DFP-1010 DF BEARING PROCESSOR USER FUNCTIONAL TEST PROCEDURE

I   DESCRIPTION

This procedure provides users with the means to implement a "closed-box" functional test of the DFP-1010 DF Bearing Processor 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 outer cabinet be removed from the unit. 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 DFP-1010 to the factory for repair, since the results will quickly point the factory technician to the source of trouble.

Since implementing this procedure requires the use of DFControl (the computer interface software supplied with the DFP-1010), the user should be familiar with its basic operation. Users not familiar with DFControl should review Section IV of the DFP-1010 Operator's Manual (DFP-1010 OPERATION) prior to performing this procedure.

II   APPLICABILITY

As of this writing, this procedure is applicable to all DFP-1010 DF bearing processors beginning with serial number 001.

III   APPLICABLE DOCUMENTS

A.   RF Products DFP-1010 DF Bearing Processor/Display Operator's Manual (doc. # dfp1010_opm_01)

B.   RF Products DTI-100A DF Bearing Synthesizer Operator's Manual (doc. # dti100a_opm_01)

IV   TEST EQUIPMENT REQUIRED

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

B.   RF signal generator, 10.7 MHz frequency capability, 50 ohm output, with internal and external AM and FM modulation capability (HP 8640B, HP 8656B, HP 8657A/B, Marconi 2019A, or similar).

C.   Regulated DC power supply, +13.8 VDC nominal output with 1 ampere minimum output current capacity (Astron RS-7A or similar).

D.   Multi-meter, w/DC current measurement ability up to 1 ampere (Micronta 22-185A or similar).

E.   Windows 95/98/NT4 personal computer (120 MHz or faster) with uncommitted serial port and DFControl user software (supplied on the RF Products Publications CD included with the DFP-1010 Operator's Manual). DFControl must be Version 1.2 or higher.

F.   Audio monitor with speaker output and volume control.

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

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

I.   (Optional.) Frequency counter, 100-1000 Hz capability (Leader LDC-825 or similar).

V   TEST PROCEDURE

A.   PHYSICAL INSPECTION, MECHANICAL ALIGNMENT, & PRELIMINARY STEPS

1__   With the DFP-1010 disconnected from its power source, carefully inspect the unit for any signs of physical damage.

2__   Remove the fuse from the fuse-holder (located near the upper right corner of the front-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__   Remove the front-panel configuration setup cover plate (by first loosening the four captive thumbscrews) to expose the spare fuse and the configuration setup switches.

4__   (Optional.) Verify that the spare fuse is present (it is located immediately above the dip-switches and to the immediate left of the **DELAY COMP** switch). *Carefully* remove it from its two retaining clamps (by carefully prying from the left with a flat-blade screwdriver) and inspect it to verify that it is a GMA-type 5 mm x 20 mm 2.5 ampere fast-blow fuse (i.e., the same type as that was verified in step V-A-2 above). Also verify that this fuse is good, preferably using an ohmmeter. If an ohmmeter is unavailable, rely instead on visual inspection. Once verified, carefully reinstall the spare fuse in its retaining clamps.

5__   Some of the configuration setup switches will likely need to be changed from their current settings as part of this procedure. To facilitate returning these switches to their current settings at the completion of this procedure, record these settings in the spaces provided below:

IF SELECT_____   **DIP-SWITCH #8**_____

DELAY COMP_____   **DIP-SWITCH #9**_____

Note that the remaining dip-switch sections (1-7 and 10) are non-functional).

6__   Set the configuration setup switches as follows:

IF SELECT - 10.7   **DIP-SWITCH #8 - IF** (down)

DELAY COMP - 0   **DIP-SWITCH #9 - NORM** (down)

Verify that the remaining dip-switch sections (1-7 and 10) are down.

B.   **POWER-UP TEST**

1__   Set the **DC POWER** switch to **OFF** and then connect the DFP-1010 to the +13.8 VDC regulated power source.

2__   Power-up the DFP-1010 by setting the **DC POWER** switch to **ON** and verify that the power indicator lamp (part of the **DC POWER** rocker switch) illuminates.

3__   Verify with the multi-meter that the current drawn by the DFP-1010 from the +13.8 VDC supply is approximately 450 milliamperes. *Be sure nothing is connected to the* **ANTENNA CONTROL**, **11-16 VDC** *power output, or* **REMOTE** *connectors while conducting this measurement*.

4__   Remove the power cable from the lower 11-16 VDC power connector and connect it instead to the upper 11-16 VDC power connector (after first removing its tethered protective cap). Verify that the unit still powers-up.

C.   **COMPUTER INTERFACE TEST**

1__   Set the **DC POWER** switch to **OFF**.

2__   Connect the computer interface cable between the DFP-1010 **REMOTE** connector and the host computer serial port.

3__   Install the supplied user software DFControl (V1.2 or higher) and its associated files in the host computer as discussed in Section IV-C-2 of the Operator's Manual ("Installing DFControl").

4__   Set the **DC POWER** switch back to **ON**.

5__   Confirm that dip-switch #8 is still set to **IF** (down) and verify that the audio cable (and any attached adaptor) has been removed from the DFP-1010 **AM AUDIO IN** jack.

7__   Start DFControl and verify that it is able to "handshake" with the DFP-1010 as indicated by the appearance a green status light on the main user screen. See DFP-1010 Operator's Manual Section IV-C-3 ("Starting And Exiting DFControl"). If DFControl will

not start, follow the troubleshooting steps discussed in that Section.

D.   LISTEN-THROUGH TESTS

1__   Restore all of DFControl's **Operating Modes** to their default attributes. To do this, first click **Configure** and then **Operating Modes**. Once done, click the **Restore to Defaults** bar for the current **Mode to Edit** (represented by a number from 1 to 10). Next, repeat this process for the remaining 9 **Modes to Edit** so that all 10 **Operating Modes** are reset to their default attributes.

2__   Connect the audio monitor to the **LINE AUDIO OUT** phono jack.

3__   Set the **Operating Mode** is to **FM Voice**, verify that the **IF Bandwidth** is set to **Wide**, and set the **Audio Output** to **Enabled**.

4__   A hissing sound should be audible from the audio monitor. Adjust its volume control as required for a comfortable listening level.

5__   Verify that the hissing sound can be muted by setting the **Audio Output** to **Disabled**. Once verified, reset to **Enabled.**

6__   Without changing the setting of the audio monitor volume control, change the **Operating Mode** to **AM Voice** and verify that the hissing sound greatly diminishes in volume as compared to **FM Voice**. Verify that the **IF Bandwidth** is still set to **Wide**.

7__   Increase the audio monitor volume control as required so that the hissing sound is again plainly audible.

8__   Set the **Operating Mode** to **SSB Voice** and verify that the hissing sound is similar in volume as compared to **AM Voice**, but lower in pitch. Also verify that this causes the **IF Bandwidth** to change to **Narrow**.

9__   With the **Operating Mode** still in **SSB Voice**, change the **IF Bandwidth** to **Wide** and verify that the hissing sound becomes higher in pitch as a result.

10__   Return the **Operating Mode** to **FM Voice**, set up the signal generator for a 10.700 MHz -60 dBm CW output and connect the signal generator RF output to the DFP-1010 **IF IN** jack through a short length of 50 ohm coaxial cable.

11__   Verify that the application of the 10.700 MHz CW signal to the DFP-1010 fully quiets the FM hissing sound and results in an approximately half-scale meter indication. (Be sure that the **Meter Type** is set to **Signal Strength**.)

12__   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 audio monitor volume control as required for a comfortable listening level.

13__   Verify that the **Signal Strength Meter** is still at approximately half-scale.

14__ (Optional.) Disconnect the audio monitor and connect the oscilloscope to the **LINE AUDIO OUT** jack using an appropriate interface cable. Verify that a reasonably undistorted 1 kHz sine wave is visible on the oscilloscope with a typical amplitude of 0.3 volts peak-to-peak. Note that the actual amplitude may vary considerably.

15__ Disconnect the oscilloscope and reconnect the audio monitor to the **LINE AUDIO OUT** jack.

16__ Set the **Operating Mode** to **AM Voice** and reconfigure the signal generator for 50% internal AM at a 1 kHz modulation rate (be sure to disable signal generator FM) at the same -60 dBm output level. A clean-sounding 1 kHz tone should again be plainly audible. Adjust the audio monitor volume control as required for a comfortable listening level.

17__ Verify that the **Signal Strength Meter** is still at approximately half-scale.

18__ (Optional.) Disconnect the audio monitor and connect the oscilloscope to the **LINE AUDIO OUT** jack using an appropriate interface cable. Verify that a reasonably undistorted 1 kHz sine wave is visible on the oscilloscope with a typical amplitude of 0.5 volts peak-to-peak. Note that the actual amplitude may vary considerably.

19__ Disconnect the oscilloscope and reconnect the audio monitor to the **LINE AUDIO OUT** jack.

20__ Set the **Operating Mode** to **SSB Voice** and reconfigure the signal generator for a -60 dBm CW (unmodulated) output at 10.701 MHz. A clean-sounding tone near 1 kHz should again be plainly audible. If a tone near 1 kHz is not heard, change the signal generator frequency slightly as required. Adjust the audio monitor volume control as required for a comfortable listening level.

21__ Verify that the **Signal Strength Meter** is still at approximately half-scale.

22__ (Optional.) Disconnect the audio monitor and connect the oscilloscope to the **LINE AUDIO OUT** jack using an appropriate interface cable. Verify that a reasonably undistorted 1 kHz sine wave is visible on the oscilloscope with a typical amplitude of 0.6 volts peak-to-peak and then disconnect the oscilloscope. Note that the actual amplitude may vary considerably.

23__ Restore the signal generator frequency to 10.700 MHz.

24__ Change the **Meter Type** command field to **Center Tune** and verify that the meter indicates zero (plus or minus half a division) on the tuning scale.

25__ Increment the signal generator frequency upward in 1 kHz steps, stopping at 10.704 MHz and verify that the meter correctly tracks this change (the tuning scale is calibrated in steps of approximately 1 kHz). In a similar fashion, verify that the tuning meter again correctly tracks the frequency change when the signal generator frequency is incremented downward in 1 kHz steps, stopping at 10.696 MHz.

26__ Return the signal generator frequency to 10.700 MHz, change the **Meter Type** to

Signal Strength, disconnect the audio monitor, and leave the test setup intact for the tests that follow.

E.   BEARING DISPLAY TESTS

1__   Verify that the signal generator is still set for a 10.700 MHz -60 dBm CW output and confirm that nothing is plugged into the **AM AUDIO IN** jack.

2__   Set the **Operating Mode** to **FM Voice** and verify that the **IF Bandwidth** is set to **Wide**.

3__   Set the **Video Gain** to **Low Gain** and verify that the **Track & Hold** is set to **Off**, **Antenna Orientation** to **Ground**, **Bearing Offset** and **Averaging Time** both to **0.0**, and DF operation not disabled.

4__   Configure the bearing display for 0.2° resolution. To do this, first click **Configure**, then **Display Options**, then **0.2**.

5__   Connect the DTI-100A DF Bearing Synthesizer to the signal generator and DFP-1010 (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 30% 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 30% modulation level).

6__   A 0° bearing should now be visible with a full-length analog bearing display bearing vector, and a numeric bearing display indication of 0° (+/- 1.0°).

7__   Verify that the center dot in the analog bearing display is yellow (as opposed to red).

8__   Rotate the DTI-100A **AZIMUTH** selector in succession to the remaining 11 azimuths and confirm that the correct bearings are indicated on both the analog and numeric bearing displays. All azimuths should be correct to within 1.0°.

9__   Set the DTI-100A **AZIMUTH** selector back to 0°. With the **Operating Mode** still set to **FM Voice**, rotate the DTI-100A **AZIMUTH** selector to 315°. The analog bearing display vector should correspondingly move from 0° to 315° in approximately 2 seconds.

10__   Change the **Operating Mode** to **CW Beacon** and wait a moment for the display to settle. Rotate the DTI-100A **AZIMUTH** selector from 315° back to 0°. The analog bearing display vector should correspondingly move from 315° to 0° in just under one second.

11__   Change the **Operating Mode** to **A.I.D. Beacon** and wait a moment for the display to settle. Rotate the DTI-100A **AZIMUTH** selector from 0° to 315°. The analog bearing display vector should correspondingly move from 0° to 315° in approximately half a second.

12__   Set the **Operating Mode** back to **FM Voice** and the **Video Gain** to **High Gain**.

13__ Rotate the DTI-100A **AZIMUTH** selector back to 0°, set the signal generator external AM modulation percentage to 0% and then *slowly* increase it while observing the yellow center dot in the analog bearing display. Verify that the dot changes from yellow to red when the modulation percentage reaches 15% or so and note this percentage.

14__ *Slowly* decrease the signal generator external AM modulation percentage while observing the red dot. Verify that the dot changes from red back to yellow when the modulation percentage reaches a level approximately three percentage points less than that observed in the previous step.

15__ Note that the analog bearing display has three concentric rings (two closely spaced outer rings containing the azimuth calibration marks and a much smaller gray inner ring closer to the center dot). The two outer rings change from green to yellow when the bearing vector reaches (or begins to exceed) full-scale. Verify that these two outer rings are yellow.

16__ Set the **Operating Mode** to **CW Beacon**.

17__ Reset the signal generator external AM modulation percentage to 30% and then rotate the DTI-100A **GAIN** control slowly counter-clockwise (to reduce modulation) until the bearing vector length is approximately half-scale. Verify that the two yellow outer rings change to green as a result.

18__ Carefully rotate the DTI-100A **GAIN** control clockwise until the two outer rings *just* change from green to yellow. If this step seems "tricky" and difficult to implement precisely, try first reducing the signal generator external AM modulation percentage.

19__ Change the **Video Gain** from **High Gain** to **Low Gain**. The bearing vector should diminish in length to 25% of what it was when the **Video Gain** was set to **High Gain**, and should now be very close in length to the radius of the gray inner ring.

20__ Set the **Track & Hold** to **T&H On,** the **Operating Mode** to **FM Voice**, and restore the signal generator external AM modulation percentage to 30% (appropriately resetting the DTI-100A **GAIN** control as required).

21__ Disconnect the coaxial cable from the signal generator to interrupt the signal input to the DFP-1010. The 0° analog display vector should remain "frozen" for approximately 2.5 seconds before it disappears. **Note 1:** 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 RF output (with some signal generators, these switches only partially disable the RF output). **Note 2:** Some DFP-1010's may be customized for hold times other than 2.5 seconds.

22__ Change the DTI-100A **AZIMUTH** selector from 0° to 90°, restore the signal generator output to the DFP-1010, and repeat the previous step.

23__ Repeat the previous step for a DTI-100A **AZIMUTH** selection of 45°. Observe the bearing carefully to verify that it does not drift during the 2.5 second "hold" period.

24__ Again restore the signal generator output and set the **Track & Hold** to **T&H Off**.

25__ Set dip-switch #9 to **RECP** (up). The bearing should change from 45° to 225° as a result. Return dip-switch #9 to **NORM** (down).

26__ Rotate the DTI-100A **AZIMUTH** selector to 0° and set the **Video Gain** to **High Gain** and the **Operating Mode** to **CW Beacon**.

27__ Increase the signal generator external AM modulation percentage to 50% and set the RF output level to -130 dBm.

28__ Verify that a 0° bearing vector is present with a length approximately 30-50% full-screen. Although bearing jitter will be present, the bearing should nonetheless 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 azimuth change should be clearly discernable. This step confirms DF sensitivity.

29__ Disconnect the DTI-100A from the DFP-1010.

F. **AGC TESTS (Optional)**

1__ Set up the signal generator for a 10.7 MHz -20 dBm CW output.

2__ Verify that the **Meter Type** command field is still set to **Signal Strength** and reduce the output level of the signal generator as required for an **Signal Strength** meter reading of *just slightly less* than full-scale (but not greater than -20 dBm.)

3__ Set the **Operating Mode** to **CW Slow,** wait a moment or two for the change to take effect, then disable the signal generator RF output (do this either via the signal generator carrier on/off switch or by rapidly disconnecting the coaxial cable). The **Signal Strength** meter indication should fall to 1.5 (i.e, 15% full-scale) in approximately 2 seconds. Repeat this step as many times as necessary for confirmation, but once completed, *leave the signal generator RF output disabled before proceeding to the next step*.

5__ Set the **Operating Mode** to **A.I.D. Beacon**, wait a moment or two for the change to take effect, restore the signal generator RF output, then again disable the signal generator RF output. The **Signal Strength** meter indication should fall to 1.5 in approximately (typically just under) 1 second. Even though it may be difficult to precisely gauge the amount of time required for the **Signal Strength** meter indication to fall, it should fall noticeably faster than in the previous step. If necessary, repeat both the previous step and this step for comparison as many times as required for confirmation, but be sure to *leave the signal generator RF output disabled prior to changing the* **Operating Mode**.

6__ Set the **Operating Mode** to **CW Fast**, wait a moment or two for the change to take effect, restore the signal generator RF output, then again disable the signal generator RF output. The **Signal Strength** meter indication should fall to 1.5 in approximately (typically just under) 0.5 second. Even though it may be difficult to precisely gauge the

amount of time required for the **Signal Strength** meter indication to fall, it should fall noticeably faster than in the previous step. If necessary, repeat both the previous step and this step for comparison as many times as required for confirmation, but be sure to *leave the signal generator RF output disabled prior to changing the **Operating Mode***.

G.   ANTENNA BANDSWITCHING TESTS

1__   Set the **DF Antenna Model** to **Generic** and the **DF Antenna Band** to **Band #2**.

2__   Using a voltmeter or oscilloscope, probe pins 3, 4, and 7 of the **ANTENNA CONTROL** connector to verify the correct logic states .   Refer to DFP-1010 Operator's Manual Appendix D (DFP-1010 FRONT-PANEL MULTI-PIN CONNECTOR PIN-OUTS) for the pin-out of this connector. Also refer to the DF ANTENNA BAND 3-BIT LOGIC CODES table in Appendix I (DF ANTENNA FREQUENCY COVERAGE INFORMATION) of this same manual for the correct logic states and their corresponding voltage levels.

CAUTION

Be careful not to short adjacent pins to each other or to the connector shell while conducting this measurement.

3__   Repeat the above step for **DF Antenna Bands 3-9**.

H.   TONE TESTS

1__   Set the DFControl **Operating Mode** to **FM Voice** and confirm that DF operation is enabled.

2__   Probe pin 1 of the DFP-1010 rear-panel **ANTENNA CONTROL** connector with the o'scope and verify the presence of a 1.0 VPP clean sine wave (the X-axis tone). Using a frequency counter, verify that the tone frequency is 133 Hz (for standard units). *Be careful not to short-circuit adjacent pins in this and the following steps.*

3__   In a similar fashion, probe pin 2 of the **ANTENNA CONTROL** connector and verify the presence of a 1.0 VPP clean sine wave (the Y-axis tone). Using a frequency counter, verify that the tone frequency is 160 Hz (for standard units). Pin 2 is immediately counter-clockwise from pin 1.

4__   Set the **Operating Mode** to **A.I.D. Beacon** and repeat the previous two steps. The X- and Y-axis tone frequencies should now be 533 Hz and 640 Hz, respectively (and still 1.0 VPP clean sine waves).

5__   Set the **Operating Mode** to **Spare 2**, click **Configure**, click **Operating Modes**, then select **Medium Tones**. The X- and Y-axis tone frequencies should now be 267 Hz and 320 Hz, respectively (and still 1.0 VPP clean sine waves).

I. <u>FINAL STEPS</u>

__ Disconnect all test equipment and restore the DFP-1010 front-panel configuration setup switches to their original positions (recorded in step V-A-5). 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 front-panel configuration setup cover plate using the four captive thumbscrews. Re-install the tethered protective cap to the upper 11-16 VDC power connector if this has not already been done.

VI <u>RETURNING EQUIPMENT TO FACTORY FOR REPAIR</u>

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) 583-2024/2140 (Tel/Fax) or via e-mail at mail@rfproducts-rdf.com to obtain return authorization.