

# The Deluxe Tenna Dipper

Design by: KD1JV

Distributed by: Hendricks QRP kits, [www.qrpkits.com](http://www.qrpkits.com)



The "Tenna Dipper" provides a simple means of determining the 50 ohm resonate frequency of an HF antenna or ATU (Antenna Tuning Unit). The small size and battery operation makes the unit ideal for use in the field.

## Features:

- Wide tuning range: ~3 MHz to ~30 MHz in two ranges
- Four digit LED frequency readout

## Usages:

- Eliminates the need for a transmitter and SWR bridge when:
  - Trimming length of resonate dipole antenna.
  - QRM free adjusting of antenna tuners
  - Quickly adjust short, portable vertical antennas.

## **How it works:**

A voltage controlled R/C oscillator generates a 5 volt square wave signal. This signal drives a resistive Wheatstone bridge. One leg of the bridge is the "unknown" resistance, the antenna. A wide band step up transformer is connected across the bridge to detect the signal produced when the bridge is unbalanced. This signal is further amplified by a Darlington pair transistor amplifier. A high brightness LED is used to visually indicate the current in the collector of the amplifier. When the antenna impedance at the unknown leg of the bridge is equal to 50 ohms, the bridge is in balance and the LED will go out. Hence the name for this device, the Tenna Dipper, as we dip the brightness of the LED to find the 50 ohm match.

## **Using the Tenna Dipper.**

### Finding the resonate frequency of a coax feed dipole antenna:

Simply connect the feed line to the Tenna Dipper and adjust the frequency until the SWR indicating LED goes from bright to very dim or completely out. Then read the frequency on the display.

### Adjusting an antenna or ATU to a specific frequency (or band)

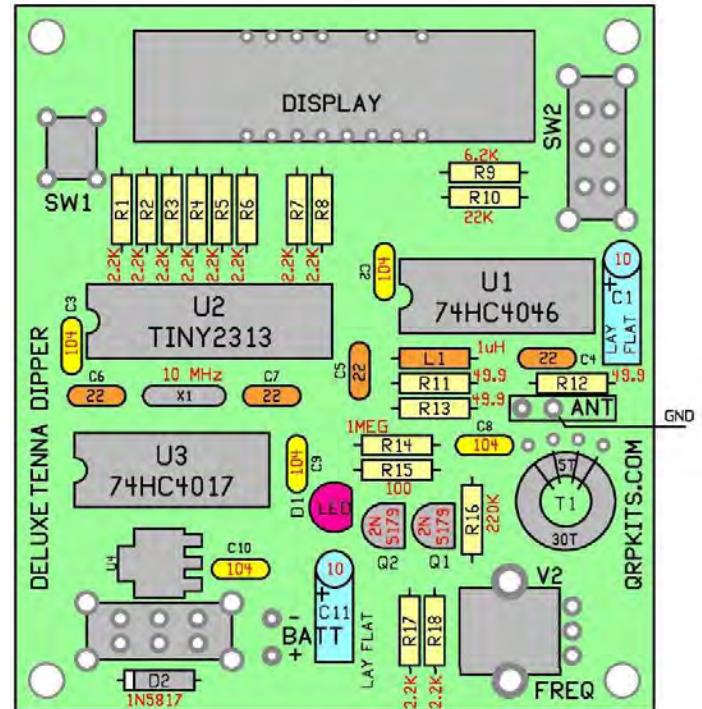
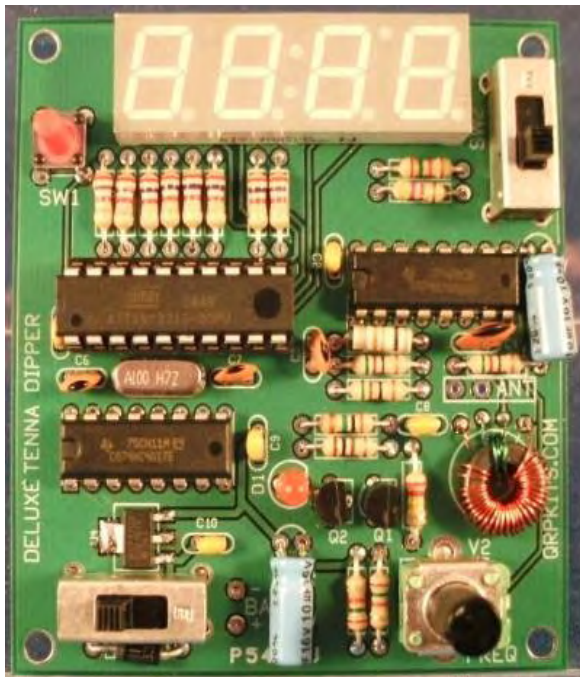
Connect the feed line which will go to the transmitter to the Tenna Dipper and set the oscillator desired frequency. Now adjust the antenna or ATU to make the SWR indicating LED to be very dim or go out completely.

The Tenna Dipper is very handy for adjusting short vertical antennas such as the PAC-1 or MP-1. Set the Tenna Dipper frequency to the desired band and connect to the antenna. You can watch the brightness of the LED from a distance, so you don't have to run back and forth between the antenna and the 'Dipper. Since the proximity of your body to the antenna can affect the match, once the match is close, be sure to step a few feet away from the antenna to make fine adjustments and find the perfect match.

Parts list:

√	QTY	Part number	
	1	CD74HC4046AEE4	
	1	CD74HC4017E	
	1	ATTINY2313-20PU	
	1	1N5817	
	2	MPS5179	NPN RF TRANSISTOR
	1	MCP1703-5002E/DB	5V LDO REG
	1	4 DIGT 7 segment LED	
	1	T-1 super bright red LED	
	1	10 K LINEAR POT	9 mm potentiometer
	2	DPDT SLIDE SW	
	1	6mm / 13mm TAC	PB Switch
	1	RFC 1 uH	
	1	FT37-43 TOROID	
	1	10.00 MHz HC49US	Crystal
	4	49.9 OHM 1 %	
	1	100 OHM 5% 1/4W	
	10	2.2 K 5% 1/4w	
	1	6.2 K 5% ¼ W	
	1	22 K 5% 1/4w	
	1	220 K 5% 1/4w	
	1	1 MEG 5% 1/4w	
	4	22 pdf NPO 0.1" LS	
	5	0.1 ufd MONO X7R 0.1" LS	
	2	10 ufd/16V ALUM ELECTRO	
	1	20 pin DIP socket	
	1	2 feet # 30 magnet wire	
	1	6 CELL AA HOLDER	
	1	BNC Jack	
	1	RED FILTER FILM	2" X 0.75"
	1	BOX	
	1	CIRCUIT BOARD	
	1	DECAL SET	
	1	MOUNTING HARDWARE	

## Assembly:



- Mount U4 first. This is a SMT (Surface Mount) part. First lightly tin one of the three solder pads which are in a row. Place the part over the pads, (hold part with your needle nose pliers) then use the tip of the soldering iron to heat and gently push on the lead over the pad which you just tinned. Then heat and flow a little solder to all of the leads of the part.
- Next mount all the resistors: (plus RFC and diode)



Location	QTY	Value	Color code
R1,2,3,4,5,6,7,8,17,18	10	2.2 K	Red/Red/Red/Gold
R9	1	6.2 K	Blue/Red/Red/Gold
R10	1	22 K	Red/Red/Orange/Gold
R11,12,13	3	49.9 Ohm 1%	Yellow/White/White/Gold/BLK
R14	1	1 Meg	Brown/Black/Green/Gold
R15	1	100 ohms	Brown/Black/Brown/Gold
R16	1	220 K	Red/Red/Yellow/Gold
L1 (looks like resistor)	1	1 uhy	Brown/ Black/ Gold/Gold
D2	1	1N5817	Note polarity line, match with line on board.

- Now the capacitors:

Location	Qty	Value	Markings/Type
C2,3,8,9,10	5	0.1 ufd	104 monolithic
C4,5,6,7	4	22 pfd	22 NPO
C1, C11	2	10 ufd /16V	Alum electrolytic <b>NOTE: these two caps must be mounted laying flat to the board as shown in photo.</b>

C1 and C11 lay flat to board.

- T1: Wind and mount T1. First wind 30 turns of #30 magnet wire on the black, FT37-42 core. Then wind an additional 5 turns in the space between the start and finish of the 30 turn winding. Trim and tin the wires ends. The 30 turn wire ends go into the two outside pads and the 5 turn winding wire ends go into the two inside holes.



5 turn winding to inside holes

30 turn winding to outside holes.

- Remaining parts

Location	Part	
Q1, Q2	2N5179	Transistors TO-92
U1	74HC4046	16 pin dip IC – DO NOT USE SOCKET – Using a socket here will affect tuning range and stability of oscillator.
U3	74HC4017	16 pin DIP IC – Socket can be used if desired
U2	20 pin IC socket – check for any leads bent over and not sticking through pads before soldering.	Insert Tiny2313 chip into socket after remaining parts on board are installed.
Display	4 digit LED display	Due to missing pins, this part can only go in one way.
SW2/3	DPDT slide switches	Make sure switch body is flush and square to board before soldering more then one lead.
D1	Clear LED T1 size	Note polarity, flat side of part matches flat side of part outline on board. Space so that the bottom of the LED body is about 1/2 inch above the board.
SW1	TACT push button switch	
V2	9 mm, 10 K potentiometer.	

- You can now install U2, the TINY2313 into the socket.
- Wire the battery holder to the board, red wire to the '+' pad and black wire to the '-' pad.

### **Testing:**

Make sure the on/off switch is in the off position (slide to left). Install six "AA" batteries into battery holder. Turn unit on with on/off switch.

The frequency display should light up, showing all 8's and decimal points lit for a couple of seconds. This indicates all the segments are working. Then the current frequency will be displayed, in MHz. [ xx.xx ] MHz The SWR indication LED should be fully bright.

Now check the tuning range of the oscillator by adjusting V2 and the range switch, SW2. Exact tuning range is dependent on component tolerances.

Low range : About 3.0 MHz to 11.7 MHz

High range : About 11.0 MHz to 30 + MHz (note SWR LED will dim slightly above 27 MHz.)

Clicking the display shift switch, SW1, will make the display change from showing the frequency in MHz with 10 kHz resolution to displaying the frequency in kHz, with 100 Hz resolution. This is indicated by the decimal point shifting from between the 2<sup>nd</sup> and 3<sup>rd</sup> digit to between the 3<sup>rd</sup> and 4<sup>th</sup> digit. In the kHz display range, you will see the R/C oscillator isn't real stable, as the 100 Hz digit will be jumping around. This is normal.

Now test the operation of the SWR bridge by placing the left over 49.9 ohm resistor across the ANT pads. The SWR LED should go out.

If the board passed all these tests, it is now fully functional and can be mounted in the case.

### **Case Prep:**

Before mounting the board, the case should be prepped by adding the control label decals. The decals are applied the same as model decals. Cut around each group of text or symbols you wish to apply. It doesn't have to be perfect as the background film is transparent. Use the mechanical diagram on page 7 to get the correct spacing around the holes and cutouts, as it is very easy to do a great decal installation and have a portion covered up with a knob

**Thoroughly clean the surface of the panel to remove any oils or contamination. We have found that moving the decals into position on bare aluminum chassis is difficult, due to the brushed surface, so we advise pre-coating the chassis with the Krylon clear before applying the decals, and then, after as well.**

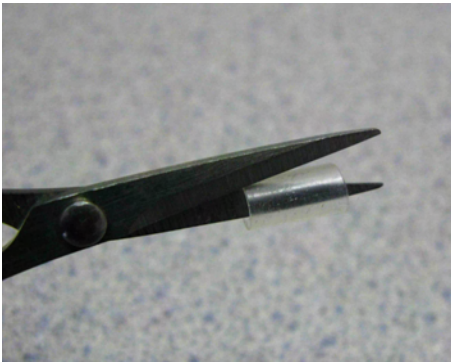
Trim around the decal. After trimming, place the decal in a bowl of lukewarm water, with a small drop of dish soap to reduce the surface tension, for 10-15 seconds. Using tweezers, handle carefully to avoid tearing. Start to slide the decal off to the side of the backing paper, and place the unsupported edge of the decal close to the final location. Hold the edge of the decal against the panel, with your finger, and slide the paper out from under the decal. You can slide the decal around to the right position, as it will float slightly on the film of water. Use a knife point or something sharp to do this. When in position, hold the edge of the decal with your finger and gently squeegee excess water out from under the decal with a tissue or paper towel. Work from the center, to both sides. Remove any bubbles by blotting or wiping gently to the sides. Do this for each decal, and take your time. Allow to set overnight, or speed drying by placing near a fan for a few of hours. When dry, spray two **light** coats of matte finish, Krylon, clear to seal and protect the decals, and allow to dry in between coats. All decals come with two complete sets, in case you mess one up.

- Remove the batteries from the battery holder
- The board is placed into the top half of the case and secured with four #4 screws in the corners.
- Install the BNC jack to the case and wire back to the ANT terminal pads on the bottom of the board. Note that the ground pad is the one towards the side of the board.
- The battery holder is then mounted into the bottom half of the case with two, #4 flat head screws.

### **Adding a knob to frequency adjust control.**

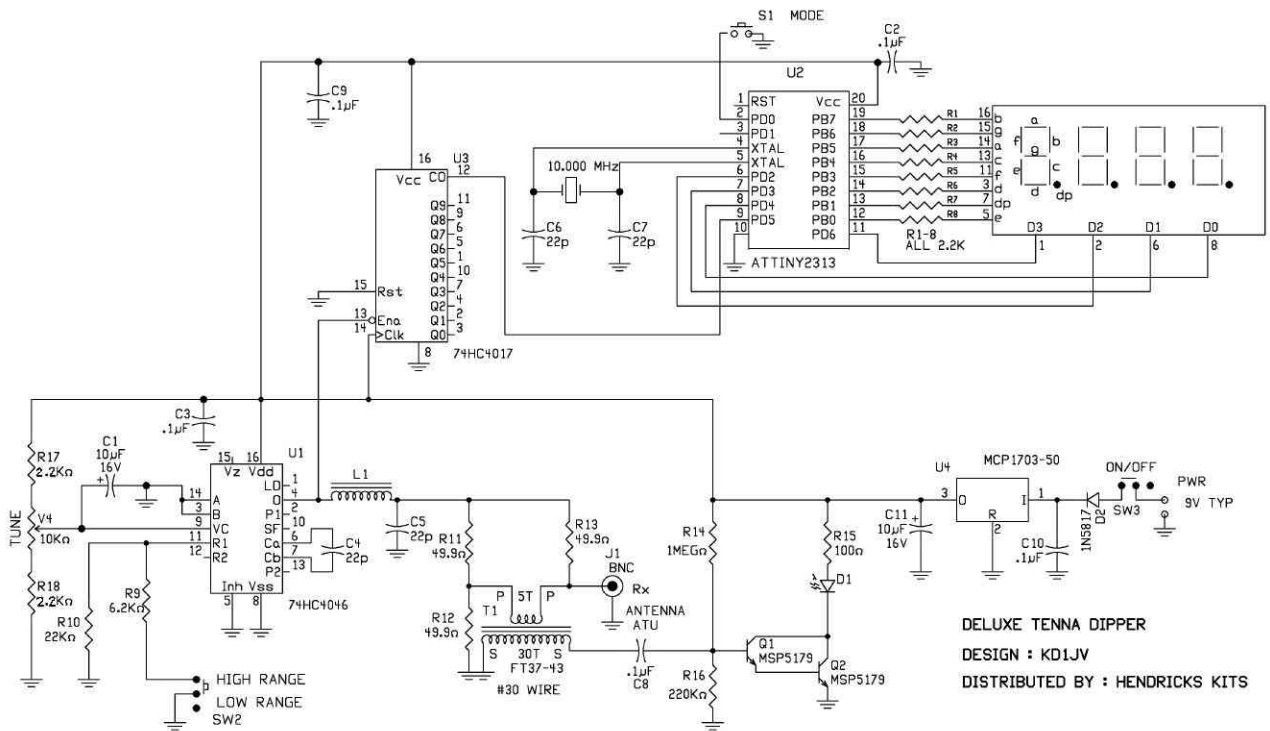
Since the frequency adjust pot uses a 9 mm shaft, a reducing sleeve must be added in order to use a standard 1/4" shaft knob. A piece of 3/8<sup>th</sup> inch plastic tubing is used for this.

Simply cut the tubing length wise with a pair of small scissors as shown below. Then, after first making sure the set screw for the knob is retracted, drop the tubing into the knob as shown in the second photo. Then insert the knob onto the pot shaft and tighten the set screw.





Schematic:



Decal layout:

