ROHDE&SCHWARZ

Technical Information

ROMES Software Option

UMTS PN Scanner

TS5K51C

Material-No. 1156.2858.02

Benefits

- Highly Effective, Time-Saving UMTS Network Optimization
- Test Receiver / Spectrum Analyzer Based Solution
- Network Independent
- Indoor and Outdoor Use
- Runs on any high-class PC or Notebook
- Integral Part of ROMES Network Optimization System Platform, Scalable
- Additional Use with other Network Optimization (e.g. CW & CDMA & GSM/GPRS) Measurements

Features

- Unrivalled Measurements in UMTS Networks
- High-End R&S Test Receiver ESPI or Spectrum Analyzer FSP/FSU as RF Front End
- Combined Operation with UMTS Test Mobile for Serving Cell Tracking (available soon)
- Integrated GPS System with Map Display
- High Speed Measurements in Steps of 1, 2, 5, 10 per Second
- Sensitivity with ESPI: -127 dBm (High Dynamic Mode), -119 dBm (High Speed Mode)
- Sensitivity with FSP/FSU: -118 dBm (High Dynamic Mode), -110 dBm (High Speed Mode)

Performance

- Automatic Pilot and Scrambling Code Detection and Analysis with 2500 Dynamic Rake Receivers
- Multipath Measurement (CIR View)
- Multi Channel Capability (up to 12 Channels simultaneously)
- UMTS Frequency Band and Uplink Channel - Spectrum Display
- Automatic and Configurable Best Server (Top N 32) Display Mode
- Pilot Pollution Analysis
- Spectrum Display Function (70 dB Dynamic from Receiver), also for Uplink
- Configurable Spectrum Display Rate (Data Compression Mode)
- P-SCH (Primary) and S-SCH (Secondary Synchronization Channel) Power Measurement
- Relative Frequency Error of Node-B
- RMS (Root Mean Square) of Delay Spread related to Chip
- Time Drift of Node-B
- Phase Noise Display

General

In a UMTS Mobile Radio Network, it is essential to achieve accurate information about the receiving conditions of a mobile unit at any place and any time. The most important step (together with the availability of reasonable test mobile stations TMS) is to implement a mobile unit to measure and identify all Node-B signals in the air. This is complementary to CW measurements in GSM/GPRS technology.

According to UMTS/3GPP specification, numerous Node-B share one frequency band. Ideally, the total power of the serving cell is more than 20 dB higher than all other neighbors. In reality, this is impossible for a functioning network, and optimization work requires then the knowledge of all base stations that exceed this threshold of 20 dB distance.

Thus, every UMTS network operator needs a powerful instrument for "UMTS Interference Analysis" and PN Scanning in his mobile network.

Rohde & Schwarz Solution

R&S has developed this instrument to achieve highest quality and customer satisfaction. The minimum necessary components are:

- ESPI Test Receiver or FSP/FSU Spectrum Analyzer
- ROMES Network Optimization Software with UMTS Interference Analyzer Module
- GPS with PPS-Pulse and/or Synchronization Unit for Triggering
- Powerful PC or Notebook

Figure 1: Notebook with UMTS Interference Analyzer

The principle behind this analyzer is different to that of all other currently available products. Ordinary PN Scanners use the standard technology of mobile telephones with means of regular, hardware-based rake receivers. To fulfil the real requirements for interference analysis in UMTS, R&S has replaced this principle by the development of "Dynamic Rake Receivers". These Dynamic Rake Receivers are capable of tracing up to 5000 different signal propagation paths leading to max. 2500 Node-B's simultaneously, where static rake receivers allow only the tracing of 4 or 8 paths.

With this technology, the UMTS Interference Analyzer can synchronize on UMTS base stations with inexperienced speed, accuracy and dynamic range. Future development will include a 3GPP telephone (commercial and with trace function, when available) to add smart control to the Interference Analyzer.

The UMTS Interference Analyzer is part of the extensive software platform ROMES, which supports the simultaneous measurement and analysis within different wireless network technologies. All measurement data will be stored together with positioning and timing information, for later replay or detailed analysis & processing. The Receivers FSP/FSU and ESPI fit mechanically in a 19” rack and need five height units.

Information & Parameter Displays

All necessary information for the UMTS Interference Analyzer will be displayed either graphically or in numeric / text values. These comprise (among many others for different tasks in Network Optimization):

Display Windows UMTS:

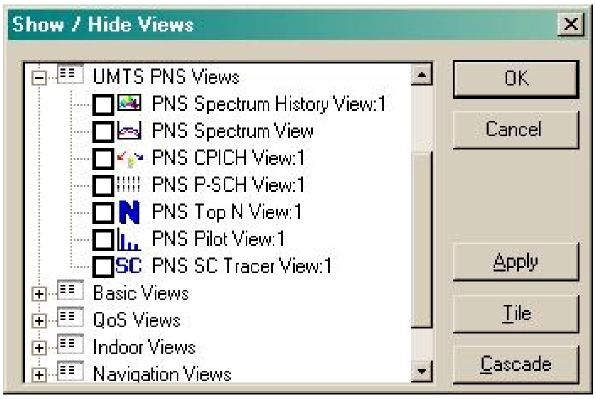


Figure 2: Display Windows for UMTS PN Scanner

- Spectrum History View (Multiple)
- Spectrum View
- CPICH View (Multiple)
- P-SCH View (Multiple)
- Pilot View (Multiple)
- Scrambling Code Tracer View (Multiple)
- TOP N (Incl. Best Server) View (Multiple)

Display Windows General:

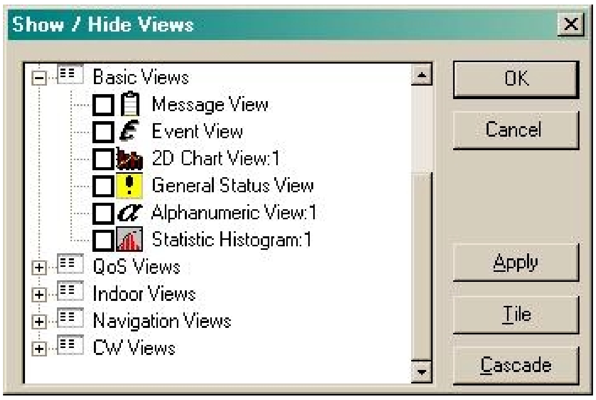


Figure 3: Display Windows for General Information

- Message View
- Event View
- 2D Chart View (Multiple)
- General Status View
- Alphanumeric View (Multiple)
- Statistics View (Multiple)

Display Windows Quality-of-Service:

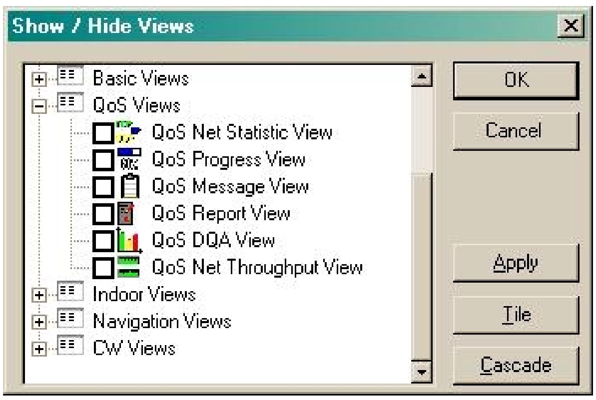


Figure 4: Display Windows for Quality-of-Service Information

- QoS Net Statistic View
- QoS Progress View
- QoS Message View
- QoS Report View
- QoS DQA View
- QoS Net Throughput View
- Indoor View for Real-Time Indoor Map Display
- Route Track with GIS Info for Real-Time Map Display (Multiple)
- GPS Info View

UMTS Network Information Views

To make the underlying measurements and algorithms as transparent as possible, the ROMES Displays offer different views for the steps within measurement process.

- **P-SCH (Primary Synchronization Channel) View:**

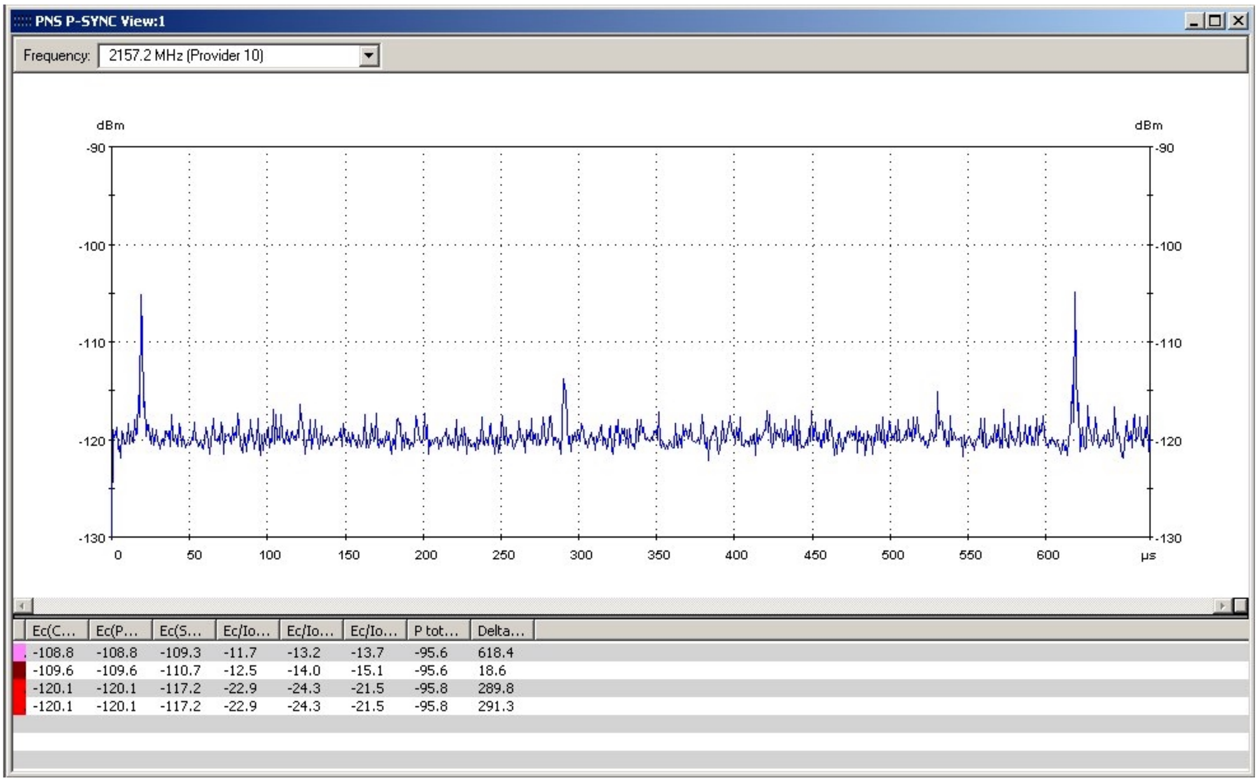


Figure 5: P-SCH View for “Provider 10”

To synchronize upon UMTS-Signals on air, it is necessary to find at least one P-SCH channel for every Node-B. The result of this step is displayed in the P-SCH View (Figure 5). It shall be noted here that in the Table in the lower part, only **verified** peaks are listed. They represent original Node-B-Signals, not peaks produced by so-called accidental correlation or cross-correlation of the P-SCH code.

Figure 6 shows the configuration of the P-SCH View.

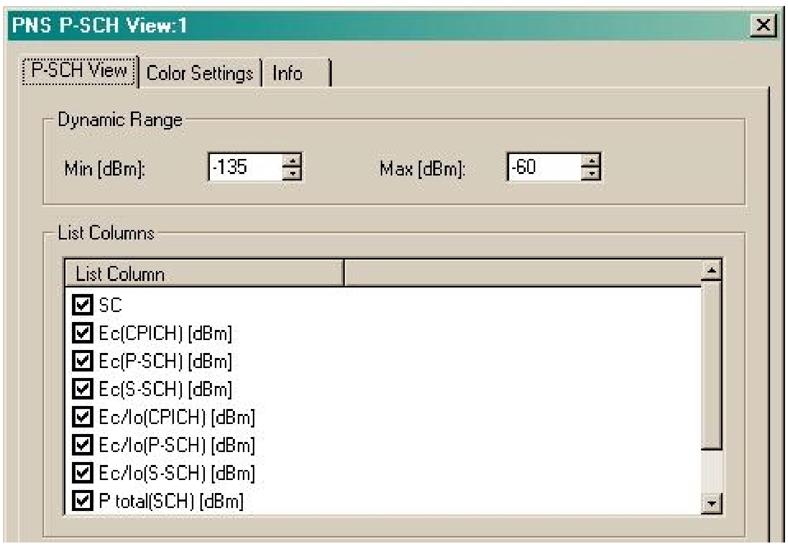


Figure 6: P-SCH Configuration View

- **CPICH (Common Pilot Channel) View:**

The CPICH View is the core of the PN Scanner. It is a view that can be opened for multiple UARFCN, and provides various information. The CPICH View is divided into 3 parts, and the partial windows can be shifted and changed against each other. Figure 7 shows 2 CPICH Views in parallel, displaying the channels on 2157.2 MHz and 2167.2 MHz.

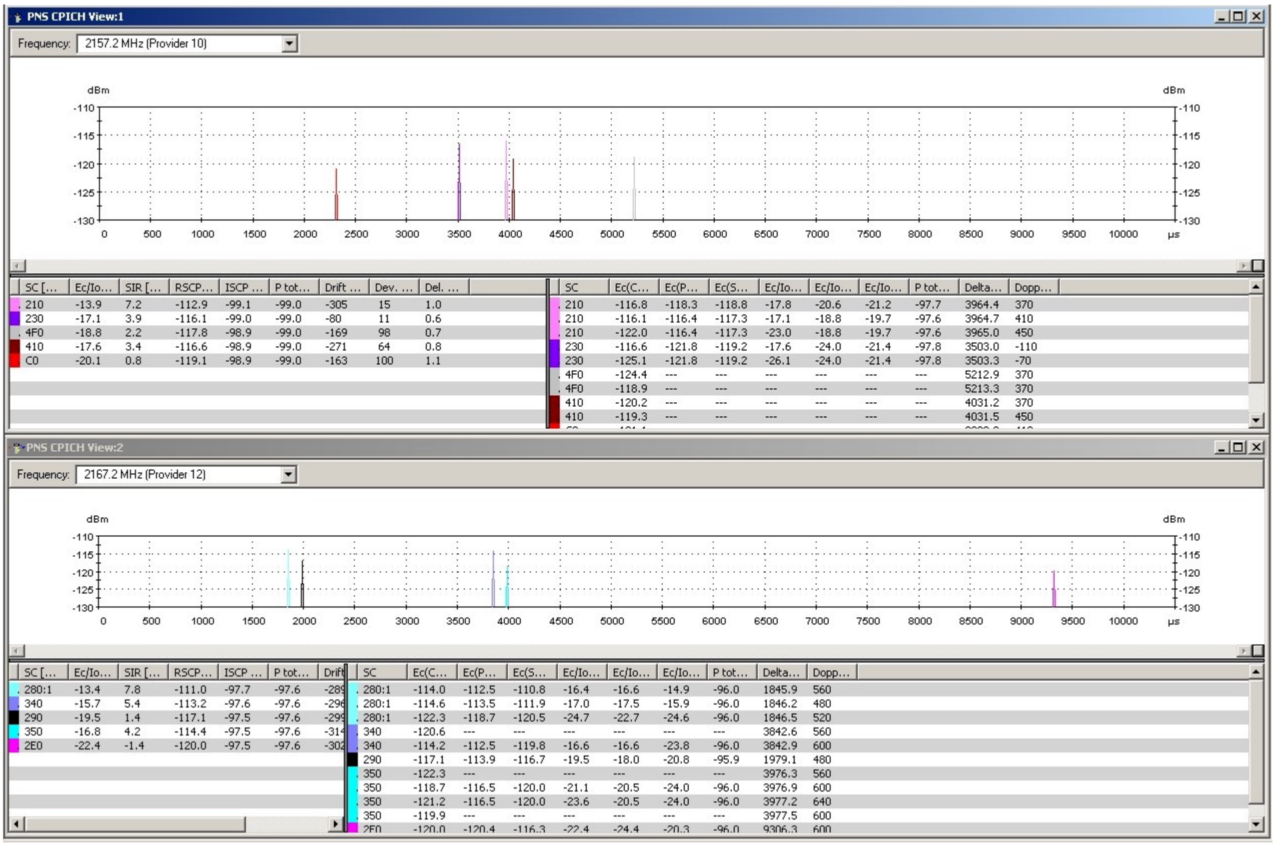


Figure 7: Two CPICH Views on 2 Different UARFCN Channels

CIR Window: This top windows shows the channel impulse response on the CPICH. The X-Scale shows the internal, relative time base, the Y-Scale shows the peak power E_c (CPICH). The identified peaks will be used for further investigation of the received Node-B's. Taking the S-SCH channel, the Code Group of the received Node-B's can be found. Once the Code Group is known, the PCPICH provides information about the transmitted Scrambling Code. The result of the correlation with the CPICH is displayed in the *CPICH View* (Figure 7).

Node-B List (Left): For each found Scrambling Code on the CPICH, the CPICH view has an entry in this left table. Each Scrambling Code represents one Node-B.

CIR Peak List (Right): For each entry in the left table, the right table shows the different peaks of the channel impulse response, together with the corresponding Scrambling Code (SC). The peak's power and relative arrival time give the crucial information about reflections and/or interference.

Figure 8 shows the Lower Left Window in more detail, giving details to the parameters, and how they are measured by the Rohde & Schwarz PN Scanner:

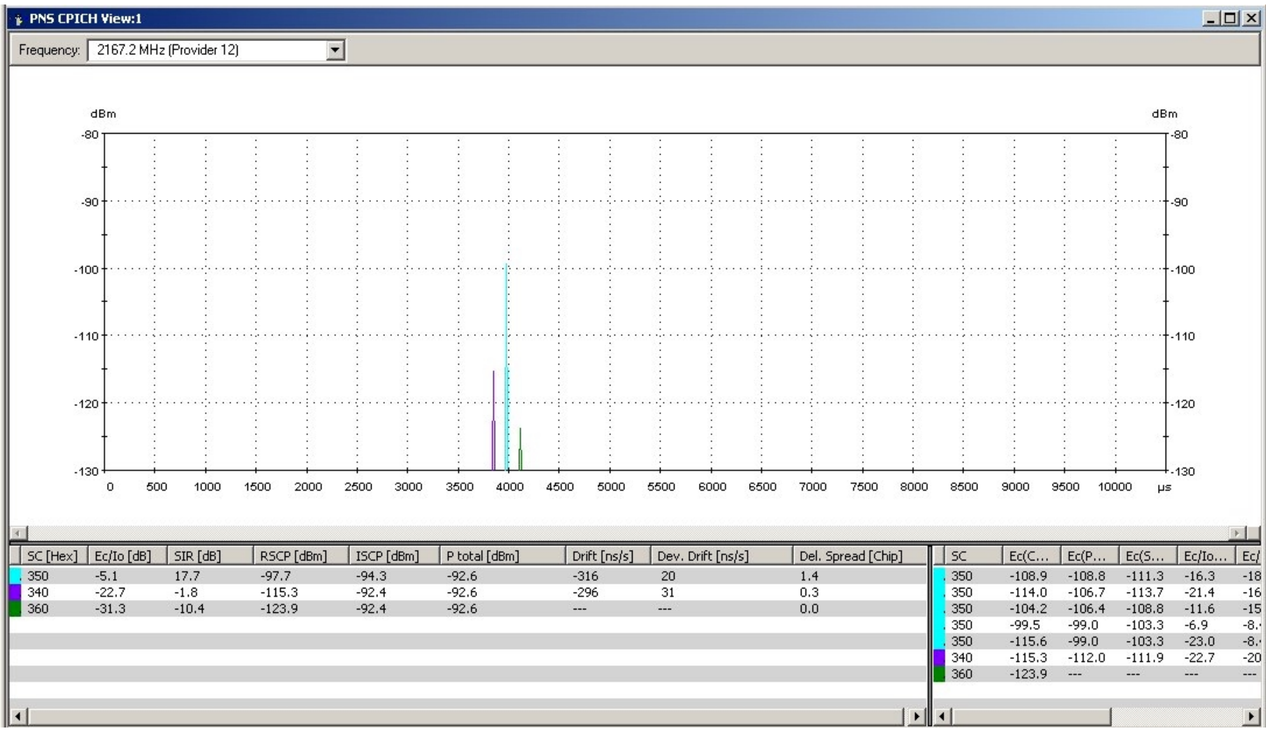


Figure 8: CPICH View with Detailed Node-B Display (Left)

SC [Hex/Dec]:	Scrambling Code (512 SC Codes, 0 - 8176), either in Hex or in Decimal Format
E_c/I_0 [dB]:	The Average Chip Energy of PCPICH (unbiased), divided by the Total Inband Energy per Chip Duration; E_c/I_0 is identical to RSCP/RSSI
SIR [dB]:	Signal to Interference Ratio = RSCP / ISCP * SF (Spreading Factor), whereas SF=256 for a PCPICH
RSCP [dBm]:	Received Signal Code Power (E_c) = Integral Power on one SC for all Measured Peaks, Unbiased
ISCP [dBm]:	Interference Signal Code Power = the Interference upon the Received Signal Measured on the Pilot Bits, Orthogonal & Non-orthogonal
P Total [dBm]:	Total Average Inband Power within the Correlation Section of the PCPICH
Drift [ns/s]:	Mean Time Drift of PCPICH Signal Related to Internal Clock (can be absolutely synchronized by pps/GPS)
Dev. Drift [ns/s]:	90% Confidence Interval Width of Mean Time Drift Value
Delay Spread [Chip]:	RMS Delay Spread = Standard Deviation of Arrival Times, Weighted against Path Power

Figure 9 shows the channel impulse response within the zoomed CPICH view (with Reflections 1 – 5), and the Lower Right Window in more detail, giving details to the parameters, and how they are measured by the Rohde & Schwarz PN Scanner:

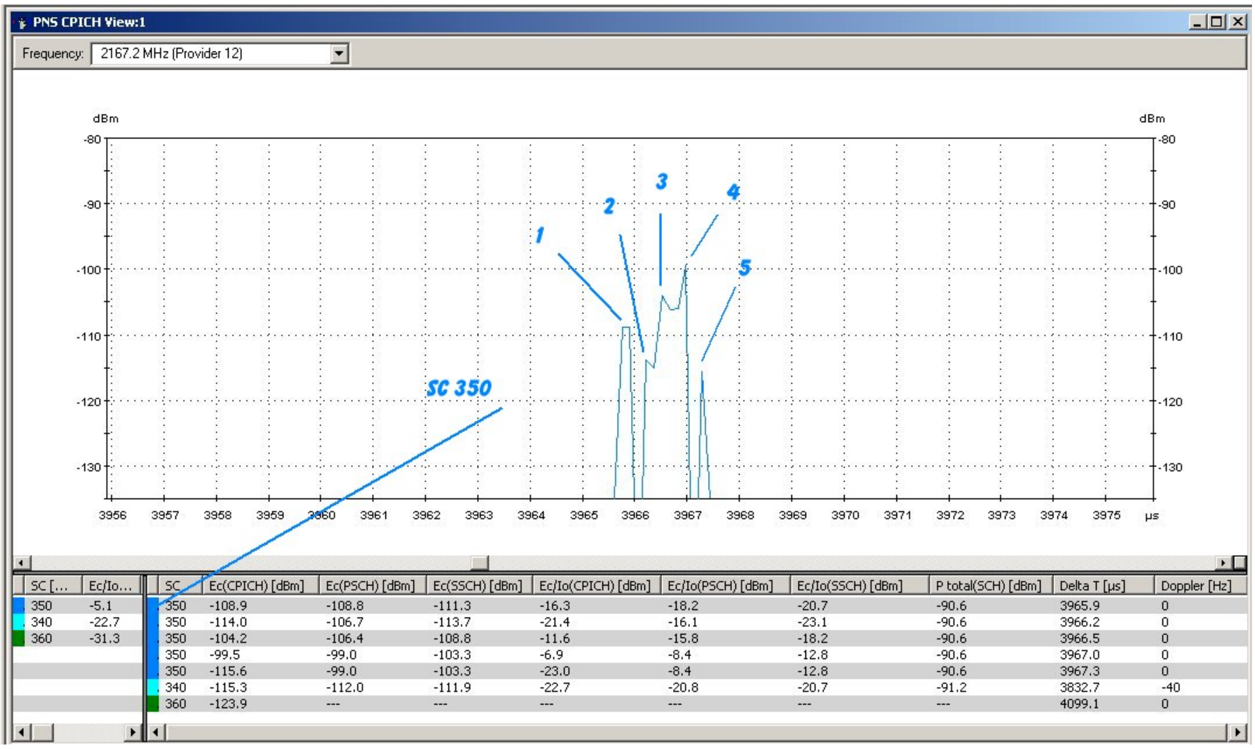


Figure 9: CPICH View with Detailed CIR Peak Display (Right)

SC [Hex/Dec]:	Scrambling Code (512 SC Codes, 0 - 8176), either in Hex or in Decimal Format
Ec(CPICH) [dBm]:	The Average Chip Energy of PCPICH (unbiased), Divided by Chip Duration
Ec(P-SCH) [dBm]:	The Average Chip Energy of P-SCH (unbiased), Divided by Chip Duration
Ec(S-SCH) [dBm]:	The Average Chip Energy of S-SCH (unbiased), Divided by Chip Duration
E_c/I_0 (CPICH) [dBm]:	The Average Chip Energy of PCPICH (unbiased), Divided by the Total Inband Energy per Chip Duration
E_c/I_0 (P-SCH) [dBm]:	The Average Chip Energy of P-SCH (unbiased), Divided by the Total Inband Energy per Chip Duration
E_c/I_0 (S-SCH) [dBm]:	The Average Chip Energy of S-SCH (unbiased), Divided by the Total Inband Energy per Chip Duration
P Total(SCH) [dBm]:	Total Average Inband Power for the SCH Slots of the Measured Node B Signal
Delta T [µs]:	Peak Time within the System Time Frame (can be absolutely synchronized by pps/GPS)
Doppler [Hz]:	Measured Frequency Offset of PCPICH, Resolution 20 Hz

Figure 10 shows the configuration windows of the CPICH view, with the possible settings in each of the 3 partial windows. All available parameters can be included or excluded in the display.

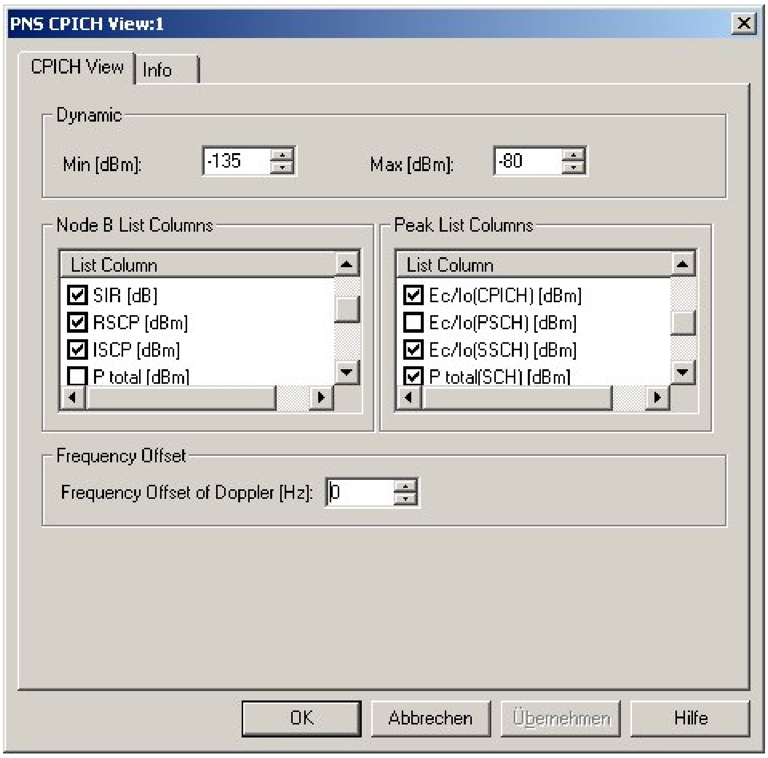


Figure 10: CPICH View Configuration

- **SC (Scrambling Code) Trace View:**

To trace certain characteristics in the reception of one Scrambling Code from one Node-B, the *SC Trace View* has been implemented into the PN Scanner. This view shows the channel impulse response (CIR) on one Scrambling Code, in 2D chart and in a “waterfall” diagram, for analysis of propagation channels varying over time. Particularly the waterfall diagram gives insights to all reflections and interferers for a Node-B.

It is possible to open multiple Scrambling Code Trace Views, as many as are necessary for a measurement tour.

One specific feature this trace views offers, is the determination of birth-death situation within a fading scenario (Figure 11). In addition to interference, a UE has to manage hostile time variance of RF channels, characterized by strong fading for a distinct multipath. The importance of fading is underlined by a special fading model for UE and Node B tests, designed and standardized by 3GPP. Obviously, any PN-Scanner should have the capability to measure and display this kind of adverse receiving conditions, in order to information about severe drops in quality. The R&S solution for this measurement task shows a 3GPP Birth Death Fading situation, generated with the R&S fading simulator SMIQ 03.

Figure 12 shows, beside reflections caused by buildings, the drifting of the Node B time base, as the system’s internal clock is synchronized by external GPS pps.

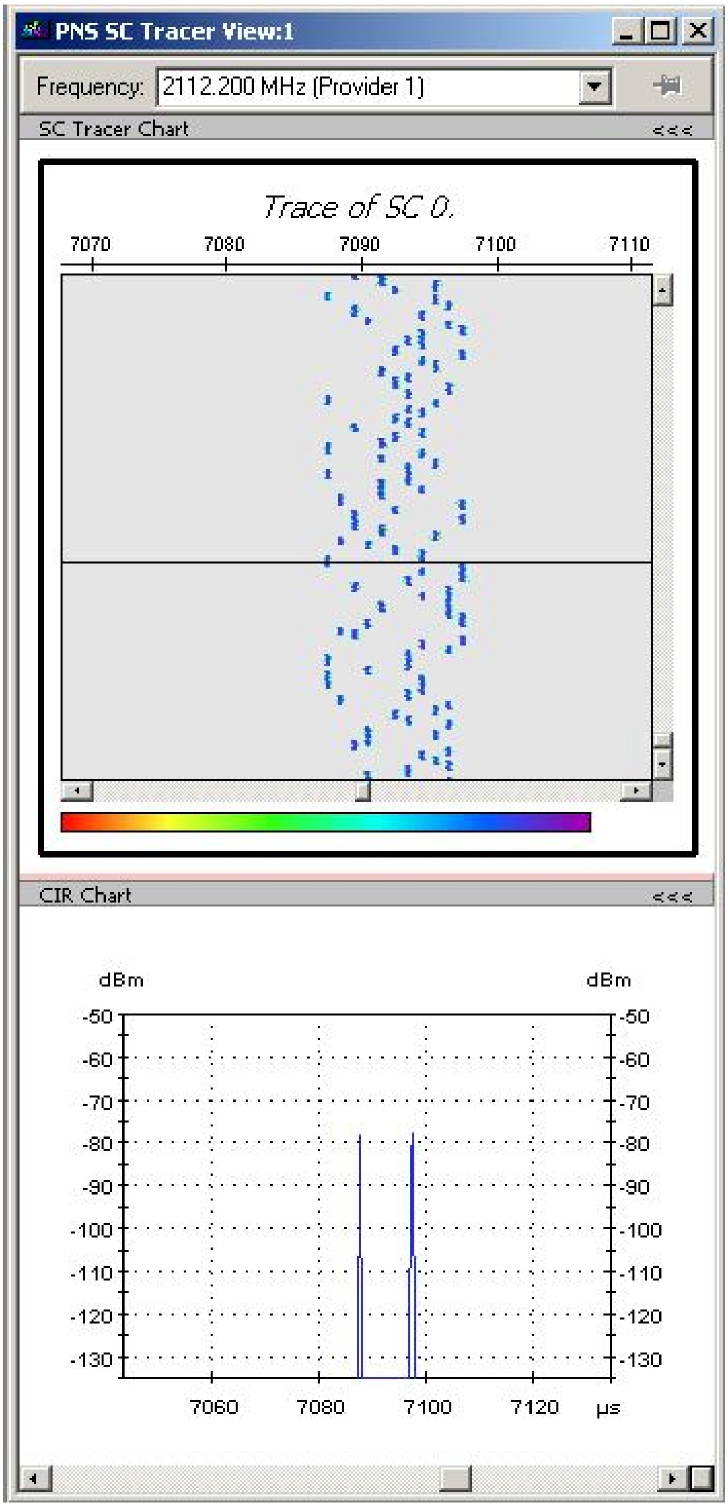


Figure 11: CIR Trace View (Waterfall & 2D) with Birth-Death

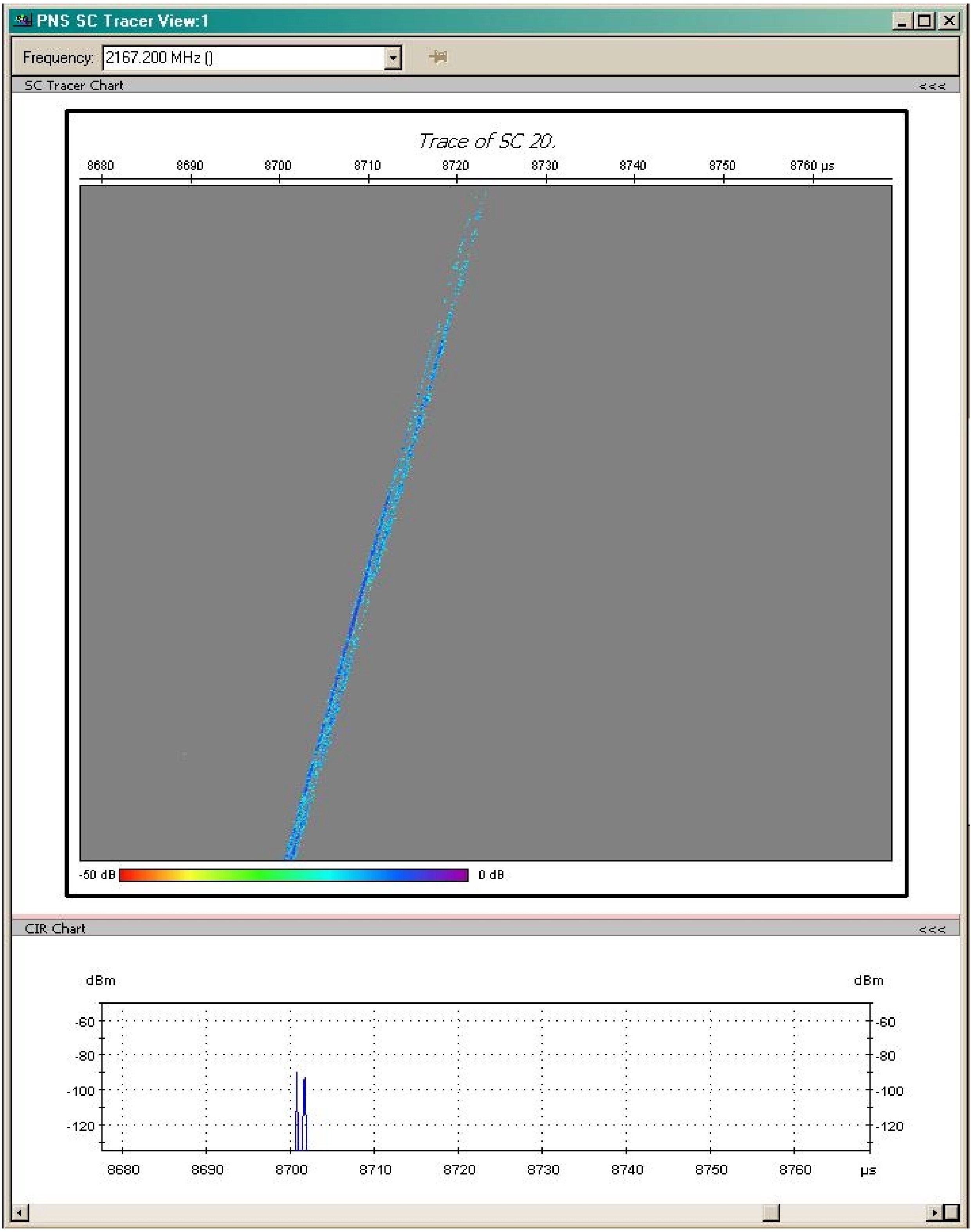


Figure 12: CIR Trace View (Waterfall & 2D) for SC 20H

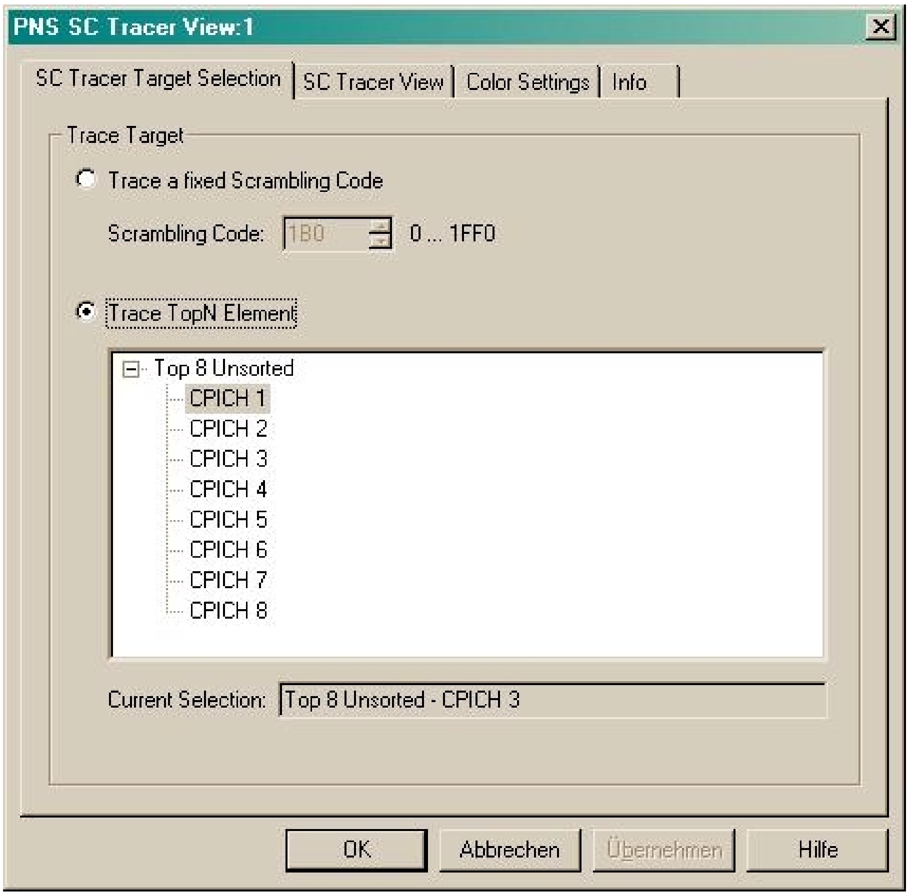


Figure 13: CIR Trace View Configuration

The SC Trace View will be configured 2 ways. For special purposes, a fixed Scrambling Code can be entered (e.g. 1B0), so the display will always show the trace of this specific SC. Otherwise, and normally, one of the TOP N Scrambling Codes of the CPICH View will be displayed.

In addition, the Trace View can be configured with different colors, so the user will have the optimum displays tailored to his needs.

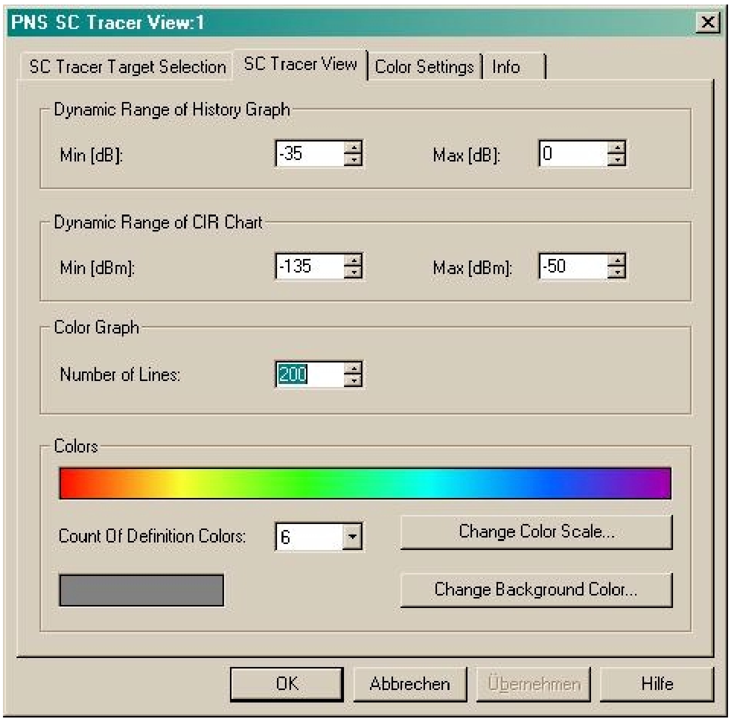


Figure 14: CIR Trace View Display Configuration

- **RF Spectrum View:**

The display of RF spectra provides very important information on signal characteristics, particularly fading effects and interferers on co- or adjacent channels. Within the PN Scanner, the spectrum analyzer function of the ESPI resp. FSP/FSU are being made use of, and the below described, different types of spectra are available.

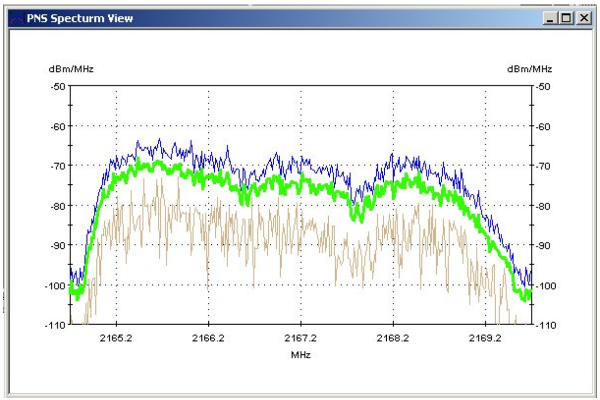


Figure 15: Spectrum Display on one Downlink Channel

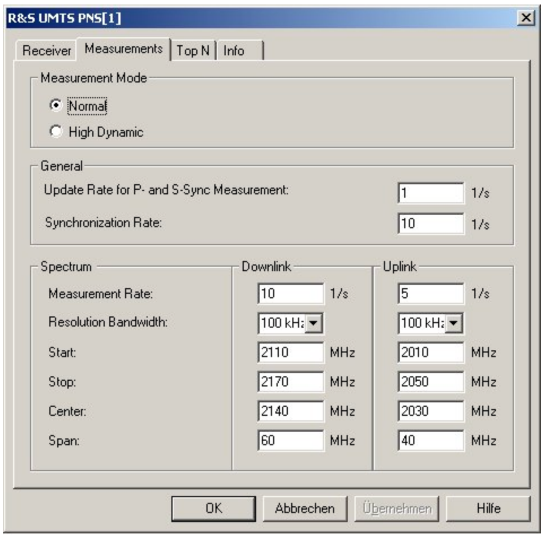


Figure 16: Spectrum Display Configuration on UL & DL

It is possible to configure 2 independent spectrum displays that are fully configurable. The spectra can, for example, show the Uplink and Downlink Channels, or the complete UMTS DL band and one Uplink Channel. The update rates can be set by the operator, independent from each other.

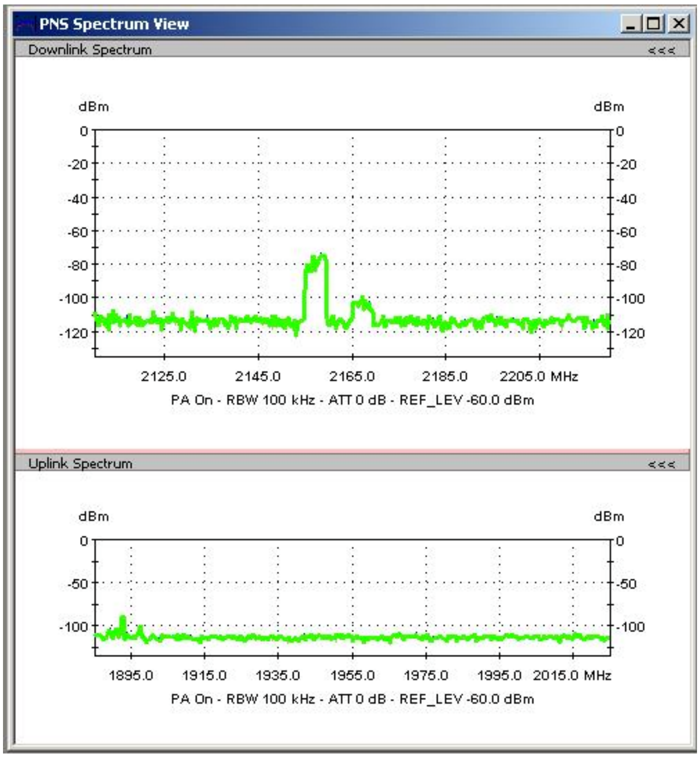


Figure 17: Spectrum Display of UMTS Band – Uplink & Downlink

- **Spectrum History View:**

For even better analysis, the *Spectrum History View* (Figure 18) is available. It does not only show the current spectrum. In a colored waterfall diagram the spectrum development during the drive test can be observed easily.

In the figure to the right, the complete UMTS Downlink Spectrum is shown. Fading effects on different channels as well as specific incidents (tunnel, see middle part) can be seen.

One extremely important information in this display is the detection of **external (i.e. non-UMTS) interference**, which can be determined easily (see fine interfering line in the left part).

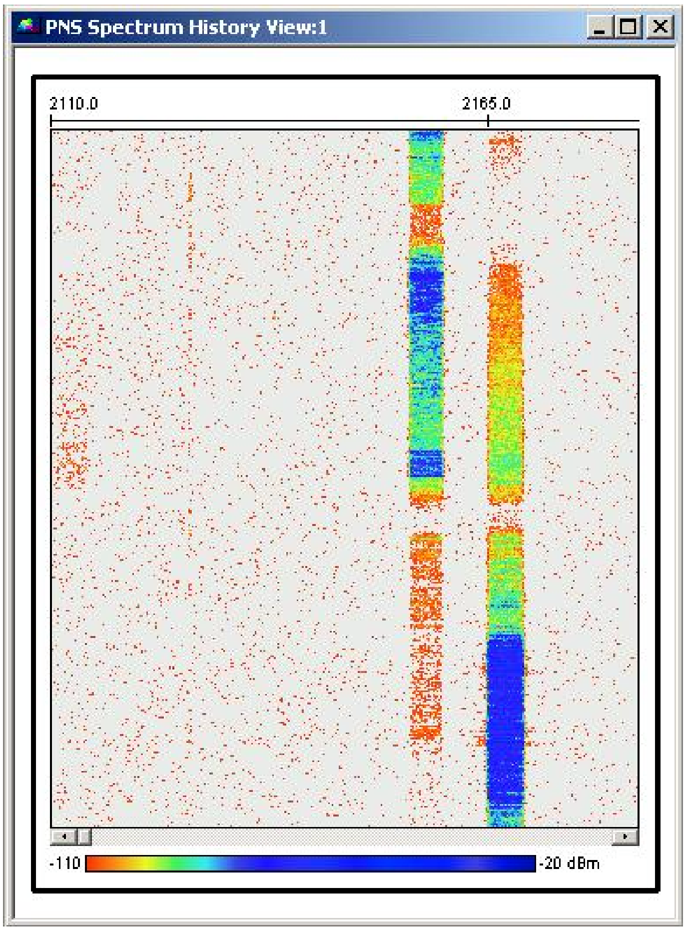
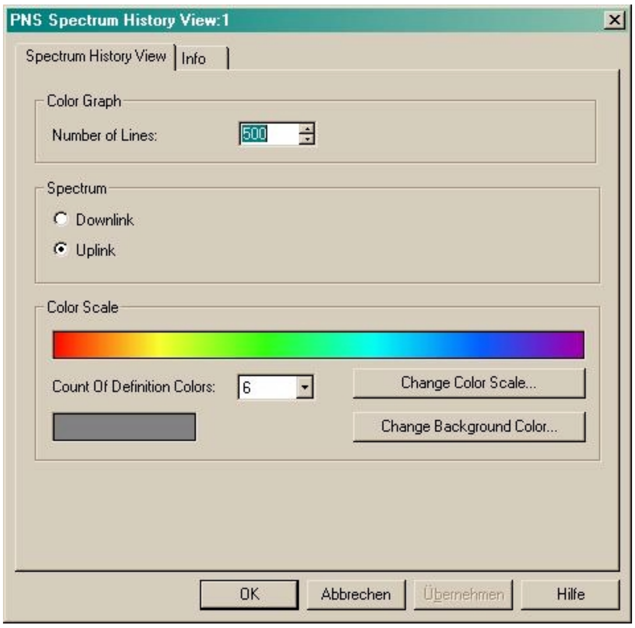


Figure 18: Spectrum History Display



The Spectrum History Display can be configured to the needs of the operator, just as all the other displays, separately for Uplink & Downlink.

Figure 19: Spectrum History Display Configuration

- **Pilot View:**

The *Pilot View* (Figure 20) gives an picture of all found pilots at the measurement point, together with a certain history that keeps measured pilots for some time. The view has two display modes. The Min-Max-Average-Current Mode show the minimal, the maximal the average and the current value of the RSCP of the Scrambling Code.

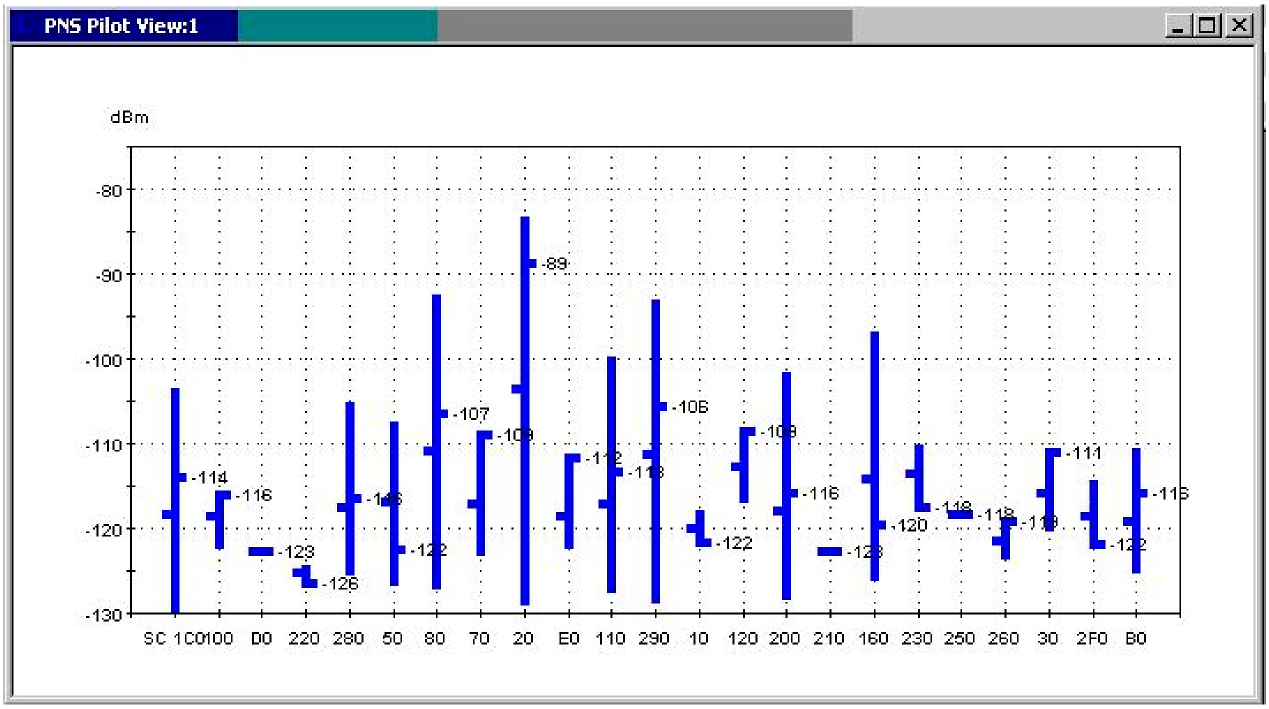


Figure 20: Pilot View (Average, Min, Max, Current)

The Bar Mode shows the RSCP in the well known standard display. It is possible to open multiple Pilot Views, as many as are necessary for a measurement tour.

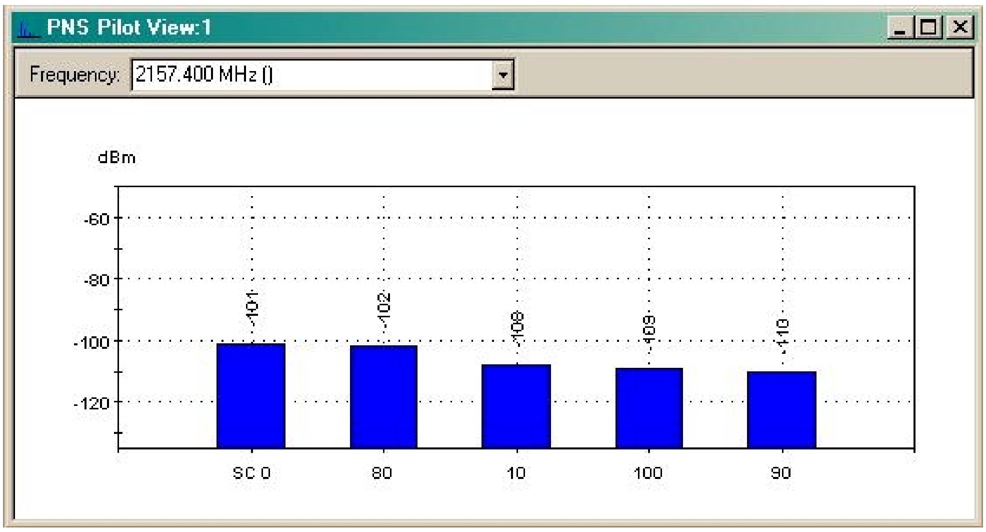
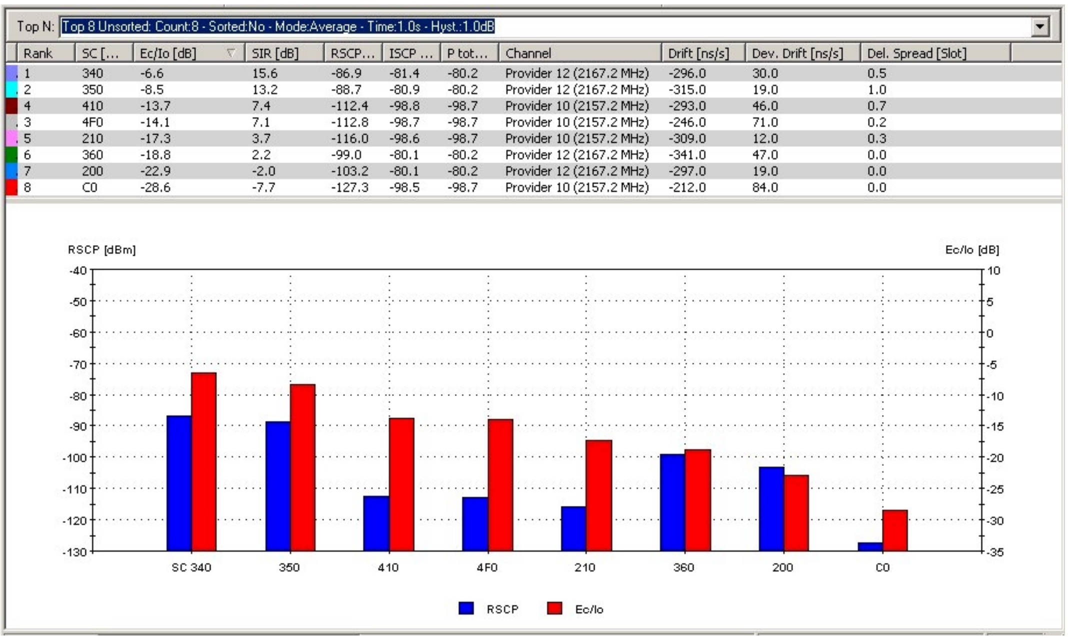


Figure 21: Pilot View (Bar Chart, Sorted)

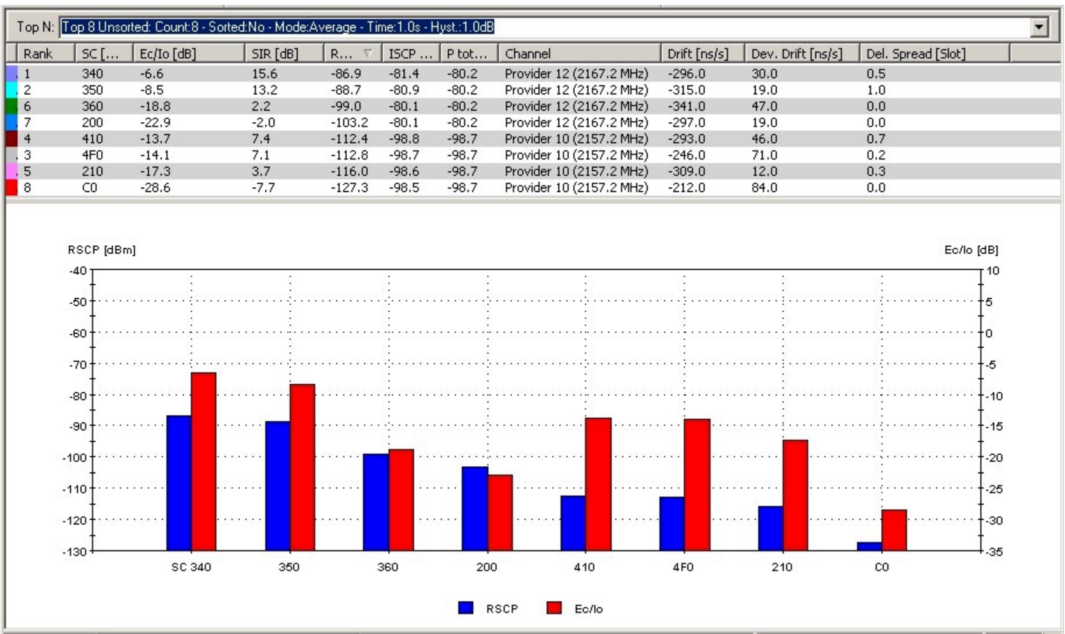
- **TOP N View:**

For various optimization and verification measurements, is most useful to have a configurable display that automatically sorts the best values. The TOP N Display (Figure 22) has these capabilities, together with selection and display of the best server(s). See also Configuration Settings for TOP N Views.



Rank	SC [...	Ec/Io [dB]	SIR [dB]	RSCP...	ISCP ...	P tot...	Channel	Drift [ns/s]	Dev. Drift [ns/s]	Del. Spread [Slot]
1	340	-6.6	15.6	-86.9	-81.4	-80.2	Provider 12 (2167.2 MHz)	-296.0	30.0	0.5
2	350	-8.5	13.2	-88.7	-80.9	-80.2	Provider 12 (2167.2 MHz)	-315.0	19.0	1.0
4	410	-13.7	7.4	-112.4	-98.8	-98.7	Provider 10 (2157.2 MHz)	-293.0	46.0	0.7
3	4F0	-14.1	7.1	-112.8	-98.7	-98.7	Provider 10 (2157.2 MHz)	-246.0	71.0	0.2
5	210	-17.3	3.7	-116.0	-98.6	-98.7	Provider 10 (2157.2 MHz)	-309.0	12.0	0.3
6	360	-18.8	2.2	-99.0	-80.1	-80.2	Provider 12 (2167.2 MHz)	-341.0	47.0	0.0
7	200	-22.9	-2.0	-103.2	-80.1	-80.2	Provider 12 (2167.2 MHz)	-297.0	19.0	0.0
8	C0	-28.6	-7.7	-127.3	-98.5	-98.7	Provider 10 (2157.2 MHz)	-212.0	84.0	0.0

Figure 22: TOP N View, Ec/Io Sorted

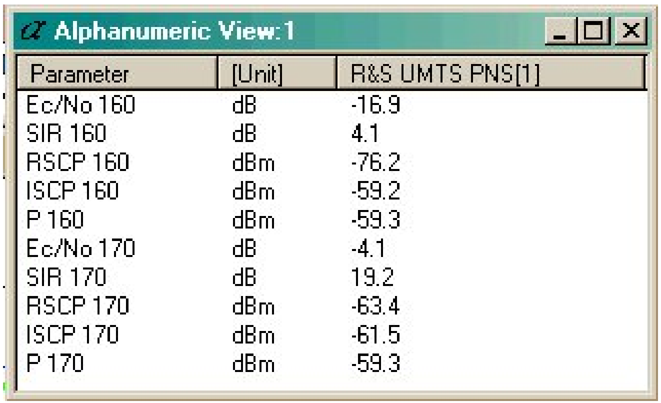


Rank	SC [...	Ec/Io [dB]	SIR [dB]	R...	ISCP ...	P tot...	Channel	Drift [ns/s]	Dev. Drift [ns/s]	Del. Spread [Slot]
1	340	-6.6	15.6	-86.9	-81.4	-80.2	Provider 12 (2167.2 MHz)	-296.0	30.0	0.5
2	350	-8.5	13.2	-88.7	-80.9	-80.2	Provider 12 (2167.2 MHz)	-315.0	19.0	1.0
6	360	-18.8	2.2	-99.0	-80.1	-80.2	Provider 12 (2167.2 MHz)	-341.0	47.0	0.0
7	200	-22.9	-2.0	-103.2	-80.1	-80.2	Provider 12 (2167.2 MHz)	-297.0	19.0	0.0
4	410	-13.7	7.4	-112.4	-98.8	-98.7	Provider 10 (2157.2 MHz)	-293.0	46.0	0.7
3	4F0	-14.1	7.1	-112.8	-98.7	-98.7	Provider 10 (2157.2 MHz)	-246.0	71.0	0.2
5	210	-17.3	3.7	-116.0	-98.6	-98.7	Provider 10 (2157.2 MHz)	-309.0	12.0	0.3
8	C0	-28.6	-7.7	-127.3	-98.5	-98.7	Provider 10 (2157.2 MHz)	-212.0	84.0	0.0

Figure 23: TOP N View, RSCP Sorted

- **Standard Views:**

Additionally to the special UMTS PN Scanner Views the measured data (E_c/I_0, SIR, RSCP, ISCP and Power) can be displayed in the ROMES Standard View like *Alphanumeric View*, the *2D Chart View* and on the *Route Track View*.



Parameter	[Unit]	R&S UMTS PNS[1]
Ec/No 160	dB	-16.9
SIR 160	dB	4.1
RSCP 160	dBm	-76.2
ISCP 160	dBm	-59.2
P 160	dBm	-59.3
Ec/No 170	dB	-4.1
SIR 170	dB	19.2
RSCP 170	dBm	-63.4
ISCP 170	dBm	-61.5
P 170	dBm	-59.3

Figure 24: Alphanumeric View

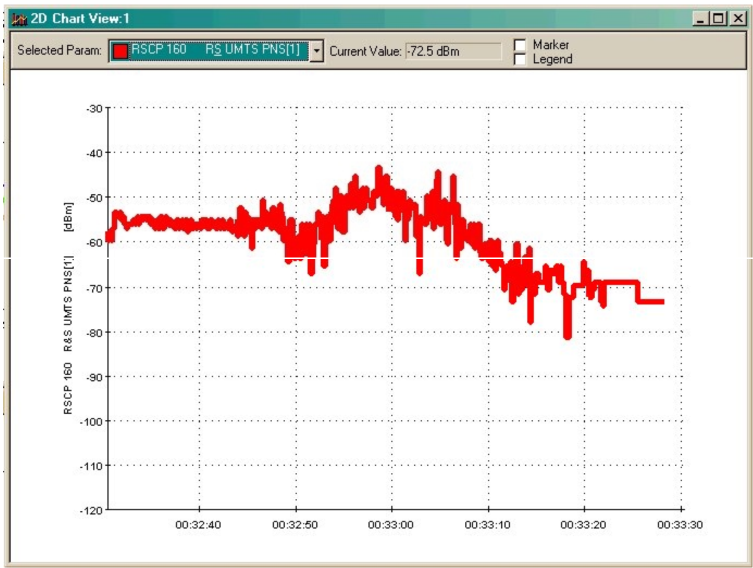


Figure 25: 2D Chart View for RSCP

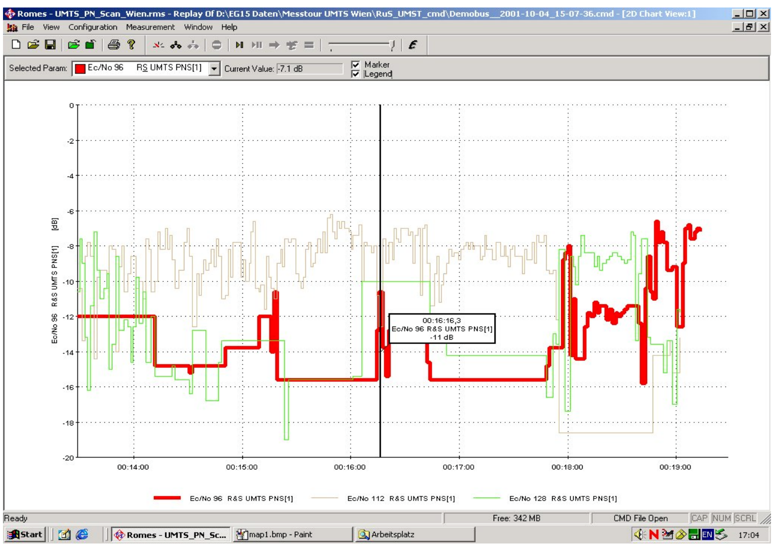


Figure 26: 2D Chart View for Ec/No (Io)

The Statistic Histogram View delivers Online Statistics for any selected measurement parameter, multiple of these displays can be displayed in parallel.

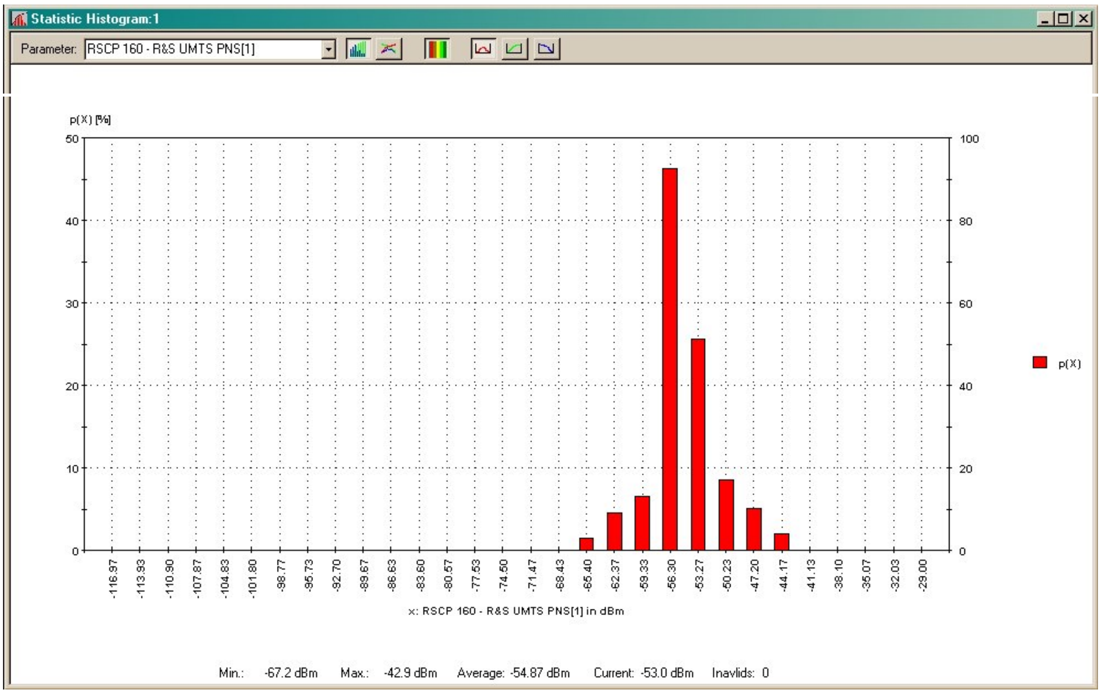


Figure 27: Statistic Histogram View (e.g. RSCP)

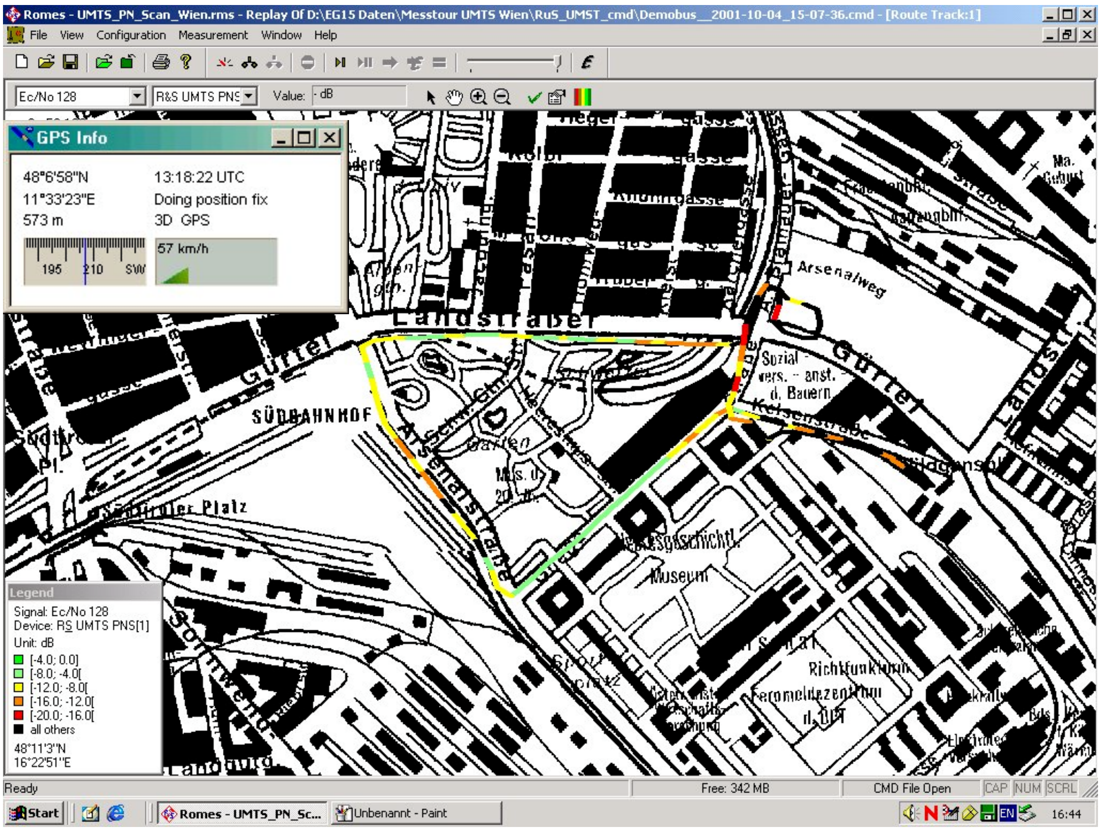


Figure 28: Route Track Module with GPS Display

- **Frequency Selection Concept:**

As far as the system is able to analyze UMTS Signals in different frequency bands within one measurement section, all UMTS Network Information Views are multiple views headlined and synchronized with one frequency selection bar. Each (multiple) view may be opened for different instances and each instance may be configured privately. By means of a frequency selection bar all views with the same instance number switch to a frequency selected in parallel. So there is a choice to display measurement results of different frequency bands within multiple instances of UMTS Network Information Views in parallel or to open only one instance of different views and focus all views to one measured frequency band at once with a single mouse click.

When a view is able to show measurement results from different frequencies as the Spectrum-, Top-N- and Trace-Views, the frequency bar is switched to either “inactive” or “not implemented”.

The Software User Interface

The Modular Concept

ROMES is based on a modular system concept, allowing any type of data to be collected and analyzed. Any sensor (e.g. test receiver, test mobile or GPS receiver) capable of result transfer to a PC or Notebook can be integrated into the system family. This opens a wide range of use, from measurements in mobile radio to almost any kind of measurement application. The modular concept enables the implementation of very small systems and high performance systems alike. And it makes the software future proof, as it can easily be extended to accommodate upcoming technologies.

The UMTS Interference Analyzer is embedded in the modular Network Optimization Software ROMES. It consists of a dedicated driver which has to be installed together with the base software platform (see Data Sheet ROMES, PD 0757.6679.21).

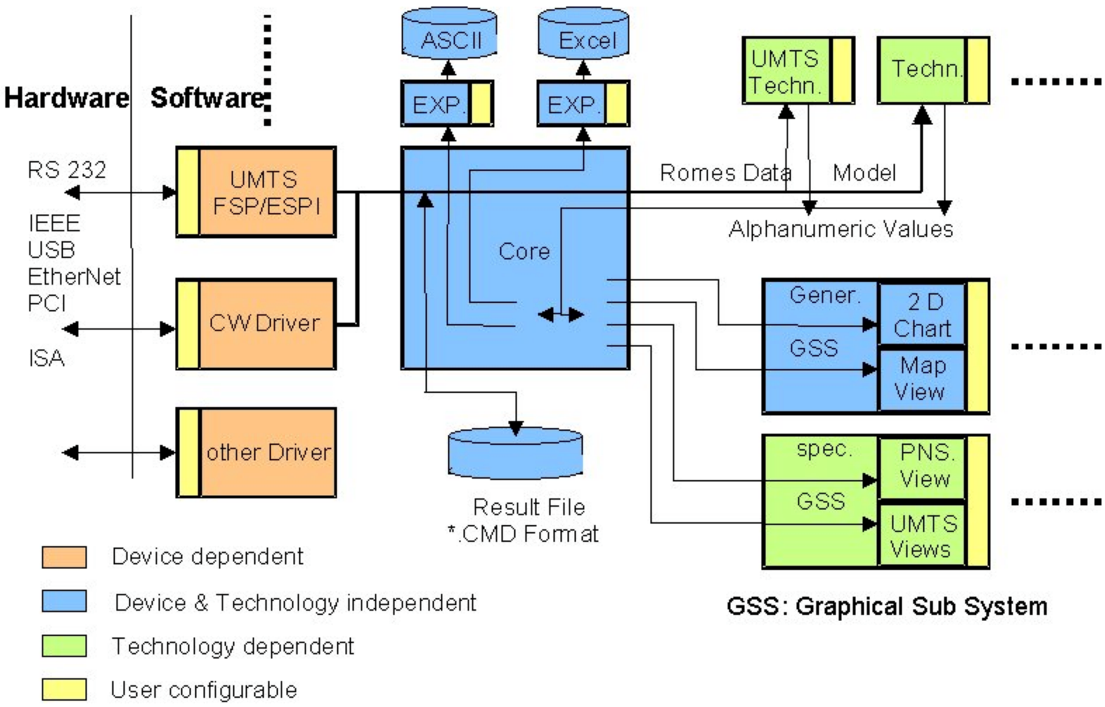


Figure 29: Modular Software Concept of Romes3 for UMTS

A core unit is acting as a shunting station. It transfers the data from the external hardware via the driver to the result file and to the displays. In general two different display types are supported, one is the general view e.g. 2 D-Chart, Alphanumeric or GIS View, the other is the technically specific view, e.g. GSM Measurement Report, UMTS Interference Analyzer View, etc.

In addition, post processing of data with an external software, e.g. Excel is possible. A comfortable, freely definable export function and numerous specific export functions are also available. Upgrading to new hardware is easy. Only a new driver has to be installed if new hardware is attached.

UMTS Receiver Settings

The Receiver Settings (Test Receiver ESPI or Spectrum Analyzer FSP/FSU) require the mere setting of

- Type of Receiver (ESPI or FSP/FSU)
- Type of Connection (LAN or IEEE 488.2)
- Selected Frequency Bands and Name of Provider
- Add new Freq. Bands and Provider Names if needed
- Simulation Mode On / Off

All other relevant parameters will be set optimum and automatically:

- Minimal measurement interval in slots
- Number of used slots
- Number of rakes
- Total Dynamic
- Maximal Peak Dynamic
- Total Dynamic for Code
- Maximal Peak Dynamic for Code
- Sample Distance for Spectrum
- Number of Samples for Spectrum
- Overlap of Samples for Spectrum

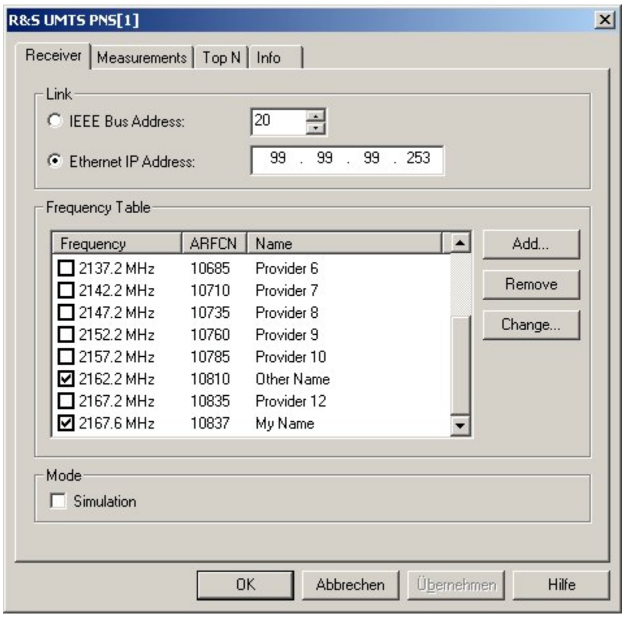


Figure 30: UMTS Receiver Settings for ESPI or

Measurement Settings:

- Mode: High Dynamic or High Speed Mode
- Synchronization Rate
- Update Rate for P-SCH View
- Spectrum Setting:
  - Store Spectrum Yes/No
  - Spectrum Update Rate
  - Resolution Bandwidth of Scan
  - Start, Stop Frequency, or alternatively Center, Span Frequency

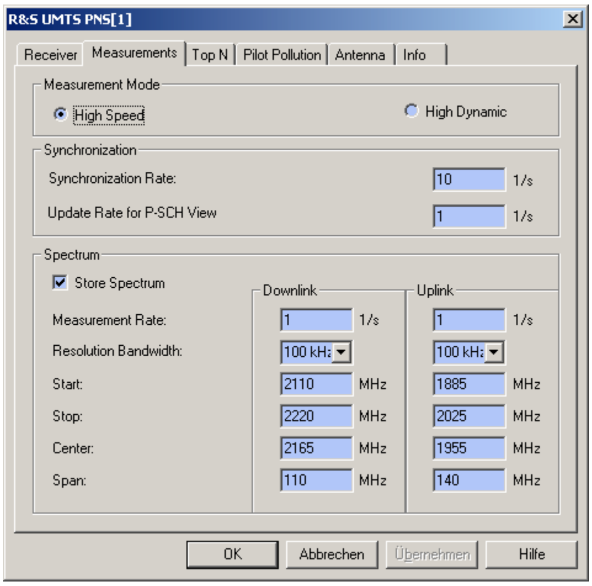


Figure 31: UMTS Measurement & Spectrum Settings

Top N Configuration:

All Top N Views are fully user configurable:

- User-specific Name of this Top N
- Number of CPICH's
- Frequencies: Only found CPICH's on the selected frequency are taken into account.
- Interval of Observation for Rank Decision
- Calculation Mode: Peak or Average
- Hysteresis for Rank Changes

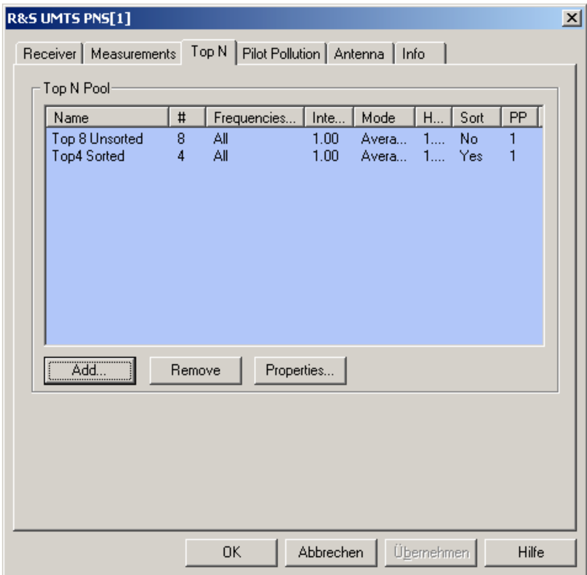


Figure 32: UMTS TOP N View Settings

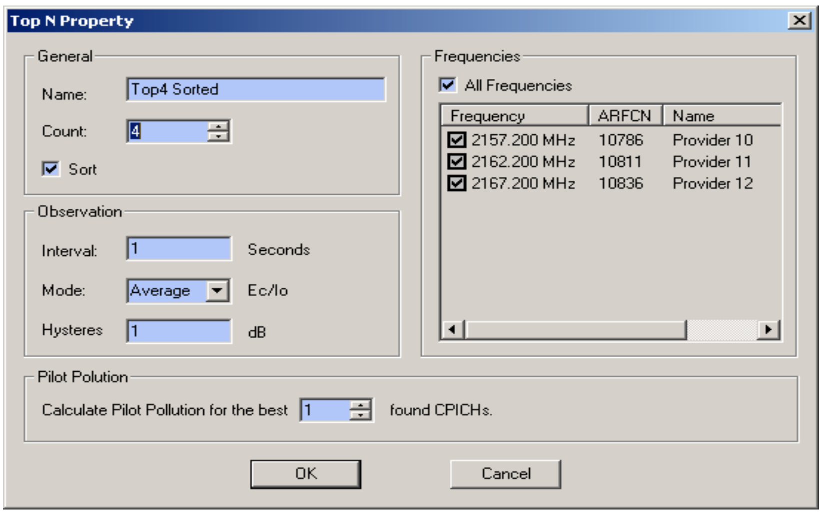


Figure 33: UMTS TOP N Property Settings

All configured Top N Views are available as parameters for all Basic Views, e.g. 2D-Chart View, Alphanumeric View or Route Track View. This allows to follow the best server - concerning a configured Top N - on the map or to see its graph in the 2D-Chart View.

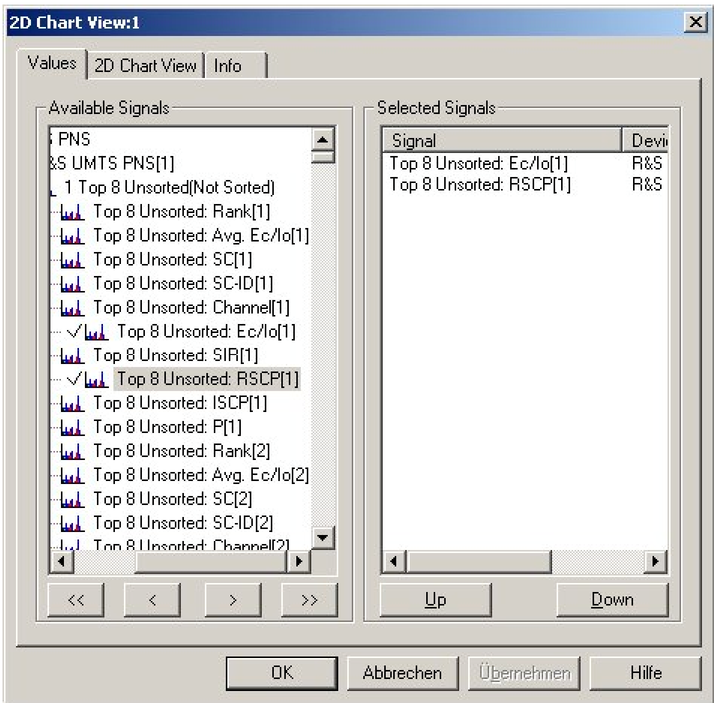


Figure 34: UMTS TOP N Property Settings

Pilot Pollution:

The Rohde & Schwarz PN Scanner automatically calculates the Pilot Pollution for the current server. To get a helpful and quick overview of the quality of the coverage two parameters were designed. The Hard Pilot Pollution (HPP) counts all measured CPICH's, which RSCP is higher than the read graph. The Soft Pilot Pollution (SPP) counts all measured CPICH's , which RSCP is higher than the read graph as 1, and all that have a RSCP between the blue and red graph with an value between 0 and 1.

The red and blue graphs are freely configurable and can be adapted to certain circumstances or measurement goals.

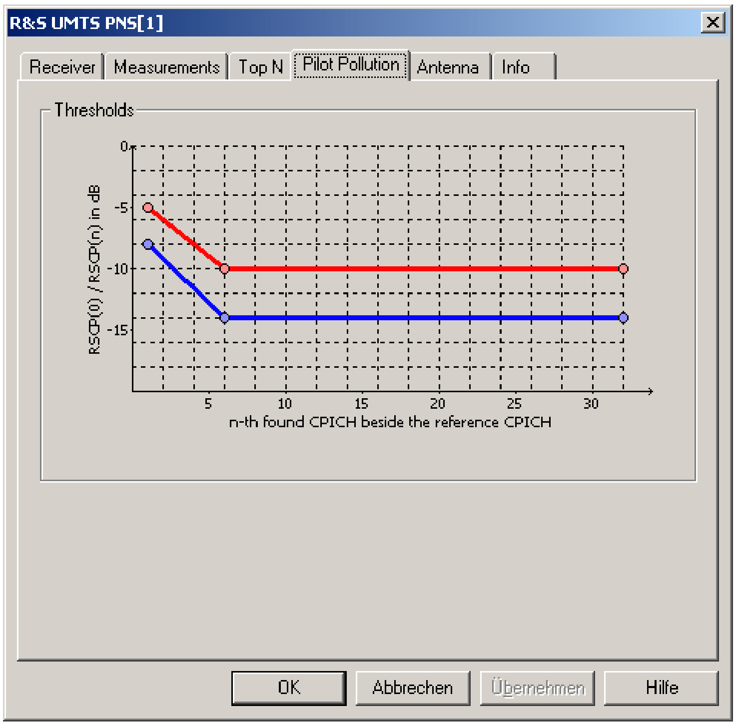


Figure 35: Pilot Pollution Info Settings

Future Development

Rohde & Schwarz guarantees a long-lasting life cycle of their products. Part of this long-term planning is a continuous development and enhancement on existing products and platforms, but part of this is also development of new products that will be made integral part of the ROMES product family of Network Optimization Systems.

The UMTS Interference Analyzer has, compared to other available products, the exceptional advantage that is developed as ROMES Software Option to be operated on regular Intel or AMD based computers. Minor modifications or major add-ons will be developed in short time, they require a mere software update or upgrade for the existing systems. **No hardware changes will be necessary**.

As Frontend, currently the R&S receivers ESPI and FSP/FSU are being used. For the future, new and more compact receivers that fulfil the necessary requirements for high-quality measurements in UMTS and other bands can easily be integrated into the system concept.

The **roadmap** for the UMTS Interference Analyzer foresees, among many other developments, the integration of **UMTS Test Mobiles** by September 2002. This way, the signalization capabilities of the test mobile can be combined with the RF analysis capabilities of the interference analyzer. There will be a **Tracking Mode**, where the serving cells in UMTS will automatically be set for the analyzer (all RF Channels and Scrambling Codes), provided the UMTS mobile delivers this information.

New Features available by September 2002:

- Use of UMTS Base Station Lists with Position Determination for Unknown Base Stations
- End-To-End Data & Testing (QoS) with Commercial UMTS Mobile Phones
- Video and Voice Quality Testing
- Evaluation Software Module UMTS for RODAS (successor of ROSEVAL)

New Features available in 2003:

- Integration of TDD Measurements
- Integration of Code Domain Power Measurement (with FSP & FSP-K72)

Two Applications in One - UMTS Interference Analyzer + CW Measurements within one System

General

The UMTS Interference Analyzer can be configured in four different packages. Figure 36 shows a system designed as a cost effective and very light notebook version. Alternatively, high performance solutions in Figure 37 with dead reckoning navigation function and distance trigger for signal strength measurements are also available.

Notebook Configuration for UMTS Interference Analysis (see Figure 36)

Notebooks are very cost effective control units for drive test equipment. The design consists of separate items and is normally installed with magnet mount antennas in various vehicles.

Configuration:

- **Notebook** (800 MHz, 128 MB RAM, 10 GB HD) equipped with PCMCIA IEEE-Bus Interface or LAN Interface
- **FSP/FSU** (Spectrum Analyzer) or **ESPI** (Test Receiver) with Sync. Unit **TS95SYN**
- **GPS System** (e.g. Garmin Mouse)
- **Network Optimization Software ROMES** incl. **UMTS PN Scanner Option TS5K51C** and or **ESPI CW Measurement Option TS5K10E**.

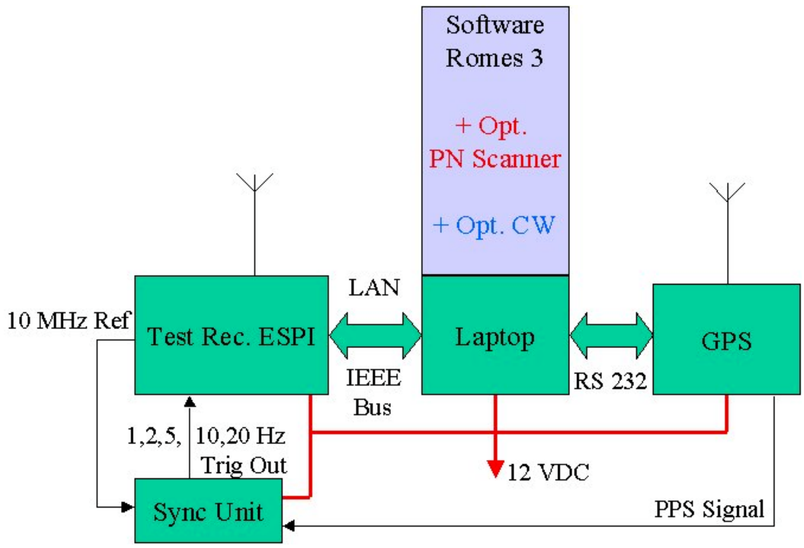


Figure 36: Notebook Configuration for UMTS Interference Analysis

Process Controller Configuration for UMTS PN Scanner (**see Figure 37**)

The high performance Process Controller (two CPU's in parallel mode) improves the performance of the notebook version. In addition it is designed for upgrades (e.g. Interference Measuring System) for GSM. System parts are integrated into a 19" rack. The system is bigger than the notebook version, but it is extremely reliable. Due to its bulk it is designed for fix installation into special test vehicles with fix mounted antennas.

In the CW measurement mode the signal strength can be measured very fast and very precisely with the Test Receiver ESPI. Only ESPI, which has an integrated preselection can be used for CW measurements. The maximum rate is approx. 2000 measurements per second. Depending on the selected IF filter band width the test speed has to be reduced. Complete frequency or channel lists can be defined for parallel measurements of different signals. The application is not restricted to special frequency bands (e.g. UMTS, GSM, IS95, ETACS...). The user is free to select all available frequencies of the test receiver. In the setup of the software measurements according to the Lee Criterion or distance trigger can be selected.

Configuration:

- **Process Controller TSPC2** equipped with IEEE-Bus or LAN Interface
- **External LCD Display** with resolution 1024 x 768 or better
- **FSP/FSU** (Spectrum Analyzer) or **ESPI** (Test Receiver) with Sync. Unit **TS95SYN**
- **Inertial GPS System TS-GINA and Distance Trigger Unit**
- **Power supply control unit**
- **Network Optimization Software ROMES** incl. **UMTS PN Scanner Option TS5K51C** and or **ESPI CW Measurement Option TS5K10E**.

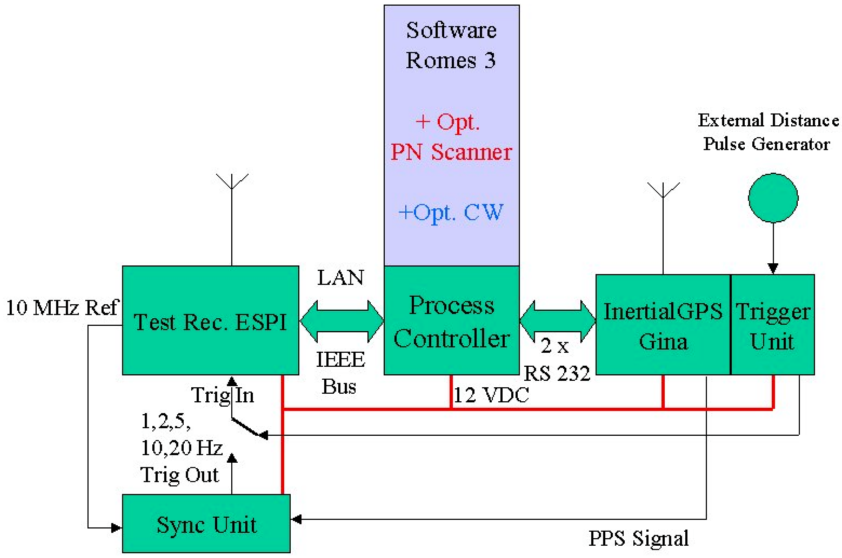


Figure 37: ProcessController Configuration for UMTS Interference Analyzer

Hardware for UMTS Interference Analyzer and CW Signal Strength Measurements

Notebook Versions for UMTS Interference Analyzer and CW Application

Configuration 1: **Only UMTS Interference Analyzer:**
Spectrum Analyzer FSP/FSU or Test Receiver ESPI can be used

Configuration 2: **Only CW Signal Strength:**
Test Receiver ESPI has to be used

Configuration 3: **UMTS Interference Analyzer and CW:**
Signal Strength; Test Receiver ESPI has to be used

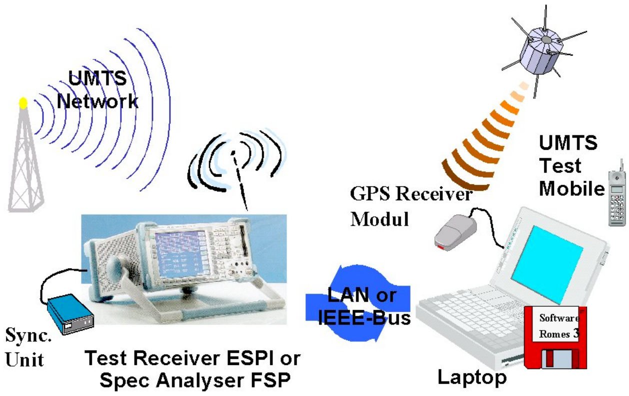


Figure 38: Notebook Version of UMTS Interference Analyzer

High Performance System for UMTS Interference Analyzer and CW Application

Configuration 4: **Only UMTS Interference Analyzer:** **Spectrum Analyzer FSP/FSU or Test Receiver ESPI can be used**

Configuration 5: **UMTS Interference Analyzer and CW Signal Strength:** **Test Receiver ESPI has to be used;**
In this configuration the Synchronization Unit and the CW Trigger Unit have to be used alternatively by switching the "Trig In" of the Test Receiver.

All Items are integrated in a 19" rack and installed into a test vehicle.

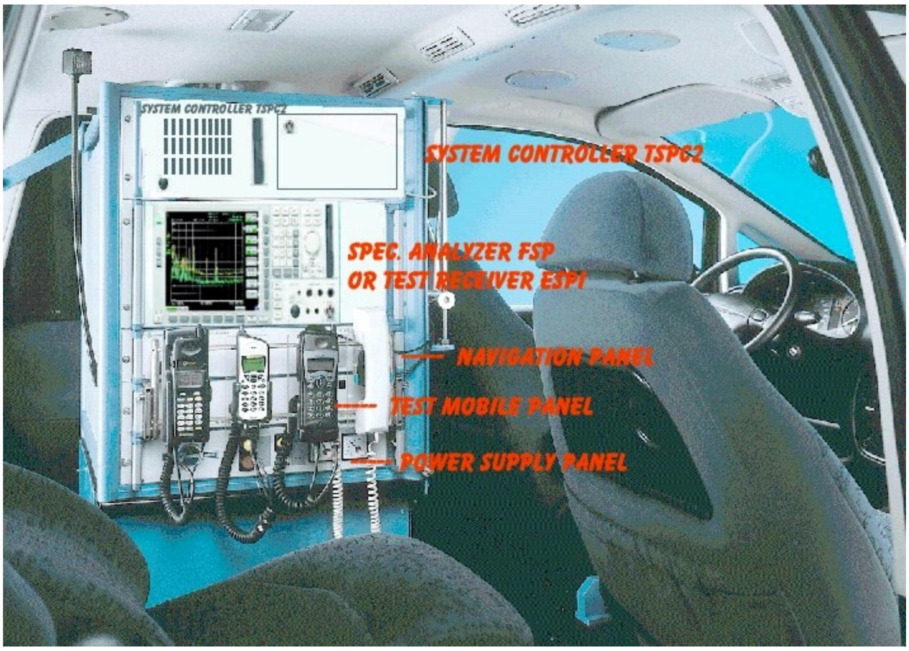


Figure 39: System Controller Configuration for UMTS Interference Analyzer

Test Vehicle Installation:

Figure 40: Test Vehicle Nissan Patrol (4 wheel Drive)

Figure 41: Test Vehicle VW Sharan

ROHDE & SCHWARZ

Technical Data

RF Frontend:

• Frequency Range:	9 kHz – 3 GHz (7 GHz with ESPI7)
• Frequency Accuracy:	± 1 PPM ± 0.01 PPM with OCXO Option FSP-B4
• OCXO Aging:	± 0.1 PPM
• Frequency Resolution:	0.1 Hz
• IF Bandwidth:	10 Hz ... 10 MHz (Steps 10, 3) Multiple Special Filters from 100 Hz to 8 MHz, specifically DAB/DVB, CDMAOne, Tetra, IS136, W-CDMA
• RF Input:	50 Ω Impedance, N-Type Connector
• Trigger Input:	BNC-Type Connector
• RF Input Range:	-150 dBm ... + 30 dBm (in UMTS Band)
• Level Accuracy:	< 1.5 dB (Receiver Mode) < 0.5 dB (Analyzer Mode)
• Noise Figure:	21.5 dB (12 dB with Pre-Amplifier Option)
• 1 dB Compression Point:	0 dBm nominal
• Adjacent Channel Desensitization:	Depends on Resolution Bandwidth RBW
• IP3	> 2 dBm, typ. 5 dBm

UMTS Interference Analyzer:

• Time Accuracy	± 1 PPM ± 0.01 PPM with OCXO Option FSP-B4 ± infinite with GPS PPS
• Sampling Rate:	1/2/5/10 Hz
• Synchronization Acquisition Time	24 ms per Pilot
• Synchronization Level E_c/I_0:	< -14.5 dB (High Speed Mode) < -25 dB (High Dynamic Mode)
• Number of Rake Receivers:	up to 2500
• Power Measurement with ESPI:	-119 ... +10 dBm (High Speed Mode) -127 ... +10 dBm (High Dynamic Mode)
• Power Measurement with FSP/FSU:	-110 ... +10 dBm (High Speed Mode) -118 ... +10 dBm (High Dynamic Mode)
• Level Accuracy:	< 1.5 dB (E_c/I_0) < 1 dB (RSCP)
• Adjacent Channel Rejection:	> 65 dB, typ. > 70 dB
• Base Station Measurement:	up to 2500 Base Stations (Node-B) simultaneously
• Spectrum Monitor Function:	2 Spectra (Uplink & Downlink, free configurable)
• Display:	up to 1600 x 1200, depending on Type of Monitor

Parameter Display:

UMTS:

- Spectrum View, Free Configurable for 2 Spectra (e.g. Uplink & Downlink, Downlink & UMTS Band)
- Spectrum History View (Multiple)
- CPICH View (Multiple)
- P-SCH View (Multiple)

- Scrambling Code Tracer View (Multiple)
- Channel Impulse Response View (Multiple)
- Pilot View (Multiple)
- TOP N View (Multiple)

General:
- General Status View
- Event / Alarm View
- 2D Chart View (Multiple)
- Alphanumeric View (Multiple)
- Parameter Statistics View (Multiple)
- Route Track View for Real-Time Map Display (Multiple),
- GPS Info View
- Indoor View for Real-Time Indoor Map Display

Data Storage within ROMES:

- Full Storage with Spectra:
  - High Sensitivity: less than 200 Mbytes per Hour
  - High Speed: less than 2000 Mbytes per Hour
- Normal Storage (Reduced Spectrum and P-SCH at 1 Hz): 60 Mbytes per Hour, Zipped ~ 50 Mbytes
- Minimum Storage (without Spectrum and P-SCH): 8 Mbytes per Hour, Zipped ~ 2 Mbytes

Measured Parameters:

General:
- RSSI of received channel
- E_c, E_c/I_0, SIR, RSCP, ISCP, Total Power

TOP-N:
- E_c/I_0 (Peak of Average for Observation Interval)

P-SCH / S-SCH:
- Graphical Display of Correlation Result
- Relative Power of detected peaks (in dB)
- Time Delay of detected peaks (in µs)

P-CPICH:
- Scrambling Code (up to 512, Hexadecimal)
- Total Power of CPICH (in dBm)
- Parameters for every Scrambling Code:

Result	Description	Specification
E_c/I_0	The received energy per chip divided by the power density in the band	TS 25.215; 5.1.6
SIR	Signal to Interference Ratio	TS 25.215; 5.1.3
RSCP	Received Signal Code Power	TS 25.215; 5.1.3
ISCP	Interference Signal Code Power	TS 25.215; 5.1.3

Table 1: Measured Parameters of CPICH per Scrambling Code

- Parameters per identified peak for every Scrambling Code:

Result	Description	Specification
Power	Power of Identified Peak	-
Time	• Relative Time of Arrival • Absolute Timing against GPS Clock	-

Table 2: Measured Parameters of CPICH per Identified Peak per Scrambling Code

Spectrum:

- Spectrum full or partial UMTS Downlink and/or Uplink Band
- Spectrum History

Sampling Rates:

The Sampling Rates depend on three aspects:

- Required Measurements
- Number of Node-B's and reflections in the air PC
- Performance of the Controller

The following table shows the system's update rates in High Speed Mode, based on measurements with the R&S TSPC2 Process Controller (2 x Pentium III 1 GHz). The measurements were made in July 2002 with ROMES Version 3.21 and 8 Scrambling Codes on one UARFCN:

Update Rate [Meas./sec]	0,1	0,2	0,5	1,0
Spectrum Uplink /Downlink	✓	✓	✓	✓ Refresh Adjustable
Spectrum History	✓	✓	✓	✓ Refresh Adjustable
TOP N		✓	✓	✓
P-SCH	✓	✓	✓	✓ Refresh Adjustable
PCPICH	✓	✓	✓	✓
Peaks	✓	✓	✓	✓
# Node-B's	30	30	30	30
Update [s]	**0,1**	**0,2**	**0,5**	**1,0**

Table 3: Update Rates on High Speed Mode

The update rate in High Dynamic Mode is ~ 1.0 seconds.

Dynamic Range & Sensitivity:

The sensitivity of the PN Scanner for the trace of E_c/I_0 and RSCP can reasonably only be given by probability. The diagrams below show the likelihood for the detection of a pilot (per sample), for High Speed Mode (Table 4 & 5) and High Dynamic Mode (Table 6 & 7). As up to 10 samples are taken per second in the High Speed Mode, a probability of 10% still delivers at approximately one valid value (E_c/I_0 and RSCP) per second for the given, minimum sensitivity.

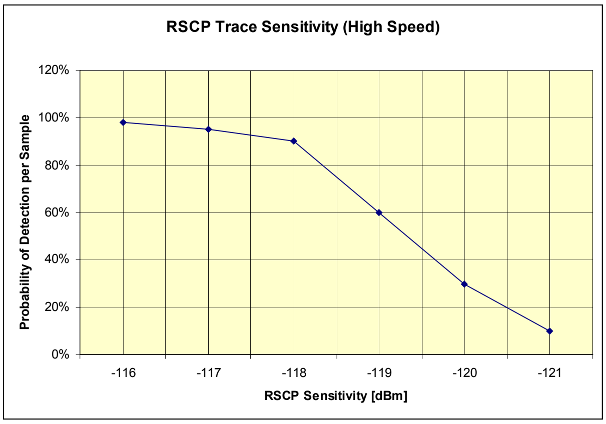


Table 4: Trace Sensitivity RSCP (High Speed)

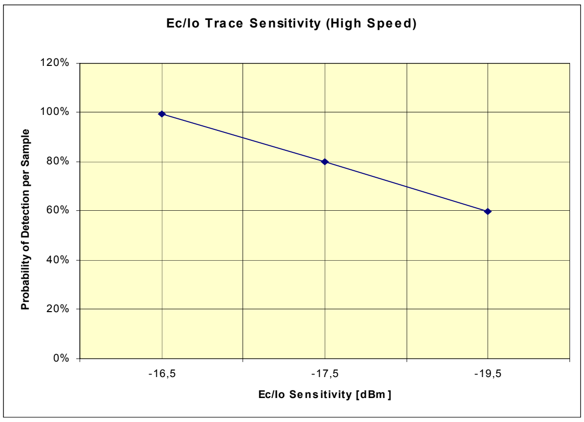


Table 5: Trace Sensitivity Ec/Io (High Speed)

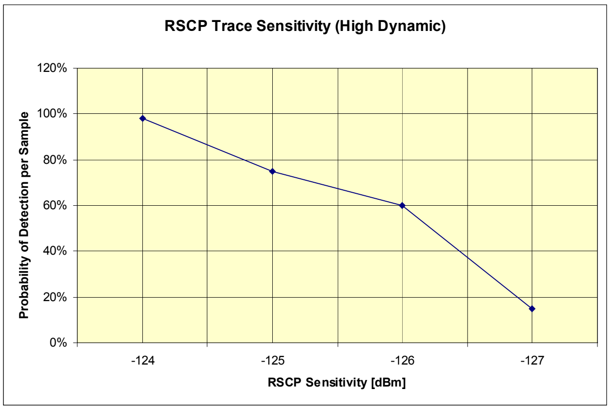


Table 6: Trace Sensitivity Ec/Io (High Dynamic)

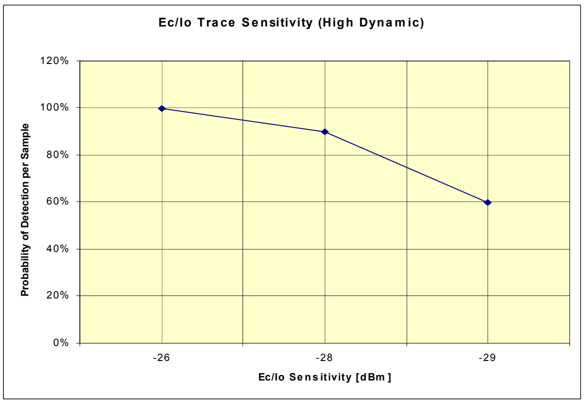


Table 7: Trace Sensitivity Ec/Io (High

According to the above tables, CPICH's will analyzed with reasonable success up to the following values:

Mode		Dynamic Range per Sample	Sensitivity ESPI (and FSP/FSU with PreAmp FSP-B9)	Sensitivity FSP/FSU without PreAmp FSP-B9
HIGH SPEED	RSCP	20 dB (-119/-110 ... –10 dBm)	- 119 dBm	- 110 dBm
HIGH DYNAMIC	RSCP	29 dB (-127/-115 ... 0 dBm)	- 127 dBm	- 115 dBm

Table 8: Typical Sensitivity and Dynamic Ranges

Note:

See also data Sheet of "Test Receiver ESPI" (PD 757.6540.11) for further technical information on ESPI
See also Technical Information on "TS5K10E" for further technical information on CW Measurements

Figure 42: Spectrum Analyzer FSP

Figure 43: Spectrum Analyzer FSP with DC Power Supply