MEDAV

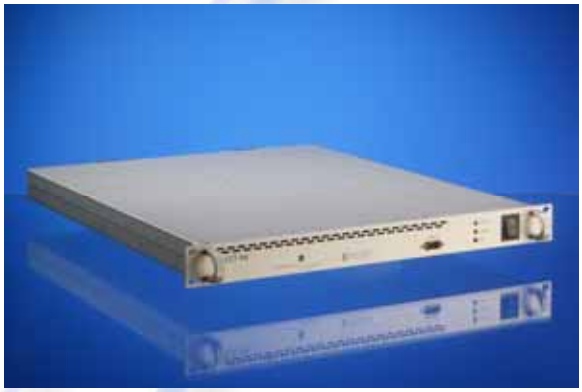
WIR VERSTEHEN DIE ZEICHEN DER ZEIT

KEEPING PACE WITH THE SIGNAL OF TIME

PRELIMINARY

ComCat™ Tuner
- CCT NG-

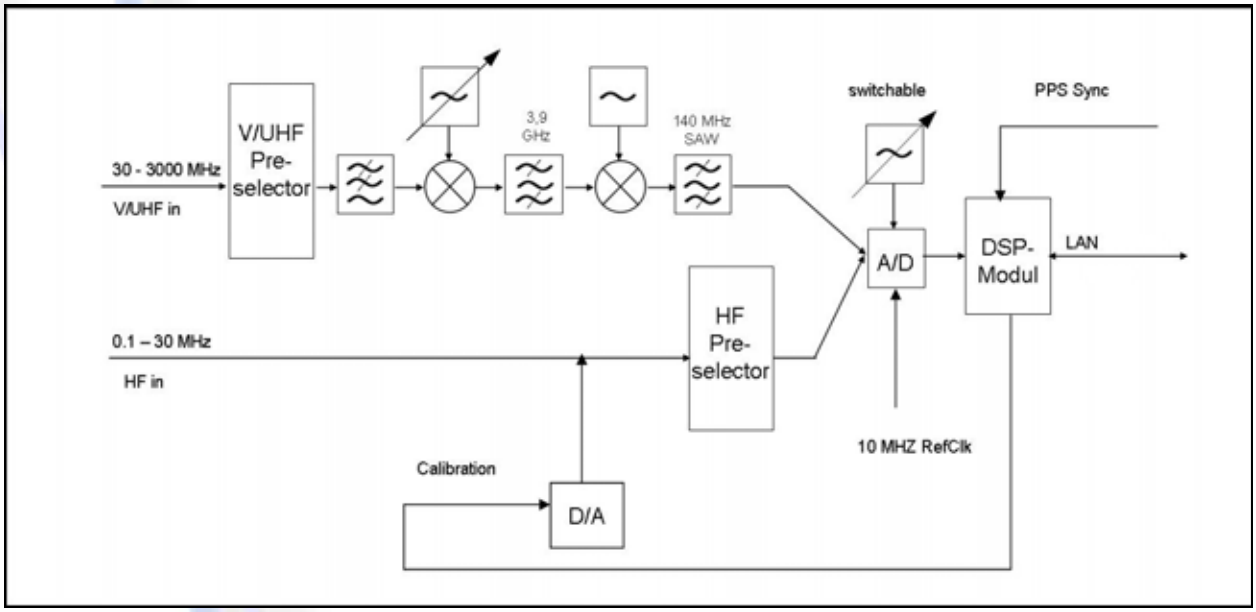
HF-VHF-UHF Digital Tuner with
Integrated Wideband ADC
and Digital IF Output to LAN



- Frequency range: 100 kHz – 3 GHz
- IF, FFT and PSD bandwidth: 7,8 kHz – 24 MHz
- 1 Hz tuning resolution
- High in-band dynamic range
- Direct RF sampling of HF and IF sampling of V/UHF signals
- Output of digital complex baseband data (CBB) up to 16 MHz to LAN (max. 24 MHz by using snapshot memory)
- Output of pre-processed complex spectrum (FFT) data to LAN for external use up to 16 MHz bandwidth
- Output of pre-processed power spectrum density (PSD) data to LAN for external use up to 24 MHz bandwidth

- Synchronization of multiple tuners
- Real-time frequency response calibration of the entire HF path, e.g. for Direction Finding (DF) applications
- Compact 19” / 1U size
- Robust design
- Embedded ADC and high speed signal processing core
- Preselectors to suppress out-band signals
- Fully remote controlled operation using TCP/IP or CORBA software interface

- Smart processing algorithms for comprehensive signal detection, signal search and classification applications on external PC hardware
- Embedded 128 MByte snapshot memory for CBB data included by WB option.



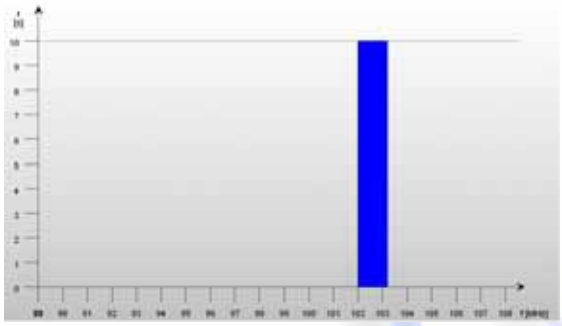
Simplified ComCat Tuner (CCT NG) Block Diagram

General Modes

Manual Mode

In the manual mode, the CCT™ works on a simple fixed frequency.

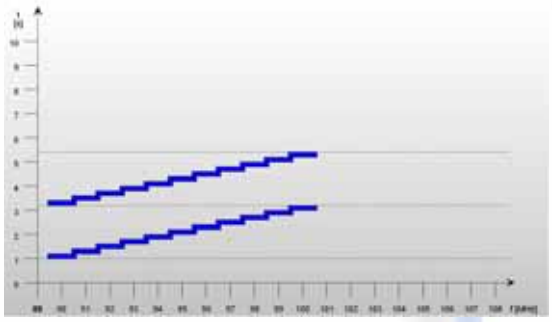
After setting the desired center frequency and bandwidth CCT™ outputs the received signal in form of a digitized CBB (Complex Baseband) over GBit LAN. The adjoining figure shows as an example the tuner receiving at 102.6 MHz with a bandwidth of 1.2 MHz.



Scan Mode

In the scan mode, the tuner scans a defined frequency range. The user can define the start and stop frequency as well as scan bandwidth and scan step width. The control of the scan process is done by CCT™ automatically.

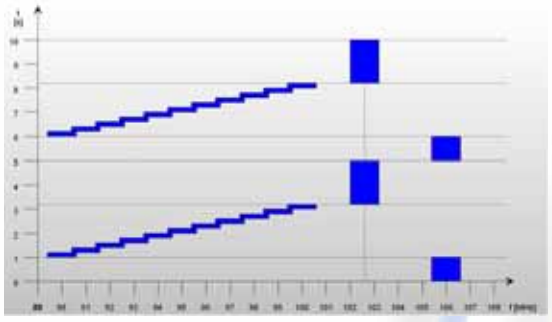
The adjoining figure shows a sample scan from 90.0 MHz to 100.0 MHz. The scan is repeated.



Search Mode

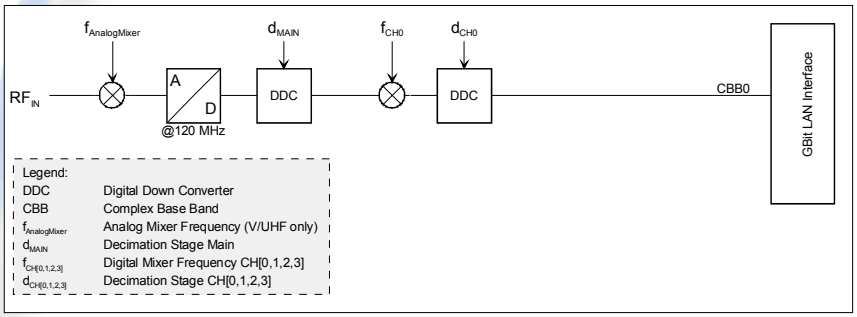
In search mode, the tuner can monitor predefined frequency locations. The user can enter the desired frequency locations with some more specifications like duration and bandwidth in the tuners “job list”. Every row in the “job list” defines a job. A job can be a fixed frequency type or, again, a scan type.

The adjoining figure shows as a sample job list with 3 entries or rows. After the job list is finished, the tuner restarts from beginning. The first and the last entry describe a fixed frequency receiving at 102.6 MHz and at 106.0 MHz. The duration can be defined separately in every entry. An entry can contain a another scan, as the second entry in this example shows.



DSP Post Processing Mode: COMPLEX BASEBAND

Basic mode for receiving wideband and narrowband signals



Simplified logical block diagram

DSP Component

The direct (in HF only) or analog mixed input signal is sampled by the high speed AD converter at 120 MHz. Two DDC's and one digital mixer are used to filter out the signal at the desired frequency and bandwidth.

Description

The embedded high speed signal processing core of the ComCat Tuner acts as a digital down converter (DDC) with extraordinary high selectivity, flexible bandwidth and high tuning resolution.

After down conversion and decimation, a digital complex baseband (CBB) signal ("digital IF signal") is output to LAN for external post processing.

The center frequency range is different for the three tuner models:

D2 (HF) 100 kHz... 30 MHz

D3 (V/UHF) 30 MHz... 3 GHz

D4 (H/V/UHF) 100 kHz... 3 GHz

IF Bandwidth		
16,000 MHz	(19,200 MHz)	(24,000 MHz)
8,00 0MHz	9,600 MHz	12,000 MHz
4,000 MHz	4,800 MHz	6,000 MHz
2,000 MHz	2,400 MHz	3,000 MHz
1,000 MHz	1,200 MHz	1,500 MHz
500,000 kHz	600,000 kHz	750,000 kHz
250,000 kHz	300,000 kHz	375,000 kHz
125,00 0 kHz	150,000 kHz	187,500 kHz
62.500 kHz	075,000 kHz	93,750 kHz
31.250 kHz	37,500 kHz	46,875 kHz
15.625 kHz	18,750 kHz	23,438 kHz
7.813 kHz	9,375 kHz	11,719 kHz

The table above shows some of the possible bandwidths.

(IF Bandwidth > 20 kHz in HF and > 200 kHz in V/UHF are only available with option WB)

(The IF bandwidth 19,2 MHz and 24,0 MHz cannot be output to LAN)

Data format:

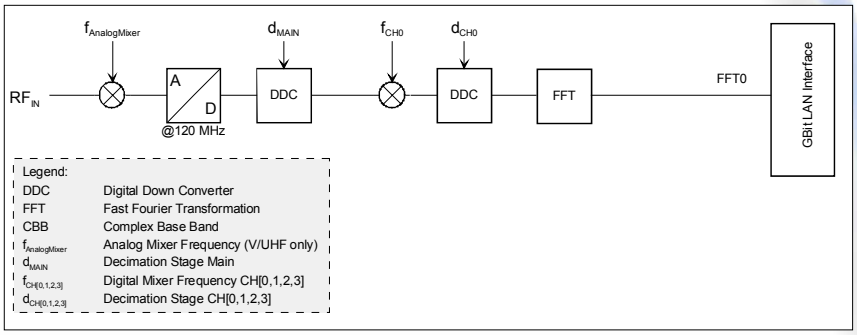
Selectable 16 or 32 bit signed integer per sample.
(32 or 64 bit for complex sample)

Application

- Wideband (up to 16 MHz) or narrowband signal acquisition
- Monitoring of signals
- Various analog and digital demodulators available (VD technique)

DSP Post Processing Mode: COMPLEX FFT

HIGH PERFORFMANCE FFT



Simplified logical block diagram

DSP Component

If the FFT option is available, an additional FFT processor can be activated.

Description

The embedded high speed signal processing core allows the gapless real-time FFT computation of the internal digital complex baseband signal.

The computed FFT data are forwarded to the LAN interface, for external post processing facilitating spectrum display, signal search & detection or direction finding applications.

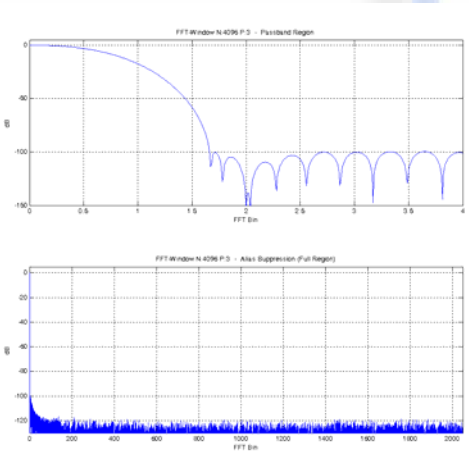
The time and frequency resolution depends on bandwidth and FFT length. The adjoining table shows some possible combinations.

4096 point complex FFT		
IF Bandwidth	Frequency resolution	Time resolution
16,000 MHz	4882,813 Hz	0,2048 ms
8,000 MHz	2441,406 Hz	0,4096 ms
4,000 MHz	1220,703 Hz	0,8192 ms
2,000 MHz	610,352 Hz	1,6384 ms
1,000 MHz	305,176 Hz	3,2768 ms
...	...	...
1024 point complex FFT		
IF Bandwidth	Frequency resolution	Time resolution
16,000 MHz	19531,25 Hz	0,0512 ms
8,000 MHz	9765,625 Hz	0,1024 ms
4,000 MHz	4882,813 Hz	0,2048 ms
2,000 MHz	2441,406 Hz	0,4096 ms
1,000 MHz	1220,703 Hz	0,8192 ms
...	...	...

Selectivity

High-quality channelizing is achieved with the following characteristics of the FFT window:

- High concentration of energy within FFT bandwidth, just small leakage to only the adjacent FFT bin
- 3dB bandwidth equals FFT bin bandwidth
- effective bandwidth equals FFT bandwidth
- minimum side lobe suppression of 100dB
- far-off alias suppression of about 120dB



Data format

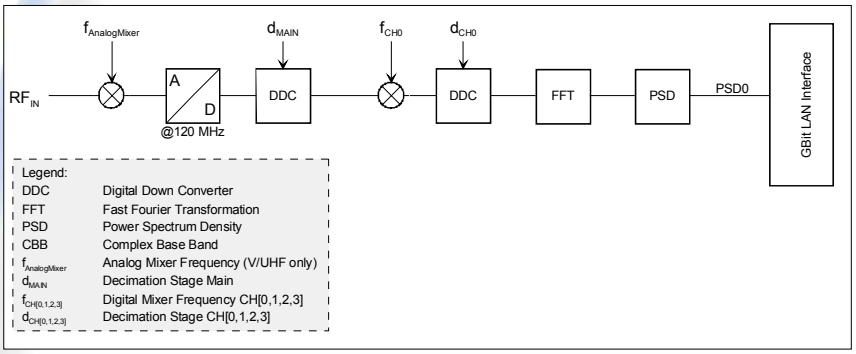
16 bit short float per sample
(32 bit per complex sample)

Application

- H/V/UHF direction finding
- Direction finding products (Watson Watt or Interferometer based) are available in VD technique

DSP Post Processing Mode: POWER SPECTRUM DENSITY

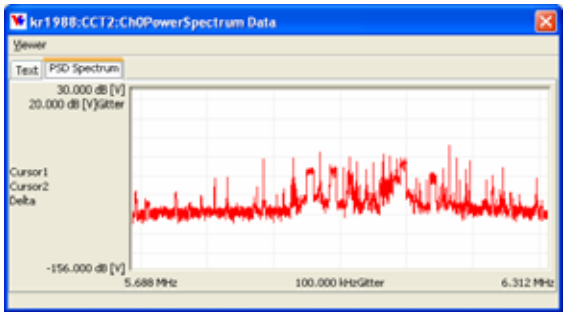
HIGH PERFORFMANCE PSD



Simplified logical block diagram

DSP Component

If the PSD option is available, the additional DSP block PSD (Power Spectrum Density) can be added to the complex FFT block.



Description

The PSD block calculates a logarithmic scaled power spectrum density vector.

This vector has—compared with CBB or FFT output—a highly decreased data rate.

The implemented averaging helps to detect weak signals in a noisy surrounding and will further decrease the data rate.

Data format

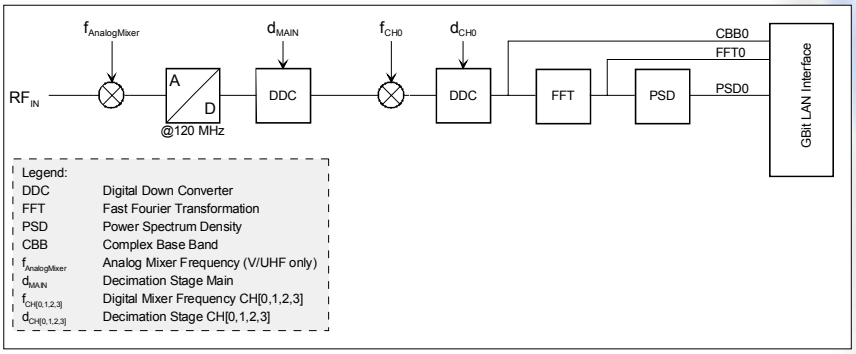
16 bit unsigned integer

Application

- High speed scan and search receiver
- Panorama display
- Manual or automatic (using powerful modules in VD technique) detection of stationary and frequency agile (e.g. hopper) signals

DSP Post Processing Mode: COMPLETE PROCESSING

HIGH PERFORFMANCE CBB, FFT AND PSD



Simplified logical block diagram

DSP Component Combination

All of the prior described components can—if available—be combined. This allows for simultaneous processing and output of digitized IF (CBB), complex spectrum (FFT) and Power Spectrum Density (PSD) vectors.

Please note that the resulting data rate must be less then 80 MB/s.

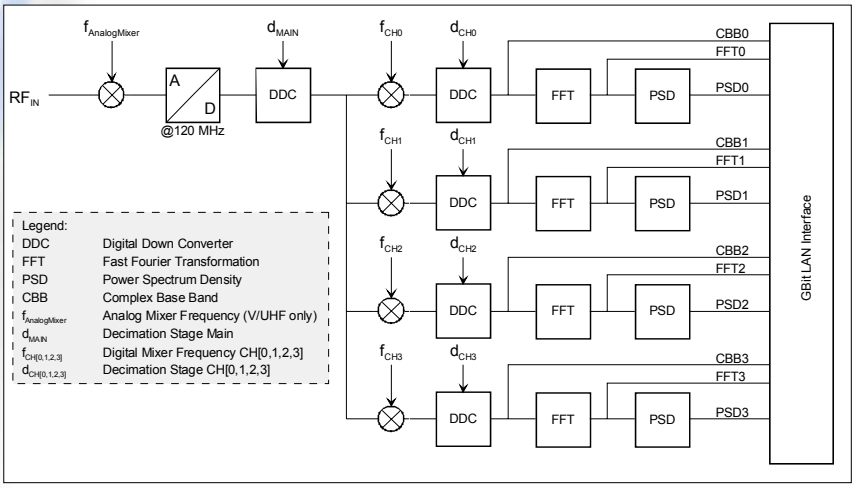
Data rates over GBit LAN interface (CBB configured to 16 bit / sample, 32 bit per I/Q)			
IF Bandwidth	CBB / FFT Data rate	PSD Av = 1 data rate	PSD Av = 4 data rate
16 MHz	80 MB/s	40 MB/s	10 MB/s
8 MHz	40 MB/s	20 MB/s	5 MB/s
4 MHz	20 MB/s	10 MB/s	2,5 MB/s
2 MHz	10 MB/s	5 MB/s	1,25 MB/s
1 MHz	5 MB/s	2.5 MB/s	0.625MB/s

Application

- High speed scan and search receiver
- Panorama display
- Manual or automatic (using powerful modules in VD technique) detection of stationary and frequency agile (e.g. hopper) signals
- H/V/UHF direction finding
- Direction finding products (Watson Watt or Interferometer based) are available in VD technique
- Wideband (up to 16 MHz) or narrowband signal acquisition
- Monitoring of signals
- Various analog and digital demodulators available (VD technique)

DSP Post Processing Mode: MULTI CHANNEL

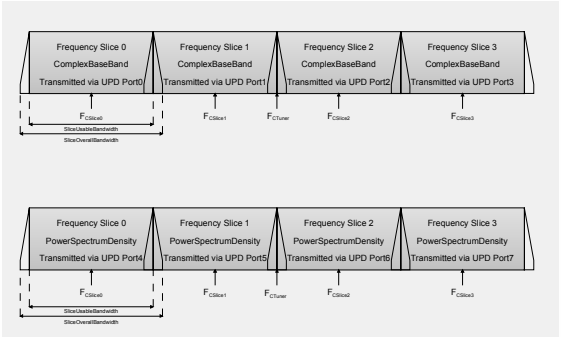
HIGH PERFORFMANCE MULTI CHANNEL CBB, FFT AND PSD



Simplified logical block diagram

DSP Components

All available DSP components are used in this mode. The received and digitized IF signal can be separated into four channels nearly independent of each other.

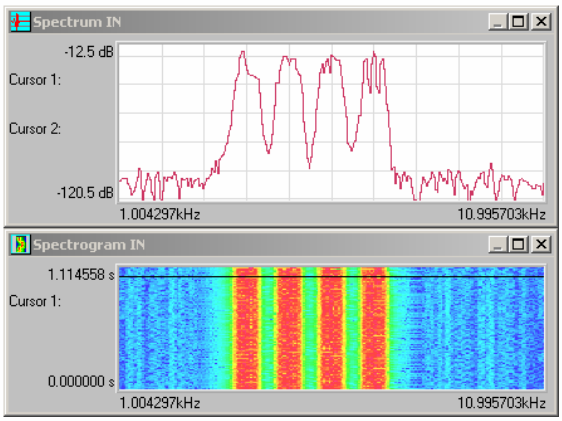


Description

Inside the IF band, up to four channels can be defined after the first DDC (24 MHz, 19.2 MHz or 16 MHz bandwidth).

Each channel can be independently adjusted regarding center frequency and bandwidth within the band.

Using the multicast LAN protocol, the results of each channel can be routed to one or more predefined workstations. This reduces the computing power required on the workstations by the factor of four or more.

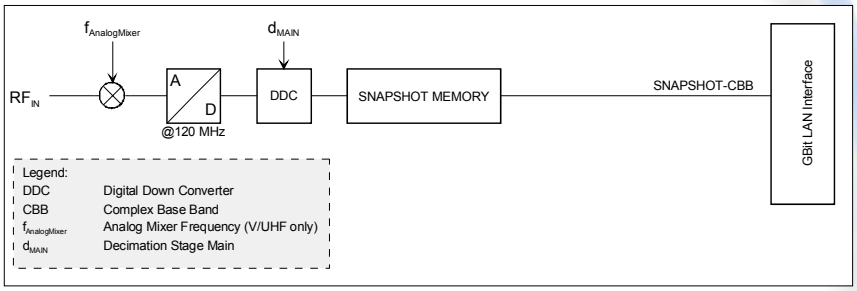


Application

- Monitoring of up to 4 channels
- Distributed computing

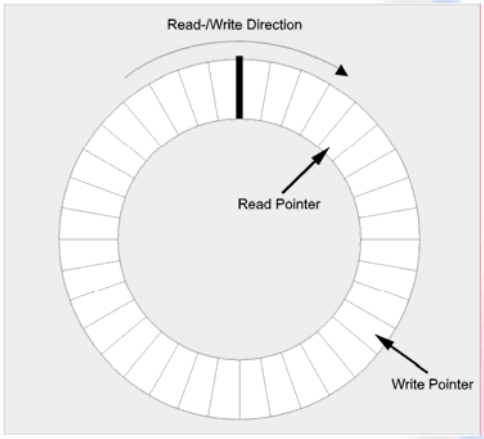
DSP Post Processing Mode: SNAPSHOT MEMORY

HIGHEST SPEED DATA ACQUISITION



DSP Component

The digitized IF can be recorded in the internal SNAPSHOT memory.



Buffer memory

Description

An additional internal SNAPSHOT memory (RAM) at 24 MHz for wideband CBB data can be used as a buffer for time limited bursts of wideband signals.

The buffer bridges the gap between wideband CBB data at high data rate and limited data transfer capacity on slow LAN connections. This allows realizing applications demanding for high instantaneous bandwidth.

Applications

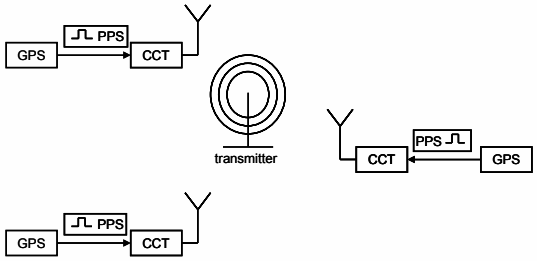
- Acquisition of IF signals up to 24 MHz bandwidth
- Slow LAN connections (e.g. DSL, MODEM) between CCT™ and workstation

Further Features: Synchronizing Multiple ComCat Tuners

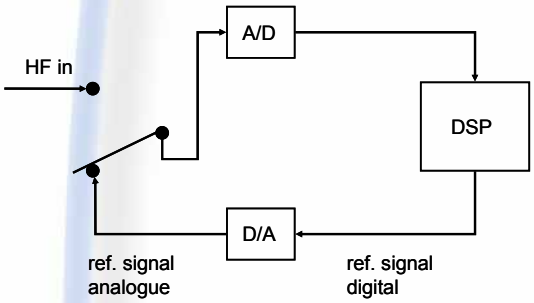
ComCat Tuners can be synchronized e.g. by an external PPS signal to enable phase-synchronous processing.

Using an external single PPS signal for multiple ComCat Tuners allows for e.g. direction finder applications.

Providing multiple PPS signals for multiple ComCat Tuners supports e.g. hyperbolic location (TOA) or synchronized wideband signal recording applications.



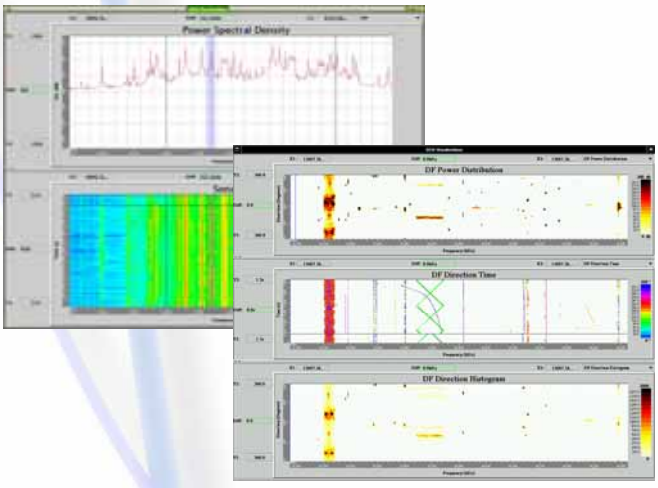
Further Modes: Calibrating the HF Signal Path



A digital reference signal can be loaded and internally connected to the HF input after D/A conversion. After determination of the true frequency response, the frequency response of the whole ComCat Tuner RF signal path can be corrected by the corresponding Virtual Device “CCTNG” during online operation.

Calibration of the signal path is a mandatory precondition e.g. for direction finders and various common measurement applications.

Further Features: Smart Software Interface for fast Integration



For integration into IT-based systems, a standardized LAN interface is used for parameterization and CBB output.

The ComCat Tuner is fully remote controlled using a TCP/IP software interface. A high level interface is used to run customer specific software on external PC hardware.

Numerous software modules, ready-to-run on external PC hardware as “virtual devices” (VD), are available to post-process raw CBB or pre-processed FFT and PSD data.

The VD collection includes software modules for spectrum display, signal recording, direction finding, signal search & detection, classification, demodulation and decoding.

CCT – Technical Specifications

General

Analog to Digital Converter	
Sampling Rate	120 MS/sec
Resolution:	14 bit
External References	
10 MHz:	50 Ohm, 0dBm to +10 dBm
1 PPS:	CMOS 3.3 V (5V tolerant input)
Digital Postprocessing	
Digital Down Converter	
Complex Baseband	variable bandwidth: 7,8125 kHz to 24 MHz
Complex FFT	4096- or 1024-point-FFT, variable bandwidth: 7,8125 kHz to 24 MHz
Power Density Spectrum	magnitude and logarithm of complex FFT
Averaging	variable averaging of PSD by 1,2,4,8,16,32,64,128
Digital Output via LAN	
Complex Baseband	16 or 32 bit signed integer, I and Q samples
Complex FFT	16 bit floating point, complex 4 k or 1k FFT
Power Density Spectrum	16 bit unsigned integer, logarithmic scaling range 256 dB
Maximum Data Rate	approx. 80 MByte / sec
Operating Temperature	0°C to 50°C Rated temperature -10°C to +55°C
Storage Temperature	-40°C to 70°C
Humidity	Max. 85%, non-condensing
Power Consumption	100-240 Volt AC, 50-60 Hz, 50 Watt
Mechanical	
Width	19 inch
Height	1 RU (Rack Units)
Depth	560 mm
Weight	11 kg
Interface	
RF Input	N, Female, 50 Ohm (optional 2 for HF)
10 MHz Reference Input	BNC, Female
1 PPS	BNC, Female
LAN	RJ45, (10/100/1000 Base-T)
RS 232	D-SUB9. Male
Power Supply	IEC 320
Standards	
MTBF	> 10.000 hrs (MIL-HDBK)
Compliant to	EN 61010-1:2002 / EN 61000-6-2:2002 / EN 61000-6-3:2002

	CCT-NG-D2	CCT-NG-D3	CCT-NG-D4
Frequency Range	100 kHz - 30 MHz(1)	30 MHz – 3 GHz(2)	100 kHz – 3 GHz(1,2)
Frequency Accuracy	+/- $1x10^{-6}$	+/- $1x10^{-6}$	+/- $1x10^{-6}$
Tuning Resolution	1 Hz	1 Hz	1 Hz
CBB Bandwidth			
HF	7,8125 kHz to 20 kHz 7,8125 kHz to16 MHz(3)		7,8125 kHz to 20 kHz 7,8125 kHz to16 MHz(3)
V/UHF		7,8125 kHz to 200 kHz 7,8125 kHz to16 MHz(3)	7,8125 kHz to 200 kHz 7,8125 kHz to16 MHz(3)
Tuning Accurancy	< 0.2 Hz	< 0.2 Hz	< 0.2 Hz
External Reference Frequency	10 MHz	10 MHz	10 MHz
RF Gain			
Max. HF	25 dB min.		25 dB min.
Max. V/UHF		30 dB min.	30 dB min.
Flatness			
HF	+/- 2 dB		+/- 2 dB
V/UHF		+/- 3 dB	+/- 3 dB
Max. Attenuation			
HF	66 dB		66 dB
V/UHF		58 dB	58 dB
Attenuator Stepsize			
HF	6 dB		6 dB
V/UHF		2 dB	2 dB
Gain Control	AGC, MGC	AGC, MGC	AGC, MGC
Input Sensitivity @ S/N = 10 dB			
HF @ BW = 500 Hz	-128 dBm		-128 dBm
HF @ BW = 3 kHz	-120 dBm		-120 dBm
HF @ BW = 25 kHz	-111 dBm		-111 dBm
V/UHF @ BW = 3 kHz		-114 dBm	-114 dBm
V/UHF @ BW = 25 kHz		-105 dBm	-105 dBm
V/UHF @ BW = 500 kHz		-92 dBm	-92 dBm
Oscillator Phase Noise			
HF @ 1 kHz offset	-130 dBc/Hz typical		-130 dBc/Hz typical
HF @ 10 kHz offset	-140 dBc/Hz typical		-140 dBc/Hz typical
V/UHF @ 10 kHz offset		-100 dBc/Hz typical	-100 dBc/Hz typical
Maximum Input Power			
HF	+20 dBm typical (+30 dBm with input attenuator active)		+20 dBm typical (+30 dBm with input attenuator active)
V/UHF		+15 dBm typical	+15 dBm typical
Input IP3			
HF	+37 dBm @ P_{in} > +3 dBm		+37 dBm @ P_{in} > +3 dBm
V/UHF		+25 dBm @ P_{in} > +3 dBm	+25 dBm @ P_{in} > +3 dBm
Input IP2			
HF	+75 dBm (1.5 .. 30 MHz) @ P_{in} > +3 dBm		+75 dBm (1.5 .. 30 MHz) @ P_{in} > +3 dBm
V/UHF		No measurements available	No measurements available
Noise Figure			
HF	9 dB typical, @ maximum gain		9 dB typical, @ maximum gain
V/UHF		12 to 15 dBm typical @ maximum gain	12 to 15 dBm typical @ maximum gain
Image Frequency Rejection	> 100 dB	> 100 dB	> 100 dB
IF Rejection			
HF	Due to direct HF sampling technique not applicable		Due to direct HF sampling technique not applicable
V/UHF		> 100 dB @ 30 MHz - 2200 MHz > 80 dB @ 2200 MHz -3000 MHz	> 100 dB @ 30 MHz - 2200 MHz > 80dB @ 2200 MHz -3000 MHz

	CCT-NG-D2	CCT-NG-D3	CCT-NG-D4
Oscillator Reradiation at antenna input			
HF	< -110 dBm		< -110 dBm
V/UHF		No measurements available	No measurements available
Spurious Response			
HF	< -125 dBm		< -125 dBm
V/UHF		No measurements available	No measurements available
Preselector			
HF	12-Band		12-Band
V/UHF		11-Band	11-Band
PLL Settling Time to 1 Hz accuracy			
HF	Due to direct HF sampling technique not applicable		Due to direct HF sampling technique not applicable
V/UHF		5 ms typ.	5 ms typ.
Scan Rate			
HF	max. 4 GHz / s		max. 4 GHz / s
V/UHF		max. 2 GHz / s	max. 2 GHz / s
SFDR (referred to full scale of A/D converter)			
HF	85 dB typical		85 dB typical
V/UHF		70dB typical	70dB typical

Preselector Specifications

HF 12 Band Preselector	Bands overlap by 500 kHz		**V/UHF 11 Band Preselector**	Bands overlap by 2 MHz	
Band 0	Preselector bypass		n.a.		
Band 1	0.1 MHz	1.0 MHz	Band 1	20 MHz	47 MHz
Band 2	0.5 MHz	2.0 MHz	Band 2	45 MHz	70 MHz
Band 3	1.5 MHz	3.5 MHz	Band 3	68 MHz	87 MHz
Band 4	3.0 MHz	5.5 MHz	Band 4	85 MHz	110 MHz
Band 5	5.0 MHz	7.0 MHz	Band 5	108 MHz	172 MHz
Band 6	6.5 MHz	8.5 MHz	Band 6	170 MHz	242 MHz
Band 7	8.0 MHz	11.0 MHz	Band 7	240 MHz	470 MHz
Band 8	10.5 MHz	13.5 MHz	Band 8	468 MHz	962 MHz
Band 9	13.0 MHz	16.5 MHz	Band 9	960 MHz	1710 MHz
Band 10	16.0 MHz	19.5 MHz	Band 10	1708 MHz	2202 MHz
Band 11	19.0 MHz	23.5 MHz	Band 11	2200 MHz	3000 MHz
Band 12	23.0 MHz	30.0 MHz	n.a		

Options

CCT-WB[4]	- Extension of continous signal output rate (bandwidth) over LAN up to: max. 16 MHz [5] for CBB / FFT or max. 24 MHz for PSD - Extension of CBB bandwidth up to 24 MHz in snapshot memory
CCT-FFT	Additional firmware for complex polyphase FFT computation
CCT-PSD	Additional firmware for power density computation
CCT-MC	Up to 4 Channels of DSP computing
CCT-AAI	Additional antenna input for HF signals
CCT-HFCAL	Additional firmware for calibration the HF path (only available in D2 and D4)
CCT-TRIG	Additional firmware for synchronising multiple tuners
CCT-EXT-SYNC	Additional firmware and hardware for synchronising multiple tuners (digital and analog)
SYNC-DISTRIBUTION-UNIT	Additional hardware for synchronising multiple tuners (digital and analog)

Ordering Information

	CCT WB	CCT-FFT	CCT-PSD	CCT-MC	CCT-AAI	CCT-HFCAL	CCT-TRIG	CCT-EXT-SYNC	SYNC-DISTRIBUTION-UNIT
CCT-NG-D2	●	●	●	●	●[7]	●[7]	●		
CCT-NG -D3	●	●	●	●	-	-	●	●[6]	●[6]
CCT-NG -D4	●	●	●	●	●[7]	●[7]	●	●[6]	●[6]

● Available
- Not available

Remarks:

1 = with reduced performance from 0.1 MHz to 0.5 MHz
2 = with reduced performance from 30 MHz to 50 MHz
3 = with CCT-WB option
4 = Please notice preselector specifications
5 = Max. value depends on LAN and workstation performance
6 = Both options should be combined for guaranteed performance
7 = CCT-CAL and CCT-AAI are mutually exclusive

Development in cooperation with IZT

Innovationszentrum Telekommunikations-technik GmbH

Company Principles and Policy

Technology

… in development and company management is state-of-the-art, and represents only the best.

Quality

… in all areas of our company is regarded as the almost requirement for risk-free and successful cooperation with our customers, and business partners.

Market Position

… we are the specialists in the field of signal and data processing as well as pattern recognition, and we are glad to face competition.

Colleagues

… form the roots of our company, and give the performance required for maintaining and building the technical base, and close personal cooperation we have with our clientele.

Growth

… we strive toward a healthy, stable foundation at home and abroad.

Services

… are comprehensive and complete. As a full-system company we offer standard equipment, systems, and services.

Trust

… in the relationships to our business partners, and within our own company forms the basis of our business.

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