IZT R5010
Wideband Receiver

- Frequency range up to 18 GHz

- Up to 120 MHz instantaneous bandwidth

- Six independent digital downconverters

- Real-time spectrum calculation

- Large internal buffer memory

Overview

The IZT R5010 is a wideband receiver with frequency range up to 18 GHz, up to 120 MHz instantaneous bandwidth and powerful internal signal processing.
Typical applications are COMINT and satellite monitoring systems, broadband RF recorders or quality measurements in mobile communication networks.

Key Features

Highest Reception Quality

The IZT R5010 uses IZT's latest generation of tuners with sub-octave preselectors, dual conversion and a variable 1st IF for maximum robustness against false reception and high-power mixers for maximum linearity. A low-noise preamplifier can be activated for maximum sensitivity. Built-in test equipment allows for end-to-end verification and alignment of the receiver. The receiver can be operated in manual or automatic gain control mode. All internal clocks can be sychronized to an external source or the built-in GNSS receiver.

The available frequency range will be determined by the installed tuner modules:

- Configurable preselector with 16 high-/lowpass filters for direct sampling from 9 kHz to 140 MHz for highest performance up to the lower VHF range or alternatively
- Configurable preselector with 16 high-/lowpass filters for direct sampling from 9 kHz to 40 MHz for highest flexibility and performance in the HF range
- Superhet tuner for 20 MHz to 6000 MHz
- Microwave frontend for 6 GHz to 18 GHz

Figure 1: IZT R5010 Receiver

Figure 2: Interfaces of the IZT R5010 Receiver

Large Instantaneous Bandwidth and Six DDCs

IZT R5010 uses latest FPGA technology for signal processing.

In its baseline configuration the IZT R5010 offers an instantaneous bandwidth of 60 MHz. Software option IZT R5010-BW1 increases the available bandwidth to 80 MHz. With option IZT R5010-BW2 the maximum bandwidth of 120 MHz will be activated.

Up to six DDC channels can be set up within the instantaneous bandwidth of the receiver. Each DDC can handle the full bandwidth, so the only limitation is the maximum output streaming capacity of 20 Gb per second. The decimation is continuously variable and can be choosen independently for all six DDCs. With maximum decimation, the sample rate can be set as low as 10 kHz at the output of a DDC. The IZT R5010's flexible job control allows the user to define complex scan scenarios that will be executed by the receiver. The output data is provided via UDP as complex I/Q data with embedded meta data very similar to the proven IZT R3000 data format. Accurate time stamps allow for calculating the reception time for each sample down to sub-nanosecond accuracy.
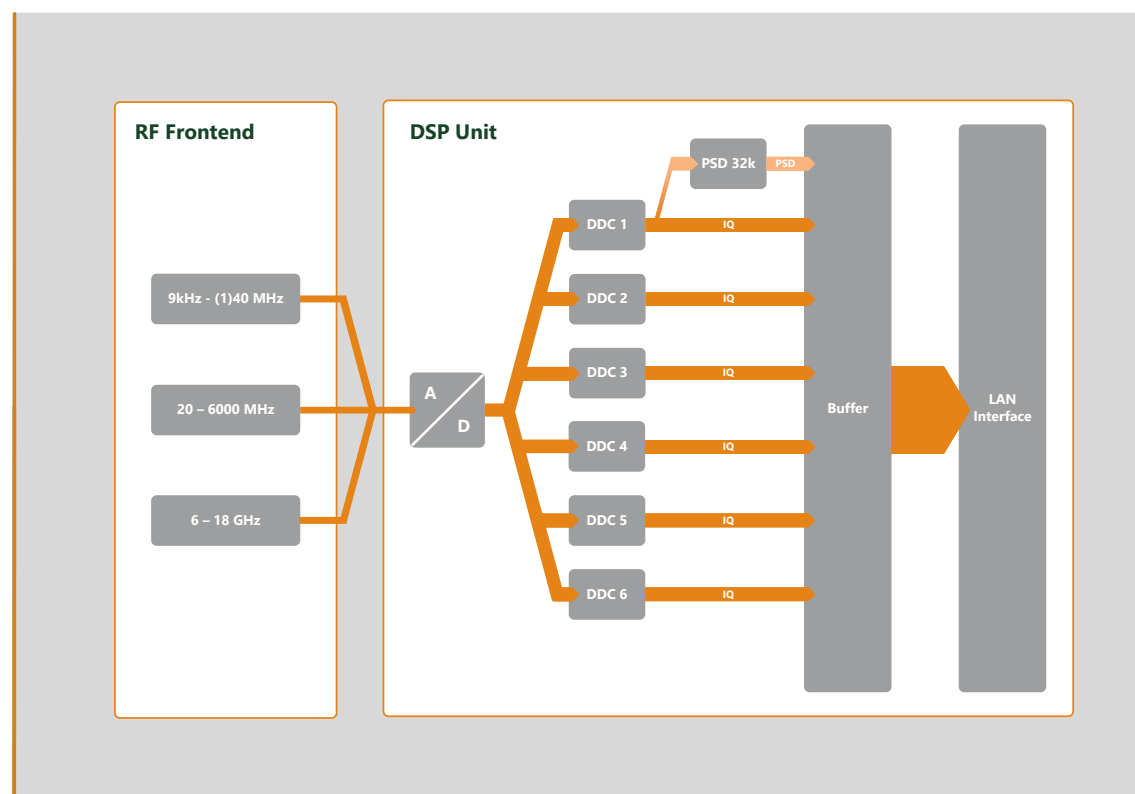

Figure 3: IZT R5010 Receiver Block Diagram

Broadband PSD

With option IZT R5010-PSD the receiver calculates a PSD with 32678 points in FPGA with very high frequency selectivity. The PSD is always connected to DDC0. By adjusting the variable decimation rate of the DDC, the bin spacing of the PSD can be set to an arbitrary value in the range of 1 kHz to 5 kHz. The bandwidth observed by the PSD will change accordingly from 29 MHz to up the full instantaneous bandwidth. To reduce the data rate, a RMS detector can accumulate frames before the result is sent to the host computer via the digital interface. The number of averages can be set between 1 and 4096.

Internal Memory Buffer

Not all use cases require or even support the continuous streaming of the large bandwidth. Therefore the IZT R5010 can be equipped with an optional internal RAM buffer. With this option, the user can configure, which of the DDC channels will be routed to the buffer instead of the data output.

Once the buffer is full, the respective stream will stop. Commanded by the user the content of the buffer will be streamed to the client at a data rate set by the user. With option IZT R5010-BUF1 a maximum number of 256 megasamples can be stored. The maximum available memory depth is 1280 megasamples with option IZT R5010-BUF2. Operation through the buffer and continuous streaming may happen in parallel, as long as the maximum capacity of the output interface is not exceeded.

Specifications

RF Input		
Frequency range	-	9 kHz – 18 GHz
Receiver frontends	HF	9 kHz – 40 MHz
	HVHF	9 kHz – 140 MHz
	VUHF	20 MHz – 6000 MHz
	RF18	6000 MHz – 18000 MHz
Instantaneous bandwidth	-	120 MHz
Number of antenna inputs	-	3
Connector	Type	N (f), 50 Ω

RF Performance HF		
Frequency range	-	9 kHz – 40 MHz [1]
Frequency conversion	-	Direct sampling
Maximum input power	-	+20 dBm, +30 dBm with input attenuator active
Return loss input	-	< -10 dB
Gain	-	24 dB +/- 1dB, 100 kHz – 40 MHz
Attenuation	-	0 dB – 45 dB, 3 dB steps
Noise figure	-	8 dB +/- 1 dB @ maximum gain, 500 kHz – 40 MHz
Input IP3	-	+40 dBm typical
Filterbank	-	Cascade of switchable 16 high-pass and 16 low-pass filters, free combination, electronic switching
Corner frequencies high pass filters	-3 dB	9 kHz, 1.25 MHz, 1.56 MHz, 2 MHz, 2.5 MHz, 3.125 MHz, 4 MHz, 5 MHz, 6.25 MHz, 8 MHz, 10 MHz, 12.5 MHz, 16 MHz, 20 MHz, 25 MHz, 32 MHz, 40 MHz
Corner frequencies low pass filters	-3 dB	1.12 MHz, 1.5 MHz, 1.9 MHz, 2.25 MHz, 3 MHz, 3.75 MHz, 4.5 MHz, 6 MHz, 7.5 MHz, 9 MHz, 12 MHz, 15 MHz, 18 MHz, 24 MHz, 30 MHz, 36 MHz, 40 MHz
Corner frequency ratio	-	1 : 1.26, approx.
Phase noise	-	-140 dBc/Hz @ 1 kHz

[1] Degraded performance: 9 kHz to 100 kHz

RF Performance HVHF		
Frequency range	-	9 kHz – 140 MHz [2]
Frequency conversion	-	Direct sampling
Maximum input power	-	+15 dBm, no damage
Return loss input	-	< -10 dB
Gain	-	24 dB +/- 1 dB, 100 kHz – 140 MHz
Attenuation	-	0 dB – 45 dB, 3 dB steps
Noise figure	-	8 dB +/- 1 dB @ maximum gain, 500 kHz – 140 MHz
Input IP3	-	+40 dBm, typical
Input IP3	@ 28 MHz @ 14 MHz @ 3 MHz	+19 dBm @ maximum gain +21 dBm @ maximum gain +13 dBm @ maximum gain
Filterbank	-	Cascade of switchable 16 high-pass and 16 low-pass filters, free combination, electronic switching
Corner frequencies high-pass & low-pass filters	-	9 kHz, 3.15 MHz, 4 MHz, 5 MHz, 6.3 MHz, 8 MHz, 10 MHz, 12.6 MHz, 16 MHz, 20 MHz, 25 MHz, 32 MHz, 40 MHz, 50 MHz, 63.5 MHz, 80 MHz, 100 MHz, 140 MHz
Corner frequency ratio	-	1 : 1.26, approx.
Phase noise	-	-140 dBc/Hz @ 1 kHz

[2]Degraded performance: 9 kHz to 100 kHz

Specifications

RF Performance VUHF		
Frequency range	-	20 MHz – 6000 MHz [1]
Maximum input power	-	+15 dBm, no damage
Return loss input	-	< -16 dB
Input IP3	-	+25 dBm, typical
Input IP3	@ 1500 MHz	+15 dBm @ maximum gain, preamp off -1 dBm @ maximum gain, preamp on
Noise figure	overall	<= 15 dB
Noise figure	-	9.5 dB @ 300 MHz, preamp on 9 dB @ 1500 MHz, preamp on 15 dB @ 1500 MHz, preamp off 9.5 dB @ 3000 MHz, preamp on 12 dB @ 6000 MHz, preamp on
Sensitivity	@ 1500 MHz	-120 dBm, SNR = 10 dB, RBW = 3 kHz, preamp on -114 dBm, SNR = 10 dB, RBW = 3 kHz, preamp off
Gain	-	40 dB, preamp on 25 dB, preamp off
Attenuation	-	0 dB – 30 dB, 1 dB steps
Settling time	LO1	1.6 msec, step 100 MHz
Phase noise, overall	-	-95 dBc/Hz @ 10 kHz in fast mode -120 dBc/Hz @ 10 kHz in low noise mode
Phase noise	@ 300 MHz	-125 dBc/Hz @ 10 kHz -135 dBc/Hz @ 1 MHz
	@ 1500 MHz	-123 dBc/Hz @ 10 kHz -132 dBc/Hz @ 1 MHz
	@ 3000 MHz	-122 dBc/Hz @ 10 kHz -132 dBc/Hz @ 1 MHz
	@ 6000 MHz	-123 dBc/Hz @ 10 kHz -130 dBc/Hz @ 1 MHz
Spurious level	-	No more than 5 spurs above -107 dBm
Frequency conversion	-	Double conversion superheterodyne with variable 1st IF
1st Intermediate frequency	IF1	6640 MHz, 7920 MHz
2st Intermediate frequency	IF3	240 MHz
LO1 Leakage	-	< -100 dBm
LO2 Leakage	-	< -120 dBm
IF1 Blocking	-	> 100 dB
IF2 Blocking	-	> 120 dB
IF1 /2 Blocking	-	> 100 dB
Image rejection IF1	-	> 120 dB
Image rejection IF2	-	> 110 dB

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[1]Degraded performance: 20 MHz to 30 MHz

Preselektor VUHF		
Filtertype	-	Sub-octave with overlapping
Number of preselectorfilters	-	14, electronic switching
Filter 1	Freq	50 MHz – 80 MHz (20 to 80 MHz)
Filter 2	Freq	80 MHz – 120 MHz
Filter 3	Freq	110 MHz – 170 MHz
Filter 4	Freq	160 MHz – 260 MHz
Filter 5	Freq	240 MHz – 390 MHz
Filter 6	Freq	350 MHz – 570 MHz
Filter 7	Freq	530 MHz – 860 MHz
Filter 8	Freq	800 MHz – 1260 MHz
Filter 9	Freq	1200 MHz – 1960 MHz
Filter 10	Freq	1900 MHz – 2960 MHz
Filter 11	Freq	2900 MHz – 3460 MHz
Filter 12	Freq	3400 MHz – 3960 MHz
Filter 13	Freq	3900 MHz – 4860 MHz
Filter 14	Freq	4800 MHz – 6060 MHz

Specifications

RF Performance RF18		
Frequency range	-	6000 MHz – 18000 MHz
Maximum input power	-	+15 dBm, damage level
Return loss input	-	< -10 dB
Input IP3	-	+18 dBm, typical, @ maximum gain
Noise figure	-	15 dB, typical
Gain	-	28 dB, typical
Attenuation	-	0 dB to 61 dB, 1 dB steps
Sweep time	-	< 10 msec
Scanning speed	-	> 12 GHz/s, frequency scan, random > 40000 GHz/s, frequency scan within 120 MHz bandwidth
Phase noise	-	-100 dBc/Hz @ 10 kHz, typical, fast mode
Phase noise	@ 6000 MHz	-128 dBc/Hz @ 10 kHz -143 dBc/Hz @ 1 MHz
	@ 12000 MHz	-122 dBc/Hz @ 10 kHz -139 dBc/Hz @ 1 MHz
	@ 18000 MHz	-117 dBc/Hz @ 10 kHz -133 dBc/Hz @ 1 MHz
Frequency conversion	-	Single conversion superheterodyne
1st Intermediate frequency	IF1	240 MHz
LO1 Leakage	-	< -110 dBm, typical
IF1 Blocking	-	> 120 dB, typical
Image rejection IF1	-	> 110 dB, typical
Preselector filter	-	Tracking bandpass filter

Signal Processing		
Number of DDCs	-	Up to six, independent and variable decimation rate
Output data types	-	I/Q data via UDP, PSD, VITA 49.1 compatible
I/Q sample rate	-	Variable, up to 156.25 MSPS
PSD	-	32768 points, WOLA-3, up to 163.84 MSPS, 120 MHz bandwidth continuously
FFT	-	32768 points, complex
Streaming	-	Up to 6 channels continuously
Synchronization	-	Internal GPS receiver to synchronize system clock and RF
Scanning speed	HVHF	Up to 4000 GHz/sec
Scanning speed	VUHF	Up to 40 GHz/sec
Scanning time	VUHF	2 msec per 120 MHz frequency step plus time for gathering data
Frequency resolution	-	< 1 µHz

Interfaces		
Antenna inputs	-	RF1, RF2, RF3: N (f), 50 Ω
Data, monitor and control	-	SFP+ 1, SFP+ 2
Monitor and control	-	RJ45 LAN
10 MHz reference input/output	-	REF IN/OUT, SMA (f)
Trigger input	-	TR1 IN, TR2 IN SMA (f)
Trigger output	-	TR2 OUT SMA (f)
Synchronisation of multiple R5010	-	SREF IN, CLK IN, CLK OUT, TR2 IN, TR2 OUT, REQ IN, REQ OUT, LO1 IN, LO1 OUT, LO21 IN, LO21 OUT, LO22 IN, LO22 OUT SMA (f)
USB	-	USB 2.0
Service	-	COM Port
Status LED	-	Power-on & health-status

Power Supply		
Input voltage	V_{supply}	90 to 250 VAC, 47 to 400 Hz
AC connector	Type	Type F, CEE 7/3
Input voltage (DC option)	V_{supply}	10 to 30 VDC
DC connector (DC option)	Type	4-pin connector (Lutronic 2420 04 T18CB100)
Power consumption	P	120 W
Grounding bolt	-	M5

Certification		
EMI / EMC	-	EN 55032 / EN 55032 B FCC 47 CFR Part 15 B
Conformity	-	CE marking

Specifications

General Data	
Dimensions (W x H x D)	19" x 1 U x 600 mm [1]
	484 mm x 44 mm x 650 mm [2]
Weight	approx. 12 kg [3]
Temperature range	0 to +50°C

Specifications are subject to change without further notice.

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[1]without handles and interface connectors
[2]including handles and with interface connectors
[3]depending on options

Ordering Guide

Option	Description
IZT R5010-CHS	Base Unit, 60 MHz bandwidth, 1 channel (DDC)
IZT R5010-HF	HF Frontend frequency range 9 kHz – 40 MHz
IZT R5010-HVHF	HVHF Frontend frequency range 9 kHz – 140 MHz
IZT R5010-RF6	Frontend frequency range 20 MHz – 6 GHz
IZT R5010-RF18	Frequency Range Extension 6 GHz – 18 GHz [1]
IZT R5010-REF	Internal GNSS Receiver for synchronization
IZT R5010-BUF1	256 MS Internal Snapshot Memory
IZT R5010-BUF2	1280 MS Internal Snapshot Memory [2]
IZT R5010-BW1	80 MHz receiver bandwidth
IZT R5010-BW2	120 MHz receiver bandwidth [3]
IZT R5010-MC	Six Independent Channels (DDC) within receiver bandwidth
IZT R5010-PSD	32768-point PSD Spectrum
IZT R5010-DCW	Wide-range (10-30 V) DC instead of AC power supply

[1] Requires R5010-RF6
[2] Option BUF2 includes BUF1
[3] Option BW2 includes BW1

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Wideband Receiver

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 9001:2015 certified.

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