SignalCalc-QC

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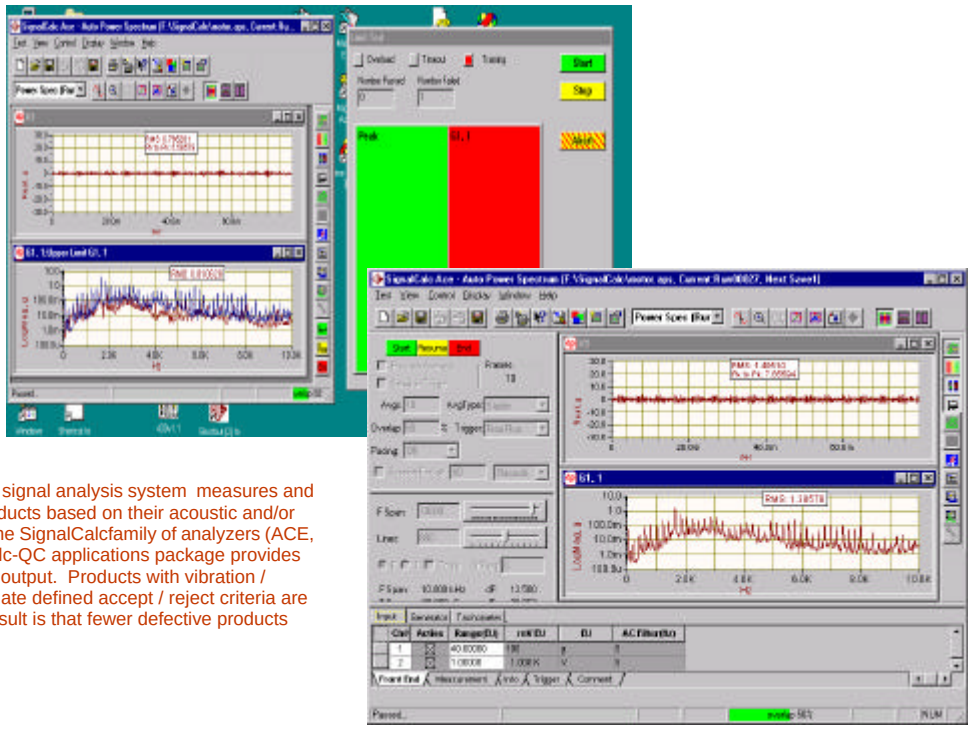
QUALITY CONTROL

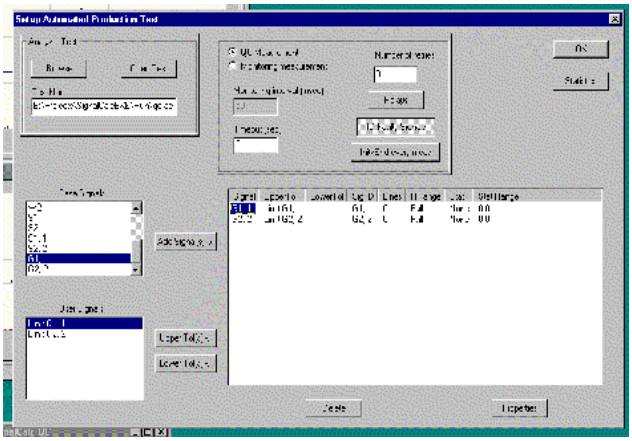


SignalCalc-QC is a dynamic signal analysis system measures and evaluates manufactured products based on their acoustic and/or vibration output. Based on the SignalCalcfamily of analyzers (ACE, 430, and 620), the SignalCalc-QC applications package provides on-line testing of production output. Products with vibration / acoustic signatures that violate defined accept / reject criteria are flagged for rejection. The result is that fewer defective products reach the market.

SignalCalc-QC Sound & Vibration Production Test System

Overview

Quality control has become a major focus for manufacturers in recent years. Manufacturers are striving to produce products that are consistent with design specifications. The drive for manufacturing consistency is motivated by the need to: reduce manufacturing scrap and thereby reduce manufacturing costs, increase the reliability of products in the field, reduce or eliminate the number of products with noise or vibration problems reaching the consumer, and achieve national / international quality certifications to maintain market competitiveness. Better quality control improves profits by increasing revenues and decreasing costs. Clearly, a good production test system, which enhances quality control, will result in improved profits.



Signal Measurements

Superior quality control results can be achieved by SignalCalc-QC due to its measurement flexibility. A robust architectural design enables the system to measure and apply evaluation criteria in the Power Spectrum, Transfer Function, Synchronous Average, Correlation, and Real-Time Full and 1/3 Octave measurements. Signals are measured and evaluated on a per frequency bin and per time sample basis, as appropriate, to capture subtle abnormalities in a product's vibration and/or acoustic signature. Depending on the specific measurement, you can select from the following signal analysis formats: Real, Imaginary, Phase, Magnitude, and dB Magnitude. SignalCalc-QC also provides overall signal level measurement and the ability to apply a series of user defined scalar criteria to measured levels.

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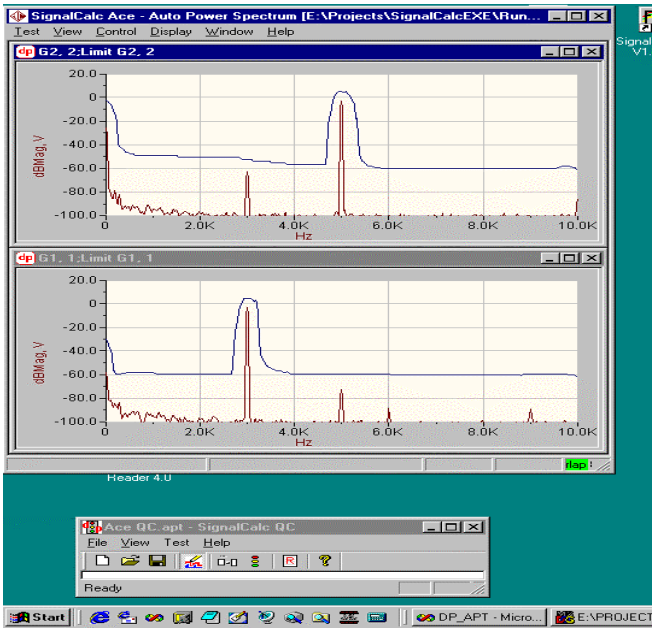
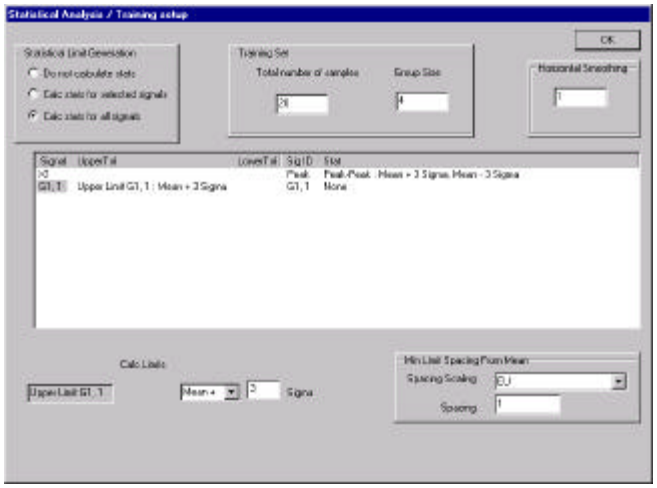
Evaluation Criteria

Without SignalCalc QC, developing the evaluation criteria for on-line production testing of products can be time consuming, expensive, and frustrating. With SignalCalc-QC the time, costs are aleviated by its several methods implementing evaluation criteria.

SignalCalc QC offers a highly effective and productive user interface. Users have the options of: importing an ASCII file which was developed in a spreadsheet, importing a signal file from any member of the Data Physics SignalCalc and Signal Star Controller family, or measuring a signal and applying fixed offsets. In addition, SignalCalc-QC offers two advanced criteria development features: an Interactive GUI and an Advanced Statistics package. Using the mouse controlled Interactive GUI, the user can simply hand draw the evaluation criterion to be used for on-line production testing.

Should the application require a statistical basis for criteria implementation, the Advanced Statistics package enables the user to establish test limits using either traditional Overall Variation dispersion statistics or Within-Subgroup Variation dispersion statistics. Within-Subgroup Variation eliminates the need to develop a base set of known "good" units to establish the test criteria. This reduces the time required to implement a testing strategy and results in faster payback of the investment. Statistical parameters are developed for each time sample, and FFT or (1/n)th octave frequency bin





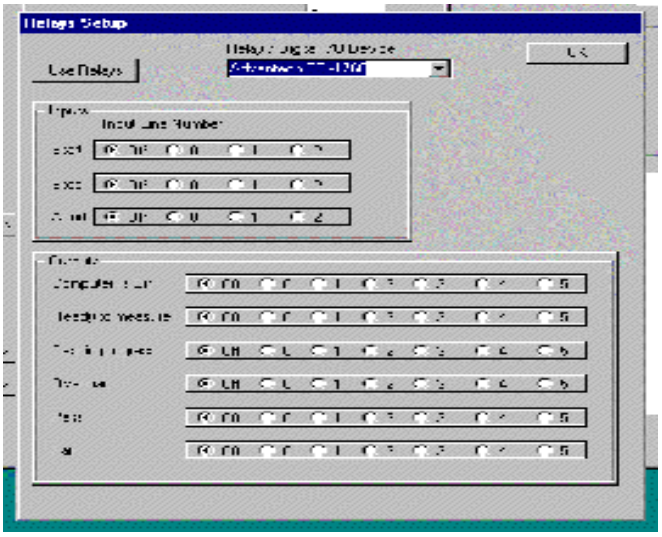
Evaluation Criteria

SignalCalc-QC is powered with an innovative evaluation criteria application strategy. Multiple evaluation criteria can be applied simultaneously, in both the time and frequency domains, to the same measured signal so that product defects can be quickly identified and classified. Consider, for example, a product that might have several different failure modes, each with a different vibration / acoustic signature. SignalCalc-QC can detect the defect and classify it according to type so that production could track specific production defect rates and rework non-conforming units.

Dependability

To ensure a successful system implementation, SignalCalc-QC is designed to adapt to its environment in that it supports multiple data export formats and offers automated report generation using Microsoft ™ Excel. Opto-isolated relays and specialized support software provide for integration into existing production line automation systems. Further, the SignalCalc-QC modular design facilitates application specific modification / enhancements to accommodate specialized mathematical, evaluation, control, and test administration algorithms.

Fail Safe Countermeasures



Because a quality control test system can wreak havoc on a production line if it rejects acceptable units, SignalCalc-QC incorporates several features that reduce the occurrence of false rejections. The user can specify the number of frequency bins and time samples that are permitted to fail before the product under test fails. The user can also specify a range over the horizontal axis (time or frequency) upon which the evaluation criteria are applied.

The Advanced Statistics Package provides for horizontal axis smoothing which reduces the effects of frequency and time domain smearing. In addition, the user can specify minimum statistical offsets to ensure that the statistically derived criteria are not established too tightly. These advanced "fail safe" features help to ensure that "acceptable" products are not falsely rejected thereby improving production throughput and reducing production scrap costs.

While the success of a quality control system depends on its ability to detect subtle product defects or inconsistencies, it can wreak havoc on a production line if it also rejects production units that are acceptable. SignalCalc-QC incorporates several features that reduce the occurrence of false rejections. The user can specify the number of frequency bins, time samples, and $(1/n)^{th}$ octaves that are permitted to fail before the product under test fails. The user can also specify a range over the horizontal axis (time or frequency) to which the evaluation criteria are applied. This feature is often used to eliminate the noise prone lower end of the frequency spectrum. The Advanced Statistics Criteria Creator provides for horizontal axis smoothing, which reduces the effects of frequency and time domain smearing.

Consider a case in which the evaluation criteria were developed for motors running at 1800 rpm. Should the motors on any given day be tested at 1780 rpm, the resulting spectrum would be shifted to the left resulting in unwarranted product rejections. The smoothing feature would provide for the minor speed variations enabling the good units to be accepted. The advanced statistics package also provides for those cases in which a test sample of products has only minor variation resulting in too tight evaluation criteria. Minimum statistical offsets can be set to ensure an acceptably wide criteria for on-line production testing. These advanced features ensure that "acceptable" products are not falsely rejected thereby improving production throughput and reducing scrap costs.

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The Data Physics Solution

Data Physics has designed SignalCalc-QC with the flexibility, innovation, intelligence, and adaptability to ensure a successful production line implementation. The resulting benefits include reduced production costs, reduced field service costs, increased revenues, improved standard compliance and increased profits.

Specifications

HARDWARE / SOFTWARE PLATFORMS:

- SignalCalc Ace Analyzer (2 Channel Inputs / 2 Channel Outputs)
- DP430 Analyzer (From 1 to16 Channel Inputs / 1 to 8 Channel Outputs)
- DP 620 VXI Analyzer (From 4 to 1024 Channel Inputs / 1 to 16 Channel Outputs)
- Windows 95, 98, 2000, NT 4.0

PASS / FAIL CRITERIA[2]:

- Multiple pass/fail criteria can be uniquely identified and classified.
- Multiple criteria can be applied simultaneously, both in the time and frequency domains.
- Time and frequency specific evaluation criteria can be developed and applied to the following signal types:
  - Autospectrum, Transfer Function, Synchronous Average Correlation Correlation, Real-Time Octave, dB min, dB max)
- The following units can be applied, as appropriate, to pass/fail criteria: Real, Imaginary, Phase, Magnitude, dB Magnitude.
- Overall signal level pass/fail criteria can be applied using the following units: RMS, Max, Min, Peak to Peak, Mean.
- The user can specify the range over the horizontal axis (time or frequency) over which the specific and overall evaluation criteria are to be applied.
- The user can specify the number of frequency bins, time samples, and $(1/n)^{th}$ octaves permitted to fail before the product under test fails.
- Evaluation criteria can be developed and implemented in SignalCalc-QC by the following methods:
  - Importing an ASCII file
  - Using a previously recorded Data Physics (.sig) file
  - Measuring a signal and applying user defined offsets
  - Creating a criteria using the interactive GUI[3]
  - Deriving criteria statistically using SPC techniques[3]

STATISTICAL CRITERIA[3]:

- Test Limits may be determined using either traditional Overall Variation dispersion statistics, or using Within-Subgroup Variation dispersion statistics.
- Test limits may automatically be recalculated "on the fly". The use of Within-Subgroup statistics allows you to train limits without having to set aside a training set of "good" units.
- User definable group and population sample size.
- User definable horizontal axis smoothing which reduces the effect of frequency and time domain smearing.
- Should a test sample of products have only minor variation resulting in very tight evaluation criteria, minimum tolerance levels can be established to force a wider acceptance value.

DATA PRESENTATION:

- Data export in multiple formats
- Automated report generation utilizing Microsoft™ Excel

AUTOMATION / CUSTOMIZATION

- Opto-Isolated relays and support software provide for easy integration of SignalCalc-QC into existing production automation systems.

Functional and modular design of applications software enables Data Physics to customize mathematical, evaluation, and control algorithms to meet customer specific requirements. [1]

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1 If a requested enhancement has general applicability to the overall QC market, no or minimal charges will be applied. Modifications, which are customer specific with limited market applicability, will be made on a time and materials basis.

2 Pass / Fail criteria are often called: evaluation criteria, masks, tolerance masks, test limits, and limit signals.

3 The criteria development methods, interactive GUI and SPC statistics are only available in the Advanced SignalCalc-QC package.