

**ACQUA EC Compact
 (Code 6841)**

Advanced Communication Quality Analysis

Extendable Compact Version for
 Echo Canceller Tests



OVERVIEW

ACQUA EC Compact is a special dual-channel analysis system for echo cancellers. It allows measurements according to ITU-T G.168 and advanced tests created by HEAD acoustics. ACQUA EC Compact includes the quality standard HQS-EC which provides predefined measurement descriptors to gather and evaluate measurement data in a simple and quick manner.

The measurement frontends MFE IV.3 and MFE VI which are included in the delivery allow analog and digital (E1/T1) access to echo cancellers via fully synchronized in- and outputs.

A variety of options allows the individual tailoring of the software and its performance to specific requirements made necessary by the development of modern echo cancellers in the field of communications.

For manufacturers ACQUA EC Compact offers objective guidelines to optimize their echo cancellers. For administrations it provides selection criteria to ensure a high quality level.

DESCRIPTION

Speech quality assessment of echo cancellers is quite a challenge due to the various kinds of signal processing involved (e.g. adaptive filters and non-linear processors in telephone networks in combination with various speech coders, noise reduction algorithms, voice activity detection and other signal processing in VoIP scenarios). Echo cancellers typically also introduce undesired artifacts like temporal clipping, limited double talk performance or modulation of background noise.

All these aspects have a significant influence on conversational speech quality. In order to allow the assessment of the corresponding parameters, ACQUA EC Compact has been developed by HEAD acoustics.

In combination with the quality standard HQS-EC and the measurement frontends MFE IV.3 and MFE VI, ACQUA EC Compact provides advanced tests for the analysis of

- Delay in sending and receiving direction
- Listening speech quality under single talk conditions in sending and receiving direction
- Echo performance
- Double talk performance
- Quality of background noise transmission

The measurements are based on current ITU-T Recommendations and ETSI standards such as:

- ITU-T Rec. P.501, Test Signals for Use in Telephony

- ITU-T Rec. P.502, Objective analysis methods for speech communication systems, using complex test signals
- ITU-T Rec. G.168, Digital Echo Canceller
- ETSI TS 101 329-5: Telecommunications and Internet Protocol Harmonization over Networks (TIPHON); End-to-end Quality of Service in TIPHON systems; Part 5: Quality of Service (QoS) measurement methodologies
- ITU-T Rec. P.340, Transmission Characteristics and Speech Quality Parameters of Hands-free Telephones
- ITU-T Rec. P.50, Artificial Voices

Other tests determine speech quality parameters to analyze the performance of the equipment under test even though no ITU-T or ETSI Recommendations or requirements are available yet. These tests can be used to optimize echo cancellers.

Additional recordings using real speech under single talk conditions, echo conditions and with simulated double talk are implemented in HQS-EC. Besides the measured parameters these recordings provide listening examples which can be used for audio demonstrations.

Special Features:

- Analysis in the time domain, determination of level, time constants, delay, etc.
- Analysis in the frequency domain, determination of spectral echo attenuation, echo loss, transfer functions
- Analog and digital (E1/T1) access to echo cancellers

- Calibration of the in- and output channels
- Individual settings definable
- Automated measurement sequences
- Modifiable measurement descriptors
- Editing and automatic verification of tolerance schemes
- Acoustic real-time playback for analysis support
- Integrity and reproducibility of data due to archiving of measurement sequences and results in a database
- Automatic or manual generation of measurement reports
- Import/Export of ASCII, Excel, WAV files

APPLICATIONS

- Quality control of echo cancellers
- Conformance testing of echo cancellers
- Experimental development and optimization of echo cancellers

MEASUREMENT SIGNALS

In the measurement descriptors the following signals are used:

- Test signals according to ITU-T P.501, e.g. Composite Source Signal (CSS)
- AM/FM modulated test signal according to ITU-T P.501 to evaluate double talk performance
- Pseudo Noise
- Artificial Voice (ITU-T P.50)
- User definable test signals

MEASUREMENTS

Preparation Measurements - References

Preparation Measurements - Delay

- Delay cross correlation / echo delay
- ERL check

Measurements in Sending Direction

- Idle channel noise, activation in sending / receiving direction
- Frequency response - transformation / 1/12 octave / 1/3 octave
- Junction loudness rating (JLR)
- AGC test
- Switched level, characteristic curve
- Switched level, 5 dB / 10 dB / 15 dB
- Activation sensitivity - switch on
- Attenuation range (switch on / switch over / double talk)
- MOS-LQO - objective MOS (P.800.1), German (optional)

Measurements in Receiving Direction

(same measurements as in sending direction)

Echo Measurements

- Echo loss (G.122), single talk
- Convergence (G.168), NLP enabled / NLP disabled
- Convergence (echo analysis, spectrography)
- Echo attenuation vs. time, $-5 \text{ dB}_{\text{mo}}$ / $-25 \text{ dB}_{\text{mo}}$
- Spectral echo attenuation

Measurements determining Double Talk Performance

- Convergence and residual echo level, $-5 \text{ dB}_{\text{mo}}$ / $-15 \text{ dB}_{\text{mo}}$
- Double talk CSS, $-15/-35/-15 \text{ dB}_{\text{mo}}$
- Double talk CSS, $-15/-35/-15 \text{ dB}_{\text{mo}}$, analysis DT / analysis echo
- Double talk CSS, $-5/-25/-5 \text{ dB}_{\text{mo}}$
- Double talk CSS, $-5/-25/-5 \text{ dB}_{\text{mo}}$, analysis DT / analysis echo
- Convergence, AM/FM signal, $-5 \text{ dB}_{\text{mo}}$
- Echo attenuation during double talk

Quality of Background Noise

Transmission Tests

- Minimum activation level (Hoth noise)
- Quality of background noise transmission (car / pub / café)
- Direct sound sensitivity S (speech)
- Background noise sensitivity N (car / café)
- Comparison of sensitivities S and N (car / café)
- Background noise with far end CSS (car / pub / café)

Speech Recordings

- Speech - single talk (send / receive)
- Speech - double talk (send / receive)
- Speech - echo with near end BGN (car / pub / café)

Technical Data ACQUA EC Compact											
Hardware:	ACQUA PC <-> MFE VI via USB port										
Input:	THD + N $\geq 80 \text{ dB}$ (1 kHz), channel separation > 60 dB										
MIC In	2 x at front, normal sensitivity 114 dB, -10 dB, +10 dB and +20 dB, no separate channel switching, electric calibration possible										
Telecom In	2 x at front, symmetrical, 600 Ohm, sensitivity 1 V at 114 dB										
Line In	2 x at front, BNC, asymmetrical, sensitivity 1 V, input impedance 50 kOhm										
Pulse In	2 x at rear, BNC, galvanically separated via optical coupler, limit frequency ca. 5 kHz, TTL level sensitivity, input impedance 36 kOhm										
AES EBU In	1 x at rear, XLR socket										
USB In/Out	1 x at rear, universal serial bus port										
DC In/Out	1 x at rear, XLR 4-pin for 12 V power supply incl. 5 V output on pin 4										
Output:	THD + N $\geq 78 \text{ dB}$ (1 k Hz)										
Pulse Out:	2 x at rear, BNC, not galvanically separated, TTL level										
Line Out:	2 x at front, BNC, level 1 V for all sensitivities										
Telecom Out:	2 x at front, symmetrical, 600 Ohm, sensitivity 1 V for all sensitivities										
AES EBU Out:	1 x at rear, XLR socket										
USB In/Out:	1 x at rear, universal serial bus port										
DC In/Out:	1 x at rear, XLR 4-pin for 12 V power supply incl. 5 V output on pin 4										
MFE IV.3 <-> MFE VI via AES/EBU											
E1/T1 interface	According to ITU-T G.703 (1544 kbit/s, 2048 kbit/s); internal/external synchronization; 3pin Telecom balanced and coaxial unbalanced in- and outputs (for more information cf. data sheet PMA I, Code 6351)										
Software:	ACQUA Compact incl. HQS-EC and G.168 standards										
FFT-based analyses:	<table border="0"> <tr> <td>Dynamic range:</td> <td>Time domain: > 96 dB; Freq. domain: > 126 dB</td> </tr> <tr> <td>FFT-Length:</td> <td>32 - 32768 points</td> </tr> <tr> <td>Weighting windows:</td> <td>Hamming, Hanning, Bartlett, Blackman, Rectangle, 5 x Kaiser-Bessel</td> </tr> <tr> <td>Display:</td> <td>averaged, smoothed, 3-D (optional), spectrogram (optional), octave, 1/3, 1/6-, 1/12-, 1/24-, 1/48 octave</td> </tr> <tr> <td>Overlapping:</td> <td>0-99 %, fully selectable or adaptive</td> </tr> </table>	Dynamic range:	Time domain: > 96 dB; Freq. domain: > 126 dB	FFT-Length:	32 - 32768 points	Weighting windows:	Hamming, Hanning, Bartlett, Blackman, Rectangle, 5 x Kaiser-Bessel	Display:	averaged, smoothed, 3-D (optional), spectrogram (optional), octave, 1/3, 1/6-, 1/12-, 1/24-, 1/48 octave	Overlapping:	0-99 %, fully selectable or adaptive
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Filter-based analyses	- time signal, A-, B-, C-weighted (optional) - octave, 1/3 octave filter analysis (optional)										
IIR filters in SMDs											
Kinds of filter:	High-pass, low-pass, band-pass, parametric filters, band-stop, all-pass										
Orders of filter:	1st to 4th										
Types of filter:	Butterworth, Bessel, 4 x Tschebycheff										
Limiting frequency:	$3 \text{ Hz} \leq f \leq 20 \text{ kHz}$										
Center frequency:	$3 \text{ Hz} \leq f \leq 20 \text{ kHz}$										
Q factor:	$0.1 \leq Q \leq 100$										
Dynamic range:	> 96 dB										
FIR filters in SMDs											
Kinds of filter:	Fully selectable, transfer function editable (graphically) according to magnitude and phase (optional)										
Number of points:	- 4096 (depending on selected FFT length)										
Generator (optional)											
Types of signal:	Sine; white noise, pink noise (all with any pulse/interval sequence required); triangle, square wave, sweep, stepped sweep, other user definable signals; Fourier generator 1 Hz-20 kHz										
Other:	Cf. data sheets ACQUA, MFE IV.3, MFE VI, HQS-EC, G.168										

STANDARD DELIVERY ITEMS

- **ACQUA Compact Software:** Advanced Communication Quality Analysis (compact version)
- **HQS-EC:** HEAD Quality Standard for echo canceller measurements
- **G.168:** Digital echo canceller tests according to ITU-T Rec. G.168
- **MFE IV.3:** Digital measurement frontend with E1/T1 interface
- **MFE VI:** Portable dual-channel measurement frontend with USB port

OPTIONS

- **ACOPT09:** Speech level voltmeter (ITU-T P.56)
- **ACOPT10:** TOSQA (Telecommunications Objective Speech Quality Assessment)
- **ACOPT16:** PESQ (Perceptual Evaluation of Speech Quality)
- **ACOPT17:** „Relative Approach“
- **ACOPT18:** Remote Control ACQUA via COM interface
- Various upgrade options available upon request

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