CAEN
Tools for Discovery

Electronic Instrumentation

User Manual UM1935

CAENDigitizer Library

Library of functions for CAEN Digitizers high level management

Rev. 15 - 14 October 2016

Purpose of this User Manual

This User Manual contains the full description of the C version of CAENDigitizer library, software rel. 2.7.6.

For future release compatibility, check in the relevant library Release Notes file.

Change Document Record

Date	Revision	Changes
16 February 2012	01	Fully revised and implemented §**5**
18 June 2012	02	Fully revised to document the software library 2.2.1
08 October 2012	03	Removed LabVIEW content
10 December 2012	04	Revised functions at pp. **71 – 71**
08 May 2013	05	Revised DPP-CI and DPP-PSD digital probes
07 March 2014	06	Added preliminary support to 743 digitizer series; added support to 730 digitizer series, to DT5790 board and to DPP-ZLEplus firmware; updated: **Return Codes**, functions **GetInfo**, **Set / GetDPP_PHA_VirtualProbe** and **MallocDPPEvents**; added function **GetCorrectionTables** and chapter § **2.**
05 June 2014	07	Added a note to **Set / GetTriggerPolarity**
23 July 2014	08	Revised for final 743 support. Added support for x781. Added § **5.** Added functions **Set / GetDPP_VirtualProbe** and **GetDPP_SupportedVirtualProbes**
26 September 2014	09	Updated **SetDPPParameters**, **MallocDPPEvents**, **Set / GetNumEventsPerAggregate** and **Set / GetRecordLength**
02 February 2015	10	Updated **Set / GetChannelSelfTrigger**, **Set / GetAcquisitionMode**, § **1**. Added **Calibrate**.
09 Semptember 2015	11	Updated functions: **GetInfo**, **Set / GetRecordLength**, **Set / GetChannelSelfTrigger**, **SetDPPParameters**, **DPP codes**, **Calibrate**; added a note to **Set / GetDPPAcquisitionMode**; added **Set / GetTriggerLogic**, **ReadTemperature**, **Set / GetChannelPairTriggerLogic**; added § **9**
09 November 2015	12	Updated functions: **Set / GetRecordLength**, **Set / GetChannelEnableMask**, **Set / GetNumEventsPerAggregate**, **SetDPPEventAggregation**, **Set / GetDPPAcquisitionMode**; Updated **DPP Example Codes**
25 January 2016	13	Updated functions: **Reset**, **Set / GetRecordLength**, **Calibrate**. Moved function **Set / GetChannelPulsePolarity** to § **6**.
09 March 2016	14	Added note in **Reset** and **OpenDigitizer** functions for 743 family. Added support for V1743 in **Set / GetAnalogMonOutput** function. Added function **Set / GetSAMTriggerCountVetoParam**. Added note in **DPP Example** and **Acquisition Example**. Added support for 740D family. Updated **Acquisition Example** and **DPP Example Codes**
14 October 2016	15	Updated **MallocDPPEvents** function: added *uint32_t Format2* in *CAEN_DGTZ_DPP_PSD_Event_t* structure, related to the CFD of the 751 digitizer family.

Symbols, Abbreviated Terms and Notation

ADC	Analog to Digital Converter
DPP	Digital Pulse Processing
FFT	Fast Fourier Transform
FSR	Full Scale Range
OS	Operating System
SBC	Single Board Computer

Reference Document

[RD1] UM2784 - CAENDigitizer LabView User & Reference Manual

[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] AN2472 - CONET1 to CONET2 migration

All documents can be downloaded at: http://www.caen.it/csite/LibrarySearch.jsp

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1 Introduction

CAEN has developed a family of Sampling ADCs modules with different form factors (VME, NIM and Desktop). They all provide the possibility to be handled and readout by a host PC via different communication channels.

The CAENDigitizer is a library of functions designed specifically for the digitizer family and it supports also the boards running special DPP (Digital Pulse Processing) firmware. The purpose of this library is to allow the user to open the digitizer, program it and manage the data acquisition in an easy way: with few lines of code the user can make a simple readout program without the necessity to know the details of the registers and the event data format.

The CAENDigitizer library implements 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 CAENDigitizer independent from the physical layer.

Supported platforms are Windows and Linux 32 and 64 bit. A specific version of CAENDigitizer library has been developed for LabVIEW and is documented in the soon to be relased **[RD1]**.

Drivers & Libraries

Drivers

In order to interface with the hardware, CAEN provides the drivers for all the different types of physical communication channels 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) in the "Software/Firmware" tab at the digitizer web page (**login required**).

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

- **USB 2.0 Drivers for V1718** CAEN Bridge, required to interface the VME boards, is downloadable on CAEN website (www.caen.it) in the "Software/Firmware" tab at the V1718 web page (**login required**).

Note: for the installation of the V1718 USB driver, refer to the User Manual of the Bridge (**[RD3]**).

- **Optical Link Drivers** are managed by the A2818 PCI card or the A3818 PCIe card. The driver installation package is available on CAEN website in the "Software/Firmware" area at the A2818 or A3818 page (**login required**)

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

Libraries

The CAENDigitizer library is based on a set of middleware software also required by CAEN software tools 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.):

- **CAENVMELib** is a set of ANSI C functions which permit a user program to use and configure the CAEN Bridges and Controllers V1718/VX1718 (VME-USB2.0 Bridge), V2718/VX2718 (VME-PCI/PCIe Optical Link Bridge), A2818/A3818 (PCI/PCIe-CONET Controller).

  The CAENVMElib installation package is available on CAEN website in the 'Download' area at the CAENVMELib Library page. Reference document: **[RD3]**.

- **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 is based in turn on CAENVMElib and it 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 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 channels (see):

- PC → USB → Digitizer (either Desktop or NIM models)
- PC → USB → V1718 → VME → Digitizers (VME models only)
- PC → PCI (A2818) → CONET → Digitizers (all models)
- PC → PCI (A2818) → CONET → V2718 → VME → Digitizers (VME models only)
- PC → PCIe (A3818) → CONET → Digitizers (all models)
- PC → PCIe (A3818) → CONET → V2718 → VME → Digitizers (VME models only)

CONET (Chainable Optical NETwork) indicates the CAEN proprietary protocol for communication on Optical Link. Refer to **[RD7]** for useful information.

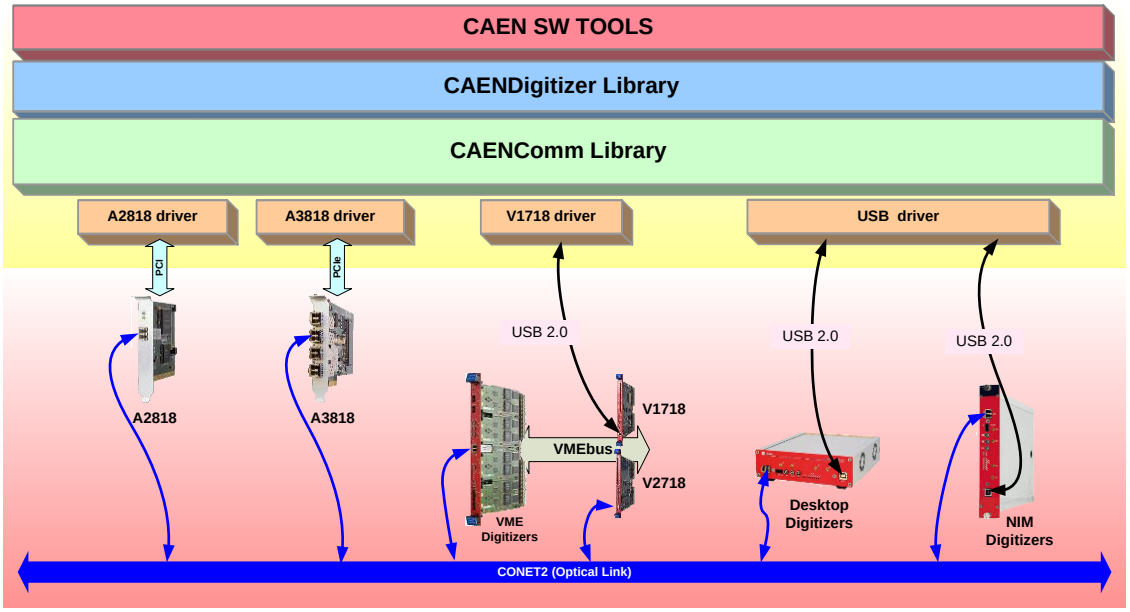


Fig. 1.1: Hardware and Software layers

Installation

The CAENDigitizer library is compliant with both Windows and Linux OS, 32 and 64 bits.

Before installing CAENDigitizer library, 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** 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** you **have installed the required CAEN libraries** CAENVMELib and CAENComm.

Then:

- **Download the CAENDigitizer installation package** compliant with your OS from CAEN website under the 'Download' area at the WaveDump page (**login required**):

  Home / Products / Firmware/Software / Digitizer Software / Software Libraries / CAENDigitizer Library

Note: at this stage, if the required libraries still haven't been installed, it is possible to download them by clicking on the red link under the library packet link.

- **Extract files** to your host.

For Windows users:

- **Launch the installer** and **follow** the instructions in the **installation wizard**.

For Linux users:

- **Execute** the instructions in the **README file** within the library package.

Note: installation of the CAENDitizer library also includes a "Samples" folder with a set of source files and projects for readout with the default firmware for waveform recording (p. **53**) and DPP firmware (p. **84**) to be available for user practice, as well as functions for the offline data correction (p. **54**) of x742 digitizers.

Return Codes

Error code	Value	Meaning
CAEN_DGTZ_Success	0	Operation completed successfully
CAEN_DGTZ_CommError	-1	Communication error
CAEN_DGTZ_GenericError	-2	Unspecified error
CAEN_DGTZ_InvalidParam	-3	Invalid parameter
CAEN_DGTZ_InvalidLinkType	-4	Invalid Link Type
CAEN_DGTZ_InvalidHandler	-5	Invalid device handler
CAEN_DGTZ_MaxDevicesError	-6	Maximum number of devices exceeded
CAEN_DGTZ_BadBoardType	-7	Operation not allowed on this type of board
CAEN_DGTZ_BadInterruptLev	-8	The interrupt level is not allowed
CAEN_DGTZ_BadEventNumber	-9	The event number is bad
CAEN_DGTZ_ReadDeviceRegisterFail	-10	Unable to read the registry
CAEN_DGTZ_WriteDeviceRegisterFail	-11	Unable to write into the registry
CAEN_DGTZ_InvalidChannelNumber	-13	The Channel is busy
CAEN_DGTZ_ChannelBusy	-14	The channel number is invalid
CAEN_DGTZ_FPIOModeInvalid	-15	Invalid FPIO Mode
CAEN_DGTZ_WrongAcqMode	-16	Wrong acquisition mode
CAEN_DGTZ_FunctionNotAllowed	-17	This function is not allowed for this module
CAEN_DGTZ_Timeout	-18	Communication Timeout
CAEN_DGTZ_InvalidBuffer	-19	The buffer is invalid
CAEN_DGTZ_EventNotFound	-20	The event is not found
CAEN_DGTZ_InvalidEvent	-21	The event is invalid
CAEN_DGTZ_OutOfMemory	-22	Out of memory
CAEN_DGTZ_CalibrationError	-23	Unable to calibrate the board
CAEN_DGTZ_DigitizerNotFound	-24	Unable to open the digitizer
CAEN_DGTZ_DigitizerAlreadyOpen	-25	The Digitizer is already open
CAEN_DGTZ_DigitizerNotReady	-26	The Digitizer is not ready to operate
CAEN_DGTZ_InterruptNotConfigured	-27	The Digitizer has not the IRQ configured
CAEN_DGTZ_DigitizerMemoryCorrupted	-28	The digitizer flash memory is corrupted
CAEN_DGTZ_DPPFirmwareNotSupported	-29	The digitizer DPP firmware is not supported in this lib version
CAEN_DGTZ_InvalidLicense	-30	Invalid Firmware License
CAEN_DGTZ_InvalidDigitizerStatus	-31	The digitizer is found in a corrupted status
CAEN_DGTZ_UnsupportedTrace	-32	The given trace is not supported by the digitizer
CAEN_DGTZ_InvalidProbe	-33	The given probe is not supported for the given digitizer's trace
CAEN_DGTZ_NotYetImplemented	-99	The function is not yet implemented

Tab. 1.1: Return codes table

2 Communication

These functions allow to open and close the connection with the digitizer as well as get board information such as the serial number, the model, the firmware revision, etc. To open one board is necessary to describe the physical communication channel from the PC to the device (as already indicated in the introduction). Once the device is opened, the function returns a handle that becomes the unique identifier of that device; any access operation to the device (except for VME IRQ management) will take place according to its handle, thus making transparent the physical channel.

OpenDigitizer

Desktop and NIM versions can be directly handled via USB, just connecting the digitizer to the host PC via the USB cable (the USB driver is available on Digitizer web page).

Description
Opens the digitizer and gets the device handle. See the examples below for the different types of communication channels and the relevant parameters.

Note: in case of 743 family, this function also resets the SAMLONG Dlls.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_OpenDigitizer (CAEN_DGTZ_ConnectionType LinkType,
                         int LinkNum,
                         int ConetNode,
                         uint32 t VMEBaseAddress,
                         int *handle
                         );

typedef enum CAEN_DGTZ_ConnectionType {
    CAEN DGTZ USB                          = 0,
    CAEN DGTZ OpticalLink                  = 1,
    CAEN DGTZ PCI OpticalLink              = 1, // Deprecated use 'CAEN DGTZ OpticalLink'
    CAEN_DGTZ_PCIE_OpticalLink             = 1, // Deprecated use 'CAEN_DGTZ_OpticalLink'
    CAEN_DGTZ_PCIE_EmbeddedDigitizer       = 1, // Deprecated use 'CAEN_DGTZ_OpticalLink'
} CAEN_DGTZ_ConnectionType;
```

Arguments

Name	Description
LinkType	Indicates the physical communication channel. It can be CAEN_DGTZ_USB (either direct connection or VME through V1718), CAEN_DGTZ_OpticalLink (A2818/A3818 -> Optical Link, either direct connection or VME through V2718). **Note:** functions CAEN_DGTZ_PCI_OpticalLink, CAEN_DGTZ_PCIE_OpticalLink, and CAEN_DGTZ_PCIE_EmbeddedDigitizer are now deprecated.
LinkNum	Link number: in case of USB, the link numbers are assigned by the PC when you connect the cable to the device; it is 0 for the first device, 1 for the second and so on. There is not a fixed correspondence between the USB port and the link number. For the CONET, the link number indicates which link of A2818 or A3818 is used; Link index start from 0 (1st Optical link port in the 1st slot used). It is not known a priori which is the first slot used (it depends on the motherboard of the PC used.). **IMPORTANT Note: if A2818 and A3818 are installed together, the A2818 have the lowest index assigned**.
ConetNode	The CONET node identifies which device in the Daisy chain is being addressed. The node is 0 for the first device in the chain, 1 for the second and so on. In case of USB, *ConetNode* must be 0.
VMEBaseAddress	VME Base Address of the board (rotary switches setting) expressed as a 32-bit number. This argument is used only for the VME models accessed through the VME bus and **MUST BE 0** in all other cases.
***handle**	Pointer to the handler returned by the open function

Return Values
0: Success; Negative numbers are error codes (see Return Codes).

Examples

See examples described in Sect. **Examples of Communication Settings**.

CloseDigitizer

Description
This function closes the digitizer.

Synopsis
```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_CloseDigitizer (int handle);
```

Arguments

Name	Description
handle	Device handler

Return Values
0: Success; Negative numbers are error codes (see Return Codes).

WriteRegister

Description
Generic write access to one register of the digitizer. The CAENDigitizer library provides specific functions for most of the parameters settings; in the case where there is not a specific function for accessing a particular register or the user wants to force the writing of a datum, this function makes it possible to perform a direct access to the registers. It is worth noticing that the overwriting of some settings can cause inconsistency of the operations.

Synopsis
```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_WriteRegister(int handle,
                        uint32_t Address,
                        uint32_t Data
                        );
```

Arguments

Name	Description
handle	Device handler
Address	Register address. For the VME access, this is the lower 16 bit part of the VME address bus
Data	32 bit data to write

Return Values
0: Success; Negative numbers are error codes (see Return Codes).

ReadRegister

Description
Generic read access to one register of the digitizer (see **WriteRegister** for more details).

Synopsis
```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_ReadRegister(int handle,
                       uint32_t Address,
                       uint32_t *Data
                       );
```

Arguments

Name	Description
handle	Device handler
Address	Register address. For the VME access, this is the lower 16 bit part of the VME address bus
***Data**	Data read from the board (32 bit)

Return Values
0: Success; Negative numbers are error codes (see Return Codes).

Reset

Description
This function resets the Digitizer. All internal registers and states are restored to default values.

Note: in case of 743 family, this function resets also the SAMLONG Dlls.

With respect to 730, 731, 751 and 761 digitizer families, starting from CAENDigitizer release 2.6.1, the Reset function has been modified so that it no loger includes the channel calibration routine implemented in the code. This calibration must be performed on command by the dedicated Calibrate function (go to page 29).

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_Reset (int handle);
```

Arguments

Name	Description
`handle`	Device handler

Return Values
0: Success; Negative numbers are error codes (see Return Codes).

GetInfo

Description

The function reads from the board some information such as serial number, model, number of channels, firmware release and other parameters of the device.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetInfo(int handle,
                  CAEN_DGTZ_BoardInfo_t *BoardInfo
                  );

typedef struct {
    char                        ModelName[12];
    uint32_t                    Model;
    uint32_t                    Channels;
    uint32 t                    FormFactor;
    uint32 t                    FamilyCode;
    char                        ROC_FirmwareRel[20];
    char                        AMC_FirmwareRel[40];
    uint32 t                    SerialNumber;
    uint32 t                    PCB Revision;
    uint32 t                    ADC NBits;
    uint32_t                    SAMCorrectionDataLoaded; //used only for x743 boards
    int                         CommHandle;
    char                        License[MAX_LICENSE_LENGTH];
} CAEN DGTZ BoardInfo t;

typedef enum
{
    CAEN_DGTZ_V1724     =0L,
    CAEN DGTZ V1721     =1L,
    CAEN DGTZ V1731     =2L,
    CAEN DGTZ V1720     =3L,
    CAEN_DGTZ_V1740     =4L,
    CAEN_DGTZ_V1751     =5L,
    CAEN_DGTZ_DT5724    =6L,
    CAEN DGTZ DT5721    =7L,
    CAEN DGTZ DT5731    =8L,
    CAEN DGTZ DT5720    =9L,
    CAEN_DGTZ_DT5740    =10L,
    CAEN_DGTZ_DT5751    =11L,
    CAEN_DGTZ_N6724     =12L,
    CAEN DGTZ N6721     =13L,
    CAEN DGTZ N6731     =14L,
    CAEN DGTZ N6720     =15L,
    CAEN_DGTZ_N6740     =16L,
    CAEN_DGTZ_N6751     =17L,
    CAEN_DGTZ_DT5742    =18L,
    CAEN DGTZ N6742     =19L,
    CAEN DGTZ V1742     =20L,
    CAEN_DGTZ_DT5780    =21L,
    CAEN_DGTZ_N6780     =22L,
    CAEN_DGTZ_V1780     =23L,
    CAEN DGTZ DT5761    =24L,
    CAEN DGTZ N6761     =25L,
    CAEN_DGTZ_V1761     =26L,
    CAEN_DGTZ_DT5743    =27L,
    CAEN_DGTZ_N6743     =28L,
    CAEN_DGTZ_V1743     =29L,
    CAEN DGTZ DT5730    =30L,
    CAEN DGTZ N6730     =31L,
    CAEN_DGTZ_V1730     =32L,
    CAEN_DGTZ_DT5790    =33L,
    CAEN_DGTZ_N6790     =34L,
    CAEN_DGTZ_V1790     =35L,
    CAEN DGTZ DT5781    =36L,
    CAEN DGTZ N6781     =37L,
    CAEN_DGTZ_V1781     =38L,
    CAEN_DGTZ_DT5725    =39L,
    CAEN DGTZ N6725     =40L,
    CAEN DGTZ V1725     =41L,
} CAEN DGTZ BoardModel t;

typedef enum {
    CAEN_DGTZ_XX724_FAMILY_CODE  = 0L,
    CAEN_DGTZ_XX721_FAMILY_CODE  = 1L,
```

```
    CAEN_DGTZ_XX731_FAMILY_CODE  = 2L,
    CAEN_DGTZ_XX720_FAMILY_CODE  = 3L,
    CAEN_DGTZ_XX740_FAMILY_CODE  = 4L,
    CAEN_DGTZ_XX751_FAMILY_CODE  = 5L,
    CAEN_DGTZ_XX742_FAMILY_CODE  = 6L,
    CAEN_DGTZ_XX780_FAMILY_CODE  = 7L,
    CAEN_DGTZ_XX761_FAMILY_CODE  = 8L,
    CAEN_DGTZ_XX743_FAMILY_CODE  = 9L,
    CAEN_DGTZ_XX730_FAMILY_CODE  = 11L,
    CAEN_DGTZ_XX790_FAMILY_CODE  = 12L,
    CAEN_DGTZ_XX781_FAMILY_CODE  = 13L,
    CAEN_DGTZ_XX725_FAMILY_CODE  = 14L,
} CAEN_DGTZ_BoardFamilyCode_t;
```

Arguments

Name	Description
handle	Device handler
***Board Info**	Pointer to the structure containing the Board Info filled by the CAEN_DGTZ_GetInfo

BoardInfo Fields

Name	Description
ModelName	Model name: for example “V1724”
Model	See type enum `CAEN_DGTZ_BoardModel_t`
Channels	Number of channels
FormFactor	Format Factor (VME, NIM, Desktop); see type `CAEN_DGTZ_BoardFormFactor_t`
FamilyCode	Family (ADC type); see type `CAEN_DGTZ_FamilyCode_t`
ROC_FirmwareRel	Firmware Revision of the FPGA on the mother board (ROC); for example “01.02”
AMC_FirmwareRel	Firmware Revision of the FPGA on the daughter board (AMC)
SerialNumber	Serial number of the board
PCB_Revision	PCB Revision number
ADC_NBits	Number of bits of the ADC
CommHandle	Device handler for the underlying library CAENComm

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Interrupt Configuration

All digitizers can generate interrupt requests (IRQ) to the PC to the occurrence of a particular condition: if the memory contains at least Ne events ready for reading, where Ne is a programmable parameter.

This allows to create programs that build the process of readout (read access to the memory buffer) on interrupts: they perform passive wait cycles, until they are awakened by the driver at the arrival of an interrupt from the digitizer; at such point , the process can read data, aware to find at least Ne events in memory, without having to check in advance the presence of data, as in the case of the readout based on polling.

The readout based on the interrupts is therefore more efficient, in terms of employment of the PC resources, compared to the one based on polling.

The interrupt requests are transferred from the digitizer to the PC via the optical link, in one of the following ways:

- Direct connection to the optical link (all models): the digitizer sends the interrupt request on the optical link to the A2818 PCI or A3818 PCIe connected to the PC, and these, in their turn, assert the interrupt request on the PCI bus or PCIe respectively. In this case, the interrupt request coming to the PC is uniquely associated with the digitizer which sent it.
- Connection via VME bus: in this case, the digitizer asserts the interrupt request on the VME bus on one of the 7 IRQ lines, and this request is detected by the VME master (V2718), which sends it via optical link to the PC, in the same manner described above. In this case, since the lines IRQ [7 .. 1] of the VME are shared with all modules on VME bus, it is necessary to identify the module that sent the request, as explained farther.

Note: interrupts cannot be used in case of communication via USB (either directly or through V1718 and VME)

Set / GetInterruptConfig

Description

Enable / Disable the digitizer to generate an interrupt request when the memory contains at least Ne events ready for reading, where Ne is the parameter *event_number*.

- In the case of VME models, the IRQ level to be activated on VME bus can be set from 1 to 7;
- in the case of the optical link, level should be 1.

The *status_id*, according to the specifications of the VME bus, is the value returned by the card during the interrupt acknowledge cycle and allows the operator to see which digitizer has asserted the interrupt request on the VME bus; in the programming stage, the user must set different *status_id* values for each digitizer. In the case of the optical link, the *status_id* is meaningless.

The mode parameter sets the interrupt release policy of the digitizer: in particular, **Roak** (Release On Acknowledge) mode in case of VME boards foresees that the request is issued immediately after the interrupt acknowledge cycle (IACK), while in the case of **Rora** (Release on Register Access) mode, the interrupt request is not released by the digitizer until the user accesses a particular registry to disable it; in the case of the digitizer, the release occurs by setting to zero the level in the VME Control register, by calling the "Set" function of **Set / GetInterruptConfig** with status = disabled.

The methods Rora and Roak, arising from the VME specifications, are implemented also in the CONET protocol of the optical link, with the exception that the Roak does not require the interrupt acknowledge cycle (IACK).

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetInterruptConfig (int handle,
                              CAEN DGTZ EnaDis t state,
                              uint8 t level,
                              uint32 t status id,
                              uint16 t event number,
                              CAEN_DGTZ_IRQMode_t mode
                              );

CAEN DGTZ ErrorCode CAENDGTZ API
CAEN DGTZ GetInterruptConfig (int handle,
                              CAEN_DGTZ_EnaDis_t *state,
                              uint8_t *level,
                              uint32 t *status id,
                              uint16 t *event number,
                              CAEN DGTZ IRQMode t *mode
                              );

typedef enum {
                              CAEN DGTZ ENABLE = 1L,
                              CAEN DGTZ DISABLE = 0L,
} CAEN DGTZ EnaDis t;

typedef enum {
                               CAEN_DGTZ_IRQ_MODE_RORA = 0,
                               CAEN DGTZ IRQ MODE ROAK = 1,
} CAEN_DGTZ_IRQMode_t;
```

Arguments

Name	Description
handle	Device handler
state	Enable/Disable
level	VME IRQ Level (from 1 to 7). Must be 1 for direct connection through CONET
status_id	32 bit number assigned to the device and returned by the device during the Interrupt Acknowledge
event_number	If the number of events ready for the readout is equal to or greater than *event_number*, then the digitizer asserts the interrupt request
mode	Interrupt release mode: *CAEN_DGTZ_IRQ_MODE_RORA* (release on register access) or *CAEN_DGTZ_IRQ_MODE_ROAK* (release on acknowledge)

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

IRQWait

Description

Once set up the digitizer to generate an interrupt request by the function described above, the reading process can enter a state of passive waiting to be woken up as the interrupt request from the digitizer which is communicating with (the one identified uniquely from the handle passed as a parameter), is sent. This function is valid only for direct connection to link optical digitizer, in the case of communication via the VME, use **VMEIRQWait**. The timeout parameter indicates the maximum waiting time before being forced to wake up even without interrupt. In this case, the value returned by the function is 18.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_IRQWait(int handle,
                  uint32_t timeout
                  );
```

Arguments

Name	Description
`handle`	Device handler
`timeout`	Timeout (max wait time) in ms

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

VMEIRQWait

Description

This function, as the one described above, implements the passive waiting from which the waking occurs up in response to an interrupt request from the digitizer. The main difference is that in this case, the digitizer asserts a IRQ (1 to 7) on the VME bus and this is transferred to the PC by the master VME V2718. Since other digitizers could be on the VME bus (and therefore different handles that identify them within the program), and each one can generate interrupts, even on the same IRQ line, the management of interrupts cannot take place through the handle of the digitizer (which cannot be uniquely associated with the request arrived at the PC) but must be performed through the handle of the master VME V2718 which is the unique collector of interrupt requests to the PC. Once awakened from the waiting status, the process of reading can understand what digitizer has actually sent the request via the interrupt acknowledge cycle.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_VMEIRQWait(CAEN_DGTZ_ConnectionType LinkType,
                     int LinkNum,
                     int ConetNode,
                     uint8_t IRQMask,
                     uint32_t timeout,
                     int *VMEHandle
                     );

typedef enum CAEN_DGTZ_ConnectionType {
    CAEN_DGTZ_USB                       = 0,
    CAEN_DGTZ_OpticalLink               = 1,
    CAEN_DGTZ_PCI_OpticalLink           = 1, // Deprecated use 'CAEN_DGTZ_OpticalLink'
    CAEN_DGTZ_PCIE_OpticalLink          = 1, // Deprecated use 'CAEN_DGTZ_OpticalLink'
    CAEN_DGTZ_PCIE_EmbeddedDigitizer    = 1, // Deprecated use 'CAEN_DGTZ_OpticalLink'
} CAEN_DGTZ_ConnectionType;
```

Arguments

Name	Description
LinkType	Indicates the physical communication channel. It can be CAEN_DGTZ_USB (either direct connection or VME through V1718), CAEN_DGTZ_OpticalLink (A2818/A3818 -> Optical Link, either direct connection or VME through V2718). **Note:** functions CAEN_DGTZ_PCI_OpticalLink, CAEN_DGTZ_PCIE_OpticalLink, and CAEN_DGTZ_PCIE_EmbeddedDigitizer are now deprecated.
LinkNum	Link number: in case of USB, the link numbers are assigned by the PC when you connect the cable to the device; it is 0 for the first device, 1 for the second and so on. There is not a fixed correspondence between the USB port and the link number. For the CONET, the link number indicates which A2818 or A3818 is used; also in this case, it is not known a priori which PCI/PCIe card is assigned to which number.
ConetNode	The CONET node identifies which device in the Daisy chain is being addressed. The node is 0 for the first device in the chain, 1 for the second and so on. In case of USB, ConetNode must be 0.
IRQMask	A bit-mask indicating the IRQ lines
timeout	Timeout (max wait time) in msec
***VMEHandle**	Device handler of the CAEN VME Bridge that received the interrupt request

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

VMEIRQCheck

Description

This function allows to read the status of interrupt requests on the VME bus (IRQ1-7) and, for this reason, the handle to be passed is the VME master one, not the digitizer one. This function can only be used for digitizer that communicate via the VME bus. The purpose of this function is almost exclusively for debugging.

Synopsis

```
CAEN DGTZ ErrorCode CAENDGTZ API
CAEN DGTZ VMEIRQCheck(int VMEHandle,
                      uint8 t *Mask
                      );
```

Arguments

Name	Description
VMEHandle	Device handler of the VME bridge that handles the interrupts
***Mask**	Mask of the IRQ lines read from the VME bus (1=IRQ active, 0=IRQ not active)

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

VMEIACKCycle

Description

This function performs an interrupt acknowledge cycle to know the board_id of the board that raised an interrupt. As described previously, in the case of interrupt requests on the VME bus, it is not possible to know in advance which digitizer asserted a certain IRQ line. Indeed, it could also happen that a line is asserted by any other slave on the VME bus with which no communication is established. For this reason, when the reading process on hold in a specific IRQ is awakened, it must perform an interrupt acknowledge cycle to see which one generated the interupt. The identification is as follows: during acknowledge cycle (which is very similar to a read cycle), the slave that caused the interruption puts on his bus status_id, actually the value previously programmed by the user through the “Set” function of **Set / GetInterruptConfig** function. In the case of multiple cards having different values of the programmed status_id, the user will be able to figure out who sent the request, and then which one is to be read. It should be noted that in the case of multiple cards on the bus (even inhomogeneous), the interrupt management must be centralized, as the acknowledge cycle should be performed only once. It is therefore not recommended (although possible) to have more process waiting on the same IRQ line.

Synopsis

```
CAEN DGTZ ErrorCode CAENDGTZ API
CAEN DGTZ VMEIACKCycle(int VMEHandle,
                       uint8_t level,
                       int32_t *board_id
                       );
```

Arguments

Name	Description
VMEHandle	Device handler of the CAEN VME bridge that handles the interrupts
level	IRQ level (from 1 to 7) on which to perform the interrupt acknowledge cycle
***board_id**	Data (status_id) returned by the digitizer that asserted the interrupt request

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Examples

WAVEDUMP Code *(To be implemented)*

RearmInterrupt

Description

Rearm the Interrupt.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_RearmInterrupt (int handle);
```

Arguments

Name	Description
handle	Device handler

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Data Readout

The data reading from the memories of the digitizer is done through BlockRead cycles (although it is possible also to run cycles to read each buffer). In the case of direct communication via USB or optical link, the protocol that manages the blocks transfer is CAEN proprietary and therefore there are no ambiguities or special options to be decided. Conversely, if reading takes place through the VME bus, since the standard provides different types of access and not all VME masters support all modes (or do it differently), the reading mode may need to be adapted according to the master features. The library foresees the use of master CAEN V1718 and V2718 and the readout mode is optimized for these modules.

ClearData

Description
This function Clears the data stored in the buffers of the Digitizer.

Note: generally it is not necessary to call this function, because the digitizer runs automatically a clear cycle when an acquisition starts. The function can be used during an acquisition when aware that the data stored in memory are not interesting and not going to be read

Synopsis
```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_ClearData(int handle);
```

Arguments

Name	Description
handle	Device handler

Return Values
0: Success; Negative numbers are error codes (see Return Codes).

DisableEventAlignedReadout

Description
By default, in the data transfer from the memory of the digitizer to the PC, regardless of the type of link used, events are aligned: the digitizer stop the transfer after transferring an integer number Ne of events, where Ne is user programmable through the “Set” function of **Set / GetMaxNumEventsBLT**, even if the user has requested the transfer of more data. In the case of communication via USB and optical links, the premature termination of the transfer is foreseen by the protocol; instead, for the VME Block Transfer, the transfer is interrupted by the digitizer asserting the bus error (if enabled, see above).

Synopsis
```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_DisableEventAlignedReadout(int handle);
```

Arguments

Name	Description
handle	Device handler

Return Values
0: Success; Negative numbers are error codes (see Return Codes).

Set / GetMaxNumEventsBLT

Description

Concerning the Digitizers running the waveform recording firmware for waves digitizing, this function sets/gets the maximum number of events for each transfer. Regardless of the type of link, during a block transfer cycle, the digitizer stops the transfer after a predetermined number of events (or when the memory is empty). The greater the number of events transferred (and thus the size of the block read), the greater the efficiency of the readout, since the protocol overhead is smaller. In contrast, higher values for **MaxNumEventsBLT** imply the need to allocate a memory buffer for very large the readout.

Note: if using DPP-PHA, DPP-PSD or DPP-CI firmware, you have to refer to the **SetDPPEventAggregation** function.

Synopsis

```
CAEN DGTZ ErrorCode CAENDGTZ API
CAEN DGTZ SetMaxNumEventsBLT(int handle,
                             uint32 t numEvents
                             );

CAEN DGTZ ErrorCode CAENDGTZ API
CAEN DGTZ GetMaxNumEventsBLT(int handle,
                             uint32 t *numEvents
                             );
```

Arguments

Name	Description
handle	Device handler
numEvents	Maximum number of events to transfer in a BlockRead

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

MallocReadoutBuffer

Description

This function allocates the memory buffer for the data block transfer from the digitizer to the PC. The size of the buffer allocated is calculated by the function according to the size of the event, the number of enabled channels and the maximum number of events transferred by each block transfer (see previous function). For this reason, the function must be called after having programmed the digitizer, if the parameters that determine the size of the buffer change, it is necessary to free it by calling the **FreeReadoutBuffer** function and then reallocated.

Note: the buffer pointer must be initialized to NULL.

Synopsis

```
CAEN DGTZ ErrorCode CAENDGTZ API
CAEN_DGTZ_MallocReadoutBuffer(int handle,
                              char **buffer
                              uint32_t *size);
```

Arguments

Name	Description
handle	Device handler
****buffer**	Pointer to the readout buffer allocated **(WARNING: **buffer MUST be initialized to NULL)**
***size**	The size in byte of the buffer allocated

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

FreeReadoutBuffer

Description
Frees memory allocated by the **MallocReadoutBuffer** function.

Synopsis
```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_FreeReadoutBuffer(char **buffer);
```

Arguments

Name	Description
****buffer**	Pointer to the readout buffer to free, returned by the **MallocReadoutBuffer** function.

Return Values
0: Success; Negative numbers are error codes (see Return Codes).

ReadData

Description
This function performs a block transfer of data from the digitizer to the computer. The size of the block to be transferred is determined by the function according to parameters set and the mode of readout. The block can contain one or more events. The data is transferred into the buffer memory previously allocated by **MallocReadoutBuffer** function. The function returns in *bufferSize* the size of the data block read from the card, expressed in bytes.

Note:
CAEN_DGTZ_SLAVE_TERMINATED_READOUT_MBLT for VME accesses:
In this case the digitizer is programmed to assert the VME Bus Error during a Block Transfer cycle to prematurely end the cycle when it no longer has data to transfer or has completed the transfer of the maximum number of events planned (see *BLT_EVENT_NUM* register, or **Set / GetMaxNumEventsBLT** function). This use of the Bus Error, though not specifically provided by the VME standard for this purpose, it is actually very common. However, some VME masters have a Bus Error management not suitable for this purpose.
CAEN_DGTZ_POLLING_MBLT for VME accesses:
The VME Bus Error generation is disabled, the transfer always continues until the completion of the number of bytes required and, if there are no data to be transferred, the digitizer will insert filler words (0xFFFFFFFF)

Synopsis
```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_ReadData(int handle,
                   CAEN_DGTZ_ReadMode_t mode,
                   char *buffer,
                   uint32 t *bufferSize
                   );

typedef enum {
                                CAEN_DGTZ_SLAVE_TERMINATED_READOUT_MBLT  = 0,
                                CAEN_DGTZ_SLAVE_TERMINATED_READOUT_2eVME = 1,
                                CAEN_DGTZ_SLAVE_TERMINATED_READOUT_2eSST = 2,
                                CAEN_DGTZ_POLLING_MBLT                   = 3,
                                CAEN_DGTZ_POLLING_2eVME                  = 4,
                                CAEN_DGTZ_POLLING_2eSST                  = 5,
} CAEN_DGTZ_ReadMode_t;
```

Arguments

Name	Description
handle	Device handler
mode	CAEN_DGTZ_SLAVE_TERMINATED_READOUT_MBLT = 0 CAEN_DGTZ_SLAVE_TERMINATED_READOUT_2eVME = 1 CAEN_DGTZ_SLAVE_TERMINATED_READOUT_2eSST = 2 CAEN_DGTZ_POLLING_MBLT = 3 CAEN_DGTZ_POLLING_2eVME = 4 CAEN_DGTZ_POLLING_2eSST = 5
***buffer**	Pointer to the readout buffer
***bufferSize**	Size of the data block read from the board (expressed in bytes)

Return Values
0: Success; Negative numbers are error codes (see Return Codes).

GetNumEvents

Description

This function scans the readout buffer and gets the number of events contained in the data block previously read by the **ReadData** function. The number of events is returned in the parameter *numEvents*.

Note: if using DPP-PHA, DPP-PSD or DPP-CI firmware, you have to refer to the **GetDPPEvents** function.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetNumEvents(int handle,
                       char *buffer,
                       uint32_t buffsize,
                       uint32_t *numEvents
                       );
```

Arguments

Name	Description
handle	Device handler
***buffer**	Pointer to the readout buffer
buffsize	Size of the data block contained in the readout buffer. This value is given by the **ReadData** function.
***numEvents**	Number of events contained in the readout buffer

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

GetEventInfo

Description

This function retrieves the information (trigger time stamp, event number, channel mask, etc.) associated to one event contained in the readout buffer. This function reads the header of the *numEvent* event in the buffer, fills the eventInfo structure and set the data pointer *EventPtr* to the first word of the event data in the readout buffer. This pointer will be passed to the **DecodeEvent** function described below.

Note: if using DPP-PHA, DPP-PSD or DPP-CI firmware, you have to refer to the **GetDPPEvents** function.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetEventInfo(int handle,
                       char *buffer,
                       uint32_t buffsize,
                       int32_t numEvent,
                       CAEN_DGTZ_EventInfo_t *eventInfo,
                       char **EventPtr
                       );

typedef struct
{
                              uint32_t EventSize;
                              uint32_t BoardId;
                              uint32_t Pattern;
                              uint32_t ChannelMask;
                              uint32_t EventCounter;
                              uint32_t TriggerTimeTag;
} CAEN_DGTZ_EventInfo_t;
```

Arguments

Name	Description
handle	Device handler
***buffer**	Pointer to the readout buffer
buffsize	Size of the data block contained in the readout buffer
numEvent	Number of the requested event in the readout buffer (0 is the first event in the buffer)
***eventInfo**	Pointer to the structure that contains the information about the requested event
****EventPtr**	Pointer to the requested event data in the readout buffer

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

DecodeEvent

Description
Each type of digitizer has a different event data format. This function decodes (unpacks) the data of a specified event and fills the event structure containing the data of each channel (i.e. the waveform and/or other parameters in case of DPP) separately. There are two ways to allocate the memory for the unpacked event data:

- If the pointer ***Evt* to the event structure passed to the function is initialized to NULL, then the event is automatically allocated by the **DecodeEvent** function that knows the exact size of the decoded event data, hence there is no waste in the memory usage. In this case, the user must free the event memory buffer once it has been used.
- The memory buffer for the decoded event can be allocated once at the beginning of the acquisition; this is done by the **AllocateEvent** function. This solution is more efficient in terms of readout rate (no waste of time to allocate and free the memory) but requires more memory because the buffer must be able to contain the maximum event size. In this mode, the memory free must be done at the end of the acquisition.

Note: if using DPP-PHA, DPP-PSD or DPP-CI firmware, you have to refer to the **GetDPPEvents** function.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_DecodeEvent(int handle,
                      char *evtPtr,
                      void **Evt
                      );
```

Arguments

Name	Description
handle	Device handler
***evtPtr**	Pointer to the event data in the readout buffer (this is the pointer returned by the **GetEventInfo** function).
****Evt**	Pointer to the decoded event structure. This pointer must be initialized to NULL if you want the function to allocate the memory buffer automatically. Conversely, if the memory buffer has been already allocated, this is the pointer to that memory buffer. The latter case is more efficient in terms of readout rate.

Return Values
0: Success; Negative numbers are error codes (see Return Codes).

AllocateEvent

Description
This function allocates the memory buffer for the decoded event data. The size of the buffer is calculated in order to keep the maximum event size.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_AllocateEvent(int handle,
                        void **Evt
                        );
```

Arguments

Name	Description
handle	Device handler
****Evt**	Pointer to memory buffer for the event structure.

Return Values
0: Success; Negative numbers are error codes (see Return Codes).

FreeEvent

Description

This function releases the event memory buffer allocated by either the **DecodeEvent** or **AllocateEvent** function.

Note: if using DPP-PHA, DPP-PSD or DPP-CI firmware, you have to refer to the **GetDPPEvents** function.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_FreeEvent(int handle,
                    void **Evt
                    );
```

Arguments

Name	Description
handle	Device handler
****Evt**	Pointer to memory buffer for the event structure.

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Calibrate

Description

This function must be used with 730, 751 and 761 digitizer families, as well as with V1731 digitizers, to perform the channel calibration after the ADCs have stabilized their operating temperature (see also **ReadTemperature** function). The calibration will not need to be repeated at each acquisition run unless the operating temperature changes significantly or clock settings are modified (e.g. switching from internal to external clock).

In case of V1731 digitizers, this function performs a software calibration to align the channels samples. This calibration is required any time the digitizer switches from DES mode to normal mode and viceversa.

Note: please refere to the User Manual of the relevant board for the calibration description.

Synopsis

```
CAEN_DGTZ_ErrorCode
CAENDGTZ_API CAEN_DGTZ_Calibrate(int handle
                                 );
```

Arguments

Name	Description
handle	Device handler

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

ReadTemperature

Description

This function is to be used with 730 and 751 digitizer families and returns the channel temperature value. Monitoring for the internal temperature takes part in the channel calibration required by such modules (see also **Calibrate** function).

Note: please refere to the User Manual of the relevant board for the calibration description.

Synopsis

```
CAEN DGTZ ErrorCode CAENDGTZ API
CAEN DGTZ ReadTemperature(int handle,
                          int32_t ch,
                          uint32_t *temp
                          );
```

Arguments

Name	Description
handle	Device handler
ch	The channel number referred to the temperature value to set / get
***temp**	The channel temperature value expressed in °C

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

LoadDRS4CorrectionData

Description

Regarding the x742 series, in order to compensate for unavoidable construction differences in the DRS4 chips, a data correction is required (for details, please refer to the User Manual of the board). This function loads the correction parameters stored on board, while a **DecodeEvent** function is then needed to apply them. The correction parameters to load depend on the operating sampling frequency.

Note: to be used only with x742 series.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_LoadDRS4CorrectionData (int handle,
                                  CAEN_DGTZ_DRS4Frequency_t frequency
                                  );

typedef enum
{
                                    CAEN_DGTZ_DRS4_5GHz    = 0L,
                                    CAEN_DGTZ_DRS4_2_5GHz  = 1L,
                                    CAEN_DGTZ_DRS4_1GHz    = 2L,
} CAEN_DGTZ_DRS4Frequency_t;
```

Arguments

Name	Description
handle	Device handler
frequency	The DRS4 sampling frequency.

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Enable/Disable DRS4Correction

Description
Enables/disables the data correction in the x742 series.

Note: to be used only with x742 series.

Note: if enabled, the data correction through the **DecodeEvent** function only applies if a **LoadDRS4CorrectionData** has been previously called, otherwise the **DecodeEvent** runs the same, but data will be provided out not compensated.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_EnableDRS4Correction (int handle);

CAEN DGTZ ErrorCode CAENDGTZ API
CAEN_DGTZ_DisableDRS4Correction (int handle);
```

Arguments

Name	Description
handle	Device handler

Return Values
0: Success; Negative numbers are error codes (see Return Codes).

GetCorrectionTables

Description
This function reads the correction tables from the x742 digitizer FLASH, related to the selected sampling frequency, and fills in a structure with the read values. This way, the stored correction table become available to be used, for instance, with a software relying on the CAENDigitizer library.

Note: to be used only with 742 digitizer series.

Synopsis

```
CAEN DGTZ ErrorCode CAENDGTZ API
CAEN DGTZ GetCorrectionTables(int handle,
                              int frequency,
                              void *CTable
                              );

typedef struct {
    int16 t     cell[MAX X742 CHANNEL SIZE][1024];
    int8 t      nsample[MAX X742 CHANNEL SIZE][1024];
    float       time[1024];
} CAEN_DGTZ_DRS4Correction_t;
```

Arguments

Name	Description
handle	Device handler
frequency	Sampling frequency of the DRS4 chips which sample the input analog signal and the fast trigger signal
***CTable**	The pointer to a *CAEN_DGTZ_DRS4Correction_t* structure to be filled in with the values read from the x742 FLASH.

Return Values
0: Success; Negative numbers are error codes (see Return Codes).

3 Trigger Configuration

The acquisition in the digitizer is ruled by the trigger, which is a signal that decides when to start the acquisition window and save samples of the ADC or the values of interest calculated on line (DPP) in the digitizer memory.

The digitizer can have the following trigger sources: External Trigger (digital signal from the panel), Software Trigger (write access to the specific register), Self Trigger Channel (internal signal generated by a digitizer channel under certain conditions, for example when the input signal exceeds a programmable threshold).

All trigger sources can be enabled or not to generate the acquisition trigger for the channels. Similarly, it is possible to decide which triggers should participate in the generation of the Trigger Output (NIM or TTL digital output of the digitizer panel). Trigger Output cannot necessarily coincide with the acquisition trigger: for example, in order to trigger multiple cards at once, as one of their channel has “auto triggered“; for this purpose, the auto triggering channel is used only to generate the Trigger Outputs (but not for the acquisition trigger); all Trigger Outputs are ORed externally to the cards and the resulting signal is sent in parallel to all cards Trigger Inputs, which are programmed to enable only the Trigger Input to generate the acquisition Trigger.

Note: in digitizer series X740, the auto trigger channel is divided into two levels: each 8-channel group generates a “group local trigger”, given by the OR a of channel triggers enabled to generate them. The group triggers, in their turn, may participate or not to generate the acquisition trigger and / or trigger output.

SendSWtrigger

Description

This function sends a Software trigger to the Digitizer. The SW trigger can be used to save an acquisition window on all channels at the same time and/or to generate a pulse on the Trigger Output of the board, according to the SW trigger mode set by the “Set” function of the **Set / GetSWTriggerMode**.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SendSWtrigger (int handle);
```

Arguments

Name	Description
`handle`	Device handler

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Examples

WAVEDUMP Code *(To be implemented)*

Set / GetSWTriggerMode

Description

This function decides whether the trigger software should only be used to generate the acquisition trigger, only to generate the trigger output, or both.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetSWTriggerMode(int handle,
                           CAEN_DGTZ_TriggerMode_t mode
                           );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetSWTriggerMode(int handle,
                           CAEN_DGTZ_TriggerMode_t *mode);
typedef enum
{
                               CAEN_DGTZ_TRGMODE_DISABLED        = 0,
                               CAEN_DGTZ_TRGMODE_EXTOUT_ONLY     = 2,
                               CAEN_DGTZ_TRGMODE_ACQ_ONLY        = 1,
                               CAEN_DGTZ_TRGMODE_ACQ_AND_EXTOUT  = 3,
}CAEN_DGTZ_TriggerMode_t;
```

Arguments

Name	Description
handle	Device handler
mode	SW Trigger mode: CAEN_DGTZ_TRGMODE_DISABLED = 0, CAEN_DGTZ_TRGMODE_EXTOUT_ONLY = 2, CAEN_DGTZ_TRGMODE_ACQ_ONLY = 1, CAEN_DGTZ_TRGMODE_ACQ_AND_EXTOUT = 3,

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Set / GetExtTriggerInputMode

Description

This function decides whether the external trigger should only be used to generate the acquisition trigger, only to generate the trigger output, or both.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetExtTriggerInputMode(int handle,
                                 CAEN_DGTZ_TriggerMode_t mode
                                 );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetExtTriggerInputMode(int handle,
                                 CAEN_DGTZ_TriggerMode_t *mode);
typedef enum
{
                               CAEN_DGTZ_TRGMODE_DISABLED        = 0,
                               CAEN_DGTZ_TRGMODE_EXTOUT_ONLY     = 2,
                               CAEN_DGTZ_TRGMODE_ACQ_ONLY        = 1,
                               CAEN_DGTZ_TRGMODE_ACQ_AND_EXTOUT  = 3,
}CAEN_DGTZ_TriggerMode_t;
```

Arguments

Name	Description
handle	Device handler
mode	External Trigger mode CAEN_DGTZ_TRGMODE_DISABLED = 0, CAEN_DGTZ_TRGMODE_EXTOUT_ONLY = 2, CAEN_DGTZ_TRGMODE_ACQ_ONLY = 1, CAEN_DGTZ_TRGMODE_ACQ_AND_EXTOUT = 3,

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Set / GetChannelSelfTrigger

Description
This function mainly applies to the digitizers running the waveform recording firmware for waves digitizing, since it manages the global trigger generation and its propagation through the TRG-OUT connector.

For the x740 series, use the **Set / GetGroupSelfTrigger** function.

Note: since x730 board family has even and odd channels paired, the user shouldn't call this function separately for the channels of the same pair, otherwise the second call will overwrite the setting of the first one. The user should instead call at maximum once for every pair with the relevant bits of the *channelmask* already set to the correct value.

In case of Digital Pulse Processing (DPP) firmware, this function can also be used when it is required to manage the global trigger and/or propagate it out on TRG-OUT connector.

Note: with DPP firmware, you should enable each channel you want to acquire to self-trigger on its own input. If you want to disable this option you have to set DPPParams.selft = 0 (for DPP-PSD and DPP-CI).
In case of DPP-PHA this option is not available in the library, while it is available via register write: set bit[24] = 0 of register 0x1n80 to enable the self-trigger of channel n, set it to 1 to disable the self-trigger.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetChannelSelfTrigger(int handle,
                                CAEN_DGTZ_TriggerMode_t mode,
                                uint32_t channelmask
                                );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetChannelSelfTrigger(int handle,
                                uint32_t channel,
                                CAEN_DGTZ_TriggerMode_t *mode
                                );

typedef enum
{
                               CAEN_DGTZ_TRGMODE_DISABLED        = 0,
                               CAEN_DGTZ_TRGMODE_EXTOUT_ONLY     = 2,
                               CAEN_DGTZ_TRGMODE_ACQ_ONLY        = 1,
                               CAEN_DGTZ_TRGMODE_ACQ_AND_EXTOUT  = 3,
}CAEN_DGTZ_TriggerMode_t;
```

Arguments

Name	Description
handle	Device handler
mode	Channel Self Trigger mode CAEN_DGTZ_TRGMODE_DISABLED = 0, The channel self-trigger neither participates in the global trigger generation nor it is propagated on TRG-OUT. CAEN_DGTZ_TRGMODE_EXTOUT_ONLY = 2, The channel self-trigger doesn't participate in the global trigger generation but it is propagated out on TRG-OUT. CAEN_DGTZ_TRGMODE_ACQ_ONLY = 1, The channel self-trigger participate in the global trigger generation but it is not propagated out on TRG-OUT. CAEN_DGTZ_TRGMODE_ACQ_AND_EXTOUT = 3, The channel self-trigger participates in the global trigger generation and it is propagated out on TRG-OUT.
channelmask	The function applies only to those channels that have the relevant bit in the mask equal to 1 (only for Set)
channel	INT value corresponding to the channel index (only for Get)

Return Values
0: Success; Negative numbers are error codes (see Return Codes).

Set / GetGroupSelfTrigger

Description

This function is valid only for the x740 series. In fact, in this type of digitizer, the channels are grouped 8 by 8. The trigger properties are referred to the groups and cannot be set individually channel by channel. Each group of 8 channels generates one single self trigger which is the OR of the 8 self triggers in the group (with a programmable trigger enable mask, see next function). The group self trigger can generate the acquisition trigger for the board and/or a pulse on the Trigger Output.

Note: to be used only with x740 series.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetGroupSelfTrigger(int handle,
                              CAEN_DGTZ_TriggerMode_t mode,
                              uint32_t groupmask
                              );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetGroupSelfTrigger(int handle,
                              uint32_t group,
                              CAEN_DGTZ_TriggerMode_t *mode
                              );
typedef enum
{
                               CAEN_DGTZ_TRGMODE_DISABLED        = 0,
                               CAEN_DGTZ_TRGMODE_EXTOUT_ONLY     = 2,
                               CAEN_DGTZ_TRGMODE_ACQ_ONLY        = 1,
                               CAEN_DGTZ_TRGMODE_ACQ_AND_EXTOUT  = 3,
}CAEN_DGTZ_TriggerMode_t;
```

Arguments

Name	Description
handle	Device handler
mode	Group Self Trigger mode CAEN_DGTZ_TRGMODE_DISABLED = 0, CAEN_DGTZ_TRGMODE_EXTOUT_ONLY = 2, CAEN_DGTZ_TRGMODE_ACQ_ONLY = 1, CAEN_DGTZ_TRGMODE_ACQ_AND_EXTOUT = 3,
groupmask	The function applies only to those groups that have the relevant bit in the mask equal to 1 (only for Set)
group	INT value corresponding to the group index (only for Get)

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Set / GetChannelGroupMask

Description

This function decides which channels in a group of 8 participate to the generation of the self-trigger of that group. The self-trigger is the OR of the channels enabled by this function that are above the threshold. **WARNING:** the channels that are not connected must be disabled here, otherwise it may happen that one channel has a DC offset higher than the threshold and it keeps the OR always active.

Note: to be used only with x740 series.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetChannelGroupMask(int handle,
                              uint32_t group,
                              uint32 t channelmask
                              );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetChannelGroupMask(int handle,
                              uint32_t group,
                              uint32 t *channelmask
                              );
```

Arguments

Name	Description
`handle`	Device handler
`group`	INT value corresponding to the group index
`channelmask`	Channels Trigger mask for the group (8 bits)

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Set / GetChannelTriggerThreshold

Description

This function sets the Trigger Threshold for a specific channel. The threshold is applied to the digital signal after the ADC and it is expressed in ADC counts. The user should take care of the DC offset adjust when converting the digital threshold in the corresponding voltage level on the analog input.

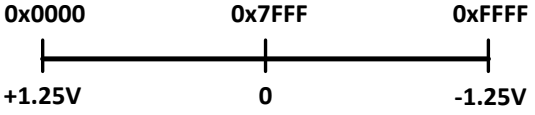
For the x740 series, use the **Set / GetGroupTriggerThreshold** function. For the DPP firmware, use the **SetDPPParameters** function.

Synopsis

```
CAEN DGTZ ErrorCode CAENDGTZ API
CAEN_DGTZ_SetChannelTriggerThreshold(int handle,
                                     uint32_t channel,
                                     uint32 t Tvalue
                                     );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetChannelTriggerThreshold(int handle,
                                     uint32 t channel,
                                     uint32 t *Tvalue
                                     );
```

Arguments

Name	Description
`handle`	Device handler
`channel`	Channel to set
`Tvalue`	Threshold value (in ADC counts). **Note:** in case of x743 digitizer, the threshold value is described in the scheme below. 

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Set / GetGroupTriggerThreshold

Description

This function sets/gets the Trigger Threshold for a specified group of channel. The threshold is common to the 8 channels in the group. See the **Set / GetChannelTriggerThreshold** function for further details.

Note: to be used only with x740 series.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetGroupTriggerThreshold(int handle,
                                   uint32_t group,
                                   uint32_t Tvalue
                                   );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetGroupTriggerThreshold(int handle,
                                   uint32_t group,
                                   uint32_t *Tvalue
                                   );
```

Arguments

Name	Description
handle	Device handler
group	Group to set
Tvalue	Threshold value

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Set / GetRunSynchronizationMode

Description

Sets/gets the run synchronization mode of the digitizer, used to synchronize an acquisition on multiple boards.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetRunSynchronizationMode (int handle,
                                     CAEN_DGTZ_RunSyncMode_t mode
                                     );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetRunSynchronizationMode (int handle,
                                     CAEN_DGTZ_RunSyncMode_t *mode
                                     );

typedef enum
{
                                     CAEN_DGTZ_RUN_SYNC_Disabled,
                                     CAEN_DGTZ_RUN_SYNC_TrgOutTrgInDaisyChain,
                                     CAEN_DGTZ_RUN_SYNC_TrgOutSinDaisyChain,
                                     CAEN_DGTZ_RUN_SYNC_SinFanout,
                                     CAEN_DGTZ_RUN_SYNC_GpioGpioDaisyChain
} CAEN_DGTZ_RunSyncMode_t;
```

Arguments

Name	Description
handle	Device handler
mode/*mode	The run synchronization mode to set/get

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Set / GetIOLevel

Description
Sets/gets the I/O level.

Synopsis
```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetIOLevel (int handle,
                      CAEN_DGTZ_IOLevel_t level
                      );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetIOLevel (int handle,
                      CAEN_DGTZ_IOLevel_t *level
                      );

typedef enum
{
                      CAEN_DGTZ_IOLevel_NIM = 0L,
                      CAEN_DGTZ_IOLevel_TTL = 1L,
} CAEN_DGTZ_IOLevel_t;
```

Arguments

Name	Description
handle	Device handler
level/*level	The I/O level of the digitizer to set/get

Return Values
0: Success; Negative numbers are error codes (see Return Codes).

Set / GetTriggerPolarity

Description
Sets/gets the trigger polarity of a specified channel.

Note: not to be used with DPP firmware.

Synopsis
```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetTriggerPolarity (int handle,
                              uint32_t channel,
                              CAEN_DGTZ_TriggerPolarity_t Polarity
                              );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetTriggerPolarity (int handle,
                              uint32_t channel,
                              CAEN DGTZ TriggerPolarity t *Polarity
                              );

typedef enum
{
                              CAEN_DGTZ_TriggerOnRisingEdge  = 0L,
                              CAEN DGTZ TriggerOnFallingEdge = 1L,
} CAEN_DGTZ_TriggerPolarity_t;
```

Arguments

Name	Description
handle	Device handler
channel/*channel	Selects the channel to set/get the trigger polarity for
Polarity/*Polarity	The polarity of the trigger to set/get

Note: *channel* parameter is unused (i.e. the setting is common to all channels) for those digitizers that do not support the individual trigger polarity setting. Please refer to the Registers Description document of the relevant board for check

Return Values
0: Success; Negative numbers are error codes (see Return Codes).

Set / GetGroupFastTriggerThreshold

Description

Sets/gets the threshold value on TRn input (used as external trigger) for the local trigger generation in x742 series. As the threshold is an hardware threshold (input of a programmable 16-bit DAC, whose voltage output goes to a comparator), it is not easy to set and the user can refer to the board User Manual for setting examples.

Note: to be used only with x742 series.

Synopsis

```
CAEN DGTZ ErrorCode CAENDGTZ API
CAEN DGTZ SetGroupFastTriggerThreshold (int handle,
                                        uint32_t group,
                                        uint32_t Tvalue
                                        );

CAEN DGTZ ErrorCode CAENDGTZ API
CAEN DGTZ GetGroupFastTriggerThreshold (int handle,
                                        uint32_t group,
                                        uint32_t *Tvalue
                                        );
```

Arguments

Name	Description
handle	Device handler
group	The channels group the threshold is applied to
Tvalue/*Tvalue	The value of the TRn threshold to set/get

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Set / GetGroupFastTriggerDCOffset

Description

Regarding the x742 series, sets/gets the TRn signal DC offset when it is sampled in the DRS4 chips in order to make positive, negative or bipolar input signals to be compliant with the DRS4 input dynamics. The DC offset also affects the TRn when used as trigger, in this case it relates to the threshold setting above described (please refer to the board User Manual for setting examples).

Note: to be used only with x742 series.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN DGTZ SetGroupFastTriggerDCOffset (int handle,
                                       uint32 t group,
                                       uint32_t DCvalue
                                       );

CAEN DGTZ ErrorCode CAENDGTZ API
CAEN DGTZ GetGroupFastTriggerDCOffset (int handle,
                                       uint32_t group,
                                       uint32_t *DCvalue
                                       );
```

Arguments

Name	Description
handle	Device handler
group	The channels group the DC offset is applied to
DCvalue/*DCvalue	The value of the TRn DC offset to set/get

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Set / GetFastTriggerDigitizing

Description
Regarding the x742 series, enables/disables (set) the presence of the TRn signal in the data readout as well as allows for checking the status of the setting (get).

Note: to be used only with x742 series.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetFastTriggerDigitizing (int handle,
                                    CAEN_DGTZ_EnaDis_t enable
                                    );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetFastTriggerDigitizing (int handle,
                                    CAEN_DGTZ_EnaDis_t *enable
                                    );

typedef enum
{
                                    CAEN_DGTZ_ENABLE  = 1L,
                                    CAEN_DGTZ_DISABLE = 0L,
} CAEN_DGTZ_EnaDis_t;
```

Arguments

Name	Description
handle	Device handler
enable/*enable	The enable flag to set/get

Return Values
0: Success; Negative numbers are error codes (see Return Codes).

Set / GetFastTriggerMode

Description
Enables/disables (set) the TRn input as local trigger in x742 series, as wells allows for checking the status of the setting (get).

Note: to be used only with x742 series.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetFastTriggerMode (int handle,
                              CAEN_DGTZ_TriggerMode_t mode
                              );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetFastTriggerMode (int handle,
                              CAEN_DGTZ_TriggerMode_t *mode
                              );

typedef enum
{
                              CAEN_DGTZ_TRGMODE_DISABLED       = 0L,
                              CAEN_DGTZ_TRGMODE_ACQ_ONLY       = 1L,
}CAEN_DGTZ_TriggerMode_t;
```

Arguments

Name	Description
handle	Device handler
mode/*mode	The fast trigger value to set/get.

Return Values
0: Success; Negative numbers are error codes (see Return Codes).

Set / GetDRS4SamplingFrequency

Description
Regarding the x742 series, sets/gets the sampling frequency of the DRS4 chips which sample the input analog signal and the fast trigger signal.

Note: to be used only with x742 series.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetDRS4SamplingFrequency (int handle,
                                    CAEN_DGTZ_DRS4Frequency_t frequency
                                    );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetDRS4SamplingFrequency (int handle,
                                    CAEN_DGTZ_DRS4Frequency_t *frequency
                                    );

typedef enum
{
                                    CAEN_DGTZ_DRS4_5GHz   = 0L,
                                    CAEN_DGTZ_DRS4_2_5GHz = 1L,
                                    CAEN_DGTZ_DRS4_1GHz   = 2L,
} CAEN_DGTZ_DRS4Frequency_t;
```

Arguments

Name	Description
handle	Device handler
frequency/*frequency	The sampling frequency value to set/get

Return Values
0: Success; Negative numbers are error codes (see Return Codes).

Set / GetOutputSignalMode

Description
Sets/gets the signal to be provided out over the TRG-OUT output channel in the x742 series.

Note: to be used only with x742 series.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetOutputSignalMode (int handle,
                               CAEN_DGTZ_OutputSignalMode_t mode
                               );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetOutputSignalMode (int handle,
                               CAEN_DGTZ_OutputSignalMode_t *mode
                               );

typedef enum
{
                               CAEN_DGTZ_TRIGGER          = 0L,
                               CAEN_DGTZ_FASTTRG_ALL      = 1L,
                               CAEN_DGTZ_FASTTRG_ACCEPTED = 2L,
                               CAEN_DGTZ_BUSY             = 3L,
} CAEN_DGTZ_OutputSignalMode_t;
```

Arguments

Name	Description
handle	Device handler
mode/*mode	The output signal mode to set/get.

Return Values
0: Success; Negative numbers are error codes (see Return Codes).

4 Acquisition

Set / GetChannelEnableMask

Description
This function enables/disables the channels for the acquisition. Disabled channels don't give any trigger and don't participate to the event data.

For the x740, x742 and x743 series, use the **Set / GetGroupEnableMask** function.

Note for DPP Firmware: *SetChannelEnableMask()* should be called before the **SetDPPEventAggregation** function.

Synopsis

```
CAEN DGTZ ErrorCode CAENDGTZ API
CAEN DGTZ SetChannelEnableMask(int handle,
                               uint32_t mask
                               );
CAEN DGTZ ErrorCode CAENDGTZ API
CAEN DGTZ GetChannelEnableMask(int handle,
                               uint32 t *mask
                               );
```

Arguments

Name	Description
handle	Device handler
mask	Enable Mask. Bit n corresponds to channel n. Please, refer to the User Manual of the specific board for the allowed number of channels

Return Values
0: Success; Negative numbers are error codes (see Return Codes).

Examples

WAVEDUMP Code *(To be implemented)*

Set / GetGroupEnableMask

Description
This function enables/disables the groups for the acquisition. This function is valid only for the x740, x742 and x743 series. Disabled groups don't give any trigger and don't participate to the event data. The 8 channels (for x740 and x742) or 2 channels (for x743) in a group are all enabled/disabled according to the relevant bit in the enable mask.

Note: to be used only with x740 and x742 series.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetGroupEnableMask(int handle,
                             uint32_t mask
                             );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetGroupEnableMask(int handle,
                             uint32_t *mask
                             );
```

Arguments

Name	Description
handle	Device handler
mask	Enable Mask. Bit n corresponds to group n. Please, refer to the User Manual of the specific board for the allowed number of groups.

Return Values
0: Success; Negative numbers are error codes (see Return Codes).

SWStartAcquisition

Description

This function starts the acquisition in a board using a software command. When the acquisition starts, the relevant RUN LED on the front panel lights up. It is worth noticing that in case of multiple board systems, the software start doesn't allow the digitizer to start synchronously. For this purpose, it is necessary to use to start the acquisition using a physical signal, such as the S-IN or GPI as well as the TRG-IN-TRG-OUT Daisy chain. Please refer to Digitizer manual for more details on this issue.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SWStartAcquisition(int handle);
```

Arguments

Name	Description
handle	Device handler

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

SWStopAcquisition

Description

This function stops the acquisition in a board using a software command.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SWStopAcquisition(int handle);
```

Arguments

Name	Description
handle	Device handler

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Set / GetRecordLength

Description
This function sets the size of the acquisition window, that is the number of samples that belong to it. Due to the way the samples are written into the memory (more samples are put in parallel), there is a specific granularity of the record length depending on the board model. For example, in the x720 series, the samples are written 4 by 4, hence the record length must be a multiple of 4. Please, refer to the User Manual of the specific board for the granularity value. The function accepts any value for the parameter size and then takes the closest value multiple of the granularity. The function **GetRecordLength** returns the exact value.

Note: each time the record length is changed, the post-trigger must be updated (through the *SetPostTriggerSize*).

Note for DPP Firmware: *SetRecordLength()* should be called before the **SetDPPEventAggregation** function.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetRecordLength (int handle,
                           uint32_t size,
                           ...
                           );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetRecordLength (int handle,
                           uint32_t *size,
                           ...
                           );
```

Arguments

Name	Description
`handle`	Device handler
`size/*size`	The size of the record (in samples) to set/get. **Note:** in case of x743, the allowed sizes are those for which: "size **mod** 16 = 0"; the minimum accepted size is: size > 4*16
`channel (optional)`	INT value corresponding to the channel index. **To be used only with digitizers running DPP-PSD and DPP-PHA firmware. This parameter is not supported in DPP-CI firmware.** **Note:** for the DPP-PSD and DPP-PHA firmware of 730 family, the Set function is managed inside couples of channels, i.e. inside channel 0 and channel 1, channel 2 and channel 3, etc. It is only possible to set the record length for the even channel of the couple, then the same value is automatically applied for the odd channel of the couple.

Return Values
0: Success; Negative numbers are error codes (see Return Codes).

Set / GetPostTriggerSize

Description

This function sets the post trigger size, that is the position of the trigger within the acquisition window. The size is expressed in percentage of the record length. 0% means that the trigger is at the end of the window, while 100% means that it is at the beginning.

Note: the post-trigger must be updated each time the record length is changed (through the *SetRecordLength*).

Synopsis

```
CAEN DGTZ ErrorCode CAENDGTZ API
CAEN DGTZ SetPostTriggerSize(int handle,
                             uint32_t percent
                             );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN DGTZ GetPostTriggerSize(int handle,
                             uint32 t *percent
                             );
```

Arguments

Name	Description
handle	Device handler
percent	Post trigger in percent of the record length

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Set / GetAcquisitionMode

Description

Gets/Sets digitizer acquisition mode.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetAcquisitionMode(int handle,
                             CAEN DGTZ AcqMode t mode
                             );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetAcquisitionMode(int handle,
                             CAEN DGTZ AcqMode t *mode
                             );

typedef enum
{
                              CAEN DGTZ SW CONTROLLED        = 0,
                              CAEN DGTZ S IN CONTROLLED      = 1,
                              CAEN_DGTZ_FIRST_TRG_CONTROLLED = 2
}CAEN_DGTZ_AcqMode_t;
```

Arguments

Name	Description
handle	Device handler
mode	The acquisition mode: CAEN_DGTZ_SW_CONTROLLED. Start and stop acquisition is issued by software command. CAEN_DGTZ_S_IN_CONTROLLED. Acquisition starts when the external signal on S-IN connector sets high, while is stopped when it sets low. Instead of S-IN. GPI connector must be referred in case of Desktop/NIM boards. CAEN_DGTZ_FIRST_TRG_CONTROLLED. Start is issued on the first trigger pulse (rising edge) on the TRG-IN connector. This pulse is not used as a trigger; actual triggers start from the second pulse on TRG-IN. The Stop acquisition must be SW controlled. Please refer to the digitizer documentation for details.

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Set / GetChannelDCOffset

Description

This function sets the 16 bit DAC that adds a DC offset to the input signal in order to adapt it to the dynamic range of the ADC. By default, the DAC is set to middle scale (0x7FFF) which corresponds to a DC offset of –Vpp/2, where Vpp is the voltage range (peak to peak) of the ADC. This means that the input signal can range from –Vpp/2 to +Vpp/2. If the DAC is set to 0x0000, then no DC offset is added and the range of the input signal goes from 0 to +Vpp. Conversely, when the DAC is set to 0xFFFF, the DC offset is –Vpp and the range goes from –Vpp to 0. The DC offset can be set on channel basis except for the x740 in which it is set on group basis; in this case, you must use the **Set / GetGroupDCOffset** functions.

Synopsis

```
CAEN DGTZ ErrorCode CAENDGTZ API
CAEN DGTZ SetChannelDCOffset(int handle,
                             uint32_t channel,
                             uint32_t Tvalue
                             );

CAEN DGTZ ErrorCode CAENDGTZ API
CAEN DGTZ GetChannelDCOffset(int handle,
                             uint32_t channel,
                             uint32_t *Tvalue
                             );
```

Arguments

Name	Description
handle	Device handler
channel	INT value corresponding to the channel index
Tvalue	DAC value (from 0x0000 to 0xFFFF)

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Set / GetGroupDCOffset

Description

The same as Set/Get ChannelDCoffset, but in this case it is applied to the groups of the x740 series.

Note: to be used only with x740 series.

Synopsis

```
CAEN DGTZ ErrorCode CAENDGTZ API
CAEN DGTZ SetGroupDCOffset(int handle,
                           uint32 t group,
                           uint32_t Tvalue
                           );

CAEN DGTZ ErrorCode CAENDGTZ API
CAEN_DGTZ_GetGroupDCOffset(int handle,
                           uint32_t group,
                           uint32_t *Tvalue
                           );
```

Arguments

Name	Description
handle	Device handler
group	INT value corresponding to the group index
Tvalue	DAC value (from 0x0000 to 0xFFFF)

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Set / GetDESMode

Description

This function enables or disables the Dual Edge Sampling mode, that is the channel interleaving option to double the sampling frequency. This option is available in the x731 and x751 series only.

WARNING: when the DES mode is enabled, only the odd channels (for the x751) or the even channels (for the x731) will work; the other channels must be left unconnected

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetDESMode(int handle,
                     CAEN_DGTZ_EnaDis_t mode);

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetDESMode(int handle,
                     CAEN_DGTZ_EnaDis_t *mode);
typedef enum
{
                     CAEN_DGTZ_ENABLE      = 1,
                     CAEN_DGTZ_DISABLE     = 0,
} CAEN_DGTZ_EnaDis_t;
```

Arguments

Name	Description
handle	Device handler
mode	CAEN_DGTZ_ENABLE to enable the DES mode, CAEN_DGTZ_DISABLE to disable the DES mode

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Set / GetZeroSuppressionMode

Description
sets/gets the Zero Suppression mode.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetZeroSuppressionMode(int handle,
                                 CAEN_DGTZ_ZS_Mode_t mode
                                 );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetZeroSuppressionMode (int handle,
                                  CAEN_DGTZ_ZS_Mode_t *mode
                                  );
typedef enum
{
                                  CAEN_DGTZ_ZS_NO        = 0,
                                  CAEN_DGTZ_ZS_INT       = 1,
                                  CAEN_DGTZ_ZS_ZLE       = 2,
                                  CAEN_DGTZ_ZS_AMP       = 3,
} CAEN_DGTZ_ZS_Mode_t;
```

Arguments

Name	Description
handle	Device handler
mode	Zero Suppression Mode : CAEN_DGTZ_ZS_NO = 0 (no Zero suppression), CAEN_DGTZ_ZS_INT = 1 (Full Suppression based on the integral of the signal), CAEN_DGTZ_ZS_ZLE = 2 (Zero Length Encoding), CAEN_DGTZ_ZS_AMP = 3 (Full Suppression based on the signal amplitude),

Supported digitizers and permitted zero suppression modes

Digitizer	0	1	2	3
x720	X		X	X
V1721/V1731	X		X	X
x724	X	X	X	X

Return Values
0: Success; Negative numbers are error codes (see Return Codes).

Set / GetChannelZSParams

Description
Sets/Gets Zero Suppression parameters for a specific channel in the supported digitizers (see the table in the **Set / GetZeroSuppressionMode** functions).

Note: the **Set / GetChannelZSParams** functions are to be used in combination with **Set / GetTriggerPolarity** and **Set / GetZeroSuppressionMode** functions which relate to the trigger polarity logic and the zero suppression algorithm.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetChannelZSParams(int handle,
                             uint32_t channel,
                             CAEN_DGTZ_ThresholdWeight_t weight,
                             int32_t threshold,
                             int32_t nsamp
                             );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetChannelZSParams(int handle,
                             uint32_t channel,
                             CAEN_DGTZ_ThresholdWeight_t *weight,
                             int32_t *threshold,
                             int32_t *nsamp
                             );
typedef enum
{
                             CAEN_DGTZ_ZS_FINE   = 0,
                             CAEN_DGTZ_ZS_COARSE = 1,
}CAEN_DGTZ_ThresholdWeight_t;
```

Arguments

Name	Description
handle	Device handler
channel	INT value corresponding to the channel index. Use -1 for all channels
weight	Zero Suppression weight*. **Used in "Full Suppression based on the integral of the signal" supported only by x724 series.** CAEN_DGTZ_ZS_FINE = 0 (Fine threshold step; the threshold is the *threshold* parameter), CAEN_DGTZ_ZS_COARSE = 1 (Coarse threshold step; the threshold is *threshold* × 64) For "Full Suppression based on the signal amplitude" and "Zero Length Encoding" algorithms, the value of *weight* doesn't affect the function working.
threshold	Zero Suppression Threshold to be used depending on the ZS algorithm*.
nsamp	Number of samples to be used by the ZS algorithm*.

*Refer to the digitizer User Manual for definition and representation.

Return Values
0: Success; Negative numbers are error codes (see Return Codes).

Set / GetAnalogMonOutput

Description

Sets/Gets the signal to output on the Analog Monitor Front Panel output in VME digitizers running the waveform recording firmware for waves digitizing.

Note: the function is not supported by V1742 and digitizers running DPP firmware.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetAnalogMonOutput(int handle,
                             CAEN_DGTZ_AnalogMonitorOutputMode_t mode
                             );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetAnalogMonOutput(int handle,
                             CAEN_DGTZ_AnalogMonitorOutputMode_t *mode
                             );

typedef enum
{
                               CAEN_DGTZ_AM_TRIGGER_MAJORITY     = 0,
                               CAEN_DGTZ_AM_TEST                 = 1,
                               CAEN_DGTZ_AM_ANALOG_INSPECTION    = 2,
                               CAEN_DGTZ_AM_BUFFER_OCCUPANCY     = 3,
                               CAEN_DGTZ_AM_VOLTAGE_LEVEL        = 4,
}CAEN_DGTZ_AnalogMonitorOutputMode_t;
```

Arguments

Name	Description
handle	Device handler
mode	Analog Monitor Mode CAEN_DGTZ_AM_TRIGGER_MAJORITY = 0 (Trigger Majority Mode), CAEN_DGTZ_AM_TEST = 1 (Test Mode), CAEN_DGTZ_AM_ANALOG_INSPECTION = 2 (Analog Inspection Mode), CAEN_DGTZ_AM_BUFFER_OCCUPANCY = 3 (Buffer Occupancy Mode), CAEN_DGTZ_AM_VOLTAGE_LEVEL = 4 (Voltage Level Mode),

Supported digitizers and permitted AM modes

Digitizer	0	1	2	3	4
V1720-V1721-V1731-V1740-V1743-V1751	X	X		X	X
V1724	X	X	X	X	X

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Set / GetAnalogInspectionMonParams

Description

Sets/Gets the Analog Inspection Monitor parameters for a V1724 digitizer running the waveform recording firmware for waves digitizing.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetAnalogInspectionMonParams(int handle,
                                       uint32_t channelmask,
                                       uint32 t offset,
                                       CAEN DGTZ AnalogMonitorMagnify t mf,
                                       CAEN_DGTZ_AnalogMonitorInspectorInverter_t ami
                                       );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN DGTZ GetAnalogInspectionMonParams(int handle,
                                       uint32 t channelmask,
                                       uint32_t *offset,
                                       CAEN_DGTZ_AnalogMonitorMagnify_t *mf,
                                       CAEN DGTZ AnalogMonitorInspectorInverter t *ami
                                       );

typedef enum
{
                                    CAEN_DGTZ_AM_MAGNIFY_1X                  = 0,
                                    CAEN DGTZ AM MAGNIFY 2X                  = 1,
                                    CAEN DGTZ AM MAGNIFY 4X                  = 2,
                                    CAEN_DGTZ_AM_MAGNIFY_8X                  = 3,
}CAEN_DGTZ_AnalogMonitorMagnify_t;

typedef enum
{
                                    CAEN DGTZ AM INSPECTORINVERTER P 1X      = 0,
                                    CAEN_DGTZ_AM_INSPECTORINVERTER_N_1X      = 1,
}CAEN_DGTZ_AnalogMonitorInspectorInverter_t;
```

Arguments

Name	Description
handle	Device handler
channelmask	channel enable mask
offset	DC Offset for the analog output signal
mf	Multiply factor
ami	Invert Output

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Set / GetEventPackaging

Description

This function allows to enable or disable the Pack 2.5 mode of V1720/DT5720 Digitizers

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetEventPackaging(int handle,
                            CAEN_DGTZ_EnaDis_t mode
                            );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetEventPackaging(int handle,
                            CAEN_DGTZ_EnaDis_t *mode
                            );

typedef enum {
                              CAEN_DGTZ_ENABLE = 1L,
                              CAEN_DGTZ_DISABLE = 0L,
} CAEN_DGTZ_EnaDis_t;
```

Arguments

Name	Description
handle	Device handler
mode	Enable/Disable the Pack 2.5 mode

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Acquisition Example

CAEN provides an acquisition example included in the library packet together with source C files and Visual Studio project (**compliant with Visual Studio Professional 2010**). This example can be used as base for users who want to develop their own software to control digitizers running the waveform recording firmware.

In Windows systems, the sample code is located in the “Samples” subfolder of “CAEN” main directory (see **Fig. 4.1**).

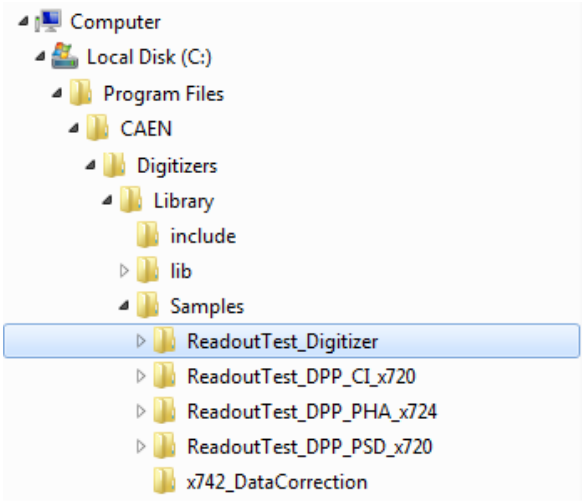


Fig. 4.1: Acquisition example location (Windows 7 64-bit OS as reference)

In Linux systems, the sample code is located in the “samples” subfolder of the library main directory.

x742 Offline Data Correction Functions

In the installation package of CAENDigitizer library, additional functions are provided inside the “Sample” folder to let the user perform offline the correction of raw data acquired with x742 digitizers.

Note: the functions are not included in the CAENDigitizer run time library and are intended also for offline use.

LoadCorrectionTables

Description
Loads the correction table stored onto the board into a user defined structure.

Synopsis

```
int32_t LoadCorrectionTables(int handle, DataCorrection_t *Table,
                             uint8_t group,
                             uint32_t frequency
                             );

typedef struct {
                    int16_t      cell[MAX_X742_CHANNELS+1][1024];
                    int8_t       nsample[MAX_X742_CHANNELS+1][1024];
                    float        time[1024];
} DataCorrection_t;
```

Arguments

Name	Description
handle	Device handle
Table	Pointer to the structure to be filled with the correction table values
group	Channel group
frequency	DSR4 sampling frequency

Return Values
0: Success.

ApplyDataCorrection

Description
Applies the desired correction data (configured through a mask) to the raw data acquired by the user.

Synopsis

```
void ApplyDataCorrection(DataCorrection_t* CTable,
                         CAEN_DGTZ_DRS4Frequency_t frequency,
                         int CorrectionLevelMask,
                         CAEN_DGTZ_X742_GROUP_t *data
                         );

typedef struct {
                    int16_t      cell[MAX_X742_CHANNELS+1][1024];
                    int8_t       nsample[MAX_X742_CHANNELS+1][1024];
                    float        time[1024];
} DataCorrection_t;
```

Arguments

Name	Description
CTable	Pointer to the structure filled with the correction data
frequency	DSR4 sampling frequency
CorrectionLevelMask	Mask for the correction type to be applied (3-bit): Bit0 = Cell Offset correction Bit1 = Index Sampling correction Bit2= Time correction
data	Raw acquired data to be corrected

Return Values
0: Success.

GetNumEvents

Description
Gets the current number of events stored in the acquisition buffer.

Synopsis
```
int32 t GetNumEvents(char *buffer,
                     uint32_t buffsize,
                     uint32_t *numEvents
                     );
```

Arguments

Name	Description
buffer	Address of the acquisition buffer
buffersize	Size of the data stored in the acquisition buffer
numEvens	Number of events stored in the acquisition buffer

Return Values
0: Success.

GetEventPtr

Description
Retrieves the event pointer of a specified event in the acquisition buffer.

Synopsis
```
int32_t GetEventPtr(char *buffer,
                    uint32_t buffsize,
                    int32 t numEvent,
                    char **EventPtr
                    );
```

Arguments

Name	Description
buffer	Address of the acquisition buffer
buffersize	Acquisition buffer size
numEvent	Index of the requested event
EventPtr	Pointer to the requested event in the acquisition buffer

Return Values
0: Success.

X742_DecodeEvent

Description
Decodes a specified event stored in the acquisition buffer writing data in Evt memory.

Note: once used, the Evt memory MUST be deallocated by the caller.

Synopsis
```
int32 t X742 DecodeEvent(char *evtPtr,
                         void **Evt
                         );
```

Arguments

Name	Description
evtPtr	Pointer to the requested event in the acquisition buffer
Evt	Pointer to the event structure with decoded event (MUST BE NULL)

Return Values
0: Success.

5 x743 Specific Functions

This paragraph describes the CAENDigitizer functions that specifically apply to the digitizers in the 743 series and are not to be used with other digitizer series. A set of the main functionalities of the board can be managed, like the acquisition, the calibrations and the test pulse generation.

Note that the SAM acronym used in some of the described functions corresponds to the SAMLONG Sampling Analog Memory the x743 boards are based on, housing two channels (i.e. one SAMLONG chip houses 2 channels).

Each SAMLONG chip in an N-channel board is indexed between 0 and N/2 – 1. This index is called *samIndex* and is used in some of the functions below to define parameters that are common to the group of two channels housed in the same chip. (The corresponding channel numbers are *2*samIndex* and *2*samIndex + 1*) .

For example, in a 16-channel digitizer board, the SAMLONG chip with *samIndex = 3* is housing channels 6 and 7.

Set / GetSAMCorrectionLevel

Description
These functions allow to set and get the configuration of the different types of data correction required by the x743, in order to compensate for unavoidable construction differences among the SAMLONG chips (refer to the board User Manual).

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetSAMCorrectionLevel(
                                int handle,
                                CAEN_DGTZ_SAM_CORRECTION_LEVEL_t level
                                );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetSAMCorrectionLevel(
                                int handle,
                                CAEN_DGTZ_SAM_CORRECTION_LEVEL_t *level
                                );

typedef enum {
    CAEN_DGTZ_SAM_CORRECTION_DISABLED       = 0,
    CAEN_DGTZ_SAM_CORRECTION_PEDESTAL_ONLY  = 1,
    CAEN_DGTZ_SAM_CORRECTION_INL            = 2,
    CAEN_DGTZ_SAM_CORRECTION_ALL            = 3,
} CAEN_DGTZ_SAM_CORRECTION_LEVEL_t;
```

Arguments

Name	Description
handle	Device handler
level / *level	The value of (i.e. the pointer to, in case of Get) the *CAEN_DGTZ_SAM_CORRECTION_LEVEL_t* structure indicating the correction setting to program: CAEN_DGTZ_SAM_CORRECTION_DISABLED (no correction is set) CAEN_DGTZ_SAM_CORRECTION_PEDESTAL_ONLY (Only Pedestal correction is set) CAEN_DGTZ_SAM_CORRECTION_INL (Only INL correction is set) CAEN_DGTZ_SAM_CORRECTION_ALL (Both INL and Pedestal corrections are set)

Return Values
0: Success; Negative numbers are error codes (see Return Codes).

Set / GetSAMPostTriggerSize

Description

These functions allow to set and get the post-trigger delay value (with respect to the actual trigger signal) which provokes the freezing of the currently stored signal in the sampling capacitance cells of the SAMLONG chip.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetSAMPostTriggerSize(
                                int handle,
                                int SamIndex,
                                uint8 t value
                                );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetSAMPostTriggerSize(
                                int handle,
                                int SamIndex,
                                int32_t *value
                                );
```

Arguments

Name	Description
handle	Device handler
SamIndex	Index of the SAMLONG chip that is housing the channels : 2*SamIndex and 2*SamIndex +1. See description above.
value / *value	Value (range between 1 and 255) of the post-trigger delay (pointer to, in case of Get) . Unit is the sampling period multiplied by 16.

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Set / GetSAMSamplingFrequency

Description

These functions allow to set and get the sampling frequency of the SAMLONG chip.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAENDGTZ_API CAEN_DGTZ_SetSAMSamplingFrequency(
                                               int handle,
                                               CAEN DGTZ SAMFrequency t frequency
                                               );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetSAMSamplingFrequency(
                                  int handle,
                                  CAEN DGTZ SAMFrequency t *frequency
                                  );

typedef enum {
    CAEN DGTZ SAM 3 2GHz        = 0L,
    CAEN DGTZ SAM 1 6GHz        = 1L,
    CAEN DGTZ SAM 800MHz        = 2L,
    CAEN_DGTZ_SAM_400MHz        = 3L,
} CAEN_DGTZ_SAMFrequency_t;
```

Arguments

Name	Description
handle	Device handler
frequency / *frequency	The value of (i.e. the pointer to, in case of Get) the *CAEN_DGTZ_SAMFrequency_t* structure indicating the SAMLONG sampling frequency: CAEN_DGTZ_SAM_3_2GHz (SAMLONG sampling frequency of 3.2 GS/s) CAEN_DGTZ_SAM_1_6GHz (SAMLONG sampling frequency of 1.6 GS/s) CAEN_DGTZ_SAM_800MHz (SAMLONG sampling frequency of 800 MS/s) CAEN_DGTZ_SAM_400MHz (SAMLONG sampling frequency of 400 MS/s)

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Read_EEPROM

Description

This function allows to read data from the on-board EEPROM where various information about the daughterboard is stored (See the **Data Correction** paragraph in the User Manual of the x743 board).

Synopsis

```
ErrorCode CAENDGTZ_API
_CAEN_DGTZ_Read_EEPROM(
                        int handle,
                        int EEPROMIndex,
                        unsigned short add,
                        int nbOfBytes,
                        unsigned char* buf
                        );
```

Arguments

Name	Description
handle	Device handler
EEPROMIndex	Corresponds to the Index of the daughterboard that houses 2 SAMLONG chips, which corresponds to 4 channels.
add	Address in the EEPROM to access (range value between 0 and 65535)
nbOfBytes	Number of Bytes to read
*buf	Returned buffer of the read values (in bytes)

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

LoadSAMCorrectionData

Description

This function loads all the calibrations values present in the on-board EEPROMs as Individual Pedestal correction values, Time INL Corrections values, Trigger Thresholds DAC Offset calibrations values and Line Offset calibrations.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_LoadSAMCorrectionData(
                                int handle
                                );
```

Arguments

Name	Description
handle	Device handler

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Enable / DisableSAMPulseGen

Description
These functions allow to enable and disable the generation of the test pulses from the individual pulser each input channel is equipped with (refer to the board User Manual).

Note: pulseSource is common to each pair of channels sharing the same SAMLONG chip.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_EnableSAMPulseGen(
                            int handle,
                            int channel,
                            unsigned short pulsePattern,
                            CAEN_DGTZ_SAMPulseSourceType_t pulseSource
                            );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_DisableSAMPulseGen(
                             int handle,
                             int channel
                             );

typedef enum {
    CAEN_DGTZ_SAMPulseSoftware            = 0,
    CAEN_DGTZ_SAMPulseCont                = 1,
} CAEN_DGTZ_SAMPulseSourceType_t;
```

Arguments

Name	Description
handle	Device handler
channel	INT value corresponding to the channel index
pulsePattern	Pulse pattern value
pulseSource	The value of the *CAEN_DGTZ_SAMPulseSourceType_t* structure: CAEN_DGTZ_SAMPulseSoftware : A pulse will be sent to the enabled inputs using the function *SendSAMPulse (int handle)* CAEN_DGTZ_SAMPulseCont : Pulses are sent continuously from the FPGA to the enabled inputs using and internal oscillator.

Return Values
0: Success; Negative numbers are error codes (see Return Codes).

SendSAMPulse

Description
This function permits sending a single pulse from the FPGA to the enabled channels (programmed through the *EnableSAMPulseGen()* function (see **Enable / DisableSAMPulseGen**) *but only* if the **pulseSource** for the selected channel is set to *CAEN_DGTZ_SAMPulseSoftware.*

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SendSAMPulse(
                       int handle
                       );
```

Arguments

Name	Description
handle	Device handler

Return Values
0: Success; Negative numbers are error codes (see Return Codes).

Set / GetSAMAcquisitionMode

Description

These function allows to set and get the acquisition mode of the x743 digitizer, selecting between the digital oscilloscope and the embedded charge integration mode.

Note: the x743 firmware features a charge integration acquisition mode here referred to as DPP-CI, but it must not be confused with the special DPP-CI firmware supported by the 720 digitizer series.

Synopsis

```
CAEN DGTZ ErrorCode CAENDGTZ API
CAEN DGTZ SetSAMAcquisitionMode(
                                int handle,
                                CAEN_DGTZ_AcquisitionMode_t mode
                                );

CAEN DGTZ ErrorCode CAENDGTZ API
CAEN_DGTZ_GetSAMAcquisitionMode(
                                int handle,
                                CAEN_DGTZ_AcquisitionMode_t *mode
                                );

typedef enum  {
    CAEN_DGTZ_AcquisitionMode_STANDARD    = 0,
    CAEN_DGTZ_AcquisitionMode_DPP_CI      = 1,
} CAEN_DGTZ_AcquisitionMode_t ;
```

Arguments

Name	Description
handle	Device handler
mode / *mode	The value of (i.e. the pointer to, in case of Get) the *CAEN_DGTZ_AcquisitionMode_t* structure indicating acquisition mode: CAEN_DGTZ_AcquisitionMode_STANDARD (digital oscilloscope mode) CAEN_DGTZ_AcquisitionMode_DPP_CI (Charge Integration mode) Charge data are expressed in pC

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Set / GetChannelPairTriggerLogic

Description

These function allows to set and get the trigger logic for the generation of the trigger requests from the self-trigger signals coming from each pair of channels of the x743 digitizers.

For a generic couple ChannelA-ChannelB (i.e. CH0-CH1, or CH2-CH3 and so on), the AND and OR the channel trigger requests are allowed.

The trigger requests from each channel pair can be further processed by another trigger logic level (see **Set / GetTriggerLogic** function) to generate the board common trigger (i.e. the event storing).

Note: please, consult the x743 User Manual for details about the trigger management.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetChannelPairTriggerLogic(int handle,
                                     uint32_t channelA,
                                     uint32_t channelB,
                                     CAEN_DGTZ_TrigerLogic_t logic,
                                     uint16_t coincidenceWindow
                                     );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetChannelPairTriggerLogic(int handle,
                                     uint32_t channelA,
                                     uint32_t channelB,
                                     CAEN_DGTZ_TrigerLogic_t *logic,
                                     uint16_t *coincidenceWindow
                                     );

typedef enum {
    CAEN_DGTZ_LOGIC_OR            = 0,
    CAEN_DGTZ_LOGIC_AND            = 1,
} CAEN_DGTZ_TrigerLogic_t;
```

Arguments

Name	Description
handle	Device handler
channelA / channelB	The number of the channels in a pair. A and B must belog to the same couple (CH0-CH1; CH2-CH3;...; $CH_{max.num.ch.-2}$-$CH_{max.num.ch.-1}$)
logic / *logic	The self-trigger logic: CAEN_DGTZ_LOGIC_OR = the trigger request is the OR of the self-trigger signals from the pair CAEN_DGTZ_LOGIC_AND the trigger request is the AND of the self-trigger signals from the pair
coincidenceWindow / *coincidenceWindow	The coincidence gate (in ns). It corresponds to the *Primitives Gate Length* parameter of the WaveCatcher software (see the software User Manual). **Note:** it mustbe ≥ 15 ns. (it should be a multiple of 5 ns also;otherwise, the library will put the closer multiple of 5 as gate length). Maximum value is 5*255 = 1275 ns.

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Set / GetTriggerLogic

Description

Sets/gets the of the trigger logic configuration to process the, at the motherboard level, the trigger requests generated by the enabled channel pairs according to the **Set / GetChannelPairTriggerLogic** function.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAENDGTZ_API CAEN_DGTZ_SetTriggerLogic(int handle,
                                       CAEN_DGTZ_TrigerLogic_t logic,
                                       uint32 t majorityLevel
                                       );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAENDGTZ_API CAEN_DGTZ_GetTriggerLogic(int handle,
                                       CAEN_DGTZ_TrigerLogic_t *logic,
                                       uint32 t *majorityLevel
                                       );

typedef enum {
                                      CAEN DGTZ LOGIC OR       = 0,
                                      CAEN DGTZ LOGIC AND      = 1,
                                      CAEN DGTZ LOGIC MAJORITY = 2,
} CAEN_DGTZ_TrigerLogic_t;
```

Arguments

Name	Description
handle	Device handler
logic/*logic	The trigger logic to set/get according to the *CAEN_DGTZ_TrigerLogic_t* structure: CAEN_DGTZ_LOGIC_OR = the common trigger is the OR of the channel pairs trigger requests. CAEN_DGTZ_LOGIC_AND = the common trigger is the AND of the channel pairs trigger requests CAEN_DGTZ_LOGIC_MAJORITY = the common trigger is given by the majority policy upon the value of the *majoritylevel* parameter
majoritylevel/*majoritylevel	Value of the majority level. Allowed values range between 0 and max num. channel – 1 (“0” means more than 0, ie ≥ 1)

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

Set / GetSAMTriggerCountVetoParam

Description

This function enables/disables the trigger counter veto, and programs the time window for the veto.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetSAMTriggerCountVetoParam(
                                      int handle,
                                      int channel,
                                      CAEN_DGTZ_EnaDis_t enable,
                                      uint32_t vetoWindow
                                      );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetSAMTriggerCountVetoParam(
                                      int handle,
                                      int channel,
                                      CAEN_DGTZ_EnaDis_t *enable,
                                      uint32_t *vetoWindow
                                      );

typedef enum
{
 CAEN_DGTZ_ENABLE                    = 1,
 CAEN_DGTZ_DISABLE                   = 0,
} CAEN_DGTZ_EnaDis_t;
```

Arguments

Name	Description
handle	Device handler
channel	INT value corresponding to the channel index
enable/*enable	Veto enable/disable flag according to the *CAEN_DGTZ_EnaDis_t* structure: CAEN_DGTZ_ENABLE = Veto is enabled CAEN_DGTZ_DISABLE = Veto is disabled
vetoWindow/* vetoWindow	Time window for veto duration expressed in ns

Return Values

0: Success; Negative numbers are error codes (see Return Codes).

6 DPP Specific Functions

In order to handle acquisitions with the DPP firmware (PHA, PSD, CI), the C functions described in this chapter can be used.

DPP codes

Description
Define DPP firmware code

Synopsis

```
#define STANDARD_FW_CODE      (0x00)    // In case of waveform recording firmware
#define V1724_DPP_PHA_CODE    (0x80)    // In case of the DPP-PHA for x724 boards
#define V1720_DPP_CI_CODE     (0x82)    // In case of the DPP-CI for x720 boards
#define V1720 DPP PSD CODE    (0x83)    // In case of the DPP-PSD for x720 boards
#define V1751 DPP PSD CODE    (0x84)    // In case of the DPP-PSD for x751 boards
#define V1751_DPP_ZLE_CODE    (0x85)    // In case of the DPP-ZLE for x751 boards
#define V1743_DPP_CI_CODE     (0x86)    // In case of the DPP-PSD for x743 boards
#define V1730 DPP PSD CODE    (0x88)    // In case of the DPP-PSD for x730 boards
#define V1730_DPP_PHA_CODE    (0x8B)    // In case of the DPP-PHA for x730 boards
```

Set / GetDPPPreTriggerSize

Description
Sets/gets the pre-trigger size, which is the portion of acquisition window visible before a trigger.

Synopsis

```
CAEN DGTZ ErrorCode CAENDGTZ API
CAEN DGTZ SetDPPPreTriggerSize (int handle,
                                int ch,
                                uint32_t samples
                                );

CAEN DGTZ ErrorCode CAENDGTZ API
CAEN_DGTZ_GetDPPPreTriggerSize (int handle,
                                int ch,
                                uint32_t *samples
                                );
```

Arguments

Name	Description
handle	Device handler
samples/*samples	The size of the record (in samples)
ch	The channel whose pre-trigger has to be set/get. ch=-1 writes the same value for all channels. DPP-CI only supports ch=-1 (different channels must have the same pre-trigger)

Return Values
0: Success; negative numbers are error codes (see Return Codes).

Set / GetChannelPulsePolarity

Description
Sets/gets the value of the pulse polarity for the specified channel.

Synopsis
```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetChannelPulsePolarity (int handle,
                                   uint32_t channel,
                                   CAEN_DGTZ_PulsePolarity_t pol
                                   );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetChannelPulsePolarity (int handle,
                                   uint32_t channel,
                                   CAEN_DGTZ_PulsePolarity_t *pol
                                   );

typedef enum
{
                                   CAEN_DGTZ_PulsePolarityPositive = 0,
                                   CAEN_DGTZ_PulsePolarityNegative = 1,
} CAEN_DGTZ_PulsePolarity_t;
```

Arguments

Name	Description
handle	Device handler
channel	The channel to set/get information for
pol/*pol	Value of the pulse polarity

Return Values
0: Success; Negative numbers are error codes (see Return Codes).

GetDPPEvents

Description
Decodes and returns all the DPP events stored in the acquisition buffers.

Synopsis
```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetDPPEvents (int handle,
                        char *buffer,
                        uint32_t buffsize,
                        void **events,
                        uint32_t *numEventsArray
                        );
```

Arguments

Name	Description
handle	Device handler
***buffer**	The address of the acquisition buffer
buffsize	The acquisition buffer size (in samples)
****events**	The pointer to the event list (allocated via MallocDPPEvents)
***numEventsArray**	The pointer to an array of *int* which will contain the number of events found per channel

Return Values
0: Success; negative numbers are error codes (see Return Codes).

MallocDPPEvents

Description

Allocates the event buffer matrix which is handled by the **GetDPPEvents** function. The matrix has one event array per channel and must be declared as a MAX_CH-sized array of pointers.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_MallocDPPEvents (int handle,
                           void **events,
                           uint32 t *allocatedSize
                           );

typedef struct
{
    uint32_t Format;
    uint64 t TimeTag;
    uint16 t Energy;
    int16_t Extras;
    uint32_t Extras2;
    uint32 t *Waveforms; /*!< pointer to coded data inside the readout buffer. only meant
                              to be supplied to CAEN DGTZ DecodeDPPWaveforms */
} CAEN DGTZ DPP PHA Event t;

typedef struct
{
    uint32 t Format;
    uint32 t  Format2;      //enables the event format including the CFD information (751
                              family only)
    uint32_t TimeTag;
    int16_t ChargeShort;
    int16 t ChargeLong;
    int16 t Baseline;
    int16 t Pur;
    uint32_t *Waveforms; /*!< pointer to coded data inside the readout buffer. only meant
                              to be supplied to CAEN_DGTZ_DecodeDPPWaveforms */
    uint32_t Extras;
} CAEN DGTZ DPP PSD Event t;

typedef struct
{
    uint32_t Format;
    uint32_t TimeTag;
    int16 t Charge;
    int16 t Baseline;
    uint32 t *Waveforms; /*!< pointer to coded data inside the readout buffer. only meant
                              to be supplied to CAEN_DGTZ_DecodeDPPWaveforms */
    uint32_t Extras
} CAEN_DGTZ_DPP_CI_Event_t;
```

Arguments

Name	Description
handle	Device handler
****events**	The pointer to the event matrix, which shall be of type: CAEN_DGTZ_DPP_PHA_Event_t, for DPP-PHA, CAEN_DGTZ_DPP_PSD_Event_t, for DPP-PSD CAEN_DGTZ_DPP_CI_Event_t, for DPP-CI **Note:** please refer to the DPP User Manual for the event format description
***allocatedSize**	The size in bytes of the event list

Return Values

0: Success; negative numbers are error codes (see Return Codes).

FreeDPPEvents

Description

Deallocates the event buffer matrix.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_FreeDPPEvents (int handle,
                         void **events
                         );
```

Arguments

Name	Description
`handle`	Device handler
`**events`	The pointer to the event buffer

Return Values

0: Success; negative numbers are error codes (see Return Codes).

MallocDPPWaveforms

Description

Allocates the waveform buffer, which is used by **CAEN_DGTZ_DecodeDPPWaveforms**.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_MallocDPPWaveforms (int handle,
                              void **waveforms,
                              uint32_t *allocatedSize
                              );

typedef struct
{
    uint32_t Ns;
    uint8_t  DualTrace;
    uint8_t  VProbe1;
    uint8_t  VProbe2;
    uint8_t  VDProbe;
    int16_t *Trace1;
    int16_t *Trace2;
    uint8_t  *DTrace1;
    uint8_t  *DTrace2;
} CAEN_DGTZ_DPP_PHA_Waveforms_t;

typedef struct
{
    uint32_t Ns;
    uint8_t  dualTrace;
    uint8_t  anlgProbe;
    uint8_t  dgtProbe1;
    uint8_t  dgtProbe2;
    uint16_t *Trace1;
    uint16_t *Trace2;
    uint8_t  *DTrace1;
    uint8_t  *DTrace2;
    uint8_t  *DTrace3;
    uint8_t  *DTrace4;
} CAEN_DGTZ_DPP_PSD_Waveforms_t;

#define  CAEN_DGTZ_DPP_CI_Waveforms_t  CAEN_DGTZ_DPP_PSD_Waveforms_t  /*!<  \brief  Waveform
                                types  for  DPP-CI  and  DPP-PSD  are  the  same,  hence  this
                                define */
```

Arguments

Name	Description
handle	Device handler
****waveforms**	The pointer to the waveform buffer, which shall be of type: CAEN_DGTZ_DPP_PHA_Waveforms_t, for DPP-PHA CAEN_DGTZ_DPP_PSD_Waveforms_t, for DPP-PSD CAEN_DGTZ_DPP_CI_Waveforms_t, for DPP-CI
***allocatedSize**	The size in bytes of the waveform buffer

Return Values

0: Success; negative numbers are error codes (see Return Codes).

FreeDPPWaveforms

Description
Deallocates the waveform buffer.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_FreeDPPWaveforms (int handle,
                            void *waveforms
                            );
```

Arguments

Name	Description
handle	Device handler
***waveforms**	The pointer to the waveform buffer

Return Values
0: Success; negative numbers are error codes (see Return Codes).

DecodeDPPWaveforms

Description
Decodes the waveforms contained inside an event.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_DecodeDPPWaveforms (int handle,
                              void *event,
                              void *waveforms
                              );
```

Arguments

Name	Description
handle	Device handler
***event**	The pointer to the event
***waveforms**	The pointer to the (preallocated) waveform list

Return Values
0: Success; negative numbers are error codes (see Return Codes).

SetDPPEventAggregation

Description
Sets event aggregation parameters.

Note: this function should be called only after any other function affecting the internal event aggregation, specifically:

- *SetRecordLength()*
- *SetChannelEnableMask()*
- *SetNumEventsPerAggregate()*
- *SetDPPAcquisitionMode()*

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetDPPEventAggregation (int handle,
                                  int threshold,
                                  int maxsize
                                  );
```

Arguments

Name	Description
handle	Device handler
threshold	Specifies how many events to let accumulate in the board memory before they are rendered available for readout. A low number maximizes responsiveness, since data are read as soon as they are stored in memory, while a high number maximizes efficiency, since fewer transfers are made. Supplying 0 will let the library choose the most reasonable value depending on acquisition mode and other parameters.
maxsize	Specifies the maximum size in bytes of the event buffer on the PC side. This parameter might be useful in case the computer has very low RAM. Normally, though, it is safe to supply 0 as this parameter, so that the library will choose an appropriate value automatically.

Return Values
0: Success; negative numbers are error codes (see Return Codes).

Set / GetNumEventsPerAggregate

Description
Sets/Gets the number of events that each aggregate will contain.

Note: *SetNumEventsPerAggregate()* should be called before the **SetDPPEventAggregation** function.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetNumEventsPerAggregate (int handle,
                                    uint32_t numEvents,
                                    ...
                                    );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetNumEventsPerAggregate (int handle,
                                    uint32_t *numEvents,
                                    ...
                                    );
```

Arguments

Name	Description
handle	Device handler
numEvents	Number of events per aggregater.
Channel (optional)	INT value corresponding to the channel index (required for DPP-PSD and DPP-CI, ignored by DPP-PHA). **Note:** for the DPP-PSD firmware of 730 family, the Set function is managed inside couples of channels, i.e. inside channel 0 and channel 1, channel 2 and channel 3, etc. It is only possible to set the record length for the even channel of the couple, then the same value is automatically applied for the odd channel of the couple.

Return Values
0: Success; negative numbers are error codes (see Return Codes).

Set / GetMaxNumAggregatesBLT

Description
Sets/Gets the maximum number of aggregatess for each transfer.

Note: with DPP-PHA, DPP-PSD and DPP-CI, also the *maxsize* parameter of **SetDPPEventAggregation** can be used.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetMaxNumAggregatesBLT (int handle,
                                  uint32_t numAggr
                                  );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetMaxNumAggregatesBLT (int handle,
                                  uint32_t *numAggr
                                  );
```

Arguments

Name	Description
handle	Device handler
numAggr	Max number of aggregates per block transfer (BLT)

Return Values
0: Success; negative numbers are error codes (see Return Codes).

SetDPPParameters

Description

Sets DPP configuration parameters for DPP-PHA, DPP-PSD or DPP-CI.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetDPPParameters (int handle,
                            uint32_t channelMask,
                            void *params
                            );

/* DPP parameter structure to be initialized and passed to CAEN_DGTZ_SetDPPParameters.
   To be used only for DPP-PHA */

typedef struct{
      int M     [MAX_DPP_PHA_CHANNEL_SIZE]; //Signal Decay Time Constant (ns)
      int m     [MAX_DPP_PHA_CHANNEL_SIZE]; //Trapezoid Flat Top (ns)
      int k     [MAX_DPP_PHA_CHANNEL_SIZE]; //Trapezoid Rise Time(ns)
      int ftd   [MAX_DPP_PHA_CHANNEL_SIZE]; //Flat Top Delay (ns)
      int a     [MAX_DPP_PHA_CHANNEL_SIZE]; /*Trigger Filter smoothing factor (i.e. number
                                               of samples over which to perform the
                                               smoothing): 1, 2, 3, 4, 16, 32 samples*/
      int b     [MAX_DPP_PHA_CHANNEL_SIZE]; //Input Signal Rise time (ns)
      int thr   [MAX_DPP_PHA_CHANNEL_SIZE]; //Trigger Threshold (LSB)
      int nsbl  [MAX_DPP_PHA_CHANNEL_SIZE]; /*Number of Samples for Baseline Mean (allowed
                                               values are from 0 to 6, where 0 = 0, 1= 16,
                                               2 = 64, 3 = 256, 4 = 1024, 5 = 4096, 6 =
                                               16384)*/
      int nspk  [MAX_DPP_PHA_CHANNEL_SIZE]; /*Number of Samples for Peak Mean (allowed
                                               values are from 0 to 3, where 0 = 1, 1 = 4,
                                               2 = 16, 3 = 64)*/
      int pkho  [MAX_DPP_PHA_CHANNEL_SIZE]; //Peak Hold Off (ns)
      int blho  [MAX_DPP_PHA_CHANNEL_SIZE]; //Base Line Hold Off (ns)
      int otrej;                            //This parameter is deprecated
      int trgho [MAX_DPP_PHA_CHANNEL_SIZE]; //Trigger Hold Off (ns)
      int twwdt [MAX_DPP_PHA_CHANNEL_SIZE]; /*Zero crossing acceptance window for the Rise
                                               Time Discriminator (RTD) in the pile-up
                                               rejection, starting from the RC-CR2
                                               overthreshold which arms the acquisition
                                               (When 0, the RTD is disabled)*/
      int trgwin [MAX_DPP_PHA_CHANNEL_SIZE]; /*Trigger acceptance window in coincidence
                                               mode*/
      int dgain     [MAX_DPP_PHA_CHANNEL_SIZE]; /*Digital Gain to apply to the input
                                               digitized waveform:
                                               0x0: Digital Gain = 1;
                                               0x1: Digital Gain = 2
                                               0x2: Digital Gain = 4
                                               0x3: Digital Gain = 8*/
      float enf   [MAX_DPP_PHA_CHANNEL_SIZE]; //Energy Normalization Factor
      int decimation [MAX_DPP_PHA_CHANNEL_SIZE]; /*Number of samples over which to apply
                                               the decimation of the input digitized
                                               waveform:
                                               0x0: Decimation disabled;
                                               0x1: 2 samples (50 MSps);
                                               0x2: 4 samples (25 MSps);
                                               0x3: 8 samples (12.5 MSps)*/
} CAEN_DGTZ_DPP_PHA_Params_t;

/* DPP parameter structure to be initialized and passed to CAEN_DGTZ_SetDPPParameters.
   To be used only for DPP-PSD */

typedef struct {
    int blthr   [MAX_DPP_PSD_CHANNEL_SIZE]; //This parameter is deprecated
    int bltmo   [MAX_DPP_PSD_CHANNEL_SIZE]; //This parameter is deprecated
    int trgho   [MAX_DPP_PSD_CHANNEL_SIZE]; //Trigger Hold Off (samples)
    int thr     [MAX_DPP_PSD_CHANNEL_SIZE]; //Trigger Threshold (LSB)
    int selft  [MAX_DPP_PSD_CHANNEL_SIZE]; /*Channel self-trigger enable (options: 0 =
                                               Disabled, 1 = Enabled)*/
    int csens   [MAX_DPP_PSD_CHANNEL_SIZE]; /*Charge Sensitivity (options for x720: 0= 40,
                                               1 = 160, 2= 640, 3 = 2560 fC/LSB; options
                                               for x751: 0 = 20, 1 = 40, 2 = 80, 3 = 160, 4
                                               = 320, 5 = 640 fC/LSB)*/
    int sgate   [MAX_DPP_PSD_CHANNEL_SIZE]; /*Short (i.e. prompt) Charge Integration Gate
                                               witdh (samples)*/
    int lgate   [MAX_DPP_PSD_CHANNEL_SIZE]; //Long (i.e. total) Charge Integration Gate
                                               witdh (samples)
```

```
    int pgate   [MAX_DPP_PSD_CHANNEL_SIZE]; //Gate Offset (samples)
    int tvaw         //Trigger Validation Acceptance Window in coincidence mode (samples)
    int nsbl         /*Number of Samples for Baseline Mean (options for x720: 0 = FIXED, 1
                                            = 8, 2 = 32, 3 = 128; options for x751: 0 =
                                            FIXED, 1 = 8, 2 = 16, 3 = 32, 4 = 64, 5 =
                                            128, 6 = 256, 7 = 512; options for x730: 0 =
                                            FIXED, 1 = 16, 2 = 64, 3 = 256, 4 = 1024)*/
    CAEN DGTZ DPP TriggerConfig t trgc //This parameter is deprecated (must be set to 1)
    CAEN DGTZ DPP PUR t purh          /*Pile-Up option selection (0 =
                                            CAEN DGTZ DPP PSD PUR DetectOnly, 1 =
                                            CAEN_DGTZ_DPP_PSD_PUR_Enabled). Ignored for
                                            x751*/
    int purgap                        /*Pile-Up Rejection GAP value (LSB). Ignored for
                                            x751*/
} CAEN DGTZ DPP PSD Params t;


/* DPP parameter structure to be initialized and passed to CAEN_DGTZ_SetDPPParameters.
   To be used only for DPP-CI */

typedef struct {
    int blthr   [MAX_DPP_CI_CHANNEL_SIZE]; //this parameter is deprecated
    int bltmo   [MAX_DPP_CI_CHANNEL_SIZE]; //this parameter is deprecated
    int trgho   [MAX_DPP_CI_CHANNEL_SIZE]; //Trigger Hold Off (samples)
    int thr     [MAX DPP CI CHANNEL SIZE]; //Trigger Threshold (LSB)
    int selft   [MAX DPP CI CHANNEL SIZE]; /*Channel self-trigger enable (options: 0 =
                                            Disabled, 1 = Enabled)*/
    int csens   [MAX_DPP_CI_CHANNEL_SIZE]; /*Charge Sensitivity Charge Sensitive (options
                                            0= 40, 1 = 160, 2= 640, 3 = 2560 fC/LSB)*/
    int gate    [MAX DPP CI CHANNEL SIZE]; //Charge Integration Gate width (samples)
    int pgate   [MAX DPP CI CHANNEL SIZE]; //Gate Offset (samples)
    int tvaw    [MAX DPP CI CHANNEL SIZE]; /*Trigger Validation Acceptance Window in
                                            coincidence mode (samples)*/
    int nsbl    [MAX_DPP_CI_CHANNEL_SIZE]; /*Number of Samples for Baseline Mean (options
                                            for x720: 0 = FIXED, 1 = 8, 2 = 32, 3 =
                                            128)*/
    CAEN DGTZ DPP TriggerConfig t trgc //This parameter is deprecated (must be set to 1)
} CAEN DGTZ DPP CI Params t;
//----------------------------
#define MAX_V1730DPP_CHANNEL_SIZE   (16)
#define MAX_V1720DPP_CHANNEL_SIZE   (8)

#define  MAX DPP CI CHANNEL SIZE  (MAX V1720DPP CHANNEL SIZE)  //The max number of channels
                                                                 for DPP-CI
#define  MAX_DPP_PSD_CHANNEL_SIZE  (MAX_V1730DPP_CHANNEL_SIZE)  //The max number of channels
                                                                 for DPP-PSD
#define  MAX_DPP_PHA_CHANNEL_SIZE  (MAX_V1730DPP_CHANNEL_SIZE)  //The max number of channels
                                                                 for DPP-PHA
```

Arguments

Name	Description
handle	Device handler
channelMask	A bit mask indicating to which channels the DPP parameters are applied
***params**	The pointer to a preallocated struct of type: CAEN_DGTZ_DPP_PHA_Params_t, in case of DPP-PHA CAEN_DGTZ_DPP_PSD_Params_t, in case of DPP-PSD CAEN_DGTZ_DPP_CI_Params_t, in case of DPP-CI **Note**: refer to the User Manual of the relevant DPP for parameters extended description

Return Values

0: Success; negative numbers are error codes (see Return Codes).

Set / GetDPPAcquisitionMode

Description
Sets/gets the DPP acquisition mode.

Note: *SetDPPAcquisitionMode()* should be called before the **SetDPPEventAggregation** function.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetDPPAcquisitionMode (int handle,
                                 CAEN_DGTZ_DPP_AcqMode_t mode,
                                 CAEN_DGTZ_DPP_SaveParam_t param
                                 );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetDPPAcquisitionMode (int handle,
                                 CAEN_DGTZ_DPP_AcqMode_t * mode,
                                 CAEN_DGTZ_DPP_SaveParam_t *param
                                 );

typedef enum
{
                                 CAEN_DGTZ_DPP_ACQ_MODE_Oscilloscope = 0L,
                                 CAEN_DGTZ_DPP_ACQ_MODE_List         = 1L,
                                 CAEN_DGTZ_DPP_ACQ_MODE_Mixed        = 2L,
} CAEN_DGTZ_DPP_AcqMode_t;

typedef enum
{
                                 CAEN_DGTZ_DPP_SAVE_PARAM_EnergyOnly    = 0L,
                                 CAEN_DGTZ_DPP_SAVE_PARAM_TimeOnly      = 1L,
                                 CAEN_DGTZ_DPP_SAVE_PARAM_EnergyAndTime = 2L,
                                 CAEN_DGTZ_DPP_SAVE_PARAM_ChargeAndTime = 4L,
                                 CAEN_DGTZ_DPP_SAVE_PARAM_None          = 3L,
} CAEN_DGTZ_DPP_SaveParam_t;
```

Arguments

Name	Description
handle	Device handler
mode/*mode	The DPP acquisition mode to set/get. CAEN_DGTZ_DPP_ACQ_MODE_Oscilloscope = 0L: enables the acquisition of the samples of the digitized waveforms. **Note:** Oscilloscope mode is not supported by DPP-PSD firmware of the 730 digitizer family. CAEN_DGTZ_DPP_ACQ_MODE_List = 1L: enables the acquisition of time stamps and energy values for each DPP firmware. CAEN_DGTZ_DPP_ACQ_MODE_Mixed = 2L: enables the acquisition of both waveforms, energies or charges, and time stamps.
param/*param	The acquisition data to retrieve in the acquisition **Note:** CAEN_DGTZ_DPP_SAVE_PARAM_ChargeAndTime is NOT USED

Return Values
0: Success; negative numbers are error codes (see Return Codes).

Set / GetDPPTriggerMode

Description
Sets/gets the DPP Trigger mode.

Note: to be used only with DPP-PSD and DPP-CI firmware.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetDPPTriggerMode (int handle,
                             CAEN DGTZ DPP TriggerMode t mode
                             );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetDPPTriggerMode (int handle,
                             CAEN_DGTZ_DPP_TriggerMode_t *mode
                             );

typedef enum
{
                             CAEN_DGTZ_DPP_TriggerMode_Normal,
                             CAEN_DGTZ_DPP_TriggerMode_Coincidence,
} CAEN_DGTZ_DPP_TriggerMode_t;
```

Arguments

Name	Description
handle	Device handler
mode/*mode	For SetDPPTriggerMode, it is the desired trigger mode which can be set CAEN_DGTZ_DPP_TriggerMode_Normal CAEN_DGTZ_DPP_TriggerMode_Coincidence For GetDPPTriggerMode, it is the current trigger mode.

Return Values
0: Success; negative numbers are error codes (see Return Codes).

Set / GetDPP_VirtualProbe

Description

Set/gets the information about virtual probes (both analog and digital probes) of any of the DPP firmware (PHA/PSD/CI).

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetDPP_VirtualProbe (int handle,
                               int trace,
                               int probe) ;

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetDPP_VirtualProbe (int handle,
                               int trace,
                               int *probe);

#define ANALOG_TRACE_1 (0)
#define ANALOG_TRACE_2 (1)
#define DIGITAL_TRACE_1 (2)
#define DIGITAL_TRACE_2 (3)
#define DIGITAL_TRACE_3 (4)
#define DIGITAL_TRACE_4 (5)

#define CAEN_DGTZ_DPP_VIRTUALPROBE_Input (0)
#define CAEN_DGTZ_DPP_VIRTUALPROBE_Delta (1)
#define CAEN_DGTZ_DPP_VIRTUALPROBE_Delta2 (2)
#define CAEN_DGTZ_DPP_VIRTUALPROBE_Trapezoid (3)
#define CAEN_DGTZ_DPP_VIRTUALPROBE_TrapezoidReduced (4)
#define CAEN_DGTZ_DPP_VIRTUALPROBE_Baseline (5)
#define CAEN_DGTZ_DPP_VIRTUALPROBE_Threshold (6)
#define CAEN_DGTZ_DPP_VIRTUALPROBE_CFD (7)
#define CAEN_DGTZ_DPP_VIRTUALPROBE_None (8)

#define CAEN_DGTZ_DPP_DIGITALPROBE_TRGWin (9)
#define CAEN_DGTZ_DPP_DIGITALPROBE_Armed (10)
#define CAEN_DGTZ_DPP_DIGITALPROBE_PkRun (11)
#define CAEN_DGTZ_DPP_DIGITALPROBE_Peaking (12)
#define CAEN_DGTZ_DPP_DIGITALPROBE_CoincWin (13)
#define CAEN_DGTZ_DPP_DIGITALPROBE_BLHoldoff (14)
#define CAEN_DGTZ_DPP_DIGITALPROBE_TRGHoldoff (15)
#define CAEN_DGTZ_DPP_DIGITALPROBE_TRGVal (16)
#define CAEN_DGTZ_DPP_DIGITALPROBE_ACQVeto (17)
#define CAEN_DGTZ_DPP_DIGITALPROBE_BFMVeto (18)
#define CAEN_DGTZ_DPP_DIGITALPROBE_ExtTRG (19)
#define CAEN_DGTZ_DPP_DIGITALPROBE_OverThr (20)
#define CAEN_DGTZ_DPP_DIGITALPROBE_TRGOut (21)
#define CAEN_DGTZ_DPP_DIGITALPROBE_Coincidence (22)
#define CAEN_DGTZ_DPP_DIGITALPROBE_PileUp (23)
#define CAEN_DGTZ_DPP_DIGITALPROBE_Gate (24)
#define CAEN_DGTZ_DPP_DIGITALPROBE_GateShort (25)
#define CAEN_DGTZ_DPP_DIGITALPROBE_Trigger (26)
#define CAEN_DGTZ_DPP_DIGITALPROBE_None (27)
```

Arguments

Name	Description
handle	Device handler
trace	The Trace to set/get
probe	The Virtual Probe to set/get on the given trace

Return Values

0: Success; negative numbers are error codes (see Return Codes).

Examples

1. How to set the “Delta2” probe on the “analog trace 1” of the DPP-PHA firmware:

   ret |= CAEN_DGTZ_SetDPP_VirtualProbe(handle, ANALOG_TRACE_1, CAEN_DGTZ_DPP_VIRTUALPROBE_Delta2);

2. How to disable the dual trace, i.e. set “None” on the “analog trace 2” of the DPP-PHA firmware:

   ret |= CAEN_DGTZ_SetDPP_VirtualProbe(handle, ANALOG_TRACE_2, CAEN_DGTZ_DPP_VIRTUALPROBE_None);

3. How to set the “Peaking” probe on the “digital trace 1” of the DPP-PHA firmware:

   ret |= CAEN_DGTZ_SetDPP_VirtualProbe(handle, DIGITAL_TRACE_1, CAEN_DGTZ_DPP_DIGITALPROBE_Peaking).

GetDPP_SupportedVirtualProbes

Description

Get the list of virtual probes supported on board's given trace any of the DPP firmware (PHA/PSD/CI).

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetDPP_SupportedVirtualProbes(int handle,
                                        int trace,
                                        int probes[],
                                        int *numProbes
                                        );
```

Arguments

Name	Description
handle	Device handler
trace	The Trace to be get the probes list of
probes[]	The list of Virtual Probes supported by the trace. **Note:** it must be an array of length MAX_SUPPORTED_PROBES
numProbes	The number of probes supported by the trace

Return Values

0: Success; negative numbers are error codes (see Return Codes).

Set / GetDPP_PHA_VirtualProbe

Description
Set/gets the information about the output signal of the DPP-PHA acquisition mode.

Note: this function is currently **deprecated**. Please use the **Set / GetDPP_VirtualProbe** function.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetDPP_PHA_VirtualProbe (int handle,
                                   CAEN_DGTZ_DPP_VirtualProbe_t mode,
                                   CAEN_DGTZ_DPP_PHA_VirtualProbe1_t vp1,
                                   CAEN_DGTZ_DPP_PHA_VirtualProbe2_t vp2,
                                   CAEN_DGTZ_DPP_PHA_DigitalProbe_t dp
                                   );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetDPP_PHA_VirtualProbe (int handle,
                                   CAEN_DGTZ_DPP_VirtualProbe_t *mode,
                                   CAEN_DGTZ_DPP_PHA_VirtualProbe1_t *vp1,
                                   CAEN_DGTZ_DPP_PHA_VirtualProbe2_t *vp2,
                                   CAEN_DGTZ_DPP_PHA_DigitalProbe_t *dp
                                   );

typedef enum
{
                                   CAEN_DGTZ_DPP_VIRTUALPROBE_SINGLE = 0,
                                   CAEN_DGTZ_DPP_VIRTUALPROBE_DUAL   = 1,
} CAEN_DGTZ_DPP_VirtualProbe_t;

typedef enum
{
                                 CAEN_DGTZ_DPP_PHA_VIRTUALPROBE1_Input     = 0,
                                 CAEN_DGTZ_DPP_PHA_VIRTUALPROBE1_Delta     = 1,
                                 CAEN_DGTZ_DPP_PHA_VIRTUALPROBE1_Delta2    = 2,
                                 CAEN_DGTZ_DPP_PHA_VIRTUALPROBE1_trapezoid = 3,
} CAEN_DGTZ_DPP_PHA_VirtualProbe1_t;









typedef enum
{
                                 CAEN_DGTZ_DPP_PHA_VIRTUALPROBE2_Input        = 0,
                                 CAEN_DGTZ_DPP_PHA_VIRTUALPROBE2_S3           = 1,
                                 CAEN_DGTZ_DPP_PHA_VIRTUALPROBE2_DigitalCombo = 2,
                                 CAEN_DGTZ_DPP_PHA_VIRTUALPROBE2_trapBaseline = 3,
                                 CAEN_DGTZ_DPP_PHA_VIRTUALPROBE2_None         = 4,
} CAEN_DGTZ_DPP_PHA_VirtualProbe2_t;

typedef enum
{
                                 CAEN_DGTZ_DPP_PHA_DIGITAL_PROBE_trgWin     = 0,
                                 CAEN_DGTZ_DPP_PHA_DIGITAL_PROBE_Armed      = 1,
                                 CAEN_DGTZ_DPP_PHA_DIGITAL_PROBE_PkRun      = 2,
                                 CAEN_DGTZ_DPP_PHA_DIGITAL_PROBE_PURFlag    = 3,
                                 CAEN_DGTZ_DPP_PHA_DIGITAL_PROBE_Peaking    = 4,
                                 CAEN_DGTZ_DPP_PHA_DIGITAL_PROBE_TVAW       = 5,
                                 CAEN_DGTZ_DPP_PHA_DIGITAL_PROBE_BLHoldoff  = 6,
                                 CAEN_DGTZ_DPP_PHA_DIGITAL_PROBE_TRGHoldOff = 7,
                                 CAEN_DGTZ_DPP_PHA_DIGITAL_PROBE_TRGVal     = 8,
                                 CAEN_DGTZ_DPP_PHA_DIGITAL_PROBE_ACQVeto    = 9,
                                 CAEN_DGTZ_DPP_PHA_DIGITAL_PROBE_BFMVeto    = 10,
                                 CAEN_DGTZ_DPP_PHA_DIGITAL_PROBE_ExtTRG     = 11,
} CAEN_DGTZ_DPP_PHA_DigitalProbe_t;
```

Arguments

Name	Description
`handle`	Device handler
`mode/*mode`	The Virtual Probe mode to set/get.
`vp1/*vp1`	The Virtual Probe1 mode to set/get
`vp2/*vp2`	The Virtual Probe2 mode to set/get
`dp/*dp`	The Digital Probe mode to set/get

Return Values

0: Success; negative numbers are error codes (see Return Codes).

Set / GetDPP_PSD_VirtualProbe

Description
Sets/gets the information about the output signal of the DPP-PSD acquisition mode.

Note: this function is currently **deprecated**. Please use the **Set / GetDPP_VirtualProbe** function.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetDPP_PSD_VirtualProbe (int handle,
                                   CAEN_DGTZ_DPP_VirtualProbe_t mode,
                                   CAEN_DGTZ_DPP_PSD_VirtualProbe_t vp,
                                   CAEN_DGTZ_DPP_PSD_DigitalProbe1_t dp1,
                                   CAEN_DGTZ_DPP_PSD_DigitalProbe2_t dp2
                                   );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetDPP_PSD_VirtualProbe (int handle,
                                   CAEN_DGTZ_DPP_VirtualProbe_t *mode,
                                   CAEN_DGTZ_DPP_PSD_VirtualProbe_t *vp,
                                   CAEN_DGTZ_DPP_PSD_DigitalProbe1_t *dp1,
                                   CAEN_DGTZ_DPP_PSD_DigitalProbe2_t *dp2
                                   );

typedef enum
{
                                   CAEN_DGTZ_DPP_VIRTUALPROBE_SINGLE = 0,
                                   CAEN_DGTZ_DPP_VIRTUALPROBE_DUAL   = 1,
} CAEN_DGTZ_DPP_VirtualProbe_t;

typedef enum
{
                               CAEN_DGTZ_DPP_PSD_VIRTUALPROBE_Baseline  = 0,
                               CAEN_DGTZ_DPP_PSD_VIRTUALPROBE_Threshold = 1,
} CAEN_DGTZ_DPP_PSD_VirtualProbe_t;

typedef enum
{
    /************************************************************
    *  WARNING WARNING WARNING WARNING WARNING WARNING WARNING  *
    *  The following values are valid for the following DPP-PSD *
    *  Firmwares:                                               *
    *       x720 Boards: AMC_REL <= 131.5                       *
    *       x751 Boards: AMC_REL <= 132.5                       *
    *  For newer firmwares, use the values marked with 'R6' in  *
    *  the name.                                                *
    *  WARNING WARNING WARNING WARNING WARNING WARNING WARNING  *
    ************************************************************/

    /* x720 Digital Probes Types */
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE1_Armed          = 0,
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE1_Trigger        = 1,
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE1_ChargeReady    = 2,
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE1_PileUp         = 3,
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE1_BlOutSafeBand  = 4,
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE1_BlTimeout      = 5,
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE1_CoincidenceMet = 6,
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE1_Tvaw           = 7,

    /* x751 Digital Probes Types */
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE1_OverThr        = 8,
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE1_GateShort      = 9,
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE1_None           = 10,

    /************************************************************
    *  WARNING WARNING WARNING WARNING WARNING WARNING WARNING  *
    *  The following values are valid for the following DPP-PSD *
    *  Firmwares:                                               *
    *       x720 Boards: AMC_REL >= 131.6                       *
    *       x751 Boards: AMC_REL >= 132.6                       *
    *  For older firmwares, use the values above.               *
    *  WARNING WARNING WARNING WARNING WARNING WARNING WARNING  *
    ************************************************************/
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE1_R6_ExtTrg      = 11, /* x720 only */
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE1_R6_OverThr     = 12,
```

```
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE1_R6_TrigOut      = 13,
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE1_R6_CoincWin     = 14,
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE1_R6_PileUp       = 15,
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE1_R6_Coincidence  = 16,
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE1_R6_GateLong     = 17, /* x751 only */
} CAEN_DGTZ_DPP_PSD_DigitalProbe1_t;

typedef enum
{
    /************************************************************
    *  WARNING WARNING WARNING WARNING WARNING WARNING WARNING  *
    *  The following values are valid for the following DPP-PSD *
    *  Firmwares:                                               *
    *       x720 Boards: AMC REL <= 131.5                       *
    *       x751 Boards: AMC REL <= 132.5                       *
    *  For newer firmwares, use the values marked with 'R6' in  *
    *  the name.                                                *
    *  WARNING WARNING WARNING WARNING WARNING WARNING WARNING  *
    ************************************************************/

    /* x720 Digital Probes Types */
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE2_Armed           = 0,
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE2_Trigger         = 1,
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE2_ChargeReady     = 2,
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE2_PileUp          = 3,
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE2_BlOutSafeBand   = 4,
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE2_BlTimeout       = 5,
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE2_CoincidenceMet  = 6,
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE2_Tvaw            = 7,

    /* x751 Digital Probes Types */
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE2_GateShort       = 8,
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE2_GateLong        = 9,
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE2_None            = 10,




    /************************************************************
    *  WARNING WARNING WARNING WARNING WARNING WARNING WARNING  *
    *  The following values are valid for the following DPP-PSD *
    *  Firmwares:                                               *
    *       x720 Boards: AMC_REL >= 131.6                       *
    *       x751 Boards: AMC_REL >= 132.6                       *
    *  For older firmwares, use the values above.               *
    *  WARNING WARNING WARNING WARNING WARNING WARNING WARNING  *
    ************************************************************/
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE2_R6_GateShort    = 11,
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE2_R6_OverThr      = 12,
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE2_R6_TrgVal       = 13,
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE2_R6_TrgHO        = 14,
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE2_R6_PileUp       = 15,
    CAEN_DGTZ_DPP_PSD_DIGITALPROBE2_R6_Coincidence  = 16,
} CAEN_DGTZ_DPP_PSD_DigitalProbe2_t;
```

Arguments

Name	Description
handle	Device handler
mode/*mode	The Virtual Probe mode to set/get.
vp/*vp	The Virtual Probe to set/get. **Note:** ignored for x751; VirtualProbes are always Input and Baseline
dp1/*dp1	The Digital Probe1 to set/get
dp2/*dp2	The Digital Probe2 to set/get

Return Values

0: Success; negative numbers are error codes (see Return Codes).

Set / GetDPP_CI_VirtualProbe

Description
Sets/gets the information about the output signal of the DPP-CI acquisition mode.

Note: this function is supported only by DPP-CI firmware from release 3.4_130.16 on.

Note: this function is currently **deprecated**. Please use the **Set / GetDPP_VirtualProbe** function.

Synopsis

```
CAEN DGTZ ErrorCode CAENDGTZ API
CAEN DGTZ SetDPP CI VirtualProbe (int handle,
                                  CAEN DGTZ DPP VirtualProbe t mode,
                                  CAEN DGTZ DPP CI VirtualProbe t vp,
                                  CAEN_DGTZ_DPP_CI_DigitalProbe1_t dp1,
                                  CAEN_DGTZ_DPP_CI_DigitalProbe2_t dp2
                                  );

CAEN DGTZ ErrorCode CAENDGTZ API
CAEN_DGTZ_GetDPP_CI_VirtualProbe (int handle,
                                  CAEN_DGTZ_DPP_VirtualProbe_t *mode,
                                  CAEN_DGTZ_DPP_CI_VirtualProbe_t *vp,
                                  CAEN DGTZ DPP CI DigitalProbe1 t *dp1,
                                  CAEN DGTZ DPP CI DigitalProbe2 t *dp2
                                  );

typedef enum
{
                                  CAEN DGTZ DPP VIRTUALPROBE SINGLE = 0,
                                  CAEN DGTZ DPP VIRTUALPROBE DUAL   = 1,
} CAEN DGTZ DPP VirtualProbe t;

typedef enum
{
                               CAEN DGTZ DPP CI VIRTUALPROBE Baseline = 0,
} CAEN DGTZ DPP CI VirtualProbe t;




typedef enum
{
    /************************************************************
    *  WARNING WARNING WARNING WARNING WARNING WARNING WARNING  *
    *  The following values are valid for the following DPP-CI  *
    *  Firmwares:                                               *
    *       x720 Boards: AMC REL <= 130.20                      *
    *  For newer firmwares, use the values marked with 'R22' in *
    *  the name.                                                *
    *  WARNING WARNING WARNING WARNING WARNING WARNING WARNING  *
    ************************************************************/
    CAEN DGTZ DPP CI DIGITALPROBE1 BlOutSafeBand         = 0,
    CAEN_DGTZ_DPP_CI_DIGITALPROBE1_BlTimeout             = 1,
    CAEN_DGTZ_DPP_CI_DIGITALPROBE1_CoincidenceMet        = 2,
    CAEN DGTZ DPP CI DIGITALPROBE1 Tvaw                  = 3,

    /************************************************************
    *  WARNING WARNING WARNING WARNING WARNING WARNING WARNING  *
    *  The following values are valid for the following DPP-CI  *
    *  Firmwares:                                               *
    *       x720 Boards: AMC REL >= 130.22                      *
    *  For older firmwares, use the values above.               *
    *  WARNING WARNING WARNING WARNING WARNING WARNING WARNING  *
    ************************************************************/
    CAEN_DGTZ_DPP_CI_DIGITALPROBE1_R22_ExtTrg            = 4,
    CAEN DGTZ DPP CI DIGITALPROBE1 R22 OverThr           = 5,
    CAEN DGTZ DPP CI DIGITALPROBE1 R22 TrigOut           = 6,
    CAEN DGTZ DPP CI DIGITALPROBE1 R22 CoincWin          = 7,
    CAEN_DGTZ_DPP_CI_DIGITALPROBE1_R22_Coincidence       = 9,
} CAEN_DGTZ_DPP_CI_DigitalProbe1_t;

typedef enum
{
    /************************************************************
```

```
    *  WARNING WARNING WARNING WARNING WARNING WARNING WARNING  *
    *  The following values are valid for the following DPP-CI  *
    *  Firmwares:                                               *
    *       x720 Boards: AMC REL <= 130.20                      *
    *  For newer firmwares, use the values marked with 'R22' in *
    *  the name.                                                *
    *  WARNING WARNING WARNING WARNING WARNING WARNING WARNING  *
    ***********************************************************/
    CAEN_DGTZ_DPP_CI_DIGITALPROBE2_BlOutSafeBand    = 0,
    CAEN_DGTZ_DPP_CI_DIGITALPROBE2_BlTimeout        = 1,
    CAEN_DGTZ_DPP_CI_DIGITALPROBE2_CoincidenceMet   = 2,
    CAEN_DGTZ_DPP_CI_DIGITALPROBE2_Tvaw             = 3,

    /***********************************************************
    *  WARNING WARNING WARNING WARNING WARNING WARNING WARNING  *
    *  The following values are valid for the following DPP-CI  *
    *  Firmwares:                                               *
    *       x720 Boards: AMC_REL >= 130.22                      *
    *  For older firmwares, use the values above.               *
    *  WARNING WARNING WARNING WARNING WARNING WARNING WARNING  *
    ***********************************************************/
    CAEN_DGTZ_DPP_CI_DIGITALPROBE2_R22_OverThr      = 5,
    CAEN_DGTZ_DPP_CI_DIGITALPROBE2_R22_TrgVal       = 6,
    CAEN_DGTZ_DPP_CI_DIGITALPROBE2_R22_TrgHO        = 7,
    CAEN_DGTZ_DPP_CI_DIGITALPROBE2_R22_Coincidence  = 9,
} CAEN_DGTZ_DPP_CI_DigitalProbe2_t;
```

Arguments

Name	Description
handle	Device handler
mode/*mode	The Virtual Probe mode to set/get.
vp/*vp	The Virtual Probe to set/get
dp1/*dp1	The Digital Probe1 to set/get
dp2/*dp2	The Digital Probe2 to set/get

Return Values

0: Success; negative numbers are error codes (see Return Codes).

DPP Example Codes

CAEN provides a set of DPP example codes intended to let the developer deal with the library C functions to build up a readout cycle when using DPP-PHA, DPP-CI and DPP-PSD firmware. The CAENdigitizer installation package includes the source C files and Visual Studio projects (**compliant to Visual Studio Professional 2010**).

Note: the DPP example codes may not include all the library functions and the user must consider to tailor the code and parameters according to his actual purposes.

Note: the DPP-CI example code works only with the DPP-CI firmware from release 3.4_130.16 on.

In Windows systems, the DPP example codes are located in the "Samples" subfolder of "CAEN" main directory (see **Fig. 6.1**).

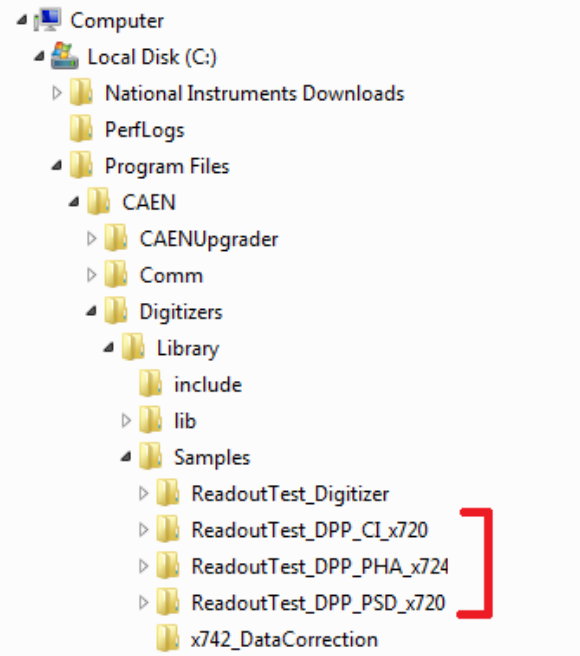


Fig. 6.1: DPP examples location (Windows 7 64-bit OS as reference)

In Linux systems, the DPP example codes are located in the "samples" subfolder of the library main directory.

7 ZLEplus (x751) Specific Functions

This chapter describes the CAENDigitizer library functions relying on the DPP-ZLE*plus* special firmware supported by the digitizers of the 751 series.

MallocZLEEvents

Description
It allocates the event buffer matrix which is handled by the **GetZLEEvents** function. The matrix has one event array per channel and must be declared as a MAX_CH-sized array of pointers.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_MallocZLEEvents(
                          int handle,
                          void **events,
                          uint32_t *allocatedSize
                          );

typedef struct
{
    uint32_t timeTag;
    uint32_t baseline;
    uint32_t *Waveforms;
} CAEN_DGTZ_751_ZLE_Event_t;
```

Arguments

Name	Description
handle	Device handler
****events**	The pointer to the event matrix, which shall be of type: CAEN_DGTZ_751_ZLE_Event_t
***allocatedSize**	The size in bytes of the event list

Return Values
0: Success; negative numbers are error codes (see Return Codes).

FreeZLEEvents

Description
Deallocates the event buffer matrix.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_FreeZLEEvents(
                        int handle,
                        void **events
                        );
```

Arguments

Name	Description
handle	Device handler
****events**	Pointer to the event buffer matrix

Return Values
0: Success; negative numbers are error codes (see Return Codes).

GetZLEEvents

Description
This function returns an array of events (and the number of events present in the array) that are the events stored in the buffer read from the **ReadData** function). Each event has a baseline, a Time Tag and as associate waveform (to be decoded by the **DecodeZLEWaveforms** function)

Synopsis

```
CAEN DGTZ ErrorCode CAENDGTZ API
CAEN DGTZ GetZLEEvents (
                        int handle,
                        char *buffer,
                        uint32_t buffsize,
                        void **events,
                        uint32 t *numEventsArray
                        );
```

Arguments

Name	Description
handle	Device handler
***buffer**	Pointer to the address of the acquisition buffer
buffsize	The acquisition buffer size (in samples)
****events**	Pointer to the event list (allocated via the **MallocDPPEvents** function)
***numEventsArray**	Pointer to an array of *int* which will contain the number of events found per channel

Return Values
0: Success; negative numbers are error codes (see Return Codes).

MallocZLEWaveforms

Description
Allocates the waveform buffer whch is handled by the **DecodeZLEWaveforms** function.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_MallocZLEWaveforms(
                             int handle,
                             void **waveforms,
                             uint32 t *allocatedSize
                             );

typedef struct
{
    uint32_t Ns;
    uint16 t *Trace1;
    uint8 t *Discarded;
} CAEN_DGTZ_751_ZLE_Waveforms_t;
```

Arguments

Name	Description
handle	Device handler
****waveforms**	The pointer to the waveform buffer, which shall be of type: CAEN_DGTZ_751_ZLE_Waveforms_t
***allocatedSize**	The size in bytes of the waveform buffer

Return Values
0: Success; negative numbers are error codes (see Return Codes).

FreeZLEWaveforms

Description
Deallocates the waveform buffer.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_FreeZLEWaveforms(
                            int handle,
                            void *waveforms
                            );
```

Arguments

Name	Description
handle	Device handler
***waveforms**	The pointer to the waveform buffer

Return Values
0: Success; negative numbers are error codes (see Return Codes).

DecodeZLEWaveforms

Description
This function decodes the waveforms contained inside an event: takes one event and returns the waveform associated to that event in a waveform buffer.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_DecodeZLEWaveforms(
                              int handle,
                              void *event,
                              void *waveforms
                              );
```

Arguments

Name	Description
handle	Device handler
***event**	The pointer to the event
***waveforms**	The pointer to the (preallocated) waveform list

Return Values
0: Success; negative numbers are error codes (see Return Codes).

Set / GetZLEParameters

Description

It allows to set / get the ZLE parameters.

Synopsis

```
CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_SetZLEParameters(
                          int handle,
                          uint32_t channelMask,
                          void *params
                          );

CAEN_DGTZ_ErrorCode CAENDGTZ_API
CAEN_DGTZ_GetZLEEvents(
                       int handle,
                       char *buffer,
                       uint32 t buffsize,
                       void **events,
                       uint32_t *numEventsArray
                       );

typedef struct {
    int NSampBck         [MAX_ZLE_CHANNEL_SIZE];
    int NSampAhe         [MAX_ZLE_CHANNEL_SIZE];
    int ZleUppThr        [MAX_ZLE_CHANNEL_SIZE];
    int ZleUndThr        [MAX_ZLE_CHANNEL_SIZE];
    int selNumSampBsl    [MAX_ZLE_CHANNEL_SIZE];
    int bslThrshld       [MAX_ZLE_CHANNEL_SIZE];
    int bslTimeOut       [MAX_ZLE_CHANNEL_SIZE];
    int preTrgg;
} CAEN_DGTZ_751_ZLE_Params_t;

#define MAX_V1751DPP_CHANNEL_SIZE    (8)
#define MAX_ZLE_CHANNEL_SIZE         (MAX_V1751DPP_CHANNEL_SIZE)
```

Arguments

Name	Description
handle	Device handler
channelMask (Set only)	A bit mask indicating to which channels the ZLE parameters are applied.
***params (Set only)**	Pointer to the ZLE paramters array, which shall by of type: CAEN_DGTZ_751_ZLE_Params_t (see the *DPP-ZLEplus User Manual* for parameters description).
***buffer**	Pointer to the readout buffer (see **ReadData**)
buffsize	Size of the data block read from the board, expressed in bytes (see **ReadData**)
****events**	Pointer to the event matrix (with channels as rows and event arrays as columns)
***numEventsArray**	Pointer to an array of *int* which will contain the number of events found per channel

Return Values

0: Success; negative numbers are error codes (see Return Codes).

8 Examples of Communication Settings

Example No.1

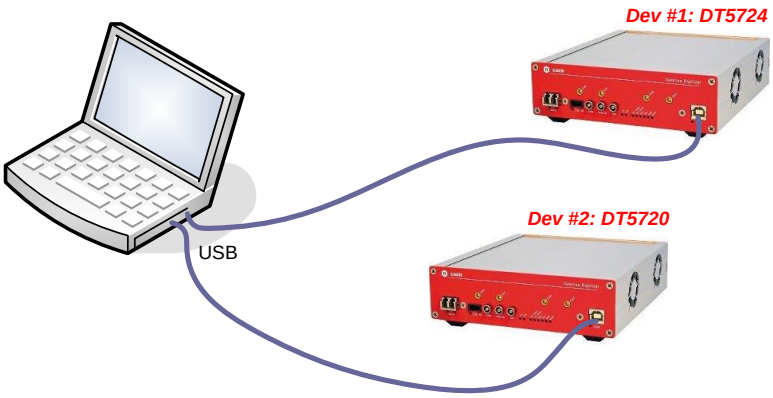


Fig. 8.1: Connection example no.1

The host PC is connected via 2 USB ports to two desktop digitizer:

- Dev#1: DT5724 - 4 Channel 14 bit 100 MS/s Digitizer
- Dev#2: DT5720 - 4 Channel 12 bit 250 MS/s Digitizer

The computer is first connected to DT5724 then to the DT5720.

Open Dev#1: DT5724 connected via USB cable

```
CAEN_DGTZ_OpenDigitizer (
                        CAEN_DGTZ_USB,     LinkType: physical communication channel = USB
                        0,                 LinkNum: Link number = 0 first device
                        0,                 ConetNode: if USB = 0
                        0,                 VMEBaseAddress: must be= 0
                        &handleDT5724_1    Pointer to the handler returned by function
);
```

Open Dev#2: DT5720 connected via USB cable

```
CAEN_DGTZ_OpenDigitizer (
                        CAEN_DGTZ_USB,     LinkType: physical communication channel = USB
                        1,                 LinkNum: Link number = 1 second device
                        0,                 ConetNode: if USB = 0
                        0,                 VMEBaseAddress: must be = 0
                        &handleDT5720 2    Pointer to the handler returned by function
);
```

Arguments description

Name	Description
LinkType	= CAEN_DGTZ_USB. Indicates USB as the physical communication channel.
LinkNum	Link number: in case of USB, the link numbers are assigned by the PC when you connect the cable to the device; it is 0 for the first device (DT5724), 1 for the second (DT5720) There is not a fixed correspondence between the USB port and the link number.
ConetNode	In case of USB, ConetNode must be 0.
VMEBaseAddress	Not used = 0 (used only for model accessed via VME).

Example No.2

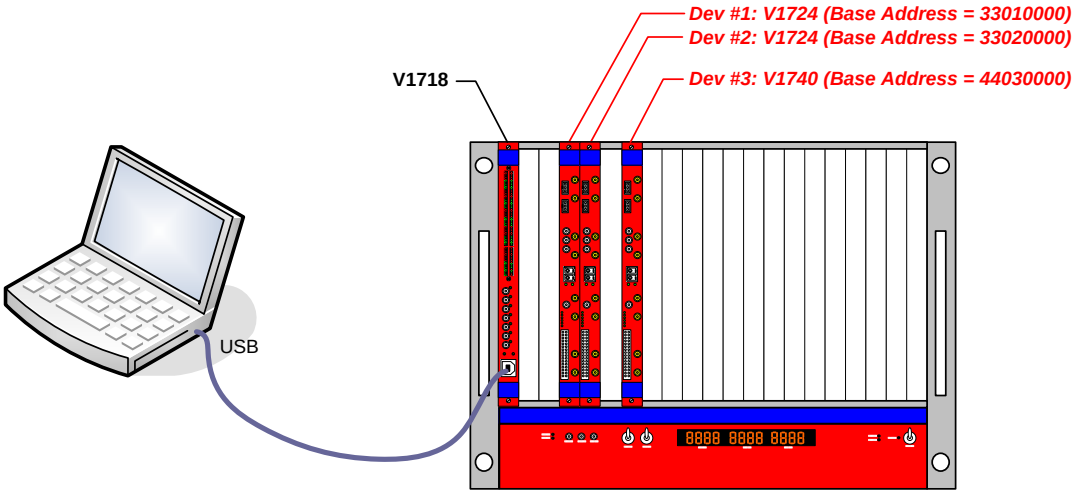


Fig. 8.2: Connection example no.2

The host PC is connected via USB ports to one V1718 VME-USB2.0 Bridge housed in a VME crate. The crate contains also the following boards

- Dev#1: V1724 - 8 Channel 14 bit 100 MS/s Digitizer (Base address = 0x33010000)
- Dev#2: V1724 - 8 Channel 14 bit 100 MS/s Digitizer (Base address = 0x33020000)
- Dev#3: V1740 - 64 Channel 12 bit 62.5 MS/s Digitizer (Base address = 0x44030000)

Open Dev#1: V1724 (VME base address 0x33010000) accessed via VMEbus through the V1718:

```
CAEN_DGTZ_OpenDigitizer (
                         CAEN_DGTZ_USB,     LinkType: physical communication channel = USB
                         0,                 LinkNum: Link number = 0 first device
                         0,                 ConetNode: if USB = 0
                         0x33010000,        VMEBaseAddress
                         &handleV1724_1     Pointer to the handler returned by function
);
```

Open Dev#12: V1724 (VME base address 0x33020000) accessed via VMEbus through the V1718:

```
CAEN_DGTZ_OpenDigitizer (
                         CAEN_DGTZ_USB,     LinkType: physical communication channel = USB
                         0,                 LinkNum: Link number = 0 first device
                         0,                 ConetNode: if USB = 0
                         0x33020000,        VMEBaseAddress
                         &handleV1724_2     Pointer to the handler returned by function
);
```

Open Dev#3: V1740 (VME base address 0x44030000) accessed via VMEbus through the V1718:

```
CAEN_DGTZ_OpenDigitizer (
                         CAEN_DGTZ_USB,     LinkType: physical communication channel = USB
                         0,                 LinkNum: Link number = 0 first device
                         0,                 ConetNode: if USB = 0
                         0x44030000,        VMEBaseAddress
                         &handleV1740_3     Pointer to the handler returned by function
);
```

Arguments description

Name	Description
LinkType	= CAEN_DGTZ_USB. Indicates USB as the physical communication channel .
LinkNum	Link number: in case of USB, the link numbers are assigned by the PC when you connect the cable to the device; it is 0 for the first device, 1 for the second There is not a fixed correspondence between the USB port and the link number.
ConetNode	In case of USB, ConetNode must be 0.
VMEBaseAddress	VME Base Address of the board (rotary switches setting) expressed as a 32 bit number. This argument is used only for the VME models accessed through the VME bus and MUST BE 0 in all other cases.

Example No.3

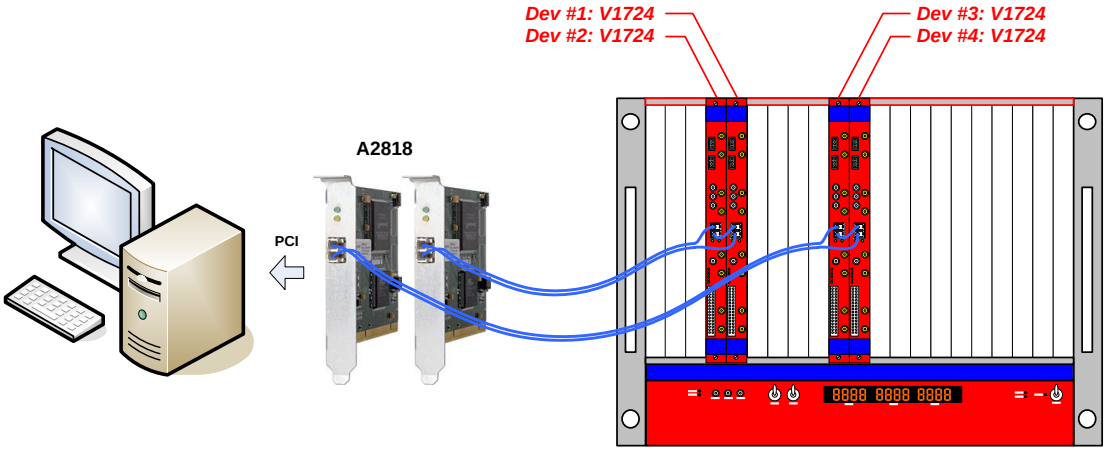


Fig. 8.3: Connection example no.3

The host PC houses two CAEN A2818 PCI CONET Controllers; the VME crate houses the following boards:

- Two V1724 Digitizer connected in a Daisy chain between them end to the A2818 #0: Dev#1 (first in Daisy chain) and Dev#2 (second in Daisy chain)
- Two V1724 Digitizer connected in a Daisy chain between them end to the A2818 #1: Dev#3 (first in Daisy chain) and Dev#4 (second in Daisy chain)

Note: the A2818 number refers to the PCI slot and depends on the motherboard of the PC used. **It is not known a priori which PCI card is assigned to which number.** In this example we assume that the A2818 connected to Dev#1 and Dev#2, is inserted into the first PCI slot and get Link Number = 0.

Open Dev#1: V1724 first device in Daisy chain of A2818#0:

```
CAEN_DGTZ_OpenDigitizer (
        CAEN_DGTZ_OpticalLink,      LinkType: physical communication channel = Optical Link via A2818 (PCI Controller)
        0,                          LinkNum: Link number = 0 first device
        0,                          ConetNode: first device in the chain  =0
        0,                          VMEBaseAddress: must be = 0
        &handleV1724_1              Pointer to the handler returned by function
);
```

Open Dev#2: V1724 second device in Daisy chain of A2818#0:

```
CAEN_DGTZ_OpenDigitizer (
        CAEN_DGTZ_OpticalLink,      LinkType: physical communication channel = Optical Link via A2818 (PCI Controller)
        0,                          LinkNum: Link number = 0 first device
        1,                          ConetNode: second device in the chain = 1
        0,                          VMEBaseAddress: must be = 0
        &handleV1724_2              Pointer to the handler returned by function
);
```

Open Dev#3: V1724 first device in Daisy chain of A2818#1:

```
CAEN_DGTZ_OpenDigitizer (
        CAEN_DGTZ_OpticalLink,      LinkType: physical communication channel = Optical Link via A2818 (PCI Controller)
        1,                          LinkNum: Link number = 1 second  device
        0,                          ConetNode: first device in the chain =0
        0,                          VMEBaseAddress: must be = 0
        &handleV1724_3              Pointer to the handler returned by function
);
```

Open Dev#4: V1724 second device in Daisy chain of A2818#1:

```
CAEN_DGTZ_OpenDigitizer (
        CAEN_DGTZ_OpticalLink,      LinkType: physical communication channel = Optical Link via A2818 (PCI Controller)
        1,                          LinkNum: Link number = 1 second  device
        1,                          ConetNode: second device in the chain = 1
        0,                          VMEBaseAddress: must be = 0
        &handleV1724_4              Pointer to the handler returned by function
);
```

Arguments description

Name	Description
`LinkType`	= CAEN_DGTZ_OpticalLink. Indicates A2818 -> Optical Link, either direct connection or VME through V2718 as the physical communication channel. **Note**: the function CAEN_DGTZ_PCI_OpticalLink is now deprecated, though it is still possible to use it.
`LinkNum`	Link number: For the CONET, the link number indicates which link of A2818 or A3818 is used. For A2818 refers to the PCI slot and depends on the motherboard of the PC used. Link index start from 0 (1st link in the 1st slot used). It is not known a priori which is the first slot used.
`ConetNode`	The CONET node identifies which device in the Daisy chain is being addressed. The node is 0 for the first device in the chain, 1 for the second and so on. See **Fig. 8.4**.
`VMEBaseAddress`	Not used = 0 (used only for model accessed via VME).

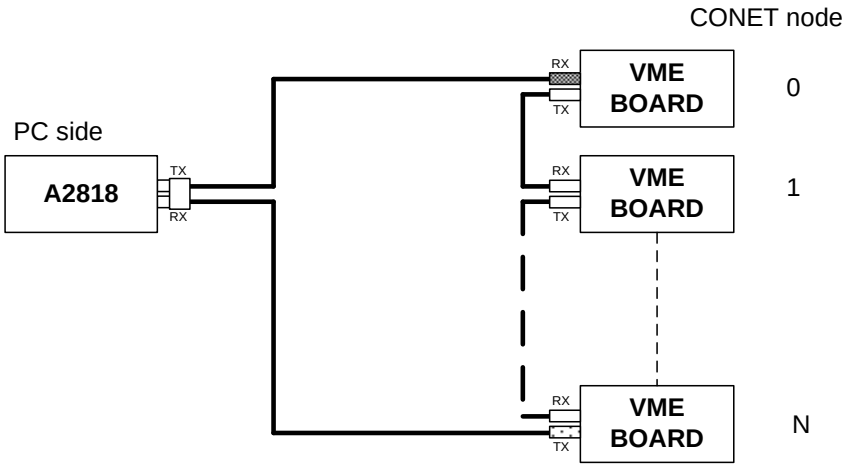


Fig. 8.4: A2818 network scheme

Example No.4

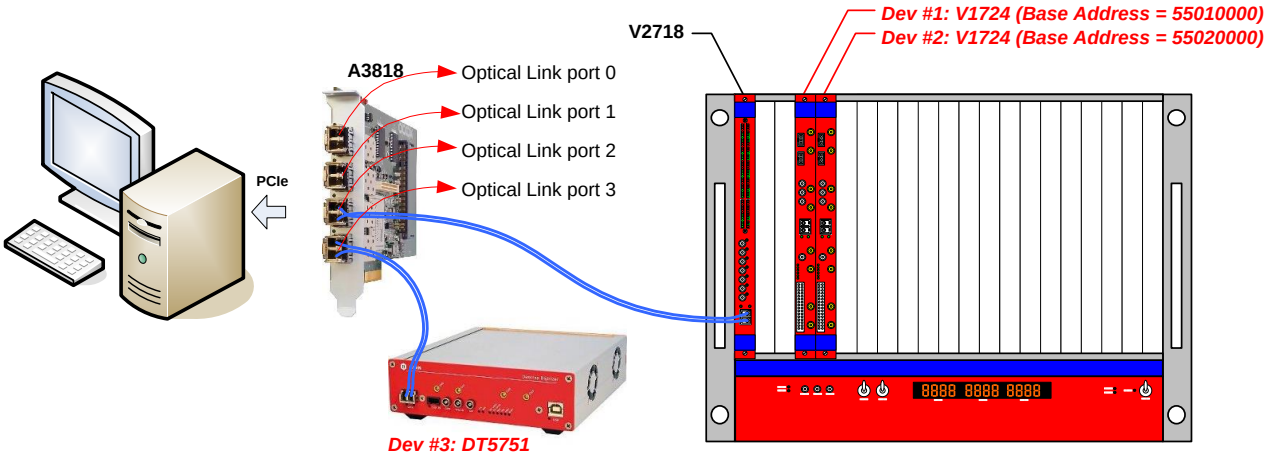


Fig. 8.5: Connection example no.4

The host PC houses one CAEN A3818C PCIe CONET Controller with 4 Optical Link;

- port#3 is connected to Dev#3 (DT5751 - 2/4 Channel 10 bit 2/1 GS/s Digitizer)
- port#2 is connected to a V2718 VME-PCI Optical Link Bridge housed in a VME crate that contains the following boards:
    - Dev#1: V1724 - 8 Channel 14 bit 100 MS/s Digitizer (Base address = 0x55010000)
    - Dev#2: V1724 - 8 Channel 14 bit 100 MS/s Digitizer (Base address = 0x55020000)

Open Dev#1: V1724 (VME base address 0x55010000) accessed via VMEbus through the V2718 connected to A3818 port#2:

```
CAEN_DGTZ_OpenDigitizer (
        CAEN_DGTZ_OpticalLink,      LinkType: physical communication channel = Optical Link via A3818 (PCIe Controller)
        2,                          LinkNum: unique device, Link number =A3818 port number: 2
        0,                          ConetNode: unique device in the chain  =0
        0x55010000,                 VMEBaseAddress
        &handleV1724_1              Pointer to the handler returned by function
);
```

Open Dev#2: V1724 (VME base address 0x55020000) accessed via VMEbus through the V2718 connected to A3818 port#2:

```
CAEN_DGTZ_OpenDigitizer (
        CAEN_DGTZ_OpticalLink,      LinkType: physical communication channel = Optical Link via A3818 (PCIe Controller)
        2,                          LinkNum: unique device, Link number =A3818 port number: 2
        0,                          ConetNode: unique device in the chain  =0
        0x55020000,                 VMEBaseAddress
        &handleV1724_2              Pointer to the handler returned by function
);
```

Open Dev#3: DT5751 first device in Daisy chain of A3818 port#2

```
CAEN_DGTZ_OpenDigitizer (
        CAEN_DGTZ_OpticalLink,      LinkType: physical communication channel = Optical Link via A3818 (PCIe Controller)
        3,                          LinkNum: unique device, Link number =A3818 port number: 3
        0,                          ConetNode: unique device in the chain  =0
        0,                          VMEBaseAddress: must be = 0
        &handleDT5751_3             Pointer to the handler returned by function
);
```

Arguments description

Name	Description
`LinkType`	= CAEN_DGTZ_OpticalLink. Indicates A3818 -> Optical Link, either direct connection or VME through V2718 as the physical communication channel. **Note**: the function CAEN_DGTZ_PCIE_OpticalLink is now deprecated, though it is still possible to use it.
`LinkNum`	Link number: For the CONET, the link number indicates which link of A2818 or A3818 is used. For A3818 refers to the PCI slot and depends on the motherboard of the PC used. Link index start from 0 (1st Optical link port in the 1st slot used). It is not known a priori which is the first slot used. **IMPORTANT Note: if also A2818s are installed, these ones have lower index assigned**.
`ConetNode`	The CONET node identifies which device in the Daisy chain is being addressed. The node is 0 for the first device in the chain, 1 for the second and so on .
`VMEBaseAddress`	used only for model accessed via VME. Must be 0 in other cases

Example No.5

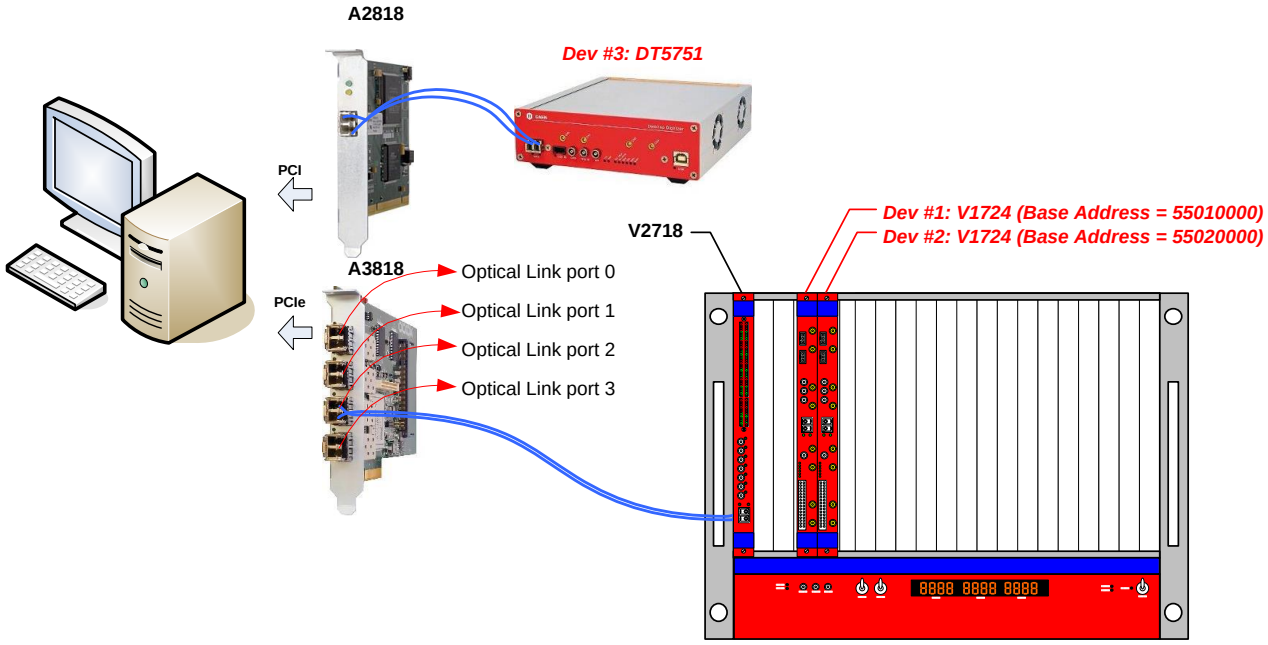


Fig. 8.6: Connection example no.5

The host PC houses

- one A2818 PCI CONET Controller connected to Dev#3 (DT5751 - 2/4 Channel 10 bit 2/1 GS/s Digitizer)
- one CAEN A3818C PCIe CONET Controller with 4 Optical Link; with port#2 connected to a V2718 VME-PCI Optical Link Bridge housed in a VME crate that contains the following boards:
    - Dev#1: V1724 - 8 Channel 14 bit 100 MS/s Digitizer (Base address = 0x55010000)
    - Dev#2: V1724 - 8 Channel 14 bit 100 MS/s Digitizer (Base address = 0x55020000)

Open Dev#1: V1724 (VME base address 0x55010000) accessed via VMEbus through the V2718 connected to A3818 port#2:

```
CAEN_DGTZ_OpenDigitizer (
        CAEN_DGTZ_OpticalLink,      LinkType: physical communication channel = Optical Link via A3818 (PCIe Controller)
        3,                          LinkNum: 3 = A3818 port number+1 (to A2818 is assigned the first link =0)
        0,                          ConetNode: unique device in the chain  =0
        0x55010000,                 VMEBaseAddress
        &handleV1724_1              Pointer to the handler returned by function
);
```

Open Dev#2: V1724 (VME base address 0x55020000) accessed via VMEbus through the V2718 connected to A3818 port#2:

```
CAEN_DGTZ_OpenDigitizer (
        CAEN_DGTZ_OpticalLink,      LinkType: physical communication channel = Optical Link via A3818 (PCIe Controller)
        3,                          LinkNum: 3 = A3818 port number+1 (to A2818 is assigned the first link =0)
        0,                          ConetNode: unique device in the chain  =0
        0x55020000,                 VMEBaseAddress
        &handleV1724_1              Pointer to the handler returned by function
);
```

Open Dev#3: DT5751 first device in Daisy chain of A2818

```
CAEN_DGTZ_OpenDigitizer (
        CAEN_DGTZ_OpticalLink,      LinkType: physical communication channel = Optical Link via A2818 (PCI Controller)
        0,                          LinkNum: A2818 has lower index assigned = 0
        0,                          ConetNode: unique device in the chain  =0
        0,                          VMEBaseAddress: must be = 0
        &handleDT5751_3             Pointer to the handler returned by function
);
```

Arguments description

Name	Description
`LinkType`	= CAEN_DGTZ_OpticalLink. Indicates A3818 (A2818) -> Optical Link, either direct connection or VME through V2718 as the physical communication channel. **Note**: functions CAEN_DGTZ_PCI_OpticalLink and CAEN_DGTZ_PCIE_OpticalLink are now deprecated, though it is still possible to use them.
`LinkNum`	Link number: For the CONET, the link number indicates which link of A2818 or A3818 is used. For A3818/A2818 refers to the PCI slot and depends on the motherboard of the PC used. Link index start from 0 (1st Optical link port in the 1st slot used). It is not known a priori which is the first slot used. **IMPORTANT Note: if also A2818s are installed, these ones have lower index assigned**.
`ConetNode`	The CONET node identifies which device in the Daisy chain is being addressed. The node is 0 for the first device in the chain, 1 for the second and so on .
`VMEBaseAddress`	Used only for model accessed via VME. Must be 0 in other cases

9 Technical Support

CAEN makes available the technical support of its specialists at the e-mail addresses below:

support.nuclear@caen.it
(for questions about the hardware)

support.computing@caen.it
(for questions about software and libraries)

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