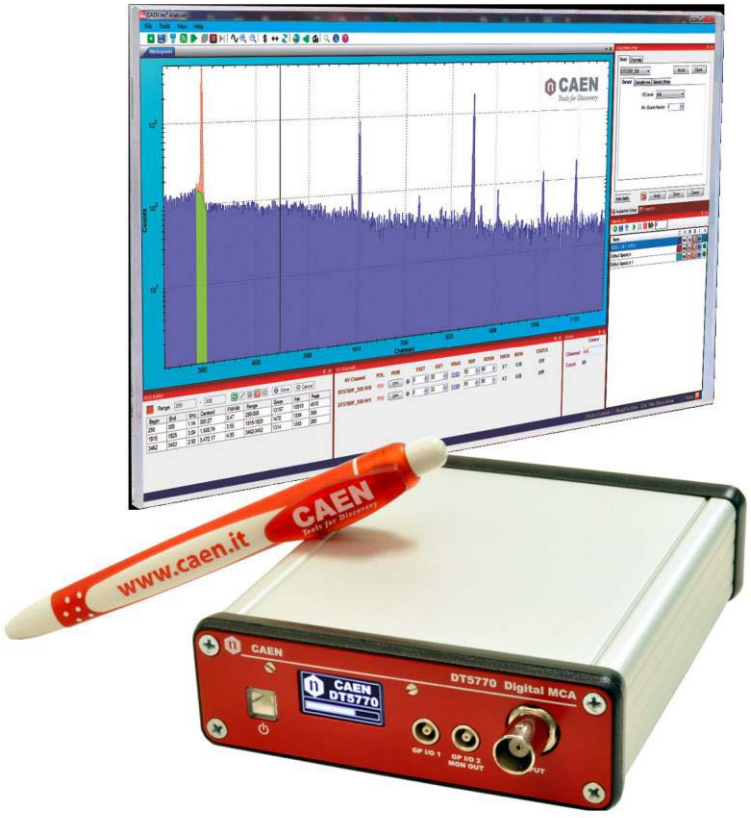
Rev. 02 - 09/05/2017

DT5770

Digital Multi Channel Analyzer



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User Manual
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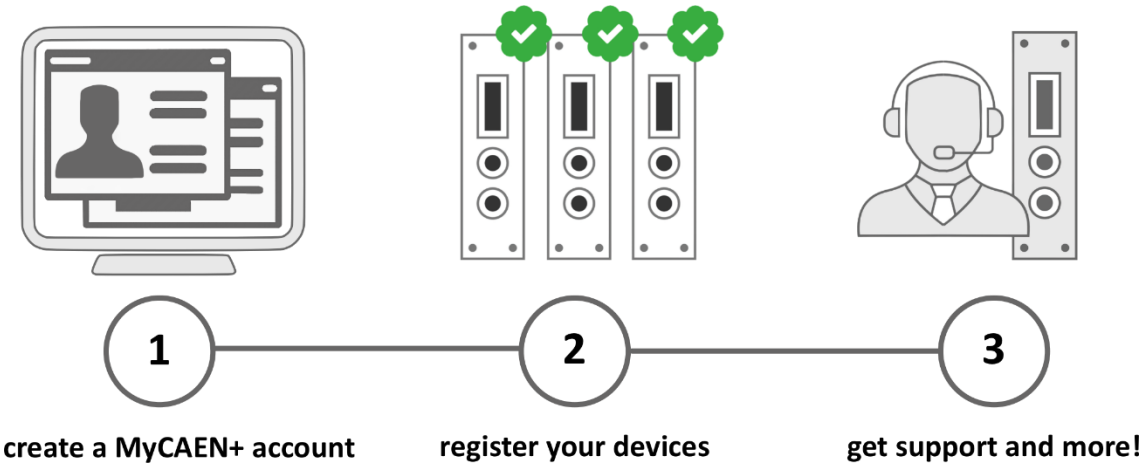
MyCAEN+ dashboard is designed to offer you a direct access to all our after sales services. Registration is totally free, to create an account go to https://www.caen.it/become-mycaenplus-user and fill the registration form with your data.



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Purpose of this Manual

This User Manual contains the full description of the DT5770 Digital MCA.

Change Document Record

Date	Revision	Changes
July 8th, 2015	00	Initial release
September 16th, 2016	01	Revised all pages for typos correction Page 11: added **Cooling System** paragraph
May 9th, 2017	02	Removed reference to USB power supply in Chap. **4** and **13**. Corrected the default IP address at p. **25**

Symbols, abbreviated terms and notation

ADC	Analog to Digital Converter
CSP	Charge Sensitive Preamplifier
DPP	Digital Pulse Processing
DPP-CI	DPP for Charge Integration
DPP-PHA	DPP for Pulse Height Analysis
DPP-PSD	DPP for Pulse Shape Discrimination
MCA	Multi-Channel Analyzer
OLED	Organic Light Emitting Diode

Reference Documents

[RD1] UM3182 - MC2Analyzer User Manual

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

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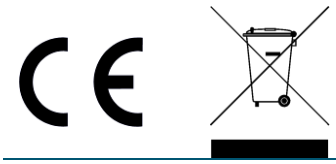

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1 Introduction

The **DT5770** is a compact desktop system integrating single 16k-channel Digital MCA and LV power supply capabilities for Gamma and X-ray spectrometry.

DT5770 is ideally suited for high energy resolution detectors, such as **HPGe**, connected to the output of a Charge Sensitive Preamplifier (CSP), even including Transistor Reset Preamplifiers (TRP) for ultra-high count rates, but this MCA can also properly work with PMT-based detectors like **NaI**.

The Digital MCA operates as a traditional spectroscopy acquisition chain made of Shaping Amplifier plus Peak Sensing ADC, thus representing a digital replacement of that modules. Thanks to this digital approach, other functionalities become possible, such as calculating the trigger time tag.

It is possible to apply the digital algorithm used in the DT5770 also to signals that are not coming from CSP (for instance the output of a PMT), but for this type of detector CAEN recommends solutions based on its faster digitizers (such as the 720 or 751 series) running specific algorithms for the digital Charge Integration (DPP-CI) or Pulse Shape Discrimination (DPP-PSD). For details, please consult the relevant DPP firmware web page on CAEN website.

The DT5770 features:

- **1x 150 MS/s 14-bit ADC** on single ended input with BNC connector, featuring 4-step configurable input range (1.25 / 2.5 / 5 / 10 V_{pp}) and adjustable DC offset via a 10-bit DAC on each input in the full range.
- **1x ±12 V (100 mA) and ±24 V (50 mA) PREAMP bias output** through DB9 connector for preamplifier power supply.

The Digital MCA is equipped with a **DPP-PHA Firmware**, that is a Digital Pulse Processing algorithm making the board a spectroscopy acquisition system providing energy spectra (i.e. pulse height histograms) as well as portions of the waveform for debugging, monitoring and pulse shape analysis.

DT5770 houses USB 2.0 and Ethernet interfaces as communication links for configuration, firmware upgrade and data collection.

The Digital MCA is fully controlled by CAEN new MC^2 Analyzer software (see Chap. **12**) in order to exploit the DT5770 features in the Spectroscopy environment.

The following list summarizes what can be done by the Digital MCA in combination with the MC^2 Analyzer supported software:

- receive the signals coming from a CSP and adapt to the dynamic range (by the programmable DC offset and Gain);
- detect input pulses and generate a local trigger on them;
- calculate the time of arrival of the trigger, the pulse height by means of digital shaping filters (trapezoidal filters);
- detect pile-up conditions and manage the count loss (dead-time);
- get the spectra internally generated (on-board) through USB or Ethernet link.
- accumulate, plot and save the histograms (energy spectra over up to 16k channels), compensate for the dead-time;
- generate output files (histograms) in a binary or ASCII format.
- run the signal inspector that plots the waveforms of the input signals as well as of the internal filters in order to adjust the parameters of the acquisition;
- set manually or automatically parameter configurations.
- perform advanced mathematical analysis on both the ongoing histograms and collected spectra (e.g. peak search, background subtraction, peak fitting, energy calibration, ROI selection, dead time compensation, histogram rebin)
- power supply a preamplifier.

Board Model	Description	Product Code
DT5770	Digital MCA	WDT5770AXAAA

Tab. 1.1: Product reference table

2 Technical Specifications

<table>
<tr><td>MECHANICAL</td><td colspan="4">Dimensions
106 W x 38 H x 128 L mm³
(without connectors)
106 W x 38 H x 150 L mm³
(including connectors)

Weight
300 g</td></tr>
<tr><td>ENVIRONMENTAL</td><td colspan="4">Operational Conditions
0 – 50°C Temperature Range - EMC compliant</td></tr>
<tr><td>ANALOG INPUT</td><td colspan="4">Input Features
▪ BNC connector
▪ Single ended, DC/AC coupled
▪ Both continuous and pulsed reset preamplifiers supported
▪ Impedance: 50 Ω / 1 kΩ (sw selectable)
▪ Positive and negative signals accepted
▪ Programmable 4-step analog coarse gain corresponding to 1.25 Vpp, 2.5 Vpp, 5 Vpp, 10 Vpp ranges
▪ Bandwidth: DC to 30 MHz
▪ Programmable fine gain: 1..100
▪ Programmable DC offset adjustment on the input in the full scale range

Number of Inputs
1</td></tr>
<tr><td>TRP FEATURES</td><td colspan="4">Transistor Reset Preamplifier Support
▪ Selectable gains in the range [2:110] in 12 steps.
▪ AC coupling software selectable ($\tau_{shaperAC}$ ~600ns)</td></tr>
<tr><td>ADC</td><td colspan="4">Resolution
14 bits

Sampling Rate
150 MS/s</td></tr>
<tr><td>DIGITAL SIGNAL PROCESSING</td><td colspan="4">▪ Manual and automated trigger threshold adjustment
▪ Manual and automated Pole-Zero cancellation; decay time up to 0.65 ms
▪ Digital decimation in programmable steps: 2-4-8
▪ Digital fine gain
▪ Pile-up rejection and Live Time correction
▪ Baseline restorer with programmable averaging
▪ Adjustable moving average low pass filter to reduce the high frequency noise</td></tr>
<tr><td>PREAMPLIFIER POWER SUPPLY</td><td colspan="4">Preamp Features
▪ DB9 connector
▪ ±12 V,100 mA output (DB9/pin4/pin9)
▪ ±24 V, 50 mA output (DB9/pin6/pin7)
▪ Output voltage tolerance: 2%
▪ Voltage ripple < 5 mVpp

Preamp Outputs
1

Extra Features
▪ Aux. analog input, 0 ÷ 10 V (DB9/pin3)
▪ Ext. input for detector’s temperature readout (DB9/pin8)</td></tr>
<tr><td>OPERATING MODES</td><td colspan="4">▪ Pulse Height Analysis (PHA): 16k-channel pulse height histogram internally built up; 1k-2k-4k-8k-16k rebin options at software level
▪ Oscilloscope mode for waveforms monitoring</td></tr>
<tr><td>TRIGGER MODES</td><td colspan="4">▪ Internal trigger
▪ External: channel is triggered by external trigger only (GP I/O 1 or GP I/O 2)</td></tr>
<tr><td rowspan="18">ANALOG/DIGITAL I/O</td><td>Connector</td><td></td><td>Description</td><td>Options</td></tr>
<tr><td rowspan="8">▪ GP I/O 1 (LEMO, TTL)
▪ GP I/O 2 (LEMO, TTL)</td><td rowspan="4">Zin = 50 Ω</td><td>Digital Input</td><td>Veto</td></tr>
<tr><td>Digital Input</td><td>Gate</td></tr>
<tr><td>Digital Input</td><td>Ext. Trigger</td></tr>
<tr><td>Digital Input</td><td>Reset</td></tr>
<tr><td rowspan="9">22-Ω terminated</td><td>Digital Output</td><td>Trigger</td></tr>
<tr><td>Digital Output</td><td>Energy probe</td></tr>
<tr><td>Digital Output</td><td>Pile-up inhibit</td></tr>
<tr><td>Digital Output</td><td>Event rejected</td></tr>
<tr><td>Digital Output</td><td>Baseline suspended</td></tr>
<tr><td>Digital Output</td><td>Acquisition run/stop</td></tr>
<tr><td>Digital Output</td><td>SCA (COMING SOON)</td></tr>
<tr><td>Digital Output</td><td>Clock</td></tr>
<tr><td>▪ GP I/O 2 (LEMO)</td><td rowspan="6">50-Ω terminated</td><td>Analog Output</td><td>Input signal</td></tr>
<tr><td>Analog Output</td><td>Fast Trapezoid</td></tr>
<tr><td>Analog Output</td><td>Trapezoid</td></tr>
<tr><td>Analog Output</td><td>Energy data</td></tr>
<tr><td>Analog Output</td><td>Baseline</td></tr>
<tr><td>Analog Output</td><td>Trapezoid - Baseline</td></tr>
</table>

DISPLAY	OLED display for online monitoring (e.g. ICR, dead time, measurement time)	
COMMUNICATION INTERFACE	**Ethernet** 10/100BT	**USB** USB 2.0 compliant
FIRMWARE	Firmware can be upgraded via USB/Ethernet	
SOFTWARE	Fully controlled by MC² Analyzer spectroscopy software For developers: general purpose C libraries with demo samples available	
POWER REQUIREMENTS	**Operating Supply Voltage** +5 VDC **Absolute Max. Rating** +5.5 DVC The module can be powered by an external AC/DC stabilized power supply included in the kit (5 VDC, 3.5 A)	**Consumptions (Typ. @ +5 VDC)** 1.5 A

Tab. 2.1: Specifications table

3 Packaging and Compliancy

The unit is a Desktop module housed in an alloy box (weight ~ 300 g) with the following dimensions:

106 W x 38 H x 128 L mm³ (connectors not included)

106 W x 38 H x 150 L mm³ (including connectors).

Fig. 3.1: DT5770 front view

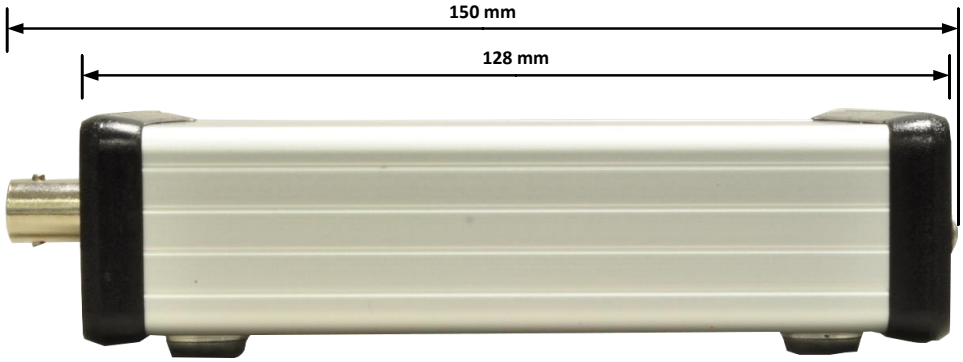


Fig. 3.2: DT5770 side view

CAUTION: to manage the product, consult the operating instructions provided.

A potential risk exists if the operating instructions are not followed!

CAUTION: it is hardly recommended to power supply the device by the provided AC/DC stabilized power supply unit. In any case, the user must act in conformity to the declared power requirements (see **Tab. 2.1**).

RISK OF IRREVERSIBLE HARDWARE DAMAGE

DO NOT SUPPLY MORE THAN 5 VDC!!!

Do not operate the device exceeding the voltage absolute maximum rating of 5.5 V!

CAEN provides the specific document "Precautions for Handling, Storage and Installation", available in the documentation tab of the product's web page, that the user is mandatory to read before to operate with CAEN equipment.

Cooling System

The upper panel of the mechanical box is provided with venting holes to allow the internal fan to dissipate hot air and to consequently cool down the module during normal working.

The cooling system was conceived and implemented to guarantee proper functioning of the module and to protect it from overheating.

Fig. 3.3: DT5770 view of venting holes details

The fan of the cooling system is activated as soon as the Power Supply Unit is plugged to the module, even if the latter is not yet switched ON through the ON/OFF button.

Note.:. In order to completely turn off the module, it is necessary to both press the ON / OFF button and disconnect the Power Supply Unit.

CAUTION: it is strongly recommended not to obstruct, block off, cover or plug up the venting holes; make sure that air can always flow around them.

Risk of overheating

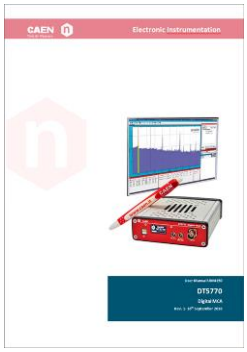
Do not block off the cooling system when the module is working

Delivery kit

CAEN provides the DT5770 in a kit including power supply, cables and documentation (see **Fig. 3.4**).

Fig. 3.4: Delivery kit

Kit components are detailed in **Tab. 3.1** below.

DESCRIPTION	ITEM
DT5770 module	
Power Supply Unit (cable and AC/CD adapter)	
Link cables (USB and Ethernet)	
Documentation (User Manual)	

Tab. 3.1: Kit composition

4 Power Requirements

The module can be powered by the external AC/DC stabilized power supply provided with the digitizer and included in the delivered kit (5 VDC, 3.5 A).

Power requirements are reported in **Tab. 4.1**.

OPERATING SUPPLY VOLTAGE (nominal)	+5 VDC
ABSOLUTE MAX. RATING	+ 5.5 VDC
CONSUMPTIONS (@ +5 VDC)	1.5 A (Typ.)

Tab. 4.1: Power requirements table

Note.: Using a different power supply source, like battery or linear type, it is recommended the source to provide +5 VDC and at least 1.5 A +10%; the power jack is a 2.1 mm type, a suitable cable is the RS 656-3816 type (or similar).

Fig. 4.1:AC/DC power supply unit

CAUTION: it is hardly recommended to power supply the device by the provided AC/DC stabilized power supply unit. In any case, the user must act in conformity to the declared power requirements (see **Tab. 4.1**).

RISK OF IRREVERSIBLE HARDWARE DAMAGE

DO NOT SUPPLY MORE THAN 5 VDC!!!

Do not operate the device exceeding the voltage absolute maximum rating of 5.5 V!

5 Panels Description

Fig. 5.1: Front panel view

Fig. 5.2: Rear panel view

Front Panel

ANALOG INPUT

FUNCTION

Input connectors receiving the analog signals from the detectors.

ELECTRICAL SPECS

Input dynamics: 1.25 V_{pp}; 2.5 V_{pp}; 5 V_{pp}; 10 V_{pp} (software selectable).

Input impedance (Z_{in}): 50 Ω, 1 kΩ (sw selectable).

MECHANICAL SPECS

Series: BNC connectors.

Type: 364M595L (part number).

Manufacturer: Bomar Interconnect/ Winchester Electronics.

GENERAL PURPOSE INPUT/OUTPUT

FUNCTION

General purpose digital input or output, sw programmable as:

- Signal (OUT)
- Trigger (IN)
- Reset (IN)

Please refer to Chap. **8** for details.

ELECTRICAL SPECS

Signal level: TTL.

Digital input: Z_{in} = 50 Ω.

Digital Output: 22-Ω terminated.

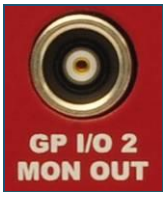
MECHANICAL SPECS

Series: Coaxial Connectors (RF).

Type: EPL.00.250.NTN.

Manufacturer: LEMO

GENERAL PURPOSE INPUT/OUTPUT – ANALOG OUTPUT



FUNCTION

General purpose digital input or output and analog output, sw programmable as:

- Signal (OUT)
- Trigger (IN)
- Reset (IN)
- Analog monitor (OUT)

Please, refer to Chap. **8** for details.

ELECTRICAL SPECS

Signal level: TTL.

Digital input: Z_{in} = 50 Ω.

Digital Output: 22-Ω terminated.

Analog output: 50-Ω terminated.

MECHANICAL SPECS

Series: Coaxial Connectors (RF).

Type: EPL.00.250.NTN.

Manufacturer: LEMO.

OLED DISPLAY

FUNCTION

OLED display showing acquisition information:

- ICR indicator (k counts/s)
- Dead Time indicator (%)
- Acquisition timer (“hh:mm:ss”)
- Acquisition Run indicator
- Dead Time progress bar

Please, refer to Chap. **9** for details

ELECTRICAL SPECS

N.A.

MECHANICAL SPECS

Series: OLED displays.

Type: *N.A.*

Manufacturer: *N.A.*

POWER SWITCH

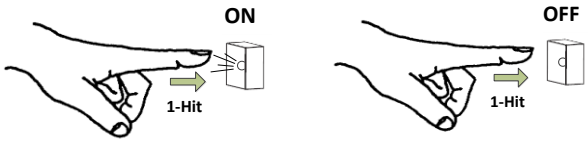
FUNCTION

Tactile switch with integrated pure white LED used to power on/off the device.

ELECTRICAL SPECS

N.A.

ON / OFF FUNCTION



MECHANICAL SPECS

Series: Illuminated Tactile Switches.

Type: MCSPJP4-YCA043T.

Manufacturer: MULTICOMP.

POWER LED (PURE WHITE): when on, it indicates that the device is powered on.

Rear Panel

PREAMPLIFIER POWER SUPPLY OUTPUT

FUNCTION

Connector for preamplifier power supply.

ELECTRICAL SPECS

See Chap. **2**

MECHANICAL SPECS

Series: D-Sub connectors.

Type: 5747844-2 (D-Sub, female, 9-pole) with clips D110277.

Manufacturer: TE Connectivity (D-sub connector); ITT Cannon (clips).

PINOUT

See Chap. **6**

ETHERNET PORT

FUNCTION

10/100 BT Ethernet input to control the DT5770 for configuration, data collection and firmware upgrade.

Default IP: 192.168.0.98

ELECTRICAL SPECS

N.A.

MECHANICAL SPECS

Series: RJ45 connectors.

Type: 6605834-1.

Manufacturer: TRP Connector B.V.

ETHERNET CABLE

2m Ethernet cable included in the DT5770 kit.

MiniUSB PORT

FUNCTION

MiniUSB connector for USB connection to the DT5770. USB link manages the board configuration, data collection, firmware upgrade.

ELECTRICAL SPECS

N.A.

MECHANICAL SPECS

Series: miniUSB connectors.

Type: 0548190519 (B-type).

Manufacturer: Molex Inc.

USB CABLE

1m USB Cable - DUAL POWER, Type A to mini B, provided in the DT5770 kit.

DC INPUT

FUNCTION

Power supply DC input connector (+5 VDC).

ELECTRICAL SPECS

Operating: 1.5 A / 5 VDC

Rated: 5A / 12VDC

Life: 5000 insertions minimum.

Insulation resistance between any open contact > 100MW @ 500VCD.

Suitable for use with Ø2.1mm and Ø2.5mm DC plug.

MECHANICAL SPECS

Series: DC10L series.

Type: FC681465P.

Manufacturer: CLIFF ELECTRONIC COMPONENTS.

PINOUT

IDENTIFYING LABEL

FUNCTION

Board's identifying label indicating the serial number (S/N).

6 PREAMP Power Supply

The DT5770 is equipped with a single Low Voltage Power Supply output for preamplifier, providing: ±12 V / 100 mA or ±24 V / 50 mA on DB9 female connector. Detailed technical specifications are reported in **Tab. 2.1**.

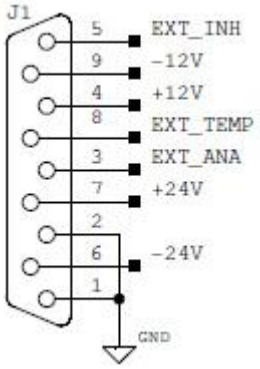


Fig. 6.1: DB9 connector pinout

PINOUT DESCRIPTION:

- **PIN1-2:** ground.
- **PIN3:** spare external analog input with 0 ÷ 10 V dynamics **(not managed by CAEN software)**.
- **PIN4:** +12 V / 100 mA power supply output.
- **PIN5:** *not connected*.
- **PIN6:** -24 V / 50 mA power supply output.
- **PIN7:** +24 V / 50 mA power supply output.
- **PIN8:** external input for detector's temperature readout from a PT100 or PT1000 sensor model **(not managed by CAEN software)**.
- **PIN9:** -12 V / 100 mA power supply output.

7 Notes on MCA Operating

The DT5770 operates on the analog signals provided on its input by applying a PHA algorithm implemented in the equipped DPP-PHA Firmware for the Digital Pulse Height Analysis.

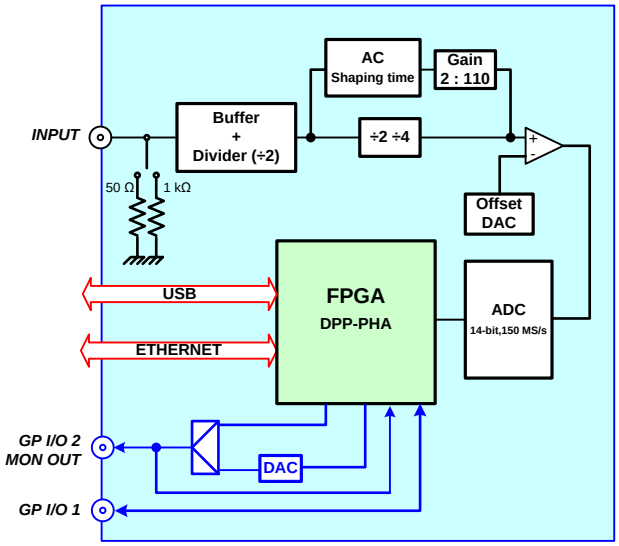


Fig. 7.1: Simplified functional diagram of the DT5770

DT5770 is an acquisition system that receives the analog signal and performs the A/D conversion (@150 MS/s, 14 bit) at the input of the module, just after an analog input stage whose purpose is to adapt the signal voltage swing to the dynamic range of the ADC. After the A/D conversion, the stream of samples is managed by an FPGA programmed to perform on-line Digital Pulse Processing in order to implement the MCA based on the Pulse Height Analysis (**DPP-PHA**); the algorithms implemented in the DPP-PHA firmware are based on the trapezoidal filter (Moving Window Deconvolution) for the calculation of the pulse height. The energy spectra are build up in the on-board FPGA and made available for the readout.

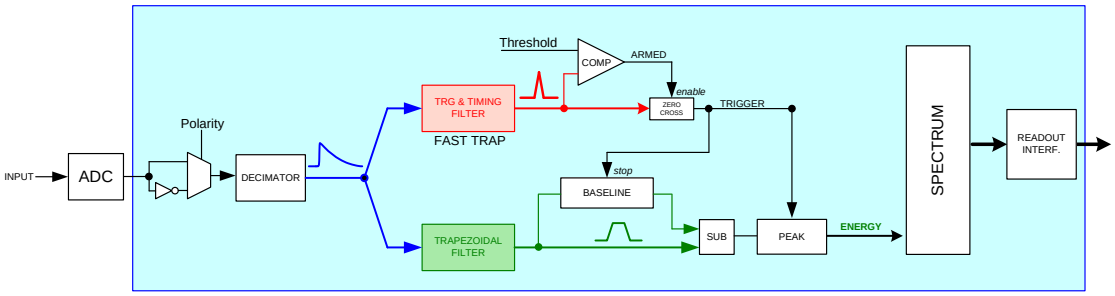


Fig. 7.2: Block diagram of the processing chain programmed into the FPGA

Refer to **[RD1]** for a detailed description of:

- Principle of operation of the DPP-PHA Firmware.
- Acquisition modes supported at firmware level.
- Memory organization and data format.

8 General Purpose I/Os

The DT5770 is equipped with 2 front panel connectors software programmable for Digital Input, Digital Output and Analog Output functions: GP I/O 1, GP I/O 2 – ANALOG MON (see Chap. **5**).

Selecting the function can be managed through the MC² Analyzer software (please, refer to **[RD1]** details).

Digital Input/Output Options

Tab. 8.1 describes the selection of functions for the general purpose connectors when used as digital inputs/outputs.

MODE	FUNCTIONS	DIRECTION	SUPPORTED CONNECTOR		
Signal	**Energy Sampled:** corresponds to the point where the energy of the trapezoid is evaluated	**OUT**	**GP I/O 1**	**GP I/O 2**	
	Baseline Sampled: corresponds to the samples where the baseline is averaged				
	Reset Detected: digital probe which is high when there is a reset. The high status is held for the whole reset duration				
	Running: digital probe which is high for the whole acquisition run				
	Saturation: corresponds to the signal saturation				
	Pile-up Rejected: this probe is high when the last event is rejected due to a pile-up condition				
	Pile-up Inhibit: corresponds to the time the board is inhibited due to a pile-up condition				
	Reset Periodic: programmable output to generate a periodic reset.				
	Clock (75 MHz): propagation of the clock out. The clock has half frequency of the internal clock				
	Baseline Inhibit: corresponds to the samples where the baseline is not evaluated				
	SCA: Single Channel Analyzer function **(COMING SOON)**				
Trigger	**Gate / Veto:** the external trigger works as a gate/veto. The trigger logic senses to the signal level	**IN**	**GP I/O 1**	**GP I/O 2**	**Note:** The two GP can be combined through AND/OR logic
	Start/Stop: the external trigger manages the start/stop acquisition				
	Coincidence: the external trigger enables the acquisition opening a gate of fixed length, or programmable length which stops at the first input pulse				
Reset	The external signal is used as reset of the Transistor Reset Preamplifier. It is possible to program the reset length and the reset period via software.	**IN**	**GP I/O 1**	**GP I/O 2**	

Tab. 8.1: Digital Input/output functions selection

Analog Output Options

The GP I/O 2 connector can be optionally configured as analog output (10-bit and 62.5-MHz DAC) as in **Tab. 8.2**.

MODE	FUNCTIONS	DIRECTION	SUPPORTED CONNECTOR
Analog	**Input**	**OUT**	**GP I/O 2**
	Fast Trapezoid		
	Baseline		
	Trapezoid		
	Sampled Energy		
	Trapezoid-Baseline		

Tab. 8.2: Analog output functions selection

9 On-board Display

The OLED display integrated in the front panel of the DT5770 presents a splash screen as soon as the device is switched on and holds it on for the entire initialization time, which is graphically visible by a progress bar (see **Fig. 9.1**).

Fig. 9.1: Splash screen

Once the board is ready, the display shows a set of run-time information related to the acquisition and the PHA algorithm (see **Fig. 9.2**):

- **ICR indicator** (kcps) – Incoming Count Rate value updated at 1-Hz frequency;
- **Measurement timer** ("hh:mm:ss") – Count-up acquisition timer;
- **Dead Time bar** – Progress bar of the Dead Time percentage related to the measurement;
- **Dead Time indicator (%)** – Dead Time percentage value related to the measurement;
- **Acquisition Run indicator** – Graphical spots to indicate that the acquisition is running.

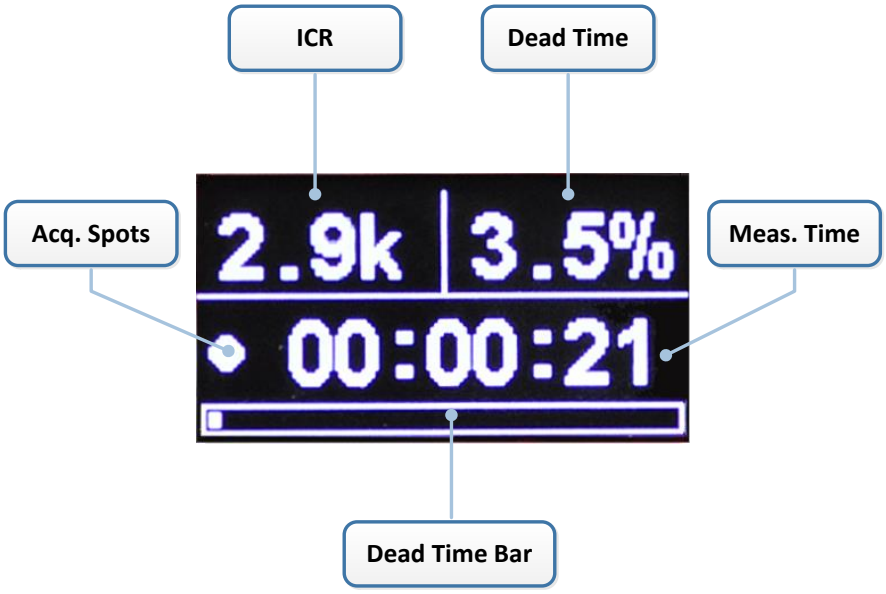


Fig. 9.2: Run-time information display

10 Communication Interfaces

The DT5770 features two communication interfaces:

- USB (USB2.0 compliant)
- Ethernet (10/100 BT)

USB Driver Installation

The USB driver of the DT5770 is free downloadable from the MCA web page in the “Software / Firmware” tab. This driver needs to be manually installed as follows:

1. Plug the provided USB cable into a USB port of the host PC and power on the DT5770.
2. If Windows Update service is active, the operating system will try to search and install the driver automatically by browsing the net. This operation ends with a failure and the device is not recognized.
3. Right click on the DT5770 item in the Windows Device Manager’s “Other devices” list and select the “Update Driver Software…” option (see **Fig. 10.1**).

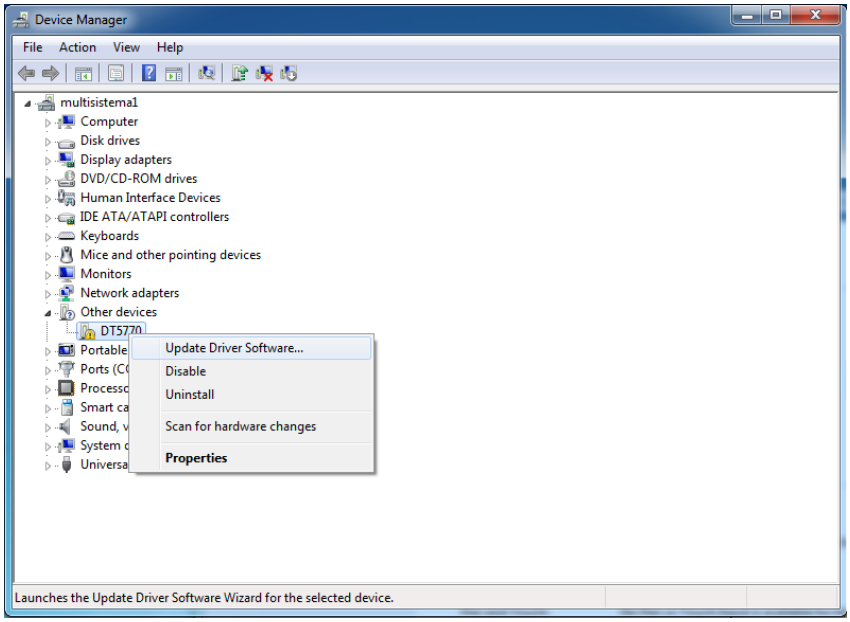


Fig. 10.1: DT5770 unknown device in Windows Device Manager

4. Select “Browse my computer for driver software” (see **Fig. 10.2**)

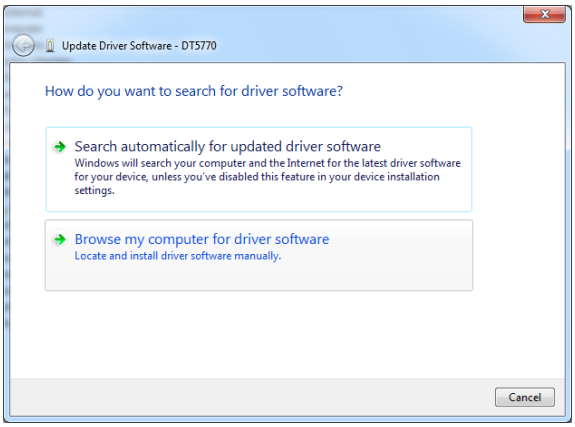


Fig. 10.2: Driver Software manual search and install selection

5. Point the driver folder in the PC destination path through the “Browse…” button and check “Include subfolders” (see **Fig. 10.3**).

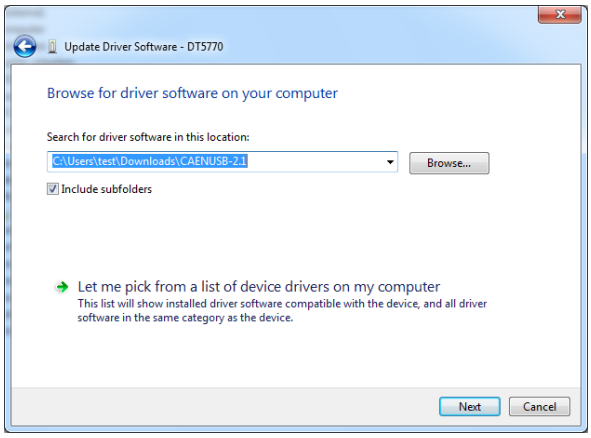


Fig. 10.3: Pointing the driver file to update

6. Windows informs the driver software is successfully installed (see **Fig. 10.4**).

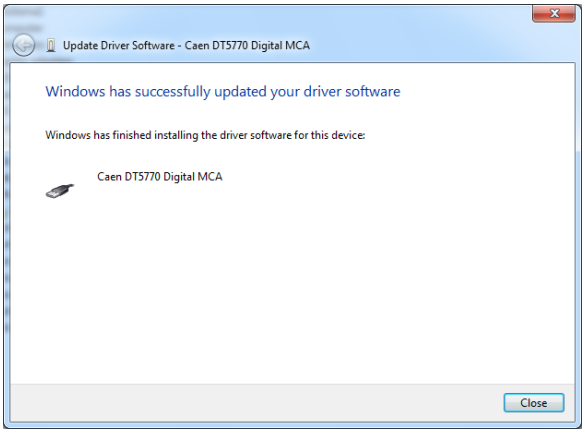


Fig. 10.4: Installation completed

7. The device is now recognized by the operating system and listed in the “Device Manager” area (see **Fig. 10.5**).

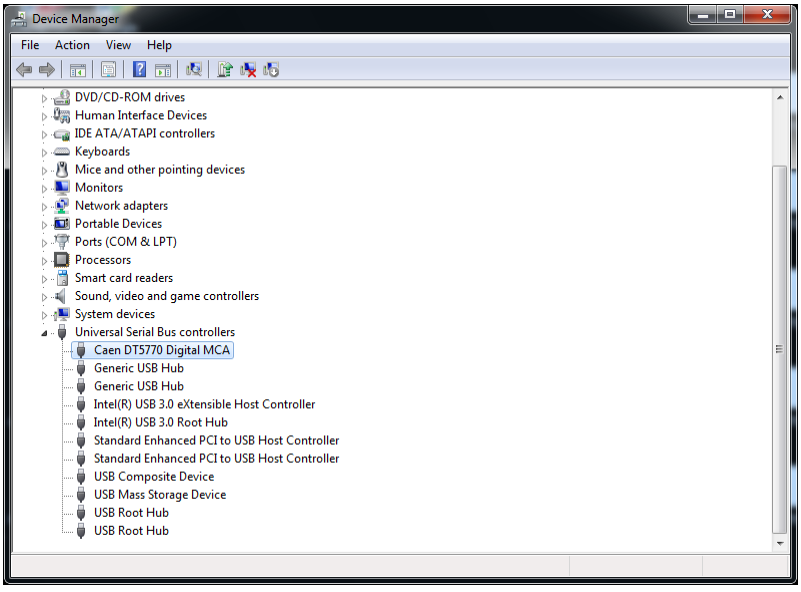


Fig. 10.5: Device recognized

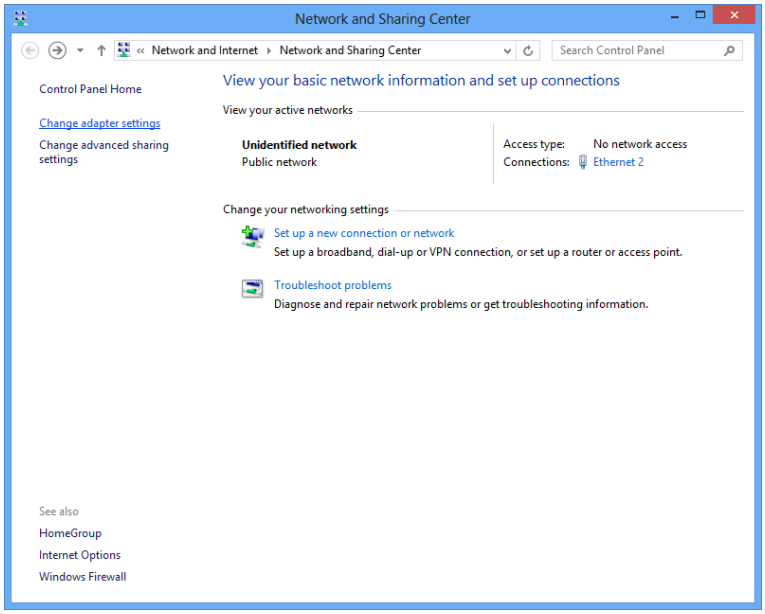
Network Configuration

In order to exploit the communication via Ethernet interface, the user must perform the network configuration. After the Ethernet cable has been connected from the MCA to the computer, configure the network according to the following instructions.

Note: The default IP Address of DT5770 MCA is: **192.168.0.98.** This address ca be modified by the user as described in Sect. **DT5770 Upgrader**

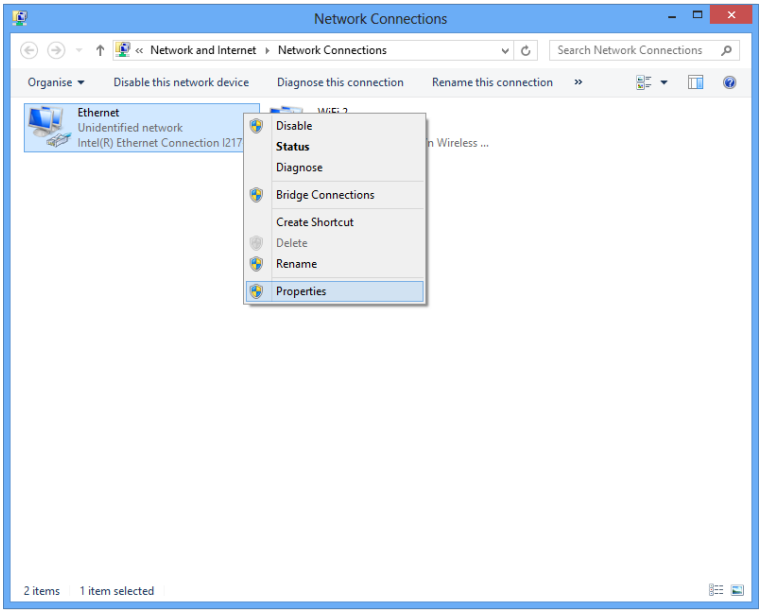
1. Open the path:

`Control Panel - Network and Internet - Network and Sharing Center`

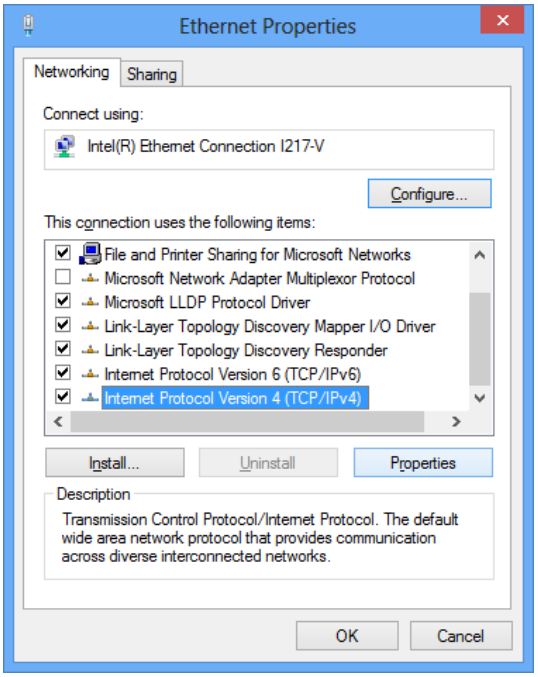


2. Click on “Change adapter settings”.

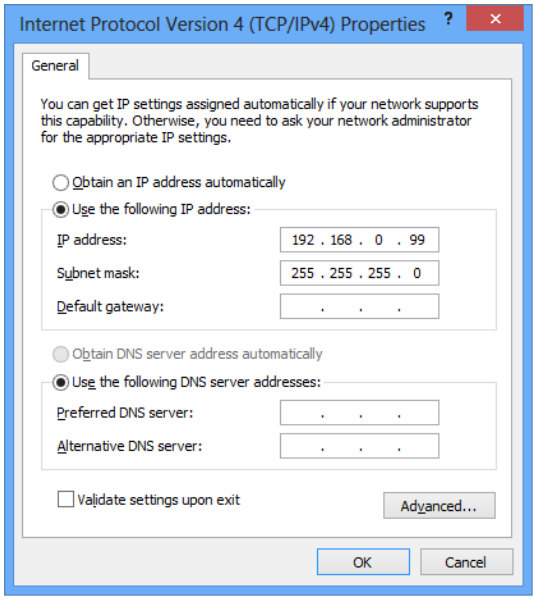
3. Right click on the Ethernet icon and select “Properties”:



4. Click on “Internet Protocol Version (TPC/IPv4)”, and select “Properties”:



5. Copy the following configuration on the “Internet Protocol Version (TPC/IPv4) Properties” window:



11 Libraries

CAEN Software tools (see Chap. **12**) rely on the following additional set of C libraries which are embedded into the Windows software **setup**. The user does not need to install them aside, unless he/she wants to write his/her own readout software:

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

  The CAENVMElib installation package is available on CAEN website (www.caen.it) in the "Download" tab at:

  Home / Products / Firmware/Software / Software Tools / Software Libraries / CAENVMELib Library

- **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 on CAENVMELib and requires the CAENVMELib library (access to the VME bus) even in the case the VME is not used. This is the reason why it is necessary that **the CAENVMELib is already installed on your PC before installing the CAENComm**.

  The CAENComm installation package is available on CAEN website (www.caen.it) in the "Download" tab at:

  Home / Products / Firmware/Software / Software Tools / Software Libraries / CAENComm Library

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

  The CAENDigitizer installation package is available on CAEN website (www.caen.it) in the "Download" tab at:

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

- **CAENDPP** is a high level library of C functions designed to completely and exclusively control the digitizers running the DPP-PHA firmware.

  The CAENDPP installation package is available on CAEN website (www.caen.it) in the "Download" tab at:

  Home / Products / Firmware/Software / Software Tools / Software Libraries / CAENDPP Library

Currently, the CAENComm (and so the CAENDigitizer and CAENDPP) supports the following communication interfaces (see also **Fig. 11.1**):

PC → USB → DT5770

PC → Ethernet → DT5770

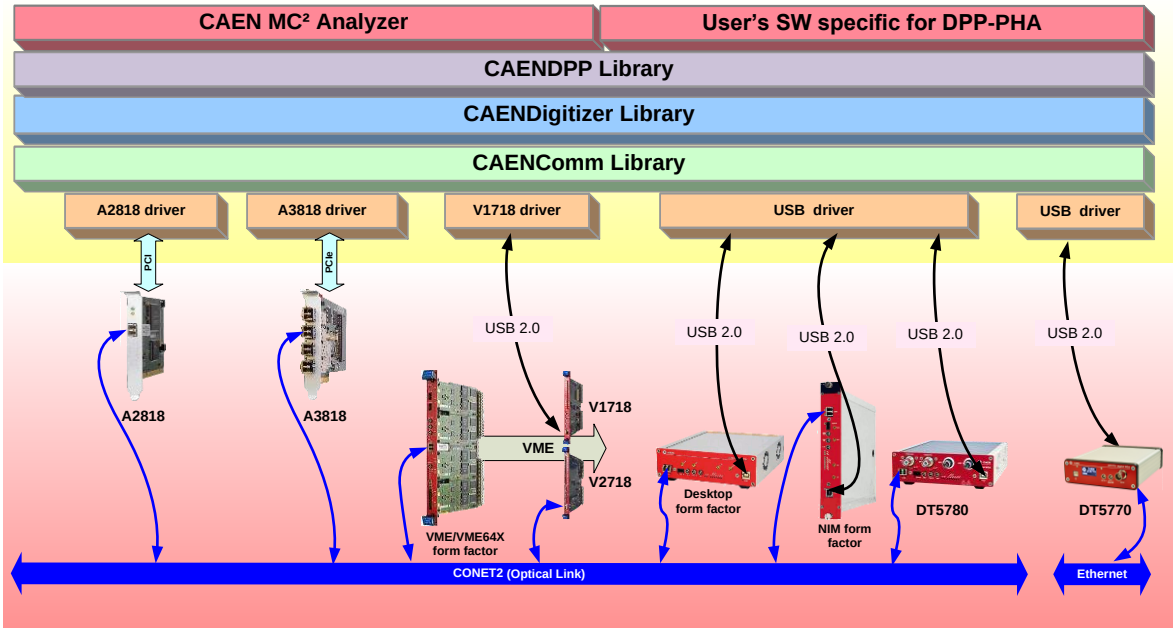


Fig. 11.1: Hardware and software layers scheme

12 Software Tools

CAEN provides software tools to interface DT5770 Digital MCA, which are available for free download on www.caen.it at:

Home / Products / Firmware/Software / Digitizer Software

MC² Analyzer (MC²A)

MC² Analyzer (MC²A) is a software specifically designed for CAEN MCAs (DT5770 Digital MCA, x780 Dual Digital MCA, x781 Dual/Quad Digital MCA) and for digitizers running the DPP-PHA firmware, like 724 and 730 families.

The software is able to completely control and manage a set of boards acquiring data simultaneously, making therefore a multi-board system a "Multichannel - Multichannel Analyzer".

MC²A allows the user to set all the relevant DPP-PHA parameters for each supported acquisition channel (like trigger threshold, shaping parameters, etc.), handle the communication with the connected boards, run the data acquisition and plot both waveforms for on-line monitoring of the acquisition and histograms. It can also control the HV power supplies provided in the x780.

Moreover, it is able to perform advanced mathematical analysis on both the ongoing histograms and collected spectra: peak search, background subtraction, peak fitting, energy calibration, ROI selection, dead time compensation, histogram rebin and other features available.

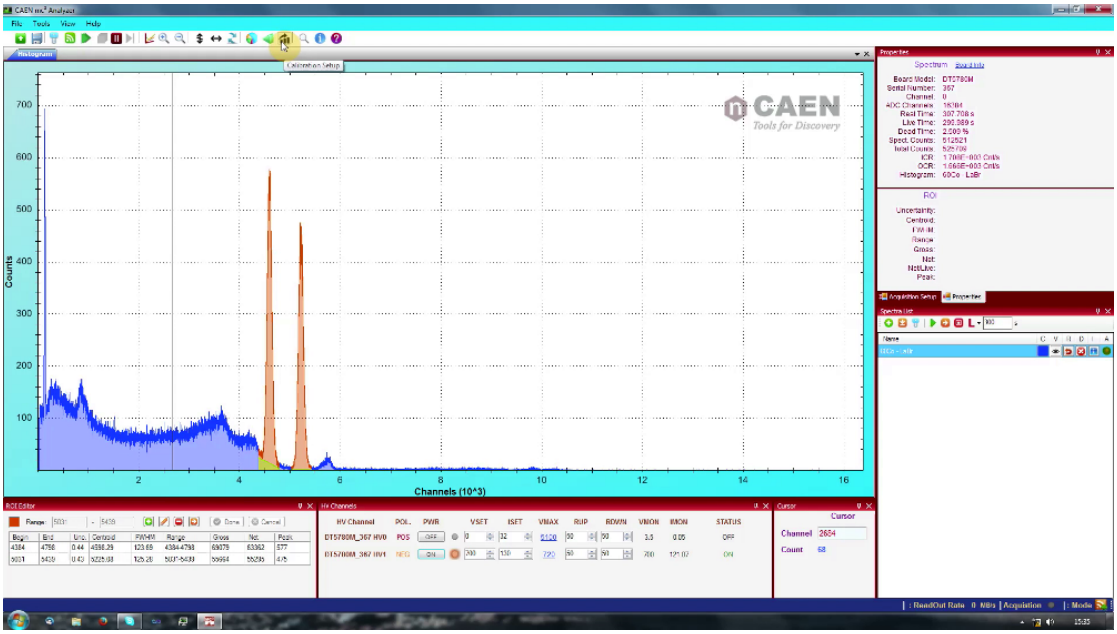


Fig. 12.1: MC² Analyzer (MC²A) software tool

MC² Analyzer is currently available only for Windows platforms. The installation package can be downloaded on CAEN web site (www.caen.it) at:

Home / Products / Firmware/Software / Digitizer Software / Readout Software

The reference document for installation instructions and program detailed description is **[RD1]**.

Note: Windows version of MC² Analyzer is stand-alone (the required libraries are installed locally with the program; only the communication driver must be installed apart by the user).

DT5770 Upgrader

CAEN DT5770 Upgrader is a free software tool allowing the following operations:

- Upload different versions of the DT5770 firmware
- Retrieve board information
- Change the IP configuration parameters used by the Ethernet connection.

Note: Please, refer to Chap. **14** for the firmware upgrade procedure.

Installation and Run

The installation package is free downloadable from the DT5770 web page and is compliant with Windows 32 and 64-bit platforms:

Home / Products / Spectroscopy Solutions / Digital Multichannel Analyzers / Multi Channel Analyzers / DT5770

The program requires additional third-party software to be installed: **Microsoft .NET Framework vs 4.5 or higher**.

1. Download the installation packages from the CAEN web site path reported above.
2. Unpack it and launch the program installer file.
3. Follow the installation wizard till the process is completed.
4. Run the program either by the Desktop or Quick Launch Menu icon, if selected during the installation process, or double-click on the program executable file in the destination folder (default path is: *C:\Program Files (x86)\CAEN\Digitizers\DT5770\DT5770*).

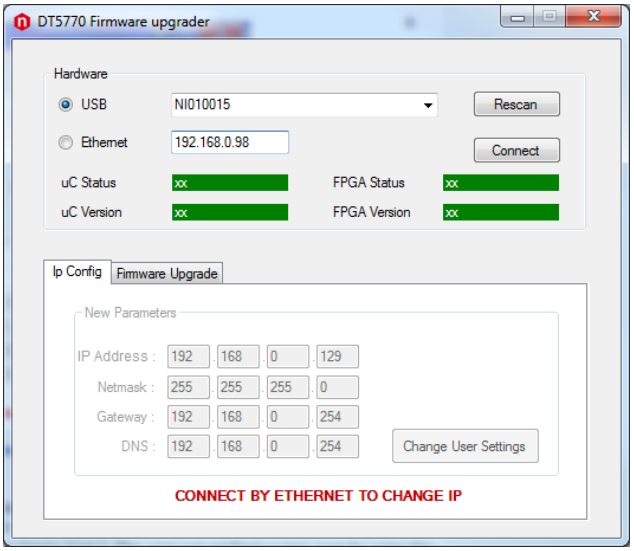


Fig. 12.2: CAEN DT5770 Upgrader main screen

Board Connection

1. Check the relevant check-cell in order to select the communication link (USB or Ethernet).
2. If connecting through the Ethernet, type the IP Address related to the DT5770 you want to connect to (default IP: **192.168.0.98**). Check you have configured your network as indicated in Chap. **10**.
3. If connecting through the USB link, the program automatically scans for the connected hardware. The serial number of each identified DT5770 is displayed in the top pull-down menu. A new scan can be performed by using the "Rescan" button.
4. Click on the "Connect" button.
5. The device status and firmware version of the internal microcontroller and FPGA are retrieved and visible in specific green active boxes (see **Fig. 12.3**).

Note: If using the USB link, only the FPGA firmware revision is read out by the software.

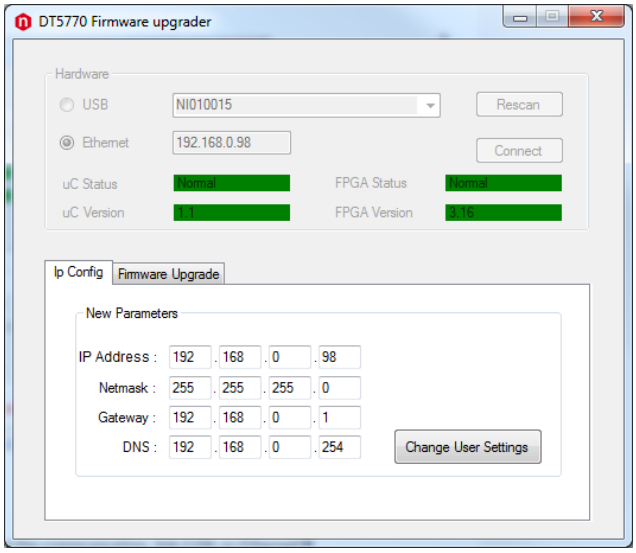


Fig. 12.3: Board information

IP Configuration

Connecting the DT5770 Upgrader to the hardware through the Ethernet interface, the user can change the IP configuration of the module.

1. At the connection, the actual IP parameters are displayed in the "IP Config" tab.
2. Type the new values in the relevant parameters boxes (e.g. IP Address: **192.168.0.100**).
3. Click on the "Change User Settings" button and select "Yes" in the next confirmation windows to make the changes effective (see **Fig. 12.4**).

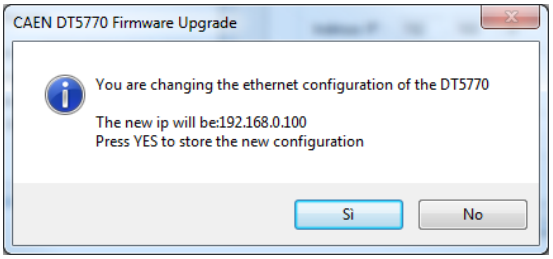


Fig. 12.4: IP change confirmation message

4. The DT5770 enters the rebooting status (the white LED of the power switch blinks and the OLED display shows "Bootloader"). This process may take time.

5. Wait for the module to turn automatically off.
6. Click “Ok” in the pop-up window to restart the program application (see **Fig. 12.5**).

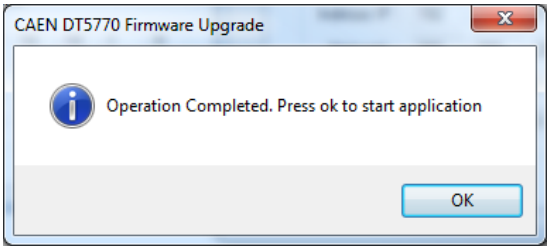


Fig. 12.5: IP update completed message

7. Turn on the DT5770 and scan for hardware (“Rescan” button).
8. Select the Ethernet link, type the new IP Address and connect (“Connect” button) to check the IP change is effective (see **Fig. 12.6**).

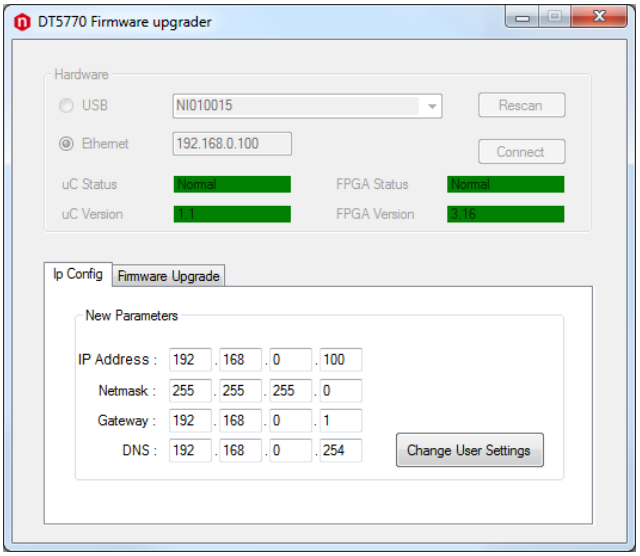


Fig. 12.6: Ethernet connection with the new IP configuration

Disconnect or Exit the Program

In order to disconnect or to exit the DT5770 Upgrader, the top-right red “X” button must be clicked in the program window.

13 HW Installation

Power ON Sequence

To power ON the board, follow the procedure below:

1. Plug the +5 VDC jack of the provided AC/DC adapter in the DT5770 rear DC input;

CAUTION: it is strongly recommended to power supply the device by the provided AC/DC stabilized power supply unit. In any case, the user must act in conformity to the declared power requirements (see **Tab. 2.1**).

RISK OF IRREVERSIBLE HARDWARE DAMAGE

DO NOT SUPPLY MORE THAN 5 VDC!!!

Do not operate the device exceeding the voltage absolute maximum rating of 5.5 V!

2. power up the device by short press the ON/OFF button;
3. the OLED display shows a splash screen frame for the duration of the board initialization;
4. wait for the initialization process to be completed before operating the DT5770 (refer to Chap. **9**).

See Chap. **5** to identify the relevant components

Power ON Status

At Power-ON, the module is in the following status:

- the Output Buffer is cleared;
- registers are set to their default configuration

14 Firmware and Upgrades

The DT5770 Digital MCA runs two main firmware:

- FPGA firmware – The firmware for the on-board FPGA;
- uC firmware – The firmware for the on-board microcontroller.

Firmware updates are available for download on CAEN website (www.caen.it) in the “Software/Firmware” tab at the DT5770 web page **(login required)**:

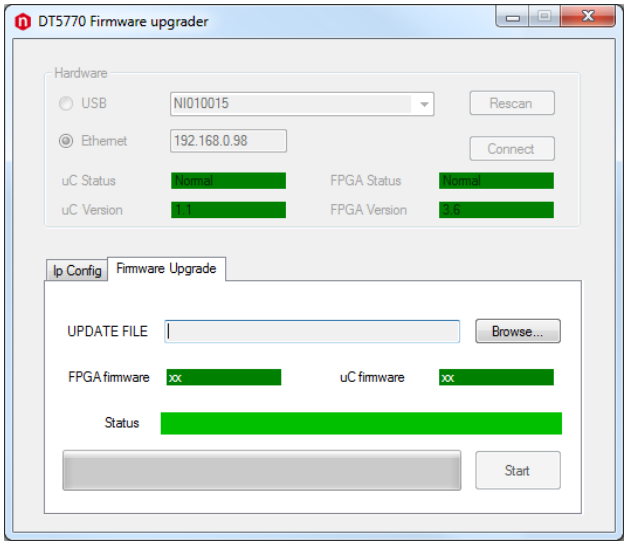
Home / Products / Spectroscopy Solutions / Digital Multichannel Analyzers / Multi Channel Analyzers / DT5770

The file has NIU extension and is a sort of archive format file aggregating the two required firmware files.

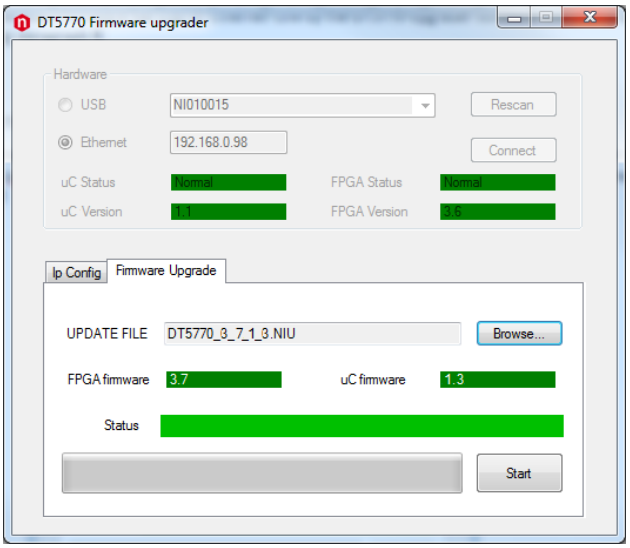
It is possible to upgrade the board firmware via USB or Ethernet Link by the DT5770 Upgrader software tool (see Chap **12**), as explained in the following paragraph.

Firmware Upgrade

1. Connect to the DT5770 as described in Chap. **12**;

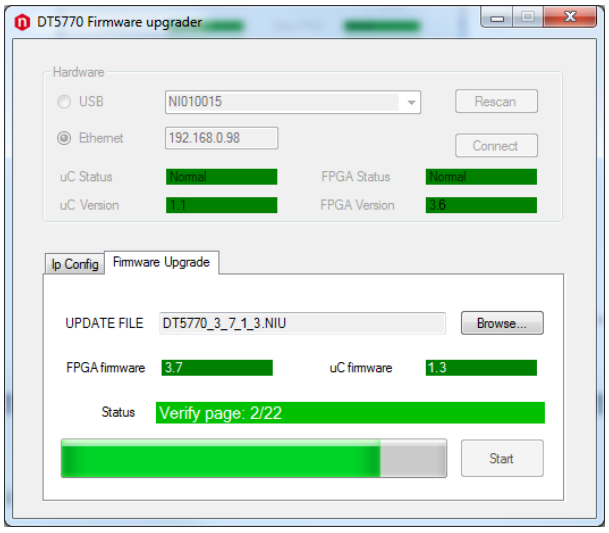


2. Select the “Firmware Upgrade” tab, then point to the NIU file on your PC through the “Browse” button. The file will be added to the “UPDATE FILE” text box. The version of the firmware files in the NIU are displayed in the “FPGA firmware” and “uC firmware” green text boxes (“xx” is shown if the firmware file is not present).

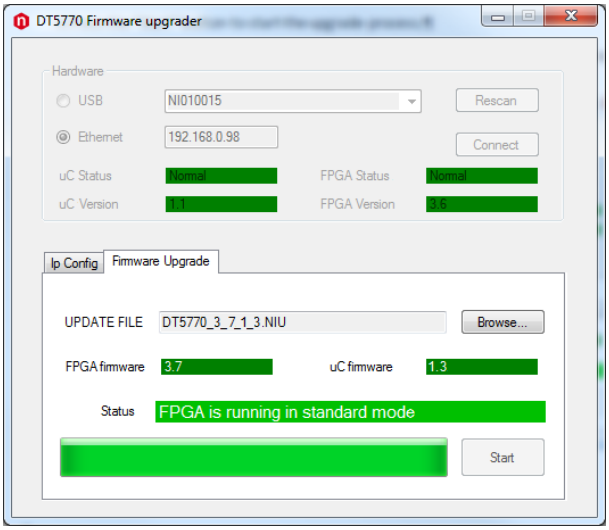


3. Press the “Start” button to start the upgrade process;

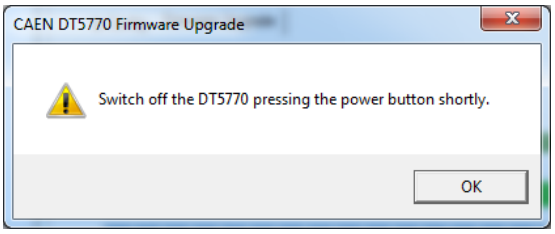
4.The “Status” active box displays the information on the ongoing steps. The upgrade process elapsing time is shown in the progress bar on the bottom.



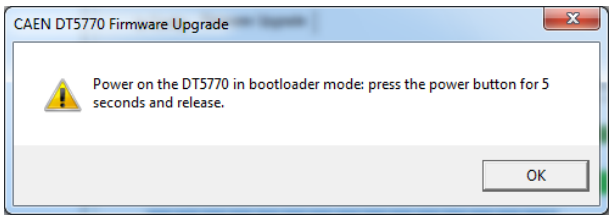
5.The program starts by writing the FPGA firmware.



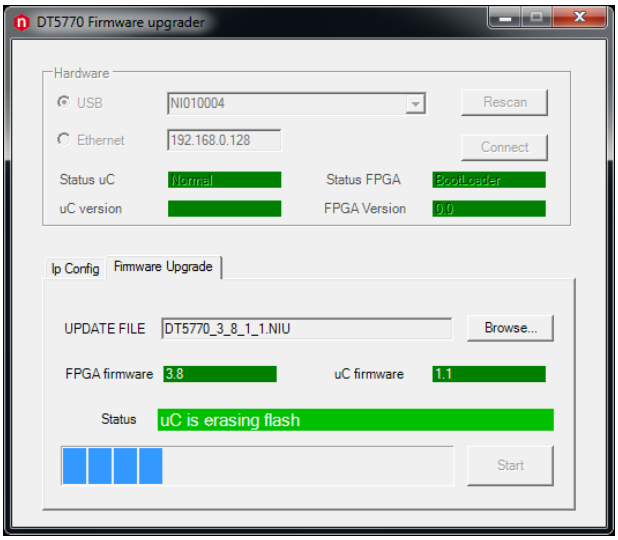
6.After the FPGA firmware is updated, the customer is asked for shooting down the DT5770 (short press the ON/OFF button, then click the “OK” button in the pop-up window to go on);



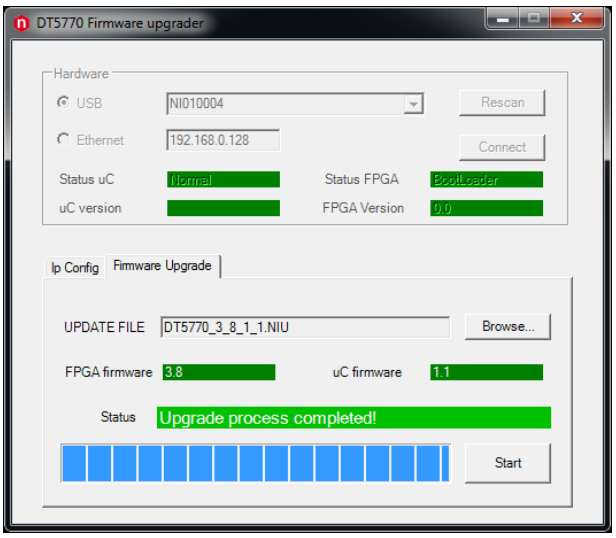
then reboot the DT5770 in Bootloader mode (keep the ON/OFF button pressed for at least 5 seconds, then release). Wait until the “Bootloader” string is blinking in the on-board display, then click the “OK” button in the pop-up window to go on.



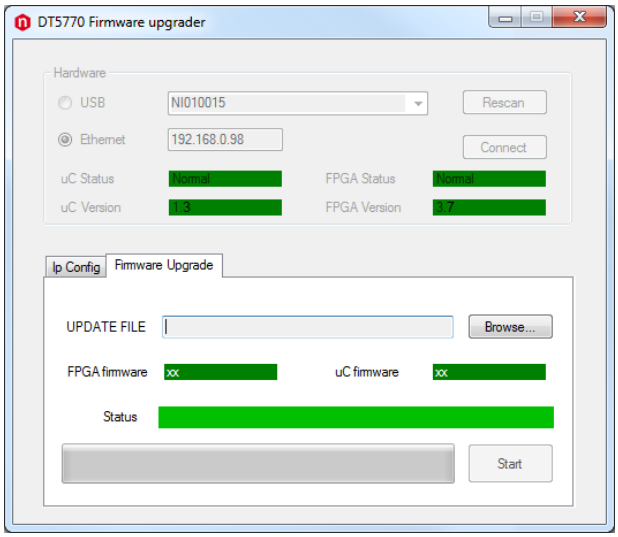
7.The program starts writing the uC firmware.



10.When the whole process is completed, shut down the board.



11.You can finally power on the DT5770 and re-connect the DT5770 Upgrader to check that the firmware changes are effective.



15 Technical Support

CAEN support services are available for the user by accessing the *Support & Services* area on CAEN website at www.caen.it.

Returns and Repairs

Users who need for product(s) return and repair have to fill and send the Product Return Form (PRF) in the *Returns and Repairs* area at *Home / Support & Services*, describing the specific failure. A printed copy of the PRF must also be included in the package to be shipped.

Contacts for shipping are reported on the website at *Home / Contacts*.

Technical Support Service

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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