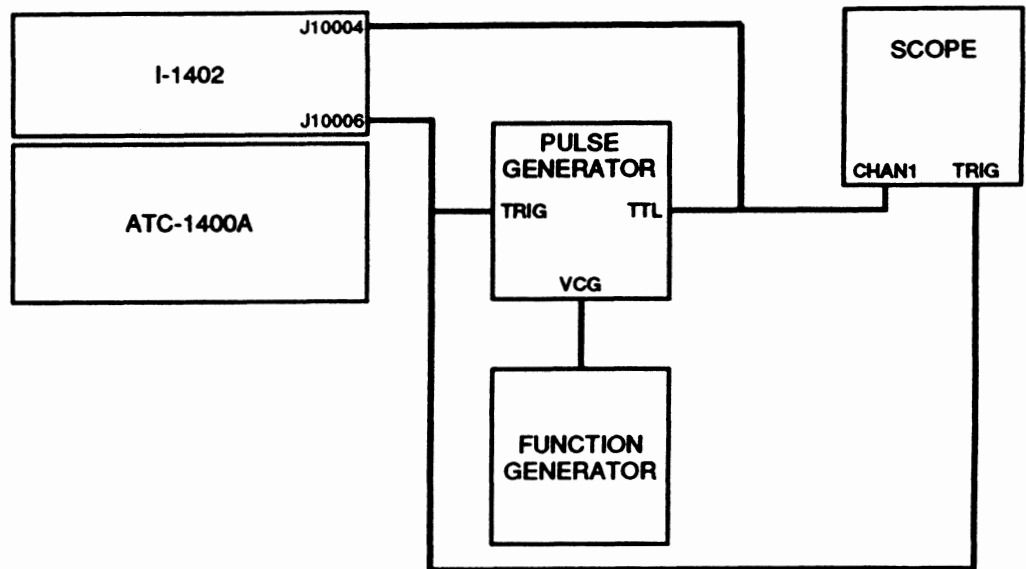
67. Disconnect Oscilloscope channel 2 from J10006 (AT).
68. Connect Oscilloscope channel 2 to J10007 (AV).
69. Set REPLY DELAY Switch (J) to 1.
70. Adjust REPLY DELAY 1 Control (L) from limit to limit. Verify time from Generator RF Pulse P₄ to reply pulse F₁ varies from 180 to 280 μ s in 500 ns steps. Refer to 1-2-3, Figure 8.
71. Set REPLY DELAY Switch (J) to 2.
72. Adjust REPLY DELAY 2 Control (F) from limit to limit. Verify time from Generator RF Pulse P₄ to reply pulse F₁ varies from 180 to 280 μ s in 500 ns steps.
73. Set REPLY DELAY Switch (J) to CAL.
74. Set MODE SELECT Control (Q) to XPDR MODE 4/A.
75. Verify time from Generator RF Pulse P₄ to reply pulse F₁ is 200 μ s (\pm 50 ns).
76. Set MODE SELECT Control (Q) to XPDR MODE 4/B.
77. Verify time from Generator RF Pulse P₄ to reply pulse F₁ is 260 μ s (\pm 50 ns).
78. Set MODE SELECT Control (Q) to XPDR MODE 4/O.
79. Verify time from Generator RF Pulse P₄ to reply pulse F₁ is 230 μ s (\pm 50 ns).
80. Set MODE SELECT Control (Q) to XPDR MODE 4/RANDOM.
81. Verify time from Generator RF Pulse P₄ to reply pulse F₁ is between 200 and 260 μ s.
82. Set MODE SELECT Control (Q) to XPDR MODE 4/A.
83. Verify F₁ to F₂ reply pulse spacing is 1.75 μ s (\pm 10 ns).
84. Verify F₁ to F₃ reply pulse spacing is 3.5 μ s (\pm 10 ns).
85. Verify reply pulse widths are 0.45 μ s (\pm 10 ns).

DECODED VIDEO INPUT

86. Set MODE SELECT Control (Q) to XPDR MODE 4/A.



STEP PROCEDURE



6706007

Decoded Video Input Test Setup Diagram
Figure 20

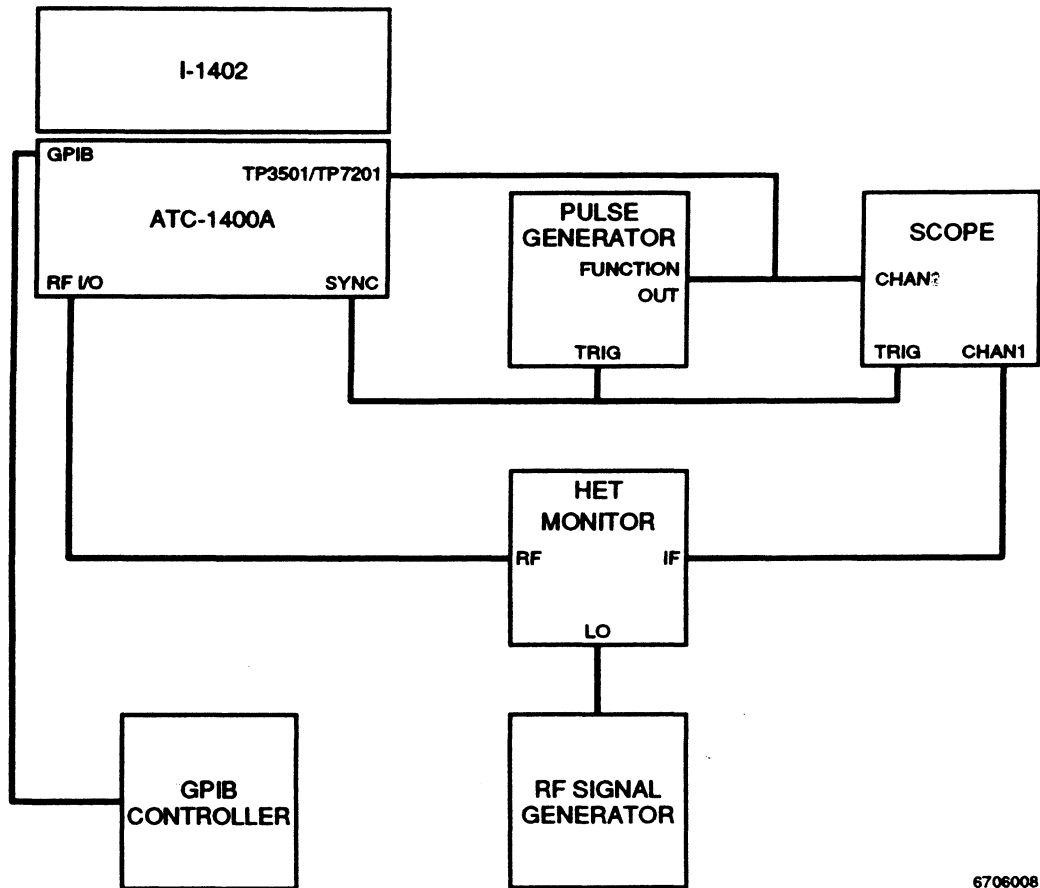
87. Set CODE INT/EXT Switch (AB) to EXT.
88. Connect equipment as shown in 1-2-5, Figure 20.
89. Set Function Generator for 100 Hz sine wave.
90. Set Pulse Generator for single pulse, delay mode triggered.
91. Adjust Function Generator output amplitude for 0.5 μ s peak to peak jitter.
92. Verify STABLE Indicator (C) illuminates.
93. Increase Function Generator amplitude for 0.6 μ s peak to peak jitter.
94. Verify UNSTABLE Indicator (D) illuminates.

GPIB REPLY DELAY

95. Set CODE INT/EXT Switch (AB) to INT.
96. Connect equipment as shown in 1-2-5, Figure 21.
97. Set PRF/SQTR Thumbwheels (41) for 1000.
98. Set T₀/TAC/T_D Switch (30) to T₀.



STEP PROCEDURE



6706008

GPIB Test Setup Diagram
Figure 21

99. Set RF LEVEL Control (6) to read -10 dBm on RF LEVEL -dBm Display (3).
100. Set MODE SELECT Control (Q) to XPDR MODE 4/A.
101. Adjust Pulse Generator for 100 μ s reply delay from P₄ on Oscilloscope.
102. Send command, "AX2=UUTD?", to read reply delay through GPIB controller.
103. Verify GPIB value is 100 μ s (\pm 50 ns).
104. Disconnect test equipment.



OPERATION MANUAL
MODE 4 TEST SYSTEM

(4) RADAR ATC

PREREQUISITES: Calibrated ATC-1400A
2-2-2J(1) Power Supply

TEST EQUIPMENT: 1 Heterodyne Monitor
1 Oscilloscope
1 Pulse Generator
1 RF Signal Generator

STEP PROCEDURE

1. Connect I-1402 to ATC-1400A according to 1-2-1E.
2. Apply power to Mode 4 Test System.

NOTE: Use I-1402 POWER Switch (R) to control power to Mode 4 Test System.

3. Set Front Panel Controls as follows:

CONTROL SETTING

(J)	REPLY DELAY Switch	CAL
(M)	REPLY FORMAT Switch	NORM
(N)	"X" PULSE Switch	OFF
(Q)	MODE SELECT Control	RADAR ATC
(V)	REPLY CODE/ALTITUDE Thumbwheels	0000
(W)	REPLY ON/OFF Switch	ON
(AB)	CODE INT/EXT Switch	INT
(7)	CW/NORM/OFF Switch	NORM
(18)	SLS/ECHO ON/OFF Switch	OFF
(25)	XPDR DEV P ₃ /CAL Switch	CAL
(28)	XPDR DEV P ₂ /CAL Switch	CAL
(32)	PRF/SQTR Switch	ON
(38)	XPDR MODE Control	A
(40)	DISPLAY SELECT Control	PRF/SQTR Hz
(41)	PRF/SQTR Thumbwheels	1000
(42)	DBL INTERR/INTRF PULSE Thumbwheels	OFF
(45)	FREQ/FUNCTION SELECT Thumbwheels	1090 XPDR
(52)	RANGE/VEL/ACCEL Thumbwheels	0000

NOTE: All other ATC-1400A controls are set to normal positions.

4. Connect TP3501/7201 on ATC-1400A to Tee Connector on Pulse Generator. Refer to ATC-1400A Maintenance Manual for location of TP3501/7201.
5. Set Pulse Generator for 2 negative going 0.8 μ s pulses spaced 8 μ s apart at \approx 250 Hz PRF with 0.2 Vp-p amplitude.

NOTE: Pulse Generator simulates RADAR (UUT) Output according to 1-2-3, Figure 12.



OPERATION MANUAL
MODE 4 TEST SYSTEM

- | STEP | PROCEDURE |
|------|--|
| 6. | Adjust amplitude on Pulse Generator until 100 through 1000 watts is displayed on XMTR PWR WATTS Display (1). |
| 7. | Connect Oscilloscope channel 1 to XMTR Connector (61). Trigger Oscilloscope from channel 1. |
| 8. | Connect Oscilloscope channel 2 to J10006 (AT). |
| | RANGE DELAY |
| 9. | Adjust RANGE/VEL/ACCEL Thumbwheels (52) from 0 to 200 nmi. Verify range delay from P ₃ to I-1402 Trigger Output pulse varies from 0 to 2471.8 μ s in 12.359 μ s steps. |
| 10. | Disconnect Oscilloscope channel 1 from XMTR Connector (61). |
| | REPLY DELAY |
| 11. | Connect SYNC Connector (29) to Oscilloscope external trigger. |
| 12. | Connect Oscilloscope channel 1 to Heterodyne Monitor IF output connector. |
| 13. | Connect RF I/O Connector (9) to Heterodyne Monitor RF input connector. |
| 14. | Connect RF Signal Generator to Heterodyne Monitor LO input connector. |
| 15. | Set RF Signal Generator for 1090 MHz. |
| 16. | Set REPLY DELAY Switch (J) to 1. |
| 17. | Adjust REPLY DELAY 1 Control (L) from limit to limit. Verify time from I-1402 Trigger Output pulse to ATC-1400A GEN RF Output F ₁ pulse varies from 1.0 to 12 μ s in 50 ns steps. Sample signals are shown in 1-2-3, Figure 12. |
| 18. | Set REPLY DELAY Switch (J) to 2. |
| 19. | Adjust REPLY DELAY 2 Control (F) from limit to limit. Verify time from I-1402 Trigger Output pulse to ATC 1400A GEN RF Output F ₁ pulse varies from 1.0 to 12 μ s in 50 ns steps. Sample signals are shown in 1-2-3, Figure 12. |
| 20. | Set REPLY DELAY Switch (J) to CAL. |
| 21. | Verify time from I-1402 Trigger Output pulse to F ₁ pulse is 3 μ s (\pm 50 ns). |



- | STEP | PROCEDURE |
|------|---|
| 22. | Disconnect Oscilloscope channel 2 from J10006 (AT). |
| | NORMAL REPLY |
| 23. | Connect Oscilloscope channel 2 to GEN Connector (15). |
| 24. | Verify time interval between F ₁ and F ₂ pulses is 20.3 μ s (\pm 50 ns). Refer to ATC-1400A GEN RF Output in 1-2-3, Figure 12. |
| 25. | Set REPLY CODE/ALTITUDE Thumbwheels (V) to each code listed in Appendix D. Verify each code pulse position accordingly. |
| | NOTE: Access reference signal with pulses 1.45 μ s apart by connecting Oscilloscope channel 2 to CAL MARKS Connector (26) and switching 1.0 μ s/1.45 μ s Switch (27) to 1.45 μ s. Use CAL \emptyset Control (23) to align signals. |
| 26. | Set "X" PULSE Switch (N) to ON. Verify "X" Pulse appears in specified position. |
| | EMERGENCY REPLY |
| 27. | Set REPLY FORMAT Switch (M) to EMER. |
| 28. | Set REPLY CODE/ALTITUDE Thumbwheels (V) to 0000. |
| 29. | Set XPDR MODE Control (38) to 1, 2, T, 3/A, B, D and AC ₁ . For each setting, verify Oscilloscope displays pulse timing according to Emergency Code Format in 1-2-2, Figure 4. |
| | IDENTIFICATION REPLY |
| 30. | Set REPLY FORMAT Switch (M) to IDENT. |
| 31. | Set XPDR MODE Control (38) to 1. |
| 32. | Verify Oscilloscope displays pulse timing according to Identification Code Format, Mode 1 in 1-2-2, Figure 4. |
| 33. | Set XPDR MODE Control (38) to 2, T, 3/A, B, D and AC ₁ . For each setting, verify Oscilloscope displays pulse timing according to Identification Code Format; Modes 2, 3/A, T, B, D and AC ₁ ; in 1-2-2, Figure 4. |
| 34. | Set REPLY FORMAT Switch (M) to NORM. |



STEP PROCEDURE

REPLY PULSE WIDTH

35. Verify F₁ and F₂ pulse widths are 0.45 μ s (± 10 ns). Refer to I-1402 Reply Output in 1-2-3, Figure 6.

VARIABLE F₂ PULSE WIDTH

36. Set XPDR PULSE WIDTH VAR/CAL Switch (20) to VAR.
37. Adjust XPDR PULSE WIDTH Thumbwheels (49) from limit to limit. Verify F₂ pulse varies in width from 0.2 to 1.95 μ s in 50 ns steps (± 10 ns). Refer to ATC-1400A GEN RF Output in 1-2-3, Figure 12.
38. Set XPDR PULSE WIDTH VAR/CAL Switch (20) to CAL.

F₂ DEVIATION

39. Set XPDR P₂/CAL Switch (28)) to + Δ .
40. Adjust XPDR P₂/P₃ DEV Thumbwheels (44) to 1.95.
41. Verify F₁ to F₂ pulse spacing varies to 22.25 μ s (± 10 ns).
42. Set XPDR P₂/CAL Switch (28) to - Δ .
43. Verify F₁ to F₂ pulse spacing varies to 18.35 μ s (± 10 ns).

ECHO

44. Set SLS/ECHO ON/OFF Switch (18) to ON.
45. Set SLS/ECHO Thumbwheels (50) to 0.
46. Set RANGE/VEL/ACCEL Thumbwheels (52) to 0000.
47. Connect Oscilloscope channel 1 to Tee Connector on Pulse Generator output. Verify echo is present in first reply at 196.4 μ s (-50 to +59 ns) following P₁.
48. Disconnect test equipment.



OPERATION MANUAL
MODE 4 TEST SYSTEM

(5) RADAR MODE 4

PREREQUISITES: Calibrated ATC-1400A
2-2-2J(1) Power Supply

TEST EQUIPMENT: 1 Heterodyne Monitor
1 Oscilloscope
1 Pulse Generator
1 RF Signal Generator

STEP PROCEDURE

1. Connect I-1402 to ATC-1400A according to 1-2-1E.
2. Apply power to Mode 4 Test System.

NOTE: Use I-1402 POWER Switch (R) to control power to Mode 4 Test System.

3. Set Front Panel Controls as follows:

<u>CONTROL</u>	<u>SETTING</u>
(H) DISPARITY DELAY Switch	CAL
(J) REPLY DELAY Switch	CAL
(Q) MODE SELECT Control	RADAR ATC
(W) REPLY ON/OFF Switch	ON
(X) DISP ON/OFF Switch	ON
(Y) P2 ON/OFF Switch	ON
(Z) P3 ON/OFF Switch	ON
(AA) P4 ON/OFF Switch	ON
(AB) CODE INT/EXT Switch	INT
(7) CW/NORM/OFF Switch	NORM
(18) SLS/ECHO ON/OFF Switch	OFF
(25) XPDR DEV P ₃ /CAL Switch	CAL
(28) XPDR DEV P ₂ /CAL Switch	CAL
(32) PRF/SQTR Switch	ON
(45) FREQ/FUNCTION SELECT Thumbwheels	1090 XPDR
(52) RANGE/VEL/ACCEL Thumbwheels	0000

NOTE: All other ATC-1400A controls are set to normal positions.

4. Connect Oscilloscope channel 1 to Heterodyne Monitor IF output connector.
5. Connect RF I/O Connector (9) to Heterodyne Monitor RF input connector.
6. Connect RF Signal Generator set at 1090 MHz to Heterodyne Monitor LO input connector.
7. Connect Oscilloscope channel 2 to J10007 (AV). Trigger Oscilloscope from channel 2.
8. Connect Pulse Generator TTL output to J10002 (AU).



OPERATION MANUAL
MODE 4 TEST SYSTEM

- | STEP | PROCEDURE |
|------|---|
| 9. | Set Pulse Generator for one pulse, 1 μ s wide at 1 kHz PRF.

RADAR MODE 4/RANDOM |
| 10. | Set MODE SELECT Control (Q) to RADAR MODE 4/RANDOM. |
| 11. | Verify RADAR MODE 4 Indicator (T) illuminates. |
| 12. | Refer to 1-2-3, Figure 14. Verify time from P ₄ pulse (I-1402 Output to RADAR (UUT) Challenge Video Input) to first reply pulse (ATC-1400A Generator RF) ranges from 202 to 262 μ s. |
| 13. | Verify P ₆ through P ₃₇ conform to Random Format in Appendix B.

RADAR MODE 4/A |
| 14. | Set MODE SELECT Control to RADAR MODE 4/A. |
| 15. | Verify time from P ₄ to first reply pulse is 202 μ s (\pm 50 ns). |
| 16. | Verify pulses P ₆ through P ₃₇ conform to A Word Format in Appendix B.

RADAR MODE 4/B |
| 17. | Set MODE SELECT Control to RADAR MODE 4/B. |
| 18. | Verify time from P ₄ to first reply pulse is 262 μ s (\pm 50 ns). |
| 19. | Verify pulses P ₆ through P ₃₇ conform to B Word Format in Appendix B.

RADAR MODE 4/0 |
| 20. | Set MODE SELECT Control to RADAR MODE 4/0. |
| 21. | Verify time from P ₄ to first reply pulse is 232 μ s (\pm 50 ns). |
| 22. | Verify pulses P ₆ through P ₃₇ conform to 0 Word Format in Appendix B.

REPLY PULSES |
| 23. | Set MODE SELECT Control (Q) to RADAR MODE 4/A. |
| 24. | Verify spacing between reply pulses is 1.75 μ s (\pm 10 ns). |
| 25. | Verify reply pulse widths are 0.45 μ s (\pm 10 ns). |



STEP PROCEDURE

REPLY DELAY

26. Set REPLY DELAY Switch (J) to 1.
27. Adjust REPLY DELAY 1 Control (L) from limit to limit. Verify time from P₄ to first reply pulse varies from 180 to 280 μ s in 500 ns steps. Sample signals are shown in 1-2-3, Figure 14.
28. Set REPLY DELAY Switch (J) to 2.
29. Adjust REPLY DELAY 2 Control (F) from limit to limit. Verify time from P₄ to first reply pulse varies from 180 to 280 μ s in 500 ns steps. Sample signals are shown in 1-2-3, Figure 14.
30. Set REPLY DELAY Switch (J) to CAL.

RANGE DELAY

31. Adjust RANGE/VEL/ACCEL Thumbwheels (52) from 0 to 200 nmi. Verify Range Delay Plus Reply Delay shown in 1-2-3, Figure 14 varies from 202 to 2673.8 μ s.
32. Set RANGE/VEL/ACCEL Thumbwheels (52) to 0000.

DISPARITY DELAY

33. Disconnect Oscilloscope channel 2 from J10007 (AV).
34. Connect Oscilloscope channel 2 to J10005 (AR). Trigger Oscilloscope from channel 1.
35. Verify Disparity Out Pulse is 0.5 μ s (\pm 10 ns) wide and positive TTL level.
36. Verify time from P₁ to I-1402 SLS/GTC Output Disparity Pulse is 5.9 μ s (\pm 50 ns). Refer to 1-2-3, Figure 14.
37. Set DISPARITY DELAY Switch (H) to 1.
38. Adjust DISPARITY DELAY 1 Control (K) from limit to limit. Verify time from P₁ to Disparity Out Pulse varies from -6.1 to 17.9 μ s in 100 ns steps.
39. Disconnect Oscilloscope channel 1 from Heterodyne Monitor.
40. Connect Oscilloscope channel 1 to Tee Connector on Pulse Generator output.
41. Set DISPARITY DELAY Switch (H) to 2.



- | STEP | PROCEDURE |
|------|---|
| 42. | Adjust DISPARITY DELAY 2 Control (G) from limit to limit. Verify time from generated pulse to Disparity Out Pulse varies from 360 to 384 μ s in 100 ns steps.

NOTE: Pulse Generator simulates I-1402 EXT SYNC Input from RADAR (UUT) Pre-Trigger Output according to 1-2-3, Figure 14. |
| 43. | Set DISPARITY DELAY Switch (H) to CAL.

TIME DECODED VIDEO DELAY |
| 44. | Disconnect Oscilloscope channel 1 from Pulse Generator and channel 2 from J10005 (AR). |
| 45. | Connect Oscilloscope channel 1 to J10007 (AV) and channel 2 to J10006 (AT). |
| 46. | Verify time from P ₄ I-1402 Video Output to RADAR (UUT) Time-Decoded Video Input pulse is 261.5 μ s (\pm 10 ns). Sample signals are shown in 1-2-3, Figure 14. |
| 47. | Verify Time-Decoded Video Input pulse is 1.0 μ s wide and positive TTL.

EXT MOD INPUT |
| 48. | Disconnect Pulse Generator from J10002 (AU). |
| 49. | Connect Pulse Generator to J10001 (AS). |
| 50. | Disconnect Oscilloscope channel 1 from J10007 (AV). |
| 51. | Connect Oscilloscope channel 1 to GEN Connector (15). |
| 52. | Verify Oscilloscope channel 1 shows 1.0 μ s pulse. |
| 53. | Disconnect Oscilloscope channel 1 from J10007 (AV). |
| 54. | Disconnect Pulse Generator from J10001 (AS).

EXT TRIGGER DELAY |
| 53. | Connect Pulse Generator function out to TP3501/7201 on ATC-1400A. Refer to ATC-1400A Maintenance Manual for location of TP3501/7201. |
| 54. | Connect Oscilloscope channel 1 to XMTR Connector (61). |



OPERATION MANUAL
MODE 4 TEST SYSTEM

STEP	PROCEDURE
55.	Set Pulse Generator for 2 negative going $0.8 \mu\text{s}$ pulses spaced $8 \mu\text{s}$ apart, at $\approx 250 \text{ Hz}$ PRF with $0.2 \text{ V}_{\text{p-p}}$ amplitude.
56.	Adjust amplitude on Pulse Generator until 100 through 1000 watts is displayed on XMTR PWR WATTS Display (1).
57.	Set CODE INT/EXT Switch to EXT.
58.	Verify time from P_1 to Trigger Pulse is $6.45 \mu\text{s}$ ($\pm 50 \text{ ns}$).
59.	Verify Trigger Pulse width is $1.0 \mu\text{s}$ and positive TTL.



OPERATION MANUAL
MODE 4 TEST SYSTEM

G. Calibration/Verification Data Sheet

TECHNICIAN _____ DATE _____

ATC-1400A S/N _____ I-1402 S/N _____

STEP	DATA	RESULT
------	------	--------

(1) POWER SUPPLY

- | | | |
|----|--|-------|
| 1. | dc Bus resistance 20 k Ω | _____ |
| | +5 V Bus resistance 200 Ω | _____ |
| | +12 V Bus resistance 300 Ω | _____ |
| | -12 V Bus resistance 400 Ω | _____ |
| | +40 V Bus resistance 20 k Ω | _____ |
| 3. | +18 Vdc (+16.0 to +24.0 Vdc) | _____ |
| | +5.1 Vdc (+4.9 to +5.3 Vdc) | _____ |
| | +12 Vdc (+11.7 to +12.3 Vdc) | _____ |
| | -12 Vdc (-12.3 to -11.7 Vdc) | _____ |
| | +37.5 Vdc (+35.0 to +40.0 Vdc) | _____ |
| 4. | Pulse PC Board Assembly Voltage
+5 Vdc (+4.8 to +5.2 Vdc) | _____ |

(2) XPDR ATC

- | | | |
|----|---|-----------|
| 5. | F1 to F2 Pulse Spacing 20.3 μ s
(20.29 to 20.31 μ s) | _____ |
| 6. | Reply Code 0000 Pulses Present | _____ (✓) |
| | Reply Code 1111 Pulses Present | _____ (✓) |
| | Reply Code 2222 Pulses Present | _____ (✓) |
| | Reply Code 3333 Pulses Present | _____ (✓) |
| | Reply Code 4444 Pulses Present | _____ (✓) |
| | Reply Code 5555 Pulses Present | _____ (✓) |
| | Reply Code 6666 Pulses Present | _____ (✓) |
| | Reply Code 7777 Pulses Present | _____ (✓) |
| 7. | Pulse Spacing 1.45 μ s
(1.44 to 1.46 μ s) | _____ |
| 8. | "X" Pulse Present | _____ (✓) |



OPERATION MANUAL
MODE 4 TEST SYSTEM

STEP	DATA	RESULT
12.	Correct Emergency Reply Code Format	_____ (✓)
15.	Correct Identification Reply Code Format for Mode 1	_____ (✓)
16.	Correct Identification Code Format for Modes 2, T, 3/A, B, D and AC ₁	_____ (✓)
17.	F ₁ to SPI 24.65 μs (24.64 to 24.66 μs)	_____
18.	SPI Pulse Width 0.5 μs (0.49 to 0.51 μs)	_____
26.	P ₃ to F ₁ 3 μs (2.95 to 3.05 μs)	_____
28.	Reply Delay 1 changes 0 to 12 μs in 50 ns intervals	_____ (✓)
30.	Reply Delay 2 changes 0 to 12 μs in 50 ns intervals	_____ (✓)
31.	Reply Pulse Width 0.45 μs (0.44 to 0.46 μs)	_____
32.	Reply Pulses at positive TTL Level	_____ (✓)
35.	Reply Pulse Width 0.45 μs (0.35 to 0.55 μs)	_____
36.	Pulse Amplitude Changes 3 to 27 Vdc	_____ (✓)
37.	Pulse Amplitude 4.5 Vdc	_____ (✓)
43.	RF Level -20 dBm (-22 to -18 dB)	_____
48.	+3.0 dB Adjustment	_____ (✓)
49.	RF Levels within 10% Tolerance	_____ (✓)
52.	RF Level changes <0.05 dB	_____ (✓)
58.	MODE GROUP DELAY Indicator (U) Illuminates	_____ (✓)
(3)	XPDR MODE 4	
11.	XPDR MODE 4 Indicator (S) Illuminates	_____ (✓)
12.	XPDR Mode 4 P ₁ Pulse Coincident with XPDR ATC P ₁ Pulse (±5 ns)	_____ (✓)
13.	P ₁ -P ₃₇ Pulse Widths 0.5 μs (0.49 to 0.51 μs)	_____ (✓)
	P ₂ Pulse Width	_____



OPERATION MANUAL
MODE 4 TEST SYSTEM

STEP	DATA	RESULT
14.	P ₁ to P ₂ Pulse Spacing 2.0 μ s (1.99 to 2.01 μ s)	_____
15.	P ₁ to P ₃ Pulse Spacing 4.0 μ s (3.99 to 4.01 μ s)	_____
16.	P ₁ to P ₄ Pulse Spacing 6.0 μ s (5.99 to 6.01 μ s)	_____
17.	P ₁ to P ₅ Pulse Spacing 8.0 μ s (7.99 to 8.01 μ s)	_____
19.	Randomly Changing Pulse Sequence Present	_____ (✓)
23.	P ₁ to P ₂ Pulse Spacing 3.95 μ s (3.94 to 3.96 μ s)	_____
24.	P ₁ to P ₃ Pulse Spacing 5.95 μ s (5.94 to 5.96 μ s)	_____
25.	P ₁ to P ₄ Pulse Spacing 7.95 μ s (7.94 to 7.96 μ s)	_____
27.	P ₁ -P ₂ Merged Pulse Width 0.05 ms + Step 13 P ₂ Width (\pm 10 ns)	_____
28.	P ₁ to P ₃ Pulse Spacing 2.05 μ s (2.04 to 2.06 μ s)	_____
29.	P ₁ to P ₄ Pulse Spacing 4.05 μ s (4.04 to 4.06 μ s)	_____
33.	P ₂ Pulse Width Varies 0.2 to 1.95 μ s	_____ (✓)
36.	P ₃ Pulse Width Varies 0.2 to 1.95 μ s	_____ (✓)
38.	P ₄ Pulse Width Varies 0.2 to 1.0 μ s	_____ (✓)
41.	P ₅ Amplitude Varies -19 to +6 dB	_____ (✓)
44.	Correct A Word format	_____ (✓)
46.	Correct B Word format	_____ (✓)
48.	Correct O Word format	_____ (✓)
50.	Double Interrogation Pulse Spacing P ₁ to P ₁ 72 μ s (71.95 to 72.05 μ s)	_____
51.	P ₅ Not in Second Interrogation	_____ (✓)



OPERATION MANUAL
MODE 4 TEST SYSTEM

STEP	DATA	RESULT
52.	Double Interrogation Pulse Spacing P ₁ to P ₁ Varies 0 to 399.9 μ s (\pm 50 ns)	_____ (✓)
56.	P ₄ to Disparity Out Pulse Spacing 198 μ s (197.95 to 198.05 μ s)	_____
57.	Disparity Out Pulse Width 0.5 μ s (0.49 to 0.51 μ s)	_____
	At Positive TTL Level	_____ (✓)
59.	P ₄ to Disparity Out Pulse Varies 0 to 100 μ s in 500 ns steps	_____ (✓)
61.	P ₄ to Disparity Out Pulse Varies 180 to 280 μ s in 500 ns steps	_____ (✓)
65.	P ₄ to Trigger Out Pulse Spacing 194 μ s (193.95 to 194.05 μ s)	_____
66.	Trigger Out Pulse Width 1.0 μ s (0.99 to 1.01 μ s)	_____
	At Positive TTL Level	_____ (✓)
70.	P ₄ to F ₁ Reply Delay 1 Varies 180 to 280 μ s in 500 ns steps	_____ (✓)
72.	P ₄ to F ₁ Reply Delay 2 Varies 180 to 280 μ s in 500 ns steps	_____ (✓)
75.	P ₄ to F ₁ Reply Delay A Word Format 200 μ s (199.95 to 200.05 μ s)	_____
77.	P ₄ to F ₁ Reply Delay B Word Format 260 μ s (259.95 to 260.05 μ s)	_____
79.	P ₄ to F ₁ Reply Delay O Word Format 230 μ s (229.95 to 230.05 μ s)	_____
81.	P ₄ to F ₁ Reply Delay A Word Format 200 to 260 μ s	_____ (✓)
83.	F ₁ to F ₂ Pulse Spacing 1.75 μ s (1.74 to 1.76 μ s)	_____
84.	F ₁ to F ₃ Pulse Spacing 3.5 μ s (3.49 to 3.51 μ s)	_____
85.	Reply Pulse Widths 0.45 μ s (0.44 to 0.46 μ s)	_____
92.	STABLE Indicator (C) Illuminates	_____ (✓)
94.	UNSTABLE Indicator (D) Illuminates	_____ (✓)



OPERATION MANUAL
MODE 4 TEST SYSTEM

STEP	DATA	RESULT
103.	GPIB Reply Delay 100 μ s (99.95 to 100.05 μ s)	_____
(4)	RADAR ATC	
9.	Range Delay P ₃ to I-1402 Trigger Output Pulse Varies 0 to 2471.8 μ s in 12.359 μ s steps	_____ (✓)
17.	I-1402 Trigger Output Pulse to F ₁ Reply Delay 1 Varies 0 to 12 μ s in 50 ns steps	_____ (✓)
19.	I-1402 Trigger Output Pulse to F ₁ Reply Delay 2 Varies 0 to 12 μ s in 50 ns steps	_____ (✓)
21.	I-1402 Trigger Output to F ₁ Reply Delay 3 μ s (2.95 to 3.05 μ s)	_____
24.	F ₁ to F ₂ Reply Pulse Spacing 20.3 μ s (20.25 to 20.35 μ s)	_____
25.	Correct Reply Code Pulse Positions	_____ (✓)
26.	"X" Pulse Present	_____ (✓)
29.	Correct Emergency Reply Code Format	_____ (✓)
32.	Correct Identification Reply Code Format for Mode 1	_____ (✓)
33.	Correct Identification Code Format for Modes 2, T, 3/A, B, D and AC ₁	_____ (✓)
35.	F ₁ and F ₂ Pulse Widths 0.45 μ s (0.44 to 0.46 μ s)	_____
37.	F ₂ Pulse Width Varies 0.2 to 1.95 μ s in 50 ns steps	_____ (✓)
41.	F ₁ to F ₂ Reply Pulse Spacing Varies 22.25 μ s (22.24 to 22.26 μ s)	_____
43.	F ₁ to F ₂ Reply Pulse Spacing 18.35 μ s (18.34 to 18.36 μ s)	_____
47.	P ₁ to Echo Spacing 196.4 μ s (196.35 to 196.99 μ s)	_____
(5)	RADAR MODE 4	
5.	RADAR MODE 4 Indicator (Q) Illuminates	_____ (✓)



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MODE 4 TEST SYSTEM

STEP	DATA	RESULT
12.	P ₄ to F ₁ Reply Delay Random Format 202 to 262 μ s	_____ (✓)
13.	P ₆ through P ₃₇ Correct Random Format	_____ (✓)
15.	P ₄ to F ₁ Reply Delay A Word Format 202 μ s (201.95 to 202.05 μ s)	_____
16.	P ₆ through P ₃₇ Correct A Word Format	_____ (✓)
18.	P ₄ to F ₁ Reply Delay B Word Format 262 μ s (261.95 to 262.05 μ s)	_____
19.	P ₆ through P ₃₇ Correct B Word Format	_____ (✓)
21.	P ₄ to F ₁ Reply Delay 0 Word Format 232 μ s (231.95 to 232.05 μ s)	_____
22.	P ₆ through P ₃₇ Correct 0 Word Format	_____ (✓)
24.	Reply Pulse Spacing 1.75 μ s (1.74 to 1.76 μ s)	_____
25.	Reply Pulse Widths 0.45 μ s (0.44 to 0.46 μ s)	_____
27.	P ₄ to F ₁ Reply Delay 1 Varies 180 to 280 μ s in 500 ns steps	_____ (✓)
29.	P ₄ to F ₁ Reply Delay 2 Varies 180 to 280 μ s in 500 ns steps	_____ (✓)
31.	P ₄ to F ₁ Range Delay + Reply Delay Varies 202 to 2673.8 μ s	_____ (✓)
35.	Disparity Out Pulse Width 0.5 μ s (0.49 to 0.51 μ s)	_____
	At Positive TTL	_____ (✓)
36.	P ₁ to Disparity Out Pulse Spacing 5.9 μ s (5.85 to 5.95 μ s)	_____
38.	P ₁ to Disparity Out Pulse Varies -6.1 to 17.9 μ s in 100 ns steps	_____ (✓)
42.	Generated Pulse to Disparity Out Pulse Varies 360 to 384 μ s in 100 ns steps	_____ (✓)
46.	P ₄ to Time-Decoded Video Input Pulse 261.5 μ s (261.49 to 261.51 μ s)	_____ (✓)



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STEP	DATA	RESULT
47.	Time-Decoded Video Input Pulse Width 1.0 μ s	_____ (✓)
	At Positive TTL	_____ (✓)
52.	Externally Modulated Pulse Present	_____ (✓)
58.	P ₁ to Trigger Pulse 6.45 μ s (6.4 to 6.5 μ s)	_____
46.	Trigger Pulse Width 1.0 μ s	_____ (✓)
	At Positive TTL	_____ (✓)



SECTION 3 - SPECIFICATIONS

1. MODE 4 Test System Specifications.

NOTE: These specifications supersede ATC-1400A specifications whenever the ATC-1400A is mated to the I-1402. Refer to ATC-1400A Operation/Maintenance Manual, Section 1-3-1 for specifications not outlined here.

A. RF LEVEL VERNIER

Range	± 3.0 dB.
Step	0.1 dB.
Accuracy	$\pm 10\%$.

B. ATC XPDR

(1) GEN CODE DELAY (P₃ to F₁)

CAL Position	3.0 μ s (± 50 ns).
Variable Delay 1 Control	0 to 12 μ s.
Variable Delay 2 Control	0 to 12 μ s.

(2) REPLY CODE/ALTITUDE CODE OUTPUT (J10007/J10008)

Pulse Spacing	1.45 μ s (± 10 ns).
Pulse Width (J10007)	0.45 μ s (± 10 ns).
(J10008)	0.45 μ s (± 100 ns).
F ₁ to F ₂ Spacing	20.3 μ s (± 10 ns).
F ₁ to SPI Spacing	24.65 μ s (± 10 ns).
Pulse Jitter (using ATC-1400A 20 MHz clock and T0 SYNC)	<5 ns.
Amplitude (J10007)	Positive TTL.
(J10008)	Nominal 4.5 volts, internally adjustable from +3 to +27 volts into 1 k Ω .

(3) SPI PULSE

Width (J10007)	0.5 μ s (± 10 ns).
(J10008)	0.5 μ s (± 100 ns).
Pulse Position	24.65 μ s (± 10 ns).

(4) CODE FORMATS Refer to Appendix D.



B. ATC XPDR (continued)

(5) IDENT PATTERN

Mode 1	Double reply.
All other modes	Single reply.

(6) EMER PATTERN

All modes except C and AC₂ 4 replies (F₁ - F₈).

(7) MODE GROUP DELAY (P₁ rising edge to suppressor pulse rising edge)

Double Interrogation Selected and Suppressor Switch ON	Mode Group Delay LED - ON
--	---------------------------

Minimum Delay (Thumbwheels = 0)	20.5 μ s.
------------------------------------	---------------

Adjustable (Thumbwheels varied)	20.5 to 399.9 μ s.
------------------------------------	------------------------

(8) UUT Reply Delay (GPIB Only)

Range (P ₃ rising edge to F ₁ rising edge)	0.2 to 199.9 μ s.
---	-----------------------

Resolution	25 ns.
------------	--------

Accuracy	\pm 50 ns.
----------	--------------

C. MODE 4 XPDR

(1) GEN PULSES P₁ THROUGH P₃₇

Pulse Width	0.5 μ s (\pm 10 ns).
-------------	-----------------------------

Pulse Spacing

P ₁ to P ₂	2.0 μ s (\pm 10 ns).
----------------------------------	-----------------------------

P ₁ to P ₃	4.0 μ s (\pm 10 ns).
----------------------------------	-----------------------------

P ₁ to P ₄	6.0 μ s (\pm 10 ns).
----------------------------------	-----------------------------

P ₁ to P ₅	8.0 μ s (\pm 10 ns).
----------------------------------	-----------------------------

P ₁ to P ₆ (Format 0)	9.0 μ s (\pm 10 ns).
---	-----------------------------

P ₁ to P ₆ (Formats A and B)	10.0 μ s (\pm 10 ns).
---	------------------------------

Code Format Refer to Appendix B.

P ₁ thru P ₄ Deviation	\pm 1.95 μ s (\pm 10 ns).
--	------------------------------------

P ₁ thru P ₄ Pulse Width	0.2 to 1.90 μ s (P ₄ + dev, max = 1.0 μ s).
--	---



C. MODE 4 XPDR (continued)

Ps Amplitude (SLS)	-19 dB to +6 dB.
Accuracy	Per ATC-1400A SLS Level specifications.
(2) DI/INTRF SPACING (ATC-1400A Thumbwheel Control)	
Interference Pulse	-17.5 to 399.9 μ s (\pm 50 ns)
DI Spacing	72 to 399.9 μ s (\pm 50 ns).
(3) REPLY OUTPUT (J10007/J10008) [Code=INT]	
Pulse Width (J10007)	0.45 μ s (\pm 10 ns).
(J10008)	0.45 μ s (\pm 100 ns).
Pulse Spacing	1.75 μ s (\pm 10 ns).
F1 to F3 Spacing	3.5 μ s (\pm 10 ns).
Delay (CAL Position)	
Mode 0	230.0 μ s (\pm 50 ns).
Mode B	260.0 μ s (\pm 50 ns).
Mode A	200.0 μ s (\pm 50 ns).
Random	200 to 260 μ s in quasi-random fashion.
Variable Delay 1 Control	180 to 280 μ s.
Variable Delay 2 Control	180 to 280 μ s.
Amplitude Level (J10007)	Positive TTL.
(J10008)	Nominal 4.5 volts, internally adjustable +3 to +27 volts into 1 k Ω .
(4) DISPARITY (J10005) [Code=INT]	
Delay	
CAL Position	198.0 μ s (\pm 50 ns).
Delay 1 Control	0 to 100.0 μ s.
Delay 2 Control	180 to 280 μ s.
Pulse	0.5 (\pm 10 ns) Positive TTL.



C. MODE 4 XPDR (continued)

(5) TRIGGER OUTPUT (J10006) [Code=INT] (Time-Decoded Video)

P4 rising edge to Trigger
Pulse Rising edge 194.0 μ s (\pm 50 ns).
Pulse Width 1.0 μ s nominal.

(6) TRIGGER OUTPUT (J10006) [Code=EXT] (UUT Pre-trigger)

Width 1.0 μ s nominal.

(7) DECODED VIDEO INPUT (J10004) [Code=EXT]

Stable (<0.45 μ s jitter) Stable LED Illuminated.
Unstable (>0.65 μ s jitter) Unstable LED Illuminated.

(8) CHALLENGE VIDEO INPUT (J10001) [Code=EXT]

Polarity Positive.
Amplitude Level 2.5 to 15 volts.

(9) UUT REPLY DELAY [Code=EXT, GPIB Only]

Range (P4 rising edge to
first reply pulse) 0.2 to 199.9 μ s.
Resolution 25 ns.
Accuracy \pm 50 ns.

D. ATC RADAR

- (1) MODE SELECT Modes 1, 2, 3/A and C
(ATC-1400A Mode (Mode is determined by
Select Switch) the ATC-1400A Mode Select
 Switch and not the UUT
 Pulse Spacing).
- (2) RANGE DELAY 0.0 to 200 nmi
(ATC-1400A in 1 nmi steps
Range Controls) (12.359 μ s/nmi).



D. ATC RADAR (continued)

- (3) ECHO (ATC-1400A SLS/ECHO ON/OFF Switch)
- | | |
|--|--|
| ON | enables echo at fixed range delay of 15 nmi (185.4 μ s) plus range and reply delays. |
| Accuracy | ± 50 ns, +0.005%. |
| Position (fixed) | Leading edge is nominally 0.3 μ s prior to leading edge of generator output. |
| Amplitude Level (ATC-1400A SLS/ECHO Thumbwheels) | -19 to +6 dB in 1 dB steps for all pulses simultaneously. |
| Accuracy | Per ATC-1400A SLS Level specifications. |
- (4) REPLY CODES (I-1402 REPLY CODE/ALT Thumbwheel Switches)
- Codes are in accordance with the test criteria in Appendix D for Modes 1, 2, 3/A and C.
- (5) REPLY DELAY (from Scope Trigger Output [J10006])
- | | |
|--------------------------|--------------------------|
| CAL | 3.0 μ s \pm 50 ns. |
| Variable Delay 1 Control | 1.0 to 12 μ s. |
| Variable Delay 2 Control | 1.0 to 12 μ s. |
- (6) F₂ REPLY PULSE (ATC-1400A GEN OUTPUT)
- Deviation from F₁ (ATC-1400A P₂ Deviation Controls)
- | | |
|--------------|---|
| Cal Position | 20.3 μ s (± 50 ns). |
| Variable | ± 1.95 μ s in 0.05 μ s steps. |
- Width (ATC-1400A XPDR PULSE WIDTH Controls)
- | | |
|--------------|--|
| Cal Position | 0.45 μ s (± 10 ns). |
| Variable | 0.2 μ s to 1.95 μ s in 0.05 μ s steps. |
- (7) SCOPE TRIGGER (J10006)
- 1.0 μ s wide, coincidental with the end of range delay (± 50 ns).

E. MODE 4 RADAR

- (1) RANGE DELAY (ATC-1400A Range Controls)
- 0.0 to 200 nmi in 1 nmi steps (12.359 μ s/nmi).



E. ~~MODE 4 RADAR~~ (continued)

(2) ECHO (ATC-1400A SLS/ECHO ON/OFF Switch)

ON	enables echo at fixed range delay of 15 nmi (185.4 μ s) plus range and reply delays.
Accuracy	± 50 ns, +0.005%.
Position (Fixed)	occurs nominally 0.3 μ s prior to generator output.
Amplitude Level (ATC-1400A SLS/ECHO Thumbwheels)	-19 to +6 dB in 1 dB steps for all pulses simultaneously.
Accuracy	Per ATC-1400A SLS Level specifications.

(3) DISPARITY DELAY (J10005)

Cal Position	5.9 μ s (± 50 ns) following P ₁ .
Delay 1 Control	-6.1 μ s to 17.9 μ s following P ₁ .
Delay 2 Control	360 μ s to 384 μ s after pre-trigger input.
Pulse Width	0.5 μ s (± 10 ns).

(4) REPLY [Code=INT]

Pulse Width	0.45 μ s (± 10 ns) fixed.
Pulse Spacing	1.75 μ s (± 10 ns).
Delay ("CAL" Position)	
Format 0	232 μ s (± 50 ns).
Format A	202 μ s (± 50 ns).
Format B	262 μ s (± 50 ns).
Random	202 to 262 μ s in quasi-random fashion.
Variable Delay 1 Control	180 μ s to 280 μ s.
Variable Delay 2 Control	180 μ s to 280 μ s.
Number of pulses	Three.
Amplitude Level	3 to 27 volts (Preset to 4.5 volts).



E. MODE 4 RADAR (continued)

(5) REPLY (J10001) [Code=EXT]

Input from Encryption Device +2.5 to 15 volts.

(6) ENABLE TRIGGER (J10001) [Code=EXT]

Polarity Positive TTL.
Width 1.0 μ s nominal.
Delay 0.45 ms (\pm 50 ns) after P4.

(7) TIME-DECODED VIDEO (J10006) [Code=INT]

Polarity Positive TTL.
Width 1.0 μ s nominal.
Delay 261.5 μ s (\pm 10 ns) plus range delay following P4.

(8) PRE TRIGGER (J10002) [Code=INT]

To initiate interrogation +2.5 to +15 volts input.

(9) CHALLENGE VIDEO Output (J10007/J10008) [Code=INT]

P1 through P4

Spacing (J10007) 2.0 μ s (\pm 10 ns).
(J10008) 2.0 μ s (\pm 50 ns).

Width Cal Position

(J10007) 0.5 μ s (\pm 10 ns).
(J10008) 0.5 μ s (\pm 100 ns).
Variable 0.2 to 1.95 μ s.

P2 thru P4

Position Variable \pm 1.95 μ s.
Control Selectable ON/OFF.

P6 thru P37

Format A, B, 0 or Random.
Width (J10007) 0.5 μ s (\pm 10 ns).
(J10008) 0.5 μ s (\pm 100 ns).
Spacing Even μ s intervals (Information Pulses).



E. MODE 4 RADAR (continued)

Amplitude (J10007)	Positive TTL.
(J10008)	+3 to 27 volts adjustable (Preset to +4.5 volts)

(10) DISPARITY OUTPUT (J5) [Code=INT]

ISLS Trigger

Level	TTL.
Width	0.5 μ s (\pm 10 ns).
Position (CAL)	5.9 μ s (\pm 10 ns) after P1.
Delay 1 Control	\pm 12.0 μ s from CAL.

GTC Trigger

Level	TTL.
Width	0.5 μ s (\pm 10 ns).
Delay 2 Control	360 to 384 μ s after pre-trigger.

F. POWER

(1) AC INPUT	105 to 120/220 to 250 VAC, 50 to 400 Hz, < 30 W.
(2) AC OUTPUT	Line output fused at 3 amps and switched.



SECTION 4 - REPACKING FOR SHIPMENT

1. I-1402 Shipping and Repacking Procedures.

A. Shipping Information

IFR test sets returned to factory for calibration, service or repair must be repackaged and shipped subject to the following conditions:

- (1) Do not return any products to factory without first receiving authorization from IFR Customer Service Department.

CONTACT: Customer Service Dept.
IFR Systems, Inc.
10200 West York Street
Wichita, Kansas 67215

Telephone: (800)-835-2350
TWX: 910-741-6952

- (2) All test sets must be tagged with:
 - (a) Owner's identification and address.
 - (b) Nature of service or repair required.
 - (c) Model No.
 - (d) Serial No.
- (3) Sets must be repackaged in original shipping containers using IFR packing models. If original shipping containers and materials are not available, contact IFR Customer Service Dept. for shipping instructions.
- (4) All freight costs on non-warranty shipments are assumed by customer. (See "Warranty Packet" for freight charge policy on warranty claims.)

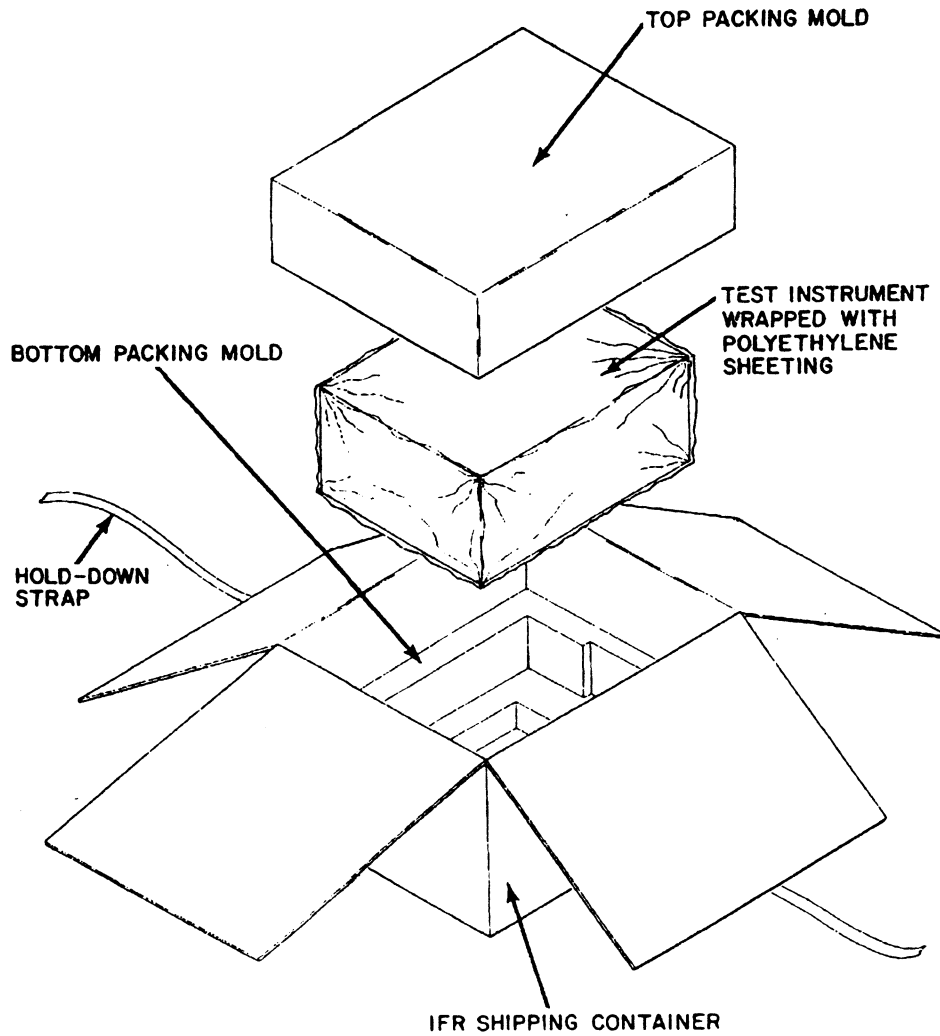
B. Repacking Procedure (Refer to Figure 1)

- (1) Make sure bottom packing mold is seated on floor of shipping container.
- (2) Carefully wrap test set with polyethylene sheeting to protect finish.
- (3) Place test set into shipping container, making sure set is securely seated in bottom packing mold.
- (4) Place top packing mold over top of set and press down until mold rests solidly on bottom packing mold.



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- (5) Close shipping container lids and seal with shipping tape or an industrial stapler. Tie all sides of container with break resistant rope, twine or equivalent.



Repacking Procedure
Figure 1



SECTION 5 - STORAGE

1. I-1402 Storage Precautions.

- A. No particular storage requirements are necessary during extended periods in which the Test Auxiliary will not be utilized.
- B. The following common-sense practices should be done, however:
 - (1) Disconnect the Test Auxiliary from any electrical power source.
 - (2) Disconnect and store the AC power cable and any other accessories with the Test Auxiliary.
 - (3) Cover the Test Auxiliary to prevent dust and debris from covering and entering the Test Auxiliary.



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APPENDIX A - CONNECTOR PIN-OUT TABLES

1. Table of I/O Connectors

REFERENCE DESIGNATOR	CONNECTOR NAME	CONNECTOR TYPE	SIGNAL INPUT/OUTPUT	SIGNAL TYPE
J10001	EXT MOD	BNC	Input	TTL
J10002	EXT SYNC	BNC	Input	TTL
J10003	EXT CLOCK	BNC	Input	TTL
J10004	DECODED VIDEO	BNC	Input	TTL
J10005	DISPARITY	BNC	Output	TTL
J10006	TRIGGER	BNC	Output	TTL
J10007	REPLY (TTL)	BNC	Output	TTL
J10008	REPLY (3-27 V)	BNC	Output	3-27 VDC, Variable
J10010	AUX BUS	25-Pin, Type D	Input/Output	See Pin-Out Table
J10011	IFR BUS	25-Pin, Type D	Input/Output	See Pin-Out Table
J10013	LEVEL	SMB	Output	0-7 VDC, Variable



2. Pin-out Table for AUX BUS Connector J10010 (BA)

J10010 AUX BUS CONNECTOR PIN ASSIGNMENTS				
Pin No.	Signal Name	Signal Type	Input/Output	Polarity
1	Ground			
2	N/C			
3	N/C			
4	N/C			
5	External Pulse	TTL	Output	Active Low
6	External SLS	TTL	Output	Active Low
7	N/C			
8	Pulse	TTL	Input	Positive
9	20 MHz	TTL	Input	Rising Edge
10	A/A Interrogations	TTL	Input	Rising Edge
11	50% Video	TTL	Input	Positive
12	N//C			
13	N/C			
14	Self Interrogate	Open Collector	Input/Output	Active Low (Trigger on Rising Edge)
15	Ground			
16	Ground			
17	Ground			
18	Ground			
19	Ground			
20	Ground			
21	Ground			
22	Ground			
23	N/C			
24	Ground			
25	N/C			



3. Pin-out Table for IFR BUS Connector J10011 (AH)

J10011 IFR BUS CONNECTOR PIN ASSIGNMENTS				
Pin No.	Signal Name	Signal Type	Input/Output	Polarity
1	Ground			
2	A0	TTL	Input	Positive
3	A1	TTL	Input	Positive
4	Ground			
5	A2	TTL	Input	Positive
6	D7	TTL	Input/Output	Positive
7	D6	TTL	Input/Output	Positive
8	A3	TTL	Input	Positive
9	Ground			
10	Ground			
11	A4	TTL	Input	Positive
12	D5	TTL	Input/Output	Positive
13	Ground			
14	A5	TTL	Input	Positive
15	D4	TTL	Input/Output	Positive
16	Ground			
17	WRITE	TTL	Input	Positive Strobe
18	D3	TTL	Input/Output	Positive
19	Ground			
20	READ	TTL	Input	Positive Strobe
21	D2	TTL	Input/Output	Positive
22	INTA	Open Collector	Output	Active Low
23	INTR	Open Collector	Input	Active Low
24	D1	TTL	Input/Output	Positive
25	D0	TTL	Input/Output	Positive



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APPENDIX B - MODE 4 INTERROGATION WORD
FORMAT CODE POSITION CHART

1. The following chart reflects the pulse spacing (nominal delay) for interrogation word format 0, A, B and Random.

INTERROGATION WORD FORMAT				
PULSE	0 (μ s)	A (μ s)	B (μ s)	Random (μ s)
P6	9	10	10	9, 10, or OFF
P7	11	13	12	11, 12, or OFF
P8	13	15	15	13, 14, or OFF
P9	15	17	17	15, 16, or OFF
P10	17	OFF	19	17, 18, or OFF
P11	19	20	OFF	19, 20, or OFF
P12	21	OFF	22	21, 22, or OFF
P13	23	24	25	23, 24, or OFF
P14	25	26	OFF	25, 26, or OFF
P15	27	OFF	28	27, 28, or OFF
P16	29	30	30	29, 30, or OFF
P17	31	33	32	31, 32, or OFF
P18	33	35	35	33, 34, or OFF
P19	35	OFF	37	35, 36, or OFF
P20	37	38	OFF	37, 38, or OFF
P21	39	41	40	39, 40, or OFF
P22	41	43	OFF	41, 42, or OFF
P23	43	45	44	43, 44, or OFF
P24	45	OFF	OFF	45, 46, or OFF
P25	47	48	48	47, 48, or OFF
P26	49	50	51	49, 50, or OFF
P27	51	52	53	51, 52, or OFF
P28	53	54	55	53, 54, or OFF
P29	55	OFF	57	55, 56, or OFF
P30	57	58	OFF	57, 58, or OFF
P31	59	61	60	59, 60, or OFF
P32	61	63	62	61, 62, or OFF
P33	63	OFF	64	63, 64, or OFF
P34	65	66	66	65, 66, or OFF
P35	67	68	OFF	67, 68, or OFF
P36	69	OFF	70	69, 70, or OFF
P37	71	71	OFF	71, 72, or OFF
P1	Reference			
P2	2 μ s (\pm Dev) with P2 Dev ON			
P3	4 μ s (\pm Dev) with P3 Dev ON			
P4	6 μ s (\pm Dev) with P4 Dev ON			
P5	8 μ s (\pm Dev) with SLS ON			



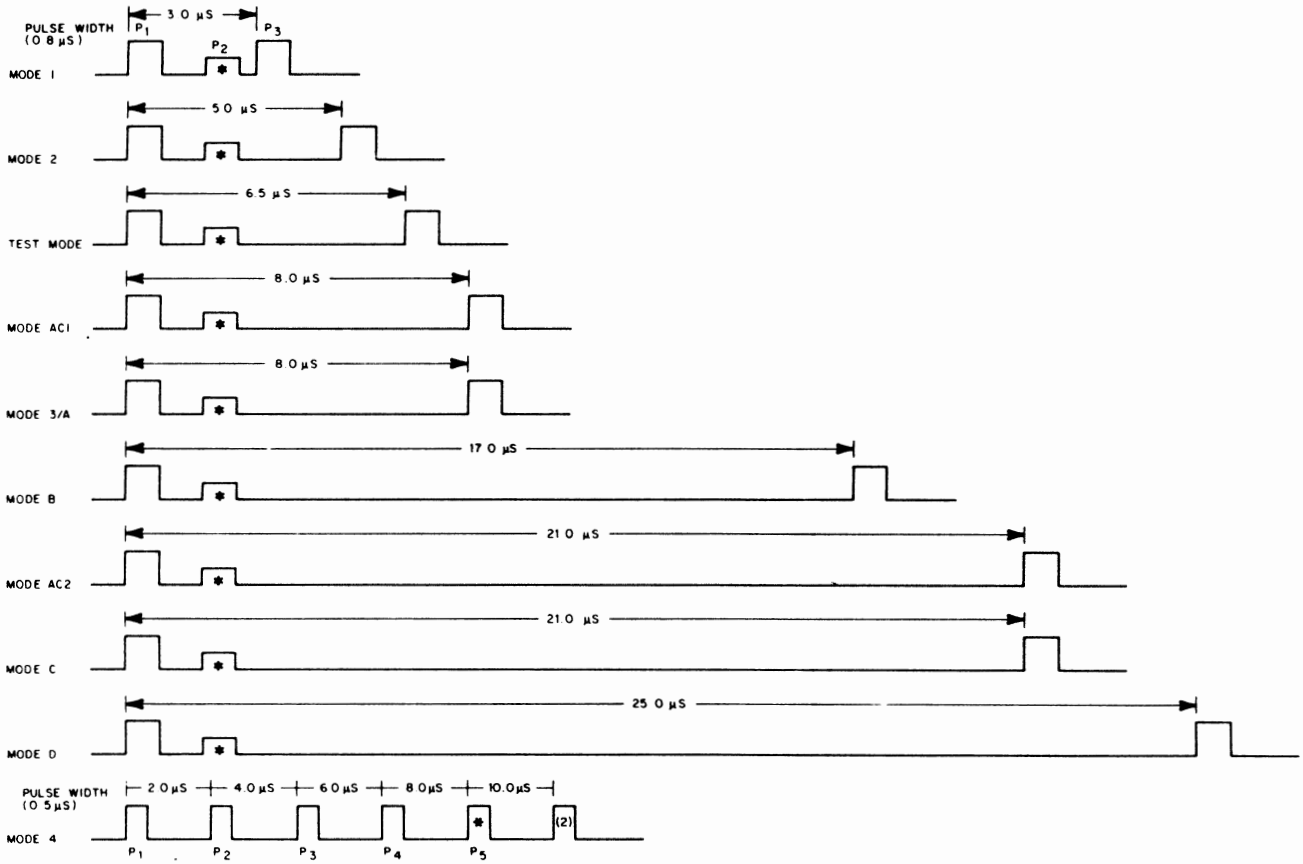
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APPENDIX C - INTERROGATION AND REPLY PULSE SPACING CHARTS

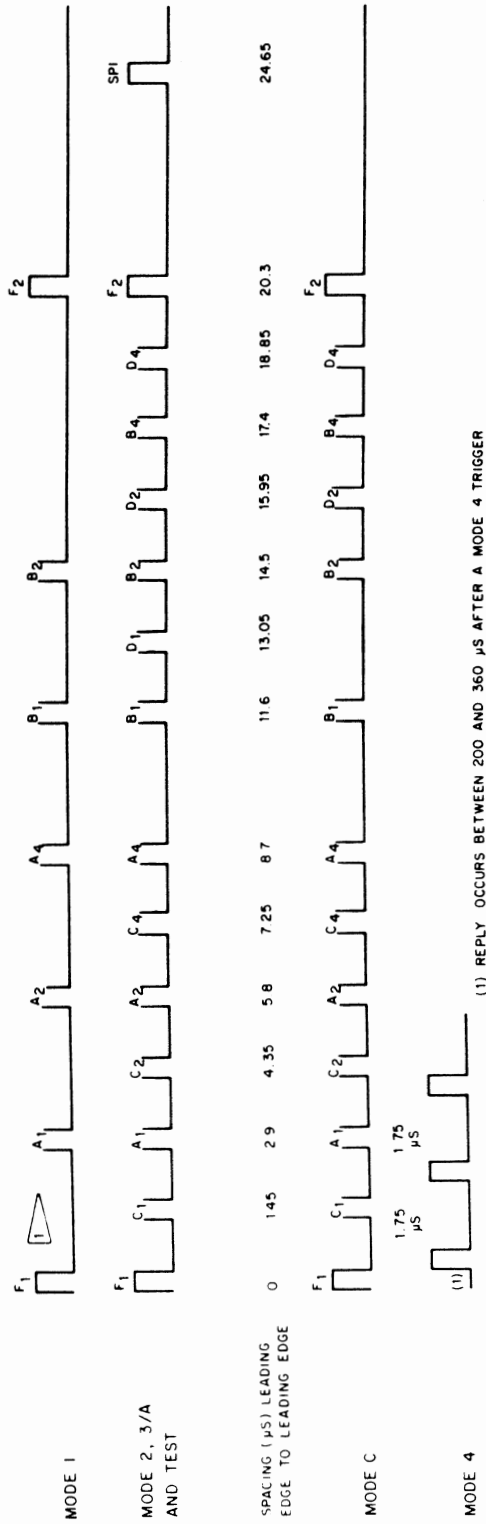
1. Interrogation Pulse Spacing



- * SIDE-LOBE SUPPRESSION (SLS)
- (2) SLS PULSE MAY BE FOLLOWED BY AS MANY AS 32 PULSES, SPACED AT 2 μs INTERVALS.



2. Reply Pulse Spacing



1 THE OPERATOR SHOULD SELECT 0000 TO 7700 (C AND D ARE ZERO) FOR MODE 1 OPERATION ON THE I-1402 REPLY CODE/ALTITUDE THUMBWHEELS.



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APPENDIX D - ATC CODES/PULSE BINARY CONVERSION TABLE

MODE C (random altitude, in feet)

CODE	ALTITUDE	F1	C1	A1	C2	A2	C4	A4	X	B1	D1	B2	D2	B4	D4	F2 (verify)
9010	-1,000	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1
0000	0	1	0	0	1	0	0	0	0	0	0	1	0	1	0	1
0099	9,900	1	0	0	1	1	1	1	0	1	0	0	0	1	0	1
0555	55,500	1	0	0	1	0	0	1	0	0	0	0	0	1	1	1
1001	100,100	1	1	1	1	0	0	1	0	1	0	1	1	1	0	1
1267	126,700	1	0	0	0	0	1	0	0	0	0	0	1	0	0	1

MODES 1, 2, 3/A (random IDENT codes)

CODE	DESC	F1	C1	A1	C2	A2	C4	A4	X	B1	D1	B2	D2	B4	D4	F2 (verify)
0000	octal	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
4210	octal	1	1	0	0	0	0	1	0	0	0	1	0	0	0	1
0124	octal	1	0	0	1	0	0	0	0	1	0	0	0	0	1	1
7700	octal	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
0077	octal	1	1	0	1	0	1	0	0	1	1	0	1	0	1	1
9999	>7777	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
X Pulse		1	x	x	x	x	x	x	1	x	x	x	x	x	x	1

Pulse Positions	F1	0.00 μ s	(reference)
	C1	1.45 μ s	
	A1	2.90 μ s	
	C2	4.35 μ s	
	A2	5.80 μ s	
	C4	7.25 μ s	
	A4	8.70 μ s	
	X	10.15 μ s	
	B1	11.60 μ s	
	D1	13.05 μ s	
	B2	14.50 μ s	
	D2	15.95 μ s	
	B4	17.40 μ s	
	D4	18.85 μ s	
	F2	20.30 μ s	
	SPI	24.65 μ s	



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APPENDIX E - ABBREVIATIONS

A		E	
A	Ampere(s)	EMER	Emergency
AC	Alternating Current	Ext	External
ASCII	American Standard Code for Information Interchange	EXT SYNC	External Synchronization
ATC	Air Traffic Control	EXT MOD	External Modulation
ATCRBS	Air Traffic Control RADAR Beacon System		F
ATE	Automatic Test Equipment	FETS	Field Effect Transistors
	B	F1	First Framing Pulse (reply)
	C	F2	Second Framing Pulse (reply)
CAL	Calibrated Position		G
CMOS	Complimentary MOS Logic	GEN	Generated
	D	GPIB	General Purpose Interface Bus
dB	Decibel	GTC	Gain Time Trigger
DBL	Double		H
dBm	Decibels compared to 1 milliwatt.	Hz	Hertz
DEV	Deviation		I
DI	Double Interrogation	IDENT	Identification Reply
DISP	Disparity	IEEE	Institute of Electrical and Electronic Engineers
DSDL	Disparity Delay (GPIB)	IFR	IFR Systems, Inc
DSD1	Disparity Delay 1 (GPIB)	Int	Internal
DSD2	Disparity Delay 2 (GPIB)	INTRF	Interference
		INTERR	Interrogation
		ISLS	Interrogation Sidelobe Suppression
		I/O	Input/Output



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	J		P
	K	PC	Printed Circuit
kHz	Kilo-Hertz (10^3)	P(n)	Interrogation Pulse, n-number represents pulse position
KIR	Interrogator Computer (Cryptographic Device)	PRF	Pulse Repetition Frequency
KIT	Transponder Computer (Cryptographic Device)	PULS	"X" pulse (GPIB)
	L	PWR	Power
LED	Light Emitting Diode		Q
LVL	Level		R
	M	RATC	RADAR ATC Test Function (GPIB)
MHz	Mega-hertz (10^6)	REV No.	Revision Number
MOS	Metal Oxide Conductor	RF	Radio Frequency
μ s	Micro-second (10^{-6})	RFLV	RF Level (GPIB)
ms	Milli-second (10^{-3})	RLCD	Reply Code (GPIB)
MTL	Minimum Triggering or Threshold Level	RLDL	Reply Delay (GPIB)
	N	RLD1	Reply Delay 1 (GPIB)
nmi	Nautical Miles	RLD2	Reply Delay 2 (GPIB)
NORM	Normal	RLFM	Reply Format (GPIB)
ns	Nano-second (10^{-9})	RM4	RADAR Mode 4 Test Function (GPIB)
Ω	Ohm(s)	RNG	Range
		RPLY	Reply (GPIB)
			S
		SLS	Sidelobe Suppression
		SPI	Special Identification Pulse
		Sqtr	Squitter
		STAB	Time-Decoded Video Stability (GPIB)
		SYNC	Synchronous



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	T
TTL	Transistor - Transistor Logic
TWX	Teletypewriter Exchange
	U
UUT	Unit Under Test
UUTD	UUT Reply Delay (GPIB)
	V
V	Volt(s)
VAC	Volts Alternating Current
VAR	Variation
VDC	Volts Direct Current
	W
W	Watt(s)
	X
XATC	XPDR ATC Test Function (GPIB)
XMTR	Transmitter
XM4	XPDR Mode 4 Test Function (GPIB)
XPDR	Transponder
	Y
	Z



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APPENDIX F - METRIC/BRITISH IMPERIAL CONVERSION TABLE
With NAUTICAL DISTANCE CONVERSIONS

To Convert:	Into:	Multiply By:	To Convert:	Into:	Multiply By:
cm	feet	0.03281	meters	feet	3.281
cm	inches	0.3937	meters	inches	39.37
feet	cm	30.48	m/sec	ft/sec	3.281
feet	meters	0.3048	m/sec	km/hr	3.6
ft/sec	km	1.097	m/sec	miles/hr	2.237
ft/sec	knots	0.5921	miles	feet	5280
ft/sec	miles/hr	0.6818	miles	km	1.609
ft/sec ²	cm/sec ²	30.48	miles	meters	1609
ft/sec ²	m/sec ²	0.3048	miles	nmi	0.8684
grams	ounces	0.03527	miles/hr	ft/sec	1.467
inches	cm	2.54	miles/hr	km/hr	1.609
kg	pounds	2.205	miles/hr	knots	0.8684
kg/cm ²	psi	0.0703	nmi	feet	6080.27
km	feet	3281	nmi	km	1.8532
km	miles	0.6214	nmi	meters	1853.2
km	nmi	0.5396	nmi	miles	1.1516
km/hr	ft/sec	0.9113	ounces	grams	28.34953
km/hr	knots	0.5396	pounds	kg	0.4536
km/hr	miles/hr	0.6214	psi	kg/cm ²	0.0703
knots	ft/sec	1.689	100 ft	km	3.048
knots	km/hr	1.8532	100 ft	miles	1.894
knots	miles/hr	1.1516	100 ft	nmi	1.645



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APPENDIX G - TEST EQUIPMENT REQUIREMENTS

1. General

This appendix contains a list of test equipment suitable for performing all testing procedures contained in this manual. Other equipment meeting specifications listed in this appendix may be substituted in place of recommended models. Equipment listed in this appendix may exceed minimum required specifications for some procedures contained in this manual.

2. Recommended Test Equipment

TYPE	MODEL	SPECIFICATIONS
Digital Multimeter	FLUKE 8010A or Equivalent	Resistance: 0 to 200 kW Accuracy: ±1% Voltage: 3.5 Digit (1 mV) Accuracy: ±0.1% Basic dc
Function Generator	WAVETEK 145 or Equivalent	Frequency Range: 0.0001 Hz to 20 MHz Functions: Sine Wave Output Level: 0 to 30 Vp-p (≤15 Vp-p into 50 Ω)
Heterodyne Monitor	ANZAC MD-141 or Equivalent	
Oscilloscope	TEK 2465 or Equivalent	Bandwidth: dc to 100 MHz Vertical Accuracy: ±10% Time Accuracy: ±0.7% of Time Interval ±0.6% of Full Scale Δ Time Accuracy: ±0.5% of Time Interval ±0.3% of Full Scale



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TYPE	MODEL	SPECIFICATIONS
Pulse Generator	WAVETEK 145 or Equivalent	Frequency Range: 0.0001 Hz to 20 MHz Functions: Pulse Voltage Controlled Generator: 0-1000:1 frequency change with 0 to 2 V input Pulse Delay: 50 ns to 10 ms Pulse Width: 25 ns to 1 ms Output Level: 30 Vp-p (15 Vp-p into 50 Ω)
RF Power Meter with Power Sensor	Boonton 4200 and Boonton 4200-5B of Equivalent	Power Range: -30 to +10 dBm Accuracy: ± 0.1 dB
RF Signal Generator	HP8657B or Equivalent	Frequency Range: 1030 to 1090 MHz Resolution: 1 Hz RF Output: -130 to 15 dBm

**CUSTOMER RECOMMENDED CHANGES
TO TECHNICAL MANUALS**

CUSTOMER INFORMATION				PRODUCT INFORMATION
NAME (PLEASE PRINT) _____			DATE _____	MODEL # _____ SERIAL # _____
YOUR TITLE _____		BUSINESS PHONE # _____		MANUAL TYPE
COMPANY NAME _____				<input type="checkbox"/> OPERATOR'S GUIDE
BUSINESS ADDRESS _____				<input type="checkbox"/> OPERATION MANUAL
CITY _____ STATE _____ ZIP _____				<input type="checkbox"/> MAINTENANCE MANUAL
				<input type="checkbox"/> ILLUSTRATED PARTS CAT.
				PUBLICATION DATE _____
PLEASE BE SPECIFIC IN IDENTIFYING PROBLEMS				
PAGE NO.	PARA. NO.	FIGURE NO.	TABLE NO.	COMMENTS

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