



iPA™ II

Intelligent Preamplifier for HPGe Detectors



Optimized to perform high-resolution gamma spectroscopy and timing measurements, the iPA II is a low-noise, high speed resistive feedback preamplifier for High Purity Germanium (HPGe) detectors, enabling extensive control and monitoring of critical State-of-Health parameters of the preamplifier and detector.

When energy is deposited in the detector, the iPA II preamplifier converts the charge to a step-function output pulse. The output of this pulse is directly proportional to the total charge accumulated in the event.

FEATURES

- ✓ Low noise
- ✓ Diode protected FET input
- ✓ Independently terminated energy and timing outputs
- ✓ Supports capacitive LN₂ level probe
- ✓ USB 2.0 serial communication
- ✓ Integrated flash memory for parameter and status logging
- ✓ Software application for setup of preamplifier and monitoring

iPA II INTELLIGENT PREAMPLIFIER FOR HPGE DETECTORS

LOW-NOISE & HIGH SPEED PERFORMANCE

A carefully selected low-noise field-effect transistor (FET) input circuit optimizes noise characteristics for ultra-high source impedance of germanium detectors. In addition, a protection network prevents damage to the preamplifier input from high-voltage transients.

The charge amplifier and buffer stages are designed to support the low-noise and high-speed performance needed for precise energy and timing spectroscopy. Special circuits monitor detector temperature and activity to warn when improper operating conditions exist.

EXTENSIVE CONTROL AND MONITORING CAPABILITIES

An included USB 2.0 serial data interface supports extensive control and monitoring of critical preamplifier and detector functions. The iPA Control Panel software application provides real-time monitoring of the detector current and temperature, along with pertinent internal preamplifier operating voltages. The integrated data logging feature periodically records and stores key operating parameters in the iPA II preamplifier memory.

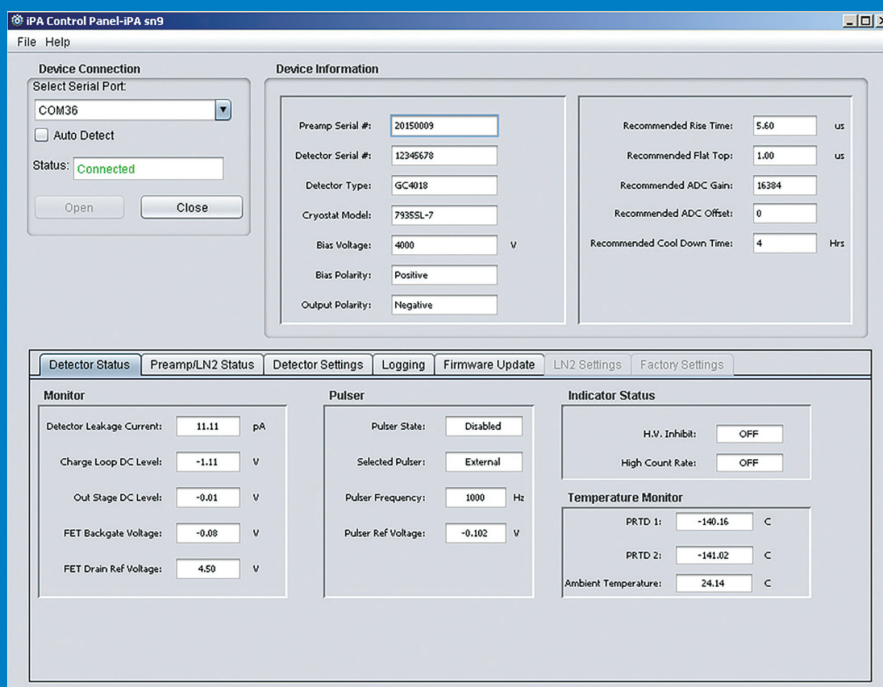
A standard test input and internal test pulser are provided to assist system setup and as a diagnostic aid. The internal test pulser is digitally controlled through the iPA Control Panel software.

CONNECTION TO MULTI-CHANNEL ANALYZER (MCA)

The iPA II preamplifier is compatible with most MCA devices as it is provided with standard detector cable connections. When connected to the Lynx II MCA via USB, users can monitor critical data of the complete detector system - including the iPA II preamplifier - on one common platform. Insights into these data enable preventive measures to enhance equipment availability and productivity. Meanwhile, all the critical data are logged in the Lynx II on-board memory, which facilitates an efficient data-driven review process of the complete system when needed.

LN₂-LEVEL MONITORING

The iPA II detector also includes an integrated LN₂ level monitoring circuit, for use with an optional Mirion capacitive LN₂ level-sensing probe. The iPA II and probe work together to continuously measure the LN₂ level within the Dewar. The measurement is displayed on the iPA Control Panel status screen, and warns the user when the LN₂ level becomes low and the Dewar requires refilling.



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SPECIFICATIONS

INPUTS

- Test Input: Charge coupled to preamplifier input at 0.5 pC/V nominal; voltage gain to outputs 0.5X, 1X, 2.5X, or 5X (as selected), $\pm 30\%$. Input impedance is 93 Ω .
- HV Input: Detector bias voltage, 0 to ± 5 kV dc; no limit to the rate at which bias may be applied; series resistance to detector bias point is 2000 M Ω nominal. High voltage ground is isolated from signal ground by 470 Ω .
- LN₂ Input: Low-capacitance SMA coaxial connection for optional Mirion LN₂ Dewar capacitive level-sensing probe. Input impedance is 100 k Ω .
- USB: USB C 2.0 serial data interface; supports data transfer rates up to 480 Mbps.
- Power: Accepts ± 12 V dc and ± 24 V dc from main shaping amplifier or MCA.

OUTPUTS AND INDICATORS

- Energy Output:
 - Provides unipolar pulses with peak amplitude linearly proportional to the charge input, non-inverting. Decay time constant is 50 μ s ($\pm 10\%$).
 - Output swing range is ± 10 V open circuit. Output impedance is 93 Ω , series connected, dc coupled. Output dc offset is 0 ± 75 mV dc (at gain of 100 mV/MeV), or 0 ± 100 mV dc (at gain of 500 mV/MeV).
- HV Inhibit Output (Requires cryostat with temperature sensor): Provides a logic signal to turn off High Voltage Power Supply when detector temperature exceeds level which causes detector leakage. Output is +5 V when temperature is correct and $< +0.5$ V under fault condition; capable of sinking 0.45 mA to -12 V. High voltage inhibit ground is isolated from signal ground by 47 Ω to prevent introduction of ground loop noise.
- HV Inhibit Indicator (Requires cryostat with temperature sensor): Green LED glows when detector is at normal operating temperature. Red LED glows if temperature exceeds level, which causes detector leakage.
- High Rate Indicator: Provides a visual indication of count rate overload. LED glows Red when max rate is reached. LED glows Green when the count rate is below max count rate.
- Internal Pulser Indicator: Provides a visual indication of the internal pulser status. The LED glows Red when the internal pulser is active, and turns off when the internal pulser is not active.
- Timing Output: Unipolar pulse for each input event; signal parameters same as above, except 50 Ω output.

PERFORMANCE

- Integral Nonlinearity: $< \pm 0.05\%$ for an output swing of ± 8 V (unterminated).
- Gain Stability: $\leq \pm 0.005\%$ / $^{\circ}\text{C}$ (± 50 ppm / $^{\circ}\text{C}$) over a range of 0 to $+50$ $^{\circ}\text{C}$; $\leq \pm 0.01\%$ over 24 hours at constant temperature after 1 hour stabilization.
- Charge Sensitivity: 1, 2, 5, or 10 V/pC, corresponding to 50, 100, 250, or 500 mV/MeV (Ge) equivalent, as selected digitally. Shipped in the 500 mV/MeV position. Gain tolerance is $\pm 25\%$.
- Count Rate: Count rate performance has been demonstrated up to 200 000 counts per second for 60 Co source (1.33 MeV).

Connector Types:

- HV Input: SHV
- Test Input: BNC UG-1094 / U
- Energy Output: BNC UG-1094 / U
- Timing Output: BNC UG-1094 / U
- HV Inhibit Output: BNC UG-1094/U (iPA-SL), Amphenol 31-10 (iPA)
- LN₂ Input: SMA (Emerson 142-0701-501)
- USB: USB C 2.0 (Molex 2130830005)
- Power: Molex 83611-9006 (iPA); Amphenol 17-20090 (iPA-SL)

Accessories:

- Cable Adapter: 0.9 m (3 ft) 9-pin DSUB-Micro to DSUB cable
- USB Cable: 3 m (10 ft) USB-A to USB-C cable

Power Requirements:

- +24 V dc – 12 mA –24 V dc – 10 mA
- +12 V dc – 90 mA –12 V dc – 18 mA

Physical:

- Size: iPA unit (on Flanged Cryostats): 7.6 x 10.2 x 4.4 cm (3 x 4 x 1.75 in.)
- iPA-SL: (on Slimline Cryostats): cylindrical, 12.7 x 7.9 cm (5 x 3.1 in.)
- Net Weight: 0.40 kg (0.88 lb)
- Shipping Weight: 0.86 kg (1.9 lb)

Software:

The "iPA Control Panel" application requires the following to be installed on the PC:

- USB drivers for the iPA unit. The software distribution disk contains drivers for both 32-bit and 64-bit operating systems
- Java 6 or higher

The iPA II detector comes pre-configured from the factory and does not necessarily require the software application to be run. To access the intelligent features, USB connection and software application are required.

Environmental:

- Operating Temperature: 0 $^{\circ}\text{C}$ to 50 $^{\circ}\text{C}$
- Operating Humidity: 0-80% relative, non-condensing
- Tested to the environmental conditions specified by EN 61010, Installation Category I, Pollution Degree 2

