PureSound

SPEAKER TEST SYSTEM

Key features for a modern, state-of-the-art test system are speed, simplicity, reproducibility and automation in a factory environment. The PureSound speaker test system exactly answers these needs. The key element is the unique Rub & Buzz defects analysis with a 100% correlation to the human ear. It replaces the subjective human ear perception against an objective, reliable and repeatable test feature.

The PureSound speaker test system is based on the FX100 Audio Analyzer, operated via the PC-based turnkey production software RT-Speaker. It is tailored for the total quality control of single components, pre-assembled parts or finished products.

Key Features:

- Speed: Cycle time down to 1 second based on speaker type.
- Accuracy: The FX100 Audio Analyzer is based on reliable technologies providing accurate and consistent test results.
- Rub&Buzz: Superior Rub&Buzz defects detection with a 100% correlation to the human ear. Objective Rub&Buzz testing replaces subjective golden ears.
- Noise Immunity: Maximum performance in noisy production environment using dedicated technologies.
- System Integration: Tailored for automated production lines with PLC interface, barcode reader or remote control via TCP/IP commands; offering full data logging and statistics (e.g. Cpk, Ppk).
- Multi-Channel Operation: Testing two DUTs in parallel or multiple DUTs sequentially without any operator interaction.

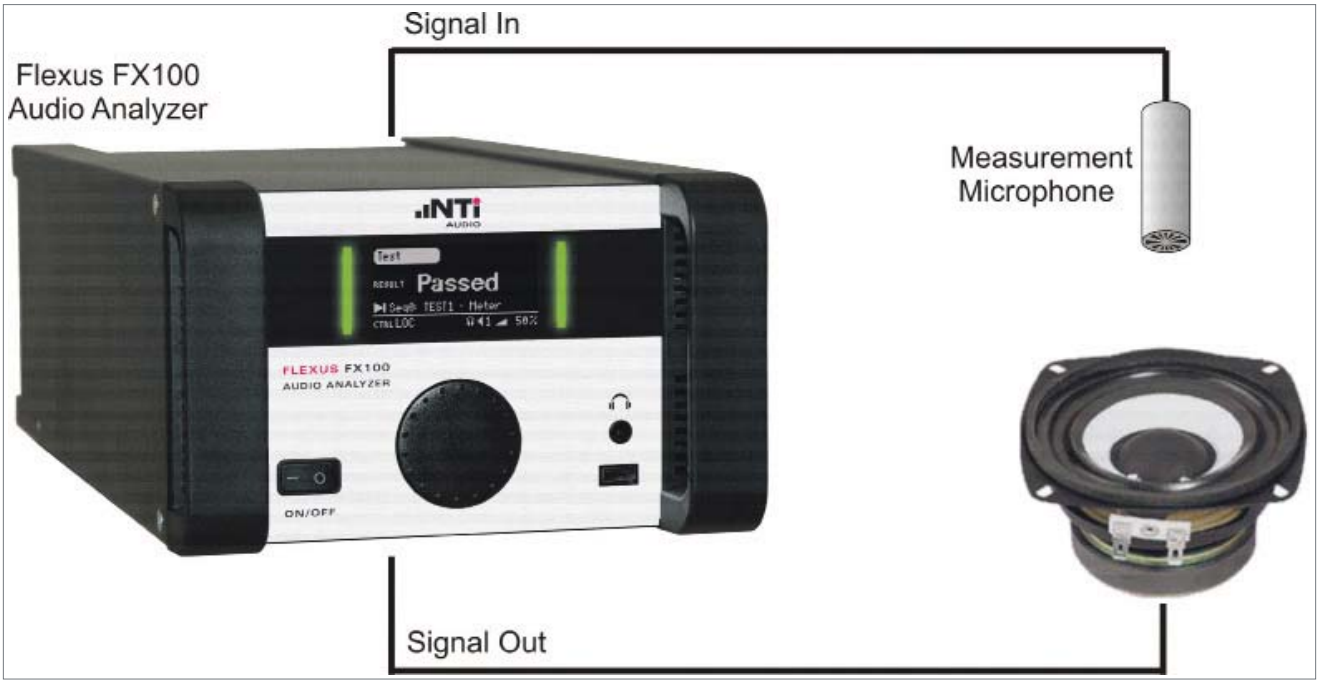
Multimedia speaker testing

Mobile Devices

Pro Audio Loudspeaker

INTRODUCTION

Electro-acoustical transducers naturally bear a particularly high error rate. Sorting out faulty devices in an early production stage increases the overall yield and reduces the cost of waste material and optimizes the quality of the manufactured goods. The FX100 Audio Analyzer and the production software RT-Speaker form together the PureSound Speaker Test System comprising exactly the required features for quality control and production line testing.



Basic Speaker Test Configuration

Test Functions:

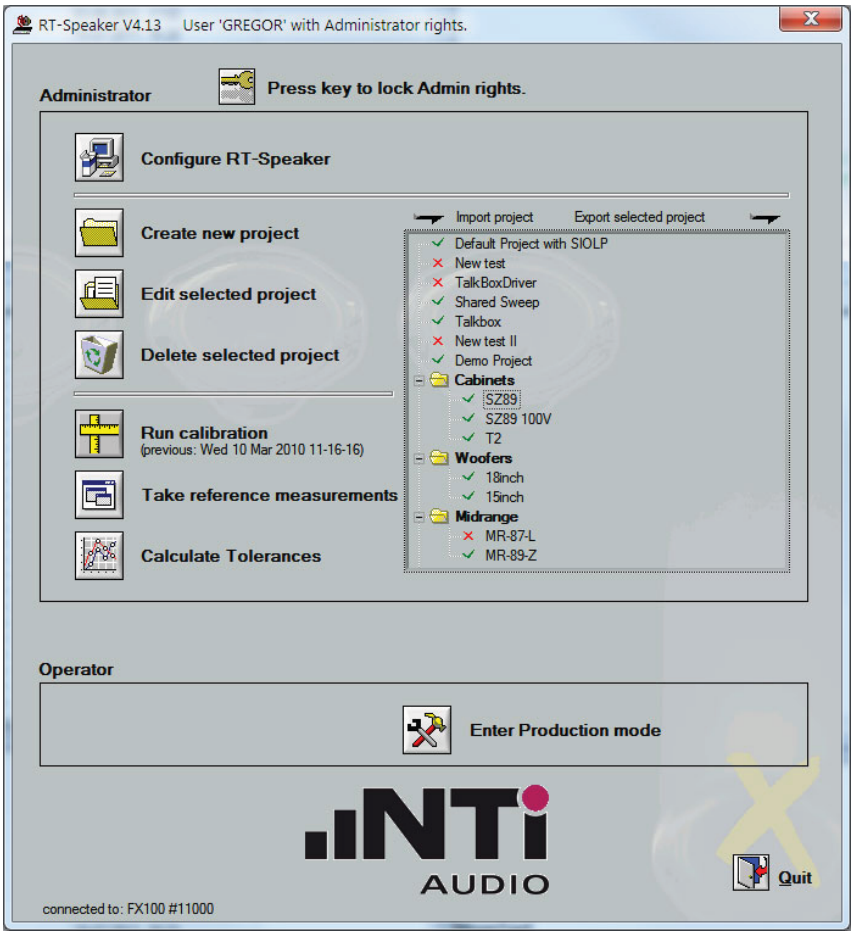
- Frequency Response
- Sound Pressure Level dBSPL
- Rub & Buzz analysis with100% correlation to the human ear
- Impedance Response & Resonance Frequencies
- Distortion THD, THD+N, 2nd - 35th harmonics
- Speaker Polarities
- Thiele/Small Parameters
- DC Resistance

PureSound detects any audible manufacturing flaws of speakers or transducers, such as air-leaks, misaligned coils, rubbing voice coils, loose particles, touching wires etc.

SIMPLE AND INTUITIVE OPERATION

The PureSound speaker test system is setup and configured within a few minutes. The FX100 Audio Analyzer communicates with the PC-software RT-Speaker via the USB interface. RT-Speaker provides an intuitive user interface for test setup and display of all measurement results.

The main menu guides the production administrator through the basic system configuration on to the test parameter settings, which are contained in a single “Project“ folder. After an automated calibration sequence the reference measurements can be recorded, tolerances automatically calculated and the Production Mode started. The RT-Speaker software provides a simple PASSED/FAILED readout or a detailed view of all measured speaker parameters.



PC-Software RT-Speaker

The key element is the Rub&Buzz test technology with a unique and reliable defects analysis. The cycle time may be set down to 1.0 second (based on the speaker type) for a complete test including the outstanding Rub&Buzz analysis.

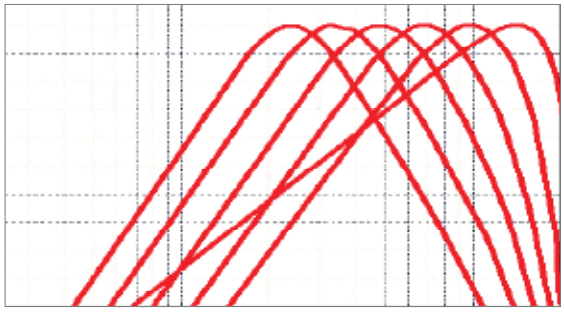
UNIQUE RUB & BUZZ TEST IN TIME DOMAIN

The patented measurement technology enables the PureSound speaker test system to conduct fast and reliable Rub&Buzz tests with a perfect equivalence to the human “Golden Ear”.

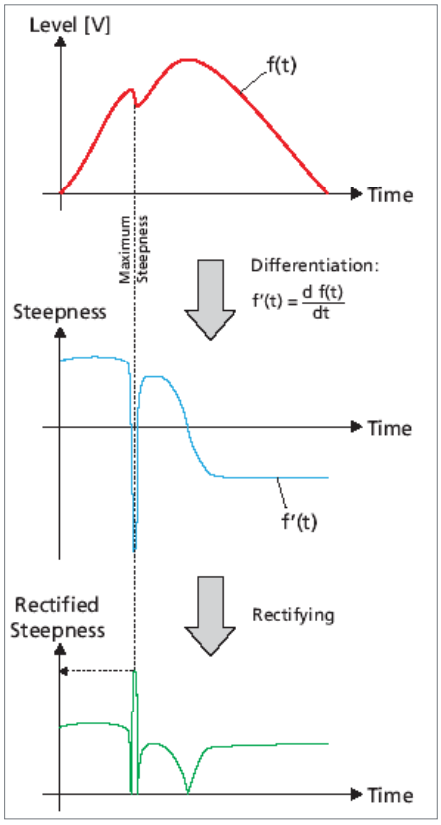
TECHNOLOGY:

Gliding chirp triggers all frequencies

The measured signal is first processed with a filter bank, simulating the psycho-acoustic perception of the human ear. Then the Transient Steepness Analysis is carried out by differentiation and rectifying the time signal. The result displays all sound energy changes audible to the human ear.



PureSound filters



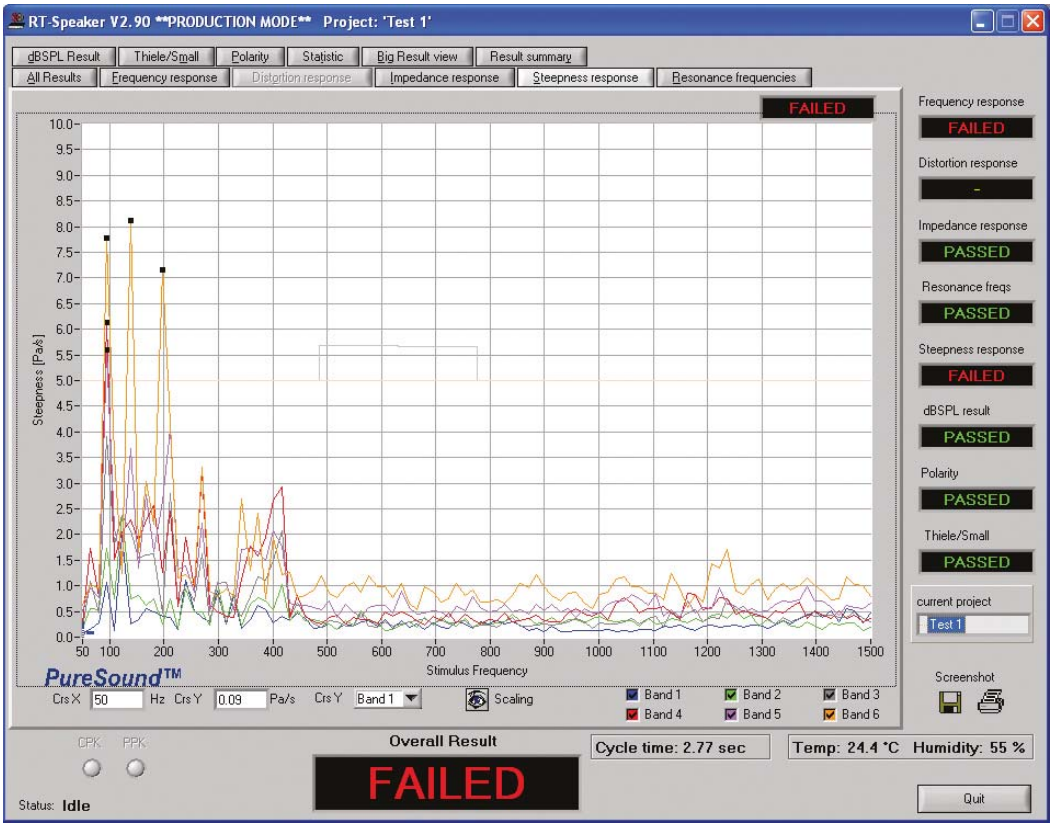
100% CORRELATION TO HUMAN EAR

The NTi Audio Rub & Buzz test technology is the outstanding approach for perceptual audio testing in the time domain. The algorithms model the human ear as a transient analyzer, effectively measuring every audible manufacturing imperfection with an unmatched correlation to the acuity of “Golden Ears” – “You measure what you hear”. This correlation allows cost saving and much improved test accuracy by replacing the subjective “Golden Ear“ with a successful and objective Rub & Buzz test.

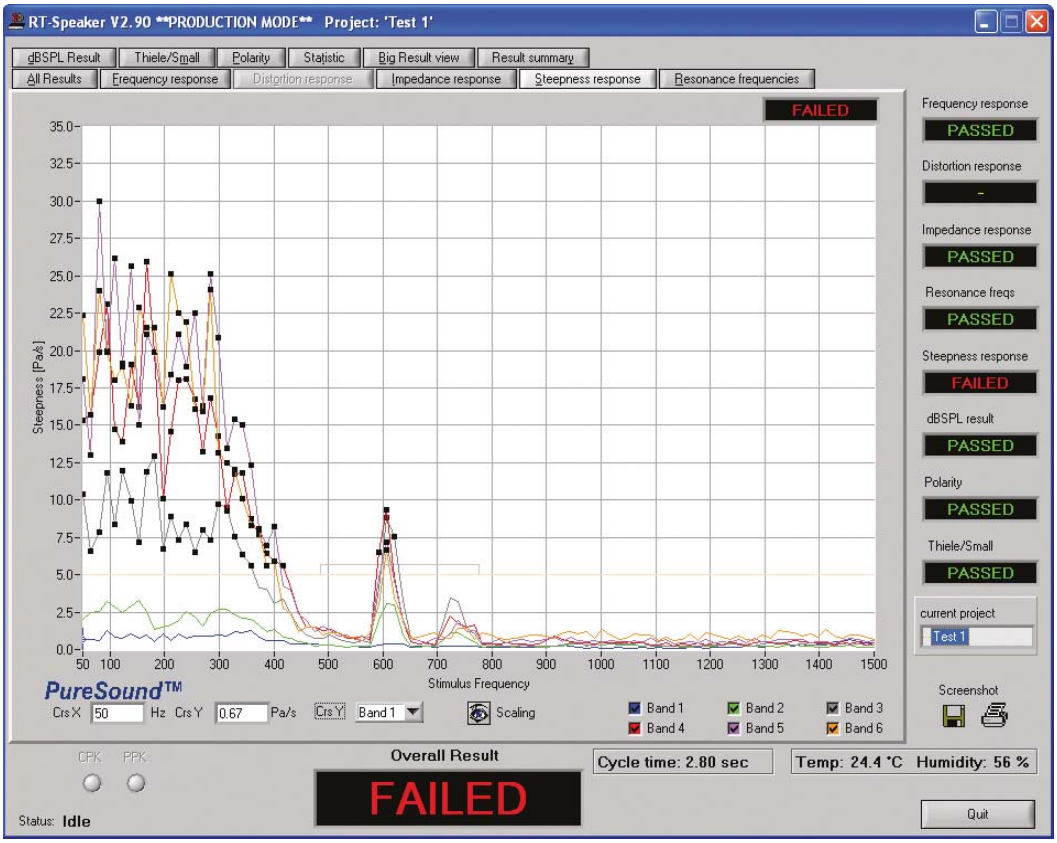
In the past “Golden Ear“ tests have been carried out based on the judgment of individual persons, which may even vary over time as the human ears tire during the day. PureSound offers a 100% repeatable, objective Rub&Buzz test at any location around the globe.

PRODUCTION NOISE IMMUNITY

PureSound measures Rub&Buzz even in noisy factory environments. An effective, advanced noise cancellation algorithm eliminates non-correlating signal components from the test signal, thus immunizing the measurement process against factory noise. The typical test time is one second.



Rub & Buzz analysis: Loose particles



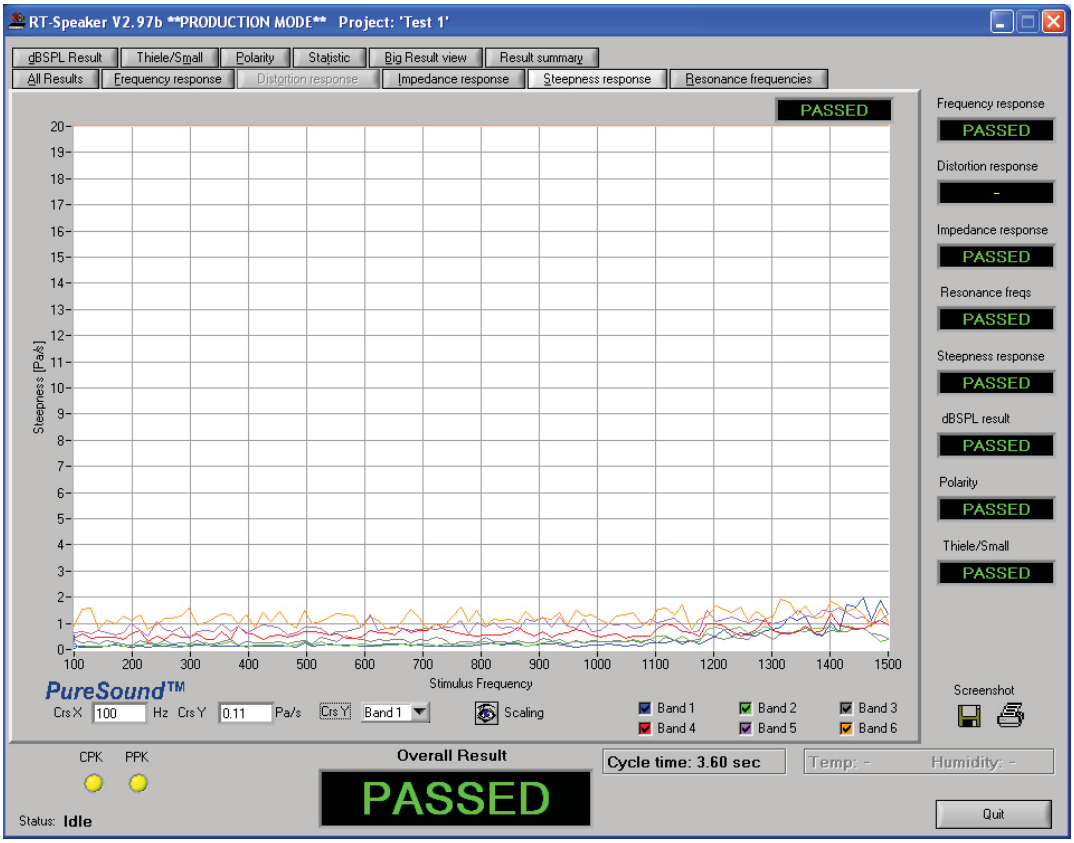
Rub & Buzz analysis: Rubbing voicecoil

DETECTING SLIGHTEST RUB & BUZZ DEFECTS

PureSound provides a complete speaker or transducer characterization, detecting even the most subtle manufacturing flaws of speakers or transducers, such as air-leaks, misaligned coils, rubbing voice coils, loose particles, touching wires or defects from any other cause, also supporting the automatic qualification of the nature of these defects.

PURESOUND IN R&D

PureSound acquires “fingerprints” of speaker non-linearity’s to compare developments in every design stage over its entire life. Such a continuous Rub & Buzz measurement monitors the objective quantification of design changes to audible effects, minimizing design flaws. As lower the measured Rub & Buzz is in the development stage as better are the test results of the final product. Furthermore in the supplier selection process different speaker-samples can be compared against each other in order to choose the sample with lowest Rub & Buzz for the final product.



Rub & Buzz analysis: PASSED loudspeaker

COMPARING PURESOUND AGAINST CONVENTIONAL METHODS

Rub & Buzz defects are audible for the human ear, but hard to measure with older measurement techniques. Tests carried out in the frequency domain, such conventional FFT spectrum analysis or high order harmonic tracking filters, typically fail to discriminate short instantaneous Rub&Buzz effects like loose particles. The test results may not correlate with the human hearing at all since the energy content of the signal caused by the defect is not sufficient and consistent for FFT measurements. PureSound is the solution for today's quality control. It ensures the delivery of final-branded units without audible defects, reduces warranty returns and prevents unnecessary shipping costs, missed deadlines and customer claims.

Fast Measurements

The default measurements are carried out with a logarithmic sine sweep signal. A dedicated technology ensures best noise immunity even in noisy production environments.

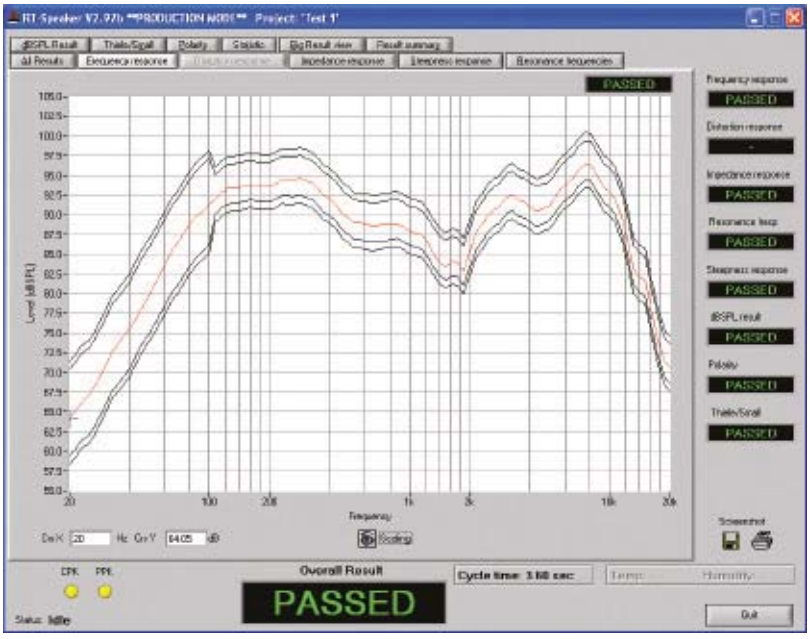
The fast sweep signal serves as stimulus for simultaneous measurements of:

- Frequency Response
- Sound Pressure Level dBSPL
- Impedance Response & Resonance Frequencies
- Distortion THD, 2nd - 35th harmonics
- Individual driver Polarities
- Thiele/Small Parameters

This highly accurate and repeatable set of measurements typically occupies the device under test for one second. All completed measurements are compared in real-time against user-defined tolerances for individual PASSED/FAILED decisions.

FREQUENCY SWEEP WITH TOLERANCE CLASSES

The smart “learn-mode” simplifies tolerance definition by feeding the system with a representative set of one or more “Golden Samples”. The unique tolerance management derives its tolerance criteria automatically and supports up to five different quality clusters, which may be user-defined in any language, such as “Excellent”, “OK”, “Acceptable”, “Class 3” and “Reject”. This enables the manufacturer e.g. to charge a premium for selected “Excellent” products or match speaker pairs for stereo applications.



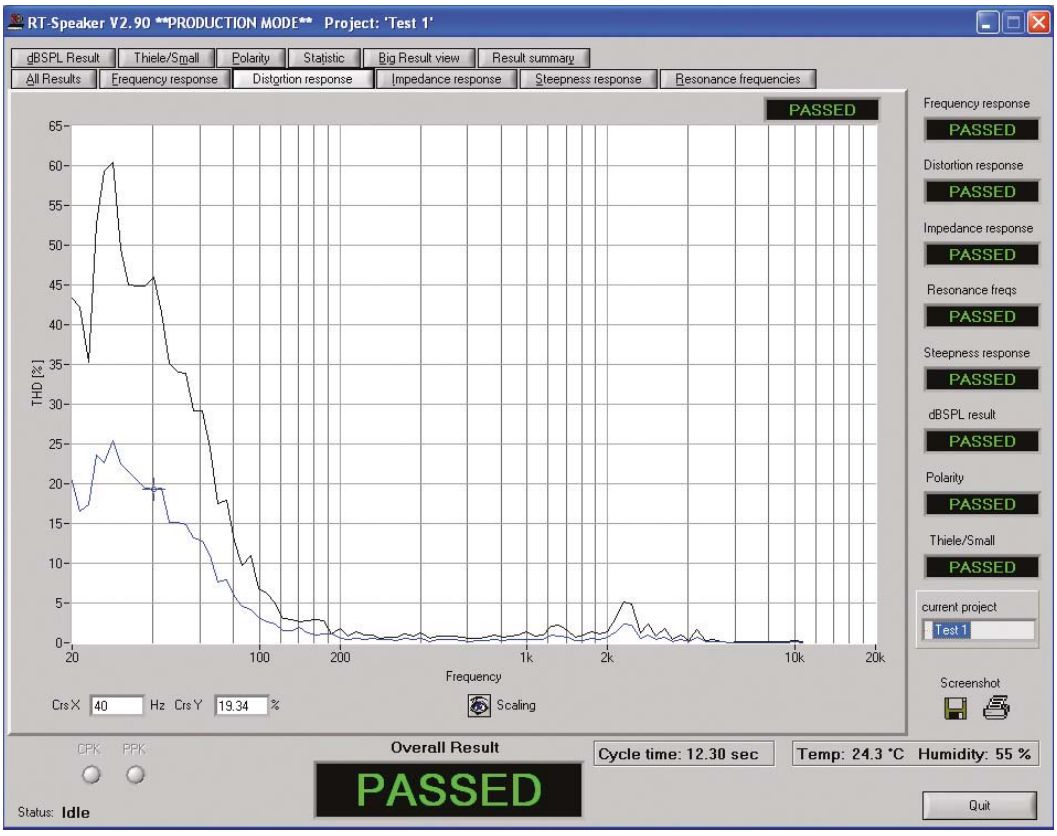
Frequency response measurement with absolute results

Meeting individual customer requirements, the PureSound speaker test system measures up to 5 different resonance frequencies, speaker polarities and sound pressure levels at once. This is of great help e.g. for performance verifications at speaker systems with woofer, mid-range or tweeters installed or ensuring a minimum sound level at different frequencies or frequency ranges.

DISTORTION TESTING

The distortion measurement includes THD, THD+N, individual 2nd to 35th harmonic and sum of multiple harmonics. The non-linear behavior of the device may be assessed simultaneously with the frequency response test or examined via a separate sweep. All measurements are optimized for speed to maintain maximized throughput for production lines.

Distortion measurements have been proven inadequate for reliable defects detection, its presence is not intended to replace the unmatched sensitivity and accuracy of the PureSound Rub & Buzz measurement! Distortion is just another useful tool valuable for correlation to R&D specifications, e.g. at sampling inspections.



Distortion analysis THD

THIELE/SMALL PARAMETERS

The FX100 Audio Analyzer measures the Thiele/Small parameters DC-resistance Rs, R, R0, Qms, Qes, Qts, C, L and df without extending test time. All parameters are tested with one very fast single sweep signal. The results are compared against tolerance limits in real time for an accurate PASSED/FAILED test result. The sensitive T/S parameters are an excellent monitoring base for the integrated CPK/PPK module, effectively supervising the stability of the production process.

AUTOMATION IN PRODUCTION LINES

System integration into existing high volume production lines and connection to host controllers is very simple, as the speaker test system supports remote control via TCP/IP commands. The patented measurement algorithms have been optimized for factory noise immunity. This maximizes your production line yield and allows conducting the same measurement in R&D as well as in the production floor. Measurements can be started by an external button or automatically as the speaker is connected. The FX100 Analyzer offers an integrated DIO-Interface for automated operation, such as

- Connection to external PLC
- Test result indication to the operator
- External pre- or post-test actions independent of test result
- Automated splitting of PASSED/FAILED samples
- Individual bin splitting of different FAILED samples

Automated splitting in FAILED production bins

SERIAL NUMBER HANDLING

RT-Speaker offers manual and automatic serial number handling. Flexible bar code interpretation extracts the model type and loads the corresponding project file automatically. For example a widely varied mix of different speakers can be tested sequentially without even touching the keyboard of the controlling PC.

ONLINE PRODUCTION MONITORING

Complete measurement setups can be exported from the customer or engineering PC and sent by e-mail to the assembly line reducing time and installation efforts. The actual production test results can be monitored over the web around the globe. An activated TCP/IP-link to a server gives direct access to measurements, pre-set tolerances and the production statistics.

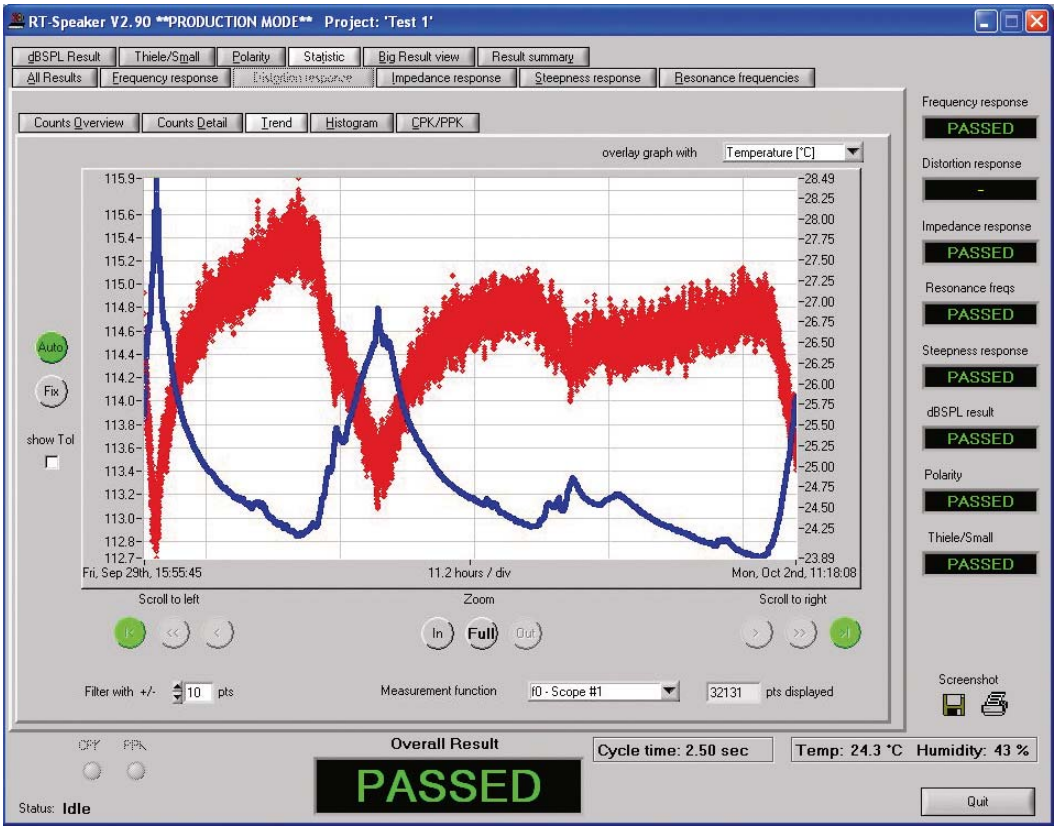
DATA LOGGING

All test results are automatically stored as log-files, which can be opened with e.g. MS Excel. This simplifies the utilization of spreadsheet or data-mining software. The user has the choice between single, batch, daily or weekly log-files with individually specified logging data. This feature supports detailed quality monitoring for after-sales service and simplifies data comparisons of returned speakers, a valuable add-on for speaker manufacturers or rental companies.

STATISTICAL PROCESS CONTROL (SPC)

Statistical data is calculated on the fly while the production tests are running. The detailed histogram, trend analysis and Cpk/Ppk values (=short/long term production variation) provide a clear assessment of the currently manufactured quality level.

Speaker parameters are very sensitive to changing environmental factors, such as temperature and humidity. RT-Speaker offers detailed on-line correlation of test results with the actual temperature & humidity using the optional Environmental Sensor. The trend monitor supports identifying failed speaker batches due to environmental effects and highlights necessary calibrations or reference sampling for maintaining reliable PASSED/FAILED test results at the same time.



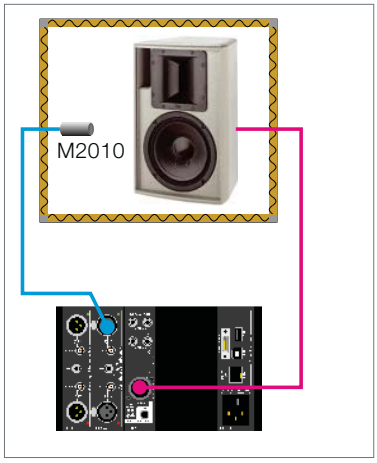
Statistical trend analysis correlated with the environmental temperature

Applications

BASIC SPEAKER TEST CONFIGURATION

The basic system configuration is quickly set up and ready to go for measurements within a few minutes. For noisy production environments an acoustically shielded test-box is recommended. The measurement microphone distance to the speaker under test is commonly equal or higher than the speaker diameter.

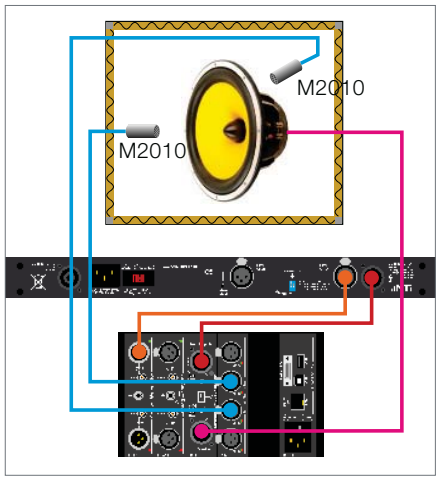
Regardless whether it is a passive or an active system, RT-Speaker evaluates the complete performance of the system cabinet. All speakers can be tested at once or sequentially using various available test configurations.
In a passive system, the impedance measurement enables RT-Speaker to record the impedance plot and identifies multiple resonance frequencies from several drivers.



FX100 Audio Analyzer with FX-SIP

WOOFER TESTING

Woofers with large mechanical dimensions are challenging objects for quality control. The transfer function and acoustical performance needs to be measured in axis from the front.
A woofer with its big membrane area and low frequency characteristics acts more or less like a piston with very large excursions. It is obvious that manufacturing defects are most audible close to the motor itself. The front microphone inside the test box is somewhat shielded by the membrane and in some cases not very effective. With a second microphone mounted at the rear-side, any Rub & Buzz can be measured, which is not audible from the front.
The offered DC resistance measurement ensures accurate Thiele/Small parameter testing for all woofer types.



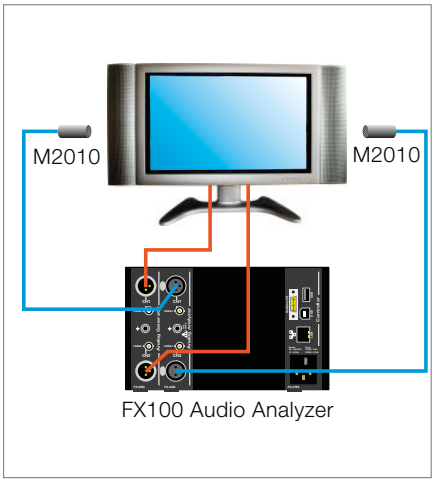
FX100 Audio Analyzer with FX-SIH & FX-IS

System includes:

- 1x FX100 Audio Analyzer
- 1x Speaker Impedance Module FX-SIH
- 1x Input Switcher Module FX-IS
- 1x RT-Speaker Software including PureSound Rub & Buzz
- 2x Measurement Microphone M2010
- 1x Audio Amplifier

STEREO CONSUMER PRODUCT TESTING

Automated testing of consumer products with multiple inputs and electrical or acoustical outputs is supported by the PureSound speaker test system. The individual acoustical performance of Left/Right speakers is typically measured in sequential order.
Additional microphones or vibration sensors may probe for housing vibrations or loose grids. Input- and Output Switcher Modules may be integrated for such comprehensive matrix testing.



TV testing configuration

System includes:

- 1x FX100 Audio Analyzer
- 1x RT-Speaker Software including PureSound Rub & Buzz
- 2x Measurement Microphone M2010

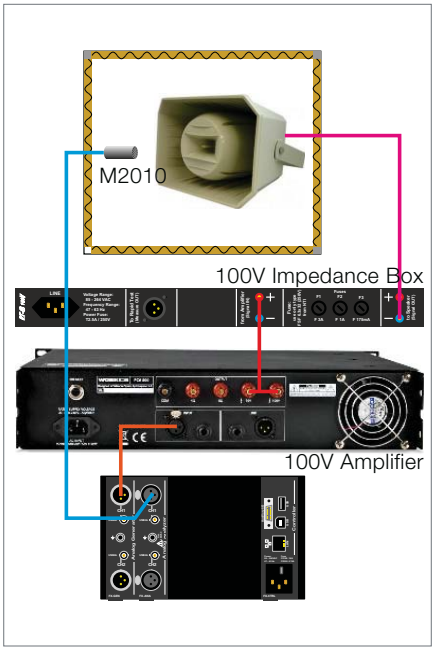
Optional:

- 1x Input Switcher Module FX-IS
- 1x Output Switcher Module FX-OS

100 V SPEAKER TESTING

The PureSound speaker test system allows impedance response- & resonance frequency testing of 100 V speakers, which are often used in public address systems. Lower speaker test voltages, such as 75 V, 50 V, 25 V are also supported. In the past the speaker and the 100 V transformer had to be tested separately as individual components. The complete assembly could not be tested. Assembling faults often have been detected at the actual speaker installation on-site only.

The PureSound speaker test systems offers the all-in-one solution for testing the completely assembled 100 V speaker with transformer. The RT-IB 100V Impedance Box enables impedance measurements up to 30 kΩ, allowing to test all powertaps of a 100 V speaker transformer.



FX100 Audio Analyzer

System includes:

- 1x FX100 Audio Analyzer
- 1x RT-Speaker Software including PureSound Rub & Buzz
- 1x RT-IB 100 V Impedance Box
- 1x M2010 Measurement Microphone

MOBILE PHONE SPEAKER & RECEIVER TESTING

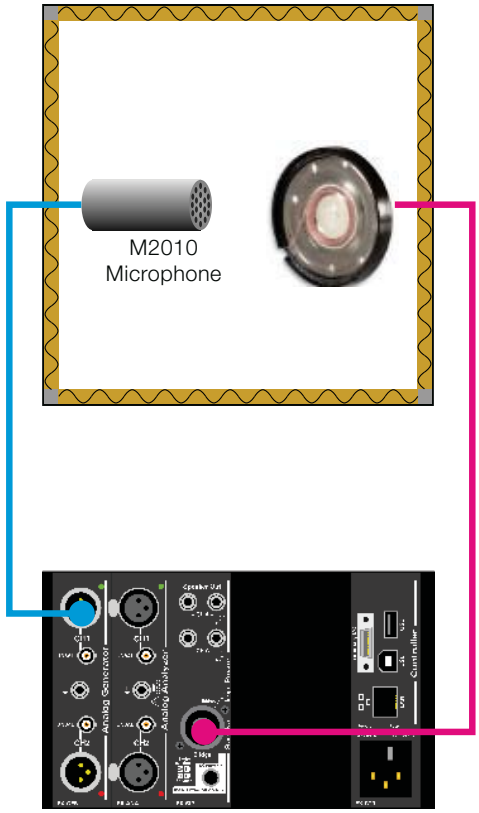
Telecom transducers are very small yet important components in modern mobile phones. Best performance over a wide frequency range and as small as possible is expected. Their naturally high problem rates may result in high costs for waste goods from finished materials. Nowadays manufacturers increase the production yield by a 100% quality control of the individual component, the preassembly and finally the completed phone. Especially the PureSound Rub&Buzz test is of great help to filter out any products with abnormal noise as early as possible, thus final testing of completed phones achieves close to a 100% PASSED rate and best performance. Vibration motor testing is included!

The mobile phone test adapter TA2010 or artificial ears (type IEC 318 or IEC 711) are available, which simulate the acoustical conditions at the human ear.

They are typically used for mobile phone receiver testing.

System includes:

- 1x FX100 Audio Analyzer
- 1x Speaker Impedance Module FX-SIP
- 1x RT-Speaker Software including PureSound Rub & Buzz
- 1x M2010 Measurement Microphone or Artificial Ear
- 1x Audio Amplifier



FX100 Audio Analyzer
with FX-SIP

Telecom transducer test setup; FX100 Audio Analyzer with FX-SIP

FX100 Loudspeaker Test System
Feature Overview

	Basic Loudspeaker Test Software	**Standard** Loudspeaker Test Software	**Premiere** Loudspeaker Test Software
Measurement Functions			
Automated calibration sequence	•	•	•
Reference measurements	•	•	•
PureSound Rub&Buzz defect detection	•	•	•
Frequency response		•	•
Impedance response		•	•
Distortion response		•	•
Thiele/Small parameters		•	•
Multiple Resonance frequency readings		•	•
Multiple dBSPL readings		•	•
Multiple Polarity readings		•	•
DC Resistance		•	•
2-DUT parallel measurement			•
Loudspeaker directivity (Polar plots)			•
Interface			
Front panel PASS/FAIL indication	•	•	•
Temperature & Humidity sensor support	•	•	•
Barcode scanner support		•	•
Digital IO interface			•
DUT auto detect			•
TPC/IP remote control			•
Remote monitoring			•
Audio switcher support			•
Pre/Post-test actions			•
Turntable support			•
Data Handling			
Data Logging	•	•	•
Golden Sample finder (BMA)		•	•
Serial number handling		•	•
Result classifying			•
Statistic package			•
Administratives			
Calibration manager	•	•	•
Project Backup/Restore	•	•	•
Project sequencing		•	•
User role management			•
Multiple cycles			•
Automated documentation			•
Customized reports			•

ORDERING INFORMATION

Basic Configuration

- FX100 Audio Analyzer
- Speaker Impedance Module
  - FX-SIP (with built-in 30 W amplifier)
  - FX-SIH (for high power speakers, requires external amplifier)
- RT-Speaker Software including PureSound Rub & Buzz
- Power Amplifier
- 1/2“ Measurement Microphone class 1 frequency response,
  - M2010: SPL max = typ. 145 dB
  - M2015, SPL max = typ. 155 dB

FX100 Modules

- Input Switcher Module FX-IS
- Output Switcher Module FX-OS
- Channel Extension 2CH -> 4CH
- FX-AES (for digital audio loudspeakers)

Accessories

- Input Switcher IS-1002
- Output Switcher OS-0210
- Environmental Sensor
- Class 1 Sound Calibrator
- RT-IB Impedance Test Box for 100 V speaker applications

Automation Accessories

- Digital I/O Adapter for FX100
- Digital I/O Card, 6503, 6528,
- Digital I/O 6501, USB

Artificial Ear

- Kit Artificial Ear
- ICP or 200 V Microphone, IEC318 or IEC711, including pre-amplifier and power supply (available with special mounting fixture to test stand)

Other Turnkey PC-Software

RT-Microphone

Microphone Production Testing

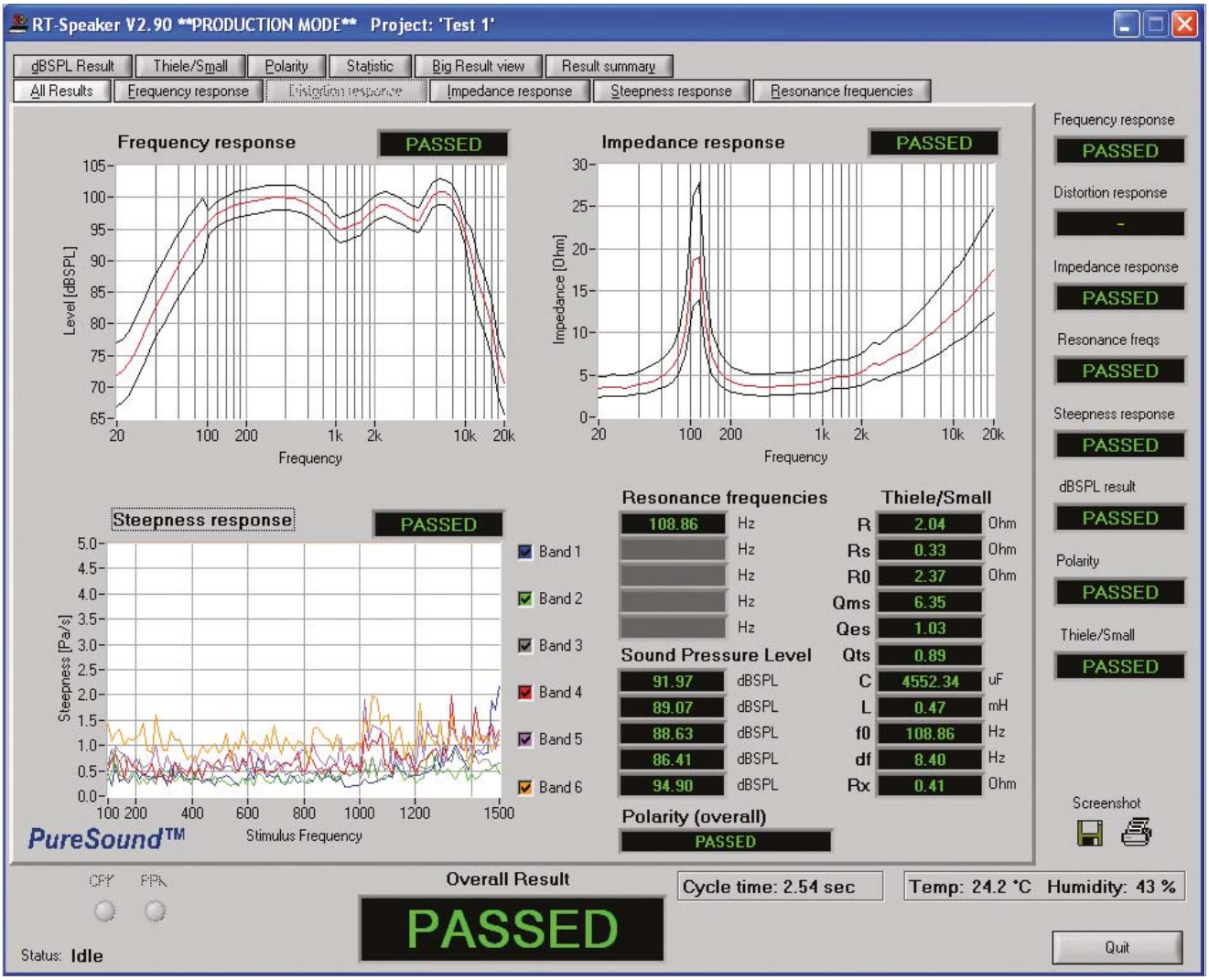
SPECIFICATIONS

Analog Generator	
Test Signals	Sine, StepSweep, GlideSweep, White Noise
Level Range	10 µV to 12.45 V (-100 dBV to 21.9 dBV)
Level Accuracy	± 0.05 dB
Level Flatness	< ± 0.01 dB (10 Hz to 20 kHz)
Frequency Range	5 Hz to 80 kHz
THD+N	• -104 dB @ 1 kHz, 0 dBV (typical) • ≤ -101 dB + 1.3 µV (20 Hz to 20 kHz fundamental, Low-pass 22 kHz)

Analog Analyzer	
Measurement Functions	• Level (selective & wideband), Frequency, FFT, Gain, THD, THD+N, • Harmonics k2-k35, Phase, Crosstalk, Polarity, DC-Level, DC-Impedance, • optional: PureSound™ Rub&Buzz
Sweeps	Frequency Sweep, Time Sweep, Level Sweep, Table Sweep
Speed	Frequency response down to 200 ms from 20 Hz to 20 kHz (GlideSweep)
Level Range	<1.0 µV to 141 V (max 200 Vp), channel independent auto ranging
Level Accuracy	± 0.1 dB @ 1 kHz
Level Flatness	< ± 0.02 dB (20 Hz to 20 kHz)
Frequency Range	DC, 5 Hz to 80 kHz

THD+N	• -104 dB @ 1 kHz, 0 dBV (typical) • ≤ -104 dB + 1.5 µV (20 Hz to 20 kHz fundamental, LP 22 kHz)
Residual Noise	≤ 1.5 µV (20 Hz to 20 kHz bandwidth)
Filters	• A-Weighting, C-Weighting, AES17 Brickwall • Highpass 22Hz, Highpass 400Hz, Lowpass 22kHz
Crosstalk	≤ –120 dB + 1 µV to 20 kHz
Input Bias Supply	2 VDC, 48 VDC Phantom Power, ICP®
Input Coupling	AC or DC

General	
Channels	• 2 or 4 Parallel Independent Inputs/Outputs Analog • XLR and BNC connectors
Extension Slots	3 empty slots @ Base Unit FX100 for modular extensions
Interfaces	• USB 2.0 Communication to PC • Headphone connector for audio out, 1/4”Jack Stereo • LAN (prepared for later firmware extension)
Pass / Fail Result	• Built in DIO-Interface controls external peripherals • Dual color display with green/red indication
FX-Control Suite	• PC Software with full access to all audio analyzer features • Parallel measurements with internal/external triggering • Calculation panels for mathematical processing of measurement data • Result reporting: txt-files, csv-files or xlsx-files • Full tolerance handling and hardware wiring diagram
Programming	Supports .NET Assembly (e.g. C#.NET, Visual Basic.NET)
Design	Desktop use or ½ size 19” rack mounting, 3 rack units high



Overview test results

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