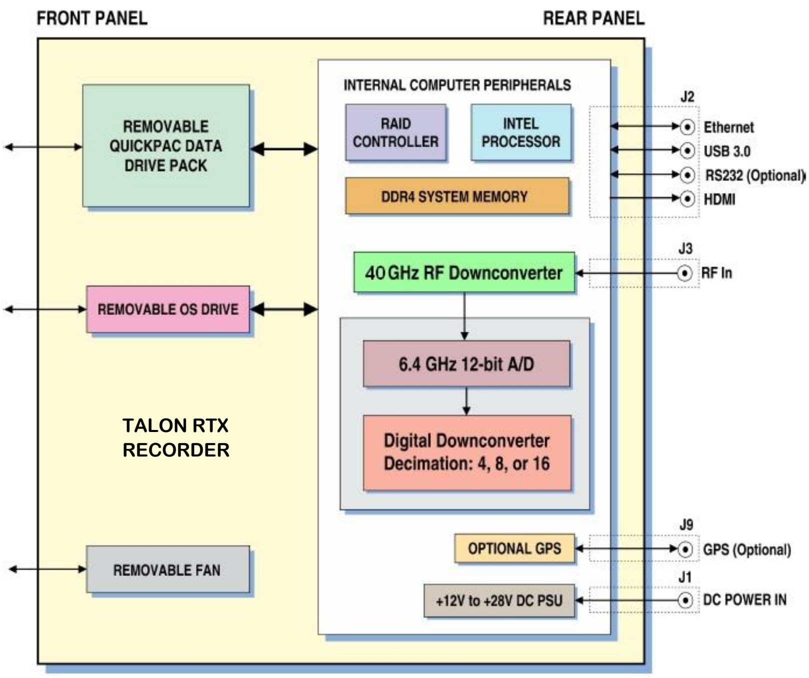
26GHz (up to 40GHz*) Mobile SIGINT Recorder
Application Note 105

When Pentek *(now part of Mercury)* was asked to supply a rugged airborne recording platform that could capture RF signals up to 26GHz (with a wide <1GHz bandwidth) and store them in real-time, it needed some innovative thinking to squeeze all this functionality into the restricted space available. Using the existing Talon RTX recorder platform as a starting point, Pentek added an RF tuner from a trusted 3rd party, outputting an IF with up to 1GHz usable bandwidth. By sampling the IF at 5GHz (12 bit) and then using the on-board FPGA to down-convert and decimate the data, Pentek can produce a stream of I & Q samples at 1.25GSPS which are recorded onto the SSDs in real-time. The result is a highly rugged ½ ATR RF recorder suitable for use in manned or unmanned vehicles on land, sea and in the air.

System Architecture

Pentek's Talon Recording System is based around a rugged PC platform, fitted with an RF tuner and an ADC data capture module which can sample up to 6.4GSPS. Raw or FPGA-processed data can be stored in real-time on a RAID array implemented on a removable disk cartridge. This flexible modular approach allows the platform to be modified to incorporate new requirements with a minimum of rework. For this application Pentek added a wide bandwidth tuner which could tune to frequencies up to 26GHz and output an IF compatible with the existing ADC capture card. The IF data is sampled and transferred to the FPGA processor, where Pentek have developed new digital down-conversion (DDC) code to translate the incoming signal to baseband and store it as complex I & Q samples.

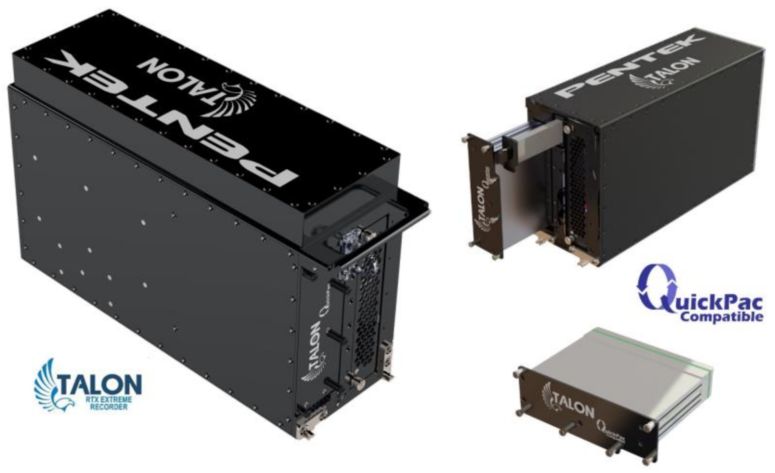


Designed to operate in the toughest environments, the recorder chassis keeps all electronics sealed from the outside environment and removes heat by conducting to forced-air cooling channels. Operating temperature range is from –40° to +50° C, and with high levels of shock/vibration tolerance, the recorder is ideal for UAVs, aircraft pods, tight equipment bays, military vehicles and most outdoor environments.

An optional GPS receiver provides precise time stamping of recordings and can track and record the GPS position of the system during operation. Recorded data is stored on a removable cartridge called a QuickPac, which can be removed from the recorder at the end of a mission. The QuickPac can then be inserted into a PC-based docking station for post-mission data analysis. By using multiple QuickPacs, the vehicle can be turned around very quickly between missions. Note that the recorder's system drive holding the OS and recorder application is also removable for security.

The sealed ½ ATR chassis uses MIL-STD circular connectors for I/O and power to control RF emissions while protecting the recorder’s electronics from humidity, water, dust, sand and salt fog. In addition to meeting MIL-STD 461 specifications for radiated RF emissions, conducted emission military specifications are met by design with a built-in conducted emissions filter. Maximum power consumption is around 180W (typ. DC +24V) and the unit weighs around 10kg making it suitable for land, sea and air applications.

Flexible control of the recorder parameters before and during the mission is critical - this recorder uses a Client-Server software architecture (called Systemflow) which separates the real-time recording tasks from the non-real-time control of the system. In this architecture, the Server is responsible for providing the real-time recording facilities, while the Client is responsible for issuing commands to control the recorder. The Server and Client communicate through a standard socket connection, allowing the Client to either run locally (on the recorder itself) or on a remote processor (e.g. an external mission computer). The Client consists of a Graphical User Interface (GUI) and a programming API – the server interface is identical regardless of where the Client runs which simplifies development.



The GUI provides the user with simple screens and dialogs for Configuration, Record, Playback and Status, each with intuitive controls and indicators. The user can easily move between screens to set configuration parameters, control and monitor a recording, play back a recorded signal and monitor board, temperature and voltage levels. The signal viewer, integrated into the recording GUI, allows the user to monitor real-time signals or signals recorded on disk. Once the system is configured the user can save the configuration as a profile - users can create an unlimited number of profiles, each of which can be loaded back into the recorder with a couple of mouse clicks. The GUI interface is ideal for testing the recorder, and setting up and storing multiple preset configurations which can be selected later via the API (see below).

The API a provided in the form of a C-callable library giving the flexibility to integrate the recorder control into a wider application. The library includes commands to start/stop the recorder (with optional time delay), request the status of the system, read the current state of recording, indicate temperature levels and data loss warnings, etc. The Server continually monitors the A/D clocks, the DMA status and FIFO levels to provide the Client with warnings of any problems with the system.

The Talon recorder captures data to disk as a binary file. Each file contains a header, immediately followed by the recorded data stored in raw two’s–complement format. The header contains important information about the recording that can be used to process and analyse the data (e.g. sample rate, data format, GPS time/location, etc). The data is stored as either raw A/D samples or down-converted and decimated data in I & Q format.

Conclusion
Designing a new data recording platform from the ground up is a complex and time-consuming task. Pentek’s Talon RTX modular recorders allow a new set of operational requirements to be met in a much shorter time, by keeping redesign to a minimum. ***Note:** For example, changing the front-end tuner to a higher frequency range (e.g. 40GHz) is a relatively simple upgrade.

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