

User's Manual

for

WavePond® DAx11500z, DAx11000z Arbitrary WaveForm Generators

1-Channel, 1.5 GS/sec, 9-bit (DAx11500z)

1-Channel, 1.0 GS/sec, 9-bit (DAx11000z)

(8K Samples Memory per channel - DAx11500z)

(8K Samples Memory per channel - DAx11000z)

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ILLUSTRATIONS / TABLES

1 GENERAL INFORMATION

1.1 Introduction

{
For **BREVITY** for the rest of this document both the **DAX11500z** and the **DAX11000z** will be referred to as **DAX11500** unless specific data requires a distinction between the two such as specifications.
}

The DAX11500z and DAX11000 are USB based Arbitrary Waveform Generators with a maximum sampling rate of 1.5 GS/sec and 1.0 GS/sec respectively. They are designed to produce any waveform from DC up to and even past many times Nyquist frequency using bands and/or using RTZ mode. The 9-bit D/A and on-board high resolution frequency synthesizer allow the user to seamlessly fit looping waveforms into memory, alleviating the need for more expensive and less reliable options.

The DAX11500 module has the following standard features:

- (1) Channel, 1.5 GS/sec, 9-bit D/A outputs (750 mVpp Typical) [SMA]
- DC Coupled outputs into 50 ohms
- 1ppm Internal Programmable Clock Synthesizer with < 5psec Jitter (typical)
- Internal Clock Synthesizer operates from 25 MHz to 1.5 GHz. (1.0 GHz for DAX11000)
- SFDR less than -40 dB @ 500 MHz (typ)
- Full scale Trise/Tfall = 150 picoseconds (typical)
- 8000 Samples Memory
- 3.3V TTL Prog. Marker Out [SMA]
- 3.3V TTL TRIG_IN (Asynchronous Trigger Capability with 667 psec resolution) [SMA]
- USB box powered by permanently tethered 100V/240VAC to 12V DC power supply.
- All functions controlled through USB.

1.2 References

See USB 2.0 specifications.

1.3 Deliverables

1.3.1 Software

The DAX11500 currently comes with (2) command line executables (dax115.exe, run_script.exe) that can also act as GUI programs, both specifically for the Windows 10/11 operating systems. Future releases will include Linux versions along with Python that will work for both. There is no plans for macOS at this time.

The main GUI program (dax115.exe) can perform many tasks including loading waveforms from a file, generating sine, square, triangle, and sawtooth waves, changing clock rates, triggering etc. The GUI program can also be used to execute command line API calls when parameters are detected. If any parameters are detected on the command line then the GUI itself is not displayed and the appropriate calls are made to the hardware. After each command line call the program removes itself from memory and returns control to the calling program.

There is also the "run_script.exe" executable that can call text files with multiple command lines and is the preferred method of running the DAX11500. For example you can name one script file "initialize_dax115.txt" for commands that only happen once per session. This program also provides a GUI (when no parameters are used) which is specifically designed to write and test script files. **See sections 3 and 4 for details on how these work.**

1.3.2 Hardware

By default the DAX11500 hardware consists of an aluminum box (example shown below), 6ft USB cable (USB A Male connector), and 12V power supply module. The last two are permanently connected to the enclosure.



1.3.3 DAX11500z Checklist

Item #	Qty	Part Number	Description
1	1	DAX11500z	(1) Channel, 1.5 GSPS, 9-bit, Arbitrary Waveform Generator System housed in USB controlled aluminum box with 8K Memory. USB cable is permanently attached along with the power cable.

1.4 Product Specification

DAX11500 (all specifications are at 25C unless otherwise specified)

I/O SPECIFICATIONS

Analog Outputs (SMA)	
Number of D/A Outputs	1
Vertical Resolution	9-bits
Output Impedance	50 ohms
Amplitude	750 mV _{pp} typical into 50 ohms
T(rise) / T(fall)	150 psec typical
Memory Size	8K samples
Maximum # of Segments	1
Segment Size Range	16 samples up to total memory; Modulo 4 only.
Segment Resolution	4 samples
Maximum Segment Loops	1, infinite
LVTTL Outputs (SMA)	
(2) Marker Outputs (3.3V TTL). One at beginning of waveform and one user programmable.	
LVTTL Inputs (SMA)	
(1) Trigger input (3.3V). Input is DC coupled to 0.9V into 50 ohms. Actual trigger level is 1.0V. Trigger delay = TBD.	
See software function description for functionality. Maximum re-trigger rate is approximately 1 MHz.	
Master Clock (internal)	
Frequency	25 MHz to 1.5 GHz standard
Phase Noise	-100dBc/Hz @ 1KHz Offset Typical @ Fc = 1.5 GHz
Jitter	< 5 picoseconds

GENERAL

Power Supply (Vcc)	+ 12.0V +/- 10%, 2A typical.
Operating Temperature	15 to 30 degrees C standard
Operating Humidity	5 to 95% non-condensing
Size	6" x 6.5" x 2.5"
Data Bus	USB 2.0

1.5 Technical Support / Software Updates

For technical support:

Sales/Tech	https://chase-scientific.com/sales.html
Mail	Chase Scientific P.O. Box 1487 Langley, WA 98260
Software	https://chase-scientific.com/wavepond.html.com

1.6 FCC Warning

This equipment is intended for use in a laboratory test environment only. The equipment generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to subpart J of part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case, the user, at their own expense, is required to take whatever measures may be required to correct this interference.

1.7 Warranty

WavePond warrants to the original purchaser that its DAX11500, DAX11000, and the component parts thereof, will be free from defects in workmanship and materials for a period of ONE YEAR from the data of purchase.

WavePond will, without charge, repair or replace at its option, defective or component parts upon delivery to WavePond's service department within the warranty period accompanied by proof of purchase date in the form of a sales receipt.

EXCLUSIONS: This warranty does not apply in the event of misuse or abuse of the product or as a result of unauthorized alterations or repairs. It is void if the serial number is altered, defaced or removed.

WavePond shall not be liable for any consequential damages, including without limitation damages resulting from loss of use. Some states do not allow limitation or incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific rights. You may also have other rights that vary from state to state.

WavePond warrants products "directly" sold anywhere in the world. If a WavePond product is purchased through an authorized distributor then warranty details are resolved through them.

NOTICE: WavePond reserves the right to make changes and/or improvements in the product(s) described in this manual at any time without notice.

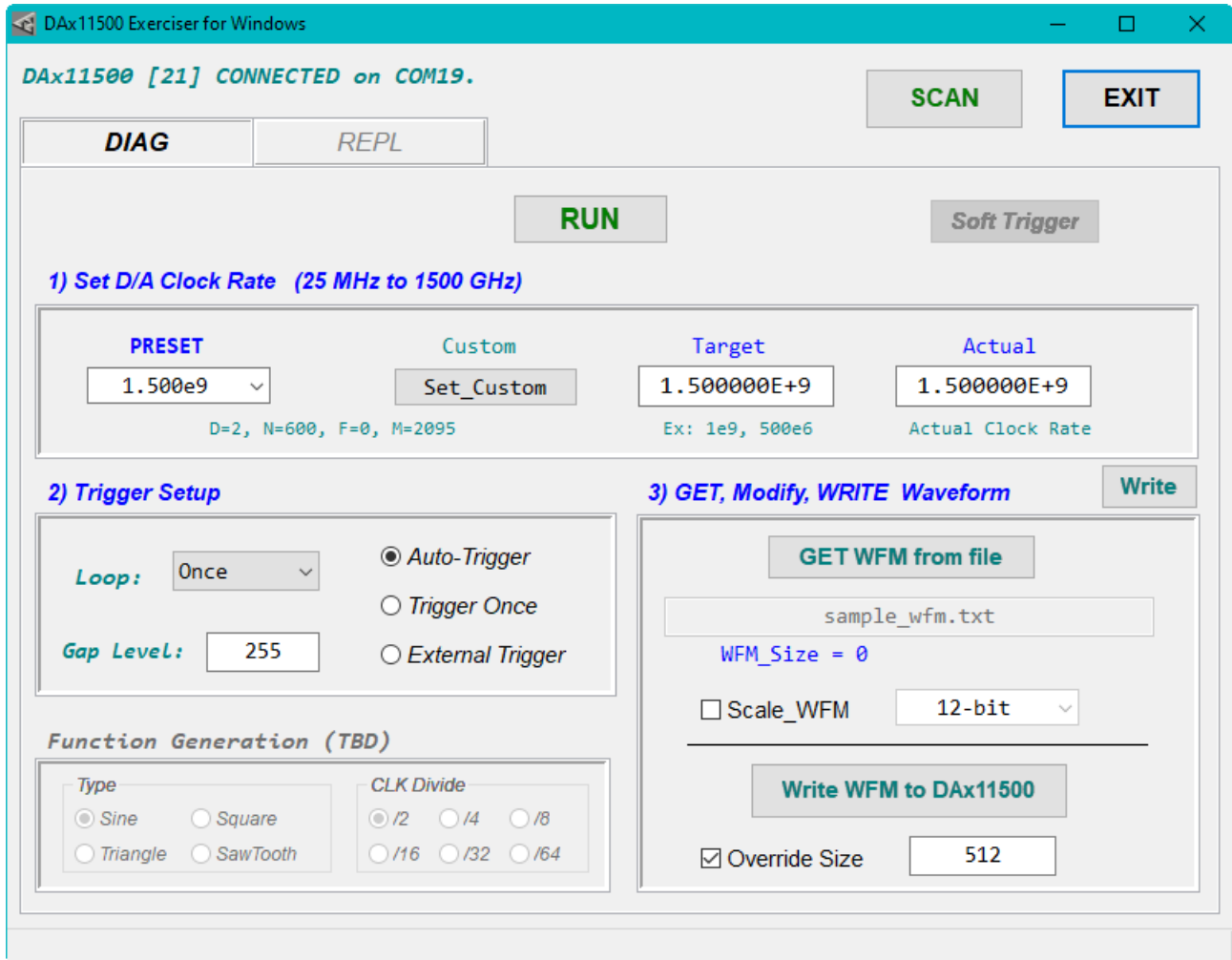
2 SOFTWARE GUI APPLICATION #1

2.1 Introduction

This GUI application is provided to quickly check whether the DAX board is detected and operating properly, to load custom waveforms, and to run command lines in non-GUI mode (see section 4).

2.2 Operation

Below is a screen shot of "dax115.exe". In general, the on-screen controls are self explanatory, but a few comments here will help you get started.



Simply run "dax115.exe" to display the DAX11500 exerciser program. If the DAX11500 is plugged in, turned on, and the USB cable is attached to your computer you should see the above screen. If you ran the program before plugging in the unit simply click on the button called "SCAN".

1) Set D/A Clock Rate:

You can use the drop-down menu to select some preset values (e.g. 1.00e9, 1.30e9) or leave it as default at 1.500e9. You can also set a custom value by entering a number in the "Target" box and clicking "Set Custom" button. The "Target" box accepts floating point numbers and positive integers. The "Actual" box shows how accurate the clock really is. The range that's acceptable is between 25 MHz and 1.5 GHz.

You can change the clock rate while the waveform is running.

2) Set Trigger Mode:

Auto-Trigger is the simplest to start with. It provides a software trigger every msec. If Loop = Once then there will be a waveform output played once every 1 msec. When Loop = Infinite, then the waveform will wrap around on itself and loop continuously. The "Trigger Once" and "External Trigger" is self explanatory.

The "Gap Level" must be between 0 and 511. This is the voltage level between waveform bursts. By default it is 255 which is zero volts output. Zero is - **375mV** while 511 translates to + **375mV**.

You can change the trigger modes while the waveform is running.

3) Load WaveForm From Text File:

In this section the "GET WFM from file" button loads a single waveform from a user file. The file loaded is displayed in the box below the button and a label shows the waveform size (number of points). The second button writes it to the DAX11500. The override checkbox and value box is defaulted to 512 but you can change that. Its mainly to truncate your waveform to the size you want.

Each line in the file represents a single point in an increasing time sequence and must be between 0 and 511 (no minus signs permitted). The time between data points (i.e. lines) is $1/(\text{Clock Rate})$.

VERY IMPORTANT ==>>>

The minimum number of points permissible for the DAX11500 is 4, and the maximum number is 7936. The number of points (lines) must be a number **EVENLY DIVISIBLE BY 4**. Not following this rule will result in undefined outputs.

Writing to the DAX11500 will automatically return the "STOP" button to the "RUN" state, so you cannot load waveforms while you are outputting ... at this time.

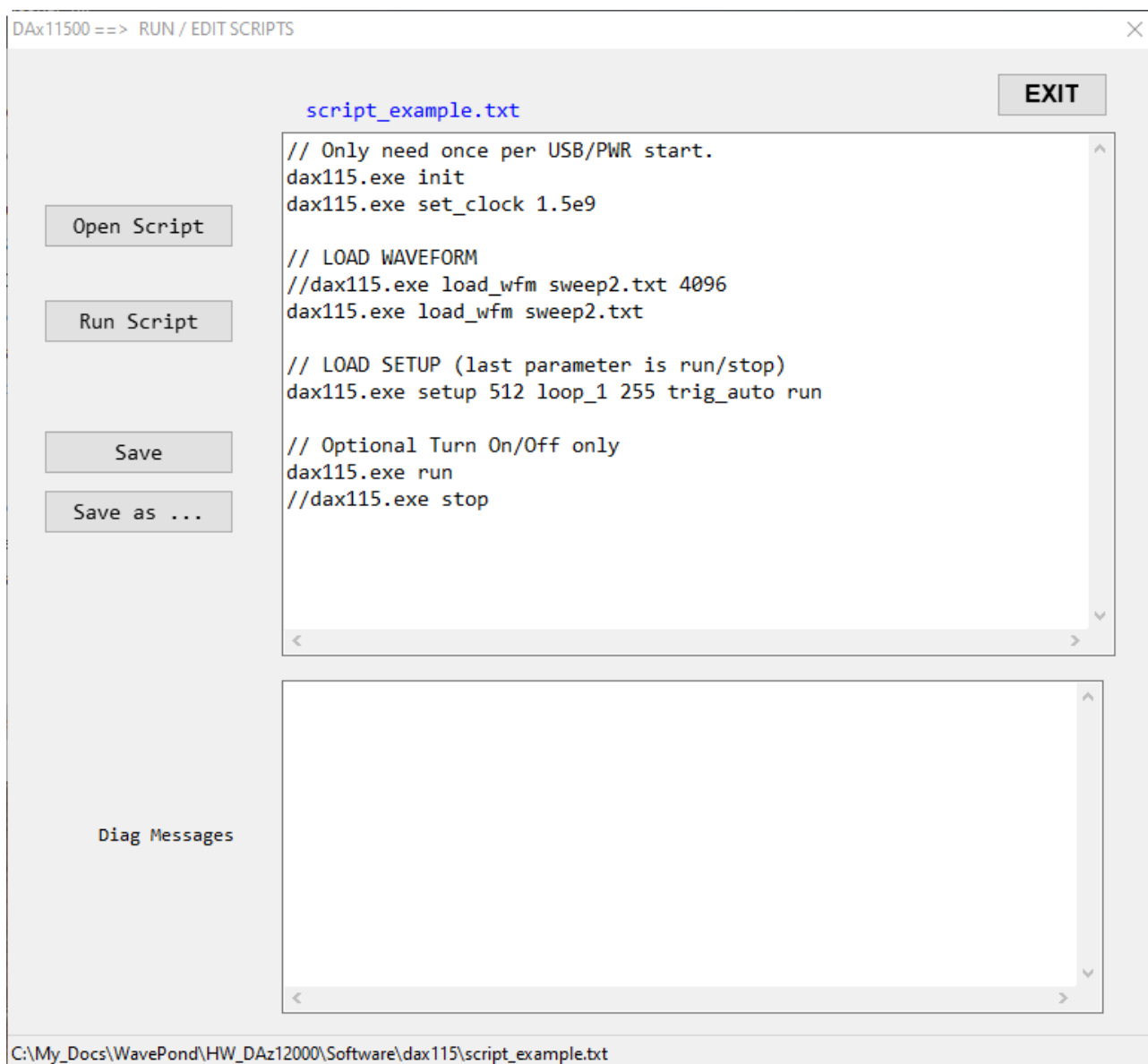
3 SOFTWARE GUI APPLICATION #2

3.1 Introduction

This GUI application is provided to read, write, and save script files. Its pretty handy. Once you're satisfied with the results you can then call this program and use the file name as the single parameter, e.g. "run_script.exe yourfile".

3.2 Operation

Below is a screen shot of "run_script.exe" in GUI mode. The screenshot is pretty self explanatory. You will also find a few examples within the dax11500.zip file (downloadable from "<https://chase-scientific.com/wavepond.html>").



Simply run "run_script.exe" to display the DAX11500 script execution GUI. Before running this program you should have the DAX11500 is plugged in, turned on, and the USB cable is attached to your computer. It will not give you a message if the DAX11500 is not connected properly -- it will simply not do anything when you run it.

When you actually run "run_script.exe" from your program you will pass it one parameter which will be the file name.

4 Windows 10/11 Programmer's Interface (Command Line / Script Mode)

4.1 Using the Command line / Script Mode

WavePond's DAX11500 arbitrary waveform generator uses the Windows default "Microsoft Virtual Serial Port Driver" over USB so drivers never need to be installed. Please review the following description on how to use the command line API.

The DAX11500 has two modes of API operation:

1) High level command line API access:

"run_script.exe your_script.txt"

This is the recommended method to use. It calls the *low level* program "dax115.exe". It allows you to test/debug your scripts separately before running your preferred tools, e.g. C/C++, Python, LabView, etc. When "run_script.exe" is run by itself (no parameters) then the "run_script.exe" GUI comes up and allows you to write your scripts. When they're working the way you want, you just call ==>> "run_script.exe your_script.txt". <=====

A typical "your_script.txt" might look like this ==>

```
-----
// Only need once per USB/PWR start. You can put this in its own separate file.
dax115.exe init
dax115.exe set_clock 1.5e9

// LOAD WAVEFORM
dax115.exe load_wfm sweep2.txt

// LOAD SETUP
dax115.exe setup 512 loop_1 255 trig_auto run

// [Optional] Turn On/Off only
dax115.exe run
-----
```

The "/" characters anywhere in the line prevents the line from being executed.

2) Lowest level command line API access:

"dax115.exe set_clock 1.50e9"

First, the same GUI program, i.e. "dax115.exe", is also used for the external program calls via the user's preferred programming language. All programming languages have methods to call external programs. When a parameter is called with "dax115.exe" such as "dax115.exe init" the GUI is not displayed. Instead the parameters (commands) will be read, executed, and the program will terminate.

The following sections will describe how to use the commands in detail. [These commands can be used for high level command access \(see #1 above\)](#) or [low level commands \(#2 above\)](#).

4.2 API Installation

The "dax115.exe" and "run_script.exe" needs to be copied to any directory (or directories) you wish to keep your scripts. Your waveforms should be in the same directory. When you execute "DAX115.exe init" it will automatically create a text file called "dax115_com_sn.wavepond" which includes the S/N and COM port of the currently USB connected device. This will be used for subsequent commands.

4.3 Function Calls

4.3.1 Function List

Command Line Calls

```
dax115.exe init           {Always required when first connecting USB & Power.}
                               {Not needed again unless USB or PWR disconnected}
```

```
dax115.exe set_clock value_float
dax115.exe load_wfm file_name <sam_size>  {<> is optional}
dax115.exe setup sam_size loop level trig <run/stop>  {<> is optional}
dax115.exe run
dax115.exe stop
```

```
run_script.exe <file_name>  {This can include all calls above}
```

The "run_script.exe" is used for automating various tasks for increased speed and/or simplicity. Its the recommended method. See details below for each command along with any nuances or restrictions.

Any errors are reported in the file "errors.wavepond".

4.3.2 Command Descriptions / Usage

4.3.2.1 init

Description

Scans all 256 COM ports for the DAX11500. When it finds one it stores the SN and COM number in the file "dax115_com_sn.wavepond" which is used for subsequent calls. This must be called whenever the USB cable has been disconnected and/or the power has been turned off.

Parameters

none

Example

```
dax115.exe init
```

4.3.2.2 set_clock <value_Hz_Float>**Description**

Sets the Sampling Rate to the desired value in floating point format.

Parameters

value_Hz_Float: Must be between 25e6 and 1.5e9.

Example

```
dax115.exe set_clock 1.500e9 {sets sampling clock to 1.5 GHz}
```

4.3.2.3 load_wfm <file_name {sam_size}>**Description**

Opens the file and reads all the lines available up to a maximum of 8000. The file must be a text file and each line must be a value between 0 and 511. **MAKE SURE OUTPUT IS TURNED OFF BEFORE LOADING WAVEFORMS.**

Parameters

file_name: Just the file name if local, otherwise requires full path.

{sam_size}: Optional size override.

Example

```
dax115.exe load_wfm sinewave.txt {loads sinewave.txt into DAX11500}
```

4.3.2.4 setup < sam size loop level trig run/stop>**Description**

Configures the DA11500 for a specific sample size (sam_size, looping (loop), DAC value between triggers (level), trigger type (trig), and run/stop.

Parameters

sam_size: 4 <= CardNum <= (7936) { Must be evenly divisible by 4 }

loop = loop_1 {one segment per trigger}
loop_inf {waveform is continuously looped (no gaps)}

level: 0 < level < 511 {this voltage shows up between triggered segments}

trig = trig_auto {Internal Trigger every 1 msec}
trig_once {Internal Trigger occurs once}
trig_ext {External Trigger}

run/stop = run {These save extra steps}
stop

Example

```
dax115.exe setup 2048 loop_1 255 trig_auto run
```

4.3.2.5 run

Description

Outputs the waveform previously setup.

Parameters

none

Example

```
dax115.exe run
```

4.3.2.6 stop

Description

Stops waveform output.

Parameters

none

Example

```
dax115.exe stop
```

4.3.3 (TBD)

5 MISCELLANEOUS

5.1 Calibration

The DAx11500 have no user features to perform calibration. DC offsets on the analog outputs can be adjusted by the factory to place the center value (255 out of 511) above, below, or at zero volts.

5.2 Maintenance

No maintenance is required.

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