Andromeda image appears courtesy of Adam Evans

CCERA Gen IV *Dual-channel* Riometer specifications and features

Specifications
- Tuning range: 25-45MHz in 100Hz increments—other ranges available with upconverter
  Frequency stability over temperature: 0.5PPM 0-40C
  Master Clock Phase noise: –138dBc/1kHz, -150dBc/10kHz, -152dBc/100kHz
- Noise figure 3.8dB typical—about 410K noise temperature equivalent
- Dynamic range: >75dB noise floor to peak
  - ~14dB available below typical T_{ant} @ 30Mhz
  - ~60dB available for SREs
- Detection bandwidth: flexible software-defined from 75kHz to 600kHz
- REF source: ~30dB ENR avalanche diode noise source
  - Superior noise flatness (compared to bipolar transistor)
  - Superior long-term stability (compared to bipolar transistor)
  - Dual-stabilized (passive thermal, and electronic compensation)
- Analog image rejection: 65dBc typical
- Analog ACR: 47dBc typical
- Analog IIP3 -7dBm typical
- DSP filter rejection prior to detection: >75dB
  - Provides (combined with analog) >100dB ACR

Features and Architecture
- Software Defined Radio DSP architecture
  - Open Source *GNU Radio*[1] framework
  - Open Source Riometer[2] application
- Dual matched SDR receivers, FFT-driven detection
  - SKY receiver – configured for two switched channels
  - REF receiver
- DSP-based RFI excision
  - Removes sparse spontaneous spectral features using modal estimate
  - Impulse-noise removal with configurable threshold and hold-off
- Algebraic conversion to sky temperature in logging and real-time display
  - Given knowledge of system noise temperature estimates and REF noise
  - Calibrated at CCERA facility
- Logs both 1Hz and 15Hz estimates for both REF and SKY
  - Records tagged with both UTC and LMST
- Logs spectral data
  - Input and **excised** spectrum
  - Peak-hold of input spectrum
  - Statistics for **excision** events
- **Automatic antenna fault detection and reporting**
- Channel switching at 2Hz

See: http://www.gnuradio.org

See: https://github.com/ccera-astro/riometer_iv

Canadian Centre for Experimental Radio Astronomy: http://www.ccera.ca

Computer System features
- Ubuntu Linux on high-performance ARM-based SBC
- NTP support
- GPS support for fall-back timing
- Enclosure temperature monitoring for:
  - Enclosure general ambient temperature
  - Thermal-control-slab temperature
- Local 64GB or larger SSD
- Flexible data-logging to central server
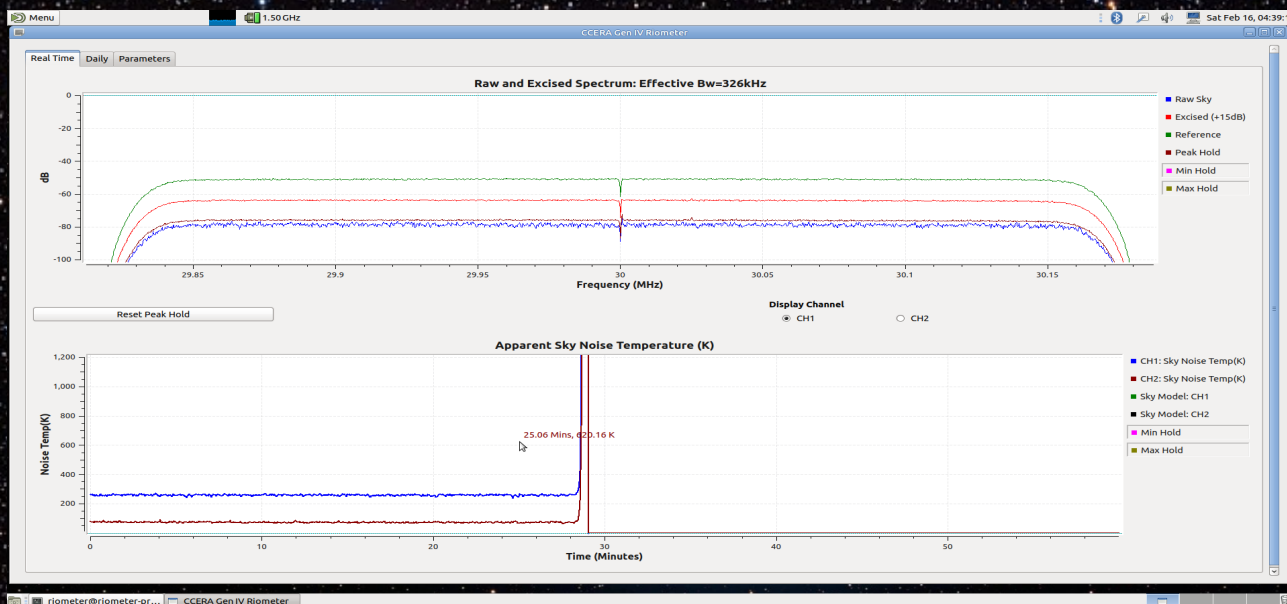- VNC/Remote-desktop enabled
- SSH enabled

Hardware notes
- Type-N RF connector
- Keyboard/Mouse/HDMI ports
- External 19.5VDC 4.77A laptop charger supply
- Fault indicators
  - Antenna Fault
  - Temperature Fault (General, or thermal-control slab)
  - Time synchronization fault (NTP and GPS both failing)
- All signals brought out to front panel, power on back panel.
  - 10/100/1000Mbit network
  - Keyboard/Mouse USB ports
  - GPS USB port
  - HDMI port
  - RF IN—surge arrestor on RF IN
- Thermal control slab
  - Receivers and noise source mounted to aluminum thermal mass
    - Reduces thermal variations
    - Improves gain stability as an **adjunct** to other design features

Pricing, Warranty and Support
- $3500.00 with 64GB SSD, $3600.00 with 128GB SSD
- Subtract $150.00 for NO GPS
- Add $450.00 for desktop rack/EMI enclosure
- 1 year warranty
- Six month technical support via e-mail
- System software upgrades
  - Customer pays only for (modest) shipping on system-image SD cards
    - This is the "safest" option, because it guarantees compatibility
  - Customer can perform base-system upgrade via "apt" at any time
  - Riometer application continuously updated via GitHub
- Also ask about our cost-reduced "headless" version for outdoor deployments
  - POE powered   No SSD
  - 300kHz maximum bandwidths   No GPS
  - Passive reference   No system monitoring

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