



# JSR-14™

## Neutron Analysis Shift Register



### KEY FEATURES

- Combines multiplicity capabilities with traditional coincidence counting at one low price
- Operates in selectable JSR-12™ or Multiplicity mode (Mirion 2150™ unit)
- Is fully computer controlled
- Similar to the Mirion InSpector™ analyzer in form factor
- Based on the Los Alamos design
- Like for like replacement of JSR-12 unit when operating in the JSR-12 mode
- Uses same JSR-12 battery backed RAM for storage of data points and systems settings
- Supplied control software used for setup and acquisition is easy to learn, based in Visual Basic, and is compatible with Windows 95 and NT operating systems
- Can operate from facility mains with battery in reserve or with batteries in “Ping Pong” mode
- Configurable to operate with high voltage operative after power is lost and restored without rebooting system software
- Selectable long delay of 1 or 4 ms provides optimal counting conditions for both coincidence or multiplicity applications
- Battery operation, small size and light weight makes it ideal for portable applications
- Special features allow for installed operation as well

### DESCRIPTION

The JSR-14 Neutron Analysis Shift Register is a portable, fully computer controlled neutron analyzer that provides both neutron coincidence and multiplicity capability that is selectable through use of the provided setup software. The JSR-14 system functions as a direct replacement of the Mirion JSR-12 Neutron Coincidence Analyzer and the 2150 Multiplicity Module. The JSR-14 unit is based on a Los Alamos specification and shares the same chassis and form factor of the Mirion InSpector Multi-Channel Analyzer. The JSR-14 system is fully compatible with existing software operating with either the JSR-12 or Mirion 2150 Multiplicity Module. The JSR-14 system supports the same JSR-12 battery backed storage of system settings and 3000 data runs with time and date stamping of all data points by the system real-time clock. Also, the JSR-14 unit has the ability to operate in one of three different high voltage modes for portable and facility installed neutron counting applications. In addition, the JSR-14 system can be powered with an ac charger/adaptor using facility provided ac power, or operated with the unique “Ping Pong” camcorder battery system found on the Mirion InSpector analyzer. When using ac power, the JSR-14 unit is protected from power loss for three hours by the use of a battery in the spare battery port. The memory buffer and hardware settings are protected by a lithium battery that is designed to operate for five years and easily replaced. Another feature is a programmable long delay of 1 and 4 milliseconds providing compatibility with 2150 multiplicity module and JSR-12 coincidence settings.

### ELECTRONICS

All JSR-14 front end electronics are programmable. The JSR-14 unit features signal input, two auxiliary scalars, gate input, gate output (TTL output level configurable in JSR-12 or 2150 Multiplicity mode), RS-232 serial interface, and a High Voltage output. In addition, the JSR-14 system has sufficient +5 V dc output to power ten JAB-01 Preamp/Discriminator boards. Full computer control of the front end eliminates physical switching of modules or jumpers. Functions such as changing the detector bias are totally computer controlled. The user will never have to initiate changes in operating parameters.

### USER INTERFACE

The user interface is provided through a notebook or other suitable computer. A status display panel on the acquisition unit displays all vital information to its user. Brightly colored, well positioned status LEDs provide battery state and instrument status information. A total of four LEDs cover the critical status of the instrument – the two battery states, the acquisition status, and the high voltage status.

## SOFTWARE

The JSR-14 unit comes with a neutron setup and acquisition software package that is based in Visual Basic and is compatible with Windows 95 and NT. It allows the operator to quickly define the operating modes, set up the counting parameters, and manually collect coincidence and multiplicity data. This software package displays the Reals plus Accidentals (R+A), Accidentals (A) and Totals (T) data during acquisition in real time for both coincidence and multiplicity modes. In multiplicity mode, the individual multiplicity channels are available for inspection after the acquisition is completed. All system configuration and hardware settings are stored in non-volatile memory, available in the event of power loss.

**MODE CONFIGURATION** – System configuration information is contained within the system bootstrap. Any changes in mode settings require a reboot of the JSR-14 unit. The following mode selections are available from the software:

- **UNIT MODE** – User selects operation in either JSR-12 (coincidence) or Mirion 2150 (multiplicity) modes.
- **POWER MANAGEMENT MODE** – User selects the primary power source as ac mains or batteries.
- **HIGH VOLTAGE MODE** – User selects to operate JSR-14 high voltage control in manual, installed or portable modes.
- **BAUD RATE** – Configured from factory for initial system startup in autoranging mode, user may select new rate.
- **HARDWARE CONFIGURATION** – In the hardware setup portion of the software, the user may select the gate width, pre-delay, high voltage, count times, and counting recycle configurations. The system acquisition screen informs the user of the system settings and counting data during acquisition.

## DATA ACQUISITION

The JSR-14 internal clock rate is 4 MHz, with a pulse pair resolution of 50 ns. Internal diagnostics continuously monitor the state of the data acquisition, providing internal flagging of under and over flows whenever they occur. A second and third totals counter is provided for an additional channel input. They can be operated in synchronization with the regular input or as a totally separate counter.

## POWER MANAGEMENT

A unique feature of the JSR-14 unit is the dual battery design with programmable power management. There are two power management modes, AC Mains Mode and Battery Mode that are selectable using the JSR-14 set up and acquisition software. Instrument power is always derived from one of the two power ports, whether it is from the ac power supply or a battery. Two front panel LEDs provide a complete picture of the battery's operation and status. The port currently in use is indicated by a blinking green LED. An ac power adapter accepts multivoltages rated from 110 to 220 V ac at 50 to 60 Hz.

**BATTERY MODE** – In battery mode, the system monitors both batteries, switching to draw power from the port with the lowest power available. As this battery cycles through its discharge curve, the system will detect a "battery low" condition and change the LED color to a blinking red. This indication is a prelude to an automatic battery switchover. Continuous operation of the instrument will be assured if the battery in reserve is charged and ready to go as indicated by the green LED status. At switchover, the now depleted battery is indicated by a constant red LED color, while the new battery LED assumes a blinking green status. Uninterrupted continuous operation can be maintained indefinitely by changing the discharged battery as the power manager switches from old to new.

**AC MAINS MODE** – In ac mains mode, the system is set up for power supplied from port "A" where the AC Power Adapter is connected. A battery is then connected to port "B", acting as a backup. An automatic switchover to the alternate battery port will occur if ac power is lost. In this way, the instrument is essentially set up for battery backed ac operation. The LEDs indicate system power status as described above in "Battery Mode".

## HIGH VOLTAGE

Three separate high voltage modes are available to the user.

**MANUAL MODE** – High voltage is turned ON independent of setting the high voltage magnitude value.

**INSTALLED MODE** – High voltage operates in conjunction with the main power switch. This feature is designed to provide support for unattended neutron counting systems.

High voltage is made available to detectors after power is lost and restored without rebooting system software. The system operates by storing the status of the voltage internally. When the power is shut down, and brought back again, the system automatically provides its original high voltage value.

**PORTABLE MODE** – High voltage can be set and operated in an implied fashion using a single set-voltage command or in a similar manner to the Manual Mode, using two separate commands.

## PACKAGING

JSR-14 batteries are commercially available Sony compatible camcorder type. They are 5 cm (2 in.) long and 3.8 cm (1.5 in.) thick, and allow approximately four hours of operation with ten JAB-01 preamplifier boards. Replacements are readily available in most camera stores, and are expected to be supported by industry for a very long period of time. The battery ports are external, with easy access. Dual batteries ensure uninterrupted operation as the user can change one while the other maintains power to the instrument.

## CARRYING AND STORAGE

Carrying the instrument is similar to carrying an executive style notebook PC. A soft-sided carrying case suitable for the JSR-14 unit, notebook PC, and accessories are included. The instrument can be conveniently carried in an attaché case.

## APPLICATIONS

The JSR-14 unit is a data acquisition and analysis electronics package used in the measurement of plutonium and uranium (high and low enriched) materials. The added flexibility of coincidence and multiplicity counting ability, provides the user with analysis capability for a broad range of material configurations. These configurations include: Pu pellets, powder, solutions, Mixed Oxides, MOX fuel pellets, Pu fuel assemblies, HEU and LEU in metals, oxides, powders, fuel pellets and rods, as well as uranium hexafluoride (UF<sub>6</sub>) samples. The multiplicity analysis capability is very useful for measurement of scrap and other waste materials. The JSR-14 system can also be used in various gross neutron counting applications such as those found in facility installed process systems.

# JSR-14 Neutron Analysis Shift Register

**NUCLEAR SAFEGUARDS** – Nuclear safeguards applications prevent unauthorized diversion of nuclear material. Regulatory Agencies routinely make *in situ* measurements during inspection trips at various nuclear sites. Data collection times are often short, and sometimes they must be conducted in hostile environments.

**PORTABLE APPLICATIONS** – The JSR-14 unit is designed to facilitate travel, allowing for quick setup and disassembly. Such measurements are performed at a site for extended periods, often in harsh industrial environments. The JSR-14 enclosure is very rugged, absorbing shock due to minor impacts. The JSR-14 configured battery mode, allows full day continuous operation using the Mirion JCC-12™/JCC-13™ counters (INVS) from batteries alone, while an AWCC or HLNC can be operated for about seven hours. If required, the user can replenish batteries without interrupting data acquisition, providing indefinite counting capability, as long as there are charged batteries on hand.

**INSTALLED APPLICATIONS** – The JSR-14 unit portability does not compromise any of its installed applications' abilities. Operating from the ac mains, a battery in reserve, and high voltage configured in the "Installed Mode"; the JSR-14 unit is ideal for an installed neutron counting system, operating in attended or continuous unattended safeguard applications. The JSR-14 operates with any software already running JSR-12 or the 2150 multiplicity modes, making it a drop-in replacement for already installed systems.

## SPECIFICATIONS

### CONNECTORS

**SIGNAL** – Rear panel BNC connector accepts TTL compatible pulses for standard shift register counting or multiplicity operation; pulse width >30 ns.

**AUX 1** – Rear panel BNC connector accepts TTL compatible pulses for 1st totals scaler; pulse width >30 ns.

**EXTERNAL** – Rear panel 9-pin female D-style connector; pins 1, 6, 7 and 8 are ground; pin 9 is not connected.

- Pin 2: Aux 2 – TTL compatible input for second totals scaler; pulse width >30 ns.
- Pin 3: Index – TTL compatible input used to trigger a cycle.
- Pin 4: Gate Out – TTL compatible output; Low when counting and High when Idle.
- Pin 5: Gate In – TTL compatible input; High suspends counting and Low for normal operation.

**+5 V** – Rear panel BNC connector providing a +5 V dc output; ±1%; 700 mA max; short circuit protected.

**HV** – Rear panel SHV connector (isolated from chassis ground by 47 Ω resistor) providing +500 to 2500 V dc with 100 μA output current capability; programmable resolution of 1 part in 2048.

**RS-232** – Rear panel 9-pin male D-type connector; EIA RS-232 interface to host personal computer. Supports baud rates of 300, 600, 1200, 2400, 4800, 9600, and 19.2 k.

### CONTROLS

**ON/OFF:** \ OFF – No power is consumed.

**ON** – Batteries continually tested and status displayed using front panel LEDs.

### INDICATORS

**BATTERY STATUS** – A, B – Red/Green LEDs indicate the following:

- OFF – Battery not installed.
- BLINKING GREEN – Battery good and in use.
- STEADY GREEN – Battery good and available.
- BLINKING RED – Battery low warning and in use.
- STEADY RED – Battery low warning or discharged.



Small size and battery operation make the JSR-14 unit ideal for portable applications

# JSR-14 Neutron Analysis Shift Register

**BATTERY CAPACITY** – LED array indicators standard on Sony Battery Pack Model NP-80D, or equivalent.

**HV** – Yellow LED to indicate the presence of HV at the rear panel SHV connector.

**ACQ** – Green LED to indicate that a count is in progress.

## POWER SUBSYSTEM

**BATTERY PACK** – Dual 6 V NiMH battery packs; standard Sony Model NP-80D Battery Pack, or equivalent, such as Duracell DR-11 (ICN 95200440).

**BATTERY LIFE** – Approximately four hours of counting for two batteries when connected to a Neutron Counter containing ten JAB-01 Preamp/Disc boards.

**POWER RESERVE** – Battery cartridges may be changed, one at a time, without interrupting instrument operation.

**FAST CHARGER** – Separate charger for standalone batteries; charge time: approximately three and one half hours; standard Sony AC-V16 (ICN 95200436) or equivalent.

**AC ADAPTER** – 110/220 V ac powered external supply connected to the instrument in place of Battery A. Battery B can be used to supply power to the instrument if mains (ac) power is lost.

**BATTERY BACKUP** – Battery backup used to run the Real Time Clock and 3000 run storage.

**LOW BATTERY SENSOR** – When both batteries packs become fully discharged, the instrument will automatically enter the OFF state, disconnecting the batteries to prevent damage due to deep discharge.

**POWER MANAGEMENT** – Power Management allows setting of ac or lowest battery first and automatic battery switch over.

**SYSTEM POWER CONTROL** – No System Power Control from host computer; always full power.

## HVPS

**MULTI-RANGE** – Programmable +500 to +2500 V dc; resolution to within 1 part in 2048.

**LOAD CURRENT** – 100  $\mu$ A.

**NON-LINEARITY** –  $\pm 0.6\%$  of full scale.

**RIPPLE AND NOISE** –  $\leq 50$  mV peak to peak at rated load current.

**TEMP COEFFICIENT** –  $\pm 50$  PPM/ $^{\circ}$ C after a 30 minute warm up.

**REGULATION** –  $\leq 0.02\%$  variation in output voltage over the load range at constant ambient temperature.

**OVERLOAD PROTECTION** – Power supply will withstand any overload, including a short circuit, for an indefinite period.

**CURRENT LIMIT** – 350  $\mu$ A maximum.

**SETTLING TIME** –  $< 100$  V/s, turn ON or OFF.

## SHIFT REGISTER

### COUNTING REGISTERS:

- REAL+ACCIDENTAL – 48 bits deep; internally clocked at 4 MHz.
- ACCIDENTAL – 48 bits deep; internally clocked at 4 MHz.
- TOTALS – 36 bits deep; internally clocked at 4 MHz.

**DERANDOMIZING BUFFER** – 16-event deep buffer on signal input; random input capture rate; synchronized output rate at 4 MHz.

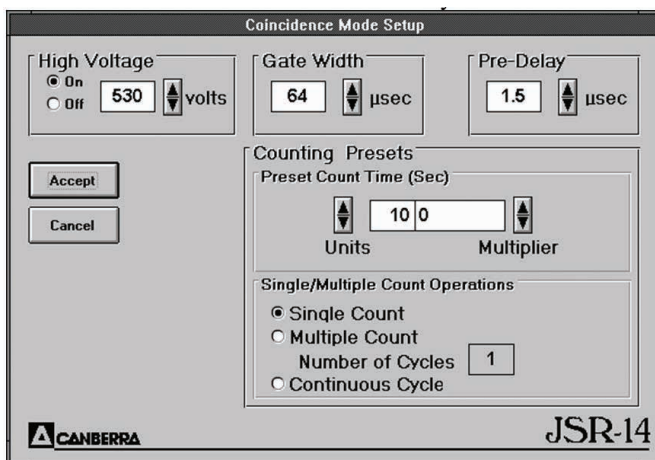
**PULSE PAIR RESOLUTION** – 50 ns.

**DATA STORAGE** – Storage of last 3000 runs in battery backed RAM.

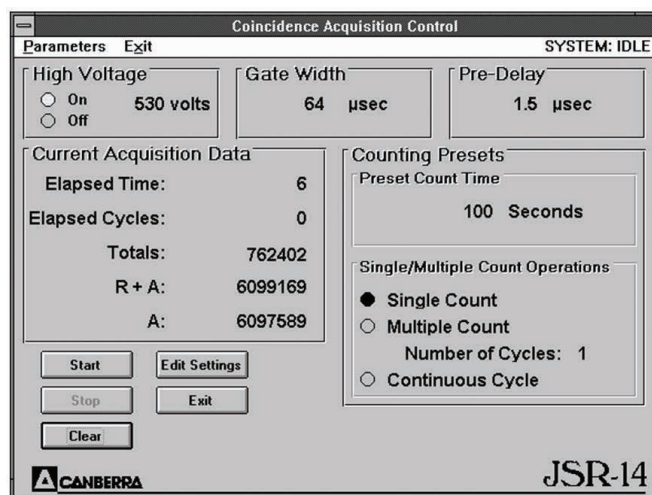
## MULTIPLICITY SCALERS

**SCALERS** – 256 channels; 32 bits deep.

**DATA STORAGE** – Internal histogram memory with storage of the last multiplicity data run in battery backed RAM.



Setup of the JSR-14 unit is easy using the included setup software



Performing coincidence or multiplicity measurements is fast and easy with the JSR-14 system

## AUXILIARY SCALERS

**SCALERS** – Two scalers AUX1 and AUX2; 40 bits deep each; 2-event deep buffer; random input capture rate; synchronized output rate at 16 MHz.

**PULSE PAIR RESOLUTION** – 50 ns.

**DATA STORAGE** – No storage of data in battery backed RAM.

## PROGRAMMABLE PARAMETERS

**AUX COUNTER CONTROL** – Independent start/stop of auxiliary counters.

**HVPS SETTING** – +500 V dc to +2500 V dc; resolution to within 1 part in 2048.

**TIME AND DATE** – Real time clock/ calendar with seconds, minutes, hours, day, date, month, and year with leap year compensation. 24 hr mode. Accuracy of  $\pm 1$  minute per month at 25 °C. Five years of operation with a lithium battery if no power is applied.

## JSR-12 PROGRAMMABLE PARAMETERS

**GATE WIDTH** – 1 to 250  $\mu$ s in 1  $\mu$ s steps.

**PREDELAY** – 0.5 to 7.5  $\mu$ s in 0.5  $\mu$ s steps.

**PRESET** – 0.1 to  $9.9 \times 10^9$  s.

**MULTIPLERUN** – Continuous cycles or preset for 1-99 cycles.

## 2150 PROGRAMMABLE PARAMETERS

**GATE WIDTH** – 0.25  $\mu$ s to 1024  $\mu$ s in steps of 250 ns.

**PREDELAY** – 0 to 1023.75  $\mu$ s in steps of 250 ns.

**PRESET** – 0.1 to  $1.67 \times 10^6$  s.

**MULTIPLE RUN** – Continuous counting cycles retaining data from the previous count cycle only.

## PHYSICAL

**SIZE** – 26.9 x 27.2 x 4.8 cm (10.6 x 10.7 x 1.9 in.) width x depth x height.

**WEIGHT** – 3.2 kg (7.0 lb) with batteries.

**OPERATING TEMPERATURE** – 0 to 45 °C.

**RELATIVE HUMIDITY** – 8 to 80%, non-condensing.

## ENVIRONMENTAL

**OPERATING TEMPERATURE** – 0 to 50 °C.

**OPERATING HUMIDITY** – Up to 95%, non-condensing. Tested to the environmental conditions specified by EN 61010, Installation Category I, Pollution Degree 2.

## OPTIONS

Model 1212 Cigarette Lighter Adapter.

Multiplicity Results		
Bin	Accidentals+Reals	Accidentals
0	17511	17259
1	71111	71118
2	143333	142811
3	190152	190512
4	191205	190894
5	153238	154814
6	102115	101620
7	57498	57631
8	28971	28490
9	12854	12801
10	5094	5100
11	1829	1828
12	576	612

Multiplicity results are readily available once data acquisition is complete



©2017 Mirion Technologies (Canberra), Inc. All rights reserved.

Copyright ©2017 Mirion Technologies, Inc. or its affiliates. All rights reserved. Mirion, the Mirion logo, and other trade names of Mirion products listed herein are registered trademarks or trademarks of Mirion Technologies, Inc. or its affiliates in the United States and other countries. Third party trademarks mentioned are the property of their respective owners.

# CANBERRA