ANTENNA SWITCHING

SkookumLogger can control your antenna relays using a YCCC Master Of Antenna Switching (MOAS II) device. The technical documentation is the MOAS II Programming manual V1.0 linked at the end of the Downloads section at the MOAS II site. You may want to skim this document to learn about capabilities and terminology. The user interface for switching controls is a combination of menu items in the Radio menus, displays in the Map windows, and the XK-24 keypad.

SkookumLogger reads a JSON file named AntennaConfiguration at startup to define your antennas, how they are related to your rotators, and how they are switched. This document describes the expected content of that file.

A default configuration file is built into SkookumLogger. The content of that file is listed below as an example. You can create your own configuration file with a plain text or JSON-aware editor and place it in the SkookumLogger support folder to override the default configuration.

GQAntennaTest is an app for testing a configuration file outside SkookumLogger, where it can present details about issues that it may discover. Contact me for a copy of that app.

SkookumLogger supports one MOAS, two radios, three rotators and 63 antennas.

CONFIGURATION FILE SPECIFICATION

The configuration file is a plain text file that must conform to the JSON syntax.

ABOUT JSON

This is a brief description of the JSON syntax. Consult the internet for more definitive information.

A JSON file contains a group of key – value pairs. A *key* is case-sensitive string with no spaces. A *value* is a string, a number, a boolean (true or false), a list (array), or a group (dictionary). Pair elements are separated by a colon. Each pair must end with a comma except the last pair in a group. The order of of pairs within a group does not matter.

All strings must be wrapped in double quotes (but *not* curly quotes). Lists are wrapped in [and]. List elements are separated by commas. Groups are wrapped in { and }.

In the following, keys appear in bold type, omitting the required quotes.

MISCELLANEOUS TOP-LEVEL PAIRS

The optional **Comment** key has a string value. These pairs are ignored when loading the configuration.

The required **MOASSerialPortName** key has a string value. The MOAS port name will always begin with "usbserial-" followed by 8 letters and digits.

The optional **HotSwitchDelay** key has a number value, between 0 and 9999 ms. The default is 0 ms.

The required **Antennas** key has a list value. Each list element is a group describing a single physical antenna.

ANTENNAS LIST GROUP PAIRS

The required **AntennaID** key has a unique number value between 0 and 63.

The required **AntennaName** key has a unique string value that appears on menus and the SkookumLogger maps.

The optional **KeyID** key has a number value between 1 and 24 that associates the antenna with a XK-24 keypad key.

The optional **RotatorID** key has a number value 1, 2, or 3, associating a rotator with the antenna. The presence of this key identifies the antenna as rotary.

When **RotatorID** is present, the optional **MainLobeOffsetFromRotatorBearing** key has a number value in degrees.

When **RotatorID** is not present, the required **MainLobeBearing** key has a number value in degrees that specifies the direction of the antenna pattern main lobe. For dipoles this is the broadside direction for the fundamental (halfwave) band.

The optional **ReceiveOnly** key has a boolean value that treats the antenna differently from TX antennas. The RotatorID key is ignored and the **MainLobeBearing** is required.

The optional **IsSteppIr** key has a boolean value that, for SkookumLogger, identifies the antenna is to be associated with a radio when selected for use with that radio. Then, SkookumLogger sends frequency change information for that radio to the SteppIr controller.

The optional **ConflictsWithOtherAntennas** key has a list value containing other antennaID numbers that cannot be selected at the same time this antenna is selected. Each antenna always conflicts with itself.

The required **BandSegments** key has a list value. Each list element is a group describing bands supported by the antenna.

BANDSEGMENT GROUP PAIRS

The optional **IsDefault** key has a boolean value that identifies the antenna as the default choice for the band of segment.

The required **BandName** key has a string value that is one of the band names supported by SkookumLogger or "Any". The SkookumLogger band names are: 160m, 80m, 40m, 30m, 20m, 17m, 15m, 12m, 10m, 6m, 4m, 2m, 125cm, 70cm, 33cm, and 23cm. "Any" supports dummy loads.

The optional **Radio1Only** and **Radio2Only** keys have boolean values that flag a band segment as useable for only one of the two radios. This supports separate dummy loads for each radio.

The required **PatternTypeName** key has string value that identifies the characteristics of the azimuthal antenna pattern for drawing on the SkookumLogger great circle maps. The recognized values are Omnidirectional, Unidirectional, Bidirectional, DipoleHarmonicA, DipoleHarmonicB, and DipoleHarmonicC. Case matters.

The three DipoleHarmonic patterns apply for half-wave dipole operated on a higher frequency, A for an 80m dipole used on 15m, B for a 40m dipole used on 15m, and C for a 40m dipole used on 6m. All of these patterns are four-lobe cloverleafs with a null in the direction specified by the `MainLobeBearing` value, with slightly different lobe orientations and lobe beamwidths. I estimated the lobe orientations and beamwidths using miniCocoaNEC for dipole a 60 high over average ground to generate the azimuth pattern at the elevation angle for the first peak in the elevation plane. Lobe beamwidth is the full angle between points 5 dB (one S-unit) down from the lobe peak. The values are built into SkookumLogger.

The `MainLobeBeamwidth` key is required for Unidirectional and Bidirectional patterns, with number value in degrees.

The required `Radio1Relays` key has a list value. The list elements are MOAS relay numbers between 0 and 63.

The optional `Radio2Relays` key has a list value. The list elements are MOAS relay numbers between 0 and 63.

The optional `Radio1AlternateRelays` key has a list value. The list elements are MOAS relay numbers between 0 and 63. See Alternate Relays.

The optional `Radio2AlternateRelays` key has a list value. The list elements are MOAS relay numbers between 0 and 63. See AlternateRelays.

ABOUT THE XK-24 KEYPAD

The XK-24 USB keypad has 24 keys, each with a blue backlight, a red backlight, and a user-customizable label. SkookumLogger automatically discovers the device at startup. The **Window ▶ External Devices ▶ XK-24 Keypad** window has an array of 24 menus for associating key presses with SkookumLogger functions. These are the functions relevant to antenna switching:

Select Antenna for Key ID – Select the transmit antenna associated with the key's ID in the configuration file. Press a key and release within one-half second to select the antenna for Radio 1. Press and hold for more than one-half second to select the antenna for Radio 2.

Select Receive antenna for Key ID – Select the receive antenna associated with the key's ID in the configuration file, for Radio 1.

Select Best Antennas – Choose the transmit and receive antennas with main lobe bearings closest to the Radio 1 target station bearing.

**Rotator ▶ Set Rotator n to Target Bearing** – Turn rotator 1, 2, or 3 to the Radio 1 target bearing.

When a key is pressed and released, the XK-24 Keypad displays the Key ID.

When a transmit antenna is selected for Radio 1, the blue backlights for other Radio 1 transmit antennas are turned off and the blue backlight for the selected antenna is turned on. If the selection causes a MOAS conflict, the blue backlight blinks, indicating that Radio 1 has no transmit antenna. The red backlights behave similarly for Radio 2.

About GQAntennaTest

The app reads a configuration file and has a simple window that displays antenna choices and status, input fields for setting radio frequencies, and a button for a Swap TX Antennas function. The menu bar has Radio 1 and Radio 2 menus which display TX and RX antennas available for the current frequencies and choose which antennas are selected.
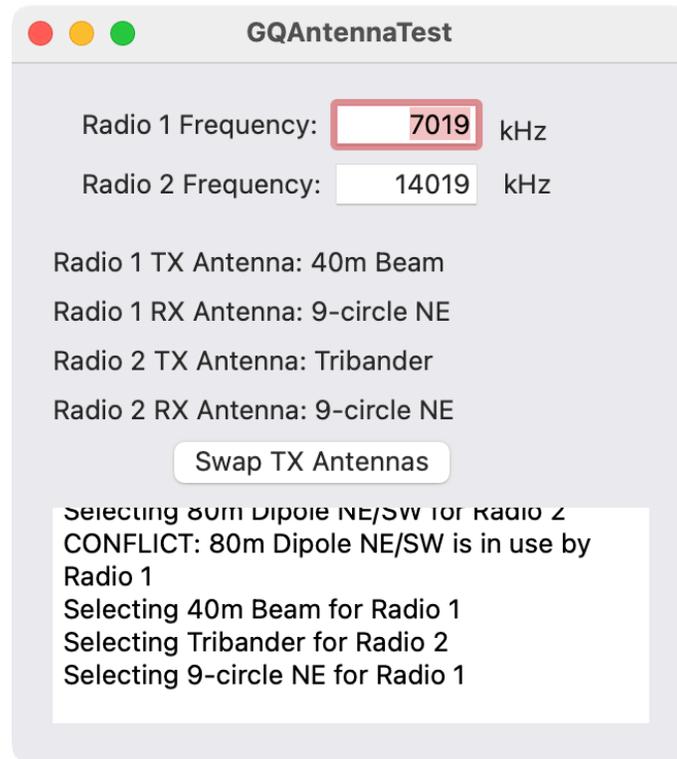
Terminology:

Select means enable a specified set of antenna relays.

No Antenna means no TX antenna relays are selected, typically due to a conflict.

Conflict means that MOAS has rejected a selection request, as, for example, trying to use the same antenna for both radios.

Loading a Configuration

After starting GQAntennaTest, use File > Open to load a configuration file. If the syntax of the file is incorrect, macOS will display this unhelpful alert:

The best way to find syntax errors is to copy the text of the configuration file and paste into an online JSON validation site. http://json-validator.com is ugly but effective. Indenting is unnecessary but helpful. BBEdit has a JSON mode that detects some types of errors, handles indentation, and understands how to edit plain text.

When loading the file, GQAntennaTest confirms that no required keys are missing, and that no keys are unknown. Optional keys can be omitted. After loading, Several sanity tests are run:

The data couldn't be read because it isn't in the correct format.

OK
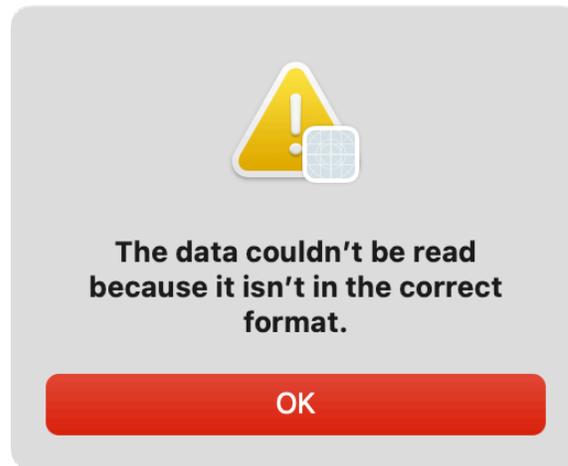
- All BandSegment.BandName and BandSegment.PatternTypeNames values are valid.
- All BandSegments with IsDefault value true are for different bands.
- Antenna.MainLobeBearing is specified for all antennas except rotary antennas and Omnidirectional antenna patterns.
- BandSegment.MainLobeBeamwidth is specified when the BandSegment.PatternTypeName is either Unidirectional or Bidirectional.

You can load the same or a different configuration file without restarting the app.

STARTUP

After loading a configuration, the app attempts to set up and activated the MOAS. If only a "loaded" configuration message appears in the status box, either the MOAS is not powered on, the USB cable is not connected, or the port name is wrong in the configuration file.

BEHAVIOR

When activation succeeds, the app sets initial frequencies for the two radios, resulting in initial TX antenna selections. You can choose various antennas from the Radio 1 and Radio 2 menus, and enter frequencies in kHz to see how the configuration reacts.

2T2R INTERLOCK

To guarantee that the radios cannot transmit at the same time, connect the radio KEY OUT lines to MOAS TX inputs 1 and 2, and the corresponding MOAS INHIBIT outputs to the radio inhibit inputs.

ANTENNA HOT-SWITCHING

To guarantee that an in-use antenna won't be changed while transmitting, connects the radio KEY OUT lines to the MOAS TX inputs 1 and 2. MOAS will delay changing the TX antenna while transmitting until after the TX input has been high (not transmitting) for the number of milliseconds specified by the `HotSwitchDelay` value. For example when using QSK, to prevent switching

between code elements and letter spaces and to allow switching during word spaces, set the delay to 200 ms. The duration of a word space with CT spacing is 240 ms at 30 WPM.

CONFLICTING ANTENNAS

The two radios cannot select the same antenna; this is a conflict condition detected by MOAS. You can add other conflict conditions that prevent selecting other antennas when an antenna is in use. The outcome of a conflict is to select "No Antenna" (no relays) for the radio that caused the conflict.

FREQUENCY CHANGES

The BandSegment groups for an antenna determine the bands that the antenna supports. When a radio frequency change is a band change, the app creates a list of all antennas with segments that contain the new band, and updates the radio menus. Then an antenna for the radio is selected: first, select the previous antenna for the new band, if not found select the default antenna in the list, if not found select the first antenna in the list.

DUMMY LOAD

When a segment band name is "Any", the antenna (typically a dummy load) will always appear on the menu. If it is the only item on the menu, then it will be selected by the above rule when a radio changes to a band with no antennas. Use the `Radio1Only` and `Radio2Only` keys to create two dummy loads that do not conflict.

RECEIVE ANTENNAS

The antennas listed in the TX Antennas menu may be used for both transmitting and receiving. The antennas listed in the RX Antennas menu have the `ReceiveOnly` value equal to true. These antennas do not conflict with TX antennas or other RX antennas. Instead, whichever RX antenna was most recently selected is used for both radios. This handles my receive antenna, which has eight directions switched by MOAS, one direction at a time, and will work for remotely-switched beverages that share a common feed line into the shack.

SWAP TX ANTENNAS

This function interchanges the two radios' transmit antennas, only if swapping would yield usable antennas on both radios. If not, nothing changes.

ALTERNATE RELAYS

An alternate set of relays for a TX antenna segment is used to select a different antenna for a radio while the other radio is transmitting. `Radio1AlternateRelays` applies when radio 2 is transmitting, and `Radio2AlternateRelays` applies when radio1 is transmitting. If the array of relay IDs is empty, "No Antenna" will be selected. If the pair is not present in the segment configuration, the selected antenna will not be switched.

USING THE CONFIGURATION FILE WITH SKOOKUMLOGGER

Name the file AntennaConfiguration.json and place it in the support folder. If you edit the file, you will need to restart SkookumLogger to reload the file.

The path to the support folder is:

```
~/Library/Containers/com.k1gq.SkookumLogger/Data/Library/Application Support/
SkookumLogger
```

SkookumLogger does most of the sanity testing that is performed by GQAntennaTest, but displays issues only to the debug log.

DEFAULT SKOOKUMLOGGER CONFIGURATION

The default configuration describes four antennas, a receive-only vertical for 40m, a tribander for 20m, 15m and 10m, and dipoles for 40m and 80m. The tribander is associated with Rotator 1.

```
{
"MOASSerialPortName" : "nada",
"Antennas" :
    [
        {
        "AntennaID" : 1,
        "AntennaName" : "40m Receive Vertical",
        "ReceiveOnly" : true,
        "BandSegments" :
            [
                {
                "IsDefault" : true,
                "BandName" : "40m",
                "PatternTypeName" : "Omnidirectional"
                 }
            ]
        },
        {
        "AntennaID" : 2,
        "AntennaName" : "Tribander",
        "RotatorID": 1,
        "BandSegments" :
            [
                {
                "IsDefault" : true,
                "BandName" : "20m",
                "PatternTypeName" : "Unidirectional",
                "MainLobeBeamwidth" : 60
                 },
                 {
                "IsDefault" : true,
                "BandName" : "15m",
                "PatternTypeName" : "Unidirectional",
                "MainLobeBeamwidth" : 55
                 },
                 {
                "IsDefault" : true,
                "BandName" : "10m",
                "PatternTypeName" : "Unidirectional",
                "MainLobeBeamwidth" : 50
                 }
            ]
        },
```

```json
    {
    "AntennaID" : 3,
    "AntennaName" : "80m Dipole",
    "MainLobeBearing" : 50,
    "BandSegments" :
        [
            {
            "IsDefault" : true,
            "BandName" : "80m",
            "PatternTypeName" : "Bidirectional",
            "MainLobeBeamwidth" : 100.0
             }
        ]
    },
    {
    "AntennaID" : 4,
    "AntennaName" : "40m Dipole",
    "MainLobeBearing" : 50,
    "BandSegments" :
        [
            {
            "IsDefault" : true,
            "BandName" : "40m",
            "PatternTypeName" : "Bidirectional",
            "MainLobeBeamwidth" : 80.0
             }
        ]
    }
   ]
}
```