

## AE9000-500 Rugged 1GHz/160MHz Disk Recorder

- Single-/multi-channel analogue IF recorder
- 1GHz & 160MHz IF centre frequencies
- 500 MHz Recording Bandwidth
- 8 and 16-Bit Recording Modes
- Optimised Input Filtering
- 8 TB removable Disk Packs as standard
- Built-in down/up-shifting
- Real-time FFT/waterfall display
- Intuitive Graphical User Interface
- Data extraction direct to workstation/network
- Community-standard headers supported
- Longer record durations optional



**Avalon AE9000-500 Disk Recorder (front view).**

### TECHNICAL OVERVIEW

The compact, self-contained Avalon AE9000HW-500 SIGINT Disk Recorder is designed to record, reproduce and export a single channel of wideband analogue IF (intermediate frequency) data at centre frequencies of 1 GHz IF or 160 MHz IF at pre-defined bandwidths. Depending on the selected IF, recording bandwidths of up to 500 MHz (1 GHz IF) and 100 MHz (160 MHz IF) are supported.

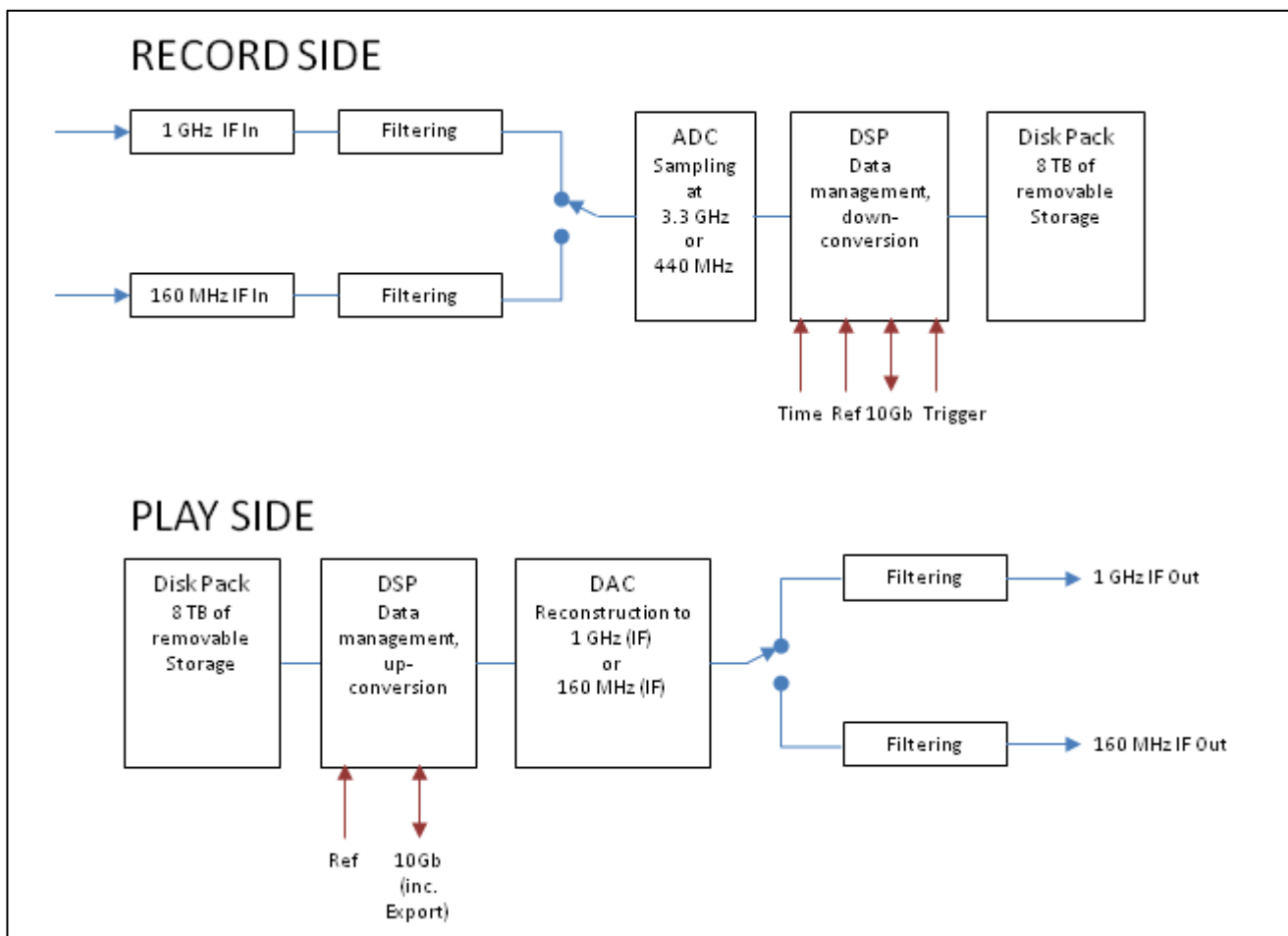
As shown below, two separate input paths are provided; one for the 1 GHz IF and one for the 160 MHz IF. Each path incorporates input signal conditioning (including gain control) and high-precision anti-alias filtering. When the user selects one of the input paths, the analogue-to-digital converter is automatically programmed to sample the analogue input at the appropriate sample rate (3.3 GHz for the 1 GHz IF and 440 MHz for the 160 MHz IF). The sampling depth for both IFs is 12-bits. 1 GHz IF signals are recorded at 8-bit resolution and 160 MHz IFs are recorded at 16-bit (2 byte) resolution. The resultant data stream is passed to the DSP block which handles time-stamping, down-conversion (to complex baseband IQ format), data management and writing to the 8 TB (standard) removable disk pack. When the user wishes to record at lower bandwidths, the DSP block also decimates the data stream by the appropriate number of divisions. Data is stored on the disk pack as a series of fixed file-size 'clusters', each with a community-standard (Midas Blue) header.

During Playback, the recorded data is up-converted back to its full data rate within the DSP block and then reconstructed into its original full-bandwidth analogue IF form before being passed through the appropriate filtering path. During digital Extract tasks, the DSP block combines the appropriate number of recorded clusters into a single file which is then typically networked to a remote server or other storage device.

AE9000HW-500 is supplied with a fully-featured stand-alone graphical user interface (GUI) which can be run either on the recorder itself (with attached monitor, mouse and keyboard), or on a remote laptop/PC (via Ethernet). The GUI can be compiled to run under most popular operating systems, including Debian, Windows, etc.).

In common with all Avalon recorders, AE9000HW-500 is designed for a wide range of 'platform' applications including, laboratory, mobile, field-portable, surface ships, submarines and jet/turbo-prop 'passenger' aircraft.

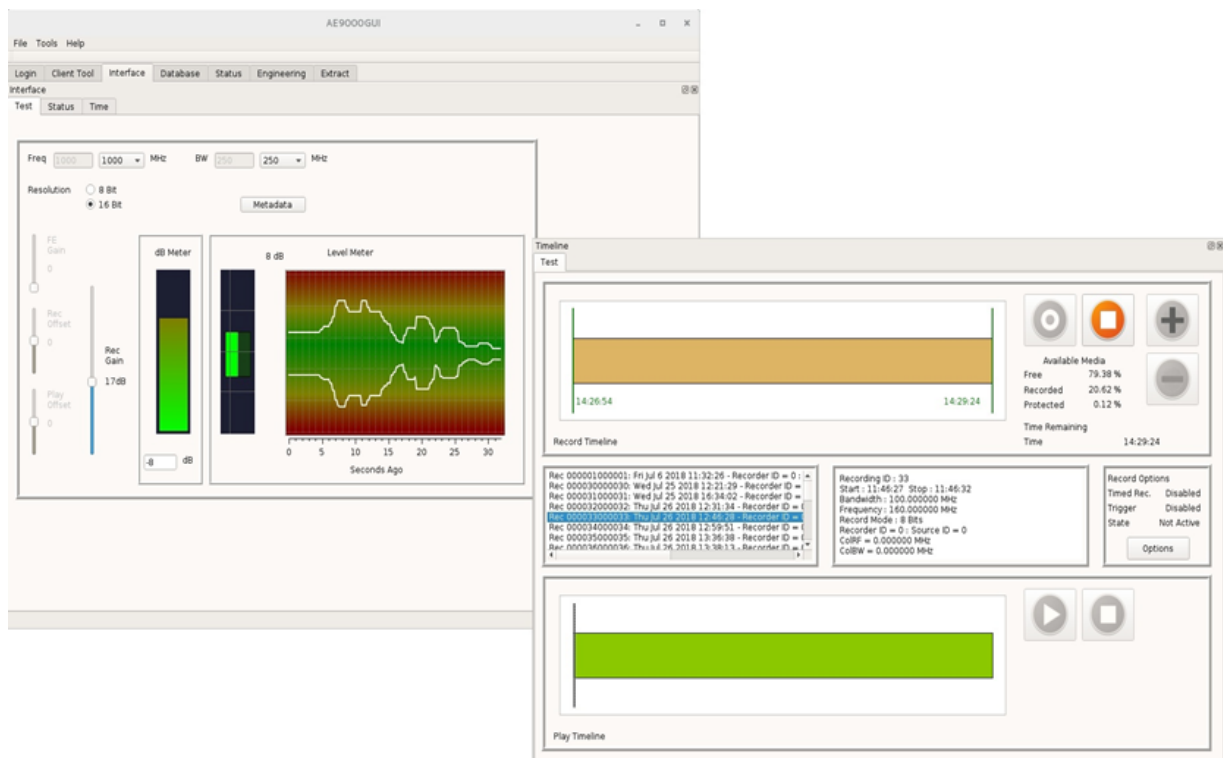
In addition to normal analogue replay, recorded data can be exported in digital form. Data can be exported directly to solid-state disk, workstation/network or optional built-in USB-3 Disk Pack using software utilities running on the recorder itself. Data stored on external media can be restored to the same or another AE9000HW-500 for analogue replay – or, transferred to conventional storage media at a remote analysis facility.



## GRAPHICAL USER INTERFACE (GUI)

The Recorder is typically controlled from either an external PC/Laptop using an Avalon-developed GUI Application or from the pre-loaded version stored on the Recorder. The Avalon GUI Application may be compiled to run under a range of Windows and Linux operating systems.

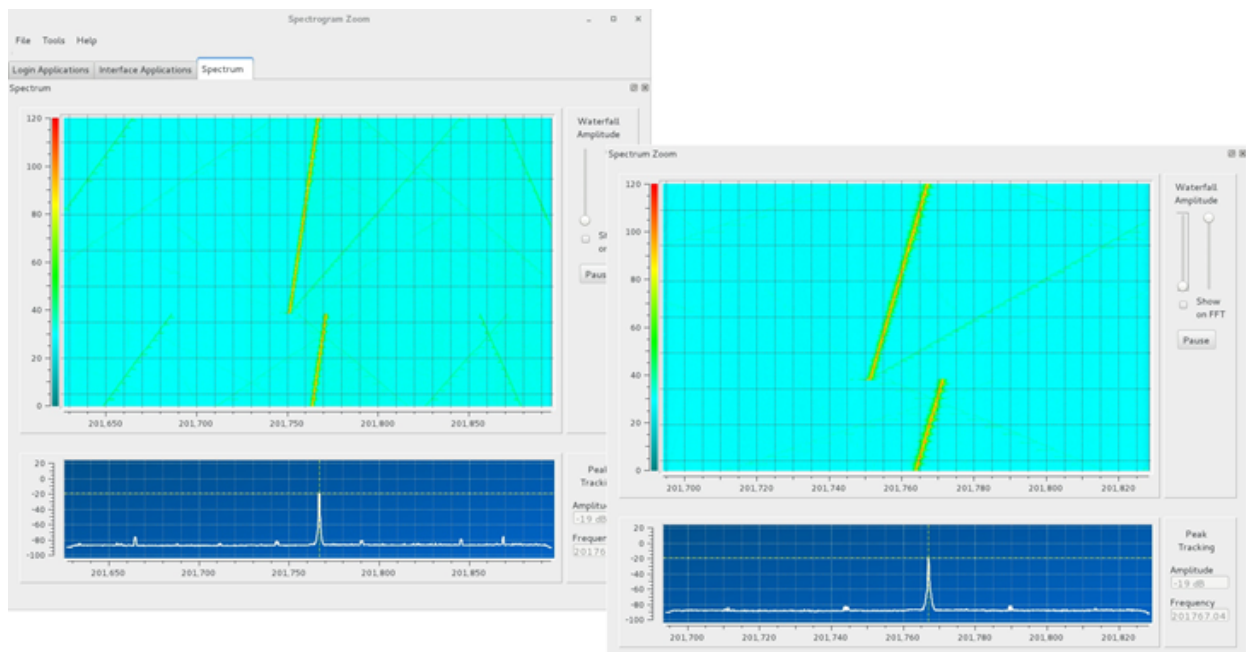
The GUI provides control over all the Recorder functionality, including: RECORD, PLAY, STOP, Data selection (for extraction/forwarding, etc.), Data handling, including transcription to networked storage media and control and monitoring of Input Signals and Levels.



GUI examples

## REAL-TIME FFT / WATERFALL DISPLAY

AE9000-500 features a powerful, real-time FFT function that can be used to visualise the incoming signal. In Record and Standby modes, the spectrogram display reflects the Record Input signal, during Playback the spectrogram will display the reconstructed signal. Typical examples of real-time FFTs are shown below...



FFT examples

## TECHNICAL SPECIFICATIONS

<b>Number of Channels:</b>	1															
<b>Supported IF frequencies:</b>	1 GHz and 160 MHz (two paths, user-selectable).															
<b>Maximum Bandwidths:</b>	<table border="1"> <thead> <tr> <th>IF Path</th> <th>Bandwidth</th> <th>8-bit</th> <th>16-bit</th> <th>Lower Bandwidths (user-selectable)</th> </tr> </thead> <tbody> <tr> <td>1GHz</td> <td>500 MHz</td> <td>YES</td> <td>NO</td> <td>250, 125 and 62.5 MHz</td> </tr> <tr> <td>160 MHz</td> <td>100 MHz</td> <td>YES</td> <td>YES</td> <td>50, 25 &amp; 12.5 MHz</td> </tr> </tbody> </table>	IF Path	Bandwidth	8-bit	16-bit	Lower Bandwidths (user-selectable)	1GHz	500 MHz	YES	NO	250, 125 and 62.5 MHz	160 MHz	100 MHz	YES	YES	50, 25 & 12.5 MHz
IF Path	Bandwidth	8-bit	16-bit	Lower Bandwidths (user-selectable)												
1GHz	500 MHz	YES	NO	250, 125 and 62.5 MHz												
160 MHz	100 MHz	YES	YES	50, 25 & 12.5 MHz												
<b>Frequency Response:</b>	+/-1 dB (typical) with optimised (internal) anti-alias filters.															
<b>Recording Duration (8 TB):</b>	500 MHz (8-bit) mode: 100 minutes. 100 MHz (16-bit) mode: 5 hours.															
<b>Recording Format:</b>	IQ pairs (centred on 0 Hz), 2s-complement.															
<b>Backup/Transfer/Archive:</b>	To a remote server via 40 Gb Ethernet port.															
<b>Replay (analogue):</b>	Same format and bandwidth as recording (with automatic detection of recording mode).															
<b>Replay (digital):</b>	Binary files for computer analysis, c/w Midas Blue headers.															
<b>Input Levels for FS rec.:</b>	-20 to +10 dBm from 50 $\Omega$ source (AC coupled).															
<b>Output Level from FS rec.:</b>	0 dBm into 50 $\Omega$ load (AC coupled).															
<b>Spur Free Dynamic Range:</b>	Typical figures: ~50 dB (1 GHz mode), ~67 dB (160 MHz mode).															
<b>Reference Frequency:</b>	Stable internal 10 MHz clock, or external 10 MHz source.															
<b>Time Source:</b>	Internal, Network (via Ethernet), IRIG-B.															
<b>GPS:</b>	GPS data supplied to recorder by the system controller as Ethernet messages.															
<b>Local Control:</b>	Avalon GUI (Figure 3) running on recorder, with attached monitor/mouse/keyboard.															
<b>Remote Control:</b>	Via 10/100/1000BASE-T Ethernet), using Avalon GUI (or user-furnished equivalent) running on remote laptop/PC. Most popular OS's (including Windows Server 10) supported. APIs also available from Avalon.															
<b>Trigger Mode:</b>	From Ethernet command or TTL level change.															
<b>Voice Log:</b>	Audio 'channel' presented to the laptop/PC built-in/external speakers.															

<b>LOOP recording:</b>	The recording media can be configured as a simulated 'endless loop' for record and play.
<b>SKIP mode:</b>	Permits the user to tag selected passages of data with SKIP flags to avoid accidental overwriting. SKIP flags can be set either while recording or when the recorder is stopped.
<b>Real-time FFT &amp; Y/T display:</b>	Real-time calculation and display of FFT (waterfall/spectrogram) and Amplitude vs. Time (remote laptop/PC only).
<b>Media Life:</b>	2,500 hours warranted minimum life at maximum bandwidth. Typical media life more than 10,000 hours.
<b>Data Extraction Ports:</b>	10Gb Ethernet and USB-3
<b>Dimensions:</b>	217mm (19" Half-width) x 4u x 560 mm deep
<b>Weight:</b>	~ 25 Kg.
<b>Power:</b>	100 to 240 Volts, 47 to 63 Hz, 600 Watts.
<b>Environmental:</b>	EMC/RFI: Designed to conform to the applicable sections of MIL-STD-461. Shock/Vibration: Designed to conform to the applicable sections of MIL-STD-810, and US Navy specifications. Similar construction approved for flight in USAF Rivet Joint and other military and civilian turbo-jet and propeller aircraft.
<b>System Control:</b>	Stand-alone, fully-featured Avalon-designed GUI (graphical user interface) running on an external laptop/PC (via Ethernet port).
<b>File Format:</b>	Midas Blue (Platinum 2.0) or MATLAB™ <a href="#">see note 1</a>

Note 1: MATLAB is a trademark of The MathWorks Inc.

## OPTIONS

- An Additional Ethernet card (10Gbit/s) can be factory-fitted.
- 16TB (total capacity) removable disk pack
- Extra-long-life SSD packs – refer to Avalon Electronics Ltd. for details.

