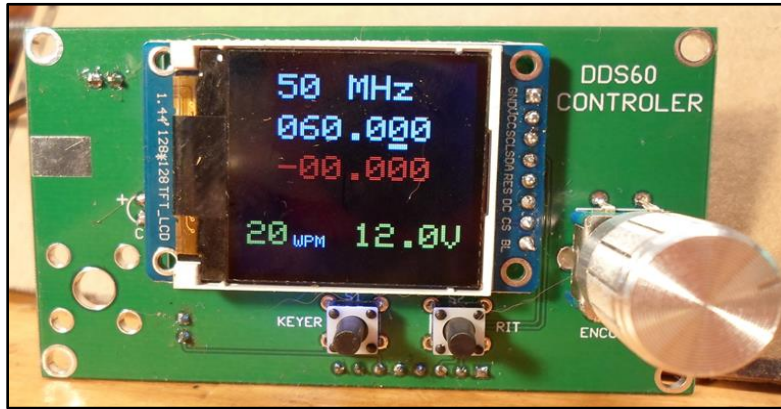


User Manual

Ver 1.0 April 2016



The Midnight DDS60 VFO Controller Kit is an outgrowth of previous designs from Steve Weber KD1JV in which he developed small multi-function boards to control the earlier DDS-based VFO boards from the AmQRP Club. In this latest version, Steve has accommodated the AD9851-based “DDS-60” VFO board, reaching a ‘clean’ 60 MHz and provided a multitude of VFO, transceiver and keyer functions for the homebrewers. Further, an SLT design of a sample enclosure is available, as is the re-introduction of the DDS-60 in kit form to enable a lower-cost means to finish off the kit. // **Note 1:** ‘Offshore’ AD9851 VFO boards may also be used with the DDS60 VFO Controller Kit. **Note 2:** This kit requires soldering 1206-sized surface mount parts, including a rather small 32-pin FPGA controller chip.

General Features:

- Range: 1000 Hz (1 kHz) to 60.000.000 MHz ... with 1 Hz resolution.
- Tuning rates: 10 Hz to 100 kHz.
- Rotary tuned.
- 160 to 6M Ham bands and full range general coverage selection.
- 5 frequency memories per band.
- Programmable IF offset frequency for single conversion receivers.
- 1.44” Color TFT display
- Input voltage displayed.
- Supply 9 to 12V.

Transceiver functions:

- Iambic B mode keyer.
- Auto Straight key detection (on power up).
- 5 to 30 WPM in 1 WPM steps.
- Two (2) 63 character CW message memories.
- Audio Mute and Transmitter keying outputs.
- Level adjustable Side Tone output (600 Hz).
- RIT (+/- 99.000 kHz).

Operation:

The DDS60 VFO is controlled by two push buttons and a rotary encoder. The encoder has a built in switch activated by pushing the knob, which is generally used as an “Enter” switch. These switches have various functions depending on how long they are pushed.

Tuning:

The rotary encoder changes the operating frequency at the currently selected tuning rate. When a Ham band is selected, the tuning ends at the band limits.

Tuning rates:

- The current tuning rate is indicated by a decade pointer line under the selected digit.
- The default tuning rate is 100 Hz.
- A short push and release of the Tuning knob advances the tuning rate.
- Tuning rates of 10 Hz, 100 Hz, 1 kHz, 10 kHz and 100 kHz are available.

RIT Switch:

The RIT switch has three main functions.

1. Enable/disable RIT. (Tap)
2. Access frequency memories. (Hold for 1 second)
3. Select Band. (Hold for 2 seconds)

RIT:



- A short click of the RIT switch toggles RIT on and off.
- When RIT is enabled, the display will show the delta from the transmit frequency on the line under the main frequency display.
- The tuning rate is automatically set to 10 Hz for fine tuning. The tuning rate can be changed as normal, but the 100 kHz step should not be used.
- The original tuning rate when RIT was enabled is restored on exiting RIT.
- RIT tuning is limited to +/- 99,000 Hz. Once the limit is reached, RIT and receiver frequency will reset to 0 delta.

Frequency Memories:



- A long (1 second) hold of the RIT switch activates frequency memory.
- There are 5 frequency memories per band.
- A frequency stored in location 1 will become the default power on frequency.
- Use the encoder to select a location.
- The contents of the location is displayed in red on line 3. If the location has not yet been used, “empty” will be displayed.
- The RIT switch is again used to recall or store a memory location.
 - Hold closed the RIT switch to cycle between Recall or Store.

- Release switch when desired operation is displayed.
- Push the encoder switch to preform the desired operation.
- The encoder switch will escape this mode if Recall or Store have not been selected.



Band Select:

- Hold the RIT switch closed for two (2) seconds.
- Use the encoder to select desired band.
- Push encoder switch to load the new band and band limits.
- QRP CW calling frequency is the default initial frequency.

KEYER switch:

The keyer switch is used to send or store messages and to change the code speed. You can store two (2) messages of up to 63 characters each (including word spaces).

NOTE: The RIT switch is used as the "enter" switch in keyer modes. This a bit quicker and easier to use than using the encoder PB switch.



- **Short click – SEND MSG**
 - Tap the **DOT** or **DASH** paddle to send a stored message. If the location is empty, it will simply exit the mode.
 - Once sending starts, the message can be paused or terminated using the paddle. The paddle is sensed during the letter and word spaces.
 - Pause – **DOT** paddle
 - Terminate – **DASH** paddle



- **One (1) second hold – change code speed.**
 - The wpm digit will turn Red, indicating it can be changed.
 - Use the encoder to select desired speed, 5 to 30 wpm.
 - Click the **RIT** switch to exit.



▪ Three (3) second hold – ENT MSG

- Begin entering your message via the paddle or terminate with **RIT** switch.
- Note that “Ideal” timing is used to determine letters groups and insert word spaces. Word spaces are easy, as the wait between words can be infinite. Letter spaces seem to be a problem for those who don't leave enough space at the end of a letter group.



- Once you finish entering the message, click the **KEYER** switch to review.
- If the message sounds good, store the message.
- Tap the **DOT** paddle for memory location 1
 - Tap the **DASH** paddle for memory location 2
 - Or click the **RIT** switch to re-enter the message.

Straight Key mode:

Straight key mode is enabled when the DASH input is grounded on power up. If the paddle jack is wired so that DIT in on TIP and DASH is on RING, a mono phone plug will ground the DASH input and TIP is used to key. Or close the Dash paddle when turning on power.

- The keyer speed can be changed using the encoder.
- Message memory 1 is available if it has been programmed.

Side Tone generator:

A 600 Hz side tone is active when keying. A trimmer resistor allows setting the side tone level. (CCW increases level) The trimmer is behind the DDS60 daughter card, so the level will need to be adjusted with the card removed.

Voltage display:

Since the voltage display is not calibrated, it may be off by up to +/- 0.3 volts.

When the supply drops below 9V, the voltage readout will change to red [8.9] to advise you the supply is getting marginal.

Power supply:

9 to 12 Volts at 120 ma.

Set Up Functions:

- Calibration
- Storing an IF offset.
- Setting Heterodyne mode.
- Clearing the EEPROM (factory reset).

Calibration:

- Hold the Enter switch closed for 3 seconds. [Display = CAL]
- Wait a few minutes for warm up to allow the frequency to stabilize.
- Adjust the output to 10.000,000 MHz.
- Push the Encoder switch to store and exit.

Store IF Offset:

- Tune the VFO to the desired IF frequency. (Use GC – General coverage mode)
- Hold Enter switch closed for 4 seconds Display. [Store IF]
- The current VFO frequency will be stored when the Enter switch is released.
- Enter the Heterodyne mode to program how the offset is used.

Heterodyne mode:

Hold the Encoder switch closed for six (6) seconds. See Display [H MODE]
Use encoder to select mode.

This option determines what happens with an IF offset.

The IF frequency can be added to either the output frequency (case 1), or added to the displayed frequency (case 2), or subtracted from the displayed frequency (case 3).

Case 0 is the default.

Display [VFO=DSPY]

The output frequency is as shown on the display in both receive and transmit modes. This is the mode used when the VFO is used as a signal generator or with a Direct Conversion receiver. If an IF offset has been stored, selecting this mode will clear the offset.

Case 1

Display [VFO+IF]

This mode is used to provide the LO for a single conversion receiver and is applied to the first mixer. The transmit frequency is unchanged and can be sent directly to the output amplifiers. This eliminates the need for a transmit mixer and band pass filter.

Case 2/3 is used when replacing an Analog VFO so the display reads the operating frequency, not the VFO frequency. This mode is used for single band transceivers.

Case 2:

Display [DSPY+IF]

Case 3:

Display [IF-DSPY]

For example:

A 20-meter rig using a 5.0 to 5.5 MHz VFO with an IF of 9 MHz would use VFO+IF to display 14 MHz.

Or:

A 80-meter rig with 5 MHz VFO and 9 MHz IF would use IF-VFO to display 4.0 MHz.

Since it's not possible to know beforehand what specific IF frequency will be needed for your application you will need to use the General Coverage band selection to set the VFO to the required VFO frequency, .

- Select the General Coverage band (GC).
- Tune the VFO to a desired start up frequency.
- Store that frequency into Memory location 1, so the VFO will power up on that frequency.
- Now tune the VFO to the IF frequency and store it.
- Enter the Heterodyne mode setting function.
- Use the encoder to select the desired function.
- Select Case 0 [VFO=DSPLY] to negate IF frequency.
- Select Case 1 [VFO+IF] to add the IF frequency to the VFO output in receive mode.
- Select Case 2 [DSPLY+IF] to add the IF frequency to the Display. This only affects the frequency displayed.
- Select Case 3 [IF-DSPLY] to subtract the Display frequency from the IF frequency.
- Push the encoder enter PB to store and activate the selection.

Factory Reset / Erase EEPROM

This function erases the contents of the EEPROM memory including band data, calibration data, CW messages and frequencies stored in memory.

- Hold the Encoder switch closed for (6) seconds.
- Display [EE ERASE].
- Display [RIT-erase].
- Push RIT to erase or Encoder switch to exit.
- If RIT pushed – Display [EE erased].
- 1 second delay.
- Display [Esw-exit] – Push Encoder switch to exit.
- Cycle power to affect change.
- When power comes back on, you will need to calibrate and select a band.

Resistor Band select:

A band may be selected on power up by using a resistor value as show in the table. The resistor is connected from the “BAND” I/O port pin and ground. This feature can be used to make a multi-band transceiver using plug in band modules. The resistor on the band module will ensure the proper band is selected for the module. This eliminates the need to remember to change the band when changing filters.

160	33K
80	22K
40	15K
30	10K
20	4.7K
15	3.3K
10	2.2K

Flashing the Processor:

The processor chip in this kit is already programmed, so there is no need to do anything in this section unless you wish to re-flash (i.e., change the programming).

The display board includes the standard 10 pin AVR ISP interface. Header pins are not normally installed but can be if you wish. Just make sure to do it before installing the display module. Otherwise, pins can be held in place with friction with some side torque.

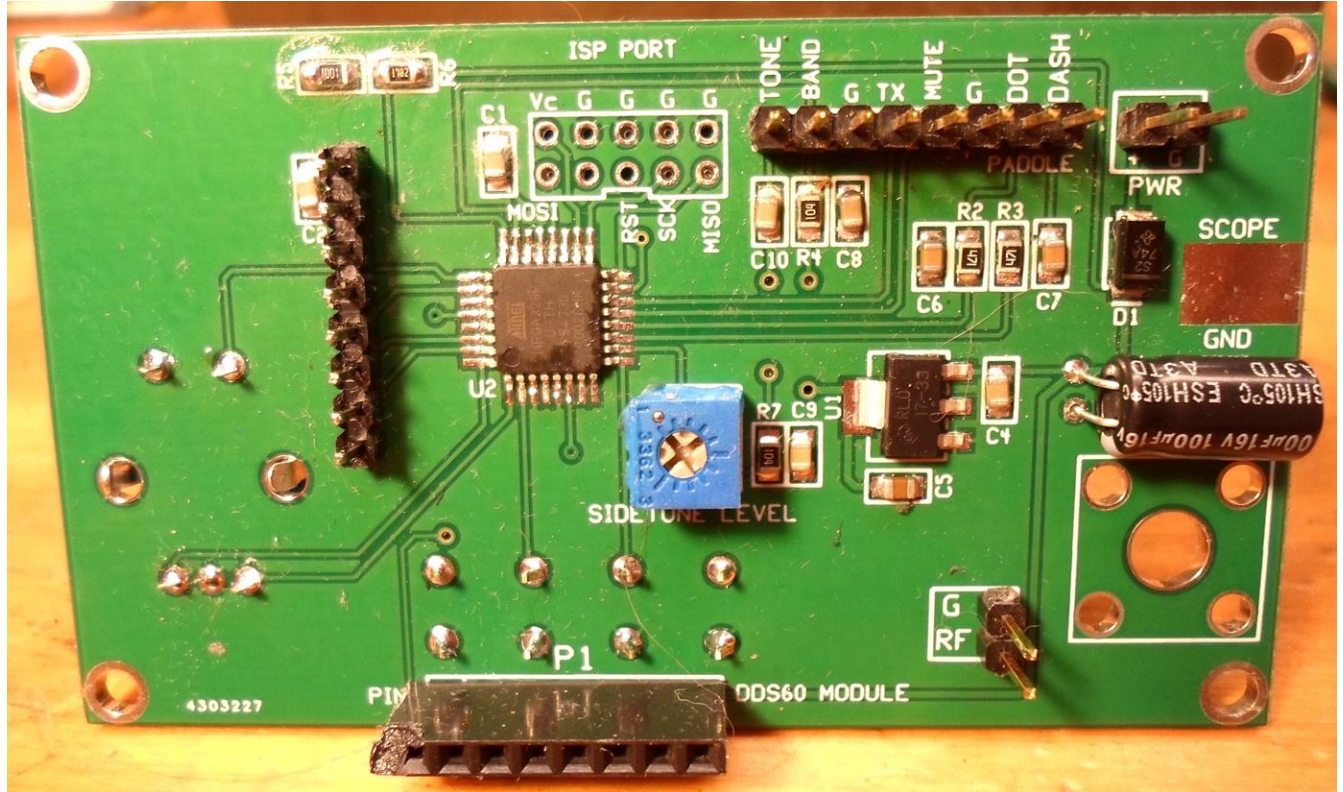
The bootloader is not programmed, so you will need a programmer such as USBtinyISP or the OLIMEX AVR-ISP-MK2. An odd thing about the OLIMEX, it will not program the processor from the Arduino IDE. It will however work with the AVR Studio 7 IDE. The programmer can be used to power the board, but it must be set to 3.3V

The processor runs at 8 MHz, so when compiling a Sketch, have the board option set to “Fio” so that the correct set up values for the timers are used. You will also need to install the required Adafruit files in your library.

Assembly:

QTY	Value	Color coding		
	Capacitors			
4	10 nF	BLK-BRN-ORG	103	
4	100 nF	BLK-BRN-YEL	104	
1	1 uF	BLK-BRN-GRN	105	
1	100 uf	Alum electrolytic		
	Resistors			
2	470 ohms	471		
1	1K	102 or 1002		
1	17.8K	1783		
2	100K	104		
1	20K	Trimmer resistor		
	Semiconductors			
1	3.3V regulator	17-33 ORG	TO-223	
1	ATMEGA328P/ AU	processor		
1	Shotkey diode			
1	1.44"	TFT display		
	Mechanical			
1	EC11 encoder			
2	6mm TACT SW			
2	2 pin SIP			
2	8 pin SIP			
1	8 pin socket			
1	knob			

Reference photo component side



Soldering:

The use of solder paste is recommended, especially for mounting the processor IC. An “embossing” heat pencil is typically used to melt the solder. These can be found at hobby stores. The embossing heat pencil has a low air flow and doesn't get as hot as a typical heat gun. Small tubes of solder paste can be obtained on ebay.

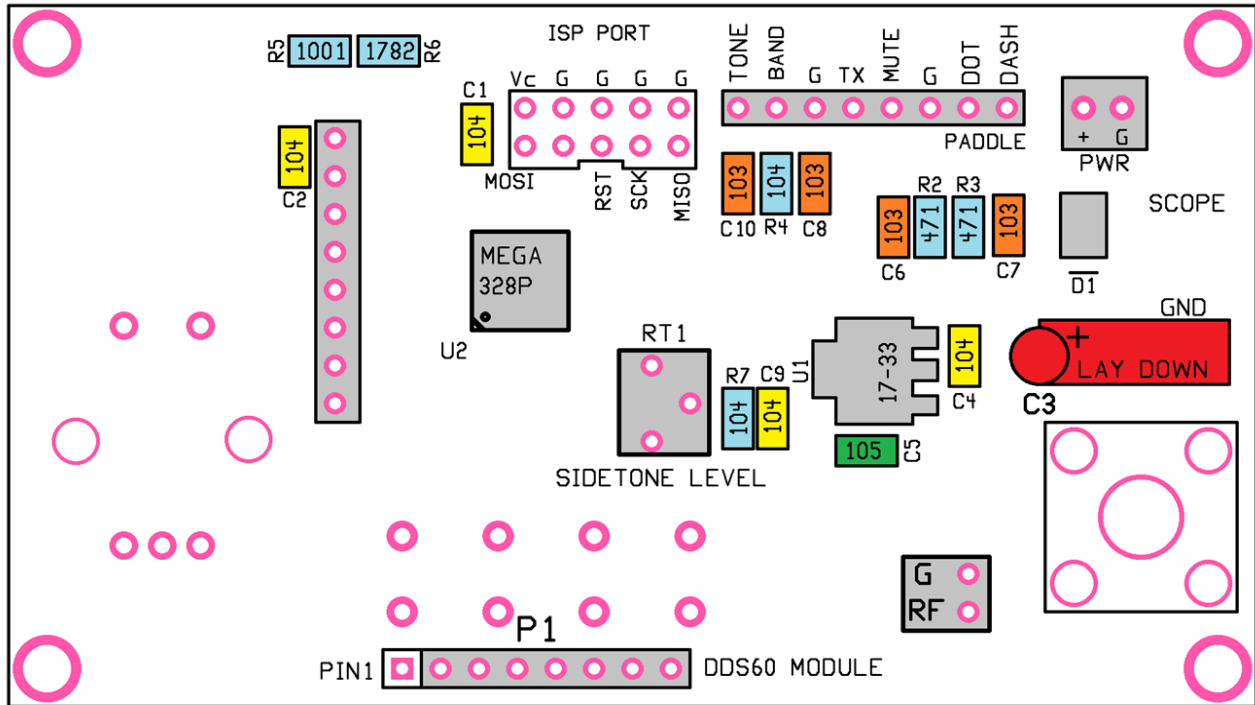
Hand soldering:

A small amount of very thin solder is supplied for hand soldering. For the resistors and caps, lightly tin one pad, tack down the part and solder the other end, then touch up the tacked end.

For the processor IC, tin one corner pad, place the chip and carefully line up the leads with the pads and tack into place. Proceed to solder the rest of the leads with a small amount of solder. You will need a fine tip on your soldering iron. Solder Wick might be needed to remove shorts between leads.

Component side assembly

- Capacitor locations are color coded in accordance with their zero multiplier, using the resistor color coding. Yellow = 104 = 100 nF, Orange = 103, etc.
- You will likely need a magnifier to read the value on the resistors.



Recommended placement order of SMT components:

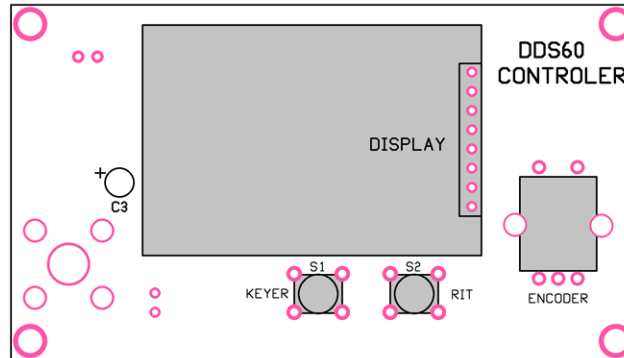
- U2 – be sure to line up the pin one corner as shown in lower right hand side. Look for the dimple on the corner of the chip.
- U1
- C1, C2, C4, C9 Brown/Black/Yellow
- C6, C7, C8, C10 Brown/Black/Orange
- C5 Brown/Black/Green
- R2, R3 – 471
- R4, R7 – 104
- R5 – 1001
- R6 – 1782
- D1 – note direction of cathode band marking.

Through hole parts:

- RT1 – 20K trimmer pot
- C3 – 100 ufd/16V electrolytic. Long lead plus. Bend over and lay flat to board.
- The 8-pin display SIP gets installed from the component side, with the long leads inserted into the board. Solder the pins from the top of the board. See reference photo.

- Place the 8 pin I/O SIP pins, short leads into the board.
- Place the two 2 pin SIP headers, Power and RF out.
- Place the 8 pin SIP socket at P1.

Top side through hole parts:



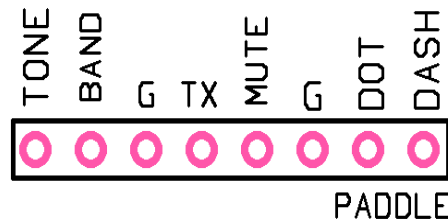
- Place display on SIP pins.
- Solder one corner pad.
- Make sure display is square and level to the board.
- Solder the remaining pins.
- Place S1 and S2, TACT switches
- Place the encoder

Assembly is now complete.

- Plug DDS60 module into P1 socket. Be sure it is inserted with the reference clock side of the board towards the back of the controller board. The 9851 DDS chip side faces “out”. If the board is inserted improperly, the 9851 chip will be fried. This should only be an issue if the DDS60 board uses right angle header pins.
- Connect power and proceed with calibration and set up.
- On initial power up, you will be asked to do a calibration and select an initial band. See page 4 for procedure.

NOTE: To achieve full output from the DDS60 card for frequencies below 100 kHz, C1 and C7 need to be changed to 1 uF. Tacking a 1 uf ceramic 0805 chip cap over the existing C1 & C7 would be the easiest thing to do.

I/O header:



PIN 1 – TONE – 600 Hz side tone when transmitting. Level set with trimmer under DDS60 board, so it has to be set without the DDS board installed.

PIN 2 – BAND – A resistor connected between here and ground will automatically select a band on power up. See table for values.

PIN 3 – GROUND

PIN 4 – TX – LOGIC HIGH (3.3V) when transmitting.

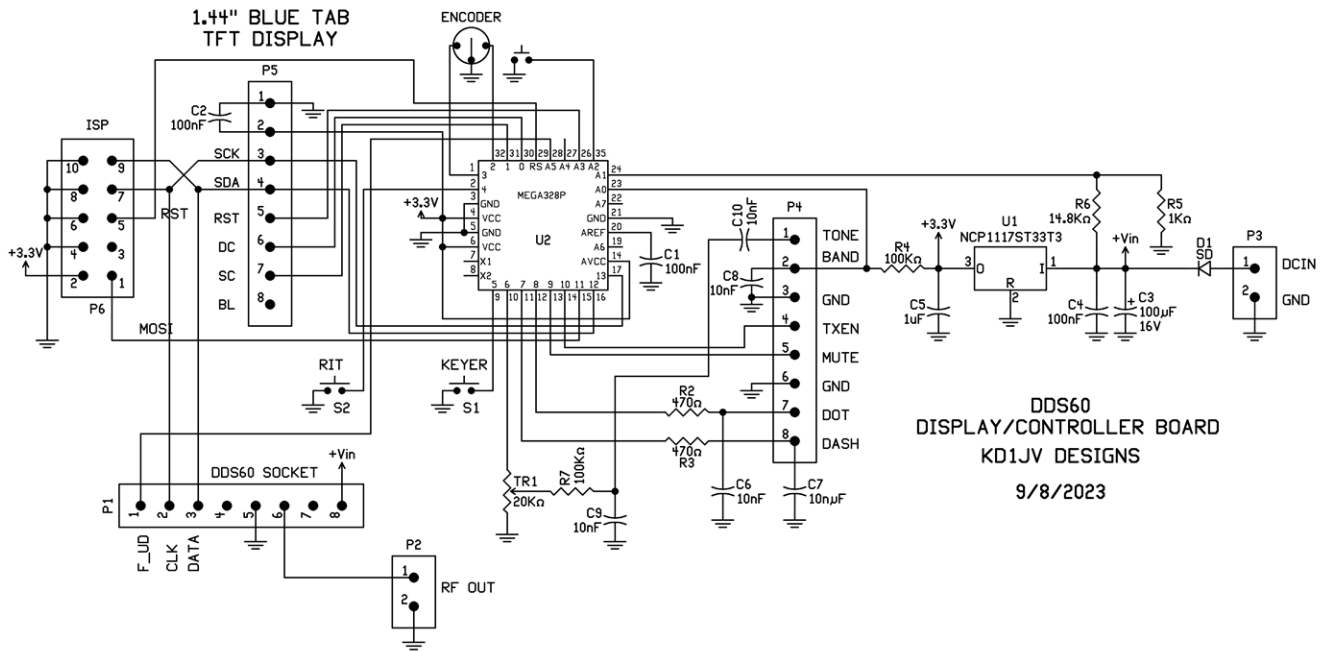
PIN 5- MUTE – LOGIC HIGH (3.3V) when transmitting. Output goes high before TX output and goes low 5 ms after TX goes low.

PIN 6 -GROUND

PIN 7 – Paddle DOT input. Straight key input.

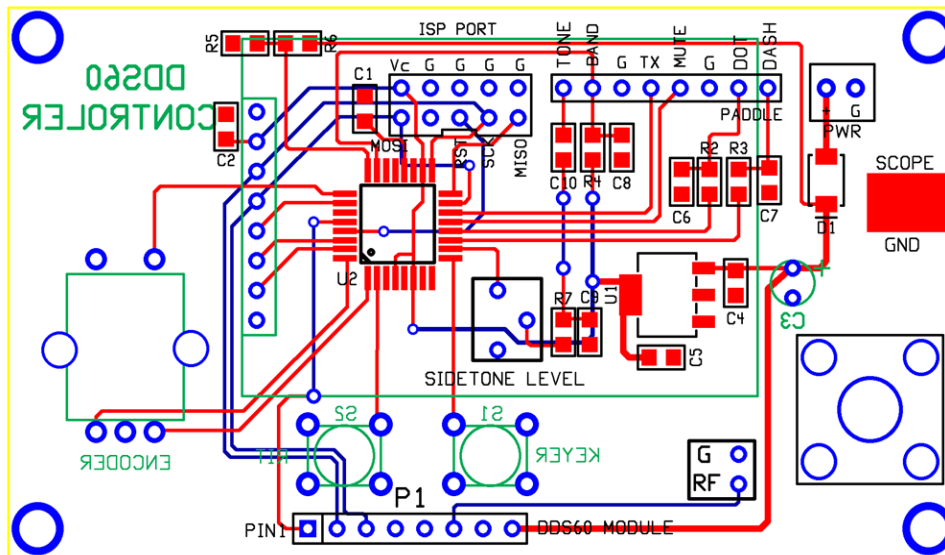
PIN 8 – Paddle DASH input. Ground for Straight Key mode, detected on power up.

REFERENCE:



Board tracks:

Ground plane not shown for clarity.



QUESTIONS:

If you have any questions or problems with this kit, please contact ...

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ERRATA:

April 2026: Initial Release.