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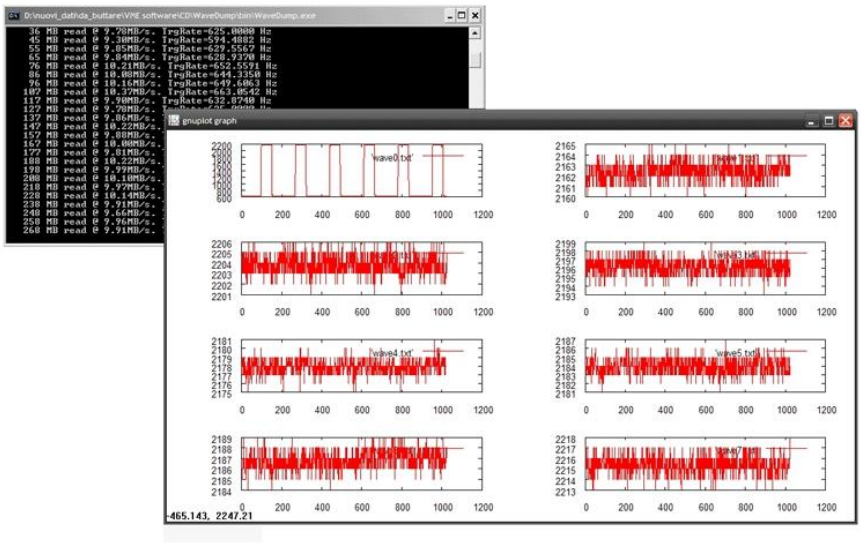
Electronic Instrumentation



User Manual UM2091

WaveDump

CAEN Digitizer Readout Application

Rev. 18 - September 3rd, 2021

Purpose of this Manual

This document is the WaveDump User Manual, aligned to the **rel. 3.10.3** of the software. It contains information for the installation, the complete command list explained and the syntax of the configuration file.

Change Document Record

Date	Revision	Changes
Apr 14th, 2011	04	Revised all chapters, new document format.
Mar 1st, 2012	05	Revised Chap. **1**.
Jun 7th, 2012	06	Updated Sec. System requirements & installation setup.
Apr 3rd, 2014	07	Updated sections: Chap. **4**.
Feb 2nd, 2015	08	Revised all chapters, new document format. Major updates in Chap. **2** and **4**. Added Chap. **5** and **7**.
Nov 9th, 2015	09	Updated Chap. **1**, **3**, **5**; added Chap. **6**.
Apr 28th, 2016	10	Updated Chap. **2**, **4** and **6**.
Jan 13th, 2017	11	Updated Chap. **3** and **4**.
May 31st, 2017	12	Updated Chap**. 2, 3** and **4**.
Dec 22nd, 2017	13	Updated Sec. **Block Diagram**. Extended the Decimation support to the 724 family in Chap. **4**. Added note on software compatibility with A3818 driver in Chap. **2**.
Dec 5th, 2018	14	Revised Sec. **Overview,** Sec. **Installation,** Chap. **3** and Chap. **4**. Added Sec. **Configuration File Management** and Sec. **Other Permitted Settings**.
Jan 24th, 2019	15	Modified note in Sec. **OUTPUT_FILE_FORMAT** `option`. Added note in Sec. **OUTPUT_FILE_HEADER** `option`.
Nov 8th, 2019	16	Added notes on 725S and 730S digitizers. Updated Chap. **6** and Chap. **7**.
Apr 26th , 2021	17	Added support to V3718 Bridge and A4818 Adapter. Updated **Reference Document**, Sec. **Drivers**, **Figure 2.4**, Sec. **Common Settings**.
Sep 3rd, 2021	18	Added support to V4718 Bridge. Updated Sec. **OUTPUT_FILE_FORMAT** `option` and Sec. **OUTPUT_FILE_HEADER** `option` for 742 digitizers family. Updated information about data saving path in Chap. **3**.

Symbols, Abbreviated Terms, and Notation

ADC	Analog to Digital Converter
DPP	Digital Pulse Processing
FFT	Fast Fourier Transform
FSR	Full Scale Range
PCB	Printed Circuit Board

Reference Document

[RD1] GD2483 - WaveDump QuickStart Guide

[RD2] GD2783 – First Installation Guide to Desktop Digitizers & MCA

[RD3] Technical Information Manual of V1718 and VX1718 VME – USB2.0 Bridge

[RD4] Technical Information Manual of A3818 PCI Express Optical Link Controller

[RD5] Technical Information Manual of A2818 PCI Optical Link Controller

[RD6] UM1934 - CAENComm User & Reference Manual

[RD7] UM1935 – CAENDigitizer User and Reference Manual

[RD8] AN2472 - CONET1 to CONET2 migration

[RD9] GD2512 - CAENUpgrader QuickStart Guide

[RD10] GD5695 - 742 Quick Start Guide

[RD11] UM7685 – V3718 Bridge User Manual

[RD12] DS7799 – A4818 Adapter Data Sheet

[RD13] UM8305 – V4718 Bridge User Manual

https://www.caen.it/support-services/documentation-area/

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1 Introduction

The WaveDump User Manual contains information for the installation, description of the complete command list and the syntax of the configuration file. The user can refer to WaveDump QuickStart Guide **[RD1]** for a practical first-use example.

WaveDump is a C-based console application developed to control all CAEN digitizer models running the waveform recording firmware. Digitizers running CAEN special Digital Pulse Processing (DPP) firmware must be controlled by dedicated readout software, as indicated in the relevant DPP web page.

WaveDump has been thought to demonstrate the use of CAEN libraries and methods for an efficient readout and data analysis. Besides being a ready to use software, WaveDump is provided with C source files and Visual Studio project to let the users customize the code for personalized solutions.

Multi-board management is not supported.

WaveDump supports the CAEN digitizers families as in the table below:

Supported Digitizer Families
720
V1721 – V1731
724
725
730
740
742
751
761

WAVEDUMP MANAGES ONLY CAEN DIGITIZERS RUNNING THE DEFAULT FIRMWARE FOR WAVEFORM RECORDING

WAVEDUMP, AS IS, PERMITS ONLY SINGLE BOARD CONTROL

2 Software Interface

Overview

WaveDump is a C-based console application for data acquisition management of CAEN digitizer families equipped with the waveform recording firmware (DPP firmware is not supported). Only a single board can be programmed according to a text configuration file containing a list of parameters and instructions; additional permitted commands can be added by the user in the configuration file, if necessary (see Chap. **4**).

Specifically, WaveDump can perform the following operations:

- connect to the digitizer through a physical communication interface (USB, Optical Link);
- read and display information about the board (model, serial number, FW revision, etc.);
- program the digitizer according to parameters written in a configuration file (text file);
- perform channel calibration (automatically at start-up and manually) required by specific digitizer families
- start and stop the acquisition (run on / off);
- enable a forced trigger (one-shot or continuous);
- read the event data and display the transfer rate (MB/s) and the trigger rate; the readout can take place with or without the use of interrupts;
- perform some simple data analysis (post-processing) such as the signal FFT and the histogram of the sample amplitude (energy histogram is not supported);
- save the waveforms (sequence of samples) to ASCII or binary output files; the writing can be “one-shot” (i.e. single event) or continuous (recording of a sequence of events);
- plot the acquired waveform, the FFT or the histogram of the selected channels using an external graphical tool (*gnuplot*).

WaveDump C-source files and the Visual Studio project are provided for advanced users, allowing for customized implementations.

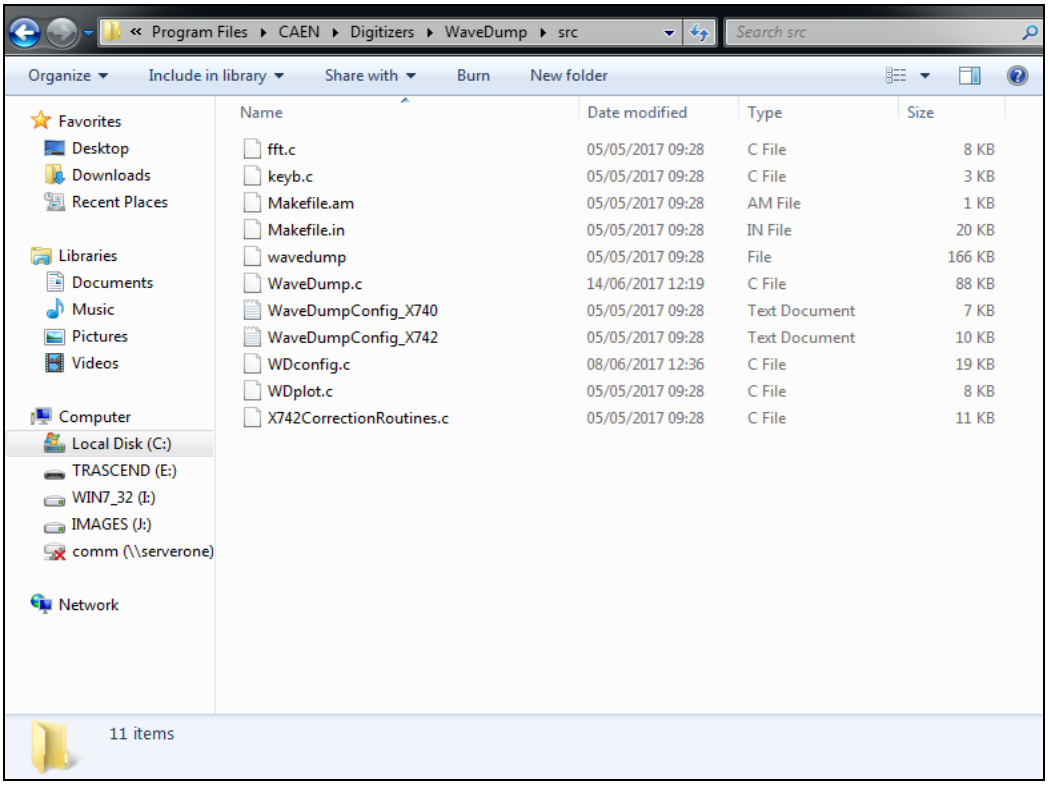

Figure 2.1: C-source files for Windows version. The path is visible in the top bar

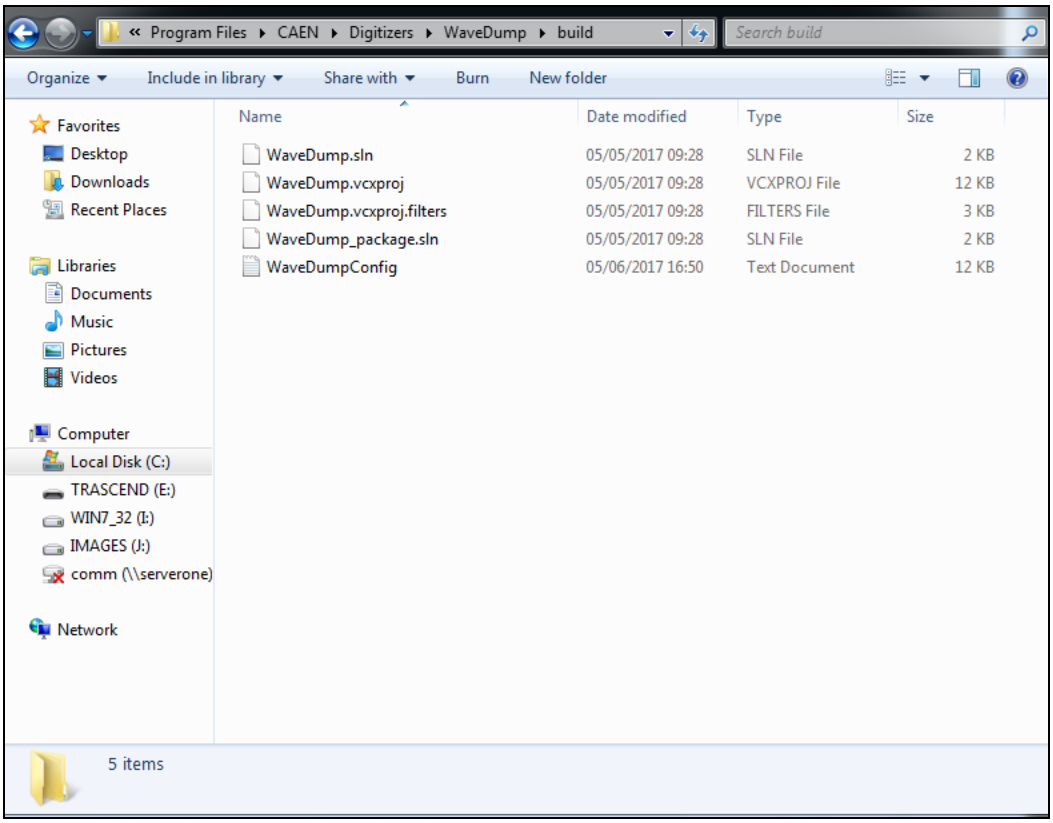

Figure 2.2: Visual Studio project files for Windows version. The path is visible in the top bar

For the Linux version, the C-code files are in the “src” subfolder of the “wavedump” directory.

The source code of WaveDump shows the sequence of steps to do to program the digitizer and manage the data acquisition.

Since WaveDump is capable of handling different digitizer types, some parts of the code may be redundant because they must include various cases. Users who want to control a specific digitizer, can remove all those pieces of code that are not of interest. In case of digitizer with channels managed by groups (e.g. 740 and 742 families), to simplify the use of WaveDump, only 8 channels of one group at a time can be plotted, although all channels are simultaneously enabled for the acquisition (and so for the output files saving).

In addition to read out, to plot and save the raw data, WaveDump implements also some simple examples of data analysis (FFT and sample amplitude histogram); starting from them, the user can easily develop his own post-processing algorithms.

Thanks to the C programming language and the absence of a GUI, WaveDump is portable to any platform; the code is compatible with both Windows® and Linux™.

Block Diagram

The block diagram of the WaveDump architecture is schematized in **Figure 2.3** below.

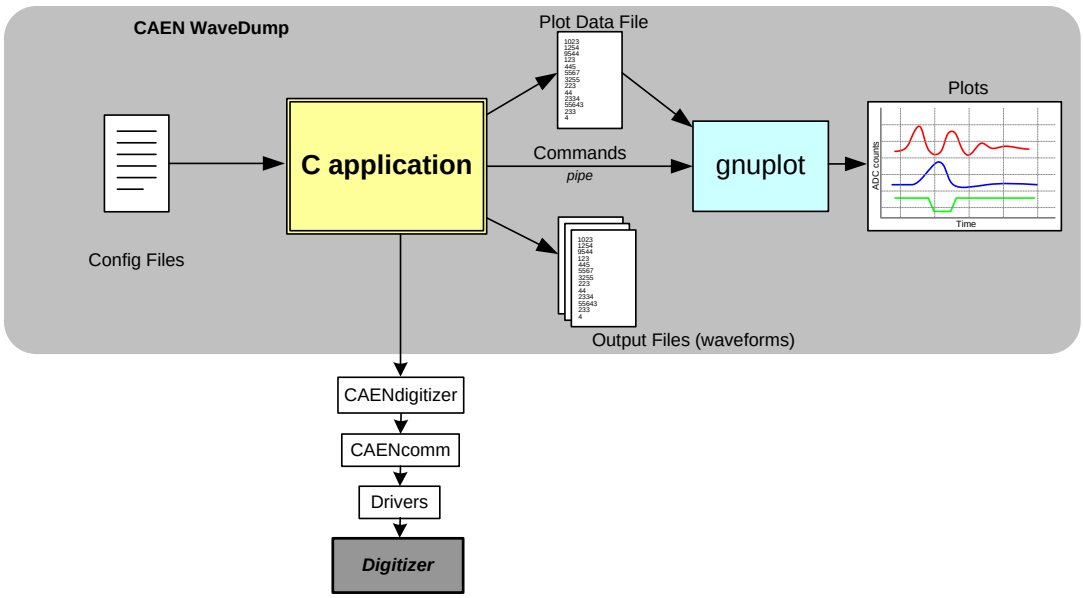

Figure 2.3: CAEN WaveDump software architecture

The program core is a C application that programs the Digitizer according to a set of parameters as written in the configuration text file, starts/stops the acquisition and manages the data readout. Data (waveforms, FFTs or histograms) are plotted using *gnuplot*, an external plotting tool, or saved to output text files.

In the WaveDump installation directory, there is a generic configuration text file (in principle, it can be used with every supported digitizer family), a second configuration file specific for 740 digitizer family, and a third one specific for 742 digitizer family; each file contains a list of defined parameters and includes elucidatory comments (see also Sec. **Installation** and Chap. **4**):

- ***WaveDumpConfig.txt***
- ***WaveDumpConfig_x740.txt***
- ***WaveDumpConfig_x742.txt***

The user can edit the configuration file or create a GUI that allows to set the parameters through a control panel and then generate the configuration file.

As introduced at the beginning of this manual, *WaveDump* relies on an external program (namely ***gnuplot***) for data plotting; data for the plot are written into a file, while the plot commands are passed from *WaveDump* to *Gnuplot* through a pipe. All functions related to the plotting are contained in a source file separated from *WaveDump*; the user can replace the calls to *gnuplot* to use other tools. Starting from WaveDump version 4.2, *gnuplot* is automatically copied to the proper working directory during the installation of *WaveDump* (only for Windows installation). Linux users must install *gnuplot* apart.

Drivers & Libraries

Drivers

To deal with the hardware, CAEN provides the drivers for all the different types of physical communication interfaces featured by the specific digitizer and compliant with Windows and Linux OS:

- **USB 2.0 Drivers for NIM/Desktop** boards are downloadable on CAEN website (www.caen.it) at the digitizer web page (**login required**) in:

  "Downloads" page -> "Software" tab

Note: Windows OS USB driver installation for Desktop/NIM digitizers is detailed in **[RD2]**.

- **USB 2.0 Drivers for V1718 and V3718** CAEN Bridges, required for VME boards interface, are downloadable on CAEN website (www.caen.it) at the V1718 and V3718 web pages (**login required**) in:

  "Downloads" page -> "Software" tab

Note: For the installation of the USB driver, refer to the User Manual of the relevant Bridge **[RD3][RD11]**.

- **USB 3.0 Driver for the A4818 Adapter** (CONET to USB3) is required only for Windows OS and downloadable on CAEN website (www.caen.it) at the adapter web page (**login required**) in:

  "Downloads" page -> "Software" tab

Note: For the installation of the USB driver, refer to the Data Sheet of the adapter **[RD12]**.

- **Optical Link Drivers** are managed by the A2818 PCI card or the A3818 PCIe card. The driver installation packages are available on CAEN website at the A2818 or A3818 page (**login required**) in:

  "Downloads" page -> "Software" tab

IMPORTANT:

STARTING FROM REL. 3.8.1 BUILD DECEMBER 2017, WAVEDUMP FOR WINDOWS WORKS ONLY WITH A3818 DRIVER REL. 2.0.0 OR HIGHER!

Note: For the installation of the Optical Link driver, refer to the User Manual of the specific Controller **[RD4] [RD5]**.

Libraries

CAEN libraries are a set of middleware software required by CAEN software tools (including WaveDump) for a correct functioning. These libraries, including also demo and example programs, represent a powerful base for users who want to develop customized applications for the digitizer control (communication, configuration, readout, etc.):

- **CAENDigitizer** is a library of functions designed specifically for the Digitizer family and it supports also the boards running the DPP firmware. The CAENDigitizer library is based on the CAENComm library. For this reason, **the CAENComm libraries must be already installed on the host PC before installing the CAENDigitizer**.

  The CAENDigitizer installation package is available on CAEN website in the 'Download' area at the CAENDigitizer Library page. Reference document **[RD7]**.

- **CAENComm** library manages the communication at low level (read and write access). The purpose of the CAENComm is to implement a common interface to the higher software layers, masking the details of the physical channel and its protocol, thus making the libraries and applications that rely on the CAENComm independent from the physical layer. Moreover, the CAENComm requires the CAENVMELib library (access to the VME bus) even in the cases where the VME is not used. This is the reason why **CAENVMELib has to be already installed on your PC before installing the CAENComm**.

  The CAENComm installation package, and the link to the required CAENVMELib, is available on CAEN website in the 'Download' area at the CAENComm Library page. Reference document **[RD6]**.

Currently, the CAENComm (and so the CAENDigitizer) supports the following communication interfaces:

- PC → USB 2.0 → Digitizers (either Desktop or NIM models)
- PC → USB 2.0 → V1718/V3718 → VME → Digitizers (VME models only)
- PC → USB 3.0 → V4718 → VME → Digitizers (VME models only)
- PC → ETH → V4718 → VME → Digitizers (VME models only)
- PC → USB 3.0 → A4818 → CONET → Digitizers (all models)
- PC → PCI (A2818) → CONET → Digitizers (all models)
- PC → PCI (A2818) → CONET → V2718/V3718/V4718 → VME → Digitizers (VME models only)
- PC → PCIe (A3818) → CONET → Digitizer (all models)
- PC → PCIe (A3818) → CONET → V2718/V3718/V4718 → VME → Digitizers (VME models only)
- PC → USB → A4818 → CONET → V2718/V3718/V4718 → VME → Digitizers (VME models only)

CONET (Chainable Optical NETwork) indicates the CAEN proprietary protocol for communication on Optical Link. Refer to **[RD8]** for useful information.

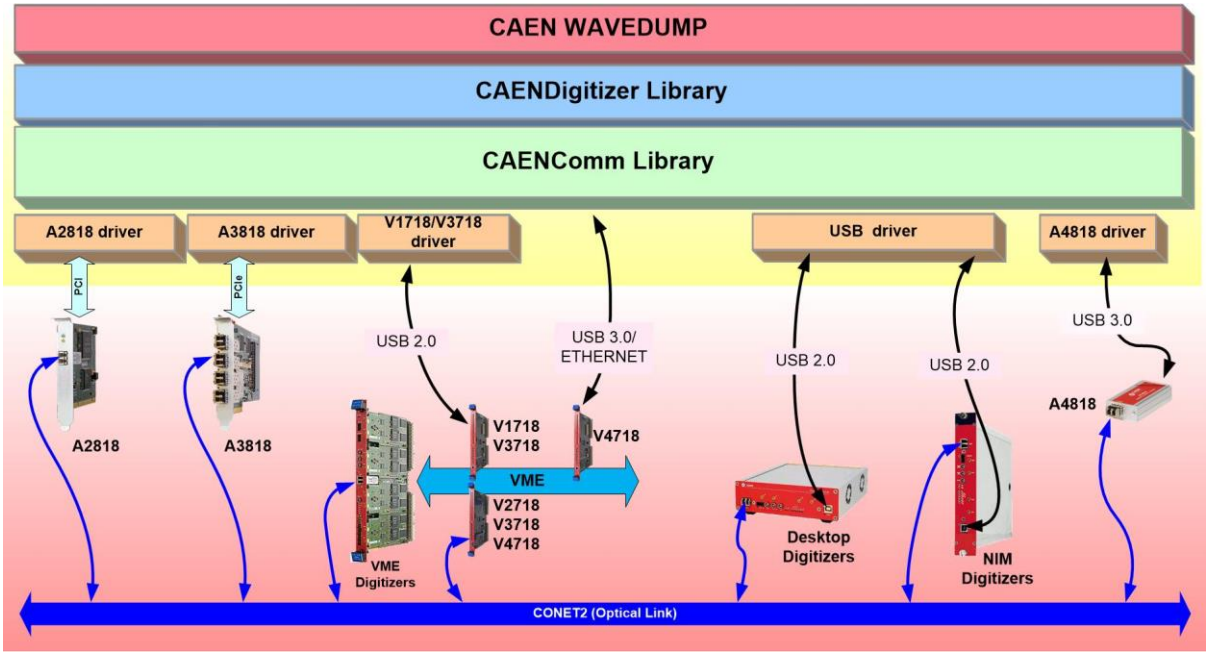

Figure 2.4: Required libraries and drivers

Installation

Before installing WaveDump, perform the following steps:

- **Make sure that your hardware (Digitizer and/or Bridge, or Controller) is properly installed** (refer to the related User Manual for hardware installation instructions).
- **Make sure of a proper cable connection** by USB, Optical link or Ethernet between the host PC and the target hardware.
- **Make sure that you have installed the driver for your OS and the physical communication layer to be used**. Driver installation packages are downloadable on CAEN website (**login required**) as reported in the **Drivers** paragraph.
- **Make sure that a waveform recording firmware is running on the board**. You can use the CAENUpgrader tool to read the digitizer firmware revision **[RD9]**. The waveform recording firmware can then be identified by the AMC FPGA firmware revision formatted as:

  W.Z

  where the major revision number of the AMC FPGA must be less than 128 (i.e. W < 128).

  AMC FPGA revision number ≥ 128 means DPP firmware, which is not supported by the software; in this case, a specific message is displayed by the software (**Figure 2.5)**; the user must quit the software and upgrade the digitizer with a supported firmware.

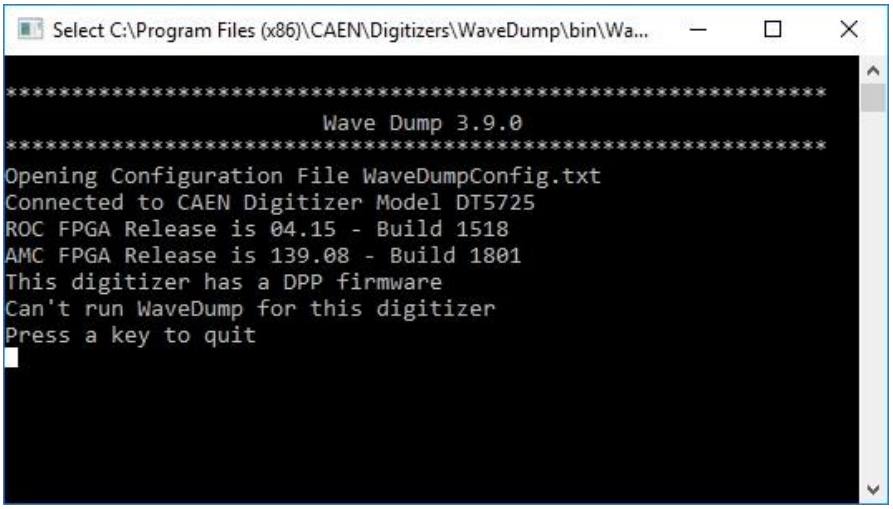

Figure 2.5: WaveDump message for not supported firmware found

Windows Users

The Windows installation package of WaveDump is **standalone:** it installs all the binary files required to directly use the software (i.e. no need to install the required CAEN libraries in advance).

- **Download the installation package** compliant with your OS from CAEN website on the WaveDump page (**login required**)
- **Extract** the **files** to your host.
- **Run the installer** and **complete**.

WaveDump is finally installed at the default path:

C:\Program Files\CAEN\Digitizers\WaveDump

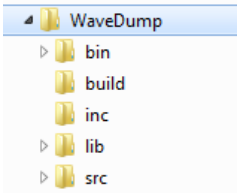

Figure 2.6: Subfolders structure of WaveDump main directory

The "*bin*" subfolder contains the executable file (WaveDump.exe), a **general-purpose default configuration file (*WaveDumpConfig.txt*)**, the **x742 models default configuration file (*WaveDumpConfig_x742.txt*)** and the **x740 models default configuration file (*WaveDumpConfig_x740.txt*)**.

The *"build"* folder contains the Visual Studio project, while the header and the source code of the WaveDump are in the *"inc"* and *"src"* folders, respectively.

Linux Users

Linux users must additionally install third-party **gnuplot** graphical tool and the required **CAEN Libraries**: CAENVMElib, CAENComm and CAENDigitizer. The libraries can be downloaded from CAEN website (**login required**). **Installation instructions** can be found in the **README file** inside each library folder.

- **Download** the WaveDump installation package for Linux from CAEN website on the WaveDump page (**login is required**).
- **Unpack** the **installation package** (tar –zxf <WaveDump-x.y.z.tar.gz).
- **Follow** the instructions on the **INSTALL** file

  Type: ./configure

  make

  sudo make install

  Launch the software typing **wavedump**

The default configuration files location is:

/etc/wavedump/WaveDumpConfig.txt (general purpose default configuration file);

/etc/wavedump/WaveDumpConfig_x742.txt (default configuration file for x742 digitizers);

/etc/wavedump/WaveDumpConfig_x740.txt (default configuration file for x740 digitizers).

Configuration File Management

Windows OS

Destination path (default): *C:\Program Files\CAEN\Digitizers\WaveDump\bin*

- DIGITIZER x720 x724 x725 x730 x751 x761 (and obsolete V1721, V1731)

The user must modify the settings in **the *WaveDumpConfig.txt*** file. WaveDump parses the config file at start-up and configures the target digitizer accordingly.

- DIGITIZER x740

The user must modify only the Connection Parameter settings in the ***WaveDumpConfig.txt***, while all other settings must be modified in the ***WaveDumpConfig_740.txt*** file. At start-up, the software reads the connection parameters from the *WaveDumpConfig.txt* file, then recognizes the board, and warns the user that settings must be modified in the *WaveDumpConfig_740.txt* file.

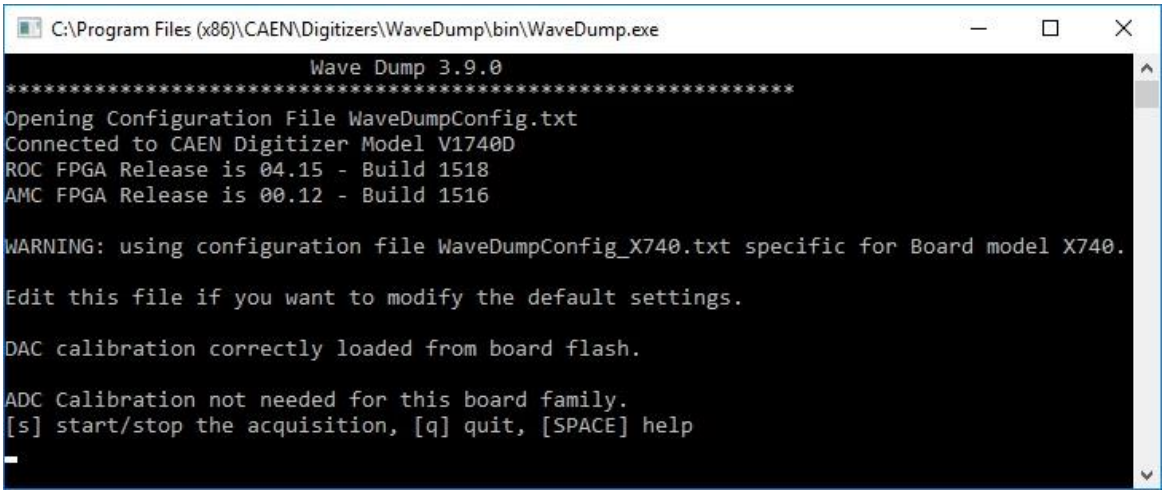

Figure 2.7: Warning using specific configuration file for x740 digitizers

- DIGITIZER x742

The user must modify only the Connection Parameter settings in the ***WaveDumpConfig.txt***, while all other settings must be modified in the ***WaveDumpConfig_742.txt*** file. At start-up, the software reads the connection parameters from the *WaveDumpConfig.txt* file, then recognizes the board, and warns the user that settings must be modified in the *WaveDumpConfig_742.txt* file.

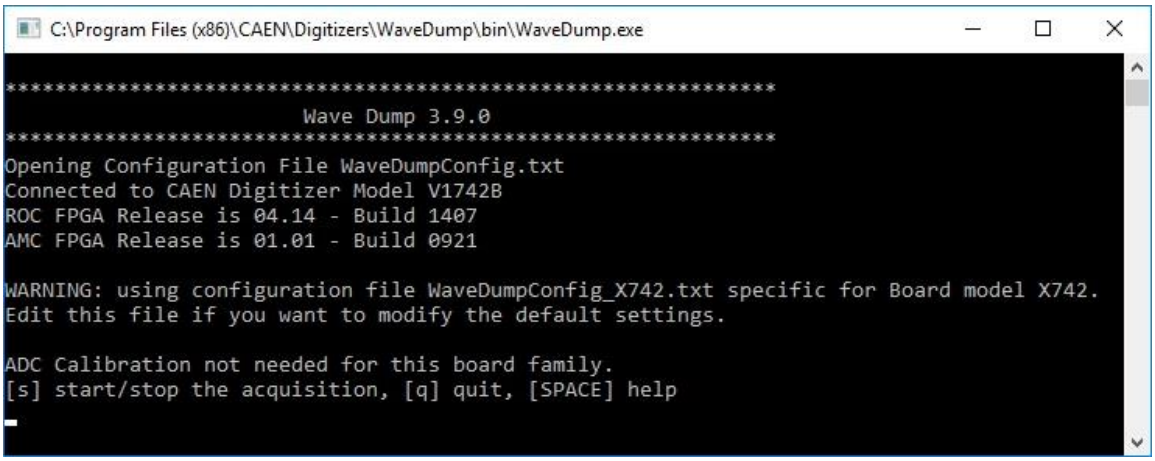

Figure 2.8: Warning using specific configuration file for x742 digitizers

Note: Administrator rights are required to modify any configuration file of WaveDump under the "*Program Files*" folder. To modify the file, the options are to enable full permissions in the original folder or to use the software without the administrator rights by copying the entire "bin" folder under another location, as for example the "Documents" folder.

Linux OS

Destination path: /etc/wavedump/

The same instructions on the use of the default configurations files are valid as for the Windows OS.

Note: Administrator rights are required to modify the *configuration file* of the WaveDump software under the "/etc/wavedump" folder.

Alternatively, the user can make the software parse one of the local config files copies at the path:

/wavedump-x.y.z/Setup/

To do that, the software must be launched by typing **wavedump** and the **path** of the wanted configuration file.

Note: In case of x742 and x740 digitizers:

- *Setup/WaveDumpConfig_x742.txt* is to be used with 742 digitizers
- *Setup/WaveDumpConfig_x740.txt* is to be used with 740 digitizer

By this option, all the settings in the linked configuration file will be read by WaveDump, including the Connection Parameter settings.

3 On-line Commands

Once started (following the instructions in Sec. **Installation**), WaveDump parses the configuration file as in Sec. **Configuration File Management.** If a formal error occurs, it is displayed in the shell.

Possible not valid parameter values or syntax errors in the configuration file are indicated by the software by displaying a warning message. Even if the operation of WaveDump may not be affected, the error can be found and fixed.

At start-up, WaveDump retrieves general information from the target digitizer, programs it and waits for the start of the acquisition ('**s**' key). The table below lists the accepted WaveDump on-line commands associated to specific keys.

Key	Function
s	Start / Stop acquisition
q	Quit WaveDump
R	WaveDump restart; this command allows you to reload the configuration file and restart with a new acquisition
t	Single Software Trigger; this command sends a software trigger (single shot), useful especially when the card has no data (no trigger) because it forces the acquisition of an event. In analogy with the oscilloscope, this command corresponds to the “Force trigger” button.
T	Continuous Software Trigger; this command enables / disables the continuous generation of software trigger at a fixed rate. Inside the acquisition loop, the program sends a trigger, reads the corresponding event and executes data analysis. It corresponds to the "Auto trigger” of the oscilloscope.
p	Single-event plot of the waveforms of each channel enabled for plotting (which does not necessarily coincide with the n channels enabled for acquisition). The plot is single-shot.
P	Continuous Plot; this command enables / disables the continuous plot of the enabled channels**.** When enabled, the input signal trace of channel 0 is plotted by default. Check the “c” command to enable the other channels.
w	Save Single Event to Disk; this command causes the writing of a file for each enabled channel, named wave_n.txt, where n is the channel number. For Windows OS, and starting from rel. 3.10.2 of the WaveDump software, data are saved at the following path: ➢ *C:\Users\UserName\WaveDump* **Warning:** the files are overwritten each time. Each file can be ASCII or binary and may contain a header or not, depending on the settings assigned in the configuration file.
W	Continuous Event Saving; this command enables / disables the continuous events saving to file. As for the “w” command, it creates one file per channel; then it writes the events consecutively. For Windows OS, and starting from rel. 3.10.2 of the WaveDump software, data are saved at the following path: ➢ *C:\Users\UserName\WaveDump* **Attention:** in this mode, the file size can grow up very quickly**.**
0 .. 7	This command insert / remove channel n (n = 0 .. 7) from the plot (if such a channel is enabled). In case of x740, n refers to the channel within the currently active group, for example, if it's on group 2 (channels 16 to 23), press 3 to insert / remove the channel 19. In case of V1725 and V1730, n refers to channel n or n+8, depending on the visualization mode enabled by the command ‘g’ (see below).
g	In case of 740 and 742 series, this command switches to the next group of 8 channels (only for). **Note:** the active group refers only to the plot (in fact, the plotter can handle only 8-traces), while the acquisition is always enabled on all groups. In case of V1725 and V1730, this command switches the plot visualization from 0-7 channels to 8-15 channels and vice versa (se also the “0..7” description).
f	This command toggles between waveform plot and FFT plot.
h	This command toggles between waveform plot and histogram samples amplitude plot (not supported by 742 series).
m	This command displays the temperature values (in °C) of the ADC channels. It is supported only by 725, 730 and 751 digitizer families.
c	This command performs the channel calibration required by 725, 730, 751, and 761 digitizer families (meaningless in case of x725S and x730S digitizers).

D	This command performs the manual DAC calibration on the input channels (not supported by 742 series). Calibration is performed on all channels at once; the calibration coefficients are then saved into the on-board FLASH, and automatically reloaded by the software at next start-ups. Calibration is applied only if the `BASELINE_LEVEL` is used in the configuration file (see Chap. **4**).
[Space]	This command displays the online help

Tab. 1: WaveDump on-line commands

Inside the *Gnuplot* window, there are active bindkeys and functions associated to the mouse:

Key	Function
a	Autoscale to be x-axis and y
r	Enable / Disable ruler
g	Enable / Disable grid
y	Set the scale y at full scale for the specific digitizer (scale x remains unchanged)
p	Return to previous zoom

Tab. 2: Gnuplot window commands

Zoom Area: right click on one corner of the area, release the button, left click on the opposite corner.

Click with the right button on the window bar to open a menu that allows to make the print, copy the screenshot to the clipboard, change colours, etc.

4 Configuration File Syntax

This chapter describes the structure of the WaveDump configuration file and the syntax of the all the defined settings, including the ones present in the default configuration files and ones that can be added. A special section (p. **26**) is then dedicated to the individual settings of the x742 digitizers which are present only in the ***WaveDumpConfig_x742.txt*** file.

The WaveDump configuration file is divided in two parts: **common settings**, indicated in the `[COMMON]` section, and **individual settings** for individual channel settings indicated in the `[n]` section, where n is the number of channel (or group in the case of x740 and x742 digitizers). The common settings are set equal to all channels, while the individual settings can be set individually for each channel (group).

The individual settings can be performed also in the common settings part: in this case, they are applied to all channels.

Note: Settings are executed sequentially, therefore commands written at the end of the file may overwrite settings written at the beginning, except for the `WRITE_REGISTER` command that is always executed at the end of the file.

Note: The special commands `@ON` and `@OFF` allow to skip entire blocks of lines: indeed, the WaveDump software can ignore all the configurations from the `@OFF` command to the `@ON`.

Common Settings

OPEN `LinkType PID IPAddress LinkNumber NodeNumber BaseAddress`

Specifies the path of the physical channel to open communication with the digitizer:

`LinkType`	Identifies the type of communication channel, choosing between **`USB, PCI, USB_A4818, ETH_V4718, USB_V4718`**: • **USB** option to be used in the following connection setups: PC → USB 2.0 → Desktop/NIM digitizer PC → USB 2.0 → V1718/V3718 → VME digitizer • **PCI** option to be used in the following connection setups: PC → PCI (A2818) → CONET → Desktop/NIM/VME digitizer PC → PCI (A2818) → CONET → V2718/V3718/V4718 →VME digitizer PC → PCIe (A3818) → CONET → Desktop/NIM/VME digitizer PC → PCIe (A3818) → CONET → V2718/V3718/V4718 → VME digitizer • **USB_A4818** option to be used in the following connection setup: PC → USB 3.0 (A4818) → CONET → Desktop/NIM/VME digitizer • **USB_A4818_V2718** option to be use in the following connection setup: PC → USB 3.0 (A4818) → CONET → V2718 → VME digitizer • **USB_A4818_V3718** option to be used in the following connection setup: PC → USB 3.0 (A4818) → CONET → V3718 → VME digitizer • **USB_A4818_V4718** option to be used in the following connection setup: PC → USB 3.0 (A4818) → CONET → V4718 → VME digitizer • **ETH_V4718** option to be used in the following connection setup: PC → Ethernet → V4718 → VME digitizer • **USB_V4718** option to be used in the following connection setup: PC → USB 3.0 → V4718 → VME digitizer
`LinkNumber`	The number of the connection. Typically, it is 0 (only one digitizer connection to the PC). In case of more digitizers connected it is necessary to specify which one has to be accessed. Remember that WaveDump can handle only one digitizer at a time. `LinkNumber` identifies which USB or A2818/A3818 is in use. Be aware that it is not known in advance which `LinkNumber` corresponds to which USB port or PCI slot
`NodeNumber`	This parameter must be specified only when connected via optical link (PCI) and indicates the node number in the daisy chain. Typically, it is `0` (only one digitizer in the optical chain), it may be different if more than one digitizer (or V2718/V3718/V4718) is connected in a daisy chain.
`PID`	The PID, Product Identification number. The PID value to be specified in this field is the A4818 one for these types of connections: • PC → USB 3.0 (A4818) → CONET → V2718/V3718/V4718 → VME digitizer • PC → USB 3.0 (A4818) → CONET → Desktop/NIM/VME digitizer The PID value to be specified in this field is the V4718 one for this type of connection: • PC → USB 3.0 → V4718 → VME digitizer

IP Address	The IP address of the V4718 VME Bridge. To be inserted only in case of this type of connection: • PC → Ethernet → V4718 → VME digitizer
BaseAddress	Indicates the Base Address (32-bit hexadecimal number) to access the digitizer via the VME bus. This number should be 0 for the direct connection from PC to digitizer.

CORRECTION_LEVEL <CORR_MASK> <CUST_TABLE_MASK> <FILENAME1> <FILENAME2> . . .

Valid Only for x742 Digitizers (*WaveDumpConfig_x742.txt*)

This command allows to apply the data correction needed by this digitizer family. There are three types of corrections: cell offset, index sampling, and time correction (see digitizer User Manual for further details). The three correction files are available on each digitizer flash and they can be automatically applied during the event decode. The user can also use his/her custom correction files. Custom files should have the following name structure:

a. BaseInputFileName + "_cell.txt" for the cell offset corrections

b. BaseInputFileName + "_nsample.txt" for the index sampling correction

c. BaseInputFileName + "_time.txt" for the time correction

CORR_MASK (correction mask) allows to select the combination of corrections to be applied. Options are:

- CORR_MASK = AUTO the three corrections are automatically read and applied to the event (this is the default configuration). The following fields must be blank.
- CORR_MASK corresponds to a 3-bit number, where bit[0] corresponds to the cell offset correction, bit[1] to the index sampling correction, and bit[2] to the time correction. For example: if you want to apply only the first and the third correction, CORR_MASK = 5, etc.

CUST_TABLE_MASK identifies the groups to which the corrections are applied.

This field must be filled only when CORR_MASK value is different from AUTO. Options are:

- CUST_TABLE_MASK = AUTO: the corrections specified in CORR_MASK are applied to all groups.
- CUST_TABLE_MASK corresponds to a 4-bit number, where *n* bit corresponds to the *n* group to be enabled for corrections. For example, if you want to set the corrections for groups 0, 2 and 3, CUST_TABLE_MASK = 13, etc.

When CUST_TABLE_MASK is different from AUTO the user must specify the file name to be used for each group of interest.

FILENAME1, FILENAME2, … corresponds to the BaseInputFileName of the correction files to be used for the group enabled by the CUST_TABLE_MASK value.

EXAMPLES:

1. Use of the default configuration. The software automatically reads the three correction files from the digitizer flash and applies them to the events.

   ```
   CONFIGURATION_LEVEL AUTO
   ```

2. Only some of the corrections are enabled and applied to all groups. For example, you can apply the cell offset and the time corrections.

   ```
   CONFIGURATION_LEVEL 5 AUTO
   ```

   Analogously it is possible to disable all corrections.

   ```
   CONFIGURATION_LEVEL 0 AUTO
   ```

3. Different corrections are applied to different groups. The specific file name for each group must be specified. For example, if you want to apply the cell offset and time corrections to group 0, 1 and 2 (VME form factor) you should write:

   ```
   CONFIGURATION_LEVEL 5 7 FILE_GR0 FILE_GR1 FILE_GR2
   ```

Where "FILE_GRn" is the "BaseInputFileName" for group n. All files must be available in the working folder of WaveDump, otherwise the full path must be specified.

DRS4_FREQUENCY `option`

Valid Only for x742 Digitizers (*WaveDumpConfig_x742.txt*)

This command sets the DRS4 chip frequency.

`option` can be:

`0`: 5 GHz (default value);

`1`: 2.5 GHz;

`2`: 1 GHz.

3: 750 MHz

Note: Option 3 (750 MHz) is supported only from 742 AMC firmware release 1.00 or higher. Furthermore, the board should have the data corrections for this frequency. In case your board does not have the 750 MHz corrections, contact CAEN for the upgrade (see Chap. **7**).

OUTPUT_FILE_FORMAT `option`

This command defines the format of the output file.

`option` can be:

`BINARY` 2 bytes per sample are saved. The width is reduced to 1 byte in case of 721 and 731 digitizer series. For the 742 digitizers family, two cases are possible:

- The corrections are enabled. The ADC data (sample) is modified by applying the corrections and then supplied as a float on 4 bytes.
- The corrections are disabled. The ADC data (sample) is unchanged and is supplied as an unsigned integer on the first 12 bits of the 4 bytes.

`ASCII` The data are saved as a column of integer values.

The data format is the following:

Block CH0;

Block CH1;

...

Block CHn (according to which channels have data available);

where each block is:

<header0> (32bit)

<header1> (32bit)

...

<header5> (32bit)

<Nsamples*16bit> (where Nsamples depends on RECORD LENGTH)

For the 742 digitizers family, each block is composed of 8 headers (see next section for further details) instead of 6 as for all other digitizer families.

In case the HEADER is disabled, each Block is made simply by the <channel> + <samples>.

Note: the sample value is expressed in ADC counts.

OUTPUT_FILE_HEADER `option`

If enabled, a header for each event is included in the output file.

`option` can be:

`YES` to include the header;

`NO` to exclude the header.

The HEADER is so composed (for all digitizer families except the 742 one):

<header0> Event Size (i.e. header + samples)

<header1> Board ID

<header2> Pattern (meaningful only for VME boards)

<header3> Channel

<header4> Event Counter

<header5> Trigger Time Tag

For the 742 digitizers family, the HEADER is so composed:

<header0> Record Length

<header1> Board ID

<header2> Channel

<header3> Event Counter

<header4> Pattern (meaningful only for VME boards)

<header5> Trigger Time Tag

<header6> DC offset (DAC)

<header7> Start Index Cell

Note: The Trigger Time Tag value is expressed in units of the digitizer Trigger Clock, depending on the family: 8 ns for 720-725-740-751-761; 10 ns for 724; 8.5 ns for 742. See the digitizer User Manual for deeper information.

RECORD_LENGTH `Ns`

Indicates the number `Ns` of samples to be acquired for each trigger (acquisition window).

Note: Due to constraints on the granularity of this setting, it is possible that the real number of acquired samples is approximated to a value close to what set (see the digitizer User Manual and Registers Description document).

The maximum value of `Ns` depends on the memory size and varies from model to model (according to digitizer specifications).

In Case of x742 Digitizers:

`Ns` options are only `1024`, `520`, `256` and `136`

TEST_PATTERN `option`

Data from the ADC can be replaced by an internal test pattern, that is a triangular wave ranging from 0 to full scale.

`option` can be:

`YES` to enable the TEST_PATTERN;

`NO` to disable it

EXTERNAL_TRIGGER `option`

This command manages how the External Trigger is used.

`option` can be:

`ACQUISITION_ONLY`: the arrival of a trigger on the front panel (TRG-IN) causes the acquisition of one event in all the channels of the board.

`ACQUISITION_AND_TRGOUT`: the same as `ACQUISITION_ONLY`. In addition, the external trigger is also propagated to the TRG-OUT (or GPO for the Desktop and NIM versions) front panel connector.

`DISABLED`: the external trigger is ignored.

FAST_TRIGGER `option`

Valid Only for x742 Digitizers (*WaveDumpConfig_x742.txt*)

This command allows to use the fast trigger inputs TR0 and TR1 to trigger the data acquisition of groups 0-1, and 2-3 respectively

`option` can be:

`ACQUISITION_ONLY` to enable it;

`DISABLED` to disable it.

ENABLED_FAST_TRIGGER_DIGITIZING `option`

Valid Only for x742 Digitizers (*WaveDumpConfig_x742.txt*)

Signal from fast trigger (TR0 and TR1) can be digitized and made available for readout on the eighth channel of each group.

`option` can be:

`YES` to enable it;

`NO` to disable it.

DECIMATION_FACTOR `Ns`

Valid only for x724 (*WaveDumpConfig.txt*) and x740 (*WaveDumpConfig_x740.txt*)

This command sets the decimation factor, which corresponds to the number of samples `Ns` to be averaged in the decimation algorithm.

`Ns` is an integer value selectable amongst 1, 2, 4, 8, 16, 32, 64, 128.

Data are accordingly stored in the FPGA at a frequency of:

$\frac{62.5\ MS/s}{Ns}$ For the x740 models

$\frac{100\ MS/s}{Ns}$ For the x724 models

Note: This parameter is supported only by x724 digitizers running FPGA firmware revision ≥ 4.14_0.14.

Note: This parameter is supported only by x740 digitizers running FPGA firmware revision ≥ 4.5_0.8

POST_TRIGGER `value`

This command indicates the post-trigger size in percentage of the total record length, which finally is the number of further samples that are written by the FPGA in the channel memory, when a trigger occurs, before to freeze the buffer.

`value` is an integer value ranging from `0` to `100`.

In Case of x742 Digitizers:

There is a delay of about 42 ns on Fast Trigger TR, and about 115 ns on TRG-IN; the post trigger is added to this delay.

PULSE_POLARITY `option`

This command determines whether the channel input signal polarity is positive or negative.

`option` can be:

`POSITIVE` if the input signal has positive polarity;

`NEGATIVE` if the input signal has negative polarity.

If the `BASELINE_LEVEL` parameter is active, this setting establishes how the value of the `TRIGGER_THRESHOLD` parameter is calculated with respect to the `BASELINE_LEVEL value` (see Sec. **TRIGGER_THRESHOLD** `value`).

If the `DC_OFFSET` parameter is used (see Sec. **Other Permitted Settings**), this setting establishes if the trigger is issued when the input signal crosses the trigger threshold on the rising edge (in case of positive pulse polarity) or on the falling edge (in case of negative pulse polarity).

FPIO_LEVEL `option`

Indicates the electrical level for the front panel LEMO I/Os (TRG-IN, TRG-OUT and S-IN for VME boards; TRG-IN, GPI and GPO for Desktop and NIM boards).

`option` can be:

`TTL` if the desired I/O level is TTL,

`NIM` if the desired I/O level is NIM.

WRITE_REGISTER `address data mask`

This command allows to write values directly in the board registers.

`address` is the hexadecimal address offset of the register (16-bit value);

`data` is the data to be written into the register (16 or 32-bit value);

`mask` is the bit masking for the `data` writing (16 or 32-bit value): only bits that are 1 in the mask are modified.

EXAMPLES:

1. Set only bit [12] of register 1080 to 1, leaving the other bits to their previous value:

   ```
   WRITE_REGISTER 1080 1000 1000
   ```

2. Set bit [12] = 1 and bit [13] = 0 of register 1080, leaving the other bits to their previous value:

   ```
   WRITE_REGISTER 1080 1000 3000
   ```

3. Set register 1080 to the value of 0x45:

   ```
   WRITE_REGISTER 1080 45 FFFFFFFF
   ```

Note: Writes are executed at the end of the digitizer programming, therefore they can overwrite common or individual settings**.**

Individual Settings

The following settings are usually individually applied on each channel; however, the user can put them also in the [COMMON] section to apply them to all channels.

Parameters not specified into the Individual Settings section are intended to assume the value defined in the Common Settings section.

The list of individual parameters for each channel must be reported after the [i] keyword, where "i" is the number of the selected channel (i.e. the group for x740 and x742 digitizers).

Example:

```
[0]
ENABLE_INPUT            YES         # setting 1 of channel "0" section
BASELINE_LEVEL          10          # setting 2 of channel "0" section
[1]
ENABLE_INPUT            NO          # setting 1 of channel "1" section
BASELINE_LEVEL          0           # setting 1 of channel "1" section
...
```

ENABLE_INPUT `option`

This command enables or disables the corresponding channel for the acquisition.

`option` can be:

`YES` to enable it (the events acquired from this channel can be plot and saved by the software).

`NO` to disable it (no event from this channel is acquired)

Note: For x740 and x742 digitizers, this setting refers to a group of 8 channels: all channels belonging to the group are enabled/disabled at the same time.

Note: For x751 digitizers (and obsolete V1721, V1732), enabling `DES_MODE` setting may overwrite the `ENABLE_INPUT` one. In fact, when working in DES Mode, the digitizer supports only half the available input channels. Then, channels disabled by the `DES_MODE` remain disabled anyway (see the relevant digitizer User Manual).

BASELINE_LEVEL value

The BASELINE_LEVEL setting acts in combination with the PULSE_POLARITY command. It allows to shift the input dynamics accordingly to the input signal polarity (the signal dynamics is 0 to FSR for positive input polarity or -FSR to 0 for negative input polarity, where FSR is the full-scale range).

The BASELINE_LEVEL option makes use of the channel DAC calibration for a more precise setting of the channel DC-offset, which results in a more effective setting of the trigger threshold. The user is recommended to perform the channel DAC calibration by the "D" command (see **Tab. 1**).

Note: For x740 digitizers, the BASELINE_LEVEL is calculated for the first enabled channel of a group, and the value is then common to all the enabled channels in the same group.

Note: The BASELINE_LEVEL setting is **not supported by x742 digitizers**.

value is a float number that ranges from 0 to 100.0, where 0 corresponds to the full signal dynamics. Some examples are provided in the table below

value	PULSE_POLARITY=POSITIVE	PULSE_POLARITY=NEGATIVE
0	0 to +FSR	-FSR to 0
50	+FSR/2 to +FSR	-FSR/2 to 0
100	null (usually not used)	null (usually not used)

TRIGGER_THRESHOLD value

This is the setting of the trigger threshold (in ADC counts) for the generation of the channel self-trigger.

value is an integer value that ranges from 0 to $2^{Nbit}-1$, where Nbit is the number of bits of the ADC.

Enabling the BASELINE_LEVEL parameter, the value set for the threshold is not absolute, but relative to the measured input signal baseline, and it is calculated as follows:

- PULSE_POLARITY POSITIVE -> threshold = input signal baseline + TRIGGER_THRESHOLD
- PULSE_POLARITY NEGATIVE -> threshold = input signal baseline - TRIGGER_THRESHOLD

Using the DC_OFFSET parameter (see Sec. **Other Permitted Settings**), the value that must be set for the threshold is absolute.

CHANNEL_TRIGGER option

This command enables/disables the self-trigger function for a specific channel (or group, in case of x740 digitizers). The OR of all the enabled channel self-triggers is used as a global trigger for the board. Moreover, as for the EXTERNAL_TRIGGER command, the CHANNEL_TRIGGER decides how the channel self-triggers generated from the threshold crossing are used.

option can be:

ACQUISITION_ONLY: the self-trigger causes the acquisition of one event in all the channels of the board, regardless the channel(s) that generated it.

ACQUISITION_AND_TRGOUT: the same as ACQUISITION_ONLY. In addition, the global trigger is also propagated to the TRG-OUT front panel connector of the VME digitizer version, or GPO for NIM and Desktop versions.

TRGOUT_ONLY: the self-trigger does not cause the acquisition of an event, but the trigger signal is propagated to the TRG-OUT (GPO) front panel connector only.

DISABLED: the self-trigger of the relevant channel is ignored.

Note: ACQUISITION_AND_TRGOUT and TRGOUT_ONLY features **are not supported by x742 digitizers**.

CHANNEL_TRIGGER with x725 and x730 digitizers:

Specifically, the even and odd channels of x725 and x730 digitizers are paired. In WaveDump, the CHANNEL_TRIGGER setting of a couple of channels is then the OR of the CHANNEL_TRIGGER settings of the two channels.

Please, refer to the x730 and x725 digitizer User manual for details on the trigger management.

GRP_CH_DC_OFFSET dc_0, dc_1, dc_2, dc_3, dc_4, dc_5, dc_6, dc_7

Valid Only for x742 Digitizers (*WaveDumpConfig_x742.txt*)

The GRP_CH_DC_OFFSET command allows to adjust the DC_OFFSET level for each channel of a group.

dc_0 ... dc_n are float numbers that indicate the DC offset level for channel 0, …, n of the groups. Values range from −50 to 50, where −50 corresponds to a dynamic from -3FSR/2 to -FSR/2 (maximum negative signal), 50 corresponds to a dynamic from +FSR/2 to +3FSR/2 (maximum positive signal). Default value is 0, which corresponds to a signal dynamic of -FSR / 2 to +FSR / 2 (bipolar signal).

GROUP_TRG_ENABLE_MASK mask

Valid Only for x740 Digitizers (*WaveDumpConfig_x740.txt*)

This command enables the channels of a specific group to generate a self-trigger. The OR output the self-triggers from the enabled channels is the group trigger. Then, the OR of all group triggers generates the global trigger for the board (see User Manual of the digitizer for the complete description of the trigger management).

mask is a hexadecimal number ranging from 0 to FF.

Note: When using BASELINE_LEVEL option, it is recommended to **enable the self-trigger only for those channels receiving an input signal**, to avoid problems in the trigger management.

Specific Settings for x742 Digitizers

The following settings are valid only for x742 Digitizers (*WaveDumpConfig_x742.txt*), which support Fast Trigger channels TR0 and TR1.

For a complete description of Wave Dump practical use with 742 models, specifically for trigger management, please refer to the Quick Start Guide **[RD10]**.

The list of individual parameters for each group and Fast Trigger channel must be reported after the [i] keyword, where "i" is the number of the selected group or the Fast Trigger channel name.

Example:

```
[0]
ENABLE_INPUT          YES                    # setting 1 of group "0" section
GRP_CH_DC_OFFSET      0,0,50,0,-50,0,0,0     # setting 2 of group "0" section
...
[TR0]
DC_OFFSET              32768       # setting 1 of Fast Trigger 0 section
TRIGGER_THRESHOLD      20934       # setting 2 of Fast Trigger 0 section
```

Note: signal TR0 is the Fast Trigger for both groups 0 and 1 (all form factor versions), while signal TR1 is the Fast Trigger for groups 2 and 3 (VME only).

For the Fast Trigger channels TR0 and TR1 the following parameters are available:

DC_OFFSET value

Set the DC_OFFSET level of the Fast Trigger channel.

value is a float number ranging from −50.0 to 50.0, where −50.0 corresponds to a signal dynamic from -3/2 FSR to –FSR/2 (maximum negative dynamics), 0 corresponds to a signal dynamic from –FSR/2 to +FSR/2 (bipolar signal) and +50.0 corresponds to a signal dynamic from +FSR/2 to +3FSR/2 (maximum positive dynamics)

TRIGGER_THRESHOLD `value`

Set the `TRIGGER_THRESHOLD` for the comparison level of the Fast Trigger channel.

`value` ranges from `0` to `65535`.

According to the PCB revision of the board (refer to **[RD7]** for further details) and to the TRn type of signal we suggest different values of `DC_OFFSET` and `TRIGGER_THRESHOLD`.

Here some examples:

1. PCB rev. 0:
    a. NIM signal on TR:
    ```
    DC_OFFSET 4096
    TRIGGER_THRESHOLD 29053
    ```
    b. AC signal on TR:
    ```
    DC_OFFSET 4096
    TRIGGER_THRESHOLD 27776
    ```
    c. TTL signal on TR:
    ```
    DC_OFFSET 16384
    TRIGGER_THRESHOLD 29016
    ```
2. PCB rev. 1:
    a. NIM signal on TR
    ```
    DC_OFFSET 32768
    TRIGGER_THRESHOLD 20934
    ```
    b. AC signal on TR
    ```
    DC_OFFSET 32768
    TRIGGER_THRESHOLD 26214
    ```
    c. +2V signal on TR
    ```
    DC_OFFSET 43520
    TRIGGER_THRESHOLD 26214
    ```

Other Permitted Settings

This section describes a list of parameters not present in the default configuration files, but they can be added by the user and are managed by the software.

GNUPLOT_PATH "path"

Path for the *gnuplot* executable file. For Windows installation, it is normally ".\", since *gnuplot* is copied into the working directory. For Linux systems, it is "/usr/bin/".

ENABLE_DES_MODE option

Supported only by x751 and obsolete V1731 Digitizers.

This command enables the Dual Edge Sampling (DES) mode. When enabled, only half of the channels are active (even channels in case of V1731, while odd ones in case of x751), regardless the ENABLE_INPUT setting in the configuration file. When enabled, those channels will work at the double of the sampling frequency of the digitizer (i.e. 1 GS/s for V1731 and 2 GS/s for x751 digitizers).

option can be:

YES to enable it;

NO to disable it.

MAX_NUM_EVENTS_BLT Ne

This parameter indicates the maximum number of events Ne that can be transferred in a block transfer. Higher values of Ne may lead to a more efficient usage of the readout bandwidth, requiring more memory allocation for the block transfer.

Ne is an integer value ranging from 1 to 1023.

USE_INTERRUPT value

This command enables/disables the interrupt acquisition mode. If enabled, the digitizer can give an interrupt to the reading process; the interrupt can occur either when a number N of events is reached, or when a timeout occurs. It is useful to set the same number of interrupts as the MAX_NUM_EVENTS_BLT value. Refer to **[RD7]** for all the parameters to be set for a correct use the of interrupts (as for example the Rora or Roak release mode, the interrupt level on the VME bus, the time-out, etc. that must be defined in the source code).

value can be:

0 to disable the interrupt acquisition mode;

0 < value < 1024 to set an interrupt after N event read from the board.

SKIP_STARTUP_CALIBRATION option

Supported Only by x725 x730 x751 x761 Digitizers (meaningless in case of x730S and x725S)

This command controls the start-up automatic channel calibration needed by a set of CAEN digitizers. The start-up ADC calibration is enabled and so performed by default, but the user can choose to skip it and perform it manually later by a specific procedure (see Chap. **6**).

option can be:

YES if channel calibration is not to be performed automatically by the software at WaveDump start-up;

NO if channel calibration is to be performed automatically by the software at WaveDump start-up (default).

Note: a new and manual channel calibration (see Chap. **3**) is recommended to be done if the channel temperature varies significantly, or after a PLL reprogramming. (refer to the relevant digitizer User Manual for details).

DC_OFFSET `value`

The `DC_OFFSET` command allows to shift the input dynamics (-FSR / 2 to +FSR / 2, where FSR is the full-scale range) towards negative or positive values. The `DC_OFFSET` value is expressed in percentage of the FSR.

`value` is a float number that ranges from `-50.0` to `50.0`, where `-50.0` corresponds to a signal dynamic from -FSR to 0 (completely negative signal), and `50.0` corresponds to a signal dynamic from 0 to FSR (completely positive signal). Default value is `0`, which corresponds to a signal dynamics of-FSR / 2 to +FSR / 2 (bipolar signal).

Note: `DC_OFFSET` is alternative to `BASELINE_LEVEL`, so do not use DC_OFFSET if you are already using the BASELINE_LEVEL.

In Case of x740 and x742 Digitizers:

The `DC_OFFSET` value is the same for all channels in the group.

In Case of x742 Digitizers:

As an alternative to `DC_OFFSET`, it is possible to set different values for each channel in the group through the `GRP_CH_DC_OFFSET` command (see p.**26**).

`DC_OFFSET` applies also to the additional channels TR0 and TR1 (see Sec. **Specific Settings for x742 Digitizers**).

5 Temperature Protection

Valid for 725 and 730 digitizer families only

The 725 and 730 digitizer families feature a temperature protection procedure saving the hardware from possible damages due to internal over-temperature conditions. Substantially, this consists in monitoring the channels temperature and, as soon as it exceeds a fixed limit, the firmware automatically:

- turns off all the channel ADCs;
- stops the acquisition, if running (data possibly stored at that moment can be readout in any case).

Please, refer to the board User Manual for details on the temperature protection procedure.

TEMPERATURE PROTECTION IS NOT SUPPORTED BY ROC FPGA FIRMWARE RELEASES < 4.5

WaveDump manages this feature as follows:

- If the over-temperature condition is reached by the board during the acquisition, while the firmware performs the channels turning off, a message of “Over Temperature” is displayed, the acquisition is stopped, and the user is required to quit the program.
- As long as the board remains in over-temperature condition, it is not possible to restart the acquisition (“Over Temperature” message is still displayed).
- As soon as the board exits the over-temperature condition, a new acquisition can be started by the user.

TEMPERATURE PROTECTION IS NOT MANAGED BY WAVEDUMP SOFTWARE RELEASES < 3.6.6

6 Calibration

ADC Channel Calibration

Valid only for 725, 730, 751 and 761 digitizer families (not needed for x725S and x730S)

Digitizers in the 725, 730, 751, and 761 families perform a self-calibration of the ADCs at power-on. Anyway, to achieve the best performance, the calibration procedure is recommended to be executed, on command, after the ADCs have stabilized their operating temperature.

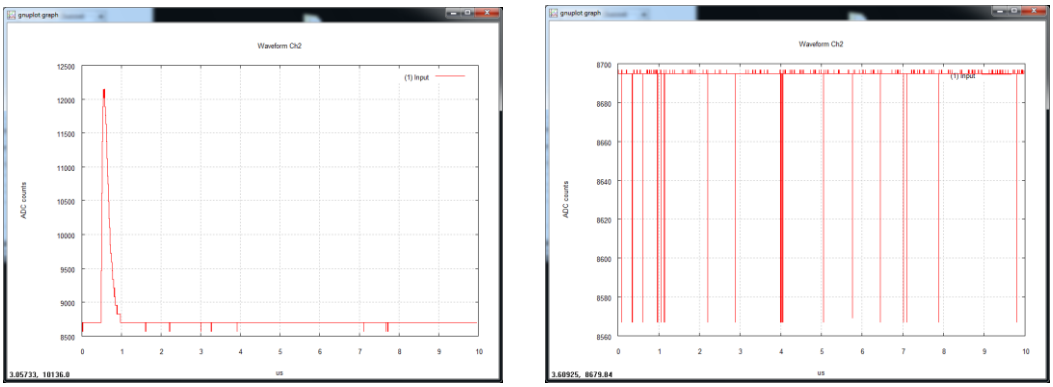

Figure 6.1: Example of uncalibrated input channel (baseline case on the right)

The calibration will not need to be repeated at each run unless the operating temperature changes significantly, or clock settings are modified (e.g. switching from internal to external clock).

ADC Channel Calibration Procedure

1. Launch WaveDump software. A message of ADC calibration successfully executed will be displayed (see **Figure 6.2**).

NOTES:

a) **In case of 720, 724, 740, 742 digitizer families and old V1721, V1731 digitizers, WaveDump displays:**

"ADC Calibration not needed for this board family"

b) **In case of 751 and 761 digitizer families, the message is:**

"ADC Calibration successfully executed"

c) **In case of 725 and 730 digitizer families, the message is:**

"ADC Calibration check: the board is calibrated"

d) **If SKIP_STARTUP_CALIBRATION parameter is set to YES in configuration file (see Chap. 4), the automatic start-up calibration is not performed, and no message is displayed**

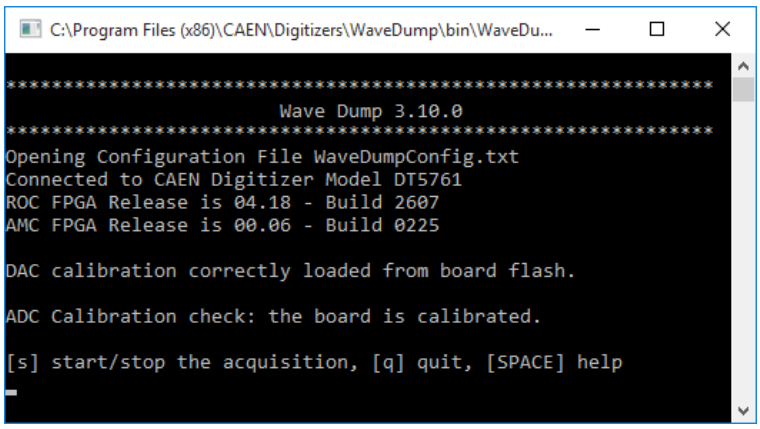

Figure 6.2: Automatic calibration for a DT5761 digitizer at WaveDump first run

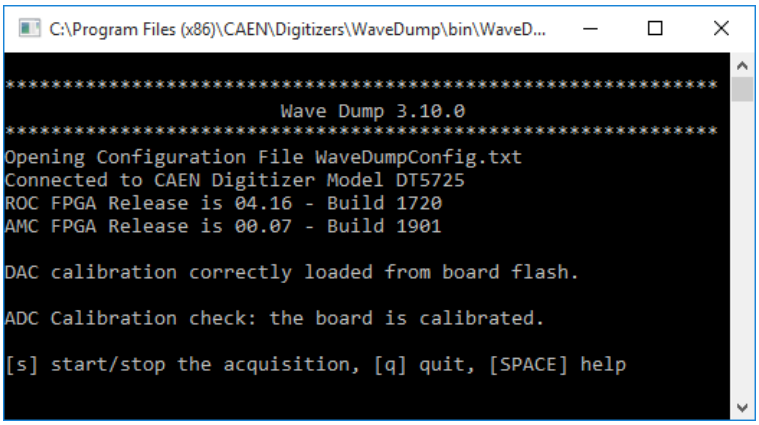

Figure 6.3: Automatic calibration for a DT5725 digitizer at WaveDump first run

The user can start using the program sure that the digitizer has been calibrated at least once.

2. At any time, the user can check the channel temperatures (with the acquisition not running) by issuing multiple “m” commands from the keyboard.
3. In case of significant variations, issuing a “c” command provokes a manual channel calibration to be executed (meaningless in case of x725S and x730S).

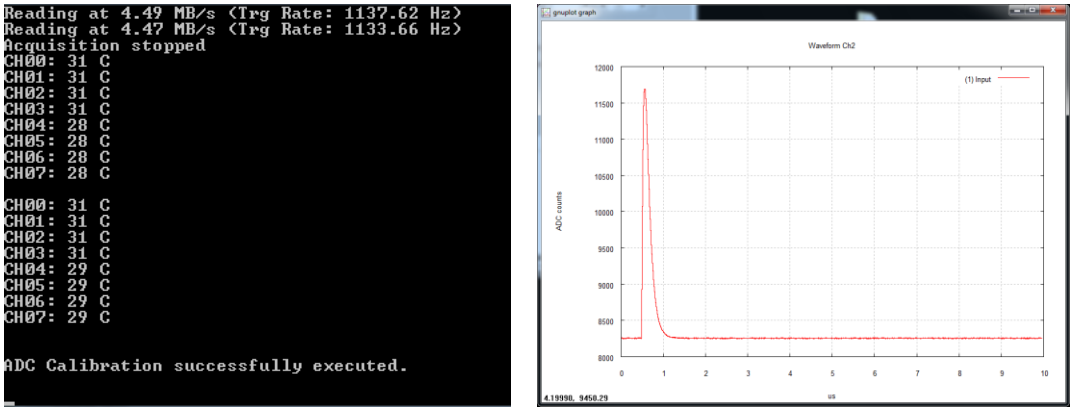

Figure 6.4: Temperature monitoring with manual calibration command (left) and calibrated input signal (right)

4. A new acquisition can start.

Please, refer to the User Manual of the specific board for a detailed explanation of the channel calibration.

DAC Calibration

Valid for all the WaveDump supported digitizer families but 742 one

This calibration ought to be done when working in channel trigger mode with `BASELINE_LEVEL` and `TRIGGER_THRESHOLD` parameters (see Sec. **Individual Settings**).

After the calibration values are computed for the first time, they are stored in the digitizer on-board FLASH; WaveDump retrieves and applies such values at any further run (see "D" command description in Chap. **3**).

The calibration values in the FLASH cannot be deleted but the DAC calibration can be performed again, and stored values will be overwritten by the new computed ones.

Once connected to the target digitizer, WaveDump checks the FLASH for DAC calibration values; if no calibration data are found, the user can type the "D" online command (see Chap. **3**) and will be guided by the software through the DAC calibration steps (see **Figure 6.5**).

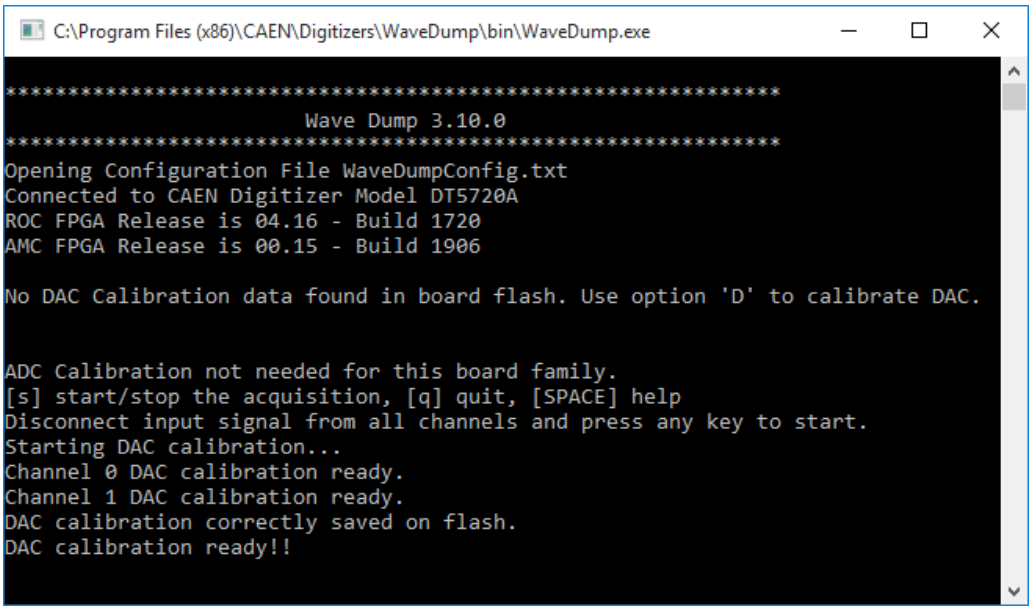

Figure 6.5: Step-by-step instructions for DAC calibration

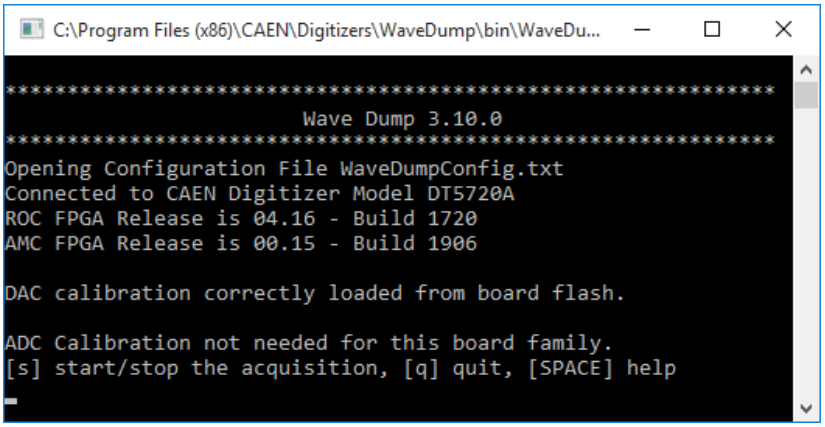

Figure 6.6: DAC calibration values retrieved at next software run

7 Technical Support

CAEN makes available the technical support of its specialists for requests concerning the software and hardware. Use the support form available at the following link:

https://www.caen.it/support-services/support-form/

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