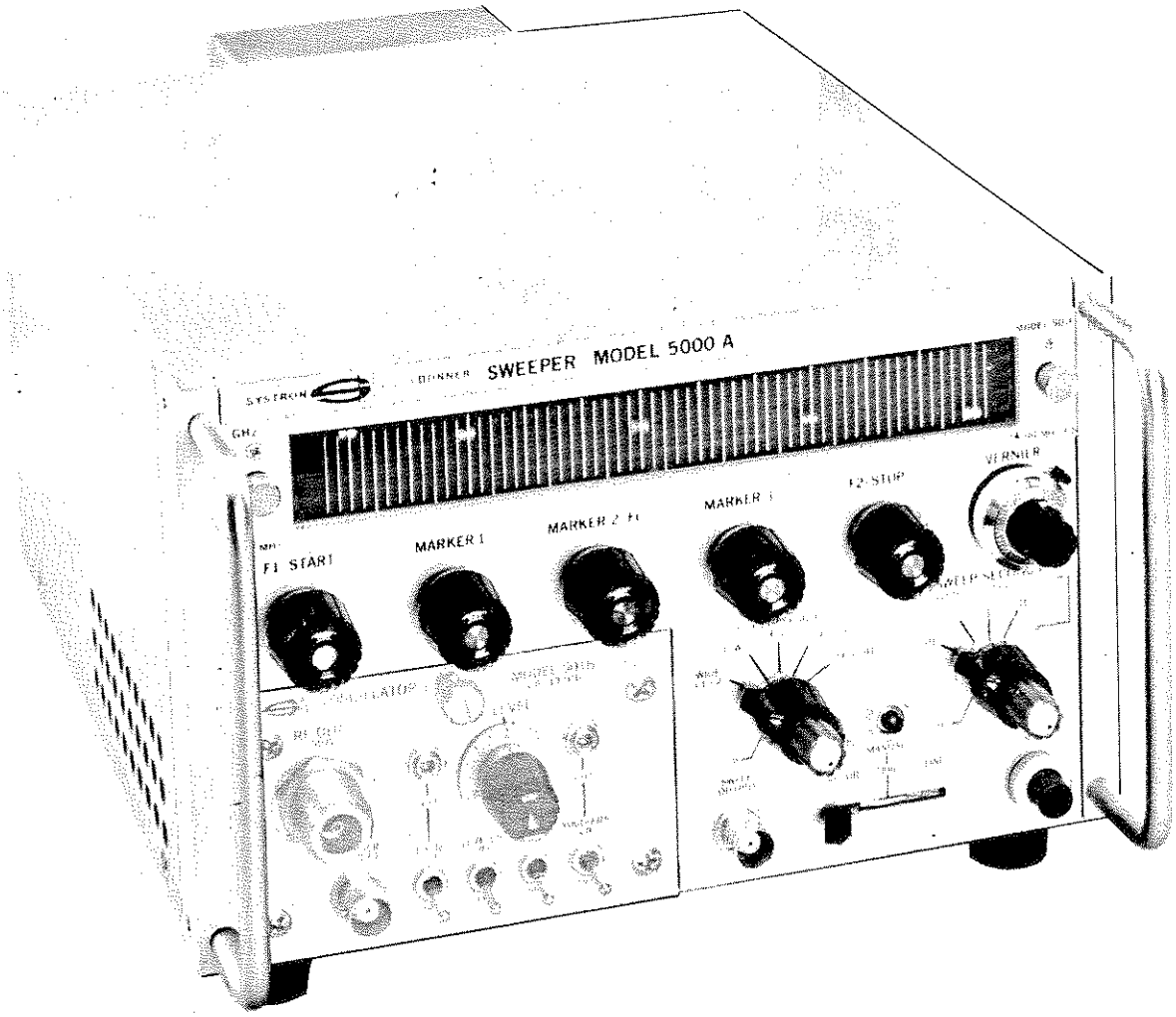
OPERATION AND SERVICE MANUAL



MODEL 5000A

SWEEPER MAINFRAME

MICROWAVE DIVISION

SYSTRON DONNER CORPORATION

TEST AND MEASUREMENT GROUP

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SECTION I

GENERAL INFORMATION

1-1. SCOPE

This manual provides general information, installation data, operating instructions, circuit descriptions, maintenance data, performance checks, calibration procedures, parts lists, and circuit diagrams for the Systron-Donner (Microwave Division) Model 5000A Sweeper Mainframe.

The Model 5000A Sweeper Mainframe, hereinafter referred to as the Model 5000A, the 5000A, or the mainframe, is shown in Figure 1-1 with a typical RF plug-in installed. Instruction manuals for the various RF and adapter plug-ins are supplied separately with each plug-in, and the information contained in these manuals is not duplicated herein.

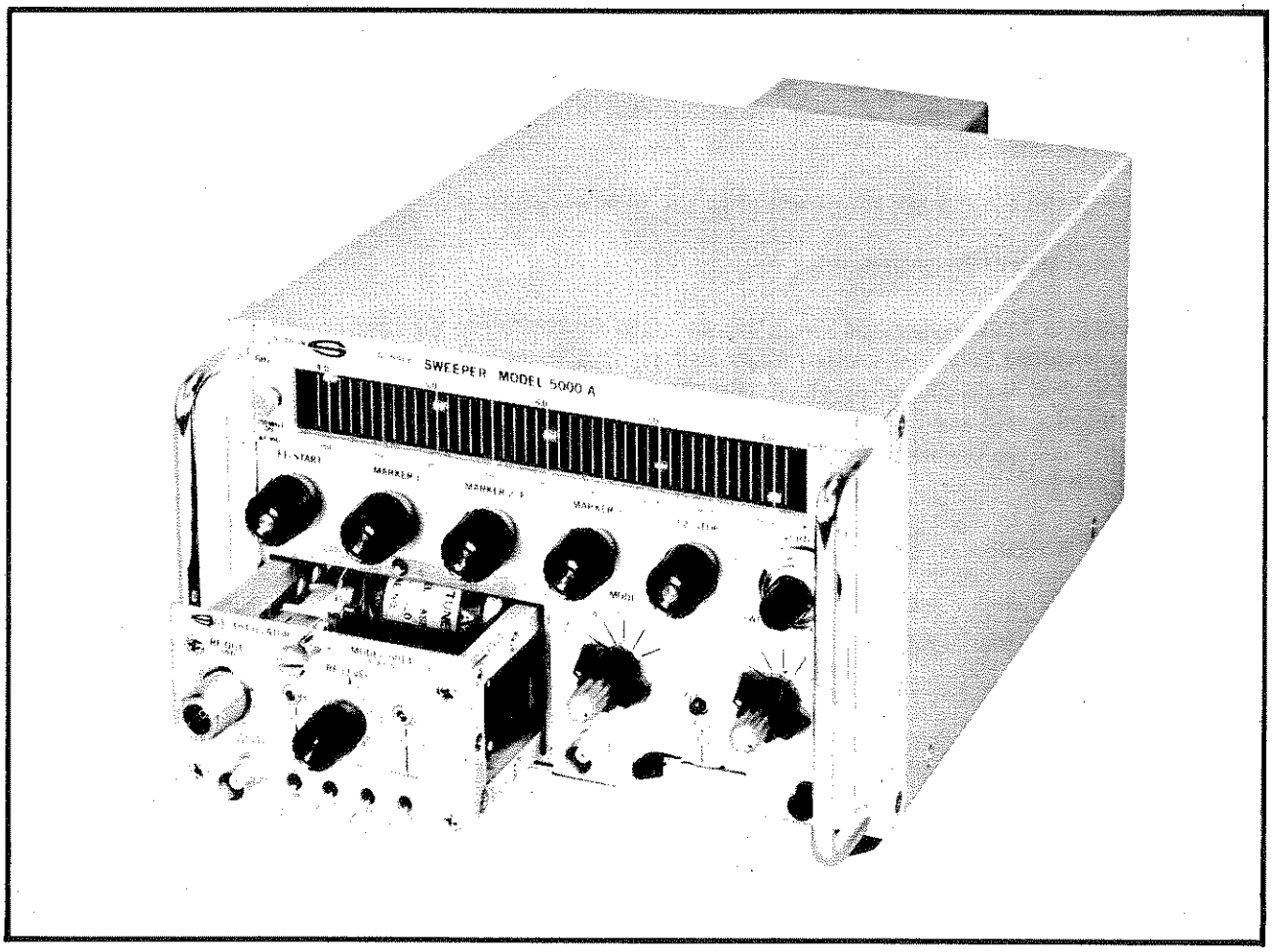


Figure 1-1. Model 5000A Sweeper Mainframe

1-2. DESCRIPTION OF EQUIPMENT

The Model 5000A accepts a variety of swept RF generator plug-in units operating over the 100 kilohertz to 26.5 gigahertz region. Each RF plug-in is supplied with a plastic frequency dial scale calibrated for the range of the plug-in. This dial scale is attached to the mainframe with the plug-in for simple frequency range changes.

Major subassemblies of the 5000A are the power supply module, the power supply regulator boards and rear-panel mounted regulator transistors, two sweep generator boards, three mode generator boards, a marker generator board, the dial system assembly, and front-panel mounted operating mode switches. Most of the printed circuit assemblies are interconnected with the 5000A through chassis-mounted board-edge connectors.

1-3. CAPABILITIES AND PERFORMANCE

The Model 5000A provides versatile power supply and control signal outputs for operation of swept microwave RF sources to cover the electromagnetic spectrum presently in common use. These RF sources are intended for use in laboratory or field tests of electronic communications components, subsystems, and systems by offering a precisely-calibrated alternative to time-consuming point-by-point testing of amplitude versus frequency characteristics over wide ranges.

The power supplies provide four separate outputs for maximum versatility of plug-in operation.

Detailed performance specifications for the Model 5000A are given in Table 1-1. Detailed performance specifications for the various RF and sweeping current supply plug-in units are supplied in the applicable manuals.

Salient features of the 5000A are summarized in the following paragraphs.

1-3.1 External Power Requirements

The 5000A operates from sinusoidal single-phase 50 or 60 Hertz (to 400 Hertz on special order) power lines supplying nominal levels of 94 to 127 or 187 to 253 volts rms (root mean square). These supply voltages are available throughout most of the world. The IEC-approved power line connector on the chassis of the 5000A will readily mate with a variety of power cables available locally to meet specific power connector pin configurations. A power cable is supplied for connection to grounded 115 volt power line receptacles.

1-3.2 Output Range

The frequency range of the 5000A is determined by the RF plug-in unit used. Each RF plug-in covers a single band with the operating frequency indicated on a slide rule dial accurate to within one percent of the dial reading.

A sweeping current power supply plug-in, Model 5222A, is also available for the 5000A. The output current, up to one Ampere, is indicated on the supplied dial scale.

1-3.3 Wide Sweep Capacity

Some RF plug-in units are available to cover extreme bandwidths. These units sweep over a range of several octaves in a single band.

1-3.4 Multiple Sweep Modes

Several operating modes are available: F1-F2 sweep mode, commonly called *wide* sweep mode, allows a frequency sweep to be started at any desired frequency within the range of the plug-in and terminated at any other such frequency. For narrow sweeps, Fc ± ΔF sweep mode (commonly called ΔF mode) allows the output of the plug-in to be swept or deviated symmetrically about a selected center frequency. The center frequency and deviation are calibrated functions. A non-swept (CW) output mode is also available, or the frequency may be controlled by a voltage source external to the 5000A.

1-3.5 Extended Sweep Rates

Sweep repetition rates of less than 10 milliseconds to over 100 seconds are available, as is manual sweep control.

1-3.6 Sweep Trigger Modes

Each frequency sweep may be initated internally at the end of the previous sweep, synchronized with power line frequency, initiated manually with a front-panel pushbutton, or initiated electrically with an external triggering signal.

1-3.7 Amplitude Modulation Modes

The output amplitude of the RF plug-in is controlled by switches on its own front panel to turn the output on and off at a one kilohertz rate, turn the output off only during sweep retrace time, reduce the output amplitude at marker points, or modulate the amplitude with the signal from an external leveler. An external amplitude control signal may be coupled through the rear-panel **EXT'L A.M.** jack directly to the RF plug-in.

1-3.8 Display Blanking Output

An output of plus 19 volts available during the sweep retrace period or while awaiting a sweep trigger signal may be used to eliminate the trace from the CRT display unit or X-Y recorder.

1-3.9 Optional Configurations

1-3.9.1 OPTION M1 NEGATIVE BLANKING. Model 5000A mainframes equipped with this option have a blanking output pulse with an amplitude of approximately minus 19 volts; the blanking pulse output of a standard 5000A is approximately plus 19 volts.

1-3.9.2 OPTION M3 POSITIVE TUNING REFERENCE. Model 5000AM3 has an adjustable output of zero to plus 10 volts (minimum) to zero to plus 35 volts (maximum) proportional to the RF output frequency of the plug-in. This output is used to drive some swept response analyzers and network analyzers such as the Hewlett-Packard 8410B and its accessories. The positive tuning reference output is in addition to the standard zero to plus 10 volt sweep output and the zero to minus 10 volt frequency volts output present in all 5000A's. Option M3 is not available in units equipped with Option M10.

1-3.9.3 OPTION M10 REMOTE CONNECTORS. Two multi-pin connectors added to the rear panel of the 5000A carry sweep, blanking, and marker output signals to a display unit and operating power to an accessory unit. The 5000AM10 is provided in many Systron-Donner test sets to reduce interconnection cabling between it and the Model 7000M1 Display Unit and to provide operating power for the Model 1206 IF Amplifier. Option M10 is not available in units equipped with Option M3.

1-3.9.4 OPTION M16 EXTENDED POWER LINE FREQUENCY RANGE. Model 5000A mainframes are normally supplied for operation from 50 or 60 Hertz power sources. Model 5000AM16 will operate from power line frequencies of 50 to 400 Hertz. (400 Hertz power lines are commonly found on aircraft and ships.)

1-4. ACCESSORIES

1-4.1 Accessories Supplied with 5000A

1-4.1.1 EXTENDER BOARD. Each 5000A is supplied with a printed circuit board extender assembly part number 950007. The extender, a servicing aid used with the other plug-in printed circuit assemblies, is stored inside the 5000A near the rear panel.

1-4.1.2 PHASE LOCK PLUG. One Model 9106 miniature phone plug is supplied with the 5000A; this plug mates with the rear-panel **PHASE LOCK** jack. The 9106 is supplied with a shorting wire in place but not soldered.

1-4.2 Optional Accessories

1-4.2.1 MODEL 9001 STORAGE CABINET. The storage cabinet holds four 5000-series RF plug-ins, keeping the plug-ins readily available and preventing loss of dial scales or damage to the plug-ins. When used with the Model 9004 rack-mounting kit (not included with 9001), the 5000A and 9001 bolt together to form a unit in 5¼ inches of standard 19-inch EIA rack space.

1-4.2.2 MODEL 9002 RACK ADAPTER CABINET. Model 9002 is a filler cabinet to allow mounting the half-rack width 5000A in a standard 19-inch EIA rack. No additional rack-mounting hardware is required; all necessary parts are included with the 9002.

1-4.2.3 MODEL 9004 RACK MOUNTING KIT. This kit contains the plates, handles, and all other hardware required for mounting the 5000A side-by-side with the 9001 Storage Cabinet or another half-rack instrument in 5¼ inches of rack space.

1-4.2.4 MODEL 9016 RACK MOUNTING KIT. This kit contains all hardware required to mount a 5000A Sweeper Mainframe and a Model 7000 Display Unit side-by-side in 5¼ inches of rack space.

1-4.2.5 MODEL 9107 PEN LIFT RELAY. In some cases, the plus 19 volt blanking output signal (minus 19 volts for 5000AM1) may not be the correct amplitude for blanking the sweep retrace. Many X-Y recorders require an external contact closure to drop or to lift the recording pen; the 9107 relay has single-pole, double-throw contacts rated for one Ampere at 115 volts ac (250 milliamperes at 24 volts dc) to serve this purpose when required.

1-4.2.6 MODEL 9041 TRANSIT CASE. Each pressure-molded fiberglass transit case will accommodate one Model 5000A with any plug-in; the handles are padded for easy carrying.

1-4.2.7 MODEL 9201 TEST PLUG-IN. This unit plugs into the 5000A in place of an RF plug-in, simulating the maximum power supply and heat load of a properly-operating plug-in. Each pin of the interface connector is brought out to a test point on the front panel of the 9201 to aid in calibration or troubleshooting of the 5000A.

1-4.2.8 MODEL 9202 EXTENDER. This unit fits between the 5000A and the plug-in unit to allow access to the calibration components and internal circuitry of the plug-in.

1-4.2.9 MODEL 9203 INVERTER. Used in conjunction with the 9202 Extender, this maintenance accessory allows physical inversion of the plug-in unit for easier testing or trouble isolation of the lower printed circuit assembly.

1-4.2.10 FLEXIBLE PLUG-IN EXTENSION. Any plug-in may be operated outside the 5000A mainframe using this 24-inch extension cable. Part number 109618 flexible extension is intended for trouble isolation and repair of plug-ins; it should not be used for final frequency or power level calibration because of voltage drops in the wires which carry high currents to the plug-in.

1-4.2.11 MODEL 9210 CALIBRATION DIAL. Recalibration of the frequency dial assembly may be necessary after parts replacement; in general, the dial scale supplied with an RF plug-in may be used for calibration of the 5000A. The 9210 calibration dial is recommended for facilities which have several 5000A's and several plug-ins of various ages and which need an absolute standard dial scale.

Table 1-1. Performance Specifications

ITEM	PARAMETER	SPECIFICATION
1	**Plug-in Compatibility**	
1.1	RF Plug-ins	All 5000-series RF plug-ins
1.2	RF Modules	All 525-series RF modules may be tested and calibrated with the 5000A using a 9202 Extender or 109618 flexible extension cable
1.3	Sweeping Current Supply Plug-ins	5222 and 5222A
1.4	Test Plug-in	9201
1.5	Extender Plug-in	9202
2	**Operating Modes**	
2.1	Wide F1—F2 Mode	Output frequency of RF plug-in is swept or manually scanned from limit set by **F1—START** control to limit set by **F2—STOP** control:
2.1.1	Band Coverage	100% of plug-in bandwidth
2.1.2	Sweep Direction	Up-band or down-band
2.1.3	Calibration Error	⩽ ±2%
2.2	CW Mode	Output frequency of RF plug-in is a discrete frequency set by **MARKER 2—Fc** control:
2.2.1	Band Coverage	100% of plug-in bandwidth
2.2.2	Calibration Error	⩽ ±2%
2.3	Fc ± ΔF x 1 Mode	Output frequency of RF plug-in is swept or manually scanned about a center frequency set by **MARKER 2—Fc** control:
2.3.1	Maximum Band Coverage	10% of plug-in bandwidth (**Fc ± ΔF VERNIER** set to **CALIB**)
2.3.2	Minimum Band Coverage	< 0.01% of plug-in bandwidth (**Fc ± ΔF VERNIER** set to **0**)
2.3.3	Sweep Direction	Up-band
2.3.4	Calibration Error	⩽ ±10% of indicated bandwidth
2.4	Fc ± ΔF x .1 Mode	Output frequency of RF plug-in is swept or manually scanned about a center frequency set by **MARKER 2—Fc** control:
2.4.1	Maximum Band Coverage	1% of plug-in bandwidth (**Fc ± ΔF VERNIER** set to **CALIB**)
2.4.2	Minimum Band Coverage	<0.01% of plug-in bandwidth (**Fc ± ΔF VERNIER** set to **0**)
2.4.3	Sweep Direction	Up-band
2.4.4	Calibration Error	⩽ 10% of indicated bandwidth

Table 1-1. Performance Specifications (Continued)

ITEM	PARAMETER	SPECIFICATION	
2	Operating Modes (Cont.)		
2.5	Fc ± ΔF x .01 Mode	Output frequency of RF plug-in is swept or manually scanned about a center frequency set by **MARKER 2—Fc** control:	
2.5.1	Maximum Band Coverage	0.1% of plug-in bandwidth (**Fc ± ΔF VERNIER** set to **CALIB**)	
2.5.2	Minimum Band Coverage	< 0.01% of plug-in bandwidth (**Fc ± ΔF VERNIER** set to **0**)	
2.5.3	Sweep Direction	Up-band	
2.5.4	Calibration Error	⩽ 10% of indicated bandwidth	
3	**Frequency Range**	Depends on RF plug-in used	
4	**Frequency Accuracy**	± 1% of indicated frequency at +25°C ambient and full rated RF output power of plug-in (worst-case combination of 5000A and RF plug-in specifications)	
5	**Frequency Vernier**		
5.1	Modes	Wide F1-F2, Fc ± ΔF, and CW	
5.2	Calibration	Calibrated in frequency as indicated by dial scale supplied with plug-in; vernier frequency adds to frequency shown by dial frequency indicators.	
5.3	Calibration Error	⩽ ± 10% of indicated frequency	
6	**Sweep Trigger**		
6.1	Recurrent Mode	New sweep is automatically initated ≈ 3 ms after end of retrace	
6.2	Triggered Mode	Each sweep is initiated by the front-panel **MANUAL** pushbutton or by an external trigger pulse to the rear-panel **EXT'L TRIG** connector:	
6.2.1	Amplitude	⩾ +3 V	
6.2.2	Pulse Width	⩾ 1 μs	
6.2.3	Input Impedance	≈ 10 kΩ	
6.3	Line Trigger Mode	Start of each sweep is syncrhonized with positive peak of power line frequency	
7	**Sweep Speeds**	Vernier at X1	Vernier at X10
7.1	.01 Seconds		
7.1.1	Forward Trace	8.5—9.5 ms	94—104 ms
7.1.2	Retrace	0.8—1.2 ms	0.8—1.2 ms

Table 1-1. Performance Specifications (Continued)

ITEM	PARAMETER	SPECIFICATION	
7	Sweep Speeds (Cont.)	Vernier at X1	Vernier at X10
7.2	.1 Seconds		
7.2.1	Forward Trace	85—95 ms	940—1040 ms
7.2.2	Retrace	8—12 ms	8—12 ms
7.3	1 Second		
7.3.1	Forward Trace	0.85—0.95 s	9.4—10.4 s
7.3.2	Retrace	80—120 ms	80—120 ms
7.4	10 Seconds		
7.4.1	Forward Trace	8.5—9.5 s	94—104 s
7.4.2	Retrace	0.8—1.2 s	0.8—1.2 s
8	Manual Scan	Manually varies frequency between limits set in Wide F1—F2 Mode or Fc ± ΔF Mode	
9	External Sweep	External input voltage through **EXT'L SWEEP** connector adds to voltage determined by setting of **F1—START** control (Wide F1—F2 Mode) or **MARKER 2—Fc** control (CW and Fc ± ΔF Modes). **F2—STOP** control has no effect:	
9.1	Amplitude	0 to +10 V	
9.2	Input Impedance	≈ 25 kΩ	
9.3	Coupling	DC	
9.4	3 dB Bandwidth	10 kHz	
10	Sweep Output	Front and rear-panel **SWEEP OUTPUT** connectors	
10.1	Internal Sweep		
10.1.1	Modes	Wide F1—F2 and Fc ± ΔF	
10.1.2	Waveform	Linear ramp (sawtooth)	
10.1.3	Amplitude	0 V ±40 mV to +10 V ±40 mV	
10.1.4	Linearity Error	⩽ ±0.5% from straight line	
10.1.5	Output Impedance	< 100 Ω	
10.1.6	Current	10 mA max.	
10.2	Manual Scan		
10.2.1	Modes	Wide F1—F2 and Fc ± ΔF	
10.2.2	Waveform	Output voltage proportional to frequency	
10.2.3	Amplitude	0 V ±100 mV to +10 V ±100 mV	
10.2.4	Output Impedance	< 100 Ω	
10.2.5	Current	10 mA max.	

Table 1-1. Performance Specifications (Continued)

ITEM	PARAMETER	SPECIFICATION
10	Sweep Output (Cont.)	
10.3	External Sweep	
10.3.1	Modes	Wide F1—F2, Fc ± ΔF, and CW
10.3.2	Waveform	Identical to input signal
10.3.3	Amplitude	Identical to input signal
10.3.4	Output Impedance	Depends on input signal generator
10.3.5	Current	Depends on input signal generator
11	RF Blanking	+4.2 ±0.2 V during sweep retrace
12	Blanking Output	Rear-panel **BLANKING OUTPUT** connector
12.1	Internal Sweep, 5000A	Normally-supplied configuration
12.1.1	Modes	Wide F1—F2 and Fc ± ΔF
12.1.2	Waveform	Positive Pulse
12.1.3	Amplitude, Forward Sweep	≈ −600 mV
12.1.4	Amplitude, Sweep Retrace	+18 to +20 V
12.1.5	Pulse Period	Identical to sweep retrace period in recurrent sweep mode; refer to Item 7 of this table
12.1.6	Output Impedance	≈ 1 kΩ
12.2	Internal Sweep, 5000AM1	With negative blanking Option
12.2.1	Modes	Wide F1—F2 and Fc ± ΔF
12.2.2	Waveform	Negative pulse
12.2.3	Amplitude, Forward Sweep	≈ −200 mV
12.2.4	Amplitude, Sweep Retrace	−18 to −20 V
12.2.5	Pulse Period	Identical to sweep retrace period in recurrent sweep mode; refer to Item 7 of this table
12.2.6	Output Impedance	≈ 1 kΩ
12.3	Manual Scan	Blanking output fixed at ≈ −600 mVdc (5000A) or ≈ −200 mVdc (5000AM1)
12.4	External Sweep	Blanking output fixed at ≈ −600 mVdc (5000A) or ≈ −200 mVdc (5000AM1)
13	Frequency Reference Output	All 5000A configurations
13.1	Modes	All; rear-panel **FREQ VOLT** connector monitors frequency reference signal coupled to plug-in
13.2	Amplitudes	
13.2.1	Minimum	0 V
13.2.2	Maximum	−10 V
13.2.3	Lowest Usable Limit of Plug-in	−0.100 V
13.2.4	Highest Usable Limit of Plug-in	−9.900 V

Table 1-1. Performance Specifications (Continued)

ITEM	PARAMETER	SPECIFICATION
13	**Frequency Reference Output (Cont.)**	
13.2.5	24.5% of Rated Band	−2.585 V
13.2.6	50% of Rated Band	−5.000 V
13.2.7	74.5% of Rated Band	−7.415 V
13.3	Linearity Error	
13.3.1	5000A Only	⩽ ±0.5%
13.3.2	5000A and Plug-in	⩽ ±1%
13.4	Output Impedance	≈ 1 kΩ
14	**Positive Frequency Reference Output**	5000AM3
14.1	Modes	All
14.2	Amplitudes	Proportional to frequency of RF plug-in
14.2.1	Minimum	0 V
14.2.2	Maximum	Adjustable +10 to +35 V
14.3	Output Impedance	≈ 10 Ω
15	**Markers**	
15.1	Wide F1—F2 Mode	
15.1.1	Marker Coverage	100% of Band
15.1.2	Markers Available	Marker 1, Marker 2, and Marker 3
15.1.3	Marker Frequency Calibration	Direct-reading in frequency
15.1.4	Calibration Error	⩽ ±1%
15.2	Fc ± ΔF Mode	
15.2.1	Marker Coverage	±5% of Band
15.2.2	Markers Available	Marker 1 and Marker 3
15.2.3	Marker Frequency Calibration	Reading in frequency offset from Fc
15.2.4	Calibration Error	⩽ ±10%
15.3	Marker Output	Rear-panel MARKER OUTPUT connector
15.3.1	Waveform	Triangular pulse
15.3.2	Marker 1 Amplitude	⩾ −1.0 V peak
15.3.3	Marker 2 Amplitude	⩾ −1.2 V peak
15.3.4	Marker 3 Amplitude	⩾ −1.0 V peak
15.3.5	Output Impedance	≈ 3 kΩ

Table 1-1. Performance Specifications (Continued)

ITEM	PARAMETER	SPECIFICATION
16	Quieting	Output activates tuning-bandwidth rate limit circuitry in RF plug-in:
16.1	Modes	CW and Manual Scan
16.2	Amplitude	
16.2.1	CW Mode	+3 to +6.5 Vdc
16.2.2	Manual Scan Mode	+4 to +7 Vdc
18	1 kHz Output	Rear-panel **1 KHZ OUTPUT** connector carries 1 kHz output of RF plug-in; refer to RF plug-in manual for detailed specifications:
17.1	Waveform	Square Wave
17.2	Frequency	1000 Hz nominal
17.3	Adjustment Range	$\geqslant$ ±50 Hz (set by RF plug-in)
17.4	Amplitude	$\approx$ +2 V peak
17.5	Output Impedance	$\approx$ 1 kΩ
18	External Amplitude Modulation	Rear-panel **EXT'L A.M.** connector couples external input directly to RF plug-in; refer to appropriate RF plug-in manual for specifications
19	Phase Lock	Rear-panel **PHASE LOCK** connector couples external input directly to RF plug-in; refer to appropriate RF plug-in manual for specifications
20	Power Input	
20.1	Voltages	104 V ±10% (93.6 to 114.4 Vac) 115 V ±10% (103.5 to 126.5 Vac) 208 V ±10% (187.2 to 228.8 Vac) 230 V ±10% (207 to 253 Vac)
20.2	Frequency	
20.2.1	5000A	47—63 Hz
20.2.2	5000AM16	50—400 Hz
20.3	Phase	1 ϕ
20.4	Power	$\leqslant$ 90 VA
21	Power Supplies	
21.1	+30 V Output	
21.1.1	Tolerance	+30.0 Vdc ±100 mVdc
21.1.2	Current Limit	800 ±50 mA

Table 1-1. Performance Specifications (Continued)

ITEM	PARAMETER	SPECIFICATION
21	Power Supplies (Continued)	
21.1.3	Current Distribution	20 mA used in 5000A mainframe with 780 mA available for plug-in (a combined total of 1.0 A is available from the +30 V and +20 V outputs)
21.1.4	Load Regulation	⩽ 0.01% (±3 mVdc change for 0 to 600 mA load current)
21.1.5	Line Regulation	⩽ 0.01% (±3 mVdc change for ±10% change in line voltage)
21.1.6	Ripple @ 600 mA Load	⩽ 300 μV p-p, 1 Hz—30 kHz bandwidth
21.2	+20 V Output	
21.2.1	Tolerance	+20 Vdc ±20 mVdc
21.2.2	Current Limit	1.2 A ±100 mA
21.2.3	Current Distribution	200 mA used in 5000A mainframe, with 1.0 A available for plug-in (a combined total of 1.0 A is available from the +20 V and +30 V outputs)
21.2.4	Load Regulation	⩽ 0.01% (±2 mVdc change for 0 to 1.0 A load)
21.2.5	Line Regulation	⩽ 0.01% (±2 mVdc change for ±10% change in line voltage)
21.2.6	Ripple @ 1.0 A Load	⩽ 200 μV p-p, 1 Hz—30 kHz bandwidth
21.3	−20 V Output	
21.3.1	Tolerance	−20 Vdc ±20 mVdc
21.3.2	Current Limit	1.2 A ±100 mA
21.3.3	Current Distribution	200 mA used in 5000A mainframe with 1.0 A available for plug-in
21.3.4	Load Regulation	⩽ 0.01% (±2 mVdc change for 0 to 1.0 A load)
21.3.5	Line Regulation	⩽ 0.01% (±2 mVdc change for ±10% change in line voltage)
21.3.6	Ripple @ 1.0 A Load	⩽ 200 μV p-p, 1 Hz—30 kHz bandwidth
21.4	+250 V Output	
21.4.1	Tolerance	+250 Vdc ±25 Vdc (no load)
21.4.2	Current	40 mA available; output voltage decreases to ≈ 100 Vdc
21.4.3	Regulation	Unregulated
21.4.4	Ripple	⩽ 1 V p-p (no load)
22	Environment	
22.1	Operating Temperature	0 to +55°C (+32 to +131°F) ambient
22.2	Storage Temperature	−55 to +85°C (−67 to +185°F) ambient
22.3	Altitude	0 to 10,000 feet (3,05 km)

Table 1-1. Performance Specifications (Continued)

ITEM	PARAMETER	SPECIFICATION
23	Dimensions	
23.1	Height	5.25 in. (13,3 cm)
23.2	Width	8.50 in. (21,6 cm)
23.3	Total Depth	13.5 in. (34,3 cm)
23.4	Depth from Front Panel	11.75 in. (29,9 cm)
24	Weight (without plug-in)	≈ 15 lbs (6,8 kg)

SECTION II

INSTALLATION

2-1. UNPACKING AND INSPECTION

The 5000A is shipped in a specially constructed container to provide maximum protection during transit. Use care when unpacking to prevent damage to equipment such as cabinet finish, controls, connectors, etc.

2-1.1 Removing Contents

To remove the 5000A from the shipping container, cut and fold back outer carton top flaps, remove top protective cushion, lift instrument clear of shipping container, open dust protection bag and remove equipment.

2-1.2 Visual Inspection

The 5000A was carefully tested and inspected prior to shipment. Inspect the instrument for damage incurred during shipment. Check that the power cable is supplied with the test instrument. If the instrument is damaged in any way, notify the freight carrier immediately. Do not discard any packing materials, as the freight carrier's agent will wish to examine them.

2-1.3 Electrical Inspection

Conformance with operation and performance specifications may be verified by following the *performance check* procedures in Section V of this manual.

2-2. PREPARATION FOR USE

2-2.1 Normal Line Voltage Operation

The 5000A is shipped ready for use. Required power source is 115 or 230 volts rms (root mean square), single phase. The maximum allowable variation is plus or minus ten percent. The sweeper is normally shipped with the **115/230 V** switch in the **115 V** position. For operation from 230 volts, follow the directions below:

1. Be sure the power cord is disconnected.
2. With a small screwdriver, move the **115/230 V** switch on the rear panel to the **230 V** position.
3. Replace the 1 Ampere fuse with a ½ Ampere slow-blowing fuse (not supplied).
4. Connect the power cord between the **LINE** connector and power source.

2-2.2 Low Line Voltage Operation

The 5000A may be operated from power lines as low as 94 volts rms. To prepare a unit for operation from a 104 or 208 volt (plus or minus 10 percent) power line, follow the directions below:

1. Be sure the power cord is disconnected.

2. Remove the bottom cover of the 5000A

3. Locate power supply printed circuit assembly A7; jumper wires A7W1 are located near connector J20, below the power transformer (refer to Sheet of Figure 5- in Section V).

4. With a small (25 to 60 watt) soldering iron, remove one end of both jumper wires from both **115 V** terminals.

5. Move these jumper wire ends to the **104 V** terminals.

6. Replace the bottom cover.

7. If the unit is to be used with a 204 volt ac line, set the **115/230 V** switch to **115**; set the switch to **230** for use with a 208 volt line.

8. Check the fuse; use a 1 Ampere slow-blowing fuse for 104 volt operation, or a ½ Ampere fuse (not supplied) for 208 volt operation.

9. Connect the power cord between the **LINE** connector and power source.

2-2.3 Instrument Grounding

This sweeper is equipped with a three-conductor power cable which, when plugged into an appropriate receptacle, grounds the instrument for safety. The offset center pin of the rear panel three-prong **LINE** connector is the ground pin. It is recommended that the instrument be grounded to protect operating personnel. To preserve the protective feature of the instrument when operating from a two-contact outlet, use a two-prong adapter with the ground wire connected to a convenient ground point.

2-2.4 Manual Scan Quieting Disable

To reduce noise and increase stability of the RF output signal, the bandwidth of the oscillator tuning input in the RF plug-in is automatically reduced when the 5000A **MODE** switch is set to **CW** or when the **SWEEP SECONDS** switch is set to **MANUAL SCAN.**

Because the quieting circuit is activated in Manual Scan mode, the sweep start and stop frequencies set in Manual Scan will not correspond exactly with the start and stop frequencies while sweeping. If it is important that the start and stop frequencies be exactly calibrated, it is possible to modify the 5000A so that the quieting circuits will not be enabled when the **SWEEP SECONDS** switch is set to **MANUAL SCAN.**

After this modification has been incorporated, frequency shift between **MANUAL SCAN** and any of the other **SWEEP SECONDS** switch settings will be minimal.

1. Unplug the power cord.

2. Remove the top cover.

3. Locate printed circuit board A9. (Refer to Sheet 2 of Figure 5-3 in Section V.)

4. Locate Zener diode A9CR3 (1N5245) as shown in Figure 8-12 in Section VIII of this manual.

5. Clip either lead of the diode, or unsolder it from the circuit board.

6. Be sure that the loose lead from A9CR3 is not near or touching anything.

7. No calibration adjustments are required after these operations.

8. Replace the top cover.

2-2.5 Plug-in Unit Installation

To install a plug-in in the 5000A:

1. Be sure operating power has been turned off.

2. Remove the clear plastic dial scale from the bracket on the right side of the plug-in by loosening the two captive knurled knobs.

3. Insert the RF plug-in through the rectangular hole in the 5000A front panel.

4. Lock the plug-in in place by turning the small knob at the top of the plug-in clockwise.

5. Install the clear plastic dial plate in the large rectangular cutout at the top of the 5000A.

6. Simultaneously tighten both knurled screws by turning them clockwise until they are finger tight. Be sure the dial fits in the panel without binding.

2-3. MOUNTING

2-3.1 Bench Use

The sweeper is normally supplied with plastic feet and a fold-away tilt stand for convenient bench operation. The tilt stand permits raising the front of the instrument so that the frequency scale and control markings can be seen easily.

2-3.2 Rack Mounting

Several kits are available to rack mount the sweeper (refer to Paragraph 1-4.2). Necessary hardware is provided, including joining plates and corner brackets with handles. Instructions for rack mounting are provided with the selected hardware kit.

2-4. PACKAGING FOR SHIPMENT

If the instrument is to be packaged for shipment, use the original shipping container and packaging. If the original material has been discarded or is not in condition for re-use, perform the following packaging procedure:

1. Wrap the sweeper in a heavy wrapping or plastic protective covering.

2. Place a protective cushion in the bottom of the shipping carton and place the sweeper on the protective cushion.

3. Surround the remaining sides and top with additional protective cushions. Place front and rear protective cushions in such a manner as to provide support for the sweeper without resting it on controls or connectors.

2-5. SHIPPING METHOD

This sweeper should be shipped only by truck freight, rail freight, air freight, or parcel delivery service. If it is shipped by parcel post, damage is likely to occur. Systron-Donner is not responsible for units damaged in shipment to the factory for repair, whether such units are in-warranty or not.

2-6. INSURANCE

For your own protection, insure the sweeper for full value whenever it is shipped.

2-7. RETURNS FOR REPAIR

Be sure to fully identify any instrument that is returned to Systron-Donner or a Systron-Donner Service Center for repair of any kind, in-warranty or not. The paperwork with the unit must show the instrument serial number, a description of the problem or malfunction to be corrected, and the exact address to which the instrument should be returned when repair is completed. Please also include the *name* and *telephone number* of the cognizant party in your organization; this may speed the identification and repair of malfunctions.

SECTION III

OPERATING INSTRUCTIONS

3-1. SCOPE

This section contains descriptions of all operating controls and indicators, an initial operating procedure, and a summary of precautions for proper usage of the 5000A sweeper mainframe and a typical RF plug-in. Specific operating instructions for the various plug-ins used with the 5000A sweeper mainframe are contained in the manuals supplied with plug-ins.

3-2. FRONT PANEL CONTROLS AND INDICATORS

The front-panel controls, indicators, and connectors are illustrated in Figure 3-1, and are listed and described in Table 3-1.

3-3. REAR PANEL CONTROLS AND INDICATORS

The rear-panel controls and connectors are illustrated in Figure 3-2, and are listed and described in Table 3-2.

3-4. INITIAL OPERATING PROCEDURES

Figure 3-3 contains condensed initial operating procedures for the Model 5000A mainframe and a typical RF plug-in. These procedures are applicable to any swept measurement situation.

3-5. HINTS AND PRECAUTIONS

3-5.1 Changing Plug-ins

It is imperative that the 5000A mainframe power be turned off before removing or inserting a plug-in of any kind. Accidental misalignment of connector pins while the power is on can cause serious damage.

To protect external circuitry from possible damage, rotate the plug-in's **RF LEVEL** control fully counterclockwise before turning mainframe power on. Allow at least ten minutes' warmup time after power is turned on before making critical frequency measurements. Wideband swept measurements where frequencies do not have to be set to the worst-case mainframe and plug-in specification of plus and minus one percent may be made within a few seconds of turn-on.

CAUTION

WHEN A PLUG-IN EXTENSION CABLE OR RIGID EXTENDER IS USED, ALLOW AT LEAST TEN SECONDS TO ELAPSE AFTER POWER IS TURNED OFF BEFORE CONNECTING THE PLUG-IN UNIT. THIS PERIOD IS REQUIRED FOR THE CAPACITORS IN THE PLUS 250 VOLT POWER SUPPLY TO DISCHARGE.

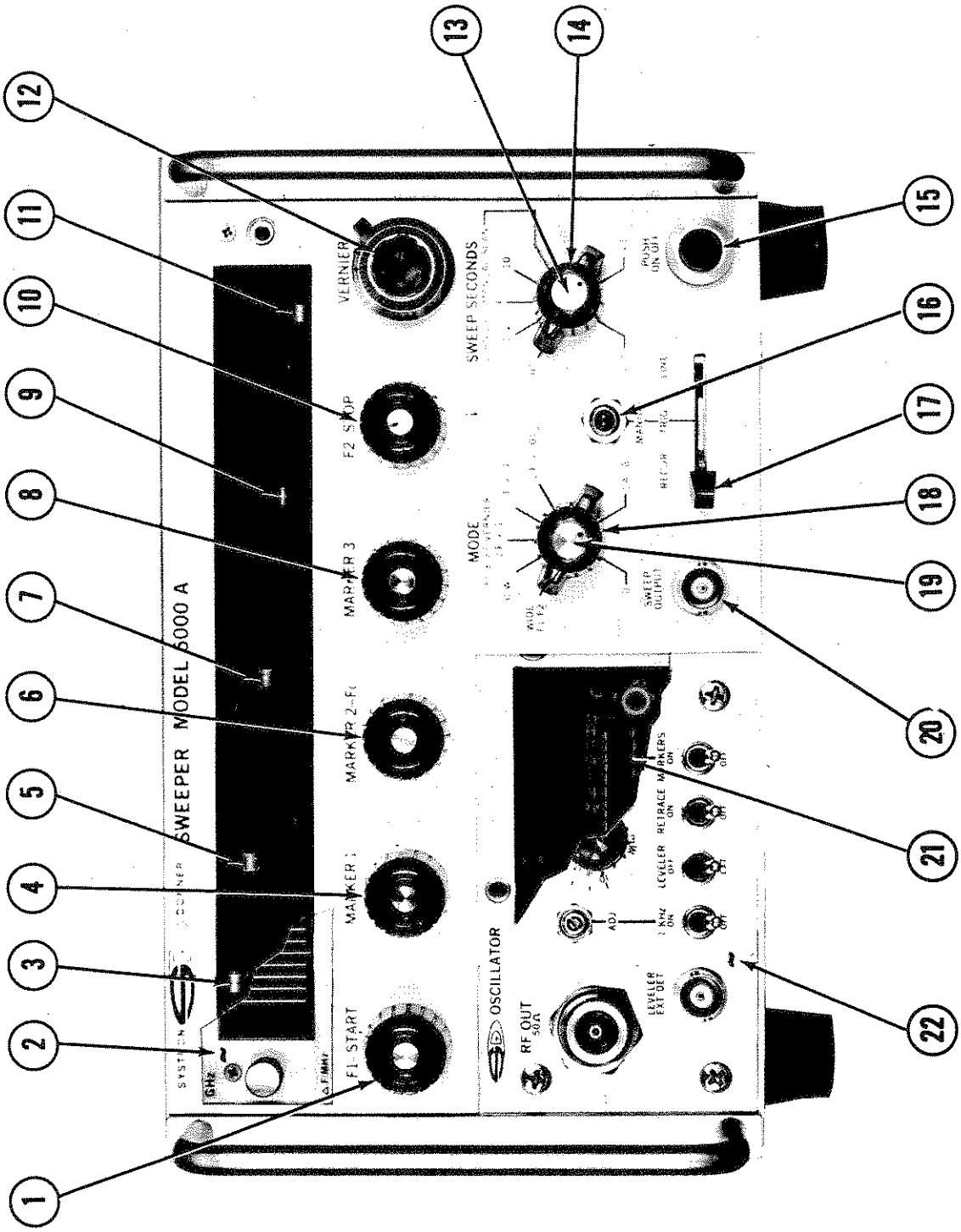


Figure 3-1. Front-Panel Controls and Indicators

Table 3-1. Front-Panel Controls and Indicators

INDEX NO. (FIG. 3-1)	FRONT PANEL NAME AND DESCRIPTION	FUNCTION
1	**F1–START** control	This control functions in Wide F1—F2 sweep mode to set the start frequency, as shown on the upper portion of the frequency scale by the gold indicator. The sweep start frequency may be set above or below the sweep stop frequency.
2	Dial Scale	Interchangeable plastic dial scale, supplied with each RF plug-in, has calibration markings for CW, wide sweep, and narrow sweep mode operating frequencies.
3	F1—Start Frequency Indicator	Gold indicator shows the selected F1—Start frequency in Wide F1—F2 sweep mode. The frequency is indicated on the upper part of the dial scale.
4	**MARKER 1** control	Sets the frequency of Marker 1 in Wide F1—F2 and Fc ± ΔF sweep modes.
5	Marker 1 Frequency Indicator	Green indicator shows the selected Marker 1 frequency on the upper part of the dial scale in Wide F1—F2 sweep mode or on the lower part of the dial scale in Fc ± ΔF sweep mode. The frequency indication in the latter mode is valid only when Item *19* is set to **CALIB**.
6	**MARKER 2–Fc** control	This control sets the frequency of Marker 2 (the marker of highest amplitude) when the **MODE** switch (Item *18*) is set to **WIDE F1–F2**. When the **MODE** switch is set to one of the Fc ± ΔF positions, the control establishes the center frequency (Fc) about which symmetrical sweep occurs. The same control sets the discrete frequency output when the **MODE** switch is set to **CW**.
7	Marker 2—Fc Frequency Indicator	Red indicator shows the selected Marker 2 frequency (Wide F1—F2 sweep mode), center frequency (Fc ± ΔF mode), or CW frequency. The frequencies are read on the upper part of the dial scale.
8	**MARKER 3** control	Sets the frequency of Marker 3 in Wide F1—F2 and Fc ± ΔF sweep modes.

Table 3-1. Front-Panel Controls and Indicators (Continued)

INDEX NO. (FIG. 3-1)	FRONT PANEL NAME AND DESCRIPTION	FUNCTION
9	Marker 3 Frequency Indicator	Blue indicator shows the selected Marker 3 frequency in Wide F1—F2 and Fc ± ΔF sweep modes (also refer to Item *19*).
10	**F2—STOP** control	Sets the frequency at which the frequency sweep ends in Wide F1—F2 sweep mode (only).
11	F2—Stop Frequency Indicator	Orange indicator shows the selected F2—Stop frequency in Wide F1—F2 sweep mode. The frequency is read on the upper part of the dial scale.
12	**VERNIER** control	Ten-turn potentiometer increases frequency of RF plug-in with CW rotation. Dial scale marking directly above **VERNIER** control gives full-scale frequency increase from zero to maximum.
	IMPORTANT **The dial frequency indicators for F1, F2, Fc, CW, and marker frequencies will not be calibrated when the VERNIER control is set to any position other than maximum CCW (0).**	
13	**VERNIER/MANUAL SCAN** control	This control allows the forward sweep rate in Wide F1—F2 and Fc ± ΔF sweep modes to be varied over a 10:1 range from the rate set by the **SWEEP SECONDS** switch. The period of sweep retrace is not affected by the setting of the **VERNIER/MANUAL SCAN** control. When the **SWEEP SECONDS** switch is set to **MANUAL SCAN**, the **VERNIER/MANUAL SCAN** control is used to set the output frequency of the RF plug-in to any point between the selected sweep start and sweep stop frequencies in Wide F1—F2 and Fc ± ΔF modes.
14	**SWEEP SECONDS** switch **.01**	This switch selects the period of the sweep ramp which controls the output frequency of the RF plug-in in Wide F1—F2 and Fc ± ΔF sweep modes: The forward sweep time is ≈ 9 ms (**VERNIER/MANUAL SCAN** at **x1**) to 100 ms (**VERNIER/MANUAL SCAN** at **x10**); sweep retrace time is ≈ 1 ms. This switch position produces flicker-free displays on oscilloscopes and CRT displays in **RECUR** and **LINE** trigger modes.

Table 3-1. Front-Panel Controls and Indicators (Continued)

INDEX NO. (FIG. 3-1)	FRONT PANEL NAME AND DESCRIPTION	FUNCTION
14 (Cont.)	**SWEEP SECONDS** switch (cont.)	
	.1	Sweep time is adjustable from ≈ 90 ms to ≈ 1 s, retrace time is ≈ 10 ms. This sweep speed is used mainly with oscilloscopes and CRT displays. *It is not recommended that line trigger mode be used; multiple triggering could occur at some settings of the* **VERNIER/MANUAL SCAN** *control.*
	1	Sweep time is adjustable from ≈ 900 ms to ≈ 10 s; retrace time is ≈ 100 ms. This sweep rate is appropriate for long-persistence CRT displays and X-Y recorders. *Do not use line triggering mode at this sweep speed.*
	10	Forward sweep time may be varied from ≈ 9 s with the **VERNIER/MANUAL SCAN** control at **x1** to ≈ 100 s at **x10**. The sweep retrace period is ≈ 1 s. This sweep speed is useful when X-Y displays, variable-persistence CRT displays, or digital-storage devices are employed. *Do not use line triggering.*
15	**PUSH ON–OFF** switch	Controls primary power to the 5000A; push to activate, push again to deactivate. The pushbutton lights red to indicate that power is on.
16	**MANUAL** pushbutton	A single press of the **MANUAL** pushbutton initiates the sweep when the **RECUR-TRIG-LINE** switch is set to **TRIG**. *If the* **MANUAL** *pushbutton is pressed before the end of sweep, a new sweep cycle will be initiated immediately without completion of the previous sweep.*
17	**RECUR-TRIG-LINE** switch	This lever switch selects the method of initiating (triggering) the start of each sweep:
	RECUR	The start of each sweep is initiated ≈ 3 ms after the end of the preceding sweep.
	TRIG	Sweep is initiated by pressing the **MANUAL** pushbutton or by an externally-applied signal (≥ 1 μs, ≥ +3 V peak) to the rear-panel **EXT'L TRIG** connector.

Table 3-1. Front-Panel Controls and Indicators (Continued)

INDEX NO. (FIG. 3-1)	FRONT PANEL NAME AND DESCRIPTION	FUNCTION
17 (Cont.)	**RECUR-TRIG-LINE** switch (Cont.)	
	LINE	The start of each sweep is synchronized with power line frequency. (This is *not* a line sweep mode.) *To avoid multiple triggering, line trigger mode should be used only at* **.01 SWEEP SECONDS.**
18	**MODE** switch	This switch selects the operating mode of the frequency-controlling circuits:
	WIDE F1—F2	Wide sweep mode (F1—Start, F2—Stop); the output frequency of the RF plug-in is varied between the frequencies indicated by the gold (start) and orange (stop) dial indicators on the upper portion of the dial scale. The output frequency may be swept or manually scanned either up-band or down-band. *The* **F1—START** *control is not operative in external sweep mode (see Table 3-2, Item 9).*
	CW	Single discrete frequency signal output of the plug-in is determined by the **CW** control and indicated by the red frequency indicator on the upper portion of the dial scale.
	Fc ± ΔF x 1	The output signal of the plug-in is swept symmetrically around a center frequency determined by the **MARKER 2—Fc** control and indicated on the upper part of the dial scale by the red indicator. The total deviation from Fc is + and – 5% of the bandwidth of the RF plug-in, as shown on the lower portion of the dial scale. *The ΔF sweep width as shown on the dial scale is calibrated only when the* **Fc ± ΔF VERNIER** *control is set to* **CALIB.**
	Fc ± ΔF x .1	The total deviation from Fc is + and – 0.5% of the plug-in bandwidth, and is indicated by dividing the lower dial scale markings by a factor of 10. *The dial markings are not valid unless* **Fc ± ΔF VERNIER** *is set to* **CALIB.**
	Fc ± ΔF x .01	The total deviation from Fc is + and – 0.05% of plug-in bandwidth; divide the lower dial scale markings by 100. **Fc ± ΔF VERNIER** *must be set to* **CALIB** *if the dial scale markings are to be used.*

Table 3-1. Front-Panel Controls and Indicators (Continued)

INDEX NO. (FIG. 3-1)	FRONT PANEL NAME AND DESCRIPTION	FUNCTION
19	**Fc ± ΔF VERNIER** control	Allows reduction of deviation from Fc in all Fc ± ΔF sweep modes from the calibrated maximum of ±5%, ±0.5%, or ±0.05% of plug-in bandwidth to ≈ zero deviation. *Frequency coverage of ΔF sweep and frequency calibration of markers 1 and 3 are calibrated only when this control is set to the* **CALIB** *position — fully CW with the switch actuated.*
20	**SWEEP OUTPUT** connector	This connector is in parallel with the **SWEEP OUTPUT** connector on the rear panel; the sweep ramp output drives the horizontal (sweep) input of an X-Y display in Wide F1—F2 or Fc ± ΔF sweep modes. In Manual Scan mode, the output is a 0 to +10 V level. There is no usable ramp output in CW mode. The output signal in External Sweep mode is identical to the external sweep input signal.
21	Interface Connector	24-pin female connector, inside plug-in compartment. Provides all power and signal connections between the 5000A mainframe and the plug-in.
	WARNING THIS CONNECTOR CARRIES LETHAL VOLTAGE.	
22	Plug-in Unit	The actual generation of output signals is accomplished with an RF plug-in or sweeping current supply plug-in; this allows maximum versatility of the 5000A mainframe. Refer to the appropriate instruction manual for the plug-in used and to Figure 3-3 of this manual for plug-in operating instructions.

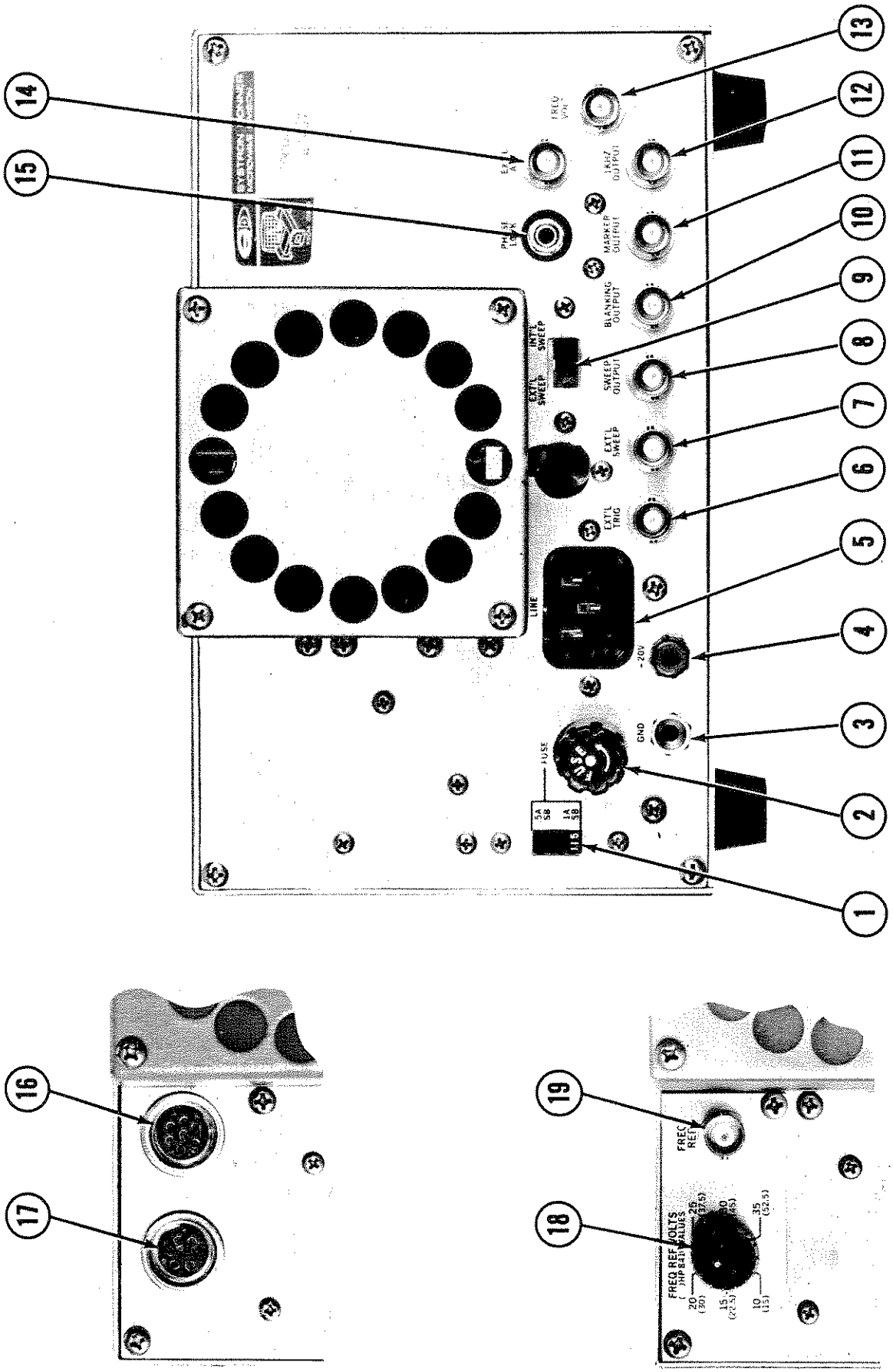


Figure 3-2. Rear-Panel Controls and Connectors

Table 3-1. Rear-Panel Controls and Connectors

INDEX NO. (FIG. 3-2)	REAR PANEL NAME AND DESCRIPTION	FUNCTION
1	**115/230 V** switch	Screwdriver-slot switch. Used to select 115 or 230 V power line operation (104 or 208 V when unit has been modified for low-voltage operation).
	CAUTION DO NOT MOVE THIS SWITCH WHEN THE LINE POWER CORD IS CONNECTED TO A POWER SOURCE.	
2	**FUSE** holder	Contains 1 A (115 V operation) or 0.5 A (230 V operation) slow-blowing instrument fuse.
3	**GND** terminal	Banana jack connects directly to chassis ground (power supply common) for grounding of equipment in a test setup or for use in conjunction with **+20 V** output (Item *4*).
4	**+20 V** terminal	Banana jack carries +20 ±0.01 Vdc for use as a source for external frequency-control or amplitude-control networks. *Digital circuitry or other transient-producing devices should not be powered from the* **+20 V** *terminal; noise introduced at this terminal could adversely affect the residual FM characteristics of the installed RF plug-in.*
	IMPORTANT This output is not current-limited. The operator should take care to allow circuitry connected to this output to draw no more than 10 mAdc.	
	CAUTION DO NOT SHORT-CIRCUIT THE +20 VOLT OUTPUT TO GROUND OR TO ANOTHER VOLTAGE SOURCE. DAMAGE TO THE 5000A MAINFRAME OR INSTALLED RF PLUG-IN UNIT COULD RESULT.	
5	**LINE** connector	Grounded 3-pin connector accepts input from power line through supplied or locally-available power cordset. *Late-production units employ an IEC (International Electrotechnical Commission) approved* **LINE** *connector conforming to worldwide safety standards.*

Table 3-2. Rear-Panel Controls and Connectors (Continued)

INDEX NO. (FIG. 3-2)	REAR PANEL NAME AND DESCRIPTION	FUNCTION
6	**EXT'L TRIG** connector	A pulse or level of ⩾ +3 V, ⩾ 1 μs, will initiate the start of sweep when the front-panel **RECUR-LINE-TRIGGER** switch is set to **TRIG.**
7	**EXT'L SWEEP** connector	Accepts external frequency-control input signal up to 10 V p-p when **EXT'L SWEEP/INT'L SWEEP** switch is set to **EXT'L SWEEP.** Positive polarity increases output frequency of RF plug-in. *Refer to Paragraph 3-5.6 for external sweep mode operating procedures.*
8	**SWEEP OUTPUT** connector	This connector is in parallel with the **SWEEP OUTPUT** connector on the front panel; the sweep ramp output drives the horizontal (sweep) input of an X-Y display in Wide F1—F2 or Fc ± ΔF sweep modes. In Manual Scan mode, the output is a 0 to +10 V level. There is no usable ramp output in CW mode.
9	**EXT'L SWEEP/INT'L SWEEP** switch **EXT'L SWEEP** **INT'L SWEEP**	Allows selection of the internal sweep ramp generator or an external generator as the source of frequency-control signals for the RF plug-in: Disables **F2—STOP** control and connects **SWEEP OUTPUT** connectors directly to **EXT'L SWEEP** connector; the **F1—START, VERNIER,** and all marker controls operate as in internal sweep mode. *Refer to Paragraph 3-5.6 for external sweep mode operating procedures.* Enables internal sweep ramp generator and configures 5000A for normal F1—F2, CW, or ΔF operation.
10	**BLANKING OUTPUT** connector	This connector carries +19 V during sweep retrace and trigger holdoff to blank the beam on Model 7000 Display Unit or other CRT displays (–19 V for 5000A Option M1).
11	**MARKER OUTPUT** connector	Output point for two triangular pulses ≈ –1 V in Fc ± ΔF mode at marker points set by front-panel **MARKER 1** and **MARKER 3** controls. An additional triangular pulse ≈ –1.2 V peak as set by **MARKER 2—Fc** control is available in Wide F1—F2 mode.

Table 3-2. Rear-Panel Controls and Connectors (Continued)

INDEX NO. (FIG. 3-2)	REAR PANEL NAME AND DESCRIPTION	FUNCTION
12	**1 KHZ OUTPUT** connector	Square-wave output of RF plug-in is brought to this connector without processing or modification in mainframe. The 1 kHz output may be fed to a frequency counter, used as a synchronizing signal for an oscilloscope or spectrum analyzer, etc. *Refer to Table 1-1.*
13	**FREQ VOLT** connector	The frequency-control voltage from the 5000A mainframe to the RF plug-in may be monitored at this connector. The voltage is proportional to output frequency, and is normally within the 0 to –10 V range. *The output voltage proportional to frequency does not include the effects of voltage introduced into the* **PHASE LOCK** *connector.*
14	**EXT'L A.M.** connector	Input point for external amplitude modulation or power control voltages; input signals are coupled directly to the RF plug-in without processing or modification by the 5000A mainframe. In general, the sensitivity is ≈ 100 mV/mW when the plug-in is operating in leveled mode. Positive-polarity inputs increase the output amplitude of the plug-in; negative inputs reduce the output amplitude. *Refer to the appropriate plug-in instruction manual for input signal specifications.*
15	**PHASE LOCK** connector	Input point for frequency-correction or FM signals; the signals are fed directly to the RF plug-in without processing or modification by the 5000A mainframe. *The input impedance and sensitivity vary widely among different models of RF plug-in; refer to appropriate plug-in instruction manual for phase lock signal specifications.*
16	**REMOTE 1206** connector	Seven-pin connector carries +20 V and –20 V power for operation of Model 1206 IF Amplifier or other device. *This connector is present only in 5000A mainframes ordered with Option M10.*
17	**REMOTE 7000** connector	Five-pin connector carries sweep output, blanking output, and marker output signals to Model 7000 Display Unit or other device. *This connector is supplied in Model 5000AM10 only.*

Table 3-2. Rear-Panel Controls and Connectors (Continued)

INDEX NO. (FIG. 3-2)	REAR PANEL NAME AND DESCRIPTION	FUNCTION
18	**FREQ REF VOLTS** control	Sets the maximum voltage output from a low of ≈ +10 to ≈ +35 V at the highest output frequency of the RF plug-in. The positive frequency reference output is specifically designed for use with network and swept response analyzers. *This control is present only in 5000A mainframes equipped with Option M3.*
19	**FREQ REF** connector	Output connector for positive frequency reference of 0 to an adjustable maximum of +10 to +35 V. *Present only in Model 5000AM3.*

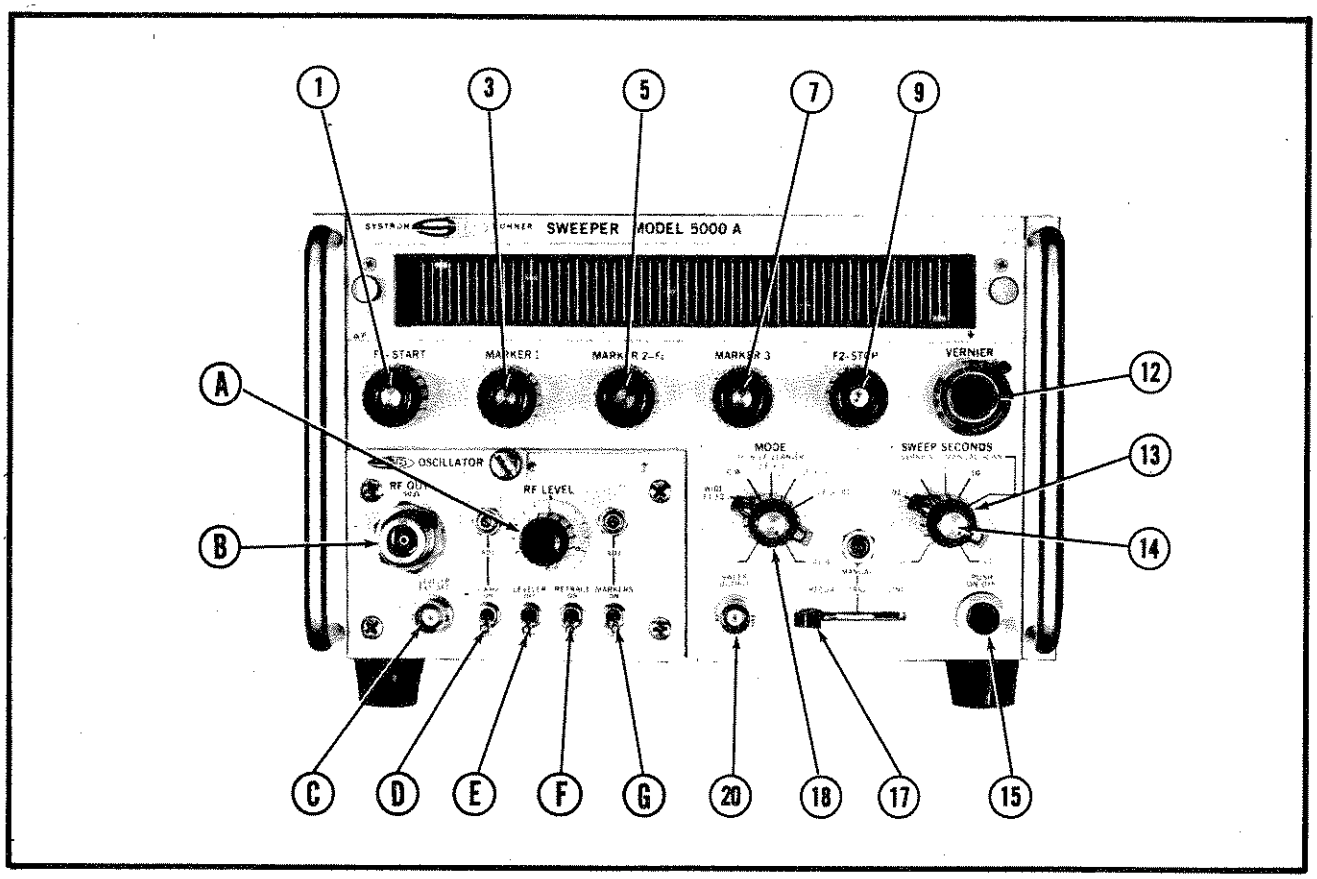


Figure 3-3. Initial Operating Procedures (Sheet 1 of 3)

A. PRELIMINARY CONTROL SETTINGS WITH RF PLUG-IN

Control	Setting
RF LEVEL (A)	Maximum CCW
PUSH ON-OFF (15)	Depressed to turn mainframe power on
INT'L SWEEP/EXT'L SWEEP	INT'L SWEEP (Rear panel)
SWEEP OUTPUT (20)	Connect to X-axis input of CRT display unit
RF OUT 50 Ω (B)	Connect suitable RF output cable to circuit or device to be sweep tested
MODE (18)	WIDE F1–F2
SWEEP SECONDS (13)	.1
SWEEP SECONDS VERNIER (14)	x1
TRIGGER (17)	RECUR
1 KHZ (D)	OFF
RETRACE (F)	OFF
MARKERS (G)	OFF

B. TYPICAL TEST METHOD WITH RF PLUG-IN

Control	Setting
F1–START (1)	Adjust so *GOLD* dial indicator is at lowest frequency of interest
F2–STOP (9)	Adjust so *ORANGE* dial indicator is at highest frequency of interest
LEVELER (E)	OFF
RF LEVEL (A)	Slowly increase the RF output of the plug-in while observing detected response of test item on display unit (oscilloscope or chart recorder).

Continue to increase the RF amplitude until the desired power level is reached. If an external leveler is used, connect its input to **LEVELER EXT DET** (C) and set the **LEVELER** switch (E) to **EXT**. Increase power until the output becomes unleveled as indicated on the display unit trace. Reduce setting of **RF LEVEL** control (A) as required.

If the shape of the swept response changes as a function of **SWEEP SECONDS VERNIER** (14) setting, reduce sweep speed until the distortion is no longer evident. This effect may be noticed when sweeping high-Q circuits, when the crystal detector output capacitor is of high value, or when logarithmic converters are used at the display unit input. In general, use the lowest sweep speed which allows comfortable viewing of the display unit trace with minimal distortion.

To use direct-reading frequency markers, set **MARKERS** switch (G) to **ON**.

Figure 3-3. Initial Operating Procedures (Sheet 2 of 3)

Adjust **MARKER 2** (5) until the pip on the trace is over an area of interest in the swept response curve. The frequency of the discontinuity, anomaly, or other event is shown by the *RED* dial indicator. Adjust **MARKER 1** (3) and **MARKER 3** (7) to calibrate the swept response curve at points on either side of the frequency of interest. In many cases, it will be desirable to examine parts of the trace using narrow sweeps without disturbing the F1—F2 settings:

Control	Setting
MARKER 2—Fc (5)	Adjust so *RED* indicator is centered in the narrow band area of interest as read on upper part of frequency scale
MODE (18)	**Fc ± ΔF x 1**
MARKER 1 (3)	Set marker 1 so *GREEN* indicator shows lower calibration frequency on lower part of frequency scale
MARKER 3 (7)	Set marker 3 so *BLUE* indicator shows upper calibration frequency on upper part of frequency scale
Fc ± ΔF VERNIER (19)	Set to **CALIB**. When ΔF sweep width is reduced by rotating control CCW, Markers 1 and 3 become uncalibrated

C. OTHER CONTROLS

1. **TRIGGER** (17): Trigger modes other than recurrent have specific uses. In line trigger mode, the effects of power ground loops or power line-frequency noise in the displayed swept response curve can be minimized by synchronizing the sweep with these components. Manual mode is used for single sweeps or sweeps triggered on command when chart recorders or other plotting devices are used.

2. **RETRACE** (F): If a fast-rising pulse caused by turning off the RF output of the plug-in during retrace is causing distortion at the ends of the display unit trace, depress this pushbutton to leave RF on during retrace. This is also recommended if power meters are used in the system.

3. **1 KHZ** (D): Use the 1 kHz square wave to amplitude-modulate the RF output for use with VSWR detectors or ratiometers.

4. **VERNIER** (12): For fine frequency adjustments in CW and narrow Fc ± ΔF sweeps; read frequency up to maximum indicated on dial scale which must be added to frequency indicated by the *RED* indicator on upper part of dial scale. **VERNIER** must be set to **0.0** (full ccw) to ensure accuracy of frequency readings.

Figure 3-3. Initial Operating Procedures (Sheet 3 of 3)

3-5.2 Power Supply Overloads

All power supplies in the 5000A are protected against overload or short circuit; this protection comprises foldback current limiting for the plus 30 volt, plus 20 volt, and minus 20 volt power supplies. The plus 250 volt supply is protected by the main power line fuse.

When an overload or short circuit occurs in any of the foldback-protected power supplies, the affected supply voltage will drop to zero; the other supplies may be affected as well. The power supply will *not* recover by itself; the main power line must be turned off by pressing the **PUSH ON-OFF** switch. Wait a minimum of 15 seconds before turning the power back on, or the affected power supply capacitors will not have fully discharged and the power supply will not recover. If the power supply does not recover after 15 full seconds with the power off, there is a malfunction in the 5000A or RF plug-in causing a permanent overload condition.

NOTE

Many RF plug-ins contain circuitry which will "crowbar" the power supply to protect the oscillator module in the plug-in. If this occurs often when the 5000A **MODE** switch is moved, or when the output frequency is at the high-frequency end of the band, the RF plug-in probably needs recalibration or repair.

3-5.3 Sweep Outputs

SWEEP OUTPUT connectors on the front and rear panels of the 5000A carry a sweep ramp of zero to plus 10 volts amplitude in Wide F1—F2 and Fc ± ΔF sweep modes; the period of the ramp is selected by the **SWEEP SECONDS** switch and the **VERNIER/MANUAL SCAN** control. This zero to plus 10 volt ramp is normally used to drive the X axis of a CRT display or chart recorder. Whenever **MANUAL SCAN** is selected, in either sweep mode, a level between zero and plus 10 volts (determined by the setting of the **VERNIER/MANUAL SCAN** control) is available.

The rear-panel **FREQ VOLTS** connector is a monitoring point for the frequency control voltage fed to the RF plug-in; when the **F1—START** control is set fully counterclockwise, the **F2—STOP** control is set fully clockwise, and the **MODE** switch is set to **WIDE F1—F2**, the sweep ramp is zero to minus 10 volts. Again, the period of the ramp is set by the **SWEEP SECONDS** switch and **VERNIER/MANUAL SCAN** control. The ramp varies with the frequency control settings, so that a narrow sweep up-band may be characterized by a minus 4 to minus 6 volt ramp; a wide sweep down-band (**F1—START** control clockwise, **F2—STOP** control counterclockwise) may be characterized by a minus 9 to minus 1 volt ramp. At any instant, the voltage output is proportional to frequency, in any sweep mode.

When one of the Fc ± ΔF settings of the **MODE** switch is selected, the ramp is swept symmetrically about a dc level determined by the setting of the **Fc** control; the voltage deviation is determined by the multiplier setting of the **MODE** switch and the position of the **Fc ± ΔF VERNIER** control.

If an external tuning voltage is used and selected with the **EXT'L SWEEP/INT'L SWEEP** switch, the **SWEEP OUTPUT** connectors carry the external input voltage or ramp.

3-5.4 Display Blanking

The ramp generator in the Model 5000A Sweeper Mainframe generates a blanking pulse during the retrace (flyback) portion of the sweep ramp in all triggering modes and during trigger holdoff time in externally or line-triggered modes. The period of the blanking pulse in recurrent triggering mode is one-tenth of the sweep rate; the amplitude is plus 18 to 20 volts (minus 18 to 20 volts for Model

5000AM1). The blanking pulse is available in Wide F1—F2 and Fc ± ΔF sweep modes. The blanking output is present in CW mode and while the ramp generator is awaiting a trigger signal in Line Trigger mode or External/Manual Trigger mode. No blanking pulse is generated during the three-millisecond start-of-sweep delay period in External Sweep mode, or in Manual Scan mode.

The Systron-Donner Model 7000 Display Unit is compatible with the blanking level available from the 5000A; set the 7000 rear-panel **BLANKING** switch to "–" to use the plus 18 volt blanking signal, or to "+" to use the minus 18 volt blanking signal. Some other CRT display units will not accept blanking signals of these levels and durations; general-purpose oscilloscopes generally couple Z-axis (intensity modulation) signals through a low-value, high-voltage capacitor to the CRT cathode. This type of circuit will not respond to a relatively low level (18 volt) pulse of one millisecond to one second in width.

If a differential-input oscilloscope is used as a display unit, the blanking output of the 5000A may be coupled into one input of the vertical amplifier, while the detected signal output is coupled to the other input. The retrace blanking signal will drive the CRT trace off-screen and out of sight. A dual-trace oscilloscope might be used if it has an *A + B* or *Added* mode.

3-5.5 Line Trigger Operation

When the **RECUR-TRIG-LINE** switch is set to **LINE**, the sweep ramp will be initiated approximately as the ac line voltage reaches the peak of its positive half-cycle. The *start* of each sweep is synchronized with the line frequency, but the *period* of each sweep is independently set by the controls. This mode is *not* a line sweep (sine wave sweep) mode as was used in most early and some contemporary sweepers of lower precision.

IMPORTANT

Line Trigger mode is not compatible with all sweep speeds; multiple triggering can occur at SWEEP SECONDS switch settings of .1, 1, and 10 and with some settings of the VERNIER/MANUAL SCAN control at the .01 SWEEP SECONDS setting. In these cases, the sweep ramp will retrace and forward sweep begin again before the previous sweep reaches its normal ten-volt peak.

3-5.6 External Sweep

External sweep mode may prove useful to the 5000A operator under several special circumstances:

1. A sweeper mainframe and RF plug-in used in an automated test system could be swept by the output of an electromechanical programmer or computer through a digital-to-analog conversion device

2. One 5000A sweeper mainframe could use the sweep ramp output of another 5000A (or another sweeper mainframe with a zero to plus ten volt ramp) for dual-channel or fixed-offset swept measurements

3. One or more 5000A sweeper mainframes could be driven by a master ramp generator to which other swept test equipment — network analyzers, spectrum analyzers, etc. — was also connected to achieve synchronous swept-signal generation and measurement capability

4. Where a linear ramp sweep waveform with fast retrace is not appropriate to the measurement situation and a sine-wave sweep, triangular sweep, logarithmic or exponential sweep, or some other relationship of output frequency versus time is desired.

External sweep signals to the 5000A replace the functions of the internal ramp generator, including the **VERNIER/MANUAL SCAN** control, and portions of the internal mode generator, including the **F2—STOP** control.

The rear-panel **+20 V** jack may be used as a voltage source for an external frequency-control potentiometer. A typical installation of this type will have the *CW* terminal of a 2,000-ohm potentiometer connected to the **+20 V** jack, the *CCW* terminal connected to the **GND** jack, and the *slider* (or *wiper*) terminal connected through a 25,000-ohm resistor to the **EXT'L SWEEP** jack. The potentiometer should be a precision ten-turn linear tapered unit with matching turns-counting dial. The fixed resistor should be a precision low-noise wirewound device with a tolerance of plus or minus one-half percent or better.

3.5.6.1 EXTERNAL SWEEP BANDWIDTH. The operator may select a wide tuning bandwidth of approximately 10 kilohertz for fast slew rate or high-amplitude external sweep inputs, or may select a limited bandwidth of approximately 10 Hertz for dc and other inputs with a low change rate. Setting the **SWEEP SECONDS** switch to any of the four sweep speed settings selects the wide bandwidth for an external sweep input. Setting the **SWEEP SECONDS** switch to **MANUAL SCAN** or the **MODE** switch to **CW** automatically selects the limited bandwidth by activating quieting circuits in the RF plug-in.

3-5.6.2 EXTERNAL SWEEP OPERATING MODES. In all cases, positive-polarity external sweep inputs cause the output frequency of the RF plug-in to increase; negative-polarity inputs cause the output frequency to decrease. (The polarities are with respect to chassis ground.)

When the **MODE** switch is set to **WIDE F1—F2**, a positive-going external sweep signals *adds to* the setting of the **F1—START** control; a negative-going input *subtracts from* the setting of the **F1—START** control. All three markers will operate normally as in internal sweep mode.

When the **MODE** switch is set to any of the three **Fc ± ΔF** settings, the external sweep input signal adds to (or subtracts from) the setting of the **MARKER 2—Fc** control. External sweep inputs which are ac-coupled or symmetrical about zero sweep the frequency of the RF plug-in symmetrically about the center frequency, Fc. Marker 1 and Marker 3 are available to the plug-in.

At the **CW** setting of the **MODE** switch, the external sweep input signal also adds to (or subtracts from) the setting of the **MARKER 2—Fc** control, or causes the plug-in output frequency to sweep symmetrically about Fc. Markers 1 and 3 are disabled in this mode; the tuning bandwidth limiting (quieting) circuits in the RF plug-in are enabled, reducing the tuning bandwidth to about ten Hertz.

3-5.6.3 FREQUENCY CALIBRATION. The frequency band covered by the RF plug-in is determined by the peak-to-peak value of the external sweep input signal; the minimum allowable voltage is zero, the maximum is plus ten volts. With the **F1—START** control and the **VERNIER** control both set to their counterclockwise limits, the output frequency of the plug-in is directly proportional to the input voltage. A ten-volt signal covers one hundred percent of the rated bandwidth of the plug-in; a five-volt signal covers one-half the rated bandwidth, and so on. The frequency calibration factor in kilohertz, megahertz, or gigahertz per volt may be calculated by subtracting the low-frequency limit of the plug-in from the high-frequency limit, then dividing the result by ten. The product of the voltage times frequency-per-volt figure, when added to the low-frequency limit of the plug-in, yields the output frequency for any external voltage input.

IMPORTANT

Do not exceed the specified voltage limits for the external sweep input. Some types of RF plug-in contain oscillator modules which will cause the power supplies of the 5000A to current-limit when driven beyond their usable band limits. A sufficiently high voltage *could* cause damage to the mainframe.

3-5.6.4 VERNIER. The **VERNIER** control operates in all modes, including all external sweep modes. The voltage introduced by the **VERNIER** control adds to the external sweep voltage, increasing the output frequency of the RF plug-in. The **VERNIER** control is usually left at **0** to eliminate confusion in external sweep mode.

3-5.6.5 PHASE LOCK. Any phase-lock input to the 5000A is coupled directly to the RF plug-in. The polarity of the phase-lock signal determines the direction of frequency change. As is the case when internal sweep mode is employed, the phase-lock signal is entirely separate from the frequency-control output of the 5000A and is not accounted for by frequency calibration markings or by output frequency versus frequency-control voltage calculations.

3-5.7 Sweep Frequency Limits

There will be measurement situations where the operator may wish to set the beginning and ending points of sweep more accurately than is possible with the use of the frequency dial scale and frequency indicators alone. The following techniques allow the sweep limits to be set to an accuracy of one-tenth percent rather than the specified worst-case accuracy of plus or minus one percent for the 5000A mainframe and a typical RF plug-in.

3-5.7.1 WIDE F1—F2 MODE. A frequency counter covering the range of interest is required to set the frequency limits to plus or minus one-tenth percent accuracy in Wide F1—F2 Sweep mode:

1. Allow the RF plug-in in the 5000A mainframe to stabilize (warm up) for at least 30 minutes.

2. Connect the output of the RF plug-in through a suitable attenuator and/or directional coupler to the input of the frequency counter.

3. Set the 5000A **MODE** switch to **WIDE F1—F2**.

4. Set the 5000A **SWEEP SECONDS** switch to **MANUAL SCAN**.

5. Rotate the **VERNIER/MANUAL SCAN** control fully counterclockwise.

6. Adjust the **F1—START** control to the desired start-of-sweep frequency as indicated on the frequency counter.

7. Rotate the **VERNIER/MANUAL SCAN** control fully clockwise.

8. Adjust the **F2—STOP** control to the desired end-of-sweep frequency as indicated on the frequency counter.

9. Repeat Steps *5* through *8* as many times as necessary to set the sweep limits to the desired accuracy.

10. Set the **SWEEP SECONDS** switch to the desired sweep rate.

IMPORTANT

The frequencies set in the steps above will tend to shift at faster sweep rates. Therefore, it is not useful to attempt to set the sweep limits closer than plus or minus one-tenth percent. Refer to Paragraph 3-5.7.3 in this section and Paragraph 2-2.4 in Section II for further information.

3-5.7.2 Fc ± ΔF MODE. A frequency counter covering the range of interest is required to set the frequency limits of the symmetrical sweep to plus or minus one-tenth percent accuracy in ΔF Sweep mode. This method is useful for setting narrow ΔF sweeps to calibrated limits when the switch-selected limits of plus or minus 5 percent, plus or minus 0.5 percent, and plus or minus 0.05 percent of the RF plug-in's bandwidth are not suitable:

1. Allow the RF plug-in in the 5000A mainframe to stabilize (warm up) for at least 30 minutes.

2. Connect the output of the RF plug-in through a suitable attenuator and/or directional coupler to the input of the frequency counter.

3. Set the **SWEEP SECONDS** switch to **MANUAL SCAN.**

4. Set the 5000A **MODE** switch to **ΔF x 1.**

5. Set the **VERNIER/MANUAL SCAN** control to the middle of its rotation, with the indicator dot on the knob pointing straight up.

6. Adjust the **MARKER 2—Fc** control until the frequency counter shows the desired center-of-sweep frequency.

7. Rotate the **VERNIER/MANUAL SCAN** control fully counterclockwise and note the frequency counter reading.

8. Rotate the **VERNIER/MANUAL SCAN** control fully clockwise and note the frequency counter reading.

9. Select the **MODE** switch setting (**ΔF x 1, ΔF x .1,** or **ΔF x .01**) which is most appropriate to the desired sweep rate.

10. Rotate the **Fc ± ΔF VERNIER** control fully counterclockwise to **0.**

11. Adjust the **MARKER 2—Fc** control to set the desired center-of-sweep frequency as indicated by the frequency counter.

12. Adjust the **Fc ± ΔF VERNIER** and **MARKER 2—Fc** controls to set the start-of-sweep and end-of-sweep frequencies while the **VERNIER/MANUAL SCAN** control is rotated from one end of its rotation to the other.

IMPORTANT

The ΔF sweep limits set in the steps above will tend to shift somewhat at faster sweep rates. Therefore, it is not useful to attempt to set the ΔF sweep limits closer than plus or minus one-tenth percent. Refer to Paragraph 3-5.7.3 in this section and Paragraph 2-2.4 in Section II for further information.

3-5.7.3 LIMITATIONS ON ACCURACY. Several factors contribute to the limitation of plus or minus one-tenth percent as the best practical accuracy achievable in a swept mode:

1. **Slow Drift:** Unless the frequency-control circuits in the 5000A mainframe, the frequency-control circuits in the RF plug-in, and the oscillator module itself achieve perfect thermal stability, there will always be a certain amount of frequency drift. Allowing the sweeper and plug-in to warm up for at least 30 minutes before making critical measurements will eliminate the majority of thermal drift errors, but changes in ambient air temperature and internal temperature changes (due to power supply dissipation, oscillator heating, etc.) continue to cause long-term instability which limits the ultimate accuracy of the output frequency.

2. **Residual Frequency Modulation:** Electromagnetic and/or electrostatic noise impulses conducted or radiated into the frequency-control circuits of the mainframe or plug-in, as well as the basic inaccuracies of the plug-in's oscillator module itself, contribute to short-term instability which prevents the output frequency of the RF plug-in from being absolutely identical from one sweep to the next.

3. **Quieting Circuits:** To reduce residual frequency modulation in non-swept modes, the bandwidth of the frequency-control circuits in the RF plug-in is reduced to approximately ten Hertz when the **MODE** switch is set to **CW** or when the **SWEEP SECONDS** switch is set to **MANUAL SCAN**. This factor leads to frequency errors when start and stop frequencies are set with a frequency counter in Manual Scan mode and the **SWEEP SECONDS** switch is then set to one of its other positions. A modification may be made to the 5000A which will reduce frequency errors from this cause; refer to Paragraph 2-2.4 in Section II.

4. **Oscillator Modules:** Oscillator modules used in 5000-series RF plug-ins are tuned to frequency by a voltage applied to a *varactor* or by the flux of an electromagnet surrounding a sphere of *YIG* material. The YIG oscillators in particular are affected by *hysteresis*, the property which causes the output frequency of the oscillator to vary depending upon the polarity direction of the tuning current.

   Both types of oscillator tend to shift frequency slightly as the sweeping speed is changed. To reduce the effect of this trait in precision measurements, chart recorders and other devices should be calibrated at the same sweep speed which is to be used for the measurement.

3-5.8 Markers

The 5000A Sweeper Mainframe has an internal generator which produces an output pulse when the frequency-control voltage to the RF plug-in is coincident with a voltage set by one of the **MARKER** controls. Three variable frequency markers are available in Wide F1—F2 Sweep mode; two markers are available in Fc ± ΔF Sweep mode. Markers are present when the **SWEEP SECONDS** switch is set to **MANUAL SCAN**, but are disabled when the **MODE** switch is set to **CW**.

A variety of methods for adding frequency reference points to a swept response trace are available. Model 5000A includes a direct marker output fo the RF plug-in and a marker generator output which may be directly connected to the display unit used with the sweeper. Some of the methods used for adding markers to the swept frequency signal from a 5000A with its RF plug-in are detailed by category in the following paragraphs.

When used as part of a user-designed system, the sweeper mainframe and plug-in may be controlled by external frequency and amplitude inputs. The marker output pulses could be used in such a system to stop the external ramp generator, count and log the output frequency of the RF plug-in, then resume the sweep, continue to the next marker point and count that frequency. The complexity and configuration of such a system is optional with the user; Systron-Donner does not manufacture interface controllers of this type for the 5000A.

3-5.8.1 DIRECT TRACE MARKING. A grease pencil or similar device may be used to mark frequency reference points directly on the faceplate of a CRT display unit. Put the 5000A in CW or Manual Sweep mode, and use a frequency counter to set the reference points. This technique is usable in wide (F1—F2) or narrow (ΔF) sweeps.

3-5.8.2 HETERODYNE MARKER (Figures 3-4 and 3-5). A signal of known frequency can be combined with the swept signal to yield a heterodyne marker, sometimes known as a *birdie* marker. Figure 3-5 shows a typical setup (crystal-controlled markers could be used rather than the variable signal generator and frequency counter shown). Note that the directional coupler is connected *backwards* so it may be used to inject signals; a 20 or 30-decibel coupler is usually used to keep isolation between the marker and sweeper high.

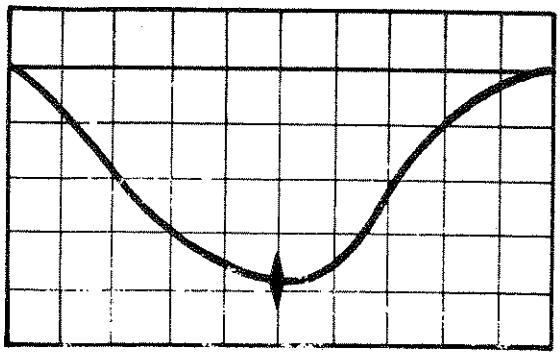
3-5.8.3 COMB MARKERS (Figure 3-4). A comb generator can be used to obtain multiple frequency markers if a single marker frequency is insufficient. A comb generator generally contains one, two, or three crystals and a harmonic generator. Such a unit might be used to add heterodyne markers at fixed intervals over the entire range of the swept output.

The setup shown in Figure 3-5 is applicable if a comb generator is used rather than the signal generator shown; the frequency counter and the second directional coupler are not needed.

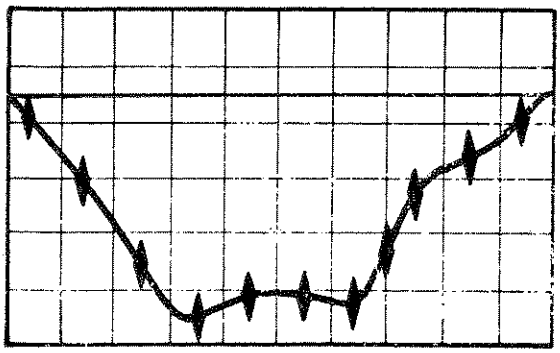
3-5.8.4 CAVITY WAVEMETER (Figure 3-4). A cavity wavemeter interposed between the output of the RF plug-in and the input of the detector will add an RF dip marker at a single frequency determined by the setting of the wavemeter. Cavity wavemeters commonly available cover 100 MHz to 18 GHz in overlapping ranges. The wavemeter is usually connected just ahead of the detector so that the momentary RF dip will not affect the unit being tested.

3-5.8.5 RF DIP MARKERS (Figure 3-4). All standard 5000-series RF plug-ins for the 5000A mainframe have the capability of producing RF dip markers. To use these markers, simply set the plug-in MARKERS switch to ON. The amplitude of the RF dip is controlled by the MARKERS ADJ potentiometer, also located on the front panel of the plug-in. Because the dip in amplitude is generated by a fast-rising pulse, and the pulsed RF passes through the circuit under test, this type of marker may not be the best choice at fast sweep speeds, in high-Q circuits, or in measurements where the detected RF signal is processed by a logarithmic amplifier (including Systron-Donner Model 7011 plug-in for Model 7000 Display Unit and Systron-Donner Models 4020, 4020A, and 4021 Digital RF Power Meters with logarithmic analog output).

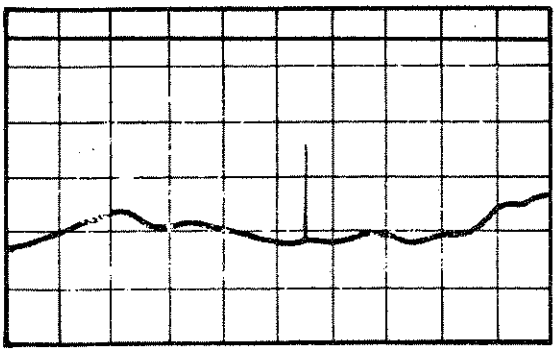
RF dip markers are best used when the RF plug-in is operating in leveled mode or in leveling-off mode at less than full power output. The markers will disappear when the plug-in operates in unleveled mode or in leveling-off mode at full power output.



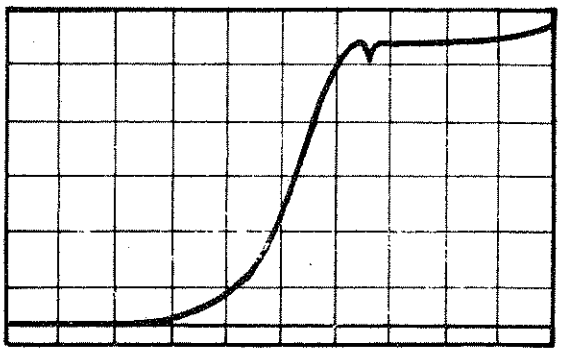
A HETERODYNE MARKER APPEARS WHEN THE OUTPUT FREQUENCY OF THE RF PLUG-IN IS COINCIDENT WITH THE FREQUENCY OF AN RF SIGNAL GENERATOR INJECTED BEFORE THE DETECTOR. THE PEAK OF THE MARKER *BIRDIE* IS THE MARKER POINT.



COMB MARKERS ARE FIXED-INTERVAL HETERODYNE FREQUENCY MARKERS GENERATED BY A PRECISION SOURCE AND HARMONIC GENERATOR. THE FREQUENCY INTERVAL BETWEEN ANY TWO ADJACENT MARKERS IS IDENTICAL, BUT THERE IS NO ABSOLUTE FREQUENCY CALIBRATION.



CAVITY WAVEMETERS ABSORB SOME OF THE RF OUTPUT OF THE PLUG-IN AT THE RESONANT FREQUENCY OF THE CAVITY. THE RESULTING RF DIP INDICATES THE MARKER FREQUENCY WHICH IS READ ON THE CALIBRATED DIAL OF THE WAVEMETER. THE DEPTH OF THE DIP IS NOT CONSTANT OVER THE FREQUENCY RANGE OF THE WAVEMETER OR THE AMPLITUDE RANGE OF THE PLUG-IN. THE DIP TENDS TO BE NARROWER AND SHARPER THAN RF DIP MARKERS GENERATED BY THE RF PLUG-IN.



RF DIP MARKERS ARE MOMENTARY REDUCTIONS IN RF AMPLITUDE; THEY VARY IN WIDTH ON THE CRT DISPLAY, BECAUSE THEY ARE GENERATED BY FIXED-WIDTH PULSES. THEY CAN BECOME QUITE WIDE OVER NARROW SWEEP WIDTHS.

RF DIP MARKERS ALSO TEND TO VARY IN HEIGHT, ESPECIALLY WHEN THE RF PLUG-IN IS OPERATED IN AN UNLEVELED MODE. FINALLY, **RF DIP MARKERS** TEND TO DISAPPEAR AT LOW AND HIGH POWER LEVELS, OR WHERE THERE IS A LARGE AMOUNT OF ATTENUATION IN THE SWEPT CIRCUIT.

Figure 3-4. Heterodyne and RF Dip Marker Characteristics

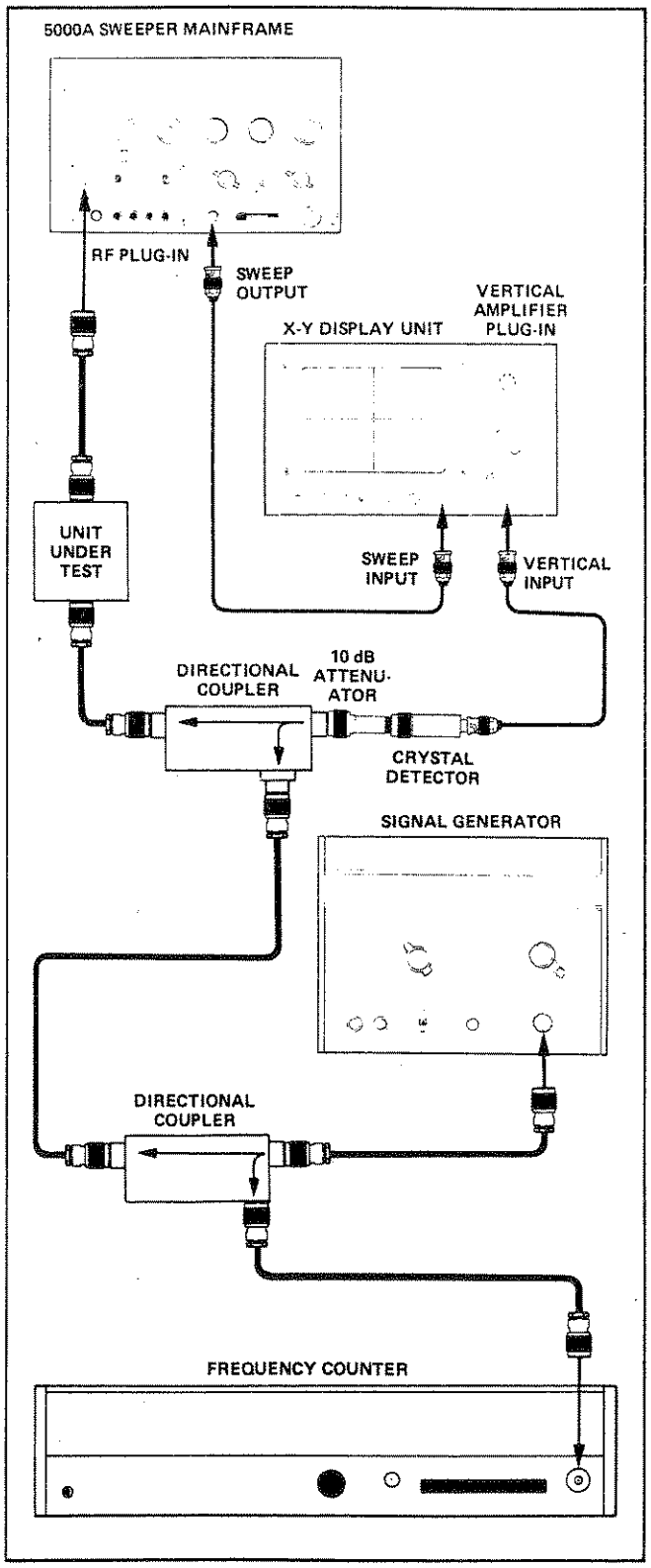
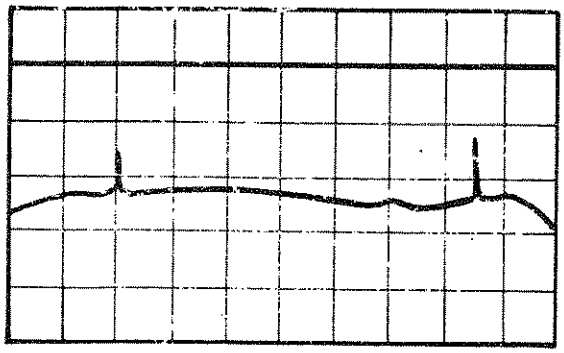
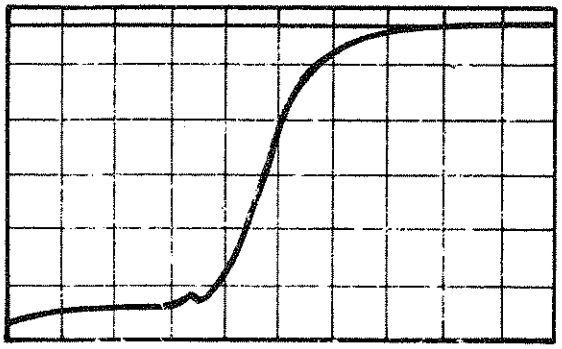


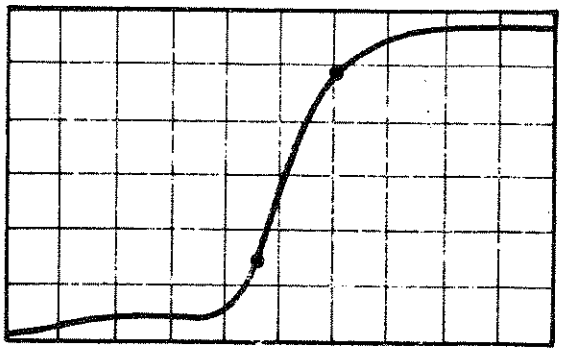
Figure 3-5. Typical Setup



VIDEO BYPASS MARKERS DO NOT VARY IN HEIGHT WITH RF AMPLITUDE, BUT REQUIRE A DIFFERENTIAL OR SUMMING INPUT AMPLIFIER IN THE CRT DISPLAY UNIT SO THAT THEY MAY BE ADDED TO THE SWEPT RESPONSE TRACE.



VIDEO BYPASS MARKERS ALSO TEND TO VARY IN WIDTH, JUST AS RF DIP MARKERS DO. ALTHOUGH THE HEIGHT OF THE MARKERS IS CONSTANT, THEY DO TEND TO DISAPPEAR ON TRACES WITH VERY STEEP SLOPES.



INTENSITY MARKERS DO NOT VARY IN WIDTH OR HEIGHT; THEY ARE BRIGHTENED DOTS. THE OVERALL TRACE INTENSITY MUST BE KEPT FAIRLY LOW, AND MANY OSCILLOSCOPES AND CRT DISPLAYS REQUIRE HIGH VOLTAGE PULSES FOR Z-AXIS MODULATION. AC-COUPLED Z-AXIS INPUTS WON'T FUNCTION WITH WIDE BLANKING PULSES.

Figure 3-6. Amplitude and Intensity Marker Characteristics

3-5.8.6 VIDEO BYPASS MARKERS (Figure 3-6). Video bypass markers produce dips on the detected RF signal which appear similar to RF dips. The advantage of video bypass markers is that the markers are not added to the swept response signal until after detection, and no marker signals are passed through the unit under test (fast-rising marker signals may cause undesirable ringing in otherwise properly-functioning circuits and devices).

To add video bypass markers to a conventional oscilloscope, connect a cable from the rear-panel **MARKER OUTPUT** connector of the 5000A to the second input channel of a differential oscilloscope preamplifier. A dual-trace oscilloscope preamplifier may be used rather than a differential amplifier if the preamplifier's *mode* control is set to $A + B$. If only a single input channel is available in the display unit, the marker output may be summed into the preamplifier input with a suitable series resistor. This latter technique may result in a slightly noisier oscilloscope trace, however, and could reduce the sensitivity of some crystal detectors which provide the primary input to the preamplifier.

Other X-Y display and recording devices, such as chart recorders and plotters, will accept marker inputs through their Y-axis preamplifiers in much the same manner as oscilloscopes. Because of the slower sweep speeds used with these devices, though, RF dip markers may usually be employed without disturbing the circuits under test. The Systron-Donner Model 7000 X-Y Display Unit accepts the marker output of the 5000A through its rear-panel **VERTICAL IN** connector to produce video bypass markers on the CRT trace.

NOTE

Model 7000M1 Display Units connected to Model 5000AM10 sweeper mainframes in integrated test sets use this type of marker input.

3-5.8.7 INTENSITY MARKERS (Figure 3-6). The marker pulses at the **MARKER OUTPUT** jack of the 5000A may be coupled into the intensity (Z) axis of a conventional oscilloscope or CRT display unit to produce brightened dots on the trace at marker points. Some oscilloscopes, including many older (vacuum-tube type) oscilloscopes, will not be driven to produce intensified dots by the marker output of the 5000A without external amplification and/or polarity reversal. The Z-axis performance specifications in the applicable oscilloscope instruction manual should be consulted to verify that a marker input of minus one volt peak is suitable to intensify the trace.

Systron-Donner Model 7000 Display Unit accepts the marker output of the 5000A through its rear-panel **MARKERS** connector when the **MARKERS POLARITY** switch is set to – (minus). The front-panel **INTENSITY** control of the 7000 should be adjusted for satisfactory trace brightness with discernable brightened dots.

3-5.9 Sweeping Current Supply

The 5000A Sweeper Mainframe will accept Current Supply Plug-in Model 5222 or Model 5222A in place of its normally-installed RF plug-in. The sweeping current supply formed by these two units is suitable for loads requiring ten milliamperes to one ampere, either polarity.

3-5.9.1 INSTALLATION. Prior to installation of the current supply plug-in, the internal current limit switch or wire jumper must be set to the *one ampere* position. The plug-in and dial scale are installed in the same manner as when RF plug-ins are used.

3-5.9.2 WIDE F1—F2 SWEEP MODE. The start-of-sweep current limit is set by the **F1—START** control and the end-of-sweep current is set by the **F2—STOP** control; output current may be swept in either direction. Output current polarity selection is switch-selected in the 5222A or manually selected

by reversal of the output leads in the earlier 5222. Any sweep speed may be used, including Manual Scan mode.

3-5.9.3 CW MODE. The current output of the plug-in is adjustable from ten milliamperes to one ampere with the MARKER 2—Fc control.

3-5.9.4 Fc ± ΔF SWEEP MODE. The output current is swept symmetrically about a current set by the MARKER 2—Fc control to a maximum of plus and minus 50 milliamperes (ΔF x 1), 5 milliamperes (ΔF x .1), or 500 microamperes (ΔF x .01). Any sweep speed may be used, including Manual Scan mode.

3-5.9.5 VERNIER. The VERNIER control functions in all modes, adding from zero to 100 milliamperes of output current to the values shown by the dial indicators.

3-5.9.6 MARKERS. Markers are not present in the current output of the plug-in, but the marker generator provides video bypass or intensity markers to an external display unit as if an RF plug-in were being used. Refer to Paragraph 3-5.8 for a description of marker functions.

3-5.9.7 SWEEP TRIGGER. Current sweep may be initiated recurrently, about three milliseconds after the end of the previous sweep (RECUR), manually or externally (TRIG), or in synchronization with the power line frequency (LINE). External sweep mode may be used if desired.

3-5.9.8 BLANKING OUTPUT. The output current of the plug-in is not blanked during sweep retrace, but the rear-panel BLANKING OUTPUT connector carries the normal plus 18 volt blanking pulse during sweep retrace time (minus 18 volts in 5000AM1). This output may be used to blank the display unit if desired (refer to Paragraph 3-5.4).

3-5.9.9 REFERENCE OUTPUTS. The rear-panel FREQ VOLT jack of the 5000A carries a voltage output proportional to the current output of the plug-in; the voltage to current ratio is linear from minus 100 millivolts (equivalent to 10 milliamperes) to 9.9 volts (equivalent to 1 Ampere).

The 5222A is equipped with a front-panel MONITOR connector which carries a proportional output voltage at a factor of one millivolt per milliampere.