CANBERRA

# InSpector 2000 DSP Portable Spectroscopy Workstation

## Features

- Full featured portable MCA based on Digital Signal Processing (DSP) technologies
- Unsurpassed temperature stability for consistent, quality operation in adverse environmental conditions
- Accommodates a wide dynamic range of count rates, minimal loss of spectrum resolution
- Low system dead time to reduce count times and improve measurement accuracy
- Wide range of processing time settings to allow precise match to detector characteristics and application requirements
- Ultra small, ultra light weight package
- 10 hour HPGe battery life (12 hour NaI)
- Fast USB and highly optimized RS-232 host interfaces supported
- 16K Channel conversion gain/spectrum memory
- PHA and MCS modes supported
- Digital oscilloscope to assist with setup
- Built-in power up diagnostics

## Description

The InSpector™ 2000 is a high performance, portable spectroscopy workstation based on Digital Signal Processing (DSP) technology. Applications for the InSpector 2000 include all HPGe, NaI and Cd(Zn) Te detector applications common in environmental characterization; nuclear safeguards; decommissioning and decontamination; and in-facility monitoring. The instrument provides unsurpassed count rate and resolution performance coupled with environmental stability previously seen only in high-end laboratory systems. Package size and battery life set a new standard for field portability and convenience. The host Genie™ 2000 software environment provides the user with the ultimate flexibility in field operation. A wide range of application specific software options, designed specifically for field spectroscopy, is available under the Genie 2000 family.

The unprecedented performance of the InSpector 2000 derives from the application of DSP technology. Previously limited to laboratory applications due to the high power requirements of the internal components, DSP now gives the field spectroscopist the capability to perform high precision measurements in adverse environmental conditions with a portable instrument. Earlier analog spectroscopy systems were prone to count rate and environmental instabilities that required continual adjustment of the signal processing subsystem – and often compromised analysis results. With the InSpector 2000, these problems are dramatically reduced – while portability is significantly improved.

The heart of the InSpector 2000 is the Digital Signal Processor subsystem. Unlike conventional systems, which digitize the signals at the end of the signal processing chain, the InSpector 2000 digitizes the preamplifier signals at the front end of the signal processing chain. This approach minimizes the amount of analog circuitry at the front end of the instrument, resulting in increased stability, accuracy and reproducibility.

The use of DSP technology also improves the overall signal acquisition performance. Signal filtering functions previously implemented in traditional analog electronics are limited. DSP allows filtering functions and pulse shapes that are not realizable using conventional analog processing techniques. The result is a more efficient trapezoidal filter function, which exhibits less processing time, less sensitivity to ballistic deficit, and superior resolution. With trapezoidal filtering, the pulses can be processed more rapidly and accurately, so the spectrum resolution is enhanced while throughput is increased.

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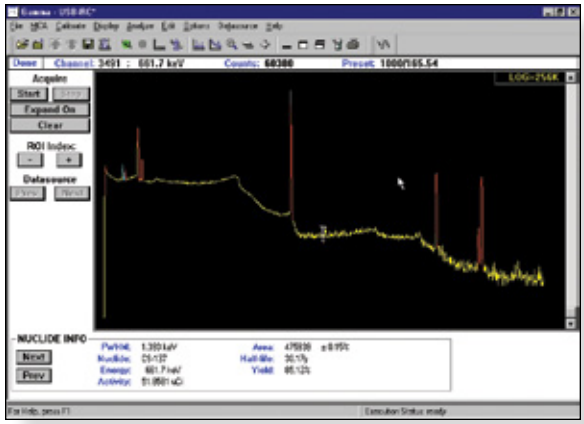
**Performance Benefits for Field Applications**
These improvements in signal processing performance provide several tangible benefits to the field spectroscopist. Most significant for field operation is the significantly improved temperature stability. Important even in temperature controlled laboratory environment – the improved stability becomes far more dramatic in field operations where ambient temperatures may vary as much as ±10 °C in the course of a work day. Without temperature stability, the operator is forced into frequent QA checks and gain adjustments in order to retain calibrated peak position and quality peak shape. The InSpector 2000 offers peak gain stability in some cases a factor of two to three times better than past generation analog products – even better than lab DSP products. Zero stability is improved even more. Zero drift is barely measurable over the full operating temperature range.

Count rate performance is another potentially significant issue for the field user. In many nuclear safeguards, or decommissioning and decontamination applications, measurements may be taken in areas ranging from natural background to highly contaminated. Count rate ranges of several orders of magnitude are not uncommon. The dynamic range of the DSP based system allows such a wide range of count rate to be encountered with minimal shift in peak positioning and minimal peak broadening.

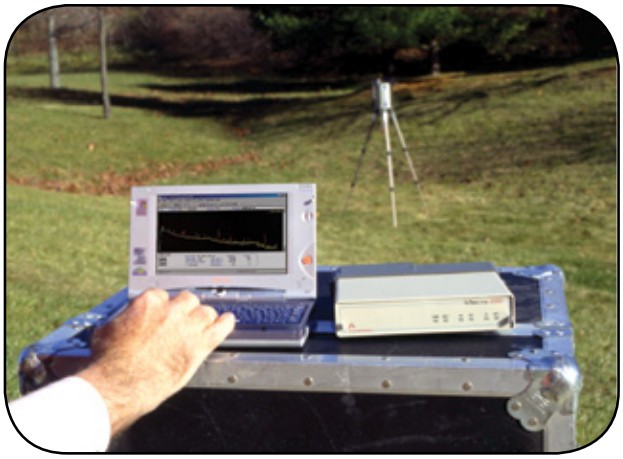
Even when a system is used largely for low activity work, the count rate performance can be significant. Any dead time reduction achieved through faster signal processing can improve measurement sensitivity. One study has demonstrated that the use of DSP at a count rate as low as 3 kcps can reduce count time to achieve a desired MDA by as much as 20% compared to typical analog systems. With the increased use of higher efficiency germanium detectors, more users are seeing higher count rates in natural background – particularly when counting open areas of soil. The presence of any contamination can further raise count rates increasing the possibility of significant dead time.




Traditional analog portable instruments typically are equipped with only two shaping times – due to the physical space required by the components that would be needed to provide more. This limitation means that the user cannot always precisely optimize processing time to provide the best performance for a given detector or application requirement – the shaping time limitation requires a compromise. In the InSpector 2000, processing time is controlled digitally by altering the rise/fall and flat top times of the trapezoidal filter. There are 40 rise/fall times and 21 flat top times in the InSpector 2000 – for practical purposes giving the user an “infinite” range of processing time adjustability.

The InSpector 2000 supports both the traditional Pulse Height Analysis (PHA) mode as well as a multichannel scaling (MCS) mode for time varying applications. The MCS mode can display data from either an external TTL input, a full spectrum integral or a Region of Interest (ROI). The InSpector 2000 also supports two memory groups (8K per group maximum) with a “ping-pong” memory feature that allows the user to acquire a spectrum into one memory group while reading from a second. Both the ping-pong memory and the MCS mode make the InSpector 2000 ideal for applications involving characterization of a surface or area while the detector is moving.

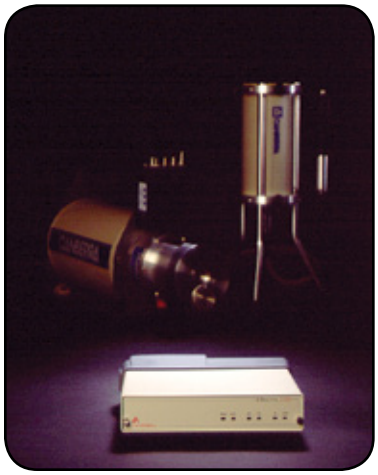
# InSpector 2000 DSP Portable Spectroscopy Workstation



## Applications

**Environmental Characterization**
Superior temperature stability of the InSpector 2000 ensures that peak shape and position is preserved even in adverse conditions over long acquisition times. Gain and zero temperature coefficients are even better than lab based DSP products. Lower dead times can reduce Minimum Detectable Activities (MDA).

**Decommissioning and Decontamination**
The InSpector 2000's wide dynamic range ensures stability and quality results over the wide range at count rates associated with varying contamination levels.



**Nuclear Safeguards**
Exceptional throughput/resolution performance ensures high quality results over a wide range of count rates for complex U and Pu spectra. Ultra portability and easy setup allows inspections to be performed rapidly with minimal impact on site operations.

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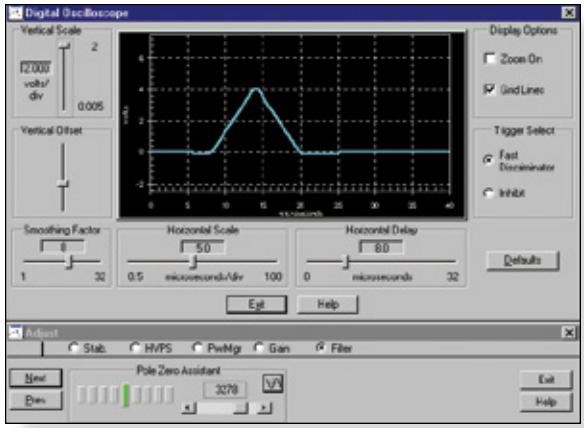
The InSpector 2000 is designed for full 16K channel memory/conversion gain operation. This capability is particularly advantageous where a wide energy range is required. Many users involved in field characterization will benefit from this capability to evaluate natural radionuclides with energies >2.5 MeV while retaining very good spectral resolution in the complex 200 – 500 keV range.

**Efficient, Convenient Operation**

In addition to the unique characteristics of the InSpector 2000 in terms of spectroscopy performance, the unit offers a number of additional features that facilitate convenient, efficient operation in field applications. At 1.3 kg (2.8 lb) the instrument sets a new standard for full featured multichannel analyzers – less than half the weight of previous generation instruments. The 3.8 x 18.5 x 17.3 cm (1.5 x 7.3 x 6.8 in.) package reduces the footprint to less than half that of older generation instruments – making it perfectly compatible with the latest generation of mini-notebook computers.

The InSpector 2000 provides an extraordinary amount of battery life from a standard Lithium-ion Sony® CAMcorder battery. The Li-ion technology provides long life, outstanding shelf charge hold time and virtually eliminates the memory effect associated with older battery technologies.

With the standard full capacity battery, the user can expect a full 10 hours of operation with an HPGe detector and a standard RC type preamplifier. A typical NaI detector will run over 12 hours. An optional, low profile battery is available with 1/3 the life of the standard battery. The low profile battery reduces the unit weight and footprint still further and is suitable for applications where longer battery life is not needed.




In some cases, the power management features built in to the InSpector 2000 further extend battery life. With power management enabled, the InSpector 2000 will shut itself down in an orderly manner after a user-selectable period of time with acquisition stopped and no communications activity.

Where desired, external power can be supplied via the dc input connector. This can be a standard ac adapter (included), a car battery adapter (optional) or a user-supplied dc source. When the external dc source is connected, a mounted CAMcorder battery is always trickle charged. This feature facilitates the use of the InSpector 2000 in emergency response applications – it can be used in a facility as a laboratory device – then taken out in a portable mode with full confidence of a full battery charge. Additionally, the mounted battery can function as an uninterruptible power supply (UPS) in laboratory operations.

# InSpector 2000 DSP Portable Spectroscopy Workstation

Two methods of host communications are supported. The preferred method is the Universal Serial Bus (USB) interface which provides ultra fast host communications at 12 Mbits/second. This provides data transfer and display update performance that previously had been available only in laboratory systems based on Ethernet media. USB provides the additional capability of having multiple units attached to a single host/port via a USB hub. This allows multiple InSpector 2000s to be deployed in a single fixed location monitoring application. USB requires the use of either Windows® 98 or Windows 2000 operating environments.

The second method of host interface is a standard RS-232 serial connection. Due to the communications rate constraints of serial ports, the InSpector 2000 has been designed for highly compressed/optimized communications. Using the serial link, the user can expect screen updates in the range of an update per second on 8K spectra at moderate count rate. Note that this rate varies due to count rates and spectrum sizes.

To facilitate optimal pole/zero adjustment, the InSpector 2000 is equipped with a Pole/Zero Assistant (PZA) feature. The PZA allows the user to adjust the pole/zero cancellation circuit while logic in the InSpector 2000 analyzes and displays the degree of overshoot and undershoot exhibited by the filtered signal. The user simply moves the P/Z control until the over/under indicator is centered – indicating optimal adjustment.

Purists who wish to view the actual signal while adjusting pole/zero or other parameters will use the digital oscilloscope function implemented with the InSpector 2000 and host computer software. With the digital oscilloscope, the user views a graphical reconstruction of the digitized, filtered signal. Scaling and trigger functions are similar to those of an actual oscilloscope.

Upon initial power up, the InSpector 2000 performs a set of internal diagnostic analyses, checking the status of the microprocessor and its components as well as the signal processing logic. During this time, the Fault LED is illuminated. If the Fault LED remains illuminated, a fault is indicated. While in this state another LED will blink to indicate the nature of the fault. A blinking ACQ LED indicates a problem with the microprocessor or related components. If the Battery LED blinks, this indicates a possible problem with the power supply or signal processing logic and a blinking HV LED indicates HV Inhibit signal.

**InSpector 2000 rear panel shown with optional low profile battery attached**

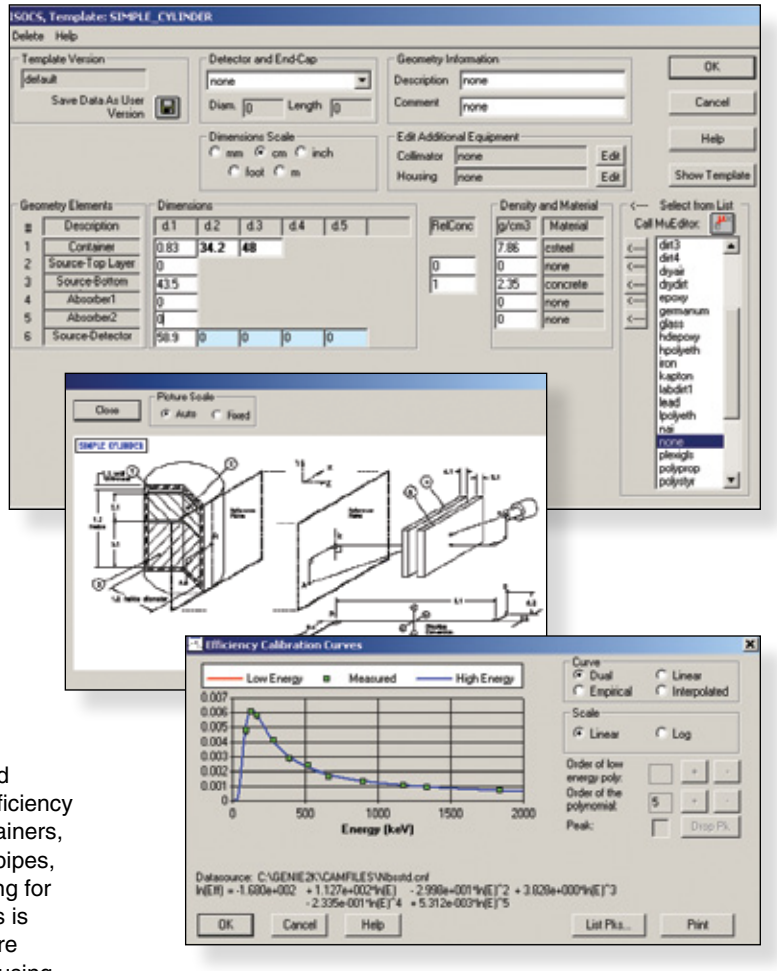
# InSpector 2000 DSP Portable Spectroscopy Workstation

**Genie 2000 Software Support**
The InSpector 2000 is supported by CANBERRA's industry standard Genie 2000 spectroscopy software suite. Genie 2000 offers unsurpassed capability to the gamma spectroscopist – intuitive user interface, time proven data reduction algorithms, extensive quality assurance capabilities and flexible report generation. These facilities are documented extensively in Genie 2000 documentation.

Additionally, there are a number of Genie 2000 based layered application software products that are specifically designed for field portable applications. These provide dedicated user interface environments and analysis facilities for those applications – allowing operation by technicians with application specific procedural training, rather than highly trained spectroscopists.

A brief description of these application packages follows:

*In Situ* **Object Counting Software (ISOCS™):**
One of the larger challenges in many field applications is generating an accurate efficiency calibration for large objects – waste containers, large pieces of equipment, walls, floors, pipes, fume hoods, planes of soil, etc. Calibrating for such geometries with radioactive sources is generally impractical. The ISOCS software is designed to develop such calibrations using mathematical modeling instead of sources – resulting in accurate calibrations at minimal cost.



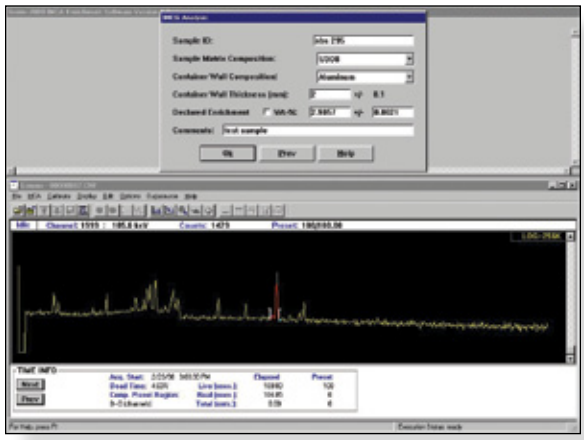

*In Situ* **Object Counting Software**

# InSpector 2000 DSP Portable Spectroscopy Workstation

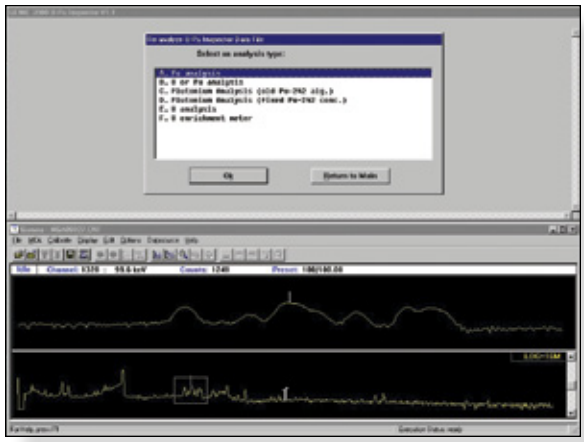
*In Situ* **Soil Counting System:**
Counting large areas of contaminated or potentially contaminated soil also has calibration complications. Specially developed, mathematically generated calibrations for this application are available for specially characterized CANBERRA germanium detectors.

**IMCA Uranium Enrichment Software:**
The IMCA software was specifically designed to duplicate IAEA inspection procedures with respect to uranium enrichment assay. It supports the standard IAEA NAID (Am-doped NaI) detector and GDET (CANBERRA LEGe) detector. A user interface specifically designed for safeguards inspectors, temperature stabilized NaI operation and automatic gain adjustment are standard features of the software. (Consult factory for upgrades required to support InSpector 2000).

**Uranium/Plutonium (U-Pu) InSpector Software:**
U-Pu InSpector software uses the worldwide standard Multi-Group Analysis (MGA) for plutonium and Multi-Group Analysis for Uranium (MGAU) software codes. A technician/inspector oriented user interface makes the software simple to operate in a procedural sense without in-depth spectroscopy knowledge.



**IMCA Uranium Enrichment Software**



**Uranium/Plutonium (U-Pu) InSpector Software**

# InSpector 2000 DSP Portable Spectroscopy Workstation

## Specifications

**INPUTS/OUTPUTS**

Note: Signals indicated with asterisks are provided on the Detector Composite Connector and accessed by the associated Composite Cable.

AMP IN* – Accepts positive or negative signals from an associated detector preamplifier; amplitude for full scale conversion ±10 V divided by selected gain; maximum input (signal +dc) for Linear operation is dependent on the Input Attenuator setting; Attenuator OFF (x1): ±4 V, Attenuator ON (x 0.25): ±12 V, dc coupled and protected to ±24 V maximum; rise time: less than the selected Rise Time + Flat Top settings; decay time constant: 45 µs to infinity; $Z_{in}$ is 1.3 Ω.

RESET* – Accepts a standard TTL Logic signal; functionality is dependent on the Reset Preamp Inhibit mode selected; disables pulse processing, extends the system dead time, resets the pileup rejector and gates off the baseline restorer. Auto: system is gated off for the greater of the Reset Preamp Inhibit Time "OR" the Internal Inhibit time; Manual: functionality same as Auto mode except the signal processor is inhibited for the greater of the user selected Inhibit Setting "OR" the Internal Inhibit Time "OR" the Reset Preamp Inhibit Time.

Positive true or negative true signal polarities, user selectable; minimum pulse width is 100 ns; logic high ≥+2 V, logic low ≤+0.8 V; maximum input voltage +5.5 V.

HV INH* – Accepts input from the detector preamplifier to shut down the HVPS in the event of a detector warm-up; polarity is user selectable to match the preamplifier. Positive polarity: for all CANBERRA preamplifiers; Enable condition (cold detector) is an open circuit or active high ≥+1.4 V to +24 V; Inhibit condition (warm detector) is – 24 V to <+1.4 V or ground. Negative polarity: all preamplifiers and LN monitors where enable condition (cold detector) is – 24 V to <+1.4 V; Inhibit condition (warm detector) is open circuit or active high ≥+1.4 V to +24 V. With Negative selected an open input will disable the high voltage.

MCS IN – MCS counts input; TTL compatible; maximum rate ≤1 MHz.; minimum pulse width ≥20 ns; logic low ≤+0.8 V, logic high ≥+2 V.

THERM IN* – Thermistor monitor input; voltage range 0 to +5 V.

BATTERY IN – Sony NP-F950/NP-F550 or equivalent Lithium-ion battery; Nominal 7.2 V dc at 0.70 amps.

DC POWER – Auxiliary dc power input; 2.5/5.5 mm rear panel connector; Nominal 7.5 V dc at 0.70 amps.

HV OUT – Dual range and polarity high voltage power supply; Voltage range and polarity selected by programming modules:
±10 to ±1300 V dc or ±1300 to ±5000 V dc; high voltage output provided on rear panel SHV connector. Low end of the 5000 V range is limited to 1300 V by software.

RS-232 – RS-232 interfaces to host personal computer; software selectable baud rate, 2.4K to 115K supported; rear panel 3-pin miniature connector.

USB – High Speed USB Interface for host communication; USB Series B connector.

- The InSpector 2000 is compatible with the Universal Serial Bus specification Rev 1.1.
- All CANBERRA USB devices are configured as a vendor specific Interface class. The InSpector 2000 belongs to the MCA subclass.
- The maximum cable length supported by USB is 5 m.

PREAMP* – Provides ±24 V (±5%), ±12 V (±5%) and ground for standard preamplifiers;

Overload protected;
+24 V at 40 mA max.
–24 V at 20 mA max.
+12 V at 80 mA max.
–12 V at 30 mA max.

**INDICATORS**

HV – Green LED, indicates HVPS is ON or HV fault condition, constant on indicates HVPS is on and high voltage may be present at the rear panel SHV connector. Blinks for a fault condition such as a high voltage overload or inhibit due to a detector warm up if connected.

FAULT – Green LED, indicates a power on diagnostic failure or high voltage fault.

ACQ – Green LED, indicates MCA is acquiring.

COMM – Green LED, indicates USB or RS-232 activity.

BATT – Green LED indicates power status.

- Steady On – Power switch is ON and the InSpector 2000 is powered by the ac adapter or charged battery.
- Slow Blink – The battery is becoming discharged with less than 5% of capacity remaining.
- Fast Blink – The battery has become discharged (two minutes or less of operation remaining) and the InSpector 2000 is going through an orderly shut down; acquisition is halted, data is backed up in memory, the HVPS is ramped down to zero volts and the instrument is shut off.

ICR – Green LED, indicates incoming count rate; blink rate proportional to count rate.

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## PROGRAMMABLE CONTROLS

### Gain

The combination of Coarse Gain, Fine Gain and Super Fine Gain (SFG) set the overall system gain to match the requirements of the detector and energy application; overall gain is continuously adjustable from x2.24 to x2438.

COARSE GAIN – x2.5, x5, x10, x20, x40, x80, x160, x320, x640, x1280 (referenced to 10 V full-scale output).

FINE GAIN – Range is x0.9 to x1.9.

SUPER FINE GAIN – Range is x0.9975 to x1.0025.

GAIN ATTENUATOR – ON/OFF; When ON (selected) enables a divide by four input attenuator to minimize overload due to preamp signals with large dc offsets and Reset Preamps with large output ramp dynamic range; Coarse Gain settings displayed include the effects of the attenuator, the Coarse Gain selections reduce from 10 to 8 covering a range of x2.5 to x320. When OFF is selected the signal attenuation is removed.

MCA/INPUT SIZE – PHA Mode: Selections of 256, 512, 1024, 2048, 4096, 8192 or 16384 channels. Support for two memory groups of 8192 or less channels; MCS Mode: selections of 256, 512, 1024, 2048, 4096, or 8192 channels, support for two memory groups of 8192 or less channels.

LLD Mode – Selects Automatic or Manual LLD mode; AUTOMATIC: the LLD cutoff is automatically set just above the spectral noise threshold; MANUAL: allows the LLD cutoff to be set manually as a percentage of the full scale spectral size or range.

LLD Setting – Active when the Manual LLD mode is selected, sets the minimum input acceptance level, range is 0 to 100%.

INP POLARITY – Selects either POSITIVE or NEGATIVE input polarity.

INH POLARITY – Selects either Active High or Active Low Reset Preamp Inhibit polarity.

PUR GUARD – Selects Guard Time (GT) multiplier in increments of 1.1, 1.3, 1.5, 1.7, 1.9, 2.1, 2.3 and 2.5 to reject trailing edge pile-up in the event of detector/preamp anomalies.

FDISC SHAPING – Selects NORMAL or LOW ENERGY to optimize the fast discriminator shaping for the selected detector type; NORMAL: The Fast Discriminator shaping is optimized for Ge detectors and general gamma spectroscopy, the fast discriminator filter rise time is set to 0.040 µs; LOW ENERGY: the Fast Discriminator filter rise time is set proportional to the slow shaping rise time selection.

FDISC MODE – Sets the Fast Discriminator Threshold mode. AUTO: the threshold is optimized automatically above the system noise level; MANUAL: allows threshold to be adjusted manually.

FDISC SETTING – Active when manual FDISC mode is selected; sets the Fast Discriminator threshold level, range is 0 to 100%; the front panel ICR LED serves as a user aid when manually setting the Fast Discriminator threshold.

INHIBIT MODE – Selects AUTO or MANUAL Reset Preamp Inhibit Modes; disables pulse processing, extends the system dead time, re-initializes the pileup rejector and gates off the baseline restorer. AUTO: system is gated off for the greater of the Reset Preamp Inhibit Time “OR” the Internal Inhibit time functionality same as Auto mode except the signal processor is inhibited for the greater of the user selected Inhibit Setting “OR” the Reset Preamp Inhibit Time “OR” the Internal Inhibit Time.

INHIBIT SETTING – Active when the MANUAL Reset Preamp Inhibit Mode is selected, sets the Inhibit Time, range 0 to 160 µs in increments of 1 µs.

LTC MODE – ON/OFF; ON: Enables pile-up rejector and live time corrector (LTC). LTC generates dead time to extend the acquisition time to compensate for events that are piled-up and rejected. OFF: Pile-up rejector and LTC disabled.

LT TRIM – Allows adjustment of the trapezoid pulse evolution time or dead time to optimize Live Time Correction (LTC) performance. The adjustment range is 0 to 1000; the default value of 500 provides good LTC performance for a wide range of applications.

### Filter

Note: Filter output (Trapezoid Signal) may be displayed on the Host computer using the digital oscilloscope feature.

RISE TIME – 40 rise and fall times ranging from 0.4 µs to 38 µs.

FLAT TOP – 21 flat top time selections ranging from 0 to 3 µs.

BLR MODE – AUTO, HARD, MEDIUM, SOFT; AUTO: The baseline restorer is automatically optimized as a function of trapezoid shaping time and count rate; HARD, MEDIUM, or SOFT: Sets the baseline restorer to fixed rates as selected.

POLE/ZERO – Pole/zero is adjusted by computer control; range: 45 µs to infinity; a digital oscilloscope and Pole/Zero Assistant is provided as a user aid when optimizing the pole/zero setting.

The Pole/Zero Assistant measures and analyzes the tail of the trapezoid signal and provides visual feedback showing the quality of the pole zero adjustment via a simulated null meter or Pole/Zero Quality Indicator.

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PREAMP TYPE – RC, RESET; selects the pole/zero mode; RC: pole/zero can be adjusted manually by computer command; range: 45 µs to infinity; RESET: Sets pole/zero at infinity for use with pulsed charged restoration (RESET) preamplifiers.

POWER MANAGEMENT – ON/OFF; the InSpector 2000 can be programmed to automatically shut down when no acquisition and communication with the host computer is detected. ON: With no acquisition and no communication detected the InSpector 2000 automatically shuts down after a programmable delay; OFF: Automatic shutdown feature is disabled.

SHUT DOWN DELAY – Allows adjustment of the shut down delay when the automatic shutdown power management mode is selected; the adjustment range is 1 minute to 250 minutes.

**Digital Oscilloscope**

Allows examination of the digital trapezoid signal reconstructed in time to assist and verify instrument setup, pole/zero optimization and manual Reset Preamp INHIBIT adjustments.

**HVPS**

VOLTAGE RANGE – (Programmable Modules) Output voltage range and polarity selected by plug-in programming modules: +10 to +1300 V dc, +1300 to +5000 V dc, –10 to –1300 V dc and –1300 to –5000 V dc, module type is read by firmware and displayed on host application; Low end of the 5000 V range is limited to 1300 V by software.

VOLTAGE LIMIT – Sets maximum voltage limit of voltage range selected; +10 to +1300 V dc, +1300 to +5000 V dc, –10 to –1300 V dc or –1300 to –5000 V dc. Voltage range and polarity selected by plug-in programming modules.

STATUS – ON, OFF; sets the HVPS ON or OFF.

VOLTAGE – Allows adjustment of the HVPS output over the voltage range selected by the HV module type and voltage limit selections.

HVPS RESET – Resets a power supply fault, after a fault condition has occurred (requires cycling HV off and on).

INH SIGNAL – Sets the polarity sense of the High Voltage Inhibit input. Positive setting: for all CANBERRA preamplifiers; Enable condition (cold detector) is an open circuit or active high ≥+1.4 V to +24 V; Inhibit condition (warm detector) is – 24 V to <+1.4 V or ground. Negative setting: all preamplifiers and LN monitors where enable condition (cold detector) is –24 V to <+1.4 V; Inhibit condition (warm detector) is open circuit or active high ≥+1.4 V to +24 V. With Negative selected an open input will disable the high voltage.

**Stabilizer**

GAIN MODE – ON, OFF, HOLD; ON/OFF: enables or disables the Gain Mode; HOLD: disables the stabilizer Gain Mode, but maintains the current Gain correction factor; Centroid (0 to 16 376 channels), Window (1 to 128 channels), Spacing (2 to 512 channels), Ratio (0.01 to 100), Rate Div (1 to 16); Correction Range of 1% for Ge and 10% for NaI detectors.

**MCS**

MODES – TTL, Integral, ROI Discrimination; Events are counted for the duration of a programmed number of sweeps. Each SWEEP incorporates a programmed number of channels. Each channel represents a DWELL duration.

- TTL – TTL pulses counted from MCS IN connector.
- Integral – Total gamma events counted from DSP spectrum. ROI Discrimination Gamma events counted if they occur within the programmed ROI window.

**Programmable Settings**

DWELL TIME SETTINGS – 5.00 ms to 10.0 s in 14 steps: 5.00 ms, 10.0 ms, 20.0 ms, 40.0 ms, 80.0 ms, 100.0 ms, 200.0 ms, 400.0 ms, 800 ms, 1.0 s, 2.0 s, 4.0 s, 8.0 s and 10.0 s.

- Dwell Time Resolution – Less than 10 µs.
- Sweep Counter – 65 535 sweeps.
- ROI Disc Window – 1 to 8192 channels.
- Sweep Mode – Sweep Counter or Sweep Forever.
- MCS Channel Range – 256 to 8192.
- Start/Stop control – Software.

# InSpector 2000 DSP Portable Spectroscopy Workstation

**Performance**

**Signal Processing**

SPECTRUM BROADENING – The FWHM of $^{60}$Co 1.33 MeV gamma peak for an incoming count rate of 2 kcps to 100 kcps will typically change less than 6% for 2.8 µs rise/fall time, 0.8 µs flat top and proper P/Z matching. These results may not be reproducible if the associated detector exhibits an inordinate amount of long rise time signals.

INTEGRAL NON-LINEARITY – ≤±0.025% of full scale over the top 99% of selected range.

DIFFERENTIAL NON-LINEARITY – ≤±1% over the top 99% of the range including the effects from integral non-linearity.

GAIN DRIFT – ≤35 ppm/°C after 15 minutes of operation.

ZERO DRIFT – ≤3 ppm/°C after 15 minutes of operation. Typically, less than 1 channel over full temperature range (8K Spectrum).

OVERLOAD RECOVERY – Recovers to within 1% of full scale output from x1000 overload in 2.5 non-overlapped pulse widths at full gain, at any shaping (processing time), and with pole/zero properly set.

**Pileup Rejection/Live Time Correction**

PULSE PAIR RESOLUTION – Better than 500 ns with NORM Detector Type selected.

DEAD TIME CORRECTION – Extended Live-Time correction, accuracy of reference peak area changes 5% (3% typical) at up to 50% system dead time with a setting of 5.6 µs rise time and 0.8 µs flat top.

**Acquisition**

DATA MEMORY GROUPS – 1–16K (PHA) Channels or 2–8K (PHA) channels (single mode only); 28 bits per channel, 10 year data retention (power loss). Divisible into halves, quarters, eighths, and sixteenths. 2–8K (MCS) channels; 28 bits per channel, 10 year data retention (power loss).

Note: No simultaneous operation of PHA/MCS.

STORAGE MODE – PHA or MCS.

PRESET MODE

- PHA Mode – Live or True Time, Counts in single channel, Counts in ROI, Counts in multiple ROIs.
- MCS Mode – Sweeps, Count greater or equal to preset Counts, Count greater or equal to preset ROI Counts.

TIME RESOLUTION – 0.01 s live and true time.

PRESET TIME – 1 to >4 x$10^7$ s.

PRESET SWEEPS – 1 to 65 535.

**HVPS**

Plug-in programming modules select the maximum voltage range and polarity. Identification of installed module is reported by the software.

- 1300 Volt Range:
  +10 V to +1300 V or –10 V to –1300 V dc at 300 µA.
- 5000 Volt Range:
  +1300 V to +5000 V dc or –1300 V to –5000 V dc at 20 µA.

ADJUSTMENT RESOLUTION – 1 part in 4096, all modules.

RIPPLE

- ±1300 V dc range:
  ≤25 mVpp in 50 MHz bandwidth at maximum voltage and full load.
- ±5000 V dc range:
  ≤50 mVpp in 50 MHz bandwidth at maximum voltage and full load.

TEMP. COEFFICIENT – ≤±50 ppm/°C after 15 minute warm-up.

OUTPUT STABILITY – Long term drift of output voltage is ≤0.01%/h and ≤0.02%/8 h at constant load and ambient temperature after 15 minute warm-up.

VOLTAGE ACCURACY – ±5% of setting.

REGULATION – ≤5% variation in output voltage over the load range at constant ambient temperature.

OVERLOAD PROTECTION – The high voltage power supply will withstand any overload, including a short circuit for an indefinite period.

# InSpector 2000 DSP Portable Spectroscopy Workstation

**Cables**

COMPOSITE DETECTOR CABLES (STANDARD) – Detector composite cable, 3 m (10 ft); provides preamp power (9-pin D), Energy, HV Inhibit, (BNCs) and High voltage (SHV).

Optional detector composite cable, 3 m (10 ft); same as standard cable except includes TRP RESET cable (BNC).

COMPUTER CABLES

- RS-232 (Standard) – Used for connecting the instrument to an IBM PC compatible serial port; 1 m (3 ft); 9-pin D connector for connection to the PC com port and a 3-pin miniature circular connector for connecting to the InSpector 2000 RS-232 port; baud rates supported are 2400, 4800, 9600, 14.4 k, 19.2 k, 28.8 k, 38.4 k, 57.6 k, and 115.2 k.
- USB (Standard) – Used to connect the host IBM compatible computer USB port to the InSpector 2000 rear panel USB port; 1 m (3 ft); shielded cable.
- MCS CABLE (Standard) – Used for connecting the instrument to a TTL compatible logic signal. The cable is a one meter long RG-134 coaxial cable. The cable has a BNC Female connector for connecting to an MCS signal source and a MCX connector for connecting to the InSpector 2000 rear panel MCS input.

**Physical**

Metal and Plastic enclosure.

SIZE – 3.8 x 18.5 x 17.3 cm (1.5 x 7.3 x 6.8 in.) H x W x D.

WEIGHT – 1.3 kg (2.8 lb) Includes NP-F950 Sony Lithium-ion high capacity battery.

**Environmental**

OPERATING TEMPERATURE – 0 to 50 °C.

OPERATING HUMIDITY – Up to 80% non-condensing.

Meets the environmental conditions specified by EN 61010, Installation Category I, Pollution Degree 2.

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