

WFGUI User Documentation

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1. Preface by Matthias Klumpp

We, the contributors, want to thank the author for his excellent work he has spent on developing and improving this tool. It provides a very good base for all the analog audio enthusiasts, especially those working on vintage equipment, to keep their units in good working shape

2. What is WFGUI ?

- WFGUI (**Wow & Flutter Graphical User Interface**) is a tool that provides possibilities to adjust speed and measure speed fluctuations real-time by software means that in former times needed to be done by hardware Wow & Flutter meters.
- It can be used for turntables, audio cassette decks or open reel tape decks by playing a reference disk or tape with either a 3000Hz or 3150Hz tone.
- The output signal of the audio device is then input to the PC's soundcard and evaluated by WFGUI.

Note:

This software is provided in good faith, but supplied "as is" without any warranty of any kind.

3. Communities & discussions

WFGUI was presented in several internet forums.

English:

Tapeheads: <http://www.tapeheads.net/showthread.php?t=32287>

DiyAudio: <http://www.diyaudio.com/forums/analogue-source/254453-software-w-f-meter.html>

German:

New-Hifi-Classic: <http://new-hifi-classic.de/forum/index.php?topic=7328.0>

Bandmschienenforum: <http://forum2.magnetofon.de/board7-digitale-audiotechnik/board84-anwendung-und-praxis/15584-wfgui-wow-flutter-echtzeitmessung-per-software/ - post166946>

4. Download

WFGUI can be downloaded from the following sites:

Alex Nikitin's page: <http://www.ant-audio.co.uk/index.php?cat=post&gry=library>

New-Hifi-Classic Server: http://uebergabe-daten.hifi-classic.at/httpdocs/kuni/WFGUI/WFGUI_Test_WAV_Files.zip

5. Further improvements

- The author is spending his spare time on developing this tool without charging anything.
- Please be aware that he has no obligation for anything, but hopefully will continue to work on further suggestions and improvements.
- The a.m. communities can be used to report problems and suggestions.

6. System requirements

- WFGUI was tested with Win XP / 7 / 8 and should flawlessly run on these platforms.
- The PC system should have at least a 1,6GHz dual core processor and - of course - a sound card.

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7. Accuracy

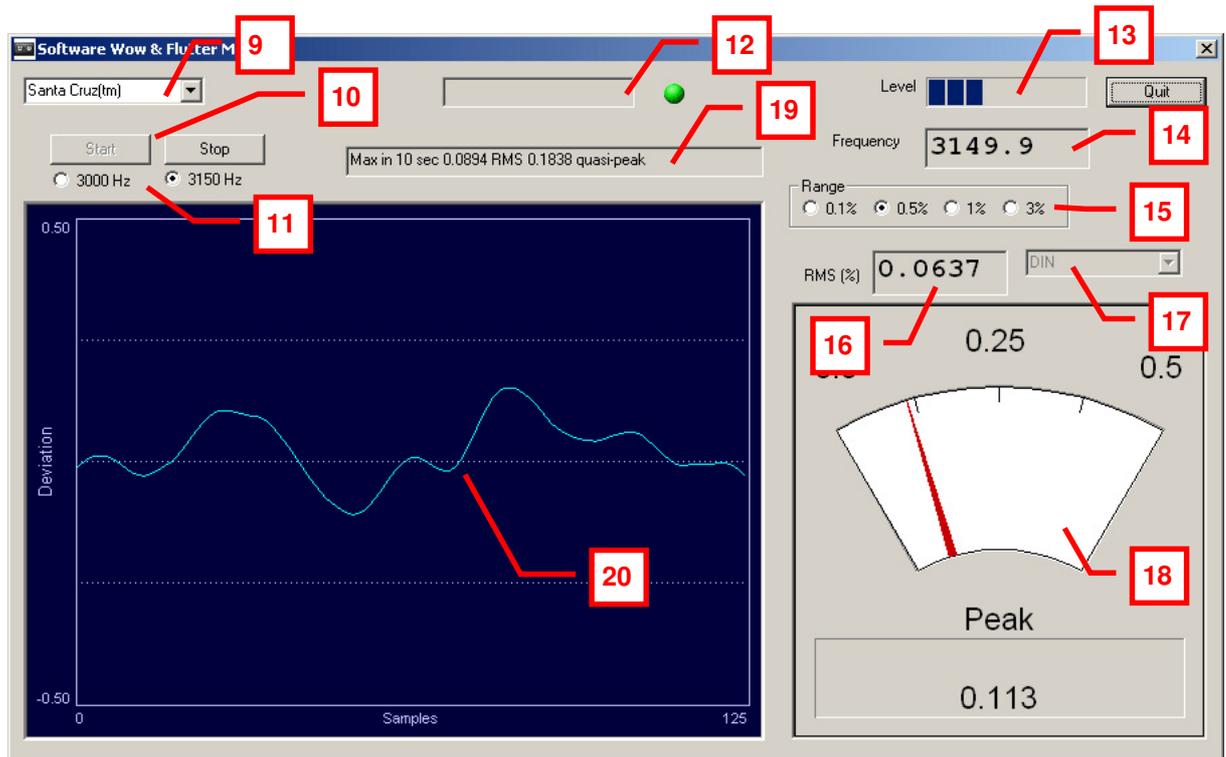
WFGUI's accuracy was initially tested with several WAV files taken from audio cassette decks. The results were compared to hardware W&F meters.

	Sony WM-D6C	Sony TC-D5M	Tandberg TCD-310	ASC AS-3001	Tandberg TCD-3014
Speed					
WFGUI	-0,01% (3149,7Hz)	-0,65% (3129,6Hz)	-0,02% (3149,5Hz)	+0,09% (3152,8Hz)	-0,06% (3148,0Hz)
Woelke ME106	-0,02%	-0,70%	-0,04%	+0,08%	-0,08%
Philips PM6307	0%	-0,60%	0%	-	-
Kenwood FL140	¹⁾	¹⁾	¹⁾	-	-
W&F (DIN)					
WFGUI (peak)	0,11%	0,08%	0,29%	0,28%	0,08%
Woelke ME106	0,12%	0,08%	0,30%	0,30%	0,09%
Philips PM6307	0,10%	0,06%	0,26%	-	-
Kenwood FL140	¹⁾	¹⁾	¹⁾	-	-
W&F (unweighted)					
WFGUI (peak)	0,36%	0,18%	0,37%	0,52%	0,13%
Woelke ME106	0,44%	0,30%	0,38%	0,50%	0,20%
Philips PM6307	0,40%	0,10%	0,35%	-	-
Kenwood FL140	¹⁾	¹⁾	¹⁾	-	-

¹⁾ Just little or no difference (<5% of the value measured) found in reading between WFGUI and the Kenwood FL-140 in all modes except in non-weighted peak measurements (still less than 10% of the value measured).

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8. GUI overview



9. Signal (sound card) input

- The sound card device for input signal capturing can be selected here (drop down box shows one entry per detected sound card).
- WFGUI only shows the primary recording channel (as selected in the control panel) of each device.
- A selection of the various input/recording channels of a sound card (e.g. microphone, line etc.) can't be done directly from within WFGUI.

Win XP:

Input/recording channel selection can be done with the sound mixer control.

Win 7 / 8:

Win 7 / 8 doesn't offer a sound mixer with selection of the recording channel anymore.

Instead, this needs to be done in the sound settings of the control panel.

Note:

- Just setting the wanted recording channel to "default" might sometimes not be recognized correctly by WFGUI. This seems to depend on the hardware.
- In such cases, all unwanted recording channels need to be deactivated instead.
- By selecting "Stereomix" for recording, this provides a way to analyze also WAV files while playing them e.g. with Audacity.

Note:

- Data capturing is done with standard 44.1kHz / 16 bits.
- WFGUI applies a general input filter with 600Hz bandwidth to the incoming signal.

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10. Start / Stop button

- By these buttons the measurement can be started, stopped and re-started.

11. Center frequency

- Defines the center frequency WFGUI is using for its analysis.
- The setting can be changed during a running measurement.
- 3000Hz setting: Frequencies <2850Hz or >3150Hz are ignored (valid range: $\pm 5\%$)
- 3150Hz setting: Frequencies <2992,5Hz or >3307,5Hz are ignored (valid range: $\pm 5\%$)
- The accuracy of the test frequency (3000 / 3150Hz) will have no effect at all on W&F measurements within the $\pm 5\%$ valid range.

12. Signal quality indicator

- If the signal quality is good for WFGUI to analyze W&F, then the "lamp" is green.
 - ⇒ Level needs to be higher ~ 24mV / -30dBm
 - ⇒ Frequency must be in valid range
- Otherwise the "lamp" is grey and a message is shown in the box.
- The indicator only works when the measurement is started.

13. Signal level meter

- Shows the applied signal level.
- With sound mixer level sliders all set to 100%, full range is ~ 170mV / -13dBm (absolute value may depend on the hardware).
- The signal level doesn't have any impact on the calculation accuracy as far as the level is high enough for data capturing.
- The level meter only works when the measurement is started.

Note:

- There are intentionally no voltage levels given on the level meter.
- WFGUI doesn't control the mixer gain, it therefore has no way to determine the absolute level.
- Read samples are internally within a range of ± 32767 (16 bit sampling resolution).
- If they are < 50 WFGUI simply declares the level being too low.

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14. Frequency counter

- Currently measured frequency.
- For speed adjustment the measured frequency should equal the reference frequency specified for the played reference tape or disk.
- Frequency **outside** the valid range ($\pm 5\%$) of the center frequency:
 - Frequency display is still updated, but then rounded down to 5Hz
 - This mode is useful to adjust speed deviations near to $\pm 0\%$
 - ***The speed of the audio device needs to be adjusted prior to do any W&F measurement in order to get into the valid range again for further analysis of W&F.***
- Frequency **inside** the valid range ($\pm 5\%$) of the center frequency:
 - Accuracy is a lot more precise as indicated by the format with a decimal point.
 - This mode is required to reliably measure W&F.

Note:

- WFGUI's frequency counter relies upon the sound card oscillator
- Some sound cards may give very accurate results, but some may give an error.
- It's therefore recommended to test the used sound card in this respect.
- Anyway the accuracy of the reference crystal in the sound card will have no effect at all on W&F measurements within the $\pm 5\%$ valid range.

15. Display range

- Display range for scope and needle instrument.
- The setting can be changed during a running measurement.

16. RMS% value

- RMS (root mean square) value in % of the currently evaluated Wow & Flutter.
- The result depends on the selected W&F evaluation method.

17. W&F evaluation method

- Specifies according to which standard the W&F shall be evaluated.
- The setting can't be changed anymore if the measurement was started.
- If it is to be changed, WFGUI needs to be stopped, closed and re-opened.
- For details about the filters, refer to the diagrams below.

DIN (weighted):

- Applies a weighting filter according to the German Industry Standard (**Deutsche Industrie-Norm**)

Unweighted:

- Applies a Bessel bandpass filter, 4th order, -3dB frequencies: 0,3 - 200Hz

Wow:

- Applies a Bessel bandpass filter, 4th order, -3dB frequencies: 0,3 - 6Hz

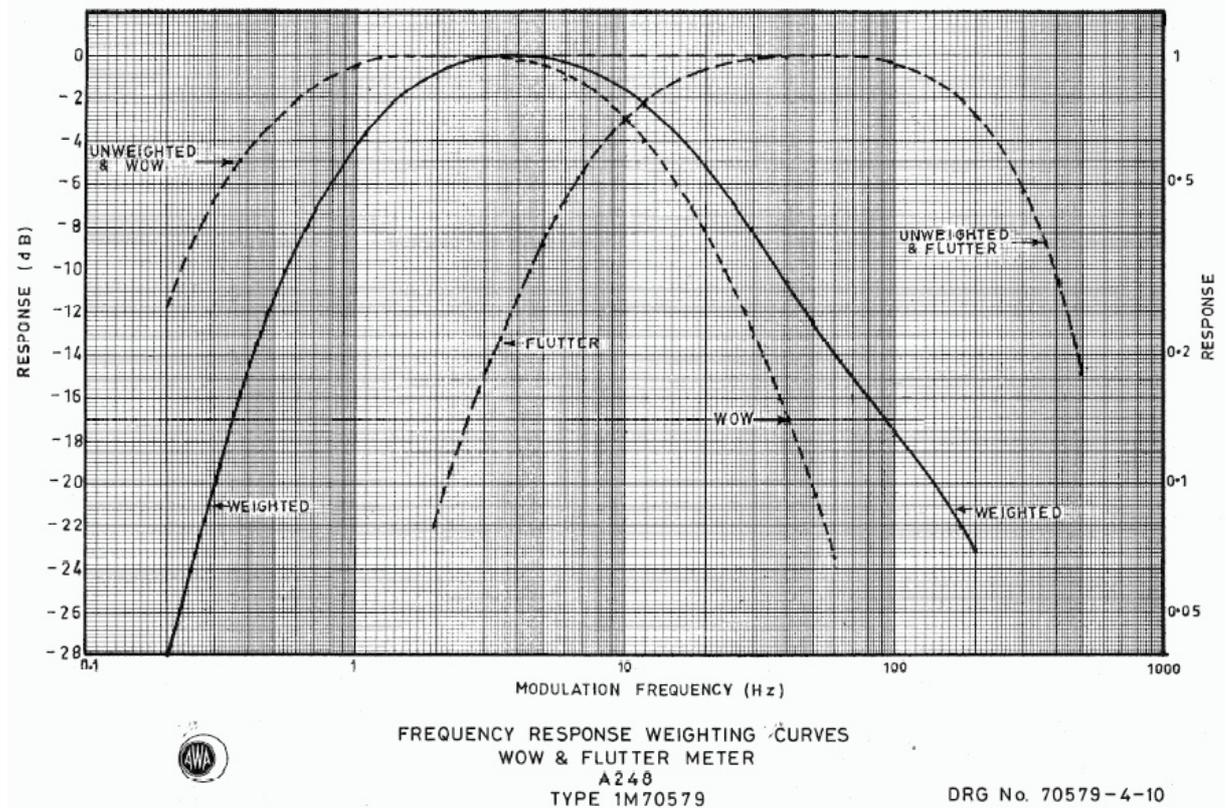
Flutter:

- Applies a Bessel bandpass filter, 4th order, -3dB frequencies: 6 - 200Hz

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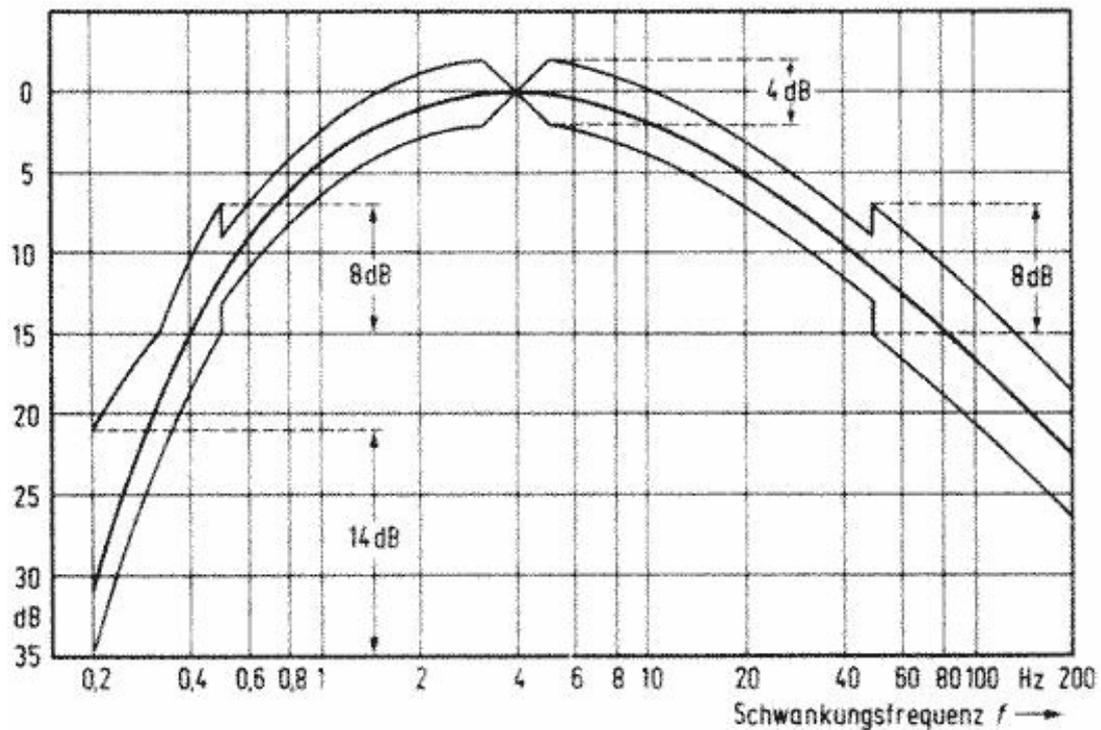
Weighting filters used by WFGUI:

General characteristics of different weighting filters:



In detail the weighting filter according DIN 45507 with allowed tolerances:

- Bessel filter (0,2Hz to 200Hz) consisting of a 1st order low pass and 2nd order high pass filter.



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18. Peak value (needle instrument + numeric display)

- Peak (current) value in % of the currently evaluated Wow & Flutter.
- The result depends on the selected W&F evaluation method.
- The dynamics of the needle instrument are adjusted to simulate attack and decay of a real analog hardware instrument.

19. Maximum value

- Maximum value of RMS and (quasi) peak in % during the evaluation period of the last 10s.
- Re-calculation of these values starts newly, if WFGUI is stopped and re-started.

Note:

- If the signal is not steady (i.e. turned off and on while capturing), the first 20s will not show reliable values. These values should therefore be discarded.

20. Oscilloscope

- The scope screen shows ~200ms of the demodulated signal (period of the last 125 samples).
- E.g. when testing with an artificial 2Hz sine modulated 3150 Hz you can clearly see the sine wave going between ± 0.5 for 0.5% Wow.
- This therefore not only shows the real peaks but also gives a good idea of the nature of the Wow & Flutter.
- The result depends on the selected W&F evaluation method.

21. Version history

wfgui_4_60.exe

- First public beta version with capability of signal real-time processing directly from sound card.

wfgui_6_00.exe

- Changed ranges to 0,1%, 0,4%, 1% and 4%
- Changed the meter color to light yellow
- Added saving of raw "demodulated" data in a file "WF_out.dat" in the current directory:
 - The program mimics the structure of a hardware tool.
 - The input filter applied to the raw 3 (or 3.15) KHz data is always present but is pretty flat around the center frequency and should not affect the demodulated signal's spectrum much.
 - Then the signal is frequency demodulated by calculating time between consecutive zero crossings and subtracting the "perfect" interval.
 - This demodulated signal is optionally saved before being processed by the next filter.

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22. Internet links with additional technical information

- Measuring method for W&F as per DIN 45507 (German):
http://www.theimann.com/Analog/Misc_Tech/Mess_TB/Teil2.html
- Schematic for a W&F meter (German):
http://www.theimann.com/Analog/Misc_Tech/TonSchwMess/index.html
- Article "Speed, pitch and timing errors in tape recording and reproducing" by John McKnight (English):
http://home.comcast.net/~mrltapes/mcknight_speed.pdf