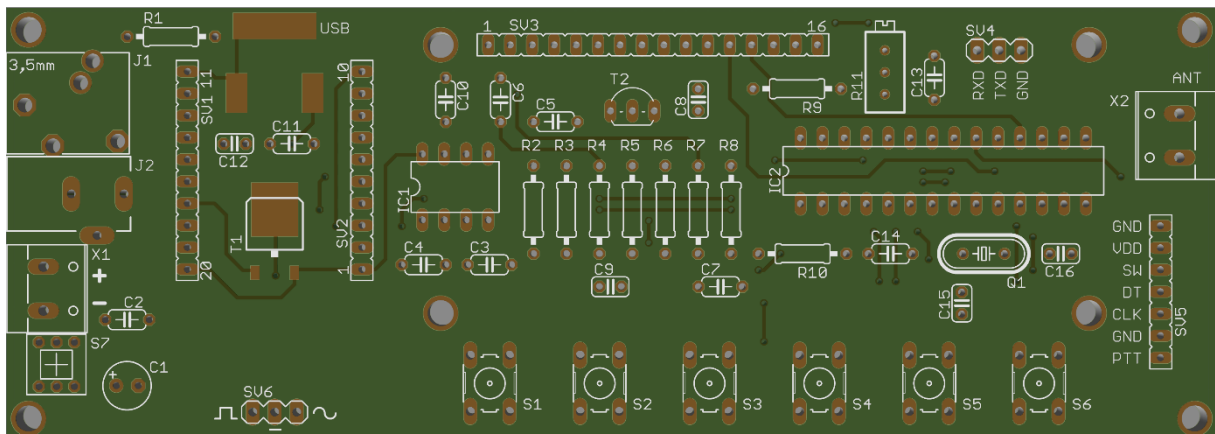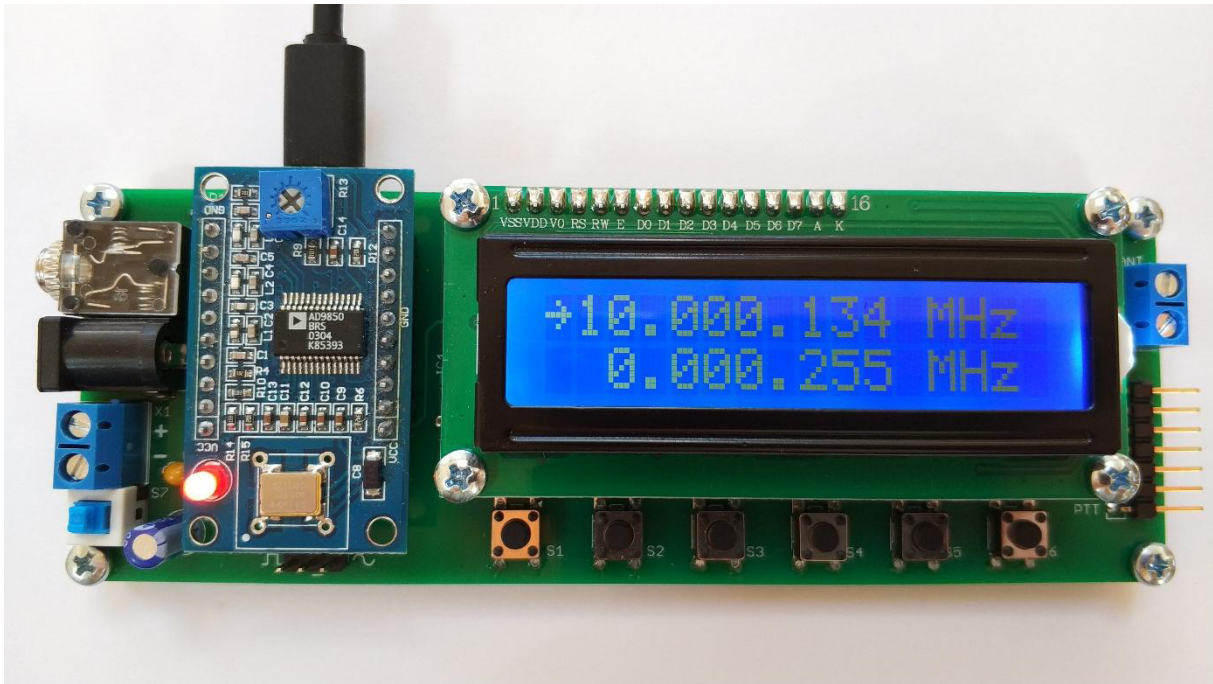# DDS AM Modulator 0-45MHz v2.0

Technical Data:
Operating voltage: 5VDC (with polarity reversal protection)
Current consumption: 120-140mA
Transmit frequency: 0-45MHz
Transmission range: 5-200cm (range increases at higher frequencies)
Dimensions of the board: 140mm x 50mm (~2"x5")

Features:
Tuning steps: 10MHz, 1MHz, 100kHz, 10kHz, 1kHz, 100Hz, 10Hz, 1Hz
AM modulation (external audio)
PTT mode / keypad
2 x 16-character LCD display
Stores frequency settings
Frequency sweep (settings for frequency, time, step size, mode)
Remote access via PC (UART)*
Supports Rotary Digital Encoder

1. Parts List and Assembly

Parts list:

Resistors	Value	Marking			Quantity
R1…R5	1KΩ	brn	blk	red	5
R6	220KΩ	red	red	yel	1
R7	470Ω	yel	viol	brn	1
R8	100Ω	brn	blk	brn	1
R9	10Ω	brn	blk	blk	1
R10	10KΩ	brn	blk	org	1
R11	10KΩ	Rotary Potentiometer			1
Capacitors					
C1	100µF	100µF			1
C2…C7, C10, C11, C13, C14	100nF	104			10
C8, C9	330pF	331			2
C12	10nF	103			1
C15, C16	22pF	22			2
Semiconductor					
T1 - Power Mosfet	IRFR9024N	IRFR9024N			1
T2 - NPN Silicon Transistor	BC547C	BC547C			1
Others					
J1 = audio jack		S1-S6 = pushbuttons		4x threaded nut 6mm	
J2 = DC hollow socket 2.1mm		S7 = Switch		4x threaded nut 12mm	
X1, X2 = terminal block		Display 1602, 16x1 pin header		12x screw M3	
SV1, SV2 = female connector 10x1		IC1 = NE602, IC socket		ANT = 1m wire	
SV3 = female connector 16x1		IC2 = ATMEGA328P, IC socket		DDS module board	
SV5 = 7x1 pin header w.		Q1 = quartz 8.000MHz		USB = MicroUSB board	
SV6 = 3x1 pin header		RDE = Rot. Digital Enc. - type KY-040			

Description and Assembly

Thank you for purchasing the DDS AM Modulator Kit. By choosing this kit you have decided on a high-quality product, with which you will surely have a lot of fun. The Construction is easy, just install the components on the board according to the parts list. Installation of the mini-USB power connector is not obvious. The following section describes the recommended soldering procedure for the board.

Installing the Micro-USB Board
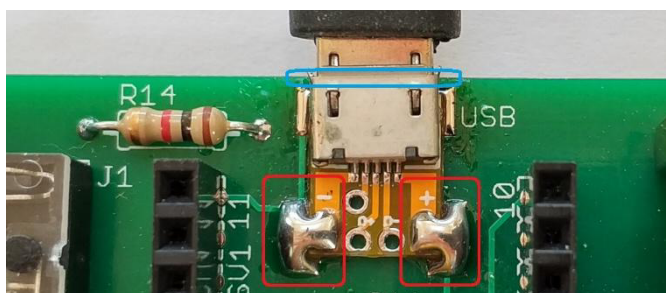
The micro-USB board is placed and aligned as shown. At the connections shown in the red rectangles, apply a lot of solder until contacts on both boards are joined. Then heat the foil on the main board below blue circled area, so that the cup becomes firmly soldered.

Important Installation Notes

- The notch on one end of each IC must be installed at the end of the IC socket with a similar notch. Maintain uniform pressure on the bottom of the circuit board when pressing ICs into their sockets. Avoid bending the circuit board.
- Switch "S7" should be installed the two black notches on the side of the blue plastic button toward the left.

- Power can be supplied to the board in three ways:

  1. A 4-cell AA battery holder can be connected to terminal block "X1". Only 1.2V batteries should be used in the battery holder. 1.5V batteries will provide more than 6V and will exceed the safe input voltage of the device. T-1 protects the Modulator from reverse polarity.
  2. A standard 2.1mm hollow-tip power plug can be used to supply regulated 5V at "J1". Outside is ground, inside is positive voltage.
  3. A standard 2A cell phone charger, with mini USB plug, can be attached to the Modulator using the connector on the main circuit board, under the DDS Module.

- The DDS module must be installed with the LED toward "SV6" near the bottom of the board. The variable resistor will be at the top of the main circuit board. See photo of the finished Modulator.

Attach the 1m long antenna wire at "ANT", on Terminal Block "X2". To improve the range of the Modulator, a ground wire can be connected below "Ant", to the screw on a power socket, a water or heating pipe, etc. When all the parts are on the board and the antenna is attached, the Modulator is ready for use.

2. Setup and Operation of the Modulator
Three methods of applying power to the device are provided:
      1) Plug a 5V power supply into the hollow socket J-2 (2.1mm).
      2) Place 4x AA batteries in a battery holder and connect the leads to terminal block "X1".
      3) Plug a USB cable into the micro USB socket.

You can operate the DDS AM Modulator with both the battery and 1 of the power supply plugs connected. If the power supply is unplugged from the socket, the board receives the power from battery compartment.

When first starting the DDS Modulator, the contrast must be adjusted using potentiometer "R13" on the motherboard. (Not the potentiometer on the DDS Module, also labeled R13. This one controls the timing of square waves which appear at "JV6").

Set the Modulator Frequencies
When first starting the Modulator, the display will look like this:

→ 0.000.255 MHz
0.000.255 MHz

Press "S6", to set the frequency opposite the →. After setting the frequency, Press "S6" again to save the upper frequency and select the lower frequency. Enter the lower frequency. Press "S6" once more to save the lower frequency.

In this menu window, each frequency can be changed by pressing buttons "S1" to "S5". Each button changes the corresponding digit shown in the table below. Pressing the button will add "1" to the displayed digit. If a 9 is displayed, and the button pushed, then the nine will roll back to a "0". The value of any digit to the left is not changed.

S1	Ten thousand	10 MHz
S2	Thousand	1 MHz
S3	Hundred	100 kHz
S4	Ten	10 kHz
S5	One	1 kHz

To change the value of the 100Hz, 10Hz and 1Hz digits, press and hold "S1", then press "S3", "S4", or "S5" to change 100Hz, 10Hz, and 1Hz digits:

Press S1 - S5 only   Press S1 with S2, S3 or S4

→`12.`000`.000 MHz`   →   →`12.000.`000` MHz`

The frequency can be changed with by pressing "S1" and "S3" to "S5" according to the table:

S1+S3	Hundred	100 Hz
S1+S4	Ten	10 Hz
S1+S5	One	1 Hz

Save the Frequencies
When you have set the frequency using the method above, save the frequencies by pressing "S6" twice. The cursor will jump from one line to the other, then back. Each jump saves the line where the cursor is located.

→ `1.620.000 MHz`   `1.620.000 MHz`   1.620.000MHz were saved.
   `12.000.000 MHz`   →`12.000.000 MHz`
                  →

Playing music on a radio
Tune your radio receiver to find an open frequency on the long, medium or short-wave band. Place the radio close to the Modulator. Adjust the receiver volume control so that the rushing noise is heard at a comfortable level. Set the Modulator transmission frequency to match the radio receiver frequency, using the methods described above.

Connect an audio jack between "J1" on the board, and the audio output of a PC, Smartphone or MP3 player. When connected, and with the DDS Modular running, slowly increase the volume until the audio from the Radio is loud, but not distorted. Adjust the receiver frequency for the best sounding audio.

4. SETUP MENU
The setup menu is used to set a few other operating parameters. To enter the Setup Menu, press and hold "S1" while turning on the Modulator. Continue Holding "S1" until the SETUP menu is displayed. Pressing "S2" or "S3" will change the parameters of each Setup menu item. "S6" switches to the next menu item, and saves any changes made.

`==== SETUP ====`

↓Automatic

`Encoder`   `Encoder    >`   **S2 = Disable**
`>Disabled`   →   `Enabled`   **S3 = Enable**

↓S6

`<Encoder Timing>`
`156  3.20ms`

↓S6

`<     PTT     >`   `<     PTT     >`   **S2 = Key**
`Key`   →   `External`   **S3 = External**

↓S6

`<    DE/EN`   `<    DE/EN`   **S2 = Deutsch**
`Deutsch`   →   `English`   **S3 = English**
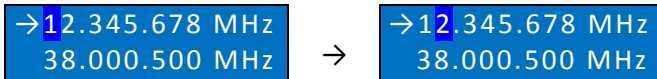
Activation and Adjustment of the Digital Encoder
You can enable or disable the digital encoder (e.g. type KY-040 at "SV5") using the SETUP Menu, as shown above.

Adjustment of the Digital Encoder

The encoder is queried on a preset time interval. The "encoder timing" value can be changed using the Startup Menu item "Encoder Timing". So, if you want to use a different encoder, or if switching (during rotation of the encoder knob) results in incorrect operation, the timing can be adjusted between 0.99ms (1 kHz) and 6. 59ms (151Hz).

Setting Frequencies with the Digital Encoder

When the digital encoder is "Enabled", it is always operating. Frequencies are set using the encoder.

→**1**2.345.678 MHz   →1**2**.345.678 MHz
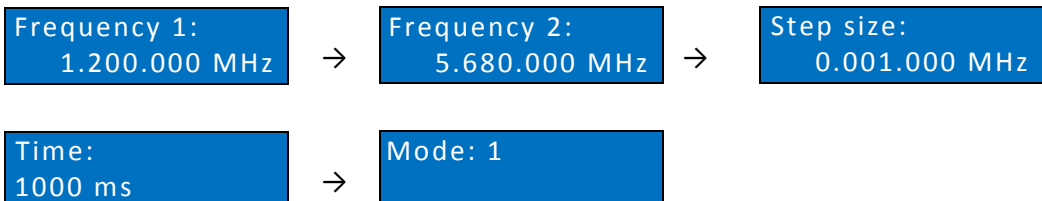 38.000.500 MHz   →   38.000.500 MHz

When the Modulator is first turned on, the cursor is always positioned at the left most digit. The highlighted value can be changed from 0-9. Pressing the encoder knob moves the curser 1 digit to the right. The cursor returns to the left digit if the encoder knob is pressed with the cursor at the far-right digit. The displayed frequency is always saved by pressing button "S6", which moves the → to the other frequency on the screen.

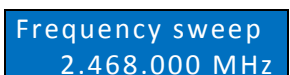(The highlighted areas in the image above will not seen on the Modulator screen. They are used for explanation only.)

5. Frequency Sweep Output

The Frequency Sweep menu is used to enter a range of frequencies to sweep. The start frequency (Frequency 1), end frequency (Frequency 2), Step Size, Time in milliseconds between steps, and the Sweep Mode are entered by selecting the following frames from the menu. Press "S1" and "S2" simultaneously to enter the menu. (If that does not work, be sure you push "S1" just slightly before "S2"). The two frequencies and the step size can be changed with the encoder. If the encoder is not enabled, they can be changed using the buttons as described in Section 2, Set the Modulator Frequencies.) "F6" saves these settings and moves to the next menu Item. Time and mode are always set with Buttons. The time is set using "S1" and "S2" to change the 2nd digit from the left. If the digit is a 9, pressing the Button adds 1 to the digit on the left. "S3" and "S4" are used to change the third digit from the left. The smallest time available is 10ms. Increasing the value of the third digit from the left past 9, adds 1 to the second digit. 1 push on a button results in 1 change in the displayed value. Holding a button does not repeat the function. "S6" saves the time and changes to the next parameter. To select a Mode, press one of the first 4 buttons, according to the table below. When a button is pressed, the mode changes to the number of that button. Mode can be changed until more than once before you press "S6", which saves the value and starts the frequency sweep output in the continuous mode.

Frequency 1:
  1.200.000 MHz →   Frequency 2:
  5.680.000 MHz →   Step size:
  0.001.000 MHz

Time:
1000 ms →   Mode: 1

In the example below, the DDS Modulator begins at 1.200.000MHz, waits 1000ms, and then adds 1 kHz to the readout. The mode defines the direction and what happens when the sweep is completed.

1	F1→F2, F2→F1, F1→F2, F2→F1…
2	F2→F1, F1→F2, F2→F1, F1→F2…
3	F1→F2, F1→F2, F1→F2, F1→F2…
4	F2→F1, F2→F1, F2→F1, F2→F1…

Frequency sweep
  2.468.000 MHz

When the sweep function is activated, it will be in the continuous mode. Pressing the "S1" button begins a single sweep. Pressing "S1" again and again, runs only one sweep with each press. Pressing "S2" starts continuous sweeping again. To exit the frequency sweep mode, turn the MW Modulator off and on again.

6. The DDS Modulator as a Sine and Square Wave Frequency Generator

Unmodulated Sine and Square wave signals, are available directly from the DDS Module, at "SV6". The center pin is ground. The Square wave output is the left pin, and the Sine wave output is the right pin. The pins are labeled. You can use just one signal, or both signals at the same time, without interference. The Sine wave output is ±0.5VPP, and the Square wave output is ±2.5VPP at 1kHz. The duty cycle of the square wave output is adjusted with the variable resistor on the top end of the DDS MODULE circuit board.

7. Push to Talk - PTT

Using the PTT Setup menu, select either mode. If the PTT Setup "Key" is selected, the signal generator output toggles between the two frequencies with each press of "S6". If "external" is selected, the lower frequency is emitted while "S6" is pressed, and the upper frequency is emitted when it is released. Shorting the PTT output pins, near the bottom right side of the main board on "SV5", function in the same way as pressing "S6". In fact, the "PTT" pin is connected directly to "S6".

8. DDS AM Modulator as a Carrier Frequency Generator for Transmitters and Receivers

The DDS AM Modulator can be used as a VFO, or carrier frequency generator, for transmitters and/or receivers. A thorough knowledge of radio theory and expertise in the design or repair of radios is required to install the Modulator for use in this function. In addition, a connection is provided at SV5 for activating the PTT by the external radio. The PTT function of the DDS AM Modulator is used as the send and receive frequency and can provide RX and TX frequencies for a radio.

| → 1.620.000 MHz | → RX (receive) |
| 12.000.000 MHz | → TX (send) |

In the External PTT mode (not the Key mode), when the external key is pressed and held, 12MHz will be available at "SV6". When you release the button, for receive, the 1.62MHz frequency will be output. The "PTT" pin <u>must</u> be shorted to "GND" in order to change the output frequency.

9. Alternative Antenna - Inductive Transmission with Coil and Capacitor Tuned Circuit

As an alternative to using the 1m antenna wire, a tuned circuit comprised of a coil and capacitor in series can be connected between the "Ant" and ground terminals at "X2". The tuned circuit is easily constructed as described below. The photos depict the size and type of winding described. The coil provides a short-range signal that may be more convenient for use with your application.
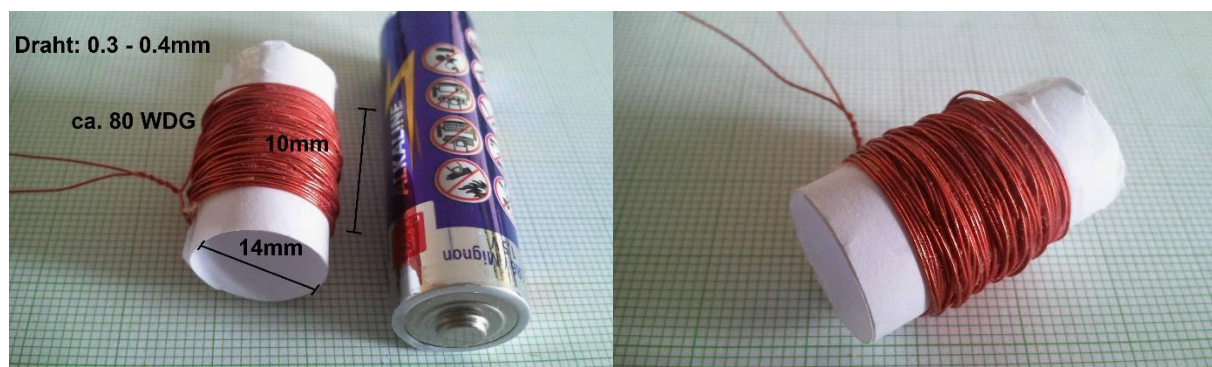
The coil should be approximately 80 turns on a 14mm (±1/2") diameter form, randomly wound at a width of about 10mm (±3/8"). A 1nF capacitor should be connected in series with the coil, and the two leads connected between the ground and "ANT" connections at "X2". The resonant frequency of this circuit is approximately 1.7MHz. This configuration will adequately cover long wave to shortwave commercial AM broadcast frequencies. To increase the signal strength at higher frequencies, reduce either the value of the capacitor, or the number of turns on the coil.

Power Supply

AD9850 DDS Module

Sine and Square
Wave Output

Antenna

UART

Encoder & PTT

Display