# Service Guide

## Agilent Technologies
## 8564EC and 8565EC
## Spectrum Analyzers

Agilent Technologies

**Manufacturing Part Number: 08564-900xx**

**Printed in USA**

**January 2010**

**Supersedes: December 1999**

## Notice



## Certification

Agilent Technologies certifies that this product met its published specifications at the time of shipment from the factory.
Agilent Technologies further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology, to the extent allowed by the Institute's calibration facility, and to the calibration facilities of other International Standards Organization members.

## General Safety Considerations

The following safety notes are used throughout this manual. Familiarize yourself with these notes before operating this instrument.

WARNING

**Warning denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a warning note until the indicated conditions are fully understood and met.**

CAUTION

Always use the three-prong AC power cord supplied with this product. Failure to ensure adequate grounding may cause product damage.

**CAUTION**

Caution denotes a hazard. It calls attention to a procedure that, if not correctly performed or adhered to, could result in damage to or destruction of the instrument. Do not proceed beyond a caution sign until the indicated conditions are fully understood and met.

**WARNING**

**This is a Safety Class 1 Product (provided with a protective earth ground incorporated in the power cord). The mains plug shall be inserted only in a socket outlet provided with a protected earth contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited.**

**WARNING**

**No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock do not remove covers.**

**WARNING**

***Before this instrument is switched on,* make sure it has been properly grounded through the protective conductor of the ac power cable to a socket outlet provided with protective earth contact.**

**Any interruption of the protective (grounding) conductor, inside or outside the instrument, or disconnection of the protective earth terminal can result in personal injury.**

**If this instrument is used in a manner not specified by Agilent Technologies, the protection provided by the instrument may be impaired.**

**There are many points in the instrument which can, if contacted, cause personal injury. Be extremely careful. Any adjustments or service procedures that require operation of the instrument with protective covers removed should be performed only by trained service personnel.**

**CAUTION**

*Before this instrument is switched on,* make sure its primary power circuitry has been adapted to the voltage of the ac power source.

Failure to set the ac power input to the correct voltage could cause damage to the instrument when the ac power cable is plugged in.

This product conforms to Enclosure Protection IP 2 0 according to IEC-529. The enclosure protects against finger access to hazardous parts within the enclosure; the enclosure does not protect against the entrance of water.

## Warranty

This Agilent Technologies instrument product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Agilent Technologies will, at its option, either repair or replace products that prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by Agilent Technologies. Buyer shall prepay shipping charges to Agilent Technologies and Agilent Technologies shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to Agilent Technologies from another country.

Agilent Technologies warrants that its software and firmware designated by Agilent Technologies for use with an instrument will execute its programming instructions when properly installed on that instrument. Agilent Technologies does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error-free.

## LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. AGILENT TECHNOLOGIES SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

## EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. AGILENT TECHNOLOGIES SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

# Contents

# Contents

# 1 General Information

# Introduction

This 8564EC and 8565EC Spectrum Analyzers Service Guide contains information required to adjust and service the 8564EC and 8565EC to the assembly level.

## How to Use this Guide

Chapters 1 through 5 contain adjustments and parts information that can be used to adjust your spectrum analyzer and to help you fix problems.

Chapter 6, “General Troubleshooting”, can be used to identify the location of a problem to a board or functional area in the spectrum analyzer.

Chapters 7 through 13, which cover functional areas, can then be used to help you localize the problem further.

## Conventions Used in this Guide:

| | |
|---|---|
| `Screen Text` | This font indicates text displayed on the screen |
| **Key** | This font indicates a softkey or a hardkey |
| 8564E/EC, 8565E/EC | These terms are used to refer to both E-series and EC-series instruments |

## Documentation Outline

*8560 E-Series and EC-Series Spectrum Analyzer Calibration Guide*

- Tells you how to run verification software.
- Tells you what your spectrum analyzer’s specifications are.
- Tells you how to test your spectrum analyzer.

*8560 E-Series and EC-Series Spectrum Analyzer User’s Guide*

- Tells you how to make measurements with your spectrum analyzer.
- Tells you how to install your spectrum analyzer.
- Tells you how to program your spectrum analyzer.

*8560 E-Series and EC-Series Spectrum Analyzer Quick Reference Guide*

- Is an abbreviated version of the *8560 E-Series and EC-Series Spectrum Analyzer’s User’s Guide*.
- Provides you with a listing of all remote programming commands.

*8560 E-Series Spectrum Analyzer Component Level Information*

- Provides schematics and parts lists for the instrument.

# Instrument Variations

There are options available to the 8564EC and 8565EC. The following table lists these options and identifies the assemblies which are unique to them.

**Table 1-1 Instrument Variations**

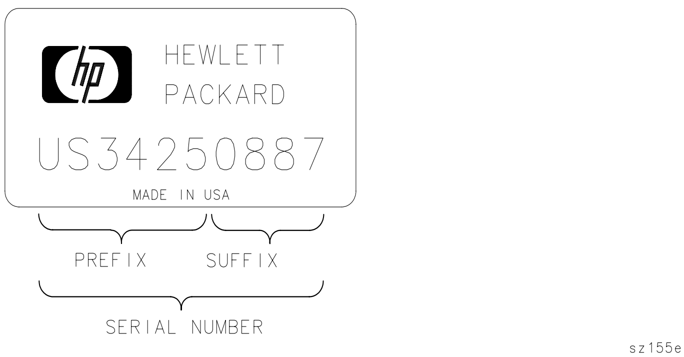
| Option | Added | Deleted |
|---|---|---|
| 8564EC and 8565EC Option 001 (2nd IF Output) | W19 Cable Assembly Rear-Panel J10 | |
| 8564EC and 8565EC Option 005 (add Alternative Sweep Output) | W58 Cable Assembly | |
| 8564EC and 8565EC Option 006 (Frequency Coverage Down to 30 Hz) | A8 Low Band Mixer (Opt 006) | A8 Low Band Mixer (Std) |
| | | |
| 8564EC and 8565EC Option 008 (SIG ID) | A15 RF Assembly (Opt 008) | A15 RF Assembly (Std) |
| 8564EC and 8565EC Option 103 (Delete OCXO) | A15 RF Assembly (Opt 103) | A15 RF Assembly (Std)<br>W49 Cable Assembly<br>W50 Cable Assembly<br>A21 OCXO |

# Serial Numbers and Repair Information

Agilent Technologies makes frequent improvements to its products to enhance performance, usability, or reliability. Agilent Technologies service personnel have access to complete records of design changes to each type of equipment, based on the equipment's serial number. Whenever you contact Agilent Technologies about a product, have the complete serial number available to ensure obtaining the most complete and accurate information possible.

The serial number label is usually attached to the rear of the product. The serial number has two parts: the prefix (two letters and the first four numbers), and the suffix (the last four numbers).

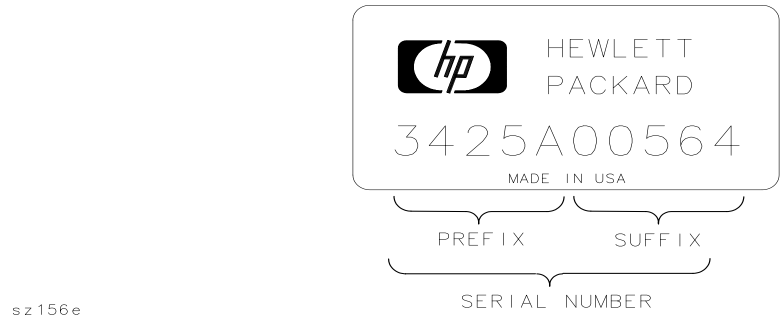
**Figure 1-1 Serial Number Label Example**




The two letters identify the country in which the unit was manufactured. The four numbers of the prefix are a code identifying the date of the last major design change incorporated in your Agilent Technologies product. The four-digit suffix is a sequential number and, coupled with the prefix, provides a unique identification for each unit produced. Whenever you list the serial number or refer to it in obtaining information about your Agilent Technologies product, be sure to use the complete number, including the full prefix and the suffix.

Units which were produced before the serial number format was changed may also be covered by this documentation. On earlier serial number labels, the prefix consists of the first four numbers and a single letter. The suffix is a five-digit sequential number.

**Figure 1-2 Earlier Serial Number Label Example**




It is important that you realize that the new serial number format (US00000000) is always considered "above" the earlier format (0000A00000) when you encounter change information such as "....serial prefix 3425A and above" or "....serial number 3425A00564 and above."

# Service Kit

The spectrum analyzer service kit (part number 08562-60021) contains service tools required to repair the instrument. Refer to Table 1-2 for a list of items in the service kit.

**Table 1-2 Service Kit Contents**

| Description | Quantity | Part Number |
|---|---|---|
| Cable Puller | 1 | 5021-6773 |
| PC Board Prop | 1 | 5021-7459 |
| Line Filter Assembly | 1 | 5061-9032 |
| Line Switch Cable | 1 | 5062-0728 |
| Extender Cable | 1 | 5062-0737 |
| BNC to SMB (snap-on) Cable | 2 | 85680-60093 |
| Connector Extractor Tool Kit | 1 | 8710-1791 |

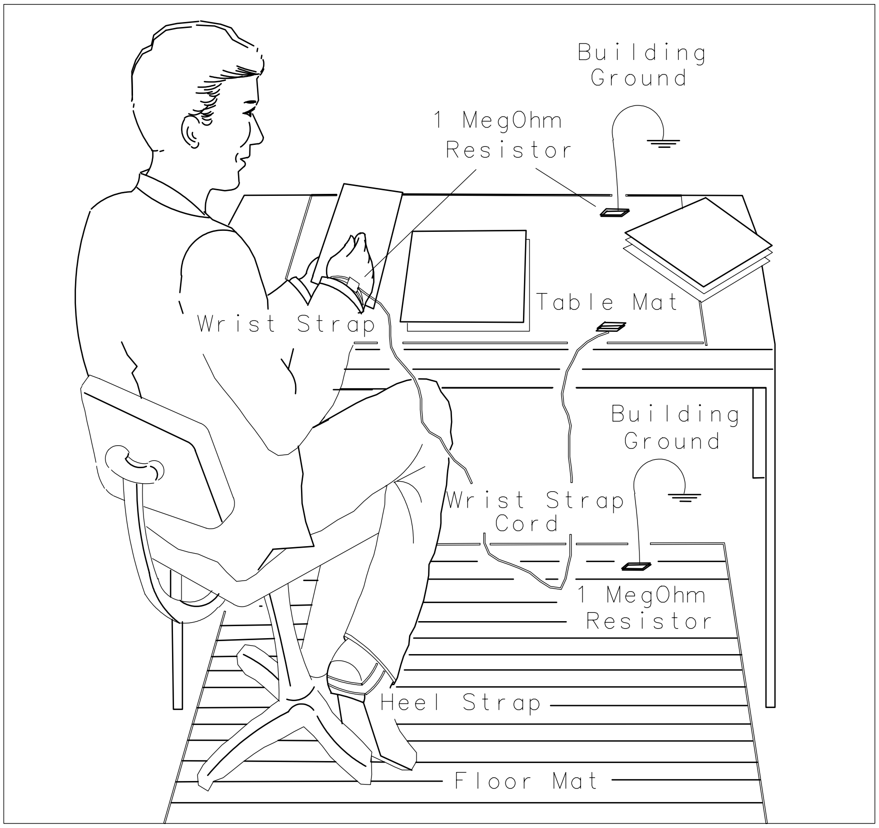
# Electrostatic Discharge

Electrostatic discharge (ESD) can damage or destroy electronic components. Therefore, all work performed on assemblies consisting of electronic components should be done at a static-free workstation. Figure 1-3 is an example of a static-safe workstation using two kinds of ESD protection:

- Conductive table mat and wrist-strap combination
- Conductive floor mat and heel-strap combination

These methods may be used together or separately.

**Figure 1-3 Example of a Static-Safe Workstation**




ORMAT46

## Reducing Potential for ESD Damage

The suggestions that follow may help reduce ESD damage that occurs during instrument testing and servicing.

- Before connecting any coaxial cable to an spectrum analyzer connector for the first time each day, momentarily ground the center and outer connectors of the cable.
- Personnel should be grounded with a resistor-isolated wrist strap before touching the center pin of any connector and before removing any assembly from the unit.
- Be sure all instruments are properly earth-grounded to prevent build-up of static discharge.

## Static-Safe Accessories

**Table 1-3 Static-Safe Accessories**

| Part Number | Description |
|---|---|
| 9300-0797 | Set includes: 3M static control mat 0.6 m × 1.2 m (2 ft × 4 ft) and 4.6 cm (15 ft) ground wire. (The wrist-strap and wrist-strap cord are not included. They must be ordered separately.) |
| 9300-0980 | Wrist-strap cord, 1.5 m (5 ft) |
| 9300-1383 | Wrist-strap, color black, stainless steel, without cord, four adjustable links and 7 mm post-type connection. |
| 9300-1169 | ESD heel-strap (reusable 6 to 12 months). |

# Returning Instruments for Service

## Service Tag

If you are returning the instrument to Agilent Technologies for servicing, fill in and attach a blue service tag. Service tags are supplied in the back of this chapter.

Please be as specific as possible about the nature of the problem. If you have recorded any error messages that appeared on the screen, or have completed a performance test record, or have any other specific data on the performance of the spectrum analyzer, please send a copy of this information with the unit.

## Original Packaging

Before shipping, pack the unit in the original factory packaging materials if they are available. If the original materials are unavailable, identical packaging materials may be acquired through any Agilent Technologies Sales and Service Office. Descriptions of the packaging materials are listed in Figure 1-4 on page 36.

## Other Packaging

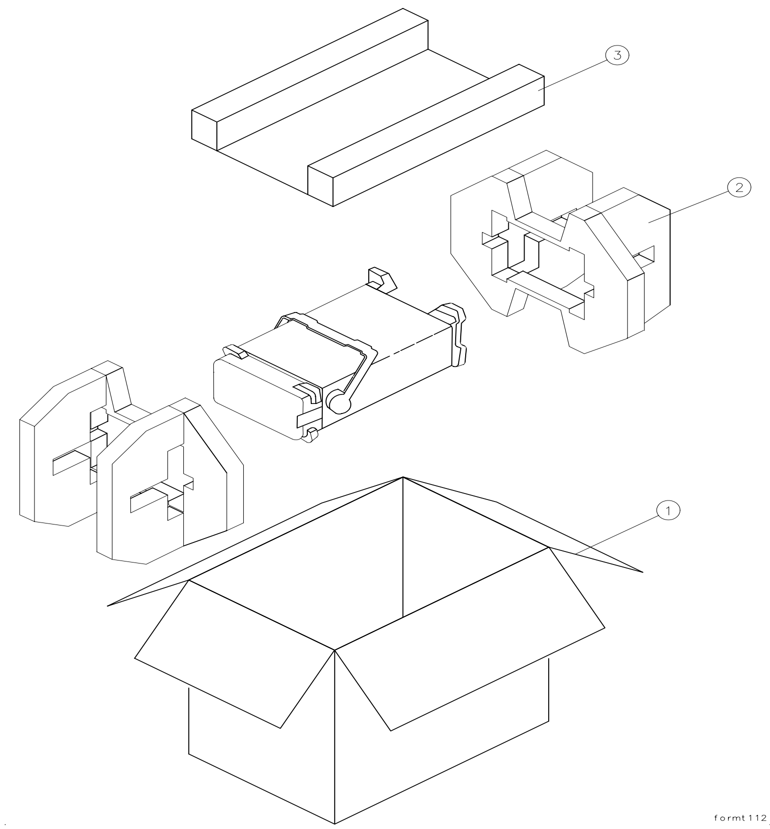
**CAUTION** Spectrum analyzer damage can result from using packaging materials other than those specified. Never use styrene pellets in any shape as packaging materials. They do not adequately cushion the equipment or prevent it from shifting in the carton. They cause equipment damage by generating static electricity and by lodging in the spectrum analyzer fan.

Repackage the spectrum analyzer in the original packaging materials or with commercially available materials described in steps 4 and 5, below.

1. Attach a completed service tag to the instrument.
2. Install the front-panel cover on the instrument.
3. Wrap the instrument in antistatic plastic to reduce the possibility of damage caused by electrostatic discharge.
4. Use the original materials or a strong shipping container that is double-walled, corrugated cardboard carton with 159 kg (350 lb) bursting strength. The carton must be both large enough and strong enough to accommodate the spectrum analyzer and allow at least 3 to 4 inches on all sides of the spectrum analyzer for packing material.

5. Surround the equipment with at least 3 to 4 inches of packing material, or enough to prevent the equipment from moving in the carton. If packing foam is unavailable, the best alternative is SD-240 Air Cap™ from Sealed Air Corporation (Commerce, CA 90001). Air Cap looks like a plastic sheet covered with 1-1/4 inch air-filled bubbles. Use the pink-colored Air Cap to reduce static electricity. Wrap the equipment several times in this material to both protect the equipment and prevent it from moving in the carton.
6. Seal the shipping container securely with strong nylon adhesive tape.
7. Mark the shipping container "FRAGILE, HANDLE WITH CARE" to assure careful handling.
8. Retain copies of all shipping papers.

**Figure 1-4 Spectrum Analyzer Shipping Container and Cushioning Materials**




| Item | Part Number | Description |
|---|---|---|
| 1 | 9211-6969 | Outer Carton |
| 2 | 9220-5073 | Pads (2) |
| 3 | 9220-5072 | Top Tray |

# Recommended Test Equipment

Table 1-4 lists the recommended test equipment required for operation verification, performance tests, adjustments, troubleshooting, and the Test and Adjustment Module. Any equipment that meets the critical specifications given in the table can be substituted for the recommended model(s). Operation verification, and the performance tests, are located in the calibration guide.

**Table 1-4 Recommended Test Equipment**

| Instrument | Critical Specifications for Equipment Substitution | Recommended Model | Use |
|---|---|---|---|
| **Sources** | | | |
| Synthesized sweeper | Frequency range:<br>8564EC, 10 MHz to 40.0 GHz<br>8565EC, 10 MHz to 50.0 GHz<br>Frequency accuracy (CW): $1 \times 10^{-9}$/day<br>Leveling mode: Internal<br>Power level range: –35 to +16 dBm | 83650A<br>Option 001, 008 | P,A,T,V |
| Synthesizer/ level generator | Frequency range: 200 Hz to 80 MHz<br>Frequency accuracy: $1 \times 10^{-7}$/month<br>Flatness: ±0.15 dB<br>Attenuator accuracy: <±0.09 dB<br>External 10 MHz reference input<br>Frequency resolution: 1 Hz | 3335A*, † | P,A,T,M,V |
| Synthesized signal generator | Frequency range: 100 kHz to 2.5 GHz<br>Residual SSB phase noise at 1 GHz:<br><–73 dBc/Hz at 10 Hz offset<br><–107 dBc/Hz at 1 kHz offset<br><–124 dBc/Hz at 10 kHz offset<br><–124 dBc/Hz at 100 kHz offset | 8663A | P,V |
| Pulse/function generator | Frequency range: 10 kHz to 50 MHz<br>Pulse width: 200 ns;<br>Output amplitude: 5 V peak-to-peak<br>Functions: pulse &triangle<br>Pulse rise time: <100 ns<br>TTL sync output | 8116A | P,A |

**Table 1-4 Recommended Test Equipment**

| Instrument | Critical Specifications for Equipment Substitution | Recommended Model | Use |
|---|---|---|---|
| AM/FM signal generator | Frequency range: 1 MHz to 200 MHz<br>Frequency modulation mode<br>Modulation oscillator frequency: 1 kHz<br>FM peak deviation: 5 kHz | 8640B<br>8642A | A |
| **Counters** | | | |
| Frequency standard | Output frequency: 10 MHz<br>Accuracy: $<1 \times 10^{-10}$ | 5061B | P,A |
| Microwave frequency counter | Frequency range: 9 MHz to 26.5 GHz<br>Timebase accuracy (aging): $<5 \times 10^{-10}$/day<br>External frequency reference input | 5343A*<br>Option 001 | P,A,M,V |
| Universal counter | Modes: TI A→B, frequency count<br>Time interval measurement range: 100 ns to 120 s<br>Frequency count range: 400 Hz to 11 MHz<br>Frequency resolution: 1 mHz<br>Timebase accuracy (aging): $<3 \times 10^{-7}$/month<br>External 10 MHz reference input | 5334A/B | P |
| **Receivers** | | | |
| Spectrum analyzer<br>*(for Option 002)* | Frequency range: 300 kHz to 7 GHz<br>Relative amplitude accuracy:<br>300 kHz to 2.7 GHz: <±1.8 dB<br>300 kHz to 7 GHz: <±4.0 dB<br>Absolute amplitude accuracy:<br>3.9 GHz to 6.9 GHz: <±2.7 dB<br>Frequency accuracy:<br><±10 kHz at 7 GHz | 8566B* | P,A,T |
| Spectrum analyzer | Frequency range: 300 kHz to 7 GHz<br>Amplitude range: –70 dBm to +20 dBm | 8566B* | A,T |
| Measuring receiver | Compatible w/power sensors<br>dB relative mode<br>Resolution: 0.01 dB<br>Reference accuracy: <±1.2% | 8902A* | P,A,T, M,V |
| **Sensors** | | | |

**Table 1-4 Recommended Test Equipment**

| Instrument | Critical Specifications for Equipment Substitution | Recommended Model | Use |
|---|---|---|---|
| Power sensor | Frequency range: 50 MHz to 50 GHz<br>Maximum SWR:<br>1.15 (50 to 100 MHz)<br>1.10 (100 MHz to 2 GHz)<br>1.15 (2.0 to 12.4 GHz)<br>1.20 (12.4 to 18 GHz)<br>1.25 (18 to 26.5 GHz)<br>1.30 (26.5 to 40 GHz)<br>1.50 (40 to 50 GHz) | 8487A | P,V |
| **Other Equipment** | | | |
| Controller | Required to run operation verification software and adjustment/diagnostic software (8564EC and 8565EC) | 9816A,<br>9836A/C,<br>310, 320<br>332, 360 | V |
| Oscilloscope | Bandwidth (3 dB): dc to 100 MHz<br>Two channels<br>Minimum vertical deflection factor: ≤5 mV/div<br>Minimum timebase setting: <100 ns<br>Digitizing display with time cursors<br>Delta-t cursor accuracy in 500 ns/Div: <0.1 µs | 54501A* | P,A,T |
| Amplifier | Frequency range:<br>8564EC, 2.0 to 8.0 GHz<br>8565EC, 2.0 to 8.0 GHz<br>Minimum output power (leveled)<br>2.0 to 8.0 GHz: +16 dBm<br>Output SWR (leveled): <1.7 | 11975 | P |
| Power supply | Output voltage: ≥24 Vdc<br>Output voltage accuracy: <±0.2 V | 6114A | A |
| Signature multimeter | Clock frequency >10 MHz<br>Time interval function | 5005A/B | T |

Table 1-4 **Recommended Test Equipment**

| Instrument | Critical Specifications for Equipment Substitution | Recommended Model | Use |
|---|---|---|---|
| Digital voltmeter | Range: –15 Vdc to +120 Vdc<br>Accuracy: <±1 mV on 10 V range<br>Input impedance: ≥1 M Ω | 3456A* | A,T |
| **Probes** | | | |
| DVM test leads | ≥36 inches, alligator clips, probe tips | 34118A | A,T |
| High-frequency probe | No substitute | 85024A | T |
| High-voltage probe | Voltage division ratio: 1000:1 | 34111A | T |
| **Accessories** | | | |
| Directional bridge | Frequency range: 1 to 80 MHz<br>Coupling: 6 dB (nominal)<br>Maximum coupling deviation: <1 dB (nominal)<br>Directivity: 40 dB minimum<br>Impedance: 50 Ω (nominal) | 8721A | P |
| Directional coupler<br>*(two required)* | Frequency range: 2.0 to 8.1 GHz<br>Coupling: 16.0 dB (nominal)<br>Maximum coupling deviation: ±1 dB (nominal)<br>Directivity: 14 dB minimum<br>Flatness: 0.75 dB maximum<br>VSWR: <1.45<br>Insertion loss: <1.3 dB | 0955-0098 | P |
| 10 dB step attenuator | Attenuation range: 30 dB<br>Frequency range: dc to 80 MHz<br>Connectors: BNC (f) | 355D | P,V |
| 1 dB step attenuator | Attenuation range: 12 dB<br>Frequency range: dc to 80 MHz<br>Connectors: BNC (f) | 355C | P,V |
| 20 dB fixed attenuator | Frequency range: dc to 18 GHz<br>Attenuation accuracy: <±1 dB<br>Maximum SWR: 1.2 (dc to 2.9 GHz) | 8491B Option 020 | P,V |
| 10 dB fixed attenuator | Frequency range: dc to 18 GHz<br>Attenuation accuracy: <±0.6 dB<br>Maximum SWR: 1.2 (dc to 2.9 GHz)<br>Connector: APC 3.5 | 8491B Option 010 | P,V |
| Termination | Frequency range: dc to 50 GHz<br>Impedance: 50 Ω<br>Maximum SWR: <1.22<br>Connector: 2.4 mm (f) | 85138B | P,V |

**Table 1-4 Recommended Test Equipment**

| Instrument | Critical Specifications for Equipment Substitution | Recommended Model | Use |
|---|---|---|---|
| Low-pass filter | Cutoff frequency: 50 MHz<br>Rejection at 65 MHz: >40 dB<br>Rejection at 75 MHz: >60 dB | 0955-0306 | P,M,V |
| Low-pass filter<br><br><br><br>*(two required)* | Cutoff frequency: 1.8 GHz<br>Rejection at >3 GHz: >45 dB<br>0.1 dB ripple | 0955-0491 | P |
| Low-pass filter<br><br><br><br><br>*(two required)* | Cutoff frequency: 4.4 GHz<br>Rejection at 5.5 GHz: >40 dB | 11689A | P |
| Power splitter | Frequency range: 30 Hz to 50 GHz<br>Insertion loss: 6 dB (nominal)<br>Output tracking: <0.35 dB, <26.5 GHz<br><0.40 dB, <50 GHz<br>Equivalent output SWR:<br>1.29, <26.5 GHz<br>1.50, <40 GHz<br>1.65, <50 GHz | 11667C | P,A,V,T |
| Service accessory kit | No substitute | 08562-60021 | A,T |
| Tuning tool | No substitute | 8710-1010 | A |
| **Cables** | | | |
| Test cable | Connectors: BNC (m)-to-SMB (f)<br>Length: ≥61 cm (24 in.) | 85680-60093 | A,M |
| Cable, RG-214/U | Connectors: Type N (m)<br>Length: ≥91 cm (36 in.) | 11500A | P,V |
| Cable | Connectors: SMA (m)<br>Length: 24 to 36 inches | 8120-1578 | P |
| Cable, 50 Ω coaxial<br>*(five required)* | Connectors: BNC (m)<br>Length: ≥ 122 cm (48 in.) | 10503A | P,A,V |

**Table 1-4 Recommended Test Equipment**

| Instrument | Critical Specifications for Equipment Substitution | Recommended Model | Use |
|---|---|---|---|
| Cable<br>*(two required)* | Frequency range: 30 Hz to 26.5 GHz<br>Maximum SWR: <1.4 at 26.5 GHz<br>Maximum insertion loss: 3 dB<br>Connectors: APC 3.5 (m), both ends<br>Length: ≥ 61 cm (24 in.) | 8120-4921 | P,A,M,V |
| Cable | Frequency range: 30 Hz to 50 GHz<br>Maximum SWR: <1.55 at 50 GHz<br>Maximum insertion loss: 5.75 dB<br>Connectors: 2.4 mm (f) to 2.4 mm (m)<br>Length: ≥ 1 m (39 in.) | 8120-6164 | P,A,V,T |
| Cable, GPIB<br>*(eight required)* | Required w/operation verification software<br>Required w/85629B test & adjustment module<br>Length: 2 m (6.6 ft.) | 10833B | P,A,M |
| Adapters | | | |
| Adapter | Type N (f)-to-BNC (m) | 1250-1477 | P,A |
| Adapter<br>*(three required)* | Type N (m)-to-BNC (f) | 1250-1476 | P,A,V |
| Adapter | Type N (f)-to-BNC (f) | 1250-1474 | P,V |
| Adapter | Type N (m)-to-N (m) | 1250-1475 | P |
| Adapter | Type N (f)-to-APC 3.5 (m) | 1250-1750 | A |
| Adapter*(two required)* | Type N (m)-to-APC 3.5 (m) | 1250-1743 | P,M,V |
| Adapter | Type N (m)-to-APC 3.5 (f) | 1250-1744 | P,V |
| Adapter | Type N (m)-to-BNC (m) | 1250-1473 | P |
| Adapter | Type N (m)-to-N (f) | 1250-1472 | P |
| Adapter<br>*(two required)* | Type N (f)-to-APC 3.5 (f) | 1250-1745 | P,V |
| Adapter<br>*(two required)* | Type N (m)-to-SMA (f) | 1250-1250 | P,V |
| Adapter | Type N (f)-to-SMA (f) | 1250-1772 | P |
| Adapter | BNC (f)-to-BNC (f) | 1250-0059 | A |
| Adapter | BNC tee (f) (m) (f) | 1250-0781 | P,A,M,V |
| Adapter | BNC (f)-to-SMA (m) | 1250-1200 | P,A,V |
| Adapter | BNC (f)-to-dual banana plug | 1251-2816 | A,T |
| Adapter<br>*(two required)* | APC 3.5 (f)-to-APC 3.5 (f) | 5061-5311 | P,M,V |
| Adapter<br>*(two required)* | APC 3.5 (m)-to-APC 3.5 (m) | 1250-1748 | P,V |
| Adapter | 2.4 mm (f)-to-2.4 mm (f) | 11900B | P,A,T,V |
| Adapter | APC 3.5 (f)-to-2.4 mm (f) | 11901B | P |

**Table 1-4 Recommended Test Equipment**

| Instrument | Critical Specifications for Equipment Substitution | Recommended Model | Use |
|---|---|---|---|
| Adapter | APC 3.5 (m)-to-2.4 mm (f) | 11901D | P |
| Adapter | Type N (f)-to-2.4 mm (f) | 11903B | P,A,T,V |
| Adapter | Type N (f)-to-2.4 mm (m) | 11903C | P |

* Part of microwave workstation
P = performance tests
A = adjustments
M= test & adjustment module
T = troubleshooting
V = operation verification

# Sales and Service Offices

Agilent Technologies has sales and service offices around the world providing complete support for Agilent Technologies products. To obtain servicing information, or to order replacement parts, contact the nearest Agilent Technologies Sales and Service Office listed in Table 1-5 on page 45. In any correspondence, be sure to include the pertinent information about model numbers, serial numbers, and assembly part numbers.

**NOTE** Within the USA, a toll-free phone number is available for ordering replacement parts. Refer to the section entitled, "Ordering Information" in Chapter 4 , “Assembly Replacement,” for the phone number and more information.

### Table 1-5 Agilent Technologies Sales and Service Offices

| UNITED STATES | | |
|---|---|---|
| Instrument Support Center<br>Agilent Technologies<br>(800) 403-0801 | | |
| **EUROPEAN FIELD OPERATIONS** | | |
| Headquarters<br>Agilent Technologies S.A.<br>150, Route du Nant-d'Avril<br>1217 Meyrin 2/ Geneva<br>Switzerland<br>(41 22) 780.8111 | France<br>Agilent Technologies France<br>1 Avenue Du Canada<br>Zone D'Activite De<br>Courtaboeuf<br>F-91947 Les Ulis Cedex<br>France<br>(33 1) 69 82 60 60 | Germany<br>Agilent Technologies GmbH<br>Agilent Technologies Strasse<br>61352 Bad Homburg v.d.H<br>Germany<br>(49 6172) 16-0 |
| Great Britain<br>Agilent Technologies Ltd.<br>Eskdale Road, Winnersh<br>Triangle Wokingham, Berkshire<br>RG41 5DZ England<br>(44 118) 9696622 | | |
| **INTERCON FIELD OPERATIONS** | | |
| Headquarters<br>Agilent Technologies<br>3495 Deer Creek Rd.<br>Palo Alto, CA 94304-1316<br>USA<br>(415) 857-5027 | Australia<br>Agilent Technologies Australia<br>Ltd.<br>31-41 Joseph Street<br>Blackburn, Victoria 3130<br>(61 3) 895-2895 | Canada<br>Agilent Technologies (Canada)<br>Ltd.<br>17500 South Service Road<br>Trans-Canada Highway<br>Kirkland, Quebec H9J 2X8<br>Canada<br>(514) 697-4232 |
| Japan<br>Agilent Technologies Japan, Ltd.<br>Measurement Assistance Center<br>9-1, Takakura-Cho, Hachioji-Shi,<br>Tokyo 192-8510, Japan<br>TEL (81) -426-56-7832<br>FAX (81) -426-56-7840 | Singapore<br>Agilent Technologies<br>Singapore (Pte.) Ltd.<br>150 Beach Road<br>#29-00 Gateway West<br>Singapore 0718<br>(65) 291-9088 | Taiwan<br>Agilent Technologies Taiwan<br>8th Floor, H-P Building<br>337 Fu Hsing North Road<br>Taipei, Taiwan<br>(886 2) 712-0404 |
| China<br>China Agilent Technologies<br>38 Bei San Huan X1 Road<br>Shuang Yu Shu<br>Hai Dian District<br>Beijing, China<br>(86 1) 256-6888 | | |

# 2 Adjustment/Diagnostic Software

# Introduction

Automated adjustment and diagnostic software is required to provide some of the spectrum analyzer adjustments. The software also provides automated diagnostics for troubleshooting. Instructions for using these programs are included in this chapter. The *8564E/8565E Adjustment/Diagnostic Software* is essential for proper adjustment of an 8564EC or 8565EC spectrum analyzer.

Never perform adjustments as routine maintenance. Adjustments should be performed after a repair or performance test failure. For information on which adjustments to perform, see Table 2-1 on page 51. Where both a manual and an automated adjustment number are shown for a given adjustment, either the manual OR the automated adjustment may be performed.

Some of the adjustments must be done manually. The manual adjustment procedures can be found in Chapter 3 of this service guide. The following lists identify all of the automated and manual adjustment procedures:

**Automated Adjustments**



**Manual Adjustments**

1. IF Bandpass Adjustment
2. IF Amplitude Adjustments
3. DC Log Amplifier Adjustments
4. Sampling Oscillator Adjustment
5. YTO Adjustment
6. Calibrator Amplitude Adjustment
7. 10 MHz Reference Adjustment — OCXO
8. 10 MHz Reference Adjustment — TCXO (Option 103)
9. Demodulator Adjustment
10. External Mixer Bias Adjustment
11. External Mixer Amplitude Adjustment
12. 600 MHz Reference Adjustment

## Safety Considerations

Although this instrument has been designed in accordance with international safety standards, this manual contains information, cautions, and warnings which must be followed to ensure safe operation and to prevent damage to the instrument. Service and adjustments should be performed only by qualified service personnel.

WARNING

**Adjustments in this section are performed with power supplied to the instrument and protective covers removed. There are voltages at many points in the instrument which can, if contacted, cause personal injury. Be extremely careful. Adjustments should be performed only by trained service personnel.**

**Power is still applied to this instrument with the LINE switch in the off position. Before removing or installing any assembly or printed circuit board, remove the line-power cord.**

**Capacitors inside the instrument may still be charged, even if the instrument has been disconnected from its source of supply.**

**Use a nonmetallic adjustment tool whenever possible.**

## Which Adjustments Should Be Performed?

Table 2-1 on page 51 lists the adjustments that should be performed when an assembly is repaired or changed. It is important to perform the adjustments in the order indicated to ensure that the instrument meets its specifications.

## Instrument Service Position

Refer to Chapter 4 for information on removing the spectrum analyzer cover assembly and accessing all internal assemblies.

**Table 2-1 Related Adjustments**

| Assembly Changed or Repaired | Perform the following related adjustments in the order listed | Adjustment Number | |
|---|---|---|---|
| | | Manual | Automated* |
| A1A1 keyboard | No related adjustment | | |
| A1A2 RPG | No related adjustment | | |
| A2 controller | | | |
| | If EEROM from old A2 controller could not be used in new A2 or if EEROM must be replaced, also perform the following adjustments: | | |
| | LOMA adjustments | | 4 |
| | External mixer amplitude adjustment or | | |
| | 3rd amp/2nd IF align† | 11 | 5 |
| | Front end cal | | 7 |
| A3 interface | Front end cal | | 7 |
| A4 log amp/cal osc | | | |
| | Demodulator adjustment | 9 | |
| | IF amplitude adjustment† | 2 | 9 |
| | DC log amplifier adjustment† | 3 | 10 |
| A5 IF | IF bandpass adjustment† | 1 | 8 |
| | IF amplitude adjustment† | 2 | 9 |
| A6 power supply | No related adjustment | | |
| *If any automated adjustment is required, you must first perform automated adjustment “1. Initial Information” on page 63. | | | |

**Table 2-1 Related Adjustments**

| Assembly Changed or Repaired | Perform the following related adjustments in the order listed | Adjustment Number | |
|---|---|---|---|
| | | Manual | Automated* |
| A7 LOMA | LOMA adjustments | | 4 |
| | Front end cal *(or perform the frequency response performance test in the 8560 E-Series and EC-Series Spectrum Analyzer Calibration Guide. The adjustment must be performed if the performance test fails).* | | 7 |
| A8 low band mixer | Front end cal | | 7 |
| A9 input attenuator | Front end cal *(or perform the frequency response performance test in the 8560 E-Series Spectrum Analyzer Calibration Guide. The adjustment must be performed if the performance test fails).* | | 7 |
| A10/A12 RYTHM/SB TX | Front end cal | | 7 |
| A11 YTO | YTO adjustment‡ | 5 | |
| | LO frequency‡ | | 2 |
| | YTO FM coil‡ | | 3 |
| A13 2nd converter | Front end cal | | 7 |
| A14 frequency control | | | |
| | YTO adjustment‡ | 5 | |
| | LO frequency‡ | | 2 |
| | YTO FM cal‡ | | 3 |
| | Front end cal | | 7 |

*If any automated adjustment is required, you must first perform automated adjustment "1. Initial Information"

†Either the manual or the automated adjustment may be performed.

**Table 2-1 Related Adjustments**

| Assembly Changed or Repaired | Perform the following related adjustments in the order listed | Adjustment Number | |
|---|---|---|---|
| | | Manual | Automated* |
| A15 RF | 10 MHz reference adjustment (TCXO, Option 103) or CAL OUT adjustment† | 8 | 6 |
| | Calibrator amplitude adjustment or CAL OUT adjustment† | 6 | 6 |
| | External mixer bias adjustment | 10 | |
| | Sampling oscillator adjustment | 4 | 11 |
| | External mixer amplitude adjustment or 3rd amp/2nd IF align† | 11 | 5 |
| | Front end cal | | 7 |
| A15U100 sampler | Sampling oscillator adjustment† | 4 | 11 |
| A19 GPIB | No related adjustment | | |
| A21 OCXO | 10 MHz reference adjustment (OCXO) | 7 | |

*If any automated adjustment is required, you must first perform automated adjustment "1. Initial Information"

†Either the manual or the automated adjustment may be performed.

‡Perform either the manual "YTO adjustment" (5) or the automated "LO frequency" and "YTO FM coil" adjustments (2 and 3)

# Getting Started

First, make sure you have a compatible controller (computer) and the proper test equipment. The following paragraphs describe requirements for controllers and test equipment. Once the proper equipment is identified, proceed to "Equipment Connections"

## Spectrum Analyzers

The *8564E/8565E Adjustment/Diagnostic Software* can be used to adjust or troubleshoot ONLY an 8564EC or an 8565EC.

Errors will occur if this software is used to test spectrum analyzers other than the 8564EC or 8565EC.

## Controller (Computer)

The *8564E/8565E Adjustment/Diagnostic Software* requires using one of the following HP controllers and the HP BASIC operating system:

| Controller |
|---|
| HP 9000 model 236 (HP 9836) |
| HP 9000 model 310 |
| HP 9000 model 320 |
| HP 9000 model 350 |

| Operating System |
|---|
| HP BASIC 5.13 or later, and all BIN files |

**NOTE** When using an HP 9000 model 236 (HP 9836) controller, the graphics in the IF diagnostics program will be very distorted and difficult to read. The tabular data printed at the end of the IF diagnostics program (which contains the same text information as the graphics) is clearly readable.

Other HP 9000 Series 300 controllers are compatible with the adjustment/diagnostic software; however, the graph printouts might not be full width. This is especially true with medium- and high-resolution displays.

The *8564E/8565E Adjustment/Diagnostic Software* requires at least 4 Megabytes of free memory.

## Test Equipment

Table 2-2 on page 56 lists the test equipment required to perform the automated adjustments. Test equipment which is not listed here is not compatible with the adjustment/diagnostic software. You do not need all the test equipment connected to perform the adjustments. You need only connect the equipment specified in each adjustment to run that adjustment.

## Warm-up Time

### Test Equipment Warm-up

Allow sufficient warm-up time for test equipment. Refer to their individual operating and service manuals for warm-up specifications.

### Spectrum Analyzer Warm-up

Warm the spectrum analyzer up for at least 30 minutes before performing the first adjustment.

**Table 2-2 Test Equipment Required for Automated Adjustments**

| Description | Model Number |
|---|---|
| Controller* | HP 9000 model 236 (HP 9836) or |
| | HP 9000 model 310 or |
| | HP 9000 model 320 or |
| | HP 9000 model 350 |
| Synthesizer/level generator | 3335A |
| Synthesized sweeper† | 83650A |
| Spectrum analyzer‡ | 8566B (preferred) or |
| | 8563E (2nd choice) or |
| | 8563A or |
| | 8562A |
| Power meter | 438A |
| 4.2 GHz power sensor | 8482A |
| 50 GHz power sensor | 8487A§ |
| Frequency counter | 5342A |
| Digital multimeter | 3478A |
| Power splitter | 11667C |
| Test and Adjustment Module (TAM) | 85629B |
| Cable, 50 GHz coax | 8120-6164 |
| Cable, BNC-to-SMB (2 required) | 85680-60093 |
| Cable, BNC-to-BNC (3 required) | 10503A |
| Cable, 36 inch SMA | 8120-1578 |
| Cable, GPIB (8 required) | 10833A/B |

* 4 megabytes of free memory is required for the adjustment program.

† The software menu shows the 8340 as the synthesized sweeper, but it drives the required 83650A (programming language set to "analyzer" mode).

‡ The software menu shows the 8566 as the spectrum analyzer, but it will drive the other three spectrum analyzers listed. If an 8566 is used, it must be an 8566B, not 8566A.

§ Must have calibration factors down to 10 MHz; a standard 8487A is only calibrated down to 50 MHz.

## Equipment Connections

### Computer (Controller) Setup

For HP 9000 model 236 computers, setup instructions are provided in Chapter 1, "Computer Installation," of the *BASIC Operating Manual*. For HP 9000 model 310, 320, or 350 computers, setup information is provided in the *Configuration Reference Manual* for the Series 300 computers.

### GPIB Cables

All GPIB controlled test equipment should be connected to the internal GPIB of the controller (select code 7).

# Using the Adjustment/Diagnostic Software

## To Load the Program

**NOTE** The *8564E/8565E Adjustment/Diagnostic Software* needs to be installed on either an HFS formatted hard disk system or an SRM system. It cannot be used with only a flexible disk drive.

1. If necessary, load HP BASIC into the computer memory. See the documentation for your computer for more information about loading HP BASIC.
2. Create a new directory on your hard disk drive or SRM node. For example, `8564eadj`.
3. Download the 8564EC & 8565EC Adjustment/Diagnostics software from www.agilent.com/find/8560_software.
4. Unzip the download file to the directory created in step 2.
5. Use the MSI command to change to the mass storage device where the new directory (created in step 2) is located. For example, `MSI ":,700,0"` for an HFS system or `MSI ":,21.0"` for an SRM system.
6. Access the directory (created in step 2) using the MSI command, then type `MSI "MANAGER/CAL_DATA/SENSOR_DATA"`. Press **RETURN** (or **ENTER**).
7. Type `LOAD "PS_EDITOR",1` and press **RETURN** (or **ENTER**).
8. Press New Sensor.

9. At the prompt "`Enter power sensor model #. Example, 8487`", enter the first 4 digits of the model number of the power sensor for which you are entering calibration data. Do not enter any alpha characters; the power sensor model must be 4 digits. You will then be prompted to enter the last four digits of the power sensor serial number. For example, if the serial number is 2937A00564, enter 0564.

10. Press Edit Sensor.

**NOTE**

When entering the power sensor calibration data, be sure to enter the 50 MHz calibration factor. The 50 MHz calibration factor is not always explicitly listed in the table included with the power sensor, but is referred to as the "REF CF" (reference calibration factor).

When entering the power sensor calibration data for the 8487A, be sure to also enter a 10 MHz calibration factor. The standard 8487A is calibrated only down to 50 MHz, but the software uses it down to 10 MHz.

The calibration data does *not* have to be entered in frequency order. Frequencies may be entered in any order.

When editing, use the arrow keys (▲, ▼) to get to the entry that you want to edit. Use the **Backspace** key to delete characters, then enter new characters.

11. Enter the frequency (in MHz) and press **RETURN** (or **ENTER**).

12. Enter the calibration factor (for the corresponding frequency) and press **RETURN** (or **ENTER**).

13. Repeat steps 17 and 18 for all calibration points. Press "Q" when done.

14. Press Store Sensor when finished entering data for each power sensor.

15. Repeat steps 13 through 19 for any other power sensors that will be used.

16. Press quit.

## To Use the Adjustment Program

1. MSI to the parent directory (created in "To Load the Program", step 2).
2. Type `LOAD "MANAGER/MANAGER",1` and press **RETURN** (or **EXECUTE**).
3. Press Set inst addr.

4. At the prompt `ENTER STATION NUMBER WHERE THE ADDRESS WILL BE USED`, type **7**, then **RETURN** (or **ENTER**).

5. Verify that the default GPIB addresses are the addresses actually set on all of the instruments.

**NOTE** If you change any of the GPIB addresses, press RECORD ADR before continuing.

6. Press EXIT-NO RECORD.

7. Press Test Dut.

**CAUTION** Be sure power to the 8564E/EC or 8565E/EC (DUT) is turned off before connecting the 85629B TAM to the DUT. Failure to do so may cause damage to the DUT or the TAM.

**NOTE** `Initial Information` must always be run first

The WR PROT/WR ENA on the A2 controller must be in the WR PROT (write protect) position.

8. Press Select, then CONTINUE.

9. Enter the power sensor "RP" numbers (last 4 digits of each serial number) for the 8482A and 8487A (shows `8485A POWER SENSOR` on controller screen).

10. Enter employee number (or any number; an entry here is required to continue).

11. Press DONE.

12. Select `Initial Information`.

13. Enter the serial numbers (up to 5 digits) for the "tower" (A10/A12 RYTHM/SBTX) and the LOMA (A7 LO Multiplier/Amplifier). Entering these serial numbers is optional.

14. Enter the voltages printed on the microcircuits. Be sure to enter the proper polarity, plus (+) or minus (–).

**NOTE**

All but two of the microcircuit entries required (M4 and M5) are voltages listed on the A7 LOMA. Although the label on A7 lists "Int B4, Int B5, SBTX B4, and SBTX B5", the software requires that you enter only "Int B4" (Int4) and "SBTX B4" (SBTX4).

M4 and M5 values are listed on the tower (A10/A12).

If the program is interrupted (power failure or the like) before DONE is pressed, none of the previously entered values under `Initial Information` will be saved. If this occurs, rerun `Initial Information` from the start.

15.When the last value required has been entered, press DONE.

16.Any of the listed adjustments can be selected next (`Initial Information` must always be run first).

**NOTE**

The 83650A must be in "Analyzer" mode. Check the 83650A user documentation for the correct setting of the rear panel switch.

For some adjustments, the user prompts are displayed on the spectrum analyzer display (DUT), not the controller display.

Use the 10 MHz reference out of the 83650A wherever a 10 MHz reference input to another instrument in the setup is required, except for adjustments using the 3335A. (The spectrum analyzer provides the 10 MHz reference to the 3335A.)

The program calls out an 8566, but an 8562A, 8563A, or 8563E can be used to make spectrum analyzer measurements. The 8566B or an 8560 E-Series spectrum analyzer is recommended for speed of measurement.

# Automated Adjustments

The following automated adjustments can be performed in any order, EXCEPT number one (1) Initial Information. This initial information routine must ALWAYS be run first.

# 1. Initial Information

This Initial Information routine must ALWAYS be run first. Carefully follow the instructions and prompts that the software program displays. Any of the listed adjustments may be selected next.

# 2. LO Frequency

## Assembly Adjusted

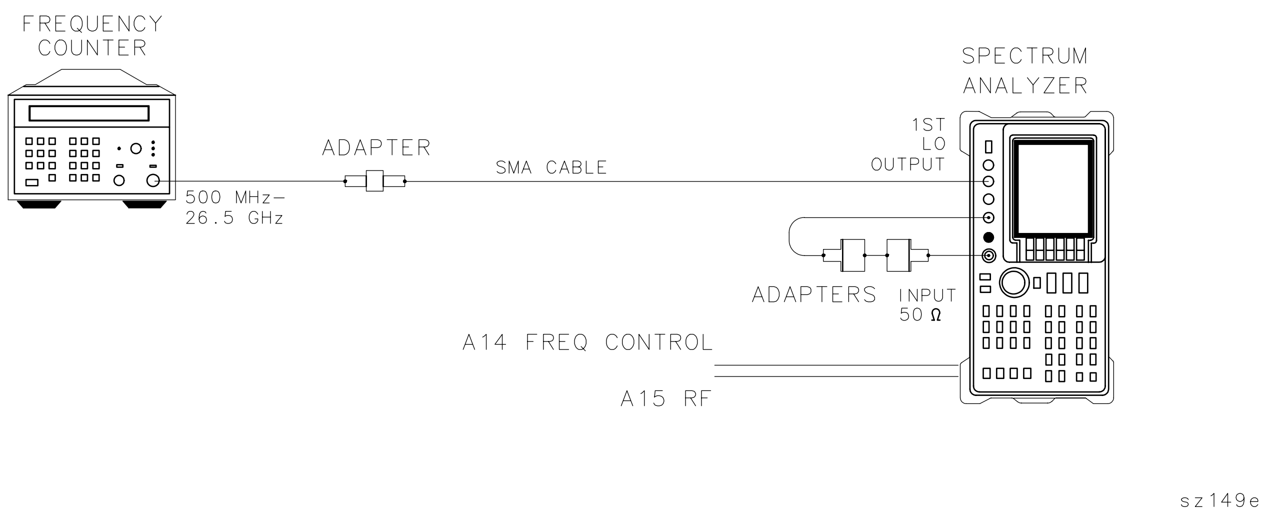
A14 frequency control assembly

## Related Performance Tests

Frequency Readout Accuracy and Frequency Count Marker Accuracy

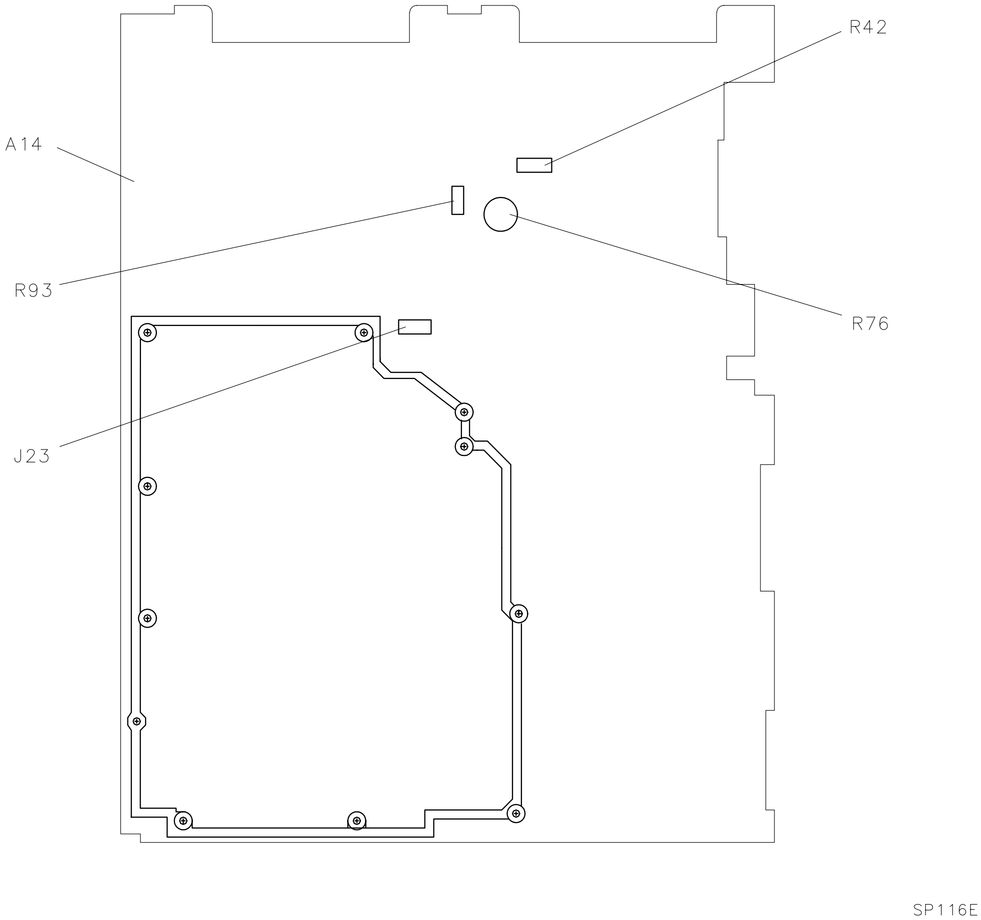
## Procedure

**Figure 2-1 LO Frequency Adjustment Setup**




1. Connect the equipment as shown in Figure 2-1 on page 64 and carefully follow the instructions issued by the software program. See Figure 2-2 on page 65 for adjustment locations.
2. Observe the upper right-hand corner of the spectrum analyzer display while making adjustments. Prompts will appear to let you know when the LO frequency is correctly adjusted.
3. Whenever this adjustment is performed, the YTO FM Coil (3) automated adjustment must also be performed.

**Figure 2-2 LO Frequency Adjustment Locations**



# 3. YTO FM Coil

## Assembly Adjusted

A14 frequency control assembly

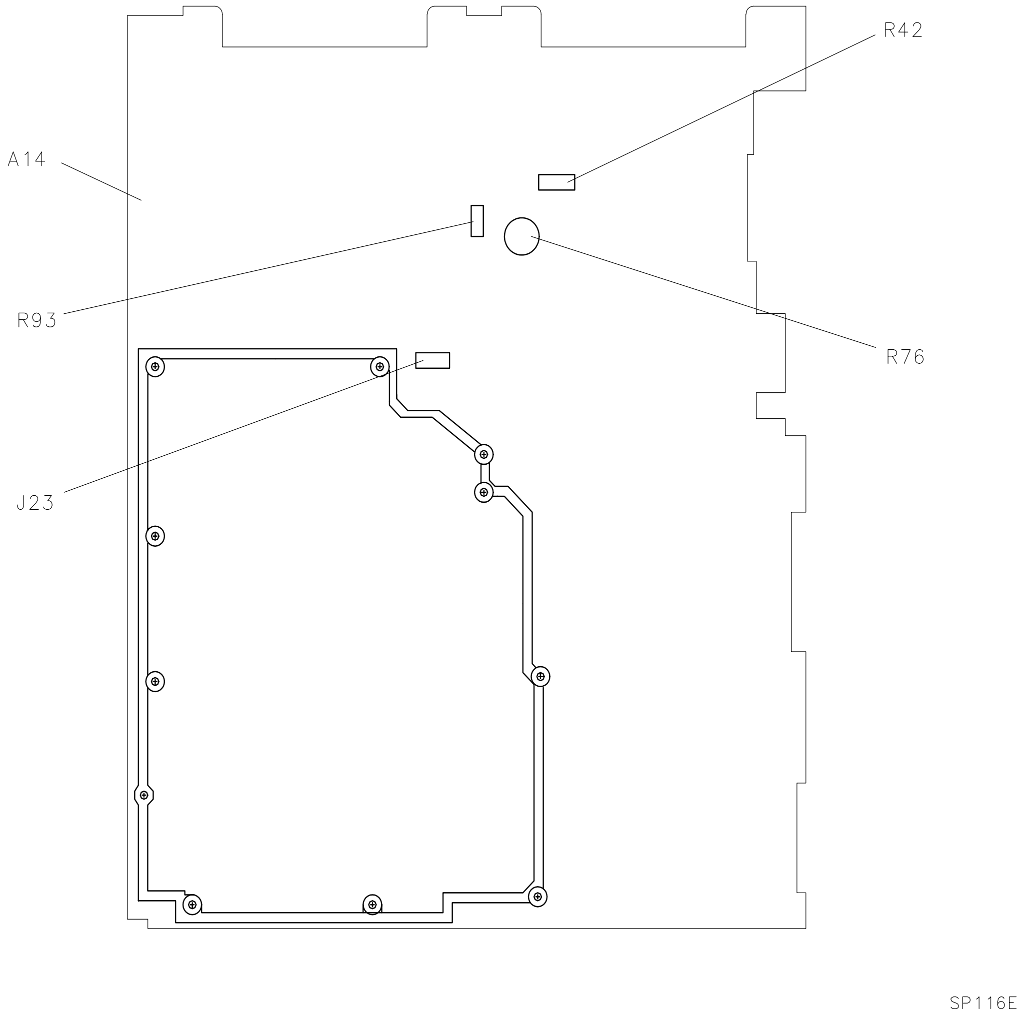
## Related Performance Tests

Frequency Span Accuracy, Frequency Readout Accuracy, and Frequency Count Marker Accuracy

## Procedure

1. Connect the CAL OUTPUT to the INPUT 50Ω on the spectrum analyzer being adjusted. See Figure 2-3 on page 67 for adjustment locations.
2. Carefully follow the instructions issued by the software program.

**Figure 2-3 YTO FM Coil Adjustment Locations**



# 4. LOMA Adjustments

## Assembly Adjusted

A14 frequency control assembly

## Related Performance Test

1ST LO OUTPUT Amplitude

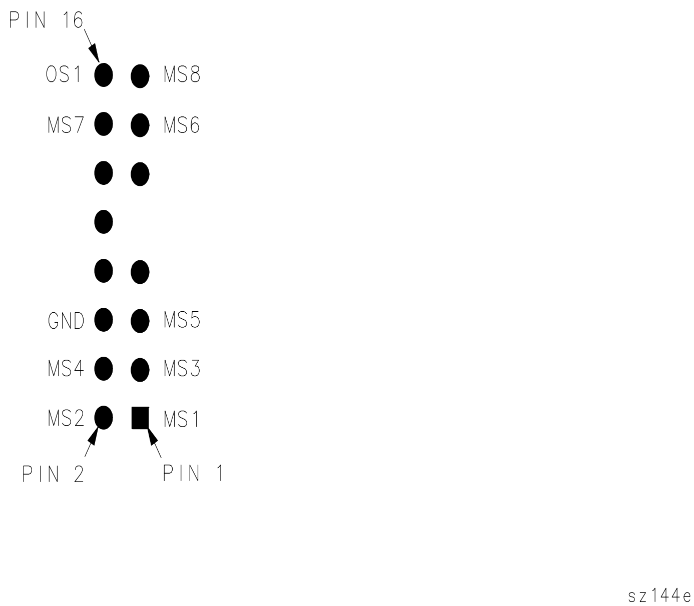
## Procedure

**CAUTION** When connecting the 8587A power sensor to the 1 ST LO OUTPUT, be sure to use proper adapters. Failure to do so will result in damage to the expensive connector of the power sensor.

**NOTE** On the DVM, "Front terminals" must be selected or the adjustment program will not run.

Carefully follow the instructions issued by the software program. See Figure 2-4 on page 68 for test connector pin locations.

**Figure 2-4 A14J18 and A14J15 Pin Locations**



# 5. 3rd Amp/2nd IF Align

## Assembly Adjusted

A15 RF assembly

## Related Performance Test

IF Input Amplitude Accuracy

## Procedure

**CAUTION** When connecting the 11667C power splitter, be sure to use proper adapters where necessary. Failure to do so will result in damage to the expensive connectors of the power splitter.

1. Connect the input port of an 11667C power splitter to the 85650A output.
2. Connect one output port of the power splitter, through a 20-dB pad, to the front panel IF INPUT on the spectrum analyzer.
3. Carefully follow the instructions issued by the software program.

# 6. Cal Out Adjustment

## Assembly Adjusted

A15 RF assembly

## Related Performance Test

Calibrator Amplitude and Frequency Accuracy

## Procedure

1. Connect the 8482A power sensor (through adapter) to the front panel CAL OUTPUT on the spectrum analyzer.
2. Carefully follow the instructions issued by the software program.
3. If the spectrum analyzer has Option 103, TCXO frequency reference, the TCXO will also be adjusted.

# 7. Front End Cal

## Assembly Adjusted

A10/A12 RYTHM/SBTX (tower) A14 frequency control assembly
A15 RF assembly

## Related Performance Tests

Displayed Average Noise Level Frequency Response

## Procedure

1. Carefully follow the instructions issued by the software program.

NOTE

This test requires long waiting periods between adjustments. Total time required to complete the entire Front End Cal is approximately two (2) hours.

Make sure that the 10 MHz reference output from the 83650A is connected to the rear panel 10 MHz IN/OUT on the spectrum analyzer being adjusted.

The software program will tell you, "Waiting for instrument to warm up." If the spectrum analyzer being adjusted has already been on for more than 30 minutes, press CONTINUE on the controller.

# 8. IF Bandpass Poles

## Assembly Adjusted

A5 IF assembly

## Related Performance Test

Resolution Bandwidth Accuracy and Selectivity

## Procedure

**NOTE** Use special tuning tool, part number 8710-1010.

1. Carefully follow the instructions issued by the software program.
2. After each adjustment of a component, press RECHECK POLE (on controller) to determine the current DAC value.

# 9. IF Amplitude

## Assembly Adjusted

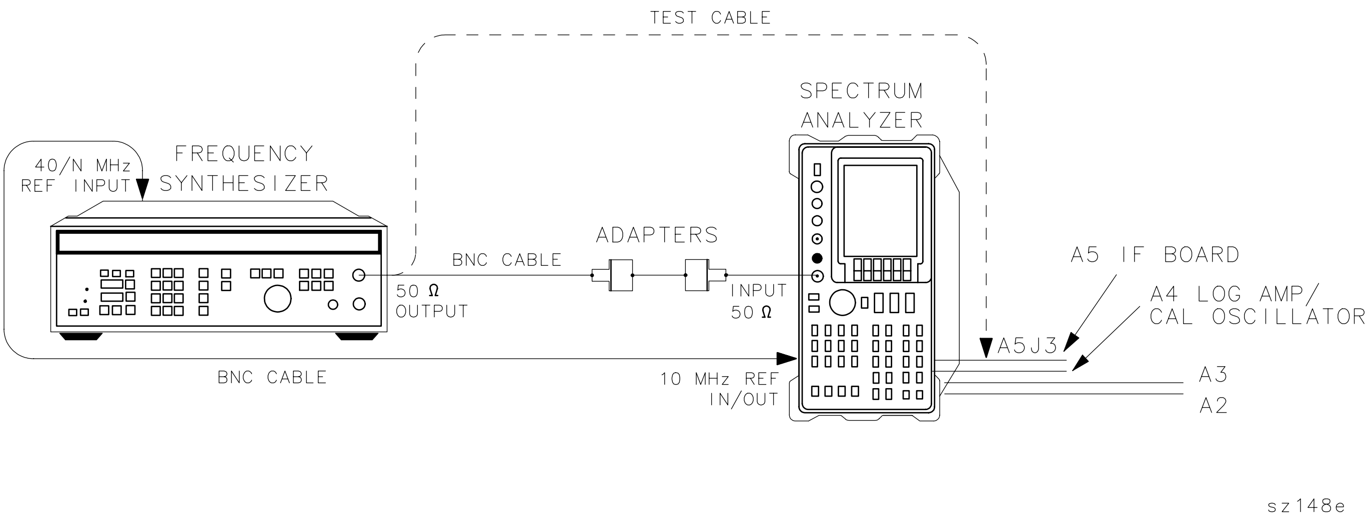
A4 log amp/cal oscillator assembly A5 IF assembly

## Related Performance Tests

IF Gain Uncertainty Scale Fidelity

## Procedure

**Figure 2-6 IF Amplitude Adjustment Setup**




1. Connect equipment as shown in Figure 2-6 on page 75 and carefully follow the instructions issued by the software program.

# 10. DC Log Adjustment

## Assembly Adjusted

A4 log amp/cal oscillator assembly

## Related Performance Tests

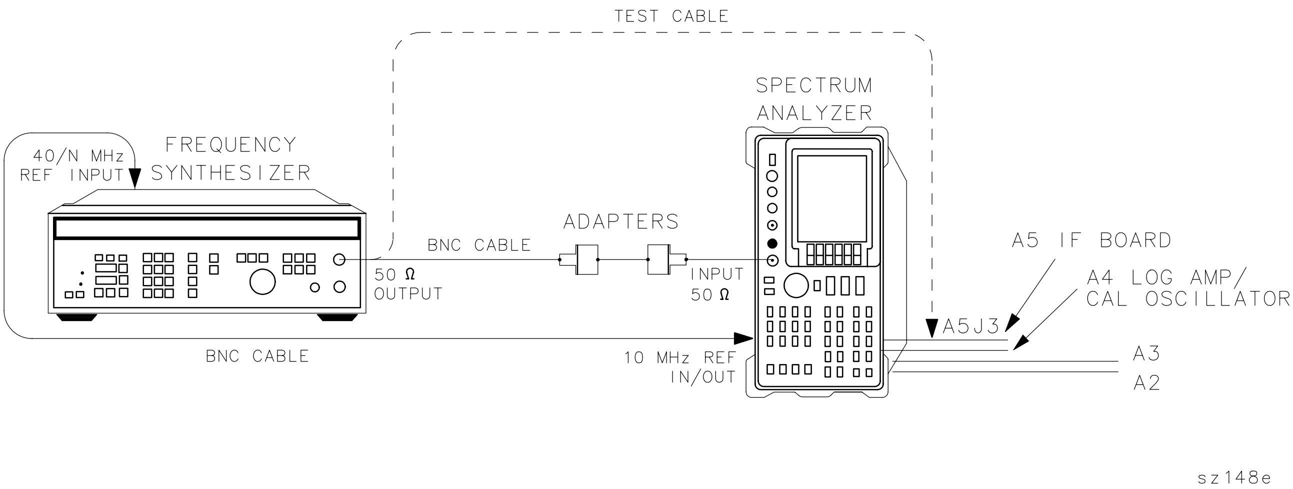
IF Gain Uncertainty Scale Fidelity

## Procedure

**NOTE** These adjustments need only be done under the following conditions:

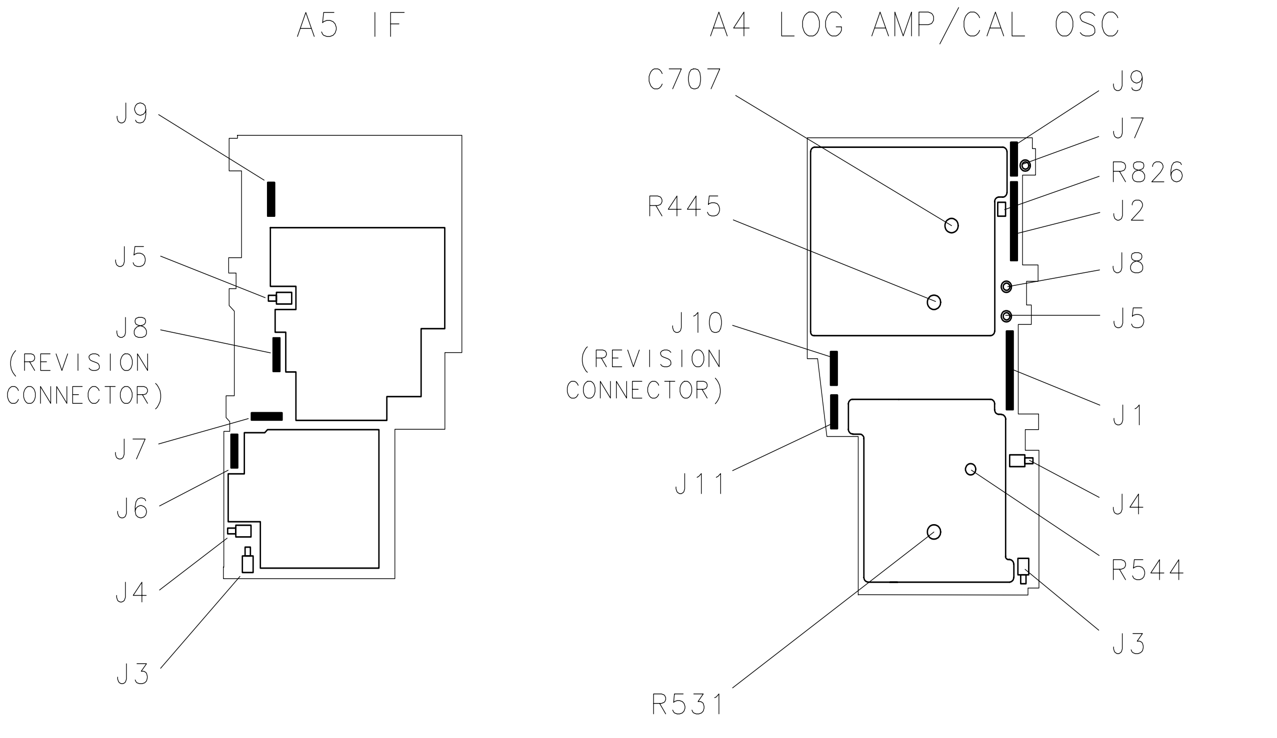
| | |
|---|---|
| Limiter phase | Only if a repair is made to blocks F, G, H, I, or J. |
| Linear fidelity | Only if a repair is made to blocks C, D, F, G, H, I, J, K, O, IF gain accuracy, RBW switching, or log fidelity. |
| Log fidelity | Only if a repair is made to blocks D, F, H, K, IF gain accuracy, RBW switching, or log fidelity. |

**Figure 2-7 DC Log Adjustment Setup**



1. Connect the 3335A to the INPUT 50Ω of the spectrum analyzer being adjusted.
2. Carefully follow the instructions issued by the software program. See Figure 2-8, “DC Log Adjustment Locations,” for adjustment locations.

**Figure 2-8 DC Log Adjustment Locations**



# 11. Sampling Oscillator

## Assembly Adjusted

A15 RF assembly

## Related Performance Test

There is no related performance test for this adjustment.

## Procedure

1. Carefully follow the instructions issued by the software program.

# To Use the Diagnostics

**NOTE**

When performing DAC/LATCH Control or Cal Osc Control, freeze the spectrum analyzer by pressing **TRIG**, EXTERNAL, **SGL SWP**, **CAL**, then IF ADJ OFF. (Do not provide a trigger.) When it is necessary to observe the effects of changes on the display, set the spectrum analyzer for a long sweep time (> 10 seconds) and make changes during a sweep.

The program calls out an 8566, but an 8562A, 8563A, or 8563E can be used to make measurements that require using another spectrum analyzer. The 8566B or an 8560 E-Series spectrum analyzer is recommended for speed of measurement.

Cycle the DUT spectrum analyzer power when you are done doing diagnostics.

## DAC Control

The DAC control program supplies the current DAC value and allows you to set some of the DACs in the spectrum analyzer. The recommended instrument state for the spectrum analyzer under test may differ, depending on which DAC is selected. See Table 2-3 on page 80 for the recommended instrument state.

1. To preset state 1, set the spectrum analyzer as follows:

   Center frequency ........................................................ any
   Span ................................................................. any
   Trigger ......................... External (with no trigger applied)
   IF ADJ ............................................................ OFF
   Sweep ........................................................... Single

2. Press **SAVE**, SAVE STATE, STATE 1.
3. To preset state 2, set the spectrum analyzer as follows:

   Center frequency ..................................................... any
   Span ................................................................. any
   Reference level ....................................................... any
   Resolution bandwidth .............................................. any
   Sweep time .................................................. >10 seconds
   Sweep ........................................................ CONTinue
   Trigger ....................................................... FREE RUN

4. Press **SAVE**, SAVE STATE, STATE 2.
5. See Table 2-3 on page 80 to set the recommended instrument state (**RECALL**, RECALL STATE, STATE 1 or STATE 2) for each DAC selection.

6. Select the PC board that includes the DAC of interest, then select the DAC.
7. Use SELECT to set single values. (The default for entries is decimal, but hexidecimal or binary can entered by appending either an "H" or a "B", respectively. For example, "A2H" or "10100010B".)
8. Use ADJUST for continuous changing of the DAC value. Position the arrow-tipped cursor to select the digit to be changed.
9. The UP, DOWN, and RAMP keys can also be used to exercise the DAC.

**Table 2-3 DAC Control Recommended Instrument State**

| DAC | Reference Designator | Recommended Instrument State* |
|---|---|---|
| Intensity DAC | A2U212A | State 1 |
| Focus DAC | A2U212B | State 1 |
| LOMA Power DAC | A14U601A | State 1 |
| LOMA Gate Bias DAC | A14U601B | State 1 |
| LOMA Sampler Power DAC | A14U601C | State 1 |
| LOMA SBTX Power DAC | A14U601D | State 1 |
| YTO Fine DAC | A14U301A | State 1 |
| YTO Coarse DAC | A14U301B | State 1 |
| YTF Slope DAC | A14U409A | State 1 |
| YTF Offset DAC | A14U409B | State 1 |
| SBTX Bias DAC | A14U424A | State 1 |
| Sampler Amplifier Gate Bias DAC | A14U424B | State 1 |
| Main Coil Tune DAC | A14U314 | Refer to ”Check main coil tune DAC (steps 47-49)” under ”Unlocked YTO PLL” in Chapter 11 .. |
| Scan Ramp DAC | A14U316 | State 2 |
| Span DAC | A14U315 | State 2 |
| Sweep Generator DAC | A14U307 | State 2 |
| RF Gain A DAC | A3U417A | Refer to ”Flatness Control (RF Gain DACs)” in Chapter 8 . |
| *Refer to steps 1 and 3 of ”DAC Control” for spectrum analyzer state settings, unless otherwise noted. | | |

**Table 2-3 DAC Control Recommended Instrument State**

| DAC | Reference Designator | Recommended Instrument State* |
|---|---|---|
| RF Gain B DAC | A3U417B | Refer to "Flatness Control (RF Gain DACs)" in Chapter 8 . |
| RT DAC 1 | A3U409B | State 1 |
| Video Trigger DAC | A3U409A | State 1 |
| Crystal 1 Center Frequency DAC | A5U812B | State 1 |
| Crystal 2 Center Frequency DAC | A5U813B | State 1 |
| Crystal 3 Center Frequency DAC | A5U809B | State 1 |
| Crystal 4 Center Frequency DAC | A5U807B | State 1 |
| Crystal 1 Bandwidth DAC | A5U812C | State 1 |
| Crystal 2 Bandwidth DAC | A5U813C | State 1 |
| Crystal 3 Bandwidth DAC | A5U809C | State 1 |
| Crystal 4 Bandwidth DAC | A5U807C | State 1 |
| Crystal 1 Symmetry DAC | A5U812D | State 1 |
| Crystal 2 Symmetry DAC | A5U813D | State 1 |
| Crystal 3 Symmetry DAC | A5U809D | State 1 |
| Crystal 4 Symmetry DAC | A5U807D | State 1 |
| LC 1 Center Frequency DAC | A5U810B | State 1 |
| LC 2 Center Frequency DAC | A5U810D | State 1 |
| LC 3 Center Frequency DAC | A5U806B | State 1 |
| LC 4 Center Frequency DAC | A5U806D | State 1 |
| LC 1 Bandwidth DAC | A5U810A | State 1 |
| LC 2 Bandwidth DAC | A5U810C | State 1 |
| LC 3 Bandwidth DAC | A5U806A | State 1 |
| LC 4 Bandwidth DAC | A5U806C | State 1 |
| Step Gain 1 DAC | A5U812A | State 1 |
| Step Gain 2 DAC | A5U813A | State 1 |
| Step Gain 3 DAC | A5U809A | State 1 |
| Fine Attenuation DAC | A5U807A | State 1 |
| Video Offset DAC | A4U102A | State 1 |

*Refer to steps 1 and 3 of "DAC Control" for spectrum analyzer state settings, unless otherwise noted.

**Table 2-3 DAC Control Recommended Instrument State**

| DAC | Reference Designator | Recommended Instrument State* |
|---|---|---|
| Log Offset Coarse DAC | A4U102B | State 1 |
| Log Offset Fine DAC | A4U102C | State 1 |
| Local Oscillator Tune DAC | A4U102D | State 1 |
| *Refer to steps 1 and 3 of "DAC Control" for spectrum analyzer state settings, unless otherwise noted. | | |

## Latch Control

Latch control is very similar to the DAC control diagnostics except you can control individual bits. Use state 1 setup (refer to step 1 in ”DAC Control”).

**Table 2-4 Latch Control Recommended Instrument State**

| Latch | Reference Designator | Recommended Instrument State* |
|---|---|---|
| IF Latch 1 | A5U808 | State 1 |
| IF latch 2 | A5U811 | State 1 |
| Log Latch 1 | A4U103 | State 1 |
| Log Latch 2 | A4U104 | State 1 |
| Log Latch 3 | A4U105 | State 1 |
| Control 1 Latch | A14U313 | State 1 |
| Control 2 Latch | A14U417 | State 1 |
| Scan Time Range Latch | A14U309 | State 1 |
| Span Attenuator Latch | A14U310 | State 1 |
| RF Attenuator Latch | A14U406 | State 1 |
| PIN Switch Latch | A14U425 | State 1 |
| Offset Lock Loop Latch | A15U904 | State 1 |
| RF Latch | A15U903 | State 1 |

*Refer to steps 1 and 3 of ”DAC Control” for spectrum analyzer state settings, unless otherwise noted.

## Display IF CAL Data

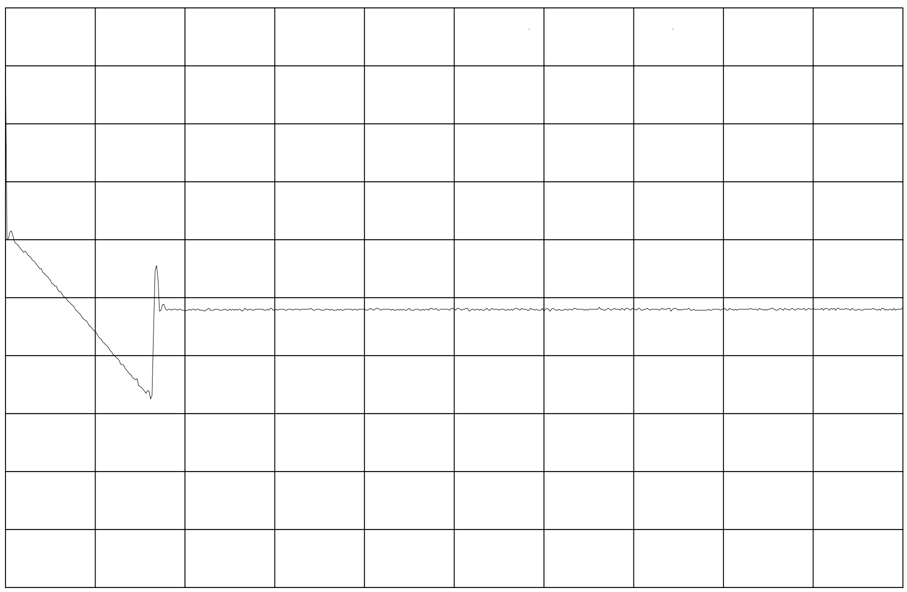
With the IF CAL data displayed, you can check for control problems using a logic probe on the latches. You can also check the DAC values. The DAC values for each filter pole should be within a 32 DAC-count range.

**NOTE** When you change the spectrum analyzer state, you need to EXIT the "Display IF CAL Data" program and SELECT it again.

## Cal Oscillator Control

1. Using another spectrum analyzer, look at the output of the cal oscillator. Refer to the A4 schematic diagram in the *8560 EC-Series Spectrum Analyzer Component Level Information* and *8560 E-Series Spectrum Analyzer Component Level Information*. The display on the test spectrum analyzer should be similar to that shown in Figure 2-9 on page 84.

**Figure 2-9 CAL Oscillator Swept Output, 20 kHz Width**



2. Use the up/down arrows (▲, ▼) on the controller keyboard to select CF, Sweep Width, or RF On/Off for the cal oscillator.
3. Use the left/right arrows (▲, ▼) to change parameters within each selection.

**NOTE** You can select sweep width *only* when CF is at 10.7 MHz.

## IF Diagnostics

**CAUTION** Be sure power to the 8564EC or 8565EC is turned off before connecting the 85629B TAM to the DUT. Failure to do so may cause damage to the DUT or the TAM.

Connect the 85629B test and adjustment module. Follow the program instructions, using the TAM's dc probe. An asterisk will appear at points of failure.

**NOTE** When performing IF Diagnostics, the values without MIN or MAX limits are for information only.

The individual filter poles may also be measured using an 3335A synthesizer and a spectrum analyzer (an 8566B or 8563E is preferred). Step gains can also be checked using the synthesizer and the spectrum analyzer.

## RF Diagnostics

**CAUTION** Be sure power to the 8564EC or 8565EC is turned off before connecting the 85629B TAM to the DUT. Failure to do so may cause damage to the DUT or the TAM.

Be sure power to the 8564EC or 8565EC is turned off before connecting the test board, part number 08564-69201. Failure to do so may cause damage to the A14 frequency control assembly or some very expensive microcircuits (A7, A10 and A12).

**NOTE** Be sure there is a jumper connecting the two pins on J3, and a jumper connecting the two pins on J20 of the test board.

This program assumes a loss of 0.1 dB/GHz to avoid having to monitor the input power with a splitter and a power meter. It is therefore *IMPORTANT* to use a high-quality, low-loss cable from the source to the input of the spectrum analyzer under test. Part number 8120-6164 is recommended for this purpose.

1. Using the 8564E and 8565E adjustment/diagnostic software, select the RF diagnostics.
2. Connect the test board (P/N 08564-69201) between the A14 frequency control assembly and the microcircuits (A7 LOMA and A10/A12 RYTHM/SBTX). The test board is labeled µCKT and INSTR SIDE.
   a. Disconnect W16 from A14J9 and W12 from A14J10.
   b. Connect W16 to J4 on the test board and W12 to J5 on the test board.
   c. Connect J2 on the test board to A14J10 (use 24-conductor ribbon cable, part number 08564-60012).
   d. Connect J1 on the test board to A14J9 (use 20-conductor ribbon cable, part number 8120-5526).
3. You will then be prompted to make different connections to the 85629B Test and Adjustment Module (TAM), a source or spectrum analyzer. Connection locations are shown in Figure 2-10 on page 87 and Figure 2-11 on page 88. Carefully follow the instructions on the controller display. Read the prompts *VERY* carefully! If a wrong connection is inadvertently made, the result could lead to a wrong determination of the fault. (The software could tell you that the SBTX/RYTHM is faulty, when in fact the real fault is in the A8 low band mixer, a much less expensive component.)
4. If a failure occurs, the diagnostic software indicates what failed, for example: `Low Band`, and then prompts you to perform the test(s) that exercises that function or area ("`Low Band Check`").

**Figure 2-10 Diagnostic Software Connection Locations, A14 and A15**

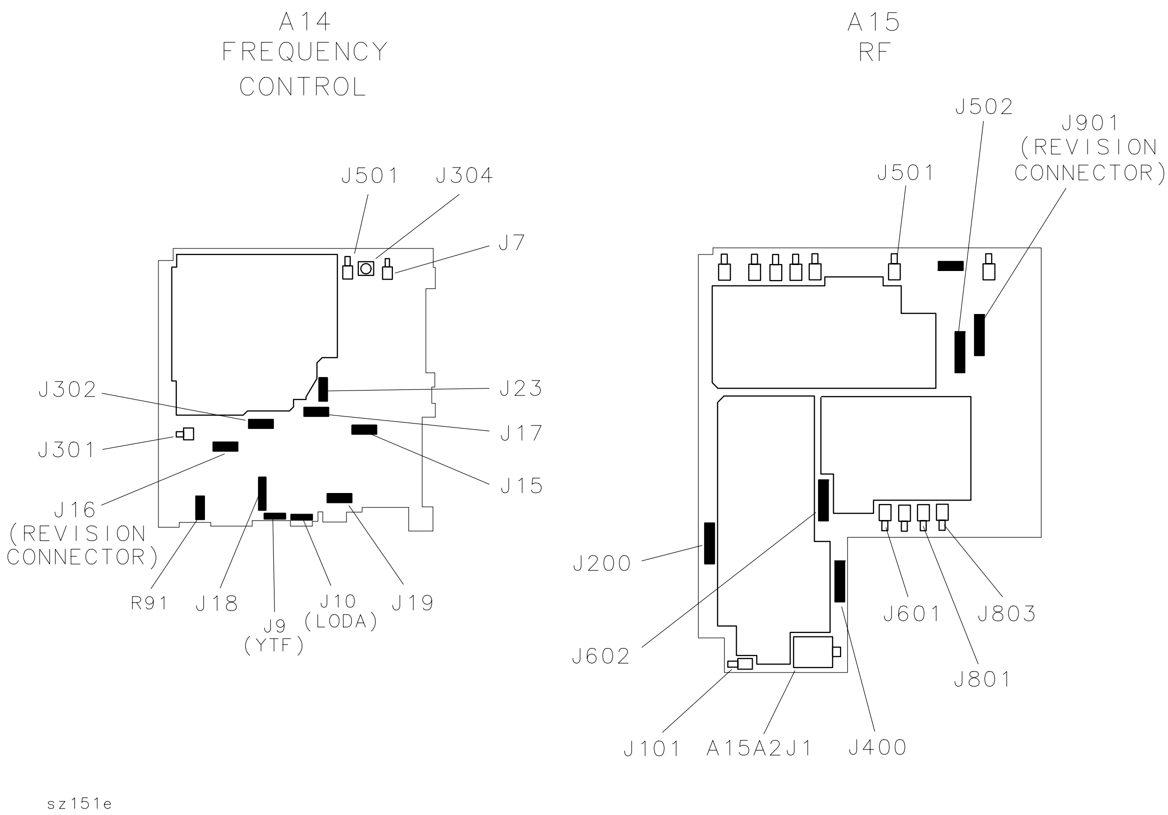
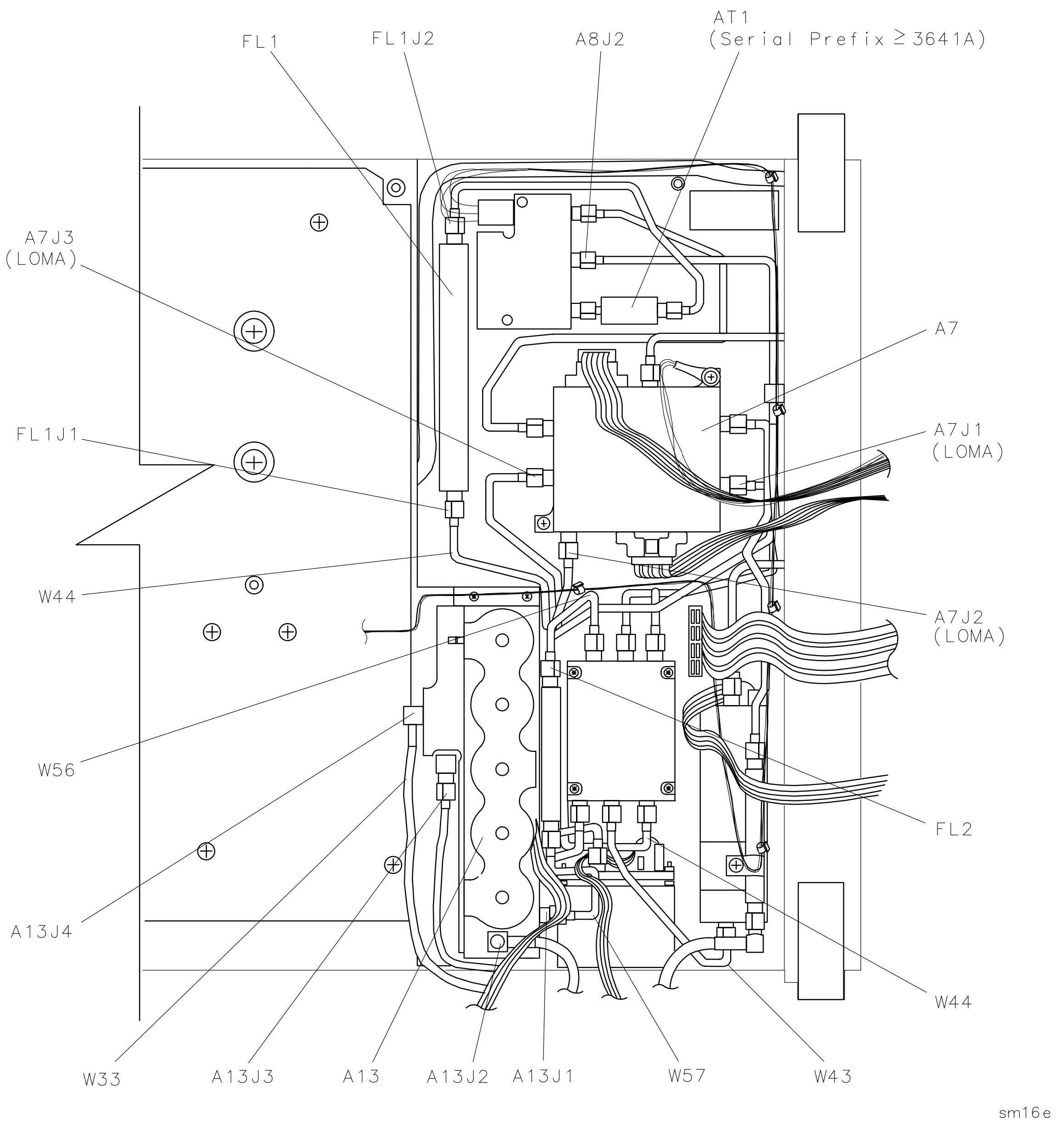


**Figure 2-11 Diagnostic Software Connection Locations, RF Section**



# 3 Manual Adjustment Procedures

# Introduction

This chapter contains information on manual adjustment procedures. Never perform adjustments as routine maintenance. Adjustments should be performed after a repair or performance test failure. For information on which adjustments to perform, refer to Table 3-1 on page 93.

Information on automated adjustments can be found in Chapter 2 of this service guide. Following is a list of the automated adjustments:

**Automated Adjustments**

1. Initial Information
2. LO Frequency
3. YTO FM Coil
4. LOMA Adjustments
5. 3rd Amp/2nd IF Align
6. Cal Out Adjustment
7. Front End Cal
8. IF Bandpass Poles
9. IF Amplitude
10. DC Log Adjustments
11. Sampling Oscillator

**Manual Adjustments**

**NOTE** Before performing any adjustments, allow the spectrum analyzer to warm up for at least 5 minutes.

## Safety Considerations

Although this instrument has been designed in accordance with international safety standards, this manual contains information, cautions, and warnings which must be followed to ensure safe operation and to prevent damage to the instrument. Service and adjustments should be performed only by qualified service personnel.

**WARNING** **Adjustments in this section are performed with power supplied to the instrument and protective covers removed. There are voltages at many points in the instrument which can, if contacted, cause personal injury. Be extremely careful. Adjustments should be performed only by trained service personnel.**

**Power is still applied to this instrument with the LINE switch in the off position. Before removing or installing any assembly or printed circuit board, remove the line-power cord.**

**Capacitors inside the instrument may still be charged, even if the instrument has been disconnected from its source of supply.**

**Use a nonmetallic adjustment tool whenever possible.**

## Which Adjustments Should Be Performed?

Table 3-1 on page 93 lists the manual adjustments that should be performed when an assembly is repaired or changed. It is important to perform the adjustments in the order indicated to ensure that the instrument meets its specifications.

## Test Equipment

The equipment required for the manual adjustment procedures is listed in Table 1-5, "Recommended Test Equipment." Any equipment that satisfies the critical specifications given in the table may be substituted for the preferred test equipment.

If an 3335A is not available for performance tests, tests using alternate test equipment are available. See Chapter 3a, “Manual Adjustment Procedures: 3335A Source not Available,” on page 161.

## Adjustable and Factory-Selected Components

Table 3-2 on page 96 lists the adjustable components by reference designation and name. For each component, the table provides a description and lists the adjustment number.

Refer to Table 3-3 on page 98 for a complete list of factory-selected components used in the instrument along with their functions. Factory-selected components are identified with an asterisk on the schematic diagrams.

## Adjustment Tools

For adjustments requiring a nonmetallic tuning tool, use fiber tuning tool, part number 8710-0033.

Two different tuning tools may be necessary for IF bandpass adjustments, depending upon the type of tuning slug used in the slug-tuned inductors. If the tuning slug requires a slotted tuning tool, use part number 8710-1010. If the tuning slug requires a forked tuning tool, use part number 8710-0772.

Never try to force an adjustment control. This is especially critical when tuning variable capacitors or slug-tuned inductors. Required service accessories, with part numbers, are listed under Service Kit, in Chapter 1 , “General Information.”

## Instrument Service Position

Refer to Chapter 4 for information on removing the spectrum analyzer cover assembly and accessing all internal assemblies.

**Table 3-1 Related Adjustments**

| Assembly Changed or Repaired | Perform the following related adjustments in the order listed | Adjustment Number Manual | Adjustment Number Automated* |
|---|---|---|---|
| A1A1 keyboard | No related adjustment | | |
| A1A2 RPG | No related adjustment | | |
| A2 controller | | | |
| | If EEROM from old A2 controller could not be used in new A2 or if EEROM must be replaced, also perform the following adjustments: | | |
| | LOMA adjustments | | 4 |
| | External mixer amplitude adjustment or | | |
| | 3rd amp/2nd IF align† | 11 | 5 |
| | Front end cal | | 7 |
| A3 interface | | | |
| | Front end cal | | 7 |
| A4 log amp/cal osc | | | |
| | Demodulator adjustment | 9 | |
| | IF amplitude adjustment† | 2 | 9 |
| | DC log amplifier adjustment† | 3 | 10 |
| A5 IF | IF bandpass adjustment† | 1 | 8 |
| | IF amplitude adjustment† | 2 | 9 |
| A6 power supply | No related adjustment | | |

*If any automated adjustment is required, you must first perform automated adjustment "1. Initial Information" on page 63.

†Either the manual or the automated adjustment may be performed.

**Table 3-1 Related Adjustments**

| Assembly Changed or Repaired | Perform the following related adjustments in the order listed | Adjustment Number | |
|---|---|---|---|
| | | **Manual** | **Automated*** |
| A7 LOMA | LOMA adjustments | | 4 |
| | Front end cal *(or perform the frequency response performance test in the 8560 E-Series and EC-Series Spectrum Analyzer Calibration Guide. The adjustment must be performed if the performance test fails).* | | 7 |
| A8 low band mixer | Front end cal | | 7 |
| A9 input attenuator | Front end cal *(or perform the frequency response performance test in the 8560 E-Series and EC-Series Spectrum Analyzer Calibration Guide. The adjustment must be performed if the performance test fails.)* | | 7 |
| A10/A12 RYTHM/SBTX | Front end cal | | 7 |
| A11 YTO | YTO adjustment‡ | 5 | |
| | LO frequency‡ | | 2 |
| | YTO FM coil‡ | | 3 |
| A13 2nd converter | Front end cal | | 7 |
| A14 frequency control | | | |
| | YTO adjustment‡ | 5 | |
| | LO frequency‡ | | 2 |
| | YTO FM cal‡ | | 3 |
| | Front end cal | | 7 |

*If any automated adjustment is required, you must first perform automated adjustment "1. Initial Information" on page 63.

†Either the manual or the automated adjustment may be performed.

‡Perform either the manual "YTO adjustment" (5) or the automated "LO frequency" and "YTO FM coil" adjustments (2 and 3).

**Table 3-1 Related Adjustments**

| Assembly Changed or Repaired | Perform the following related adjustments in the order listed | Adjustment Number | |
|---|---|---|---|
| | | **Manual** | **Automated*** |
| A15 RF | 10 MHz reference adjustment (TCXO, Option 103) or CAL OUT adjustment† | 8 | 6 |
| | Calibrator amplitude adjustment or CAL OUT adjustment† | 6 | 6 |
| | External mixer bias adjustment | 10 | |
| | Sampling oscillator adjustment | 4 | 11 |
| | External mixer amplitude adjustment or 3rd amp/2nd IF align† | 11 | 5 |
| | Front end cal | | 7 |
| A15U100 sampler | Sampling oscillator adjustment† | 4 | 11 |
| A19 GPIB | No related adjustment | | |
| A21 OCXO | 10 MHz reference adjustment (OCXO) | 7 | |

*If any automated adjustment is required, you must first perform automated adjustment"1. Initial Information" on page 63.

†Either the manual or the automated adjustment may be performed.

‡Perform either the manual "YTO adjustment" (5) or the automated "LO frequency" and "YTO FM coil" adjustments (2 and 3).

**Table 3-2 Adjustable Components**

| Reference Designator | Adjustment Name | Adjustment Number | Description |
|---|---|---|---|
| A4C707 | FM DEMOD | 16 | Adjusts the FM demodulation for a peak response. |
| A4R445 | LIMITER PHASE | 5 | Adjusts Limiter Phase for peak response. |
| A4R531 | LOG AMP TOS | 5 | Minimizes error to Top of Screen. |
| A4R544 | LIN FIDELITY BOW | 5 | Minimizes Linearity Fidelity error. |
| A4R826 | CAL OSC AMPTD | 4 | Sets calibration oscillator output power (nominally –35 dBm). This power is injected into the IF during the AUTO IF ADJUST routines. |
| A5L300 | LC CTR 1 | 3 | Adjusts center frequency of first stage of LC bandwidth filter to 10.7 MHz. |
| A5L301 | LC CTR 2 | 3 | Adjusts center frequency of second stage of LC bandwidth filter to 10.7 MHz. |
| A5L700 | LC CTR 3 | 3 | Adjusts center frequency of third stage of LC bandwidth filter to 10.7 MHz. |
| A5L702 | LC CTR 4 | 3 | Adjusts center frequency of fourth stage of LC bandwidth filter to 10.7 MHz. |
| A5R343 | 15 DB ATT | 4 | Adjusts the attenuation of the reference 15 dB attenuator for 15 db between minimum and maximum attenuation. |

**Table 3-2 Adjustable Components**

| Reference Designator | Adjustment Name | Adjustment Number | Description |
|---|---|---|---|
| A5T200 | XTAL CTR 1 | 3 | Adjusts center frequency of first stage of crystal bandwidth filter to 10.7 MHz. |
| A5T202 | XTAL CTR 2 | 3 | Adjusts center frequency of second stage of crystal bandwidth filter to 10.7 MHz. |
| A5T500 | XTAL CTR 3 | 3 | Adjusts center frequency of third stage of crystal bandwidth filter to 10.7 MHz. |
| A5T502 | XTAL CTR 4 | 3 | Adjusts center frequency of fourth stage of crystal bandwidth filter to 10.7 MHz. |
| A14R42 | 6.01 GHz | 7 | Adjusts the main coil tune driver current at a YTO frequency of 6.01 GHz (near the upper YTO frequency limit). |
| A14R76 | FM SPAN | 7 | Adjusts the FM span accuracy by affecting the sensitivity of the FM coil driver. |
| A14R93 | 3.2 GHz | 7 | Adjusts the main coil fixed driver current at a YTO frequency of 3.2 GHz (near the lower YTO frequency limit). |
| A15C100 | SMPL MATCH | 6 | Transforms the sampler input impedance to 50 ohms over the 285 to 297.2 MHz range. |
| A15C210 | VCO RANGE | 6 | Adjusts the VCO tank capacitance so that 21V on the VCO tune line equals 298 MHz VCO frequency. |
| A15C629 | SIG ID | 19 | Fine adjusts the 298 MHz SIG ID oscillator frequency to optimize its performance. |
| A15U302 | 10 MHz ADJ | 15 | Adjusts frequency of the temperature compensated crystal oscillator (TCXO) to 10 MHz. |
| A15R561 | CAL AMPTD | 13 | Adjusts amplitude of the 300 MHz calibrator signal to −10.0 dBm. |
| A15R926 | EXT BIAS ZERO | 17 | Adjusts zero bias point of external mixer bias. |

**Table 3-3 Factory Selected Components**

| Reference Designator | Adjustment Number | Basis of Selection |
|---|---|---|
| A5C204 | 3 | Selected to optimize center frequency of LC tank that loads the crystal. |
| A5C216 | 3 | Selected to optimize center frequency of LC tank that loads the crystal. |
| A5C326 | 3 | Selected to optimize LC pole center frequency. |
| A5C327 | 3 | Selected to optimize LC pole center frequency. |
| A5C505 | 3 | Selected to optimize center frequency of LC tank that loads the crystal. |
| A5C516 | 3 | Selected to optimize center frequency of LC tank that loads the crystal. |
| A5C717 | 3 | Selected to optimize LC pole center frequency. |
| A5C718 | 3 | Selected to optimize LC pole center frequency. |

# 1. IF Bandpass Adjustment

## Assembly Adjusted

A5 IF assembly

## Related Performance Test

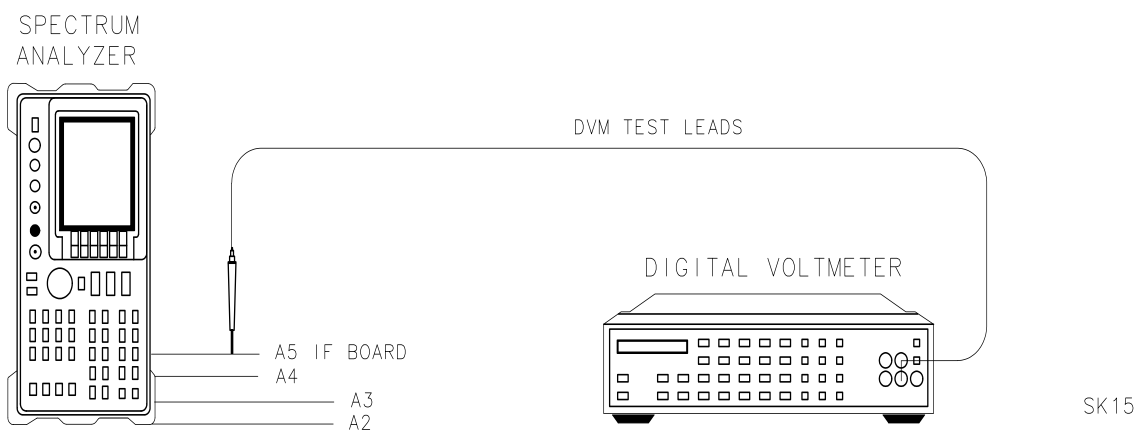
Resolution Bandwidth Accuracy and Selectivity

## Description

The center frequency of each IF bandpass filter pole is adjusted by DAC-controlled varactor diodes and an inductor (for the LC poles) or a transformer (for the crystal poles). The inductors and transformers are for coarse tuning and the varactors are for fine tuning by the microprocessor. The inductors and transformers are adjusted such that the varactor diodes are biased near the middle of their capacitance range. The varactor diode bias is measured with the DVM.

**NOTE** This procedure is not a routine adjustment. It should be performed only if repairs to the A5 IF assembly are made. If the entire A5 IF assembly is replaced, the assembly arrives pre-adjusted from the factory and requires no further adjustment.

**Figure 3-5 IF Bandpass Adjustment Setup**



## Equipment

Digital voltmeter ........................................................ 3456A

DVM test leads .......................................................... 34118A

Special tuning tool

(use with slotted tuning slugs) ....................................... 8710-1010

Special tuning tool

(use with forked tuning slugs) ......................................... 8710-0772

## Procedure

1. Turn the spectrum analyzer off by pressing **LINE**. Disconnect the power cord. Remove the spectrum analyzer cover and fold down the A2 controller, A3 interface, A4 log amp, and A5 IF assemblies. Reconnect the power cord. Turn the spectrum analyzer on and allow it to warm up for at least 30 minutes.

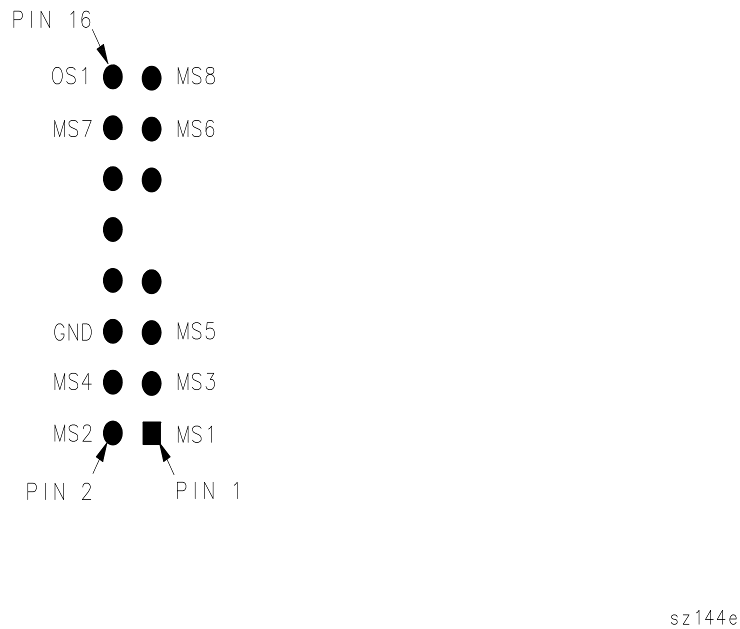
2. Connect the negative DVM lead to pin 6 of A5J6. See Figure 3-5 on page 110 and Figure 3-6 on page 112. Set the 3456A controls as follows:

   Function ........................................................... DC VOLTS

   Range ................................................................ 10 VOLTS

3. On the spectrum analyzer press **PRESET**, **SPAN**, 2, **MHz**, **CAL**, and **IF ADJ ON OFF** so OFF is underlined.

**Figure 3-6** **A5J6 Pin Locations**




## LC Bandpass Adjustments

4. On the spectrum analyzer, press **ADJ CURR IF STATE**. Wait for the IF ADJUST STATUS message to disappear before continuing with the next step.

5. Read the voltage on A5TP5 (this is an empty-hole type of test point). If the voltage is less than +6.06 Vdc, turn A5L300 LC CTR 1 clockwise. If the voltage is greater than +6.26 Vdc, turn LC CTR 1 counterclockwise.

6. Repeat steps 1and 2until the voltage reads +6.16 Vdc ±100 mV.

**NOTE** If the range for the LC CTR adjustment is insufficient, replace the appropriate factory-selected capacitor as listed in Table 3-4 on page 113. To determine the correct replacement value, center the LC CTR adjustment and press **ADJ CURR IF STATE**. After the IF ADJUST STATUS message disappears, read the DVM display. Choose a capacitor value from Table 3-5 on page 113, based on the DVM reading and the presently loaded capacitor value. Table 3-8 on page 115 lists a few capacitor part numbers.

**CAUTION** Turn the spectrum analyzer off by pressing **LINE** to the off position before removing or replacing any shield.

7. Move the positive DVM lead to A5TP6.

8. Adjust A5L301 LC CTR 2 by repeating steps 4 through 6.

9. Move the positive DVM test lead to A5TP2 (this is a resistor-lead type of test point).

10. Adjust A5L700 LC CTR 3 by repeating steps 4 through 6.

11. Move the positive DVM test lead to A5TP1 (this is a resistor-lead type of test point).

12. Adjust A5L702 LC CTR 4 using the procedure in steps 4 through 6.

**Table 3-4 Factory-Selected LC Filter Capacitors**

| LC CTR Adjustment | Fixed Factory Select Capacitor |
|---|---|
| A5L300 LC CTR 1 | A5C326 |
| A5L301 LC CTR 2 | A5C327 |
| A5L700 LC CTR 3 | A5C717 |
| A5L702 LC CTR 4 | A5C718 |

**Table 3-5 LC Factory-Selected Capacitor Selection**

| DVM Reading (V) | Currently Loaded Capacitor Value (pF) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Replace **6.8** with: | Replace **8.2** with: | Replace **10** with: | Replace **12** with: | Replace **15** with: | Replace 18 with: | Replace 20 with: |
| 0 to 1.5 | * | * | * | * | * | * | * |
| 1.5 to 2.5 | 18 | 18 | * | * | * | * | * |
| 2.5 to 3.5 | 15 | 15 | 18 | 18 | * | * | * |
| 3.5 to 4.5 | 10 | 12 | 15 | 15 | 18 | * | * |
| 4.5 to 5.5 | 8.2 | 10 | 12 | 15 | 18 | * | * |
| 5.5 to 6.5 | No change | No change | No change | No change | No change | No change | No change |
| 6.5 to 7.5 | No change | No change | No change | No change | No change | No change | No change |
| 7.5 to 8.5 | * | 6.8 | 8.2 | 10 | 12 | 15 | 18 |
| 8.5 to 9.5 | * | * | 6.8 | 8.2 | 12 | 15 | 18 |
| 9.5 to 10 | * | * | 6.8 | 8.2 | 10 | 12 | 15 |
| * Indicates a condition that should not exist; suspect broken hardware. | | | | | | | |

## XTAL Bandpass Adjustments

13. On the spectrum analyzer, press **SPAN**, 1, **MHz**, and **CAL**.

14. Move the positive DVM test lead to A5TP7.

15. On the spectrum analyzer, press **ADJ CURR IF STATE**. Wait for the `IF ADJUST STATUS` message to disappear before continuing to the next step.

16. Read the voltage displayed on the DVM. If the voltage is less than +6.06 Vdc, turn A5T200 XTAL CTR 1 clockwise. If the voltage is greater than +6.26 Vdc, turn XTAL CTR 1 counterclockwise.

17. Repeat steps 15 and 16 until the voltage reads +6.16 Vdc ±100 mV.

**NOTE** If the range for the XTAL CTR adjustment is insufficient, replace the appropriate factory-selected capacitor as listed in Table 3-6 on page 114. To determine the correct replacement value, center the XTAL CTR adjustment, and press **ADJ CURR IF STATE**. After the `IF ADJUST STATUS` message disappears, read the DVM display. Choose a capacitor value from Table 3-7 on page 115, based on the DVM reading and the presently loaded capacitor value. Table 3-8 on page 115 lists a few capacitor part numbers.

**CAUTION** Turn the spectrum analyzer off by pressing **LINE** to the off position before removing or replacing any shield.

18. Move the positive DVM test lead to A5TP8.

19. Adjust A5T202 XTAL CTR 2 using the procedure in steps 15 through 17.

20. Move the positive DVM test lead to A5TP3.

21. Adjust A5T500 XTAL CTR 3 using the procedure in steps 15 through 17.

22. Move the positive DVM test lead to A5TP4.

23. Adjust A5T502 XTAL CTR 4 using the procedure in steps 15 through 17.

**Table 3-6 Factory-Selected XTAL Filter Capacitors**

| XTAL CTR Adjustment | Fixed Factory Select Capacitor |
|---|---|
| A5T200 XTAL CTR 1 | A5C204 |
| A5T202 XTAL CTR 2 | A5C216 |
| A5T500 XTAL CTR 3 | A5C505 |
| A5T502 XTAL CTR 4 | A5C516 |

**Table 3-7 XTAL Factory-Selected Capacitor Selection**

| DVM Reading (V) | Currently Loaded Capacitor Value (pF) | | | | | |
|---|---|---|---|---|---|---|
| | Replace **15** with: | Replace **18** with: | Replace **20** with: | Replace **22** with: | Replace **24** with: | Replace 27 with: |
| 0 to 1.5 | * | * | * | * | * | * |
| 1.5 to 2.5 | 27 | * | * | * | * | * |
| 2.5 to 3.5 | 22 | 27 | 27 | * | * | * |
| 3.5 to 4.5 | 18 | 22 | 24 | 27 | 27 | * |
| 4.5 to 5.5 | 18 | 20 | 22 | 24 | 27 | * |
| 5.5 to 6.5 | No change | No change | No change | No change | No change | No change |
| 6.5 to 7.5 | No change | No change | No change | No change | No change | No change |
| 7.5 to 8.5 | * | 15 | 18 | 18 | 22 | 24 |
| 8.5 to 9.5 | * | 15 | 15 | 18 | 20 | 24 |
| 9.5 to 10 | * | * | 15 | 18 | 20 | 24 |
| * Indicates a condition that should not exist; suspect broken hardware. | | | | | | |

**Table 3-8 Capacitor Part Numbers**

| Capacitor Value (pF) | Part Number |
|---|---|
| 6.8 | 0160-4793 |
| 8.2 | 0160-4792 |
| 10 | 0160-4791 |
| 12 | 0160-4790 |
| 15 | 0160-4789 |
| 18 | 0160-4788 |
| 20 | 0160-5699 |
| 22 | 0160-4787 |
| 24 | 0160-5903 |
| 27 | 0160-4786 |

# 2. IF Amplitude Adjustments

The IF amplitude adjustments consist of the cal oscillator amplitude adjustment and the reference 15 dB attenuator adjustment.

## Assembly Adjusted

A4 log amp/cal oscillator A5 IF assembly

## Related Performance Tests

IF Gain Uncertainty Scale Fidelity

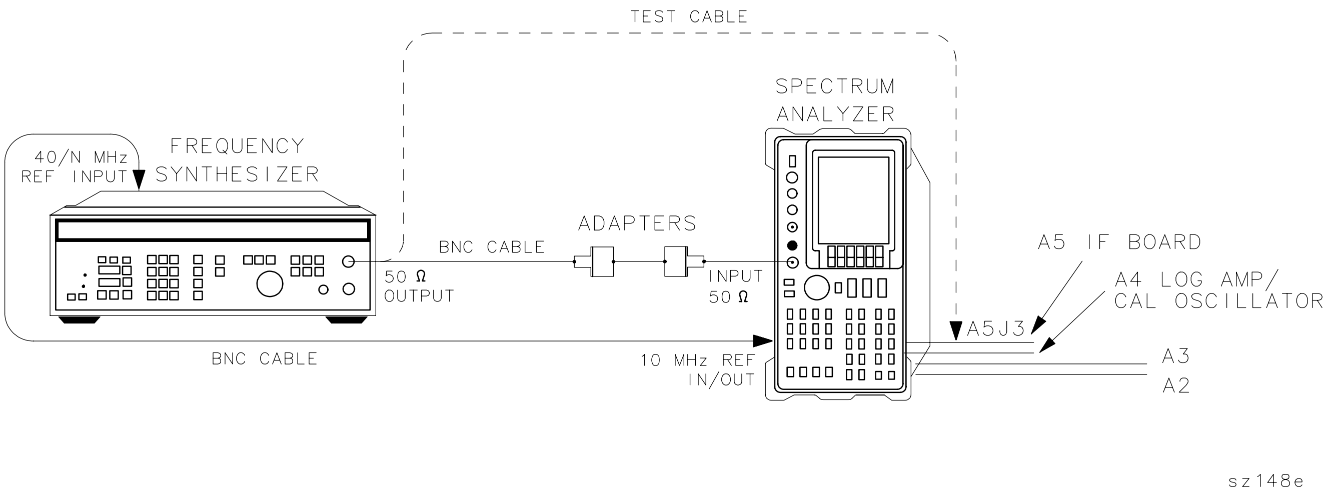
## Description

This adjustment sets the output amplitude of the A4 log amp/cal oscillator and the absolute amplitude of the reference 15 dB attenuator.

The output of the A4 log amp/cal oscillator is adjusted so that a –55 dBm signal applied to the 10.7 MHz IF input on the A5 IF assembly (A5J3) causes a displayed signal of –60 dBm. The effect of this adjustment is visible only after the **ADJ CURR IF STATE** sequence is complete. **ADJ CURR IF STATE** causes the IF gain adjustment to use the "new" output amplitude from the A4 log amp/cal oscillator.

This procedure also sets the attenuator of the reference 15 dB attenuator so that a source amplitude change of 50 dB combined with a spectrum analyzer reference level change of 50 dB displays an amplitude difference of 50 dB.

**Figure 3-7 IF Amplitude Adjustment Setup**




## Equipment

Frequency synthesizer ................................................ 3335A

**Adapters**

Type N (m) to BNC (f) ................................................ 1250-1476

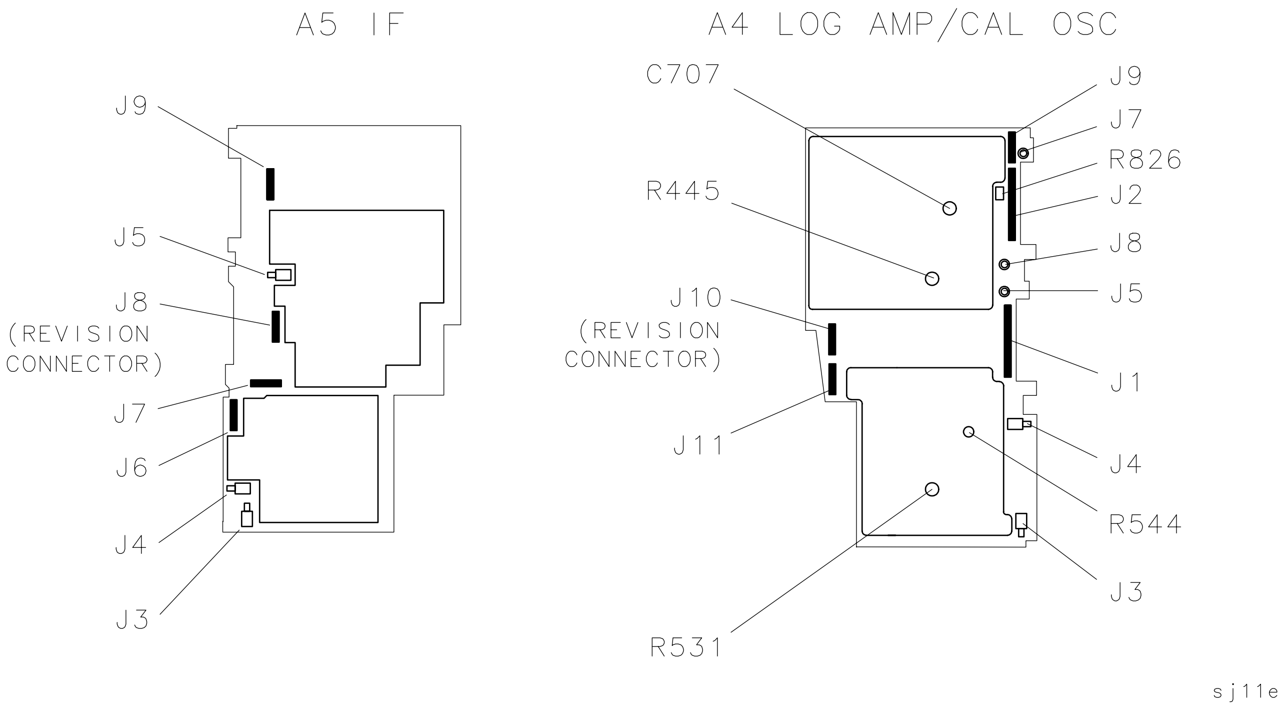
Type N (f) to 2.4 mm (f) ..................................................... 11903B

**Cables**

BNC, 122 cm (48 in) 10503A

Test cable 85680-60093

**Figure 3-8** **IF Amplitude Adjustment Locations**




**NOTE** The 15 dB reference attenuator adjustment is preset at the factory and need not be done if the entire A5 IF assembly is replaced.

## Procedure

1. Press **LINE** to turn the spectrum analyzer off. Remove the spectrum analyzer cover and place the spectrum analyzer in the service position as illustrated in Figure 3-7“IF Amplitude Adjustment Setup,” on page 117.
2. Disconnect W29, violet coax cable, from A5J3. Connect the test cable between A5J3 and the 50Ω output of the 3335A. Press **LINE** to turn the spectrum analyzer on.
3. On the spectrum analyzer, press **MKR**, **CAL**, and **IF ADJ ON OFF** so OFF is underlined.
4. Set the 3335A controls as follows:

   Frequency ............................................................ 10.7 MHz
   Amplitude ............................................................ –55 dBm

5. Note the marker value. Ideally it should read –60 dBm ±0.1 dB.

6. If the marker reads less than –60.1 dBm, rotate A4R826 CAL OSC AMPTD one-third turn clockwise for every 0.1 dB less than –60 dBm. If the marker reads greater than –59.9 dBm, rotate A4R826 CAL OSC AMPTD one-third turn counter clockwise for every 0.1 dB greater than –60 dBm. See Figure 3-8 on page 118 for the location of A4R826. A change in the displayed amplitude will not be seen until **ADJ CURR IF STATE** is pressed.

**NOTE** If A4R826 has inadequate range, refer to "Inadequate CAL OSC AMPTD Range" in Chapter 9.

7. Press **ADJ CURR IF STATE**. After allowing the analyzer time to complete the adjustments, the displayed amplitude and marker reading should change.
8. Repeat steps 7 and 8 until the marker reads –60 dBm ±0.1 dB.
9. Disconnect the test cable from A5J3 and reconnect W29 to A5J3.

## A5 Reference Attenuator Adjustment

10. Set the spectrum analyzer reference level to –60 dBm. If markers are displayed, press **MKR** and **MARKERS OFF**.
11. Set the 3335A **AMPLITUDE** to –60 dBm.
12. Connect a BNC cable between the 50Ω output of the 3335A and the spectrum analyzer INPUT 50Ω .
13. On the spectrum analyzer, press **CAL** and **REF LVL ADJ**. Use the front panel knob or step keys to place the peak of the displayed signal 3 dB to 5 dB below the reference level.
14. Press **PEAK SEARCH** and **MARKER DELTA** on the spectrum analyzer. Set the spectrum analyzer reference level to –10 dBm.
15. Change the 3335A **AMPLITUDE** to –10 dBm.
16. Press **CAL** on the spectrum analyzer.
17. Note the ΔMKR amplitude. Ideally, it should read 50.00 dB ±0.1 dB.
18. If the ΔMKR amplitude is less than 49.9 dB, rotate A5R343 15 dB ATTEN one-half turn counterclockwise for each 0.1 dB less than 50.00 dB. If the ΔMKR amplitude is greater than 50.1 dB, rotate A5R343 15 dB ATTEN one-half turn clockwise for each 0.1 dB greater than 50.00 dB. Do not adjust A5R343 more than five turns before continuing with the next step.
19. Press **ADJ CURR IF STATE** on the spectrum analyzer. Note the ΔMKR amplitude reading.
20. Repeat steps 11 through 20 until the ΔMKR amplitude reading is 50.00 dB ±0.1 dB.

## A5 Adjustment Verification

21. On the spectrum analyzer, disconnect W29 from A5J3. Connect the test cable between A5J3 and the 50Ω output of the 3335A.

22. Set the spectrum analyzer reference level to –10 dBm.

23. Set the 3335A **AMPLITUDE** to –5 dBm.

24. Press **MKR** and **MARKER NORMAL** on the spectrum analyzer.

25. The MARKER amplitude should read –10 dBm ±0.13 dB. If the reading is outside of this range, repeat steps 4 through 21.

26. On the spectrum analyzer, reconnect W29 to A5J3. Press **PRESET** and set the controls as follows:

    Center frequency .................................................... 300 MHz
    Span ....................................................................... 0 Hz
    Reference level ...................................................... –10 dBm
    Resolution bandwidth ............................................. 300 kHz

27. Connect a BNC cable between the 8563E CAL OUTPUT and INPUT 50Ω .

28. On the spectrum analyzer, press **MKR CAL** and **REF LVL ADJ**.

29. Use the knob or step keys to adjust the REF LEVEL CAL setting until the MKR reads –10.00 dBm ±0.1 dB.

30. On the spectrum analyzer, press **STORE REF LVL**.

# 3. DC Log Amplifier Adjustments

There are three DC log adjustments; limiter phase, linear fidelity, and log fidelity.

## Assembly Adjusted

A4 log amp/cal oscillator

## Related Performance Tests

IF Gain Uncertainty Scale Fidelity

## Description

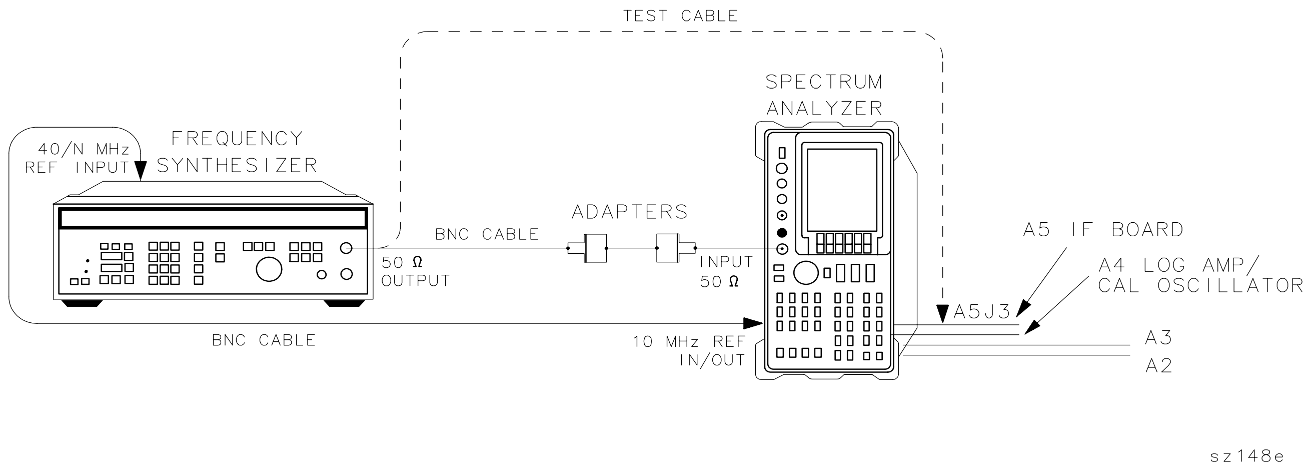
These three adjustment need only be done under the following conditions:

| | |
|---|---|
| Limiter phase | Only if a repair is made to blocks F, G, H, I, or J. |
| Linear fidelity | Only if a repair is made to blocks C, D, F, G, H, I, J, K, O, IF gain accuracy, RBW switching, or log fidelity. |
| Log fidelity | Only if a repair is made to blocks D, F, H, K, IF gain accuracy, RBW switching, or log fidelity. |

If multiple adjustments are required they should be done in the following order:

1. Limiter Phase
2. Linear Fidelity
3. Log Fidelity

**Figure 3-9 DC Log Adjustment Setup**




## Equipment

Frequency synthesizer .................................................. 3335A

### Adapters

Type N (m) to BNC (f) .................................................. 1250-1476

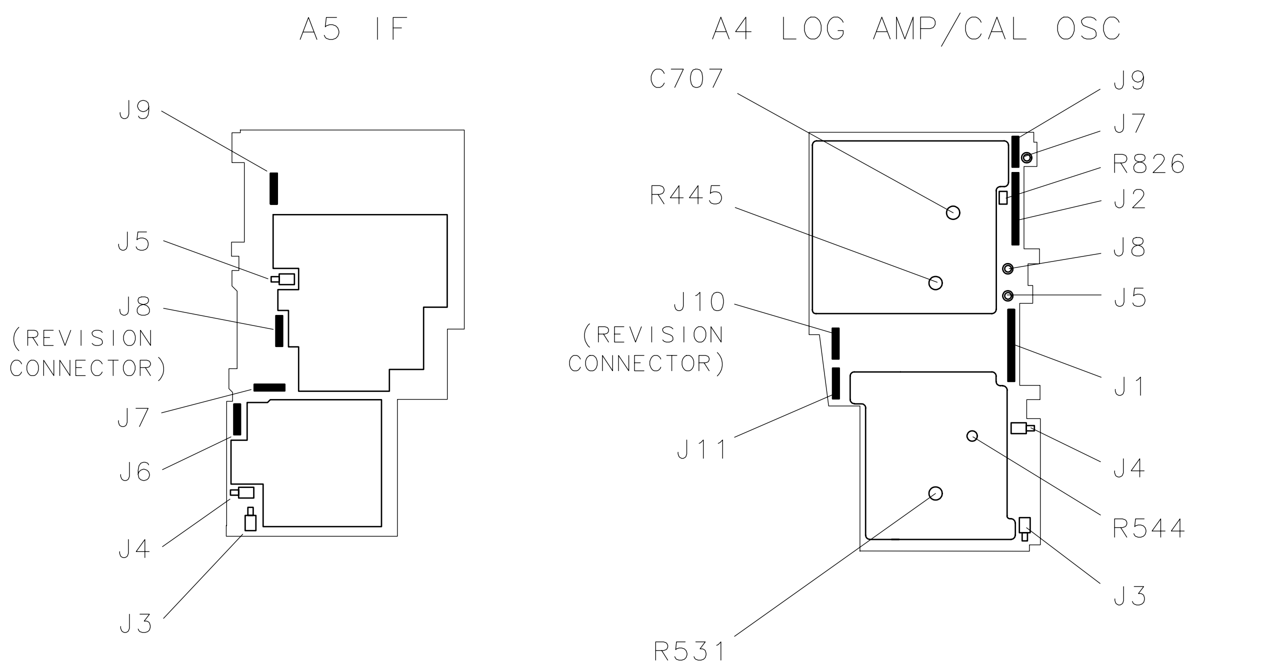
Type N (f) to 2.4 mm (f) ................................................ 11903B

### Cables

BNC, 122 cm (48 in) .................................................. 10503A

Test cable ......................................................................... 85680-60093

**Figure 3-10 DC Log Adjustment Locations**

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**NOTE** Adjustments should be made with all of the shields on and only after allowing at least a 20 minute warmup.

---

## A4 Limiter Phase Adjustment

1. Press **LINE** to turn the spectrum analyzer off. Remove the spectrum analyzer cover and place the spectrum analyzer in the service position as illustrated in Figure 3-9 on page 122. See Figure 3-10 on page 123 for adjustment location.

2. Connect the 3335A 50Ω output to the spectrum analyzer 50Ω input. Press **LINE** to turn the spectrum analyzer on.

3. Set the spectrum analyzer controls as follows:

   Center frequency ............................................ 15 MHz
   Span ........................................................................ 0
   Reference level ........................................... –10 dBm
   dB/division ............................................... 1 dB/DIV
   Resolution bandwidth ................................... 300 kHz
   IF ADJ ..................................................................OFF

4. Set up an 3335A as follows:

   Frequency .................................................................. 15 MHz
   Amplitude ................................................................ –18 dBm

5. Press **CAL**, **ADJ CURR IF STATE**, wait for the analyzer to complete adjustments then press **MKR**.
6. Adjust A4R445 for maximum on-screen amplitude. Refer to Figure 3-10 on page 123 for the location of A4R445.

### A4 Linear Fidelity Adjustment

1. Press **LINE** to turn the spectrum analyzer off. Remove the spectrum analyzer cover and place the spectrum analyzer in the service position as illustrated in Figure 3-9 on page 122. See Figure 3-10 on page 123 for adjustment location.
2. Connect the 3335A 50Ω output to the spectrum analyzer 50Ω input. Press **LINE** to turn the spectrum analyzer on.
3. Press **PRESET AMPLITUDE**, **LINEAR**, **MORE 1 of 3**, **AMPTD UNITS**, **dBm**, **CAL**, **IF ADJ ON OFF** (OFF).
4. Press **PEAK SEARCH**, **MARKER DELTA**.
5. Reduce the 3335A input power to –58 dBm.
6. If the delta marker amplitude reads –40 dB ±2 dB, no adjustment is necessary.
7. If the signal is lower on the screen than expected ( delta marker amplitude reads less than –42dB) then adjust A4R544 (see Figure 3-10 on page 123) for an even lower level and press **CAL**, **ADJ CURR IF STATE**. Allow sufficient time for the analyzer to complete the adjustment.
8. If the signal is higher on the screen than expected ( delta marker amplitude reads greater than –38 dB) then adjust A4R544 for an even higher level signal and press **CAL**, **ADJ CURR IF STATE**. Allow sufficient time for the analyzer to complete the adjustment.
9. Repeat steps 5 through 10.

### A4 LOG Fidelity Adjustment

1. Press **LINE** to turn the spectrum analyzer off. Remove the spectrum analyzer cover and place the spectrum analyzer in the service position as illustrated in Figure 3-9 on page 122. See Figure 3-10, “DC Log Adjustment Locations,” for adjustment location.
2. Connect the 3335 50Ω output to the spectrum analyzer 50Ω input. Press **LINE** to turn the spectrum analyzer on.

3. Press **PRESET**, **CAL**, **IF ADJ ON OFF** (OFF), **ADJ CURR IF STATE**.

4. Set the spectrum analyzer controls as follows:

   Center frequency .................................................. 15 MHz
   Span ........................................................................... 0
   Resolution bandwidth ......................................... 300 kHz
   Reference level .................................................... –10 dBm

5. Set up an 3335A as follows:

   Frequency .............................................................. 15 MHz
   Amplitude ............................................................ –10 dBm

6. Press **MKR**, **MARKER DELTA** on the spectrum analyzer.

7. Decrease the 3335A power to –26 dBm.

8. Calculate the error: EQUATION {\rm Error} = {\rm delta\ marker\ reading}-{\rm 16\ dB} EQUATION.

9. If the error is less than ±0.2 dB, no adjustment is necessary.

10. Set the 3335A power to –10 dBm.

11. Adjust A4R531 (see Figure 3-10, “DC Log Adjustment Locations,”) to read two times the error. For example, if the calculated error is +0.75 dB, adjust A4R531 for a delta marker amplitude reading of +1.5 dB. Press **CAL**, **ADJ CURR IF STATE**.

12. Repeat steps 7 through 11.

# 4. Sampling Oscillator Adjustment

## Assembly Adjusted

A15 RF assembly

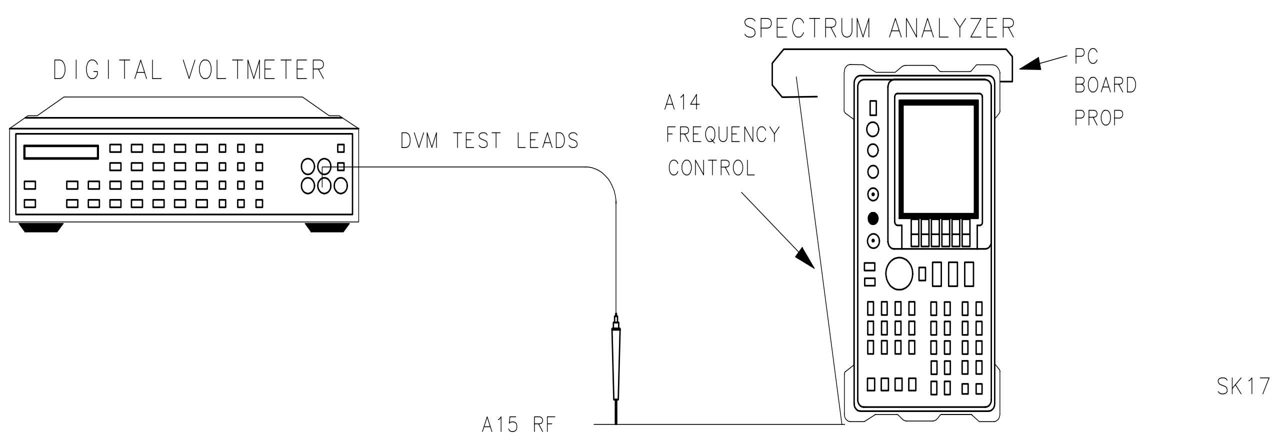
## Related Performance Test

There is no related performance test for this adjustment procedure.

## Description

The sampling oscillator tank circuit is adjusted for a tuning voltage of 5.05 V dc when the sampling oscillator is set to 297.222 MHz. The voltage monitored is actually the tuning voltage divided by 4.05. The setting is then checked at other frequencies for the full tuning range of the sampling oscillator.

**Figure 3-11 Sampler Adjustment Setup**




## Equipment

Digital voltmeter ........................................................... 3456A

DVM test leads ........................................................... 34118A

## Procedure

1. Press **LINE** to turn the spectrum analyzer off and disconnect the line power cord. Remove the spectrum analyzer cover and fold down the A15 RF and A14 frequency control assemblies. Prop up the A14 frequency control assembly. Reconnect the line power cord and press **LINE** to turn the spectrum analyzer on. Connect the equipment as illustrated in Figure 3-11 on page 126.
2. Press **PRESET** on the spectrum analyzer and set the controls as follows:

   Center frequency ................................................ 2126 MHz
   Span ....................................................................... 0 Hz

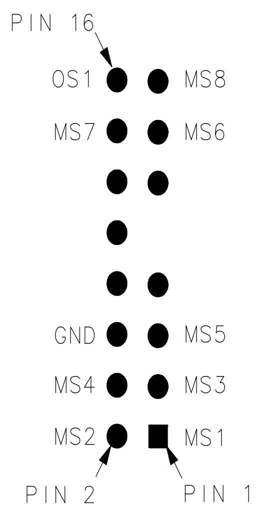
3. Set the 3456A controls as follows:

   Function ........................................................... DC VOLTS
   Range ........................................................ 10V, MANUAL

## Sampling Oscillator Adjustment

1. Connect the negative DVM test lead to A15J200 pin 6. Connect the positive DVM lead to A15J200 pin 13.
2. Adjust A15C210 VCO RANGE for a DVM reading of 5.05 V ±0.05 V.

**Figure 3-12 A15J200 Pin Locations**



## Sampler Match Adjustment

1. Connect the negative DVM test lead to A15J400 pin 6, and the positive DVM test lead to A15J400 pin 1.
2. Press **FREQUENCY** and set the spectrum analyzer center frequency to 2302.3 MHz. This sets the sampling oscillator to 291.667 MHz.
3. Adjust A15C100 SMPL MATCH to peak the voltage displayed on the DVM.
4. Record the displayed voltage in Table 3-9 on page 128 as the displayed voltage for the sampling oscillator frequency of 291.667 MHz.
5. Press **FREQUENCY** on the spectrum analyzer. Use the keypad to set the spectrum analyzer center frequency to the frequencies listed in Table 3-9 on page 128. At each listed frequency, record the displayed voltage in the table.
6. If the difference between the maximum and minimum voltages is less than 0.50 V, and all voltage readings are between +0.5 and +2.5 Vdc, proceed to step 15.
7. Locate the center frequency at which the voltage is lowest. Use the keypad to set the spectrum analyzer to this frequency.
8. Readjust SMPL MATCH to set the displayed voltage to 0.8 ±0.1 Vdc.
9. Set the spectrum analyzer center frequency to 2302.3 MHz and repeat steps 9 through 13.
10. Move the positive DVM test lead to A15J400 pin 3. Check that the measured voltage is the negative of the voltage at pin 1, within ±0.1 Vdc.
11. Disconnect the DVM probes from A15J400.

**Table 3-9 Sampling Adjustments**

| Center Frequency (MHz) | Sampling Oscillator (MHz) | Displayed Voltage (Vdc) | | | | |
|---|---|---|---|---|---|---|
| | | 1st Trial | 2nd Trial | 3rd Trial | 4th Trial | 5th Trial |
| 2156.3 | 285.000 | | | | | |
| 2176.3 | 286.364 | | | | | |
| 2230.3 | 288.462 | | | | | |
| 2263.3 | 290.000 | | | | | |
| 2302.3 | 291.667 | | | | | |
| 2158.3 | 293.478 | | | | | |

**Table 3-9 Sampling Adjustments**

| Center Frequency (MHz) | Sampling Oscillator (MHz) | Displayed Voltage (Vdc) | | | | |
|---|---|---|---|---|---|---|
| 2196.3 | 295.000 | | | | | |
| 2378.3 | 296.471 | | | | | |
| 2422.3 | 297.222 | | | | | |

# 5. YTO Adjustment

## Assembly Adjusted

A14 frequency control assembly

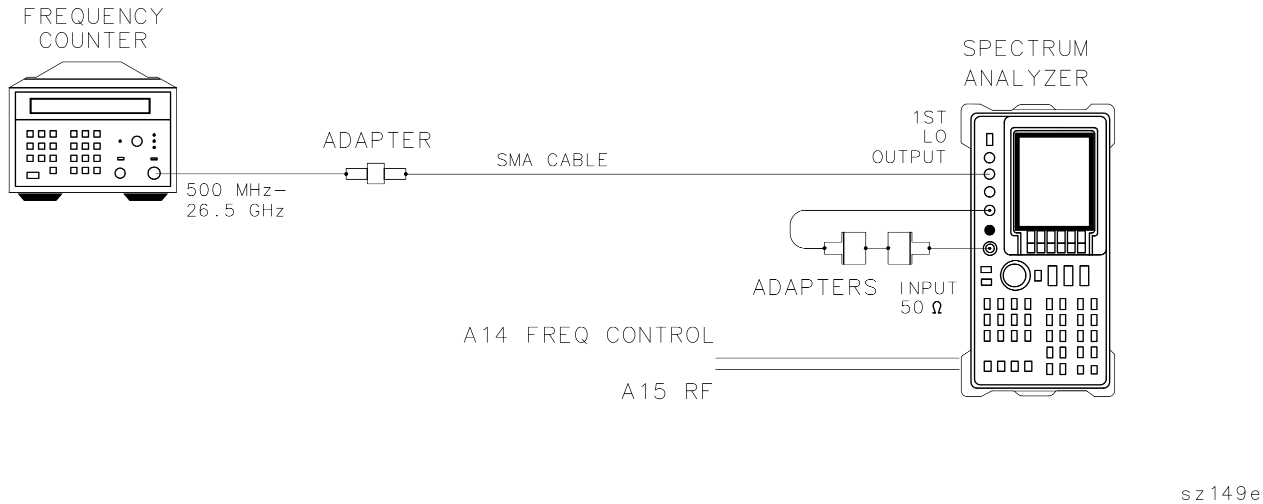
## Related Performance Tests

Frequency Span Accuracy Frequency Readout Accuracy and Frequency Count Marker Accuracy

## Description

The YTO main coil adjustments are made with the phase-lock loops disabled. The YTO endpoints are adjusted to bring these points within the capture range of the main loop. The YTO FM coil is adjusted to place the 300 MHz CAL OUTPUT signal at the center vertical graticule in a 20 MHz span.

**Figure 3-13 YTO Adjustment Setup**



## Equipment

Microwave frequency counter ....................... 5343A Option 001

**Adapters**

Type N (m) to BNC (f) ................................................ 1250-1476

Type N (f) to 2.4 mm (f) ..................................................11903B

APC 3.5 (f) to APC 3.5 (f) ............................................ 5061-5311

**Cables**

BNC, 122 cm (48 in) ........................................................10503A

SMA, 61 cm (24 in) ...................................................... 8120-1578

## Procedure

**NOTE** This adjustment cannot be performed if preselected external mixer mode is selected.

The **SAVELOCK ON OFF** function must be OFF.

### YTO Main Coil Adjustments

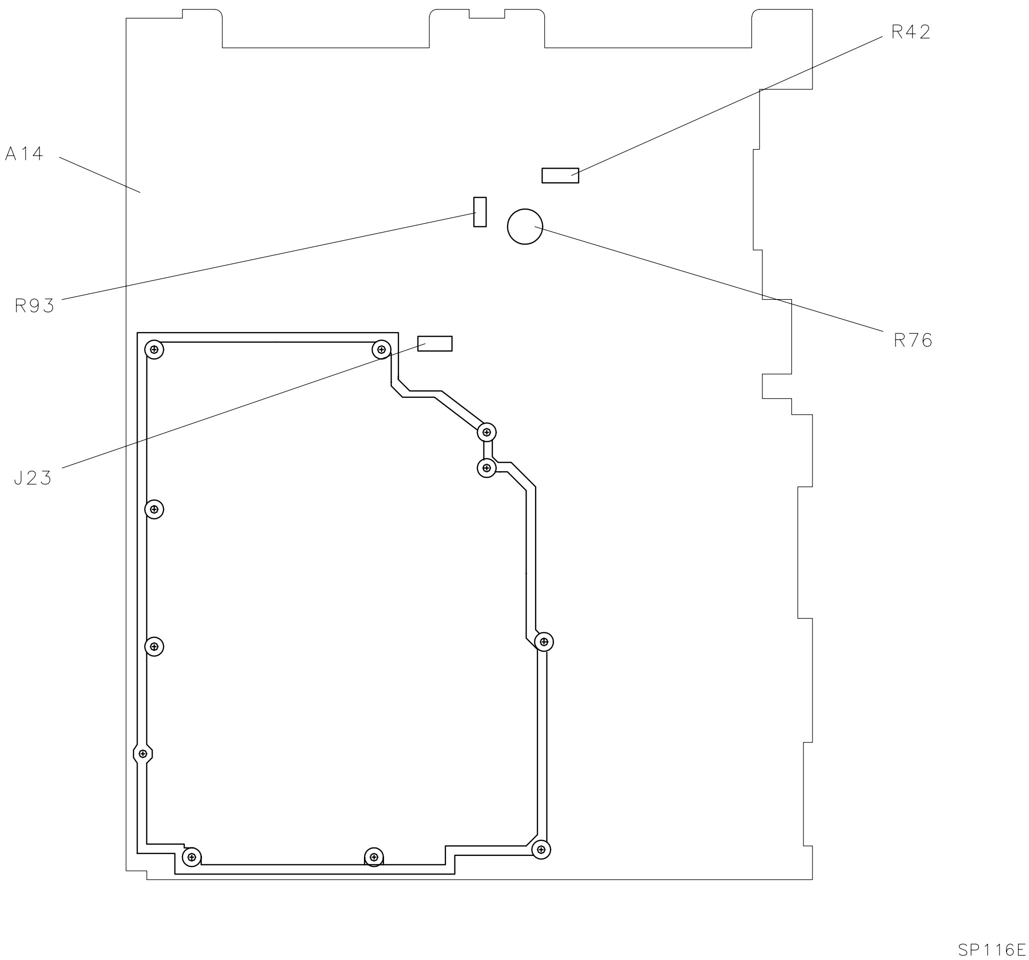
1. Press **LINE** to turn the spectrum analyzer off. Remove the spectrum analyzer cover and fold down the A15 RF and A14 frequency control assemblies.
2. Disconnect the 50Ω termination from the 1ST LO OUTPUT. Connect the equipment as shown in Figure 3-13 on page 130. Press **LINE** to turn the spectrum analyzer on.
3. Move the jumper on A14J23 from the NORM position (pins 1 and 2 jumpered) to the TEST position (pins 2 and 3 jumpered). See Figure 3-14"YTO Adjustment Locations," on page 132 for the location on the A14 frequency control assemblies.
4. On the spectrum analyzer, press the following keys:

   **CONFIG**, **EXT MXR PRE UNPR**, (UNPR) **AUX CTRL**, **EXTERNAL MIXER**, **LOCK HARMONIC**, 6 Hz **SPAN**, **ZERO SPAN FREQUENCY**, **CENTER FREQ**, 18.8893 GHz, **SGL SWP SAVE**, **SAVE STATE**, **STATE 0 FREQUENCY**, 35.7493 GHz **SAVE**, **SAVE STATE**, **STATE 1 RECALL**, **RECALL STATE**, **STATE 0**.
5. On the 5343A, press **SHIFT** 7 and set the controls as follows:

   Sample rate ......................................... Fully counterclockwise
   10 Hz–500 MHz/500 MHz–26.5 GHz switch ......
   500 MHz-26.5 GHz

6. Adjust A14R93 3.2 GHz for the appropriate frequency counter reading of 3.200 GHz ±1 MHz.
7. On the spectrum analyzer, press **STATE 1**.
8. Adjust A14R42 6.01 GHz for a frequency counter reading of 6.010 GHz ±1 MHz.
9. On the spectrum analyzer, press **STATE 0**.
10. Repeat steps 6 through 9 until both of these interacting adjustments meet their tolerances.

**Figure 3-14 YTO Adjustment Locations**



11. Place the jumper on A14J23 in the NORM position (pins 1 and 2 jumpered).

12. Disconnect the SMA cable from the 1ST LO OUTPUT jack and reconnect the 50Ω termination on the 1ST LO OUTPUT.

## YTO FM Coil Adjustments

13. On the spectrum analyzer, press **PRESET** and set the controls as follows:

    Center frequency ..................................................... 300 MHz
    Span ................................................................... 20 MHz

14. Adjust A14R76 FM SPAN until the 300 MHz CAL OUTPUT SIGNAL is aligned with the center vertical graticule line.

# 6. Calibrator Amplitude Adjustment

## Assembly Adjusted

A15 RF assembly

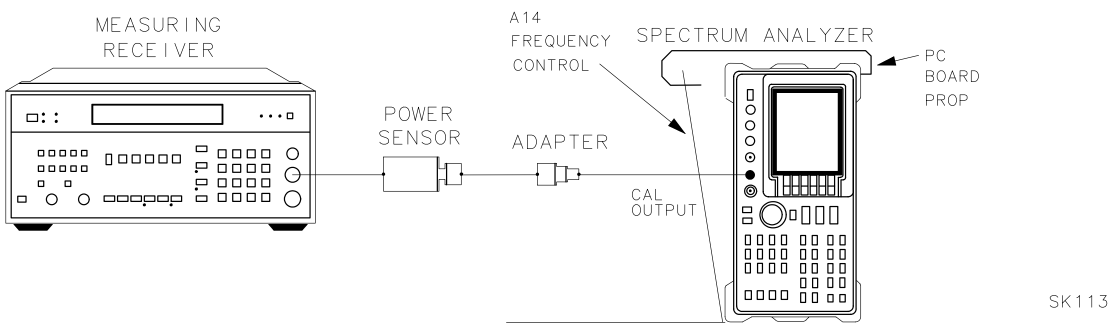
## Related Performance Test

Calibrator Amplitude and Frequency Accuracy

## Description

The CAL OUTPUT amplitude is adjusted for –10.00 dBm measured directly at the front panel CAL OUTPUT connector.

**Figure 3-15 Calibrator Amplitude Adjustment Setup**




## Equipment

Measuring receiver ........................................................ 8902A

Power sensor ................................................................. 8482A

Adapters

Type N (f) to BNC (m) ............................................... 1250-1477

## Procedure

**NOTE** The spectrum analyzer should be allowed to warm up for at least 30 minutes before performing this adjustment.

1. Place the spectrum analyzer in the service position shown in Figure 3-15 on page 134. Prop the A14 frequency control board assembly in the service position.
2. Zero and calibrate the 8902A/8482A combination in log display mode. Enter the power sensor 300 MHz cal factor into the 8902A.
3. Connect the 8482A through an adapter directly to the spectrum analyzer CAL OUTPUT connector.
4. Adjust A15R561 CAL AMPTD for a –10.00 dBm reading on the 8902A display.

# 7. 10 MHz Reference Adjustment — OCXO

## Assembly Adjusted

A21 OCXO assembly

**NOTE** Replacement oscillators are factory adjusted after a complete warmup and after the specified aging rate has been achieved. Thus, readjustment should typically not be necessary after oscillator replacement and is generally not recommended.

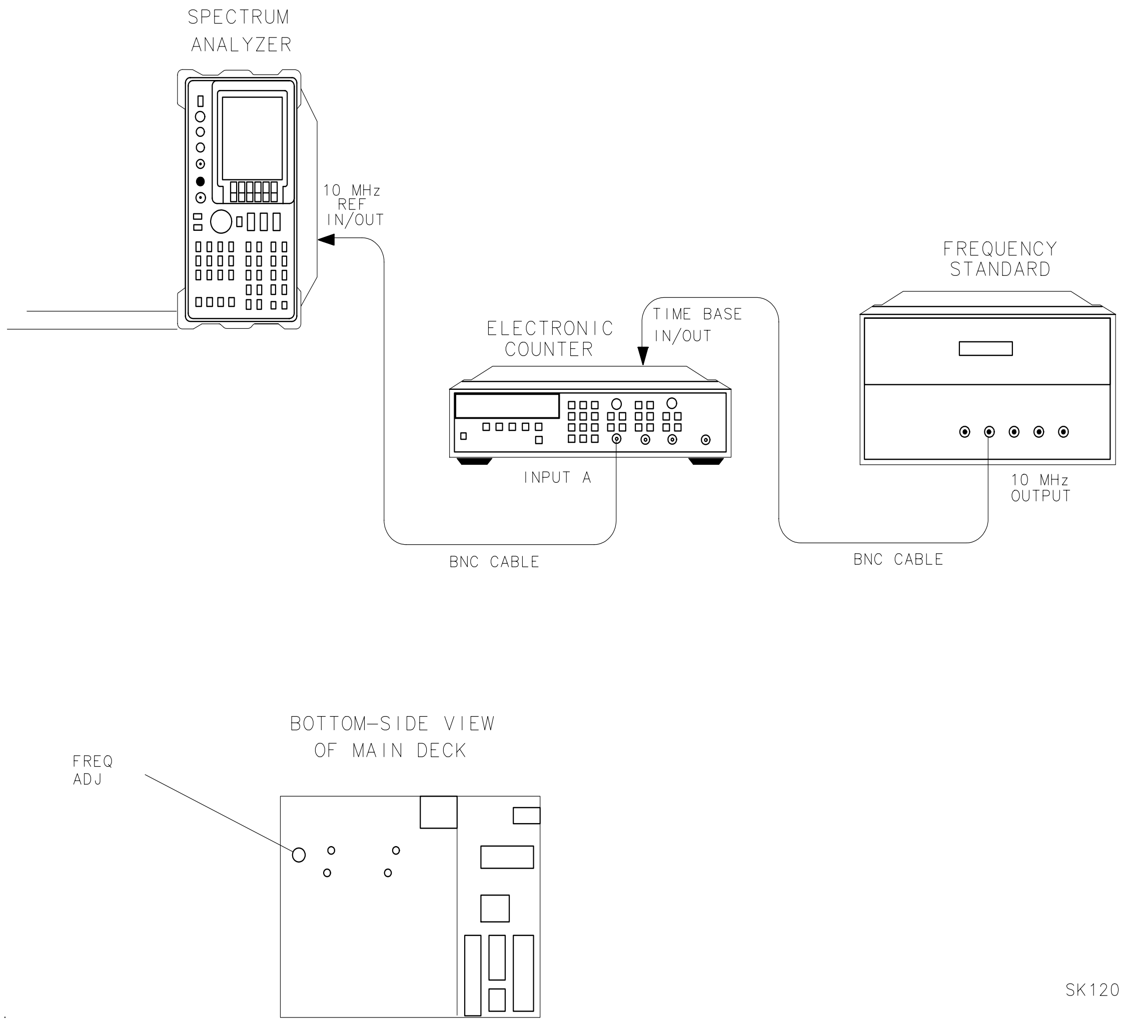
## Related Performance Test

10 MHz Reference Accuracy

## Description

The frequency of the internal 10 MHz frequency reference is compared to a known frequency standard and adjusted for minimum frequency error. This procedure does not adjust the short-term stability or long-term stability of the A21 10 MHz ovenized crystal oscillator (OCXO). Stability is determined by the characteristics of the particular oscillator and the environmental and warmup conditions to which it has been recently exposed. The spectrum analyzer must be on continuously for at least 24 hours immediately prior to oscillator adjustment to allow both the temperature and frequency of the oscillator to stabilize.

**Figure 3-16 10 MHz Reference Adjustment Setup and Adjustment Location**




## Equipment

Frequency counter ........................................................... 5334A/B

Frequency standard ................. 5061B Cesium Beam Standard Cable

BNC, 122 cm *(2 required)*.................................................... 10503A

## Procedure

**NOTE** Failure to allow a 24 hour minimum warmup time for OCXO frequency and temperature stabilization may result in oscillator misadjustment.

1. Connect equipment as shown in Figure 3-16 on page 137 as follows:

   a. Press **LINE** to turn the spectrum analyzer on. After the automatic power-on adjustment sequence is complete, press **PRESET** to ensure that the frequency reference is set to internal.

   b. Allow the spectrum analyzer to remain powered on continuously for at least 24 hours to ensure that the A21 OCXO temperature and frequency stabilize.

**NOTE** If the reference is set to **10 MHz EXT**, press **10 MHz INT**. Allow the 24 hour warmup for the OCXO before continuing. When the 10 MHz reference is set to **10 MHz EXT**, the OCXO is not operating or warmed up.

   c. Connect the frequency standard to the frequency counter rear panel TIMEBASE IN/OUT connector.

   d. Connect a BNC cable between the spectrum analyzer rear panel 10 MHz REF IN/OUT connector and INPUT A on the frequency counter.

2. Set the frequency counter controls as follows:

   Function/data ........................................................ FREQ A
   Input ......................................................................... A
   ×10 Attenuator ............................................................ OFF
   AC ........................................................ OFF (DC coupled)
   50ΩZ . .................................. ..OFF (1 MΩ input impedance)
   Auto Trigger ............................................................... ON
   100 kHz filter A .......................................................... OFF
   INT/EXT switch (rear panel) .......................................... EXT

3. Select a 1 second gate time on the 5334A/B frequency counter by pressing **GATE TIME**, 1, **GATE TIME**.

4. To offset the displayed frequency by –10.0 MHz, press MATH, **SELECT/ENTER**, **CHX/EEX**, 10, **CHS/EEX**, 6, **SELECT/ENTER**, **SELECT/ENTER**. The frequency counter should now display the difference between the frequency of the INPUT A signal and 10.0 MHz with a displayed resolution of 0.010 Hz (10 MHz).

5. Locate the FREQ ADJ control on the spectrum analyzer. This control is accessible through the center deck of the spectrum analyzer. See Figure 3-16 on page 137.

6. Remove the dust-cap screw.

7. Use a nonconductive adjustment tool to adjust the FREQ ADJ control on the A21 OCXO for a frequency counter reading of 0.00 Hz.
8. On the 5334A/B frequency counter, select a 10-second gate time by pressing **GATE TIME**, 10, **GATE TIME**. The frequency counter should now display the difference between the frequency of the INPUT A signal and 10.0 MHz with a resolution of 0.001 Hz (1 mHz).
9. Wait at least two gate periods for the frequency counter to stabilize, then adjust the FREQ ADJ control on A21 OCXO for a stable frequency counter reading of 0.000 Hz ±0.010 Hz.
10. Replace the dust-cap screw to A21 OCXO.

# 8. 10 MHz Reference Adjustment — TCXO (Option 103)

## Assembly Adjusted

A15 RF assembly

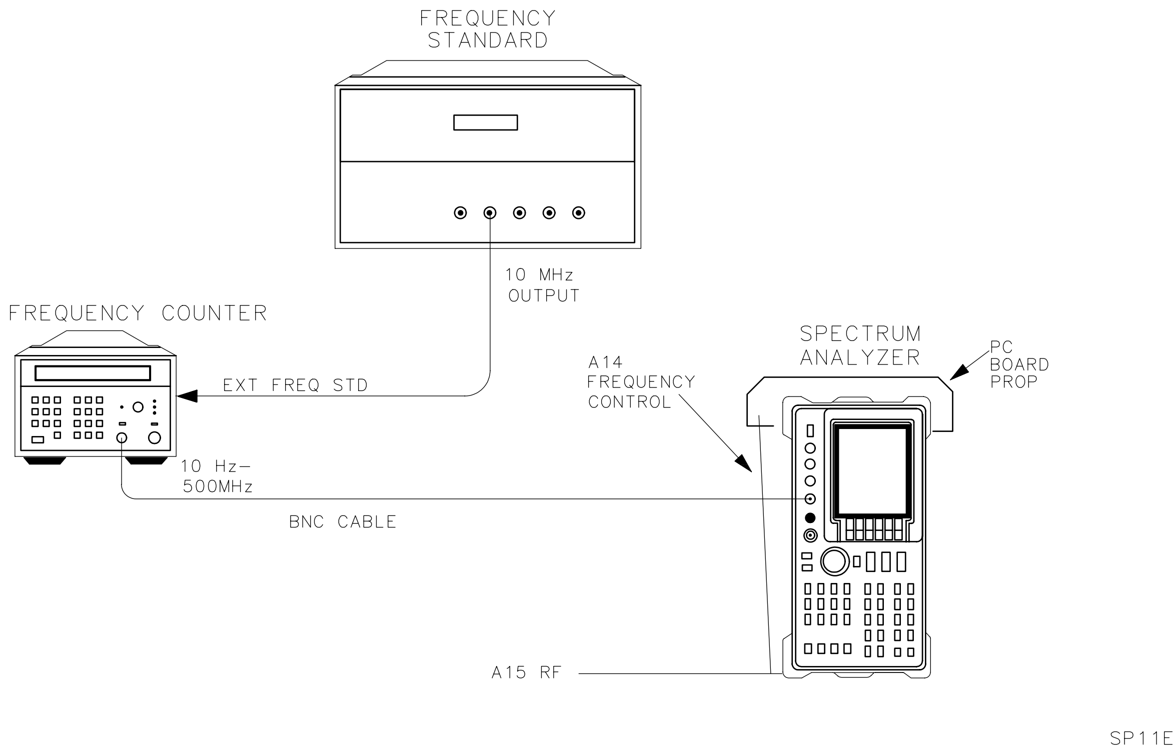
## Related Performance Test

10 MHz Reference Output Accuracy (Option 103)

## Description

The frequency counter is connected to the analyzer CAL OUTPUT. The CAL OUTPUT is locked to the 10 MHz frequency reference which yields better effective resolution. The temperature-compensated crystal oscillator (TCXO) is adjusted for a frequency counter reading of 300 MHz.

**Figure 3-17 10 MHz Reference Adjustment Setup — TCXO**



## Equipment

Microwave frequency counter .......................... 5343A Option 001

Frequency standard .................... 5061B Cesium Beam Standard

(or any 10 MHz frequency standard with accuracy <±1 X $10^{-10}$)

### Cables

BNC, 122 cm *(2 required)* .................................................. 10503A

## Procedure

**NOTE** Allow the spectrum analyzer to warm up for at least 30 minutes before performing this adjustment.

1. Connect the equipment as shown in Figure 3-17“10 MHz Reference Adjustment Setup — TCXO,” on page 140. Prop up the A14 frequency control assembly.
2. Set the frequency counter controls as follows:

   Sample rate ............................................................ Midrange
   50Ω–1 MΩ switch ......................................................... 50Ω
   10 Hz–500 MHz/500 MHz–26.5 GHz switch .. 10 Hz– 500 MHz

3. Press **AUX CTRL REAR PANEL**. Verify that the 10 MHz reference is set to **10 MHz INT**.

**NOTE** When the 10 MHz reference is set to **10 MHz EXT**, the TCXO is not operating and warmed up. If the reference is set to **10 MHz EXT**, set the reference to **10 MHz INT** and allow 30 minutes for the TCXO to warm up.

4. Remove dust cap from A15U302, TCXO. The dust cap is toward the rear of the spectrum analyzer.
5. Adjust 10 MHz ADJ on A15U302 for a frequency counter reading of 300.000000 MHz ±30 Hz.
6. Replace the dustcap on A15U302.

# 9. Demodulator Adjustment

## Assembly Adjusted

A4 log amplifier/cal oscillator assembly

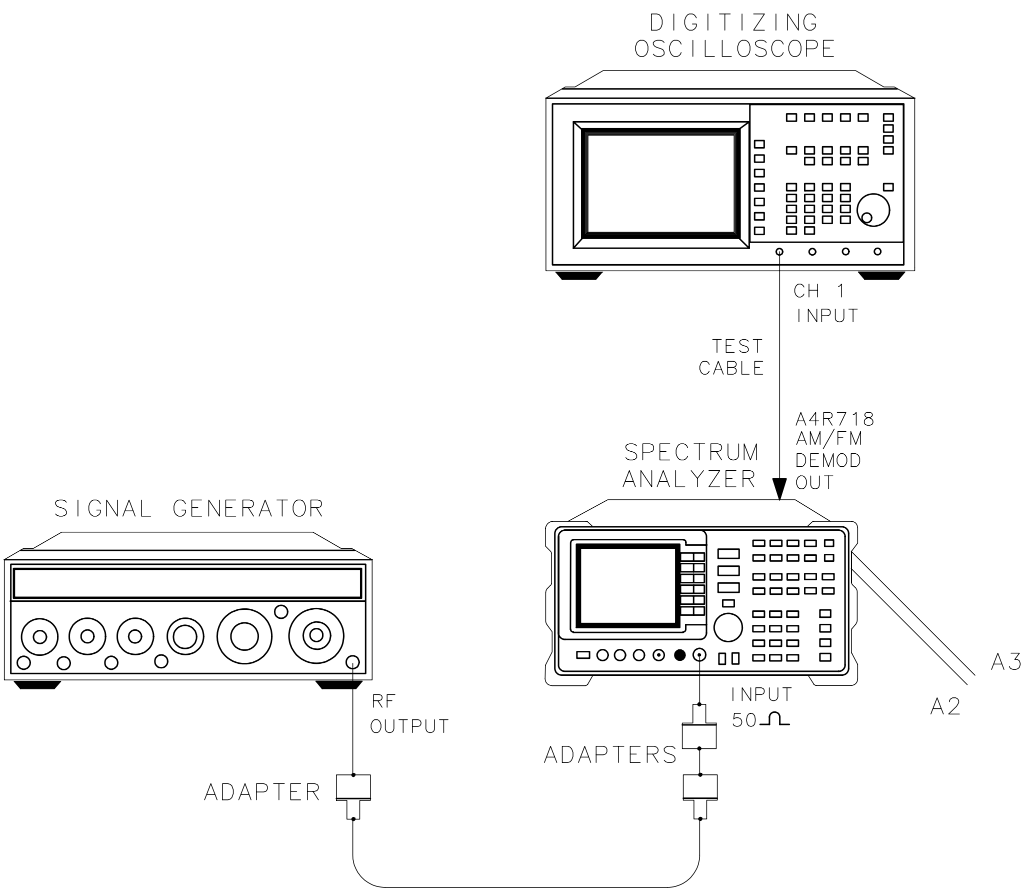
## Related Performance Test

There is no related performance test for this adjustment.

## Description

A 5 kHz peak-deviation FM signal is applied to the INPUT 50Ω . The detected audio is monitored by an oscilloscope. FM DEMOD is adjusted to peak the response displayed on the oscilloscope.

**Figure 3-18 Demodulator Adjustment Setup**



## Equipment

AM/FM signal generator ................................................ 8640B

Oscilloscope ........................................................................ 54501A

### Adapters

Type N (m) to BNC (f) *(2 required)* ........................... 1250-1476

Type N (f) to 2.4 mm (f) ................................................ 11903B

### Cables

BNC, 122 cm (48 in) ...................................................... 10503A

Oscilloscope probe ........................................................ 10432A

## Procedure

1. Press **LINE** to turn the spectrum analyzer off. Place the spectrum analyzer in the service position as illustrated in Figure 3-18 on page 142.
2. Connect the oscilloscope probe from the oscilloscope channel 1 input to probe A4C723 (the end closest to A4U707) as in Figure 3-19 on page 144. Press **LINE** to turn the spectrum analyzer on. Connect the 8640B RF OUTPUT to the spectrum analyzer INPUT 50Ω .
3. Set the 8640B controls as follows:

   Range MHz ............................................................ 61 to 128
   Frequency ......................................................... 100.000 MHz
   Output level ...................................................... –10 dBm
   RF .................................................................................. ON
   AM ................................................................................ OFF
   FM ................................................................................. INT
   Modulation frequency .......................................... 1000 Hz
   Peak deviation ....................................................... 5 kHz
   Scale FM ........................................................... (k/MHz)

4. Adjust the 8640B FM deviation vernier for a full-scale reading on the meter. Set the FM to off.

5. Set the oscilloscope controls as follows:

| | |
|---|---|
| Channel 1 | on |
| Channel 2 | off |
| Channel 1 | 50 mV/division |
| Channel 1 | ac |
| Channel 1 | BW lim |
| Time base | 1.0 ms/division |
| Trigger | auto |
| Trigger source | 1 |
| Trigger level | 0.0 V |

6. On the spectrum analyzer, press **PRESET**, then set the controls as follows:

| | |
|---|---|
| Center frequency | 100 MHz |
| Span | 5 MHz |
| Reference level | –10 dBm |
| Resolution bandwidth | 100 kHz |

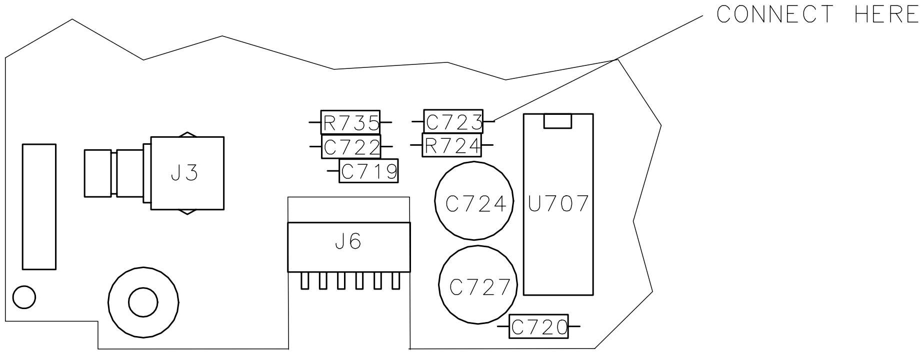
7. On the spectrum analyzer press: **PEAK SEARCH**, **MARKER →CF SPAN**, **ZERO SPAN AUX CTRL**, **AM/FM DEMOD**, **FM DEMOD ON OFF**(ON) **CAL**, **IF ADJ ON OFF** (OFF) **TRIG**, and **SWEEP CONT SGL** (SGL). Set the volume control to midrange.

8. A 1 kHz sine wave should be observed on the oscilloscope. Rotate the volume knob on the front panel of the spectrum analyzer until the amplitude of the 1 kHz signal is at about 150 mV (3 divisions on the oscilloscope).

9. Adjust A4C707 FM DEMOD for a maximum peak-to-peak response on the oscilloscope.

10. Press **LINE** to turn the spectrum analyzer off. Disconnect the test cable from A4C723.

**Figure 3-19 Demodulator Adjustment Locations**



# 10. External Mixer Bias Adjustment

## Assembly Adjusted

A15 RF assembly

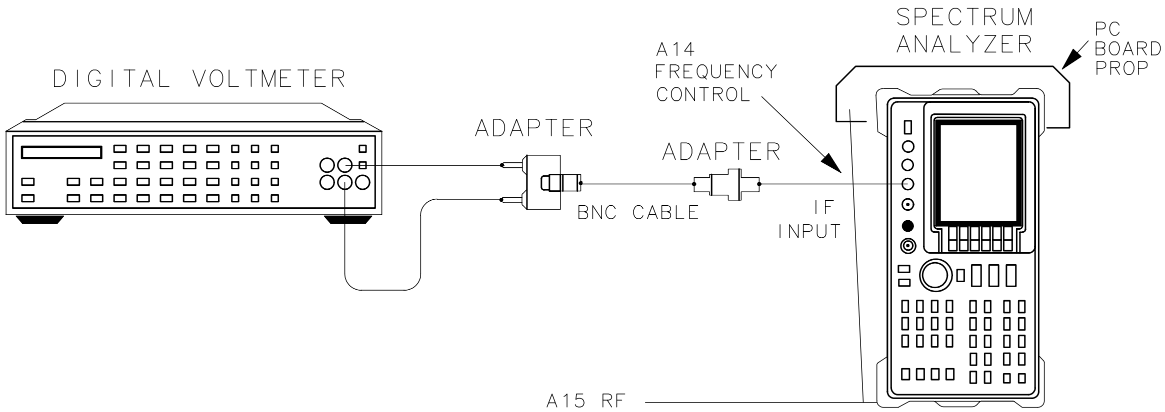
## Related Performance Test

There is no related performance test for this adjustment.

## Description

A voltmeter is connected to the spectrum analyzer IF INPUT with the external mixer bias set to off. The bias is adjusted for a 0 Vdc output.

**Figure 3-20 External Mixer Bias Adjustment Setup**




## Equipment

DVM ........................................................................ 3456A

### Adapters

Type BNC (f) to SMA (m) ............................................ 1250-1200

Type BNC (f) to dual banana plug .............................. 1251-2816

### Cables

BNC, 122 cm (48 in) ........................................................ 10503A

## Procedure

1. Press **LINE** to turn the spectrum analyzer off, and disconnect the ac power cord. Remove the spectrum analyzer cover and connect the equipment as illustrated in Figure 3-20 on page 145. Fold down the A15 RF assembly. Reconnect the power cord and set the **LINE** switch to on.
2. Set the 3456A controls as follows:

   Function .......................................................... DC VOLTS
   Range ............................................................................ 0.1 V
   Resolution ............................................................... 100 mV
3. On the spectrum analyzer press **AUX CTRL**, **EXTERNAL MIXER**, **BIAS**, then **BIAS OFF**.
4. Adjust A15R926 EXT BIAS ZERO for a DVM reading of 0.000 Vdc ±12.5 mV.

# 11. External Mixer Amplitude Adjustment

## Assembly Adjusted

A15 RF assembly

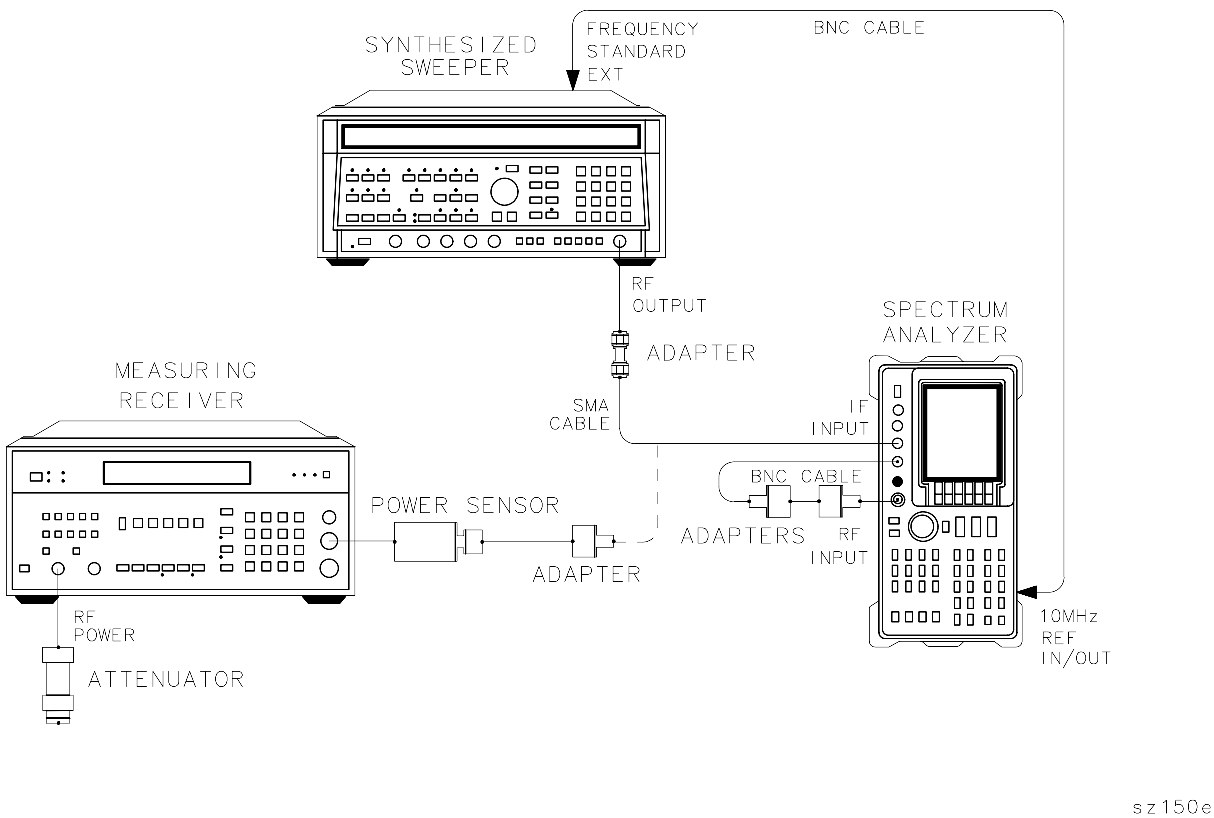
## Related Performance Test

IF Input Amplitude Accuracy

## Description

The slope of the flatness compensation amplifiers is determined. The user-loaded conversion losses for K-band are recorded and reset to 30 dB. A 310.7 MHz signal is applied to the power sensor and the power level of the source is adjusted for a –30 dBm reading. The signal is then applied to the IF INPUT. The flatness compensation amplifiers are then adjusted (via DACs) to place the displayed signal at the reference level.

**Figure 3-21 External Mixer Amplitude Adjustment Setup**



## Equipment

Synthesized sweeper .................................................... 8340A/B

Measuring receiver ......................................................... 8902A

Power sensor ................................................................... 8481D

50 MHz reference attenuator ....................................... 11708A

*(supplied with 8481D)*

### Adapters

Type N (f) to SMA (f).................................................. 1250-1772

Type N (m) to BNC (f)................................................ 1250-1476

Type APC 3.5 (f) to APC 3.5 (f) ................................ 5061-5311

Type N (f) to 2.4 mm (f).................................................. 11903B

### Cables

BNC, 122 cm (48 in) ....................................................... 10503A

SMA, 61 cm (24 in)..................................................... 8120-1578

## Procedure

1. Press LINE to turn the spectrum analyzer off and disconnect the power cord. Remove the spectrum analyzer cover and reconnect the power cord.
2. Set up the equipment as illustrated in Figure 3-21 on page 147. Do not connect the SMA cable to the spectrum analyzer.
3. Move the WR PROT/WR ENA jumper on the A2 controller assembly to the WR ENA position. The jumper is on the edge of the A2 board assembly and can be moved without folding the board down.
4. Press **LINE** to turn the spectrum analyzer on. On the spectrum analyzer, press **CONFIG**, **EXT MXR PRE UNPR** (UNPR), **AUX CTRL**, **EXTERNAL MIXER**, **AMPTD CORRECT**, then **CNV LOSS VS FREQ**.
5. Press ⇓ or ⇓ to display the conversion loss value for each frequency listed in Table 3-10 on page 149. Record any conversion loss reading *not equal* to 30 dB in Table 3-10 on page 149 at the appropriate frequency.

6. If all conversion loss values equal 30 dB, skip to step 7, otherwise continue to step a.

   a. Refer to Table 3-10 on page 149 and press ⇓ or ⇓ to select a frequency at which the conversion loss value does not equal 30 dB.

   b. Use the spectrum analyzer front panel keys to set the conversion loss value to 30 dB.

   c. Repeat steps a and b for all frequencies having a conversion loss value other than 30 dB.

7. Press **INSTR PRESET** on the 8340A/B and set the controls as follows:

   CW frequency ...................................................... 310.7 MHz
   Power level ............................................................. −30 dBm

**Table 3-10 Conversion Loss Data**

| Frequency (GHz) | Conversion Loss (dB) (≠30 dB) |
|---|---|
| 18 | |
| 20 | |
| 22 | |
| 24 | |
| 26 | |
| 27 | |

8. Connect the 8481D to the 11708A attenuator already connected to the 8902A RF power connector. Zero and calibrate the 8902A/8481D combination in log mode. Enter the power sensor 50 MHz cal factor into the 8902A. Connect the power sensor, through an adapter, to the SMA cable.

9. Adjust the 8340A/B **POWER LEVEL** until the power displayed on the 8902A reads −30 dBm ±0.05 dB.

10. On the spectrum analyzer, press **CAL**, **MORE 1 OF 2**, **SERVICE CAL DATA**, **3RD IF AMP**, then **CAL 3RD AMP GAIN**.

11. Wait until the message `ADJUSTMENT DONE` appears in the active function block and press **EXT MXR REF CAL**.

12. Disconnect the SMA cable from the power-sensor/adapter and connect the cable to the spectrum analyzer IF INPUT.

13. Use the spectrum analyzer front panel knob, step keys, or keypad to change the amplitude of the displayed signal until the marker reads 0 dBm ±0.17 dB.

14. Press **PREV MENU**, **STORE DATA**, and **YES** on the spectrum analyzer.

15. Place the WR PROT/ WR ENA jumper on the A2 controller assembly in the WR PROT position.

---

**NOTE** The following steps should only be performed if you need to replace the 30 dB conversion loss values to those recorded in Table 3-10 on page 149.

---

16. Press **AUX CTRL**, **EXTERNAL MIXER**, **AMPTD CORRECT**, then **CNV LOSS VS FREQ** on the spectrum analyzer.

17. Press ⇓ or ⇓ to select frequencies where the conversion loss value was recorded in Table 3-10 on page 149.

18. Use the spectrum analyzer front panel keys to enter the conversion loss values recorded for the frequency.

# 12. 600 MHz Reference Adjustment

## Assembly Adjusted

A15 RF assembly

## Related Performance Test

There is no related performance test for this adjustment.

## Description

The 100 MHz VCXO and the tripler are adjusted for a maximum signal level at 600 MHz. A spectrum analyzer is used to monitor the amplitude of the 600 MHz signal while performing these adjustments.

## Equipment

Spectrum analyzer ........................................................ 8566A/B

## Procedure

1. Press **LINE** to turn the spectrum analyzer off, disconnect the power cord, and remove the spectrum analyzer cover. Fold down the A15 RF and A14 frequency control assemblies. Prop up the A14 frequency control assembly.
2. Disconnect W33, gray/brown coax cable, from A15J701.
3. Connect the signal at A15J701 to the input of the 8566A/B spectrum analyzer.
4. Reconnect the power cord and press **LINE** to turn the spectrum analyzer on.
5. Set the center frequency of the 8566A/B to 600 MHz and set the frequency span and resolution bandwidth of the 8566A/B for the best display of the 600 MHz signal.
6. Set the peak of the 600 MHz signal near the top graticule line on the 8566A/B display and set to 1 dB per division.
7. Adjust A15C750, VCXO Adjust, for maximum amplitude.
8. Adjust A15C751 Tripler Adjust, for maximum amplitude. The level, after proper adjustment, should be between –3 and +4.8 dBm (typically 0 to +1 dBm).
9. Reconnect W33 to A15J701.

# 3a Manual Adjustment Procedures: 3335A Source not Available

## What You'll Find in This Chapter

This chapter provides alternative procedures for the adjustment of the spectrum analyzer that do not require the use of the 3335A Synthesizer Level Generator. The 3335A has been discontinued. Because of the unavailability of the 3335A, new adjustments procedures are required that use different signal sources. If the 3335A is not available, substitute these procedures for those of the same number found in Chapter 3 , “Manual Adjustment Procedures.”

# Required Test Equipment

The following table lists the test equipment required to execute the adjustments in this chapter. These adjustments originally required the use of the 3335A Synthesizer Level Generator.

**Table 3a-1 Recommended Test Equipment**

| Instrument | Critical Specifications for Equipment Substitution | Recommended Model |
|---|---|---|
| **Sources** | | |
| Synthesized Signal Generator | Frequency range: 250 kHz to 3 GHz<br>Frequency resolution: 1 Hz<br>Attenuator resolution: 0.02 dB<br>Level accuracy: ±0.5 dB<br>External 10 MHz Ref. Input | E4421B or E4422B, E4432B, E4433B |
| **Cables** | | |
| Cable, 50 Ω coaxial<br>*(four required)* | Connectors: BNC (m)<br>Length: ≥ 122 cm (48 in.) | 10503A |
| Cable | Test Cable | 85680-60043 |
| **Adapters** | | |
| Adapter<br>*(four required)* | Type N (m)-to-BNC (f) | 1250-1476 |
| Adapter | Type N (f)-to-2.4 mm (f) | 11903B |
| Adapter | 2.4 mm (f) to BNC (f) | 1250-2187 |
| Adapter<br>*(Option 026 only)* | APC-3.5 (f) to APC-3.5 (f) | 5061-5311 |
| Adapter<br>*(Option 026 only)* | APC-3.5 (f) to BNC-3.5 (f) | 1250-1200 |

# 2a. IF Amplitude Adjustments

The IF amplitude adjustments consist of the cal oscillator amplitude adjustment and the reference 15 dB attenuator adjustment.

## Assembly Adjusted

A4 log amp/cal oscillator A5 IF assembly

## Related Performance Tests

IF Gain Uncertainty Scale Fidelity

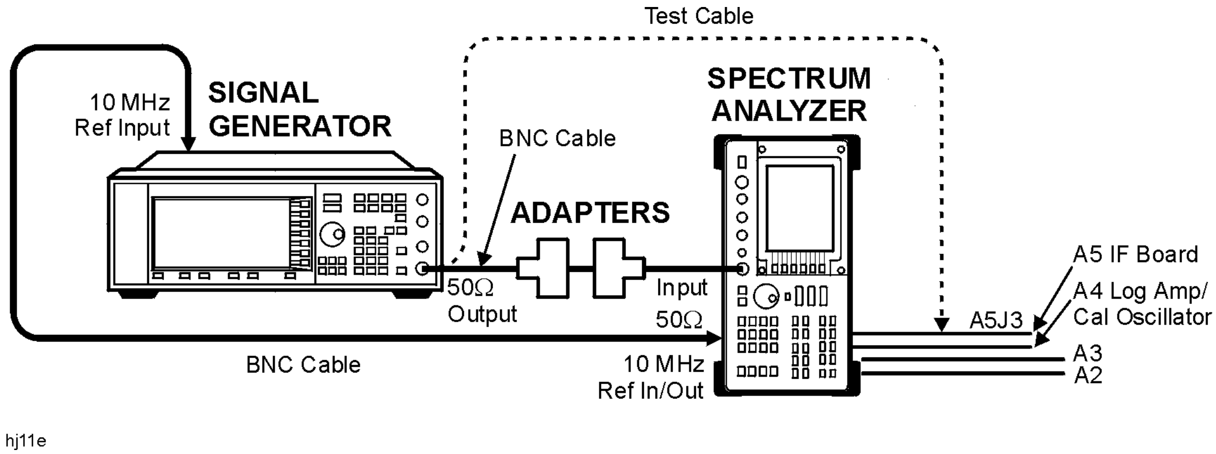
## Description

This adjustment sets the output amplitude of the A4 log amp/cal oscillator and the absolute amplitude of the reference 15 dB attenuator.

The output of the A4 log amp/cal oscillator is adjusted so that a –55 dBm signal applied to the 10.7 MHz IF input on the A5 IF assembly (A5J3) causes a displayed signal of –60 dBm. The effect of this adjustment is visible only after the **ADJ CURR IF STATE** sequence is complete. **ADJ CURR IF STATE** causes the IF gain adjustment to use the "new" output amplitude from the A4 log amp/cal oscillator.

This procedure also sets the attenuator of the reference 15 dB attenuator so that a source amplitude change of 50 dB combined with a spectrum analyzer reference level change of 50 dB displays an amplitude difference of 50 dB.

**Figure 3a-1 IF Amplitude Adjustment Setup**



## Equipment

Signal Generator . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . E4421B

### Adapters

Type N (m) to BNC (f) . . . . . . . . . . . . . . . . . . . . . . . . . 1250-1476

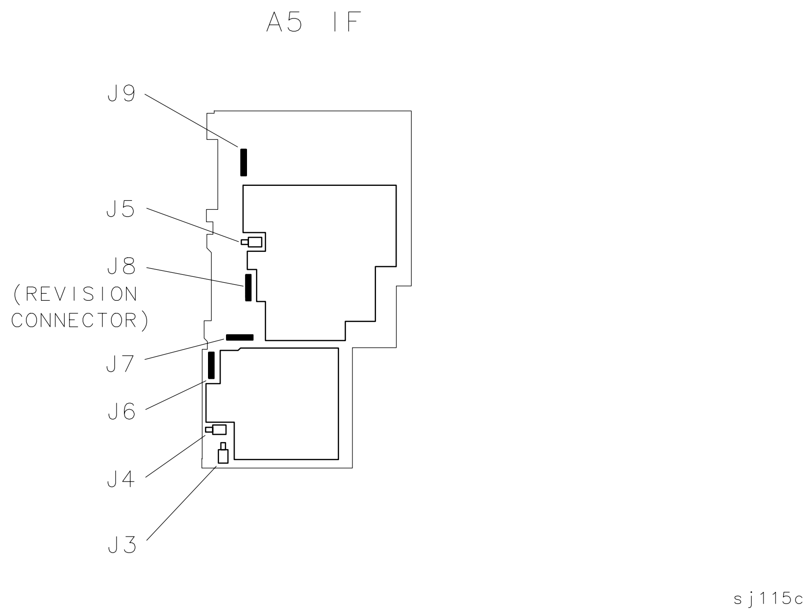
Type N (f) to 2.4 mm (f) . . . . . . . . . . . . . . . . . . . . . . . . . . .11903B

### Cables

BNC, 122 cm (48 in) . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .10503A

Test cable . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 85680-60093

**Figure 3a-2 IF Amplitude Adjustment Locations**




**NOTE** The 15 dB reference attenuator adjustment is preset at the factory and need not be done if the entire A5 IF assembly is replaced.

## Procedure

1. Press **LINE** to turn the spectrum analyzer off. Remove the spectrum analyzer cover and place the spectrum analyzer in the service position as illustrated in Figure 3a-1.
2. Disconnect W29, violet coax cable, from A5J3. Connect the test cable between A5J3 and the RF output of the E4421B. Press **LINE** to turn the spectrum analyzer on.

3. Set the spectrum analyzer controls as follows:

   Center Frequency . . . . . . . . . . . . . . . . . . . . . . . . . . . 10.7 MHz

   Span . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .200 kHz

   Reference Level . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .–60 dBm

   Attenuator . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .0 dB

   dB/division . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .1 dB/DIV

   Resolution bandwidth . . . . . . . . . . . . . . . . . . . . . . . . . .300 kHz

   Video bandwidth . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .100 Hz

4. On the spectrum analyzer, press **MKR**, **CAL**, and **IF ADJ ON OFF** so OFF is underlined.

5. Set the E4421B controls as follows:

   Frequency . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 10.7 MHz

   Amplitude . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .–55 dBm

   Mod On/Off . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Off

6. Note the marker value. Ideally it should read –60 dBm ±0.1 dB.

7. If the marker reads less than –60.1 dBm, rotate A4R826 CAL OSC AMPTD one-third turn clockwise for every 0.1 dB less than –60 dBm. See Figure 3a-2 for the location of A4R826. A change in the displayed amplitude will not be seen until **ADJ CURR IF STATE** is pressed.

8. If the marker reads greater than –59.9 dBm, rotate A4R826 CAL OSC AMPTD one-third turn counter clockwise for every 0.1 dB greater than –60 dBm. See Figure 3a-2 for the location of A4R826. A change in the displayed amplitude will not be seen until **ADJ CURR IF STATE** is pressed.

**NOTE** If A4R826 has inadequate range, refer to “Inadequate CAL OSC AMPTD Range” in Chapter 9 .

9. On the spectrum analyzer, press **ADJ CURR IF STATE**. After allowing the analyzer time to complete the adjustments, the displayed amplitude and marker reading should change.

10. Repeat step 7 and step 9 until the marker reads –60 dBm ±0.1 dB.

11. Disconnect the test cable from A5J3 and reconnect W29 to A5J3.

## A5 Reference Attenuator Adjustment

1. Set the spectrum analyzer reference level to –60 dBm. If markers are displayed, press **MKR** and **MARKERS OFF**.
2. Set the E4421B **AMPLITUDE** to –60 dBm.
3. Connect a BNC cable between the RF output of the E4421B and the spectrum analyzer INPUT 50Ω .
4. On the spectrum analyzer, press **CAL** and **REF LVL ADJ**. Use the front panel knob or step keys to place the peak of the displayed signal 3 dB to 5 dB below the reference level.
5. On the spectrum analyzer, press **PEAK SEARCH** and **MARKER DELTA**. Set the spectrum analyzer reference level to –10 dBm.
6. Change the 4421B **Amplitude** to –10 dBm.
7. On the spectrum analyzer, press **CAL**.
8. Note the ΔMKR amplitude. Ideally, it should read 50.00 dB ±0.1 dB.
9. If the ΔMKR amplitude is less than 49.9 dB, rotate A5R343 15 dB ATTEN one-half turn counterclockwise for each 0.1 dB less than 50.00 dB. Do not adjust A5R343 more than five turns before continuing with the next step.
10. If the ΔMKR amplitude is greater than 50.1 dB, rotate A5R343 15 dB ATTEN one-half turn clockwise for each 0.1 dB greater than 50.00 dB. Do not adjust A5R343 more than five turns before continuing with the next step.
11. On the spectrum analyzer, press **ADJ CURR IF STATE**. Note the ΔMKR amplitude reading.
12. Repeat step 1 through step 11 until the ΔMKR amplitude reading is 50.00 dB ±0.1 dB.

## A5 Adjustment Verification

1. On the spectrum analyzer, disconnect W29 from A5J3. Connect the test cable between A5J3 and the RF output of the E4421B.
2. Set the spectrum analyzer reference level to –10 dBm.
3. Set the E4421B **Amplitude** to –5 dBm.
4. On the spectrum analyzer, press **MKR** and **MARKER NORMAL**.
5. The MARKER amplitude should read –10 dBm ±0.13 dB. If the reading is outside of this range, repeat step 4 of “Procedure” on page 165 through “A5 Reference Attenuator Adjustment” step 12.

6. On the spectrum analyzer, reconnect W29 to A5J3. Press **PRESET** and set the controls as follows:

   Center frequency . . . . . . . . . . . . . . . . . . . . . . . . . . . . 300 MHz

   Span . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .0 Hz

   Reference level . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .–10 dBm

   Resolution bandwidth . . . . . . . . . . . . . . . . . . . . . . . . .300 kHz

7. Connect a BNC cable between the 8563E CAL OUTPUT and INPUT 50Ω .
8. On the spectrum analyzer, press **MKR CAL** and **REF LVL ADJ**.
9. Use the knob or step keys to adjust the REF LEVEL CAL setting until the MKR reads –10.00 dBm ±0.1 dB.
10. On the spectrum analyzer, press **STORE REF LVL**.

# 3a. DC Log Amplifier Adjustments

There are three DC log adjustments; limiter phase, linear fidelity, and log fidelity.

## Assembly Adjusted

A4 log amp/cal oscillator

## Related Performance Tests

IF Gain Uncertainty Scale Fidelity

## Description

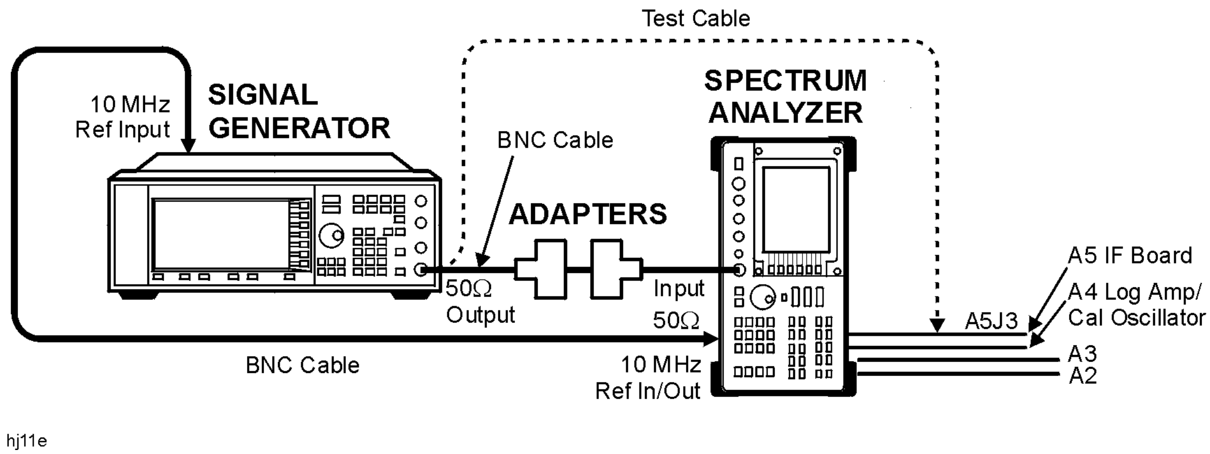
These three adjustment need only be done under the following conditions:

| | |
|---|---|
| Limiter phase | Only if a repair is made to blocks F, G, H, I, or J. |
| Linear fidelity | Only if a repair is made to blocks C, D, F, G, H, I, J, K, O, IF gain accuracy, RBW switching, or log fidelity. |
| Log fidelity | Only if a repair is made to blocks D, F, H, K, IF gain accuracy, RBW switching, or log fidelity. |

If multiple adjustments are required they should be done in the following order:

1. Limiter Phase
2. Linear Fidelity
3. Log Fidelity

**Figure 3a-3 DC Log Adjustment Setup**




## Equipment

Signal Generator . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . E4421B

**Adapters**

Type N (m) to BNC (f) . . . . . . . . . . . . . . . . . . . . . . . . 1250-1476

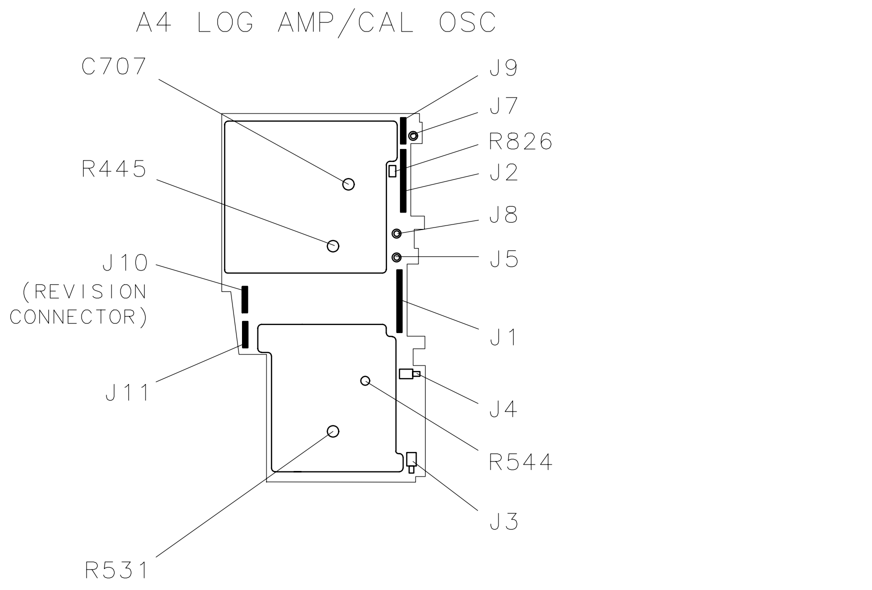
Type N (f) to 2.4 mm (f) . . . . . . . . . . . . . . . . . . . . . . . . 11903B

**Cables**

BNC, 122 cm (48 in) . . . . . . . . . . . . . . . . . . . . . . . . . . 10503A

Test cable . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 85680-60093

**Figure 3a-4 DC Log Adjustment Locations**




**NOTE** Adjustments should be made with all of the shields on and only after allowing at least a 20 minute warmup.

## A4 Limiter Phase Adjustment

1. Press **LINE** to turn the spectrum analyzer off. Remove the spectrum analyzer cover and place the spectrum analyzer in the service position as illustrated in Figure 3a-3. See Figure 3a-4 for adjustment location.
2. Connect the E4421B RF output to the spectrum analyzer 50Ω input. Press **LINE** to turn the spectrum analyzer on.
3. Set the spectrum analyzer controls as follows:

| | |
|---|---|
| Center frequency | 15 MHz |
| Span | 0 Hz |
| Reference level | –10 dBm |
| dB/division | 1 dB/DIV |
| Resolution bandwidth | 300 kHz |
| IF ADJ | OFF |

4. Set up an E4421B as follows:

   Frequency . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 15 MHz

   Amplitude . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .–18 dBm

   Mod On/Off . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Off

5. On the spectrum analyzer, press **CAL** and **ADJ CURR IF STATE**, wait for the analyzer to complete adjustments then press **MKR**.

6. Adjust A4R445 for maximum on-screen amplitude. Refer to Figure 3a-4 for the location of A4R445.

## A4 Linear Fidelity Adjustment

1. Press **LINE** to turn the spectrum analyzer off. Remove the spectrum analyzer cover and place the spectrum analyzer in the service position as illustrated in Figure 3a-3. See Figure 3a-4 for adjustment location.

2. Connect the E4421B RF output to the spectrum analyzer 50Ω input. Press **LINE** to turn the spectrum analyzer on.

3. On the spectrum analyzer, press **PRESET AMPLITUDE**, **LINEAR**, **MORE 1 of 3**, **AMPTD UNITS**, **dBm**, **CAL**, and **IF ADJ ON OFF** (OFF).

4. Set the spectrum analyzer controls as follows:

   Center frequency . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 15 MHz

   Span . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 5 MHz

   Resolution bandwidth . . . . . . . . . . . . . . . . . . . . . . . . .300 kHz

   Reference level . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .–10 dBm

5. Set up an E4421B as follows:

   Frequency . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 15 MHz

   Amplitude . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .–10 dBm

   Mod On/Off . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Off

6. On the spectrum analyzer, press **PEAK SEARCH** and **MARKER DELTA**.

7. Reduce the E4421B input power to –58 dBm.

8. If the delta marker amplitude reads –40 dB ±2 dB, no adjustment is necessary.

9. If the signal is lower on the screen than expected (delta marker amplitude reads less than –42dB) then adjust A4R544 (see Figure 3a-4) for an even lower level and press **CAL** and **ADJ CURR IF STATE**. Allow sufficient time for the analyzer to complete the adjustment.

10. If the signal is higher than expected (delta marker amplitude reads greater than –38 dB) then adjust A4R544 for an even higher level signal and press **CAL** and **ADJ CURR IF STATE**. Allow sufficient time for the analyzer to complete the adjustment.

11. Repeat step 7 through step 10.

## A4 LOG Fidelity Adjustment

1. Press **LINE** to turn the spectrum analyzer off. Remove the spectrum analyzer cover and place the spectrum analyzer in the service position as illustrated in Figure 3a-3. See Figure 3a-4 for adjustment location.

2. Connect the E4421B RF output to the spectrum analyzer 50Ω input. Press **LINE** to turn the spectrum analyzer on.

3. On the spectrum analyzer, press **PRESET**, **CAL**, **IF ADJ ON OFF** (OFF), and **ADJ CURR IF STATE**.

4. Set the spectrum analyzer controls as follows:

   Center frequency . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 15 MHz

   Span . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 0 MHz

   Resolution bandwidth . . . . . . . . . . . . . . . . . . . . . . . . . . 300 kHz

   Reference level . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . –10 dBm

5. Set up an E4421B as follows:

   Frequency . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 15 MHz

   Amplitude . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . –10 dBm

   Mod On/Off . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Off

6. On the spectrum analyzer, press **MKR** and **MARKER DELTA**.

7. Decrease the E4421B power to –26 dBm.

8. Calculate the error:

$$\text{Error} = \text{delta marker reading} - 16\ \text{dB}$$

9. If the error is less than ±0.2 dB, no adjustment is necessary.

10. Set the E4421B power to –10 dBm.

11. Adjust A4R531 (see Figure 3a-4) to read two times the error. For example, if the calculated error is +0.75 dB, adjust A4R531 for a delta marker amplitude reading of +1.5 dB. Press **CAL** and **ADJ CURR IF STATE**.

12. Repeat step 7 through step 11.

# 4 Assembly Replacement

# Introduction

This chapter describes the removal and replacement of all major assemblies. The following replacement procedures are provided:



Tools required to perform the procedures are listed in Table 4-1 on page 178.

The words *right* and *left* are used throughout the replacement procedures to indicate the side of the spectrum analyzer as viewed from the front panel. See Figure 4-1 on page 179.

Numbers in parentheses are used throughout the replacement procedures to indicate numerical callouts on the figures.

**CAUTION** The spectrum analyzer contains static-sensitive components. Read the section entitled, “Electrostatic Discharge” in Chapter 1 .

# Access to Internal Assemblies

Servicing the 8564EC or the 8565EC requires the removal of the spectrum analyzer cover assembly and the folding down of six board assemblies. Four of these assemblies lay flat along the top of the spectrum analyzer and two lay flat along the bottom of the spectrum analyzer. All six assemblies are attached to the spectrum analyzer right side frame using hinges and fold out of the spectrum analyzer allowing access to all major assemblies. See Figure 4-1 on page 179.

- To remove the spectrum analyzer cover assembly, refer to "Procedure 1. Spectrum Analyzer Cover."
- To access the A2, A3, A4, and A5 assemblies, refer to "Procedure 5. A2, A3, A4, and A5 Assemblies."
- To access the A14 and A15 assemblies, refer to "Procedure 8. A14 and A15 Assemblies."
- To remove and replace the backlight cables, which illuminate the A18 LCD, refer to "Procedure 2. A1 Front Frame/A18 LCD."
- To remove the A17 LCD board, refer to "Procedure 2. A1 Front Frame/A18 LCD."

# Cable Color Code

Coaxial cables and wires will be identified in the procedures by reference designation or name followed by a color code. The code is identical to the resistor color code. The first number indicates the base color with second and third numbers indicating any colored stripes. For example, W23, coax 93, indicates a white cable with an orange stripe.

**Table 4-1 Required Tools**

| Description | Part Number |
|---|---|
| 5/16-inch open-end wrench | 8720-0015 |
| 3-mm hex (Allen) wrench | 8710-1366 |
| 4-mm hex (Allen) wrench | 8710-1164 |
| 17-mm socket wrench | T362609 |
| No. 4 hex (Allen) wrench | 5020-0288 |
| No. 6 hex (Allen) wrench | 5020-0289 |
| 7 mm nut driver | 8710-1217 |
| 3/8-inch nut driver | 8720-0005 |
| 7/16-inch nut driver | 8720-0006 |
| 9/16-inch nut driver (drilled out, end covered with heatshrink tubing) | 8720-0008 |
| Small No. 1 pozidrive screwdriver | 8710-0899 |
| Large No. 2 pozidrive screwdriver | 8710-0900 |
| T-8 TORX screwdriver | 8710-1614 |
| T-10 TORX screwdriver | 8710-1623 |
| T-15 TORX screwdriver | 8710-1622 |
| Long-nose pliers | 8710-0030 |
| Wire cutters | 8710-0012 |

# Procedure 1. Spectrum Analyzer Cover

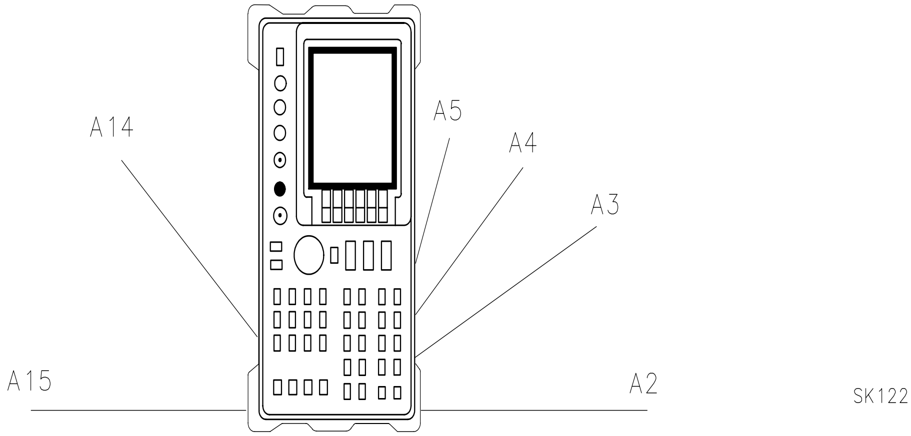
## Removal/Replacement

1. Disconnect the line-power cord, remove any adapters from the front panel connectors, and place the spectrum analyzer on its front panel.
2. If an 85620A Mass Memory Module or 85629B Test and Adjustment Module is mounted on the rear panel, remove it. Loosen (but do not remove) the four rear-bumper screws, using a 4 mm hex wrench. Pull the cover assembly off towards the rear of the instrument.

**CAUTION** When replacing the spectrum analyzer cover, use caution to avoid damaging any cables.

3. When installing the cover assembly, be sure to locate the cover air vent holes on the bottom side of the spectrum analyzer. Attach with the four screws loosened in step 2, and tighten the four screws gradually to ensure that the cover is seated in the front frame gasket groove.
4. Torque each screw to 40 to 50 inch-pounds to ensure proper gasket compression to minimize EMI.

**Figure 4-1 Hinged Assemblies**




**NOTE** Figure 4-1 shows an 8560 E-series instrument. In the assembly removal and replacement procedures the words “left” and “right ” assume you are facing the front panel of the instrument, as shown in Figure 4-1, with A14 and A15 to your left, and A2 through A5 on your right. The 8560 EC-series instrument is identical except the A2 board is smaller.

# Procedure 2. A1 Front Frame/A18 LCD

## Removal of the Front Frame

1. Remove the spectrum analyzer cover assembly as described in "Procedure 1. Spectrum Analyzer Cover." Place the instrument on its side, with the display section upper-most, as shown in Figure 4-1 on page 179.
2. Fold out the A2, A3, A4, and A5 assemblies as described in steps 2 through 6 under “Procedure 5. A2, A3, A4, and A5 Assemblies.” Facing the front panel, the A2, A3, A4, and A5 assemblies will lay to your left.
3. Fold out the A14 and A15 assemblies as described in steps 3 through 4 under “Procedure 8. A14 and A15 Assemblies.” Facing the front panel, the A14 and A15 assemblies will lay to your right.
4. Disconnect ribbon cable A1A1W1, which connects HDR1 on the A1 front frame assembly and A3J602 on the A3 interface board.
5. Disconnect the following cables from the A2 controller board:
   a. Ribbon cable W60, which connects J8 on the A2 controller board with J1 on the A17 display driver board.
   b. W61, which connects J9 on the A2 controller board with J7 on the A17 display driver board.
6. Disconnect ribbon cable W64 from the J1 VGA port on the rear panel (do not disconnect W64 from the A17 display driver board).
7. Disconnect the W3 line switch cable from the power supply.
   a. Remove the power supply cover. Use a T-6 TORX driver to remove the 3 screws (0515-2309) that secure the power supply cover to the power supply.
   b. Remove the line switch connector from A6J2 on the power supply.
   c. Loosen FL 1. Remove the two screws (0515-2332) which are used to secure FL 1 to the right side of the chassis.
   d. After FL 1 has been loosened, route the W3 line switch cable through the opening behind FL 1, from the left to the right side of the instrument (if you still have difficulty routing W3 through the opening, use an open ended 5/16-inch wrench to further loosen, or disconnect FL 1).

   To disconnect the line switch from the front panel, see “Removal of the Front Frame” on page 180.

8. Disconnect the following connectors which are attached to the inside of the A1 front panel assembly:

   a. INPUT 50 Ω RF connector. Use a 5/16-inch open-end wrench to disconnect cable W41 from the front panel. Loosen the opposite end of cable W41, which is connected to the attenuator.

   b. RF OUT 50 Ω connector *for Option 002 spectrum analyzers*. Use a 5/16-inch wrench to disconnect cable W47 from the front panel.

   c. 1ST LO OUTPUT connector. Disconnect cable W42 from A7J3 and from the front panel 1st LO OUTPUT connector.

      To remove the 1st LO OUTPUT connector use a 5/16 socket and thread pliers. Use the pliers to hold the 1st LO connector in place, while loosening the connector inside the instrument with the 5/16-inch socket.

   d. 1ST LO OUTPUT connector *For Option 002 spectrum analyzers*. Disconnect W46 from the front panel.

   e. IF INPUT connector. Disconnect W36 from the front panel.

9. Remove the following from the face of the front panel:

   a. VOLUME knob. Use a 0.050 Allen wrench to remove the two screws (3030-0007) that secure the volume knob to the face of the front panel. If necessary, use a 5/16-inch nut driver to drill out the nut which secures the VOLUME potentiometer assembly. Cover the tip with heatshrink tubing or tape to avoid scratching the enameled front panel.

   b. CAL OUTPUT connector. Use a 9/16-inch nut driver to remove the dress nut that holds the front panel CAL OUTPUT connector to the front panel. If necessary, drill out the nut driver to fit over the BNC connectors and cover the tip with heatshrink tubing or tape to avoid scratching the enameled front panel.

10. Remove the front frame from the chassis of the instrument.

   a. Remove the screw (0515-1227) that secures the top of the attenuator to the inside of the front frame of the instrument.

   b. Remove the three screws (0515-1101) that secure the A1 front frame assembly to the bottom of the spectrum analyzer.

   c. Remove the three screws (0515-1101) that secure the A1 front frame assembly to the top of the spectrum analyzer.

   d. Remove the A1 front frame assembly from the chassis.

   Note that the line switch cable is still attached to the front frame. To remove the line switch you must first remove the display driver and LCD assembly. For instructions on removing the line switch, see "Removal of the Line Switch from the Front Panel" on page 183.

## Removal of the Display Driver Board, Inverter Board, and LCD

After the front panel has been removed, follow these steps to remove the display driver and LCD:

1. Disconnect the following cables from the A17 display driver board. These can be disconnected through openings in the display driver shield. See Figure 4-2 on page 184.
   a. W60, a ribbon cable that connects J1 on the A17 display driver board with J8 on the A2 controller board.
   b. W61, which connect J7 on the A17 display driver board with J9 on the A2 controller board.
2. Remove the four screws (0515-0665) that secure the display driver shield to the LCD backplate. Use a T-10 TORX driver set to 6 in./lbs. Remove the display driver shield.
3. Disconnect the following cables from the A17 display driver board:
   a. W64, the VGA ribbon cable, which connects J4 on the A17 display driver board to J1 on the rear panel.
   b. W63, a ribbon cable that connect J5 on the A17 display driver board with the LCD.
4. If you want to remove the A17A1 inverter board, proceed to step a. If you intend to keep the A17A1 inverter board secured to the A17 display driver board, proceed to step 4.
   a. Remove the two screws (0515-0430) which secure the A17A1 inverter board to standoffs on the A17 display driver board.
   b. Disconnect W62 from J6 on the A17 display driver board (do not disconnect W62 from the A17A1 inverter board, to which it is attached).
5. Remove the two backlight cables from the inverter board.
6. Remove the four screws (0515-0372) which secure the display driver board to the LCD backplate. Use a T-10 TORX driver. Remove the display driver board.
7. Remove four black cushions (0400-0333) from the inner-most posts on the LCD backplate.
8. Remove the two large screws (0515-0382) which secure the LCD backplate to the left side of the front panel chassis. Use a T-15 TORX driver.
9. Remove the four (0515-0430) screws which secure the LCD backplate to the right side of the front panel chassis. Use a T-8 TORX driver.

10. Carefully lift the display driver backplate over the two backlight cables and the W63 ribbon cable.
11. Remove the LCD assembly from the black rubber mount Take care not to damage the backlight cables or W63 ribbon cable.
12. To remove the glass plate, first remove the LCD display from the display mount. Carefully remove the glass from the inside of the display mount.

**NOTE** The LCD glass plate was originally placed in the LCD assembly in a clean room environment to ensure optimal performance of the LCD display. Take all possible precautions to ensure that the glass plate is clean before replacing it in the LCD assembly.

## Removal of the Backlights

1. Remove the LCD assembly by following steps 1 through 12 in "Removal of the Display Driver Board, Inverter Board, and LCD" on page 182.
2. Remove each backlight cable assembly (2090-0380). *Carefully* grasp the end of the metal backlight assembly, which is connected to the backlight cable, and pull the backlight out from its slot. The backlight cable slots are located at the top and at the bottom of the LCD.

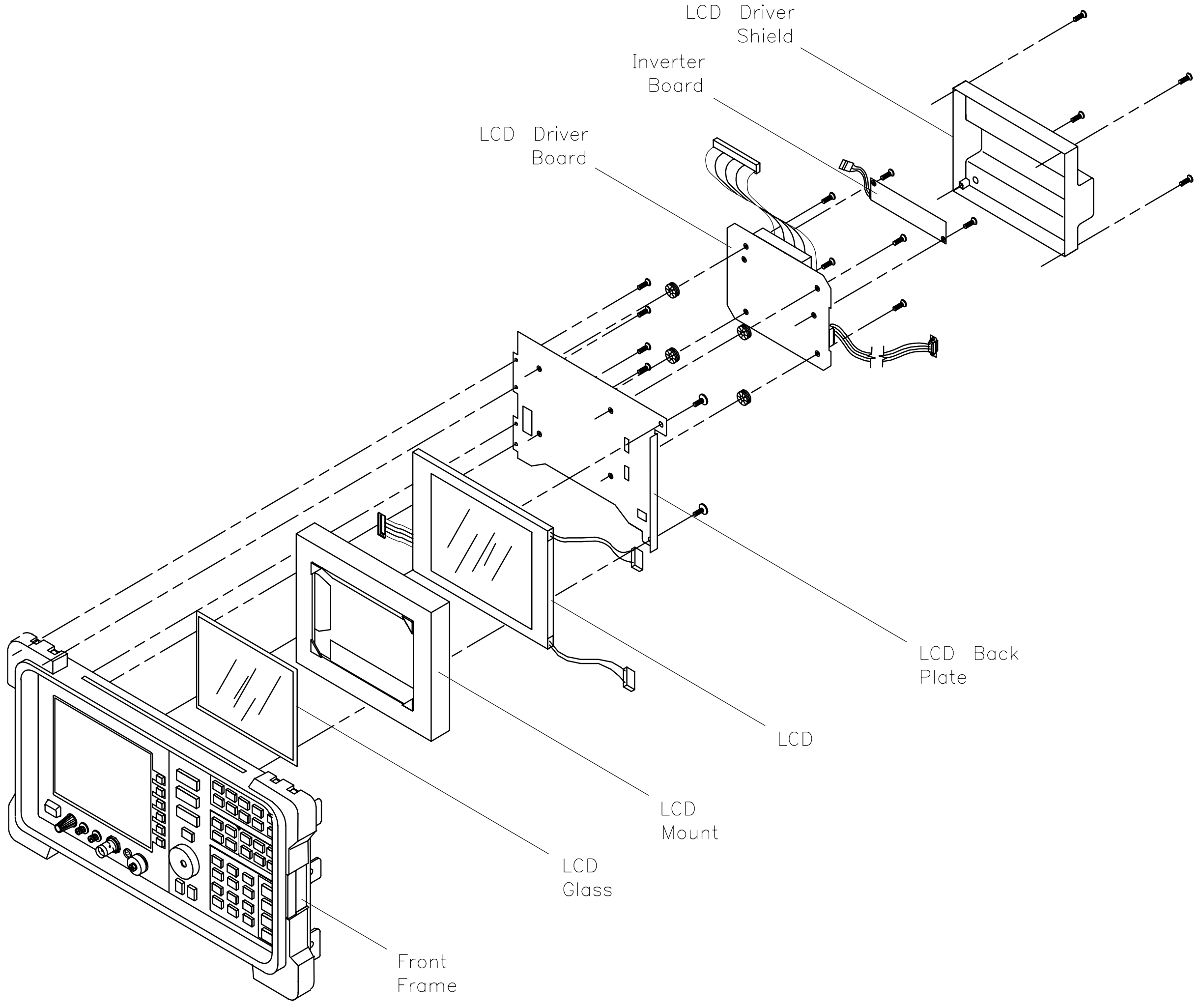
**NOTE** Whenever there is a need to replace a single backlight, both backlights must be replaced.

## Removal of the Line Switch from the Front Panel

After the A1 front frame assembly, the A17 display driver, and the A18 LCD have been removed, you can proceed to remove the line switch. Follow these steps:

1. Remove the green LED from the line switch assembly on the front frame, by gently pulling on the orange and black cables (wrapped in shrink tubing), to which the LED is connected.
2. Remove the two screws (0515-1521) that secure the line switch to the front frame.
3. Remove the screw (0515-0430) that secures the striped green and white ground cable to the line switch.
4. Remove the line switch from the front panel.

**Figure 4-2 LCD Assembly - Exploded View**



## Removal of the Keyboard

1. Disconnect cable A1A1W1 from HDR1 on the A1 front panel assembly and from A3J602 on the A3 interface board.
2. Disconnect the power probe cable from the probe power connector on the front frame PC board.
3. Unhook the RPG cable.
4. Remove the seven screws (0515-1934) that secure the front frame PC board to the front frame. Use a T-8 TORX driver set to 6-in/lbs.

## Replacement of the Front Frame

1. Remove the cover assembly as described in "Procedure 1. Spectrum Analyzer Cover." Place the instrument on its side, with the display section upper-most, as shown in Figure 4-1 on page 179.
2. Fold out the A14 and A15 assemblies as described in steps 3 through 4 under "Procedure 8. A14 and A15 Assemblies." Facing the front panel, the A14, and A15 assemblies will lie to your right.
3. Fold out the A2, A3, A4, and A5 assemblies as described in steps 2 through 6 under "Procedure 5. A2, A3, A4, and A5 Assemblies." Facing the front panel, the A2, A3, A4, and A5 assemblies will lie to your left.
4. Place the A1 front frame assembly in the chassis of the instrument.
   a. Position the A1 front frame assembly in the chassis.
   b. Insert the three screws (0515-1101) that secure the front frame chassis to the bottom of the spectrum analyzer.
   c. Insert the three screws (0515-1101) that secure the front frame chassis to the top of the spectrum analyzer
   d. Insert the screw (0515-1227) that secures the top of the attenuator to the inside of the A1 front frame assembly.
5. Secure the following connectors to the inside of the A1 front panel assembly.
   a. INPUT 50 Ω RF connector. Use a 5/16-inch open-end wrench to connect cable W41 to the front panel from the attenuator.
   b. RF OUT 50 Ω connector *for Option 002 spectrum analyzers*. Use a 5/16-inch open-end wrench to connect cable W47 to the front panel.

c. 1ST LO OUTPUT connector. Connect cable W42 from A7J3 to the front panel 1st LO OUTPUT connector.

   To replace the 1st LO OUTPUT connector use a 5/16 socket and thread pliers. Use the pliers to hold the 1st LO connector in place, while tightening the connector inside the instrument with the 5/16-inch socket.

d. 1ST LO OUTPUT connector *for Option 002 spectrum analyzers.* Connect W46 from the front panel.

e. IF INPUT connector. Connect W36 from the front panel.

6. Replace the following from the face of the front panel.

   a. VOLUME knob and potentiometer. Use a 5/16-inch nut driver to secure the VOLUME potentiometer assembly. Use a 0.050 Allen wrench to replace the two screws (3030-0007) that secure the volume knob to the face of the front panel.

   b. CAL OUTPUT connector. Replace the dress nut that holds the CAL OUTPUT connector to the front panel.

7. If the line switch has been disconnected from the power supply you will have to route the W3 line switch cable from the right side of the instrument, through the opening behind FL 1, to the power supply on the left side of the instrument.

   a. Loosen the two screws (0515-2332) that secure FL 1 to the instrument’s chassis.

   b. Route the W3 line switch cable from the right side of the instrument to the left side, through the opening that can now be accessed, since FL 1 has been loosened. If the opening is still tight, loosen or remove FL 1 using a 5/16 -inch wrench.

   c. Secure the W3 line switch cable to the instrument chassis by routing it through the white collar, that is adjacent to the power supply assembly, on the chassis of the instrument.

   d. Route the W3 line switch cable through the notched opening on the right side of the power supply, and insert the line switch connector into A6J2.

   If the line switch has been disconnected from the front panel, see the instructions for its replacement on page 189.

8. Replace the power supply cover by inserting the 3 screws (0515-2309) that secure the power supply cover to the power supply.

9. If the LCD assemblies have not been removed from the front panel assembly, you will need to reconnect the following cables, which are routed through openings in the display driver shield.

a. W60, the large ribbon cable (80 lines) that goes to J8 on the A2 controller board.

b. W61, a coax cable that connects to J10 on the A2 controller board.

c. W64, the VGA ribbon cable (10 lines), that goes to J1 on the rear panel.

## Replacement of the Display Driver Board, Inverter Board, and LCD

Follow these steps to replace the A18 LCD assembly, the A17 display driver, and the A17A1 inverter board.

**NOTE** If the line switch assembly has been removed from the front panel, it must be replaced before you replace the display driver and LCD assemblies.

1. Place the front panel face down on your bench. The opening for the display will be on the right side of the front panel.
2. If the LCD glass place has been removed, carefully insert the glass plate into the brackets on the front side of the rubber display mount. Make sure that the side of the glass which has a broad silver border (the left side, when facing the front of the display) is inserted into the side of the mount that has larger brackets, into which the glass plate will slide.

**NOTE** The glass plate was originally placed in the LCD assembly in a clean room environment to ensure optimal performance of the LCD display. Take all possible precautions to ensure that the glass plate is clean before placing it in the LCD assembly.

3. Insert the LCD into the display mount. The LCD is correctly oriented when the small ribbon cable from the LCD extends through an opening in the right side of the display mount, and the two backlight cables extend through openings on the left side of the mount.
4. Carefully lower the LCD bookplate onto the display mount. Ensure that the ribbon cable on the right, and the two backlight cables on the left, are inserted into the appropriate openings in the LCD backplate.
5. Lower the LCD backplate and LCD assembly, as a unit, into the display section on the right side of the A1 front frame chassis.

6. Secure the LCD backplate to the chassis.

    a. Insert four (0515-0444) screws into the right side of the backplate. Use a T-8 TORX driver.

    b. Insert two large (0515-0382) screws into the left side of the LCD backplate. Use a T-15 TORX driver.

7. Place the four black cushions (0400-0333) on the four inner-most posts on the LCD backplate.

8. Place the A17 display driver board on the four black cushions. Insert the four screws (0515-0372) that secure the A17 display driver board to the LCD backplate, into the posts on which you have set the cushions. Use a T-10 TORX driver.

9. If the A17A1 inverter board has been removed from the driver board, proceed to step a. below. If the inverter board is attached to the A17 display driver, proceed to step 10.

    a. Connect the W62 cable from the A17A1 inverter board to J6 on the A17 display driver board.

    b. Insert 2 screws (0515-0430) that secure the A17A1 inverter board to the standoffs on the A17 display driver board.

10. Reconnect ribbon cable W63, which connects the A18 LCD with J5 on the A17 display driver board.

11. Connect the two backlight cables from the A18 LCD to the two slotted connectors on the A17A1 inverter board.

12. Route W64, the VGA cable, from J1 on the rear panel, through the rectangular opening in the display driver shield, to J7 on the A17 display driver board (the display driver shield has not yet been secured to the LCD backplate).

13. Lower the display driver shield onto the LCD backplate. Insert four screws (0515-0665) that secure the LCD backplate to the display driver board shield. Use a T-10 TORX driver.

14. Route cable W61 from J9 on the A2 controller board, through the circular opening in the display driver shield, to J7 on the A17 display driver board.

15. Route cable W60 from J8 on the A2 controller board, through the rectangular opening in the display driver shield, to J7 on the A17 display driver board.

16. Connect ribbon cable A1A1W1 from J602 on the A3 interface board to HDR1 on the A1 front panel assembly.

## Replacing the Backlights

1. If the LCD or backlights have not been removed from the front frame, follow the procedures outlined in “Removal of the Front Frame” on page 180, “Removal of the Display Driver Board, Inverter Board, and LCD” on page 182, and “Removal of the Backlights” on page 183, as needed.
2. *Carefully* grasp the end of the replacement backlight cartridge (2090-0380), which is attached to the backlight cable, and insert the backlight into the backlight slot at the top of the LCD. Repeat for the backlight located at the bottom of the LCD.

**NOTE** Whenever there is a need to replace a single backlight, both backlights must be replaced.

3. Insert the LCD into the display mount. The LCD assembly is correctly oriented when the small ribbon cable extends through an opening in the right side of the display mount.
4. Follow steps 4 through 17 of “Replacement of the Display Driver Board, Inverter Board, and LCD” on page 187, to complete replacement of the LCD into the front panel. Follow the instructions in “Replacement of the Front Frame” on page 185, to replace the front panel in the front frame.

## Replacement of the Line Switch

After you have replaced the A1 front frame assembly you can replace the line switch by following these steps (note that the line switch must be replaced before the LCD and display driver can be replaced):

1. Insert the line switch into the A1 front frame assembly. Insert the two screws (0515-1521) that secure the line switch to the front frame.
2. Insert the screw (0515-0430) that secures the striped green and white ground cable for the line switch (this screw also secures the ground for the power probe; if the black cable from the power probe cable assembly is not secured to the ground, secure it also).
3. Carefully insert the green LED from the top-center of the line switch assembly into the LED opening in the A1 front frame assembly.

## Replacement of the Keyboard

1. Insert the seven screws (0515-1934) that secure the front frame PC board to the A1 front frame assembly. Use a T-8 TORX driver.
2. Connect the RPG cable to the RPG connector on the front frame PC board.

3. Connect the power probe cable to the connector that is labelled "probe power" on the front frame PC board.
4. Connect A1A1W1 from HDR1 on A1 front frame assembly to A3J602 on the A3 interface board.

# Procedure 3. A1A1 Keyboard/Front Panel Keys

## Removal

1. Remove the front frame from the spectrum analyzer. Place the front frame face down on the bench. For 8564EC and 8565EC instruments, follow the instructions in "Procedure 2. A1 Front Frame/A18 LCD."
2. Disconnect A1W1 from A1A1J3 and the RPG cable from A1A1J2.
3. Remove the nine screws holding the A1A1 keyboard assembly to the front frame and remove the assembly.
4. Remove the rubber keypad.

## Replacement

1. Install the rubber keypad, ensuring that the screw holes are visible through the pad.
2. Place the A1A1 keyboard assembly over the rubber keypad. Secure with nine panhead screws.
3. Connect the RPG cable to A1A1J2, and A1W1 to A1A1J3.
4. Install the front frame assembly. For 8564EC and 8565EC instruments, follow the instructions in "Procedure 2. A1 Front Frame/A18 LCD."

# Procedure 4. A1A2 RPG

## Removal

1. Remove the A9 input attenuator as described in "Procedure 7. A7 through A13 Assemblies."
2. Disconnect the RPG cable from the A1A1 keyboard assembly.
3. Pull the front panel RPG knob off of the face of the front panel of the spectrum analyzer. Proceed to step 4.
4. Use a 7/16-inch nut driver, set to 20-in./lbs., to remove the nut holding the RPG shaft to the front panel.
5. Remove the RPG.

## Replacement

1. Place the RPG into the front frame with the cable facing the bottom of the spectrum analyzer. Place a lock washer and nut on the RPG shaft to hold it in the frame.
2. Use a 7/16-inch nut driver to secure the RPG assembly to the front frame.
3. Connect the RPG cable to A1A1J2.
4. Insert the RPG knob into the front panel assembly.
5. Replace the A9 input attenuator as described in "Procedure 7. A7 through A13 Assemblies."

# Procedure 5. A2, A3, A4, and A5 Assemblies

## Removal

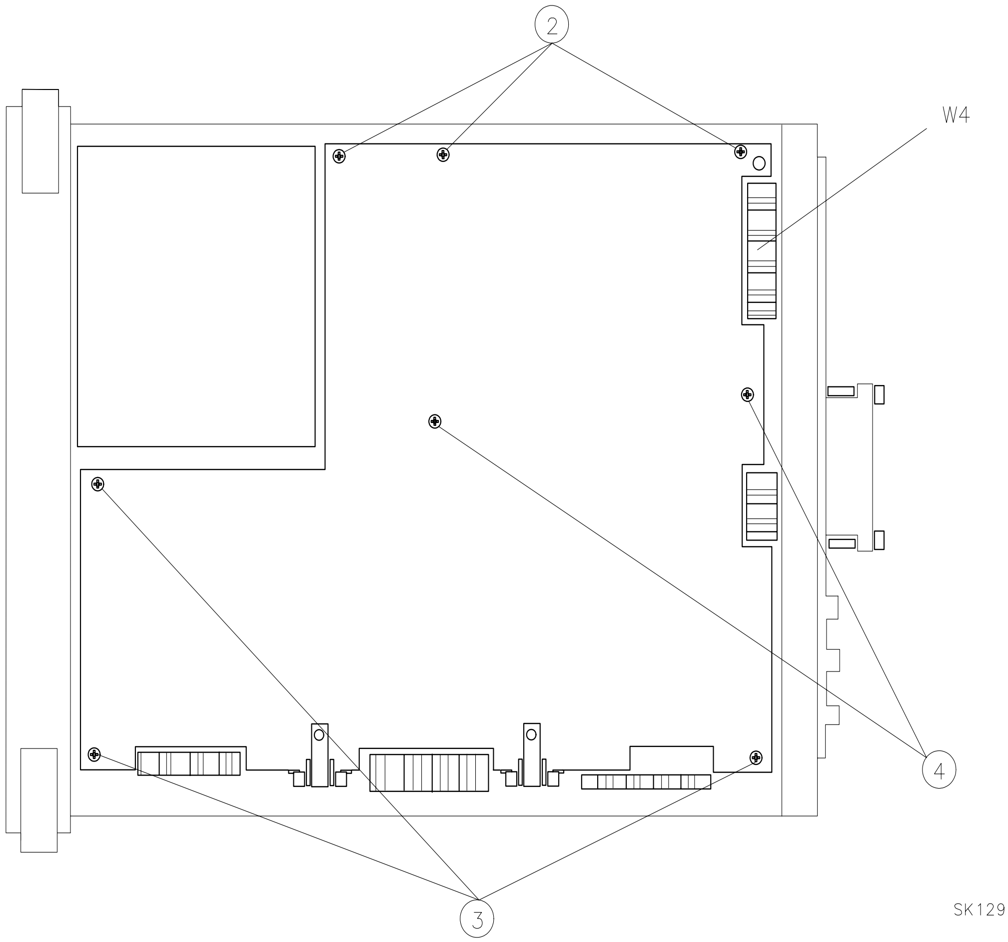
1. Remove the spectrum analyzer cover.
2. Place the spectrum analyzer on its right side frame.
3. Remove the eight screws holding the A2, A3, A4, and A5 assemblies to the top of the spectrum analyzer. These screws are labeled (2), (3), and (4) in Figure 4-8 on page 203. They are also labeled on the back of the A2 board assembly.
4. Remove ribbon cable W4 from A2J6. See Figure 4-8 on page 203.

**CAUTION** Do not fold the board assemblies out of the spectrum analyzer one at a time. Always fold the A2 and A3 assemblies as a unit and the A4 and A5 assemblies as a unit. Folding out one assembly at a time binds the hinges attaching the assemblies and may damage an assembly and hinge.

5. The board assemblies are attached to the right side frame of the spectrum analyzer with two hinges. Fold both the A2 and A3 assemblies out of the spectrum analyzer as a unit.
6. Fold both the A4 and A5 assemblies out of the spectrum analyzer as a unit.
7. Remove the cables from the assembly being removed, as illustrated in Figure 4-9 on page 204.
8. Remove the two screws that attach the assembly being removed to its two mounting hinges.

**CAUTION** Do not torque shield TORX screws to more than 8 inch-pounds. Applying excessive torque will cause the screws to stretch.

**Figure 4-8 A2, A3, A4, and A5 Assembly Removal**




## Replacement

1. Place the spectrum analyzer on its right side on the work bench.
2. Attach the assembly being installed to the two chassis hinges with two panhead screws.
3. Leave the assembly in the folded-out position and attach ribbon cables W1 and W2.
4. Attach all cables to the assembly, as illustrated in Figure 4-9 on page 204.
5. Locate the cable clip on the inside of the right side frame. Make sure that the coaxial cables are routed properly on the clip as illustrated in Figure 4-12 on page 206

6. Lay the A2, A3, A4, and A5 assemblies flat against each other in the folded-out position. Make sure that no cables become pinched between the two assemblies.

**Figure 4-9 Assembly Cables (1 of 3)**

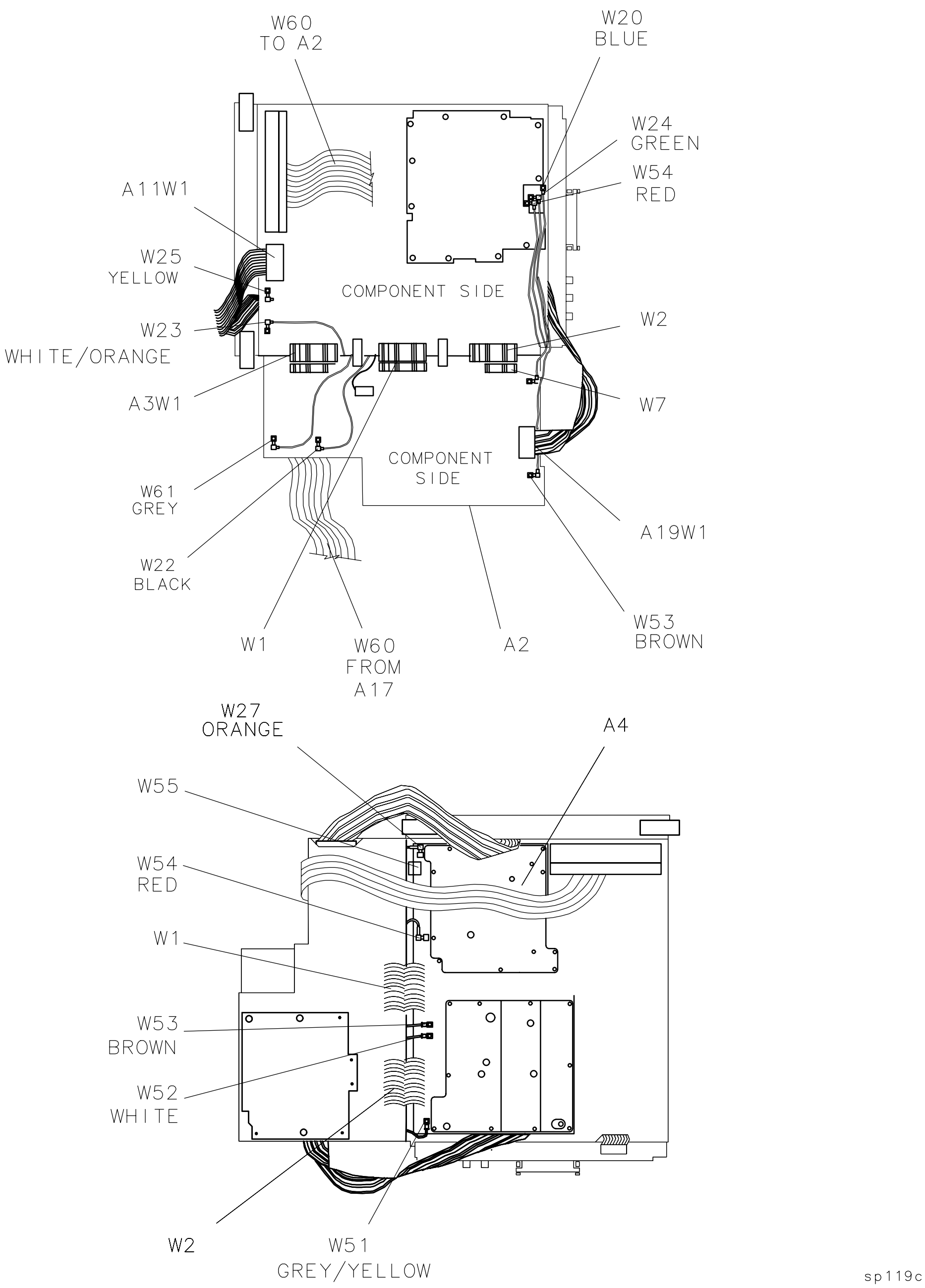


**Figure 4-10 Assembly Cables (2 of 3)**

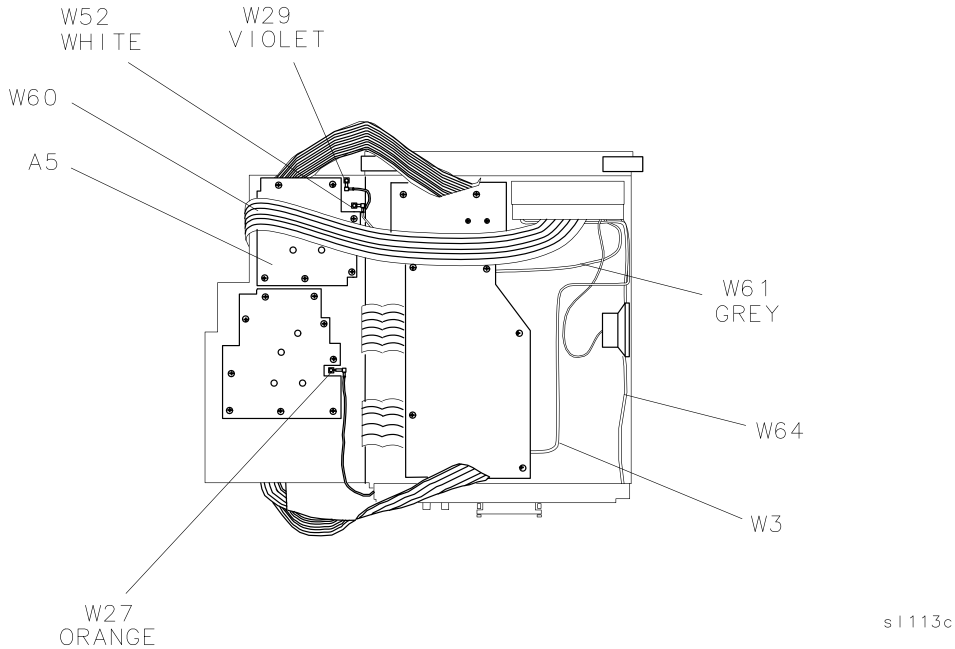
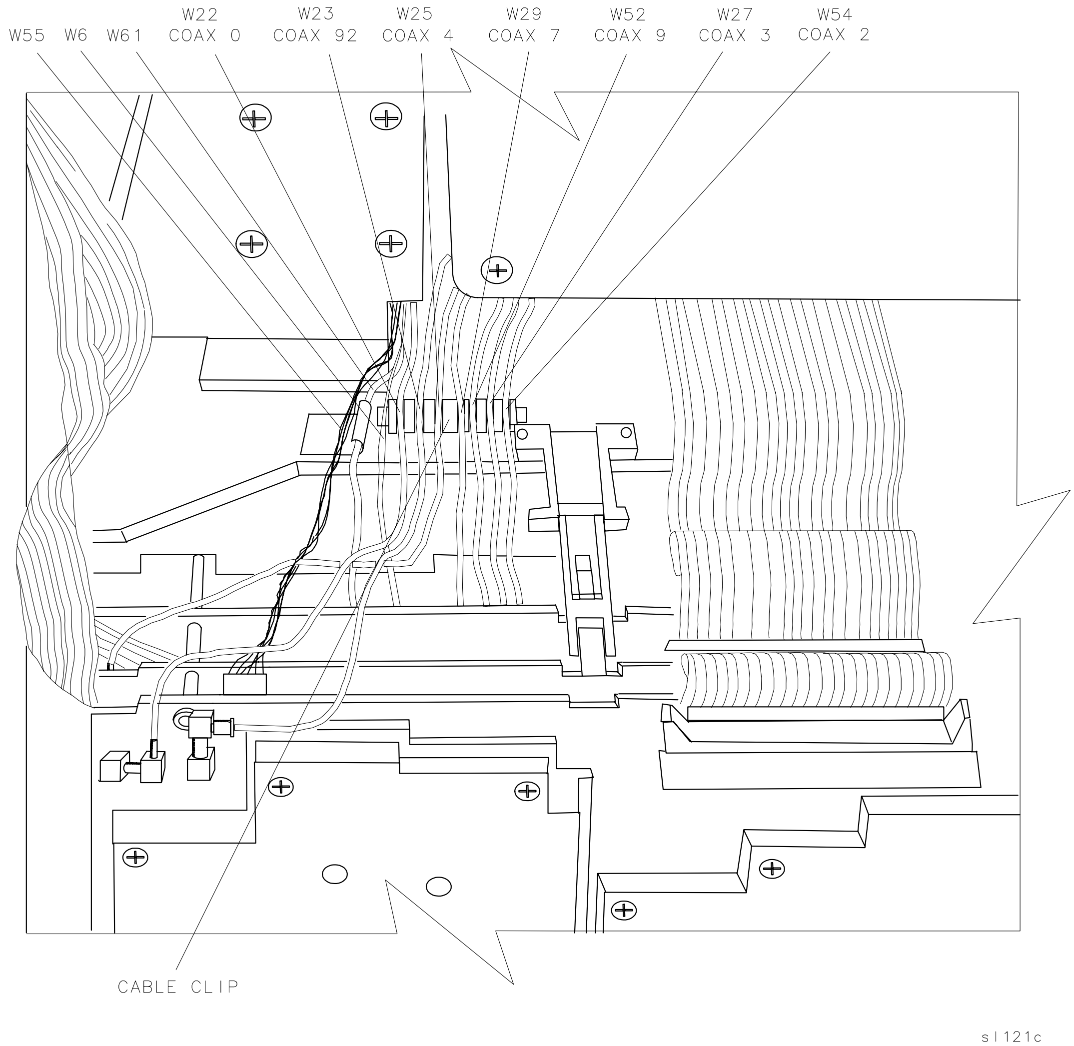


**Figure 4-12 Coaxial Cable Clip**




7. Check to ensure that no cables will become pinched under the hinges when folding up the A4 and A5 assemblies.

8. Fold the A4 and A5 assemblies together as a unit into the spectrum analyzer. Use caution to avoid damaging any cable assemblies. The standoffs on the A5 assembly must fit into the cups on the A6 power supply top shield.

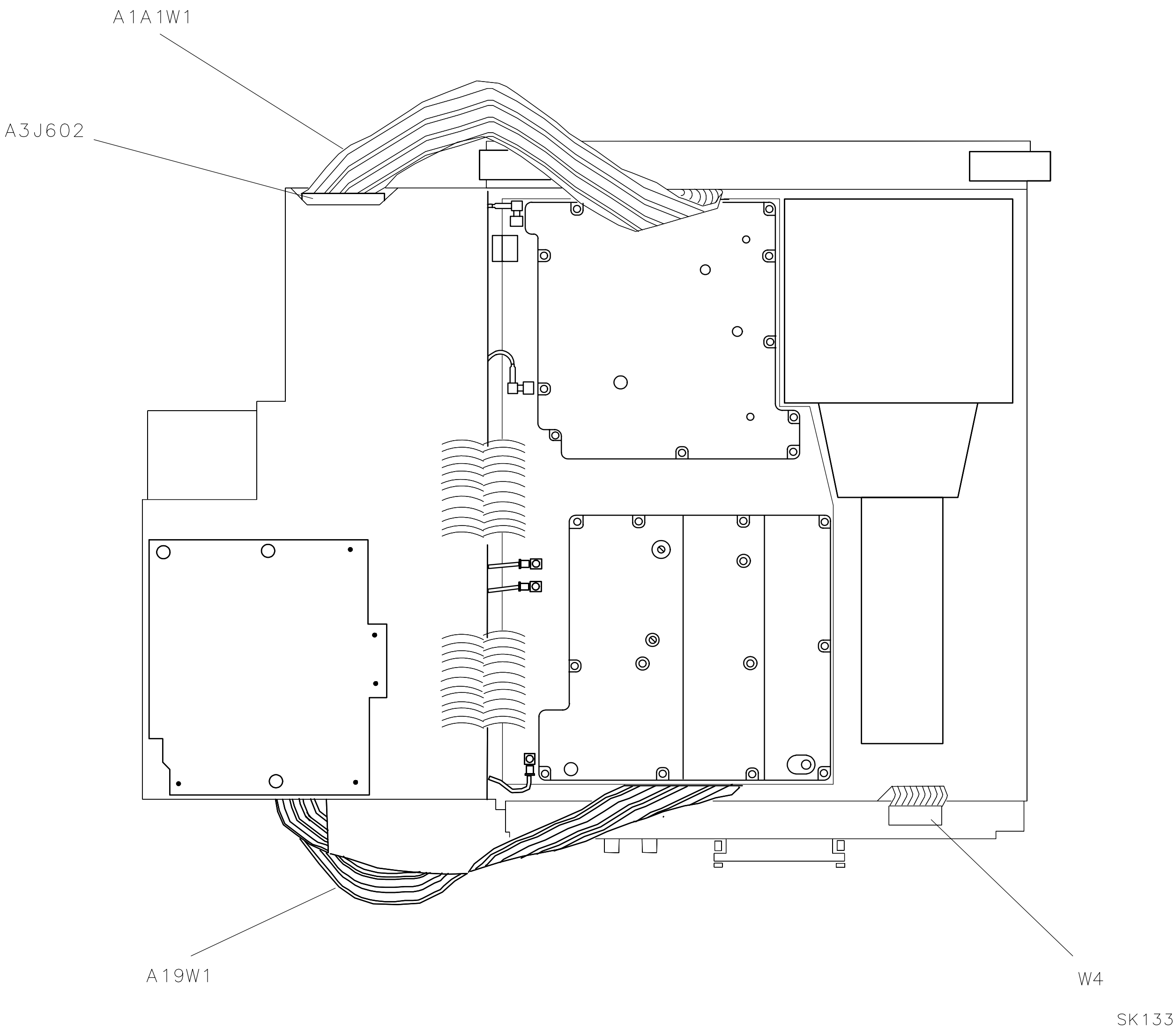
9. Fold the A2 and A3 assemblies together as a unit into the spectrum analyzer. Be sure to fold GPIB cable A19W1 between the A3 and A4 assemblies, using the two sets of hook and loop (Velcro) fasteners.

10. Fold ribbon cable A1A1W1 between A3 and A4 assemblies. Take care to dress the protective tubing as close to A3J602 connector as possible, so that the tubing does not fold with the cable. See Figure 4-14 on page 208.

11. Attach ribbon cable W4 to A2J6 while folding up the assemblies.

12. Secure the assemblies using the eight screws removed in "Removal," step 3. See Figure 4-8 on page 203.

**Figure 4-14 GPIB and A1A1 W1 Cable Placement**



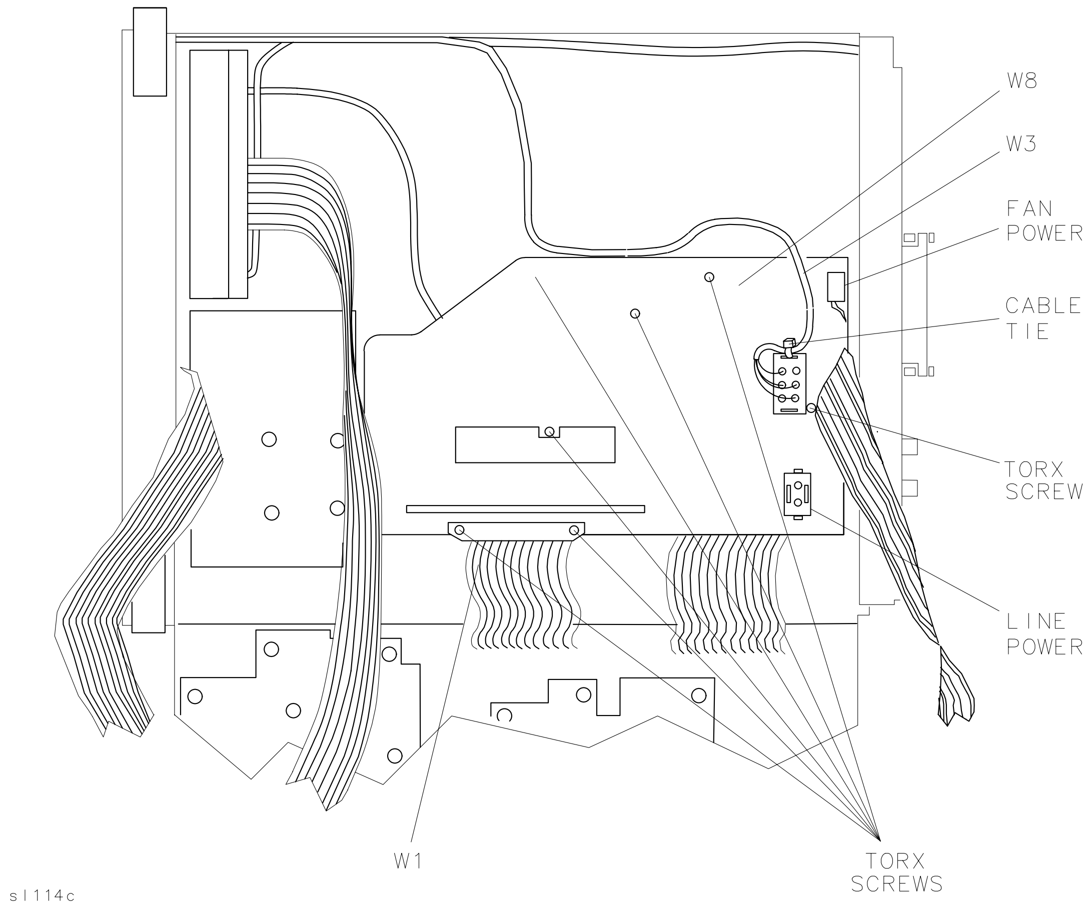
# Procedure 6. A6 Power Supply Assembly

## Removal

WARNING **The A6 Power Supply assembly contains lethal voltages with lethal currents in all areas. Use extreme care when servicing this assembly. Always disconnect the power cord from the instrument before beginning this replacement procedure. Failure to follow this precaution will represent a shock hazard which may result in personal injury.**

1. Disconnect the power cord from the spectrum analyzer.
2. Remove the spectrum analyzer cover assembly. Refer to "Procedure 1. Spectrum Analyzer Cover."
3. Fold out the A2, A3, A4, and A5 assemblies as described in steps 2 through 6 under "Procedure 5. A2, A3, A4, and A5 Assemblies."
4. Place the spectrum analyzer on the workbench with A2, A3, A4, and A5 folded out to the right.
5. Remove the three screws securing the power supply shield to the power supply and remove the shield. See Figure 4-16 on page 211.
6. Disconnect all cables from the A6 power supply assembly. See Figure 4-17 on page 214.
7. Use a T-10 TORX driver to remove the screws from the shield wall, the heatsink, the base of the power supply (0515-1950) and the A6 power supply assembly.
8. Remove the A6 power supply assembly by lifting from the regulator heatsink toward the front of the spectrum analyzer.

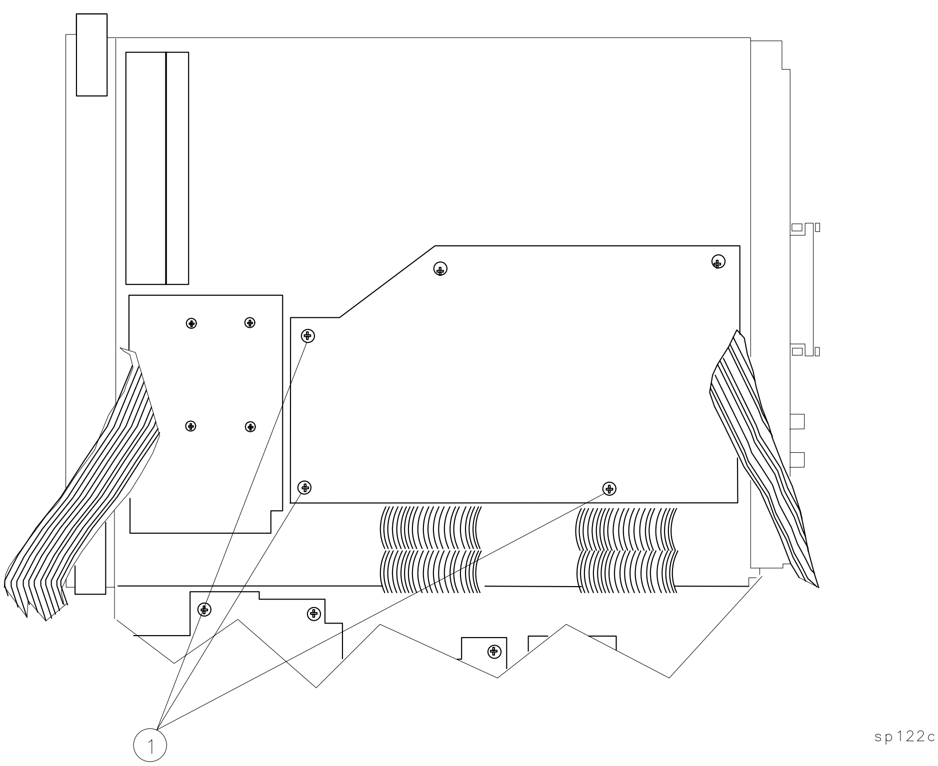
**Figure 4-15 Power Supply Cover**



## Replacement

1. Ensure that the bottom shield wall is in place before replacing the A6 power supply assembly.
2. Attach the A6 power supply assembly to the spectrum analyzer chassis and top shield wall using the four screws, torqued to 10-inch lbs. Attach all other screws, torqued to 6-inch lbs.
3. Connect W1 to A6J1, W3 to A6J2, fan power wires to A6J3, W8 to A6J4, and the line-power jack to A6J101. See Figure 4-17 on page 214.
4. Ensure that all cables are safely routed and will not be damaged when securing the A6 cover.
5. Secure the power supply cover shield to the power supply using three flathead screws (1). See Figure 4-16 on page 211. One end of the cover fits into a slot provided in the rear frame assembly. Ensure that the extended portion of the cover shield is seated in the shield wall groove.
6. Fold the A2, A3, A4, and A5 assemblies into the spectrum analyzer as described in steps 6 through 12 under “Procedure 5. A2, A3, A4, and A5 Assemblies.”

**Figure 4-16 Power Supply Cover**



# Procedure 7. A7 through A13 Assemblies

A separate replacement procedure is supplied for each assembly listed below: *

- A7 LO Multiplier/Amplifier (LOMA)
- A8 Low Band Mixer
- A9 Input Attenuator
- A10/A12 RYTHM/SBTX
- A11 YTO
- A13 Second Converter

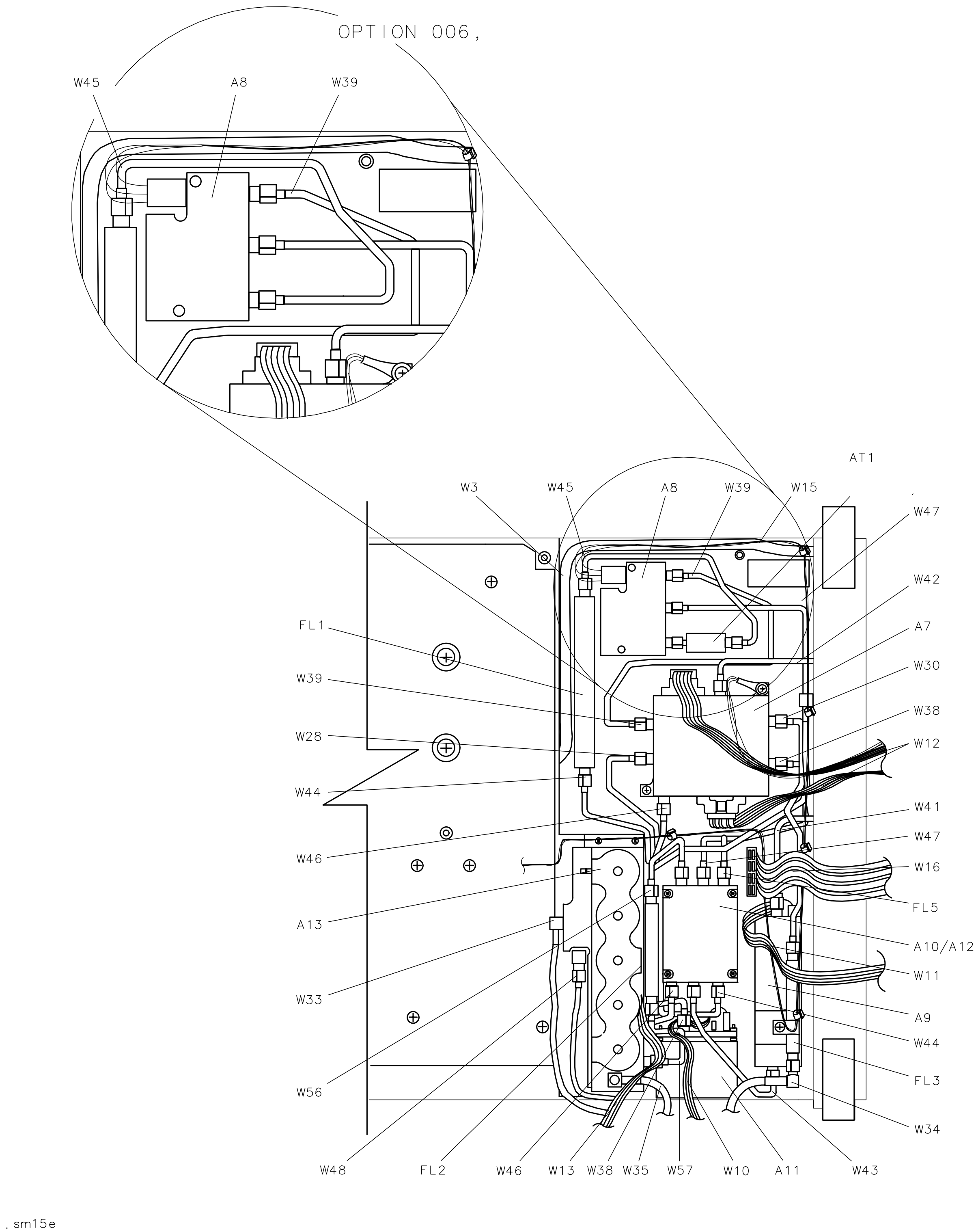
Before beginning a procedure, do the following:

1. Fold out the A14 and A15 assemblies as described in "Procedure 8. A14 and A15 Assemblies."
2. If the A9 input attenuator, A11 YTO, or A10/A12 RYTHM/SBTX assembly is being removed, also fold down the A2, A3, A4, and A5 assemblies as described in "Procedure 5. A2, A3, A4, and A5 Assemblies."

Use Figure 4-20 on page 221 to locate the assemblies and cables called out in this procedure.

**NOTE** Use a torque wrench to tighten all SMA connectors to 113 Ncm (10 in-lb). part number 8710-1655 can be used for this purpose. The style of torque wrench may vary, but in all cases do not tighten the connectors beyond the point at which the torque wrench "clicks" or "breaks-away."

**Figure 4-20 8564ECand 8565EC Assembly Locations**



# A7 LO Multiplier/Amplifier (LOMA)

## Removal

1. Remove the two screws securing the A7 assembly to the spectrum analyzer center deck.
2. Use a 5/16-inch wrench to disconnect W46, W28, W39, W42, W30, and W38 from the A7 assembly.
3. Remove W12 from the A7 assembly (two ribbon cable connectors and ground lug).
4. Remove the A7 assembly.

## Replacement

1. Use a 5/16-inch wrench to attach W46, W28, W39, W42, W30, and W38 to the A7 assembly.
2. Connect cable W12 (both ribbon cable connectors) to the A7 assembly.
3. Use two panhead screws to secure A7 to the center deck. Be sure to attach the ground lug on the screw near the J5 SAMPLER connector of A7.
4. Torque all RF cable connections to 113 Ncm (10 in-lb).

## Removal

1. Place the spectrum analyzer upside-down on the work bench with A14 and A15 folded out to the left.
2. Use a 5/16-inch wrench to remove W45 between FL1 and AT1. (For Option 006, remove W45 between FL1 and A8J1.)
3. Loosen W47 and W39 at A8J2, and A8J3.
4. Remove the two screws securing A8 to the center deck.
5. Remove W47 and W39 from the A8 assembly.
6. Remove AT1 from A8J1, if present.
7. For analyzers having serial number prefix ≥3641A, or Option H13: disconnect W15 from A8.

## Replacement

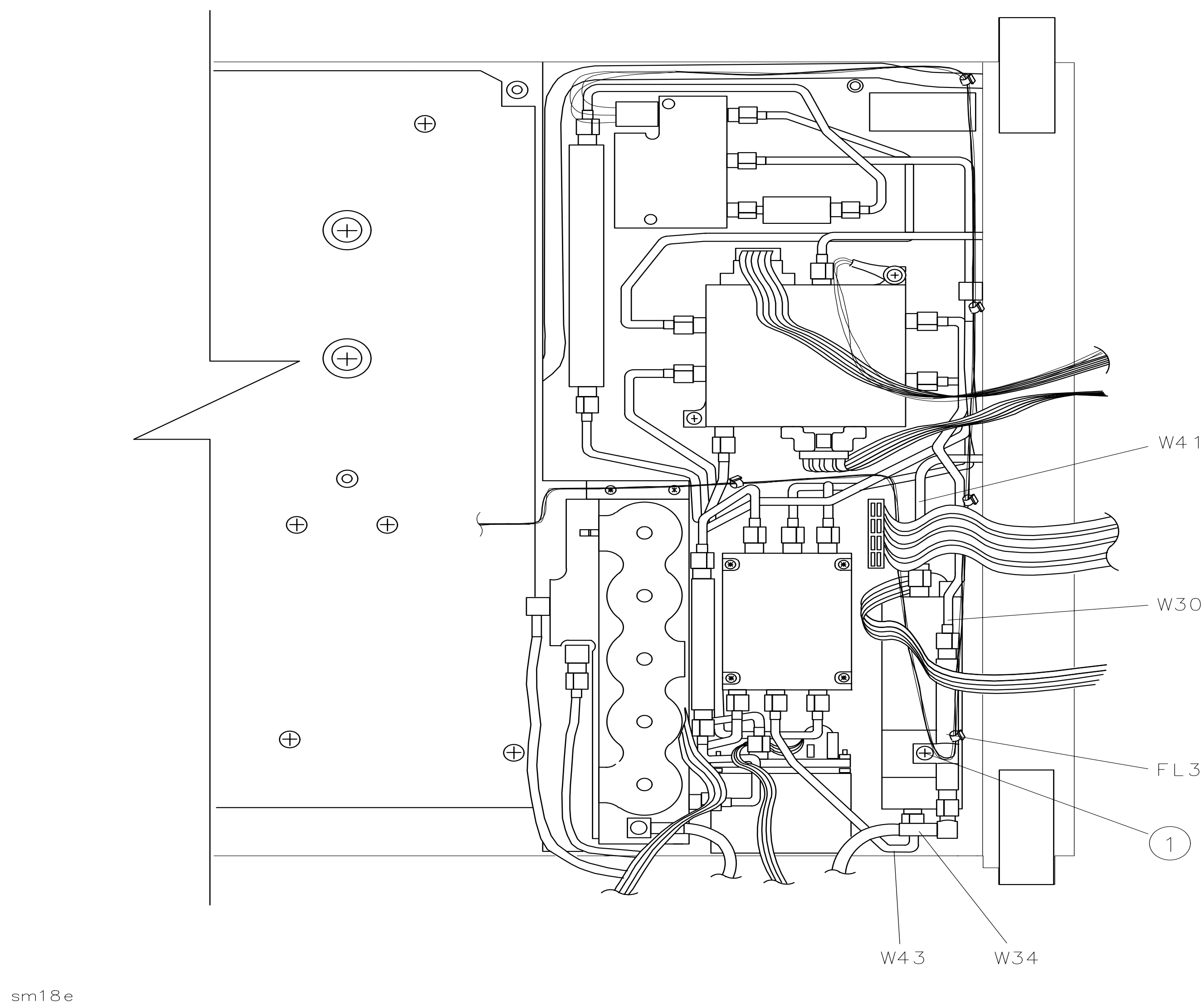
1. For analyzers without Option 006: connect AT1 to A8J1.
2. Place A8 on the center deck and attach W56 and W39, using caution to avoid damaging any of the center conductor pins in the cable.
3. Use two panhead screws to secure A8 to the center deck. Reconnect W45 to FL1 and A8J1, or AT1.
4. Torque all semirigid coax connections on A8, FL1, and AT1 (if present) to 113 Ncm (10 in-lb). Ensure that all cable connections are tight.
5. Connect W15 to A8.

# A9 Input Attenuator

## Removal

1. Place the spectrum analyzer upside-down on the work bench.
2. Disconnect W16 ribbon cable from the A10/A12 assembly and move it out of the way.
3. Remove screw (1) and the cable clamp securing FL3 to the attenuator mounting bracket. See Figure 4-21 on page 224.

**Figure 4-21 A9 Attenuator Removal**

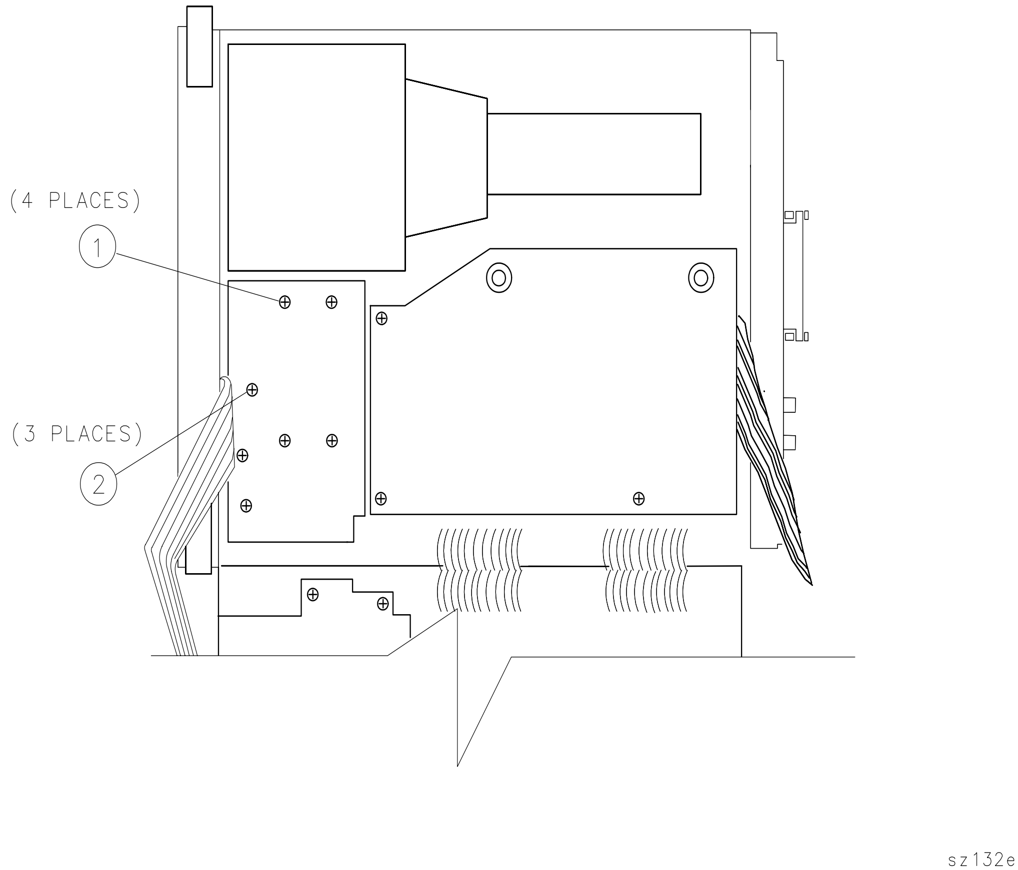


4. Disconnect W30 from A7 and move this cable/filter out of the way.
5. Remove the three screws (2) securing the A9 input attenuator mounting bracket to the center deck. See Figure 4-22 on page 226.
6. Loosen W43 from the attenuator connector, then disconnect the other end of W43 from A12J3 with a slight downward pressure to prevent damage to the center conductor pin.
7. Disconnect W41 from the front panel INPUT 50Ω connector, swinging the attenuator assembly upward to free the connection.
8. Remove the attenuator and disconnect the attenuator ribbon cable (W11), and the 2 semirigid coax cables (W41 and W43).
9. Remove the attenuator from the attenuator mounting bracket.

## Replacement

1. Ensure that the bracket that secures the attenuator to the center deck is attached to the attenuator. For proper orientation of the attenuator when mounting the bracket, refer to Figure 5-4 in chapter 5.
2. Connect the attenuator-control ribbon cable to the A9 input attenuator.
3. Loosely connect semirigid cable W43 to the attenuator assembly. See Figure 4-21 on page 224.
4. Loosely connect semirigid cable W41 to the front panel RF INPUT connector.
5. Loosely connect the other end of W41 to the attenuator and swing the attenuator down into place.
6. Connect semirigid cable W43 to A12J3 and torque all semirigid cable connections to 113 Ncm (10 in-lb).
7. Attach the attenuator to the center deck with three panhead screws (2). See Figure 4-22 on page 226.
8. Connect W30 to A7 and attach FL3 to the attenuator mounting bracket using a small cable clamp and one panhead screw (1). See Figure 4-21 on page 224. Torque the connections to W30 and FL3 to 113 Ncm (10 in-lb).
9. Connect W16 ribbon cable to the A10/A12 assembly.

### Figure 4-22 A9 and A10/A12 Mounting Screws



# A10/A12 RYTHM/SBTX

## Removal

**CAUTION** Do NOT remove the brackets from the A10/A12 assembly. If these brackets are removed and reinstalled, the performance of the spectrum analyzer will be altered. A new or rebuilt A10/A12 assembly includes new mounting brackets already attached to it.

1. Disconnect W16 ribbon cable from the A10/A12 assembly.
2. Use a 5/16-inch wrench to remove W43, W44, W46, and W47 from the A10/A12 assembly. See Figure 4-20 on page 221.
3. Remove W56/FL2/W57 (as a unit) and set it aside.
4. Remove W28 from the A10/A12 assembly (beneath where W56/FL2/W57 was connected to the A10/A12 assembly).
5. Remove four screws (1) securing A10/A12 to the center deck. These screws are located on the top-side of the center deck as illustrated in Figure 4-22, “A9 and A10/A12 Mounting Screws.”
6. Carefully remove the A10/A12 assembly and disconnect W48 (gray cable).

## Replacement

1. Orient the A10/A12 assembly for the proper cable connections.
2. Connect W48 (gray cable) to the A10/A12 assembly (beneath where W46 connects to the A10/A12 assembly). See Figure 4-20 on page 221.
3. Connect W28 to the A10/A12 assembly (beneath where W56 connects to the A10/A12 assembly). See Figure 4-20 on page 221.
4. Connect W43, W44, W46, and W47 to the A10/A12 assembly.
5. Connect W16 ribbon cable to the A10/A12 assembly.
6. Install W56/FL2/W57 and torque all RF cable connections to 113 Ncm (10 in-lb).
7. Secure the A10/A12 assembly to the spectrum analyzer center deck using four screws.

# A11 YTO

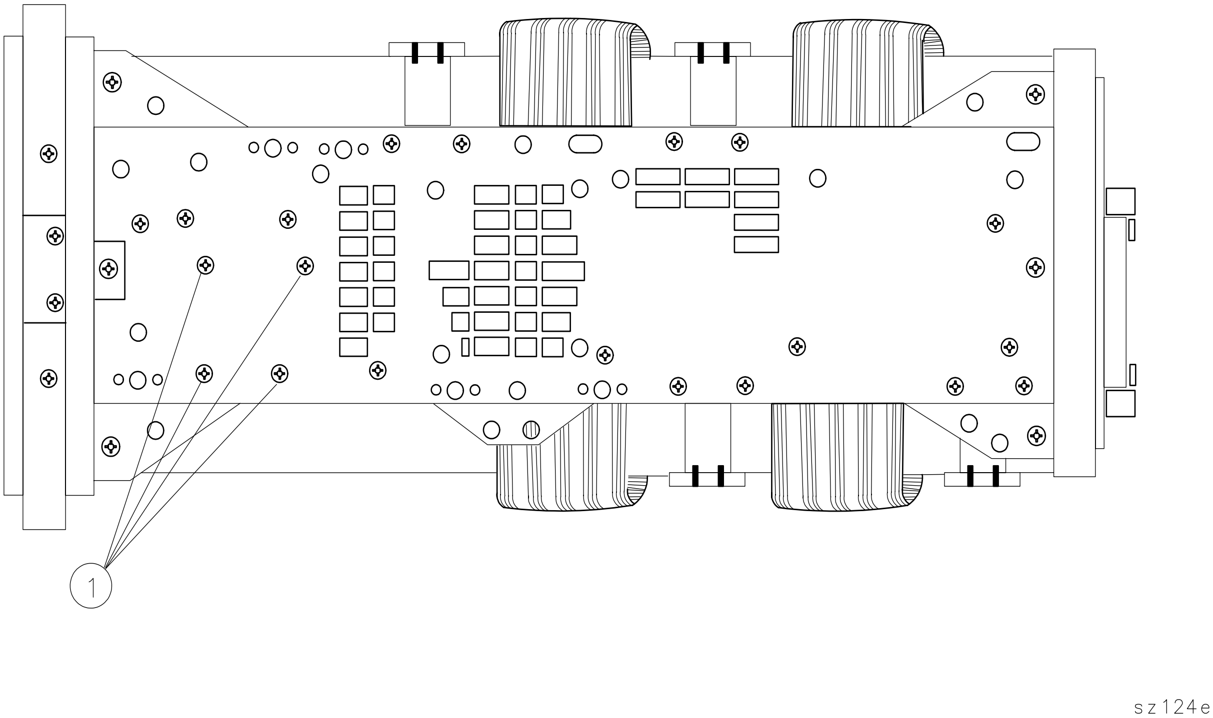
## Removal

1. Carefully disconnect W43 semirigid cable from A9J2 and A12J3 and move it out of the way.
2. Remove W56/FL2/W57 (as a unit) and disconnect W38 at the A11 assembly.
3. Remove four screws (1) securing A11 to the right-side frame. See Figure 4-23, “A11 Mounting Screws at Right Side Frame.” Remove the screws while holding onto A11.
4. Disconnect W10 ribbon cable from the A11 YTO assembly.

## Replacement

1. Connect W10 ribbon cable to the A11 YTO assembly.
2. Orient the A11 assembly in the spectrum analyzer so its four mounting holes line up with the holes in the right side frame and the output connector is lined up with W38.
3. Secure the A11 assembly to the right side frame using four screws.
4. Connect W38 to A11.
5. Install W56/FL2/W57 between A12J1 and A13J1.
6. Reconnect W43 semirigid cable to A9J2 and A12J3 and torque all RF cable connections to 113 Ncm (10 in-lb).

Figure 4-23 A11 Mounting Screws at Right Side Frame



# A13 Second Converter

**CAUTION** Turn off the spectrum analyzer power when replacing the A13 second converter assembly. Failure to turn off the power may result in damage to the assembly.

## Removal

1. Place the spectrum analyzer upside-down on the work bench.
2. Disconnect W33, coax 81, and W35, coax 92, from the A13 assembly.
3. Disconnect W48, coax 8, from A13J3.
4. Disconnect W56/FL2/W57 (as a unit) and set it aside.
5. Remove the four screws securing A13 to the main deck and remove the assembly.
6. Disconnect ribbon cable W13 from the A13 assembly.

## Replacement

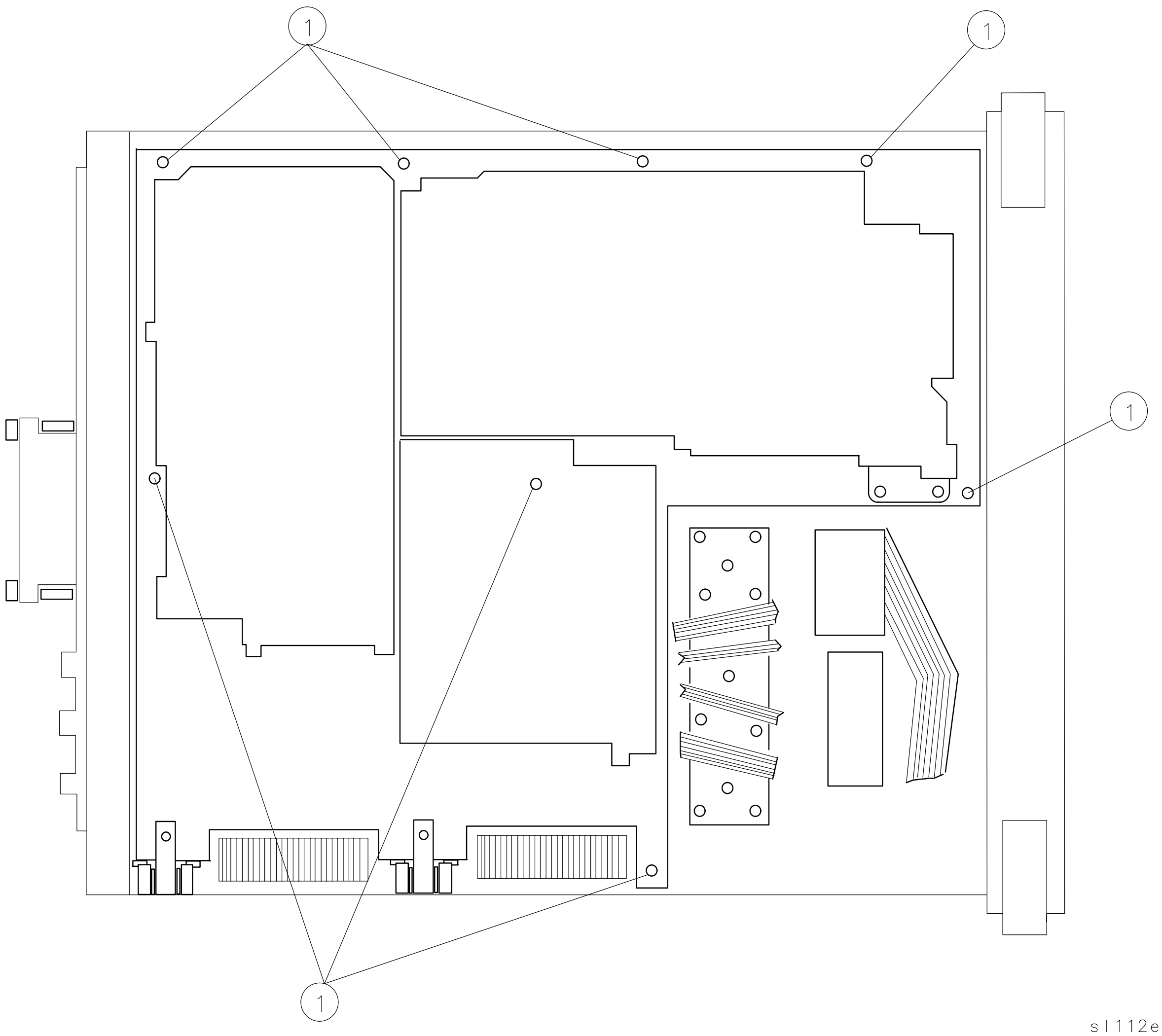
1. Connect ribbon cable W13 to the A13 assembly.
2. Secure A13 to the spectrum analyzer main deck, using four panhead screws.
3. Connect W33, coax 81, to A13J4 600 MHz IN jack.
4. Connect W35, coax 92, to A13J2 310.7 MHz OUT jack.
5. Connect W48, coax 8, to A13J3. Route W48 under W35, coax 92.
6. Install W56/FL2/W57 and ensure that all of the connections on W56/FL2/W57 and on W48 are torqued to 113 Ncm (10 in-lb).

# Procedure 8. A14 and A15 Assemblies

## Removal

1. Remove the spectrum analyzer cover as described in "Procedure 1. Spectrum Analyzer Cover."
2. Place the spectrum analyzer on its right side frame.
3. Remove the eight screws (1) holding the A14 and A15 assemblies to the bottom of the spectrum analyzer. See Figure 4-24 on page 231.

**Figure 4-24 A14 and A15 Assembly Removal**



**CAUTION** DO NOT fold the board assemblies out of the spectrum analyzer one at a time. Always fold the A14 and A15 assemblies as a unit. Folding out one assembly at a time binds the hinges attaching the assemblies and may damage an assembly and hinge.

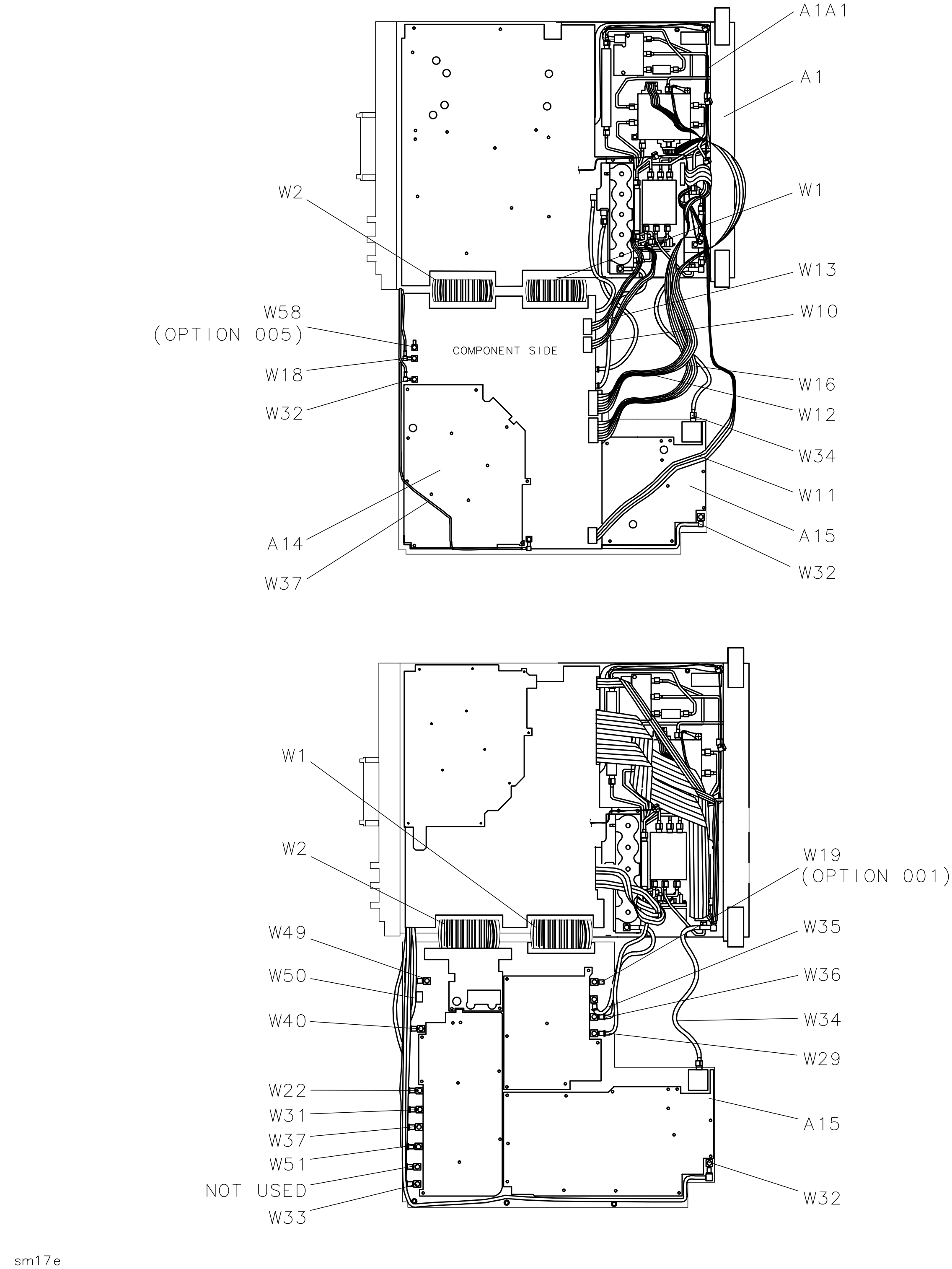
4. The board assemblies are attached to the spectrum analyzer right side frame with two hinges. Fold both the A14 and A15 assemblies out of the spectrum analyzer as a unit.
5. Remove all cables from the assembly being removed.
6. Remove the two screws that attach the assembly being removed to its two mounting hinges.

**CAUTION** DO NOT torque shield screws to more than 5 inch-pounds. Applying excessive torque will cause the screws to stretch.

## Replacement

1. Attach the removed assembly to the two chassis hinges with two panhead screws.
2. Attach all cables to the assembly as illustrated in Figure 4-25 on page 233. When connecting W34 to A15, torque the SMA connector to 113 Ncm (10 in-lb).
3. Lay the A14 and A15 assemblies flat against each other in the folded out position. Make sure that no cables become pinched between the two assemblies. Ensure that all coaxial cables are clear of hinges and standoffs before continuing onto the next step.
4. Fold both board assemblies into the spectrum analyzer as a unit. Use caution to avoid damaging any cable assemblies.
5. Secure the assemblies using the eight screws removed in "Removal" step 3. See Figure 4-24 on page 231.
6. Secure the spectrum analyzer cover assembly as described in "Procedure 1. Spectrum Analyzer Cover."

**Figure 4-25 A14 and A15 Assembly Cables**



# Procedure 9. B1 Fan

## Removal/Replacement

WARNING **Always disconnect the power cord from the instrument before beginning this replacement procedure. Failure to follow this precaution can present a shock hazard which may result in personal injury.**

1. Remove the four screws securing the fan assembly to the rear frame.
2. Remove the fan and disconnect the fan wire from the A6 power supply assembly.
3. To reinstall the fan, connect the fan wire to A6J3 and place the wire into the channel provided on the left side of the rear frame opening. Secure the fan to the rear frame using four panhead screws.

NOTE The fan must be installed so that the air enters through the front and sides of the instrument and exits out the rear of the instrument.

# Procedure 10. BT1 Battery

**WARNING** **Battery BT1 contains lithium polycarbon monofluoride. Do not incinerate or puncture this battery. Dispose of discharged battery in a safe manner.**

**CAUTION** To avoid loss of the calibration constants stored on the A2 controller assembly, connect the spectrum analyzer to the main power source and turn on before removing the battery.

The battery used in this instrument is designed to last several years. An output voltage of +3.0 V is maintained for most of its useful life. Once this voltage drops to +2.6 V, its life and use are limited and the output voltage will deteriorate quickly. When the instrument is turned off, stored states and traces will only be retained for a short time and may be lost. Refer to “State- and Trace-Storage Problems,” in Chapter 10 , “Controller Section.” The battery should be replaced if its voltage is +2.6 V or less.

## Removal/Replacement

1. Remove any option module attached to the rear panel.
2. Locate the battery assembly cover on the spectrum analyzer rear panel. Use a screwdriver to remove the two flathead screws securing the cover to the spectrum analyzer.
3. Remove the old battery and replace it with the new one, ensuring proper polarity.
4. Measure the voltage across the new battery. Nominal new battery voltage is approximately +3.0 V. If this is not the case, check the battery cable and A2 controller assembly.
5. Secure the battery assembly into the spectrum analyzer.

# Procedure 11. Rear Frame/Rear Dress Panel

## Removal

WARNING **The A6 power supply assemblies contain lethal voltages with lethal currents in all areas. Use extreme care when servicing these assemblies. Always disconnect the power cord from the instrument before beginning this replacement procedure. Failure to follow this precaution can present a shock hazard which may result in personal injury.**

1. Disconnect the line-power cord from the spectrum analyzer.
2. Remove the spectrum analyzer cover, and place the spectrum analyzer on its right side frame.
3. Fold out the A2, A3, A4, and A5 assemblies as described in"Procedure 5. A2, A3, A4, and A5 Assemblies," steps 3 through 5.
4. Disconnect the GPIB cable at A2J5.
5. Place the spectrum analyzer top-side-up on the work bench with A2 through A5 folded out to the right.

6 .Remove the three screws securing the power-supply shield to the power supply, and remove the shield. See (1) in Figure 4-2 on page 184.

7 .Disconnect the fan and line-power cables from A6J3 and A6J101 on the A6 power supply assembly.

8 .Remove the two flathead screws that secure the rear-panel battery assembly, and remove the assembly. Remove the battery and unsolder the two wires attached to the battery assembly.

9 .Use a 9/16-inch nut driver to remove the dress nuts holding the BNC connectors to the rear frame. If necessary, drill out the nut driver to fit over the BNC connectors, and cover it with heatshrink tubing or tape to avoid scratching the dress panel.

10.Remove four screws that secure the rear frame to the main deck. See (1) in Figure 4-28 on page 241.

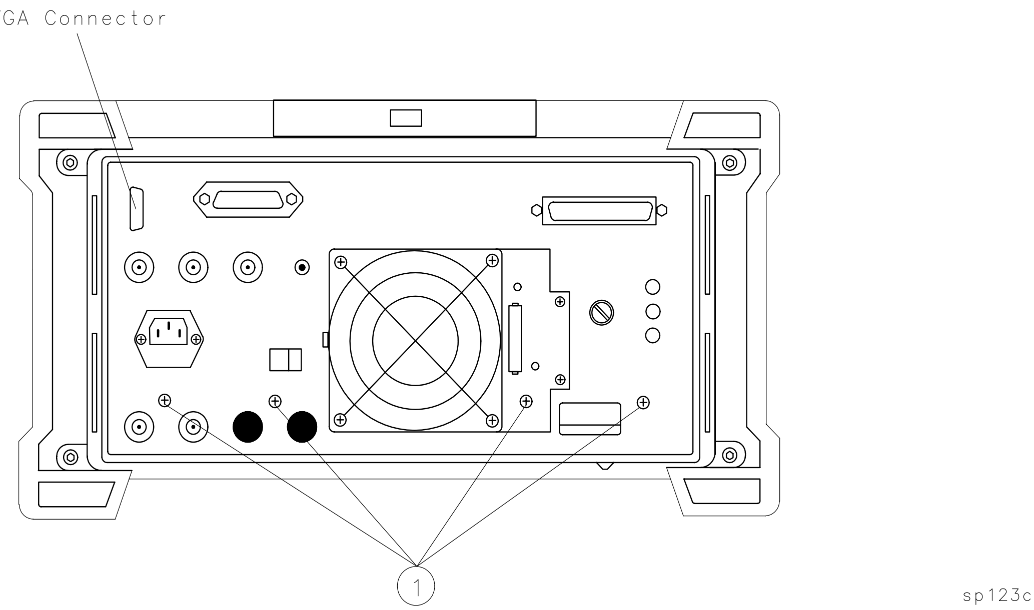
11.Remove the six screws that secure the rear frame to the left and right side frames.

12.Remove the knurled nut that secures the earphone jack. Carefully remove the jack using caution to avoid losing the lock washer located on the inside of the rear-frame assembly. Replace the washer and nut onto the jack for safekeeping.

13.Remove the rear-frame assembly.

14.To remove the rear dress panel, remove the two nuts located on the inside of the rear frame near the display adjustment holes.

**Figure 4-28 Main Deck Screws**



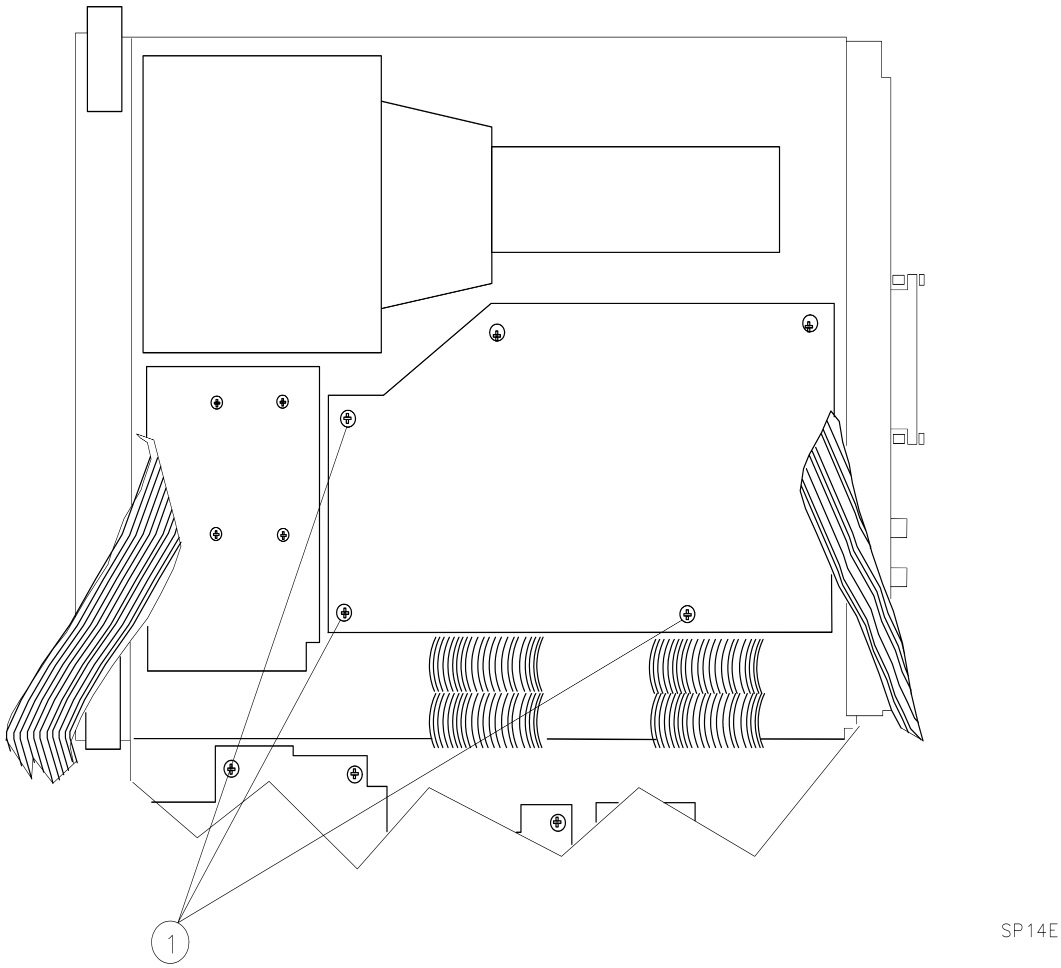

## Replacement

1. If the rear dress panel is removed, secure it to the rear frame using two nuts. Ensure that the dress panel is aligned with the frame.
2. Place the spectrum analyzer on its front panel allowing easy access to the rear-frame area.
3. Place the rear frame on the spectrum analyzer and secure the knurled nut on the earphone jack. A lock washer should be used on the inside of the rear frame and a flat washer on the outside.
4. Place the coax cable's BNC connectors into the appropriate rear-frame holes as described below. Use a 9/16-inch nut driver to attach the dress nuts holding the BNC connectors to the rear frame.

| Rear Panel Jack EC-series | RF Cable |
|---|---|
| J1 | W64 |
| n/a | W55 |
| J4 | W24, coax 5 |
| J5 | W23, coax 93 |
| J6 | W25, coax 4 |
| J7 | W55 |
| J8 | W18, coax 97 |
| J9 | W31, coax 8 |
| J11 | W58, coax 8 |

5. Secure the rear frame to the spectrum analyzer main deck, using four panhead screws (1). See Figure 4-28 on page 241.
6. Secure the rear frame to the spectrum analyzer side frames using three flathead screws per side. Use caution to avoid damaging any coaxial cables.
7. Place the spectrum analyzer top-side-up on the work bench.
8. Pull the red and black battery wires through the rear-frame's battery-assembly hole. Solder the red wire to the battery-assembly's positive lug and the black wire to the negative lug. Replace the battery.
9. Secure the battery assembly to the rear frame, using two flathead screws.
10. Connect the fan and line-power cables to A6J3 and A6J101 on the A6 power supply.
11. Ensure that all cables are safely routed and will not be damaged when securing the A6 cover.
12. Secure the power-supply cover shield to the power supply, using three flathead screws (1). One end of the cover fits into a slot provided in the rear-frame assembly. Ensure that the extended portion of the cover shield is seated in the shield wall groove. See Figure 4-29 on page 243.
13. Connect the GPIB cable to A2J5.
14. Fold the A2, A3, A4, and A5 assemblies into the spectrum analyzer as described in procedure 5.

**Figure 4-29 A6 Power Supply Cover**



# Procedure 12. EEROM

## Removal/Replacement

**CAUTION** The EEROM is replaced with the power on. Use a nonmetallic tool to remove the defective EEROM and install the new EEROM.

**NOTE** In EC-series analyzers the EEROM reference designator is U23.

1. Turn the spectrum analyzer **LINE** switch off. Remove the spectrum analyzer cover assembly and fold out the A2, A3, A4, and A5 assemblies as described in “Procedure 5. A2, A3, A4, and A5 Assemblies,” steps 3 through 5.
2. Turn the spectrum analyzer **LINE** switch on.
3. Set the WR PROT/WR ENA jumper on the A2 controller assembly to the WR ENA position.
4. Press **CAL**, **MORE 1 OF 2**, **SERVICE CAL DATA**, **COPY EEROM**. The spectrum analyzer will store the contents of the EEROM into the program RAM.
5. Using a nonmetallic tool, carefully remove the defective EEROM.
6. Carefully install a new EEROM.
7. Press **COPY TO EEROM**. The spectrum analyzer will store the contents of the program RAM into the new EEROM.
8. Turn the spectrum analyzer **LINE** switch off, then on, cycling the power. Allow the power-on sequence to finish.
9. If error message `701, 702, or 703` is displayed, press **RECALL**, **MORE**, and **RECALL ERRORS**. Use the STEP keys to view any other errors.
10. If error message `701 or 703` is displayed, perform the "Front End Cal" adjustment in the 8564E/8565E adjustment/diagnostic software (see Chapter 2 , “Adjustment/Diagnostic Software”).
11. If error message `719 or 720` is displayed, the model number and/or the option information has been corrupted. The spectrum analyzer must be returned to an Agilent Technologies customer service center to have this data restored.
12. If error message `704` is displayed, press **SAVE**, **SAVE PRSEL PK**, and **PRESET**.

13. If there are no errors after cycling the spectrum analyzer power, the EEROM is working properly, but the frequency-response correction data might be invalid. Check the spectrum analyzer frequency response.

14. Place the WR PROT/WR ENA jumper in the WR PROT position.

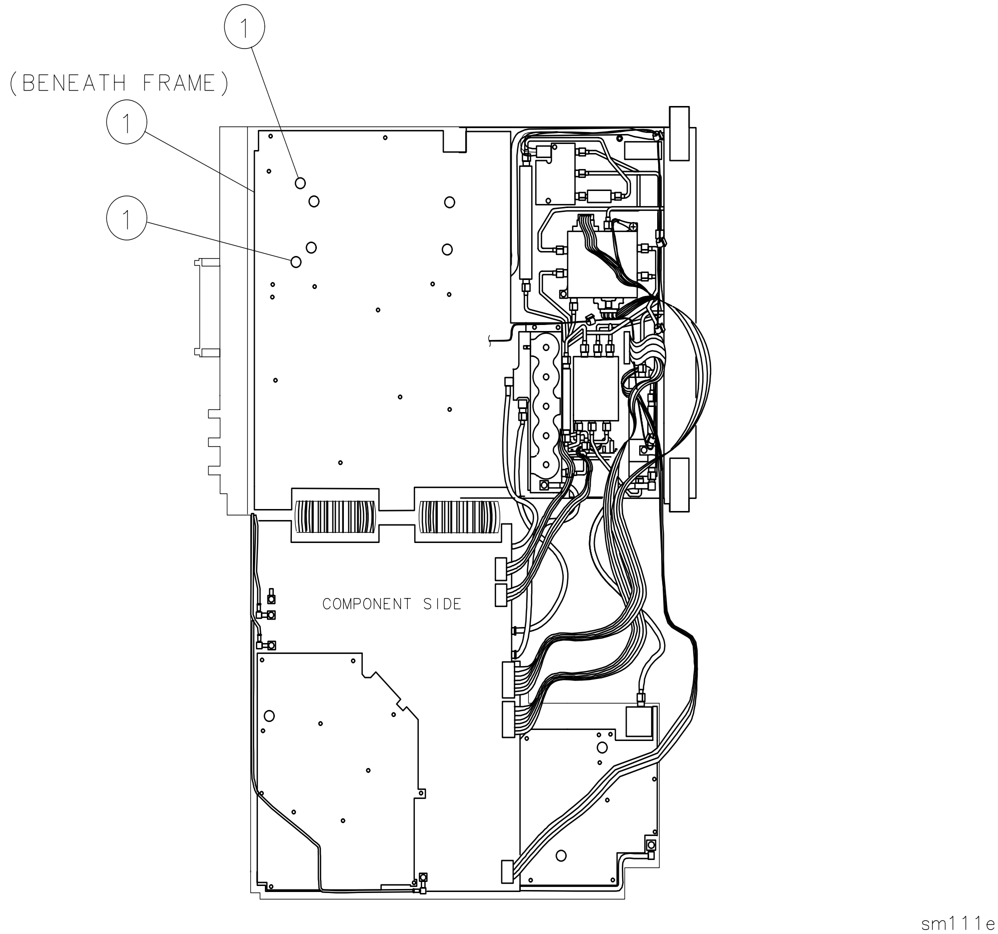
15. Fold the A2 and A3 assemblies into the spectrum analyzer as described in "Procedure 5. A2, A3, A4, and A5 Assemblies."

# Procedure 13. A21 OCXO

## Removal

1. Remove the rear frame assembly as described in "Procedure 11. Rear Frame/Rear Dress Panel," steps 1 through 20.
2. Place the spectrum analyzer on its right-side frame.
3. Fold out the A14 and A15 assemblies as described in "Procedure 9. A14 and A15 Assemblies Removal," steps 3 and 4.
4. Remove the three screws (1) securing the OCXO to the main deck. See Figure 4-34, "A21 OCXO Mounting Screws."
5. Disconnect W49, coax 82, from the OCXO and disconnect W50 (orange cable) from the A15 RF assembly. Clip the tie wraps that hold W49 and W50 together and remove the OCXO from the spectrum analyzer (with the orange cable connected).

**Figure 4-34 A21 OCXO Mounting Screws**



## Replacement

**CAUTION** Ensure that the insulator is installed between the A21 OCXO and the main deck. Failure to do so will result in damage to the instrument by shorting the power supply.

1. Connect W49, coax 82, to the OCXO and position the OCXO in the spectrum analyzer. Dress W50, orange cable, next to W49 through the opening in the deck.
2. Secure the OCXO to the spectrum analyzer main deck using three screws (1) and insulating washers. See Figure 4-34 on page 257.
3. Connect W50 to A15J306. Install tie wraps to hold W49 and W50 together.
4. Fold the A14 and A15 assemblies into the spectrum analyzer as described in “Procedure 8. A14 and A15 Assemblies.”
5. Perform the rear frame assembly replacement procedure described in “Procedure 11. Rear Frame/Rear Dress Panel.”

# 5 Replaceable Parts

# Introduction

This chapter contains information on ordering all replaceable parts and assemblies. Locate the instrument parts in the following figures and tables:

# Ordering Information

To order a part or assembly, quote the part number, indicate the quantity required, and address the order to the nearest Agilent Technologies office. See Table 1-5 on page 45.

To order a part that is not listed in the replaceable parts table, include the instrument model number, the description and function of the part, and the number of parts required. Address the order to the nearest Agilent Technologies office.

## Direct Phone-Order System

Within the USA, a phone order system is available for regular and hotline replacement parts service. A toll-free phone number is available, and Mastercard and Visa are accepted.

Regular Orders: The toll-free phone number, (800) 227-8164, is available 6 am to 5 pm, Pacific time, Monday through Friday. Regular orders have a four-day delivery time.

Hotline Orders: Hotline service for ordering emergency parts is available 24 hours a day, 365 days a year. There is an additional hotline charge to cover the cost of freight and special handling.

The toll-free phone number is (800) 227-8164, is available 6 am to 5 pm, Pacific time, Monday through Friday and (916) 785-8HOT for after-hours, weekends, and holidays. Hotline orders are normally delivered the following business day.

# Parts List Format

The following information is listed for each part:

1. The part number.
2. The total quantity (Qty) in the assembly. This quantity is given only once, at the first appearance of the part in the list.
3. The description of the part.
4. A five-digit code indicating a typical manufacturer of the part.
5. The manufacturer part number.

**Table 5-1 Reference Designations**

| REFERENCE DESIGNATIONS | | | | | |
|---|---|---|---|---|---|
| A | Assembly | F | Fuse | RT | Thermistor |
| AT | Attenuator, Isolator, Limiter, Termination | FL | Filter | S | Switch |
| B | Fan, Motor | HY | Circulator | T | Transformer |
| BT | Battery | J | Electrical Connector (Stationary Portion), Jack | TB | Terminal Board |
| C | Capacitor | K | Relay | TC | Thermocouple |
| CP | Coupler | L | Coil, Inductor | TP | Test Point |
| CR | Diode, Diode Thyristor, Step Recovery Diode, Varactor | M | Meter | U | Integrated Circuit, Microcircuit |
| DC | Directional Coupler | MP | Miscellaneous Mechanical Part | V | Electron Tube |
| DL | Delay Line | P | Electrical Connector (Movable Portion), Plug | VR | Breakdown Diode (Zener), Voltage Regulator |
| DS | Annunciator, Lamp, Light Emitting Diode (LED), Signaling Device (Visible) | Q | Silicon Controlled Rectifier (SCR), Transistor, Triode Thyristor | W | Cable, Wire, Jumper |
| E | Miscellaneous Electrical Part | R | Resistor | X | Socket |
| | | | | Y | Crystal Unit (Piezoelectric, Quartz) |
| | | | | Z | Tuned Cavity, Tuned Circuit |

**Table 5-2 Abbreviations**

| ABBREVIATIONS | | | | | |
|---|---|---|---|---|---|
| **A** | | **C** | | CONT | Contact, Continuous, Control, Controller |
| A | Across Flats, Acrylic, Air (Dry Method), Ampere | C | Capacitance, Capacitor, Center Tapped, Cermet, Cold, Compression | CONV | Converter |
| ADJ | Adjust, Adjustment | | | CPRSN | Compression |
| ANSI | American National Standards Institute (formerly USASI-ASA) | | | CUP-PT | Cup Point |
| | | CCP | Carbon Composition Plastic | CW | Clockwise, Continuous Wave |
| | | CD | Cadmium, Card, Cord | **D** | |
| ASSY | Assembly | CER | Ceramic | | |
| AWG | American Wire Gage | CHAM | Chamfer | D | Deep, Depletion, Depth, Diameter, Direct Current |
| **B** | | CHAR | Character, Characteristic, Charcoal | | |
| BCD | Binary Coded Decimal | | | DA | Darlington |
| BD | Board, Bundle | CMOS | Complementary Metal Oxide Semiconductor | DAP-GL | Diallyl Phthalate Glass |
| BE-CU | Beryllium Copper | | | DBL | Double |
| BNC | Type of Connector | | | DCDR | Decoder |
| BRG | Bearing, Boring | CNDCT | Conducting, Conductive, Conductivity, Conductor | DEG | Degree |
| BRS | Brass | | | D-HOLE | D-Shaped Hole |
| BSC | Basic | | | DIA | Diameter |
| BTN | Button | | | DIP | Dual In-Line Package |

**Table 5-2 Abbreviations**

| | | | | | |
|---|---|---|---|---|---|
| **D** | | | | HEX | Hexadecimal, Hexagon, Hexagonal |
| DIP-SLDR | Dip Solder | FDTHRU | Feedthrough | | |
| D-MODE | Depletion Mode | FEM | Female | | |
| DO | Package Type Designation | FIL-HD | Fillister Head | HLCL | Helical |
| | | FL | Flash, Flat, Fluid | HP | Hewlett-Packard Company, High Pass |
| DP | Deep, Depth, Diametric Pitch, Dip | FLAT-PT | Flat Point | | |
| | | FR | Front | | |
| DP3T | Double Pole Three Throw | FREQ | Frequency | **I** | |
| | | FT | Current Gain Bandwidth Product (Transition Frequency), Feet, Foot | IN | Inch |
| DWL | Dowell | | | **J** | |
| | | | | JFET | Junction Field Effect Transistor |
| **E** | | | | | |
| E-R | E-Ring | FXD | Fixed | **K** | |
| EXT | Extended, Extension, External, Extinguish | | | | |
| | | **G** | | K | Kelvin, Key, Kilo, Potassium |
| **F** | | | | | |
| | | GEN | General, Generator | KNRLD | Knurled |
| F | Fahrenheit, Farad, Female, Film (Resistor), Fixed, Flange, Frequency | GND | Ground | KVDC | Kilovolts Direct Current |
| | | GP | General Purpose, Group | | |
| | | | | **L** | |
| | | **H** | | | |
| FC | Carbon Film/Composition, Edge of Cutoff Frequency, Face | | | LED | Light Emitting Diode |
| | | H | Henry, High | | |
| | | HDW | Hardware | LG | Length, Long |
| | | HEX | Hexadecimal, | LIN | Linear, Linearity |

**Table 5-2** **Abbreviations**

| | | | | | |
|---|---|---|---|---|---|
| **L** | | **N** | | PAN-HD | Pan Head |
| | | | | PC | Printed Circuit |
| LK | Link, Lock | N | Nano, None | PCB | Printed Circuit Board |
| LKG | Leakage, Locking | N-CHAN | N-Channel | | |
| LUM | Luminous | NH | Nanohenry | P-CHAN | P-Channel |
| | | NM | Nanometer, Nonmetallic | PD | Pad, Power Dissipation |
| **M** | | NO | Normally Open, Number | PF | Picofarad, Power Factor |
| M | Male, Maximum, Mega, Mil, Milli, Mode | NOM | Nominal | PKG | Package |
| | | NPN | Negative Positive Negative (Transistor) | | |
| MA | Milliampere | | | PLSTC | Plastic |
| MACH | Machined | NS | Nanosecond, Non-Shorting, Nose | PNL | Panel |
| MAX | Maximum | | | PNP | Positive Negative Positive (Transistor) |
| MC | Molded Carbon | NUM | Numeric | | |
| MET | Metal, Metallized | NYL | Nylon (Polyamide) | POLYC | Polycarbonate |
| MHz | Megahertz | **O** | | POLYE | Polyester |
| MINTR | Miniature | | | POT | Potentiometer |
| MIT | Miter | OA | Over-All | POZI | Pozidrive Recess |
| MLD | Mold, Molded | OD | Outside Diameter | PREC | Precision |
| MM | Magnetized Material, Millimeter | OP AMP | Operational Amplifier | PRP | Purple, Purpose |
| | | | | PSTN | Piston |
| MOM | Momentary | OPT | Optical, Option, Optional | PT | Part, Point, Pulse Time |
| MTG | Mounting | | | | |
| MTLC | Metallic | | | PW | Pulse Width |
| SMA | Subminiature | **P** | | | |
| MW | Milliwatt | PA | Picoampere, Power Amplifier | **Q** | |
| | | | | Q | Figure of Merit |

**Table 5-2 Abbreviations**

| | | | | | |
|---|---|---|---|---|---|
| **R** | | SPDT | Single Pole | UF | Microfarad |
| R | Range, Red, Resistance, Resistor, Right, Ring | SPST | Single Pole Single Throw | UH | Microhenry |
| | | | | UL | Microliter, Underwriters' Laboratories, Inc. |
| | | SQ | Square | | |
| REF | Reference | SST | Stainless Steel | | |
| RES | Resistance, Resistor | STL | Steel | UNHDND | Unhardened |
| RF | Radio Frequency | **T** | | **V** | |
| RGD | Rigid | | | V | Variable, Violet, Volt, Voltage |
| RND | Round | T | Teeth, Temperature, Thickness, Time, Typical | | |
| RR | Rear | | | VAC | Vacuum, Volts— Alternating Current |
| **S** | | | | | |
| SAWR | Surface Acoustic Wave Resonator | | | VAR | Variable |
| | | PB | Lead (Metal), | VDC | Volts—Direct Current |
| SEG | Segment | TA | Ambient Temperature, Tantalum | **W** | |
| SGL | Single | | | | |
| SI | Silicon, Square Inch | | | W | Watt, Wattage, White, Wide, Width |
| | | TC | Temperature Coefficient | | |
| SL | Slide, Slow | | | W/SW | With Switch |
| SLT | Slot, Slotted | THD | Thread, Threaded | WW | Wire Wound |
| SMA | Subminiature A Type (Threaded Connector) | THK | Thick | **X** | |
| | | TO | Package Type Designation | | |
| | | | | X | By (Used with Dimensions), Reactance |
| SMB | Subminiature B Type (Slip-on Connector) | TPG | Tapping | | |
| | | TR-HD | Truss Head | | |
| | | TRMR | Trimmer | **Y** | |
| SMC | Subminiature C-Type (Threaded Connector) | TRN | Turn, Turns | | |
| | | TRSN | Torsion | YIG | Yttrium-Iron-Garnet |
| | | **U** | | **Z** | |
| SPCG | Spacing | UCD | Microcandela | ZNR | Zener |

**Table 5-3 Reference Designations, Abbreviations, and Multipliers**

| MULTIPLIERS | | | | | |
|---|---|---|---|---|---|
| Abbreviation | Prefix | Multiple | Abbreviation | Prefix | Multiple |
| T | tera | $10^{12}$ | m | milli | $10^{-3}$ |
| G | giga | $10^{9}$ | μ | micro | $10^{-6}$ |
| M | mega | $10^{6}$ | n | nano | $10^{-9}$ |
| k | kilo | $10^{3}$ | p | pico | $10^{-12}$ |
| da | deka | 10 | f | femto | $10^{-15}$ |
| d | deci | $10^{-1}$ | a | atto | $10^{-18}$ |
| c | centi | $10^{-2}$ | | | |
| | | | | | |

# Replaceable Parts

## Table 5-4 Replaceable Parts

| Reference Designation | Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| | | | **ACCESSORIES SUPPLIED** | | |
| | 5063-0274 | 1 | FRONT COVER | 28480 | 5063-0274 |
| | 85620A | 1 | MASS MEMORY MODULE | 28480 | 85620A |
| | 1810-0118 | 1 | TERMINATION-COAXIAL SMA; 0.5W; 50Ω | 16179 | 2003-6113-02 |
| | 1250-1200 | 1 | ADAPTER, SMA (m) TO BNC (f) | 28480 | 1250-1200 |
| | 1250-2187 | 1 | ADAPTER, K (f) TO 2.4 mm (f) | 28480 | 1250-2187 |
| | 1250-2188 | 1 | ADAPTER, 2.4 mm (f) TO 2.4 mm (f) | 28480 | 1250-2188 |
| | 10502A | 1 | 50Ω COAX CABLE WITH BNC MALE | 28480 | 10502A |
| | 8710-1755 | 3 | WRENCH-HEX KEY | 55719 | AWML4 |
| | | | **OPTION 908** | | |
| | 5062-0800 | 1 | RACK KIT WITH FLANGES (Includes Parts Listed Below) | | |
| | 5001-8739 | 2 | PANEL-DRESS | 28480 | 5001-8739 |
| | 5001-8740 | 2 | PANEL-SUB | 28480 | 5001-8740 |
| | 5001-8742 | 2 | SUPPORT-REAR | 28480 | 5001-8742 |
| | 5021-5807 | 2 | FRAME-FRONT | 28480 | 5021-5807 |
| | 5021-5808 | 2 | FRAME-REAR | 28480 | 5021-5808 |
| | 5021-5836 | 5 | CORNER-STRUT | 28480 | 5021-5836 |
| | 0510-1148 | 10 | RETAINER-PUSH-ON KB-TO-SHFT EXT | 11591 | 669 |
| | 0515-0886 | 16 | SCREW-MACH M3 × 0.5 6MM-LG PAN-HD | 28480 | 0515-0886 |
| | 0515-0887 | 8 | SCREW-MACH M3.5 × 0.6 6MM-LG PAN-HD | 28480 | 0515-0887 |
| | 0515-0889 | 12 | SCREW-MACH M3.5 × 0.6 6MM-LG | 28480 | 0515-0889 |
| | 0515-1241 | 8 | SCREW-MACH M5 × 0.8 12 MM-LG PAN-HD | 28480 | 0515-1241 |
| | 0515-1331 | 22 | SCREW-METRIC SPECIALTY M4 × 0.7 THD; 7MM | 28480 | 0515-1331 |
| | 5061-9679 | 2 | MOUNT FLANGE | 28480 | 5061-9679 |
| | 0515-1114 | 6 | SCREW-MACH M4 × 0.7 10MM-LG PAN-HD | 28480 | 0515-1114 |
| | 8710-1755 | | WRENCH-HEX KEY | 55719 | AWML4 |
| | 5958-6573 | 2 | ASSEMBLY INSTRUCTIONS | 28480 | 5958-6573 |
| | | | **OPTION 909** | | |
| | 5062-1900 | 1 | RACK KIT WITH FLANGES AND HANDLES (Includes Parts Listed Below) | | |
| | 5001-8739 | | PANEL-DRESS | 28480 | 5001-8739 |
| | 5001-8740 | | PANEL-SUB | 28480 | 5001-8740 |
| | 5001-8742 | | SUPPORT-REAR | 28480 | 5001-8742 |
| | 5021-5807 | | FRAME-FRONT | 28480 | 5021-5807 |
| | 5021-5808 | | FRAME-REAR | 28480 | 5021-5808 |
| | 0510-1148 | | RETAINER-PUSH-ON KB-TO-SHFT EXT | 11591 | 669 |
| | 0515-0886 | | SCREW-MACH M3 × 0.5 6MM-LG PAN-HD | 28480 | 0515-0886 |

# 8564/5EC Replacement Parts

| Reference Designator | Description | 8564EC | 8565EC | Part Number | Conditions |
|---|---|---|---|---|---|
| A1A1 | Bd Assy - Keyboard | x | x | 08563-60181 | n/a |
| A1A2 | RPG Assy | x | x | 1990-1525 | n/a |
| A2 | Bd Assy - Controller | x | x | 08563-60172 | n/a |
| A3 | Bd Assy - Interface | x | x | 08563-60174 | n/a |
| A4 | Bd Assy - Log Amp / Cal Osc | x | x | 08563-60163 | n/a |
| A5 | Bd Assy - IF Filter | x | x | 08563-60178 | n/a |
| A6 | Assy - Power Supply | x | x | 08563-60180 | < 4123A (kit with 08564-60034) |
| | | x | x | 08564-60034 | >= 4123A |
| A6A2 | Bd Assy - Regulator | x | x | 08564-60030 | n/a |
| A7 | LO Multiplier Dist Amp | x | x | 5086-7869 | n/a |
| A8 | Low Band Mixer | x | x | 5087-7032 | Std |
| | | x | x | 5086-7982 | Option 006 |
| A9 | Input Attenuator | x | x | 33325-60006 | n/a |
| A10/A12 | RYTHM/SBTX | x | - | 5086-7930 | n/a |
| | | - | x | 5086-7883 | n/a |
| A11 | Leveled YTO | x | x | 5086-7906 | n/a |
| A13 | Second Converter | x | x | 5086-7957 | n/a |
| A14 | Bd Assy - Frequency Control | x | x | 08564-60033 | n/a |
| A15 | Bd Assy - RF | x | x | 08563-60186 | Standard |
| | | x | x | 08563-60184 | Option 103 |
| | | x | x | 08563-60186 | Option 008 w/o 103 |
| A15U100 | Sampler Assy | x | x | 5086-7806 | n/a |
| A17 | Bd Assy - LCD Driver | x | x | 08563-60180 | < 4123A (kit with 08563-60177) |
| | | x | x | 08563-60177 | >= 4123A |
| A17A1 | Bd Assy - LCD Inverter | x | x | 0950-3644 | n/a |
| A18 | LCD | x | x | 2090-0379 | n/a |
| A18DS1/2 | LCD Backlight Tube | x | x | 2090-0380 | n/a |
| A19 | Bd Assy - GPIB Interface | x | x | 08562-60042 | n/a |
| A20 | Battery Holder Assy | x | x | 5062-7755 | n/a |
| A21 | 10MHz OCXO Assy | x | x | 5063-0245 | Not Option 103 |
| B1 | Fan Assy | x | x | 5061-9036 | n/a |
| BT1 | Battery - 3.0V Lithium | x | x | 1420-0341 | n/a |
| F1 | Fuse - 5A 250V | x | x | 2110-0709 | 230 VAC Operation |
| | Fuse - 5A 125V | x | x | 2110-0756 | 115 VAC Operation |
| FL1 | LPF - 2.9GHz | x | x | 0955-0703 | n/a |
| FL2 | LPF - 4.4GHz | x | x | 0955-0519 | n/a |
| FL3 | LPF - 7.0GHz | x | x | 0955-0721 | n/a |
| FL4 | Line Filter Assy | x | x | 5061-9032 | n/a |
| LS1 | Loudspeaker Assy | x | x | 9160-0282 | n/a |

# Cable Assemblies

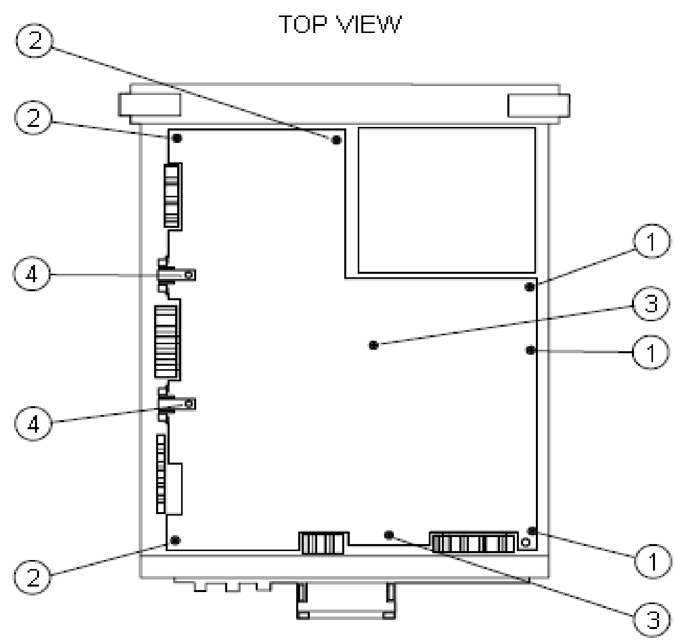
| Reference Designator | Part Number | Description | From | To |
|---|---|---|---|---|
| Ribbon Cables | | | | |
| W1 | 8120-5682 | Ribbon Cable - Main Power | A6J1 - Power Supply Assembly | A2J2 / A3J1 / A4J1 / A5J1 / A14J1 / A15J1 |
| W2 | 5061-9025 | Ribbon Cable - Main Control | A3J2 - Interface Board | A4J2 / A5J2 / A14J2 / A15J2 |
| W4 | 8121-0063 | Ribbon Cable - Option Module | A2J11 - Controller Board | Rear Panel J3 - OPTION MODULE |
| W10 | 5062-0742 | Ribbon Cable - YTO Control | A14J3 - Frequency Control Board | A11J1 - YTO |
| W11 | 08562-60064 | Ribbon Cable - Attenuator Control | A14J6 - Frequency Control Board | A9 - Input Attenuator |
| W12 | 5063-0655 | Ribbon Cable - LOMA Control | A14J10 - Frequency Control Board | A7J7 - LOMA |
| W13 | 5062-0743 | Ribbon Cable - Second Converter Control | A14J12 - Frequency Control Board | A13J6 - Second Converter |
| W16 | 8120-5676 | Ribbon Cable - SBTX/RYTHM Control | A14J9 - Frequency Control Board | A12/A10 - SBTX/RYTHM |
| W60 | 8121-0064 | Ribbon Cable - Display Control | A2J8 - Controller Board | A17J1 - Display Driver Board |
| W63 | 8120-8409 | Ribbon Cable - Display Data | A18J1 - LCD | A17J5 - Display Driver Board |
| W64 | 8121-0062 | Ribbon Cable - VGA Output | A17J4 - Display Driver Board | Rear Panel J1 - VGA OUT |
| A1A1W1 | 8121-0065 | Ribbon Cable - Keyboard Interface | A3J602 - Interface Board | A1A1J1 - Front Panel Keyboard |
| A1A2 | 1990-1525 | Ribbon Cable - RPG Assembly | Front Panel - Rotary Pulse Generator | A1A1J2 - Front Panel Keyboard |
| A19W1 | 5061-9031 | Ribbon Cable - GPIB | A19J1 - GPIB Board | A2J7 - Controller Board |
| | | | | |
| Wire Harnesses | | | | |
| W3 | 5064-3966 | Wire Harness - Line Switch Assembly | Front Panel - Line Switch | A6J2 - Power Supply Assembly |
| W6 | 5062-7755 | Wire Harness - Battery Cable / Plate Assembly | BT1 - Battery | A2J3 - Controller Board |
| W8 | 5022-6195 | Wire Harness - Display Power | A6J5 - Power Supply Assembly | A17J8 - Display Driver Board |
| W15 | 08562-60188 | Wire Harness - Lowband Mixer Bias | A14J11 - Frequency Control Board | A8J4 - Lowband Mixer |
| W50 | 5063-0245 | Wire Harness - OCXO Power (Includes A21 OCXO) | A21 - OCXO Power Terminals | A15J306 - RF Board |
| W55 | 5062-6471 | Wire Harness - Volume Control / Speaker / Earphone | Speaker/Earphone/Volume Control | A4J6 - DC Logger Board |
| W62 | 8120-8482 | Wire Harness - Backlight Power | A17J6 - Display Driver Board | A17A1 - Inverter Board |
| A1W1 | 8121-0033 | Wire Harness - Probe Power | Probe Power Filter Board | A1A1J3 - Front Panel Keyboard |
| FL4 | 5061-9032 | Wire Harness - Line Module Assembly | Rear Panel - AC Input | A6J10 - Power Supply Assembly |
| | | | | |
| Flexible RF Cables | | | | |
| W18 | 5062-0721 | Cable - SMB/BNC - White/Violet - LO Sweep | A14J7 - Frequency Control Board | Rear Panel J8 - LO SWP OUTPUT |
| W19 | 5062-0723 | Cable - SMB/SMA - Gray/Orange - Option 001 | A15J803 - RF Board | Rear Panel J10 - 2nd IF OUT |
| W20 | 5062-0717 | Cable - SMB/SMB - Blue - 0 Span Video | A2J5 - Controller Board | A3J103 - Interface Board |
| W22 | 5062-0709 | Cable - SMB/SMB - Black - 10 MHz Freq Count | A2J9 - Controller Board | A15J302 - RF Board |
| W23 | 5062-0719 | Cable - SMB/BNC - White/Orange - External Trigger In | A3J600 - Interface Board | Rear Panel J5 - EXT/GATE TRIG INPUT |
| W24 | 5062-0720 | Cable - SMB/BNC - Green - Video Out | A3J102 - Interface Board | Rear Panel J4 - VIDEO OUT |
| W25 | 5062-0718 | Cable - SMB/BNC - Yellow - Blanking Out | A3J601 - Interface Board | Rear Panel J6 - BLKG/GATE OUTPUT |
| W27 | 5062-0714 | Cable - SMB/SMB - Orange - Filtered 10.7 MHz IF | A4J3 - DC Logger Board | A5J5 - IF Board |
| W29 | 5062-0711 | Cable - SMB/SMB - Violet - 10.7 MHz IF | A5J3 - IF Board | A15J601 - RF Board |
| W31 | 5062-0722 | Cable - SMB/BNC - Gray - 10 MHz Reference In/Out | A15J301 - RF Board | Rear Panel J9 - 10 MHz IN/OUT |
| W32 | 5063-1638 | Cable - SMB/MCX - Gray/Violet - Sampler IF | A15J101 - RF Board | A14J501 - Frequency Control Board |
| W33 | 5062-0706 | Cable - SMB/SMB - Gray/Brown - 2nd LO Drive | A13J4 - Second Converter | A15J701 - RF Board |
| W34 | 8120-6367 | Cable - SMA/SMA - 7GHz Filter to Sampler | FL3J2 - 7.0 GHz Low Pass Filter | A15U100J1 - RF Board Sampler |
| W35 | 5062-0710 | Cable - SMB/SMB - White/Red - Internal 2nd IF | A13J2 - Second Converter | A15J801 - RF Board |
| W36 | 5062-0725 | Cable - SMB/SMA - Gray/Blue - External 2nd IF | A15J802 - RF Board | Front Panel J3 - IF INPUT |
| W37 | 5062-0707 | Cable - SMB/SMB - Gray/Green - 10 MHz Reference | A15J303 - RF Board | A14J301 - Frequency Control Board |

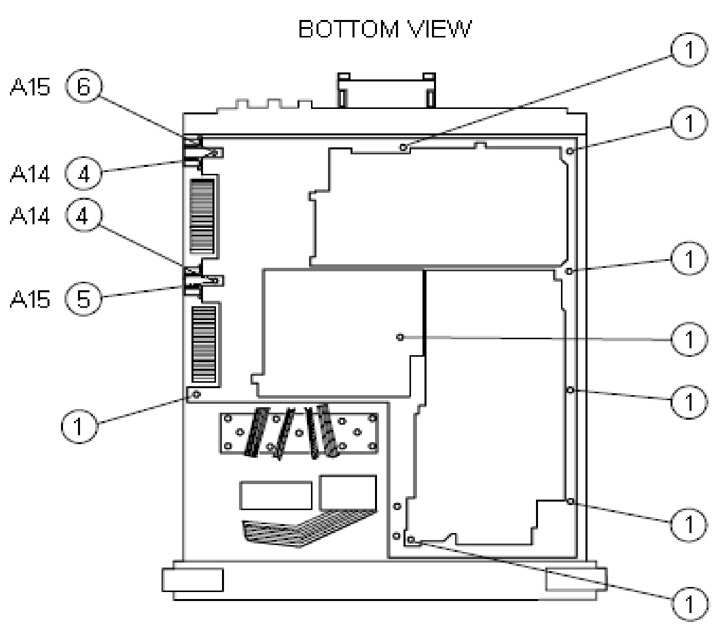
## Cable Assemblies

| Reference Designator | Part Number | Description | From | To |
|---|---|---|---|---|
| Flexible RF Cables (continued) | | | | |
| W40 | 5062-0724 | Cable - SMB/BNC - Gray/White - CAL Out | A15J501 - RF Board | Front Panel J5 - CAL OUT |
| W48 | 8120-5660 | Cable - SMB/SMA - RYTHM IF Out to 2nd Converter In | A10J1 - RYTHM | A13J3 - Second Converter |
| W49 | 5062-4892 | Cable - SMB/SMB - Gray/Red - OCXO Output | A21J1 - OCXO Output | A15J305 - RF Board |
| W51 | 5062-6478 | Cable - SMB/SMB - Gray/Yellow - 10 MHz Reference | A4J7 - DC Logger Board | A15J304 - RF Board |
| W52 | 5062-6477 | Cable - SMB/SMB - White - 10.7 MHz CAL Signal | A4J8 - DC Logger Board | A5J4 - IF Board |
| W53 | 5062-6476 | Cable - SMB/SMB - Brown - Frequency Counter | A2J13 - Controller Board | A4J5 - DC Logger Board |
| W54 | 5062-6475 | Cable - SMB/SMB - Red - Video | A3J101 - Interface Board | A4J4 - DC Logger Board |
| W58 | 5062-0722 | Cable - SMB/BNC - Gray - Option 005 | A14J20 - Frequency Control Board | Rear Panel J11 - ALT SWP OUT |
| W61 | 8120-5026 | Cable - SMB/SMB - Gray - Display 10MHz | A2J10 - Controller Board | A17J7 - Display Driver Board |
| | | | | |
| Semi-Rigid Cables | | | | |
| W28 | 5022-0915 | Semi-Rigid Cable - LOMA to RYTHM | A7J3 - LOMA | A10J4 - RYTHM |
| W30 | 5022-3707 | Semi-Rigid Cable - LOMA to FL3 | A7J5 - LOMA | FL3J1 - 7.0 GHz Low Pass Filter |
| W38 | 5022-3708 | Semi-Rigid Cable - YTO Out to LOMA In | A11J2 - YTO | A7J1 - LOMA |
| W39 | 5022-2830 | Semi-Rigid Cable - LOMA to Lowband Mixer | A7J4 - LOMA | A8J3 - Lowband Mixer |
| W41 | 08564-20019 | Semi-Rigid Cable - RF Input to Attenuator In | Front Panel J1 - RF INPUT | A9J1 - Input Attenuator |
| W42 | 5022-3790 | Semi-Rigid Cable - LOMA to EXT Mixer LO Output | A7J6 - LOMA | Front Panel J4 - LO Output |
| W43 | 5022-0908 | Semi-Rigid Cable - Attenuator Out to SBTX In | A9J2 - Input Attenuator | A12J13 - SBTX |
| W44 | 5022-1151 | Semi-Rigid Cable - A10 Lowband Out to FL1 In | A10J2 - RYTHM | FL1J1 - 2.9 GHz Low Pass Filter |
| W45 | 5022-2828 | Semi-Rigid Cable - FL1 Out to Lowband Mixer In | FL1J2 - 2.9 GHz Low Pass Filter | A8J1 - Lowband Mixer |
| W46 | 5022-0907 | Semi-Rigid Cable - LOMA to SBTX | A7J2 - LOMA | A12J4 - SBTX |
| W47 | 5022-2829 | Semi-Rigid Cable - Lowband Mixer Out to SBTX | A8J2 - Lowband Mixer | A12J5 - SBTX |
| W56 | 5022-0910 | Semi-Rigid Cable - SBTX IF Out to FL2 In | A12J1 - SBTX | FL2J1 - 4.4 GHz Low Pass Filter |
| W57 | 5022-0184 | Semi-Rigid Cable - FL2 Out to 2nd Converter Lowband In | FL2J2 - 4.4 GHz Low Pass Filter | A13J1 - Second Converter |
| | | | | |

# PCB Mounting Replacement Parts

| Item | Description | Part Number | Quantity |
|---|---|---|---|
| 1 | Screw-Machine w/Washer - Pan-HD - M3X0.5 - 30MM-LG | 0515-1349 | 11 |
| 2 | Screw-Machine w/Washer - Pan-HD - M3X0.5 - 60MM-LG | 0515-2310 | 3 |
| 3 | Screw-Machine w/Washer - Pan-HD - M3X0.5 - 110MM-LG | 0515-2308 | 2 |
| 4 | Screw-Machine w/Patch-LK - Pan-HD - M3X0.5 - 6MM-LG | 0515-2332 | 10 |
| 5 | Screw-Machine w/Washer - Pan-HD - M3X0.5 - 12MM-LG | 0515-0664 | 1 |
| 6 | Screw-Machine w/Washer - Pan-HD - M3X0.5 - 8MM-LG | 0515-1950 | 1 |



# Instrument Cover Replacement Parts

| Item | Description | Part Number | Quantity |
|---|---|---|---|
| 1 | Bail Handle | 5041-8992 | 1 |
| 2 | Trim Cap | 5041-8912 | 2 |
| 3 | Screw-Machine w/Patch-LK - Pan-HD - M4X0.7 - 10MM-LG | 0515-1819 | 4 |
| 4 | Spring | 1460-2164 | 2 |
| 5 | Ring Gear | 5022-3789 | 2 |
| 6 | Socket Gear | 5022-3779 | 2 |
| 7 | Handle Plate | 5022-3780 | 2 |
| 8 | Backup Plate | 5001-8728 | 2 |
| 9 | Screw-Machine w/Patch-LK - Flat-HD - M4X0.7 - 8MM-LG | 0515-2043 | 6 |
| 10 | Screw-Machine w/Patch-LK - Flat-HD - M5X0.8 - 16MM-LG | 0515-2049 | 2 |
| 11 | Cover - Instrument | 5001-8800 | 1 |
| 12 | Moisture Deflector - Left | 5041-7238 | 1 |
| 13 | Moisture Deflector - Right | 5041-3989 | 1 |
| 14 | Side Trim | 5041-8913 | 2 |
| 15 | Screw-Machine w/Patch-LK - Pan-HD - M4X0.7 - 10MM-LG | 0515-1819 | 2 |
| 16 | Rear Foot | 5041-8907 | 2 |
| 17 | O-Ring | 0900-0024 | 4 |
| 18 | Lock Washer | 2190-0587 | 4 |
| 19 | Screw-Machine - Socket-HD - M5X0.8 - 40MM-LG | 0515-3187 | 4 |
| 20 | Insulator - 292 x 355 MM - .51 THK | 08562-80028 | 1 |

# Main Chassis Replacement Parts

| Item | Description | Part Number | Quantity |
|---|---|---|---|
| 1 | Screw-Machine w/Lock-Washer - Pan-HD - M3X0.5 - 8MM-LG | 0515-2145 | 4 |
| 5 | Cover, A6 Power Supply (Includes Label) | 5002-1010 | 1 |
| 6 | Screw-Machine - Flat-HD - M3X0.5 - 45MM-LG | 0515-2309 | 3 |
| 14 | Main Deck | 5002-1008 | 1 |
| | EMI Shield - Main Deck (Not Shown) | 5002-1009 | 1 |
| | Screw-Machine - Flat-HD - M3X0.5 - 5MM-LG (Not Shown) | 0515-1521 | 10 |
| 15 | Front End Deck | 5002-4047 | 1 |
| 16 | Screw-Machine w/Washer - Pan-HD - M3X0.5 - 8MM-LG | 0515-1950 | 4 |
| 17 | Screw-Machine - Flat-HD - M3X0.5 - 6MM-LG | 0515-1227 | 2 |
| 18 | Side Frame | 5021-7464 | 2 |
| 19 | Screw-Machine - Flat-HD - M4X0.7 - 8MM-LG | 0515-1101 | 12 |
| 20 | Screw-Machine - Flat-HD - M3X0.5 - 5MM-LG | 0515-1521 | 12 |
| 21 | Screw-Machine - Flat-HD - M3X0.5 - 6MM-LG | 0515-1227 | 8 |
| 22 | Screw-Machine - Flat-HD - M3X0.5 - 6MM-LG | 0515-1227 | 5 |
| 23 | Board Mount | 5021-5484 | 5 |
| 24 | Hinge Assembly - 2 Board | 5062-0750 | 2 |
| 25 | Hinge Assembly - 4 Board | 5062-0751 | 2 |
| 26 | Cable Clamp | 5041-7250 | 1 |
| 28 | Screw-Machine - Flat-HD - M3X0.5 - 6MM-LG | 0515-1227 | 2 |
| 30 | Shield Wall - Top | 5063-0269 | 1 |
| 31 | Shield Wall - Bottom | 5063-0268 | 1 |
| 32 | Screw-Machine w/Washer - Pan-HD - M3X0.5 - 16MM-LG | 0515-0375 | 2 |
| 33 | Screw-Machine w/Washer - Pan-HD - M3X0.5 - 40MM-LG | 0515-1715 | 1 |

# Front Frame Replacement Parts

| Item | Description | Part Number | Quantity |
|---|---|---|---|
| 1 | Nameplate - 8564EC | 08564-80055 | 1 |
| | Nameplate - 8564EC - Option 006 | 08564-80056 | 1 |
| | Nameplate - 8565EC | 08565-80054 | 1 |
| | Nameplate - 8565EC - Option 006 | 08565-80055 | 1 |
| 2 | Overlay - Connector Dress Panel | 5181-8245 | 1 |
| 4 | Knob - RPG | 5041-9610 | 1 |
| 6 | Nut - 3/8-32-THD - .094-IN-THK | 2950-0043 | 1 |
| 7 | Lock Washer - Internal - 3/8 IN - .377-IN-ID | 2190-0016 | 1 |
| 8 | Front Dress Panel | 5181-8246 | 1 |
| 9 | Probe Power Jack | 5060-0467 | 1 |
| 10 | Nut - 15/32-32-THD - .1-IN-THK | 0590-1251 | 1 |
| 11 | Adapter - COAX - SMA (f) to SMA (f) | 1250-1666 | 2 |
| | Hole Plug - Option 327 (Not Shown) | 6960-0171 | 1 |
| 12 | Screw-Machine w/Lock-Washer - Pan-HD - M3X0.5 - 8MM-LG | 0515-2145 | 12 |
| 13 | Bumper Kit (Includes 4 Bumpers) | 5062-4806 | 1 |
| 15 | Catch Latch | 5021-5483 | 2 |
| 16 | Screw-Machine - Pan-HD - M2.5X0.45 - 6MM-LG | 0515-0366 | 4 |
| | Lock Washer - Helical - 2.6MM-ID - 5.1MM-OD - 0.6MM-THK | 2190-0583 | 4 |
| 17 | Front Frame | 5022-3662 | 1 |
| 18 | RFI Shielding - Round Strip | 8160-0520 | 1 |
| 19 | Nut - 9/16-28-THD | 0590-2563 | 1 |
| 20 | Lock Washer - Internal - 3/8 IN - .377-IN-ID | 2190-0016 | 1 |
| 21 | Nut - 3/8-32-THD - .188-IN-THK | 2950-0144 | 1 |
| 22 | Connector - RF Input | 5064-3970 | 1 |
| 24 | Rubber Keypad | 5041-9630 | 1 |
| 26 | Line Switch Cable Assembly | 5064-3966 | 1 |
| 28 | Screw-Machine - Flat-HD - M3X0.5 - 5MM-LG | 0515-1521 | 2 |
| 31 | Screw-Machine w/Washer - Pan-HD - M2.5X0.45 - 6MM-LG | 0515-1934 | 7 |
| 32 | Potentiometer - 20K OHM +-20PCT - 0.25W | 2100-4232 | 1 |
| 33 | Washer - 1/4-IN - .26-IN-ID | 3050-0014 | 2 |
| 34 | Lock Washer - Internal - 1/4-IN - .256-IN-ID | 2190-0067 | 1 |
| 35 | Nut - 1/4-32-THD - .062-IN-THK | 2950-0072 | 1 |
| 36 | Knob - Volume Control | 0370-3079 | 1 |

## LCD Replacement Parts

| Item | Description | 8564EC | 8565EC | Part Number | Quantity |
|---|---|---|---|---|---|
| 1 | Screw-Machine w/Washer - Pan-HD - M3X0.5 - 6MM-LG | x | x | 0515-0430 | 2 |
| 2 | Screw-Machine w/Washer - Pan-HD - M3X0.5 - 8MM-LG | x | x | 0515-0372 | 4 |
| 3 | Rubber Grommet - Round - 0.219-IN-ID - 0.563-IN-OD - 0.062-IN-THK | x | x | 0400-0333 | 4 |
| 4 | Glass Filter | x | x | 1000-1014 | 1 |
| 5 | LCD Mount | x | x | 5041-9632 | 1 |
| 6 | LCD Backplate | x | x | 5000-8314 | 1 |
| 7 | LCD Driver Shield | x | x | 5022-3667 | 1 |
| 8 | Bracket - Board Mounting | x | x | 5022-3665 | 1 |
| 9 | Bracket - Attenuator Mounting | x | x | 5022-3664 | 1 |
| 10 | Screw-Machine - Flat-HD - M3X0.5 - 6MM-LG | x | x | 0515-1227 | 4 |
| 11 | Screw-Machine - Pan-HD - M2.5X0.45 - 6MM-LG | x | x | 0515-0366 | 4 |
| 12 | Screw-Machine - Flat-HD - M4X0.7 - 8MM-LG | x | x | 0515-1101 | 2 |
| 13 | Foam Pad - (Adheres to A17J5) | x | x | 0340-1130 | 1 |
| 14 | Screw-Machine w/Washer - Pan-HD - M3X0.5 - 14MM-LG | x | x | 0515-0665 | 4 |

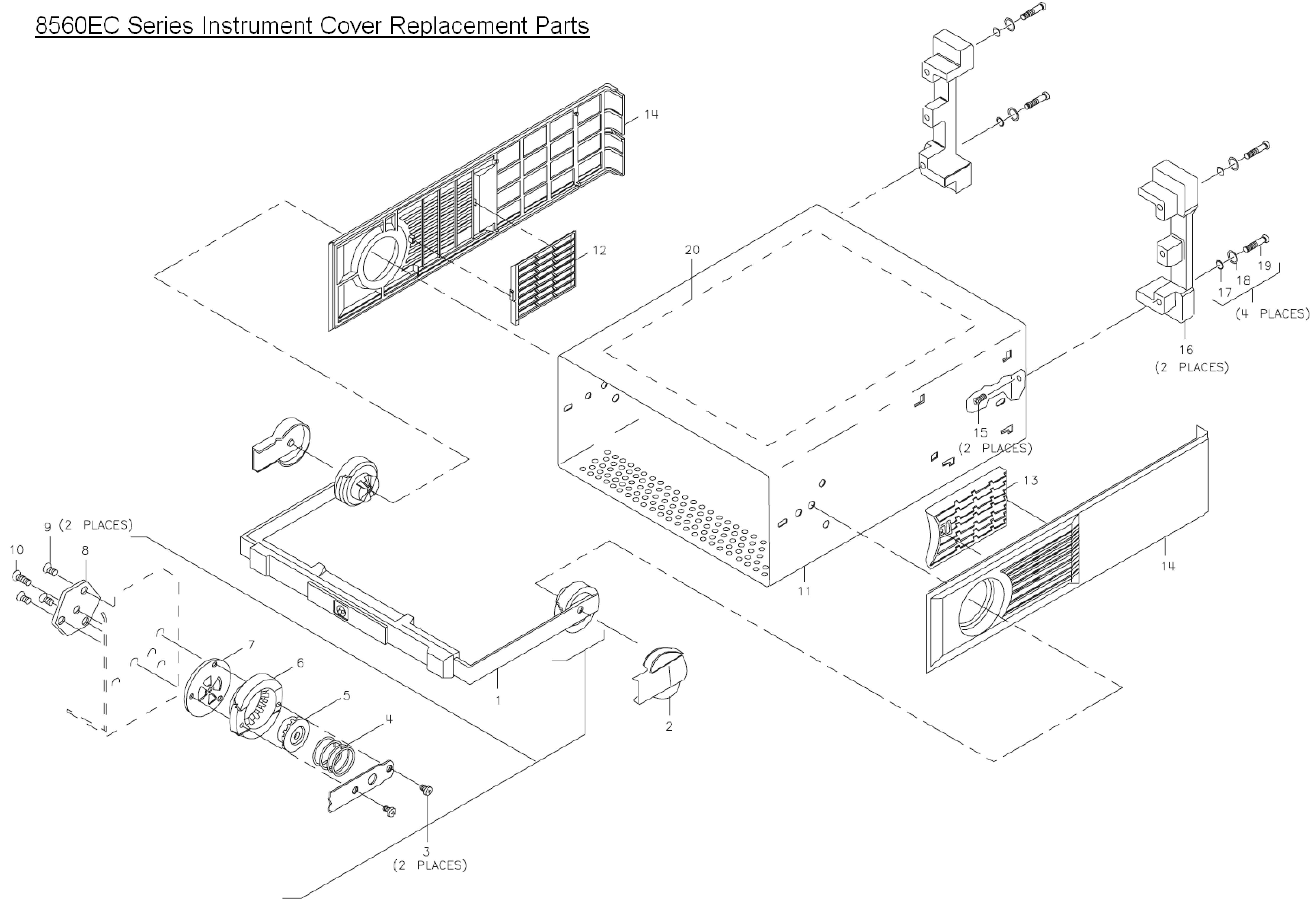
# Rear Frame Replacement Parts

| Item | Description | 8564EC | 8565EC | Part Number | Quantity |
|---|---|---|---|---|---|
| 1 | Screw-Machine - Flat-HD - M3X0.5 - 6MM-LG | x | x | 0515-1946 | 2 |
| 2 | Battery Holder (Includes Wiring) | x | x | 5062-7755 | 1 |
| 3 | Screw-Machine w/Patch-LK - Pan-HD - M4X0.7 - 40MM-LG | x | x | 0515-2216 | 4 |
| 4 | Fan Grill | x | x | 3160-0309 | 1 |
| 5 | Spacer - Round - 0.180-IN-ID - 0.250-IN-OD - 0.875-IN-LG | x | x | 0380-0012 | 4 |
| 7 | Hole Plug - D-Hole - 0.5-IN-D | x | x | 6960-0149 | 1 |
| 8 | Hole Plug - D-Hole - 0.312-IN-D | x | x | 6960-0023 | 1 |
| 9 | Adapter - COAX - SMA (f) to SMA (f) | x | x | 1250-1753 | 1 |
| 10 | Screw-Machine - Flat-HD - M3X0.5 - 6MM-LG | x | x | 0515-1946 | 2 |
| 11 | Screw-Machine - Pan-HD - M4X0.7 - 6MM-LG | x | x | 0515-0684 | 1 |
| 12 | Nut - 15/32-32-THD | x | x | 2950-0035 | 5 |
| 13 | Earphone Jack (Includes Cable/Speaker/Volume Control) | x | x | 5062-6471 | 1 |
| 14 | Rear Dress Panel | x | x | 5002-4049 | 1 |
| 16 | RFI Shielding - Round Strip | x | x | 8160-0520 | 1 |
| 17 | Rear Frame | x | x | 5022-3778 | 1 |
| 18 | Screw - GPIB Connector | x | x | 5021-6391 | 2 |
| 19 | Screw-Machine - Flat-HD - 4-40 - 0.25-IN-LG | x | x | 2200-0225 | 2 |
| 20 | Nut w/Lock-Washer - M4X0.7 - 3.2MM-THK | x | x | 0535-0082 | 2 |
| 21 | Screw-Machine w/Washer - Pan-HD - M4X0.7 - 8MM-LG | x | x | 0515-0433 | 1 |
| 22 | Nut - M4X0.7 - 3.2MM-THK | x | x | 0535-0023 | 2 |
| 23 | VGA Connector And Cable | x | x | 8121-0062 | 1 |
| B1 | Fan Assembly (Includes Wiring) | x | x | 5061-9036 | 1 |
| BT1 | Battery - 3.0V 1.2A-HR - Lithium Polycarbon | x | x | 1420-0341 | 1 |

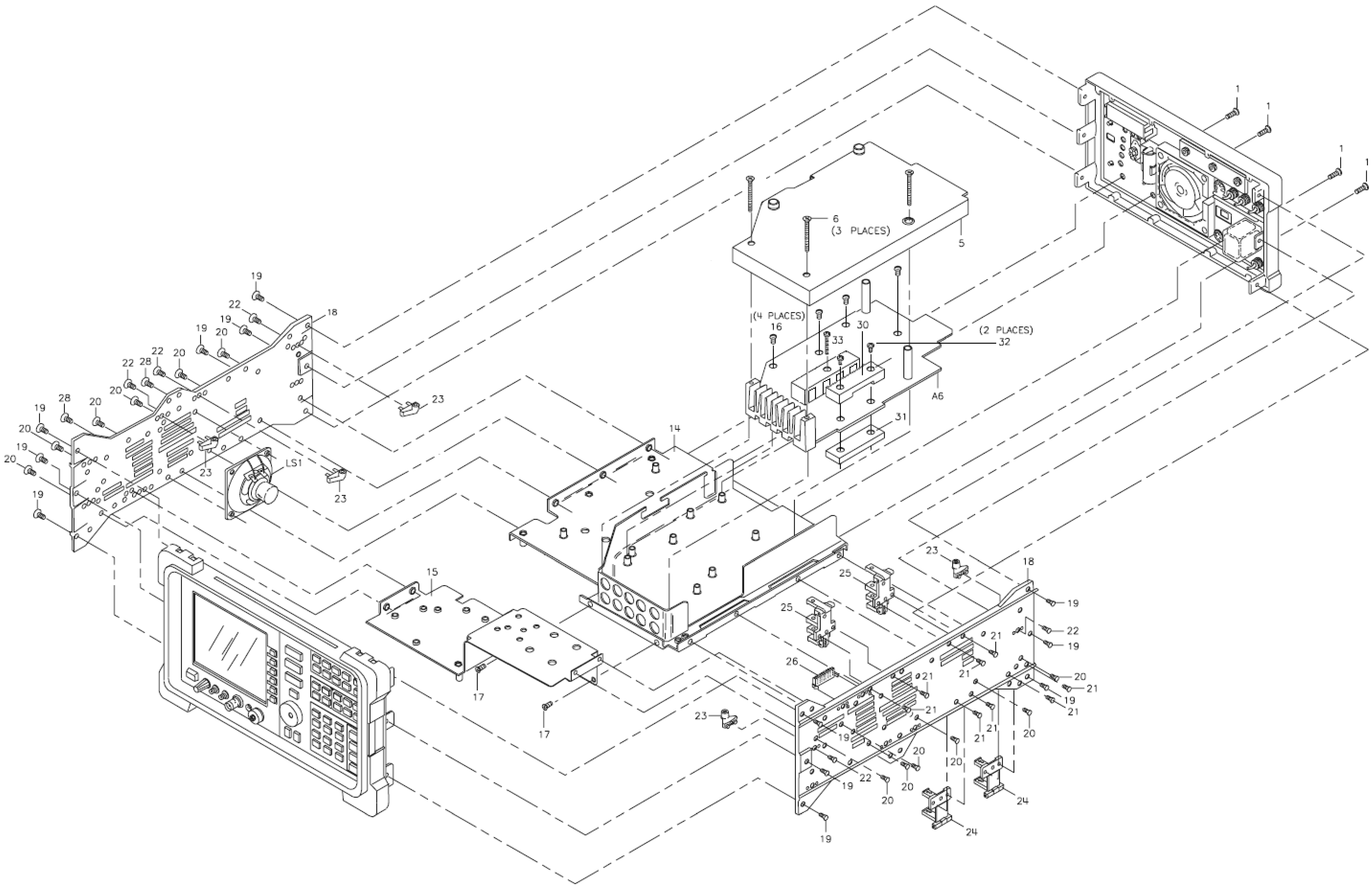
# RF Deck Replacement Parts

| Item | Description | Part Number | Quantity |
|---|---|---|---|
| 1 | Screw-Machine - Flat-HD - M3X0.5 - 16MM-LG | 0515-1603 | 2 |
| 2 | Screw-Machine w/Patch-LK - Pan-HD - M3X0.5 - 6MM-LG | 0515-2332 | 2 |
| 3 | Screw-Machine w/Patch-LK - Pan-HD - M3X0.5 - 6MM-LG | 0515-2332 | 2 |
| 4 | Filter Clamp | 5021-7467 | 1 |
| 6 | Screw-Machine w/Patch-LK - Pan-HD - M3X0.5 - 6MM-LG | 0515-2332 | 2 |
| 7 | Main Deck | 5002-1008 | 1 |
| 8 | Screw-Machine - Flat-HD - M3X0.5 - 6MM-LG | 0515-1227 | 2 |
| 9 | Front End Deck | 5002-4047 | 1 |
| 11 | Screw-Machine - Flat-HD - M3X0.5 - 5MM-LG | 0515-1032 | 4 |
| 12 | Screw-Machine - Flat-HD - 6-32 - 0.375-IN-LG | 2360-0461 | 4 |
| 14 | Screw-Machine w/Washer - Pan-HD - M3X0.5 - 8MM-LG | 0515-1950 | 2 |
| 18 | Attenuator Bracket | 5002-1007 | 1 |
| 20 | Screw-Machine - Flat-HD - M3X0.5 - 6MM-LG | 0515-1227 | 3 |
| 22 | Screw-Machine - Flat-HD - M3X0.5 - 5MM-LG | 0515-1521 | 4 |
| 23 | Screw-Machine w/Washer - Pan-HD - M3X0.5 - 25MM-LG | 0515-0667 | 2 |
| 24 | Polyiron Insert | 9220-7979 | 1 |
| 25 | EMI Shield | 5002-1009 | 1 |
| 26 | Screw-Machine - Flat-HD - M3X0.5 - 5MM-LG | 0515-1521 | 10 |
| 27 | Filter Clamp | 1400-0015 | 1 |
| 28 | Screw-Machine w/Washer - Pan-HD - M4X0.7 - 8MM-LG | 0515-0433 | 1 |

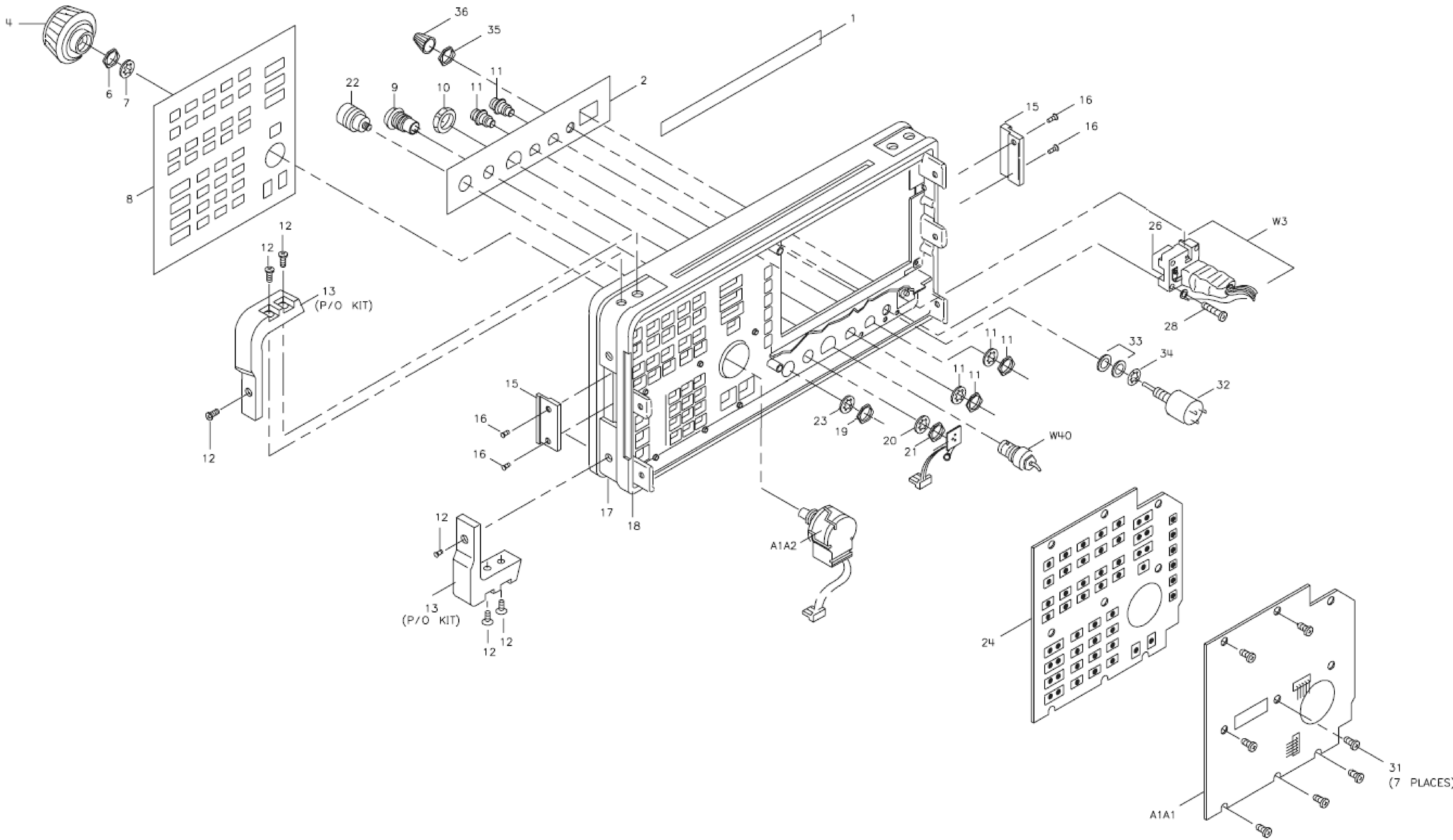
# 8560EC Series Instrument Cover Replacement Parts



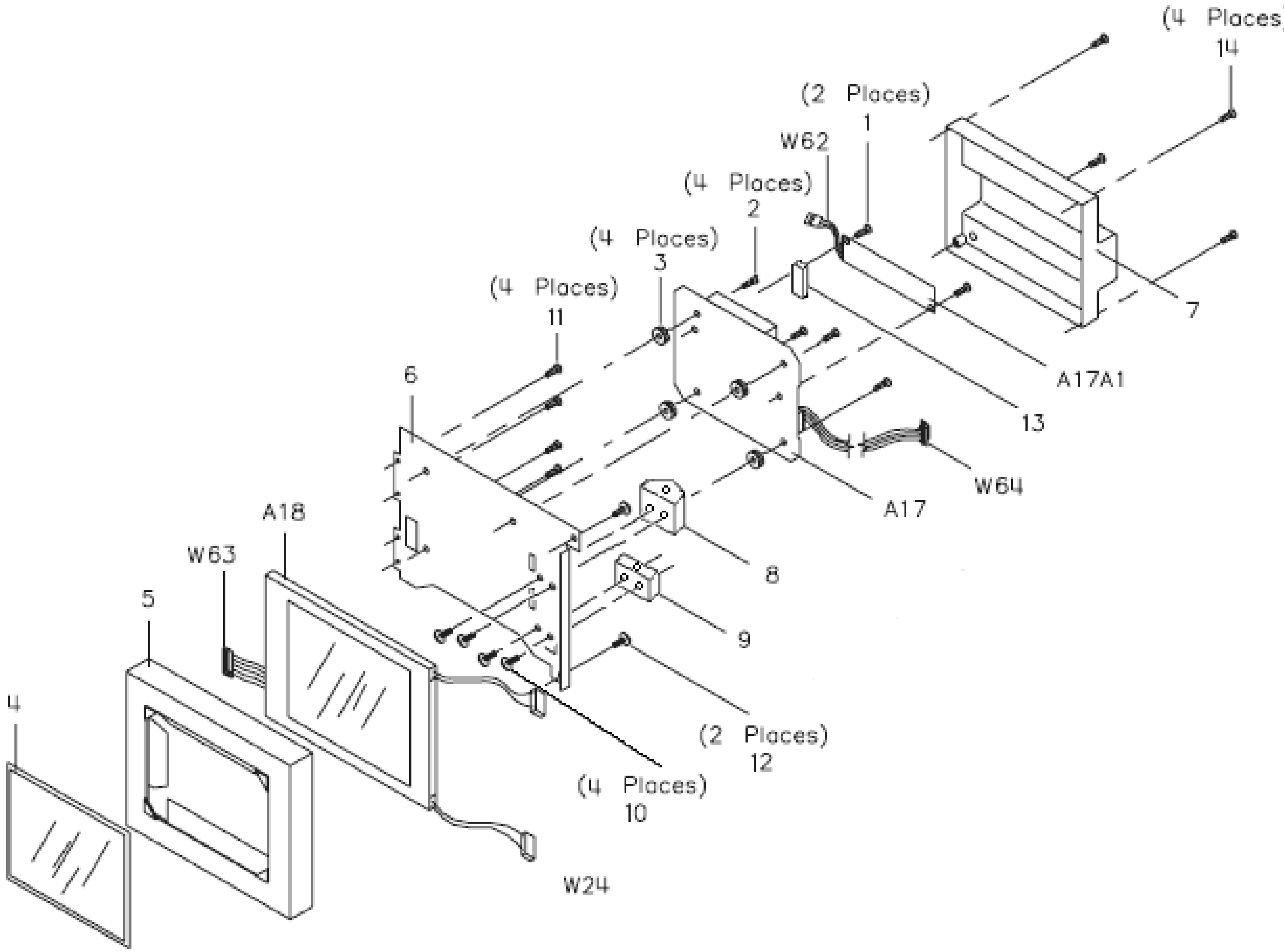
# 8560EC Series Main Chassis Replacement Parts



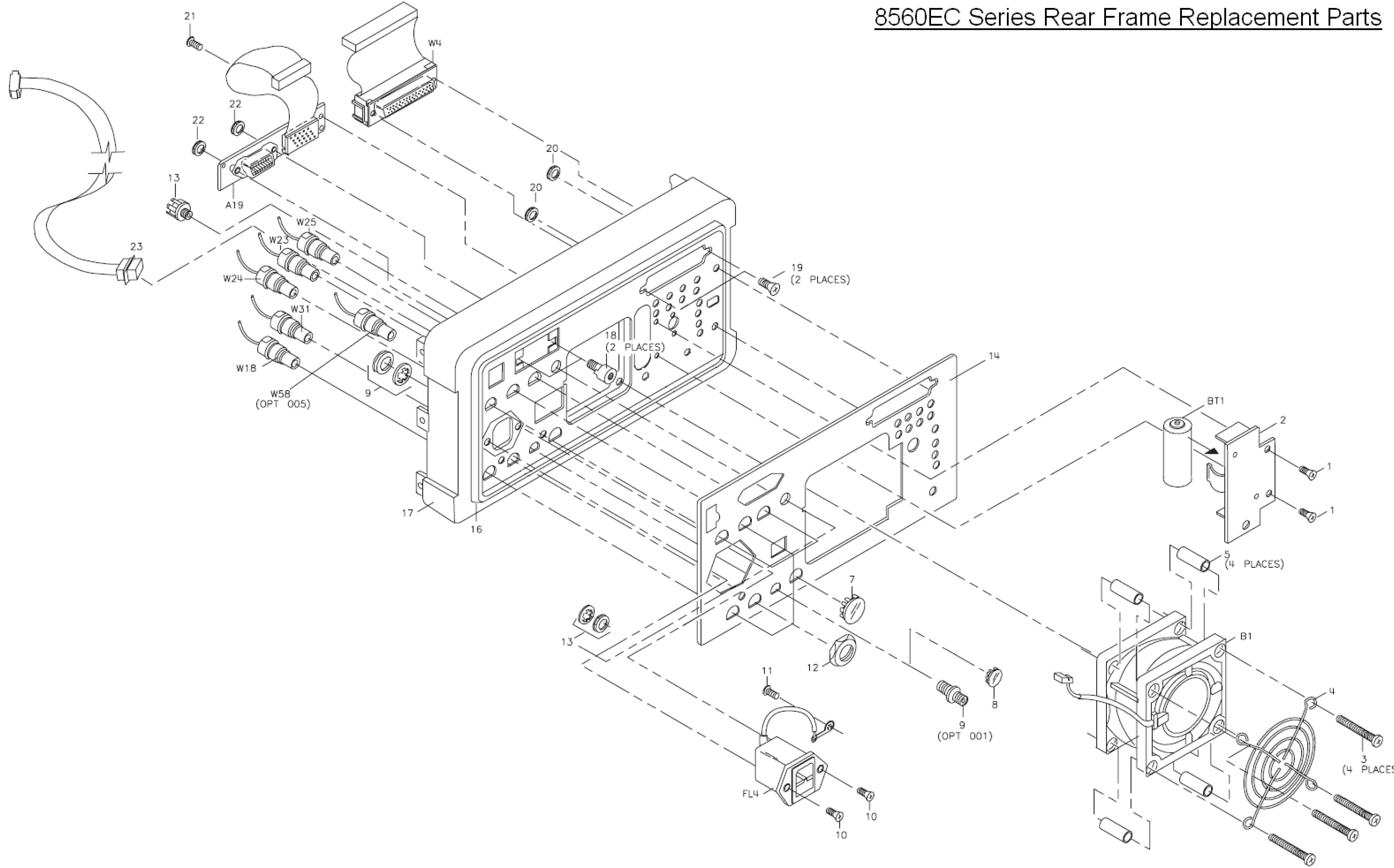
# 8560EC Series Front Frame Replacement Parts



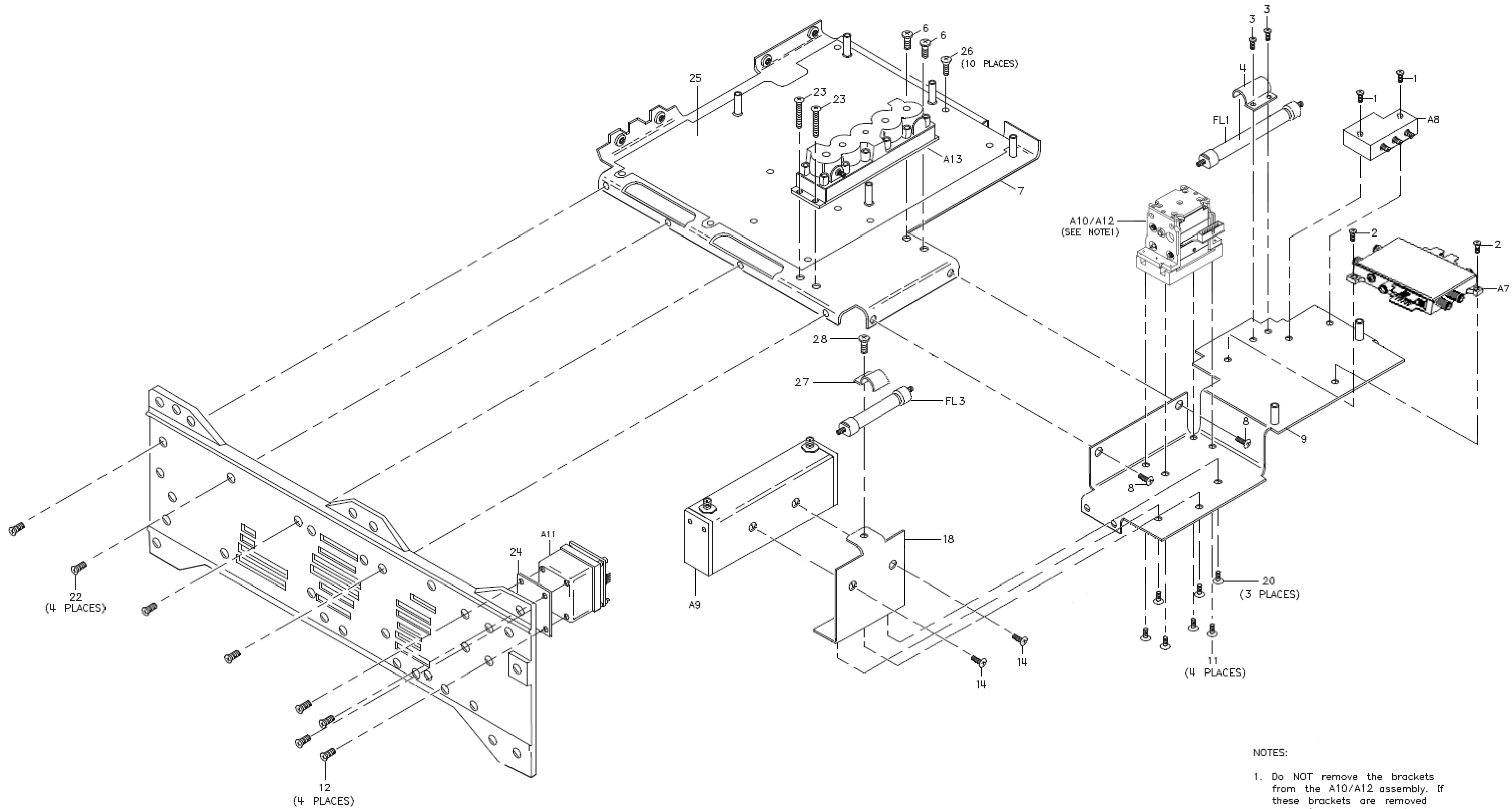
# 8560EC Series LCD Replacement Parts



# 8560EC Series Rear Frame Replacement Parts



# 8564EC / 8565EC RF Deck




NOTES:

1. Do NOT remove the brackets from the A10/A12 assembly. If these brackets are removed and reinstalled, the performance of A10 will be altered. A new or rebuilt A10 assembly includes new mounting brackets already attached to it.

# 6 Major Assembly and Cable Locations

# Introduction

This chapter identifies the instrument's assemblies and cables and contains the following figures:



Use the list below to determine the figure(s) illustrating the desired assembly or cable.

| Assemblies | Figure |
|---|---|
| A1 Front Frame | 6-6 |
| A1A1 Keyboard | 6-6 |
| A2 Controller | 6-1 |
| A3 Interface | 6-1 |
| A4 Log Ampli er/Cal Oscillator | 6-1 |
| A5 IF Filter | 6-1, 6-3 |
| A6 Power Supply | 6-3 |
| A7 LO Multiplier/Amplifer (LOMA) | 6-8 |
| A8 Low Band Mixer | 6-8 |
| A9 RF Attenuator | 6-8 |
| A10/A12 RYTHM/SBTX | 6-8 |
| A11 YTO | 6-8 |
| A13 Second Converter | 6-8 |
| A14 Frequency Control | 6-1, 6-6 |
| A15 RF | 6-1, 6-5, 6-6 |
| A17 LCD Driver | 6-3 |
| A18 LCD | 6-3 |
| A19 GPIB | 6-3 |
| A20 Battery Assembly | 6-9 |
| B1 Fan | 6-9 |
| BT1 Battery | 6-9 |
| FL1 Low Pass Filter | 6-8 |
| FL2 Low Pass Filter | 6-8 |
| FL3 Low Pass Filter | 6-8 |
| FL4 Line Filter | 6-9 |
| FL5 Low Pass Filter | 6-8 |
| LS1 Speaker | 6-3 |

**Figure 6-1 Hinged Assemblies**

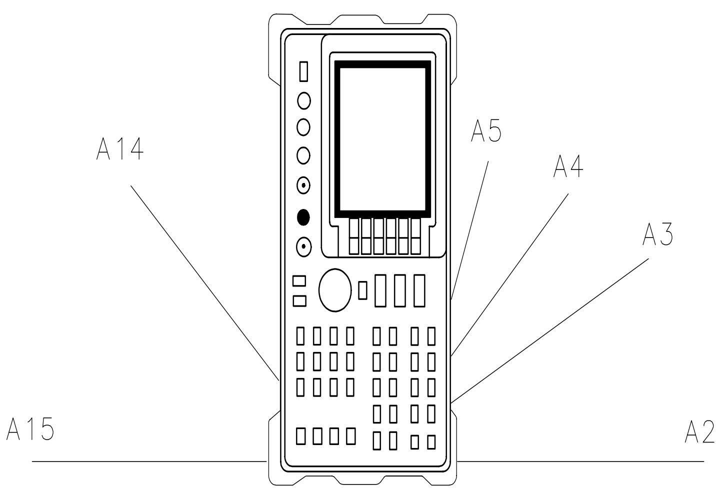


**Figure 6-2 Top View (A2 and A3 Unfolded)**

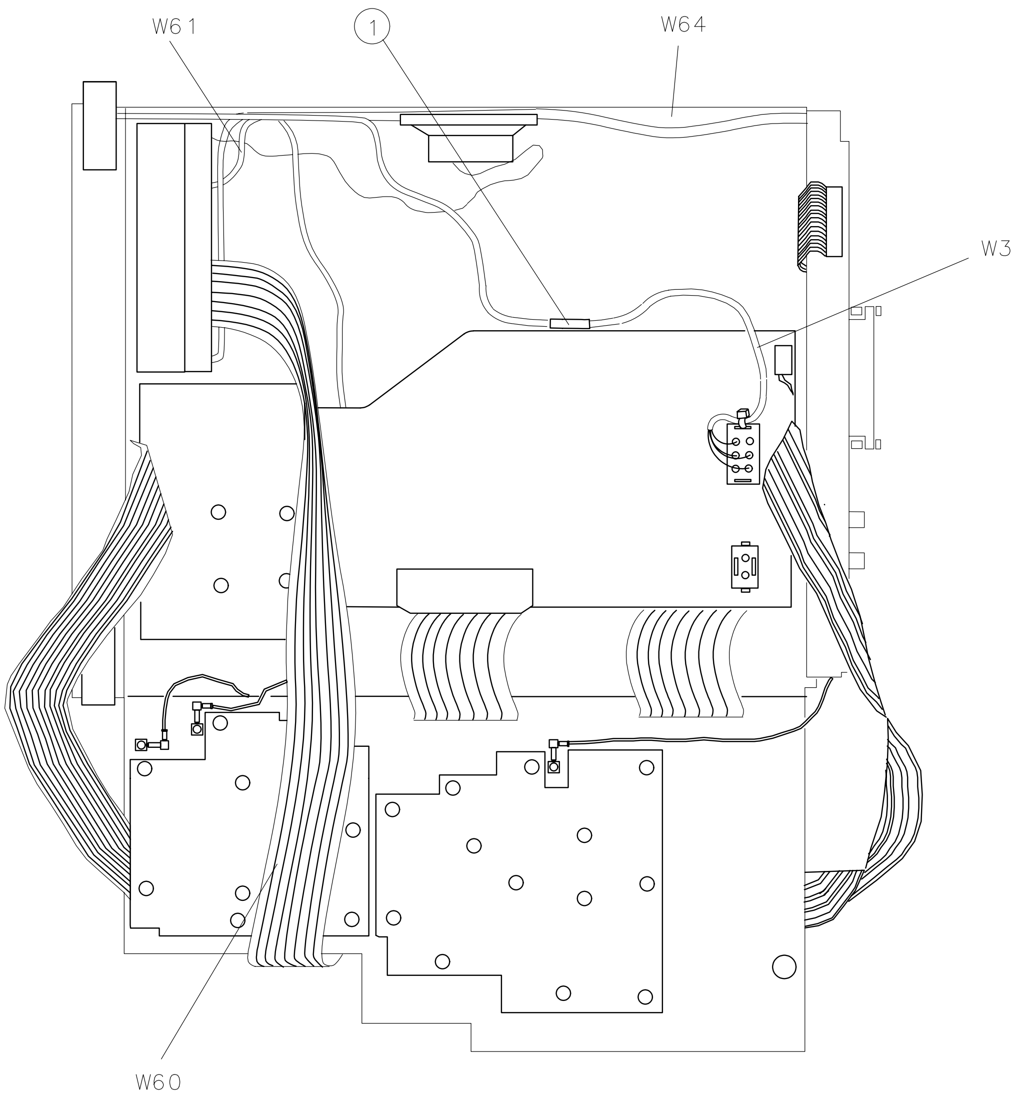
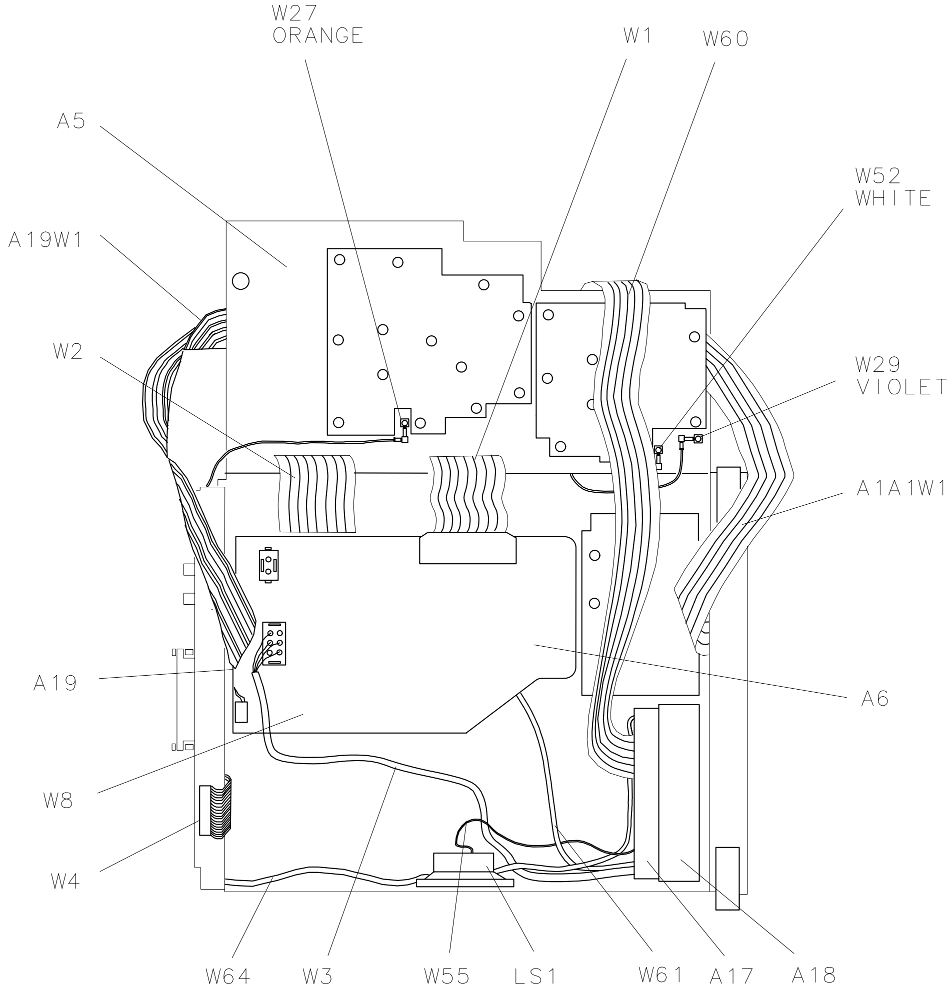


**Figure 6-3 Top View (A2, A3, A4, and A5 Unfolded)**



### Figure 6-5 Bottom View (A15 Unfolded)

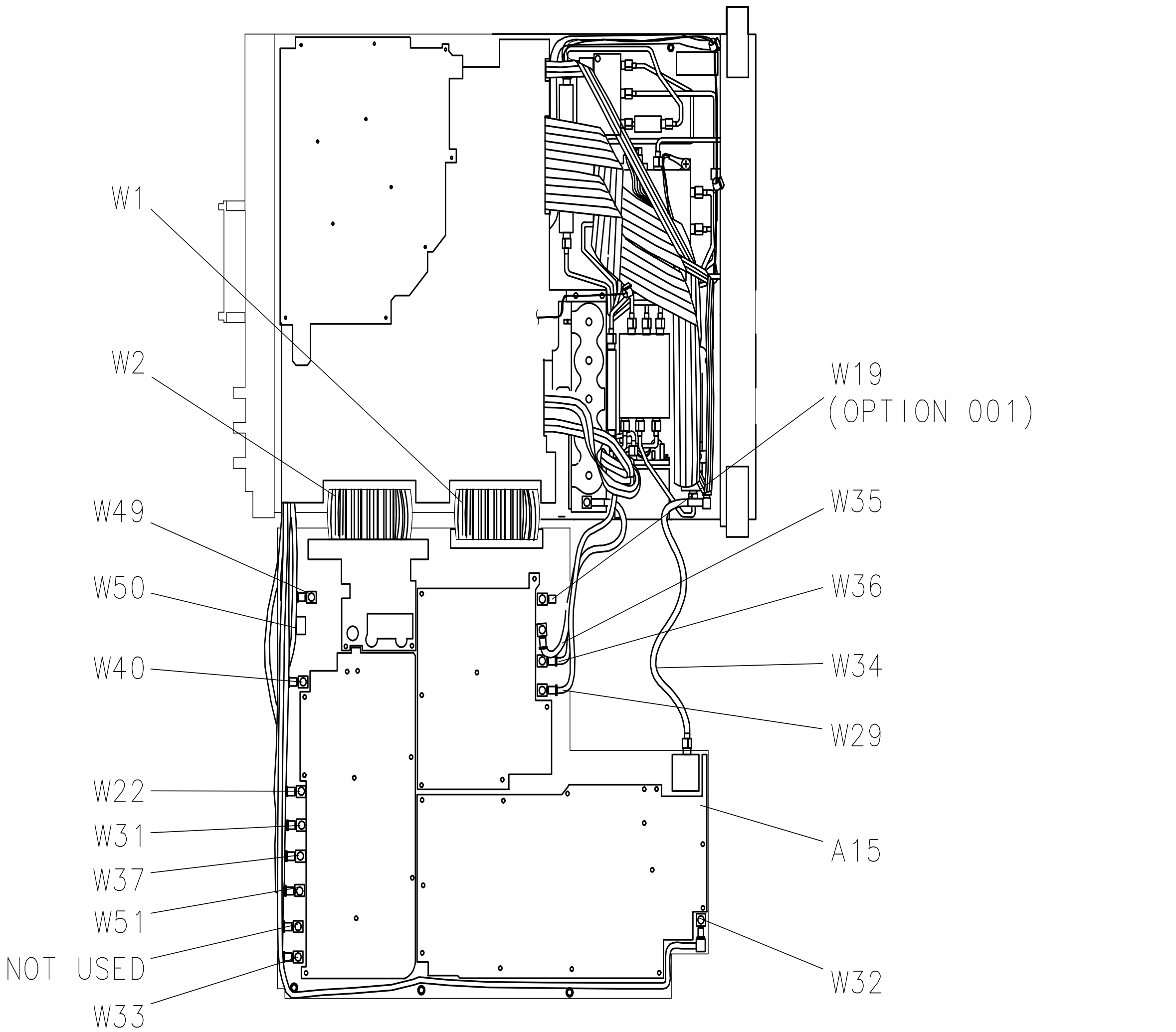


**Figure 6-6 Bottom View (A15 and A14 Unfolded)**

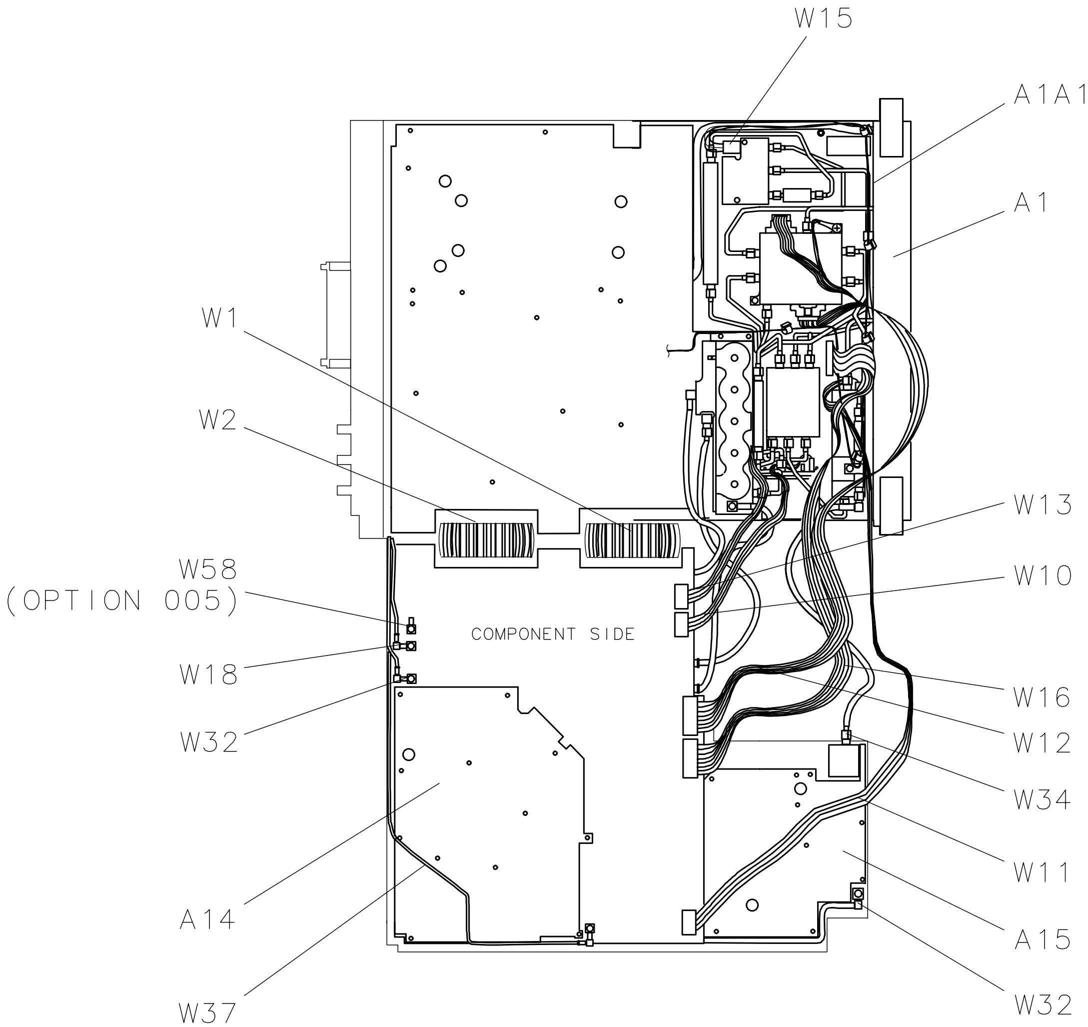


**Figure 6-8 Front End**

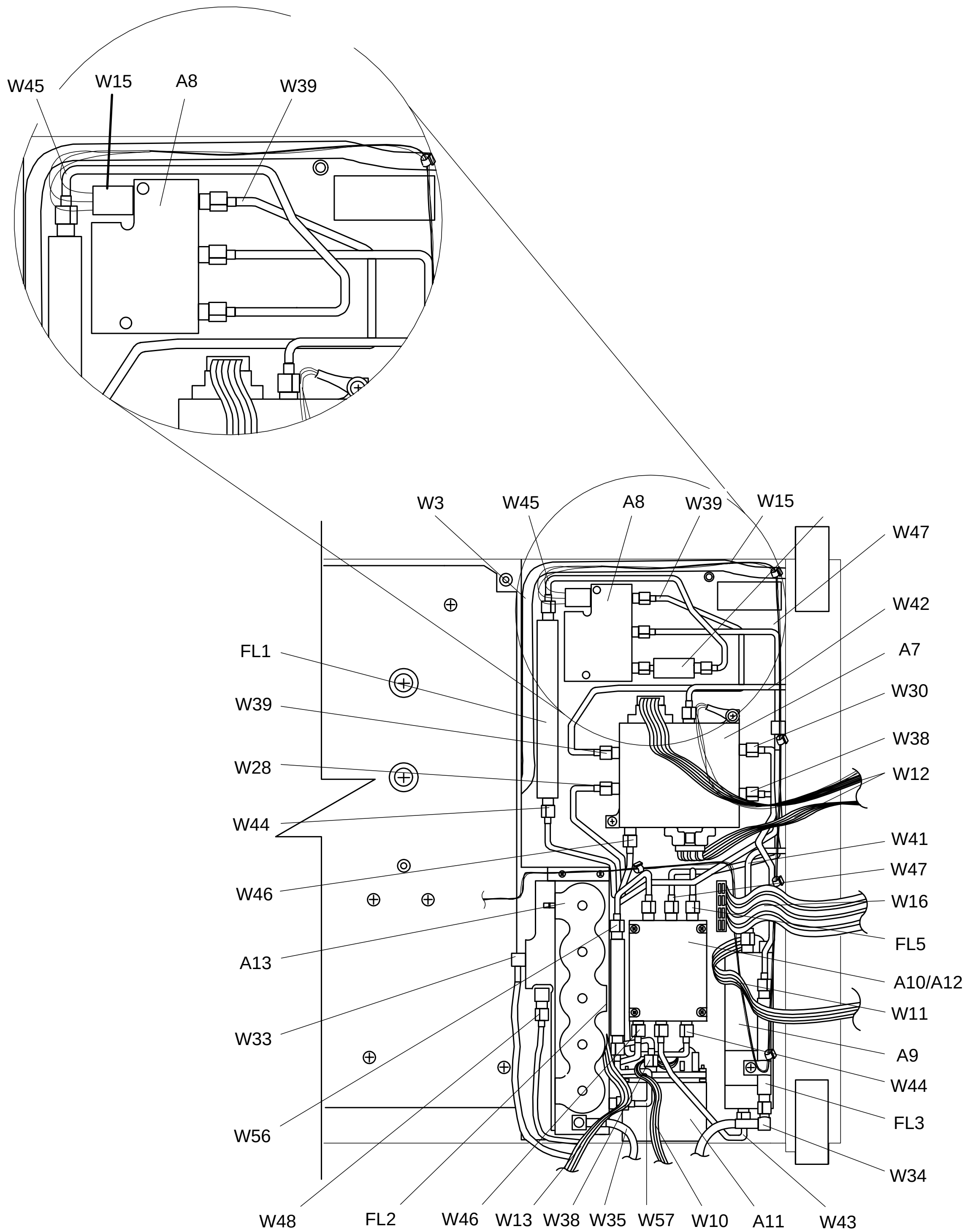
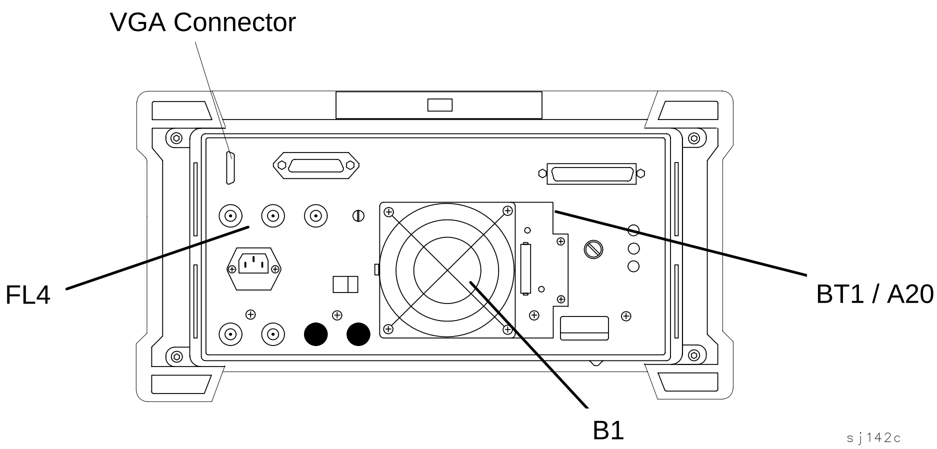


**Figure 6-9 Rear View**



# 7 General Troubleshooting

# Introduction

This chapter provides information needed to troubleshoot your spectrum analyzer to one of the six major functional sections. Chapters 8 through 13 cover troubleshooting for each of these sections. Before troubleshooting, read the rest of this introduction. To begin troubleshooting, refer to "Troubleshooting to a Functional Section" on page 324.



**NOTE** When a part or assembly is replaced, adjustment of the affected circuitry is usually required. Refer to the adjustment procedures in Chapters 2 and 3.

**WARNING** **Troubleshooting and repair of this instrument with the cover removed exposes high voltage points that, if contacted, may cause personal injury. Maintenance and repair of this instrument should be performed only by a skilled person who knows the hazards involved. Where maintenance can be performed without power applied, power should be removed. When any repair is completed, be sure that all safety features are intact and functioning and that all necessary parts are connected to their grounds.**

## Assembly Level Text

To locate troubleshooting information for an individual assembly, refer to Table 7-1 on page 325.

## Block Diagrams

Instrument-level block diagrams are located at the end of this chapter. Power levels and voltages shown on block diagrams are provided only as a troubleshooting aid. They should not be used for making instrument adjustments.

## Assembly Test Points

The spectrum analyzer board assemblies contain four types of test points: post, pad, extended component lead, and test jack. Figure 7-1 on page 318 illustrates each type of test point as seen on both block diagrams and circuit boards. The name of the test point will be etched into the circuit board next to the test point (for example, TP2). In some instances, the test point will be identified on the board by its number only.

### Pad

Each pad test point uses a square pad and a round pad etched into the board assembly. The square pad is the point being measured. The round pad supplies a grounding point for the test probe.

### Test Jack

The test jack is a collection of test points located on a 16-pin jack. There are approximately 20 test jacks used throughout the spectrum analyzer. The pins on the test jack may be manually probed, provided caution is used to prevent accidental shorting between adjacent pins.

Figure 7-1 on page 318 illustrates the pin configuration for the test jack. Line names are the same for all test jacks. The following mnemonics are used: MS (measured signal) and OS (output signal). Test jack test points are identified on block diagrams by both the jack/pin number and line name.

## Ribbon Cables

Ribbon cables are used extensively in the spectrum analyzer. The following cables use different pin numbering methods on the jacks (signal names remain the same but the pin numbers vary):

W2, control cable
W4, option cable
A3W1, interface cable
A19W1, GPIB cable

Figure 7-2 on page 319 and Figure 7-3 on page 320 illustrate the pin configurations of these five cables. Cables W1 and W2 use two pin numbering methods on their many jacks. These methods are identified in the interconnect and block diagrams by the letters "A" and "B" next to the jack designator (for example, J1(A)). Board assembly jacks connected to W1 will always be labeled J1. Board assembly jacks connected to W2 will always be labeled J2.

**Figure 7-1 Assembly Test Points**

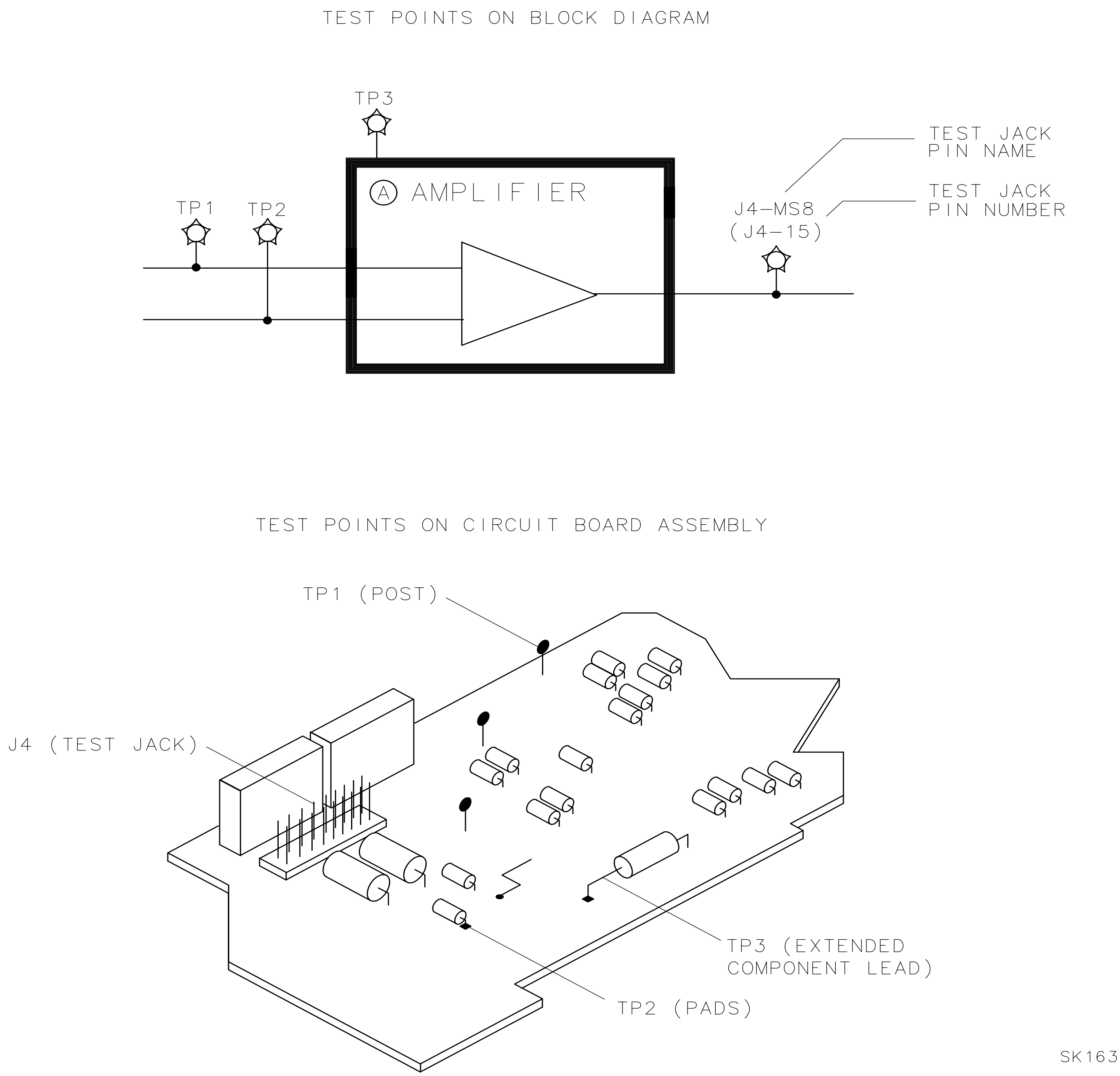



Figure 7-4 on page 321 shows the pin configuration for the 80 pin, W60 cable that is found on EC-series instruments. The numbering of the pins is identical on the A2 Controller board and the A17 Display Driver board.

**Figure 7-2** **Ribbon Cable Connections (1 of 3)**

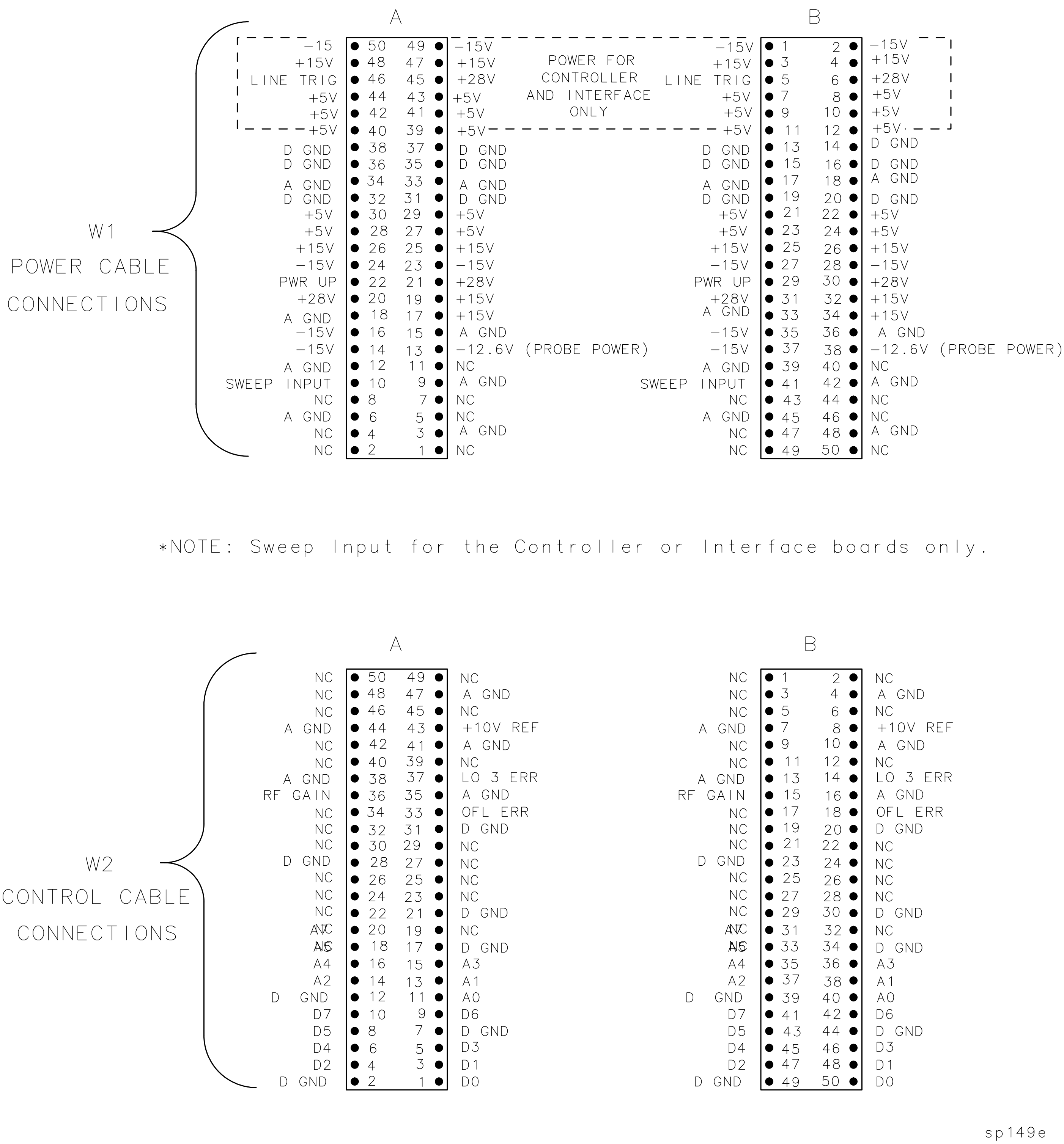


**Figure 7-3 Ribbon Cable Connections (2 of 3)**

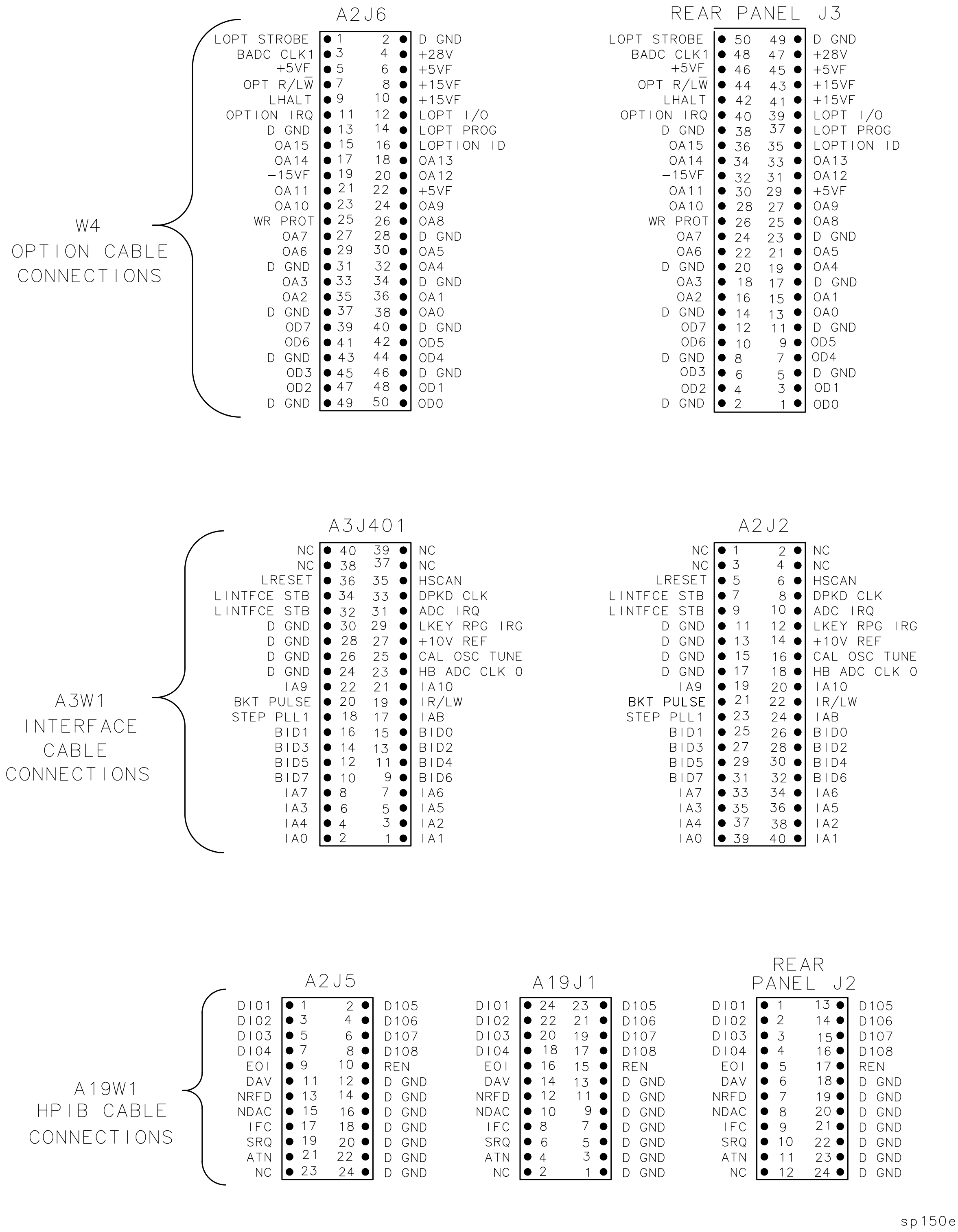


**Figure 7-4 Ribbon Cable Connections (3 of 3)**

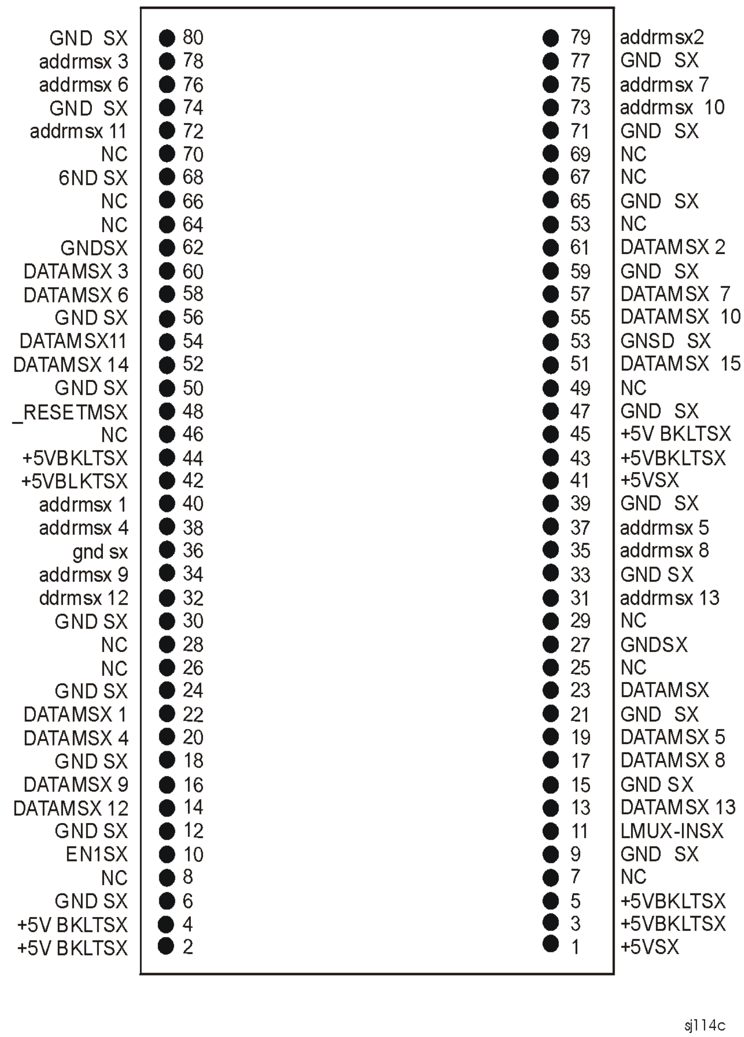
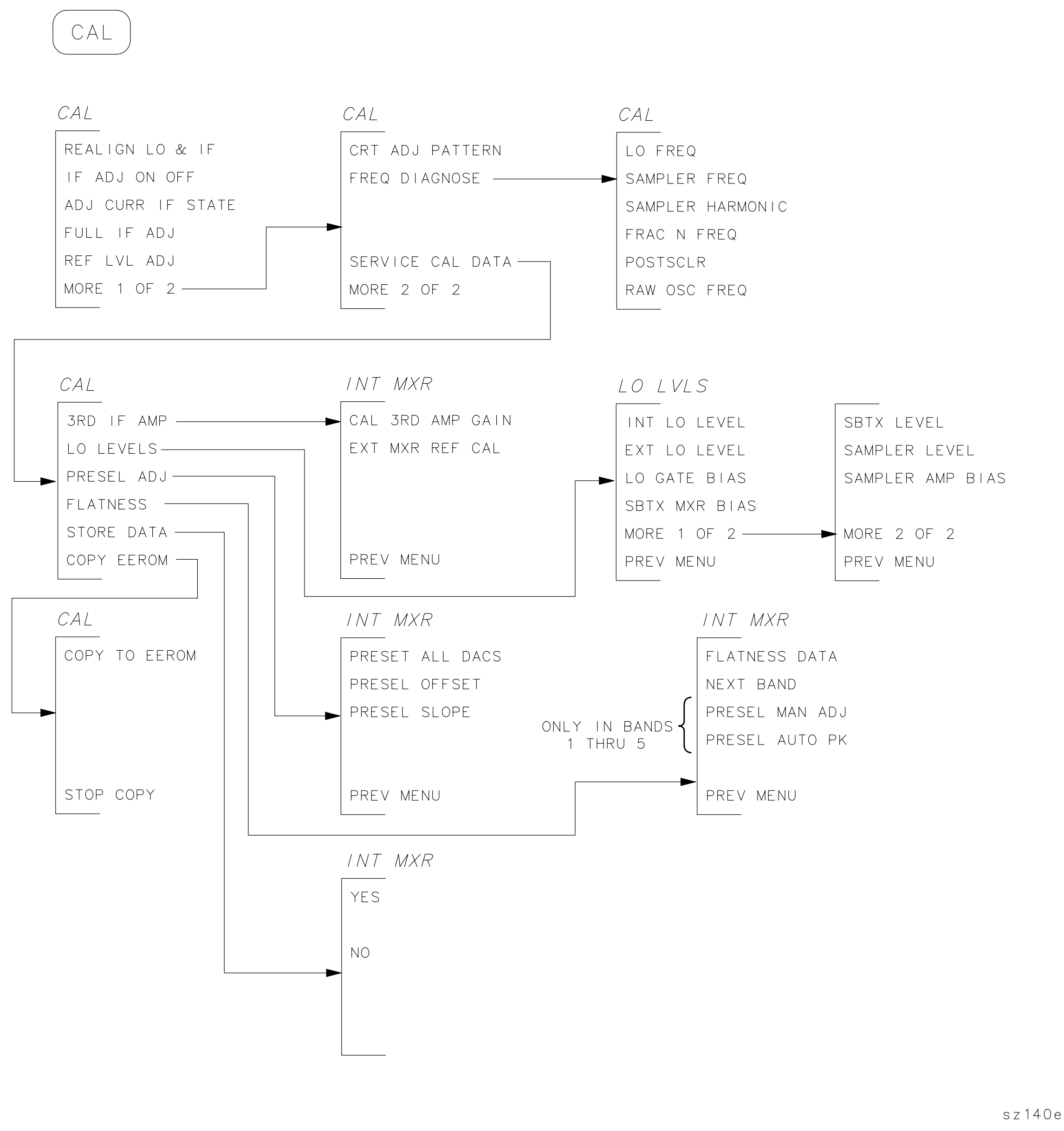



**Figure 7-4 shows A2J8 connections on 8560 EC-Series Instruments. Lines 2 – 5 and 42 – 44 supply +5V to the two LCD backlights. Lines 1 and 41 supply +5V to the A17A1 Inverter board. Lines 1 – 6 and 41 – 44 are identical on A17J1.**

## Service Cal Data Softkey Menus

The jumper on A2J12 is shipped from the factory in the WR PROT (write protect) position (jumper on pins 2 and 3). When the jumper is set to the WR ENA (write enable) position (jumper on pins 1 and 2), an additional service cal data menu is displayed under **CAL**. Figure 7-5 on page 323 illustrates those areas of the service cal data menu that are available.

**Figure 7-5 Service Cal Data Menu**



# Troubleshooting to a Functional Section

1. Refer to Table 7-1 on page 325 for the location of troubleshooting information.
2. If error messages are displayed, refer to "Error Messages" in this chapter. You will find both error descriptions and troubleshooting information.
3. If a signal cannot be seen, and no error messages are displayed, the fault is probably in the RF Section. Refer to Chapter 12 , “RF Section.”
4. Blank displays result from problems caused by either the controller or display/power supply sections. Because error messages 700 to 759 caused by the controller section cannot be seen on a blank display, use the following BASIC program to read these errors over GPIB. If the program returns an error code of 0, there are no errors.

```
10 DIM Err$[128]
20 OUTPUT 718;"ERR?;"
30 ENTER 718; Err$
40 PRINT Err$
50 END
```

   a. If there is no response over GPIB, set an oscilloscope to the following settings:

      Sweep time .................................................. 2 ms/div
      Amplitude scale ............................................ 1 V/div

   b. The signals at A2J202 pin 3 and pin 14 should measure about 4 Vp-p. If the levels are incorrect, refer to Chapter 10 and troubleshoot the A2 controller assembly.

   c. Set the oscilloscope to the following settings:

      Sweep time ...................................................... 1 ms/div
      Amplitude scale ................................................ 2 V/div

   d. The signal at A2J202 pin 15 should consist of TTL pulses. If the signal is at a constant level (high or low), troubleshoot the A2 controller assembly.

5. Display problems such as intensity or distortion are caused by either the controller or display/power supply sections. Refer to Chapter 10 or Chapter 13 .

**Table 7-1 Location of Assembly Troubleshooting Text**

| Instrument Assembly | Location of Troubleshooting Text |
|---|---|
| A1A1 keyboard | Chapter 8 ADC/Interface Section |
| A1A2 RPG | Chapter 8 ADC/Interface Section |
| A2 controller | Chapter 10 Controller Section |
| A3 interface | Chapter 8 ADC/Interface Section |
| | Chapter 9 IF Section |
| A4 log amplifier/cal oscillator | Chapter 9 IF Section |
| A5 IF | Chapter 9 IF Section |
| A6 power supply | Chapter 13 Display/Power Supply Section |
| A6A2 regulator | Chapter 13 Display/Power Supply Section |
| A7 LOMA | Chapter 12 RF Section |
| A8 low band mixer | Chapter 12 RF Section |
| A9 input attenuator | Chapter 12 RF Section |
| A10 RYTHM | Chapter 12 RF Section |
| A11 YTO | Chapter 11 Synthesizer Section |
| A12 SBTX | Chapter 12 RF Section |
| A13 2nd converter | Chapter 12 RF Section |
| A14 frequency control | Chapter 11 Synthesizer Section |
| | Chapter 12 RF Section |
| A15 RF assembly | Chapter 11 Synthesizer Sectionn |
| | Chapter 12 RF Section |
| A17 LCD driver | Chapter 13 Display/Power Supply Section |
| A18 LCD | Chapter 13 Display/Power Supply Section |
| A19 GPIB | Chapter 10 Controller Section |
| A21 OCXO | Chapter 11 Synthesizer Section |
| FL1, FL2 | Chapter 12 RF Section |

# Error Messages

The spectrum analyzer displays error messages in the lower right-hand corner of the display. A number, or error code, is associated with each error message. These error messages alert the user to errors in spectrum analyzer function or use.

Multiple error messages may exist simultaneously. Refer to "Viewing Multiple Messages" below.

The following information can be found in this section:

## Viewing Multiple Messages

Although multiple errors may exist, the spectrum analyzer displays only one error message at a time. To view any additional messages, do the following:

1. Press **RECALL** and **MORE 1 OF 2**.
2. Press **RECALL ERRORS**. An error message is displayed in the active function block.
3. Use the up and down step keys to scroll through any other error messages which might exist, making note of each error code.

## Error Message Elimination

When an error message is displayed, always perform the following procedure:

1. Press **SAVE** and **SAVE STATE**.
2. Store the current state in a convenient STATE register. (It may be necessary to set **SAVELOCK** to OFF.)
3. Press **CAL** and **REALIGN LO &IF**. Wait for the sequence to finish.
4. Press **RECALL** and **RECALL STATE**.
5. Recall the previously stored STATE.
6. If an error message is still displayed, refer to the following list of error messages for an explanation of the error.

## System Analyzer Programming Errors (100 to 150)

Refer to the *8560 E-Series Spectrum Analyzers User's Guide* for information on programming the spectrum analyzer.

`100 NO PWRON` Power-on state is invalid; default state is loaded. Press **SAVE**, **PWR ON STATE** to clear error message.

`101 NO STATE` State to be RECALLed not valid or not SAVEd.

`102 # ARGMTS` Command does not have enough arguments.

`103 # ARGMTS` Command does not have enough arguments.

`104 # ARGMTS` Command does not have enough arguments.

`105 # ARGMTS` Command does not have enough arguments.

`106 ABORTED!` Current operation is aborted; GPIB parser reset.

`107 HELLO ??` No GPIB listener is present.

`108 TIME OUT` Spectrum analyzer timed out when acting as controller.

109 CtrlFail Spectrum analyzer unable to take control of the bus.

110 NOT CTRL Spectrum analyzer is not system controller.

111 # ARGMTS Command does not have enough arguments.

112 ??CMD?? Unrecognized command.

113 FREQ NO! Command cannot have frequency units.

114 TIME NO! Command cannot have time units.

115 AMPL NO! Command cannot have amplitude units.

116 ?UNITS?? Unrecognizable units.

117 NOP NUM Command cannot have numeric units.

118 NOP EP Enable parameter cannot be used.

119 NOP UPDN UP/DN are not valid arguments for this command.

120 NOP ONOF ON/OFF are not valid arguments for this command.

121 NOP ARG AUTO/MAN are not valid arguments for this command.

122 NOP TRC Trace registers are not valid for this command.

123 NOP ABLK A-block format not valid here.

124 NOP IBLK I-block format not valid here.

125 NOP STRNG Strings are not valid for this command.

126 NO ? This command cannot be queried.

127 BAD DTMD Not a valid peak detector mode.

128 PK WHAT? Not a valid peak search parameter.

129 PRE TERM Premature A-block termination.

130 BAD TDF Arguments are only for TDF command.

131 ?? AM/FM AM/FM are not valid arguments for this command.

132 !FAV/RMP FAV/RAMP are not valid arguments for this command.

133 !INT/EXT INT/EXT are not valid arguments for this command.

134 ??? ZERO ZERO is not a valid argument for this command.

135 ??? CURR CURR is not a valid argument for this command.

136 ??? FULL FULL is not a valid argument for this command.

137 ??? LAST LAST is not a valid argument for this command.

138 !GRT/DSP GRT/DSP are not valid arguments for this command.

139 PLOTONLY Argument can only be used with PLOT command.

140 ?? PWRON PWRON is not a valid argument for this command.

141 BAD ARG Argument can only be used with FDIAG command.

142 BAD ARG Query expected for FDIAG command.

143 NO PRESL No preselector hardware to use command with.

144 COUPL?? Invalid COUPLING argument, expected AC or DC.

## ADC Errors (200 to 299)

These errors are directly related to the ADC/interface section. Suspect a faulty A2 controller, A3 interface assembly or, in 8560 E-series analyzers with Option 007, the A16 fast ADC (FADC) assembly.

Errors 202 through 207 apply only to EC-series analyzers and E-series analyzers with fast ADC (Option 007).

200 SYSTEM ADC driver/ADC hardware/firmware interaction; check for other errors.

201 SYSTEM ADC controller/ADC hardware/firmware interaction; check for other errors.

202 FADC CAL Binary search failed during FADC linear offset calibration.

This error applies only to EC-series analyzers and E-series analyzers with fast ADC (Option 007).

203 FADC CAL Binary search failed during FADC log offset calibration.

This error applies only to EC-series analyzers and E-series analyzers with fast ADC (Option 007).

204 FADC CAL Binary search failed during FADC log expand offset calibration.

This error applies only to EC-series analyzers and E-series analyzers with fast ADC (Option 007).

205 FADC CAL Slope derivation failed during FADC linear offset calibration.

This error applies only to EC-series analyzers and E-series analyzers with fast ADC (Option 007).

206 FADC CAL Slope derivation failed during FADC log offset calibration.

This error applies only to EC-series analyzers and E-series analyzers with fast ADC (Option 007).

207 FADC CAL Slope derivation failed during FADC log expand offset calibration.

This error applies only to EC-series analyzers and E-series analyzers with fast ADC (Option 007).

250 OUTOF RG ADC input is outside of ADC range.

251 NO IRQ Microprocessor not receiving interrupt from ADC.

## LO and RF Hardware/Firmware Failures (300 to 399)

### YTO Loop Errors (300 to 301)

These errors often require troubleshooting the A14 frequency control assembly (synthesizer section) or the ADC circuits.

300 YTO UNLK YTO (1st LO) phase locked loop is unlocked. The ADC measures YTO_ERR voltage under phase-lock condition.

301 YTO UNLK YTO (1st LO) phase locked loop is unlocked. Same as ERR 300 except ERR 301 is set if the voltage is outside certain limits.

### YTO Loop Errors (317 to 320)

These messages indicate that the YTO main coil coarse DAC (ERR 317) or fine DAC (ERR 318) is at its limit. If error codes 300 or 301 are not present, a hardware problem exists in the YTO loop but the loop can still acquire lock. Refer to Chapter 11 to troubleshoot the YTO PLL. The ADC circuit on the A3 interface assembly may also cause this error.

317 FREQ ACC Main coil coarse DAC at limit. The main coil coarse DAC is set to bring YTO ERR close enough to 0 volts for the main coil fine DAC to bring YTO ERR to exactly 0 volts. ERR 317 is set if the main coil coarse DAC is set to one of its limits before bringing YTO ERR close enough to 0 volts.

318 FREQ ACC Main coil fine DAC at limit. The main coil fine DAC is set to bring YTO ERR to 0 volts after the main coil coarse DAC has brought YTO ERR close to 0 volts. ERR 318 is set if the main coil fine DAC is set to one of its limits before bringing YTO ERR to 0 volts.

319 WARN COA YTO coarse tune DAC near limit.

320 WARN FIN YTO fine tune DAC near limit.

### YTO Loop Error (331)

This error rarely occurs but is usually indicative of a digital hardware failure.

`331 FREQ ACC` Invalid YTO frequency. Firmware attempted to set the YTO to a frequency outside the range of the YTO (2.95 to 6.8107 GHz). Suspect a digital hardware problem, such as a bad RAM on the A2 controller assembly. Contact the factory.

### 600 MHz Reference Loop (333)

This error requires troubleshooting the A15 RF board assembly (synthesizer section) or the ADC circuits.

`333 600 UNLK` The 600 MHz reference oscillator PLL is unlocked. If error codes 302, 303, 304, 327 or 499 are also present, suspect the 10 MHz reference, the A21 OCXO, or the TCXO (Option 103), or the A15 RF assembly. ERR 333 is set if LO3ERR is outside of its prescribed limits.

### Sampling Oscillator (335)

This error indicates an unlocked sampling oscillator (also known as the offset lock loop).

`335 SMP UNLK` Sampling oscillator PLL is unlocked. ERR 335 is set if OFL_ERR is outside its prescribed limits.

### 10 MHz Reference (336)

This message occurs during the internal IF calibration routines. The routine locks the cal oscillator to the internal 10 MHz reference, regardless of the setting of INT/EXT REF.

`336 10 MHz Ref` Calibration oscillator failed to lock within 5 seconds after going to internal 10 MHz reference. ERR 336 will not be cleared until a successful full calibration "LO Re-Align" is executed.

### Fractional N PLL (337)

This error indicates an unlocked fractional N phase locked loop. This error only applies to the hardware in an 8560 E-series or EC-series spectrum analyzer.

`337 FN UNLK` Fractional N circuitry is unable to lock.

### LOMA (Local Oscillator Multiplier/Amplifier) Leveling Loop Errors (338 to 340)

These errors are generated when one of the LOMA (local oscillator multiplier/amplifier) loops is unlevelled. These errors only apply to the hardware in an 8564E/EC or 8565E/EC spectrum analyzer.

`338 LOMA AGC` The LOMA main loop AGC is unleveled. Error 338 may be displayed if the front panel LO OUTPUT is not terminated in 50 ohms. This error is usually accompanied by error codes 300 or 301. ERR 301 YTO UNLK is cleared once ERR 338 has been cleared. Check the output of the A11 YTO with the jumper on A14J23 in the TEST position. The YTO power output should be between +9 and +13 dBm. If the YTO is working properly, refer to "A7 LOMA Drive" in Chapter 12. The LOMA AGC voltage is monitored by the ADC. ERR 334 is set if LOMA AGC is outside of its prescribed limits. Refer to "A7 LOMA Drive" in Chapter 12.

`339 SBTX AGC` The LOMA SBTX (switched barium-tuned mixer) loop AGC is unleveled. If ERR 338 LOMA AGC is also present, refer to ERR 338. Otherwise, refer to "A7 LOMA Drive" in Chapter 12.

`340 SAMP AGC` The LOMA (local oscillator multiplier/amplifier) sampler loop AGC is unleveled. If ERR 338 LOMA AGC is also present, refer to ERR 338. Otherwise, refer to "A7 LOMA Drive" in Chapter 12.

### YTO Loop Settling Errors (351 to 354)

These errors are generated when the YTO loop error voltage will not stabilize at an acceptable value during the YTO loop locking routines. These errors only apply to the hardware in an 8560 E-series or EC-series spectrum analyzer.

`351 SETL FLD` YTO error voltage is not settling.

`352 TWID FLD` Unable to bring YTO error voltage DAC's to quiescent point.

`353 SRCH FLD` No acceptable YTO DAC value found.

`354 LK ITERS` Cannot lock. Lock iteration routine terminated.

### Sampling Oscillator (355)

This error indicates an unlocked sampling oscillator during the local oscillator (LO) alignment routine. This error only applies to the hardware in an 8560 E-series or EC-series spectrum analyzer.

`355 SMP CAL` Sampler unlock condition during calibration routine. This error remains until a successful recalibration is performed.

### Span Accuracy Calibration Errors (356 to 361)

These errors are generated when the span accuracy calibration fails. The span accuracy calibration is done during "power up", IF calibration (every 5 minutes), and LO IF realignment routines. Span accuracy calibration sweeps occur during the retrace (dead time) of the main sweep ramp. The firmware then detects any span accuracy calibration errors. These errors only apply to firmware revisions 931216 and later.

`356 SPAC CAL` Sweep data problem finding "bucket 1" of the span accuracy calibration sweep. This error indicates a possible failure of the sweep generator, span attenuator, or main/FM coil sweep switches on the A14 frequency control assembly. Refer to Chapter 11 , "Synthesizer Section."

`357 SPAC CAL` Cannot find the "x" intersection for "bucket 1" of the span accuracy calibration sweep. This error indicates a possible failure of the sweep generator, span attenuator, or main/FM coil sweep switches on the A14 frequency control assembly. Refer to Chapter 11 , "Synthesizer Section."

`358 SPAC CAL` Sweep data problem finding "bucket 2" of the span accuracy calibration sweep. This error indicates a possible failure of the sweep generator, span attenuator, or main/FM coil sweep switches on the A14 frequency control assembly. Refer to Chapter 11 , "Synthesizer Section."

`359 SPAC CAL` Cannot find "x" intersection for "bucket 2" of the span accuracy calibration sweep. This error indicates a possible failure of the sweep generator, span attenuator, or main/FM coil sweep switches on the A14 frequency control assembly. Refer to Chapter 11 , "Synthesizer Section."

360 SPAC CAL The start bucket correction is out of range. This error indicates a possible failure of the sweep generator on the A14 frequency control assembly. Refer to “Sweep Generator Circuit,” in Chapter 11 , “Synthesizer Section.”

361 SPAC CAL The percent of span correction is out of range. This error indicates a possible failure of the sweep generator on the A14 frequency control assembly. Refer to “Sweep Generator Circuit,” in Chapter 11 , “Synthesizer Section.”

## Automatic IF Errors (400 to 599)

These error codes are generated when the automatic IF adjustment routine detects a fault. This routine first adjusts amplitude parameters, then resolution bandwidths in this sequence: 300 kHz, 1 MHz, 100 kHz, 30 kHz, 10 kHz, 3 kHz, 1 kHz, 300 Hz, 100 Hz, 30 Hz, 10 Hz, 3 Hz, 1 Hz, and 2 MHz. The routine restarts from the beginning if a fault is detected. Parameters adjusted after the routine begins but before the fault is detected are correct; parameters adjusted later in the sequence are suspect. Refer to "Automatic IF Adjustment" in Chapter 8.

The IF Section relies on the ADC and video circuitry to perform its continuous IF adjustments. IF-related errors occur if the ADC, video circuitry, or A4 assembly linear path is faulty.

400 AMPL <300 Unable to adjust amplitude of resolution bandwidths less than 300 Hz.

401 AMPL 300 Unable to adjust amplitude of 300 Hz resolution bandwidth.

402 AMPL 1K Unable to adjust amplitude of 1 kHz resolution bandwidth.

403 AMPL 3K Unable to adjust amplitude of 3 kHz resolution bandwidth.

404 AMPL 10K Unable to adjust amplitude of 10 kHz resolution bandwidth.

Errors 405 to 416: When these 10K resolution bandwidth (RBW) error messages appear, use the following steps to check for errors 581 or 582:

1. Press **LINE** to turn the spectrum analyzer off.

2. Press **LINE** to turn the spectrum analyzer on and observe the lower right-hand corner of the display for 10 seconds.
3. If ERR 581 or ERR 582 appears, the fault is most likely caused by the cal oscillator. Refer to errors 581 and 582.
4. If ERR 581 or ERR 582 does not appear, troubleshoot the A5 IF assembly.

Multiple IF errors during IF adjust: If a FULL IF ADJ sequence (pressing **CAL** and **FULL IF ADJ**) results in IF errors while displaying `IF ADJUST STATUS: AMPLITUDE`, the cal oscillator on the A4 assembly might not be providing the correct output signal. Perform the following steps:

1. Disconnect W30 (white) from A5J4.
2. Connect W30 to the input of a second spectrum analyzer and set its controls as follows:

   Center frequency........................... 10.7 MHz
   Reference level .............................. –30 dBm

3. Observe the spectrum analyzer display while pressing **FULL IF ADJ** on the spectrum analyzer. If a –35 dBm signal does not appear, troubleshoot the cal oscillator on the A4 assembly.
4. If a –35 dBm signal does appear, troubleshoot the A5 IF assembly.

`405 RBW 10K` Unable to adjust 10 kHz resolution bandwidth in first crystal pole.

`406 RBW 10K` Unable to adjust 10 kHz resolution bandwidth in second crystal pole.

`407 RBW 10K` Unable to adjust 10 kHz resolution bandwidth in third crystal pole.

`408 RBW 10K` Unable to adjust 10 kHz resolution bandwidth in fourth crystal pole.

`409 RBW 10K` Unable to adjust 10 kHz resolution bandwidth in first crystal pole.

`410 RBW 10K` Unable to adjust 10 kHz resolution bandwidth in second crystal pole.

`411 RBW 10K` Unable to adjust 10 kHz resolution bandwidth in third crystal pole.

`412 RBW 10K` Unable to adjust 10 kHz resolution bandwidth in fourth crystal pole.

`413 RBW 10K` Unable to adjust 10 kHz resolution bandwidth in first crystal pole.

`414 RBW 10K` Unable to adjust 10 kHz resolution bandwidth in second crystal pole.

`415 RBW 10K` Unable to adjust 10 kHz resolution bandwidth in third crystal pole.

`416 RBW 10K` Unable to adjust 10 kHz resolution bandwidth in fourth crystal pole.

`417 RBW 3K` Unable to adjust 3 kHz resolution bandwidth in first crystal pole.

`418 RBW 3K` Unable to adjust 3 kHz resolution bandwidth in second crystal pole.

`419 RBW 3K` Unable to adjust 3 kHz resolution bandwidth in third crystal pole.

`420 RBW 3K` Unable to adjust 3 kHz resolution bandwidth in fourth crystal pole.

`421 RBW 10K` Unable to adjust 10 kHz resolution bandwidth in first crystal pole.

`422 RBW 10K` Unable to adjust 10 kHz resolution bandwidth in second crystal pole.

`423 RBW 10K` Unable to adjust 10 kHz resolution bandwidth in third crystal pole.

`424 RBW 10K` Unable to adjust 10 kHz resolution bandwidth in fourth crystal pole.

`425 RBW 3K` Unable to adjust 3 kHz resolution bandwidth in first crystal pole.

`426 RBW 3K` Unable to adjust 3 kHz resolution bandwidth in second crystal pole.

`427 RBW 3K` Unable to adjust 3 kHz resolution bandwidth in third crystal pole.

`428 RBW 3K` Unable to adjust 3 kHz resolution bandwidth in fourth crystal pole.

`429 RBW <300` Unable to adjust resolution bandwidths less than 300 Hz. ADC handshake.

`430 RBW 300` Unable to adjust 300 Hz resolution bandwidth. ADC handshake.

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| `431 RBW 1K` | Unable to adjust 1 kHz resolution bandwidth. ADC handshake. |
| `432 RBW 3K` | Unable to adjust 3 kHz resolution bandwidth. ADC handshake. |
| `433 RBW 10K` | Unable to adjust 10 kHz resolution bandwidth. ADC handshake. |
| `434 RBW 300` | 300 Hz resolution bandwidth amplitude low in first crystal pole. |
| `435 RBW 300` | 300 Hz resolution bandwidth amplitude low in second crystal pole. |
| `436 RBW 300` | 300 Hz resolution bandwidth amplitude low in third crystal pole. |
| `437 RBW 300` | 300 Hz resolution bandwidth amplitude low in fourth crystal pole. |
| `438 RBW 1K` | 1 kHz resolution bandwidth amplitude low in first crystal pole. |
| `439 RBW 1K` | 1 kHz resolution bandwidth amplitude low in second crystal pole. |
| `440 RBW 1K` | 1 kHz resolution bandwidth amplitude low in third crystal pole. |
| `441 RBW 1K` | 1 kHz resolution bandwidth amplitude low in fourth crystal pole. |
| `442 RBW 3K` | 3 kHz resolution bandwidth amplitude low in first crystal pole. |
| `443 RBW 3K` | 3 kHz resolution bandwidth amplitude low in second crystal pole. |
| `444 RBW 3K` | 3 kHz resolution bandwidth amplitude low in third crystal pole. |
| `445 RBW 3K` | 3 kHz resolution bandwidth amplitude low in fourth crystal pole. |
| `446 RBW 10K` | 10 kHz resolution bandwidth amplitude low in first crystal pole. |
| `447 RBW 10K` | 10 kHz resolution bandwidth amplitude low in second crystal pole. |
| `448 RBW 10K` | 10 kHz resolution bandwidth amplitude low in third crystal pole. |
| `449 RBW 10K` | 10 kHz resolution bandwidth amplitude low in fourth crystal pole. |
| `450 IF SYSTM` | IF hardware failure. Check other error messages. |

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|---|---|---|
| 451 | IF SYSTM | IF hardware failure. Check other error messages. |
| 452 | IF SYSTM | IF hardware failure. Check other error messages. |
| 454 | AMPL | Unable to adjust step gain amplifiers. Check other errors. |
| 455 | AMPL | Unable to adjust fine attenuator of the step gain amplifiers. |
| 456 | AMPL | Unable to adjust fine attenuator of the step gain amplifiers. |
| 457 | AMPL | Unable to adjust fine attenuator of the step gain amplifiers. |
| 458 | AMPL | Unable to adjust first step gain stage. |
| 459 | AMPL | Unable to adjust first step gain stage. |
| 460 | AMPL | Unable to adjust first step gain stage. |
| 461 | AMPL | Unable to adjust second step gain stage. |
| 462 | AMPL | Unable to adjust second step gain stage. |
| 463 | AMPL | Unable to adjust third step gain stage. |
| 464 | AMPL | Unable to adjust third step gain stage. |
| 465 | AMPL | Unable to adjust third step gain stage. |
| 466 | LIN AMPL | Unable to adjust linear amplifier scale. |
| 467 | LOG AMPL | Unable to adjust step gain amplifiers. |
| 468 | LOG AMPL | Unable to adjust third step gain stage. |
| 469 | LOG AMPL | Unable to adjust step gain amplifiers. |
| 470 | LOG AMPL | Unable to adjust third step gain stage. |
| 471 | RBW 30K | Unable to adjust 30 kHz resolution bandwidth in first LC pole. |
| 472 | RBW 100K | Unable to adjust 100 kHz resolution bandwidth in first LC pole. |
| 473 | RBW 300K | Unable to adjust 300 kHz resolution bandwidth in first LC pole. |
| 474 | RBW 1M | Unable to adjust 1 MHz resolution bandwidth in first LC pole. |
| 475 | RBW 30K | Unable to adjust 30 kHz resolution bandwidth in second LC pole. |
| 476 | RBW 100K | Unable to adjust 100 kHz resolution bandwidth in second LC pole. |

`477 RBW 300K` Unable to adjust 300 kHz resolution bandwidth in second LC pole.

`478 RBW 1M` Unable to adjust 1 MHz resolution bandwidth in second LC pole.

`483 RBW 10K` Unable to adjust 10 kHz resolution bandwidth.

`484 RBW 3K` Unable to adjust 3 kHz resolution bandwidth.

`485 RBW 1K` Unable to adjust 1 kHz resolution bandwidth.

`486 RBW 300` Unable to adjust 300 Hz resolution bandwidth.

`487 RBW 100` Unable to adjust 100 Hz resolution bandwidth.

`488 RBW 100` Unable to adjust 100 Hz resolution bandwidth.

`489 RBW 100` Unable to adjust 100 Hz resolution bandwidth.

`490 RBW 100` Unable to adjust 100 Hz resolution bandwidth.

`491 RBW <300` Unable to adjust the resolution bandwidths less than 300 Hz. Crystal sweep gain problem.

`492 RBW 300` Unable to adjust 300 Hz resolution bandwidth. Crystal sweep gain problem.

`493 RBW 1K` Unable to adjust 1 kHz resolution bandwidth. Crystal sweep gain problem.

`494 RBW 3K` Unable to adjust 3 kHz resolution bandwidth. Crystal sweep gain problem.

`495 RBW 10K` Unable to adjust 10 kHz resolution bandwidth. Crystal sweep gain problem.

`496 RBW 100` Unable to adjust 100 Hz resolution bandwidth. Inadequate Q.

`497 RBW 100` Unable to adjust 100 Hz resolution bandwidth. Alignment problem.

`498 RBW 100` Unable to adjust 100 Hz resolution bandwidth. Gain problem.

`499 CAL UNLK` Cal oscillator is unlocked. Verify the unlocked conditions as follows:

1. Place A4 in its service position and disconnect W51 (gray-yellow) from A4J7.
2. Connect W51 to the input of another spectrum analyzer. This is the 10 MHz reference for the cal oscillator.

3. If a 10 MHz signal (approximately 0 dBm) is not present, suspect the A15 RF assembly, the A21 OCXO, or the A15 assembly TCXO (Option 103). If the 10 MHz reference is present, continue with step 4.
4. Reconnect W17 to A4J7 and monitor the tune voltage at A4J9 pin 3 with an oscilloscope.
5. Press **PRESET** on the spectrum analyzer under test.
6. If the voltage is either +15 Vdc or –15 Vdc, the cal oscillator is probably at fault. Normally, the voltage should be near +15 V during a sweep, and between –9 V and +9 V during retrace.

An *intermittent* error 499 indicates the cal osc phase-locked-loop probably can lock at 10.7 MHz, but cannot lock at the 9.9 and 11.5 MHz extremes. This may prevent the cal oscillator from adjusting the 1 MHz or 30 kHz through 300 kHz bandwidths. This symptom implies a failure in the oscillator, function block X. (See the A4 log amp/cal oscillator schematic sheet 4 of 4.) The oscillator is unable to tune the required frequency range with the –9 V to +9 V control voltage. Troubleshoot A4CR802 (most probable cause), L801, C808, C809, and U807.

`500 AMPL 30K` Unable to adjust amplitude of 30 kHz resolution bandwidth.

`501 AMPL .1M` Unable to adjust amplitude of 100 kHz resolution bandwidth.

`502 AMPL .3M` Unable to adjust amplitude of 300 kHz resolution bandwidth.

`503 AMPL 1M` Unable to adjust amplitude of 1 MHz resolution bandwidth.

`504 AMPL 30K` Unable to adjust amplitude of 30 kHz resolution bandwidth.

`505 AMPL .1M` Unable to adjust amplitude of 100 kHz resolution bandwidth.

`506 AMPL .3M` Unable to adjust amplitude of 300 kHz resolution bandwidth.

`507 AMPL 1M` Unable to adjust amplitude of 1 MHz resolution bandwidth.

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| 508 AMPL 30K | Unable to adjust amplitude of 30 kHz resolution bandwidth. Insufficient gain during LC bandwidth calibration. |
| 509 AMPL .1M | Unable to adjust amplitude of 100 kHz resolution bandwidth. Insufficient gain during LC bandwidth calibration. |
| 510 AMPL .3M | Unable to adjust amplitude of 300 kHz resolution bandwidth. Insufficient gain during LC bandwidth calibration. |
| 511 AMPL 1M | Unable to adjust amplitude of 1 MHz resolution bandwidth. Insufficient gain during LC bandwidth calibration. |
| 512 RBW <300 | Unable to adjust resolution bandwidths less than 300 Hz. Insufficient gain during crystal bandwidth calibration. |
| 513 RBW 300 | Unable to adjust 300 Hz resolution bandwidth. Insufficient gain during crystal bandwidth calibration. |
| 514 RBW 1K | Unable to adjust 1 kHz resolution bandwidth. Insufficient gain during crystal bandwidth calibration. |
| 515 RBW 3K | Unable to adjust 3 kHz resolution bandwidth. Insufficient gain during crystal bandwidth calibration. |
| 516 RBW 10K | Unable to adjust 10 kHz resolution bandwidth. Insufficient gain during crystal bandwidth calibration. |
| 517 RBW 100 | Unable to adjust 100 Hz resolution bandwidth. Crystal sweep problem. |
| 518 RBW 300 | Unable to adjust 300 Hz resolution bandwidth. Crystal sweep problem. |
| 519 RBW 1K | Unable to adjust 1 kHz resolution bandwidth. Crystal sweep problem. |
| 520 RBW 3K | Unable to adjust 3 kHz resolution bandwidth. Crystal sweep problem. |
| 521 RBW 10K | Unable to adjust 10 kHz resolution bandwidth. Crystal sweep problem. |
| 522 RBW 10K | Unable to adjust symmetry of 10 kHz resolution bandwidth in first crystal pole. |
| 523 RBW 10K | Unable to adjust symmetry of 10 kHz resolution bandwidth in second crystal pole. |
| 524 RBW 10K | Unable to adjust symmetry of 10 kHz resolution bandwidth in third crystal pole. |

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| 525 RBW 10K | Unable to adjust symmetry of 10 kHz resolution bandwidth in fourth crystal pole. |
| 526 RBW <300 | ADC timeout during IF ADJUST of <300 Hz resolution bandwidth. |
| 527 RBW <300 | Step gain correction failed for <300 Hz resolution bandwidth. Check narrow bandwidth SGO attenuator. |
| 528 RBW <300 | Calibration of dc level at ADC failed for <300 Hz resolution bandwidth. |
| 529 RBW <300 | Invalid demodulated data for <300 Hz resolution bandwidth flatness and IF down-converter. Demod data for calibration may be bad. |
| 530 RBW <300 | Adjustment of VCXO down-converter failed with resolution bandwidths less than 300 Hz. Narrow bandwidth VCXO calibration failed. |
| 531 RBW <300 | Flatness correction data for resolution bandwidths <300 Hz not acceptable. |
| 532 RBW <300 | Absolute gain data for resolution bandwidths <300 Hz not acceptable. |
| 533 RBW <300 | ADC timeout adjusting resolution bandwidths less than 300 Hz. Timeout during data sampling narrow bandwidth chunk. |
| 534 RBW <300 | Unable to do frequency count of CAL OSC using IF down-converter when adjusting resolution bandwidths less than 300 Hz. |
| 535 RBW <300 | Unable to obtain adequate FM demod range to measure 500 Hz IF filter with resolution bandwidths less than 300 Hz. |
| 536 RBW <300 | Unable to auto-range chirp signal while setting VCXO or doing flatness calibration with resolution bandwidths less than 300 Hz. |
| 537 RBW <300 | Unable to auto-range CW CAL OSC signal to count VCXO signal with resolution bandwidths less than 300 Hz. |
| 538 RBW <300 | Shape of 500 Hz IF filter appears too noisy to adjust VCXO down-converter for resolution bandwidths less than 300 Hz. |
| 539 RBW <300 | Unable to auto-range the CW CAL OSC signal to pretune the VCXO for resolution bandwidths less than 300 Hz. |

`540 RBW <300` Unable to find CW CAL OSC signal during VCXO pretune at power-up with resolution bandwidths less than 300 Hz.

`550 ID CALOSC` CAL Oscillator ID. Indicates incompatible hardware. Cal Osc not expected

`551 ID LOGBD` LOG Board ID. Indicates incompatible hardware. Log board not expected.

`552 LOG AMPL` Unable to adjust amplitude of log scale.

`553 LOG AMPL` Unable to adjust amplitude of log scale.

`554 LOG AMPL` Unable to adjust amplitude of log scale.

`555 LOG AMPL` Unable to adjust amplitude of log scale.

`556 LOG AMPL` Unable to adjust amplitude of log scale.

`557 LOG AMPL` Unable to adjust amplitude of log scale.

`558 LOG AMPL` Unable to adjust amplitude of log scale.

`559 LOG AMPL` Unable to adjust amplitude of log scale.

`560 LOG AMPL` Unable to adjust amplitude of log scale.

`561 LOG AMPL` Unable to adjust amplitude of log scale. Possible problem in second step gain.

`562 LOG AMPL` Unable to adjust amplitude of log scale. Possible problem in second step gain.

`563 LOG AMPL` Unable to adjust amplitude of log scale. Possible problem in third step gain range.

`564 LOG AMPL` Unable to adjust amplitude of log scale.

`565 LOG AMPL` Unable to adjust amplitude of log scale.

`566 LOG AMPL` Unable to adjust amplitude of log scale.

`567 LOG AMPL` Unable to adjust amplitude of log scale. Possible problem in log offset/log expand stage.

`568 LOG AMPL` Unable to adjust amplitude of log scale. Possible problem in log offset/log expand stage.

`569 LOG AMPL` Unable to adjust amplitude of log scale. Possible problem in log offset/log expand stage.

`570 LOG AMPL` Unable to adjust amplitude of log scale. Possible problem in log offset/log expand stage.

`571 AMPL` Unable to adjust step gain amplifiers.

`572 AMPL 1M` Unable to adjust amplitude of 1 MHz resolution bandwidth.

`573 LOG AMPL` Unable to adjust amplitude of log scale. Check video offset circuitry.

`574 LOG AMPL` Unable to adjust amplitude of log scale. Check video offset circuitry.

`575 LOG AMPL` Unable to adjust amplitude of log scale. Check video offset circuitry.

`576 LOG AMPL` Unable to adjust amplitude of log scale. Check video offset circuitry.

`577 LOG AMPL` Unable to adjust amplitude of log scale. Check video offset circuitry.

`578 LOG AMPL` Limiter calibration error from DC logger calibration.

`579 LOG AMPL` Attenuator CAL level error from DC logger calibration.

`580 LOG AMPL` Calibration level error from DC logger fidelity calibration.

`581 AMPL` Unable to adjust 100 kHz resolution bandwidth and resolution bandwidths less than or equal to 10 kHz. ADC/CALOSC handshake calibration problem in crystal sweep. Refer to Error 582.

`582 AMPL` Unable to adjust 100 kHz resolution bandwidth and resolution bandwidths less than or equal to 10 kHz. Bad CALOSC calibration in sweep rate. Test the 100 kHz resolution bandwidth filter 3 dB bandwidth as follows:

1. Connect the CAL OUTPUT signal (A4J8) to the INPUT 50Ω.
2. Press **PRESET** and set the controls as follows:

   Center frequency ........................ 300 MHz
   Span ............................................. 500 kHz
   Resolution bandwidth .................. 100 kHz
   Log dB/div ......................................... 1 dB
   Reference level ......... adjust to place signal peak at top of the screen

3. Press **PEAK SEARCH** and **MARKER DELTA** and turn the knob clockwise to position the marker until the delta MKR reads –3 dB ±0.1 dB.
4. Press **MARKER DELTA** and move the marker to the other side of the peak until the delta MKR reads 0 dB ±0.1 dB.

5. If the delta MKR frequency is between 90 kHz and 110 kHz, the 100 kHz resolution bandwidth is working properly. If the frequency is outside these limits, read the following information on the A4 cal oscillator sweep generator.

If the 100 kHz resolution bandwidth works properly, the cal oscillator sweep generator is failing to sweep its oscillator frequency at the correct rate. The error is detected in sweeping on the skirts of the 100 kHz resolution bandwidth.

A properly operating sweep generator generates a series of negative-going parabolas. These parabolas generate the sweeps used to adjust resolution bandwidths of 10 kHz and below. Check the sweep generator with the following steps. Refer also to the "300 Hz to 3 kHz Resolution Bandwidth Out of Specification" troubleshooting text in Chapter 9 , "IF Section."

1. Remove the shields.
2. Connect an oscilloscope probe to A4U804C pin 8.
3. On the spectrum analyzer, press **CAL** and **FULL IF ADJ**.
4. Approximately 8 seconds after starting the **FULL IF ADJ**, check for negative-going parabolas (similar to half-sine waves) 5 ms wide and approximately –4 V at their peak. Refer to Chapter 9 , "IF Section," for more information on the A4 log amp/cal oscillator assembly.

`583 RBW 30K` Unable to adjust 30 kHz resolution bandwidth.

`584 RBW 100K` Unable to adjust 100 kHz resolution bandwidth.

`585 RBW 300K` Unable to adjust 300 kHz resolution bandwidth.

`586 RBW 1M` Unable to adjust 1 MHz resolution bandwidth.

`587 RBW 30K` Unable to adjust 30 kHz resolution bandwidth.

`588 RBW 100K` Unable to adjust 100 kHz resolution bandwidth.

`589 RBW 300K` Unable to adjust 300 kHz resolution bandwidth.

`590 RBW 1M` Unable to adjust 1 MHz resolution bandwidth.

`591 LOG AMPL` Unable to adjust amplitude of log scale.

`592 LOG AMPL` Unable to adjust amplitude of log scale.

| | |
|---|---|
| 593 LOG TUNE | Limiter calibration tune error from DC logger calibration. |
| 594 LOG OFST | Attenuator calibration offset error from DC logger calibration. |
| 595 LOG ATTN | Attenuator calibration absolute error from DC logger calibration. |
| 596 LOG FID | Fidelity error from DC logger calibration. |
| 597 LOG OFST | Fidelity offset error from DC logger calibration. |
| 598 LOG OFST | Fidelity offset unstable from DC logger calibration. |
| 599 LOG GAIN | Fidelity gain error from DC logger calibration. |

## System Errors (600 to 651)

ADC timeout errors occur if the A2 controller assembly frequency counter is faulty. Refer to Chapter 8 , “ADC/Interface Section.”

| | |
|---|---|
| 600 SYSTEM | Hardware/firmware interaction; check other errors. |
| 601 SYSTEM | Hardware/firmware interaction; check other errors. |
| 650 OUTOF RG | ADC input is outside of the ADC range. |
| 651 NO IRQ | Microprocessor is not receiving interrupt from ADC. |

## Digital and Checksum Errors (700 to 799)

### EEROM Checksum Errors (700 to 704)

Faults on the A2 controller assembly can cause these errors. Refer to Chapter 10 , “Controller Section.”Although some of these errors might result in a blanked display, it is possible to read these errors over GPIB. Refer to “Troubleshooting to a Functional Section” on page 324.

The EEROM on the A2 controller assembly is used to store data for frequency response correction, elapsed time, focus, and intensity levels. Error codes from 700 to 703 indicate that some part of the data in EEROM is invalid. An EEROM error could result from either a defective EEROM or an improper sequence of storing data in EEROM. Check the EEROM with the following steps:

1. Place the WR PROT/WR ENA jumper on the A2 controller assembly in the WR ENA position.

2. On the spectrum analyzer, press **CAL MORE 1 OF 2**, **SERVICE CAL DATA**, **FLATNESS**, and **FLATNESS DATA**. Enter a value of 130. Press **PREV MENU**, **STORE DATA**, **YES**, and **DISPLAY**.
3. Press **INTEN**, enter an intensity value of 90, and press **STORE INTEN**.
4. Press **MORE 1 OF 2 FOCUS**, enter a focus value of 128, and press **STORE FOCUS**. Turn the **LINE** switch off, then on, cycling the power.
5. If errors are still present, the EEROM A2U501 is defective. Refer to the EEROM replacement procedure in Chapter 4 .

`700 EEROM` Checksum error of EEROM A2U501.

`701 AMPL CAL` Checksum error of frequency response correction data.

`702 ELAP TIM` Checksum error of elapsed time data.

`703 AMPL CAL` Checksum error of frequency response correction data. Default values being used.

`704 PRESELCT` Checksum error of customer preselector peak data. External preselector data recalled in internal mode, or internal preselector data recalled in external mode. To clear the error, press **RECALL**, **MORE 1 OF 2**, **FACTORY PRSEL PK**, **SAVE**, and **SAVE PRSEL PK**.

### Program ROM Checksum Errors (705 to 710)

The instrument power-on diagnostics perform a checksum on each programmed ROM (A2 controller assembly). If an invalid checksum is found for a particular ROM, an error code is generated. If a defective programmed ROM is found, replace it with another ROM with the same part number. Refer to Chapter 5 , “Replaceable Parts.”

Although some of these errors might result in a blanked display, it is possible to read these errors over GPIB. Refer to “Troubleshooting to a Functional Section” on page 324.

`705 ROM U306` Checksum error of program ROM A2U306.

`706 ROM U307` Checksum error of program ROM A2U307.

`707 ROM U308` Checksum error of program ROM A2U308.

`708 ROM U309` Checksum error of program ROM A2U309.

`709 ROM U310` Checksum error of program ROM A2U310.

710 ROM U311 Checksum error of program ROM A2U311.

### RAM Check Errors (711 to 716)

The instrument power-on diagnostics check the program RAM. This includes the two RAMs used for STATE storage. If any STATE information is found to be invalid, all data in that RAM is destroyed. A separate error code is generated for each defective program RAM. All RAM is battery-backed. See “State- and Trace-Storage Problems” in Chapter 10 .

711 RAM U303 Checksum error of system RAM A2U303.

712 RAM U302 Checksum error of system RAM A2U302.

713 RAM U301 Checksum error of system RAM A2U301.

714 RAM U300 Checksum error of system RAM A2U300.

715 RAM U305 Checksum error of system RAM A2U305.

716 RAM U304 Checksum error of system RAM A2U304.

### Microprocessor Error (717)

717 BAD uP Microprocessor not fully operational. Refer to Chapter 10, "Controller Section."

## Battery Problem (718)

If STATE or TRACE data is found to be corrupt, the processor tests the display RAMs and the program RAMs containing the STATE information. If the RAMs are working properly, this error message is generated. To check the BT1 battery and the battery backup circuitry, refer to “State- and Trace-Storage Problems” in Chapter 10 .

718 BATTERY? Nonvolatile RAM not working; check battery BT1. This error can also be generated if the battery has been disconnected then reconnected. If this is the cause, cycling power clears the error.

## Model/Option Number Errors (719 to 720)

If one of these errors occurs, return the instrument to a service center for repair.

719 MODEL #? Could not read ID string from EEROM A2U501.

720 OPTION #? Cannot identify an option number.

## RAM Check Error (721)

| | |
|---|---|
| `721 AMPC RAM` | Checksum error of the ampcor function correction data. |

## System Errors (750 to 759)

These errors often require troubleshooting the A2 controller and A3 interface assemblies.

| | |
|---|---|
| `750 SYSTEM` | Hardware/firmware interaction, zero divide. Check for other errors. |
| `751 SYSTEM` | Hardware/firmware interaction, floating point overflow. Check for other errors. |
| `752 SYSTEM` | Hardware/firmware interaction, floating point underflow. Check for other errors. |
| `753 SYSTEM` | Hardware/firmware interaction, log error. Check for other errors. |
| `754 SYSTEM` | Hardware/firmware interaction, integer overflow. Check for other errors. |
| `755 SYSTEM` | Hardware/firmware interaction, square root error. Check for other errors. |
| `756 SYSTEM` | Hardware/firmware interaction, triple overflow. Check for other errors. |
| `757 SYSTEM` | Hardware/firmware interaction, BCD overflow. Check for other errors. |
| `758 SYSTEM` | Unknown system error. |
| `759 SYSTEM` | Hardware/firmware interaction. Code invoked for wrong instrument. |

## Fast ADC Error (760)

This error applies only to EC-series instruments and to E-series instruments with fast ADC (Option 007).

| | |
|---|---|
| `760 NO FADC` | The FADC board did not respond properly to initialization commands. |

## Option Module Errors (800 to 899)

These error codes are reserved for option modules, such as the 85629 test and adjustment module and the 85620A mass memory module. Refer to the option module manual for a listing of error messages.

## User-Generated Errors (900 to 999)

These error codes indicate user-generated errors.

900 TG UNLVL Tracking generator output is unleveled.

901 TGFrqLmt Tracking generator output unleveled because START FREQ is set below tracking generator frequency limit (300 kHz).

902 BAD NORM The state of the stored trace does not match the current state of the spectrum analyzer.

903 A > DLMT Unnormalized trace A is off-screen with trace math or normalization on.

904 B > DLMT Calibration trace (trace B) is off-screen with trace math or normalization on.

905 EXT REF Unable to lock cal oscillator when set to external frequency reference. Check that the external 10 MHz reference is within tolerance.

906 OVENCOLD The oven-controlled crystal oscillator (OCXO) oven is cold.

907 DO IF CAL Unit is still performing IF calibrations, or is in need of IF calibrations which were not yet done due to an OVENCOLD condition. An OVENCOLD error is indicative of a bandwidth ≤1 kHz not getting calibrated.

908 BW>>SPCG Channel bandwidth is too wide, compared to the channel spacing, for a meaningful adjacent channel power computation.

909 SPANACP The frequency span is too small to obtain a valid adjacent channel power (ACP) measurement.

910 SPAN>ACP The frequency span is too wide, compared to the channel bandwidth, to obtain a valid adjacent channel power (ACP) measurement.

911 ACPSTATE Adjacent channel power (ACP) measurement has been compromised (invalid measurement parameters).

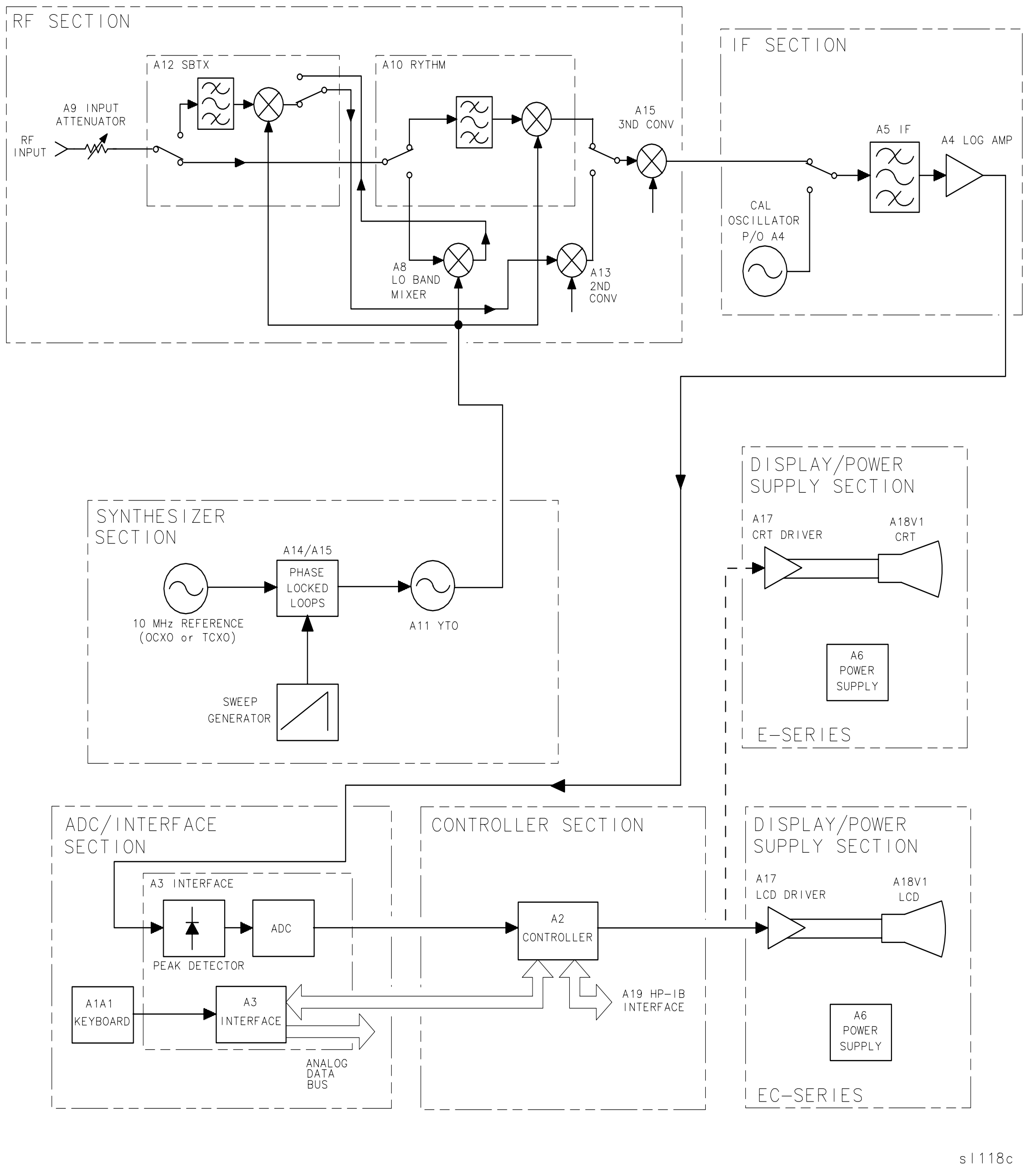
921 ↑AMPCOR↑ Measurement data which would normally be displayed above the top graticule, and therefore has unspecified accuracy, has been corrected by the amplitude correction function (ampcor) to appear between the top and bottom graticule.

922 ↓AMPCOR↓ Measurement data which would normally be displayed below the bottom graticule, and therefore has unspecified accuracy, has been corrected by the amplitude correction function (ampcor) to appear between the top and bottom graticule.

# Block Diagram Description

The spectrum analyzer is comprised of the six main sections listed below. See Figure 7-6 on page 352. The following descriptions apply to the simplified block diagram and overall block diagram located at the end of this chapter. Assembly level block diagrams are located in Chapters 8 through 13.

**Figure 7-6 Functional Sections**



## RF Section

The RF section of the 8564EC and 8565EC includes the following assemblies:

A7 LOMA (LO multiplier/amplifier)
A8 low band mixer
A9 input attenuator
A10 RYTHM (YIG-tuned filter/mixer)
A11 YTO (YIG-tuned oscillator)
A12 SBTX (switched barium-tuned mixer)
A13 second converter
A14 frequency control assembly (also in synthesizer section)
A15 RF assembly (also in synthesizer section)
FL1, FL2, FL3, and FL5 low-pass filters

The RF section converts all input signals to a fixed IF of 10.7 MHz. The RF section microcircuits are controlled by signals from the A14 frequency control and A15 RF assemblies.

Band 0 ............................................................ 9 kHz to 2.9 GHz

Bands 1 through 3 ............................................. 2.9 to 26.5 GHz

Bands 4 and 5 ..................................................... 26.5 to 50 GHz

Band 0 and bands 4 and 5 use triple conversion to produce the 10.7 MHz IF, and a fourth conversion used only in the digital resolution bandwidths (≤100 Hz). In band 0, A8 low band mixer up-converts the RF input to a 1st IF of 3.9107 GHz. In bands 4 and 5, A12 SBTX down-converts the RF input to a 1st IF of 3.9107 GHz. A13 second converter down-converts the 3.9107 GHz IF to an IF of 310.7 MHz. A third conversion on the A15 RF assembly down-converts the second IF to the 10.7 MHz third IF. A fourth conversion on the A4 log amplifier assembly down-converts the third IF to the 4.8 kHz fourth IF used only in the digital resolution bandwidths (≤100 Hz).

Bands 1 through 3 use double conversion. A third conversion is used for the digital resolution bandwidths (≤100 Hz). A10 RYTHM down-converts the RF input to a 1st IF of 310.7 MHz. Although this IF passes through the A13 second converter, it bypasses the second mixer. The second conversion on the A15 RF assembly down-converts the 310.7 MHz IF to 10.7 MHz. A third conversion on the A4 log amplifier assembly down-converts the second IF to the 4.8 kHz third IF used only in the digital resolution bandwidths (≤100 Hz).

### A7 LOMA

The A7 LOMA (LO multiplier/amplifier) levels the output of the A11 YTO and distributes the YTO fundamental frequency to the front panel 1ST LO OUTPUT, A8 low band mixer, A10 RYTHM, and A15U100 sampler. It also doubles the YTO frequency and levels this signal for use by the A12 SBTX. The leveling circuitry is on the A14 frequency control assembly.

### A8 Low Band Mixer

A8 low band mixer is dc-coupled and contains a limiter.

The high-band mixing is done in either the A10 YIG-tuned filter/mixer or the A12 SBTX. PIN diode switches in A10 and A12 direct the RF input to the appropriate mixer. A PIN diode switch in A7 LOMA directs the 1st LO to the appropriate mixer. Power for the LO and RF amplifiers is provided via W15 from A14.

### A9 Input Attenuator

The attenuator is a 50Ω precision, coaxial step attenuator. Attenuation in 10 dB steps from 0 dB to 70 dB is accomplished by switching the signal path through one or more of the three resistive pads. The attenuator automatically sets to 70 dB when the spectrum analyzer turns off, providing ESD protection. (Note that the input attenuator is not field-repairable.)

### A10 YIG-Tuned Filter/Mixer

The YIG-tuned filter/mixer (RYTHM) is a combination of an RF switch, a microwave (2.9 GHz to 26.8 GHz) mixer, and a tracking preselector. The PIN diode switch directs the RF input to the appropriate mixer in the A10 RYTHM assembly or A8 low band mixer.

The tracking preselector is a YIG-tuned filter. It functions as a tunable bandpass filter for microwave signals. Coarse frequency control originates from slope and offset DACs located on the A14 frequency control assembly. (Slope and offset DAC values are loaded into EEROM.)

Fine frequency control originates from a preselector peak DAC located on the A3 interface assembly. Values for the preselector peak DAC are interpolated approximately every 17 MHz based upon data taken during the frequency response (flatness) adjustment. The preselector bandwidth varies from greater than 30 MHz, at 2.75 GHz, to greater than 60 MHz, at 26.5 GHz.

The mixer is ac coupled. It uses the first, second, and fourth harmonics, mixed with the 1st LOcal oscillator, to cover the frequency range. A PIN diode switch in A7 LOMA directs the 1st LO to the appropriate mixer. The A14 frequency control assembly provides PIN diode bias.

### A11 YTO

A11 is a YTO (YIG-tuned oscillator). YIG (yttrium-iron-garnet) is a ferro-magnetic material which is polished into a small sphere and precisely oriented in a magnetic field. Changes in this magnetic field alter the frequency generated by the YTO. Current control of the magnetic field surrounding the YIG sphere tunes the oscillator to the desired frequency.

### A12 Switched Barium-Tuned Mixer (SBTX)

The switched barium-tuned mixer (SBTX) is a combination of an RF switch, tracking preselector, millimeter (26.5 GHz to 50 GHz) mixer, and low-noise amplifier. The PIN diode switch directs the RF input to the appropriate mixer in the A12 SBTX or to A10 RYTHM, where it may be again switched to the A8 low band mixer.

The tracking preselector is a barium-tuned filter. It functions as a tunable bandpass filter for millimeter signals. Coarse frequency control originates from slope and offset DACs located on the A14 frequency control assembly. (Slope and offset DAC values are loaded into EEROM.)

Fine frequency control originates from a preselector peak DAC located on the A3 interface assembly. Values for the preselector peak DAC are interpolated approximately every 17 MHz based upon data taken during the frequency response adjustment ('front-end cal'). The preselector 3 dB bandwidth varies from approximately 200 MHz at 26.5 GHz to approximately 300 MHz at 50 GHz.

The millimeter mixer IF (3.9107 GHz) is fed through a low-noise amplifier and one input of a PIN diode switch before being sent to the A13 second converter. The other switch input accepts the IF output of the A8 low band mixer.

### A13 Second Converter

The A13 second converter down-converts the 3.9107 GHz 1st IF (low-band and millimeter band) to a 310.7 MHz 2nd IF. In the microwave band, it passes the 310.7 MHz 1st IF from the A10 YIG-tuned filter/mixer to the A15 RF assembly. The converter generates a 3.6 GHz second LO by multiplying a 600 MHz reference. Bandpass filters remove unwanted harmonics of the 600 MHz driving signal. 1st IF and 2nd LO signals are filtered by cavity filters.

### Second IF Amplifier (part of A15)

The second IF amplifier (SIFA) amplifies and filters the second IF. Access to this pre-filtered signal is available at the rear panel 2ND IF OUTPUT (Option 001 only).

The external mixing input from the front panel IF INPUT connector is also directed through the SIFA. A dc bias is placed onto the IF INPUT line for biasing external mixers.

### Third Converter (part of A15)

The third converter down-converts the 310.7 MHz IF to 10.7 MHz. A PIN-diode switch selects the LO signal used. For normal operation, a 300 MHz LO signal is used. The signal is derived from the 600 MHz reference PLL. During signal identification (SIG ID ON), the 298 MHz SIG ID oscillator is fed to the double balanced mixer on alternate sweeps.

### Flatness Compensation Amplifiers (part of A15)

The flatness compensation amplifiers amplify the output of the double-balanced mixer. The variable gain of the amplifier (0 to 45 dB) compensates for flatness variations within a band. Band conversion loss is compensated by step gain amplifiers in the IF section.

Control for the amplifiers originates from two DACs on the A3 Interface assembly. (DAC values are interpolated approximately every 17 MHz based on data obtained during the frequency response adjustment.) The flatness-compensation control circuitry on A15 converts the RF GAIN voltage, from A3, into two currents: RF GAIN1 and RF GAIN2. These currents drive PIN diodes in the flatness compensation amplifiers.

## Synthesizer Section

The 1st LO is phase-locked to the 10 MHz standard internal to the instrument by four PLLs. See Figure 7-7 on page 358.

The reference PLL supplies reference frequencies for the instrument. The three remaining PLLs tune and phase-lock the LO through its frequency range. To tune the LO to a particular frequency, the instrument microprocessor must set the programmable feedback dividers (N) and reference dividers (R) contained in each PLL.

### Sweeping the 1st LO

The spectrum analyzer uses a method called lock and roll to sweep the 1st LO (A11 YTO) for LO spans >2 MHz. This involves phase-locking the spectrum analyzer at the start frequency during the retrace of the sweep, then sweeping through the desired frequency range in an unlocked condition. The sweep ramp, which sweeps the LO during the roll part of the lock and roll process, is generated on the A14 frequency control assembly. It is applied to either the main coil or the FM coil of the A11 YTO. For LO spans≤2.0 MHz, the YTO PLL remains locked and the fractional N PLL sweeps while remaining phase locked. The frequency/span relationships are as follows:

| A11 YTO Spanwidth | Sweep Applied To |
|---|---|
| **20.1 MHz to 3.8107 GHz** | A11 YTO main coil |
| **2.01 MHz to 20.0 MHz** | A11 YTO FM coil |
| **100 Hz to 2 MHz** | Fractional N phase locked loop |

When the sweep ramp is applied to the YTO, the spectrum analyzer must prevent this loop from trying to compensate for changes in the output frequency. To accomplish this, the spectrum analyzer opens the PLL by disconnecting the YTO PLL phase detector output.

### Reference PLL (part of A15)

The 100 MHz PLL output is routed through multipliers to provide 600 MHz for the second LO, and 300 MHz for the third LO and the sampling oscillator reference.

The reference PLL is also divided down to 10 MHz for the fractional N PLL. The reference PLL is locked to a 10 MHz OCXO (oven-compensated crystal oscillator) or a TCXO (Option 103). The PLL can also be locked to an external frequency reference.

The 10 MHz reference also supplies the reference for the frequency counter on the A2 controller assembly, and the cal oscillator on the A4 assembly.

### YTO PLL (A7, A11, part of A14, part of A15)

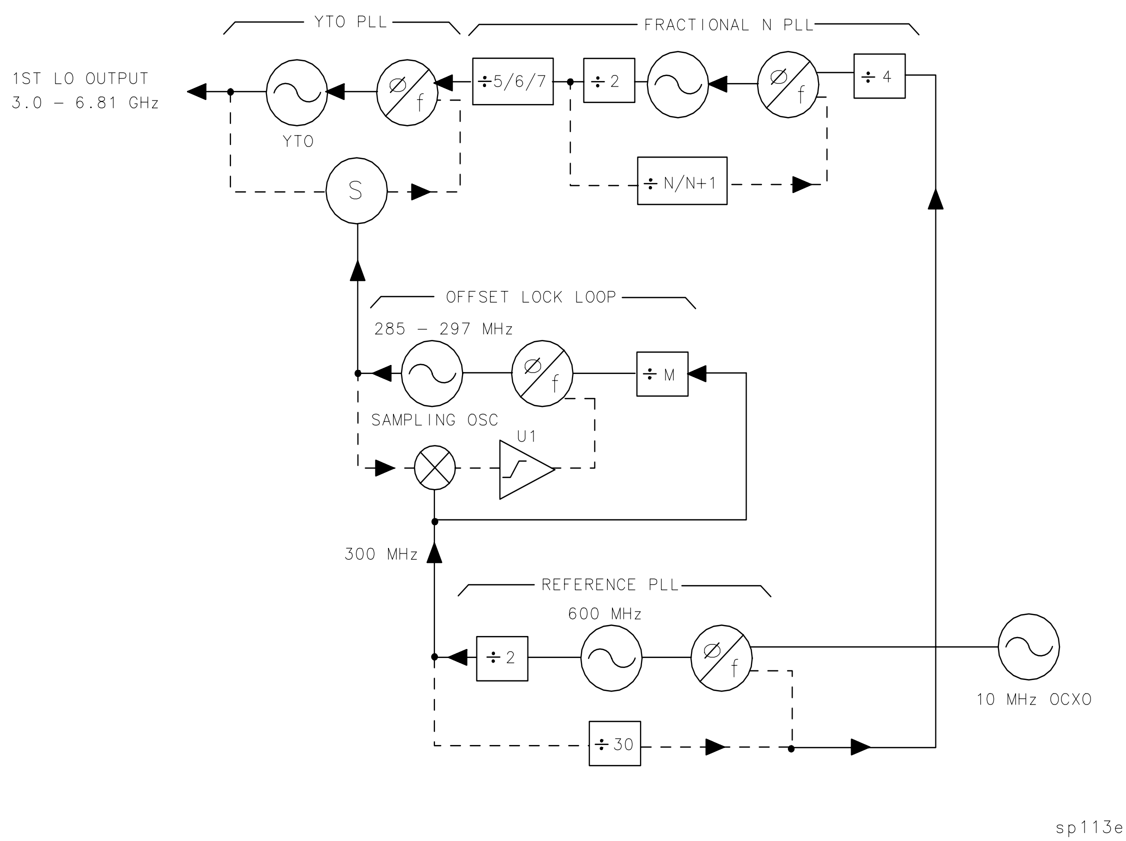
The YTO PLL produces the 1st LO of the instrument (3.0 to 6.81 GHz). The YTO output is mixed with a harmonic of the sampling oscillator in the sampler (A15A2), and the resulting frequency is phase-locked to the output of the fractional N PLL.

The A15U100 sampler mixes the LO signal from the A7 LOMA with a harmonic of the sampling oscillator. The mixing product, the sampler IF, is between 60 and 96 MHz (same frequency range as the fractional N PLL).

### Offset Lock Loop (part of A15)

The 285 MHz to 297.2 MHz sampling oscillator is used to sample the YTO. By changing the offset lock loop programmable dividers, the YTO frequency can be changed.

**Figure 7-7 Phase Lock Loops**



### Fractional N PLL (part of A14)

The fractional N PLL produces an output of 60 MHz to 96 MHz. This PLL output serves as the reference frequency for the YTO PLL. A one-to-one relationship in frequency tracking exists between the fractional N PLL and the YTO. A change of 1 MHz in the fractional N PLL will produce a 1 MHz change in the YTO frequency.

## IF Section

The IF section processes the 10.7 MHz output of the RF section and sends the detected video to the ADC/interface section. The following major assemblies are included in this section:

A3 interface assembly
A4 log amplifier/calibration oscillator assembly
A5 IF assembly

The spectrum analyzer uses trace-data manipulation to generate the 5 dB/DIV scale from the 10 dB/DIV scale. The A3 interface assembly amplifies and offsets the 10 dB/DIV video to generate the 2 dB/DIV scale. The 1 dB/DIV scale is generated from the 2 dB/DIV scale through trace data manipulation. The first 50 dB of IF gain (log and linear mode) is achieved using the linear step-gain amplifiers on the A5 assembly. The video-offset circuit on the A4 assembly provides the remaining 60 dB of log mode IF gain. The linear amplifiers on the A4 assembly provide 40 dB of linear mode gain. IF gain steps of less than 10 dB (regardless of the reference level) are accomplished on the A5 assembly.

### A4 Log Amplifier/Cal Oscillator Assembly

The A4 log amplifier has separate log and linear amplifier paths. After amplification, the signal path consists of a linear detector, video log amp, buffer amplifier, video offset, and video buffer amplifier. Other auxiliary functions include the frequency counter prescaler/conditioner, the AM/FM demodulator, and down-conversion to 4.8 kHz for digital resolution bandwidths of 1 Hz through 100 Hz.

The cal oscillator, which is part of A4, supplies the stimulus signal for automatic IF adjustments. Normally, the oscillator operates only during retrace (for a few milliseconds) to adjust part of the IF. (All IF parameters will be re-adjusted approximately every five minutes.) With continuous IF adjust on, a group of IF parameters are adjusted during each retrace period (non-disruptive). If continuous IF adjust is off, the most recent IF calibration data will be used.

The IF parameters adjusted include step gains, log amplifier gain and offset, bandwidth centering, 3 dB bandwidth, bandwidth amplitude, crystal-filter symmetry, and oscillator frequency used in 1 Hz through 100 Hz resolution bandwidths.

The cal oscillator output has three forms (all –35 dBm):

- 10.7 MHz
- 9.9 to 11.5 MHz in 100 kHz steps
- Frequency sweeps from 20 kHz to 2 kHz centered at 10.7 MHz (lasting 5 to 60 ms respectively)

The purpose of these signals is:

- Adjust gains, log amps, and video slopes and offsets
- Adjust 3 dB bandwidth and center frequencies of LC resolution BW filters (30 kHz through 1 MHz).
- Adjust 3 dB bandwidth, symmetry, and gain of the crystal resolution BW filters (300 Hz through 10 kHz).
- Adjust gain and gain-vs-frequency for digital resolution bandwidths (1 Hz through 100 Hz).

### A5 IF Assembly

The A5 IF assembly has four crystal filter poles, four LC filter poles, and step gain amplifiers. The crystal filters provide resolution bandwidths of 300 Hz to 10 kHz. The LC filters provide resolution bandwidths of 30 kHz to 2 MHz. All filter stages are in series. PIN diode switches bypass unwanted stages.

An automatic IF adjustment, in spectrum analyzer firmware, sets center frequency and 3 dB bandwidth of all filter poles through varactor and PIN diodes. The firmware also controls crystal-pole symmetry and the step gain amplification.

## ADC/Interface Section

The ADC/interface section is the link between the controller section and the rest of the spectrum analyzer. It controls the RF, synthesizer, and IF sections through address and data lines on the W2 control cable (analog bus). Analog signals from these sections are monitored by the ADC (analog to digital converter) circuit on the ADC/interface section.

The ADC/interface section includes the A3 interface assembly, A1A1 keyboard, and A1A2 RPG (front panel knob). The A3 assembly includes log expand, video filter, peak detector, track-and-hold, real-time DACs, RF gain DACs, +10 V reference, and ADC circuitry. The digital section of the A3 assembly includes ADC ASM, sweep trigger, keyboard interface, RPG interface, and analog bus interface circuitry.

### ADC

The spectrum analyzer can digitize signals with either the main ADC on the A3 interface assembly, or the optional A16 fast ADC (Option 007). The main ADC is used for digitizing video signals (when the sweep time is ≥30 ms) and various other signals such as PLL error voltages. The fast ADC is used only to digitize video signals for sweep times ≤30 ms.

**Main ADC (part of A3 interface assembly)** For slower sweep times (≤30 ms) the spectrum analyzer uses a successive-approximation type of ADC. The main ADC has a 10-bit resolution but it is realized with 12-bit hardware. The ADC algorithmic state machine (ADC ASM) controls the interface between the start/stop control and the ADC itself, switching between positive and negative peak detectors when the NORMAL detector mode is selected, and switching the ramp counter into the ADC for comparison to the analog sweep ramp.

**Fast ADC** When Option 007 is installed and sweep times ≤30 ms are selected, the spectrum analyzer digitizes video signals with the A16 fast ADC. The fast ADC uses an 8-bit flash ADC, sampled at a 12 MHz rate. Only POS PEAK, NEG PEAK, and SAMPLE detector modes are available with fast ADC; NORMAL detector mode is not available. Pretriggering is possible with fast ADC.

### Log Expand/Video Functions

The A3 interface assembly performs log expand and offset functions. The log expand/log offset amplifier provides a 2 dB/Div log scale. When the main ADC is used, the 5 dB/Div scale is derived by multiplying the digitized 10 dB/Div trace data by two in the CPU. When the fast ADC is used, the 5 dB/Div scale is derived by amplifying the video signal by two. The 1 dB/Div scale is similarly derived by either multiplying the 2 dB/Div trace data by two (main ADC) or amplifying the video signal by two (fast ADC).

The spectrum analyzer uses two types of video filters. An RC low-pass circuit provides 300 Hz to 3 MHz video bandwidths. Video bandwidths ≤100 Hz are generated using digital filtering. Digitally filtered video bandwidths use a sample detector. When sample detection is selected, the effective video bandwidth is limited to approximately 450 kHz. When a digital filter is selected, a D appears along the left edge of the CRT, indicating that something other than the normal detector mode is being used.

After filtering, the video is sent to the positive and negative peak detectors. These detectors are designed for optimum pulse response. The positive peak detector resets at the end of each horizontal "bucket" (there are 601 such buckets across the screen). The negative peak detector resets at the end of every other bucket. When reset, the output of the peak detector equals its input.

### Triggering

The spectrum analyzer has five trigger modes: free run, single, external, video, and line. The free run and single trigger signal comes from the 1 MHz ADC clock. The line trigger signal comes from the A6 power supply. Video triggering originates from the A3 video filter buffer circuit. External triggering requires either a high or low TTL logic level as determined by the setting of the trigger polarity function. The external trigger signal is received from a rear panel BNC connector. A DAC in the trigger circuit sets the video trigger level. The trigger circuit is responsible for setting HSCAN high.

## Controller Section

The controller section includes the A2 controller assembly and A19 GPIB assembly. The battery on the rear panel provides battery backup for state and trace storage.

In 8564EC and 8565EC instruments the A2 contains the CPU, RAM, ROM, the display ASM, Fast ADC circuitry, GPIB interface, control, frequency counter, display RAM, option module interface, and EEROM.

The A19 GPIB is a mechanical interface between the standard GPIB connector and the ribbon cable connector on the A2 controller assembly.

All four RAM ICs are battery-backed. The battery-backed RAM stores trace information (two display memory RAMs) and spectrum analyzer state information (two program RAMs). A total of eight traces and ten states may be stored. Typical battery life is five years with the lithium battery. Trace and state information may be retained for up to 30 minutes with a dead battery and power turned off. This is due to the very low data retention current of the RAM.

### EEROM

The EEROM stores important amplitude-related correction data. This includes data for LO distribution amplifier DACs, preselector slope and offset DACs, RF gain DACs (flatness correction), and preselector peak DAC. The spectrum analyzer serial number, model number, and installed options are also stored in EEROM.

**Firmware** The spectrum analyzer firmware reads the model number and installed options from the EEROM to determine how to respond to certain keystrokes.

**Display ASM** Much of the miscellaneous digital control is performed by A2U100. U100 functions as the display ASM (algorithmic state machine) and character ROM. It also converts the 16-bit CPU data bus to an 8-bit data bus for the rest of the spectrum analyzer.

## Display/Power Supply Section

### A6 Power Supply

The A6 power supply is a switching supply operating at 40 kHz

The speed of the spectrum analyzer fan is variable. A thermistor on A6 senses the temperature and adjusts the fan speed accordingly. This allows the spectrum analyzer to run quietly in most room-temperature environments and faster (louder) only when necessary.

### A17 LCD Display Driver

The display is an LCD color flat panel screen with 640 X 480 VGA resolution. A connector for an external VGA is available at the rear panel. The A17A1 backlight supply provides the high voltage to supply the two backlights in the LCD display. The LCD display is not adjustable.

The display driver board consists of the Hitatchi 7707 processor, an Actel FPGA, DRAM, SRAM, a filter circuit, and a video DAC. This board monitors the 8560 EC-series controller board, copies display instructions to local memory, creates a bitmap from the data, and generates the signals needed to drive the LCD and a VGA monitor. The video DAC converts the digital color information from the LCD to analog; these analog signals drive the RGB color lines on the VGA port on the rear panel.


sm13c

FIGURE 7-8. SIMPLIFIED BLOCK DIAGRAM




FIGURE 7-9.

OVERALL BLOCK DIAGRAM

8564EC AND 8565EC OVERALL BLOCK DIAGRAM


sm123c

FIGURE 7-9. 8564EC AND 8565EC OVERALL BLOCK DIAGRAM (SHEET 3 OF 5)

# 8 ADC/Interface Section

# Introduction

The ADC/Interface section includes the A1A1 keyboard, A1A2 RPG (rotary pulse generator), A3 interface,
assemblies. Table 8-1 on page 379 lists signal versus pin numbers for control cable W2. Figure 8-1 on page 380 illustrates the location of the test connectors on A3.

**Table 8-1 W2 Control Cable Connections (1 of 2)**

| Signal | A3J2 (pins) | A4J2 (pins) | A5J2 (pins) | A14J2 (pins) | A15J2 (pins) |
|---|---|---|---|---|---|
| D0 | 1* | 1 | 50 | 1 | 1 |
| D GND | 2* | 2 | 49 | 2 | 2 |
| D1 | 3* | 3 | 48 | 3 | 3 |
| D2 | 4* | 4 | 47 | 4 | 4 |
| D3 | 5* | 5 | 46 | 5 | 5 |
| D4 | 6* | 6 | 45 | 6 | 6 |
| D GND | 7* | 7 | 44 | 7 | 7 |
| D5 | 8* | 8 | 43 | 8 | 8 |
| D6 | 9* | 9 | 42 | 9 | 9 |
| D7 | 10* | 10 | 41 | 10 | 10 |
| A0 | 11* | 11 | 40 | 11 | 11 |
| D GND | 12* | 12 | 39 | 12 | 12 |
| A1 | 13* | — | 38 | 13 | 13 |
| A2 | 14* | — | 37 | 14 | 14 |
| A3 | 15* | 15 | 36 | 15 | 15 |
| A4 | 16* | — | 35 | 16 | 16 |
| D GND | 17* | 17 | 34 | 17 | 17 |
| A5 | 18* | — | 33 | 18 | — |
| A6 | 19* | — | 32 | — | — |
| A7 | 20* | — | 31 | 20 | — |
| D GND | 21* | 21 | 30 | 21 | 21 |
| LRF_STB | 22* | — | — | — | 22 |
| LFC_STB | 23* | — | — | 23 | — |
| LIF_STB | 24* | — | 27 | — | — |
| CAL OSC TUNE | 25 | 25* | — | — | — |
| LLOG_STB | 26* | 26 | — | — | — |
| VCMON | — | — | — | 27 | — |
| D GND | 28* | 28 | 23 | 28 | 28 |
| RT PULSE | 29* | — | — | — | — |
| HSCAN | 30* | — | — | 30 | — |
| D GND | 31* | 31 | 20 | 31 | 31 |
| RESERVED | — | — | — | — | — |
| OFL ERR | 33 | — | — | — | 33* |
| R/T DAC3 | 34* | — | — | — | — |

* Indicates signal source.

Table 8-2

## Table 8-1. W2 Control Cable Connections (2 of 2)

| Signal | A3J2 (pins) | A4J2 (pins) | A5J2 (pins) | A14J2 (pins) | A15J2 (pins) |
|---|---|---|---|---|---|
| A GND | 35* | 35 | 16 | 35 | 35 |
| RF GAIN | 36* | — | — | — | 36 |
| LO3 ERR | — | — | — | 37 | 37* |
| A GND | 38* | 38 | 13 | 38 | 38 |
| LVFC_ENABLE | 39* | — | — | 39 | — |
| FC ERR | 40 | — | — | 40* | — |
| A GND | 41* | 41 | 10 | 41 | 41 |
| YTO ERR | 42 | — | — | 42* | — |
| +10V REF | 43* | 43 | — | — | 43 |
| A GND | 44* | 44 | 7 | 44 | 44 |
| SCAN RAMP | 45 | — | — | 45* | — |
| VIDEO TRIGGER | 46* | — | — | — | — |
| A GND | 47* | 47 | 4 | 47 | 47 |
| NC | — | — | — | — | — |
| R/T DAC2 | 49* | — | — | — | — |
| R/T DAC1 | 50* | — | — | 50 | — |
| * Indicates signal source. | | | | | |

Figure 8-1

## A3 Test Connectors

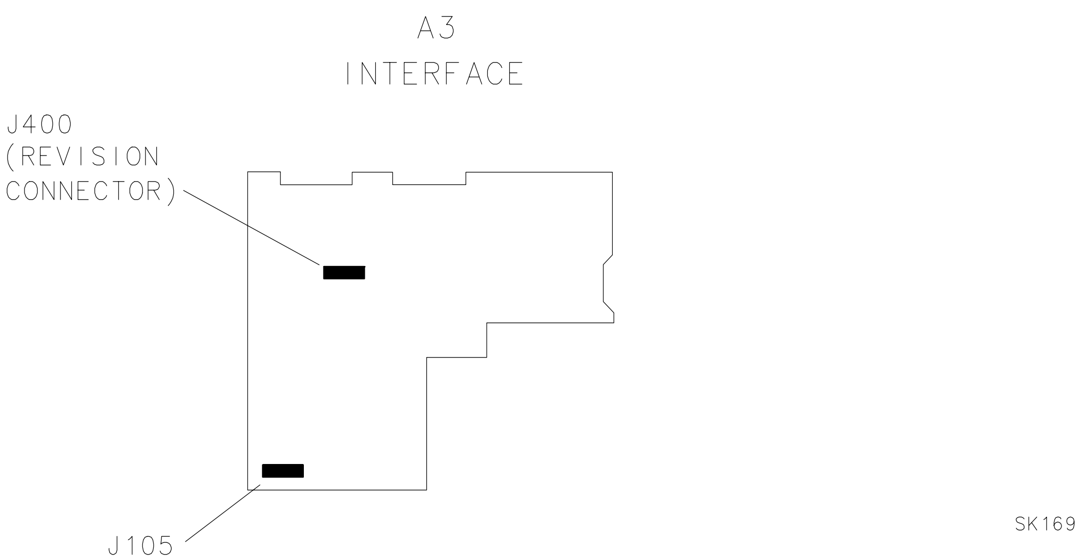
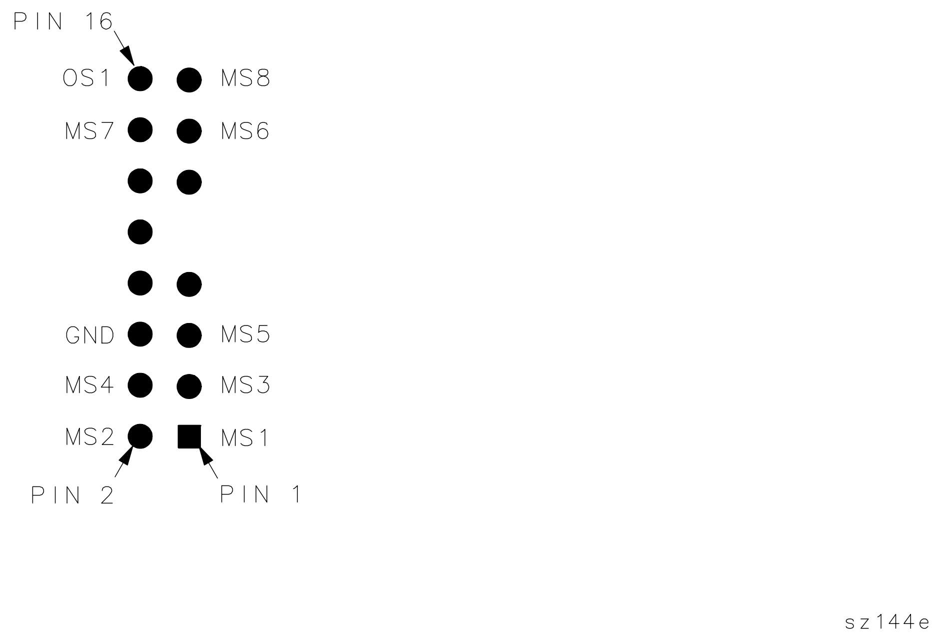


**Figure 8-2 A3 Test Connector Pin Locations**



# Keyboard/RPG Problems

## Keyboard Interface

Refer to function block G of A3 Interface Assembly Schematic Diagram (sheet 3 of 6) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

A pressed key results in a low on a keyboard sense line (LKSNS0 through LKSNS7). This sets the output of NAND gate U607 high, generating KBD/RPG_IRQ. The CPU determines the key pressed by setting only one keyboard scan line (LKSCN0 through LKSCN5) low through U602 and reading the keyboard sense lines.

1. If none of the keys or RPG responds, check ribbon cable, A1A1W1. (This cable connects the A1A1 keyboard to the A3 interface assembly.) The keys are arranged in a row/column matrix, as shown in Table 8-3 on page 382.
2. If an entire row or column of keys does not respond, and the RPG does respond, there might be an open or shorted wire in A1A1W1.

**Table 8-3 Keyboard Matrix**

| | LKSNS0 | LKSNS1 | LKSNS2 | LKSNS3 | LKSNS4 | LKSNS5 | LKSNS6 | LKSNS7 |
|---|---|---|---|---|---|---|---|---|
| **LKSCN0** | CONFIG | SAVE | RECALL | GHz | MHz | kHz | Hz | PRESET |
| **LKSCN1** | MODULE | TRIG | DISP | 9 | 6 | 3 | BK SP | ↑ |
| **LKSCN2** | PEAK SEARCH | BW | TRACE | 8 | 5 | 2 | • | ↓ |
| **LKSCN3** | FREQ COUNT | AUTO COUPLE | MKR → | 7 | 4 | 1 | 0 | HOLD |
| **LKSCN4** | SWEEP | SK1 | SK2 | SK3 | SK4 | SK5 | SK6 | MKR |
| **LKSCN5** | AUX CRTL | MEAS/ USER | CAL | SGL SWP | COPY | FRE-QUENCY | SPAN | AMPLI-TUDE |

3. Check that all inputs to NAND gate A3U607 (LKSNS lines) are high when no key is pressed. If any input is low, continue with the following:
   a. Disconnect A1A1W1 from A3J602 and again check all inputs to U607.
   b. If any input is low with A1A1W1 disconnected, suspect A3U604, A3U607, or A3U602.
   c. Reconnect A1A1W1 to A3J602.

4. Monitor A3U607 pin 8 with a logic probe. A TTL high should be present when any key is held down. Monitor this point while pressing each key in succession.
5. Check that the LKSCN lines (outputs of A3J602 pins 1 through 6) read a TTL low with no key pressed. (Any TTL high indicates a faulty A3 Interface assembly.)
6. Check that a pulse is present at each LKSCN output of U602 when a key is pressed.
7. Check that only one input to U607 (LKSNS lines) goes low when a key is pressed.
8. Check that U602 pin 9 (LKBD_RESET) pulses low when a key is pressed.
9. If LKBD_RESET is incorrect and a pulse is not present at each of the LKSCN outputs of U602 when a key is pressed, check for LWRCLK and LSCAN_KBD.

## RPG Interface

Refer to function block J of A3 Interface Assembly Schematic Diagram (sheet 3 of 6) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

U608B latches the RPG direction from the two RPG outputs, RPG_COUNT and RPG_COUNT1. Counterclockwise RPG rotation produces low-going pulses which result in a high output on U608B. Clockwise RPG rotation results in a low output from U608B. U612A provides the edge to trigger one-shot U423B, which generates a 90 ms pulse. This pulse gates U610A for counting of RPG pulses by U606. Gates U610D and U614D prevent retriggering of U423B until its 90 ms pulse has timed out.

**NOTE** Elsewhere, RPG_COUNT1 is referred to as RPG_01 and RPG_COUNT is referred to as RPG_02.

1. Monitor A3U401 pin 2 with a logic probe or oscilloscope. Pulses should be present as the RPG is rotated.
2. Monitor A3U608 pin 12 as the RPG is rotated. Pulses should be present.
3. If pulses are missing at both points, check for power and ground signals to A1A1W1 and A1A2W1. If both power and ground are there, the A1A2 RPG is probably defective.
4. If pulses are missing at only one point, check for an open or short on A1A1W1 and A1A2W1. If these cables are working properly, A1A2 RPG is probably defective.

5. Press **LINE** to turn spectrum analyzer off and disconnect A1A1W1 from A3J602. Jumper A3U608 pin 12 (RPG_COUNT1) to U608 pin 14 (+5 Vdc). Jumper U401 pin 2 (RPG_COUNT1) to U511 pin 11 (HDPKD_CLK). This provides a 7.8 kHz square wave to the RPG_COUNT input of the RPG Interface.
6. Press **LINE** to turn spectrum analyzer on.
7. Check A3U608 pin 9 for narrow, low-going pulses approximately every 90 ms.
8. Check A3U608 pin 13 (LRPG_RESET) for narrow, low-going pulses approximately every 90 ms.
9. Check A3U612 pin 5 for narrow, low-going pulses approximately every 90 ms.
10. Check U608 pin 5 (HRPG_IRQ) for narrow, high-going pulses approximately every 90 ms.
11. If HRPG_IRQ is correct but LRPG_RESET is incorrect, check U505 pin 13 (LKBD/RPG_IRQ) for narrow, low-going pulses approximately every 90 ms.
12. If HRPG_IRQ and LKBD/RPG_IRQ are correct but LRPG_RESET is incorrect, suspect a failure on the A2 controller assembly.
13. Check U610 pin 3 for a 7.8 kHz square wave. Check U606 pin 2 (HRPG_RESET) for narrow, high-going pulses approximately every 90 ms. Refer to Table 8-4 on page 384 and check the frequencies at divide-by-16 counter A3U606.
14. If all the checks above are correct but the spectrum analyzer does not respond to the RPG, suspect a problem in either the A1A2 RPG or the A1A1 Keyboard.
15. Press **LINE** to turn spectrum analyzer off.
16. Reconnect A1A1W1 to A3J602 and remove all jumpers.

**Table 8-4 Counter Frequencies**

| A3U606 pin # | Nominal Frequency (Hz) |
|---|---|
| 3 | 3900 |
| 4 | 1950 |
| 5 | 975 |
| 6 | 488 |
| 11 | 244 |
| 10 | 122 |
| 9 | 61 |

# Triggering or Video Gating Problems

Refer to function block H of A3 Interface Assembly Schematic Diagram (sheet 3 of 6) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

The 1 MHz ADC clock provides synchronization in FREE RUN and SINGLE triggering. LINE triggering synchronization originates on the A6 power supply. Trigger MUX A3U613 selects between FREE RUN, VIDEO, LINE, and EXTERNAL trigger sources. The trigger signal sets the output of the HSCAN latch high. HBADC_CLK0 provides the trigger signal for FREE RUN. The VIDEO TRIG signal must be at least 25 mV (0.25 divisions) peak-to-peak to trigger in video trigger mode.

The 3 MHz video bandwidth is not available when using video gating. The trigger for Gated Video has two modes of operation, level mode and edge mode. In the edge mode, positive-edge or negative-edge triggering can be selected. Output 0 from pin 10 of A3U617 generates the gate delay and output 1 from pin 13 of A3U617 generates the gate length. The duration of these two time intervals is set using front-panel softkeys under the **SWEEP** key. The trigger input for Gated Video is the rear panel EXT/GATE TRIG INPUT (TTL > 10 kΩ).

1. Check that the trigger MUX is receiving the proper trigger source information by selecting each of the following trigger modes and checking the TRIG_SOURCE0 and TRIG_SOURCE1 lines as indicated in Table 8-5 below.
2. If a trigger mode does not work, check that a trigger signal is present at the appropriate trigger MUX input, as indicated in Table 8-5.

**Table 8-5 Trigger MUX Truth Table**

| Trigger Mode | TRIG_SOURCE0 U613 pin 14 | TRIG_SOURCE1 U613 pin 2 | MUX Input Pin Number U613 |
|---|---|---|---|
| FREE RUN | L | L | 6 |
| VIDEO | H | L | 5 |
| LINE | H | H | 3 |
| EXTERNAL | L | H | 4 |

3. Check that the appropriate trigger MUX input signal is present at the trigger MUX output (A3U613 pin 7).
4. To check the video trigger level DAC, connect the positive lead of a DVM to A3J400 pin 1 and the negative DVM lead to A3TP4.
5. Press **TRIG** and **VIDEO**.
6. Press the STEP ▼ key several times while noting the DVM reading and position of the video trigger level on the screen.

7. Check that the voltage displayed on the DVM changes by 1 V for each step of the VIDEO TRIG LEVEL.
8. If the voltage changes incorrectly, proceed as follows:
   a. Check the –10 Vdc reference (A3U409 pin 4).
   b. While using the front-panel knob to adjust the video trigger level, check for the presence of pulses on A3U409 pin 15 (LDAC2).
   c. While using the front-panel knob to adjust the video trigger level, check for the presence of pulses on A3U409 pin 16 (LWRCLK).
   d. Check that pulses are present on U409 pin 6 (IA0).
9. If the LWRCLK and LDAC2 signals are not correct, refer to "Interface Strobe Select" on page 409
10. If correct trigger pulses are present at the trigger MUX output (A3U613 pin 7), but the instrument does not appear to be sweeping, proceed as follows:
    a. Press **PRESET**, **SWEEP**, and **DLY SWP ON OFF** until ON is underlined, then **DLY SWP [** ] 30 milliseconds.
    b. Using an oscilloscope, check for activity at pins 1 and 3 of A3U615A.
    c. If there is activity at pin 1 but not at pin 3 of A3U615A, suspect A3U616 or A3U617.
    d. If there is activity at pin 1 and pin 3 of A3U615A, suspect A3U615. (Check pin 5 for activity.)
11. If there is a problem with Video Gating, proceed as follows:
    a. Press **PRESET** and set the spectrum analyzer as follows:

       Center frequency .............................................. 300 MHz
       Span ............................................................................ 0 Hz
       Sweep time ......................................................... 150 ms

    b. Press **TRIG**, **EXTERNAL**, then **SWEEP** and **GATE ON OFF** until ON is underlined.
    c. Press **GATE DLY [** ] 10 milliseconds, then press **GATE LEN [**] 30 milliseconds.
    d. Connect a pulse/function generator (such as an 8116A) to provide a 5 V peak-to-peak square wave (TTL level) to the spectrum analyzer rear panel EXT/GATE TRIG INPUT and also (using a BNC tee) to the channel 4 input of the oscilloscope (54501A).

e. Set the pulse/function generator to NORMAL mode with a duty cycle of 50% and a frequency of 10 Hz.

f. Press the following keys on the oscilloscope:

**CLEAR DISPLAY**

**off frame axes grid** .................................... highlight **grid**

**connect dots off on** ..................................... highlight **on**

**TRIG**

**source 1 2 3 4** ............................................... highlight **4**

**level** ................................................................. 2 V

**TIMEBASE**

**TIMEBASE** ..................................................... 50 ms/div

**CHAN**

**CHANNEL 1 2 3 4 off on**

highlight **CHANNEL 1 on**

set V/div to 0.2 V and offset to 0.6 V (10:1 probe used)

highlight **CHANNEL 4 on**

set V/div to 2 V and offset to 0 V

**DISPLAY**

**DISPLAY norm avg env** ........................... highlight **norm**

g. Using a 10:1 probe connected to channel 1 of the oscilloscope, check for activity at pins 10 and 13 of A3U617.

h. If either pin (or both) show no activity, check for activity at pin 21 (LTIMER) of A3U617.

i. If LTIMER is not active, troubleshoot the Interface Strobe Select circuitry (block K).

j. If there was activity at pins 10 and 13 of A3U617, suspect A3U616.

# Preselector Peaking Control (Real Time DAC)

Refer to function block H of A3 Interface Assembly Schematic Diagram (sheet 3 of 6) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

The spectrum analyzer uses a real-time DAC (R/T DAC1) to peak the preselector.

1. Press **PRESET** on the spectrum analyzer and set the span to 0 Hz.
2. Connect a positive DVM lead to A3J400 pin 3 and the negative DVM lead to A3TP4.
3. Press **MKR**, **AUX CTRL**, **INTERNAL MIXER**, and **PRESEL MAN ADJ**.
4. Monitor the DVM reading while changing the PRESELECTOR TUNE value from 0 to 255. The PRESELECTOR TUNE value is the setting of R/T DAC1.
5. Check that the DVM reading increases from 0 to approximately +10 Vdc as R/T DAC1 is set from 0 to 255.
6. If the voltage does not change as described, set the spectrum analyzer to single trigger mode and check the following:
   a. Check that A3U409B pin 18 is at –10 Vdc.
   b. Check for the presence of pulses at U409 pin 6 (IA0).
   c. Check that pulses are present at U409 pin 15 (LDAC2).
   d. Check that pulses are present at U409 pin 16 (LWRCLK).
7. If the LDAC2 or LWRCLK signals are incorrect, refer to “Interface Strobe Select” on page 409

# Flatness Control (RF Gain DACs)

Refer to function block M of A3 Interface Assembly Schematic Diagram (sheet 4 of 6) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

RF Gain DACs control the A15 assembly flatness compensation amplifiers. The RF Gain DACs are arranged so that the output of one DAC is the voltage reference for the other DAC. This results in an RF GAIN voltage which is exponentially proportional to the DAC settings. Each DAC is set to the same value. The A15 RF assembly converts the RF GAIN signal to a current for driving the PIN diode attenuators in the Flatness Compensation Amplifiers. The exponentially-varying voltage compensates for the nonlinear resistance-versus-current characteristic of the PIN diodes.

1. Place the WR PROT/WR ENA jumper on the A2 controller assembly in the WR ENA position.
2. Press **CAL**, **MORE 1 OF 2**, **SERVICE CAL DATA**, **FLATNESS**, and **FLATNESS DATA**. Press **NEXT BAND** until `FLATNESS BAND # 0` is displayed.
3. Press the ▲ key until `DATA @ 300 MHz` is displayed. Note the number directly below `DATA @ 300 MHz` this is the RF Gain DAC value.
4. Connect a positive DVM lead to A3J400 pin 13 and the negative DVM lead to A3TP4.
5. Check that the DVM reading increases from near 0 Vdc to between –1.3 and –1.9 Vdc as the RF Gain DAC setting is increased from 0 to 4095.
6. If the DVM readings are incorrect, press **PRESET**, **SGL SWP**, **CAL**, **MORE 1 OF 2**, **SERVICE CAL DATA**, **FLATNESS**, and **FLATNESS DATA**. Press **NEXT BAND** until `FLATNESS BAND # 0` is displayed. Press the ▲ key until `DATA @ 300 MHz` is displayed. Proceed as follows:
   a. Check the +10 V reference.
   b. Check for narrow, low-going pulses at A3U417 pin 13 (LWRCLK).
   c. While rotating the front-panel knob, check for narrow, low-going pulses at A3U417 pin 1 (LDAC1) and pin 14 (LDACU1).
   d. While rotating the front-panel knob, check for narrow, low-going pulses at U417 pin 16 (L_IA0) and pin 15 (IA4).
7. If the LWRCLK, LDAC1, or LDACU1 is incorrect, refer to the Interface Strobe Select block in this chapter.

8. Place the WR PROT/ WR ENA jumper on the A2 controller assembly in the WR PROT position. Press **PRESET**.

# A3 Assembly Video Circuits

Voltages from A3J101 to the Variable Gain Amplifier on A3 correspond (approximately) to on-screen signal levels. (One volt corresponds to the top of the screen and zero volts corresponds to the bottom of the screen.) This is true for both log and linear settings except when the spectrum analyzer is in 1 dB/div or 2 dB/div. In these cases the log expand amplifier is selected, and 1 V corresponds to top-screen and 0.8 or 0.9 V corresponds to bottom-screen. The spectrum analyzer can be set to zero span at the peak of a signal to generate a constant dc voltage in the video circuits during sweeps.

1. Disconnect W26 from A3J101 and W20 from A2J4.
2. Connect W26 to A2J4.
3. Set the spectrum analyzer to the following settings:

   Span ........................................................................ 0 Hz
   Sweep time ................................................................. 20 ms
   Resolution bandwidth ................................................ 1 MHz
   Log/division ........................................................ 10 dB/DIV

4. If a trace is displayed, troubleshoot the A3 assembly. If a trace is absent, connect an oscilloscope to the rear panel BLKG/GATE OUTPUT.
5. The presence of a TTL signal (TTL low during 20 ms sweep) indicates a good A3 Interface Assembly. Troubleshoot the IF section.
6. If the BLKG/GATE OUTPUT is always at a TTL high or low, troubleshoot the trigger/video gating circuits on A3.
7. Reconnect W26 to A3J101 and W20 to A2J4.
8. Remove the A3 assembly shield.
9. If the video filters appear faulty, see to “Video Filter” on page 395
10. If there appears to be a peak detector problem, refer to “Positive/Negative Peak Detectors” on page 397
11. Connect the spectrum analyzer CAL OUTPUT to the INPUT 50Ω and set the controls as follows:

    Center frequency .................................................. 300 MHz
    Span ........................................................................ 0 Hz
    Reference level ...................................................... –10 dBm

12. If the spectrum analyzer works correctly in 5 dB/div and 10 dB/div but not in 1 dB/div or 2 dB/div, refer to “Log Offset/Log Expand” on page 393 Continue with step 13 if the problem involves on-screen amplitude errors which appear to originate in the video chain.

13. Press **CAL** and **IF ADJ ON OFF** until OFF is underlined. Monitor A3TP9 with an oscilloscope. If the voltage is not approximately +1 Vdc, troubleshoot the Log Amplifier on A4. (Refer to the IF troubleshooting procedure in Chapter 9 , “IF Section.”)

14. To confirm proper video input to the video circuit, set the spectrum analyzer to Log 10 dB per division and change the reference level in 10 dB steps from –10 dBm to +30 dBm. At each 10 dB step, the input voltage should change 100 mV. The input level should be +0.6 Vdc for a +30 dBm reference level.

**NOTE** The on-screen amplitude level will probably not change as expected, since the video circuitry is assumed to be faulty.

15. Monitor A3TP14 while stepping the reference level from –10 dBm to +30 dBm. If the voltage does not step approximately 100 mV per 10 dB step, refer to “Video MUX” on page 394

16. If the Video MUX is working properly, monitor A3TP15 with the oscilloscope and step the reference level from –10 dBm to +30 dBm. If the voltage does not change 100 mV per 10 dB step, refer to “Video Filter” on page 395

17. If the voltage at A3TP15 is correct, move the oscilloscope probe to A3TP17 and step the reference level between –10 dBm and +30 dBm. If the voltage does not change 100 mV per 10 dB step, refer to “Video Filter Buffer Amplifier” on page 396

18. If the voltage at A3TP17 is correct, move the oscilloscope probe to A3TP6. Set the following controls to keep the ADC MUX set to the MOD_VIDEO input during the sweep:

    Sweep time ........................................................... 50 s
    Detector mode ....................................................... Sample

19. Step the reference level from –10 dBm to +30 dBm while monitoring the voltage change on the oscilloscope. If the voltage does not change 100 mV per 10 dB step, refer to “ADC MUX” on page 400

20. If the voltage at A3TP6 is correct, move the oscilloscope probe to A3TP8 and step the reference level between –10 dBm and +30 dBm. If the voltage at A3TP8 is not the same as that at A3TP6, replace A3U110.

21. If the voltage at A3TP8 and A3TP6 are equal, move the oscilloscope probe to A3TP7.

22. Change the reference level from –10 dBm to 0 dBm. The voltage change on A3TP7 should be between 630 mV and 770 mV. If the voltage change is outside of these limits, refer to “Variable Gain Amplifier (VGA)” on page 402 The gain of the VGA should be 7 ±10%.

## Log Offset/Log Expand

Refer to function block X of A3 Interface Assembly Schematic Diagram (sheet 5 of 6) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

The log scales are modified using a combination of amplification and digital trace manipulation. The video input to the A3 assembly is either 10 dB/div or linear. To obtain the 5 dB/div scale, the CPU manipulates the trace data from the 10 dB/div scale. To obtain the 2 dB/div scale, the video signal is amplified and offset so that top-screen in 10 dB/div corresponds to top-screen in 2 dB/div. To obtain the 1 dB/div scale, the CPU manipulates trace data from the 2 dB/div scale.

In 2 dB/div, Log Offset/Log Expand amplifies the top 20 dB of the display. This is done by offsetting the video signal by –0.8 V and providing a gain of 5 to the top 0.2 V of the video signal. The –0.8 V offset is accomplished by sinking 2 mA through R114 by current source U105/Q101.

1. On the spectrum analyzer, press **PRESET**, **SPAN**, **ZERO SPAN**, **CAL**, and **IF ADJ OFF**.
2. Disconnect W26 (coax 2) from A3J101 and connect the output of a function generator to A3J101.
3. Set the function generator to the following settings:

   Output .................................................................. Sine wave
   Amplitude ......................................................... 1 V pk-to-pk
   DC Offset ............................................................... +500 mV
   Frequency ..................................................................... 50 Hz

4. Set the spectrum analyzer sweep time to 50 ms.
5. Adjust the function generator amplitude and offset until the sine wave fills the entire graticule area.
6. Measure and note the function generator peak-to-peak voltage using an oscilloscope.

$V_{(10\ \mathrm{dB/div})}$ = ________________________________V

7. Set the spectrum analyzer to 2 dB/div.
8. Readjust the function generator amplitude and offset until the sine wave again fills the entire graticule area.
9. Measure the function generator peak-to-peak voltage and dc offset.

$V_{(2\ \mathrm{dB/div})}$ = ______________________________V

10. The ratio of voltage recorded in step 6 to the voltage recorded in step 9 should be 5 ±3%. If the ratio is not 5, troubleshoot the A3 Interface assembly.

11. Reconnect W26 to A3J101.

## Video MUX

Refer to function block U of A3 Interface Assembly Schematic Diagram (sheet 5 of 6) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

1. Press **PRESET** and set the spectrum analyzer controls as follows:

   Center frequency ................................................ 300 MHz
   Span .................................................................... 0 Hz

2. Press **SGL SWP**, **CAL**, and **IF ADJ OFF**. Connect the CAL OUTPUT to the INPUT 50Ω connector.

3. Check for a TTL high on A3U104 pin 2 and a TTL low on U104 pin 10. Set the spectrum analyzer to 2 dB/div and check for a TTL high on A3U104 pin 10 and a TTL low on A3U104 pin 2.

4. If the logic levels on A3U104 are incorrect, check the LLOG_STB signal as follows:

   a. Monitor A3U104 pin 9 with an oscilloscope or logic probe. Check that a 1 microsecond, low-going pulse is present when switching between 10 dB/div and 2 dB/div.

   b. Check the inputs to A3U104 (pins 3 and 11) while switching between 10 dB/div and 2 dB/div.

   c. If the logic signals are incorrect, refer to "Analog Bus Drivers," on page 407, and "Analog Bus Timing" on page 408

5. Check comparators A3U109A/C for proper outputs. The outputs should be high when the noninverting input is greater than the threshold voltage of +1.3 Vdc.

6. If A3U104 and A3U109 are working properly, set the **AMPLITUDE** and **REF LVL** to 0 dBm.

7. Monitor the voltage at A3TP14 while switching the spectrum analyzer between 10 dB/div and 2 dB/div. The voltage should switch between 0.8 and 0.4 Vdc.

8. If the voltage at A3TP14 is incorrect, suspect either A3Q220 or A3Q221.

9. The Video MUX will appear faulty if A3CR109 is shorted or leaky. Diode A3CR109 clamps the voltage at A3TP14 to –0.4 V when in log expand with less than 0.8 V at J101. To confirm this failure, lift the cathode of diode A3CR109 and perform steps 1 through 7 again.

10. To return the spectrum analyzer to automatic sweep, press **SWEEP**, **SWEEP CONT SGL** or press **PRESET**.

## Video Filter

Refer to function block V of A3 Interface Assembly Schematic Diagram (sheet 5 of 6) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

The spectrum analyzer uses digital filtering for 1 Hz to 100 Hz video bandwidths. An RC low-pass filter is used for 300 Hz to 3 MHz video bandwidths. Various series resistances and shunt capacitances switch into the video filter to change its cutoff frequency. The 3 MHz video bandwidth is not available when Gated Video is selected.

When sample detection is selected, the effective video bandwidth is limited to approximately 450 kHz by the track and hold circuitry.

When Gated Video is selected, the video signal is "gated" (turned on periodically for a set duration of time). This function is shown in block V of the block diagram as a series switch that allows the video signal to pass only when it is closed. The actual switch, U109B/CR118, shunts the video to ground (video signal is passed only when the switch is open). The control circuitry for this switch is described under "Triggering or Video Gating Problems" on page 385 The rear panel EXT/GATE TRIG INPUT provides the connection for triggering in the Gated Video mode. The gate output signal is available at the rear panel BLKG/GATE OUTPUT connector. Positive or negative edge mode, or level mode can be selected from the front panel.

1. Press **PRESET** and set the spectrum analyzer controls to the following settings:

   Center frequency .................................................... 225 MHz
   Span ........................................................................ 550 MHz
   Sweep time ............................................... Uncoupled (MAN)

2. Press **CAL** and **IF ADJ OFF**.

3. Step the Video BW from 3 MHz to 10 kHz. At each step, the peak-to-peak deviation of the noise should decrease.

4. Step the Video BW down to 1 Hz. At each step, the amplitude of the LO feedthrough should decrease.

5. Refer to Table 8-6 on page 396 and check for correct latched levels for the selected video bandwidth setting.

6. If the output of latch A3U102 is not correct, trigger an oscilloscope on LLOG_STB (U102 pin 9) and monitor U102 pin 1 and other latch inputs while changing the video bandwidth.
7. If the inputs are incorrect, troubleshoot the analog bus. Correct inputs with bad outputs indicate a faulty U102.
8. Check that the outputs of A3U111A, A3U111B, and A3U107A/B/C/D are correct for their inputs. The outputs should be high with noninverting inputs higher than the +1.4 V threshold voltage. If a voltage drop is noticed across these components, suspect A3CR109 or A3Q317B. Since no dc current flows through any of the series resistances or FETS (drain to source), no voltage drops should occur.
9. To return the spectrum analyzer to automatic sweep, press **SWEEP**, **SWEEP CONT SGL** or **PRESET**.

**Table 8-6 A3U102 Latch Outputs**

| Video BW | Pin 2 | Pin 5 | Pin 7 | Pin 10 | Pin 12 | Pin 15 |
|---|---|---|---|---|---|---|
| 300 Hz | H | L | L | L | L | L |
| 1 kHz | L | L | L | L | L | H |
| 3 kHz | L | H | L | L | L | L |
| 10 kHz | L | L | L | L | H | L |
| 30 kHz | H | L | H | L | L | L |
| 100 kHz | L | L | H | L | L | H |
| 300 kHz | L | H | H | L | L | L |
| 1 MHz | L | L | H | L | H | L |
| 3 MHz | L | L | L | H | L | L |

## Video Filter Buffer Amplifier

Refer to function block W of A3 Interface Assembly Schematic Diagram (sheet 5 of 6) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

The video filter buffer amplifier provides outputs for video trigger, positive and negative peak detectors, and the analog zero-span (sweeps <30 ms). The zero-span video output is terminated in 500 ohms on the A2 Controller assembly. The amplifier is a high-input-impedance buffer amplifier with a gain of one when properly terminated.

Current source U307C provides twice the current of Q316. Resistor R145 and current source U307D shift the dc level. Resistor R260 terminates the peak detector inputs in 500 ohms. The unterminated gain is 1.1. Diode CR114 prevents latchup during positive overdrive conditions while CR113 protects Q318 during overdrive. Diode CR117 is a 12.7 V zener that limits the output of the peak detector to +1.5 V. Typically, limiting occurs at +1.1 V.

## Positive/Negative Peak Detectors

Refer to function blocks Y and Z of A3 Interface Assembly Schematic Diagram (sheet 5 of 6) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

The following information pertains to the positive peak detector and is applicable to troubleshooting the negative peak detector.

The positive peak detector consists of an input amplifier (A3U204 and A3Q210) followed by detector diodes (A3CR203 and A3CR204) and hold capacitor A3C217. Output amplifier A3Q206, Q211, and Q212 buffers the hold capacitor. Both the input and output amplifiers have a gain of one. Each amplifier has local feedback. On the output amplifier the emitter of Q212 connects to the gate of Q206. On the input amplifier the feedback goes through Q209 and Q208 back to the base of U204D. Global feedback occurs from the output amplifier through R223 back to the input amplifier U204D. The peak detector resets through Q207.

1. Press **PRESET** and set the spectrum analyzer controls as follows:

   Center frequency ..................................................... 300 MHz
   Span ......................................................................... 500 MHz
   Resolution bandwidth ................................................. AUTO
   Video bandwidth ......................................................... AUTO
   Log dB/division ..................................................... 10 dB/DIV

2. If the spectrum analyzer does not meet the conditions in steps a through e below, the positive and negative peak detectors are probably faulty. Continue with step 3 to check the detectors.

   a. The peak-to-peak deviation of the noise in NORMAL detector mode should be approximately two divisions. Press **TRACE**, **TRACE B**, **CLEAR WRITE B**, **VIEW B**, **TRACE A**, **MORE 1 of 3**, and **DETECTOR MODES**.

   b. Select **DETECTOR POS PEAK** mode.

   c. Confirm that the noise is about one-third division peak-to-peak. The noise should also be no higher than the top of the noise level in NORMAL detector mode.

d. Select **DETECTOR NEG PEAK** mode. The noise should be about one-third of a division peak-to-peak. The noise should also be no lower than the bottom of the noise in NORMAL mode.

e. Select **DETECTOR SAMPLE** mode. Check that the noise appears between the top and bottom of the noise in NORMAL mode.

3. On the spectrum analyzer, connect the front-panel CAL OUTPUT to the INPUT 50Ω and set the controls to the following settings:

   Center frequency ................................................ 300 MHz
   Span ................................................................... 0 Hz
   Sweep time ....................................................... 5 s
   Detector mode .................................................. POS PEAK

4. Monitor A3TP17 and A3TP16 simultaneously with an oscilloscope.

5. Change the reference level from –10 dBm to +30 dBm and verify a voltage change at both A3TP17 and A3TP16 of 0.9 V to 0.5 V in 100 mV steps.

6. Check the entire range of the detector by substituting a dc source at J101 and varying its output from 0 V to 1 V.

7. If the peak detector appears latched up, check LPOS_RST (U422 pin 4) for a negative TTL level reset pulses. The reset pulses should occur every 130 µs and should be approximately 250 ns wide.

8. If the reset pulses are absent, troubleshoot the Peak Detector Reset circuitry.

9. If the reset pulses are present, check the gate of Q207. The pulses should be positive-going from –12.7 V to –1.35 V.

10. The peak detector can be made into a unity gain amplifier by shorting the cathode of CR203 to the anode of CR204. If the peak detector functions normally as a unity gain amplifier, suspect Q208 or CR203 or CR204.

## Peak Detector Reset

Refer to function block R of A3 Interface Assembly Schematic Diagram (sheet 4 of 6) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

1. Press **PRESET** on the spectrum analyzer and set the controls as follows:

   Center frequency ................................................ 300 MHz
   Span ................................................................... 0 Hz
   Sweep time ....................................................... 5 s
   Detector mode .................................................. POS PEAK

2. Check that HHOLD (A3U526 pin 11) has 18 µs wide pulses every 128 µs.

3. Check that HODD (U408 pin 5) is a square wave with a period of 16.7 ms (2 × sweep time/600).
4. Check LPOS_RST (U422 pin 4) for 200 ns low-going pulses every 128 µs.
5. Check LNEG_RST (A3U422 pin 12) for 200 ns low-going pulses every 128 µs.
6. Set the detector mode to NORMAL and check that LNEG_RST (A3U422 pin 12) has two pulses spaced 40 µs apart and then a single pulse approximately 88 µs from the second pulse.
7. Check HMUX_SEL0 (A3U408 pin 3) and HMUX_SEL1 (A3U408 pin 9) according to Table 8-7.

**Table 8-7 HMUX_SELO/1 versus Detector Mode**

| Detector Mode | HMUX_SEL0 (U408 pin 3) | HMUX_SEL1 (U408 pin 9) |
|---|---|---|
| NORMAL | 15 µs pulse every 128 µs | 40 µs pulse every 128 µs |
| SAMPLE | H | H |
| POS PEAK | H | L |
| NEG PEAK | L | H |

## Rosenfell Detector

Refer to function block S of A3 Interface Assembly Schematic Diagram (sheet 4 of 6) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

If both HPOS_HLDNG and HNEG_HLDNG are high during the same bucket, HROSENFELL will also be set high. This indicates that the video signal probably consists of noise, since it rose and fell during the same period. The HROSENFELL signal is valid only when the NORMAL (rosenfell) detector mode is selected.

1. Remove anything connected to the 8564EC or 8565EC front-panel INPUT 50Ω connector. Press **PRESET** on the spectrum analyzer and set the controls as follows:

   Center frequency .................................................. 300 MHz
   Span ..................................................................... 0 Hz
   Sweep time ............................................................ 5 s
   Detector mode ...................................................... NORMAL

2. Check LPOS_RST and LNEG_RST as described in "Peak Detector Reset" on page 398

3. Check A3U423 pin 4 for two low-going 3.3 µs pulses 40 µs apart occurring every 130 µs.
4. Check that HROSENFELL (A3U610 pin 6) has two pulses spaced approximately 40 µs apart and then a third pulse 60 µs from the second pulse. Each pulse should be approximately 10 µs wide and low-going.
5. Monitor HROSENFELL with an oscilloscope while reducing the video bandwidth from 1 MHz to 1 kHz.
6. As the video bandwidth is decreased to 1 kHz, the HROSENFELL line should increasingly show a low logic level. With a video bandwidth of 1 kHz, a nearly flat line should be displayed on the CRT.
7. Set the sweep time to 50 ms. Externally trigger the oscilloscope using the spectrum analyzer rear panel BLKG/GATE OUTPUT.
8. Check that HPOS_HLDNG (A3U416 pin 4) is mostly high with a 1 MHz video bandwidth and mostly low with a 1 kHz video bandwidth.
9. Check that LNEG_HLDNG (U408A pin 13) is mostly high with a 1 MHz video bandwidth and mostly low with a 1 kHz video bandwidth.

## ADC MUX

Refer to function block AA of A3 Interface Assembly Schematic Diagram (sheet 6 of 6) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

The ADC MUX switches various inputs into the video path for conversion by the ADC. The SCAN RAMP input is used during sweeps having a width of equal to or greater than 2.01 MHz times N, to control the timing of the ADC operations. Some combination of MOD_VIDEO, NEG_PEAK, and POS_PEAK is used for the video signal to be converted by the ADC. The YTO ERR, FCMUX, CAL OSC TUNE, and OFL ERR inputs are used only during diagnostic and auto adjust routines and during retrace.

1. Set the spectrum analyzer to the following settings:

   Center frequency ................................................ 300 MHz
   Span ................................................................... 0 Hz
   Reference level ..................................................... –10 dBm
   Sweep time ........................................................... 50 s
   DETECTOR MODE ............................................ SAMPLE

2. Refer to Table 8-8 and check for correct logic levels at A3U108 pins 1, 15, and 16. Check for proper output signals at TP6. If the select lines are not changing, suspect the ADC ASM or the VGA/ADC MUX Control. If the select lines are changing, but the proper video inputs are not being switched to the output, replace U108. In SAMPLE mode, the input is MOD_VIDEO (pin 7); in POS PEAK mode, the input is POS_PEAK (pin 5); and in NEG PEAK mode, the input is NEG_PEAK (pin 6).
3. Check for the presence of the YTO ERR signal at A3J2 pin 42 with an oscilloscope probe.
4. If ERR 300 YTO UNLK or 301 YTO UNLK occurs and the voltage is near zero during a sweep and positive during retrace (YTO is being locked), the fault is on the A3 assembly. If a constant dc voltage is present, refer to the Synthesizer section troubleshooting procedure in Chapter 11.

**Table 8-8 Logic Levels at A3U108**

| Detector Mode | U108 pin 1 | U108 pin 15 | U108 pin 16 |
|---|---|---|---|
| SAMPLE | H | L | H |
| POS PEAK | H | L | L |
| NEG PEAK | L | L | H |

5. Set the spectrum analyzer to the following settings:

   Span ................................................................. 5 MHz
   Sweep time ......................................................... 50 ms

6. Check for the presence of the SCAN RAMP signal by connecting an oscilloscope probe to A3J2 pin 45 (component side of A3J2). Connect the negative-probe lead to A3TP4.
7. A 0 to 10 V ramp should be present in both LINE and FREE RUN trigger modes. If the waveform is present only in LINE trigger, ADC control signal HBADC_CLK0 may be faulty. Refer to "ADC Control Signals" on page 403.
8. If the scan ramp is present, but is not being switched to the output of U108, replace U108. If the scan ramp is absent in either mode, do the following:
   a. Connect the oscilloscope probe to A3J400 pin 15 (HSCAN).
   b. A TTL signal (high during 50 ms sweep time and low during retrace) should be present, indicating A3 is working properly. Refer to the Synthesizer section troubleshooting procedure in Chapter 11. A faulty TTL signal indicates a bad A3 Interface assembly.

9. Set the spectrum anal"ADC Control Signals" in this chapter.yzer to the following settings:

   Sweep time ............................................................ 100 ms
   Span ...................................................................... 100 MHz

10. Press **CAL** and **IF ADJ ON** and check for the presence of the CAL OSC TUNE signal by monitoring A3J401 pin 25 with an oscilloscope. If `ERR 499 CAL UNLK` is displayed and a signal within the range of –10 V to +10 V is present during part of the retrace period, the fault is on the A3 assembly.

11. If a constant dc voltage is present during the sweep and all of the retrace period, refer to the IF Section troubleshooting procedure in Chapter 9 , “IF Section.”

## Variable Gain Amplifier (VGA)

Refer to function block AB of A3 Interface Assembly Schematic Diagram (sheet 6 of 6) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

The VGA provides adjustable gain in the video path. Its nominal gain of 7 can be adjusted ±10%. U112 removes dc offset to keep U113 in its monotonic range. (Both U112 and U113 are set to the same value.) The DAC settings cannot be changed from the front panel.

## Track and Hold

Refer to function block AC of A3 Interface Assembly Schematic Diagram (sheet 6 of 6) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

1. Press **PRESET** on the spectrum analyzer and set the controls as follows:

   Center frequency ............................................... 300 MHz
   Span ............................................................................ 0 Hz
   Detector mode ...................................................... Sample
   Reference level .................................................... –70 dBm
   Log dB/division .................................................. 2 dB/DIV
   Sweep time ............................................................ 50 ms

2. Disconnect any signal from the spectrum analyzer input. A full scale display of sampled noise should be present.

3. Trigger an oscilloscope on the positive going edge of HHOLD (A3U506 pin 16).

4. The waveform at A3TP10 should be random noise with an average level of approximately 4 V. The noise should have a flat spot in its response while HHOLD is high, indicating proper operation of U114.

# A3 Assembly ADC Circuits

The ADC consists of a 12-bit DAC, 12-bit successive approximation register (SAR), data multiplexers, and data latches. The ADC ASM (algorithmic state machine) controls the ADC. Eight inputs are controlled by the ADC MUX. These include a positive peak detector, negative peak detector, sampled video, scan ramp, YTO error voltage, FC MUX voltages, Cal Oscillator tune voltage, and offset lock error voltage. A MUX on the A14 frequency control assembly selects which voltage is sent to the ADC MUX on the FC MUX signal line.

During NORMAL detector mode sweeps, when noise is detected by the rosenfell detector, the ADC ASM automatically switches between POS PEAK and NEG PEAK.

## ADC Control Signals

Refer to function blocks B and F of A3 Interface Assembly Schematic Diagram (sheet 2 of 6) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

The ADC requires two signals from the A2 controller assembly: HBADC_CLK0 and HBBKT_PULSE. HBBKT_PULSE is used only in zero span. Use the following steps to verify the signals:

1. Disconnect W22 from A2J8.
2. If a 10 MHz TTL signal is absent on W22, refer to the 10 MHz Reference (on the A15 RF assembly) troubleshooting procedure in Chapter 12 , “RF Section.”
3. Set the spectrum analyzer **SPAN** to zero.
4. Reconnect W22.
5. With an oscilloscope probe, monitor A3J401 pin 20.
6. If TTL pulses are absent, the A2 controller assembly is faulty. Refer to Chapter 10 , “Controller Section.” The presence of TTL pulses indicates a faulty A3 assembly.
7. Monitor A3J401 pin 23 (HBADC_CLK0). If a 1 MHz TTL clock signal is present, HBADC_CLK0 is working properly.
8. If HBKT_PULSE or HBADC_CLK0 is missing, disconnect A3W1 from A2J2.
9. Monitor A2U5 pin 3 for HBKT_PULSE and A2U5 pin 7 for HBADC_CLK0.
10. If HBADC_CLK0 is absent, troubleshoot the A2 controller assembly.

11. HBKT_PULSE is absent, refer to the information on troubleshooting the frequency counter in Chapter 10 , "Controller Section."

12. Reconnect A3W1 to A2J2.

## ADC Start/Stop Control

Refer to function block B of A3 Interface Assembly Schematic Diagram (sheet 2 of 6) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

The ADC Start/Stop Control determines the start time of all ADC conversions. Multiplexer A3U509 chooses the source of the start signal. Both HSTART_SRC and HBUCKET tell the ASM to start a conversion.

1. Press **PRESET** on the spectrum analyzer and set the following controls:

   Span ........................................................................ 0 Hz
   Sweep time ................................................................ 60 s
   Detector mode ...................................................... SAMPLE

2. Check for a TTL high at A3U509 pin 2 and a TTL low at A3U509 pin 14.

3. Set the detector mode to NORMAL.

4. Check that A3U509 pins 2 and 14 are both TTL low.

5. Set the spectrum analyzer to the following settings:

   Span ..................................................................... 1 MHz
   Detector mode ...................................................... SAMPLE

6. Check for a TTL high at A3U509 pin 2 and a TTL low at A3U509 pin 14.

7. Press **CAL** and **REALIGN LO &IF**. During the realignment, A3U509 pin 2 should be TTL low and pin 14 should be TTL high until the 10 kHz and narrower resolution bandwidths are adjusted. If correct, the Start/Stop Control circuitry is being selected properly by the processor and U508 in the ADC Register block is working properly.

8. Press **PRESET** on the spectrum analyzer and set the controls as follows:

   Span ........................................................................ 0 Hz
   Detector mode ...................................................... SAMPLE
   Sweep time .......................................................... 400 ms

9. Check that A3U509 pin 7 has positive 15 μs pulses with a 667 μs period (sweep time/600). Check that A3U509 pin 9 has positive 15 μs pulses with a 667 μs period (sweep time/600). The pulses should be present during the sweep but absent during retrace.

10.Set the detector mode to NORMAL.

11.Check that A3U509 pin 9 has pulses every 130 µs and U509 pin 7 has pulses every 667 µs (although pulse widths may be changing).

## ADC ASM

Refer to function block F of A3 Interface Assembly Schematic Diagram (sheet 2 of 6) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

1. Press **PRESET** on the spectrum analyzer and set the controls as follows:

   Span ........................................................................ 0 Hz
   Sweep time ........................................................................ 60 s
   Detector mode ........................................................ SAMPLE

2. Check that HSTART_SRC (U504 pin 4) goes TTL high, causing HHOLD (U506 pin 16) to go high 15 µs later.
3. Check that HSTART_ADC (U506 pin 15) goes TTL high 19 µs after HSTART_SRC goes high.
4. HHOLD should stay TTL high for approximately 18 µs, and HSTART_ADC should stay high for approximately 31 µs.
5. Check that LCMPLT (U504 pin 15) goes TTL low 12 µs after HSTART_ADC goes high (12 bits at 1 µs per bit). LCMPLT indicates that the successive approximation state machine (SASM) has completed the ADC conversion.
6. Check that LDONE (U506 pin 19) goes TTL low approximately 2 µs after LCMPLT goes low.

## ADC

Refer to function block A of A3 Interface Assembly Schematic Diagram (sheet 2 of 6) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

The successive approximation state machine (SASM) consists of A3U527 and A3U528. Upon the occurrence of HSTART_ADC, the SASM successively toggles bits from high to low starting with the most significant bit. The digital result is then converted to an analog current in DAC U518 and compared with the SAMPLED VIDEO. If the DAC current is too high, the output of U512 will be low, telling the SASM that the "guess" was high and that the bit just toggled should remain low. It then moves on to the next most significant bit until all 12 bits have been "guessed" at. Each "guess" takes 1 µs (one cycle of HBADC_CLK0), or 12 µs to complete a conversion. When the conversion is completed, the SASM sets LCMPLT low. The bits are written to the data bus by buffers U514 and U516.

1. Set the spectrum analyzer controls as follows:

   Center frequency .................................................. 300 MHz
   Span .................................................................. 0 Hz
   Sweep time .................................................................. 60 s
   Detector mode ..................................................... SAMPLE

2. Trigger an oscilloscope on HSTART_ADC (U506 pin 15) and monitor the outputs of the SASM (U527 pins 18 and 19; U528 pins 14 through 23). Each bit should start high and be switched low. It will either stay low or return to a high state 1 µs later, depending on the comparison at U512.

3. If the outputs do not exhibit this bit pattern, and the ADC ASM checks are working properly, suspect A3U527, U528, or one of the latches (U514/516). If the output of comparator U512 does not toggle back and forth during a conversion, suspect either U512 or one of the clipping diodes (CR500/CR501).

**NOTE** Because currents are being summed at U512 pins 2 and 3, voltage levels at these points are difficult to interpret.

## Ramp Counter

Refer to function block D of A3 Interface Assembly Schematic Diagram (sheet 2 of 6) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

The ramp counter is used for sweeps with widths greater than 2.0 MHz times N. The analog sweep ramp is compared to the digital ramp counter. When the analog sweep ramp exceeds the DAC output generated for that ramp counter setting, HRAMP_COMP toggles high, indicating the end of a bucket. The ramp counter counts horizontal buckets. There are 601 buckets per sweep, so the ramp (bucket) counter counts from 0 to 600. The ramp counter is incremented by HRST_PK_ENA.

1. Press **PRESET** on the spectrum analyzer and set the controls as follows:

   Span ............................................................... 5 MHz
   Detector mode ..................................................... SAMPLE

2. For spans greater than 2.0 MHz times N0, HODD (A3U525 pin 3) is a square wave with a period defined by (2 × sweep time/600). For example, for a 6 s sweep time, HODD has a period of 20 ms. The ramp (bucket) counter will be odd every other bucket.

# A3 Assembly Control Circuits

A digital control problem will cause the following three steps to fail:

1. On the spectrum analyzer, press **AMPLITUDE**, **ATTEN MAN**, 6, 0, and **dB**.
2. A click should be heard after pressing dB in step 1, unless ATTEN was previously set to 60 dB.
3. Press 1, 0, and **dB**. Another click should be heard. If no clicks were heard, but the ATTEN value displayed on the CRT changed, the digital control signals are not operating properly.

## Analog Bus Drivers

Refer to function block N of A3 Interface Assembly Schematic Diagram (sheet 4 of 6) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

1. Press **PRESET** on the spectrum analyzer, and set the controls as follows:

   Span ........................................................................ 0 Hz
   Trigger ................................................................... Single

2. Monitor A3U401 pin 3 (LRF_STB) with an oscilloscope or logic probe. This is the strobe for the A15 RF Assembly.
3. Press **AUX CTRL** and **REAR PANEL** and check that pulses occur when toggling between **10 MHz INT** and **10 MHz EXT**.
4. Monitor U401 pin 5 (LFC_STB) with an oscilloscope or logic probe. This is the strobe for the A14 frequency control assembly.
5. Press **AMPLITUDE** and check that pulses occur when toggling between **ATTEN** settings of 10 and 20 dB.
6. Monitor U401 pin 7 (LIF_STB) with an oscilloscope or logic probe. This is the strobe for the A5 IF assembly.
7. Press **AMPLITUDE** and check that pulses occur when toggling between **REF LVL** settings of –10 dBm and –20 dBm.
8. Monitor U401 pin 9 (LLOG_STB) with an oscilloscope or logic probe. This is the strobe for the log amplifier on the A4 assembly.
9. Press **AMPLITUDE** and check that pulses occur when toggling between **LINEAR** and **LOG dB/DIV**.
10. To check the Address and Data Lines, place a jumper from A3TP1 and A3TP2 to A3U406 pin 20 (+5 V).

11. Check that address lines A0 through A7 and data lines D0 through D7 are all TTL high.
12. If any address or data line is low, press **LINE** to turn spectrum analyzer off and disconnect the W2 control cable from A3J2. Press **LINE** to turn spectrum analyzer on. Ignore any error messages.
13. Check that address lines A0 through A7 and data lines D0 through D7 are all high. If all address and data lines are high, suspect a fault either in W2 or one of the other four assemblies which connect to W2.
14. If any address or data line is low, check the appropriate input of either U405 (data lines) or U406 (address lines).
15. If a data line input is stuck low, check the data bus buffer. If an address line input is stuck low, check A3W1 and the A2 controller assembly.
16. If the appropriate input is high or toggling between high and low, suspect a failure in either U405 (data lines) or U406 (address lines).
17. Remove jumpers.

## Analog Bus Timing

Refer to function block P of A3 Interface Assembly Schematic Diagram (sheet 4 of 6) in the *Spectrum Analyzer Component Level Information* and *8560 E-Series Spectrum Analyzer Component Level Information*.

Analog bus timing (ABT) generates the strobes for the A4, A5, A14, and A15 assemblies. The A14 frequency control assembly also requires a qualifier for its strobe, LVFC_ENABLE. A3U400 and A3U414 provide a 2 µs delay between the time HANA_BUS goes high and the enable line to demultiplexer A3U407 goes low.

1. Press **PRESET** on the spectrum analyzer and set the controls as follows:

   Center frequency .................................................. 300 MHz
   Span ...................................................................... 100 MHz

2. Check that A3U407 pin 1 goes low approximately 2 µs after HANA_BUS (A3U400 pin 3) goes high.
3. If HANA_BUS is absent, check for pulses on ABT A3U505 pin 2 and IA10 (A3U505 pin 5).
4. If A3U407 pin 1 is not delayed 2 µs from HANA_BUS, check for the presence of the 1 MHz HBADC_CLK0.
5. If A3U407 pin 1 is not delayed 2 µs from HANA_BUS and HBADC_CLK0 is correct, suspect a fault in either A3U414 or A3U400.

6. Press **PRESET** and set the controls as follows:

   Span .......................................................................... 0 Hz
   Trigger ................................................................... SINGLE

7. Monitor A3U401 pin 3 (LR_STB) with an oscilloscope or logic probe. This is the strobe for the A15 RF assembly.
8. Press **AUX CTRL** and **REAR PANEL** and check that pulses occur when toggling between **10 MHz INT** and **10 MHz EXT**.
9. Monitor A3U401 pin 5 (LF_STB) with an oscilloscope or logic probe. This is the strobe for the A14 frequency control assembly.
10. Press **AMPLITUDE** and check that pulses occur when toggling between **ATTEN** settings of 10 and 20 dB.
11. Monitor A3U401B pin 7 (LIF_STB) with an oscilloscope or logic probe. This is the strobe for the A5 IF assembly.
12. Press **AMPLITUDE** and check that pulses occur when toggling between **REF LVL** settings of –10 dBm and –20 dBm.
13. Monitor A3U401B pin 9 (LLOG_STB) with an oscilloscope or logic probe. This is the strobe for the A4 log amplifier/cal oscillator assembly.
14. Press **AMPLITUDE** and check that pulses occur when toggling between **LINEAR** and **LOG DB/DIV**.

## Interface Strobe Select

Refer to function block K of A3 Interface Assembly Schematic Diagram (sheet 3 of 6) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

Interface strobe select generates the various strobes used by circuits on the A3 Interface Assembly. Table 8-9 on page 410 and Table 8-10 on page 410 are the truth tables for demultiplexers A3U410 and A3U500.

**Table 8-9 Demultiplexer A3U410 Truth Table**

| Selected Output Line | IA1 | IA2 | IA3 |
|---|---|---|---|
| Pin 15, LSCAN_KBD | L | L | L |
| Pin 14, LDACU1 | H | L | L |
| Pin 13, LDAC1 | L | H | L |
| Pin 12, LDAC2 | H | H | L |
| Pin 11, LDAC3 | L | L | H |
| Pin 10 | H | L | H |
| Pin 9, LTIMER | L | H | H |
| Pin 7, LADC_REG1 | H | H | H |

**Table 8-10 Demultiplexer A3U500 Truth Table**

| Selected Output Line | IA0 | IA1 | IA2 |
|---|---|---|---|
| Pin 15, LSENSE_KBD | L | L | L |
| Pin 14, LINT_PRIOR | H | L | L |
| Pin 13, LADC_DATA1 | L | H | L |
| Pin 12, LDAC_DATA0 | H | H | L |
| Pin 11, HCNTR_LD0 | L | L | H |
| Pin 10, HCNTR_LD1 | H | L | H |
| Pin 9, LRPG_RD | L | H | H |
| Pin 7, LADC_REG0 | H | H | H |



FIGURE 8-3. A3 INTERFACE ASSEMBLY BLOCK DIAGRAM

# 9 IF Section

# Introduction

The IF section contains the A4 log amplifier/cal oscillator and the A5 IF assemblies. Figure 9-2 on page 431 illustrates the location of the A4 and A5 test connectors. Figure 9-7 on page 436 illustrates the level and paths through the IF section.

# Troubleshooting Using the Diagnostic Software

**NOTE**

Whenever the software program says "Connect the 8566 to ....," just about any spectrum analyzer with GPIB will work. However, an 8566B or 8563E is recommended for speed of measurement. (The 8562A and 8560A-Series spectrum analyzers are much slower when using the diagnostics program.)

For required hardware and instructions on how to load the 8564E/8565E adjustment/diagnostic software, refer to Chapter 2 , “Adjustment/Diagnostic Software.” The diagnostic software can be used to quickly isolate a number of common problems that might cause the spectrum analyzer to fail. Carefully follow the instructions displayed by the software program.

**Figure 9-1 A4 and A5 Test Connectors**

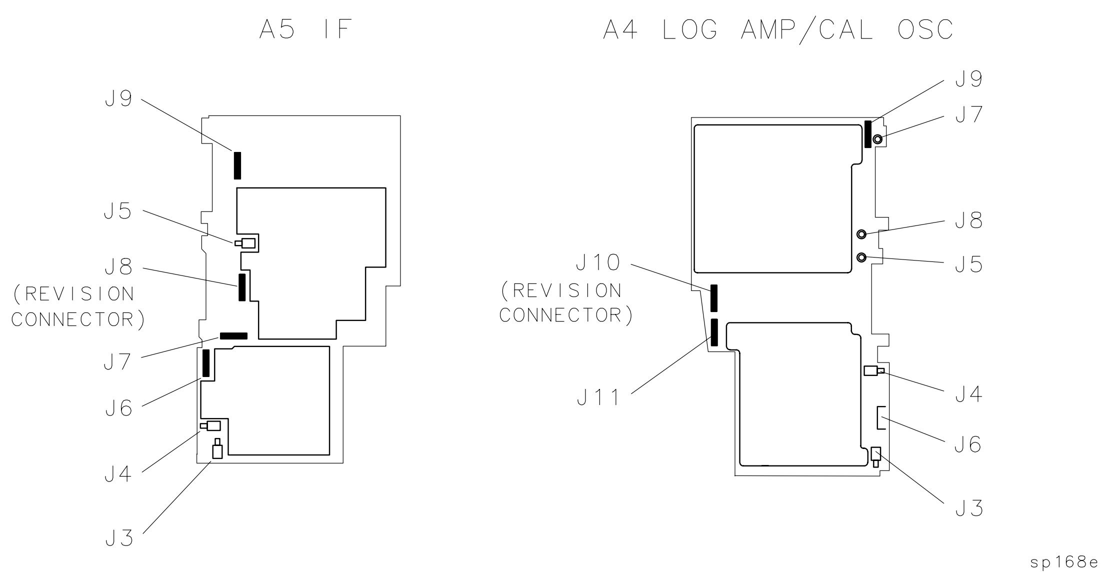
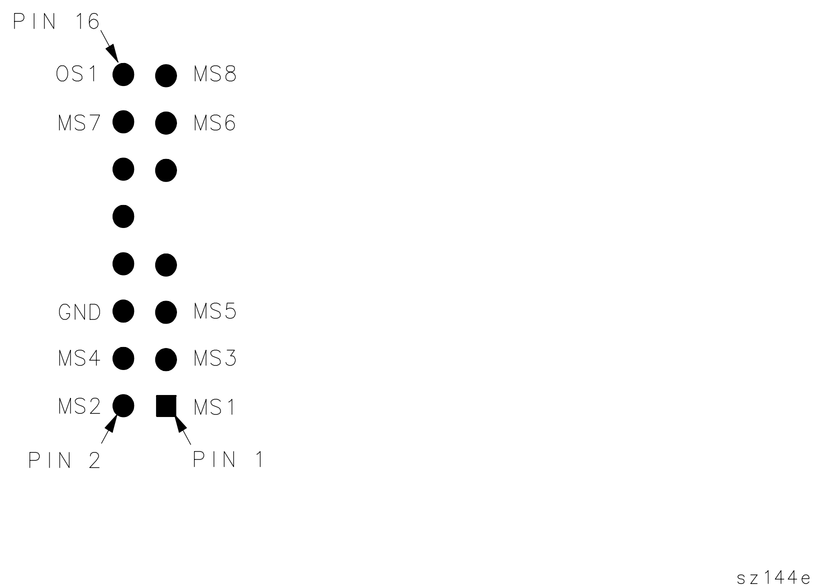


**Figure 9-2 A4 and A5 Test Connector Pin Locations**




**NOTE** Because the cal oscillator circuitry on the A4 assembly is such an integral part of the IF adjustment, always check this assembly first, before checking the rest of the IF Section. A faulty cal oscillator can cause many apparent "faults" in the rest of the IF Section.

## Troubleshooting the Cal Oscillator on A4 Using Diagnostic Software

1. From the 8564E/8565E adjustment/diagnostic software menu, select "CAL Oscillator Control."
2. Set the 8564EC or 8565EC to external trigger and press **SGL SWP**, **CAL**, and **IF ADJ OFF**.
3. Using a second spectrum analyzer, look at the output of the cal oscillator at A4J8. Set the second spectrum analyzer to external trigger (positive-edge) and use the signal at A4U104 pin 2, with ground connection at A4U104 pin 10, to externally trigger the second spectrum analyzer. (A 20-pin IC clip is recommended to avoid inadvertently shorting pins together on A4U104.)
4. Select cw frequencies of 9.9 MHz, 10.7 MHz, and 11.5 MHz in the diagnostic software menu. The amplitude should be –35 dBm at each frequency.
5. Select the 20 kHz sweep width in the software menu. The display on the second spectrum analyzer should be similar to that shown in Figure 9-3 on page 433.

6. Select the 10 kHz sweep width in the software menu. The display on the second spectrum analyzer should be similar to that shown in Figure 9-4 on page 433.
7. Select the 4 kHz sweep width in the software menu. The display on the second spectrum analyzer should be similar to that shown in Figure 9-5 on page 434.
8. Select the 2 kHz sweep width in the software menu. The display on the second spectrum analyzer should be similar to that shown in Figure 9-6 on page 434.
9. If the cal oscillator is not sweeping, check the output of the sweep generator circuit (A4U804 pin 8 of function block Z). A series of negative-going parabolas should occur. Frequency and amplitude vary, depending on the sweep width chosen. Table 9-1 lists the RANGE, MA0, and MA1 values for the sweep widths.

**Table 9-1 Sweep Width Settings**

| Sweep Width | Sweep Time | Res BW Adjusted | RANGE A4U105 Pin 6 | MA1 A4U105 Pin 2 | MA0 A4U105 Pin 5 |
|---|---|---|---|---|---|
| 20 kHz | 5 ms | 10 kHz | +5 V | 0 V | 0 V |
| 10 kHz | 10 ms | 3 kHz | +5 V | 0 V | +5 V |
| 4 kHz | 30 ms | 1 kHz | +5 V | +5 V | 0 V |
| 2 kHz | 15 ms | 300 Hz | +5 V | +5 V | +5 V |

**Figure 9-3 CAL Oscillator Swept Output, 20 kHz Width**

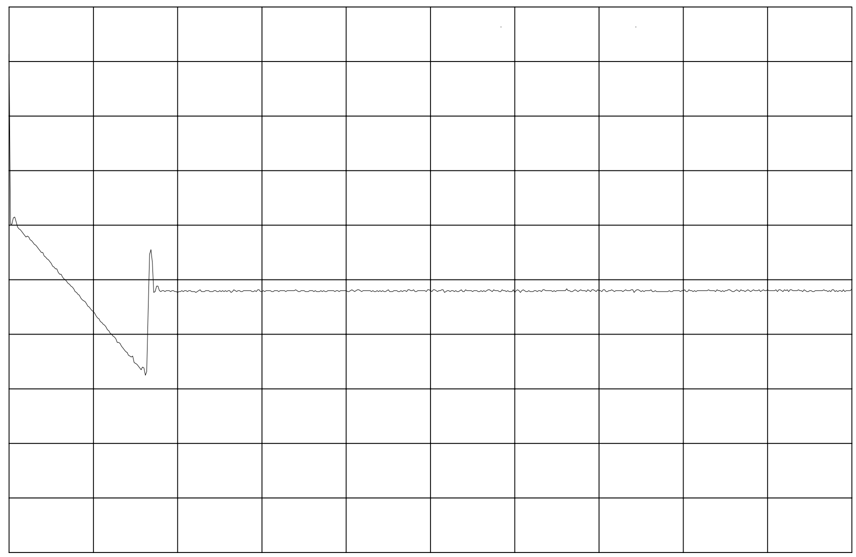


**Figure 9-4 CAL Oscillator Swept Output, 10 kHz Width**

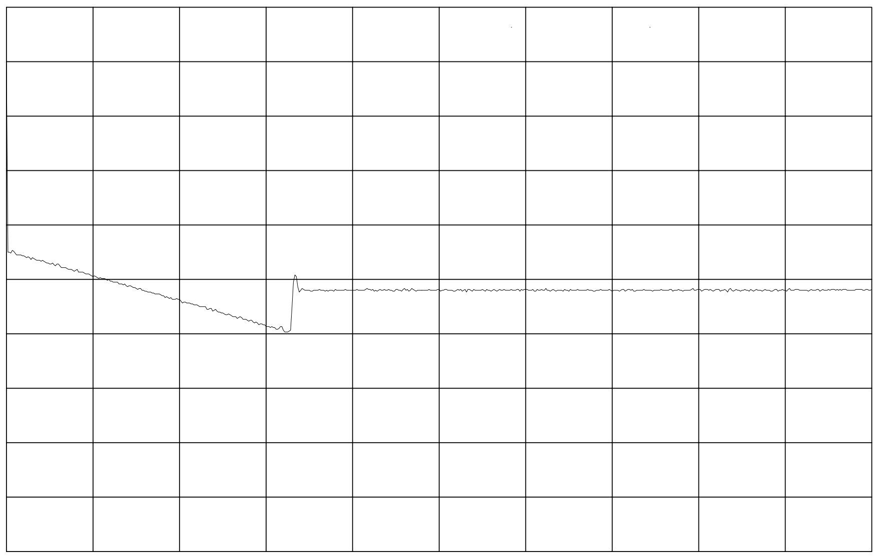


**Figure 9-5 CAL Oscillator Swept Output, 4 kHz Width**

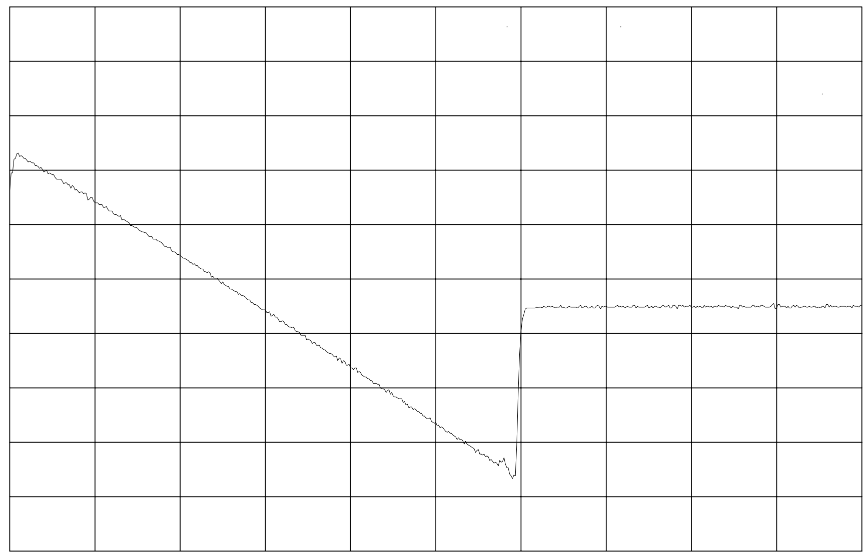
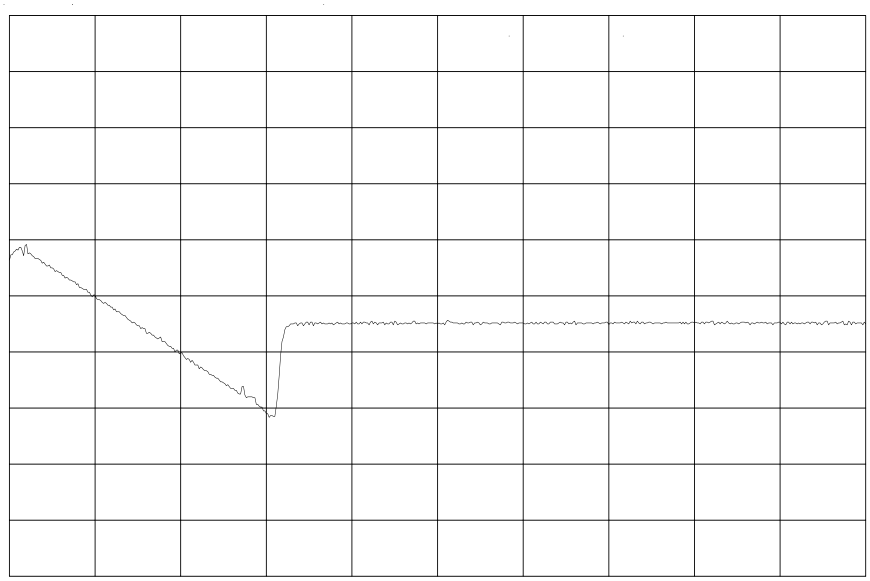


**Figure 9-6 CAL Oscillator Swept Output, 2 kHz Width**



## Troubleshooting A5 Using Diagnostic Software

The IF diagnostics in the software include:

DC probe (using the TAM)
Gain checks
LC frequency checks
Xtal frequency checks

### DC Probe

Using the up/down arrow, select "DC probe" in the IF diagnostics menu. Connect the TAM (Test and Adjustment Module) and use the dc probe as directed by the diagnostic software program. The current into each IF filter or amplifier stage is measured and compared to limits. This helps locate shorted or open components. An asterisk will appear at the points of failure. An @ indicates a measurement error (bad setup, GPIB not responding, test equipment error, or major failure).

**NOTE** In the following gain and frequency checks, an 8566B or 8563E is the preferred spectrum analyzer.

### Gain Checks

Using the up/down arrow, select "Gain checks" in the IF diagnostics menu. An 3335A synthesizer/level generator is used as a stimulus and a spectrum analyzer is used to measure the response. The gain of each stage is measured and compared to limits. An asterisk will appear at the points of failure. An "@" indicates a measurement error (bad setup, GPIB not responding, test equipment error, or major failure).

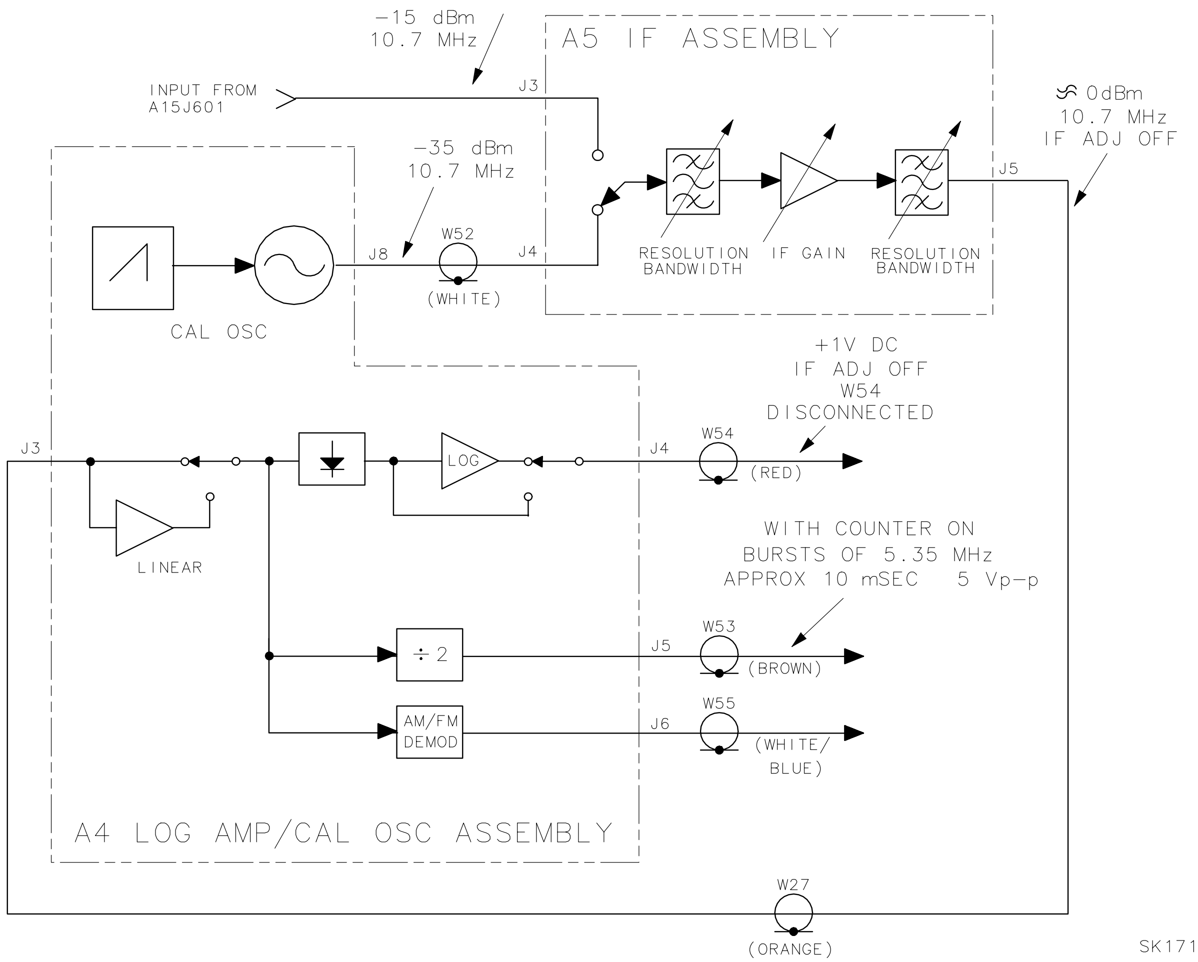
### LC Frequency Checks

Using the up/down arrow, select "LC frequency checks" in the IF diagnostics menu. An 3335A synthesizer/level generator is used as a stimulus and a spectrum analyzer is used to measure the response. The center frequency tuning range and the bandwidth adjustment range are measured for each pole. The LC pole selection menu allows selection using the up/down arrows. Select "All Poles" first, unless a particular pole is suspected to have failed. An asterisk will appear at the points of failure. An "@" indicates a measurement error (bad setup, GPIB not responding, test equipment error, or major failure).

### Xtal Frequency Checks

Using the up/down arrow, select "Xtal frequency checks" in the IF diagnostics menu. An 3335A synthesizer/level generator is used as a stimulus and a spectrum analyzer is used to measure the response. The symmetry adjustment range and the bandwidth adjustment range are measured for each pole. The Xtal pole selection menu allows selection using the up/down arrows. Select "All Poles" first, unless a particular pole is suspected to have failed. An asterisk will appear at the points of failure. An "@" indicates a measurement error (bad setup, GPIB not responding, test equipment error, or major failure).

**Figure 9-7 IF Section Troubleshooting Simplified Block Diagram**



# Automatic IF Adjustment

The 8564EC or 8565EC spectrum analyzer performs an automatic adjustment of the IF Section whenever needed.

The cal oscillator on the A4 assembly provides a stimulus signal which is routed through the IF during the retrace period.

The A3 Interface assembly measures the response using its analog-to-digital converter (ADC). The 8564EC or 8565EC spectrum analyzer turns the cal oscillator off during a sweep.

When IF ADJ is ON, the 8564EC or 8565EC spectrum analyzer readjusts part of the IF circuitry during each retrace period to readjust the IF completely every 5 minutes.

Automatic IF adjustment is performed upon the following conditions:

Power on: (unless **STOP ALIGN** is pressed). The IF parameter variables are initialized to values loaded in program ROM and all possible IF adjustments are made. If **STOP ALIGN** is pressed, the adjustment is halted.

If **REALIGN LO &IF** is selected: All possible IF adjustments (and LO adjustments) are made with the most recent IF parameter variables used as the starting point.

If **FULL IF ADJ** is selected: All possible IF adjustments are made with the most recent IF parameter variables used as the starting point. (**FULL IF ADJ** is located in the **CAL** menu.)

If **ADJ CURR IF STATE** is selected: All amplitude data and some resolution bandwidths are adjusted. The bandwidths adjusted are a function of the currently selected resolution bandwidth setting.

Between sweeps: IF ADJ must be set to ON. When IF ADJ is OFF, an A is displayed along the left side of the graticule.

If a FULL IF ADJ sequence cannot proceed beyond the amplitude portion, check the output of the cal oscillator on the A4 assembly as follows:

1. Disconnect cable W52 (coax 9) from A5J4. Connect cable W52 to the input of a second spectrum analyzer.
2. Set the second spectrum analyzer center frequency to 10.7 MHz and the reference level to –30 dBm.
3. On the 8564EC or 8565EC spectrum analyzer under test, press **FULL IF ADJ** and observe the display of the second spectrum analyzer.
4. If a –35 dBm signal does not appear, the cal oscillator is probably at fault.

## Parameters Adjusted

The following IF parameters are adjusted in the sequence listed:

1. Amplitude
    a. Video Offsets: analog (using log amplifier video offset DAC) and digital (applying stored constant to all readings)
        1. Linear Scale Offset
        2. Log Scale Offset
            1. Wideband and Narrowband modes
            2. 0 to 60 dB range in 10 dB steps
            3. 10 dB/division and 2 dB/division (log expand) modes
    b. Step Gains (A5 IF Assembly)
        1. First Step Gain for 16 different DAC settings
        2. Second Step Gain for 16 different DAC settings
        3. Third Step Gain for 0, 15, and 30 dB attenuation relative to maximum gain
        4. Fine Attenuator for 32 evenly-spaced DAC settings
    c. Log Amplifier Slopes and Fidelity
        1. Wideband (RES BW 300 kHz through 2 MHz) and Narrowband modes (RES BW 300 Hz through 100 kHz)
        2. 10 dB/division and 2 dB/division (log expand) modes
    d. Linear Scale Gains - On the log amplifier assembly (P/O A4)
    e. Peak Detector Offsets (both Positive and Negative Peak Detectors with respect to normal sample path used by Auto IF Adjust)
2. LC Bandwidths
    a. 300 kHz resolution bandwidth center frequency, bandwidth, and gain
    b. 1 MHz resolution bandwidth center frequency, bandwidth, and gain
    c. 2 MHz resolution bandwidth gain
    d. 100 kHz resolution bandwidth center frequency, bandwidth, and gain
    e. 30 kHz resolution bandwidth center frequency, bandwidth, and gain

f. Gain of all resolution bandwidth relative to the 300 kHz RES BW

3. Crystal Bandwidths

   a. The cal oscillator sweep rate is measured against the 100 kHz resolution bandwidth filter skirt. This result is used in compensating the sweeps used for adjusting the crystal bandwidths.

   b. 10 kHz resolution bandwidth

      1. Center frequency of LC tank that loads the crystal

      2. Symmetry adjustment to cancel crystal case capacitance.

      3. Bandwidth

   c. 3 kHz resolution bandwidth: center frequency of LC tank and bandwidth of resolution bandwidth

   d. 1 kHz resolution bandwidth: bandwidth

   e. 300 Hz resolution bandwidth: bandwidth

   f. Gain of all resolution bandwidth relative to the 300 kHz RES BW.

4. Digital Bandwidths (1 Hz through 100 Hz; 10 Hz through 100 Hz if Option 103).

   a. VCXO (final LO) tuned to align digital bandwidths with crystal bandwidth center frequency.

   b. Overall gain.

   c. Gain variation with input frequency.

## Requirements

For the Automatic IF Adjustment routine to work, the spectrum analyzer must provide the following basic functions:

- Power supplies
- Control signals
- ADC
- 10 MHz frequency reference to the A4 log amp/cal oscillator
- A15 RF assembly isolation from the RF signal during IF adjustment

A15 RF assembly isolation is a function of the REDIR signal in the A15 Flatness Compensation Control block.

The references against which the Automatic IF Adjustment routine aligns are:

- 10 MHz reference (A15)
- Linear scale fidelity, especially the 10 dB gain stage in A4 linear amplifier block
- 15 dB reference attenuator (A5)
- Cal Oscillator output power (A4)

# Performance Test Failures

Failures in IF-Section-related performance tests may be investigated using the following information.

## IF Gain Uncertainty Performance Test

Failure of this performance test indicates a possible problem with the 8564EC or 8565EC spectrum analyzer IF gain circuits. Assuming no major IF problems causing IF adjustment errors, IF gain problems in the first 50 dB of IF gain (REF LVLs of 0 dBm to –50 dBm with 10 dB ATTEN) are a result of faults on the A5 IF Assembly. IF gain problems in the next 60 dB of IF gain (REF LVLs of –60 dBm to –110 dBm, 10 dB ATTEN) result from log amplifier faults on the A4 assembly.

A signal level of –5 dBm is required at input (A5J3) for displaying a signal at top screen with 10 dB input attenuation and a 0 dBm reference level.

Isolate IF gain problems on the log amplifier assembly (A4) with the following steps:

1. On the 8564EC or 8565EC spectrum analyzer, press **PRESET**, **SPAN**, **ZEROSPAN**, **FREQUENCY**, 1 **GHz**, **AMPLITUDE**, –50 dBm.
2. Press **CAL** and **IF ADJ OFF**.
3. Disconnect cable W27 (coax 3) from A5J5 and connect cable W27 to the output of a signal generator.
4. Set the signal generator controls as follows:

   Amplitude ............................................................ +10 dBm
   Frequency ............................................................ 10.7 MHz

5. Simultaneously decrease the signal generator output and the 8564EC or 8565EC spectrum analyzer REF LVL in 10 dB steps. The signal displayed by the spectrum analyzer should remain at the reference level for each step. If the signal deviates from the reference level, troubleshoot the video offset circuitry on the A4 assembly.
6. Repeat steps 1 through 5 with the 8564EC or 8565EC spectrum analyzer set to linear.

## Scale Fidelity Performance Test

Failure of this performance test indicates a possible problem with the A4 assembly:

- If the Linear, 5 dB/div, or 10 dB/div scales are out of specification, the fault is most likely on the log amplifier assembly (P/O A4).
- If only the 1 dB/div or 2 dB/div scales are out of specification, the fault is most likely on the A3 interface assembly.

## Resolution Bandwidths Performance Tests

Most resolution bandwidth problems are a result of A5 IF assembly failures. The resolution bandwidths are adjusted in the following sequence using 300 kHz as the reference: 1 MHz, 2 MHz, 100 kHz, 30 kHz, 10 kHz, 3 kHz, 1 kHz, 300 Hz, 100 Hz, 30 Hz, 10 Hz, 3 Hz, and 1 Hz. The 3 Hz and 1 Hz bandwidths are not available with Option 103.

If the IF adjustment routine encountered an error, the previously adjusted resolution bandwidths should be working properly and default DAC values are used for the remaining resolution bandwidth settings.

If the IF bandpass adjustments and the automatic IF adjustments fail to bring the resolution bandwidths within specification, troubleshoot the A5 IF assembly.

# Log Amplifier (P/O A4 Assembly)

The log amplifier on the A4 assembly performs several functions. It provides log and linear paths converting the 10.7 MHz IF signal to video. In addition it also provides offset circuitry, AM/FM demodulator circuitry, a frequency counter output, and down conversion of the 10.7 MHz IF to 4.8 kHz for use by the digital IF.

The log amp results are realized by using a wide dynamic range linear detector followed by a video log amp. The detector is used for both linear and log paths and contains a mixer that acts as the down converter mixer for the digital IF.

**CAUTION** For troubleshooting, it is recommended that you use an active probe, such as an 85024A, and another spectrum analyzer. If an 1120A active probe is being used with a spectrum analyzer having dc coupled inputs, such as the 8566A/B, 8569A/B and the 8562A/B, either set the active probe for an ac-coupled output or use a dc-blocking capacitor between the active probe and the spectrum analyzer input. Failure to do this can result in damage to the spectrum analyzer or the probe.

## Log Amplifier

Refer to function blocks K, L, and AE of A4 Log Amplifier Schematic Diagram (sheets 3 of 4 and 4 of 4) in the *8560 E-Series Spectrum Analyzer Component Level Information*. The log amplifier receives the detected video signal from the Detector/Mixer and outputs a voltage proportional to the log of the input voltage. The linear output is tapped off at the emitter of U501D. U507 provides input offset adjustment capability and adjusts the offset of the op amp formed by U501A, B, C, and D. Q502 is a buffer. Q501 switches in additional offset for digital RBWs. The logarithmic characteristic of the base-emitter junction of U502B is used in the feedback path to produce the logging affect. U502D is used to adjust for non-linearities in the linear mode. R531 is used to adjust log fidelity at the top of the screen.

Use the following steps to verify proper operation of the log amplifier chain:

1. Press **CAL** and **IF ADJ OFF**. Set the digital multimeter to read dc volts and connect the negative lead to the chassis of the 8564EC or 8565EC spectrum analyzer.
2. Remove W27 from A4J3 and inject a 10.7 MHz signal of +10 dBm into A4J3.
3. Set the 8564EC or 8565EC spectrum analyzer to log mode, with a resolution bandwidth of 300 kHz and single sweep.

4. Using the DMM, check the voltage at U503 pin 6.
5. Verify that this level is about –700 mV.
6. Adjust the source amplitude to place the signal at the reference level.
7. Reduce the input signal level in 10 dB steps, down to –60 dBm, while noting the voltage displayed on the DMM. The voltage should increase (become less negative) at a rate of 30 mV for each 10 dB decrease in input power. Troubleshoot the A4 assembly if the signal does not decrease properly.
8. Set the 8564EC or 8565EC spectrum analyzer resolution bandwidth to 100 kHz to place the wide/narrow filter in narrow mode.
9. Repeat steps 2 through 7.
10. If log fidelity is poor near the bottom of the screen or the 1 MHz resolution bandwidth is narrow, a fault might exist in the wide/narrow filter switch. (Refer to function block G of A4 log amplifier schematic diagram in the *8560 E-Series Spectrum Analyzer Component Level Information*.) Check this switch as follows:
    a. Monitor voltages on A4U302 pins 1 and 7 while changing the 8564EC or 8565EC spectrum analyzer resolution bandwidth from 100 kHz to 300 kHz.
    b. If the voltages do not come within a few volts of the +15 V and –15 V supplies, U103 and U302 are suspect.
    c. Disconnect the digital multimeter and reconnect W27 to A4J3.

## Linear Amplifiers

Refer to function block C of A4 log amplifier schematic diagram (sheet 2 of 4) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

The linear amplifiers consist of two variable gain stages, U201C and U201E as well as the buffer amplifier A4U201B, A4U201D, and A4Q201. The linear amplifiers provide 0 to 40 dB of IF gain in 10 dB steps. The gain of A4U201C can be increased by 20 dB by turning on A4CR201 and A4CR210 with the control line LIN_20B. The gain of A4U201E can be increased by either 10 dB or 20 dB with the control lines LIN_10 or LIN_20A respectively. The gain can be selected by setting the reference level of the 8564EC or 8565EC spectrum analyzer.

**Table 9-2 IF Gain Application Guidelines (ATTEN=10 dB)**

| Power into A4J3 | Reference Level | Gain of A4U201C (Pin 8 in; Pin 3 out) | Gain of A4U201E (Pin 3 in; Pin 10 out) | Total Gain |
|---|---|---|---|---|
| +6 dBm | –50 dBm | 0 dB | 0 dB | 0 dB |
| –4 dBm | –60 dBm | 0 dB | 10 dB | 10 dB |
| –14dBm | –70 dBm | 0 dB | 20 dB | 20 dB |
| –24 dBm | –80 dBm | 20 dB | 10 dB | 30 dB |
| –34 dBm | –90 dBm | 20 dB | 20 dB | 40 dB |

Total gain can be measured by injecting the specified power into A4J3 and measuring the total gain provided by A4U201C and A4U201E. The following procedure provides a means of troubleshooting the linear amplifiers:

1. On the 8564EC or 8565EC spectrum analyzer, press **PRESET**, **SPAN**, **ZERO, SPAN**, **CAL**, **IF ADJ OFF**, **FREQUENCY**, 1 **GHz**, **AMPLITUDE**, –50 dBm, **LINEAR**, **MORE**, **AMPTD UNITS**, **dBm**, and **AMPLITUDE**.
2. Disconnect W27 (coax 3) from A4J3 and connect the output of a signal generator to A4J3.
3. Set the signal generator controls as follows:

   Amplitude ................................................................ +6 dBm
   Frequency ............................................................ 10.7 MHz
4. Simultaneously decrease the signal generator output and 8564EC or 8565EC spectrum analyzer REF LVL in 10 dB steps to –90 dBm. At each step, the signal displayed on the spectrum analyzer should be within one division of the previous position.
5. If a problem exists, isolate it by comparing the actual gain of A4U201C and A4U201E with those listed in the above gain guidelines.
6. Reconnect W27 (coax 3) to A4J3.

## Video Offset

Refer to function block P of A4 log amplifier schematic diagram (sheet 3 of 4) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

The circuit provides a programmable video offset, with a step size of 5 mV, from –300 mV to +900 mV.

1. On the 8564EC or 8565EC spectrum analyzer, press **PRESET**, **SPAN**, **ZERO SPAN**, **FREQUENCY**, 1 **GHz**, **AMPLITUDE**, –50 dBm, **CAL**, **IF ADJ OFF**.
2. Disconnect W27 (coax 3) from A4J3 and connect a signal generator to A4J3.
3. Set the signal generator controls as follows:

   Amplitude ............................................................ +10 dBm
   Frequency .......................................................... 10.7 MHz

4. Simultaneously decrease the signal generator output and 8564EC or 8565EC spectrum analyzer reference level in 10 dB steps down to –110 dBm. At each step, the signal displayed on the spectrum analyzer should be close to the reference level.
5. Reconnect W27 (coax 3) to A4J3 and cycle the spectrum analyzer power. Press **STOP REALIGN** when it appears.
6. On the 8564EC or 8565EC spectrum analyzer, press **SWEEP**, **SINGLE**, **CAL**, and **IF ADJ OFF**.
7. The offset DAC, A4U102 pin 2, should now be at its default value of approximately +2.45 V. The voltage at U601 pin 3 should be approximately 0 V for a DAC output of 2.45 V.
8. If this default offset voltage is incorrect, DAC U102 is the most probable cause.

## Video Output

1. On the 8564EC or 8565EC spectrum analyzer, press **PRESET**, **FREQUENCY**, 300 **MHz**, **SPAN**, 100 **Hz**, **AMPLITUDE**, –10 dBm, **SGL SWP**, **CAL** and **IF ADJ OFF**.
2. Connect the CAL OUTPUT to the INPUT 50Ω connector.
3. Disconnect W54 (coax 2) from A4J4. Connect a short SMB to SMB cable from A4J4 to an SMB tee and connect W54 to the tee. Connect a test cable from the tee to the input of an oscilloscope.

4. Set the oscilloscope controls as follows:

   Amplitude scale .................................................. 200 mV/div
   Offset ..................................................................... +400 mV
   Coupling ..................................................................... dc
   Sweep time ...................................................... 50 µs/division

5. The oscilloscope should display a 4.8 kHz sine wave.

6. Disconnect the cable from the CAL OUTPUT and the INPUT 50Ω connectors.

7. Set the resolution bandwidth to 2 MHz.

8. Broadband noise should be displayed on the oscilloscope from approximately +200 mV to +400 mV.

9. As the **REF LVL** is decreased in 10 dB steps from −10 dBm to −70 dBm, the noise displayed on the oscilloscope should increase in 100 mV increments. If this response is not observed, refer to "Step Gains" and "Video Offset".

10. Reconnect cable W54 to A4J4.

## Frequency Counter Prescaler/Conditioner

Refer to function block Q of A4 log amplifier schematic diagram (sheet 4 of 4) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

The frequency counter prescaler/conditioner divides the frequency by two, and then attenuates it. The circuit consists of frequency divider (U703A) and an output attenuator. The frequency divider turns on only when the instrument is counting.

## AM/FM Demodulator

Refer to function block R of A4 Log Amplifier Schematic Diagram (sheet 4 of 4) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

The demodulator circuitry on the log amplifier on A4 produces a low-level audio signal. This audio signal is then amplified by the audio amplifier on A4. The FM demodulator demodulates narrowband FM (5 kHz deviation) signals. The detector (block J) demodulates AM signals.

1. If demodulation problems occur when the spectrum analyzer is in the frequency domain, perform the Frequency Span Accuracy performance test and, if necessary, the YTO Adjustments procedure.

2. If an FM signal cannot be demodulated, perform the Demodulator Adjustment procedure. If the output of A4C707 cannot be adjusted as described in the Demodulator Adjustment procedure, troubleshoot the FM Demodulator or Audio MUX circuits on A4.

## 4.8 kHz IF Filters

Refer to function block N of A4 Log Amplifier Schematic Diagram (sheet 3 of 4) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

Problems with the 4.8 kHz filters can result in spurious signals appearing 2.88 kHz to 3.52 kHz greater than the frequency of the desired response. Also, `ERR 536 RBW <300` may occur when problems exist with the 4.8 kHz IF filters.

Measure the passband of the 4.8 kHz IF filters as described in the following procedure:

1. On the 8564EC or 8565EC spectrum analyzer, press **CAL**, **IF ADJ OFF**, **SPAN**, and 600 **Hz**.
2. Disconnect W27 from A4J3 and inject a 10.7 MHz signal of –20 dBm into A4J3.
3. Fine-tune the frequency of the signal generator to center the signal on the screen. Set the signal generator to sweep one 2 kHz span about this center frequency. Press **SGL SWP** on the 8564EC or 8565EC spectrum analyzer.
4. Set another spectrum analyzer, such as the 8566A/B, to 4.8 kHz center frequency and 2 kHz span.

**CAUTION** If a dc block is not used, damage to the 8566A/B results. The 8566A/B and many other spectrum analyzers have dc-coupled inputs and cannot tolerate dc voltages on their inputs.

5. Connect the VIDEO OUTPUT (rear panel) of the 8564EC or 8565EC spectrum analyzer through a 20 dB attenuator and dc block to the input of the 8566A/B. Set the sweep time of the 8566A/B to 10 seconds.
6. Set the 8566A/B to single trigger and press TRACE A **CLEAR-WRITE**. Trigger a sweep of the 8566A/B and the signal generator simultaneously. The 8566A/B shows the passband of the 4.8 kHz IF filters. The 3 dB bandwidth of the filters should be 1.2 kHz. The passband of the filters should be flat within 2 dB over 800 Hz.
7. Reconnect W27 (coax 3) to A4J3.

## 10.7 MHz IF Filters

1. Press **PRESET**, **FREQUENCY**, 300 **MHz**, **SPAN**, 600 **Hz**, **CAL**, and **IF ADJ OFF**.
2. Disconnect W29 (coax 7) from A5J3. Set the signal generator for a 10.7 MHz signal at –50 dBm and connect it to A5J3.
3. Fine tune the frequency of the signal generator to center the signal on the 8564EC or 8565EC spectrum analyzer display. Set the signal generator to sweep one 2 kHz span about this center frequency.
4. On the 8564EC or 8565EC spectrum analyzer, press **SGL SWP**.
5. Disconnect W27 (coax 3) from A5J5. Connect a test cable from A5J5 to the input of an 8566A/B.
6. Set the 8566A/B as follows:

   Center frequency ................................................... 10.7 MHz
   Span ................................................................... 2 kHz
   Reference level ........................................................ +10 dBm
   Sweep ................................................................... Single

7. Press TRACE A **CLEAR-WRITE** on the 8566A/B.
8. Trigger a sweep on the signal generator and on the 8566A/B simultaneously. The 8566A/B should display a 3 dB bandwidth of approximately 500 Hz.
9. Reconnect W27 (coax 3) to A5J5 and W29 (coax 7) to A5J3.

## 4.8 kHz and 10.7 MHz IF Filters

1. On the 8564EC or 8565EC spectrum analyzer, press **PRESET**, **FREQUENCY**, 300 **MHz**, **SPAN**, 600 **Hz**, **CAL**, and **IF ADJ OFF**.
2. Disconnect W29 (coax 7) from A5J3. Set the signal generator for a 10.7 MHz signal at –60 dBm and connect it to A5J3.
3. Fine tune the frequency of the signal generator to center the signal on the 8564EC or 8565EC spectrum analyzer display. Set the signal generator to sweep one 2 kHz span about this center frequency.
4. On the 8564EC or 8565EC spectrum analyzer, press **SGL SWP**.

**CAUTION** Damage to the 8566A/B results if a dc block is not used. The 8566A/B and many other spectrum analyzers have dc-coupled inputs and cannot tolerate dc voltages on their inputs.

5. Set the 8566A/B to 4.8 kHz center frequency and 2 kHz span.
6. Connect the VIDEO OUTPUT (rear panel) of the 8564EC or 8565EC spectrum analyzer through a 20 dB attenuator and dc block to the input of the 8566A/B. Set the sweep time of the 8566A/B to 10 seconds.
7. Set the 8566A/B to single trigger and press TRACE A **CLEAR-WRITE**. Trigger a sweep on the 8566A/B and on the signal generator simultaneously. The 8566A/B should show a 3 dB bandwidth of 600 Hz ±100 Hz.
8. Reconnect W29 (coax 7) to A5J3.

## 10.6952 MHz VCXO

Refer to function block E of A4 log amplifier schematic diagram (sheet 2 of 4) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

The purpose of the 10.6952 MHz voltage-controlled crystal oscillator (VCXO) is to provide an LO for down-converting the peak of the 10.7 MHz IF filter passband to 4.8 kHz. Since the peak of the passband of the 10.7 MHz IF filters is 10.7 MHz ±300 Hz, the frequency of the VCXO is between 10.6949 MHz and 10.6955 MHz. This frequency can best be measured at the collector of A4Q202.

The center frequency of the 300 Hz resolution-bandwidth filters and the 1 Hz to 100 Hz filters should differ no more than 10 Hz. If the center frequency is different by more than this, or if no signal is present in the 1 Hz to 100 Hz resolution-bandwidth settings, troubleshoot the 10.6952 MHz VCXO.

Error message `ERR 539` may occur if the VCXO is not oscillating. If problems exist with the VCXO control voltage, error messages `ERR 536` or `ERR 530` may occur.

Between sweeps the VCXO, at times, is turned off. To prevent the oscillator from turning off, press **PRESET**, **FREQUENCY**, 0.3 **GHz**, **SPAN**, 1 **kHz**, **SGL SWP**, **CAL**, and **IF ADJ OFF**.

## Input Switch

Refer to function block D of A4 Log Amplifier Schematic Diagram (sheet 2 of 4) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

The input switch switches between log and linear modes. In addition it contains a 20 dB attenuator which is used only in digital resolution bandwidth settings. CR207, CR208, and CR209 form the input switch. CR205 and CR206 switch in R234 when in linear mode to maintain a constant impedance at J3. CR210, CR211, CR212, and CR221 switch the 20 dB attenuator in and out.

## LO Switch

Refer to function block F of A4 log amplifier schematic diagram (sheet 2 of 4) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

The LO switch switches the limiter input between the 10.7 MHz path or the 10.6952 MHz VCXO path.

## Synchronous Detector

A wide dynamic range linear detector is realized by the limiter (block G), the isolation amplifier (block H), the LO amplifier (block I), and the detector/mixer (block J). The combination of these circuits form what is commonly known as a synchronous detector.

The input signal is split between two paths. One path flows through the isolation amplifier and the other path flows through the limiter and LO amplifier The path flowing through the limiter generates the LO for the detector/mixer block. The path through the isolation amplifier drives the RF port.

To troubleshoot this group of circuits set the RBW to 300 kHz. Inject 10.7 MHz at +6 dbm into J3. Probe the gate of A4Q404 or A4Q405 with a scope. Look for a 0 to –3 V square wave. Decrease the input power from +6 dBm to –84 dBm in 10 dB steps. The square wave signal should remain unchanged. It is normal for the phase of the signal to jitter at the lowest signal levels.

The signals at the gates of A4Q404 and A4Q405 should be 180 degrees out of phase from each other. If they are not 180 degrees out of phase or one of the signals are not present, troubleshoot the LO Amplifier or the FETs in the mixer. If the signal is not a symmetrical square wave, troubleshoot the LO amplifier. If the signal drops out prematurely or is not present at all, troubleshoot the limiter or LO amplifier.

Repeat the procedure for an RBW ≤ 100 kHz. If the log amplifier works in the 300 kHz RBW but not in the narrower RBWs, troubleshoot the log narrow filter in the limiter or isolation amplifier. A4CR302 and A4CR303 are varactor diodes in the limiter filter and are used to tune the filter.

### Limiter

Refer to function block G of A4 log amplifier schematic diagram (sheet 2 of 4) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

The limiter consists of 7 identical 20 dB gain stages. A "log narrow filter" is switched in for RBWs ≤100 kHz. This filter is switched in using the control lines NARROW between the 4th and 5th stages. During normal operation, the limiter serves to amplify even the smallest 10.7 MHz signals up to a level sufficient to drive the LO Amplifier and subsequent detector/mixer. This signal serves as the LO for the mixer circuitry.

### Isolation Amplifier

Refer to function block H of A4 log amplifier schematic diagram (sheet 3 of 4) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

The isolation amplifier prevents LO port to RF port feedthrough in the mixer from feeding back to the input of the limiter and causing loop oscillations. In addition, the isolation amplifier matches the phase of the non-limited signal path to the phase of the limited signal path. The isolation amplifier should have a gain of about 4 dB and also has a "log narrow filter" that is switched with the control line NARROWB.

### Detector/Mixer

Refer to function block J of A4 log amplifier schematic diagram (sheet 3 of 4) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

Sum and difference frequencies are produced in the Detector/Mixer. The difference frequency produces video (dc to approximately 3 MHz), since the two signals are at the same frequency. During digital resolution bandwidths the two signals are separated by about 4.8 kHz.

## Log Offset/Gain Compensation

Refer to function blocks L and M of A4 log amplifier schematic diagram (sheet 3 of 4) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

### Log Offset Compensation

The gain of A4U503 is set to unity, with A4R539 and A4R540 combining for a gain of 0.5. Therefore, the gain from A4U503 pin 3 to A4U508 pin 3 should be 0.5.

### Log Gain Compensation

The gain of A4U508 is nominally 6.8, measuring from pin 3 to pin 8. To check the log offset/gain compensation circuits inject a +10 dBm signal into J3 with the 8564EC or 8565EC spectrum analyzer set to log mode. Measure A4U503 pin 3, $V_{in}$ (1) and A4U508 pin 3, $V_{out}$ (1) and record the results. Decrease the input level to –40 dBm and make the same measurements recording $V_{in}$ (2) and $V_{out}$ (2).

The gain is then:

$$\frac{(V_{OUT}(1) - V_{OUT}(2))}{(V_{IN}(1) - V_{IN}(2))}$$

This gives an offset-independent gain measurement.

## Video MUX

The video MUX switches the video output between linear, log and 4.8 kHz IF (for digital RBWs). The demod video is an unused feature. The easiest way to troubleshoot this circuit is to look for blown FETs. Bad FETs are characterized by having significant gate current. Only one of the signal lines LIN_VIDEO, IF_VIDEO or LOG_VIDEO should be high (+15 V) at any given time. The others should be low (–15 V). Also look for a voltage drop of several volts across the gate resistors R601, R605, R609, or R613 when in either the off or on state. This indicates gate current and thus a bad FET.

# A5 IF Assembly

The input switch connects the IF to either the cal oscillator on the A4 assembly or the 10.7 MHz IF output from the A15 RF assembly. The automatic IF adjustment uses the cal oscillator on A4 at instrument turn-on and between sweeps to align the IF filters and step-gain amplifiers. During sweeps the input switch selects the 10.7 MHz IF output from A15. The LC filters are variable-bandwidth filters that provide resolution bandwidths from 30 kHz to 2 MHz. The automatic IF adjustment sets the bandwidths and center frequencies of each filter stage.

The crystal filters are variable-bandwidth filters that provide resolution bandwidths from 300 Hz to 10 kHz. The automatic IF adjustment sets the filter bandwidths and symmetry.

The step-gain amplifiers consist of the first step-gain stage, second step-gain stage, and third step-gain stage. These amplifiers provide gain when the 8564EC or 8565EC spectrum analyzer reference level is changed. The amplifiers also provide gain range to compensate for variations in the IF filter gains, which change with bandwidth and environmental conditions, and band conversion loss in the front end. Fixed-gain amplifiers shift the signal levels to lower the noise of the IF chain.

The assembly has two variable attenuators. The fine attenuator provides the 0.1 dB reference level steps. The reference 15 dB attenuator provides a reference for automatic adjustment of the step-gain amplifiers and the log amplifier. The reference 15 dB attenuator also provides gain for changes in spectrum analyzer reference level.

Various buffer amplifiers provide a high-input impedance to prevent loading of the previous filter pole and a low-output impedance to drive the next filter pole.

Digital control signals from the W2 control cable, the "analog bus," drive the control circuitry. At the beginning of each sweep the analog bus sets each control line for instrument operation. At the end of each sweep the analog bus sets each control line for the next portion of the automatic IF adjustment routine. IF adjustments continuously remove the effects of component drift as the spectrum analyzer temperature changes.

The assembly contains a reference limiting amplifier. This amplifier provides a known amount of limiting for the automatic IF adjustment routines. (Limiting occurs only during the automatic IF adjustment routines.) The LC34_Short switches are open during sweeps. The current in the reference limiter is increased during sweeps to prevent limiting.

**CAUTION** For troubleshooting, it is recommended that you use an active probe, such as an 85024A, and another spectrum analyzer. If an 1120A active probe is being used with a spectrum analyzer having dc-coupled inputs, such as the 8566A/B, 8569A/B and the 8562A/B, either set the active probe for an ac-coupled output or use a dc-blocking capacitor between the active probe and the spectrum analyzer input.

**CAUTION** Do not short control voltages to ground. These voltages are not short-circuit protected. DACs damaged by shorting these voltages might not fail until several weeks after the shorting takes place.

Do not short power supply voltages to ground. The 8564EC or 8565EC spectrum analyzer power supply current limiting cannot protect the resistors in series with the power supply.

**NOTE** Some transistors have collectors connected to the case. Electrical connection of the case to the collector might not be reliable, making collector voltage measurements on the transistor case unreliable.

## IF Signature

1. Disconnect W27 (coax 3) from A5J5.
2. Connect an SMB tee to A5J5, using a short coaxial cable with SMB connectors.
3. Connect one output of the tee to cable W27 (coax 3).
4. Connect an 85024A active probe, with a 10:1 divider installed, to the other output of the tee.
5. Connect the output (type N connector) of the active probe to the input of the 8566A/B spectrum analyzer.
6. Connect the probe power cable to the 8564EC or 8565EC spectrum analyzer front panel PROBE POWER connector (you may need to use a probe power extension cable, 10131B).

7. Set the 8566A/B controls as follows:

| | |
|---|---|
| Reference level | +10 dBm |
| Center frequency | 10.7 MHz |
| Span | 0 Hz |
| Resolution bandwidth | 300 kHz |
| Video bandwidth | 300 kHz |
| Sweep time | 5.5 s |
| Trigger | Single |

8. On the 8566A/B, press **SHIFT**, (trace A blank) to set detector to SAMPLE mode.

9. On the 8564EC or 8565EC spectrum analyzer, press **PRESET** and set the controls as follows:

| | |
|---|---|
| Center frequency | 300 MHz |
| Span | 5 MHz |

10. On the 8564EC or 8565EC spectrum analyzer, press **SGL SWP** and **CAL**.

11. Simultaneously press **SINGLE** on the 8566A/B and **ADJ CURR IF STATE** on the 8564EC or 8565EC spectrum analyzer. The IF signature is displayed on the 8566A/B display. It may be necessary to experiment with different time intervals between initiating the sweep on the 8566A/B and initiating the current IF state adjustment on the 8564EC or 8565EC spectrum analyzer.

12. Compare the IF signature to the signature of a properly operating spectrum analyzer illustrated in Figure 9-8 on page 458. If the signatures do not closely resemble each other, a more detailed view of the signature may show the failed hardware.

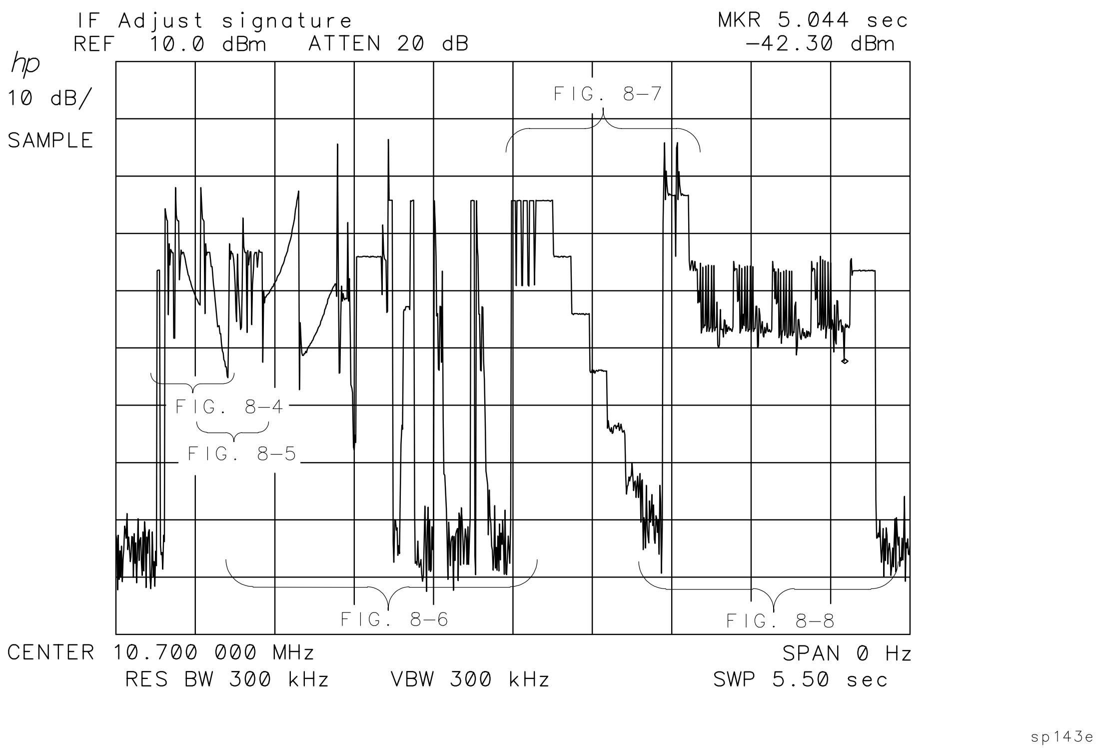
    a. Set the 8566A/B controls as follows:

| | |
|---|---|
| Sweep time | 550 ms |
| dB/division | 5 dB |
| Reference level | −5 dBm |

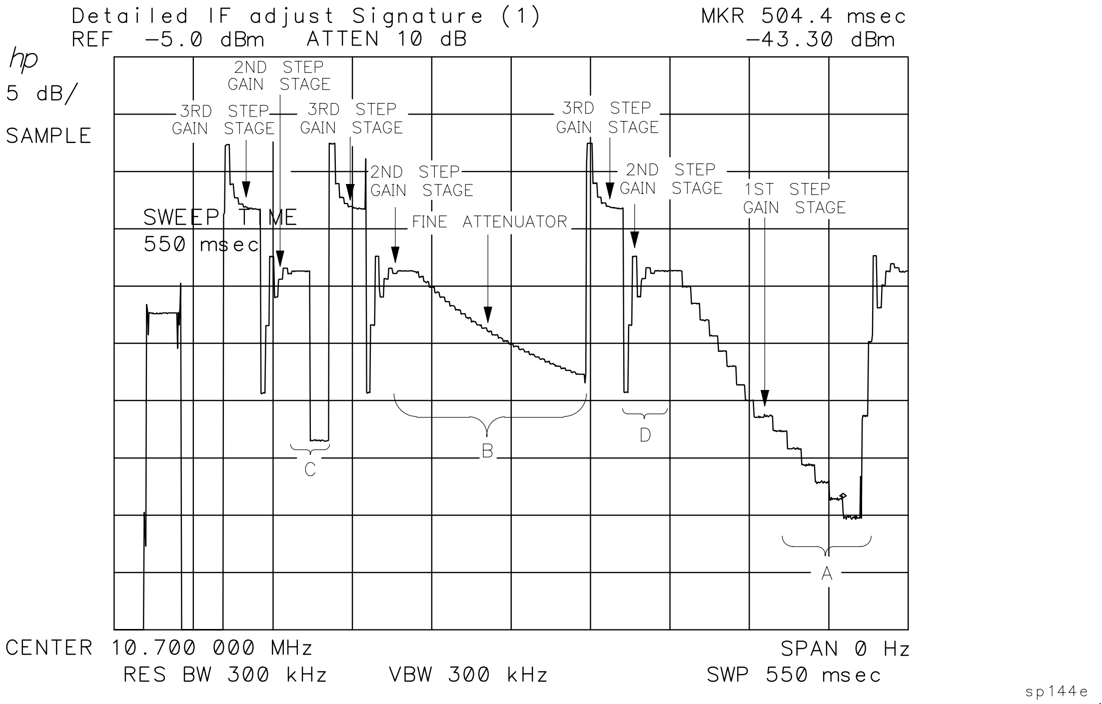
b. Press **SINGLE** on the 8566A/B and, a very short time later, press **ADJ CURR IF STATE** on 8564EC or 8565EC spectrum analyzer. Figure 9-9 on page 459 through Figure 9-13 on page 461 illustrate detailed IF signatures of a properly operating 8564EC or 8565EC spectrum analyzer. It may be necessary to experiment with different time intervals between initiating the sweep on the 8566A/B and initiating the current IF state adjustment on the 8564EC or 8565EC spectrum analyzer to obtain the waveforms shown. Note the changes in the 8566A/B video bandwidth and sweep time.

13. Reconnect W27 (coax 3) to A5J5.

**Figure 9-8 IF Adjust Signature**



## Figure 9-9 Detailed IF Adjust Signature (1)




## Figure 9-10 Detailed IF Adjust Signature (2)

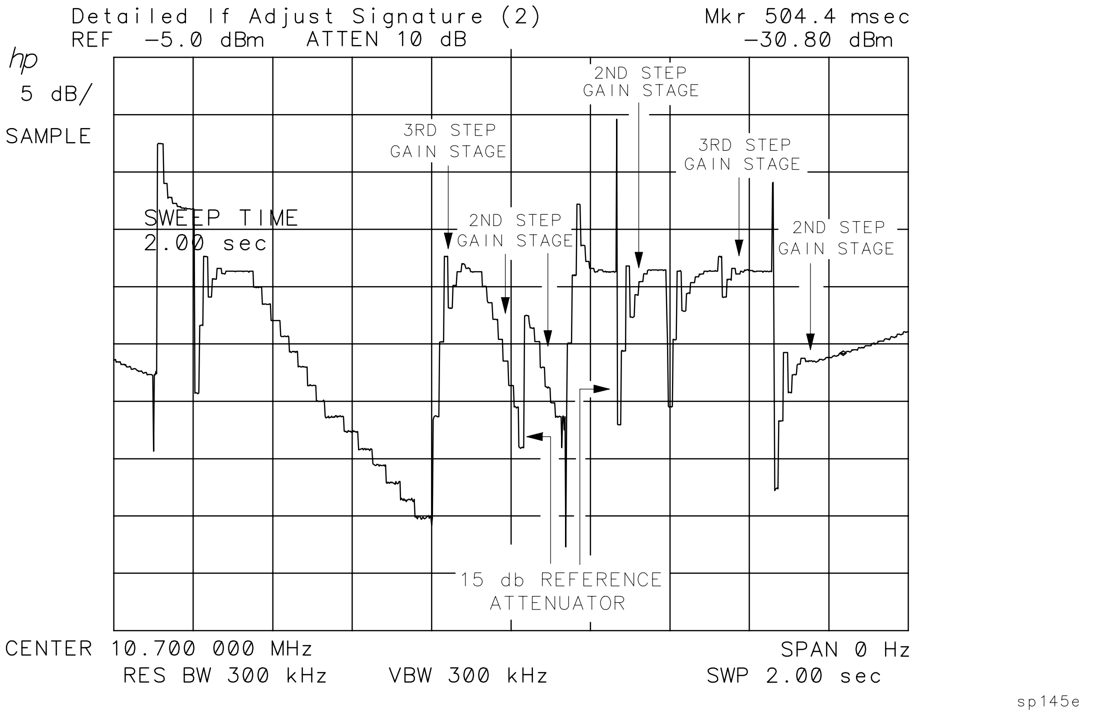


**Figure 9-11 Detailed IF Adjust Signature (3)**

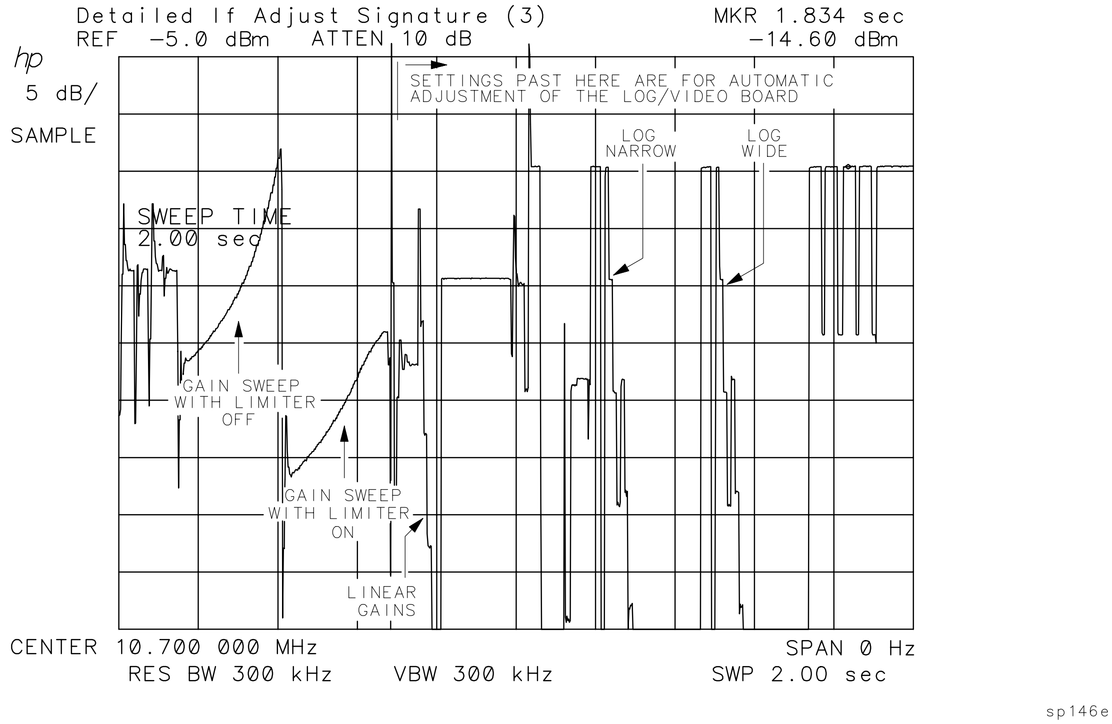



**Figure 9-12 Detailed IF Adjust Signature (4)**

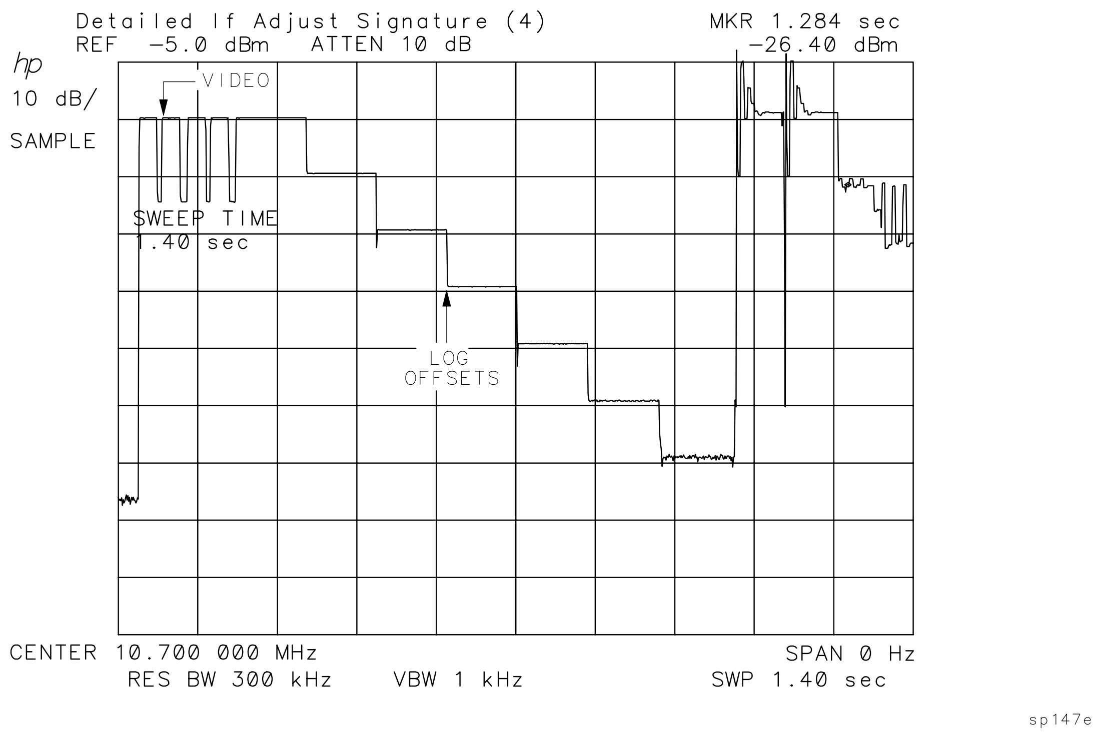
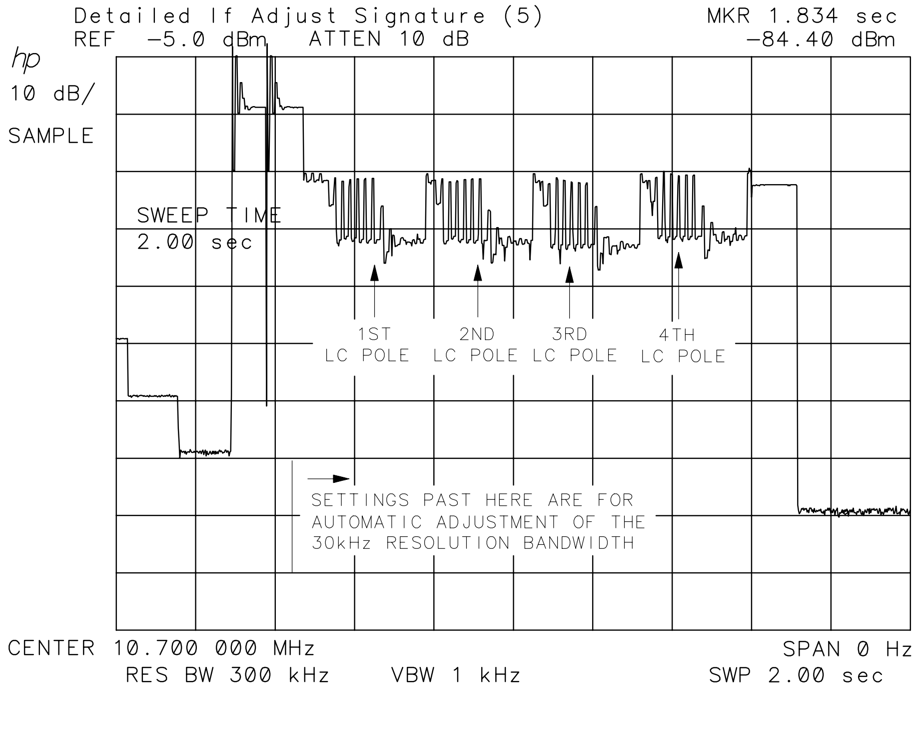


**Figure 9-13 Detailed IF Adjust Signature (5)**



## Common IF Signature Problems

**Region A of Figure 9-9, “Detailed IF Adjust Signature (1)” is noisy:**

Suspect the first LC pole.

**Region B of Figure 9-9 on page 459 is flat**:

Suspect the third step-gain stage, the fine attenuator, or the fourth LC-pole output amplifier.

**Region C of Figure 9-9, “Detailed IF Adjust Signature (1)” has no 15 dB step**:

Suspect the reference 15 dB attenuator.

**Region D of Figure 9-9 on page 459 is flat**:

Suspect the second step-gain stage.

**Entire signature noisy**:

If the signature resembles Figure 9-14 on page 463, suspect a broken first step-gain stage or a break in the signal path in the input switch, first crystal pole, or second crystal pole.

**Correct shape but noisy**:

If the signature resembles Figure 9-15, “Noise with Correct Shape” suspect the second crystal-pole output amplifier.

**Amplitude of Region B of Figure 9-16, “Region B Amplitude Variation” varies more than 12 dB**:

Suspect the third step-gain stage output amplifier.

**Region B of Figure 9-17, “Region B Amplitude Offset” is kinked**:

Suspect the fourth LC-pole output amplifier.

**Figure 9-14 Noisy Signature**

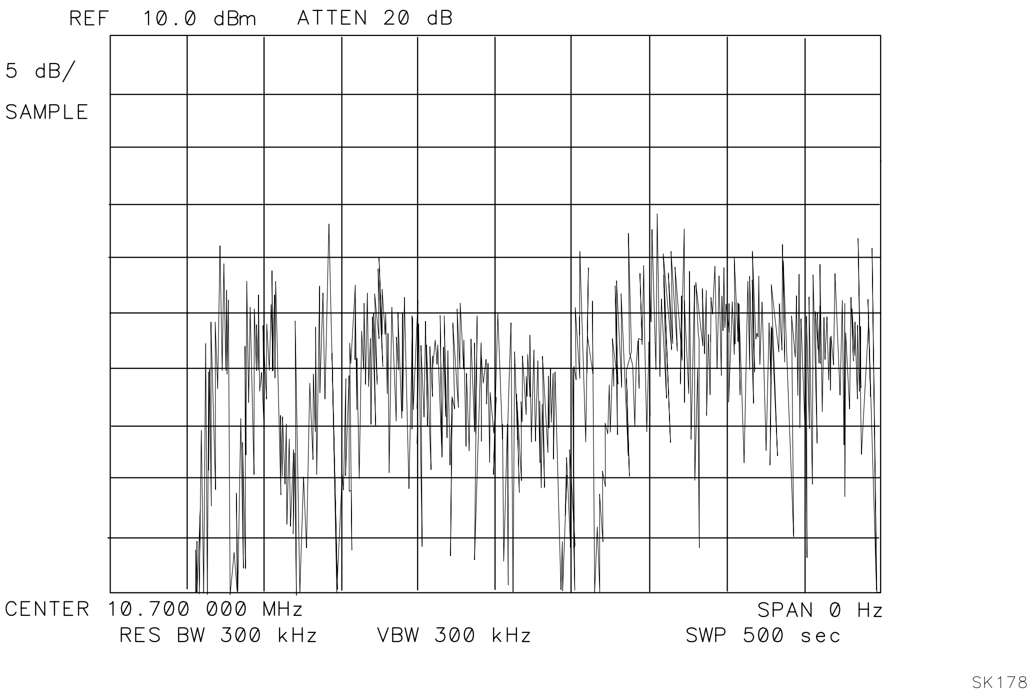



**Figure 9-15 Noise with Correct Shape**

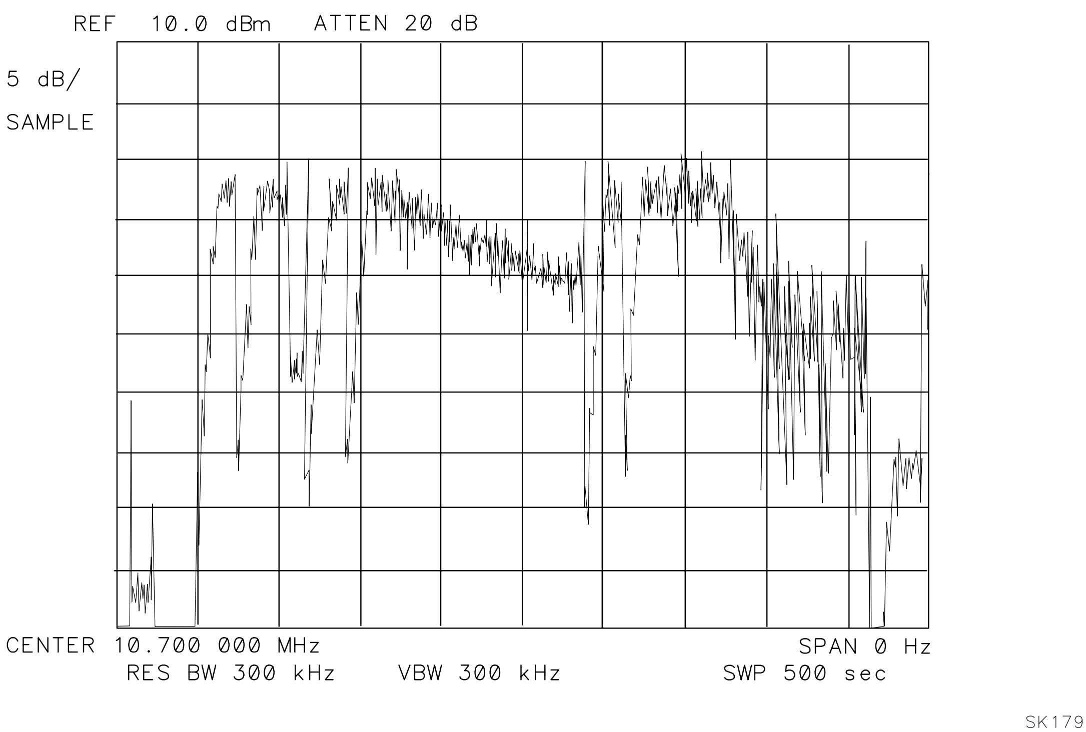


**Figure 9-16 Region B Amplitude Variation**

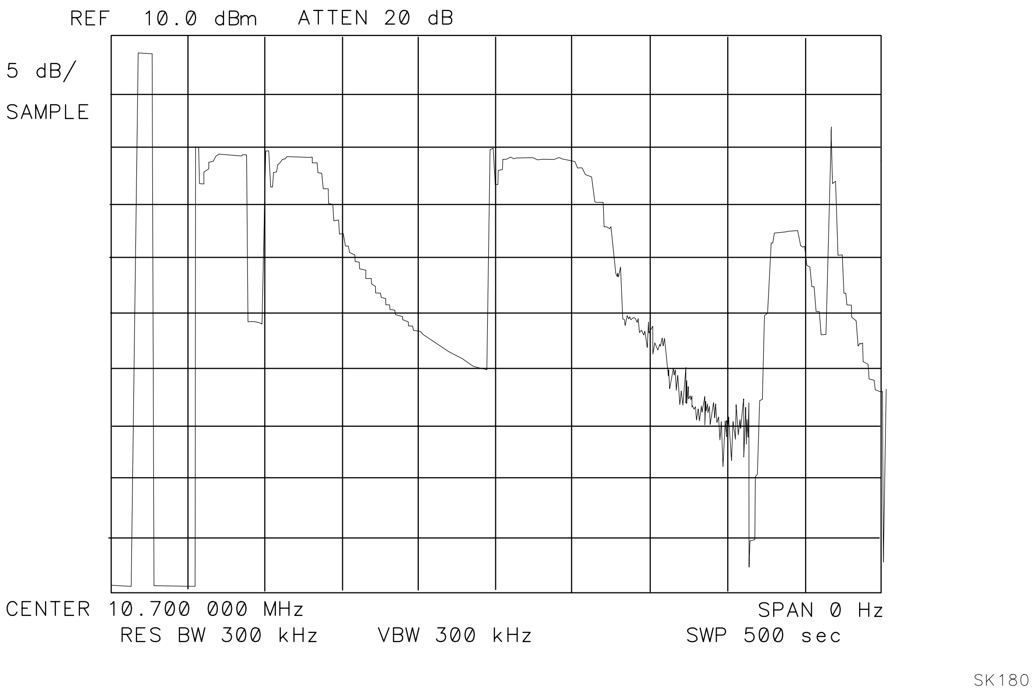
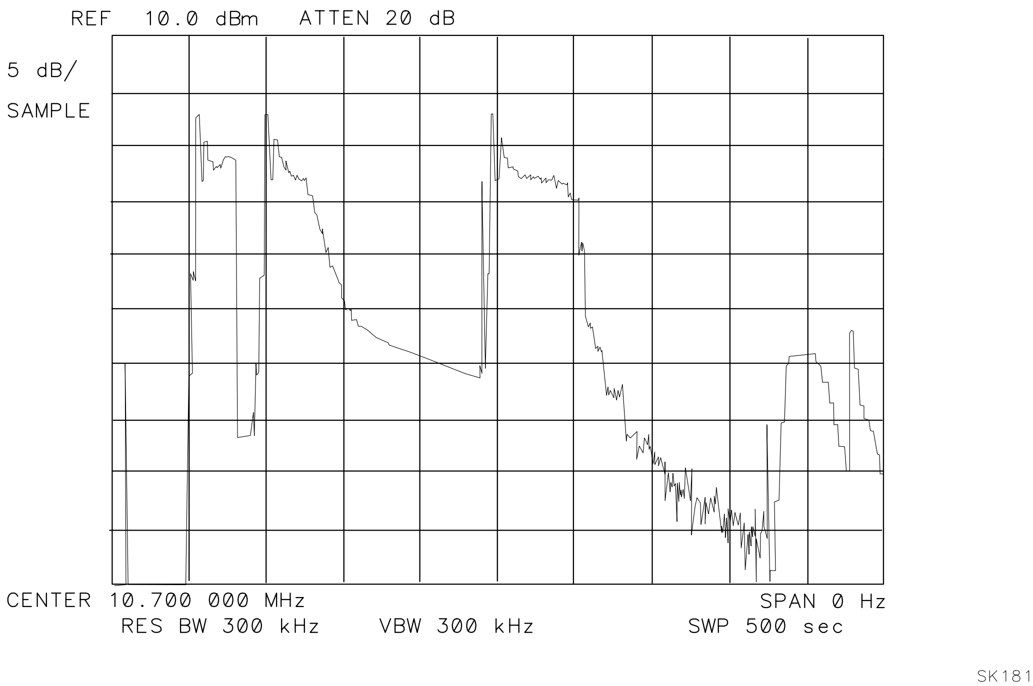



**Figure 9-17 Region B Amplitude Offset**



## 1 MHz Resolution Bandwidth Problems

Check the crystal shorting switches as follows:

1. On the 8564EC or 8565EC spectrum analyzer, press **PRESET** and set the controls as follows:

   Resolution bandwidth ............................................. 1 MHz
   Span ..................................................................... 500 kHz
   Center frequency ................................................. 300 MHz

2. On the 8564EC or 8565EC spectrum analyzer, connect the 300 MHz CAL OUTPUT to the INPUT 50Ω.
3. If the trace flatness is not within 2.5 dB, a failure probably exists.
4. A trace similar to Figure 9-18 on page 465 indicates a crystal short failure.
5. Press **SPAN** to set the spectrum analyzer to 3 MHz. A trace that slopes across the screen (see Figure 9-19, “Faulty LC Pole”) indicates a failed LC pole. To isolate the broken pole refer to the shape factor information in “30 kHz Resolution Bandwidth Problems.”

**Figure 9-18 Faulty Crystal Short**

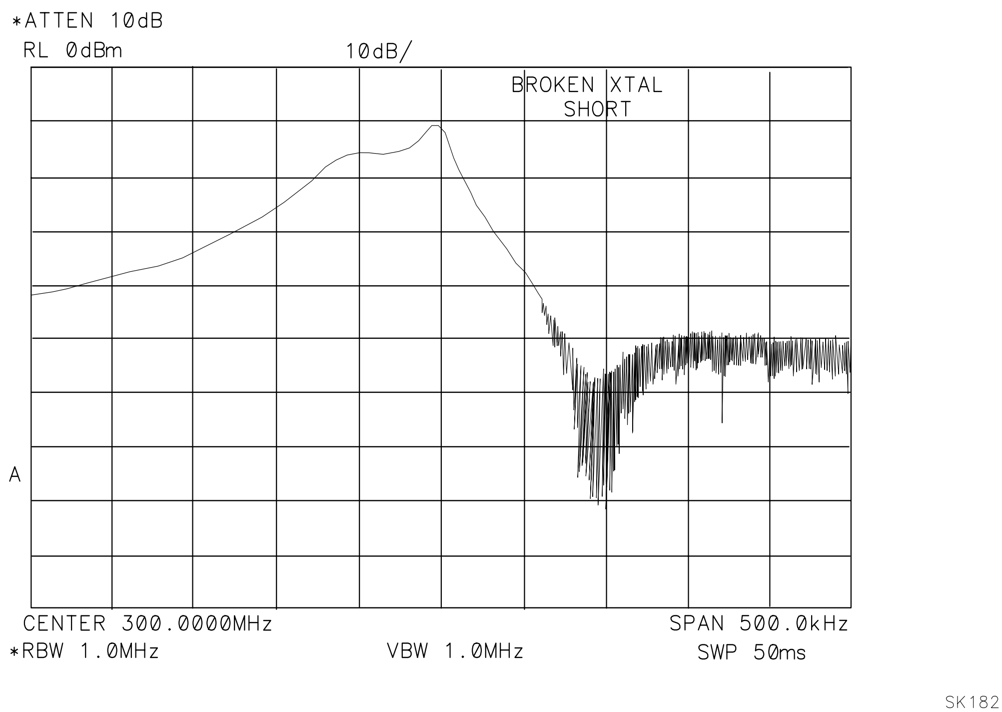
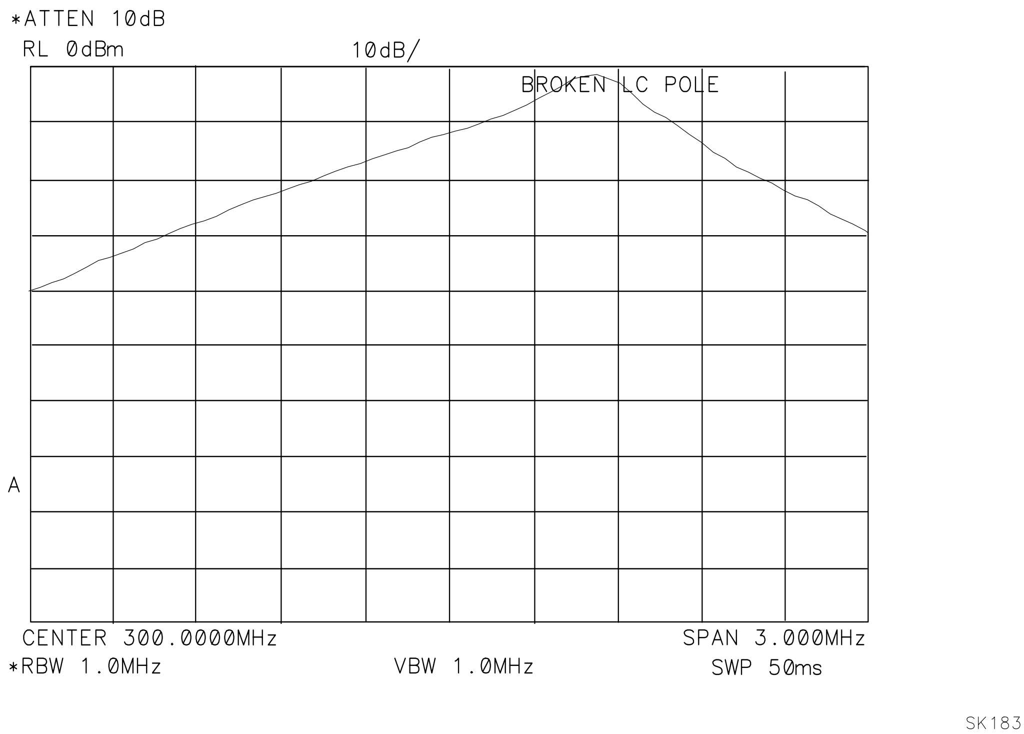


**Figure 9-19 Faulty LC Pole**




## 30 kHz Resolution Bandwidth Problems

Shape factor too high: Shape factor is the ratio of the 60 dB bandwidth to the 3 dB bandwidth. Shape factor should be less than 15:1. If one of the LC poles malfunctions, the shape factor may be the only indication of the failure. Isolate the non-functioning pole with the IF signature. Region E of Figure 9-13 on page 461 illustrates the four LC- pole adjustments. Take several signatures to examine the LC-pole adjustments. If one of the four sections of Region E is consistently longer than the others, the corresponding LC pole is faulty.

IF gain compression: FET transistors Q301, Q303, Q700, and Q701 can deteriorate with age. Measuring less than 0 volts on the FET source indicates a bad FET.

Bandwidth too wide: Check for contamination on the printed-circuit board. Clean the board as required.

## 3 kHz and 10 kHz Resolution Bandwidth Problems

Asymmetric Filter Response: Check the crystal symmetry control with the following steps:

1. Press **PRESET**.
2. Set the 8564EC or 8565EC spectrum analyzer controls as follows:

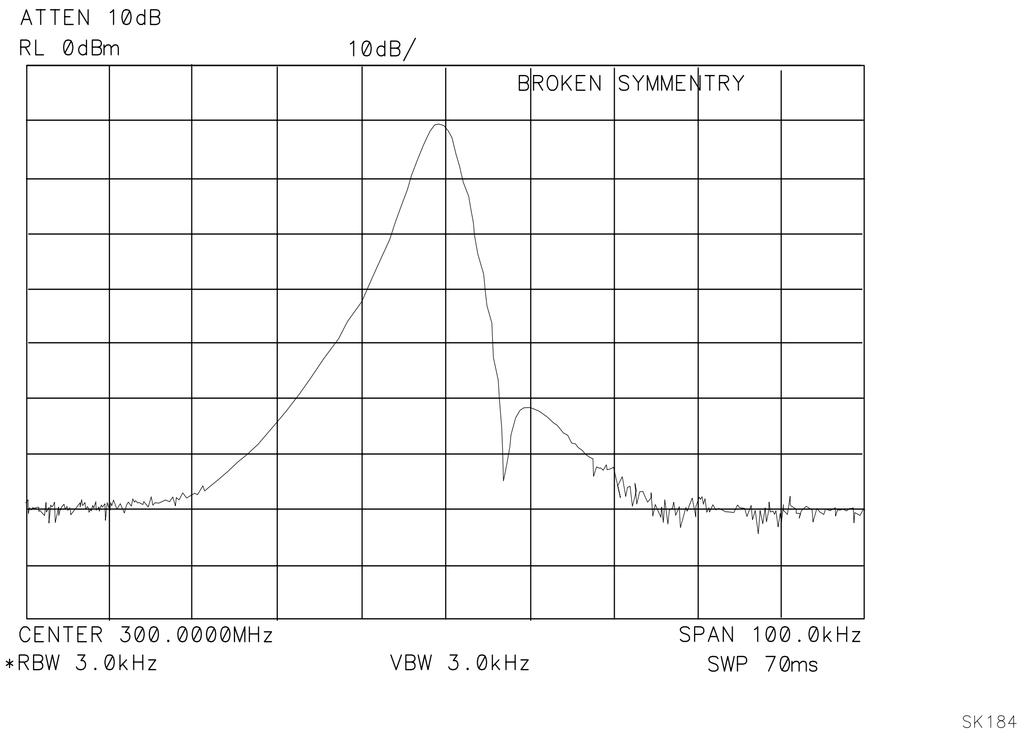
   Resolution bandwidth .................................................. 3 kHz
   Span .......................................................................... 100 kHz
   Center frequency .................................................... 300 MHz

3. On the 8564EC or 8565EC spectrum analyzer, connect the 300 MHz CAL OUTPUT to the INPUT 50Ω .
4. A trace similar to Figure 9-20, "Faulty Crystal Symmetry" indicates a failed crystal-symmetry circuit.

Narrow 10 kHz resolution bandwidth: Check for printed-circuit board contamination. Clean the board as required.

IF Gain Compression in 10 kHz resolution bandwidth: FET transistors Q202, Q203, Q501, and Q503 can deteriorate with age. Measuring less than 0 volts on the FET source indicates a bad FET.

**Figure 9-20 Faulty Crystal Symmetry**



## Step Gains

Refer to function blocks B, H, and I of A5 IF filter schematic diagram (sheets 1 of 3 and2 of 3) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

1. On the 8564EC or 8565EC spectrum analyzer, press **PRESET**, **SPAN**, **ZEROSPAN**, **FREQUENCY**, and 1 **GHz**.
2. Press **CAL** and **IF ADJ OFF**.
3. Disconnect W29 (coax 7) from A5J3 and W27 (coax 3) from A5J5.
4. Inject a –5 dBm, 10.7 MHz signal into A5J3.
5. Monitor the output of A5J5 with another spectrum analyzer.
6. Simultaneously decrease the signal generator output and 8564EC or 8565EC spectrum analyzer reference level in 10 dB steps down to a –50 dBm reference level.
7. At each step, the signal displayed on the other spectrum analyzer should be close to +10 dBm. (More subtle IF gain problems might require smaller signal generator and reference level steps.)
8. Reconnect W29 to A5J3 and W27 (coax 3) to A5J5.

# Cal Oscillator (P/O A4 Assembly)

The cal oscillator on the A4 assembly supplies the stimulus signal for automatic IF adjustments. Normally, the oscillator operates only during retrace (for a few milliseconds) to adjust part of the IF. (All IF parameters are to be readjusted about every 5 minutes.) With continuous IF adjust ON, a group of IF parameters are adjusted during each retrace period (non-disruptive). If continuous IF adjust is OFF, the most recent IF calibration data is used.

The IF parameters adjusted include step gains, log amplifier gain and offset, bandwidth centering, 3 dB bandwidth, bandwidth amplitude, and crystal-filter symmetry.

The cal oscillator provides three types of output signals (all –35 dBm):

- 10.7 MHz
- 9.9 to 11.5 MHz in 100 kHz steps
- Frequency sweeps from 20 kHz to 2 kHz centered at 10.7 MHz (lasting 5 to 60 ms respectively)

The signals perform the following functions:

- Adjust gains, log amps, and video slopes and offsets.
- Adjust 3 dB bandwidth and center frequencies of LC resolution bandwidth filters (30 kHz through 1 MHz).
- Adjust 3 dB bandwidth, symmetry, and gain of the crystal resolution bandwidth filters (300 Hz through 10 kHz).

The cal oscillator uses a phase-locked loop (PLL). The oscillator (function block X) is locked to the instrument 10 MHz reference. The reference divider (function block U) divides the reference and delivers a 100 kHz TTL signal to the phase detector (function block V). The divide-by-N circuitry (function block Y) divides the oscillator output of 9.9 MHz to 11.5 MHz (by 99 to 115) resulting in a 100 kHz output to the phase detector. When the cal-oscillator PLL is locked, narrow positive and negative of equal width pulses occur at the phase detector output. Since the phase detector drives a low-input impedance at the loop integrator, observe the positive pulses at A4CR808 anode and negative pulses at A4CR809 cathode.

The loop integrator acts as a low-pass filter that filters the pulses and inverts the result. If the anode of A4CR808 is more positive (with respect to ground) than the cathode of A4CR809 is negative, the loop integrator output should saturate to approximately –13 V. Conversely, if the anode of A4CR808 is less positive than the cathode of A4CR809 is negative, the integrator should saturate to a positive voltage.

**NOTE** If error messages ERR 581 AMPL or ERR 582 AMPL appears, refer to error message ERR 582 AMPL in Chapter 6 and perform the procedure provided.

1. The oscillator output frequency should exceed 11.5 MHz if the CAL OSC TUNE line, A4U804 pin 14, exceeds +9 V. The oscillator frequency should be less than 9.9 MHz if CAL OSC TUNE is less than –9 V. The oscillator only operates when CALOSC_OFF is low (0 V).
2. If the cal oscillator remains locked (no error code ERR 499 displayed) but does not have the correct output level, troubleshoot the output leveling circuitry (function blocks AA, AB, and AC) or output attenuator (function block AD).

## Cal Oscillator Unlock at Beginning of IF Adjust

1. Press **LINE** to turn the 8564EC or 8565EC spectrum analyzer off and then on. The words IF ADJUST STATUS appear on the display 10 seconds after the instrument is turned on (assuming the rest of the instrument is working correctly). Immediately observe the lower right corner of the display for error messages. If the message ERR 499 CAL UNLK appears (before errors ERR 561, ERR 562 and ERR 565), the cal oscillator is unable to phase-lock. Expect to see the ERR 499 message for only about 1 second.
2. If the 8564EC or 8565EC spectrum analyzer registers an unlocked cal oscillator, continue with step 3 to verify the presence of externally supplied signals.
3. Check A4U811 pin 9 for a 100 kHz TTL-level square wave verifying operation of A4U811, A4Q802, and the 10 MHz input signal from A4J7.
4. Check the +15 VF, +5 VF and –15 V power supplies, and +10 V reference on the A4 assembly.
5. Check that A4U807 pin 5 (CALOSC_OFF) becomes TTL low (0 V) at the start of a FULL IF ADJ (press **CAL** and **FULL IF ADJ**). The phase modulation output at A4U804 pin 8 should also remain at 0 volts. If these checks are correct, troubleshoot blocks V, W, X, and Y. See Figure 9-26, “A4 Log Amplifier/Cal Oscillator Block Diagram (2 of 2).”

## Inadequate CAL OSC AMPTD Range

Refer to function block AC of A4 Log Amplifier Schematic Diagram in the *8560 E-Series Spectrum Analyzer Component Level Information*.

1. If A4R826, CAL OSC AMPTD, has inadequate range to perform the IF Amplitude Adjustment, press **CAL**.
2. Rotate A4R826 fully clockwise and disconnect W52 (coax 9) from A5J4.
3. Connect A5J4 to the input of a second spectrum analyzer.
4. Set the other spectrum analyzer controls as follows:

   Center frequency .................................................. 10.7 MHz
   Reference level ....................................................... −30 dBm

5. Observe the spectrum analyzer display while pressing **FULL IF ADJ**. The signal level should be greater than −34.55 dBm. If the signal level is incorrect, continue with step 7.
6. Rotate A4R826 fully counterclockwise. The signal should be less than −36.25 dBm. If the signal level is correct at both settings, troubleshoot the A5 IF assembly. If the signal level is incorrect, continue with step 7.
7. Troubleshoot the ALC loop on this assembly using the following steps:
   a. Connect a positive DVM probe to A4J9 pin 4.
   b. On the 8564EC or 8565EC spectrum analyzer, press **CAL**.
   c. Press **FULL IF ADJ**. Observe the DVM reading between the displayed messages `IF ADJUST STATUS: 300 kHz RBW` and `IF ADJUST STATUS: 3 kHz RBW`. During this time period, the voltage should be within a 2 to 10 Vdc range.
   d. Observe the DVM reading while `IF ADJUST STATUS: AMPLITUDE` is displayed. The reading should be within the 2 to 10 Vdc range.
   e. If the DVM reading is outside the range in step c but inside the range in step d, suspect one of the reactive components in the filter.
8. If the ALC loop is working correctly (A4J9 pin 4 within the test tolerances given), then either the output attenuator is defective, or A4U810 pin 6 (in ALC loop integrator) is outside of its +3 to +6 Vdc range.
9. Reconnect W52 (coax 9) to A5J4.

## 300 Hz to 3 kHz Resolution Bandwidth Out of Specification

1. If the 3 dB bandwidth of one of these filters is incorrect, suspect a failure of one of the five available sweeps from the cal oscillator sweep generator (function block Z). These sweeps are generated by changing the switch settings of A4U803 which routes signals through A4U802 and A4U804.
2. Disconnect W52 (coax 9) from A4J8.
3. Connect an SMB tee to A4J8, using a short coaxial cable with SMB connectors.
4. Connect one output of the tee to cable W52 (coax 9).
5. Connect an 85024A active probe to the other output of the tee.
6. Connect the output (type N connector) of the active probe to the input of the 8566A/B spectrum analyzer.
7. Connect the probe power cable to the 8564EC or 8565EC spectrum analyzer front panel PROBE POWER connector (you may need to use a probe power extension cable, 10131B).
8. Press **INSTR PRESET** on the 8566A/B and set the controls as follows:

| | |
|---|---|
| Center frequency | 10.8 MHz |
| Span | 0 Hz |
| Reference level | −43 dBm |
| Resolution bandwidth | 100 kHz |
| Video bandwidth | 10 kHz |
| Sweep time | 50 ms |
| Scale | 1 dB/division |
| Sweep | SINGLE |

9. On the 8564EC or 8565EC spectrum analyzer, press **PRESET** and **CAL**.
10. Press **FULL IF ADJ**. When the display reads `ADJUSTING IF: 10 kHz RBW`, press **SINGLE** on the 8566A/B.
11. The 8566A/B screen illustrates frequency versus time of the output sweeps of the cal oscillator. See Figure 9-21, “Output Waveform, 10 kHz Resolution Bandwidth.” The slope of the 8566A/B 100 kHz resolution bandwidth is used to detect frequency changes. Sweeps that vary (greater than 30 percent) from the normal levels, trigger error code `ERR 581` or `ERR 582`.
12. Press **FULL IF ADJ**. When the display reads `ADJUSTING IF: 3 kHz`, press **SINGLE** on the 8566A/B.

13. Figure 9-22 on page 475 illustrates normal operation. Severe failures (slope error greater than 30 percent) and subtle 3 kHz resolution bandwidth errors (less than 30 percent) indicate a problem with A4U802, A4U803, A4U804, or A4U106.

14. Severe failure of the bandwidth accompanied by subtle errors in the output signal indicate an A5 failure.

15. Set the 8566A/B controls as follows:

    Center frequency ............................................. 10.710 MHz
    Resolution bandwidth ............................................. 10 kHz
    Video bandwidth ....................................................... 1 kHz
    Sweep time ............................................................ 200 ms

16. On the 8564EC or 8565EC spectrum analyzer, press **FULL IF ADJ**. When the message `IF ADJUST STATUS:1 kHz RBW` appears, press **SINGLE** on the 8566A/B.

17. Figure 9-23, “Output Waveform, 1 kHz Resolution Bandwidth” illustrates normal operation. Severe failures (slope error greater than 30 percent) and subtle 3 kHz resolution bandwidth errors (less than 30 percent) indicate a problem with A4U802, U803, U804, or U106.

18. On the 8564EC or 8565EC spectrum analyzer, press **FULL IF ADJ**. When the message `IF ADJUST STATUS: 300 Hz RBW` appears, press **SINGLE** on the 8566A/B.

19. Figure 9-24 on page 477 illustrates normal operation. Severe failures (slope error greater than 30 percent) and 3 kHz resolution bandwidth errors (less than 30 percent) indicate a problem with A4U802, U803, U804, or U106.

20. Reconnect W52 (white) to A4J8.

**Figure 9-21 Output Waveform, 10 kHz Resolution Bandwidth**

**Figure 9-22 Output Waveform, 3 kHz Resolution Bandwidth**

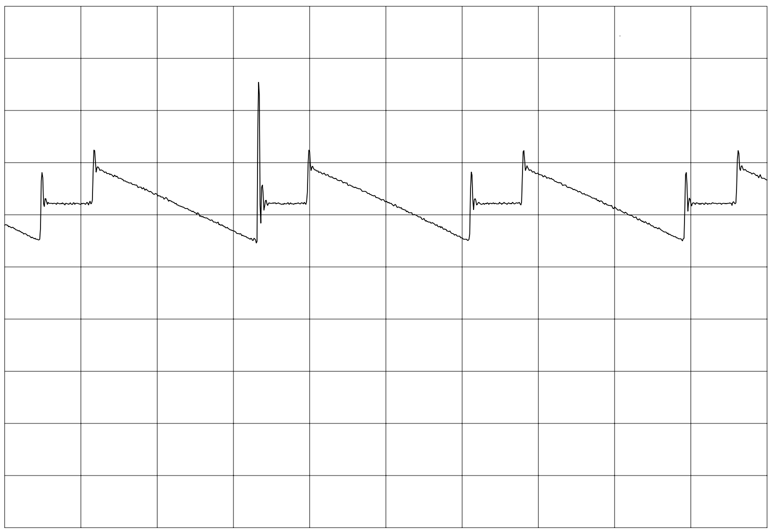


**Figure 9-23 Output Waveform, 1 kHz Resolution Bandwidth**

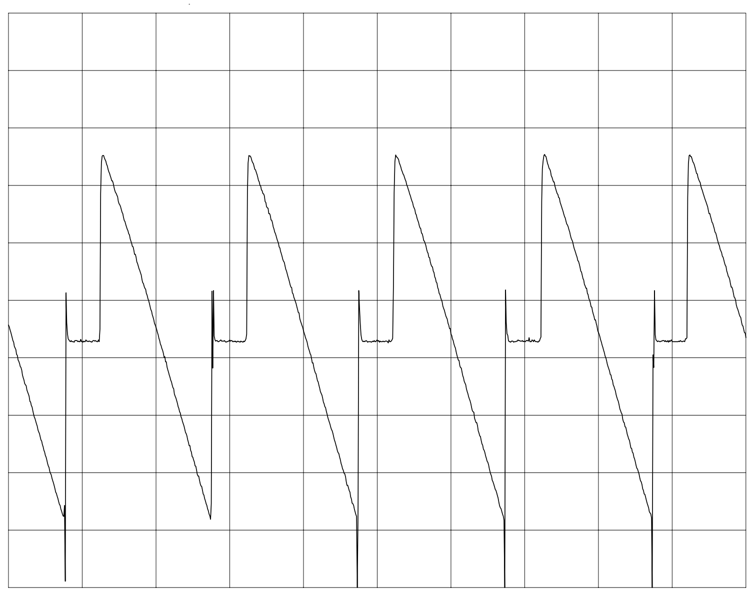


**Figure 9-24 Output Waveform, 300 Hz Resolution Bandwidth**

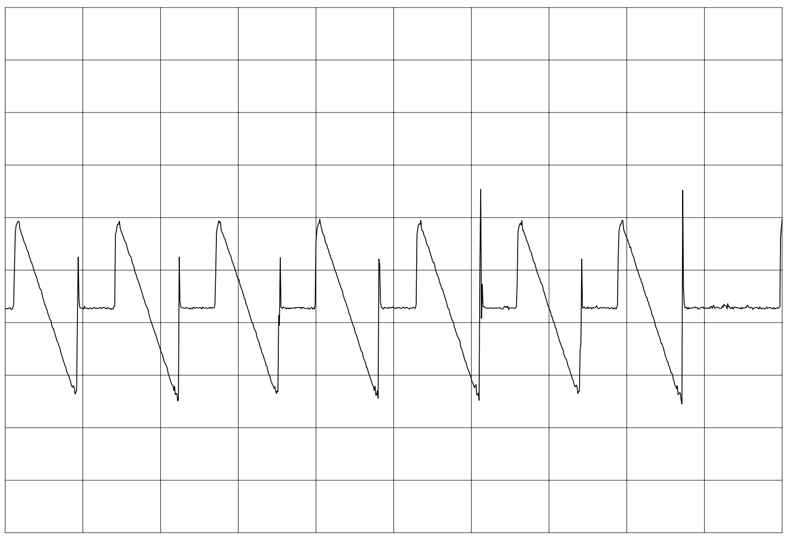
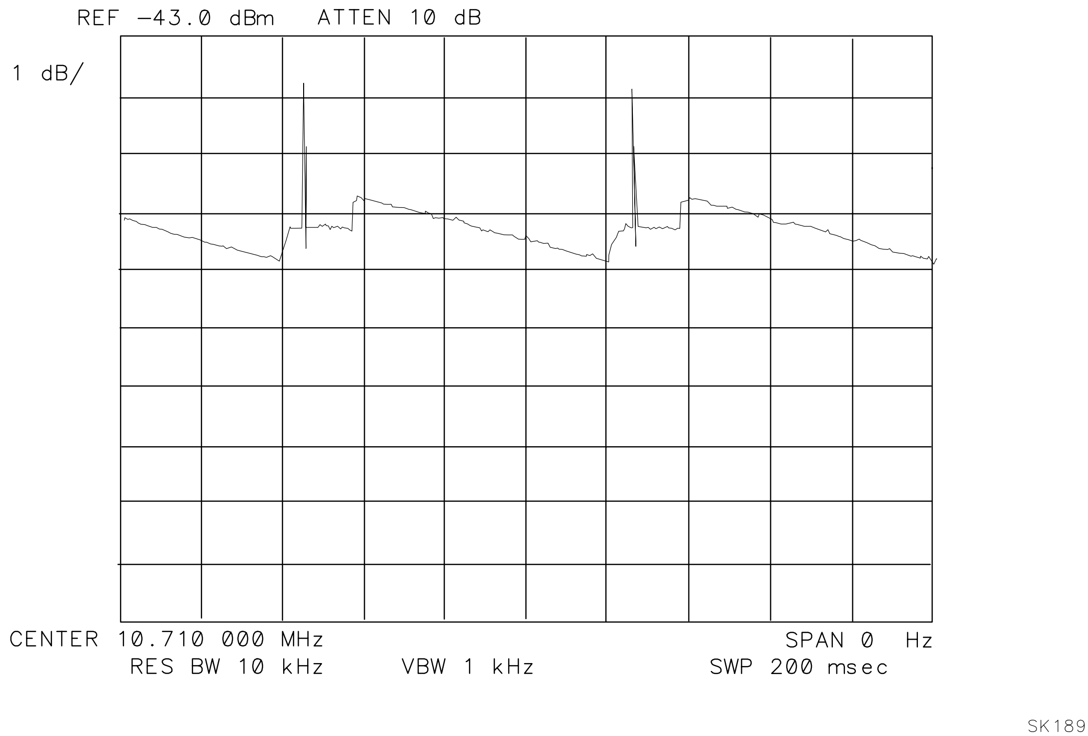


**Figure 9-25 Failed Crystal Set Symptoms**




## Low-Pass Filter

Refer to function block AB of A4 Log Amplifier Schematic Diagram (sheet 4 of 4) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

1. Connect a DVM positive probe to A4J9 pin 4.
2. On the 8564EC or 8565EC spectrum analyzer, press **CAL**.
3. Press **FULL IF ADJUST**. Observe the DVM reading between the displayed messages `IF ADJUST STATUS: 300 kHz RBW` and `IF ADJUST STATUS: 3 kHz RBW`. During this time period, the voltage should be within a 2 to 10 Vdc range.
4. Observe the DVM reading while `IF ADJUST STATUS: AMPLITUDE` is displayed. The reading should be within the 2 to 10 Vdc range.
5. If the DVM reading is outside the range in step 3 but inside the range in step 4, suspect one of the reactive components in the filter.

## Sweep Generator

Refer to function block Z of A4 log amplifier schematic diagram (sheet 4 of 4) in the *8560 E-Series Spectrum Analyzer Component Level Information*.

A properly operating sweep generator generates a series of negative-going parabolas. Before the sweep, switches A4U802C and A4U802D turn on, shorting A4C802 and A4C801 (the output is at 0 volts). These switches open to start the sweep. The output of A4U804A, pin 1, is 0.35 V to 10 V, depending on the sweep width selected by A4U802A and A4U803A. This voltage appears across A4R801. Capacitor A4C801 integrates the current through A4R801. The output of A4U804B is a straight, negative-going ramp. Capacitor A4C802 and resistor A4R802 integrate the output of A4U804A which starts a negative ramp (A4U804C) at the beginning of the sweep. The ramp from A4U804B is added to the current in A4R802 via A4U803B. Integrating this ramp results in the parabolic output waveform.

## AM/FM Demodulation, Audio Amplifier, and Speaker

Refer to function blocks R, S, and T of A4 Log Amplifier Schematic (sheet 4 of 4) Diagram in the *8560 E-Series Spectrum Analyzer Component Level Information*.

If the audio circuits are not functioning use the following procedure to isolate the problem:

1. Set an AM signal generator controls as follows:

   Frequency .............................................................. 100 MHz
   Amplitude ................................................................ –6 dBm
   Modulation type ..................................................... 80% AM
   Modulation frequency ............................................... 400 Hz

2. Set the 8564EC or 8565EC spectrum analyzer controls as follows:

   Center frequency ...................................................... 100 MHz
   Span ........................................................................ 0 Hz
   Sweep time ................................................................ 50 ms
   Reference level .......................................................... 0 dBm
   Resolution bandwidth ................................................. 10 kHz
   Amplitude scale ........................................................ LINEAR

3. Adjust the 8564EC or 8565EC spectrum analyzer reference level and center frequency to display the 400 Hz modulation frequency eight divisions peak-to-peak.

4. On the 8564EC or 8565EC spectrum analyzer, press **AUX CTRL**, **AM/FM DEMOD**, **AM DEMOD ON**, and set the sweep time to 5 seconds.

5. Vary the volume and listen for the variation in speaker output level. Clipping is normal at the highest volume levels.
6. If the audio is not working correctly monitor the signal at A4U704 pin 3 with an oscilloscope. The signal should be 20 mV peak-to-peak ±25 percent (with +2.5 V of dc bias). If the signal measures outside these limits, the fault is prior to the audio amplifier (block T).
7. If the signal is correct, troubleshoot the audio amplifier and speaker.

A4 LOG AMPLIFIER/CAL OSCILLATOR BLOCK DIAGRAM


sz110e

FIGURE 9-26. A4 LOG AMPLIFIER/CAL OSCILLATOR BLOCK DIAGRAM (1 of 2)

A4 LOG AMPLIFIER/CAL OSCILLATOR BLOCK DIAGRAM

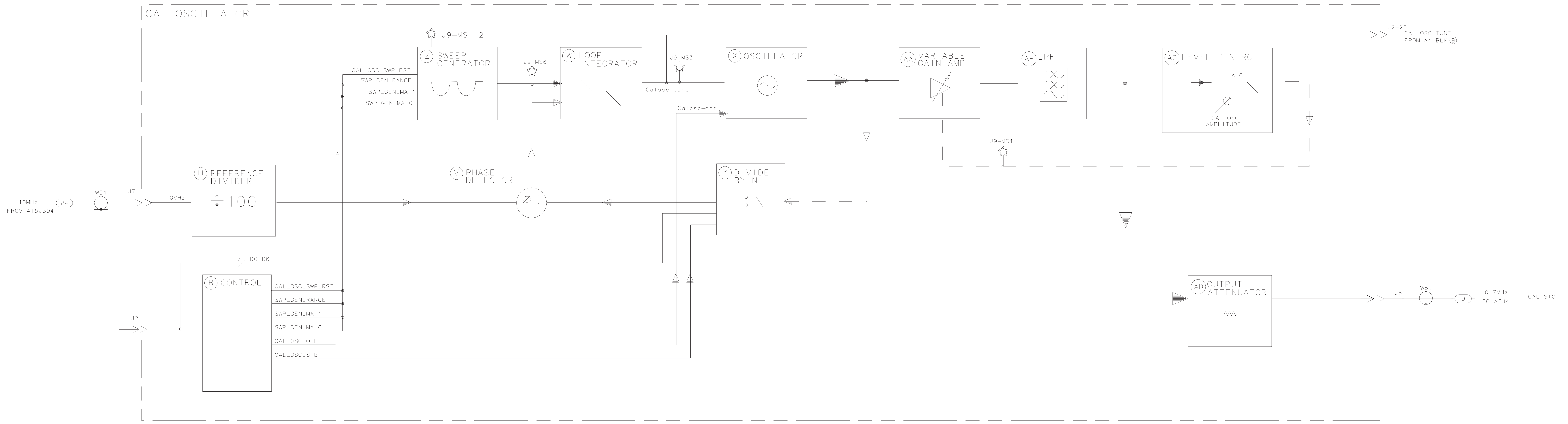



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FIGURE 9-26. A4 LOG AMPLIFIER/CAL OSCILLATOR BLOCK DIAGRAM (2 of 2)


A5 IF ASSEMBLY BLOCK DIAGRAM
IF ASSEMBLY
10.7MHz IF IN FROM A15J601
CAL SIGNAL FROM A4J8
W29
W30
J3
J4
10.7 MHz
A INPUT SWITCH
SA MODE
B 1ST STEP GAIN STAGE
STEP GAIN 1
NBW ATTEN
C 1ST XTAL POLE
XTAL CTR
D 2ND XTAL POLE
E 1ST LC POLE
LC CTR
F 2ND LC POLE
G 15 dB REF ATTENUATOR
15dB ATTEN
ATTEN 15dB
H 2ND STEP GAIN STAGE
STEP GAIN 2
SHEET 2 OF 4
I 3RD STEP GAIN STAGE
STEP GAIN 3
J FINE ATTEN
FINE ATTEN
K 3RD XTAL POLE
L 4TH XTAL POLE
K POST AMP
NORMAL GAIN
LC34 SHORT
N 3RD LC POLE
O 4TH LC POLE
10.7MHz
J5
W27
10.7 MHz IF OUT TO A4J3
SHEET 3 OF 4
CONTROL CABLE W2
POWER CABLE W1
J2
J1
R SUPPLY FILTERING
+5VF
+15VF
-15VF
P CONTROL DACS
A0-A7
D0-D7
IFSTB
+10V REF
Q TEST CONNECTOR JUNCTION
SHEET 4 OF 4

# 10 Controller Section

# Introduction

The controller section includes the A2 controller assembly, A19 GPIB assembly, and BT1 battery. The presence of a display (graticule and annotation) verifies that most of A2 controller assembly is operating properly.



**NOTE** When measuring voltages or waveforms, make ground connections to A2TP3. The metal board-standoffs are not grounded and should not be used when taking measurements. Figure 10-1 on page 489 shows the location of the A2 test connectors.

**Figure 10-1 A2 Test Connectors**

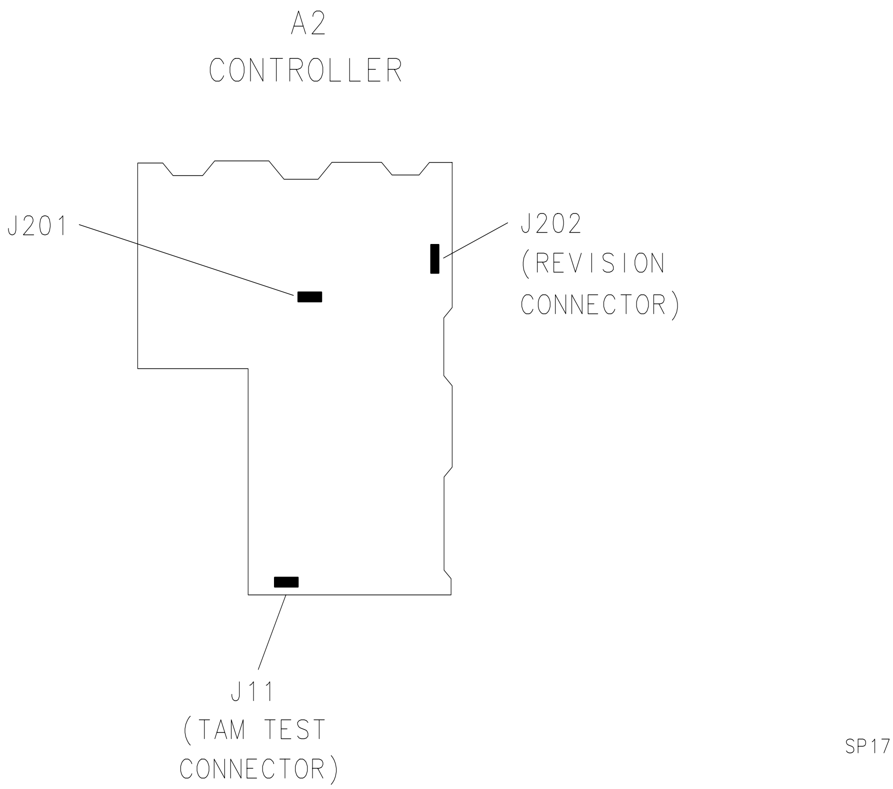
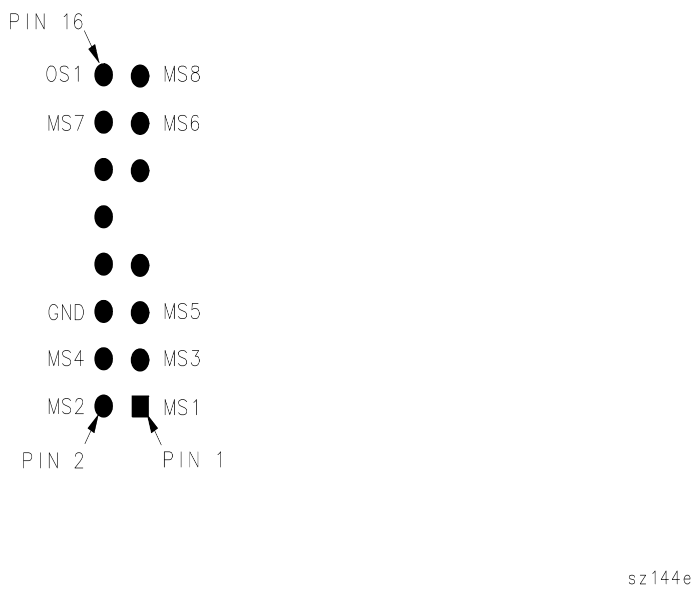



**Figure 10-2 A2 Test Connector Pin Locations**



# Frequency-Count Marker Problems

The FREQ COUNT function works by dividing the 10.7 MHz IF signal by two (prescaling) and counting the divided-down signal using the frequency counter on the A2 controller assembly . The prescaler is on the A4 Log amplifier/cal oscillator assembly . Perform the following steps to determine whether the problem is on the A4 log amplifier/cal oscillator or the A2 controller assembly:

1. Disconnect W53 from A2J13.
2. Connect the output of a synthesized source, such as an 3335A, to A2J13.
3. Set the synthesized source to the following settings:

   Amplitude ........................................................... +10 dBm
   Frequency ........................................................... 5.35 MHz

4. Set the spectrum analyzer to the following settings:

   Center frequency ............................................... 300 MHz
   Span ........................................................................ 1 MHz

5. On the spectrum analyzer, press **FREQ COUNT**. The frequency counter actually reads one half the frequency of the 10.7 MHz IF. If the CNT frequency display reads all asterisks, the frequency counter is probably at fault.
6. If a valid frequency is displayed, troubleshoot the prescaler on the A4 log amplifier/cal oscillator assembly.
7. Reconnect W53 to A2J13.

# Frequency Counter

The frequency counter counts the frequency of the last IF and provides accurate timing signals for digital zero-spans. The circuit also provides timing signals to the ADC (analog to digital converter) on the A3 interface assembly. The nominal input frequency is 5.35 MHz (10.7 MHz divided by 2). The 10 MHz reference from the A15 RF assembly provides the frequency reference in the frequency count mode. The frequency reference in digitized zero spans (sweep times ≥30 ms) is the 4 MHz HPIB_CLK, selected by a clock select multiplexer in U35.

The 10 MHz reference from the A15 RF assembly is first filtered and passed through a comparator to generate a TTL, 50 percent duty cycle signal. C128, L16, and R91 provide a bandpass filter centered at 10 MHz. The output of comparator U33B is the actual reference used for the Frequency Counter. An additional stage of filtering is performed on this signal to provide a 10 MHz signal for the A17 LCD Driver assembly.

In the frequency count mode, the 10 MHz reference is prescaled by 5 to generate a 2 MHz timebase. This timebase feeds through the clock select multiplexer in U35 to the CLK2 input of programmable timer U15. The output (OUT2) of programmable timer U15 is the gating signal (HBKT_PULSE); it performs the frequency count. The gating time interval is a function of the counter resolution which may be set between 10 Hz and 1 MHz. Table 10-1 on page 506 lists the gate time for each setting of COUNTER RES. The gate time is the period during which HBKT_PULSE (pin 20 of U15) is low.

The FREQ COUNT input, A2J13, is gated by HBKT_PULSE. The gated signal clocks divide-by-16 counters within U35. These counters are cascaded to form a divide-by-256 counter. The MSB of this counter, CD7, clocks the CLK0 input of U15. The frequency of CD7 is a function of COUNTER RES as shown in Table 10-1 on page 506. If timer U15 overflows, OUT0 will be set, generating CNTOVFLIRQ, which will interrupt the CPU.

If IRQAK2 is high, HBKT_PULSE will generate FREQCNTLIRQ. Upon receiving the FREQCNTLIRQ interrupt, the CPU latches the CD0 to CD7 onto the BID bus by setting LCDRD (low counter data read) low and reading the counter data from the BID bus. The CPU will also read the data from the timer, U15, by setting L8254CS and LCNTLRD low, placing the timer data on the BID bus. The CPU then resets IRQAK2 low.

**Table 10-1 Gate Times**

| Counter Res | Gate Time* (U15 pin 20 low state) | A2TP16 | A2TP15 |
|---|---|---|---|
| 10 Hz | 200 ms | 2 MHz | 4.18 kHz |
| 100 Hz | 20 ms | 2 MHz | 418 Hz |
| 1 kHz | 2 ms | 2 MHz | 41.8 Hz |
| 10 kHz | 2 ms | 2 MHz | 41.8 Hz |
| 100 kHz | 2 ms | 2 MHz | 41.8 Hz |
| 1 MHz | 2 ms | 2 MHz | 41.8 Hz |
| * U15 pin 10 = (FREQ COUNT input × Gate Time)/256 | | | |

1. Disconnect W22 from A2J9.
2. If a 10 MHz, TTL-level signal is not present at the end of W22, continue with step 3. If a 10 MHz signal is present at W22, proceed as follows:
   a. Reconnect W22 to A2J9.
   b. Set the spectrum analyzer to the following settings:

      Span ............................................................... Zero Span
      Sweep time ............................................................ 20 ms

   c. Monitor the signal at A2J2 pin 21. This is an output of the frequency counter, HBUCKET PULSE.
   d. If HBUCKET PULSE is stuck high, troubleshoot the frequency counter.
3. Check for a 10 MHz signal at A15J302. If the signal is not present at A15J302, the A15 RF assembly is probably defective.

# Video Input Scaling Amplifiers and Limiter

The video input scaling amplifiers help provide scaling (10 dB/div, 5 dB/div, 2 dB/div, or 1 dB/div) and buffer the flash video output. When the GAINX2 control line is low, switch U44D is open and switch U44C is closed. Thus, the scaled video at TP26 virtually follows the video input (0 - 1 V). When the GAINX2 control line is high, switch U44C is open and switch U44D is closed. Amplifier U43 then provides a gain of $2(V_{in}) -1$ V. Voltage clamp CR4 prevents the scaled video input to amplifier U45 from going more negative than –0.35 V or more positive than +1.25 V.

**NOTE** When measuring voltages or waveforms on the Fast ADC section of the A2 controller assembly, connect the ground (or common) lead to the ground-plane trace associated with the shield. This digital ground plane is totally isolated from the chassis.

1. Press **PRESET** on the 8560 EC-series spectrum analyzer and set the controls as follows:

   | | |
   |---|---|
   | Center frequency | 300 MHz |
   | Span | 0 Hz |
   | Reference level | –10 dBm |
   | Log/division | 10 dB/DIV |
   | Sweep time | 20 ms |

2. Connect the CAL OUTPUT to the INPUT 50Ω connector.
3. Adjust the spectrum analyzer reference level to place the signal at the top graticule line on the LCD display.
4. Measure the dc level at pin 3 of U10. If the voltage measured is not +1.0 ±0.15 V, troubleshoot the A3 interface assembly.
5. Measure the dc level at pin 3 of U17. The level should be approximately the same as the level measured at pin 3 of U10. If not, suspect switch U9.
6. Set the spectrum analyzer scale to 5dB per division.
7. Adjust the spectrum analyzer reference level to place the signal at the top graticule line on the LCD display.
8. Measure the dc level at pin 3 of U10 and pin 3 of U17. The level should be +1.0 ±0.25 V. If the level measured at pin 3 of U17 differs from the level measured at pin 3 of U10 by more than 0.25 volts, troubleshoot U10 and associated circuitry.

9. Disconnect the CAL OUTPUT signal from the INPUT 50Ω connector.
10. The level at pin 3 of U10 should drop to –0.35 Vdc. If the level is less (more negative) than –0.35 Vdc, replace voltage clamp D3.
11. Measure the dc level of the flash video at pin 2 of R47. The level should be near 0 Vdc with the signal at the bottom graticule line (no input to the spectrum analyzer).
12. Connect the CAL OUTPUT to the INPUT 50Ω connector.
13. Measure the dc level of the flash video at pin 2 of R47. The level should be near +1.7 Vdc.

# 12-Bit Flash ADC

The flash ADC (U22) converts the analog video signal into 12-bit digital values at a fixed rate of 12 megasamples per second.

When measuring voltages or waveforms on the Fast ADC of the A2 controller assembly, connect the ground (or common) lead to the ground-plane trace associated with the shield. This digital ground plane is totally isolated from the chassis.

1. Press **PRESET** on the spectrum analyzer and set the controls as follows:

   Center frequency ..................................................... 300 MHz
   Span ....................................................................... 0 Hz
   Reference level ........................................................ –20 dBm
   Log/division ............................................................. 5 dB/DIV
   Sweep time ................................................................ 20 ms

2. Connect the CAL OUTPUT to the INPUT 50Ω connector.
3. Pins 2 through 13 (ADC0-ADC11) of U22 should all be high (logic 1), corresponding to an ADC digital count of 255 for the analog input of +2 volts or greater.
4. Disconnect the CAL OUTPUT signal from the INPUT 50Ω connector.
5. Pins 2 through 13 (ADC0-ADC11) of U22 should all be low (logic 0), corresponding to an ADC digital count of zero for the analog input of 0 volts or less.

## 32 K-Byte Static RAM

The static RAM stores the ADC samples that are taken when the Fast ADC circuitry is in the "write" mode. When not in the "write" mode, the static RAM is read by the CPU to retrieve the fast ADC data. The 8-bit DFADC bus connects the outputs of latches within U35 to the data port of static RAM U21.

# Reference Clock

The reference clock circuitry takes the 8 MHz square wave clock and triples the frequency to 24 MHz. This is accomplished through two stages of filtering of the 8 MHz signal, to extract the third harmonic. The 8 MHz signal is first passed through a high pass filter consisting of C123 and L15. The the signal passes through a bandpass filter centered at 24 MHz, consisting of C106, C08, L13, and R80. The comparator U28B generates a square wave. The signal then passes through a second stage of filtering by using the bandpass filter consisting of C89, C88, L12, and R77. Comparator U28A then regenerates the square wave. A divide-by-two flip flop in U16 divides the 24 MHz signal to create the 12 MHz signal used by the ADC.

# 16 MHz Harmonic Filter

The 16 MHz Harmonic Filter generates a 16 MHz signal through a series of stages, consisting of a filter and a comparator. The 10 MHz reference signal from the A15 RF assembly is first prescaled by 2.5 to yield a 4 MHz signal with a 20 percent duty cycle. This prescaling is performed within U35. The 4 MHz signal is then passed, first, through a high pass filter, and then, through a bandpass filter at 16 MHz. The high pass filter consists of R85, C122, and L14. The bandpass filter consists of L19 and C139. The filter basically filters the fourth harmonic of the 4 MHz signal to generate a 16 MHz signal. The resulting signal is then passed through comparator U34A to generate a 16 MHz square wave. Three more stages, consisting of a bandpass filter followed by a comparator, further filter the signal so that a clean 16 MHz signal results. The 16 MHz signal which is the result of these successive stages of filtering is output at pin 10 of U34. U35 buffers this signal to provide the 16 MHz clock for the CPU. In addition, divide-by-two flip flops are located within U35, which generate 8 MHz and 4 MHz signals.

# State- and Trace-Storage Problems

State storage is in the two of the four Program RAMs and trace storage is in the two display RAMs. With low battery voltage, it is normal for states and traces to be retained if the power is off for less than 1 minute. If the power is left off for more than thirty minutes with low battery voltage, the stored states and traces will be lost.

The following steps test battery backup:

1. Measure the voltage on W6 at A2J3. If the voltage is less than 2.6 V, check the BT1 battery.
2. If the battery voltage is correct, reconnect W6 to A2J3, turn the analyzer power off and wait 5 minutes.
3. Measure the voltage at A2U19 pin 32and A2U26 pin 32.
4. If the voltage is less than 2.0 Vdc, the RAM power battery-backup circuitry on the A2 controller assembly is probably at fault.

# Keyboard Problems

If the analyzer does not respond to keys being pressed or the knob being rotated, the fault could be either on the A3 interface assembly or the A2 controller assembly. To isolate the A2 controller assembly, use the following procedure. This procedure tests the analyzer response over GPIB and the keyboard/RPG interrupt request signal.

1. Enter and run the following BASIC program:

```
10 OUTPUT 718; "IP; SP 1 MHz;"
20 WAIT 2 ! Wait 2 seconds
30 OUTPUT 718;"AT 70 DB;"
40 WAIT 2 ! Wait 2 seconds
50 OUTPUT 718;"AT 30 DB;"
60 WAIT 2 ! Wait 2 seconds
70 OUTPUT 718;"AT 10 DB;"
80 END
```

2. When the program runs, three or four clicks should be heard. This is the A9 input attenuator changing attenuation value.
3. If the display shows the analyzer to be in RMT and the ATTEN value displayed on the LCD changed according to the program, the A2 controller assembly is working properly. Refer to Chapter 8 , “ADC/Interface Section.”
4. If there was no response over GPIB, the A2 controller is probably defective. Be sure to also check the A19 GPIB assembly and A19W1.
5. If there was an improper response (for example, the displayed ATTEN value changed but no clicks were heard), the A2 controller is probably working properly.
6. attach a logic probe to A2U35 pin 213.

   Look for pulses while pressing a key and rotating the knob (RPG). This is the interrupt request signal for the keyboard and RPG.
7. If the interrupt request signal is always low, troubleshoot the A2 controller assembly.
8. If the interrupt request signal is always high, the fault is on either the A3 interface or A1A1 keyboard assembly.

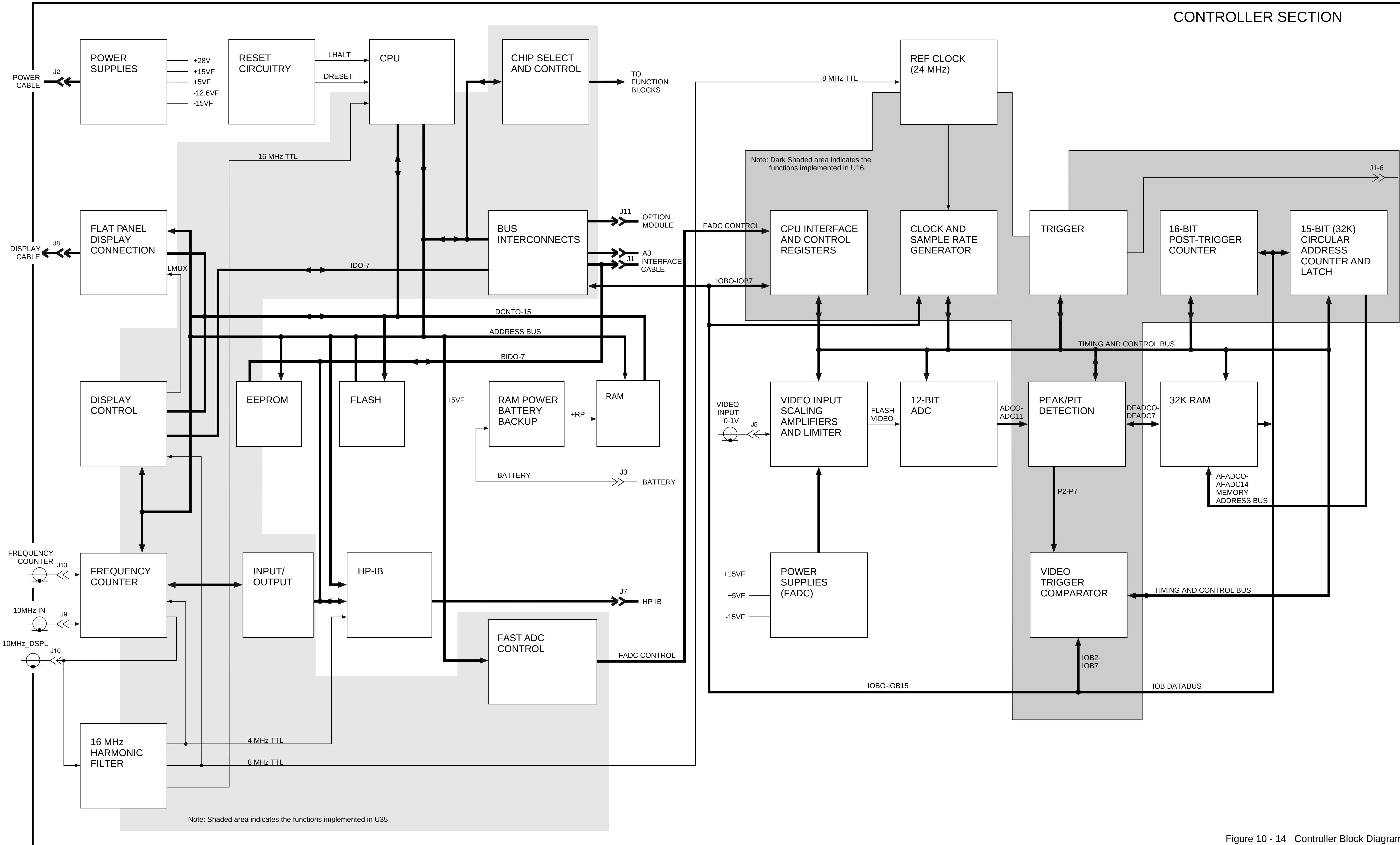



Figure 10 - 14 Controller Block Diagram

sm130c

# 11 Synthesizer Section

# Introduction

The synthesizer section includes the A7 LOMA (LO multiplier/amplifier), the A11 YTO, and parts of the A14 frequency control and A15 RF assemblies. Simplified and detailed block diagrams for each assembly are located at the end of this chapter.

**CAUTION** All of the assemblies are extremely sensitive to electrostatic discharge (ESD). For further information regarding electrostatic cautions, refer to “Electrostatic Discharge”"Electrostatic Discharge Information" in Chapter 1 .

**CAUTION** Using an active probe, such as an 85024A, with a spectrum analyzer is recommended for troubleshooting the RF circuitry. If an 1120A active probe is being used with a spectrum analyzer, such as the 8566A/B, or 8569A/B having dc coupled inputs, either set the active probe for an ac coupled output or use a dc blocking capacitor (11240B) between the active probe and the spectrum-analyzer input. Some spectrum analyzers can be set to ac coupled. Failure to do this can result in damage to the analyzer or the probe.

# Test Connector Locations

When troubleshooting suspected faulty circuits, use Table 11-1 on page 525 to determine which procedure to perform.

Figure 11-1 illustrates test connector locations on the A14 and A15 assemblies.

The pin locations of a 16-pin test connector are indicated in Figure 11-2 on page 525.

**Figure 11-1 A14 and A15 Assembly Test Connectors**

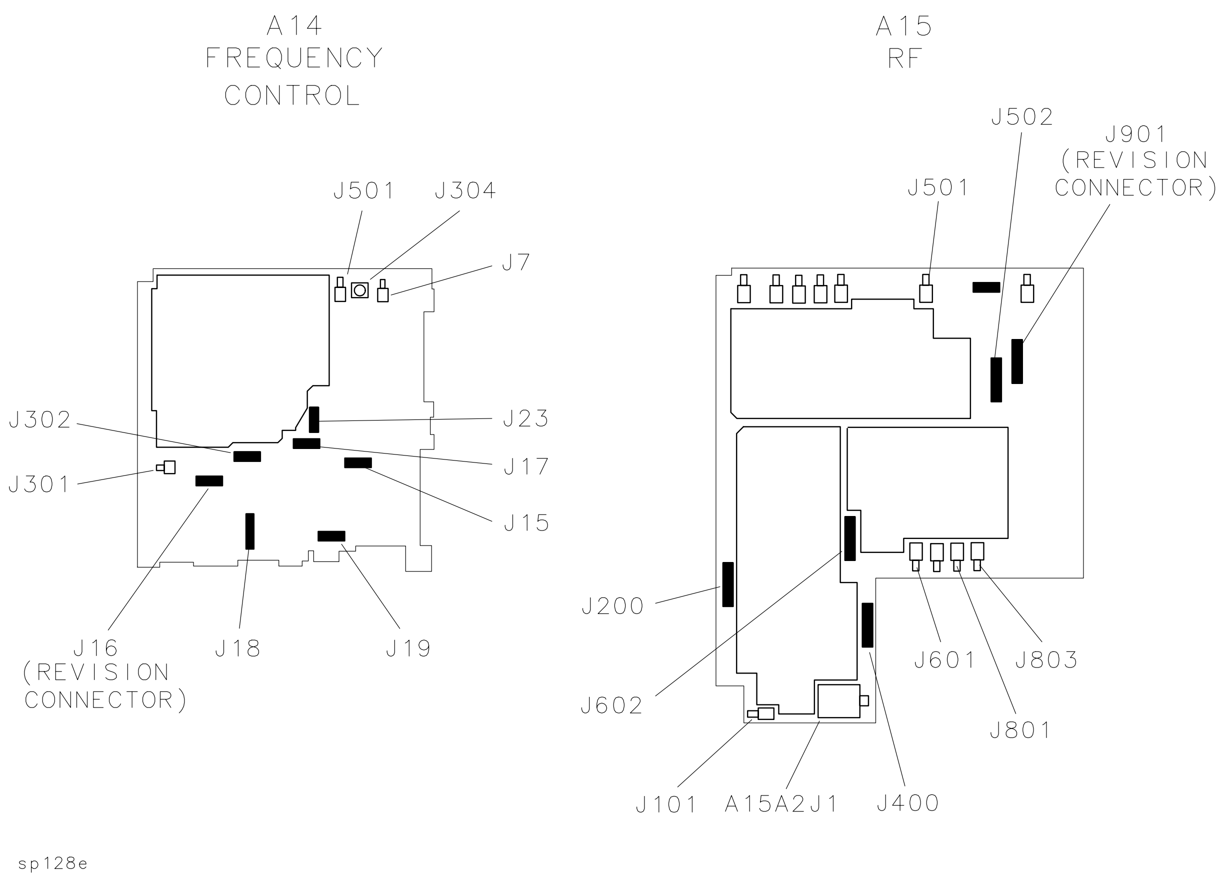


**Figure 11-2 Test Connector Pin Locations**

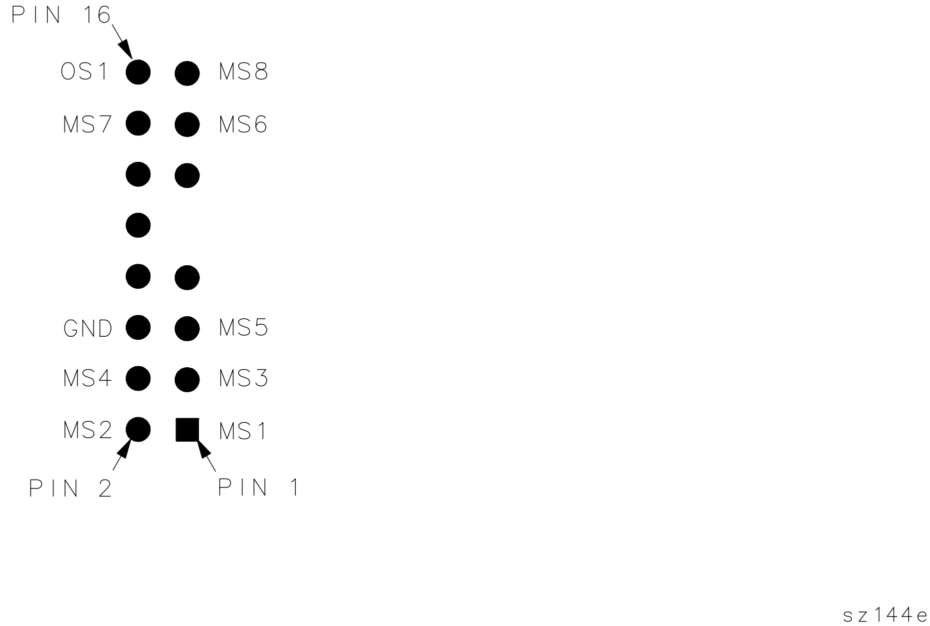



**Table 11-1 Troubleshooting Suspected Faulty Circuits**

| Suspected Circuit | Procedure to Perform |
|---|---|
| YTO loop | Confirming a Faulty Synthesizer Section (steps 12-33) |
| 1st LO | Confirming a Faulty Synthesizer Section *(steps 9-11)* |
| 1st LO pretune frequency and amplitude | Unlocked YTO PLL (steps 9-12) |
| Fractional N oscillator | Unlocked YTO PLL *(steps 13-17)* |
| 3rd LO drive | Third LO Driver Amplifier (100 MHz VCXO) (steps 1-6) |
| 10 MHz signal at other input to reference PLL<br>phase/frequency detector | Unlocked Reference PLL *(steps 12 and 13)* |
| Sampling oscillator tune voltage | Confirming a Faulty Synthesizer Section *(steps 1-4)* |
| A14 frequency control assembly | Confirming a Faulty Synthesizer Section *(steps 12-18)* |
| A14J301 10 MHz REF input | Confirming a Faulty Synthesizer Section *(steps 5-8)* |
| A15 RF assembly | Confirming a Faulty Synthesizer Section *(steps 18-25)* |
| Current source A14U307 | 1st LO Span Problems (All Spans) *(steps 14-21)* |

**Table 11-1 Troubleshooting Suspected Faulty Circuits**

| Suspected Circuit | Procedure to Perform |
|---|---|
| YTO loop phase/frequency detector | Unlocked YTO PLL *(steps 27-34)* |
| YTF gain and offset DACs | YTF Driver Circuit *(steps 10-23)* |
| Level at amplifier input | Third LO Driver Amplifier *(steps 1-6)* |
| Levels into mixer A15U400 | Unlocked YTO PLL *(steps 3-13)* |
| Offset PLL | Unlocked YTO PLL *(steps 1 and 2)* |
| Main coil tune DAC | Unlocked YTO PLL *(steps 45-49)* |
| Main coil coarse and fine DACs | Unlocked YTO PLL *(steps 41-44)* |
| Sweeping fractional N | Fractional N Span Problems (LO Spans £2 MHz) |
| Reference PLL phase/frequency detector | Unlocked Reference PLL *(steps 17-22)* |
| Path to offset PLL phase/frequency detector | Unlocked YTO PLL *(steps 3-7, 14-19)* |
| Sampler drive output of A7 | Unlocked YTO PLL *(steps 18-21)* |
| Sampler IF | Unlocked YTO PLL *(steps 22-26)* |
| Sampler/sampler IF operation | Sampler and Sampler IF (steps 1-15) |
| Span attenuator | 1st LO Span Problems (All Spans) *(steps 6-13)* |
| Sweep generator | Sweep Generator Circuit |
| Sweep + tune multiplier | YTF Driver Circuit *(steps 4-9)* |
| 600 MHz reference loop amplifier | Unlocked Reference PLL *(steps 23-26)* |
| YTO loop | Unlocked YTO PLL |
| YTO FM coil driver | 1st LO Span Problems (2.01 MHz to 20 MHz) *(step 6)* |
| YTO FM coil driver and main loop error voltage driver | Unlocked YTO PLL *(steps 35-40)* |

# Troubleshooting Test Setup

Some synthesizer section problems require placing the YTO PLL in an unlocked condition. This is done by moving jumper A14J23 to the TEST position. This grounds the YTO ERROR signal and disables the CPU from detecting an unlocked YTO. The FM coil driver output is set to its mid-range level causing the YTO to be controlled only by the main coil tune DAC.

Synthesizer section troubleshooting is best done with the spectrum analyzer SPAN set to 0 Hz (even though it is still possible to sweep the Main and FM coils of the YTO).

With the YTO in its unlocked conditions and the SPAN set to 0 Hz, the nominal YTO frequency is not necessarily the value listed as LO FREQ in the Frequency Diagnose menu. The YTO has an initial pretune accuracy of ±20 MHz. To display the nominal YTO frequency, press **CAL**, **MORE 1 OF 2**, **FREQ, DIAGNOSE**, **LO FREQ**.

The fractional N oscillator frequency is the same as the desired sampler IF. To display the fractional N oscillator frequency press **CAL**, **MORE 1 OF 2**, **FREQ DIAGNOSE**, **FRAC N FREQ**. If the sampler IF is negative (YTO frequency is lower than the desired sampling oscillator harmonic), the fractional N frequency will be displayed as a negative number.

# Confirming a Faulty Synthesizer Section

The A11 YTO (the 1st LO of the spectrum analyzer) is a YIG-tuned oscillator which tunes from 2.95 to 6.8107 GHz. The A7 LO multiplier/amplifier (LOMA) levels the A11 output and distributes the signal to the following:

A8 low band mixer
A10 YIG-tuned mixer/filter (RYTHM)
A12 switched barium-tuned mixer (SBTX)
A15U100 sampler
1ST LO OUTPUT to the front panel

The synthesizer section includes the following PLLs (Phase Locked Loops):

| | |
|---|---|
| **YTO PLL** | A7, A11, A14 and A15 assemblies |
| **Offset PLL** (sampling oscillator PLL) | A15 RF assembly |
| **Fractional N PLL** | A14 frequency control assembly |
| **Reference PLL** | A15 RF assembly |

The fractional N PLL is sometimes swept backwards (higher frequency to lower frequency). This is necessary because of the way in which the sampler IF signal is produced.

**NOTE** The frequency control board is digitally controlled. If multiple failures appear in unrelated areas of the circuitry, the control may be at fault. Refer to the troubleshooting procedures in this chapter for further help on isolating those failures.

### Check Sampling Oscillator Tune Voltage (steps 1-4)

1. Connect the positive lead of a DVM to A15J200 pin 13 and the negative lead to A15J200 pin 6. This measures the sampling oscillator tune voltage which is an input to the ADC MUX of the A3 interface assembly.
2. Set the spectrum analyzer to the following settings:

   Span .......... 0 Hz
   Center frequency .......... 389.5 MHz
   Trigger .......... SINGLE

3. Use the data entry keys to tune the **CENTER FREQ** to the values listed in Table 11-2 on page 529.

4. As the sampling oscillator frequency is increased, the DVM reading should also increase. If the tune voltage is correct, but the ADC measures the voltage and determines it to be out of specification, troubleshoot the A3 assembly ADC MUX.

**Table 11-2 Center Frequency Tuning Values**

| 8564EC and 8565EC Center Frequency (MHz) | Sampling Oscillator Frequency (MHz) |
|---|---|
| 2156.3 | 285.000 |
| 2176.3 | 286.364 |
| 2199.5 | 287.500 |
| 2230.3 | 288.462 |
| 799.3 | 288.889 |
| 2263.3 | 290.000 |
| 2282.3 | 290.909 |
| 2302.3 | 291.667 |
| 2155.3 | 292.500 |
| 2158.3 | 293.478 |
| 2336.3 | 294.444 |
| 2196.3 | 295.000 |
| 1.3 | 296.000 |
| 2378.3 | 296.471 |
| 2410.3 | 297.000 |
| 2422.3 | 297.222 |

**Check A14J301 10 MHz reference input (steps 5-8)**

5. Disconnect W37 from A14J301.
6. Connect a test cable from W37 to the input of another spectrum analyzer. Tune the other spectrum analyzer to the following settings:

   Center frequency .................................................. 10 MHz
   Span ............................................................. 2 MHz

7. The amplitude of the 10 MHz reference signal should measure >–1 dBm. If the signal does not measure >–1 dBm, troubleshoot the A15 10 MHz distribution and A21 OCXO (If not Option 103).
8. Reconnect W37 to A14J301.

**Check 1st LO (steps 9-11)**

9. Connect the CAL OUTPUT to INPUT 50Ω.

10. Set the spectrum analyzer to the following settings:

| | |
|---|---|
| Center frequency | 300 MHz |
| Span | 100 MHz |

11. If the 1st LO is present, a signal should be displayed at about –10 dBm (approximately ±20 MHz from the center frequency). If no signal is displayed and `ERR 338 LOMA AGC`, `ERR 339 SBTX AGC`, or `ERR 340 SAMP AGC` is not present, suspect the A7 LOMA. If no signal is displayed and `ERR 338 LOMA AGC`, `ERR 339 SBTX AGC`, or `ERR 340 SAMP AGC` is present, check the A11 YTO as follows:

    a. Set jumper A14J23 to the TEST position.

    b. Set the spectrum analyzer to the following settings:

    | | |
    |---|---|
    | Center frequency | 50 Hz |
    | CF step | 300 MHz |
    | Span | 0 Hz |

    c. Connect a power meter directly to the output of the A11 YTO.

    d. Press the spectrum analyzer step-up key and measure the YTO output power at each step.

    e. Make sure that the A11 YTO output power is between +9 and +13 dBm.

    f. Set jumper A14J23 to the NORM position and reconnect the A11 YTO.

**Check A14 frequency control assembly (steps 12-18)**

12. On the spectrum analyzer press **PRESET**, **SPAN**, **ZERO SPAN**, **CAL**, **MORE 1 OF 2**, **FREQ DIAGNOSE**, and **FRAC N FREQ**. Note the fractional N oscillator frequency. (Ignore the minus sign, if present.)

Fractional N Oscillator Frequency = ________________MHz

13. Check A14J304 (FRAC N TEST) port with a spectrum analyzer for this exact frequency. The amplitude should be approximately -10 dBm.

14. Disconnect W32 from A14J501 and connect the output of a signal source to A14J501. Remove the jumper from A14J23. Connect the positive lead of a DVM to A14J23 pin 1, and the negative lead to A14J23 pin 3. See Figure 11-3 on page 531.

15. Set the signal source to the following settings:

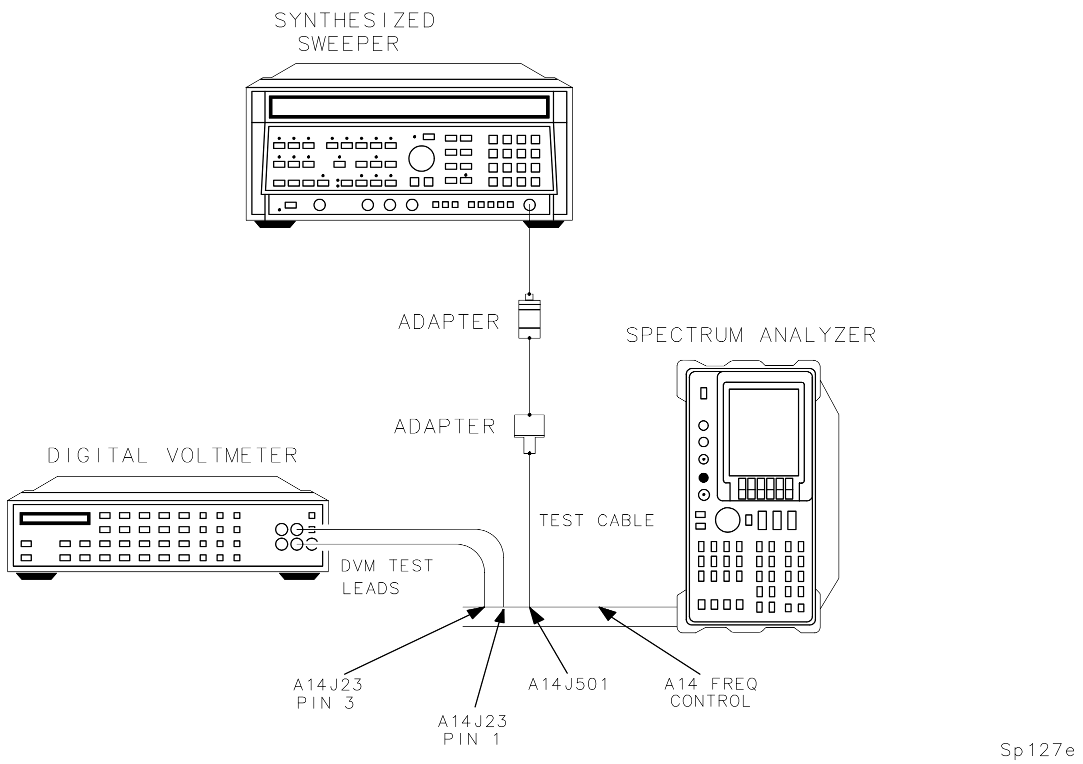
| | |
|---|---|
| Power | 0 dBm |
| Frequency | Frequency recorded in step 12 |

16. Tune the source 1 kHz below the fractional N frequency. The voltage measured on the DVM should be approximately 12 Vdc.

17. Tune the source 1 kHz above the fractional N frequency. The voltage measured on the DVM should be approximately –12 Vdc.

18. If the DVM reading does not change, the A14 frequency control assembly is defective. Reconnect W32 to A14J501. Replace the jumper on A14J23 to the NORM position.

**Figure 11-3 YTO Loop Test Setup**




**Check A15 RF assembly (steps 19-25)**

19. Disconnect W34 from A15U100J1 and disconnect W32 from A15J101.

20. Connect a frequency counter to A15J101. Connect a high-frequency test cable from an 8340A/B synthesized sweeper to A15U100J1. See Figure 11-4 on page 532.

21. Connect a BNC cable from the spectrum analyzer 10 MHz REF IN/OUT to the 8340A/B FREQUENCY STANDARD EXT input.

22. Set the 8340A/B to the following settings:

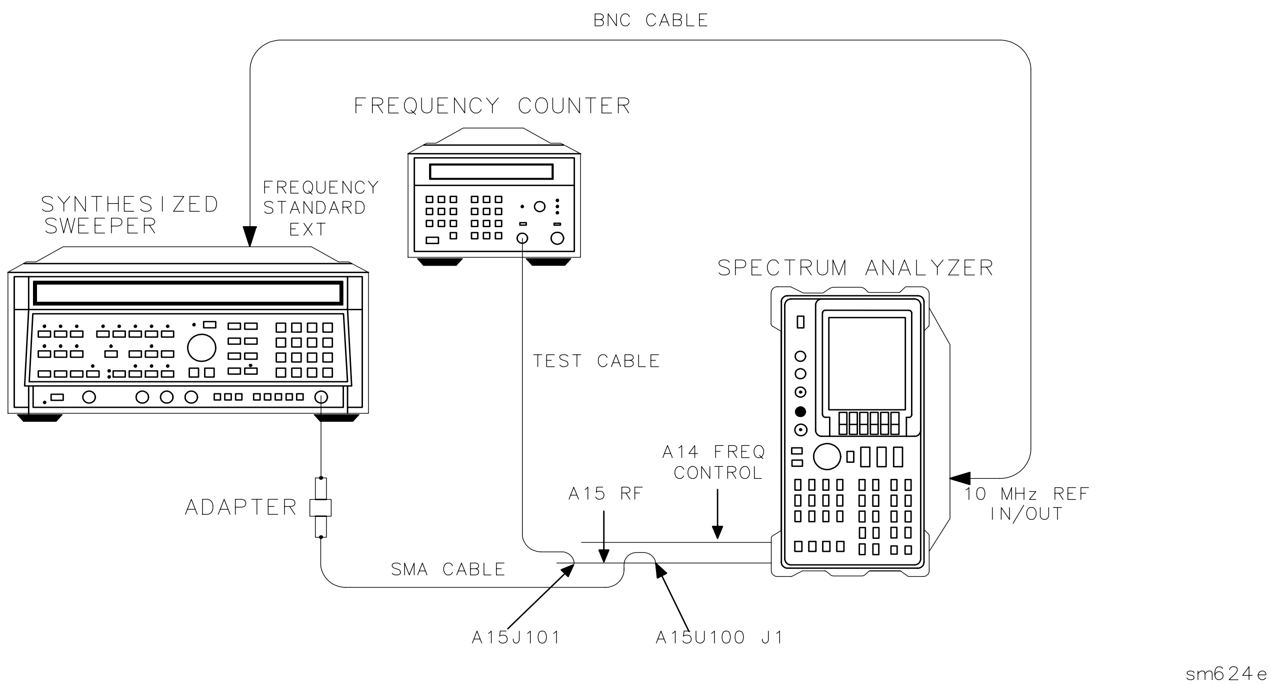
Frequency standard .......................................................... EXT
Power level ................................................................ –5 dBm

23. Set the spectrum analyzer to the following settings:

Span ...................................................................... 0 Hz
Trigger ................................................................ SINGLE

24. Set the spectrum analyzer and 8340A/B frequencies to the combinations listed in Table 11-3 on page 533 and press **SGL SWP** on the spectrum analyzer.

**Figure 11-4 Sampler and Sampling Oscillator Test Setup**




25. At each combination, the frequency counter should measure a sampler IF as shown in Table 11-3 on page 533. (The offset PLL sampling oscillator tunes to the frequencies listed in the table.) If the frequency counter does not read the indicated sampler IF ±10 kHz, suspect the A15 RF assembly.

26. Reconnect W34 to A15U100J1 and W32 to A15J101.

27. The 1ST LO OUTPUT, located on the front panel, must be terminated in 50Ωs. If the YTO unlocks only with certain center frequency and span combinations, check that the termination is in place.

28. Set the spectrum analyzer **CENTER FREQ** and **SPAN** to generate the unlock conditions.

29. On the spectrum analyzer press **SGL SWP**.

30. Move jumper A14J23 to the TEST position.

31. Disconnect W34 from A15U100J1 and measure the power of the signal at the end of W34.

32. If the power is less than –6.5 dBm, suspect W34, A7 LOMA, or A11 YTO.

33. Move jumper A14J23 to the NORM position.

**Table 11-3 Sampling Oscillator Test Frequencies**

| 8340A CW Frequency (GHz) | 8564/5EC Center Frequency (MHz) | Offset PLL Sampling Oscillator Freq (MHz) | Counter Reading Sampler IF (MHz) |
|---|---|---|---|
| 6.067000 | 2156.3 | 285.000 | 82.000 |
| 6.087000 | 2176.3 | 286.364 | 73.364 |
| 6.110200 | 2199.5 | 287.500 | 72.700 |
| 6.141000 | 2230.3 | 288.462 | 83.308 |
| 4.710000 | 799.3 | 288.889 | 87.778 |
| 6.174000 | 2263.3 | 290.000 | 84.000 |
| 6.193000 | 2282.3 | 290.909 | 83.909 |
| 6.213000 | 2302.3 | 291.667 | 88.000 |
| 6.066000 | 2155.3 | 292.500 | 76.500 |
| 6.069000 | 2158.3 | 293.478 | 94.044 |
| 6.247000 | 2336.3 | 294.444 | 63.667 |
| 6.107000 | 2196.3 | 295.000 | 88.000 |
| 3.912000 | 1.3 | 296.000 | 64.000 |
| 6.289000 | 2378.3 | 296.471 | 63.118 |
| 6.321000 | 2410.3 | 297.000 | 84.000 |
| 6.333000 | 2422.3 | 297.222 | 91.333 |

# General PLL Troubleshooting

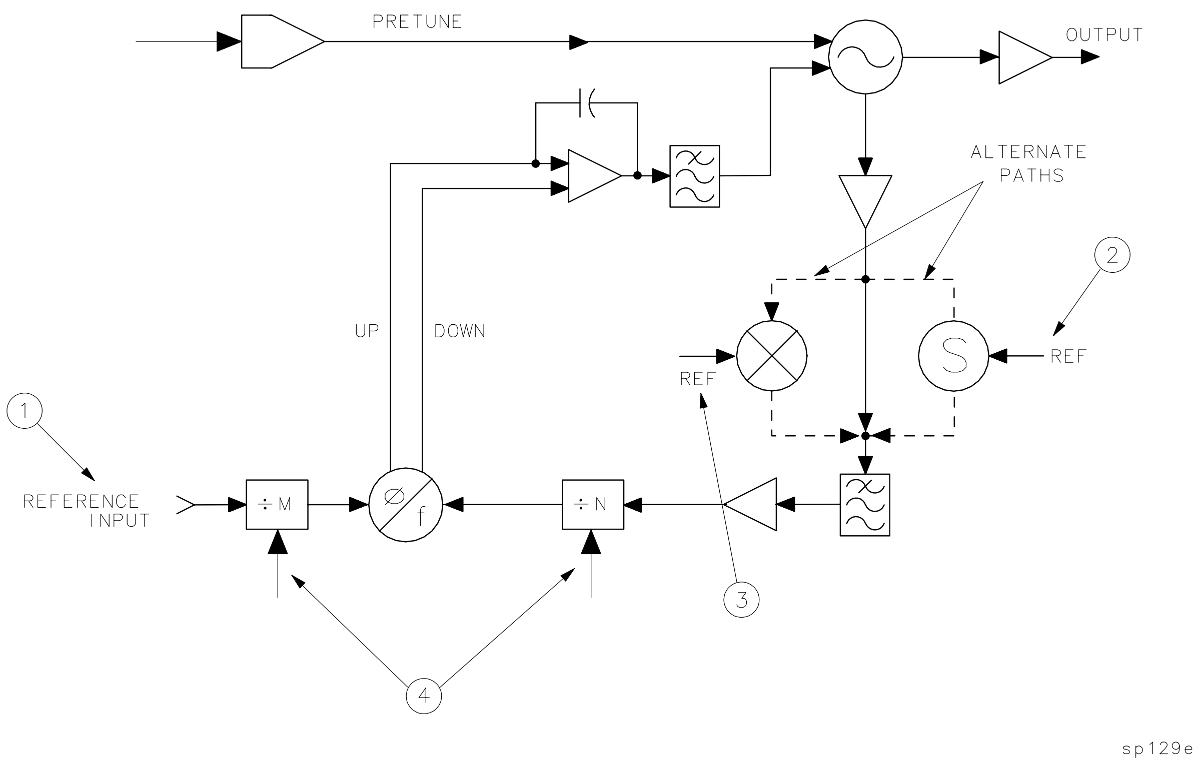
The synthesizer section relies heavily on phase-locked loops (PLL). Typically, faulty PLLs are either locked at the wrong frequency or unlocked. The information below applies to troubleshooting these two classes of problems on a generalized PLL.

## PLL Locked at Wrong Frequency

Numbers in the following text identify items in Figure 11-5 on page 535:

- Any frequency errors at reference (1) will be multiplied by N/M on the PLL output.
- A sampler reference-frequency error (2) will be multiplied by its harmonic on the PLL output.
- A mixer reference-frequency error (3) produces the identical error on the PLL output.
- If divider input or output frequencies (4) are wrong, check for incorrect divide numbers and data controlling the dividers.

**Figure 11-5 PLL Locked at Wrong Frequency**




## Unlocked PLL

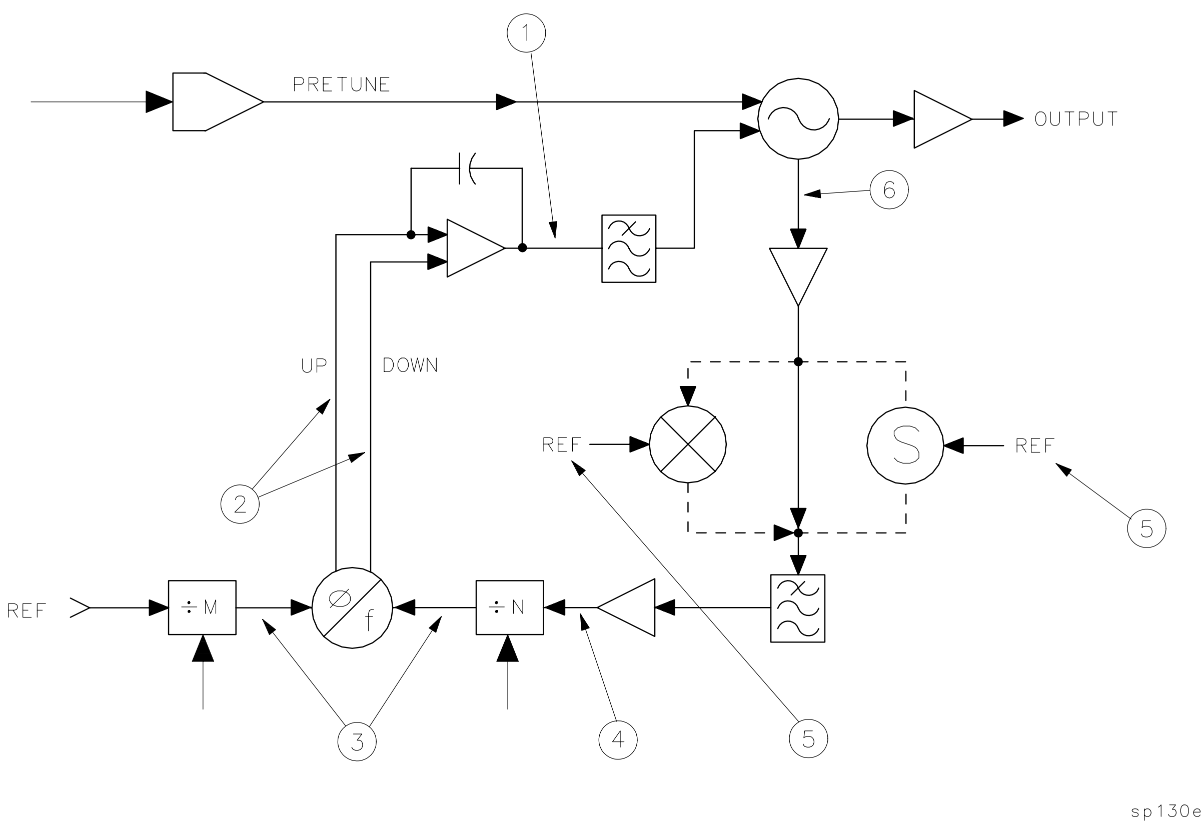
An unlocked PLL can be caused by problems inside or outside the PLL. Troubleshoot this problem by working backward from the oscillator as described in the steps below. Numbers in the following text identify items in Figure 11-6 on page 536.

1. The loop integrator output voltage (1) should be attempting to tune the oscillator to the correct frequency:

   The voltage at (1) should increase as the frequency increases on all of the PLLs:

| PLL | Measurement Point |
|---|---|
| YTO PLL | A14J23 pin 1 (YTO ERROR) |
| Reference PLL | A15J502 pin 3 (LO3 ERR) |
| Sampler PLL | A15J200 pin 13 (OFL ERR) |
| Fractional N PLL | A14TP13 (INTEGRATOR) |

**Figure 11-6 Unlocked PLL**




2. If the integrator output voltage changes in the manner described in step 1, the problem is external to the PLL. For example, the reference frequency could be faulty. If the integrator output voltage appears incorrect, confirm that the pulses out of the phase detector (2) are attempting to tune the oscillator in the correct direction.

3. If the phase detector output is bad, check the inputs to the detector (3). One input should be higher in frequency than the other; this should match the phase detector outputs.

4. Confirm proper power levels for the signals at the input to the "N" dividers (4), the reference inputs (5 and 7), and the loop feedback path (6).

# Unlocked Reference PLL (100 MHz VCXO)

## Operation (100 MHz VCXO)

The 600 MHz reference is generated by tripling, then doubling the output of the 100 MHz phase-locked loop. If the 600 MHz reference is off frequency, the 100 MHz phase-lock circuitry is probably at fault. If there is no signal present at A15J701, or if the level is less than –3 dBm, the 100 MHz VCXO, the tripler, or the doubler circuitry has probably failed. Refer to function blocks Q, R, and S of the A15 RF schematic (sheet 2 of 4) in the *8560 E-Series Spectrum Analyzer Component Level Information* binder.

## Troubleshooting (100 MHz VCXO)

**Check 100 MHz VCXO, tripler, and doubler (steps 1-7)**

1. Using an active probe/spectrum analyzer combination, such as the 85024A/8566B, measure the tripler output at A15TP700. The tripler output should be +3 dBm ±2 dB.
2. If the tripler output is within tolerance, suspect the doubler circuitry. Refer to function block S of the A15 RF schematic (sheet 2 of 4).
3. If the tripler output is too low, probe the output of A15U700 RF amplifier. The level should be +16.5 dBm ±2 dB. The level at the input of A15U700 should be +8.5 dBm ±2 dB.
4. If the level at the input of A15U700 is too low, suspect a faulty 100 MHz VCXO. Refer to function block Q of the A15 RF schematic (sheet 2 of 4).
5. On the spectrum analyzer, press **AUX CTRL**, **REAR PANEL**, and **10 MHz INT**.
6. Measuring the tune voltage indicates if the 100 MHz PLL is locked. Connect the ground lead the voltmeter to A15J1 pin 3 and measure the voltage at A15J700 pin 3.
7. The tune voltage should be between +1 and +24 Volts. If the tune voltage is incorrect, place the P700 jumper (on A15J700) in the TEST position (pin 1 to pin 2). This sets the tune voltage for varactor A15CR700 to the nominal +13 Volts, making it easier to troubleshoot the 100 MHz VCXO, tripler, and doubler. Remember to return P700 jumper to the NORMAL position when you have finished troubleshooting the oscillator circuitry.

8. If the 100 MHz oscillator is working, the reason for the unlocked condition is either a problem in the 10 MHz reference or a fault in the signal path around the loop.

**Check 10 MHz reference to phase/frequency detector (steps 9-14)**

9. On the spectrum analyzer, press **AUX CTRL**, **REAR PANEL**, and **10 MHz INT**.

10. Check the 10 MHz reference frequency-accuracy by connecting a frequency counter to A15J301 and verify that the reference frequency is 10 MHz ±40 Hz after a 5 minute warm-up period.

11. If a 10 MHz signal >1 V peak-to-peak is not present at A15J301, refer to the “10 MHz Reference” in Chapter 12 .

12. Measure the signal at TP301 with an oscilloscope. Refer to function block M of A15 RF schematic (sheet 2 of 4).

13. Measure the signal at U502 pin 11 with an oscilloscope. Refer to function block X of A15 RF schematic (sheet 2 of 4). This signal should be TTL levels at 10 MHz with a 60 percent duty cycle.

14. If TTL-level signals (approximately 10 MHz) are not present, check signals backwards through the loop to find a fault in the signal path.

15. Measure the signals at the following test points with an active probe/spectrum analyzer combination:

| | |
|---|---|
| **Junction of C570 and C571** | 100 MHz, +2.5 dBm ±2 dB |
| **Junction of R715, R716, R567, and R568** | 100 MHz, –3 dBm ±2 dB |
| **U700 pin 3** | 100 MHz, +16.5 dBm ±2 dB |
| **U700 pin 1** | 100 MHz, +8.5 dBm ±2 dB |

16. If an approximately 10 MHz TTL signal is present at U502 pin 11 with 60 percent duty cycle, and the RF portion of the phase-lock loop is functioning, the fault probably lies in the phase/frequency detector or the 100 MHz lock loop integrator.

**Check phase/frequency detector (steps 17-22)**

17. Monitor U504 pin 5 and U503 pin 9 with an oscilloscope. These are the two outputs of the phase/frequency detector. Refer to function block O of A15 RF schematic (sheet 2 of 4).

18. A locked loop will exhibit stable, narrow (approximately 20 ns wide), and positive-going TTL pulses occurring at a 10 MHz rate at U504 pin 5 and U503 pin 9.

19.If the loop is unlocked, but signals are present on both inputs of the phase/frequency detector, the output pulses will be superimposed on each other.

20.If the loop is unlocked, and there is no signal at one of the phase/frequency detector inputs, one phase detector output will be at TTL low and the other will be at TTL high. For example, if there is no input signal at U504 pin 3, U504 pin 5 will be TTL low and U503 pin 9 will be TTL high. If there is no input signal at U503 pin 11, U503 pin 9 will be TTL low and U504 pin 5 will be TTL high.

21.To remove the 10 MHz reference input to the phase/frequency detector, press **AUX CTRL**, **REAR PANEL**, and **10 MHz EXT** with no signal applied to the rear panel 10 MHz REF IN/OUT connector.

22.To remove the divided-down 100 MHz signal from the phase/frequency detector, short R595. Refer to function block X of A15 RF schematic (sheet 2 of 4).

**Check the 100 MHz lock loop integrator (steps 23-27)**

23.Remove 10 MHz reference input to the phase/frequency detector by pressing **AUX CTRL**, **REAR PANEL**, and **10 MHz EXT**. No signal should be connected to the rear panel 10 MHz REF IN/OUT connector.

**NOTE** The outputs of phase/frequency detector are low-pass filtered to reduce the 10 MHz component of the signal. The filtered signals are then integrated by U506 and the result is fed to the tune line of the 100 MHz VCXO.

24.Check that the voltage on A15J502 pin 3 is less than 0 Vdc. Refer to function block P of A15 RF schematic (sheet 2 of 4).

25.Press **AUX CTRL**, **REAR PANEL**, and **10 MHz INT** and remove the divided-down 100 MHz input to the phase/frequency detector by shorting R572.

26.Check that the voltage on A15J502 pin 3 is greater than 13 Vdc.

27.If the loop is locked, the voltage on A15J502 pin 3 should be between 0 and +6 Vdc.

28.If the front-panel CAL OUTPUT amplitude is out of specification and cannot be brought within specification by adjusting A15R561, CAL AMPTD, check the calibrator AGC amplifier with the following steps. Refer to function block W of A15 RF schematic (sheet 1 of 4).

**NOTE** The 300 MHz CAL OUTPUT signal comes from the tripled 100 MHz which is passed through a leveling loop. The 300 MHz signal passes through a low-pass filter for reducing higher harmonics. These harmonics can fool the detector. The 300 MHz signal passes through a variable attenuator controlled by PIN diode CR503 which is controlled by the feedback loop. Diode CR504 is the detector diode (the same type as CR505). Diode CR504 provides temperature compensation between the reference voltage and the detected RF voltage.

- Measure the level of 300 MHz at A15 TP505 with an active probe/spectrum analyzer combination. If the signal is less than +2 dBm, repeat the first 27 steps of this procedure.
- If the signal at this point is correct, place a short across the PIN diode CR503.
- If the signal level at the CAL OUTPUT is still less than –10 dBm with CR503 shorted out, troubleshoot the RF forward path through amplifier Q505. (The signal amplitude decreases.)
- If the CAL OUTPUT signal level is greater than –10 dBm, troubleshoot the PIN diode attenuator, the detector, or the feedback path.

29. Measure the detector voltage at A15J502 pin 14. The voltage should measure approximately +0.3 Vdc when the CAL OUTPUT signal is at –10 dBm. This voltage should change with adjustment of A15R561, CAL AMPTD.
30. Check that the voltage at U507A Pin 3 is +1.7 Vdc. If this voltage is not correct, there may be a problem with the +10 V reference.
31. Measure voltage at U507B pin 5 while adjusting R561. This is the temperature-compensated adjustable voltage reference to which the detected voltage is compared. It should vary between +0.15 V and +0.6 V.
32. Adjust R561 to its limits and verify that the output U507B pin 7 measures approximately +1 Vdc at one limit and –12 Vdc at the other limit.

## Third LO Driver Amplifier (100 MHz VCXO)

The third LO driver amplifier (Q503) amplifies the 300 MHz from the 300 MHz distribution amplifier to a sufficient level to drive the LO port of the double balanced mixer. During the SIG ID operation, diodes CR501 and CR502 turn off the 3rd LO driver amplifier in order to minimize the amount of 300 MHz going to the double-balanced mixer.

**Check level at amplifier input (steps 1-5)**

1. Press **AUX CTRL**, **INTERNAL MIXER**. Press **SIG ID OFF**, if Option 008 is installed.

   Use an active-probe/spectrum-analyzer combination to confirm the power level of the 300 MHz signal at the following test points:

| | |
|---|---|
| **A15X602 pin 5** | ≥+7 dBm |
| **A15TP504** | ≥+15 dBm |

2. If the signal at A15X602 pin 5 is low, but the signal at A15TP504 is correct, press **AUX CTRL**, **INTERNAL MIXER**. Press **SIG ID OFF**, if present.
3. Check that PIN diode switches CR603 and CR605 are reverse biased by approximately +10 Vdc. Refer to function block F of A15 RF schematic (sheet 4 of 4).
4. Measure 300 MHz signal at A15TP503 using an active probe/spectrum analyzer combination. If the signal is not approximately +10 dBm, refer to "Unlocked Reference PLL" in this chapter.
5. If the level at the TP503 is correct, but signal at TP504 is too low, the fault is probably in the amplifier.

# Unlocked Offset Lock Loop (Sampling Oscillator)

## Operation

The offset lock loop drives the A15U100 sampler. The offset lock loop sampling oscillator tunes to one of sixteen discrete frequencies between 285 MHz and 297.222 MHz. Refer to A15 schematic (sheet 3 of 4). The oscillator output and the reference PLL 300 MHz signal is mixed by A15U400 to produce a 3 MHz to 15 MHz IF signal. The 3 MHz to 15 MHz signal is compared in the phase/frequency detector with the divided-down 300 MHz from the reference PLL. The phase/frequency detector drives a voltage-to-current diode switch which drives the loop integrator. Loop bandwidth switches vary the loop bandwidth to minimize noise sidebands. The sampling oscillator must produce low noise because the A15U100 sampler multiplies noise by a factor of approximately 24.

Table 11-4 on page 548 lists the prescaler and postscaler divide numbers in the offset loop reference divide chain, for each of the 16 discrete frequencies to which the offset lock loop may be set. It also indicates what the reference frequency into the phase/frequency divide chain is. Refer to function block AN of A15 RF schematic (block 3 of 4).

## Troubleshooting

**Check loop references (steps 1 and 2)**

1. Use an active probe and spectrum analyzer to confirm the presence of the following reference to the offset lock loop input. Refer to function block AM of A15 RF schematic (sheet 3 of 4).

| | |
|---|---|
| **A15TP404** | 300 MHz at +5 dBm |

2. If this signal is not correct, refer to "Unlocked Reference PLL" in this chapter.

**Check levels into mixer (steps 3-13)**

3. Set the spectrum analyzer to the following settings:

   Center frequency .................................................... 300 MHz
   Span ......................................................................... 0 Hz
   Trigger ................................................................... SINGLE

4. Force the PLL to unlock by shorting A15X201 pin 1 to A15X201 pin 5 with a short length of wire. Then connect a dc power supply to A15J200 pin 16.

5. Monitor A15TP201 with an active probe/spectrum analyzer combination. Vary the dc supply until the frequency of the sampling oscillator is 296 MHz.

6. The voltage required to tune the oscillator should measure between +15 Vdc and +19 Vdc. If the voltage is out of this range, perform the sampling oscillator adjustment in Chapter 2.
7. Vary the voltage to tune the sampling oscillator to 296 MHz.
8. Use an active probe/spectrum analyzer combination to measure the 300 MHz LO signal at the following test point. Refer to function block AI of A15 RF schematic (sheet 3 of 4).

| | |
|---|---|
| **A15TP402** | +7 dBm |

9. If the signal is not measured near the indicated power, troubleshoot the offset lock loop buffer (function block AM of A15 RF schematic sheet 3 of 4).

**Table 11-4 Sampling Oscillator PLL Divide Numbers**

| Sampling Oscillator Frequency (MHz) | Center Frequency* (MHz) | Reference Divide Chain | | Reference Frequency (MHz) |
|---|---|---|---|---|
| | | Prescaler | Postscaler | |
| 285.000 | 2156.3 | 10 | 2 | 15.000 |
| 286.364 | 2176.3 | 11 | 2 | 13.636 |
| 287.500 | 2199.5 | 8 | 3 | 12.500 |
| 288.462 | 2230.3 | 13 | 2 | 11.538 |
| 288.888 | 799.3 | 9 | 3 | 11.111 |
| 290.000 | 2263.3 | 10 | 3 | 10.000 |
| 290.909 | 2282.3 | 11 | 3 | 9.091 |
| 291.666 | 2302.3 | 9 | 4 | 8.333 |
| 292.500 | 2155.3 | 8 | 5 | 7.500 |
| 293.478 | 2158.3 | 23 | 2 | 6.522 |
| 294.444 | 2336.3 | 9 | 6 | 5.556 |
| 295.000 | 2196.3 | 10 | 6 | 5.000 |
| 296.000 | 1.3 | 15 | 5 | 4.000 |
| 296.471 | 2378.3 | 17 | 5 | 3.529 |
| 297.000 | 2410.3 | 20 | 5 | 3.000 |
| 297.222 | 2422.3 | 18 | 6 | 2.778 |

* To set the sampling oscillator to a desired frequency, set span to 0 Hz and **CENTER FREQ** to the value listed in the table.

10. Measure the 296 MHz loop feedback signal at the following test point:

| | |
|---|---|
| **A15TP400** | +2 dBm |

11.If the feedback signal is not near the indicated power, measure the signals at the following test points on the feedback path. Refer to function blocks AD, AG, and AH of A15 RF schematic (sheet 3 of 4).

| | |
|---|---|
| **A15TP200** | +4 dBm |
| **A15TP201** | +9 dBm |
| **A15TP202** | +5.5 dBm |

12.Measure the 4 MHz loop-IF signal at the mixer output. The frequency of the IF is the same as the reference frequency and can be found in Table 11-4 on page 548.

| | |
|---|---|
| **A15R447** (end nearest L414) | –6 dBm |

13.If the IF signal is not near the indicated power, troubleshoot the loop mixer (function block AI).

### Check path to phase/frequency detector (steps 14-19)

14.Measure the loop IF signal at the input to the IF amplifier/limiter (function block AK):

| | |
|---|---|
| **A15L428** (end nearest U411) | 4 MHz (approximately –6 dBm) |

15.Confirm the presence of a 4 MHz square-wave reference frequency signal at U406 pin 3. The square wave is TTL and should be less than +0.6 V and greater than +2.2 V.

16.Disconnect the jumper from X201 pins 1 and 5. Disconnect the dc power supply which is connected to A15J200 pin 16.

17.Set the spectrum analyzer to the following settings:

Center frequency ........................................................ 300 MHz
Span .......................................................................... 0 Hz

18.Use an oscilloscope to confirm the presence of a 4 MHz TTL-level reference frequency signal at U406 pin 11.

19.Connect a short across A15R425. Connect A15U406 pins 3 and 11 together. This puts the same signal on both the phase/frequency detector inputs.

20.Observe the phase/frequency detector outputs, U406 pins 6 and 9, with an oscilloscope. Narrow TTL pulses should be present. Pin 9 is normally low, pulsing high, and pin 6 is normally high, pulsing low.

21.Check the end of L417 (nearest C445) with an oscilloscope. With the oscilloscope input ac-coupled, a triangle waveform approximately 20 mVp-p should be present.

22. Short C441 with a wire jumper. (Connect the jumper from the end of R462 nearest C441 to the end of R460 nearest C443.) This changes the loop integrator into a voltage follower. Refer to function block AB of A15 RF schematic (sheet 3 of 4).

23. Check the voltages at the following points:

| | |
|---|---|
| **A15U408 pin 6** | +2.5 Vdc (approximately) |
| **A15X201 pin 1** | +2.5 Vdc (approximately) |

24. If the voltages are not correct suspect A15U408.

25. Remove the jumpers.

# Unlocked YTO PLL

## Operation

The A11 YTO is locked to two other oscillators, the fractional N oscillator and the offset PLL sampling oscillator. For LO spans of 2.01 MHz and greater, either the FM or main coil of the YTO is swept directly. For LO spans less than or equal to 2 MHz, the fractional N oscillator is swept. The sampling oscillator remains fixed-tuned during all sweeps.

The output of A11 YTO feeds through the A7 LO multiplier/amplifier (LOMA) to the A15U100 sampler. The offset PLL sampling oscillator, which drives the sampler, oscillates between 285 and 297.222 MHz. The sampler generates harmonics of the sampling oscillator and one of these harmonics mixes with the YTO frequency to generate the sampler IF frequency. As a result, the frequency of the sampler IF is determined by the following equation:

$$\mathrm{F_{IF}} = \mathrm{F_{YTO}} - (N \times \mathrm{F_{SAMP}})$$

Where:

— $F_{IF}$ is the sampler IF

— $F_{YTO}$ is the YTO frequency

— N is the desired sampling oscillator harmonic

— $F_{SAMP}$ is the sampling oscillator frequency

Notice that $F_{IF}$ can be positive or negative depending upon whether the sampling oscillator harmonic used is less than or greater than the YTO frequency. The actual sampler IF is always positive, but the sign is carried along as a "bookkeeping" function which determines which way to sweep the fractional N oscillator (up or down) and what polarity the YTO error voltage should have (positive or negative) to maintain lock.

To check if a negative sampler IF is selected, press **CAL**, **MORE 1 OF 2**, **FREQ DIAGNOSE**, **FRAC N FREQ**. If the fractional N oscillator frequency is positive, the sampler IF is also positive. A negative fractional N frequency indicates that the sampler IF is negative.

Notice that the polarity of the YTO loop error voltage (YTO ERROR) out of the YTO loop phase/frequency detector changes as a function of the polarity of the sampler IF. That is, for positive sampler IFs, an increasing YTO frequency results in an increasing YTO ERROR signal. For negative sampler IFs, an increasing YTO frequency results in a decreasing YTO ERROR signal. This implies that to maintain lock in both cases, the sense of YTO ERROR must be reversed such that, with a negative sampler IF, an increasing YTO ERROR results in an increasing YTO frequency. This is accomplished with error-sign amplifier, A14U328B. This amplifier can be firmware-controlled to operate as either an inverting or non-inverting amplifier. Digital control line ERRSGN (from A14U313 pin 19) controls the polarity of this amplifier. When ERRSGN is high (positive sampler IF), the amplifier has a positive polarity.

In fractional N spans (LO Spans ≤2 MHz) the YTO remains locked to the sweeping fractional N PLL. Thus, the sampler IF must always equal the fractional N oscillator frequency (conditions for lock). Since the YTO must always sweep up in frequency, for negative sampler IFs, the fractional N oscillator must sweep from a higher frequency to a lower frequency. This is necessary since an increasing YTO frequency decreases the sampler IF for negative sampler IFs. The opposite is true for positive sampler IFs, so in these cases, the fractional N oscillator sweeps more conventionally from a lower frequency to a higher frequency.

Table 11-5 on page 553 summarizes the amplifier polarities for the various combinations of sampler IF polarities and LO spans.

The YTO main coil filter is used to improve residual FM in FM spans. See function block I of A14 frequency control schematic (sheet 2 of 5) in the Component-Level Information binder. Transistors Q304 and Q305 switch the filter (capacitor C36 and resistor R48) into the circuit. Transistor Q303 and U333 keep C36 charged during main spans so the frequency does not jump when C36 is switch in.

**Table 11-5 Amplifier Polarities**

| | | YTO Error Sign Amplifier | ERRSGN (A14U313 pin 19) |
|---|---|---|---|
| **Fractional N Oscillator Swept** | Positive Sampler IF | Positive | TTL High |
| | Negative Sampler IF | Negative | TTL Low |
| **FM/Main YTO Coils Swept** | Positive Sampler IF | Positive | TTL High |
| | Negative Sampler IF | Negative | TTL Low |

## Troubleshooting an Unlocked YTO PLL

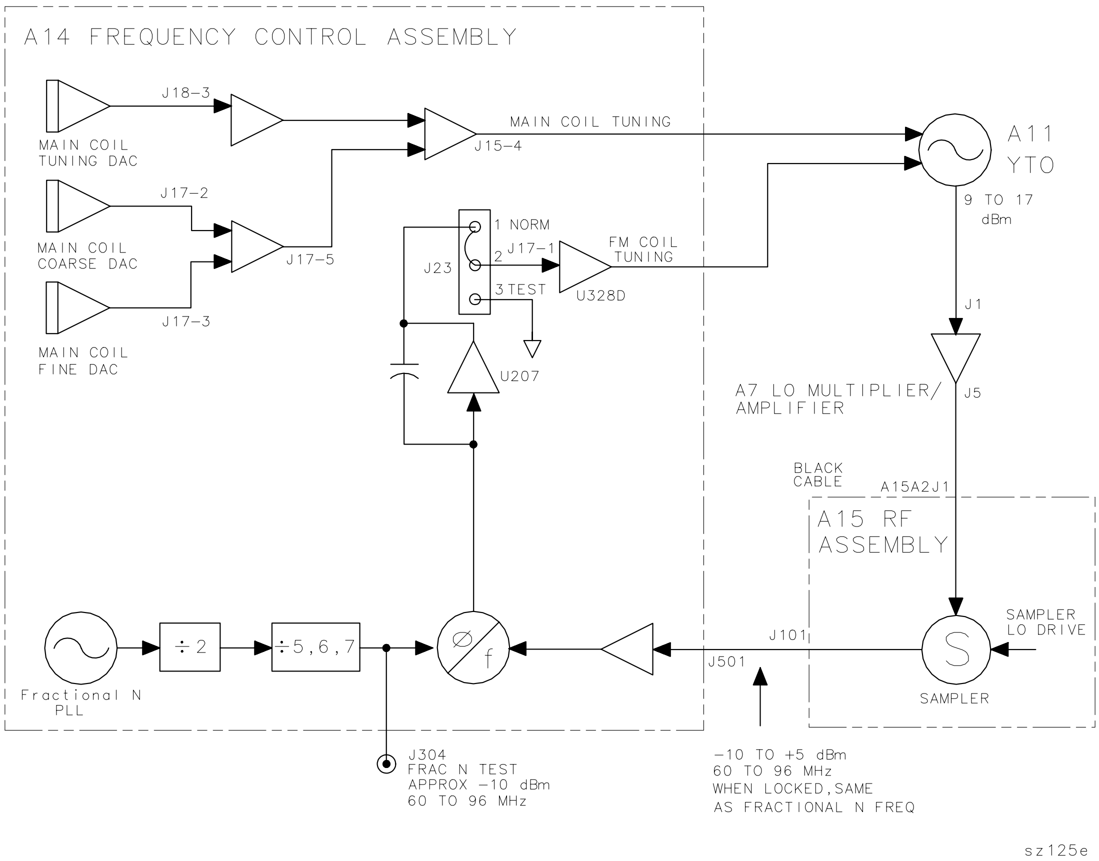
1. If the YTO PLL is unlocked, error code 301 should be displayed. Place the spectrum analyzer in ZERO SPAN. Figure 11-7 on page 554 illustrates the simplified YTO PLL.
2. Move the jumper on A14J23 to connect pins 2 and 3 (TEST position). Refer to Figure 11-1 on page 524 for the location of A14J23. Error code 301 should no longer be displayed. (The YTO PLL feedback path is now open and the YTO error voltage is forced to zero.)
3. On the spectrum analyzer, press **CAL**, **MORE 1 OF 2**, **FREQ DIAGNOSE**, and **LO FREQ**. The displayed LO FREQ is the desired YTO frequency calculated. Record the calculated YTO frequency below:

   YTO frequency (calculated) =________________ MHz

4. Measure the YTO frequency at the front-panel 1ST LO OUTPUT jack and record below:

   YTO frequency (measured) = _________________MHz

**Figure 11-7 Troubleshooting an Unlocked YTO PLL**




5. Calculate the YTO frequency error by subtracting the frequency recorded in step 3 from the frequency recorded in step 4. Record the result below:

YTO Frequency Error = ______________________MHz

YTO frequency error = YTO frequency $_{\text{(MEASURED)}}$ − YTO frequency$_{\text{(CALCULATED)}}$

6. On the spectrum analyzer, press **MORE 1 OF 2**, **FREQ DIAGNOSE**, and **FRAC N FREQ**. Record the fractional N frequency below:

Fractional N frequency = ______________________MHz

7. If the YTO frequency error recorded in step 5 is greater than 20 MHz, do the following:

   - Check the YTO adjustments using the automated adjustment in Chapter 2 or the manual adjustment in Chapter 3.

- Check the YTO DACs using the procedure in steps 41 through 49 below.
- Refer to steps 9 through 34 below.

8. If the YTO Frequency error recorded in step 5 is less than 20 MHz, do the following:
   - Measure the frequency at A14J304. The frequency should be equal to the frequency recorded in step 6. If not, refer to "Unlocked Fractional N PLL" in this chapter.
   - Measure the input and output levels of the A15U100 sampler. If the sampler appears defective, check the LO drive to the sampler as described in "Sampler and Sampler IF."
   - Refer to steps 34 through 51 below.

**Check 1st LO pretune frequency and amplitude (steps 9-12)**

9. The pretuned frequency of the 1st LO must be sufficiently accurate for the YTO loop to acquire lock. The amplitude of the 1st LO must be sufficient to drive the A15U100 sampler. Perform the YTO Adjustment procedure, particularly the YTO main coil adjustments. (If available, use a synthesized microwave spectrum analyzer instead of the microwave frequency counter specified in the adjustment procedure.)
10. If the YTO main coil cannot be adjusted, proceed to step 33 to troubleshoot the main coil coarse and fine DACs and main coil tune DAC.
11. The front-panel 1ST LO OUTPUT should measure between +14.5 and +18.5 dBm in amplitude.
12. If the 1ST LO OUTPUT amplitude is out of the specified range, perform the automated LOMA adjustments. Refer to Chapter 2.

**Check the fractional N oscillator (steps 13-17)**

13. Set the spectrum analyzer to the following settings:

    Center frequency .................................................... 300 MHz
    Span ..................................................................... 0 Hz

14. Monitor the fractional N PLL output at A14J304 (FRAC N TEST) with a synthesized spectrum analyzer such as an 8568A/B or 8566A/B. Refer to function block AI of A14 frequency control schematic (sheet 4 of 5).
15. The signal at A14J304 (FRAC N TEST) should measure approximately –10 dBm at 66.7 MHz. If the loop is unlocked, the sampler IF frequency can also be seen on A14J304, about 30 dB below the fractional N signal.

16. If a problem exists only at particular CENTER FREQ and SPAN settings, determine the desired fractional N oscillator frequency by pressing **CAL**, **MORE 1 OF 2**, **FREQ DIAGNOSE**, **FRAC N FREQ** and setting the spectrum analyzer to SINGLE trigger mode.

17. If the fractional N oscillator frequency is not correct, refer to "Unlocked Fractional N PLL" in this chapter.

**Check sampler drive output of A7 LOMA (steps 18-21)**

18. Set A14J23 jumper to the TEST position and set the spectrum analyzer to the following settings:

    Center frequency .................................................. 2.9 GHz
    Span ................................................................... 0 Hz

19. Disconnect cable W34 from A15U100J1.

20. Use a power meter to measure the A7 LOMA sampler-drive output at the end of W34. The power should measure greater than –9 dBm.

21. Place A14J23 jumper in the NORMAL position and reconnect W34 to A15U100J1.

**Check sampler IF (steps 22-26)**

22. Set the spectrum analyzer to the following settings:

    Center frequency ................................................ 300 MHz
    Span ................................................................... 0 Hz

23. Place A14J23 jumper in the TEST position.

24. Disconnect W32 from A15J101. Monitor the sampler IF output (A15J101, SAMPLER IF) with a synthesized spectrum analyzer such as an 8568A/B or 8566A/B.

25. The sampler IF should measure between 46 MHz and 86 MHz at –15 dBm to +2 dBm. If the signal frequency or amplitude is incorrect, refer to "Unlocked Offset PLL" in this chapter.

26. Set A14J23 jumper in the NORMAL position. Reconnect W32 to A15J101.

**Check FM loop sense (steps 27-34)**

27. Set A14J23 jumper in the TEST position.

28. Set the spectrum analyzer to the following settings:

    Center frequency ................................................ 300 MHz
    Span ................................................................... 0 Hz

29. Connect an RF signal-generator output to A14J501. Set the signal generator to the following settings:

    Frequency ................................................................ 56 MHz
    Amplitude ................................................................ 0 dBm

30. Monitor A14J17 pin 1 with a DVM or oscilloscope. Connect ground to A14J17 pin 6.

31. As the signal generator frequency is increased to 76 MHz, the voltage at A14J17 pin 1 should change from approximately +12 V to –12 V.

32. Set the signal generator to the following settings and repeat step 30.

    Frequency ................................................................ 56 MHz
    Amplitude ............................................................ –15 dBm

33. If the voltage monitored in step 30 is correct with a 0 dBm output but not with –15 dBm output, suspect the limiting amplifier function block AE.

34. Place A14J23 jumper in the NORMAL position and reconnect W32 to A14J501.

**Check YTO FM coil driver and main loop error voltage driver (steps 35-40)**

35. To troubleshoot the YTO FM coil driver, refer to step 6 of "1st LO Span Problems (2.01 MHz to 20 MHz)."

36. Steps 36 through 40 verify that the YTO-loop error voltage is reaching the FM coil. The main loop error voltage driver has a gain of either 1.5 or 15; the analyzer firmware controls the gain during the locking process. The error voltage is read by the ADC on the A3 interface assembly. U324D calibrates out any offsets from true ground. A14U326A inverts the sense of the YTO loop to lock the YTO on lower sampler-sidebands (YTO frequency (sampler frequency × sampler harmonic)). The fractional N frequency indicated in the FREQ DIAGNOSE menu will be negative when locking to lower sidebands. Refer to function blocks E, M, and N of A14 frequency control schematic (sheet 2 of 5) in the *8560 E-Series Spectrum Analyzer Component Level Information* binder.

    Set the spectrum analyzer to the following settings:

    Center frequency .................................................. 300 MHz
    Span ......................................................................... 0 Hz

37. Remove A14J23 jumper and connect a dc power supply to A14J23 pin 2. Connect ground to A14J23 pin 3. Set the dc power supply to +7.5 Vdc.

38. Verify the nominal test-point voltages listed in Table 11-6 on page 558.

39. Change the input voltage to –7.5 volts and re-verify that the voltages listed in Table 11-6 on page 558 are the same except for a change in polarity.

40. Change the **CENTER FREQ** to 678.8 MHz with the SPAN remaining 0 Hz. This will change the switch setting of U326A and invert the voltages listed in Table 11-6 on page 558.

**Table 11-6 Voltages in FM Coil and Main Loop Drivers**

| Measurement Points | Voltages |
|---|---|
| **A14U405 pin 6** | +3.116 Vdc |
| **A14U322 pin 2** | approx. +1.5 Vdc |
| **A14J17 pin 4** | >+10 Vdc |

**Check main coil coarse and fine DACs (steps 41-46)**

41. The main coil coarse and fine DACs correct any initial pretune errors in the YTO main coil. The DACs adjust the FM-coil current to zero before any sweep begins. Refer to function block J of A14 frequency control schematic (sheet 2 of 5).

42. Set the spectrum analyzer to the settings listed below. This sets both DACs to 128 (the DAC setting range is 0 to 255).

    Center frequency ................................................ 300 MHz
    Span ................................................................... 0 Hz
    Trigger ....................................................... SINGLE, EXT
    (with no external trigger connected)

43. Press **SAVE**, **PWR ON STATE** and turn off the spectrum analyzer.

44. Place A14J23 jumper in the TEST position and turn on the spectrum analyzer.

45. Verify the voltages listed in Table 11-7 on page 558.

**Table 11-7 Main Coil Coarse and Fine DACs Voltages**

| Measurement Points | Voltages |
|---|---|
| **A14J17 pin 2** | –5 Vdc |
| **A14J17 pin 3** | –5 Vdc |
| **A14J17 pin 5** | +5 Vdc |

46. Place A14J23 jumper in the NORMAL position.

**Check main coil tune DAC (steps 47-49)**

47. Set the spectrum analyzer to the following settings:

    Center frequency ...................................................... 300 MHz
    Span ......................................................................... 0 Hz

48. Place A14J23 jumper in the TEST position.

49. Measure the output of the main coil tune DAC (A14J18 pin 3) with a DVM. Refer to function block E of A14 frequency control schematic (sheet 2 of 5).

50. If the spectrum analyzer center frequency is 300 MHz, the voltage at A14J18 pin 3 should measure –3.35 V ±0.25 V. The voltage may also be determined from the following equation:

    $V = -(\text{1st LO Frequency} - 2.95\text{ GHz}) \times 2.654\text{ V/GHz}$

51. The voltage at A14U330 pin 2 should measure –3.4 V ±0.2 Vdc. This represents a current setting the YTO to approximately 2.95 GHz.

52. Return A14J23 jumper to the NORMAL position.

# Unlocked Fractional N PLL

## Operation

The fractional N oscillator is used as a reference for the 1st LO phase locked loop. It provides the 1 Hz start-frequency resolution for the 1st LO, and is the means by which the 1st LO is swept in LO spans of 2 MHz or less (fractional N spans). The prescaler, fractional N divider, and the postscaler are preset at power-on.

The PLL operates to produce an output frequency in the range of 60 MHz to 96 MHz selectable in 1 Hz increments. The output frequency can be swept (increasing or decreasing) over a selectable 100 Hz to 2 MHz range.

To determine the fractional N frequency for any given center frequency, press **CAL**, **MORE 1 OF 2**, **FREQ DIAGNOSE**, and **FRAC N FREQ**. The FRAC N FREQ frequency displayed is the frequency that will be measured at A14J304 with the spectrum analyzer in zero span.

## Confirming an Unlocked Condition

1. Set the spectrum analyzer to the following settings:

   Center frequency ................................................ 300 MHz
   Span ...................................................................... 0 Hz

2. Connect A14J304 FRAC N TEST to the input of a synthesized spectrum analyzer and view the fractional N PLL output at 66.7 MHz.

**NOTE** If a synthesized spectrum analyzer is not available, connect A14J304 to the input of a 20 dB gain amplifier, such as an 8447E. Connect the output of the amplifier to the input of a frequency counter.

3. If the fractional N oscillator measures a stable 66.7 MHz, the fractional N PLL is probably locked.
4. Check the two LEDs visible through the shield on A14. If either LED is lit, the fractional N PLL is not locked.
5. If either LED on A14 is lit, and no error message is displayed, check FC MUX U305. Refer to function block AH of A14 frequency control schematic (sheet 4 of 5).
6. If neither LED is lit, but the output frequency is wrong by more than 1 MHz, check the postscaler, function block AV.

7. Check that the postscaler is dividing properly. The frequency at A14J304 should be equal to the frequency at A14TP4 divided by either 5, 6, or 7. Refer to Table 11-8 on page 561. To keep the divide number at a constant value set the spectrum analyzer to:

   Span ........................................................................ 0 Hz
   Trigger ........................................................ SINGLE, EXT

   (with no external trigger connected)

**Table 11-8 Postscaler Divide Numbers**

| Divide Number | D11 | D10 | D9 | Input Range (MHz) (A14J304) | Output Range (MHz) (A14TP4) |
|---|---|---|---|---|---|
| 7 | 0 | 0 | 1 | 840 to 973 | 60.0 to 69.5 |
| 6 | 0 | 1 | 0 | 834 to 987.96 | 69.5 to 82.33 |
| 5 | 0 | 1 | 1 | 823.2 to 960 | 82.33 to 96.0 |

If the output frequency is wrong by less than 1 MHz, the phase locked loop is not unlocked but still requires repair. Continue with the "Fractional N Oscillator PLL" section.

## Fractional N PLL

The fractional N PLL provides a synthesized frequency in the range of 60 MHz to 96 MHz. The 800 MHz to 1020 MHz voltage controlled oscillator (VCO) in the loop is divided down to lock with the 2.5 MHz reference. Simultaneously, the VCO is divided by two and then by either 5, 6, or 7 to generate the 60 MHz to 96 MHz output.

The prescaler (function block AR) supplies the clock signal for the fractional divider and is required for the fractional divider to operate. At the start of a fractional N sweep the fractional divider is set to a value for the start frequency and a sweep rate. It then sweeps for as long as HSCAN is high. Use the following procedure to troubleshoot unlocked loop problems or problems of locking to the wrong frequency (by less than 1 MHz):

1. Check the two LEDs on A14 frequency control assembly. If either LED is lit, the fractional N phase locked loop is not locked.
2. The 10 MHz reference is required for fractional N operation. It is divided by four to 2.5 MHz in the reference divider circuitry, block AN. It is used to lock the divided voltage controlled oscillator (VCO) frequency. Check that the 10 MHz reference is present at A14J301. The 10 MHz reference is derived from the 600 MHz reference on the A15 RF assembly.
3. Change the spectrum analyzer from the fractional N span to 0 Hz.

4. Check the frequency at A14TP1. It should equal the value found by pressing **CAL**, **MORE 1 OF 2**, **FREQ DIAGNOSE**, and **RAW OSC FREQ**.
5. Check the tune voltage at R240 in function block AQ.
6. Look up the expected problem area in Table 11-9 on page 562 with the information from steps 4 and 5. Go to the appropriate troubleshooting steps.

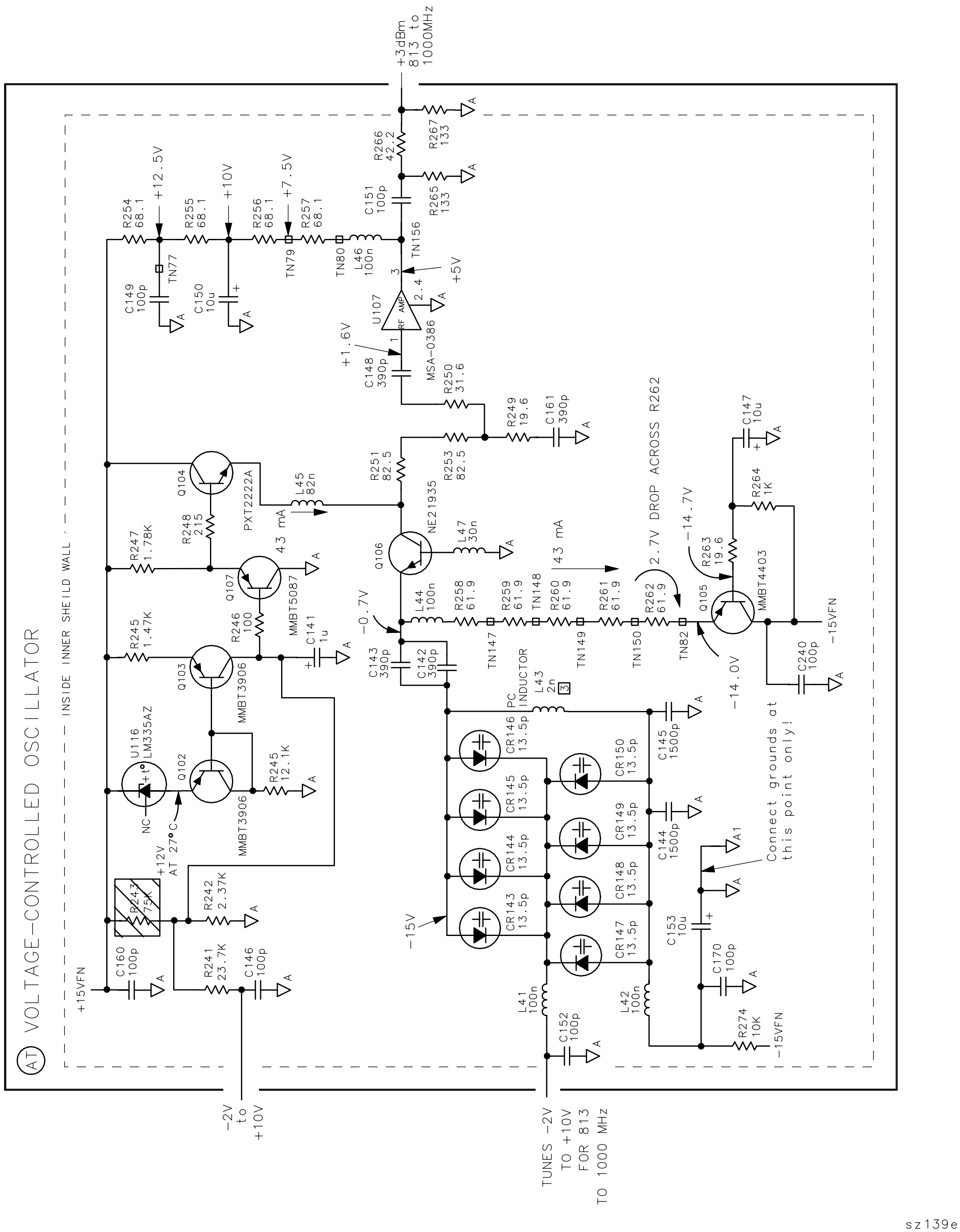
**Table 11-9 Unlocked Fractional N Troubleshooting Areas**

| Measured VCO Frequency Relative to Expected Value | Tune Voltage | | | | |
|---|---|---|---|---|---|
| | Below –4 V | About –3.3 V | Between –2 V and +10 V | About +11 V | Above +12.5 V |
| Measured > expected | VCO clamp | VCO | Divider or integrator | Divider or integrator | VCO clamp |
| Measured < expected | VCO clamp | Divider or integrator | Divider or integrator | VCO | VCO clamp |
| Measured, not oscillating | VCO clamp | VCO | VCO | VCO | VCO clamp |

7. VCO clamp troubleshooting: Q131, Q132 and the associated components should limit the tune voltage at R240 to about –3.3 V to +11 V . If the integrator (its output voltage is on TP13) tries to produce a voltage outside this range, excess current is shunted through CR131 and Q131 for positive excursions or CR132 and Q132 for negative excursions. The base of Q131 should be at about +9.60 V, and the base of Q132 should be at about –2.09 V for proper operation.

8. VCO troubleshooting: Check the dc biases in the VCO function block. The bias voltages, for some points in the VCO, are indicated in Figure 11-8 on page 564

**Figure 11-8 VCO Bias Voltages for A14 Assemblies**



9. Divider and integrator troubleshooting: Measure the frequency of the pulses at TP6 in block AO. Look up the expected problem area in Table 11-11 on page 566 and go to the appropriate troubleshooting steps.

**Table 11-11 Divider and Integrator Troubleshooting**

| Measured VCO Frequency Relative to Expected Value | TP6 Frequency | | | |
|---|---|---|---|---|
| | **zero** | **<2.5 MHz** | **2.5 MHz** | **>2.5 MHz** |
| Measured > expected | Dividers | Dividers | Dividers | Detector or integrator |
| Measured < expected | Both | Detector or integrator | Dividers | Dividers |

10.Divider troubleshooting:

a. Check the frequency at A14TP2. It should be equal to the frequency at A14TP1 divided by two.

b. The signal at A14TP3 should be greater than –14 dBm.

c. Use an analog oscilloscope to view the signal at A14TP5. Adjust the scope triggering to view the divide-by-16 signal. The frequency at this point will be varying as the prescaler changes its divide number to either 16, 17, 20, or 21. The prescaler uses 16 as the divide number most frequently. The frequency displayed on the oscilloscope should equal the frequency from TP2 divided by 16.

d. Use an oscilloscope to view the signal at pin 8 of U112. Its average frequency should be given by:

$$f = f(A14TP5) \times 80\ \text{MHz/RAW OSC FREQ}$$

where: f(A14TP5) is the frequency measured at TP5, and RAW OSC FREQ comes from step 4 (A14TP1).

If the frequency is in error, the fractional divider, block AS, is not functioning. Check that FRAC N RUN on U113 pin 39 is high.

e. Use an oscilloscope to verify that the signals at N_in (U112 pin 8) and N_out (TP6) are identical except for a sub-microsecond delay.

Detector and integrator troubleshooting: Check the phase detector output on TP11 in block AO. If F_ref is higher in frequency than TP6 (reclocked VCO/N), then the average voltage at TP11 should be positive by 0.05 V to 10 V. If F_ref is lower, TP11 should be –0.05 V to –10 V.

The polarity of the output of the loop gain (block AP, TP12) should be the same as the polarity of the input (TP11).

The integrator op amp (U106) output (TP13) should try to go very positive (about +12 V) if its average input (TP12) is positive. If its average input is negative, it should try to go very negative (about –4 V). If its average input is zero and it is functioning correctly, it may take on any output voltage between –4 V and +12 V

# Frequency Span Accuracy Problems

The spectrum analyzer employs lock-and-roll tuning to sweep the 1st LO for spans greater than 2.0 MHz. The 1st LO is locked to the start frequency immediately after the previous sweep has been completed. The 1st LO is then unlocked, and, when a trigger signal is detected, the 1st LO sweeps (rolls).

When there is a considerable delay between the end of one sweep and the beginning of the next, the actual 1st LO start frequency may differ from the locked start frequency. This start frequency drift will be most noticeable in a 2.01 MHz LO span (the narrowest FM coil span). This drift is not noticeable in either free run or line trigger modes.

The sweep is generated by different oscillators in the synthesizer section depending on the desired 1st LO span (due to harmonic mixing, this is not necessarily the same as the span setting of the analyzer). Refer to Table 11-12 on page 568 for a listing of sweep-signal destinations versus 1st LO spans.

Sweeping the fractional N oscillator results in sweeping the YTO FM coil. There is a one-to-one relationship between the frequency span of the fractional N assembly and the 1st LO span. The fractional N oscillator sweep is generated digitally. The oscillator is always synthesized, rather than employing lock and roll tuning.

**Table 11-12 Sweep Signal Destination versus Span**

| 1st LO Span | Sweep Signal Destination |
|---|---|
| >20 MHz | A11 YTO main coil |
| 2.01 MHz to 20 MHz | A11 YTO FM coil |
| ≤2 MHz | None Fractional N oscillator sweeps without a sweep ramp signal. |

## Determining the 1st LO Span

The 1st LO span depends on the spectrum analyzer harmonic-mixing number. Use the following steps to determine the 1st LO span:

1. Read the span setting displayed on the spectrum analyzer.

2. Determine the harmonic-mixing number from the information in Table 11-13 on page 569.

**Table 11-13 Harmonic Mixing Number versus Center Frequency**

| Center Frequency | Harmonic Mixing Number |
|---|---|
| 9 kHz to 2.9 GHz | 1 |
| 2.75 GHz to 6.46 GHz | 1 |
| 5.86 GHz to 13.2 GHz | 2 |
| 12.4 GHz to 31.15 GHz | 4 |
| 30.5 GHz to 50.6 GHz | 8 |
| 18 GHz to 325 GHz | 6 through 54 depending upon lock harmonic selected |

3. Use the following equation to determine the 1st LO span used.

$$\text{First LO Span} = \frac{\text{Display Span Setting}}{\text{Current Band Harmonic Mixing Number}}$$

4. Refer to Table 11-12 on page 568 to determine the circuit associated with the span.

## Confirming Span Problems

1. First perform either the manual "7. YTO Adjustment" in Chapter 3 , or the automated "2. LO Frequency" and "3. YTO FM Coil" adjustments in Chapter 2 .
   - On the spectrum analyzer press **CAL**, **REALIGN LO &IF**, and retest all spans.
   - If the YTO adjustment has sufficient range and only LO spans of 2.01 MHz or greater are faulty; test YTO linearity by performing step c.
   - Test the span in question at different center frequencies in the same band. If the span accuracy changes significantly (2% or more), suspect the A11 YTO.
2. If only 1st LO spans of 2 MHz or less are faulty, suspect the A14 fractional N PLL.
3. If there are several spans in the main coil and FM coil ranges affected, suspect the A14 span attenuator.

## YTO Main Coil Span Problems (LO Spans >20 MHz)

For YTO main coil spans, the YTO is locked at the beginning of the sweep and the sweep ramp is summed into the main coil tune driver.

1. Perform the "7. YTO Adjustment" in Chapter 3 . If the YTO adjustments cannot be performed, continue with step 2.
2. Set the spectrum analyzer to the following settings:

   Start frequency ........................................................ 10 MHz
   Stop frequency ......................................................... 2.9 GHz

3. Verify that a –1.2 V to –4.8 V ramp (approximately) is present at A14U331 pin 2.
4. If this ramp is not present, troubleshoot the main/FM sweep switch. See function block H of A14 frequency control schematic (sheet 2 of 5).
5. Measure the output of the main coil tune DAC at A14J18 pin 3. At the frequency settings of step 2, this should be –2.48 V.

   If the voltage is not –2.48 V, troubleshoot the main coil tune DAC. See function block E of A14 frequency control schematic (sheet 2 of 5).

## YTO FM Coil Span Problems (LO Spans 2.01 MHz to 20 MHz)

In YTO FM coil spans, the YTO loop is locked and then opened while the sweep ramp is summed into the FM coil. The FM coil sensitivity is corrected by changing the sensitivity of the FM coil driver.

1. Perform the "7. YTO Adjustment" in Chapter 3 . If the YTO adjustments cannot be performed, continue with this procedure.
2. Set the spectrum analyzer to the following settings:

   Center frequency .................................................... 300 MHz
   Span ........................................................................ 20 MHz
   Sweep time ................................................................. 50 ms

3. Check for the presence of a 0 V to –10 V sweep ramp at A14J15 pin 14 (input to the main/FM sweep switch). Refer to function block H of A14 frequency control schematic (sheet 2 of 5).
4. Check for the presence of a 0 V to +5 V sweep ramp at A14U405 pin 6 (YTO FM coil driver). Refer to function block M of A14 frequency control schematic (sheet 2 of 5).
5. Check the state of the Main/FM sweep switches as indicated in Table 11-14 on page 571.

6. The rest of the procedure troubleshoots the YTO FM coil driver. Refer to function block M of A14 frequency control schematic (sheet 2 of 5).

**Table 11-14 Settings of Sweep Switches**

| Switch | Switch State | Switch Control Line (Pin #) | Control Line State (TTL) |
|---|---|---|---|
| U318A | Closed | 1 | High |
| U318B | Open | 16 | High |
| U318C | Closed | 9 | Low |
| U318D | Open | 8 | Low |

7. Set the spectrum analyzer to the following settings:

   Center frequency .................................................... 300 MHz
   Span ........................................................................ 0 Hz
   Trigger ........................................................ SINGLE, EXT

   a. On the spectrum analyzer press **SAVE**, **SAVE STATE**, **STATE 0**.

   b. Remove A14J23 jumper and connect a dc voltage source to A14J23 pin 2. Connect the voltage source ground to A14J23 pin 3.

   c. Connect a microwave frequency counter or another spectrum analyzer to the spectrum analyzer 1ST LO OUTPUT. (front panel output)

   d. Set the dc-voltage source output for 0 Vdc and note the 1st LO frequency.

   e. Set the dc-voltage source output for +10 Vdc. The 1st LO frequency should momentarily increase approximately +15.6 MHz.

   f. The voltage at A14U332 pin 2 should be approximately 19% of the voltage at A14J23 pin 2.

   g. If the 1st LO frequency did not change in step e, press **LINE** to turn spectrum analyzer off and disconnect W10 from A14J3.

   h. Place a jumper between A14J3 pins 9 and 10. Place a 50 Ω, 3 watt resistor across A14J3 pins 5 and 6 (resistor, part number 0811-1086). Press **LINE** to turn spectrum analyzer on.

   i. On the spectrum analyzer, press **RECALL**, **STATE**, **STATE 0**.

j. If the voltage at U332 pin 2 is correct with A14J3 pins 9 and 10 shorted, but was incorrect with W10 connected, the YTO FM coil is probably open; replace the A11 YTO.

k. Replace A14J23 jumper. Remove the jumper and resistor from A14J3. Reconnect W10 to A14J3.

## Fractional N Span Problems (LO Spans ≤2 MHz)

If the fractional N spans are inaccurate or non-existent, but the fractional N PLL is locked to the correct frequency and other spans are correct, there may be a problem with the HSCAN signal. Check that HSCAN is present at the fractional divider, U113 pin 41 in function block AS. HSCAN comes from the A3 interface assembly and goes to the sweep generator circuitry in function block A and to fractional N.

## 1st LO Span Problems (All Spans)

1. Set the spectrum analyzer to the following settings:

   Center frequency ................................................ 300 MHz
   Span ...................................................................... 20 MHz
   Resolution BW ....................................................... 1 MHz
   Video BW ................................................................ 1 MHz
   Sweep time ............................................................... 50 ms

2. Check that there is 0 V to +10 V ramp of 50 ms duration at A14J15 pin 15.

3. If a scan ramp is not present, refer to "Sweep Generator" in this chapter.

4. If there is a 0 to –10 V ramp at A14J15 pin 14, the fault is probably in the Main/FM sweep switch. See function block H of A14 frequency control schematic (sheet 2 of 5).

5. Check that there is a 0 V to +10 V ramp at U325 pin 1. The ADC of the spectrum analyzer obtains information about the sweep from this node.

**Check span attenuator (steps 6-13)**

6. Continue with step 7 to check the span attenuator. See function block L of A14 frequency control schematic (sheet 2 of 5).

7. With the spectrum analyzer set to the settings in step 1, monitor A14U323 pin 6 with an oscilloscope. A 0 V to –10 V ramp should be present.

8. Change the spectrum analyzer span to 10 MHz and check for a 0 V to –5 V ramp at U323 pin 6.

9. Change the spectrum analyzer span to 2.01 MHz and check for a 0 V to –1 V ramp at U323 pin 6.

10. Set the spectrum analyzer to the following settings:

Start frequency ............................................................ 10 MHz
Stop frequency ............................................................ 2.9 GHz
Sweep time ............................................................ 80 ms

11. Monitor A14J15 pin 14 for a 0 V to –7.4 V ramp. Switches U317A, U317B, and U317D should be open and U317C should be closed.

12. Change the spectrum analyzer SPAN to 365 MHz and check for a 0 to –936 mV ramp at A14J15 pin 14. Switches U317A, B, and C should be open and U317D closed.

13. Change the spectrum analyzer SPAN to 36.5 MHz and check for a 0 to –93.6 mV ramp at A14J15 pin 14. Switches U317B, C, and D should be open and U317A closed.

## 1st LO Span Problems (Multiband Sweeps)

During multiband sweeps, the sweep ramp at A14J15 pin 15 should go from 0 V to +10 V for each band or portions of a band covered. See function block A of A14 frequency control schematic (sheet 1 of 5) in the *8560 E-Series Spectrum Analyzer Component Level Information*. However, the scan ramp at A14U325A pin 1 is scaled according to the percentage of the total span that the band is covering. See function block B of A14 schematic (sheet 1 of 5). Also, the sum of the individual ramps is 10 V. For the 8564EC, Figure 11-9 on page 574 illustrates both sweep and the scan ramp for a 0 GHz to 40 GHz span with instrument preset conditions. For the 8565EC, Figure 11-10 on page 574 illustrates both sweep and the scan ramp for a 0 GHz to 50 GHz span with instrument preset conditions.

**Figure 11-9 8564EC Sweep and Scan Ramps**

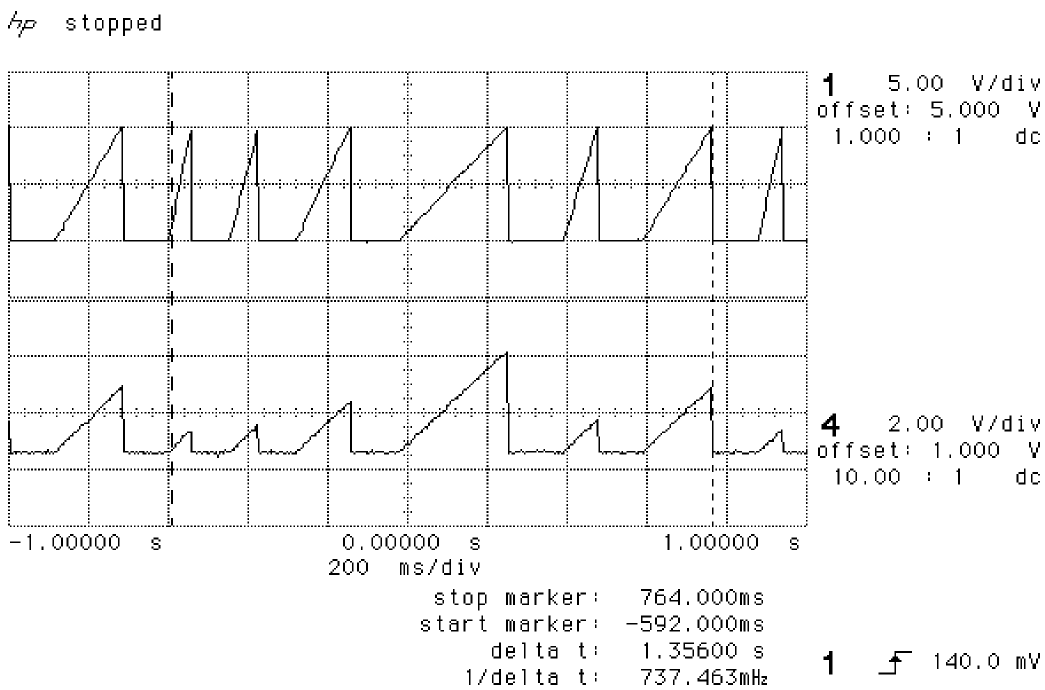
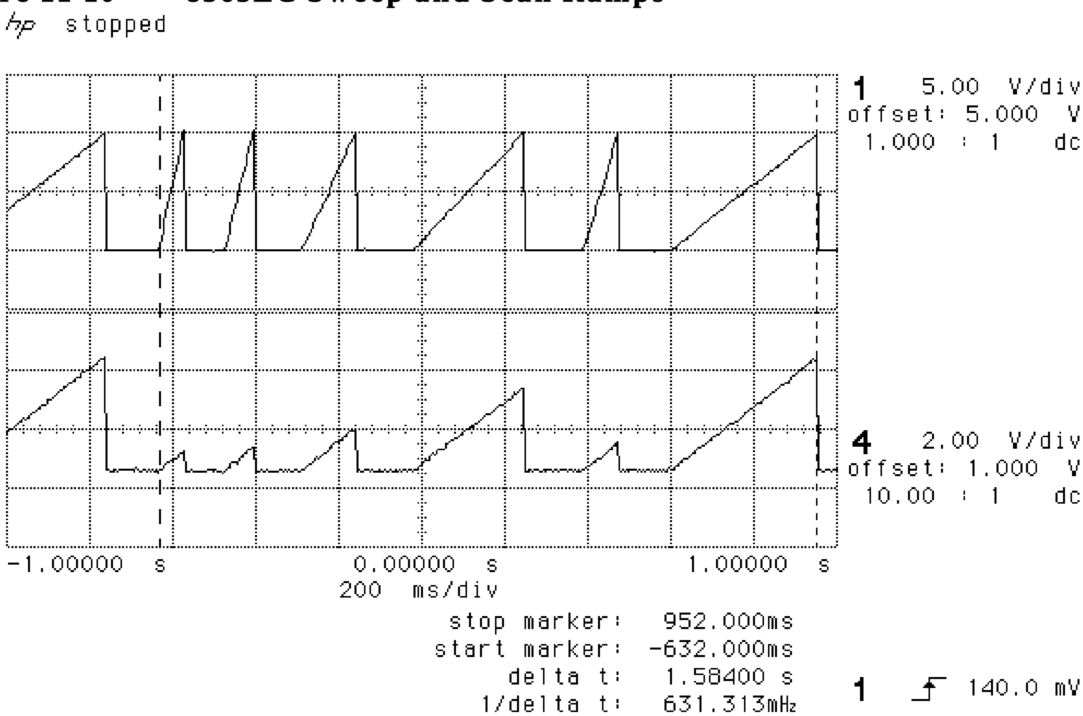



**Figure 11-10 8565EC Sweep and Scan Ramps**



# Phase Noise Problems

System phase noise can be a result of noise generated in many different areas of the spectrum analyzer. When the spectrum analyzer is functioning correctly, the noise can be observed as a function of the distance away (the offset) from the carrier frequency. The major contributor to system noise can be characterized as coming from specific circuit areas depending upon the offset frequency.

Some very general recommendations can be made for identifying which circuitry is the cause of the noise at certain offsets. The recommendations below apply with a center frequency of 1 GHz.

**Table 11-15 Settings of Sweep Switches**

| Carrier Frequency Offset | Major Contributor (when working correctly) |
|---|---|
| 100 Hz | Reference (OCXO or TCXO) |
| 1 kHz | 100 MHz reference PLL |
| 3 kHz | Fractional N PLL |
| 10 kHz to 150 kHz | Offset lock loop or YTO loop |
| >150 kHz | YTO |

## Phase Noise in Locked versus Unlocked Spans

Input a signal to the spectrum analyzer. Set the center frequency to the input signal frequency, set the span to 2 MHz, and plot the display. This plots the system noise for a locked sweep. Plot the display again with a span of 2.01 MHz (lock and roll sweep).

The crossover point of the noise floor of the two plots is typically at an offset of about 50 kHz, for a functioning instrument.

If the crossover point is shifted out to a higher offset frequency, suspect the YTO loop circuitry.

If the crossover point is shifted in to a lower offset frequency, suspect the offset or fractional N loop circuitry.

## Reference versus Reference PLL Phase Noise

If the problem seems to be in the frequency reference or reference PLL circuitry, measure the noise with internal and external references. If there is no difference, suspect the circuitry associated with the 100 MHz VCXO

## Fractional N versus Offset PLL or YTO PLL Phase Noise

If the spectrum analyzer has excessive noise at >1 kHz offset, measure the noise with center frequencies of 100 MHz and 2.5 GHz.

If the measurements are equal, suspect the fractional N circuitry and the YTO loop circuitry on the A14 frequency control assembly.

If the measurements differ by 2 dB to 5 dB, with the 2.5 GHz measurement at a higher noise level, suspect the offset lock loop circuitry.

# Sampler and Sampler IF

The A15U100 sampler creates and mixes harmonics of the sampling oscillator with the 1st LO. The resulting sampler IF (60 MHz to 96 MHz) is used to phase-lock the YTO. The sampler IF filters unwanted products from the output of A15U100 and amplifies the IF to a level sufficient to drive the YTO loop. When the IF is between 78 and 87 MHz, PIN diodes switch a 120 MHz notch filter in the sampler IF section.

1. Set the spectrum analyzer to the following settings:

   Center frequency .................................................... 300 MHz
   Span ..................................................................... 0 Hz

2. Disconnect W32 from A15J101.
3. Connect the input of a power splitter to A15J101. Connect W32 to one of the splitter outputs. Connect the other splitter output to the input of another spectrum analyzer.
4. If a 66.7 MHz signal, greater than –15 dBm, is not displayed on the other spectrum analyzer, set a microwave source to the following settings:

   Frequency ........................................................ 4.2107 GHz
   Amplitude ............................................................... –5 dBm

5. Connect the microwave source to A15U100J1. A 66.7 MHz signal at approximately 0 dBm should be displayed on the other spectrum analyzer.
6. Use an active probe/spectrum analyzer combination to measure the signal at the following test points:

| | |
|---|---|
| **A15TP101** | 66.7 MHz, –8 dBm |
| **A15TP201** | 296 MHz, +9 dBm |

7. If a correct signal is seen at A15TP201 but the signal at A15TP101 is wrong, proceed as follows:
   - Use an oscilloscope to measure the signals at the following test points:

     **A15J400 pin 1** +0.8 Vdc to +1.6 Vdc (≤0.5 Vp-p variation)

     **A15J400 pin 3** –0.8 Vdc to –1.6 Vdc (≤0.5 Vp-p variation)
   - If these levels are wrong, perform the "Power and Sampler Match Adjustments" in the sampling oscillator adjustment procedure. Refer to Chapters 2 and 3.

- If adjusting the sampler match does not bring the signal at A15TP101 within specification when the signal at A15TP201 is correct, the A15U100 sampler is defective.

8. The sampler IF signal at A15J101 is 60 MHz to 96 MHz at –10 dBm to +5 dBm. If the signal at A15TP101 is correct, but the signal at A15J101 is wrong, the fault lies in the sampler IF circuitry. Continue with the following steps.

9. Set the spectrum analyzer to the following settings:

   Center frequency ................................................ 300 MHz
   Span ................................................................... 0 Hz

10. Set a microwave source to the following settings:

    Frequency ....................................................... 4.2107 GHz
    Amplitude ............................................................. –5 dBm

11. Connect the microwave source to A15U100J1.

12. Measure the signal at U103 pin 1 using an active probe/spectrum analyzer combination.

13. If a 94.7 MHz signal, approximately –14 dBm, is present, but the signal at A15J101 is low, suspect U103.

14. When U104 pin 3 is at TTL low, U104 pin 6 should near –15 Vdc and PIN diodes CR101, CR102, and CR103 should be reverse-biased.

15. Set the spectrum analyzer under test to the following settings:

    Center frequency ................................................ 89.3 MHz
    Span ................................................................... 0 Hz

16. Check that U104 pin 3 is at a TTL high and U104 pin 6 is greater than +7 V. PIN diodes CR101, CR102, and CR103 should all be turned on with about 7 mA of forward current.

17. Disconnect the power splitter and reconnect W32 to A15J101.

# Sweep Generator Circuit

The sweep generator circuitry generates a ramp from 0 to 10 volts during the sweep time. The available sweep times range from 50 µs to 2,000 seconds. The sweep times are generated in two different ranges, a 50 µs to 30 ms range and a 50 ms to 2,000 second range. The 50 µs to 30 ms range is only needed for analog zero span sweeps.

The sweep generator is controlled with an 8-bit latch and the control signal HSCAN. The latch, U308, controls the sweep rate. HSCAN determines when to reset the scan ramp and when to let it sweep.

Operation of the 50 ms to 2,000 second range will be described using a 50 ms sweep time as the example. For a 50 ms sweep time, Q1 shorts out C16. The D to A converter, U307, has zero output current. U334A is a buffer with zero offset, because there is no current coming out of U307. The buffering of U334 makes the base-emitter voltages on Q3A and Q3B the same. These two transistors are matched, so their collector currents should be identical when their base-emitter voltages are identical. The emitter current of Q3B is 200 µA, therefore the emitter current of Q3A is 200 µA and the sweep ramp is generated by C14. The sweep time is given by the formula:

$$sweeptime = capacitance(C14) \times \frac{\Delta V}{current}$$

Where ΔV is equal to 10 Volts.

With a capacitance of 1 µF and a current of 200 µA, the sweep time should be 50 ms. The DAC setting is increased for longer sweep times. This increases the current sunk by the DAC output U307 pin 4, which increases the emitter voltage on Q3A, decreasing the base-emitter voltage drop. Q3A acts as an exponentiator and reduces its collector current, creating a slower sweep ramp.

For the shorter sweep times, 50 µs to 30 ms, Q1 is opened putting C16 in series with C14. This changes the effective capacitance from 1 µF to 1,000 pF, or a reduction of 1,000 to 1.

The HSCAN signal uses Q2 to reset the ramp. Q2 shorts the integrator and sets its output nominally to ground.

### Check the sweep generator circuit

Center frequency .................................................... 300 MHz
Span ...................................................................... 100 MHz
Sweep time ................................................................. 50 ms

Press **PRESET** and set the spectrum analyzer to the following settings:

18. Using an oscilloscope, check that the sweep ramp at A14U320 pin 6 sweeps linearly from 0 to +10 Volts in 50 ms, then resets to 0 Volts.

19. Change the sweep time to 10 seconds and check that the sweep ramp (U320 pin 6) sweeps linearly from 0 to +10 Volts in 10 seconds, then resets to 0 Volts.

20. Change the spectrum analyzer settings as follows:

    Span .......................................................................... 0 Hz
    Sweep time ............................................................ 10 ms

21. Check that the ramp (U320 pin 6) sweeps linearly from 0 to +10 Volts in 10 ms, then resets to 0 Volts.

22. If the any of the sweep times were not within specification or the sweep ramp appeared to be non-linear in the preceding steps, proceed with the following checks:

23. Connect the negative lead of a voltmeter to A14Q3 pin 8 and connect the positive lead to A14U312 pin 1 to check the temperature sensor (U312).

24. The voltage at pin 1 should be 10 mV/°C times the temperature of the A14 frequency control assembly. (For example, if the ambient temperature is approximately 20°C, and the A14 frequency control assembly is 10°C warmer, the actual temperature of the A14 assembly is 30°C and U312 pin 1 should measure 300 mV.)

25. To check the temperature-dependent offset voltage generator, connect the positive lead of the voltmeter A14Q3 pin 6. The voltmeter should read –600 mV ±150 mV.

26. To check the DAC buffer, A14U334A, connect the positive lead of the voltmeter to A14U334 pin 2. The voltmeter should read the same voltage measured at A14Q3 pin 6, within 2 mV. (The same voltage should be present at U334 pin 3.)

27. To check the buffered DAC, press **PRESET** and set the spectrum analyzer as follows:

    Center frequency ................................................ 300 MHz
    Span ................................................................... 100 MHz
    Sweep time ............................................................ 50 ms

28. Connect the positive lead of the voltmeter to A14U334 pin 1. The voltmeter should read the same voltage measured at U334 pin 2, within 2 mV.

29. Change the spectrum analyzer sweep time to 2000 seconds. The voltage at A14U334 pin 1 should increase by 275 mV ±20 mV (compared to the voltage measured in step 12).

**Figure 11-11 Simplified Synthesizer Section**

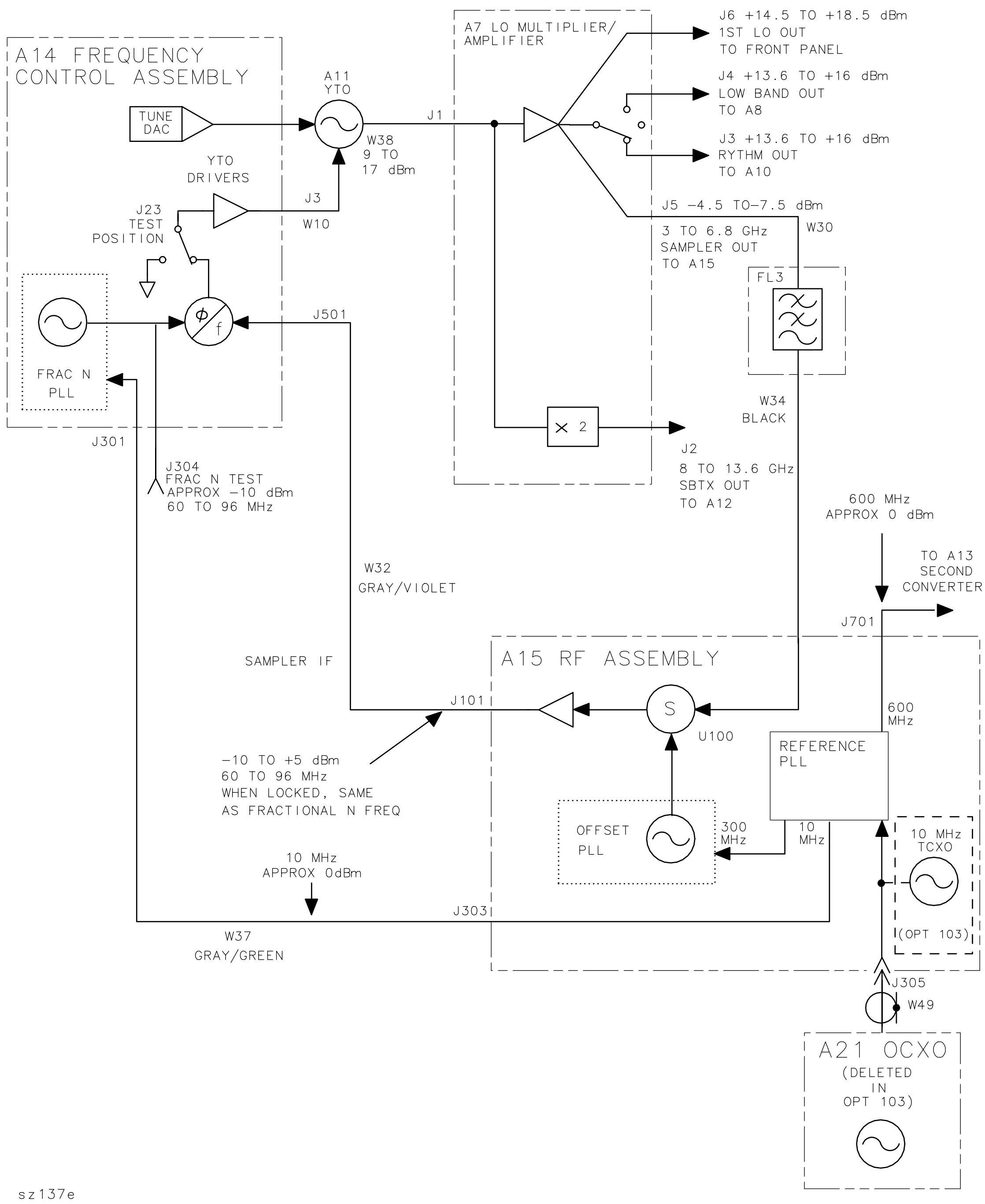
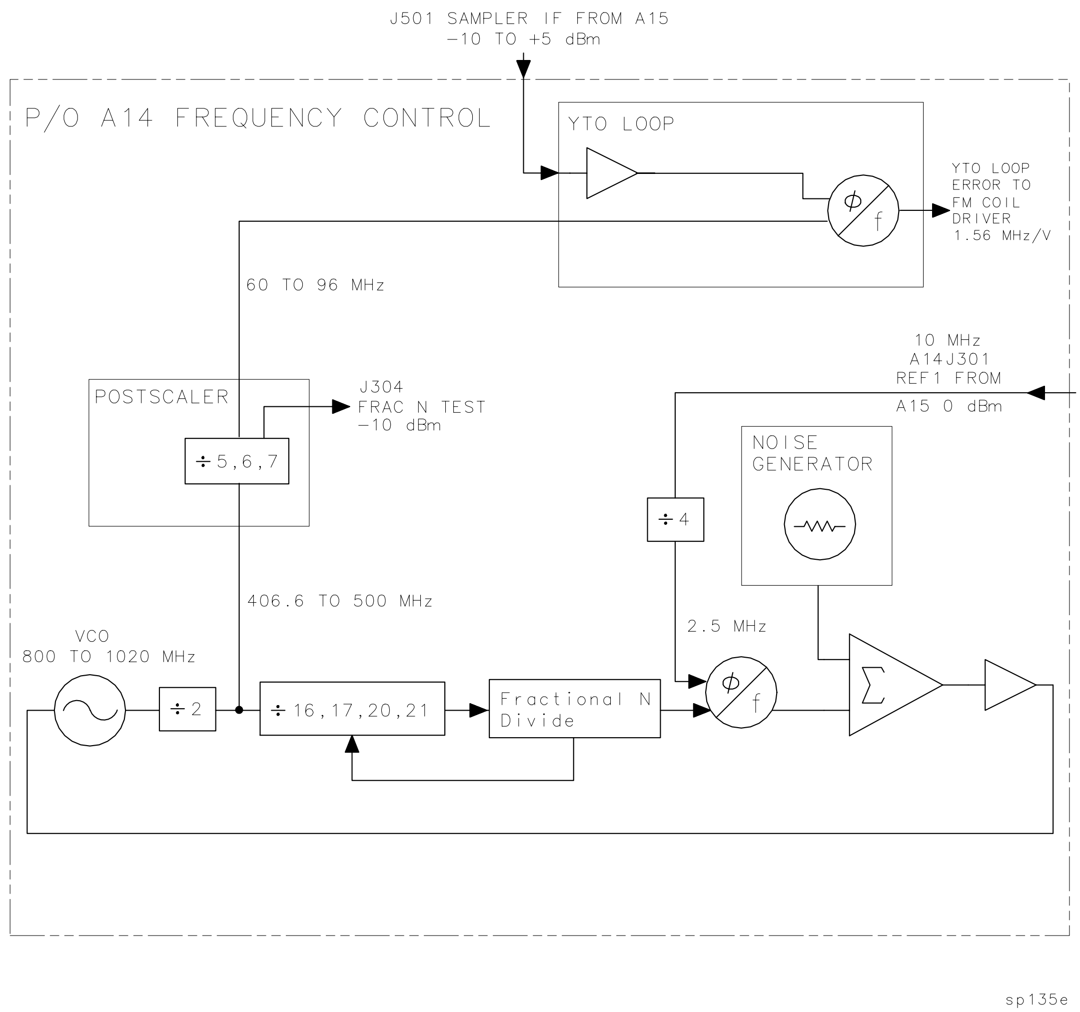
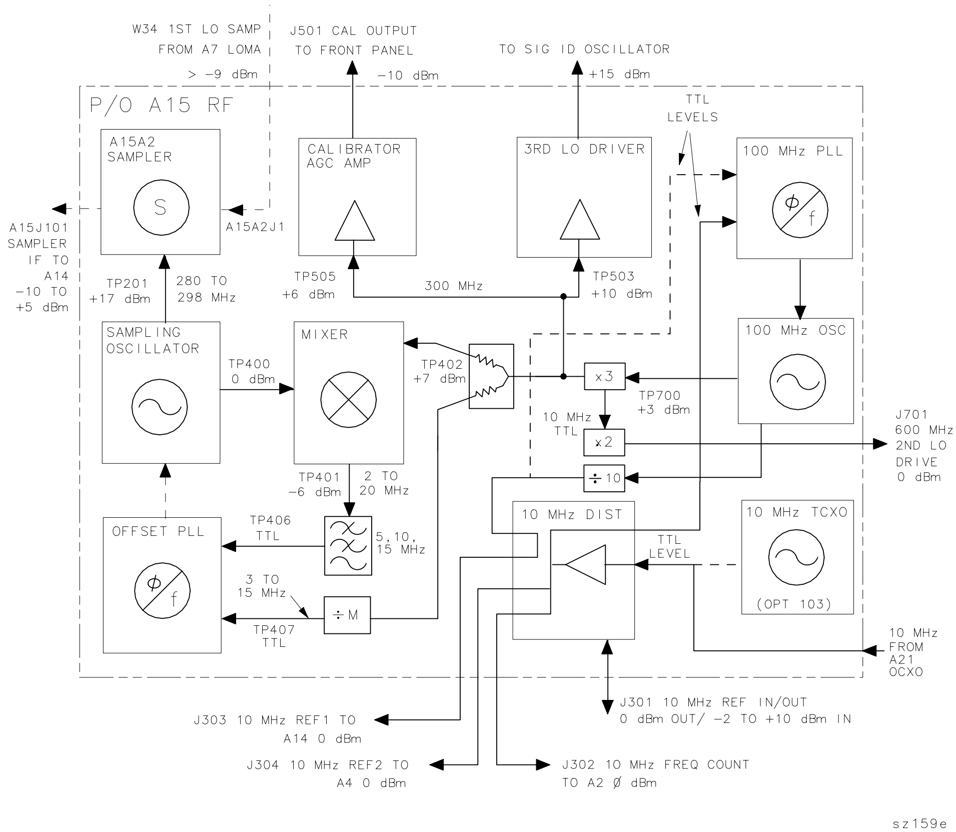


**Figure 11-12 Simplified A14 Assembly Block Diagram**



## Figure 11-13 Simplified A15 Assembly Block Diagram (100 MHz PLL)



# A21 OCXO

The spectrum analyzer uses an oven-controlled crystal oscillator (OCXO). It is deleted in Option 103 and replaced by a temperature-compensated crystal oscillator (TCXO), located on the A15 RF assembly. Connectors J305 and J306 on the A15 RF assembly are located where the TCXO would be installed in an Option 103.

The oven in the OCXO is powered only when the spectrum analyzer is powered on; there is no standby mode of operation. The OCXO oscillator operates only when the internal frequency reference is selected. Control line HEXT (High = EXTernal frequency reference) is inverted by A15U303B (Refer to the A15 RF assembly schematic diagram, block M, sheet 2 of 4) to generate LEXT. LEXT is sent to the OCXO via A15J306 pin 4. When LEXT is low, the oscillator in the OCXO will be turned off.

Replacement OCXOs are factory adjusted after a complete warmup and after the specified aging rate has been achieved. Thus, readjustment should typically not be necessary after OCXO replacement, and is generally not recommended.

If adjustment is necessary, the spectrum analyzer must be on continuously for a minimum of 24 hours immediately prior to oscillator adjustment to allow both the temperature and frequency of the oscillator to stabilize. Failure to allow sufficient stabilization time could result in oscillator misadjustment.

Check operation of the A21 OCXO as follows:

1. Disconnect W49 (Coax 82) from A15J305. Connect the output of W49 to the input of another spectrum analyzer.
2. Check that the fundamental frequency is 10 MHz and that the power level is 0 dBm ±3 dB. Also check that the harmonics are at least –25 dBc. Excessive harmonics can generate spurious responses on the fractional N oscillator on the A14 frequency control assembly.
3. If the OCXO has no output, check A15J306 pin 1 for +15 Vdc. Check A15J306 pin 4 for a TTL-high level.
4. If A15J306 pin 4 is at a TTL-low level, press **AUX CTRL** and **REAR PANEL**. Press **10 MHz EXT INT** until INT is underlined. A15J306 pin 4 should read a TTL-high level. Press **10 MHz EXT INT** until EXT is underlined. A15J306 pin 4 should read a TTL-low level.

sm127c

FIGURE 11-14 FREQUENCY CONTROL BLOCK DIAGRAM


sm128c

FIGURE 11-15. RF ASSEMBLY BLOCK DIAGRAM
(FOR A15 08563-60054, 08563-60055, OR 08563-60056).


sm129c

FIGURE 11-16. RF ASSEMBLY BLOCK DIAGRAM

FOR A15 EARLIER THAN 08563-60054, 08563-60055, or 08563-60056.

# 12 RF Section

## Introduction

The RF Section converts the input signal to a 10.7 MHz IF (Intermediate Frequency). See Figure 12-11 on page 631 for a detailed block diagram.

**NOTE** The block diagrams for the A14 and A15 assemblies are located in Chapter 11, Synthesizer Section.



**CAUTION** All of the RF assemblies are extremely sensitive to Electrostatic Discharge (ESD). For further information regarding electrostatic cautions, refer to “Electrostatic Discharge” in Chapter 1 .

# Troubleshooting Using the Diagnostic Software

The adjustment and diagnostic software is documented in Chapter 2 . The software troubleshoots RF failures by testing signal paths and allowing you to control various latches and DACs. The first thing it does is to check that all of the frequency bands are functional. Depending on the results of that testing it may do some other checks.

Using the 8564E and 8565E adjustment/diagnostic software, select the RF diagnostics.

Connect the test board between the A7 LOMA and A10/A12 RYTHM/SBTX microcircuits, and the A14 Frequency Control board. The test board is labeled µCKT and INSTR SIDE.

1. Disconnect W16 from A14J9 and W12 from A14J10.
2. Connect W16 to J4 on the test board and W12 to J5 on the test board.
3. Connect J2 on the test board to A14J10 (use 24-conductor ribbon cable, part number 08564-60012).
4. Connect J1 on the test board to A14J9 (use 20-conductor ribbon cable, part number 8120-5526).

You will then be prompted to make different connections to the 85629B Test and Adjustment Module (TAM), a source or spectrum analyzer. Connection locations are shown in Figure 12-1 on page 596 and Figure 12-2 on page 597.

The software can be used to control the DACs and latches for troubleshooting. Refer to Chapter 2 , “Adjustment/Diagnostic Software,” for listings of DACs and latches.

**Figure 12-1 Diagnostic Software Connection Locations, A14 and A15**

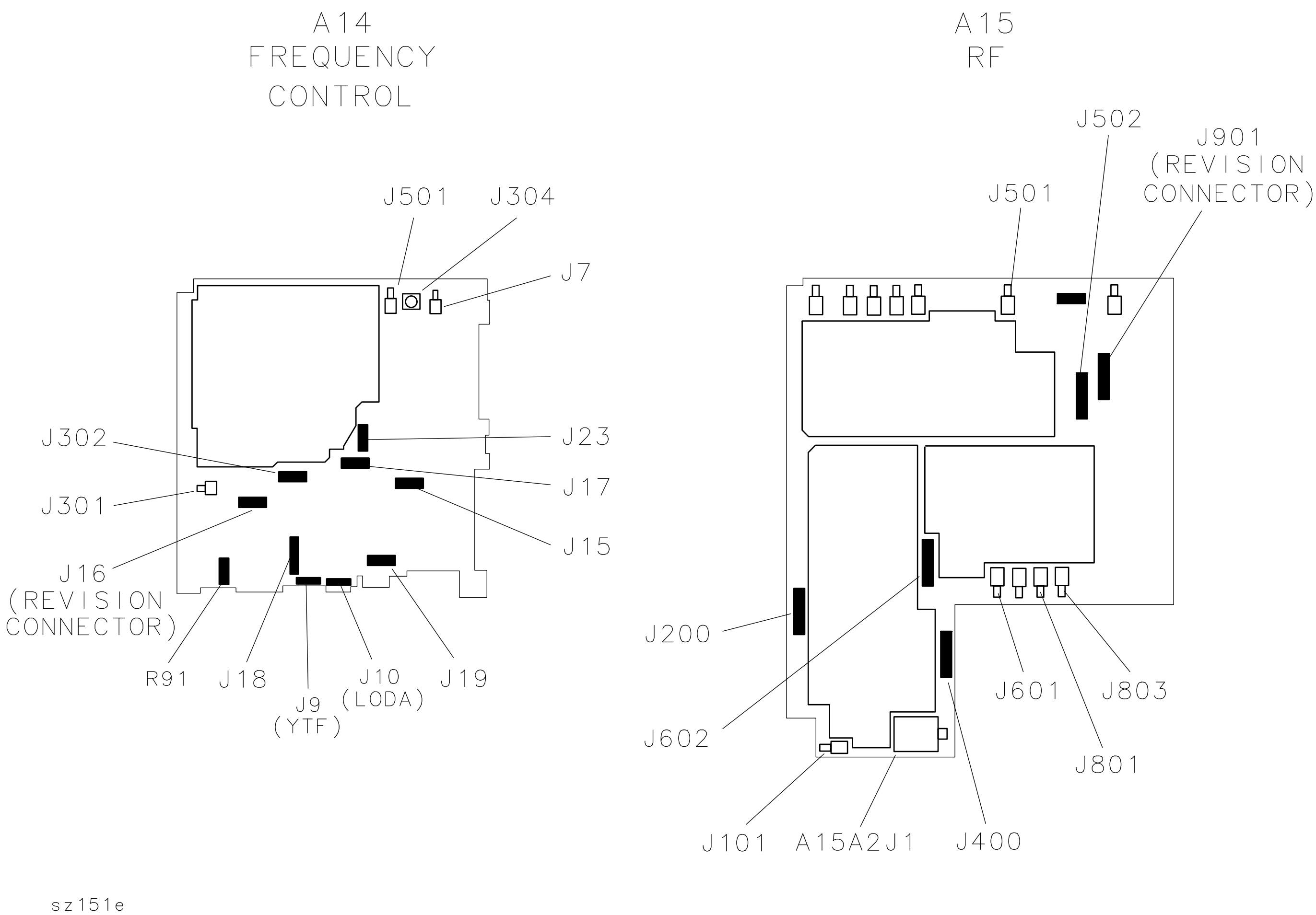


**Figure 12-2 Diagnostic Software Connection Locations, RF Section**

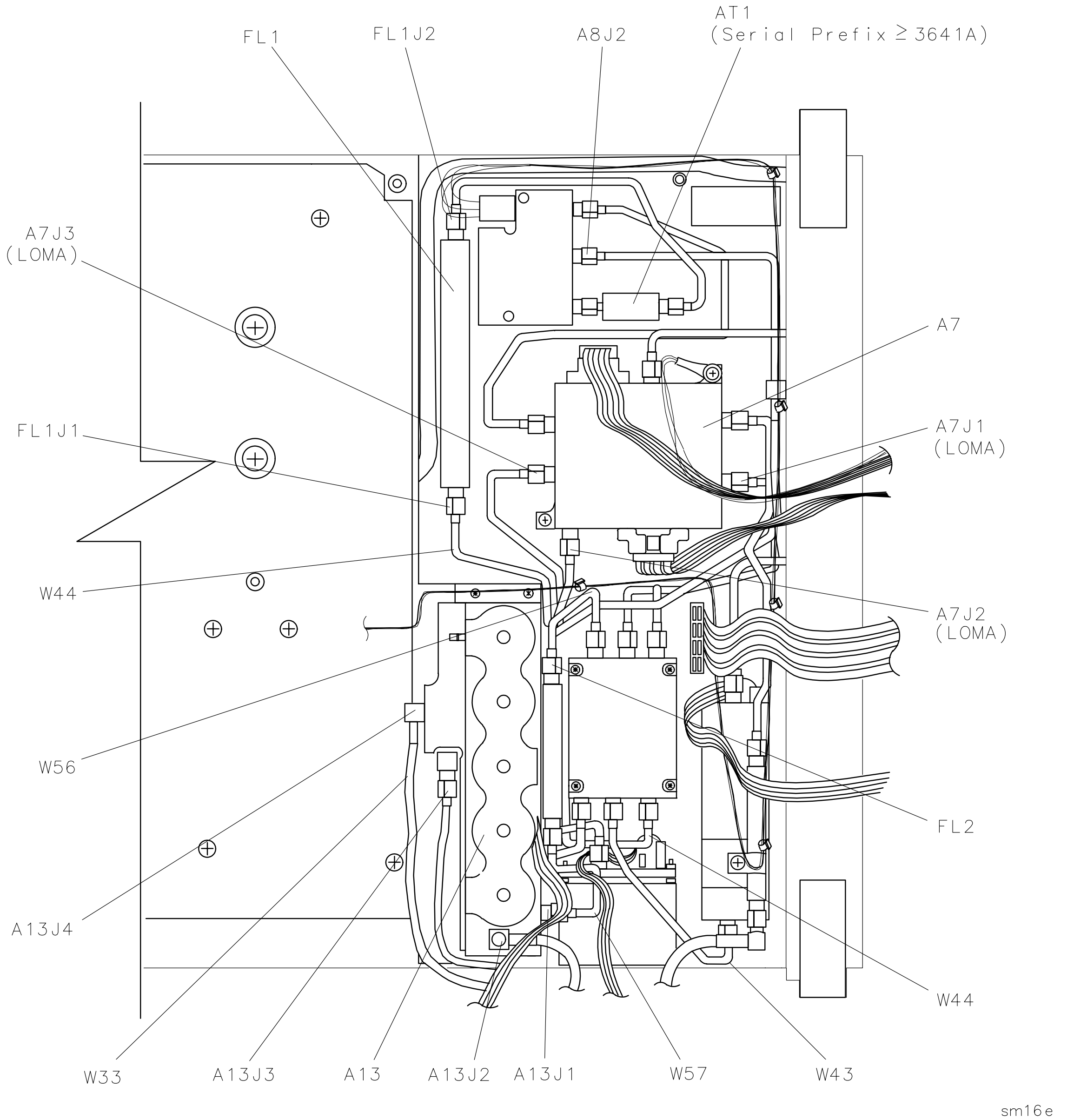


**Table 12-1 Procedures To Use For Isolating Faults**

| Suspected Faulty Circuit | Manual Procedure to Perform |
|---|---|
| 2nd IF Amplifier | Third Converter |
| 2nd IF Distribution | Third Converter |
| 10.7 MHz IF Out of Double Balanced Mixer | Third Converter |
| 300 MHz CAL OUTPUT | 8. Calibrator Amplitude Adjustment in Chapter 3 |
| A7 LO Multiplier and Distribution Amplifier | A7 LO Multiplier and Distribution Amplifier |
| A8 Low Band Mixer | A8 Low Band Mixer |
| A9 Input Attenuator | A9 Input Attenuator |
| A13 Second Converter | A13 Second Converter |
| A13J2 INT 2nd IF | A13 Second Converter *(steps 1 to 6)* |
| A14 Latch | Control Latch for Band-Switch Drivers |
| A15 Control Latches | Control Latch for Band-Switch Drivers |
| A15J601 10.7 MHz | Third Converter |
| External 10 MHz Reference Operation | 10 MHz Reference (steps 5 to 11) |
| Gain of Flatness Compensation Amplifier | Third Converter |
| INT 10 MHz Reference Operation | 10 MHz Reference *(steps 1 to 4)* |
| LO Feedthrough | Low Band Problems (steps 1 to 3) |
| LO Power | Low and High Band Problems (steps 4 to 9) |
| PIN Switches in SIG ID Oscillator (Opt 008) | SIG ID Oscillator (Option 008) |
| Second Converter Control | A13 Second Converter |
| SIG ID Oscillator (Opt 008) | Signal ID Oscillator Adjustment in Chapter 3 |
| SIG ID Oscillator Operation (Opt 008) | SIG ID Oscillator (Option 008)) |
| Third Converter | Low and High Band Problems *(step 10)* |

**CAUTION** Use of an active probe, such as an 85024A, with another spectrum analyzer is recommended for troubleshooting the RF circuitry. If an 1120A Active Probe is being used with a spectrum analyzer, such as the 8566A/B, 8569A/B and the 8562A/B, having dc coupled inputs, either set the active probe for an ac coupled output or use a dc blocking capacitor (11240B) between the active probe and the spectrum analyzer input. Failure to do this can result in damage to the spectrum analyzer or to the probe.

## Low Band Problems

1. Disconnect all inputs from the front panel INPUT 50Ω connector.
2. Set the spectrum analyzer to the following settings:

   Center frequency .......................................................... 0 Hz
   Span ......................................................................... 1 MHz
   Input attenuator ........................................................... 0 dB

3. The LO feedthrough amplitude observed on the display should be between –6 (above top of screen) and –30 dBm.

**NOTE** The marker will not PEAK SEARCH on the LO Feedthrough when in a non-zero span. To measure the LO Feedthrough amplitude with the markers, set the SPAN to 0 Hz and **CENTER FREQ** to 0 Hz. Press **MKR** ON.

4. If the LO feedthrough amplitude is within limits, but signals are low, the RF path following the A8 mixer is probably operating properly.
5. If the LO feedthrough amplitude is higher than –5 dBm (signal will be "clipped" at top of screen) and signals are low in amplitude, suspect a defective A8 mixer assembly.
6. If signal amplitudes <2.9 GHz are bad, but signals >26.8 GHz are good, check the A8 Low Band Mixer or the filter FL1. If both the LO feedthrough and signal amplitudes are low, check the A12 SBTX.
7. Perform the steps located in “Control Latch for Band-Switch Drivers” on page 615.
8. Check A13 second converter mixer diode bias at A14J19 pin 1. The bias voltage should be between –150 and –800 mVdc.
9. Troubleshoot the signal path. Refer to the power levels listed on Figure 12-11 on page 631, RF Section Troubleshooting Block Diagram.

## High Band Problems

1. If the low band is functioning, but amplitudes of signals >26.8 GHz are wrong, check the A12 SBTX.
2. If the low band and millimeter band signals are correct, but microwave band signals are wrong, check the A10 RYTHM.
3. Perform the steps located in "Control Latch for Band-Switch Drivers" on page 615.
4. Troubleshoot the signal path. Refer to the power levels listed in Figure 12-11 on page 631, RF Section Troubleshooting Block Diagram.

# Low and High Band Problems

1. On the spectrum analyzer, press **PRESET** and **REALIGN LO & IF**. If any error messages are displayed, refer to “Error Messages” in Chapter 7 .

2. Perform "External Mixer Amplitude Adjustment" in Chapter 3. If this adjustment cannot be completed, perform the steps located in "Third Converter" in this chapter.

3. Perform the "1st LO OUTPUT Amplitude" performance test in the calibration guide.

4. If the performance test fails, perform the "LOMA Adjustments" using the adjustment/diagnostic software. If the adjustment fails, set the spectrum analyzer to the following settings:

   Center frequency ................................................ 300 MHz
   Span .................................................................... 0 Hz

5. Place the jumper on A14J23 in the TEST position. Remove W38 from the input of A7.

6. Use a power meter or another spectrum analyzer to measure the output of A11 YTO. The power should be between +2 dBm and +13 dBm.

7. Reconnect W38 to A7. Place the jumper on A14J23 in the NORM position.

8. If ERR 334 (unlevelled output) is present and the A11 YTO power output is correct, the A7 drive circuit may be defective. Refer to “A7 LO Multiplier and Distribution Amplifier” on page 602.

9. Troubleshoot the signal path. Refer to the power levels listed on Figure 12-11 on page 631, RF Section Troubleshooting Block Diagram.

10. Check Third Converter as follows:

    a. On the spectrum analyzer, press **PRESET** and set the controls as follows:

       Center frequency ............................................ 300 MHz
       Span ................................................................ 0 Hz

    b. Inject a –28 dBm, 310.7 MHz signal into A15J801.

    c. If a flat line is displayed within 2 dB of the reference level, but the External Mixer Amplitude Adjustment fails, troubleshoot the A15 RF Assembly.

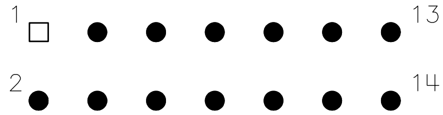
# A7 LO Multiplier and Distribution Amplifier

**NOTE** YTO unlock errors may occur if the power delivered to the A15U100 sampler is less than –9.5 dBm. Frequency response will be degraded in both internal and external mixing modes if the output power is low or unlevelled.

**CAUTION** Connecting or disconnecting the A7 bias with the spectrum analyzer power turned on will destroy the A7 assembly. Always press **LINE** to turn the spectrum analyzer off before removing or reinstalling W12 to either the A7 or A14J10.

**NOTE** ERR 334 may be displayed if the LO OUTPUT connector on the front panel is not properly terminated into a 50Ω termination.

**Figure 12-3** **A14J10, Solder Side of A14 (Ignore Pin Numbers on Mating Connector)**




1. Press **LINE** to turn the spectrum analyzer off. Disconnect W12 from A14J10.
2. Connect a jumper between A14J10 pin 5 and A14J19 pin 6. Connect a jumper between A14J18 pin 13 and A14J18 pin 1. See Figure 12-3 on page 602.
3. Connect the positive lead of a DVM to A14J18 pin 14 and the negative lead to A14J18 pin 6.
4. Press **LINE** to turn the spectrum analyzer on.
5. The voltage measured on the DVM should be more negative than –9.4 Vdc.
6. Move the jumper from A14J18 pin 1 to A14J18 pin 2. The voltage measured on the DVM should be more positive than +12.3 Vdc.
7. If the voltages do not meet the limits listed in steps 5 and 6, troubleshoot the A14 frequency control assembly.
8. Connect the positive DVM lead to A14J10 pin 1.

9. The measured voltage should be approximately +5 Vdc. If the voltage is not +5 Vdc, troubleshoot the A14 frequency control assembly.

10. Connect the positive lead of a DVM to A14J18 pin 15. The voltage should measure within ±10 mV of the Gate Bias voltage listed on the A7 label.

11. If this voltage is not within the correct range, refer to the "LO Distribution Amplifier Adjustment" in Chapter 2, adjustment procedures.

12. If the voltage varies between 0 Vdc and –2 Vdc, adjust the Gate Bias for a DVM reading within ±10 mV of the Gate Bias voltage listed on the A7 label. If the voltage does not vary between 0 Vdc and –2 Vdc, troubleshoot the A14 Frequency Control Assembly.

13. Disconnect the jumper from A14J19 to A14J10. Press **LINE** to turn the spectrum analyzer off. Reconnect W12 to A14J10. Press **LINE** to turn the spectrum analyzer on.

14. If the DVM reading changes significantly, the A7 is probably defective.

# A8 Low Band Mixer

1. Connect the spectrum analyzer CAL OUTPUT to the INPUT 50 Ω connector.
2. Set the spectrum analyzer as follows:

   Center frequency ........................................ 300 MHz
   Span ........................................................ 0 Hz
   Input attenuation ........................................ 10 dB

3. If the spectrum analyzer serial number prefix is 3641A or greater, make sure A8 is receiving the –5 V and –4 V supply voltages from frequency control board assembly A14 via cable assembly W12.
4. Using another spectrum analyzer, check for approximately –21 dBm (300 MHz) at the input of A8. (This level can easily be measured at the output of FL1 by disconnecting W45 from FL1.)
5. If the level at the input of A8 is less than –25 dBm, suspect FL1 low-pass filter, A10 RYTHM, A12 SBTX, or A9 input attenuator. Refer to power levels shown on Figure 12-11 on page 631, RF Section Troubleshooting Block Diagram.
6. Check for approximately –30 dBm (3.9107 GHz) at the output of A8. (This level can easily be measured at the output of FL2 by disconnecting W57 from FL2.)
7. If the level at the output of A8 is less than –35 dBm, suspect A8 low band mixer or FL2 low-pass filter.

# A9 Input Attenuator

1. Perform the "Input Attenuator Accuracy" performance test in the *8560 E-Series Spectrum Analyzer Calibration Guide*.
2. If there is a step-to-step error of approximately 10 dB or more, continue with step 3.
3. On the spectrum analyzer, press **AMPLITUDE**, and **ATTEN AUTO MAN** until MAN is highlighted.
4. Step the input attenuator from 0 dB to 60 dB. A "click" should be heard at each step. The absence of a click indicates faulty attenuator drive circuitry. It will be necessary to use the DATA keys to enter an input attenuator setting of 0 dB (the step key will not allow selecting 0 dB input attenuation).
5. Monitor the pins of A14U421 with a DVM while setting the input attenuator to the values listed in Table 12-2 on page 606.
6. If one or more logic levels listed in Table 12-2 on page 606 is incorrect, disconnect W11 from A14J6 and repeat step 5 using Table 12-4 on page 607.

**NOTE** When W11 is disconnected, the +28 V levels listed in Table 12-2 on page 606 are floating and will read approximately 0.2 V. Refer to Table 12-4 on page 607.

7. If one or more logic levels listed in Table 12-4 on page 607 is incorrect with W11 disconnected, troubleshoot the A14 frequency control assembly.
8. If all logic levels are correct, the A9 input attenuator is probably defective.

**Table 12-2 Attenuator Control Truth Table (W11 connected to A14J6)**

| A14U421 | | | | | | |
|---|---|---|---|---|---|---|
| ATTEN Setting (dB) | 10 dB | | 30 dB | | 20 dB | |
| | Pin 16 | Pin 15 | Pin 14 | Pin 13 | Pin 12 | Pin 11 |
| 0 | L | H* | L | H* | L | H* |
| 10 | H* | L | L | H* | L | H* |
| 20 | L | H* | L | H* | H* | L |
| 30 | H* | L | L | H* | H* | L |
| 40 | H* | L | H* | L | L | H* |
| 50 | L | H* | H* | L | H* | L |
| 60 | H* | L | H* | L | H* | L |
| | ON | OFF | ON | OFF | ON | OFF |
| * reads ≈ 0.2 V (floating) when W11 is disconnected<br>H ≈ 28 V L ≈ 0.6 V | | | | | | |

**Table 12-3 Attenuator Control Truth Table (W11 connected or disconnected from A14J6)**

| A14U420 | | | | | | |
|---|---|---|---|---|---|---|
| ATTEN Setting (dB) | 10 dB | | 30 dB | | 20 dB | |
| | Pin 1 | Pin 2 | Pin 3 | Pin 4 | Pin 5 | Pin 6 |
| 0 | H | L | H | L | H | L |
| 10 | L | H | H | L | H | L |
| 20 | H | L | H | L | L | H |
| 30 | L | H | H | L | L | H |
| 40 | L | H | L | H | H | L |
| 50 | H | L | L | H | L | H |
| 60 | L | H | L | H | L | H |
| | OFF | ON | OFF | ON | OFF | ON |
| H TTL High L TTL Low | | | | | | |

**Table 12-4 Attenuator Control Truth Table (W11 connected or disconnected from A14J6)**

| A14U421 | | | | | | |
|---|---|---|---|---|---|---|
| **ATTEN Setting (dB)** | **10 dB** | | **30 dB** | | **20 dB** | |
| | **Pin 16** | **Pin 15** | **Pin 14** | **Pin 13** | **Pin 12** | **Pin 11** |
| 0 | L | F | L | F | L | F |
| 10 | F | L | L | F | L | F |
| 20 | L | F | L | F | F | L |
| 30 | F | L | L | F | F | L |
| 40 | F | L | F | L | L | F |
| 50 | L | F | F | L | F | L |
| 60 | F | L | F | L | F | L |
| F Floating (≈0.2 V) L ≈ 0.6 V | | | | | | |

# A10 YIG-Tuned Filter/Mixer (RYTHM)

The RF diagnostics routine in the adjustment/diagnostic software is recommended for troubleshooting faults in and around A10. The RF diagnostics will prompt you where to connect a source and another spectrum analyzer to make RF signal level measurements.

A test board, part number 08564-69201, is connected between the A7 LOMA and A10/A12 RYTHM/SBTX ribbon cables, and the A14 frequency control assembly. DC measurements are made using the TAM manual probe cable on several test connectors on the test board. An 3478A DVM is used to measure the voltage across A14R91 (the large power resistor next to A14Q404) to determine the tuning current in the A10 preselector.

Be sure to follow all prompts precisely; failure to do so will result in incorrect fault determinations.

## A12 Switched Barium-Tuned Mixer (SBTX)

The RF diagnostics routine in the adjustment/diagnostic software is recommended for troubleshooting faults in and around A12. The RF diagnostics will prompt you where to connect a source and another spectrum analyzer to make RF signal level measurements.

A test board, part number 08564-69201, is connected between the A7 LOMA and A10/A12 RYTHM/SBTX ribbon cables, and the A14 frequency control assembly. DC measurements are made using the TAM manual probe cable on several test connectors on the test board. An 3478A DVM is used to measure the voltage across A14R91 (the large power resistor next to A14Q404) to determine the tuning current in the A12 preselector.

Be sure to follow all prompts precisely; failure to do so will result in incorrect fault determinations.

# A13 Second Converter

**CAUTION** The A13 assembly is extremely sensitive to Electrostatic Discharge (ESD). For further information regarding electrostatic cautions, refer to "Electrostatic Discharge" in Chapter 1 .

1. Connect the spectrum analyzer CAL OUTPUT to the INPUT 50Ω connector.
2. Set the spectrum analyzer to the following settings:

   Center frequency .................................................. 300 MHz
   Span ..................................................................... 0 Hz
   Input attenuation ...................................................... 10 dB

3. Disconnect W35 (coax 92) from A13J2.
4. Connect a test cable from A13J2 to the input of a second spectrum analyzer.
5. Tune the second spectrum analyzer to 310.7 MHz. The signal displayed on the second spectrum analyzer should be approximately –38 dBm.
6. Remove the test cable from A13J2 and reconnect W35 to A13J2.
7. Disconnect W33 (coax 81) from A13J4 and connect W33 through a test cable to the input of a second spectrum analyzer.
8. Tune the second spectrum analyzer to a center frequency of 600 MHz.
9. If a 600 MHz signal is not present, or its amplitude is less than –5 dBm, the fault is probably on the A15 RF assembly.
10. Reconnect W33 to A13J4.
11. Connect the positive lead of a DVM to A14J19 pin 15 and the negative lead to A14J19 pin 6.

    If the DVM does not measure between +14.0 Vdc and +15.0 Vdc perform the following:

    a. Press **LINE** to turn the spectrum analyzer being tested, off and disconnect W13 from A14J12.
    b. Press **LINE** to turn the spectrum analyzer on again and set the it to the following settings:

       Center frequency ............................................... 300 MHz
       Span .................................................................... 10 MHz

c. The voltage should measure +15 Vdc ±0.2 V. If the voltage measures outside this limit, the A14 frequency control assembly is probably defective.

d. Press **LINE** to turn the spectrum analyzer off. Reconnect W13 to A14J12, and press **LINE** to turn the spectrum analyzer on. Set it to the following settings:

Center frequency ............................................ 300 MHz
Span ........................................................................ 0 Hz

12. Move the positive lead of the DVM to A14J19 pin 1. The voltage should measure between –150 mVdc and –800 mVdc. If the voltage measures outside this limit, the A13 Second Converter is probably defective.

# A14 Frequency Control Assembly

**NOTE** The block diagrams for the A14 and A15 assemblies are located in Chapter 11 , “Synthesizer Section.”

## LO Multiplier/Amplifier Drive

Refer to function block Z on the A14 Frequency Control Schematic Diagram in the *8560 E-Series Spectrum Analyzer Component Level Information*.

1. Set the spectrum analyzer to the following settings:

   Center frequency .................................................... 300 MHz
   Span ................................................................. 2 MHz

2. On the spectrum analyzer, press **SGL SWP** and measure the signal power at the output of A7J4. See Figure 12-4 on page 614.

3. If the output power is low, the output voltage of A14U602B at A14J18 pin 14 (item (1) of Figure 12-4 on page 614) should be greater than 0 V. If the output power is high, the voltage should be more negative than –10 V. If the voltages do not measure as indicated, check that the voltages at A14J18 pins 5 and 13 are consistent with the output of the operational amplifier.

**NOTE** The voltages on A14J18 pins 5, 13, and 14 are referred to as LOMA PIN DRV T, RYTHM/LB SENSE, and LOMA INPUT PIN ATTEN respectively.

4. Set the spectrum analyzer to the following settings:

   Center frequency ...................................................... 35 GHz
   Span ................................................................. 2 MHz

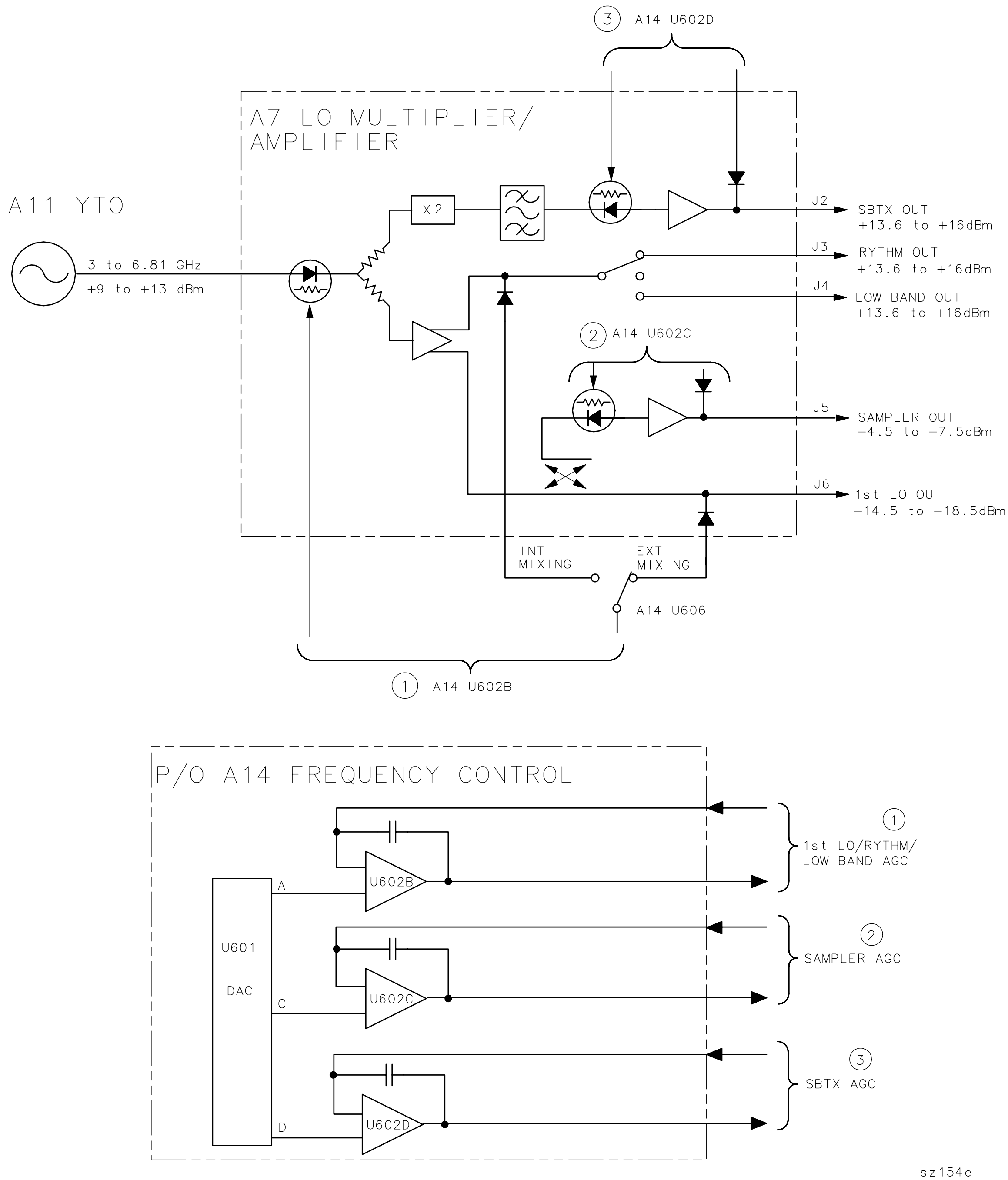
5. On the spectrum analyzer, press **SGL SWP** and measure the signal power at the output of A7J2. (See item (1) of Figure 12-4 on page 614.)

6. If the output power is low, the output voltage of A14U602D at A14J10-21 (item (3) of Figure 12-4 on page 614) should be greater than 0 V. If the output power is high, the voltage should be more negative than –10 V. If the voltages do not measure as indicated, check that the voltages at A14J15 pin 5 and A14U602 pin 13 are consistent with the output of the operational amplifier.

**NOTE** The voltages on A14J10 pin 21 and A14J15 pin 5 are referred to as SBTX PIN ATTEN and SBTX SENSE, respectively.

- If the voltages measure as indicated in step 3 and step 6, measure the A11 YTO output. See Figure 12-4 on page 614.
- If all measurements are within limits, refer to "A7 LO Multiplier and Distribution Amplifier" in this chapter.

**Figure 12-4 A7 LO Multiplier/Amplifier Drive**



## Control Latch for Band-Switch Drivers

Refer to function block P on A14 Frequency Control Schematic Diagram in the *8560 E-Series Spectrum Analyzer Component Level Information*.

1. Connect the positive lead of a DVM to A14U417 pin 14 (LLOWBAND) and the negative lead to A14J18 pin 6.
2. Set the spectrum analyzer to the following settings:

   Center frequency ................................................ 300 MHz
   Span .................................................................... 0 Hz

3. The voltage should measure approximately 0 Vdc (TTL low).
4. Set the spectrum analyzer center frequency to 3 GHz.
5. The voltage should measure approximately +5 Vdc (TTL high).
6. Move the positive lead of the DVM to A14U406 pin 12 (LSBTX).
7. The voltage should measure approximately +5 Vdc (TTL high).
8. Set the spectrum analyzer center frequency to 35 GHz.
9. The voltage should measure approximately 0 Vdc (TTL low).

## YTF Driver Circuit

The YTF driver circuitry consists of the Sweep + Tune Multiplier, FAV (Frequency Analog Voltage) Generator, YTF Gain and Offset, and YTF Drive. Refer to function blocks Q, R, S, and T on A14 frequency control schematic diagram. The FAV generator generates the 0.5 V/GHz signal. The YTF driver circuitry can be half-split by checking the rear panel FAV OUTPUT.

**NOTE** The rear panel output changes according to the external-mixer mode selected. The preselected external-mixer mode must not be selected while executing this procedure. Make sure that the rear panel output is set for .50 V/GHz and not .25 V/GHz.

The Sweep + Tune Multiplier takes tune information (YTO start frequency) and sweep (based on LO span) and multiplies it so that it is correct for the appropriate YTF band.

C31 of the FAV Generator holds the YTF steady during retraces between multiband sweeps. Switch U606C and R94 provide the YTF dehysteresis pulse. A dehysteresis pulse is activated at the end of spans greater than 1 MHz. In microwave bands, amplifier U402A provides an offset voltage to account for the 310.7 MHz offset (U415A open) between the desired harmonic of the YTO frequency and the center frequency. In low band, switch U415A is closed to account for the negative 3.9107 GHz 1st IF offset between the YTO frequency and the center frequency. In millimeter bands, U415D is closed to account for the positive 3.9107 GHz 1st IF offset between the desired harmonic of the YTO frequency and the center frequency. This signal is 0.5 V/GHz of tuned frequency and is available at the rear panel. The output can be set for 0.50 V/GHz or 0.25 V/GHz.

1. On the spectrum analyzer, press **PRESET**, and set the controls to the following settings:

   Start frequency ........................................................... 0 Hz
   Stop frequency ..................................................... 26.5 GHz

2. On the spectrum analyzer, press **AUX CTRL**, **REAR PANEL**, and **V/GHz .25 .50** so that .50 is underlined.

3. Monitor the rear panel LO SWP | FAV OUTPUT with an oscilloscope. The waveform should resemble Figure 12-5 on page 617.

4. Set the spectrum analyzer controls as follows:

   Start frequency ......................................................... 8 GHz
   Stop frequency ........................................................ 10 GHz

5. Monitor A14J15 pin 1 with an oscilloscope. The waveform should resemble Figure 12-7 on page 618.

6. If the ramp is not correct, confirm the operation of the Main Coil Tune DAC and Sweep Generator. Refer to "Unlocked YTO PLL" in Chapter 11 .

7. Set the spectrum analyzer to the following settings:

   Center frequency ........................................................ 5 GHz
   Span .................................................................... 0 Hz

8. Monitor A14J15 pin 3 with a DVM. For a center frequency of 5 GHz, the voltage should measure –1.33 Vdc ±0.2 Vdc. Use the following formula to calculate the voltage:

   EQUATION {\rm V\sb {(J15\ pin\ 3)]] = {\rm {-0.25\ V \over GHz}\ (freq\ in\ GHz)+offset} EQUATION

   Offset voltage: –0.98 V in bands 0 and 5

   –0.078 V in bands 1, 2, and 3

   +0.98 V in band 4

**Figure 12-5 8564EC Rear Panel SWP Output**

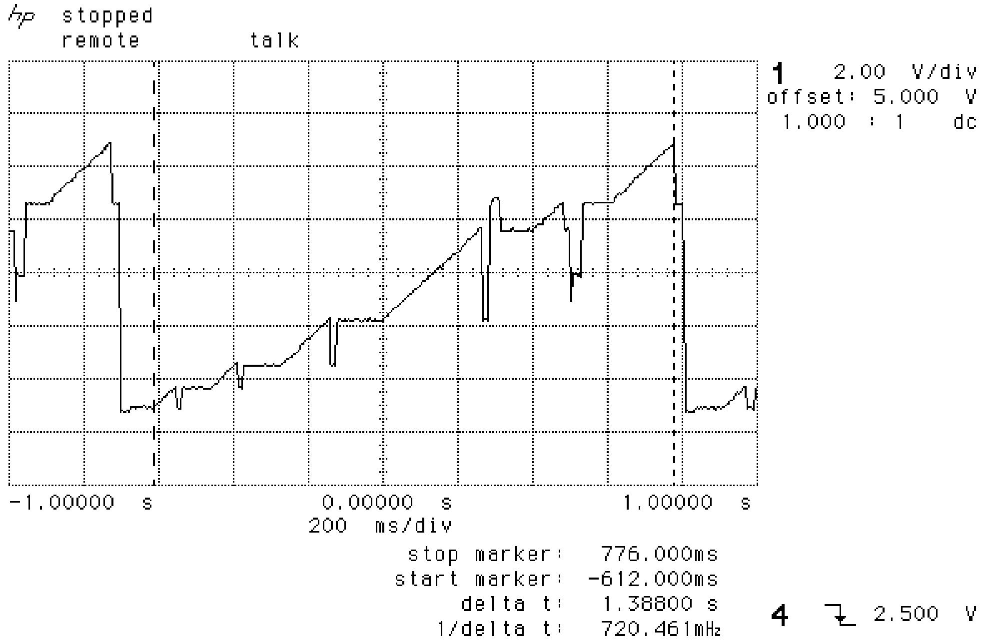



**Figure 12-6 8565EC Rear Panel SWP Output**

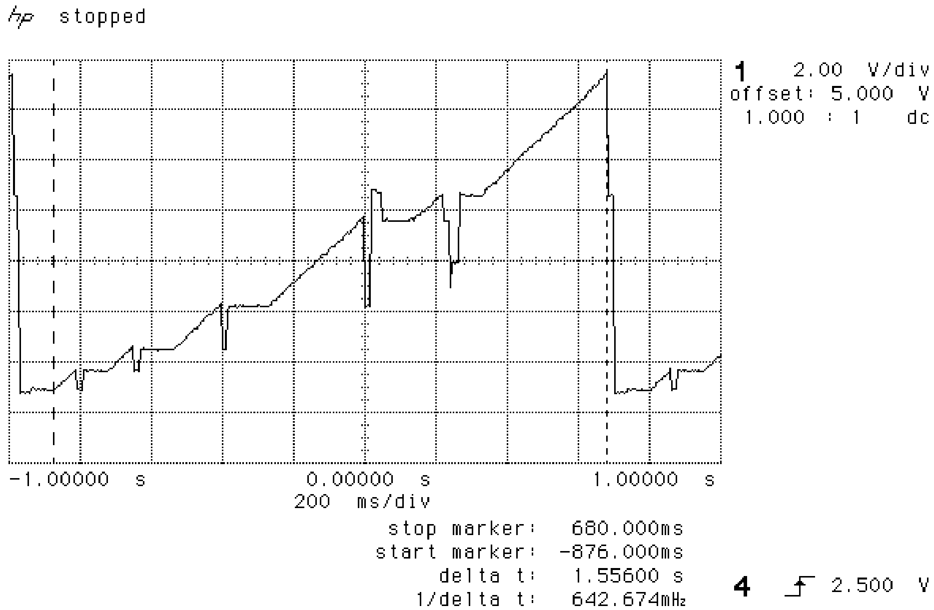


**Figure 12-7 8564EC Signal at A14J15 Pin 1**

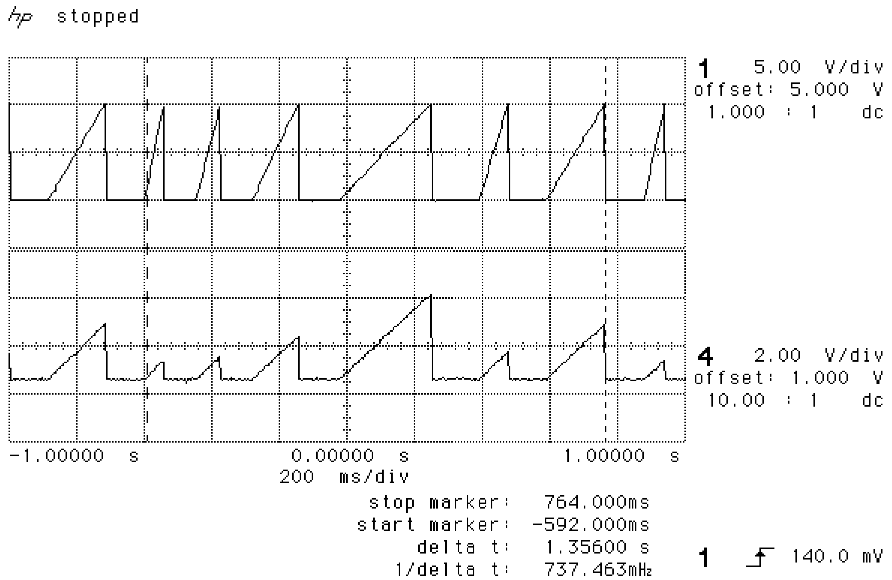
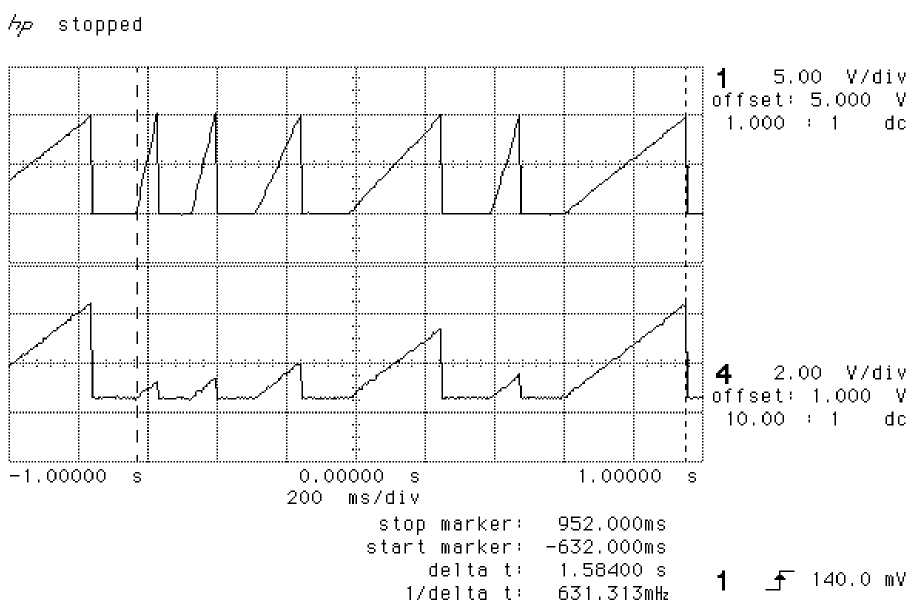



**Figure 12-8 8565EC Signal at A14J15 Pin 1**



9. Check the voltage at A14J15 pin 3 with the spectrum analyzer center frequency set to the frequencies listed in Table 12-5. The following table lists the voltage that should be measured at A14J15 pin 3, the settings for the four switches (U416 in function block Q), and the gain through the Sweep + Tune Multiplier.

**Table 12-5 Sweep + Tune Multiplier Values**

| N* | Center Frequency | A14J15 Pin 3 (Vdc) | U416A | U416B | U416C | U416D | Gain† |
|---|---|---|---|---|---|---|---|
| 1 | 5 GHz | –1.33 | Open | Closed | Closed | Closed | –0.208 |
| 2 | 10 GHz | –2.58 | Open | Closed | Open | Closed | –0.417 |
| 4 | 15 GHz | –3.83 | Open | Closed | Open | Open | –0.833 |
| 4 | 20 GHz | –5.08 | Open | Closed | Open | Open | –0.833 |
| 4 | 30 GHz | –6.52 | Open | Closed | Open | Open | –0.833 |
| 8 | 40 GHz | –10.98 | Open | Open | Open | Open | –1.666 |
| 8 | 50 GHz | –13.48 | Open | Open | Open | Open | –1.666 |

* N is the harmonic mixing mode.

†Gain is the ratio of the change in the voltage at A14J15 pin 3 to the change in the voltage at A14J15 pin 1, within a given band.

10. Move the WR PROT/WR ENA jumper on the A2 Controller assembly to the WR ENA position.

11. Set the spectrum analyzer to the following settings:

    Center frequency ....................................................... 5 GHz
    Span ..................................................................... 0 Hz

12. On the spectrum analyzer, press **CAL**, **MORE 1 OF 2**, **SERVICE CAL DATA**, **PRESEL ADJ**, and **PRESEL OFFSET**.

13. Connect a DVM to A14J16 pin 13.

14. Set the DAC to values from 0 to 255 to yield DVM readings from 0 V to –10 V respectively.

15. Set the spectrum analyzer center frequency to 40 GHz and measure the voltage at A14U414 pin 1: V

16. Connect the DVM to A14J16 pin 1.

17. Press **PRESEL SLOPE**.

18. Set the DAC to values from 0 to 255 to yield DVM readings from 0 V to the voltage measured in step 15.

19. On the spectrum analyzer, press **CAL** and **REALIGN LO & IF**.

20. Connect the DVM to A14J16 pin 3.

21. Change the center frequency in 1 GHz steps and confirm that the voltage changes by 220 mV/GHz in microwave bands and 250 mV/GHz in millimeter bands.

22. Move the WR PROT/WR ENA jumper on the A2 Controller assembly to the WR PROT position.

# A15 RF Assembly

**NOTE** The block diagrams for the A14 and A15 assemblies are located in Chapter 11, Synthesizer Section.

## Confirming a Faulty Third Converter

1. Perform the "IF Input Amplitude Accuracy" performance test in the *8560 E-Series Spectrum Analyzer Calibration Guide*. This exercises most of the third converter.
2. If the performance test fails, perform the manual “13. External Mixer Amplitude Adjustment” on page 147 or the automated “6. 3rd Amp/2nd IF Align” on page 71 of this manual.
3. If adjustment cannot be made, disconnect W35 (coax 92) from A15J801.
4. On the spectrum analyzer, press **PRESET** and set the controls to the following settings:

   Center frequency .................................................. 300 MHz
   Span ................................................................................. 0 Hz

5. Connect a signal generator to A15J801.
6. Set the signal generator to the following settings:

   Frequency .................................................. 310.7 MHz CW
   Power ............................................................................ –28 dBm

7. If a flat line is displayed within 2 dB of the reference level and the performance test passed, troubleshoot microcircuits A7, A8, A9, A10, A12, and A13.
8. If a flat line is displayed within 2 dB of the reference level and the performance test failed, troubleshoot the 2nd IF distribution circuitry on the A15 RF assembly.
9. Disconnect the signal generator from A15J801 and reconnect W35.

## Confirming Third Converter Output

1. Connect the spectrum analyzer CAL OUTPUT to the INPUT 50Ω connector.
2. Set the spectrum analyzer to the following settings:

   Center frequency ................................................. 300 MHz
   Span ................................................................................. 0 Hz
   Input attenuation ...................................................... 10 dB

3. Press **SGL SWP**, **CAL**, **IF ADJ OFF**.
4. Disconnect W29 (coax 7) from A15J601.
5. Connect a test cable from A15J601 to the input of another spectrum analyzer.
6. Tune the other spectrum analyzer to 10.7 MHz. The signal displayed on the other spectrum analyzer should be approximately –15 dBm.
7. Remove the test cable from A15J601 and reconnect W29 to A15J601.

## Third Converter

Refer to function blocks A, B, C, D, and E on A15 RF Section Schematic Diagram in the *8560 E-Series Spectrum Analyzer Component Level Information*.

The 3rd converter consists of the 2nd IF distribution, 2nd IF amplifier, double balanced mixer, 10.7 MHz bandpass filter, and flatness compensation amplifier. The 2nd IF distribution switches between two possible 2nd IF inputs: the internally generated 2nd IF, or the external mixing IF INPUT. A variable dc bias can be applied to the IF INPUT for external mixers which require such bias. The selected input is fed to the 2nd IF Amplifier. This amplifier consists of four stages of gain and two stages of SAW filters for image frequency rejection.

The flatness compensation amplifier consists of two fixed-gain stages and two stages of variable gain. This provides an overall adjustable gain of 4 dB to 30 dB. This gain is adjusted during a spectrum analyzer sweep to compensate for front end conversion loss versus frequency.

The gain of the flatness compensation amplifiers is driven to a minimum by the REDIR line going low during automatic IF adjustment.

The 10.7 MHz bandpass filter provides a broadband termination to the mixer while filtering out unwanted mixer products. Perform the following steps to test the amplifier gain:

1. On the spectrum analyzer, press **AUX CTRL**, then **INTERNAL MIXER**.
2. In the 2nd IF distribution (function block A), diode CR802 should be forward biased and diode CR801 should be reverse biased.
3. Disconnect W35 (coax 92) and connect a signal source to A15J801. Set the source to the following settings:

   Frequency ............................................................ 310.7 MHz
   Amplitude ............................................................... –30 dBm

**CAUTION** For troubleshooting, it is recommended that you use an active probe, such as an 85024A, and a second spectrum analyzer. If an 1120A active probe is being used with a spectrum analyzer having dc coupled inputs, such as the 8566A/B, 8569A/B and the 8562A/B, either set the active probe for an ac-coupled output or use a dc-blocking capacitor between the active probe and the spectrum analyzer input. Failure to do this can result in damage to the spectrum analyzer or the probe.

4. Use an active probe with a second spectrum analyzer to measure the signal at A15TP601 (function block C). The signal should measure –17 dBm ±4 dB confirming the operation of the 2nd IF Amplifier.

5. Use an active probe with a second spectrum analyzer to measure the 300 MHz into the LO port of the third mixer. The signal should measure at least +20 dBm.

6. Measure the 10.7 MHz IF output power of the mixer. The signal level should be approximately –22 dBm.

7. Move the WR PROT/WR ENA jumper on the A2 controller assembly to the WR ENA position.

8. While measuring the signal at the mixer 10.7 MHz IF output, adjust the signal source until the level of the 10.7 MHz IF is –40 dBm.

9. On the spectrum analyzer, press **SGL SWP**, **CAL**, **IF ADJ OFF**, **MORE 1 OF 2**, and **FLATNESS**. Increase the gain of the flatness compensation amplifiers to maximum by entering 0 using the data keys. This sets the gains in the flatness compensation amplifiers to their maximum values.

10. Connect the second spectrum analyzer to A15J601 and measure the 10.7 MHz IF signal level. The signal should measure greater than –10 dBm. If the signal level is incorrect, continue with step 13.

11. Enter 4095 into the spectrum analyzer flatness data. The signal level at A15J601 should measure less than –36 dBm. This sets the gain of flatness compensation amplifiers to a minimum. If the signal level is incorrect, continue with step 13.

12. Check that the gain stages are properly biased and functioning.

13. Check the attenuator stages and flatness compensation control circuitry.

    a. For minimum gain (flatness data equals 4095), RF GAIN (A15U909 pin 10) should be at –1.6 Vdc and the current through each section as measured across R667 or R668 should be about 7 mA.

b. For maximum gain (flatness data equals 0), RF GAIN (A15U909 pin 10) should be at approximately 0 Vdc and the current through each attenuator section should be close to 0 mA.

**CAUTION** As long as the flatness data just entered is not stored, the previously-stored flatness data will be present after the power is cycled.

14. Move the WR PROT/WR ENA jumper on the A2 controller assembly to the WR PROT position.

15. Reconnect the cable to A15J801.

## Flatness Compensation Control

Refer to function block G on A15 RF Section Schematic Diagram in the *8560 E-Series Spectrum Analyzer Component Level Information*.

The Flatness Compensation Control consists of a buffer amp (U909C) and two identical voltage-to-current converters (U909B and U909D). The thermistor RT901 in the buffer amp provides temperature compensation for the PIN diodes in the gain stages and the SAW filters.

## PIN Switch Drivers

Refer to function block H on A15 RF Section Schematic Diagram in the *8560 E-Series Spectrum Analyzer Component Level Information*.

The control latches control the PIN Switch Drivers illustrated in Function Block I.

1. Connect the positive lead of a DVM to A15J901 pin 15 (HEXTMIX). Connect the negative lead to A15J901 pin 6. The measured signal controls the switching between internal and external IF signals.
2. On the spectrum analyzer, press **AUX CTRL** and **EXTERNAL MIXER**. The voltage on the DVM should measure approximately +5 Vdc (TTL high).
3. On the spectrum analyzer, press **AUX CTRL** and **INTERNAL MIXER**. The voltage on the DVM should measure approximately 0 Vdc (TTL low).
4. Connect the DVM positive lead to A15J901 pin 13 (LSID). The signal measured turns on the SIG ID oscillator.
5. On the spectrum analyzer, press **SIG ID ON** (if present), **SGL SWP**.
6. Subsequent pushes of **SGL SWP** should cause the signal measured on the DVM to toggle between TTL high and low levels.
7. Connect an oscilloscope probe to A15U902 pin 7 (LRDIR) and the probe ground lead to A15J901 pin 6. The signal measured controls the flatness compensation circuit.

8. On the spectrum analyzer, press **PRESET** and set the **SPAN** to 1 MHz.

   Set the oscilloscope for the following settings:

   Amplitude scale ........................................................ 2 V/div
   Sweep time ........................................................ 20 ms/div

9. The waveform should be at a TTL high during part of the retrace period and a TTL low during the sweep (about 50 ms).

## SIG ID Oscillator (Option 008)

Refer to function block F on A15 RF Section Schematic Diagram in the *8560 E-Series Spectrum Analyzer Component Level Information*.

SIG ID is available only with Option 008. The SIG ID Oscillator provides a shifted third LO (approximately 298 MHz) to distinguish true signals from false signals (such as image or multiple responses). When the spectrum analyzer is set to **SIG ID ON**, the SIG ID Oscillator turns on during alternate sweeps.

1. Set the spectrum analyzer to the following settings:

   Trigger ........................................................ single sweep
   SIG ID ................................................................... on

2. Use an active probe with a second spectrum analyzer to measure the signal level at A15X602.

3. On the spectrum analyzer, press **SGL SWP**. With each press of **SGL SWP**, the analyzer alternates between the following two states:

   State 1:

   A15J901 pin 13 (LSID)...................................... TTL low
   SIG ID Oscillator ........................................................ ON
   Signal at A15X602..298MHz ±50 kHz (at least +1 dBm)

   State 1:

   A15J901 pin 13 (LSID)......................................TTL high
   SIG ID Oscillator ......................................................OFF
   3rd LO Driver Amplifier .... Provides LO for Double Balanced Mixer

4. With the SIG ID oscillator on, measure the frequency at A15X602 with a frequency counter and an active probe. If the frequency is not 298 MHz ±50 kHz, refer to the “14. Signal ID Oscillator Adjustment (serial prefix 3517A and below)” on page 151. (There is no adjustment for instruments with A15 RF assembly 08563-60084 or greater.)

5. On the spectrum analyzer, press **SGL SWP** until A15J901 pin 13 is at TTL low. Diodes CR603 and CR605 should be forward biased and CR604 should be reverse biased (approximately 6 Vdc reverse bias). Diodes CR501 and CR502 should be forward-biased, disabling the 3rd LO Driver Amplifier.
6. The voltage at the R622/R623 node should measure approximately –5 Vdc, biasing Q604 on.
7. If oscillator bias voltages are correct, place a 100Ω resistor across SAWR U602 input and output. If the SAWR has failed, this will provide the equivalent loss of a correctly functioning SAWR, and the circuit will begin to oscillate.

## 10 MHz Reference

The spectrum analyzer 10 MHz reference consists of 10 MHz OCXO (Option 103: TCXO) with associated TTL level generator and distribution circuitry. The OCXO (or TCXO) and TTL level generator are turned off when an external 10 MHz reference is used. Also, with the analyzer set to EXTernal frequency reference, U304A output (low) forces the output of U304D to stay high. This allows U304B to control the outputs of U303B, U304C, and U303D. In INTernal frequency reference, U304D controls the outputs of these three NAND gates, and the output of U304B is held high.

Check the 10 MHz reference by performing the following steps:

1. Set the spectrum analyzer 10 MHz reference to internal by pressing **AUX CTRL**, **REAR PANEL**, and **10 MHz EXT INT** so that INT is underlined.
2. Use a second spectrum analyzer to confirm the presence of a 10 MHz signal at the following test points:

   A15J303 .................................................................. ≥–10 dBm

   A15J304 .................................................................. ≥–10 dBm

   A15J301 .................................................................. ≥–2 dBm

3. Check for a 1.3 Vp-p waveform at A15J302 using an oscilloscope. See Figure 12-9 on page 627.
4. Check that the signal at A15J301 is 10 MHz ±40 Hz (with Option 103 TCXO reference) using a frequency counter. If necessary, perform the appropriate 10 MHz reference adjustment.
5. If there is no problem with INTernal 10 MHz reference operation, check EXTernal 10 MHz reference operation as follows.
6. Set the spectrum analyzer 10 MHz reference to external by pressing **10 MHz EXT**.

7. Connect a 10 MHz, –2 dBm, signal to the rear panel 10 MHz REF IN/OUT connector.
8. Check the signals at A15J301, A15J302, A15J303, and A15J304 according to the procedure in steps 2 through 4.
9. If the signals are correct in EXTernal operation, but not in INTernal operation, the problem lies in A21 OCXO (or Option 103 TCXO), its voltage reference, or the TTL level generator. Check these areas as follows:
    a. On the spectrum analyzer, press **10 MHz INT**.
    b. Check U305 pin 3 for approximately +12 Vdc (Option 103 only).
    c. Check, with an oscilloscope, for a 10 MHz sine wave greater than or equal to 1 V p-p at J305, or at U302 pin 3 (with Option 103).
10. If the signal at U304 pin 13 is correct (see Figure 12-10 on page 628), but there is a problem with the signals at A15J301, A15J302, A15J303, or A15J304, suspect U303 or U304 in the 10 MHz Distribution circuitry.

**Figure 12-9 10 MHz Reference at A15J302**

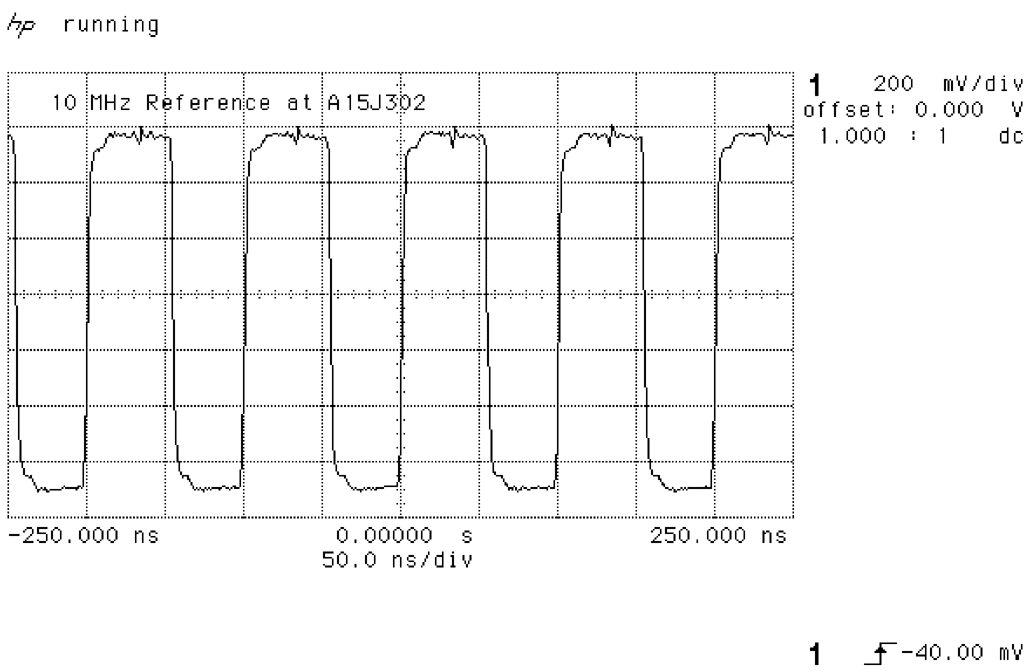


**Figure 12-10 10 MHz TTL Reference at U304 Pin 13**

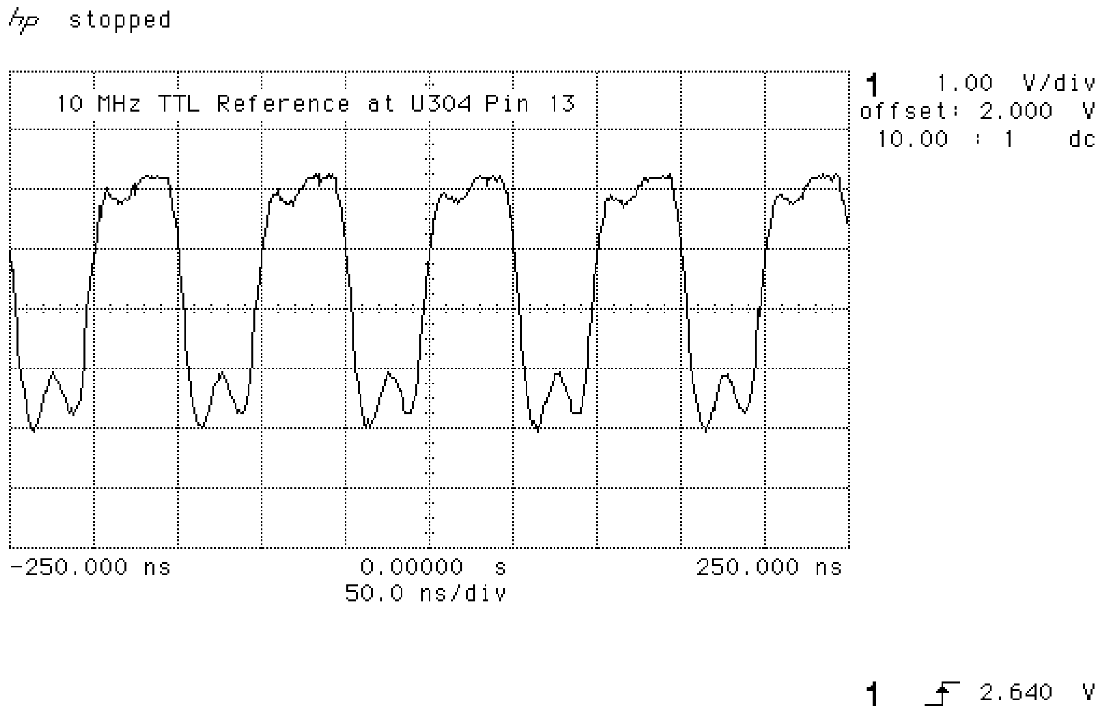


Table 12-6 on page 629 lists the RF Section mnemonics shown in Figure 12-11 on page 631 and provides a brief description of each.

**Table 12-6 RF Section Mnemonic Table**

| Mnemonic | Description | |
|---|---|---|
| TUNE+, TUNE– | YTF Tune Signal (SBTX or RYTHM) | |
| HTR+, HTR– | YTF Heater Power | |
| MAIN COIL+, MAIN COIL– | YTO Main Coil Tune Signal | |
| FM+, FM– | YTO FM Coil Tune Signal | |
| LO SENSE | LO Amplitude Sense Voltage | |
| LEVEL ADJUST | LO Amplitude Adjustment Voltage (PIN ATTEN) | |
| GATE BIAS | LOMA Gate Bias Voltage | |
| HEXTMIXB | External Mixer: | +12V=EXT MIX |
| | | –12V=INT MIX |
| HSIGIDOFFA | SIG ID Oscillator ON: | +12V=SIG ID OFF |
| | | –8V=SIG ID ON |
| PIN SW | PIN Diode Switch Control (SBTX or RYTHM LO Band/HI Band) | |
| PIN DIODE SWITCH | PIN Diode Switch Control For 2ND Conv. IF Output | |
| MIXER BIAS | Detected Voltage on 2ND Converter Mixer Diode | |
| RFGAIN | Voltage to Control Gain of Flatness Comp. Amps. | |
| RFGAIN1 and RFGAIN2 | Currents to Drive PIN Diodes in Flatness Comp. Amps. | |
| L10dB ON, L20dB ON, L30dB ON | Control Lines to Set Attenuator Sections 10, 20, and 30 to Attenuate Position (Active Low) | |
| L10dB OFF, L20dB OFF, L30dB OFF | Control Lines to Set Attenuator Sections 10. 20, and 30 to Bypass Position (Active Low) | |

RF SECTION BLOCK DIAGRAM


| Band | Freq (GHz) | Harmonic | 1st IF Freq (MHz) |
|---|---|---|---|
| 0(Low) | 0 - 2.9 | 1 | 3910.7 |
| 1 | 2.9 - 6.46 | 1 | 310.7 |
| 2 | 6.46-13.2 | 2 | 310.7 |
| 3A | 13.2 -22.0 | 4 | 310.7 |
| 3B | 22.0 -26.8 | 8 | 310.7 |
| 4 | 26.5 -31.15 | 4 | 3910.7 |
| 5A | 31.0 -40.0 | 8 | 3910.7 |
| 5B | 40.0 -50.0 | 8 | 3910.7 |

| Band | SIGNAL LEVEL RANGE (dBm) (NOTE 1) |
|---|---|
| 1 | -28.0 to -38.0 |
| 2 | -33.0 to -43.0 |
| 3A | -34.5 to -46.0 |
| 3B | -34.0 to -40.0 |

| Band | SIGNAL LEVEL RANGE (dBm) (NOTE 1) |
|---|---|
| 0 (LOW) | -32.0 to -39.0 (PREFIX <3641A) |
| 0 (LOW) | -23.0 to -27.0 (PREFIX ≥3641A) |
| 4 | -30.0 to -39.0 |
| 5A | -37.0 to -45.0 |
| 5B | -43.0 to -50.0 |

| Band | SIGNAL LEVEL RANGE (dBm) (NOTE 1) |
|---|---|
| 0 (LOW) | -38.0 to -46.0 (SERIAL PREFIX <3641A) |
| 0 (LOW) | -28.0 to -35.0 (SERIAL PREFIX ≥3641A) |
| 1 | -30.5 to -40.5 |
| 2 | -35.5 to -45.5 |
| 3A | -36.5 to -48.5 |
| 3B | -36.5 to -48.5 |
| 4 | -36.0 to -46.0 |
| 5A | -43.0 to -52.0 |
| 5B | -49.0 to -57.0 |

| Band | SIGNAL LEVEL RANGE (dBm) (NOTE 2) |
|---|---|
| 0 (LOW) | -25.0 to -33.0 (SERIAL PREFIX <3641A) |
| 0 (LOW) | -15.0 to -22.0 (SERIAL PREFIX ≥3641A) |
| 1 | -17.5 to -27.5 |
| 2 | -22.5 to -32.5 |
| 3A | -23.5 to -35.5 |
| 3B | -23.5 to -35.5 |
| 4 | -23.0 to -33.0 |
| 5A | -30.0 to -39.0 |
| 5B | -36.0 to -44.0 |

| Band | SIGNAL LEVEL RANGE (dBm) (NOTE 2) |
|---|---|
| 0 (LOW) | -30.0 to -38.5 (SERIAL PREFIX <3641A) |
| 0 (LOW) | -20.5 to -27.5 (SERIAL PREFIX ≥3641A) |
| 1 | -23.0 to -33.0 |
| 2 | -28.0 to -38.0 |
| 3A | -29.0 to -41.0 |
| 3B | -29.0 to -41.0 |
| 4 | -28.5 to -38.5 |
| 5A | -35.5 to -44.5 |
| 5B | -41.5 to -49.5 |

| Band | SIGNAL LEVEL RANGE (dBm) (NOTE 1) |
|---|---|
| 0 (LOW) | -26.0 to -34.0 (SERIAL PREFIX <3641A) |
| 0 (LOW) | -19.0 to -27.0 (SERIAL PREFIX ≥3641A) |
| 1 | -18.5 to -28.5 |
| 2 | -23.5 to -33.5 |
| 3A | -24.5 to -36.5 |
| 3B | -24.5 to -36.5 |
| 4 | -24.0 to -34.0 |
| 5A | -31.0 to -40.0 |
| 5B | -37.0 to -45.0 |

NOTES:

1. Levels indicated are as measured with the spectrum analyzer input attenuation set to 10dB and a -10dBm signal level at the INPUT (in the band being measured). Center frequency must be tuned to the frequency of the signal at the input of the spectrum analyzer Press SPAN, 0Hz, then CAL, IF ADJ ON/OFF so OFF is underlined. Press SGL SWP.
2. Measured using an active probe and an additional spectrum analyzer. Note 1 also applies to these levels.
3. AT1 is not present with Option 006 installed or in instrument with serial >3804A.



FIGURE 12-11. RF SECTION, TROUBLESHOOTING BLOCK DIAGRAM

# 13 Display/Power Supply Section

# Introduction

The Display/Power Supply chapter consists of the following sections:



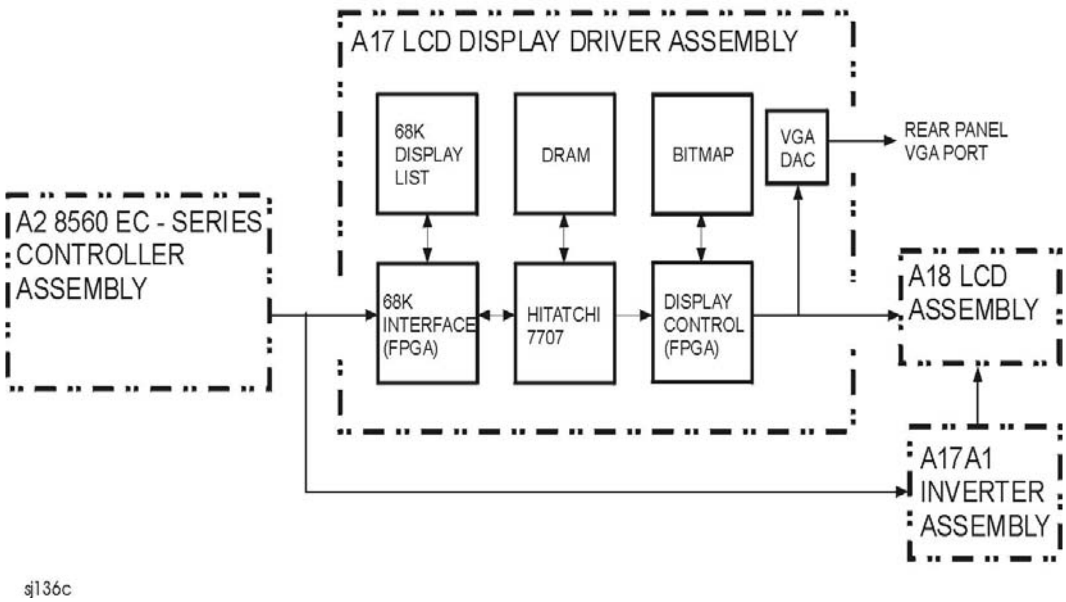
WARNING **The A6 power supply in 8560 EC-series instruments contains lethal voltages with lethal currents in all areas. Use extreme care when servicing these assemblies. Always disconnect the power cord from the instrument before servicing these assemblies. Failure to follow this precaution can represent a shock hazard which may result in personal injury.**

**Always use an isolation transformer when troubleshooting the A6 power supply module. When using an isolation transformer, connect a jumper between A6TP101 and A6TP301. This connects the circuit common to earth ground. Remove this jumper when the isolation transformer is**

# LCD Display

The display section of 8564EC and 8565EC instruments contain the A17 display driver, the A17A1 inverter board, the A18 LCD (liquid crystal display), and the A6 power supply. The A6 power supply is explained in the power supply section which begins on page 590. Figure 13-1 on page 636 illustrates the LCD block diagram.

**Figure 13-1 Simplified LCD Block Diagram**




## Overview of A17 Display Driver Board

The A17 display driver board monitors the 8560 EC-series controller board, copies display instructions to local memory, creates a bitmap from the data, and generates the signals needed to drive the LCD display and a VGA monitor. The display driver consists of a Hitatchi 7707 processor, an FPGA, DRAM, SRAM, a filter circuit, and a video DAC.

The FPGA is connected to the address bus, data bus, and the display memory control signals on the controller board. The FPGA monitors the control signals and determines when the Hitatchi 7707 processor writes to display memory. When this occurs, the FPGA makes a duplicate of this information on the display driver board. The other main function of the FPGA is to provide the signals necessary to drive a TFT LCD display and a standard VGA monitor.

The processor reads display information received from the controller board, creates a bitmap, and copies the bitmap into SRAM. The FPGA outputs this information to the LCD and VGA displays. The DRAM is used by the processor to run its program. The filter circuit provides the clock signals that are needed to run the display driver board. The video DAC converts the digital color information that goes to the LCD to analog signals; these signals drive the RGB color lines on the VGA port.

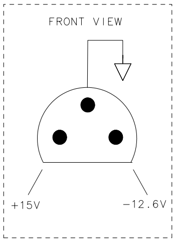
# Troubleshooting the LCD Display

**NOTE** There are no adjustments for intensity or focus of the LCD.

## Blank Display

1. If the LED above the front-panel LINE switch is lit, most of the A6 power supply is functioning properly.
2. Carefully check the voltages on the front-panel PROBE POWER jack. Be careful to avoid shorting the pins together. See Figure 13-2
3. Check that the fan is operating. If the PROBE POWER voltages are correct, and the fan is turning, the A6 power supply is probably working properly.
4. If all of the power supply indicators along the outside edge of the A2 controller assembly are lit, the A6 power supply is probably working properly.
5. Connect a VGA monitor to the VGA port on the rear of the instrument. If the display is still blank, suspect the A2 controller, a loose cable, or the display driver.
6. If the LED is not lit, or the fan is not working, or the probe power voltages are not correct, or the power supply indicators on the edge of the A2 controller assembly are not working properly, proceed to the section on troubleshooting the power supply on page 658.
7. Open the left side of the instrument (see "Procedure 2. A1 Front Frame/A18 LCD" on page 166). Make voltage measurements at pins 1, 2, 3, 4, 5, 41, 42, 43, 44, and 45 on J8 of the A2 controller (see Figure 13-3 on page 640). These pins should measure 5V ±0.25V. If any of these measurements is out of tolerance suspect the A2 controller board or the power supply. If the voltages for these pins are correct, make the same measurements at the identical pins on J1 of the A17 display driver board. If these measurements are correct, suspect the A18 LCD assembly or the A17A1 inverter board. If these measurements are not correct, suspect the A17 LCD driver or A17A1 inverter board.

**Figure 13-2 Probe Power Socket**



## Dim Display

1. If the display is dim, suspect the backlights, which are inserted into the LCD assembly from the backlight assembly. Always replace both backlights at the same time. To replace the backlights, see page 189 of procedure 2A.

## Troubleshooting Using the VGA Port

1. Connect a VGA monitor to the rear VGA port of the instrument (the VGA port is always active and requires no user interaction).
2. Observe the display.

   If the display on the VGA monitor is working correctly, the problem is probably caused by the LCD, or by a cable problem. Proceed to step 1 in “Troubleshooting using part substitution.”

   If the display on the VGA monitor shows the same symptom(s) you have seen on the instrument’s LCD, the problem is probably caused by the A2 controller board, the display driver, or by a cable problem. Proceed to step 2 in “Troubleshooting using part substitution.”

## Troubleshooting Using Part Substitution

1. Disconnect the power cord, turn the instrument off, and open the left side. Ensure that W60, W61, W62, W63, and W64 are tight. Reconnect the power cord and check the instrument to see whether the problem is corrected. If not, proceed to step 2.
2. Disconnect the power cord and turn the instrument off. Replace W60, the ribbon cable that connects the A2 board to the display driver board. Reconnect the power cord and check the display to see whether the problem is corrected. If not, proceed to step 3.
3. Disconnect the power cord and turn the instrument off. Replace W61, the 10 MHz reference cable that connects the A2 board to the display driver board. Reconnect the power cord and check to see whether the problem is corrected. If not, proceed to step 4.
4. Disconnect the power cord and turn the instrument off. Remove and replace (see procedure 2A on page 180) the A17 display driver board. Reconnect the power cord and check the instrument to see whether the problem is corrected. If not, proceed to step 5.
5. Remove and replace (see procedure 5 on page 202) the A2 controller board. Check to see whether the problem is corrected. If not, proceed to step 6.
6. Disconnect the power cord and turn the instrument off. Remove and replace (see procedure 2A on page 180) the A18 LCD. Reconnect the power cord and check the instrument to see whether the problem is corrected.

**Figure 13-3 Location of +5V supply pins on J1 of A17 and J8 of A2**

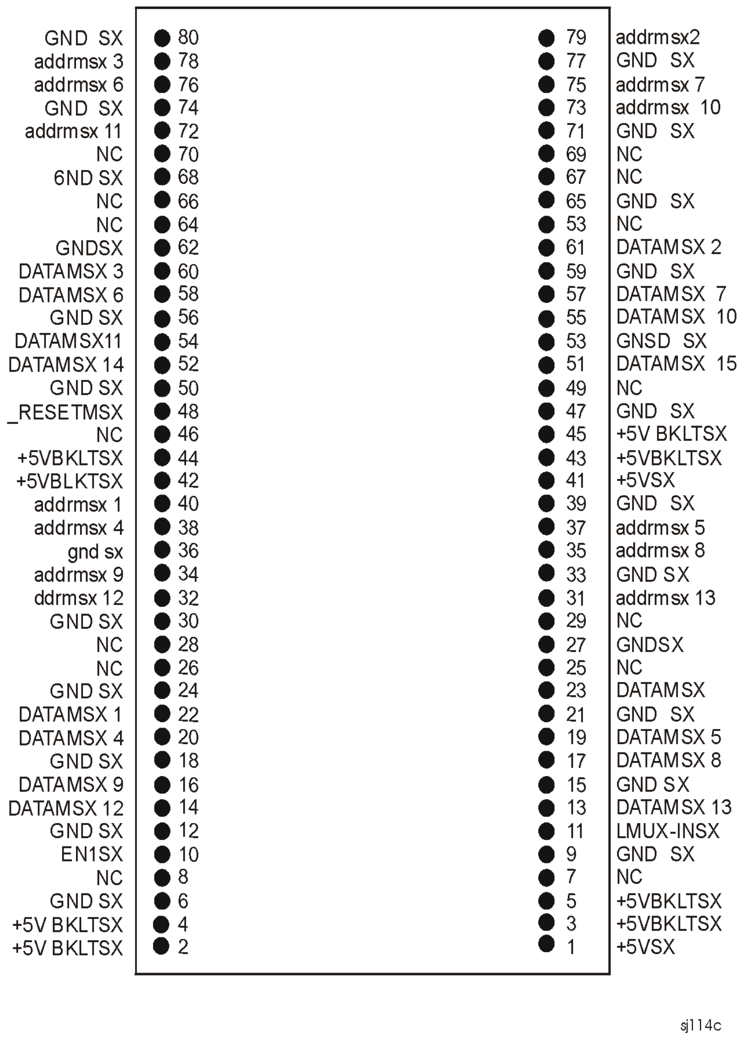



Figure 13-3 shows A2J8 connections on 8560 EC-Series Instruments. Lines 2 –5 and 42 – 44 supply +5V to the two LCD backlights. Lines 1 and 41 supply +5V to the A17A1 Inverter board. Lines 1 – 6 and 41 – 44 are identical on A17J1.

# A6 Power Supply Assembly

8564EC , and 8565EC spectrum analyzers use a switching power supply operating at 40 kHz to supply the low voltages for most of the analyzer hardware.

Kick starting occurs when there is a fault either on the power supply or on one of the other assemblies. The power supply will try to start by generating a 200 ms pulse ("kick") every 1.5 seconds. A kick-starting power supply often appears to be dead, but the fan will make one or two revolutions and stop every 1.5 seconds.

## Dead Power Supply

1. Use an isolation transformer and connect a jumper between A6TP101 and A6TP301.
2. Connect the negative lead of a DVM to A6TP301.
3. Check TP308 for +5 V.
4. Check TP302 for +15 V.
5. Check TP303 for –15 V.
6. Check TP304 for +28 V.
7. Check TP305 for –12.6 V.
8. Measure the voltage at TP108 to verify the output of the input rectifier. The voltage should be between +215 Vdc and +350 Vdc.
9. If it is not within this range, check the rear panel fuse, input rectifier, input filter, and the rear panel line voltage selector switch.
10. Measure the voltage at TP206 to verify the output of the kick-start/bias-circuitry. The voltage should be approximately +14 Vdc. Test point 206 is on pin 1 of U203.
11. If there is no voltage at TP206, check TP210 for pulses 200 ms wide with an amplitude of 14.7 V. If there are no pulses present, the kick-start circuitry is probably defective. If the pulses are low in amplitude (about 1 V), Q201 is probably shorted.
12. If there are pulses at TP206, or there are pulses at TP210, but not at TP206, the buck regulator control circuitry is probably faulty.

## Line Fuse Blowing

1. If the line fuse blows with the LINE switch in the off position, suspect either the input filter or the power switch cable assembly.
2. If the line fuse blows when the 8564EC and 8565EC spectrum analyzers are turned on, disconnect the power cord and lift the drain of A6Q102 from TP108. If the line fuse still blows, suspect CR102 through CR105.
3. If the fuse is not burned out, check A6TP108 for a voltage of between +215 V and +350 V.
4. If the voltage at TP108 is correct, disconnect the power cord. Wait 60 seconds for the high voltage to discharge. Remove and check A6Q102.
5. If Q102 is shorted, Q103, Q104, CR106, and CR108 are also probably shorted. If Q102 is working properly, measure the resistance between TP102 and TP101 (positive ohmmeter lead to TP102).
6. If the resistance is less than 1 kΩ, suspect either Q103 or Q104 in the DC-DC Converter.

## Supply Restarting Every 1.5 Seconds (Kick Start)

See function blocks G, H and L of A6 power supply schematic diagram in the component-level information binder.

If there is a short on the power supply or on one of the other assemblies, the power supply will attempt to "kick start." (Every 1.5 seconds the supply will attempt to start, but will be shut down by a fault condition.) The kick start and bias circuits provide power for the control circuitry during power-up. The kick start circuitry is an RC oscillator which emits a 200 ms pulse every 1.5 seconds. These pulses switch current from the Input Rectifier through Q201 to charge C201. When the power supply is up, a winding on T103 provides power to the control circuitry. This voltage is high enough to keep Q201 turned off.

1. Monitor the waveforms at TP206 and TP208 simultaneously on an oscilloscope.
2. If the signal at TP208 goes high before the signal at TP206 goes low, an overcurrent condition has been detected. Suspect a short in the secondary (output rectifier, voltage regulators, or another assembly).

## Low Voltage Supplies

1. Connect the negative lead of a DVM to A6TP301.
2. Check A6TP302 for +15 Vdc.
3. Check A6TP303 for –15 Vdc.
4. Check A6TP304 for +28 Vdc.
5. Check A6TP305 for –12.6 Vdc.
6. Check A6TP308 for +5 Vdc.
7. If the voltages measured above are correct but the power supply LEDs on the A2 controller assembly are not lit, check W1.
8. If the voltages are low, disconnect W1 from A6J1 and measure the test point voltages again. Unless a dummy load is connected to the A6 power supply, the voltages should return to their nominal voltages but be unregulated.
9. If the voltages do not return to near their nominal range, the A6 power supply is probably at fault.
10. If the +5 V supply is low, suspect the +5 V regulator or the feedback circuit. To check the feedback circuit, measure the voltage of the +5 V reference (U305 pin 6) and the ±5 V references to the voltage regulators (U306B pin 7 and U306D pin 14).
11. Check output of U306A pin 1. If the feedback circuit is working properly, the output of U306A should be near +13 Vdc.

## Buck Regulator Control

See function block H of the A6 power supply schematic diagram in the component-level information binder.

The buck regulator control pulse-width modulates the buck regulator and provides a synchronized signal to the DC-DC converter control circuitry. The buck regulator control has two feedback paths. The first is the output of the buck regulator, which provides coarse regulation. The second is the feedback circuit which samples and compares the +5 Vdc output of the output rectifier.

U202B and associated circuitry senses the output of the input rectifier and will turn off U203 if the voltage at TP108 is less than approximately +170 Vdc. Also, it will not allow U203 to start up until this voltage exceeds +215 Vdc. A low on the output of U202B will also clear the overcurrent latch in the DC-DC converter control circuitry.

Thermal shutdown occurs when RT201, mounted on the main heatsink, reaches a temperature of 100 C. When this occurs, the voltage at U203 pin 13 exceeds 0.6 V and inhibits pulses to the buck regulator.

R203, R204, U211, and associated circuitry provide feedforward for U203. This makes the loop gain independent of input line voltage and cancels 120 Hz ripple by more than 10 dB.

U202C and its associated circuitry permit the power supply to start up at low line voltages at low temperatures. At low line voltages U202C will draw charge away from C206 through R205. This allows the buck regulator to turn on and draw current through the thermistors in the input rectifier. This warms up the thermistors, thereby decreasing their resistance and increasing the voltage at TP108. When the voltage is sufficiently high at TP108, the output of U202C will open and C206 will be allowed to charge normally.

U202A converts the sawtooth at TP204 to a squarewave to drive the DC-DC Converter Control circuitry. The frequency of the sawtooth is determined by the resistance at pin 7 of U203 and the capacitance at pin 8 of U203.

## DC-DC Converter Control

See function block I of A6 power supply schematic diagram in the component-level information binder.

The DC-DC converter control circuitry divides the 80 kHz squarewave from U202A and generates two complementary 40 kHz squarewaves to drive the FETs in the DC-DC converter. Also, U202D and its associated circuitry monitor the voltage across sense resistor R116 in the DC-DC converter. When the current through the FETs in the DC-DC converter exceeds 1.8 A, the voltage across R116 will cause the output of U202D to go high. This sets a latch in U204 which turns off U203.

## Power Up

See function block M of the A6 power supply schematic diagram in the component-level information binder.

The power up circuitry generates the PWR UP signal, which tells the microprocessor that the supplies are up and stable. PWR UP will go high when the +5 Vdc supply exceeds +4.99 Vdc. PWR UP will go low when this voltage is less than +4.895 Vdc. Once PWR UP is set low, it will stay low for at least 50 ms before going high, even if the +5 Vdc supply exceeds +4.99 Vdc before 50 ms have elapsed.


sm14c

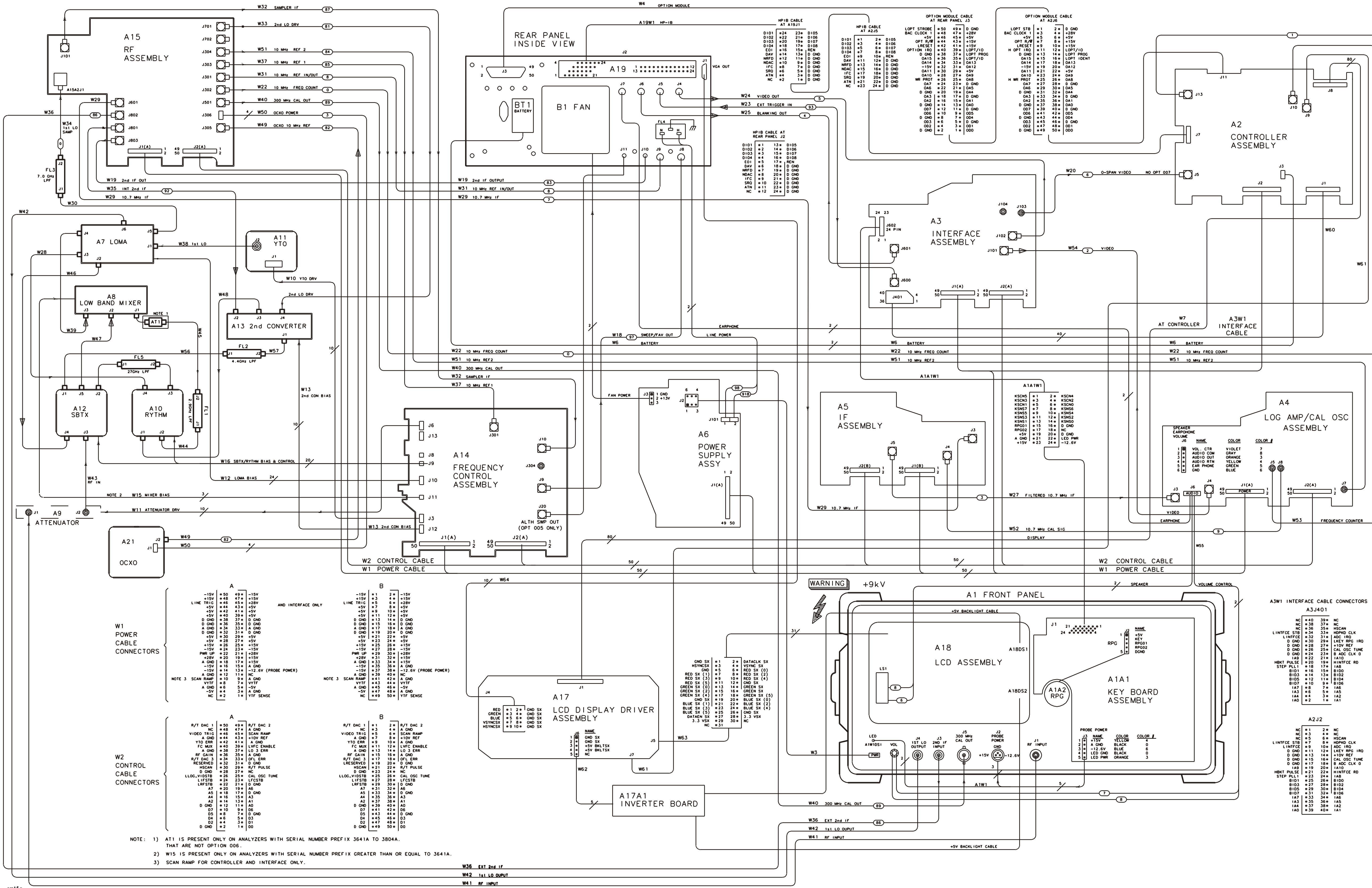
FIGURE 13-9. A6 POWER SUPPLY BLOCK DIAGRAM

# 14 Component-Level Information Packets

# Introduction

Component-Level Information Packets (CLIPs) contain a parts list, a component-location diagram, and schematic diagrams for selected instrument assemblies.

8564EC AND 8565EC INTERCONNECT DIAGRAM




NOTE: 1) AT1 IS PRESENT ONLY ON ANALYZERS WITH SERIAL NUMBER PREFIX 3641A TO 3804A. THAT ARE NOT OPTION 006.

2) W15 IS PRESENT ONLY ON ANALYZERS WITH SERIAL NUMBER PREFIX GREATER THAN OR EQUAL TO 3641A.

3) SCAN RAMP FOR CONTROLLER AND INTERFACE ONLY.

sm15c

# Index