



**Model: RLR-465NX**

***UHF, NXDN™ Digital Liberty Repeater, 10 W, 6.25 kHz***

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## **ALIGNMENT AND DUPLEXER TUNING INSTRUCTIONS**

*FOR USE BY AUTHORIZED SERVICE/MAINTENANCE PERSONNEL ONLY*

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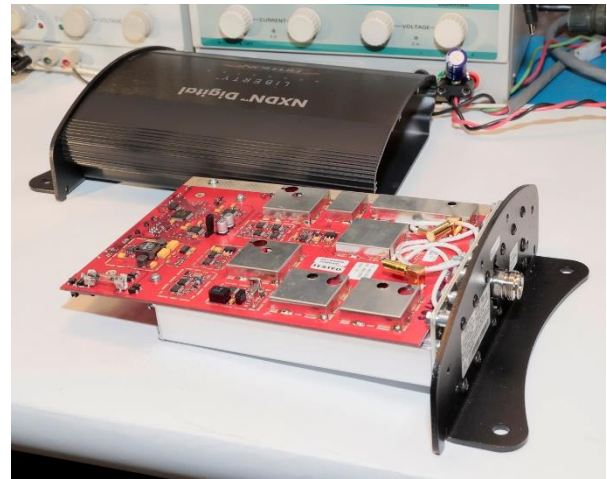
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## DISASSEMBLY

Remove the power and interface connectors before disassembling the unit. The unit is disassembled for alignment/service by removing the six T-10 torx screws from the end plate with the antenna connector as indicated by the white arrows. The cover with the other end plate is then slid off.



## DUPLEXER

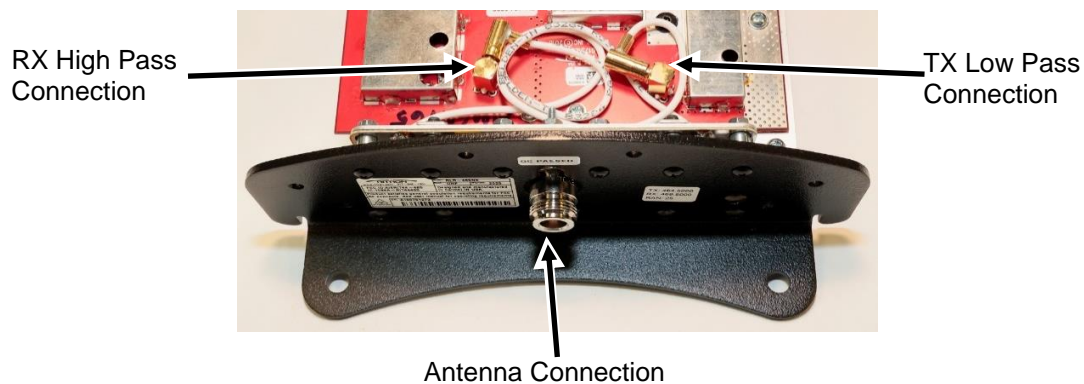
The duplexer allows the Repeater to simultaneously transmit and receive. To accomplish this, the receive input path must suppress (notch) the transmitter signal by 65dB or more. In addition, on the transmit path, transmitter noise on the receive frequency must be also suppressed by about 65dB. The duplexer contains four cavities, two for each path to achieve the necessary notch depth. Because the notches are very narrow, the duplexer must be re-tuned if the frequency of operation is changed by more than 50 kHz. Follow the procedure below to tune the duplexer:

1. Unplug the two RF cables connecting the duplexer to the main PCB.
2. View video in the attached link for Duplexer Tuning Instructions.

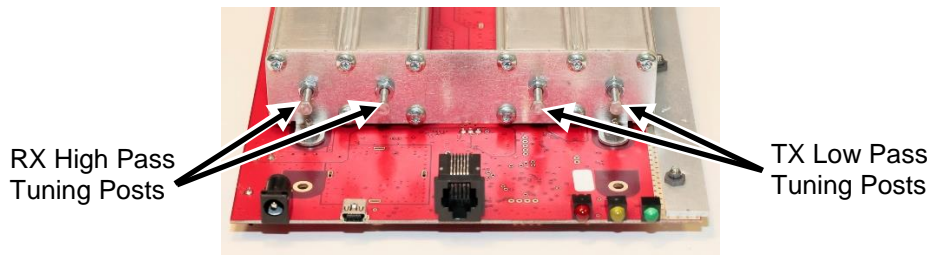
Instructions for Freedom R8100: <https://www.youtube.com/watch?v=V16Wz8JfJ1U>

Instructions for Aeroflex 3920: <https://www.youtube.com/watch?v=jaCaCWUDI5s>

Generic Tuning Instructions: [https://www.youtube.com/watch?v=tf5h\\_wz9G2o](https://www.youtube.com/watch?v=tf5h_wz9G2o)  
<https://www.youtube.com/watch?v=jtwJOSLLqG4>



Note that the duplexer cables are terminated in female SMB connectors. An adapter will most likely be required to mate with the cables to/from the test set/equipment. SMB Adapters can be purchased from most electronic component suppliers.

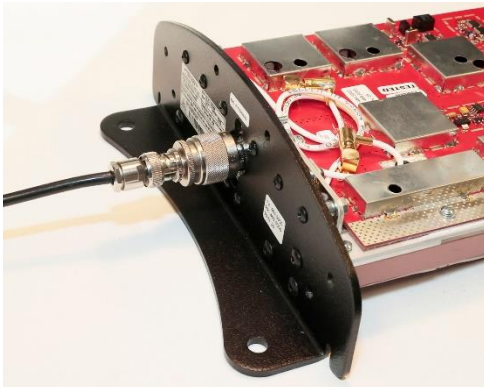


### PRELIMINARY

1. When aligning the RLR-465NX Repeater with the PC programming Software, NXDN mode is disabled so that Analog Service Monitors can be used for the RF adjustments and measurements. The analog adjustments have been correlated to NXDN performance so that once the repeater is aligned for analog operation it will be also automatically aligned for NXDN once the Repeater is returned to normal NXDN operation.
2. Alignment of the Repeater requires connection to the pins on the front panel modular jack. The attached photos will show the use of a matching modular plug and cable with breakout wires.
3. The frequency deviation numbers shown are for super-narrow (6.25 kHz channel spacing) operation.
4. Ensure that the Repeater is properly programmed for the correct Transmit and Receive Frequency and the correct RAN Code.
5. Refer to the RLR-465NX ALIGNMENT POINTS diagram at the end of these instructions and the accompanying photos for the location of alignment points and adjustments.
6. If the Duplexer required re-tuning, reconnect the RX and TX SMB connections to the RX and TX RF Input connectors on the Radio Board Assembly.

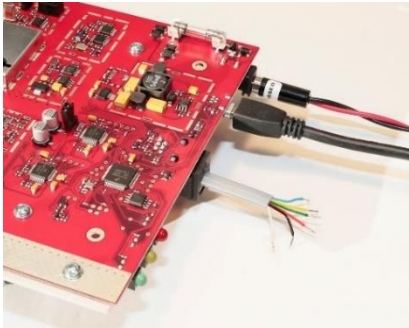


7. Connect the Repeater Antenna Port to the Full Duplex RF Input/Output of the Service Monitor. Provisions should be made to couple the RF output signal to a demodulator, a frequency counter, and an RF wattmeter. The demodulated output must be viewable on an oscilloscope.



8. Set the Service Monitor to receive the Transmit Frequency of the Repeater, and to generate the Receive Frequency of the Repeater.

9. a. Connect +13.8 Vdc to the DC Input of the Repeater. For the DC Power Jack, the center connection is positive(+) and the outer sleeve is negative(-).  
b. Connect the USB Connector of the PC Programming Cable to the mating USB Connector on the radio assembly.  
c. Connect an RJ-12 Connector and Cable with trimmed leads to the mating connector on the Radio Assembly.



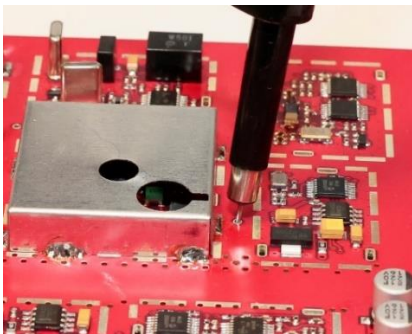
10. Start the RLR-PCPS Programming Software. Select Repeater/Read to Read the radio information.
11. Verify the TX Frequency, RX Frequency, and RAN Code.

## RECEIVER

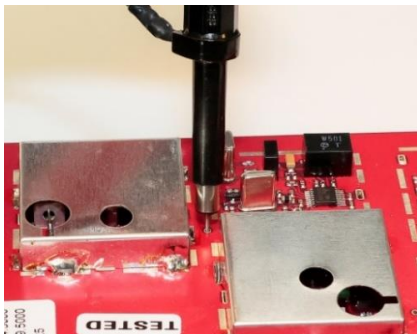
### RX VCO Band and Reference Oscillator Adjustment

**NOTE: After each adjustment, click on the “Program Repeater” button then the “Read Repeater” button to save and read the radio information.**

- 1) Go to the “Alignment” tab and click “Frequency/Power” then “Center Frequency on Repeater Frequency”. This will load the repeater local oscillator frequency into the RX synthesizer.  $LO(freq) = RX(freq) - 43.650 \text{ MHz}$ .
- 2) Measure tuning voltage on TP102. The VCO tuning voltage will range from about 1 Vdc at 450 MHz to 4 Vdc at 470MHz.



- 3) Connect probe from the Frequency Counter to the Receiver Local Oscillator test point TP101 and measure the Repeater LO Frequency.

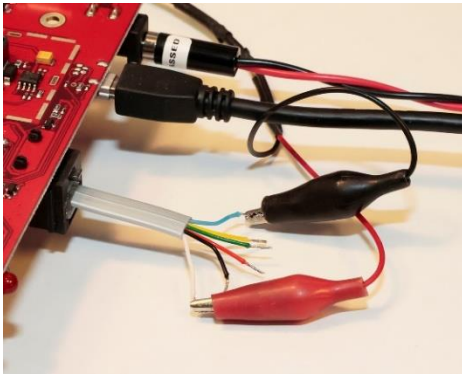




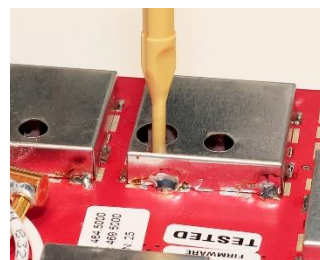
- 4) Adjust "RX Freq Trim" to within +/- 50 Hz of LO Frequency on the Frequency Counter.
- 5) Click the "Main" tab.

#### RX Filter Alignment and Sensitivity

- 6) Set signal generator RF output level to -118 dBm with 1.5 kHz deviation of a 1 kHz tone.
- 7) Connect the SINAD meter to Pin 6(de-emphasized output) and Pin 1(Gnd) of the RJ-12 connector.



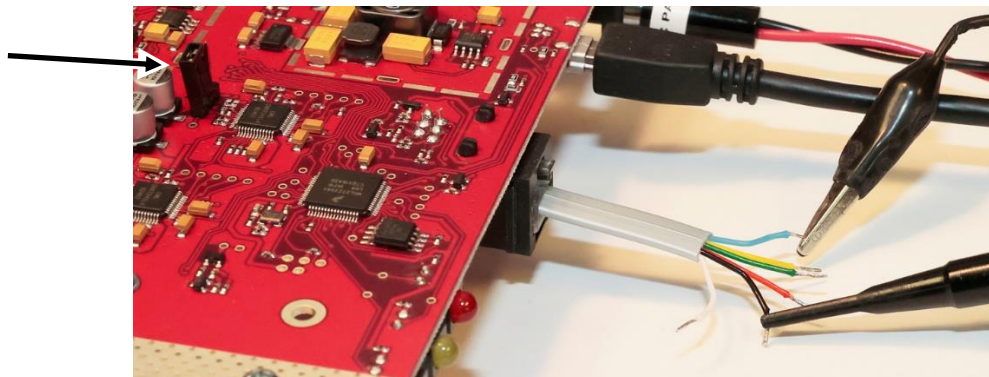
- 8) Adjust C102, C108, C115 and C121 to maximize SINAD. The signal generator RF output level can be temporarily set higher if needed to see the demodulated 1 kHz sine wave. Unit should obtain at least -118 dBm (-120 dBm typically) sensitivity for a 12 dB SINAD when tuned up is completed.



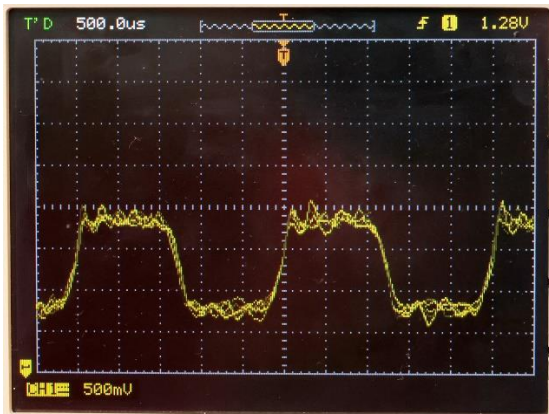
#### 2<sup>nd</sup> IF Local Oscillator Filter Distortion

- 9) Modulate RX carrier frequency with square wave of 400 Hz. Raise the signal generator RF Output Level amplitude to about -110 dBm.
- 10) Click the "Alignment" tab, the "Miscellaneous" button, and then the "IF Trim" radio button. Connect scope probe to the Pin 5(flat output port) and Pin 1(Gnd) of the RJ-12 connector. Jumper J308 should be connecting pins 2 and 3 to get the RX signal. These are the lower two pins as seen on the picture below. This is the factory default.

J308  
Default Position



- 11) Adjust the “IF Trim” for equal amplitude of the noise on the top and bottom of the demodulated and band pass limited square wave as shown in the photo below. This adjusts the 43.2 MHz 2nd local oscillator frequency to center the signal in the 450 kHz pass band. The DC discriminator output level will also vary as this is adjusted. The adjacent channel rejection is also affected by this tuning.



### Squelch

- 12) Although squelch levels are not used in NXDN communications the carrier detect amber LED can be set to serve as a diagnostic of channel activity. Recall that the amber LED will flash when RSSI detection level is exceeded and be a solid color when and if an NXDN signal is detected.
- 13) Click the “Alignment” tab then “CD Calibration” and follow the instructions on that tab. Here you will calibrate at two predefined RF levels and once done set the squelch on and off levels in the two other boxes. This is done by typing in your desired “Carrier Detect ON” and “Carrier Detect OFF” levels in the boxes. The yellow RX LED will blink when a carrier is detected in this range.

## **TRANSMITTER**

- 1) Verify the TX Duplexer Input Port is connected to the TX RF port J201 of the PCB.

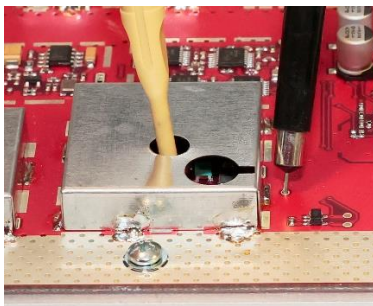
### TX Frequency Adjustment

**NOTE: After each adjustment, click on the “Program Repeater” button then the “Read Repeater” button to save and read the radio information.**

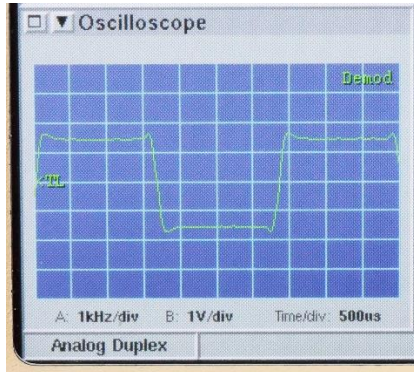
- 2) Click the “Alignment” tab, the “Frequency/Power” button, and then click “Center Frequency on Repeater Frequency” button. By clicking the “Transmit” button at the top of the form you can now adjust the TX Frequency of the Repeater to within +/- 50 Hz. Click the “Transmit” button to stop transmitting.

### TX VCO Band, Modulation Balance and Deviation Adjustment

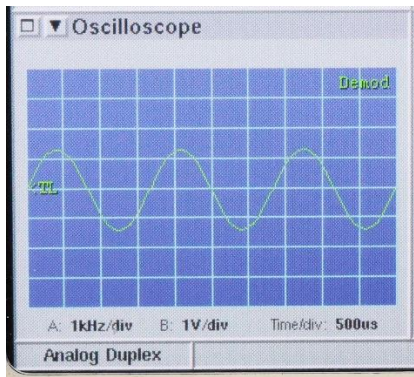
- 3) a. Click the “Alignment” tab and then the “Deviation/Balance” button. Now select “Auto alignment- Upper Edge Balance”. Click the “Transmit” button. Transmit Frequency is 470 MHz, the VCO tuning voltage at TP201 should measure 4.0 +/- 0.2 Vdc, if not, adjust C296.



- b. Adjust the “Auto alignment- Upper Edge Balance” slider bar to yield flattest square wave on the transmitter recovered audio. Click the “Transmit” button to stop transmitting.



- c. Repeat this for the “Auto alignment- Lower Edge Balance”. The Transmit Frequency is 450 MHz, the VCO tuning voltage at TP201 should measure 0.8 +/-0.2 Vdc.
- d. Select “Auto alignment- Upper Edge Deviation” and click the “Transmit” button. Adjust the slider to yield 1350 +/- 50 Hz peak deviation. Here, an internal 600 Hz sine wave is generated. Click the “Transmit” button to stop transmitting.



- e. Repeat the above procedure for “Auto alignment- Lower edge Deviation”.

#### TX Power Adjustment

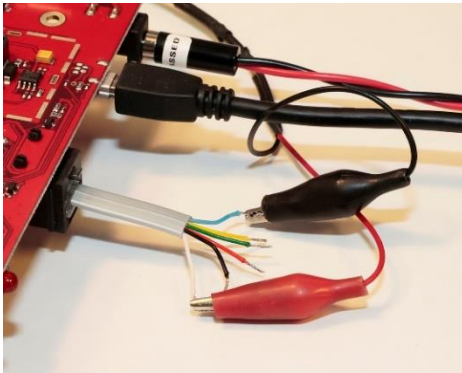
- 4) To set the power, click “Alignment” tab and “Frequency/Power”. Select “High Power on repeater frequency” and click the “Transmit” button. Set the slider bar to desired power between 2 and 10 W.
- 5) Click the “Transmit” button. Adjust RF Output capacitor C206 for maximum power. Look at the power supply current draw and adjust to minimize current if possible. A non-metal tuning tool must be used to avoid incorrect tuning.



- 6) Select "Low Power on repeater frequency" and click the "Transmit" button. Adjust C206 for 2 Watts. This will be the reduced power output should the repeater PCB temperature ever exceed 55 °C. This power output will persist until the temperature drops 52 °C. Click the "Transmit" button then the "Program Repeater" button to save the settings.

#### TX/RX Sensitivity De-sense

- 7) Click on the "Main" tab. Set the Service Monitor to generate the Receive Frequency of the Repeater. Generate a 1kHz Tone at +/-1.5 kHz deviation at a level of -120 dBm.
- 8) Connect the SINAD meter to Pin 6(de-emphasized output) and Pin 1(Gnd) of the RJ-12 connector.



- 9) The SINAD Meter should measure approximately 14 dB.
- 10) Click the "Transmit" button.
- 11) The SINAD measurement should not change more than 0.5 dB. Click on the "Transmit" button to stop transmitting.

#### CWID Deviation Adjustment

- 12) Click on the "Alignment" tab, "Miscellaneous" button, and then select CWID Amplitude.
- 13) Set the Service Monitor to receive the Transmit Frequency of the Repeater. Click on the "Transmit" button and set CWID Amplitude slider for +/-1.5 kHz deviation as measured on the Deviation Meter.

#### **RE-ASSEMBLY**

1. Disconnect all equipment from the repeater radio assembly.
2. To re-assemble the repeater, slide the radio assembly into the open end of the repeater enclosure.





3. Be sure that the connectors and LEDs line up with the openings at the closed end of the repeater enclosure. Insert and tighten the six T-10 torx screws into the end plate with the antenna connector as indicated by the white arrows.



4. The re-assembly is complete.

## RLR-465NX ALIGNMENT POINTS

