

IZT R5020 HF Receiver



- Highest signal quality in the frequency range up to 30 MHz
- Ultimate linearity and full HF-band coverage at the same time
- Passive input channelizer minimizes second order intermodulation
- Twelve AD Converters

The IZT R5020 is a broadband receiver with a patented preselector filter bank. It is designed to digitize the complete HF band from 9 kHz to 30 MHz with an exceptional dynamic range.

The IZT R5020 can be used with the IZT Signal Suite software or with 3rd party software through an SDK.



FIGURE 1: IZT R5020 DSP SECTION

Key Features

FULL HF COVERAGE WITH ULTIMATE LINEARITY

The IZT R5020 is a broadband receiver designed to digitize the whole HF band from 9 kHz to 30 MHz in very high quality. Key components of the IZT R5020 are a multichannel digitizer from IZT’s R5000 receiver series and a very high-performance, analog channelizer with overlapping bandpass filters.

IZT’s patented design outperforms conventional receivers by using a passive, low-loss channelizing filter with 12 overlapping frequency bands in front of any active electronics. Each output channel has a dedicated AD converter preceded by an electronic attenuator and subsequent low noise high linearity amplifier.

Automatic gain control is performed independently for each channel.

The receiver is still sensitive enough to be operated without a preamplifier.

The IZT R5020 design overcomes typical limitations of legacy receivers: Especially when large receive antenna systems are used, the input power into the receiver can be very high. In consequence, limiting the receiver bandwidth by preselection filters becomes essential. The biggest concern are second order intermodulation products which require preselection filters with less than one octave relative bandwidth.

With conventional receivers, it is not possible to monitor the whole HF frequency band at a time. Most receivers will allow bypassing the preselector filters, but usually this will require a reduced gain to avoid clipping due to strong signals and the strongest signal or the sheer amount of incoming energy will force the receiver gain control to reduce its sensitivity over the whole instantaneous bandwidth.

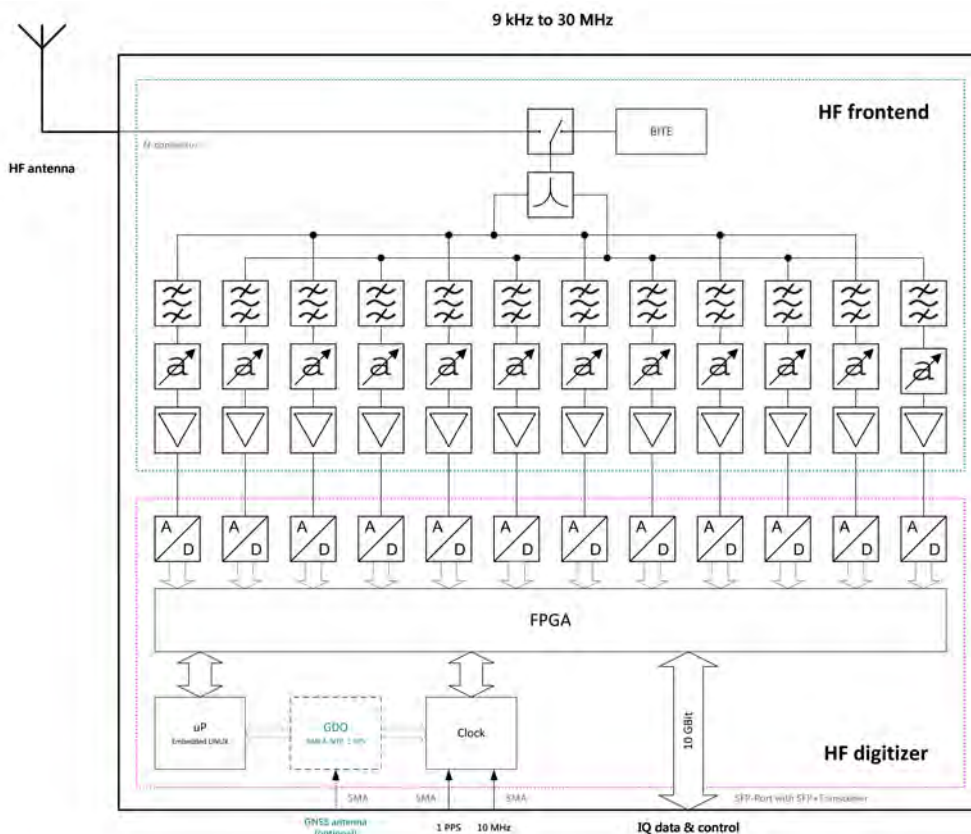


FIGURE 2: IZT R5020 BLOCK DIAGRAM

ANALOG CHANNELIZER

Two banks of overlapping, passive bandpass filters channelize the whole HF spectrum into 12 bands. Mechanically large inductors ensure minimum intermodulation.

The filter corner frequencies from 9 kHz to 30 MHz are shown in Table 1. The filters are grouped in two banks A and B. Only filter no. 1 is a lowpass, while all other filters are bandpass filters with a relative bandwidth of approx. 1:1.6. These filters therefore meet the sub-octave criterion and improve the second-order intercept point. The center frequencies of the filters increase by approximately 1:1.3, ensuring adequate overlap at the corner frequencies. The filters within one bank do not overlap and therefore can be coupled with minimum loss.

A reactive power divider with high interport isolation allows for coupling banks A and B. Only behind the filters, each channel has a highly linear electronic attenuator and a subsequent amplifier with a large dynamic range. This technique avoids second-order intermodulations in the active stages up to the AD converter. In addition, it allows for individual gain adjustment in each channel. Only the channels loaded with very strong input signals have to reduce their gain while quieter channels can still operate with maximum sensitivity.

A built-in test source is available enabling the receiver software to estimate and thereafter equalize the frequency responses of the analog filters so that they can be combined into a broadband data stream by the post processing software if necessary.

POWERFUL DIGITAL PROCESING

Each of the 12 channels is digitized with 16 bit resolution and processed in an FPGA. For full simultaneous coverage of the HF band, one DDC is assigned to one AD converter. For special scenarios it is possible to concentrate the available pool of DDCs at a single AD converter. The DDCs support an arbitrary user-defined sample rate and up to 40 MHz bandwidth.

The output data is provided via UDP/IP as complex I/Q data with embedded meta data compatible to the IZT R5000 receiver series. Accurate time stamps allow for calculating the reception time for each sample down to sub-nanosecond accuracy.

The IZT R5020 contains an ovenized crystal oscillator as timing reference. Multiple IZT R5020 can be accurately synchronized with respect to time and frequency.

With option IZT R5020-REF, the R5020 contains a GNSS receiver module serving as highly accurate reference time source to discipline the OCXO.

Filter No.	Bank	Frequency
1	A	0 MHz to 1.2 MHz
2	B	1.1 MHz to 1.6 MHz
3	A	1.4 MHz to 2.1 MHz
4	B	1.9 MHz to 2.9 MHz
5	A	2.6 MHz to 3.8 MHz
6	B	3.4 MHz to 5.1 MHz
7	A	4.6 MHz to 6.9 MHz
8	B	6.2 MHz to 9.3 MHz
9	A	8.3 MHz to 12.4 MHz
10	B	11.1 MHz to 16.7 MHz
11	A	14.9 MHz to 22.4 MHz
12	B	18.8 MHz to 30 MHz

TABLE 1: CORNER FREQUENCIES OF THE BAND-PASS FITERS

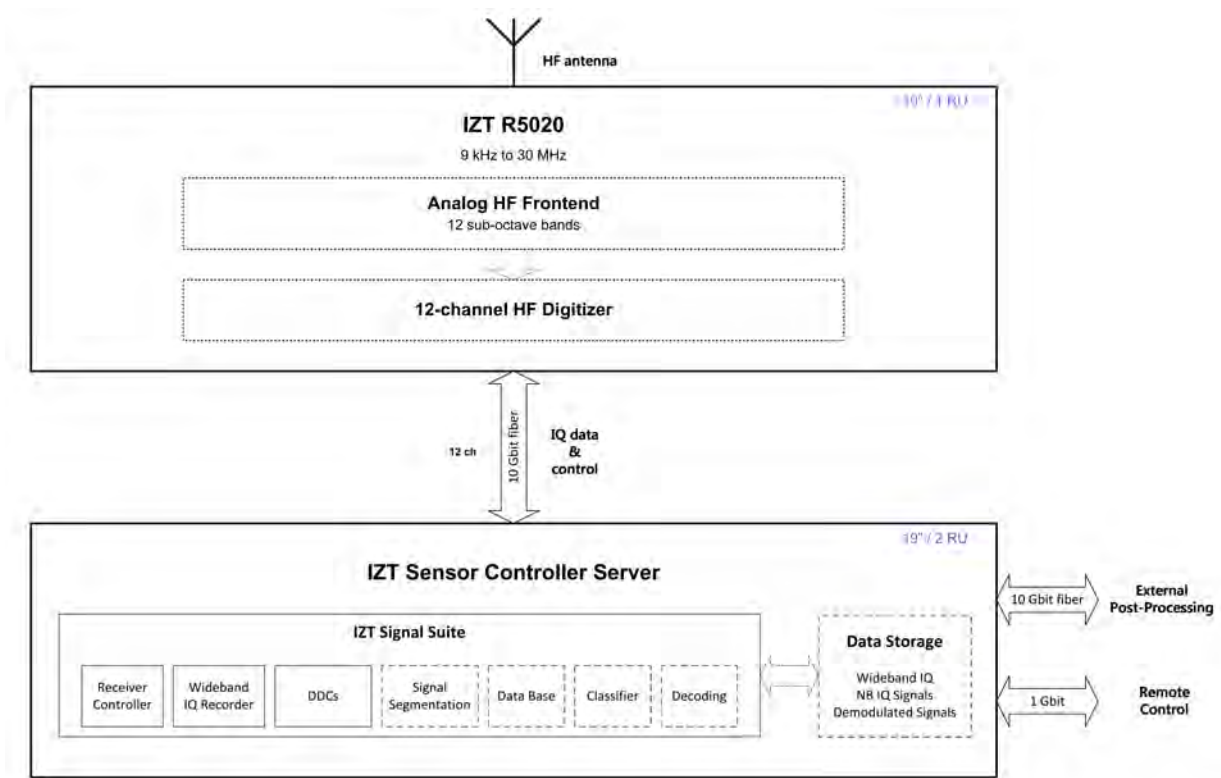


FIGURE 3: IZT R5020 WITH IZT SENSOR CONTROLLER SERVER

SOFTWARE PROCESSING

IZT R5020 is primarily designed to interface with the IZT Signal Suite software running on a sensor controller server. The processing chain is shown in figure 3. The IZT Signal Suite performs the following functions:

- Controlling the IZT R5020
- Wideband IQ recording
- Narrow-band DDCs

If required, the IZT Signal Suite can perform additional functions:

- Signal Segmentation
- Data Base
- Classifier
- Decoding
- Interfacing with a large storage system

MECHANICAL DESIGN

IZT R5020 comes in a 1U 19" enclosure with 550 mm depth. All interfaces like LAN connectors for control and data as well as RF and synchronization interfaces are placed on the rear panel. The front panel contains only interfaces potentially required for software updates or low-level system recovery.



FIGURE 4: IZT R5020 FRONT



FIGURE 5: IZT R5020 BACK

FRONT PANEL INTERFACES

Interfaces potentially required for software updates or low-level system recovery are located on the front panel of the IZT R5020. The intake for cooling air is also located on the front side. Three indicator lights show the summary status of the receiver.

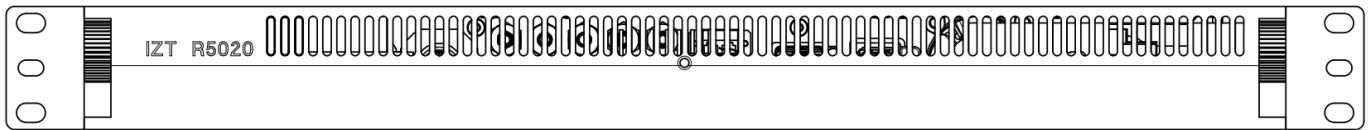


FIGURE 6: IZT R5020 FRONT PANEL

REAR PANEL INTERFACES

All electrical interfaces of the IZT R5020 are located on the rear panel. Interfaces which are reserved for future use are not populated and covered with blind panels.

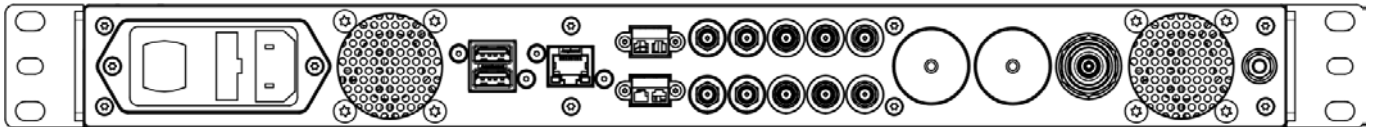


FIGURE 7: IZT R5020 REAR PANEL

Label	Specification	Description
POWER	IEC 320 90 - 264 V AC, 47 - 63 Hz	Power supply
CLK IN	SMA, female, 50 Ohm	Internal, synchronization of multiple units
CLK OUT	SMA, female, 50 Ohm	Internal, synchronization of multiple units
AUX 1	SMA, female, 50 Ohm	<i>reserved for future use</i>
AUX 2	SMA, female, 50 Ohm	<i>reserved for future use</i>
GPS IN	SMA, female, 50 Ohm	GPS antenna input
REF IN/OUT	SMA, female, 50 Ohms	10 MHz reference input / output
PPS IN	SMA, female, 50 Ohm	PPS input for synchronization ¹
BLNK IN	SMA, female, 50 Ohm	Blanking input ²
PPS IN	D38999/24WA98PN	PPS input for synchronization ³
BLNK IN	D38999/24WA98PN	Blanking input ⁴
RF1	N, female, 50 Ohms	Antenna input
SERVICE	USB 2.0	Low level service interface
USB	USB 2.0	Service interface
LAN	1 GBit, RJ45	Optional web interface
SFP+ 1	10 GBit optical, multimode, SFP +	Data and Configuration
SFP+ 2	10 GBit optical, multimode, SFP +	<i>reserved for future use</i>

¹ standard version

² standard version

³ with option R5020-SYM

⁴ with option R5020-SYM

D38999/24WA98PN

With option R5020-SYM the 1PPS and blanking signals are supplied as RS422 signals through D38999 connectors instead of the standard SMA connectors.

Parameter	Value
Connector type	D38999/24WA98PN
Differential input voltage, minimum	0.4 V
Differential input voltage, recommended	4 V
Differential input voltage, maximum	10 V
Hysteresis voltage	50 mV
Propagation delay, minimum	7 ns
Propagation delay, typical	13 ns
Propagation delay, maximum	20 ns
Termination	100 Ohm
Mating connector	D38999/26WA98SN

TABLE 3: INTERFACE SPECIFICATION D38999/24WA98PN

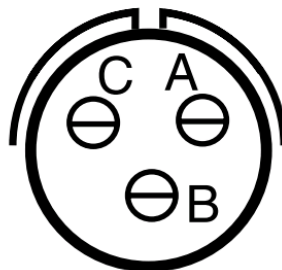


FIGURE 8: CONNECTOR PINOUT

Pin	Function
A	Blanking Signal - P / 1PPS - P
B	Blanking Signal - N / 1PPS - N
C	Shield / Ground

TABLE 4: CONNECTOR PINOUT

Performance Characteristics

Parameter	Value
Frequency range	9 kHz to 30 MHz
RF input	50 Ω , VSWR <1:3
Maximum input level	+20 dBm, +30 dBm with attenuator active
Noise figure	12dB typ.
Spurious	<-120dBm Max 5 spurs @ -120...-110dBm
Input attenuator	20dB in each channel, user configurable
Pre-Amplifier	approx. 13dB in each channel, user configurable
Third order intercept point	typ. +40 dBm
Second order intercept point	typ. +100 dBm
Instantaneous bandwidth	30 MHz
Preselector	12 bands, suboctave, organized in two banks
Phase noise	< -110 dBc/Hz @ 100 Hz < -140 dBc/Hz @ 1 kHz
Reference frequency	10.000 MHz AVAR < 1×10^{-11} , $\tau = 1$ s Long term per day < 1×10^{-9} Temperature drift < 5×10^{-8}
Data output	UDP via one 10 Gbps optical LAN output
Mechanical size	19", 1U, approx. 500 mm deep
Power consumption	approx. 180 W
MTBF	53 500 h
Operating temperature	-20 °C to 50 °C
Storage temperature	-40 °C to 85 °C

Ordering Guide

Item	Description
IZT R5020	Broadband HF Receiver
IZT R5020-REF	Internal GNSS receiver for synchronization
IZT R5020-SYM	Symmetric inputs for 1PPS and blanking signals

IZT R5020 HF 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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