

The SmartION is an advanced microcomputer-based instrument for the measurement of Gamma, Beta and X-ray radiation. It provides functions previously not available in meters of this type, including data logging, alarm, remote calibration and security features. Operation is simple, reliable and maintenance-free, and the instrument is housed in a robust case.

Mini SmartION Series

Data Logging Ion Chamber



- Sensitive ion chamber
- Electrometer with minimal leakage and drift
- Measurement in $\mu\text{Sv h}^{-1}$, μGy^{-1} and mR^{-1}
- Data logging by random or pre-ordered routes
- Audible alarm preset
- Large character LCD digital and analog display
- Local/ remote calibration and interlocks
- Handle-mounted function keys facilitate one-handed operation
- Tested against the requirements of standard IEC 60846
- Complies with SDI communication protocol



The instrument's ion chamber has a capacity of 450 cm^3 . Measurement in mixed beta/gamma fields is simplified by the moveable beta shield, which is 550 mg cm^{-2} plastic. The Ambient Dose Equivalent (Sv^{-1}) version is corrected for a response of H' (0.07) from 10 keV with the shield open and $H^*(10)$ from 22 keV with it shut. The 7 mg cm^{-2} window density permits accurate measurement of beta dose rates in the energy (E_{max}) range of 150 keV to 2.5 MeV. The chamber is vented to the air volume within the instrument and thence to atmosphere.

The electrometer is based upon a low-leakage MOSFET operational amplifier. Special guard-ring techniques and packaging pin-out keep offset leakage to a minimum. Careful matching and circuit design minimize zero drift with temperature. Zero adjustment is established by microcomputer control:

pressing the Zero button engages a precision digital servo loop adjustment.

There are three SmartION models: the basic version is the 2100; the 2120 has an integrating dose facility; the 2140 has an integrated barcode reader. Each of these models is available to measure the quantities ambient dose equivalent rate (Sv), air kerma (Gy) and exposure (R). In each case the ion chamber is configured at the time of manufacture.

Dose rate data from random surveys can be stored in up to 400 storage locations. Ordered location surveys are organized by downloading 4-character locations before issue from a PC file (ASCII) through a serial cable which is supplied with the PC software option. The memory inside Smart-ION is non-volatile through switch-off, as is the internal clock.

System Specifications

A dose rate alarm is provided which may be set from 10% of the lowest range, through 6.5 decades to 100% of the highest range. The dose rate is displayed in characters 1 cm (0.4") high on a custom-made liquid crystal display, with the appropriate units and location code, if any. The wide simulated analogue scale has 50 segments clearly indicating dose rate trends. Status indications show battery condition, ion chamber bias and beta shield position.

The wipe-clean membrane keys offer easy access to the wide-range of functions, some can be locked-out using the PC remote interface to protect calibration and alarm settings, route codes and backlight timer from unauthorized tampering.

Local calibration is provided for use with beta sources. Up-Down keys obviate an insecure screwdriver adjustment, while an RS232 link to a remote PC allows the monitor to be safely tested with high dose rate gamma radiation sources. The super-vised PC link also enables the calibration to lock out of operator interface, adjust or lock the alarm, clock adjustment, a battery-saving time-out and access to certain engineering adjustments.

The energy-conscious design uses two 'D' size alkaline cells, with chamber bias and clock back-up using very long-life Lithium cells. The case is molded in hard-wearing wipe-clean ABS/polycarbonate with easy external access to a separate battery compartment.

If the expected dose rate is greater than the current displayed range, the user can set the meter on the required range to reduce the autoranging time. Any of the five ranges can be selected. This feature is useful in situations where the range-changing delay could be hazardous, e.g. where high intensity, collimated beams are encountered.

The Mini SmartION 2120 model includes two integrating (dose) ranges: 0 to 50 μSv and 0 to 500 μSv . This version is suitable for measuring radiation from linear accelerators and pulsed x-ray systems. In addition, the Mini SmartION 2140 model has an integral bar-code reader. By placing bar-code placards at analysis points, the dose-rate encountered can automatically be registered in memory against the actual location. Software can be provided for interfacing to Windows™ based dosimetry and plant management systems.

| Characteristics | Integrated Dose (2120 only): | Energy dependence: |
|--|---|--|
| Ion Chamber vented to atmosphere. | - 0 to 50 μSv (0 to 5 mR) | Closed Open |
| Walls of resin bonded paper: | - 0 to 500 μSv (0 to 50 mR) | (H*(10)) H'(0.07) |
| 250 mg cm ⁻² , windows of | 2120 Only, integrating: Effect of Dose rate | 5.9 - 0.79 |
| aluminized polyester with a total | on aggregated dose accuracy: -3% @ | 16 1.08 1.00 |
| density of 7 mg cm ⁻² . Collecting | 2 mSv h ⁻¹ (200 mR/h), -10% @ 200 | 33 1.04 0.99 |
| potential 45 V. | mSv h ⁻¹ (20 R/h), -20% @ 500 mSv h ⁻¹ | 65 (²⁴¹ Am) 0.9 0.82 |
| Measurement quantity and units: | (50 R/h) | 248 0.98 0.83 |
| Three versions of each of 2100, 2120 | Effective range: 1 $\mu\text{Sv h}^{-1}$ to 500 mSv h ⁻¹ | 1250 (⁶⁰ Co) 0.98 - |
| and 2140 denoted by the suffix S/G/R: | (100 $\mu\text{R/h}$ to 50 R/h) | H'(0.07) beta response: |
| S H*(10) and H'(0.07) Sv | Relative intrinsic error: $\pm 15\%$ | ⁹⁰ Sr/ ⁹⁰ Y Emax 2.27 MeV 1.01 |
| G Air Kerma Gy | (to conventionally true value): | ²⁰⁴ Tl Emax 0.77 MeV 0.62 |
| R Exposure R | Linearity: $\pm 15\%$ (reference radiation ¹³⁷ Cs) | ¹⁴⁷ Pm Emax 0.23 MeV 0.82 |
| Range of measurement: Dose Rate: 0 to 500 | Statistical fluctuations: | Overload: Recovery from 12 Sv h ⁻¹ |
| mSv h ⁻¹ (0 to 50 R/h) in 5 autoranges: | - 2.9 $\mu\text{Sv h}^{-1}$ (0.29 mR/h) 4.5% | (1200 R/h) to background levels |
| - 0 to 50 $\mu\text{Sv h}^{-1}$ (0 to 5 mR/h) | - 40 $\mu\text{Sv h}^{-1}$ (4.0 mR/h) 1% | < 3 mins. |
| - 0 to 500 $\mu\text{Sv h}^{-1}$ (0 to 50 mR/h) | Response time: | Geotropism: $\pm 6\%$ for 90° change in meter |
| - 0 to 5 mSv h ⁻¹ (0 to 500 mR/h) | - 0 to 45 $\mu\text{Sv h}^{-1}$ (0 to 4.5 mR/h) 6 s | orientation |
| - 0 to 50 mSv h ⁻¹ (0 to 5 R/h) | - 0 to 450 $\mu\text{Sv h}^{-1}$ (0 to 45 mR/h) 6 s | Warm-up time: 1 minute |
| - 0 to 500 mSv h ⁻¹ (0 to 50 R/h) | - 0 to 450 mSv h ⁻¹ (0 to 45 R/h) 1 s | Ambient temperature range: -10 to 50 °C |
| | | (14 to 122 °F) |

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