ACCELERATOR CONTROL COMPONENTS
National Electrostatics Corp.

AccelNET Control System

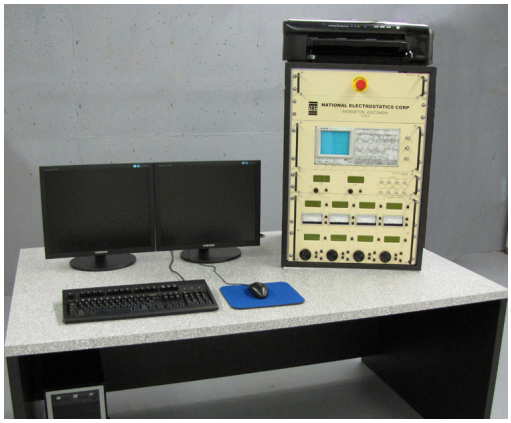
Applications

The NEC AccelNET computer-based control system is designed to operate all aspects of the accelerator system, from ion source startup to monitoring the voltage of the Pelletron to automating data collection. AccelNET also controls diagnostic equipment (beam profile monitors, Faraday cups), and assists in beam tuning. All power supplies and controllers needed for normal operation are interfaced to beamline computers via NEC's AccelNET Control Technology (ACT) system, Process Control Stations (PCS), or through Ethernet/Serial connections. Fiber optic connections are utilized to provide communication across varying voltage potentials. Customers may also choose to interface with the accelerator control computer via this network. If allowed access via the Internet, NEC can also log in remotely for additional support and maintenance.

Design

The control console consists of a desk with an equipment rack. It contains the computer, monitors, keyboard/ mouse, an emergency off button (EMO), and an assignable knobs/meters interface. When Beam Profile Monitors (BPMs) are present, a networked oscilloscope is provided. The computer is a modern PC running the Linux operating system.

NEC offers a knobs/meters interface that is used for analog control/readback of any system parameter. The assignable knobs provide selectable sensitivities, while the meter display range can be fixed or auto ranging, allowing high sensitivity during fine adjustments.



The AccelNET software manages the display and control functions through a database management system. Multi-window applications provide customization of the operator interface to meet user and workflow preferences for convenient setup, fine tuning, data display, and other procedures. Operators may save and restore preferred system configurations, knob/meter arrangements, and setup preferences. Typically, beam setup from cold start can be done by menu commands, with little or no fine tuning.

Parameters are displayed in two (2) formats: text formatted pages of parameter lists and graphic displays of the system layout. Controls can be adjusted by menu-driven restoration of stored values, increment/decrement buttons, keyboard input of the desired parameter value, or assigning the parameter to a knob/meter for analog mode adjustments. All control/readback parameters can also be displayed on a strip chart recorder.

Control signals are transmitted continuously while the control is being adjusted; otherwise, the transmission is about six (6) times per minute. Readout displays are updated approximately once per second; those assigned to a meter are updated about ten (10) times per second.

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Control resolution is 16 bits where ACT is present, using bipolar 16-bit ADCs. Ion source controllers typically have 12-bit resolution, while other items such as bending magnet power supplies may have higher resolution as needed.

System and Safety Interlocks

AccelNET includes a number of hardware and software interlocks to protect personnel, equipment, and samples. Sample queue control, data logging, and safety interlocks permit unattended operation.

High Voltage & Vacuum Interlocks

Sections of accelerators with exposed high voltage, such as ion sources and high voltage decks, are surrounded by safety cages or panels. Doors to the cages are equipped with safety switches are in series along with key switches, EMOs, and other devices as part of the hardware interlock chain. These interlock chains are designed on a per application basis and are implemented inside the ACT chassis. Any disruption to the interlock chain prevents AC power from being applied to high voltage power supplies or other high voltage devices on that section of the machine. All hardware safety interlocks are implemented in AccelNET with redundant software interlocks. Grounding bars are provided near ion sources to ensure safety during maintenance.

Vacuum conditions in each beamline region are continually monitored to ensure quality vacuum. In the event of poor vacuum, the power supplies for beamline components will be turned off to prevent sparking or potential damage. Software interlocks can be bypassed for maintenance and testing, if needed.

Radiation

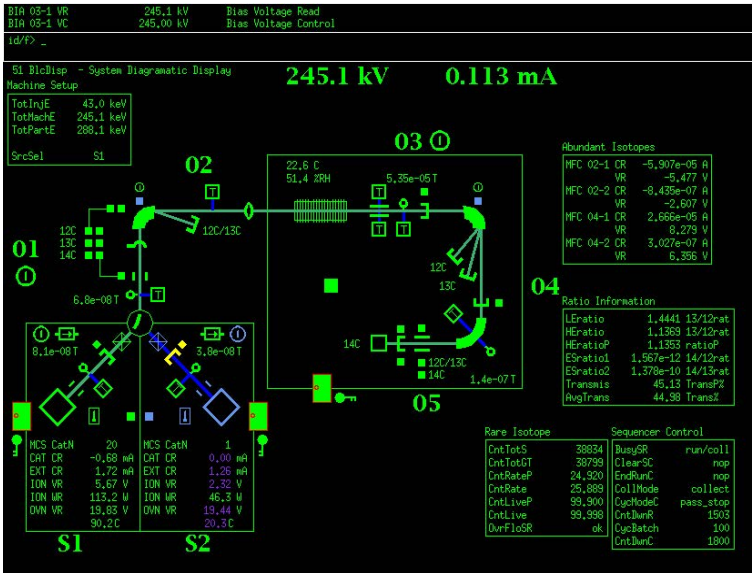
Many of our customers work in radiation controlled environments and may be responsible for monitoring the low energy x-rays produced by the accelerator systems.

Customers are encouraged to add X-ray monitors on both sides of the beamline with interlocks into the computer software so that if radiation is above a certain threshold, the source can be turned off, or a Faraday cup can be inserted to stop the beam.

System Operation/Parameters

An additional set of interlock conditions will pause or stop data collection routines and alert the user that certain readbacks have migrated away from expected parameters. These interlocks are set up in the database and configuration files and can be customized to each user. For example, an injector Faraday cup can be inserted to stop radiation, or the ion source can go into a “safe mode” to preserve samples.

If communication between AccelNET and the ACT chassis is disturbed, hardware “watchdog” timers on the ACT cards will time out and set all control parameters to pre-programmed values for each beamline component. These default values will remain static until communication is restored and AccelNET services are reset.



Example of the diagramatic display of the accelerator system displayed on the control computer

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Customer Interfacing with AccelNET

AccelNET provides several tools and protocols that allow users to interface with the control system. A customer interface box is typically provided that includes relay contacts for customer control and 24 VDC inputs from the facility . The interlock chain can also be designed to include customers' existing safety hardware such as entry doors or other monitors.

Command line interface tools are available for single interactions or execution from any general scripting language to build automation and interfaces. A native TCL/Tk based scripting engine is included for more tightly integrated interactions. A TCP/IP based ASCII protocol is also available for network connected remote interaction.

AccelNET can connect to a customer supplied local or network printer.

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