

# Installing the N4YG DDS in a Ten Tec Omni D

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Every once in a while luck finds a path to our door and it was with such a lucky happening that I purchased a Ten Tec Omni for \$90. The radio had a few technical problems which were resolved in about 15 minutes at no cost and a simple cleaning of one contact. Lucky me! In no time I was on the air and despite adequate warm up periods the PTO drifted some 100 to 200 Hz. In today's world that is unacceptable.

My first thought was to install an X-Lock-3 frequency stabilizer from Cumbria Designs in the UK. I have made three installations of the X-Lock in a HW-101, Corsair I, and a TR-7 so I know it works. But then there is the ever PTO rebuild scenario with the Ten Tec PTO's. So that solution was discarded in favor of installing the N4YG DDS board. Using that board not only provided a highly stable VFO source but it came with bonuses such as being prebuilt and tested, having an A, B and Split VFO functionality as well as variable rate tuning for very fast or slow QSY. Another bit of icing on the cake is that the board can be made to remember the last frequency when you power down. How great it is to be able to power up the radio and it already is on frequency. Finally an RIT function is embedded in the DDS board that gives about a +/- 1.5 kHz spread.

Thus started my journey of acquiring and installing an N4YG DDS. The website for the N4YG DDS is quite good and has much information

including several who proceeded me along this path namely AA4BQ and W0CCA. After several rounds of emails and profiting from the prior experience database, I considered the two options for installation. One is to physically install the DDS inside the Omni D and the other is an external install.

The internal installation most likely would require some shielding to prevent unwanted signal from entering the radio. Such was the case with one of the prior installations. Internal installation requires physically removing the PTO assembly, disconnecting wiring to the Spot switch and rewiring of the Offset pot. Installation of the DDS board itself requires drilling some holes in the Omni D sub-chassis. For those not so experienced in working on parts and assemblies in tight quarters this could prove to be a daunting task. The internal install also means that if for some reason the radio would be returned to stock, reversing the process while not impossible would once again take some experience and skill.

The other option is the external installation where the DDS would operate much like a remote VFO. That is the option I chose. This option is minimally invasive and requires pulling the VFO jumper on the back panel of the Omni D and inserting the output of the DDS into the RCA jack marked "VFO In", a connection to +12VDC at the Auxiliary +12 VDC jack also located on the back panel and an internal connection to any board or control where there is an "R" voltage present. Three connections and that is it. A return to stock involves reinstalling the VFO jumper, disconnecting the +12 VDC and removing the connection to the "R" pin. One minute max is about all that would take. The internal PTO, and Offset selection are inactive using this method and everything is now done on the Remote DDS. Below is my DDS installation sitting next to the Omni D. The yellow wire is the temporary connection to an "R" location.



First some baseline information about the stock Omni D which is essentially a single conversion radio with a 9.0 MHz IF. On all stock bands except 20M, the 5.0 MHz PTO signal is heterodyned with various crystal frequencies to provide the proper injection frequencies. You will note that the Omni D as well as other Ten Tec Radios define their SSB operation as normal and opposite versus USB or LSB.

The reason for this is that below 20M the PTO + Crystal Frequencies are on the high side of the incoming signal which causes a sideband inversion (ie LSB) using the same Carrier Crystal for 20M and above the PTO + Crystal Frequencies are on the low side (on 20M there is no heterodyne crystal) so USB results. Clever approach. But in all cases the PTO tunes the same frequency range 5.0 to 5.5 Mhz. The DDS is merely substituting for the PTO with the added functionality as previously mentioned.

So what comes in the N4YG DDS kit? The complete kit includes the DDS board, the interface cables, high quality optical encoder, and 4 each mounting pillars. In my case N4YG threw in a few LEDs and some

dropping resistors. Since the premise of the kit is an internal installation the Omni D, the Spot Switch and Offset control would be pressed into service as a mode switch and RIT control. These are not used in the remote installation. Thus I had to supply a momentary Push Button Switch and a 25K pot for the RIT. I didn't have a 25K pot so I used a 100K Ohm pot bridged with a 33K Ohm ¼ watt resistor. The equivalent parallel resistance is 25 K Ohms.

The table below defines what is required to build the remote installation.

Item	Supplier	Comments
DDS Board	N4YG	
Optical Encoder	N4YG	
Cables/ Mounting Hardware	N4YG	
Spot Switch	Owner	Use a momentary from Radio Shack
25K RIT Pot	Owner	I used a 100K + 33k Bridging Resistor
Green LED	Owner	Standard Green LED from Radio Shack
Red LED's (2)	Owner	Standard Red LED from Radio Shack
LED Holder	Owner	Holder available from Radio Shack
Knob Large	Owner	I used a TT knob from an Omni VI
Knob Small	Owner	I used a TT knob from an Argosy
150 Ohm (3)	Owner	¼ watt from Radio Shack

Case	Owner	Surplus Power Supply Case from a TT 262G
Misc. Wire and Connectors	Owner	Junk Box.

The wiring instructions for the Corsair II were used for the install and that is where N4YG has done a super job at labeling the DDS Board connectors. Each wire is marked so it is clear what goes to where. In the case of the VFO A, B and Split LED's I used a 150 Ohm dropping resistor in series with the wire which are connected to the anode side of the LED (longer lead) and the cathode (shorter lead) of each LED is grounded. Larger values of resistance will make the LED less bright. I wanted the LED's to be in my

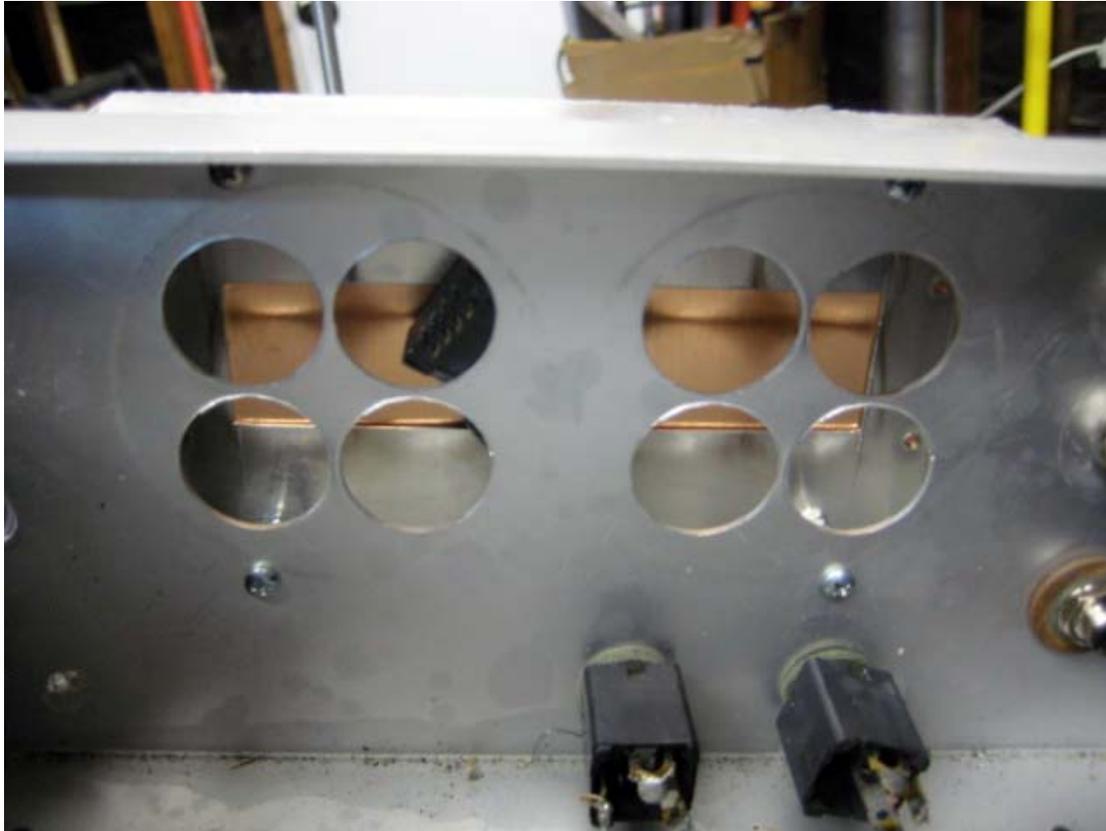
face and clear from a few feet away to clearly indicate which VFO was being used.

The N4YG DDS board is relatively small measuring some 3 inches by 3 inches and so there are many commercial enclosures that would work. That said having too small of a box will mean the remote DDS is moving all about the operating desk and anchoring the box to the operating desk does somewhat limit your flexibility.

Enter the Model 262G TT enclosure. Several years ago I bought a Ten Tec Model 540 as a tech special which I modified to now have a digital display. When the Model 540 arrived there were two boxes and one included the Model 262 case which had been gutted and reused to have some sort of keyer built in. Thus I had a freebie case in the deal.

In looking at the case I could see where the front panel could be readily adapted for the DDS install. The Model 262G has two front facing speakers which are covered by a plastic frame and speaker grill cloth. Removing that reveals large holes in the front panel which would present some problems in the mounting of the optical encoder. My resolution of the problem was a sub-panel to mount the optical rotary encoder which is now affixed to the front panel. All of the other existing control and indicator holes were used without having to drill any additional holes. The 262G case may be a bit of an overkill in terms of space but it looks Ten Tec and is Ten Tec and so a perfect complement to the Omni D.

Following are some close up photos of the installation inside the 262G case



Backside of the front panel showing the encoder and the connection point



I have a small label machine from Brothers and made these labels which cover the original Ten Tec lettering.

Finally this is a photo of the internal portion of the 262G and how the DDS board was mounted internally. I purposefully mounted it in an open area and if required could add additional shielding around the board. That has not been required.



A sub chassis of approximately 4 inches by 4 inches was cut from a piece of single sided copper PC board. The N4YG DDS board comes with four ¼ inch spacers which are used to mount the DDS Board on the Copper Board and provides a solid ground plane. The Copper Board is then elevated above the base of the 262G by four more spacers and thus provides a solid grounding to the Ten Tec case. Many of the back panel connections are reused to connect the input and outputs of the DDS board. There are two RCA jacks on the back panel both of which are floating and one of these is used to connect the RF Output of the DDS to the VFO Input port on the Omni D. I insured that the ground pin of the RCA Jack I used for the RF output was physically connected to ground.

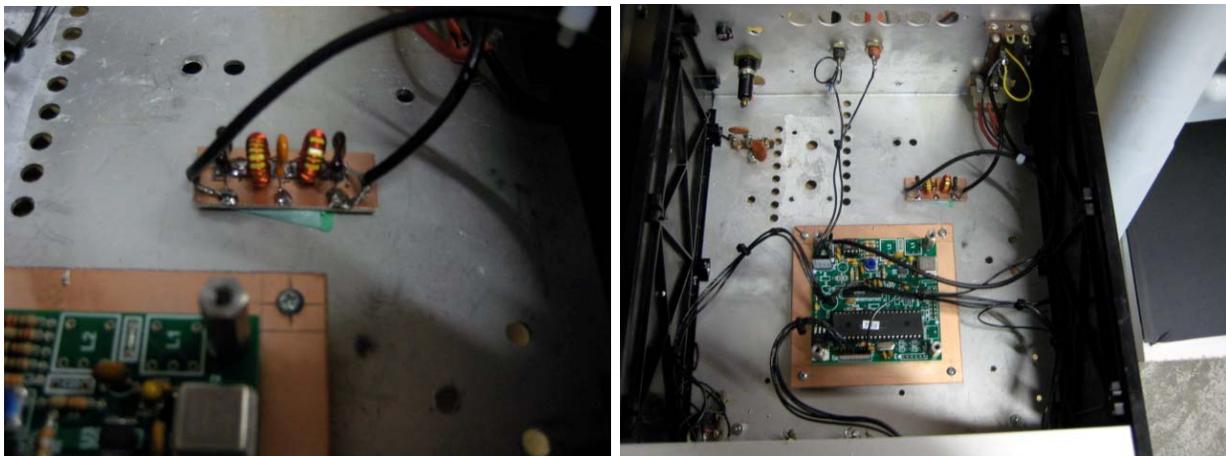
The DDS worked first time and I am happy with the result given the limitations of a 35 year old radio. The frequency stability is outstanding and

having the two VFO's and split operation puts in on par with the technology of today. Too bad more hams do not realize that with a bit of upgrading some of the old boat anchors can compete with the modern several thousand dollar radios of today. The total investment was less than \$300 and it only took about 5 hours total to build the hardware and make the installation. Thanks Joe!

### **Refinement to the Installation**

The Omni D, again a single conversion transceiver, uses crystal mixing to place the LO above or below the incoming frequency with the exception of 20 Meters where the LO is directly mixed with the incoming to achieve the 9.0 MHz IF signal. After a few days of operation I noted some "squeals and squeaks" only on 20 Meters which I quickly recognized as some possible harmonics of the DDS causing the issue. I have seen this before in several homebrew radios I have constructed and the cure was to insert a 5 MHz Low Pass Filter in line between the DDS and the Omni. The photo below, shows that installation and the parts values are 680 PF for the two outer capacitors, and 1000 PF (0.001 Ufd) for the center capacitor. The two inductors consist of 25 Turns of #24 on a T-37-6 powdered iron core (yellow) form. This circuit is a lift from a project by W7ZOI published in QST in Dec 89 and Jan 90.

The Low Pass Filter did its job and so no more squeals and squeaks. I highly recommend that this be a standard installation feature for any Ten Tec applications.



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PS: There is a youtube video showing the DDS in action with the Omni D

[http://www.youtube.com/watch?v=WgdqXj5qeys&feature=c4-overview&list=UU4\\_ft4-oTdCMIWIL4XXHScg](http://www.youtube.com/watch?v=WgdqXj5qeys&feature=c4-overview&list=UU4_ft4-oTdCMIWIL4XXHScg)