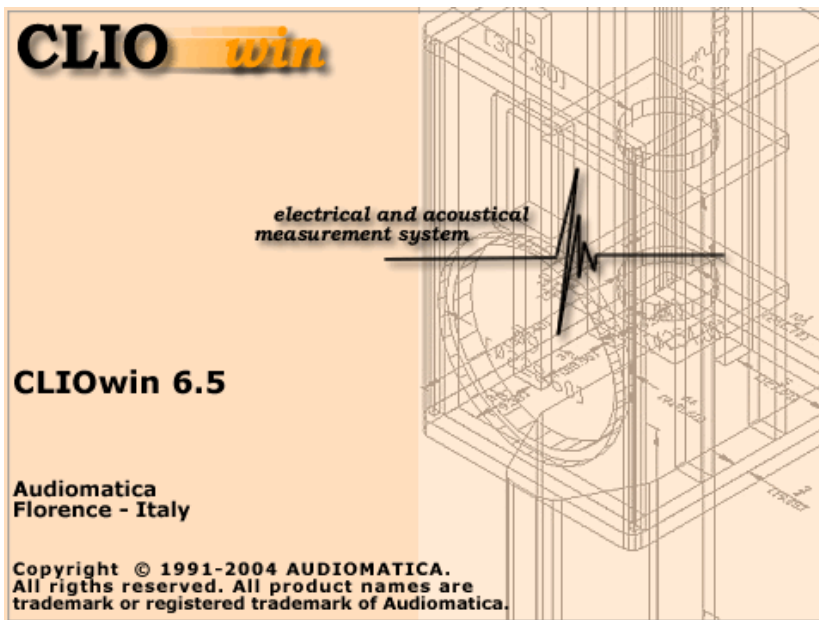


CLIO

ELECTRICAL & ACOUSTICAL TESTS



QC Software extension

User's Manual



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January 2004

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14 QUALITY CONTROL

14.1 INTRODUCTION

The Quality Control software extension for CLIOwin is a powerful suite for executing state of the art production line testing.

CLIOwin QC implements all the measurement techniques found in the CLIOwin standard software adding a versatile script processor that handles the test sequence most appropriate for your needs.

CLIOwin QC is able to test the production of loudspeakers, drivers, microphones, amplifiers and of any other electroacoustic device.

CLIOwin QC can interact with external hardware or production line controller, with PC peripherals, with network or with custom written software to realize a fully automatic line test.

14.2 FEATURES OF CLIOWIN QC

CLIOwin QC is exceptionally powerful as it relies on the power of CLIOwin.

Some of the measurements possible:

- Frequency response with MLS
- Impedance with MLS
- Polarity
- Frequency response with Sinusoidal Sweep
- Impedance with Sinusoidal Sweep
- Single harmonic response with Sinusoidal Sweep
- Narrowband FFT analysis with definable stimulus
- T&S parameters
- Sensitivity
- Frequency
- THD
- IMD
- Noise

The application of single measurements or the combination of more give the best answer to complex topics like rub&buzz testing.

Some of the QC management features are better explained starting from the various subjects taking part to this complex operation and from their points of view:

- The operator working on the line
- The quality control engineer responsible for production line operation
- The company and its managers controlling the overall process

14.2.1 THE OPERATOR'S POINT OF VIEW

A quality control test can be controlled by simple Go-NoGo masks letting even the least experienced operator work without problems and with a zero time learning curve.

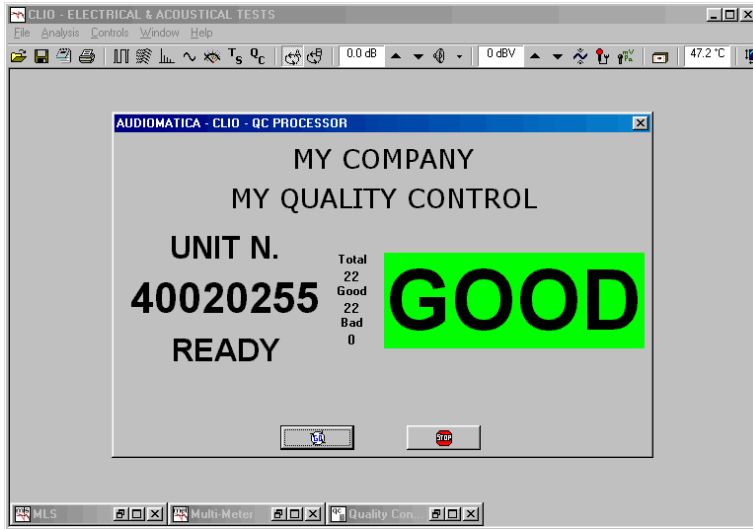


Figure 14.1

A more complex operation foresees the continuous display of the measurements executed until the reaching of the final result.

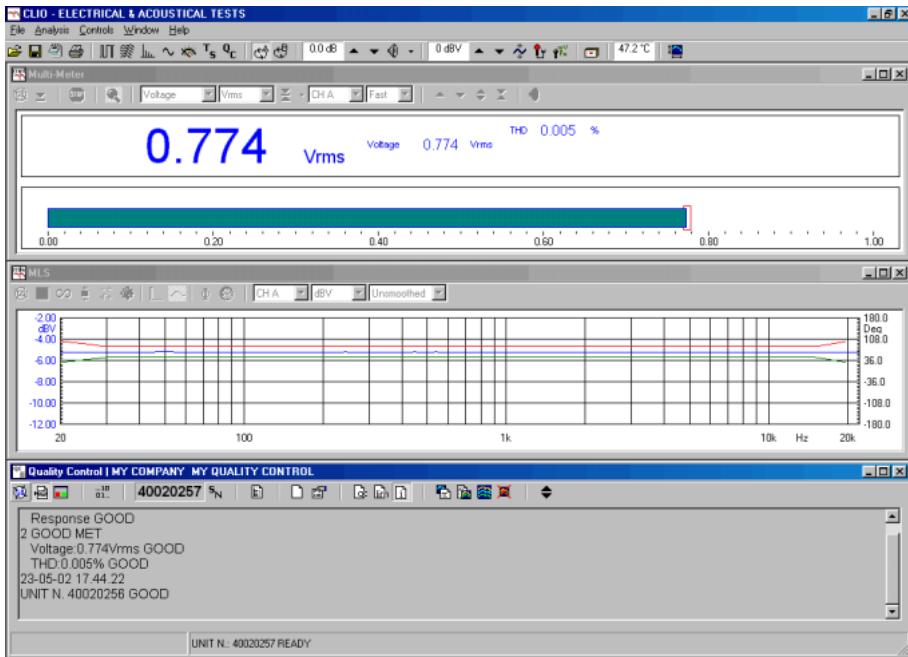


Figure 14.2

A third possibility is to view and interact with the test sequence during its execution.

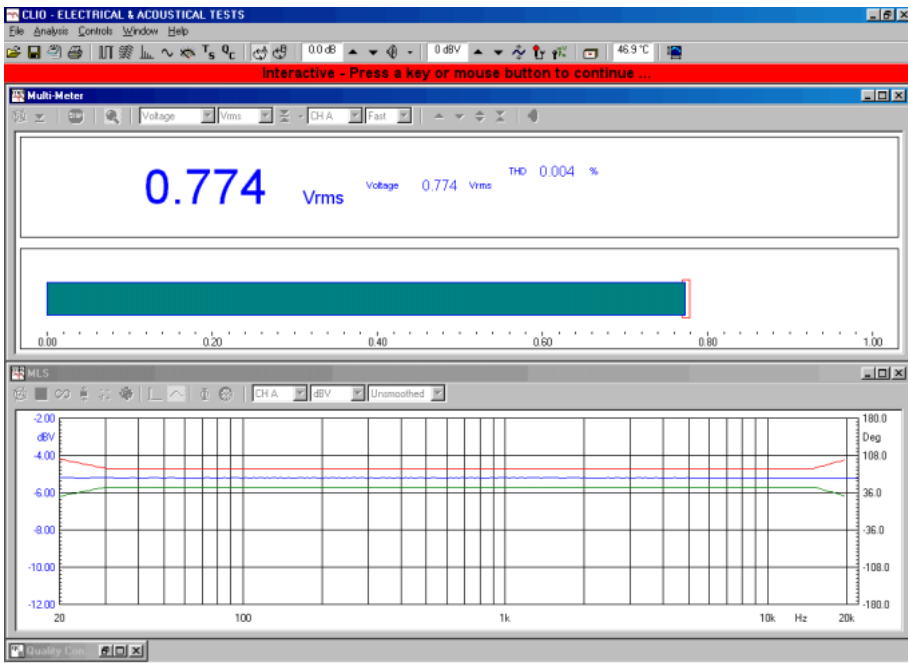


Figure 14.3

Complete test information and report are always presented to the user.

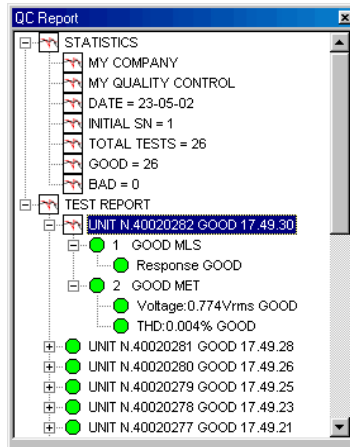


Figure 14.4

14.2.2 THE ENGINEER'S POINT OF VIEW

As the QC is integrated inside the CLIOwin software no new user interface has to be learned by the engineer who has experienced CLIOwin inside her or his research laboratory. A quality control test relies on real measurements saved on disk and on a simple text script.

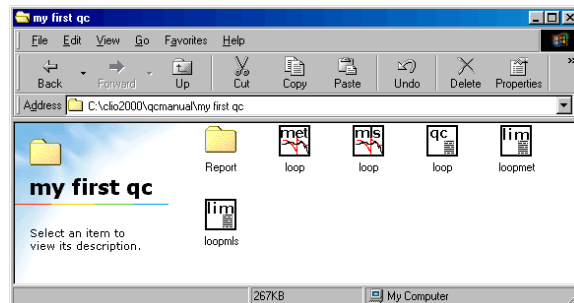


Figure 14.5

Defining a QC script is easy as it takes writing only few descriptive lines of text, no programming languages or complex instructions are involved.

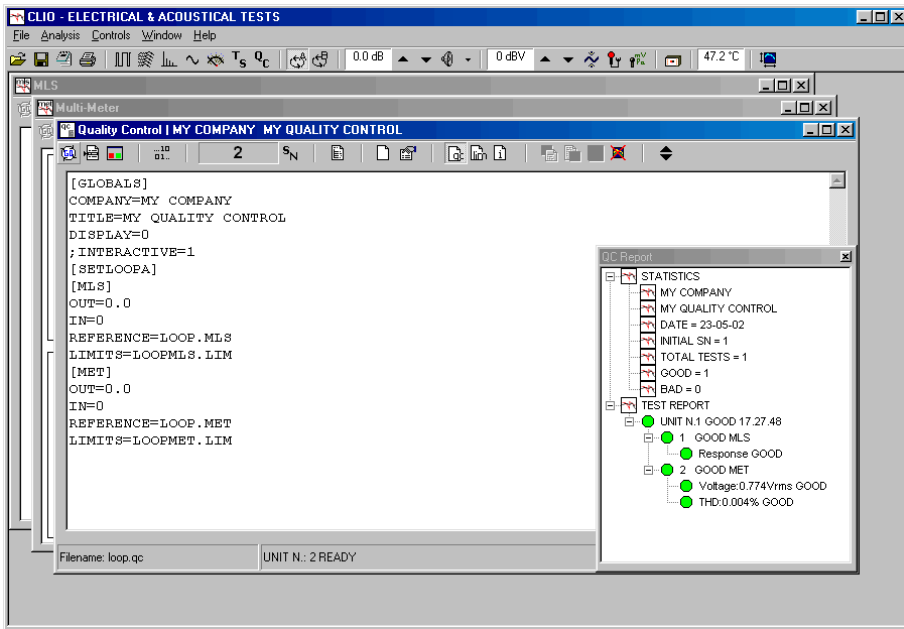


Figure 14.6

It is possible to capture the active measurement; the check masks can also be input in a visual manner drawing limits over the measurement; debugging is helped by an internal corrector.

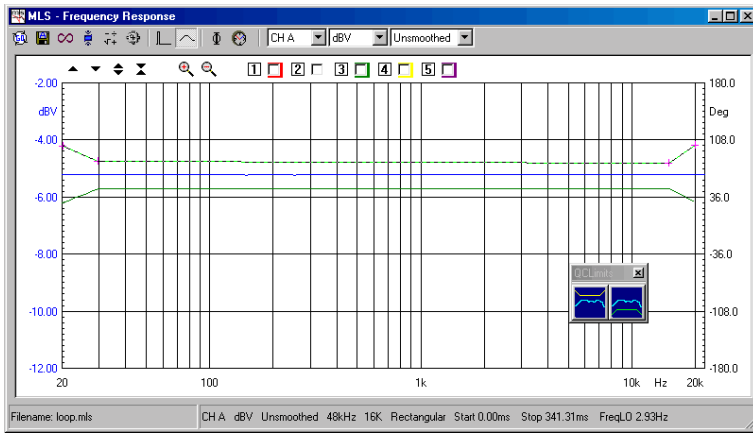


Figure 14.7

14.2.3 THE COMPANY'S POINT OF VIEW

CLIOwin for quality control executes line testing in a fast, accurate and reliable manner. Its flexibility permits easy handling of trade-offs between parameters like speed and accuracy matching always company's needs. The autosaving and exporting capabilities together the complete result reporting give instant access to the production parameters and statistics even during its operation. The production batch is fully managed while preserving serial number coherence.

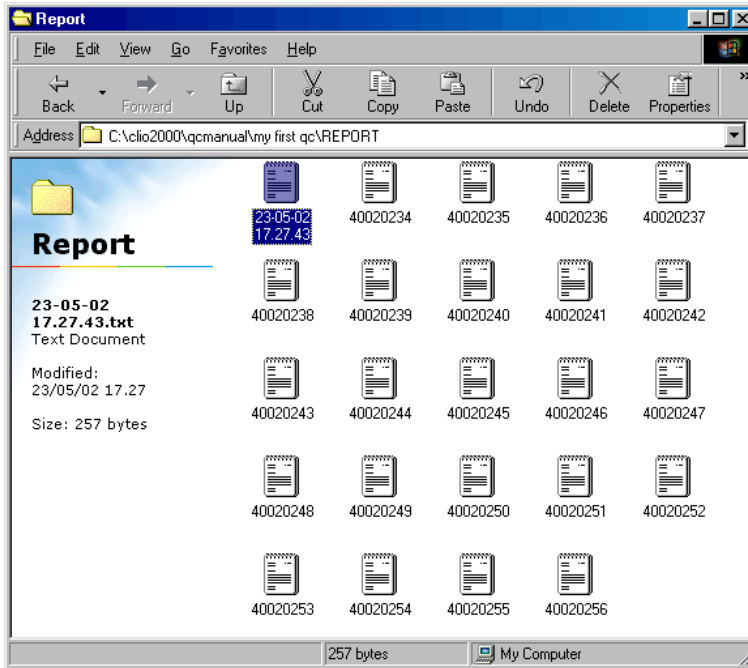


Figure 14.8

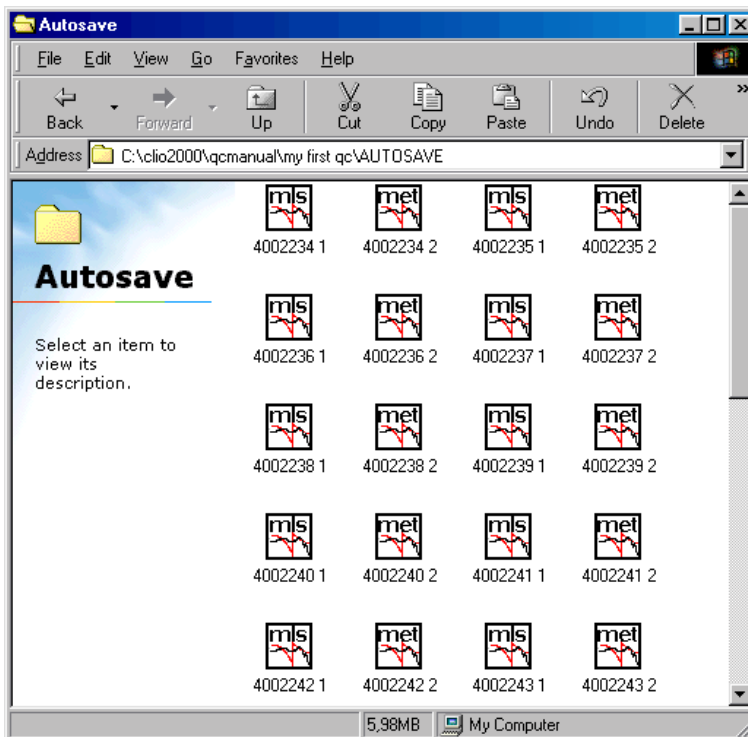


Figure 14.9

14.3 THE QC SOFTWARE OPERATION

The QC software is a "file driven" event processor that, in sequence, performs a number of user-defined measurements to test the quality of a production line.

The text file ('.qc' extension) driving this process is called the **QC Script**.

CLIO's QC processor does the following job:

- reads the QC script and loads it in memory
- interprets it
- executes all the tests
- reports the test result and production statistics
- manages the production batch and serial number
- prompts for the next test

The following block diagram outlines the QC process.

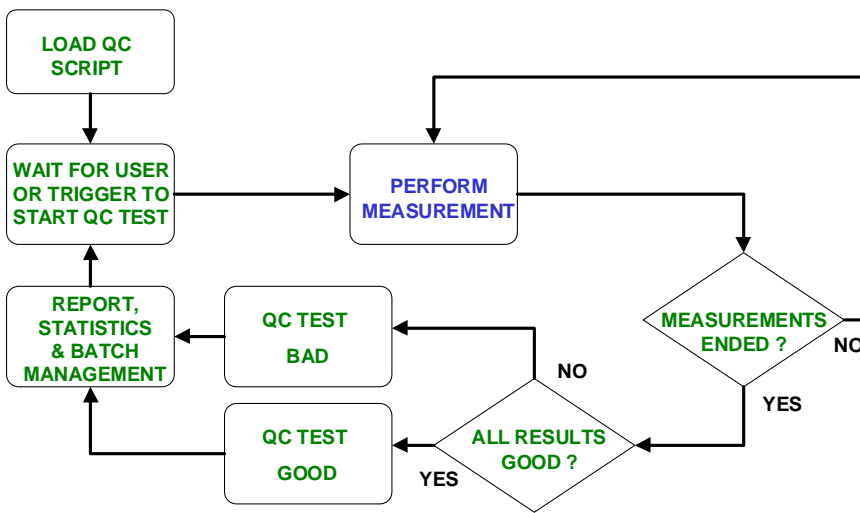


Figure 14.10

You can see the operation of loading the QC script from disk that begins our quality control session; then CLIO waits that the user, or an external trigger (for example a TTL signal from the automation controller), gives the actual start to the QC test; the measurements defined are then executed in sequence until the last is reached; the result of the test is given by the sum of all the checks done inside the test sequence, it is good only if all checks gave positive result; the QC test ends updating report and statistics while managing the production batch; the next device can then be put under test.

To proceed further it is advisable to go into a greater detail of the former block diagram; this is done in Fig.14.11 and 14.12; Fig.14.11 zooms the entire QC test sequence adding the blocks in red, while Fig.14.12 zooms the "Perform Measurement" single block (the blue one).

Three different operating modes are here outlined: the DISPLAY mode, the INTERACTIVE mode and the DISPLAYONBAD mode.

If none of these modes is active the QC test proceeds without any measurement shown, with simple go-no-go masks, as in Fig.14.1.

If **DISPLAY** mode is active then the executed measurements are shown and persist on the screen for a definable amount of time, the test automatically proceeds until the end. Fig.14.2 depicts such a situation.

If **INTERACTIVE** mode is active the executed measurements are shown and then the software prompts for user input . The sequence is not continued until the user executes particular actions. It is also possible to loop certain measurements for D.U.T. tuning (see Fig.14.12). Fig.14.3 depicts such a situation.

If **DISPLAYONBAD** mode is active then the executed measurements are shown only if their result is not good. The sequence is stopped for user acceptance.

Fig.14.11 shows also the **Autosave** management which is of great importance for controlling the production and characterizing a batch. This feature is completely user definable allowing for binary or text files, operation conditioned by the test result, coherence with serial number and single test number; the operator can also be prompted for file name input.

Two blocks are devoted to the execution of particular actions conditioned by the result of the single test or the result of all tests. Among these we find:

- messages to the operator
- print of the measurement
- execution of custom written software
- generation of TTL signals to manage automatic lines
- pause for a predefined amount of time
- stop the sequence

The last red block, right before the end of the QC test, represents the **Cyclic Script**. The cyclic script is a particular sequence of QC operations described and saved in a script file that is executed regularly after a certain number of QC tests have been executed; this is useful for retesting reference quantities that characterize the entire process and maintain traceability to environmental conditions. The typical example is the reference loudspeaker tested every 100 production units have passes the QC test.

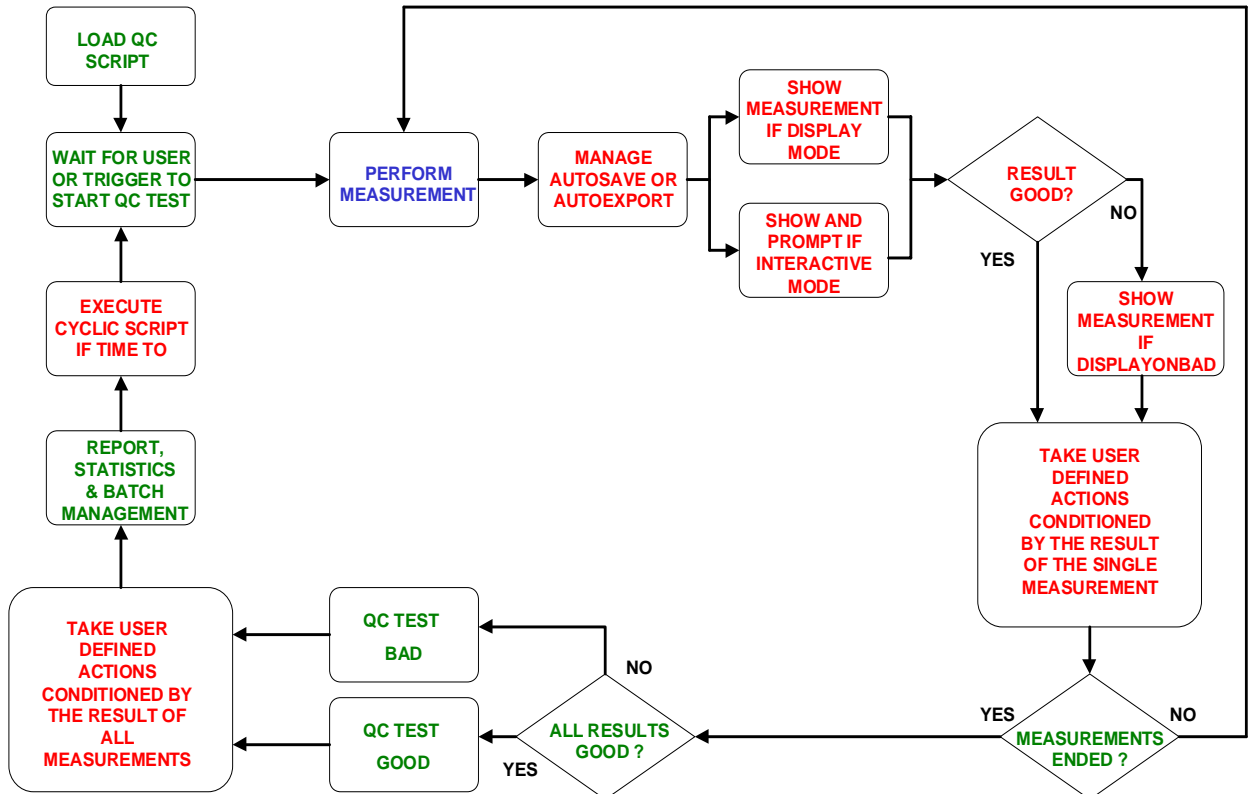


Figure 14.11

The third diagram in Fig. 14.12 shows us how the single QC measurement is performed. As said before CLIOwin QC relies on the measurements present in the standard version of the software; the possible measurements within QC are: MLS ([**MLS**]), FFT ([**FFT**]), Sinusoidal ([**SIN**]) and Multimeter ([**MET**]); we have now put in evidence the keywords that define the tests inside the script.

To understand this operation we must define two files: the **Reference File** and the **Limits File**; these files are the heart of the QC operation, together the QC Script they contribute to define all the parameters of the single measurement.

The Reference File is a standard CLIOwin measurement file (extension '.mls', '.mlsi', '.fft', '.sin', '.sini' or '.met') created within its relative menu; it contains most of the settings needed to fully configure your measurement. As CLIOwin resets the measurement control panel to the settings of the file loaded from disk, the QC processor does the same job; in this easy but effective way of operating you will be sure that, for example, the sampling frequency of your QC MLS measure will be the one you chose, or the display settings will be the same as when you saved the reference file. And all this is defined, inside the QC script, with a **single** text line:

```
REFERENCE=myreferencefile.mls
```

where we imagined that you gave the name 'myreferencefile' to a saved MLS measurement.

The Limits File is a text file ('.lim' extension) defining the frequency mask or quantities needed to check the executed measurement. The syntax used is the same as the QC script. A Limits file can be as simple as:

```
[UPPER LIMIT DATA]
100          +5
500          +3
5000         +1
10000        +5
[LOWER LIMIT DATA]
100          -5
500          -3
5000         -1
10000        -5
```

In principle nothing else is needed to define the basic measurement; here is an example of a section of a QC script defining a MLS measurement:

```
[MLS]
REFERENCE=MYREFERENCEFILE.MLS
LIMITS=MYLIMITSFILE.LIM
```

While performing a QC measurement CLIO can calculate more parameters from the data acquired and have these parameters to concur to the final result. As an example it is possible to make a polarity check within a MLS frequency response measurement or make a T&S parameters check within an impedance measurement. The following script adds the polarity check to the former MLS test.

```
[MLS]
REFERENCE=MYREFERENCEFILE.MLS
LIMITS=MYLIMITSFILE.LIM
POLARITY=1
```

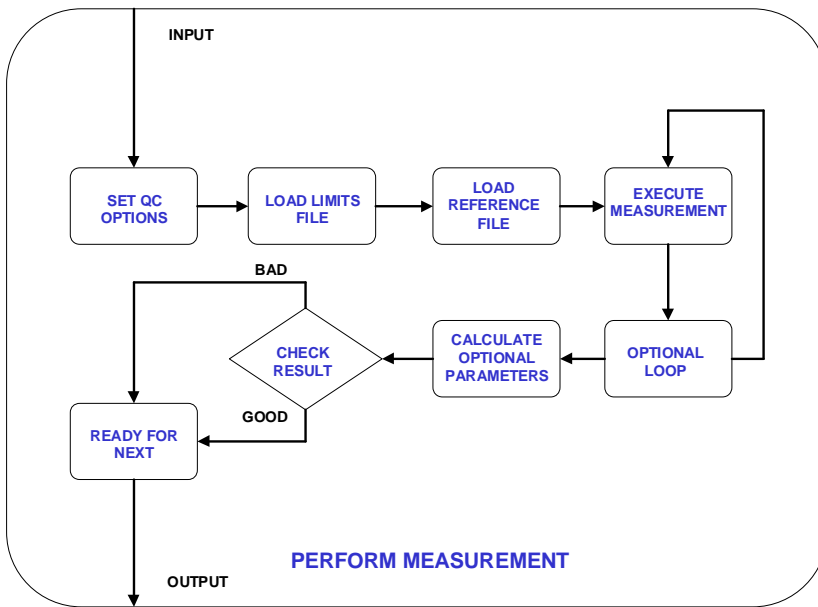


Figure 14.12

Here is a list of the parameters that can be calculated within each measurement:

MLS - Average (or single frequency) level
 - Polarity
 - T&S parameters

FFT - Average (or single frequency) level

Sinusoidal - Average (or single frequency) level
 - 2nd harmonic response
 - 3rd harmonic response
 - 4th harmonic response
 - 5th harmonic response
 - T&S parameters

14.4 THE QC CONTROL PANEL

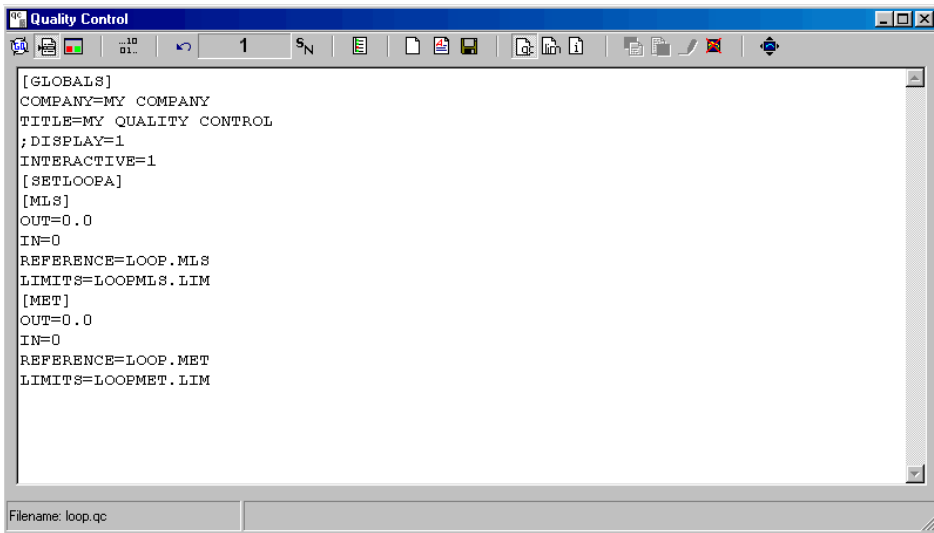




Figure 14.13

Figure 14.13 shows the Quality Control panel that is composed by a toolbar similar to the other CLIOwin panels plus a text display area that is used either for editing the QC files (QC script and Limits file) or for showing information about the QC test.


When the QC display handles file editing it has a white background while, when showing information, it is lightly coloured.

14.4.1 TOOLBAR BUTTONS

 Starts a QC test.

 Enables tracing of the QC script during execution. If pressed, during test execution the QC control panel is not minimized and remains visible showing the current script section under execution.

 Forces the QC result panel to be displayed after tests completion. Refer to 14.4.3 for more details.

 Enables external trigger. This button overrides the setting in the script (**MANUAL** keyword). See 14.8.2 and the commands reference for more details.

 Skips the last measured unit.

 Used to input the current device serial number.

 Recalls the QC Report panel Refer to 14.4.3 for more details.


 Starts a new QC script editing session. The text present is cancelled.


 Edit the current text.

 Immediately saves the current text as Script or Limits file.

 Enters the **Script Text mode**. The QC display presents the currently loaded QC script file.


 Enters the **Limits Text mode**. The QC display presents the currently loaded Limits file.


 Enters the **Information Text mode**. During tests the QC display shows the current QC script section under execution. When the test sequence is finished the QC display shows information about the executed tests.

 If in **Script Text display mode**, 'captures' the active measurement generating a 'piece' of script file relative to the currently loaded reference and limits files. The text is inserted at cursor position. As an example the following text is generated in the assumption that you have MLS open with the active measurement saved as 'myreferencefile.mls' and that you have loaded the 'mylimitsfile.lim' inside QC; also captured are output level and input sensitivity (here assumed to be 0dBu and 0dBV respectively).

```
[MLS ]
OUT=0.0
IN=0
REFERENCE=MYREFERENCEFILE.MLS
LIMITS=MYLIMITSFILE.LIM
```

If in **Limits Text display mode**, 'captures' the limits file of the active measurement loading it inside the QC display.

 Creates the frequency curves relative to the limits file under editing and shows them in the active measurement control panel.

 Enables the Draw Limits controls that let you visually input the frequency limits directly drawing on the active measurement control panel. Fig. 14.14 shows the MLS control panel with the Draw Limits controls on the top. Clicking on one of the two buttons starts drawing of the relative limit curve; to finish input **double-click** on the last frequency point.

Note: it is mandatory to input points from left to right.

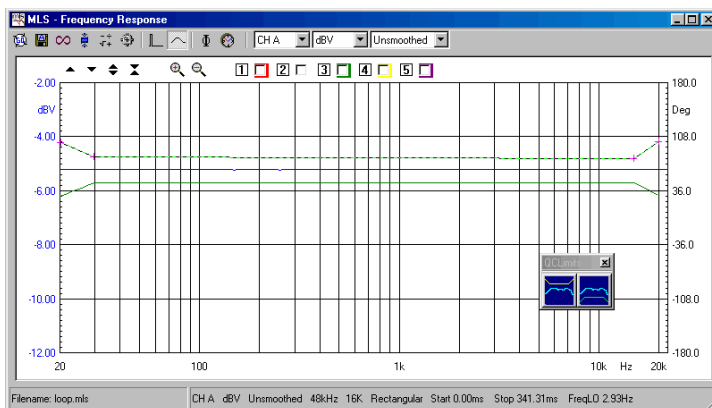




Figure 14.14

 Hides (if visible) or shows (if hidden) the limits curves in the active measurement control panel.

 Releases all the measurement control panels. Each panel acquires its normal appearance. In fact, when a QC test sequence is running, each panel 'loses' its overlay and curve controls and its status bar in order to maximize the graph display when the windows are tiled. Fig.14.15 shows the MLS control panel in the two different situations.

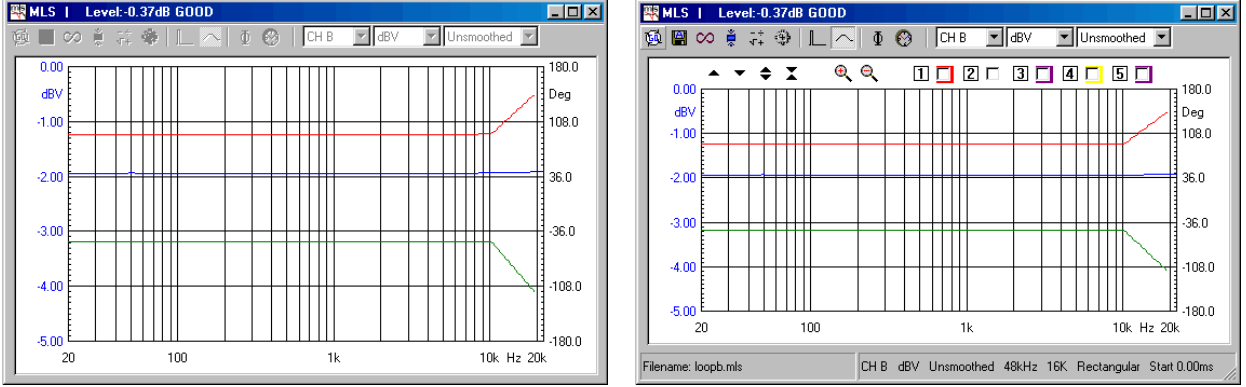


Figure 14.15

When control panels are managed under QC there are two other differences: toolbar buttons are usually disabled while the title of the window is used to display the result of the parameters that have been calculated: in Fig. 14.15 we see written 'Level:0.37dB GOOD' which reports the result of an average level check done on the measured MLS frequency response.

14.4.2 THE QC REPORT PANEL

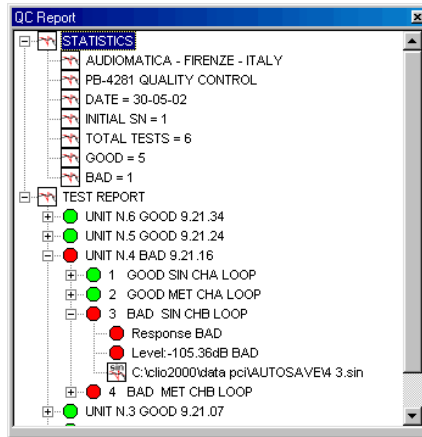


Figure 14.16

The QC Report panel serves as an interactive tool of great help for inspecting a production while it is tested; it is composed by two tree views named **STATISTICS** and **TEST REPORT** that handles all the information pertaining to your QC session in a very compact form.

The QC Report panel can be kept open during the tests and it accompanies the work in a really effective visual form.

Under **STATISTICS** you find information about:

- QC test and Company names
- Date of the first unit tested

- Name of the production batch
- First serial number tested
- Total number of units tested, number of goods and bads

Under TEST REPORT you find information about:

- DUT test result with serial number and time of production
- Single tests results
- Name of the saved files

The QC Report panel is also the starting point for reviewing a saved measurement as described below. The name of the saved file is a sensible area where you can double-click to **review** the measurement.

14.4.3 REVIEWING A MEASUREMENT

During a QC tests session it is possible to review a measurement that has been saved to disk. This is important when, for example, trying to understand why a measurement went bad. As we saw before the QC report panel indicates all the name of the files that have been created during the test execution, under the relative serial number and single test number.

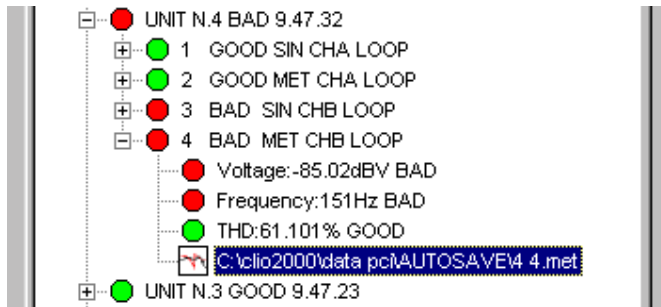


Figure 14.17

As soon as a QC sequence is terminated simply open the tree view of your interest, identify the measurement you want to inspect and double click on its name (Fig.14.17). CLIO loads the measurement as if it were performed inside the running QC, together with its pertinent limits and executes all the calculations defined in the QC script ending with the result check and display. Fig.14.18 describes such a process; compare it with Fig.14.12.

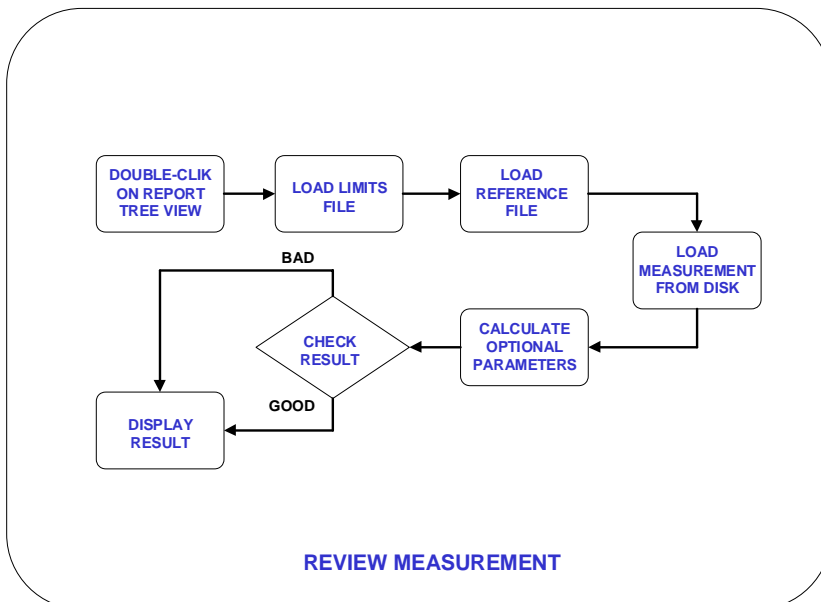


Figure 14.18

Reviewing a saved measurement from within QC is different than simply opening the file from the measurement control panel; in this second case no post processing due to QC operation is applied. Fig. 14.19 shows a measurement (blue curve) reviewed inside QC with its limits (red and green curves) and the same measurement loaded from the measurement control panel (purple curve); the shift in level is due to QC operation when it separately checks for relative level and frequency behaviour.

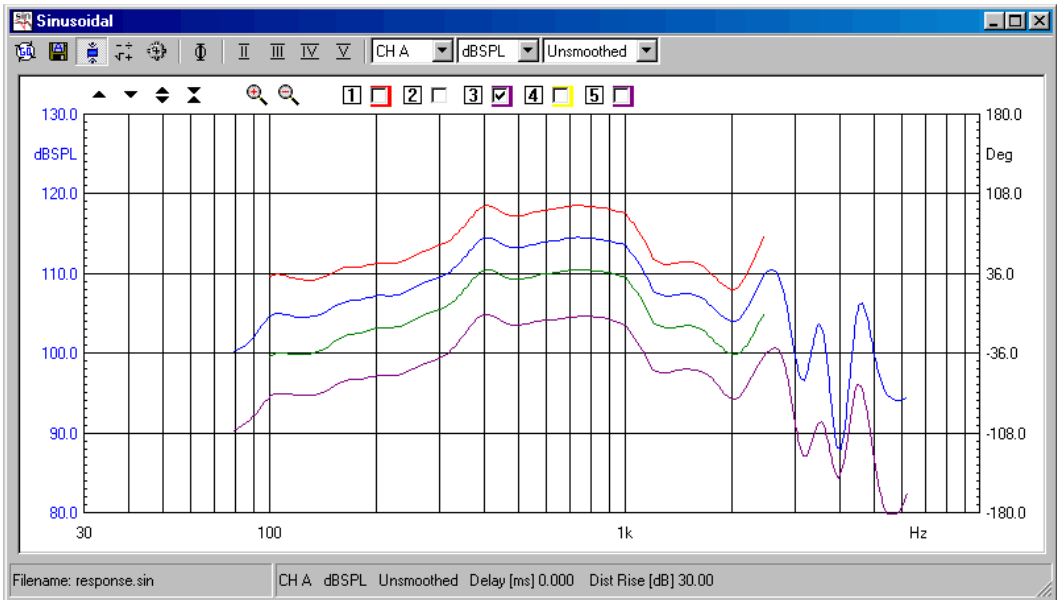


Figure 14.19

Note: the review operation can be done only when inside a QC session; if CLIOwin is exited when, later, QC is started again a new QC session will be created; report information and review operation will apply to the new session.

14.4.4 THE QC RESULT PANEL

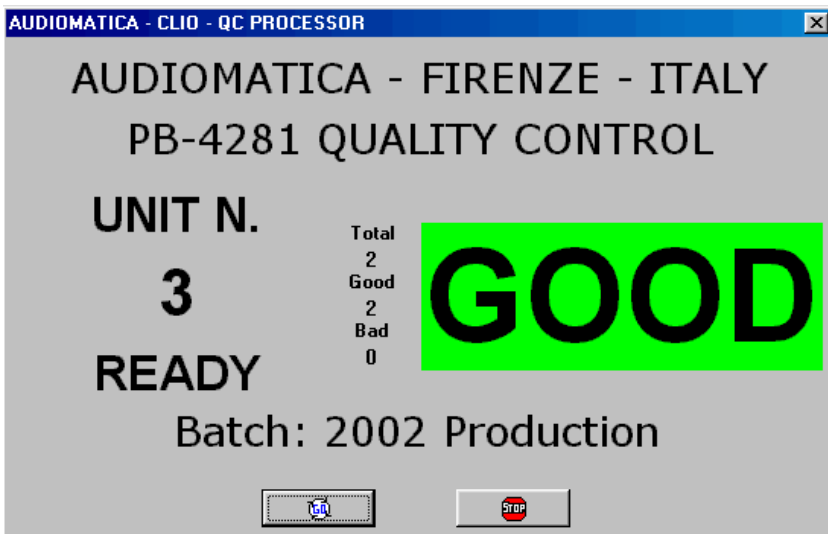



Figure 14.20

The QC Result panel usually accompanies QC sessions where measurement display is not needed. This results in a situation with simple go-no-go masks for use with completely automatic lines or operators who don't need to take particular actions with respect to the test result.

To activate the QC Result panel from within the QC script use the DISPLAY=0 keyword.

Note: for maximum QC test speed use the QC Result display and don't show single measurements as the display of a graphical objects and measurement curves usually employs a lot of processor time.

The QC Result panel can be forced to appear at the end of the QC sequence pressing the  button.

14.4.5 THE QC BANNER

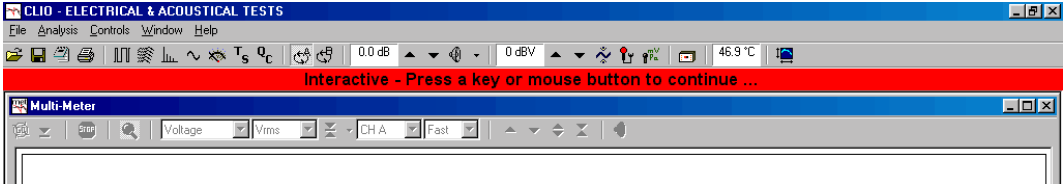


Figure 14.21

The QC Banner is managing information and messages given to the operator while in Interactive mode.

14.4.6 QUALITY CONTROL MENU AND SHORTCUTS

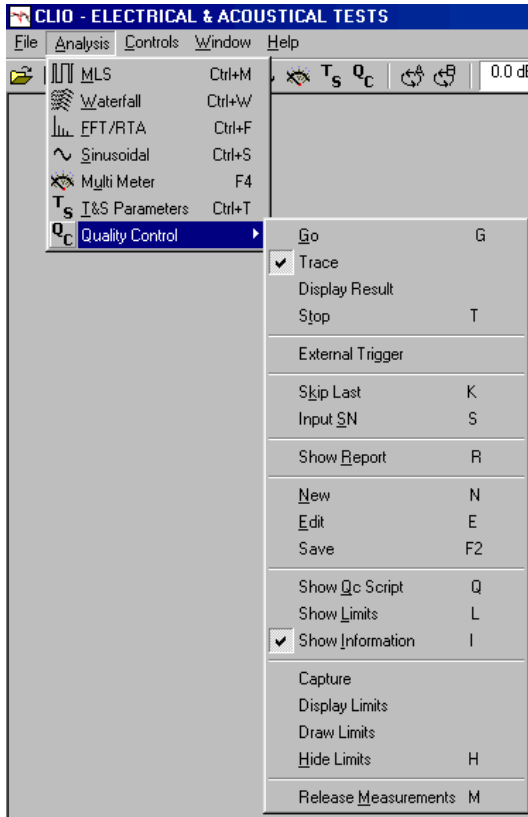


Figure 14.22

Figure 14.22 shows the Quality Control menu accessible from the Analysis menu. Here below we list also all the available Hot Keys.

ESC or T

Exits the QC test sequence.

End

Exits the QC test sequence in Interactive mode.


SpaceBar


Continues the QC test sequence in Interactive mode.


G Starts a QC test. Equivalent to .

K Skip last executed measurement. Equivalent to .

S Input serial number. Equivalent to .

R Show Report. Equivalent to .

N New QC script. Equivalent to .

E Edit QC script. Equivalent to .

F2 Saves QC script. Equivalent to .

CTRL-E

Ends an editing session, while inside the text display.

CTRL-C

Copy selected text.

CTRL-V

Paste selected text.


CTRL-X

Cut selected text.


CTRL-Z

Undo/redo text input.

Q Show QC script. Equivalent to 

L Show Limits. Equivalent to 

I Show Information. Equivalent to 

H Hide Limits. Equivalent to 

M Release measurements. Equivalent to 

14.4.7 QC REGISTERED FILE EXTENSIONS

CLIOwin Quality Control registers the following files extensions beyond the ones already registered by CLIOwin.



QC script files.



QC Limits files.

14.5 MY FIRST QC SCRIPT

14.5.1 WHAT TO KNOW ABOUT QC SCRIPTS

A quality control script is a text file that stores information in logical groupings, called **sections**.

Each section is initiated by a bracketed keyword in the form **[keyword]**.

Within each section, QC definitions are stored in named keys.

Keys within a section take the form **keyword=value**.

For example the section called [GLOBALS] defines several settings useful all along the test sequence:

```
[GLOBALS]
COMPANY=MY COMPANY
TITLE=MY QUALITY CONTROL
BATCH=MY PRODUCTION BATCH NAME
```

It is possible to input comment lines initiated by a **semicolon**. It is **not** possible to start a comment after a keyword.

```
;this is a correct comment line
COMPANY=MY COMPANY ;this comment is not allowed
```

With these brief notes clear you are ready to write a QC script.

14.5.2 HOW TO WRITE MY FIRST QC SCRIPT

You may write your script with any text editor that stores plain ASCII files (usually '.txt' ones), like Notepad; the only thing you should remember is that QC scripts must have the '.qc' extension while limits files the '.lim' extension; the common behaviour of Windows to hide registered files extensions renders this action sometimes difficult. It is not uncommon to believe to have saved a file with, say, the name 'myfile.qc' (where you tried to force the extension) and then find it actually saved as 'myfile.qc.txt' because the text editor automatically appended the registered extension.

You may write your script directly editing it within the QC control panel text display; in this case the extension management is guaranteed by CLIOwin and you will be able to use some tools, like measurements capture, that are of help during everyday job. Doing like this it is possible to immediately test the script pressing Go.

Let's now write our first QC script.

Have your CLIO system in the same situation as when you perform system calibration: output A connected to input A; see chapter 3 for details. Don't connect any external device to the system. Set output level at OdBu and input sensitivity at OdBV (see Chapter 5 for details). Have default settings loaded.

Open MLS; press Go. You should obtain a straight line as in Fig.14.23. Save this measurement as 'Loop.mls'.

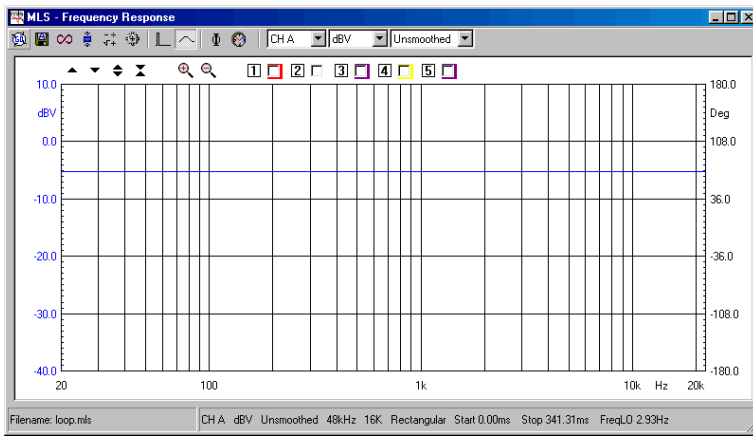





Figure 14.23

Now open the QC control panel. Press **N**, we are starting a new script. Press **Ctrl-E** to exit edit mode and then press **L** to enter Limits Text mode. Input the following frequency masks as limits:

```
[UPPER LIMIT DATA]
20          -4.2
30          -4.7
15000      -4.7
20000      -4.2
[LOWER LIMIT DATA]
20          -6.2
30          -5.7
15000      -5.7
20000      -6.2
```

Press **F2** and save the limits file as 'loop.mls.lim'. Click now on the  (script) button and then click on the  (capture) button. Your blank text display should now be filled with your first QC script:

```
[MLS]
OUT=0.0
IN=0
REFERENCE=LOOP.MLS
LIMITS=LOOPMLS.LIM
```

Click on the  go button; the QC processor should execute a QC test performing an MLS measurement, displaying it together with the defined limits, everything as in Fig.14.24; the text display should now present information on the executed test.

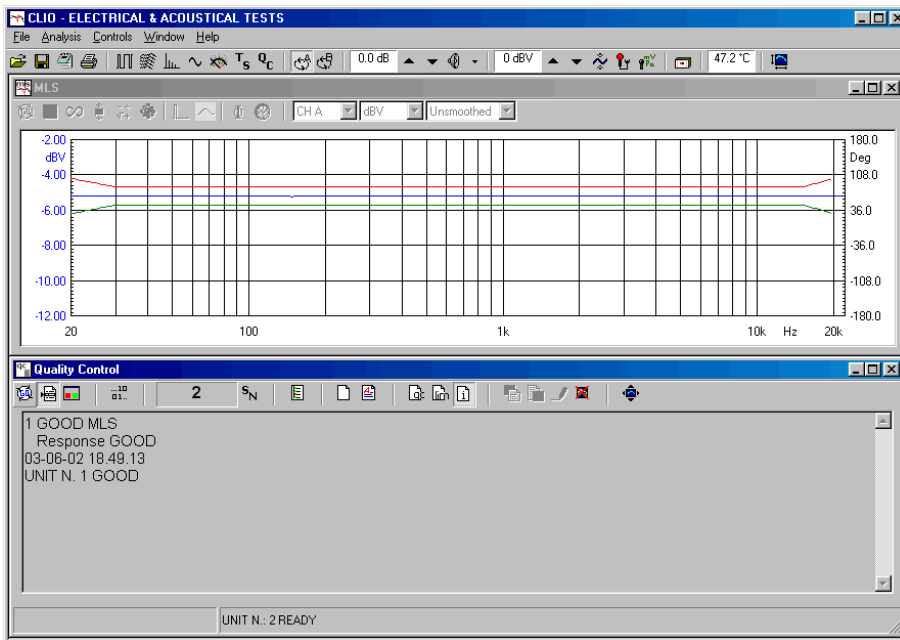



Figure 14.24

Let's now complete this first exercise adding a Multimeter measurement of level and total harmonic distortion at 1kHz.

Close the MLS and QC control panels. Press **F4** to open (and run) the Multimeter control panel, click then on the  generator button to switch the generator on and play the default 1kHz sinusoid. Press now **T** to stop measuring; save this measurement as 'loop.met'; Fig.14.25 should be what you have in front.

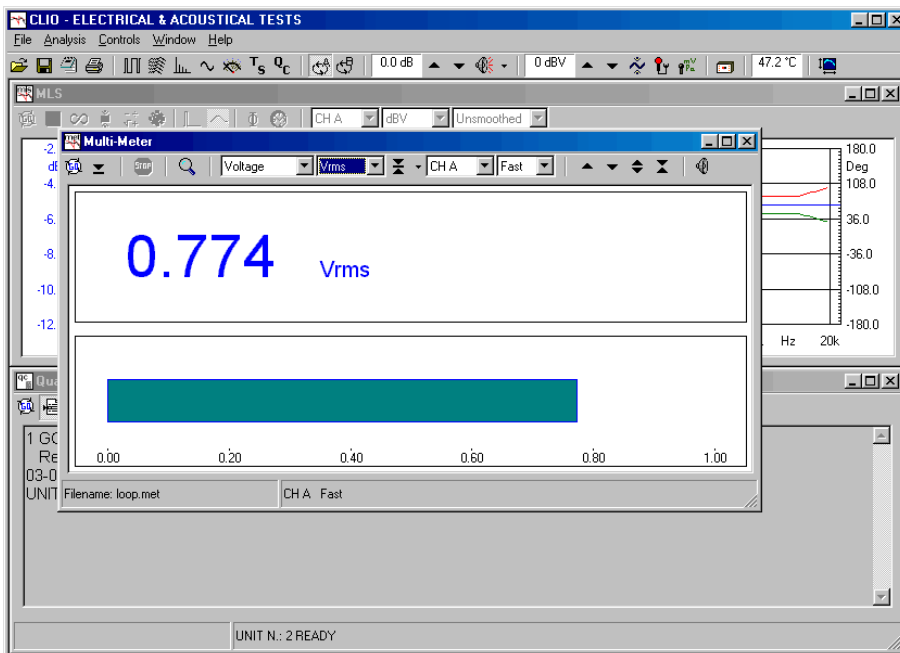



Figure 14.25

Press now **Ctrl-Q** and then **L** to go back inputting a limits file definition. Input the following:

```
[UPPER LIMIT DATA]
VOLTAGE=0.78
```



```
THD=0.01
[LOWER LIMIT DATA]
VOLTAGE=0.77
THD=0.0001
```

Save this as 'loopmet.lim'. Click now on the  button and position the cursor inside the text display after the last line of text; clicking now, as before, on the capture button the following lines should be added and you are ready for this new QC test.

```
[MET]
OUT=0.0
IN=0
REFERENCE=LOOP.MET
LIMITS=LOOPMET.LIM
```

Pressing now Go inside QC executes this two-measurements QC test sequence; Fig.14.26 shows the test at its end.

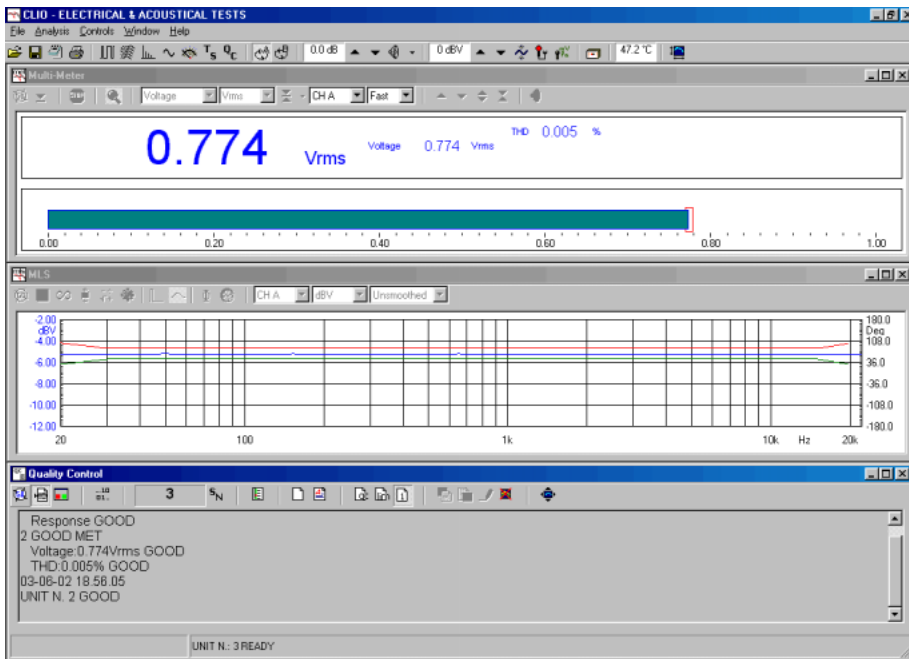


Figure 14.26

This concludes our first approach to QC script writing and debugging. All the files necessary to "study this lesson" are furnished within the '`\DATA\MY FIRST QC`' directory under the CLIOwin installation directory.

The 'loop.qc' script is doing exactly what just described with a difference: measurements are performed in **interactive mode**; just load it and run it to feel the differences.

As a final, but not least important, note on how to define a limits file it is possible to input the frequency mask as a text file as below.

```
[UPPER LIMIT DATA]
FILE=UPPER.TXT
[LOWER LIMIT DATA]
FILE=LOWER.TXT
```

The files 'upper.txt' and 'lower.txt' are export ASCII files that may be produced by other applications or CLIOwin itself.

The 'upper.txt' file may look like:

Freq[Hz]	dBV
100	5
500	3
5000	1
10000	5

14.6.1 ABSOLUTE VS. RELATIVE FREQUENCY LIMITS

The following limits file defines an **absolute** frequency limit.

```
[ABSOLUTE]
[UPPER LIMIT DATA]
200          100
300          97
10000        97
15000        100
[LOWER LIMIT DATA]
200          82
300          85
10000        85
15000        82
```

The frequency mask is shown in Fig.14.29.

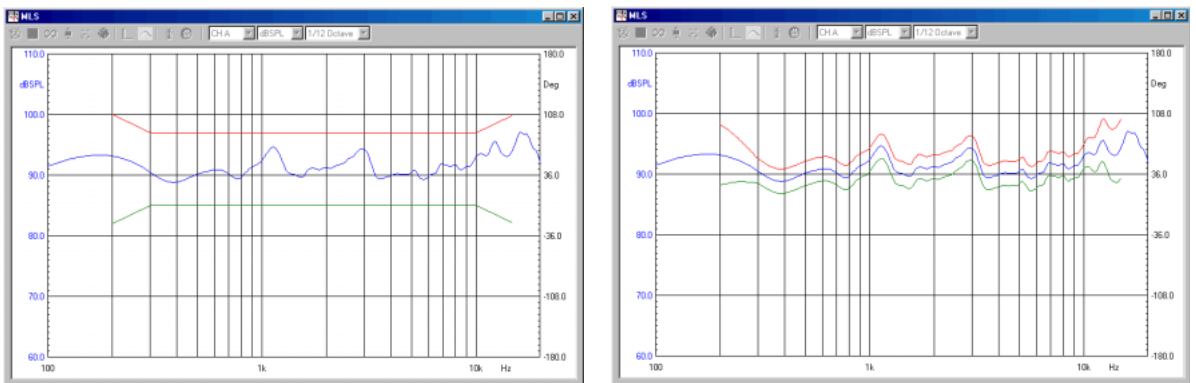


Figure 14.29 and 14.30

The following limits file defines a **relative** frequency limit.

```
[RELATIVE]
[UPPER LIMIT DATA]
200          5
```

```

300                2
10000              2
15000              5
[LOWER LIMIT DATA]
200                -5
300                -2
10000              -2
15000              -5

```

The frequency mask is shown in Fig.14.30. **Relative means with respect to the reference file defined in the QC test.** Data values will be added and subtracted to the reference value at the specified frequencies.

It is possible to input up to 100 frequency points to define the check mask. The QC processor will execute the check starting from the first frequency point, ending at the last; no check will be done outside this frequency range.

Inside a frequency limits file it is possible also to define an average level check (see 14.6.2 and 14.6.3) and a Thiele&Small parameters check (see 14.6.4).

A frequency limit file can be applied to an MLS, Sinusoidal or FFT test. To define a limits file for a Multimeter measurement see later.

14.6.2 AVERAGE LEVEL CHECK

The following limits file defines an **average level check** inside the same relative frequency limit shown before.

```

[RELATIVE]
[LEVEL]
UPPER=3
LOWER=-3
[UPPER LIMIT DATA]
200                5
300                2
10000              2
15000              5
[LOWER LIMIT DATA]
200                -5
300                -2
10000              -2
15000              -5

```

When a level check is defined inside a limits file the QC result is actually a combination of two separate checks; one is the frequency behaviour of the measurement compared against the frequency mask, the second is a level check which compares the average level of the measured curve with the average level of the reference.

The levels are calculated averaging in the frequency band defined by the limits.

Fig.14.31 shows such a situation; the title of the measurement control panel reports the level check.

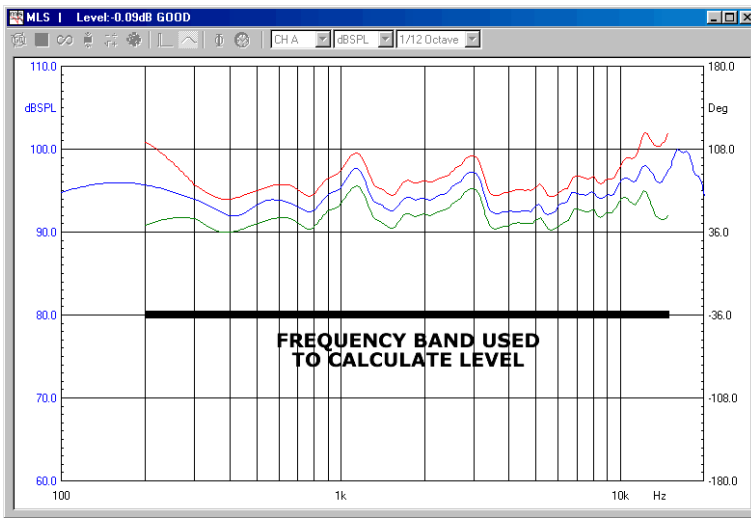


Figure 14.31

The level check shown means that the value of the measurement averaged in the band shown is 0.09dB higher than the reference average level in the same frequency band.

The measured curve is shifted of this value and then the frequency check is performed (see also 14.6.4).

The level shift means that the curve is displayed with a level different from the measured one. Refer also to Fig. 14.19.

As two separate checks are done there may be two distinct cases when a unit results bad. The following figures try to explain these two cases.

Figure 14.32 shows us the case when a unit is testing bad because the frequency behaviour is not good while the average level is OK.

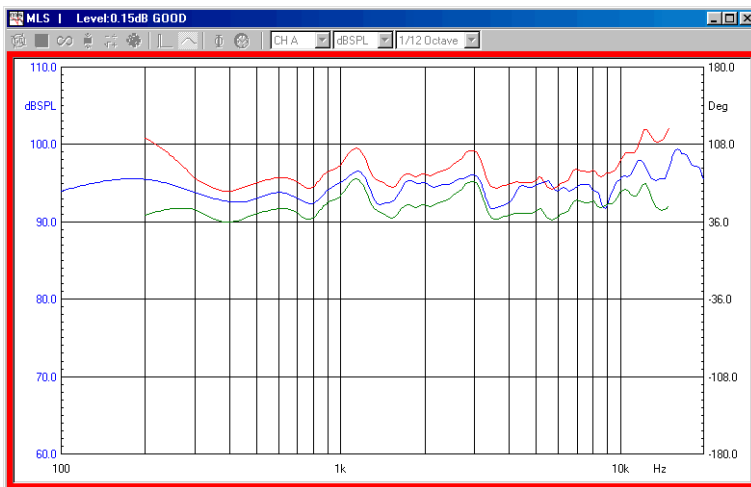
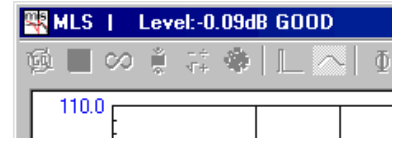


Figure 14.32

Figure 14.33, instead, shows us the case when a unit is testing bad because the average level is not good while the frequency behavior is OK.



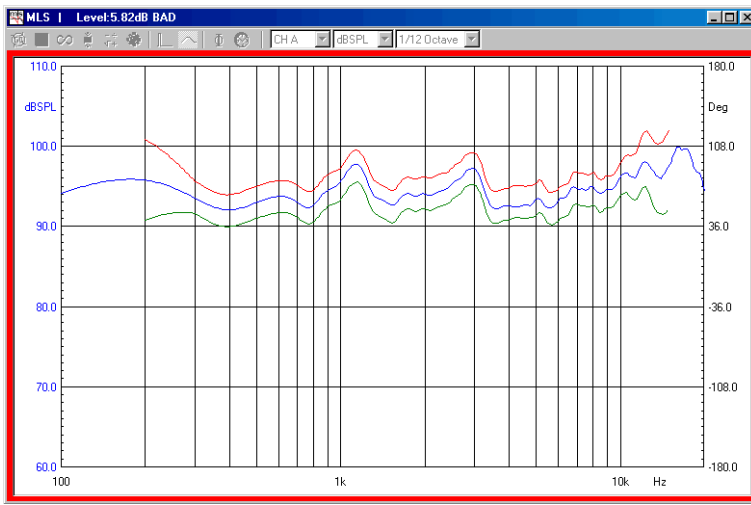


Figure 14.33

14.6.3 ALIGNED MASK

The following limits file defines a **single point level check with a frequency mask aligned to it**.

```
[ABSOLUTE]
[LEVEL]
UPPER=3
LOWER=-3
ALIGNFREQ=5000
ALIGNLEV=90
[UPPER LIMIT DATA]
200      5
300      2
800      2
1000     6
3000     6
4000     2
7000     2
15000    8
[LOWER LIMIT DATA]
200      -5
300      -2
10000    -2
15000    -5
```

The **align point** (in the example 90dB SPL@5000Hz) is used both to build the frequency mask (that is specified relative to it) and to identify the frequency at which to perform the level check.

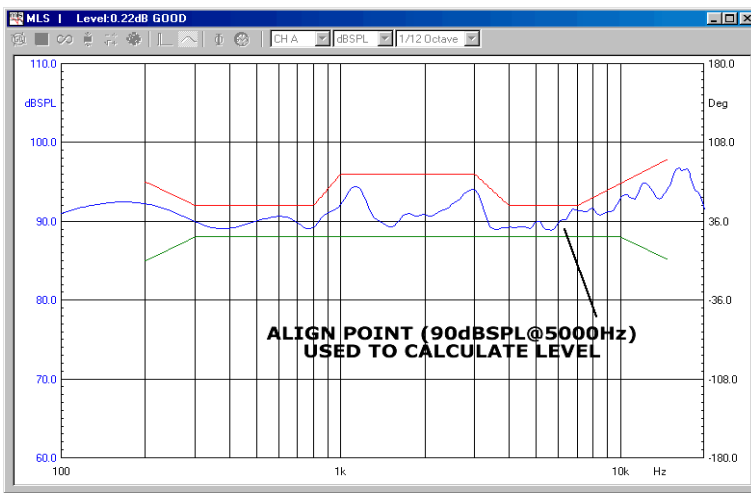


Figure 14.34

Fig.14.34 shows an mask aligned to the point (90dB SPL @ 5000Hz). The level check means that the value of the measurement at 5000Hz is 0.22dB higher than the align point.

The measured curve is shifted of this value to pass exactly at 90dB SPL at 5000Hz; then the frequency check is performed (see also 14.6.4).

The level shift means that the curve is displayed with a level different from the measured one. Refer also to Fig. 14.19.

14.6.4 FLOATING LIMITS VS. FLOATING CURVES

When an average or single frequency level check is defined (14.6.2 or 14.6.3) it is possible to define floating limits instead of floating curves using the [FLOATING] keyword.

```
[RELATIVE]
[FLOATING]
[LEVEL]
UPPER=3
LOWER=-3
[UPPER LIMIT DATA]
200          5
300          2
10000       2
15000       5
[LOWER LIMIT DATA]
200         -5
300         -2
10000      -2
15000      -5
```

In this case the measured curve is presented on screen with correct values while the limits curves are moved around it.

14.6.5 THIELE&SMALL PARAMETERS CHECK

It is possible to execute QC tests of the following T&S parameters:

Qt, Qe, Qm, Fs, Cms, Mms, Mmd, BI, Vas, dBSPL and **ZMin**.

To evaluate the first four parameters it is necessary to input the value of the DC resistance of the voice coil with the keyword **REDC**.

To evaluate the remaining parameters, by means of a simplified estimation routine, it is necessary to input the value of the driver diameter with the keyword **DIAMETER** and one among the following fixed quantities: **KNOWNMMD** (fixed mass) or **KNOWNMMS** (fixed mass plus air load) or **KNOWNCMS** (fixed compliance).

The following limits file defines a T&S parameters check inside a limits file with a frequency mask for an impedance response. The parameters checked are **Qt, Qe, Qm** and **Fs**.

```
[ TSPARAMETERS ]
QTUPPER=0.3
QTLLOWER=0.05
QEUPPER=0.3
QELOWER=0.05
QMUPPER=5
QMLOWER=2
FSUPPER=90
FSLLOWER=50
REDC=5.5
[ UPPER LIMIT DATA ]
29.89          142.35
40.52          161.18
102.15         161.18
152.62         143.53
[ LOWER LIMIT DATA ]
29.89          11.29
49.23          20.00
64.33          45.88
76.28          47.06
98.49          22.35
141.87         11.76
```

The following section define a T&S check of **Qts, Fs, Cms, BI** and **ZMin** having fixed the mechanical mass **Mmd** value.

```
[ TSPARAMETERS ]
REDC=6.2
DIAMETER=110
KNOWNMMD=10.7952
QTSUPPER=0.6
QTSLOWER=0.3
FSUPPER=90
FSLLOWER=50
CMSUPPER=1.1
CMSLOWER=0.8
BLUPPER=6.5
BLLLOWER=6
ZMINUPPER=7.5
ZMINLOWER=7
```


14.6.6 SINUSOIDAL HARMONICS CHECK

When executing sinusoidal frequency response measurements it is possible to activate quality control checks over single harmonic responses from the second to the fifth.

This QC operation will be defined in the relative limits file as in the following example:

```
[UPPER LIMIT DATA]
1000          106
2000          116
5000          116
7000          96
[LOWER LIMIT DATA]
1000          89
2000          99
4000          99
6000          80
[3 UPPER LIMIT DATA]
300           70
500           90
2000          90
5000          70
[4 UPPER LIMIT DATA]
200           55
400           68
1300          79
1900          79
2500          77
5300          77
6300          67
```

In this example we defined a check on the third and fourth harmonic with an upper limit only. It is possible to define also the lower limit but usually this is not the case. **The complete listing of the applicable keywords is in the reference section.**

Fig. 14.35 shows the sinusoidal control panel after the test defined with the above limits file.

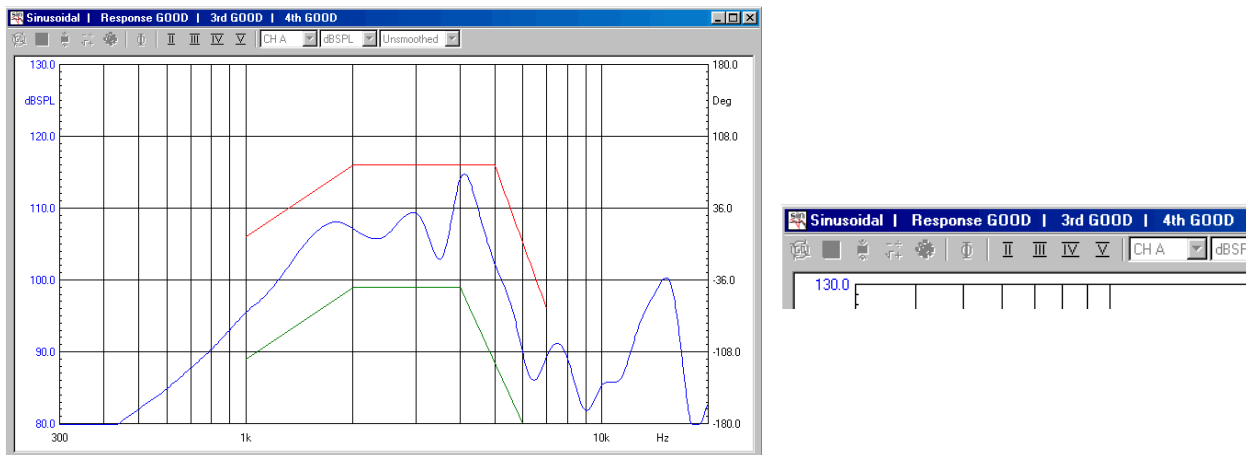


Figure 14.35

You may note that the buttons of the harmonics are now active to let you inspect them. When pressed the relative harmonic is shown with its limits as in fig. 14.36.

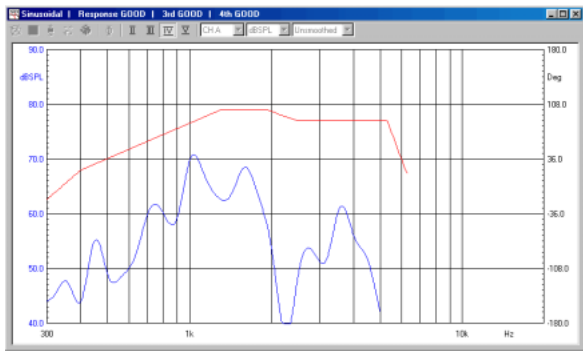
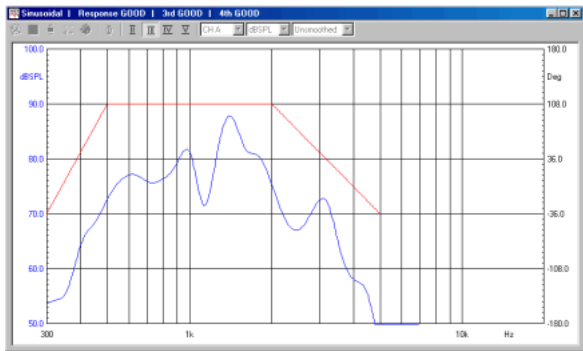


Figure 14.36

14.6.7 MULTIMETER LIMITS FILES

The following limits file defines a multimeter QC check.

```
[UPPER LIMIT DATA]
VOLTAGE=0.78
THD=0.01
[LOWER LIMIT DATA]
VOLTAGE=0.77
THD=0.0001
```

The parameters available are:

- PRESSURE
- VOLTAGE
- FREQUENCY
- THD
- IMD

14.7 MANAGING PRODUCTION BATCHES

Managing a production batch is a rather complex while delicate topic as it involves diverse needs of diverse areas inside your company.

CLIOwin QC handles your batch doing the following:

- Maintains a directory structure where different files are saved
- Automatically saves production report files
- If requested autosaves data files
- Maintains serial number coherence
- Calculates statistical data about the batch

The result is that you will find the production well documented both for your internal purpose aimed to achieve the highest quality standard and also for interfacing with your client who request technical information about the units.

14.7.1 DIRECTORIES CREATED BY CLIOWIN QC

Suppose you saved your script inside the directory 'My qc'. When you run the script CLIOwin automatically creates one or more directories under 'My qc'. There are four cases depending on the option you set:

- 1) No Autosave is active. A Batch is not defined.
CLIOwin creates the 'Report' directory where all the production report files are saved. Fig.14.37 shows this situation.
- 2) Autosave is active. A SaveFolder is not defined. A Batch is not defined.
CLIOwin creates the 'Report' directory where all the production report files are saved. It also creates the 'Autosave' directory where all data files are saved. Fig.14.38 shows this situation.

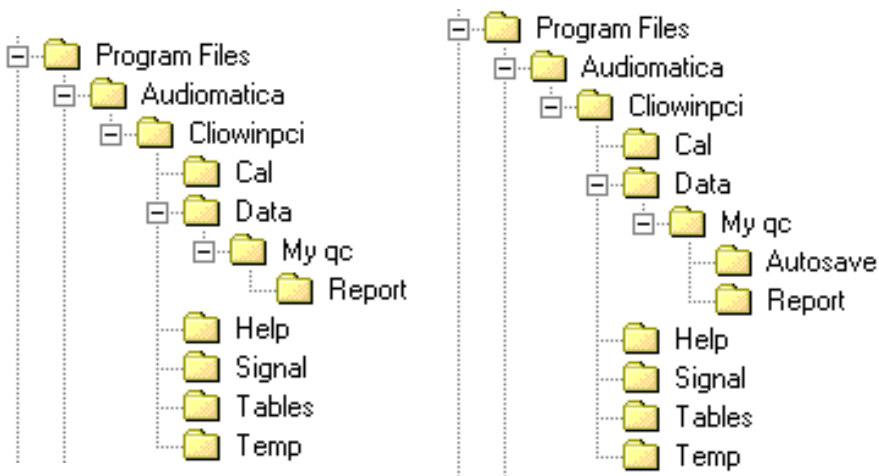


Figure 14.37 and 14.38

- 3) A Batch is defined and is named 'My Batch'. A SaveFolder is not defined.
CLIOwin creates the 'My Batch' directory where all the production report and also data files are saved. Fig.14.39 shows this situation.
- 4) A SaveFolder is defined and is named 'My Savefolder'.
CLIOwin creates the 'My Savefolder' directory where all the production report and also data files are saved. Fig.14.40 shows this situation.

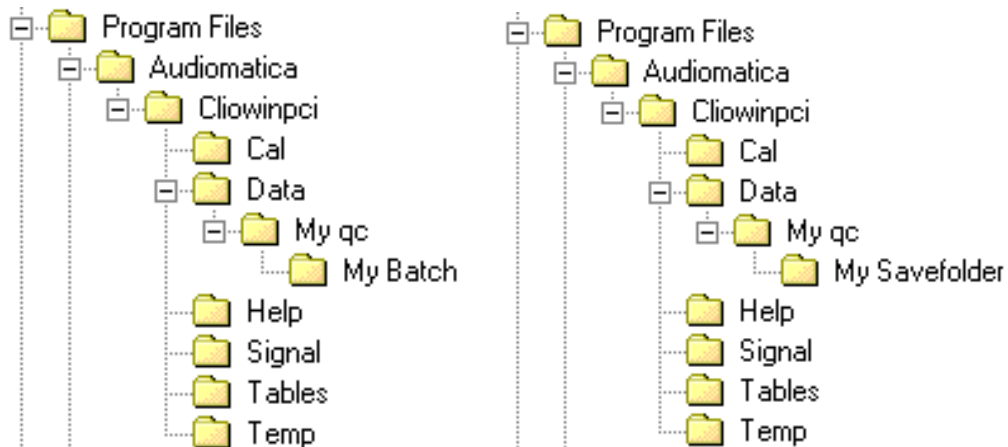


Figure 14.39 and 14.40

14.7.2 PRODUCTION REPORT FILES

Suppose that today, June 6, 2002, at 6:46, you started a production of your devices; the batch, named 'My Batch', ended yesterday with unit number 100.

After two units tested CLIOWin will add, under the folder 'My Batch', the following report files:

```
'production_06-06-02_6.46.18.txt'
'101.txt'
'102.txt'
```

After 20 units tested:

```
'production_06-06-02_6.46.18.txt'
'101.txt'
'102.txt'
.....
'120.txt'
```

If you stop the production, exit CLIOWin, and then restart it at 7:01, after two more units tested:

```
'production_06-06-02_6.46.18.txt'
'production_06-06-02_7.01.05.txt'
'101.txt'
'102.txt'
.....
'122.txt'
```

The files '**production_date time.txt**' describe the QC session. They look like:

```
STATISTICS
MY COMPANY
MY QUALITY CONTROL
BATCH = My Batch
DATE = 06-06-02
INITIAL SN = 101
TOTAL TESTS = 2
GOOD = 2
BAD = 0
```

TEST REPORT

UNIT N.102 GOOD 6.46.24

1 GOOD MLS

Response GOOD

C:\Program files\Audiomatica\Cliowinpci\Data\My qc\My

Batch\102_1.mls

2 GOOD MET

Voltage:0.775Vrms GOOD

THD:0.006% GOOD

C:\Program files\Audiomatica\Cliowinpci\Data\My qc\My

Batch\102_2.met

UNIT N.101 GOOD 6.46.18

1 GOOD MLS

Response GOOD

C:\Program files\Audiomatica\Cliowinpci\Data\My qc\My

Batch\101_1.mls

2 GOOD MET

Voltage:0.775Vrms GOOD

THD:0.006% GOOD

C:\Program files\Audiomatica\Cliowinpci\Data\My qc\My

Batch\101_2.met

The files '*serialnumber.txt*' describe the single QC test and look like this:

1 GOOD MLS

Response GOOD

2 GOOD MET

Voltage:0.775Vrms GOOD

THD:0.006% GOOD

06-06-02 6.46.24

UNIT N. 102 GOOD

14.7.3 AUTOSAVED DATA FILES

Again supposing we are in the situation of the preceding paragraph let's see how data files are saved. As it can be seen from the report files our QC test consists of a MLS and a Multimeter measurement. As the MLS test is defined **before** the Multimeter inside the script then it assumes number 1 as single QC test while the Multimeter test assumes number 2; this is already clear from the report files above.

After two units tested we find the following measurement files:

'101_1.mls'

'101_2.met'

'102_1.mls'

'102_2.met'

As you see the QC **single test numbering** is integral part of the name of the autosaved data file.

14.7.4 WYSIWYG OPERATION

Wysiwyg (i.e. "what you see is what you get") operation is the way the QC processor saves and exports data files while executing quality control. Setting WYSIWYG=1 under [GLOBALS] results in files saved as you see them on screen, with all the processing

peculiar to QC applied. For example if a frequency response is executed with MODE=DIFFERENCE active (i.e. divided by the reference) than the saved file will be divided by the reference, if wysiwyg is active, otherwise no.

14.7.5 STATISTICAL INFORMATION ON MEASURED DATA

Statistical information characterizing the production can be obtained by CLIOwin using the STATISTICS keyword under [GLOBALS].

CLIOwin will save, under the report directory, the following files:

- One file named '**data_table.txt**' with statistical informations on all the measured parameters.
- One file named '**avg_testnumber.txt**' per each response test defined containing the average response for that test.
- One file named '**sdmax_testnumber.txt**' per each response test defined containing the average response plus two times the standard deviation for that test.
- One file named '**sdmin_testnumber.txt**' per each response test defined containing the average response minus two times the standard deviation for that test.

The statistical files keep track of the all the units saved within a batch even if the production is stopped and then restarted.

Let's now see how the 'data_table.txt' looks like; supposing the same case of 14.7.2, after two tests, we would have the following:

```
SN Voltage THD
101 0.775 0.006
102 0.775 0.006
```

```
Avg 0.775 0.006
SDMax 0.776 0.006
SDMin 0.775 0.006
```

The other response files representing average and standard deviation curves may be imported within each control panel with the Import feature recallable with **Shift-F3**.

14.7.6 SERIAL NUMBER COHERENCE

There are several ways to handle the serial numbers of your devices and to maintain their coherence through all the production of one batch.

Before starting a test it is possible to input manually the serial number thus forcing it; to do this just click on the **S_N** button.


The operator can be prompted for serial number input using the [SNINPUT] keyword.

It is possible to avoid that a bad unit increases the serial number using the INCREASEONBAD keyword.

Set INCREASEONBAD=0 if you want that only good units participate to serial number, report, statistical and autosave management.

The operator, under her or his judgement, can force the final result of a bad test if the keyword PROMPTFORGOOD=1 is used.

14.7.6 THE SKIP LAST BUTTON

When a QC test is finished it is also possible to null its result pressing the Skip Last  button. All information saved with the test will be erased comprising serial number increment and statistical data. The production report will mark the unit as 'SKIPPED'.

14.8 INTERACTING WITH EXTERNAL HARDWARE

The interaction with an external hardware gives CLIOwin the possibility of realizing semi or fully automatic production lines QC tests. Several keywords have been introduced to implement this functionality (see to reference section for a complete listing).

14.8.1 INPUT SENSITIVITY AND OUTPUT VOLTAGE CONTROL

As we have already seen it is of fundamental importance to correctly set CLIO's input sensitivity and output level (see 5.4). The IN and OUT keywords are used for this. The script below sets the input sensitivity at 10dBV and output level at 0dBu. These numbers directly appear also in the main tool bar of CLIOwin.

```
...  
IN=10  
OUT=0  
...
```

The OUTUNITS keyword can be used, under [GLOBALS], to define the output level unit of measure; you may choose either V, dBV or dBu; default is dBu. To output 1V simply write:

```
[GLOBALS]  
OUTUNITS=V  
...  
OUT=1  
...
```

If you feed the output to a power amplifier the resulting signal at amplifier terminals will be amplified by the gain of the amplifier. It is possible to take this effect into account and specify the output level directly at the amplifier in the particular case you are using a CLIOQC Amplifier&SwitchBox. The following script can be used to set 2.83V at the output of the amplifier.

```
[GLOBALS]  
OUTUNITS=V  
...  
OUTQCBOX=2.83  
...
```

14.8.2 SC-01 DC OUTPUT CONTROL

The SC-01 Signal Conditioner has the capability of superimposing a DC voltage to the generated signal (see 5.4). It is possible to manage this DC voltage with the DCON and DCV keywords. The script below sets a 0.5V DC at SC-01 channel A output.

```
[PERFORM]  
DCV=0.5  
DCON=1
```

If you feed the output of the SC-01 to a DC coupled amplifier the resulting DC voltage, if present, at amplifier terminals will be amplified by the gain of the amplifier. It is possible to take this effect into account and specify the DC voltage directly at the amplifier in the particular case you are using a CLIOQC Amplifier&SwitchBox. The following script can be used to have 5V DC at the output of the amplifier.


```
[PERFORM]
DCVQCBOX=5
DCON=1
```

14.8.3 CLIOQC AMPLIFIER&SWITCHBOX CONTROL

Using a CLIOQC amplifier&switchbox it is possible to setup powerful QC environment like the one depicted in the example 6 (see 14.9.6) where it is shown the simultaneous control of near and far field responses and impedance.

Custom controls have been implemented to easily control all the internal functions of this unit:

- [SETINPUT1] Selects input 1 of the CLIOQC Ampli&SwitchBox.
- [SETINPUT2] Selects input 2 of the CLIOQC Ampli&SwitchBox.
- [SETINPUT3] Selects input 3 of the CLIOQC Ampli&SwitchBox.
- [SETINPUT4] Selects input 4 of the CLIOQC Ampli&SwitchBox.
- [SETINPUT5] Selects input 5 of the CLIOQC Ampli&SwitchBox.
- [SETINPUT6] Selects input 6 of the CLIOQC Ampli&SwitchBox.
- [SETINPUT7] Selects input 7 of the CLIOQC Ampli&SwitchBox.
- [SETINPUT8] Selects input 8 of the CLIOQC Ampli&SwitchBox.
- [SETIMPEDANCE] Selects impedance mode of the CLIOQC Ampli&SwitchBox.
- [SETISENSE] Selects I Sense mode of the CLIOQC Ampli&SwitchBox.

14.8.4 EXTERNAL TRIGGER


It is possible to trigger the QC tests sequence with an external TTL signal wired to the PC parallel printer port. This operation is controlled by the External Trigger button  in the QC control panel and by the **MANUAL** keyword inside the QC script.

Fig.14.41 shows a foot pedal switch and diagrams its connection to the PC to obtain the control of the QC test.

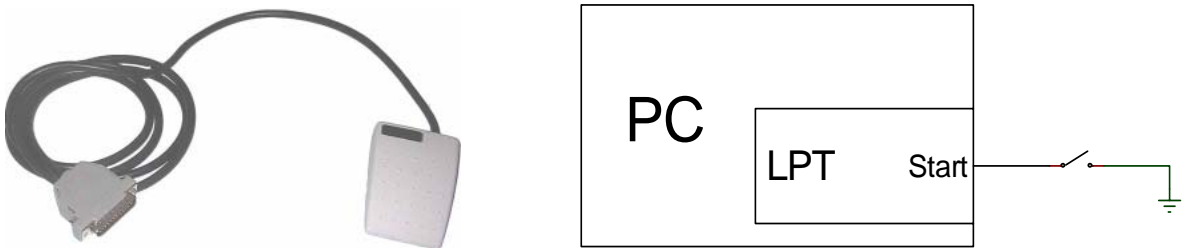


Figure 14.41

The QCBox Model4 has a dedicated input 'PEDAL IN' that can be used to connect the external foot pedal or trigger signal.



The following lines are needed inside a script file to enable a switch (or externally generated TTL signal) to start and continue a QC measurement.

```
[GLOBALS]
...
...
MANUAL=0
```

Please refer to 14.8.7 and to the commands reference for more details on TTL input signal management.

14.8.5 SIGNALS GENERATION

It is possible to define the status of the bits of the active parallel port thus generating TTL signals controlled by the software; the following is a list of the kind of signals possible:

- signals output at startup (INITIALBITS)
- signals conditioned by the result of a single measure ([IF LAST GOOD], [IF LAST BAD])
- signals conditioned by the global result ([IF ALL GOOD], [IF ALL BAD])
- unconditioned signals ([PERFORM])

Let's see an example of generation of external signals conditioned by the result of the measurement:

```
[GLOBALS]
...
...
INITIALBITS=0
[FFT]
...
...
[MLS]
...
...
[IF LAST BAD]
BIT=3
BITVALUE=1
DELAY=200
[IF LAST GOOD]
BIT=3
BITVALUE=0
DELAY=200
[IF ALL GOOD]
BIT=1
BITVALUE=1
[PERFORM]
BIT=0
```

```

BITVALUE=1
DELAY=200
[PERFORM]
8BITVALUE=0

```

This example defines a signal high on bit 3 if the MLS test performs bad, a signal high on bit 1 if all the tests are OK and an unconditioned pulse of 200 ms on bit 0 that may be used to signal the end of the QC test sequence.

Referring to Figure 14.42 we can see the time signal of the three bits in the two possible cases A and B; in case A the MLS test performed bad and in case B good.

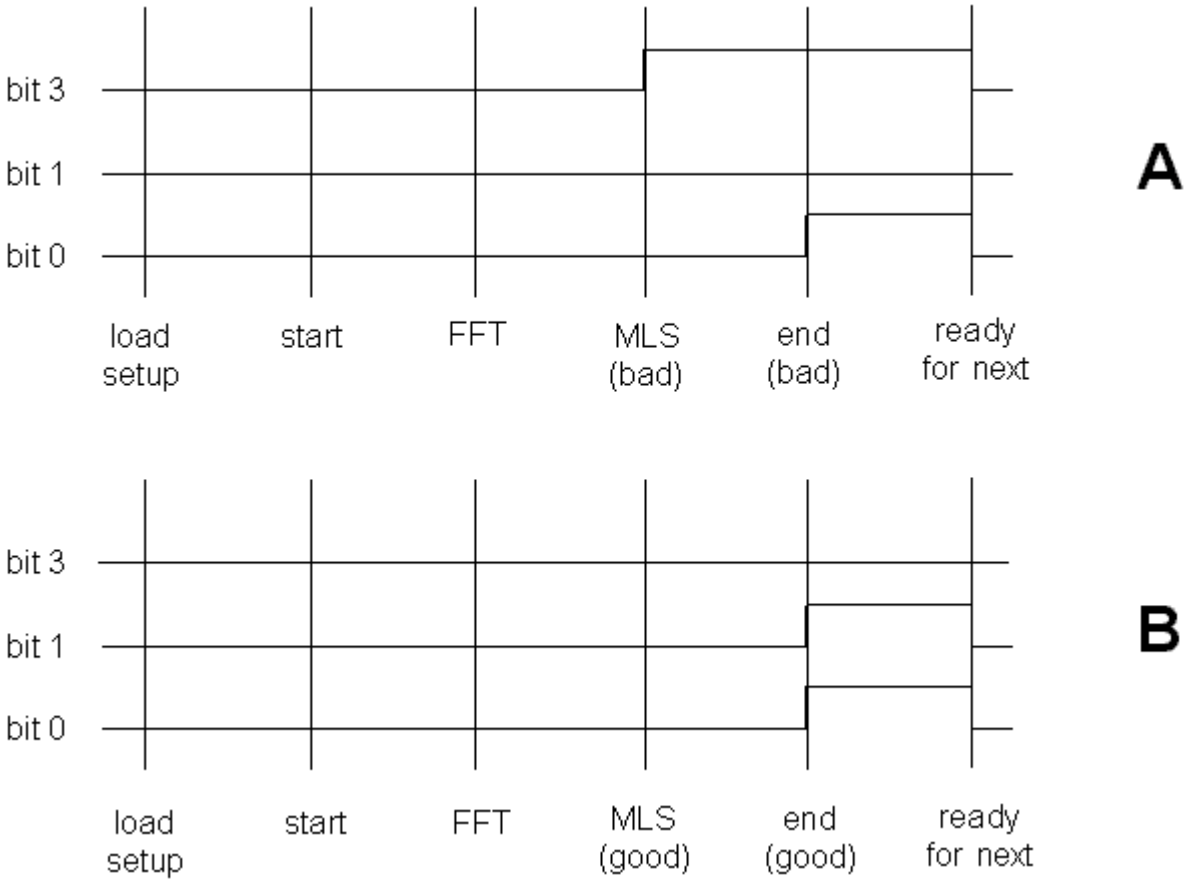


Figure 14.42

In the example shown each single bit of the parallel port was controlled separately by means of the BIT and BITVALUE keywords; it is also shown how to simultaneously control the 8 bits with the 8BITVALUE keyword.

In the next example the value of 33 (decimal) is directly output, thus setting bits 0 and 4 to one and all the others to zero.

```

[PERFORM]
8BITVALUE=33

```

14.8.6 TIME DELAYS GENERATION

It is possible to define a time delay in any point of a script file with the following definition:


```

[PERFORM]
DELAY=200

```

In this example the QC sequence waits for 200 millisecond when encountering these keywords. In the previous paragraph you can see also the possibility of mixing time delays with signals definitions in order to generate pulses.

14.8.7 PARALLEL PORT SIGNALS MANAGEMENT

The TTL signals generated with the active parallel printer port of the PC may be interactively controlled by means of the External Hardware menu recallable with **Shift-F4**. After opening this box press the Direct TTL Control button  and you obtain the control panel shown in fig 14.43. To get TTL signals operation please select a parallel port among the available ones.

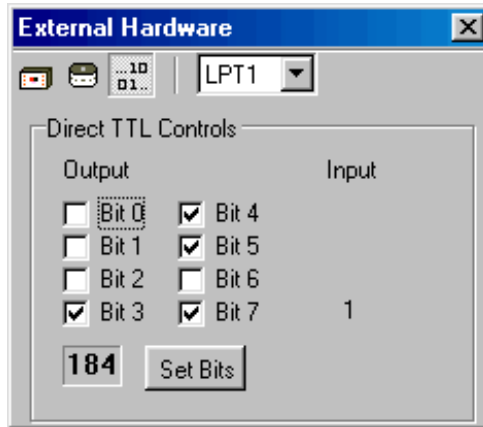


Figure 14.43

The Direct TTL Controls dialog lets you set the status of the eight output bits using the appropriate check boxes while triggering it with the Set Bits button; a decimal representation of the output binary word is also present. On the left side it is reported the status of the input start bit.

The pinout of the standard parallel port is shown in fig. 14.44; note the eight output bits and the start trigger pulse in input.

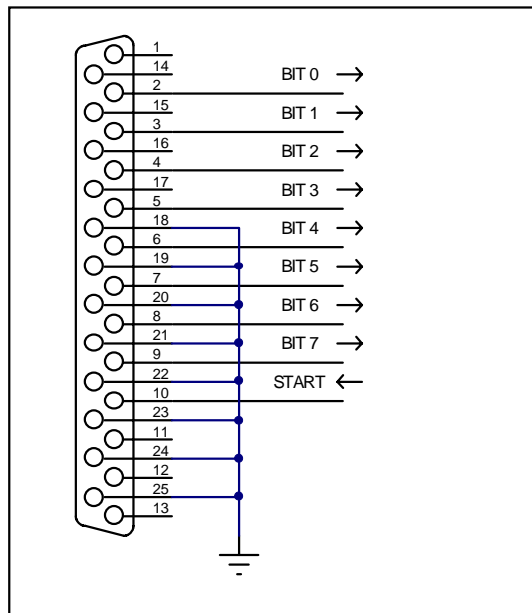


Figure 14.44

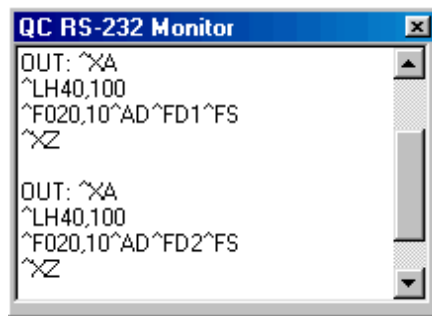
14.8.6 RS-232 SERIAL PORT CONTROL

During QC execution it is possible to control serial devices, like label printers, connected via an RS-232 link to your PC. You can select and configure a COM port for QC control within the File>Setup>QC panel (see 6.3.6).

The following script can be used to print a label at the end of a QC test if the result of the test is good; the printing commands refer to a Zebra Z4M printer.

```
[GLOBALS]
OPENSERIAL=1
SERIALMONITOR=1
...
...
...
...
...
...
[IF ALL GOOD]
SERIALOUT=^XA^LH40,100,^F020,10^AD^FD@SERIALNUMBER^FS^XZ
```

Note the @SERIALNUMBER acronym that is used to output the current serial number. It is possible to activate, mainly for debugging purposes, a monitor window that echoes RS-232 activity; to do this use the SERIALMONITOR keyword.



The same text output in the above example could be saved in an ASCII file and loaded with the SERIALOUTFILE keyword:

```
...
...
[IF ALL GOOD]
SERIALOUTFILE=SERIAL.TXT
```

14.9 LEARNING CLIOWIN QC WITH EXAMPLES

14.9.1 EXAMPLE 1: QC OF A MICROPHONE PREAMPLIFIER

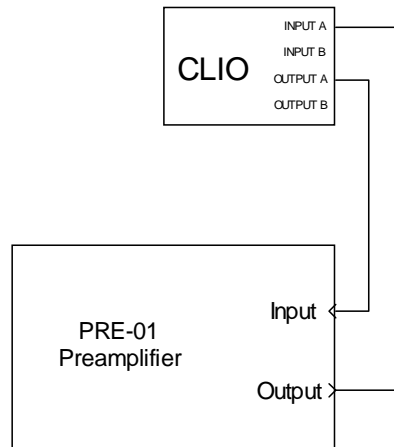


Figure 14.45

This example is taken from our internal QC procedure for the PRE-01 Microphone Preamplifier. Figure 14.45 shows the connections required. The PRE-01 features three weighting filters and two gain positions. This test is a representative case of the following requirements:

- 1) The limits are **ABSOLUTE** as they are taken from the IEC tables for the specified tolerance. Since the perfect device has still to be built it is not possible to use relative limits from a real life measured reference.
- 2) The IEC specifies a response in term of a 0 dB at 1kHz. The absolute level at 1kHz is however left to the test procedure. As we want to perform the test near the highest level the device is able of accept, we need to use the **PROCESS** feature to shift the real measure to the specs level.
- 3) Changing in switches position is required during test. We have therefore to use the **INTERACTIVE** feature.
- 4) A level regulation is required to align the gain at 1kHz with and without filter. This brings in the **LOOP** feature of the **[MET]** multimeter test.
- 5) Its very difficult for the operator to set switch accordingly to the next test to be performed. The **PERFORM** and **MESSAGE** feature greatly simplifies this, avoiding errors.

The QC script, reported here with comments, allows the check of the filters response against Type 1 tolerance specification. It also check for +/- 0.2 dB gain tolerance of the gain switch in both position. As an additional features allows, within the test, to adjust a variable gain trimmer that has to be settled; this procedure, **LOOP**, also ends with a check of the adjusted level to be within +/- 0.2 dB. At every level check a distortion test, **THD** defined in the LEV1.LIM file, is performed. As a general rule a QC procedure is defined from one QC file (.qc extension) and several limits file (.lim extension) declared in the qc file. Process files (.mpro or .spro) are also involved here and these are the only ones not specifically QC related. It is a good idea to dedicate a directory for each QC test. The files involved here are:

PRE01.QC

LEV1.LIM
A.LIM
B.LIM
C.LIM
ASHIFT.SPRO

You can find them in the '\\DATA\EXAMPLE1' directory under the installation directory.

```
[GLOBALS]
COMPANY=AUDIOMATICA S.R.L. FLORENCE
TITLE=PRE01 TEST PROCEDURE
INTERACTIVE=1
SAVEONBAD=1
```

```
[PERFORM]
MESSAGE=FILTER OFF DIP ON OFF OFF OFF
```

```
[MET]
OUT=2.44
IN=10
REFERENCE=FILTER.MET
LIMITS=LEV1.LIM
```

```
[PERFORM]
MESSAGE=FILTER ON DIP ON OFF OFF OFF
```

```
[MET]
OUT=2.44
IN=10
REFERENCE=FILTER.MET
LIMITS=LEV1.LIM
LOOP=1
```

```
[PERFORM]
MESSAGE=FILTER ON DIP ON OFF OFF ON
```

```
[MET]
OUT=-17.56
IN=10
REFERENCE=FILTER.MET
LIMITS=LEV1.LIM
```

```
[SIN]
OUT=-10
IN=10
REFERENCE=A.SIN
LIMITS=A.LIM
PROCESS=ASHIFT.SPRO
```

```
[PERFORM]
MESSAGE=FILTER ON DIP OFF ON OFF ON
```

```
[SIN]
OUT=-10
IN=10
```

REFERENCE=A.SIN
LIMITS=B.LIM
PROCESS=ASHIFT.SPRO

[PERFORM]

MESSAGE=FILTER ON DIP OFF OFF ON ON

[SIN]

OUT=-10

IN=10

REFERENCE=A.SIN

LIMITS=C.LIM

PROCESS=ASHIFT.SPRO

[PERFORM]

MESSAGE=SET DEFAULT SETTINGS FILTER OFF DIP ON OFF OFF ON

14.9.2 EXAMPLE 2: THE AMPLIFIER&SWITCHBOX UNDER QC

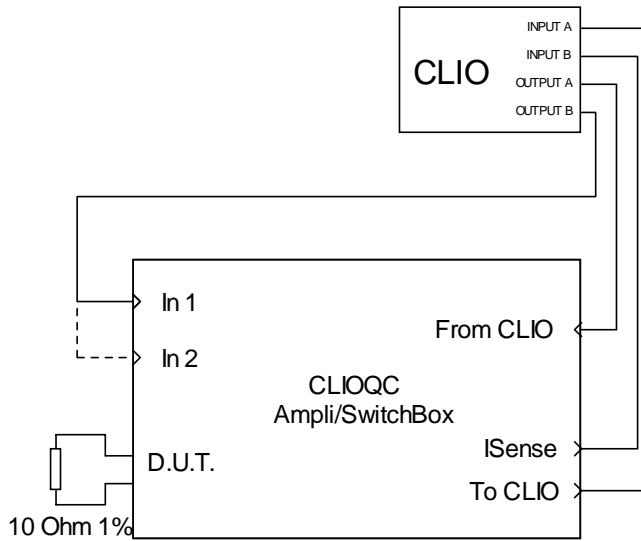


Figure 14.46

This example details the quality control procedure that Audiomatica uses to test its production of CLIOQC Amplifier&Switchbox.

A precision 100Ohm 2W 1% resistor is needed and must be connected across DUT terminals. The procedure, executed in Interactive mode, guides the operator and requests the manual connection of the unit; the cable coming from output B of CLIO must be swapped during the test between input 1 and 2.

The test begins with two impedance measurements, the first executed in ISense Mode, the second executed in Internal Mode. Then it is performed a THD measurement with FFT and finally the frequency response of each input channel.

Note the keywords used to alternatively mute CLIO's output.

```
[GLOBALS]
COMPANY=AUDIOMATICA S.R.L. FLORENCE
TITLE=QCBOX TEST PROCEDURE
INTERACTIVE=1

[PROMPT]
MESSAGE=CONNECT:
MESSAGE2=[OUTA->FROM CLIO][INA->TO CLIO][OUTB->CH1][INB->ISENSE]

[PROMPT]
MESSAGE=PLACE 10 OHM 1% RESISTOR ACROSS D.U.T. TERMINALS

[SETIMPEDANCE]
[SETMUTE]

[PERFORM]
DELAY=500

[SIN]
```

```
OUT=0
IN=-20
REFERENCE=IMPEDANCE.SINI
LIMITS=IMPEDANCE.LIM
```

```
[SETINPUT1]
```

```
[PERFORM]
DELAY=500
```

```
[SIN]
OUT=10
IN=-20
REFERENCE=ISENSE.SINI
LIMITS=IMPEDANCE.LIM
```

```
[FFT]
OUT=10.0
IN=-10
ACQUISITIONDELAY=200
REFERENCE=FFT.FFT
LIMITS=FFT.LIM
```

```
[RESETMUTEB]
[SETMUTEA]
```

```
[PERFORM]
DELAY=500
```

```
[SIN]
OUT=10
IN=10
REFERENCE=CH.SIN
LIMITS=CH.LIM
```

```
[PROMPT]
MESSAGE=CONNECT:
MESSAGE2=[OUTB -> CH2]
```

```
[SETINPUT2]
```

```
[PERFORM]
DELAY=500
```

```
[SIN]
REFERENCE=CH.SIN
LIMITS=CH.LIM
```

```
[RESETMUTEA]
```

You can find the files of this example in the '`\DATA\EXAMPLE2`' directory under the installation directory.

14.9.3 EXAMPLE 3: A FOUR-WAYS CROSSOVER

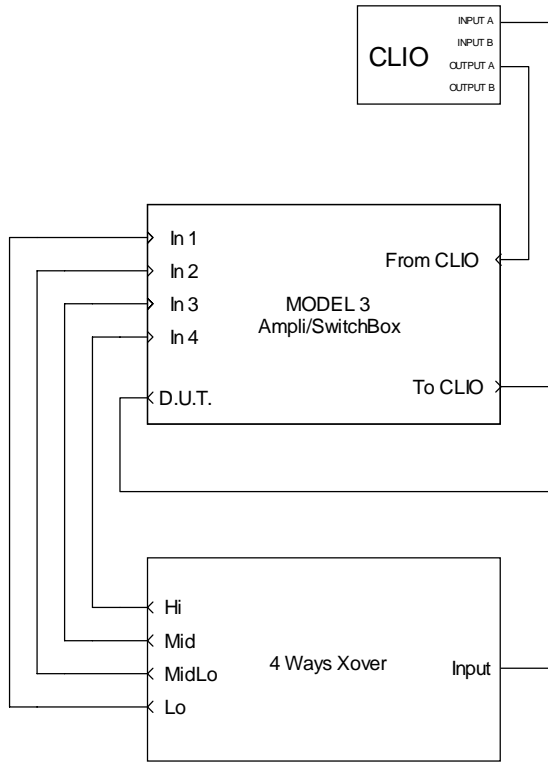


Figure 14.47

The test setup of Fig.14.47 shows us the application of an 8 input CLIOQC Model3 Amplifier&Switchbox to assess the quality of a production of a 4-ways crossover.

The following self-explaining script implements the procedure required to tests the frequency response of each way; to be noted are the unique input and output settings under [GLOBALS].

```
[GLOBALS]
COMPANY=MY COMPANY
TITLE=4-WAYS CROSSOVER QUALITY CONTROL
OUT=0.0
IN=10
```

```
[SETINPUT1]
```

```
[MLS]
REFERENCE=LO.MLS
LIMITS=LO.LIM
```

```
[SETINPUT2]
```

```
[MLS]
REFERENCE=MIDLO.MLS
LIMITS=MIDLO.LIM
```

```
[SETINPUT3]
```

```
[MLS]
REFERENCE=MID.MLS
LIMITS=MID.LIM
```

```
[SETINPUT4]
```

```
[MLS]
```

```
REFERENCE=HI.MLS
```

```
LIMITS=HI.LIM
```

You can find the files of this example in the '`\DATA\EXAMPLE3`' directory under the installation directory.

14.9.4 EXAMPLE 4: A MEDIUM SIZED PRODUCTION OF A 13CM DRIVER

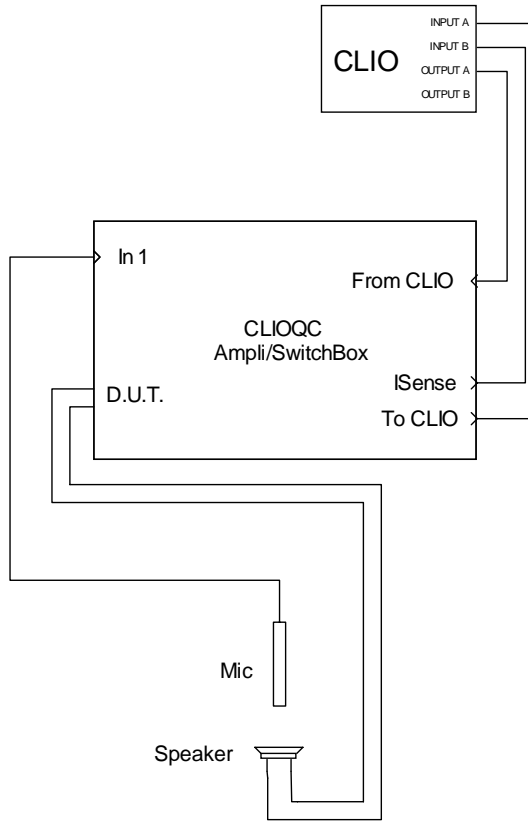


Figure 14.48

We describe here the quality control test of the production of a 13cm woofer (Fig. 14.48).

This procedure accounts for:

- A) Frequency response measurement
- B) Sensitivity check
- C) Impedance measurement
- D) T&S parameters check
- E) Batch management with statistics
- F) Autosaving of all measured drivers

```
[GLOBALS]
COMPANY=MY COMPANY
TITLE=133MM DRIVER QUALITY CONTROL
AUTOBATCH=1
STATISTICS=1
AUTOSAVE=1
```

```
[SETINPUT1]
```

```
[SIN]
OUT=0.0
IN=10
REFERENCE=RESPONSE.SIN
LIMITS=RESPONSE.LIM
```

```
[SETISENSE]
```

```
[SIN]  
OUT=0.0  
IN=10  
REFERENCE=IMPEDANCE.SINI  
LIMITS=IMPEDANCE.LIM
```

Inside the '**RESPONSE.LIM**' file we find the section defining the sensitivity check.

```
[LEVEL]  
UPPER=3  
LOWER=-3
```

Inside the '**IMPEDANCE.LIM**' file we find the section defining the T&S parameters check; with the **KNOWNMMD** keyword we implements the simplified estimation method fixing the driver's mass value. The parameters tested are Fs, Qts, Vas, BI, Cms and Zmin.

```
[TSPARAMETERS]  
REDC=3  
DIAMETER=133  
KNOWNMMD=19.75  
FSUPPER=55  
FSLOWER=45  
QTSUPPER=0.6  
QTSLOWER=0.3  
BLUPPER=7  
BLOWER=5  
ZMINUPPER=5  
ZMINLOWER=3  
VASUPPER=13  
VASLOWER=10  
CMSUPPER=0.6  
CMSLOWER=0.3
```

You can find the files of this example in the '**\DATA\EXAMPLE4**' directory under the installation directory.

14.9.5 EXAMPLE 5: A LARGE SIZED PRODUCTION OF A 2CM TELEPHONE DRIVER

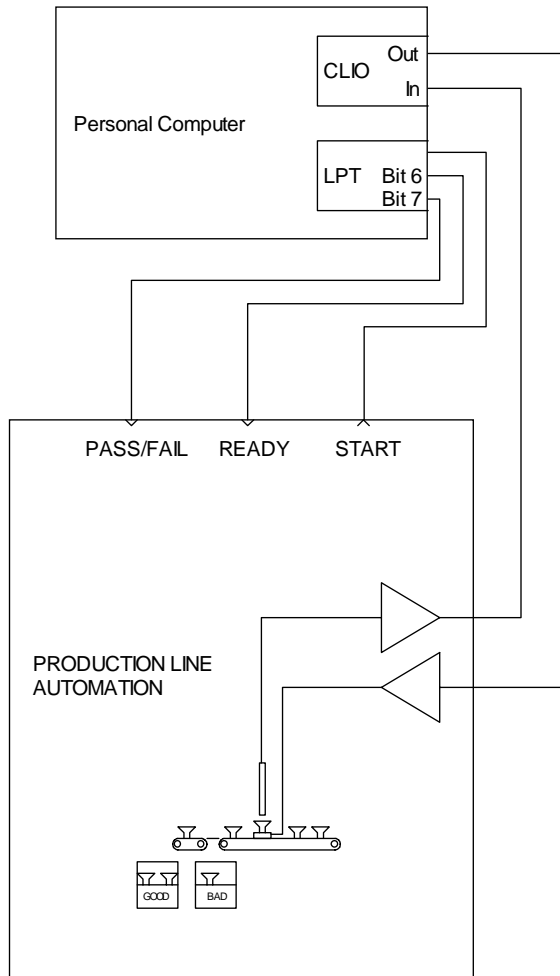


Figure 14.49

We describe here the quality control test of the production of a 2cm telephone driver.

The test setup, in Fig. 14.49, shows us a fully automatic test environment where CLIO is interacting with a production line automation controller.

The automatic interaction is instructed with the **MANUAL** keyword which tells the QC processor to start when triggered by the external automation; on the other end the signals generated by CLIO tell to the automation controller the result of the test and the ready status.

```
[GLOBALS]
MANUAL=0
INITIALBITS=0
OUT=-3.0
IN=10
```

```
[MLS]
REFERENCE=RESPONSE.MLS
LIMITS=RESPONSE.LIM
POLARITY=1
```

```
[IF ALL GOOD]
```

```
BIT=7  
BITVALUE=0
```

```
[ IF ALL BAD ]  
BIT=7  
BITVALUE=1
```

```
[ PERFORM ]  
DELAY=1000  
BIT=7  
BITVALUE=0
```

```
[ PERFORM ]  
BIT=6  
BITVALUE=1
```

```
[ PERFORM ]  
DELAY=1000  
BIT=6  
BITVALUE=0
```

You can find the files of this example in the '`\DATA\EXAMPLE5`' directory under the installation directory.

14.9.6 EXAMPLE 6: A CYCLIC SCRIPT (USED TO MANAGE MY ROGERS LS3/5A TWO-WAYS LOUDSPEAKER PRODUCTION)

This example describes a hardware and software setup to do quality control over a production of loudspeakers units; the responses taken come from our samples of Rogers LS3/5A speakers. The hardware setup is shown in Fig.14.50

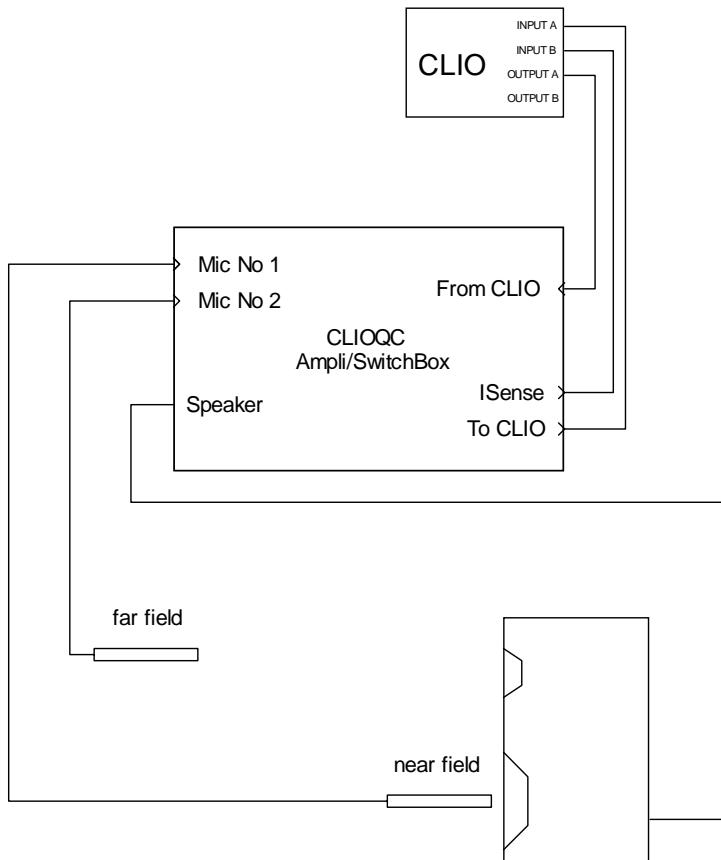


Figure 14.50

As you can see we employ a CLIOQC Amplifier&SwitchBox that connects two measuring microphones, one for near field response and the other for far field response. The internal switcher is used to configure impedance with current sensing or frequency response measurements and to select the correct microphone.

The quality control of such a production relies on what is called **a reference loudspeaker** i.e. a unit which is kept aside the line and retested regularly to give reference data curves for the units under test. These data trace environmental conditions.

To accomplish the recurrent operation of testing the reference loudspeaker CLIOwin QC implements what is called the **cyclic script** i.e. a QC script that is launched by the main script on a timed basis and executed once. When the cyclic script is launched the operator is prompted and the reference unit must be placed on the line.

The three keywords used to define this operation are CYCLIC, REPETITION and CYCLICFIRST under [GLOBALS]. CYCLIC defines the name of the cyclic script; this file must reside in the same directory of the calling one. REPETITION defines after how many units it is run; we put 4 in the example only for letting you test it, this number is chosen after evaluating the particular condition of the production line. CYCLICFIRST, which in the example is commented away, tells the software to execute the cyclic script **before**

the first run of the main script; this is useful to set known conditions at the beginning of a QC session.

```
[GLOBALS]
CYCLIC=ROGERSCYCL.QC
;CYCLICFIRST=1
REPETITION=4
OUT=0
IN=-20
```

The rest of the main script for producing my LS3/5As deals with the three actual measurements for testing nearfield, farfield and impedance data; the first two are done with MLS, the third with Sinusoidal. Before each measurement definition the relative commands that set the correct function of the Amplifier&SwitchBox; note that the impedance is done in 'ISense' mode.

```
[SETINPUT2]
```

```
[MLS]
REFERENCE=NEARFIELD.MLS
LIMITS=NEARFIELD.LIM
```

```
[SETINPUT1]
```

```
[MLS]
REFERENCE=FARFIELD.MLS
LIMITS=FARFIELD.LIM
```

```
[SETISENSE]
```

```
[SIN]
OUT=-6.0
IN=-30
REFERENCE=IMPEDANCE.SINI
LIMITS=IMPEDANCE.LIM
```

The main QC script end here. It is a fairly simple one, that can be customized for any production of loudspeaker. Let's now see the cyclic script. The basic idea is to execute the same measurements as in the main script and save them with the names of the reference files for the main script itself. AUTOSAVE=1 prepares for saving all the measurements done; SAVEFOLDER= is a particular syntax to set the script directory as the current one.

```
[GLOBALS]
AUTOSAVE=1
SAVEFOLDER=
OUT=0
IN=-20
```

The rest of the cyclic script resembles the main script with the difference that, after each measurement, we define the name of the file to be saved and force it to be equal to the name of the reference file; in this way the reference file itself is updated. SAVEPROMPT=1 instructs the QC processor to prompt for user acceptance of the save operation; this is useful for validating the procedure and avoiding errors.

```
[SETINPUT2]
```

```
[MLS]
REFERENCE=NEARFIELD.MLS
LIMITS=NEARFIELD.LIM
SAVENAME=NEARFIELD
SAVEPROMPT=1
[SETINPUT1]
```

```
[MLS]
REFERENCE=FARFIELD.MLS
LIMITS=FARFIELD.LIM
SAVENAME=FARFIELD
SAVEPROMPT=1
```

```
[SETISENSE]
```

```
[SIN]
OUT=-6.0
IN=-30
REFERENCE=IMPEDANCE.SINI
LIMITS=IMPEDANCE.LIM
SAVENAME=IMPEDANCE
SAVEPROMPT=1
```

You can find the files of this example in the '**\DATA\EXAMPLE6**' directory under the installation directory.

14.10 QC SCRIPT SYNTAX REFERENCE

14.10.1 KEYWORDS FOR GENERAL SETTINGS

NOTE: "**SCRIPTDIR**" means the directory where the QC script is saved.

[GLOBALS]

Starts a section containing settings and definitions valid for the whole test sequence.

AUTOBATCH

=1 Enables automatic batch naming. The name of the production batch is set equal to the current name of the folder where the QC script is saved (SCRIPTDIR).

=0 Does not perform autobatch. If omitted defaults to 0.

AUTOSAVE =1 Autosaves all measurements. Applies to all measurements.

=0 Does not perform autosave. If omitted defaults to 0.

BATCH Name of the production batch. See also AUTOBATCH and SAVEFOLDER.

CYCLIC Name of the cyclic script. The cyclic script is executed every REPETITION times instead of the actual script. All measurements executed inside the cyclic script do not take part in production report, batch management and serial numbering. See also CYCLICFIRST.

CYCLICFIRST

=1 Executes the cyclic script before executing the QC test itself.

If omitted defaults to 0 i.e. no cyclic script executed first.

Refer also to CYCLIC and REPETITION for defining the cyclic script behavior.

COMPANY Text used as the first title of the QC control panel. Usually the company name.

DCON =1 sets DC voltage superimposed to channel A output active.

=0 sets DC voltage to 0.

If omitted defaults to 0.

DCV Value of output DC voltage to be set (see DCON).

DCVQCBOX

Value of output voltage to be set (see DCON) taking into account QCBox gain. This is the DC voltage that will be present at QCBox output..

DELAY Value in milliseconds of a pause to be performed.

DISPLAY =1 displays the result of each measurement.

=0 executes all the measurements without displaying.

If omitted defaults to 0 i.e. NOT DISPLAY.

DISPLAYONBAD

=1 displays the measurement if bad. Applies to all the measurements.

=0 Not active. If omitted defaults to 0.

DISPLAYTIME

Approximate time of display (in ms) when in DISPLAY mode.

- IN** Sets the input sensitivity; if omitted autorange is activated.
- INITIALBITS**
8-BIT binary value that will be output at startup before QC script execution.
- INCREASEONBAD**
=1 Increases serial number when unit is bad.
=0 Does not increase serial number when unit is bad.
If omitted defaults to 1 i.e. increases on bad.
- INTERACTIVE**
=1 displays the result of each measurement and prompts.
=0 executes all the measurements without prompting.
If omitted defaults to 0 i.e. NOT INTERACTIVE.
- MANUAL** =1 starts the QC sequence manually (pressing Go).
=0 the sequence is started by an external trigger signal.
If omitted defaults to 1 i.e. MANUAL.
- MESSAGEONBAD**
Text to be displayed when unit performs bad.
If omitted defaults to 'BAD'
- MESSAGEONGOOD**
Text to be displayed when unit performs good.
If omitted defaults to 'GOOD'
- OPENSERIAL**
Opens the QC COM port for serial communication. See 6.3.6 for RS-232 settings. See also SERIALMONITOR.
- OUT** Sets the generator output level (with OUTUNITS defined under [GLOBALS]).
- OUTQCBOX**
Sets the generator output level taking into account QCBox gain (with OUTUNITS defined under [GLOBALS]). This is the level that will be present at QCBox output.
- OUTUNITS** Sets the unit of measure of the output level. It is possible to set dBu, dBV or V.
If omitted defaults to dBu.
- PHANTOM** =1 Switches phantom power supply on.
=0 Switches phantom power supply off. If omitted defaults to 0.
Valid through all the QC test sequence.
- PROMPTFORGOOD**
=1 Prompts when unit is bad for user acceptance and overrides result.
=0 No prompt when unit is bad.
If omitted defaults to 0 i.e. no prompt.
- REPETITION**
Number representing the frequency of execution of the cyclic script.
- SAVEBINARY**
=1 saves also in binary format if SAVETEXT=1. Ignored if used alone. Applies

to all the measurements. If omitted defaults to 0. Remember that if neither SAVETEXT nor SAVEBINARY are specified the default format is binary.

SAVEFOLDER

Forces the name of the autosave directory.

If omitted the default autosave directory is SCRIPTDIR\AUTOSAVE if no batch name is defined, otherwise it is SCRIPTDIR\BATCH where BATCH is the name of production batch.

If you desire to save files in the script directory itself use the particular syntax "SAVEFOLDER=" i.e. leave blank the right part.

SAVEONGOOD

=1 Autosaves all measurements, if global result is good. Applies to all measurements.

=0 Does not perform autosave. If omitted defaults to 0.

If you want to autosave also in case of bad measurement add the keyword SAVEONBAD=1 under [GLOBALS].

SAVEONBAD

=1 Autosaves all measurements, if global result is bad. Applies to all the measurements.

=0 Not active. If omitted defaults to 0.

Refer also to SAVEONGOOD and AUTOSAVE.

SAVETEXT =1 saves ASCII file instead of binary format. Applies to all the measurements.

=0 saves files with normal binary format. If omitted defaults to 0.

SERIALMONITOR

=1 Activates the RS-232 monitor panel during QC execution.

=0 Does not activate the RS-232 monitor panel. If omitted defaults to 0.

STARTSIGLOGIC

Defines the logic of the external trigger signal.

=1 is active high.

=0 is active low.

If omitted defaults to 0 i.e. active low.

STATISTICS

=1 Enables statistical data files generation.

=0 Disables statistical data files generation. If omitted defaults to 0.

STATFILESRES

Number of data lines present in statistical frequency files; maximum is 2048.

TITLE Text used as the second title of the QC control panel. Usually a description of the test.

WYSIWYG =1 Enables wysiwyg processing.

=0 Disables wysiwyg processing. If omitted defaults to 0.

14.10.2 KEYWORDS FOR MEASUREMENTS SETTINGS

- [FFT] Starts a section containing the definition of an FFT measurement.
- [MLS] Starts a section containing the definition of an MLS measurement.
- [SIN] Starts a section containing the definition of a Sinusoidal measurement.
- [MET] Starts a section containing the definition of a Multimeter measurement.

ACQUISITIONDELAY

Approximate time in milliseconds that is expected before executing the measurement after switching the generator on. Valid only for FFT and Multimeter measurements.

COMMENT Input a comment used by the report files.

DCON =1 sets DC voltage superimposed to channel A output active.
=0 sets DC voltage to 0.
If omitted defaults to 0.

DCV Value of output DC voltage to be set (see DCON).

DCVQCBOX

Value of output voltage to be set (see DCON) taking into account QCBox gain. This is the DC voltage that will be present at QCBox output..

DISPLAYONBAD

=1 displays the measurement if bad.
=0 Not active. If omitted defaults to 0.

IN Sets the input sensitivity; if omitted autorange is activated.

LIMITS Name of the limits file.

LOOP =1 Loops the current Multimeter measurement to let the user perform an adjustment on the unit under test.
=0 Executes the Multimeter measurement and exits.
If omitted defaults to 0.

MODE =DIFFERENCE Executes the measurement referring it to the reference file.
Valid only for MLS and Sinusoidal measurements.
=NORMAL Executes the measurement normally.
If omitted defaults to NORMAL

OUT Sets the generator output level (with OUTUNITS defined under [GLOBALS]).

OUTQCBOX

Sets the generator output level taking into account QCBox gain (with OUTUNITS defined under [GLOBALS]). This is the level that will be present at QCBox output.

POLARITY =1 Executes a polarity check. Valid only for an MLS measurement.
=0 Not Active. If omitted defaults to 0.

PROCESS Name of a process file to be applied to the test. Valid only for MLS and Sinusoidal measurements.

REFERENCE

Name of the reference file.

SAVEBINARY

=1 saves also in binary format if SAVETEXT=1. Ignored if used alone.
If omitted defaults to 0. Remember that if neither SAVETEXT nor SAVEBINARY are specified the default format is binary.

SAVENAME Name of the file to be saved.

SAVEONBAD

=1 automatically saves the current measurement if bad.
=0 Not active. If omitted defaults to 0.
Refer also to AUTOSAVE.

SAVEONGOOD

=1 Autosaves the current measurements, if result is good.
=0 Does not perform autosave. If omitted defaults to 0.
If you want to autosave also in case of bad measurement add the keyword SAVEONBAD=1.

SAVEPROMPT

=1 Prompts the user for file name input.
=0 Autosaves without prompting.
If omitted defaults to 0.

SAVETEXT =1 saves ASCII file instead of binary format.
=0 saves files with normal binary format. If omitted defaults to 0.

SAVETEXTPARAM

Controls the number of saved frequency points (valid only for MLS)
=0 saves 256 points.
=1 saves 512 points.
=2 saves 1024 points.
=3 saves 2048 points.
If omitted defaults to 0, i.e. 256 points.

14.10.3 KEYWORDS FOR CONDITIONAL EXECUTION

[PERFORM]

Starts a section always executed, unconditioned by the result of the preceding measurement. See below for the keywords possible within.

[IF LAST GOOD]

[IF LAST BAD]

Starts a section conditioned by the result of the preceding measurement.

[IF *..parameter..* GOOD]

[IF *..parameter..* BAD]

Starts a section conditioned by the result of one particular parameter measured during the preceding measurement.

..parameter.. can be one of the following:

2HARMONIC

3HARMONIC

4HARMONIC

5HARMONIC

FREQUENCY

FS

IMD

LEVEL

POLARITY

QTS

QES

QMS

RESPONSE

PRESSURE

THD

VOLTAGE

[IF ALL GOOD]

[IF ALL BAD]

Starts a section conditioned by the global result of the QC sequence.

Note: The following keywords apply to any kind of section for conditional execution.

BIT Number of the bit to be singularly controlled with "BITVALUE".

BITVALUE

Status (=1 or =0) of the bit defined with "BIT".

8BITVALUE

8-BIT decimal value to be output by the currently selected parallel port..

ABORT

Stops the script execution after executing all keywords in the current section. Result is forced bad. See also STOP.

CLOSESERIAL

Closes the QC COM port after serial communication.

- DCON** =1 sets DC voltage superimposed to channel A output active.
=0 sets DC voltage to 0.
If omitted defaults to 0.
- DCV** Value of output DC voltage to be set (see DCON).
- DCVQCBOX**
Value of output voltage to be set (see DCON) taking into account QCBox gain. This is the DC voltage that will be present at QCBox output..
- DELAY** Value in milliseconds of a pause to be performed.
- EXPORTGRAPHICS**
Exports the current measurement to a graphical file. The same file naming convention used for data files is used.
- EXTERNAL** Name of an executable file to be launched. See also PARAMETERS and WAITCOMPLETION.
- IN** Sets the input sensitivity; if omitted autorange is activated.
- MESSAGE** Text to be displayed in a prompting message to the user.
- MESSAGE2** Second line of text to be displayed in a prompting message to the user.
- MESSAGE3** Third line of text to be displayed in a prompting message to the user.
- MESSAGE4** Fourth line of text to be displayed in a prompting message to the user.
- OPENSERIAL**
Opens the QC COM port for serial communication. See 6.3.6 for RS-232 settings.
- OUT** Sets the generator output level (with OUTUNITS defined under [GLOBALS]).
- OUTQCBOX**
Sets the generator output level taking into account QCBox gain (with OUTUNITS defined under [GLOBALS]). This is the level that will be present at QCBox output.
- PARAMETER1**
String to be passed, as first parameter, to the executable defined with "EXTERNAL". Some parameters relative to the QC tests can be passed with the following acronyms:
@SERIALNUMBER passes the current serial number.
@RESULT passes the current result.
@LASTRESULT passes the last test result.
@GLOBALRESULT passes the global test result.
- PARAMETER2**
String to be passed, as second parameter, to the executable defined with "EXTERNAL". See also PARAMETER1 above.
- PARAMETER3**
String to be passed, as third parameter, to the executable defined with "EXTERNAL". See also PARAMETER1 above.

PARAMETER4

String to be passed, as fourth parameter, to the executable defined with "EXTERNAL". See also PARAMETER1 above.

PRINT Prints the current measurement. The default Windows printer is used.

SERIALOUT

ASCII text to be sent to serial device.

You may use some acronyms preceded by @:

@SERIALNUMBER is translated in the current serial number

@DATE is translated in the current date

@TIME is translated in the current time

SERIALOUTFILE

Name of an ASCII file containing text to be sent to serial device.

STOP Stops the script execution after executing all keywords in the current section. Result is unaltered. See also ABORT.

WAITCOMPLETION

=1 The QC script wait for the external program to end before continuing execution.

=0 The QC sequence continue without waiting. If omitted defaults to 0.

14.10.4 KEYWORDS FOR HARDWARE CONTROL

[RESETLOOPA]

Opens internal loop on channel A. Valid only for CLIOwin running PB-4281 PCI card and SC-01 signal conditioner.

[RESETLOOPB]

Opens internal loop on channel B. Valid only for CLIOwin running PB-4281 PCI card and SC-01 signal conditioner.

[RESETMUTEA]

Switches mute for channel A off.

[RESETMUTEB]

Switches mute for channel B off.

[RESETPHANTOM]

Switches phantom power off.

[SETIMPEDANCE]

Selects impedance mode of the CLIOQC Amplifier&SwichthBox.

[SETINPUT1]

[SETINPUT2]

[SETINPUT3]

[SETINPUT4]

[SETINPUT5]

[SETINPUT6]

[SETINPUT7]

[SETINPUT8]

Selects the relative input channel of the CLIOQC Amplifier&SwichthBox.

[SETISENSE]

Selects isense mode of the CLIOQC Amplifier&SwichthBox.

[SETLOOPA]

Closes internal loop on channel A. Valid only for CLIOwin running PB-4281 PCI card and SC-01 signal conditioner.

[SETLOOPB]

Closes internal loop on channel B. Valid only for CLIOwin running PB-4281 PCI card and SC-01 signal conditioner.

[SETMUTEA]

Switches mute for channel A on.

[SETMUTEB]

Switches mute for channel B on.

[SETPHANTOM]

Switches phantom power on.

14.10.5 OTHER KEYWORDS

[SNINPUT]

Prompts the user for serial number input.

[STOP]

Immediately stops the script execution.

14.10.6 KEYWORDS USED IN LIMITS FILES

[ABSOLUTE]

Defines an absolute limit file. This is also the default condition when the [RELATIVE] keyword is not specified.

[FLOATING]

If present forces floating limits curves.

[RELATIVE]

Defines a relative limit file.

[LEVEL] Starts a section defining a check on the sensitivity of the measured curve.

ALIGNFREQ

Align frequency for the sensitivity check. Valid only when ALIGNLEV is specified and it is not ALIGNLEV=REFERENCE. See below.

ALIGNLEV Align level for the sensitivity check. If it is specified "ALIGNLEV=REFERENCE" then the sensitivity check is against the average level of the reference in the band defined by the frequency mask used for the response check. If omitted defaults to ALIGNLEV=REFERENCE.

LOWER Lower limit for the sensitivity check.

UPPER Upper limit for the sensitivity check.

[TSPARAMETERS]

Starts a section defining a Thiele&Small parameters check.

REDC Value (in Ohms) to be input representing the DC resistance of the voice coil. REDC must **always** be specified.

DIAMETER Input value (in mm) specifying the driver diameter. It is needed **only** when testing Cms, Mms, Mmd, Bl, Vas, dBSPL or ZMin; used with one of the fixed parameters: KNOWNMMD or KNOWNMMS or KNOWNCMS. **You must specify only one fixed parameter.**

KNOWNMMD

Input value for the fixed Mmd parameter. It is needed **only** when testing Cms, Mms, Mmd, Bl, Vas, dBSPL or ZMin.

KNOWNMMS

Input value for the fixed Mms parameter. It is needed **only** when testing Cms, Mms, Mmd, Bl, Vas, dBSPL or ZMin.

KNOWNCMS

Input value for the fixed Cms parameter. It is needed **only** when testing Cms, Mms, Mmd, Bl, Vas, dBSPL or ZMin.

FSLOWER Lower limit for Fs.

FSUPPER Upper limit for Fs.

QELOWER Lower limit for Qes.

QEUPPER Upper limit for Qes.

QMLOWER Lower limit for Qms.

QMUPPER Upper limit for Qms.

QTLLOWER Lower limit for Qts.

QTUPPER Upper limit for Qts.

CMSLOWER
Lower limit for Cms.

CMSUPPER
Upper limit for Cms.

MMSLOWER
Lower limit for Mms.

MMSUPPER
Upper limit for Mms.

MMDLOWER
Lower limit for Mmd.

MMDUPPER
Upper limit for Mmd.

BLLOWER Lower limit for Bl.

BLUPPER Upper limit for Bl.

VASLOWER
Lower limit for Vas.

VASUPPER
Upper limit for Vas.

DBSPLLOWER
Lower limit for dB SPL.

DBSPLUPPER
Upper limit for dB SPL.

ZMINLOWER
Lower limit for ZMin.

ZMINUPPER
Upper limit for ZMin.

[UPPER LIMIT DATA]

[LOWER LIMIT DATA]

Start a section containing the frequency mask used for the QC check. The frequency mask has to be defined as a list of N couples like:

Frequency_1	Value_1
.....	
.....	

Frequency_N Value_N

In the case of a multimeter measurement contains several measured parameters value.

It is possible to load frequency data from an external ASCII text file using the FILE keyword.

FILE Name of a text file containing a frequency mask definition.

FREQUENCY

Executes a frequency check. Valid for a multimeter measurement.

IMD Executes an intermodulation distortion check. Valid for a multimeter measurement.

PRESSURE Executes a sound pressure level check. Valid for a multimeter measurement.

THD Executes a total harmonic distortion check. Valid for a multimeter measurement.

VOLTAGE Executes a voltage check. Valid for a multimeter measurement.

[2 UPPER LIMIT DATA]

[2 LOWER LIMIT DATA]

[3 UPPER LIMIT DATA]

[3 LOWER LIMIT DATA]

[4 UPPER LIMIT DATA]

[4 LOWER LIMIT DATA]

[5 UPPER LIMIT DATA]

[5 LOWER LIMIT DATA]

Start a section containing the frequency mask used for the QC check of the single harmonics of a sinusoidal frequency sweep. The presence of the relative section defines the QC check.

The frequency mask has to be defined as a list of N couples like:

Frequency_1 Value_1

.....

.....

Frequency_N Value_N

It is possible to load frequency data from an external ASCII text file using the FILE keyword.

FILE Name of a text file containing a frequency mask definition.

[REFERENCE DATA]

Start a section containing the frequency response used as reference; if present substitute data taken from the reference file (as defined in 14.3). The frequency mask has to be defined as a list of N couples like:

Frequency_1 Value_1

.....

.....

Frequency_N Value_N

It is possible to load frequency data from an external ASCII text file using the FILE keyword.

FILE Name of a text file containing a frequency mask definition.

