

# **MoeTronix WSPR Beacon**

## **User Guide**

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# Table of Contents

1	Overview.....	3
2	PCB Connections/Switches/LED's.....	5
2.1	DC Power.....	5
2.2	Power Switch.....	5
2.3	RS232 DB-9 Connector.....	5
2.4	SMA GPS Antenna Input.....	5
2.5	BNC RF Connector.....	5
2.6	Mode Switch.....	5
2.7	LED Indicators.....	6
3	Operation.....	7
3.1	General Setup Mode.....	7
3.2	Tune Mode.....	8
3.3	Boot Mode.....	8
3.4	GPS Mode.....	9
3.5	GPS Raw Mode.....	9
3.6	WSPR Operation Mode.....	10
4	Transmit Modules.....	11
4.1	Changing Modules.....	11
4.2	Using On Board TX.....	12

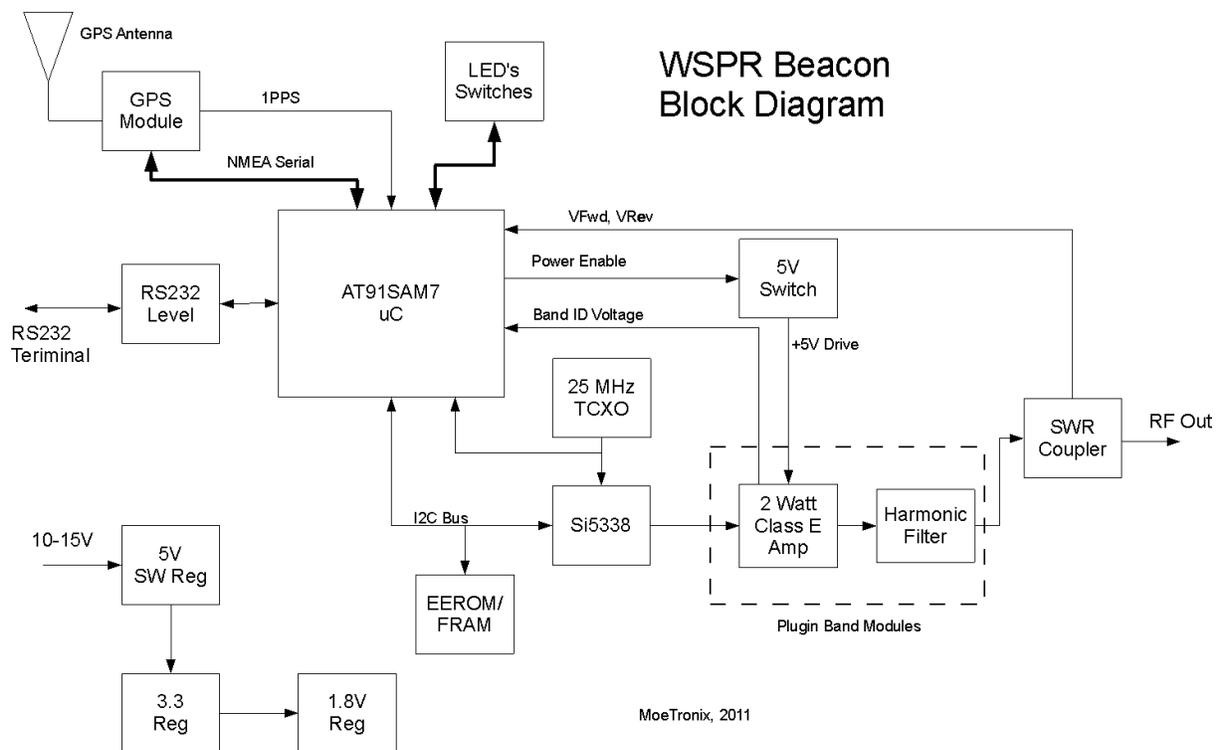
# 1 Overview

The WSPR beacon is a stand alone WSPR mode transmitter that only requires DC power and antenna to beacon out WSPR format signals on any one amateur HF band. It puts out approximately 2 to 3 Watts of RF using a plug-in Class E amplifier/filter board for the band desired.

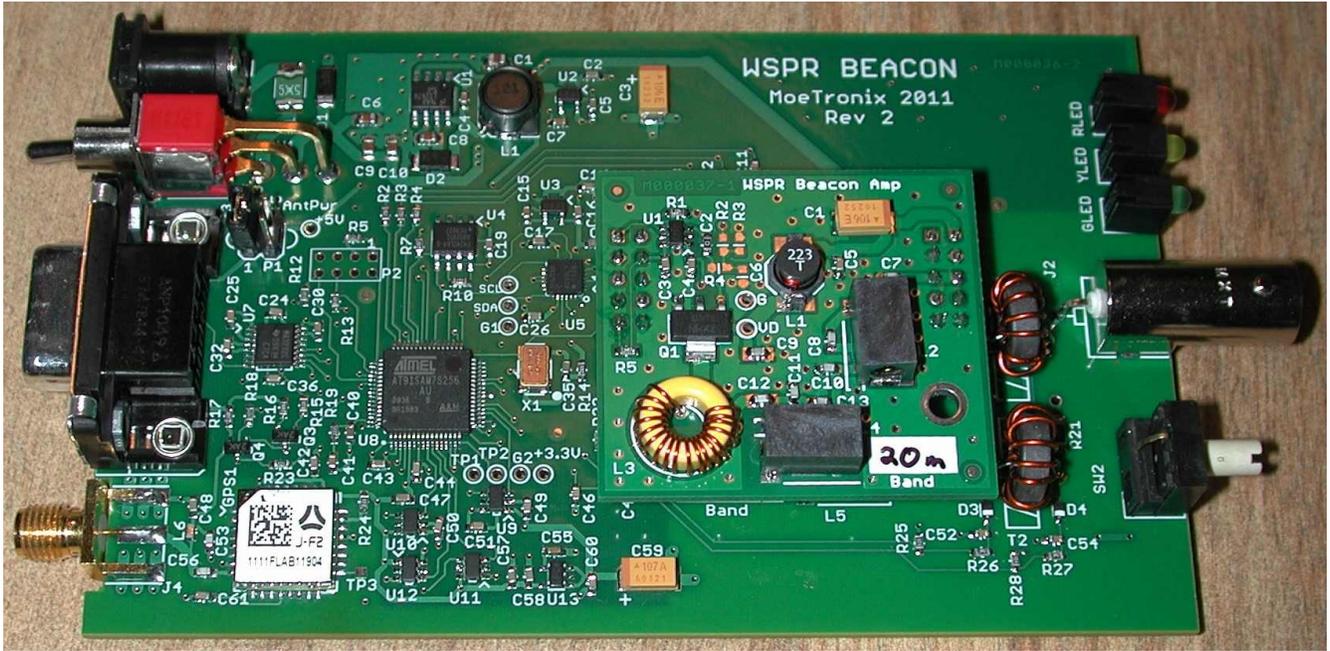
The following features are implemented:

- An RS232 serial port can be connected to a PC to setup parameters such as Call sign, frequency within the band in 1Hz steps, and transmit timing interval.
- Built in VSWR measurement for tuning and antenna failure protection.
- Built in GPS receiver for automatic grid square creation and transmit timing.
- Temperature compensated frequency reference for accurate transmit frequency and internal time clock for GPS signal outages.

Block diagram of beacon:



Main Board:



Connections and Controls:

Front



Back



## **2 PCB Connections/Switches/LED's**

### **2.1 DC Power**

The unit requires a standard 2.1mm center positive power connector providing 8 to 15 Volts DC at .5 A. Since this voltage is directly connected to the RF amplifier, it must be clean in order to not AM modulate the Class E amplifier.

When not transmitting the unit draws around 60mA. The transmit current varies with module and antenna loading but is typically between 200 and 500mA.

The DC power is protected with a auto resetting polyfuse in case of PA FET failure or other component failure that would short the power.

### **2.2 Power Switch**

The toggle switch at the back is used to power on and off the unit. It is a true power switch and removes all power from the unit.

### **2.3 RS232 DB-9 Connector**

This connector is used to connect to a standard RS232 9 pin serial port on a PC or any USB serial port cable. The port is fixed at 115200 bps, 8 bits, No parity.

### **2.4 SMA GPS Antenna Input**

The SMA connector at the rear should be connected to a GPS antenna. Either an active or passive antenna will work. If the antenna is active, one must select with a jumper on the board depending on whether it is a 5 volt or 3 volt version. An outdoor antenna is not needed unless the indoor location is poor such as a metal building.

### **2.5 BNC RF Connector**

The BNC is the RF output of the beacon and should be connected to an antenna matched to 50 Ohms on the desired frequency. The VSWR is monitored during normal transmit and will shut down if the VSWR is greater than 5:1. In the Tune mode, the VSWR protection is disabled so one must not tune with a poor load for too long to prevent over heating the FET.

### **2.6 Mode Switch**

The rotary mode switch on the front is used to select various operation modes. It has 16 positions labeled 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E, and F. The current selection is a bit difficult to see since the long slot on the switch shaft indicates where the switch is positioned.

## Implemented Modes:

- '0' == Boot Mode for entering firmware update mode on power up. Tx Off
- '1' thru 'B' == Normal WSPR Beaconsing Mode
- 'C' == Raw GPS data monitor Mode Tx Off
- 'D' == TX On Tune Mode
- 'E' == Parameter Setup Mode using RS232 port. Tx Off
- 'F' == GPS Monitor mode Tx Off



## 2.7 LED Indicators

Three LED's are used to indicate various status states depending on the operation mode.

MODE	GREEN	YELLOW	RED
Normal WSPR	On == Time is Valid Off == Time Not Valid	On == No GPS Signal Off == GPS 3D Locked Blink == GPS Locking	Off == Tx Off, no Time Sync Short Blink==Waiting to Tx Long Blink==Transmitting WSPR
Setup	Mostly On Blink	Off	Off
Tune	Short Blink	Intensity is Reflected Power	Intensity is VSWR
GPS	GYB "Chaser" blink	GYB "Chaser" blink	GYB "Chaser" blink
GPS Raw	Mostly On Blink	Mostly On Blink	Mostly On Blink
Boot Enable Mode	Fast Blink	Fast Blink	Fast Blink
In Boot Mode (After power cycle)	Blink Opposite of RED	Off	Blink Opposite of GREEN

## 3 Operation

### 3.1 General Setup Mode

Before operation, one must at a minimum enter their amateur call sign before legally being able to transmit. Other setup options are transmit frequency within the 200Hz WSPR band and time interval between transmissions.

To enter setup information select Mode Switch position 'E' to enter setup mode. Connect an RS232 cable between the beacon and a PC running some sort of terminal program such as Hyperterminal or PuTTY and setup to 115200bps, 8 bits, No Parity, No Flow Control.

All settings are stored in non-volatile memory so need be entered only once.

Pressing the 'Enter' key should return a text menu with prompts to be able to enter or edit various settings.

```
Call = AE4JY
```

```
Freq = 7.040100 MHz
```

```
Power = 33 dBm
```

```
Interval = 8 Min
```

```
Press 'C', 'F', 'P', or 'I' to Edit
```

```
Press ESC twice to abort edit mode
```

```
Press Enter to accept edit
```

```
>
```

Pressing the 'C' key allows editing the call sign. Use the delete or backspace key to delete characters and type desired new characters. Hit the Enter key to accept or hit the ESC key twice to abort the edit.

Pressing the 'F' key allows editing the frequency. Use the delete or backspace key to delete characters and type desired new characters. Hit the Enter key to accept or hit the ESC key twice to abort the edit. Note that each band has its own frequency setting so one must have the desired band module installed to edit its frequency. Each frequency band is 200 Hz wide and can be set to 1Hz resolution.

Pressing the 'P' key allows editing the reported power in dBm(0 to 63) not the actual power which is fixed. Use the delete or backspace key to delete characters and type desired new characters. Hit the Enter key to accept or hit the ESC key twice to abort the edit.

Pressing the 'I' key allows editing the transmit interval in minutes. Use the delete or backspace key to delete characters and type desired new characters. Hit the Enter key to accept or hit the ESC key twice to abort the edit.

Verify all settings before changing to operational mode.

### **3.2 Tune Mode**

When the mode switch is placed in tune Mode 'D', the transmitter is turned on continuously in order to test or tune an antenna. Before entering this mode make sure an antenna or dummy load is connected to prevent overheating of the Transmitter FET.

The VSWR can be continuously monitored using the Serial port and a terminal program. One should tune the antenna as close to 1.00 as possible but will operate with much worse matches. Over 5.00 and it will automatically shut off when in the normal operation mode but not in tune mode.

>

```
VSWR = 2.52
```

An VSWR of 0.00 means there is no RF probably due to a missing module or hardware failure.

The Yellow and Red LED's also indicate the VSWR match by varying intensity with VSWR and reverse power.

The Red LED intensity is brighter for larger VSWR ratios so should be tuned for minimum brightness.

The Yellow LED intensity is brighter for larger reflected power and should also be tuned for minimum brightness. It has higher gain so is more sensitive.

One should minimize the Red LED first then fine tune to get minimum Yellow brightness. Unless the match is nearly perfect, the Yellow LED will probably still be slightly on.

### **3.3 Boot Mode**

If the Mode Switch is placed in the '0' position, all LED's will blink quickly and the TX is turned off.

The following prompt is shown in the terminal if connected:

>

```
Power Cycle to Enter Boot Mode
```

In order to actually enter the boot mode and be able to update the firmware, one must power cycle the Beacon. After power cycling with the switch in the '0' position, the Red and Green LED's will alternately blink and the programming utility can now be run to update the code.

In order to exit the boot mode, change the mode switch to something other than '0' and power cycle the device.

### **3.4 GPS Mode**

If the Mode Switch is placed in the 'F' position, The LED's will blink in a “chaser” sequence and the TX is turned off.

This mode monitors the GPS status and outputs formatted time and position information to the serial port terminal.

The format is:

```
NumSats=10    Grid Square EM73wx
```

```
UTC 20 Hours : 23 Minutes : 39 Seconds
```

```
Latitude N3358.6406    Longitude W08408.1742
```

```
Altitude 310.3 meters
```

### **3.5 GPS Raw Mode**

If the Mode Switch is placed in the 'C' position, all LED's will blink in a mostly on manner and the TX is turned off.

This mode outputs all NMEA sequences directly from the GPS receiver to the serial port terminal.

Typical format is:

```
$GPRMC,202620.000,A,3358.6396,N,08408.1740,W,0.00,185.43,150112,, ,A*74
```

```
$GPGGA,202621.000,3358.6396,N,08408.1740,W,1,10,0.9,310.9,M,-31.0,M,,0000*66
```

```
$GPGSA,A,3,21,18,15,09,27,22,06,29,03,26,, ,1.4,0.9,1.1*36
```

```
$GPGSV,3,1,12,21,82,274,32,18,59,328,37,15,47,041,37,09,45,122,36*73
```

```
$GPGSV,3,2,12,27,43,084,27,22,24,290,26,06,18,295,22,29,13,192,10*7A
```

### **3.6 WSPR Operation Mode**

When the Mode Switch is in positions '1' to 'B', the beacon is in normal WSPR transmit mode.

In this mode the beacon waits for the beginning of the even minutes and if the time interval has expired, begins transmitting the WSPR signal. After sending all the symbols, the transmitter is turned off and it waits for the next time interval to expire. A random number of minutes is added to the user specified interval to increase the chance of a receiver hearing the beacon. If the Time interval is set to zero, the beacon transmits on every even minute.

Various status strings are sent to the serial port terminal for monitoring progress.

While waiting to transmit, the current GPS status, the time and time for the next transmission is displayed along with a running total of transmissions since power up.

```
Sats = 8   UTC = 20:43:53   Next = 10:6   Total = 2
```

While transmitting, the time and a symbol countdown is displayed.

```
!Transmitter On! UTC = 20:31:50   Symb = 0
```

```
!Transmitter On! UTC = 20:43:8   Symb = 62
```

## 4 Transmit Modules

Each HF band requires a different plug in module to operate due to the narrow band nature of class E amplifiers. Each module has a unique resistor value assigned to it so it can be automatically identified by the main board.

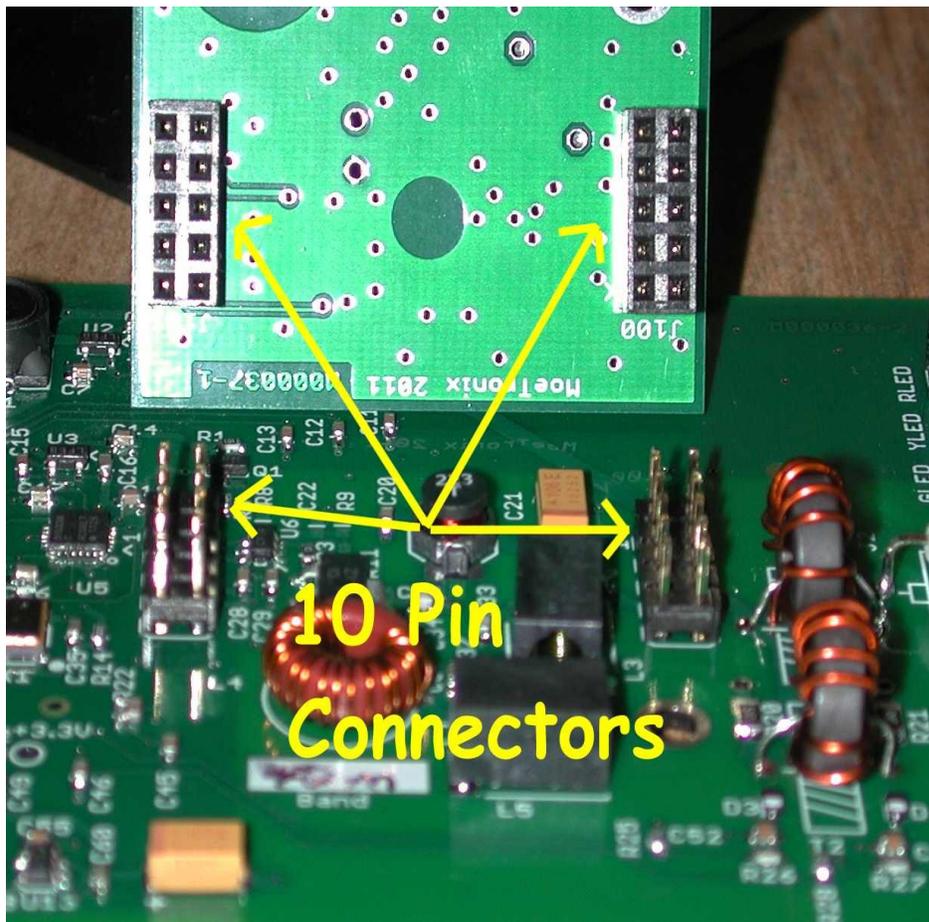
The main board also has a default band transmitter permanently installed so that a TX module is not required if only a single band is needed. Three jumpers must be used to select the on board transmitter.

### 4.1 Changing Modules

#### **!! Warning !!**

- **Make sure the power switch is turned off before removing or installing a module.**
- **Handle the boards with extreme care since ESD can easily damage the unit. A good habit is to touch the BNC ground to discharge yourself before touching anything else.**

The Modules have two 10 pin connectors that must be aligned correctly. They are not keyed so can be off by a pin or two so care must be exercised.

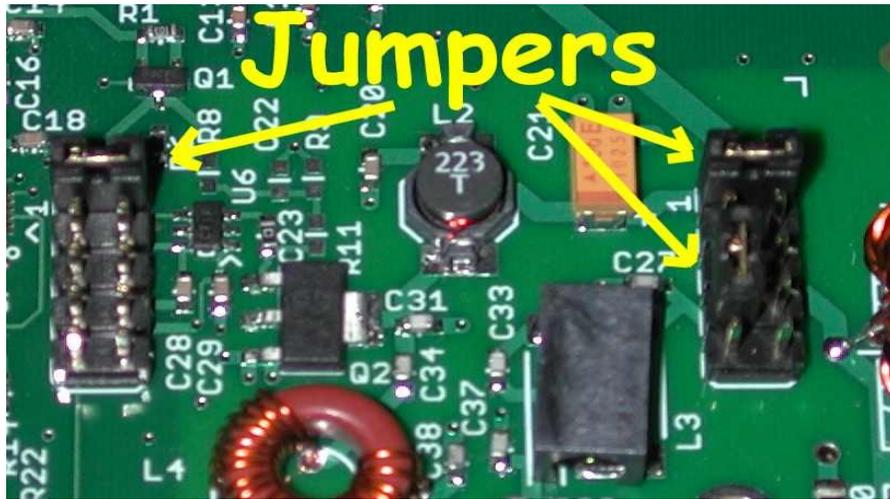


## 4.2 Using On Board TX

Three jumpers must be placed on the module connectors in order to enable the on board transmitter.

Currently the default module is on 40 meters.

The three jumpers are as shown:



On P4, pins 1 and 2 need a jumper. (Input clock)

On P3, pins 1 and 2 need a jumper. (+12V power)

On P3, pins 5 and 7 need a jumper. (Antenna out)