

DDS9914 / DDS9915 Arduino Shield V2.2

OPERATING MANUAL

Firmware vo.85

⚠ WARNING

Use only a power supply with a voltage rating of 12 volts!
USB-port of this device is used only for data transfer!

GENERAL GUIDE

The device is an expansion board (shield) for Arduino Mega based on the ATmega2560 microcontroller with **5-volt** logic levels, since the board has logic signal level converters from **3.3V to 5V**.

Power is supplied to the device through the Arduino, and connection is made through the power jack (**12 volts only!**).

To fully operate the device, an **I²C OLED display of 0.96 inches** is required (optional and not included). The display is powered by **5 volts** from the **5v pin** on the Arduino.

The device is controlled by an **encoder** and a **BACK** button (not used in the current software version). An **external encoder** and **push-button** can be connected to the **ExENC** (PH2.0-3p) and **ExBACK1** (PH2.0-2p) connectors, if needed.

The **AD9914/15 clocking** can be done in **two** ways:

- Using **On Board TCXO** source;
- Using an external source (TCXO/OCXO/Clock Generator with output impedance **50 Ohm**), when using it, **make sure that capacitor C20 (100nF 0603) is removed** (Figure 2). This will **disconnect** on board TCXO **output** from **DDS Clk input!**

The type and frequency of the clock source **must be correctly set** in the device settings (At **"SETUP"** menu). All settings are saved in non-volatile memory.

The **output signal** is taken from the **SMA** connector labeled **"RF OUT"** on the board.

When using an **external clock source**, the signal is fed to the **SMA** connector labeled **"REF CLK IN"**, when using it, **make sure that capacitor C20 is removed** (Figure 2).

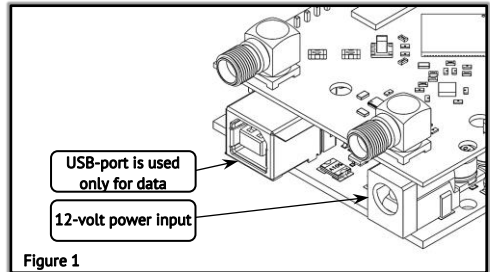


Figure 1

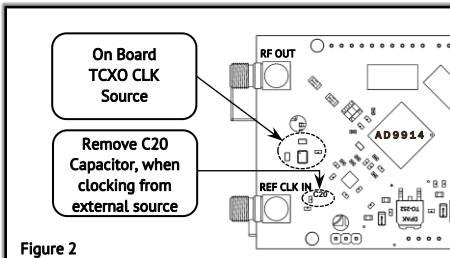


Figure 2

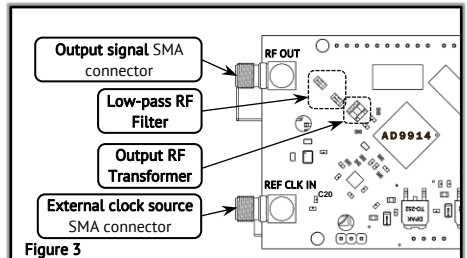


Figure 3

The level of the external clock signal **must be** within the range of **-10 dBm to +10 dBm** for a sinusoidal signal. For example, if the signal level from an external generator is **+16 dBm**, it is necessary to connect it only through an attenuator of at least **6 dB** (**16 dBm - 6 dB = 10 dBm**). For signals of other waveforms, such as a clipped sine or square wave, the level must be **0.2 - 2 Vpp**.

The device contains a **low-pass filter** and an output **matching transformer** at the output (**RF OUT**), therefore a software limit of **100 kHz** is applied to the minimum **output frequency** of the device (Figure 3).

OPERATION

After powering on the module, **firmware** information is displayed on the screen for 2 seconds.

Notifications are displayed in the **"Info string"** area. For example, it may indicate that the set frequency value exceeds the allowable limit.

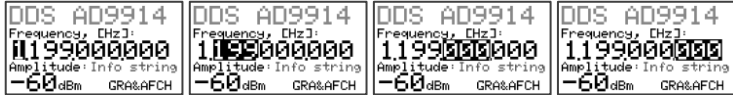
The module has a built-in **temperature sensor**. The temperature value is displayed on the screen in the top right corner. When the temperature reaches **90°C**, the **DDS shuts down** to prevent damage! A **cooling fan** is installed above the frequency synthesizer. Operation **without** the fan is **prohibited!** The normal operating temperature range is between **50 and 60°C**.



Main menu:

Rotating the **encoder knob** moves the cursor through menu items or changes the value of the selected item. **Pressing** the encoder knob activates or deactivates the parameter editing mode, or enters a submenu (depending on the context). Fast rotation of the knob allows jumping through **10** values at a time.

Frequency [Hz]: The maximum **output frequency** is limited to **1999 MHz (AD9914) / 1499 MHz (AD9915)**, but it is important to note that the maximum output frequency that can be obtained is **half** of the frequency of the AD9914/15 core. For example, with a core frequency of **2.64 GHz**, the maximum output frequency **cannot exceed 1320 MHz**. The **core frequency** can be changed in the **"Setup"** menu.



Amplitude: [dBm] The signal level can be adjusted from **-68 dBm to 0 dBm**.



Setup menu:

(To enter the settings menu, **press and hold** the encoder knob for **2 second**)

Clock Src: Allows selecting the **Software clock source**, with **two** options available:

- "TCXO/OCXO"** - Temperature Compensated Crystal Oscillator / Oven-Controlled Crystal Oscillator. In this case, DDS PLL is **enabled** and the **hardware** clock sources can be the **On Board TCXO** or External **OCXO/TCXO** connected to **"REF CLK IN"** input via SMA connector.
- "External clock"** - In this case, DDS PLL is **disabled**, and **hardware** clock sources are an **External Generator** connected to **"REF CLK IN"** input via SMA connector **ONLY!**

In addition to selecting the clock source in the menu, it is also necessary to ensure that the component listed in the **Table 1** are set to the position corresponding to the **hardware** clock source.



Hardware Clock Source (only one at a time)	Capacitors	Comments
	C20	
On Board TCXO - Oscillator 1ppm (Z2)	✓	means that the component must be installed
REF CLK IN - External Generator or OCXO or TCXO	*	means that the component must be removed

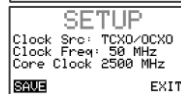
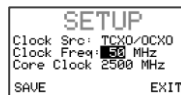
Table 1.

Clock Freq: Allows setting the frequency of the clock source, with different frequencies available for each source:

- For **"TCXO/OCXO"**, frequencies of **5, 10, 20, 25, 40, 50, 100** and **125 MHz** are available (**50 MHz** on default). **PLL is enabled**;
- For **"External clock"**, it is possible to manually set the frequency in the range of **500 MHz to 4000 MHz** (depend by Model, refer to Specification) with a step of **1 MHz**. **PLL is disabled**.

DDS Core Clock: Allows changing the core frequency. When in "Clock Src." the **"TCXO/OCXO"** option is selected and PLL is **enabled**, the core frequency can be set from **2400 MHz to 2640 MHz**, with the adjustment step depending on the clock source frequency. When in "Clock Src." the **"Ext. Clock"** option is selected and PLL is **disabled**, the core frequency can be set in the range of **500 MHz to 4000 MHz**. The nominal AD9914 core frequency is **3500 MHz (AD9915 is 2500 MHz)**, setting a **higher frequency is overclocking**, and operation at such a frequency is **not guaranteed!!!**

The clock settings are **applied only after** selecting the **"SAVE"** option. The **"EXIT"** option allows exiting **without saving** the settings.



⚠ WARNING

It is not recommended to set the core frequency above 4000 MHz for AD9914 and 3000MHz for AD9915!

Factory Reset: To reset all settings to **factory defaults**, you should **hold down** the encoder knob and **apply power** to the device while keeping the button pressed.

Communication Interface: Starting with version 0.82, the ability to control via the serial port has been added. To view the list of serial port commands, follow the link below (**QR firmware**).

SPECIFIATIONS

Model:	DDS AD9914	DDS AD9915
Frequency:	100 kHz to 1999 MHz @4000 MHz Core Clock, if using built-in PLL then DDS clock is limited to 2.64GHz and output frequency is 1.32GHz	100 kHz to 1499 MHz @3000 MHz Core Clock, if using built-in PLL then DDS clock is limited to 2.64GHz and output frequency is 1.32GHz
Spurs max:	-60 dBc	-60 dBc
Frequency step:	1 Hz	1 Hz
Output power:	+0 dBm to -68 dBm (on 50 Ohm load)	+0 dBm to -68 dBm (on 50 Ohm load)
Output level up to:	0.63 V _{peak-to-peak} (0 dBm 50 Ohm at 100 MHz) *Refer to Figure 4.	0.63 V _{peak-to-peak} (0 dBm 50 Ohm at 100 MHz) *Refer to Figure 4. (Valid at frequencies below 1000 MHz)
Power Supply:	Only External Power Supply DC 12V, 1A	Only External Power Supply DC 12, 1A
Output filter:	2 stage 7-th order, 1400 MHz cut-off (-3 dB)	2 stage 7-th order, 1000 MHz cut-off (-3 dB)
On Board Reference clock sources <i>(on choice)</i> :	TCXO 50 MHz 1ppm Oscillator (default), or External Oscillator up to 4000 MHz	TCXO 50 MHz 1ppm Oscillator (default), or External Oscillator up to 3000 MHz
Reference clock input level (REF CLK IN)	0.2 to 2 V _{peak-to-peak} , -10 dBm to +10 dBm	0.2 to 2 V _{peak-to-peak} , -10 dBm to +10 dBm
Display <i>(on choice)</i> :	OLED 0.96 inches I ² C	OLED 0.96 inches I ² C
Size:	53 x 114 x 40 mm (W x L x H)	53 x 114 x 40 mm (W x L x H)
Weight:	116 g	116 g

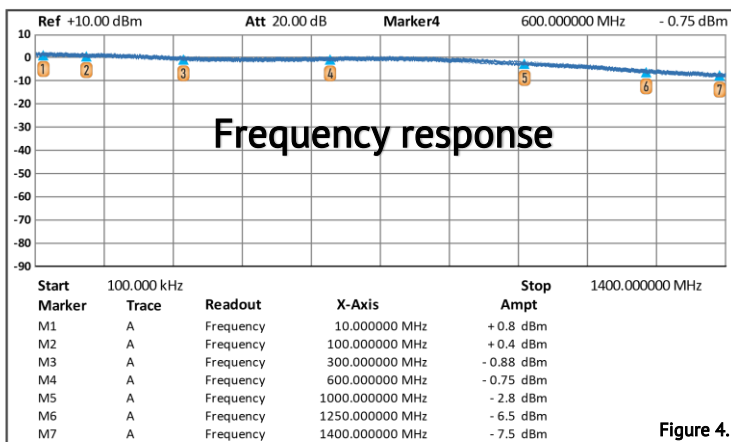


Figure 4.



website:

<http://www.gra-afch.com>



firmware:

<https://github.com/afch/DDS-AD9914-Arduino-Shield>
<https://github.com/afch/DDS-AD9915-Arduino-Shield>



video

compilation of firmware:
<https://youtu.be/zsoyni8oeqk>