SECTION 1 - DESCRIPTION

1. General Description and Capabilities

A. Description

The S-1403/ATC-1400A (Mode S Test System) provides transponder pulse code modulation for the purpose of testing Air Traffic Control Radar Beacon (ATCRBS) and Mode Select (Mode S) Transponders. It can be operated manually using front panel controls and switches, or remotely by Automatic Test Equipment (ATE) control through the General Purpose Interface Bus (GPIB).

B. Features

The Mode S Test System incorporates the following test features:

- Air Traffic Control Radar Beacon System (ATC) Test Function
- Programmable Mode S Sequence (SEQ) Test Function
- All Call Short (ACS) Test Function
- All Call Long (ACL) Test Function
- Interlacing (INTLCE) Mode S with ATC Test Function
- Double Interrogation (DI) Test Function
- BURST Test Function
- An RF output at a fixed frequency and output level for diversity antenna testing.
- A vernier level control which provides an additional 3.0 dB RF output power in 0.1 dB steps for all modes.
- A four-line by forty-column indicator for displaying Mode S parameters.
- Twenty-four position Keyboard for numerical data entry, function selection and cursor control.
- Continuous rotation "SLEW" Control, used as an alternate to key entry.
- A battery backup memory for saving front panel selections plus storage for an additional test setup.
- A menu to allow operator input and monitoring of uplink and downlink formats.
- Programmable sixteen-item sequence for uplink and downlink format information.
- Remote operation through the ATC-1400A IEEE-488 1978 interface port.
- Rear panel interconnects for control and signal monitoring.

- P_4 and P_6 width and offset; P_4 and P_5 amplitude control.
- Synchronous Phase Reversal (SPR) offset control with respect to P_6 rising edge.

C. System Overview

The Mode S Test System consists of seven test functions providing the pulse and DPSK modulation needed to verify the proper operation of a Mode S transponder. These functions allow the operator to simulate:

- An ATCRBS environment (ATC Function) in which an ATC ground system transmits a standard two-pulse interrogation and expects either a Mode A or Mode C reply. The S-1403 has the additional capability to decode and display Mode S Squitter replies, allowing the operator to determine the aircraft address.
- A Mode S environment (SEQ Function) in which a ground or airborne (TCAS) interrogator can transmit a number of uplink formats to the Mode S transponder and decode its downlink format replies. Up to sixteen unique uplink formats may be programmed with their accompanying replies displayed on each of the S-1403 Sequence Menu displays.
- An intermode environment (INTLCE Function) in which both ATCRBS and Mode S interrogations are interlaced at a normal ratio of ten ATCRBS per one Mode S.

For all these environmental simulations, the S-1403 in conjunction with the ATC-1400A, provides control for all pulse parameters for testing the limits of operation of the Unit Under Test (UUT). Indication of proper operation is provided by percent reply displays that discriminate between ATCRBS and Mode S replies. In addition to these common signal environment simulations, the Mode S Test System provides means of testing both minimum interrogation spacing (DI Test Function) and rate limiting (BURST Test Function).

- The ACS (All Call Short) and ACL (All Call Long) Test Functions provide a quick and convenient way to determine if the transponder is replying properly as either ATCRBS or Mode S. These functions provide full control over the P_4 pulse characteristics to determine the proper response.
- Diversity testing is also possible in all functions by enabling ANT B. This tests the UUT's ability to switch antennas by simulating a disparity in amplitude or time from the ANT A to the ANT B output.
- Detailed explanation of the operation of each of the seven functions is provided in 1-2-4. The user should read these paragraphs and review the associated timing diagrams before proceeding.

The outer 25-pin ribbon cable between the S-1403, J10010 and ATC-1400A, J6 (Auxiliary Bus) is used to transmit high speed clock (20 MHz) and pulse video information from the ATC-1400A to the S-1403. The S-1403 uses the clock input for all pulse generation (interrogation) functions for both ANT A (ATC-1400A RF I/O) and ANT B output. The S-1403 uses the reply video information from ANT A, to measure reply pulse parameters. The ATC-1400A also provides a synchronization signal called Self Interrogation (Self Interr), driven by the ATC-1400A PRF generator. Self Interr is used to "drive" every function unless the EXT SYNC IN control has been turned on. ATC-1400A SLS enable gate control by the S-1403 is accomplished through the Auxiliary Bus.

The 25-pin ribbon cable between the S-1403, J10011 and ATC-1400A, J5 (IFR Bus) allows the two units to transfer control and data information. Upon power-on, after each unit has performed an initialization sequence, the S-1403 transmits (to the ATC-1400A) the control output and data input locations within the ATC-1400A, the S-1403 will override and monitor. Until power is removed, the S-1403 maintains primary control over the selected ATC-1400A functions. The IFR Bus also allows ASCII GPIB commands to be relayed to the S-1403 for execution and relays return data back to the ATC-1400A GPIB interface.

The S-1403 uses three separate coaxial cables to control the following ATC-1400A functions:

- RF Level, by raising or lowering an analog signal on the RF Vernier Output Connector, is sent directly to the ATC-1400A Modulator for a ±3 dB offset.
- A digital drive from the S-1403 directly to the ATC-1400A Phase Modulator for DPSK transitions in the ANT A interrogation output (Mode S).
- A gating control signal on the Measurement Gate Output that enables the ATC-1400A power meter circuit.

The remaining interfaces on the rear of the S-1403 are used in test performances and are explained in detail later.

The S-1403's LCD display provides supplemental display and control fields to the ATC-1400A. Nearly all of the ATC-1400A's display and switch inputs have been left active as well. Those still used are listed in the following chapter along with a description of their use. Users of this system who are familiar with the ATC-1400A operation should have little trouble understanding the use of the S-1403/ATC-1400A System. Some of the ATC-1400A switch operations are defined differently in this manual so as to better represent their modified use as a system control. Also some of the System Specifications have been altered from the ATC-1400A specifications.

In every case, the S-1403/ATC-1400A System Specifications take precedence over the ATC-1400A specifications.

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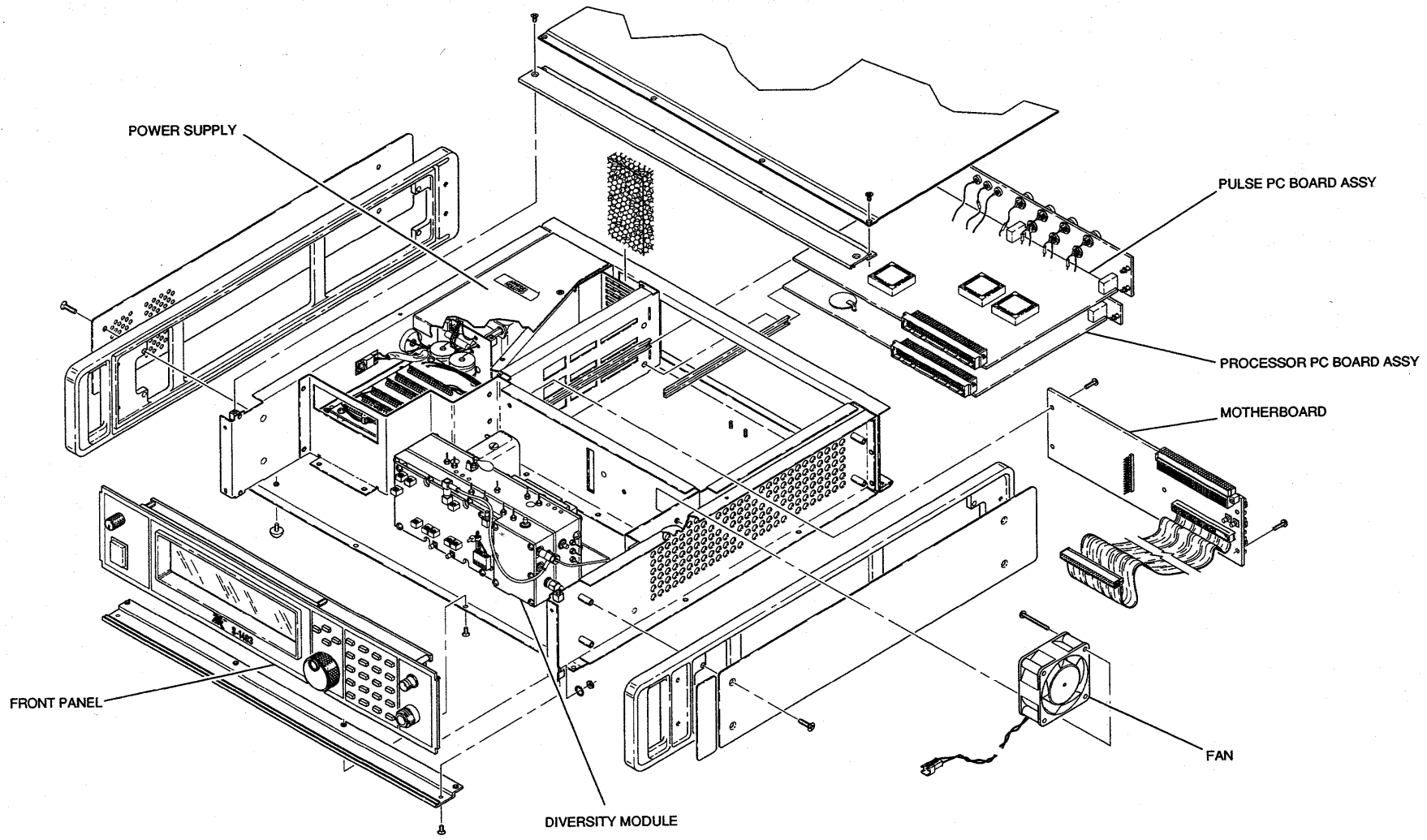


S-1403 Composite
Figure 1

SECTION 2 - OPERATION

1. Installation

Installation of the Mode S Test System is a simple procedure:

STEP	PROCEDURE
1.	Set the instrument into an operating position.
2.	Furnish electrical power to the test set by connecting an ac power cable to available power source (either 105 to 120 VAC or 220 to 250 VAC, 50 to 400 Hz, 10 W).

This section includes recommendations regarding installation and operating safety, equipment inspection, power requirements, required installation tools and bench/rack installation.

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 the system without reading and complying with all instructions contained in this manual. All procedures contained in this manual must be performed in the exact sequence and in the manner described.

(2) Grounding Requirements

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

WARNING: TO MINIMIZE SHOCK HAZARD, ALL EQUIPMENT CHASSIS AND CABINETS MUST BE CONNECTED TO AN ELECTRICAL GROUND. FOR THIS PURPOSE, ALL IFR SYSTEMS, INC., TEST SETS ARE EQUIPPED WITH A STANDARD THREE-PRONGED POWER CABLE WHICH MUST BE CONNECTED TO A PROPERLY GROUNDED THREE-PRONG WALL RECEPTACLE. TO SUMMARIZE, IT IS THE CUSTOMER'S RESPONSIBILITY TO:

WARNING: HAVE A QUALIFIED ELECTRICIAN CHECK ALL RECEPTACLE(S) FOR PROPER GROUNDING.

WARNING: REPLACE ANY STANDARD TWO-PRONGED RECEPTACLE(S) WITH PROPERLY GROUNDED THREE-PRONG RECEPTACLE(S).

(3) Operating Safety

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

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

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

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

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

INPUT VOLTAGE	F1 - AC IN FUSE	F2 - AC OUT VOLTAGE
105 to 120 VAC	3.0 A, 250 V Fast Blo	1.0 A, 250 V Fast Blo
220 to 250 VAC	3.0 A, 250 V Fast Blo	0.5 A, 250 V Fast Blo

D. Installation Equipment

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

E. Installation Procedure

The S-1403 and ATC-1400A are shipped in separate containers. To prepare the units for operation, proceed as follows:

STEP	PROCEDURE

1. Remove both the S-1403 and ATC-1400A Test Sets from their respective containers.
2. Place the S-1403 on top of the ATC-1400A.
3. Connect the two 25-pin type D ribbon cables and three SMB-to-SMB coax cables to test sets as shown in 1-2-1, Figure 1.
4. Calibrate the Mode S Test System per Section 2-2-2, Paragraph H(4), System Calibration. The System must be calibrated any time the S-1403 is replaced.

The S-1403, when interfaced with the ATC-1400A, can be installed in either a bench-top or rack-mount fashion. All IFR Systems, Inc., test sets are normally shipped from factory with plastic feet installed for a bench-top installation.

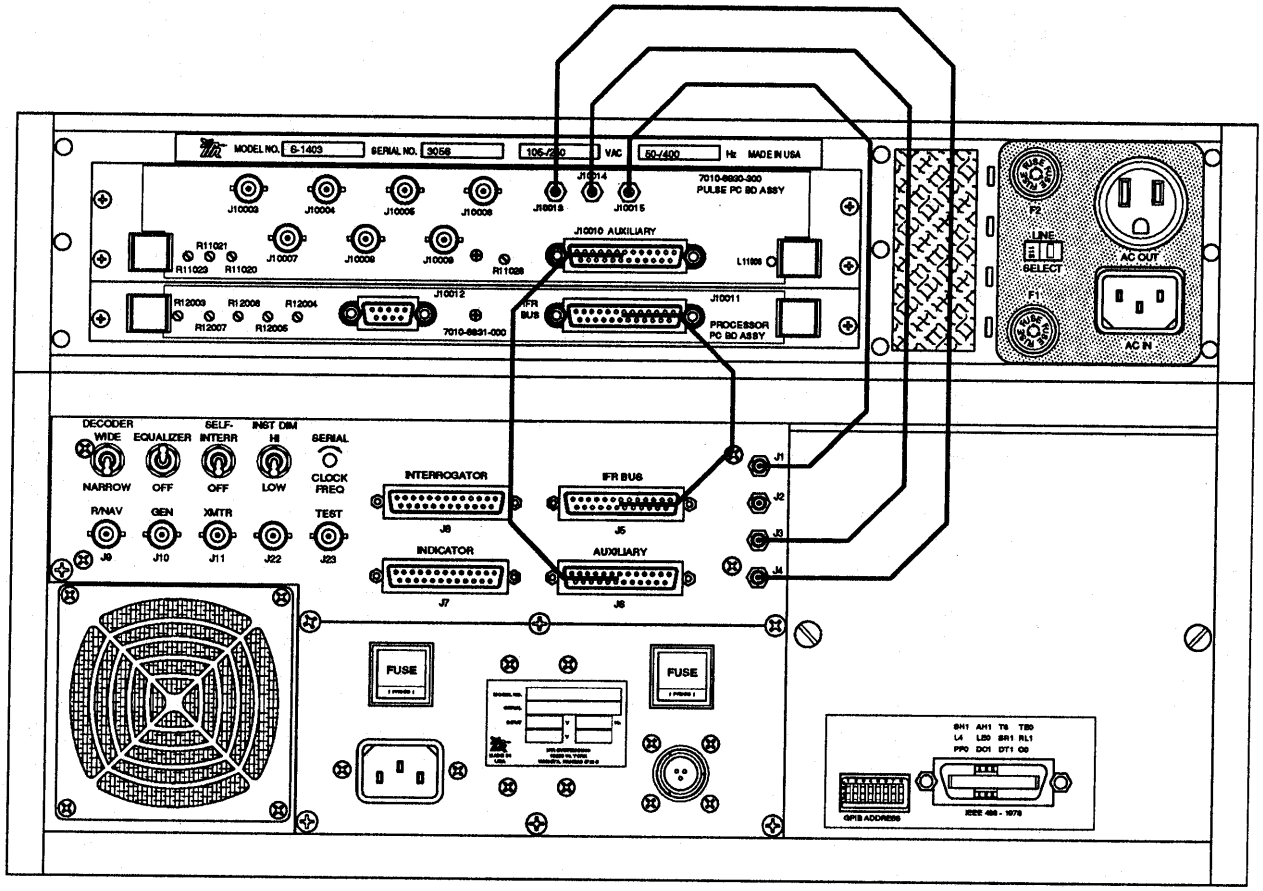
Kit Required	Instrument	IFR Systems Part Number
Rack Mount	ATC-1400A S-1403	7001-7636-800 7001-6740-800
Bench/Stack Mount	ATC-1400A S-1403	7005-6743-000 One kit required per Mode S System

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

F. Power-up Procedure

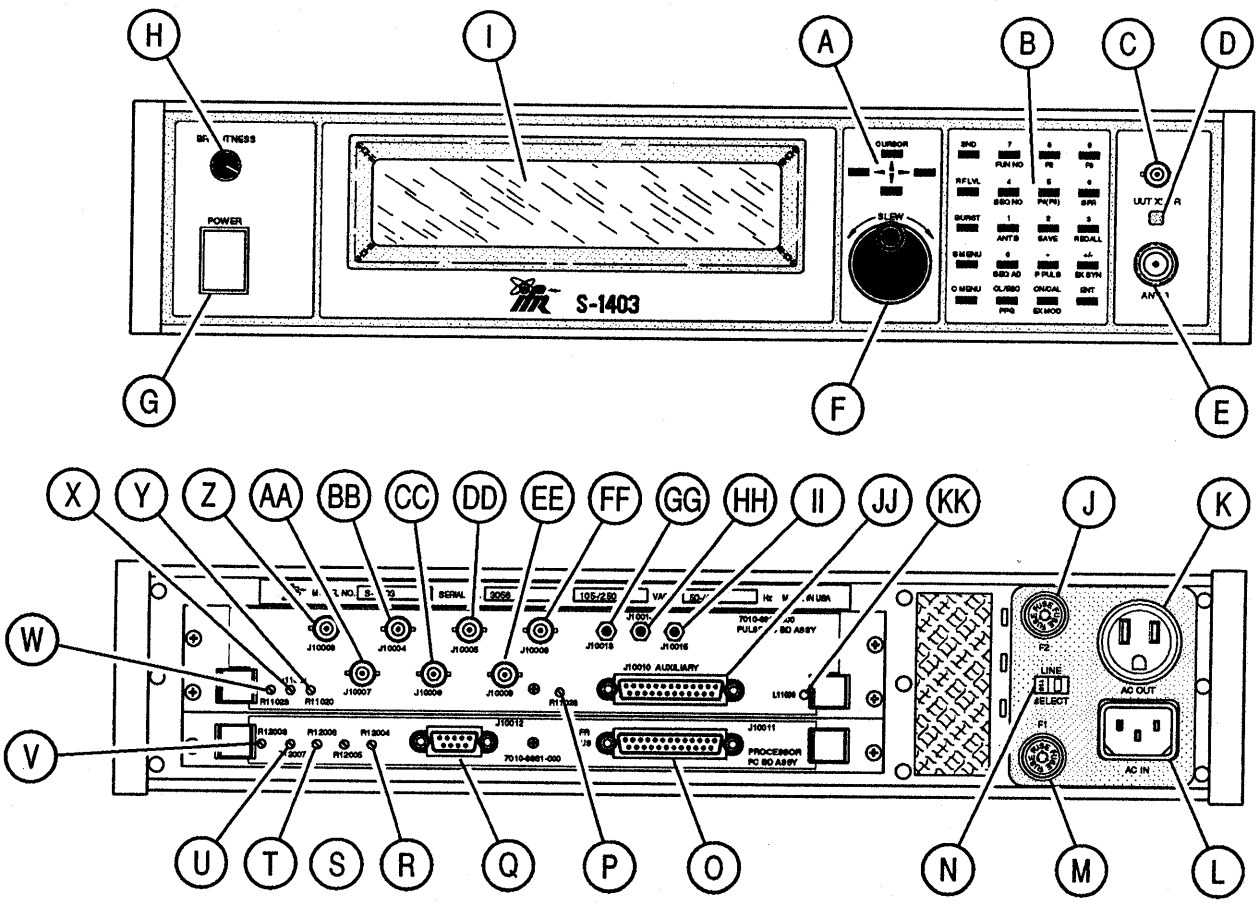
STEP	PROCEDURE

1. Remove 3-conductor ac power cable from S-1403 shipping container and connect female end to AC IN Connector (L) on rear panel of S-1403. Connect 3-pin grounded plug on opposite end of ac power cable to standard 3-pin grounded receptacle.
2. Place POWER Switch (G) to "ON" Position to energize Test Set and verify POWER Switch is illuminated.

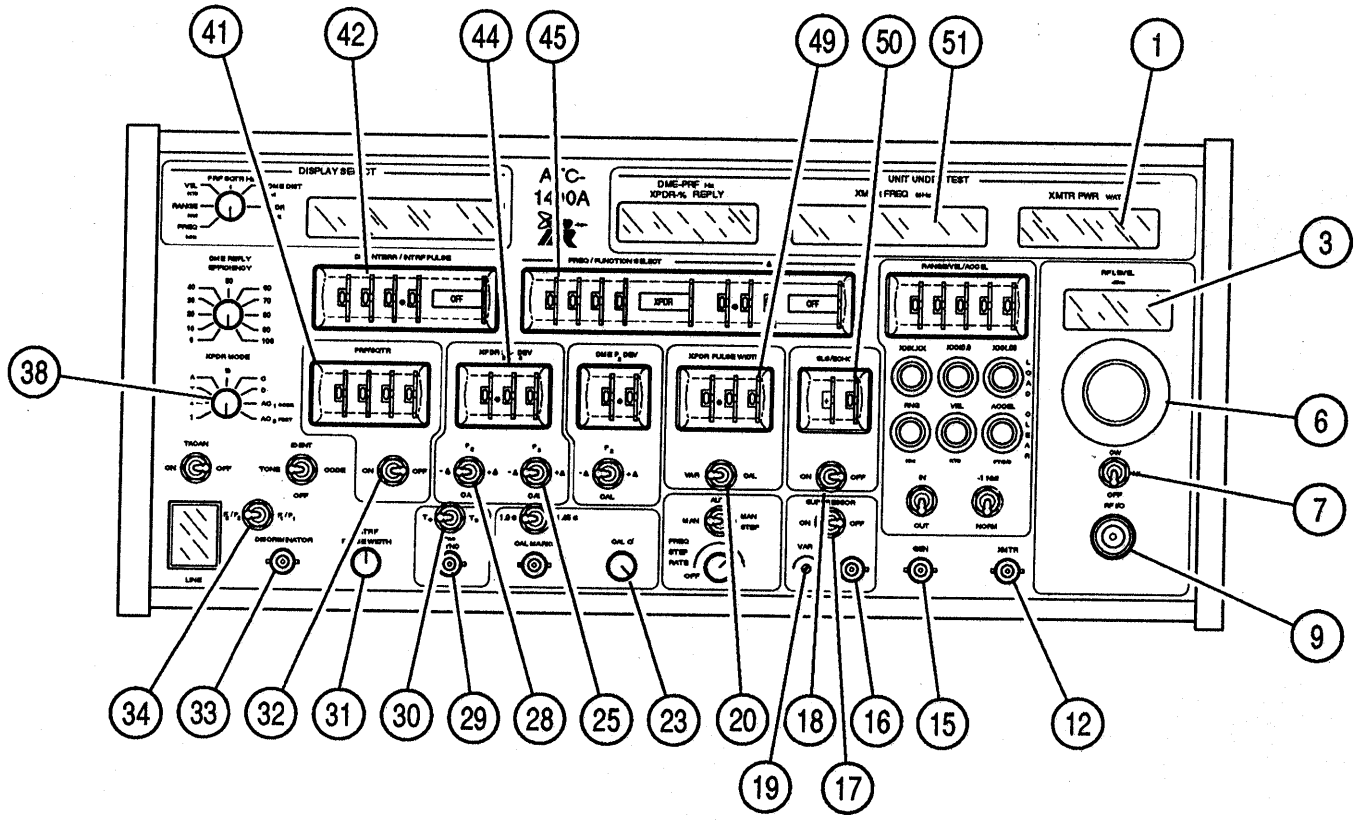


S-1403 to ATC-1400A Interconnections
Figure 1

2. Description of Controls, Connectors and Indicators



A. CURSOR Keys
B. KEYBOARD
C. UUT XMTR Connector (J10001)
D. UUT XMTR Indicator
E. ANT B Connector (J10002)
F. SLEW Control
G. POWER Switch
H. BRIGHTNESS Control
I. MENU Display
J. F2 Fuse
K. AC OUT Connector
L. AC IN Connector
M. F1 Fuse
N. LINE SELECT Switch
O. IFR BUS Connector (J10011)
P. DPSK AMPLITUDE BALANCE Adjust (R11026)
Q. TEST Connector (J10012)
R. R12004
S. R12005
T. R12006
U. SPR TIMING Adjust (R12007)
V. R12003
W. Zero Scale Adjust (R11023)
X. Full Scale Adjust (R11021)
Y. REF VOLTAGE Adjust (R11020)
Z. EXT MOD IN Connector (J10003)
AA. SCOPE TRIG OUT Connector (J10007)
BB. EXT SYNC IN Connector (J10004)
CC. EXT SYNC OUT Connector (J10008)
DD. MODE S/ATCRBS S DISCRETE OUT Connector (J10005)
EE. PREPULSE OUT Connector (J10009)
FF. ANT B VIDEO OUT Connector (J10006)
GG. RF VERNIER OUT Connector (J10013)
HH. MEASUREMENT GATE OUT Connector (J10014)
II. DPSK OUT Connector (J10015)
JJ. AUXILIARY Connector (J10010)
KK. 80 MHz Adjust (L11006)



NK.

1. XMTR PWR WATTS Display
3. RF LEVEL -dBm Display
6. RF LEVEL Control
7. CW/NORM/OFF Switch
9. RF I/O Connector
12. XMTR Connector
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 P_3/CAL Switch
28. XPDR DEV P_2/CAL Switch
29. SYNC Connector
30. T_O/TAC/T_D Switch
31. INTERF PULSE WIDTH Control
32. PRF/SQTR ON/OFF Switch
33. DISCRIMINATOR Connector
34. F_2/P_2 F_1/P_1 Switch
38. XPDR MODE Control
41. PRF/SQTR Thumbwheels
42. DBL INTERR/INTERF PULSE Thumbwheels
44. XPDR P_2/P_3 DEV Thumbwheels
45. FREQ/FUNCTION SELECT Thumbwheels
49. XPDR PULSE WIDTH Thumbwheels
50. SLS/ECHO Thumbwheels
51. XMTR FREQ MHz Display

Mode S System Front and Rear Panels
Figure 2

A. S-1403 Front and Rear Panel Description of Controls, Connectors and Indicators

The S-1403 Keyboard was designed to control the Menu display, eliminating the need for Thumbwheel Switches, Rotary knobs and resolvers for changing data values. The I/O Connector Pinout Tables are provided in Appendix A.

ITEM	DESCRIPTION

A. CURSOR Keys (Up, Down, Left, Right)

These keys are used to select a data or control field for editing. After positioning the cursor at the desired field, the entire field can be changed one character at a time for both decimal and octal data.

B. KEYBOARD

Used for data entry and control of the microprocessor. A keyboard entry changes the character at the position of the cursor and advances the cursor to the next character or field location. Decimal fields require all digits be changed. Octal fields allow changing of only 1 digit while leaving others unchanged.

C. UUT XMTR Connector (J10001)

RF pulses transmitted by the UUT's ANT B Connector are detected in the S-1403. The resultant detected video is presented at this connector.

D. UUT XMTR Indicator

Illuminates when transmitter replies are received on ANT B.

E. ANT B Connector (J10002)

Provides a second RF channel at a fixed power level for diversity testing.

F. SLEW Control

Used for command or data selection by rotating in either a cw or ccw direction. If several mnemonics can be selected in one field, use the SLEW Control for field selection. Octal data fields can be changed with the SLEW Control, but only one character at a time. The SLEW input allows the operator to rapidly advance to the desired function or data by bypassing all intermediate steps.

The SLEW Control changes only the value of the data characters or digits within the data or control fields indicated by the cursor.

G. POWER Switch

Applies ac power to the S-1403 Test Auxiliary and AC OUT Connector (K).

ITEM DESCRIPTION

H. BRIGHTNESS Control

Controls the brightness of the MENU Display's backlighting. Clockwise rotation of control increases brightness, while counter-clockwise rotation of control decreases brightness.

I. MENU Display

Displays the appropriate menu as selected. Refer to Para. 2C(1) for a complete description of Control Menu #1, Para. 2C(2) for a complete description of Control Menu #2 and Para. 2C(3) for a complete description of the Sequence Menu.

J. F2 Fuse

Fuses power to the S-1403. When LINE SELECT Switch (N) is in the 115 VAC position, F2 should be 1.0 amp fast blow. When LINE SELECT Switch (N) is in the 230 VAC position, F2 should be a 0.50 amp fast blow.

K. AC OUT Connector

Convenience outlet used to power the ATC-1400A.

L. AC IN Connector

Power receptacle for applying either 115 VAC or 230 VAC single phase power to the S-1403. LINE SELECT Switch (N) must be set to the correct position before applying power.

M. F1 Fuse

Fuses the power to the S-1403 and the AC OUT Connector (K). F1 should be a 3.0 amp fast blow.

N. LINE SELECT Switch

Selects the line voltage that is applied to the S-1403.

O. IFR BUS Connector (J10011)

Connects the S-1403 to the ATC-1400A to allow information exchange between the two units.

P. DPSK AMPLITUDE BALANCE Adjust (R11026)

Used only during test set calibration.

Q. TEST Connector (J10012)

For IFR Systems Inc. use only.

ITEM DESCRIPTION

R. R12004

Not used.

S. R12005

Not used.

T. R12006

Not used.

U. SPR TIMING Adjust (R12007)

Used only during test set calibration.

V. R12003

Not used.

W. Zero Scale Adjust (R11023)

Used only during test set calibration.

X. Full Scale Adjust (R11021)

Used only during test set calibration.

Y. REF VOLTAGE Adjust (R11020)

Not used.

Z. EXT MOD IN Connector (J10003)

When enabled from the S-1403 front panel or GPIB, the input from an external modulation source replaces the internal S-1403 pulse modulation.

AA. SCOPE TRIG OUT Connector (J10007)

Provides a trigger, controlled by T_O/TAC/T_D Switch (30), for time of interrogation and time of reply.

BB. EXT SYNC IN Connector (J10004)

When enabled from the S-1403 front panel or GPIB, allows SYNC from an external source.

CC. EXT SYNC OUT Connector (J10008)

Provides the sync for a second Mode S Test Set where not only diversity, but diversity with level control is required. Also, a time delay from one antenna to the other may be selected.

ITEM DESCRIPTION

DD. MODE S/ATCRB S DISCRETE OUT Connector (J10005)

Provides a negative going 3.0 µs pulse whose leading edge occurs 1.0 µs prior to the Prepulse output leading edge, when an ATCRBS interrogation is pending. This is active for all functions except ATC and DI.

EE. PREPULSE OUT Connector (J10009)

Provides a programmable TTL output pulse whose leading edge occurs from 0 to 260 µs prior to the leading edge of P1 pulse.

FF. ANT B VIDEO OUT Connector (J10006)

Allows digital version of ANT B signal to be viewed simultaneously with the analog signal from ANT B Connector (E).

GG. RF VERNIER OUT Connector (J10013)

An Analog Output Signal is presented at this connector which provides a vernier control over the ATC-1400A RF output level.

HH. MEASUREMENT GATE OUT Connector (J10014)

A framing pulse is presented at this connector allowing pulse selection in the Mode S Reply or ATCRBS Reply for UUT power measurement and frequency measurement. Power measurement is displayed on XMTR PWR WATTS Display (1). Frequency measurement is displayed on XMTR FREQ MHz Display (51).

II. DPSK OUT Connector (J10015)

Provides a bi-polar level signal which drives the phase modulator in the ATC-1400A to provide DPSK Modulation. (DPSK Modulation is the format for the method of encoding data to the Mode S Transponder.)

JJ. AUXILIARY Connector (J10010)

Connects the S-1403 to the ATC-1400A to provide discrete signal interconnect.

KK. 80 MHz Adjust (L11006)

Used only during test set calibration.

B. Keyboard Definition

The S-1403 keyboard consists of 24 keys, which allow data entry into the microprocessor to select test functions, menu formats or field data for the selected menu. Most keys have a dual function which can select either a first order function or second order function. The "2nd" key must be pressed before any second order function can be selected. Cursor keys are located adjacent to the keyboard to expedite entering data.

(1) Data Entry Keys (0 to 9 and ".")

These keys are used to enter data values to the data and control fields. They are the Standard Numerical Value keys (i.e., 0 thru 9 and ".").

(2) 2nd 1 (Ant B)

This key sequence moves the cursor to the Ant B field and allows the value to be changed. Control Menu #1 is displayed.

(3) 2nd 7 (FUN#) n

Depressing the keys in this sequence will advance the function to the # selected and position the cursor in the function field.

(4) 2nd 8 (P2)

This key sequence moves the cursor to the P2 field and allows the value to be changed. Control Menu #1 is displayed.

(5) 2nd 9 (P3)

This key sequence moves the cursor to the P3 field and allows the value to be changed. Control Menu #1 is displayed.

(6) 2nd 2 (Save) n

This key sequence saves the present test setup in one of two non-volatile memory locations. All information from both Control menus and all the items of the Sequence menu are saved.

(7) 2nd 3 (Recall) n

This key sequence recalls one of two saved test setups. Upon recall, all functions are executed to assure the system operation was updated with the new menus. After recalling the "PAGE", Control Menu #1 is displayed.

(8) 2nd (PPuls)

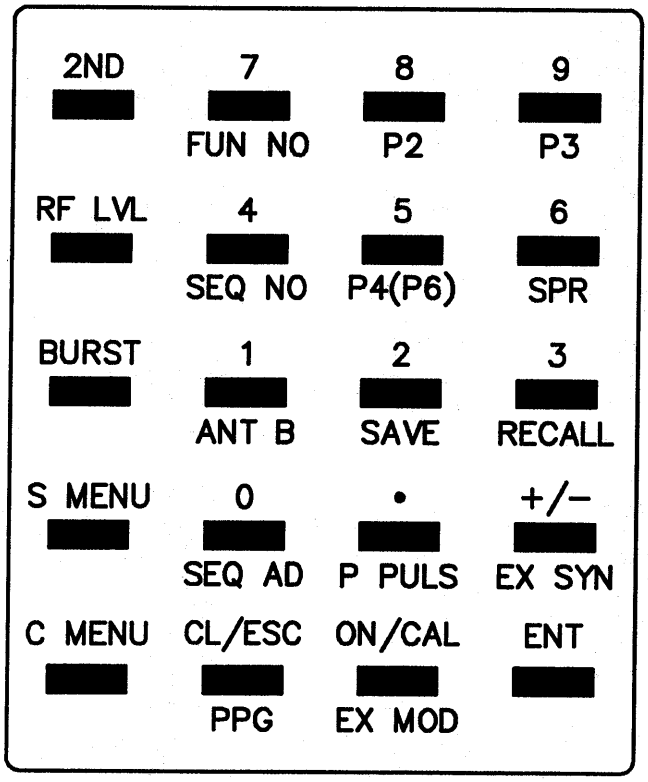
This key sequence moves the cursor to the Prepulse Control field in Control Menu #2. Control Menu #2 is displayed.

(9) 2nd +/- (ExSyn)

This key sequence moves the cursor to the Ext. Sync. Out field in Control Menu #2. Control Menu #2 is displayed.

FIRST ORDER KEYS				SECOND ORDER KEYS		
2nd	7	8	9	FUN#	P2	P3
RFLvl	4	5	6	SEQ#	P4 (P6)	SPR
Burst	1	2	3	AntB	Save	Recall
SMenu	0	"."	±	SeqAd	PPuls	Exsyn
CMenu	CL/ESC	ON/CAL	ENT	PPG	ExMod	

Data Entry and Function Keys
Table 1



S-1403 Keyboard
Figure 3

(10) 2nd ESC (PPG)

This key sequence moves the cursor to the Pulse Power Gate field in Control Menu #2. Control Menu #2 is displayed.

(11) 2nd Function Key

Pressing the 2nd function key conditions the processor to accept a second order function. This key must be pressed before selecting any function labeled on the lower part of the key.

(12) RFLvl

Pressing this key moves the cursor to the corresponding menu field, which allows data to be entered directly through the keyboard or by rotating the SLEW Control. If the current menu is not CONTROL MENU #1, the display is switched to #1.

(13) Burst

This key activates the Burst function. ATC, ACS, ACL or SEQ functions are used with the burst function (ie., pressing BURST Key activates interrogations of the selected function for the selected number of repetitions). The PRF rate is programmed by PRF/SQTR Thumbwheels (41).

NOTE: In the SEQ function, each Burst count represents one sequence item.

(14) S Menu

Pressing this key displays the Sequence menu starting with the number last displayed (default is 1).

(15) +/-

This key displays a plus or minus sign for decimal data. It changes the decimal value from plus to minus or vice versa.

NOTE: The +/- key when used, must follow data entry.

(16) C Menu

Depressing the C Menu key followed by either a one (1) or a two (2) displays the desired Control menu.

(17) CL/ESC Key

This key terminates a function or data key input sequence prior to its normal completion and returns the field value to its previous state. The ESC key resets the data or command field to the value it contained before it was changed. For Octal fields, this key will reset the entire field to zero rather than replacing the data changed with the previous data.

(18) ON/CAL

Used to set various values for rapid change of condition. The following field conditions can be selected:

ON/OFF
CAL/OFF/VAR
OFF/(Value last selected)
CAL/VAR

(19) ENT

Causes a normal termination of an input sequence.

(20) 2nd 4 (SEQ#) nn ENT

This key sequence displays the Sequence menu starting at sequence #nn.

(21) 2nd 5 (P4[P6])

This key sequence moves the cursor to the P4/P6 field and allows the value to be changed. Control Menu #1 is displayed.

(22) 2nd 6 (SPR)

This key sequence moves the cursor to the SPR (Sync Phase Reversal field and allows the value to be changed. Control Menu #1 is displayed.

(23) 2nd ON/CAL (Ex Mod)

This key sequence moves the cursor to the Ext.Mod.In. field in Control Menu #2 and allows the value to be changed. Control Menu #2 is displayed.

(24) 2nd 0 (Seq Ad)

This key sequence moves the cursor to the sequence item uplink format address field in the current Sequence menu and allows the value to be changed. The Current Sequence menu is displayed.

C. Display Menu Definition

(1) Control Menu #1 Format

FIELD	DESCRIPTION

1. Func: (Function) Field

   The desired function, as shown in 1-2-2, Table 2, is displayed depending on the keyboard selection:

2. (Error Message) Field

   One of four ERROR messages can be displayed in this field.

3. Error Message List

   a. AP Error:

      Indicates an error in the Address parity field of one of the sequence items. The AP Error message is displayed until the next downlink is received.

   b. Recall Error:

      This message occurs if a recall command is performed for a recall buffer that has not had information previously saved. The recall error message is displayed until another key is depressed on the front panel.

   c. DI/INTF Error:

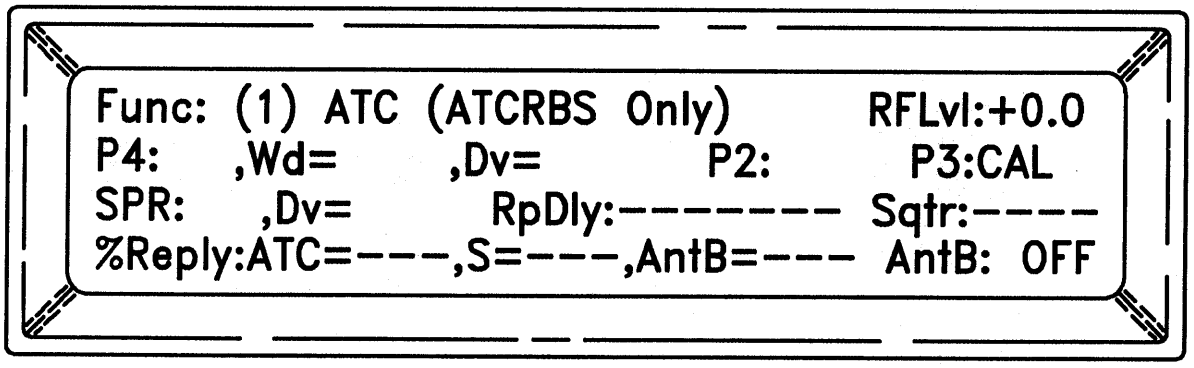
      DBL INTERR/INTRF PULSE (DI/INTRF) Thumbwheels (42) selections are monitored by the S-1403. The DOUBLE position is valid only when S-1403 is in DI function. If one test set of the Mode S Test System (either S-1403 or ATC-1400A) is set for Double Interrogation while the other test set is set for a different function, this error message will appear.

   d. RATE Error:

      This error message occurs when the PRF set by the PRF/SQTR Thumbwheels (41) are set to a rate larger than the S-1403 can operate. Limitations are defined in 1-3-1, Table 1.

4. RFLvl Field

   Displays an RF Level Vernier of up to ±3.0 dB.



Sample Control Menu #1
Figure 4

KEYBOARD SELECTION	FUNCTION	
FUNC: (1)	ATC	ATCRBS Only
FUNC: (2)	SEQ	Mode S Only
FUNC: (3)	ACS	ATCRBS Only All-Call
FUNC: (4)	ACL	ATCRBS/Mode S All-Call
FUNC: (5)	INTLCE	Ratio 1: [1 - 999] Mode S to ATCRBS
FUNC: (6)	DI	1st = ___, 2nd = ___ ATC, ACS, ACL OR SEQ for Both
FUNC: (7)	BURST	ATC/ACS/ACL/SEQ AND 1 TO 999

FUNC Field Selections
Table 2

FIELD DESCRIPTION

5. Pulse Control Field (P4/P6)

   This field controls P4 for the All-Call Functions, ACS and ACL, and P6 for the Mode S function SEQ.

   Fields not used for a particular function are left blank. Fields used, but not currently being updated, are filled with dashes.

   a. P_4/P_6:

      CAL/VAR/OFF (Level Control or Disable)

      NOTE: The second character changes from a four to a six, depending on the function selection:

   b. P_4 Wd:

      CAL/-0.2 to 3.55 µs in 0.05 µs steps.

   c. P_6 Dv:

      CAL/±1.95 µs in 0.05 µs steps CAL/VAR/OFF (Level control or Disable)

   d. P_4 Dv:

      CAL/±1.95 µs in 0.05 µs steps CAL/VAR/OFF (Level control or Disable)

6. SPR (SYNC Phase Reversal), RpDly (Reply Delay) and Sqtr (Squitter) Fields

   a. SPR:

      ON/OFF (Enable or Disable)

   b. SPR DV:

      CAL/±1.00 µs in 0.05 µs steps (Deviation)

   c. RpDly:

      000.000 to 399.000 (Read only)

   d. Sqtr:

      0.00 to 9.99; outside of range, dashes "—" are displayed.

FIELD DESCRIPTION

e. % Reply:

ATC = 0 to 127
S = 0 to 127
ANT B = 0 to 127

For all functions, the operator should refer to DISPLAY (I) for valid % Reply information. A Mode S % Reply is determined by a valid four pulse preamble. All other replies are assumed to be ATCRBS including non-valid replies. ANT B is a composite %Reply consisting of valid Mode S, ATCRBS plus any invalid replies. Squitter replies are not included in any %Reply displays.

7. Ant B Field

Enables/disables diversity and allows programming of the delay for ANT B from 0 to ±0.95 µs in 0.05 µs steps. The set value remains in memory when the channel is disabled by the ON/CAL key. Upon re-enabling, the previously programmed value is restored.

(2) Control Menu #2 Format

FIELD DESCRIPTION

1. Sqtr. Add. (Squitter Address) Field

24-bit octal value (read only)

2. Prepulse Field

0 thru 260 µs (in 1.0 µs Steps)/OFF

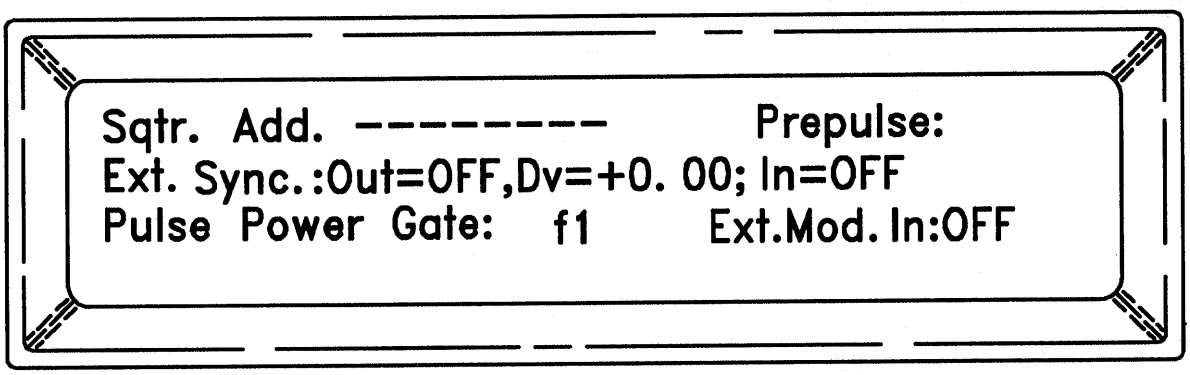
3. Ext. Sync. (External Synchronous) Field

Out = ON/OFF
Dv = -9.95 µs to 9.95 µs (in 0.05 µs steps)
In = ON/OFF

4. Pulse Power Gate (Selected Pulse) Field

The reply delay is used to determine where to measure PPMG Pulse. This allows correct PPMG positioning in ACS and ACL Test Functions independent of P_4.

For all reply pulses, the measurement gate must be enabled prior to the rising edge of the pulse to be measured. The measurement will continue until the next falling edge of the reply. In the case of Mode S replies, since they are in PPM format, care should be taken to ensure the data pulses prior to and following the pulse to be measured are in such a



Sample Control Menu #2
Figure 5

DATA KEY OR SLEW ENTRY	PULSE	DATA KEYOR SLEW ENTRY	PULSE
ON/CAL	OFF	9	b1
1	f1	10	d1
2	c1	11	b2
3	a1	12	d2
4	c2	13	b4
5	a2	14	d4
6	c4	15	f2
7	a4	16	spi
8	X		
MODE S: P1 through P116 are selectable by SLEW Control (F) or pulse number using the DATA Entry Keys.			
NOTE: Pulse Power Measurement is performed by the ATC-1400A and displayed on XMTR PWR WATTS Display (1).			

Pulse Power Mnemonics
Table 3

FIELD	DESCRIPTION

state that the power levels will not be measured as well. For example: to measure P_6 power: If P_6 is "0", P_5's state doesn't matter and P_7 should be a "0". If P_6 is a "1", then P_5 should be "1" and P_7's state doesn't matter. If P_5 were "0" and P_6 a "1", no rising edge would be detected and therefore the power reading would be zero.

For the S-1403 to control pulse power measurement, F_2/P_2-F_1/P_1 Switch (34) must be in the F_2/P_2 position. The F_1/P_1 position will measure the pulse power of an ATCRBS F_1 reply pulse only.

(3) Sequence Menu Format (Scrolled)

FIELD	DESCRIPTION

1. Sequence Number (S01 through S16) Field

   The Sequence Number (01 through 16) can be selected or displayed by selecting the Sequence menu (S menu) and entering the number using the DATA Entry Keys, or by slewing to the desired number with the SLEW Control. An alternate method is to first select the sequence number, then press the "2nd", "4", "nn" and "ENT" keys (where "nn" is the sequence number from 01 to 16). Refer to Appendix E for a description of default menus 01 through 08.

   The default condition upon power-up has all currently defined (RTCA DO-181; March, 1983) Uplink/ Downlink formats assigned to sequence numbers 1 through 8. Definitions of these formats are listed in Appendix B, Tables B-1 and B-2. The remaining Sequence Numbers are set "OFF" to disallow any transmission. Sequences are turned OFF/ON by positioning the cursor key in the sequence number field and pressing the ON/CAL key.

2. FMT (Format) Field

   "L", "S", "D" selected by Slew Control or ON/CAL Key.FMT "S" is user definable in Octal data for short (56 bit) words. FMT "L" is user definable for long (112 bit) words. FMT "D" is defined formats 0-23 according to Table B-1.

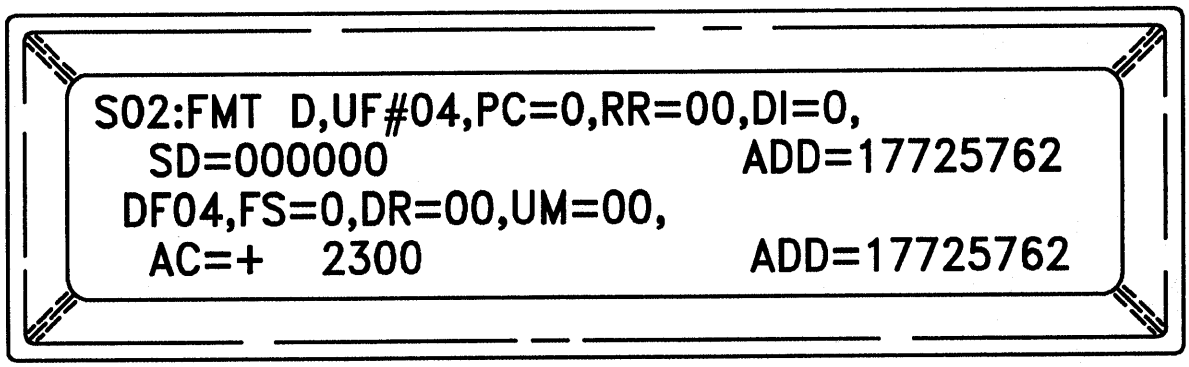
3. UF (Uplink Format) Field

   Uplink Format Numbers (00 through 31) are selected by the SLEW Control or data entry keys. This field is accessed via the cursor control keys.

4. DATA Fields

   Following the Format Number is one or more formatted Long or Short Data Fields which contain information as defined in Appendix E. The "Add" field data is converted to the required address and parity (AP) field data before transmission.

   NOTE: Any undesignated bits in the Data Fields are set to zero.



Sample Sequence Menu Format
Figure 6

FIELD	DESCRIPTION

5. DF (Downlink Format) Field

   Downlink Format Numbers (0 through 31) are read only fields that display the Downlink information received from the transponder. Downlink Formats are defined in Appendix B, Table 2; the Format Fields are defined in Appendix E.

D. ATC-1400A Front and Rear Panel Controls and Connectors

The following ATC-1400A controls and connectors are utilized with the Mode S Test System. Those controls and connectors not directly involved with testing Mode S transponders are not listed. Descriptions listed below supersede descriptions listed in the ATC-1400A Operation/Maintenance Manual.

ITEM	DESCRIPTION

1. XMTR PWR WATTS Display

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

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 in 1 dB steps by slowly turning control knob.

7. CW/NORM/OFF Switch

   a. CW

      Supplies a continuous-wave signal, which provides a convenient output for test and calibration of the ATC-1400A.

   b. NORM

      Allows ATC-1400A to operate in normal mode.

   c. OFF

      Inhibits all pulses the ATC-1400A is capable of generating.

9. RF I/O Connector

   Connects all interrogation and reply RF pulses to the antenna connector of the UUT (ANT A).

12. XMTR Connector

   RF pulses transmitted by UUT are detected by the ATC-1400A and presented at this connector.

ITEM DESCRIPTION

15. GEN Connector

RF output pulses from generator are detected and presented at this connector, to enable viewing transponder interrogations and interference pulses.

16. SUPPRESSOR OUTPUT Connector

Mutual suppression pulses are provided at this connector.

17. SUPPRESSOR ON/OFF Switch

Enables/disables mutual suppression pulses.

18. SLS/ECHO ON/OFF Switch

a. ON

Disables all other pulse amplitude control and enables the SLS pulse.

19. SUPPRESSOR VAR Adjustment

Level of the suppression pulse can be adjusted from +3 to 27 V by this control. Clockwise rotation increases level and counterclockwise rotation decreases level of suppression pulse.

20. XPDR PULSE WIDTH VAR/CAL Switch

a. VAR

Selects a variable pulse width (as read from XPDR PULSE WIDTH Thumbwheels [49]) from 0.15 µs to 1.95 µs, in 0.05 µs increments.

NOTE: Generator output level is not specified below 0.2 µs pulse width.

b. CAL

Selects a transponder pulse width of 0.8 µs.

21. FREQ STEP RATE Control

The rate the channel frequency is incremented automatically is determined by the position of this control. Position must be OFF (fully CCW) when testing Mode S.

22. MAN/AUTO/MAN STEP Switch

a. MAN

Position required for Mode S testing.

b. AUTO

Channel frequency is incremented automatically in 1 MHz steps.

ITEM DESCRIPTION

c. MAN STEP

Channel frequency can be incremented manually in 1 MHz steps.

23. CAL Ø Control

Adjusts the phase of timing calibration pulses with respect to interrogation pulses. Clockwise rotation delays timing pulses and enables the operator to align leading edge of timing pulses with F_1 of reply.

25. XPDR DEV P_3/CAL Switch

a. -Δ

Advances position of P_3 pulse from nominal, by value selected on XPDR P_2/P_3 DEV Thumbwheels (44) in microseconds.

b. CAL

P_3 pulse remains in nominal position. XPDR P_2/P_3 DEV Thumbwheels (44) have no effect on deviating P_3 pulses.

c. +Δ

Delays position of P_3 pulse from nominal, by value selected on XPDR P_2/P_3 DEV Thumbwheels (44) in microseconds.

28. XPDR DEV P_2/CAL Switch

a. -Δ

Advances position of the P_2 pulse from nominal, by value selected on the XPDR P_2/P_3 DEV Thumbwheels (44) in microseconds.

b. CAL

P_2 pulse remains in nominal position. XPDR P_2/P_3 DEV Thumbwheels have no effect on deviating P_3 pulses.

c. +Δ

Delays position of the P_2 pulse from nominal, by value selected on the XPDR P_2/P_3 DEV Thumbwheels (44) in microseconds.

29. SYNC Connector

A negative oscilloscope sync pulse generated by test set is presented at this connector. Signal output is controlled by T_O/TAC/T_D Switch.

30. T_O/TAC/T_D Switch

Sync selection control allowing the operator to sync on the interrogation, reply, or 1st or 2nd interrogation and reply sequence.

ITEM DESCRIPTION

31. INTERF PULSE WIDTH Control

Width of interference pulse is adjusted from 0.2 µs to 5 µs by this control. Clockwise rotation increases width of pulse.

32. PRF/SQTR ON/OFF Switch

Two-position toggle switch which when set to OFF, will inhibit interrogations.

33. DISCRIMINATOR Connector

The instantaneous frequency of the RF input pulses are discriminated and made available at this connector. The frequency modulation of the transmitter under test can be monitored within one pulse or between two pulses. The discriminator produces noise when no RF is present.

34. F_2/P_2 F_1/P_1 Switch

Must be in F_2/P_2 position to enable PPMG measurements.

38. XPDR MODE Control

Selects nominal P_3 pulse position of transponder interrogations.

41. PRF/SQTR Thumbwheels

Selects the interrogation rate in Hz.

42. DBL INTERR/INTERF PULSE Thumbwheels

Interference modes select interference pulse position from P1 in microseconds. DOUBLE selects double interrogation spacing when S-1403 is in DI function. DI/INTRF ERROR will display on MENU Display (I) whenever either DOUBLE is selected and S-1403 is not in DI Test Function or INTERR is selected and S-1403 is not in DI Test Function.

44. XPDR P_2/P_3 DEV Thumbwheels

Position of the P_2 or P_3 pulse can be deviated from the nominal position by value selected on the thumbwheel switches in microseconds.

45. FREQ/FUNCTION SELECT Thumbwheels

Select transponder or DME mode of operation and frequency of test set.

49. XPDR PULSE WIDTH Thumbwheels

Width of the P_1, P_2 and P_3 pulse can be varied by the value selected on thumbwheel switches in microseconds.

ITEM DESCRIPTION

50. SLS/ECHO Thumbwheels

Range is -19 to +9 dB.

Selects amplitude of sidelobe suppression pulse and interference pulse in dB, above nominal RF level.

51. XMTR FREQ MHz Display

Average frequency of UUT's RF pulses are measured between 50% amplitude point and are displayed continuously.

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.

71. IFR BUS Connector (J5)

25-pin female connector for communications between ATC-1400A and IFR BUS Connector (J10011) to allow information exchange within the Mode S Test System.

72. AUXILIARY Connector (J6)

25-pin female connector for providing discrete signal interrconnect between the Mode S Test System when connected to AUXILIARY Connector (J10010).

73. DPSK INPUT Connector (J1)

Receives a bi-polar signal which drives the internal phase shift circuit to provide DPSK Modulation (DPSK Modulation is the format for the method of encoding data to the Mode S transponder). This connector is required to be connected to DPSK OUT Connector (J10015).

75. EXTERNAL MEASUREMENT GATE Connector (J3)

Allows pulses other than F_2/P_2 and F_1/P_1 to be measured when connected to MEASUREMENT GATE OUT Connector (J10014). A framing pulse is presented at this connector which allows pulse selection in the Mode S reply or ATCRBS reply for UUT power and frequency measurements. Power measurement is displayed on XMTR PWR WATTS Display (2). Frequency measurement is displayed on XMTR FREQ MHz Display (51).

ITEM	DESCRIPTION

76. RF LEVEL INPUT Connector (J4)

Additional ±3 dB level control of RF Output received from RF VERNIER OUT Connector (J10013). The signal presented at this connector provides a vernier control over RF output level.

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3. Performance Evaluation

A. General

The procedure in this section tests the electrical performance of the S-1403 using specifications listed in 1-3-1 as the performance standards. The Performance Evaluation is designed to give the user a high level of confidence that the Mode S Test System is operating properly and should be relied upon when the operating condition of the Test System is in question. The Performance Evaluation requires approximately three hours to perform.

B. Pre-Operational Conditions

For maximum benefit of all operating procedures, it is strongly recommended that personnel read and thoroughly understand all steps of the procedure to be performed, prior to completion, and be familiar with the circuit or unit under test. Knowledge of what power, frequency and waveform to be expected at each test point is recommended.

C. Test Equipment Requirements

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

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

D. Corrective Maintenance Program

These performance checks provide a method for validating specific hardware, software and signal parameters. Should the performance checks confirm invalid parameter(s), the S-1403 must be recalibrated (2-2-2) or returned to an Authorized Repair Station as appropriate.

E. Initial ATC-1400A Control Settings

Refer to 1-2-2, Figure 6 in the ATC-1400A Operation/Maintenance Manual for the location of the ATC-1400A Front and Rear Panel Controls.

CONTROL		SETTING
(7)	CW/NORM/OFF Switch	NORM
(18)	SLS/ECHO ON/OFF Switch	OFF
(25)	XPDR DEV P3/CAL Switch	CAL
(28)	XPDR DEV P2/CAL Switch	CAL
(32)	PRF/SQTR ON/OFF Switch	ON
(37)	TACAN ON/OFF Switch	OFF
(38)	XPDR MODE Control	A
(40)	DISPLAY SELECT Control	PRF SQTR Hz
(41)	PRF/SQUITTER Thumbwheels	0200
(42)	DBL INTERR/INTERF Thumbwheels	000.0 OFF
(45)	FREQ/FUNCTION SELECT Thumbwheels	1030 XPDR
(48)	ΔF Thumbwheels	OFF
(52)	RANGE/VEL/ACCEL Thumbwheels	00000
(66)	SELF INTERROGATE ON/OFF Switch	OFF

NOTE: Remaining ATC-1400A controls do not require initial settings.

F. Performance Evaluation Procedure

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

NOTE: Alphabetic character identifiers refer to the S-1403 whereas numeric character identifiers refer to the ATC-1400A.

STEP	PROCEDURE

INITIAL CONDITIONS AND SETTINGS

1. Connect GEN OUT Connector (15) to Oscilloscope Channel 1 input.
2. Connect Oscilloscope External Trigger to S-1403, J10007 Connector (AA).
3. Apply electrical power to S-1403 and ATC-1400A.

S-1403 TO ATC-1400A COMMUNICATION

4. Verify "Initializing" is Displayed on Menu Display (I) for less than 30 seconds.
5. Verify MENU Display (I) is FUNC: (1) ATC, after Initialization period has ended.
6. Set FREQ/FUNCTION SELECT Thumbwheel (45) to TAC Y.
7. Verify "*DME MODE*" is displayed on top line of MENU Display (I).
8. Set FREQ/FUNCTION Select Thumbwheel (45) to XPDR.
9. Verify MENU Display (I) is FUNC: (1) ATC.

ATC FUNCTION (1)

10. Set T_O/TAC/T_D Switch (30) to T_O.
11. Verify P_1 to P_3 pulse spacing is 8.0 µs (±10 ns).
12. Position XPDR MODE Control (38) to C.
13. Verify P_1 to P_3 spacing is 21 µs (±10 ns).

SEQ FUNCTION (2)

14. Select S-1403 Keyboard ON/CAL key.
15. Verify MENU Display (I) is FUNC:(2) SEQ.
16. Verify Display coincides with 1-2-4, Figure 15.

STEP PROCEDURE

17. Depress SMENU Key.

18. Verify S01 (Sequence Menu number 1) is displayed.

19. Use SLEW Control (F) to change sequence menu to S02.

20. Depress ON/CAL Key to set S02 to OFF.

21. Repeat Steps 21 and 22 for S03 thru S08.

22. Use SLEW Control to verify S02 thru S08 are OFF.

23. Verify S01 is ON.

24. Verify Mode S interrogation pulse pattern of P_1, P_2 and P_6 as shown in 1-2-4, Figure 24.

ACS FUNCTION (3)

25. Depress 2nd, FUN NO, 3 Keys.

26. Verify Display coincides with 1-2-3, Figure 26.

27. Verify ATCRBS Mode A (All Call Only) interrogation per Table B in 1-2-4, Figure 28.

ACL FUNCTION (4)

28. Depress Keyboard ON/CAL Key.

29. Verify Display coincides with 1-2-3, Figure 30.

30. Set Mode to C.

31. Verify ATCRBS Mode C/Mode S ALL-CALL interrogation per Table B in 1-2-4, Figure 32.

INTLCE FUNCTION (5)

32. Depress Keyboard 2nd, FUN NO, 5 Keys.

33. Verify Display coincides with 1-2-4, Figure 34.

34. Verify ATCRBS Function consists of P_1 and P_3.

35. Verify Mode S pulse pattern consists of P_1, P_2 and P_6 occuring 200 µs following P_1 of the ATCRBS interrogation.

DI FUNCTION (6)

36. Depress Keyboard ON/CAL Key.

STEP PROCEDURE

37. Position DBL INTERR/INTERF PULSE Thumbwheels (42) to 200.0 and DOUBLE.

38. Set PRF/SQTR Thumbwheel (41) to 100.

39. Verify Display coincides with 1-2-4, Figure 45.

40. Verify ATCRBS function consists of P_1 and P_3 21 µs apart.

41. Verify second ATCRBS interrogation occurs 200 µs after P_1 of the first interrogation.

42. Verify first interrogation appears 1.0 µs following Trigger.

43. Set T_O/TAC/T_D Switch (30) to T_D.

44. Verify 2nd interrogation appears 1 µs following Trigger.

45. Move cursor to 2nd interrogation format field. Using ON/CAL Key or SLEW Control (F) select each format and verify the output at the GEN Connector (15) changes accordingly.

46. Set T_O/TAC/T_D Switch (30) to T_O.

47. Verify ACS, ACL and SEQ for first interrogation.

BURST FUNCTION

48. Depress 2nd, FUN NO, 7 Keys.

49. Position DBL INTERR/INTERF PULSE Thumbwheels (42) to 200, OFF.

50. Verify display coincides with 1-2-4, Figure 56.

51. Position cursor to the BURST# field.

52. Enter 100.

53. Depress Keyboard ENT Key.

54. Set PRF/SQTR Thumbwheels (41) to 50.

55. Depress Burst Key.

56. Verify ATCRBS P_1 to P_3 spacing of 21 µs. Interrogation should continue for two seconds (PRF=50).

P_4 (P_6) CONTROL

ALL CALL FUNCTIONS (P_4)

57. Connect RF I/O Connector (9) to Oscilloscope Channel A using Heterodyne Monitor. Set ATC-1400A output level to -10 dBm.

STEP	PROCEDURE

58. Depress Keyboard 2ND, FUN NO, 4 Keys. ACL Control Menu #1 should be displayed.

59. Position cursor to "P_4, Wd=" field.

60. Depress ON/CAL Key. This will enable variable width control.

61. Verify variable width setting (P_4, Wd=) is 0.0.

62. Verify P_4 pulse width on oscilloscope Channel 1 is 1.6 µs (±50 ns).

63. Enter variable width value of +1.95 µs.

64. Verify pulse width of 3.55 µs.

65. Depress keyboard 2ND, FUN NO 3, Keys. ACS Control Menu #1 should be displayed.

66. Position cursor to "P_4, Wd=" field.

67. Verify 2.75 µs (±50 ns) width.

68. Depress ON/CAL Key. "P_4, Wd=" field should now display CAL.

69. Verify width is 0.8 µs.

70. Depress ON/CAL Key.

71. Verify P4 Pulse width can be incremented/decremented in 50 ns steps from 0.2 µs to 2.75 µs from CAL position when utilizing SLEW Control (F).

72. Verify changing P_4 width has no effect on pulse width of P_1, P_2 or P_3.

73. Depress 2ND, FUN NO, 4 Keys. ACL Control Menu #1 should be displayed.

74. Position cursor to "P_4, Wd" field.

75. Verify P_4 width is variable from 0.2 µs to 3.55 µs pulse width (50 ns).

76. Using SLEW Control (F), return "P_4, Wd" to 0.00. Press ON/CAL Key to return P_4 to CAL.

77. Position cursor to "P_4, Dv=" field. Value displayed should be CAL. If not, depress ON/CAL Key until CAL is displayed.

78. Verify P_1 to P_4 spacing is 10.0 µs (±10 ns).

79. Set XPDR MODE Switch (38) to Mode C.

80. Verify P_1 to P_4 spacing is 23.0 µs (±10 ns).

81. Position cursor to "P_4, Dv=" field.

STEP PROCEDURE

82. Depress ON/CAL Key until "P_4, Dv=" field displays numerical value.

83. Using SLEW Control (F), verify deviation can be varied ±1.95 µs (±10 ns) in 50 ns steps.

84. Depress ON/CAL Key until "P_4, Dv=" field displays CAL.

85. Position cursor to "P_4:" field.

86. Depress ON/CAL until "VAR" is displayed.

87. Set SLS/ECHO Thumbwheels (50) to 0.

88. Verify P_4 level equals P_3 level (±0.3 dB).

89. Vary SLS/ECHO Thumbwheel from -10 dB to +3 dB.

90. Verify level at each change (±0.3 dB).

91. Set SLS/ECHO Thumbwheels (50) to 0. Set P_4 to CAL by depressing ON/CAL Key twice.

92. Using Heterodyne Monitor, verify P_4 rise time from the 10 to 90% points is 70 ns (±20 ns); also verify fall time from 90 to 10% points is 70 ns (±20 ns).

MODE S (P_6) CONTROL

93. Depress 2ND, FUN NO, 2 Keys. Verify "FUNC:(2) SEQ" is displayed on Control Display (I).

94. Depress SMENU Key.

95. Use CURSOR Keys (A) to move cursor to UF#__ field.

96. Use SLEW Control (F) to set UF# to 16.

97. Verify P_6 width is 30.25 µs (±50 ns).

98. Use SLEW Control (F) to set UF# to 00.

99. Verify P_6 width is 16.25 µs (±50 ns).

100. Depress CMENU, 1 Keys.

101. Use CURSOR Keys (A) to move cursor to "P_6, Wd=" field.

102. Depress ON/CAL Key. Numerical value should be displayed.

103. Utilizing SLEW Control (F), verify P_6 width varies from -1.5 to +1.5 µs (±50 ns) in 50 ns steps from CAL position.

104. Depress ON/CAL Key. "CAL" should be displayed.

STEP PROCEDURE

105. Use CURSOR Keys (A) to move cursor to "P_6, Dv=" field.

106. Verify "CAL" is displayed.

107. Verify P_6 position is 3.5 µs (±10 ns) following P_1.

108. Depress ON/CAL Key. Numerical value should be displayed.

109. Utilizing SLEW Control (F), verify P_6 position can be incremented/decremented from -1.95 to +1.95 µs (±50 ns), in 50 ns steps from CAL position.

110. Depress ON/CAL until CAL is displayed.

SYNC PHASE REVERSAL (SPR) CONTROL

111. Use CURSOR Keys (A) to move cursor to "SPR,Dv=" field.

112. Verify SPR occurs 2.75 µs (±50 ns) following rising edge of P_2 (CAL).

113. Depress ON/CAL Key until a numerical value is displayed.

SLS CONTROL

114. Utilizing SLEW Control (F), verify SPR varies from 1.75 to 3.75 µs from P_2 (±50 ns), in 50 ns steps.

115. Depress ON/CAL Key until "CAL" is displayed.

116. Depress 2ND, FUN NO, 4 Keys. Verify "FUNC:(4) ACL" Menu is displayed.

117. Set SLS/ECHO ON/OFF Switch (18) to ON.

118. Set SLS/ECHO Thumbwheel (50) to 0 dB.

119. Verify SLS pulse occurs 2.0 µs following P_1.

120. Verify SLS pulse width is 800 ns (±100 ns).

121. Verify P_2 amplitude equals P_1 amplitude (±0.3 dB).

122. Set SLS/ECHO Thumbwheel (50) to -10 dB.

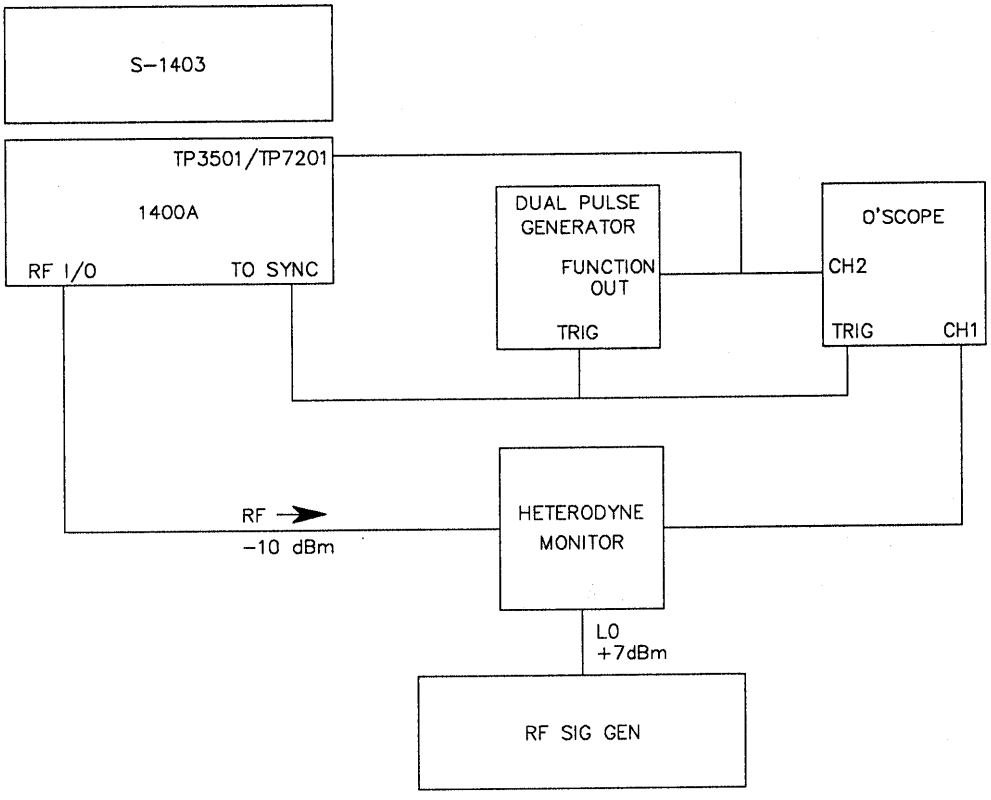
123. Verify output level is -10 dB (±0.3 dB).

124. Increment SLS/ECHO Thumbwheel and verify output level is ±0.3 dB of level displayed at SLS/ECHO Thumbwheel.

125. Set SLS/ECHO Switch (18) to OFF.

REPLY DELAY

126. Prepare test setup as shown in 1-2-3, Figure 7.



UUT Reply Measurement
Figure 7

STEP PROCEDURE

127. Set Dual Pulse Generator to produce two 0.45 µs wide pulses spaced 20.3 µs apart. Set output level for negative going pulses as shown in 1-2-3, Figure 8.

128. Depress 2ND, FUN NO, 1 Keys.

129. Adjust Generator for 3.0 µs delay from interrogation P_3 to Generator first pulse.

130. Verify Menu Display field "RpDly:" displays value measured on Oscilloscope (±100 ns).

131. Select 2ND, FUN NO, 2 Keys. Verify "FUNC:(2) SEQ" Menu is displayed.

132. Adjust Generator for 128 µs delay from interrogation SPR to Generator first pulse.

133. Verify Menu Display field "RpDly:" displays value measured on Oscilloscope (±50 ns).

PERCENT REPLY MEASUREMENTS

134. Select 2ND, FUN NO, 1 Keyboard Keys. Verify "FUNC:(1) ATC" Menu is displayed.

135. Set Pulse Generator to 3.0 µs Reply Delay.

136. Set PRF/SQTR Thumbwheels (41) to 500.

137. Verify "% REPLY: ATC" field display 100% (±1 count).

138. Verify "% REPLY: S" field display is zero (0).

139. Select Pulse Generator Trigger-Internal.

140. Set Pulse Generator PRF to 500.

141. Verify Pulse Generator PRF with Frequency Counter (±1%).

142. Verify "% REPLY: ATC" field displays 100% (±1 counts).

143. Set Pulse Generator PRF to 635.

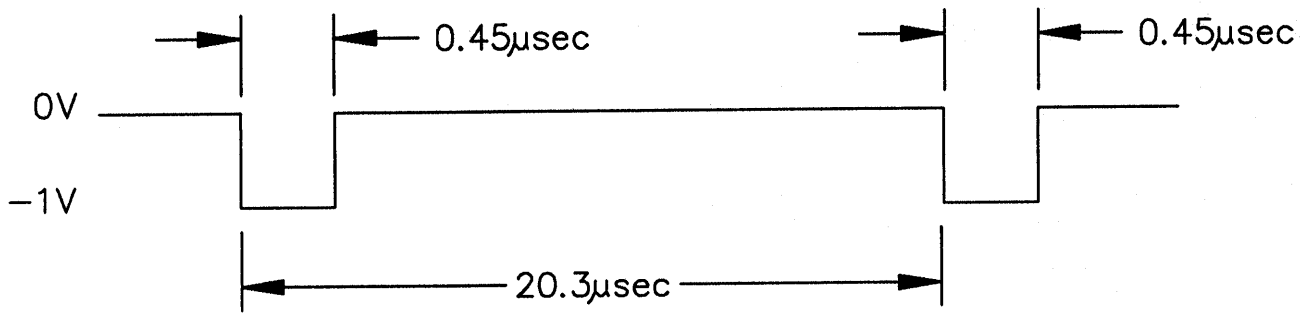
144. Verify Pulse Generator PRF with Frequency Counter (±1%).

145. Verify "% REPLY: ATC" field displays 127% (±1 counts).

146. Disconnect Pulse Generator.

PREPULSE TEST

147. Depress 2ND, FUN NO, 2 Keyboard Keys. Verify "FUNC:(2) SEQ" Menu is displayed.



Pulse Generator Waveform
Figure 8

STEP PROCEDURE

148. Set PRF/SQTR Thumbwheels to 200.

149. Depress CMENU, 2 Keys. Verify Control Menu 2 is displayed.

150. Use CURSOR Keys (A) to move cursor to "PREPULSE" field.

151. Depress ON/CAL Key.

152. Enter 00.

153. Depress ENT Key.

154. Connect Oscilloscope Channel A to PREPULSE OUT, J10009, Connector (EE).

155. Connect GEN Connector (15) to Oscilloscope Channel B.

156. Verify interrogation P_1 leading edge is coincident with trigger (±100 ns).

157. Increase Prepulse Delay to 260 µs utilizing SLEW Control (F).

158. Verify P_1 position is coincident with "PREPULSE" field value as SLEW Control is rotated (±100 ns).

EXT SYNC OUT TEST

159. Set Prepulse field to 12 utilizing SLEW Control (F).

160. Connect Prepulse to scope trigger IN.

161. Connect EXT SYNC OUT Connector (J10008) to Oscilloscope Channel A.

162. Use CURSOR Keys to select EXT.SYNC.:OUT field.

163. Select ON/CAL Key until ON is displayed.

164. Use CURSOR Keys to select "EXT.SYNC.:OUT Dv=" field. Verify "0.00" is displayed.

165. Set Oscilloscope for external trigger with both Channels A and B displayed. Verify EXT.SYNC. pulse is coincident with interrogation P_1 pulse (±100 ns).

166. Set Ext.Sync.Out,Dv= field to +9.95.

167. Verify Ext.Sync.Out pulse follows interrogation pulse by 9.95 µs (±100 ns).

168. Press +/- Key to change Ext.Sync.Out,Dv= value to -9.95.

169. Verify Ext.Sync.Out pulse precedes interrogation pulse P1 by 9.95 µs (±100 ns).

170. Set "EXT.SYNC.:OUT Dv=" field to 0.0 utilizing SLEW Control (F).

STEP PROCEDURE

EXT SYNC IN TEST

171. Use CURSOR Keys to move cursor to "EXT.SYNC.:IN=" field.

172. Depress ON/CAL Key until "EXT.SYNC.:IN=" field displays ON.

173. Set Dual Pulse Generator to Single Pulse Output and internal sync.

174. Connect Pulse Generator TTL output to J10004, EXT SYNC IN Connector (BB).

175. Connect Pulse Generator Sync Out to Oscilloscope Ext Trig.

176. Connect GEN Connector (15) to Oscilloscope Channel A.

177. Verify Mode S interrogations are coincident with Oscilloscope trigger.

178. Vary Pulse Generator PRF Control.

179. Verify interrogation rate tracks pulse generator PRF. With ON/CAL Key set "EXT.SYNC.:IN=" to OFF.

EXT MOD IN

180. Connect PREPULSE OUT (J10009) Connector (EE) to Dual Pulse Generator trigger input and Oscilloscope trigger.

181. Select external trigger mode on Pulse Generator. Set for double pulse output.

182. Disconnect Dual Pulse Generator TTL output from EXT SYNC IN (J10004) Connector (BB).

183. Connect Dual Pulse Generator TTL Output to EXT MOD IN (J10003) Connector (Z).

184. Move cursor to EXT.MOD.IN: using ON/CAL Key select ON.

185. Verify the pulses present at GEN Connector (15) coincide with pulse generator output.

186. Use ON/CAL Key to set Ext.Mod.In OFF.

PULSE POWER MEASUREMENT TEST

187. Set Dual Pulse Generator to produce two 0.45 µs pulses spaced 20.3 µs apart. Set output level as shown in 1-2-3, Figure 8.

188. Use CURSOR Keys (A) to move cursor to "EXT.SYNC.:OUT" field.

189. Depress ON/CAL Key until ON is displayed.

190. Connect EXT SYNC OUT (J10008) Connector (CC) to Dual Pulse Generator trigger input.

STEP PROCEDURE

191. Connect Dual Pulse Generator function out to TP3501 ATC-1400A or TP7201 (modified 1400).

192. Set F_2/P_2 F_1/P_1 Switch (34) to F_1/P_1.

193. Select 2ND, FUN NO, 1 Keys. Verify "FUNC:(1) ATC" Control Menu is displayed.

194. Adjust Pulse Generator delay for a reply delay reading of 3.0 µs (±0.5 µs).

195. Depress CMENU, 2 Keys. Verify Control Menu 2 is displayed.

196. Use CURSOR Keys (A) to move cursor to "PULSE POWER GATE" field.

197. Verify F_1 is displayed.

198. Record XMTR PWR WATTS Display (1).

199. Set F_2/P_2 F_1/P_1 Switch (34) to F_2/P_2.

200. Verify XMTR PWR WATTS Display (1) value has not changed from level recorded in step 199.

201. Rotate SLEW Control (F) until "X" is displayed in Pulse Power Gate field.

202. Verify XMTR PWR WATTS Display (1) displays 00.

203. Set Dual Pulse Generator spacing to 10.15 µs.

204. Verify XMTR PWR WATTS Display (1) displays value recorded in step 198.

205. Disconnect Pulse Generator.

RF VERNIER TEST

206. Connect RF Power Meter to RF I/O Connector (9).

207. Set CW/NORM/OFF Switch (7) to CW.

208. Depress RF LVL Key.

209. Enter 0.

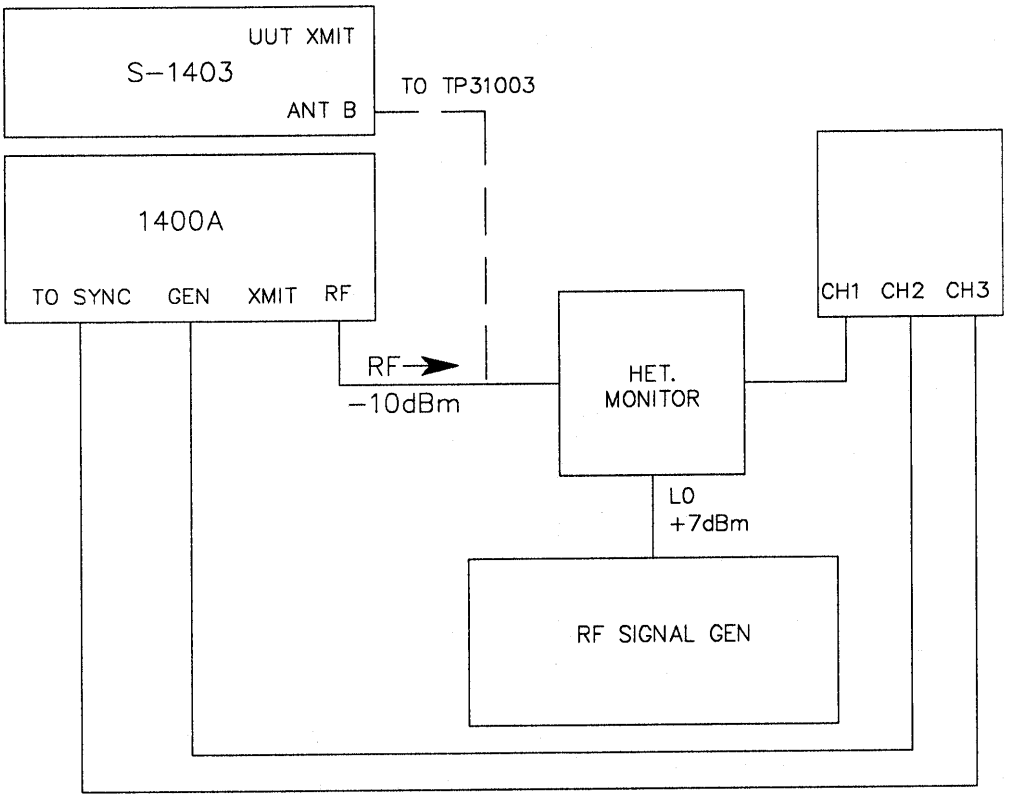
210. Depress ENT Key.

211. Set RF Level (3) to -4 dBm.

212. Record Power Meter reading.

213. Rotate SLEW Control (F) to set RFLvl field to +3.0.

214. Verify RF Power Meter displays 3.0 dB (±0.2 dBm) greater than value recorded in step 212.



Antenna B Time Delay
Figure 9

STEP PROCEDURE

215. Rotate Slew Control (F) to set "RFLvl" field to -3.0.

216. Verify RF Power Meter displays 3.0 dB (±0.2 dBm) below reference value recorded in step 212.

ANT B RF LEVEL TEST

217. Connect Spectrum Analyzer to RF I/O Connector (9).

218. Rotate RF Level Control (6) until Display (3) displays -50 dBm.

219. Rotate Slew Control (F) to set "RFLvl" field to +0.0.

220. Use CURSOR Keys (A) to position cursor in "ANT B:" field.

221. Depress ON/CAL Key until a numerical value is displayed.

222. Set Spectrum Analyzer display as reference.

223. Connect Spectrum Analyzer to ANT B Connector. Verify level is equal to reference ±1 dB.

224. Set CW/NORM/OFF Switch (7) to NORM.

ANT B TIME DELAY TEST

225. Connect Test Setup as shown in 1-2-3, Figure 9.

226. Select 2ND, FUN NO, 1 Keys. Verify "FUNC: (1) ATC" Control Menu is displayed.

227. Set Oscilloscope for 2 µs per division resolution.

228. Use Δ time to record time from sync to P_1 of ATC-1400A.

229. Connect Heterodyne Monitor to TP31003.

230. Set ANT B to ON using 2nd, FUN No, ANT B, ON/CAL Keys.

231. Verify ANT B P_1 leading edge is coincident (±25 ns) of RF I/O P_1.

232. Enter 0.95 in ANT B: field.

233. Depress ENT Key.

234. Verify ANT B leading edge is shifted to +0.95 µs from original position.

235. Select +/- Key. Verify "ANT B:" field displays -0.95.

236. Verify ANT B Leading Edge is shifted -0.95 µs from original position.

237. Set ANT B delay to +0.00.

STEP PROCEDURE

238. Depress 2ND, FUN NO, 2 Keys.

239. Monitor TP31003 using heterodyne monitor.

240. Verify P_1 Pulse Width is 0.8 µs (±10 ns).

241. Verify P_2 to SPR spacing is 2.75 µs (±50 ns).

MODE S/ATCRBS DISCRETE TEST

242. Connect Oscilloscope Channel B to GEN Connector (15).

243. Depress 2ND, FUN NO, 5 Keys. Verify "FUNC:(5) INTLCE" Control Menu is displayed.

244. Depress CMENU, 2 Keys.

245. Use CURSOR Keys (A) to move cursor to PREPULSE field.

246. Depress ON/CAL Key until a numerical value is displayed.

247. Enter 0.

248. Connect ATCRBS/MODE S DISCRETE OUT (J10005) Connector (DD) to Oscilloscope Channel A, select int trigger Channel A, negative slope.

249. Verify 3.0 µs wide TTL Low-Level pulse occurs 1.0 µs prior to interrogation P_1.

250. Enter 3.

251. Verify interrogation P_1 has shifted position.

252. Verify Discrete Pulse position has remained constant.

OSCILLOSCOPE TRIGGER TEST

253. Set DBL INTERR/INTERF PULSE Thumbwheels (42) to 200, DOUBLE.

254. Select 2ND, FUN NO, 6 Keys. Verify "FUNC:(6) DI" Control Menu is displayed.

255. Set PRF/SQTR Thumbwheels (41) to 100.

256. Utilize CURSOR Keys (A) to move cursor to "1st=" field.

257. Depress ON/CAL Key until ATC is displayed.

258. Utilize CURSOR Keys (A) to move cursor to "2ND =" field.

259. Depress ON/CAL Key until SEQ is displayed.

260. Set T_O/TAC/T_D Switch (30) to T_O.

STEP	PROCEDURE

261. Connect SCOPE TRIG OUT (J10007) Connector (AA) to Oscilloscope Channel A. Select positive slope trigger.

262. Verify first interrogation occurs 1.0 µs following SCOPE TRIG OUTPUT (J10007) Rising Edge.

263. Verify Trigger Falling Edge occurs 2.0 µs following P_3 Leading Edge.

264. Set T_O/TAC/T_D Switch (30) to T_D.

265. Verify second interrogation occurs 1.0 µs following SCOPE TRIG OUTPUT Leading Edge.

266. Verify SCOPE TRIG OUTPUT Trailing Edge occurs 127 µs following MODE S Interrogation SPR.

267 Select 2ND, FUN NO, 5 Keys. Verify "FUNC:(5) INTLCE" Control Menu is displayed.

268. Set DBL INTERR/INTERF PULSE Thumbwheels to 200.0, OFF.

269. Set T_O/TAC/T_D Switch (30) to T_O.

270. Verify T_O Pulse Leading Edge occurs 1.0 µs before P_1 of 1st interrogation.

271. Verify T_O Pulse Trailing Edge occurs 2.0 µs following P_3 Leading Edge.

272. Set T_O/TAC/T_D Switch (30) to T_D.

273. Verify T_D Pulse Leading Edge occurs 1.0 µs prior to Mode S interrogation P_1.

274. Verify T_D Pulse Trailing Edge occurs 127 µs following MODE S interrogation SPR.

275. Disconnect accessory test equipment.

4. General Operating Procedures

A. General

The procedures contained within this section are instructions relating to Front Panel (LOCAL) operations used for the individual test functions. Specific UUT Test Procedures are addressed in the UUT Manuals.

For each operational function, special considerations are listed at the beginning of each section. In addition to the operational considerations, minor anomalies may appear during the operation of the system. Known anomalies are given as part of the operational considerations directing the user to refer to Appendix F.

(1) Remote Control (GPIB) Operation

Remote communication with the Mode S 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 S Test System over the GPIB is implemented with ASCII encoded character strings. Refer to 1-2-5 for a complete description of GPIB operation.

(2) Local (Front Panel) Operation

The Mode S Test System, consisting of the S-1403 Test Auxiliary interfaced with the ATC-1400A Transponder/DME Test Set, provides supplementary transponder pulse functions for the purpose of simulating an ATCRBS/Mode S equipped Secondary Surveillance Radar (SSR) ground station.

To operate, set ATC-1400A Controls as follows:

CONTROL		SETTING
(7)	CW/NORM/OFF Switch	NORM
(18)	SLS/ECHO ON/OFF Switch	OFF
(21)	FREQ STEP RATE Control	OFF
(22)	MAN/AUTO/MAN STEP Switch	MAN
(25)	XPDR DEV P3/CAL Switch	CAL
(28)	XPDR DEV P2/CAL Switch	CAL
(32)	PRF/SQTR ON/OFF Switch	ON
(37)	TACAN ON/OFF Switch	OFF
(38)	XPDR MODE Control	A
(40)	DISPLAY SELECT Control	PRF SQTR Hz
(41)	PRF/SQUITTER Thumbwheels	0200
(42)	DBL INTERR/INTERF Thumbwheels	000.0 OFF
(45)	FREQ/FUNCTION SELECT Thumbwheels	1030 XPDR
(48)	ΔF Thumbwheels	OFF
(52)	RANGE/VEL/ACCEL Thumbwheels	00000
(66)	SELF INTERROGATE ON/OFF Switch	OFF

(3) System Characteristics

The Mode S Test System has seven (7) distinct functions of operation as follows:

These functions allow the operator to simulate signal conditions for:

- ATCRBS Environment (ATC Function)

  Where an ATC ground station is transmitting a standard two-pulse interrogation and expecting either a Mode A or Mode C reply. The S-1403 has the additional capability to decode and display Mode S squitter replies, allowing the operator to determine the aircraft address.

- Mode S Environment (SEQ Function)

  Where a ground based interrogator can transmit a number of uplink formats to the Mode S transponder and decode its replies. Up to sixteen unique uplink formats may be programmed with their accompanying replies displayed on each of the S-1403 Sequence Menu displays.

- Interlacing Environment (INTLCE)

  Where both ATCRBS and Mode S interrogations are combined at a normal ratio of ten ATCRBS to one Mode S.

For these environmental simulations, the Mode S Test System provides control for all pulse parameters to test the limits of operation of the Unit Under Test (UUT). Indication of proper operation is provided by percent reply displays that discriminate between ATCRBS and Mode S replies. In addition to these common signal environment simulations, the Mode S Test System provides a means of testing both minimum interrogation spacing (DI Test Function) and rate limiting (BURST Test Function).

The All-Call Short (ACS) and All-Call Long (ACL) Test Functions provide a quick and convenient way to determine if the transponder is replying properly as either ATCRBS or Mode S. These functions provide full control over P_4 pulse characteristics to determine the proper response.

Diversity testing is possible in all functions by enabling ANT B. This tests the UUT's ability to switch antennas by simulating a disparity in amplitude or time from the ANT A to the ANT B output.

(4) Special Mode S Considerations

Some Mode S operations utilizing the S-1403 to ATC-1400A are different from ATCRBS operations. A highlight of major differences are listed below:

- DISPLAY SELECT Readout (43) is not valid for Mode S replies.
- ANT A must be operational for ANT B to be operational.
- Squitter display does not discriminate between dual antenna inputs.
- RF adjustments utilizing SLEW Control (F) require as much as one minute to stabilize for low PRF transmissions. RF LEVEL Control (6) requires little or no stabilization time.
- Squitter inputs are summed between ANT A and ANT B. Therefore, squitter period reads double when ANT B is turned OFF. Squitter transmissions from the UUT alternate between ANT A and ANT B outputs.
- For %Reply:S=, only Mode S replies are decoded. All other replies to include invalid Mode S replies are assumed to be ATCRBS. A 32 µs measurement dead time occurs between the first ATCRBS reply pulse detected and the next attempt at reply pulse detection.

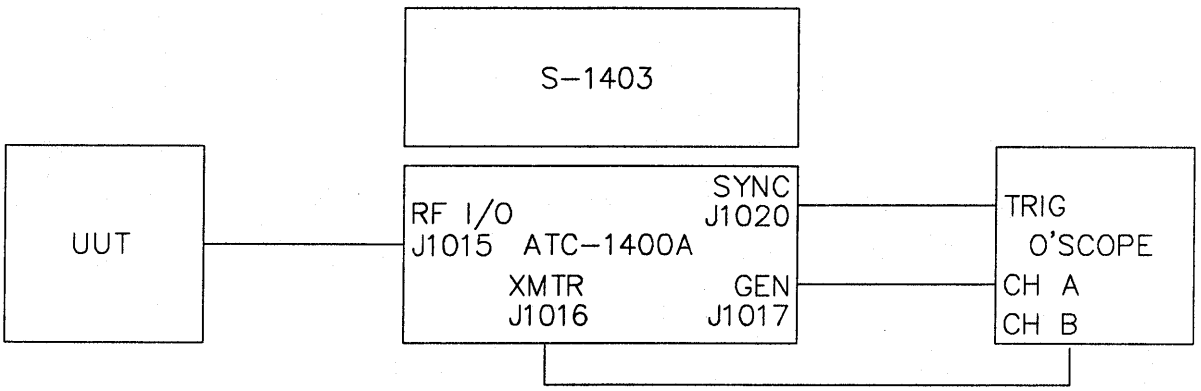
B. ATC Test Function

The following Notes highlight some special considerations for the ATC Test Function. Review these items and the anomalies for ATC Test Function listed in Appendix F prior to utilizing this test function.

NOTE: Squitter delay alternates between ANT A and ANT B. When ANTB: field is OFF, squitter is measured only by ANT A.

NOTE: Simultaneous squitter or replies to/from ANT A and ANT B will not be detected.

NOTE: PRF rate is limited to 1500 with replies occurring or 850 without replies.



ATC Test Function Hook-Up Diagram
Figure 10

(1) Description of ATC Test Function.

The ATC Test Function simulates an ATCRBS ground station standard two-pulse interrogation sequence (described in Appendix C of the ATC-1400A Operation/Maintenance Manual). The ATC Test Function also measures characteristics of the reply sequence to verify proper operation of an ATCRBS transponder.

NOTE: S-1403 controls are identified by alphabetic character identifiers whereas all ATC-1400A controls are identified by numeric character identifiers.

The ATC Function is selected utilizing the key sequence "2nd, 7, 1", or by moving the cursor to the Function (Func:) control field, in Control Menu #1, and pressing key "1". S-1403 Control Menus #1 and #2, along with the ATC-1400A parameter selections listed in 1-2-4, Table 4, are now programmed or enabled.

PARAMETER	CONTROL
Interrogation Rate	PRF/SQTR Thumbwheels (41) PRF/SQTR ON/OFF Switch (32)
P_1 Pulse Width	XPDR PULSE WIDTH Thumbwheels (49) XPDR PULSE WIDTH VAR/CAL Switch (20)
P_2 (SLS) Level	SLS/ECHO Thumbwheels (50) SLS/ECHO ON/OFF Switch (18)
P_2 Deviation	XPDR P2/P_3 DEV Thumbwheels (44) XPDR DEV P_2/CAL Switch (28)
P_2 Pulse Width	XPDR PULSE WIDTH Thumbwheels (49) XPDR PULSE WIDTH VAR/CAL Switch (20)
P_3 Pulse Width	XPDR PULSE WIDTH Thumbwheels (49) XPDR PULSE WIDTH VAR/CAL Switch (20)
P_3 Deviation	XPDR P_2/P_3 DEV Thumbwheels (44) XPDR P_3/CAL Switch (25)
Frequency	FREQ/FUNCTION SELECT Thumbwheels (45)
Suppressor Pulse	SUPPRESSOR ON/OFF Switch (17)
Interference Pulse	DBL INTERR/INTERF PULSE Thumbwheels (42)
Mode Selection	XPDR MODE Control (38)

ATC-1400A ATC Test Function Active Controls
Table 4

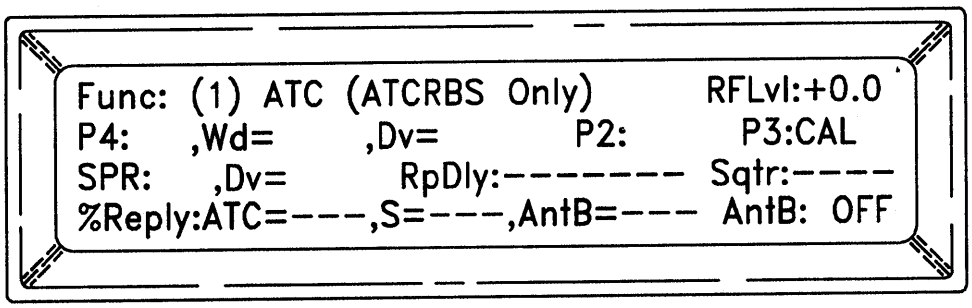
Replies to the Mode S Test system are monitored and displayed as shown in 1-2-4, Table 5:

FUNCTION	S-1403	ATC-1400A
%REPLY	X	
REPLY DELAY	X	
SQUITTER PERIOD	X	
SQUITTER ADDRESS	X	
UUT POWER		X
UUT FREQUENCY		X
GENERATOR PRF		X
ATCRBS XPDR CODE	X	X
MODE S XPDR CODE	X	X

Mode S Reply Displays
Table 5

The S-1403 controls P_3 level, reply pulse selection for power measurement (f_1, f_2, or any pulse in between), External Sync Output or Input and External Modulation Input.

(2) Control Menu #1 Display Definition



ATC Test Function Control Menu #1
Figure 11

(a) Func: (1) ATC (ATCRBS Only)

This operational mode measures the ATCRBS UUT reply delay and percent reply (refer to 1-2-2, Table 2).

(b) RFLvl:

Adjustments for RF Levels in 0.1 dB steps (within a range of ±3.0 dB). RF adjustments are in addition to the level shown in RF LEVEL -dBm Display (3). Adjustments of 1 dB or greater should be accomplished utilizing SLEW Control (6).

(c) P4:

Not active in ATC Test Function.

(d) P4:Wd=

Not active in ATC Test Function.

(e) P4:Dv=

Not Active in ATC Test Function.

(f) P2:

Not active in ATC Test Function.

(g) P3:

ATCRBS P_3 pulse level control selections: "CAL", "OFF" or "VAR". CAL selects the 0 dB reference level. OFF disables P_3 pulse. VAR enables level control from SLS/ECHO Thumbwheels (50) when the SLS/ECHO ON/OFF Switch (18) is OFF (i.e., P_2 is not enabled).

(h) RpDly:

Displays the measured reply delay for ATCRBS (3.0 µs) interrogations with 25 ns resolution and 100 ns accuracy.

(i) Sqtr:

Displays squitter period (transmission interval of DF=11 downlink format) from 0.0 to 9.99 sec with 10 ms resolution.

(j) %Reply:ATC=

Displays percent of ATCRBS replies from 0 to 127% in 1% steps.

(k) %Reply:S=

Displays percent of Mode S replies from 0 to 127% in 1% steps. During ATC Test Function, this field should display either dashes or remain blank.

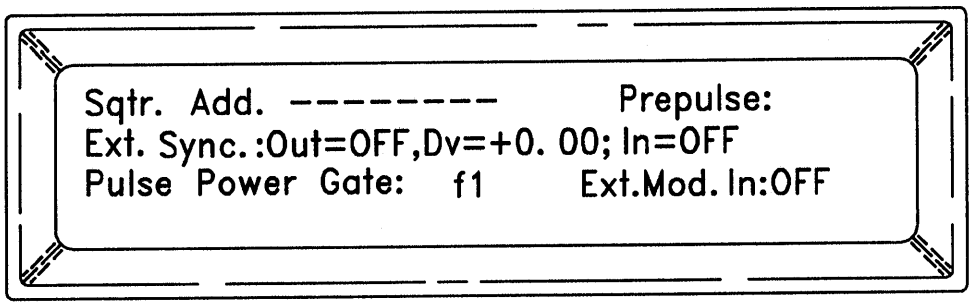
(l) %Reply:AntB=

Displays percent of replies received from ANT B Connector, from 0 to 127%, in 1% steps. If ANT B Connector (E) is not utilized, this field should display dashes or remain blank. AntB: field must be ON to receive data.

(m) AntB:

Enables (delay value) or disables (OFF) Channel B, the diversity generator. When enabled, a value from -0.95 to +0.95 µs can be selected in 0.05 µs steps as the delay from Channel A to Channel B.

(3) Control Menu #2 Display Definition



ATC Test Function Control Menu #2
Figure 12

(a) Sqtr. Add.

24-bit octal value decoded from an unsolicited ANT A reply/squitter. This value is the Mode S Transponder address and is transmitted via Downlink Format 11.

(b) Prepulse:

Not used in ATC Test Function.

(c) Ext.Sync.:Out=

ON/OFF control for external sync output function.

(d) Ext.Sync.:Dv=

Deviation control for external sync output. The range of input is from -9.95 µs to +9.95 µs in 50 ns steps.

(e) Ext.Sync.:In=

ON/OFF control for External Sync input control (positive TTL signal). Overrides EXT SYNC OUT.

(f) Pulse Power Gate:

Pulse Power Measurement Gate (select pulse) settings are selected by rotating the SLEW Control (F) or by selecting the pulse number from the sequence listed in 1-2-2, Table 2.

For all reply pulses, the measurement gate must be enabled prior to the rising edge of the pulse to be measured. The measurement will continue until the falling edge of the reply. The reply pulse to be measured must be enabled for the measurement to be valid.

The power measurement is performed by the ATC-1400A and displayed on XMTR PWR WATTS Display (1). The S-1403 controls pulse power measurement when F_2/P_2-F_1/P_1 Switch (34) is set to F_2/P_2. F_1/P_1 measures pulse power of an ATCRBS F_1 reply pulse only.

(g) Ext.Mod.In:

ON : Disables the S-1403 internal pulse generator.
OFF : Allows simultaneous internal and external modulation.

(4) Sequence Menu (Uplink/Downlink Format) Description.

ATC Test Function does not utilize sequence menus.

(5) Explanation of ATC Function Timing Diagram.

All timings specified are referenced to P_1 rising edge.

Internal timing is referenced to the SELF INTERROGATE (Pin 14, J10010) trailing edge for stability (17.95 µs delay time trailing edge to leading edge of P_1) for normal output. P_2 is output when SLS/ECHO ON/OFF Switch (18) is ON. When SLS/ECHO ON/OFF Switch (18) state changes, the S-1403 senses the change and provides the SLS Gate output at this time, allowing level control with SLS/ECHO Thumbwheels (50). Refer to 1-2-2, Table 2 for P_2 and P_3 width and deviation controls.

When the UUT replies to the interrogation, ANT A (RF I/O Connector [9]) receives the RF signal, detects the video information, and returns the video signal to S-1403 J10010 pin 11. The S-1403 measures the reply delay time and displays the result on Control Menu #1 RpDly field. The power of each individual pulse may be measured by setting F_2/P_2-F_1/P_1 Switch (34) to F_2/P_2 and selecting the desired pulse, with SLEW Control (F), in Pulse Power Gate field of Control Menu #2. The measurement gate is then output to the ATC-1400A on MEASUREMENT GATE Connector (HH), J10014, and viewed on XMTR PWR WATTS Display (1).

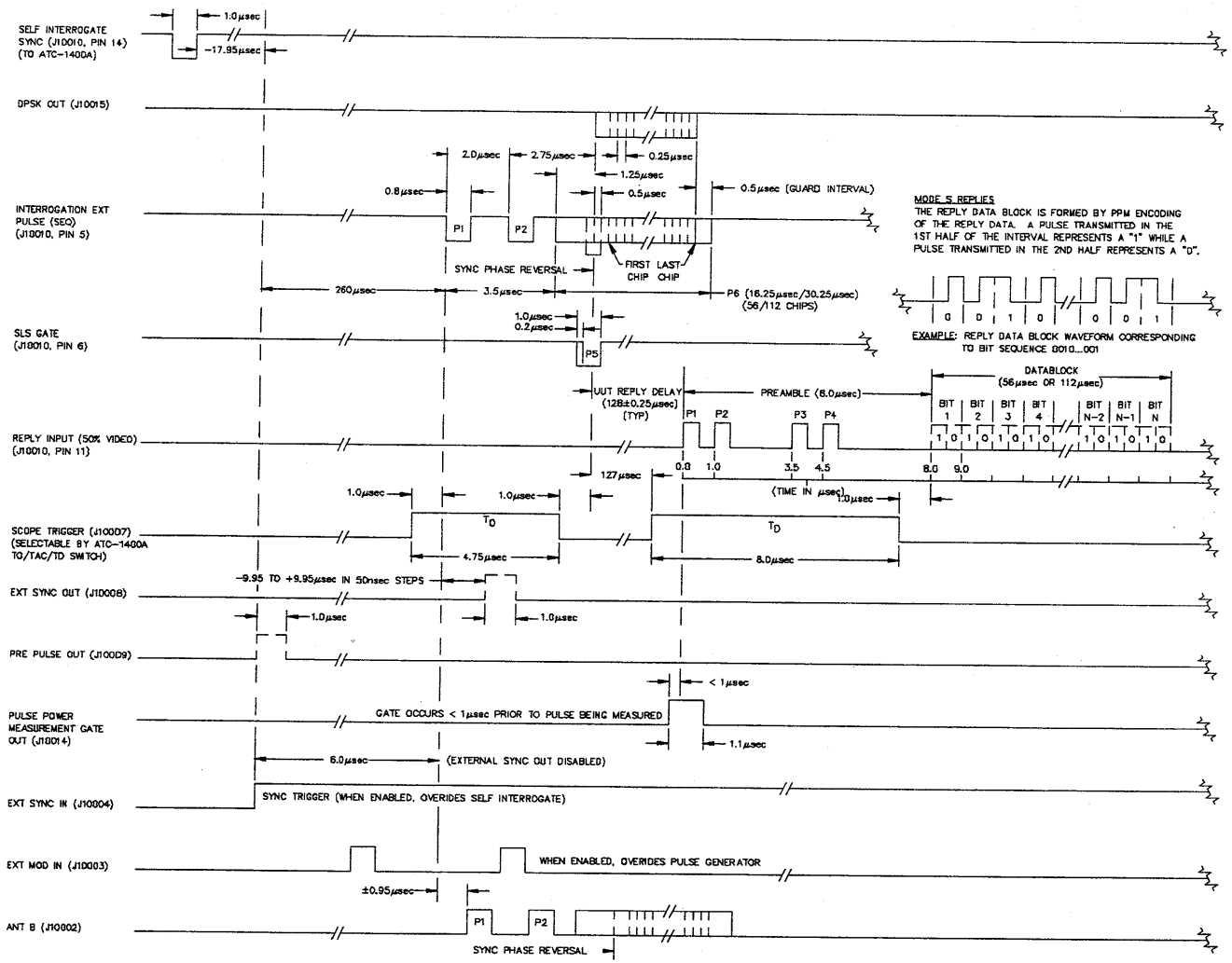
When EXT SYNC is desired, the operator must first select Ext.Sync.:In=ON and connect the external source to EXT SYNC OUT Connector (CC), J10008. The Ext pulse output rising edge sequence occurs 6.0 µs following the Sync Input.

For Ext.Mod.In=ON, both sync and the pulse information may be received from an external source, allowing the user complete control over PRF and pulse patterns. The operator should note that PRF rate limitations specified for internal sync operation apply to external PRF rate as well.

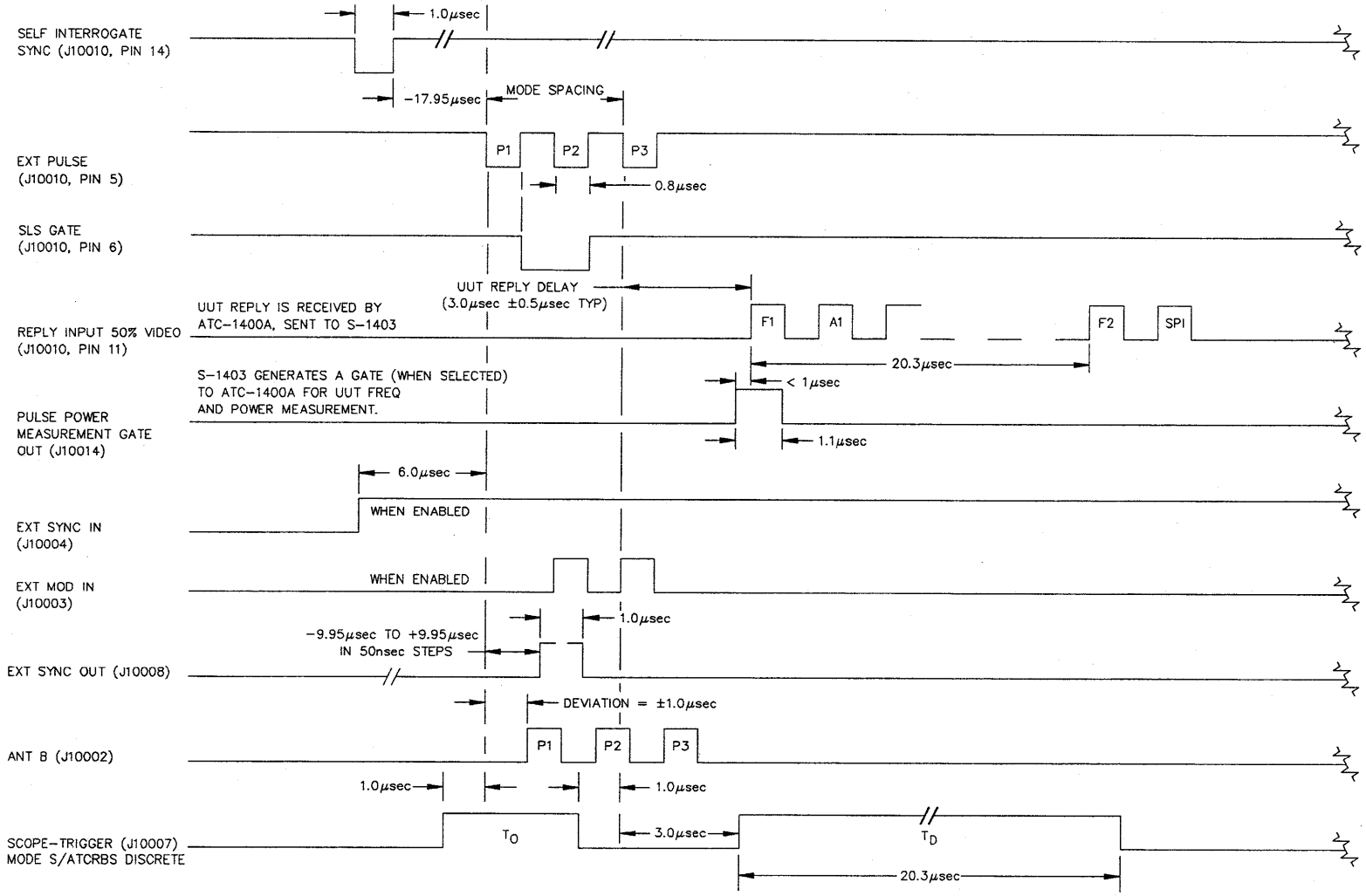
Ext.Sync.:Out=ON is provided to connect two Mode S Test Systems together for complete power level diversity training.

ANT B output, when enabled on Control Menu #1, will track ANT A output (with the exception of pulse level control). No power measurements are available for replies from ANT B.

The Scope Trigger allows the operator to view the detected video of either the generated or received signal with T_O/TAC/T_D Switch (30).



SEQ Test Function Timing Diagram
Figure 24



ATC Test Function Timing Diagram
Figure 13

C. SEQ Test Function

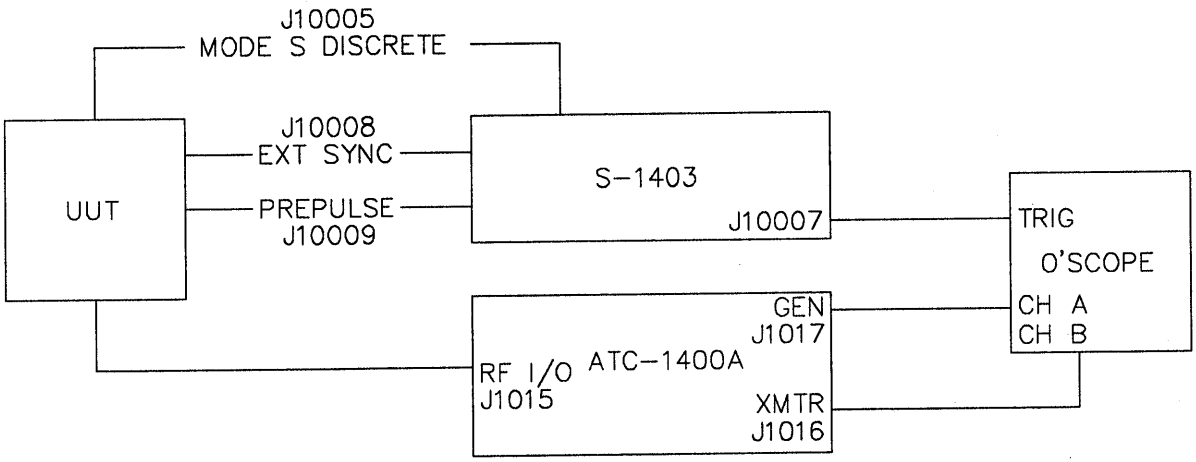
The following four Notes highlight some special considerations for SEQ Test Function. Review these Notes and the anomalies for SEQ Test Function listed in Appendix F.

NOTE: Sequence menu items (S01-S16) must be programmed prior to enabling SEQ Test Function, to avoid parity error messages from being generated from replies received during the programming of the item.

NOTE: SLS/ECHO ON/OFF Switch (18) overrides P2 variable control to allow P5 control when ON.

NOTE: PRF limitation for SEQ Test Function is 200.

NOTE: Only the Mode S preamble is detected for calculating %Reply:S=. All other replies, including invalid replies are considered ATCRBS.



SEQ Test Function Hook-Up Diagram
Figure 14

(1) Description of SEQ Test Function.

NOTE: Items identified with alphabetic characters refer to the S-1403, Items identified with numerical characters refer to the ATC-1400A.

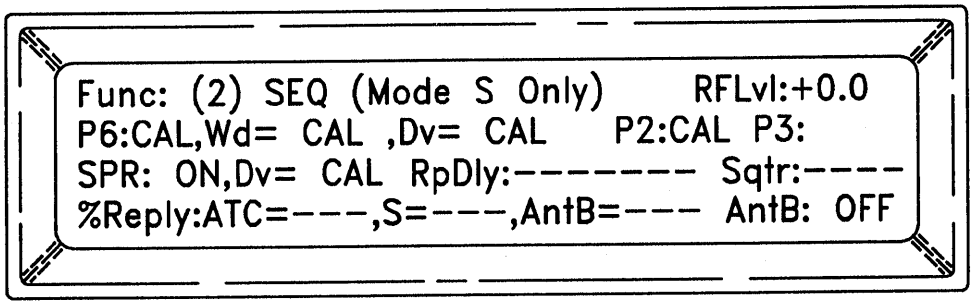
The SEQ Test function, utilizing sequence menus (2nd, SMENU, #), allows Mode S interrogations to occur as defined by active sequence menus. Sequence Menus 1 thru 7 are predefined for uplink and downlink messages. Appendix B contains Sequence Menu definitions. Appendix E contains definitions for subfields within the sequence menu.

NOTE: When testing the UUT, recommend sequence menus not required for the specific test being conducted be turned off.

SEQ Test Function verifies the UUT's (when equipped with the specific function) capability to transmit/receive Mode S discrete address, pressure altitude, maximum airspeed, transponder 4096 code, on-the-ground report,special position indications, air-to-air messages, All-Call replies, All-Call transmissions, diversity response timing and capability of the UUT to respond to extended messages (116 bit messages, UF16 thru UF24, utilized in TCASI). All messages to/from the UUT are displayed in active (ON) sequence menus using OCTAL numeric format. Section 1-2-4, Remote (GPIB) Operations contains examples of how to convert GPIB Uplink and Downlink messages for specific suspect UUT operations.

Address (ADD= fields in all sequence menus) verification is used in Mode S replies and interrogations to provide protection against the UUT acting upon information directed to another address. Upon receipt of a Mode S interrogation, the UUT performs a parity check of the twenty four bits comprising the address code, to verify the bit sequence is consistant with the preprogrammed structure. If the bit sequence is consistent, the address verification is passed; otherwise it is failed. When an address verification fails, the UUT will not accept the interrogation and the two ADD= field in all active sequence menus will not display equal values.

(2) Control Menu #1 Display Definition



SEQ Test Function Control Menu #1
Figure 15

(a) Func: (2) SEQ (Mode S Only)

This mode interrogates the Mode S Transponder with the interrogation words stored in the Sequence Menu. Every menu item that is not OFF is transmitted in numerical sequence, one format per interrogation. The sequence formats are programmed per 1-2-2. The PRF interrogation rate is controlled by PRF/SQTR Thumbwheels (41) and PRF/SQTR ON/OFF Switch (32).

(b) RFLvl:

Adjustments for RF Levels in 0.1 dB steps (within a range of ±3.0 dB). RF adjustments are in addition to the level shown in RF LEVEL -dBm Display (3). Adjustments of 1 dB or greater should be accomplished utilizing SLEW Control (6).

(c) P6:

Select "CAL" (ON), "OFF" for Mode S P_6 Control.

(d) P6:Wd=

P_6 Pulse width control. Select CAL/VAR with the ON/CAL key. CAL (±0.0) = 16.25 µs for 56-bit data field and 30.25 µs for 112-bit data field. Variable values are the CAL value 1.5 µs in 0.05 µs steps.

(e) P6:Dv=

P_6 Pulse deviation control selections. Select CAL/(Value) with the ON/CAL key. CAL (0.0) = 3.5 µs following P_1. Variable values are the CAL value ±1.95 µs in 0.050 µs steps.

(f) P2:

Mode S P_2 pulse level control selections: "CAL", "OFF" or "VAR". CAL resets the level to 0.0 dB. VAR indicates level control from SLS/ECHO Thumbwheel (50) when SLS/ECHO ON/OFF Switch (18) is OFF (i.e., P_5 not enabled). XPDR PULSE WIDTH Thumbwheels (49) and VAR/CAL Switch (20) control the P_2 pulse width. XPDR P_2/P_3 DEV Thumbwheels (44) control deviation.

(g) P3:

Not active in SEQ Test Function.

(h) SPR:

ON/OFF control for the Sync Phase Reversal.

(i) SPR:Dv=

SPR deviation control selections. Select CAL/(Value) with the ON/CAL key. CAL (±0.0) = 1.25 µs following P_6. Variable values are the CAL value ±1.0 µs in 0.050 µs steps.

(j) RpDly:

Displays the measured reply delay for Mode S (128 µs typical) interrogations with 25 ns resolution and 50 ns accuracy.

(k) Sqtr:

Displays squitter period (transmission interval of DF=11 downlink format) from 0.0 to 9.99 sec with 10 ms resolution.

(l) %Reply:ATC=

Displays any replies that are not valid Mode S replies or squitters from 0-127 in 1% steps.

(m) %Reply:S=

Displays percent of valid Mode S only replies, from 0 to 127%, in 1% steps.

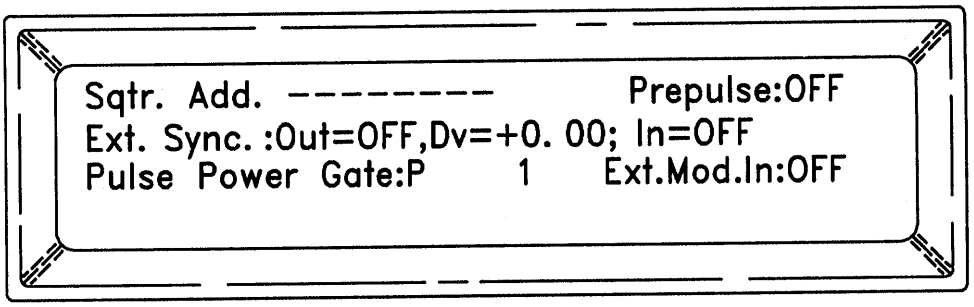
(n) %Reply:AntB=

Displays percent of replies received from ANT B connector, from 0 to 127%, in 1% steps.

(o) AntB:

Enables (delay value) or disables (OFF) Channel B, the diversity generator. When enabled, a value from -0.95 to +0.95 µs can be selected in 0.05 µs steps as the delay from Channel A to Channel B.

(3) Control Menu #2 Display Definition



SEQ Test Function Control Menu #2
Figure 16

(a) Sqtr. Add.

24-bit octal value decoded from an unsolicited Channel A reply/squitter. This value is the Mode S Transponder address and transmitted via Downlink Format 11.

(b) Prepulse:

Prepulse (=0 to 260)/OFF control. The pulse can be positioned 0 to 260 µs prior to the rising edge of the interrogation P_1 in 1.0 µs steps.

(c) Ext.Sync.:Out=

ON/OFF control for external sync output function.

(d) Ext.Sync.:Dv=

Deviation control for external sync output. The range of input is from -9.95 µs to +9.95 µs in 50 ns steps.

(e) Ext.Sync.:In=

ON/OFF control for External Sync input control (positive TTL signal).

(f) Pulse Power Gate:

Pulse power measurement gate tracks on reply delay and is selectable from P_1 to P_{116} by input of a number from 1 to 116 (or selected via SLEW Control [F]).

For all reply pulses, the measurement gate must be enabled prior to the rising edge of the pulse to be measured. The measurement continues until the next reply falling edge. Since Mode S replies are in PPM format, care should be taken to ensure the data pulse prior to and following the measurement pulse are in a state where the power level is not measured as well. For example: measuring P_6 power; If P_6 is "0", P_5 state doesn't matter and P_7 should be "0". If P_6 is a "1", P_5 should be a "1" and P_7 is neutral. If P_5 were "0" and P_6 a "1", no rising edge would be detected and therefore the power reading would be zero.

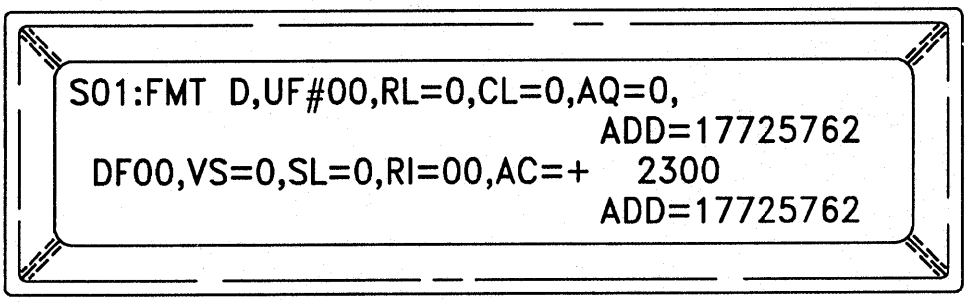
For the S-1403 to control pulse power measurement requires F_2/P_2-F_1/P_1 Switch (34) to be in the F_2/P_2 position. The F_1/P_1 position will measure the pulse power of an ATCRBS F_1 reply pulse only. The power measurement is performed in the ATC-1400A and displayed on the XMTR PWR WATTS Display (1).

(g) Ext.Mod.In.:

ON : Disables the internal pulse generator.
OFF : Allows simultaneous internal/external modulation.

(4) Sequence Menu (Uplink/Downlink Format) Description

(a) Sequence Menu S01 - Uplink/Downlink Format 00 (Short Special Surveillance)

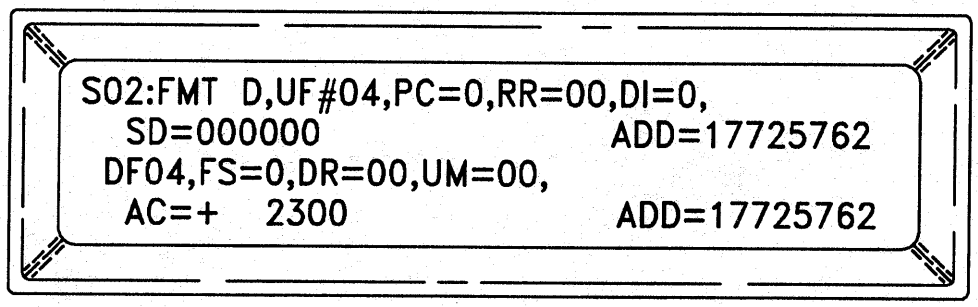


Sequence Menu S01
Figure 17

The Mode S Test System queries the UUT designating the expected response definition (DF00 or DF16) in field RL. When RL field is set to 0, the response will be DF00 (short format reply) as shown in figure 14. RL field equal to 1 declares DF16 (extended or long reply format) as the proper reply. Field CL is reserved for TCAS capable UUT's. When CL is zero, the default condition, TCAS has not generated a resolution advisory. A resolution advisory has been generated when CL is set to 1. AQ field is the command field for both UF00 and UF16. When AQ field is equal to zero (default condition for sequence menu S01), UF00 is the interrogation format. AQ field equal to 1 will direct UF16 to be the interrogation format.

Replies to the UUT, displayed as either DF00 or DF16, are determined by the value in field RL. Field VS determines the flight status of the UUT. Field AC represents the altitude related to the value in field VS. When VS is set to 1, representing an inflight condition, the value in AC symbolizes a flight altitude. VS field equal to 0 represents an on-ground condition and field VS symbolizes the airfield elevation. SL field reports TCAS sensitivity of the UUT to the interrogator (default is 0). Field RI is utilized to relay airspeed information to the interrogator. Codes 0 through 7 indicate an air-to-air non-acquisition reply. Codes 8 through 15 and an explanation of field SL are explained in Appendix E.

(b) Sequence Menu S02 - Uplink/Downlink Format 04 (Surveillance and Altitude Request)

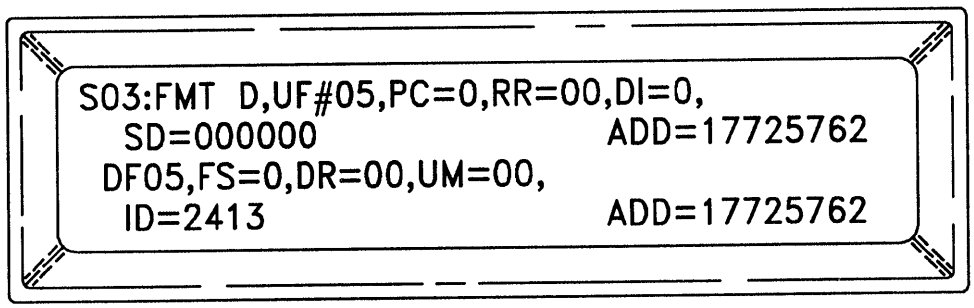


Sequence Menu S02
Figure 18

Sequence Menu 02 PC= field mandates operating instructions to the UUT. Choices of selection in field PC= are non-selective All-Call lockout (1), cancel Comm-B (4), cancel Comm-C (5) or cancel Comm-D (6). Field RR instructs the UUT to reply in either short (codes 0 through 15) or long (codes 16 through 31) format. RR values of 16 through 31 will reply utilizing DF21. Field DI instructs the UUT to receive information contained in field SD. DI equal to 0 instructs the UUT to ignore all SD field data. When DI is set to 1, SD field is for multisite use. Setting DI to 7 will instruct the UUT to reply in extended field format (refer to Appendix E). Values of 2 through 6 are not defined.

Field FS reports flight status and alerts conditions (refer to Appendix E) to the interrogator. Field DR notifies the interrogator of the UUT's intent to transmit a message. A value of 0 represents no activity. When DR is equal to 1 the message will be Comm-B format. DR field values of 16 through 31 represent a Comm-D protocol message. Values of 2 through 15 are not defined. Field UM contains the transponders status (refer to Appendix E) when DI is 1 and SD is XXXXAX (X represents any value, A represents any non-zero value). The status contains the identity of the interrogator and the Comm format for further communications. Field AC displays altitude in feet, unless the UUT is coded to reply in meters.

(c) Sequence Menu S03 - Uplink/Downlink Format 05 (Aircraft Identification Request)

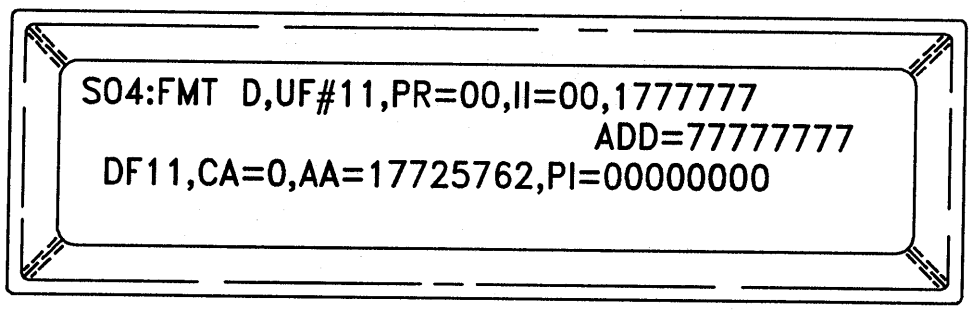


Sequence Menu S03
Figure 19

Sequence Menu 03 PC= field mandates operating instructions to the UUT. Choices of selection in field PC= are non-selective All-Call lockout (1), cancel Comm-B (4), cancel Comm-C (5) or cancel Comm-D (6). Field RR= instructs the UUT to reply in either short (codes 0 through 15) or long (codes 16 through 31) format. RR= 16 through 31 will reply in DF21. Field DI instructs the UUT to receive information contained in field SD. DI equal to 0 instructs the UUT to ignore all SD field data. When DI is set to 1, SD field is for multisite use. Setting DI to 7 will instruct the UUT to reply in extended field format (refer to Appendix E). Values of 2 through 6 are not defined.

Field FS reports flight status and alerts conditions (refer to Appendix E) to the interrogator. Field DR notifies the interrogator of the UUT's intent to transmit a message. A value of 0 represents no activity. When DR is equal to 1, the message will be Comm-B format. DR field values of 16 through 31 represent a Comm-D protocol message. Values of 2 through 15 are not defined. Field UM contains the transponders status (refer to Appendix E) when DI is 1 and SD is XXXXAX (X represents any value, A represents any non-zero value). The status contains the identity of the interrogator and the Comm format for further communications. Field ID contains the 4096 identification code set on the UUT.

(d) Sequence Menu S04 - Uplink/Downlink Format 11 (Mode S Only All-Call)

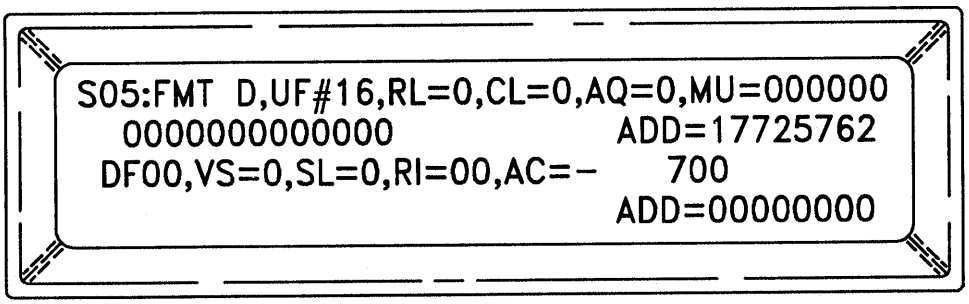


Sequence Menu S04
Figure 20

Sequence Menu S04 PR field specifies the reply probability for replies from the UUT. This reply probability is used to separate replies in a saturated ATC environment. When PR field equals 0 or 8, the UUT replies normally. When PR is 5, 6, 7, 13, 14 or 15, the UUT is instructed to not reply. Other PR field codes are contained in Appendix E. Field II identifies the interrogator for future All-Call lockouts. The seven digits after field II= is a constant value of 1777777.

Field CA notifies the interrogator of the UUT's capability to reply. When CA is 0, the UUT is unable to reply in extended formats (DF16 through 24). When CA is 1, the UUT can reply in Comm-A, Comm-B and extended formats. When CA is 2, the UUT can reply in Comm-A, Comm-B, Comm-C and extended formats. When CA is 3, the UUT can reply utilizing any Mode S format. Field AA contains the UUT address. This field should be equal to the uplink ADD field. PI= field contains the parity code overlaid on the interrogator's identity code.

(e) Sequence Menu S05 - Uplink/Downlink Format 16 (Long Special Surveillance)

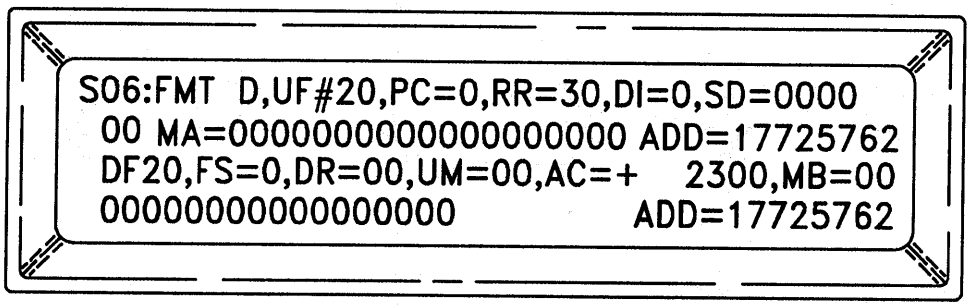


Sequence Menu S05
Figure 21

The Mode S Test System queries the UUT designating the expected response definition (DF00 or DF16) in field RL. When RL field is set to 0, the response will be DF00 (short format reply) as shown in 1-2-4, Figure 18. RL field equal to 1 declares DF16 (extended or long reply format) as the proper reply. Field CL is reserved for TCAS capable UUT's. When CL is zero, the default condition, TCAS has not generated a resolution advisory. A resolution advisory has been generated when CL is set to 1. AQ field is the command field for both UF00 and UF16. When AQ field is equal to zero, UF00 is the interrogation format. AQ field equal to 1 (default condition for sequence menu S05) will direct UF16 to be the interrogation format. This sequence menu is dedicated for long (112 bit) responses for air-to-air requests. In responding to UF16, the UUT will reply with altitude and response format information. Further communications will be through either unspecified long Downlink formats (22 or 23) or Downlink format 24. UF16 will not follow Comm-B formats. Field MU contains information used in air-to-air exchanges.

Replies to the UUT, displayed as either DF00 or DF16, are determined by the value in field RL. Field VS determines the flight status of the UUT. Field AC represents the altitude related to the value in field VS. When VS is set to 1, representing an in-flight condition, the value in AC symbolizes a flight altitude. VS field equal to 0 represents an on-ground condition and field VS symbolizes the airfield elevation. SL field reports TCAS sensitivity of the UUT to the interrogator (default is 0). Field RI is utilized to relay airspeed information to the interrogator. Codes 0 through 7 indicate an air-to-air non-acquisition reply. Codes 8 through 15 and field SL are explained in Appendix E. Field MV contains information utilized in air-to-air exchanges and does not follow Comm-B format.

(f) Sequence Menu S06 - Uplink/Downlink Format 20 (Comm-A Altitude Request)

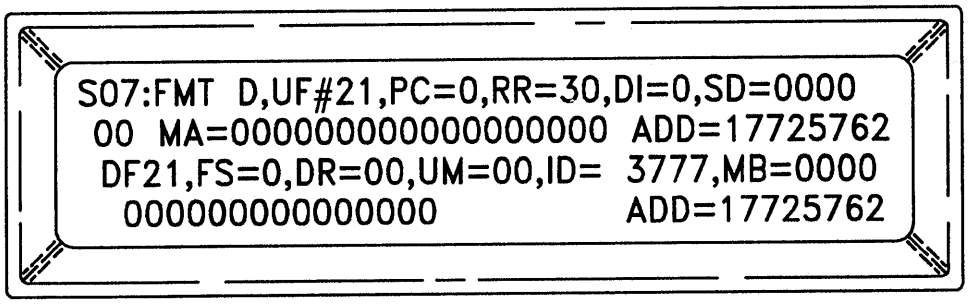


Sequence Menu S06
Figure 22

Sequence Menu 06 PC field mandates operating instructions to the UUT. Choices of selection in field PC are non-selective All-Call lockout (1), cancel Comm-B (4), cancel Comm-C (5) or cancel Comm-D (6). Field RR= instructs the UUT to reply in either short (codes 0 through 15) or long (codes 16 through 31) format. RR= 16 through 31 will reply in DF21. Field DI instructs the UUT to receive information contained in field SD. DI equal to 0 instructs the UUT to ignore all SD field data. When DI is set to 1, SD field is for multisite use. Setting DI to 7 will instruct the UUT to reply in extended field format (refer to Appendix E). Values of 2 through 6 are not defined. Field MA contains messages to the UUT and uses Comm-A format.

Field FS reports flight status and alerts conditions (refer to Appendix E) to the interrogator. Field DR notifies the interrogator of the UUT's intent to transmit a message. A value of 0 represents no activity. When DR is equal to 1, the message will be Comm-B format. DR field values of 16 through 31 represent a Comm-D protocol message. Values of 2 through 15 are not defined. Field UM contains the transponder status (refer to Appendix E) when DI is 1 and SD is XXXXAX (X represents any value, A represents any non-zero value). The status contains the identity of the interrogator and the Comm format for further communications. Field AC displays altitude in feet, unless the UUT is coded to reply in meters. Field MB contains messages to the interrogator and uses Comm-B format.

(g) Sequence Menu S07 - Uplink/Downlink Format 21 (Comm-A Identity Request)



Sequence Menu S07
Figure 23

Sequence menu S07 PC= field mandates operating instructions to the UUT. Choices of selection in field PC= are non-selective All-Call lockout (1), cancel Comm-B (4), cancel Comm-C (5) or cancel Comm-D (6). Field RR instructs the UUT to reply in either short (codes 0 through 15) or long (codes 16 through 31) format. RR 16 through 31 will reply in DF21. Field DI instructs the UUT to receive information contained in field SD. DI equal to 0 instructs the UUT to ignore all SD field data. When DI is set to 1, SD field is for multisite use. Setting DI to 7 will instruct the UUT to reply in extended field format (refer to Appendix E). Values of 2 through 6 are not defined. Field MA contains messages from the interrogator to the UUT.

Field FS reports flight status and alerts conditions (refer to Appendix E) to the interrogator. Field DR notifies the interrogator of the UUT's intent to transmit a message. A value of 0 represents no activity. When DR is equal to 1, the message will be Comm-B format. DR field values of 16 through 31 represent a Comm-D protocol message. Values of 2 through 15 are not defined. Field UM contains the transponders status (refer to Appendix E) when DI is 1 and SD is XXXXAX (X represents any value, A represents any non-zero value). The status contains the identity of the interrogator and the Comm format for further communications. ID contains the 4096 code selected on the front of the UUT. Field MB contains messages to the interrogator and uses Comm-B format.

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D. ACS Test Function

NOTE: S-1403 Controls are identified by alphabetic character identifiers whereas all ATC-1400A controls are identified by numeric character identifiers.

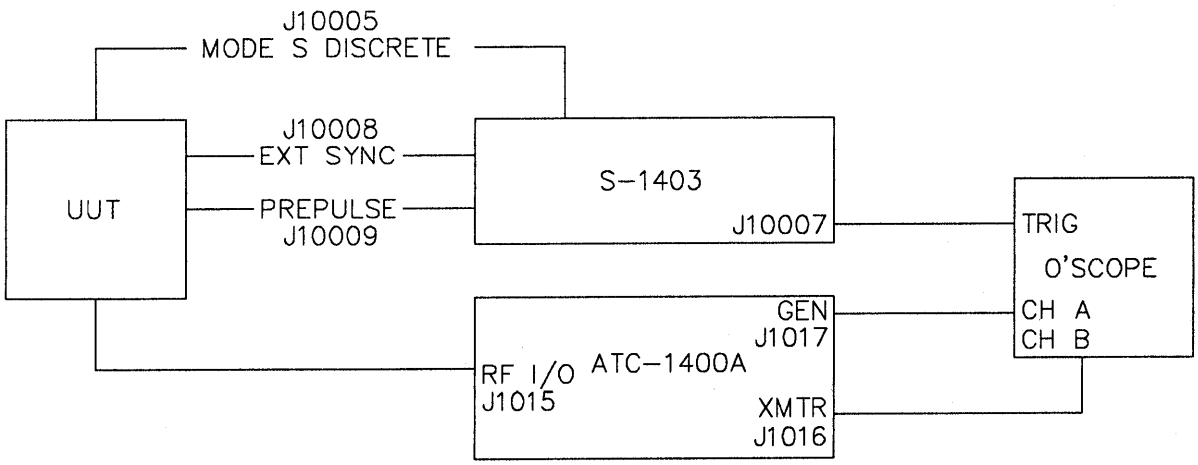
NOTE: The following four items highlight ACS Test Function anomalies. Review these items and Appendix F prior to utilizing this test function.

The PRF rate (as set by the ATC-1400A PRF/SQTR Thumbwheels [41]) is limited to 1500 ATCRBS interrogations with replies occurring (RATE ERROR occurs) and 800 without replies (with P4 disabled, no error message indicated).

The ACS Scope Trigger (J10007) occurs 3.0 microseconds early with an ATCRBS reply (P4 disabled) when the ATC-1400A SYNC switch (30) is in TD position.

Reply delay is measured from the leading edge of the P4 pulse when the P4 control is in CAL or VAR position. When P4 is turned OFF, the measurement is made from the leading edge of the P3 pulse.

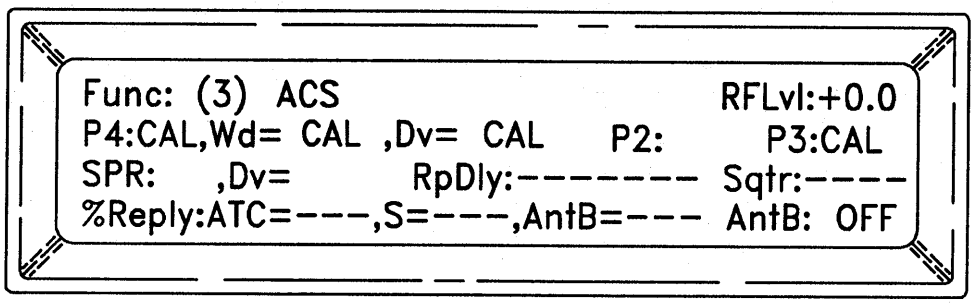
Downlink information is not decoded in the Sequence Menu for this function.



ACS Test Function Hook-Up Diagram
Figure 25

(1) Description of ACS Test Function.

ACS (All Call Short) function selects only All Call Short interrogations for transmissions. No other ATCRBS or Mode S interrogations are permitted (ACS disables Mode S replies in the Mode S Transponder allowing only ATCRBS replies).



ACS Test Function Control Menu #1
Figure 26

(2) Control Menu #1 Display Definition

(a) Func: (3) ACS.

Modes are selected by XPDR MODE Control (38). PRF/SQTR Thumbwheels (41) and PRF/SQTR ON/OFF Switch (32) control PRF rate for the interrogations.

(b) RFLvl:

Adjustments for RF Levels in 0.1 dB steps (within a range of ±3.0 dB). RF adjustments are in addition to the level shown in RF LEVEL -dBm Display (3). Adjustments of 1 dB or greater should be accomplished utilizing RF LEVEL Control (6).

(c) P4:

Select "CAL", "OFF" or "VAR" for P_4. CAL resets the level to 0.0 dB. VAR allows variable amplitude control with SLS/ECHO ON/OFF Switch (18) in the OFF position. Setting the SLS/ECHO ON/OFF Switch (18) to ON overrides P_3 and P_4 variable control, changing control to SLS (P_2).

(d) P4:Wd=

Pulse width variable control selection. Select CAL/(Value) with the ON/CAL key. CAL (0.0)= 0.8 µs for ACS. Variable values are adjustable from CAL value -0.6 to +1.95 µs in 0.05 µs steps.

(e) P4:Dv=

Pulse deviation control selection. Select CAL/(Value) with the ON/CAL key. CAL (±0.0) = 8.0 µs for ATCRBS Mode A, and 21.0 µs for ATCRBS Mode C. Variable control provides deviation from CAL value ±1.95 µs in 0.05 µs steps.

(f) P2:

Not active in ACS Test Function.

(g) P3:

Mode S All Call P_3 pulse level control selection: "CAL", "OFF", or "VAR". CAL resets the level to 0.0 dB. SLS/ECHO Thumbwheels (50) controls VAR level when the SLS/ECHO ON/OFF Switch (18) is OFF (P_2 not enabled). XPDR P_2/P_3 DEV Thumbwheels (44) and XPDR DEV P_3/CAL Switch (25) control the P_3 pulse deviation. XPDR PULSE WIDTH Thumbwheels (49) and XPDR PULSE WIDTH VAR/CAL Switch (20) control pulsewidth.

(h) SPR:

Not active in ACS Test Function.

(i) SPR:Dv=

Not active in ACS Test Function.

(j) RpDly:

Displays the measured reply delay for Mode S (128 µs typical) interrogations with 25 ns resolution and 100 ns accuracy.

(k) Sqtr:

Displays squitter period (transmission interval of DF=11 downlink format) from 0.0 to 9.99 sec with 10 sec resolution.

(l) %Reply:ATC=

Displays percent of ATCRBS replies only, from 0 to 127% in 1% steps.

(m) %Reply:S=

Displays percent of Mode S replies only, from 0 to 127% in 1% steps.

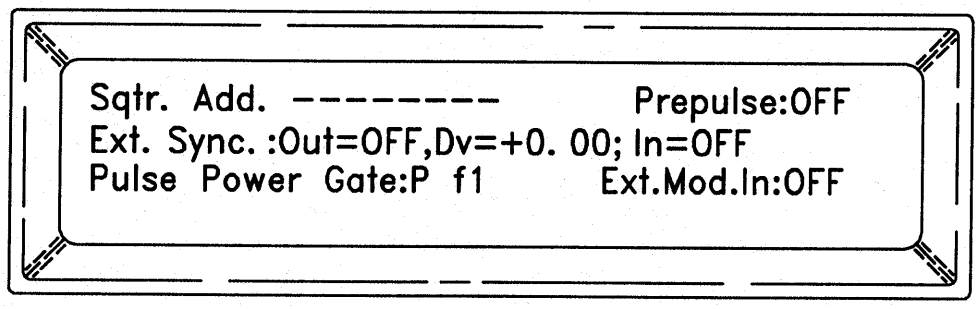
(n) %Reply:AntB=

Displays percent of replies received from the ANT B Connector (E), from 0 to 127% in 1% steps.

(o) AntB:

OFF/(delay value). Enables or disables Channel B, the diversity generator. When enabled, a value from -0.95 µs to +0.95 µs can be selected as the delay from Channel B in 0.05 µs steps.

(3) Control Menu #2 Display Definition



ACS Test Function Control Menu #2
Figure 27

(a) Sqtr. Add:

24 bit octal value decoded from an unsolicited Channel A reply/squitter. This value is the Mode S Transponder address and is transmitted via Downlink Format 11.

(b) Prepulse:

Prepulse ON/OFF Control. The pre-pulse spacing is set at the front panel. The pulse can be positioned from 0 to 260 µs prior to the rising edge of P_1 of the interrogation, in 1 µs steps.

(c) Ext.Sync.:Out=

ON/OFF control for the external sync output function.

(d) Ext.Sync.:Dv=

Deviation control for external sync output. The selectable range can vary from -9.95 µs to +9.95 µs in 50 ns steps.

(e) Ext.Sync.:In=

ON/OFF control for External Sync input control (positive TTL signal). EXT SYNC Out is not enabled when SYNC In is enabled.

(f) Pulse Power Gate:

Pulse Power Measurement Gate tracks on reply delay and is selectable from P_1 to P_{116} (by input of a number from 1 to 116 or selected via SLEW Control [F]). The reply delay is used to determine the location to measure the PPMG pulse. This allows correct positioning regardless of P_4 location.

The power measurement is performed in the ATC-1400A and displayed on XMTR PWR WATTS Display (1).

For all reply pulses, the measurement gate must be enabled prior to the rising edge of the pulse to be measured. The measurement will continue until the next falling edge of the reply. In the case of Mode S replies, since they are in PPM format, care should be taken to ensure the data pulses prior to and following the pulse to be measured are in such a state that their power levels will not be measured as well. For example: to measure P6 power; If P6 is a "0" then P5's state doesn't matter and P7 should be a "0". If P6 is a "1", then P5 should be a "1" and P7's state doesn't matter. If P5 were "0" and P6 a "1", no rising edge would be detected and therefore the power reading would be zero.

For the S-1403 to control pulse power measurement requires F2/P2-F1/P1 Switch (34) to be in the F2/P2 position. The F1/P1 position will measure the pulse power of an ATCRBS F1 reply pulse only.

(g) Ext. Mod.In.:

ON : Disables the internal pulse generator.
OFF : Allows simultaneous internal/external modulation.

(4) Sequence Menu (Uplink/Downlink Format) Description

ACS Test Function does not utilize sequence menus.

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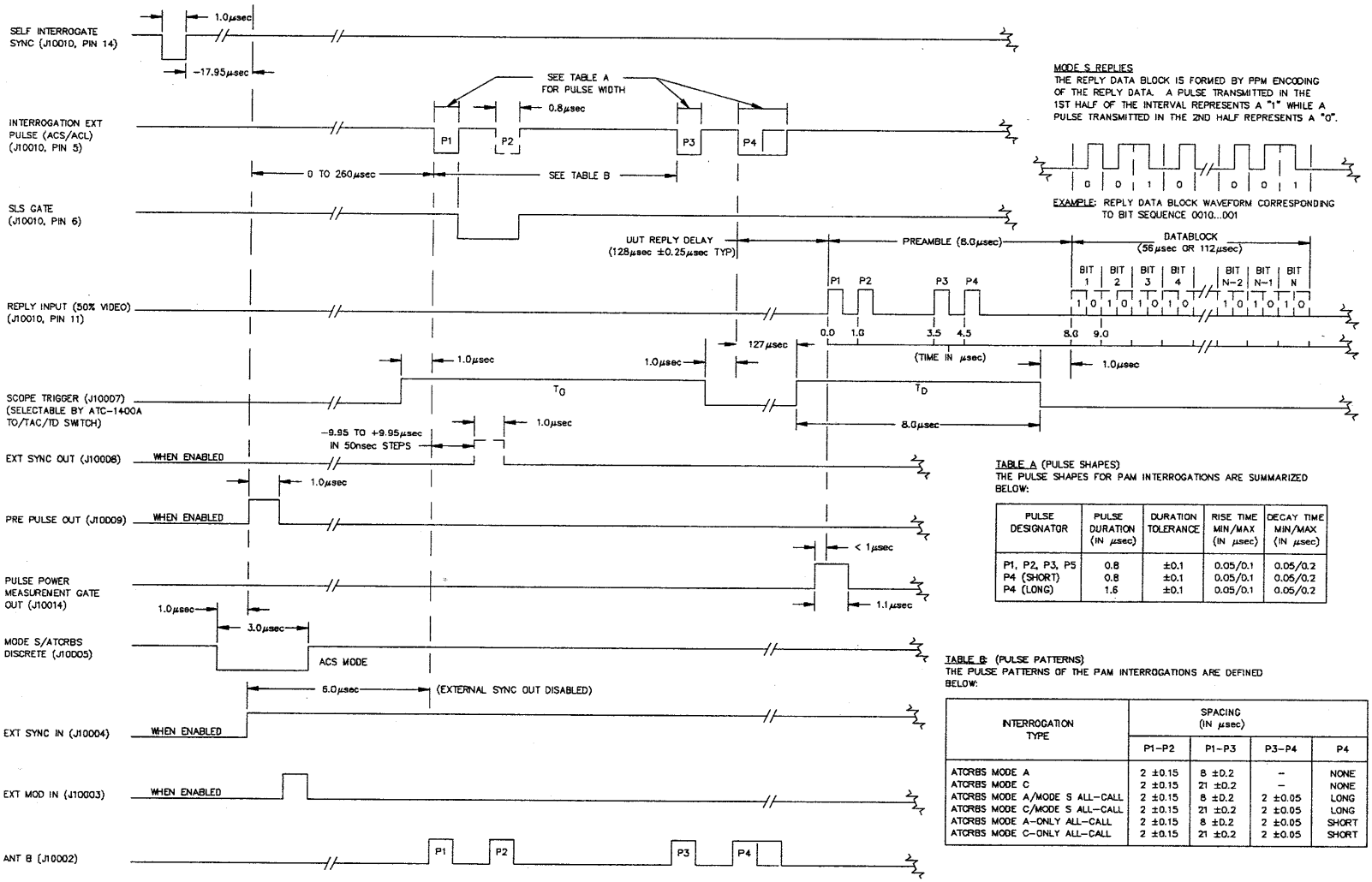


MODE S REPLIES
THE REPLY DATA BLOCK IS FORMED BY PPM ENCODING OF THE REPLY DATA. A PULSE TRANSMITTED IN THE 1ST HALF OF THE INTERVAL REPRESENTS A "1" WHILE A PULSE TRANSMITTED IN THE 2ND HALF REPRESENTS A "0".

EXAMPLE: REPLY DATA BLOCK WAVEFORM CORRESPONDING TO BIT SEQUENCE 0010...001

TABLE A (PULSE SHAPES)
THE PULSE SHAPES FOR PAM INTERROGATIONS ARE SUMMARIZED BELOW:

PULSE DESIGNATOR	PULSE DURATION (IN μsec)	DURATION TOLERANCE	RISE TIME MIN/MAX (IN μsec)	DECAY TIME MIN/MAX (IN μsec)
P1, P2, P3, P5	0.8	±0.1	0.05/0.1	0.05/0.2
P4 (SHORT)	0.8	±0.1	0.05/0.1	0.05/0.2
P4 (LONG)	1.6	±0.1	0.05/0.1	0.05/0.2

TABLE B (PULSE PATTERNS)
THE PULSE PATTERNS OF THE PAM INTERROGATIONS ARE DEFINED BELOW:

INTERROGATION TYPE	SPACING (IN μsec)			
	P1-P2	P1-P3	P3-P4	P4
ATCRBS MODE A	2 ±0.15	8 ±0.2	-	NONE
ATCRBS MODE C	2 ±0.15	21 ±0.2	-	NONE
ATCRBS MODE A/MODE S ALL-CALL	2 ±0.15	8 ±0.2	2 ±0.05	LONG
ATCRBS MODE C/MODE S ALL-CALL	2 ±0.15	21 ±0.2	2 ±0.05	LONG
ATCRBS MODE A-ONLY ALL-CALL	2 ±0.15	8 ±0.2	2 ±0.05	SHORT
ATCRBS MODE C-ONLY ALL-CALL	2 ±0.15	21 ±0.2	2 ±0.05	SHORT

ACS Test Function Timing Diagram
Figure 28

E. ACL Test Function

NOTE: S-1403 controls are identified by alhabetic character identifiers wheras all ATC-1400A controls are identified by numeric character identifiers.

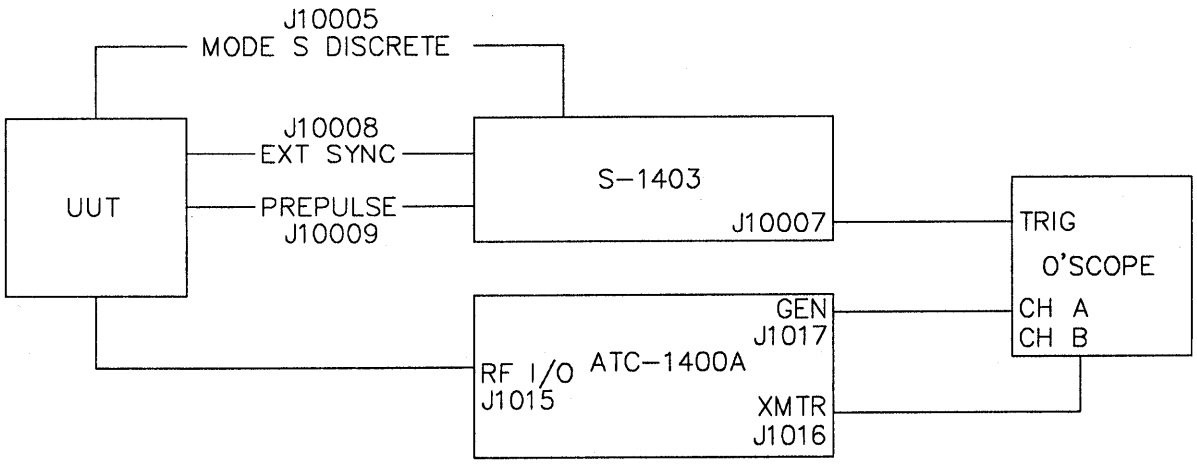
NOTE: The following four items highlight ACL Test Function anomalies. Review these items and Appendix F prior to utilizing this test function.

The PRF rate (set by PRF/SQTR Thumbwheels [41]) is limited to 1500 ATCRBS interrogations with replies occurring (rate error message occurs) and 800 without replies (P4 disabled, no error message indicated). In normal mode (P4 in CAL and Mode S reply), the PRF rate is limited to 200.

Scope Trigger (J10007) occurs 3.0 microseconds early with an ATCRBS reply (P4 disabled) when TO/TAC/TD Switch (30) is TD.

Reply delay is measured from the leading edge of the P4 pulse when the P4 field is set to CAL or VAR. When P4 field is OFF, the measurement is made from the leading edge of the P3 pulse.

SLS/ECHO ON/OFF Switch (18) overrides P3 and P4 variable control and controls the SLS pulse instead.



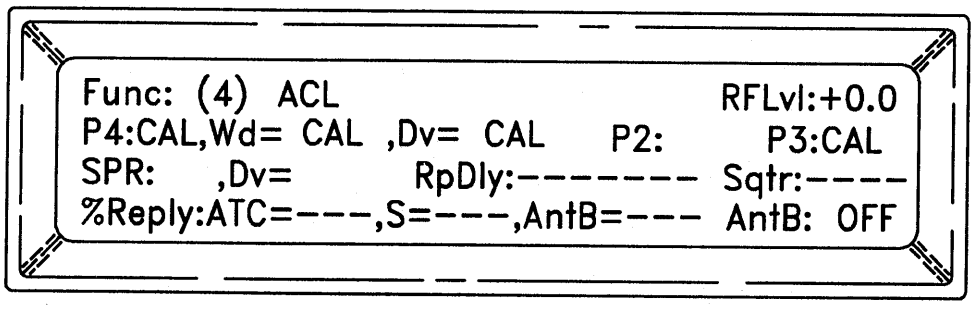
ACL Test Function Hook-Up Diagram
Figure 29

(1) Description ACL Test Function.

ACL (All Call Long) function transmits only All Call Long interrogations. ACL allows both Mode S and ATCRBS replies.

The Mode S only All-Call (ACL) is used by interrogators when Mode S aircraft are to be acquired without eliciting replies from ATCRBS only aircraft. The transponders address for this interrogation is all ones. The UUT will reply to this interrogation with its discrete address (ADD= field).

(2) Control Menu #1 Display Definition



ACL Test Function Control Menu #1
Figure 30

(a) Func: (4) ACL

Modes are selected by XPDR MODE Control (38). PRF/SQTR Thumbwheels (41) and PRF/SQTR ON/OFF Switch (32) control the PRF rate for the interrogations.

(b) RFLvl:

Adjustments for RF Levels in 0.1 dB steps (within a range of ±3.0 dB). RF adjustments are in addition to the level shown in RF LEVEL -dBm Display (3). Adjustments of 1 dB or greater should be accomplished utilizing SLEW Control (6).

(c) P4:

Select "CAL", "OFF" or "VAR" for P_4 control. CAL resets the level to 0.0 dB. SLS/ECHO ON/OFF Switch (18) in the OFF position allows variable amplitude selection.

NOTE: In the ON position, SLS/ECHO ON/OFF Switch (18) overrides P_3 and P_4 variable control controlling SLS pulse instead.

(d) P4:Wd=

Pulse width variable control selections. Select CAL/(Value) with the ON/CAL key. CAL (±0.0) = 1.6 µs. Variable range is from +1.95 µs to -1.4 µs in 0.05 µs steps relative to CAL value.

(e) P4:Dv=

Pulse deviation control selection. Select CAL/(Value) with the ON/CAL key. CAL (±0.0) = 8.0 µs for ATCRBS Mode A, and 21.0 µs for ATCRBS Mode C. Variable control to ±1.95 µs relative to CAL in 0.050 µs steps.

(f) P3:

Mode S All Call P_3 pulse level control selections are: "CAL", "OFF" or "VAR". CAL resets the level to 0.0 dB. SLS/ECHO Thumbwheels (50) controls the VAR level when the SLS/ECHO ON/OFF Switch (18) is OFF (i.e., P_2 is disabled). XPDR P_2/P_3 DEV Thumbwheels (44) and XPDR DEV P_3/CAL Switch (25) control the P_3 pulse deviation. XPDR PULSE WIDTH Thumbwheels (49) and XPDR PULSE WIDTH VAR/CAL Switch (20) control pulsewidth. SLS overrides P_3 variable control.

(g) SPR:

Not active in ACL Test Function

(h) SPR:Dv=

Not active in ACL Test Function

(i) RpDly:

Displays measured reply delay for Mode S interrogations with 25 ns resolution and 50 ns accuracy.

(j) Sqtr:

Displays squitter period (transmission interval of a DF=11 downlink format) from 0.0 to 9.99 sec with 10 ms resolution.

(k) %Reply:ATC=

Displays percent of ATCRBS replies only, from 0 to 127% in 1% steps.

(l) %Reply:S=

Displays percent of Mode S replies only, from 0 to 127% in 1% steps.

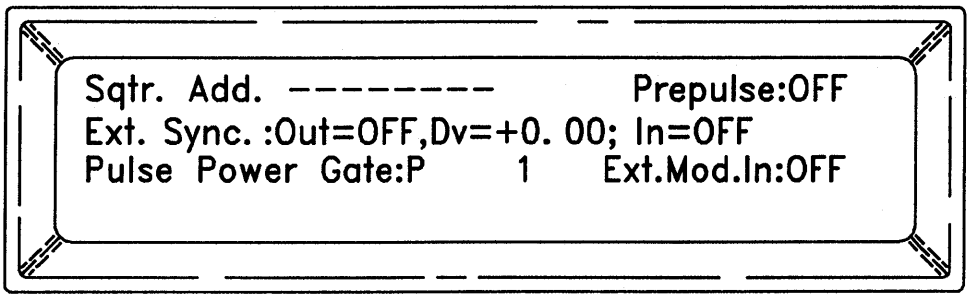
(m) %Reply:AntB=

Displays percent of replies received from the ANT B Connector (E), from 0 to 127% in 1% steps.

(n) AntB:OFF/(delay value)

Enables or disables Channel B, the diversity generator. When enabled, a value from -0.95 µs to +0.95 µs can be selected as the delay from Channel B in 0.05 µs steps.

(3) Control Menu #2 Display Definition



ACL Test Function Control Menu #2
Figure 31

(a) Sqtr. Add.

24-bit octal value decoded from an unsolicited reply (squitter) on Channel A. This value is the Mode S transponder's address and is transmitted via downlink format 11.

(b) Prepulse:

Prepulse (0 to 260)/OFF control. The prepulse spacing is set on the front panel. The pulse can be positioned from 0 to 260 µs prior to the rising edge of P_1 of the interrogation in 1 µs steps.

(c) Ext.Sync.:Out=

ON/OFF control for the external sync output function.

(d) Ext.Sync.:Dv=

Deviation control for external sync output, ranging from -9.95 µs to +9.95 µs in 50 ns steps.

(e) Ext.Sync.:In=

ON/OFF control for external sync input (positive TTL signal). Overrides EXT SYNC OUT.

(f) Pulse Power Gate:

Pulse power measurement gate tracks on reply delay and is selectable from P_1 to P_{116} (by input of a number from 1 to 116 or selected via SLEW Control [F]). The reply delay is used to determine the location to measure the PPMG pulse. This allows correct positioning regardless of the P_4 pulse.

For all reply pulses, the measurement gate must be enabled prior to the rising edge of the pulse to be measured. The measurement will continue until the next falling edge of the reply. In the case of Mode S replies, since they are in PPM format, care should be taken to ensure the data pulses prior to and following the pulse to be measured are in such a state that their power levels will not be measured as well. For example: to measure P_6 power; If P_6 is a "0", then P_5's state doesn't matter and P_7 should be a "0". If P_6 is a "1", then P_5 should be a "1" and P_7's state doesn't matter. If P_5 were "0" and P_6 a "1", no rising edge would be detected and therefore the power reading would be zero.

For the S-1403 to control pulse power measurement requires F_2/P_2-F_1/P_1 Switch (34) be in the F_2/P_2 position. The F_1/P_1 position will measure the pulse power of an ATCRBS F_1 reply pulse only. The power measurement is performed in the ATC-1400A and displayed on XMTR PWR WATTS Display (1).

(g) Ext.Mod.In:

ON : Disables the internal pulse generator.
OFF : Allows simultaneous internal/external modulation.

(4) Sequence Menu (Uplink/Downlink Format) Description

ACL Test Function does not utilize sequence menus.

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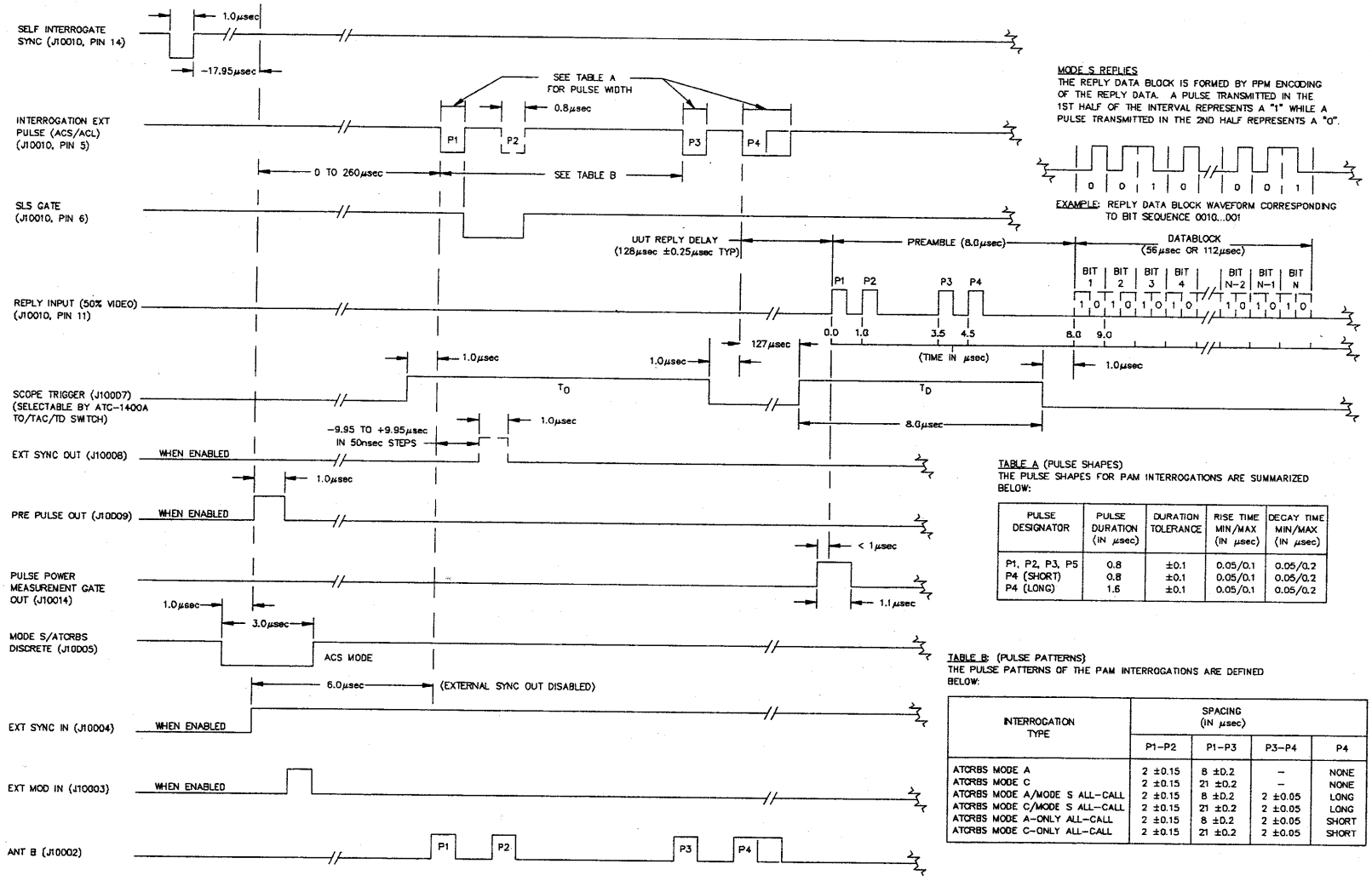


MODE S REPLIES
THE REPLY DATA BLOCK IS FORMED BY PPM ENCODING OF THE REPLY DATA. A PULSE TRANSMITTED IN THE 1ST HALF OF THE INTERVAL REPRESENTS A "1" WHILE A PULSE TRANSMITTED IN THE 2ND HALF REPRESENTS A "0".

EXAMPLE: REPLY DATA BLOCK WAVEFORM CORRESPONDING TO BIT SEQUENCE 0010...001

TABLE A (PULSE SHAPES)
THE PULSE SHAPES FOR PAM INTERROGATIONS ARE SUMMARIZED BELOW:

PULSE DESIGNATOR	PULSE DURATION (IN μsec)	DURATION TOLERANCE	RISE TIME MIN/MAX (IN μsec)	DECAY TIME MIN/MAX (IN μsec)
P1, P2, P3, P5	0.8	±0.1	0.05/0.1	0.05/0.2
P4 (SHORT)	0.8	±0.1	0.05/0.1	0.05/0.2
P4 (LONG)	1.6	±0.1	0.05/0.1	0.05/0.2

TABLE B: (PULSE PATTERNS)
THE PULSE PATTERNS OF THE PAM INTERROGATIONS ARE DEFINED BELOW:

INTERROGATION TYPE	SPACING (IN μsec)			
	P1-P2	P1-P3	P3-P4	P4
ATCRBS MODE A	2 ±0.15	8 ±0.2	–	NONE
ATCRBS MODE C	2 ±0.15	21 ±0.2	–	NONE
ATCRBS MODE A/MODE S ALL-CALL	2 ±0.15	8 ±0.2	2 ±0.05	LONG
ATCRBS MODE C/MODE S ALL-CALL	2 ±0.15	21 ±0.2	2 ±0.05	LONG
ATCRBS MODE A-ONLY ALL-CALL	2 ±0.15	8 ±0.2	2 ±0.05	SHORT
ATCRBS MODE C-ONLY ALL-CALL	2 ±0.15	21 ±0.2	2 ±0.05	SHORT

ACL Test Function Timing Diagram
Figure 32

F. INTLCE Test Function

NOTE: S-1403 controls are identified by alphabetic character identifiers whereas all ATC-1400A controls are identified by numeric character identifiers.

NOTE: The following five items highlight INTLCE Test Function anomalies. Review these items and Appendix F prior to utilizing this test function.

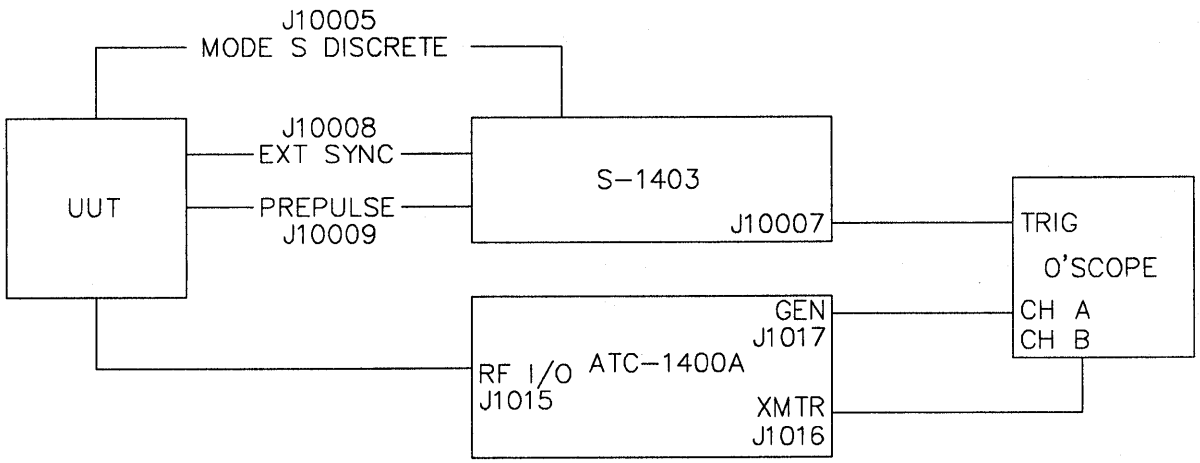
The PRF rate (set by PRF/SQTR Thumbwheels [41]) is limited to 500 for a ratio of 1:3 or less, 400 for a ratio of 1:2, and 200 for a ratio of 1:1. The RATE ERROR message displays for the last two conditions only.

Reliable downlink information is displayed in Sequence Menus when the Interlace Ratio is 1:1. For all other ratios, downlink information appears randomly.

AP ERROR conditions will not be checked in this function.

Variable pulse controls are valid for the first (ATCRBS) interrogation only.

SLS/ECHO Thumbwheels (50) select amplitude of echo replies, P2 side-lobe suppression pulses and interference pulses.



INTLCE Test Function Hook-Up Diagram
Figure 33

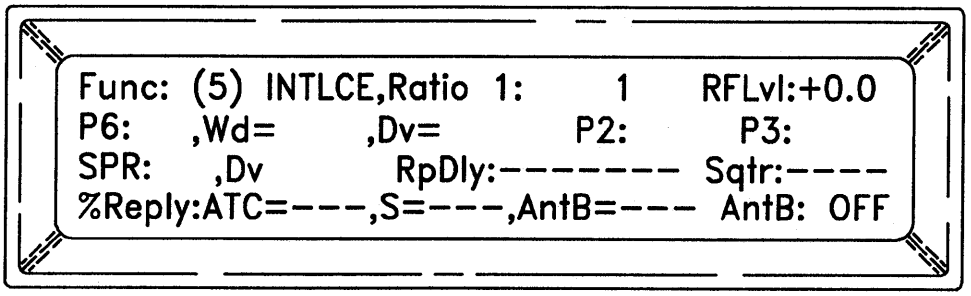
(1) Description of INTLCE Test Function.

Interlace function is used to add Mode S (SEQ) interrogations as a ratio of ATCRBS interrogations. Values can be set from 1 to 999. PRF/SQTR Thumbwheels (41) and PRF/SQTR ON/OFF Switch (32) control the PRF rate for interrogations. When the ratio is greater than 1:1 no sequence data is displayed in enabled sequence menus.

There is a 400 µs fixed delay from P_1 of the ATCRBS to P_1 of the Mode S. Variable pulse controls are valid for the first interrogation only.

NOTE: Only the first four enabled sequence items are used. Any additional enabled sequence items are not used.

(2) Control Menu #1 Display Description



INTLCE Test Function Control Menu #1
Figure 34

(a) Func: (5) INTLCE,Ratio 1:

Selects the ratio of ATCRBS to Mode S interrogations. Ratio is set at 1 ATCRBS interrogation to (value selected) Mode S interrogations. Number of ATCRBS is shown after "Ratio 1:" field.

(b) RFLvl:

Adjustments for RF Levels in 0.1 dB steps (within a range of ±3.0 dB). RF adjustments are in addition to the level shown in RF LEVEL -dBm Display (3). Adjustments of 1 dB or greater should be accomplished utilizing SLEW Control (6).

(c) P6:

Not active in DI Test Function

(d) P6:Wd=

Not active in DI Test Function

(e) P6:Dv=

Not active in DI Test Function

(f) P2:

Not active in DI Test Function

(g) P3:

Not active in DI Test Function

(h) SPR:

Not active in DI Test Function

(i) SPR:Dv:

Not active in DI Test Function

(j) RpDly:

Displays measured reply delay for ATCRBS interrogations with 25 ns resolution and 50 ns accuracy. Displays Mode S replies when no ATCRBS reply is sent.

(k) Sqtr:

Displays squitter period (transmission interval of a DF=11 downlink format) from 0.0 to 9.99 sec with 10 ms resolution.

(l) %Reply:ATC=

Displays percent of ATCRBS replies only, from 0 to 127% in 1% steps. Does not display Mode S %Replies.

(m) %Reply:S=

Displays percent of Mode S replies from 0 to 127% in 1% steps.

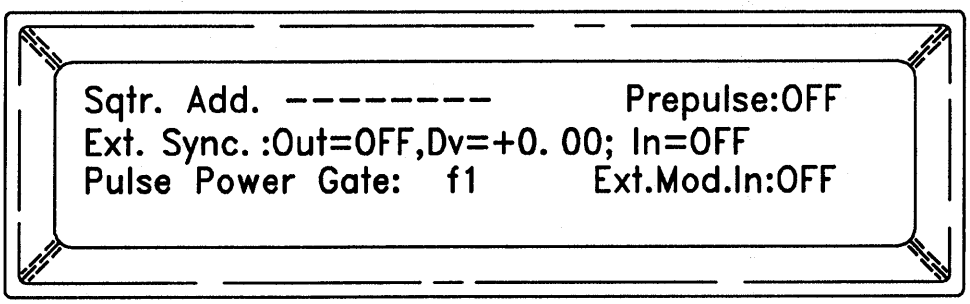
(n) %Reply:AntB=

Displays percent of replies received from the ANT B connector, from 0 to 127% in 1% steps.

(o) AntB:

OFF/(value). Enables or disables Channel B, the diversity generator. When enabled, a value from -0.95 µs to +0.95 µs can be selected as the delay from Channel A to Channel B in 0.05 µs steps.

(3) Control Menu #2 Display Definition



INTLCE Test Function Control Menu #2
Figure 35

(a) Sqtr. Add.:

24-bit octal value decoded from an unsolicited reply (squitter) on Channel A. This value is the Mode S Transponder address and is transmitted via Downlink Format.

(b) Prepulse:

(0 to 260)/OFF control. The pulse can be positioned from 0 to 260 µs prior to the rising edge of P_1 of the interrogation in 1 µs steps.

(c) Ext.Sync.:Out=

ON/OFF control for the external sync output function.

(d) Ext.Sync.:Dv=

Deviation control for external sync, ranging from -9.95 µs to +9.95 µs in 50 ns steps.

(e) Ext.Sync.:In=

ON/OFF control for external sync input control (positive TTL signal).

(f) Pulse Power Gate:

Pulse power measurement gate tracks on reply delay and is selectable from P_1 to P_{116} (by input of a number from 1 to 116 or selected via SLEW Control [F]) and is not available for measuring the second reply.

For all reply pulses, the measurement gate must be enabled prior to the rising edge of the pulse to be measured. The measurement will continue until the falling edge of the reply. For the S-1403 to control pulse power measurement requires F_2/P_2-F_1/P_1 Switch (34) be in the F_2/P_2 position. The F_1/P_1 position will measure the pulse power of an ATCRBS F_1 reply pulse only.

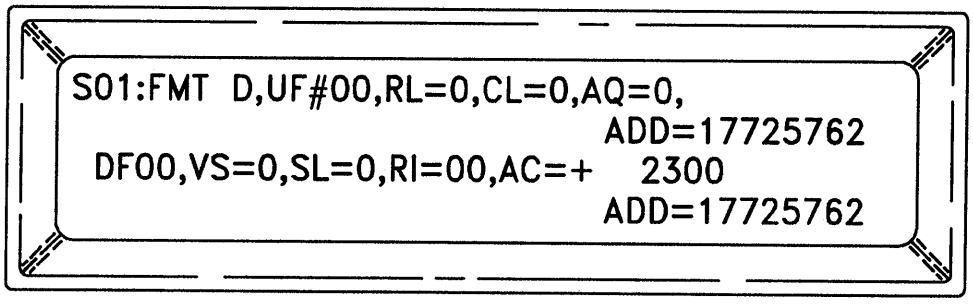
The power measurement is performed in the ATC-1400A and displayed on XMTR PWR WATTS Display (1).

(g) Ext.Mod.In:

ON : Disables the internal pulse generator.
OFF : Allows simultaneous internal/external modulation.

(4) Sequence Menu (Uplink/Downlink) Description

(a) Sequence Menu S01 - Uplink/Downlink Format 00 (Short Special Surveillance)

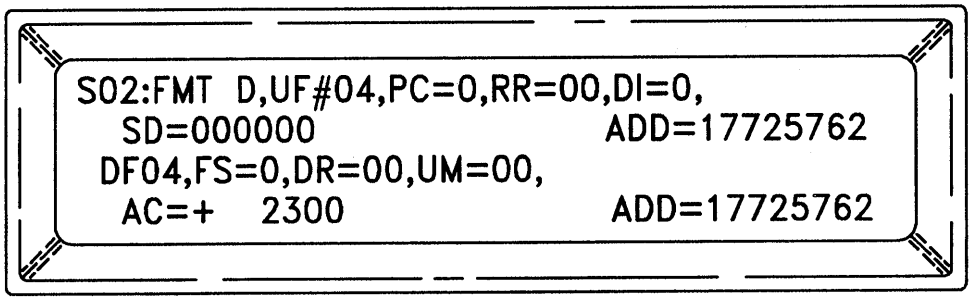


Sequence Menu S01
Figure 36

The Mode S Test System queries the UUT designating the expected response definition (DF00 or DF16) in field RL. When RL field is set to 0, the response will be DF00 (short format reply) as shown in figure 33. RL field equal to 1 declares DF16 (extended or long reply format) as the proper reply. Field CL is reserved for TCAS capable UUT's. When CL is zero, the default condition, TCAS has not generated a resolution advisory. A resolution advisory has been generated when CL is set to 1. AQ field is the command field for both UF00 and UF16. When AQ field is equal to zero (default condition for sequence menu S01), UF00 is the interrogation format. AQ field equal to 1 will direct UF16 to be the interrogation format.

Replies to the UUT, displayed as either DF00 or DF16, are determined by the value in field RL. Field VS determines the flight status of the UUT. Field AC represents the altitude related to the value in field VS. When VS is set to 1, representing an inflight condition, the value in AC symbolizes a flight altitude. VS field equal to 0 represents an on-ground condition and field VS symbolizes the airfield elevation. SL field reports TCAS sensitivity of the UUT to the interrogator (default is 0). Field RI is utilized to relay airspeed information to the interrogator. Codes 0 through 7 indicate an air-to-air non-acquisition reply. Codes 8 through 15 and an explanation of field SL are explained in Appendix E.

(b) Sequence Menu S02 - Uplink/Downlink Format 04 (Surveillance and Altitude Request)

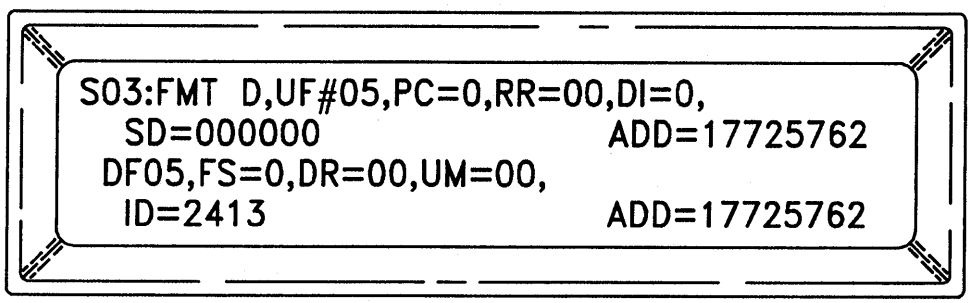


Sequence Menu S02
Figure 37

Sequence Menu 02 PC= field mandates operating instructions to the UUT. Choices of selection in field PC= are non-selective All-Call lockout (1), cancel Comm-B (4), cancel Comm-C (5) or cancel Comm-D (6). Field RR instructs the UUT to reply in either short (codes 0 through 15) or long (codes 16 through 31) format. RR values of 16 through 31 will reply utilizing DF21. Field DI instructs the UUT to receive information contained in field SD. DI equal to 0 instructs the UUT to ignore all SD field data. When DI is set to 1, SD field is for multisite use. Setting DI to 7 will instruct the UUT to reply in extended field format (refer to Appendix E). Values of 2 through 6 are not defined.

Field FS reports flight status and alerts conditions (refer to Appendix E) to the interrogator. Field DR notifies the interrogator of the UUT's intent to transmit a message. A value of 0 represents no activity. When DR is equal to 1, the message will be Comm-B format. DR field values of 16 through 31 represent a Comm-D protocol message. Values of 2 through 15 are not defined. Field UM contains the transponder's status (refer to Appendix E) when DI is 1 and SD is XXXXAX (X represents any value, A represents any non-zero value). The status contains the identity of the interrogator and the Comm format for further communications. Field AC displays altitude in feet, unless the UUT is coded to reply in meters.

(c) Sequence Menu S03 - Uplink/Downlink Format 05 (Aircraft Identification Request)

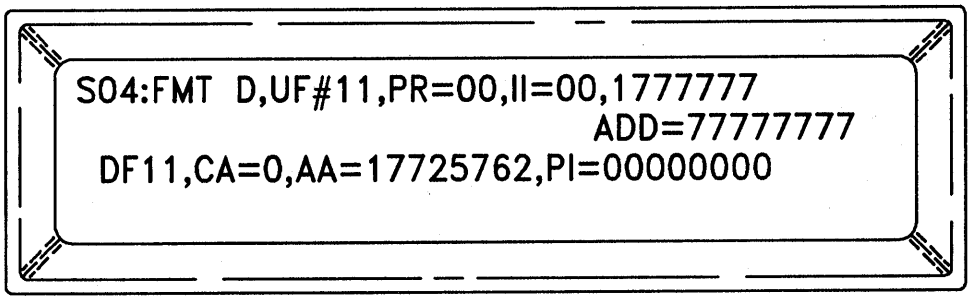


Sequence Menu S03
Figure 38

Sequence Menu 03 PC= field mandates operating instructions to the UUT. Choices of selection in field PC= are non-selective All-Call lockout (1), cancel Comm-B (4), cancel Comm-C (5) or cancel Comm-D (6). Field RR= instructs the UUT to reply in either short (codes 0 through 15) or long (codes 16 through 31) format. RR= 16 through 31 will reply in DF21. Field DI instructs the UUT to receive information contained in field SD. DI equal to 0 instructs the UUT to ignore all SD field data. When DI is set to 1, SD field is for multisite use. Setting DI to 7 will instruct the UUT to reply in extended field format (refer to Appendix E). Values of 2 through 6 are not defined.

Field FS reports flight status and alerts conditions (refer to Appendix E) to the interrogator. Field DR notifies the interrogator of the UUT's intent to transmit a message. A value of 0 represents no activity. When DR is equal to 1, the message will be Comm-B format. DR field values of 16 through 31 represent a Comm-D protocol message. Values of 2 through 15 are not defined. Field UM contains the transponder's status (refer to Appendix E) when DI is 1 and SD is XXXXAX (X represents any value, A represents any non-zero value). The status contains the identity of the interrogator and the Comm format for further communications. Field ID contains the 4096 identification code set on the UUT.

(d) Sequence Menu S04 - Uplink/Downlink Format 11 (Mode S Only All-Call)

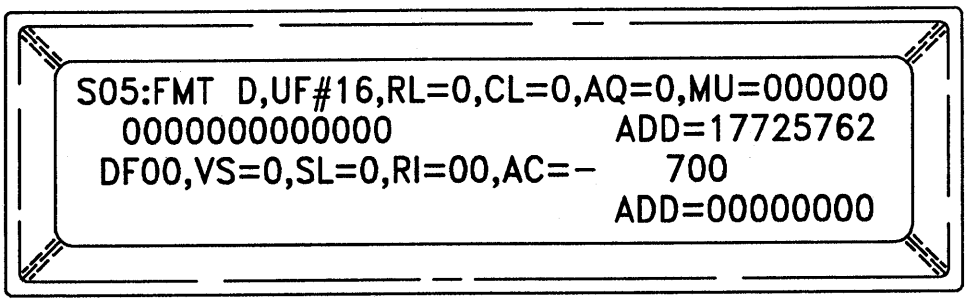


Sequence Menu S04
Figure 39

Sequence Menu S04 PR field specifies the reply probability for replies from the UUT. This reply probability is used to separate replies in a saturated ATC environment. When PR field equals 0 or 8, the UUT replies normally. When PR is 5, 6, 7, 13, 14 or 15, the UUT is instructed to not reply. Other PR field codes are contained in Appendix E. Field II identifies the interrogator for future All-Call lockouts. The seven digits after field II= is a constant value of 1777777.

Field CA notifies the interrogator of the UUT's capability to reply. When CA is 0, the UUT is unable to reply in extended formats (DF16 through 24). When CA is 1, the UUT can reply in Comm-A, Comm-B and extended formats. When CA is 2, the UUT can reply in Comm-A, Comm-B, Comm-C and extended formats. When CA is 3, the UUT can reply utilizing any Mode S format. Field AA contains the UUT address. This field should be equal to the uplink ADD field. PI= field contains the parity code overlaid on the interrogator's identity code.

(e) Sequence Menu S05 - Uplink/Downlink Format 16 (Long Special Surveillance)

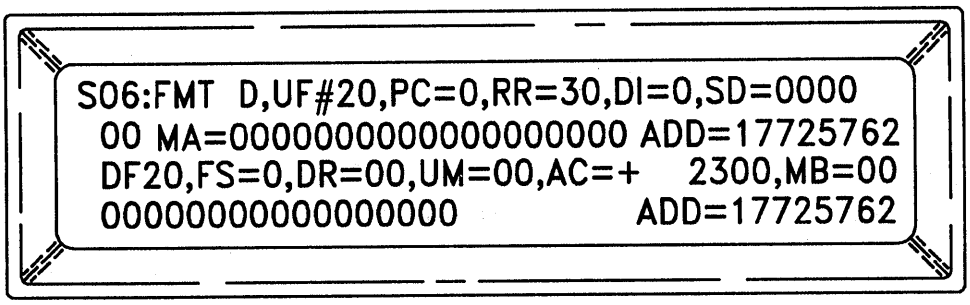


Sequence Menu S05
Figure 40

The Mode S Test System queries the UUT designating the expected response definition (DF00 or DF16) in field RL. When RL field is set to 0, the response will be DF00 (short format reply) as shown in 1-2-4, Figure 36. RL field equal to 1 declares DF16 (extended or long reply format) as the proper reply. Field CL is reserved for TCAS capable UUT's. When CL is zero, the default condition, TCAS has not generated a resolution advisory. A resolution advisory has been generated when CL is set to 1. AQ field is the command field for both UF00 and UF16. When AQ field is equal to zero, UF00 is the interrogation format. AQ field equal to 1 (default condition for sequence menu S05) will direct UF16 to be the interrogation format. This sequence menu is dedicated for long (112 bit) responses for air-to-air requests. In responding to UF16, the UUT will reply with altitude and response format information. Further communications will be through either unspecified long Downlink formats (22 or 23) or Downlink format 24. UF16 will not follow Comm-B formats. Field MU contains information used in air-to-air exchanges.

Replies to the UUT, displayed as either DF00 or DF16, are determined by the value in field RL. Field VS determines the flight status of the UUT. Field AC represents the altitude related to the value in field VS. When VS is set to 1, representing an in-flight condition, the value in AC symbolizes a flight altitude. VS field equal to 0 represents an on-ground condition and field VS symbolizes the airfield elevation. SL field reports TCAS sensitivity of the UUT to the interrogator (default is 0). Field RI is utilized to relay airspeed information to the interrogator. Codes 0 through 7 indicate an air-to-air non-acquisition reply. Codes 8 through 15 and an explanation of field SL are explained in Appendix E. Field MV contains information utilized in air-to-air exchanges and does not follow Comm-B format.

(f) Sequence Menu S06 - Uplink/Downlink Format 20 (Comm-A Altitude Request)

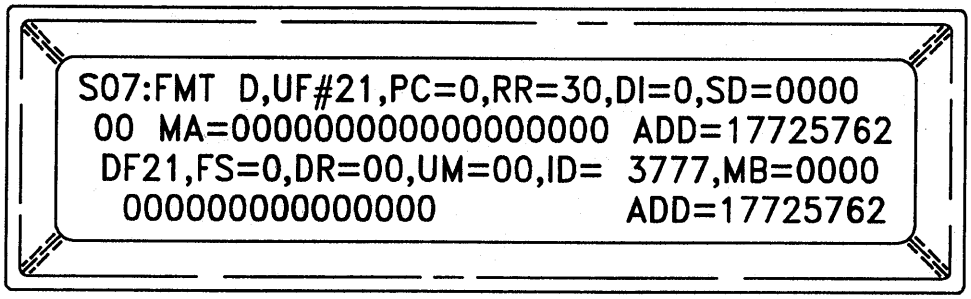


Sequence Menu S06
Figure 41

Sequence Menu 06 PC field mandates operating instructions to the UUT. Choices of selection in field PC are non-selective All-Call lockout (1), cancel Comm-B (4), cancel Comm-C (5) or cancel Comm-D (6). Field RR= instructs the UUT to reply in either short (codes 0 through 15) or long (codes 16 through 31) format. RR= 16 through 31 will reply in DF21. Field DI instructs the UUT to receive information contained in field SD. DI equal to 0 instructs the UUT to ignore all SD field data. When DI is set to 1, SD field is for multisite use. Setting DI to 7 will instruct the UUT to reply in extended field format (refer to Appendix E). Values of 2 through 6 are not defined. Field MA contains messages to the UUT and uses Comm-A format.

Field FS reports flight status and alerts conditions (refer to Appendix E) to the interrogator. Field DR notifies the interrogator of the UUT's intent to transmit a message. A value of 0 represents no activity. When DR is equal to 1, the message will be Comm-B format. DR field values of 16 through 31 represent a Comm-D protocol message. Values of 2 through 15 are not defined. Field UM contains the transponder's status (refer to Appendix E) when DI is 1 and SD is XXXXAX (X represents any value, A represents any non-zero value). The status contains the identity of the interrogator and the Comm format for further communications. Field AC displays altitude in feet, unless the UUT is coded to reply in meters. Field MB contains messages to the interrogator and uses Comm-B format.

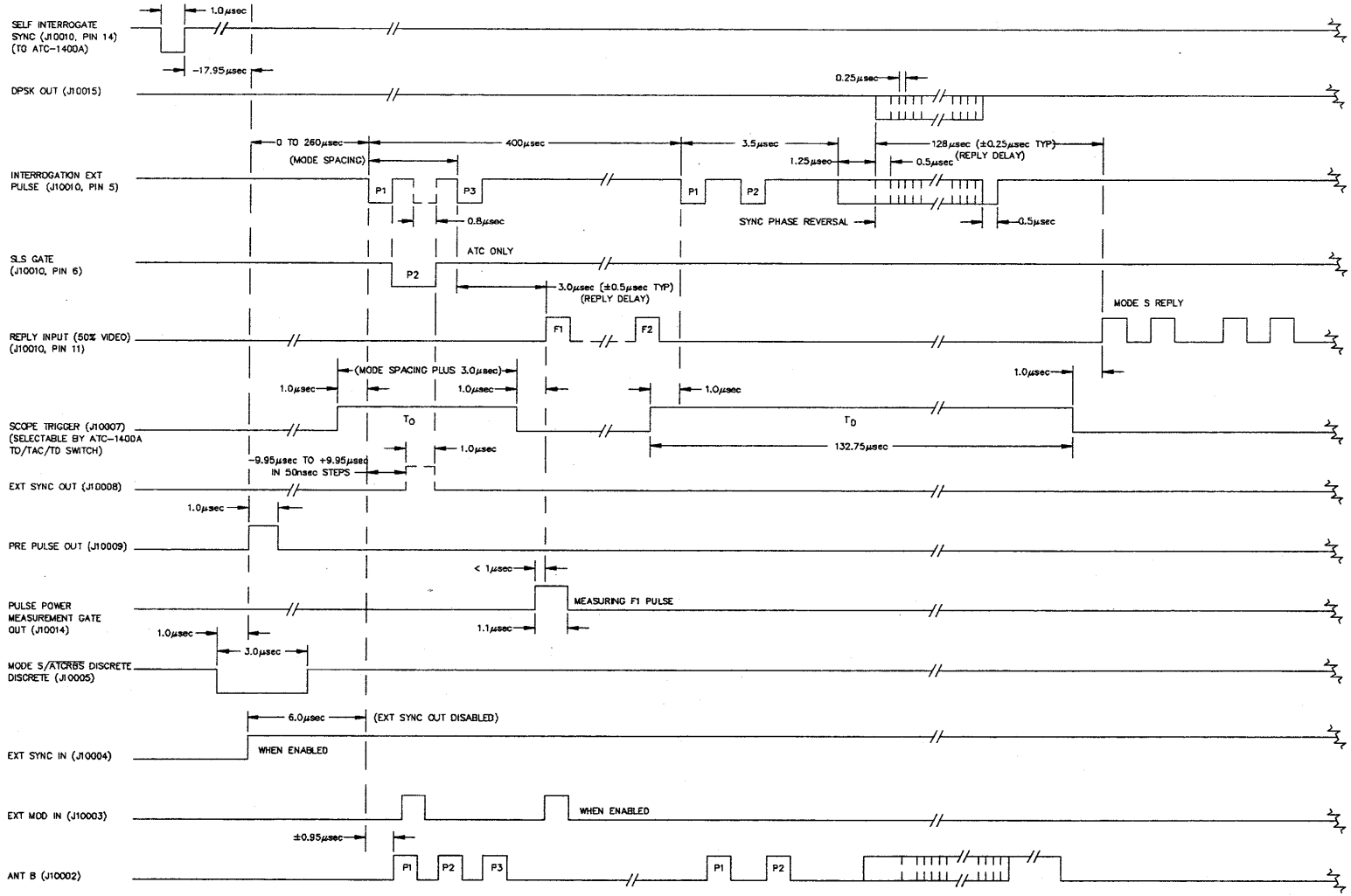
(g) Sequence Menu S07 - Uplink/Downlink Format 21 (Comm-A Identity Request)



Sequence Menu S07
Figure 42

Sequence menu S07 PC= field mandates operating instructions to the UUT. Choices of selection in field PC= are non-selective All-Call lockout (1), cancel Comm-B (4), cancel Comm-C (5) or cancel Comm-D (6). Field RR instructs the UUT to reply in either short (codes 0 through 15) or long (codes 16 through 31) format. RR 16 through 31 will reply in DF21. Field DI instructs the UUT to receive information contained in field SD. DI equal to 0 instructs the UUT to ignore all SD field data. When DI is set to 1, SD field is for multisite use. Setting DI to 7 will instruct the UUT to reply in extended field format (refer to Appendix E). Values of 2 through 6 are not defined. Field MA contains messages from the interrogator to the UUT.

Field FS reports flight status and alerts conditions (refer to Appendix E) to the interrogator. Field DR notifies the interrogator of the UUT's intent to transmit a message. A value of 0 represents no activity. When DR is equal to 1, the message will be Comm-B format. DR field values of 16 through 31 represent a Comm-D protocol message. Values of 2 through 15 are not defined. Field UM contains the transponder's status (refer to Appendix E) when DI is 1 and SD is XXXXAX (X represents any value, A represents any non-zero value). The status contains the identity of the interrogator and the Comm format for further communications. ID contains the 4096 code selected on the front of the UUT. Field MB contains messages to the interrogator and uses Comm-B format.



INTLCE Test Function Timing Diagram
Figure 43

G. DI Test Function

NOTE: S-1403 controls are identified by alphabetic character identifiers whereas all ATC-1400A controls are identified by numeric character identifiers.

NOTE: The following eight items highlight DI Test Function anomalies. Review these items and Appendix F prior to utilizing this test function.

The PRF rate set by PRF/SQTR Thumbwheel (41) is limited to 750 with replies (RATE ERROR message occurs) occurring for the ATC;ATC configuration and 500 without replies (no error message indicated). For all other configurations, the PRF limit is 100.

DBL INTERR/INTERF PULSE Thumbwheels (42) must be set DOUBLE.

XPDR MODE Control (38) is used to determine the mode used for both the first and second interrogations for ATC, ACS, and ACL functions.

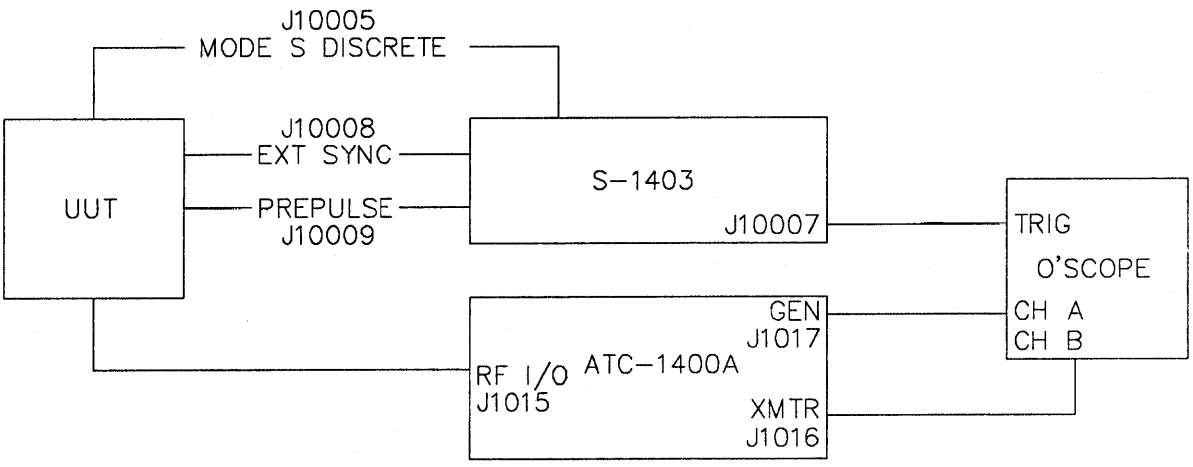
If no reply is detected for the first interrogation, the Reply Delay may not be accurate.

There is no Pulse Measurement capability for the reply to the second interrogation.

ATC-1400A % REPLY Display (46) is invalid.

If the second interrogation occurs before the first reply (DBL INTERR/ INTERF spacing is less than the expected reply delay), the reply delay will be invalid.

EXT SYNC (J10008) is not operational in this function.



DI Test Function Hook-Up Diagram
Figure 44

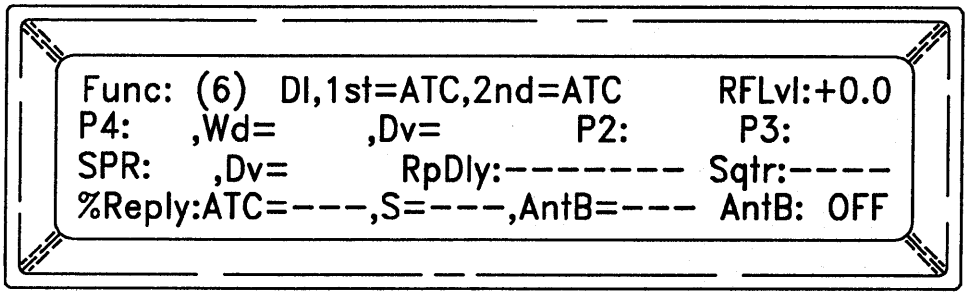
(1) Description of DI Test Function.

The Double Interrogation function allows the user to generate a dual interrogation consisting of any combination of ATCRBS or Mode S. More specifically, the selections for the first and second interrogations are: "ATC", "SEQ", "ACS", or "ACL". DBL INTERR/INTERF PULSE Thumbwheels (42) control the spacing between interrogations (refer to 1-2-2, Table 2). PRF/SQTR Thumbwheels (41) and PRF/SQTR ON/OFF Switch (32) control the PRF rate of the interrogations.

Double Interrogation (DI) requires DBL INTERR/INTERF PULSE Thumbwheels (42) set to DOUBLE. The S-1403 generates both the first and second interrogation and can generate any combination of Mode S, All Call or ATCRBS interrogations. Variable pulse control is valid for the first interrogation only.

NOTE: Replies and interrogations can be overlaid if delay between interrogations is too short.

(2) Control Menu #1 Display Definition



DI Test Function Control Menu #1
Figure 45

(a) Func:(6) DI,1st=, 2nd=

Interrogations are selected utilizing the two subfields within this field. 1st= field is selected utilizing XPDR MODE Control (38). 2nd= field is selected by placing the cursor in this field and rotating SLEW Control (F) until the requested mode is selected. The mode set by XPDR MODE Control (38) for the first interrogation will be the mode used to program the second function during ACS or ACL operations.

NOTE: Only the first four enabled sequence items will be used.

(b) RFLvl:

Adjustments for RF Levels in 0.1 dB steps (within a range of ±3.0 dB). RF adjustments are in addition to the level shown in RF LEVEL -dBm Display (3). Adjustments of 1 dB or greater should be accomplished utilizing SLEW Control (6).

(c) P4:

Not active in DI Test Function.

(d) P4:Wd=

Not active in DI Test Function.

(e) P4:Dv=

Not active in DI Test Function.

(f) P2:

Not active in DI Test Function.

(g) P3:

Not active in DI Test Function.

(h) SPR:

Not active in DI Test Function.

(i) SPR:,Dv=

Not active in DI Test Function.

(j) RpDly:

(Valid for first interrogation only.) Displays measured reply delay for ATCRBS interrogations (typically 3.0 µs) or Mode S interrogations (typically 128 µs) with 25 ns resolution and 50 ns accuracy.

(k) Sqtr:

Displays squitter period (transmission interval of a DF=11 downlink format) from 0.0 to 9.99 sec with 10 ms resolution.

(l) %Reply:ATC=

Displays percent of ATCRBS replies only, from 0 to 127 in 1% steps.

(m) %Reply:S=

Displays percent of valid Mode S replies only, from 0 to 127 in 1% steps.

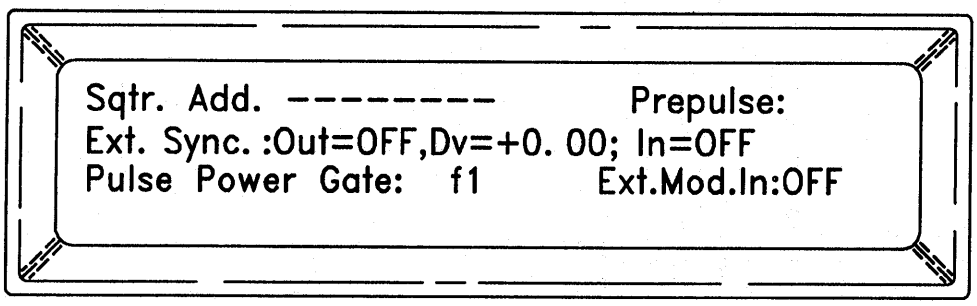
(n) %Reply:AntB=

Displays percent of replies received from the ANT B Connector, from 0 to 127 in 1% steps. ANT A input must be operational for ANT B to be operational.

(o) AntB:

OFF/(delay value). Enables or disables Channel B, the diversity generator. When enabled, a value from -0.95 µs to +0.95 µs can be selected as the delay from Channel A to Channel B in 0.05 µs steps.

(3) Control Menu #2 Display Definition



DI Test Function Control Menu #2
Figure 46

(a) Sqtr. Add.

24-bit octal value decoded from an unsolicited reply (squitter) on ANT A. This value is the Mode S Transponder's address and is transmitted via Downlink Format.

(b) Prepulse:

Not active in DI Test Function.

(c) Ext.Sync.:Out=

ON/OFF control for the external sync output function.

(d) Ext.Sync.:Dv=

Deviation control for external sync output, ranging from -9.95 µs to +9.95 µs in 50 ns steps.

(e) Ext.Sync.:In=

ON/OFF control for external sync input control (positive TTL signal).

(f) Pulse Power Gate:

Pulse power measurement gate tracks on the reply delay and is selectable from P_1 to P_{116} (by input of a number from 1 to 116 or selected via SLEW Control [F]) and is not available for the second pulse.

For all reply pulses, the measurement gate will be enabled prior to the rising edge of the pulse and continue measuring until falling edge. In the case of Mode S replies, since they are in PPM format, care should be taken to ensure the data pulses prior to and following the pulse to be measured are such that their power levels will not be measured as well. For example: to measure P_6 power; If P_6 is "0", then P_5 state doesn't matter and P_7 should be a "0". If P_6 is a "1", then P_5 should be a "1" and P_7 state doesn't matter. If P_5 were "0" and P_6 a "1", no rising edge would be detected and therefore the power reading would be zero.

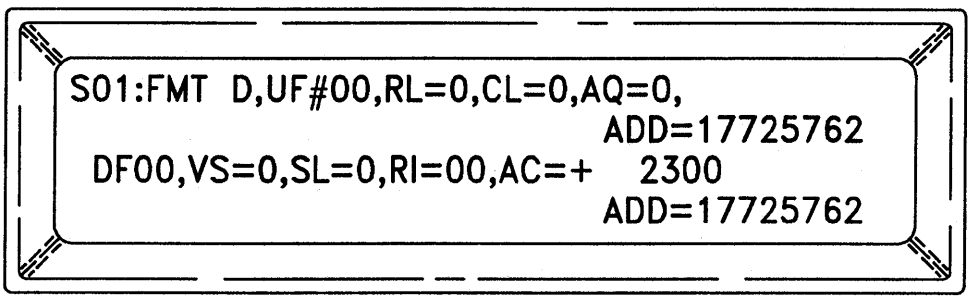
For the S-1403 to control pulse power measurement, F_2/P_2-F_1/P_1 Switch (34) must be in the F_2/P_2 position. The F_1/P_1 position measures the pulse power of an ATCRBS F_1 reply pulse only. The power measurement is performed in the ATC-1400A and displayed on XMTR PWR WATTS Display (1).

(g) Ext.Mod.In:

ON : Disables the internal pulse generator.
OFF : Allows simultaneous internal/external modulation.

(4) Sequence Menu (Uplink/Downlink) Description

(a) Sequence Menu S01 - Uplink/Downlink Format 00 (Short Special Surveillance)

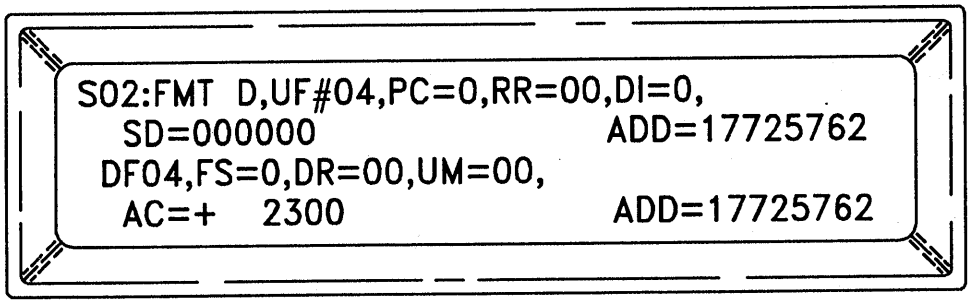


Sequence Menu S01
Figure 47

The Mode S Test System queries the UUT designating the expected response definition (DF00 or DF16) in field RL. When RL field is set to 0, the response will be DF00 (short format reply) as shown in Figure 44. RL field equal to 1 declares DF16 (extended or long reply format) as the proper reply. Field CL is reserved for TCAS capable UUT's. When CL is zero, the default condition, TCAS has not generated a resolution advisory. A resolution advisory has been generated when CL is set to 1. AQ field is the command field for both UF00 and UF16. When AQ field is equal to zero (default condition for sequence menu S01), UF00 is the interrogation format. AQ field equal to 1 will direct UF16 to be the interrogation format.

Replies to the UUT, displayed as either DF00 or DF16, are determined by the value in field RL. Field VS determines the flight status of the UUT. Field AC represents the altitude related to the value in field VS. When VS is set to 1, representing an in-flight condition, the value in AC symbolizes a flight altitude. VS field equal to 0 represents an on-ground condition and field VS symbolizes the airfield elevation. SL field reports TCAS sensitivity of the UUT to the interrogator (default is 0). Field RI is utilized to relay airspeed information to the interrogator. Codes 0 through 7 indicate an air-to-air non-acquisition reply. Codes 8 through 15 and an explanation of field SL are explained in Appendix E.

(b) Sequence Menu S02 - Uplink/Downlink Format 04 (Surveillance and Altitude Request)

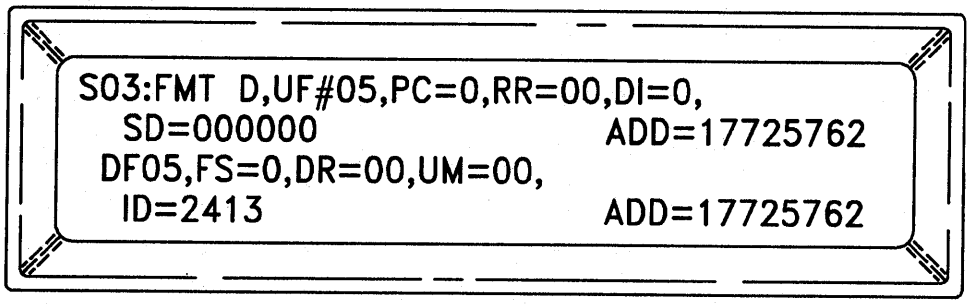


Sequence Menu S02
Figure 48

Sequence Menu 02 PC= field mandates operating instructions to the UUT. Choices of selection in field PC= are non-selective All-Call lockout (1), cancel Comm-B (4), cancel Comm-C (5) or cancel Comm-D (6). Field RR instructs the UUT to reply in either short (codes 0 through 15) or long (codes 16 through 31) format. RR values of 16 through 31 will reply utilizing DF21. Field DI instructs the UUT to receive information contained in field SD. DI equal to 0 instructs the UUT to ignore all SD field data. When DI is set to 1, SD field is for multisite use. Setting DI to 7 will instruct the UUT to reply in extended field format (refer to Appendix E). Values of 2 through 6 are not defined.

Field FS reports flight status and alerts conditions (refer to Appendix E) to the interrogator. Field DR notifies the interrogator of the UUT's intent to transmit a message. A value of 0 represents no activity. When DR is equal to 1, the message will be Comm-B format. DR field values of 16 through 31 represent a Comm-D protocol message. Values of 2 through 15 are not defined. Field UM contains the transponder's status (refer to Appendix E) when DI is 1 and SD is XXXXAX (X represents any value, A represents any non-zero value). The status contains the identity of the interrogator and the Comm format for further communications. Field AC displays altitude in feet, unless the UUT is coded to reply in meters.

(c) Sequence Menu S03 - Uplink/Downlink Format 05 (Aircraft Identification Request)

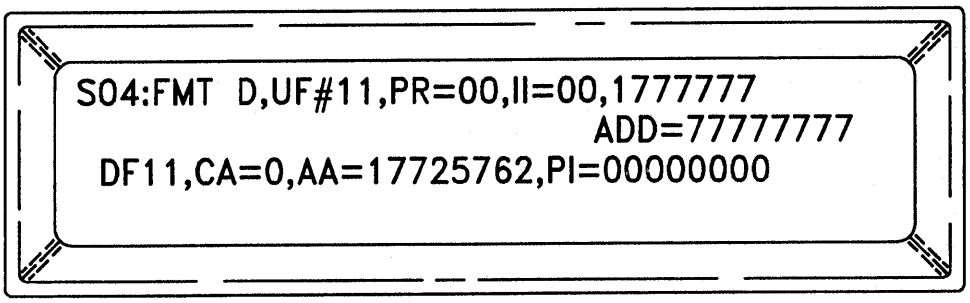


Sequence Menu S03
Figure 49

Sequence Menu 03 PC= field mandates operating instructions to the UUT. Choices of selection in field PC= are non-selective All-Call lockout (1), cancel Comm-B (4), cancel Comm-C (5) or cancel Comm-D (6). Field RR= instructs the UUT to reply in either short (codes 0 through 15) or long (codes 16 through 31) format. RR= 16 through 31 will reply in DF21. Field DI instructs the UUT to receive information contained in field SD. DI equal to 0 instructs the UUT to ignore all SD field data. When DI is set to 1, SD field is for multisite use. Setting DI to 7 will instruct the UUT to reply in extended field format (refer to Appendix E). Values of 2 through 6 are not defined.

Field FS reports flight status and alerts conditions (refer to Appendix E) to the interrogator. Field DR notifies the interrogator of the UUT's intent to transmit a message. A value of 0 represents no activity. When DR is equal to 1, the message will be Comm-B format. DR field values of 16 through 31 represent a Comm-D protocol message. Values of 2 through 15 are not defined. Field UM contains the transponder's status (refer to Appendix E) when DI is 1 and SD is XXXXAX (X represents any value, A represents any non-zero value). The status contains the identity of the interrogator and the Comm format for further communications. Field ID contains the 4096 identification code set on the UUT.

(d) Sequence Menu S04 - Uplink/Downlink Format 11 (Mode S Only All-Call)

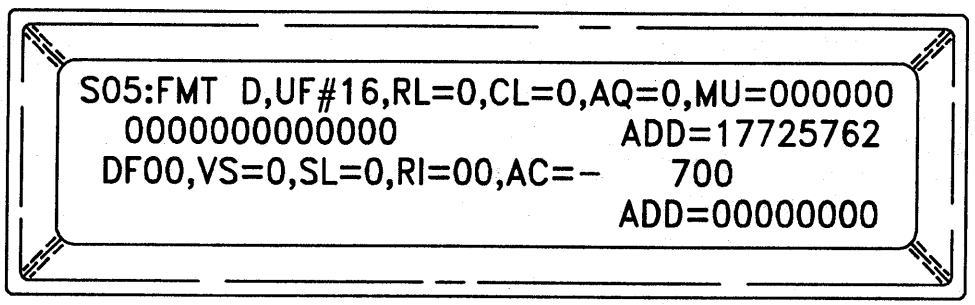


Sequence Menu S04
Figure 50

Sequence Menu S04 PR field specifies the reply probability for replies from the UUT. This reply probability is used to separate replies in a saturated ATC environment. When PR field equals 0 or 8, the UUT replies normally. When PR is 5, 6, 7, 13, 14 or 15, the UUT is instructed to not reply. Other PR field codes are contained in Appendix E. Field II identifies the interrogator for future All-Call lockouts. The seven digits after field II= is a constant value of 1777777.

Field CA notifies the interrogator of the UUT's capability to reply. When CA is 0, the UUT is unable to reply in extended formats (DF16 through 24). When CA is 1, the UUT can reply in Comm-A, Comm-B and extended formats. When CA is 2, the UUT can reply in Comm-A, Comm-B, Comm-C and extended formats. When CA is 3, the UUT can reply utilizing any Mode S format. Field AA contains the UUT address. This field should be equal to the uplink ADD field. PI= field contains the parity code overlaid on the interrogator's identity code.

(e) Sequence Menu S05 - Uplink/Downlink Format 16 (Long Special Surveillance)

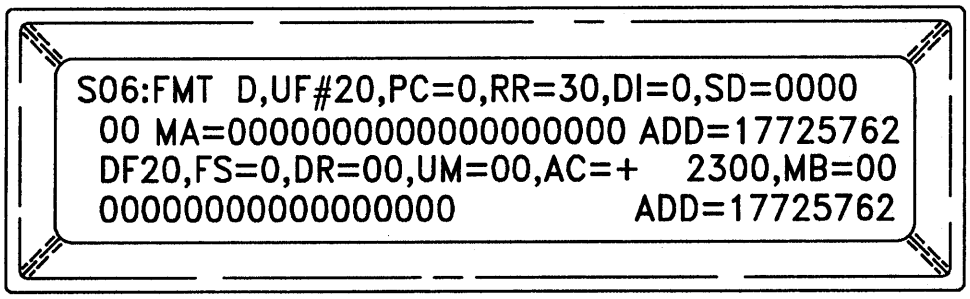


Sequence Menu S05
Figure 51

The Mode S Test System queries the UUT designating the expected response definition (DF00 or DF16) in field RL. When RL field is set to 0, the response will be DF00 (short format reply) as shown in 1-2-4, Figure 47. RL field equal to 1 declares DF16 (extended or long reply format) as the proper reply. Field CL is reserved for TCAS capable UUT's. When CL is zero, the default condition, TCAS has not generated a resolution advisory. A resolution advisory has been generated when CL is set to 1. AQ field is the command field for both UF00 and UF16. When AQ field is equal to zero, UF00 is the interrogation format. AQ field equal to 1 (default condition for sequence menu S05) will direct UF16 to be the interrogation format. This sequence menu is dedicated for long (112 bit) responses for air-to-air requests. In responding to UF16, the UUT will reply with altitude and response format information. Further communications will be through either unspecified long Downlink formats (22 or 23) or Downlink format 24. UF16 will not follow Comm-B formats. Field MU contains information used in air-to-air exchanges.

Replies to the UUT, displayed as either DF00 or DF16, are determined by the value in field RL. Field VS determines the flight status of the UUT. Field AC represents the altitude related to the value in field VS. When VS is set to 1, representing an in-flight condition, the value in AC symbolizes a flight altitude. VS field equal to 0 represents an on-ground condition and field VS symbolizes the airfield elevation. SL field reports TCAS sensitivity of the UUT to the interrogator (default is 0). Field RI is utilized to relay airspeed information to the interrogator. Codes 0 through 7 indicate an air-to-air non-acquisition reply. Codes 8 through 15 and an explanation of field SL are explained in Appendix E. Field MV contains information utilized in air-to-air exchanges and does not follow Comm-B format.

(f) Sequence Menu S06 - Uplink/Downlink Format 20 (Comm-A Altitude Request)

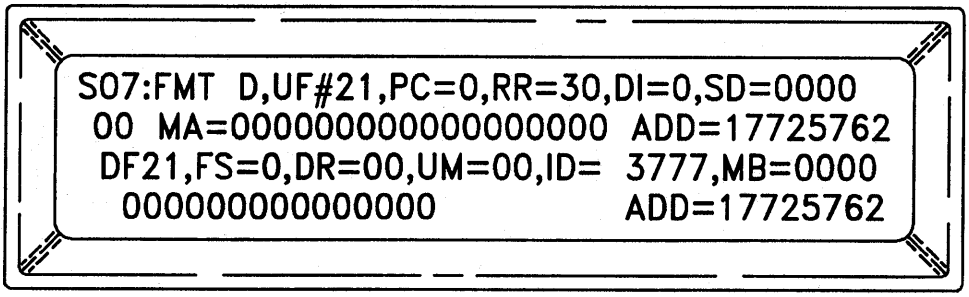


Sequence Menu S06
Figure 52

Sequence Menu 06 PC field mandates operating instructions to the UUT. Choices of selection in field PC are non-selective All-Call lockout (1), cancel Comm-B (4), cancel Comm-C (5) or cancel Comm-D (6). Field RR= instructs the UUT to reply in either short (codes 0 through 15) or long (codes 16 through 31) format. RR= 16 through 31 will reply in DF21. Field DI instructs the UUT to receive information contained in field SD. DI equal to 0 instructs the UUT to ignore all SD field data. When DI is set to 1, SD field is for multisite use. Setting DI to 7 will instruct the UUT to reply in extended field format (refer to Appendix E). Values of 2 through 6 are not defined. Field MA contains messages to the UUT and uses Comm-A format.

Field FS reports flight status and alerts conditions (refer to Appendix E) to the interrogator. Field DR notifies the interrogator of the UUT's intent to transmit a message. A value of 0 represents no activity. When DR is equal to 1, the message will be Comm-B format. DR field values of 16 through 31 represent a Comm-D protocol message. Values of 2 through 15 are not defined. Field UM contains the transponder's status (refer to Appendix E) when DI is 1 and SD is XXXXAX (X represents any value, A represents any non-zero value). The status contains the identity of the interrogator and the Comm format for further communications. Field AC displays altitude in feet, unless the UUT is coded to reply in meters. Field MB contains messages to the interrogator and uses Comm-B format.

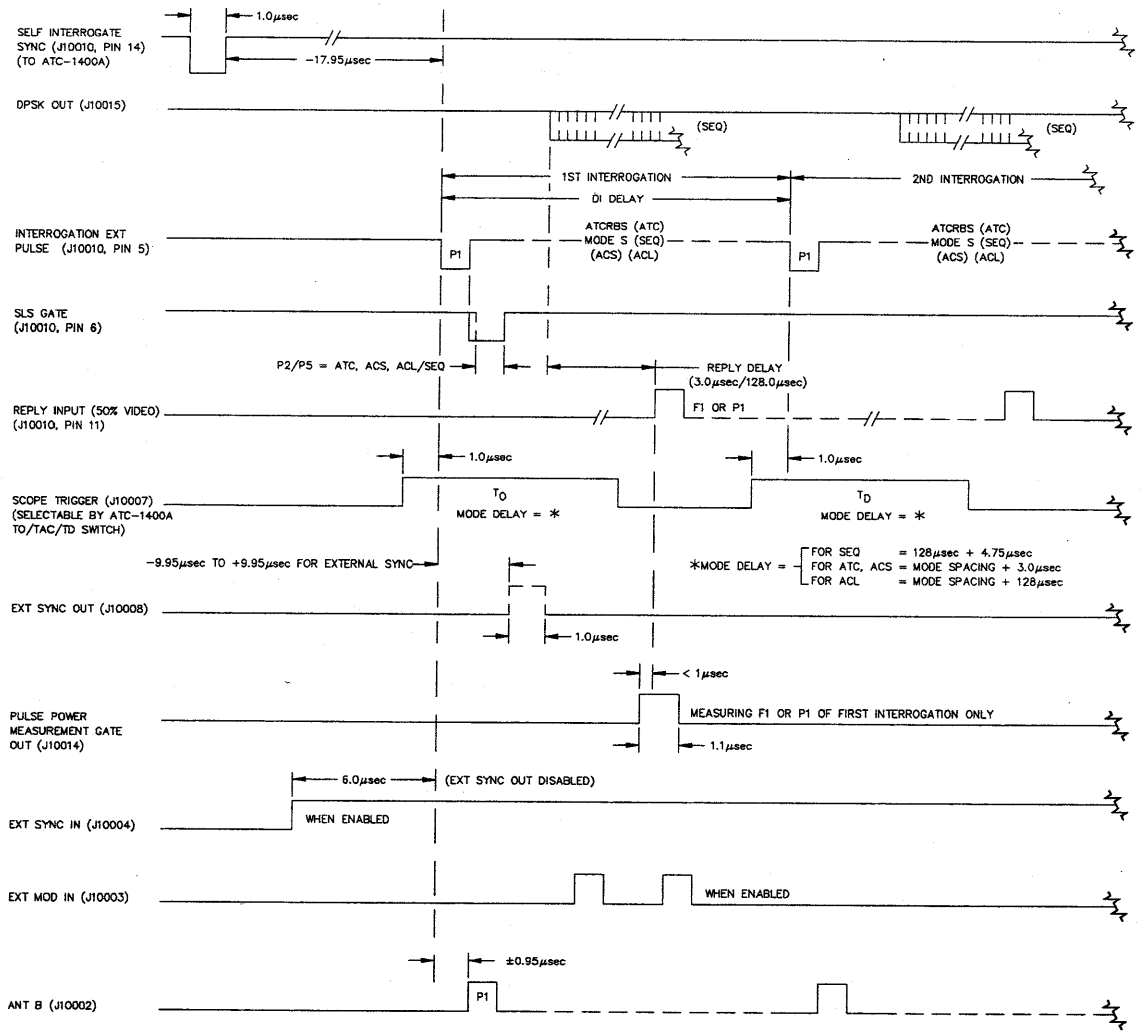
(g) Sequence Menu S07 - Uplink/Downlink Format 21 (Comm-A Identity Request)



Sequence Menu S07
Figure 53

Sequence menu S07 PC= field mandates operating instructions to the UUT. Choices of selection in field PC= are non-selective All-Call lockout (1), cancel Comm-B (4), cancel Comm-C (5) or cancel Comm-D (6). Field RR instructs the UUT to reply in either short (codes 0 through 15) or long (codes 16 through 31) format. RR 16 through 31 will reply in DF21. Field DI instructs the UUT to receive information contained in field SD. DI equal to 0 instructs the UUT to ignore all SD field data. When DI is set to 1, SD field is for multisite use. Setting DI to 7 will instruct the UUT to reply in extended field format (refer to Appendix E). Values of 2 through 6 are not defined. Field MA contains messages from the interrogator to the UUT.

Field FS reports flight status and alerts conditions (refer to Appendix E) to the interrogator. Field DR notifies the interrogator of the UUT's intent to transmit a message. A value of 0 represents no activity. When DR is equal to 1, the message will be Comm-B format. DR field values of 16 through 31 represent a Comm-D protocol message. Values of 2 through 15 are not defined. Field UM contains the transponder's status (refer to Appendix E) when DI is 1 and SD is XXXXAX (X represents any value, A represents any non-zero value). The status contains the identity of the interrogator and the Comm format for further communications. ID contains the 4096 code selected on the front of the UUT. Field MB contains messages to the interrogator and uses Comm-B format.



DI Test Function Timing Diagram
Figure 54

H. BURST Test Function

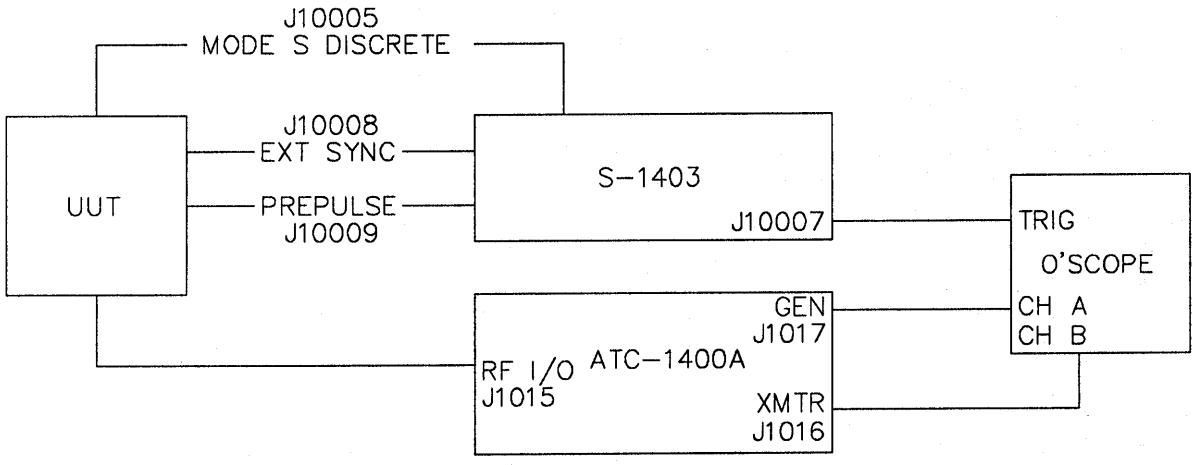
NOTE: S-1403 controls are identified by alphabetic character identifiers whereas all ATC-1400A controls are identified by numeric character identifers.

NOTE: The following two items highlight BURST Test Function anomalies. Review these items and Appendix F prior to utilizing this test Function.

The BURST number is limited according to the following three formulas:

- For a PRF setting of 1 to 399: No limitation.
- For a PRF setting from 400 to the maximum allowable: Refer to 1-3-1, Table 1.
- BURST Number Limit = Integer(3.27 ms X PRF) +1.

Downlink data is not decoded for this function.



Burst Test Function Hook-Up Diagram
Figure 55

(1) Description of BURST Test Function.

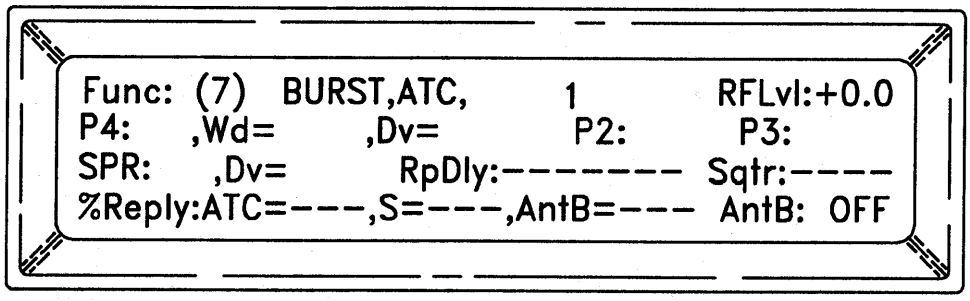
The Burst function allows the user to "Burst" a selected number of SEQ menus or ATC, ACS or ACL formats at the selected PRF rate on the ATC-1400A front panel. For example, the RTCA DO-181 specification requires the Mode S Transponder to reply at the following specified rates for short downlink formats:

50 Mode S replies in any one-second interval;
18 Mode S replies in a 100 µs interval;
8 Mode S replies in a 25 µs interval; and
4 Mode S replies in a 1.6 µs interval.

To accomplish this in the case of the first interval setting, the ATC-1400A PRF/SQTR Thumbwheels (41) are set to 50 (50 per second); the Burst Mode to SEQ, the Burst number to 50, and any uplink format selected for Sequence Item #1. The second interval requires a PRF of 180 and a Burst number of 18, and so on.

Interrogations are sent using both ANT A and ANT B when ANT B is ON. However, replies, reply delay and squitter, are monitored only on ANT B when ANT B is ON and ANT A when ANT B is OFF. Downlink data is not utilized for BURST. Displays are updated after completion of the BURST function operation.

(2) Control Menu #1 Display Definition



Burst Test Function Control Menu #1
Figure 56

(a) Func: (7) BURST

Select ATC, SEQ, ACS or ACL to be Burst at the PRF selected on PRF/SQTR Thumbwheels (41). The number of interrogations (1 to 999) follows the type declaration.

(b) RFLvl:

Adjustments for RF Levels in 0.1 dB steps (within a range of ±3.0 dB). RF adjustments are in addition to the level shown in RF LEVEL -dBm Display (3). Adjustments of 1 dB or greater should be accomplished utilizing SLEW Control (6).

(c) P4:

Not active in BURST Test Function.

(d) P4:,Wd=

Not active in BURST Test Function.

(e) P4:,Dv=

Not active in BURST Test Function.

(f) P2:

Not active in BURST Test Function.

(g) P3:

Not active in BURST Test Function.

(h) SPR:

Not active in BURST Test Function.

(i) SPR:,Dv=

Not active in BURST Test Function.

(j) RpDly:

Displays measured reply delay for ATCRBS (typically 3.0 µs) or Mode S (typically 128 µs) interrogations with 25 ns resolution and 50 ns accuracy.

(k) Sqtr:

Displays squitter period (transmission interval of a DF=11 downlink format) from 0.0 to 9.99 sec with 10 ms resolution.

(l) %Reply:ATC=

Displays percent of ATCRBS replies only, from 0 to 127 in 1% steps.

(m) %Reply:S=

Displays percent of Mode S replies only, from 0 to 127 in 1% steps.

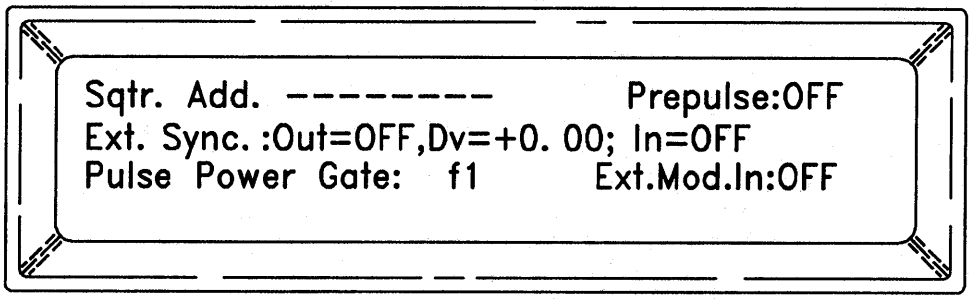
(n) %Reply:AntB=

Displays percent of replies from the ANT B connector for ATCRBS and/or Mode S, from 0 to 127 in 1% steps.

(o) AntB:

Enables (delay value) or Disables (OFF) Channel B, the diversity generator. When enabled, a value from -0.95 µs to +0.95 µs can be selected as the delay from Channel A to Channel B in 0.05 µs steps.

(3) Control Menu #2 Display Definition



Burst Test Function Control Menu #2
Figure 57

(a) Sqtr. Add.

24-bit octal value decoded from an unsolicited reply (squitter) on Channel A. This value is the Mode S Transponder's address and is transmitted via Downlink Format.

(b) Prepulse:

Prepulse (0 to 260) or OFF control. Prepulse spacing is set from the front panel. The pulse can be positioned from 0 to 260 µs before the rising edge of P_1 of the interrogation, in 1 µs steps.

(c) Ext.Sync.:Out=

ON/OFF control for the external sync output function.

(d) Ext.Sync.:Dv=

Deviation control for external sync output, from -9.95 µs to +9.95 µs in 50 ns steps.

(e) Ext.Sync.:In=

ON/OFF control for external sync input control (positive TTL signal). EXT SYNC OUT is not enabled when SYNC is enabled.

(f) Pulse Power Gate:

Pulse power measurement gate selection from P_1 to P_{116} (by input of a number from 1 to 116 or selected via SLEW Control [F]). The power measurement is performed in the ATC-1400A and displayed on XMTR PWR WATTS Display (1).

For all reply pulses, the measurement gate will be enabled prior to the rising edge of the pulse and continue measuring until falling edge. In the case of Mode S replies, since they are in PPM format, care should be taken to ensure the data pulses prior to and following the pulse to be measured are in such a state that their power levels will not be measured as well. For example: to measure P6 power; If P6 is "0", then P5 state doesn't matter and P7 should be a "0". If P6 is a "1", then P5 should be a "1" and P7 state doesn't matter. If P5 were "0" and P6 a "1", no rising edge would be detected and therefore the power reading would be zero.

For the S-1403 to control pulse power measurement, F_2/P_2-F_1/P_1 Switch (34) must be in the F_2/P_2 position. The F_1/P_1 position will measure the pulse power of an ATCRBS F_1 reply pulse only.

(g) Ext.Mod.In:

ON/OFF control for the external input, 0 to +5 volts.

(4) Sequence Menu (Uplink/Downlink Format) Description

BURST Test Function does not utilize sequence menus.

(5) Burst Test Function Timing Diagram

Burst Test function utilizes timing diagrams from the function being tested.

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5. Remote (GPIB) Operations

A. General

Remote mode of operation using the IEEE-488 (GPIB) interface in the ATC-1400A will be invoked in the S-1403 whenever the ATC-1400A sends the "REM." mnemonic to the S-1403 over the IFR bus. This occurs whenever an external controller pulls the ATN line on the interface and instructs the ATC-1400A to become a talker or a listener. The S-1403 continues to react in an auxiliary fashion to the ATC-1400A in remote mode similar to the way it does in "local" or front panel mode.

Upon receipt of the remote command, the S-1403 software disables the front panel Keyboard and SLEW Control (F) inputs, and responds only to "GPIB" instructions that are transmitted from an external controller over the GPIB. When the remote command is sent to the S-1403, the current display information will be erased and replaced with the message "***REMOTE***". Eliminating the display update allows more efficient operation through the GPIB. This feature may be overridden by issuing one of the display menu commands: "CMENUn." or "SEQN=nn", allowing display updates during REMOTE operations.

CAUTION: ATC-1400A COMMANDS MUST PRECEDE AND BE LOCATED ON A SEPARATE LINE FROM S-1403 COMMANDS. FAILURE TO PLACE COMMANDS ON SEPARATE LINE MAY RETURN FALSE PASS/FAIL INDICATIONS.

NOTE: When menus are displayed during REMOTE operation, there is no displayed indication the system is in REMOTE mode.

NOTE: No Keyboard or SLEW Control entries are accepted during REMOTE operation.

The GPIB commands closely resemble, if not duplicate, the expression used in the control and sequence menus. All commands and data are printable ASCII characters.

All commands sent to the S-1403 are identified by the use of special delimiters which classify the command as either a "set", "get", or "enable" instruction as follows:

"=" represents a "set value to" operation

"?" represents a "get value" operation

"." represents an "enable" operation

Command lines sent to the S-1403 Test Auxiliary must be preceded with the prefix "AX3=", as in :

AX3=(command 1) : (command 2) :...(command n)

NOTE: The command AX3= replaces the first five digits (UF field and DF field) of Downlink and Uplink transmission formats.

Any error conditions identified in local mode are also active in remote mode, however the errors are combined into one of three error messages that is sent to the ATC-1400A which will then set bit 1 of the SRQ register. There are generally four types of errors: RCVDATA error is the GPIB error received when the AP addresses are not the same; Input error occurs when an invalid GPIB command has been entered; and Mode error occurs when the unit is in DME mode and any command except RFLvl is entered. RECALL error occurs when a recall command has been issued and no data was previously saved.

B. Commands

In 1-2-5, Table 6, each command is shown separately as it would be executed through the ATC-1400A. In the command field, the "-" signifies a data or election entry field. The fields are separated by semicolon(s) ";". The fields will all be initialized to either the power on or the latest front panel values before going remote. The fields need not be updated each time the command is executed if no change is desired. Each field preceding the field to be changed can be skipped by sending only the semicolon separator: e.g. "P_4=;;+1.0" updates the P_4 pulse deviation only without changing the preceding level or width control fields.

In the range column, "****" indicates no value to be input or returned, otherwise a range of input values is given. If mnemonics are to be selected, the possible ones are separated by a backslash. Values to be returned are indicated by placing the values in parentheses. For example, the P_4 level control may be set to the calibrated position, the variable level position, or turned off by selecting either CAL or (/) VAR or (/) OFF.

A more detailed definition of each function is given in the front panel control section. The user should be familiar with this section before attempting to utilize the S-1403 in remote mode.

NOTE: When utilizing the GPIB commands, the Uplink and Downlink signal formats defined in RTCA Document 181 are not available within the Mode S system as defined formats. To transmit one of these specified formats requires the user to manually formulate the signals as shown in Appendix E, Tables 1 and 2.

COMMAND	RANGE/VALUES	DEFINITION
AX3=ATC	***	Enables ATCRBS interrogations only.
AX3=SEQ.	***	Enables Mode S interrogations only.
AX3=ACS.	***	Enables All-Call interrogations with a short P4 pulse and set pulse spacing at 8 µs (A) or 21 µs (C).
AX3=ACL.	***	Enables All-Call interrogations with a short P4 pulse and set pulse spacing at 8 µs (A) or 21 µs (C).
AX3=INTLCE=_	1 to 999	Enables interlace mode and set the ratio of Mode S interrogtions to ATCRBS interrogations.
AX3=DI=_;_	ATC/ACS/ACL/SEQ; ATC/ACS/ACL/SEQ	Enables double interrogation mode and set type of interrogation desired for the first and second interrogations.
AX3=BURST=_;_	ATC/ACS/ACL/SEQ; 1 to 999	Enables Burst mode. Set the type of interrogation to be burst and the number of times to generate it.
AX3=BURST.	***	Activates the BURST function, if selected.
AX3=MODE?	ATC/SEQ/ACS_/ACL:/ INTLCE;___/DI:_,__/BURST; ____,___	Displays mode Status. The mode is preceded by the selected option(s).
AX3=RFLV=__	-3.0 to +3.0 in 0.1 dB steps.	Sets RF level.
AX3=RFLV?	-3.0 to +3.0 dB	Displays RF vernier level.
AX3=P4=_;_;_	CAL/VAR/OFF; CAL/0.20 to 3.20; CAL/-1.95 to +1.95	Sets P4 (ACS/ACL) pulse conditions. The first field sets the pulse level, second field sets the pulse width and third field sets the deviation in 0.05 µs steps.
AX3=P4?	CAL/VAR/OFF; CAL/0.20 to 3.20; CAL/-1.95 to +1.95	Displays status of P4 pulse.
AX3=P6=_;_;_	CAL/OFF; CAL/-1.50 to +1.50; CAL/-1.95 to +1.95	Sets P6 (Mode S) pulse CAL/-1.95 to +1.95 conditions. The first field sets the pulse level, second field sets the pulse width, third field sets the deviation in 0.05 µs steps.
AX3=P6?	CAL/OFF; CAL/-1.50 to +1.50; CAL/-1.95 to +1.95	Returns status of P6 pulse.
AX3=P2=_	CAL/VAR/OFF	Sets level control to P2 pulse, either calibrated to 0 dB or variable control through SLS/ECHO ON/OFF Switch (18), when ON.
AX3=P2?	CAL/VAR/OFF	Displays status of P2 level control.
AX3=P3=_	CAL/VAR/OFF	Sets level control for P3.
AX3=P3?	CAL/VAR/OFF	Displays status of P3 level control.
AX3=SPR=_;_	ON/OFF; CAL/-1.00 to +1.00	Sets level control and deviation control for the Sync Phase Reversal.
AX3=SPR?	ON/OFF; CAL/-1.00 to +1.00	Displays status of SPR control.
AX3=RPDLY?	000.000 to 399.000	Displays UUT reply delay in microseconds.
AX3=SQTR?	0.00 to 9.99	Displays UUT squitter period in seconds.

Mode S GPIB Instruction Set
Table 6

COMMAND	RANGE/VALUES	DEFINITION
AX3=PRPLY?	0 to 127; 0 to 127; 0 to 127	Displays percent reply from UUT as percent of ATC, Mode S and Antenna B connector.
AX3=ANTB=_	OFF/-0.95 to +0.95	Sets control for the diversity channel (ANT B). Off disables ANT B to allow programmed delay from Channel A in 0.05 µs steps.
AX3=ANTB?	OFF/-0.95 to +0.95	Displays status of diversity control.
AX3=SQADD?	00000000	Displays the address of the squitter reply as an eight- digit octal value.
AX3=PPULSE=	0 to 260/OFF	Sets prepulse offset from 0 to 260 µs prior to P1 rising edge or OFF (disabled)
AX3=PPULSE?	0 to 260/OFF	Displays status of prepulse control.
AX3=EXSYN=_;_;_	ON/OFF; -9.95 to +9.95 ON/OFF	Enables or disables external synchronous output. Controls deviation of external synchronous pulse and enables or disables external synchronous input pulse.
AX3=EXSYN?	ON/OFF; -9.95 to +9.95 ON/OFF	Displays status of external synchronous control.
AX3=PPMG=_	OFF/1 to 16 ATC or OFF/1 to 116 (SEQ)	Sets Pulse Power Measurement Gate control for any pulse in the UUT reply for ATC mode (1 to 16), or SEQ mode (1 to 60) for short formats, or 1 to 116 for long formats.
AX3=PPMG?	1 to 16 in ATC or 1 to 116 in SEQ	Displays the PPMG control status.
AX3=EXMOD=_	ON/OFF	Enables or disables external modulation inputs.
AX3=EXMOD?	ON/OFF	Displays status of external modulation input control.
AX3=SQnn=_;_;_;_	nn=01 to 16; F/S/L; 00 to 31; 0 to 777777777 (short) or 0 to 3777777777777777777777 77(long) 0 to 7777777	Programs Sequence Item Number , 01 to 16, to be OFF/Short/Long; function number in decimal # bit data field (short) or 83-bit data field (long); and a 24-bit address field.
AX3=SQnn?	nn=01 to 16; F/S/L 00 to 31; 777777777 (short) or 3777777777777777777777 7777 (long); 0 to 77777777	Displays status of sequence number (01 to 16).
NOTE: Octal fields are justified right, referenced to the next field separator or end of line control character.		
AX3=DFSQnn?	nn=01 to 16; F/S/L 00 to 31; 0 to 777777777 (short) or 0 to 3777777777777777777777 7777 (long); 0 to 777777777	If no downlink format data exists, "NO DATA" will be displayed. Displays downlink format data for sequence item number (01 to 16).
AX3=SAVEn	n= 1 or 2	Enables the S-1403 to store the current test setup in non-volatile memory storage area (1 or 2).
AX3=RECALLn	n= 1 or 2	Enables the S-1403 to recall the test setup stored in non-volatile memory area (n) and make it the active storage area.

Mode S GPIB Instruction Set
Table 6 (Cont)

COMMAND	RANGE/VALUES	DEFINITION
AX3=SEQN=__	1 to 16 (decimal)	Enables the S-1403 to display the Sequence Menu beginning with the item number (1 to 16) entered from the front panel.
AX3=CMENUn.	n= 1 or 2	Enables the S-1403 to display Control Menu 1 (n=1) or 2 (n=2) on the front panel.
AX3=ERRM?	(INPUT/RCVDATA) RECALL/MODE/RATE, DI/INTFF	Displays error status as a command error, data input error, incorrect or inactive mode error, or no error. This is usually requested after the GPIB controller receives serial poll data indicating an auxiliary error when Bit 1 (SRQ) bit is set.

Mode S GPIB Instruction Set
Table 6 (Cont)

C. GPIB Examples

(1) EXAMPLE 1: Send Uplink Format 05 (Short Format).

From Appendix B: UF=05, Sequence number=03.
PC, RR, DI, SD and AP data fields are used.
Example transponder address is 17725762.

Refer to Appendix E for description of possible commands along with associated sub-commands.

Description of Command (from Appendix E, Table 3):

COMMAND	EXPLANATION
PC	Data being sent is for information only.
RR	Flight ID being interrogated.
DI	SD field contains multisite information.
SD	Field is comprised of sub-fields IIS, MBS, LOS, RSS and TMS
IIS	Identification of interrogator.
MBS	Reserve COMM-B for use.
MES	Close out COMM-C and COMM-D from use.
LOS	Lockout field listed in IIS from further All-Call interrogations, continue to acknowledge any other All-Call requests.
RSS	No request for field UM (Not used).
TMS	Unlinked Message/Request, acknowledge receipt.

Explanation of the data contained in the first 9 octal digits:

100 PC	10010 RR	001 D1	0100 IIS	01 MBS	111 MES	1 LOS	00 RSS	0010 TMS
			SD					

To convert the binary pulse representation to nine digit (octal), make a table similar to the following:

BINARY	100	011	110	010	110	011	111	000	010
OCTAL	4	3	6	2	6	3	7	0	2

COMMAND	DEFINITION
AX3=	Command to notify S-1403 to transfer command of tests to be conducted from the Front Panel to GPIB.
SQ03	Sequence Menu #03 (See Appendix B).
S	Short data field length.
05	Uplink format 05 (Decimal).
436263702	Nine-digit (Octal) data field.
17725762	Eight-digit (Octal) transponder address.
GPIB Command : AX3=SQ03;S;05;436263702;17725762	

(2) EXAMPLE 2: Send Uplink Format 21 (Long Format).

From Appendix B UF21 is long format.
PC, RR, DI, SD, MA and AP fields are active.
Example transponder address is 17725762.

Refer to Appendix E for description of possible commands along with associated sub-commands.

COMMAND	EXPLANATION
PC	Non-selective All-Call lockout.
RR	Identification of aircraft being interrogated.
DI	Notice to expect extended information.
SD	Field is comprised of sub-fields IIS, RRS, LOS and TMS.
IIS	Interrogator Identification.
RRS	Transmit reply in extended format.
LOS	Lockout all All-Call responses.
TMS	Linked first segment, multiple addresses, Priority individual call, acknowledge.
MA	Field is comprised of sub-fields ADS and message.
ADS	Extended message immediately follows.
*	Data bits not used in this Uplink Format message.

Explanation of the data contained in the first 35 binary digits:

001 PC	10010 RR	111 D1	0100 IIS	0101 RRS	0 *	1 LOS	00 *	1011 TMS	01011100 ADS	0...0 Message
			SD						MA	

To convert the binary pulse representation to nine digit (octal), make a table similar to the following:

BINARY	001	100	101	110	100	010	101	001	011	010	111	000
OCTAL	1	4	5	6	4	2	5	1	3	2	7	0

COMMAND	DEFINITION
AX3=	Command to notify S-1403 to transfer command of tests from Front Panel control to GPIB.
SQ07	Sequence Menu #07 (See Appendix B).
L	Long data field length.
21	Uplink format 21 (Decimal).
1456...000	25-digit (Octal) data field.
17725762	Eight-digit (Octal) transponder address.
GPIB Command : AX3=SQ07;L;21;1456425132700000000000;17725762	

(3) Example 3: Receive Downlink Format 04 (Altitude Reply)

From Appendix B DF04 is short format
FS, DR, UM, AC and AP data fields are used.
Example transponder address is 17725761

GPIB Return 3;S;4;17677;17725761

RESPONSE	DEFINITION
3	Notification to S-1403 to accept GPIB Data.
S	Short Format.
4	Downlink Format 4.
17677	Octal Data Field.
17725761	Example Transponder Address.

To convert the five (octal) digits to altitude (decimal), proceed as follows:

STEP PROCEDURE

1. Convert the octal data field digits to binary using the following format:

c1	a1	c2	a2	c4	a4	X	b1	d1	b2	d2	b4	d4
B10	B9	B8	B7	B6	B5	X	B4	Q	B3	B2	B1	B0
1	1	1	1	1	1	0	1	1	1	1	1	1
1	7			6			7			7		

If bit position Q (d1) is 0, the altitude readout is ATCRBS, refer to Appendix D, ATC-1400A Operation/Maintenance Manual for the solution.

2. Discard bit positions X and Q, and separate the bits into three fields as follows:

B10	B9	B8
1	1	1

B7	B6	B5	B4
1	1	1	1

B3	B2	B1	B0
1	1	1	1

3. Convert these binary characters into hexidecimal characters:

B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
1	1	1	1	1	1	1	1	1	1	1
7			F				F			

4. Convert the 3-digit (hexidecimal) altitude code to decimal code.

7FF = 2047 ([7 x 256 = 1792] + [15 x 16 = 240] + 15)

STEP PROCEDURE

5. Multiply decimal number by 25.

   2047 X 25 = 51175

6. Subtract 1000 from the answer derived in step 5.

   51175 - 1000 = 50715

   This is your altitude and should agree with the answer shown in sequence menu S02, AC= field.

(4) Example 4: Receive Downlink Format 05 (Identification Reply)

From Appendix B DF05 is short format
FS, DR, UM, ID and AP data fields are used
Example transponder address is 17725761

GPIB return 3;S;5;17404;17725762

RESPONSE	DEFINITION
3	Notification to S-1403 to accept GPIB Data.
S	Short Format.
5	Downlink Format 5.
17404	ID Data Field.
17725761	Example Transponder Address.

To convert the five-digit (octal) to the correct four digit (octal), proceed as follows:

STEP PROCEDURE

1. Convert the five-digit (octal) reply to binary using the following format:

c1	a1	c2	a2	c4	a4	X	b1	d1	b2	d2	b4	d4
1	1	1	1	1	0	0	0	0	0	1	0	0
1	7			4			0			4		

2. Rearrange the binary bits to the following format, discarding bit position X:

a4	a2	a1	b4	b2	b1	c4	c2	c1	d4	d2	d1
0	1	1	0	0	0	1	1	1	0	1	0

3. Convert the binary bits to octal:

a4	a2	a1	b4	b2	b1	c4	c2	c1	d4	d2	d1
0	1	1	0	0	0	1	1	1	0	1	0
3			0			7			2		

This is your identification code and should agree with the answer shown in sequence menu 03, ID= field.

BINARY	OCTAL
001	1
010	2
011	3
100	4
101	5
110	6
111	7

Binary to Octal Conversion
Table 7

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SECTION 3 - SPECIFICATIONS

1. Mode S Test System Specifications

NOTE: These specifications supersede ATC-1400A specifications whenever the ATC-1400A is mated to the S-1403. Refer to 1-3-1 in the ATC-1400A Operation /Maintenance Manual for specifications not outlined in this Section.

A. Control Menu Functions

Mode Select:

ATC:	Selects ATCRBS pulse modulation (A, C, etc.). The S-1403 Test Auxiliary generates the pulses, measures Reply Delay and %Reply, and controls selective reply pulse power measurement for ATC Modes.
SEQ:	Mode S interrogations are provided from the S-1403 Test Auxiliary, which transmits the stored sequence.
ACS:	ATCRBS All-Call (Short). Outputs an ATCRBS interrogation plus a 0.8 µs P_4 pulse to disable Mode S transponder replies.
ACL:	ATCRBS/Mode S All-Call (Long). Outputs an ATCRBS interrogation plus a 1.6 µs P_4 pulse to enable an All-Call (DF11) reply.
INTLCE:	Sets ratio of Mode S to ATCRBS interrogations. Mode S interrogations are interlaced with a fixed delay of 200 µs from P_1 of the first (ATCRBS) interrogation.
DI:	Sets double interrogation modes (Any combination of ATCRBS, All-Call and Mode S). Enable and DI delay are controlled by ATC-1400A DBL INTERR/ INTERF PULSE Thumbwheels (42). Variable pulse controls are valid for the first interrogation only.
BURST:	Programs the BURST Key to output ATC, ACS, ACL, or SEQ formats, followed by the BURST number value of 1 to 999.

B. Pulse Characteristics

All pulse accuracies, including amplitude and phase transition measurements, should be verified using a Heterodyne Monitor of the type shown in Appendix H of the ATC-1400A Operation/Maintenance Manual.

P_2 (SEQ) (ANT A and ANT B):

Position:	Calibrated at 2.0 µs (±10 ns).
Deviation:	±1.85 µs selectable in 0.05 µs increments. (ATC-1400A XPDR P_2/P_3 DEV Thumbwheels [44] and ATC-1400A XPDR DEV P_2/CAL Switch [28].)
Accuracy:	±10 ns
Width:	Calibrate 0.8 µs (±10 ns). (ATC-1400A XPDR PULSE WIDTH VAR/CAL Switch [20] in CAL position.)
	Variable 0.20 µs to 1.85 µs (±10 ns). (ATC-1400A XPDR PULSE WIDTH VAR/CAL Switch [20] in VAR position)

P_3 (ATC, ACS, ACL) (ANT A and ANT B):

P_1-P_3 Mode Spacing:	(ATC, ACS, ACL)(ATC-1400A XPDR MODE Control [38])
	3.0 µs ±10 ns (Mode 1) 5.0 µs ±10 ns (Mode 2) 6.5 µs ±10 ns (Mode T) 8.0 µs ±10 ns (Mode 3/A) 17.0 µs ±10 ns (Mode B) 21.0 µs ±10 ns (Mode C) 25.0 µs ±10 ns (Mode D)
Deviation:	±1.85 µs selectable in 0.05 µs increments. (ATC-1400A XPDR DEV P_3/CAL Switch [25])
Accuracy:	±10 ns
Width:	Calibrate 0.8 µs ±10 ns (ATC-1400A XPDR PULSE WIDTH VAR/CAL Switch [20] in CAL position)
	Variable 0.20 µs to 1.85 µs (±10 ns) ATC-1400A XPDR PULSE WIDTH VAR/CAL Switch [20] in VAR position)

P_2 SLS (ATC, ACL, ACS Functions):

NOTE: ATC-1400A SLS/ECHO ON/OFF Switch (18) disables all other pulse amplitude control and enables P_2.

Width:	Fixed at 0.8 µs. Variable 0.2 µs to 1.85 µs, in 50 ns steps)
Accuracy:	±10 ns
Position:	For ATC, ACS and ACL, 2.0 µs from leading edge of P_1.
Accuracy:	±10 ns
Deviation:	±1.85 µs selectable in 0.05 µs increments. (ATC-1400A XPDR P_2/P_3 DEV Thumbwheels [44] and ATC-1400A XPDR DEV P_2/CAL Switch [28])
Accuracy:	±10 ns

P_5 SLS: (SEQ Function):

NOTE: ATC-1400A SLS/ECHO ON/OFF Switch (18) disables all other pulse amplitude control and enables P_5.

Width:	Fixed at 0.8 µs.
Accuracy:	±100 ns
Position:	For Mode S, fixed relationship to Sync Phase Reversal from -0.4 µs before SPR to +0.4 µs following SPR.
Accuracy:	±100 ns
Deviation:	Controlled by SPR deviation

P_4 Control: (ACS, ACL) (ANT A and ANT B):

All-Call Modes:

Width:	Calibrated to 0.8 µs for P_4 (short)and 1.6 µs for P_4 (long). Variable independent of P_1, P_2 and P_3 from 0.2 µs to 2.75 µs in 0.05 µs steps for P_4 (short) and from 0.2 µs and 3.55 µs for P_4 (long).
Accuracy:	Fixed and Variable = ±50 ns.

Deviation:

CAL (±0.0):	=10 µs for ATCRBS Mode A (P_1 to P_4). =23 µs for ATCRBS Mode C (P_1 to P_4).
Variable:	±1.95 µs relative to CAL position in 0.050 µs steps.
Accuracy:	±10 ns.

P_6 Control (SEQ) (ANT A and ANT B):

Width:	Calibrated at 16.25 µs or 30.25 µs (56 or 112 phase reversals). Variable ±1.5 µs in 0.05 µs steps.
Accuracy:	±50 ns
Deviation:	CAL at 3.5 µs following P_1. Variable ±1.95 µs in 0.05 µs steps.
Accuracy:	±10 ns
Pulse Amplitude (P_2, P_3, P_4, P_2[SLS], P_5):	Variable from -19 to +6 dB in 1 dB steps using ATC-1400A SLS ECHO Thumbwheels (50)
Accuracy:	Per ATC-1400A SLS Level specification except: ±0.3 dB for -10 dB to +3 dB.

Suppressor Pulse:

ATC:	Per ATC-1400A Specifications
SEQ:	0.8 µs prior to SPR
ACS:	0.8 µs prior to P_3
ACL:	0.8 µs prior to P_3
DI:	Per ATC-1400A Specifications

Interference Pulse:

ATC, SEQ, ACS, ACL:	Per ATC-1400A Specifications.

SYNC Phase Reversal: (ANT A and ANT B):

Control:	ON/OFF
Deviation:	Calibrated at 2.75 µs after the rising edge of P_2(CAL). Variable from +1.75 µs to +3.75 µs, relative to the rising edge of P_2(CAL) in 50 ns steps (All DPSK data deviates accordingly).
Accuracy:	±50 ns
DPSK:	
Output Phase:	Switching >1.2 V P-P bipolar signal into 50 ohms
Phase Reversal Time:	<80 ns (10 to 170 degrees).
Reply Delay:	
ATCRBS (ATC):	Measures delay from P_3 (CAL) to f1 (typically 3.0 µs) to a resolution of 25 ns.
Accuracy:	±100ns
Mode S (SEQ):	Measures delay from the SYNC Phase Reversal (CAL) to the first preamble pulse of the reply (typically 128 µs) to a resolution of 25 ns.
Accuracy:	±50 ns
%Reply:	
ANT A (ATC), ATC:	0 to 127% in 1% steps.
ANT A (SEQ), S:	0 to 127% in 1% steps (Displays percent of valid Mode S replies only).
ANT B (ATC, SEQ):	Composite %Reply of 0 to 127% in 1% steps (Displays percent of valid replies that return through Antenna B).
Accuracy:	+/-1 step
Prepulse:	Positive pulse whose leading edge can be programmed from 0.0 µs to 260 µs in .0 µs steps prior to the leading edge of P1 of the interrogation. Active in all functions except ATC and DI.

EXT SYNC Out:	Positive pulse whose leading edge can be programmed to occur from -9.95 µs to +9.95 µs from the leading edge of P_1 of the interrogation in ±50 ns steps.
EXT SYNC In:	Positive TTL signal whose leading edge triggers the pulse output sequence. Not active in BURST Function
EXT MOD In:	Zero to 5 V signal used to drive the ATC-1400A modulator.
Decoder (SEQ):	Decodes downlink data and generates parity information which is compared to the "AP" field to check errors.
Squitter (ATC):	Indicates Squitter period from 0.0 to 9.99 seconds in 10 ms steps.
Accuracy:	±10 ms
Address:	Mode S address selectable from 1 to 2 to the 24th power.
	NOTE: When the address is entered, parity is generated according to RTCA specification DO-181; Mar. 1983, Section 2.2.16.2.1.
Pulse Power Measurement Gate (ATC, SEQ):	Positive TTL signal occuring 0.35 µs prior to the selected pulse.

C. ADDITIONAL FUNCTIONS

Pulse Repetition Frequency Limitations (Refer to 1-3-1, Table 1):

FUNCTION	MAXIMUM PRF	
	WITHOUT REPLIES*	WITH REPLIES
ATC	850	1500
SEQ	200	200
ACS	800	1500 ATC 200 Mode S
ACL	200	200
INTLCE	500	500 (1:3 or less [200 for Mode S]) 400 (1:2) 200 (1:1)
DI ATC;ATC All others	500	750 100
BURST	Refer to 1-3-1, Figure 1. Number limit computed by Limit = [Interger value of (3.27 ms X PRF)] + 1.0	
* Without replies in ATC, ACS and DI functions, erroneous indications occur above value listed.		

PRF Limitations
Table 1

RF Level: "RFLvl" Key followed by a number or ATC-1400A RF LEVEL Control (6) entry will raise or lower the ATC-1400A RF level by 3 dB in ±0.1 dB steps.

Accuracy: ±10%

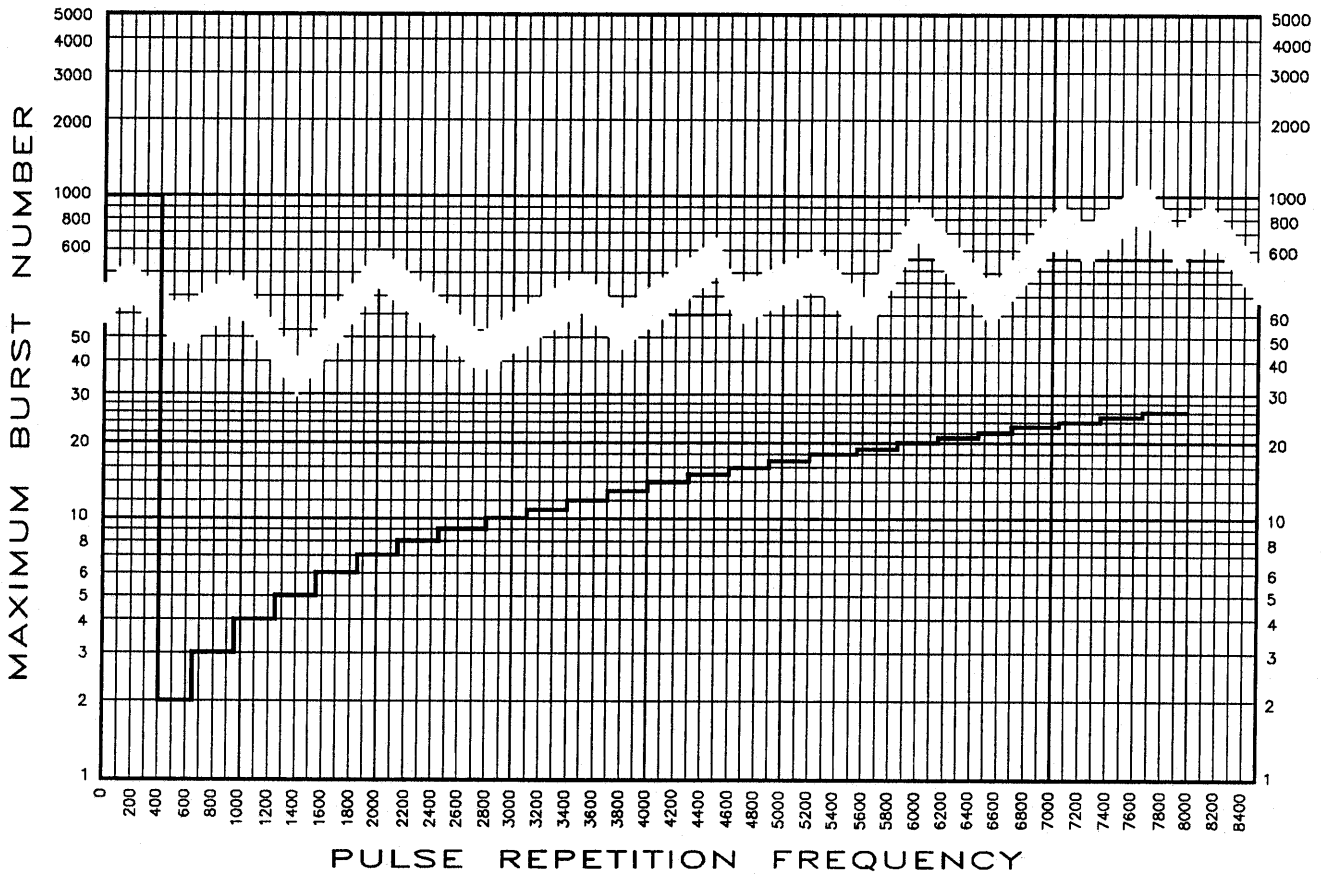
Ant B:

Control: OFF/(delay value) Used to enable or disable the second RF output for diversity testing and to set the delay of Channel B's output from Channel A.

Frequency: 1030 MHz

Accuracy: 0.001%

RF Level:	-50 dBm
Accuracy:	±1 dB relative to the output of the ATC-1400A at -50 dBm.
Delay:	Variable 0.95 µs in 0.05 µs steps.
Phase Reversal Transition:	<80 ns (10 to 170 degrees)
ANT A to ANT B Tracking Accuracy:	±25 ns
Pulse Amplitude:	No variable level capability.



Burst Test Function PRF Limitations
Figure 1

Mode S/ATCRBS Discrete Output:

ATCRBS:	TTL low-level pulse; Occurs 1.0 µs prior to Prepulse for 3.0 µs.
Mode S:	TTL high-level. Active for all functions except ATC and DI.

Scope Trigger (J10007):

ATC:

t0:	Rising edge occurs 1.0 µs prior to P_1. Falling edge occcurs 1.0 µs prior to P_3.
td:	Rising edge occurs 3.0 µs following P_3. Falling edge occurs 23.3 µs following P_3.

SEQ:

t0:	Rising edge is 1.0 µs prior to P_1. Falling edge occurs 1.0 µs prior to SPR (CAL)
td:	Rising edge is 127 µs following SPR (CAL). Falling edge is 8.0 µs later.

ACS:

t0:	Rising edge is 1.0 µs prior to P_1. Falling edge occurs 1.0 µs prior to P_4 (CAL).
td:	Rising edge is 1.0 µs prior to first pulse of the reply. Falling edge is 0.8 µs later.

ACL:

t0:	Rising edge is 1.0 µs prior to P_1 leading edge. Falling edge occurs 1.0 µs prior to P_4(CAL).
td:	Rising edge is 1.0 µs prior to the first pulse of the reply. Falling edge occurs 0.8 µs later.

INTLCE:

t0:	Leading edge is 1.0 µs prior to the leading edge of the ATCRBS interrogation P_1. Falling edge is 3.0 µs following P_3 of the interrogation.
td:	Leading Edge is 1.0 µs prior to the leading edge of P_1 of the Mode S interrogation. Falling edge occurs 132.75 µs later.

DI:	
t0:	(First Interrogation Sequence) Leading edge is 1.0 µs prior to the leading edge of first interrogation P_1. Falling edge occurs 3.0 µs later for ATCRBS and 132.75 µs later for Mode S.
td:	(Second Interrogation Sequence) Leading edge is 3.0 µs prior to the leading edge of second interrogation P_1. Falling edge occurs 3.0 µs later for ATCRBS and 132.75 µs later for Mode S.
BURST:	See ATC through ACL.

D. Power Requirements

ac Input:	105 to 120/220 to 250 VAC, 50 to 400 Hz, 40 Watts
ac Output:	Line output, fused at 3 Amps and switched.