

# Universal Neutron Counter



## N2000 Series

### Introduction

The ANTECH Universal Neutron Counter 2000 Series combines Total Neutron Counting, Shift Register Coincidence Counting, Multiplicity Counting and List Mode (LM) data acquisition in a single portable package to provide a state of the art instrument. With this new virtual instrument (VI) it is not necessary to choose between neutron multiplicity counting or list mode pulse acquisition for a safeguards inspection in the field. The 2000 Series combines the benefits of both measurement techniques; immediate measurement results are provided by the Virtual Instrument (VI) real-time software, while the time stamping information saved on a hard disk can be re-analysed as necessary. The acquired pulse train can be analysed with future techniques or improved instrument parameters.

The unit has a maximum of 19 inputs, which provide at least one input per amplifier board for the small to medium detector systems. The use of Low Voltage Differential Signalling (LVDS) with twisted wire ribbon cable (a round shielded cable is also available) provides an effective solution for sending pulses from amplifier board outputs to instrument inputs. A single D-sub connector provides signal and 5Vdc power supply connections. For this purpose a special interface board must be embedded in the junction box of a neutron detector for TTL to LVDS level conversion. For example, up-grading a standard Active Well Coincidence Counter with LVDS signalling dramatically reduces system dead time and improves the detection of faulty amplifiers or counter  $^3\text{He}$  tubes.

The four BNC inputs on the front panel are compatible with current single TTL output neutron counting systems and enable connection for up to four detector banks or amplifier arrays, like for instance a Neutron Coincidence Collar. Each input (BNC/LVDS) is equipped with a de-randomizing buffer (5-bits) and can accept short bursts of incoming pulses with a maximum frequency of 40 MHz. The sum of all 19 inputs is fed to a 8-bit de-randomizing buffer, which is read-out with the 40 MHz clock of the shift register: even very high multiplicity events are processed without losses (the maximum multiplicity of the gate is 8191). The maximum continuous summed input count rate is 5 MHz with LM Mode disabled.



Besides List Mode and Virtual Instrument acquisitions (neutron coincidence and neutron multiplicity), which can be enabled or disabled by the user, each input is equipped with a 40-bit scaler. The unit also has a 'Synch In' BNC connector to combine multiple units in a single multiplicity counter in case more inputs are required. This input can also be used to trigger an acquisition, at a sufficiently high rate for Differential Die-away Techniques (DDT) with pulsed neutron generators (up to 100 Hz rate).

### Benefits

- Simultaneous neutron totals, coincidence, multiplicity counting and list mode (time stamping) acquisition
- Compact portable design
- Virtual Instrument design: various pulse train analysis techniques are possible with real-time software
- Fully compatible with INCC and ANTECH MasterPassiveActive software
- Reduction of system dead-time through embedded pulse mixer with multiple inputs (software controllable enable/disable): 4 TTL and up to 15 LVDS
- Powered via 12 VDC

## Features

- High frequency 40 MHz acquisition clock for improved accuracy and backward compatibility with older systems that use 4MHz clocks
- 19 high count rate inputs: 4 TTL (BNC) and 15 LVDS (D-sub 37) - up to 40 MHz
- User selectable Fast Accidentals sampling (4 MHz clock) mode
- Proprietary data compression technique for time stamping information allowing very high count rates while minimising disk space requirements
- High voltage supply for <sup>3</sup>He neutron detectors - max 2000 Vdc
- Low voltage 5 Vdc supply for a maximum of 18 amplifier boards via front-panel BNC connector
- Gate Out connector (BNC) to signal when the unit is effectively counting (used for synchronizing multiple units)
- I/O connector (BNC) can be defined by the user to be an input or an output. When used as an input it can be used to start/stop an acquisition. When configured as an output it may be used to signal the end of a measurement or to trigger an alarm (for instance when a certain count rate occurs).
- The operator can select which inputs contribute to the coincidence count and which don't. All inputs also function as a scaler (a simple pulse counter)
- Each input has an input inhibit function. When enabled, input is disabled for a fixed time after an incoming pulse

## Specification

<b>External dimensions (H x W x D)</b>		85 mm x 232 mm x 210 mm (without handle and feet)
<b>Weight</b>		1620 g
<b>Temperature range</b>	<b>Operation</b>	5°C to 40°C (up to 90% RH)
	<b>Storage</b>	0°C to 50°C (up to 90% RH)
<b>Input power</b>		12 Vdc, 1.25 A
<b>Output power</b>	<b>LV</b>	5 Vdc, 1.5 A maximum
	<b>HV</b>	2000 Vdc, 100 µA maximum
<b>Safety</b>		EN60601-1
<b>EMC</b>		Complies with 2004/108/EC
<b>Maximum input count rate (momentary)</b>		40 MHz per input
<b>Maximum input pulse width</b>		12.5 ns
<b>Maximum continuous input count rate</b>		5 MHz with LM Mode disabled
<b>System clock</b>		40 MHz (time stamping resolution 25 ns)
<b>Interfaces</b>		USB 2.0
<b>Scaler</b>		40 bit totals on each input
<b>Inputs</b>	<b>BNC</b>	4 BNC (LED pulse indicators for each channel)
	<b>LVDS</b>	15 (D sub-connector 37 pin)
<b>Pre-delay</b>		0.0 - 25.575 µs (in steps of 0.025 µs)
<b>Gate Width</b>		0.0 - 819.175 µs (in steps of 0.025 µs)
<b>Long-delay</b>		4096 µs
<b>Cycle Timer</b>		0.1 ms to 1.1E8 s (in steps of 0.1 ms)
<b>Compliance</b>		CE, UKCA