QC User Manual

QC

Version 2.0 / 2.0

By KLIPPEL GmbH
KLIPPEL GmbH

Please note!
This Cinese user manual doesn't contain the latest version.
For the updated version please use the English QC user manual!

August 29, 2008

Mendelssohnallee 30, 01309 Dresden, Germany

www.klippel.de

Contents

Introduction 1

1

How to use the manual 1
....1
....3
System Requirements 4
....4
PC 4
PC 4
Amplifier 5
....5
Box Enclosure 5
....5
Production noise 6
....6
Microphone 6
....6

Getting Started 7

7

What's new in Version 2.0? 7
2.0 7
Hardware Installation 9
....9
Parts of the system 9
....9
Connecting the system 11
....11
Software Installation 22
....22
Before you begin 22
....22
Installation 23
....23
Viewing results 23
....23
Requirements 24
....24
What is a database? 24
....24
Viewing the Example database 24
....24
How to open a database? 25
....25
How data is organized? 26
....26
The Desktop 26
....26

Viewing data 27
..... 27
Reports 29
..... 29
First Measurement 29
..... 29
Quick Setup Guide 30
..... 30
Create a Test 30
..... 30
Configure Test 33
..... 33
Limit Setting 38
..... 38
Run Production 42
..... 42
Before use in production 44
..... 44
How to go on (working with the manual) 45
..... 45

Organizing Projects **47**

47

Overview 47
..... 47
QC-Start Tool 48
QC 48
Start up 48
..... 48
Create / Open a Test Setup 48
/ 48
Delete a test 49
..... 49
Create a template 50
..... 50
Synchronizing multiple QC Systems (Master Tests) 52
QC 52
Setup Menu 56
..... 56
Calibrate Menu 57
..... 57
System Menu 57
..... 57
Where is the data? (View Menu) 58
..... 58
Tools Menu 58
..... 58
Start Parameter 58
..... 58
QC Start Configuration 59
QC 59
Remote Configuration 62
..... 62
Single QC System 63
QC 63

Multiple QC Systems 63
QC 63
dB-Lab 64
dB-Lab 64

User Modes **66**

66

Operator 66
..... 66
How to start a test? 66
..... 66
Desktop 67
..... 67
Summary Window 68
..... 68
Control Panel 71
..... 71
Manual Sweep 73
..... 73
Engineer 74
..... 74
Desktop 74
..... 74
Control Panel 76
..... 76
Result Windows 76
..... 76
Window Management 77
..... 77
Property Page Tasks 78
..... 78
Property Page Limits 82
..... 82
Property Page Login 83
..... 83
Programmer 83
..... 83
Administration 85
..... 85
User Administration 85
..... 85
Security 87
..... 87
Starting the QC with Windows 89
QC Windows 89

Test Configuration **90**

90

General Structure 90
..... 90
Test 90
..... 90
Task 91

.....91
Measure.....93
.....93
How does it work together.....94
.....94
Measures and Limits.....95
.....95
Impedance (Basic).....95
.....95
T/S Parameter.....97
T/S 97
Frequency Response (Basic).....98
.....98
Average Level (Basic).....99
.....99
Harmonics / THD.....101
/THD.....101
Rub & Buzz.....105
.....105
Ambient Noise.....108
.....108
Polarity (Basic).....111
.....111
Reference Units.....115
.....115
Noise Check for Reference Units.....116
.....116
Managing Reference DUTs.....117
DUT.....117
Labeling Reference DUTs.....118
DUT.....118
Setting Limits.....119
.....119
Limit Calculation.....120
.....120
General.....120
.....120
Absolute Limits.....120
.....120
Relative Limits.....121
.....121
Shifting Limits.....122
.....122
Standard Deviation.....124
.....124
Jitter.....125
.....125
Cpk / Ppk Limits.....127
Cpk/Ppk 127
Tasks.....127
.....127
Filename Convention.....128
.....128
Test Sequences.....129
.....129
Adding Labels to Tasks.....129

129
SPL+Impedance (Basic) 131
SPL+ 131
SPL 136
136
Impedance (Imp) 141
Imp 141
Preconditioning for Ferrofluid 142
142
Control Task 144
144
Test Signals 146
146
Multitone 146
146
SineSweep 147
147
Test Templates 153
153
Basic Version 154
154
Standard Version 156
156
Golden DUT Handling 157
DUT 157
Selection of Golden DUT 157
DUT 157
Limit calibration 158
158
Serial Number Handling 159
159
Prompt for SN 160
160
Automatic Mode 160
160
Using Barcode 161
161
Routing 161
161
Output Routing 161
161
Input Routing 163
163

Storing Results **167**

167

Overview 167
167
Summary (Short form log file) 167
167
All Results (Database) 169
169
Making Reports 170
170
File Location 170

.....170
Customized formats.....171
.....171

Statistics **172**

172

Online Statistics.....172
.....172
Cpk / Ppk 172
Cpk / Ppk 172
Pass / Failed DUTs.....173
/ DUT 173
Offline Statistics.....173
.....173
Extracting data for processing.....174
.....174
Implementing my own statistics.....175
.....175

Basic, Standard, Programmable Version **177**

177

Differences between versions.....177
.....177
Programmable Version.....178
.....178
Background of programming 178
.....178
What can be modified? 179
.....179
More Information.....179
.....179

Hardware **180**

180

Setup and Configuration.....180
.....180
Calibration / Check of Accuracy 180
/ 180
Production Analyzer Calibration.....181
.....181
Amplifier Gain 183
.....183
Microphone Calibration 184
.....184
Hardware Calibration.....187
.....187
FAQ about calibration.....187
.....187
Firmware Update.....189
.....189
Accessories.....190

.....190
Microphones 190
.....190
Footswitch.....191
.....191
Temperature and Humidity Sensor 191
.....191
Bar Code Reader / Printer 191
/ 191
I/O Connector.....192
/ 192
Start switch.....192
.....192
Pin description 192
.....192
Timing.....193
.....193
Connection of Opto-coupled In- / Outputs.....194
/ 194

Optimizing Performance 195

195

Overview.....195
.....195
SPL Tests 195
SPL 195
Microphone Selection 195
.....195
Measurement Box 196
.....196
Frequency Range 200
.....200
Optimize Rub&Buzz detection 201
.....201
Rub&Buzz Type 204
.....204
Using Level Profile 208
.....208
Optimal Signal Noise Ratio (SNR) 208
SNR 208
SPL Task Limits 210
SPL 210
Impedance 213
.....213
How to find optimal excitation level and time.....213
.....213
Frequency Range 215
.....215
Checking Signals and Fitting 216
.....216
Calculation of Re 217
Re 217
Impedance Limits.....218
.....218

Troubleshooting 219

219

Hardware Problems 219
....219
Self Check at test start fails 219
....219
Amplifier Check Errors 220
....220
Signal Drop Out 221
....221
Performance Test Overview 222
....222
Using the Performance Test Tool 223
....223
Identifying the Problem 225
....225
Fixing the Problem 226
....226
Support Information for Performance Problems 229
....229
Software Problems 230
....230
Task Files not found 230
....230
Installation failed 230
....230
Script Error messages 230
....230

Appendix 232

232

Glossary 232
....232
DUT / Batch / Type 232
DUT / / 232
Ppk / Cpk 232
Ppk / Cpk 232
Quick Klippel-QC Setup Guide 236
Klippel-QC 236
Measurement Technique (Theory) 241
....241
Rub & Buzz 241
....241
Ambient Noise Immunity 246
....246
Maximal SPL 246
SPL 246

Introduction

How to use the manual

The yellow pages in the printed manual give you the most important information for a quick start (See section *Getting Started*).

Installation

To install software and hardware follow the instructions at the beginning of chapter *Getting Started / Hardware Installation*.

First measurement

To check the hardware and software setup go to the section 'First Measurement' in the chapter *Getting Started / First Measurement*. There you will find a step-by-step instruction, that will lead you through your first measurement.

What to read as an operator?

As an operator you should read the section *Operator* in the chapter *User Modes*.

What to read as an engineer or a programmer?

As an engineer / programmer you should read the following chapters to get familiar with the measurement system (minimal reading):

1. Getting Started
2. Project Management
3. User Modes
4. Test Configuration

An engineer should also read the chapter *Hardware*.

A programmer should read additionally the *Programmers Guide* that comes as a separate manual (always available as online help file).

How to visualize data from the example database?

To visualize the data from the example database delivered with the software, or from any other database (from customers or suppliers) read section *Viewing results* in the chapter *Getting Started*.

More information

The Appendix comprises a Glossary and extended information about the measurement technology.

/Hardware Installation

/First Measurement

“ ”

/Operator

1.
2.
3.
4.

“ ”

Viewing results

Concepts

The KLIPPEL QC System is a comprehensive hardware and software solution dedicated to test electro acoustic transducers at the end of the production line. The robust hardware is designed for operation in production environments. It can be integrated in a fully automated line as well as operated manually. The following data can be measured and compared to pass/fail limits:

- Frequency response, absolute level
- Rub & Buzz (impulsive defect distortion)
- Harmonic distortion (THD and Harmonics)
- Statistic process control parameters (Cpk, Ppk)
- Thiele-Small parameters
- Impedance
- Polarity

The software has three access levels (operator, engineer, programmer). An intuitive user interface (translatable to different languages) and smart limit setting algorithms are implemented to shorten training and setup periods for operators and engineers.

The KLIPPEL QC System is highly flexible. Tests can be split into several subtests each with an individual stimulus. This allows shortest test cycles using most critical signals for testing at the physical limits. A scripting language SCILAB (similar to MATLAB®) can be used to change the user interface as well as to implement new measurement ideas easily (in programmable version only).

KLIPPEL's Meta-Hearing Technology provides most sensitive testing of Rub&Buzz defects by isolating the impulsive defect distortion from the regular distortion of motor and suspension. So devices can be tested up to maximal amplitudes where the defect symptoms are almost masked by the regular output.

KLIPPEL QC

/

-
-
- THD
- Cpk, Ppk
- T/S
-
-

3

KLIPPEL QC

SCILAB

MATLAB®

System Requirements

Additionally to the KLIPPEL Production Analyzer hardware and the KLIPPEL QC software the following items are required:

PC

PC

The PC should be used exclusively to control the QC System. Since QC measurements are time critical, any program running parallel to the QC software may disturb the measurements.

Attention: Anti-Virus, Anti-Spy tools and other background software may interfere with a stable operation of the QC software. Disable any background processes that are not necessary.

The PC should meet the following requirements:

- Pentium-IV with Hyper threading or equivalent
- Min. 1024 MB RAM, 2048 MB RAM recommended if long measurement times are required
- 300 MB free disk space (additional disk space for measurement data)
- PC monitor with minimum 1024x768 pixel screen resolution
- Operating system MS Windows XP (Win2000 not supported!)
- USB 1.1 interface
- Firewire (IEEE 1394) interface

KLPPEL KLIPPEL QC

QC QC

QC

QC

PC

- Pentium-IV
- 1024MB 2048MB
- 300MB

- PC 1024x768
- MS Windows XP Win2000
- USB 1.1
- IEEE 1394

PC User Accounts

PC

For installation Administrator rights are required.

For running the software restricted user accounts may be used under the following conditions:

- OS: XP Professional
- The user must be assigned to the *Power User Group* under Windows XP. Ask your system administrator, if you are not sure about your

windows account rights.

.

- XP
- Windows XP
  Windows

Amplifier

A conventional ac-coupled audio amplifier is required for driving the transducer.

Recommended properties:

- Professional amplifier with balanced input.
- No (or switched off) intelligent input protection such as muting or DSP protection.
- No (or switched off) power saving feature (switching off the amplifier for low input).
- No DC coupling.
- AC High-pass Filter Frequency should be at 10 Hz or lower (-3 dB).
- Digital Amplifiers (Class D-Type) may also be used.
- Amplifier should be able to provide the peak values of the electric current and voltage to the loudspeaker without limiting.

Note: Be aware that some Power Amplifier have a considerable DC offset. When testing low current, high impedance driver (telecommunication driver), this offset may degrade your measurement. Please measure the DC offset with no input signal using a standard DC-voltmeter and compare it with the required testing level. It should be less than 3% for normal testing.

:

- DSP
- 10Hz -3 dB
- D

3%

Box Enclosure

Loudspeaker drivers can be tested in closed cavities. This reduces the production noise at the test microphone and ensures reproducible acoustical conditions. Then reflections and damping are almost identical for all tests, which is difficult to guarantee in free air. A box enclosure must have a sufficient size depending on the device to be tested and the sound pressure limit of the microphone.

For more details, see section *Optimizing Performance / SPL Tests / Measurement Box*.

/ SPL / Measurement Box

Production noise

The noise level occurring under production conditions can easily mask the symptoms generated by a defect DUT (Device under Test). In some cases the noise is such high that even the box enclosure and an additional isolated test cabin give not sufficient suppression. The KLIPPEL QC System can then be configured to recognize a corrupted measurement. With a second microphone the ambient sound pressure is measured and the noise at the location of the DUT predicted.

For more details, see section *Optimizing Performance / SPL Tests / Measurement Box*.

DUT

2
DUT KLIPPEL
/SPL */Measurement* Box

Microphone

To achieve a high SNR the acoustical output should be measured in the near field of the DUT. Thus the measurement microphone must be able to measure the expected sound pressure levels without limiting.

The maximum SPL level for each microphone can be entered (during calibration) and a warning is generated, if this level is exceeded.

In section *Hardware / Accessories / Microphones* a list of the provided selection of measurement microphones are given as well as common requirements for third party microphones.

Hints how to calculate the expected maximum sound pressure levels in a box enclosure can be found in the chapter *Appendix / Maximal SPL*

.

DUT

/ */Microphones*

“ / *Maximal* SPL
”

Getting Started

What's new in Version 2.0?

2.0

If you are updating from QC version 1.x, you may find here a short list and links of new features in the new software version:

1. Measure individual harmonics. Please see section *Test Configuration / Measures and Limits / Harmonics / THD*
2. Improved Ambient Noise detection considering the test box attenuation. Please see section *Test Configuration / Measures and Limits / Rub & Buzz /*
   IDD
   / / / /
   Meta Hearing Technology

/SPL *Tests.*

3. Ambient Noise
4. Manual Sine Sweep for subjective tests. Please see section *User Modes / Operator / Manual Sweep*
5. Synchronizing mulitple production lines. Please see section *Organizing Projects / QC-Start Tool / Synchronizing multiple QC Systems (Master Tests).*
6. Remote Configuration of QC systems from any network connected computer (no QC-hardware required, special license required). Please see section *Organizing Projects / Remote Configuration.*
7. Flexible extraction of large scale data. Please see section *Statistics / Offline Statistics / Extracting data for processing*

8. It is now possible to run the QC software and the R&D software (from version 202) on the same computer.

QC 1.X 2.0

1. / /*Harmonics* / *THD*
2. / / / *IDD* / / / / Meta Hearing Technology

/SPL *Tests.*

3. Ambient Noise
4. / / *Manual* Sweep
5. */QC* / *Synchronizing* multiple QC Systems (Master Tests)
6. QC QC */ Remote* Configuration
7. / / *Extracting* data for processing
8. QC R&D 2.0

Hardware Installation

Attention: Do **not** connect USB and Firewire cables between PC and QC System yet.
These cables must be connected during the software setup (see next section)

____ USB PC QC

Parts of the system

Please check the delivered parts. The system should contain (number of some items may depend on options):

Nr	Description	
1	Production Analyzer Power Supply,	
2	Cable for Power Supply 	
3	XLR-Cable	
4	Amplifier-Cable (for various amplifier output configurations there are 2 spare speakon plugs, see section on Amplifier below)	
5	Extra Speakon Cable Connector	
6,7	BNC-Cable (number depends on order)	
8,9	Measurement Microphones (number depends on order)	
10	Speaker-Cable	

11	USB-Cable	
12	Firewire-Cable	
13	USB-Dongle	

1 **2**		
3	XLR	
4 **5**		
6,7	BNC-	
8,9		

10		
11	USB	
12		
13	USB	

Connecting the system

Wire the KLIPPEL Production Analyzer according to the schematics below. The accessories shown in the wiring diagram are described in the chapter *Hardware / Accessories* (foot switch, temperature sensor).

Front side:

Rear side:

1. Connect the Cable for Power Supply (2) to Production Analyzer Power Supply (1)
2. Connect the Production Analyzer Power Supply (1) to KLIPPEL Production Analyzer (**A** - connector POWER)
3. Connect the XLR-Cable (3) between KLIPPEL Production Analyzer (**B** – connector OUT 1) and Power Amplifier input (not shown).
4. Connect one side of the BNC-Cable (6,7) to Microphone (8,9) and the other side to KLIPPEL Production Analyzer (**D, E** – connectors MIC 1, MIC 2)

In the standard configuration the Mic 1 should be located in the near field of the driver under test. It is recommended to put the Mic 1 in a box to attenuate the production noise.
Mic2 should be mounted in free air (not in the box) in about 1m distance. This microphone is used to monitor the ambient noise. Note: This microphone is not required in the QC Basic version.

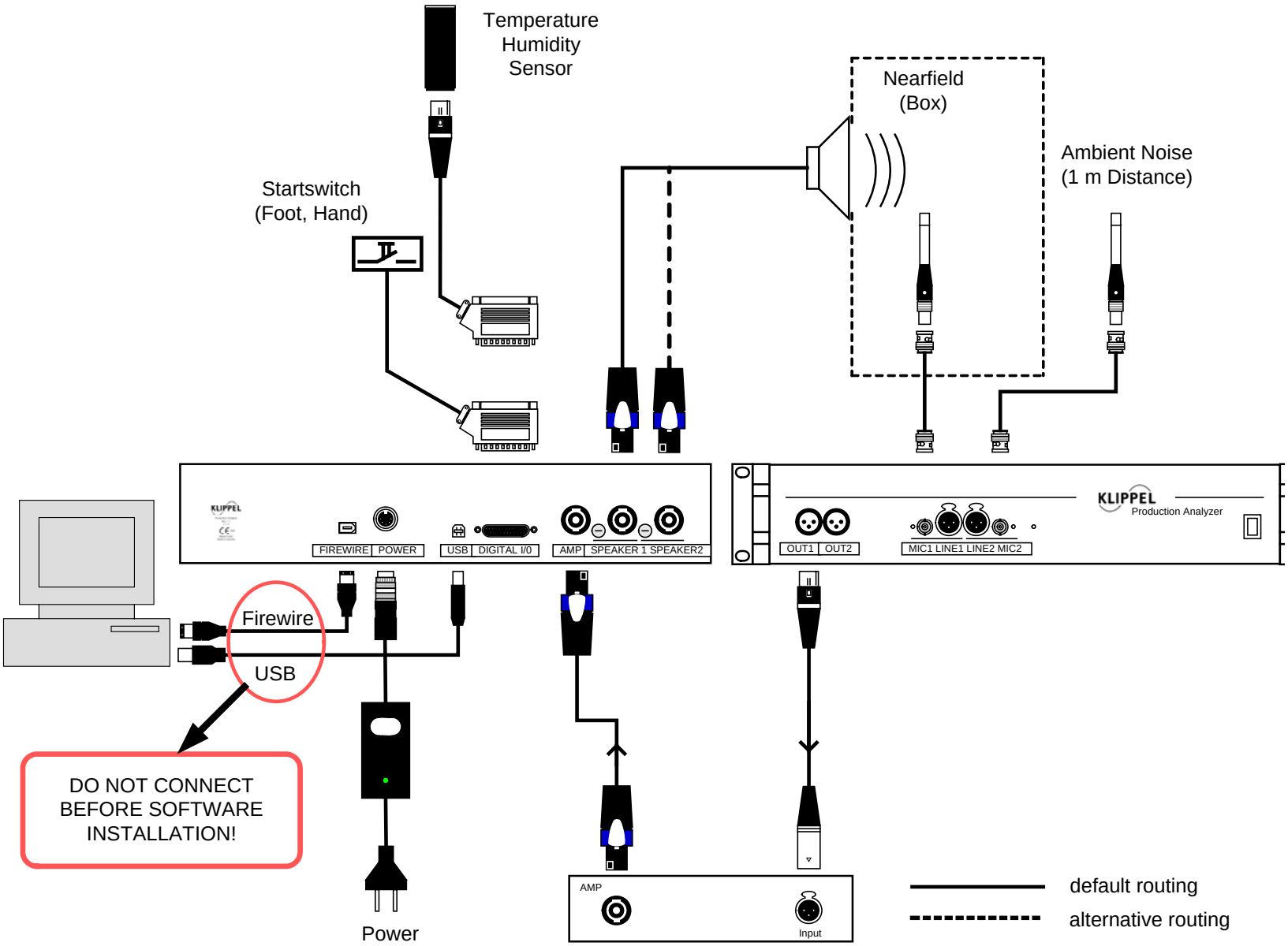
KLIPPEL

/ *Accessories*

1. 2 1
2. 1 KLIPPEL
   A
3. XLR 3 KLIPPEL 1 **B**
4. BNC 6 7 8 9
   KLIPPEL MIC1 MIC2 **D** **E**
   MIC1 DUT MIC1

MIC2 1

QC


Temperature
Humidity
Sensor
Startswitch
(Foot, Hand)
Nearfield
(Box)
Ambient Noise
(1 m Distance)
FIREWIRE
POWER
USB
DIGITAL I/0
AMP
SPEAKER 1
SPEAKER2
OUT1
OUT2
MIC1
LINE1
LINE2
MIC2
KLIPPEL
Production Analyzer
Firewire
USB
DO NOT CONNECT
BEFORE SOFTWARE
INSTALLATION!
Power
AMP
Input
default routing
alternative routing

How to connect the loudspeaker?

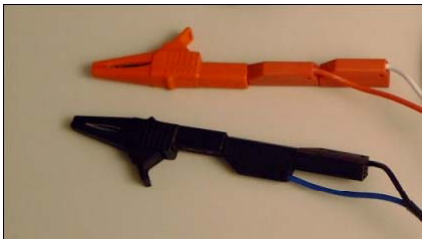
Connect the Speaker-Cable (**10**) to KLIPPEL Production Analyzer (**F**-connector SPEAKER 1 as default).

Although Klippel delivers clamps for connecting the driver, they are not suited for daily QC work.

It is strongly recommended to make dedicated adaptors to the connection schemes of the particular driver.

The Klippel QC system provides a 4 wire (Kelvin configuration) speaker connection. Using the delivered clamps the 4 wires are connected just before the clamps, so even long cables are no problem.

When making your own clamping, you may use the 4 wires to establish a Kelvin Configuration (with Force and Sense wires) directly up to the speaker terminals. For details, please refer to the *A3-Cables* specification and the *Cable Production Guide.pdf* (included in written manual).



The speaker cables may be extended by standard Speakon-Speakon cables with all 4 wires connected in a 1:1 configuration (use at least 1.5mm² wires).

Extension cables are available from Klippel as optional parts.

10 KLIPPEL SPEAKER 1 F

Klippel QC

Klippel QC 4 4

4 Force Sense A3- *Cable Production Guide.pdf*

4 1:1 - 1.5 mm²

Klippel

How to connect my power amplifier?

There are different wiring schemes required for the power amplifier connection depending on the amplifier you are using.

Please select the amplifier type from the list below and connect the amplifier according to the specific chapter below.

- Stereo Amplifier with Stereo Speakon Connectors , proceed with section *Stereo-Speakon Output Amplifier* below.
  All Amplifiers distributed by Klippel are conform to this setup!
- Stereo Amplifier with 2 Mono Speakon Connectors, proceed with section *Stereo Amplifier with 2 Mono Speakon Connectors* below.

- Stereo Amplifier with Cable Terminals, proceed with section *Stereo Amplifier with Cable Terminals* below.
- Mono Amplifier with Cable Terminals, proceed with section *Mono Amplifier with Cable Terminals* below.

NOTE: We strongly recommend to use professional power amplifiers with balanced audio input only. Only this kind of amplifier is described below. If your application require a different type of amplifier, please contact Klippel for details. In the following sections, it is assumed, that the amplifier input is an XLR connector.

- *Stereo-Speakon* Output Amplifier
  Klippel
- 2
  Stereo Amplifier with 2 Mono Speakon Connectors
- *Stereo*
  Amplifier with Cable Terminals
- *Mono*
  Amplifier with Cable Terminals

Klippel
XLR

Stereo-Speakon Output Amplifier

- Connect the Amplifier Input to OUT1 (**B**) of KLIPPEL Production Analyzer with the XLR-Cable (**3**).
- If you have an Amplifier distributed by Klippel, the settings are already done. You don't need to adjust anything.
  Just connect the Amplifier Cable (**4**) to the Output 1 of the power amplifier and to the KLIPPEL Production Analyzer Amplifier input (**C**).
  Please proceed with the section *Software Installation*.

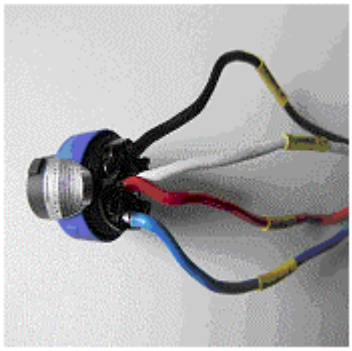
- In all other cases:
  Connect both inputs of the Stereo Amplifier in parallel. This could either be done by a switch at the Amplifier or by a patch cable. This depends on the particular Amplifier you are using, please check the Amplifier manual.
- Check in the Amplifier manual, that the Speakon Output of the Amplifier as assigned as following:

Cable Terminal output at Amplifier	Signal
Speakon Output: 1+	Hot (+) Ch. 1
Speakon Output: 1-	Cold (-) Ch. 1
Speakon Output: 2+	Hot (+) Ch. 2
Speakon Output: 2-	Cold (-) Ch. 2

- Mount one Speakon Cable Connector (**5**) to the Amplifier Cable (**4**):

Cable Terminal output at Amplifier	Connect to: (see Label at Amplifier Cable)
Speakon Output: 1+	Speaker 1+
Speakon Output: 1-	Speaker 1-
Speakon Output: 2+	Speaker 2+
Speakon Output: 2-	Speaker 2-

After Mounting it should look like this:



- Connect the Amplifier Cable (**4**) to the Stereo Output of the power amplifier and to the KLIPPEL Production Analyzer Amplifier input (**C**).
- Please proceed with the section *Software Installation*.

- XLR 3 KLIPPEL OUT1 B
- Klippel

  4 1 KLIPPEL C *Software* Installation
-
-

1 1+	1 +
1 1-	1 -
2 2+	2 +
2 2-	2 -

- 4 5

: 1+	Speaker 1+
: 1-	Speaker 1-
: 2+	Speaker 2+
: 2-	Speaker 2-

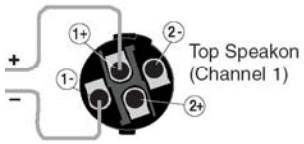
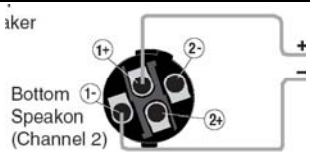
- 4 KLIPPEL C
- “ ”

Stereo Amplifier with 2 Mono Speakon Connectors

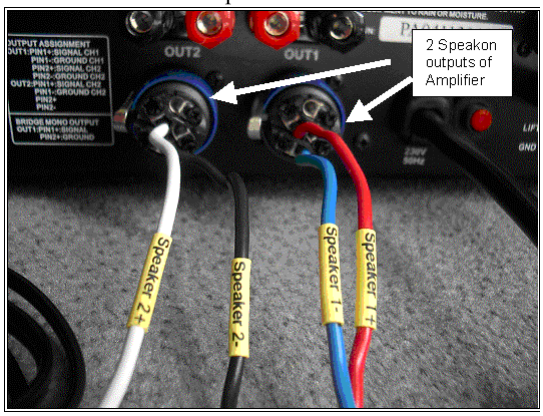
- Connect the Amplifier Input to OUT1 of Production Analyzer with XLR-Cable (**3**).
- Connect both inputs of the Stereo Amplifier in parallel. This could either be done by a switch at the amplifier or by a patch cable. This depends on the particular amplifier you are using, please check the amplifier manual.
- Check in the Amplifier Manual, that the Speakon Outputs of the Amplifier as assigned as following:

Cable Terminal output at Amplifier	**Signal**
Speakon Output 1: 1+	Hot (+) Channel 1
Speakon Output 1: 1-	Cold (-) Channel 1
Speakon Output 2: 1+	Hot (+) Channel 2
Speakon Output 2: 1-	Cold (-) Channel 2

- Mount two Speakon Cable Connector (**5**) to the Amplifier Cable (**4**). You will get an Y-cable with 3 Speakon connectors.

Cable Terminal output at Amplifier	**Connect to: (see Label at Amplifier Cable)**
	
Speakon Output: 1+	Speaker 1+
Speakon Output: 1-	Speaker 1-
	
Speakon Output: 2+	Speaker 2+
Speakon Output: 2-	Speaker 2-

After Mounting it should look like this:

The Cable:	The Connection to Amplifier:
	

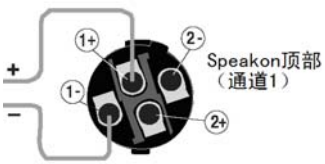
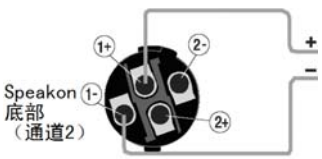
- Connect the prepared Amplifier Cable (**4**) to the two outputs of the power amplifier and to the KLIPPEL Production Analyzer Amplifier input (**C**).
- Please proceed with the section *Software Installation*.

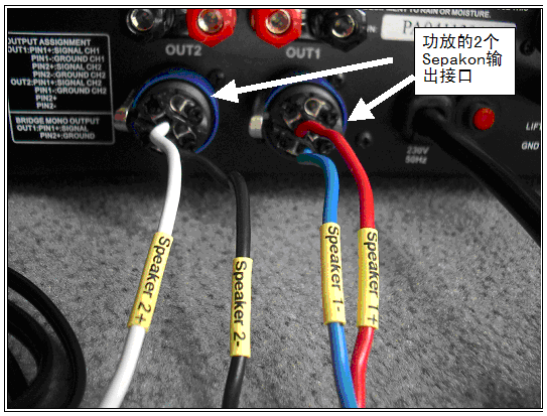
- XLR 3 OUT1
-

-

1 1+	1 +
1 1-	1 -
2 2+	2 +
2 2-	2 -

- 4 Speakon 5
  3 Y

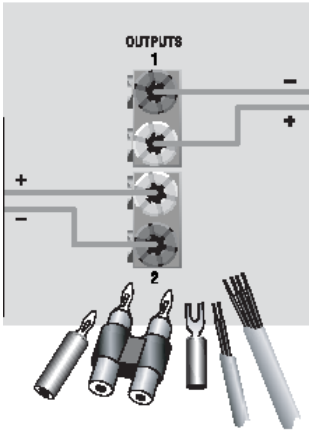
	
: 1+	Speaker 1+
: 1-	Speaker 1-
	
: 2+	Speaker 2+
: 2-	Speaker 2-



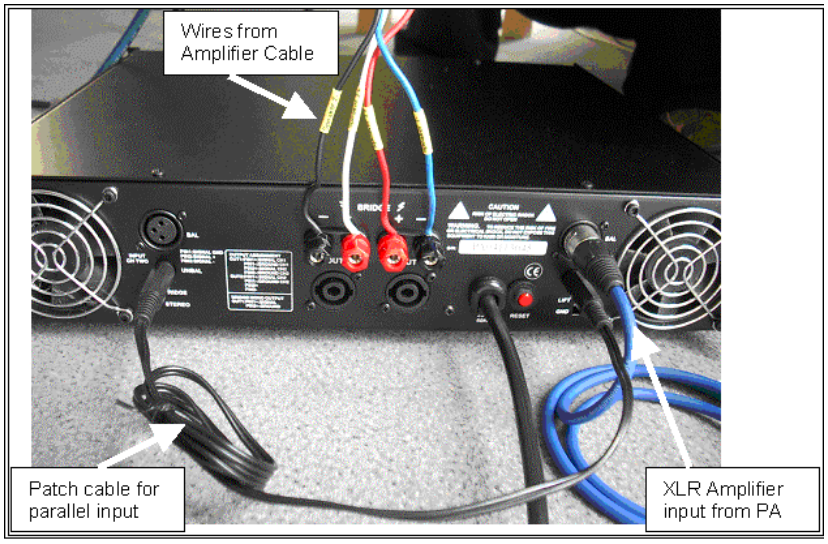
- 4 KLIPPEL
  C
- “ ”

Stereo Amplifier with Cable Terminals

- Connect the Amplifier Input to OUT1 of Production Analyzer with XLR-Cable (3).
- Connect both inputs of the Stereo Amplifier in parallel. This could either be done by a switch at the amplifier or by a patch cable. This depends on the particular amplifier you are using, please check the amplifier manual.
- Use Amplifier-Cable (4) with crimped ferrules (open wires).
- Connect wire labelled Speaker 1+ to Amplifier OUT1 HOT (+)
  Connect wire labelled Speaker 1- to Amplifier OUT1 COLD (-)
  Connect wire labelled Speaker 2+ to Amplifier OUT2 HOT (+)
  Connect wire labelled Speaker 2- to Amplifier OUT2 COLD (-)

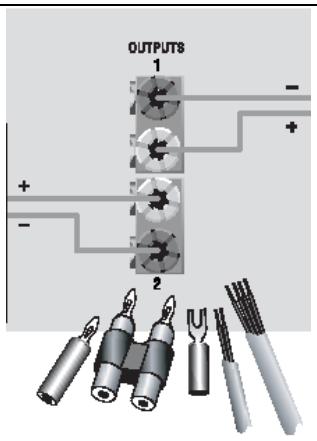
Cable Terminal output at Amplifier	**Connect to: (see Label at Amplifier Cable)**
	
Terminal Output: 1+ (red, hot)	Speaker 1+
Terminal Output: 1- (black, cold)	Speaker 1-
Terminal Output: 2+ (red, hot)	Speaker 2+
Terminal Output: 2- (black, cold)	Speaker 2-

After Connecting it should look like this:



- Connect the other end of the Amplifier Cable (4) to the KLIPPEL Production Analyzer Amplifier input (C).
- Please proceed with the section Software Installation.

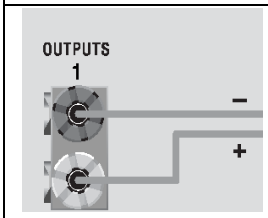
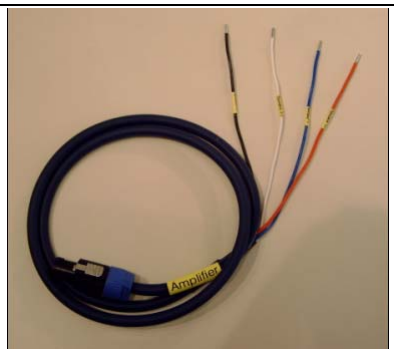
- XLR 3 OUT1
-
-
- 4
- Speaker 1+ “ 1 + ”
  Speaker 1- “ 1 - ”
  Speaker 2+ “ 2 + ”
  Speaker 2- “ 2 - ”

	
1+	Speaker 1+
1-	Speaker 1-
2+	Speaker 2+
2-	Speaker 2-

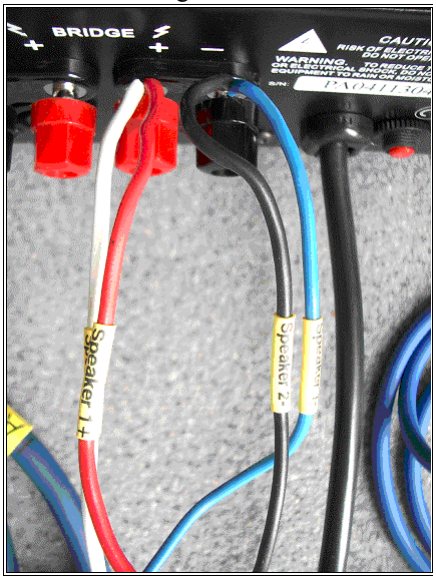
- 4 KLIPPEL C
- *Software* Installation

Mono Amplifier with Cable Terminals

- Connect the Amplifier Input to OUT1 of Production Analyzer with XLR-Cable (3).
- Use Amplifier-Cable (4) with crimped ferrules (open wires).
- Connect wire labelled Speaker 1+ and Speaker 2+ to Amplifier HOT (+) output.
- Connect wire labelled Speaker 1- and Speaker 2- wire to Amplifier COLD (-) output.

Cable Terminal output at Amplifier	**Connect to: (see Label at Amplifier Cable)**
	
Terminal Output: 1+ (red, hot)	Speaker 1+ and Speaker 2+
Terminal Output: 1- (black, cold)	Speaker 1- and Speaker 2-

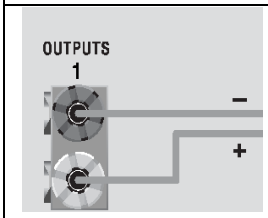
After Connecting it should look like this:



- Connect the other end of the Amplifier Cable (4) to the KLIPPEL Production Analyzer Amplifier input (C).
- Please proceed with the section *Software Installation*.

- XLR 3 OUT1
- ( ) 4
- Speaker 1+ Speaker 2+ +

- Speaker 1- Speaker 2- -

	
1+	Speaker 1+ Speaker 2+
1-	Speaker 1- Speaker 2-

- 4 KLIPPEL C
- *Software* Installation

Software Installation

The installation program leads you step by step through the software installation process.

Before you begin

Make sure you are not running other programs on your computer, especially previous versions of dB-Lab.

Important information for users of the KLIPPEL R&D System:
Different Software versions of the Klippel Measurement System can now be installed and removed as individual packages. So the installation of the Klippel QC system as well as one or more R&D installations can be installed and used on one PC. However, it is not possible to use them in parallel. See the dB-Lab manual for details.

If you have already connected the PC to the USB or Firewire port of the KLIPPEL Production Analyzer, disconnect the cables. The installation program will ask to connect the cables during the installation process.

Important Information for Windows XP:
You need administrator privileges to install the software.
The QC setup needs to modify entries in the local system registry.
If you don't have administrative privileges, ask your System Administrator for help.

dB-Lab

KLIPPEL R&D System

Klippel
PC Klippel QC
R&D
dB-Lab

PC KLIPPEL USB

Windows XP :

QC

Installation

1. Insert the Klippel Analyzer CD into your CD-ROM drive.
2. If the setup does not start automatically, choose Run… from the Start menu, enter D:\setup (where D: is the letter of your CD-ROM drive) in the dialog box, and click OK.
3. Follow the on-screen instructions.
4. During the installation you must calibrate the system. If you need more information for these steps, please refer to section *Hardware / Calibration / Check of Accuracy.*

1. KLIPPEL CD CD-ROM
2. Run
   D:\setup D: CD-ROM
   OK
3.
4.
   / Calibration / Check of Accuracy

Viewing results

The QC example database
C:\Documents and Settings\All Users
Application Data\Klippel\QC\Examples\QC Examples.kdb
as well as any other database with measurement data created by the QC system can be viewed with the KLIPPEL dB-Lab software. This section describes how to view data with dB-Lab.

Note: For further information see also the separate dB-Lab manual. It is part of the online help (Press F1, while in dB-Lab).

QC
C:\Documents and Settings\All Users
Application Data\Klippel\QC\Examples\QC Examples.kdb
QC KLIPPEL dB Lab dB-Lab

dB-Lab
dB-Lab F1

Requirements

With the QC software installation dB-Lab is already installed on your computer. To view a database on a computer with no QC system installed, you may download a free viewer version of dB-Lab from the website *www.klippel.de* .

QC dB-Lab
QC *www.klippel.de*

What is a database?

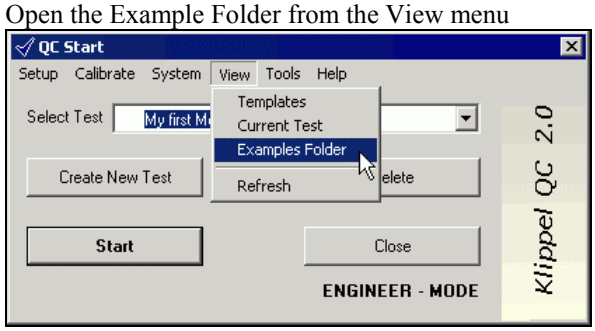
Common to all Klippel Measurement Software is the concept to store all information of a test in one single (binary) file. This file is based on a database structure and contains the test setup, reference measurements, limits, results and so on. When copying the database, all information is transferred, there is no need to group or pack multiple files. Another benefit is the synchronization of setup and results by design, which always allows to investigate the setup for any result.

Klippel

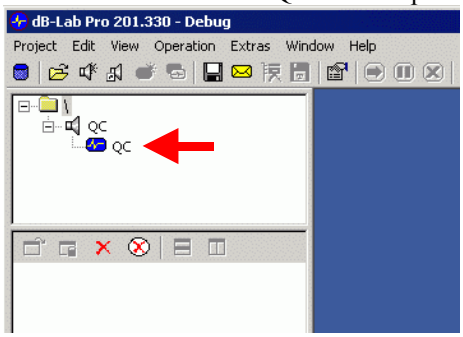
Viewing the Example database

An easy way to open the Example database is:

1. Launch QC-Start (Engineer mode)
2. Open the Example Folder from the View menu



3. Double click on the QC Example.kdb file.
4. Select the root folder entry (\ on top of the list) and press OK, if *Open Project* dialog opens.
5. Double click on the blue QC icon to open the default windows.



6. Proceed with section *The Desktop* below for exploring data.

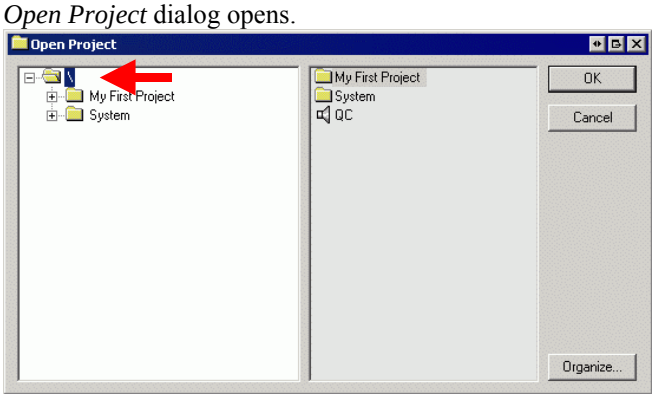
1. QC
2.

3. QC **Example.kdb**
4. \
OK
5. QC
6. *The* Desktop

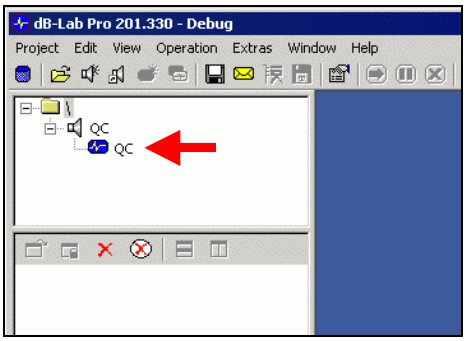
How to open a database?

A dB-Lab database has the filename extension *kdb*. The simplest way to open a database is to double-click the database file in the windows explorer. dB-Lab will start and open the database automatically.

1. Select the root folder entry (\ on top of the list) and press OK, if *Open Project* dialog opens.



2. Double click on the blue icon (labeled QC) to open the default windows



3. Select other result windows from the Result Window List (see section *The Desktop* below), if required.
You may export, print or change graphs.

dB-Lab kdb
Windows dB-Lab

1. \
OK
2. QC
3. *The* Desktop

How data is organized?

The database is organized like a file system. As in Windows, you have Folders, Files, and shortcuts. The "files" are objects that represent the tested driver. When you open a driver, you will see operations that have been or can be applied to them, and view the results of these operations.

QC databases consist of one operation only by default (QC/QC).

Elements	Definition
Folder (default: root)	Like a folder in the Windows file system a folder can contain files (objects), other (sub) folders, and shortcuts to other folders or objects. In dB-Lab Pro, they are used for project management. (not available in dB-Lab lite)
Objects (default: QC)	Represents the device under test
Operation (default: QC)	The term operation stands for any kind of measurement or calibration to produce or display data. The operation is applied to a given object and produces results as an output.
Result	The result is the output of an operation usually in numerical or graphical form. Besides display, the information can be exported to a report, the clipboard, or a file.

Windows

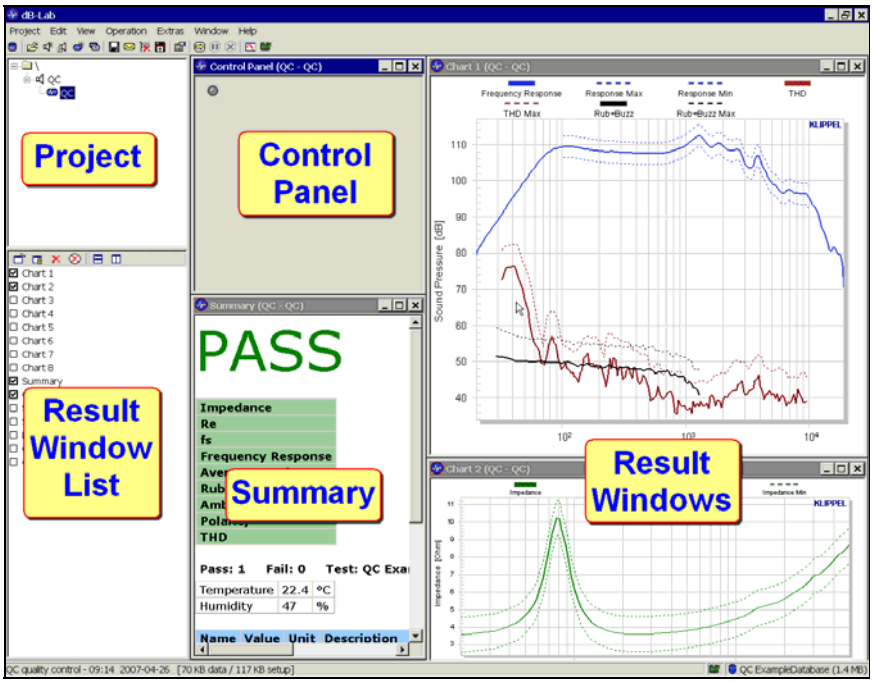
“ ”

QC QC/QC

	Windows dB-Lab dB-Lab
QC	
QC	

The Desktop

The Desktop consists of the following elements (double-click the **QC** operation to open default result windows):



The **Project** pane displays a QC object with its operations. With the **Result Window List** you can manage the results (charts or tables) that are displayed in the **Result Window** area.

Note: A QC database normally contains only one driver object (QC) with one operation (QC). **Do not change the names 'QC'!**

QC

QC

QC QC

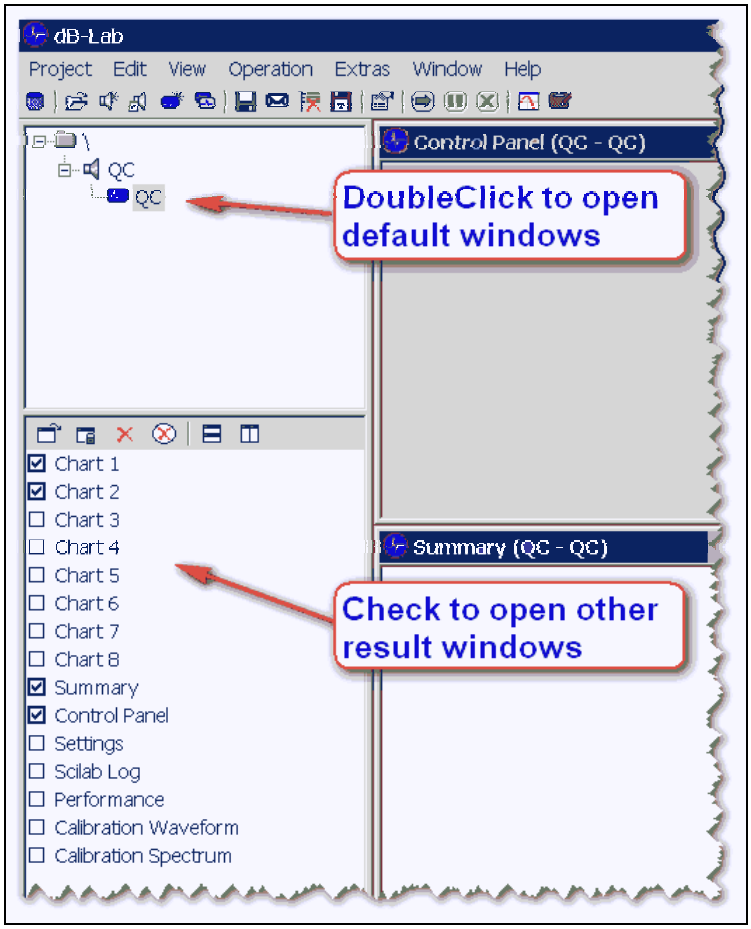
QC **“QC”**

Viewing data

The **Result Windows** show the measured curves (Frequency Response, THD, Rub&Buzz, Impedance) as solid lines. The corresponding maximal and minimal limits to each curve, that describe the allowed deviations of a good loudspeaker, are displayed as dotted curves.

1. Double-click the blue QC operation icon to open the default Result Windows

2. Check the related check box in the result windows list to open further windows.



The following windows can be displayed:

Result window	Content
Chart 1	Frequency response and all active distortion measures (THD, Rub & Buzz).
Chart 2	Impedance
Chart 3	Harmonic Distortion (single orders, THD)
Chart 4	Rub & Buzz crest factor, IDD performance measure
Chart 5	Phase
Chart 6	Spectra of voltage, current (impedance task)
Chart 7, 8	Not used
Summary	Output window for Pass / Fail information and details
Control Panel	Control elements for start/stop measurement (active in user mode only)
Settings	List of all test settings for reference when viewing
Scilab Log	Output of Scilab routines for debugging or logging. Intended use for programmable version only.
Performance	Time Analysis of the test.
Calibration Waveform	Result of internal synchronization and amplifier self test. For trouble shooting only.
Calibration Spectrum	Result of internal synchronization and amplifier self test. For trouble shooting only.

The **Summary Window** displays the test result (PASS/FAIL) and measured parameters like resonance frequency fs or DC resistance Re. In case of a

FAIL test result the parameter that hurts a limit is displayed red in the table below PASS/FAIL.

The **Control Panel** is deactivated since no user is logged in to the QC System. The panel contains control buttons (e.g. to start tests or to log out), if a user is logged in.

THD

)

1. QC
2.

1	THD
2	
3	THD
4	IDD
5	
6,7,8	
	/
	/
Scilab	Scilab

/

fs Re

/

QC

Reports

The dB-Lab Pro (part of the QC system) allows creating customizable HTML reports that contain the measured data. To learn more about the report tool, please refer to the dB-Lab manual.

dB-Lab QC

HTML dB-Lab

First Measurement

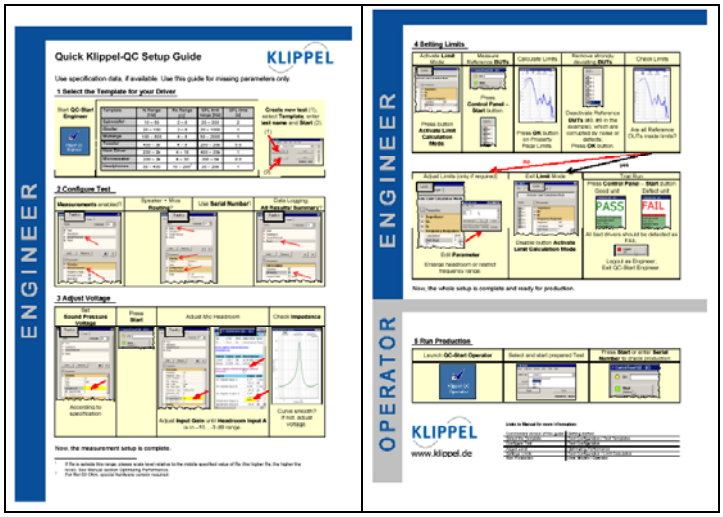
This section gives a step-by-step instruction how to setup the QC system for first time usage and how to perform the first measurement. It is

recommended to work through this section in order to check for a correct hardware and software setup.

QC

Quick Setup Guide

There is a very concentrated instruction guide available that summarizes the usage of the Klippel QC System on two pages.



This guide is intended to be placed near the QC system for reference and for new users.

The next chapters describe all steps of this Quick Setup Guide in greater detail for a better understanding.

2 **Klippel QC**

QC

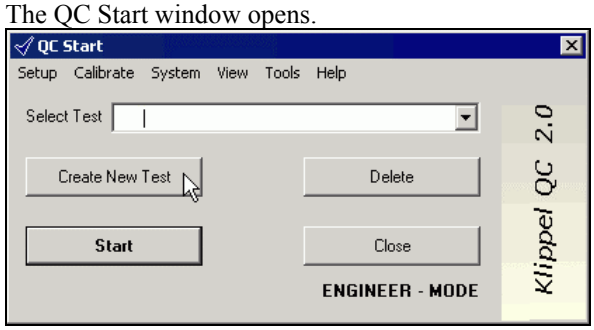
Create a Test

1. Please follow the steps below. Start the QC-Start Tool in the engineer mode. Use the desktop icon

   or choose **Start/Programs/Klippel Analyzer/QC/QC-Engineer** from the Windows Start menu.

The QC Start window opens.



The drop down list *Select Test* contains tests, that are already set up for the production line.
No test is prepared yet so we have to create one.

2. Press button **Create New Test.**

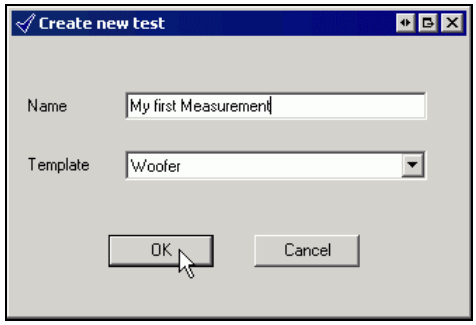
   Select a template according to the driver you want to test:

Template	fs range [Hz]	Re range [Ω][1]	SPL limit range [Hz]	SPL time [s]
Subwoofer	10 – 50	2 – 8	20 – 200	2
Woofer	20 – 150	2 – 8	20 – 1000	1
Midrange	100 – 500	4 – 8	50 – 2000	1
Tweeter	400 – 3k	4 – 8	200 – 20k	0.5
Horn Driver	200 – 2k	4 – 16	400 – 20k	1
Microspeaker	200 – 2k	4 – 30	200 – 5k	0.5
Headphones	30 – 400	10 – 200[2]	20 – 20k	1

3. In this example a woofer shall be tested.
   Select the template according to your particular test object.

   Note: For basic version users, you must select the fast version of the templates (with keyword fast in the template name). The standard template not supported in Basic version.

   Type in a test name ‘My first measurement’.

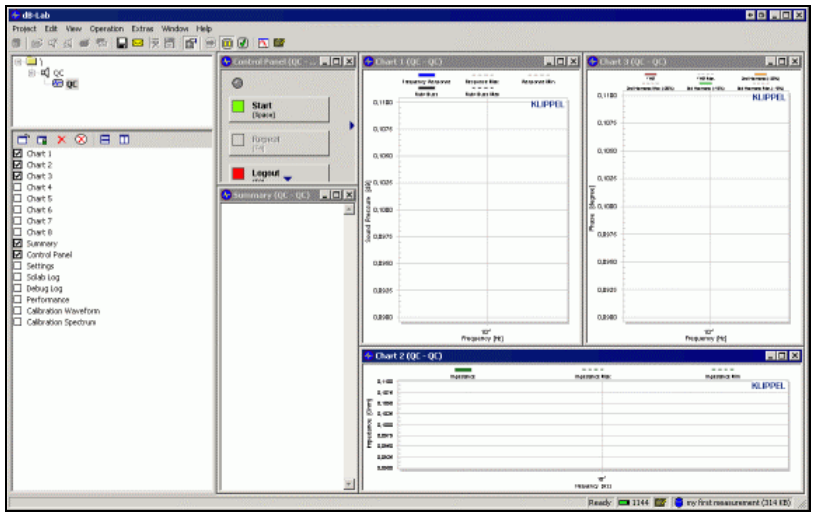


4. Press the **OK** button.

1 If Re is outside this range, please scale level relative to the middle specified value of Re (the higher Re, the higher the level). See Manual section Optimizing Performance.

2 For Re>30 Ohm, special hardware version required.

5. Press the **Start** button. The main program dB-Lab will open and a login dialog may appear (depending on your QC-system user administration). If required, log in in the engineer level.



1. QC

Windows **Start/Programs/Klippel Analyzer/QC/QC-Engineer**

QC

2.

	fs [Hz]	**Re [Ω][3]**	**SPL [Hz]**	**SPL [s]**
	10 – 50	2 – 8	20 – 200	2
	20 – 150	2 – 8	20 – 1000	1
	100 – 500	4 – 8	50 – 2000	1
	400 – 3k	4 – 8	200 – 20k	0.5
	200 – 2k	4 – 16	400 – 20k	1
	200 – 2k	4 – 30	200 – 5k	0.5
	30 – 400	10 – 200[4]	20 – 20k	1

1 Re Re

2 Re 30 Ohm .

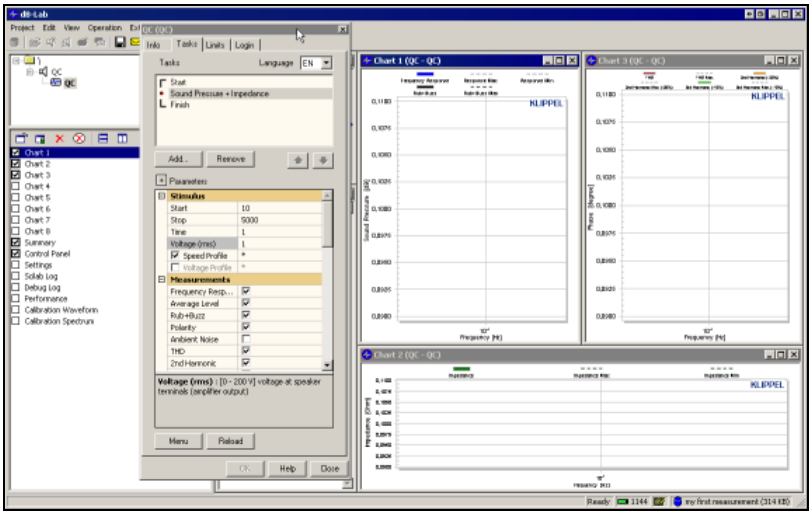
3.

“ ”

4. **OK**
5. dB-Lab
QC

Configure Test

After logging in the main screen is visible and a property page is opened up.



Note, that the Property Page in the foreground may hide the desktop partially. Just move the property page according to your needs with the mouse as indicatad.

Warning:
Don’t change the operation name "QC" in the project pane (top left) or on the Property Page "Info". The name must stay as "QC" for proper operation. The name of the test is used as database name (right bottom corner of the dB-Lab frame) for fast identification.

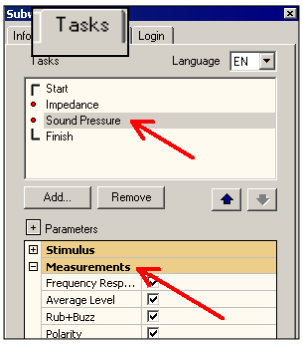
“ ” QC
“QC”
dB-Lab

Follow the steps to configure the test according to your needs:

Enable Measurements

Check, if all measurement options are enabled that are required to be tested.

1. Select the page *Tasks* of the Property Page.
2. Select *Impedance* from the *Tasks* List (Top list of the Page).
3. Select section *Measurements* in the *Parameters* list (bottom list).



En- / Disable the measurements you need.

4. Repeat this step for all tasks in the task list.

1.
2.
3.

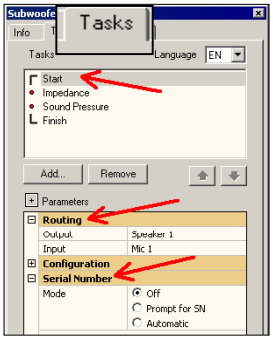
/

4.

Set Routing and Serial Number Handling

Set the hardware routing of the microphones and of the speaker channels and allow Serial Number prompt / barcode input according to your needs:

1. For both settings, open the page *Tasks* of the Property Page.
2. Select *Start* from the *Tasks* List (Top list of the Page).
3. Set the *routing* in the accordingly labeled section.
4. Set up *serial number* handling in the section *Serial Number*.
   You may use the barcode reader when configured as keyboard input device. See also section *Hardware / Accessories* for more details.



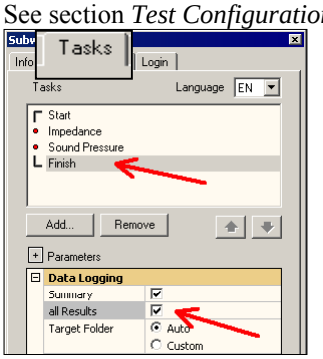
1.
2.
3.
4.

/

Set up result logging

Set the options regarding data and result export / logging.

1. Open the page *Tasks* of the Property Page.
2. Select *Finish* from the *Tasks* List (Top list of the Page).
3. Set the export options in the section *Data Logging*.
4. See section *Test Configuration / Serial Number Handling* for details.



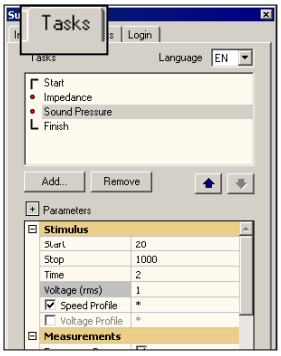
1.
2.
3.
4. / *Serial* Number Handling

Adjust SPL Voltage and Frequency Range

SPL

These two parameters are most important for the SPL setup.
Check or adjust them carefully.

1. Open the page *Tasks* of the Property Page.
2. Select *Sound Pressure* from the *Tasks* List (Top list of the Page).
3. Set the Start and Stop frequencies.
4. Set the voltage of the test.
   Note, that this voltage is the terminal rms voltage of the driver.



SPL SPL

1.
2.
3.
4.

Adjust the Microphone Headroom

For Rub&Buzz testing it is strongly recommended to optimize the dynamic range of the input channel. This can easily be done by amplifying the input signal to fully exploiting the input range. Thus the best resolution is availbale for the reliable detection of even smallest defects and artefacts.

1. Press the *Start* button of the *Control Panel.*

2. Open / Select the Summary Window
3. Expand the HTML link *Show signal characteristics (sound pressure).* A table will be shown with the signal properties of the recorded signals. Look for the value in the line *Headroom Input A.*
4. This value should be between –10 and –3 dB (0dB corresponds to a full scale input).
   If not in this range, adjust the parameter *Input Gain 1* by the following rule:

   Add abs(*Headroom Input A* + 6dB) to *Input Gain 1* parameter.

   Or use the following table:

Headroom Input A	**Add to Input Gain 1**
0 dB (marked red) → overloaded input	Reduce Input Gain by 20dB!
-6	0 (Ok)
-20	14
-30	24
-40	34

Note: If the input headroom is below 30dB, it is strongly recommended to use a more sensitive microphone (for headphone and micropseaker testing). There are several options available.
See also section *Hardware / Accessories / Microphones*.

For more details, see section *Optimizing Performance / SPL Tests / Optimal Signal Noise Ratio (SNR).*

Rub&Buzz

1.

2. /
3. HTML
   A
4. -10 -3dB 0dB
   1
   A+6dB *1*

A	1
0 dB →	20dB!
-6	0 (Ok)
-20	14
-30	24
-40	34

30dB

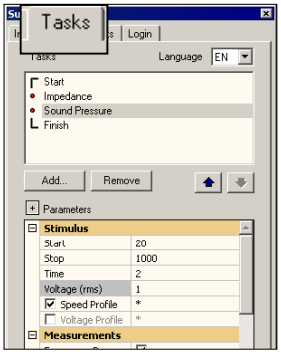
/ /Microphones

/SPL / Optimal Signal Noise Ratio (SNR)

Adjust Impedance Voltage and Frequency Range

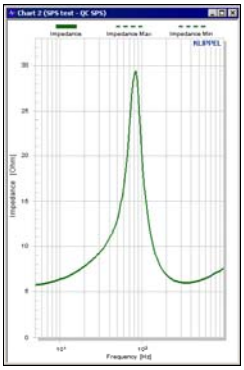
These two parameters are most important for the impedance setup. Check or adjust them carefully.

1. Open the page *Tasks* of the Property Page.
2. Select *Impedance* from the *Tasks* List (Top list of the Page).
3. Set the Start and Stop frequencies.
4. Set the voltage of the test.
   Note, that this voltage is the terminal rms voltage of the driver.



5. Press the *Start* button of the *Control Panel.*

6. Open Result Chart 2. Check the impedance curve smoothness.



If the curve is noisy, please refer to section *Optimizing Performance / Impedance / How to find optimal excitation level and time* for further adjustment and optimization.

When finishing this step, the complete measurement parameters are adjusted correctly.

1.
2.
3.
4.

5.

6. 2

/ /

Limit Setting

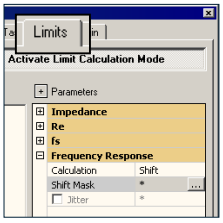
Once the measurement parameter setup is finished, the limits can be set. The following sections describe the limit calculation based on measured reference DUTs. This is the easiest way to get consistent and reliable limits.

DUT

Measure Reference DUTs

DUT

1. Open the page *Tasks* of the Property Page.
   Press the button *Activate Limit Calculation Mode*.



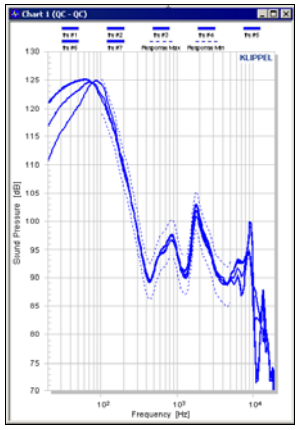
2. Press Control Panel – Start button.

   The Reference Units (DUTs) are measure now.

Note: In the Basic version only one Reference DUT is supported. Please skip the following steps referening to multiple reference DUTs.

3. Press the **OK** button on the Property Page *Limits* to calculate the limits.
4. The results of all reference DUTs are shown in the result chart as well as the calculated limits. The example shows the fundamental

SPL curves of the reference DUTs.



1.

2.

DUT

DUT

DUT

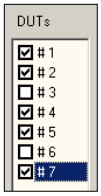
3. **OK**
4. DUT

DUT SPL

Remove strongly deviating DUTs

When measuring multiple Reference DUTs, it might happen that the tests are corrupted by Ambient Noise or that other failures cause invalid results. In this case simply disable the invalid reference tests from the DUT list:

DUTs



You may label the reference DUTs with an entered serial number string to separate multiple *Golden Units*. For more information, refer to section *Test Configuration /*

Reference Units.
Press the **OK** button on the Property Page *Limits* to recalculate the limits.

DUT

DUT

DUT

/

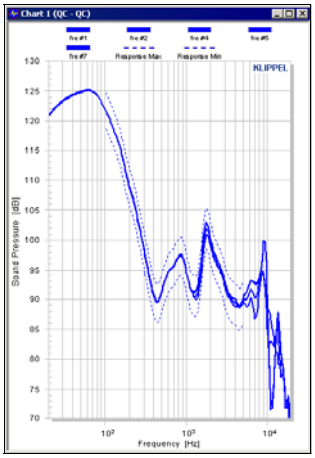
Reference Units

OK

Check and Adjust Limits

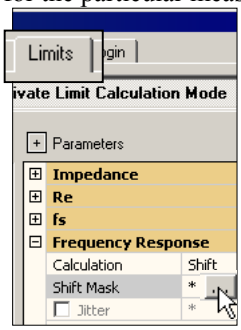
Now, the results of all reference DUTs are shown in the result chart as well as the calculated limits. The example shows the fundamental SPL curves of the reference DUTs.

After removing the strongly deviating DUTs, the example reference DUTs are all within the tolerance range of the SPL measure.

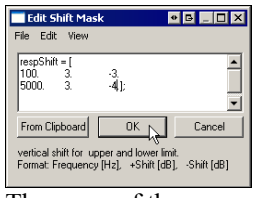


However, it could be required to modify the default limits:

1. Make sure the Limit Mode is activated. The Button *Activate Limit Calculation Mode* must be pressed on the Property Page *Limits*.
2. Select from the *Parameters* List the measure, for that the limit settings shall be changed. To each measure an own section is assigned.
3. Press the (+) sign left of the section to expand all settings applicable for the particular measure.



Modify the parameters. Note, that for some parameters a new window for entering the values (matrices) must be opened as indicitad above:



The name of the parameter may be ommited. Just enter the numbers, separate values by a *Space* and lines by *Enter*.

See section *Optimizing Performance* for more information on the settings.

4. Exit the Limit Mode.
   Release the button *Activate Limit Calculation Mode.*

DUT

DUT SPL

DUT DUT SPL

1.

2.

3. +

4.

Trial Run

It is good practise to check the measurement and limit setting on a selection of DUTs. Make sure that all defect drivers are detected accordingly.

Note: If the test fails, check the measure that failed from the list in the summary result window (red marked items). It may be required to widen up the limits or to restrict the frequency range of these limits. More details you may find in the section *Test Configuration / Limit Calculation*.

After the successful Trial Run the system is configured correctly and the test may be used in the Production Mode.

DUT

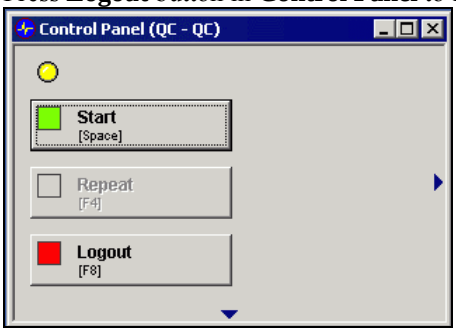
/ *Limit* Calculation

QC

Logout

To log out and shut down the QC system proceed as following:

1. Press **Logout** button in **Control Panel** to log out.



2. When the dB-Lab software is not automatically closed, open the **Project** menu and choose **Exit** to shut down the QC system or press {ALT-F4}.

Note: The QC system can be set up to close dB-Lab automatically after logging out. For details, see section *Organizing Projects / QC Start Configuration*.

QC

1.

2. dB-Lab
   Alt+F4 QC

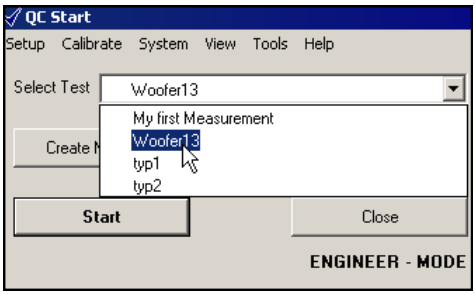
QC dB-Lab
/ *QC* Start Configuration

Run Production

While the set-up of the system needs some background information about the driver (DUT) and the Klippel QC system, the Production Mode is intuitive and minimalistic.

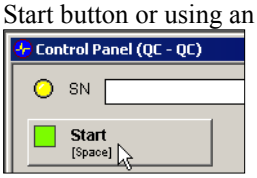
1. Simply double click on the icon Klippel QC Operator.

2. Select a prepared Test from the QC-Start *Select Test* – list.
   All tests configured according to the above sections are listed and are ready for production.
   Select for example the prepared test "My first Measurement".



3. Press the Start Button.
   dB-Lab will be opened and a login dialog may appear (depending on your QC-system user administration). If required, log in in the operator level with login and password.

4. Start testing simply by entering a serial number or pressing the Start button or using an external foot switch.



5. After testing logout from dB-Lab and close QC-Start.

For more information on the Operators point of veiw, please refer to section *User Modes / Operator*.

DUT Klippel QC

1. Klippel QC

2. QC

“ ”

3.
   dB-Lab QC
   QC

4.

5. dB-Lab QC

/ Operator

Before use in production

Before using the QC system in the production process we strongly recommend to do an 8-hour performance test of the system in the production environment by means of the QC Performance Test tool.

Due to stability requirements of a production environment, and the flexibility and fast operation of the Klippel QC System, the PC needs a sufficient performance to run the software. The QC Performance Test tool helps to evaluate whether a PC can run an uninterrupted QC Test, and can give some troubleshooting hints.

Note: Do not use the PC for other purposes during the test. Depending on the hardware configuration, the PC may appear unresponsive for minutes. You can click **STOP** anytime to cancel the test, but cleanup may still take a while.

---

1. Install the QC System in the production environment.
2. Open the QC-Start Tool in the engineer mode (choose **Start/Programs/Klippel Analyzer/QC Start (Engineer)**)
3. Choose **QC Performance Test** from the **System** menu.

The QC Performance Test tool is started.

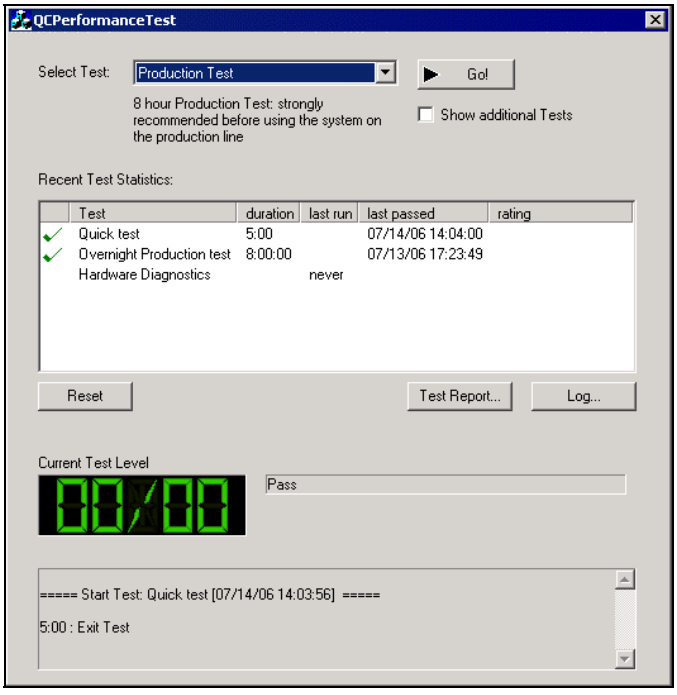
4. Select **Production Test** in the **Select Test** box.
5. Press button **Go.**

While the test is running the LED-style indicator shows the errors that occurred during the test. For a good system, no error should occur.

There are two types of errors shown: "Sync error" and "BCO error". Normally, hardware problems cause only "BCO errors", while performance problems cause both types of errors.

Click **Report** to show a report of the last test or test sequence. For a longer history, click **Log…** to show the log file.

If errors occur during the test, see chapter troubleshooting how to identify them and fix the problem.



QC QC
8
QC
PC QC
PC QC

---

1. QC
2. QC
   Start/Programs/Klippel Analyzer/QC Start (Engineer)
3. **QC**
   QC
4.
5. **Go**
   LED

   2 " Sync " " BCO "
   " BCO " 2

Log...

How to go on (working with the manual)

Once the KLIPPEL QC System is installed and checked, you should make yourself familiar with the system.

As an **Operator** you should now read chapter *User Modes / Operator.*

As an **Engineer** you should read the chapter *Organizing Projects.*

If you need more information about the user interface, you should read the chapter *User Modes.*

If you need information how to setup a measurement, you should read the chapter *Test Configuration*

It is strongly recommended to read the contents of the manual carefully. This way you'll have at least the headlines in mind, when using the system.

KLIPPEL QC

Operator

Organizing Projects

Overview

The QC-Start tool is the central interface to start and create tests, to access calibration procedures and to determine if and how the QC System is started after a Windows restart. This chapter describes how to use the QC-Start tool as an engineer and how to work with templates.

The section *QC-Start INI File* shows how to change default storage locations and how to modify the behavior of the QC-Start tool.

The section *dB-Lab* explains the differences between the usages of dB-Lab in the QC System compared to the KLIPPEL R&D measurement system. This is for people who already use the KLIPPEL R&D system and want to operate the QC system now.

QC QC
Windows QC
QC

QC *INT*
QC

dB-Lab QC dB-Lab KLIPPEL R&D
KLIPPEL R&D QC

QC-Start Tool

QC

Start up

The QC-Start tool can be started in two different modes:

1. In the Operator Mode it is used to select and start a certain test setup.
2. In the Engineer Mode it can be used additionally to
   - create / delete a test setup
   - start the system calibration
   - managing Master Tests
   - managing access rights of operator

Both operating modes of the QC can be easily started using the icons

on the desktop or using the **Start** menu items:

- **Start/Programs/Klippel Analyzer/QC Engineer**
- **Start/Programs/Klippel Analyzer/QC Operator**

QC

1. QC

2. QC
   - /
   -
   -
   -

QC

- / **/Klipel /QC**
- / **/Klipel /QC**

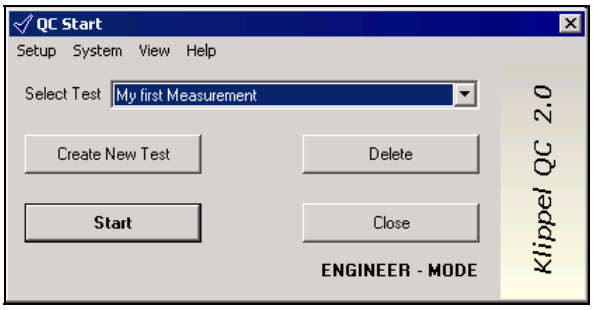
Create / Open a Test Setup

/

The QC-Start should be used to open, create, delete or start a test. Any test should be created from a template.

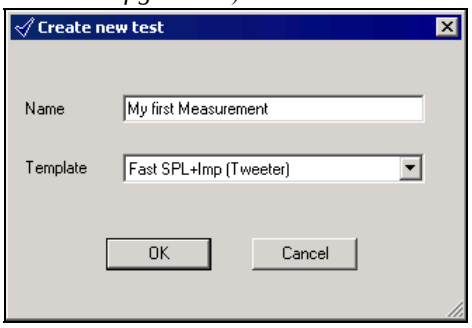
Open an existing test setup

1. Open the QC-Start Tool in the engineer mode (choose **Start/Programs/Klippel Analyzer/QC-Engineer**)
2. Select a test from the drop-down box **Select Test**.
3. Press **Start** button and log in as 'Engineer'



Create a new test

1. Open the QC-Start Tool in the engineer mode (choose **Start/Programs/Klippel Analyzer/QC-Engineer**).
2. Press button **Create New Test**.
3. Select a template from the drop-down box **Template**.
4. Type in a unique name for the test.
5. Press **OK** button.
6. Press **Start** button and log in as 'Engineer'.
7. Set up test tasks, generator and limits (see chapter *Test Configuration*)



QC

1. QC
   Start/Programs/Klippel Analyzer/QC-Engineer
2.
3. " "

1. QC
   Start/Programs/Klippel Analyzer/QC-Engineer
2.
3.
4.
5. **OK**
6. " "
7.

Delete a test

1. Select the Task to be deleted.
2. Press button **Delete**.
3. Confirm to remove the task from the list.

Note: Pressing the **Delete** button only deletes a test from the **Select Test** box. It does not delete the corresponding database on the hard disk.
As a consequence, a deleted name cannot be used again, since the data is

still available on the hard disc.
You have to permanently delete a test to use a test name again (see below).

Permanently delete a test

If you want to permanently remove a test and all connected data you must additionally to the procedure “Delete a test” above delete or move the data folder associated to this test.

1. Before deleting the test from within the QC Start tool, select *View / Current Test* from the QC-Start menu. An Explorer instance of the data folder will be opened.
2. Use the Explorer functions to delete or to move the data.
   You must remove the folder name from the Test-folder to use this test name again.

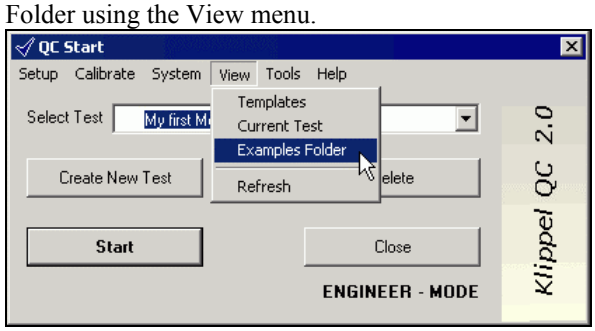
1.
2.
3.

1. QC QC
   /
2.

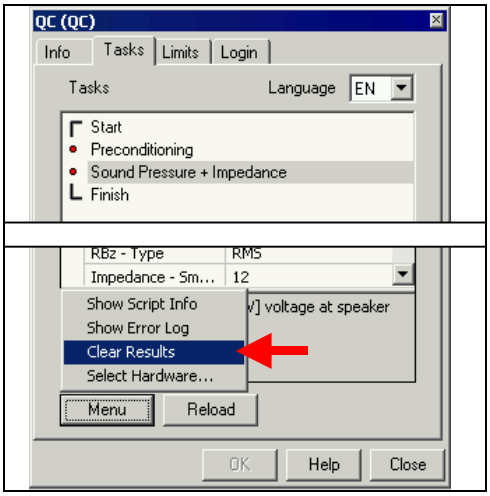
Create a template

Once you have set up a certain test, you can save it as a template. A template stores the test sequence with generator and limit calculation settings. It must not contain reference DUT or measurement data. Follow the steps to prepare and save a test setup as a template:

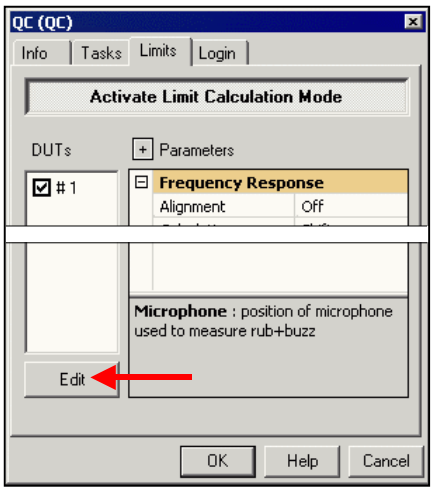
1. Open the test setup you want to store as a template (see section above).
2. Store database using the *Export Selection* Icon  button in the dB-Lab icon toolbar. Specify as target the template directory. The default directory is
   C:\Documents and Settings\All Users\Application Data\ Klippel\QC\QC\templates
3. Logout from the system, go back to QC-Start. Open the Templates Folder using the View menu.



4. Open the database by double-clicking the stored database in the explorer window. Press OK, if the *Open Project* dialog pops up.
5. Click on the **QC** operation.
6. Log in to the QC System by pressing the button from the dB-Lab icon tool bar. If not already available, open the property window by pressing the button. Click on the Property Page Tasks and select **Clear Results** from the Menu.



7. Click on the Property Page **Limits** and activate the **Limit Calculation Mode**. Delete all DUTs by pressing the **Delete All** button.



8. Log out by pressing the **Logout** button in the **Control Panel**.
9. Exit dB-Lab by choosing **Exit** from the **Project** menu.
10. It is good practice to compress the created template to minimize disc space. In the Explorer Window click with the right mouse button on the template – database and select *Compact Database*.

The template is now available from the test list within the QC-Start software.

DUT

1.

2. **dB-Lab**

   C:\Documents and Settings\All Users\Application Data\Klippel\QC\QC\templates
3. **QC**

4. **OK**
5. **QC**
6. **dB-Lab** QC

7. DUT

8.
9. dB-Lab
10. -

QC

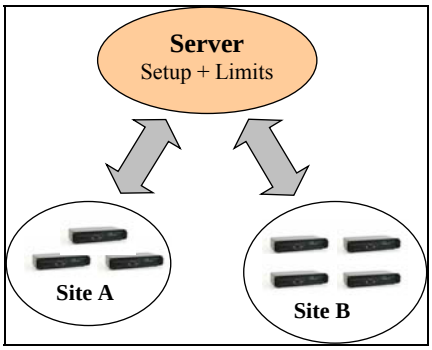
Synchronizing multiple QC Systems (Master Tests)

QC

When multiple systems are used to test the same driver type, it is highly desirable to have identical setups and limits. This can be achieved using the Master-Template functionality.

Not only lines at one location but also multiple factories can be synchronized using that technique.

The basic idea is to have a central folder (Server) in the network, were the Master tests are stored. Master Tests are simply databases with setup and limits stored at a specific place.



At each start of a test with enabled Master function, the Master Test from the server location will be copied to the test folder. So it is guaranteed that the test is running using the latest version on the server. An update of the test configuration for all lines can be done globally with much less effort than updating each QC-System.

A special function supports the modification or update of the Master-Template.

This can be done from each connected QC-System or even from a remote computer with network access.

QC

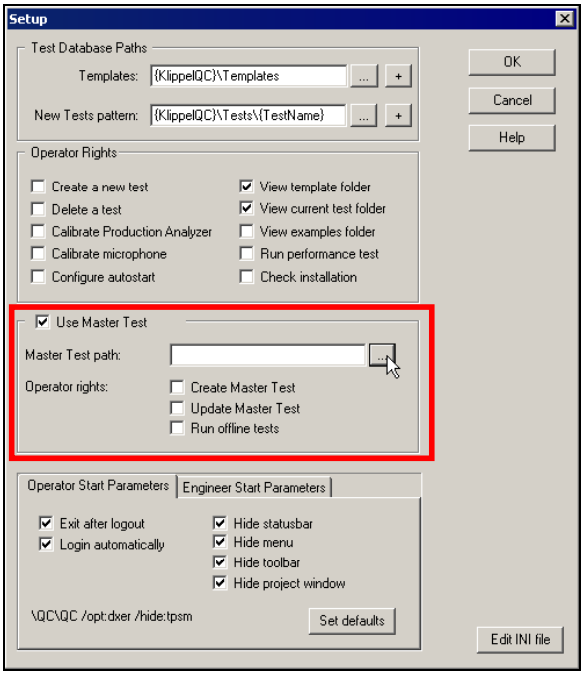
QC

Using Master Tests

To activate the Master function for a test, this Test must be created based on a Master Test.

First, the Master-Template folder location on the Template-Server must be configured.

Open QC-Start and select Setup / Edit Settings. The configuration property page will be opened.



Click on the Browse button to select a folder on the Template Server (on the network in most cases).

Then define the operator rights regarding the Master Tests. The QC-Engineer has all rights by default while the operator needs the rights to be granted here.

QC /

Browse

QC

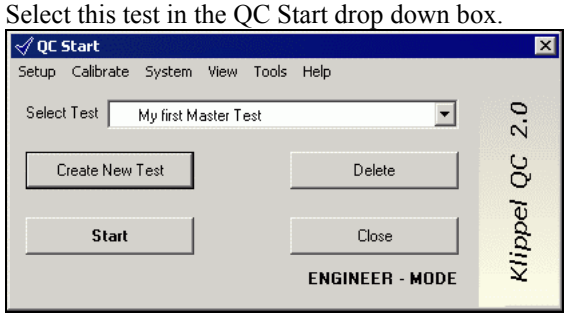
Create a Master Test

Follow the instructions below to create a master test on a server.

1. Set the *MasterPath* to a valid network path.
   Decide, which access rights are granted to the operator (the engineer has all rights by definition):
   AllowCreateMaster: Operator may create a new Master Test on the server.
   AllowUpdateMaster: Operator may update existing Master Test on the server.
   CanRunOfflineTests: Operator may start test which is connected to a Master Test, but the network connection is not working.

   The default setting is *Disabled* for all Operator rights.

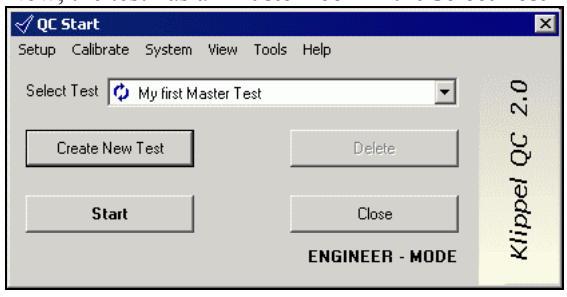
2. Create a local test which shall be connected to the server. Please refer to section *Create a template* above.
   Select this test in the QC Start drop down box.



Note: Make sure, that the specified folder for storing test results is available on all computers that should run this test. This must be ensured, when the *Target Folder* is set to *custom* (please refer to section *Storing Results / File Location*).

---

3. Select from the Menu Tools / *Create Master*. Confirm the question *Start creation of the master?*. The successful operation will be confirmed.
   Now, the test has an *Master Icon* in the *Select Test* list:



The blue icon shows, that the server is online and that the connection has been established. When the server is offline, there is a red mark .
Depending on the setting of the *CanRunOfflineTests* option (see above), the test can be executed or not. A warning is always displayed in this case.

4. The test can now be started as usual. Now, a copy from the server is made in the current test folder and this copy is started.

Note: The user access right are always stored on the local computer and cannot be transferred / synchronized using the Master Test functions.

1.

2.

QC

/ *File* Location

---

3. /

4.

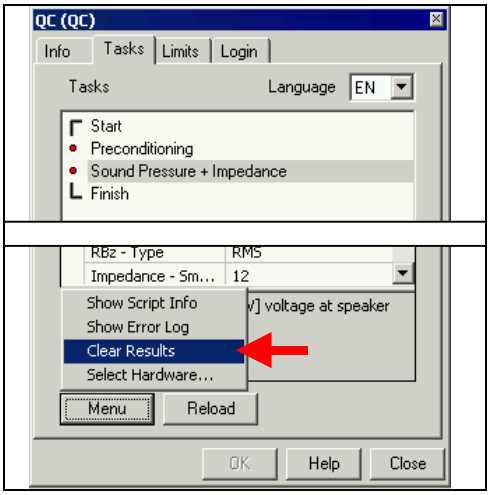
:

Update Master Tests

The master test can be updated from each connected QC-system or also from any other remote computer in the network (e.g. the R&D or QC manager office using an offline license). Please follow the steps below:

1. Modify the test locally. You may change the setup, task sequence or limits.
2. Log in to the QC System. If not already available, open the property window by pressing the button. Click on the Property Page

Tasks and select **Clear Results** from the Menu.



This removes the last results from the test, so a cleared display is shown, when starting this test.

3. Log out from the system. When returned to QC-Start, select the menu *Tools / Update Master*. You have to confirm this action and the success will be confirmed or a warning produced.

QC

R&D QC

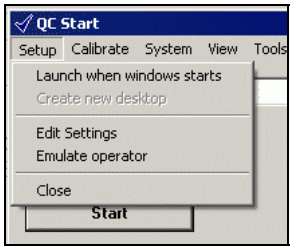
1.

2. QC

3. QC **QC** /

Setup Menu

The **Setup** menu allows to



1. configure the PC in such a way, that the QC System is started automatically at the start of the Windows system. To learn more about items of the Setup menu see chapter *User Modes / Administration.*
2. Configure the QC-Start Tool: Selecting **Edit Settings** will open a text editor with the setup (qc-start.ini) file. In this file the engineer can define, what level of access the operator will be granted. Please refer to section *QC* Start below.
3. When selecting **Emulate Operator**, the functions of the running QC-Start (in Engineer Mode only) will be restricted to the Operator rights. This simplifies the testing of granted rights. You may exit the Operator-Mode by selecting the *Setup / Emulate Operator* again.

4. **Close** will terminate the *QC-Start* program.

1. PC Windows
   QC
   /
2. QC
   qc-stat.ini
   QC
3. QC
   /
4. *QC*

Calibrate Menu

This menu directly starts the local calibration of the system with the connected power amplifier as well as the calibration of the used microphones.

It is recommended to calibrate the system on a regular basis (e.g. monthly). This routine also acts as self test for the system.

For microphone calibration a pistonphone / sound calibrator is strongly recommended to achieve absolute and accurate results. The specified sensitivities of microphones vary usually considerably with temperature and pressure.

Note: After calibrating the system also the inputs are recalibrated, thus the microphone input gain might have been changed and therefore always a calibration of the microphones is requested after calibrating the Production Analyzer.

/

System Menu

The **System** menu allows an easy access to **Production Analyzer (Hardware) Calibration** and **Microphone Calibration**. To learn more about the calibration see chapter *Hardware/ Calibration/ Production Analyzer Calibration*. Furthermore you can start the **QC Performance Test** or the **Latency Check** for a System Check or Troubleshooting.

The item **Check Installation** starts the configuration process for the QC System.

The setup can be verified or repaired. Select the link *Diagnostics* on the first page to get an overview over installed components.

If accidentally or by other reasons the PC settings have been changed, they can be restored to the required state using this procedure.

/ /

QC

QC

PC

Where is the data? (View Menu)

The View menu gives you an easy access to the **Template Folder** and the folder, were the **Current Test** is stored.
An Explorer window will be opened and the test databases are shown.

The **Refresh** option rescans the network drives for a possible Master Test connection.

Note: Databases of the Klippel QC system have the extension "kdb". Double clicking on these database files will start dB-Lab and shows the last measurement performed (See also section *Getting Started*).

Klippel QC " kdb "

dB-Lab

Tools Menu

The options in the tools menu are dedicated to the Master Test functions. Please refer to section *Synchronizing multiple QC Systems (Master Tests)* above.

Synchronizing multiple QC Systems

(Master Tests)

Start Parameter

Executing the program from the command line a start parameter decides in which mode the Start tool is invoked:

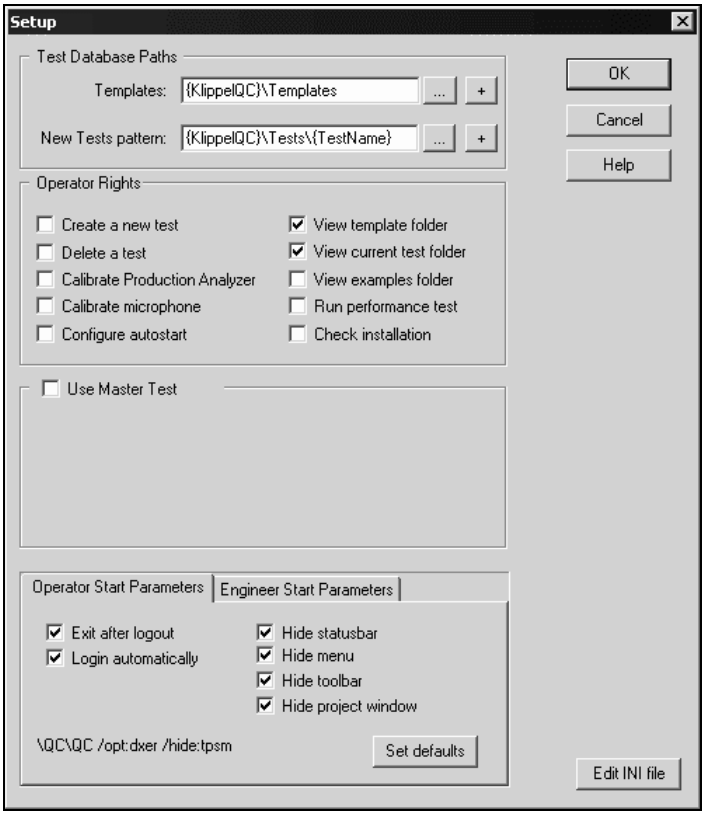
- Operator Mode
  C:\Program Files\Klippel\DA\QC\QC-Start.exe
- Engineer Mode
  C:\Program Files\Klippel\DA\QC\QC-Start.exe /expert

- **C:\Program Files\Klippel\DA\QC\QC-Start.exe**
- **C:\Program Files\Klippel\DA\QC\QC-Start.exe /expert**

QC Start Configuration

QC

The configuration of the QC-Start Tool can be changed by selecting the menu item *Setup / Edit Settings*.



/ QC

Path definitions

The top section contains all variables that specify directories where certain data is stored by the QC-System. The following variables must be defined in this section:

Item	Description
`Templates`	Path to template directory. May be on a network drive.
`NewTestPattern`	Defines how to build the path and name of the folder of a newly created test setup. (**Note**: Each test setup can be stored in its own directory) Should be on a local drive.
`MasterPath`	Path to server location of Master Tests. Network drives (e.g. W:\…) and also UNC notation (\\Server21\…) are supported.

Path variables may be specified using the following replacement strings:

Replacement String	Description
`{KlippelQC}`	Installation path of the Klippel System QC Software, by Default: **{drive}:\Documents and Settings\All Users\ Application Data\Klippel\QC\QC**
`{TestName}`	Specified name of the test at the “Create New Test” function
`{TemplateName}`	Used template at the “Create New Test” function
`{Day}`	Current Day (2 digits)

{Month}	Current Month (2 digits)
{Year}	Current Year (4 digits)
{UserName}	Logged in User Name (Windows Login)

Example:

Assume you want to store each new test setup in its own directory on hard disk C:. The directory name shall be built from the test name and the date of creation:

```
NewTestPath=C:\Tests\{TestName}_{Month}_{Day}_{Year
}
```

So a test setup named *WooferX3* created on the 01st June 2006 will be stored in the directory:

```
C:\Tests\WooferX3_06_01_2006\
```

QC

	W:\… UNC (\\Server21\…

{KlippelQC}	Klippel QC **{drive}:\Documents and Settings\All Users\ Application Data\Klippel\QC\QC**
{TestName}	“ ”
{TemplateName}	“ ”
{Day}	2
{Month}	2
{Year}	4
{UserName}	Windows

:

C

```
NewTestPath=C:\Tests\{TestName}_{Month}_{Day}_{Year
}
```

2006 6 1 *WooferX3*

```
C:\Tests\WooferX3_06_01_2006\
```

Operator Rights

This section defines which of the Engineer Mode functions are also enabled in the Operator-Mode of the QC-Start Tool.

If these rights are not ticked, the operator cannot access the corresponding menu item.

Hint: Untrained persons should not be allowed to change the calibration or test setup accidentally. Thus in the Operator Mode all engineer functions should be disabled.

QC

Use Master Test

See section *Using Master Tests* above.

The Master Test path as well as the Operator rights are described in the specified section.

Start Parameters

Specifies the start up behaviour of the measurement system dBLab (see also *dB-Lab manual*).

Select first the Operator or Engineer Access and select the items and properties, the corresponding user group shall be granted.

The derived command line from the settings is also shown.

dBLab *dB-Lab*

QC-Start ini file

QC-Start ini

Although all settings can be edited using the property page described above, all settings can be directly be changed within the ini file of QC-Start. The *QC-Start.ini* file is located by default in *C:\Documents and Settings\All Users\Application Data\Klippel\QC\QC*.

The *QC-Start.ini* file has four sections:

1. [Paths]
2. [Access]
3. [Select]
4. [StartParams]

Each section contains a set of parameters. The parameters can be changed easily by opening the file with the Windows Editor program.

Note: It is recommended to use the graphical editing of the settings. Do not edit the ini file directly, if not required.

[Select]

Specifies the default test displayed in the **Select Test** box when starting the QC-Start tool. The entry must be one of the test labels. Creating a new test setup the entry is changed automatically to the name of the new test.

QC ini

QC-Start.ini

C:\Documents and Settings\All Users\Application Data\Klippel\QC\QC.

QC-Start.ini

1. [ ]
2. [ ]
3. [ ]
4. [ ]

Windows

---

ini

[ ]

QC

Remote Configuration

The Remote QC Configuration tool provides logging into each measurement without the need of the hardware unit (Production Analyzer).

It allows the safe modification of the limits and of the measurement setup even when the test is running (using Master Tests, see *Synchronizing multiple QC Systems (Master Tests)* above). It eases the correction of limits due to (temporary) changes of the production. These changes can easily be authorized by the customer when sharing the modified data files (databases).

It is also possible to modify the graphical appearance of the QC desktop for the Operator and for the QC-Engineer.

Note: The Remote Configuration Tool is an optional component.
A special license as well as a special installation setup is required.
Please contact Klippel for details.

QC

QC

QC

Klippel

Single QC System

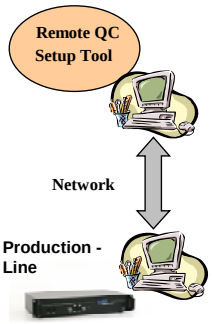
QC

Accessing the QC Database from a remote PC while it is used in production is not recommended and can cause unexpected data loss.

Using the remote QC Configuration tool, together with Master Tests (see *Synchronizing multiple QC Systems (Master Tests)* above), allows safe modification of a copy of the test while QC testing is in progress. To accept changes, the Operator only needs to log out from Klippel QC, and log on again.

Although the Master Test functions are primarily dedicated to multiple line synchroization, they should be also applied to the remote configuration of one single QC-System.

In this case, Master Tests should be stored on the local PC.



PC QC

QC QC

Synchronizing multiple QC Systems

(Master Tests)

Klippel QC

QC

PC

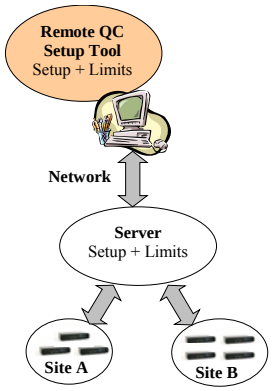
Multiple QC Systems

QC

A very useful combination is using the Remote QC Configuration tool with the Master Test functions (see *Synchronizing multiple QC Systems (Master Tests)* above) of the QC system for multiple lines:

1. Modify the Master Test offline, while the production is running from any remote computer.

2. Just instruct the operator on the production line to log out and log in again. This forces to update the current test setup with the remotely set modifications automatically.



QC

QC

Synchronizing multiple QC Systems (Master Tests)

1.

2.

dB-Lab

dB-Lab

The KLIPPEL QC measurement system runs within the universal framework software called *dB-Lab*. Users who already use *dB-Lab* with the KLIPPEL R&D measurement system should notice the following differences:

- The  button does not start the QC measurement directly but is used to log in to the QC System. The actual start is triggered by the button on the control panel, I/O pins, serial number scans or releasing the *pause* icon.
- The  button is not used to finish a measurement but to log out from the QC System.
- The  button (*pause*) is always pressed and can be released to start a single measurement.
- As long as you are logged in, many functions of dB-Lab are disabled. You have to log out to access all known functions concerning dB-Lab objects.
  Depending on the setup of the QC Start-Tool, dB-Lab may be automatically shut down when logging out. In this case double click on the database in the test folder.

Users who don't know dB-Lab should read the *dB-Lab manual* to learn more about the software.

Note: Even if familiar with dB-Lab it is strongly recommended to use the QC-Start tool for managing tests. In this case, it is required to have only one operation in a database, which is QC / QC (one object labeled "QC"; one operation labeled "QC".

KLIPPEL QC *dB-Lab*
KLIPPEL R&D *dB-Lab*

-  QC QC
I/O
-  QC
- 
- dB-Lab
dB-Lab

QC dB-Lab

dB-Lab *dB-Lab*

	dB-Lab	QC
QC/QC	“ QC ”	“ QC ”

User Modes

Operator

The Operator Mode is dedicated to run QC tests using test setups that were configured by an engineer. Depending on the setup the operator may also have the task to recalibrate the limits by means of a reference device.

QC

How to start a test?

The QC Software is started using the QC Start Tool (see picture below). Depending on your system configuration the QC Start tool - icon may already be displayed on your desktop after you have logged on to your Windows system.

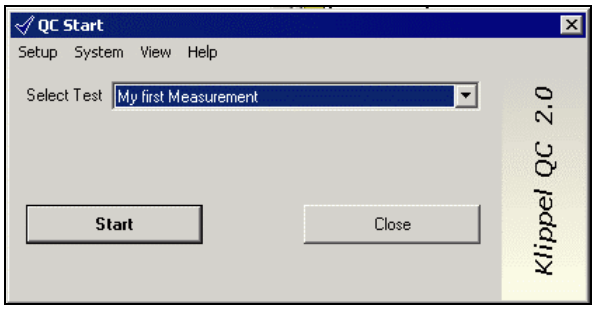
Double click on the icon.

If the icon is not visible, you can start using the **Windows-Start** menu:

- **Start/Programs/Klippel Analyzer/QC-Operator**

To start a test you have to:

1. Select the test for your application from the **Select Test** box.
2. Press **Start** button to start the test.



Depending on the access rights granted in the configuration of the QC Start-Tool, more buttons may be visible for Operators.

QC QC
Windows QC

Windows QC

- **Start/Programs/Klippel Analyzer/QC-Operator**

1.
2.

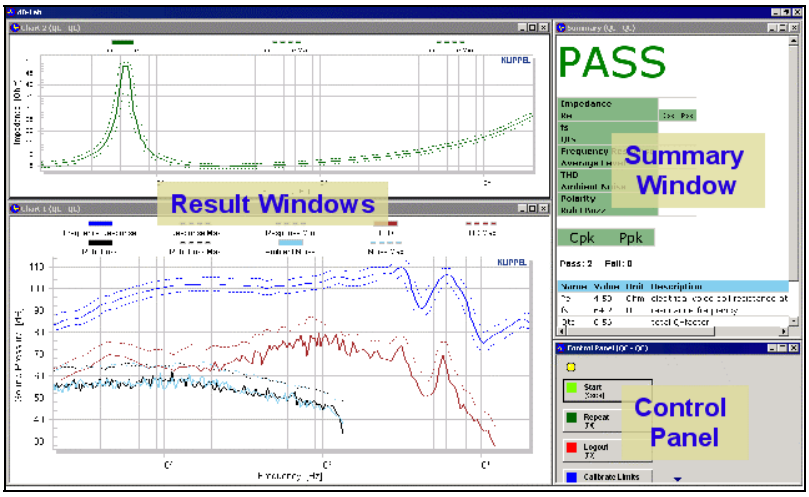
QC

Desktop

The appearance of the operator desktop depends on the test configuration that was setup in the Engineer Mode. Normally the following windows will be displayed (see also picture below):

Window	Comment
Result Windows	Display measurement results as charts.
Summary Window	Displays Pass/Fail result and measured parameters
Control Panel	Displays control buttons like measurement start

Note: If you close a window, it will be reopened automatically after you have started the next measurement. Do not close the Control Panel. However, the Hotkeys will still work.



	/

Summary Window

The Summary Window displays, if a tested device is OK or not. It also gives an overview over the test results and can display the linear parameters of a device.

PASS/FAIL

In the upper part of the window the PASS/FAIL test result is displayed.

PASS means the measured device is OK and within the set limits. All parameters that appear in the table below the word PASS must be displayed green.

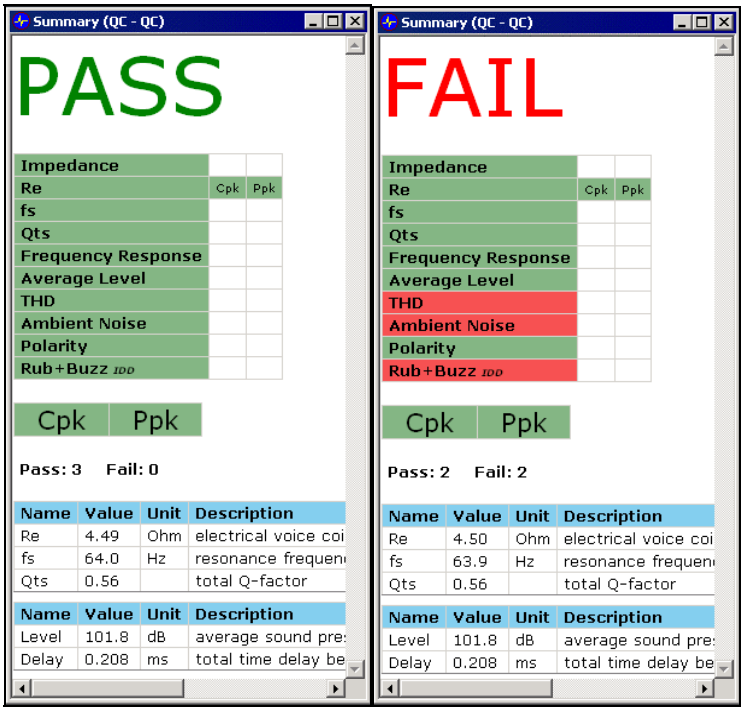
FAIL means that the measured device has hurt one or more limits. The parameters that hurt the limits are displayed red in the table below the word FAIL.

Attention: In case the noise limit was hurt (NOISE displayed red) the measurement was corrupted by ambient noise. Repeat the measurement.

Examples (see pictures below):

The left picture shows PASS measurement. All parameters with limits like Impedance, fs, Re etc. are displayed green. The tested device has passed the test.

The right picture shows a FAIL measurement where the THD (total harmonic distortion) and the Rub&Buzz limit were exceeded (both displayed red). Normally this device has failed the test. But in this example the ambient noise field is also red indicating that the ambient noise level was to high and disturbed the measurement. In this case the measurement should be repeated since the tested device may be OK.



/

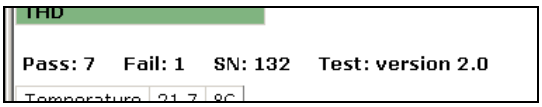
/

fs Re

THD

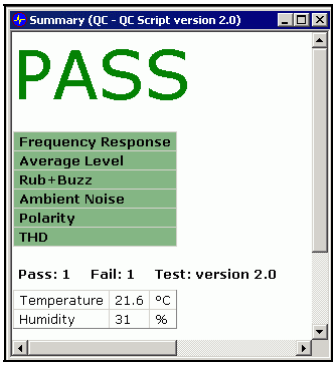
Counting / Test Name

Below the detailed test results, the number of good and bad units in the current test session are listed as well as the serial number (if applicable) and the test name (name of test selected in the QC start tool).



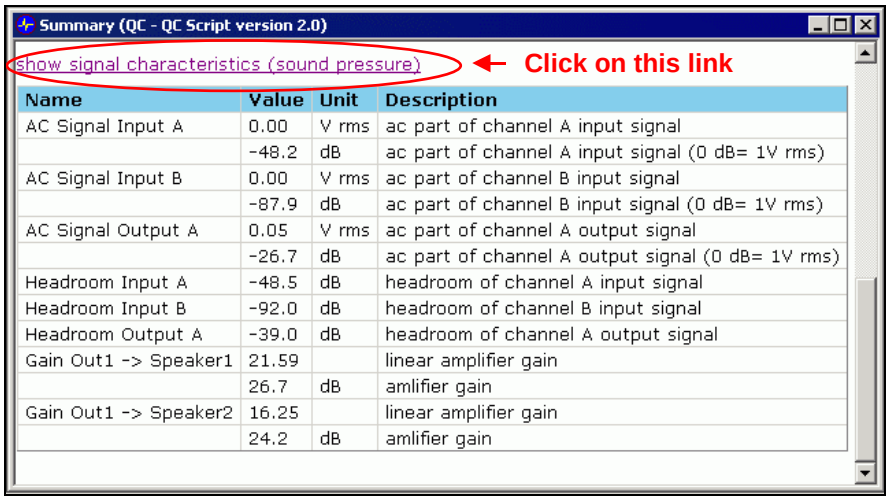
Temperature / Humidity

If the external Temperature / Humidity Sensor is connected, the environmental data are displayed automatically in the Summary window.



Signal Characteristics

For each task signal properties are listed. This data is hidden by default. Click on the link *show signal characteristics ({task-name})* to show the rms value, headroom and measured amplifier gain for this measurement.



/

QC

/

/

({ - })

Control Panel

The control panel window contains control elements that allow starting a measurement, recalibrating the limits by means of a reference device, type in a serial number of a device or exiting the test.

Start a measurement

There are two ways to start a measurement depending on the test setup

- Press **Start** button.
  (or press **Space** key on the keyboard)

or

- Type in a **Serial Number** and press **Enter** key on the keyboard.

In the second case the serial number of the tested device is recorded with the measurement and displayed in the Summary Window (e.g. SN: 12345).

Note: If you use a bar code reader to scan the serial number, you have to click into the serial number field before the **first** measurement in order to activate the field. After scanning a serial number the measurement starts automatically then.

Exit the test

Press the **Logout** button to close the test desktop and return to the QC Start tool.

Recalibrate Limits

If the button Calibrate Limits is available in the control panel, you can recalibrate the test limits by means of a reference device, if necessary. The limit calibration must be enabled in the section *Configuration / Allow Limit Calibration* of the Start Task (Engineer Login required).

1. Press **Calibrate Limits** button.
2. Connect device ('Golden DUT'), see chapter *Test Configuration / Golden DUT Handling*.
3. Press **OK** button

Repeat Tests

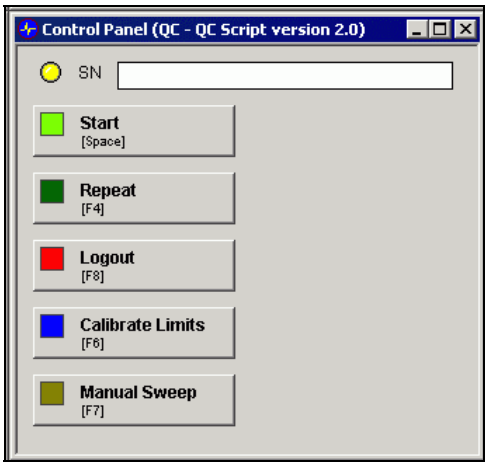
After a test against limits (which must exist), the test may be repeated. Serial numbers are not incremented. In the log file the preceeding test will be marked as `SKIPPED` to identify repeated tests.

Manual Sweep

The Manual Sweep is an easy to use Sine Sweep Generator. This button must be enabled in the section *Configuration / Allow Limit Calibration* of the Start Task (Engineer Login required).

For details refer to section *Manual Sweep* below.

Example of the Control Panel:



-

-

SN 12345

QC

/

1.
2. “ DUT ” */ Golden DUT*
   Handling
3. OK

`SKIPPED`

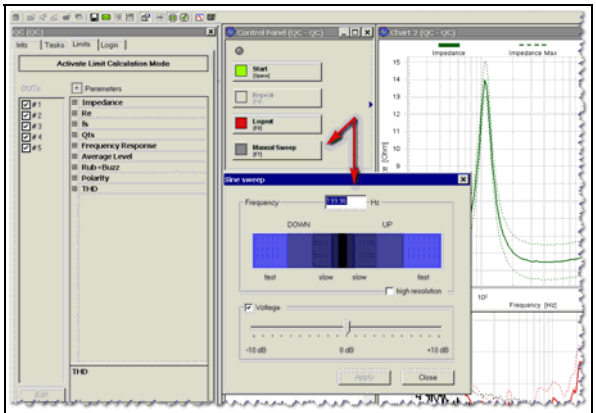
/

Manual Sweep

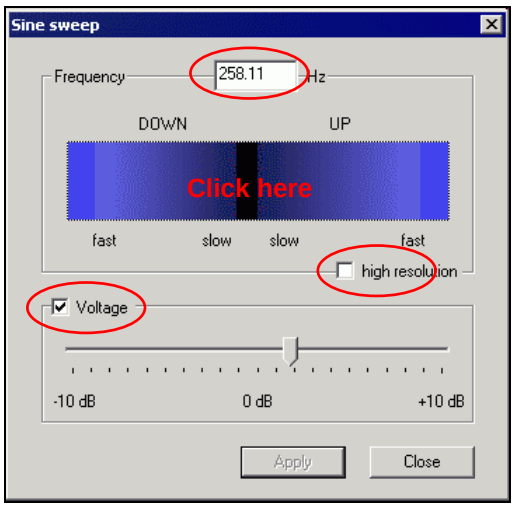
Manual Sweep

For manual testing / listening a sine generator is implemented. This provides simple verification of the automatic test results and allows detailed investigation on critical units.

The Manual Sweep can be started by a button on the Control Panel. It must be enabled in the section Configuration / Allow Limit Calibration of the Start Task (Engineer Login required).



Open Manual Sweep feature



The **frequency** can be

- entered directly or
- changed continously by clicking on the blue field (if high resolution selected, this field is red).
  As long as the mouse button is pressed, the frequency will be increased or decreased, depending on which side of the field the mouse is located. In the very center (black range) no frequency change occurs. The more the mouse is moved to the outer range, the higher the frequency change.

  The *High Resolution* mode provides a very sensitivity frequency adjustment for narrow band defects.
- The frequency range is not limited by the task setting. The sampling rate limits the high frequencies.

If enabled, the **voltage** can be modified by +/-10 dB relative to the specified voltage in the task. Note, that a potential level profile is considered in the manual sweep.

Note: The manual sweep is based on the voltage setting of the first task found in the task list, that provides SPL measures.

/

/

-
-

-

+/-10 dB

SPL

Engineer

Entering the QC System in the Engineer Mode you can setup tests, define limits, change the user interface for the operator and control the access to the system.

The following sections describe the user interface for the engineer. A description how to configure a test and define limits can be found in chapter *Test Configuration*. Information about access control can be found in the section *Administration* below.

Basically the Engineer has all functionality of the Operator described in the section *User Modes / Operator* and additional features described in this section.

QC

/

Desktop

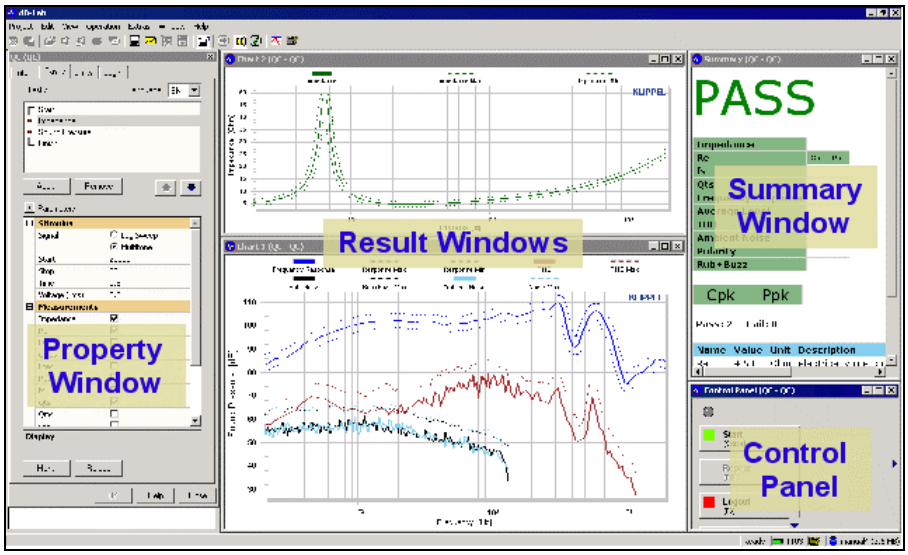
Besides the menu bar and the tool bar, the following windows are displayed on the desktop in the Engineer Mode (see also pictures below):

Window	Display
Property Window	A set of property pages (tasks, task settings, limits and user accounts) (not visible in Operator Mode)
Result Windows	Results of measurements as chart; performance information,

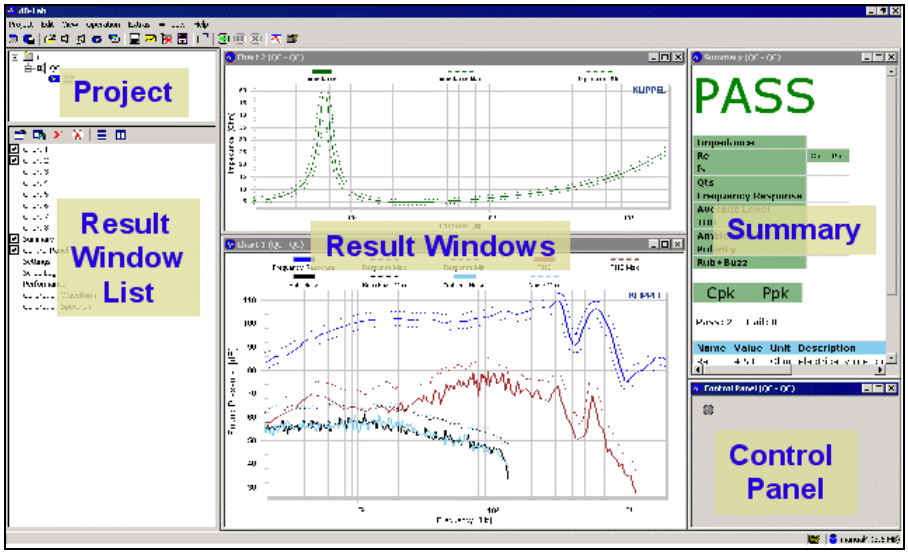
	debug information
Summary Window	PASS/FAIL results and measured parameters
Control Panel	Control elements (start measurement button etc.)
Project Window	QC measurement operation object (see dBLab manual)
Result Window List	List of all Result Windows that can be displayed. (not visible in Operator Mode)

Note: The Project Window and the Result Window List are fixed and may be covered by the Property Window. The Property Window can be opened and closed by pressing the  button in the tool bar.

State after logging in as Engineer with open Property Page:



State after logging in as Engineer without Property Page:



	/
	QC dBLab

:

Control Panel

The Control Panel is basically identical to the operator.

However, the QC-Engineer has access to all buttons, while the operators Control Panel may be restricted according to the setup in the Start-Task. For more information about the restrictions please refer to *Test Configuration / Tasks / Control Task*.

QC -

/ /

Result Windows

The Result Windows can be opened and closed by checking the corresponding check boxes in the Result Window List. The following windows are available:

Result window	Content
Chart 1	Frequency response and all active distortion measures (THD, Rub & Buzz).
Chart 2	Impedance
Chart 3	Harmonic Distortion (single orders, THD)
Chart 4	Rub & Buzz crest factor, IDD performance measure
Chart 5	Phase
Chart 6	Spectra of voltage, current (impedance task)
Chart 7, 8	Not used
Summary	Output window for Pass / Fail information and details
Control Panel	Control elements for start/stop measurement See *User Modes / Operator / Control Panel* for details.
Settings	List of all test settings for reference when viewing
Scilab Log	Output of Scilab routines for debugging or logging. Intended for programmers use.
Performance	Time Analysis of the test
Calibration Waveform	Result of internal synchronization and amplifier self test. For trouble shooting only.
Calibration Spectrum	Result of internal synchronization and amplifier self test. For trouble shooting only.

1	THD
2	
3	THD
4	IDD
5	
6	
7 8	
	/
	/ / /
Scilab	Scilab

Window Management

Result windows, Summary Window and Control Panel window can be rearranged on the desktop. The small tool bar above the Result Window List offers some windows management functions:

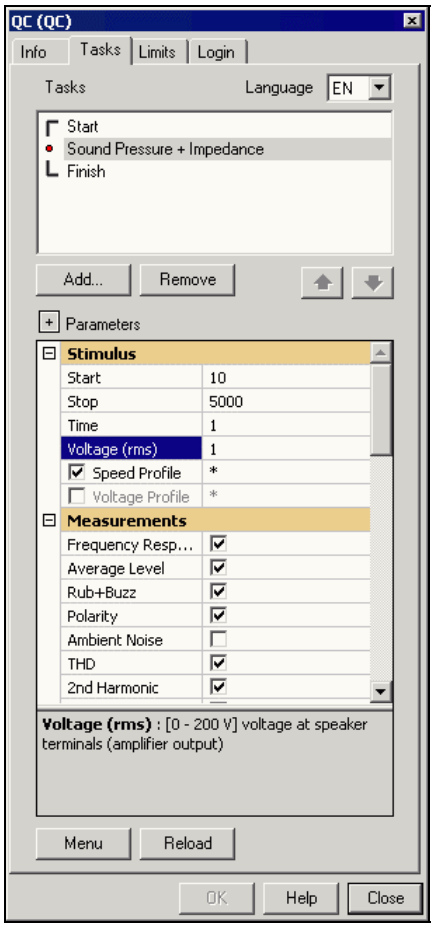
	Window Management Toolbar	
	Open Default Windows	Open the default Window set. For each Operation there is a set of default windows. They are also opened when you double-click the operation in the project window, or select the operation and press RETURN.
	Save Default Windows	Clicking this button, you can replace the default window set.
	Close All Windows	Close all result windows.
	Close Alien Windows	Close all result windows that do not belong to the selected Operation
	Tile Horizontally	Arrange windows without overlapping, prefers wide over tall windows
	Tile Vertically	Arrange windows without overlapping, prefers tall over wide windows

Default windows remember the position when button (Save Default Windows) was clicked. All other windows remember their last position. All positions are relative to the size of the main window.

Note: The default window arrangement that you store by clicking the button (Save Default Windows) will also be displayed by default in the Operator Mode. The only difference is that the Project window, Result Window List and Property Window will be hidden.

Property Page Tasks

Each test can be divided in a sequence of measurement tasks which are managed on the Tasks Page of the Property Window (see also picture below). The sequence always begins with a Start task and ends with a Finish task. Between these obligatory tasks you can add the measurement tasks you need for your test (see also chapter Test Configuration).



The Tasks page is divided in two corresponding sections:

- The task section where the measurement tasks are displayed.

- The parameter section where the corresponding parameters are displayed.

Each task has its own parameter list. By clicking on a task, the task parameters are displayed in the parameter section.

Adding/Removing a task

To add a task to the test:

1. Press the **Add…** button and select a task file in the following dialogue box.

   Note, that in the basic version the number of tasks is restricted.

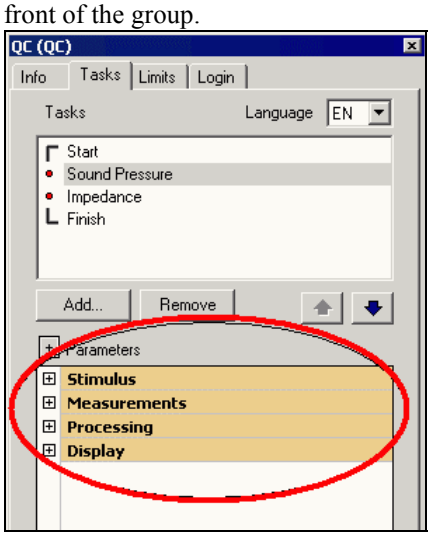
2. Change the task sequence with the  and  buttons.

To remove a task from the test:

1. Select the task.
2. Press the **Remove** button.

Parameter

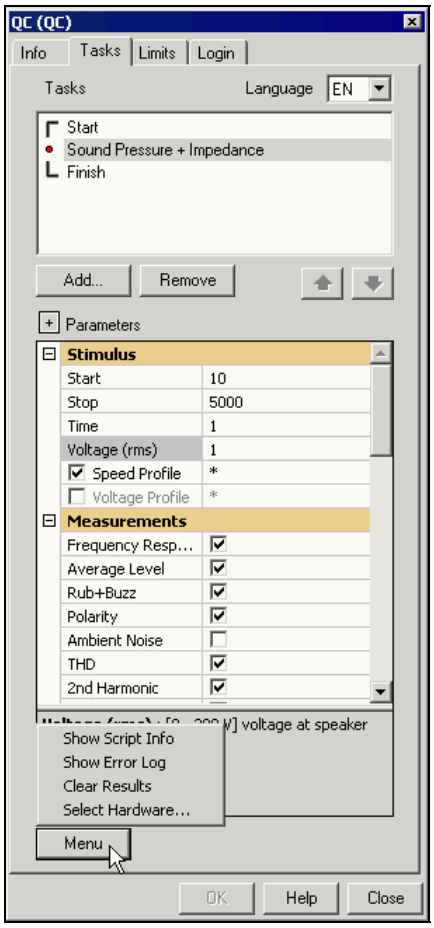
Parameters are arranged in groups (e.g. stimulus, measurements etc.). A group can be expanded or collapsed by clicking the plus or minus symbol in front of the group.



When you click on a parameter, a help line is displayed at the end of the parameter section. The help line shows some specific parameter information like maximum/minimum values or physical unit.

Menu Button

The menu button offers you access to further information.

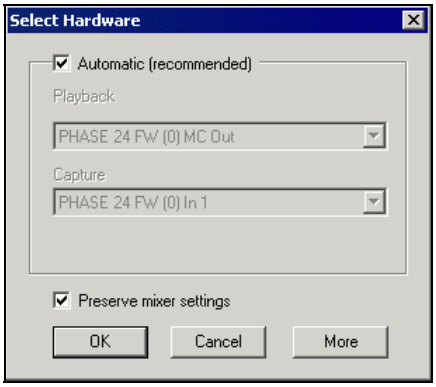


Show Script Info – displays information where the script of the task is stored.

Show Error Log – opens the log file, were all errors are accumulated during the operation. Please send this file in case of trouble to the Klippel Support.

Clear Results – All current results and limits are deleted but the reference units are kept. This is to clean operations before creating templates from used measurements.

Select Hardware – allows access to the setup of the sound device *(see next section for further information)*



-
-

I

1. ...

2. 

1.
2.

“ + ”

“ - ”

/

–

–

Klippel

–

–

Sound Device & Sampling Rate

The sound device can be setup by means of the **Menu** button at the end of the property page.

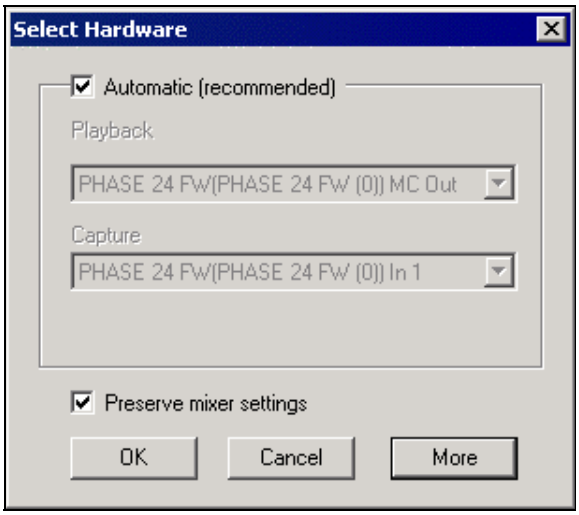
1. Press **Menu** button.
2. Choose **Select Hardware.**

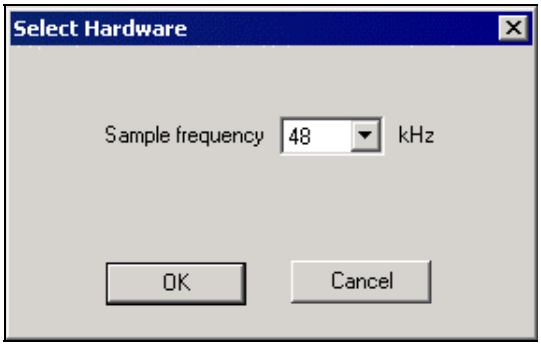
The Select Hardware dialog is opened. It is recommended to check the boxes **Automatic** and **Preserve mixer settings.**

The sample frequency can be changed by pressing the **More** button and choose the required sample frequency in the following dialogue window.

Attention: Measurements can be incorrect when you change the sample frequency.

After changing the sample frequency you must logout and login again in order to reinitialize the system.





1.
2.

Property Page Limits

The *Limit page* of the Property Window allows to manage the measurement of reference devices and to set limits to all measured curves and parameters. It is divided in two sections:

- DUT section, where the measured reference devices are displayed.
- Limit Parameter section, where the parameter limits are set.

The Limit page has two operation modes:

- Measurement Mode (Limit Calculation Mode button released)
- Limit Calculation Mode (Limit Calculation Mode button pressed)

To activate or deactivate the Limit Calculation Mode click on the **Activate Limit Calculation Mode** button at the top of the limit page.

Please refer to chapter *Test Configuration* /

Reference Units for more information about Refernce DUTs.

- DUT
-
-
-

/ DUT

Property Page Login

The property page Login allows controlling the access to the QC system by means of user accounts.

For further information see section *User Modes / Administration*.

QC

/Administration

Programmer

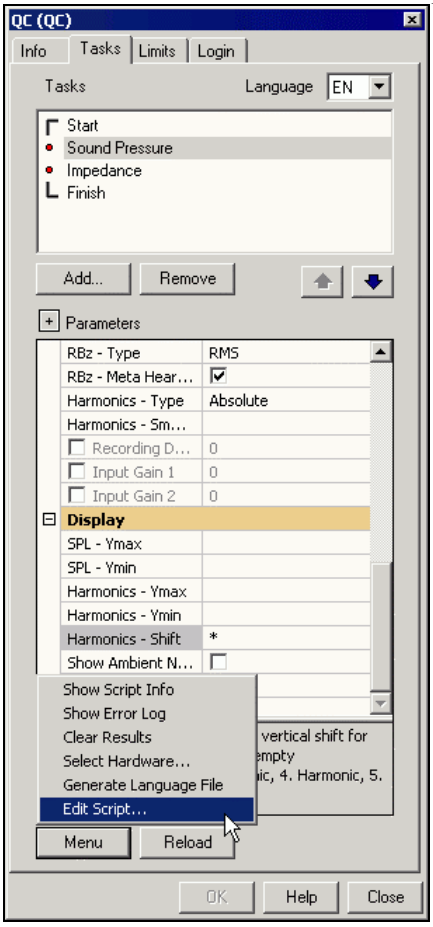
The Programmable System allows logging in as a programmer and loading your own SciLab measurement scripts as tasks. The only difference in the user interface is that the programmer has an Edit button for the scripts. Further information about programing the QC system can be found in the separate *Programmer Manual*.

Edit a script

Editable scripts have the file name extension *.kla*. You can use any text editor to edit these files.

1. Click on a task you want to edit.

2. Press **Menu** button at the end of the Property Window.



3. Select **Edit Script** from the menu.

An explorer window is opened with the script file of the task marked.

4. Open script file with an editor.

Note: Only script files with the suffix .kla can be edited. Standard scripts provided by Klippel are compiled and have the suffix .klb. See also *Programmer Manual*.

Reload a script

After you have changed a script file you have to reload it explicitly. No parameter or setting will be changed.

1. Click on a task you want to reload.
2. Press **Reload** button at the end of the Property Page (see above picture). This button is availbale only in the Programmer Mode.

SciLab

QC

.kla

1.
2.

3.

4.

:	.kla Klippel .klb .

1.
2.

Administration

The access to the KLIPPEL QC System can be controlled by means of user accounts. Each user account is assigned to one of the user groups Operators, Engineers or Programmer.

KLIPPEL QC

User Administration

Activate the User Identification

1. Open an arbitrary test and log in as engineer.
2. Click on the page **Login** of the property window.
3. Check the box **Require User Identification.**

Note: If you activate the User Identification, the settings in the page **Login** are valid for the whole QC System and not only for the opened test.

Add/ Delete a User

1. Press button **Add User** on **Login** page.
2. Choose a user group in the **Login as** box.
3. Type in a user name and a password for the new user.
4. Press **OK** button.

Note: If you *Allow Windows login* (see below*)*, you can either choose the user name from a list of Windows users on the system or you type in an arbitrary name.

To delete a user you just need to

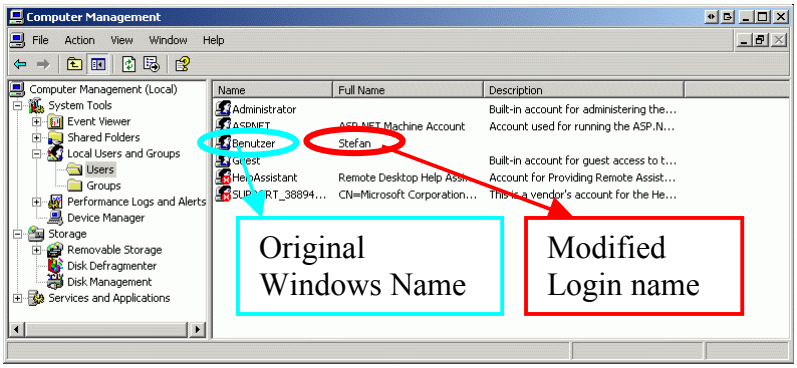
1. Click on the user you want to delete.
2. Press button **Delete User**.

Using Windows User Accounts

To ease the access to the QC system, you can allow certain users to log on to the QC system with their Windows user account. Once the user has logged on to the Windows system the QC system can be started without an additional QC login. The QC identifies the user by its Windows Login Name.

If you are using restricted user accounts, you must use Windows XP Professional and assign that user to the Power User Group. Restricted User accounts and Windows XP Home do not satisfy the system requirements!

Note: The Window Login Names are derived from the Windows "Names". These are the names that are specified at the creation of the windows account. Later on these names may be changed to a new "Full Name", which is different from the original "Name". If you can't find the name of your windows account in the list, check the Start / Settings / Control Panel / Administrative Tools / Computer Management / Local Groups and Users list, to find the original name.



To activate the use of Windows user accounts

1. Check the **Allow Windows Login** box.
2. Choose one of the **Require Windows Login** options.
3. Add users with their Windows user names (no password required).

The following options are available in the **Require Windows Login** field:

Option	Comment
For Nobody	Anyone, who is registered in the user list, can log on to the system.
For Operators	Only those operators, who are registered with their Windows user name in the Operators list, are allowed to log on to the QC system.
For Anybody	Only users, who are registered with their Windows user name in one of the user groups, are allowed to log on to the QC system.

Hint: For security reasons you can force that an operator is always logged on to the QC system with his Windows user name by choosing the **For Operators** option. He cannot log on with a different operator account without logging on as another Windows user. The **For Anybody** option extends this principle to all users.

1.
2.
3.

QC

/

1.
2. **...**
3.
4. **OK**

Windows

1.
2.

Windows

QC Windows
QC Windows QC
QC QC Windows

Windows XP
Windows XP

Windows Windows “ ”
Windows
“ ” “ ”
Windows / / / /
/

Windows

1. **Windows**
2. **Windows**
3. Windows

Windows

	Windows
	Windows QC

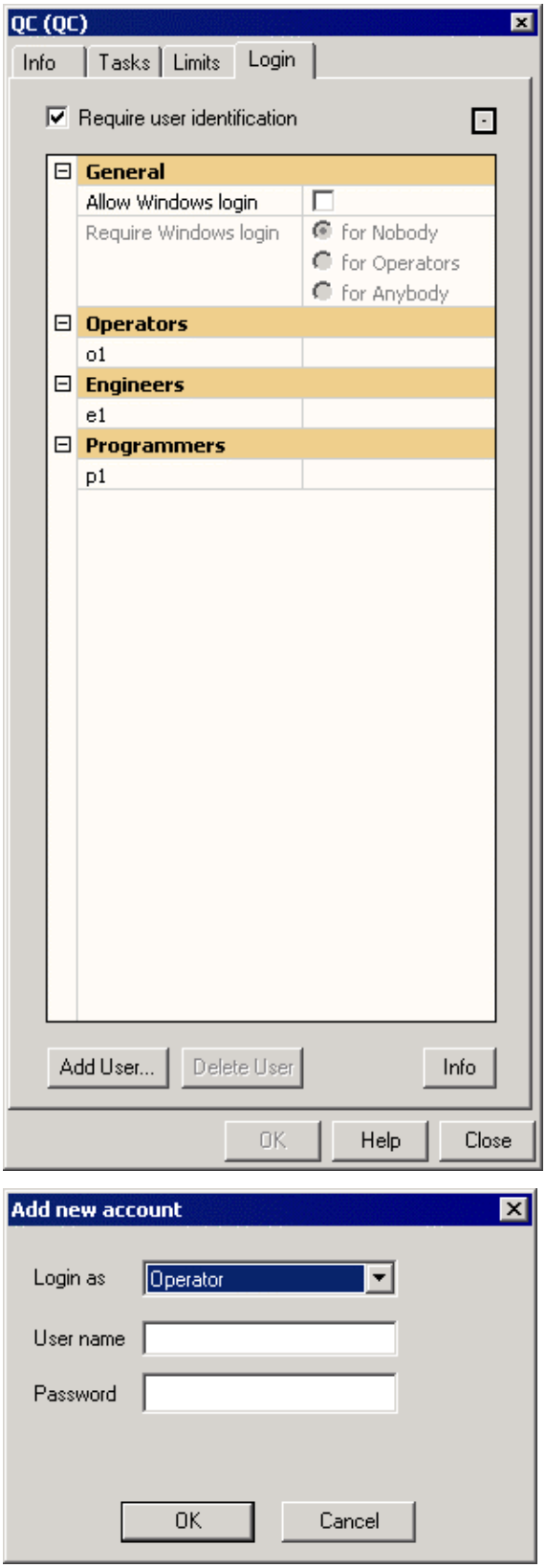
Windows QC
Windows

Security

All user accounts are stored in the file *qclogin.dat*. The default path of the file is *{Program Files}/Klippel/DA/QC/* or press **Info** button on the bottom of the property page for path information.

Use operating system functions to allow write/delete access to this file for administrators only. Operators need read access to this file.

Attention: If the file *qclogin.dat* is deleted, the user list is removed and you can access the system without a password. You may use this, if the engineer/programmer password got lost and you can't access the system.



qclogin.dat

{Program Files}/Klippel/DA/QC/

qclogin.dat i

/

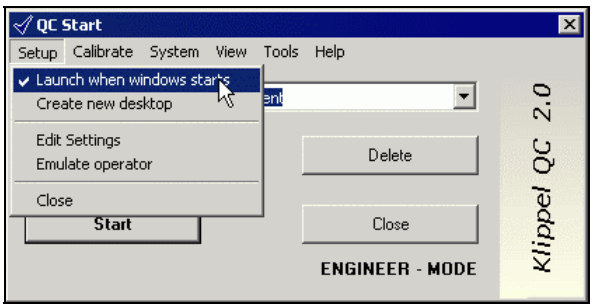
Starting the QC with Windows

QC Windows

You can setup the QC system in such a way that the QC Start Tool starts automatically with the Windows login.

1. Open the QC-Start Tool in the engineer mode (choose **Start/Programs/Klippel Analyzer/QC Start (Engineer)**)
2. Select **Launch when windows starts** from the **Setup** menu.
3. You may optionally select **Create new desktop** from the **Setup** menu.

If you choose the option **Create new desktop** the user will find an empty desktop with the QC Start Tool running after he has log on to the Windows system.



QC Windows QC

1. QC

Start/Programs/Klippel Analyzer/QC Start (Engineer)

2. **Windows**

3.

Windows

QC

Test Configuration

General Structure

All checks of a particular test object (DUT) are combined in one **test**.

Each **test** may consist of several **tasks**, that define different **measures** to be checked against limits.

DUT

Test

Tests comprise all actions performed on one DUT. Multiple Tasks can be included as well as multiple measures for each task.

Each test is stored in a database ({test name}.kdb). Within this database all results and settings are stored. However, the task definitions (task files) are not stored in the database but are linked to fixed external locations in the file system.

New tests can be created using the QC-Start tool (see chapter *Organizing Projects / QC-Start Tool*) based on test templates. In the Basic version these templates are predefined and cannot be altered. In the Standard and Programmable version user defined templates can be created and used for new tests (see chapter *Tasks*).

DUT

{ }.kdb

QC */QC*

Test Storage

By default each test (the database) is stored in a separate folder. In this folder all results should be stored for a simple data management. You can change the location in your file system where this folder is created. (see chapter *Organizing Projects / QC* Start).

Attention: It is not recommended to work on network drives. Due to high traffic peaks and CPU load the measurement could be interrupted, which leads to avoidable errors.
DO NOT USE WIRELESS NETWORK! Due to high system load in most cases no reasonable operation can be ensured!

/QC

CPU

Task

One Task describes one particular test signal applied to the DUT such as sine sweep or multitone. Several tasks can be grouped in one test. Each task can be adjusted using task parameters.

In the Basic version only predefined sequences of tasks can be chosen (but not changed) where as in the standard and programmable version arbitrary composition of tests with multiple tasks is provided. (see chapter *Tasks*).

Each task is defined in a task file, which holds all definitions for the stimulus, acquisition, post processing and limit check as well as limit calculation. In the Basic and Standard version these files are binary type. In the programmable version these files are readable and editable text files (see *In this* chapter all available default tasks are described.

Since tasks could not be used in the Basic version to compose tests, this chapter is applicable for Standard and Programmable version only.

Filename	Label on Prop.-Page Tasks	Measures / Comments
spl.{version}.task.kla	Sound Pressure	Freq.-response, Level, Polarity, THD, Rub&Buzz, IDD, Ambient Noise
imp.{version}.task.kla	Impedance	Impedance, T/S Parameter based on Multitone or Sweep
spl-imp.{version}.task.kla	Sound Pressure + Impedance	Freq.-response, Level, Polarity, THD, Rub&Buzz, IDD, Ambient Noise, Impedance, T/S Parameter based on SineSweep.
start.{version}.control.kla	Start/Finish	Global settings for routing, logging

		/
spl.{version}.task.kla		THD IDD
imp.{version}.task.kla		T/S
spl-imp.{version}.task.kla	+	THD IDD T/S
start.{version}.control.kla	/	

Filename Convention). The syntax is based on the high-level math software Scilab, which is very similar to Matlab®.

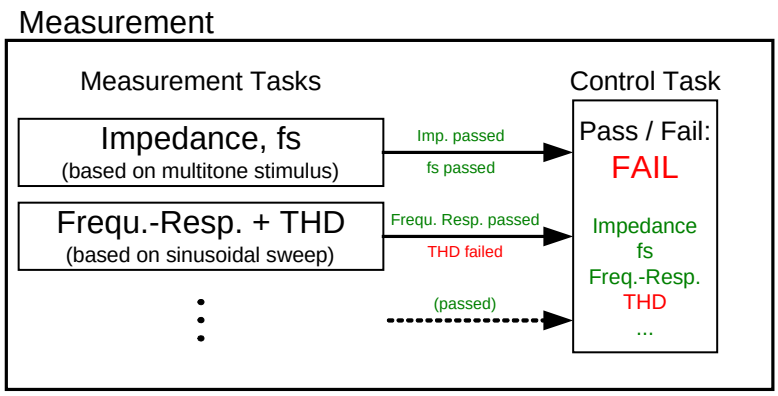
DUT

Scilab

Matlab

Control Task

The Control Task is a special task. It collects all information from the Measurement Tasks and calculates the final Pass/Fail decision, generates log files and provides parameter for the complete test (e.g. used speaker channel for the test, report folder).
The control task is displayed as Start and Finish task in the task list. For details and parameter see section *Control Task.*



/

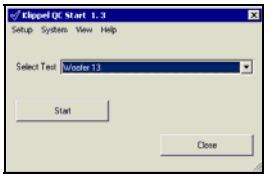
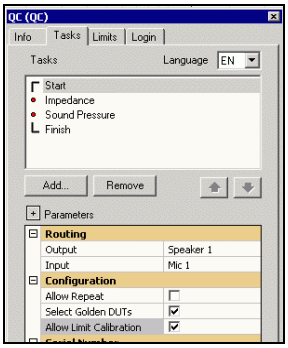
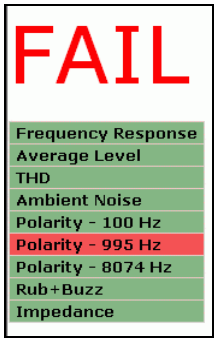
Measure

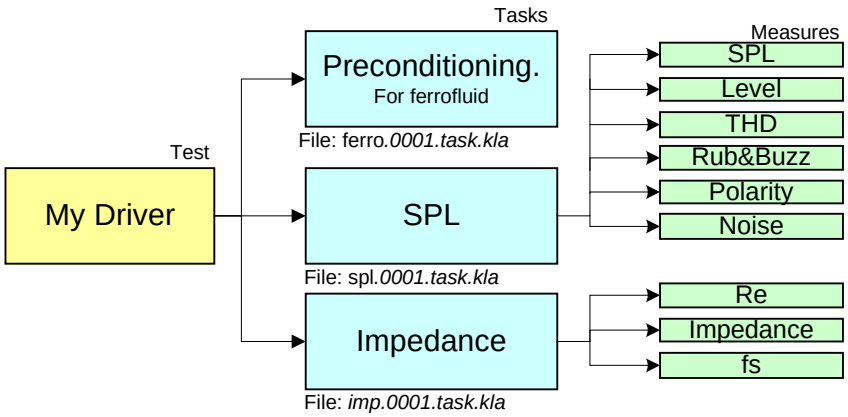
Measures are derived results from post-processed response of a task such as Re, fs or frequency response. Each measure has its own limit that can be individually adjusted with limit parameters and will be checked against these limits.
From the results of all measures the overall Pass / Fail result is calculated.

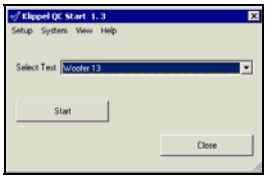
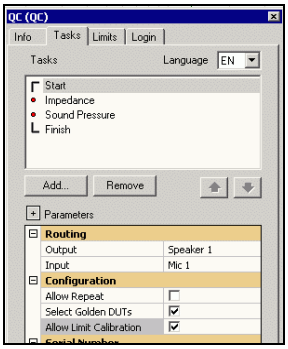
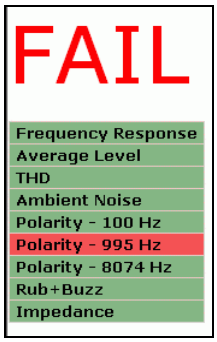
/

How does it work together

This is an example structure of a complete Test Configuration:

Test	Task	Measure
to be selected in QC Start Tool	to be configured in Property Page Tasks	Result list after limit check
		



QC		
		

Measures and Limits

All measures, their corresponding limits and parameter for setting up are described in this chapter.

For these measures all tasks are listed which provide a test of the requested measure.

Note: All Measures may be individually disabled on the Property Page *Tasks* / *Parameter* Table / section *Measurements.* If one measure is disabled, all exclusively related parameter, limits and curves are hidden.

The Measures that are part of the Basic Package are marked with Basic in the headline. All Measures (but Meta Hearing Technology for improved Rub&Buzz) are part of the Standard and Programmable QC Software Package. See also chapter *Basic, Standard, Programmable version*.

/ /

QC

Impedance (Basic)

Impedance provides the magnitude of the electrical impedance vs. frequency.

This table lists all Tasks, which provide impedance measurement:

Tasks	Info	Version	Filename Convention
Impedance	Measurement of current and voltage	Basic Standard Prog.	*Imp*
Sound Pressure + Impedance	Measurement of current only, assuming constant Voltage	Basic Standard Prog.	*SPL + Imp*

Tasks

Tasks			**Filename Convention**
			Imp
+	,		*SPL + Imp*

This table lists all basic properties related to impedance. Please use the links to get more information about details (use online help or pdf version for linked tables).

Parameter (shared among several measures or private for exclusive use by this measure) are editable on the *Property Page Tasks*.

Category	Properties
Stimulus	*SineSweep, Multitone* (Impedance Task only)
Shared Parameter	Generator, Routing, Resolution, Smoothing, Display setting for Y-axis
Limit Modes	Relative (*Relative Limits*), Statistics (*Standard Deviation*), Absolute (*Absolute Limits*), *Jitter*
Results	Impedance vs. frequency: Result Window 2

pdf

Property Page Tasks

	SineSweep *Multitone*
	Y
	Shifting Limits *Standard* Deviation *Absolute* Limits , *Jitter*
	2

The Impedance Task allows selecting two different test signals. Here is a short overview, how to select the correct one.

Stimulus	Description
Multitone	This is the optimal stimulus for best SNR at (very) low frequencies.
SineSweep	For highest speed the combined SPL+Imp task uses SineSweep for both, SPL and Impedance. Using SineSweep no intermodulation can be generated.

Note: For adjusting and optimizing the impedance task, please refer to section *Optimizing Performance / Impedance*.

	+

/ Impedance

T/S Parameter

T/S

Thiele/Small (T/S) Parameters are linear parameter describing the equivalent lumped parameter circuit of an electrodynamic transducer.

This table lists all Tasks, which provide T/S Parameter measurement:

Tasks	Info	Version	Filename Convention
Impedance	Measurement of current and voltage	Standard Prog.	*Imp*
Sound Pressure + Impedance	Measurement of current only, assuming constant Voltage	Standard Prog.	*SPL + Imp*

T/S

T/S *Tasks*

Tasks			**Filename Convention**
			Imp
+	,		*SPL + Imp*

This table lists all basic properties related to T/S Parameter . Please use the links to get more information about details (use online help or pdf version for linked tables).

Parameter (shared among several measures or private for exclusive use by this measure) are editable on the *Property Page Tasks*.

Category	Properties
Stimulus	*SineSweep, Multitone* (Impedance Task only)
Shared Parameter	Generator, Routing, Resolution, Smoothing, Display setting for Y-axis
Limit Modes	Relative (*Relative Limits*), Statistics (*Standard Deviation*), Absolute (*Absolute Limits*), *Cpk / Ppk Limits*
Results	R_e, L_e, C_{mes}, L_{mes}, R_{es}, f_s, Q_{ts}, Q_{ms}, Q_{es}

The Impedance Task allows selecting two different test signals. Refer to measure *Impedance (Basic)* for more details. For details on Cpk/Ppk, refer to *Appendix / Glossary / Ppk / Cpk.*

Note: For adjusting and optimizing the T/S parameter measurement, please refer to section *Optimizing Performance / Impedance*.

T/S

pdf

Property Page Tasks

	SineSweep *Multitone*
	, , , ,Y
	Shifting Limits *Standard* Deviation *Absolute* Limits , *Cpk / Ppk Limits*
	R_e, L_e, C_{mes}, L_{mes}, R_{es}, f_s, Q_{ts}, Q_{ms}, Q_{es}

Impedance (Basic) Cpk/Ppk / / *Ppk / Cpk*

T/S */Impedance*

Frequency Response (Basic)

Frequency Response provides the magnitude of the measured SPL vs. frequency in dB SPL.

This table lists all *Tasks*, which provide frequency response measurement:

Tasks	Info	Version	Filename Convention
Sound Pressure	Measurement of Mic at Mic 1, Mic 2, Line 1 or Line 2.	Basic Standard Prog.	*SPL*
Sound Pressure + Impedance	Measurement of Mic at Mic 1, Mic 2, Line 1 or Line 2.	Basic Standard Prog.	*SPL + Imp*

SPL dB

Tasks

Tasks			**Filename Convention**
	Mic 1, Mic 2, Line 1 Line 2 Mic		*Imp*
+	Mic 1, Mic 2, Line 1 Line 2 Mic		*SPL + Imp*

This table lists all basic properties related to frequency response . Please use the links to get more information about details (use online help or pdf version for linked tables).

Parameter (shared among several measures or private for exclusive use by this measure) are editable on the *Property Page Tasks*.

Category	Properties
Stimulus	*SineSweep*
Shared Parameter	Generator, Routing, Resolution, Display setting, Recording Delay (e.g. due to Mic distance)

Private Parameter	**Response Smoothing**: Part of octave used for smoothing, no smoothing if left empty.
Limit Modes	*Shifting Limits*, Statistics (*Standard Deviation*), Absolute (*Absolute Limits*), Alignment to level (see below), *Jitter*
Results	Frequency Response vs. Frequency in Result Window 1

Note: To obtain valid results the sensitivity of the used microphone must be known to the system. Refer to section *Hardware / Calibration / Microphone Calibration.*

Alignment to Level:

If selected, the limits are relatively shifted (aligned) to be centered around the measured level. Consequently the curve shape is checked only but not the absolute level. This must be tested using the limits of "Average Level". Average Level must be enabled to allow this mode.

Note: For adjusting and optimizing the SPL task, please refer to section *Optimizing Performance / SPL Tests*.

pdf

Property Page Tasks

	SineSweep
	MIC
	:
	Shifting Limits *Standard* Deviation *Absolute* Limits , *Jitter*
	1

/ /*Microphone* Calibration

“ ”

SPL / *SPL* Tests

Average Level (Basic)

This is a single number specifying the average level in a user defined frequency band or at discrete frequencies.

This table lists all *Tasks*, which provide average level measurement:

Tasks	Info	Version	Filename Convention
Sound Pressure	Measurement of Mic at Mic 1, Mic 2, Line 1 or Line 2.	Basic Standard Prog.	*SPL*
Sound Pressure + Impedance	Measurement of Mic at Mic 1, Mic 2, Line 1 or Line 2.	Basic Standard Prog.	*SPL + Imp*

This table lists all basic properties related to average level. Please use the links to get more information about details (use online help or pdf version for linked tables).

Parameter (shared among several measures or private for exclusive use by this measure) are editable on the *Property Page Tasks*.

Category	Properties
Stimulus	*SineSweep*
Shared Parameter	Generator, Routing, Resolution, Display setting, Recording Delay (e.g. due to Mic distance)
Private Parameter	**Level Frequencies**: In Frequency band: Format: f_{min}, f_{max} (separated by comma) At Discrete Frequencies: Format f_1; f_2; f_3 … (separated by semicolon or line break)
Limit Modes	*Shifting Limits*, Statistics (*Standard Deviation*), Absolute (*Absolute Limits*), Alignment to level (see below), *Jitter*
Results	Level in dB

Average Level must be enabled to allow the "Alignment to Level" option of the Frequency Response Limit.

The calculation of the Average Level is based on the smoothed frequency response.

Note: For adjusting and optimizing the SPL task, please refer to section *Optimizing Performance / SPL Tests*.

Tasks

Tasks			**Filename Convention**
	Mic 1, Mic 2, Line 1 Line 2 Mic		*Imp*
+	Mic 1, Mic 2, Line 1 Line 2 Mic		*SPL + Imp*

pdf

Property Page Tasks

	SineSweep
	MIC
	: f_{min}, f_{max} f_1; f_2; f_3 …
	Shifting Limits *Standard* Deviation *Absolute* Limits , *Jitter*
	dB

“ ”

SPL
/SPL Tests.

Harmonics / THD

/THD

The first 4 harmonics (2^{nd} – 5^{th}) as well as THD can be measured and checked.

The Total Harmonic Distortion (THD) provides all accumulated harmonics within the analysis bandwidth (depending on sampling frequency) versus frequency.

Note, that there are low frequency and high frequency restrictions on Harmonics / THD:

- High frequencies are limited to roughly sample frequency / 4 (Second harmonic is at Nyquist Frequency).
  On the sample frequency refer to section *User Modes / Engineer / Property Page Tasks / Sound Device & Sampling Rate*.
- Low frequencies are limited to the first full period in the time signal to calculate a valid rms value. Thus this depends on the sweep speed and start frequency if swept from lower to higher frequencies.
  The result point resolution is also restricted to full periods. When more result points are within one signal period, the points are interpolated linearly to the next valid result.
  When swept from high to low frequencies, the results for the last (and not complete) signal period at lowest frequencies are copied from the last full period and therefore are constant.

This table lists all *Tasks*, which provide harmonics / THD measurement:

Tasks	Info	Version	Filename Convention
Sound Pressure	Measurement of Mic at Mic 1, Mic 2, Line 1 or Line 2.	Standard Prog.	*SPL*
Sound Pressure + Impedance	Measurement of Mic at Mic 1, Mic 2, Line 1 or Line 2.	Standard Prog.	*SPL + Imp*

This table lists all basic properties related to harmonics / THD. Please use the links to get more information about details (use online help or pdf version for linked tables).

Parameter (shared among several measures or private for exclusive use by this measure) are editable on the *Property Page Tasks*.

Category	Properties
Stimulus	*Sine Sweep*
Shared Parameter	Generator, Routing, Resolution, Display setting, Recording Delay (e.g. due to Mic distance)
Private Parameter	**Harmonics Smoothing:** Part of octave used for smoothing, no smoothing if left empty.
	Harmonics type: Absolute: THD and 2^{nd} -5^{th} Harmonics in dB SPL Relative (dB): THD amd 2^{nd}-5^{th} Harm., relative to fundamental in dB (rel), fundamental is 0 dB. If Absolute then THD is in Result Window 1 else in result Window 3.
Limti Modes	Shifting Limits, Absolute (Absolute Limits), Jitter separately for all harmonics
Results	2^{nd} - 5^{th} Harm. – Type is absolute then THD is shown in Result Window 1 else in Result Window 3.

A **THD+N** measure based on a tracking high pass filter is available with the programmers version of the QC-System. This THD+N will consider all harmonics and noise above the fundamental from 2^{nd} order up to the Nyquist frequency.

Note: Smoothing of THD and Harmonics is possible but not recommended. The fine structure of the distortion may reveal a defect (especially if tested without Rub&Buzz), which is not detectable in a smoothed THD.

The calculation of THD and Harmonics requires a certain bandwidth of the stimulus. Please allow sufficient bandwidth (at least 1 decade, depends on speed and speed profile).

Note: For adjusting and optimizing the SPL task, please refer to section *Optimizing Performance / SPL Tests.*

2 – 5 THD

THD

/THD

- 1/4

  / /

  /Sound Device & Sampling Rate
-

/THD *Tasks*

Tasks			Filename Convention
	Mic 1, Mic 2, Line 1 Line 2 Mic		*Imp*
+	Mic 1, Mic 2, Line 1 Line 2 Mic		*SPL + Imp*

/THD
pdf
Property Page Tasks

	SineSweep
	MIC
	THD 2-5 dB THD 2-5 dB 0dB THD 1 3
	Shifting Limits *Absolute* Limits , *Jitter*
	2-5 1 3

QC THD+N
THD+N

THD

THD

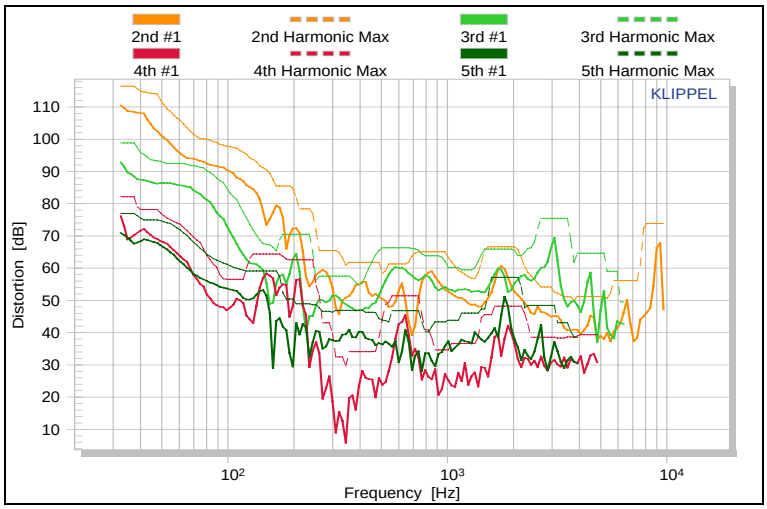
THD
10

SPL
/SPL Tests.

Separating Harmonics visually

When using the individual harmonics, it is recommended to separate them visually in order to have a more clear graph.

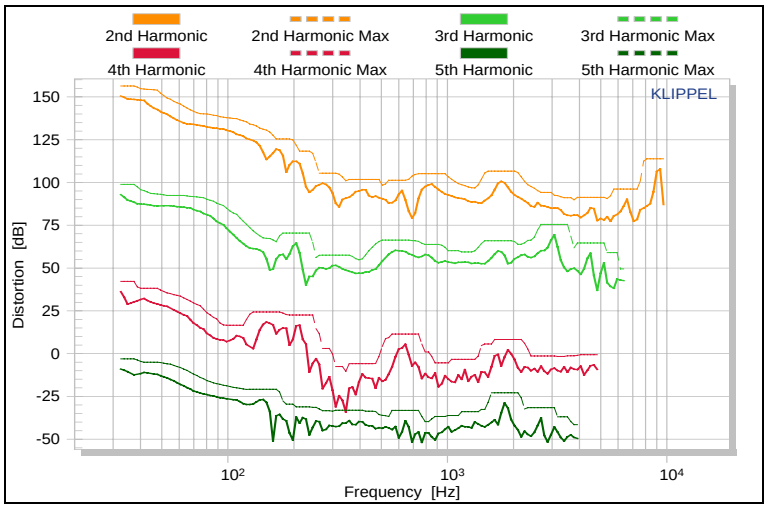
Absolute, non separated harmonics:



Apply the Harmonics – Shift parameter:

- Select Property Page Tasks
- Select Task SPL
- Open Category Display
- Set Harmonics – Shift parameter to (as an Example):
  win3YShift = [40. 0. -40. -80.]

Result: Separated Harmonics (Note: the absolute scale is NOT valid!)



Note: The absolute scale of the harmonics is NOT valid anymore, if the shift parameter is applied!

-

-
- SPL
-

- -
  Win3YShift=[40. 0. -40. -80.]

Note:

Rub & Buzz

Rub&Buzz is a generic term for a group of instantaneous, short time and low energy disturbances or defects in transducers. Although they are usually much lower in level (more than 80 dB!), they can be reliably detected. For even enhanced sensitivity the Meta Hearing technology can be optionally applied to the Rub&Buzz measure. This technique suppresses regular distortion, which mask potential defects, and provides therefore a higher rate of defect detection as well as higher headroom for limit setting.

Note, that there are low frequency and high frequency restrictions on the Rub&Buzz:

- High frequencies are limited to roughly
  f < *sample frequency / (2 * RBz Highpass).*
  On the sample frequency refer to section *User Modes / Engineer / Property Page Tasks / Sound Device & Sampling Rate*.
- Low frequencies are limited to the first full period in the signal to calculate a valid rms value. So this depends on the sweep speed and start frequency if swept from lower to higher frequencies.
  The resolution also is restricted to full periods. When by a higher resolution more points are within one signal period, the points are interpolated linearly.
  When swept from high to low frequencies, the results for the last (and not complete) signal period at the lowest frequency is copied from the last full period and therefore constant.

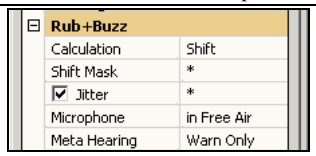
This table lists all *Tasks*, which provide Rub&Buzz measurement:

Tasks	Info	Version	Filename Convention
Sound Pressure	Measurement of Mic at Mic 1, Mic 2, Line 1 or Line 2.	Standard Prog.	*SPL*
Sound Pressure + Impedance	Measurement of Mic at Mic 1, Mic 2, Line 1 or Line 2.	Standard Prog.	*SPL+Imp*

This table lists all basic properties related to Rub&Buzz . Please use the links to get more information about details (use online help or pdf version for linked tables).

Parameter (shared among several measures or private for exclusive use by this measure) are editable on the *Property Page Tasks*.

Category	Properties
Stimulus	*SineSweep*
Shared Parameter	Generator, Routing, Resolution, Display setting, Recording Delay (e.g. due to Mic distance)

Private Parameter	**RBz Highpass:** corner frequency rel. to fundamental RBz – Type: **RMS**: repetetive defects (e.g. rubbing) **Peak**: short, impulsive defects (e.g. loose particle)
Limit Modes	 **Calculation**: *Shifting Limits*, Absolute (*Absolute Limits*), *Jitter* **Microphone:** Position of the measurement microphone. This setting influences the calculation of the Ambient Noise Limit. If measured *in Box/ Custom* the influence of ambient noise is reduced due to the shielding of the box enclosure comparing with testing *in Free Air*. See section Ambient Noise below for details. **Meta Hearing*:** Warn Only: Failed IDD but passed Rub&Buzz results in a Warning and consequently to Pass, if no other measure failed. Enforce Fail:Failed IDD results in FAIL
Results	Rub&Buzz vs. frequency in Result Window 1. Crest factor of Rub&Buzz in Result Window 4.
	Meta Hearing*: Isolated Defect Distortion based on Meta Hearing Technology vs. frequency in Result Window 1 (by default hidden, can be activated using context menu of Result Window 1 / Customize / Subsets / IDD; IDD Max. Compensation of regular Rub&Buzz distortion by Meta Hearing Technology in Result Window 4.

* Only available, if optional Hearing License is installed.

Note: For more details and background information on Meta Hearing and Isolated Defect Distortion (IDD) see section *Appendix / Glossary / MeasurementTechnique (Theory) / Rub & Buzz / Meta Hearing Technology* for Details.

Note: For adjusting and optimizing the Rub&Buzz detection, please refer to section *Optimizing Performance / SPL Tests*.

80dB

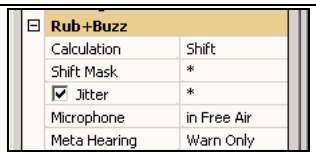
- *f* < */ (2 *).*
  / /
  /Sound Device & Sampling Rate
-

Tasks

Tasks			**Filename Convention**
	Mic 1, Mic 2, Line 1 Line 2 Mic		*Imp*
+	Mic 1, Mic 2, Line 1 Line 2 Mic		*SPL + Imp*

pdf

Property Page Tasks

	SineSweep
	MIC
	:
	 *Shifting* Limits, *Absolute* Limits , *Jitter* : IDD IDD
	1 4
	* 1 Result Window 1 / Customize / Subsets / IDD; IDD Max 4

*

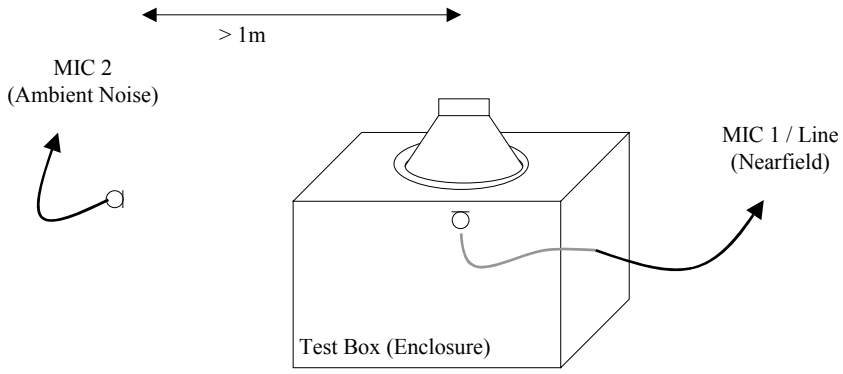
IDD

/ / / / Meta Hearing Technology

Ambient Noise

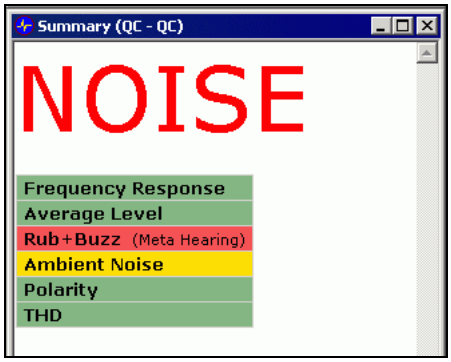
Distortion measurements (e.g. Rub&Buzz, THD, Harmonics) are sensitive to noise disturbances from production environment, here designated as *Ambient Noise*. Using a second microphone the impact on the measurement by external noise can be evaluated.

A typical setup for the test with Ambient Noise detection is shown below.



If the Ambient Noise test AND the Rub&Buzz test fails, the test result is invalid and therefore marked "NOISE" and the test should be repeated.

The overall result of this kind of test is FAIL (although NOISE is displayed).



This table lists all *Tasks*, which provide Ambient Noise measurement:

Tasks	Info	Version	Filename Convention
Sound Pressure	Nearfield microphone must be Mic1 or Line 1. Noise microphone must be Mic 2.	Standard Prog.	*SPL*
Sound Pressure + Impedance	Nearfield microphone must be Mic1 or Line 1. Noise microphone must be Mic 2.	Standard Prog.	*SPL + Imp*

This table lists all basic properties related to Ambient Noise. Please use the links to get more information about details (use online help or pdf version for linked tables).

Parameter (shared among several measures or private for exclusive use by this measure) are editable on the *Property Page Tasks*.

Category	Properties
Stimulus	*SineSweep*
Shared Parameter	Generator, Routing, Resolution, Display setting, Recording Delay (e.g. due to Mic distance)
Private Parameter	**Show Ambient Noise (Display):** If enabled, show curve in Result Window 1.
Limit Modes	No Parameter. The calculated headroom of the Rub&Buzz Limit is used to ensure optimal sensitivity for Ambient Noise. However, it is important for the sensitivity of the measurement to know the test condition. If tested in a box, an additional attenuation of the ambient noise can be considered. This attenuation can be measured and the result can be specified for optimal results. Please refer to *Testing in a box enclosure* for details.
Results	Noise floor if enabled in Result Window 1

THD

“ ”

“ ”

Tasks

Tasks			**Filename Convention**
	Mic 1 Line 1		*Imp*
+	Mic 1 Line 1 Mic 2		*SPL + Imp*

pdf

Property Page Tasks

	SineSweep
	MIC

	1
	1

Calculation of the Ambient Noise Limit

The limit of the ambient noise is derived from the Rub&Buzz limit considering the microphone noisefloor and the box enclosure shielding (noise attenuation).

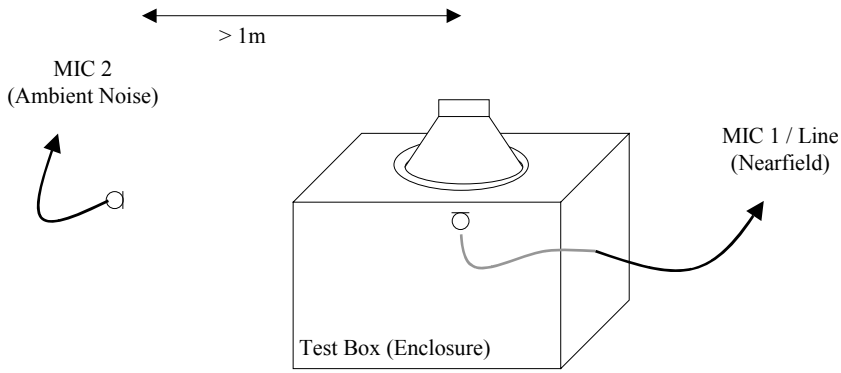
In other words, the higher the Rub&Buzz Limit, the more ambient noise can be tolerated without influencing the measurment.

Testing in a box enclosure

Please make sure that the box is appropriate in size. Refer to section *Appendix / Maximal SPL* for calculation of the maximum SPL level for a known box / driver combination.

Make sure that the maximum SPL level of your measurement microphone is not exceeded.

When testing in an enclosure, the influence of ambient noise is reduced considerably. Hence the threshold of ambient noise detection must be adopted.



This can be done generally assuming that the box has a typical ambient noise attenuation of 15dB over the whole frequency range.

Note: For Ambient Noise Monitoring a second microphone is required.
There is only one valid routing:
Nearfield Microphone → Mic 1 / Line 1 Input
Ambient Noise Microphone → Mic 2 Input
The Noise Microphone should be arranged in about 1 m distance from the DUT.
Do not use the Ambient Noise microphone inside a test enclosure!

If the specific attenuation of the box is known, a curve

frequency attenuation in dB

can be specified. Please see the section *Optimizing Performance / SPL Tests / Measurement Box / How to obtain the box attenuation curve* for details.

Although it is not recommended there is also the possibility to test in a free air environment. In this case a well shielded testing room is required.

/

/ / *Maximal* SPL

15dB

→ Mic 1/Line 1

→ Mic 2

DUT 1

---

dB

/ /

/How to obtain the box attenuation curve

Polarity (Basic)

Polarity indicates the acoustical phase of the transducer. It is based on the phase between the generator and the measured sound pressure level.

This table lists all *Tasks*, which provide polarity measurement:

Tasks	Info	Version	Filename Convention
Sound Pressure	Measurement of Mic at Mic 1, Mic 2, Line 1 or Line 2.	Basic Standard Prog.	*SPL*
Sound Pressure + Impedance	Measurement of Mic at Mic 1, Mic 2, Line 1 or Line 2.	Basic Standard Prog.	*SPL + Imp*

This table lists all basic properties related to Ambient Noise. Please use the links to get more information about details (use online help or pdf version for linked tables).

Parameter (shared among several measures or private for exclusive use by this measure) are editable on the *Property Page Tasks*.

This table lists all basic properties related to polarity. Please use the links to get more information about details (use online help or pdf version for linked tables).

Parameter (shared among several measures or private for exclusive use by this measure) are editable on the *Property Page Tasks*.

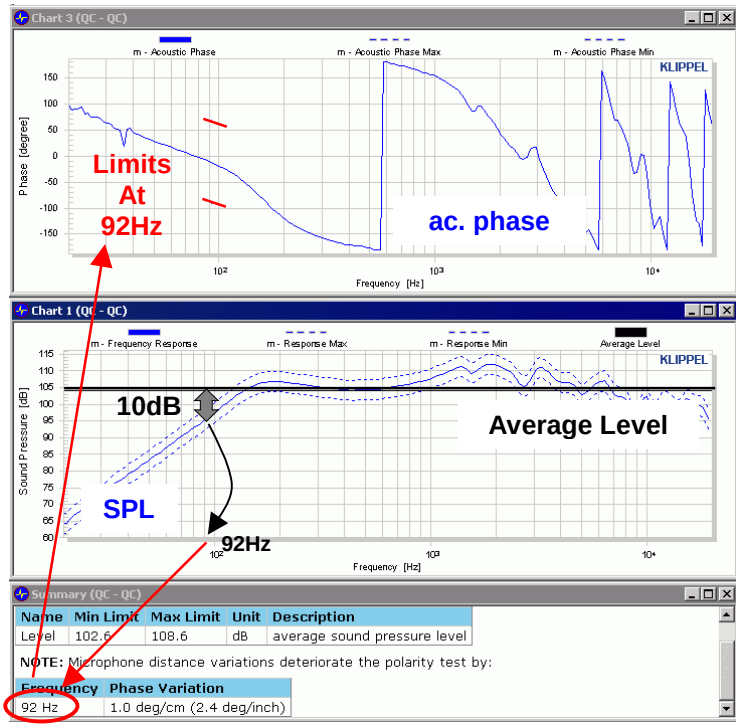
Category	Properties
Stimulus	*SineSweep*
Shared Parameter	Generator, Routing, Resolution, Display setting, Recording Delay (e.g. due to Mic distance)
Limit Modes	Test Frequencies: **Format: Frequency1 Tolerance1;** **Frequency2 Tolerance2;** **Frequency3 Tolerance3; ...** For a one-way driver one pair is sufficient. For multi way drivers for each driver the polarity of the individual channels can be checked. The test frequencies should be selected within the pass band of each channel. **Default:** * 80 The "*" character is a wild card for automatic limit setting. Refer to the example below for more details.
Results	Acoustical Phase in Result Window 5

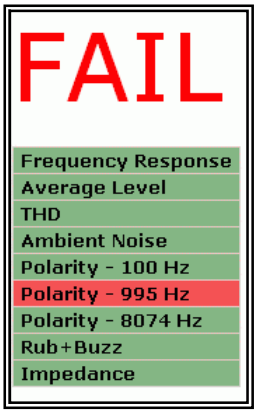
This is an example for the calculation of the acoustical phase. The limit is set to

[Test Frequencies] = * 80

which is the default setting.
The lowest frequency, were the SPL-level is 10dB below the average level is calculated (Please see middle graph below).
At this frequency the limits are set for polarity (top graph).
This ensures a good signal noise ratio during the test as well as low sensitivity against microphone distance variation.

As a result, the frequency of this lowest frequency will be displayed at the *Summary Window* (bottom window).





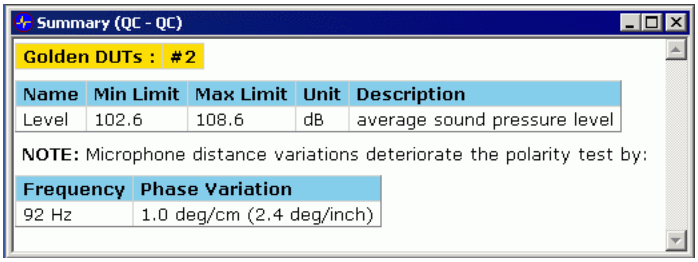
If multiple frequencies are defined to check for polarity, for each frequency an entry in the result list (in window Summary) is generated. This allows separating polarity failures of multi channel systems. Additional to the Keyword *Polarity* the test frequency is added.

In this example the limit is specified as:

[Test Frequencies] =	100	80
	995	80
	8074	80

Note: The polarity is based on the acoustical phase, which is highly determined by the geometrical distance from the driver to the Mic. Thus, to obtain consistent results a fixture is required to ensure reproducible arrangements and distances.

When calculating the limits the sensitivity of phase will be calculated, that would be caused by a variation of the microphone distance of 1 cm (1 inch). Please check the Summary result window.



Tasks

Tasks			**Filename Convention**
	Mic 1, Mic 2, Line 1 Line 2 Mic		*Imp*
+	Mic 1, Mic 2, Line 1 Line 2 Mic		*SPL + Imp*

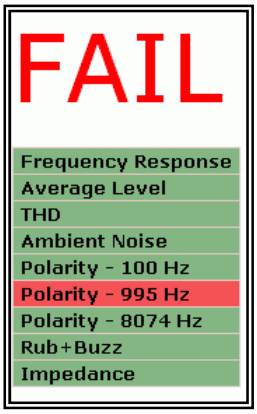
pdf

Property Page Tasks

	SineSweep
	MIC
	1 1 **2 2** **3 3 …** *** 80** “ * ”
	5

[ ] = * 80

10dB



[ ]= 100 80
995 80
8074 80

1

1

Reference Units

In most cases limits are obtained from known good samples or reference units. The simplest way to create limits is measuring one (good) sample and deviate the limits from the result (e.g. by shifting the curve) to create a tolerance corridor.

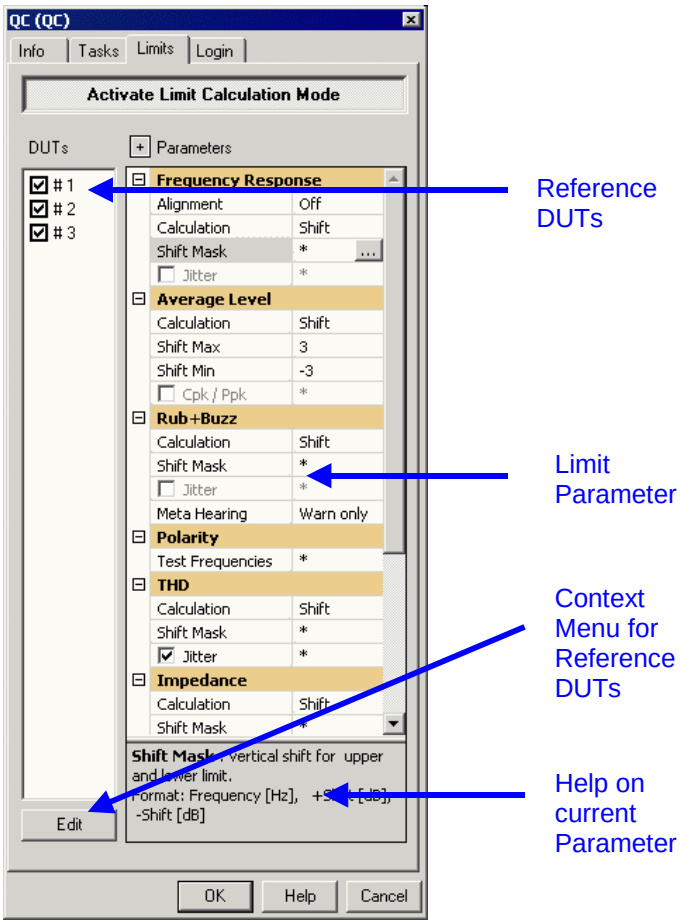
Measuring reference units is performed in a special mode, the *Limit Calculation Mode*. This mode is available in the Engineer or Programmer Mode only (see chapter *User Modes*).

The Property Page *Limits* is dedicated to Reference DUTs and Limit Calculation.

Note: Before measuring Reference DUTs and calculating limits, all settings should be double checked before. Reference DUTs are valid for the current setup only. If the setup will be changed, the reference DUT become invalid and are deleted (after a message)! So make sure that your setup is ok.

To measure Reference DUTs:

1. Activate Limit Calculation Mode.
2. Press Start to measure one or more connected DUT
3. Press OK to calculate limits or release the Limit Calculation Mode.



DUT

DUT

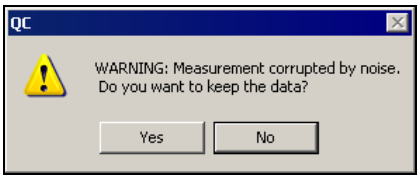
DUT DUT

DUT

1.
2. DUT
3. **OK**

Noise Check for Reference Units

When measuring Reference DUTs the noise from the production line should be minimized. However, the system detects an excessive noise although no limits are calculated yet. The following message appears:



Press "no" to reject the measurement. In this case there will be no reference DUT added to the list. You may also allow this DUT to be included in the list.

DUT

" NO " DUT

DUT

Managing Reference DUTs

DUT

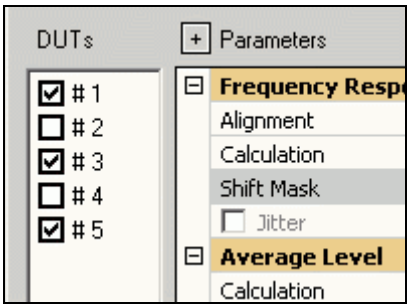
To measure Reference DUTs:

1. Activate Limit Calculation mode.
2. Connect a device you want to measure as reference.
3. Press **Start** button in the control panel.

Note: The Basic QC System allows measuring only one reference DUT. You need to upgrade to the Standard Version to get support of multiple Reference DUTs.

All checked Reference DUTs are used to calculate the limits.

Unchecked DUTs are not considered for the limits but data will not be deleted.

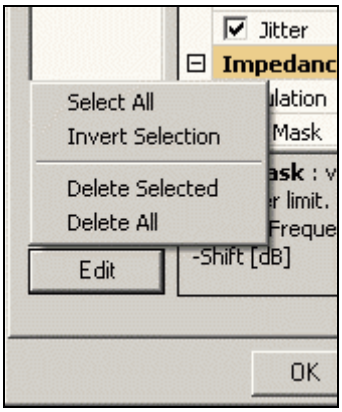


Note: For details on the limit calculation see chapter *Test Configuration / Limit Calculation.*.

Each reference device is displayed as a number in the DUT section of the Limit page. By clicking on a number the corresponding measurement curves are highlighted in the result windows.

To remove reference DUTs:

1. Activate Limit Calculation mode.
2. Click on the reference device you want to remove. Multiple selection is supported (Keep **shift** pressed while selecting range or keep **Ctrl** pressed while selecting individual DUTs).
3. Press **Edit** button to open the context menu, select **Delete Selected**.



You may use **Delete All** to remove all DUTs from the list.

Using **Select All** and **Invert Selection** you may manage the selection of a larger number of reference DUTs in an effective way.

DUT

1.
2.
3.

QC DUT

DUT

DUT

DUT

: */ Limit*

Calculation

DUT

DUT

1.
2. **shift**

   Ctrl DUT
3.

DUT

DUT

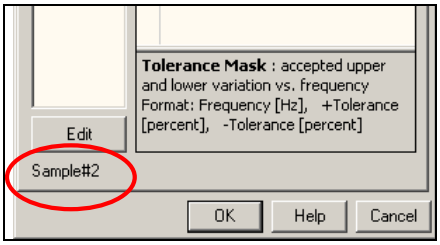
Labeling Reference DUTs

DUT

All measurements within the Limit Calculation Mode are numbered consecutively (#1, #2, #3…). These numbers are added to the curves in the result windows to assign the curves to the Reference DUTs.

However, a label can be assigned to Reference DUTs using the Serial Number function.

Specify the label as Serial Number (e.g. Sample#1) and press Enter to start the test. When selecting the reference DUT in the DUTs list, the label is shown in the bottom line of the Property Page.



More Information about Serial Number Handling can be found in section *Test Configuration / Serial Number Handling.*

#1, #2, #3…
DUT

DUT

Enter #1 DUT
DUT

Serial Number
/
Handling

Setting Limits

Limit parameters are arranged in groups like the task parameters. You have to activate the Limit Calculation Mode, if you want to change limits. Clicking on a parameter field, the help line at the bottom of the limit parameter section displays some specific information concerning the parameter (function, format etc.).

If you have more than one task in your test that measures a certain parameter, you should give each test task an own name or number. The task name will then be displayed as a part of the limit parameter and result name. Please see section *Test Configuration* / Tasks / *Adding Labels to Tasks.*

On calculation methods for limits, refer to chapter *Test Configuration / Limit Calculation.*

Adding Labels
/ /
to Tasks

Limit Calculation
/

Limit Calculation

In this chapter the generic limit calculation methods are explained. For each measure different limit calculation methods apply to keep the complexity low and dedicated to the physics.

General

For curves vs. frequency the limits are frequency dependent.

For single number measures the limit is just a number.

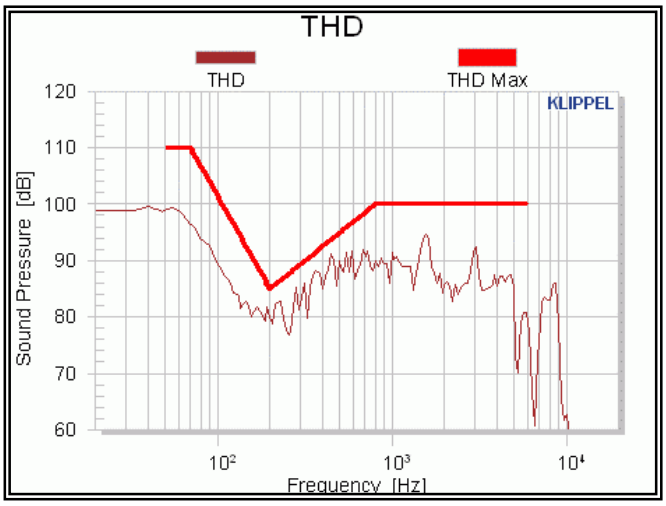
Note: The frequency range of the limit does not have to meet the range of the measure. The limit will only be applied in the range of measured values and specified limits.

Depending on the measure there might be also combinations of limit modes available. For instance it is good to combine statistics and shifting to allow a minimal headroom. Refer to the limit parameter of the tasks, which combination is available.

Absolute Limits

Arbitrary, constant limits may be specified or imported. If the frequencies of the entered limit do not agree with the measure, the limit values exactly at the frequency points of the measure are calculated by linear interpolation.

Note that absolute limits may be combined with a shift to create symmetric limits easily. Just import one absolute curve for MIN and MAX limit and apply an additional shift.



Example of absolute Limit:

Limit definition:

```
50    110
70    110
200   85
800   100
6000  100
```

Note: Absolute limits do not depend on the reference unit measurements. Even if recalibrated using Golden Units (see chapter *Golden DUT Handling*), absolute limits are always kept constant.


```
50    110
70    110
200   85
800   100
6000  100
```


:

DUT

Relative Limits

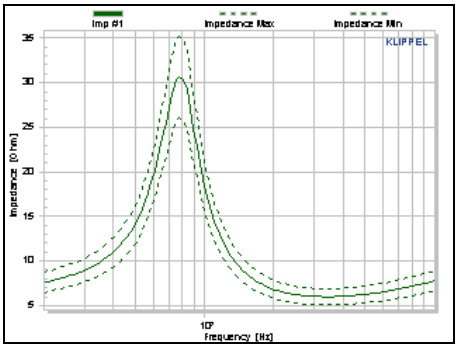
The relative limit is calculated by multiplying the tolerance value to the average of all enabled reference units. This is especially useful for the impedance curve to allow sufficient headroom at the resonance peak, were a simple shift (adding the shift value) is not sufficient.

Format for curves: [frequency +tolerance -tolerance]

Job	Example	Description
Single number measure (e.g. Re)	3 -3	Re(lim) = Re(reference) ± 3 Ohm
Constant shift for curves (e.g. impedance)	* +15 -15	for all frequencies: Imp(lim) = Imp(reference) * (1 ± tolerance/100)

For more options on frequency dependent limits, refer to section *Shifting Limits* below.

Example for relative limits (impedance):



[+ –]

Re	3 -3	Re = Re ± 3 Ohm
	* +15 -15	Imp = Imp * (1 ± /100)

Shifting Limits

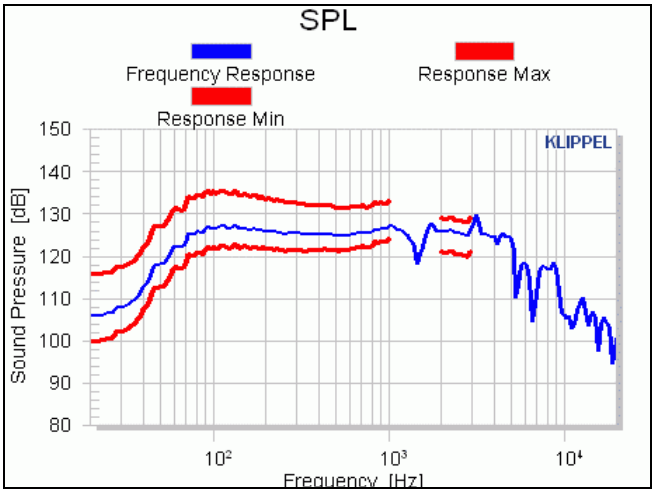
Shifting Limits

The shifted limit is calculated by adding the shift value to the average of all enabled reference units.

Format for curves: [frequency +shift -shift]

Job	Example	Description
Single number measure (e.g. Level)	3 -3	Re(max) = Re(reference) ± 3 Ohm
Constant shift for curves (e.g. SPL)	* +3 -3	for all frequencies: Spl(max) = Spl(reference) ± 3 dB
Bandlimited Shift (SPL)	10 +5 –5 800 +5 -5	limit only exists from 10 to 800 Hz. Spl(max) = Spl(reference) ± 5 dB
Frequency dependent Shift (interpolated)	10 +5 –5 500 +3 –3 800 +2 –2	limit only exists from 10 to 800 Hz. Shift interpolated between 10,500,800 Hz with frequency from ±5 → ±3 → ±2 dB
Frequency dependent Shift (Steps)	10 +5 –5 500 +5 -5 500 +3 –3 800 +3 –3	limit only exists from 10 to 800 Hz. is ± 5dB between 10 and 500 Hz; ± 3 dB from 500 Hz to 800 Hz.

Asymmetric Shift (SPL)	10 +3 –3 500 +4 –8 800 +2 –1	different positive and negative limits
Segmented limits (SPL)	20 10 -6 1000 6 -3 1500 * * 2000 3 -5 3000 3 -5	Limit defined from 20-1kHz and from 2-3kHz. '*' stands for 'not defined'. See Example graph below.



Segmented, asymmetric Limits (SPL)

Note: Shifting Limits for relative Harmonics

Relative Harmonics in dB have a shift also in dB. However, when relative Harmonics in percent are selected, the shift is specified also in dB.
So a shift of 6 dB means a limit of the double percentage of relative harmonics or THD.
The benefit is to have one shift parameter and the possibility of switching between percentage and dB scale without touching the limit setting.

[+ –]

	3 -3	Re = Re ± 3 Ohm
SPL	* +3 -3	Spl = Spl ± 3 dB
SPL	10 +5 –5 800 +5 -5	10 ~ 800 Hz Spl = Spl ± 5 dB
	10 +5 –5 500 +3 –3 800 +2 –2	10 ~ 800 Hz 10Hz ±5 dB→ 500Hz ±3 dB→ 800Hz ±2 dB
	10 +5 –5 500 +5 -5 500 +3 –3 800 +3 –3	10 ~ 800 Hz ± 5dB 10~ 500 Hz ± 3 dB 500~800 Hz
(SPL)	10 +3 –3 500 +4 –8 800 +2 –1	

(SPL)	20 10 -6 1000 6 -3 1500 * * 2000 3 -5 3000 3 -5	20Hz~1kHz 2-3kHz “ * ” “ ”

SPL

---

dB dB
dB
6dB THD
dB

Standard Deviation

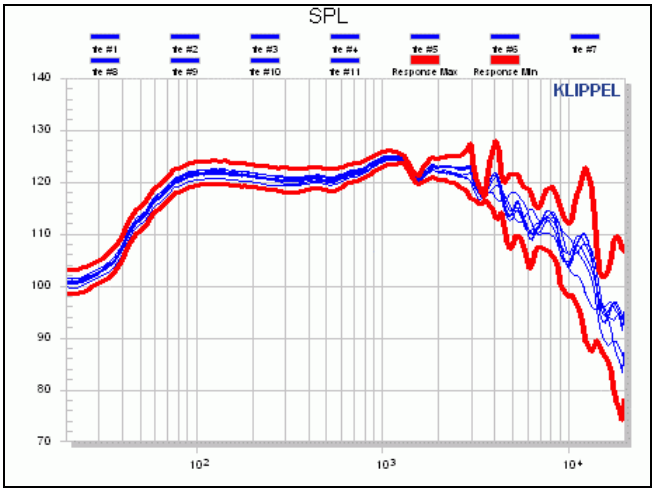
Limits also can be calculated using the standard deviation *sigma* of the reference measurements.

Sigma characterizes the variation of a parameter. The more variation the higher is sigma. Thus limits are widened up for regions were the parameter or curves vary.

Note: If using statistical calculation, ensure sufficient number of reference DUT. At least 10 DUT should be in the pool.

Format for curves: [frequency +x*sigma –x*sigma]
(x … factor of sigma)

The syntax is identical to the *Shifting Limits*. Asymmetrical, segmented and band limited limits are supported.



Example for statistical Limits (SPL)

Note: It is recommended to use a Statistical Limits always with Shift to ensure a minimal headroom. Using Statistics only the tolerance may become very useless small.

---

sigma

Sigma sigma

:	DUT DUT 10
	[+x*sigma –x*sigma] x sigma) *Shifting* Limits SPL
:	

Jitter

Sharp resonances in the measured Curve usually generate limits with identical dips and peaks in it. However, these resonances may vary during production and should not cause a failed test. To provide this functionality* limits may be "jittered" or widened up in respect to frequency or X-axis. The graph below shows the SPL measure and the normally shifted limit (dotted curve). This limit is very close to the measure and a small variation of the resonance may cause a failed test. The Jitter function is a simple search for extrema within a certain frequency range. A percentage of the current frequency is specified to define this range. The jittered max limit value is the maximum of all limit points in this range while the jittered min limit is the minimum respectively.

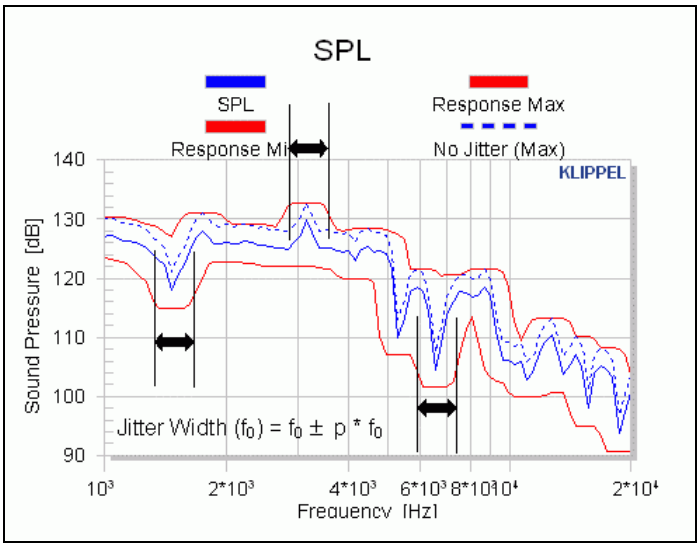
$$JitteredLimit_{Max}(f) = Max\{Limit(f \pm p * f)\} \quad p\text{...Percentage}$$

$$JitteredLimit_{Min}(f) = Min\{Limit(f \pm p * f)\}$$

Note: (1) Jitter is applied after the normal Limit Calculation.
(2) The frequency range of the Limit is **NOT** affected by the Jitter-Processing.

Jitter may be applied to SPL, THD, Rub&Buzz or Impedance. The Jitter factor p must be specified in the following format:

Job	Example	Description
Constant Jitter for complete limit	* 10	for all frequencies: p = 10 %
Bandlimited Jitter	10 8 800 8	limit is jittered only from 10 to 800 Hz.
Frequency dependent Jitter (interpolated)	5000 10 6000 20 7000 10	Jitter starts at 5kHz, increases with frequency to 6k (20%) and decreases to 7k (10%). No jitter out of the band 5 kHz – 7 kHz.
Frequency dependent Jitter (Steps)	5000 20 6000 20 6001 10 7000 10	Jitter starts at 5kHz, constant up to 6k (20%) and from 6 kHz to 7 kHz constant at 10%. No jitter out of the band 5 kHz – 7 kHz.
Segmented Jitter	2000 10 3000 10 4000 * 5000 10 6000 10	Jitter only defined from 2-3 kHz and from 5-6 kHz. '*' stands for 'not defined'. No jitter below 2 kHz, between 3 and 5 kHz and above 6 kHz.



Jittered limits (p = 10%) in SPL

*We would like to thank Pietro Massini from Sipe SpA. for suggesting this algorithm.

*

X

SPL

$$JitteredLimit_{Max}(f) = Max\{Limit(f \pm p * f)\} \qquad p...$$
$$JitteredLimit_{Min}(f) = Min\{Limit(f \pm p * f)\}$$

(1)
(2)

SPL THD

p

	* 10	p = 10 %
	10 8 800 8	10~800 Hz
	5000 10 6000 20 7000 10	5kHz 6kHz 20%) 7kHz 10% 5-7 kHz
	5000 20 6000 20 6001 10 7000 10	5kHz 20% 6kHz 6 kHz 7 kHz 10% 5-7 kHz
	2000 10 3000 10 4000 * 5000 10 6000 10	2-3kHz 5-6kHz “ * ” “ ” 2 kHz 3-5kHz 6kHz

SPL p = 10%

* Sipe SpA Pietro Massini

Cpk / Ppk Limits

Cpk/Ppk

The following parameters define the statistical post processing of parameter variation using performance indices. For background on Cpk/Ppk statistics, see chapter *Appendix / Glossary* / *Ppk / Cpk.*

Cpk Poolsize	number of DUT that are considered in the short term variation index Cpk
Cpk Limit **Ppk Limit**	Limit value for Cpk and Ppk. Ppk / Cpk < 1: Process out of control Ppk / Cpk > 1.33: Process within 4 sigma range Ppk / Cpk > 2.0: Process within 6 sigma range
Passed only	1: Only consider passed DUT in Cpk/Ppk statistics. 0: Consider all DUT in Cpk/Ppk statistics.

Cpk/Ppk / / *Ppk / Cpk.*

Cpk	Cpk DUT
Cpk **Ppk**	Cpk Ppk Ppk / Cpk < 1 Ppk / Cpk > 1.33 4 sigma Ppk / Cpk > 2.0 6 sigma
	1 Cpk/Ppk DUT 0 Cpk/Ppk DUT

Tasks

In this chapter all available default tasks are described.

Since tasks could not be used in the Basic version to compose tests, this chapter is applicable for Standard and Programmable version only.

Filename	Label on Prop.-Page Tasks	Measures / Comments
spl.{version}.task.kla	Sound Pressure	Freq.-response, Level, Polarity, THD, Rub&Buzz, IDD, Ambient Noise
imp.{version}.task.kla	Impedance	Impedance, T/S Parameter based on Multitone or Sweep
spl-imp.{version}.task.kla	Sound Pressure + Impedance	Freq.-response, Level, Polarity, THD, Rub&Buzz, IDD, Ambient Noise, Impedance, T/S Parameter based on SineSweep.
start.{version}.control.kla	Start/Finish	Global settings for routing, logging

		/
spl.{version}.task.kla		THD IDD
imp.{version}.task.kla		T/S
spl-imp.{version}.task.kla	+	THD IDD T/S
start.{version}.control.kla	/	

Filename Convention

All Task file names consist of the following structure:
{Task Name}.{version}.{function}.{Mode}
Example: spl.0001.task.kla, start.0001.control.kla

Task Name	Short name of the task (e.g. *SPL*)
Version	Code version number, 4 digits
Function	*task*: describes one measurement applied to DUT *control*: describes overall Pass/Fail calculation and overall settings (report, routing etc.)
Mode	*klb*: Binary file. Not editable. Optional linked with license requirement. Usable for Standard and Programmable version *kla*: Text file. Editable with any editor. No license requirement

{ }.{ }.{ }.{ }
spl.0001.task.kla start.0001.control.kla

	SPL
	4
	DUT /
	klb *Kla*

Test Sequences

Using the tasks it is straight forward to create test sequences that consist of multiple tasks. Just add or remove the tasks on the Property Page Tasks. Refer to section *User Mode / Engineer* / *Property Page Tasks* for more details.

Use labels (see below) to identify the tasks, if the same task is used several times.

Note: Test Sequences are available in Standard / Programmable Version only. The Basic version is restricted to one single task (except preconditioning for ferro fluids).

/ /

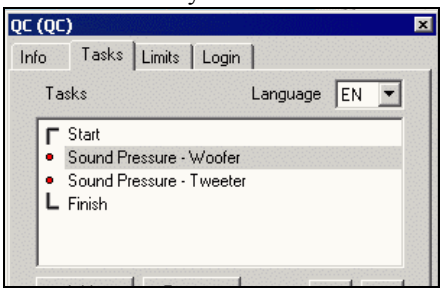
Property Page Tasks

: /

Adding Labels to Tasks

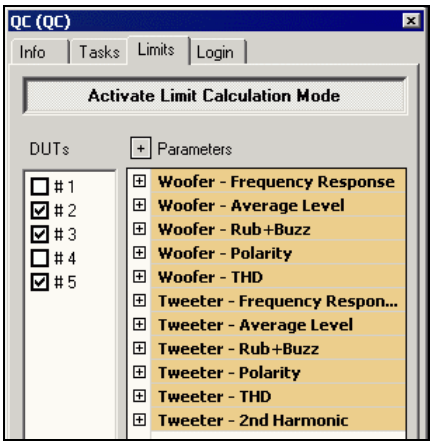
If you have more than one task in your test that measures a certain parameter, you should give each test task an own name or number. The task name will then be displayed as a part of the result and of the limit parameter name.

1. Click on the task Property Page.
2. Click on a task you want to be labeled.
3. Press function key F2 and enter a new task name.

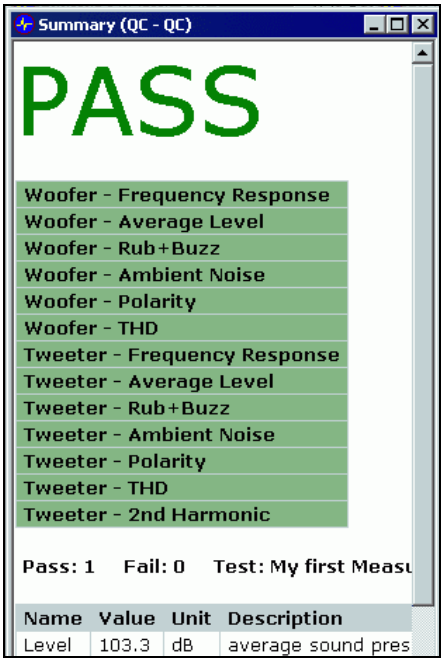


Example: You have two tasks in your test that measure the frequency response of a system or coax driver with a different setup for Woofer and Tweeter. You may now name one task *Sound Pressure-Woofer* and the other *Sound Pressure-Tweeter*. In the limit page you will then find a limit parameter Woofer-Sound Pressure and a second named Tweeter-Sound Pressure.

Limit Parameter with labels:



Result list with labels:



1.
2.
3. F2

Sound Pressure-Woofe *Sound Pressure-Tweeter*

Woofer-Sound Pressure

Tweeter-Sound Pressure

SPL+Impedance (Basic)

SPL+

The task SPL+Imp is dedicated to fast testing, comprising impedance as well as SPL related measures.

Measures	Results
Frequency Response	magnitude of frequency response in Result Window 1. Fundamental of recorded sound pressure signal.
Level	Average level of specified band or at discrete frequencies. **Note:** The realized voltage may be less than the specified voltage due to finite output impedance of the power amplifier. See section *Hardware / Calibration / Amplifier Gain* for details. The resulting level may therefore also be less.
Harmonics	Absolute THD in Result Window 1 or Relative THD in Result Window 3 (depending on mode). Individual Harmonics (2^{nd} – 5^{th}) in Result Window 3.
Rub&Buzz	Rub&Buzz distortion vs. frequency in Result Window 1. Crest factor of Rub&Buzz in Result Window 4.
Meta Hearing*	Isolated Defect Distortion based on Meta Hearing Technology vs. frequency in Result Window 1 (by default hidden, can be activated using context menu of Result Window 1 / Customize / Subsets / IDD; IDD Max. Compensation of regular Rub&Buzz distortion by Meta Hearing Technology in Result Window 4.
Polarity	Acoustical Phase in Result Window 5.
Ambient Noise**	Noise floor if enabled (Settings / Category Display) in Result Window 1
Impedance**	Impedance Magnitude vs. frequency, two signal measurement of Voltage and Current in Result Window 2. Voltage and Current signals in Result Window 6.
T/S Parameter**	Calculated parameters from fitted complex impedance. R_e, L_e, C_{mes}, L_{mes}, R_{es}, f_s, Q_{ts}, Q_{ms}, Q_{es}.

* Only available, if optional Meta Hearing License is installed.
**The Ambient Noise and the impedance with T/S parameter are mutually exclusive since the second input channel is either sensing current (impedance) or the second microphone (ambient noise).

SPL + SPL

	1
	/ /*Amplifier* Gain
	THD 1 THD 3 2-5 3
	1 4
*	IDD 1 1 / / / IDD IDD Max 4
	5
**	/ 1

**	2 6
T/S **	R_e, L_e, C_{mes}, L_{mes}, R_{es}, f_s, Q_{ts}, Q_{ms}, Q_{es}.

*

**

T/S

Parameter

The following parameter can be applied to customize this task:

Categories	Parameter	Comments
Stimulus	Start, Stop, Time	Bandwidth and Length of stimulus
	Voltage	rms level in Volt at the speaker terminals. **Note:** The realized voltage may be less than the specified voltage due to finite output impedance of the power amplifier. See section *Hardware / Calibration /* Amplifier Gain for details. **Note**: Peak value can be more than 10 dB above rms level for Multitone!
	Speed Profile	Variable speed of sinesweep. See section *Speed Profile*.
	Voltage Profile	Variable Level of sinesweep. See section *Level Profile*.
Routing	Output	Loudspeaker to be tested, only visible, if *Routing / Output* in *Control Task* is set to *controlled by Task.* See *Test Configuration / Routing / Output Routing* for details.
	Input*	Used microphone for SPL recording. Only visible, if *Routing / Output* in *Control Task* is set to *controlled by Task.* See *Test Configuration / Routing / Input Routing* for details.
Measures	Freq. Response Average Level Rub&Buzz Polarity Ambient Noise** THD 2^{nd} - 5^{th} Harmonic Impedance** T/S Parameter**	dis-/enable measures individually. If disabled, also the limits are disabled.

Categories	Parameter	Comments
Processing	Resolution	points per octave, number of result points
	Response - Smoothing	Private Parameter for Freq.-response: Part per octave for smoothing, no smoothing if value is empty.
	Level – Frequencies	Private Parameter for Level: In Frequency band: Format: f_{min}, f_{max} (separated by comma) At Discrete Frequencies: Format f_1; f_2; f_3 … (separated by semicolon or line break)
	RBz – Highpass	Private Parameter for Rub&Buzz: highpass tracking corner frequency rel. to fundamental. See section *Optimizing*

		Performance / SPL Tests / Optimize Rub&Buzz detection.
	RBz – Type	Private Parameter for Rub&Buzz: RMS: repetitive defects (e.g. rubbing) Peak: short, impulsive defects (e.g. loose particle)
	RBz-Metahearing	Absolute: THD and 2^{nd}-5^{th} Harm. in dB SPL Relative (dB) : THD and 2^{nd}-5^{th} Harm. relative to fundamental in dB(rel) Relative (%): Same but in % If Absolute then THD is in Result Window 1 else in Result Window 3.
	Harmonics-Type	Absolute: THD and 2^{nd}-5^{th} Harm. in dB SPL Relative (dB) : THD and 2^{nd}-5^{th} Harm. relative to fundamental in dB(rel) Relative (%): Same but in % If Absolute then THD is in Result Window 1 else in Result Window 3.
	Harmonics - Smoothing	Applied for THD and 2^{nd} - 5^{th} Harmonic. Part per octave for smoothing, no smoothing if value is empty.
	Impedance – Smoothing	Private Parameter for Impedance: Part per octave for smoothing, no smoothing if value is empty.
	Recording Delay	Adjustable delay for considering time delay in the response due to microphone distance or digital delay (in electronics). **Note**: The response is shortened by the delay. Increase test time if you have excessive delay.
	Input Gain 1	Hardware Preamplifier for Mic 1 and Line 1 input to optimize SNR
	Input Gain 2	Hardware Preamplifier for Mic21 and Line 2 input to optimize SNR
Display	SPL – Ymax	maximal SPL value in dB, if empty, auto scaled
	SPL - Ymin	minimal SPL value in dB, if empty, auto scaled
	Harmonics – Ymax, Ymin	Maximal / Minimal value for Result Window 3. If empty, auto scaled.
	Harmonics – Shift	Vertical shift to separate Harmonics, no shift is applied, if empty.
	Impedance - Ymax	Maximal impedance value in Ohm, If empty, auto scaled
	Impedance - Ymin	Minimal impedance value in Ohm, If empty, auto scaled
	Impedance - Scale	Lin / Log scale option for impedance axis
	Show Ambient Noise	If enabled, the Ambient Noise measure and limit will be shown in Result Window 1.
	Custom Colors	Allows to modify standard colors for measures. Enable option to expand menu.

* If Ambient Noise monitoring is enabled, SPL must be recorded using Microphone 1 / Line 1. Microphone 2 is to be used to monitor ambient noise.

** The Ambient Noise and the impedance with T/S parameter are mutually exclusive since the second input channel is either sensing current (impedance) or the second microphone (ambient noise).

The limits belonging to the measures are explained in the respecting section of chapter *Test Configuration / Measures and Limits*.

		rms / /*Amplifier* Gain rms 10dB
		Speed Profile
		Level Profile
		/ / / *Output* Routing
	*	SPL / / / *Input* Routing
	THD 2-5 ** T/S **	/

	-	
	-	f_{min}, f_{max} f_1; f_2; f_3 …

	-	/ *SPL* / *Optimize* Rub&Buzz detection
	-	
	-	THD 2-5 dB SPL dB THD 2-5 dB % % THD 1 3
	-	THD 2-5 dB SPL dB THD 2-5 dB % % THD 1 3
	-	THD 2-5
	-	
	1	SNR Mic 1 Line 1
	2	SNR Mic 21 Line 2
	SPL-Y	dB SPL
	SPL-Y	dB SPL
	-Y Y	3 /
	-	
	-Y	
	-Y	
	-	/
		1

* 1/ 1 2

**

T/S

/

Impedance testing

The fast SPL-Imp Task measures by default current and SPL in parallel.

For impedance testing it is a crucial point to consider the amplifier frequency response. Therefore since only two input channels are available, a pre-measurement will be executed to measure the voltage.

This voltage measurement will be performed **once per login** only. It will double the duration of the first measurement but will ensure the fast testing speed for all following tests.

If the optional measure *Ambient Noise* is enabled, this task can be configured to measure nearfield and ambient noise level in parallel. In this case no impedance can be measured (no current sensing possible). When selecting measures Ambient Noise and one of the impedance related measures (impedance or T/S parameter), an error message will be generated.

+

T/S

Differences to SPL and Impedance task

SPL

There are some differences between the *fast SPL + Imp* and the *SPL* and *Imp* task the user should be aware of:

- Multitone excitation only available in *Imp* task.
- Voltage measurement for each DUT only available in *Imp* task (see notes in section *Impedance testing* above.
- Either *Impedance* measurement or *Ambient Noise* monitoring available.
- In Basic version the *SPL+Imp* task is available only.

+ *SPL* *Imp*

- *Imp*
- DUT *Imp*
-
- +

SPL

The task SPL comprises all measures related to microphone sensing.

Measures	Results
Frequency Response	Magnitude of frequency response in Result Window 1. Fundamental of recorded sound pressure signal.

Level	Average level of specified band or at discrete frequencies. **Note:** The realized voltage may be less than the specified voltage due to finite output impedance of the power amplifier. See section *Hardware / Calibration / Amplifier Gain* for details. The resulting level may therefore also be less.
Harmonics	Absolute THD in Result Window 1 or Relative THD in Result Window 3 (depending on mode). Individual Harmonics (2^{nd} – 5^{th}) in Result Window 3.
Rub&Buzz	Rub&Buzz distortion vs. frequency in Result Window 1. Crest factor of Rub&Buzz in Result Window 4.
Meta Hearing*	Isolated Defect Distortion based on Meta Hearing Technology vs. frequency in Result Window 1 (by default hidden, can be activated using context menu of Result Window 1 / Customize / Subsets / IDD; IDD Max. Compensation of regular Rub&Buzz distortion by Meta Hearing Technology in Result Window 4.
Polarity	Acoustical Phase in Result Window 5.
Ambient Noise	Noise floor if enabled (Settings / Category Display) in Result Window 1

* Only available, if optional Meta Hearing License is installed.

	1
	/ /*Amplifier* Gain
	THD 1 THD 3 2-5 3
	1 4
*	IDD 1 1 / / / IDD IDD Max 4
	5
	/ 1

*

Parameter

The following parameter can be applied to customize this task:

Categories	Parameter	Comments
Stimulus	Signal	SineSweep: Continuous Sine Sweep Multitone: Sparse Spectrum Signal
	Start, Stop, Time	Bandwidth and Length of stimulus

	Voltage	rms level in Volt at the speaker terminals. **Note:** The realized voltage may be less than the specified voltage due to finite output impedance of the power amplifier. See section *Hardware / Calibration / Amplifier Gain* for details. **Note**: Peak value can be more than 10 dB above rms level for Multitone!
	Speed Profile	Variable speed of sinesweep. See section Speed Profile.
	Voltage Profile	Variable Level of sinesweep. See section Level Profile.
Routing	Output	Loudspeaker to be tested, only visible, if *Routing / Output* in *Control Task* is set to *controlled by Task.* See See *Test Configuration / Routing / Output Routing* for details.
	Input*	Used microphone for SPL recording. Only visible, if *Routing / Output* in *Control Task* is set to *controlled by Task.* See See *Test Configuration / Routing / Input Routing* for details.
Measures	Freq. Response Average Level Rub&Buzz ic Polarity Ambient Noise THD 2^{nd} - 5^{th} Harmon	dis-/enable measures individually. If disabled, also the limits are disabled.
Processing	Resolution	points per octave, number of result points
	Response - Smoothing	Private Parameter for Freq.-response: Part per octave for smoothing, no smoothing if value is empty.
	Level – Frequencies	Private Parameter for Level: In Frequency band: Format: f_{min}, f_{max} (separated by comma) At Discrete Frequencies: Format f_1; f_2; f_3 … (separated by semicolon or linebreak)
	RBz – Highpass	Private Parameter for Rub&Buzz: highpass tracking corner frequency rel. to
	RBz – Type	Private Parameter for Rub&Buzz: RMS: repetitive defects (e.g. rubbing) Peak: short, impulsive defects (e.g. loose particle)
	RBz-Metahearing	Enable Metahearing (Improved Rub&Buzz) See section *Appendix / Measurement Technique / Rub& Buzz / Meta Hearing Technology* for Details.
	Harmonics-Type	Absolute: THD and 2^{nd}-5^{th} Harm. in dB SPL Relative (dB) : THD and 2^{nd}-5^{th} Harm. relative to fundamental in dB(rel) Relative (%): Same but in % If Absolute then THD is in Result Window 1 else in Result Window 3.
	Harmonics - Smoothing	Applied for THD and 2^{nd} - 5^{th} Harmonic. Part per octave for smoothing, no smoothing if value is empty.
	Recording Delay	Adjustable delay for considering time delay in the response due to microphone distance or digital delay (in electronics).
	Input Gain 1	Hardware Preamplifier for Mic 1 and Line 1 input to optimize SNR

	Input Gain 2	Hardware Preamplifier for Mic 2 and Line 2 input to optimize SNR
Display	Y-min	minimal impedance value in Ohm, if empty, auto scaled
	Y-max	maximal impedance value in Ohm, if empty, auto scaled
	Harmonics - Ymax	Maximal value for Result Window 3. If empty, auto scaled.
	Harmonics - Ymin	Minimal value for Result Window 3. If empty, auto scaled.
	Y-scale	Lin / Log scale option for impedance axis
	Show Ambient Noise	If enabled, the Ambient Noise measure and limit will be shown in Result Window 1.
	Custom Colors	Allows to modify standard colors for measures. Enable option to expand menu.

* If Ambient Noise monitoring is enabled, SPL must be recorded using Microphone 1. Microphone 2 is used to monitor ambient noise.

The limits belonging to the measures are explained in the respecting section of chapter *Test Configuration / Measures and Limits*.

		SineSweep Multitone
		rms / /*Amplifier* Gain rms 10dB
		Speed Profile
		Level Profile
		/ / / *Output* Routing
	*	SPL / / / *Input* Routing

	ic THD 2-5	/
	-	
	-	f_{min}, f_{max} f_1; f_2; f_3 …
	-	/ *SPL* / *Optimize* Rub&Buzz detection
	-	
	-	/ / / *Meta* Hearing Technology
	-	THD 2-5 dB SPL dB THD 2-5 dB % % THD 1 3
	-	THD 2-5
	1	SNR Mic 1 Line 1
	2	SNR Mic 2 Line 2
	Y-	
	Y-	
	-Y	3
	-Y	3

	Y-	/
		1

* 1/ 1 2

/

Impedance (Imp)

Imp

The task Impedance (Imp) comprises the magnitude of impedance vs. frequency and the Thiele/Small Parameter.

Measures	Results
Impedance	Impedance Magnitude vs. frequency, two signal measurement of Voltage and Current in Result Window 2. Voltage and Current signals in Result Window 6.
T/S Parameter	Calculated parameters from fitted complex impedance. R_e, L_e, C_{mes}, L_{mes}, R_{es}, f_s, Q_{ts}, Q_{ms}, Q_{es}.

The Impedance task is based on parallel measurement of voltage and current. So it compensates automatically for amplifier frequency response and for long-term changes in the amplifier gain.

T/S

	2 6
T/S	 R_e, L_e, C_{mes}, L_{mes}, R_{es}, f_s, Q_{ts}, Q_{ms}, Q_{es}.

Parameter

The following parameter can be applied to customize this task:

Categories	Parameter	Comments
Stimulus	Signal	SineSweep: Continuous Sine Sweep Multitone: Sparse Spectrum Signal
	Start, Stop, Time	Bandwidth and Length of stimulus
	Voltage	rms level in Volt at the speaker terminals. **Note:** The realized voltage may be less than the specified voltage due to finite output impedance of the power amplifier. See section *Hardware / Calibration / Amplifier Gain* for details. **Note**: Peak value can be more than 10 dB above rms level for Multitone!
Routing	Output	Loudspeaker to be tested, only visible, if *Routing / Output* in *Control Task* is set to *controlled by Task.* See *Test Configuration / Routing/ Output Routing* for details.
Measure	Impedance T/S Parameter	dis-/enable measures individually. If disabled, also the limits are disabled.
Processing	Resolution	points per octave, number of result points

	Smoothing	part per octave for smoothing, no smoothing if value is empty.
Display	Y-min	minimal impedance value in Ohm, if empty, auto scaled
	Y-max	maximal impedance value in Ohm, if empty, auto scaled
	Y-scale	Lin / Log scale option for impedance axis
	Custom Colors	Allows to modify standard colors for measures. Enable option to expand menu.

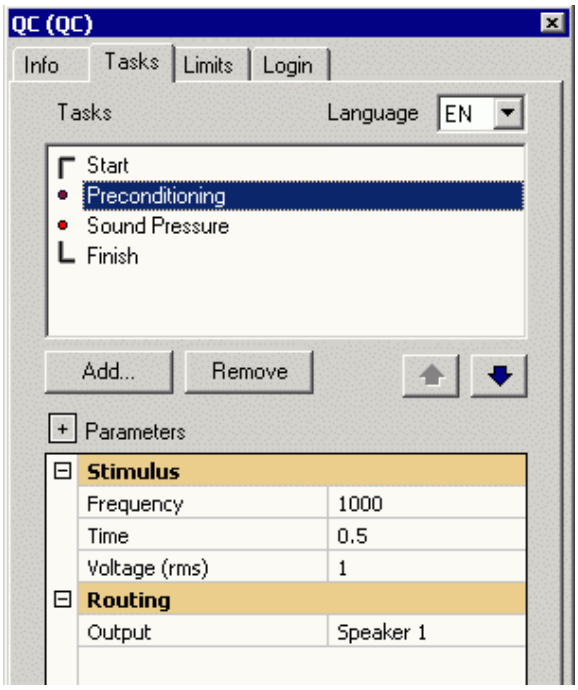
The limits belonging to the measures are explained in the respective section of chapter *Test Configuration / Measures and Limits*.

		SineSweep Multitone
		rms / */Amplifier* Gain rms 10dB
		/ / / *Output* Routing
		/ T/S
	Y-	
	Y-	
	Y-	/

/

Preconditioning for Ferrofluid

The task labeled *Precond* is intended to prepare tweeters with ferrofluid for the measurement. Using a fixed sine tone the ferrofluid is to be collected in the gap to achieve a reproducible state. This ensures consisting results in the following measurement tasks. Thus this task should be the first task of a sequence.



The following parameter can be applied to customize this task:

Categories	Parameter	Comments
Stimulus	Frequency	Constant frequency of sine wave
	Time	Duration of stimulus
	Voltage (rms)	Test level in Volt
Routing	Output	Loudspeaker to be tested, only visible, if *Routing / Output* in *Control Task* is set to *controlled by Task.* See ***Fehler! Kein gültiges Resultat für Tabelle.*** */ Routing / Output Routing* for details.

In the Basic version, the preconditioning is included in the *Tweeter* template.

		V
		/ / / *Output* Routing

Control Task

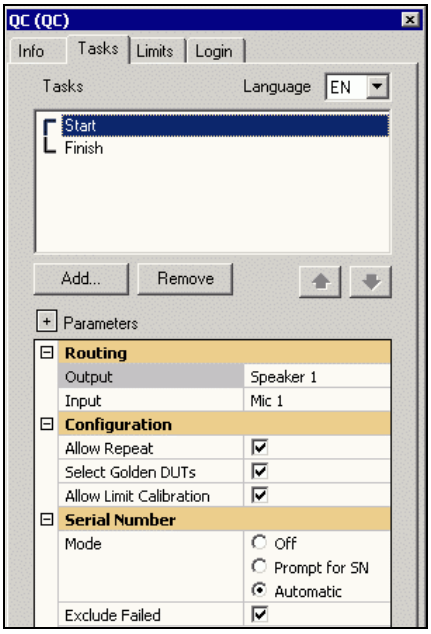
The Control Task and the belonging parameter are split into two groups.
Start Group: Defines settings that are required before running the test
Finish Group: Defines settings that are required after running the test.

Start

The following parameter can be applied to customize the start task:

Categories	Parameter	Comments
Routing	Output	For details see section *Test Configuration / Routing*
	Input	
Configuration	Allow Repeat	Enables additional button to repeat failed measurements for the operator. Using the Repeat button the Serial Number is not changed.
	Select Golden DUT	For details see section *Test Configuration / Golden DUT Handling*
	Allow Limit Calibration	
Serial Number	Mode / Exclude Failed	For details see section *Test Configuration / Serial Number Handling*

Property Page with parameter of the Control Task / Start section:



		/Routing
	DUT	
		/Golden DUT Handling

	/	/ *Serial* Number Handling

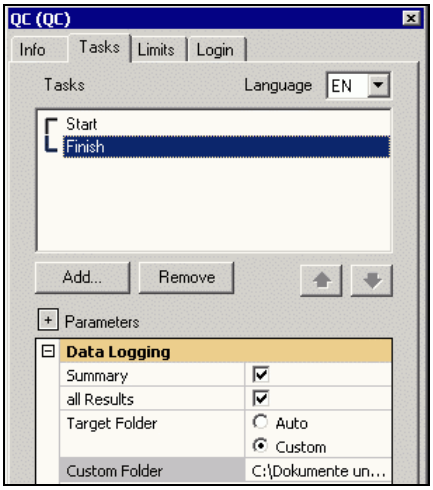
/

Finish

The following parameter can be applied to customize the start task:

Categories	Parameter	Comments
Data Logging	Summary	Enables short form log file (one line per DUT)
	All Results	Stores one database with all results per DUT
	Target Folder	*Auto*: Subfolder Log below folder of used database *Custom*: Specify folder in file system
	Custom Folder	For *Target Folder* = *Custom* only
	For details see section *Storing Results.*	

Property Page with parameter of the Control Task / Start section:



		DUT
		DUT
		=

/

Test Signals

Specific properties of different test signals should be considered for creating tests. Here you find an overview which test signal should be used in typical applications. For more information refer to specific Measures and Limits.

Test Signal	Application	Description
SineSweep	THD, Rub&Buzz	For easy separation of harmonics from the fundamental sinusoidal signal must be used.
Multitone	Impedance	Highest energy and best SNR at lowest frequencies. For stable low frequency impedance required
Multitone	Re for Woofers	

	THD	
	Re	

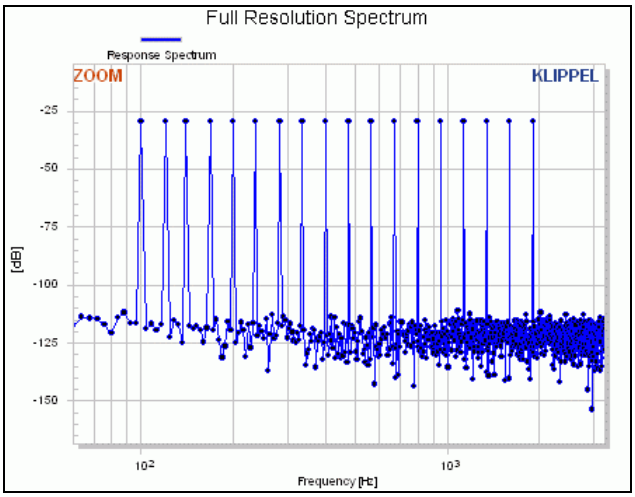
Multitone

The *multitone* tests the DUT at discrete frequencies. The energy is concentrated on these frequencies. All frequencies are selected that way that always full periods fit into the whole measurement time. That avoids any smearing in the spectrum and allows analyzing the spectral contamination between the excited lines due to noise and distortion.

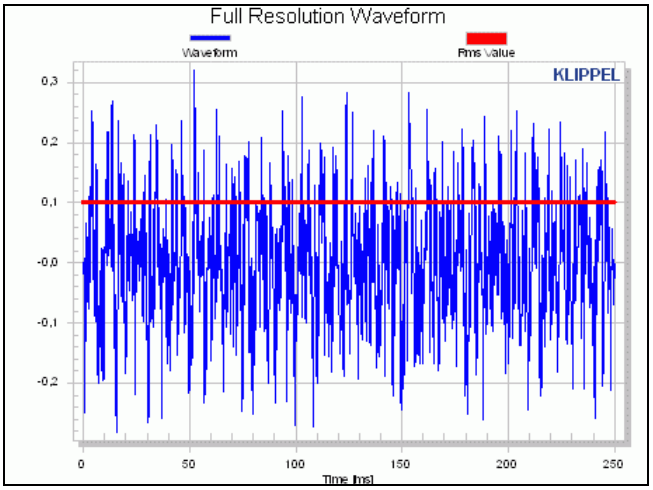
Multitone test signal generates Harmonics and Intermodulation Distortion, whereas *SineSweep* generates Harmonics Distortion only.

DUT

Spectrum



Waveform



Note: The peak value of the time signal is easily more than 10 dB higher than the rms value! The ratio between peak and rms value, the crest factor, depends on the bandwidth and number of bins. There is no absolute maximal value.

10dB

SineSweep

The LogSweep is based on a sine sweep continuously changing frequency (logarithmically with time). This enables fast tests since any relative frequency band is equally in time for a sweep with constant speed. This is a considerable advantage over linear sweeps.

Sweep Direction

For each sweep direction there are benefits and drawbacks. Please find a short discussion below.

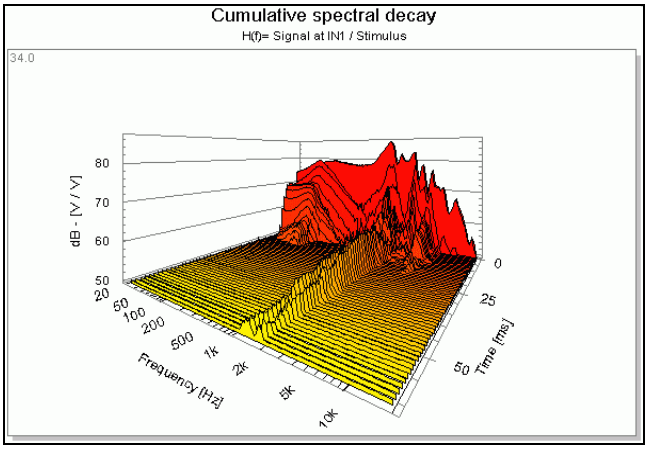
Settling time

Settling is proportional to a certain number of periods. Since period time is proportional to 1/frequency, it is obvious, that settling is much faster at high frequencies than for low frequencies

1/

Ringing

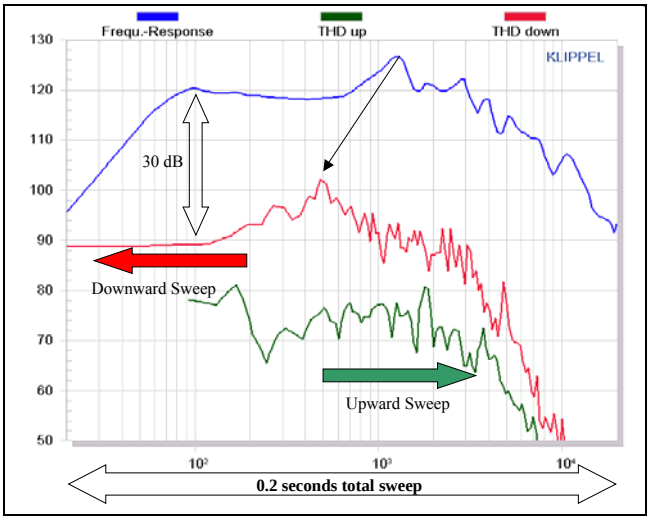
Driver with a higher Q resonance in the frequency response show a characteristic ringing when analyzing the waterfall plot. In the example below, a strong resonance at about 1 kHz oscillates more than 80ms at about 30dB below the fundamental.



If a very fast sweep from high to low frequencies (downward) is used, then the ringing is still active, and the tracking highpass filter for THD is collecting this energy. This energy is wrongly interpreted as THD, which is not true. It is just the ringing from higher frequencies. This effect is due to high speed. It can be omitted if the sweep

- starts below these resonance effects (e.g. 700 Hz in the example)
- the sweep direction is changed from down to up.

This is a linear effect and happens at all amplitudes.



The upward sweep is close to the steady state measurement and does not show this effect. This is caused by the highpass cut off frequency is shifting upwards, leaving the region of resonance, whereas for downward sweeps the highpass pass band in entering the region of resonance.

Q

1kHz

30dB 80ms

THD

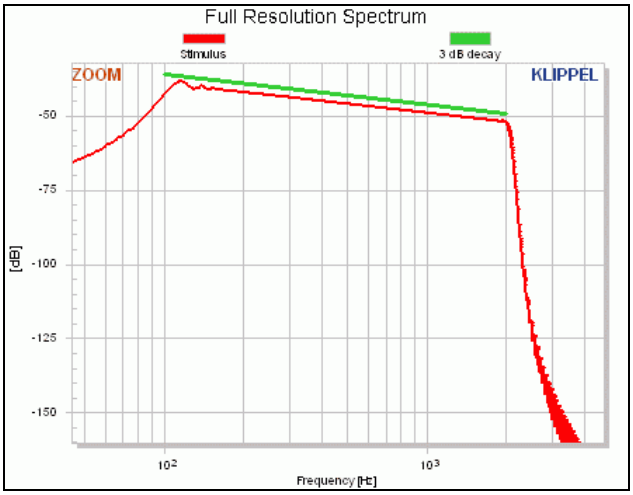
THD

- 700 Hz
-

Signal Properties

Using SineSweep no intermodulation can be generated.

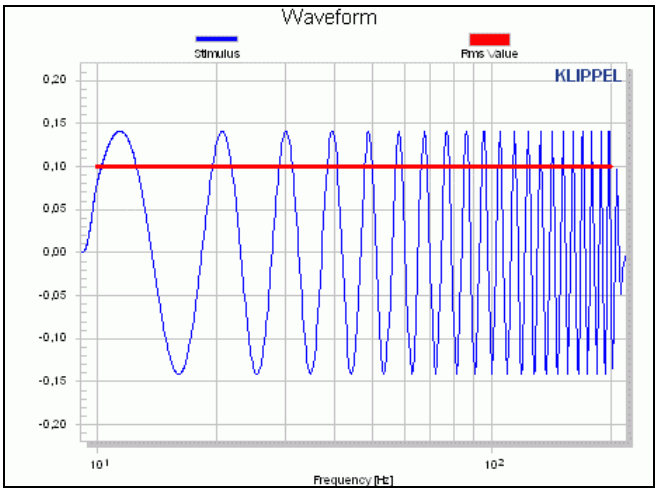
Spectrum



The spectrum has a typical –3dB / Octave decay similar to pink noise. This is typical for signal with constant energy in relative bandwidth. The ripple at the start frequency is optimally compromised between fast fading in of the signal and ripple amplitude.

–3dB

Waveform



Time signal of LogSweep vs. instantaneous frequency

The LogSweep stimulus has constant peak values over the whole length. The crest factor (ratio of peak and rms value) is minimal constant 3 dB. Thus minimal excursions (may be used for low frequency protection!) are ensured for a given rms value or power.

The variation of the frequency is continuously at each sample. There is no step or discontinuity in frequency during the test.

Note: Since for all samples the instantaneous frequency is known, it is also possible to draw the waveform vs. frequency (and not vs. time as usual). This allows identifying the exact frequency of possible disturbances or defects.

To optimize that stimulus even more, two profiles may be applied.

3dB

:

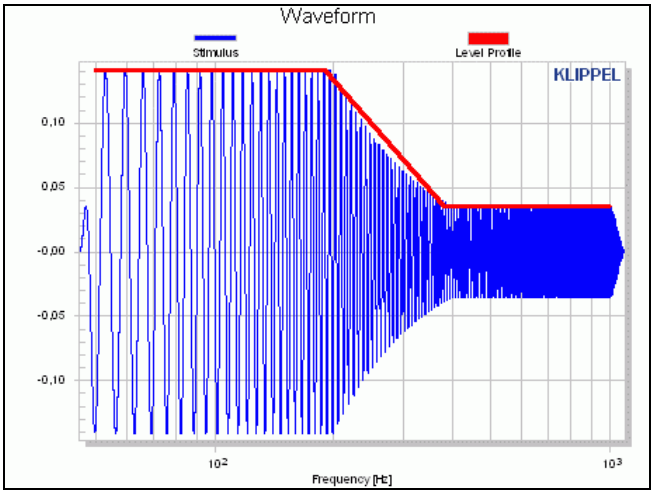
Level Profile

This profile allows shaping the stimulus level. This may be used for protecting the DUT from exceeding excursion (esp. tweeters) or power. Normally high displacement is needed below resonance to excite critical defects (rub and buzz) but at higher frequencies linear behavior may be desired to avoid distortion or to keep the annoying high frequency signal low in level.

Applications:

- Protecting the DUT from exceeding excursion below resonance
- Thermal protection at higher frequencies
- Optimize SNR during the test

- Avoid unwanted distortion / compression



Note: Very rapid changes of voltage level (such as steps) may generate audible clicks and are therefore not recommended. A warning is displayed, if the rate of level change is too high. Check always THD and Rub&Buzz at these critical frequencies to avoid peaks in these measures due to level profile.

The input parameter for the level profile are

frequency *level.*

Levels between the defined points are interpolated. To generate steps in the level profile the corner frequency should be listed twice:

Example:

```
100 -6
500 -6
500 0
1000 0
```

From 100 to 500 Hz the level is attenuated by 6 dB and from 500 Hz to 10 kHz there is unity gain (0 dB).

DUT

- DUT
-
- SNR
- /

THD

```
100 -6
500 -6
500 0
1000 0
```

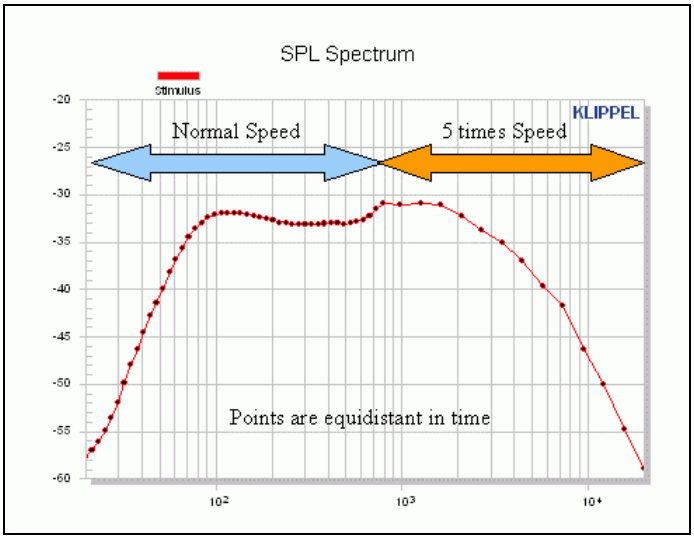
100 500 Hz 6 dB 500 Hz 10 kHz 0 dB

Speed Profile

Although the LogSweep is time efficient, it is very useful to even further shape the speed of the sweep. The Speed Profile allows defining up to 10 sections within the stimulus with different speeds. Thus testing with low speed and high energy at critical sections (e.g. around resonance) uses the main part of the testing time while high frequency response is tested at much higher speed. Shaping the speed allows to create minimal test durations without compromising at critical sections.

Applications:

- Detailed testing of Rub and Buzz around resonance
- Thermal protection at higher frequencies
- Minimizing testing time for high volume / automated lines
- Testing with one sweep only



The input parameter for the speed profile are

frequency_start *frequency_stop* *relative speed.*

To generate the speed profile of the graph above:

Example:

```
10 800 1
800 20000 5
```

The sweep is from 800Hz to 20kHz five times faster than from 10 to 800 Hz.
Note that the speed factors are relative to each other. The absolute value is no considered.
The frequency ranges must be non overlapping.

10

-
-
- /
-

– –

```
10 800 1
800 20000 5
```

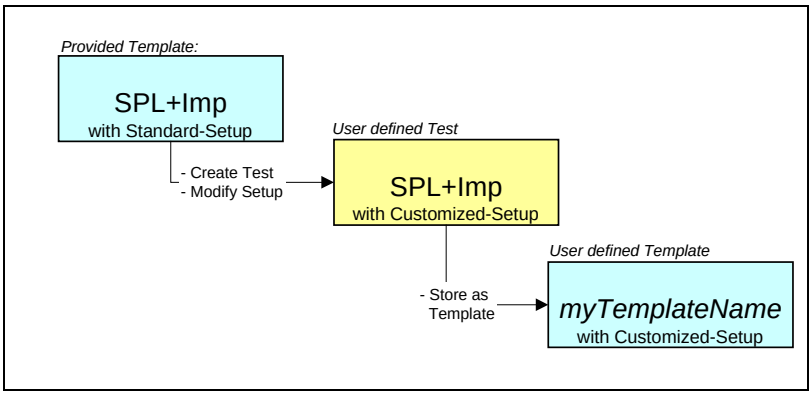
800Hz 20kHz 10 800 Hz 5

Test Templates

With the QC Software always a package of templates is provided.

- For the Basic version tests can only be created based on these templates (see section QC-Start Tool). Test Templates can be modified according to special transducer requirements and stored as tests.
- Using the **Standard Version** templates can be arbitrary composed out of provided Task Files. Test Sequences (e.g. for multi-way box testing) are supported.
- The **Programmable Version** allows to compose new tests using provided tasks or self programmed / modified tasks.

For all versions, any modified / created test can be stored as a template. For details see section *QC-Start Tool / Create a template*. The new template appears in the template selection list and can be later used for creating new tests.



QC

- QC-Start Tool
-
- /

/

QC- */ Create* a template

Basic Version

In the Basic version two templates are available:

Template	**Description**			
	fs Range [Hz]	Re Range [Ω]	SPL limit range[Hz]	SPL time [s]
Fast Subwoofer	10 – 50	2 – 8	20 – 200	2
Fast Woofer	20 – 150	2 – 8	20 – 1000	1
Fast Midrange	100 – 500	4 – 8	50 – 2000	1
Fast Tweeter	400 – 3k	4 – 8	200 – 20k	0.5
Fast Horn Driver	200 – 2k	4 – 16	400 – 20k	1
Fast Microspeaker	200 – 2k	4 – 30	200 – 5k	0.5
Fast Headphones	30 – 400	10 – 200	20 – 20k	1

In all templates the following measures are included:

- Impedance,
- fs,
- Re,
- Frequency Response,
- Average Level and
- Polarity

The keyword ***Fast*** in the template name stands for reduced measurement time. In the Basic Version always a combined task measuring Impedance and SPL in one task is used. Thus the impedance is measured with high amplitude which is needed for the SPL test. In the standard version this restriction does not exist.

In all templates the task ***Fehler! Verweisquelle konnte nicht gefunden werden.*** is used. See section *Test Configuration / Tasks* for details.

The Tweeter Template consists additionally of an Ferro Fluid Preconditioning task. You may adjust level, duration and frequency of a sine tone or sweep to accumulate distributed Ferro fluid in the gap.

Note: These Templates are basic Templates providing all measures included in the Basic Software Version. Measures can be added to these basic and all derived templates by simply installing the corresponding license. See pricelist for available add-ons.

	fs [Hz]	Re [Ω]	SPL [Hz]	SPL [s]
	10 – 50	2 – 8	20 – 200	2
	20 – 150	2 – 8	20 – 1000	1
	100 – 500	4 – 8	50 – 2000	1
	400 – 3k	4 – 8	200 – 20k	0.5
	200 – 2k	4 – 16	400 – 20k	1
	200 – 2k	4 – 30	200 – 5k	0.5
	30 – 400	10 – 200	20 – 20k	1

-
- fs
- Re
-
-
-

—

SPL

SPL

SPL+ ***Fehler! Verweisquelle konnte nicht gefunden werden.*** */ Tasks*

Standard Version

All Templates described here are available using the **Standard Version** as well as the **Programmable Version**.

Additionally to the Basic Templates listed above, the following templates are available:

Template	**Description**			
	fs Range [Hz]	Re Range [Ω]	SPL limit range[Hz]	SPL time [s]
Subwoofer	10 – 50	2 – 8	20 – 200	2
Woofer	20 – 150	2 – 8	20 – 1000	1
Midrange	100 – 500	4 – 8	50 – 2000	1
Tweeter	400 – 3k	4 – 8	200 – 20k	0.5
Horn Driver	200 – 2k	4 – 16	400 – 20k	1
Microspeaker	200 – 2k	4 – 30	200 – 5k	0.5
Headphones	30 – 400	10 – 200	20 – 20k	1

The template name without the ***Fast*** keyword stands for separated tests of impedance and SPL. Thus different level and test signals may be applied for more accurate testing.

However, when highest speed is required, of cause the ***Fast*** Templates may be used.

In all the listed templates two tasks:

- *SPL* and
- *Impedance (Imp)* are used as a sequence.

See section Test Configuration / Tasks for details.

	fs [Hz]	Re [Ω]	SPL [Hz]	SPL [s]
	10 – 50	2 – 8	20 – 200	2
	20 – 150	2 – 8	20 – 1000	1
	100 – 500	4 – 8	50 – 2000	1
	400 – 3k	4 – 8	200 – 20k	0.5
	200 – 2k	4 – 16	400 – 20k	1
	200 – 2k	4 – 30	200 – 5k	0.5
	30 – 400	10 – 200	20 – 20k	1

SPL

- *SPL*
- *Imp*

/ Tasks

Golden DUT Handling

DUT

Limits are usually created using multiple reference DUT to have average information about statistically varying measures. A golden DUT is a best fit (minimal least square deviation) to the average of the SPL measure. It represents the average and could be therefore used to readjust limits, when ambient conditions (temperature, humidity) have changed the response characteristic of the DUT or when other conditions (test enclosure etc) were changed.

Golden DUT Handling consists of two steps:

1. Selection of Golden DUT.
2. Readjusting / Recalibration of limits using Golden DUT.

Please find more information below.

Note: The Golden DUT Handling is only available in the Standard / Programmable Version of the QC system.

DUT

DUT SPL

DUT

DUT

DUT

1. DUT
2. DUT /

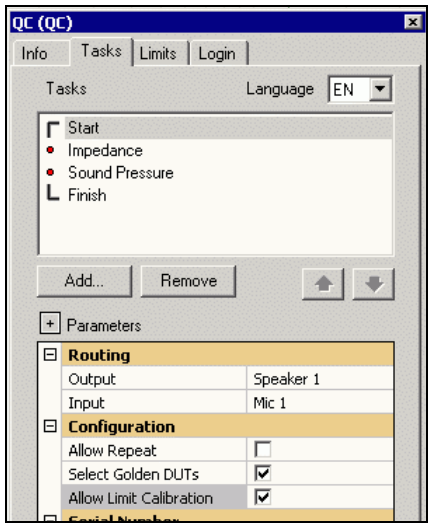
DUT QC /

Selection of Golden DUT

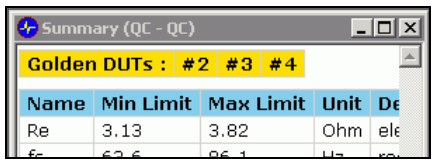
DUT

Golden DUT are selected automatically if

1. at least one SPL task is included (SPL, SPL + Imp)
2. the *Select Golden DUT* switch in the Start Task section on the property page *Tasks* is enabled.



3. when the limits are calculated (see section *Test Configuration / Limit Calculation*). The *Summary* result window shows a list of DUT with the best fit at first position in order of decreasing fitting. The three best fitting DUTs are shown.



The golden units are calculated according to their deviation (min. squared difference) of the SPL measures against the mean curve of the SPL. So the closest matches to the average of the reference DUTs are listed.

Note: If multiple SPL tasks are used, the golden DUT sorting algorithm is based on the last task in the task list having an SPL measure.

DUT

1. SPL SPL SPL+Imp
2. *DUT*

3. / *Limit* Calculation
   DUT
   DUT

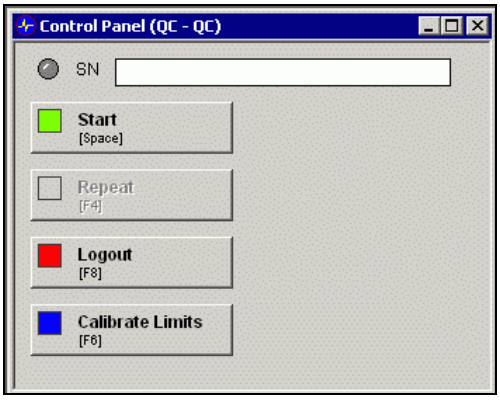
SPL SPL
DUT DUT

SPL DUT SPL

Limit calibration

To use the Golden DUT for recalibrating the limits the *Allow Limit Calibration* switch must be enabled. See screenshot in chapter *Selection of*

Golden above. If this switch is set, an additional button appears on the Control Panel *Calibrate Limits [F6]*.



To calibrate the limits connect the "golden DUT" and press the *Calibrate Limits* button at the *Control Panel*. A message box will pop up that asks you to connect the golden DUT. Connect the golden DUT and confirm with OK. Now the golden DUT will be measured and the limits will be automatically adjusted to this reference measurement.

DUT

Selection of Golden

[F6]

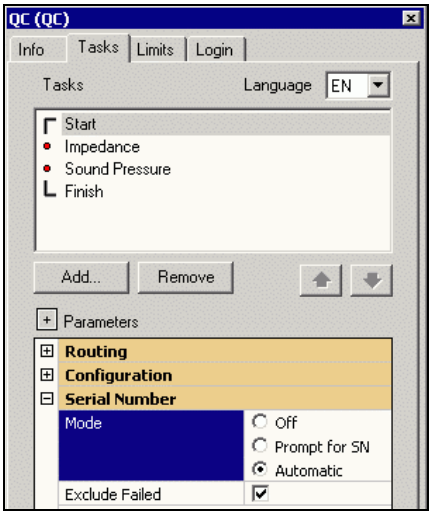
" DUT "

DUT DUT

OK DUT

Serial Number Handling

There are two different ways to handle serial numbers. Select the mode in the Start Task section on the property page *Tasks*.

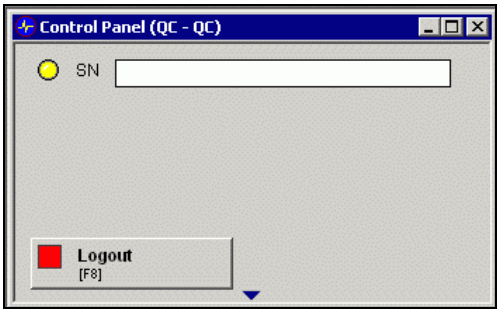


The Serial Number is shown on the Summary Page and is stored in the summary log file (see section *Storing Result / Summary (Short form log file)).*

/ *Summary* (Short form log file)

Prompt for SN

If selected, on the Control Panel a text input field appears, where the serial number can be entered. All serial numbers have to be confirmed with ENTER.



Do not use the start button (only available in Engineer Mode). This would ignore the entered serial number.

Note: In the Operator Mode, the Start button is disabled. So the operator is forced to enter a serial number. There is no other way to start the operation.

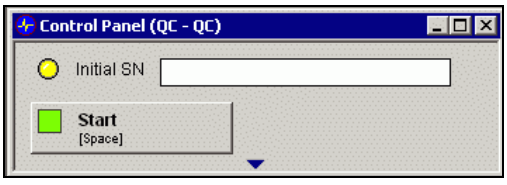
In the Engineer Mode the Start button is still enabled since it should be used to measure reference Dust for the limit generation.

ENTER

Automatic Mode

If the mode is set to Automatic, the serial numbers are increased automatically by one. You may optionally exclude failed Dust (see screenshot above) to have a consecutive numbering of passed Dust.

The operator may enter an initial serial number. However, entering the number does NOT start the test. In this mode the *Start* button must be used.



1

Using Barcode

A barcode reader may be used to enter the serial number the first mode *Prompt for Serial Number*. Since Barcode readers normally terminate the scanned string by ENTER, this is identical to the manual input of the serial number.

Note: Any filtering, processing or printing of the scanned barcode (e.g. to exclude characters, using substrings etc.) can be easily implemented in the Programmable Version.

ENTER

Routing

The Production Analyzer Hardware as well as the QC software provides flexible options to measure

- one single driver at one channel
- one driver at alternating channels (to optimize speed, measure one DUT while handling other one).
- systems with multiple drivers and up to two microphones.

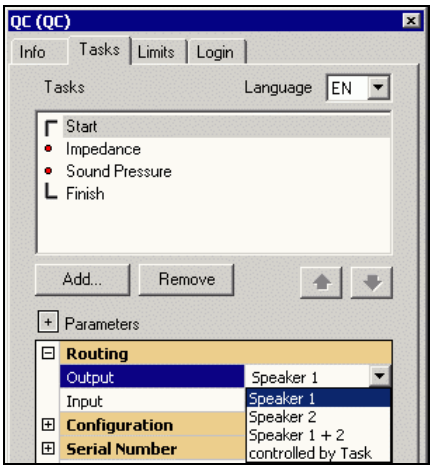
Select the routing in the Start Task section on the property page *Tasks.*

QC

-
- DUT
-

Output Routing

The Output Routing defines the used Speaker Channel to which the DUT is connected.



DUT

Speaker 1 or Speaker 2

1 2

If the output routing is defined in the Start section of the control task to one single speaker channel (Speaker 1 or Speaker 2), the routing is globally set for all included tasks. There is consequently no option to set up the routing in the individual task setups. Only this speaker channel will be connected to the amplifier during testing. The other channel is switched off using a power relais.

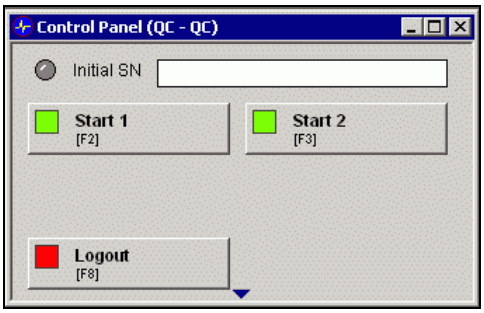
In the Control Panel there is one start button available.

1 2

Speaker 1+2

1+2

If the output routing is defined in the Start section of the control task to Speaker 1+2, alternating testing becomes possible. The routing is globally set for all included tasks. There is consequently no option to set up the routing in the individual task setups. In the control panel two start buttons are available, one to start the DUT at Speaker Channel 1 and one to start the DUT at Speaker Channel 2.



Note: If the external switch is used to start the test, always the Speaker Channel 1 is started. Using the programmable version, other input pins may be programed to start other channels / combinations.

This setting is used to test one driver at alternating channels (to optimize speed, measure one DUT while handling other one), often together with the input routing *Mic linked to Speaker* (see below).

1+2

1

2

1

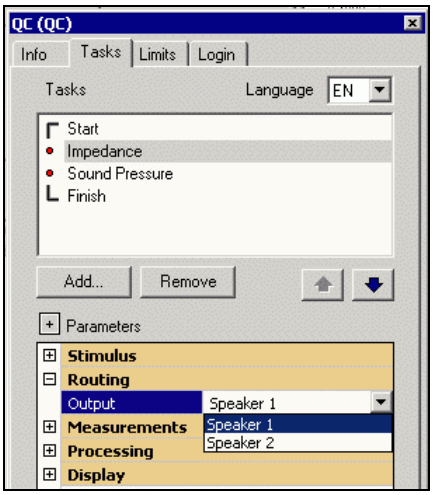
/

DUT

Mic linked to Speaker

Controlled by Task

Using this option, all individual tasks have an additional section in the Task Parameter List labeled *Routing* and a new parameter labeled *Output*.

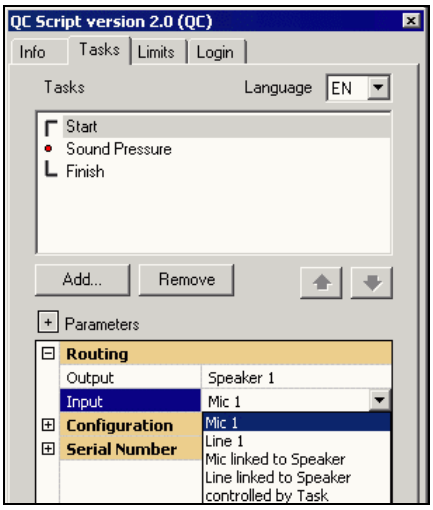


By default the channels are set to Speaker 1. Select the required channel in all used tasks. This mode is used to check systems with multiple drivers in one single test.

1

Input Routing

The input routing defines which microphone is used to measure the SPL of the DUT. It is also possible to use external microphone power supplies and to connect those to the Line inputs.



DUT SPL

Mic 1

Mic1

Microphone 1 is used for all tasks. This is the default setting. This microphone routing is globally set for all included tasks. There is consequently no option to set up the routing in the individual task setups.

1

Line 1

Line1

A Microphone with external power supply (e.g. Condensor microphones with 200V supply) is used for all tasks. This microphone routing is globally set for all included tasks. There is consequently no option to set up the routing in the individual task setups.

200V

Mic linked to Speaker

In this case, the microphone channel is selected according to the Speaker Channel. This is also used for all tasks.

When Speaker 1 is tested: measure SPL with Mic connected to Mic 1

When Speaker 2 is tested: measure SPL with Mic connected to Mic 2

This mode allows testing DUT alternatingly using two (almost) identical test stands (or enclosures). It should be used with the Output Routing Setting *Speaker 1+2.*

Note: Alternate testing cannot be used with Ambient Noise testing at the same time. For Ambient Noise testing Mic 2 input is always used. In the programmable version this restriction can be removed.

1 Mic1 SPL

2 Mic2 SPL

DUT *Speaker 1+2*

2

Line linked to Speaker

A Microphone with external power supply (e.g. Condensor microphones with 200V supply) is used for all tasks. In this case, the input channel is selected according to the Speaker Channel:
When Speaker 1 is tested: measure SPL with Mic connected to Line 1
When Speaker 2 is tested: measure SPL with Mic connected to Line 2

This mode allows testing DUT alternatingly using two (almost) identical test stands (or enclosures). It should be used with the Output Routing Setting *Speaker 1+2*.

Note: Alternate testing cannot be used with Ambient Noise testing at the same time. For Ambient Noise testing Mic 2 input is always used. In the programmable version this restriction can be removed.

200V

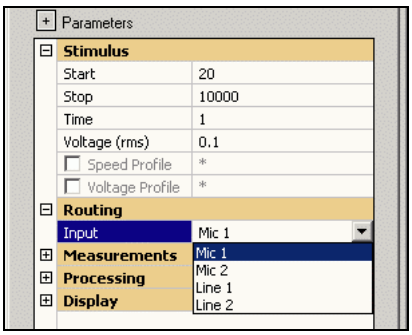
1 1 SPL
2 2 SPL

DUT *Speaker 1+2*

2

Controlled by Task

Using this option, all individual tasks have an additional section in the Task Parameter List labeled *Routing* and a new parameter labeled *Input*.



By default the channels are set to Mic 1. Select the required channels in all used tasks. This mode is used to check systems with multiple drivers and / or multiple microphone locations in one single test.
All Mic and Line inputs are available as options. Note, that the Ambient Noise Monitoring is always measured using Mic 2. When Mic 2 is required for near field testing (measuring the response, not the Ambient Noise), this cannot be combined with Ambient Noise Monitoring.

In this case disable the measure *Ambient Noise*.

1

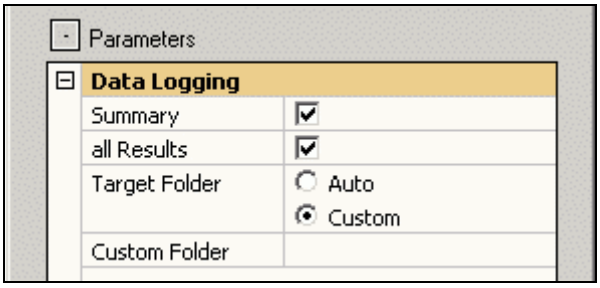
/

2 2

Storing Results

Overview

The Control Task / Finish section in all software versions provides the following options to store results.



Please refer to the section Test *Configuration / Tasks / Control Task* on information about the Control Task.

/

/ */Control* Task

Summary (Short form log file)

The Summary log file comprises test results in one line for each test. Consequently the number of lines in a log file is equal to the number of logged tests (minus the header line).

For the file location, please refer to section *File Location* below.

Contents:

This short form log file contains the following data:

Group	Description
General Info	Date
	Time
	SerialNumber
	UserName
Pass / Fail verdicts	Verdict-Overall
	Verdicts of all enabled measures
Single Number Results	All enables results (e.g. Re, fs, Level)
Conditions	Temperature
	Humidity
Cpk / Ppk	Cpk, Ppk, CpkLimit, PpkLimit

Format:

The log file does not have a fixed format. Depending on enabled measures only calculated results are stored.

The file is written in plain text format. Each file starts with a header line to identify the columns.

The separation character is a tab stop.

File Location

/	
	Re fs
Cpk / Ppk	Cpk Ppk Cpk Ppk

All Results (Database)

If storing "*all results*" is enabled, after each performed test the active operation is stored in a database format. These databases can be opened simply by double click on the icon or filename.

The filename is a compound of Serial number, Date and time to identify each tested DUT (Example: DUT SN01234 2007-11-06 10-52-38-3.kdb).

Please refer to section "Getting Started / Viewing Results" to find more details.

The database holds all information of the measurement including results, limits, reference measurements, result graphs, output messages etc. identical to the state just after the test with the following exception:

Note:
1) The contents of the result window *Calibration Spectrum* and *Calibration Waveform* are never stored in a database. This information is lost after logging out.
2) The reference units (used to calculate the limits) are not stored in the saved database for disc space saving reason. They are stored only in the original test database. However, the limits are included in all saved databases.

From these stored databases all displayed information is accessible using the internal export function for curves and data. For details see the dBLab-Manual.

For the file location, please refer to section *File Location* below.

“ ”

DUT DUT SN01234 2007-11-06 10-52-38-3.kdb

/

:

1)

2)

---

dBLab

File Location

Extracting data from Klippel Database

Klippel

A much more convenient way to assess the stored data of multiple databases is the Klippel database data extraction Tool *DBextract*.

DBextract is a utility of the QC System, allowing to export selected QC Test Results to widely configurable text files (Excel, Matlab, ASCII etc).

More information can be found in the separate manual of the Extraction Tool. It is part of the online help and also part of the paper version coming with the QC system.

Note: For implementing offline data processing, see also section *Statistics* / *Offline Statistics*.

Klippel

DBextrac

DBextract Klippel QC

Excel Matlab ASCII

QC

/ *Offline* Statistics

Making Reports

Using the report function of dB-Lab customized measurement report can be generated. All result windows as well as user defined formatting, logo and style can be used to generate a highly flexible format.

For details see section *The Report System* from the dB-Lab manual.

dB-Lab

dB-Lab

File Location

The target folder for all log files and databases can be specified in two ways:

Auto:

If the target folder is set to Auto, the log file (summary or database) is stored in a subfolder labeled *Log* created in the folder of the currently used test database.

By default it is {Program Files} / Klippel / DA / QC / tests / {*testname*} / Log.

The storage folder of the currently used database can be defined using the setup of the QC-Start tool (refer to section *Organizing Projects / QC Start tool /QC* Start *)*.

By default it is {Program Files} / Klippel / DA / QC / tests / {*testname*}.

Custom:

Any arbitrary folder can be specified as an absolute path.

Note: You should not use a network drive. This may cause larger delays due to network traffic. A defined cycle time cannot be guaranteed.

{Program Files} / Klippel / DA / QC / tests / {*testname*} / Log.

).

QC-

/QC */ QC* Start

{Program Files} / Klippel / DA / QC / tests / {*testname*}

Customized formats

Almost any format can be generated using the programming features version of the software.

1. It is possible to send Klippel your specification for a specific output format. In this case Klippel would provide you with customized scripts. This is also possible, if you are working with the Standard version (Basic version is not supported with customized export).
2. Using the programmable version you may implement the required export data yourself. There are almost no restrictions but keep in mind that generating long strings and lists as well as hard disc access slows down the complete system.

1. Klippel
   Klippel

2.

Statistics

Online Statistics

All statistical evaluations that need to be calculated immediately after processing each DUT are assigned as "online". This is required to derive information about the reliability and reproducibility of the manufacturing process as well as for controlling the production (data exchange with the production line or other computers).

In the QC standard version CPK/PPK as well as a simple Pass / Fail statistics is provided.

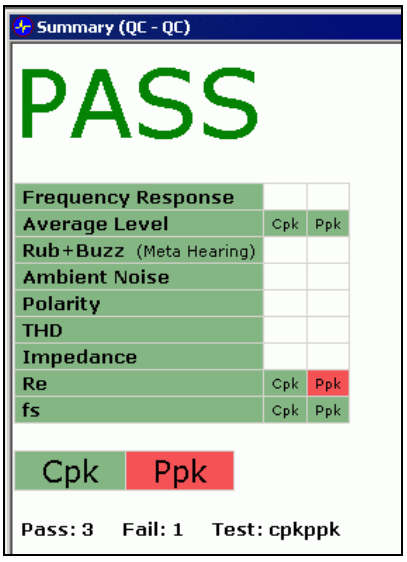
DUT “ ”

QC CPK/PPK /

Cpk / Ppk

The Production Capability Indices Cpk and Ppk assess the production process (for details and theory see *Appendix / Glossary / Ppk / Cpk*).

Cpk / Ppk



All single value results can be subject to a Cpk/Ppk analysis. This can be enabled in the Limit Calculation Mode by checking the appropriate checkbox. The Cpk results of all enabled measures are "and"-linked and displayed in the "Cpk"-box below the result list. The green color of the box indicates a stable process (all single Cpk tests passed) while the red color indicates a problem. This applies to Ppk as well.

Cpk Ppk /
/ *Ppk* / *Cpk*)

Cpk/Ppk
Cpk “ ”
“ Cpk ”
Cpk
Ppk

Pass / Failed DUTs
/ DUT

A simple counter is implemented to show the passed and failed DUTs since the last login. For longer term statistics see chapter *Offline Statistics*.

DUT *Offline* Statistics

Offline Statistics

For long term evaluation of tests as well for any post processing that is not used for immediate action on the production process, the offline statistics shall be used.

This separation into online and offline processing keeps the actual production cycle time minimal while providing an extreme high degree of flexibility for almost any evaluation of measured data.

The offline statistics is based on the stored data during the online measurement. Two kinds of storing are available:

- Summary Log file (one line per DUT)
- Complete Database (one file per DUT).

See chapter *Storing Results* for details.

- DUT
- DUT

Extracting data for processing

Klippel QC stores all results in compact binary files (*.kdb). Binary data can be saved much faster than text. This is important if the cycle time of the production line is short. A dedicated tool makes the results accessible in text format. You can scan multiple databases, and select which result to export and process. The output format is widely configurable, so import into statistics tools like Microsoft Excel is smooth and painless.

The data stored in both files, the Summary Log File and the Complete Database, can be extracted to almost any ASCII format using the *DBextract* Tool.

DBextract is a utility of the Klippel System, allowing to export selected QC Test Results to widely configurable text files (Excel, Matlab, ASCII etc).

More information can be found in the separate manual of the Extraction Tool. It is part of the online help and also part of the paper version coming with the QC system.

More information can be found in the separate manual of the Extraction Tool. It is part of the online help and also part of the paper version coming with the QC system.

Some straight forward examples of the usage are:

- Making am Excel Sheet (csv file) with all SPL response data from the last week.
- Making an Matlab compatible data file with a matrix of the impedance curve, *Re* value and *fs* value from the last 1000 DUTs.
- Creating a chart using Excel of the resonance frequency versus measured temperature and humidity
- Correlation of the Cpk / Ppk results with time, date, batch, operator, etc.

This technique allows to access all data **after** the measurement, whereas in other QC systems the contents of the logged data must be defined in advance as a setup parameter.

Klippel QC *.kdb

Microsoft Excel

DBextract ASCII

DBextract Klippel QC
Excel Matlab ASCII

QC

- SPL Excel (csv)
- 1000 DUT Re fs
  Matlab
- Excel

- Cpk / Ppk

QC

Implementing my own statistics

Also for complex statistical programming the two basic approaches hold valid:

Online statistics (see chapter above) can be easily implemented using the *Programmable Version* of the QC system. This can be done in the *Scilab* high level math language, which provides a very powerful library for statistical functions.

However, this should be restricted to those applications, were the online / real time feedback to the production line is required.

The Offline Statistics can be implemented by any program that provides statistical evaluation such as *Excel, MatLab, Scilab* or even the Klippel *MAT* module (part of the R&D system) etc. Using the data extract tool *DBextract* any results can be extracted from stored summary log file and proprietary database in an almost arbitrary ASCII file format.

See also chapter *Extracting data for processing* above.

Note: You may always provide ideas for features which are currently not included in the QC standard system. Those may be included in future releases.

QC *Programmable* Version
Scilab

.

Excel MatLab Scilab
Klippel *MAT* R&D
DBextract
ASCII

Extracting data for processing

:	QC

Basic, Standard, Programmable Version

Differences between versions

The KLIPPEL QC system is available in three versions: Basic, Standard and Programmable System. The Basic System supports only one measurement task in a test and has only some basic features included. Furthermore it can only handle one reference device for limit calculation. However it can be upgraded with additional features according to the table below.

The Standard System is a complete QC measurement system that can be upgraded with Meta-Hearing-Technology for advanced Rub&Buzz detection.

The Programmable System has additionally included a high level scripting language that allows a flexible customization (see next section).

Feature:	Basic System	Standard System	Programmable System
Impedance	incl.	incl.	incl.
SPL	incl.	incl.	incl.
Re, Fs, Qts	incl.	incl.	incl.
Polarity	incl.	incl.	incl.
T/S parameter	opt.	incl.	incl.
THD	opt.	incl.	incl.
Rub & Buzz (standard)	opt.	incl.	incl.
Ambient Noise Monitoring	opt.	incl.	incl.
Multiple Reference DUTs Statistical limit generation	–	incl.	incl.
Production indices (Cpk, Ppk)	opt.	incl.	incl.
Meta-Hearing-Technology (incl. Rub & Buzz standard)	opt.	opt.	opt.
Remote Configuration Tool	opt.	opt.	opt.

High level scripting language	—	—	incl.

incl. = feature included opt. = feature optional — = not available

Klippel QC

QC

特性			
SPL			
Re fs Qts			
T/S			
THD			
DUT	—		
Cpk Ppk			
	—	—	

= = — =

Programmable Version

Background of programming

The programmable version is designed to be most flexible while keeping the effort for customization minimal. This is achieved by supplying

- Especially adopted structure to QC requirements
- Methods to reduce amount of data to be processed to a minimum
- Library functions solving general QC problems
- Preprocessing of acquired data in a kernel to provide standard results (THD, Rub&Buzz, Phase, Magnitude, Spectra, Waveform) in already downsampled resolution to speed up tests

- QC
-
- QC
-

THD

What can be modified?

The programmable version can modified almost any properties of the QC system such as:

- Algorithms for calculation of data based on the acquired measurement data.
- Algorithms for limit calculation
- User Interface for Operator and Engineer
- Output of data in any format (binary or text based)
- Visualization of data (colors, style, axis etc.)

QC

-
-
-
-
-

More Information

More information about the programmable version can be found in the Programmer Manual.

Hardware

Setup and Configuration

For performing the first measurement with the Klippel QC system, please refer to the section *Getting Started*. There the standard routing and PC-connection are explained. In this section you can find background information and details for enhanced usage.

Basically the Production Analyzer could be used to test not only analog components but also any multimedia equipment (USB loudspeaker or USB headsets / microphones). However, in the standard configuration it uses a firewire (IEEE1394) based AD/DA converter (Phase24FW) that is feeding the digital data through the Microsoft multimedia system into the QC software.

Klippel QC
PC

USB USB /
AD/DA Phase24FW IEEE1394
QC

Calibration / Check of Accuracy
/

A complete system calibration comprises three parts, which are required to perform at different time intervals:

Calibration	Recommended Interval	Verifying
Microphone	daily - monthly	Pistonphon
Amplifier / Internal Calibration	monthly	Automatic check at every startup
Voltage / Current sensors	24 month	not available at customer site

	–	
/		
/	24	

Production Analyzer Calibration

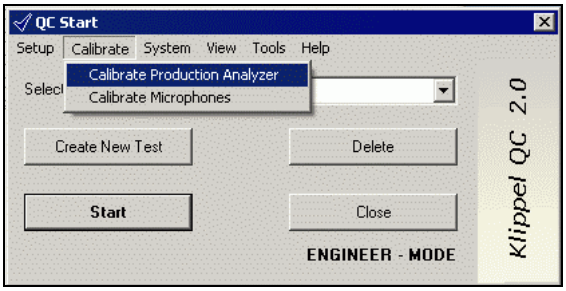
The Production Analyzer Calibration calibrates the analog in- and output using a built in reference signal generator. It also checks digital bypass routing from in- to output and vice versa in the Microsoft multimedia system.

After calibrating the in/outputs, it measures the amplifier gain and highpass characteristics and stores the gain of all found routings. It always checks for a gain from both outputs (OUT1 and 2) to both speaker channels (SPEAKER 1 and 2).

By default the output OUT1 is used to be connected to an amplifier, which may drive both speaker channels with different gains. Using the programmable version it is possible to use the output OUT2 for advanced testing such as cross correlation measurements etc.

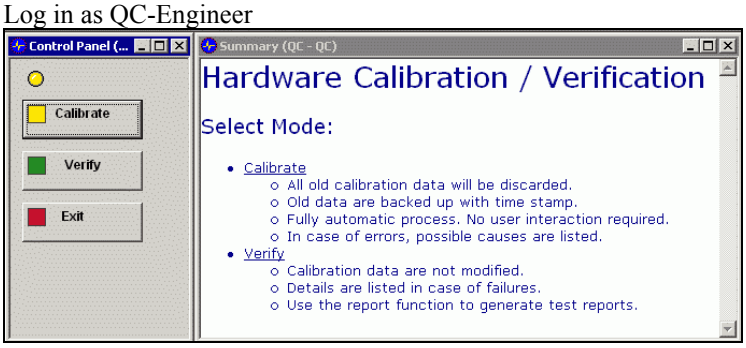
Note: Make sure, that your power amplifier is connected to the system! For the calibration process the same wiring scheme must be used as described in the section *Getting Started / Hardware Installation*. No matter, which speaker channels are used in the final application, both channels are required for the calibration process.

Using the QC-Start tool select System / Production Analyzer Calibration from the menu. If the menu entry is disabled, you need to start the QC start tool in the Engineer mode, see section *Organizing Projects*.



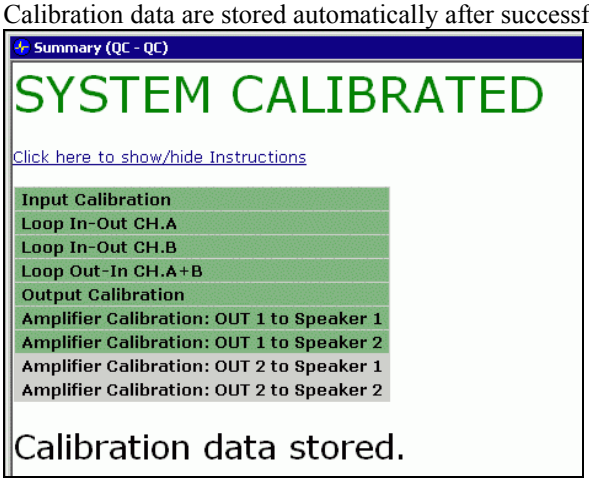
A special calibration test sequence is started. Please follow the steps below.

1. Log in as QC-Engineer



2. Press on "Calibrate" button on the user interface

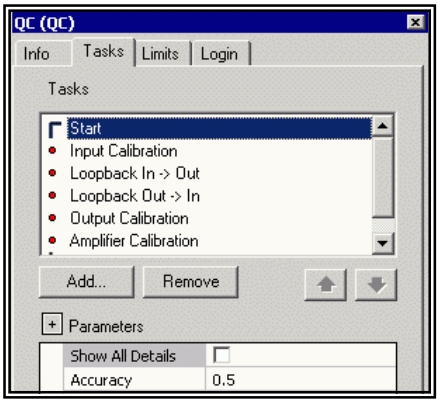
3. In case of a failed calibration follow the instruction on the Summary Window. If you do not see the instructions, click on the link *Click here to show/hide Instructions*. In case of persistent problems, please contact *support@klippel.de*.
4. Calibration data are stored automatically after successful calibration.



5. Press "*Exit*" to return to the QC-Start tool.
6. Close dB-Lab if not exiting automatically.

Note: After calibrating the system also the inputs are recalibrated, thus the microphone input gain might have been changed and therefore always a calibration of the microphones is requested after calibrating the Production Analyzer.

You may later on check a valid calibration by using the "*Verify*" option from the user interface. In this mode you may also adjust the tolerance for checking the accuracy of the parameter (Select Start task in Task list and edit Parameter Accuracy in Parameter List). It is set to 0.5% by default.



OUT1 OUT2
SPEAK1 SPEAK2
OUT1
OUT2

/ *Hardware* Installation

QC- /
QC

1. QC
2. “ ”
3. /
support@klippel.de
4.
5. “ ” QC
6. dB-Lab

“ ”

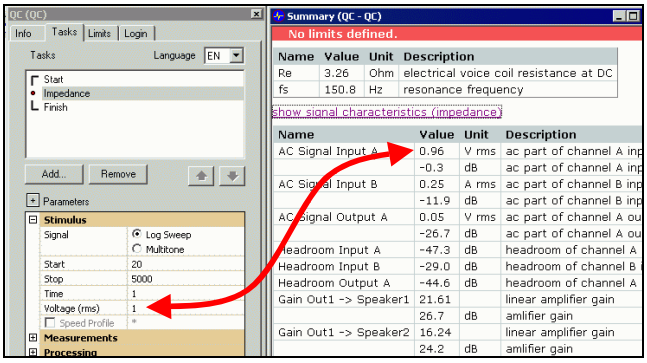
0.5%

Amplifier Gain

The detection of the amplifier gain is part of the Production Analyzer Calibration (see above).

Note: During the calibration the gain of the power amplifier is measured in a unloaded condition. When testing especially low impedance drivers, the achieved voltage at the DUT terminals may substantially be less than the specified target voltage due to a finite output impedance of the amplifier. Although this is not critical in most cases for QC tests since these tests are relative against a golden unit, it should be kept in mind.
In all impedance tasks, a warning will be generated, if the output voltage of the test is 10% below the specified voltage.

If accurate testing levels are required, the actual measured voltage should be checked using the impedance task with identical level and stimulus signal. Open the Summary result window and click on the link "Signal Characteristics" to see the rms and peak voltage of the applied test signal.



In the example above there is a voltage drop of 4% from the specified 1V to the measured 0.96V at the driver terminals.

DUT

QC

QC

10

“ ”

0.96V 1V

4%

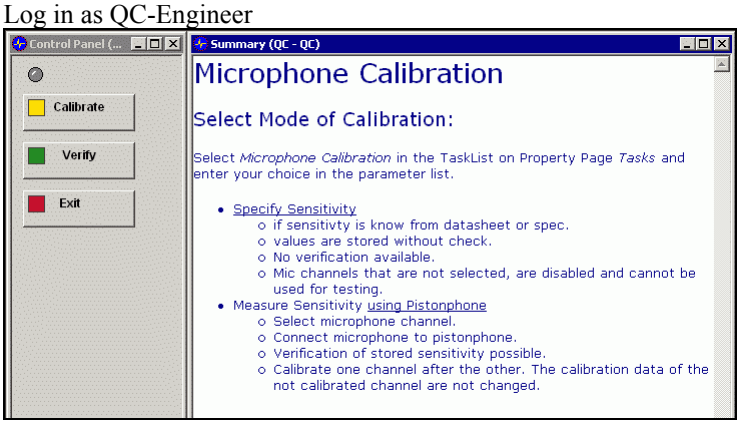
Microphone Calibration

The Microphone Calibration can be performed using a pistonphone or specifying the sensitivity manually from a datasheet.
For microphone calibration a pistonphone / sound calibrator is strongly recommended to achieve absolute and accurate results. The specified sensitivities of microphones vary usually considerably with temperature and pressure.

Note: For any delivered templates / tasks measuring SPL, both microphone channels (MIC1 + MIC2) must be calibrated! This allows Ambient Noise monitoring (optional) as well as testing at two locations.
If you have only one microphone available, calibrate it on both channels.

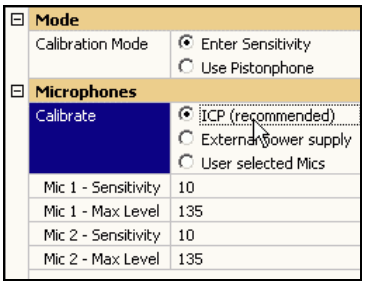
A special calibration test sequence is started. Please follow the steps below.

1. Log in as QC-Engineer



2. Adjust setup parameter on property page *Tasks*. First select the *Calibration Mode*.
3. **Specify Sensitivity**:

   Select microphone(s) for that you would like to enter the sensitivity. Enter the sensitivity from datasheet or third party measurement. It is always required to enter the maximal level, the microphone can measure without clipping or excessive distortion.

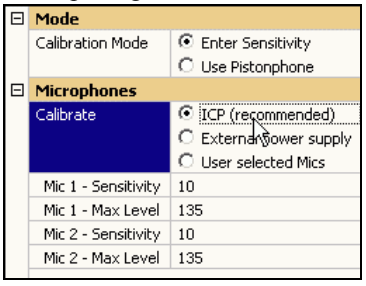


Note: The unselected microphone channels are marked as disabled. This allows to explicitly forbid microphone usage for specific purposes.

OR

Use Pistonphone:

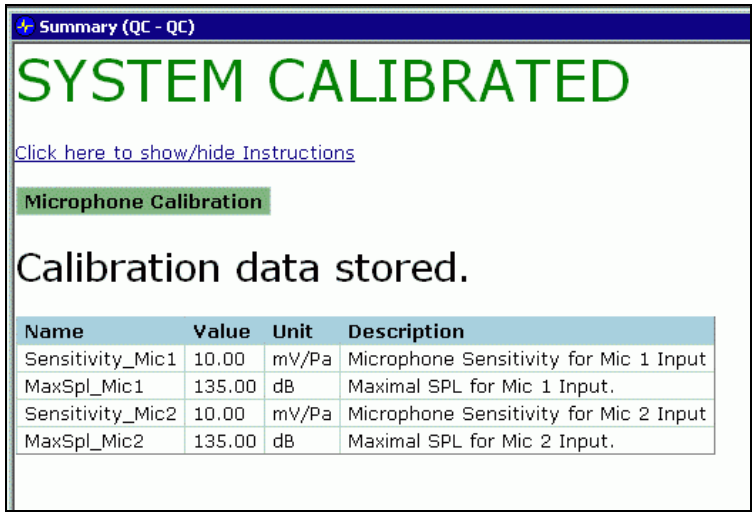
Select microphone channel and always enter the maximal level, the microphone can measure without clipping or excessive distortion. Also enter the test frequency and reference level of the pistonphone / Calibrator. You may specify an analog input gain for handling high / low input signals to ensure best SNR.



It is always required to enter the maximal level the microphone can measure without clipping or excessive distortion:

Microphone Type	Max. Peak Level
MI 17	125 dB
MI 17 HL	135 dB
40BE / 26CB	165 dB

4. Press the *Calibrate* button from the *Control Panel.*
5. For testing the validity of the Mic calibration you may later use the *Verify* function from the *Control Panel*. For the verification accuracy in percent can be specified. (For measurement only.)
6. For checking the signal properties you may enable *Show Details* to obtain SNR, headroom and RMS input values. Response Spectrum and waveform are assessable in Result Chart 1 and 2 resp. (For measurement only.)
7. In case of a failed calibration follow the instruction on the Summary Window. If you do not see the instructions, click on the link *Click here to show/hide Instructions*. In case of persistent problems, please contact *support@klippel.de*.
8. Calibration data are stored automatically after successful calibration.



9. Press "*Exit*" to return to the QC-Start tool.
10. Close dB-Lab if not exiting automatically.

/

: SPL /
MIC1+MIC2

---

1. QC

2.
3.

:

/

MI 17	125 dB
MI 17 HL	135 dB
40BE / 26CB	165 dB

4.
5.
6.
1 2
7.
/
support@klippel.de
8.
9.
10. “ ” QC
11. dB-Lab

Hardware Calibration

Hardware Calibration is to be performed by Klippel and authorized distributors only. If required, send in the Production Analyzer unit. Hardware Calibration comprises sensor calibration, climatic tests and updates of firmware and / or hardware, if applicable.

Note: A calibration interval of 24 month is recommended to ensure precise operation for the measurement system.

Klippel
/

: 24

FAQ about calibration

Q1.How often Hardware Calibration should be performed?

A1: A period of 2 years is recommended. Do not mix that with the Production Analyzer Calibration, which can be run from the QC Start Tool (See section *Organizing Projects / QC-Start Tool*).

Q2: What exactly is to be calculated during the Production Analyzer Calibration?

A2: Using an internal high precision signal generator, the input and output sensitivities of the converters and the involved windows software mixers can be calibrated and checked at the customer site. This should be done on a

monthly period. It is NOT required to send the hardware unit in for this calibration. Furthermore the amplifier gain and high pass characteristics are measured. The Production Analyzer Calibration checks also for digital feedback loops within the Windows software mixer system.

It is an ON-SITE calibration.

Q2: What exactly is to be calibrated during the Hardware Calibration? Is this just the Production Analyzer Hardware or also the measurement PC?

A2: All transfer functions from all sensor inputs to the digital input stream (including converters, multiplexer etc.) are calibrated. Also the internal reference signal generator will be calibrated. This is the reference signal for the Production Analyzer Calibration. For that calibration the measurement PC is not required.

It is an OFF-SITE calibration.

Q3: What about the microphone calibration?

A3: The microphones can be calibrated separately to measure the whole chain from SPL to digital input using a pistonphone. This can be done at the customer site without the need to send the system to Klippel.

This microphone calibration depends on temperature and humidity and should be done daily or even more often, if higher variation occur at the production site.

The Microphone Calibration can be simply initiated using QC-Start .

Q4: Is there any possibility to perform the Hardware Calibration at the customers place?

A4: Depending on the quantity of units it is possible that Klippel sends a specialist for calibration with all equipment. However, when the Hardware Calibration is done at Klippel, the systems are also long term checked (2x 24h).

After hardware modifications all units are subject to a 8 hour heating cycle test to up to 55°C.

This is not possible at the customers place.

Q5: Is it possible to calibrate the units within a standard calibration laboratory?

A5: No, unfortunately special hardware is required to calibrate the units.

Q6: Do you provide a Traceability Chart for your calibration?

A6: Yes, a certificate of Traceability to calibration standards of the highest Calibration standards of Germany (DKD/PTB) can be delivered on request.

Q1

A1 2

QC */ QC-Start*

Tool

Q2 _____

A2

Windows

Windows

Q2

PC

A2

PC

Q3

A3 SPL

Klippel

QC-

Q4

A4 Klippel

Klippel

2x24

8 55°C

Q5

A5

Q6

A6

DKD/PTB

Firmware Update

There are basically two hardware units inside the Production Analyzer that have independent firmware. Both firmware versions are checked during the installation process. If a new firmware version is required, the install process will guide you to the corresponding tool and instructions are given.

Note: Do not update the firmware outside the installation procedure. This may make the complete system inoperable.

:

Accessories

Microphones

Several microphones are available from Klippel. All have ICP power supply (also known as IEPE).

Microphone Type	Sensitivity	Max. Peak Level
MI 17	50 mV/Pa	125 dB
MK250+MV201 (Pro Mic Set)	50 mV/Pa	135 dB
MI 17 HL	10 mV/Pa	135 dB
40BE / 26CB	2mV/Pa	165 dB

For details, please refer to the specification *A4 – Microphones*.

Note:
Using the LINE inputs also phantom powered Mics as well as condensor mics with a high polarization voltage (200V) may be connected, if an external power supply is used.

Also third party microphones can be used with the Klippel QC System:

- ICP powered microphones (supply current ≈ 3mA)
- All other microphones with an external power supply (to be provided by the customer) can be connected to the *Line* inputs of the Production Analyzer Hardware.
- Note: Phantom powered Microphones can not be directly used at the *Line* inputs! An additional power supply is required.

Please see the Specification *A4 – Microphones* and *H4 QC Production Analyzer* for more details.

Klippel ICP IEPE

MI 17	50 mV/Pa	125 dB
MK250+MV201 (Pro Mic Set)	50 mV/Pa	135 dB
MI 17 HL	10 mV/Pa	135 dB
40BE / 26CB	2mV/Pa	165 dB

A4 –

:

200V

Klippel QC

- ICP ≈ 3mA
-
- :

A4 – *H4 QC*

Footswitch

To start the test, simple foot or other manual switches can be used. It is recommended to use the optional available switch interface that can be connected to any closing switch for starting.

Note: Connecting Start Pin 7 to ground (Pin 1) at the I/O connector can be used for starting the test.
TTL compatible logic must be ensured, if connected to external circuits.

I/O 7 1
TTL

Temperature and Humidity Sensor

For tracking environmental production conditions an external sensor for temperature and humidity is optionally available. The sensor must be connected to the I/O port and uses input 2 and output 4. These both signals must not be used (and are not provided at the output) for any other external use.

Although the sensor is connected to the Production Analyzer, it does not use the port exclusively. All other I/O lines can be used, simply using the D-SUB output of the sensor.

Note:
1. The sensor hardware should be fixed at a representative location in the production environment. Keep away from power amplifier and computer. Mount the sensor in about the same height as the production testing if the absolute temperature is needed.
2. Always connect the temperature / humidity sensor directly to the Production Analyzer. Do not loop any other peripheral device in between.

I/O 2 4

D-SUB I/O

:
1.

2. /

Bar Code Reader / Printer

/

Bar code reader can be used to scan serial numbers or production code and to mark the results with this number. In the Standard and Basic version the plain scanned string, terminated by a linefeed, is used as serial number. Using the programmable version, it is simple to extract any information from the scanned string such as batch number, date, type etc.

It is also possible to print barcode labels from within the programmable version as long as the printer can be controlled using a command line.

Any reader that emulates keyboard actions can be used with the QC system.

QC

I/O Connector

/

Start switch

To start tests, connect start pin 7 to ground pin 1 of the I/O connector for at least 20ms.

I/O 7 1 20

Pin description

The pin numbers correspond the standard D-SUB 25.

Keyword OPTO indicates galvanically discoupled ports using optocouplers. For these in/outputs an external supply is required! See hardware specification for details. Examples for using the I/O port are given below.

Name	Pin	Dir	Description
Login	18	OUT	high, if any user logged in (refered to ground pin 1 or 6)
Start	7	IN	start 20ms after rising edge (spike tolerant) (refered to ground pin 1 or 6)
State	13	OPTO OUT	HI: test is running Lo: system is in idle mode, waiting for start (refered to ground pin 12, shared with Finish)
Finish	25	OPTO OUT	HI: test finished (duration: 100ms) Lo: else (refered to ground pin 12, shared with State)
Result	24	OPTO OUT	HI: Test passed, Lo: Test failed and during test (refered to ground pin 23, shared with Sensor Out)
Sensor Out	11	OPTO OUT	Reserved for Temperature and Humidity Sensor (refered to ground pin 23, shared with Result)
Sensor In	19	IN	Reserved for Temperature and Humidity Sensor
not used	5,17 4,16 3,15 2	OUT	Configurable outputs in programmable version
not used	10,22	OPTO IN	Configurable inputs in programmable version (refered to commen ground pin 9)
not used	21,8	OPTO IN	Configurable inputs in programmable version (refered to commen ground pin 20)
Power	14	PWR	+5V Logic supply voltage. Max. current: 50mA
Ground	1,6	PWR	Digital System Ground, do not use for analog circuits or opto-coupled I/O !

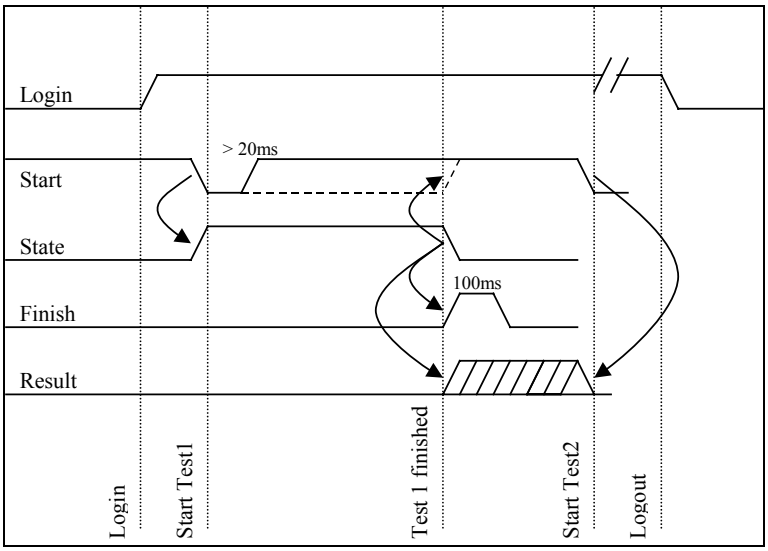
25 D

OPTO /

I/O

	18		1 6
	7		20 1 6
	13	OPTO	12
	25	OPTO	100ms 12
	24		23
	11	OPTO	23
	19		
	5,17 4,16 3,15 2		
	10,22	OPTO	9
	21,8	OPTO	20
	14		+5V 50mA
	1,6		I/O

Timing

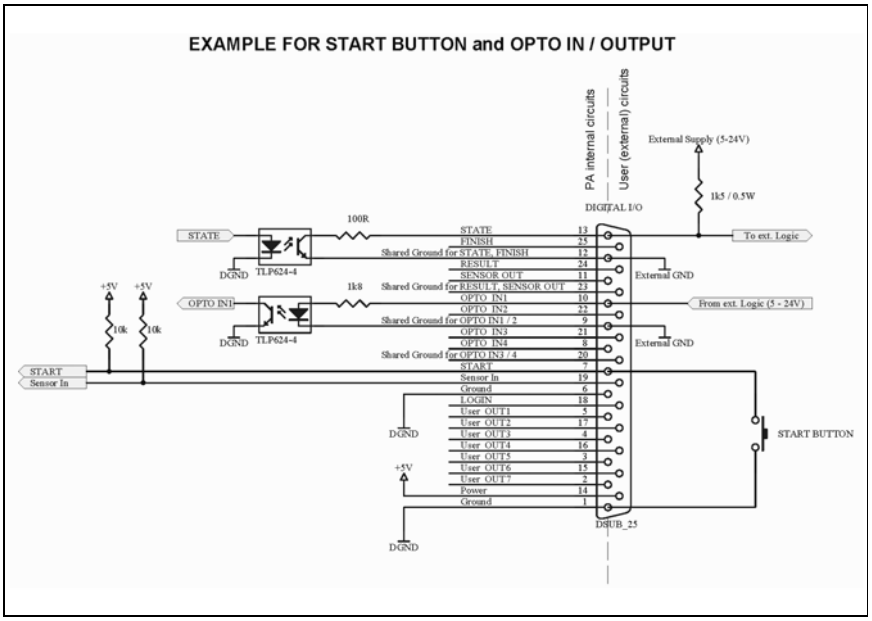


Connection of Opto-coupled In- / Outputs

/

Opto-coupled in- and output provide a robust barrier between Production Analyzer and external Hardware. However, since no power can be carried across this barrier, these in- and outputs need external power to be functional.

Recommended circuit for optocoupled input, output and start button:



Optimizing Performance

Overview

Before optimizing the system the careful reading of the chapter *Test Configuration* is strongly recommended as well as some practical experience using the system.

This chapter is not a step by step guide but gives valuable information on increasing speed and reliability of tests. It is measure oriented. However, some facts are useable generally.

SPL Tests

SPL

Microphone Selection

For QC testing it is very important to select the right microphone. The complete input signal range should be used to detect smallest failures that may be 80-100 dB below the fundamental. Therefore the microphone must

- not be clipping (a warning will be generated, if the microphone max SPL value has been specified correctly during calibration).
- should provide sufficient output. Recommended sensitivities are

Driver Type	Sensitivity
Subwoofer	2mV/Pa (very high pressure in box)
Woofer, Tweeter, Midrange	2mV/Pa – 10mV/Pa depending on Box size and testing level
Headphone, micro speaker	10mV/Pa - 50mV/Pa

Please refer to section *Hardware / Accessories / Microphones* for available microphones.

QC

80-100dB

- SPL

-

	2mV/Pa
	2mV/Pa – 10mV/Pa
	10mV/Pa - 50mV/Pa

/ / *Microphones*

Measurement Box

For testing in a production environment an test enclosure for shielding the production noise is strongly recommended. Especially for Rub&Buzz testing typically a box is required.

1. When testing Rub&Buzz with the Ambient Noise detection, the box attenuation of production noise should be known. A default value may be used but well constructed enclosures may have considerably better isolation than the default value of 15 dB. Find a procedure for the measurement of the box attenuation curve below.
2. The pressure inside a box is much higher than in free air. It is important to keep the pressure within microphone range. If the maximal pressure has been specified correctly during Mic Calibration, a warning will be given, when exceeding the Mic limit. For an estimation of the pressure inside a test box, please refer to section *Appendix / Maximal SPL*

1.

15dB

2.

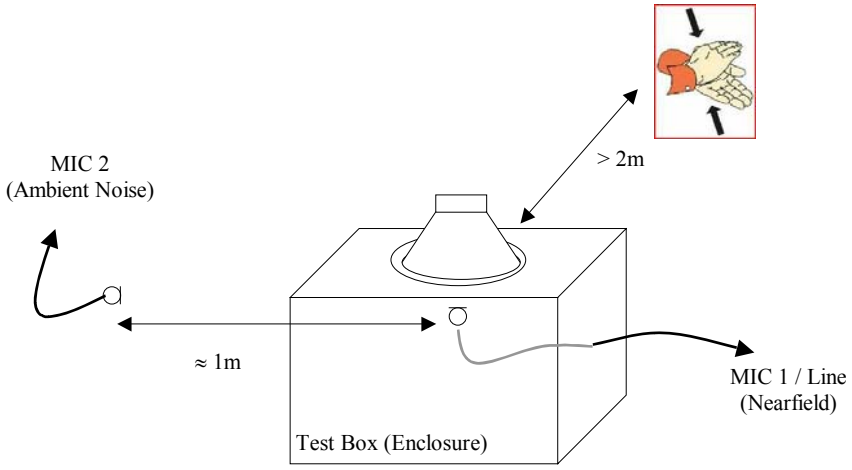
/ Maximal SPL

How to obtain the box attenuation curve

When testing with Ambient Noise detection, it is important to know, how much the production noise is attenuated by the box enclosure in order to reliably predict a possible impact on the driver test caused by production noise.

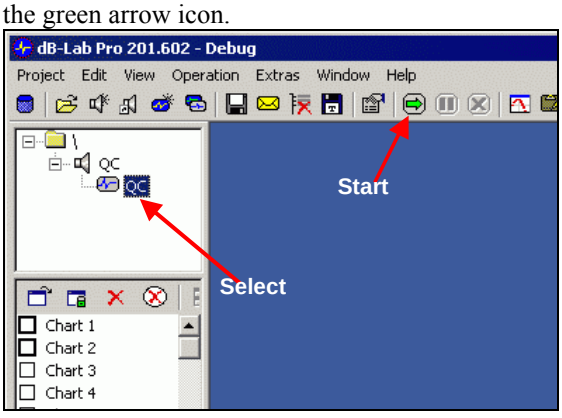
Basically the transfer function from the Ambient Noise Microphone (MIC2) to the Nearfield Microphone (MIC1) has to be measured. Unfortunately, the box attenuation can't be measured using the driver as excitation of the system, since the driver itself is part of the shielding. So external excitation is required. A high level, broad band noise can be easily generated by clapping hands. Drums, castanets or other percussion instruments are also fine.

The following setup is required for measuring the attenuation of the box enclosure vs. frequency:



Please follow the steps to calculate the box attenuation:

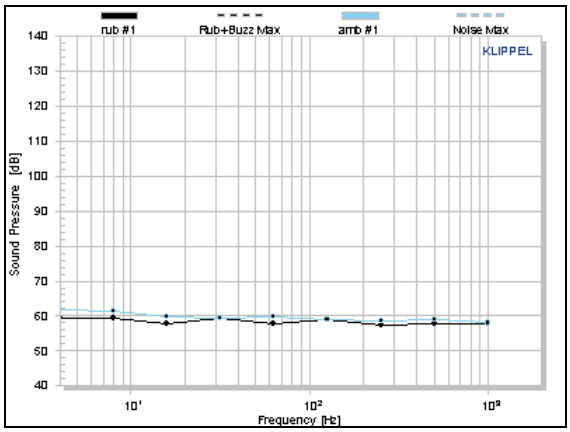
1. Start the QC-Start program in the Engineer mode.
2. Open the *Example Folder* from the *View* menu. An Windows explorer window will be opened.
3. Select the database *BoxAttenuation.kdb* and double click it. dB-Lab will start. If the *Open Project* dialog appears, confirm with OK.
4. Select the QC operation with the mouse and start it with a click on the green arrow icon.



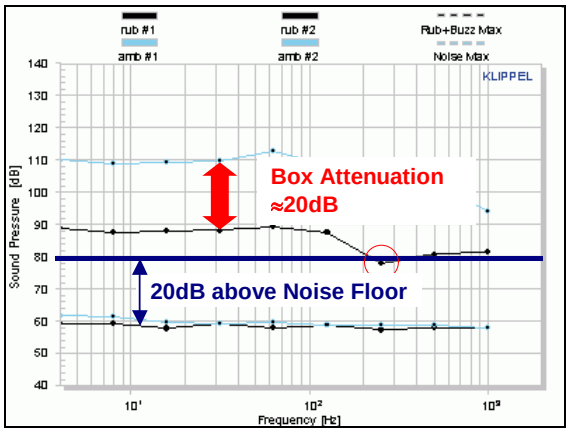
5. Login as usual.
6. Although not critical, adjust the level, if the default value is too high. The test sweep level has no influence on the measurement, it is

for monitoring only. Perform a measurement.

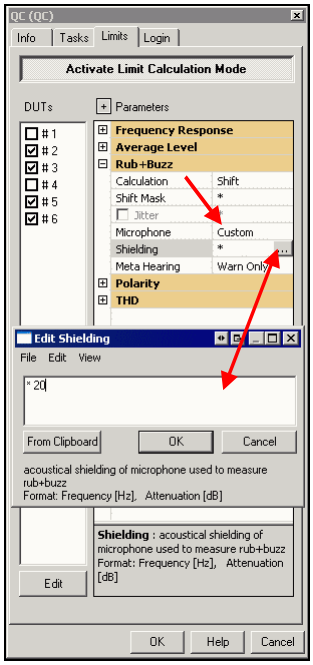
7. Activate the *Limit Calculation Mode*.
8. Do a first measurement without external excitation, try to minimize the production noise for this test. If the microphones have similar sensitivities, the ambient noise and the Rub&Buzz curve are very close.



9. Perform a second measurement with external noise. The easiest way is to clap you hands very loud and fast (approx. 3 per second) during the measurement.
10. Ignore the *Warning: Measurement corrupted by noise*. Press YES to keep the data.
11. Now you have two sets of data. The second one should be at least 20dB above the noise floor of the Rub&Buzz curve (black curve). The points which do not have that distance (red circled point) should not be considered as valid.



12. The ambient noise must be higher than the Rub&Buzz signal measured inside the box. The attenuation (shielding) of external noise is the difference (red arrow).
    Read the distance of the second set. In this example it is more or less constant at about 20dB.
13. Logout and close dB-Lab.
14. Start your current test driver using QC-Start. Login as usual.
15. Activate the Limit Calculation Mode.
16. Set the Microphone selection to Custom and enter the attenuation value (or a curve, if required) in the field Shielding.



17. In this example the value is constant for all frequencies (* stands for "all frequencies"). You may also specify a curve
    frequency1 *attenuation1*
    frequency2 *attenuation2*
    …
18. Proceed with your regular work.

Note: It is good practice, to store this attenuation characteristcs in a text file and import it via the clipboard into the *Shielding* parameter.
Just press CTRL-A and CTRL-C in the text file and use the *From Clipboard* button in the edit dialog for the *Shielding* value.

MIC2

MIC1

1. QC
2.
3. *BoxAttenuation.kdb* dB-Lab .
   OK
4. QC

5.
6.

7.
8.

9.
3
10.
11.
20dB 20dB

12.

20dB
13. dB-Lab
14. QC
15.
16. “ ”

17. *

1 *1*
2 *2*
…
18.

:

CTRL-A CTRL-C

Frequency Range

If no values are specified, the following table might be a good starting point for the frequency range. Using the 96kHz sample frequency you may measure up to 40kHz. On the sample frequency refer to section *User Modes / Engineer / Property Page Tasks / Sound Device & Sampling Rate*.

The values in the table are use in the templates for the specified driver types.

Driver Type	Start [Hz]	Stop [Hz]
Subwoofer	20	200
Woofer	20	1000
Midrange	50	2000
Tweeter *	200	20 kHz
Horn Driver *	400	20 kHz
Mircospeaker *	200	5 kHz

Headphones *	20	20 kHz

* make sure that Xmax is not violated at low frequencies

Note:
The frequency range for the sound pressure measurement depends strongly on the final application (cross-over, etc.) and should be set according to the desired working range. Do not sweep from high to low frequencies. On sweep direction see also section *Test Configuration / Test Signals / SineSweep / Sweep Direction*.

96k 40kHz
/ / */Sound* Device & Sampling Rate

	[Hz]	[Hz]
	20	200
	20	1000
	50	2000
*	200	20 kHz
*	400	20 kHz
*	200	5 kHz
*	20	20 kHz

* Xmax

:

/ / */ Sweep* Direction

Optimize Rub&Buzz detection

For the Sound Pressure task the most critical measurement is the reliability of the Rub&Buzz defect detection. Thus it is strongly recommended to have some (≥ 10) critical DUTs whith typical defects (Rub&Buzz, THD, …) that are hard to detect and cover most of the possible (known) symptoms. Furthermore DUTs, which are known to be OK, are needed as reference devices. It is good practice to check them by listening test using the Manual Sweep.

The optimization is basically a compromise of measurement time and excitation level. The following sequence is recommended:

1. set the **Rub&Buzz parameter** (Type, Rub&Buzz Highpass order). Well adjusted default values are always set in the templates for the corresponding driver types.
2. Adjust the **Level**, if not specified yet.
3. Minimize Measurement **Time** to get fastest production test.

The **Meta Hearing** Technique for most sensitive Rub&Buzz detection is automatically adjusted according to the Rub&Buzz settings. There are no special parameter for Meta Hearing.

10 DUT DUT
THD …
DUT

1.

2.
3.

How to adjust RBZ parameter?

There are two dedicated parameters for the Rub&Buzz detection that should be adjusted before optimizing level and time:

1. Rub&Buzz High Pass Order
2. Rub&Buzz Type

1.
2.

What is the Rub&Buzz High pass?

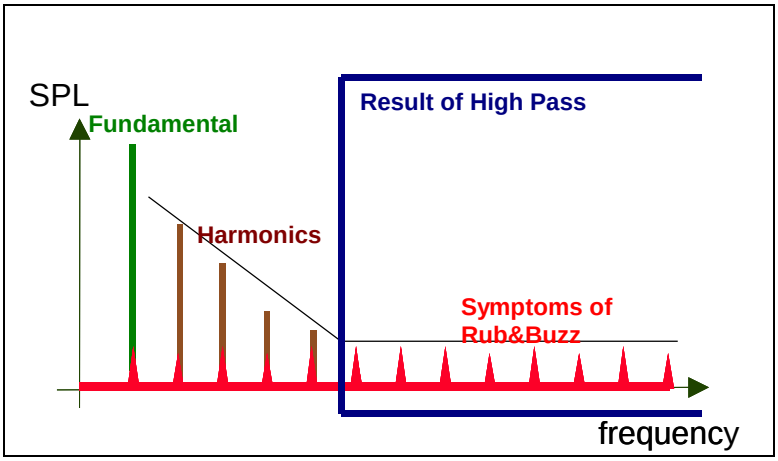
Typical Rub&Buzz defects are 80-100dB smaller in level than the **fundamental** and also 40-60 dB smaller then the **harmonics** and THD.

See the graph below for an illustration.

To analyze the Rub&Buzz defects it is crucial to separate them from the fundamental and harmonics to avoid the inherent masking of these much higher components.

Using a high pass is a very efficient method to suppress the fundamental and lower order harmonics. In a good loudspeaker, the harmonics decay with the order rapidly.

In a defective loudspeaker the **symptoms of Rub&Buzz** defect spreads its energy over the whole frequency range (red). Using the Rub&Buzz high pass higher order harmonics (having the unmasked information of the defect) can be separated from the lower order harmonics, were the information of the defect is masked (**Result of High Pass**, range marked by blue lines).



The order of Rub&Buzz high pass markes the first harmonics, which is used for Rub&Buzz detection. Note that this is relative to the frequency of the fundamental (tracking filter) and not constant.

All frequencies above the cut off frequency (harmonic and non-harmonic) are summed up and are used for Rub&Buzz detection.

80-100dB THD 40-60 dB

Adjust the Rub&Buzz Highpass order

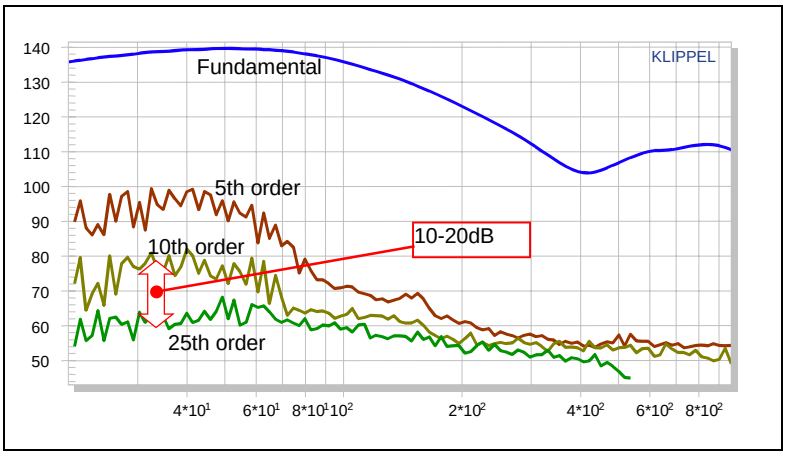
According to the following driver types typical high pass parameter should be used:

Driver Type	High Pass Order
Subwoofer	20
Woofer	10
Midrange	10
Tweeter	6
Horn Driver	10
Mircospeaker	6
Headphones	6

The following section is for illustration of the individual setting and of the check, if the order is set correctly:

Here is an example of a good driver with no Rub&Buzz defect, when the Rub&Buzz order is changed:

- If the **order is too high** (Example: green curve, 25th order), the Rub&Buzz response is dominated by the noise floor (flat characteristics). So valuable information from Rub&Buzz defects may be cut off by the high-pass.
- If the **order is correct**, the Rub&Buzz level is about 10-20 dB above the noise floor (olive curve, 10th order).
- If the **order is too low**, the regular harmonics, originating from the suspension and moter nonlinearities (which are inherenent also in good drivers), masking the Rub&Buzz level too much. So small rub&Buzz defects may be not detected due to this high level.



Summary: A good value for the Order of the Rub&Buzz high pass is characterized by a Rub&Buzz curve which is 10-20 dB above the noise floor.

	20
	10
	10
	6
	10
	6
	6

- 25

- 10-20 dB 10

-

10-20 dB

Rub&Buzz Type

As in the section above explained, the Rub&Buzz detection is based on a specific range of the measured SPL spectrum. All the energy passing the high pass will be transformed to the time domain to restore typical Rub&Buzz peaks.

The Type of Rub&Buzz detection characterizes the method, how to evaluate the restored time signal.

Peak provides the highest instantaneous value according to the selected resolution. This is good for very short clicks and loose particles. This is sensitive to ambient production noise. A well shielded test chamber or box is highly recommended, when using Peak method.

Rms provides the average energy in the interval defined by the resolution. This is good for broad band defects like a heavy rubbing of the coil. Due to the average effect in the rms calculation it is not as sensitive as the peak method.

Summary: It is recommended to set the Rub&Buzz Type to **PEAK**. With this setting the defect detection is more sensitive for very short clicking noises e.g. caused by lose particles or wire beats.

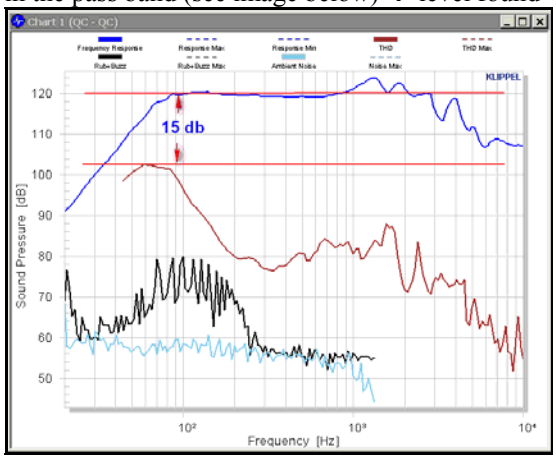
SPL

Find most critical level

The maximum stimulus voltage should be optimized, if not specified. This level should be chosen as high as possible without damaging the DUT.

It is necessary to drive the DUT with high excursion and thus activate substantial harmonic distortion and all possible Rub&Buzz defects.
Please use the following steps to optimize the level:

1. Start at a known, save level. The maximum specified continuous operating level is a good starting point.
2. Increase the voltage carefully in 3dB steps until one of the following limits is reached
   - max(THD) is about 15 dB below the average sound pressure level in the pass band (see image below) → level found



   - any hard limiting of the DUT can be heard acoustically → reduce level or use the level profile to attenuate the excursion

below the resonance frequency (see section *Using Level Profile* below).

- Rub&Buzz changes significantly compared to the previous voltage step → reduce level

---

Note!
Make sure that the working range of the microphone is not exceeded. See section *Optimizing Performance / SPL Tests / Optimal Signal Noise Ratio (SNR)* for adjusting the headroom.
If the maximum sound pressure of the microphone is exceeded, change the microphone type or use a bigger test box.

It is good practice to check good units at the optimized level.

Listen to one selected DUT (if possible, with the attached box enclosure). Use the *manual sweep* feature of the QC system (see section *User Modes / Operator / Manual Sweep*).

DUT

DUT

1.

2. 3dB
   - THD max THD 15 dB →
   - DUT " "
     →
     Using Level Profile
   - →

!

/SPL /

Optimal Signal Noise Ratio (SNR)

DUT

QC /

/Manual Sweep*)*

Optimize Time / Use Speed Profile

/

Before optimizing the speed, the level should be set to detect defective DUTs reliably. Although measurement time and level are strongly interacting, it is recommended to start with the level (which is also specified very often and not variable).

Speed Profile

Before adjusting the overall time, it is recommended to set the speed profile.

The Speed Profile is to be used to save overall measurement time. The frequency range can usually be split in two regions:

1) Low frequency region, were rub&buzz defects occur. Using a slow speed in this region provides more energy and time to excite possible defects.

2) Higher frequency regions, were no rub&buzz defects occur anymore (since displacement is very low and higher order harmonics are beyond measurement range). Here the sweep speed can be extremely fast, since typically the fundamental only is measured in this range.

For a typical measurements it is recommended to set a speed profile, which is 5 times faster above 10 times the resonance frequency:

```
speedProf = [     fstart      10·fs       1
                  10·fs       fstop       5]
```

Overall Time

The following procedure is recommended to find the optimal overall speed.

1. Find **good** units. Use manual sweep to check them carefully.
2. Find **5-10 defective** driver with small and hard to find defects (as most critical selection).
3. Start with a long measurement time (5 seconds or more)
4. Measure the good driver(s) as reference.
5. Calculate limits. To do so, press the *OK* button or release the *Activate Limit Mode button*.
6. Check defective drivers.
   If all drivers are detected as failed, you may decrease (halve) the measurement time and repeat this sequence. Use the latest duration were all defective DUTs were recognized.

Note: When decreasing measurement time, it is crucial to check, that all failed units are detected as such. When measuring too fast, possible defects may not be excited since the energy is too small, which is required to develop that defect.

DUT

---

1)

2)

10

5

```
speedProf = [     fstart      10·fs       1
                  10·fs       fstop       5]
```

1.
2. **5-10**
3. 5
4.
5. *OK*

6.

DUT

:

Using Level Profile

The Level profile has two major applications:

- protecting the driver, when mechanical limiting may appear (tweeters, headphones, microspeaker)
- modeling a crossover response
- protecting the operator at high frequencies. Rub&Buzz defects are often produced at lower frequencies, so the high level may be attenuated at higher frequencies to save the operators listening capabilities for more important tasks.

For details on the input parameters, see section *Test Configuration / Test Signals / SineSweep / Level Profile*.

-

-

-

/ / /

Level Profile

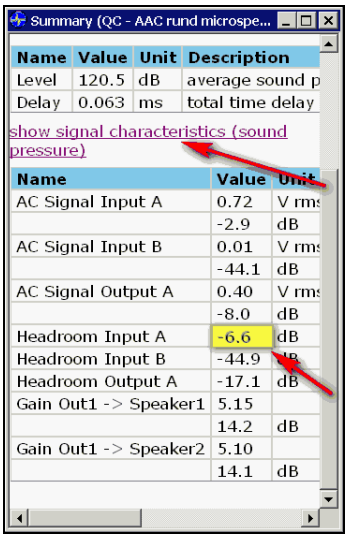
Optimal Signal Noise Ratio (SNR)

SNR

For good Rub&Buzz tests it is crucial to use the complete signal input range, since defects may be likely 80-100dB below the fundamental signal. For that purpose a programmable hardware amplifier scales the analog input signal to be close to the full scale input. Thus the noise floor masking defects is as low as possible.

To optimize the SNR:

1. perform a typical measurement
2. Open / Select the Summary Window
3. expand the link *show signal characteristics (sound pressure)* in the Result Window *Summary*. A table will be shown with the signal properties of the recorded signals. Look for the value in the line *Headroom Input A.*
4. This value should be between –10 and –3 dB (0dB corresponds to a full scale input).



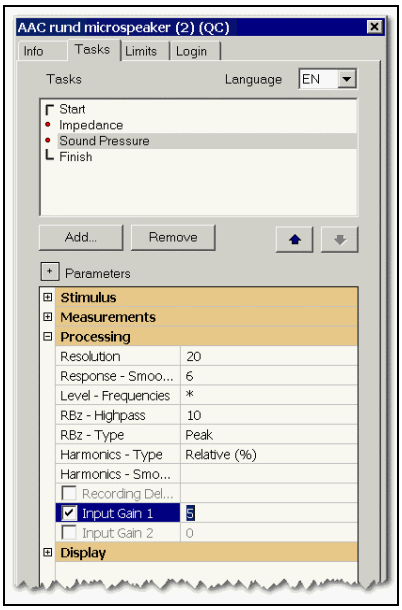
Read the value of *Headroom Input A*
If the Headroom is smaller the –10 dB, adjust the *Input Gain 1* parameter on the Property Page *Tasks*.

If the value is not in this range, adjust the parameter *Input Gain 1* by the following rule:

Add abs(*Headroom Input A* + 6dB) to *Input Gain 1* parameter.

Or use the following table. Note that the Input Gain range is restricted from –70 to +30 dB.

Headroom Input A	Add to Input Gain 1
0 dB (marked red) → overloaded input	Reduce Input Gain by 20dB!
-6	0 (Ok)
-20	14
-30	24
-40	30 (max. gain)



5. Make a new measurement and check the Headroom. If the headroom exceeds –3dB, a warning is generated.

Note: If the input headroom is below 30dB, it is strongly recommended to use a more sensitive microphone (for headphone and micropseaker testing). There are several options available.
See also section *Hardware / Accessories / Microphones*.

80-100dB

1.
2. /
3.

A

4. -10 -3dB 0dB

A
–10 dB *1*

1

A+6dB *1*

–70 +30 dB

A	**1**
0 dB →	20dB!
-6	0 Ok
-20	14
-30	24
-40	30

5.
–3dB

: *A* -30dB

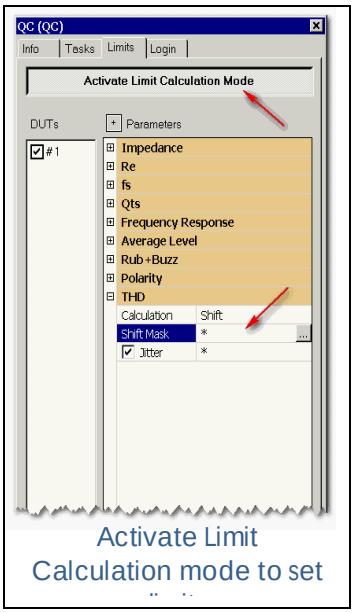
/ */ Microphones*

SPL Task Limits

SPL

In this section some short comments are given how to setup the limits. These should be applied only, if no limits are specified by any other party.

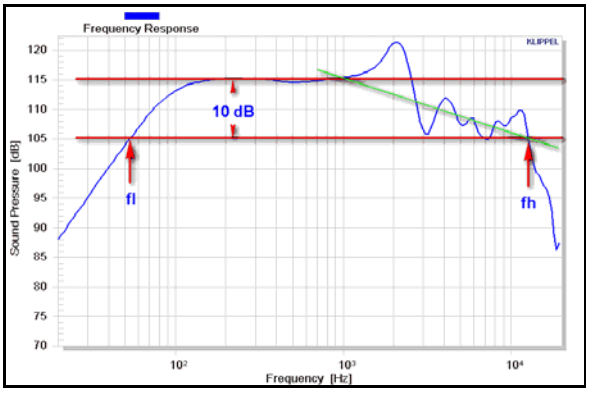
Activate the Limit Calculation Mode and select the corresponded parameter:



Frequency Response

Test the frequency response only in a meaningful frequency range. Use a frequency range according to the following recommendation:

- Determine SPL_{av} (Average Sound Pressure Level in the Passband of the DUT) or read the Level from the Summary Result Window.
- Determine f_l (lower frequency) where SPL drops -10db below SPL_{av})
- Determine f_h (high frequency) where SPL drops -10db below SPL_{av})



Use the Shifting method and adjust the Shift Mask. It is recommended to open up the limit at higher frequencies a bit to allow some more variation.

If there is no or few smoothing of the response curve applying Jitter is recommended to widen up limits at narrow peaks and dips.

See section *Test Configuration / Limit Calculation*.

- SPL_{av} DUT
- f_l SPL SPL_{av} -10dB
- f_h SPL SPL_{av} -10dB

/ Limit Calculation

THD, 2nd Harmonic, 3rd Harmonic

THD, 2 , 3

For harmonics and THD it is important to check at higher frequencies, if the fundamental is well above noise. If the fundamental has decayed considerable, disable the limit check in this frequency range.

By default there is no smoothing applied to the Harmonics / THD, so setting a Jitter of about 20% is recommended. This widens the limits around peaks and dips.

When applying limits to the individual harmonics, it is recommended to separate them visually in order to have a more clear graph.
See section *Test Configuration / Measures and Limits / Harmonics / THD / Separating Harmonics* visually.

THD

/THD 20%

/ / */THD/*

Separating Harmonics visually

Rub & Buzz

The headroom for Rub&Buzz Limit should be set close to the measurement. A default value of 6dB is recommended. Smaller headrooms are critical, since the Rub & Buzz is generally a noisy parameter.

There is no smoothing parameter for Rub&Buzz, since any kind of average would degrade the detection capability of small and very short defects.

That's why setting a Jitter of about 20% is recommended. This widens the limits around peaks and dips. Especially when using the Rub&Buzz Peak mode (see section *Optimize Rub&Buzz detection* above) extensive Jitter should be used.

The limit for the **Meta Hearing** Technology (Isolated Defect Distortion IDD) is automatically derived from the Rub&Buzz limit. No special parameter is required for Meta Hearing.

6dB

20%

Optimize Rub&Buzz detection

IDD

Impedance

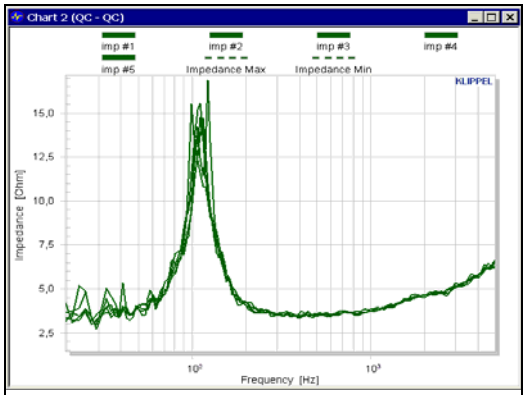
How to find optimal excitation level and time

For the impedance task the main criterion for the appropriate choice of the measurement time is the shape of the impedance curve. A short measurement time can impair the measurement in two ways:

- The curve is too noisy
- The curve is deformated due to a too short measurement time that allows no steady state vibration of the DUT

Subsequently the level is always a compromise between noise and distortion.

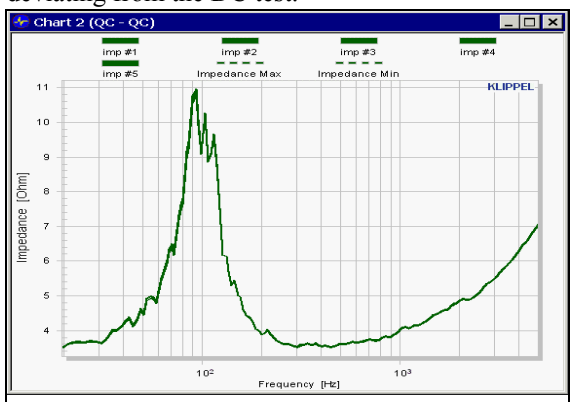
- If the test level is too low, the impedance curve is noisy and the results are NOT reproducible. Use the limit mode to overlay the curves as reference DUTs. In this case Re is not stable!



Voltage too low → noise

Remedy: **Increase level**

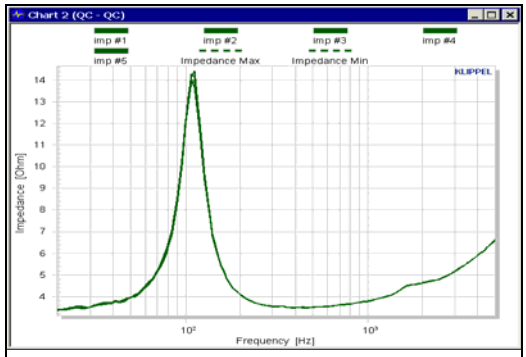
- If the test level is to high, the impedance curve is also not smooth but the shape is reproducible. In this case Re is stable but can be deviating from the DC test.



Voltage too high → distortion

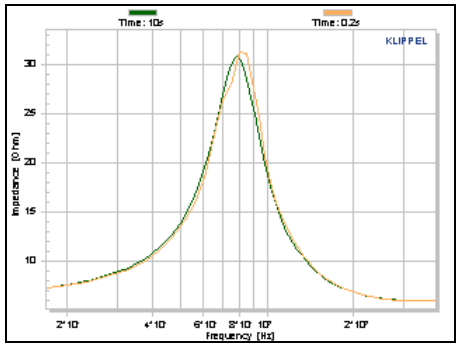
Remedy: **Decrease level**

- If the level is ok, the curve is smooth and reproducible. In this case the calculation of all T/S parameter is optimal.



Voltage OK

- In some applications a reduction of the voltage to the linear range of the DUT may lead directly from a distorted to a noisy impedance curve or unstable Re (too low SNR). In this case **increase the measurement time**.
- For very fast tests, it is also good practice, to check the influence of the measurement time. Perform two tests, one for the target time and one for 10s duration. You may copy one result in the clipboard (CTRL-C after selecting the curve with mouse), doing the second test and paste the copied curve into the result window. Normally this effect is not critical on the parameters.



Note: For a DUT with a nominal impedance above 30 Ohm it is recommended to use a special modification of the Production Analyzer hardware with more sensitive current sensors in order to have a lower noise level in the impedance curve and thus to allow a shorter measurement time.

-
- DUT

- DUT
  Re

- Re

- T/S

- DUT
  Re

- 10s

  CTRL-C

30
Production Analyzer hardware

Frequency Range

The frequency range should be chosen in such a way that the resonance frequency fs is in the middle of the displayed graph. This is necessary for a good fitting of the measured curve with the theoretical curve from the linear driver model. The following settings are recommended.

Set Start: $f_s/10$ [Hz]

Set Stop: f_s*10 [Hz]

Note: If a precise measurement of Le is required, the Stop frequency should be increased to 20*Fs or higher in order to measure a sufficient part of the high frequency branch for inductance fitting.

Using the 96kHz sample frequency you may measure up to 40kHz. On the sample frequency refer to section User Modes / Engineer / Property Page Tasks / Sound Device & Sampling Rate.

$f_s/10$ [Hz]

f_s*10 [Hz]

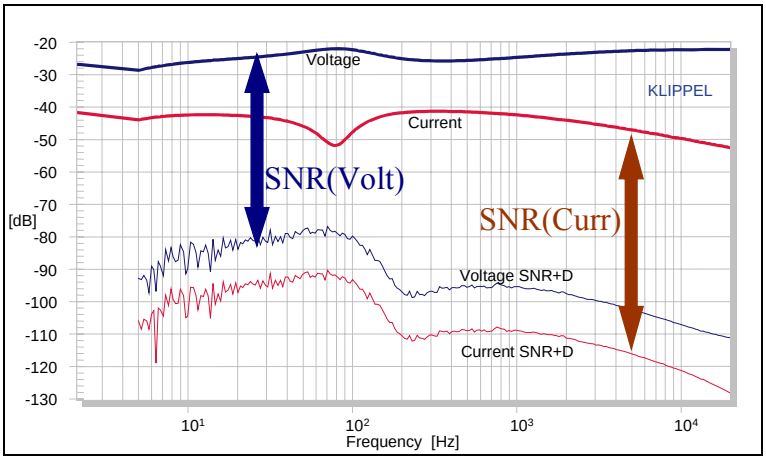
Le 20*Fs

96k 40kHz

/ / */Sound* Device & Sampling Rate

Checking Signals and Fitting

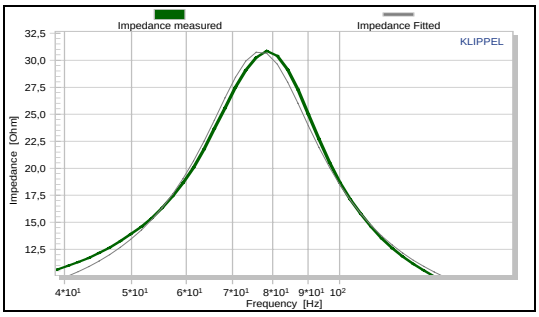
In Result Window 6 there are shown the fundamentals as well as the noise floor inclusive distortion. Please check the Signal Noise Ratio (SNR) of the voltage and current in case of any problems. 0dB corresponds to 1V / 1A rms.



The rms values and headroom may be read from the summary window expanding (click) the link *show signal characteristics (impedance).*

Note: The headroom can't be improved using the input gain. This is available only for MIC and LINE inputs.

The Thiele / Small Parameter calculation is based on a fitting algorithm of the impedance curve. It is also possible to check the fitting, The fitted impedance curve is included in Result Window 2 as a hidden curve and can be enabled by double clicking on the graph, selecting the *Subset* page and selecting also *Impedance Fitted*. The fitting should be accurate especially around the resonance peak.



6

SNR 0dB 1V / 1A

MIC LINE

T / S

2

Calculation of Re

Re

All Thiele / Small parameter are calculated based on the fitting of the impedance curve. A special handling is required for the Re value. Since there is no DC input coupling, the DC value of Re cannot be measured.

Independent on the setting of f_{start} (lowest frequency) the Re is always measured around the frequency: $f = 1 / t_{measurement}$. This is the lowest frequency which can be assessed during the measurement.

Using that technique, it is ensured that the increase of impedance due to the resonance does not affect the Re value.

Note: Check Amplifier DC Offset
Be aware that some Power Amplifier have a considerable DC offset. When testing low current, high impedance driver (telecommunication driver), this offset may degrade your measurement (esp. impedance and R_e). Please measure the DC offset with no input signal using a standard DC-voltmeter and compare it with the required testing level. It should be less than 3% for normal testing.

T / S Re

Re

f_{start} Re $f = 1 / t_{measurement}$

Re

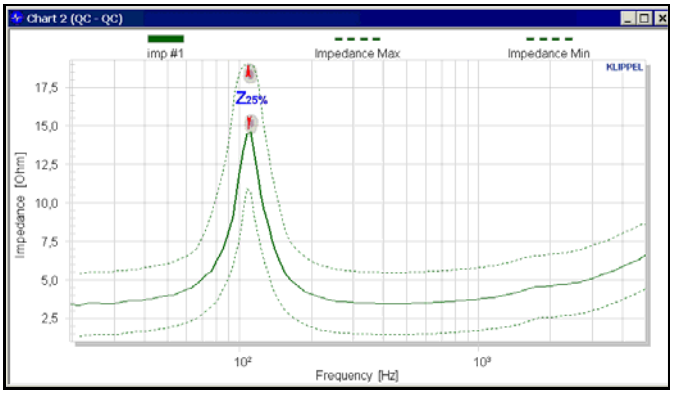
:

Re DC

3%

Impedance Limits

Around the resonance it is desirable to have a wider tolerance range than at low frequencies. The top of the impedance curve is dominated by the mechanical damping and can vary without too much influence on the performance of the driver.



To achieve that, a **relative** headroom (certain percentage of the impedance) should be used instead of simple shifting the curve by some Ohms.

It is also highly recommended to use the Jitter function for less sensitivity of slight changes in fs. Especially for high Qts driver, increasing the Jitter parameter should be considered.

Please see section *Test Configuration / Limit Calculation* for more details.

fs

Qts

/ Limit Calculation

Troubleshooting

Hardware Problems

Self Check at test start fails

Before each test in Engineer mode and at the first measurement in the Operator Mode a hardware self test is performed. This self test includes:

1. Analog loop back check:
   Is the returned voltage equal to the excitation voltage?
   This test indicates problems with the internal analog circuits and does not indicate external hardware problems.
2. Amplifier gain and clipping check:
   Did the amplifier gain change since the last calibration of the amplifier? Did somebody change the volume knob or does the amplifier clipping at high signal level?
   This test indicates a variation of the amplifier properties since the last amplifier calibration. The power amplifier may be switched off, the gain could be changed or it reached the maximal voltage (clipping). See next chapter for details.

If the first item occurs, a recalibration is required (see section *Hardware / Calibration / Check of Accuracy*)

1.

2.

Amplifier Check Errors

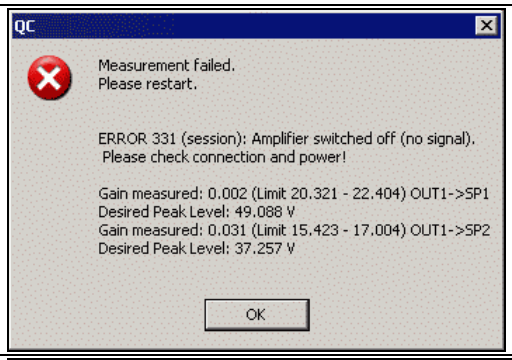
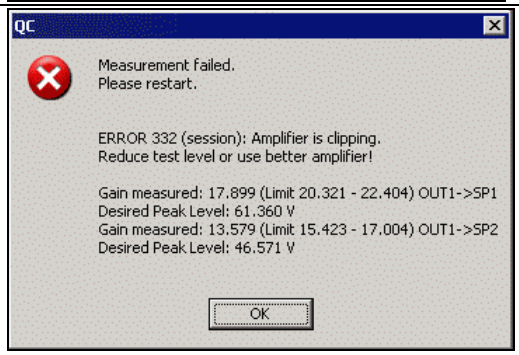
The following errors may occur during the power amplifier check.

Note: The Amplifier Check is always performed with the highest peak voltage that shall be used during the test. Especially when using Multitone-Excitation, the peak voltage is about 5…6 times higher than the rms value. Make sure that the used power amplifier is capable to provide the required peak voltage!

In all cases, please also check the Result Window

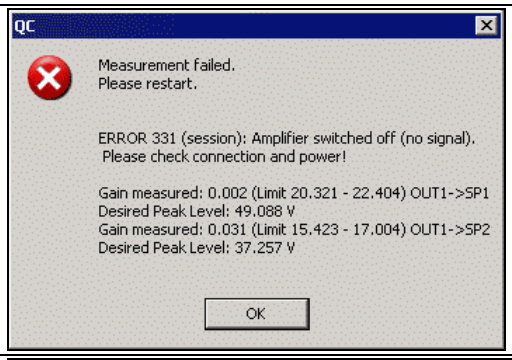
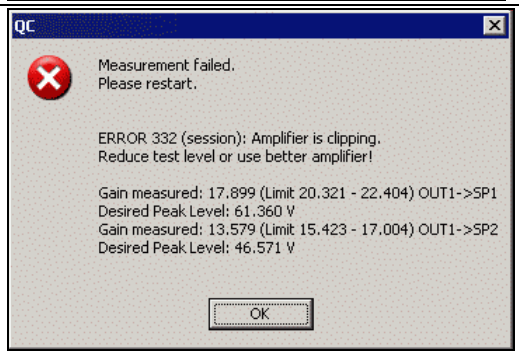
- Calibration Spectrum (Amp Response 1, 2) and
- Calibration Waveform (Amp Response 1, 2)

in the result window list (available in Engineer mode only). This provides you with the detailed test waveform and spectrum during the amplifier check.

	The Power Amplifier is switched off. Check also the Switch on the amplifier and check proper routing.
	The Power Amplifier does not have a correct gain due to clipping. The desired amplifier output peak voltage is displayed. Note: for Multitone excitation this may be about 5..6 times the rms level due to the higher crest factor of this test signal. Use an amplifier with higher gain and power, if the test level can't be reduced.
	The Power Amplifier has a correct gain but the SNR is worse than 34dB. This may be due to clipping, overloading or a defect. Use a better amplifier, if the test level can't be reduced.

5~6

- 1, 2
- 1, 2

	
	5~6
	34dB

Signal Drop Out

Signal drop out effects, audible cracks or either may cause related problems

- insufficient performance of the PC or
- disturbance by other software (most likely hardware device drivers).

To identify these problems and to ensure proper, stable operation over a long time a special tool QC Perfomance Test was developed.

Note: Do not ignore these problems! Run the tests and ensure a successful run of the *Production Test*.

See sections below for help on running the performance test and how to fix problems.

- PC
-

QC

Performance Test Overview

Due to stability requirements of a production environment, and the flexibility and fast operation of the Klippel QC System, you need a high performance PC to run the software.

During testing, we encountered very few hardware configurations that cause problems, even though there is no difference in the specification.

The QC Performance Test tool helps to evaluate whether a PC can run an uninterrupted QC Test, and can give some troubleshooting hints.

Note: The test tool simulates the typical load of an average QC Script. Due to the free choice of PC hardware and the multitude of possible QC configurations, a passing performance test does not guarantee that all configurations run successfully on the PC.

During actual QC testing, these errors may require to repeat the test, and increase the time of a test. So for some applications, infrequent errors may be acceptable.

There are three common reasons for errors during the test:

- Bad hardware or hardware drivers, e.g. WLAN or LAN
- Too much background activity (Virus scanner, etc.)
- Performance of the PC is limited

Klippel QC
PC

QC PC QC

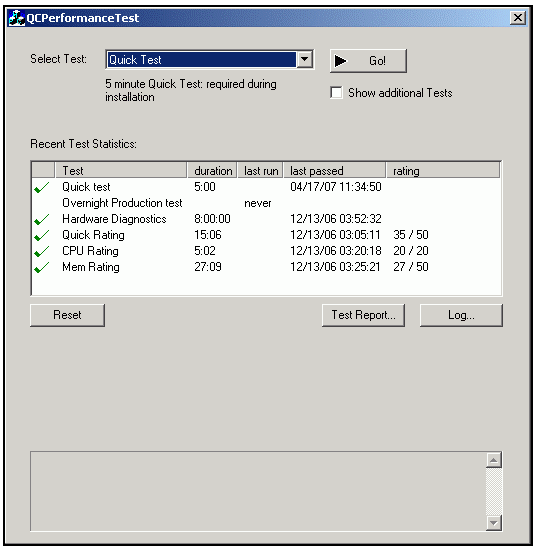
QC PC
QC PC

QC

- WLAN LAN
-
- PC

Using the Performance Test Tool

Start the "QC Performance Test" from the installation *CD / tools / Performance Check* folder or select *System / QC Performance Test* from the QC-Start Tool.



From the drop down box, you can select the test configuration to run:

- Quick Test (5 minutes)
  This test discovers the most problems and is required during installation of the QC System. It indicates all types of errors, but it may miss infrequent dropouts that occur on some systems.
- Overnight Production Test (8h)
  indicates all types of errors and how often they occur. If possible, the PC should be in the production environment already.
  It is strongly recommended to run this test in the production environment before using the Klippel QC System for production purposes.
- Hardware Diagnostics
  This test is used for troubleshooting hardware and driver problems. It tests with no additional load, to detect presence of a faulty component (hardware or driver).
  The test needs not complete every time it runs, it can be used to monitor for errors for a certain time.

The checkbox "Show Additional Tests" makes the following configurations available. They are mainly intended for support and troubleshooting.

- Quick Rating (ca. 20 minutes)
  Tests the PC at different load levels, and determines overall performance. This can be used to test whether demanding QC setups can run on the system
- Full Rating Sequence (ca. 40 minutes)
  Provides a more detailed rating, to expose specific performance limits

- Full Diagnostics Sequence (ca. 9h)
  Provides the full rating, plus a long term monitoring under low load, to expose infrequent dropouts.

Select the test configuration you wish to run and click **GO** to start it.

Note: Do not use the PC for other purposes during the test. Depending on the hardware configuration, the PC may appear unresponsive for minutes. You can click **STOP** anytime to cancel the test, but cleanup may still take a while.

While the test is running the LED-style indicator shows the errors that occurred during the test. For a good system, no error should occur.

There are two types of errors shown: "Sync error" and "BCO error". They help support identifying the source of problems. Normally, hardware problems cause only "BCO errors", while performance problems cause both types of errors.

Click **Report** to show a report of the last test or test sequence. For a longer history, click **Log…** to show the log file.

CD */ tools / Performance Check* " QC
" QC- */ QC*

- 5
  QC
- 8
  PC
  Klippel QC
-

" "

- 20
  PC
  QC
- 40
- 9

GO

PC PC

LED

“ ” “ BCO ”
“ BCO ”

...

Identifying the Problem

If the Quick Test or Production Test shows errors, you should first determine what kind of problem it is. After that, see "Fixing the problem" below for specific solutions.

Hardware Diagnostics

Run the *Hardware Diagnostics* Test (you can stop it after appropriate time, depending on how frequent the errors occur in the other tests).

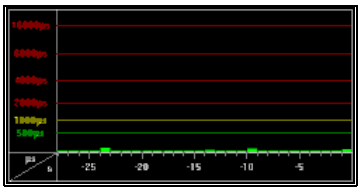
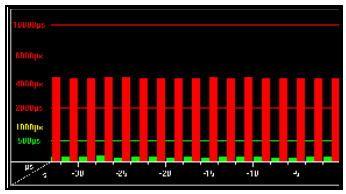
Conclusion: If *Hardware Diagnostics* runs fine, but *Quick Test* or *Production Test* still fail, you likely have a performance problem. In this case, continue with "Performance Problem" below.

Latency Check

Run the "Latency Checker" from the installation *CD / tools / Performance Check* folder or select *System / Latency Check* from the QC-Start Tool.

This program may also be downloaded from http://www.thesycon.de/deu/free_download.shtml or http://www.thesycon.de home page, and look for "free utilities".

Red bars indicate problems typically caused by other software drivers.

	
good: all bars are green, and below 1ms	bad: high latency spikes cause dropouts. **Note**: the spikes can be much more infrequent.

Conclusion: If *Latency Checker* runs ok, but *Hardware Diagnostics* fails with BCO errors, you likely have a hardware problem with the Firewire adapter, the cable or the ADC. Continue with "Hardware Problems" below.

If *Latency checker* fails, likely a driver for one of the hardware components of your PC is the cause. Continue with "Device Driver problems" below.

Test	Quick Test / Production test	Hardware Diagnostics	Latency Checker	**Suspected Cause:**
Result	**FAIL**	**FAIL**	**FAIL**	device driver
	FAIL	**FAIL**	PASS	hardware
	FAIL	PASS	PASS	performance

Other causes

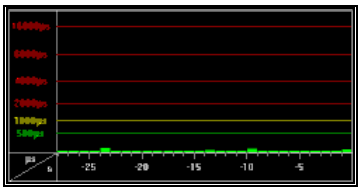
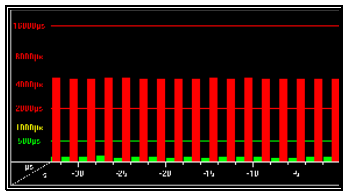
This simple table can classify not all problems indicated by the performance test. If the remedies listed to not help, and the problem persists, it may be an option to try a different PC. If you contact Klippel Support, please include dB-Lab support information (click on the yellow envelope icon in the dB-Lab icon bar), and the performance test log file (save it from within the Performance Check Software using the buttons *Test Report* and *Log*…).

“ ”

PC “
”

CD / / “ ”
QC- /

http://www.thesycon.de/deu/free_download.shtml
http://www.thesycon.de “ ”

	
1	

OK BCO
A/D
“ ”

	/			:

PC
Klippel dB-Lab dB-Lab

...

Fixing the Problem

Hardware Problems

If you identified a hardware problem, the following steps may help:

- If available, use a different Firewire / USB port
- Use a different Firewire / USB cable

- Use a different Firewire adapter card. If the original adapter is on the main board, disable it in the BIOS.

Run the *Hardware Diagnostics* test again to see if the problem is solved.

- /USB
- /USB
-

BIOS

Performance Problems

Today, PCs are often limited by the amount of memory that is readily available. While for normal applications additional memory can be simulated on disk, this is not fast enough for the real time acquisition required by the Klippel QC System.

- Disable background tasks, such as Virus scanners, automatic "real-time" backup etc.
- Make sure the PC matches the minimum specification
- If available, try a different PC.
- If they occur only for a particularly demanding QC Test setup, it usually helps to add more RAM to the PC.

If you want to contact Klippel Support, please include the results of one of the Rating Tests in QC Performance Test (enable "Show Additional Tests" to make them available).

To store the results, save it from within the Performance Check Software using the buttons *Test Report* and *Log*….

PC

Klippel QC

- “ ”
- PC
- PC
- QC PC

Klippel QC

“ ”

…

Device Driver Problems

Some device drivers can block the PC bus for such a long time that real time acquisition becomes impossible.

Note: To avoid permanently damaging the windows installation, it is recommended to make a complete backup and/or set a System Restore Point.

The first step is to identify the device driver or drivers that cause the problem. To do that, open the Windows "Device Manager" list and disable suspect device drivers step by step as described below. Run *Latency Checker* to see if the problem is gone. For infrequent problems, you can use the *Hardware Diagnostics* instead, as this provides a longer memory.

If disabling one particular driver does not completely solve the problem, but reduces the frequency of errors, keep this driver disabled and continue with other drivers.

Note: Do not disable vital drivers like keyboard or mouse!
If a particular driver does not affect the performance, don't forget to re-enable it again!
If you accidentally disabled one of the vital drivers, and the system is not accessible anymore, reboot, press [F8] after the BIOS diagnostics, and select "boot in safe mode". Then, re-enable the important devices.

Disabling driver in Device Manager:

To open Device Manager, right-click on "My Computer", select "Properties", go to the "Hardware" tab, and click "Device Manager" you see a tree of devices.

Start with drivers in this order:

- WLAN Network adapters
- Ethernet / LAN Network adapters
- Sound device drivers (except those labeled "PHASE 24")
- Other non-standard components

Right-Click on the driver and select "Disable" from the popup menu. The driver icon is displayed with a small red "stop" sign.

To enable the driver, right click again, and select "Enable".

After identifying the offending driver

If you have identified a driver as the cause of the problem, you can

- Try to update the driver through the "Device Manager" panel Right-click the device, and select "Update Driver". Allow the Driver Update Wizard to connect to the Internet
- Check the web site of the manufacturer of the PC or the offending component for a driver update, or contact their support. Some PC manufacturers offer "Update packs" with driver updates for multiple components.
- Exchange the offending component. If it is on the motherboard, disable it in the BIOS settings otherwise remove it.

PC

Windows /

Windows “
”

BIOS [F8] “ ”

“ ” “ ” “
” “ ”

- WLAN

- /LAN
- " PHASE 24 "
- " "
  " "
  " "
- " "
  " "
- PC
  PC " "
- BIOS

Support Information for Performance Problems

When you contact support with performance problems, please include:

- **dB-Lab Support information**
  In dB-Lab, select *Extras/Zip&e-mail*. In the dialog, select both *Installation and licence doagnostics* and *Log files*.
  Click "Send as e-mail" to start collecting an e-mail right away.
  (If you can't send e-mail from the production system, use "Save as .zip" instead.)

- **QC Performance test results**
  Start QC Performance Test, enable *Show additional tests*, run *Quick Test* and *Full Rating Sequence.* Click "Test Report", and add the information of the report. (You can click *Copy* to copy the text to the clipboard, and then paste it into your e-mail)

- **Screenshot of latency after running for a while**
  Compare to screenshots above.
  Also, add a verbal description if you see erratic behavior (e.g. infrequent spikes)

- **Additional Software installed on the computer**

- **dB-Lab**
  dB-Lab *Extras/Zip&e-mail*
  Installation and licence doagnostics *Log files*
  " e-mail "
  " .zip "

- **QC**
  QC
  " "
  Copy

-

Software Problems

Task Files not found

The Task files of the Standard version are installed in the following folder by default:

C:\Documents and Settings\All Users
Application Data\Klippel\QC\Scripts\Klippel\Qc\Standard

Note: The task files must not be moved to a different location. In this case the operation will not find the task scripts anymore.

C:\Documents and Settings\All Users
Application Data\Klippel\QC\Scripts\Klippel\Qc\Standard

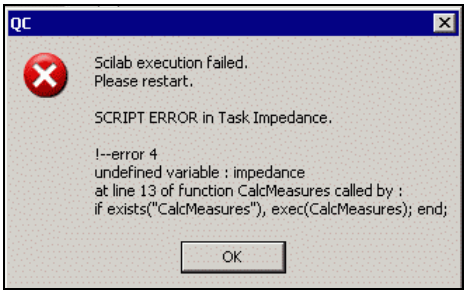
Installation failed

In case of an error in the installation process, please send e-mail to support@klippel.de and attach the log file. You can store the log file by starting the installation program *QC-InstallGuide* and go to *Diagnostics* on the first page. Then open the current log file and store it.

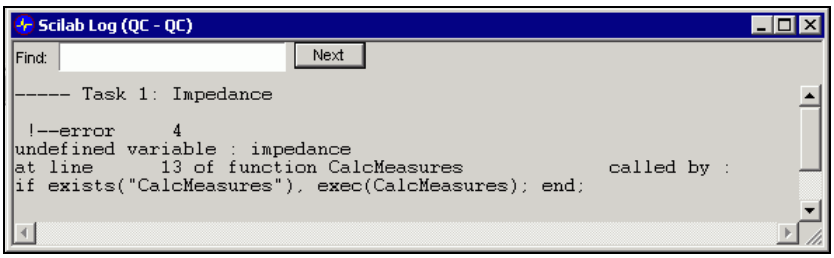
support@klippel.de
QC-InstallGuide

Script Error messages

In case of an script error message (see an example below),



Please copy the contents of the result window Scilab Log into e-mail and send it to support@klippel.de.



Scilab Log

support@klippel.de

Appendix

Glossary

DUT / Batch / Type

DUT / /

The device under test (**DUT**) designates the particular test object. It is usually part of a production batch (also called lot).

A **batch** stands for a certain production period.

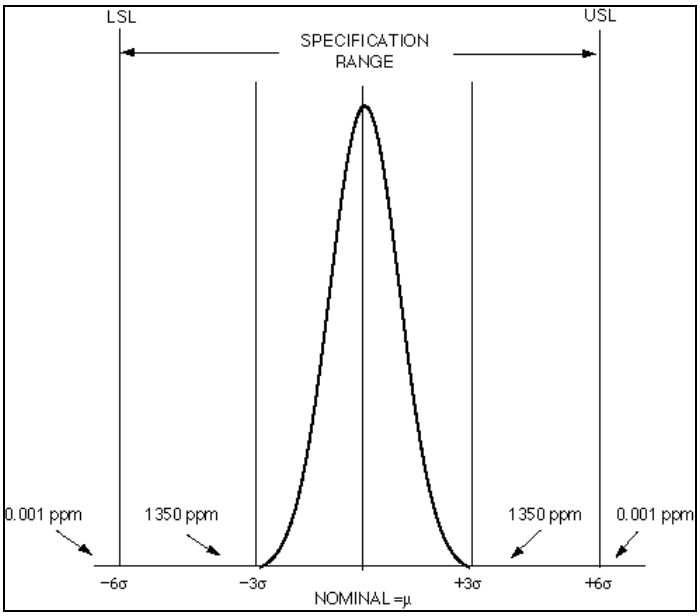
The **type** describes the geometry and parameter of a transducer and is normally manufactured in several batches.

DUT

Ppk / Cpk

Ppk / Cpk

Statistical indices are used to predict as early as possible a change in quality.



The process capability index, or Cpk, measures a process's ability to create product within specification limits. Cpk represents the difference between the actual process average and the closest specification limit over the standard deviation, times three.

By convention, when the Cpk is less than one, the process is referred to as incapable. When the Cpk is greater than or equal to one, the process is considered capable of producing a product within specification limits. In a 4-sigma process, the Cpk equals 1.33 and in a 6-sigma process, the Cpk equals 2.0.

The Cpk is inversely proportional to the standard deviation, or variability, of a process. The higher the Cpk, the narrower the process distribution as compared with the specification limits, and the more uniform the product. As the standard deviation increases, the Cpk index decreases. At the same time, the potential to create product outside the specification limits increases.

Cpk can only have positive values. It will equal zero when the actual process average matches or falls outside one of the specification limits. The Cpk index can never be greater than the Cp, only equal to it. This happens when the actual process average falls in the middle of the specification limits.

(excerpted from The Complete Guide to the CQE *by Thomas Pyzdek. 1996. Tucson: Quality Publishing Inc.)*

Cpk Cpk
3
Cpk 1 Cpk
1 4σ Cpk
1.33 6σ Cpk 2.0
Cpk Cpk
Cpk

Cpk Cpk
0 Cpk Cp
Cpk=Cp

(The Complete Guide to the CQE *Thomas Pyzdek. 1996.*
)

Process Capability Index (*Cpk*):

(*Cpk*):

$$CpK = \min\left(\frac{L_{up} - E_c}{3\sigma_c}, \frac{E_c - L_{low}}{3\sigma_c}\right)$$

using

L_{up} upper specified limit

L_{low} lower specified limit

C number of DUT investigated

E_C expected value of test results X_i within the last C measured DUT

$$E_C = \frac{1}{c}\sum_{i=1}^{c} X_i$$

σ_c Standard deviation of test results X_i within the last C measured DUT

$$\sigma_C = \sqrt{E_C\left[\left(X - E_C(X)\right)^2\right]}$$

Cpk is defined as the distance between the average of a fixed number *c* of samples (short term) and the closest limit divided by half of the process width. The process width is usually six times the standard variation.

$$CpK = \min\left(\frac{L_{up} - E_c}{3\sigma_c}, \frac{E_c - L_{low}}{3\sigma_c}\right)$$

L_{up}

L_{low}

C DUT

E_C C DUT X_i

$$E_C = \frac{1}{c}\sum_{i=1}^{c} X_i$$

σ_c C DUT X_i

$$\sigma_C = \sqrt{E_C\left[\left(X - E_C(X)\right)^2\right]}$$

Cpk c

Process Performance Index (*Ppk*):

$$PpK = \min\left(\frac{L_{up} - E_P}{3\sigma_P}, \frac{E_P - L_{low}}{3\sigma_P}\right)$$

(Ppk): using

$_P$ number of DUT in total production

E_P expected value of <u>all</u> test results X_i

$$E_P = \frac{1}{P}\sum_{i=1}^{P} X_i$$

σ_P Standard deviation of <u>all</u> test results X_i

$$\sigma_P = \sqrt{E_P\left[\left(X - E_P(X)\right)^2\right]}$$

Ppk is the overall process performance similar defined as *Cpk* but based on the total process variation of a batch (all samples used) where *Cpk* only takes into account a fixed number of samples.

$$PpK = \min\left(\frac{L_{up} - E_P}{3\sigma_P}, \frac{E_P - L_{low}}{3\sigma_P}\right)$$

$_P$ DUT

E_P X_i

$$E_P = \frac{1}{P}\sum_{i=1}^{P} X_i$$

σ_P X_i

$$\sigma_P = \sqrt{E_P\left[\left(X - E_P(X)\right)^2\right]}$$

Ppk *Cpk* *Ppk*

Cpk

Quick Klippel-QC Setup Guide

Klippel-QC

Together with the printed manual comes a laminated, two pages short guide, that should be placed near the Klippel QC System for reference and help.

On the next two pages this guide is reproduced (printed manual only, not included in online help). However, there is also a PDF version installed in the Help folder, which is by default:

```
c:\Documents and Settings\All Users\
   Application Data\Klippel\QC\Help\
   Quick Klippel-QC Setup Guide.pdf
```

Please use the pdf document for printing.

Note: A commented version of this setup guide is included in this manual in section *Getting Started / First Measurement.*

#

QC Klippel QC

PDF

```
c:\Documents and Settings\All Users\
   Application Data\Klippel\QC\Help\
   Quick Klippel-QC Setup Guide.pdf
```

pdf .

/ First

Measurement

#

ENGINEER

Quick Klippel-QC Setup Guide

Use specification data, if available. Use this guide for missing parameters only.

1 Select the Template for your Driver

Start **QC-Start Engineer**

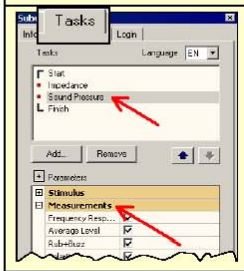
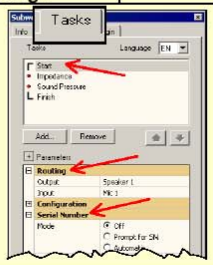
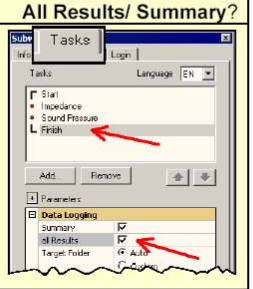
Template	fs Range [Hz]	Re Range [Ω][1]	SPL limit range [Hz]	SPL time [s]
Subwoofer	10 – 50	2 – 8	20 – 200	2
Woofer	20 – 150	2 – 8	20 – 1000	1
Midrange	100 – 500	4 – 8	50 – 2000	1
Tweeter	400 – 3k	4 – 8	200 – 20k	0.5
Horn Driver	200 – 2k	4 – 16	400 – 20k	1
Microspeaker	200 – 2k	4 – 30	200 – 5k	0.5
Headphones	30 – 400	10 – 200[2]	20 – 20k	1

Create new test (1), select **Template**, enter **test name** and **Start** (2).

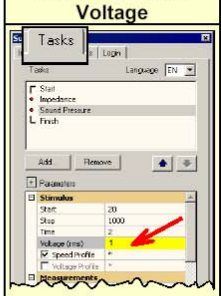
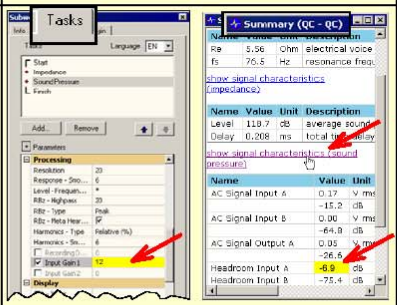
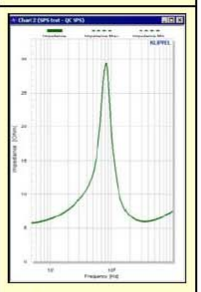
(1)

(2)

2 Configure Test

Measurements enabled?	Speaker + Mics **Routing**?	Use **Serial Number**?	Data Logging: **All Results/ Summary**?
			

3 Adjust Voltage

Set **Sound Pressure Voltage**	Press **Start**	Adjust Mic Headroom	Check **Impedance**
 According to specification		 Adjust **Input Gain** until **Headroom Input A** is in –10…-3 dB range.	 Curve smooth? If not, adjust voltage.

Now, the measurement setup is complete.

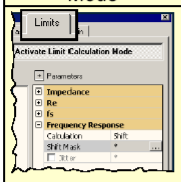
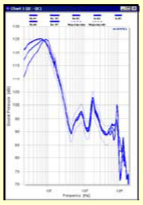
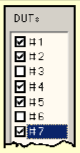
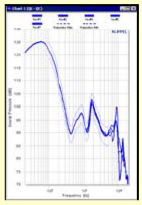
[1] If Re is outside this range, please scale level relative to the middle specified value of Re (the higher Re, the higher the level). See Manual section Optimizing Performance.

[2] For Re>30 Ohm, special hardware version required.

Quick Klippel-QC Setup Guide page 1/2

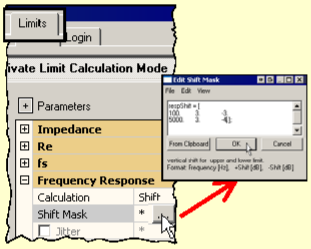
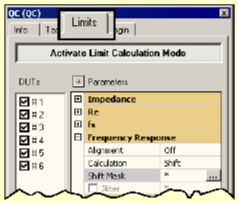
ENGINEER

4 Setting Limits

Activate **Limit** Mode	Measure Reference **DUTs**	Calculate Limits	Remove strongly deviating **DUTs**	Check Limits
				
Press button **Activate Limit Calculation Mode**.	Press **Control Panel – Start** button. 	Press **OK** button on Property Page Limits.	Deactivate Reference **DUTs** (#3, #6 in the example), which are corrupted by noise or defects; Press **OK** button.	Are all Reference DUTs inside limits?

no

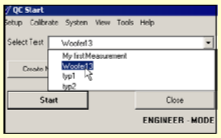
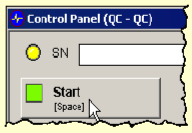
yes

Adjust Limits (only if required)	Exit **Limit** Mode	Trial Run
		Press **Control Panel – Start** button Good unit Defect unit 
Edit **Parameter** Enlarge headroom or restrict frequency range.	Disable button **Activate Limit Calculation Mode**.	All bad drivers should be detected as FAIL.  Logout as Engineer; Exit QC-Start Engineer.

Now, the whole setup is complete and ready for production.

OPERATOR

5 Run Production

Launch **QC-Start Operator**	Select and start prepared Test	Press **Start** or enter **Serial Number** to check production
		

KLIPPEL

www.klippel.de

Links to Manual for more information:

Commented version of this guide	Getting started
Select the Template	Test Configuration / Test Templates
Configure Test	Test Configuration
Adjust Level	Optimizing Performance
Settings Limits	Test Configuration / Limit Calculation
Run Production	User Modes / Operator

Quick Klippel-QC Setup Guide page 2/2

工

程

师

Klippel QC 快速设置指南

若有产品规格说明书，请使用其中的数据。仅在说明书遗失时才使用本指南的数据。

1 为扬声器选择模板

点击**QC-Start Engineer**

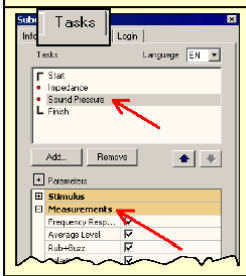
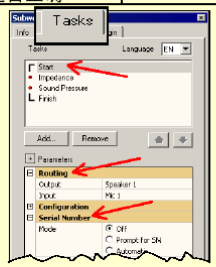
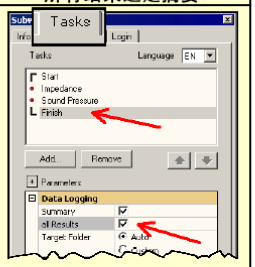
模板	fs范围 [Hz]	Re范围 [Ω][1]	SPL标称范围 [Hz]	SPL时间 [s]
Subwoofer	10 – 50	2 – 8	20 – 200	2
Woofer	20 – 150	2 – 8	20 – 1000	1
Midrange	100 – 500	4 – 8	50 – 2000	1
Tweeter	400 – 3k	4 – 8	200 – 20k	0.5
Horn Driver	200 – 2k	4 – 16	400 – 20k	1
Microspeaker	200 – 2k	4 – 30	200 – 5k	0.5
Headphones	30 – 400	10 – 200[2]	20 – 20k	1

创建新的测试(1)，选择**模板**,输入**测试名称**并**开始**(2).

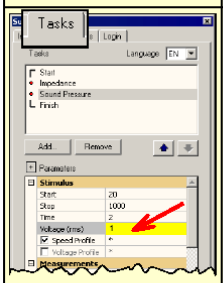
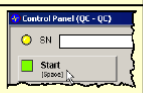
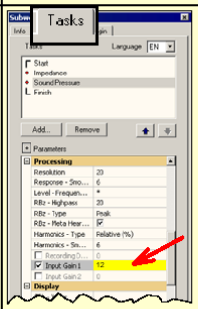
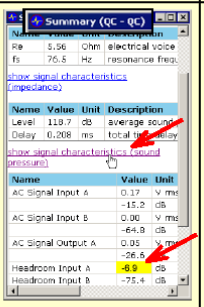
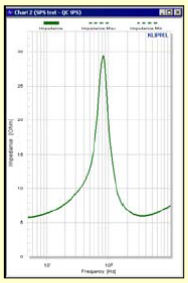
(1)

(2)

2 测试配置

开启**测量**了吗?	扬声器和Mic的**连线**是否正确?	是否使用**序列号**?	数据日志是选择**所有结果**还是**摘要**?
			

3 调整电压

设置**测试电压**	点击**开始**	调节传声器的动态余量		检查**阻抗**曲线
				
参照产品规格说明书设置		调节**输入增益**，直到**动态余量输入A**在-10dB~-3dB范围内.		曲线是否平滑? 若不平滑，请调节测试电压。

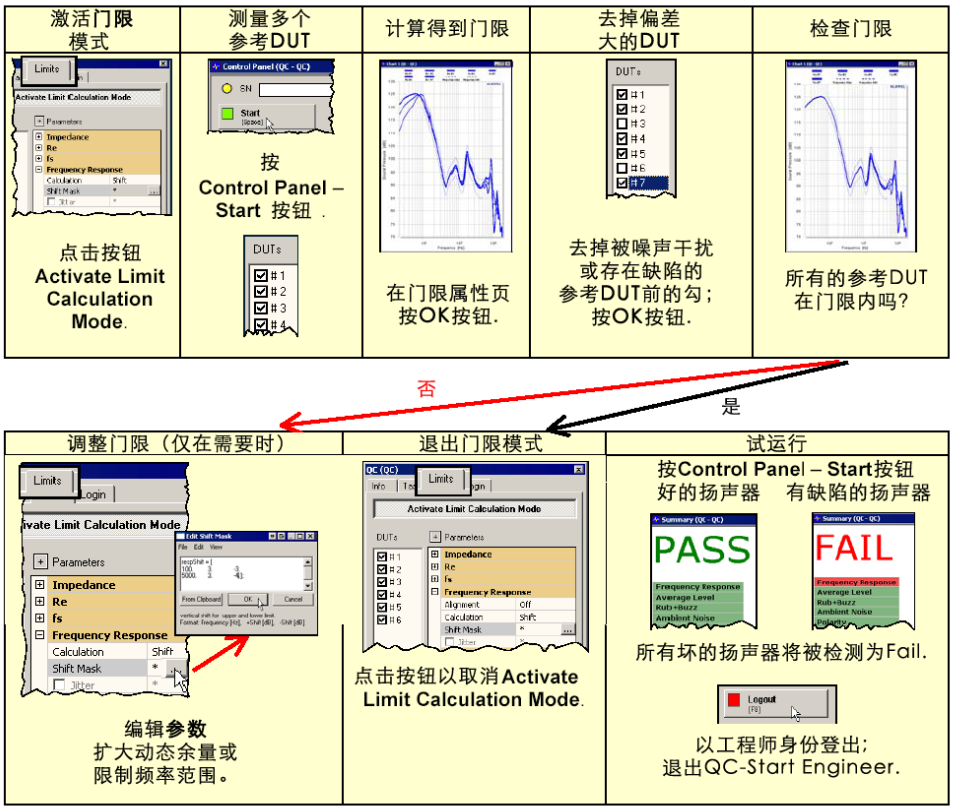
现在，测量设置已完成。

[1] 如果Re在此范围之外，请按照Re值达到额定的中值调整测试电压（Re越高，测试电压越高）。参见手册优化性能一章。

[2] 当Re>30Ω，需要使用特殊的硬件版本。

工程师

4 设置门限



现在，所有设置完成，可以投入生产线运行。

操作员

5 生产线运行

KLIPPEL
www.klippel.de

详情请对应手册中各章节：

本指南提到的描述	手册中的章节
选择模板	测试配置 / 测试模板
配置测试	测试配置
调整测试电压	优化性能
调整门限	测试配置 / 门限计算
生产线运行	用户模式 / 操作员

Measurement Technique (Theory)

For a general view on the measurement technique, the following paper is suggested for reading:

Loudspeaker Testing at the Production Line

W. Klippel, S. Irrgang, U. Seidel

KLIPPEL GmbH, Dresden, Germany

presented on the 120th AES Convention in Paris 2006.

W. Klippel, S. Irrgang, U. Seidel

KLIPPEL GmbH, Dresden

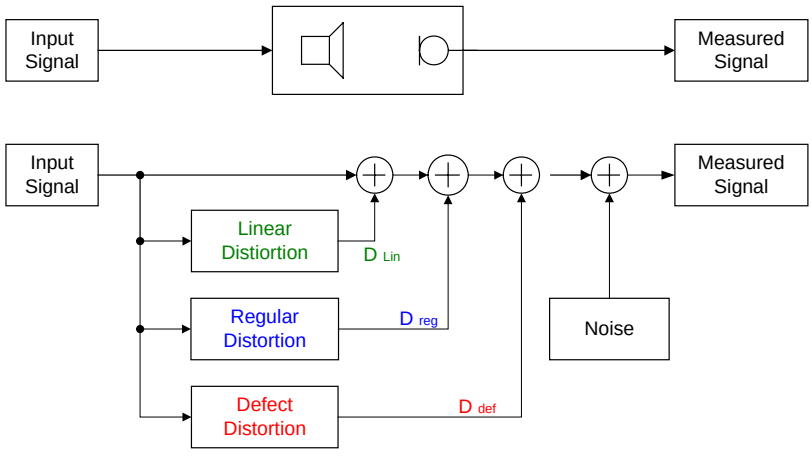
120 AES 2006

Rub & Buzz

Defects that are usually designated as Rub&Buzz are typically small in amplitude and time relative to the fundamental of a test signal and are therefore difficult to detect. In this section the approach to reliably detect these defects with superior sensitivity and reliability is discussed.

Background

The response of a DUT (Device under Test) to an input signal can be modeled by the superposition of several distortion components:



Linear distortion describes the deviation from unity response, which is the linear, wanted behavior of a loudspeaker (frequency response).

Regular distortion describes the response of determined-by-design nonlinear behavior (e.g. 2nd, 3rd order harmonics due to motor or compliance nonlinearity).

Defect distortions are all unwanted signal components due to production failures, material problems or even design errors (wires hitting the cone). Usually these defects are short-term phenomenon such as clicks, rubbing at a certain excursion or loose particles.

Ambient Noise is also an unwanted signal but not related to the driver. The influence of the noise from the ambience should be reliably separated from the distortion components (see Production Noise immunity below).

DUT

2 3

Defect Characteristics

Defects have in most cases very low energy and are usually concentrated at one time instant. They can be detected in time domain analysis best, since frequency domain (neglecting phase information) smears these effects over the whole measurement interval. Using time domain analysis, even shortest defects can be detected.
The Defect Distortion is separated from regular distortion and the fundamental using a tracking highpass filter with variable cut-off frequency.

This is an effective measure to detect Rub&Buzz defects. However, these measures do not only reveal the defect but are still contaminated with higher-order regular distortion (which are also found on good units) and noise. Testing even smaller defects that are masked by regular distortion the Meta-Hearing Technique shall be applied (see below).

Meta Hearing Technology

The new **Meta Hearing technology** (patented in DE 102 14 407, CN 1449136, US) is used to suppress the regular distortion (from motor, or suspension) inherent in the Defect Distortion and to isolate the distortion (IDD) caused by the loudspeaker defect. The peak value of IDD may be preferred for ultra short-term or singular disturbances such as loose particles. The rms value with a short time constant is preferable for oscillating defects such as rubbing of the coil.

This technology is based on a loudspeaker model, which has to be identified by a learning procedure applied to a good unit (e.g. golden unit). The continuous learning procedure provides also a compensation for parameter shifts during production. Thus loudspeakers with minor defects (stray units) are detected reliably.

These defects may be masked by regular distortion and inaudible for a human tester (Meta-Hearing technology). However, inaudible effects may provide valuable indications for loose particle detection or other defects, which become worse in the final application. The active compensation of the regular distortion provides additional headroom between a good and a defect unit. Limits are easier to define.

DE 102 14 407, CN 1449136, US

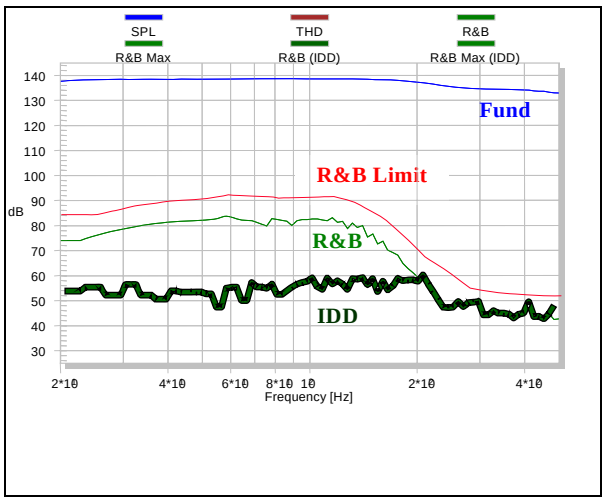
IDD IDD

Isolated Defect Distortion (IDD)

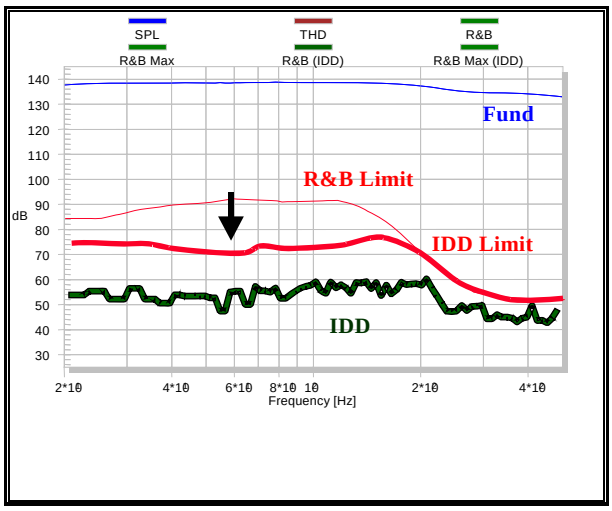
IDD

If *Meta Hearing* is activated an additional measure is calculated. It is called IDD (Isolated Defect Distortion) and is obtained by suppressing the regular distortion, which mask potential defects, and provides therefore a higher rate of defect detection as well as higher headroom for limit setting. To ensure high sensitivity the IDD limit is adjusted automatically. It is identical to the rub & buzz limit for all frequencies where no suppression of the regular distortion can be achieved. For all other frequecies it will be lowered according to the grade of suppression.

In the graph below the thin green line is the normal Rub&Buzz curve *R&B* with its limit *R&B Limit.* The thick green curve IDD is at lower frequencies up to 20 dB below the normal Rub&Buzz curve. This is the compensation achieved by Meta Hearing Technology. Thus the test is 20 dB more sensitive to potential defects.



The next graph shows the derived limit for the IDD measure *IDD Limit*. At frequencies were compensation was achieved, the limit is attenuated. Note that at high frequencies the Rub&Buzz curve and the IDD curve are identical, no compensation was achieved and therefore the IDD limit was not attenuated. Basically it is possible that the IDD limit is below the measured Rub&Buzz, detecting defects that are masked by the normal Rub&Buzz and therefore inaudible for the human ear.



IDD

IDD

IDD

R&B *R&B*

Limit IDD 20dB

20dB

IDD *IDD Limit*

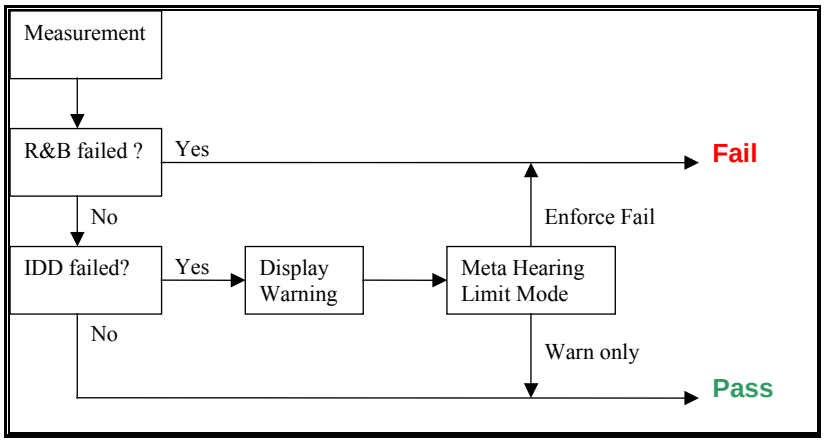
IDD IDD

IDD

Handling of IDD result

IDD

The results of rub & buzz and IDD are combined into one test verdict. If the basic rub & buzz exceeds the limit the verdict is always Fail. For the more sensitive IDD measure the user can decide wheter a limit violation leads to Warning or Fail. In case of Warning the overall result will be Pass if no other measure failed.



In order to simplify the user interface the Rub&Buzz and IDD measure are not shown simultaneously in Result Window 1. Normally Rub&Buzz is shown. IDD is shown only, if it exceeds the limit. If both measures exceed the limit only Rub&Buzz is shown.

Applications:

Warn Only	- Well trained operator who can double check the DUT by e.g. manual sweep - Not recommended for automated test setup
Enforce Fail	- Absolute safe operation to prevent any unit from shipment that differs from the preceding units (stray unit). - May be used with offline check of failed units. - Recommended for automated test setup.

IDD

IDD

1 IDD

IDD IDD

	- DUT -
	- - -

Limit Calculation of IDD

IDD

The IDD Limit is calculated as following:

$$Compensation = RBz - IDD$$

$$IDD_{Limit} = RBz_{Limit} - \min(Compensation / 2{,}10dB)$$

Thus the attenuation of the IDD Limit is not more than 10dB below the Rub&Buzz limit to ensure robust operation.

IDD

$$= \quad RBz \quad - \; IDD$$

$$IDD_{Limit} = RBz_{Limit} - \min(\qquad / \; 2 \, , \; 10 \; dB \;)$$

IDD 10dB

Ambient Noise Immunity

Ambient noise from production may impair the detection of rub& buzz defects for a human or automated tester. Shielding of the test unit by a test box or measurement cabin may help. However, an additional microphone measuring the noise in the far field (1 m distance) is used to predict the **Ambient Noise** level in the near field and to separate the defects from ambient noise disturbances. In case of an external noise disturbance the measurement can be repeated automatically.

For details on the hardware setup and noise attenuation achieved by using test enclosures, see section *Test Configuration / Measures and Limits /* *IDD* / / / / Meta Hearing Technology

/SPL *Tests.*

Ambient Noise.

1

/ /
IDD / /
/ / Meta Hearing Technology

/SPL *Tests.*

Ambient Noise

Maximal SPL

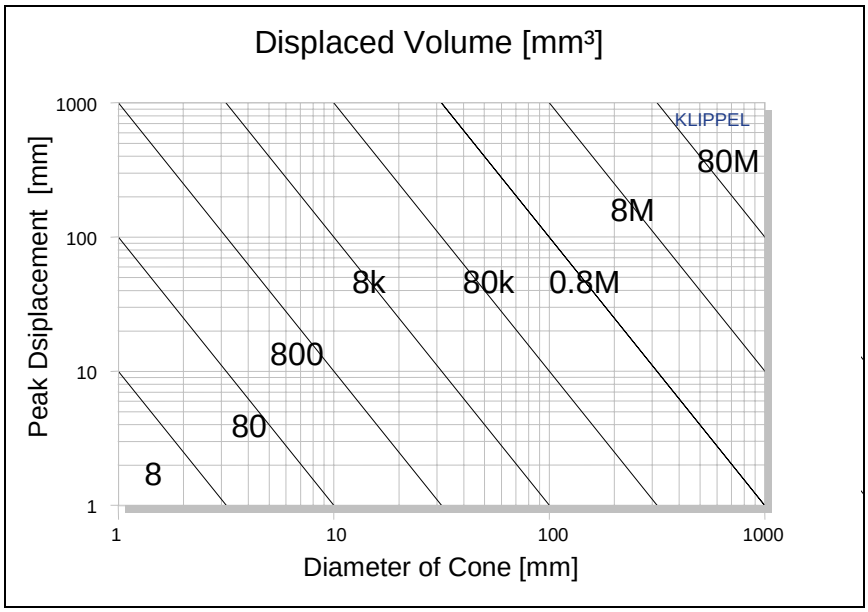
SPL

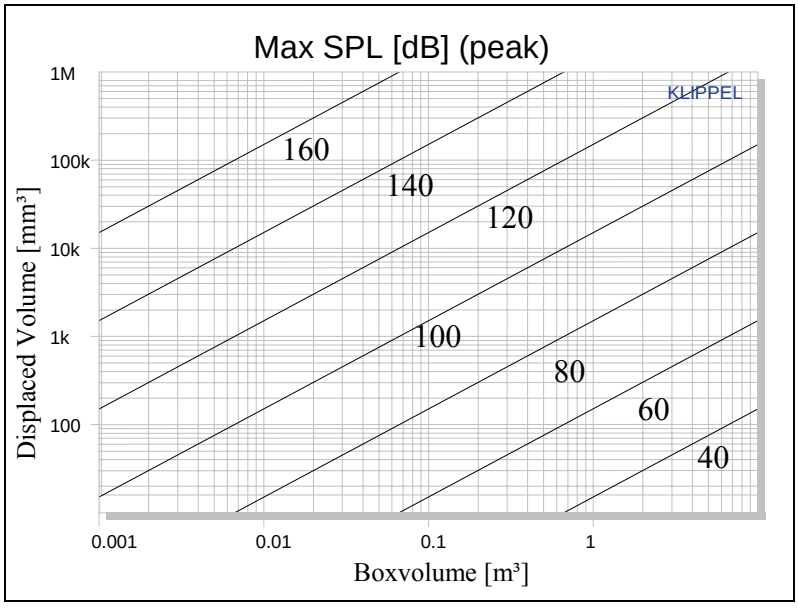
For measuring SPL in a closed test box it is essential to estimate the maximal SPL to prevent from microphone clipping and excessive distortion.

Follow the simple two-step procedure using the following 2 graphs to assess the maximal peak SPL for given peak displacement, diameter of the cone / vibrating area and testing box volume.

1. Read the displaced volume from the first graph.
2. Using the displaced volume and test enclosure volume, read the max SPL from the second graph.

Note: If the measured SPL exceeds the specified max. SPL of the microphone, a warning is generated in the *Summary* result window. See also section *Hardware / Calibration / Microphone Calibration.*





SPL

SPL

SPL

1.
2. SPL

SPL	SPL / / *Microphone* Calibration