

# IZT RecPlay

## The ultimate Record & Replay System for RF signals

- Excellent RF performance
- Extremely low RF emission
- Many hours of continuous record & replay
- Diversity & multi-frequency setup
- Ideal for MIMO system testing
- Powerful off-line post processing



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## The ultimate Record & Replay System for RF signals

IZT RecPlay provides the perfect platform for RF receiver design validation of analog and digital radio, broadcast standards and telecommunication systems. It includes a state-of-the-art wideband recorder with integrated high-performance RF receiver, an external server for data streaming and a revolutionary signal generator, which combines 31 virtual signal generators in one platform.

With a real-time bandwidth of up to 25 MHz and a frequency range of 9 kHz to 3 GHz, 6 GHz or 18 GHz, the recorder covers the whole FM broadcast band simultaneously. An unmatched bandwidth of 120 MHz allows the replay generator to combine multiple recorded and calculated scenarios.

IZT's innovative high-performance record & replay system for high-quality RF signals offers customers greatly reduced costs for field-testing, repeatable lab tests, fidelity in reproducing real RF environment and shorter time to market.

IZT RecPlay is the ideal platform for RF receiver design validation of analog and digital radio, video and Global Navigation Satellite Systems (GNSS) and development of automotive car infotainment systems and chipsets.

# Overview

## APPLICATIONS

The RF recorder is suitable for recording receive scenarios in different countries with excellent signal quality. The recordings can be stored in a library for functional testing of receivers. It is possible to record and replay signals with up to eight antennas.

The recorder covers the frequency range from 9 kHz to 3 GHz (6 GHz and 18 GHz options available) with a real-time bandwidth selectable up to 25 MHz, which is sufficient to cover the whole FM broadcast

band simultaneously. The replay generator covers the frequency range from 9 kHz to 3 GHz for a bandwidth of 120 MHz, which allows to combine different recorded and calculated scenarios inside this bandwidth.

The IZT RecPlay System consists of three components: a recording system, a server with software for off-line editing and signal sources to replay the signals. Benefits include greatly reduced costs for field testing, repeatable tests in the lab and fidelity in reproducing real RF environment which allows a shorter time to market.

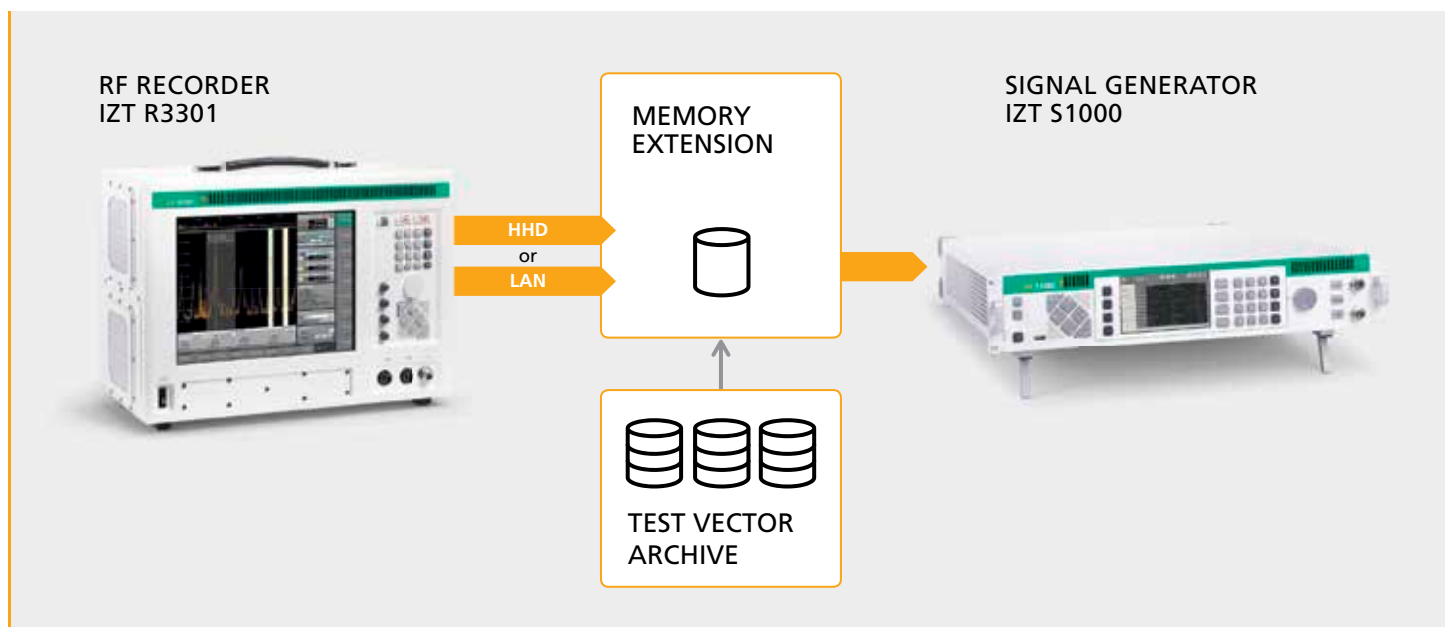


FIGURE 1: EXAMPLE OF A ONE CHANNEL IZT REPLAY SETUP

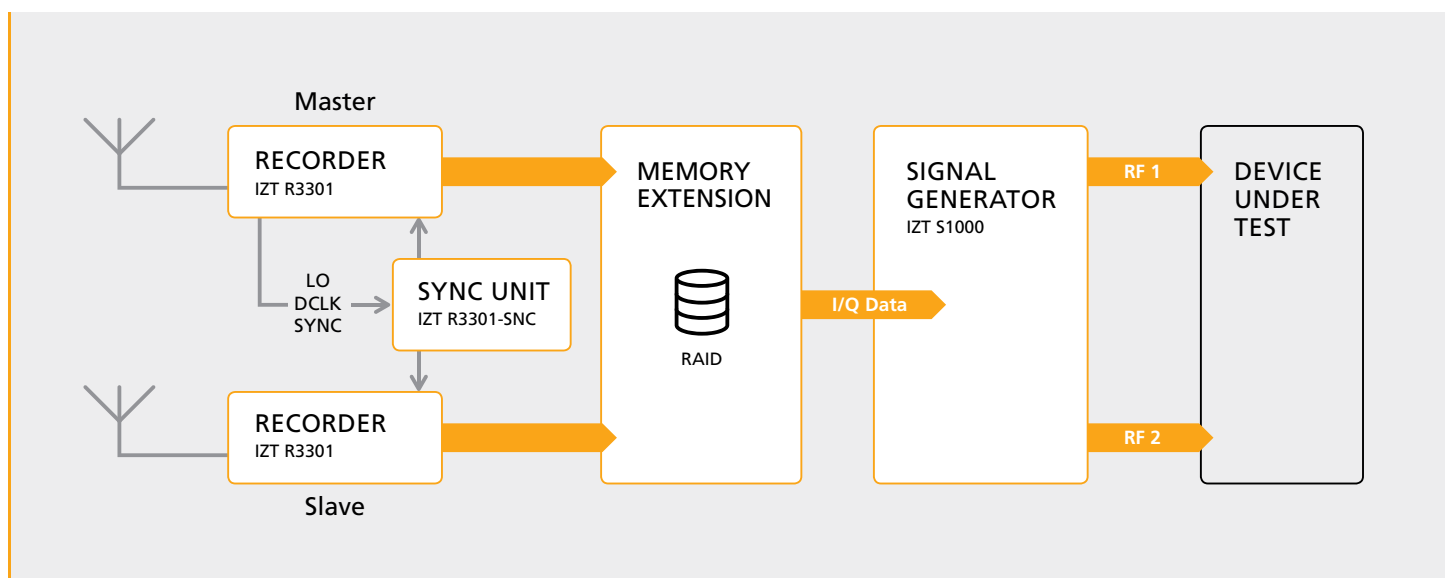


FIGURE 2: IZT REPLAY TWO CHANNEL SYSTEM SETUP FOR DIVERSITY AND MULTI-FREQUENCY SCENARIO

## RECPLAY SYSTEM

The IZT RecPlay record and replay system consists of at least one IZT R3301 RF recorder with integrated high performance RF receiver and built-in sensor controller, a memory extension for data streaming and one IZT S1000 Signal Generator for replay of the recorded IQ data (Figure 1).

An IZT RecPlay system for diversity recording consists of one IZT R3301 RF recorder per antenna and is synchronized by an external clock distribution (Figure 2).

As a common reference clock alone (e.g. 10 MHz) would not be sufficient to ensure that all receivers operate phase synchronously, one master IZT R3301 creates all necessary clock and synchronization signals, like system clock and both VHF/UHF local oscillators, and sends

them to a central clock distribution that amplifies the signals and passes them on to all receivers. A trigger impulse starts the sample-synchronous recording of the system. Intercommunication between master and slaves of the built-in servers is controlled via optical LAN interface to minimize EMI. The built-in GPS receiver of the master serves as time and location reference.

If necessary, a calibration signal can be coupled into the antenna feeds, which allows to establish zero phase shift between the antenna inputs. The captured data streams of up to approximately 120 MB/sec are sent via internal GB Ethernet to each built-in server and is stored on an integrated RAID system.

Figure 3 shows the block diagram of the recording system configured for two diversity signals. The system is modular and can be expanded up to eight antenna signals.

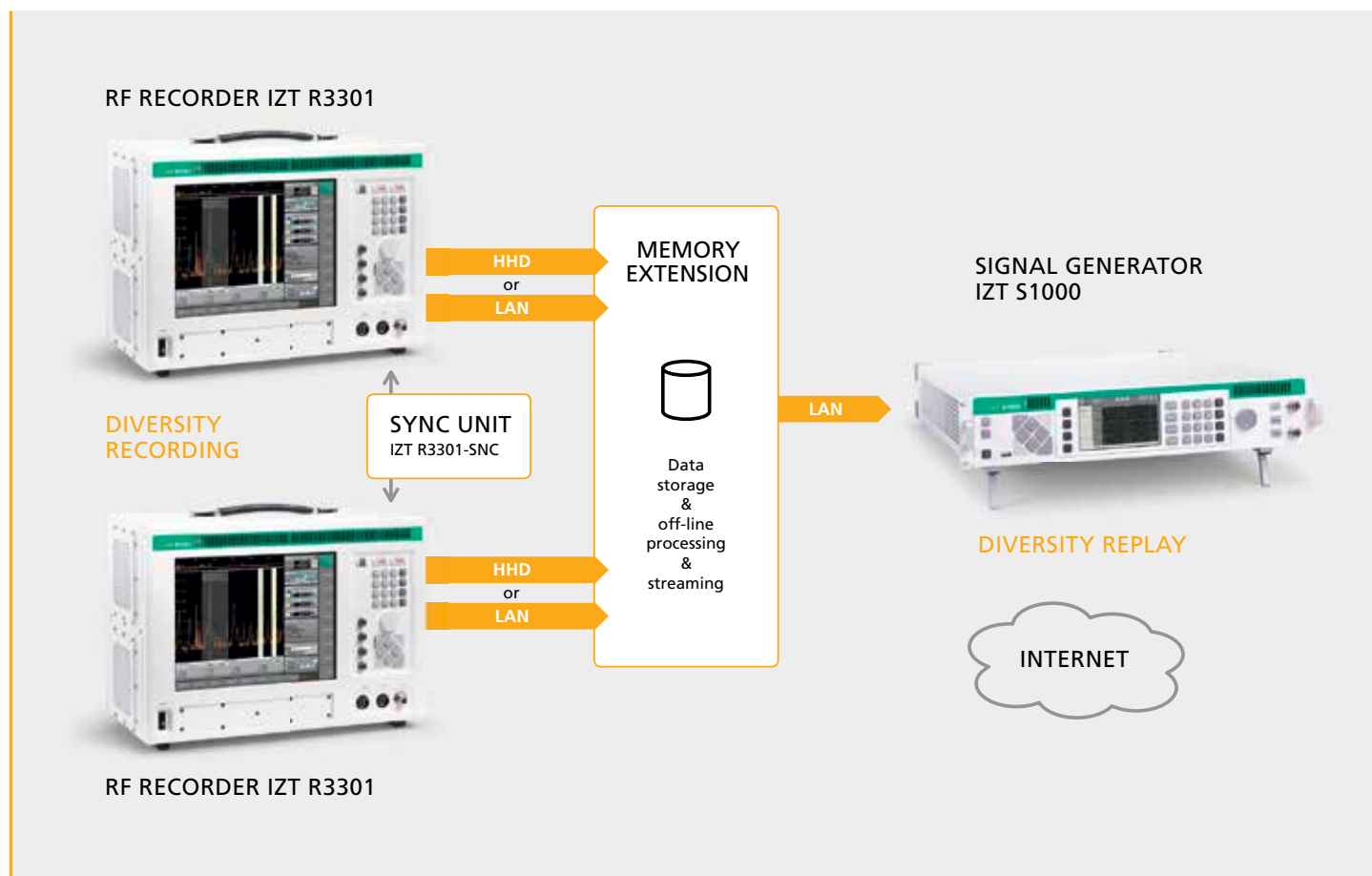


FIGURE 3: IZT RECPLAY DIVERSITY SETUP WITH STREAMING SERVER FOR DATA POST PROCESSING

# Recording system

## IZT R3301 RF RECORDER

The IZT R3301 RF recorder is a portable receiver with built-in server for data recording. It is optimized for recording RF signals in mobile and portable applications.

The outstanding RF performance and signal processing matches the professional IZT R3000 receiver series. These receivers were developed for applications of regulatory agencies, military and civilian radio surveillance and as lab test equipment.

The system is designed to produce good signal quality under extreme dynamic range and has successfully passed many rigorous technical evaluations with civilian and military customers.

With its very high dynamic range (Figure 4) and excellent phase noise this receiver platform is the ideal solution for the needs of modern digital modulation standards.

Thanks to its front panel control, touch screen and integrated processing hardware, the IZT R3301 RF recorder is the perfect portable RF recording system. While having a compact and rugged design, it also meets CISPR 25 / EN 55025 for extremely low RF emissions. The wide range AC and DC power supply is completed by an uninterrupted power supply (UPS) for surge & sub voltage protection against DC supply fluctuations.

An internal GPS module adds location information to the received signals.

The IZT R3301 is characterized as follows:

- Portable, rugged design: 45x35 x 24 cm, approx. 17 kg
- Continuous IQ data recording with up to 30 MSamples/s
- Swappable RAID system (Figure 5) for about 11 hours of continuous recording with 24 MSamples/s in 4 TB configuration
- Built-in GPS for embedded location information
- 10 to 30 V DC power supply, approx. 125 W
- 100 to 240 V AC supply with built-in UPS
- Control via touch screen
- Synchronization interface for diversity and multi-frequency recording (Figure 6)
- Low RF emissions, meets EN 55025 / CISPR 25
- Built-in high-end IZT R3000 receiver technology

The outstanding RF performance of the integrated IZT R3000 receiver technology is based on a very modern

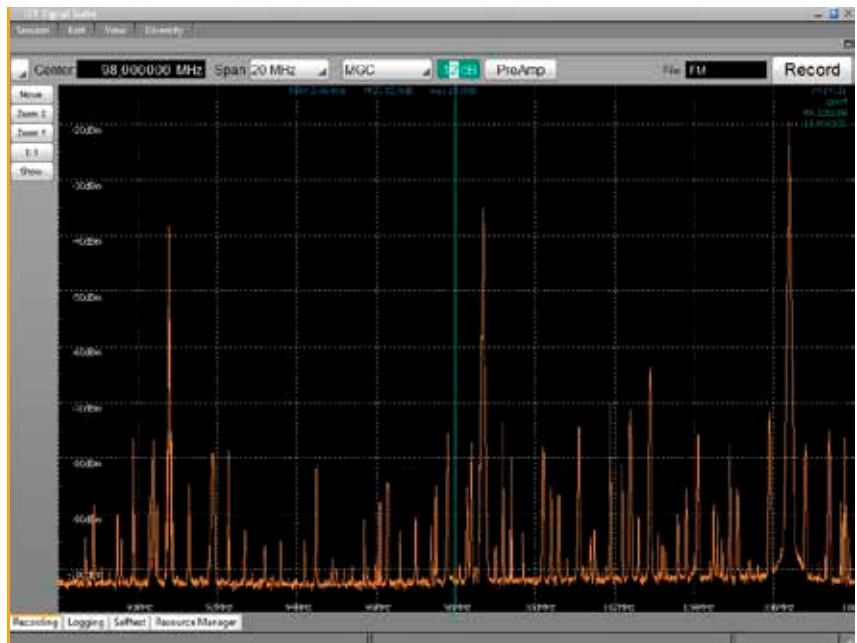


FIGURE 4: FM BROADCAST RECORDING WITH HIGH DYNAMIC RANGE



and market proven receive system with excellent reception at very good signal quality. It is highly insensitive to strong adjacent band interference due to sub-octave pre-selector filters and high first intermediate frequency.

The integrated IZT R3000 receiver is characterized as follows:

- 9 kHz to 3 GHz frequency range
- Frequency range upgradeable up to 18 GHz
- Real-time bandwidth up to 25 MHz
- Very low phase noise
- High linear RF frontend for excellent IP3 performance
- Pre-selector filter bank guarantees best IP2 performance
- Additional digital filtering
- IF Filter bandwidth: 6.25 kHz to 25 MHz
- 1 Hz tuning resolution
- Multichannel recording of up to 4 different sub-bands simultaneously

An external synchronization unit (Figure 7) provides phase coherent clock to multiple IZT R3301 RF recorders in diversity or multi-frequency setups.

It can be enhanced by a calibrated signal source (connected directly at the junction plane of the antenna connectors) in test scenarios which require phase matching between the antennas.

Remote connection between multiple recorder units is made via optical LAN interface to prevent electromagnetic interference. An optical LAN converter allows for complete remote control of a single IZT R3301 unit over longer distances without EMI problems, for example in a highly sensitive RF measurement setup inside an EMI chamber.

## APPLICATION EXAMPLE 1: DIVERSITY ANTENNA SETUP

The system is ideal for handling phase coherent and frame synchronous recordings with multiple antennas at the same center frequency, e.g. for validation of FM broadcast diversity-tuners.

This challenging use case requires a very high accuracy in signal and data processing of the record and replay system.



FIGURE 5: EASY RAID STORAGE SWAPPING

## APPLICATION EXAMPLE 2: MULTI-FREQUENCY ANTENNA SETUP

The system also fits perfectly into handling frame synchronous recording with multiple antenna channels at different center frequencies. This is an important use case for automotive customers for testing seamless DAB to FM linking in the field.

The setup allows also to record DAB and DVB or the GPS satellite signal and any other service at the same time.

Application example 1 and 2 can be combined for covering both a phase coherent FM broadcast diversity and also frame synchronous DAB recording by using a IZT RecPlay setup consisting of three synchronized RF recorders IZT R3301.

## APPLICATION EXAMPLE 3: GNSS MONITORING & INTERFERER CAPTURE

The system is a perfect platform for long-term GNSS (Global Navigation Satellite System) spectrum band monitoring and automated selective high-dynamic range IQ data capture: trigger events caused by interferers defined by spectrum mask criteria are automatically starting the wide-band IQ recording process of both the interferer itself and the GNSS services.

The recorded signals can be replayed with the IZT S1000 Signal Generator and fed to a GNSS reference receiver for evaluation. The file-based pre-recording ensures that this receiver will have sufficient time to acquire lock before the interference event.



FIGURE 6: EXTERNAL INTERFACES FOR POWER SUPPLY, LAN, GPS ANTENNA AND SYNCHRONIZATION



FIGURE 7: SYNCHRONIZATION UNIT IZT R3301-SNC

# Other IZT RF Recorder Platforms

## RF RECORDER SETUPS WITH IZT RECEIVERS

### IZT R3410 & IZT R3411



Small size mobile single channel RF recording systems can be provided by combining IZT R3410 or IZT R3411 receivers with external light-weight sensor controllers and IZT Signal Suite recorder applications. Mobile sensor controllers based on notebooks are available in different ready-to-use configurations specified by IZT to customer requirements.

The compact variant of the successful R3000 series combines a limited weight of less than 7 kg with a fanless design suited for harsh environments by maintaining the excellent RF performance and a real-time bandwidth of 24 MHz. While the IZT R3410 can provide frequency coverage from 9 kHz up to 18 GHz, the IZT R3411 is further reduced in size and weight below 5 kg covering either HF or VUHF (20 MHz ... 3 GHz) frequency ranges.

### R4000



If the real-time bandwidth of IZT R3000 based RF recorders is not sufficient for the signals of interest, IZT offers a new type of wide-band RF recorders based on the groundbreaking IZT R4000 receiver technology and IZT Signal Suite recorder applications. This system can handle recordings of one or multiple sub-bands inside an instantaneous bandwidth of 120 MHz with outstanding RF performance at frequency ranges up to 18 GHz.

### IZT R3600



Multiple recording channels can be captured simultaneously with set-ups consisting of external IZT Sensor Controllers and IZT Signal Suite recorder applications with the IZT R3600 receiver platform.

The IZT R3600 offers up to five channels with 24 MHz instantaneous bandwidth each and covers the frequency range from 9 kHz to 3 GHz or even 6 GHz. The innovative multi-channel receiver system enables users to combine phase-coherent and/or multi-frequency RF recordings by choosing common or individual reference clock per channel. The scalable multi-channel receiver system with integrated frequency and clock conditioning reduces the number of external devices and minimizes overall system costs.

The compact design in one 19-inch, 8 U chassis combined with external powerful 19-inch, 2 U IZT Sensor Controllers facilitates easy transport and set-up.

### R3302

The IZT R3302 is the more ruggedized, display-less variant of the IZT R3301 RF recorder. Like the IZT R3301 it comes with an built-in sensor controller and integrated data storage configuration, a wide-range DC supply with UPS and a built-in GPS module.



# Replay system



## IZT S1000 MULTICHANNEL SIGNAL GENERATOR

Replay of the RF signals is done with signal generator IZT S1000. Contrary to most signal generators available today, the IZT S1000 has been specifically designed to replay complex signals comprising a large number of individual carriers.

The IZT S1000 is characterized as follows:

- 9 kHz to 3 GHz frequency range
- 120 MHz bandwidth
- 31 Virtual Signal Generators (independent VSG channels)
- Dual RF outputs support diversity replay for two antennas
- Phase synchronous replay of diversity signals
- Continuous data streaming of 225 MB/s from the IZT S1000 Memory Extension
- Sharing of the available streaming capacity among all signals
- Real-time impairment simulation (fading channel simulation, time variant signal profiles, shaped noise source, nonlinearity and filter simulation, phase noise)
- Modulators for DAB, DAB+, DMB, DRM 30, DRM+, XM, Sirius, HD Radio
- Universal ARB function with up to 8 GB RAM
- Easy to use compact setup

Figure 8 shows a setup for playing two diversity signals with a maximum bandwidth of 120 MHz.

The setup can be expanded easily to a system with more diversity channels by combining multiple externally synchronized IZT S1000 Signal Generators.

For the most demanding applications, data can be streamed from the external IZT S1000 Memory Extension (Figure 10) directly into the FPGA via dual Gbit LAN.

All kinds of signals for radio testing and any IQ signals of variable sample rate, as well as multiple signals, can be streamed at the same time to the signal source.

Dedicated LAN connections via the dual Gbit LAN port make it possible to stream up to 225 MB/s. The available streaming resources can be shared among all streamed Virtual Signal Generators. Also the direct replay of a two-channel diversity recording of the complete FM broadcast band is possible.

Additional signals can be generated from the internal 4 GB memory while wide-band signals are streamed from the external IZT S1000 Memory Extension.

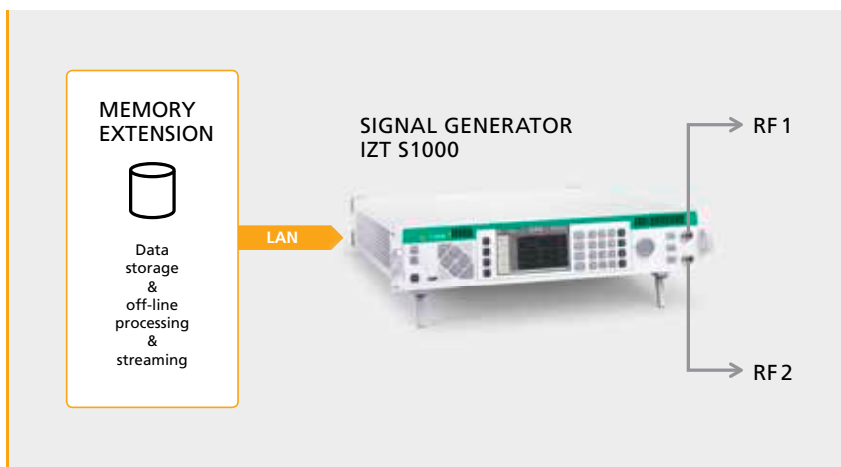


FIGURE 8: PLAYER FOR DIVERSITY SIGNALS, USING A SINGLE IZT S1000 WITH TWO RF OUTPUTS

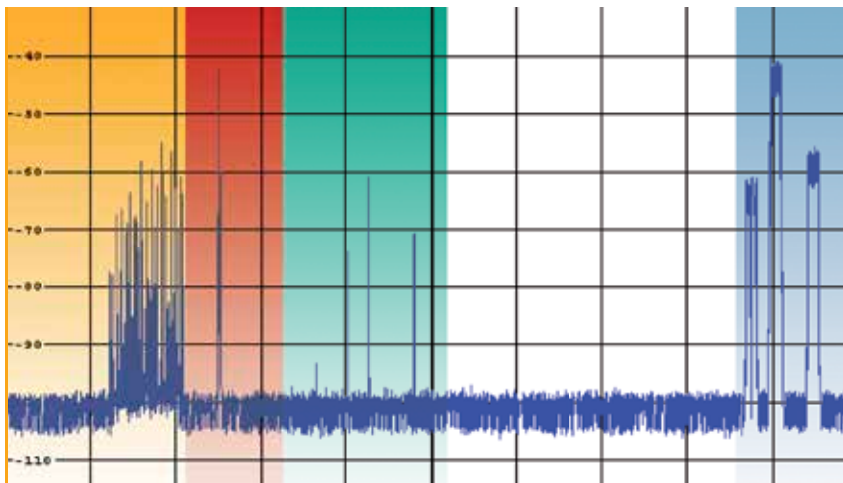


FIGURE 9: SYNTHESIZED 120 MHz SPECTRUM CONSISTING OF DIFFERENT SIGNAL TYPES



The IZT S1000 supports a great number of relevant modulation standards. This enables users to rapidly develop custom applications for research, design, charac-

terisation, validation and testing communications systems and components that modulate or demodulate signals.



FIGURE 10: IZT S1000 REPLAY SETUP WITH IZT S1000 MEMORY EXTENSION+ STREAMING SERVER AND REAL-TIME GPS MAP VISUALIZATION

	Signal 1		Signal 2		Signal 3		Signal 4	
Format	IZT R3000		IZT R3000		IZT R3000		HD Radio FM	
Sampling Rate	24000000.00000 Hz		24000000.00000 Hz		24000000.00000 Hz		744187.50000 Hz	
	Memory		Memory		Memory		Memory	
Filename	Choose a file ...		Choose a file ...		Choose a file ...		IB_FM230a_e1vfr1006.bin	
Length	0.000 s		0.000 s		0.000 s		23.777 s	
Skip & Duration	0.000 s	-1.000 s	0.000 s	-1.000 s	0.000 s	-1.000 s	0.000 s	-1.000 s
Delay	0.000 ns		0.000 ns		0.000 ns		0.000 ns	
	Harddisk		Harddisk		Harddisk		Harddisk	
Filename	Erlangen_OG_FM-Diversity_20150820.cbb		Erlangen_OG_FM-Diversity_20150820.cbb		Erlangen_OG_DAB_20150820.cbb		Choose a file ...	
Length	21.162 s		21.162 s		21.162 s		0.000 s	
Skip & Duration	0.000 s	-1.000 s	0.000 s	-1.000 s	0.000 s	-1.000 s	0.000 s	-1.000 s
Streaming Time	Immediately		Immediately		Immediately		Immediately	
Streaming Offset	0.000 ns		0.000 ns		0.000 ns		0.000 ns	
Loops	0	-1	0	-1	0	-1	0	-1
Time	0.000 s	21.162 s	0.000 s	21.162 s	0.000 s	21.162 s	0.000 s	0.000 s
Programs								
Source	Harddisk		Harddisk		Harddisk		Memory	
Mode	On		On		Off		On	
Impairments	Off	1	Off	1	Off	1	Off	1
Output	RF1		RF1		RF1		RF1	
	RF 1	RF 2	RF 1	RF 2	RF 1	RF 2	RF 1	RF 2
Frequency Name	Select ...	Select ...	Select ...	Select ...	DABSA	DABSA	Select ...	Select ...
Frequency	97.750000000 MHz	97.750000000 MHz	97.750000000 MHz	97.750000000 MHz	181.936000000 MHz	181.936000000 MHz	91.300000000 MHz	91.300000000 MHz

FIGURE 11: IZT S1000 GUI STREAMING MULTIPLE VSG SIGNALS WITH VARIABLE BANDWIDTHS AT INDIVIDUAL CENTER FREQUENCIES AND POWER LEVELS

# IZT Signal Suite – Data Processor

The IZT Signal Suite RecPlay Data Processor is a powerful unique data processing software that allows to review and edit recorded data in off-line mode:

- Fast interactive display of spectrum and spectrogram
- Display of meta data information, e.g. recorder settings, GPS location information.

The IZT Signal Suite RecPlay Data Processor can be used to extract or combine individual signals from a recording which means easy to use cut, copy, paste & merge functionality of RF signals in time and frequency domain:

- Extraction of time segments of a recording
- Extraction of signals in spectrogram (time and frequency) and conversion of the signal into a player file with adequate sample rate (Figure 13)
- Deletion of individual signals from a wide-band spectrum (Figure 14)

Moreover concatenation of single recordings in the frequency domain allows to record frequency bands in several adjacent frequency intervals and combine these recordings to a single file with large bandwidth to replay it with IZT S1000 Signal Generator platform.

The IZT Signal Suite export module supports a variety of file formats, such as IQ 12 bit, IQ 16 bit, IQ-WAV, RAW IQ and optional plug-ins for some 3rd party vendor formats. The post processing software includes an export function for Avera (NI) and R&S IQ compatible data formats and plain IQ data. Any signal data can be exported to files to be shared with other users or for later analysis with other tools. Export and import of other data formats can be supported on request.

Several additional plug-in interfaces are available for the IZT Signal Suite RecPlay Data Processor:

- Map visualization interface for embedded GPS NMEA streaming data (Figure 12)
- Analog & digital off-line demodulation from IQ file, e.g. AM, FM RDS & DAB/DAB+
- Mask trigger to find
- Fast zoom & scroll function for viewing & analysis of long-term spectrum-band recordings
- Video/audio camera replay function
- Database client for easy data synchronization with IZT RecPlay Database host application
- Encryption interface for key based IZT S1000 streaming

A separate IZT Viewer application is also available that allows user to view and demodulate exported signal files. It provides comfortable and easy to use handling of IQ data with numerous combinations of marker types in spectrum and spectrogram display - which perfectly supports the analysis of diversity and multi-channel recordings.



FIGURE 12: OFF-LINE VISUALIZATION OF GPS LOCATION INFORMATION

For both off-line post-processing and multi-channel IQ data streaming, IZT provides several server solutions with specially selected components for efficiently handling the sophisticated algorithms of the IZT Signal Suite RecPlay Data Processor with optimum performance.

- Cost effective long-term signal streaming with IZT S1000 Memory Extension+
- Powerful off-line data processing and long-term signal streaming with IZT S1000 Memory Extension+, including 2.5" tray for easy data storage swapping (Figure 10)
- High-capacity data storage servers for Testvector Archive with IZT RecPlay Database, also suitable for powerful off-line data processing and signal streaming based on individual customer requirements



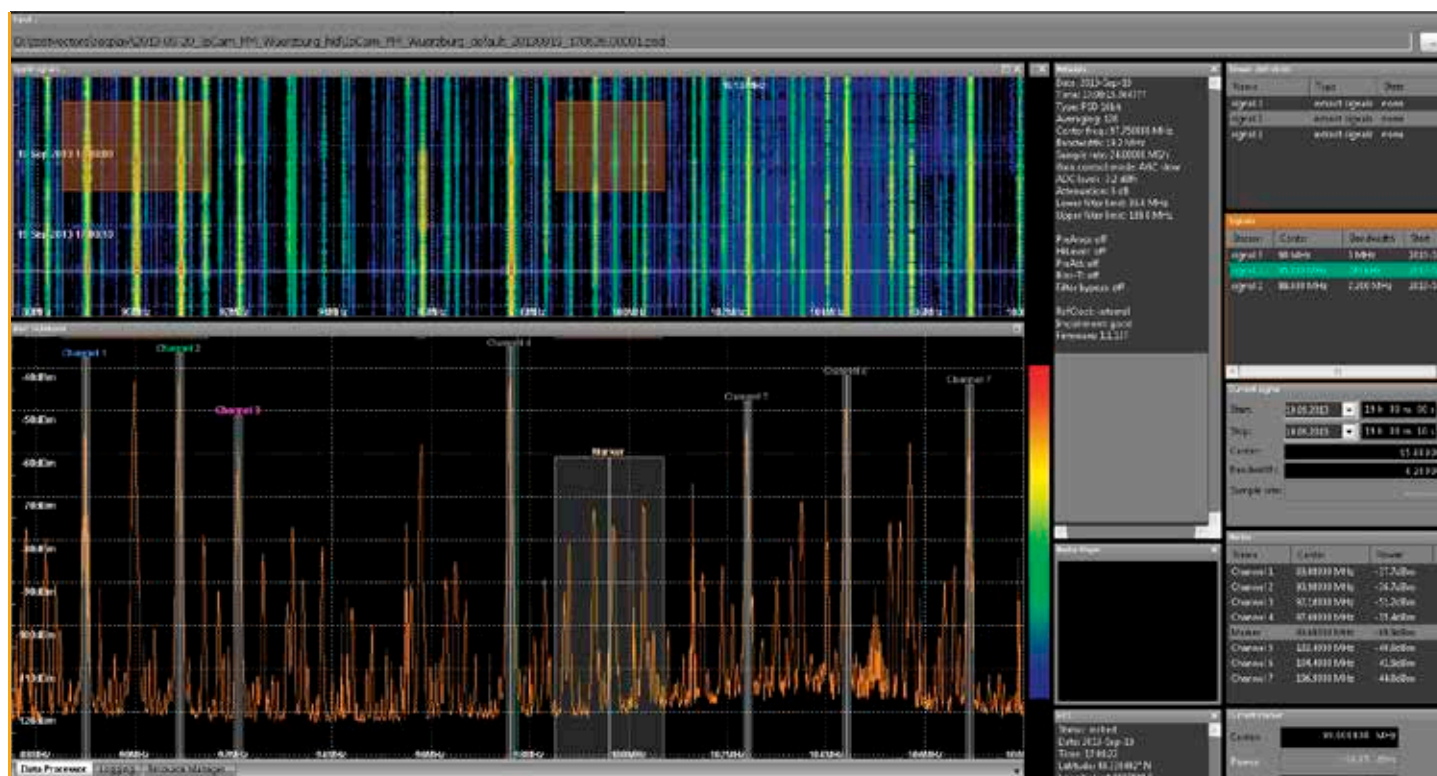


FIGURE 13: EXTRACTING MULTIPLE SIGNALS SIMULTANEOUSLY WITH INDIVIDUAL TIMELINE, BANDWIDTHS AND CENTER FREQUENCIES

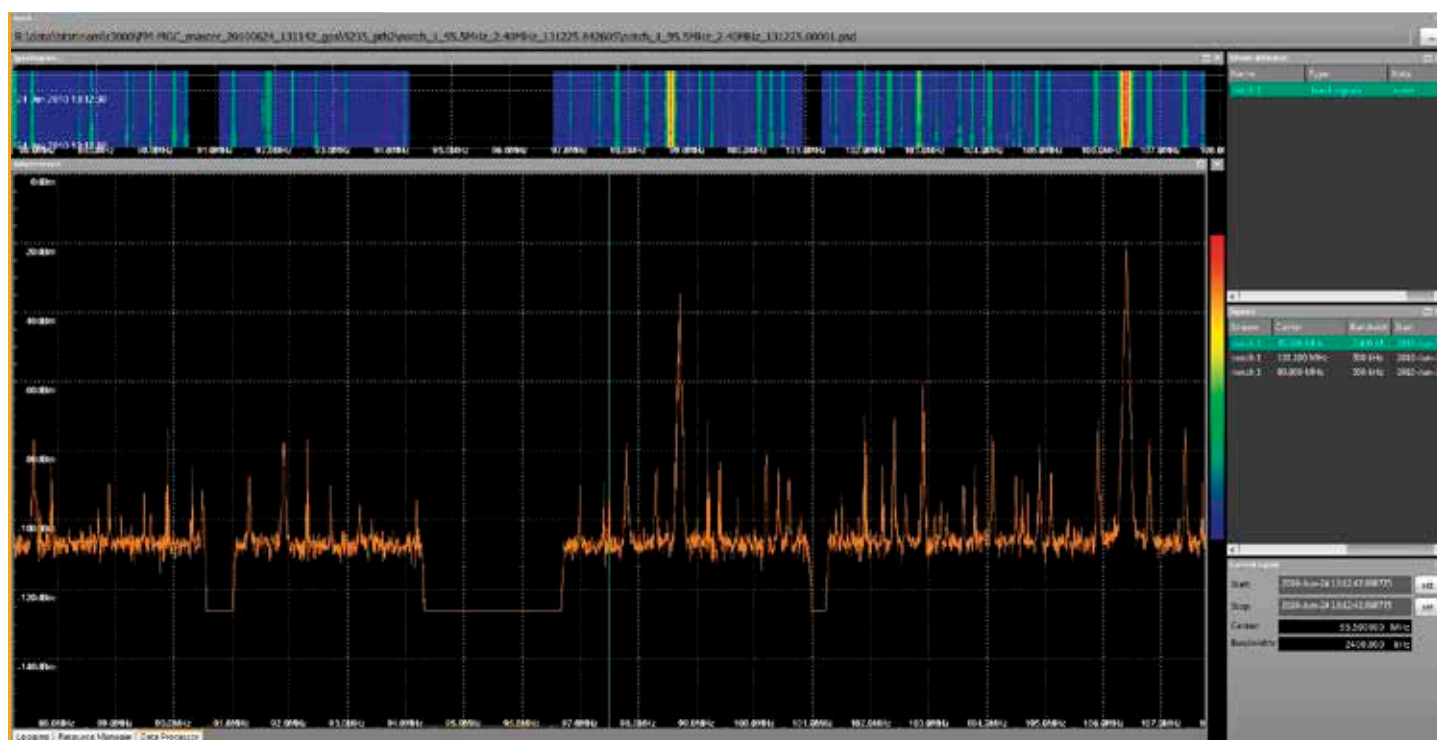


FIGURE 14: BLANKING MULTIPLE SIGNALS WITH INDIVIDUAL BANDWIDTHS AND CENTER FREQUENCIES OF A WIDEBAND FM BROADCAST RECORDING

# IZT Signal Suite – Plug-ins

## TRIGGER-CONTROLLED SIGNAL CAPTURE WITH ADJUSTABLE PRE-RECORDING TIME

Plug-in ‘Mask-triggered recording’ allows capturing live signals from the receiver or capturing signals off-line from recordings with adjustable pre-recording and follow-up time. The trigger event can be defined by power limits exceeding ITU spectrum masks (Figure 15), captured reference traces or external trigger pulses.

In combination with long-term file-based pre-recording this allows e.g. to synchronize GNSS receivers to GPS content without running into trouble regarding chip-set lock time while being replayed with IZT S1000 Signal Generator.

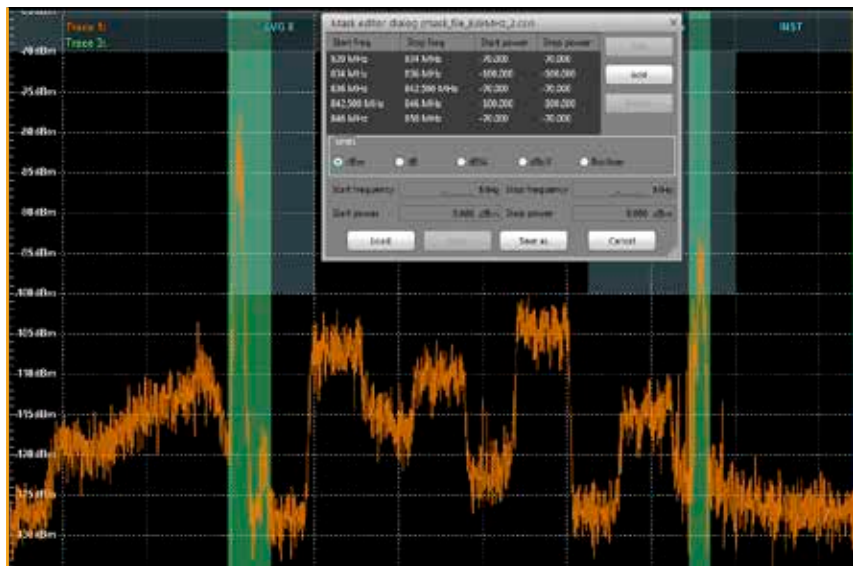


FIGURE 15: MASK TRIGGERED RECORDING

## LONG TERM SPECTRUM-BAND RECORDING

The standard spectrogram is fast enough to show several minutes of PSD data, but users working with long recordings may want an overview over hours (Figure 16), days or even weeks of data in one spectrogram.

The plug-in ‘Long-term spectrogram recording’ is able to show even these enormous amounts of data and update the display in seconds. By zooming within the spectrogram a user can drill down from a high level overview, showing one week of data on a single page, to a microsecond display, showing the maximum possible time resolution of the sensor. All this happens seamlessly, within the same display and with update times that are usually less than one or two seconds.

## PANORAMA SCAN

In frequency ranges beyond the real-time bandwidth of the recorder a continuous scanning functionality provides panorama spectrum or spectrogram display, including rapid frequency zoom. This functionality can also be combined with mask trigger and long-term spectrogram recording.

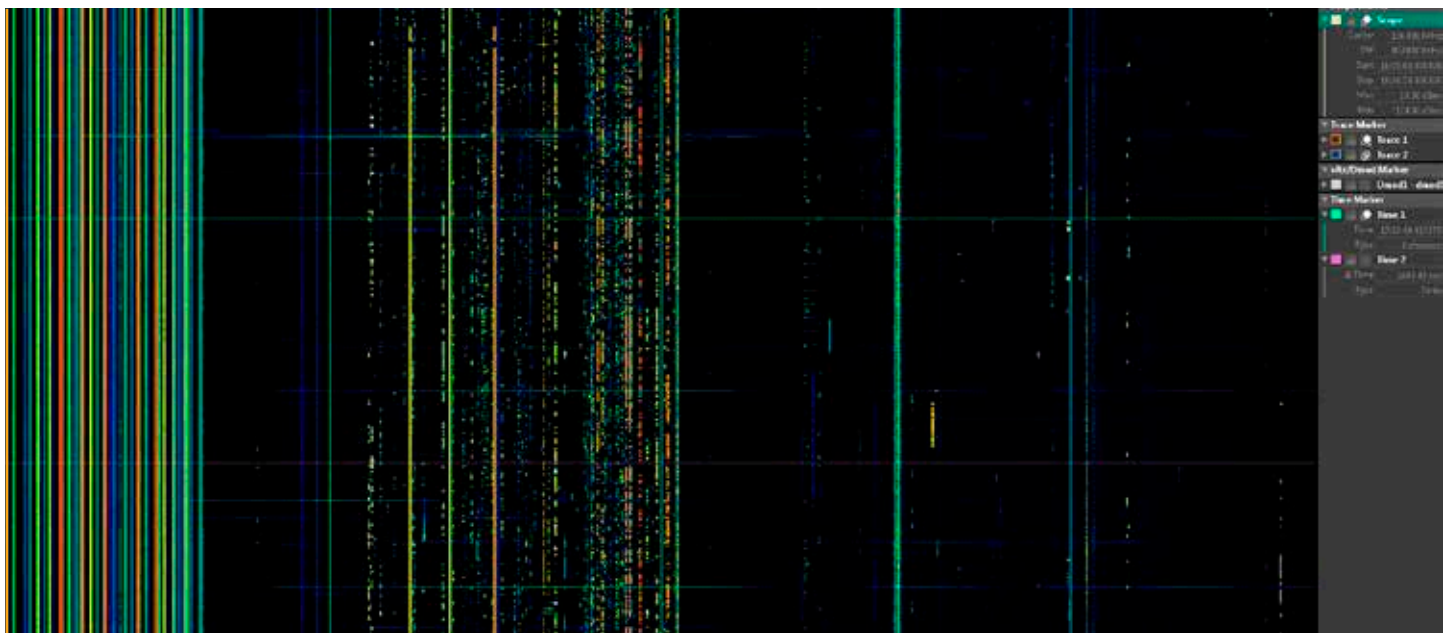


FIGURE 16: LONG TERM SPECTRUM-BAND RECORDING

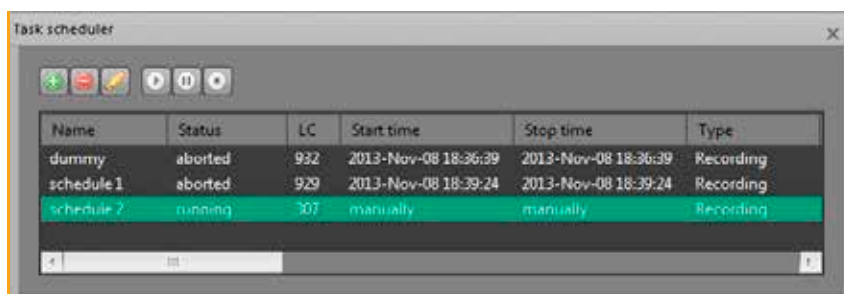
## TIME SCHEDULED RECORDING

Plug-in 'Time scheduled recording' allows time scheduled planning of recording events (Figure 17).

- Time scheduled receiver configuration and recording
- Planned tasks are automatically stored and resumed
- Setup configuration can be selected easily by recalling stored project files
- Configuration of individual parameters such as centre frequency, real-time bandwidth, gain modes, recording name and recording group supported
- Supports multi-channel recording with several receivers and vRx/Dmod sub-bands
- Manual test run functionality allows schedule configuration checking
- Start/stop time and start/length time programming

## VIDEO CAMERA INTERFACE

Plug-in 'Video camera interface' supports synchronous recording and replay of IP based video camera data streams with IZT Signal Suite RecPlay recorder (Figure 18) and off-line post-processing application IZT Signal Suite Data Processor. This allows capturing additional terrain information like traffic situation, building density, and weather conditions in addition to the GPS location information, which is implemented by design inside the IZT IQ metadata data stream.



Name	Status	LC	Start time	Stop time	Type
dummy	aborted	932	2013-Nov-08 18:36:39	2013-Nov-08 18:36:39	Recording
schedule 1	aborted	929	2013-Nov-08 18:39:24	2013-Nov-08 18:39:24	Recording
schedule 2	running	307	manually	manually	Recording

FIGURE 17: TIME TABLE SHOWING PLANNED RECORDING EVENTS INCLUDING STATUS INFORMATION



FIGURE 18: VIDEO CAPTURE WITH RF RECORDER

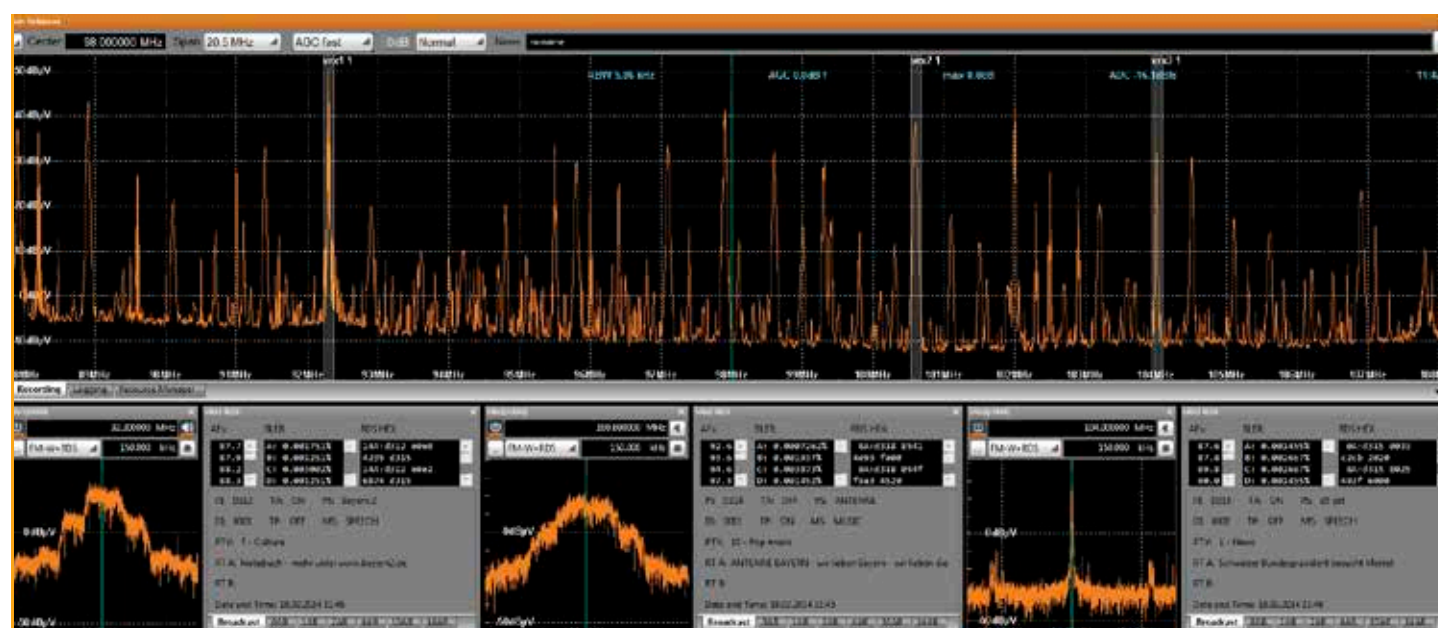


FIGURE 19: SIMULTANEOUS RDS DECODING OF THREE DIFFERENT FM BROADCAST STATIONS



DIGITAL DEMODULATORS

RDS decoding

Plug-in ‘RDS Decoding’ allows comfortable RDS decoding of FM broadcast stations with ‘live’ signals from the receiver (Figure 19) as well as extracting RDS information from file based IQ data streams with post-processing application IZT Signal Suite Data Processor.

- RDS decoding of FM broadcast stations including enhanced RDS group information for all relevant information
- Decoding live signals with IZT RecPlay recorder & IZT R4000 GUI
- Simultaneous multi-channel decoding due to IZT vRx/Dmod techniques
- File based IQ data off-line decoding with IZT Data Processor
- Export of decoded RDS information into CSV table, binary and hex file

DAB/DAB+ decoding

Plug-in ‘DAB/DAB+ decoding’ enables comfortable DAB/DAB+ decoding of DAB broadcast stations with live signals from the receiver (Figure 20).

Using IZT’s post-processing application IZT Signal Suite Data Processor, users can extract content and quality information from file-based IQ data streams

- Spectrum (phase reference- & null symbol)
- Channel Impulse Response (CIR)
- Constellation diagram
- Level (phase reference- & null symbol)
- Frequency error
- Modulation Error Ratio (MER)
- Ensemble configuration
- FIC
- MSC (per subchannel individually)
- Audio decoding

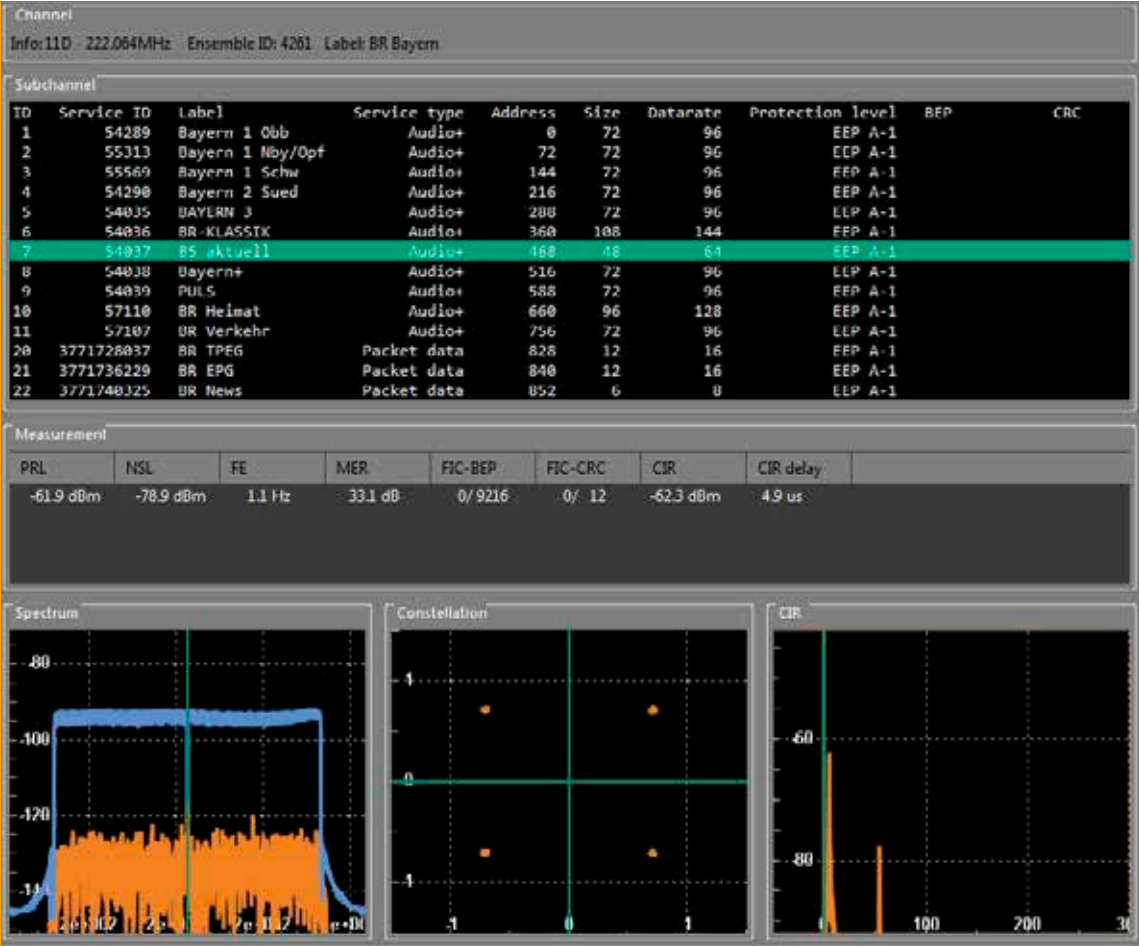


FIGURE 20: DAB/DAB+ ENSEMBLE WITH MEASUREMENT PARAMETERS

# Testvector Archive

## HIGH-CAPACITY STORAGE SOLUTION

Over time IZT RecPlay power users are collecting a massive amount of captured signal data - especially when it comes to creating a test-vector archive, like needed for storing data of numerous test drives with different signal content or the high data rates of wide-band multi-channel or sub-band recorder setups. For this purpose IZT offers high-capacity high-performance storage solutions with fast data transfer capabilities via fiber optic 10 Gbit Ethernet. A typical setup starts with a net storage capacity of 54 TB in data protecting RAID-6 configuration. This basic setup can be enhanced easily in 8 steps to a full capacity of up to 486 TB.

If needed the high-capacity storage configuration can also be enhanced by a suitable optical switch to split several testvectors from the archive to multiple memory extensions of IZT S1000 replay setups.



**Record time (UTC):** 20.09.2013 10:38:38  
**Record time (local):** 20.09.2013 12:38:38  
**Duration:** 00:09:13  
**Type:** PSDt 16bitLE2  
**Averaging:** 128  
**Center frequency:** 98,000 MHz  
**Bandwidth:** 19,200 MHz  
**Sample rate:** 24,00000 MS/s  
**Gain control:** AGC fast  
**ADC overload:** n/a  
**ADC level:** -16,1 dB  
**Attenuation:** 0  
**Lower filter limit:** 86,0 MHz  
**Upper filter limit:** 109,0 MHz

**PreAmp:** off  
**HiLevel:** off  
**PreAtt:** off  
**Bias-T:** off  
**Filter bypass:** off

**RefClock:** internal  
**RecGroup:**  
**Impairment:** good  
**Firmware:** 1.1.137  
**DataEncrypted:** off

## IZT SIGNAL SUITE – DATABASE

With an increasing number of recorded signals the need of finding signals with a certain content and properties out of a huge amount of data files arises. Therefore IZT Signal Suite Database provides easy finding of signal streams on huge storage drives of RF recorders, replay setups and high-capacity data archives by filtering key criteria like file properties, IQ metadata and tagging information.

In addition to IQ metadata such as center frequency, bandwidth and other receiver settings (Figure 21) the operator can manually add tag information describing the recording setup and his intention about the content, as for example, operator name, location, single channel, diversity or multi-channel setup, signal content and purpose of the recording or test-drive (Figure 22).

The IZT Signal Suite Database is available in two different flavors: a stand-alone application running on a single storage system or a network configuration which supports synchronization with one host application running on the high-capacity storage system and multiple clients running on one or multiple replay setups or recorders.

**Description:** IP Camera Testdrive  
**Country:** Deutschland  
**State:** Bayern  
**City:** Erlangen  
**Timezone:** Europe/Berlin  
**Location:** Tennenlohe - Großgründlach - Tennenlo  
**Company:** IZT Labs  
**Operator:** Stefan  
**Setup:** single unit  
**Mobility:** static  
**Antenna:** passive omni  
**Amplifier:** none  
**Content:** FM-W  
**Channel:** FM broadcast 87.5 ... 108.0 MHz  
**Purpose:** other  
**Vehicle:** VW Touran  
**DUT:** IZT RecPlay Setup  
**Remarks:** Circuit Testdrive with IP Camera  
**Status:** -  
**Release:** once-only  
**Approved:** true

FIGURE 21: EMBEDDED IQ METADATA

FIGURE 22: TAGGING INFORMATION

# Specifications IZT R3301 RF Recorder

Technical Specifications		
Frequency range	HF	9 kHz to 30 MHz <sup>1)</sup>
	VUHF	20 MHz to 3 GHz <sup>2)</sup>
Conversion concept	9 kHz to 30 MHz <sup>1)</sup> (HF)	Direct sampling
	20 MHz to 3 GHz <sup>2)</sup> (VUHF)	Double superheterodyne conversion
RF input	Impedance	50 Ohm
Maximum input power	HF	+20 dBm, +30 dBm with input attenuator active
	VUHF	+15 dBm
Tuning resolution	HF, VUHF	1 Hz
VSWR	HF, VUHF	< 2.1
Tuning accuracy	HF, VUHF	< 0.2 Hz
Reference frequency	HF, VUHF	10 MHz internal/external
Internal reference frequency	HF, VUHF	< 1 · 10 <sup>-7</sup>
Input sensitivity	HF: 100 kHz to 30 MHz	-120 dBm @ 3 kHz BW
	@ S/N = 10 dB	-111 dBm @ 25 kHz BW
	VUHF: 20 MHz to 3 GHz	-114 dBm @ 3 kHz BW
	@ S/N = 10 dB	-105 dBm @ 25 kHz BW
		-92 dBm @ 500 kHz BW
Oscillator phase noise	HF	-130 dBc/Hz typical @ 1 kHz offset
		-140 dBc/Hz typical @ 10 kHz offset
	VUHF	-120 dBc/Hz typical @ 10 kHz offset
Sweep time	HF, VUHF	< 3 ms typical
Scanning speed	HF, VUHF	> 4 GHz/s, linear
		> 175 GHz/s, within 24 MHz bandwidth
Input IP3	HF	+40 dBm, typical
	VUHF	+24 dBm, typical (low distortion mode)
		+13 dBm, typical (normal mode)
Noise figure	HF	9 dB typical
	VUHF	10 dB, typical (low noise mode)
		15 dB, typical (normal mode)
IF rejection	HF	not applicable
	VUHF	> 120 dB typical
Image rejection	HF	not applicable
	VUHF	> 110 dB typical
Oscillator reradiation at antenna input	HF	not applicable
	VUHF	< -110 dBm
Preselector	HF	12-band
	VUHF	11-band
IF bandwidth	HF, VUHF	6.25 kHz to 24 MHz

<sup>1)</sup> DEGRADED PERFORMANCE: 9 KHZ TO 500 KHZ

<sup>2)</sup> DEGRADED PERFORMANCE: 20 MHZ TO 30 MHZ

Signal generation	
<b>Operating system</b>	Windows 7 (64 bit)
<b>Integrated hard disk</b>	2.5" SATA system disk 500 GB
<b>Internal memory</b>	8 GB
<b>Data representation</b>	Data format: 16/32 bit IQ with embedded IZT CBB metadata information
<b>Output sample rate</b>	variable up to 30 MSamples/s
<b>Data storage</b>	4 x 2.5" SATA HDD or SSD, removable tray; 4 TB RAID system by default
<b>Recording modes</b>	stand alone, diversity, multi-frequency
<b>Gain control</b>	AGC fast/slow with adjustable ADC backoff and deadband, MGC

Interfaces		
<b>Antenna input</b>	HF, VUHF	N, female, 50 $\Omega$
<b>Data storage system</b>	SATA tray	4 x 2.5" HDD or SSD, 9.5 mm height, removable
<b>LAN</b>	GB LAN	RJ45, CAT 6
	GB LAN, optical	LC-Duplex
<b>USB</b>	2 x USB 2.0	
<b>GPS antenna</b>	Input	SMA, female, 50 Ohm
	Active biasing	< 60 mA @ 3 V DC
<b>Synchronization</b>	Input	3 x SMA, female, 50 $\Omega$ (DCLK, 2 VUHF LO)
	Output	3 x SMA, female, 50 $\Omega$ (DCLK, 2 VUHF LO)
<b>Trigger pulse</b>	Input	SMA, female, CMOS 3.3 V (5 V tolerant input)
	Output	SMA, female, CMOS 3.3 V
<b>Reference input</b>	10 MHz	SMA, female, 50 $\Omega$
<b>Remote control</b>	D-SUB 9, female	

General data	
<b>Operating temperature</b>	0° to +40°C
<b>Storage temperature</b>	-20°C to +60°C
<b>Humidity</b>	max. 85%, non-condensing
<b>EMI / EMC</b>	CISPR 22 / CISPR 25 (EN 55022 / EN 55025)
<b>MTBF</b>	> 70.000 hrs
<b>Power supply</b>	AC: 100–240 V, 47–63 Hz, 240 VA, DC: 10–30 V, approx. 125 W
	UPS: Li-Ion, 99,9 Wh; approx. 20 min. recording, 25 min. measurement
<b>Dimensions (WxHxD)</b>	450 x 347 x 234 mm
<b>Weight</b>	approx. 17 kg

Frequency range extension	IZT R3301-RF6	IZT R3301-RF18
<b>Frequency range</b>	3 GHz to 6 GHz	3 GHz to 18 GHz
<b>RF input</b>	50 Ohm <sup>3)</sup>	50 Ohm
<b>Maximum input power</b>	+15 dBm	+10 dBm
<b>VSWR</b>	< 2.1	< 2.1
<b>Oscillator phase noise</b>	-120 dBc/Hz typical @ 10 kHz offset	-114 dBc/Hz typical @ 10 kHz offset
<b>Sweep time</b>	< 3 ms typical	10 ms
<b>Scanning speed</b>	> 4 GHz/s, linear	> 1.5 GHz/s, linear
	> 175 GHz/s, within 24 MHz bandwidth	> 175 GHz/s, within 24 MHz bandwidth
<b>Input IP3</b>	+18 dBm (normal mode)	+25 dBm (low distortion mode)
	+2 dBm (low noise mode)	+15 dBm typical (low noise mode)
<b>Noise figure</b>	7 dB, typical (low noise mode, LNA on, maximum gain)	15 dB typical (low noise mode)
	17 dB, typical (normal mode, LNA off, maximum gain)	23 dB, typical (normal mode, LNA off, maximum gain)
<b>IF rejection</b>	> 120 dB typical	> 120 dB typical
<b>Image rejection</b>	> 110 dB typical	> 110 dB typical
<b>Oscillator reradiation</b>	< -110 dBm	< -110 dBm
<b>Preselector filter</b>	8-band	Tracking bandpass filter

<sup>3)</sup> THE RECEIVER'S VUHF ANTENNA INPUT IS USED, ELECTRONIC RF INPUT SWITCH. SPECIFICATION SUBJECT TO CHANGE WITHOUT FURTHER NOTICE.



# Specifications IZT S1000 Signal Generator

RF performance		
Frequency	Range	9 kHz to 3 GHz
	Resolution	0.001 Hz
Instantaneous bandwidth	9 kHz to 30 MHz	30 MHz
	90 MHz to 2940 MHz	120 MHz
Reference	Accuracy	OCXO
	Ageing	$\pm 5 \cdot 10^{-8}$ per year
	Temperature stability	$< \pm 1 \cdot 10^{-8}$
	Warm-up time	10 min
Power level	Maximum output power	+20 dBm (typ.)
	Resolution	0.1 dB
	Uncertainty	$\pm 0.5$ dB from +10 dBm to -50 dBm; $\pm 1.0$ dB below -50 dBm
	Range	-134 dBm to +20 dBm (peak)
	Dynamic range	> 75 dB (typ.)
Spectral purity	Harmonics $f > 30$ MHz	< -30 dBc at +10 dBm
	Harmonics $f < 30$ MHz	< -40 dBc at +10 dBm
	Non harmonics $> 30$ MHz	< -75 dBc (typ.)
	Non harmonics $< 30$ MHz	< -80 dBc (typ.)
Output IP3	< 30 MHz @ 10 dBm two tone signal, 2 MHz spacing	35 dBm (typ.)
	100 MHz @ 10 dBm two tone signal, 2 MHz spacing	40 dBm (typ.)
	1575 MHz @ 10 dBm two tone signal, 2 MHz spacing	34 dBm (typ.)
	2332.5 MHz @ 10 dBm two tone signal, 2 MHz spacing	32 dBm (typ.)
Signal generation		
Integrated hard disk	Size	500 GB
Internal memory	Size	4 GB, 8 GB (optional)
External LAN	Connection	2 x 1000 BaseT UDP/TCP/10 Gbit optical
Channels	Number	up to 31
Data representation	Data format	12/16 bit IQ
	Input sample rate	variable, up to 40 MSamples/s

General data

Power supply, nominal values	Input voltage range: 100 V to 240 V (AC)
	AC supply frequency: 50 Hz to 60 Hz
	Max. input current: 1.4 A (100 V) to 0.6 A (240 V)
EMC	EN 55022, class B, QP, AV
	FCC 47 CFR Part 15, Subpart B, Class B
Environmental conditions	Operating temperature: 0°C to 55°C
	Storage temperature: -40°C to +70°C
Dimensions	19", 2 U, depth 570 mm
Weight	< 12 kg
Recommended calibration interval	2 years

# Specifications IZT S1000 Memory Extension

System specification	IZT S1000 Memory Extension	IZT S1000 Memory Extension+
<b>Operating system</b>	Open SuSE 11.1 (64 bit) or Windows 7 (64 bit)	Windows 7 (64 bit)
<b>CPU</b>	AMD Phenom II X4	Intel Core I7-3820
<b>Internal memory</b>	8 GB	16 GB
<b>Internal system hard disk</b>	250 GB	500 GB
<b>Internal data storage</b>	2 x 6 TB Raid0 system	2 x 9 TB Raid5 system
		4 x 2.5" SATA tray
<b>Optical</b>	DVD-ROM	
<b>External LAN</b>	4 x Gbit high speed	4 x Gbit high speed
<b>Graphical interface</b>	On board	NVIDIA GTX 650
<b>Display</b>	17" TFT	24" TFT
<b>Interfaces</b>	2 x ESATA (Raidcontroller)	2 x ESATA
	8 x USB 2.0	6 x USB 3.0 / 2.0
		4 x USB 2.0 / 1.1
		1 x bluetooth v3.0 & WLAN
<b>Input</b>	USB keyboard, USB mouse	USB keyboard, USB mouse
<b>Width</b>	426 mm (+52 mm incl. ears)	426 mm (+52 mm incl. ears)
<b>Depth</b>	510 mm (+20 mm incl. grips)	510 mm (+20 mm incl. grips)
<b>Height</b>	133 mm	178 mm
<b>Weight</b>	17 kg	25,6 kg

Environmental specifications	
<b>Operating temperature</b>	0°C to 50°C
<b>Storage temperature</b>	-40°C to 70°C
<b>Operating humidity</b>	5% to 95% non-condensing
<b>Storage humidity</b>	5% to 99% non-condensing
<b>Maximum operating altitude</b>	2000 m

# Ordering Guide

IZT RecPlay		
<b>IZT R3301 RF recorder</b> Hardware options	<b>IZT R3301-CHS</b>	IZT R3301 Chassis
	<b>IZT R3301-HF</b>	HF frontend, frequency range 9 kHz ... 30 MHz
	<b>IZT R3301-RF3</b>	VUHF frontend, frequency range 20 MHz ... 3 GHz
	<b>IZT R3301-RF6</b>	Frequency range extension 3 GHz ... 6 GHz
	<b>IZT R3301-RF18</b>	Frequency range extension 3 GHz ... 18 GHz
	<b>IZT R3301-BST</b>	Bias-T
	<b>IZT R3301-OCX</b>	Oven stabilized reference oscillator
	<b>IZT R3301-GSR</b>	GPS synchronous reference (clock)
	<b>IZT R3301-TCS</b>	IZT R3301 transport case (for shipping)
	<b>IZT R3301-CAR</b>	IZT R3301 carrying case (packaging)
	<b>IZT R3301-TCA</b>	Transport case for IZT R3301 accessories
	<b>IZT R3301-SNC</b>	Synchronization kit for two recording units
	<b>IZT R3301-SNC6</b>	Synchronization kit 6 x
	<b>IZT R3301-OLC</b>	Ethernet converter kit
	<b>IZT R3301-SSD</b>	Solid state system disk
	<b>IZT R3301-SDD</b>	Solid state data disk
	<b>IZT R3301-CAM</b>	IP camera kit (requires RecPlay-108)
	<b>IZT R3301-GPA</b>	GPS amplifier
	<b>IZT R3301-LFM</b>	Low noise amplifier FM
	<b>IZT R3301-LDV</b>	Low noise amplifier DAB III
<b>IZT Signal Suite</b> Software Options	<b>IZT RecPlay-100</b>	IZT Signal Suite Data Processor
	<b>IZT RecPlay-107</b>	Encryption interface (plug-in)
	<b>IZT RecPlay-108</b>	IP camera interface (plug-in)
	<b>IZT RecPlay-109</b>	Import for Avera IQ recordings (plug-in)
	<b>IZT RecPlay-110</b>	GPS map visualization (plug-in)
	<b>IZT RecPlay-111</b>	Map conversion (per country package)
	<b>IZT RecPlay-120</b>	RDS demodulator (plug-in)
	<b>IZT RecPlay-130</b>	DAB/DAB+ demodulator (plug-in)
	<b>IZT RecPlay-200</b>	Database server software application
	<b>IZT RecPlay-210</b>	Database client (requires option IZT RecPlay-200)
	<b>IZT RecPlay-220</b>	Database client stand-alone
	<b>IZT RecPlay-300</b>	Recorder
	<b>IZT RecPlay-320</b>	Mask triggered recording (plug-in)
	<b>IZT RecPlay-321</b>	File-based pre-recording (plug-in)
	<b>IZT RecPlay-400</b>	Multichannel-diversity controller (notebook not included)
	<b>IZT RecPlay-500</b>	Viewer

<b>IZT S1000 Signal Generator</b> Hardware options*	<b>IZT S1000-CHS</b>	Chassis and all digital hardware
	<b>IZT S1000-RF3</b>	RF output 3 GHz
	<b>IZT S1000-RFS3</b>	RF synthesizer 3 GHz
	<b>IZT S1000-eSATA</b>	eSATA interface to connect an external HDD to the internal processor
	<b>IZT S1000-8GB</b>	8 GB high speed memory (increases the internal memory from 4 GB to 8 GB)
	<b>IZT S1000-MTX</b>	RF switching matrix
	<b>IZT S1000-MTA</b>	Switching matrix accessories kit
<b>IZT S1000</b> Software options*	<b>IZT S1000-GUI</b>	Graphical user interface
	<b>IZT S1000-LBV</b>	Labview driver
	<b>IZT S1000-110</b>	One Virtual Signal Channel VSG (up to 31 channels are possible)
	<b>IZT S1000-120</b>	High-speed LAN, 2 Gbit ports for streaming data
	<b>IZT S1000-304</b>	Fading channel simulator with fixed delays
	<b>IZT S1000-305</b>	Power level profiles
	<b>IZT S1000-306</b>	Frequency profile / delay profile
	<b>IZT S1000-402</b>	FM RDS: Generation of AM and FM signals from audio waveform files (includes RDS coder)
	<b>IZT S1000-403</b>	DAB modulator
<b>IZT S1000</b> Memory Extension	<b>IZT S1000-413</b>	Spectrum display
	<b>IZT S1000-414</b>	Video playback
	<b>IZT S1000 Memory Extension</b>	Streaming server (monitor and keyboard/mouse included)
	<b>IZT S1000 Memory Extension+</b>	Diversity & data processing server (monitor and keyboard/mouse included)
<b>Service</b>	<b>IZT software support contract</b>	Support of IZT software options
	<b>IZT WE2</b>	Warranty extension to 2 years: Extension of the standard 1 year warranty to 2 years
	<b>IZT WE3</b>	Warranty extension to 3 years: Extension of the standard 1 year warranty to 3 years
	<b>IZT Training</b>	IZT RecPlay training course
	<b>IZT R3301-CLC</b>	Factory calibration, recommended in a 2-year cycle (IZT certificate included)
	<b>IZT S1000-CLC</b>	Factory calibration, recommended in a 2-year cycle (IZT certificate included)



# IZT RecPlay

## The ultimate Record & Replay System for RF signals

**About IZT** The Innovationszentrum fuer Telekommunikationstechnik GmbH IZT specializes in the most advanced digital signal processing and field programmable gate array (FPGA) designs in combination with high frequency and microwave technology.

The product portfolio includes equipment for signal generation, receivers for signal monitoring and recording, transmitters for digital broadcast, digital radio systems, and channel simulators. IZT offers powerful platforms and customized solutions for high signal bandwidth and real-time signal processing applications. The product and project business is managed from the principal office located in Erlangen/Germany. IZT distributes its products worldwide together with its international strategic partners. The IZT quality management system is ISO 9001:2000 certified.

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