

Noble Radio NR-PAN7 Panoramic Adapter for the Drake TR-7



Description

The NR-PAN7 is a Panadapter designed specifically to operate in conjunction with the Noble Radio NRV7 DDS VFO to create a spectral display and rig control environment for the Drake TR7 using Ham Radio Deluxe and HSDR programs running on a Windows based PC. The combination of the NR-PAN7, NRV7 and the aforementioned software will allow “point and click” freq control of the TR7 using a mouse on the HSDR spectral display. The frequency may also be controlled by the HRD rig control interface as well as the main tuning knob of the NRV7. This combination creates a powerful control and logging environment for the TR7.

While designed to be used with the NRV7, the NR-PAN7 can also be used as a stand alone adapter to create a spectral frequency display for the TR7 but will not show the correct operating frequency on the spectral display or allow control of the frequency by the HSDR program.

The novel approach to the way the NR-PAN7 has been designed allows for a very easy solution to adding a Panadapter to the TR7. The conventional approach is to add a tap off of the 48.05 MHz IF signal path in the TR7's Up Converter board. This is a complicated procedure and requires major disassembly of the radio. Installation of the NR-PAN7 does not require any boards to be removed from the radio. The entire modification to the TR7 is done on the bottom of the Parent Board and only requires removal of the bottom cover. The simple installation is achieved by duplicating the Up Converter board function in the NR-PAN7. It creates its own 48.05 MHz IF signal that tracks the signals in the TR7's IF because it uses the local oscillator from the TR7 to generate its own IF signal. The signal from the antenna is bandpass filtered to remove signals below 1.7 MHz and above 35 MHz and then converted to 48.05 MHz and then bandpass filtered again before going to its own IF amplifier stage where it is amplified and applied to an SDR receiver that connects to the PC environment with a USB connection.

HSDR is used for the spectral display because it is a freeware program with many features and also connects to Ham Radio Deluxe via a DDE link so that no virtual com ports are required to use a rig control / logging program as well as a spectral display program to control the same radio. This makes for a very easy software installation and control / logging environment for the vintage Drake TR7.

The installation of the PAN7 requires a small amplifier/buffer board to be mounted on the bottom of the Parent Board where it picks up the operating voltage and Local Osc signal from the Parent Board with 3 connections. A supplied coax cable (to carry the LO signal to the NR-PAN7) is routed through the slots in the bottom cover and attached to the Amp / Buffer board to complete the modification. The Antenna signal is picked up from the EXT ANT jack on the rear panel of the TR7. There is also a 12 pin connector at the end of a cable from the PAN7 which plugs into the Accessory Jack on the back of the TR7. These connections are all that is required for the Panadapter to operate with the TR7. The SDR is connected to the PC via the USB connector on the NR-PAN7. The Accessory Jack connection provides power for the NR-PAN7 as well as the required signals to mute the Panadapter during transmit thus preventing severe overload of the spectral display. A small amount of signal will feed through to the spectral display during transmit and can be used for spotting during CW operation as well as checking the bandwidth of the transmitted signal on SSB.

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Installation of the NR-PAN7 into the TR7

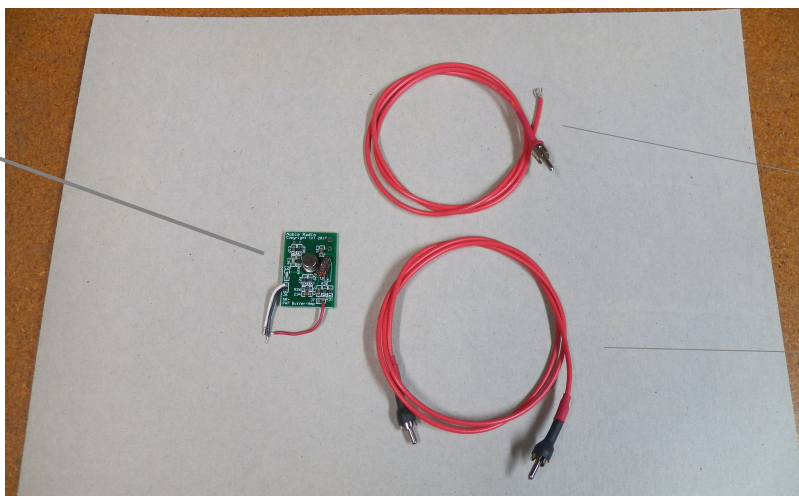
The following items are supplied with the NR-PAN7.

- 1> NR-PAN7 unit
- 2> Antenna Input cable
- 3> Local Oscillator cable
- 4> USB Cable
- 5> PA7 Amplifier Buffer board
- 6> Insulating Fiber board
- 7> Cable ties for securing the LO coax inside the TR7



NR-PAN7 MAIN UNIT

PA7
AMP/BUF
BOARD

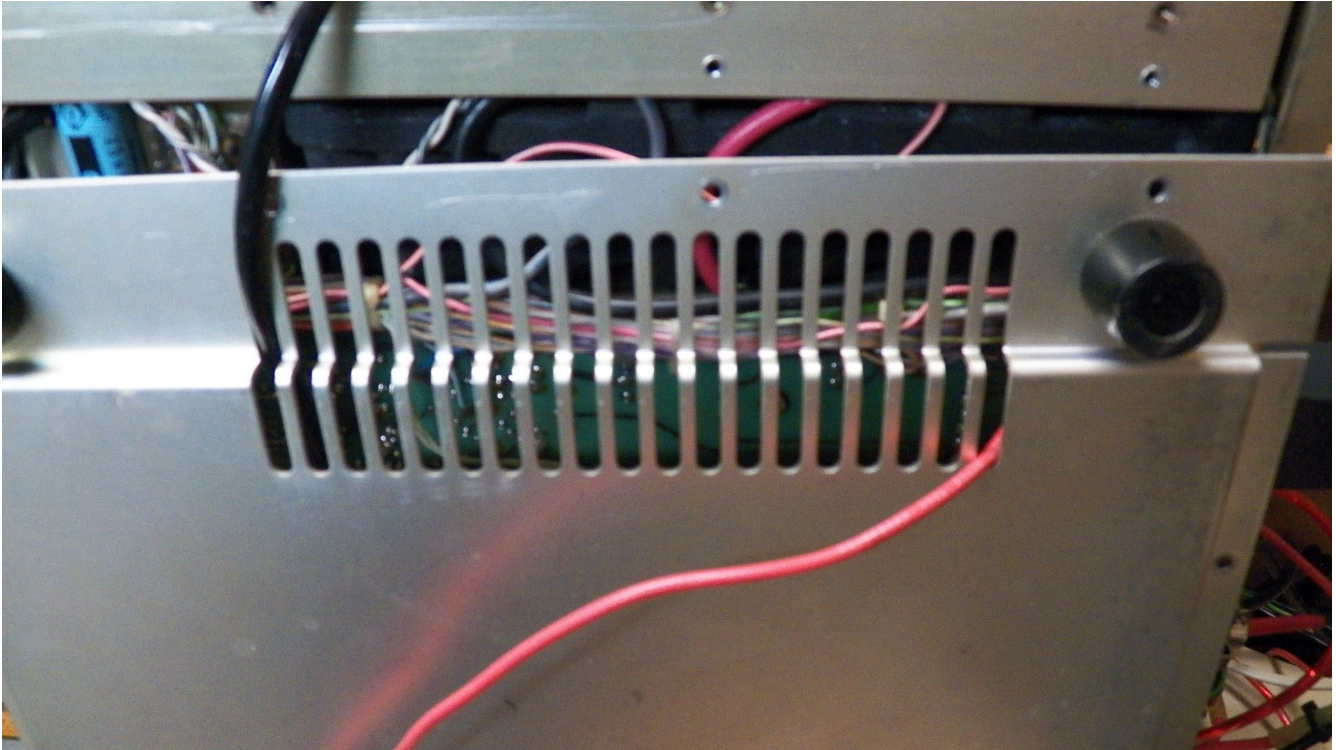


LO CABLE

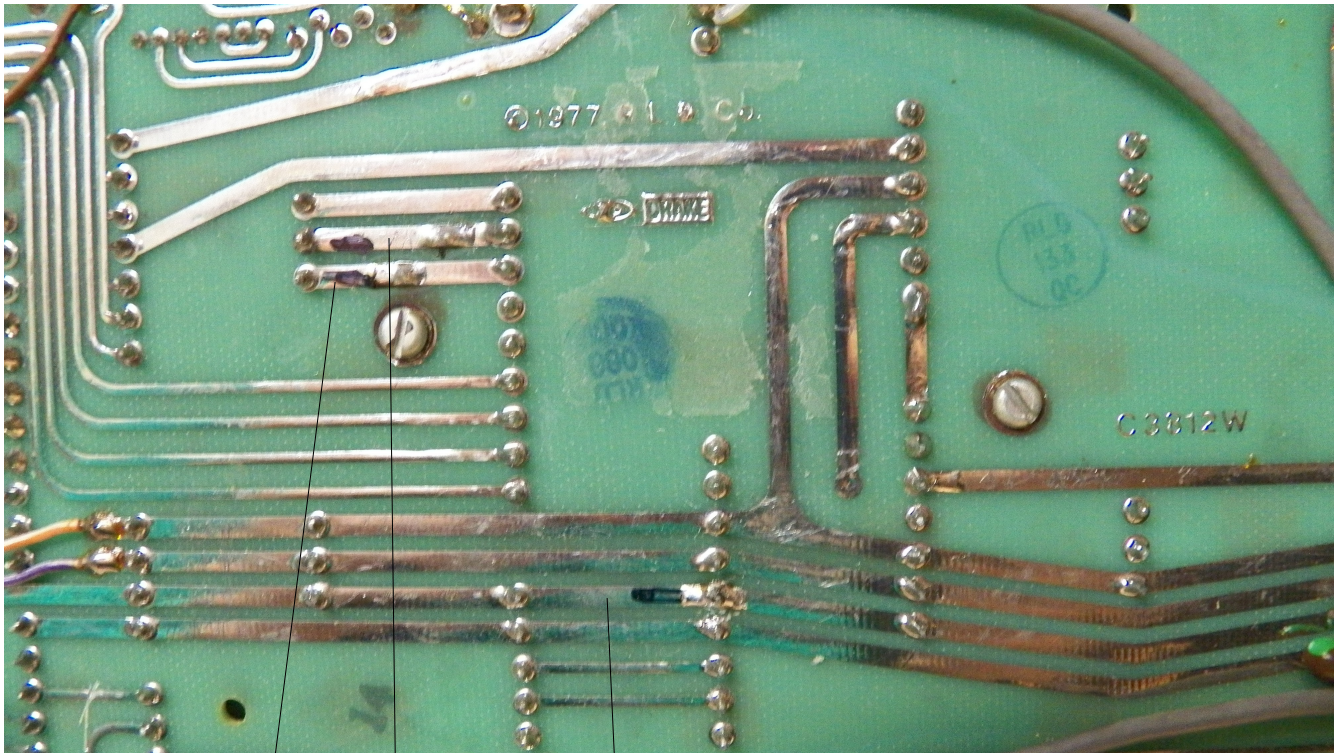
ANT
CABLE

INSTALLING PA7 AMP/BUFFER BOARD , LO AND ANTENNA CABLES

Before the NR-PAN7 can be used a small Amplifier/Buffer board (PA7) must be installed in the bottom of the Parent Board of the TR7. The bottom cover of the TR7 must be removed. Use care if a band data cable has already been installed for the NRV7 so as not to put excessive force on that cable. Once the cover is removed take the end of the LO cable without the connector and thread it through the last slot in the bottom cover from the outside of the cover (see picture below).



Once that is done flip the cover to the side so the PA7 may now be installed. The first step is to take a marking pen and mark the traces that will have wires from the PA7 board connected to them.



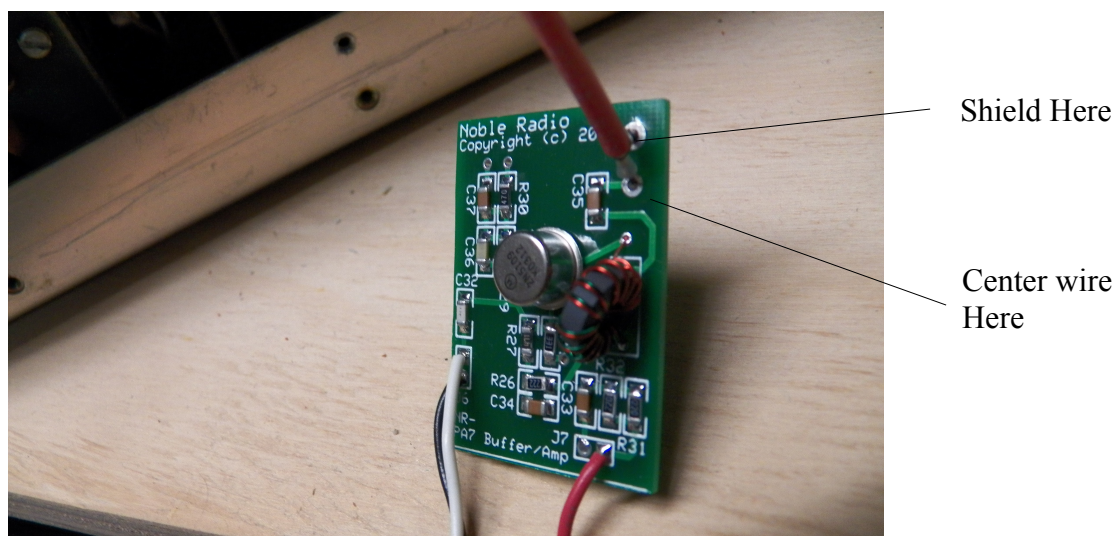
Ground –
Black wire

LO Input –
White Wire

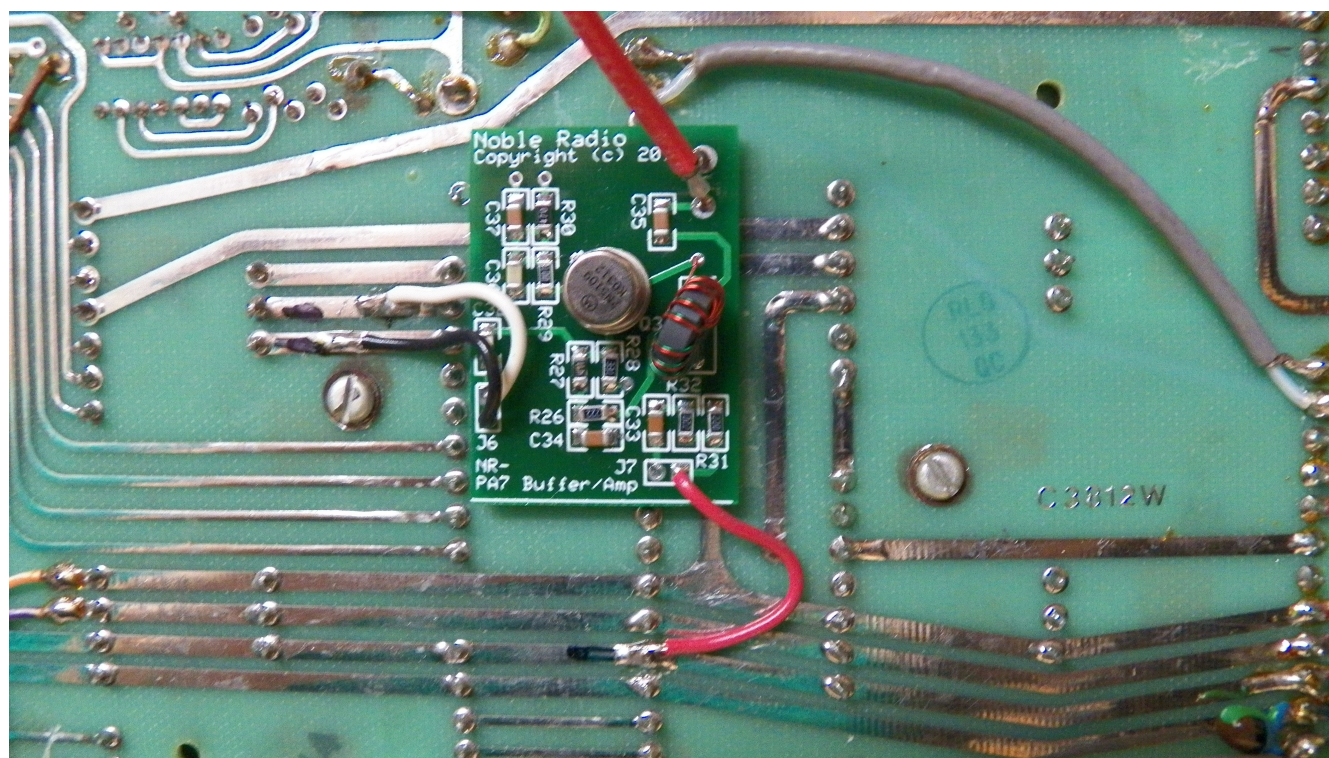
+10 Volts – Red
Wire

PARENT BOARD SHOWING PA7 CONNECTION POINTS

The next step is to connect the end of the coax that was routed through the slot in the bottom plate. It must be soldered to the holes in the PA7 board as shown in the picture below. Once the connections are made any wires protruding out of the back of the board should be cut flush to the board to prevent anything shorting to the traces on the TR7's Parent Board.



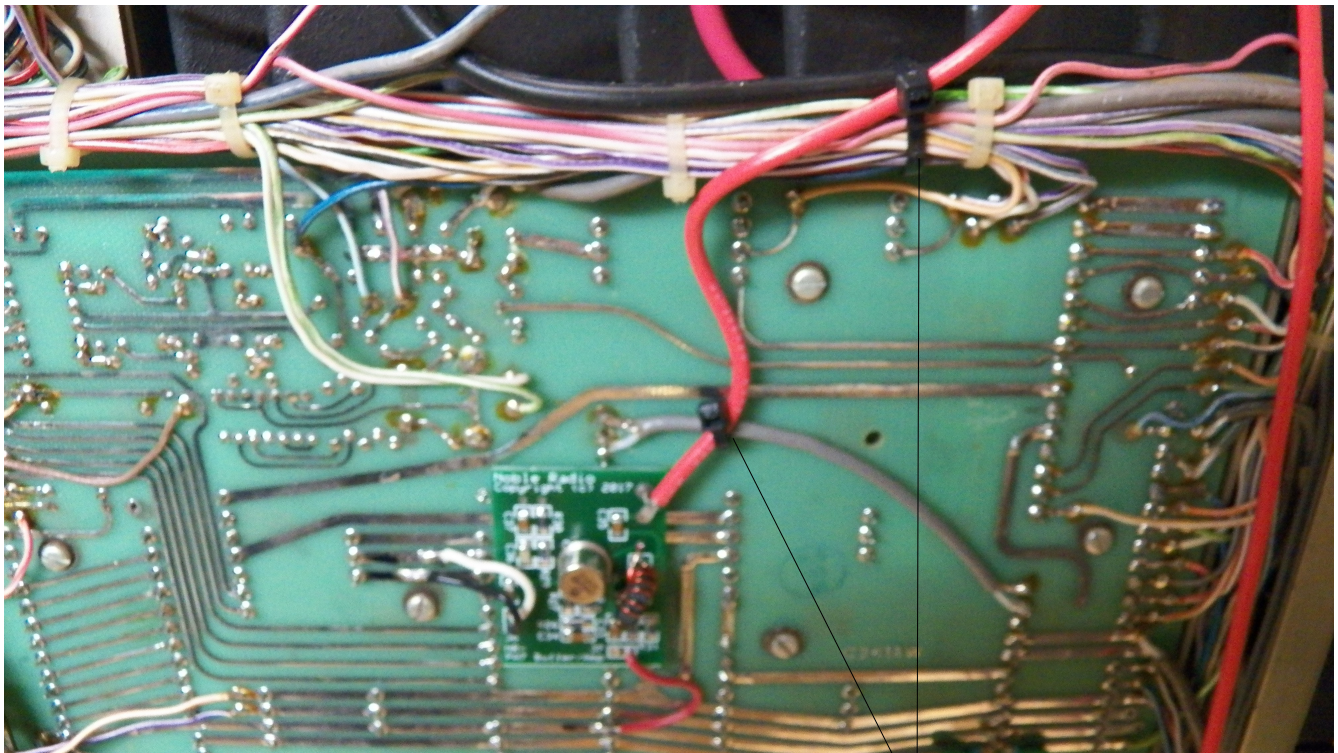
Once the connection points are marked and the coax is connected take the PA7 board and look at how it will fit between the connection pins on the Parent Board. The PA7 will attach to the board with double sided tape that is already attached to the PA7 board. The protective backing paper just needs to be removed and the PA7 can be pressed to the Parent board for a secure connection. Try the board first before removing the backing paper because once the tape is pressed to the Parent Board it will be very difficult to removed and cannot be reused. New tape will have to be put on the PA7 after the old is removed. So find the position first before sticking the board in place. The following picture shows the correct placement and orientation of the PA7 board.



PA7 Board Correctly placed on the TR7 Parent Board

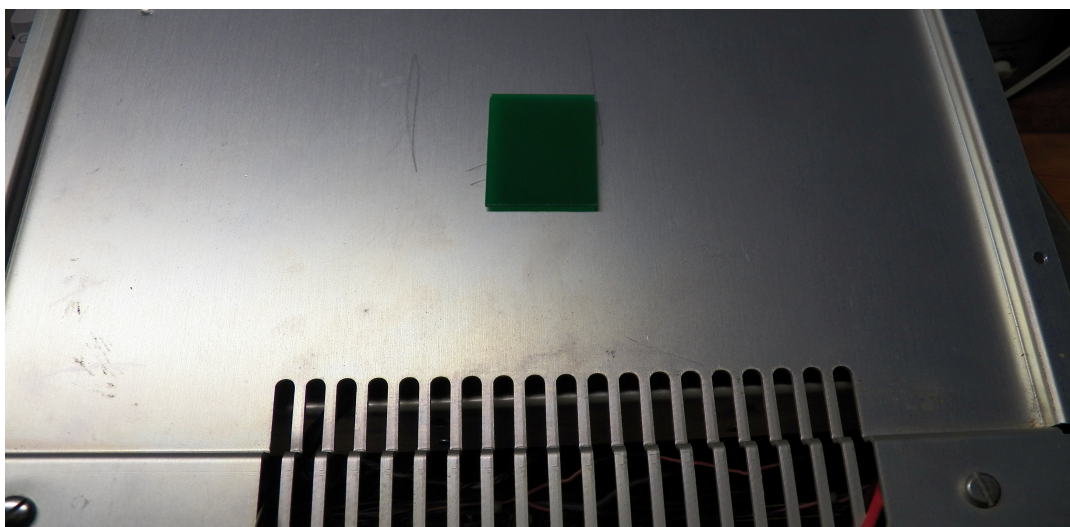
When you are sure of how it will be placed remove the backing tape and press the board firmly against the Parent board to secure it. The next step will be to solder the three wires to the connection points on the Parent board as shown in the photo. Use a minimum amount of solder to get a secure connection and be sure the solder flows from the wire onto the board traces.

The next thing to do is to secure the coax cable to the wire harnesses in the TR7. This will keep the wire in place and provide some strain relief for the PA7 board. See the photo below for the points to use for this. Use the cable ties provided with the PAN7.



Cable tie points

Before replacing the bottom cover the small rectangle of fiberglass board material should be placed in a position that is directly over the PA7 board. This will prevent any pressure on the bottom plate from allowing the plate to come in contact with the transistor on the PA7 board since this would ground the +10 volt supply in the TR7 and could cause some damage to the TR7's power supply circuits. The correct position for the material is 6 inches in from the front of the plate and 5.25 inches from the right side. This will give the center point for the board. It has a piece of double sided tape on it with backing paper that should be removed and the board pressed in place just as was done with the PA7 board.



At this point the PA7 is installed and the bottom cover can be replaced. Feed the coax and the band data cable from the NRV7 carefully through the slots until the cover is in place and then screw it down.

Installation of the Main Unit

Now that the PA7 has been installed in the TR7 the Main unit can be connected to complete the installation. Plug the 12 pin Cinch connector on the cable from the main unit into the TR7 Accessory Jack on the rear panel. Plug the coax from the PA7 board (Red Heat Shrink at the RCA Plug) into the Jack marked LO on the NR-PAN7 front panel. Plug the antenna cable (RCA plugs on both ends with black heat shrink) into the jack marked ANT on the NR-PAN7 front panel and the other end in to the jack marked EXT ANT on the TR7 rear panel. Plug the USB cable provided into the SDR OUT connector on the front panel of the NR-PAN7 and the other end into an unused USB jack on your PC or laptop. This completes the physical installation of the unit. Next the software will have to be installed and setup to use the panadapter.

Required Software and Installation

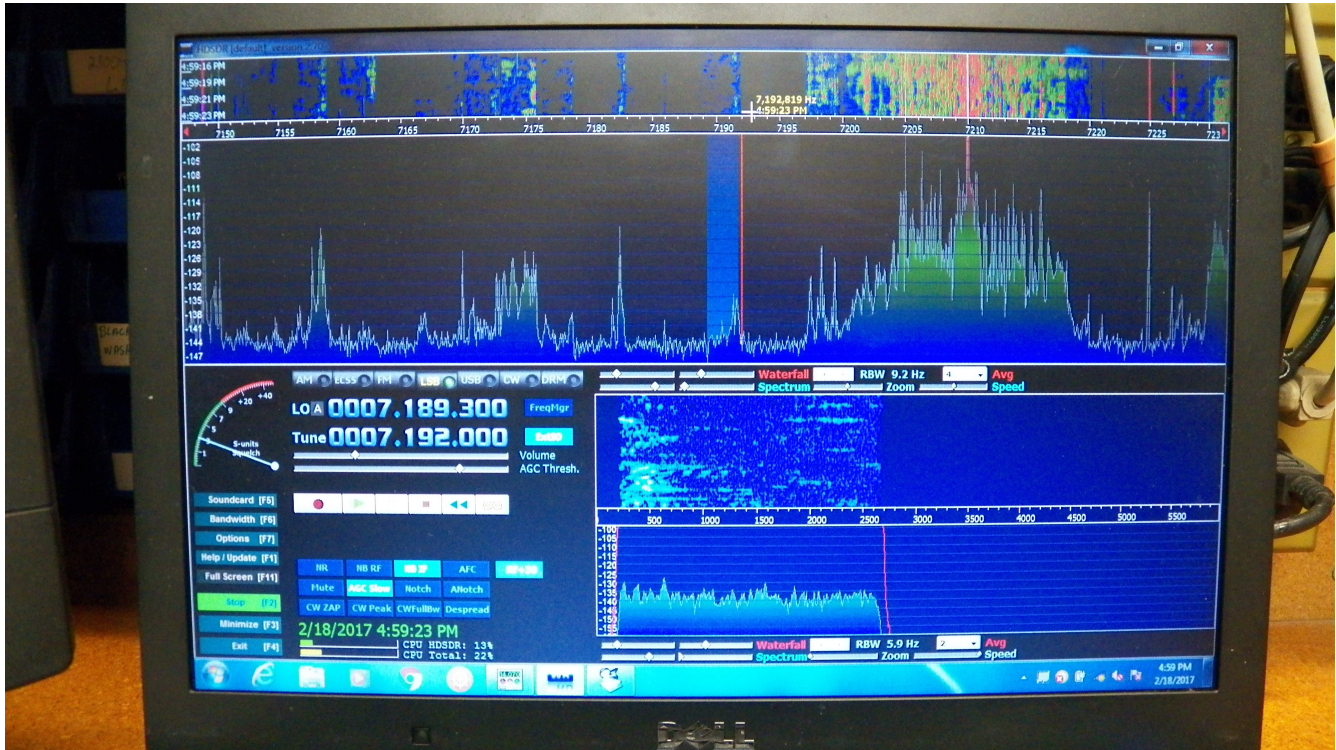
In order to use the functions of the Panadapter there must be some sort of control software setup in a PC or laptop computer. The Panadapter was designed to operate with two freeware programs to provide a spectral display plus rig control and logging functions. Ham Radio Deluxe (HRD) and HDSDR are the two applications that work well with the NR-PAN7 and the NRV7 to control the TR7.

Ham Radio Deluxe 5.24 is the final free version and can be found with an internet search for download from several sites on the internet. That program should be downloaded and installed on the control computer. HRD will give you rig control and logging plus many other functions. The next program that will need to be installed is HDSDR. It is also a freeware program that can be found at www.hdsdr.de . That will provide the spectral display for the panadapter. Once both of these programs are installed the drivers for the hardware will have to be installed. The drivers for the NRV7 USB control port are FTDI USB types and more information about installing those can be found in the manual for the NRV7. Once

the driver is installed it will be assigned a com port number in Windows. You can use that number or go to the Device Manager in Windows to change it to another port number. Just be careful not to use something that is already assigned to an active device connected to the computer. HRD will need to know to which com port the NRV7 is connected. The CONNECT menu on HRD will allow the setup of a COM port to interface to the NRV7. Make sure that the TR7 and NRV7 are powered on. In HRD set the Baud Rate to 9600 and be sure that the rig is set to the FT-857. This should now allow HRD to connect to the NRV7 and display the operating freq of the VFO. HRD should be able to change the freq of the NRV7 by clicking on the band bars or the numbers in the frequency readout. Once that is working it will be time to focus on the HSDR program and the spectral display. To use HSDR with the PAN7 the driver for the SDR receiver must be installed. The driver to use is installed with zadig. The zadig utility can be downloaded from <http://zadig.akeo.ie> . Download the latest version that is compatible with the operating system you are using. Make sure that the USB cable is plugged into the SDR OUT connector on the NR-PAN7 with the other end into an unused USB port on the PC or Laptop. Run the zadig utility by clicking on the file and opening the dialog box. The app may need to be opened and run as an administrator. Do this by right clicking it and choosing Run As Administrator. Go to OPTIONS ---> List All devices and make sure that is checked. In the drop down box chose Bulk In, Interface (Interface 0). This can also sometimes show up as an item prefixed with **RTL2832U** . Make sure that WinUSB is selected as the target driver and click on Replace Driver. The following site will also show step by step instructions for loading the SDR driver <http://www.rtl-sdr.com/tag/zadig/> . Once the driver is installed HSDR can be started. If the driver is working properly the spectral display screen should appear. To verify that the driver is installed correctly click on the ExtIO box next to the frequency display and it should show a box with the heading **ExtIO – RTL2832.DLL**. If that is present then close the box and press F7 to bring up the **OPTIONS** Menu. Point to the **Select Input** item and then make sure that **Generic RTL2832U OEM** is selected. You may also see it listed as **RealTek**. Next go to the **RF Front End Calibration** item in the F7 menu. Click on (select) **SDR on IF output, which is controlled by** and then select **HRD (DDE)**. Under Sync mode select **Full Sync in Both Directions**. Under **IF Frequency** enter **48050000**. Leave the Offset at 0 for the moment. Click **Mirror RF Spectrum in General**. Click **APPLY** and close the window. In the F7 menu select **DDE to HSDR**. Select **HRD** in the box that pops up. Next click “Manual Connect” and you should see green text at the bottom that says “Status Connection OK :)” Click OK to close the window.

With the TR7 and NRV7 powered on and HRD running and connected to HSDR via the DDE link (this should show in the pop up box that was used to select HRD as the DDE link in the previous step. If it is not connected then select Manual Connect in that box) clicking the START button on HSDR should bring the spectral display alive and any signals in the passband of the TR7's IF should appear on the display. The amplitude of the display may be way off from optimal when first started and the frequency of a tuned signal on the TR7 may not be exactly lined up with the spectral display. These factors will have to be adjusted to suit your individual taste and to calibrate frequency to the TR7. But a good starting point is to have the spectral display set for a 100 kHz width (this gives the best overall display bandwidth while still allowing for easy frequency selection of a signal with the mouse) and the SDR RF Gain set to around 30. This can be set by either using the slider from the box labeled RF+N (N being the value selected) at the right side of the buttons at the bottom left corner of the screen, or by clicking the ExtIO box. The window that appears will show a slider which will also control the gain plus a few other options. The Sample Rate should be set to 2.4 Msps as a starting point. The Buffer size should be set to 64 kB. Make sure both of the AGC selections are OFF (not checked). Offset Tuning should be checked. In some PC systems the sample rate may have to be lowered to avoid excess spurs near the center of the screen. If this is what you see then start with the lowest rate (.94 Msps) and gradually increase until the problem appears then back off one step.

The actual scale height and spectral width and speed of the update, etc are controlled by the sliders under the spectral display window. You will need to play with these to get the best display to suit your preferences. A typical display will look like the picture below.



Typical Spectral Display from the NR-PAN7

You can use the position of the sliders in the picture as a starting point for setting up your display. You can see that the frequency displayed on the Tune value is set to the actual operating freq of the TR7/NRV7 and not the frequency of the IF. Use the mouse to place the red vertical cursor on one of the signals on the spectrum display and left click the mouse. The display should instantly put the selected signal at the center of the screen and the Tune frequency on HDSDR, the NRV7, TR7 and HRD frequency displays should all change to the new frequency and the selected signal should be heard on the TR7. The proper way to select a signal depends on what sideband is in use. For USB the cursor should be placed to the left side (edge) of the signal passband. For LSB it should go to the right side. For CW it will also be to the left since on the TR7 that is an USB mode. The mode of the display will be changed with the NRV7. It is best to use the NR-PAN7 with the REV B NRV7 software. That software has improved updating capability for use with HRD plus will send LSB as the mode for operating frequencies below 10 MHz and USB for operating frequencies at 10MHz and above. The mode can be set by simply pressing the PTT on the mic for a second. The mode on the HDSDR and HRD displays will set to the correct value for SSB and that frequency. Tapping the DASH paddle on the keyer will set the mode to CW. To calibrate the amplitude of the screen use the Calibration Settings menu in the F7 menu. Note this is for Ver 2.76, last release in Feb 2017. Earlier versions will use a different menu setup. The antenna should be disconnected from the TR7 and the "S-meter Calibration" tab should be selected. The noise floor should be about -112 to -114 dBm in the "Current Level" box. If it is much different than that enter a value of -112 in the "Correct Level" box and then hit "Calculate"

This should all be done with the RF Gain set to a value of 30 dB. Next go to the sliders under the spectrum display window. Using the slider closest to the word “Spectrum” set the minimum level on the spectrum scale to -135 dBm. Using the slider to the left of that one set the max scale value to -84 dBm. That should give a good starting point for weak signals (barely moving the S-meter on the TR7) to just start to pop out of the noise floor while still keeping very strong ones from moving past the top of the display. These numbers are just a starting point and can be played with to get a display that suits your individual preference. One thing that should be noted is that the minimum of RF gain necessary should be used to prevent overload of the SDR receivers front end. Excessive gain will only result in many spurs and possible images from strong broadcast stations appearing in the spectrum. Values should be limited to between 25 and 30 dB for best results.

HSDR Calibration

In most instances the SDR receiver will not be exactly calibrated to the NRV7 VFO and will require a correction factor to be entered. The quickest way to check this is to tune in a broadcast station or a station like WWV or CHU on the TR7 using the NRV7 VFO. Zero beat the station with the NRV7 tuning knob (should be within 10 Hz or so of the actual broadcast station frequency). Look at the spectral display on HSDR and see where the carrier for the station appears. It should be exactly on the red line at the center of the display. If this is not the case, estimate what the error is from the freq display bar at the top of the spectral display and then pull up the RF Front End and Calibration box through the F7 menu. Go to the **Global Offset** box and enter the error value (in Hz) of the signal. Close the box and go back and recheck the signal. Do this until you match the TR7 frequency with the Spectral Display. At this point you should be able to accurately click on SSB signals and they should appear tuned properly on the TR7/NRV7.

Once the software is calibrated properly the audio spectral display (bottom right corner of the screen) can be used for very accurate frequency spotting on CW. Although the NR-PAN7 does provide muting of the SDR receiver output there is a small leakage of signal that comes through and appears on the spectral display. Keying the TR7 in CW mode will show this on the audio spectrum as well as the audio waterfall above it. Note the frequency where this occurs. To directly zerobeat a CW station simply tune the receiver until that received station falls at the same frequency on the waterfall.

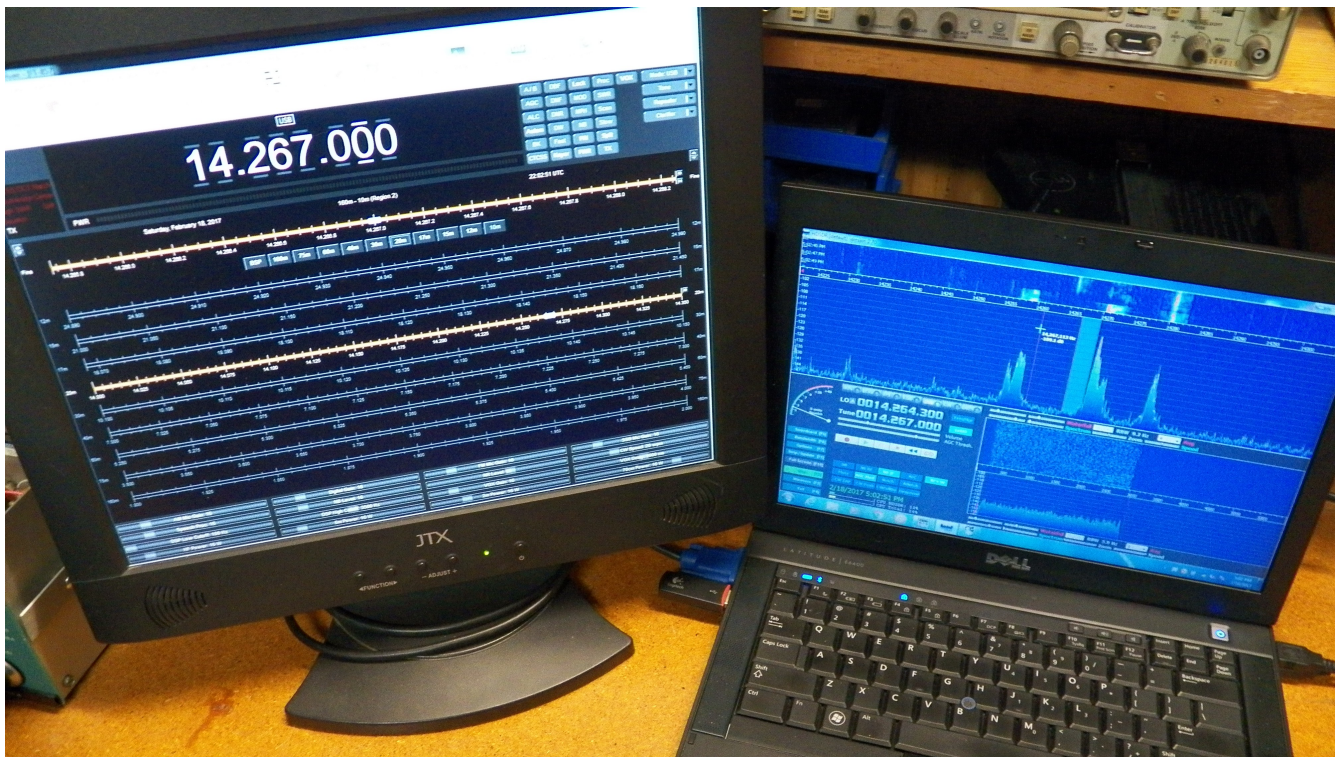
Using the SDR Receiver Capability of HSDR

Since the signals from the TR7 receiver are also being received by the SDR receiver in the PAN7 they can be processed by the DSP software in the HSDR program as well. The DSP filtering and other features can be used on received signals. This mode can also be used to more accurately set the freq offset in the previous section by listening to an AM station and matching the audio from the SDR receiver to that of the TR7. The only drawback to using it this way is that there will be a noticeable latency or delay between the real time audio from the TR7 until it actually appears at the output of the HSDR audio from the PC speakers. So it is not very easy to operate in this way but could be suitable for just receiving. Operating CW with the SDR receiver would be almost impossible. To use this mode reliably the TX enable option should be turned off. You may occasionally get data from the NRV7 that causes the HSDR program to think that the TR7 is in the transmit mode and it will mute the RX audio from the PC speakers. To avoid this issue pull up the TX menu from the F7 menu. Make sure all options are unchecked. Especially the “Mute RX audio on TX” and the “Enable TX button for

HRD(DDE)” selections. Audio from the PC RX can still be muted by the MUTE button near the bottom left corner of the display.

PC / Laptop Hardware Considerations

There is obviously a lot of processing going on between the HRD and HSDR programs so to get the best results from the system it would be advisable to use a reasonably fast computer, preferably one with at least a dual core processor and it would also need at least 2 or 3 free USB ports to support the NRV7 control port plus the SDR receiver data and also the sound card on the NRV7 if digital modes are to be used. With both HRD and HSDR running the computer should be setup with dual monitors so that each program could have its own screen making it a lot easier to see what is going on and access all the features of both programs without having to move and shrink windows around, etc. Plus the logging windows will also need to be popped up in HRD if you use that feature so it gets crowded quickly. The photo below shows a typical setup for the TR7/NRV7/NR-PAN7 running HRD and HSDR.



Typical setup for a dual screen Laptop setup

Using the NR-PAN7 without an NRV7 VFO

While the NR-PAN7 was designed to operate specifically with the NRV7 DDS VFO it can be used as a stand alone Panadapter for the TR7. Of course you will lose a lot of features by not having a VFO that can be controlled by the PC software but you can still get a spectral view of a band that the TR7 is

tuning. The PAN7 should be setup the same as described in the previous sections except for the HDSDR setup. Ham Radio Deluxe also does not need to be installed but of course can be used independently for a logging program if desired. Do not setup the DDE link to HDSDR if the NRV7 is not being used.

Now a spectrum from the TR7 should be displayed but the Tune Frequency will not be the same as that to which the TR7 is actually tuned. The signals will slide across the spectral display as the tuning knob on the TR7 is turned. To get to a signal that you see on the display you will need to turn the TR7 tuning knob until the signal of interest slides to the center of the display.

Any questions or comments about the NR-PAN7 can be directed to :

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