DFR-1000 DUAL-BAND VHF/UHF DF RECEIVER USER FUNCTIONAL TEST PROCEDURE

I DESCRIPTION

This procedure provides users with the means to implement a "closed-box" functional test of the DFR-1000 Dual-Band VHF/UHF DF Receiver to verify essential performance characteristics. It is organized to test as many features as practical in an abbreviated test with a minimum of test equipment and accessories. The procedure requires only basic familiarity with electronic test equipment and procedures, and does not require that the unit be removed from its cabinet. It is suitable both as a user acceptance test procedure as well as a means of performance verification. It is particularly recommended that this procedure be implemented prior to returning a DFR-1000 to the factory for repair, since the results will quickly point the factory technician to the source of trouble.

II APPLICABILITY

This procedure is applicable to all DFR-1000 DF receivers with serial numbers from 001 to 119 inclusive. A separate procedure (doc. # fr1000a1.tpu) is required for DFR-1000A DF receivers with serial numbers 120 and above.

III APPLICABLE DOCUMENTS

A. RF Products DFR-1000A Dual-Band VHF/UHF DF Receiver Operator's Manual (doc. # dfr1000a.oma)

B. RF Products DTI-100A DF Bearing Synthesizer Operator's Manual (doc. # dti100a.oma)

IV TEST EQUIPMENT REQUIRED

A. RF Products DTI-100/DTI-100A DF Bearing Synthesizer.

B. RF Products DFS-1000 Frequency Synthesizer (required if the DFR-1000 has no installed crystals).

C. VHF/UHF signal generator, 50 ohm output, with internal and external AM and FM modulation capability (HP 8640B, HP 8656B, Marconi 2019A, or similar).

D. Regulated DC power supply, +13.8 VDC nominal output with 3 ampere minimum output current capacity (Astron RS-7A or similar).

E. Multi-meter, w/DC current measurement ability up to 3 amperes (Micronta 22-185A or similar).

F. IBM PC/XT/AT-compatible computer w/available COM1 or COM2 serial port and DFDATA test software (required only for units having computer interface option).

G. (Optional.) Oscilloscope (Tektronix 465 or similar).

H. Miscellaneous plugs, cables, and adaptors as required.

V TEST PROCEDURE

A. PHYSICAL INSPECTION, MECHANICAL ALIGNMENT, & PRELIMINARY STEPS

1__ With the DFR-1000 disconnected from its power source, carefully inspect the unit for any signs of physical damage.

2__ Remove the fuse from the fuse-holder (located on the rear-panel) and inspect it to verify that it is a GMA-type 5 mm x 20 mm 2.5 ampere fast-blow fuse. If not, replace it with the correct type. Otherwise, reinstall it in the fuse-holder.

3__ Exercise all front-panel knobs, switches, and push-buttons to verify that all knobs rotate smoothly without binding, the toggle switches can be set to all their positions without excessive force, and the push-buttons can be depressed without sticking.

4__ Verify that the **CRT GAIN**, **SQUELCH**, **VOLUME**, and **BFO/FINE TUNE** knobs audibly "click" when rotated fully counter-clockwise to their respective detented positions.

5__ Verify that the CRT bezel can be rotated in both directions without binding. Return it back to its normal detented position with its white alignment marker matching the black front-panel reference index.

6__ Verify that the white alignment marker lines of the **CRT GAIN**, **SQUELCH**, and **VOLUME** knobs are aligned with their respective black dots when these knobs are set fully counter-clockwise to their detented positions. Use an Allen wrench as required to loosen the set screws (two per knob) and slip the knobs on the control shafts to restore mechanical alignment. **Do not** attempt mechanical realignment of the **BFO/FINE TUNE** knob (see cautionary statement below).

CAUTION

*Do not attempt to realign the **BFO/FINE TUNE** knob* - this knob has been mechanically aligned at the factory so that the DFR-1000 is tuned to the nominal selected crystal frequency when the white marker index line is set at 12 o'clock.

7__ Verify that the **SIGNAL STRENGTH** meter needle points to zero on the meter scale. If it is misaligned, insert a small screwdriver into the hole immediately below the meter and carefully rotate the meter adjustment screw to restore mechanical alignment. *Be sure that the DFR-1000 is set normally on a flat horizontal surface before attempting this adjustment.*

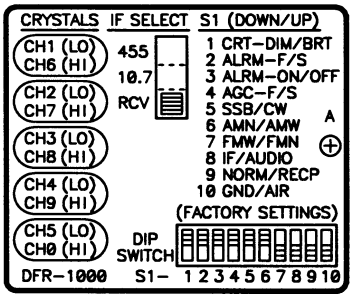
8__ Set the front-panel controls as follows:

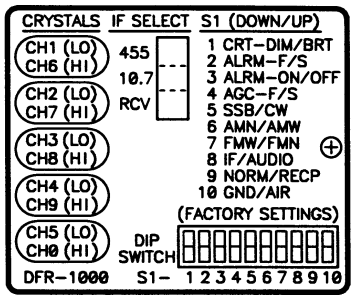
TRACK & HOLD - **OFF**
CRT - **MED**
PLL - **OFF**
MODE - **CW**

BFO/FINE TUNE - 12 o'clock
CRT GAIN - 8 o'clock
SQUELCH - 8 o'clock
VOLUME - **OFF**

Note: The **PLL** switch may not be present on some later model units.

9__ Remove the rear-panel crystal cover plate (by first loosening the four captive thumbscrews) to expose any installed crystals and the configuration setup switches. Carefully verify that all 10 dip-switches and the **IF SELECT** slide switch are positioned at their standard factory settings as indicated on the leftmost configuration setup label illustration below. If any of these switches are not set as per this standard configuration setup label, change these switch settings appropriately.





CAUTION

If any of the configuration setup switches need to be changed, *record the original settings now* on the blank rightmost configuration setup label above so that these switches can be restored to their user settings as called for upon completion of this procedure.

B. POWER-UP TESTS

1__ With the **VOLUME** knob still set to **OFF**, connect the DFR-1000 to the +13.8 VDC regulated power source.

2__ Power-up the DFR-1000 by rotating the **VOLUME** knob slightly clockwise until a click is heard. Set the **VOLUME** knob at 8 o'clock.

3__ Set the CRT **INTEN** adjustment fully counter-clockwise.

4__ After a 30 second warm-up, verify with the multi-meter that the current drawn by the DFR-1000 from the +13.8 VDC supply is approximately 1.4 amperes. **Note:** While the DFR-1000 CRT is warming up, current drain can exceed 2 amperes.

5__ Verify that the **SIGNAL STRENGTH** meter illuminates.

6__ Verify that the **FREQ** indicator displays a valid digit (1, 2, 3, 4, 5, 6, 7, 8, 9, or 0).

7__ Verify that the **FREQ** indicator increments in the proper order when the upper push-button is depressed, and that all ten digits can be obtained in succession (wrap-around occurs from 9 to 0).

8__ Verify that the **FREQ** indicator decrements in the proper order when the lower push-button is depressed, and that all ten digits can be obtained in succession (wrap-around occurs from 0 to 9).

9__ With the unit still powered-up, turn it upside down and remove the rear cabinet screw (located adjacent to the rear rubber mounting foot closest to the 11-16 VDC rear-panel power connector) using a #2 Phillips screwdriver. Verify that the removal of this screw powers-down the unit (this confirms proper operation of the safety interlock mechanism), re-install the screw, and return the unit to its normal upright position.

C. RECEIVER LISTEN-THROUGH TESTS

1__ Verify that the DFR-1000 front-panel controls are still set as per step V-A-8 (with the exception that the **VOLUME** control should be set at 8 o'clock).

2__ Set the **FREQ** selector to a channel number for which a crystal has been installed. If no crystals are installed, connect the DFS-1000 synthesizer to the DFR-1000, power it up, and set it to any legitimate frequency within the specified frequency range(s) of the DFR-1000 (frequency coverage information can be found on the serial number label affixed to the rear-panel located to the immediate right of the crystal cover plate). **Note:** See DFR-1000A Operator's Manual Appendix C or DFS-1000 Product Data Sheet as required for information regarding installation and operation of the DFS-1000.

3__ With the **MODE** switch still set to **CW**, advance the **VOLUME** control to 9 o'clock and verify that a "hissing" sound is audible from the speaker. Re-adjust the **VOLUME** control as required for a comfortable listening level.

4__ Verify that the hissing sound can be squelched by rotating the **SQUELCH** control clockwise. The squelch should activate at approximately 9-11 o'clock. Set the **SQUELCH** control back to 8 o'clock to restore the hissing sound.

5__ Without changing the setting of the **VOLUME** control, set the **MODE** switch to **AM** and

verify that the hissing sound is similar in volume to it was in **CW**, but higher in pitch. Again verify that the hissing sound can be squelched with a **SQUELCH** setting of approximately 9-11 o'clock. Set the **SQUELCH** control back to 8 o'clock.

6__ Without changing the setting of the **VOLUME** control, set the **MODE** switch to **FM** and verify that the hissing sound becomes much louder than it was in **AM**. Again verify that the hissing sound can be squelched with a **SQUELCH** setting of approximately 9-11 o'clock, and then set the **SQUELCH** control back to 8 o'clock.

7__ With the **MODE** switch still in **FM** and the **BFO/FINE TUNE** control still set for 12 o'clock, set up the signal generator for a -55 dBm CW signal and connect the signal generator RF output to the DFR-1000 **RF/IF** input through a short (4' or less) length of 50 ohm coaxial cable. Set the signal generator frequency to match that of the selected DFR-1000 crystal channel frequency (or the selected DFS-1000 synthesizer frequency).

8__ Verify that the application of the RF signal to the DFR-1000 fully quiets the FM hissing sound and results in an approximately full-scale **SIGNAL STRENGTH** meter indication. If the signal is not detected (as indicated by the absence of full quieting or full-scale **SIGNAL STRENGTH** meter deflection), adjust the DFR-1000 **BFO/FINE TUNE** control until the correct results are obtained. **Note 1:** Some DFR-1000s are factory set for less **SIGNAL STRENGTH** meter deflection to provide more meter dynamic range. If this is the case, a full-scale deflection will not be obtained at -55 dBm signal input. This does not affect either listen-through or DF sensitivity, as should be confirmed in a subsequent Section when DF sensitivity is checked. **Note 2:** If the DFS-1000 synthesizer is used in lieu of crystals for DFR-1000 frequency control, the **BFO/FINE TUNE** control has no effect. Required frequency adjustments must therefore be done using the synthesizer 1 kHz digit or at the signal generator.

9__ Set the signal generator for 3 kHz deviation internal FM at a 1 kHz modulation rate. A clean-sounding 1 kHz tone should be plainly audible. Adjust the **VOLUME** control as required for a comfortable listening level.

10__ Verify that the **SIGNAL STRENGTH** meter is still at approximately full-scale.

11__ (Optional.) Monitor the **HEADSET** audio output with the oscilloscope using an appropriate interface cable with a male phone plug at one end. Partially insert the phone plug into the **HEADSET** jack so that it is sufficiently inserted to view the 1 kHz tone waveform on the oscilloscope, but not sufficiently inserted to disconnect the speaker audio. Verify that a reasonably undistorted 1 kHz sine wave is visible on the oscilloscope. Apply hearing protection (see cautionary statement below) and slowly rotate the **VOLUME** control clockwise until the waveform begins peak clipping. Clipping should occur at a waveform amplitude of roughly 10 VPP (volts peak-to-peak). Return the **VOLUME** control to a setting that results in a comfortable listening level.

CAUTION

This step results in a speaker volume level that is uncomfortably loud. Use hearing protection for safety.

12__ Fully insert a phone plug into the **HEADSET** jack to verify that this disables the speaker audio. Remove the phone plug and set it aside.

13__ Set the DFR-1000 **MODE** switch to **AM**, do not disturb the setting of the **BFO/FINE TUNE** control, and reconfigure the signal generator for 50% internal AM at a 1 kHz modulation rate (be sure to disable signal generator FM). A clean-sounding 1 kHz tone should again be plainly audible. Adjust the **VOLUME** control as required for a comfortable listening level.

14__ Verify that the **SIGNAL STRENGTH** meter is still at approximately full-scale.

15__ (Optional.) Repeat step V-C-11.

16__ Set the DFR-1000 **MODE** switch to **CW** and reconfigure the signal generator for a CW (unmodulated) output.

17__ Adjust the **BFO/FINE TUNE** control for an audible tone of approximately 1 kHz. This tone should sound clean and undistorted. **Note:** If a synthesizer is used for DFR-1000 frequency control, make any necessary frequency adjustments with the synthesizer 1 kHz digit or the signal generator.

18__ Verify that the **SIGNAL STRENGTH** meter is still at approximately full-scale. (There are *two* settings of the **BFO/FINE TUNE** control that result in the desired 1 kHz tone. Find the one that results in greatest meter deflection.)

19__ (Optional.) Repeat step V-C-11.

20__ If the tests so far have been conducted at a low-band frequency, repeat steps V-C-17,18,19 at a high-band frequency. If the tests so far have been conducted at a high-band frequency, repeat steps V-C-17,18,19 at a low-band frequency. If the DFR-1000 under test is a single-band unit, disregard this step.

21__ Leave the test setup intact and proceed to the next Section.

D. DFS-1000 SYNTHESIZER COMPATIBILITY TEST

__ If a DFS-1000 synthesizer is available whose frequency coverage is compatible with that of the DFR-1000, connect it to the DFR-1000 and verify that the DFR-1000 performs satisfactorily under synthesizer control on both a low- and high-band frequency. This is most conveniently accomplished by performing the FM quieting test as described in steps V-C-7,8. If the DFR-1000 is already equipped with a DFS-1000, use that accompanying synthesizer. Omit this step if the DFR-1000 has no installed crystals and the preceding steps were already performed with a synthesizer. **Note:** Since the **BFO/FINE TUNE** control has no effect when the DFR-1000 is under synthesizer control, fine frequency adjustment must be accomplished either with the synthesizer 1 kHz digit or at the signal generator.

E. CRT DISPLAY PRELIMINARY TESTS

1__ Verify that the **CRT GAIN** control is still set at 8 o'clock.

2__ Rotate the **INTEN** control clockwise until a moderately bright dot appears on the CRT face and confirm that it can be sharply converged with the **FOCUS** control.

3__ Exercise the **VERT** and **HORZ** positioning controls to verify that the dot can be moved both vertically and horizontally along the CRT face.

4__ Once proper operation of the **VERT** and **HORZ** positioning controls has been confirmed, set these controls to center the dot on the CRT face and proceed to the next Section.

F. CRT DISPLAY AND INDICATOR TESTS

1__ Verify that the DFR-1000 front-panel controls are still set as per V-A-8 (with the exception that **VOLUME** control should be set near 9 o'clock, the **CRT GAIN** control to 9 o'clock, and the **MODE** switch to **FM**).

2__ Verify that the signal generator and DFR-1000 are still set in tandem to any convenient channel frequency with the signal generator set for a -55 dBm output.

3__ Connect the DTI-100A DF Bearing Synthesizer to the signal generator and DFR-1000 (refer to the DTI-100A Operator's Manual as required for details regarding this test setup). Set the DTI-100A **AZIMUTH** selector to 0° and the signal generator for 50% external AM (note that the DTI-100A **GAIN** control must be appropriately set in coordination with any relevant signal generator modulation gain controls to establish the required 50% modulation level).

4__ A 0° bearing should now be visible with a full-length CRT trace (be sure that the **CRT GAIN** control is set at 9 o'clock). Verify that the green **SIGNAL PRES** indicator is illuminated and the red **REDUCE CRT GAIN** indicator extinguished.

5__ Rotate the **CRT GAIN** control fully clockwise for maximum gain and verify that the red **REDUCE CRT GAIN** indicator illuminates after a moment or two.

6__ Set rear-panel dip-switch #1 to **DIM** (down) to enable the CRT screen-saver circuitry.

7__ Set the **CRT GAIN** control at 8 o'clock (be sure not to set it fully counter-clockwise to **AUTO**). Both the **SIGNAL PRES** and **REDUCE GAIN** indicators should extinguish. The CRT trace should also disappear or dim, indicating proper operation of the CRT screen-saver circuitry (allow at least 30 seconds for the screen saver to activate).

8__ Set rear-panel dip-switch #1 to **BRT** (up) to disable the CRT screen-saver circuitry. The CRT trace should immediately reappear.

9__ Set the **CRT GAIN** control back to 9 o'clock to restore a full-length CRT trace.

10__ Set the **TRACK & HOLD** switch to **HOLD**.

11__ Disconnect the coaxial cable from the signal generator to interrupt the signal input to the DFR-1000. The 0° bearing displayed on the CRT should remain "frozen" for approximately 2.5 seconds before the trace collapses. **Note:** Since the signal must be interrupted suddenly for the track & hold to function properly, the coaxial cable should be disconnected rapidly. If the signal generator has a carrier on/off switch, this may also be used, but it is important that the activation of such a switch result in complete disabling of the signal generator output (with some signal generators, these switches only partially disable the output).

12__ Return the **TRACK & HOLD** switch to **OFF,** leave the test setup intact, and proceed to the next Section.

G. BEARING AND SENSITIVITY TESTS

1__ Verify that the DFR-1000 front-panel controls are still set as per V-A-8 (with the exception that **VOLUME** control should be set at 9 o'clock, the **CRT GAIN** control at 9 o'clock, and the **MODE** switch to **FM**).

2__ Verify that the DFR-1000 is correctly tuned to the signal generator frequency, the signal generator output is set to -55 dBm, the signal generator and DTI-100A are properly configured for a 0° bearing using 50% modulation, and a full-length 0° CRT trace is visible.

3__ Verify that the **CRT** switch is still in **MED** and rotate the DTI-100A **AZIMUTH** switch from 0° to 315°. The CRT bearing should correspondingly move from 0° to 315° in just over half a second.

4__ Set the **CRT** switch to **FAST** and rotate the DTI-100A **AZIMUTH** selector from 315° back to 0°. The CRT bearing should correspondingly move from 315° to 0° in well under half a second (the response should be visibly much faster than that observed in step V-G-3 above with the **CRT** switch in **MED**).

5__ Set the **CRT** switch to **SLOW** and rotate the DTI-100A **AZIMUTH** selector from 0° back to 315°. The CRT bearing should correspondingly move from 0° to 315° in approximately 2 seconds (the response should be visibly much slower than that observed in step V-G-3 above with the **CRT** switch in **MED**).

6__ Set the **CRT** switch to **MED** and confirm that the CRT bearing display is correct for all 12 DTI-100A azimuth selections. When completed, set the DTI-100A **AZIMUTH** switch back to 0°.

7__ Set the **CRT GAIN** control fully clockwise for maximum gain, reduce the signal generator output to -127 dBm, and confirm that a half-length (or near half-length) 0° CRT bearing is visible. Although bearing jitter will be present, the bearing should still be recognizable as being approximately 0° (to verify this, rotate the DTI-100A

AZIMUTH selector back and forth between 0° and 22.5° - the resulting change in the CRT bearing should be clearly discernable). This step confirms DFR-1000 DF sensitivity.

8__ If the DFR-1000 is configured for dual-band operation, repeat the above DF sensitivity test at any convenient frequency in the other band.

9__ Rotate the **CRT GAIN** control fully counter-clockwise to its detented **AUTO** position. Verify that the CRT trace length stays nearly as long.

10__ Leave the test setup intact and proceed to the next Section.

H. BANDSWITCHING, RANGE TONE, AND MOTION SENSOR ALARM TESTS

1__ If a DFS-1000 synthesizer is connected to the DFR-1000, leave it connected, but power it down (i.e., set it to **CRYSTAL/SYNTH** switch to **CRYSTAL**).

2__ Exercise the DFR-1000 channel select push-buttons appropriately to select in succession channels 1, 2, 3, 4, and 5 on the **FREQ** indicator. The DTI-100A yellow **HI/LO BAND** indicator should remain extinguished for all these channels. This confirms that the DFR-1000 is sending the appropriate low-band antenna bandswitch code.

3__ Exercise the channel select push-buttons appropriately to select in succession channels 6, 7, 8, 9, and 0 on the **FREQ** indicator. The DTI-100A yellow **HI/LO BAND** indicator should illuminate for all these channels. This confirms that the DFR-1000 is sending the appropriate high-band antenna bandswitch code.

4__ Connect a DFS-1000 synthesizer if available (or use the one already connected) and set the **CRYSTAL/SYNTH** switch to **SYNTH** (up) and the **FREQUENCY/CHANNEL** switch to **FREQUENCY** (up). Set the 100 MHz (leftmost) digit to "1" and verify that the DTI-100A yellow **HI/LO BAND** indicator is extinguished. Exercise the DFR-1000 channel select push-buttons appropriately to select in succession all 10 channels. The DTI-100A yellow **HI/LO BAND** indicator should remain extinguished for all 10 selected channels. Skip this step if a synthesizer is not available.

5__ Set the DFS-1000 synthesizer 100 MHz digit to "4" and verify that the DTI-100A yellow **HI/LO BAND** indicator illuminates. Exercise the DFR-1000 channel select push-buttons appropriately to select in succession all 10 channels. The DTI-100A yellow **HI/LO BAND** indicator should remain illuminated for all 10 selected channels. This step (along with the immediately preceding step) verifies that the DFS-1000 synthesizer seizes control of DFR-1000 bandswitching functions and sends the appropriate code to the antenna. Skip this step if a synthesizer is not available.

6__ **Note:** If an older DTI-100 or DFA-400 DF bearing synthesizer is used in lieu of the DTI-100A, the above steps cannot be directly implemented as a consequence of the fact that these earlier units do not have the **HI/LO BAND** indicator. In such a case, the antenna bandswitch line can be verified by directly monitoring the **HI/LO** band pin on the DFR-1000 rear-panel **ANTENNA CONTROL** connector with a voltmeter or

oscilloscope. For units employing the standard 7-pin microphone connector, monitor pin 7 (the center pin). For units employing the 6-pin Bendix connector, monitor pin E (located at approximately 4 o'clock). In either case, a 0 VDC output corresponds to low-band and a 5 VDC output corresponds to high-band.

7__ Disconnect the DTI-100A from the signal generator and DFR-1000 and set it aside.

8__ Restore the test setup so that the DFR-1000 is again properly receiving a -55 dBm CW signal with a full-scale **SIGNAL STRENGTH** meter indication on either a high- or low-band frequency.

9__ Set the **MODE** switch to **CW** and the **BFO/FINE TUNE** control fully counter-clockwise to its detented **OFF** position. If setting the **MODE** switch to **CW** results in a lower **SIGNAL STRENGTH** meter indication, "rock" the signal generator frequency back and forth slightly as required to obtain a peak **SIGNAL STRENGTH** meter indication.

10__ Disconnect the coaxial cable from the signal generator to interrupt the signal input to the DFR-1000. A single high-pitched, short-duration "beep" should be heard (adjust the **VOLUME** control as required for a comfortable listening level).

11__ Reconnect the coaxial cable to the signal generator and set the signal generator output to -110 dBm. Wait approximately 20 seconds and again disconnect the coaxial cable. The short-duration beep should again be heard, but at a much lower pitch. This confirms proper range tone operation.

12__ Verify that the **SQUELCH** control is still set at 8 o'clock.

13__ Verify that the coaxial cable is still disconnected from the signal generator and enable the DFR-1000 motion sensor alarm by setting rear-panel dip-switch #3 to **ALRM ON** (down).

14__ Rotate the **SQUELCH** control fully counter-clockwise to its detented **ALARM SET** position. After 15-20 seconds, a continuous high-pitched tone (the motion sensor alarm) should sound.

15__ Rotate the **SQUELCH** control back to 8 o'clock and verify that the motion sensor alarm is disabled.

16__ Reconnect the coaxial cable to the DFR-1000, set the signal generator output to -55 dBm, and repeat the previous two steps. This confirms proper operation of the motion sensor alarm.

I. MISCELLANEOUS

1__ If the DFR-1000 is equipped with a computer interface, appropriately exercise this feature to confirm proper operation. **Note:** To obtain the specified 0.5° RMS bearing accuracy, set the **CRT** switch to **SLOW**.

2__ Disconnect all test equipment and restore the DFR-1000 rear-panel configuration

setup switches to their original positions (recorded in step V-A-9). If it is believed that some of these original switch settings are in error, resolve this matter first. Once these switches have been properly set, re-install the rear-panel crystal cover plate using the four captive thumbscrews (unless the optional crystal calibration procedure described in the following section is to be performed).

J. CRYSTAL CALIBRATION (OPTIONAL)

__ When testing the DFR-1000, it is good practice to trim any installed crystals precisely onto their nominal frequencies to counteract any possible crystal or oscillator circuitry aging. The procedure is straightforward for any user having a basic understanding of and familiarity with electronic test equipment. The adjustments are readily accessible without the need for removing the DFR-1000 outer cabinet. A detailed test procedure is provided in Appendix C of the DFR-1000A Operator's Manual. Note that the procedure requires a signal generator having a rated frequency accuracy of 1 ppm (part per million) or better.

VI RETURNING EQUIPMENT TO FACTORY FOR REPAIR

When returning equipment to the factory for repair, it is very important that the equipment be accompanied by a detailed report listing all symptoms, along with any background information regarding the circumstances that may have led to the failure. If a problem occurs intermittently or only in specific modes of operation, this should be noted as well. If the above user functional test procedure has been performed, the specific test(s) the unit failed should be listed. Before returning any equipment, please contact RF Products at (619) 583-2024 (Tel/Fax) or via e-mail at rfprodsdc@juno.com to obtain return authorization.

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