Acoustic Echo Compliance Test Software
per G.167 and P.340 Standards

Overview
Acoustic echo is a common phenomenon that is encountered in many types of phone calls. It occurs when speaker output is fed back to the microphone input. This will disturb the far end speaker as they hear their own voice but delayed. Acoustic echo cancellers (AEC) are used in phones or in the network to minimize this distortion. Acoustic echo, unlike line echo, is dynamic during a call as people and speakers move about.

GL’s Automated Acoustic Echo Cancellation (AEC) Test software has been developed and tested to perform acoustic echo cancellation testing in accordance with ITU-T Specifications, G.167 (03/1993) and P.340 (05/2000).

The Automated AEC Test Software uses GL Communications’ T1/E1 Analyzer products and the customers AEC hardware or software to perform Acoustic Echo Canceller testing. R_in and S_in files (stimulus and echo) are prepared by Automated AEC Test software in accordance with user inputs. R_out and S_out are captured and processed.

For details, refer to [http://www.gl.com/acousticechosimulation.html](http://www.gl.com/acousticechosimulation.html).

Main Features
- Simulates an actual acoustic echo path with acoustic filter types (Small, Medium, Large Office), Echo path delays and losses.
- Features such as filter, attenuate, and delay are available as along with a slow filter coefficient variation as a function of time to simulate a real acoustic environment.
- Real-time as well as off-line analysis with tabular Pass/Fail results.
- Simulates acoustic echo for Analog (Mobile Phone), digital (Gateway), and packet (VoIP to TDM with Gateway/IP phone) networks.
- Auto or Manual control of the Automated Acoustic Echo Canceller Test Software during testing.
- Auto analysis of the response according to G.167 (03/1993) & P.340 (05/2000) requirements.
- Detailed graphical and tabular results for individual and overall test.
- Generation of report with the plots (Report Analysis).
- Options to recalculate test parameter across different region in the waveform (Plot Results).
- Option to zoom-in on any test results to investigate further.
- Supported on Windows® OS (WIN XP) with user-friendly Graphical User Interface.
- Compatible with GL’s Universal HD T1/E1 Cards, USB portable T1/E1 units, and tProbe™ T1/E1 units

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Automated AEC Testing Scenarios
To test AECs, stimulus signals are generated and the response is captured at Stimulus/Response End. At the other end, acoustic echo is simulated; this is called the Acoustic Echo Simulation End. The following are the AEC testing concepts implemented within this software:

- Stimulus / Simulation all Digital (TDM Applications)
- Stimulus / Simulation all Analog (Mobile Phone Applications)
- Stimulus RTP (Ethernet) / Simulation Analog or Digital (VoIP IP Phone Applications)

Stimulus / Simulation all Digital (TDM Applications):
In this scenario, the AEC is assumed to be located in the network. Acoustic echoes are simulated within the GL’s T1 E1 platforms digitally. The generation of the stimulus signal and the capture of the response signal are also performed by GL’s T1 E1 platforms.

Stimulus / Simulation all Analog (Mobile Phone Applications):
In this scenario, the AEC is assumed to be in a mobile phone and accessed through an analog interface. Again, GL’s T1 E1 platforms with analog interfaces are used to convert analog signals to digital and subsequent processing is performed digitally. Level adjustment accessories are used between mobile phone and the Dual T1 E1 card to accommodate various signal levels and impedances.

Stimulus RTP (Ethernet) / Simulation Analog or Digital (VoIP IP Phone Applications):
In this scenario, the stimulus and response signals are generated by GL’s RTP Toolbox™ through an Ethernet interface and simulation is performed digitally by GL’s T1 E1 platforms, whether accessed through analog or digital interfaces.

Simulation Digital – Stimulus RTP for 8 bits (TS1 & TS2) and for 16 bits (TS1, TS2, TS3, & TS4)

Simulation Analog – Stimulus Analog (TDM to TDM - Mobile Applications) for 8 bits (TS1 & TS2) and for 16 bits (TS1, TS2, TS3, & TS4).

Test Parameters per G.167
- Auto AEC test software allows you to set the parameters for each test per ITU-T G.167. These parameters include: CSS level, attenuation (ERL), Acoustic filter types (Static and dynamic kinds of Small Office, Medium Office, Large Office and room impulse response (RIR) generator based on room parameters), Echo path delay and losses.
- The parameters can be saved into a file. A preset configuration file can be read in for establishing the test cases to be run. The settings for the test cases are as below.
- Test Signal Settings - provides options to set dBm level, file and length of the signal in seconds.
- Acoustic Echo path parameters - includes attenuation (ERL) during the acoustic path, delay and the filtering types which can be both static and dynamic. For the case of the dynamic filter operation, an option for low, medium and high dynamism is given.
- Option to select suitable test cases
- Overall EC Test Setup displays the total number of test cases based on different values provided at CSS Level, time, ERL, delay.
Working with T1 E1 Products
AEC Test software is available with GL’s T1 E1 product platforms, including USB T1 E1 Analyzer, Universal T1 E1 Cards, and #Probe™ T1 E1 units. GL's USB based T1 E1 Analyzer is featured with the Windows Client/Server DSP Operation module, which allows real-time testing using DSP commands to perform functions such as Amplification/Attenuation, Delay, Filter, File Tx/Rx, Logical operations, Echo Cancel, and so on.

Theory of Operation
The Automated AEC Test Software uses GL Communications’ T1/E1 Analyzer products and the customers AEC hardware or software to perform Acoustic Echo Canceller testing. During transmission and reception, the Rin & Sin (with echo) stimulus files (by frequently polling) are provided by AEC Test software. The output files Sout generated and possibly Rout are given back to the AEC Test software for analysis. AEC Test Software performs a full analysis (with detailed displays) that results in a "Pass" or "Fail". Automated AEC testing concepts are implemented within the software for various End to End Applications (Mobile, TDM, and VoIP) scenarios.

Set RS 232 control commands (Auto Mode)
- Auto AEC test software can be run in two modes: Auto and Manual modes. Currently auto mode is envisioned to be alias to auto mode in GL’s Auto EC (Line Echo Canceller) compliance testing. Different control mechanism will be described as customers and users have implemented.
- In default Auto mode, proper COM port settings are necessary and the EC control commands needs to be typed in. These commands are saved to an internal file. During tests, the appropriate commands will be sent per G.167 and P.340 requirements.
- Currently the tests cases as per G.167 and P.340 supports only manual mode of operation.
AEC Test Software Results

Result Analysis
Report Analysis generates reports and plots $R_{in}$ and $S_{out}$ waveforms.
Auto AEC Test Software performs a full analysis (with detailed displays) that results in a "Pass" or "Fail".
The graphs below depict the result analysis per G.167. For the 'Pass' cases, both the convergence time and the residual should meet the requirements of G.167.
For the 'Fail' cases, either one (convergence or residual) or both (convergence and residual) does not meet the requirements of G.167.

Plot Results
Plot Result option enables to recalculate test parameter across different regions in the waveform. The plot result displays $R_{in}$, $S_{out}$ files and part of the $R_{in}$ and $S_{out}$ files used to calculate the test parameter.
Red background color indicates test fail and green indicates test pass. The part of the file used for calculation is also displayed in seconds. The user can recalculate the test parameter providing necessary valid information as shown below.
Users can change the recalculate options, the current start point of calculation of the test parameter and length used for it.

Buyer's Guide
PKB081 – Automated Acoustic Echo Cancellation (AEC) Compliance Test Software

Related Hardware:
PTE001 - tProbe™ T1/E1 Base Unit
HTE001 - Universal T1/E1 Card
UTE001 - Portable USB based Dual T1 or E1 Laptop Analyzer

Related Software:
XX067 - Auto Echo Canceller Testing with / without VQT
AEC001 – AutoECTest Viewer
XX068 - Semi-Automated and Scripted EC Testing Suite
XX065 – Manual G.168 EC Test Suite for T1 & E1 (with GLC View, XX020, XX062, XX063, XX066)
PKBT67 – Automated Echo Canceller Testing – T1 Version
PKBE67 – Automated Echo Canceller Testing – E1 Version
PKB105 – Manual G.168 EC Test Suite for ATAs & Gateways