CAEN
*Tools for Discovery*

# 742 Digitizer Family
## 32+2/16+1 Channel 12-bit 5 GS/s Switched Capacitor Digitizer
Data Sheet

The 742 is a family of 12-bit, 5 GS/s Switched Capacitor Waveform Digitizers based on the DRS4 chip (Paul Scherrer Institute design).

It is available in three form factors: VME (32+2 input channels), NIM (16+1 input channels) and Desktop (16+1 input channels).

Considering the sampling frequency and the bit number, it is well suited for very fast signals as the ones coming from fast scintillators coupled to PMTs, Silicon Photomultipliers, APD, Diamond detectors and others.

The analog input signals are continuously sampled into the DRS4 chip in a circular memory buffer (1024 cells) at the default sampling frequency of 5 GS/s (200 ps of sampling period); frequencies of 2.5 or 1 GS/s can also be selected. As a trigger signal arrives, all analog memory buffers are frozen and subsequently digitized with a resolution of 12 bits into a digital memory buffer with independent read and write access.

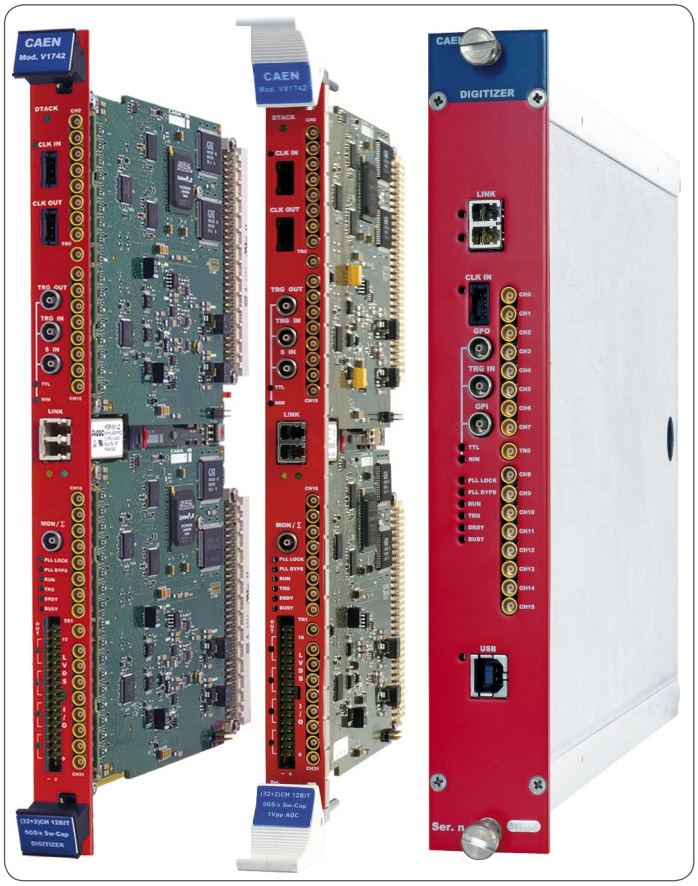
A common acquisition trigger signal can be provided externally via the front panel TRG-IN input as well as via the software but it can also be generated internally thanks to threshold self-trigger capability (only after the A/D conversion, with a trigger latency of 250 ns).

Special analog inputs (TR0 for NIM/Desktop, TR0 and TR1 for VME), can be used as low-latency external trigger signals. These special inputs can be also sampled into the DRS4s analog memory buffers for applications where high resolution timing and time analysis with a common reference signal (like a trigger or system clock) is required.

During analog to digital conversion process, the x742 cannot handle other triggers, thus generating a Dead Time.

Two memory sizes are available according to the different versions of the x742 model: 128 or 1024 events, where 1 event is made of 1024 samples.

742 family supports multi-board synchronization allowing all ADCs to be synchronized to a common clock source and ensuring Trigger Time Tag alignment. Once synchronized, all data will be aligned and coherent across multiple x742 boards.





### Highligths

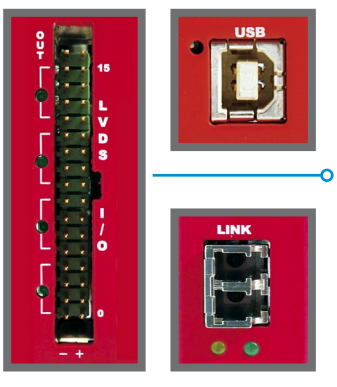
- 12-bit @ 5 GS/s, 1024 samples per event
- 5, 2.5, 1 GS/s software selectable sampling frequencies
- Analog inputs on MCX coax. connectors
- VME64/VME64X (32+2 ch.), NIM (16+1 ch.) and Desktop (16+1 ch.) modules
- 1 Vpp input dynamic range with programmable DC offset adj.
- VME, USB and Optical Link communication interfaces
- Multi-board synchronization features
- Daisy chain capability
- Demo software tools, C and LabVIEW libraries

### Applications

- Nuclear and Particle Physics
- Astroparticle Physics
- Time of Flight
- Medical Imaging (PET)

x742 is based on the DRS4 a Switched Capacitor Array. This technology relies on a set of capacitors that continuously sample the analog input signals. As soon as the trigger is issued, capacitors are decoupled from the input signals with a time interval from each other that is the sampling period.

The trigger therefore freezes the currently stored signal in the sampling capacitance cells. Subsequently the cells are multiplexed into the 12 bit ADC.




### USB
An USB 2.0 link is provided in NIM and Desktop form factors for an easy data readout.

### Digital I/O
Digital I/Os are provided in VME boards that can be used for individual trigger propagation to external trigger logic. This feature makes VME form factor ideal to scale up the acquisition channels where a global trigger generation is mandatory.

### Optical Link
An Optical link is provided in any form factor for high performance data readout through CAEN proprietary daisy-chainable CONET communication protocol.

## Technical Specifications

### GENERAL

**Form Factor**

1-unit wide, 6U VME64/VME64X, 1-unit wide NIM

154x50x164 mm³ (WxHxD) Desktop

### ANALOG INPUT

**Channels**

Single ended, 32+2 ch. (VME), 16+1 ch. (NIM, DESKTOP)

**Impedance**

50 Ω

**Connector**

MCX

**Full Scale Range (FSR)**

1 Vpp

**Bandwidth**

500 MHz

**Offset**

Programmable DAC for DC offset adjustment per channel or 8-channel group. Range: ±1 V

**TR0 TR1 Analog Input**

MCX 50 Ω, for fast local trigger and high resolution timing reference. NIM/LVTTL signals also supported.

### DIGITAL CONVERSION

**Switched Capacitor array**

Domino Ring Sampler chip (DRS4 ), 8+1 channels with 1024 storage cells each

**Resolution**

12 bits

**Sampling rate**

1 / 2.5 / 5 GS/s simultaneously on each channel

**Dead Time for Event A/D Conversion**

110 µs analog inputs only; 181 µs analog inputs + TR0, TR1 inputs

### CLOCK GENERATION

Synchronization clock source: internal/external

On-Board PLL provides generation of main board clocks from an internal (50 MHz loc. oscillator) or external (front panel CLK-IN connector) reference

### MEMORY

128 event/ch or 1024 event/ch (1024 samples per event) Multi-Event Buffer

### TRIGGER

**Trigger source**

Self-trigger: ch over/under threshold for 16-ch Common trigger generation (250 ns latency)

Fast local trigger: Programmable threshold on TR0 and TR1 input channels (each TRn signal triggers two channel groups)

External-trigger: Common by TRG-IN connector

Software-trigger: Common by software command

**Trigger propagation**

TRG-OUT (VME) / GPO (NIM and Desktop) output

**Trigger Time Stamp**

30-bit counter, 8.5 ns resolution (9 s range)

### LVDS I/O (VME only)

16 general purpose LVDS I/Os controlled by FPGA

Busy, Data Ready, Memory full, Individual Trig-Out and other functions can be programmed An Input Pattern from the LVDS I/Os can be associated to each trigger as an event marker

### SYNCHRONIZATION

**Clock propagation**

Daisy chain (VME only) through CLK-IN/CLK-OUT connectors

One-to-many clock distribution from an external clock source

Clock Cable delay compensation

**Acquisition Synchronization**

Sync Start/Stop through digital I/O (S-IN, TRG-IN or GPI input, TRG-OUT or GPO output)

External Trigger Time Stamp reset

### COMMUNICATION INTEFRACE

**Optical Link**

CAEN CONET proprietary protocol, up to 80 MB/s transfer rate

Daisy chainable: it is possible to connect up to 8/32 ADC modules to a single Optical Link Controller (Mod. A2818/A3818)

**USB (NIM & Desktop direct, VME via V1718 bridge)**

USB 2.0 compliant

Transfer rate up to 30 MB/s

**VME**

VME 64X compliant

Data transfer mode: BLT32, MBLT64 (70 MB/s using CAEN Bridge), CBLT32/64, 2eVME, 2eSST (up to 200 MB/s)

### POWER CONSUMPTIONS

Desktop: 1.7 A @ 12 V (Typ.)

NIM: 3.9 A @ +6 V, 90 mA @ -6 V

VME: 5.5 A @ +5 V, 200 mA @ +12 V, 300 mA @ -12 V

## Software

CAEN provides drivers, C and LabVIEW libraries, demo applications and utilities for the complete management of the digitizers, from board configuration to data readout and firmware upgrade.
Windows and Linux 32 and 64 bit operating systems are both supported.

| CAEN Upgrader | CAEN VME Demos | WAVE Dump | CAEN Scope |
|---|---|---|---|

## Ordering Code

| Code | Description | Form Factor |
|---|---|---|
| WDT5742XAAAA | DT5742 - 16+1 Ch. 12 bit 5 GS/s Switched-Capacitor Digitizer: 128 events/ch (1kS/event), EP3C16, SE | Desktop |
| WDT5742BXAAA | DT5742B - 16+1 Ch. 12 bit 5 GS/s Switched-Capacitor Digitizer: 1024 events/ch (1kS/event), EP3C16, SE | Desktop |
| WN6742XAAAAA | N6742 - 16+1 Ch. 12 bit 5 GS/s Switched-Capacitor Digitizer: 128 events/ch (1kS/event), EP3C16, SE | NIM |
| WN6742BXAAAA | N6742B - 16+1 Ch. 12 bit 5 GS/s Switched-Capacitor Digitizer: 1024 events/ch (1kS/event),EP3C16, SE | NIM |
| WV1742XAAAAA | V1742 - 32+2 Ch. 12 bit 5 GS/s Switched-Capacitor Digitizer: 128 events/ch (1kS/event), EP3C16, SE | 6U-VME64 |
| WV1742BXAAAA | V1742B - 32+2 Ch. 12 bit 5 GS/s Switched-Capacitor Digitizer: 1024 events/ch (1kS/events), EP3C16, SE | 6U-VME64 |
| WVX1742XAAAA | VX1742 - 32+2 Ch. 12 bit 5 GS/s Switched-Capacitor Digitizer: 128 events/ch (1kS/event), EP3C16, SE | 6U-VME64X |
| WVX1742BXAAA | VX1742B - 32+2 Ch. 12 bit 5GS/s Switched-Capacitor Digitizer: 1024 events/ch (1kS/event), EP3C16, SE | 6U-VME64X |

## Accessories

A2818
PCI CONET Controller

A3818
PCI Express CONET2 Controller

A654
MCX to LEMO Cable Adapters

A659
MCX to BNC Cable Adapters

A317
Clock Distribution Cable

AI2700
Optical Fiber Series

Cables for CONET Optical Link Networks