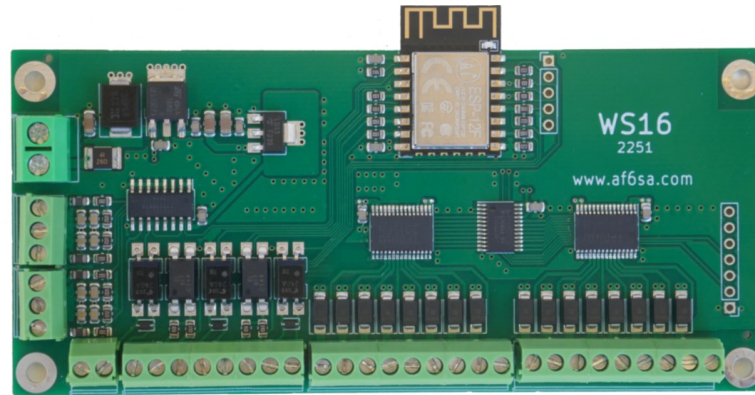


Wi-Fi Antenna Switch & Power Meter (WS16)



Features

- 2.4GHz WiFi 802.11n network interface to minimize wiring and RFI.
- Listens to UDP RadiInfo packets sent by N1MM+, DXLabs and other logging software to extract radio operating frequency and select antenna. Any transceiver that can be interfaced with N1MM+ can be used.
- Connects directly to Flex 6x00 transceivers – no PC needed for remote control and monitoring.
- WEB server to display operating Frequency, Power / SWR and select from available antenna on that band, remotely on PC / MAC or tablet. WEB pages are fully customizable.
- Measure and display Transmitting power and SWR for two transceivers with optional TM Power sensors.
- 16 digital outputs, each can provide 12V / 0.5A.
- Compatible with DX Engineering, RemoteQTH 2x6, 2x8 and other antenna switches.
- In SO2R or Multi-2 configuration, WS16 will serve a separate WEB page for each radio.
- Avoids collisions in SO2R / M2. Prevents switching two TRXs on same antenna. First radio wins.
- Opto-isolated inputs (KEYx) to prevent Antenna hot-switching. Will not switch until KEYx is released.
- ONAIR solid state relay 36V/0.5A that can be used to switch Flex 6x00 On/Off or control the station main power relay.
- Provides a fast *websocket* interface for *Node-RED* integration.

1 Setup / Installation

WS16 can be mounted inside a plastic enclosure or metal enclosure with the WiFi antenna exposed through a slot.

WiFi coverage in free space is can reach up to 100m – similar to a smartphone.

Power supply requirements for WS16 are 10Vdc to 16Vdc, current draw is 0.1A when all outputs are OFF.

WS16 outputs can be wired directly to antenna switches, that are controlled by 12Vdc. Each output is overload protected and can supply up to 500mA. Maximum 2.5A for all outputs combined.

Wiring the antenna hot-switching protection is optional, but recommend.

KEY1 and KEY2 are opto-isolated inputs. The input LED has a 1.5KOhm in series and it will be ON when 4V to 12V (2-8mA) are applied between +KEYx and -KEYx to sense if radio is transmitting. Use external resistor in series for higher operating voltage. Can be wired to Flex 6x00 TX RELAY output and 5V-12Vdc to sense transmitting.

TXE1 and TXE2 are solid state relays rated 0.5A, with 36V TVS diodes for over-voltage protection. Can be wired directly to Flex 6x00 radios TX REQUEST INPUT RCA connector.

Each pair of KEYx and TXEx can be wired to prevent antenna hot switching for each radio. After antenna change is requested, WS16 will check the corresponding KEYx to see if this radio is currently transmitting and waits until it goes to receive. When in receive WS16 can disable transmission with the TXEx relay, then safely switch new antenna selection and re-enabling transmission after a set delay.

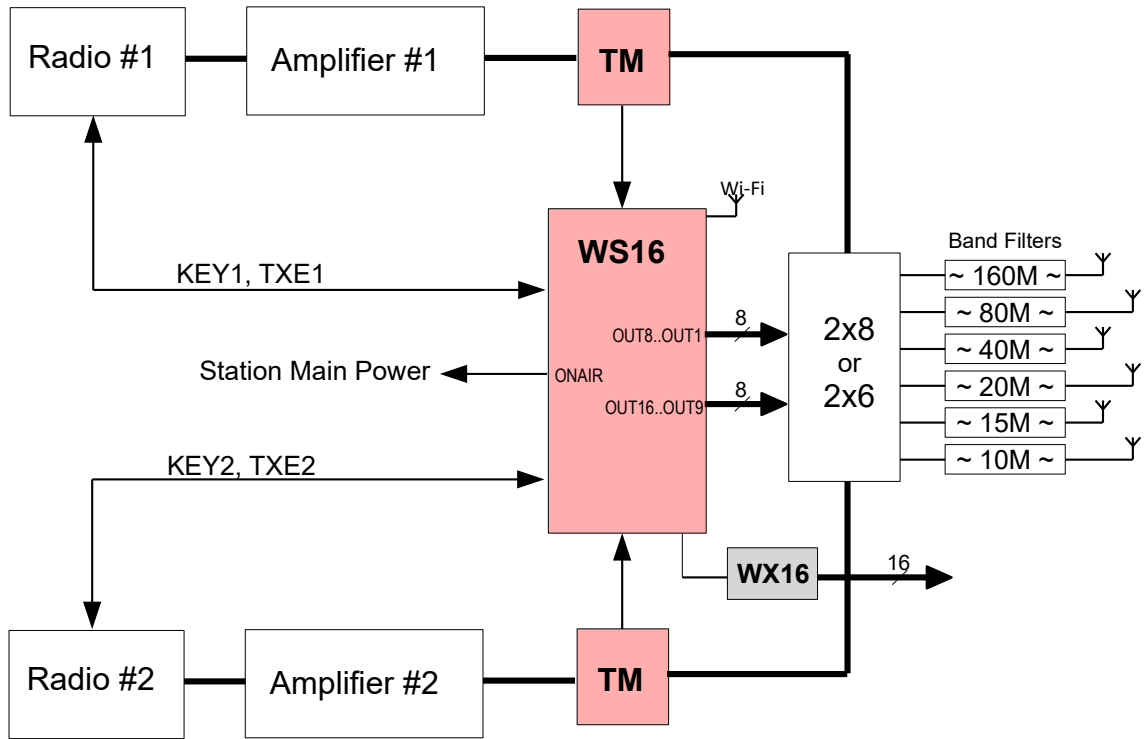
ONAIR is a solid state relay rated 0.5A, with 36V TVS diodes for over-voltage protection. It can be wired to an external relay, switching the station main power. Alternatively wire it to Flex 6x00 REMOTE POWER ON input to turn it ON/OFF remotely.

In SO2R and M2 configurations, outputs OUT1 to OUT8 are used to select antenna for radio#1 and OUT9 to OUT16 for radio#2 alternatively. WS16 firmware prevents setting them to same combination to prevent both radios to be routed to same antenna.

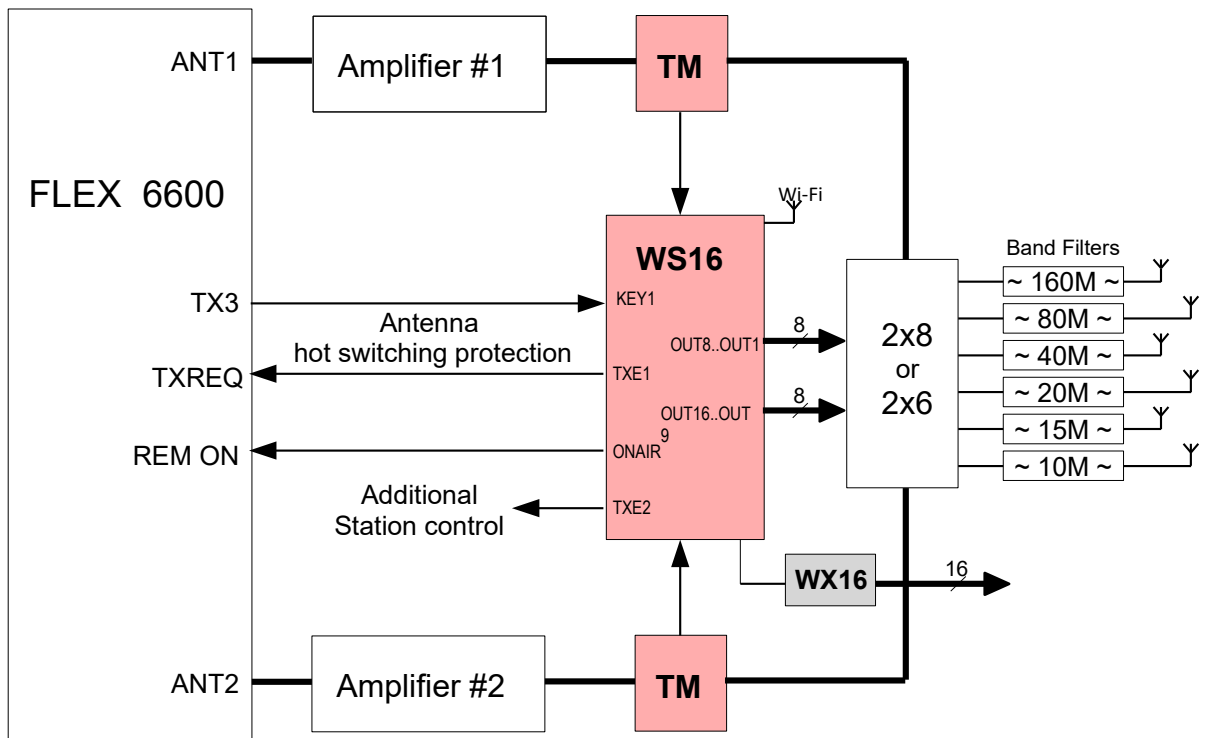
Two Tandem Match power sensors (TM) with 1:22 ratio transformers can be wired with audio or UTP cable.

VF and VR terminals should be wired to the corresponding WS16 VFx and VRx inputs for corresponding radio.

TM sensors are build with 1:22 ratio transformers, output voltage is about 3.6V at 100W and 16V at 2000W.



Two radio SO2R diagram

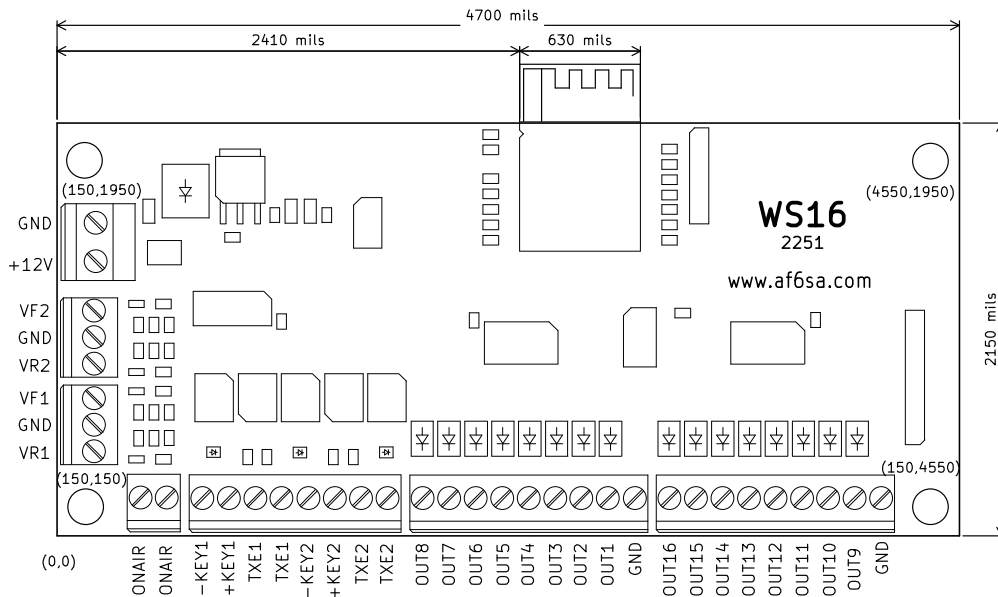


Flex 6600 SO2R setup

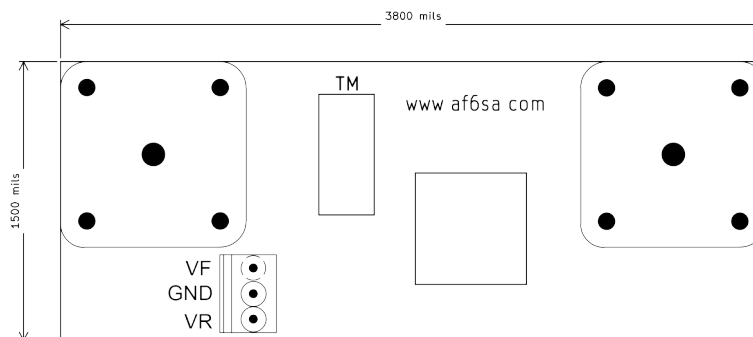
In Single Operator 1 Radio (SO1R) setup, all 16 outputs are available to select antenna.

One optional Tandem Match Power sensor (TM) can be wired to measure the transmitting power and check the SWR. KEY1 and TXE1 can be wired for hot-switching protection. The remaining TXE2 solid state relay output is free for additional station control.

An optional extension board WX16 can be installed for additional 16 outputs OUT17..OUT32



WS16 pin-out and dimensions



TM pin-out and dimensions

2 Wi-Fi Setup

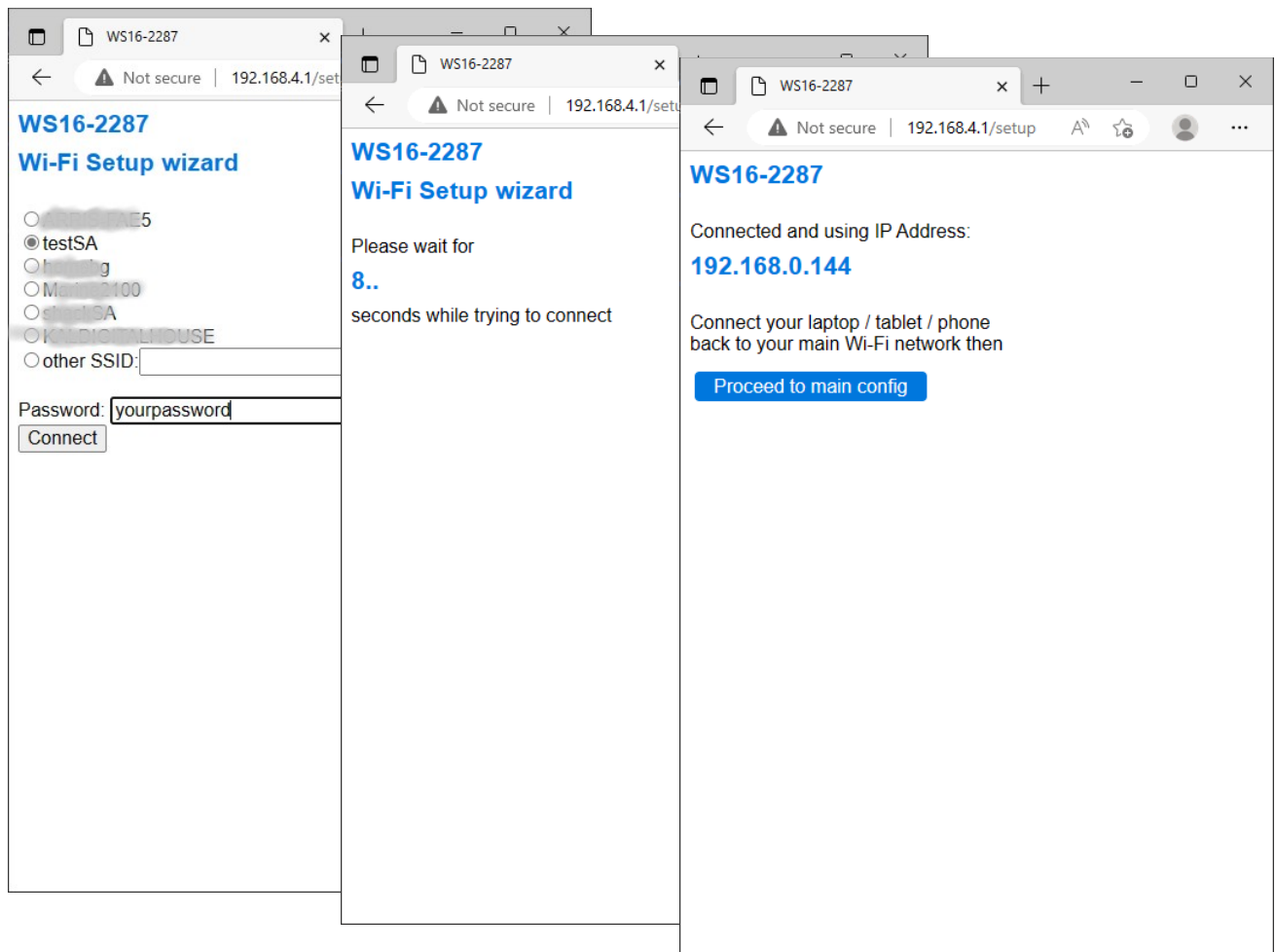
WS16 can be set and operated in two modes:

Access point (AP) mode will create a Wi-Fi network with DHCP server and provide access for up to 5 devices. You can connect your device (laptop / tablet / smartphone) to operate while portable or use it to enter credentials to your existing Wi-Fi network. Blue LED blinks once per second to indicate AP mode.

In **Station (STA)** mode WS16 will connect to an existing 2.4GHz Wi-Fi Access point and network using DHCP or fixed IP address. You need to enter name (SSID) and password (key) of the network you wish to connect. When connected, blue LED blinks twice per second. If it can't establish the connection, it will switch to **AP** mode, while trying periodically to reconnect.

When started for the first time WS16 will be in **AP** mode. Connect your laptop / tablet / smartphone to a Wi-Fi network named **WS16-xxxx**, using password **2config4**, then open a browser and go to IP: 192.168.4.1/setup.

WS16 will scan for Wi-Fi networks and present a list. Select the desired network or write its name, enter the password and press Connect.



After establishing the connection, a page with the new DHCP assigned IP address will be present.

Connect your laptop / tablet / phone back to the same Wi-Fi network and press the button to connect and continue to main configuration page.

WS16-2287

Home Tools

Main Settings

Host Name:

WEB admin:

WEB password:

Protect all:

Wi-Fi Connection Settings

Network SSID:

Password:

AP password:

STATIC IP Settings

IP address:

Gateway:

Subnet:

DNS:

Note: Leave all empty for DHCP

Host Name field is used to identify this device into the network. Host name in your network, Network SSID in AP mode. Max. 26 chars, no spaces.

WEB admin and **WEB password** – protect access to the WEB interface with a username and password. Leave it empty for free access.

Protect all – the /station and /station2 pages can be left unprotected and used without knowing WEB admin account.

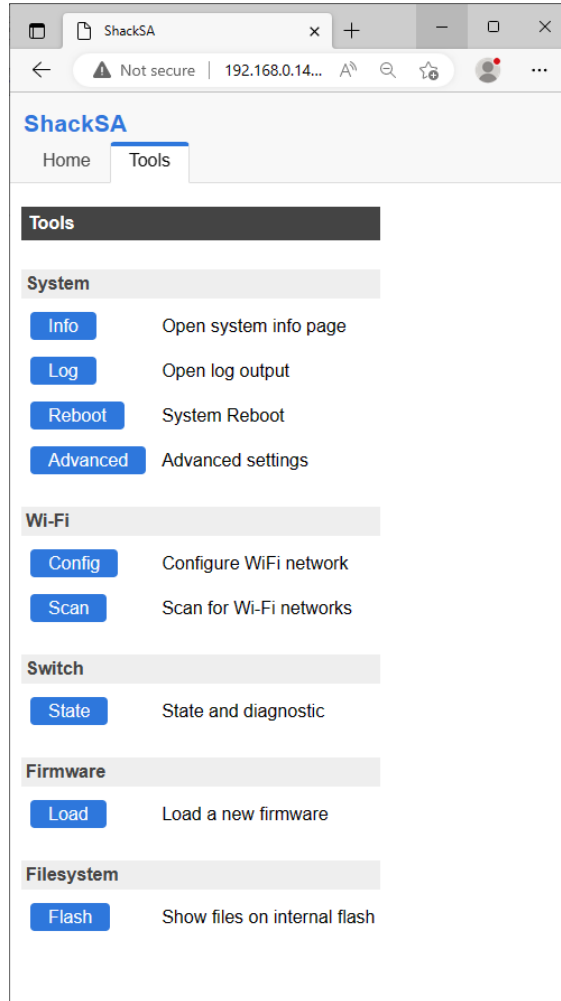
Network SSID – name of the network to connect to in STA mode. Leave it empty for AP mode.

Password – STA mode password (key). **Minimum 8 chars.**

AP password – access point mode password. Default is **2config4**. Minimum 8 chars.

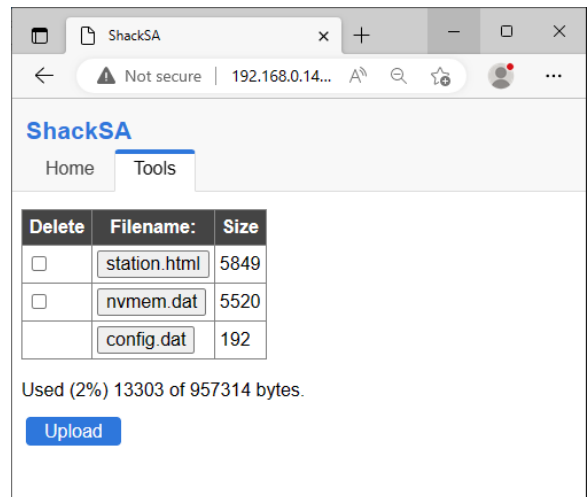
Static IP Settings – fill-out this section to use fixed IP address and restart. Leave it empty to use DHCP dynamically assigned IP address.

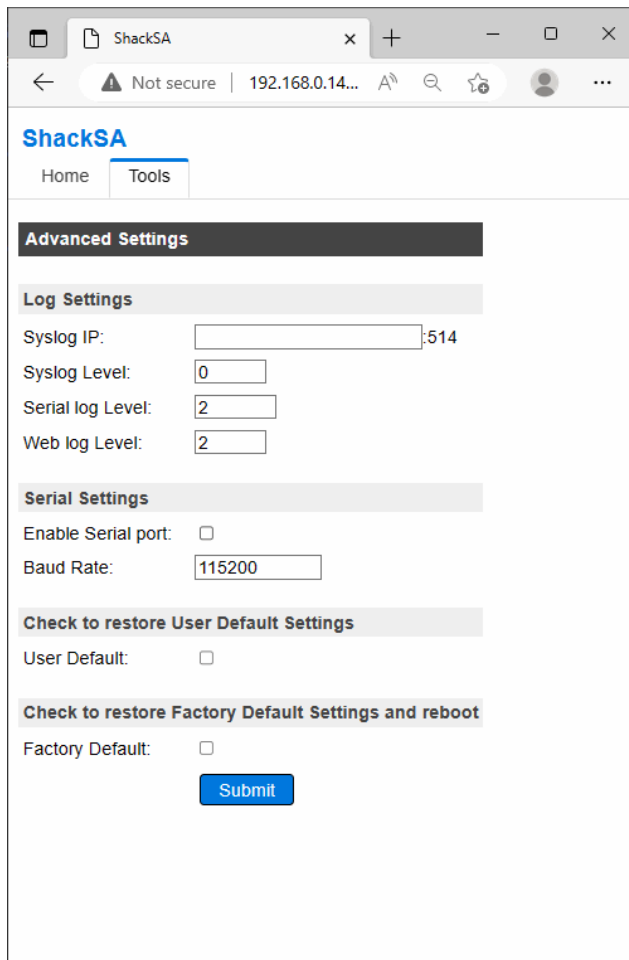
Tools tab reveals access to other pages and settings.



Firmware can be updated by uploading it through WEB interface. Suspend other communications (UDP and telnet) before starting the update. Major updates can clear User Settings to their defaults.

Files can be stored the internal flash file system and downloaded trough the WEB interface.
Click on the file name to download.
File will be deleted if the box is checked.





Syslog IP – UDP log messages can be send to this address on port 514

Syslog Level – [0..4] 0 – no messages send

Serial log Level – [0..10] Serial port messages level: 1= only errors, 2= +info, 3= +debug1 4= +debug2

Web log Level – [0..4] Web interface ToolsLog messages level.

Enable Serial port – output program status and debugging information at specified **Baud Rate**.

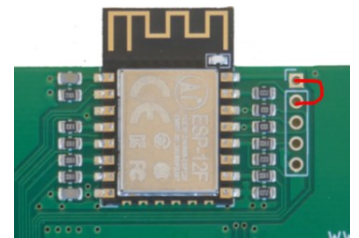
User Default – restore all user settings to their defaults.

Will not disconnect or change Wi-Fi network name and password.

Factory Default – restores all User Default settings, re-formats file system and clears Wi-Fi network name and password. System will reboot in Wireless Access Point mode.

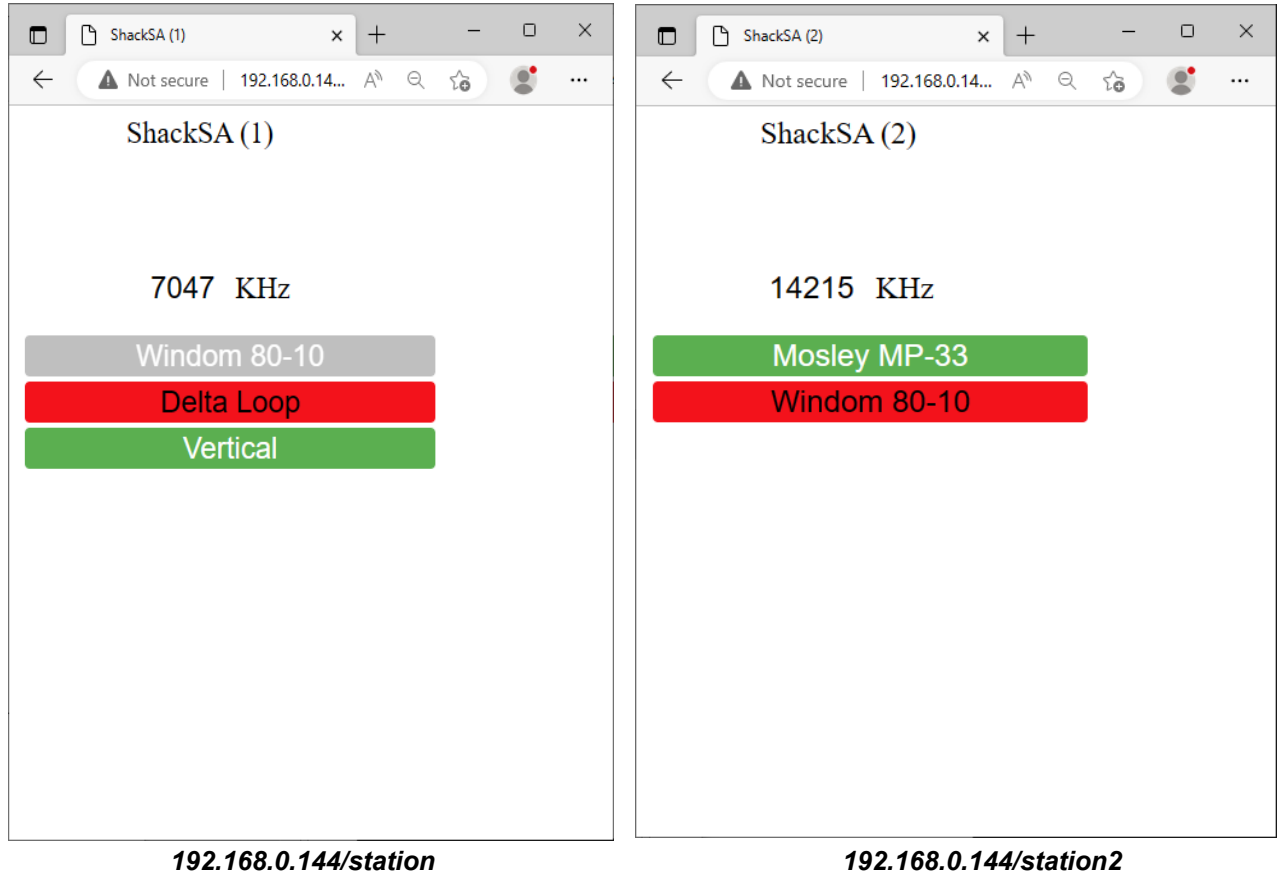
If WEB interface is not accessible, factory defaults can be restored with a jumper:

- turn off power and place a jumper between two pads as shown
- turn power on. When the blue LED starts to rapidly blink remove jumper
- wait about 30-40 sec, the LED should begin to slowly blink.
- module is reset and ready in Wireless Access Point mode.



3 WEB Station Interface

WEB server serves the file *station.html* from Flash file system as a separate WEB page for each station.



Use *your-ip/station* for radio#1 and *your-ip/station2* for radio#2 in SO2R and M2 modes

Holding CTRL while left clicking on the top line 'ShacksSA (1)' will toggle the ONAIR output to power-up your station. Switching it 'Off Air' will turn off all outputs to disconnect all antenna.

Displayed is the Transmitting Power, SWR, operating frequency and buttons with defined antenna selections for that frequency. Click or touch to change antenna.

In SO2R mode a grayed-out antenna button, indicates that antenna is currently used by the other station.

Each WEB page uses a *websocket* for fast update that can be adjusted down to 200ms.

Interface can be customized by editing *station.html* to change styles and color.



192.168.0.144/state

This WEB page is accessible from Tools > State or by entering *your-ip/state*.

Using a *websocket* for fast communication it shows for diagnostic all 4 analog inputs, KEY1, KEY2 inputs

Outputs can be toggled by clicking / touch. In SO2R you can't set

This *websocket* can be used for Node-RED integration. Description is in the technical reference section.

4 Configuration

WS16 configuration is accomplished via telnet on port 23. Using telnet allows the setup process to be formalized. A text file can be used (and is recommended) to prepare series of configuration commands for WS16 setup, documenting and backup.

PuTTY, TeraTerm or other terminal emulator can be used. (No echo is sent back.)

Commands can be sent by copy and paste from a text editor or send previously prepared text file. Pause of 0.2 sec is recommended after each line.

Backspace can be used to edit command line. Ctrl-X will cancel the command. Lines starting with '#' are treated as comments and will be ignored. Each command line starts with command name, followed by arguments, separated by space. Commands and arguments are not case sensitive.

nvmem WS16 configuration is stored in *nvmem.dat* file on FLASH.

All changes made via telnet are in RAM until saved.

nvmem save - save WS16 configuration from RAM to FLASH file system.

mode Set WS16 operating mode. Select mode before entering antenna definitions.

mode so1r 1 - each antenna has 16 outputs. KEY1 / TXE1 used for to prevent antenna hot switching.

mode so2r 2 - each antenna has 8 outputs to control 2x8 or 2x6 antenna switches.
radio#1 uses OUT8..OUT1, radio#2 uses OUT16..OUT9
KEY1 / TXE1 and KEY2 / TXE2 are used for to prevent hot switching for corresponding transceiver. Preventing both transceiver to use same antenna and transmitting simultaneously.

mode m2 2 - similar to SO2R, without disabling other radio to transmit.

mode so2r 1 - SO2R mode with one KEY1 / TXE1 used for both radios. Used for Flex 6x00.

mode so2r 0 - KEY1 for radio#1, KEY2 for radio#2. TXE outputs will be not used

band Define band segments. Band definitions are used to remember and select last used antenna after a band change.

band list - List all defined band segments as commands.
Copy output to a text file for reference and backup.

band set 14000 14350 - Defines a band segment 14000 KHz - 14350 KHz range.

band clear 1800 30000 - Clears all definitions in the 1800 KHz - 30000 KHz range.

ant Define antenna. Each definition has a name to be displayed, outputs configuration and a number that can be associated on different frequency segments.

ant list - List all defined antenna as commands. Copy to a text file for reference and backup.

ant delete 2 - delete antenna definition #2 [1..64]

ant delete all - delete antenna all antenna definitions.

ant 3 name "Windom 80-10" - Define name for antenna #3. Max 20 characters in double quotes.
ant 4 out xx000100 - Define output combination for antenna #4. OUT8 .. OUT1
In SO1R mode 16 outputs are available. SO2R requires 8 outputs.

tuner Assign antenna to a specific frequency range.

tuner list - List all assignments as commands. Copy to a text file for reference and backup.
tuner ant 3 14000 14350 - Assign antenna #3 to 14000 KHz - 14350 KHz frequency range.
tuner clear 1800 30000 - Clears all assignments in the 1800 KHz - 30000 KHz range.
tuner 14200 - List all antenna available on 14200 KHz.

qsy Change frequency and/or antenna.

qsy 14235 - Change frequency for radio#1 to 14235 KHz.
Switch to last used antenna on that band.
qsy 14235 3 - Change frequency for radio#1 to 14235 KHz. Antenna #3 will be used if available or the last used on that band.
qsy 2 7023 7 - Change frequency for radio#2 to 7023 KHz. Antenna #7 will be used if available or the last used on that band.

meter Calibrates the 10bit ADC readings for each transceiver for Power and SWR readings calculated by formulas: Forward power = $V_f^2 * C$ and Reflected power = $V_r^2 * C$

meter 1 cal 0.0032 - set calibration constant C for radio #1 to 0.0032. [0 .. 0.99]
meter 2 sense 5 - set the power [Watt] level for radio #2 to display power bar's. [0 .. 100]
meter offs 0 - ADC offset. When set to 0 WS16 will calculate the offset at power-up. [0 .. 100]

udp Selects the UDP port to listen for **RadiolInfo** broadcast's from N1MM+, DXLabs and other logger software.

udp port 12060 - Start the UDP listener on port 12060. Set it 0 to stop it.
udp useant 1 - N1MM+ can change antenna selection with Alt-F9
udp useant 0 - Prevents N1MM+ to select antenna.

flex Setup FLEX 6x00 series connection.

flex name "My FLEX alias" - Set the Flex radio name. Max 20 characters in double quotes.
flex 1 slice1 - set radio#1 to follow Flex slice1. [none, slice1, slice2, slice3, slice4]
flex 2 slice2 - set radio#2 to follow Flex slice2.
flex - display current Flex connection state.

out Directly access WS16 outputs

out 4 1 - Turn ON individual output. OUT4 → ON

out 3 0 - Turn OFF individual output. OUT3 → OFF

out 00001111xxxx0000 - Set outputs with a single command. OUT16..OUT1 from left to right.

0 → turn OFF the corresponding output

1 → turn ON the corresponding output

x → don't change this output

web Set the WEB pages update interval [200 - 5000 msec]

web update 250 - set update interval to 250 msec

txe Setup the antenna hot switching protection

txe time 50 - set guard time to 50ms. [0..100ms]

txe pol 1 open - select transmit enable for radio#1 to "open"

txe pol 2 closed - select transmit enable for radio#1 to "closed"

5 Technical reference

WS16 has *websocket* server that is used by *state.html* to display and control available resources. JavaScript code in *state.html* is a good reference and can be used for testing and as base for mod's.

WEB page can be opened locally, without uploading it into the WS16 file system.

Edit the two lines of code, including your WS16 IP address:

```
var wscURI = 'ws://192.168.0.144/wsstate';  
//var wscURI = 'ws://' + location.hostname + ':' + location.port + '/wsstate';
```

Open the modified file in your WEB browser.

Edit, save *html* file and refresh browser to see the modified page.

Data between Server and Client is exchanged in JSON format.

/wsstate status update (Server to Browser)

This JSON is send to all clients every update interval.

```
{  
  "onair":1, // ONAIR output state.  
  "pwr1":1368, "swr1":"1.49", // Transmitting power and SWR for radio#1  
  "khz1":7047, // radio#1 frequency  
  "pwr2":0, "swr2":"1.00", // Transmitting power and SWR for radio#2  
  "khz2":14023, // radio#2 frequency  
  "out":[0,0,0,0,0,0,1,0,0,0,0,0,1,0,0,1], // OUT10, OUT4 and OUT1 are ON.  
  "vf1":598, "vr1":119, // Forward and reverse analog inputs radio#1.  
  "vf2":0, "vr2":0, // Forward and reverse analog inputs radio#2.  
  "key1":1, "key2":0, // KEY inputs state. radio#1 is keyed.  
  "txen1":1, "txen2":1 // TXE state. Both radios can transmit  
}
```

This JSON is send to all clients on event of frequency change or antenna selection per radio.

```
{  
  "alist1":["Windom 80-10","Delta Loop","Vertical"], // Array of antennas available radio#1  
  "aidx1":1 // index of selected antenna for radio#1  
}  
  
{  
  "alist2":["Mosley MP-33","Windom 80-10"], // Array of antennas available for radio#2  
  "aidx2":0 // index of selected antenna for radio#2  
}
```

/wsstate commands (Browser to Server)

```
{  
  'onair':1,           // turn ONAIR output ON  
  'txen1':0,         // disable TXE1  
  'txen2':1,         // enable TXE2  
  'outs':3, 'outc':16, // set(ON) OUT3, clear(OFF) OUT16  
  'qsy1':14222,      // change frequency radio#1. Connected radio#1 can change it back  
  'antn1':3,         // select antenna #3 for radio#1  
  'aidx1':0,         // select first antenna from the list of available for radio#1  
  'utime':200        // change status update interval in msec.  
}
```

Each command can be send separately or grouped together up to 250 characters at once.