M83-0004

AS210A-PM

PORTABLE MAINFRAME

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PREFACE

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Reference Publications

AS210-01A Module Controller Operation and Maintenance Manual
AS210-02 Frequency Comparator Operation and Maintenance Manual
AS210-03 Frequency Generator Operation and Maintenance Manual
AS210-04 Digital Delay Generator Operation and Maintenance Manual
AS210-05 Standby Battery Operation and Maintenance Manual
AS210-06 Microwave Generator Operation and Maintenance Manual
AS210-08 Distribution Amplifier Operation and Maintenance Manual
AS210-20 Time Clock Operation and Maintenance Manual

CHAPTER 1
GENERAL INFORMATION

1-1 INTRODUCTION

The heart of the AS210 Electronic Counter and Frequency Standard Calibration System is the AS210A-PM Mainframe shown in Figure 1.1. The AS210A-PM Portable Mainframe can support the double width AS210-01A Module Controller and three single width AS210-type plug-ins. The highly accurate Rubidium frequency standard that provides the time base for the system's frequency measurement circuits is housed within the mainframe. The mainframe and all plug-in modules are completely programmable through an IEEE-488 interface. The AS210-01A and other plug-in modules of the AS210 series are described in separate manuals available from ARGOSystems.

1-2 AS210A-PM PHYSICAL AND ELECTRICAL DESCRIPTION

The AS210A-PM Portable Mainframe consists of two main pieces: a rugged chassis with covers and a power module assembly. The power module slides into the rear of the chassis and is secured by two captured mounting screws. AS210-type modules are inserted into the front of the chassis to mate with the power module. The AS210A-PM Portable Mainframe will slide easily under an airline seat while traveling.

The portable mainframe chassis includes a module locking bar which prevents the modules from sliding out, front and rear covers to protect the instrument during travel, and a convenient heavy-duty carrying handle. The power module contains the highly accurate rubidium frequency standard, power supply, internal/external time base selector circuitry, and the motherboard. The internal/external time base selector assembly permits the AS210 system to be phase-locked to an external frequency standard.

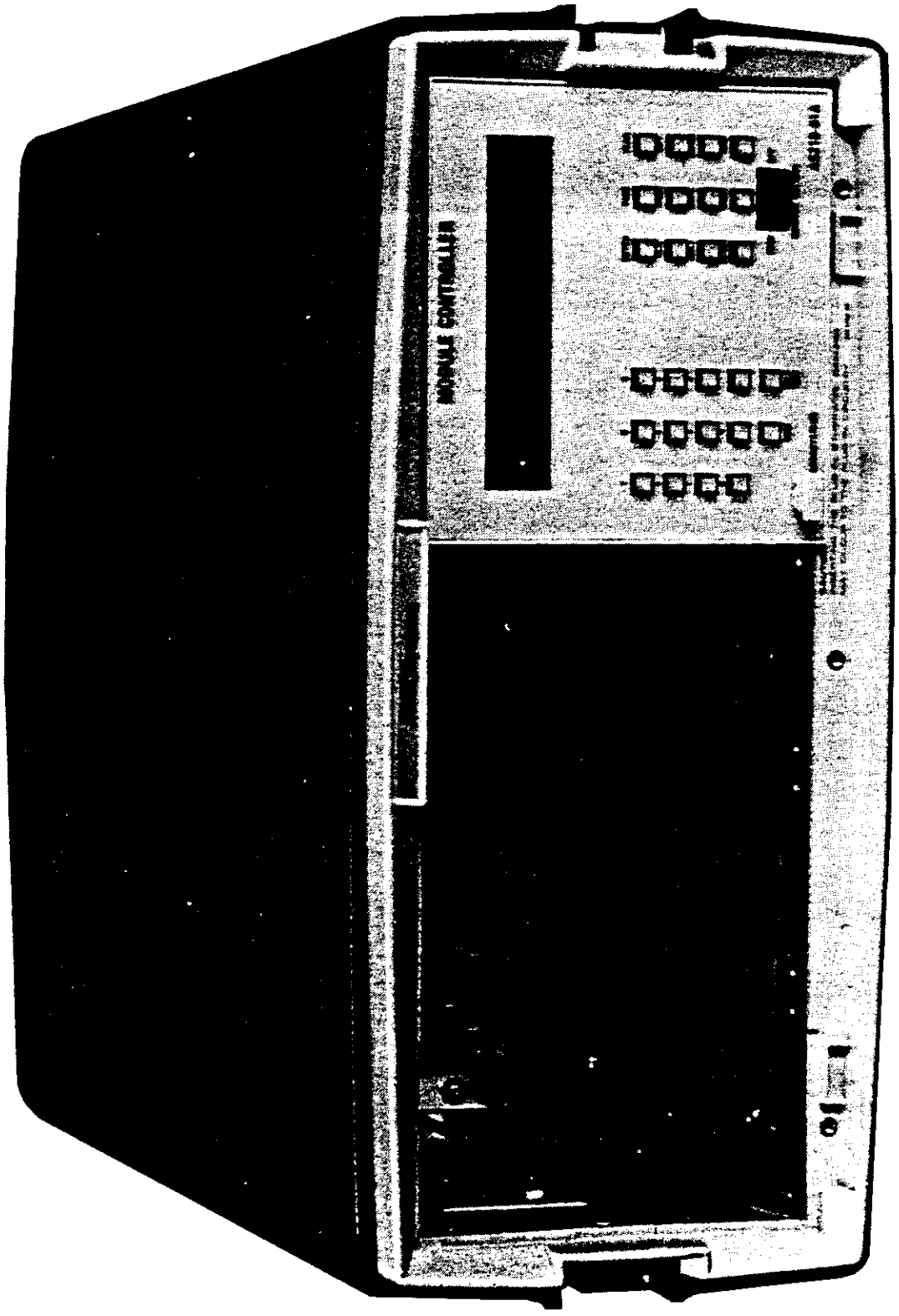

Figure 1.1 Portable Mainframe with AS210-01A Module Controller Installed

The blower fan and power transformer are located on the rear panel. Connectors and controls located on the rear panel are a 10 MHz reference frequency output, internal/external frequency select switch, IEEE-488 interface connector, power switch, external frequency reference input, and internal frequency adjustment. The power module may be removed from the chassis and modules installed for maintenance purposes. Table 1-1 is an electrical/mechanical specification for the mainframe in the AS210 Electronic Counter and Frequency Standard Calibration system.

Table 1-1

AS210 MAINFRAME SPECIFICATIONS

	SPECIFICATION	TYPICAL
INTERNAL RUBIDIUM FREQUENCY STANDARD FREQUENCY RETRACE (AFTER TURN-ON)	$\pm 3 \times 10^{-11}$	$\pm 1 \times 10^{-11}$
STABILITY VERSUS		
TIME	$\pm 2 \times 10^{-11}$ per month	$\pm 1 \times 10^{-11}$ per month
TEMPERATURE (0 to 40°C)	$\pm 1 \times 10^{-10}$	$\pm 5 \times 10^{-11}$
VIBRATION, SHOCK, PULSE, TRANSIT, DROP, AND BENCH HANDLING (PER MIL-T-28800B)	$+1 \times 10^{-10}$	$+5 \times 10^{-11}$
+10 PERCENT LINE VOLTAGE VARIATION	$\pm 1 \times 10^{-10}$	$\pm 5 \times 10^{-11}$
LINE FREQUENCY VARIATION (50-400 Hz)	$\pm 1 \times 10^{-10}$	$\pm 5 \times 10^{-11}$
WARM-UP CHARACTERISTICS	Less than 1×10^{-10} in 20 minutes maximum Less than 1×10^{-10} in 10 minutes typical	
OUTPUT FREQUENCY	10 MHz	
OUTPUT LEVEL	1 volt peak-to-peak	
INTERNAL RUBIDIUM FREQUENCY ADJUSTMENT		
RANGE	$\pm 5 \times 10^{-10}$	
RESOLUTION	3×10^{-11}	

TABLE 1-1 (Continued)

	SPECIFICATION	TYPICAL
EXTERNAL REFERENCE FREQUENCY INPUT		
FREQUENCY	1, 5, or 10 MHz	
LEVEL	1 VRMS	
REMOTE PROGRAMMING	IEEE-488	
OPERATING ENVIRONMENT		
TEMPERATURE	0-40°C	
ALTITUDE	To 15,000 ft	
HUMIDITY	0-85% relative humidity	
NON-OPERATING ENVIRONMENT		
TEMPERATURE	-55 to +75°C	
ALTITUDE	To 40,000 ft	
HUMIDITY	To 95% relative humidity	
PHYSICAL CHARACTERISTICS		
POWER (AS210A-PM)	115V or 230V ac, 2 amps 50-400 Hz	
SIZE (AS210A-PM)	Depth 20.35" Width 15.25" Height 6.81"	
WEIGHT (AS210A-PM)	30.5 lbs without plug-ins	

CHAPTER 2
INSTALLATION

2-1 INTRODUCTION

The AS210A-PM Portable Mainframe supports modules of the AS210 series. Power and signal interface is provided to the modules automatically when they are plugged in. The mainframe has a self-contained power supply and requires a source of 115 Vac prime power. The rear panel has a BNC connector for an external reference frequency standard. When an external standard is used, the rear panel INT/EXT switch is set to the EXT position. The AS210-05 Standby Battery Module may be installed on-line to supply power to the rubidium frequency standard and the AS210-20 Time Clock Module for a minimum of three hours during ac power interruptions.

CAUTION

Do not attempt installation of Tektronix plug-in modules in the AS210 Mainframe. Severe damage to plug-in and mainframe will result.

2-2 AS210A-PM LOCKING BAR REMOVAL AND INSTALLATION PROCEDURE

The AS210A-PM Portable Mainframe locking bar is useful during transit to secure the modules of the AS210 system in the mainframe. To remove the locking bar, simply loosen the three retaining screws across the face of the locking bar and remove. To install the locking bar, reverse the above procedure.

CHAPTER 3
OPERATION

3-1 INTRODUCTION

WARNING

Be sure that there is at least three inches clearance between the fan of the mainframe and any obstruction, before operating the instrument.

The AS210A-PM Portable Mainframe performs no functions by itself. Details of operation for the various plug-in modules are contained in a separate publication (see Preface). The only operator interface with the mainframe is the internal/external reference switch which is used to select the frequency reference. Figure 3.1 is the illustration of the AS210A-PM Portable Mainframe rear view. Table 3-1 describes the controls and connectors of the AS210A-PM and is keyed to Figure 3.1.

3-2 AC OPERATING VOLTAGE SELECTION

On the AS210A-PM rear panel, the fuse and voltage selector is located to the right of the fan. See Figure 3.1 and Table 3-1.

To select the ac operating voltage, slide the plastic cover open on the voltage selector and rotate the fuse-pull down. Remove the fuse and voltage select board. Position the voltage select board so that the desired printed voltage is on the top left side of the board. Push the board firmly into the module slot. Rotate the fuse-pull back into normal position and install the proper value fuse. The AS210A-PM Mainframe is now ready for operation.

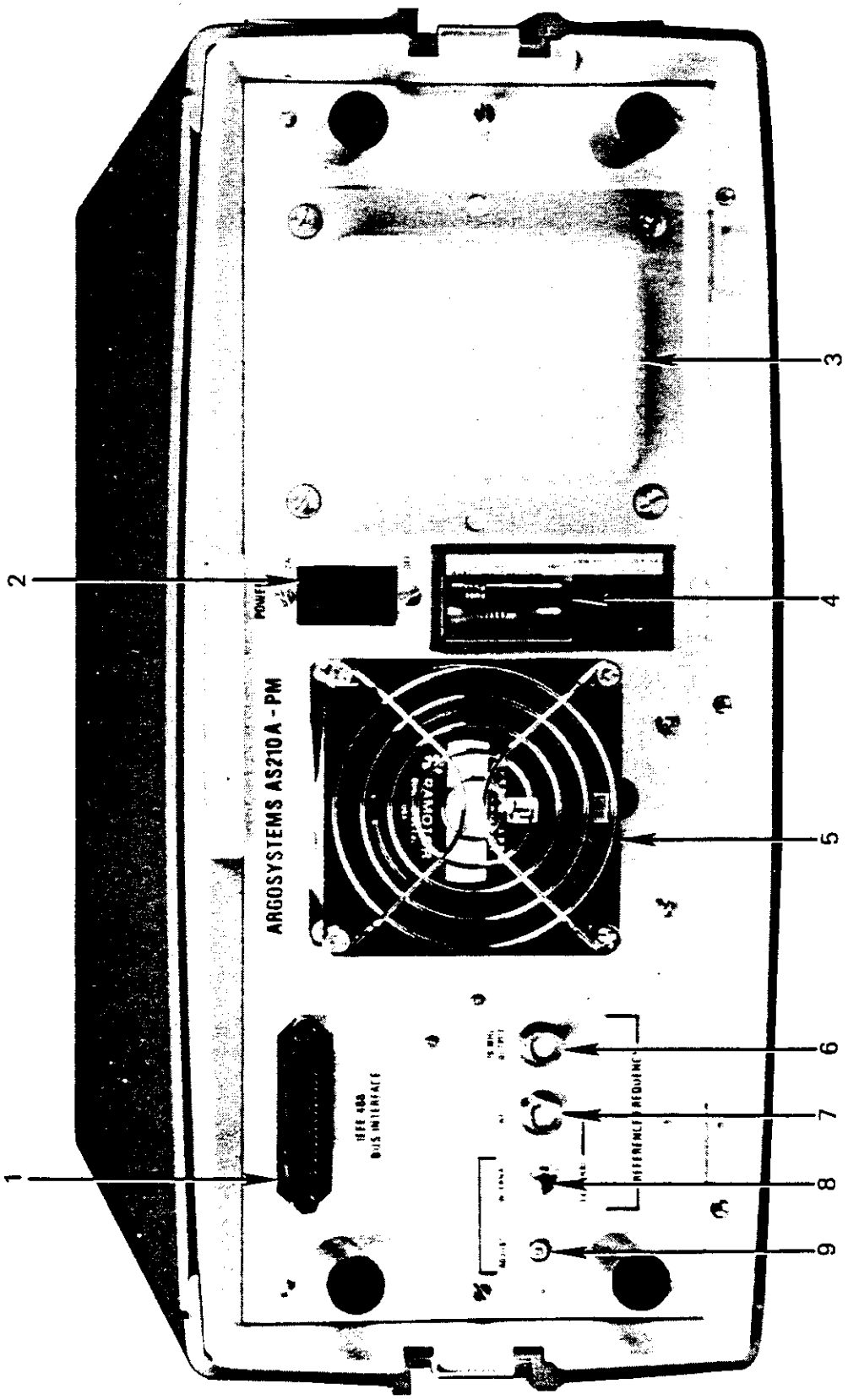

Figure 3.1 Portable Mainframe Rear Panel Controls and Connectors

Table 3-1

AS210A-PM PORTABLE MAINFRAME CONTROLS AND CONNECTORS

INDEX NUMBER FIGURE 3.1	PANEL MARKING	FUNCTION
1	IEEE-488-1975 BUS INTERFACE	Connector for remote control of the AS210 system
2	POWER	Main power switch
3		Power transformer
4		Fuse and power connector
5		Fan
	REFERENCE FREQUENCY	
6	10 MHz OUTPUT	Output connector for 10 MHz from selected frequency standard
7	INPUT	Input connection for an external frequency reference
8	INTERNAL/EXTERNAL	Switch for selecting internal or external frequency reference
9	ADJUST	Standard frequency adjustment

CHAPTER 4
THEORY OF OPERATION

4-1 INTRODUCTION

This chapter provides a functional description of the AS210A-PM Portable Mainframe. The mainframe contains dc voltage supplies, a backplane interconnect assembly, and the rubidium frequency standard. The description is keyed to the block diagram in Figure 4.1 and the schematic diagrams in Chapter 5. Details of common types of circuits are not included in this description.

4-2 DC VOLTAGE SUPPLIES

Prime ac power is applied to a power line filter/voltage selector located on the rear panel of the AS210A-PM. The voltage selector allows 115 Vac or 230 Vac be used with the system. The AS210A-PM power transformer T1 provides four ac voltages to the portable mainframe: 9.9 Vac for the +11 Vdc unregulated and +5 volt regulated supplies; 24.5 Vac for the +31 Vdc unregulated supply; 20.5 Vac for the +26 Vdc unregulated supply; and 39.5 Vac for the ±18 Vdc regulated supplies.

A bridge rectifier (CR3), filter capacitor (C4), and two +5 Vdc regulators (U3-U4), provide a +5 Vdc supply voltage for the module controller and a +5 Vdc suppy for the remaining modules in the AS210 system. Three bridge rectifiers (CR1, CR2, CR4) and four filter capacitors (C1, C2, C3, C5) provide the +31 Vdc, +26 Vdc, and ±18 Vdc unregulated supplies. The ±18 Vdc regulated voltage supplies for the AS210 system are provided by adjustable voltage regulators (U1 and U2). The ±18 volt regulators are set by factory selected resistors. If replacement becomes necessary, please contact the factory.

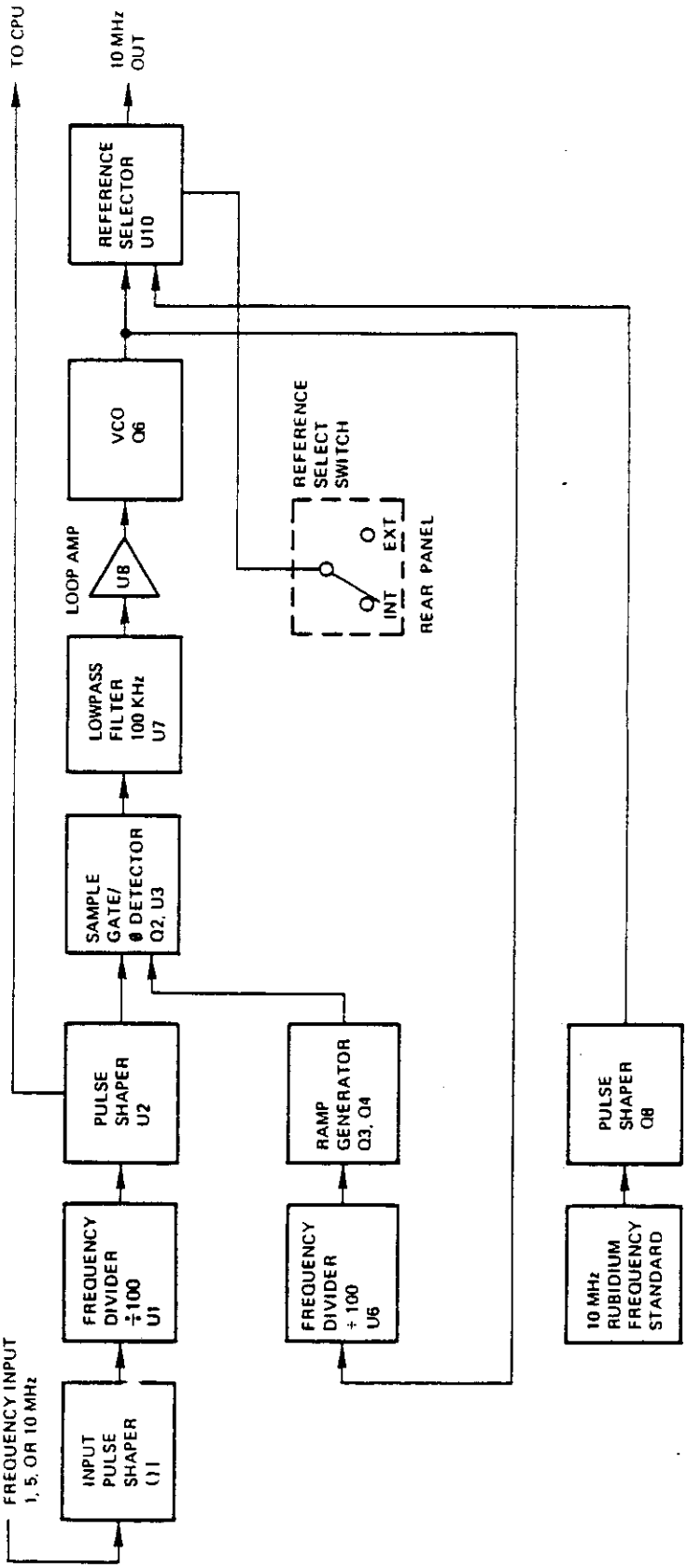

Figure 4.1 AS210A-PM Functional Block Diagram

4-3 EXTERNAL REFERENCE SELECTOR CIRCUIT, A2

The AS210 system can be used with the 10 MHz internal rubidium frequency standard or an external frequency standard of 1, 5, or 10 MHz. The external reference frequency input is located on the rear panel of the mainframe. The external reference signal is accepted automatically by the time base circuitry when the reference frequency select switch is in the EXT position. The external reference signal is divided by 100 in frequency divider U1 and shaped into a 250 nanosecond pulsewidth signal by one-shot U2 for application to phase detector U3. The phase detector compares the input standard signal with a ramp signal produced by the VCO so that the VCO is locked to the standard. The 10 MHz VCO output is divided by 100 in dual decade divider U6. The output of U6 (100 kHz) drives ramp generators Q3, Q4. The VCO output is applied to a reference selector gate which is controlled by the rear panel INT/EXT reference switch. The signal from the pulse shaper is also available to the microprocessor. If the reference frequency select switch is in the EXT position, and no signal is applied to the external frequency reference input, an error message is generated. When the reference frequency select switch is in the INT position, control transistors Q1 and Q5 turn the power off to the external reference frequency circuitry. In the external position, the +26 Vdc voltage supply for the rubidium frequency standard is disconnected so that interference does not occur to the VCO output.

CHAPTER 5
MAINTENANCE AND CALIBRATION

5-1 INTRODUCTION

The purpose of this chapter is to provide maintenance and calibration data for the AS210A-PM Portable Mainframe. Section I covers routine preventive maintenance procedures. Section II outlines performance tests for the mainframe. Section III contains the calibration/alignment procedures, and Section IV describes troubleshooting data. Figures 5.5 and 5.6 are the schematic diagrams for the AS210A-PM. Please contact the factory for any assistance required in the maintenance or servicing of the mainframes.

SECTION I

5-2 PREVENTIVE MAINTENANCE

Table 5-1 lists preventive maintenance checks and services which should be performed regularly.

Table 5-1

PREVENTIVE MAINTENANCE CHECKS AND SERVICES

ITEM	PROCEDURE
CABLES	Visually inspect cables for strained, cut, frayed, or otherwise damaged insulation.
CLEANLINESS	Make sure the exterior surfaces of the unit are clean. If necessary, clean exterior surfaces as follows: A. Remove the dust and loose dirt with a clean soft cloth. B. Remove dust or dirt from plugs and jacks with a brush. WARNING Use only warm soapy water for cleaning all plastic parts. Many solvents will cause the plastic to become brittle.
CORROSION	Make sure exterior surfaces of unit are free of rust and corrosion.
PRESERVATION	Inspect exterior surfaces of the unit for chipped paint or corrosion. If necessary, spot-paint surfaces as follows: A. Remove rust and corrosion from metal surfaces by lightly sanding them with sandpaper. B. Brush two coats of paint on base metal to protect it from further corrosion.

SECTION II

5-3 PERFORMANCE TESTING

This section describes the procedure to test the AS210A-PM Portable Mainframe to assure proper performance of the instrument. The mainframe must be used in conjunction with the AS210 Module Controller since the CPU in the AS210-01A monitors the circuits of the mainframe. If the mainframe fails any of these performance tests, please see Section III, Calibration/Alignment Procedures, and/or Section IV, Troubleshooting Procedures in this chapter.

5-4 INTERNAL FREQUENCY STANDARD ACCURACY TEST

The following is a procedure for quickly determining if the frequency standard located in the AS210A Mainframe is working. See Sections 5-11 and 5-12 for calibration. The output signal is accessible at the BNC output connector labeled 10 MHz, located on the rear panel of the mainframe. Table 5-2 contains the required equipment to perform this test.

Table 5-2
REQUIRED TEST EQUIPMENT FOR THE INTERNAL FREQUENCY STANDARD ACCURACY TEST

ITEM	RECOMMENDED TEST EQUIPMENT
ELECTRONIC COUNTER	HP-5345A
FREQUENCY STANDARD	HP-5061A or 5062C OPT 010
COAXIAL CABLE (2 Required)	3-foot long, 50 ohm, BNC

5-5 TEST PROCEDURE

A. Ensure that power is disconnected from the AS210 system before beginning this procedure.

B. Connect the equipment as indicated in Figure 5.1 and apply power to the AS210. The rubidium frequency standard in the AS210 system will require 20 minutes warm-up time to reach the specified frequency accuracy.

C. Monitor the display of the electronic counter. The reading should be 10,000,000 ±0.1 Hz. If the reading is not within the specification, see Section III, Calibration/Alignment Procedures, and/or Section IV, Troubleshooting Procedures.

D. Disconnect the frequency counter from the AS210 Mainframe.

5-6 INTERNAL FREQUENCY STANDARD DRIFT TEST

The following is a procedure for testing the drift of the internal frequency standard located in the AS210 Mainframe. The output signal is accessible at the BNC output connector labeled 10 MHz located on the rear panel of the mainframe. Table 5-3 contains the required equipment to perform this test.

Table 5-3
REQUIRED TEST EQUIPMENT FOR THE INTERNAL FREQUENCY STANDARD DRIFT TEST

ITEM	RECOMMENDED TEST EQUIPMENT
ELECTRONIC COUNTER	HP-5345A
FREQUENCY STANDARD	HP-5061A or 5062C OPT 010
COAXIAL CABLE	3-foot long, 50 ohm, BNC

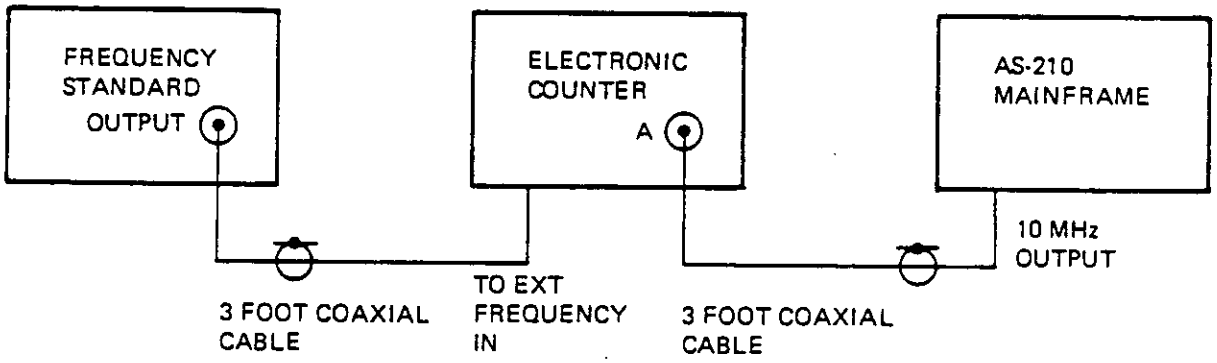

Figure 5.1 AS210 Internal Frequency Standard Test Configuration

5-7 TEST PROCEDURE WHEN USING AS210-01 MODULE CONTROLLER

A. Ensure that power is disconnected from the AS210 system before beginning.

B. Connect the equipment as indicated in Figure 5.2 and apply power to the AS210 system. The Rubidium frequency standard in the AS210 Mainframe will require 20 minutes warm-up time to reach the specified frequency accuracy.

C. Set the AS210-02 Frequency Comparator RATE switch to 1 PER HOUR.

D. Press RESET. The display should indicate "SEL?"

E. Press CONT. The display should indicate "CH 1-6".

F. Press 1, press ENTER. The display should indicate "SEL 10-".

G. Set the AS210-02 Frequency Comparator RANGE switch to 10^{-11}. Press CONT.

H. Allow the AS210 system to operate in this mode for 24 hours and 10 minutes.

I. Press HALT. The display should indicate "24 OFF".

J. Press DSPL. The display should indicate "SEL CH". Press 1, press ENTER.

K. Press CONT. Record the AS210-01 Module Controller's displayed measurement.

L. Repeat Step K until all 24 measurements are recorded.

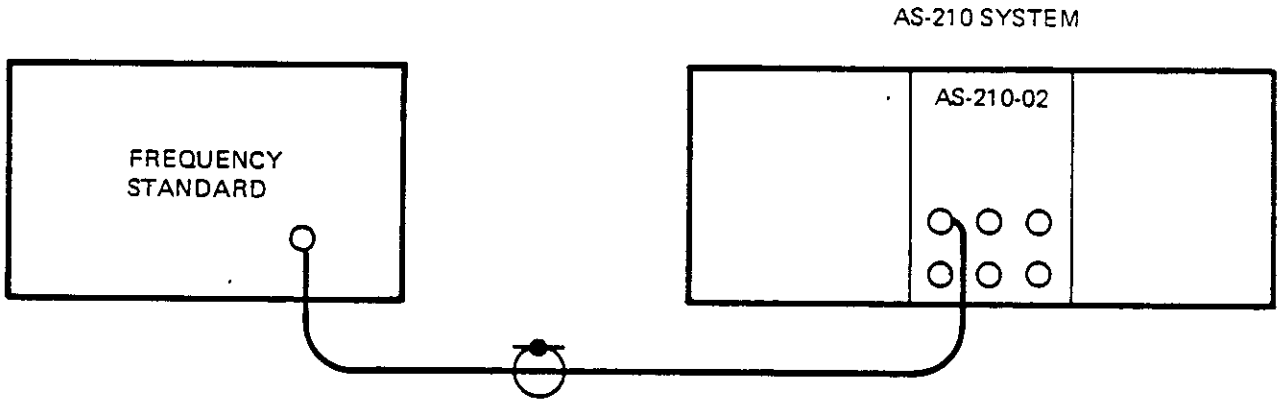

Figure 5.2 AS210 Internal Frequency Standard Drift Test Configuration

M. Compute the 24-hour AS210 internal frequency standard drift rate using the following equation and the results recorded from steps K and L.

$$\frac{\sum X_i Y_i - 276 \bar{Y}}{50} = \text{Drift rate per day}$$

with $X_i = 0, 1, 2, \ldots, 23$

$i = 1, 2, 3 \ldots, 24$

Y_i = AS210 measurement at the i^{th} hour

$$\bar{Y} = \frac{\sum Y_i}{24}$$

5-8 TEST PROCEDURE WHEN USING AS210-01A MODULE CONTROLLER

A. Repeat steps A through I of paragraph 5-7.

B. Press CALC. The display will be blank.

C. Press "YEAR".

D. The display will indicate "SEL CH".

E. Press "CONT".

F. "DP 1" will appear in display.

G. Press "2", "DP 2" will appear in display.

H. Press "CONT", last data point will automatically be selected.

I. Drift rate is displayed in display.

SECTION III

5-9 CALIBRATION/ALIGNMENT PROCEDURES

WARNING

The following calibration/alignment procedures (Chapter 5, Section III) and Troubleshooting Procedures (Chapter 5, Section IV) are for use by qualified personnel only. To avoid personal injury, do not perform any servicing other than that of routine maintenance (Chapter 5, Section I) and performance testing (Chapter 5, Section II) unless you are qualified to do so.

Figure 5.3 is a flow diagram of the calibration/alignment procedure for the AS210A-PM Portable Mainframe. Use this flow diagram with the theory of operation in Chapter 4, the text in this chapter, and the illustrated parts lists in Chapter 6. Please note it is not necessary to disassemble the AS210 system to determine if calibration/alignment is needed. For any assistance needed in performing this calibration/alignment procedure, please contact the factory.

5-10 AS210A-PM PORTABLE MAINFRAME DISASSEMBLY PROCEDURE FOR POWER MODULE REMOVAL AND INSTALLATION

WARNING

Dangerous voltages exist at several points throughout the power module. When the power module must be operated with the chassis removed, do not touch exposed connections or components. Disconnect power before cleaning the system or replacing parts.

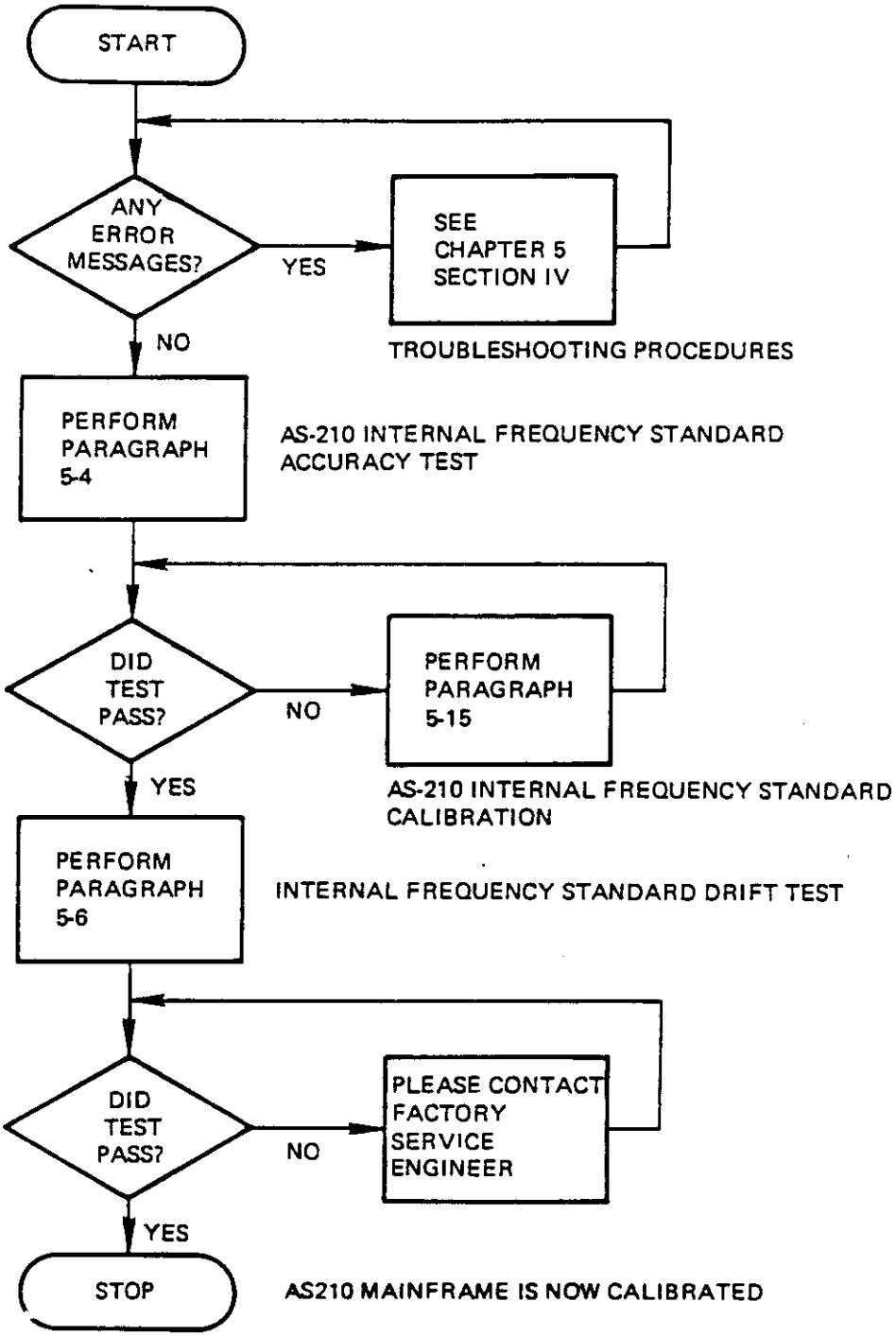

Figure 5.3 Flow Diagram of the Calibration/Alignment Procedure for the AS210 System Mainframe

Two thumbscrews on the rear panel secure the power module to the chassis. Loosen the thumbscrews and place the mainframe on end with the power module on the bottom. Lift the chassis vertically to separate the power module from the chassis. It may be necessary to use force between the motherboard and the chassis to loosen the power module. Do not operate the system with the chassis removed any longer than necessary. Reinstall the power module to protect the interior from dust and to avoid personnel shock hazards, as well as provide proper ventilation.

When reinstalling the power module in the chassis, set the chassis with the power module compartment facing up. Align the power module guide pins with their respective holes in the chassis. Tighten the thumbscrews of the power module with a straight-blade screwdriver. Plug-in modules may now be installed.

5-11 ACCESS TO MAINFRAME CIRCUITS

A. Ensure that the power is disconnected before beginning this procedure.

B. Follow the procedure described in paragraph 5-9 of this chapter to remove the power module from the AS210 chassis.

C. Using a phillips screwdriver, remove the two screws holding the internal/external time base circuit card.

D. Tilt the internal/external time base select circuit board up. This exposes filter capacitors and bridge rectifiers for troubleshooting. This also provides access to the tuning coil located on the internal/external time base circuit board.

5-12 AS210 INTERNAL FREQUENCY STANDARD CALIBRATION

The highly accurate internal rubidium frequency standard of the AS210 system is aligned initially at the factory. Figure 5.4 shows the calibration test equipment setup. Table 5-4 lists the recommended test equipment to calibrate the rubidium frequency standard. The output frequency (10 MHz) of the rubidium which is being calibrated or tested is compared to the output frequency (5 MHz) of a reference standard by the Tracor 537A Frequency Difference Meter. Refer to the Tracor 537A operator's manual for specific operation procedures for this instrument. The output of the Tracor instrument is a voltage proportional to the difference in frequency of the test source and the reference source. This voltage is put through a lowpass filter and then applied to an HP-7132A chart recorder. This Hewlett-Packard instrument uses HP-9280-0444 strip chart paper. The chart recorder gives a chart record of the frequency difference versus time. When the Tracor 537A unit is selected to an accuracy of 1 part in 10^{10} and the HP-7132A unit is properly adjusted to center the recording pen at the center of the strip chart, a range of $\pm 5 \times 10^{-10}$ parts with a resolution of 1×10^{-11} parts per minor division on the strip chart is achievable. The paper chart output of this calibration process shows the difference in frequency between the frequency standard and the output frequency of the AS210 unit under test as well as the frequency drift in time between the two sources. The AS210 Rubidium Frequency Standard should be warmed-up sufficiently before any alignment is attempted. See paragraph 5-13 of this chapter for the rubidium frequency standard output frequency adjustment procedure.

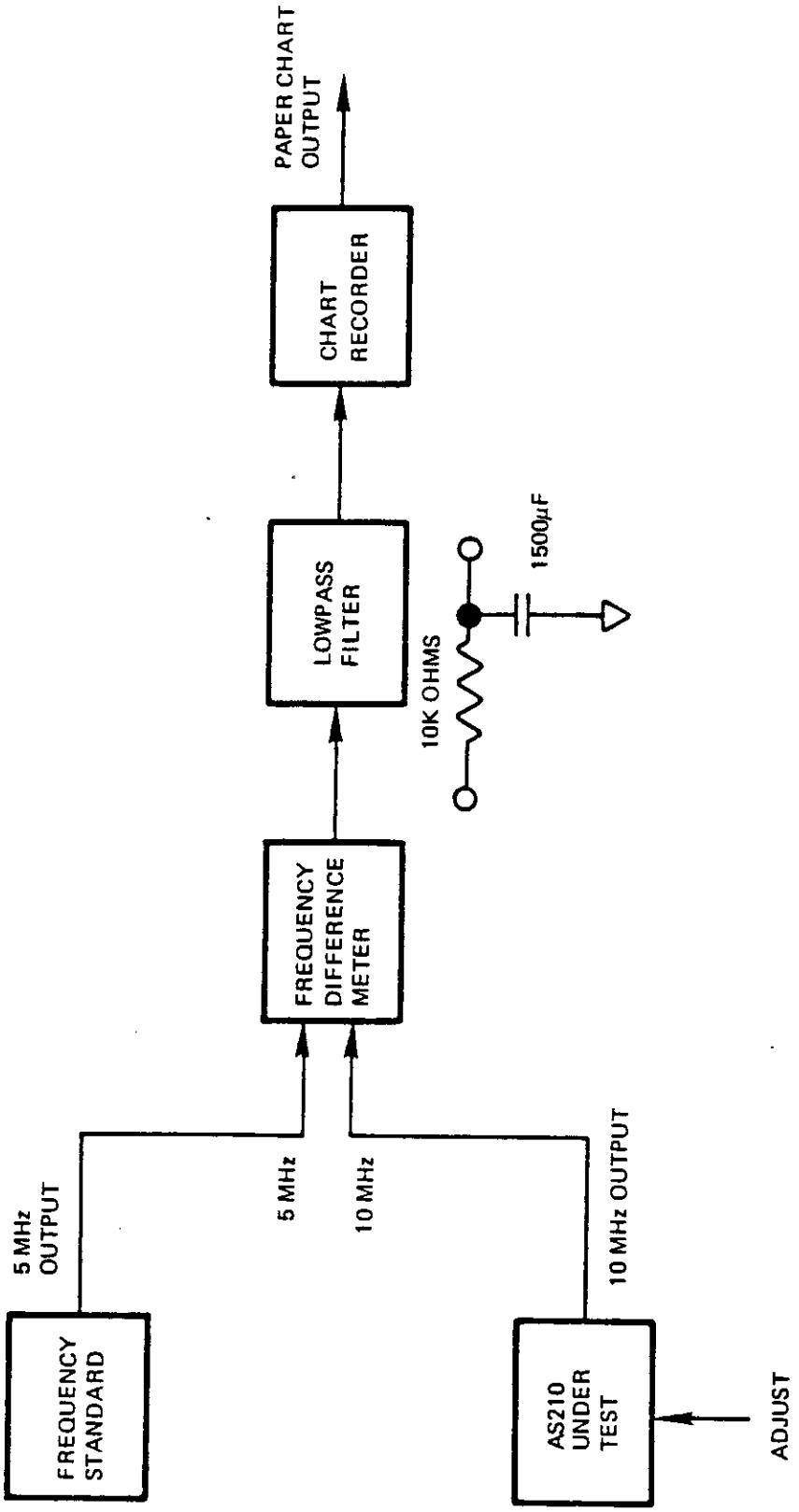

Figure 5.4 Block Diagram of Rubidium Frequency Standard Calibration Configuration

Table 5-4

TEST EQUIPMENT FOR THE AS210 INTERNAL FREQUENCY STANDARD CALIBRATION CONFIGURATION

ITEM	RECOMMENDED TEST EQUIPMENT
FREQUENCY STANDARD	HP-5061A or 5062C OPT 010
FREQUENCY DIFFERENCE METER	TRACOR 537A
LOWPASS FILTER	10 Kohms, 1500 F
CHART RECORDER	HP-7132A
PAPER CHART REFILL	HP-9280-0444
COAXIAL CABLE (4 Required)	3-foot long, 50 ohm, BNC

5-13 AS210 INTERNAL RUBIDIUM STANDARD OUTPUT FREQUENCY ADJUSTMENT

The highly accurate internal rubidium standard may be adjusted within the range of $\pm 5 \times 10^{-10}$ with a resolution of 3×10^{-11}. The reference frequency adjustment control is located on the rear panel labeled ADJUST. After the AS210 Rubidium Frequency Standard has sufficiently warmed up, the frequency may be changed by monitoring the output with the test setup described in paragraph 5-4. Turn the ADJUST control until the desired output is achieved.

5-14 AS210 TIME BASE SELECTOR PHASE-LOCKED OSCILLATOR ALIGNMENT PROCEDURE

In the AS210 Mainframe there is a phase-locked oscillator (PLO) located on the internal/external time base selector assembly. Table 5-5 lists the recommended test equipment to align the PLO. To align the mainframe PLO, use the following procedure:

A. Obtain access to the mainframe internal/external time base selector assembly by applying the disassembly procedures discussed in first part of this section.

B. Apply an RF signal to input BNC on the rear panel. The input signal must be 1, 5, or 10 MHz of a level equal to or greater than 1.0 VRMS.

C. Set the reference frequency internal/external selector switch located on the rear panel, to the EXT position.

D. With the oscilloscope, monitor the TUNE test point on the internal/external time base selector assembly. The TUNE test point should have a dc voltage between +2V and +8 Vdc. If this voltage is not within +2V and +8 Vdc, then go to E. Otherwise go to F.

E. With L2 at fully CCW, adjust in a CW direction. The tune TP should start at a +12 Vdc level. Adjust L2 until the level on the TUNE test point passes through a minimum dc level. Continue adjustment until a level of +8 Vdc is obtained.

F. Reassemble the mainframe.

Table 5-5

TEST EQUIPMENT FOR ALIGNMENT OF THE EXTERNAL TIME BASE SELECTOR PHASE-LOCKED OSCILLATOR

ITEM	RECOMMENDED TEST EQUIPMENT
FREQUENCY SYNTHESIZER	HP-8656A
OSCILLOSCOPE WITH PROBES	Tektronix 465 or Equivalent
COAXIAL CABLE	3-foot long, 50 ohm, BNC

SECTION IV

5-15 TROUBLESHOOTING PROCEDURES

Troubleshooting of the AS210 system mainframe is facilitated by error codes displayed on the AS210 Module Controller. Table 5-6 correlates the error code displayed on the module controller when a fault occurs to the malfunction. An explanation of the problem is provided with possible solutions.

5-16 POWER SUPPLY FAILURE

If a power failure occurs in any of the supplies, check the fuses located on the front of the motherboard. Fuse F1 is a five ampere SLO-BLO and fuses F2-F5 are three ampere SLO-BLO. If one of the +5 volt regulated supplies fails and fuse F1 is not open, then check fuses F6 and F7 located on the lower center part of the motherboard. If the same problem arises after replacing the fuse(s), check the load on the failed supply for shorts.

5-17 COMPENSATION OF CRYSTAL AGING

Remove power module from chassis as described in paragraph 5-9. Monitor the dc voltage on pin 6 of the rubidium frequency standard; that voltage should be approximately +8 volts $\pm$2 volts. If the quartz crystal oscillator voltage approaches the end of the control range, a correction of the crystal oscillator base frequency must be made. This is accomplished by adjusting the oscillator trimmer. The trimmer is located on the side of the rubidium under the phillips screw, which is visible when looking at the side of the power supply where the rubidium is located. A clockwise adjustment of the trimmer causes an increase in control voltage. The adjustment should be made after the unit has been operated for at least one hour. The control voltage should be set for 8 Vdc.