Innovationszentrum
Telekommunikationstechnik

IZT S1000 / IZT S1010

Options

Version 1.31

Content

1. IZT S1000 multi-channel signal source

The IZT S1000 is a novel concept of a RF signal generator. It is capable of simultaneously generating multiple test signals of different standards. This functionality is combined in a single generator resulting in substantial cost savings for the user and providing enhanced testing capabilities which could not be achieved with standard test equipment.

Up to 31 independent signals can be synthesized in real-time and distributed within 120 MHz instantaneous bandwidth.

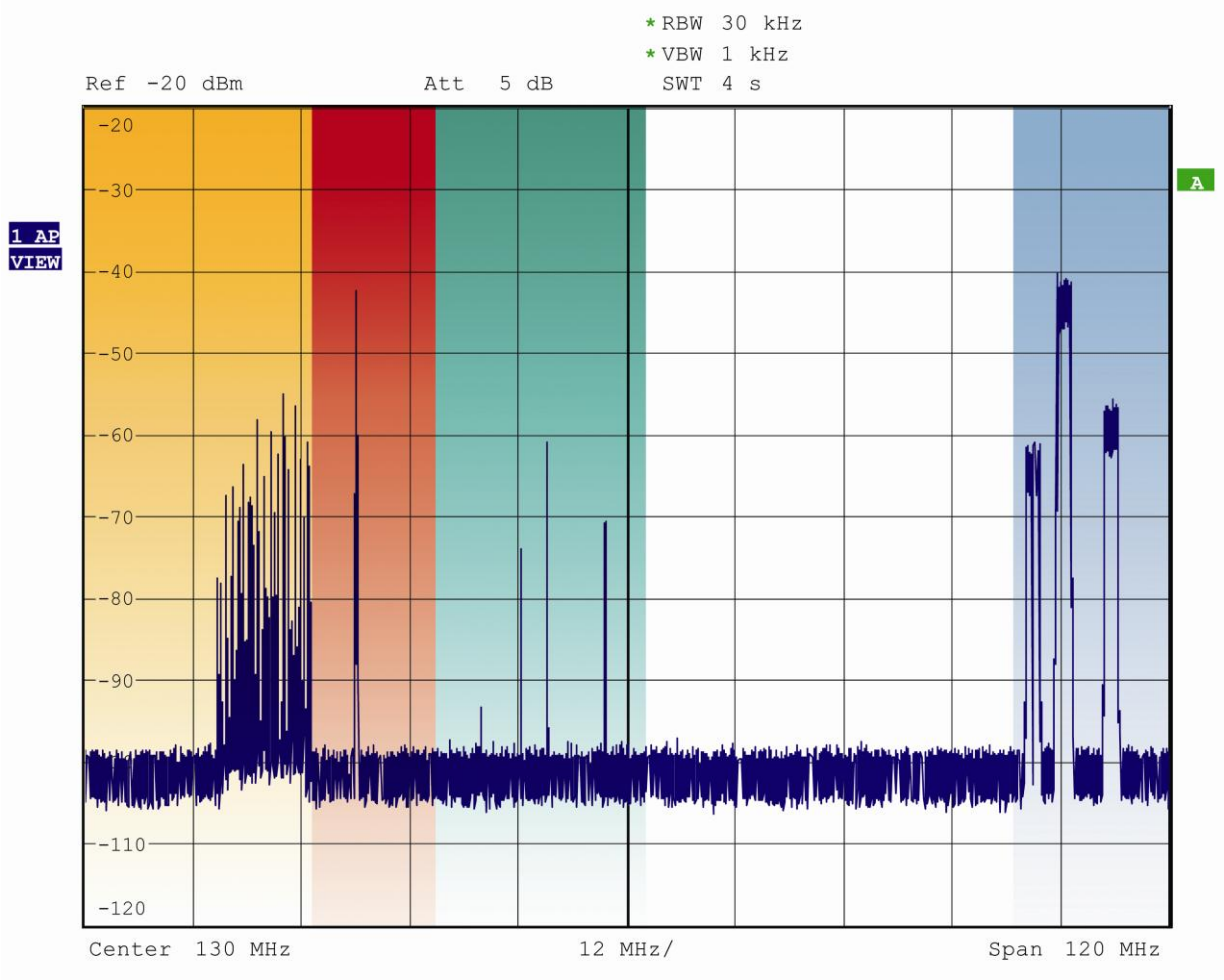


figure 1: Multiple signals within 120 MHz instantaneous bandwidth

The properties of the signals can be changed in real-time without the need for time consuming offline synthesis and upload.

The generic block diagram of the IZT S1000 signal processing is shown in figure 2.

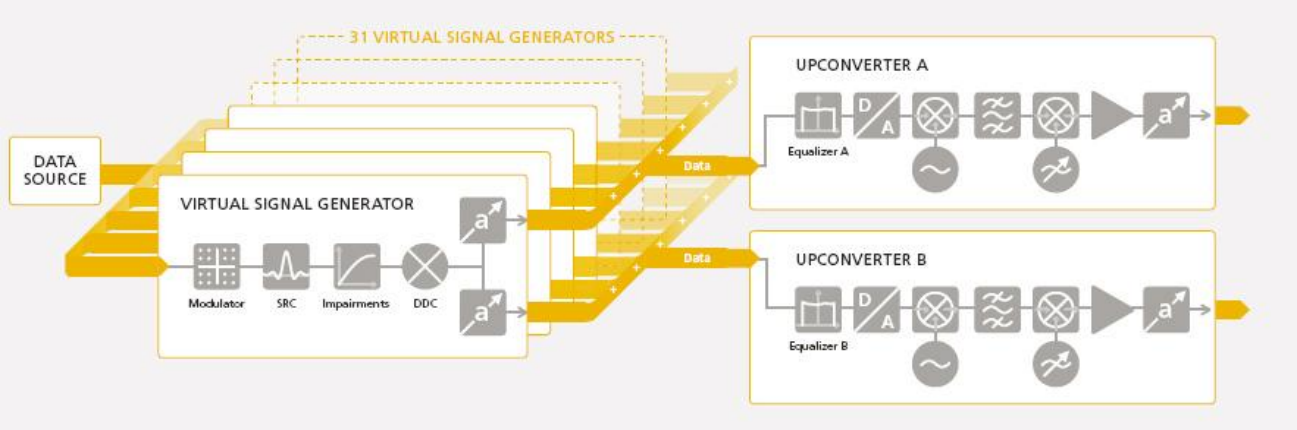


figure 2: Generic block diagram of the IZT S1000

2. Options structure

The options structure of the IZT S1000 reflects the versatility of the unit. It is strictly orthogonal in terms that no options contain part of any other option so that they can easily be combined. The following chart gives an overview about the available options.

Ordering code	Description	Min. qty.	Max. qty.
Hardware options IZT S1000			
IZT S1000-CHS	Chassis and all digital hardware	1	1
IZT S1000-ESATA	Interface for external storage	0	1
IZT S1000-SSD	Solid state system disc	0	1
IZT S1000-10G	10 Gbit option	0	1
IZT S1000-TCS	Transport case (packaging)	0	1
Hardware options IZT S1010			
IZT S1010-CHS	Chassis and all digital hardware	1	1
IZT S1010-SSD	Solid state data disc	0	1
IZT S1010-RCK-MNT	19″ Rack mounting kit with slide mechanism for IZT S1010-CHS3	0	1
IZT S1010-DC	DC supply for IZT S1010-CHS3	0	1
IZT S1010-10G	10 Gbit Option	0	1
IZT S1010-TCS	Transport case (packaging)	0	1
Hardware options IZT S1000 and IZT S1010			
IZT S1000-RF3	Upconverter 9 kHz to 3 GHz	(1)	(2)
IZT S1000-RFS3	Synthesizer for IZT S1000-RF3	(1)	2
IZT S1000-RF6	Upconverter 9 kHz to 6 GHz	(1)	(2)
IZT S1000-RFS6	Synthesizer for IZT S1000-RF6	(1)	2

IZT S1000-8GB	Increases internal RAM from 4 GB to 8 GB	0	1
IZT S1000-GPIB	GPIB Interface for remote control	0	1
IZT S1000-FHS	Frequency hopping module	0	1
IZT S1000-FHC	Additional frequency hopping channel	0	31
IZT S1000-EXT_SYNC	External synchronization interfaces	0	1
IZT S1000-MTX	RF switching matrix	0	1
IZT S1000-MTA	Switching matrix accessories kit (requires S1000-MTX)	0	1
Software options IZT S1000 and IZT S1010			
IZT S1000-GUI	Graphical User Interface	1	1
IZT S1000-LBV	LabView Driver	0	1
IZT S1000-110	VSG channel	1	31
IZT S1000-120	2 x 1Gbit external streaming including streaming software	0	1
IZT S1000-130	PSI Mode	0	1
IZT S1000-140	Advanced streaming	0	1
IZT S1000-201	real-time Sirius modulation	0	1
IZT S1000-201a	real-time Sirius overlay	0	1
IZT S1000-201b	Sirius spectral representation	0	1
IZT S1000-201c	Sirius Next Generation Overlay NGO	0	1
IZT S1000-202	real-time XM	0	1
IZT S1000-202a	real-time XM overlay	0	1
IZT S1000-202b	XM spectral representation	0	1
IZT S1000-203	DAB real time modulator	0	1
IZT S1000-203b	Live EDI input for IZT S1000-203	0	1
IZT S1000-220	HD Radio IBOC playback	0	1

IZT S1000-220a	HD-Radio test vector upgrade	0	1
IZT S1000-221	Live FM RDS modulator from Audio Source	0	1
IZT S1000-230	Internal HDD streaming	0	1
IZT S1000-301	Phase noise simulation	0	1
IZT S1000-302	Nonlinearity simulation and TX output filter simulation	0	1
IZT S1000-304	Fading channel simulator with fixed delays	0	1
IZT S1000-305	Power level profiles	0	1
IZT S1000-306	Frequency profile / delay profile	0	1
IZT S1000-307	Shaped noise	0	1
IZT S1000-310	Impairment bundle (301/302/305)	0	1
IZT S1000-402	FM-RDS GUI	0	1
IZT S1000-403	DAB modulator	0	1
IZT S1000-407	DAB/DAB+/DMB ContentServer Embedded Edition	0	1
IZT S1000-407b	DAB/DAB+/DMB ContentServer Embedded Edition upgrade	0	1
IZT S1000-408	DVB-T modulation toolbox	0	1
IZT S1000-409	DRM Modulator	0	1
IZT S1000-410	DRM30/DRM+ Modulator	0	1
IZT S1000-410a	DRM30/DRM+ Modulator for MDI Input	0	1
IZT S1000-410b	DRM30/DRM+ Modulator Bundle (S1000-410/-410a)	0	1
IZT S1000-411	Software Modulation Generator (SMG)	0	1
IZT S1000-412	GPS Output	0	1
IZT S1000-413	Spectrum display	0	1
IZT S1000-414	Video playback	0	1

IZT S1000-415	Decryption interface	0	1
IZT S1000-416	DRM/DRM+ upgrade xHE-AAC / HE-AAC	0	4
IZT S1000-417	DRM30/DRM+ Upgrade MDI Output Streaming	0	1
IZT S1000-418	DVB-T modulation toolbox	0	1
IZT S1000-418a	DVB-T signal playback license	0	1
IZT S1000-419	DVB-T2 modulation toolbox	0	1
IZT S1000-419a	DVB-T2 signal playback license	0	1
IZT S1000-420	ISDB-T modulation toolbox	0	1
IZT S1000-420a	ISDB-T signal playback license	0	1
IZT S1000 Memory Extension			
IZT S1000 Memory Extension	Enhances the IZT S1000 streaming capabilities to wideband signals; provides 2 times 12 TB storage capacity	0	1
IZT S1000 Memory Extension+	Enhances the IZT S1000 streaming capabilities to wideband signals; provides 2 times 9 TB storage capacity with fault tolerance	0	1
Service			
IZT Software Support Contract	Support for IZT software options	0	1
IZT WE2	Warranty extension to 2 years: Extension of the standard 1 year warranty to 2 years	0	1
IZT WE3	Warranty extension to 3 years: Extension of the standard 1 year warranty to 3 years	0	1
IZT S1000-CLC	IZT internal factory calibration recommended in a 2-year cycle (IZT certificate included)	0	1

3. RF Configuration possibilities

Signal Generator	Config 1	Config 2	Config 3	Config 4
S1000 3GHz	✓	✓	✓	✓
S1010 3GHz	✓	✓	✓	✓
S1000 6GHz	✓	✗	✗	✓
S1010 6GHz	✓	✗	✓	✓

Signal Generator 3GHz

Signal Generator	Number of RFS3	Number of RF3
Config 1	1	1
Config 2	1	2
Config 3	2	2
Config 4	✗	2

Signal Generator 6GHz

Signal Generator	Number of RFS6	Number of RF6
Config 1	1	1
Config 2	✗	✗
Config 3	2	2
Config 4	✗	2

4. Hardware options S1000

4.1. IZT S1000-CHS

IZT S1000-CHS is the basis of the IZT S1000 and comprises all hardware except the RF sections. IZT S1000-CHS is always required. It comprises all digital processing and a 1TB HDD.

Adding RF and software/firmware options will adapt the IZT S1000 to the specific needs. The IZT S1000-CHS mandatorily needs the S1000 GUI.

The GUI can be started on the internal TFT or at an external connected VGA-display or projector.

If a Memory Extension or Memory Extension+ ist available as well the IZTGUI will be operated on the Memory Extension

4.1.1. Different output configurations

The IZT S1000 supports two independent outputs for the generated signals. The outputs can be factory configured either as 3GHz outputs or 6GHz output. The possible configurations is shown in the Chapter 3.

4.1.2. 2U height

The IZT S1000 is housed in a 19" chassis with two rack units height.

Dimensions without installation angles: W x H x D; 452 mm x 94 mm x 569 mm.

Dimensions with installation angles: W x H x D; 482 mm x 94 mm x 569 mm.

Weight with all installed components: approx 12 kg.

4.1.3. Front panel display and keyboard

The IZT S1000 uses a 5" TFT display with a resolution of 800 x 480 dots. The keyboard layout is especially suited to manage multiple signals easily.

4.1.4. Accurate frequency and timing synchronization

The IZT S1000 provides accurate synchronization both in terms of frequency and timing. Multiple IZT S1000 can be combined to replay signals, for example to simulate recordings from multiple antennas. The synchronization signal is provided via 10 MHz, 1 pulse per second and time information via LAN or serial port.

figure 3: Front panel of the IZT S1000

4.1.5. Full remote control via Ethernet and serial port

The IZT S1000 can be fully remote controlled via Ethernet and serial RS232. Existing remote control software does not have to be modified.

4.1.6. DC supply and control signals for external equipment

The IZT S1000 has an adjustable DC output of 1.28 to 11.8 VDC/1A. This can be used, for example, to supply power to an external power amplifier, a switch matrix or similar equipment. Eight bi-directional control signals are available to control and monitor the external equipment. This functionality can be fully remote controlled via the ordinary remote control path.

4.1.7. Data Interfaces

To simplify the transfer of large files, the IZT S1000 software supports file transfer via ftp. There is a 500 GB built in hard disk for storage of I/Q data and for online modulators.

4.1.8. Operating system

The IZT S1000 uses an embedded Linux operating system.

4.1.9. USB user port and external keyboard

The IZT S1000 is equipped with an external USB Port. The USB port can be used for an external keyboard with integrated trackball or for connecting external storage devices.

4.2. IZT S1000-ESATA

4.2.1. ESATA interface for external HDD

In the S1000-CHS the ESATA interface provides the interface to connect external ESATA devices.

4.3. IZT S1000-SSD

Instead of internal HDD the IZT S1000 can be equipped with an internal Solid State Disc to increase the speed of data access.

4.4. IZT S1000-10G

IZT S1000 is available with a 10 Gbit optical LAN interface for rapid data transfer from external data storage. With this option can be obtained data transfer rates of up to 1125 MB per second. To use the S1000-10G Interface a different firmware and software is needed which is not compatible to the S1000 standard software version. It is available on request.

5. Hardware options S1010

5.1. IZT S1010-CHS

The IZT S1010-CHS3 is be the basis of the IZT S1010 and comprises all hardware except the RF sections. IZT S1010-CHS is always required.

It comprises all digital processing and a 4 x 1 TB SSD (optional) and a 250 GB SSD system disk. Adding RF outputs and firmware options will adapt the IZT S1010 to the specific needs. The IZT S1010-CHS mandatory needs the Graphical User Interface GUI.

The GUI can be started on the internal TFT with integrated touch or on the external connected TFT display or projector. The main difference to the IZT S1000-CHS is that the streaming capabilities as known from the IZT Memory Extension is included in the S1010-CHS.

5.1.1. Different output configurations

The IZT S1010 supports two independent outputs for the generated signals. Each output can be factory configured either as RF output.

5.1.2. 3U height

The IZT S1010 is housed in a 19″ chassis with three rack units height.

Dimensions without installation angles: W x H x D; 452 mm x 141 mm x 569 mm.

Dimensions with installation angles: W x H x D; 482 mm x 141 mm x 569 mm.

Weight with all installed components: approx 16 kg.

5.1.3. Front panel display and keyboard

The IZT S1010 uses a 7″ TFT display with a resolution of 1024 x 600 dots. The keyboard layout is especially suited to manage multiple signals easily. The display comprises a resistive touch. A compact keyboard is supplied which can be used to operate the signal generator.

5.1.4. Accurate frequency and timing synchronization

The IZT S1010 provides accurate synchronization both in terms of frequency and timing. Multiple IZT S1010 can be combined to replay signals, for example to simulate recordings from multiple antennas. The synchronization signal is provided via 10 MHz, 1 pulse per second and time information via LAN or serial port.

figure 4: Front panel of the IZT S1010 Signal Generator

5.1.5. Full remote control via Ethernet and serial port

The IZT S1000 can be fully remote controlled via Ethernet and serial RS232. Existing remote control software does not have to be modified.

5.1.6. DC supply and control signals for external equipment

The IZT S1010 has an adjustable DC output of 1.28 to 11.8 VDC/1A. This can be used, for example, to supply power to an external power amplifier, an IZT S1000 MTX switch matrix or similar equipment. Eight bi-directional control signals are available to control and monitor the external equipment. This functionality can be fully remote controlled via the ordinary remote control path.

5.1.7. Data interfaces

To simplify the transfer of large files, the IZT S1010 software supports file transfer via sftp, USB, USB3.

5.1.8. Operating system

The IZT S1000 uses an Linux operating system from the brand Debian8x.

5.1.9. USB user port and external keyboard

The IZT S1010 is equipped with 2 USB3 ports and 4 USB2 ports on the back part of the unit and two USB2 ports on the front. The USB ports can be used for an external keyboard with integrated trackball or for connecting external storage devices or transferring data.

figure 5: Back panel of the IZT S1010 Signal Generator

5.2. IZT S1010-SDD

The IZT S1010 can be equipped with extremely robust HDD trays which are equipped with 4 x 1 TB SSD disks. They can be used to store test vectors and they are used for a high performance streaming and very high speed file access. It is possible to use this setup up to 5000 m elevation.

5.3. IZT S1010-RCK-MNT

The rackmount option which is only available in the IZT S1010 allows to install the signal generator in a 19″ Rack with a slide mechanism.

The rack mount kit can be installed on the IZT S1010 at a later step.

Dimension: 780 x 97 x 55 mm (3.07 x 3.82 x 2.17 inch)

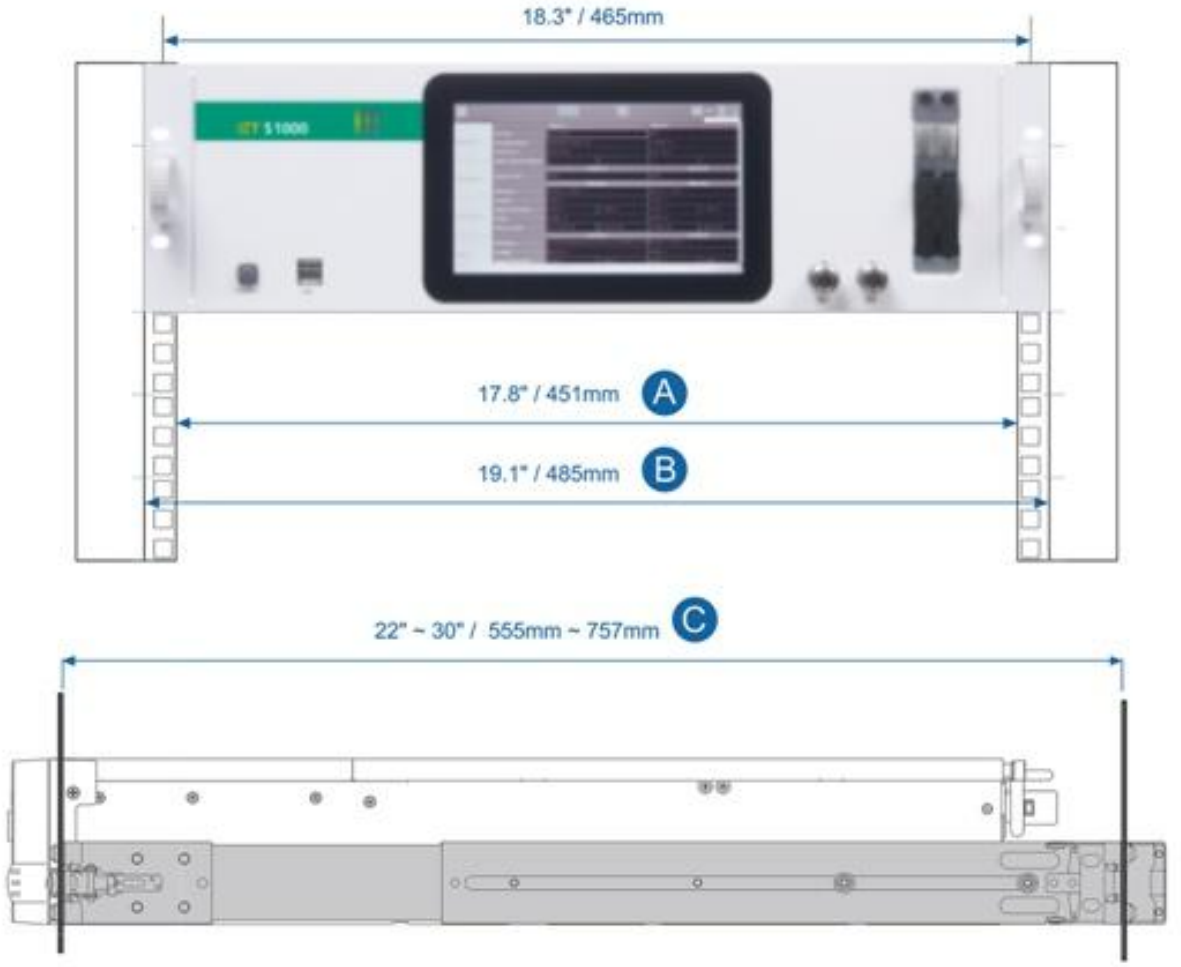
Weight: 2.25 kg (4.96lb)

Please make sure the server racks conform to the following criteria:

A. Mounting post width: 17.8"/451 mm

B. Panel width: ≥ 19.1"/485 mm

C. Mounting post depth: 22" ~ 30"/555 ~ 757 mm



5.4. IZT S1010-10G

IZT S1010 is available with a 10 Gbit optical LAN interface for rapid data transfer from internal S1010-SSD storage device and from external data storage. With this option very high data transfer rates of up to 1125 MB per second can be achieved.

The S1010-10G option enhances the S1010-CHS with three external 10G interfaces.

One of them is directly connected to the Signal Processing FPGA and the other two can be equipped with SFP+ Modules (one is delivered). A 30 cm 10 Gbit cable is provided to connect the two 10 Gbit interfaces.

To use the S1010-10G interface a different firmware and software is needed which is not compatible to the S1000 standard software version.

5.5. IZT S1010-DC

The IZT S1010 can be equipped with a DC supply which allows to use the signal generator with a DC supply. The AC supply is not available when IZT S1010-DC is installed.

Technical Values:

Voltage	10 to 30 VDC
Current	Max. 40 A
Security	Polarity protection
Cable diameter	Min. 6 mm^2
Cable lenght	Max. 4 m @ 6 mm^2 Max. 6.6 m @ 10 mm^2
Max resistance of cable	10 mOhm

6. Hardware options for IZT S1000 and IZT S1010

6.1. IZT S1000-RF3

6.1.1. Signal coverage from 9 kHz to 3 GHz

The IZT S1000 supports continuous coverage from 9 kHz to 3 GHz at center frequencies between 90 MHz and 2940 MHz. The instantaneous bandwidth is 30 MHz below 30 MHz and 120 MHz from 30 to 3 GHz.

For testing systems with antenna diversity or for generating independent signals over a wider frequency range (two independent 120 MHz frequency blocks), the IZT S1000 can be equipped with a second RF output. Noise figure and signal power range are identical to the primary RF output.

6.1.2. Wide output power level

Each signal can be placed anywhere within the available instantaneous bandwidth and its power can be set individually from below system noise floor up to +20 dBm total peak power.
The system noise floor varies from thermal noise up to a noise figure of 55dB if maximum output power is required.

The IZT S1000 being capable of up to 31 signals, this allows even diversity testing with independent fading statistics for both outputs.
The RF output is equipped with a DC block and is insensitive to wrong termination.

Attention: IZT S1000-RF3 and IZT S1000-RF6 cannot be mixed in the S1000-CHS and S1010-CHS.

6.2. IZT S1000-RF6

6.2.1. Signal coverage from 9 kHz to 6 GHz

The IZT S1000-RF6 can be used instead of the S1000-RF3 and supports continuous coverage from 9 kHz to 6 GHz at center frequencies between 90 MHz and 5940 MHz. The instantaneous bandwidth is 30 MHz below 30 MHz and 120 MHz from 30 to 6 GHz.

For testing systems with antenna diversity or for generating independent signals over a wider frequency range (two independent 120 MHz frequency blocks), the IZT S1000 can be equipped with a

second S1000-RF6 output.
Noise figure and signal power range are identical to the primary RF6 output.

6.2.2. Wide output power level

Each signal can be placed anywhere within the available instantaneous bandwidth and its power can be set individually from below system noise floor up to +20 dBm total peak power.
The system noise floor varies from thermal noise up to a noise figure of 55 dB if maximum output power is required.

The IZT S1000 being capable of up to 31 signals, this allows even diversity testing with independent fading statistics for both outputs.
The RF output is equipped with a DC block and is insensitive to wrong termination.

Attention: IZT S1000-RF3 and IZT S1000-RF6 cannot be mixed in the S1000-CHS and S1010-CHS.

6.3. IZT S1000-RFS3

6.3.1. Optional RF3 synthesizer

The IZT S1000 can be equipped with a second RF3 output synthesizer (for 3 GHz RF output), when a second RF output is installed. A single synthesizer is always required.

Two synthesizers allow to set the center frequencies of two IZT S1000-RF3 independently. For example, one can be used to cover the FM broadcast band and a second one to cover SDARS simultaneously.

Attention: IZT S1000-RFS3 and IZT S1000-RFS6 cannot be mixed in the S1000-CHS and S1010-CHS.

6.4. IZT S1000-RFS6

6.4.1. Optional RF6 Synthesizer

The IZT S1000 can be equipped with a second RF6 output synthesizer when a second RF6 output is installed. A single synthesizer is always required. If a IZT S1000-RF3 is installed it requires a IZT S1000-RFS3. If a IZT S1000-RF6 is installed it requires a IZT S1000-RFS6.

Two synthesizers allow to set the center frequencies of two IZT S1000-RF6 independently. For example, one can be used to cover the DAB broadcast band and a second one to cover Car2Car communication simultaneously.

Attention: IZT S1000-RFS3 and IZT S1000-RFS6 cannot be mixed in the S1000-CHS and S1010-CHS.

6.5. IZT S1000-8GB

6.5.1. Up to 8 GB RAM

The IZT S1000 is equipped as standard with 4 GB of fast RAM available for storing waveform data. With the option IZT S1000-8GB the RAM can be upgraded to 8 GB .

The 4 GB RAM stores for example a total duration of approx. 1600 seconds of HD-Radio signals sampled at 625 kSps complex. The total duration can be used for multiple channels (for example 16 channels, one with a duration of 1000 seconds and 15 shorter files with 40 seconds each until they loop). The option IZT S1000-8GB will double the available capacity to 3200 seconds.

6.6. IZT S1000-GPIB

The IZT S1000 can be fully remote controlled with GPIB. Standard remote control interfaces are LAN and RS232. In the IZT S1010 Chassis an external USB_to_GPIB Adapter is needed.

6.7. IZT S1000-LBV

IZT S1000 supports LabView applications and drivers which can be used to program customized test scenarios.

The single command center can send all IZT S1000 commands with Serial, GPIB or serial interface to the IZT S1000 and is capable extracting SCPI commands into SCPI command files for automatic replay.

The multiple command center can replay SCPI command files for automated test routines.

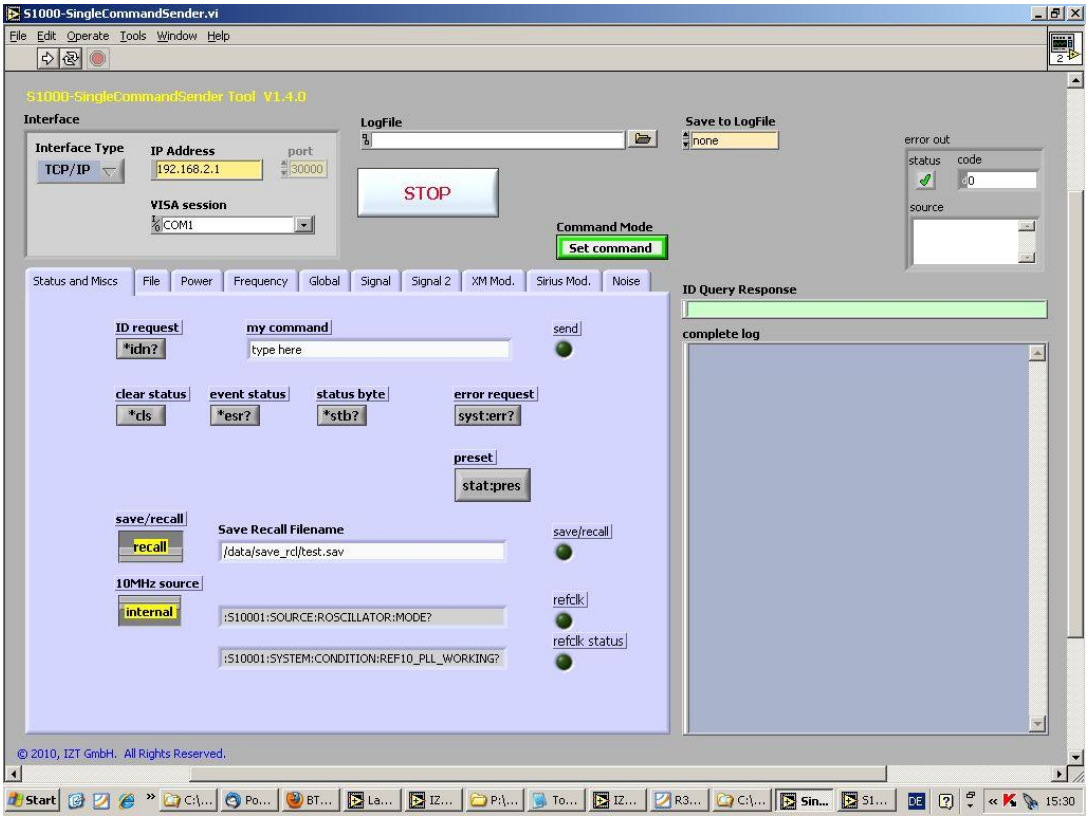


figure 6: LabView single command center

6.8. IZT S1000-FHS

The frequency hopping module IZT S1000-FHS utilizes the profile functionality of the IZT S1000 to generate hopping networks in a very efficient manner. The IZT S1000-FHS consists of 15 hopper channels.

The content is supplied by the user as narrow band I/Q data.

- Spread: up to 120/240 MHz
- Hop rate: > 2000 hops/s
- Channel spacing: user settable
- Pattern: regular or random within user-defined channel list or sequence of channels / frequencies defined by user
- Number of hoppers: up to 31. One hopper requires one IZT S1000-110 VSG (and two IZT S1000-110 VSGs with 240 MHz spread).
- Content: I/Q-data, generated by analogue modulation tool or user-supplied content

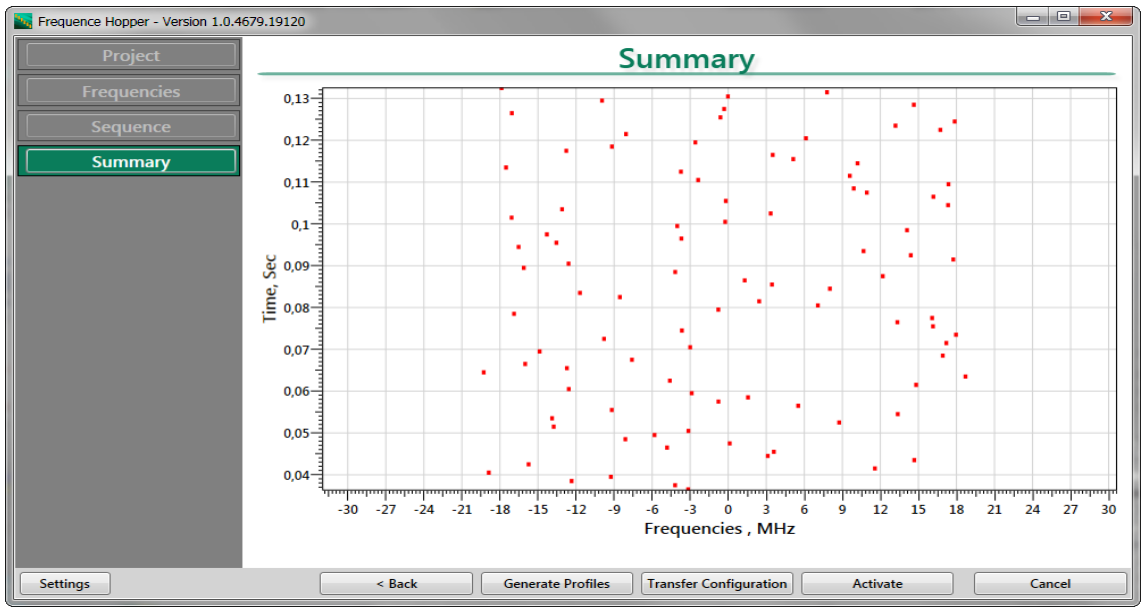


figure 7: Frequency hopping tool

6.9. IZT S1000-FHC

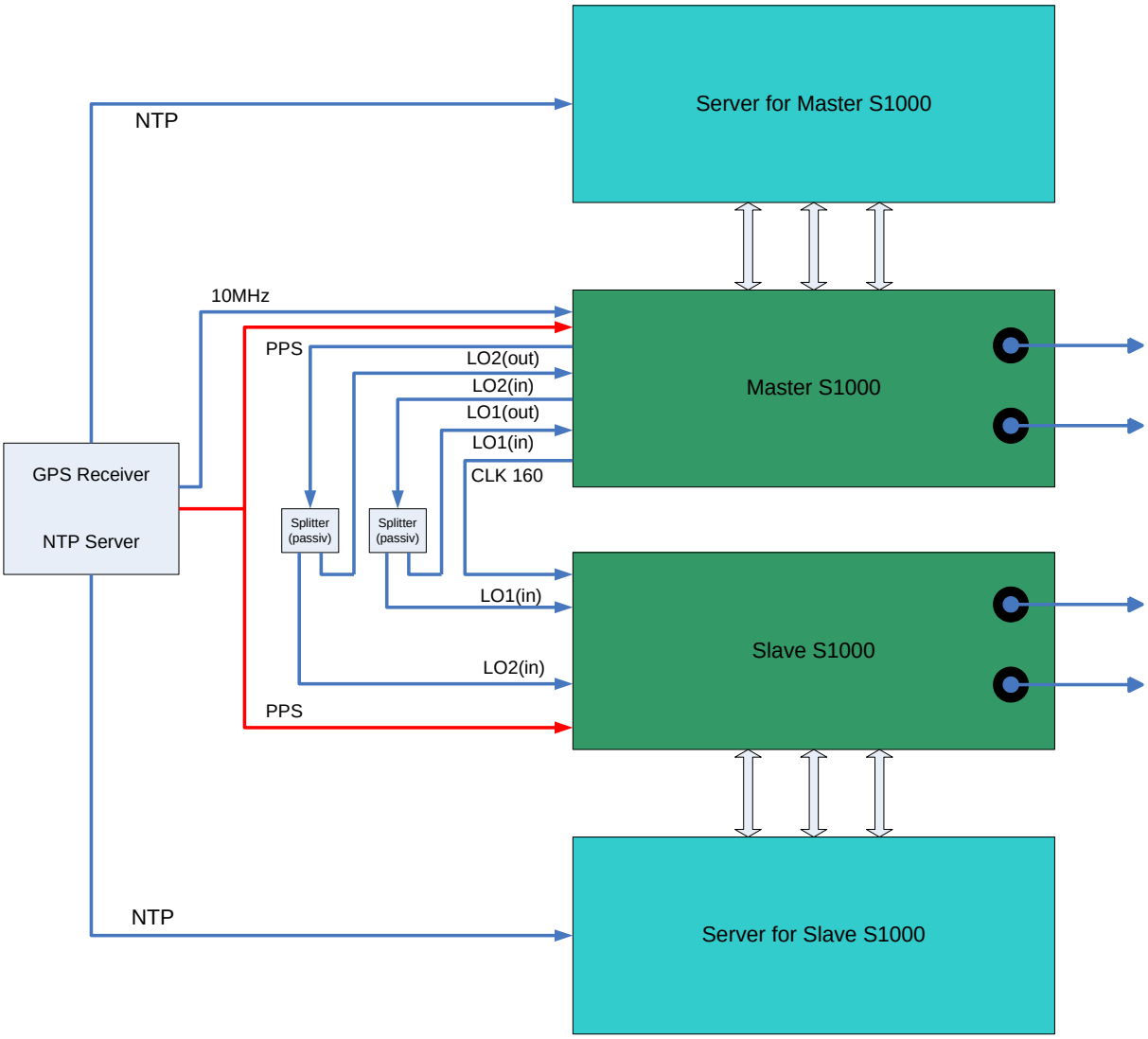
Additional hopper can be added to a total number of 31. One additional hopper requires one IZT S1000-110 VSG.

6.10. IZT S1000-EXT-SYNC

The IZT S1000-EXT-SYNC option prepares the IZT S1000 in a way that multiple IZT S1000 units can be used synchronously together. One of the IZT S1000 will take the role of the Master and the other IZT S1000 will take the role of slaves.

The Master IZT S1000 generates the central 160 MHz clock which will be sent to the slave IZT S1000. In the case of multiple slaves an additional clock distribution is needed (this can be ordered on request).

The following figure shows how to use multiple IZT S1000 including Servers and GPS receiver and NTP server to bring all units to an accurate time. This is needed for the option streaming time to have an accurate time at signal generation run.



The LO1 and LO2 needs a active spitting which can be offered including RF Cabling on request. If more than two IZT S1000 are synchronized together a IZT CSO can be used which provides up to 48 160 MHz outputs and up to 48 PPS signals. It is available on request.

6.11. IZT S1000 Memory Extension/Memory Extension+

The IZT S1000 Memory Extension/Memory Extension+ are additional external data storage devices that enable streaming of multiple and wideband signals in to the IZT S1000. 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.

The Memory Extension is obtainable in two configurations. A 2RU Linux version with Debian8x OS and a 4RU Windows7 Version.

6.12. IZT S1000-MTX

The IZT S1000-MTX is an external 2:4 RF switch matrix for the IZT S1000 Signal Generator. It can be used for test setups in DUT test environment or laboratory environments.

The switching behaviour is controlled from the IZT S1000 GUI and can also be controlled from the remote Interface.

IZT S1000-MTX	External 2:4 RF Switch Matrix for IZT S1000 Series	
Frequency Range	RF IN 1,2 RF OUT 1-4	100 kHz ... 3000 MHz 100 kHz ... 3000 MHz
RF Inputs	RF IN 1,2	SMA (f), 50 Ω
RF Outputs	RF OUT 1-4	SMA (f), 50 Ω
Maximum Input Level	RF IN 1,2 RF OUT 1-4	+10 dBm 16V DC / 100 mA
VSWR (Input / Output)	RF IN 1,2 RF OUT 1-4	< 1.6:1 < 1.6:1 (typ. <1.25:1 @ 1 GHz, < 1.35:1 @ 2 GHz)
Insertion Loss		< 4 dB (typ. 1 dB @ 1 GHz, 2.5 dB @ 2 GHz)
DC Input	GPIO S1000 RF OUT 1-4	V_{SUPPLY} = 11 ... 13 V V_{BIAS} = 6 ... 15V, I_{BIAS} = 0 ... 95 mA
LED Status Display	LED 1 LED 2 LED 3	Green (V_{in} ≥11.0 V) / Green (V_{in} <11.0 V) / Off (V_{in} <5.5 V) Green (Current Mode: GPIO) / Red (Current Mode: Poti) Green (RF Amps On) / Off (RF Amps Off)
LED RF OUT Display	RF IN 1 RF IN 2 BIAS ACTIVE	Green (RF IN 1 active) / Off (RF IN 1 terminated) Green (RF IN 2 active) / Off (RF IN 2 terminated) Orange (I_{BIAS} ≥ 10 mA) / Off (I_{BIAS} < 10 mA)
Mechanical Dimensions		443 x 430 x 41.6 mm (W x L x H)

Specification subject to change without further notice.

figure 8: MTX switch matrix

Description – Front Panel:

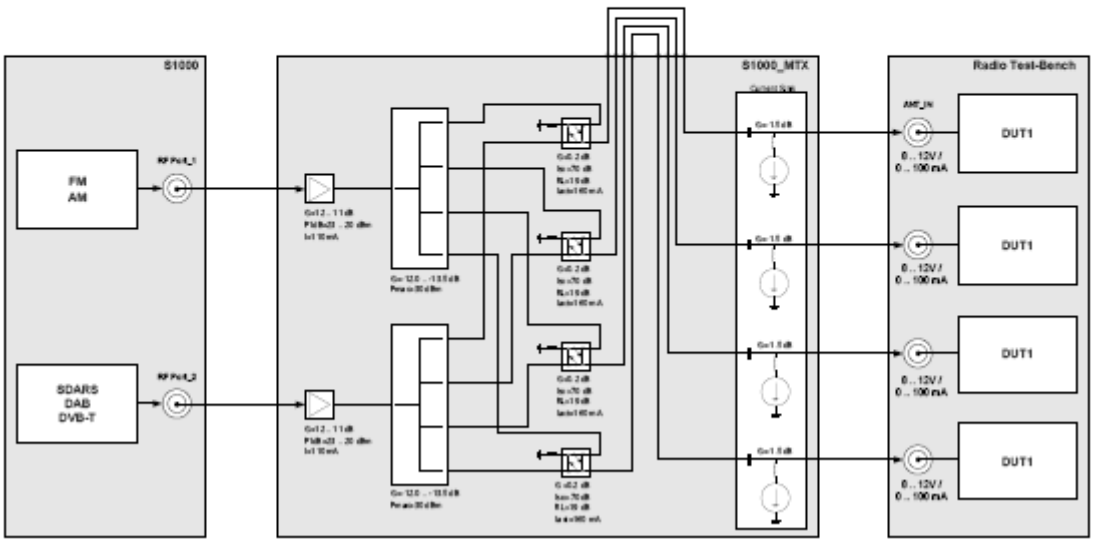
RF Ports	RF IN 1-2	Upper Connector Lower Connector	RF Input, Path 1 RF Input, Path 2
	RF OUT 1-4	Left Connector Mid Connector Right Connector	RF Output (internal); normally shorted with RF jumper cable RF Input (internal); normally shorted with RF jumper cable RF Output, DC Input
LED	RF IN 1,2	Upper Led („1") Lower Led („2")	Selected RF Input, Path 1 Selected RF Input, Path 2
	BIAS	Active	Current Sink On (I_{sink} ≥ 10 mA) / Off (I_{sink} < 10 mA)
Ctrl		Opening, left from "RF OUT 1"	Current Sink Control (Software – remote control; Potentiometer – manual control)
	RF OUT 1-4	Adjust	Manually adjustable Current Sink (I_{sink} ≥ 0 .. <100 mA)

Description – Rear Panel:

Ctrl	GPIO S1000	DSUB (15-pole)	Interface S1000 ↔ S1000-MTX, Power, Control

Remark: LAN, USB, RS232, RF IN 1 / 2 - customer configurable connectors

Block Diagram:



6.13. IZT S1000-TCS

When the IZT S1000 has to be often transported to different locations the transport box orginally delivered with it is not reliable. Especially when the unit has to be transported in an airplane, we highly recommend to use the flight case.

It can be easily pulled by the integrated wheels and handle. There is enough space to add all the documentation and cabling including keyboard.

Dimensions: 956 mm x 397 mm x 740 mm (width x height x depth)

Figure 9: Transport case

6.14. IZT S1010-TCS

When the IZT S1010 has to be often transported to different locations the transport box orginally delivered with it is not reliable. Especially when the unit has to be transported in an airplane, we highly recommend to use the flight case.

It can be easily pulled by the integrated wheels and handle. There is enough space to add all the documentation and cabling including keyboard (see pictures from the Option IZT S1000-TCS).

Dimensions: 956 mm x 437 mm x 740 mm (width x height x depth)

7. Virtual Signal Generator VSG

7.1. IZT S1000-110 VSG channel

The firmware option IZT S1000-110 (VSG) turns the IZT S1000 into an extremely flexible and powerful arbitrary waveform generator. The number of Virtual Signal Generators (VSGs) can be increased up to a total of 31 channels. The signals can be placed within the 120 MHz continuous bandwidth of the IZT S1000 with variable amplitudes.

The data is streamed as a complex of 16-bit samples from RAM or HDD in continuously looping. Each channel contains a variable sample rate converter, so it can be used for any files generated by the customer or third party, for example HD Radio files.

The total sample rate of all channels is limited to 320 MSps. The output power of each channel is individually adjustable. The frequency of each channel is adjustable in real-time within the selected 120 MHz instantaneous bandwidth.

The IZT S1000's auto calibration feature ensures optimum flatness of the power spectral density.

The use of IZT S1000 requires at least one VSG. The number of VSGs depends on the application's requirements for signal generation. For example if the application requires the replay of Sirius (and XM) signals according to this five (or eight) VSGs has to be ordered.

7.2. IZT S1000-230 HDD streaming

Up to 10 MB/s of continuous data - I/Q data, input data for online modulators or a combination of both - can be streamed from the HDD. The option IZT S1000-120 streaming input is not compatible with IZT S1000-230.

7.3. IZT S1000-120 streaming of 2 x 1 Gbit

7.3.1. Real-time streaming from external LAN

Up to 200 MB/s of continuous data can be streamed from an S1000 Memory Extension or S1000 Memory Extension+ to the IZT S1000 by using the external LAN Ports. This can be I/Q data, input data for online modulators or a combination of both.

The IZT S1000-120 option includes software which controls the IZT S1000 from the IZT S1000 Memory Extension and streams signals to the IZT S1000.

In the IZT S1010 the Memory Extension hardware is included to the S1010-CHS. The Streaming functionality S1000-120 needs to be ordered additionally to have the full streaming capability.

When more signals are streamed maximum data rate is limited to 200 MB/s on both High Speed Links (HSL).

When a customer has the Option IZT S1000-120 streaming input the IZT S1000-230 is not needed additionally. The S1000-120 Option can be enhanced with the Option S1000-140.

7.4. IZT S1000-130 PSI mode

To generate wideband signals with up to 120 MHz bandwidth 4 VSGs can be used to send out the individual signals in a special mode. The signals are added absolutely phase, delay and time synchronous and combined absolutely seamless in frequency band. The PSI option allows to use this functionality with the use of the internal memory of 4 or 8 GB.

With 8 GB is possible to have a 120 MHz file repeat length of more than 10 seconds and more than 5 seconds with 4 GB. This is a big advantage to other signal generators.

The procedure to generate a wideband signals with 4 separate VSGs is like follows:

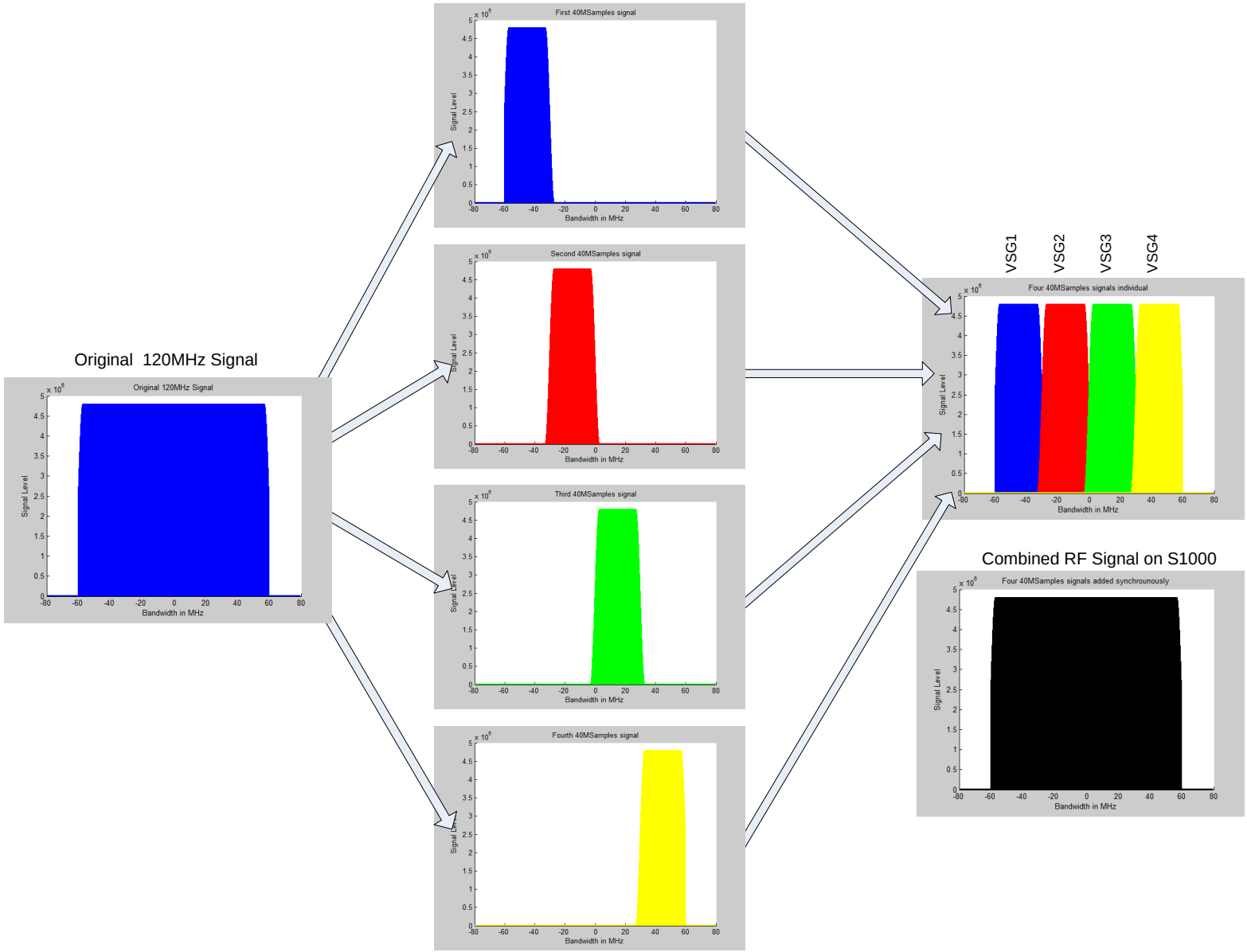
The original wideband signal is splitted into parts of 40 MS. This can be done with a tool we provide for this purpose

These individual files are replayed by placing at exact equidistant frequencies.

PSI Mode is activated before signal generation

Restrictions: When PSI Mode is activated it is not possible to use the start delays feature of the signal generator.

The following figure shows how the signals are generated and placed.



7.5. IZT S1000-140 advanced streaming

The advanced streaming option allows to send individual signals at a configured time. Each emitted signal can be configured with the following parameters during run-time:

Start time

Stop time

Frequency

Bandwidth

Source (I/Q-File: ARB12, I/Q-File: ABR16, R3000, NI)

Power profile

Frequency profile

Delay profile

Hopping sequence

31 signals streamed from IZT Memory Extension

The complete configuration (scenario) can be configured in the parameters:

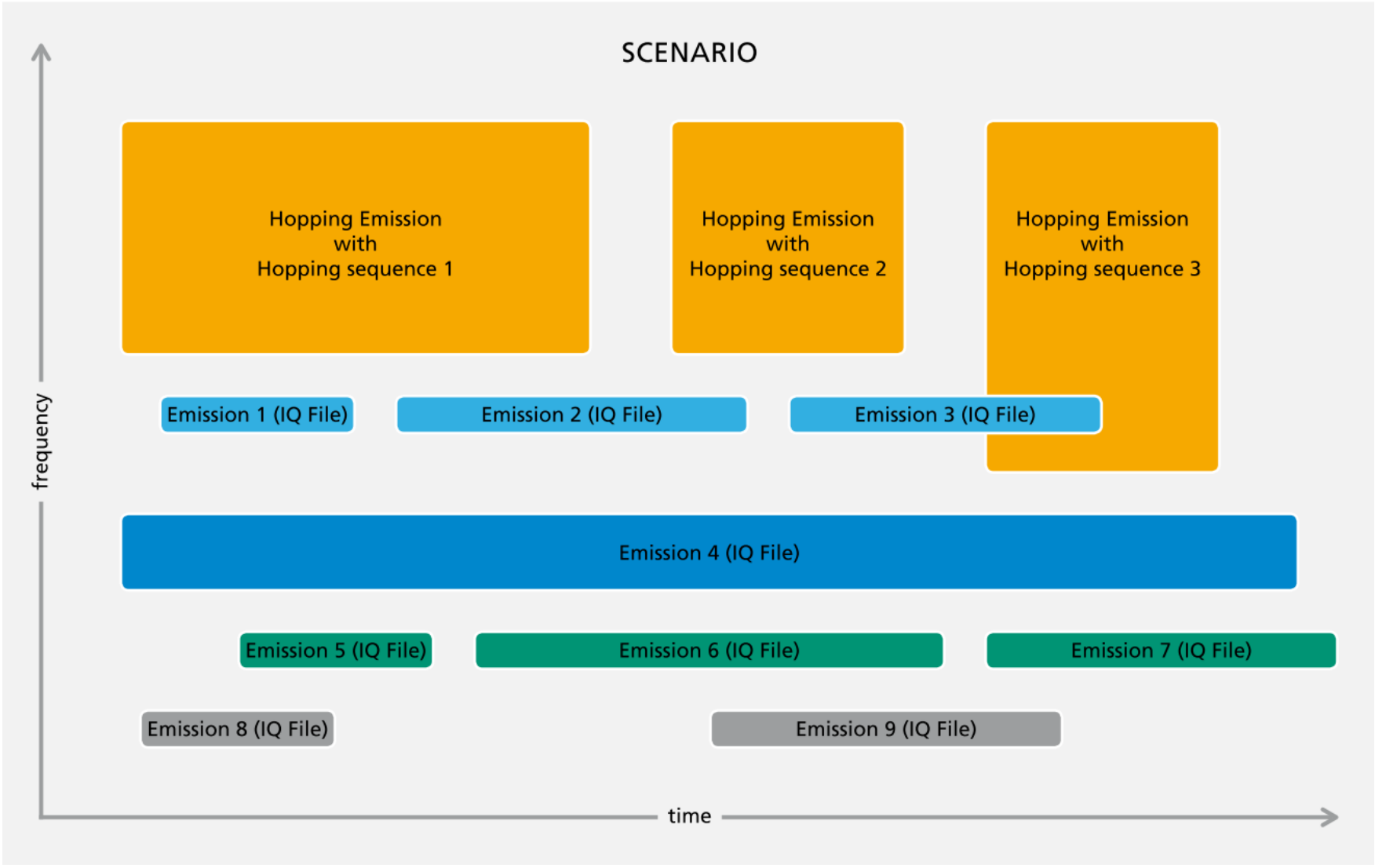
RF frequency of RF1/RF2

Noise generation

Shaped noise (additional key required)

Total bandwidth of 240 MHz (when two RFS3 and RF3 are available)

An example of a typical scenario with multiple signals is shown in following figure:



8. Real-time modulation

Besides the VSG functionality the IZT S1000 is also a real-time modulator.

The IZT S1000 provides online modulation for both SDARS systems XM Radio and Sirius Radio. The two options IZT S1000-201 and IZT S1000-201a (Sirius) and IZT S1000-202 and IZT S1000-202a (XM) can be used simultaneously if customers require both signals at the same time for testing combined receivers.

Data files are streamed from HDD and are compatible with the IZT S2000/DSG2000 data format including encryption.

8.1. IZT S1000-201 Sirius SAT/TERR

The IZT S1000-201 option generates the two QPSK-modulated Sirius satellite signals and the terrestrial OFDM modulated Sirius signal using online modulators.It requires three channels (IZT S1000-110) from the Multichannel VSGs.

8.2. IZT S1000-201a Sirius overlay

With option IZT S1000-201a overlay modulation is available for all Sirius signals. IZT S1000-201 is additionally required.

8.3. IZT S1000-201b Sirius spectral representation

With the option IZT S1000-201b is possible to generate a Sirius spectrum which can be used as an interferer spectrum for XM Radio signal.

When S1000-201 Sirius SAT/TERR option is available the S1000-201b Sirius spectral representation is not needed.

8.4. IZT S1000-201c Sirius NGO / New generation Overlay

The new broadcasting technology replaced the previously used Sirius Overlay Waveform of the Option 201a. All existing IZT S1000 and IZT S1010 Signal Generators support the NGO and are able to test upcoming broadcasting systems for the North American market after a software and firmware upgrade to a minimum Version of MB20.

The new overlay waveform allows a higher channel bit rate to transmit more channels and other data services. The legacy waveform and also the IZT test equipment is fully backwards compatible.

To use the new NGO Modulation it is also required to have S1000-110 (3) and S1000-201 Sirius SAT/TERR.

8.5. IZT S1000-202 XM SAT/TERR

The IZT S1000-202 option generates the four XM Radio QPSK modulated satellite signals and the two XM Radio MCM modulated terrestrial signals using online modulators. It requires five channels (IZT S1000-110) from the multichannel VSGs (the two terrestrial MCM signals require only one channel).

8.6. IZT S1000-202a XM overlay

The IZT S1000-202a option in combination with option IZT S1000-202 generates the four XM Radio QPSK modulated satellite signals and the two XM Radio MCM modulated terrestrial signals using online modulators for the Hierarchical XM waveform. It requires five channels (IZT S1000-110) from the multichannel VSGs (the two terrestrial MCM signals require only one channel). The IZT S1000-202a allows the use of TDMH files which are online modulated.

8.7. IZT S1000-202b XM spectral representation

With the option IZT S1000-202b is possible to generate a XM spectrum which can be used as an interferer spectrum for Sirius Radio signal.

When S1000-202 XM SAT/TERR option is available the S1000-202b XM spectral representation is not needed.

8.8. IZT S1000-203 DAB real-time modulator

The DAB real-time modulator can use ETI files directly as input and can be configured multiple times in different VSGs. The DAB real-time modulator is capable of full ETI reconfigurations. All DAB Modes I / II / III and IV are supported.

8.9. IZT S1000-203b live EDI input for IZT S1000-203

The DAB real-time modulator option and live EDI input option for the IZT S1000 enables a direct link to be set up between the IZT DAB ContentServer and the IZT S1000 with the EDI protocol. In combination with the IZT DAB ContentServer, a versatile laboratory setup can be achieved. IZT S1000-203b requires the option IZT S1000-203.

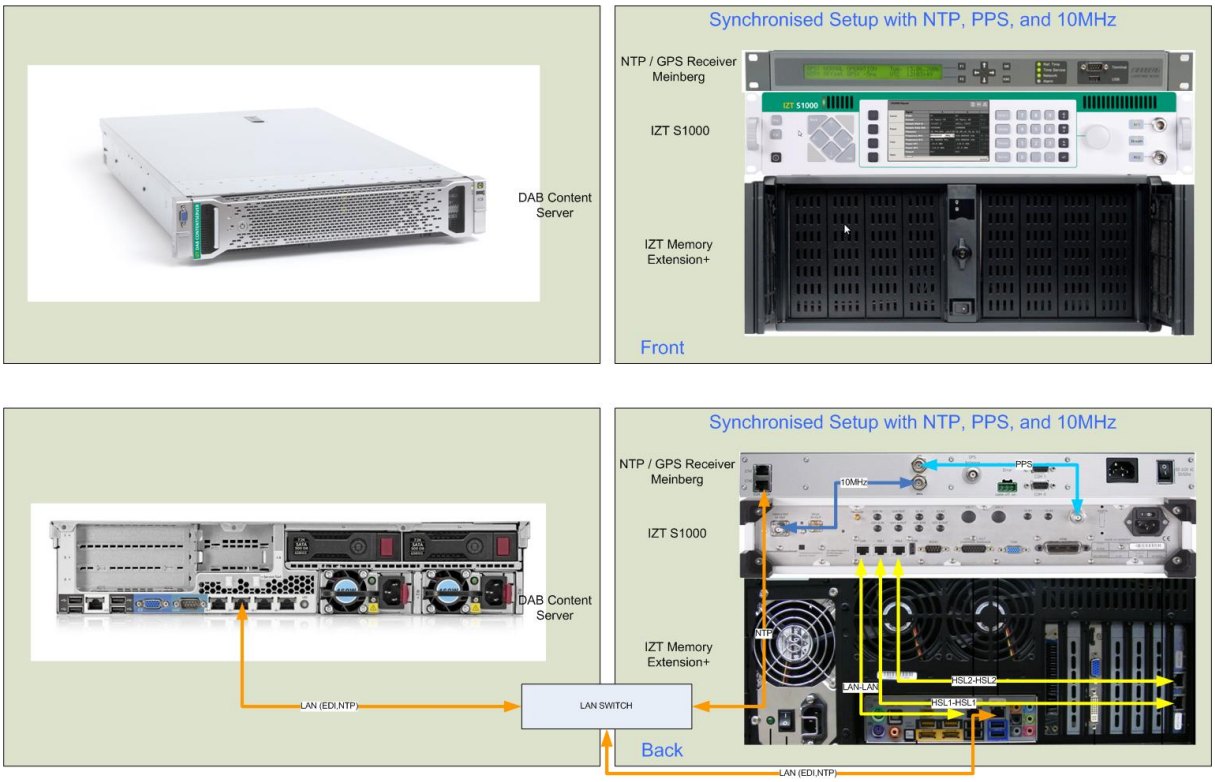


Figure 10: Typical hardware setup with IZT S1000, IZT Memory Extension and IZT DAB ContentServer

8.10. IZT S1000-220 HD Radio license

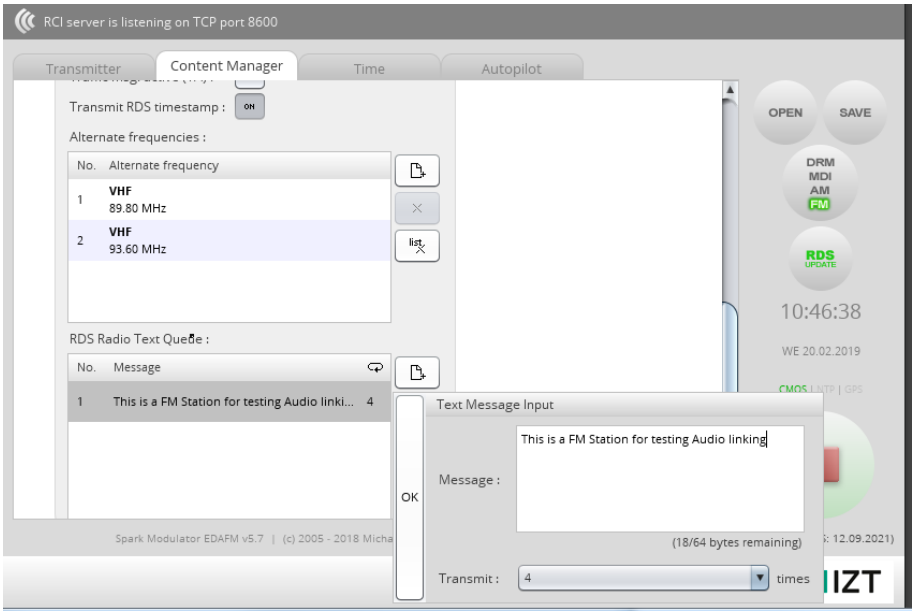
The IZT S1000-220 option allows playback of the original xPeri files for HD Radio AM and FM. If 2 upconverter (IZT S1000-RF3) and at least 2 VSG channels (IZT S1000-110) are available, AM and FM can be generated at the same time. The number of HD Radio signal generated at the same time is only restricted by the number of VSG channels or the available RAM (can be upgraded from standard 4 GB to 8 GB with option IZT S1000-8GB). The IBOC HD Radio signals can be streamed with the S1000-230 or S1000-120 option as well.

8.11. IZT S1000-220a HD Radio test vector upgrade

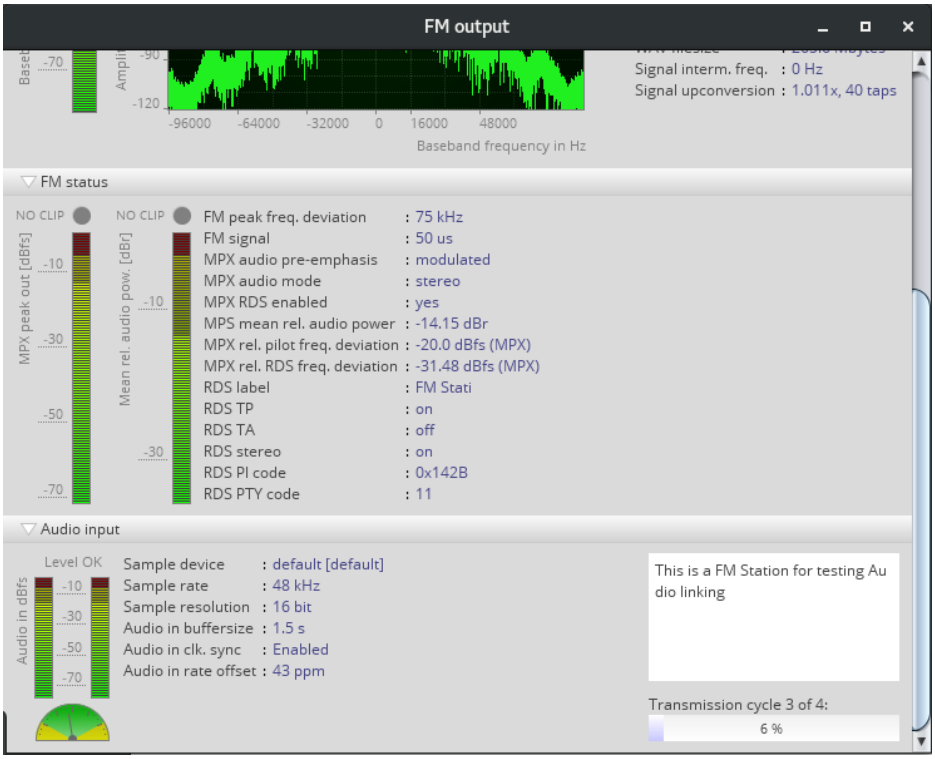
HD Radio test vector upgrade upgrades S1000 to latest release of DTS/iBiquity test vectors. All the test vectors which are officially released at the time of the order will be copied to a HDD and can be copied to the S1000, Memory Extension by the customer.

The Option 220a is not needed when the S1000 or IZT Memory Extension is ordered as well, as the test vectors are placed there automatically before the delivery.

8.12. IZT S1000-221 Live FM RDS modulator from Audio Source



The FM-RDS Parameters can be configured and the FM is generated from WAV, MP3 Audio or Soundcard Audio.



Spectrum and Audio Quality Parameters are shown during modulation.

8.13. IZT S1000-230 internal HDD streaming

Option IZT S1000-230 facilitates the real-time streaming of low to medium data rates content (for example satellite radio) from the internal HDD of the IZT S1000.

The HDD has a capacity of 1TBGB and can be extended with an external disk via the eSATA interface. It is available for additional bit streams or for upload of data into the IZT S1000's high speed sample memory.

9. VSG impairments

The powerful real-time signal processing of the IZT S1000 supports various impairment simulation like nonlinearity, phase noise, AWGN and fading channel simulation.

AWGN is included in the base unit of the IZT S1000.

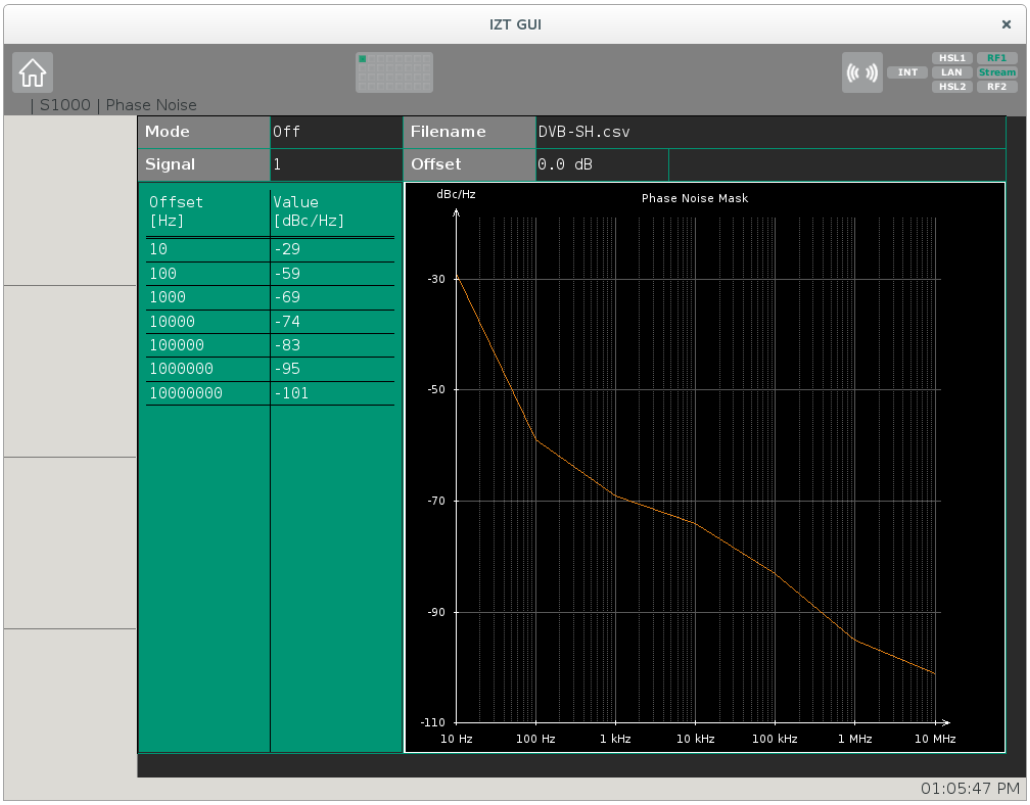
Customers who want to perform SDARS receiver type acceptance testing can use the option S1000-304, S1000-305, S1000-306 to simulate the necessary impairments.

The VSG impairments can be independently applied to VSGs.

9.1. IZT S1000-301 phase noise simulation

The IZT S1000-301 simulates phase noise of the transmitter or the receiver, based on a user controllable phase noise mask.

The phase noise simulation can be applied to one of the VSGs. The phase noise mask is configured in the IZT GUI and is applied instantly. The maximum phase noise bandwidth is 1,25 MHz.



9.2. IZT S1000-302 nonlinearity simulation and output filter simulation

9.2.1. Nonlinearity simulation

Every channel can have its own nonlinearity simulation. The number of independent nonlinearity models is limited to 4. So if more than 4 channels use nonlinearity simulation some have to share the same model.

This option can be used to simulate amplifier nonlinearity which is an important feature for realistic simulation of OFDM transmitters, satellite downlinks and pulsed systems, where nonlinear amplifiers are subject to complex waveforms.

For simulation of the transmitter power amplifier AM/AM and AM/PM conversion, four look-up tables with 1k complex entries are provided. Each VSG can be assigned to one of the tables with individually settable input backoff.

9.2.2. Output filter simulation

Each VSG can be sent through its individual 10 pole IIR filter. This simulates the narrow-band pass filter usually placed at the output of a high power transmitter.

9.3. IZT S1000-304 fading channel simulation with fixed delays

The number of fading paths is limited to 32. The total sample rate of all fading paths is limited to 160 MSps. The relative delay between the paths can be set with sub nanosecond resolution but relative and absolute delay is fixed during simulation.

9.4. IZT S1000-305 power level profiles

Power level profiles allow the user to change the attenuation of the signal every 12,8 µs or multiples of it. Therefore this feature can be used to simulate drives under bridges or through tunnels. Short drop-outs or large-scale fading can help the developer of new hardware to identify the limits of the hardware and allow him to improve his equipment.

If an emitter is output on both RF outputs then both outputs use the same profile for this emitter or one RF output use the profile and the other RF output use a constant level for this emitter.

9.5. IZT S1000-306 frequency profile / delay profile

For every channel or fading path the delay can be varied by a profile. The profile contains delay change rates. The minimum update rate of the profile is 12,8 µs. The update rate of the profile can be adjusted to 12,8 µs or multiples of 12,8 µs.

Every channel can vary the center frequency by a profile. The minimum update rate of the profile is 12,8 µs. The update rate of the profile can be adjusted to 12,8 µs or multiples of 12,8 µs.

The profile feature can be used for Doppler simulation or frequency hopper simulation. The hopps have to be within the 120 MHz continuous bandwidth.

9.6. IZT S1000-307 shaped noise

Each RF output can have an individual AWGN applied. The noise can cover the complete 120 MHz continuous bandwidth. The bandwidth, the center frequency and the level of the noise can be adjusted.

Additionally it is possible to load a shaping waveform to the IZT S1000 which allows to generate an up to 120 MHz individually shapeable AWGN waveform. It can be used to create new and non standard waveforms.

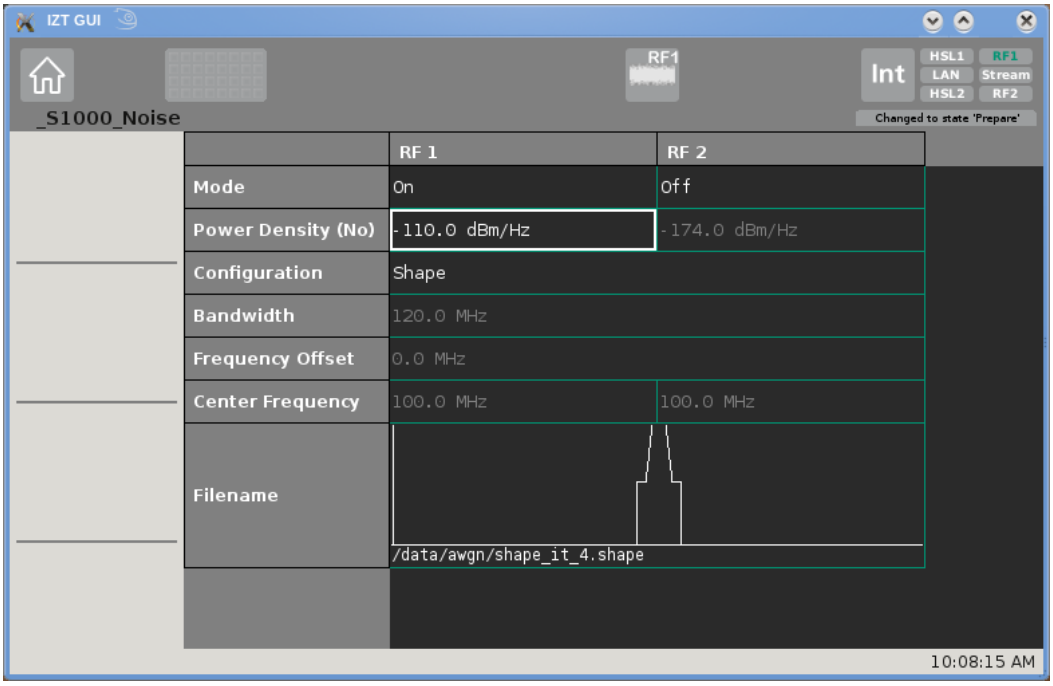


figure 11: Noise configuration in IZT GUI

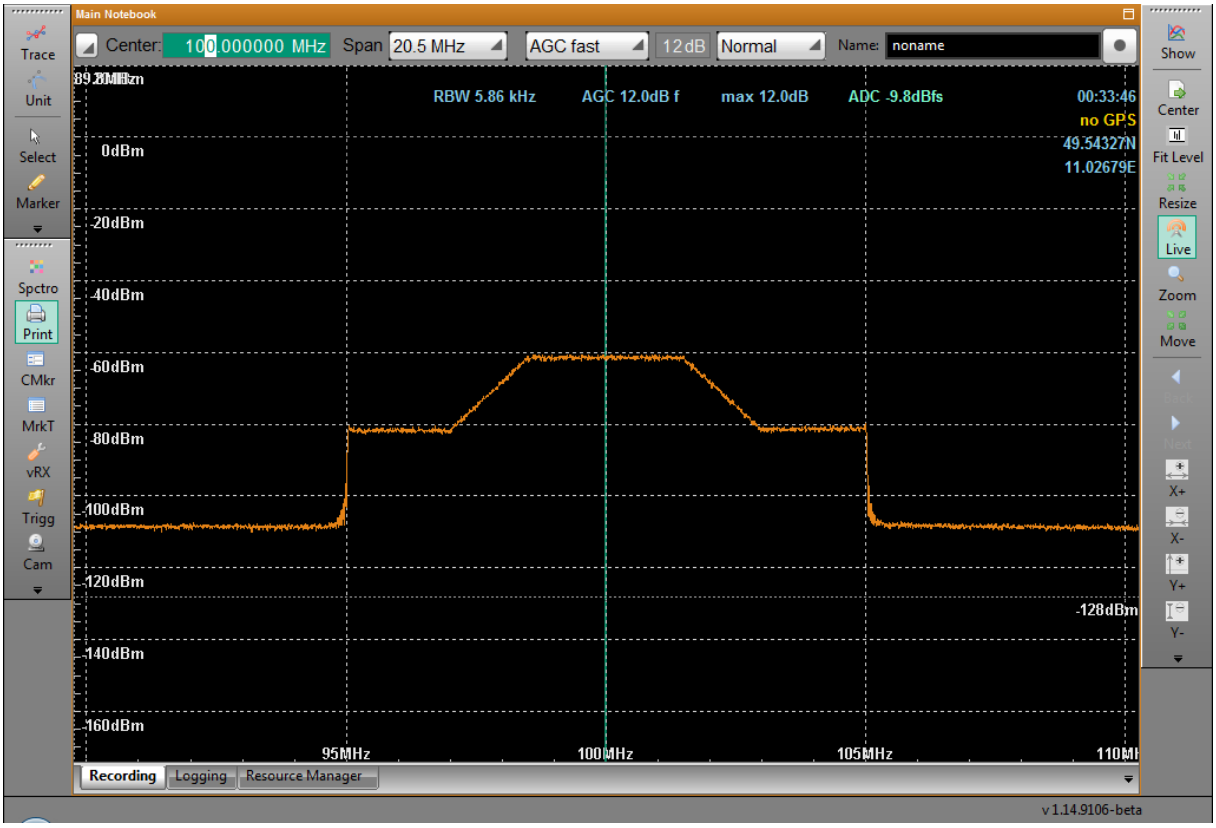
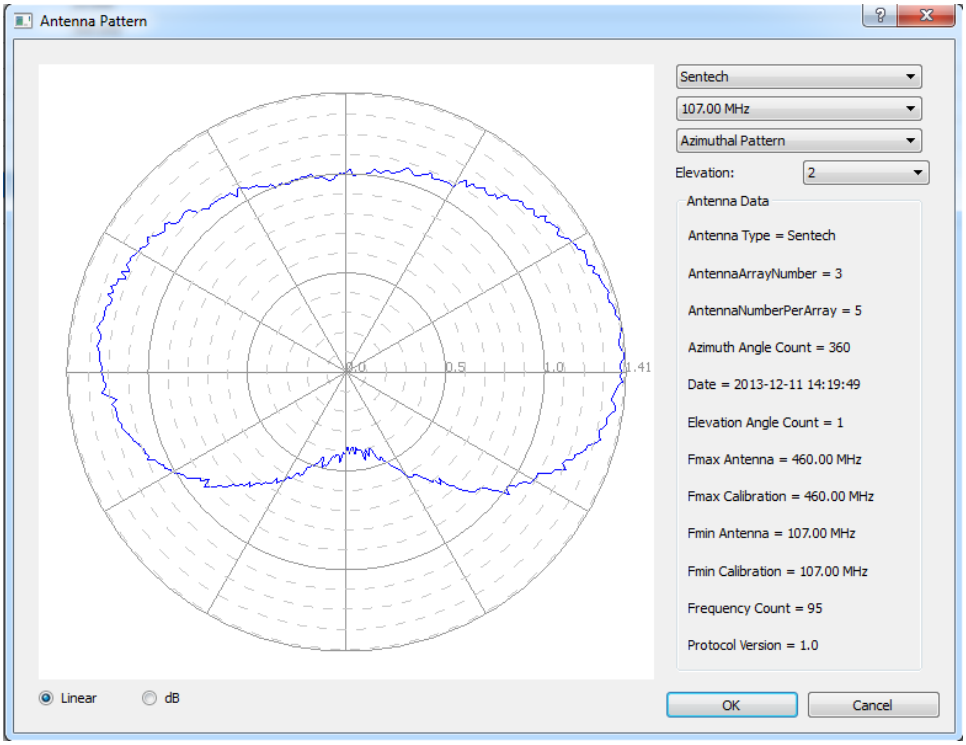


figure 12: Spectrum of configured shaped noise

9.7. IZT S1000-308 antenna diagram

The antenna diagram is a five dimensional array containing frequency, antenna element, azimuth, elevation and a complex gain.

When using the S1000 in a stimulator for testing radio direction finders via cable injection, it is possible to load the antenna diagrams of the DUT into the generator. The S1000 will then apply the appropriate power and phase simulating the antenna according to frequency, azimuth and elevation.



9.8. IZT S1000-310 COMINT package

The COMINT package contains all needed options to use the S1000 for COMINT applications.

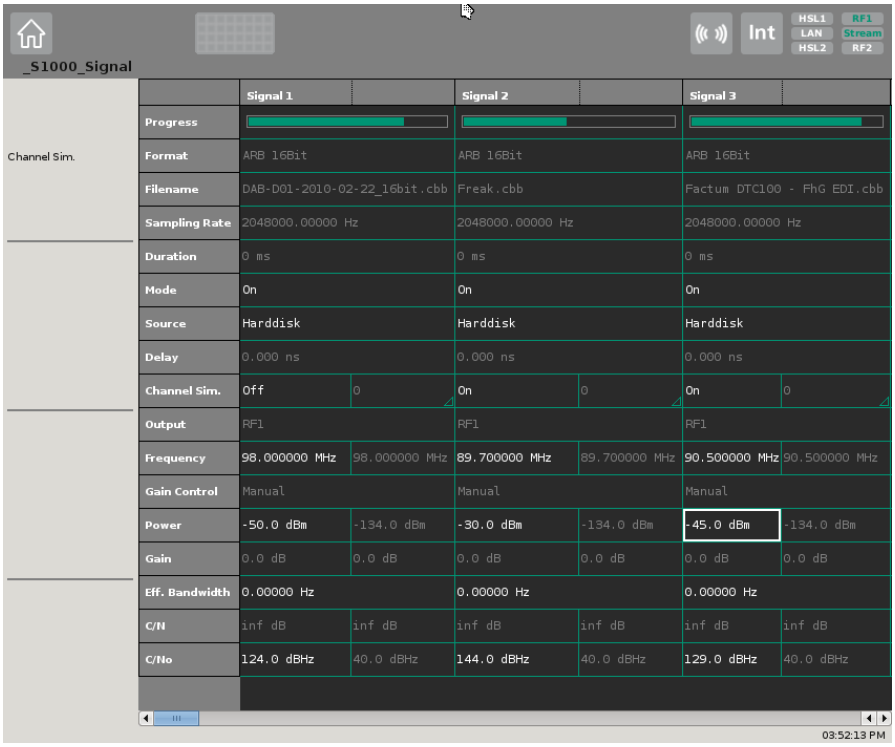
This package uses a special subset of options from S1000-304, S1000-305, S1000-306, S1000-308, S1000-120 and S1000-140.

10. IZT S1000 software options

The IZT S1000 software options are available for IZT S1000 and IZT S1010 in the same way.

10.1. IZT S1000-GUI

The IZT S1000-GUI Graphical User Interface has been specially designed for a rapid and user-friendly control of multiple signals. These support a fast and reliable navigation within the signal generator and enable the user to configure complex scenarios in just a few steps.
The parameters of the Virtual Signal Generators are organized in a grid layout with
a minimum number of layers. The front panel allows fast navigation through the grid and quick access those parameters, which are changed most frequently during operation. The GUI provides optimal support for the user by checking settings for inconsistencies and giving hints about how to resolve them.



10.2. IZT S1000-402 FM-RDS GUI

The powerful real-time FM-RDS signal processing of the IZT S1000 provides a state of the art RDS implementation. It converts regular PCM wave files to I/Q files which can be loaded to the IZT S1000 RAM, streamed from HDD or LAN.

The RDS tool is capable of setting AF, CT, EON, PI, PS, PTY, REG, RT, TA, TP.

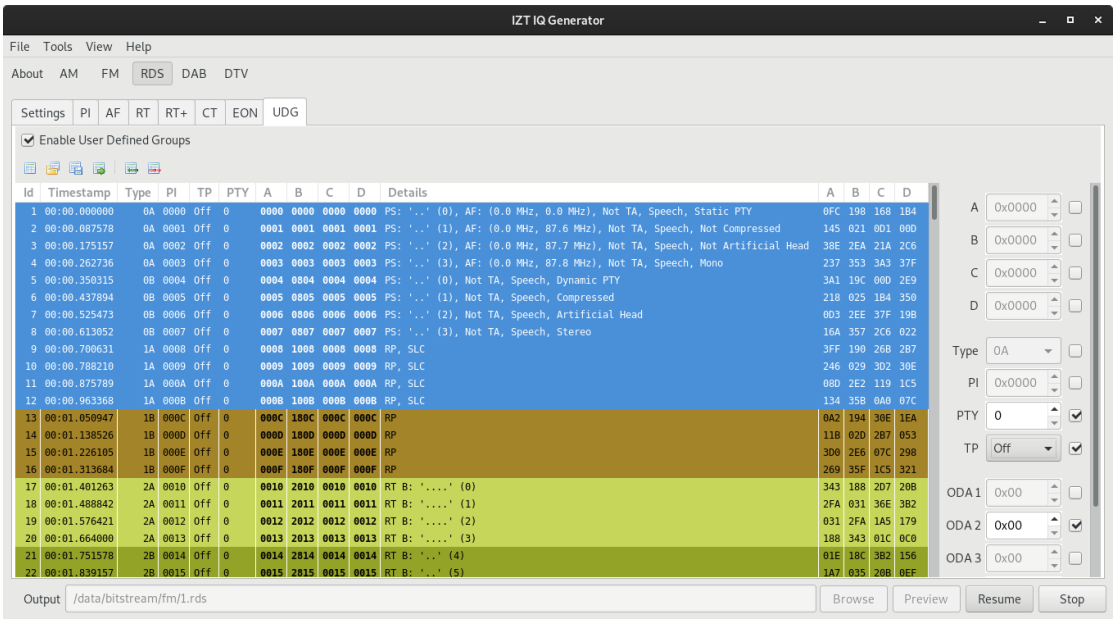


figure 13: Front panel of the IZT RDS GUI

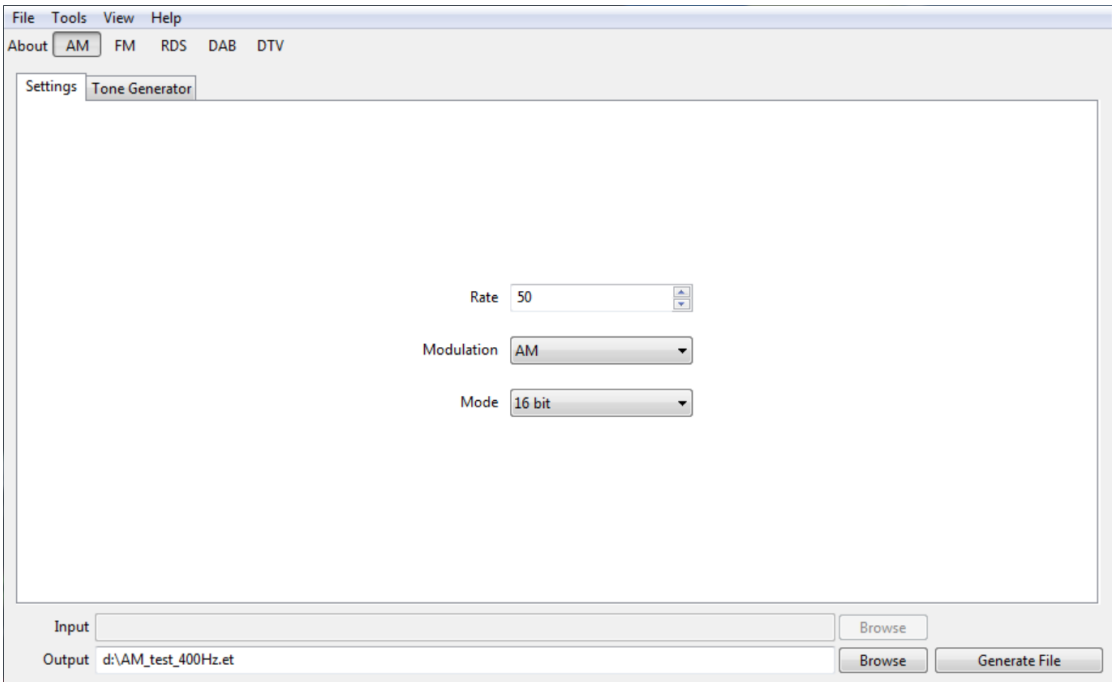


figure 14: Front panel of the IZT AM GUI

PCM wave files can be modulated to I/Q files and can be played with the IZT S1000. Modulation grade and modulation type can be changed.

10.3. IZT S1000-403 DAB waveform

The IZT S1000-403 option includes a DAB modulator which allows to generated DAB-I/Q files from any ETI file format. The waveform is compatible to DAB, DAB+ and DMB. The I/Q files which can be loaded to the IZT S1000 RAM, streamed from HDD or LAN.

Supported ETI file formats are:

RAW (ETI NI)

RAW (ETI LI)

Supported DAB modes are:

automatically detected from ETI

manually mode 1 .. 4

The output file format can be selected from 12-bit or 16-bit I/Q format.

The range can be adjusted to create best quality I/Q format.

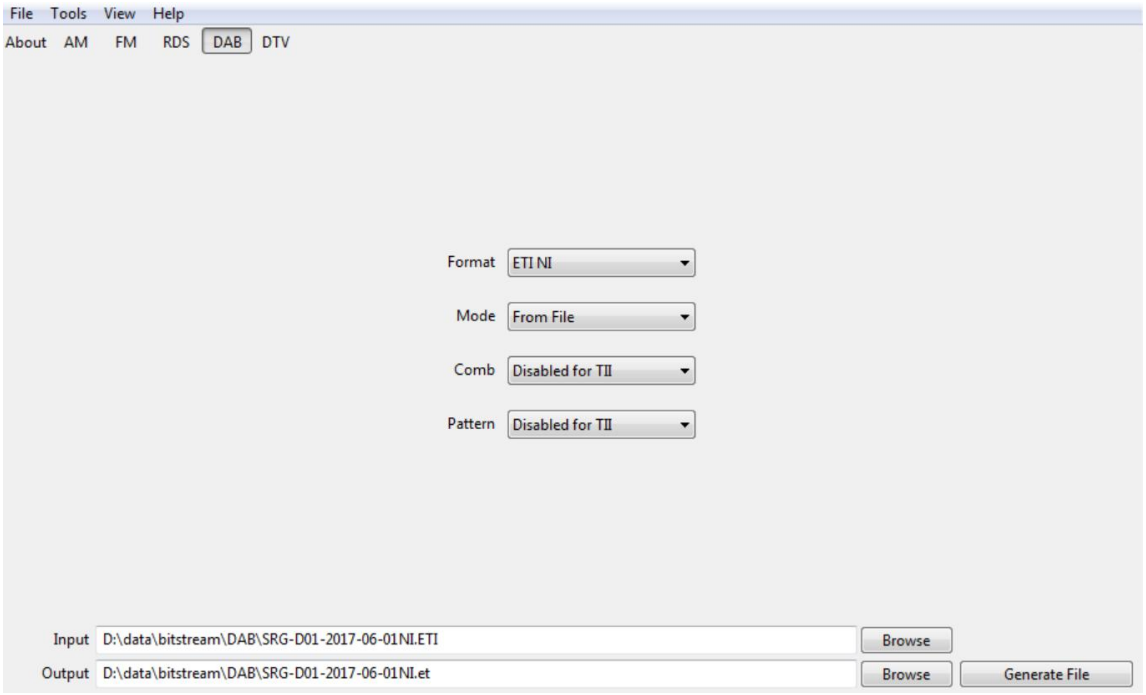


figure 15: Front panel of the IZT DAB modulator

10.4. IZT S1000-407 DAB/DAB+/DMB ContentServer Embedded Edition

The IZT DAB ContentServer is multiplexer system for DAB, DAB+ and DMB, combining audio encoding, data service management und multiplex.

The DAB ContentServer Embedded Edition is only available in combination with the S1000/S1010 signal generator and is installed on Memory Extension, Memory Extension+ or the S1010. It includes limited functionality for basic DAB receiver testing. Other features can be added as individual upgrades according to a separate ordering guide.

For full-featured DAB functionality, please refer to the IZT DAB ContentServer Developer Edition.

See also options IZT S1000-202, 202b and 403 for modulation of the resulting ETI and EDI test streams.

10.5. IZT S1000-408 DVB-T GUI

The IZT S1000-406 option includes a DVB-T modulator which allows to generate DVB-T I/Q files from transport stream files.

These TS files are COFDM modulated and either loaded to the internal memory or streamed from external server to the Gbit Ethernet ports.

The modulator supports all specified levels of QAM modulation and inner code rates. Two-level hierarchical channel coding and modulation, including uniform and multi-resolution constellations, are possible.

The playback of DVB-T I/Q files is included in standard configuration.

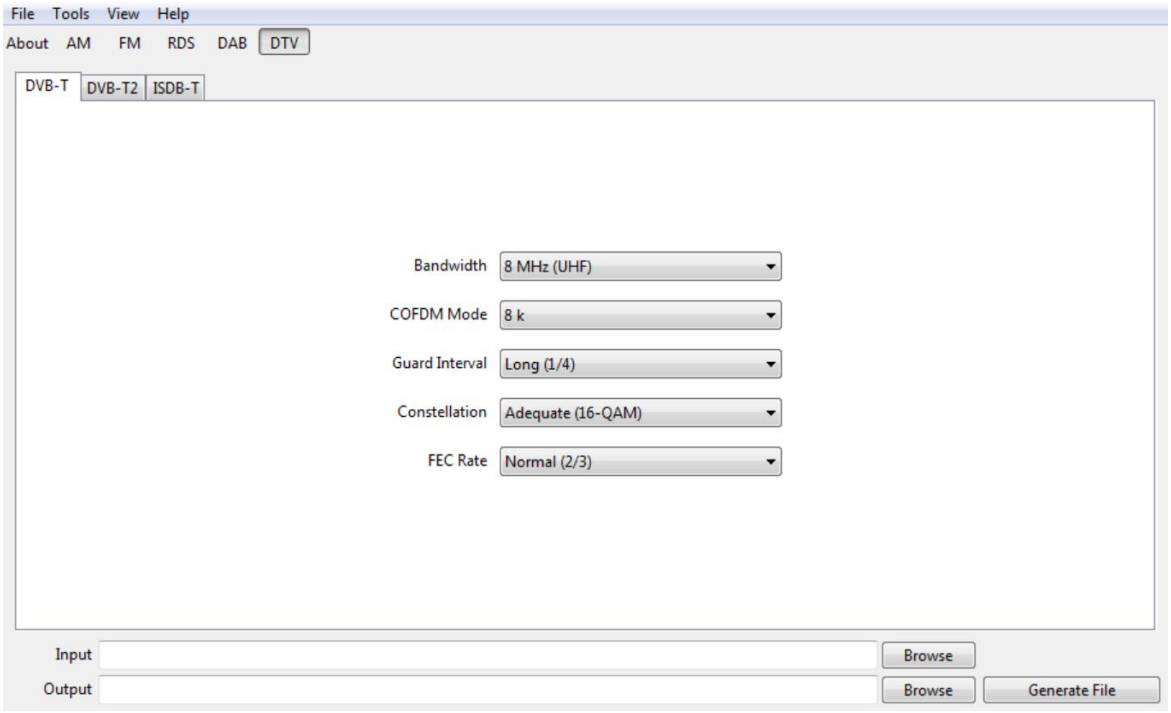


figure 16: Front panel of the IZT DVB-T modulator

10.6. IZT S1000-409 DRM30 modulator

The DRM30 modulator is a software-defined real-time modulator for DRM30. It combines a DRM content server management system with flexible data rate switching, service configurability as well as many DRM-related content generation features. This include AAC+, MOT slideshow, MOT website2, PRBS and pre-coded or live xHE-AAC (license S1000-416 required).

DRM30 robustness modes A, B, C, D as well as many baseband-postprocessing features are included (FIR, AWGN, PAPR reduction).

Along with the software, a Graphical User Interface is provided for setting up the DRM signal parameters (for example audio bit rate, transmission mode, spectrum occupancy), the stream sources and destinations and the service information (for example station label)

Live audio input from PC Audio cards is included.

10.7. IZT S1000-410 DRM30/DRM+ modulator

The DRM+ generator is a software-defined real-time modulator for DRM30 and DRM+ (Mode E). It combines a DRM/DRM+ content server management system with flexible data rate switching, service configurability as well as many DRM-related content generation features. This include AAC+, MOT slideshow, MOT website2, PRBS and pre-coded or live xHE-AAC (license S1000-416 required).

DRM30 robustness modes A, B, C, D as well as many baseband-postprocessing features are included (FIR, AWGN, PAPR reduction).

The DRM+ Option extends the functionality of the DRM30 modulator to support robustness mode E for transmissions in the VHF range.

Along with the software, a Graphical User Interface is provided for setting up the DRM/DRM+ signal parameters (for example audio bit rate, transmission mode, spectrum occupancy), the stream sources and destinations and the service information (for example station label).

10.8. IZT S1000-410a DRM30/DRM+ Modulator for MDI

The DRM30/DRM+ Modulator for MDI Option can receive MDI data from UDP broadcast of from MDI file and modulate the signal to IQ16. These files can be directly used on the IZT S1000 for replay.

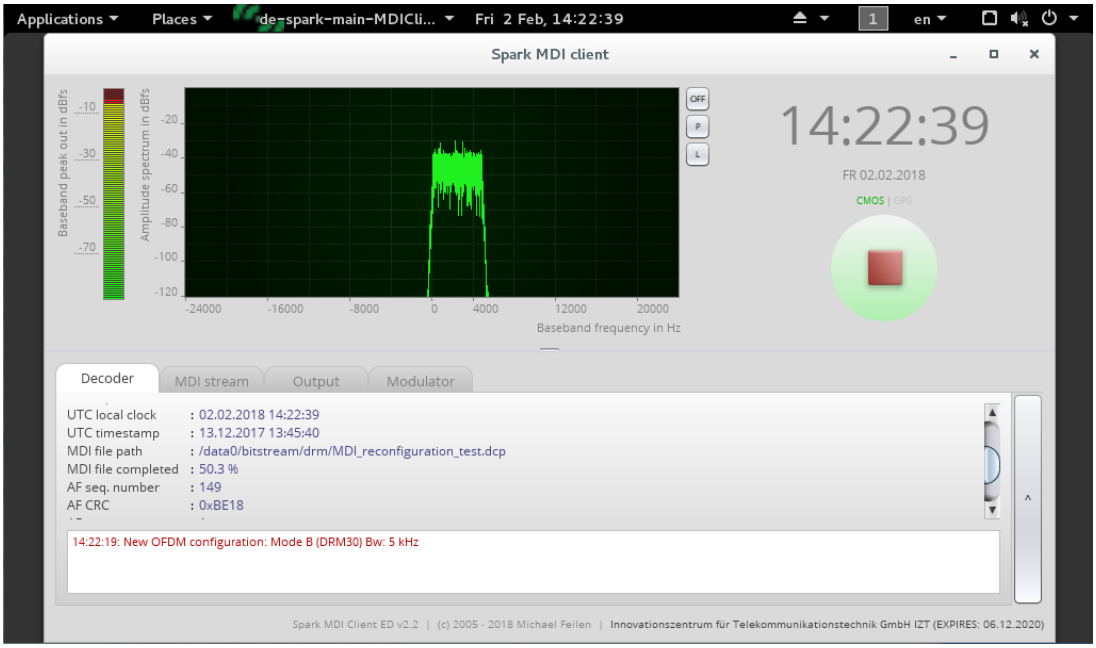


figure 16: GUI of DRM30/DRM+ Modulator for MDI

10.9. IZT S1000-410b Modulator Bundle (S1000-410/-410a)

This option is a bundle for S1000-410 and 410a.

This bundle option is a combination of DRM30, DRM+ Multiplexer, MDI Modulator and MDI input.

10.10. IZT S1000-411 Software Modulation Generator SMG

The software packet allows to generate I/Q files in single and multiple channel and continuously or burst signals.

Modulation types:

ASKn, PSKn (single and multi-channel)

QAMn (single and multi-channel), ASKnPSKm (single and multi-channel)

NCPFSKn

FSKn (single and multi-channel)

MSK (single and multi-channel)

GMSK (single and multi-channel)

F7B

TFM3

TFM5

Morse

Sine

Rectangle

Saw tooth

Triangle

Modulation of speech signals:

AM and FM modulation

Support of LSB and USB

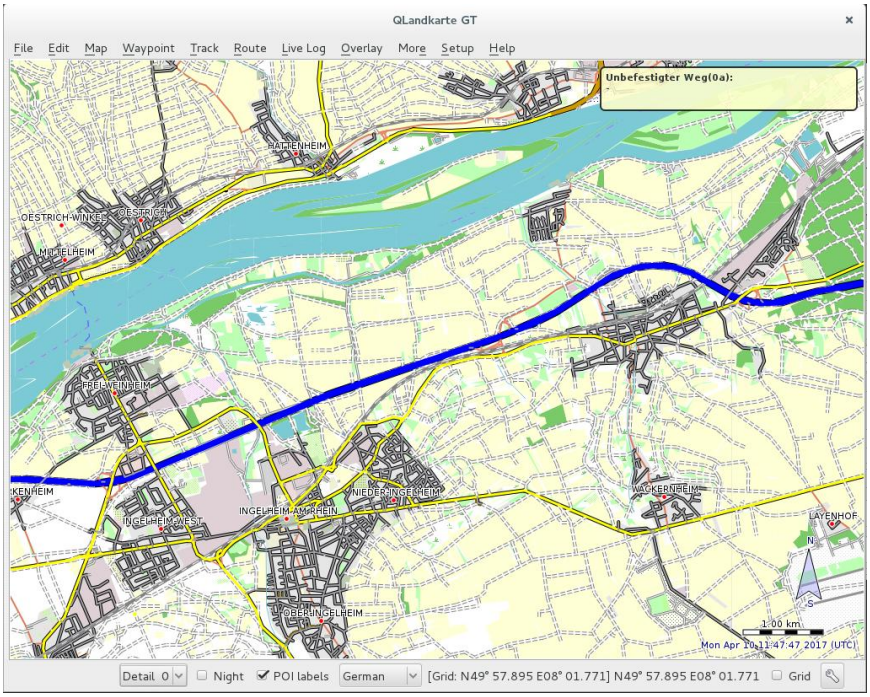
Speech input from .wav files

Primary modulation:

USB, LSB, AM, FM

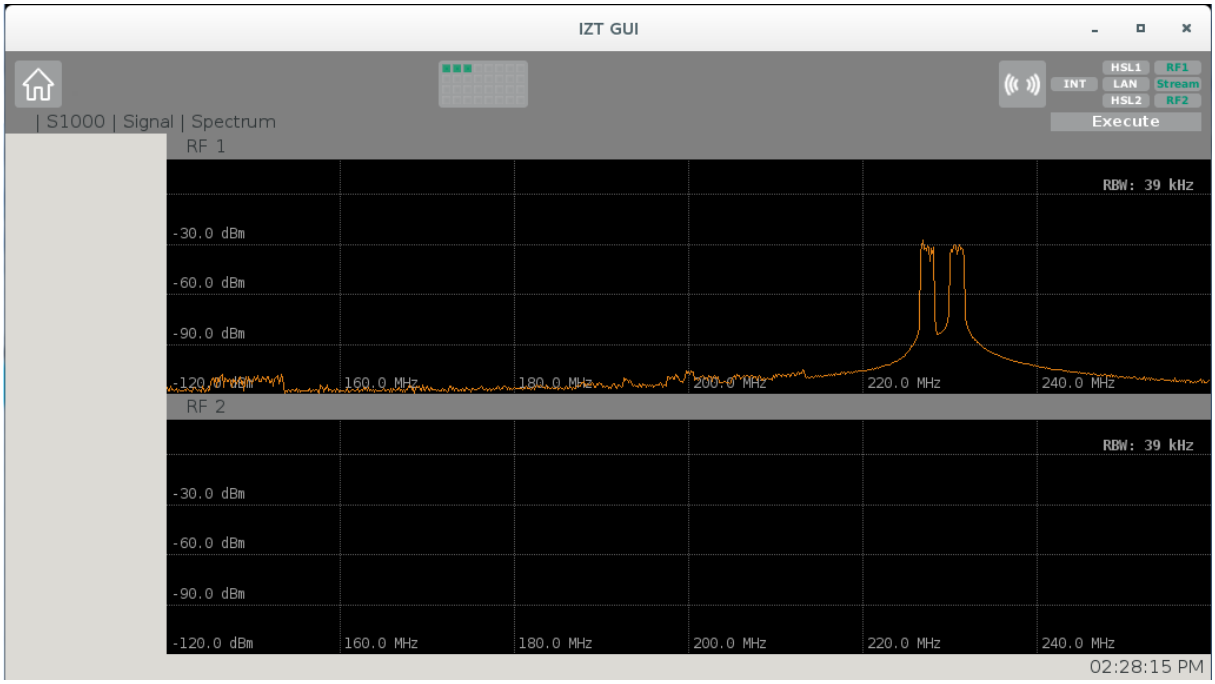
10.11. IZT S1000-412 GPS Interface

This option enables the GPS extraction of the NMEA Data from IZT R3000 recordings. The embedded GPS meta data inside the IQ streams is extracted and sent to Map Visualization software. IZT provides the QLandkarte GT software and The replayed route is shown on the mapping tool.



Additionally it is possible to send the NMEA to a RS232 interface.

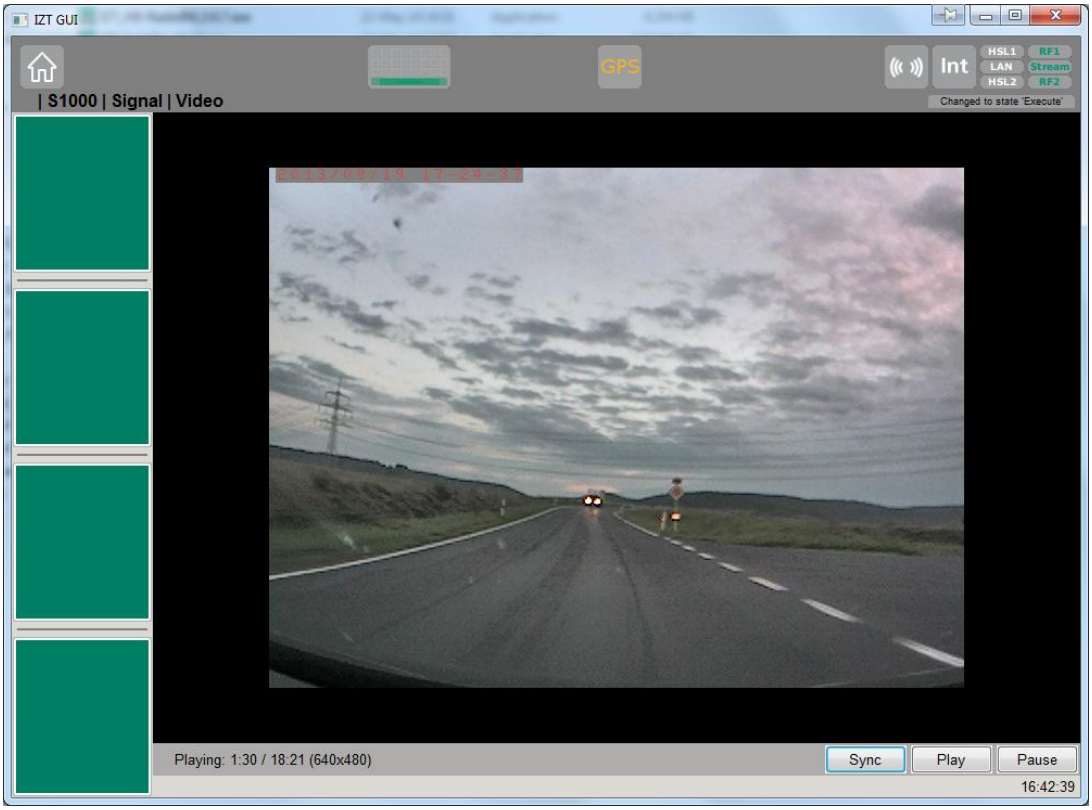
10.12. IZT S1000-413 spectrum display



The option S1000-413 enables the spectrum visualisation of both RF outputs. This helps to have a very quick overview of all generated signals in the 120 MHz bandwidth.

10.13. IZT S1000-414 video playback

The IZT S1000-414 option enables the video visualisation of R3000 recordings which are combined with video content. This helps to get additional video information besides the GPS location when replaying recordings. The video is fully synchronous to the start time, duration, length and loop parameters.



10.14. IZT S1000-416 DRM/DRM+ upgrade to xHE-AAC / HE-AAC

The DRM Modulator options IZT S1000-409 and IZT-S1000-410 can be extended by up to four xHE-AAC / HE-AAC encoder instances. The supported encoder engine is provided by Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V. and can be licensed together with the DRM and DRM+ modulator.

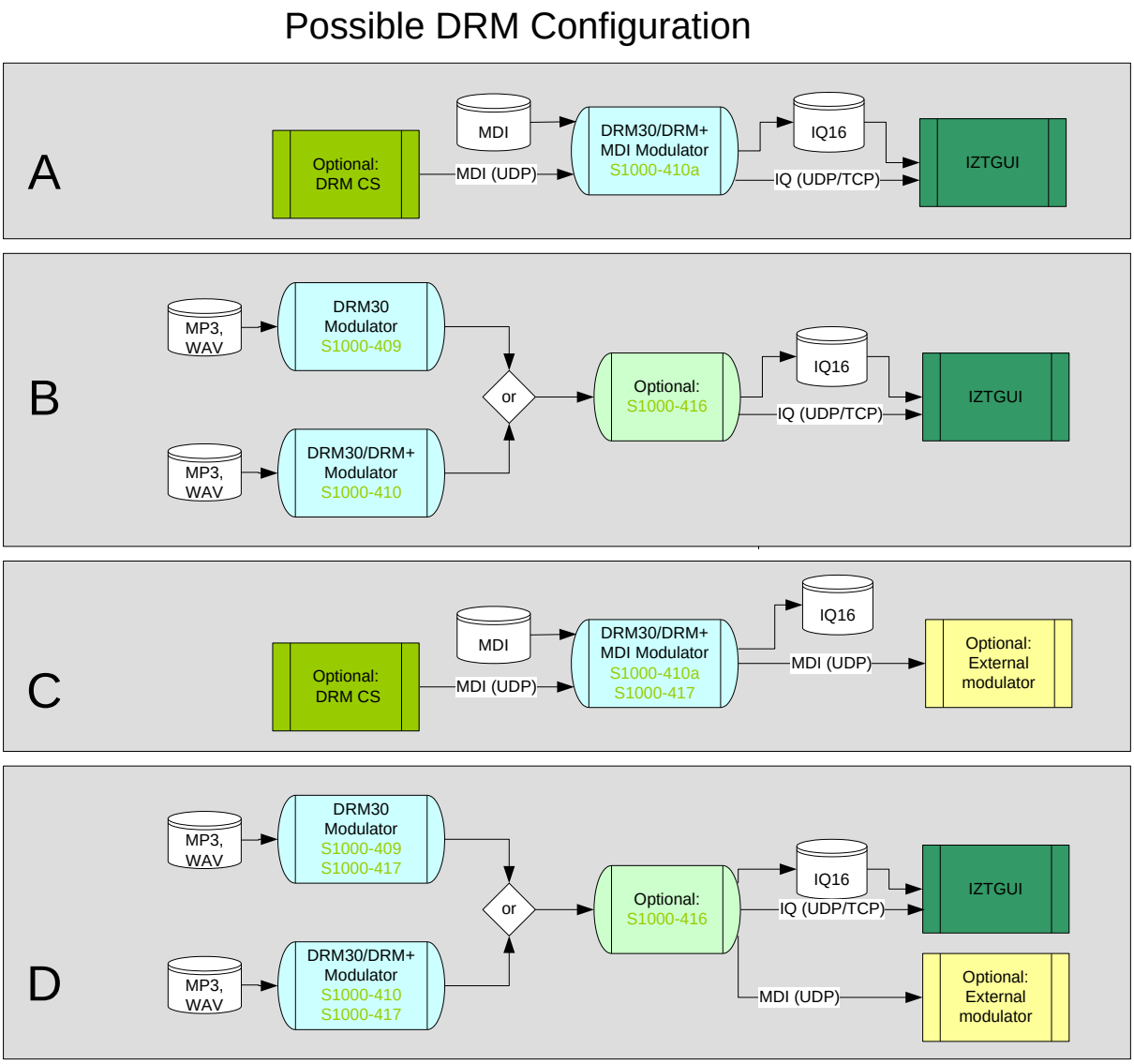
The option provides a xHE-AAC / HE-AAC encoder which can be used for the audio service encoding.

10.15. IZT S1000-417 MDI Output

This option extends S1000-409, S1000-410, S1000-410a (S1000-410b) by the MDI output functionality.

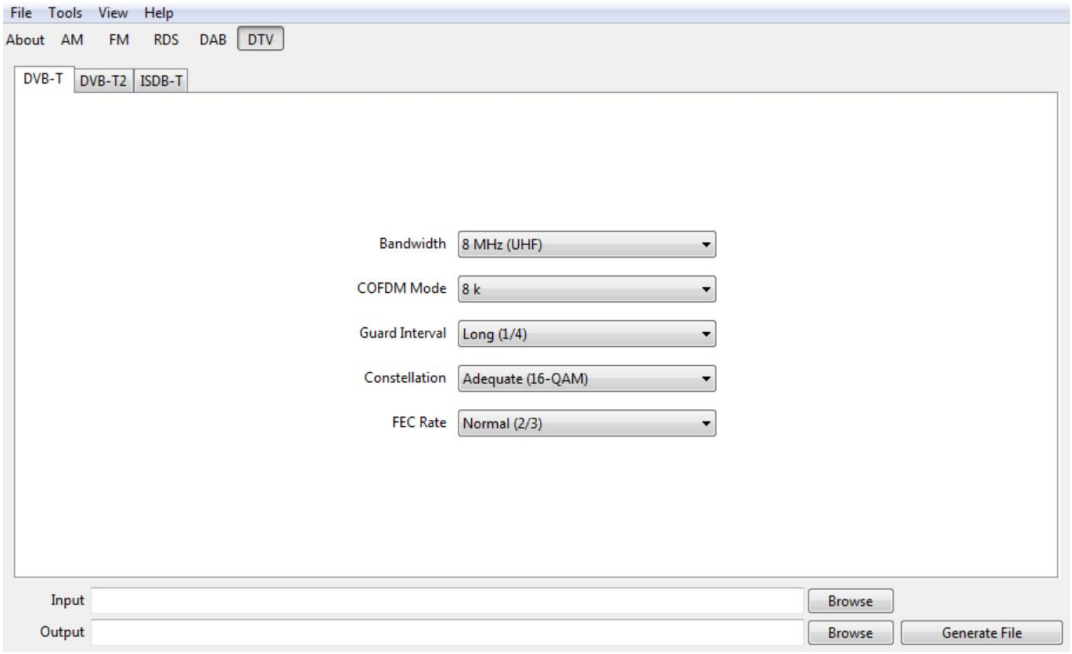
The MDI Output can be used with an external Modulator like the DT230.

10.16. Possible DRM Configurations

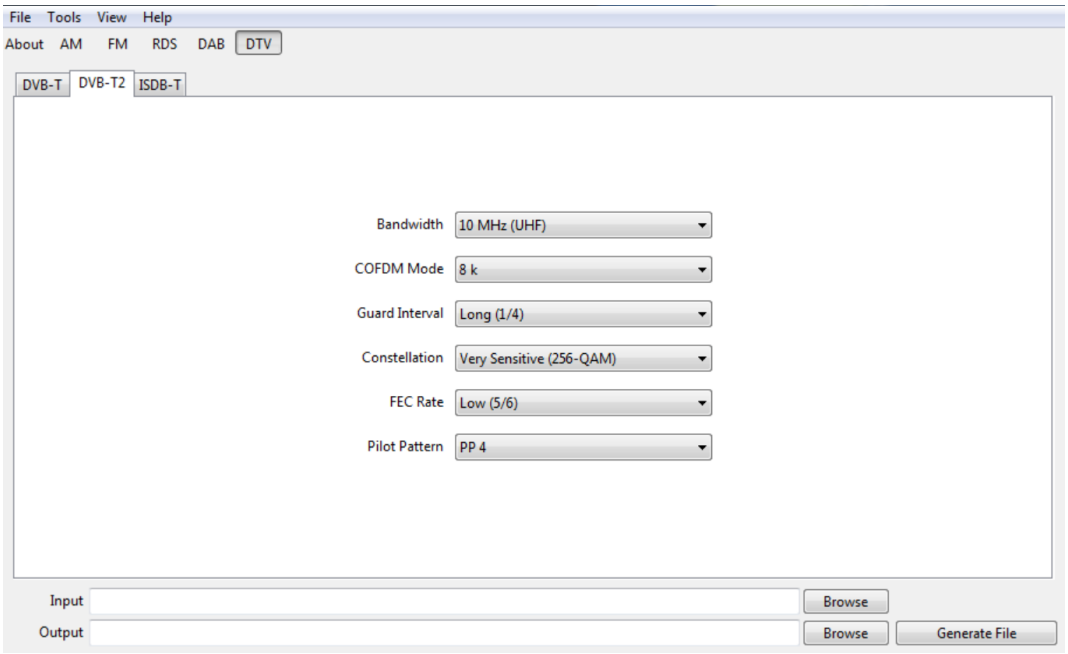


10.17. IZT S1000-418 DVB-T modulation toolbox

The DVB-T modulation toolbox generates modulated DVB-T signals from DVB-T transport streams which can be replayed on an IZT S1000 Signal Generator with the option IZT S1000-418a. The toolbox can be installed on separate PC or IZT Memory Extension.

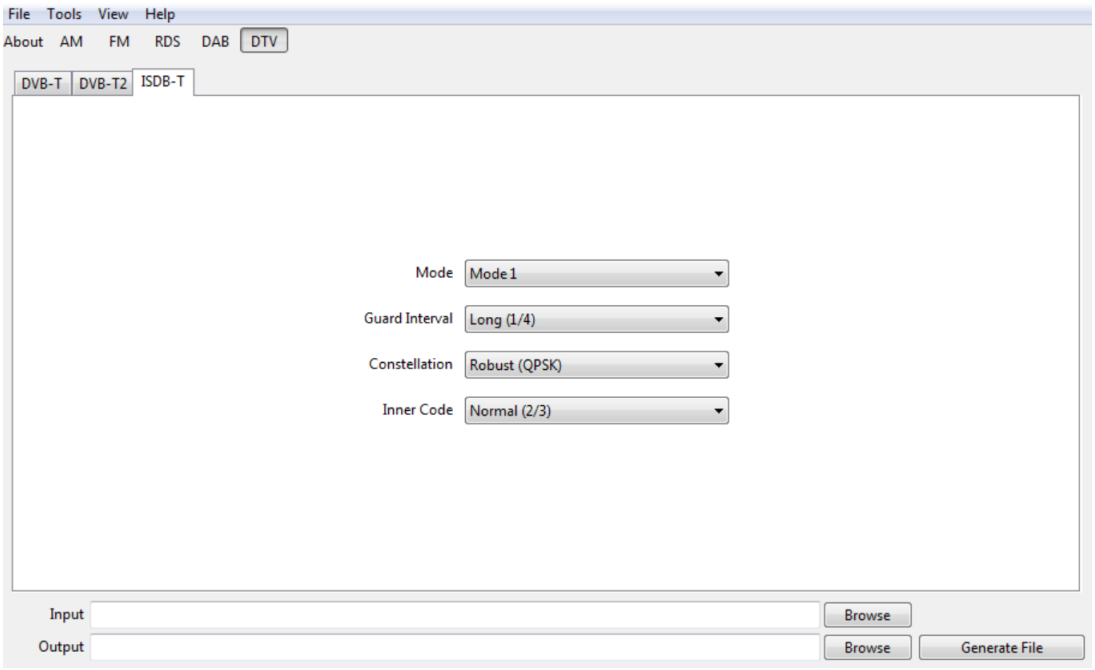


10.18. IZT S1000-419 DVB-T2 modulation toolbox



The DVB-T2 modulation toolbox generates modulated DVB-T2 signals from DVB-T2 transport streams which can be replayed on an IZT S1000 Signal Generator with the option IZT S1000-419a.The toolbox can be installed on separate PC or IZT Memory Extension.

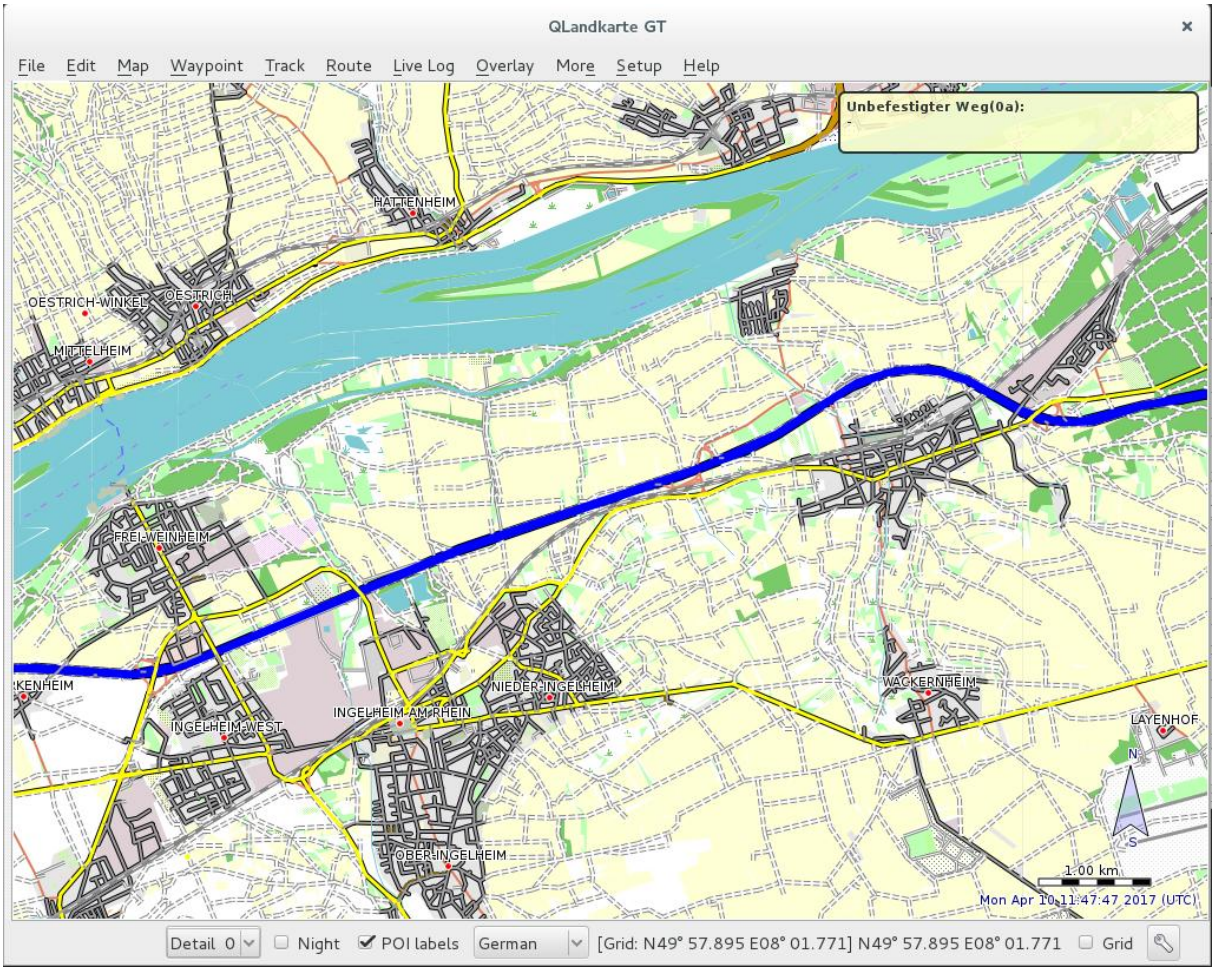
10.19. IZT S1000-420 ISDB-T modulation toolbox



The ISDB-T modulation toolbox generates modulated ISDB-T signals from transport streams which can be replayed on an IZT S1000 Signal Generator with the option S1000-420a. The toolbox can be installed on separate PC or IZT Memory Extension.

10.20. IZT S1000-430 GPS Interface

This option enables the GPS extraction of the NMEA Data from IZT R3000 recordings. The embedded GPS meta data inside the IQ streams is extracted and sent to Map Visualization software. IZT provides the QLandkarte GT software and The replayed route is shown on the mapping tool.



Additionally it is possible to send the NMEA to a RS232 interface.

11. GNSS – Global Navigation Satellite System

The Software based GNSS Simulator GIPSIE from TCA(OHB) simulates the satellite orbits by using a sophisticated orbit integrator including modelling of environmental parameters like satellite clocks, transmit power, antenna patterns, ionosphere and troposphere. The IF signal simulation is based on various settings for simulation of a user-defined radio-frequency front-end.
Furthermore the S1000 can be used to simulate jamming and spoofing scenarios on with realistic channelpower, frequency and delay variations.

The GNSS simulator calculates the satellite orbits by using a sophisticated orbit integrator including modelling of environmental parameters like satellite clocks, transmit power, antenna patterns, ionosphere and troposphere.

The GNSS simulator is available in different configurations for the supported satellite standards.

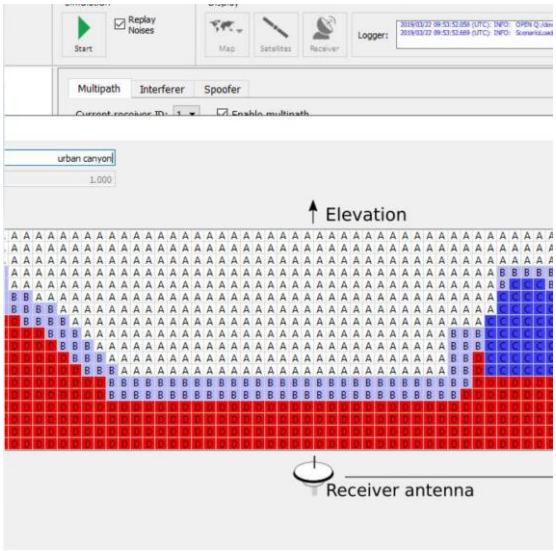
The S1000-GNSS-HS option is a specially built binary edition of the GNSS simulation software which supports moving objects in excess of 600m/s. The regular binary edition is limited to 600m/s.

The details of the supported standards are explained in the following table.

GIPSIE is licensed from:

The system is composed of the following software modules:

- Orbit integration module based on earth gravitational model including gravitational effects of sun and moon
- Simulation of complete GNSS constellations including all satellites based on default almanac or accurate ephemeris information and clock parameters
- Simulation of accurate atmospheric models for ionospheric and tropospheric delays
- Simulation of user-defined receiver antenna characteristics including reception gain patterns and multipath effects



- Navigation message simulation based on GNSS ICDs or customized user-defined message formats
- IF signal simulation based on the constellation updates with userdefined update rate and bandwidth
- 100% reproducible noise and signal degradation simulations
- Graphical user interface
- Comprehensive data logging of all intermediate results for detailed analyses and debugging support

Supported Satellite signals and features of the GNSS simulator are:

- ❖ GPS: L1 C/A, L1 C (planned), L2 CM/CL, L5 I/Q
- ❖ Galileo: E1 OS (B/C), E5a, E5b, E5 (I/Q)
- ❖ GLONASS: G1 C/A, G2 C/A
- ❖ BeiDou: B1 (I/Q), B2 (I/Q)
- ❖ NavIC: L5 SPS (I/Q), S Band SPS (I/Q)
- ❖ QZSS: L1 C/A, L2 C, LEX
- ❖ SBAS: L1 C/A
- ❖ Constellation Update Rate: up to 1000 Hz
- ❖ Resolution: up to 2x16 bit (complex I/Q)
- ❖ Operating system: Windows / Linux

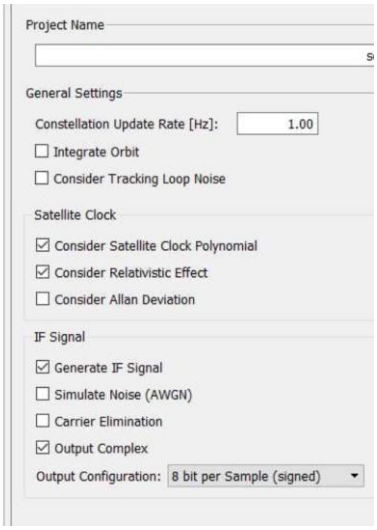
"Record & Replay" of recorded and software generated digital IF data

Cost savings during receiver development, verification, qualification and certification

time consuming outdoor testruns and validations are eliminated

Logging of simulation parameters possible

XML Configuration



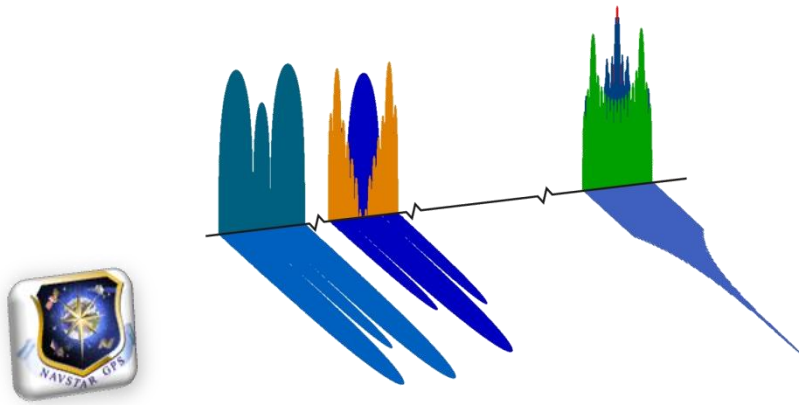
In following table are listed all GNSS options supported by IZT S1000 and IZT S1010.

GNSS Option	Features of Satellite Constellation Simulator (Gipsie)
IZT S1000-GNSS-BASE	GPS constellation and IF signal simulator including the following signals: – GPS L1 C/A – GPS L2 C – GPS L5 I/Q Simulation of the following features: – Satellite orbits based on ephemeris or orbit integration – Satellite clock model – Atmospheric delays – Antenna gain pattern – IF signal parameters including RFFE simulation – Statistical multipath model with time-dependant obstruction mask – Realistic and reproducible noise components – User-configurable navigation message contents
IZT S1000-GNSS-HS	GNSS simulation version which supports moving objects in excess of 600m/s.
IZT S1000-GNSS-GLONASS	Additional GLONASS signals: – GLONASS G1 C/A – GLONASS G2 C/A
IZT S1000-GNSS-GALILEO	Additional Galileo signals: – Galileo E1 OS – Galileo E5 (E5a + E5b) OS
IZT S1000-GNSS-BEIDOU	Additional Beidou signals: – *Beidou B1 D1-Nav* – *Beidou B2 D1-Nav*
IZT S1000-GNSS-NAVIC	Additional NavIC signals: – *NavIC L5 SPS* – *NavIC S SPS*

IZT S1000-GNSS-QZSS	Additional QZSS signals: – *QZSS L1 C/A* – *QZSS L2 CM* – *QZSS L5 I/Q* – *QZSS L1 SLAS* – *QZSS E6 CLAS*
IZT S1000-GNSS-SBAS	Additional SBAS signals: – *SBAS L1 C/A* The following SBAS systems are supported: – *WAAS, EGNOS, SDCM, GAGAN, MSAS*
IZT S1000-GNSS-MULT-RCV	Multiple receivers within one simulation sharing a consistent and realistic simulation of noise and environmental components
IZT S1000-GNSS-ECALL-BASE	Predefined eCall Test scenarios: – *Includes IZT S1000-GNSS-BASE, IZT S1000-GNSS-SBAS and IZT S1000-GNSS-GALILEO* – *GIPSIE scenarios* – *Precomputed IF signals* – *Predefined IZTGUI Configurations*
IZT S1000-GNSS-ECALL-VAL	eCall Receiver Validation: Validation software for user receiver per eCall requirements based on NMEA receiver logs

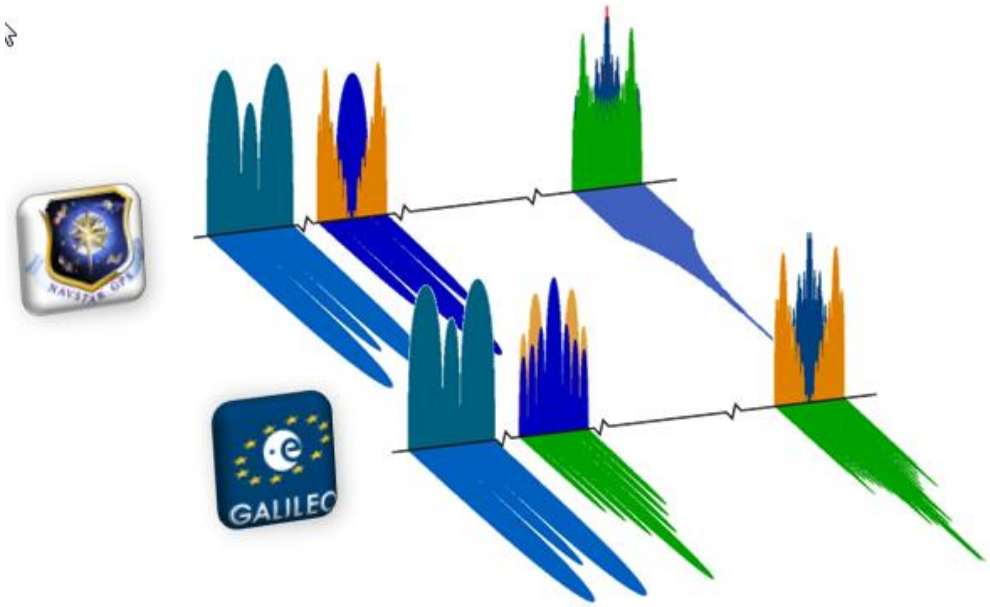
11.1. GPS

The Global Positioning System (GPS), originally Navstar GPS, is a space-based radionavigation system owned by the United States government and operated by the United States Air Force. It is a global navigation satellite system that provides geolocation and time information to a GPS receiver anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites.



11.2. Galileo

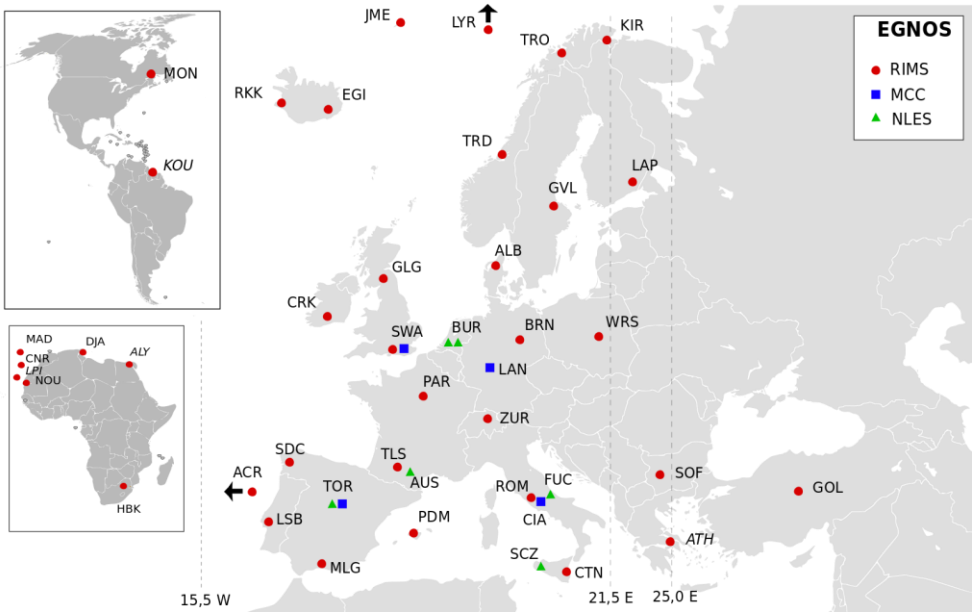
Galileo is the global navigation satellite system (GNSS) that is currently being created by the European Union (EU) through the European Space Agency (ESA) and the European GNSS Agency (GSA), headquartered in Prague in the Czech Republic, with two ground operations centres, Oberpfaffenhofen near Munich in Germany and Fucino in Italy. One of the aims of Galileo is to provide an independent high-precision positioning system so European nations do not have to rely on the Russian GLONASS, Chinese BeiDou or US GPS systems, which could be disabled or degraded by their operators at any time. The use of basic (lower-precision) Galileo services will be free and open to everyone. The higher-precision capabilities will be available for paying commercial users. Galileo is intended to provide horizontal and vertical position measurements within 1-metre precision, and better positioning services at higher latitudes than other positioning systems.



11.3. EGNOS

The European Geostationary Navigation Overlay Service (EGNOS) is a satellite based augmentation system (SBAS) developed by the European Space Agency and EUROCONTROL on behalf oft he European Commission . It supplements the GPS, GLONASS and Galileo satellite navigation systems by reporting on the reliability and accuracy of their positioning data and sending out corrections.

EGNOS consists of a network of about 40 ground stations and 3 geostationary satellites. Ground stations determine accuracy data of the satellite navigation systems and transfer it to the geostationary satellites; users may freely obtain this data from those satellites using an EGNOS-enabled receiver, or over the internet. One main use of the system is in aviation.



11.4. QZSS

The primary purpose of QZSS is to increase the availability of GPS in Japan's numerous urban canyons, where only satellites at very high elevation can be seen. A secondary function is performance enhancement, increasing the accuracy and reliability of GPS derived navigation solutions.

The Quasi-Zenith satellites transmit signals compatible with the GPS L1C/A signal, as well as the modernized GPS L1C, L2C signal and L5 signals. This minimizes changes to existing GPS receivers.

Compared to standalone GPS, the combined system GPS plus QZSS delivers improved positioning performance via ranging correction data provided through the transmission of sub-meter-class performance enhancement signals L1-SAIF and LEX from QZSS. It also improves reliability by means of failure monitoring and system health data notifications. QZSS also provides other support data to users to improve GPS satellite acquisition.

11.5. IRNSS

The Indian Regional Navigation Satellite System (IRNSS) with an operational name of NAVIC ("sailor" or "navigator" in Sanskrit, Hindi and many other Indian languages, which also stands for navigation with Indian Constellation) is an autonomous regional satellite navigation system that is being set up by India, that will be used to provide accurate real-time positioning and timing services over India and the region extending to 1.500 kilometers (930 miles) around India.

12. Wideband Streaming WBS

The S1000 and S1010 can be reconfigured with an alternative Software and Firmware which enables the Wideband Streaming functionality. In the case of WBS the software Options see chapter 6, 7, 8 and 9 can not be combined.

The S1000-10G Hardware Interface is used to stream from a connected Streaming Server to the S1000 or by the use of the S1010 in a limited streaming bandwidth.

12.1. IZT S1000-500

Wide**B**and **S**treaming GUI

The WBS-GUI controls the S1000 and streams one or two wideband signals from the internal S1010 (*) or from the connected S1000-MemoryExtension-WBS.

When using the S1010 internal streaming the maximum bandwidth which can be streamed is limited to the reading and processiong speed of the System.

When the High-Performance Wideband Steaming Firmware is used the normal S1000 Features are not available.

12.2. IZT S1000-520

Wide**B**and **S**treaming from optical 10G LAN

One 120MHz Bandwidth stream can be provided from an S1000-MemoryExtension-WBS or two times 60MHz.

The IZT S1010 in combination with the S1010-SDD option provides the data on the optical 10G interface and is then prolonged to the fast FPGA based processing board.

12.3. IZT S1000-530

IZT S1000 Trigger functionality for starting signals

This options enables the Signal start trigger functionality. When the signals are configured and activated it is possible to start the signal generation by an external puls and / or with a time. When a rising edge is detected it will issue a start of the signals.

12.4. IZT S1000-531

IZT S1000 Marker functionality

A marker is a digital pulse that can be generate at specific points within a waveform generation. A marker can be placed in every frame segment and used as a trigger for controlling the timing of other devices. For example, marker outputs are commonly used as a digital trigger for high speed digitizers, digital receivers like IZT R3000 and oscilloscopes.

The marker feature can be used to set individually the AUX1 to AUX4 signal outputs on the S1010 or AUX1 and AUX2 on S1000.

The markers which are embedded in the frames of the IQ streams headers are processed in the FPGA and will be used to drive the output levels when the incident (marker) is detected.

The signal level is TTL 3.3V.

A typical minimum configuration might look like this for a wideband streaming setup:

IZT S1000 + S1000 Memory Extension	IZT S1000 + S1000 Memory Extension-WBS	IZT S1010
S1000-CHS (*)	S1000-CHS (*)	S1010-CHS (*)
S1000-RF3 (1*)	S1000-RF3 (1*)	S1000-RF3 or S1000-RF6 (1*)
S1000-RFS3 (1*)	S1000-RFS3 (1*)	S1000-RFS3 or S1000-RFS6 (1*)
S1000-10G (*)	S1000-10G (*)	S1010-10G(*)
S1000-MemoryExtension (*)	S1000-MemoryExtension-WBS (*)	
MemExt-10G (*)	MemExt-10G (*)	S1010-SDD (*)
MemExt-SDD (*)	MemExt-WBS-SDD (*)	
S1000-500 (*)	S1000-500 (*)	S1000-500 (*)
S1000-520 (*)	S1000-520 (*)	S1000-520 (*)

S1000-530	S1000-530	S1000-530
S1000-531	S1000-531	S1000-531

(*) Mandatory items

13. Service

13.1. IZT S1000-CLC

The factory calibration is recommended in a cycle of 2 years to ensure exact power levels. A calibration certificate is included in the calibration process. With the delivery of the unit a first calibration document is included.

13.2. IZT S1000-WE2

Warranty extension of hardware components to 2 years

13.3. IZT S1000-WE3

Warranty extension of hardware components to 3 years

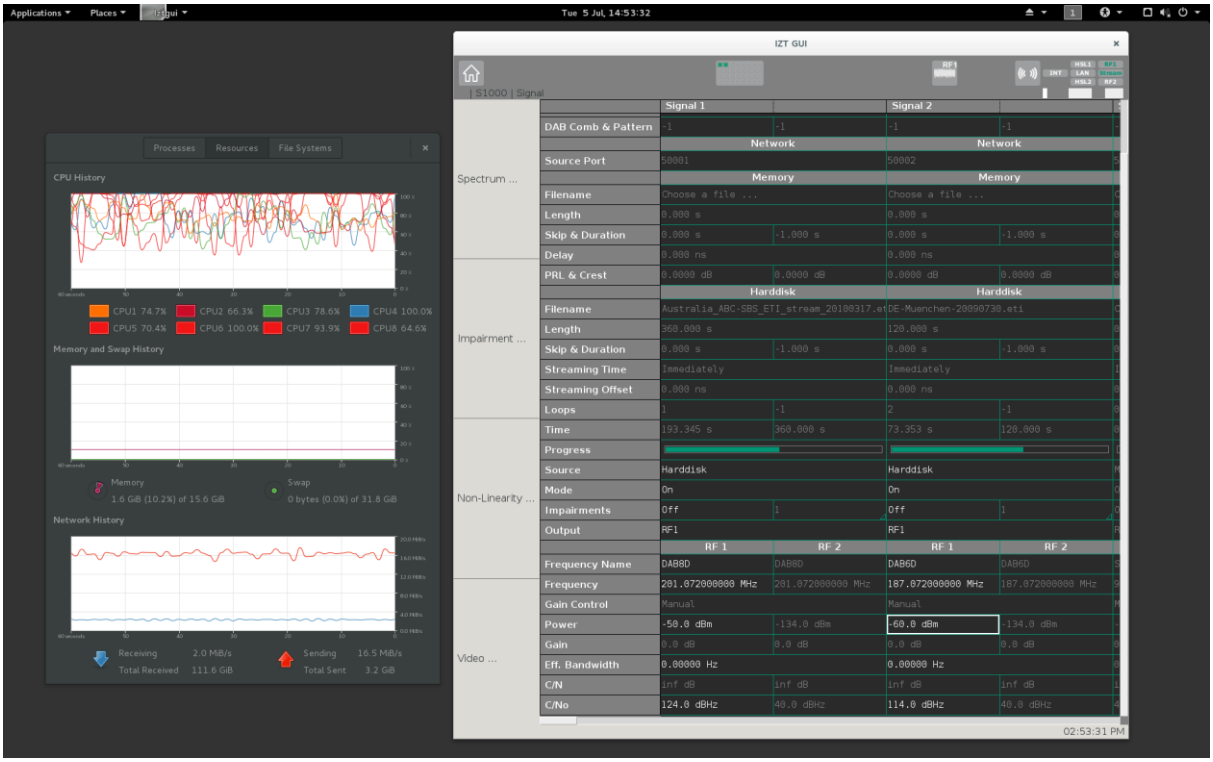
14. Memory extensions

14.1. IZT S1000 Memory Extension

The S1000 Memory Extension is a powerful streaming unit which allows to stream signals from low bandwidth up to high bandwidth to the IZT S1000 Signal Generator. It is equipped with a 2 x 12 TB hard disk capacity which is configured in a 2 x Raid0 setting for best performance.

Multiple signals can be streamed in real-time to the signal generator. Due to its modern Linux OS (Debian) it is very reliable. Remote operation via LAN and the SCPI protocol is possible.

The Debian OS is under continuous maintenance and is available as ISO Update on IZT FTP server.



14.2. IZT S1000 Memory Extension-WBS

The S1000 Memory Extension-WBS is a powerful streaming unit which allows to stream wideband signals up to to 120MHz bandwidth to the S1000 Signal Generator. It is equipped with fast SSDs to supply the needed transfer speed.

Details on request from s1000-support@izt-labs.de

14.3. IZT S1000 Memory Extension+

The S1000 Memory Extension+ is a powerful streaming unit which allows to stream signals from low bandwidth up to high bandwidth to the S1000 Signal Generator. It is equipped with 2 x 9 TB hard disk capacity in a RAID5 configuration.

Multiple signals can be streamed in real-time to the signal generator. Its operating system is a Windows7 professional edition. Remote operation via LAN and the SCPI protocol is possible.

14.4. IZT MemExt-SXD

The data disks of the IZT Memory Extension can be equipped with SSD which enables a high performance streaming and very high speed file access. It is possible to use this setup up to 5000 m elevation.

14.5. IZT MemExt-SDD

The systems disk of the IZT Memory Extension can be equipped with a SSD which enables a high performance system and very high speed file access. It is possible to use this setup up to 5000 m elevation.

14.6. IZT MemExt-10G

The IZT MemExt-10G Interface adds a physical 10 Gbit interface to the IZT Memory Extension. Once equipped with the 10 Gbit interface it can be used to connect to other IZT Memory Extensions for fast data exchange. It is also possible to connect the IZT Memory Extension to the IZT High-Capacity Test Vector Archive to have a fast access to a big data archive.

14.7. IZT High-Capacity Test Vector Archive

14.8. IZT High-Capacity Test Vector-Archive upgrade – extended storage capacity

The IZT High Capacity Storage Archive is a scalable storage system (scalable in 72 TB steps granularity). It can centrally keep a huge amount of test vectors and effectively share it among IZT S1000 Signal Generators with the connected IZT S1000 Memory Extension. Therefore the IZT S1000 Memory Extension has to be equipped with a 10 Gbit interface.

The maximum capacity of the storage system can be up to 576 TB. The storage system is configured in a RAID5 redundancy which makes it a stable way to centrally keep test vectors.

Additionally the test vectors can be directly streamed from the storage archive. Due to the high speed 10 Gbit connection it is possible to exchange the test vectors effectively between the connected units.

The IZT Database can be installed on the storage system as a host and on the IZT Memory Extension as the client system.

14.9. HP FlexFabric 5700zl-40XG-2QSFP+ switch

The FlexFabric switch is connected to the High Capacity Storage Archive with two 40 Gbit.

14.10. HP FlexFabric SFP+ module

The SFP+ modules need to be used in the IZT Memory Extension, the HP Flexfabric switch and IZT High Capacity Test Vector Archive. It is important that all of them are operated at the same wave length of the light. In our case we use 850 nm.

14.11. 10 Gbit optical cables

The 10Gbit optical cables are used to interconnect the IZT Memory Extension / IZT Memory Extension+ and the IZT High Capacity Test Vector Archive. Due to the optical cables there is no interference and it is possible to have long distances. If there are more IZT Memory Extensions to be connected to the IZT High Capacity Test Vector Archive the HP FlexFabric switch is used as an interconnection unit.