
Limit Checking with the Audio Analyzers UPL and UPD

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Subject to change

Products:

Audio Analyzer UPL

Audio Analyzer UPD



ROHDE & SCHWARZ

The limit check function can be switched on and off on the display panel (Fig.1). Trace 1 or trace B can be selected, or both traces can be monitored simultaneously. However, since there is only one tolerance mask, the latter option is expedient only if the parameter to be measured is the same for both channels.

Traces can be monitored for an upper (LIM UPPER) or a lower (LIM LOWER) limit value or for both values (LIM LOW&UP).

Moreover, fixed values (VALUE) or a tolerance curve (FILE) can be selected in this panel for limit checking.

4. Monitoring with Fixed Values

If measurement series are to be monitored using a constant limit value, for instance for level monitoring over an extended period of time - the thresholds for out-of-tolerance conditions can be entered in the display panel. In this case, a tolerance mask is inserted over the entire width of the graphic display (Fig. 2).

If limit values are exceeded in the measurement, an arrow pointing to the top or bottom is inserted in the top lefthand corner of the graphic display.

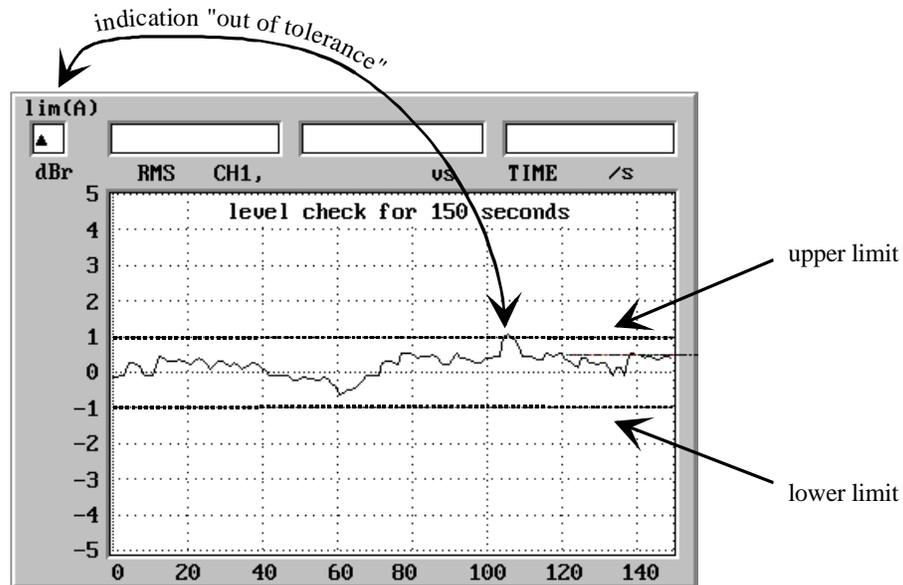


Fig. 2: Level monitoring versus time

Absolute or relative units can be selected for fixed limit values. If a limit value of 3V is selected, for example, measured values will always be compared with this absolute value irrespective of the unit in which they are displayed. If a relative unit (eg 1 dBr) is selected, measured values will be checked for a 1 dB offset (in this example) from the value specified under "Reference" line (see Fig.1). This also means that the reference for measured values and limit values is the same. A subsequent change of the reference value will cause a vertical shift of the limit lines.

5. Use of Limit Curves

In the majority of applications, measured values are checked against limit values that are themselves a function of the swept parameter. Fig.3 shows as an example the frequency response of a bandpass filter which is monitored for compliance with defined tolerance curves.

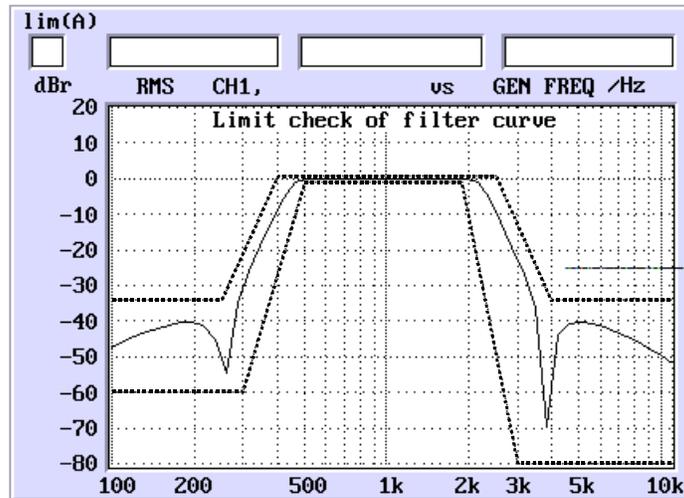


Fig. 3: Measurement of frequency response of filter using tolerance curves

Such tolerance curves can also be used with Audio Analyzers UPD and UPL. To perform such measurements, the corresponding files are to be loaded in the display panel. Lower-limit curves have the extension .LLW, upper-limit curves the extension .LUP. If both the upper and the lower limit is to be checked, both files are to be loaded. The files contain x-y pairs that are the interpolation points of the tolerance curve. Intermediate values are calculated by interpolation at the start of the measurement.

The x values are stored in the files as absolute quantities.

The y values of the limit curves are defined as factors by which the set reference value is multiplied to obtain the absolute values. In this way, the complete tolerance curve can be shifted along the y axis by simply changing the reference value without having to edit the file.

An exception to this file structure are the test functions THD, THD+N, modulation distortion, difference frequency distortion and wow & flutter. These measurements yield relative parameters in dB or % and are not related to a further reference value. The associated limit values therefore have to be entered into the files in %. This is also the case if the display is to be made in dB.

6. Editing of Limit Files

Limit files can be edited with any editor at the MS DOS level. Audio Analyzers UPD and UPL have two sample files stored in the USER directory: R&S_EXAM.LLW and R&S_EXAM.LUP. In the following, the limit-file structure is described using the sample files (Fig.4).

Each file comprises a header which is followed by the test data. Important information can be stored along with the data by means of comment lines.

```

# File: \USER\R&S_EXAM.LLW
# Date: 06/16/96
# From: ROHDE & SCHWARZ
#
# This is an example for lower limit. This file contains the
# CCIR 468-4 tolerances.
#
# The file consists of an header, followed by the data sections.
# Commentlines must start with '#'. Empty lines are not allowed.
# Any characters in line behind the number are ignored and may be used
# to comment the setting.
#
#####
#
##### beginning of header
#
(1) → → → 212 # version of hw software this file is built with
2 # format: 0 for ASCII, 1 for binary ( ieee float ), 2 for ASCII x+y
10 # comb: 1 for y only, 2 for x+y, 3 for x+y+z, 4 for DSP data,10 for new
form
(2) → → → 1 # count of traces
(3) → → → 7 # count of entries
(4) → → → 1 # x scale: 0 for lin, 1 for log
1 # y scale: 0 for lin, 1 for log
#
##### beginning of x and y values
#
(5) → → → #--X-----Y---
#
31.5 0.79432
100 0.89125
1000 0.9440609
5000 0.9440609
6300 1
20000 0.79432
31500 0

```

Fig. 4: Sample file R&S_EXAM.LLW

The following rules are to be observed in generating or editing limit files:

- Comments can be inserted into the file after entering the # character.
- Line (1) specifies the software version under which the file was generated. In previous versions, the x and y values were listed in consecutive order, which can however be read by instruments with new firmware versions.
- The number of interpolation points specified in line (2) must coincide with the number of x and y values entered.
- The linear or logarithmic division of the two axes is defined in lines (3) and (4). The interpolation of intermediate tolerance-curve values (segments) that depart from the horizontal or vertical is based on this information both for the x and y directions. The entries made in these lines must coincide with the actual scaling; this is important for obtaining a correct graphic display since interpolation points are joined by straight lines. If the entries differ from the actual scaling, bent curve sections (elliptical sections) are obtained as a result of the interpolation. These sections are not displayed and will thus remain concealed to the user.
- x values must be entered in ascending or descending order. A change of direction is not permissible.
- y values must be entered as factors. They are multiplied with the reference value defined in the display panel. Any tolerances in dB must be converted into linear multipliers prior to entering them into the file.
- x and y values must be separated by at least one blank, see line (5). In the above example, the two columns are separated by several blanks to provide a better overview.

7. Generation of Limit Value Files with Application Program

The application program LIMIT.BAS allows the convenient generation of limit files for frequency response measurements. The program is available from your local Rohde & Schwarz branch office.

For running this program, the audio analyzer must be fitted with Universal Sequence Controller UPLB10 or UPD-K1. With this option, complete test sequences can be executed automatically. Moreover, the user can generate test functions of his own in addition to those implemented in the unit.

Audio Analyzer UPD must be equipped with firmware version 3.0 or higher and UPL with firmware version 1.0 or higher for running the application program, which is written in BASIC. Moreover, an external keyboard must be connected.

The program can be installed in any directory. The limit files generated by the user are always stored in the directory from which the program is called. It is therefore advisable to install the program in the directory in which the limit files are to be stored later, otherwise the limit files may have to be copied into the desired directory.

Prior to running the application program, the settings for the intended measurements must be made in the display panel since the information for the x- and y-axis scaling is transferred into the limit files during the program run and the reference value is checked. Only absolute units (V, mV, μ V, dBV and dBu) are permissible for the reference value.

Before starting the application program, the audio analyzer must be switched to autorun by means of key F3 on the external keyboard. To load the program, LOAD"LIMIT.BAS" must be entered. Prior to this, the correct directory may have to be selected. This is possible from BASIC by entering the command SHELL, then selecting the required directory under MSDOS and returning to BASIC by means of EXIT. The directory is activated also if prior to changing to BASIC a setup is loaded which contains the required directory as a working directory.

After starting the program with RUN, four different ways of generating a limit file are offered:

- Generation of upper limit curve
- Generation of lower limit curve
- Generation of symmetrical tolerance curves for upper and lower limit values
- Generation of tolerance mask parallel to test trace

7.1. Generation of Limit Files by Point-by-Point Entry

After activating the menu item for the generation of the upper or lower limit curve or the symmetrical tolerance curve, the BASIC mask shown in Fig.5 is displayed. The frequency/tolerance pairs defining the limit values can now be entered; each numerical value must be confirmed with ENTER. No signs are entered for dB values; they are interpreted as positive or negative values for the upper / lower limit curve, respectively. Up to 30 interpolation points can be defined. Limit-value definition is terminated by entering a frequency with the value "0". Any erroneous values can be corrected subsequently. Finally, the name is entered under which the file or the two files are to be stored. The extension is added by the program.

Creation of Upper Limit File
 Key in X-Values and according Tolerance in dB
 Input of Frequency = 0 Hz stops Input

	Frequency / Hz	Tolerance / dB
Point 1	20	5
Point 2	50	5
Point 3	50	2
Point 4	100	2
Point 5	100	1
Point 6	5000	1
Point 7	12000	5
Point 8	20000	5
Point 9	0	

All Input Values ok ? < Y > < N >

Filename for Upper-Limit-File (no extension) ? **TEST**

Fig. 5: Input of values for upper tolerance curve

When entering the points of a curve, a differentiation is to be made between two possibilities:

- Interpolation points joined by steps
- Interpolation points joined by oblique lines obtained by linear interpolation.

Fig. 6 shows an example of this. The steps of the tolerance curve shown in the lefthand part of the graph are obtained by entering the frequency value twice, ie with two level values (see also screen mask above, points 1 to 5). For measured values coinciding with one of the corner points of the staircase, it is not obvious if the higher or the lower tolerance value is used. Which value is used depends on the rounding made with the built-in interpolation routine in each case. Should this uncertainty be undesirable, the tolerance values have to be entered with slightly differing frequency values.

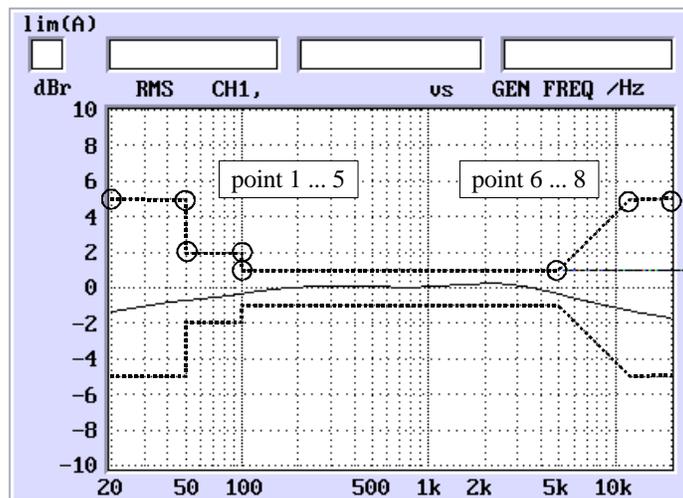


Fig. 6: Tolerance mask with / without steps

For the righthand part of the graph, only one level value was entered for each frequency point. Intermediate values are obtained by interpolation (points 6 to 8).

The above setting applies analogously to lower limit curves. For generating symmetrical tolerance curves, the values for the interpolation points need to be entered only once. The information is automatically stored in two limit files for the upper and the lower curve. The two files are stored under the same name with different extensions.

To activate tolerance curves for a measurement, the associated files must be loaded from the display panel under "Filename" (see Fig. 1).

7.2. Generation of Tolerance Mask Parallel to Test Trace

Sometimes, DUTs are to be compared with a nominal frequency response determined for a reference DUT ("golden unit"). This comparison too can be performed with application program LIMIT.BAS.

In this case too the settings in the display panel of the audio analyzer must be made first since they have an effect on the limit files. Then the reference frequency response is determined by means of a sweep and represented as a graph. The data obtained are automatically transferred to the program. Important: the nominal frequency response must be displayed as traceA since the program fetches data from this trace only.

Then, switchover is to be made to BASIC (keyF3) and the program is to be activated with LIMIT.BAS under the corresponding menu item. The screen mask shown in Fig.7 appears.

```

Creation of Limit Files from measured Curve Trace A
How many Tolerance Sections ? (1 ... 5)      3
Input Sections in Hz and shift of measured Curve in dB

      from / Hz   to / Hz   +Tol / dB  -Tol / dB
Section 1  20     50        2           2
Section 2  50     7000      1           1
Section 3  7000   20000     2           2

All Input Values ok ? < Y >   < N >

Filename for Limitfiles (no extension) ?   TEST
  
```

Fig. 7: Input of values for parallel tolerance mask

If several tolerance ranges are to be defined, the number of ranges is to be entered under "Tolerance Sections". Max. 5 ranges are possible.

When entering the frequency values, the start and stop frequencies are automatically taken from the sweep made before. The stop frequency of the previous range is taken as the start frequency of the next range. No signs are to be entered for dB values.

Fig. 8 presents the result obtained with the settings made before, showing the reference frequency response from which the traces were derived.

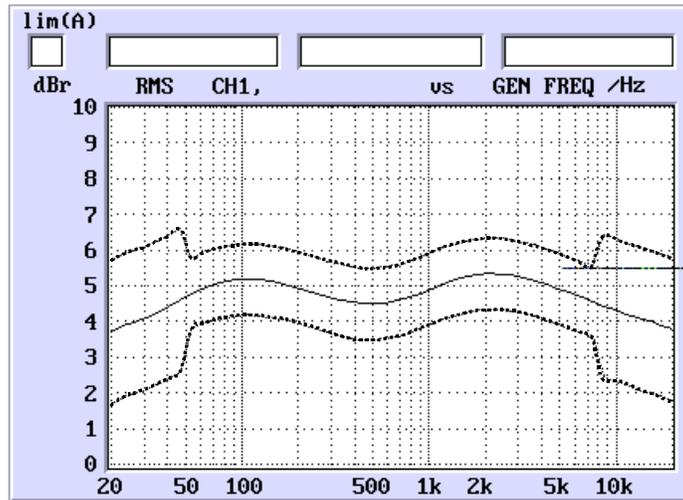


Fig. 8: Tolerance mask parallel to test trace with different tolerance ranges

From the graph it can be seen that the transition from a higher to a lower tolerance value and vice versa takes place between two test points. In the above example, the transitions do not take place exactly at the specified range limits (a logarithmic frequency sweep with 50 points was performed). The program fixes the range limits so that the last test point prior to a tolerance step is checked against the tolerance valid up until then, and the first test point after the tolerance step is checked against the new tolerance value. The larger the number of test points in a sweep, the steeper the transition points.

8. Display Modes for Different Kinds of References

With Audio Analyzers UPD and UPL, measured values as well as limit values can be used with absolute (eg V, mV, dBV, dBu) or with relative (eg dB, %, V/Vr) units. Depending on the units selected, different display modes are obtained and traces can be shifted in different ways.

A distinction is to be made between the cases described below. As a rule, the unit for the y-axis and for the measured values is the same.

a) Absolute units are used for measured values and limit values:

Test traces and limit curves cannot be shifted relative to one another. The reference has no effect on either of the two traces.

b) Absolute units are used for measured values, relative units for limit values:

If measured values are displayed with absolute units (the yaxis is also scaled in absolute units) and limit values with relative units, the tolerance curve can be shifted in a vertical direction by changing the reference value (Fig. 9). The reference value, which is in this case designated "Limit Ref", has an effect only on the limit values; the test trace remains unchanged (Fig.9).

Example: a measured value of 2 V is represented as 2 V on the y axis, which uses absolute scaling (point 1).

The Limit Ref value is to 0.5 V, and a limit value of 6 dB_r is assumed, which is calculated to give a voltage of 1 V (point 2 in the graph). If the Limit Ref value is changed to 1.5V, the limit curves are shifted since the Limit Ref value and the limit value now give a voltage of 3V (point 3 in the graph). The test trace remains unchanged; 2 V is still shown as 2 V.

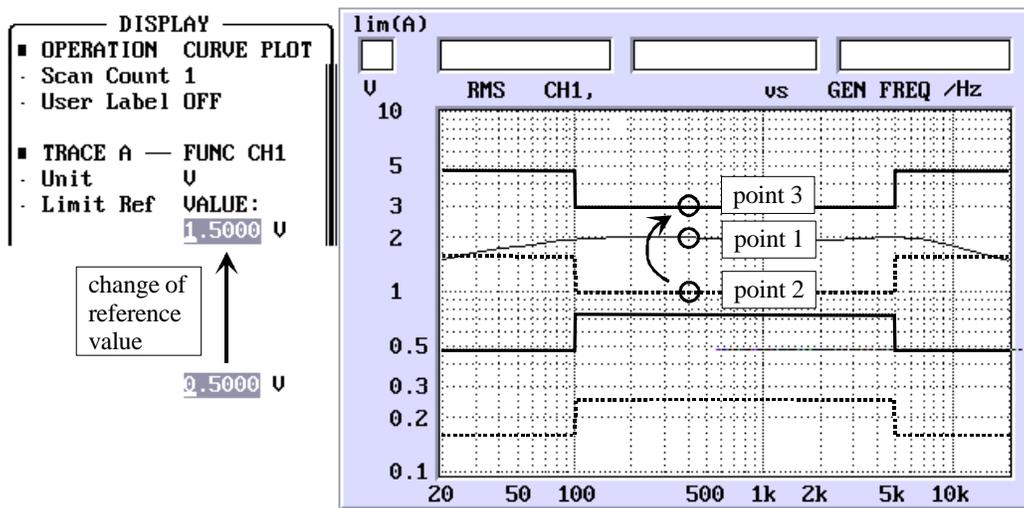


Fig. 9: Shifting of limit curve by changing the reference value

Application:

A test trace is checked for deviation from the average value. For this purpose, a tolerance mask is shifted over the test trace.

c) Relative units are used for measured values, absolute units for limit values:

This is possible only if fixed limit values are used. If the yaxis too is scaled using relative units, a change of the reference value results in a vertical shifting of the test trace and the limit curve, the position of the curves relative to one another remains the same.

d) **Relative units are used for measured values and limit values:**

Assuming that the y axis is scaled using relative units, a change of the reference value results in a vertical shifting of the test trace; the position of the limit curves remains the same. In this case the reference value has an effect both on the measured and the limit values and is designated "Reference". The effect obtained in this case may be surprising at first sight, it can however be easily understood by means of an example:

The reference value is set to 1 V, and from the graph a measured value of -20 dBr is taken which corresponds to an absolute voltage of 100mV (point 4). The upper limit for this point is defined to be 6 dBr, which corresponds to an absolute value of 2V (point 5).

The reference value is lowered to 100mV. The limit value is still 6 dBr and is also displayed as 6 dBr, ie it does not change its position on the dBr scale although it now corresponds to an absolute voltage of 200 mV. The original measured value of 100mV (the measurement is not repeated) is now referred to the new reference value and therefore displayed as 0dBr (point 6). The test trace is thus shifted.

This mode is used if a frequency response measurement is made with a tolerance mask and measured values have to be referred to the 1-kHz point. Limit values remain unchanged, the test trace is shifted to the 0-dB point at the reference frequency.

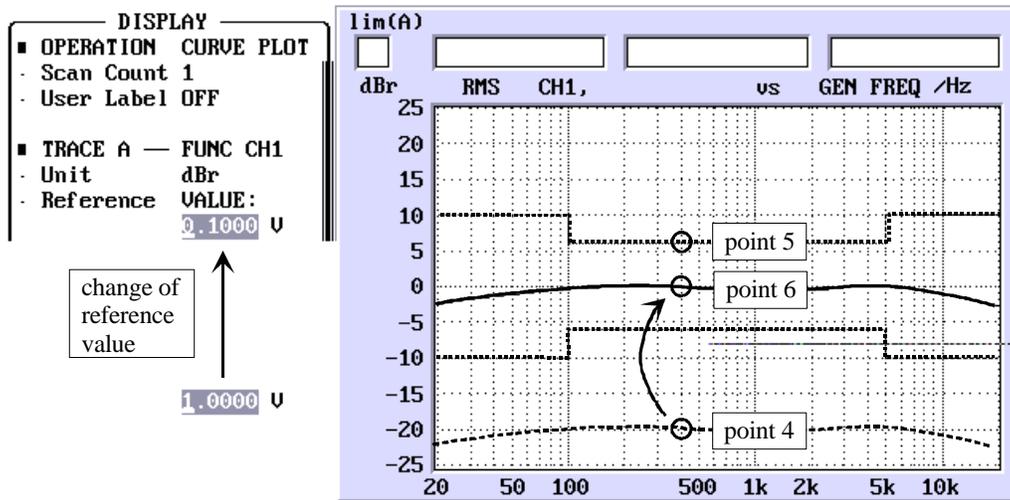


Fig. 10: Shifting of test trace by changing the reference value