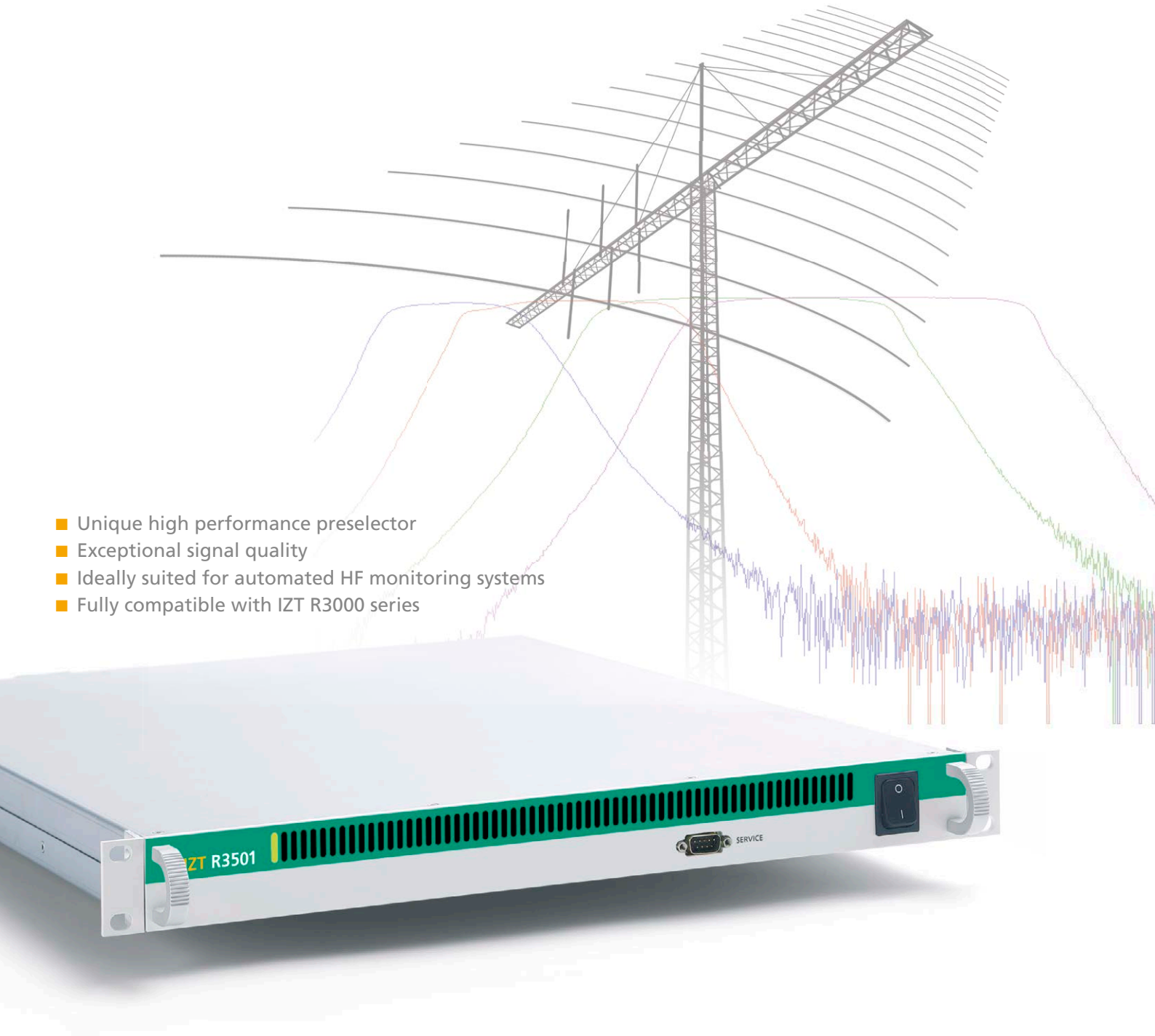
www.izt-labs.de

IZT
Innovationszentrum
Telekommunikationstechnik

IZT R3500 HF Receiver
Monitoring Receivers



- Unique high performance preselector
- Exceptional signal quality
- Ideally suited for automated HF monitoring systems
- Fully compatible with IZT R3000 series

IZT R3500
The Ultimate Sensor for Intercepting HF Signals

The interception of the High Frequency (HF) signals poses an exceptional challenge for the dynamic range of any receiver, especially when large and sensitive antenna systems are used. Management of the RF energy reaching the A/D converter by means of an analog pre-selector is essential.

A bank of sub-octave filters is the standard approach for reducing the total signal power and second order intermodulation products. This comes at the expense of inflexible filter bandwidths. The IZT R3500 instead offers a highly linear, flexible pre-selector (figure 1) with electronically configurable start and stop frequencies.

The IZT R3500 has exceptional large signal performance with a Second Order Intercept point over +100 dBm and is therefore perfectly suited for operating directly behind large gain antennas.

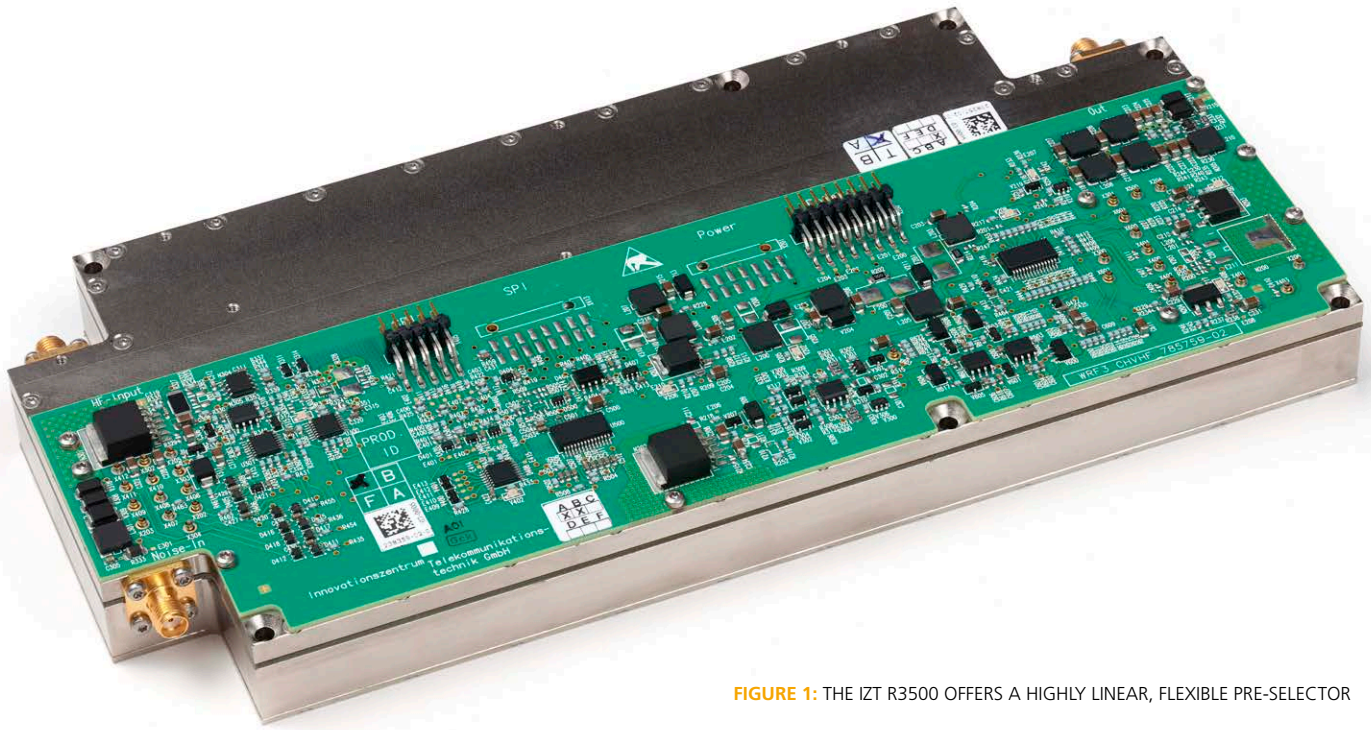


FIGURE 1: THE IZT R3500 OFFERS A HIGHLY LINEAR, FLEXIBLE PRE-SELECTOR

Overview

Modern, automatic signal classifiers are able to simultaneously analyze several megahertz of spectrum for any signals of interest. In this case, due to its fixed center frequencies and bandwidths, a sub-octave pre-selector lacks the flexibility to deal with different receive scenarios.

The IZT R3500 therefore has been equipped with a unique, high performance pre-selector, allowing the user to arbitrarily select any combination of one high-pass and one low-pass filter. These filters are then cascaded in the signal path electronically, but completely passively with no amplifiers in between.

Within the input frequency range of 9 kHz to 40 MHz, a pool of 16 low- and 16 high-pass filters (see table 1) with corner frequencies spaced in a ratio of approximately 1:1.26 can be selected by the user to limit the amount of incoming signal energy and provide highly effective protection against unwanted IP2 products. The user can freely cascade one out of 16 high-pass filters with one out of 16 low-pass filters resulting in a total of 136 individual pre-selection filters.

Figure 2 symbolizes the filter curves (green: high-pass, blue: low-pass) with the red curve indicating the selected filter combination.

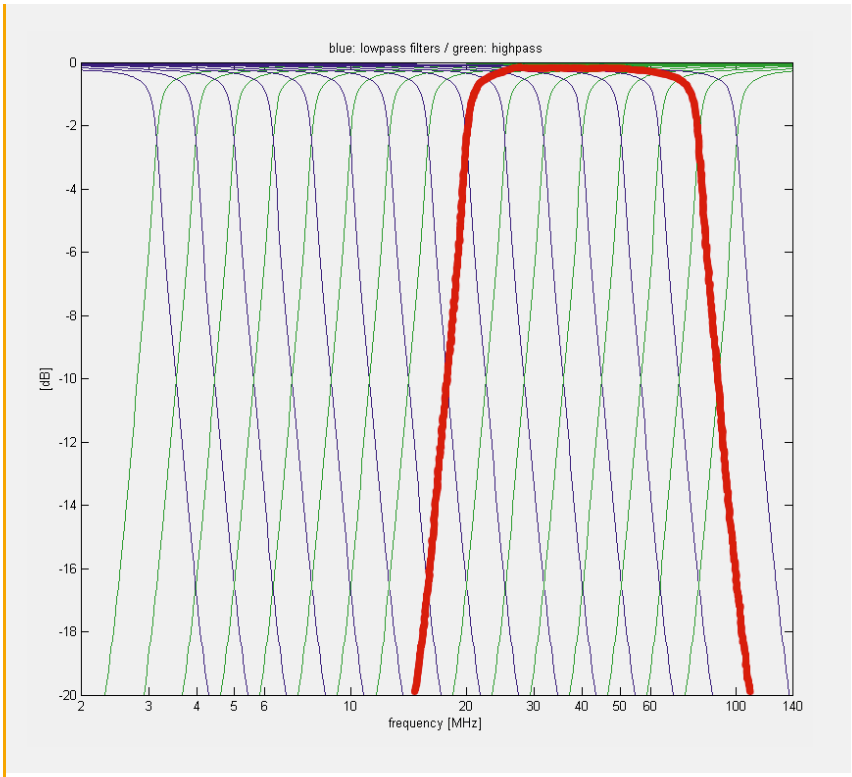


FIGURE 2: SHOWN IN RED: SELECTED LOW- AND HIGH-PASS COMBINATION

In a very large signal situation, the filters can be combined to resemble a highly selective sub-octave filter bank. For broadband, automatic signal search algorithms, a bandwidth of several megahertz may be best suited. In a low power RF environment, the filters can be switched off completely.

High-pass filters (-3 dB)	Low-pass filters (-3 dB)
0.009 MHz	1.12 MHz
1.25 MHz	1.5 MHz
1.56 MHz	1.9 MHz
2 MHz	2.25 MHz
2.5 MHz	3 MHz
3.125 MHz	3.75 MHz
4 MHz	4.5 MHz
5 MHz	6 MHz
6.25 MHz	7.5 MHz
8 MHz	9 MHz
10 MHz	12 MHz
12.5 MHz	15 MHz
16 MHz	18 MHz
20 MHz	24 MHz
25 MHz	30 MHz
32 MHz	36 MHz
40 MHz	40 MHz

TABLE 1: CORNER FREQUENCIES OF HIGH- AND LOW-PASS FILTERS

The figures 3 to 6 illustrate the operation of the IZT R3500 with very flexible filter configurations.

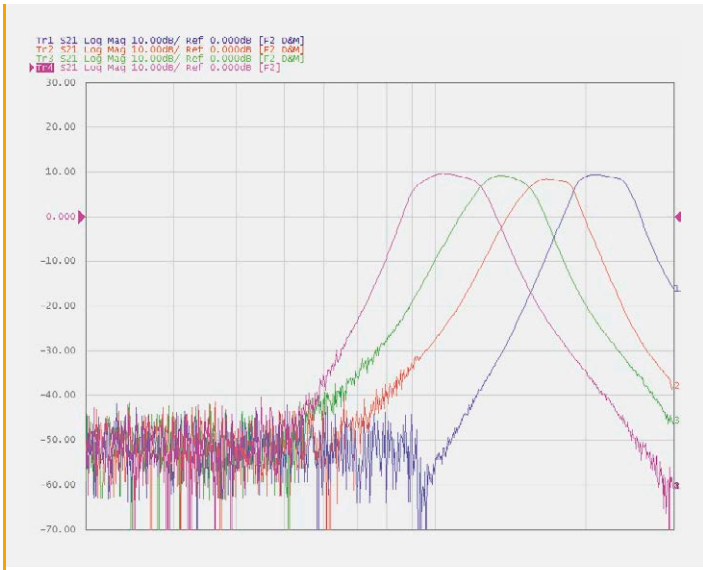


FIGURE 3: FOUR FILTER EXAMPLES FOR OPERATION WITH MAXIMUM SELECTIVITY

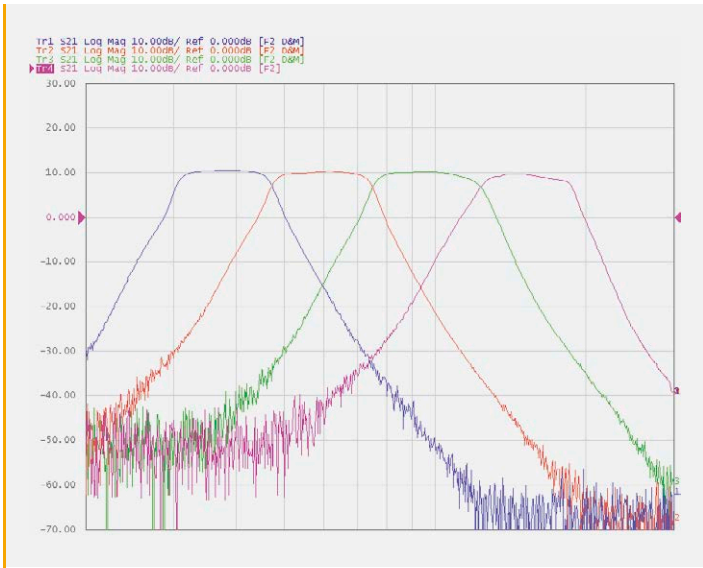


FIGURE 4: FOUR FILTER EXAMPLES FOR OPERATION WITH MEDIUM BANDWIDTH

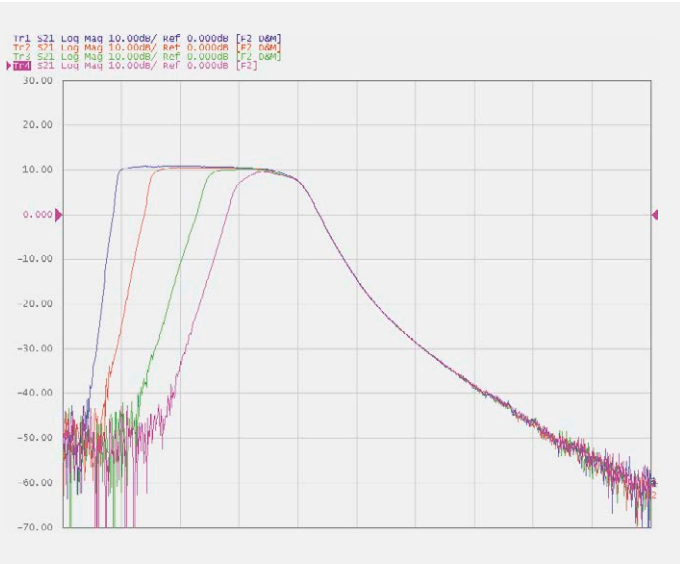


FIGURE 5: VARIABLE HIGH-PASS WITH FIXED LOW-PASS

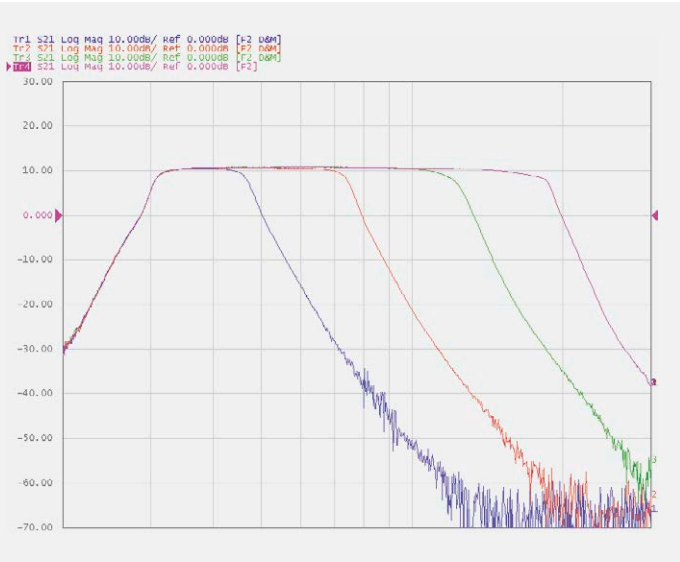


FIGURE 6: FIXED HIGH-PASS AND VARIABLE LOW-PASS

Signal Processing and Control

Like all receivers of the IZT R3000 series, the IZT R3500 supports up to four sub-channels as I/Q, complex FFT or PSD data over Ethernet. The sub-channels can be placed anywhere within 9 kHz to 40 MHz.

Signal processing, data format and control interface of the IZT R3500 are fully compatible with the IZT R3000 series, giving current users of the IZT R3000 receivers an easy migration path.

RECEIVER INTERFACES

Gigabit LAN

All digital signal and control data is transmitted and received via Gigabit Ethernet LAN. This allows fast, simple and cost efficient integration of the IZT R3000 family into an existing IT environment.
Gigabit LAN offers data rates of up to 115 MB/s provided that the host PC is capable of receiving continuous data at this rate.

Instantaneous bandwidth (single channel):
- I/Q baseband: . . . . . 24.0 MHz
- FFT (complex): . . . . . 24.0 MHz
- PSD (Power Spectral Density): . . . . . 24.0 MHz

The receiver has the capability to discard FFT frames in order to reduce data throughput. Using this feature the maximum FFT bandwidth can be extended to 24 MHz.
When multiple data types or multi-channel operation are used the maximum Gigabit LAN data rate has to be taken into account.

Antenna

N-type connectors for HF are available for the antenna signals as standard configuration. The receiver can be configured with additional antenna inputs:
- IZT R3500-AAI-HF2: two antenna inputs
- IZT R3500-AAI-HF3: three antenna inputs
- IZT R3500-AAI-HF4: four antenna inputs

Synchronization

The IZT R3500 family features a high stability internal reference clock. The receiver can be synchronized to an external 10 MHz reference source.
With option IZT R3500-TRIG an additional trigger pulse or 1 PPS signal can be used to synchronize multiple receivers with sample accuracy. This is required for direction finder applications and is usually sufficient for goniometric or Watson-Watt DF applications.
In order to realize DF systems based on a single-receiver architecture the option IZT R3500-FTRIG can be used to accept antenna synchronization pulses at intervals of 100 µs and less.
For the phase coherent synchronization of multiple receivers the option IZT R3500-EXT_SYNC provides external synchronization interfaces for the clock signal.

REMOTE CONTROL

Windows software

The IZT R3000 Wndows software can be remote controlled. The demodulated audio is available in addition to the I/Q and spectrum data of the receiver on individual UDP ports. Remote controlling the IZT R3000 Windows software offers a quick and convenient way to embed the IZT R3000 family into an existing user environment.

LAN interface

For integration into customer-specific systems the receiver can be interfaced on Ethernet LAN level.

Multiple sockets are available: One for each signal data stream (I/Q, FFT, PSD) and multiple sockets for the monitoring and control port. The signal data streams consist of raw data preceded by meta data specifying the signal, such as center frequency, bandwidth, attenuation, time-of-arrival, clipping indicator, gaps, etc. The monitoring and control port employs a user-friendly ASCII format to command and configure the receiver.

ETHERNET BASED SIGNAL DISTRIBUTION

The Ethernet based signal distribution of the IZT R3500 can eliminate costly multicoupler structures, which provide an analog interface between the antenna and a variable number of receivers. Instead, the IZT R3500 digitizes large parts of the HF spectrum in very high quality and the signal distribution is lossless and completely independent within the digital domain. This can be achieved either through the customer's software solution or the optional IZT Signal Suite software:

- Storage of sub-bands or even the whole digitized bandwidth
- Extraction of sub-bands / channels
- Buffering and storage
- Access by clients via reliable and easy to use TCP/IP connection

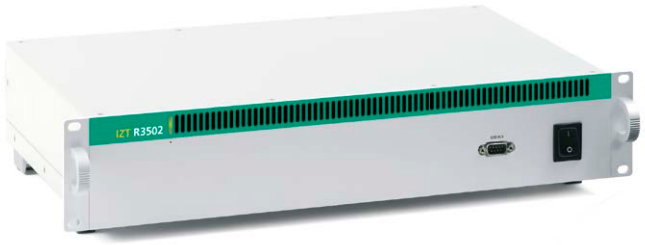
Specifications IZT R3500

Technical specifications		
Frequency range		9 kHz to 40 MHz [1)]
RF input	Impedance	50 Ω
Input VSWR		< 1:2
Maximum input power		+20 dBm, +30 dBm with input attenuator active
Tuning resolution		1 Hz
Tuning accuracy		< 0.2 Hz
Reference frequency		10 MHz internal/external
Internal reference frequency	Standard	+/-1 x 10^{-7} over temperature < 2 x 10^{-7} per year
	OCXO	+/-5 x 10^{-8} over temperature < 1 x 10^{-9} per day < 1 x 10^{-7} per year
Input sensitivity	100 kHz to 40 MHz @ S/N = 10 dB	-120 dBm @ 3 kHz BW -111 dBm @ 25 kHz BW
Oscillator phase noise		-130 dBc/Hz @ 1 kHz offset -140 dBc/Hz @ 10 kHz offset
Sweep time		< 2 ms typical
Scanning speed		8 GHz/s linear 175 GHz/s within 24 MHz
Input IP3		+40 dBm typical
Input IP2		+100 dBm typical
Noise figure		9 dB typical
IF rejection		not applicable
Image rejection		not applicable
Oscillator reradiation at antenna output		not applicable
Pre-selector		see table 1
IF bandwidth		6.25 kHz to 24 MHz
Analog to digital converter	SFDR, HF	90 dB typical (referenced to full scale of A/D converter)
Digital post-processing	Digital down converter	Variable decimation
	Complex baseband	Variable bandwidth: 6.25 kHz to 24 MHz
	Complex FFT	32-bit complex, 1024- and 4096-point FFT, polyphase filter Variable bandwidth: 6.25 kHz to 24 MHz
	Power Density Spectrum	Magnitude and logarithm of complex FFT
	Averaging	Variable averaging of PSD by 1, 2, 4, 8, 16, 32, 64 or 128
Digital data format	Complex baseband	16-bit or 32-bit signed integer, I/Q samples
	Complex FFT	16-bit floating point, complex 1024- or 4096-FFT
	Power Density Spectrum	16-bit unsigned integer, 1024- or 4096-FFT, logarithmic scaling, range 256 dB
	Maximum data rate	115 MB/s

[1)] DEGRADED PERFORMANCE 9 KHZ TO 500 KHZ

Interfaces	Antenna input, HF, VUHF	N, female, 50 Ω
	External reference input	SMA, female, 50 Ω
	External trigger pulse	SMA, female, CMOS 3.3 V (5 V tolerant input)
	External synchronization	2 x SMA, female, 50 Ω
	Service interface	RS232, D-SUB 9, male
	LAN	1 Gbit LAN, CAT6, legacy support for 100 Mbit

General data	IZT R3501	IZT R3502
Operating temperature	0°C to +50°C	0°C to +50°C
Storage temperature	-40°C to +70°C	-40°C to +70°C
Humidity	max. 85%, non-condensing	max. 85%, non-condensing
EMI / EMC	EN 61010-1:2002	EN 61010-1:2002
	EN 61000-6-2:2002	EN 61000-6-2:2002
	EN 61000-6-3:2002	EN 61000-6-3:2002
MTBF	> 70 000 h	> 70 000 h
Power supply	90 V – 264 V, 50 Hz – 60 Hz, 60 VA	AC: 90 V – 264 V, 50 Hz – 60 Hz, 60 VA
		DC: 10 V – 30 V, 60 W [2)]
Dimensions (WxHxD)	19" x 1 U x 560 mm	19" x 2 U x 320 mm
Weight	9 kg	8 kg



[2)] WITH OPTION R3500-DCW
SPECIFICATION SUBJECT TO CHANGE WITHOUT FURTHER NOTICE.

IZT R3500

The Ultimate Sensor for Intercepting HF Signals

Ordering Guide		
HF receiver	**IZT R3501**	HF receiver, 9 kHz – 40 MHz, 1 U
	IZT R3502	HF receiver, 9 kHz – 40 MHz, 2 U
Receiver options	**IZT R3500-AAI-HF2**	Two antenna inputs
	IZT R3500-AAI-HF3	Three antenna inputs
	IZT R3500-AAI-HF4	Four antenna inputs
	IZT R3500-TRIG	External trigger interface
	IZT R3500-FTRIG	External fast trigger interface
	IZT R3500-EXT_SYNC	External synchronization interface
	IZT R3500-IFOUT	Analog IF output
	IZT R3500-DCW	Wide range DC input, 10 V – 30 V (only available for IZT R3502)
	IZT R3500-OCX	Oven stabilized reference oscillator
	IZT R3500-BST	Bias-T, adjustable, 3 V – 12 V, 30 mA – 200 mA

IZT Service		
	IZT R3500-CLC	Factory calibration
	IZT R3500-CAL	Accredited ISO calibration
	IZT WE2	Warranty extension to 2 years
	IZT WE3	Warranty extension to 3 years

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

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

INNOVATIONSZENTRUM FÜR TELEKOMMUNIKATIONSTECHNIK GMBH IZT AM WEICHSELGARTEN 5 · 91058 ERLANGEN, GERMANY
GENERAL MANAGER: RAINER PERTHOLD · TEL: +49 (0)9131 9162-0 · FAX: -190 · SALES@IZT-LABS.DE · WWW.IZT-LABS.DE

IZT
Innovationszentrum
Telekommunikationstechnik