



University of Hawai'i at Mānoa  
School of Ocean and Earth Science and Technology  
Radio Oceanography Laboratory

Generic High Frequency Doppler Radar  
Synthesizer–Transmitter Unit  
Model MK3–PW–PA–TX  
User Manual

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v. 2

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## FCC Supplier's Declaration of Conformity

University of Hawai'i Generic High Frequency Doppler Radar Synthesizer-Transmitter Unit, model *MK3-PW-PA-TX*.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) this device may not cause harmful interference, and
- (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by University of Hawai'i could void the user's authority to operate the equipment.

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## Warnings



This device contains potentially dangerous high voltages and high frequency radiation. Operation and servicing is restricted to properly trained and certified personnel.

Maximum output power is 50 W (+0.5dB) for frequencies 8 MHz and below and 30 W (+0.5dB) for frequencies 12 MHz and above.



The user's authority to operate this device if connected to any radiating antenna or structure in the United States is contingent on applying for and being awarded a valid license through the FCC Universal Licensing System before transmitting. This device may not be powered up for testing unless connected to a non-radiating resistive load.

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# User operation of Synthesizer-Transmitter Unit, model MK3-PW-PA-TX

## 1. Overview

The unit is programmed to emit a repetition of frequency sweeps (chirps), typically at a rate of 1Hz to 4Hz and an occupied bandwidth of 25 to 220kHz determined by the ITU frequency allocation (see Table 1), resulting in a frequency-modulated continuous wave (FMCW mode, emission designation F1N).

Table 1. Allocation for Oceanographic High Frequency Doppler radars in Region 2.

<i>Center (MHz)</i>	<i>Occupied bandwidth (kHz)</i>
4.463	50
5.2625	25
13.500	100
16.150	100
24.550	200
26.310	220

The unit is factory-programmed to start transmitting automatically upon power up at the ITU frequency for which a low-pass filter is factory-fitted. To avoid any erroneous operation that could damage the power amplifier and/or the low-pass filter, or result in unlicensed transmissions, all frequencies are factory-disabled, except the ITU frequency for which a low-pass filter is actually factory-fitted to the unit. Programming the unit to other frequencies is password-protected and reserved to factory-authorized personnel.

If a FCC call sign has been provided at the time of factory-configuration, a full-bandwidth broadcast of the call sign is automatically scheduled every 20 min. Chirps at a rate of 1 kHz are transmitted over the same occupied bandwidth, for short periods corresponding to the dots and dashes of the Morse code, resulting in a similar frequency-modulated continuous wave (emission designation F1N).

The unit can be powered-up in two modes of operation: (a) a test mode, for which the output is connected to a 50Ω non-radiating resistive load, or (b), a live mode, for which the output is connected to a radiating antenna or structure. The user's authority to operate this device in the live mode (b) from a location within the United States is contingent on being awarded a license through the FCC Universal Licensing System. In the absence of a valid FCC license, the device may only be operated in the test mode (a).

The firmware allows programming all operations of the digital synthesizer, including chirping, calibration tones and full-bandwidth call-sign broadcast, using a single ethernet web server interface, configured through the Dynamic Host Configuration Protocol (DHCP; Figure 2). The actual settings of the digital synthesizers are continuously read back from the DDS registers and displayed on a separate diagnostic web page (Figure 3).

To comply with FCC RF exposure requirements, the antennas must be installed to ensure a minimum separation distance from persons while operational as shown in the table below:

*Table 2. Minimum separation to comply with FCC RF exposure requirements*

<i>Operating Frequency</i>	<i>Minimum Separation Distance</i>
<i>(MHz)</i>	<i>(m)</i>
4.463	10.66
5.2625	10.66
13.500	3.55
16.150	3.55
24.550	2.30
26.310	2.30

## **2. Start-up procedure**

The following steps must be performed in the order given:

1. open enclosure and verify that the frequency of the low-pass filter fitted (figure 4) corresponds to the factory-configured frequency marked on the label (figure 3).
2. verify that all breakers are off in the down positions (figure 4).
3. for mode (a), connect a power attenuator such as a Bird 100-SA-FFN-30 to the N-type RF output of the unit (figure 6).
4. for mode (b), connect the cable to the TX antenna, with a minimum cable attenuation of 5 dB (figure 6).
5. connect a CAT-6e cable from a local network to the RJ45 jack of the unit (figure 6).
6. connect a grounded power cable to the IEC-C13/C14 power inlet (figure 6) and plug into a 120 or 240V outlet (the unit auto-detects the voltage).
7. connect the power adapter of the heat-exchanger shown in figure 5 into a 120 or 240V outlet (the unit auto-detects the voltage).
8. power up the unit and the heat exchanger.
9. enable the power surge suppressor by flipping its breaker to the up position (lower DIN rail, figure 4).
10. enable the power supplies by flipping all remaining breakers in sequence from right to left to the up position (middle DIN rails, figure 4).
11. tie the 6 grounding connections of the door and close the enclosure.
12. verify that the network router has provided an IP address through DHCP (waiting 2-3 minutes may be necessary to let the boot sequence complete).
13. open browser on this IP address, verify that a screen similar to figure 1 is obtained.
14. click on "Status", verify that a popup screen similar to figure 2 is obtained and that the entry shown for ---DDS-A--- under /FREQ displays the expected factory-configured frequency.

The unit is now operating and transmitting the required signal.

### 3. Toggling between signal types

Two signal types are allowed: standard frequency-modulated continuous wave chirp for normal radar operation, and continuous tones for calibration. Continuous tones can be programmed at three distinct frequencies: at the lower limit of the allocated bandwidth  $f_0-bw/2$ , at the center frequency  $f_0$  and at the upper limit of the allocated bandwidth  $f_0+bw/2$ .

To toggle between signal types:

1. open a browser on the unit's IP address, obtain a screen similar to figure 1.
2. to change between signal types, click on the appropriate button.
3. wait 15 sec for the command to execute.
4. verify with the "Status" screen that the frequency has been updated.

The unit is now transmitting the required signal.

### 4. Power-down procedure

The following steps must be performed in the order given:

1. open a browser on the unit's IP address, obtain a screen similar to figure 1.
2. click on the "Stop" button.
3. wait 15 sec for the command to execute.
4. verify with the "Status" screen that the frequency has been updated to 0.
5. open enclosure.
6. disable the power supplies by flipping all breakers in sequence from left to right to the down position (middle DIN rails, figure 4).
7. power down the unit and the heat exchanger.
8. close enclosure and stow unit.

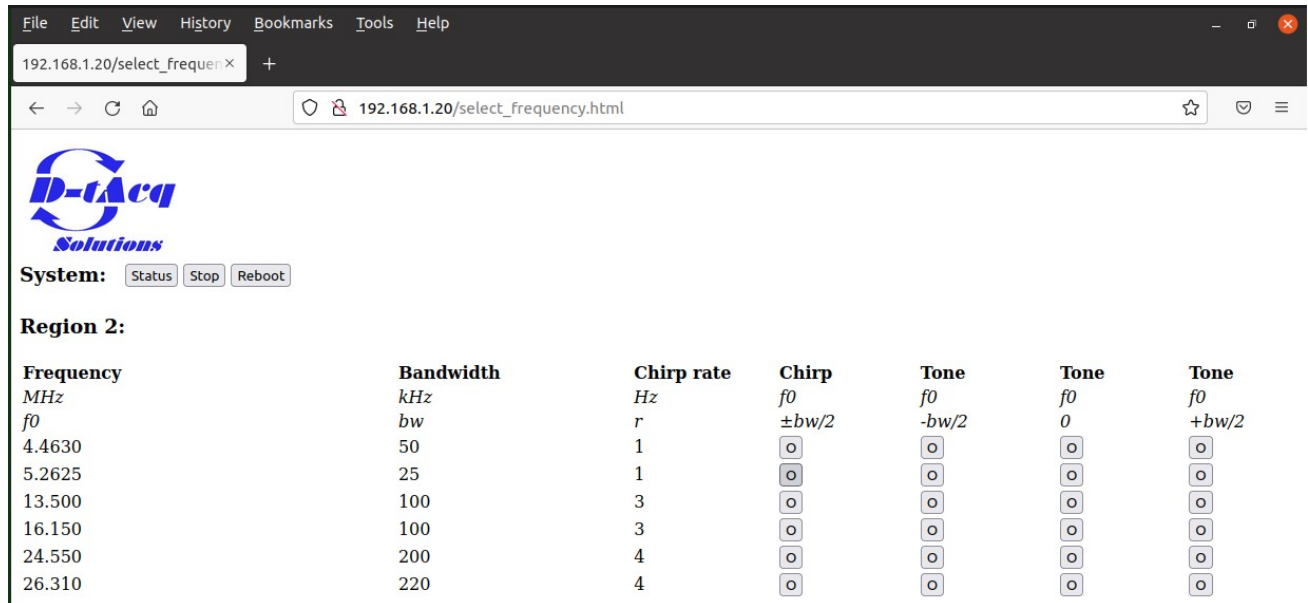


Figure 1. Web interface for programming the synthesizer/transmitter. Only the frequency for which a low-pass filter has been installed can be selected.

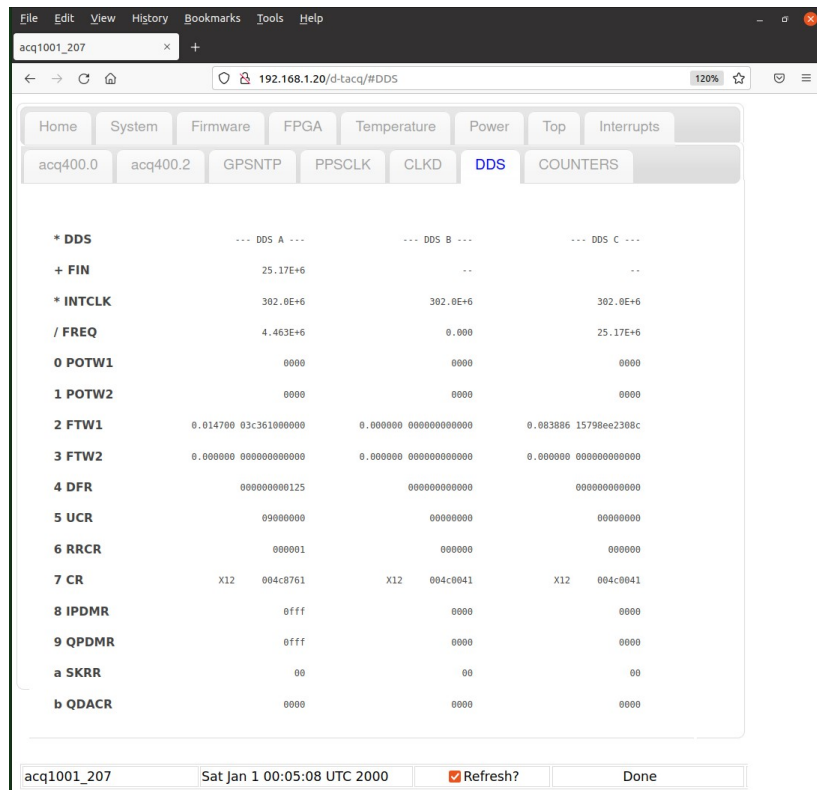



Figure 2. Diagnostic page with DDS registers read-back.

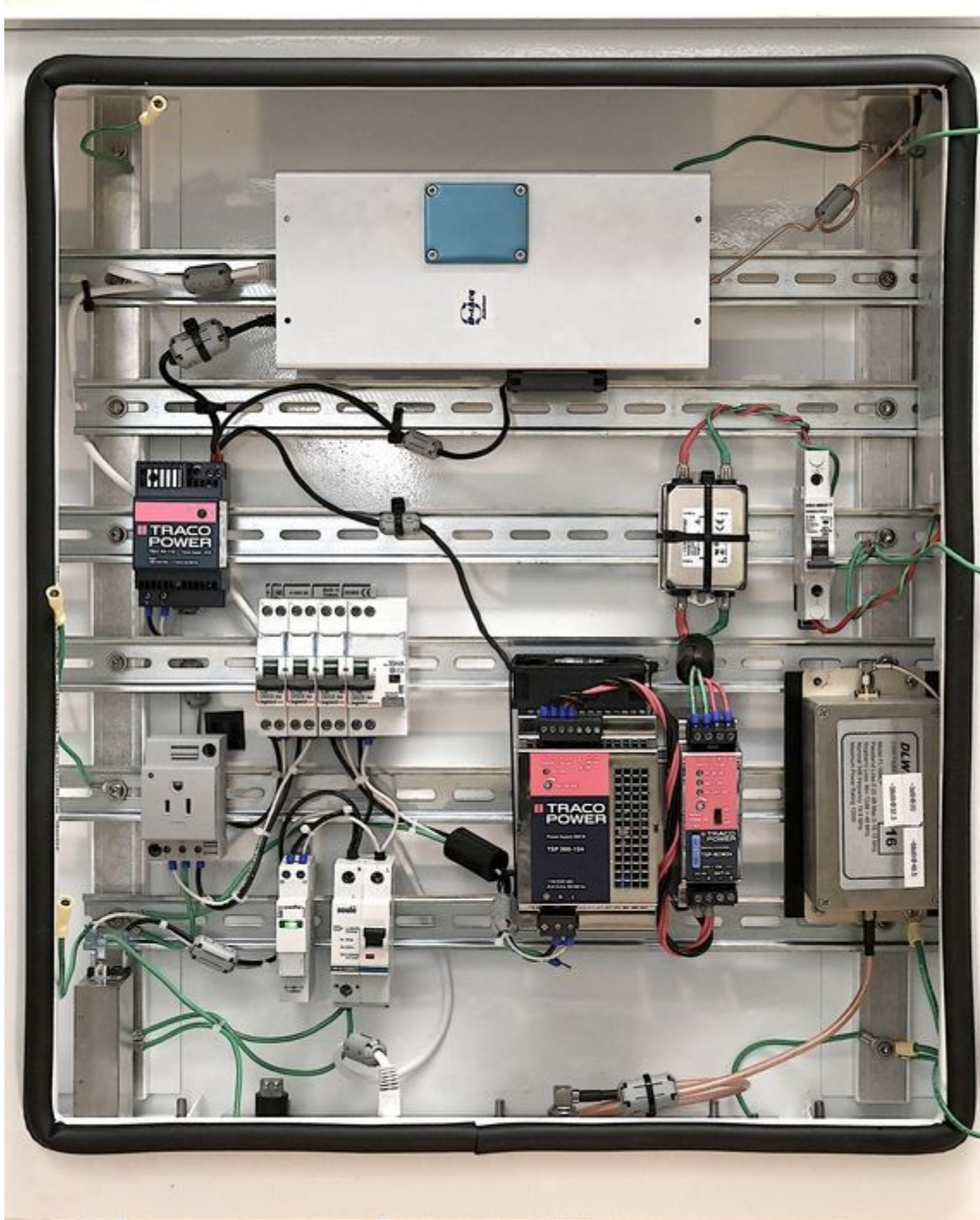
## 5. Illustrations



Figure 3. Above: Synthesizer-Transmitter Unit model MK3-PW-PA-TX, door closed. Below: device identification label, affixed to the top right of the enclosure door. The factory-programmed operating frequency and output power are marked, here 16.150 MHz/30W.

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	<b>Generic High Frequency Doppler Radar                  Synthesizer-Transmitter Unit</b>	
Model: MK3-PW-PA-TX	Serial number: 3-003	
Input voltage: 85-260 V	Input power: 250 W AC	
FCC ID: 2A562-MK3-PW-PA-TX	Modulation: FMCW mode F1N	
Operating frequency / Bandwidth / RF power:		
<input type="checkbox"/> 4.4630 MHz / 50 kHz / 50 W	<input type="checkbox"/> 5.6250 MHz / 25 kHz / 50 W	
<input type="checkbox"/> 13.500 MHz / 100 kHz / 30 W	<input checked="" type="checkbox"/> 16.150 MHz / 100 kHz / 30 W	
<input type="checkbox"/> 24.550 MHz / 200 kHz / 30 W	<input type="checkbox"/> 26.310 MHz / 220 kHz / 30 W	

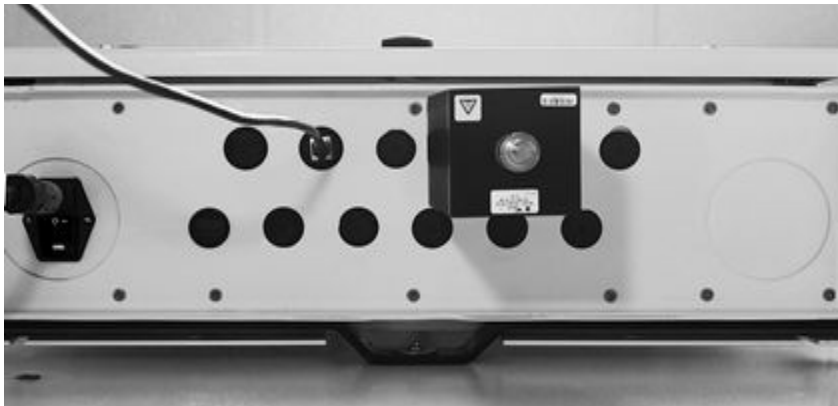




*Figure 4. Synthesizer-Transmitter Unit, door open.  
Bottom rails: power supplies with circuit breakers.  
Upper rail: digital synthesizer and controller processor.  
On the right wall: the power amplifier module and the low-pass filter.*



*Figure 5. Synthesizer-Transmitter Unit, right side view.  
The twin-fan forced air flow heat exchanger unit is seen.*



*Figure 6. Synthesizer-Transmitter Unit, bottom view.  
Connector plate with IEC-C13/C14 power inlet, RJ45 jack for CAT6 Ethernet, N-type bulkhead adapter for cable to antenna (a Bird 100-SA-FFN-30 power attenuator is attached).*