

Cellular Analog FXS & FXO VoIP xDSL  
Acoustic ISDN PRI T1/E1

# TCA 8200

Telecom Conformance Analyzer



ALL-IN-ONE CONFORMANCE TESTING SOLUTION FOR TELECOM  
EQUIPMENT ACCORDING TO WORLD-WIDE STANDARDS



EXPERTS IN GLOBAL COMPLIANCE SOLUTIONS

HERMON LABORATORIES

TCA 8200 **replaces over 20 test instruments** providing a unique '**lab-in-a-box**' solution that significantly **reduces test times and costs.**

## Solutions

- Analog FXS & FXO
- Acoustics
- Cellular phones
- Analog & Digital phones
- VoIP
- xDSL
- T1/E1
- ISDN PRI
- Physical layer testing
- VF & TIMS analysis
- Signaling
- Voice Quality testing
- Protocol testing

## Features

- Compliance testing according to major world standards
- Fully automated testing & documentation
- Built-in standards and general-purpose tests
- Supports signaling and remote EUT control
- User defined tests, test suites, and projects
- Manual operation for development and debugging testing
- Comprehensive online help
- Powerful management, display and analysis features
- Modular design – tailored to your needs

## Applications

- Compliance testing
- R&D testing
- QA testing
- Production testing



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# TCA 8200

## TELECOM CONFORMANCE ANALYZER

### Key Standards

- ETSI ES 203 021
- TBR 21
- TBR 38
- TBR 4
- TBR 12, TBR 13
- TBR 10
- FCC Part 68, TIA-968-A
- CS-03
- AS/ACIF S002, S003
- S004, S016, S038
- S041, S043.2
- ITU-T G.703
- G.823, G.824
- G.992.1, G.992.3, G.991.2
- G.992.5, G.993.1
- P.313, P.340, P.342
- P.862
- ETSI TS 102 027 / RFC 3261
- TIA-810A/B, TIA 920/A
- 3GPP TS 26.131 , TS 26.132
- 3GPP TS 51.010-1
- 3GPP2 C.S0056-0 / TIA-1042
- ETSI EN 300 903



### Compliance testing according to world major standards

The TCA 8200 Telecom Conformance Analyzer is an all-in-one compliance testing solution, according to world-wide regulatory & industry standards, for many types of telecom equipment ranging from phones to digital switches, PBXs and VoIP gateways.

In the past, approval of telecom equipment meant using a test lab with expert test engineers and numerous non-automated or semi-automated expensive test instruments and setups. Such a process usually took weeks. With the TCA 8200 you can complete tests and documentation required by the standards and agencies in a matter of hours, without a need for in-depth knowledge of the standards.

Due to liberalization of regulation processes in Europe, the USA and other countries manufacturers can now perform in-house testing and declare compliance or apply for the approval of a regulatory agency. Having an in-house compliance testing solution from the early design stages can significantly reduce time-to-market.

Test labs can also benefit from fast and cost-effective testing services for a broad range of interfaces and standards covered by the TCA 8200, its expandability and its extensive management features.

## Fully automated testing

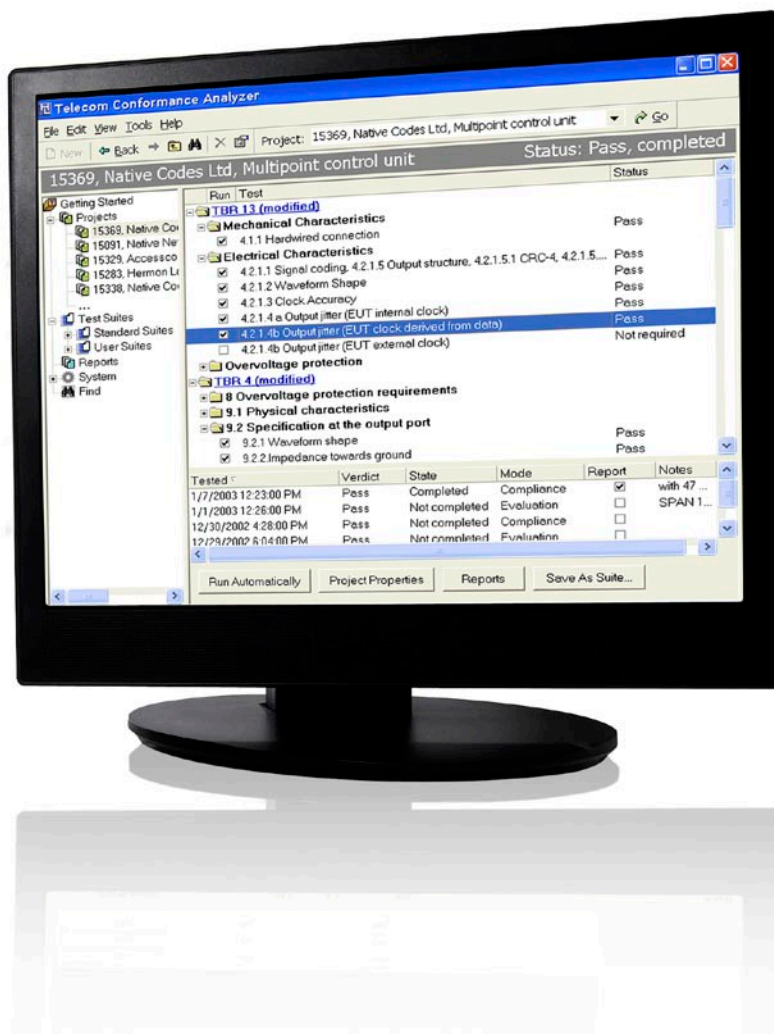
TCA 8200 comes with test suites ready for testing according to the supported standards. Tests can be performed automatically, either one by one or in a sequence. No user interaction is required except for the setting of Equipment Under Test (EUT) in response to prompts appearing on the screen.

Completely unattended testing is possible for equipment that can be remotely controlled by signaling or ASCII commands. Programmable signaling procedures allow call establishment with the EUT during tests and measurements. The EUT can also be controlled by programmable ASCII commands over the LAN, USB, Serial or GPIB interfaces.

Such functionality together with the capability to define custom tests and test sequences is especially useful for **production testing**.

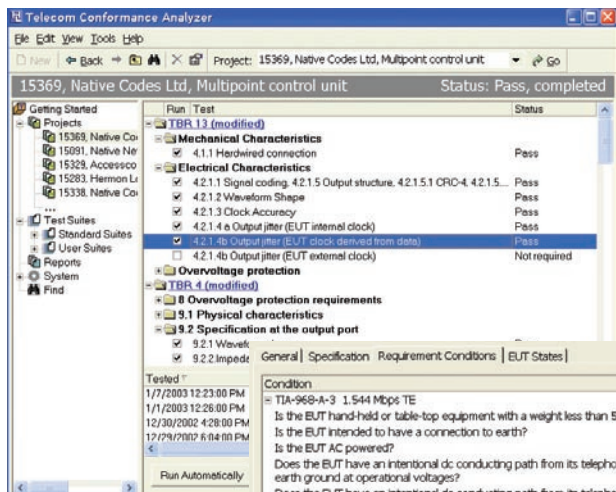
Reports are automatically generated in Microsoft Word format providing test results and all information required for a test project.

Deciding what standard's tests are applicable for a particular product can sometimes become a complicated task. Predefined and user-defined criteria for quick selection of the required tests simplify this task. The tests are automatically selected by answering Yes/No questions about the functionality supported by the product. Tests can also be manually selected. A test can be automatically repeated with different (or identical) sets of test parameters and limits.



TCA 8200 comes with pre-defined test suites, according to the supported standards.





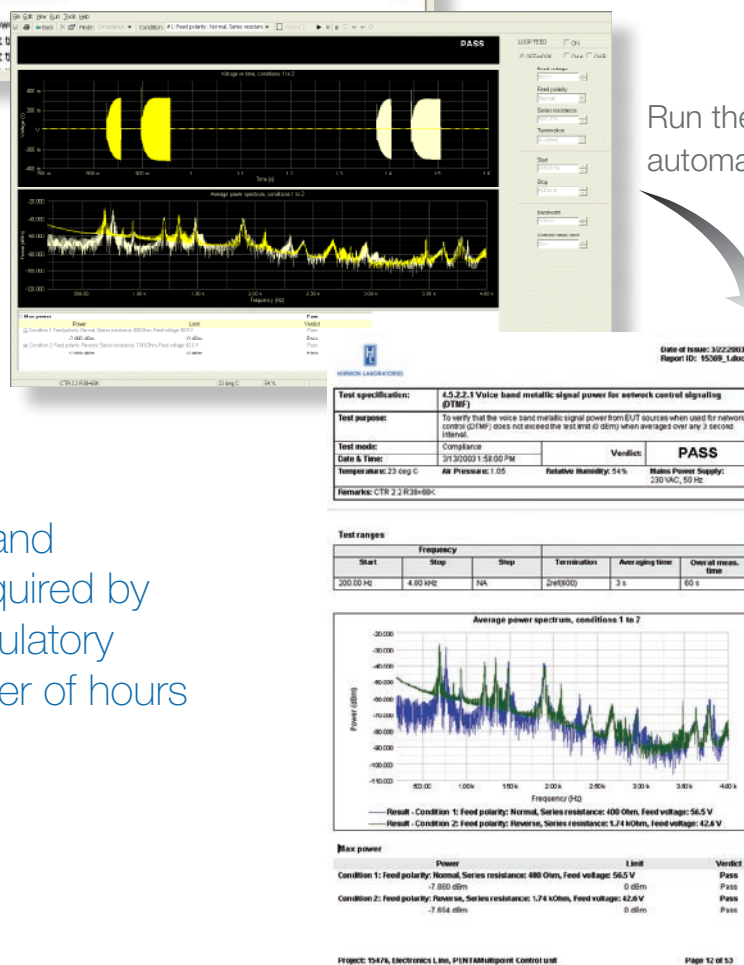
Create a test project from multiple standard suites

Select the required tests based on the product features

Run the tests automatically

Complete testing and documentation required by standards and regulatory agencies in a matter of hours

Generate MS Word reports for multiple standards



## Powerful display & analysis

Test results are continuously displayed on graphs and tables, together with current test status and verdict, key test parameters, user prompts, the current test point and measured values. Time and frequency domain measurements with minimum, maximum and average statistics are also provided.

For each test, you can set which results will appear on the display and in the test report, set limits,

number of plots per graph, style and color of each plot, select Log or Linear axis, set axis scale or select auto-scaling, select which test parameters will appear in the test report, rename test results, add comments and environment conditions description to test results.

Measured results can be analyzed by using markers, delta markers, zoom in/out, max/min peak search, scroll and pan graph features. Further analysis is possible by copy/pasting the results to the preinstalled Microsoft Excel.

## Benefit from real-time measurements and display in R&D applications

## Manual operation

Besides fully automated testing capabilities, the TCA 8200 provides on-the-fly control of test parameters and “manual” tuning and stepping which is important for **development and debugging testing**. Test execution can be paused/ resumed, automatically swept or manually stepped through multiple test ranges. A test can run once or continuously at single or multiple test points (e.g. frequency).





# Next generation testing

Tests repeated for multiple settings/configurations

Current results, user prompts and overall test verdict displayed continuously

Multiple result plots with user-defined colors and styles displayed on single or split screen in Time, Frequency, Amplitude and Phase domains

User-defined limit lines and masks

Linear or Log X and Y axis

Multiple numeric and status results with limits and verdicts displayed in a table

Test execution paused/resumed, automatically swept or manually stepped/tuned or run continuously at single or multiple test points (e.g. frequency)



Real-time line error and alarm indication facilitates setup and EUT monitoring

On-the-fly control of test parameters for debugging and development testing

Measured results analyzed with zoom, peak search and markers

Programmable signaling and remote EUT control for fully automated testing

User annotations and automatic Time & Date stamp





## Lab in a box

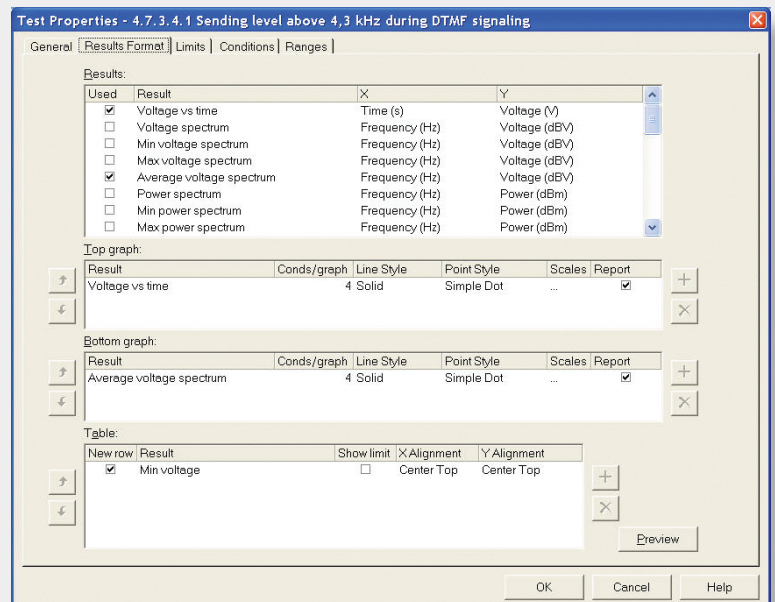
The TCA 8200 is not just a test instrument. It is also a highly integrated system of tools & features for performing and supporting tasks required in a test lab such as:

- Definition and management of test specs and test plans with customized user prompts, remote EUT control commands and automatic test selection criteria.
- Running and management of test projects.
- Generation and management of test reports.
- Integral client information database linked to test projects.
- Integral database of network signals, simulations and signaling that can be used in tests.
- Built-in calibration tests.
- Backup and restoration of all data as well as restoration of factory data.
- Emergency recovery of all software and factory data from an image disk supplied with the system.
- Quality Assurance issues have been thoroughly addressed:
  - » ISO/IEC 17025 compliant test reports.
  - » Tests, test suites, projects, and reports are uniquely identified.
  - » Changes to test definitions are recorded.
  - » TCA 8200 comes with ISO/IEC 17025 Certified calibration.

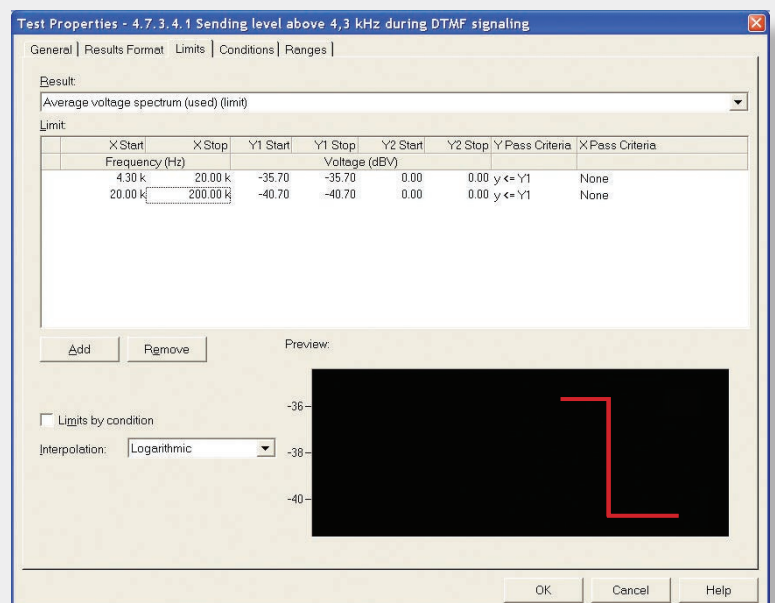
## Versatility and ease of use

The TCA 8200 features familiar Windows user interface. Test suites, test projects, tests, reports and other data and tools are presented in Windows Explorer-like tree/list views.

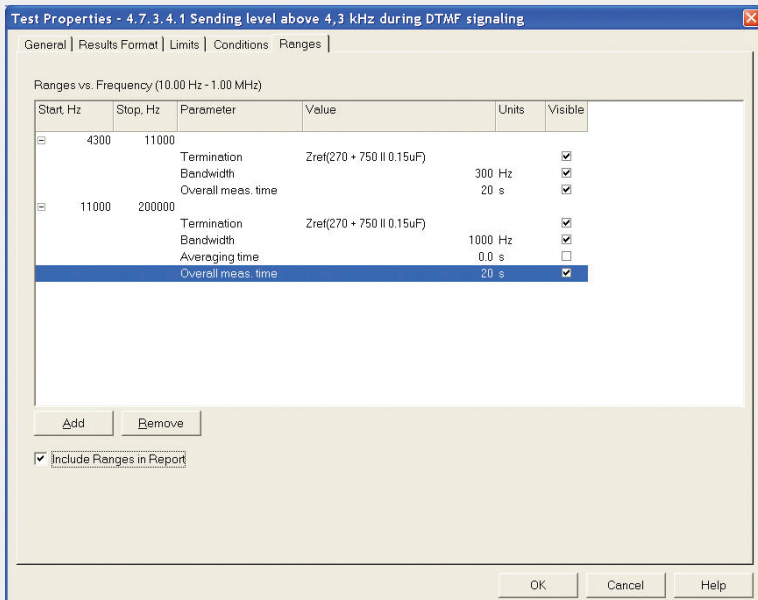
Intuitive commands such as Open, New, Delete, Save, Find, Properties, and data operations are implemented through double-click, menus, toolbar icons, and right mouse button context-sensitive pop-up menus.



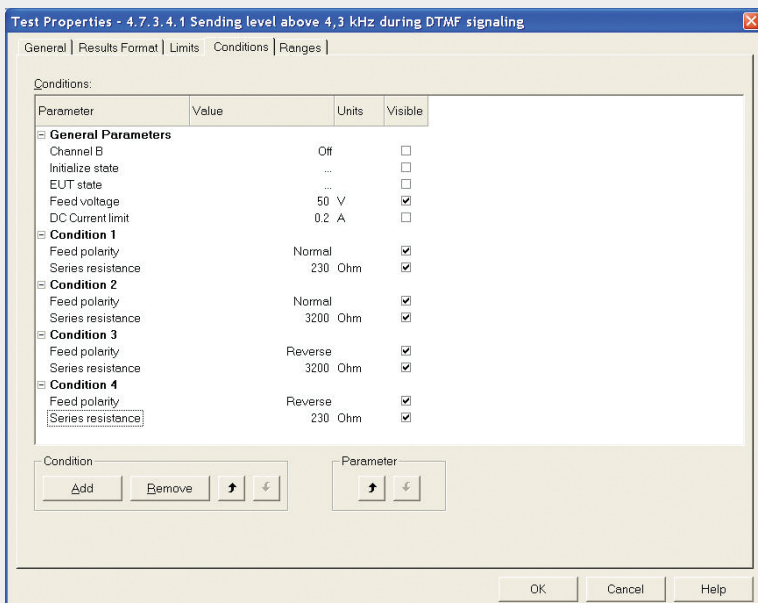
1. Setting results format



2. Setting limits



### 3. Setting test ranges



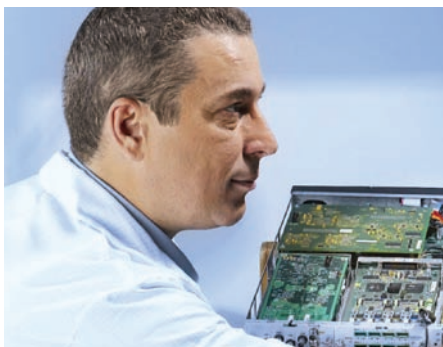
### 4. Setting test parameters

In addition to thousands of built-in tests, users can easily create new custom tests by setting the results format, test parameters, ranges, limits, EUT remote control commands, user prompts and test execution sequence. No programming or scripting is required. Both system and user tests are grouped in test suites.

New test suites for new standards or user specifications can be created. Test suites are used to access, set and run tests, and serve as templates for new suites and projects. A project provides the tools to run and manage tests and store & document test results.

A project is created from one or multiple test suites, inheriting all their definitions. It contains all necessary information required for a test project:

- Details of the product under test.
- Client details.
- Project performance information.
- Test specification - group of test definitions, created from one or more test suites. You can modify the test specification in the project and save the project test specification as a test suite, to be used as a template in other projects and suites.
- Project and tests status including the verdict.
- Test results are saved for each test execution in the project. You can:
  - » Select which results will be included in the test report.
  - » Generate test reports in Microsoft Word format for each test suite included in the project.
  - » Open, print and delete test reports from the project.
  - » Include Microsoft Word documents in a test suite or in a project to document unsupported tests or to include additional information in a test report.



Professional on-line  
tech support and  
training for both  
novice and  
advanced users

TCA 8200 replaces  
over 20 test systems  
and instruments

## On-line help and support

TCA 8200 features a comprehensive context-sensitive online help with examples and step-by-step guidance.

The tests are thoroughly documented with EUT connection and configuration instructions, test specification and measurement uncertainty data.

TCA 8200 user interface accommodates the needs of both novice and advanced users. Step-by-step wizards are provided together with straightforward shortcut operations. Remote configuration, user guidance and training can be provided over the internet via remote operation of the TCA 8200. Hermon Laboratories customer support is comprised of a professional team of engineers knowledgeable with the equipment operation and standards.

## Low cost of ownership

TCA 8200 comes with a price significantly lower than the total cost of equipment and systems it can replace such as: a digital oscilloscope, spectrum and network analyzers, digital transmission and jitter analyzer,

line and cable simulators, power supplies, protocol, frame, signaling analyzers, various test bridges and a PC. Achieving automation requires further investment in integration and software development or buying expensive third-party solutions.

## Modular design and upgradeability

TCA 8200 offers a modular design enabling you to buy only what you need. You then have the flexibility to upgrade the instrument later for additional options.

Testing capabilities are easily extended to cover new standards by defining new user test suites using the GUI or by obtaining updates from Hermon Laboratories.

## High Accuracy

TCA 8200 achieves and even surpasses the accuracy required by the supported standards through careful hardware & software design, testing automation, and by taking into consideration various signal path factors, and automatic self-calibration & extensive calibration procedures.



## Signaling

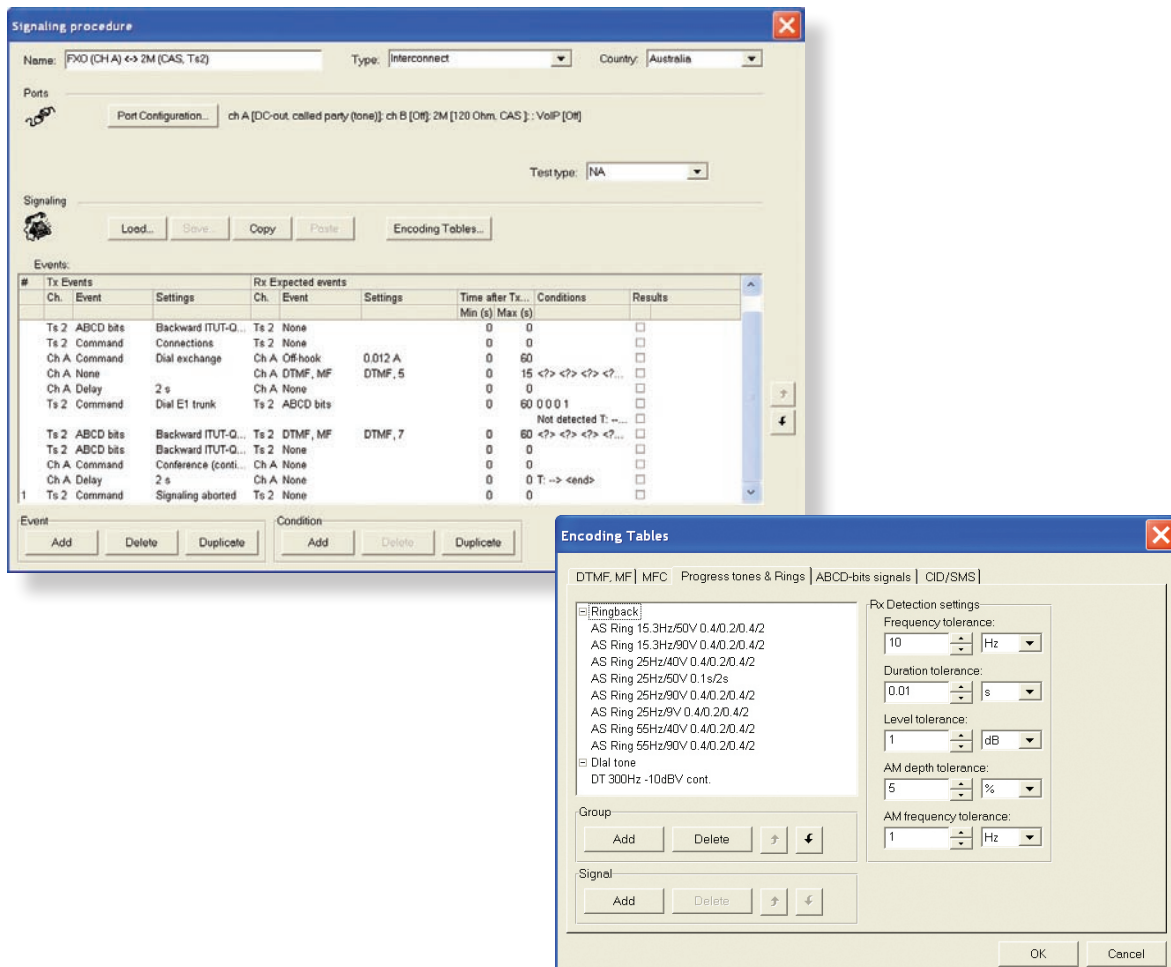
TCA 8200 built-in Signaling provides a powerful set of tools found in standalone network line and switch simulators. It allows you to perform simulation and analysis of various analog, digital (T1/E1) and VoIP signals, conditions and messages that are used in telecom networks.

Signaling can be used for two purposes:

1. Functional testing of different analog, T1, E1, VoIP signaling features at various network conditions with built-in pass/fail criteria, timing and signal measurements.
2. Establishing a voice communication path with the EUT before performing various tests (e.g. TCA 8200 can originate a call between a PBX E1 line and analog extension and then perform an inter-modulation distortion test between these two ports).

Different networks, switches and CEs (Customer Equipment) can be simulated by programmable network conditions and call scenarios. Sequences of test cases with transmitted and expected (received) signals and messages, delays, timeouts, IF/THEN/GOTO cases, remote EUT control and pass/fail criteria can be defined.

A database of pre-defined signals, messages, and signaling sequences used in multiple countries is provided.



## Supported Equipment

- Telephones
- Modems and Faxes
- PBXs
- Analog/T1/E1/VoIP gateways  
Switches and IADs
- DAAs and SLICs
- Terminal equipment
- Central Office equipment

## Analog PSTN testing

The Analog PSTN tests cover the requirements for terminal (FXO or CE) and network (FXS or CO) equipment including:

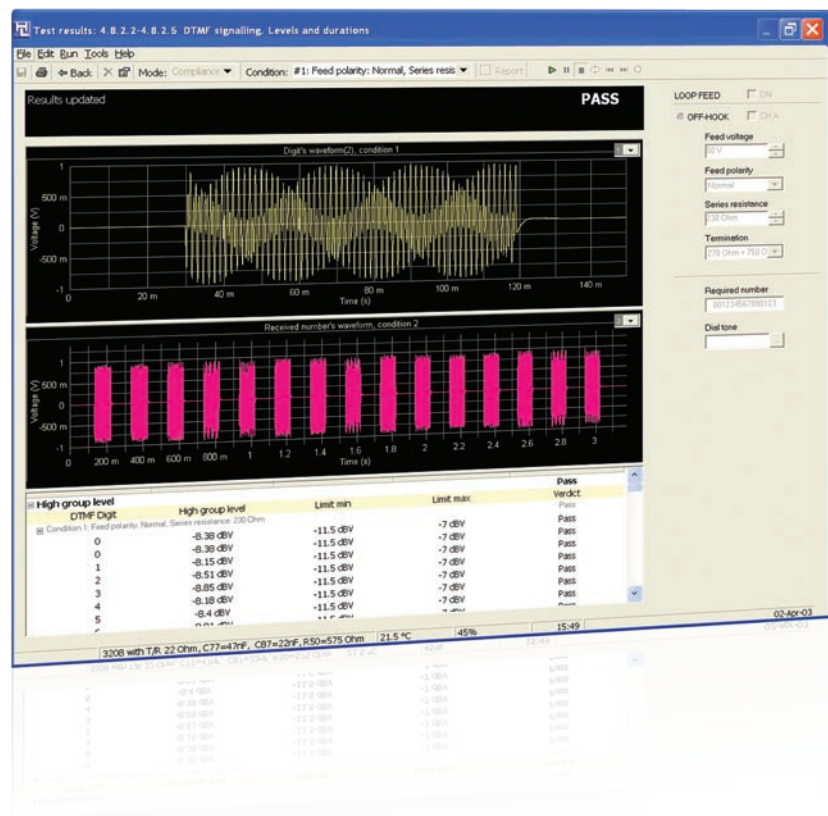
- Electrical AC, DC and timing characteristics in on-hook, off-hook states and during the transition between those states.
- Various functional and simulation tests.
- VF transmission & TIMS analysis.
- Voice Quality Testing (PESQ).
- CID/SMS protocol testing.

## Comprehensive PBX testing

Due to an extensive array of tests, built-in signaling, and simultaneous two-port analog/digital tests a PBX (and similar products) can be completely characterized by the TCA 8200's, conformance, voice quality, performance, and functional testing.

## CO, CE, and Line simulation (Signaling)

Variable complex terminations, artificial lines, series resistance, loop feed DC voltage, on-hook, off-hook, progress tones, DTMF, rings together with the other signaling features allow simulation of almost every analog network and interface in the world.



## Acoustic testing

Acoustic tests are performed to assess electro-acoustic performance, speech quality of phones and to verify compatibility with other phones and communication networks. Various characteristics of a phone are tested over its electro-acoustic path between the phone's interface, microphone, speaker and line (wired or wireless).

Handset phones are placed in a Head And Torso Simulator (HATS) or test head which provides the reference standard positions from the built-in ear and mouth simulators. The ear and mouth simulators are connected to the TCA 8200 internal input preamplifier and output power amplifier. Hands-free phones should be tested in a quiet environment such as an anechoic chamber with a test head that has a hands-free positioner or with HATS (depending on the standards).

Tests are performed according to procedures and specifications defined in ITU-T, ETSI, TIA and other standards.

TCA 8200 is a highly integrated test solution that provides the hardware and software required for the automatic testing of almost any type of analog and digital phone or electro acoustic device.

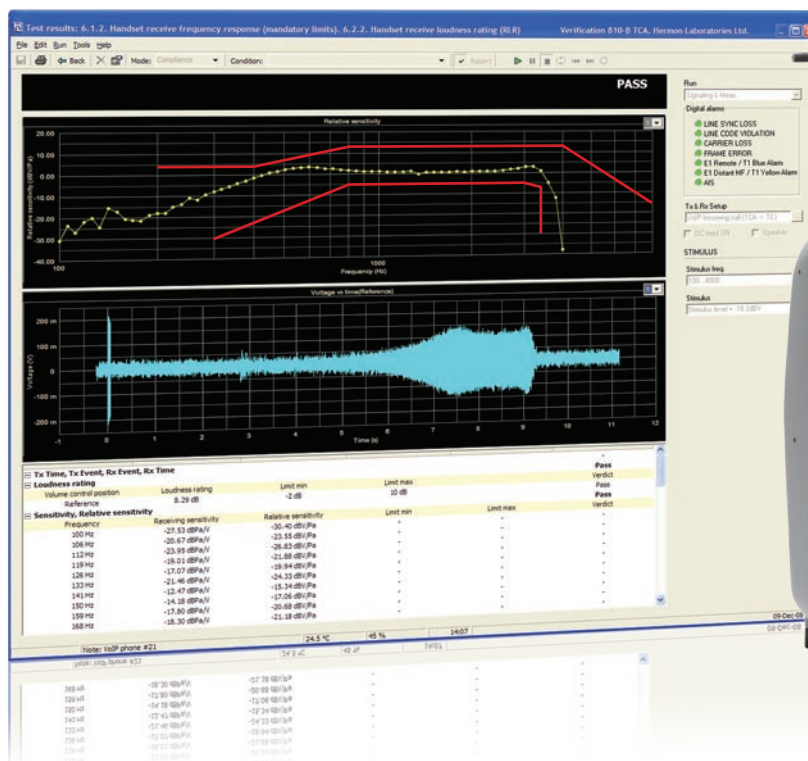
The system can be optionally configured with a VoIP software interface, analog PSTN interface, cellular RF base station simulator, wireless DECT, Wi-Fi base stations, Bluetooth wireless interface, acoustic interfaces: HATS or test head.

The interfaces are configured and automatically controlled through the system software and calibrated together with the system.

## Supported Equipment

Handsets, Headsets and Hands-free phones such as:

- Cellular phones (GSM, CDMA, WCDMA, CDMA 2000)
- VoIP phones (SIP and H.323)
- Wi-Fi handsets
- Soft phones
- DECT phones
- Bluetooth hands-free and headsets
- USB phones and adapters
- Analog telephones
- Cordless telephones
- Hearing aids
- Audio devices





## Supported Equipment

- PBXs,
- Gateways
- Routers
- Switches
- Multiplexers
- IADs
- DSUs
- LIUs and Framers

## T1/E1 testing

The T1/E1 tests cover layer-1 electrical characteristics of input and output ports, combined analog / digital transmission and functional characteristics of framed & unframed interfaces, Voice Quality testing and ISDN PRI protocol testing.

In addition to test results presented on graphs and tables, the line monitor indicators display the current error and alarm status of the TCA 8200's T1 or E1 receiver.

Jitter measurement tests feature amplitude auto-ranging and display of the measured jitter modulation waveform versus time. Pulse shape tests provide simultaneous measurements of positive and negative pulses, and space characteristics with automatic

mask fitting and scaling, and user-defined masks. Frame analysis tests provide the most powerful features for simulation and analysis of a 2.048 Mbps CCS & CRC structure. In the heart of the frame analysis tests lies the Test Procedure definition which contains a sequence of test cases. Each test case includes a user-defined transmit data pattern of variable length and the expected 'receive' events criteria. Predefined error, alarm or data patterns are provided. You can set any bit in framing and each data timeslot.

You can also define a series of expected 'receive' events such as CRC error, frame error, RAI, FEBE and AIS conditions with start time, duration repetitions limits for each event.

**Test Case**

Stimulus (Tx)

Test Case: [BIT 2 = 1, /FAS)x3, (BIT 2 = 1, FAS)x5] Description: Repeat: 1 Framing: Framed (CCS & CRC)

Frame	#	1	2	3	4	5	6	7	8	Ts 1	Ts 2	Ts 3	Ts 4	Ts 5	Ts 6	Ts 7	Ts 8	Ts 9	Ts 10
0	C1	0	0	1	0	0	1	1	1	D5	D5	D5	D5	D5	D5	D5	D5	D5	D5
1	0	1	A=0	0	0	0	0	0	0	D5	D5	D5	D5	D5	D5	D5	D5	D5	D5
2	C2	0	0	1	0	0	1	1	1	D5	D5	D5	D5	D5	D5	D5	D5	D5	D5
3	0	1	A=0	0	0	0	0	0	0	D5	D5	D5	D5	D5	D5	D5	D5	D5	D5
4	C3	0	0	1	0	0	1	1	1	D5	D5	D5	D5	D5	D5	D5	D5	D5	D5
5	1	1	A=0	0	0	0	0	0	0	D5	D5	D5	D5	D5	D5	D5	D5	D5	D5
6	C4	0	0	1	1	0	1	1	1	D5	D5	D5	D5	D5	D5	D5	D5	D5	D5
7	0	1	A=0	0	0	0	0	0	0	D5	D5	D5	D5	D5	D5	D5	D5	D5	D5

Legend: [X] Error [X] Alarm [ ] Carrier signal Off

Monitor (Rx)

Set expected event:

- ☐ NOF
- ☐ E-bit = 0
- ☐ E-bit = 1
- ☐ A-bit = 0
- ☒ A-bit = 1
- ☐ No Frame error

Start Time: Min: 0 ms Max: 30 ms After: Stimulus

Repetition: Min: 1 Max: 1

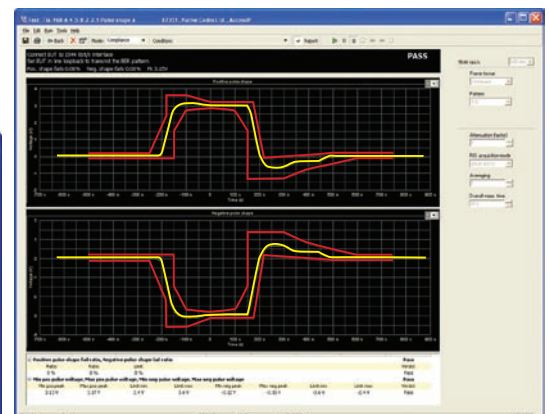
Duration: Min: 2 ms Max: 2 ms

Selected Event Sequence:

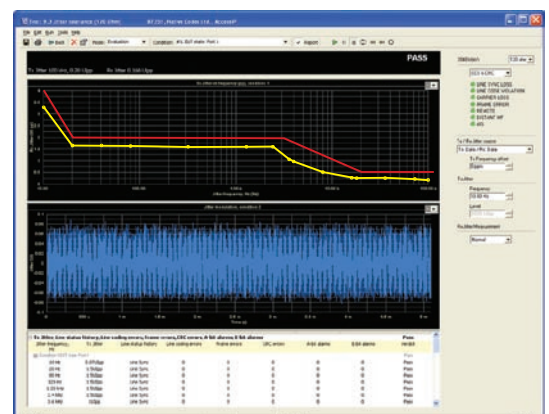
A-bit = 1, starting 0.0 - 30.0 ms from stimulus, lasting maximum 30.0 ms, occurring 1 to 3 times

OK Cancel

Frame Analysis test case definition



Pulse Shape measurement



Jitter measurement

When a frame analysis test is run the test cases sequence is executed. The data patterns are transmitted; the received events are recorded with single frame resolution and compared to the expected events criteria with an automatic verdict setting.

Predefined frame analysis tests such as TBR 4 9.4 Frame structure and 9.5 Operational functions tests are provided. CAS simulation and analysis coupled with a built-in database of signals and signaling states provides a powerful testing capability for virtually any E1/T1 CAS protocol.

## PCM and TIMS analysis

Tests such as Loss, SINAD, Attenuation, Harmonic & Inter-modulation Distortion, Group Delay and Crosstalk are used to characterize Transmission and Impairment characteristics over a voice path in equipment such as a PBX. The tests are performed between an analog FXO/FXS port and a voice (PCM) channel in a T1/E1 port. Prior to taking measurements the TCA 8200 can establish a call between the two ports providing automatic measurements.

## ISDN PRI protocol testing

The L23 option provides full layer 2 and 3 testing of 2.048 Mbps ISDN PRI in accordance with TBR 4.

Built-in tests include a user-defined series of TTCN test cases defined in TBR 4. TTCN is a programming-like language that describes protocol simulation, analysis, and verdict criteria test procedures. When the layer 2 or 3 tests are run the test cases are executed one-by-one with automatically-set verdicts and recordings of transmit and receive layer 2, 3 messages.

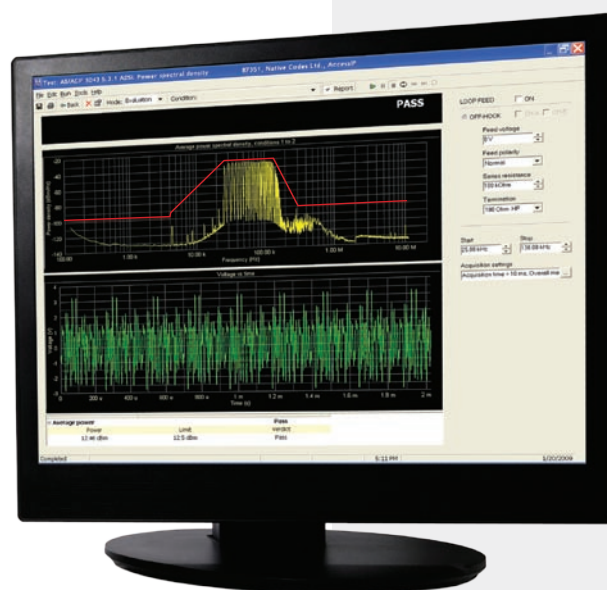
## xDSL testing

TCA 8200 offers a compliance testing solution for xDSL: ADSL, ADSL2, ADSL2+, HDSL, HDSL2, HDSL4, SHDSL, SDSL, VDSL COs and CPEs according to ITU-T & ETSI industry standards and various national US, Canada, Europe, and APAC regulatory standards.

The xDSL tests cover the electrical characteristics and transmit power requirements for various xDSL equipment.

### xDSL Key tests

- Power spectral density
- Aggregate total signal power
- Spectrum analysis
- Longitudinal output voltage
- Transverse balance
- Longitudinal conversion loss
- Return loss
- Intentional operational paths to ground
- Intentional protective paths to ground
- On-hook resistance
- DC current during ringing
- Ringing frequency impedance



## VoIP testing features

- Acoustic and telephony testing VoIP phones
- Voice Quality (PESQ) testing
- SIP Protocol testing

## SIP Conformance Analyzer features

- Fully automatic testing of SIP protocol (RFC 3261) according to ETSI TS 102-027
- TTCN-3 suites for User Agent, Proxy, Redirect server, Registrar
- Tests for valid, invalid and inopportune SIP protocol behavior and syntax variations
- User-friendly test parameter (PICS/PIXIT values) setting
- User-configurable tests suites
- On-line and off-line analysis
- Real time display of protocol traces and test results
- Logging of trace and results to file

## VoIP testing

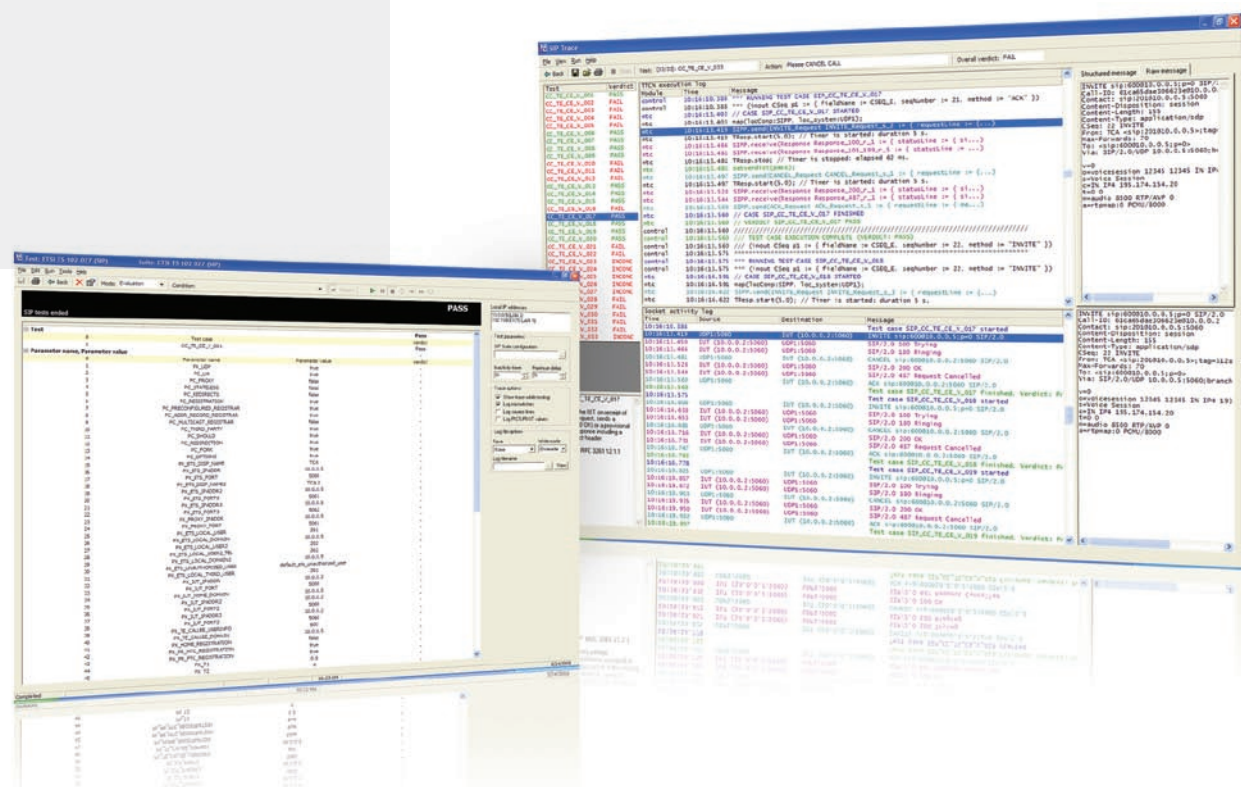
VoIP enabled products such as VoIP phones, PBXs, gateways and VoIP servers; can be evaluated by the TCA 8200 protocol testing, transmission characteristics, functional and Voice Quality testing. Coupled with the acoustic test capabilities the TCA 8200 provides a comprehensive conformance, performance and functional testing solution for VoIP phones.

## SIP Protocol Conformance testing

The SIP Conformance Analyzer is

an advanced testing solution for SIP enabled products widely used in today's VoIP and 3G networks. Comprehensive tests, protocol simulation and analysis tools verify SIP compliance according to ETSI TS 102 027 / RFC 3261 ensuring a high probability of interoperability.

Offering a full suite of over 600 test cases, the SIP Conformance Analyzer provides an automatic conformance testing solution that significantly reduces testing time and facilitates problem identification and debugging.





## Voice Quality Testing

Voice Quality Testing (VQT) utilizes the PESQ (Perceptual Evaluation of Speech Quality) algorithm to assess the voice quality of telecom equipment and networks.

The PESQ algorithm, defined in the ITU-T P.862 recommendation, models the human perception of speech, by comparing a reference speech signal with the “degraded” signal. The reference signal is transmitted by the test instrument to the EUT and the degraded output signal from the EUT is measured.

The most important result is the ITU-T P.862 PESQ MOS (Mean Opinion Score), because it directly expresses the voice quality. The PESQ MOS ranges from 1.0 (worst) up to 4.5 (best).

Additional results such as Delay and Delay Jitter, G.107 rating R factor, various waveforms, level, gain, loudness, SNR, VAD (Voice Activity Detection) parameters - Front End Clipping, Hold Over Time and Drop-outs are also provided.

Typical applications of VQT are VoIP, PSTN, ATM networks, Frame Relay, wireless equipment & networks and handset & speaker phones. Of particular interest is speech quality assessment and analysis of compression & VAD codecs such as those used in VoIP and wireless networks.

PESQ VQT can replace an array of lengthy “traditional” TIMS voice frequency measurements.

PESQ evolved from the need to automate the human listening tests (as defined in ITU P.800) and has

introduced improvements to the older PSQM+, PSQM and PAMS methodology.

The VQT measurements can be performed on any combination of the following TCA 8200 Transmit - Receive ports:

Analog, Acoustic, T1, E1, VoIP Ethernet except for T1-E1 and E1-T1 combinations.

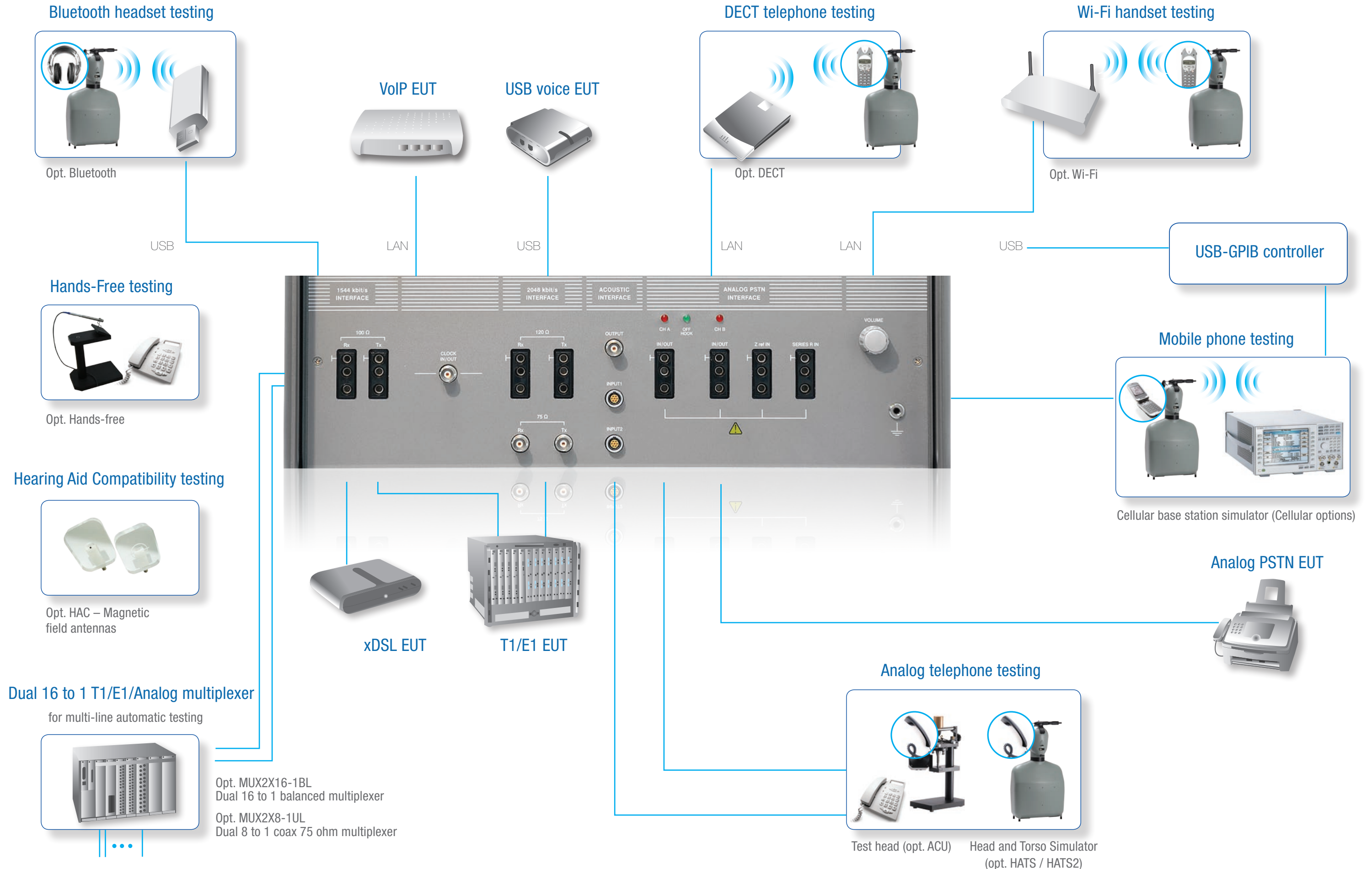
The analysis can be performed on-line and off-line (comparison of pre-recorded files). Received voice signals can be recorded to wav files.

### Key features

- PESQ MOS per ITU-T P.862
- Codec VAD testing
- Delay and Delay jitter
- Fully automatic measurements with built-in signaling
- Automatic reading/recording from/to one or auto-incremented files
- On-line and off-line analysis
- Real-time display of results and degraded versus reference waveforms



# TCA 8200 test configuration examples



## SPECIFICATIONS

Supported standards <sup>1,4,5</sup>		
Analog PSTN 2 / 4-wire TE and CO (opt. ALG)	ETSI ES 203 021, TBR 21, EG 201 121, EN 301 437 (Europe) TBR 15, 17 (Europe) <sup>5</sup> FCC Part 68, TIA-968-A (USA) CS-03 Part I (Canada) AS/ACIF S002, S003 (Australia) PTC 200, 220 (New Zealand) <sup>5</sup> YD/T 514 (China) HKTA 2011 (Hong Kong)	PSTN01 (Taiwan) JATE, Analog Terminals (Japan) IDA TS PSTN 1 (Singapore) MoC 023/96 (Israel) DPT-TE-001 (South Africa) <sup>5</sup> CNC-ST2-44-01 (Argentina) <sup>5</sup> Decree No. 392 (Brazil) <sup>5</sup> NET 001/92 (Brazil) <sup>5</sup> ANSI/TIA/EIA-464-C (USA) <sup>5</sup>
CID SMS (opt. CID SMS)	ETSI EN 300 659-1 V1.3.1, ETSI EN 300 659-2 V1.3.1, ETSI EN 300 659-3 V1.3.1, ETSI ES 201 912 V1.1.1 ETSI 300 648, ETSI EN 300 778-1,2 V1.2.1	
xDSL: ADSL, ADSL2, ADSL2+, HDSL, HDSL2, HDSL4, SHDSL, SDSL, VDSL CPE and CO (opt. DSL)	FCC Part 68, TIA-968-A 5 (USA) (ADSL) IDA TS ADSL1 <sup>5</sup> CS-03 Part VIII (Canada xDSL) AS/ACIF S043.2, S041 (Australia xDSL) ITU-T G.992.1 <sup>5</sup> , G.992.3 <sup>5</sup> , G.992.5 <sup>5</sup> , G.993.1 <sup>5</sup> (xDSL) <sup>2</sup>	ITU G.991.2 (SHDSL) <sup>2,5</sup> ETSI TS 101 388 (ADSL) <sup>2,5</sup> ETSI TS 101 270-1 1 (VDSL) <sup>2,5</sup> Taiwan ADSL 01 <sup>5</sup>
1.544 Mbps interface (opt. T1)	FCC Part 68, TIA-968-A (USA) CS-03, Part II and VI (Canada) JATE, Digital Terminals (Japan) HKTA 2017 (Hong Kong)	ITU-T G.703 (International) ITU-T G.824 jitter and wander (international) ANSI/TIA/EIA-464-C <sup>5</sup> (USA)
2.048 Mbps interface (opt. E1)	ISDN PRI: TBR 4 (Europe) – Layers 1, 2, 3 <sup>3</sup> TBR 12, 13 (Europe) AS/ACIF S003, S016, S038 (Australia) TNA 134 (ISDN L3 New Zealand)	JATE, Digital Terminals (Japan) NOM – 152 (Mexico) <sup>5</sup> ITU-T G.703 (international) ITU-T G.823 jitter and wander (international)
Acoustic and telephony testing of handset and hands-free telephones (opt. ACU, HATS, HATS2)		
Analog telephones (opt. ALG)	TBR-38 (Europe) FCC Part 68 (USA), TIA-968-A AS/ACIF S004 (Australia)	GB/T 15279-94 (China) <sup>5</sup> ITU-T P.340, P.313 (International) TIA/EIA – 470.120-C (USA) <sup>5</sup>
VoIP and Digital telephones (opt. VoIP, DECT, WiFi, Bluetooth)	TIA/EIA-810A (USA) TIA/EIA-810B (USA) TIA/EIA-920 (USA) TIA/EIA-920-A (USA)	TBR 10 (Europe) <sup>5</sup> ETSI ES 202 737 (Europe) <sup>5</sup> ETSI ES 202 738 (Europe) <sup>5</sup> ETSI ES 202 739 (Europe) <sup>5</sup> ETSI ES 202 740 (Europe) <sup>5</sup>
Cellular telephones (Cellular opt.)	3GPP TS 26.131, 3GPP TS 26.132 (International) 3GPP TS 51.010-1 (GSM 11.10) (International)	3GPP2 C.S0056-0 / TIA-1042 (International) ETSI EN 300 903 (GSM 03.50) (Europe) ITU-T P.342, P.360 (International)
Hearing Aid Compatibility (opt. HAC)	FCC 68.316 and 68.317 HAC (USA)	
SIP protocol testing (opt. SIP)	ETSI TS 102.027 / RFC 3261	
Voice Quality Testing (opt. VQT)	ITU-T P.862, P.862.1 (International)	

### Notes:

1. Excluding: High voltage (surges, overvoltage protection, leakage current), EMC, safety, environmental tests
2. See xDSL electrical characteristics and transmit power below, for supported tests
3. opt. L23 is required for Layer 2 and 3 testing
4. Contact Hermon Laboratories for other available standards
5. Some standards are optional - please consult Hermon Laboratories



## Main tests

<p>Analog PSTN</p>	<p>Automatic dialing</p> <p>Automatically repeated call attempts</p> <p>Clearing of automatic calls</p> <p>DC characteristics in on-hook and off-hook states:</p> <p>Voltage vs current, resistance vs current, DC current</p> <p>DC Resistance</p> <p>DTMF, MF, MFC Signaling</p> <p>Received digits, digit waveform vs time / frequency, low &amp; high group voltage / power / frequency, twist, tone / pause / cycle duration with statistics, noise, rise &amp; fall time, DTMF, MF, MFC digits generation with programmable frequency, level and duration</p> <p>Hazardous voltage limitations</p> <p>Impedance in on-hook and off-hook states</p> <p>Impedance - IZI, Phase, Resistance, Reactance, Inductance, Capacitance, Return loss impulse noise</p> <p>Insertion loss (Series TE)</p> <p>Intentional operational paths to ground</p> <p>Intentional protective paths to ground</p> <p>Line liberation through power failure</p> <p>Longitudinal conversion loss</p> <p>Loop current characteristics</p> <p>Loop interruption tolerance</p> <p>Output signal balance</p> <p>Progress tone detection and generation with programmable level, frequency, duration, cadence and timing</p>	<p>Pulse signaling</p> <p>Received digits, voltage/current vs time and voltage vs current plots, make/break levels and duration, resistance, inter-digit pause, pulse ratio – statistics</p> <p>Pulse digits generation with programmable duration and N / N+1 encoding</p> <p>Relative frequency response</p> <p>R.E.N determination</p> <p>Return loss</p> <p>Ring detection and generation with programmable level, frequency, duration, cadence and timing</p> <p>Ringing impedance</p> <p>Ringing signal overload</p> <p>Series DC Resistance (Series TE)</p> <p>Signaling interference</p> <p>Spectrum Analysis</p> <p>Signal and Noise level measurements vs time and frequency Instantaneous, mean, RMS voltage and power – broadband and narrowband with various BW and filters, psophometric noise, impulsive noise - statistics</p> <p>TIMS and Through Transmission – Narrowband and Broadband tests (see 1.544 Mbps and 2.048 Mbps TIMS and PCM tests)</p> <p>Through Transmission – SF cutoff</p> <p>Transient after change to the opposite polarity</p> <p>Transient response</p> <p>Transmission delay</p>
<p>Line, CO and TE simulation</p>	<p>Variable DC loop feed voltage and current limit</p> <p>Variable series resistance, complex line length and terminations</p> <p>Call simulation and analysis of FXS, FXO loop-start interfaces including:</p> <p>Generation, detection and measurements of</p> <p>DTMF, MF, MFC signals and numbers with variable levels, frequency, duration and timing</p> <p>Pulse signaling with variable duration and N / N+1 encoding</p> <p>Progress tones (dial, progress, busy, ringing tones, etc) and Rings with variable level, frequency, cadence and timing</p> <p>Off-hook, on-hook, wink, flash, polarity reversal and ground-start states with variable characteristics</p>	<p>Playback and recording of .wav files</p> <p>Programmable received event masks and if / then / goto conditions for flow control of the simulation execution and verdict setting</p> <p>Programmable user messages, user verdicts and remote commands (for EUT automatic operation)</p> <p>Pre-defined and user defined database of signals and encodings</p>
<p>CID and SMS testing</p>	<p>SMS and CID protocol testing over analog interfaces</p>	
<p>Acoustics and Telephonometry</p>	<p>Sending and Receiving Sensitivity/ frequency response</p> <p>Sending and Receiving Loudness Rating (SLR, ROLR, RLR)</p> <p>Receive Volume Control</p> <p>Sending and Receiving Linearity</p> <p>Sending and Receiving Distortion</p> <p>Sending and Receiving Noise</p> <p>Sidetone and Sidetone Masking Rating (STMR)</p> <p>Sidetone delay</p> <p>Sending and Receiving Delay</p>	<p>Spectrum Analysis with stimulus</p> <p>Sound Pressure Level (SPL)</p> <p>Instability and Howling</p> <p>Echo return loss</p> <p>Terminal weighted coupling loss single talk &amp; double talk (TCLwst &amp; TCLwdt)</p> <p>Acoustic shock protection</p> <p>Voice Quality Testing of handset and hands-free terminals (see Voice Quality Testing)</p>
<p>Hearing Aid Compatibility</p>	<p>Magnetic field intensity</p> <p>Induced voltage frequency response</p>	
<p>xDSL electrical characteristics and transmit power</p>	<p>Power spectral density</p> <p>Aggregate total signal power</p> <p>Spectrum Analysis</p> <p>Longitudinal output voltage</p> <p>Transverse balance</p> <p>Longitudinal conversion loss</p>	<p>Return loss</p> <p>Intentional operational paths to ground</p> <p>Intentional protective paths to ground</p> <p>On-hook resistance</p> <p>DC current during ringing</p> <p>Ringing frequency impedance</p>

## 1.544 Mbps and 2.048 Mbps interfaces

Layer 1 (Physical layer)	<p>Clock accuracy measurements</p> <p>Return loss</p> <p>Transverse balance</p> <p>Impedance towards ground</p> <p>Tolerable longitudinal voltage</p> <p>Receiver sensitivity</p> <p><b>Bit Error Rate tests (BERT)</b></p> <p>Pattern, line code, frame error and error rate; CRC error (2.048 Mbps), errored superframes (1.544 Mbps) RAI and REBE alarm measurements (2.048 Mbps); LOS, LOF, AIS detection; pattern and line code error insertion.</p> <p>Immunity to attenuation and reflections</p> <p><b>Simulation</b></p> <p>Transmitter carrier level attenuation..... 3.3V / 2.7V</p> <p>Cable simulator attenuation..... 0 / 6 / 12 dB</p> <p>Interfering signal with 18 dB attenuation mixed with the carrier..... on/off</p> <p>Error and alarm measurements..... As in BERT</p> <p><b>Jitter</b></p> <p>Jitter generation and measurement, jitter transfer, jitter tolerance, maximum tolerable jitter, wander generation complying or exceeding O.171, G.823, G.824, TBR 4, 12, 13</p> <ul style="list-style-type: none"> <li>• Jitter measurement and generation on data and clock</li> <li>• Jitter Measurements: <ul style="list-style-type: none"> <li>Upp and Ulrms jitter level with statistics</li> <li>Demodulated jitter vs time waveform</li> <li>Low-pass and high-pass filters with continuously variable cutoff frequency</li> </ul> </li> <li>• Error and alarm measurements</li> <li>• Transmitter clock frequency offset</li> </ul> <p><b>Pulse shape</b></p> <p>Simultaneous positive, negative pulses and space measurements with automatic mask fitting, with pulse width and pulse amplitude ratio measurements with averaging and statistics. User-defined masks.</p>	<p><b>Output power and voltage</b></p> <p>With time, spectrum and harmonic analysis</p> <p><b>TIMS and PCM analysis</b></p> <p>Two-channel A-A, A-D, D-A, D-D narrowband and broadband through transmission tests</p> <p>Stimulus/Measurement channels:</p> <p>(A) Analog channel A/B with DC loop feed simulation (in/out/off) – opt. ALG required</p> <p>(D) Encoded/decoded into any PCM timeslot of 2.048 Mbps or 1.544 Mbps interface Tx/Rx port.</p> <p>TIMS and PCM analysis tests include:</p> <p>Gain, Loss, Level, Variation of gain with frequency, Variation of gain with level, Idle channel noise, Crosstalk, Harmonic distortion, THD, Intermodulation distortion, SINAD, SNR, Noise, Spurious (in-band and out-of-band), Group delay, ERL, THL, SFTHL, LCTL, TCTL, TBRL, SF cutoff, SF guard band.</p> <p><b>Frame analysis</b></p> <p>Simulation and analysis of any error, alarm and normal operation events of 2.048 Mbps CCS &amp; CRC structure.</p> <p><i>Simulation:</i></p> <p>TBR 4 defined or user-set stimuli with up to single bit resolution, inserted into any transmit framing and data timeslots.</p> <p><i>Analysis:</i></p> <p>Automatic verdict setting according to programmable expected events criteria with time limits.</p> <p>Event recording with time, frame and multi-frame stamp, and single frame resolution.</p> <p><b>CAS Signaling analysis</b></p> <p>Call simulation and analysis of various CAS protocols:</p> <p>ABCD bits signaling simulation and analysis</p> <p>Encoded DTMF, MF, MFC signals and numbers with variable levels, frequency, duration and timing</p> <p>Encoded progress tones (dial, progress, busy, ringing tones, etc) and Rings with variable level, frequency, cadence and timing Off-hook, on-hook, wink, and other states with variable characteristics</p>
Layer 2 and 3 protocol analysis for 2.048 Mbps ISDN PRI	Layer 2 and Layer 3 TTCN conformance testing according to TBR 4 standard for 2.048 Mbps ISDN PRI with user-set PICS/PIXIT parameters and recording of Tx and Rx layer 2, 3 messages in text and binary format	
Voice over IP	<p>Acoustics and telephony tests of handset and hands-free VoIP terminals (see Acoustics and Telephony)</p> <p>Voice Quality Testing (See Voice Quality Testing)</p> <p>VoIP spectrum analysis and signal generation</p> <p>VoIP Signaling analysis</p> <p>Call simulation and analysis of SIP and H.323</p> <p>Programmable Call, Answer, Disconnect</p> <p>Playback and recording of .wav files</p>	<p>Programmable received event masks and if / then / go to conditions for flow control of the simulation execution and verdict setting</p> <p>Programmable user messages, user verdicts and remote commands (for EUT automatic operation)</p> <p>Pre-defined and user defined database of signals and encodings</p> <p>Through transmission tests <sup>4</sup></p>
SIP protocol conformance testing	Conformance testing of SIP - Session Initiation Protocol (defined in RFC 3261) over 10 / 100 Base-T Ethernet interface per ETSI TS 102 027.	
Voice Quality Testing	<p>PESQ (Perceptual Evaluation of Speech Quality) through transmission testing of a combination of the following TCA transmit – receive ports:</p> <p>Analog (FXS or FXO), acoustic (mouth or ear simulator), 2.048 Mbps (A-law encoded in a payload timeslot), 1.544 Mbps (u-law encoded in a timeslot), VoIP with on-line analysis and recording to .wav file(s)</p> <p>Off-line analysis of degraded vs reference .wav files</p>	<p>Including the following measurements:</p> <p>PESQ MOS per ITU-T P.862 and MOS LQO per ITU-T P.862.1</p> <p>Delay and delay jitter</p> <p>Reference and degraded signal level and loudness with aligned and non-aligned waveforms</p> <p>R factor (ITU-T G.107 e-model)</p> <p>VAD (Voice Activity Detection) performance analysis: Front End Clipping, Hold Over Time (Hang Over Time)</p> <p>Speech dropout</p>

## Test Interfaces (front panel)

### 1544 kbits/s interface (opt. T1)

Tx and Rx connectors.....	3-pin Siemens jack (4 mm banana compatible), 100 $\Omega$ , balanced
Line Coding.....	B8ZS, AMI
Framing Format.....	ESF (193E), D4 (193S), Unframed

### Clock Input / Output (opt. E1 or T1)

Input / Output 1.544 MHz or 2.048 MHz TTL signal, depending on test configuration	
Connectors.....	BNC female, unbalanced

### 2048 kbits/s interface (opt. E1)

Tx and Rx connectors.....	3-pin Siemens jack (4 mm banana compatible), 120 $\Omega$ , balanced BNC female, 75 $\Omega$ , unbalanced
Line Coding.....	HDB3, AMI
Framing Format.....	CCS & CRC4, CAS & CRC4, CCS, CAS, Unframed
Protocol Testing.....	ISDN PRI Layer 2 and Layer 3 testing according to ETSI TBR 4 (opt. L23)

### Analog PSTN interface (opt. ALG)

Two Analog 2-wire test ports with loop simulation and programmable ring and progress tone generator (CH A, CH B), External termination (Zref) input, External series (feed) resistance input, Speaker for audio monitoring with volume control (CH A only), Off-hook LED indicator	
Connectors .....	3-pin Siemens jack (4 mm banana compatible)

#### Loop simulation (FXS & FXO)

##### DC power supply

##### Loop feed channel

Output Voltage.....	0 - 110 Vdc
Current Limit.....	0 - 200 mA
Voltage resolution.....	30 mV
Voltage accuracy.....	200 mV
Polarity switching time.....	< 0.2 ms

##### DC resistance test channel

Output voltage.....	0 - 500 Vdc
Maximum current.....	10 mA
Voltage resolution .....	0.2 V
Voltage accuracy .....	0.4 V

##### Series resistance

Range .....	0 - 300 k $\Omega$ or external
Resolution .....	5 $\Omega$ or 10 $\Omega$ depending on test configuration
Terminations (Zref).....	Variable according to the supported standards, external or software simulated R1 + (R2    C2) for measured impedance calculation
Artificial line network.....	Variable according to the supported standards

#### Ring generator

Programmable frequency, level, on/off duration, cadence

Output voltage .....	0 - 150 Vrms
Output power .....	22.5 W maximum
Frequency.....	10 - 100 Hz
Voltage resolution.....	0.2 V
Voltage accuracy.....	0.5 V

#### Progress tone generator

Programmable frequency, level, on/off duration, cadence

### Acoustic interface (opt. ACU-INT)

#### Audio frequency generator output

Connector.....	BNC female
Connects to external mouth simulator	

#### Measurement input

Connector.....	LEMO type female (7-pin)
Frequency range.....	10 Hz – 24 kHz
Connects to external ear simulator	

#### Second measurement input (opt. ACU-INT2)

Connector.....	LEMO type female (7-pin)
Connects to external ear simulator	

### xDSL interface (opt. DSL)

Testing xDSL electrical characteristics and transmit power provided through Analog PSTN and 1544 kbit/s interfaces.

## Rear panel interfaces

### VoIP Ethernet test interface (opt. VoIP)

(One of the Ethernet LAN ports. See below)

Signaling protocols.....	SIP, H.323
Codecs.....	G.711, G.722, G.726, G.723, G.729A, GSM FR, iLBC <sup>4</sup>

### PC interfaces

<b>SVGA output</b>	- Connects to external monitor supplied with the system
Connector type.....	HD15 female
<b>USB</b>	- USB 2.0 compatible
Connector type.....	Two standard USB ports
<b>Serial</b>	- RS-232
Connector type.....	DB9 male
<b>Parallel</b>	
Connector type.....	DB25 female
<b>Ethernet LAN</b>	
10/100 Mbit/s NIC .....	Two ports
Connector type.....	RJ-45 female
<b>Audio output, Line input, Microphone input</b>	
Audio interfaces. AC '97 Audio Codec compatible	
Connector types.....	3.5 mm stereo jacks
<b>Keyboard</b>	- Connects to external keyboard
Connector type.....	PS/2 female
<b>Mouse</b>	- Connects to external mouse
Connector type.....	PS/2 female

### Built-in PC

Intel Core 2 Duo CPU  
1 GB RAM  
Internal 160 GB hard disk  
Internal flash memory card reader

### Display

External 17" LCD color monitor, supplied with the system

### External keyboard and mouse

Supplied with the system

## General

### Power requirements

100 – 240 V AC rms, 47 Hz – 53 Hz, 3 A (@ 240 V) to 6 A (@ 100 V) maximum  
with all options installed and including the external monitor

### Environmental Conditions

#### Temperature

Operating.....	5° C to 45° C
Storage.....	-10° C to 60° C

#### Relative Humidity

Operating.....	30% to 80%
Storage.....	10% to 85%

#### Altitude

Operating.....	up to 10,000 feet (3,048 meters)
Storage.....	up to 31,500 feet (9,600 meters)

### Regulatory Compliance

EMC.....	EN 61326 FCC Part 15, Class A
Safety.....	IEC/EN/UL/ 61010-1 / CSA C22.2 No. 61010-1

### Dimensions

455 mm (W) x 325 mm (H) x 690 mm (D) 17.9" (W) x 12.8" (H) x 27.2" (D)  
without 19" brackets, external monitor, keyboard, mouse, external acoustic option accessories.

### Weight

50 kg (110 lb) with all internal options installed without 19" brackets, external monitor, keyboard, mouse, and external options.



## Ordering information

TCA 8200	Telecom Conformance Analyzer
	Includes instrument mainframe with internal HD, universal card reader, operating software, MS Windows XP Professional OS, MS Office Basic factory installed, external 17" LCD color monitor, keyboard, mouse, and on-line User Manual.
At least one of the following options must be ordered.	
Opt. ALG	Analog PSTN interface testing.
Opt. CID SMS	CID and SMS simulation and testing over Analog PSTN interface.
Opt. T1	1544 kbit/s interface Layer 1 testing.
Opt. E1	2048 kbit/s interface Layer 1 testing.
Opt. L23	ETSI TBR 4 Layer 2 and Layer 3 ISDN PRI testing.
Opt. MUX2X16-1BL	Dual 16 to 1 multiplexer for switching of up to 16 T1/E1 two-pair balanced lines or up to 32 analog single pair lines. Remotely controlled by the TCA 8200 over RS-232.
Opt. MUX2X8-1UL	Dual 8 to 1 multiplexer for switching of up to 8 E1 Tx and Rx 75 ohm unbalanced lines. Remotely controlled by the TCA 8200 over RS-232.
Opt. VoIP	VoIP interface for through transmission, VQT and acoustic testing of VoIP devices.
Opt. SIP	SIP protocol testing over 10 / 100 Base-T Ethernet interface per ETSI TS 102 027 / RFC 3261.
Opt. VQT	PESQ voice quality testing. ITU-T P.862 (MOS).
Opt. DSL	Testing of xDSL electrical characteristics and transmit power.
Opt. ACU	Acoustic and telephony testing. Includes external test head for handset fixation with ear simulator and mouth simulator.
Opt. HATS	Acoustic and telephony testing. Includes Head and Torso Simulator (HATS) with built-in mouth simulator, ear simulator (right ear) and handset positioner. For handset, headset and hands-free devices testing.
Opt. HATS2	Same as Opt. HATS plus left ear simulator.
Opt. ACU-INT	Internal interface with one audio output and one measurement input. Connects to external mouth and ear simulators (not included with this option).
Opt. ACU-INT2	Adds second internal measurement input. Connects to external ear simulator (not included with this option).
Opt. Hands-free	Acoustic and telephony testing. Includes external positioner with mouth simulator and microphone for testing of hands-free phones according to IEEE Std 1329-1999.
Opt. HAC	Hearing aid compatibility test option for FCC P.68 HAC tests. Includes two magnetic field antennas and interconnecting cable. Requires opt. ACU-INT
Opt. DECT	DECT interface for acoustic and telephony testing of wireless DECT handsets. Includes external DECT base station that connects to the Analog PSTN interface.
Opt. WiFi	Wi-Fi interface for acoustic and telephony testing of wireless Wi-Fi handsets. Includes external Wi-Fi base station that connects to the Ethernet port.
Opt. Bluetooth	Bluetooth interface for acoustic testing of Bluetooth headsets and hands-free sets. Includes external USB Bluetooth adapter.
Cellular options	Acoustic and telephony testing of (GSM, CDMA, WCDMA, CDMA2000) cellular telephones. Includes external cellular base station simulator. Consult Hermon Laboratories on the cellular interface specification.

Options ACU, ACU-INT, ACU-INT2, HATS, HATS2 require option ALG.

Option DSL requires option ALG.

Option L23 requires option E1.

Option CID SMS requires option ALG.

Option VQT requires at least one of the ALG, T1 or E1 options.

All the options except for options L23, VQT, SIP, VOIP, CID SMS, WiFi, Bluetooth must be factory installed.

All the options can be installed together.

### Recommended accessories

External USB DVD RW	For backup/restore and emergency software and factory data recovery.
External USB to GPIB controller	For control of external GPIB test equipment.

Cellular Analog FXS & FXO VoIP xDSL  
Acoustic ISDN PRI T1/E1



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P/N: 820000903-A2