



### Overview

SCS9002W system is a flexible and customizable PC Based product for end-of-production quality control, based on dynamic (typically acoustics or vibrations) measurements.

High emitted noise - or high vibrations - very often means defective component; for this reason a careful measurements of vibrations or emitted noise can often identify defective components in a very effective and statistically accurate way.

The system, in a manual, semi-automated, or completely automated process, is able to perform one or more multi-channel measurements on the tested component, analyze data, extract specific components, compare the current result with a reference level or mask, and provide a test result in terms "Good" or "Fail" test item.

Database management, Process automation, Data Acquisition and Analysis tools, Data Export, Advanced Statistical functions are available utilities for integrating the Quality Control system into the Production and QA process.

The system has a modular and expandable hardware architecture, based on a multichannel (up to four in standard version) analog & digital frontend, a data acquisition PC board, and a standard or industrial PC.

Various type of transducers, like microphones or accelerometers can be directly conditioned; up to eight (in the standard version) opto-isolated digital I/O lines provide an easy and standard interface for industrial automation (i.e. in connection with a PLC).

An accurate RPM measurement (HW and software), allow very precise RPM-related analysis (i.e. for gearbox testing).

Other hardware options - like semaphore, bar code readers, slow channels input - are available.

The SCS9002W software allows flexible configuration of a standard quality control test procedure, including automation process, tolerance management and database access.

Advanced software options for statistical analysis, signal processing, listening, complete the software package.

The software has been carefully design in such a way to allow a very easy and as much as possible automated quality control process: a not skill operator – even in manual mode - can easily select predefined test setup, run a test, check the test status, print test reports, etc.

The Quality Assurance engineers, the R&D specialists, the production manager, with the same software, could access the system in an advanced mode, and be able to configure different test procedures, tune the tolerance thresholds, make objective/subjective comparison, make statistical analysis, analyze recordings, etc.

Five software modules are available:

- **Utilities:** system configuration, test configuration, license management, input and RPM monitor.
- **Test Exec:** standard test execution module, for measurement, tolerance check, data storage, etc. cycling in manual or automated mode, according with the system and test configuration.
- **Data Management:** tools for data review and analysis, statistical processing (option), component management (option), import/export tools, etc.
- **Time History Processing (option):** comprehensive acquisition and analysis package for multichannel time history recording, playback to audio device, data analysis in 2D and 3D modes.
- **Playlist:** tool for comparing different recordings by listening, for an effective defect identification and subjective/objective correlation.

**Test Exec** is the only running application on the production line in normal operations: the other software module are used, as explained later, for system configuration, data management time history processing, listening, etc., and only skilled people will normally run them.

### Hardware Specifications

The SCS9002W package can have a very large number of different configurations, depending on the specific test to be performed: in this paragraph only the most popular options are listed and described.

Please contact your local distributor or S.C.S. Controlli e Sistemi srl directly for technical details and for submitting specific request or needs.



- Example of installed quality control system (gearboxes) -

#### System Components

- Transducers and Cables
- Analog&Digital Frontend
- Data Acquisition Board
- Personal Computer (standard or industrial)
- Accessories

#### Transducers

Many different type of transducers and accessories can be selected, on the basis of the specific test to be performed.

The most commonly used transducer is the accelerometer, which is very reliable and accurate.

Microphones are widely used as well: the need of some kind of acoustic insulation, very often limits the practical use of these sensors in quality control applications.

Other sensor can be connected as well: pressure sensors, load cells, torque sensors, thermocouples, etc.

#### Acquisition Board

Standard:

National Instrument DAQ Card (bus PCI):

- 8 Analog Input Channels (multiplexed)
- Single ended or differential input type
- Input range (software selectable): +/- 50 mV up to +/- 5 V
- 200 KHz aggregate Sampling Rate
- 16 Bit A/D Converter
- Dynamic range: 85 dB typ.
- 8 Digital Line In/Out (TTL)
- 2 m shielded cable
- Optional: 2 analog output channels

Optional (on request):

- National Instruments Dynamic Signal Analyzer board (2 Input channels, 2 output channels)
- 01dB Symphonie (2 channels DSP based)
- Sound Cards.

#### Analog&Digital frontend

A modular and high accuracy analog&digital frontend allows transducer conditioning, amplification and filtering: 4 slot can accommodate up to 4 independent single channel conditioning modules (basic system: 1 module).

In the same frontend up to 8 convenient opto-insulated digital lines (IN or Out - jumper selectable) are available for process automation (basic system: 4 digital lines).

Available Modules:

- Charge/ICP/Voltage:
  - BNC Connector
  - Gain: 0/20/40 dB
  - High Pass Filter: 1-10-100 Hz
  - LP Filter: 100/1K/30 KHz
  - Anti-aliasing Filter (factory set): 5 KHz or 10 KHz
- Tachometer Input:
  - Conditioning modules available for photocell or inductive tachometer.
  - 0-20mA, 4-40 mA, +/-10 VdcdC receiver
  - 1-10-100 HZ HP filter
  - 100-1K-30 KHZ LP filter
- Other conditioning modules available on request (pressure, temperature, etc.)
- Up to 8 Digital Input/Output lines (Basic System: 4 lines)
  - Input/Output selectable (HW switch)
  - Input Level: 3-60 Vdc,
  - Static Output 60 V/0.5A,
  - Insulation > 100 Mohm,
  - Max Frequency: 5 KHz.

#### Hardware Options

- External Start Test Button (manual)
- External Semaphore (Result: Green=Good; Red= Fail)
- Bar Code Interface (Serial)
- Network communication to Host.

#### Computer

Standard configuration:

- Desktop Computer (various models)

Optional:

- Industrial Computer (various models)
- Notebook Computer.

Specification (minimum):

- Pentium II Processor, 400 MHz
- 62 MByte RAM
- Graphic board 600 X 800 resolution
- 10 GByte Hard Disk
- 1 PCI Slot available (Desktop and Industrial PC)
- 1 PCMCIA slot (notebook or Symphony based systems)
- Operating System:
  - Windows XP (Standard)
  - On request: Windows 98, NT or 2000

### Software Specifications

#### System Configuration

A dedicated utility allows setting up the system parameters, including all the hardware parameters, and the core SW parameters.

A secure access option (password protected), prevent unwanted modification of those parameters.

Main Parameters groups:

- System Parameters: HW Setting, digital lines, bar code configuration, level and type of automation, automatic S/N Increment, Sound Card Config.
- Channel Table: HW Ch#, name, sensitivity, Coupling, Voltage range, unit.
- Acquisition Parameters:
  - Available acquisition mode:
    - Autopower Spectrum (FFT)
    - Frequency Response Function (Option)
    - Order Spectrum (Option)
    - Order Levels (Option)
    - 1/3 Octave Spectrum (Option)
    - Cepstrum Analysis (Option).
  - Frequency Range:
    - FFT: 4 channels – max 20 KHz
    - 1/3 Octave: 51.2 KHz Fixed (max 3 ch's)
  - FFT Blocksize: 128 - 16384 in  $\wedge 2$  steps
  - Order resolution: 0.1 – 1.0 (order analysis only)
  - Weighting: linear or A-Weighting
  - Averaging: linear, peak hold, exponential.

- Overlapping: 0% -99%

- Tachometer: hardware setting for RPM input: HW Ch#, trigger level, hysteresis, slope, pulse/rev, smoothing, spike removal.
- Subjective Testing: a list of subjective judges can be created and activated here, in order to allow the operator to associate his own subjective judge (like "very good", "good", "fair", "bad", "very bad") to the objective measurements.

#### Test Setup

The quality control process is typically made by a sequence of measurements (the simplest test is performed with just one measurement); each measurement is made while the component under test is operating at one specific condition (i.e. rotating at a certain speed, under a certain load): each measurement result will be compare with his own specific tolerances, and will produce one result like Pass/Fail; the final test result will be the combination of each sequence result.

Many different tests can be created; usually one test identifies an unique component model.

Each test has his own tolerance set and database.

Main test parameters:

- Single or multiple test sequencing
- Test Identification codes (customizable on request)
- Measurement Mode: *Steady State* or *Ramp*
- Tolerance Type: *Spectrum*, *RMS*, *Components* (Option) or combination of them.
- Storing mode: *always*, *never*, *prompt*, *fail only*.
- Conditions List (typ. Operating Condition and Nominal RPM, associated to each cycle), mask# or component# (for all the active channels).
- Specific Order Level tolerance table.



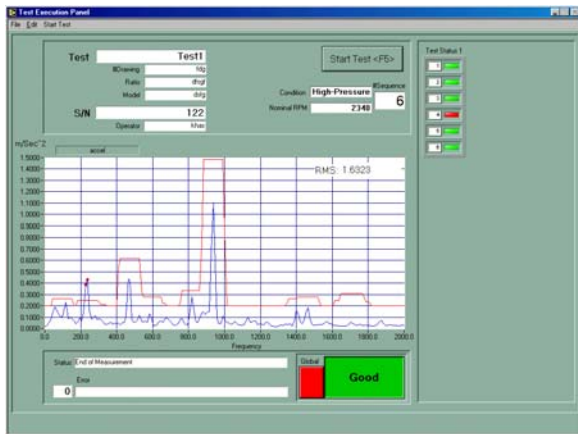
- Test Setup Panel -

#### Standard Test Procedure

Following is a typical test procedure: however, many other combinations can be created.

- 1) Select current test or multiple test sequence (manually by operator or predefined and loaded at start)
- 2) Specify database header information's (by operator or automatically):
  - a) S/N detection:
    - i) automatic increment
    - ii) manual typing
    - iii) bar code reader
  - b) Operator Code
  - c) Test Notes
  - d) Other database fields available.
- 3) Starting automatic test cycling (as specified in the Test Setup).
- 4) Start measurements:
  - a) Manual (Keyboard or Mouse)
  - b) External Button (Optional)
  - c) Input Digital Line (from PLC)
  - d) On Condition (RPM, Level Trigger, etc.).
- 5) Measurements (acquiring multichannel dynamic data)
- 6) RPM Measurements:
  - a) Use nominal RPM
  - b) Measure current RPM (checking it against the nominal – expected - RPM).

- 7) Tolerance check: each channel result is compare with the corresponding tolerance (Mask, RMS, or table of components): the single sequence result is a combination of the results of all the channels.
- 8) Test Result ("Pass" or "Fail")
  - a) To Screen (Green or Red indicator)
  - b) To Digital Line (2 lines) and/or semaphore.
- 9) Subjective Result: if activated, the operator is asked to associate to the current measurement, his subjective evaluation of the test item; the subjective result will be stored in the data Header, together with the test result (objective), for later statistical use.
- 10) Data storing according to configuration.
- 11) Return to step 4, until the measurement sequence is completed.



- Main Test Exec Panel -

Additional Functions during test execution:

- HW or SW error detection.
- Single Step and Global Test result (logical AND)
- Show Single Component Tolerance Check
- Result Table: this table, reassuming all the test cycles (Test conditions, nominal and measured RPM, meas. RMS, test results), can be displayed, printed (also automatically) and/or stored at the end of the test.

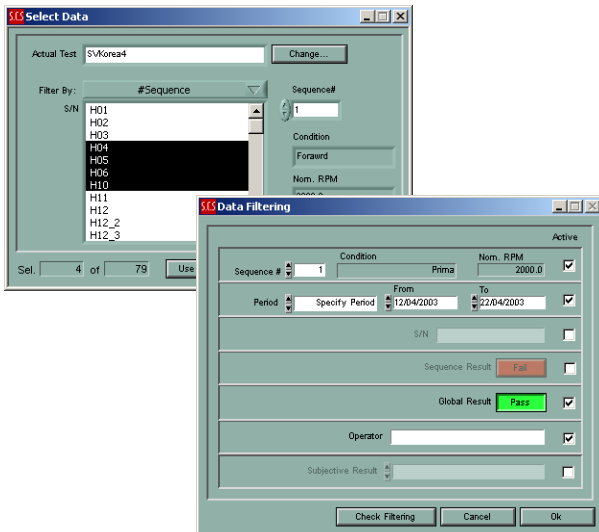
### Data Review and Analysis

Single or multiple stored data can be recalled from the database for data analysis, statistics evaluation, mask and tolerance creation and modification, reporting, etc.

A structured database allows convenient and efficient data storing and retrieving.

Main functions:

- Database access: a specific database access user interface, allow the user to easily select multiple data, based on test condition and filtering features.



- Data Selection and Filtering Panels -

- Data Review general features:
  - Multiple traces recall/overlay
  - Data Header info's display
  - Extracted components display
  - Mask overlay (if available).
- Data Header Editing utility.
- Many graphic options:
  - X and Y axis type and scaling
  - Trace appearance settings
  - Mask appearance settings
  - Cursor
  - Legend
  - Grid and background colors.
- Statistical Functions:
  - Average + n\*Sigma of the selected data.
  - Envelope + n\*Sigma of the selected data.
  - Save Result as Mask.
- Reference Mask management:
- Automatic Mask Creation, from spectrum or from existing masks (FFT Only).
  - Amplitude tolerance
  - Frequency or RPM tolerance
  - Minimum Threshold.
- Manual Editing (interpolate, rescale, etc.)
- Create mask from table (Frequency, Amplitude).
- Import mask table from text file.

### Transducer Calibration and verification

A complete calibration utilities is available for calibrating accelerometers or microphones.

Other calibration utilities are available in case of quasi-static transducer (i.e. Pressure transducer – Slope and Offset).

The calibration level is calculated based on a known signal (typically generated thanks to a vibration or acoustic calibrator); if correct, the new EU/Volts calibration level is automatically and permanently stored in the system configuration file.

### Analyzer (FFT)

This utility allows users to acquire, average, display spectral data, independently from the standard test cycle, like in a basic FFT analyzer; time and FFT data of different channels can be displayed simultaneously

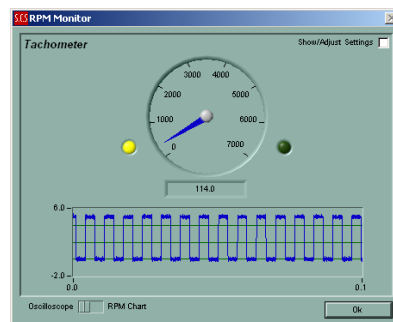
The purpose of this utility is mainly for troubleshooting.

### RPM Monitor

A simple RPM display can be activated in order to display the current RPM value, mainly for troubleshooting.

The user can tune the triggering parameters and check immediately the effects on the RPM detection.

Oscilloscope mode or Chart Mode are available, together with the standard RPM display.



- RPM Monitor Panel -

### Data Export

All data files can be exported in ASCII format.

Main functions:

- Multiple data selectin.
- Unique destination folder
- Multiple data export in a single table
- Choose export formats
- Export result table.

**Component Management (Option)**

The Component Management is a very powerful tool specifically designed for quality control of small objects (like electrical engines): we call "component" a value that represent a specific signal characteristic: many defects, even if clearly audible, produce a negligible contribution to the average spectral energy; they are not stationary, so the standard FFT analysis tends to cancel them: special algorithms have been developed in order to identify those not stationary noise or, in general, specific noise characteristics.

A table of components can be created and the quality control process will first extract the requested components, then it will compare them with predefined tolerance levels.

The Component Management Option provides various statistical tools for investigating the correlation between components values and subjective result.

Available components:

- Frequency Band
- Quefrequency Band (Cepstrum Analysis)
- Order Band
- Amplitude Variation
- Frequency Variation
- Ticks detection



- Component extraction report -

Other features:

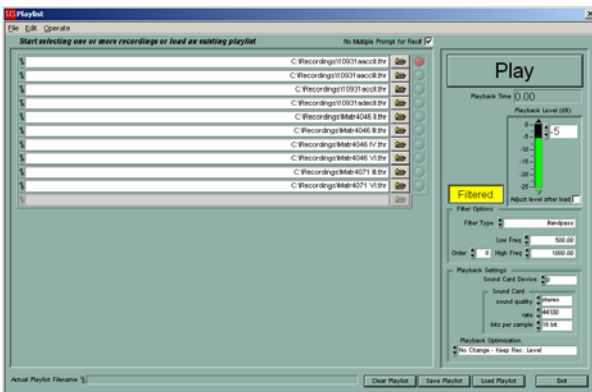
- Pass/Fail Histogram
- Subjective result editing
- Subjective/objective statistics
- Component trend
- Component Import/Export
- Playback to Sound Card with filtering

**Playlist (Option)**

This is a simple but effective utility which allows the user to listen to different recordings, and quickly switch between them: this is very useful for an accurate subjective identification of the defects.

The output level to the sound card is controlled by the application for all the loaded recordings, so the listening is not affected by auto-adjustments of the output dynamics.

Filtering on playback is available as well.



- Playlist Main Panel -

**Advanced Statistical and Reporting (Optional)**

This utility allows the user to conveniently extract data from the QA database, and make sophisticated trend, statistical and reporting analysis (special reporting on request).

Available analysis:

- Averaged Spectrum and Variance
- Trend plot of selected components (average and variance), on a specified time base (days, weeks, months)
- Production trend (good/fail percentage) on a specified time base (days, weeks, months)
- Histogramming on specific components (also available for subjective testing)
- Correlation analysis: looking for components correlating subjective evaluation and measured components.

Other functions:

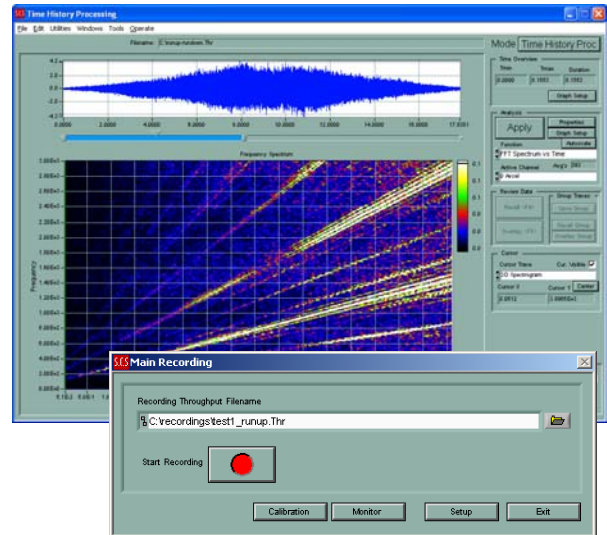
- Data selection and filtering
- Graph setting and options
- Customized reporting
- Data export (ASCII).

**Time History Recording and PostProcessing (Option)**

This is a comprehensive application for data recording and time history postprocessing: it can run independently as a standalone software, but at the same time it's completely integrated, in terms of data exchange (time histories and analysis data), with the SCS9002 Quality Control software.

It's an extremely useful and convenient tool for deeper investigations about the noise and vibration emission.

Please read the specific data sheet for detailed information's.



- Time History Postprocessing and Recording Panels -

**Special customizations**

Specific hardware and software solutions can be designed based on special needs of the customer.

SCS on request develops custom solutions, like:

- Network configurations and network database in case of multiple installations.
- Custom HW configurations (PLC communications, special communication protocols, communication to host computer, etc.)
- Custom import/export formats
- Custom reporting formats.
- Custom component's extraction algorithms.

Please contact S.C.S. Controlli e Sistemi S.r.l. for any information or for submitting specific QA request.

For informations:

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