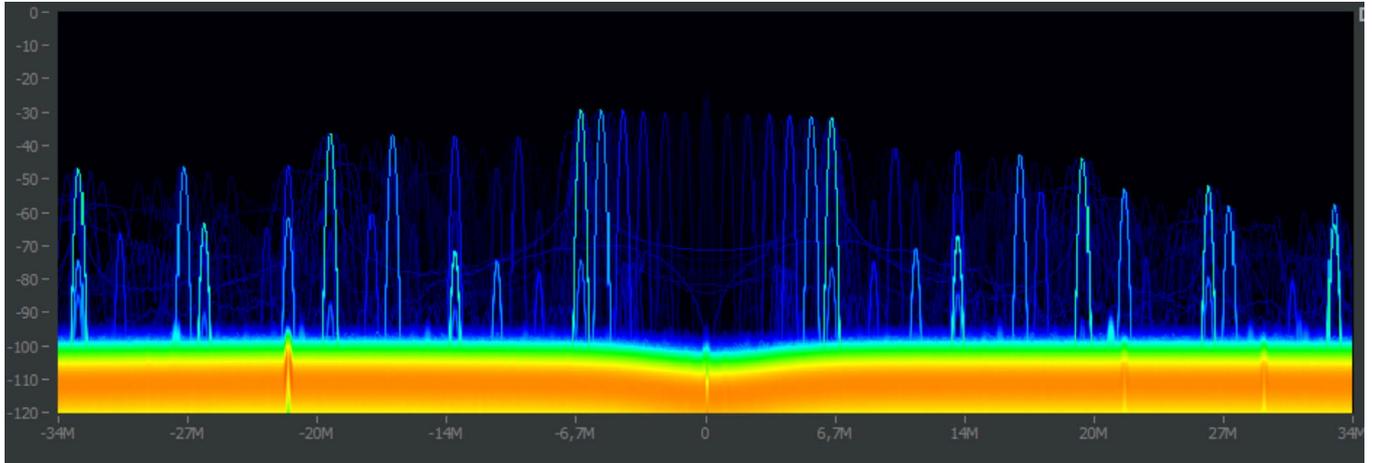


Gapless **High** **Speed** Recording

MUNIN 1005-IF wideband recording platform



Recording Wideband Signals



Applications ranging from Spectrum Monitoring over RF Testing to Signal Analysis & Characterization have common requirements of recording wideband signals without losing any acquired samples.

To maximize the performance, it is critical to carefully select the latest technology available and to optimize the architecture in order to achieve reliably high data rates. This is specifically important in mission critical applications with GNSS, Radar or Telemetry signals.

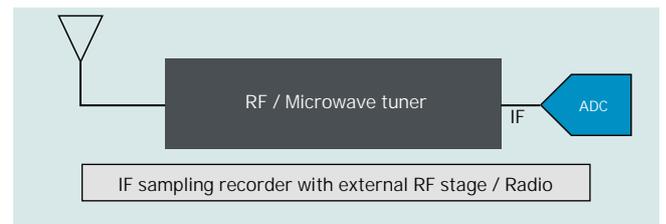
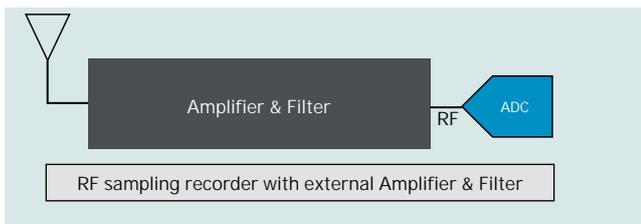
Combined with our expertise in high performance data streaming, FPGA enabled real-time signal processing and highly configurable multichannel digital downconverter technology Novator Solutions can provide leading wideband recording and playback solutions.

MUNIN: High speed and highly configurable

MUNIN 1005-IF is the latest wideband IF recording platform which ensures gapless recording of narrowband and wideband IF signals from 2MHz to 600MHz real-time bandwidth.

The configurable platform is ideal for capturing one or more IF channels in real-time for DUT characterization, spectrum analysis or setting up repeatable lab tests.

Dependent on the carrier frequency location you either add an RF stage in front of the IF input to use MUNIN as an IF sampling recorder or you use it as a direct RF sampling recorder by putting the correct attenuation and filter in front of it as illustrated below.



Benefits

Offline spectrum analysis for maximal analysis coverage.

The more information and signals that need to be analyzed the more difficult it is to perform real-time spectrum analysis. Analysis is limited by the available real-time functions and processing capacity. Further, the use of real-time spectrum analyzers is often limited by the internal memory for spectrum management.

Recording all information ensures that no fundamental information is lost, and all data can be reviewed and analyzed any time with e.g. complex analysis functions which would not be fast enough for real-time analysis. Also, as new analysis algorithms become available the same data can be used repeatedly to gain new insights.

Repeatable tests for shorter time-to market.

Running many field-tests can not only be very expensive but cost valuable time.

Recording real-world signals in different environments allows you to perform tests. This will not only reduce cost and valuable test time but potentially increase the test coverage and thus product quality.

Out-of-the-box experience for quickly getting results.

With our flexible architecture and modular hardware approach we can quickly provide a recorder which meets your individual needs without spending a lot of development time and validation effort.

Features

Gapless recording. MUNIN records all channels continuously without gaps which ensures correct post-processing or replay of the recorded data.

Long recording time. MUNIN offers standard RAID configurations from 4TB to 96TB with industrial grade SSD disks. Dependent on the channel configuration you can continuously record data from minutes over hours to days. The storage capacity can be expanded beyond 96TB.

Pre-trigger buffering. MUNIN features a circular pre-trigger buffer to capture events which happened before the trigger. Depending on the chosen buffer option and the selected real-time bandwidth it is possible to capture pre-trigger data from a few seconds to multiple minutes.

Remote control. Thanks to the server-client architecture it is the operator's freedom of choice to configure, monitor and control MUNIN locally or remotely. For remote handling you can use the build-in client application or use direct TCP/IP commands from your own developed application.

Open file format. The generated files are saved as binary files in an open file format called TDMS that can be opened by third-party software like MATLAB® for analysis. It is possible to add user-defined metadata to the standard metadata fields. Recording directly to custom file formats are available upon request

Timestamping. For accurate timekeeping you can synchronize the recorder with the optional GPS (Global Positioning System) receiver. For improved timestamp accuracy below millisecond resolution we recommend using the optional PPS (Pulse Per Second) signal. As standard we support NTP (Network Time Protocol) to distribute the timing information among all modules on the server and client. We can add IRIG-B support on request.

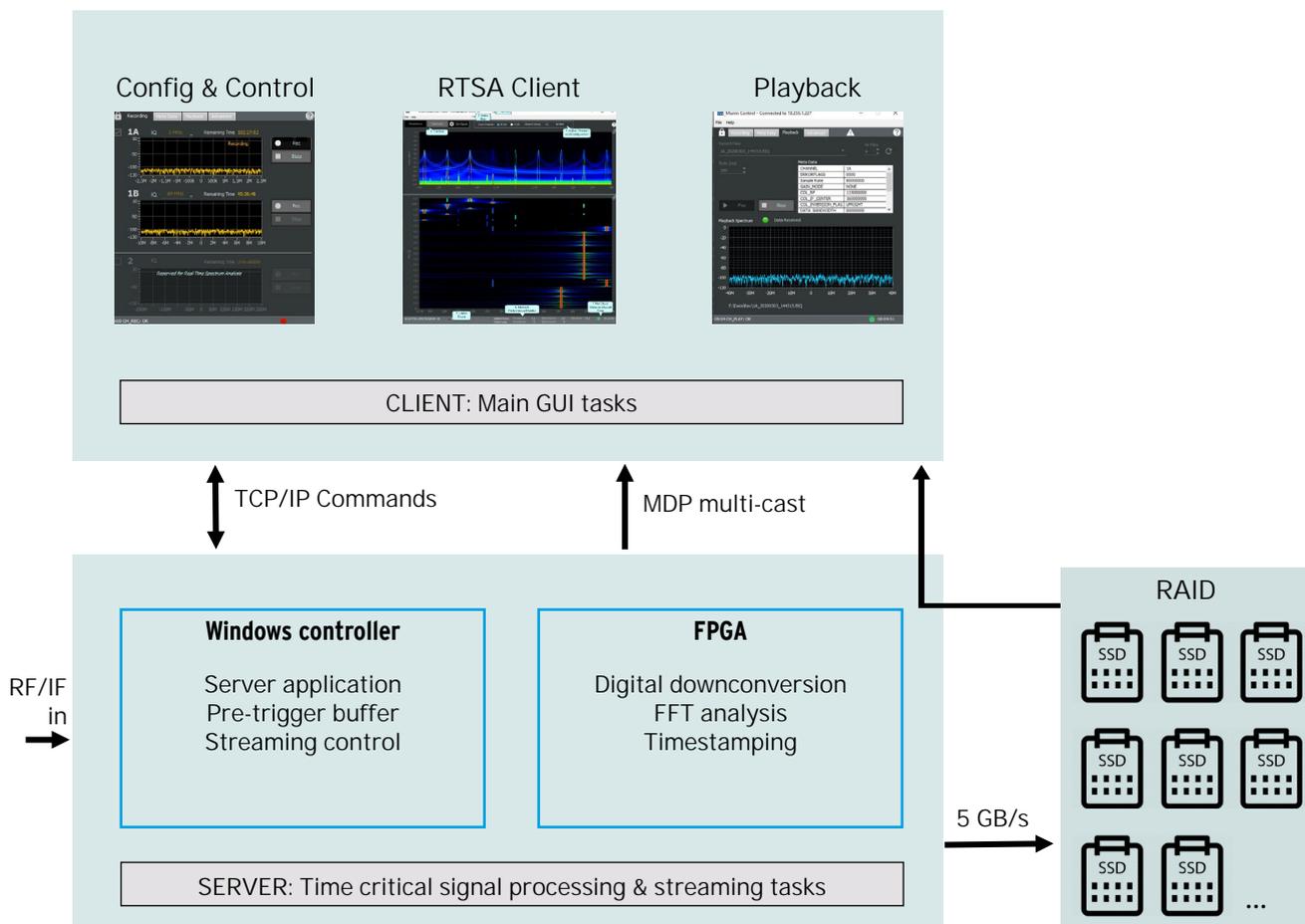
Scalable. MUNIN allows you to mix and match multiple IF inputs with various real-time bandwidths and record to a single RAID controller or multiple RAID controllers in parallel.

Playback. You can use software playback to analyze the recorded data or to characterize the DUT. By adding a signal generator, recorded data can be played back continuously in real-time. Contact us for more information about hardware playback options.

Key Technology

Streaming

The core of all record and playback systems is Novator Solutions streaming engine. The robust streaming engine is optimized for gapless high-speed streaming over many hours. The server-client architecture separates the time-critical tasks for processing and transferring data in real-time from the non-time-critical tasks for configuration and display. All server client communication is handled via TCP/IP and UDP protocol.

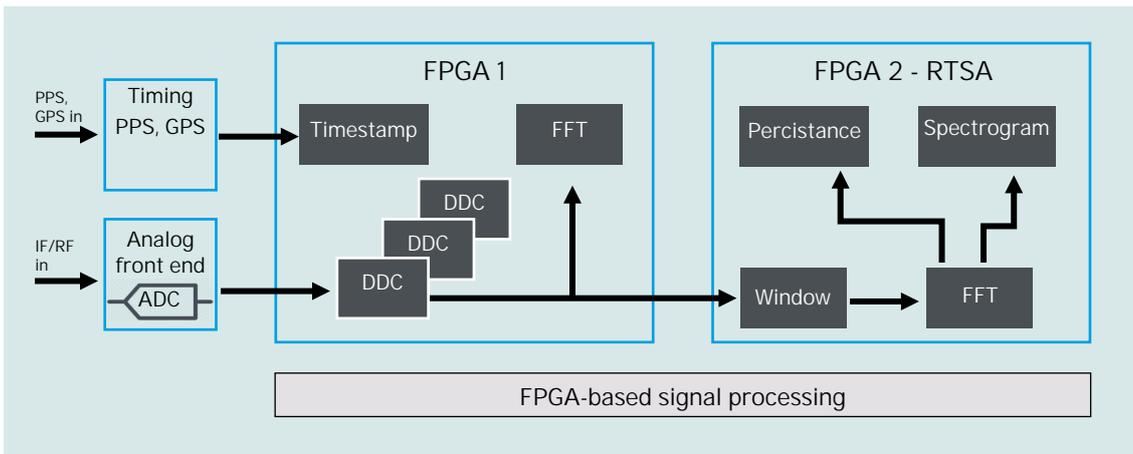


Signal processing

The most time-critical processing tasks including digital downconversion (DDC), a 1024-point FFT and optional real-time spectrum analysis (RTSA) are implemented on field-programmable gate arrays (FPGA).

The flexible DDC architecture allows downsampling of real data from nearly any IF center frequency supported by the analog front-end. With the 1024-point FFT you can monitor the spectrum of all analog channels online.

To ensure optimal performance the RTSA processing is executed on a dedicated FPGA. After the Windowing block up to 120 thousand overlapping FFTs are computed per second. To ensure effective spectrum analysis both spectrogram and persistence are computed on the FPGA as well.



Hardware platform

MUNIN uses industry proven modular PXIe platform, latest ultrascale FPGAs and industry graded disk storage from leading vendors. With the modular architecture based on National Instruments products it is possible to change the analog channel configurations quickly.

Xilinx ultrascale FPGAs ensure that signal processing blocks can be changed or added in the future. Industry graded SSD drives from e.g. Samsung or Toshiba keep your data safe and reduce the need for frequent disk drive replacements.



Products

MUNIN 1005-IF comes in several standard configurations with 70MHz input(s), 600MHz input(s) or a combination of both. Each standard configuration includes a 10-slot PXIe chassis, a controller with the latest windows OS, 24GB DRAM and 1Gbit Ethernet connection for remote control and data offloading. The 600Mhz channel configuration comes with an additional precision clock module for optimized spurious free performance.

All recorders come with a complete suite of software which includes the MUNIN server taking care of all time-critical processing and streaming aspects, MUNIN control to configure, control and monitor the recorder both locally and remotely and a software playback user interface.

Standard RAID options start at 4TB for in-chassis RAID and go up to 96TB with external RAID. The in-chassis RAID is ideal for portable applications while the External RAID is ideal for fixed installations which require extensive storage capacity.

Other options including synchronization to PPS and GPS, real-time spectrum analysis or faster data offloading can be added as needed. For future upgradability you can change from the standard 10-slot to a 18-slot chassis which gives you additional spare slots.



Product Configurations

Table 1: MUNIN 1005 configurations

Parameter	Part Number	IF-NB	IF-2xNB	IF-WB
IF Center Frequency (default) Real-Time Bandwidth		160 MHz 70 MHz	160 MHz 70 + 70 MHz	1000 MHz 600 MHz
RAID Options In-chassis RAID External RAID 24/48/96T	RAID1 RAID2-24 RAID2-48 RAID2-96	X X X X	X X X X	X X X X
Options Synchronization: PPS, GPS, (IRIG-B) Real-Time Spectrum Analyzer Fast data offloading: 10/40 Gbits/s Chassis upgrade to 18-slot	SYNC1 RTSA1 FADA10/40 CHASS18	X X X X	X X X X	X No X X
Accessories 19" rack-mount kit (10/18slot chassis)	RACK10/18	X	X	X

Customized Solutions

We provide custom implementations which are tailored to your specific recording & playback requirements. Whether you have different analog requirements, digital processing or specific storage and offloading needs we are happy to discuss a customized solution with you.

Typical Specifications

Table 2: MUNIN 1005 typical specifications

Parameter	Narrowband input	Wideband input
Full-scale input range (at 10 MHz)	2,03 Vpp	1,25 Vpp
Input coupling	AC	AC
ADC resolution	16 bits	12 bits
ADC clock	500 MHz	2,8 GHz
SFDR	88 dBc (*)	71 dBc
IF center frequency (default)	160 MHz	1000 MHz
Real-time bandwidth (+/-1dB flatness)	2 MHz - 70 MHz @160MHz cf	600 MHz @1GHz cf
IQ rate	2,5 MHz - 80 MHz	700 MHz
IQ data rate to host (MB/seconds)	320 MB/s (*)	2800 MB/s
IQ data rate to host (GB/minutes)	18,75 GB/min (*)	164 GB/min
Recording time with 4 TB storage	3h 33min (*)	24min
Recording time with 48 TB storage	42h 40min (*)	4h 52min
pre-trigger buffer (24GB DRAM)	60s (*)	7s (*)

(*) Calculated with 80 MHz IQ rate

Measured SFDR

Figure 1: Narrowband input: Single tone SFDR @165MHz

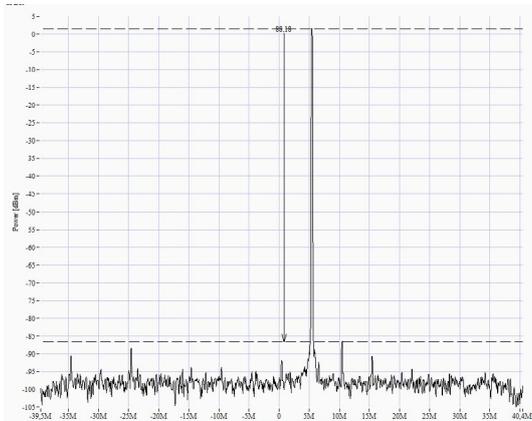
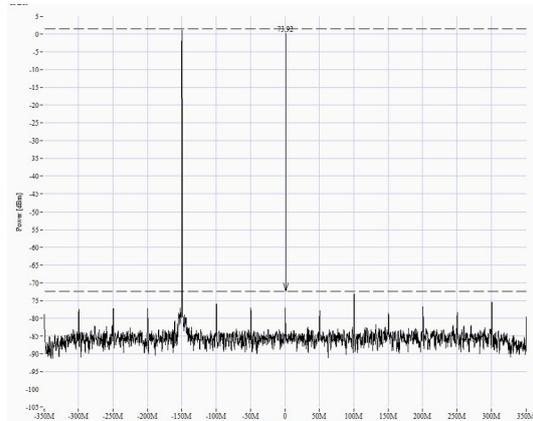


Figure 2: Wideband input: Single tone SFDR @850MHz



Note: Measurements done with Rohde & Schwarz SMA100B RF Signal Generator

RAID Storage

Table 3: MUNIN 1005 RAID specifications

Parameter	In-chassis RAID	External RAID
Form factor	PXle single slot	External RAID 2U × 485.1 × 670.6 mm
RAID	Software Controller	Hardware Controller
Supported RAID configurations	0	0, 1, 5, 6, 10, 50 & 60
Disk type	NVME SSD	SATA III SSD
Disk reliability (Warranty)	0,4 DWPD* (5 Years)	1 or 3 DWPD* (5 Years)
Capacity	4 TB per module	Up to 24x4 TB per controller

*DWPD = Drive Writes Per Day

About Novator Solutions

Based in Stockholm, Sweden, Novator Solutions are specialized in developing FPGA-based software defined radio instruments on National Instruments platforms such as PXIe and USRP. We offer turn-key solutions for channelization, analysis, wideband recording and playback of RF signals in various scenarios.

Novator Solutions is a National Instruments Gold Alliance Partner, as well as winner of numerous awards including Alliance Partner of the Year 2015 in northern Europe and Alliance Partner of the Year 2016 in Europe, Middle East, India and Africa Region (EMEIA).

Our Partners

National Instruments (NI) is an American company based in Austin, Texas, with over 7000 employees worldwide. NI provides an integrated hardware and software platform that helps engineers and scientists in nearly every industry. NI RF products and solutions span from design to test. Its high-performance PXI platform and RF instrumentation deliver unprecedented flexibility, accuracy, and measurement speed.

