MIRION Connect AMERICAS 26

Annual Users' Conference

ADVANCING RADIATION SAFETY. EMPOWERING PROGRESS.

M Resort, Henderson, NV | June 15 – June 18

MIRION TECHNOLOGIES

Advancing Radiation Safety.
Empowering Progress.

Troubleshooting Radiation Monitoring Systems

Methods and Best Practices

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Mirion Connect | Annual Users' Conference 2026

Henderson, NV

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Daily Check-In:

Tuesday

Please take a moment to check in for today's session.

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Agenda

Agenda

- *Approach*
- *Basic Questions to Ask*
- *Basic Troubleshooting*
- *Examples*
- *Survey and Q&A*

Approach

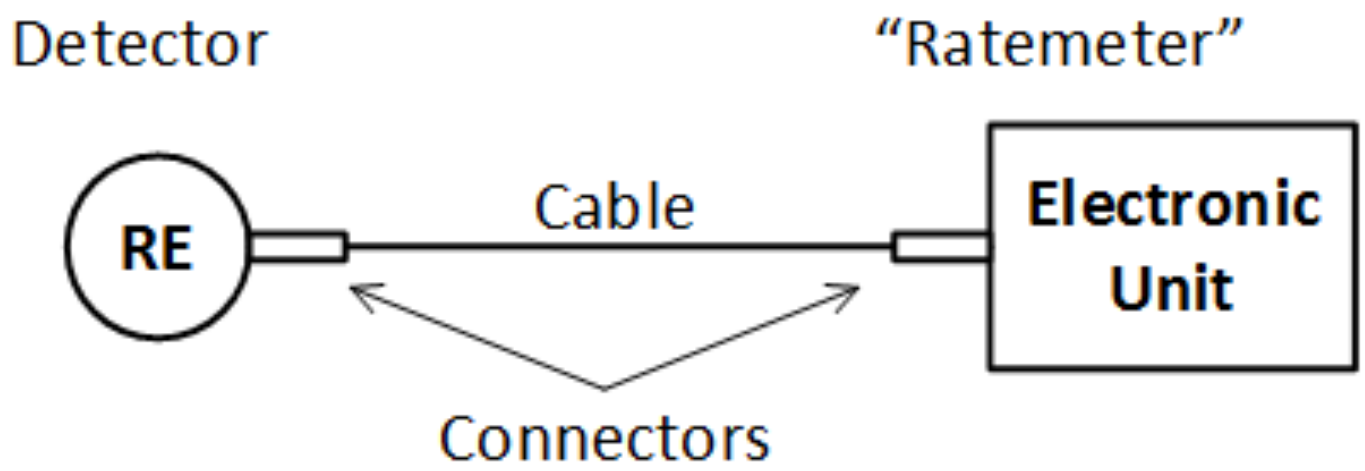
RMS Troubleshooting

- *The plant is filled with a variety of RMS equipment fulfilling different roles: area monitors, containment monitors, effluent (gas or liquid) monitors, all of varying levels of complexity*

- *Not to mention:*
  - *Varying manufacturers*
  - *Varying vintages (some analog, some digital)*

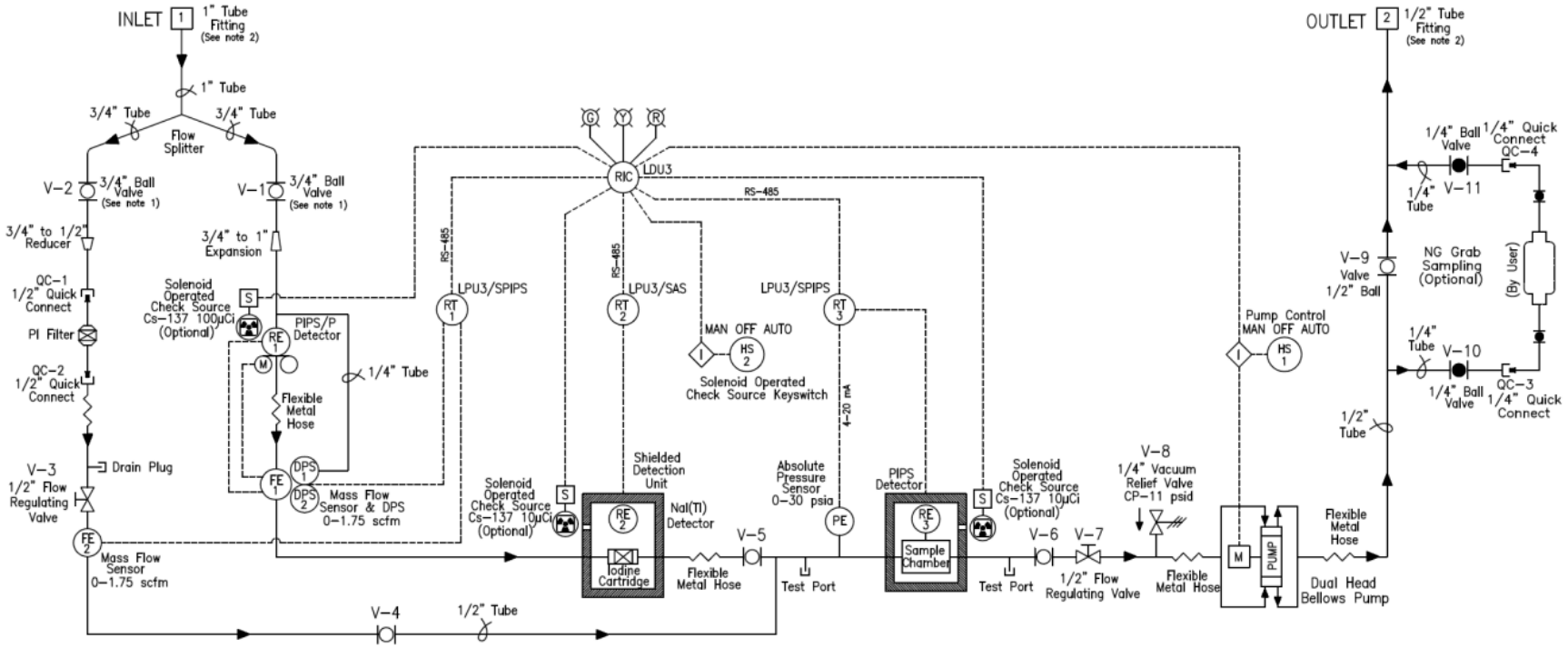
Basic RMS Channel

At its core, every radiation monitor is composed of a relatively simple set of elements.



RMS Troubleshooting

What about this thing?



PING 206S

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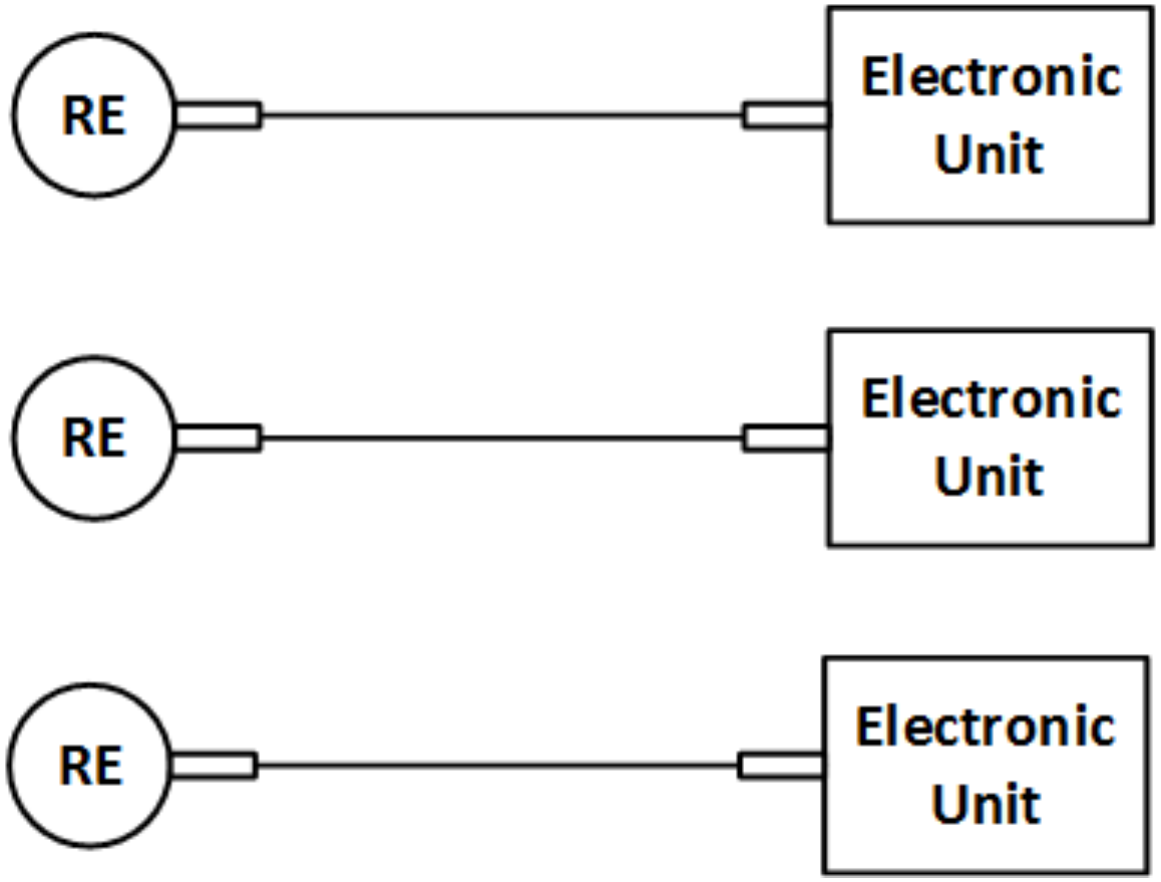
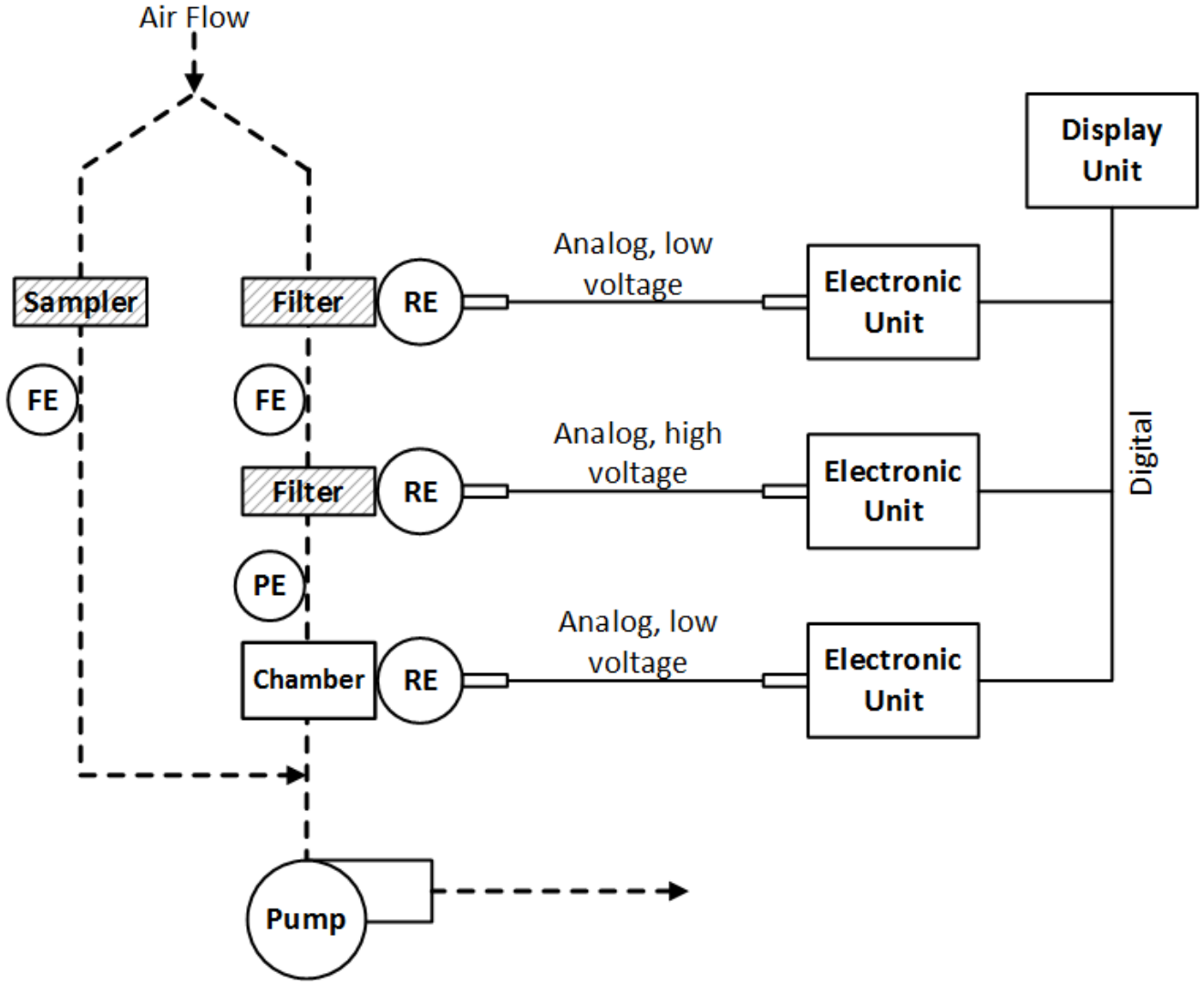
Basic RMS – Skid / System of Monitors

Still Relatively Simple



Basic RMS – Skid / System of Monitors

OK Not quite that simple, but still not too bad.



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Basic Questions

Basic Questions

- *What's the problem?*
- *When did it occur?*
- *Who has interacted with the monitor recently?*
- *Is it intermittent or continuous?*
- *What conditions have changed that might affect the monitor behavior?*
  - *This doesn't necessarily mean "Is it seeing real radiation?"*

Basic Questions

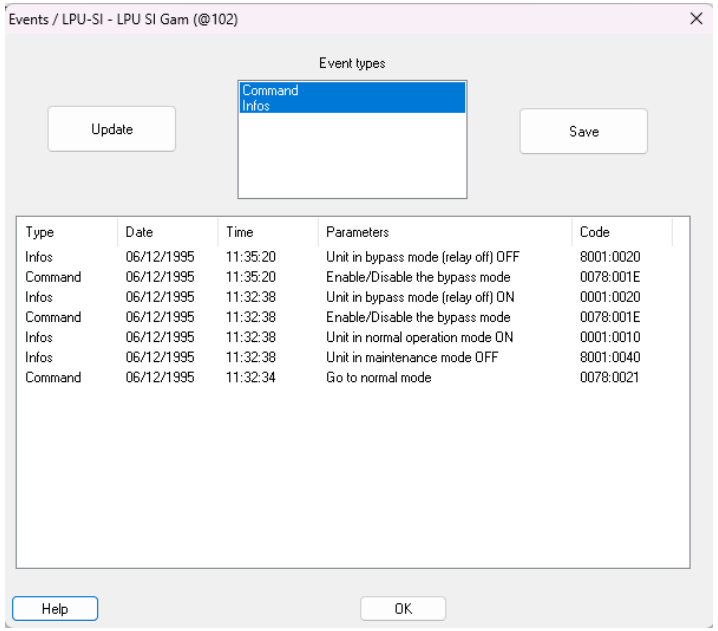
What's the Problem?

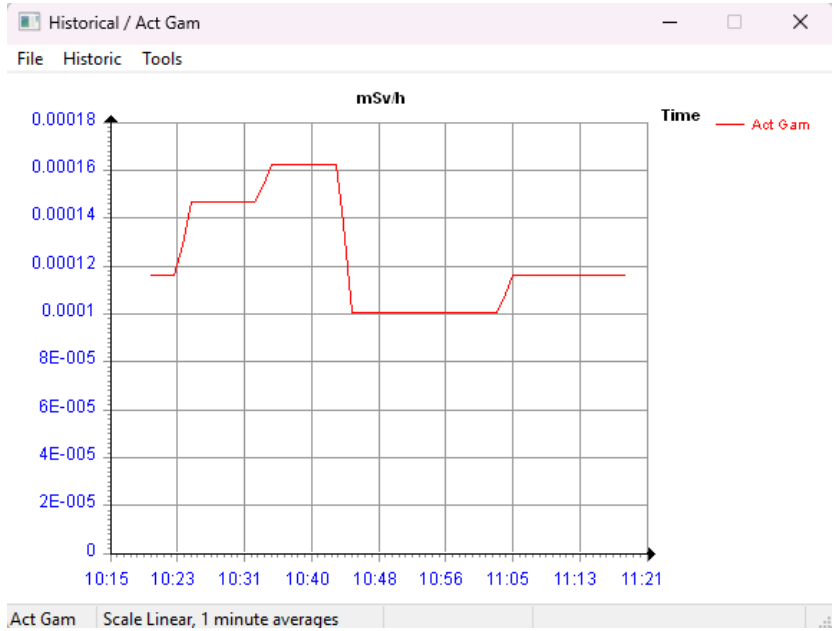
- *Noise: spikes, spurious alarms, spurious faults*
- *"Dead" electronic unit (No display, no communication, relays in rest state, etc…)*
- *Faults reported by monitor*
  - *Detector related faults (Electrical test fault, Reference peak fault, low counting (or low current) fault…)*
  - *Faults related to ancillary measurements (flow rate measurement, pressure measurement, etc.)*
- *Pump stopped*
- *Etc…*
- *Sometimes obvious (e.g. "Buzzer & light fault")*
- *Sometimes not obvious (e.g. spikes, spurious alarms)*

Basic Questions

When did it occur?

- *Usually during the night shift on a weekend…*
- *This is where your event log and historical trends come in handy!*





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Basic Questions

Who has interacted with the monitor recently?

- *Different parties, with varying levels of familiarity with the monitor, may need to interact with the monitor:*
  - *I&C Technicians: high level of familiarity, infrequent interaction (hopefully!)*
  - *Operators: lower level of familiarity, but often frequent interactions*
  - *Chemistry: lower level of familiarity, but often frequent interactions*
    - *Interaction may be "invasive" (e.g. filter change-outs)*
  - *Interaction might not work on other equipment in vicinity of monitor?*
  - *Walkdowns?*
  - *Work may not have been directed or intended*
  - *An area where an air monitor is sampling from?*

Basic Questions

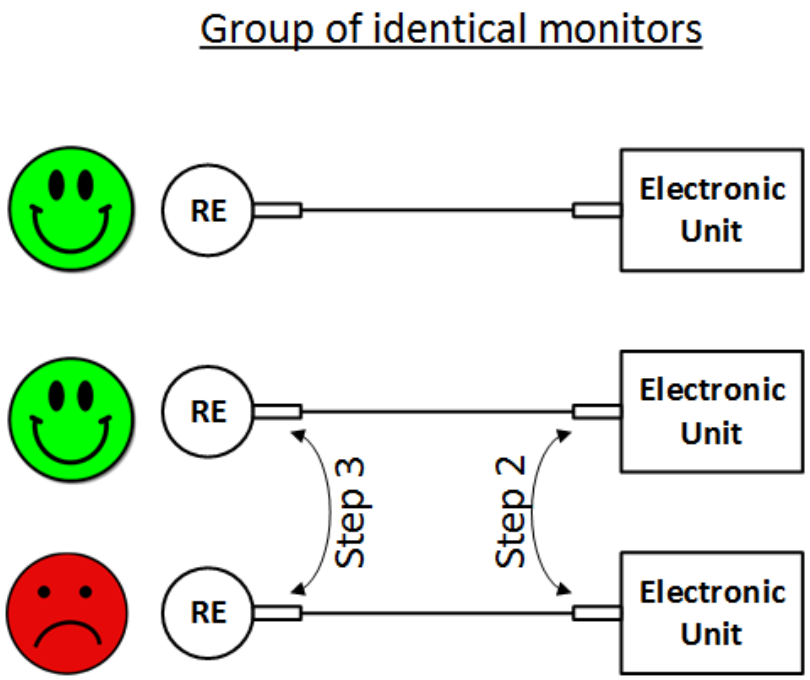
Who has interacted with the monitor recently?

- *Is it intermittent or continuous?*
- *Can it be timed/ predicted?*
- *What conditions have changed that might affect monitor behavior*
  - *Startup or shutdown*
  - *Transient condition in process being monitored?*

Basic Troubleshooting

Basic Troubleshooting

Swapping components: brute force but effective



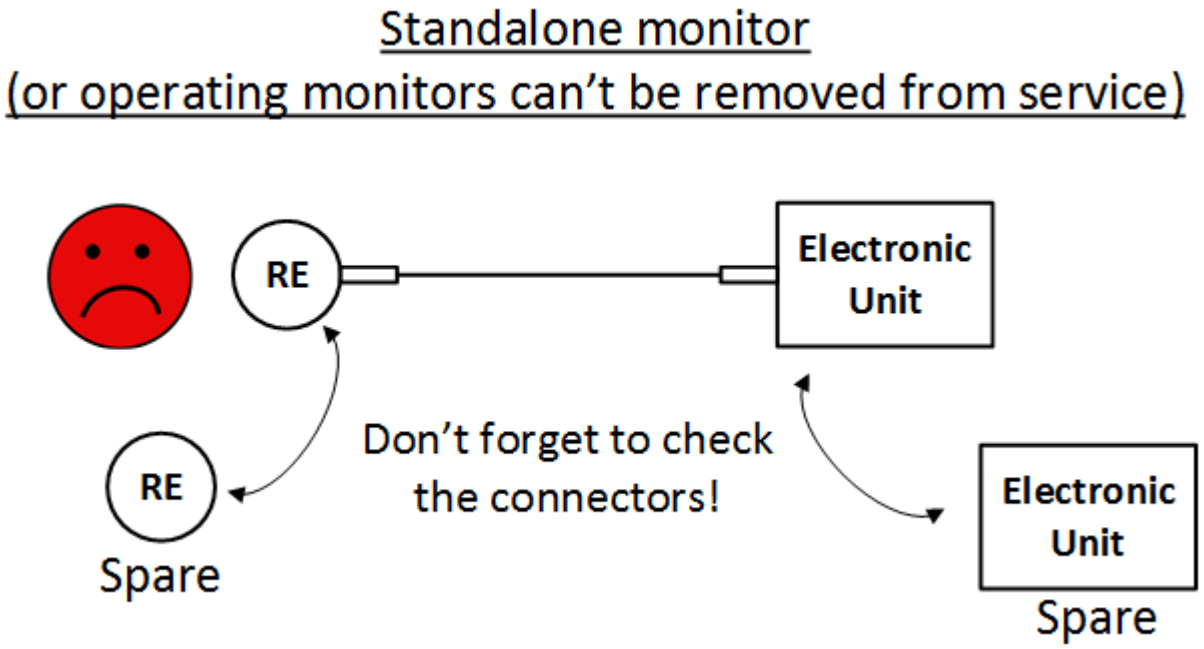
Step 1: convince yourself that swapping components won't damage the working monitor (i.e. short on a HV cable)

Step 2: switch cables at the electronic units and see where the problem goes

Step 3: if the problem follows the detector, switch at the other side (to rule out the cable)

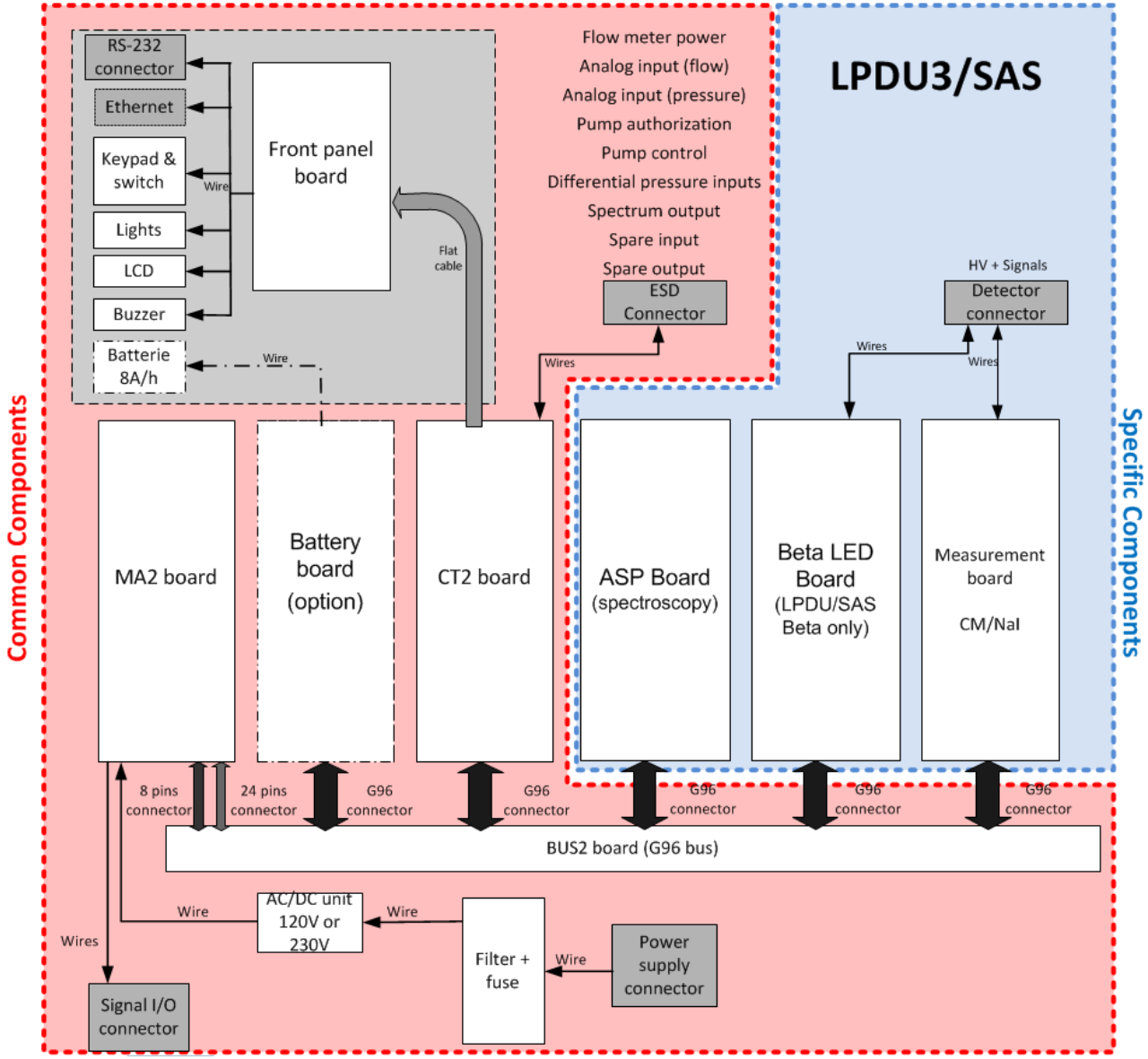
Basic Troubleshooting

Swapping components: brute force but effective



Order of component replacement depends on the nature of the problem

Troubleshooting the Electronic Unit



- *N16 Monitors*
- *IM201*
- *PM205*
- *NGM 216*
- *LM 211/212*
- *SAM 20X Adjacent-to-Line Monitors*
- *Specialized Process Monitors*

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Troubleshooting the Electronic Unit (Example: LPDU3/SAS)

LPDU Front Panel
- LCD & board
- Front panel board
- Buzzer
- Lights
- Ethernet converter (optional)

MA2 Board
- 3.3V, 5V (digital circuits)
- ±15V (analog circuits)
- 24V (lights, external sensors)
- RS485 isolation
- Analog output isolation
- Relays

CT2 Board
- Daughter board w/
  - Microprocessor
  - Embedded S/W
  - Compact flash
- ESD functions (DP inputs, analog inputs on LPDU top connector)
- Display functions
- Serial links

ASP Board
(SAS & SPIPS only)
- 1024 channel MCA
- Spectrum storage

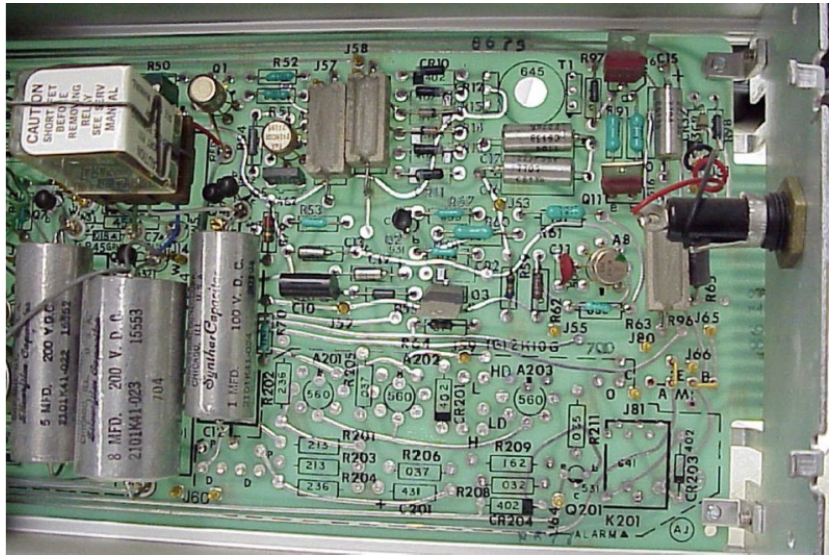
CM Board
- Detector power (low or high voltage)
- Detector signal:
  - Acquisition
  - Amplification
  - Digitization
- Detector connection monitoring (high voltage, current, etc.)

AC/DC Power Supply Block
- Filter
- Fuse
- Transformer
- AC/DC Linear Power Supply

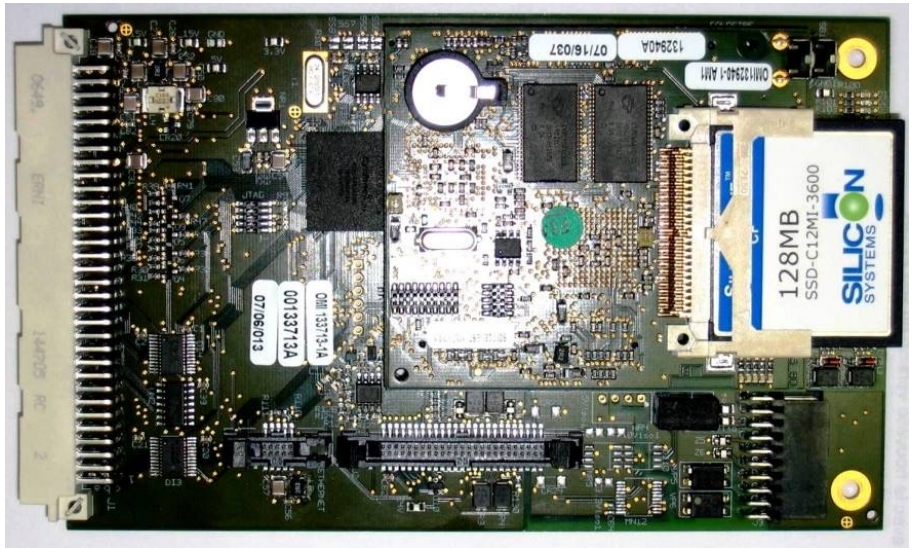
Component Level Troubleshooting

- *Not as simple as it used to be.*
- *General recommendation is to replace entire circuit boards (boards can often be sent to vendor for repair)*

Instrumentation board of old:



LPDU3 microprocessor board:



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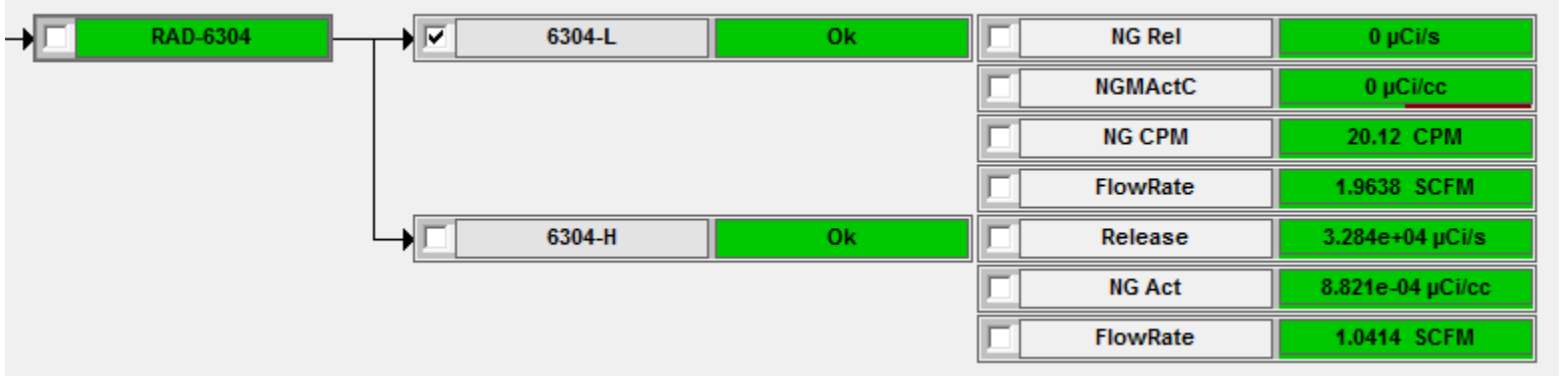
.mod File Capture and Support from Mirion

- *A .mod file is a simulator file that is a **snapshot of a unit and its stored data** that can be viewed in MASS2 as a record of monitor operation.*
- *Captures event history for the monitor, data trends, any current status fault, and all active readings at the time of file generation.*
  - *This is an invaluable tool when seeking technical support from Mirion (RMS-Support@mirion.com or via phone call to our RMS Support Team: +1 770-432-2744 [Menu Option 2]*
  - *Support may ask you to generate a set of .mod files for the entire monitor group.*
  - *This can aid in diagnosing problems for a set of monitors as they can be loaded into MASS2.*

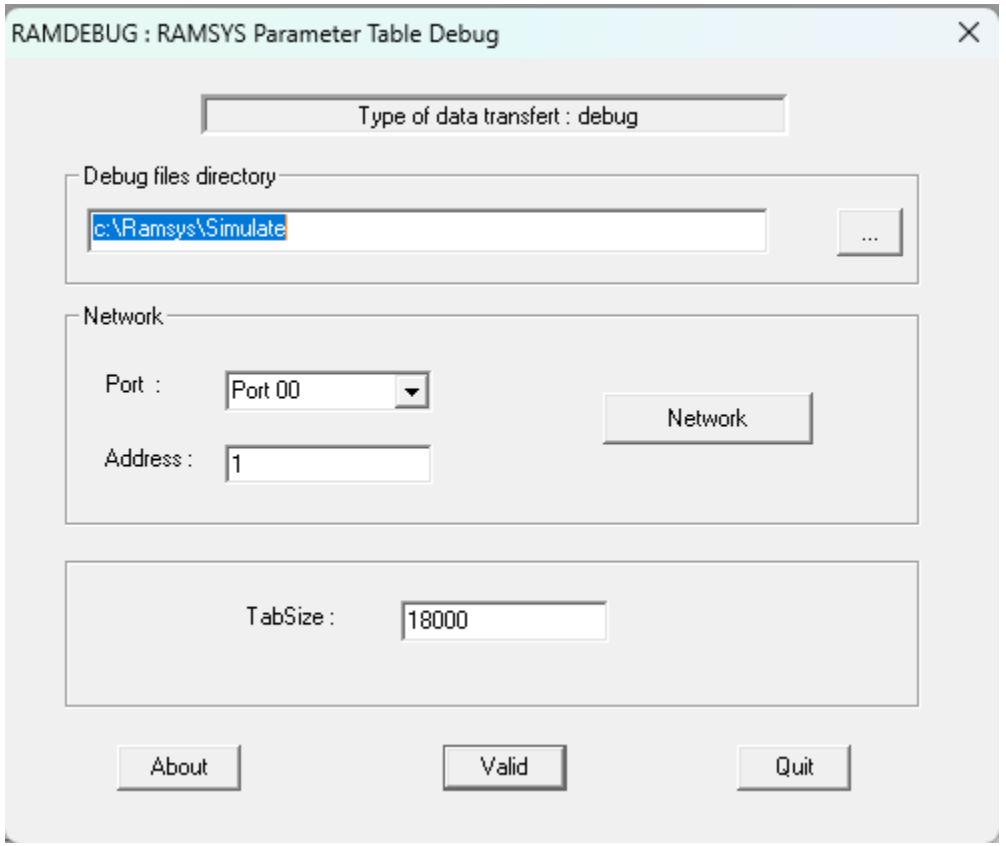
.mod File Capture and Support from Mirion

- *Generating a .mod file is simple and can be performed directly through MASS2 interface as follows:*
  - *Select an LP(D)U or xDU of interest*
  - *Verify that box next to device has check next to it:*



.mod File Capture and Support from Mirion

- *At the top menu of MASS2, select "Tools" followed by "Ramdebug", which opens the following window:*



.mod File Capture and Support from Mirion

- *Define the location to save the simulator file.*
- *Select "Valid"*
- *Once the file has been created, an "End of Debug" dialog box will appear.*
- *Resulting file will be saved with ".mod" extension. This file can be viewed later in MASS2 by the user or it can be sent to Mirion for technical support.*

- *Creating and viewing a simulator file will be discussed at a Thursday MASS2 Breakout session.*

Examples

Examples

- *Spikes on monitor with scintillation detector (high voltage)*
  - *Liquid monitor spikes, false alarms: intrusion of saltwater mist into detector connector (detector assembly on turbine deck, seaside plant)*
  - *N16 monitor spikes, false alarms: connector damaged (kicked) by workers on another job*
  - *Control room airborne monitor spikes, false alarms: pipe radiography being performed nearby (i.e. the spikes were real!)*
  - *ATL liquid monitor spikes, false alarms, temperature faults: detector installed in a well, the well flooded. Temperature faults caused by HV short to temperature wire.*

Examples

- *RS485 communication failures on containment monitor*
  - *Monitor functioned normally during commissioning*
  - *Intermittent communication failures between the control room (RDU3) and skid (LPDU3) appeared during reactor startup*
  - *Failures became progressively worse and eventually constant*
  - *RS485 was run on the cores of 2 coaxial cables (Westinghouse composite cable)*
  - *Switching to the core and shield of 1 coaxial cable resolved the problem*
  - *Cause of problem never really determined.*

Examples

- *Intermittent spikes on particulate monitor (silicon detector, low voltage)*
  - *Monitor functioned normally during commissioning*
  - *Intermittent spikes and false alarms appeared following a brief period of operation.*
  - *Replacing the detector appeared to solve the problem, but the spikes soon returned*
  - *Replacing the electronic unit (LPU) did not resolve the problems*
  - *Monitor was heat traced close to the detector temperature limit- possible temperature induced noise?*
  - *Detector was removed from service → not noisy in bench testing*
  - *Heating the detector to check for noise yielded an unexpected result- liquid water weeping from the detector!*
    - ✓ *Water + electronics = spikes*

Examples

- *Erratic Count Rate Spikes on Plastic Scintillation Detector*
  - *Customer reported that condenser air ejector monitoring system exhibited erratic count rate spikes on the LPDU and Plant Computer*
  - *On-site testing performed by Mirion personnel confirmed detector and LPDU were functioning properly; cable length alone (~320 ft) was ruled out*
  - *Introducing the current service cable within its conduit run caused background noise to jump from ~2 cps to ~1000 cps – encroaching into Window 1*
  - *Root cause: EMI and/or vibration induced by cable's routing environment near turbine deck equipment (cable was routed nearby a 440V generator).*
  - *Conclusion: EMI noise from the plant field environment cannot be fully anticipated or mitigated by Mirion – cable routing, shielding, and EMI evaluation must be addressed during the design phase and/or with site-specific knowledge.*

Survey and Q&A

Survey for:

Instrumentation and Control (I&C) Forum

Please take a moment to fill out a short survey on this session.

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Thank you