REPORT TEST

FLUENDO LOOP
FLUENDO 5G
FLUENDO DOCTOR

anti-vibration system

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pro-t-one

handmade
brainmade
heartmade

abstract

The instrumental tests have been done to measure in a qualitative and quantitative way the behavior and response of the anti-vibration devices FLUENDO LOOP - FLUENDO 5G - FLUENDO DOCTOR in the racquet sports of tennis and padel, (even if we can use them also for all the racket and bat sports).

Tests have been standardized to allow a credible and affordable simulation of impacts in the presence of a beating mass hitting the tennis racket and padel "pala".

Measurements were carried out using a piezoelectric clip-detector applied to the handle of the rackets whose signal, pre-amplified with the same gain for all tests, was conveyed to the computer where was digitally recorded using a specific software, at 44000Hz.

Recording and sampling carried out on multiple impacts, has allowed to detect the signal peaks and frequency distribution as well as the signal decay mode in the in relation to the time coordinates.

FLUENDO LOOP - anti-vibration device to be placed on TENNIS racket strings

construction material rubber - elastomeric materials - weight detected 3.0g

FLUENDO 5g - anti-vibration device to be placed at the base of TENNIS or PADEL racket shafts

construction material rubber - elastomeric materials - weight detected 4.0g

FLUENDO DOCTOR - anti-vibration device to be placed at the base of TENNIS or PADEL racket shafts

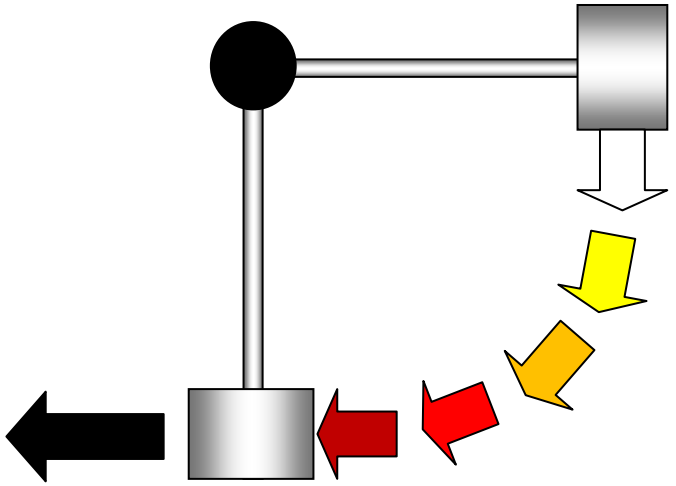
construction material rubber - elastomeric materials - weight detected 13.5g

TENNIS test procedure

For our test procedure we used a specific device called PRO-T-ONE MARTELL-ONE, a gravity pendulum used for dynamic impact tests on tennis materials and in general for sports materials.

A metallic weight, in the case of tennis equal to 1280-1300g (2.85-2.90lbs) is dropped from a height of 46cm (18.11inch) and hits the string plate of the strung racket in the ideal point of impact (sweetspot) located approximately in the center of the oval.

A tennis ball hangs from the mass (depressurized type to ensure maximum consistency of performance even with the passage of time) supported by a spoon-shaped device that allows you to orient and adjust the impact in terms of pendulum length and direction.



It is fundamental to highlight the fact that in order to simulate the impact in the most credible and realistic way possible, the racket is suspended to simulate the presence of a spherical hinge similar to that which forms with the wrist joint during the impact and at the same time in order not to affect, if not in a negligible manner, the absorption of frame vibrations in the presence or absence of anti-vibration devices.

In the impact schematization losses in the order of 10-15% were considered, which appear entirely credible given the quality and nature of the elements used.

ENERGIA TRASMESSA IN FASE DI IMPATTO CON LA PALLA

tennis

peso del maglio	1300	g	=	1,3	kg
altezza di caduta	46	cm	=	0,46	m
energia potenziale	**5,98**	**J**	**dovuta alla caduta del maglio**		
velocità	3,03	m/sec	=	10,92	km/h
velocità reale max	2,73	m/sec	=	9,83	km/h
velocità reale min	2,58	m/sec	=	9,28	km/h
energia cinetica max	**5,38**	J	**perdite**	10%	
energia cinetica min	**5,08**	J	**perdite**	15%	
quantità di moto max	3,55	con un maglio da		1300	g
quantità di moto min	3,35	con un maglio da		1300	g
velocità eq. palla	**61,19**	**m/sec**	**=**	**220,27**	**km/h**
velocità eq. palla	**57,79**	**m/sec**	**=**	**208,03**	**km/h**

The system has been dimensioned to schematize the impact of a tennis ball impacted on the string plane at an overall speed between 210 and 220 km/h (racket speed + incoming ball speed).

It is fundamental to underline, as premised, that the racket is fixed on the gantry by a suspension system capable of guaranteeing a behavior similar in dynamic terms, to the real biomechanical one → response of a spherical hinge in simulating the wrist during the ball-racket impact.

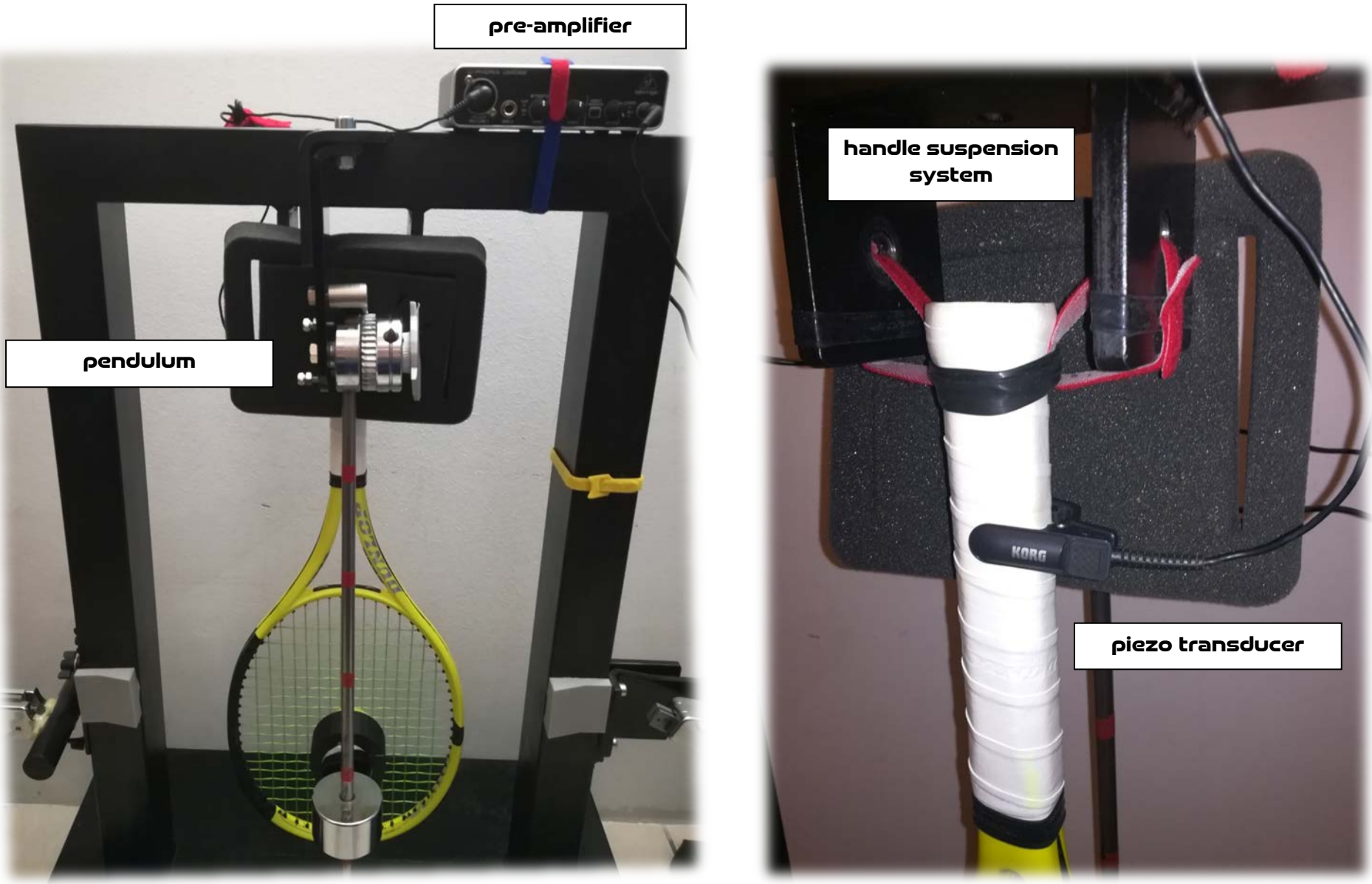
To obtain such a result, the racket handle is suspended by a couple of elastic bands holding the grip at the buttcap and a pair of velcro bands that support the rubber rings, connecting the frame, indirectly, to the steel MARTELL-ONE portal.

The working scheme of the whole system is as follows:

- Mechanical instrumentation for impact tests → pro-t-one MARTELL-ONE - beating mass 1300g (tennis)
- Suspended racket DUNLOP SX300 (300g) 2022
- KORG piezo - contact microphone on the handle
- Behringer Uphoria UMC22 signal preamplifier
- Portable computer HP Pro-Book - microprocessor Intel I5
- Recording-sampling program WAVEPAD Master Edition 2021 - sampling frequency 44kHz
- Frequency analysis program TFFT (Temporal Fourier Fast Transformation) WAVEPAD Master Edition 2021

The scheme can be schematized as follows:

Microphone → Preamplifier → Computer → Digital recorder → Frequency analyzer

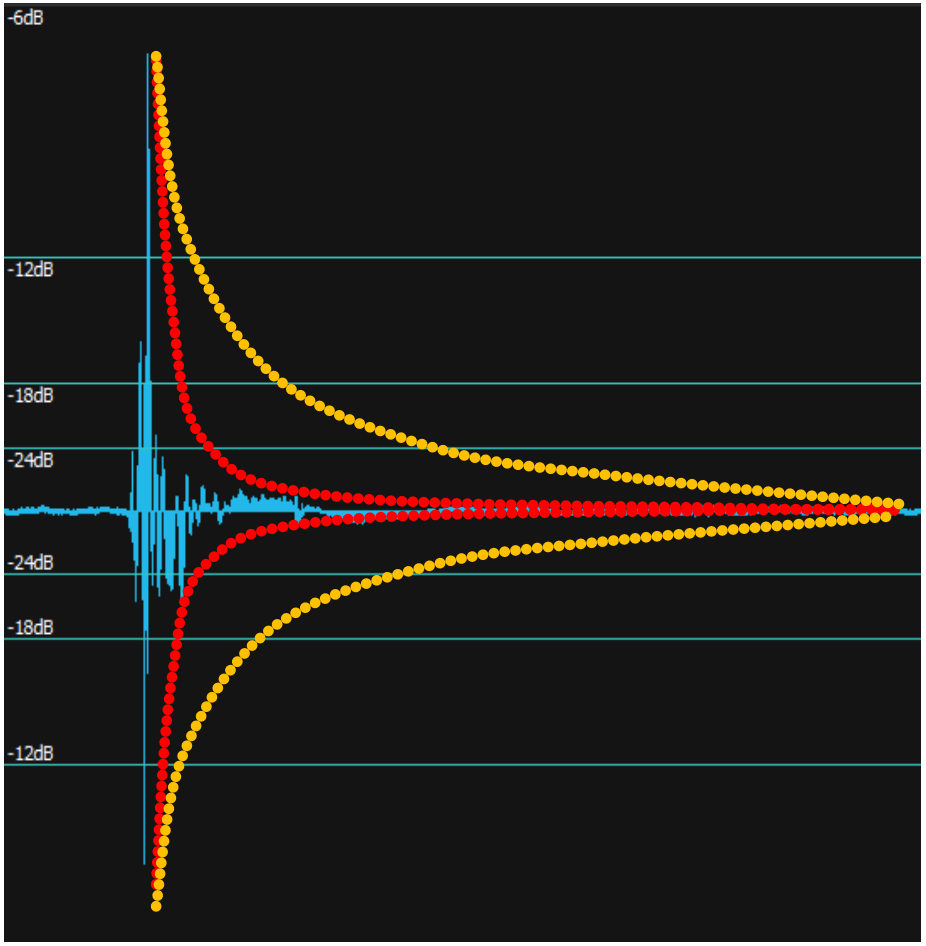


pro-t-one MARTELL-ONE - dynamic impact simulation system

From the signal recording it is possible to identify the magnitude of the vibration - impact as well as the signal decay mode.

The higher the peak, the greater the signal and consequently the impact SHOCK.

The shorter the wave tail, the better the absorption of vibrations, and on the contrary, the longer the tail, the worse the absorption of vibrations-waves.



During the experiment execution we paid attention to the measurements homogeneity and elimination of elements that could disturb data collection.

In the analysis phase we considered the average of the peaks evaluated on 7 selected impacts by eliminating the highest and the lowest value among a sequence of 10-12-15 impacts.

Despite the same drop height and execution of the weight release, variations in terms of peak value are detectable due to non-eliminable systematic elements that affect the overall system behavior.

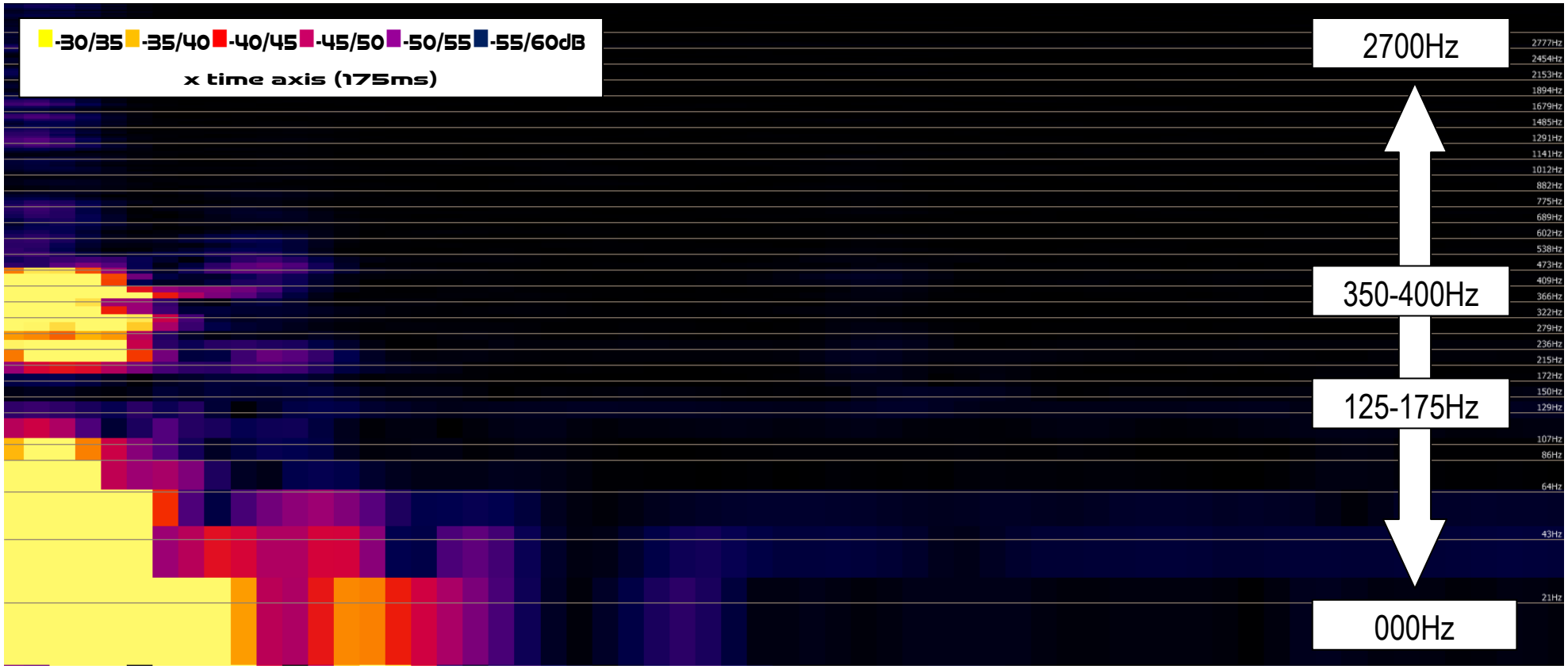
As much as possible, an attempt was made to minimize the variations and standardize the impact modes as much as possible in the direction of maximum test reliability.

The TFFT analysis, however, confirmed the reliability and consistency in terms of the general performance of the test.

The next step involved the frequency distribution analysis in terms of temporal distribution with TFFT (Temporal Fourier Fast Transformation) analysis.

This analysis allows you to accurately describe the frequencies distribution in relation to time and provides a useful tool for direct, fast and immediate evaluation of the frequency distribution, response and signal decay mode .

The colors from lightest to darkest WHITE - YELLOW - ORANGE - RED - VIOLET - BLUE - BLACK indicate the value in dB relative to the frequency of interest with the passage of time (brighter values greater intensity)



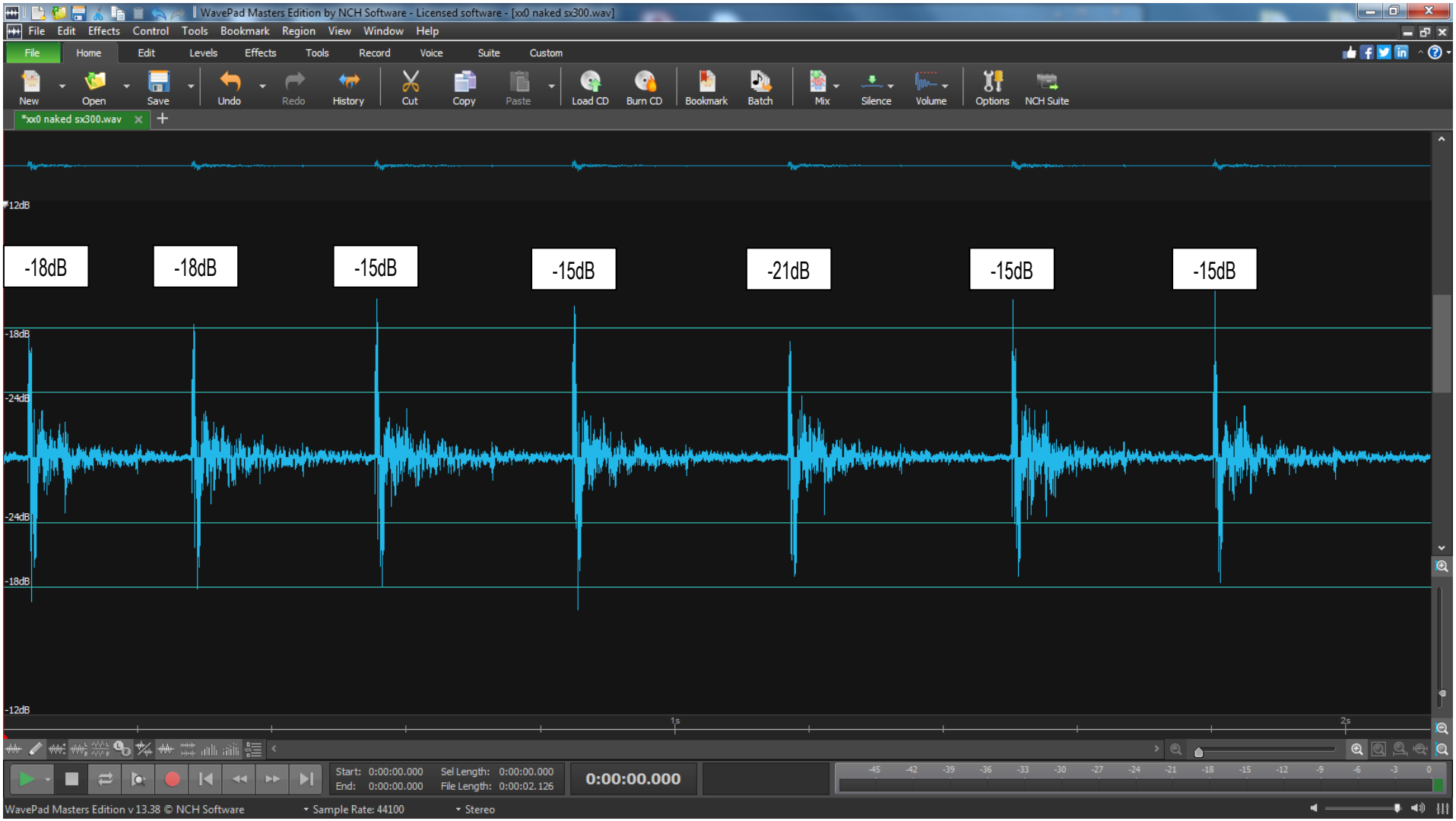
x → time

to better understand try to think at a water plane looked from above with some waves on the surface.

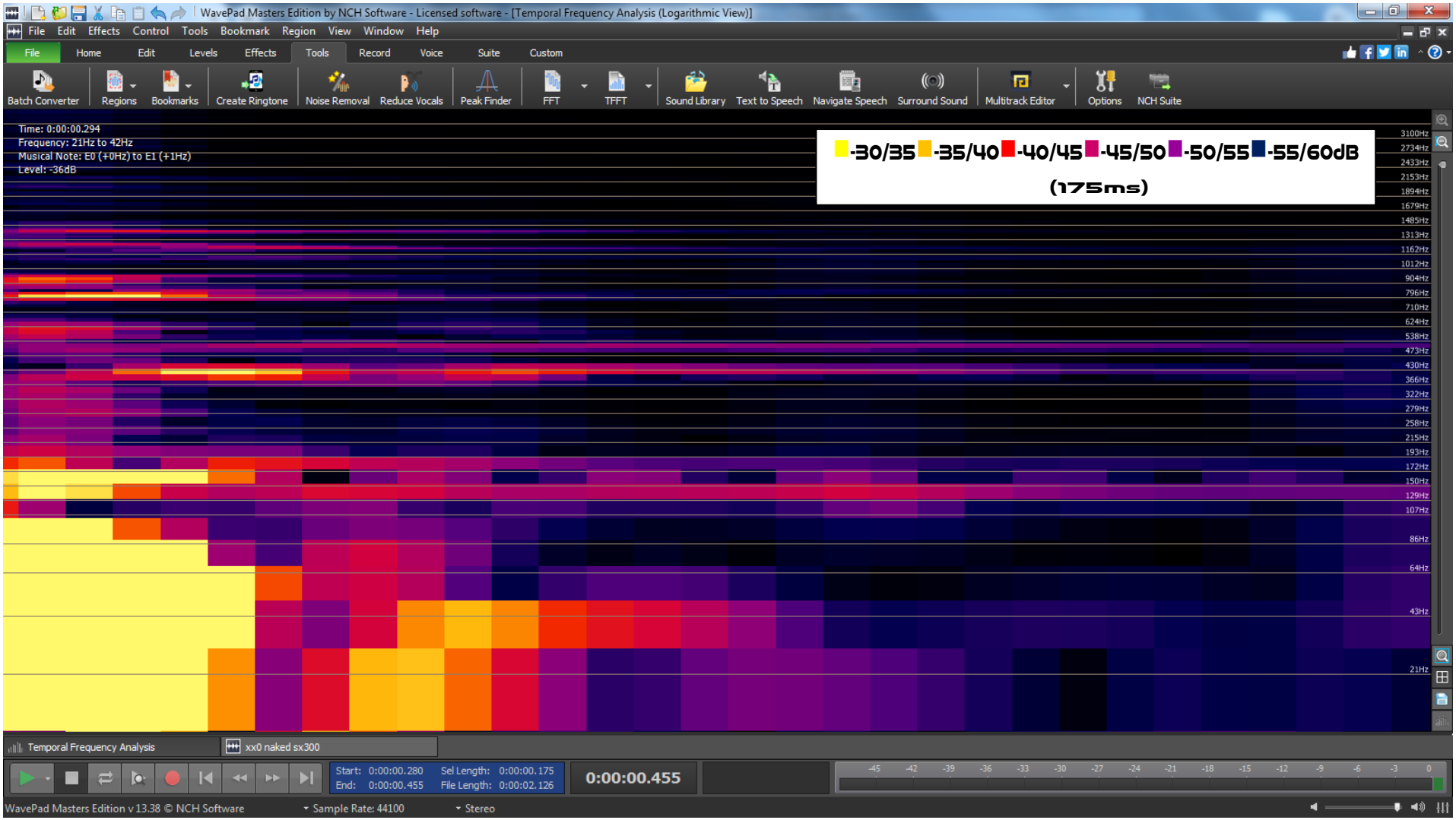
Clearer and brighter colours show the ridge of the wave.

--- TENNIS ---

test n°1 - impact test - naked racket



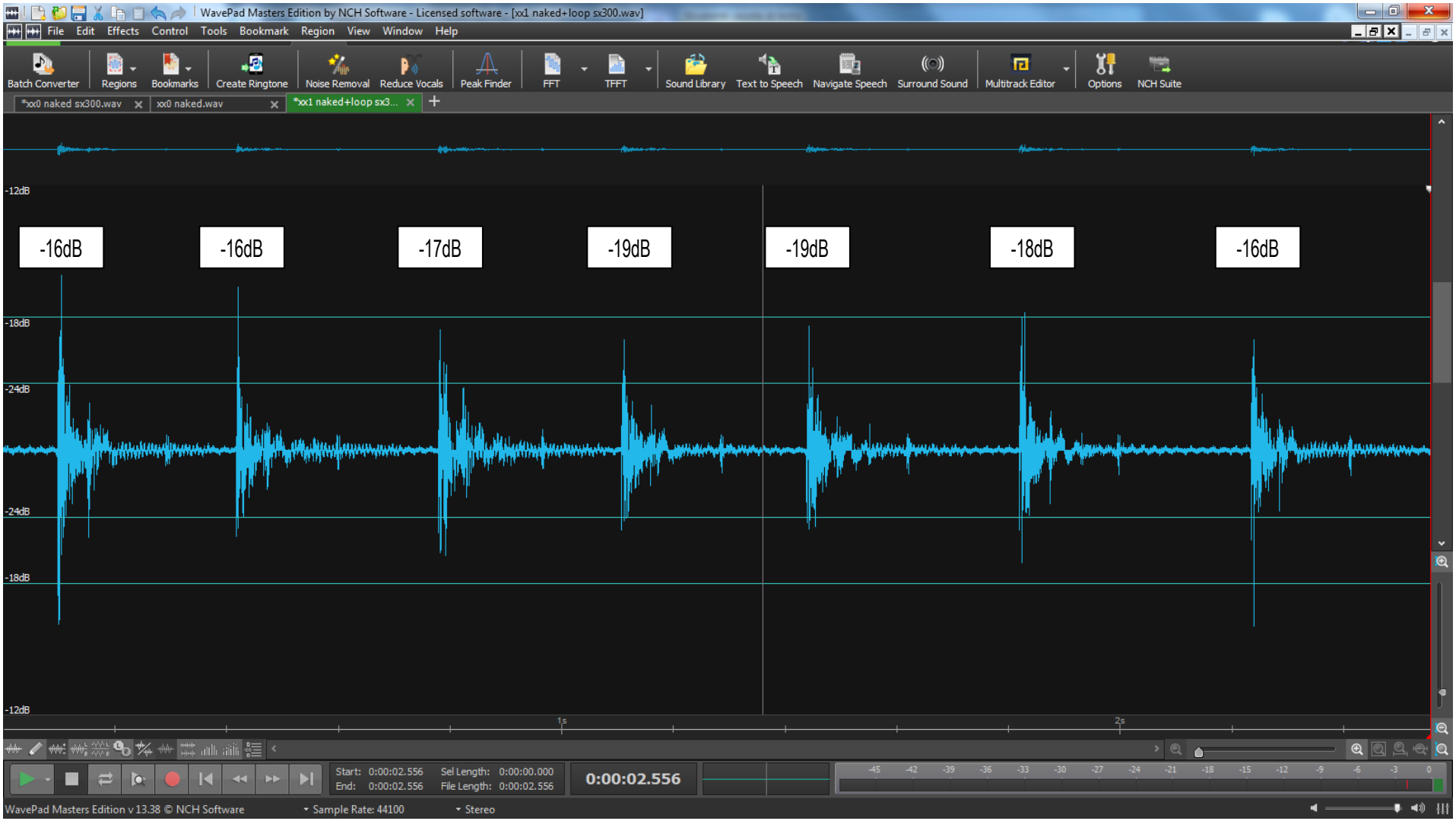
peaks reconding - naked racket



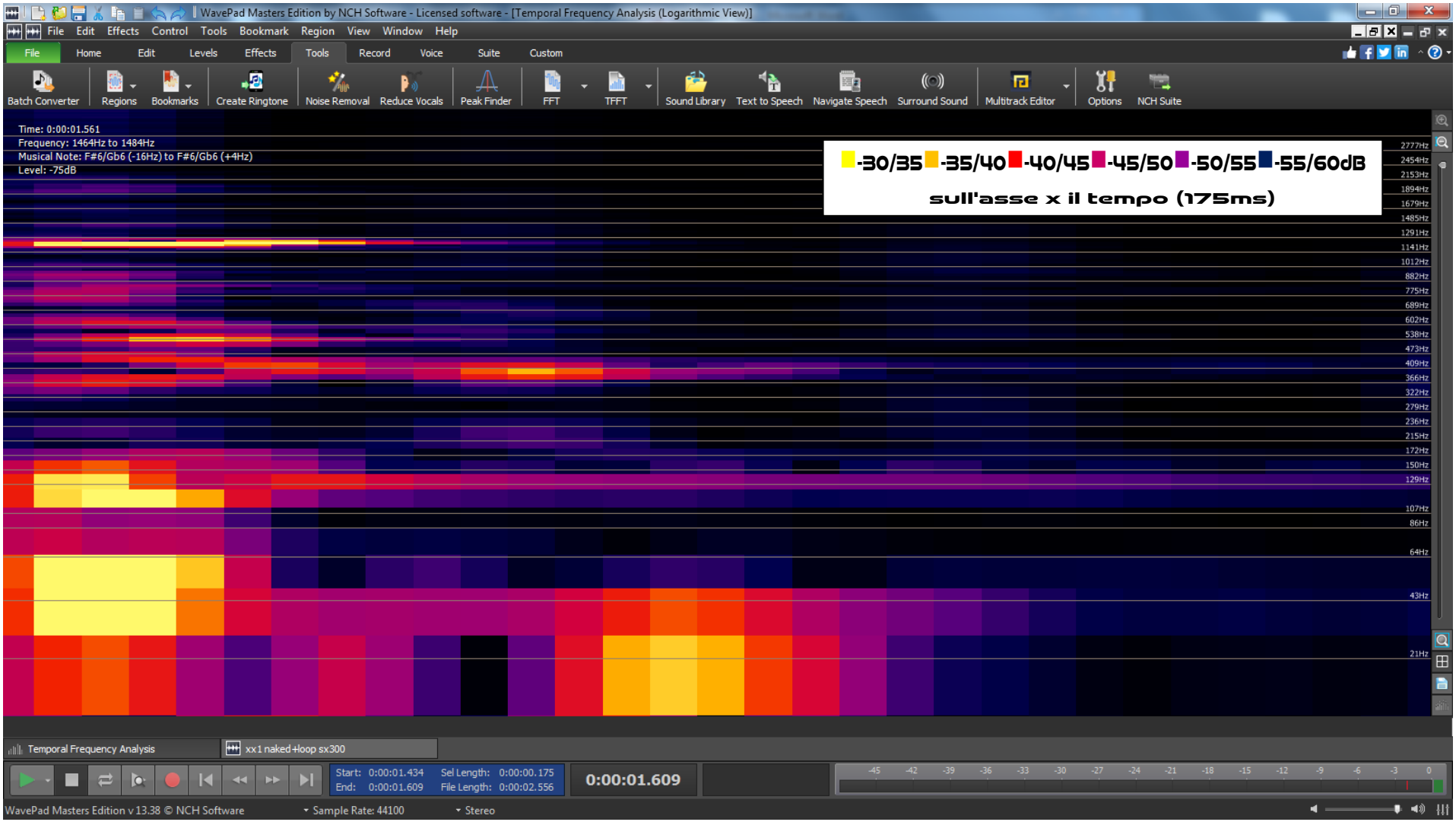
Frequency analisys TFFT - time interval 175ms

naked racket

test n°2 - impact test - racket + LOOP



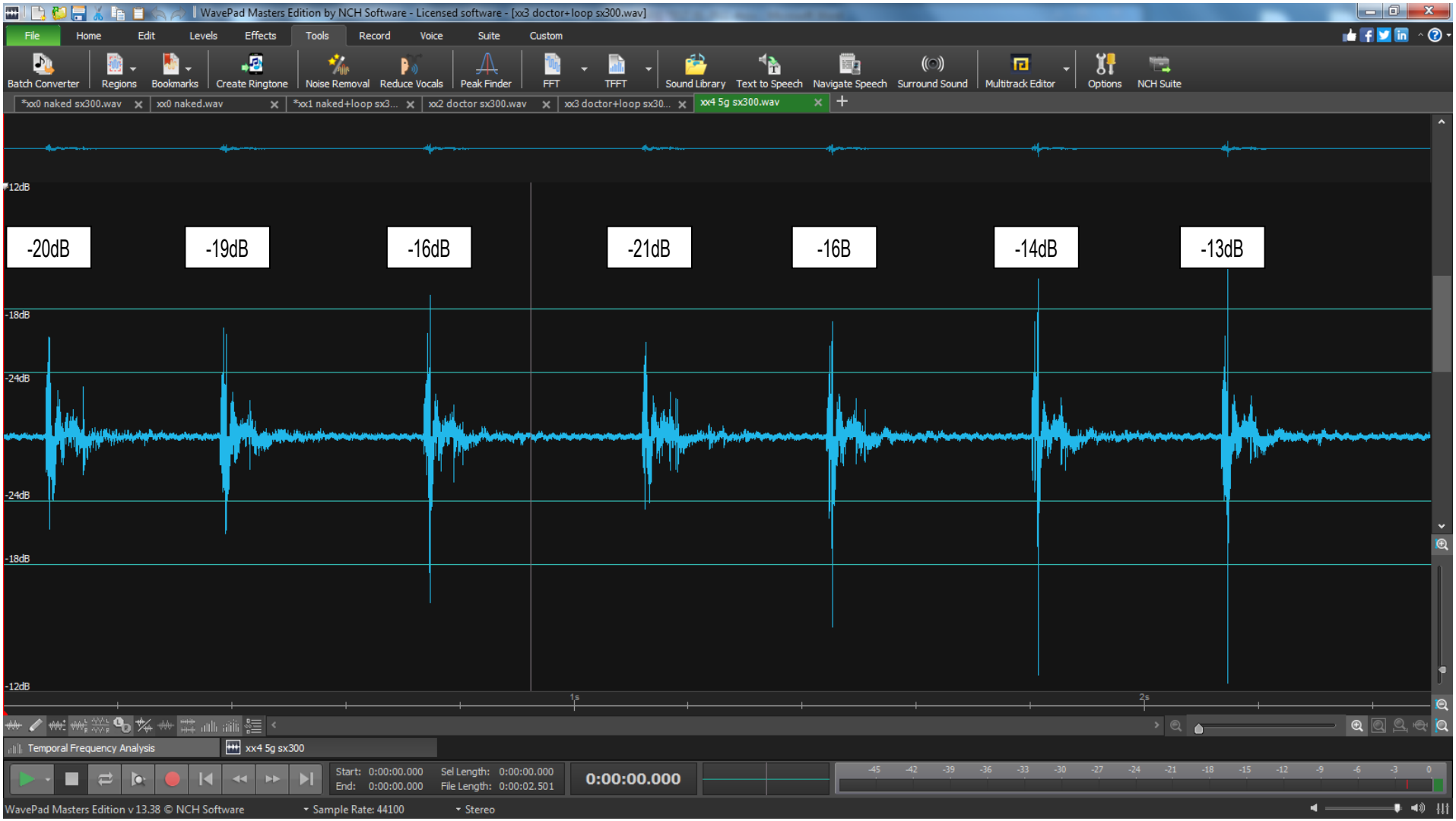
peaks recording - racket + loop



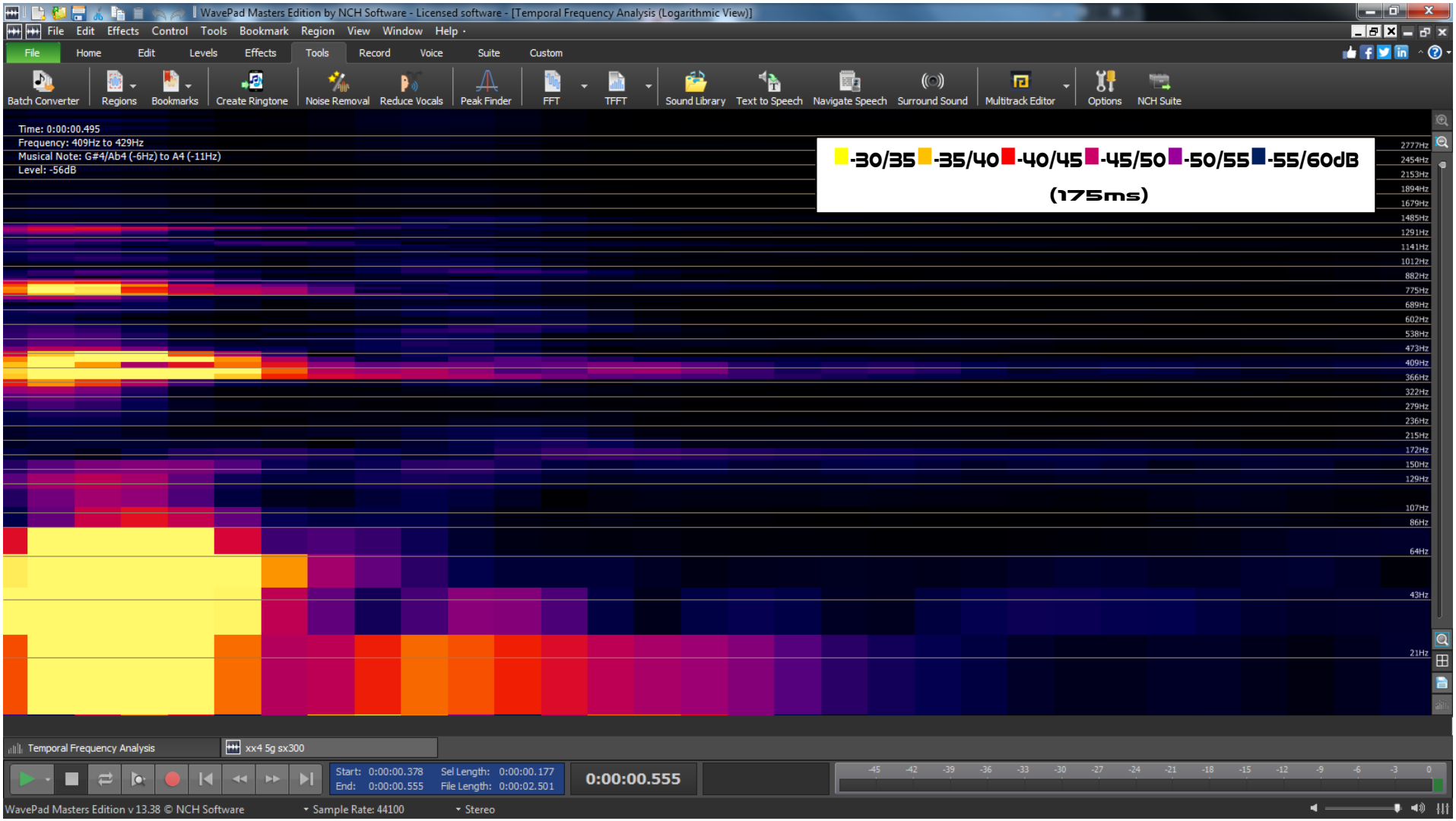
Frequency analisys TFFT - time interval 175ms

racket + loop

test n°3 - impact test + FLUENDO 5G



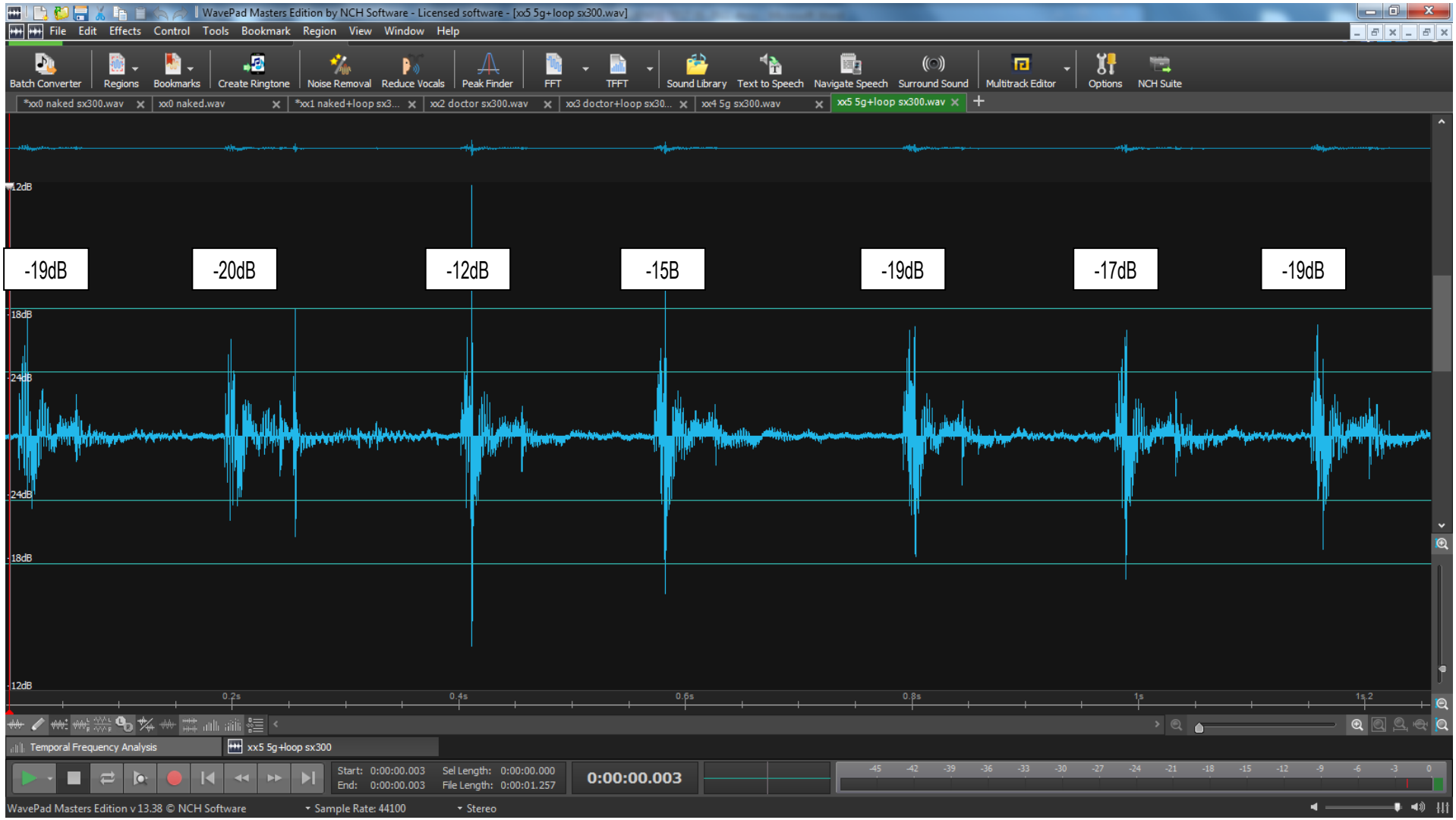
peaks reconding - racket + 5G



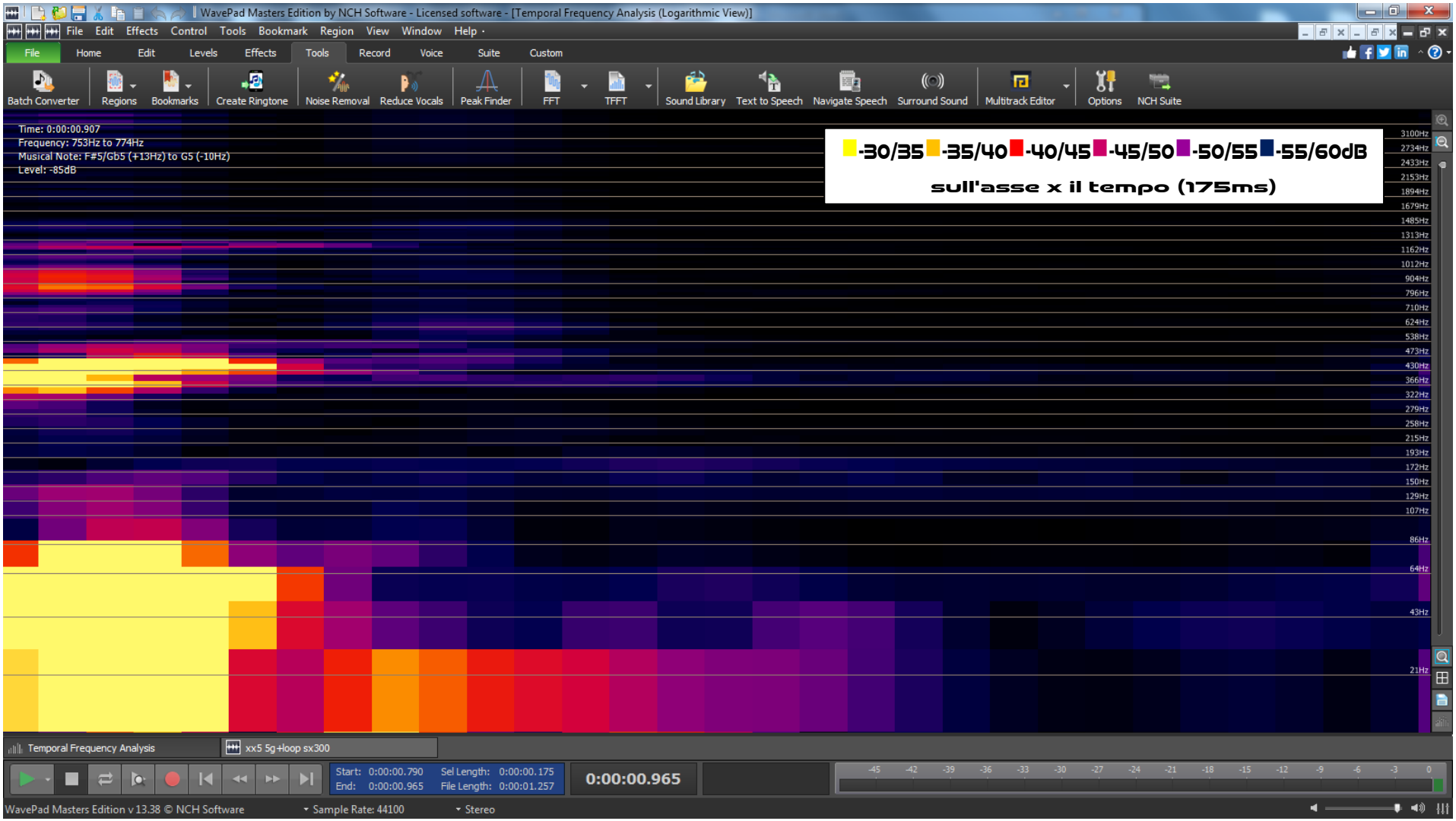
Frequency analisys TFFT - time interval 175ms

racket + 5G

test n°4 - impact test racket + 5G + LOOP



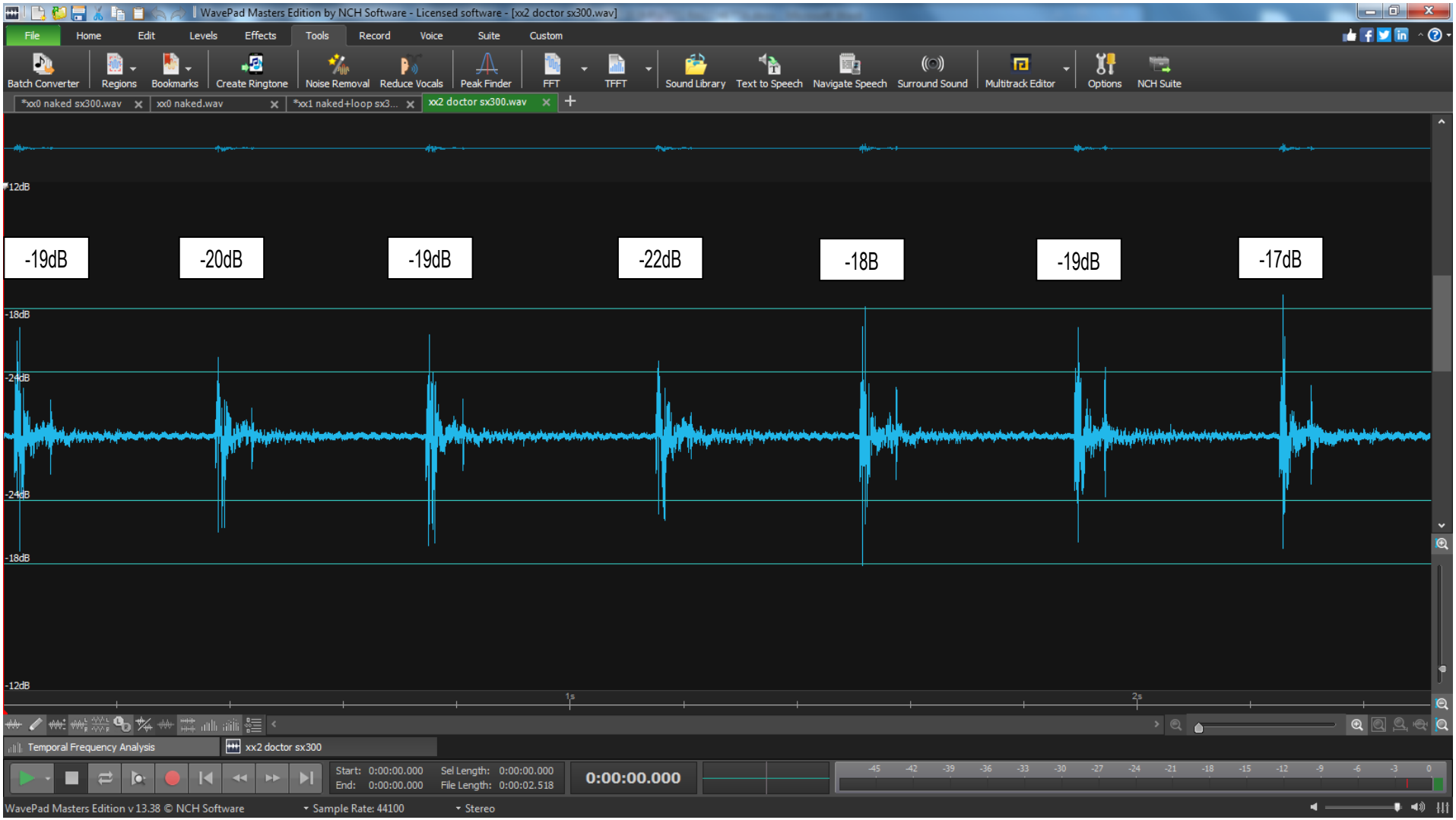
peaks recording - racket + 5G + loop



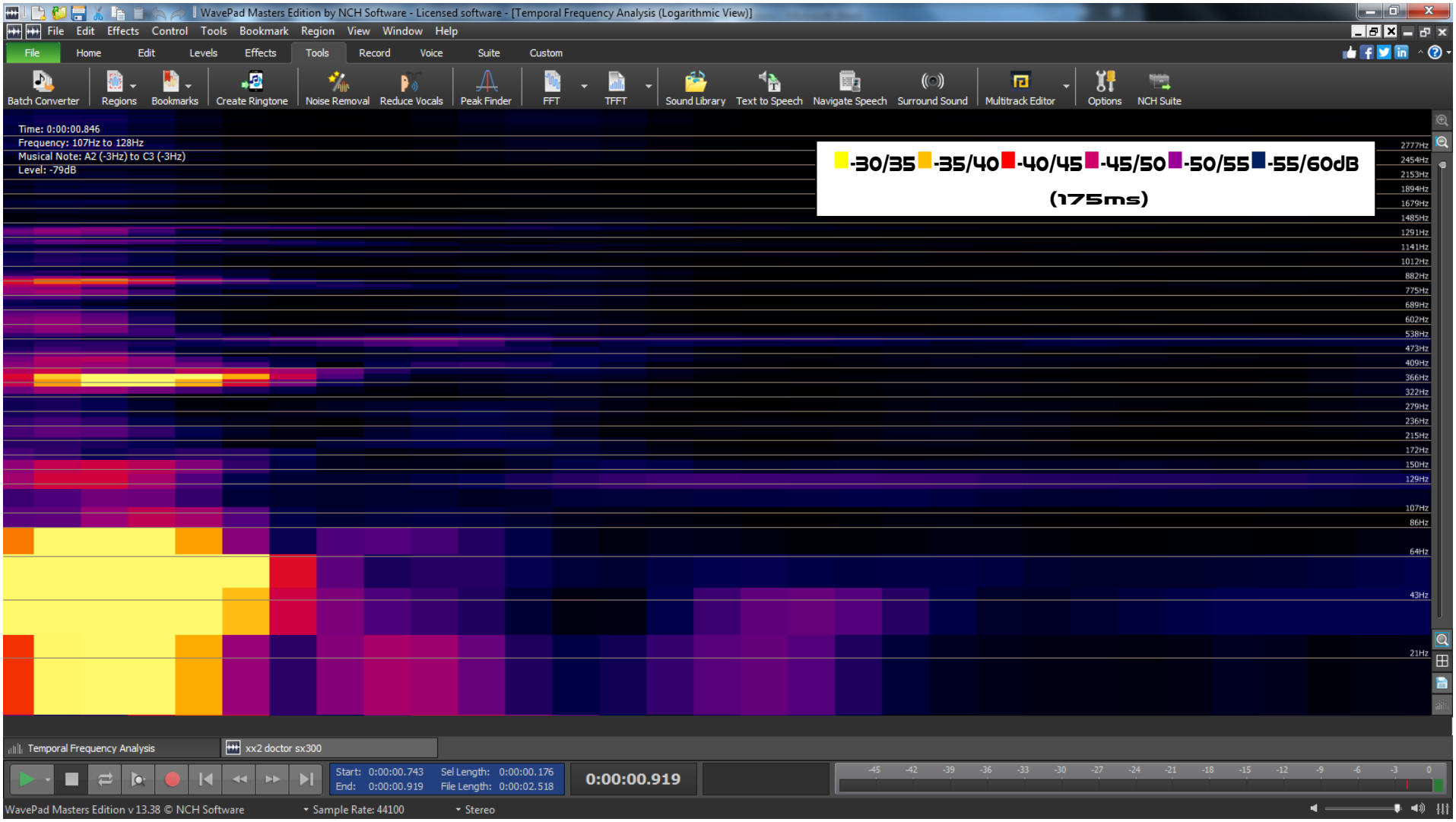
frequency analisys TFFT - time interval 175ms

racket + 5G + loop

test n°5 - impact test racket + DOCTOR



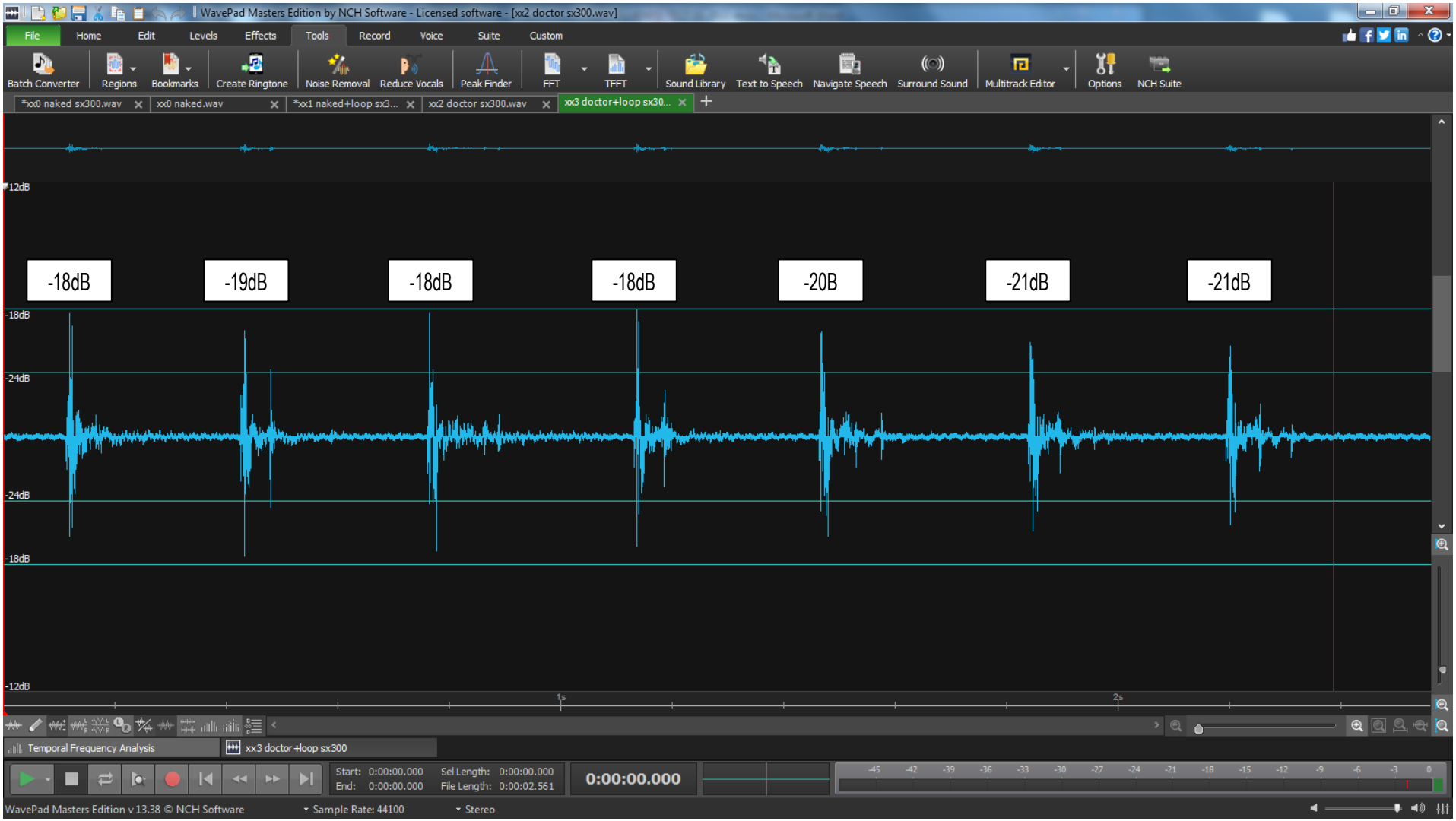
peaks recoding - racket + DOCTOR



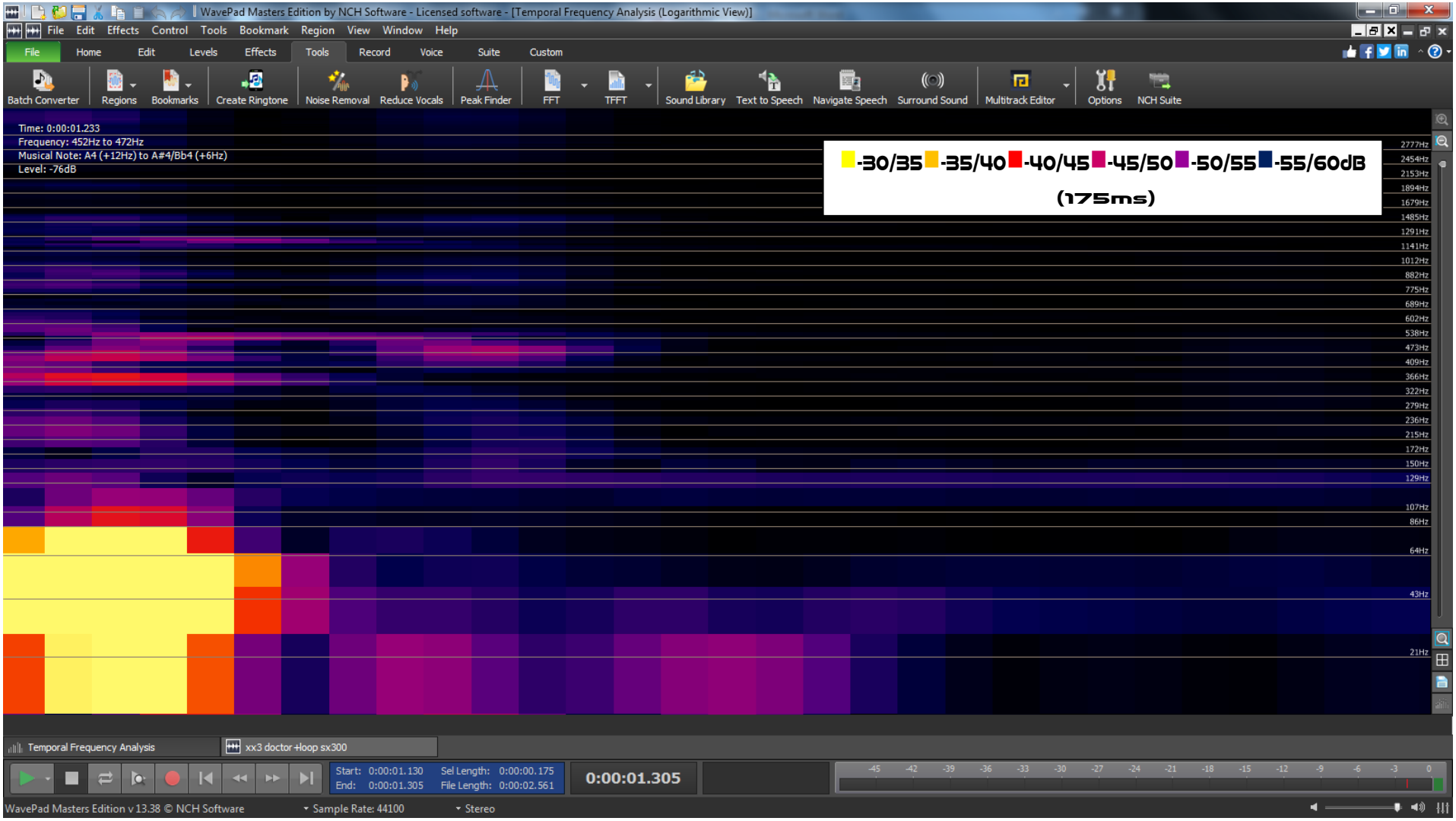
Frequency analisys TFFT - time interval 175ms

racket + DOCTOR

test n°6 - impact test racket + DOCTOR + loop



peaks reconding - racket + DOCTOR + loop



frequency analisys TFFT - time interval 175ms

racket + DOCTOR + loop

DATA COMPARISON - TENNIS

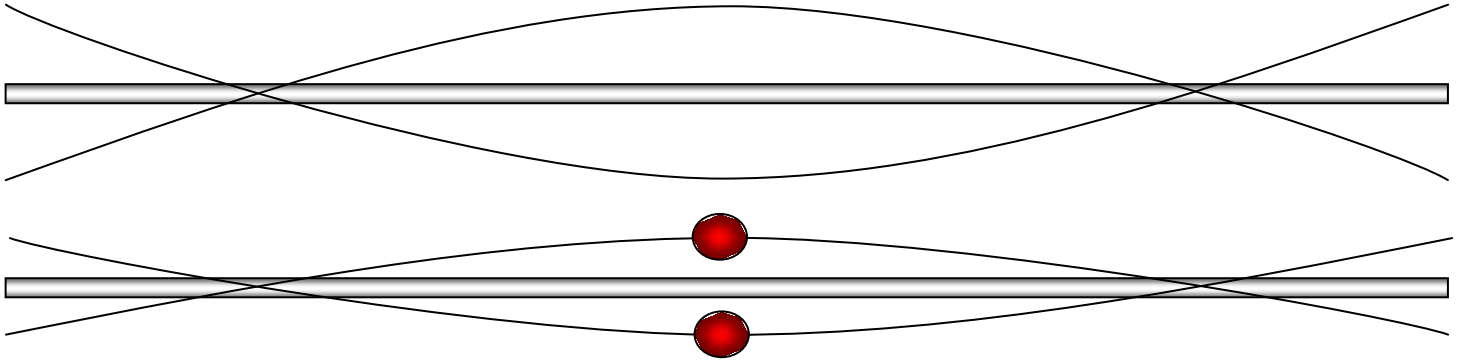
The FLUENDO LOOP acts predominantly on strings vibration modes and effects only to a lesser extent on the vibration modes of the frame around 100-200Hz. It's a powerful dumpener with an appreciable effect on string vibration dampening.

Fluendo LOOP

↓

400-600Hz

The FLUENDO 5G as well as the FLUENDO DOCTOR act directly on the racket by adding resilient elastic dampening mass in the off-node position as the racket tends to vibrate like a rod by pivoting on main nodes located approximately 135mm from the head and the handle of the tennis racket.

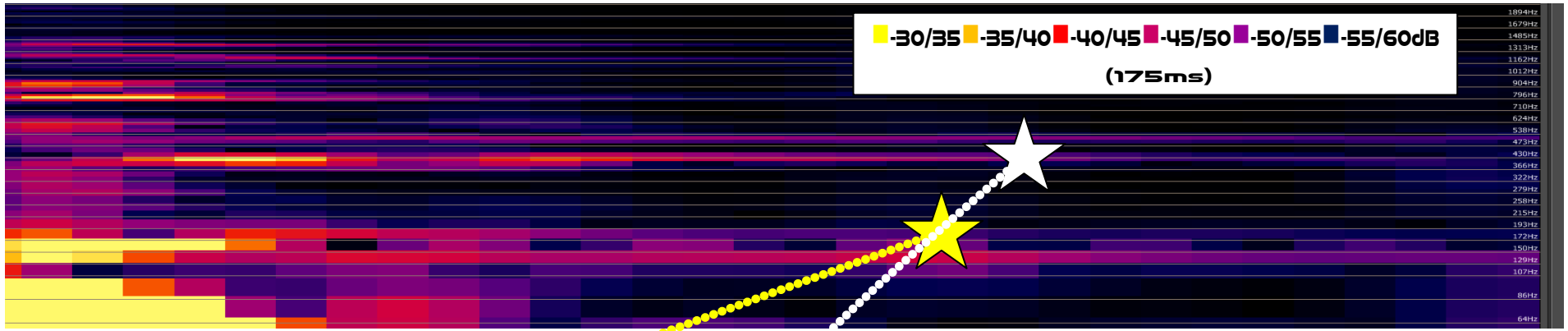


It is evident how the presence of the FLUENDO 5G device as well as and in a greater way of the FLUENDO DOCTOR device determine an accelerated frequencies decay of the typical of the strings (500-600Hz) as well as the frame (100-200Hz).

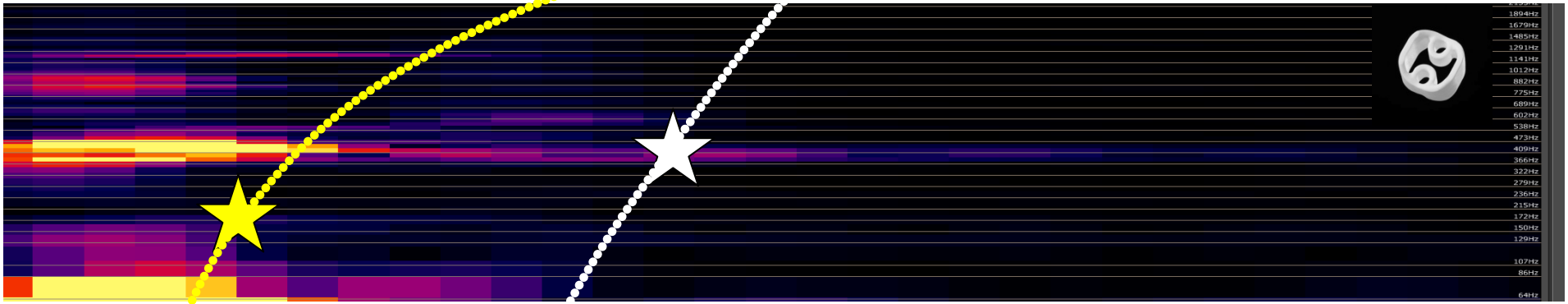
Fluendo 5G - Fluendo DOCTOR

↓

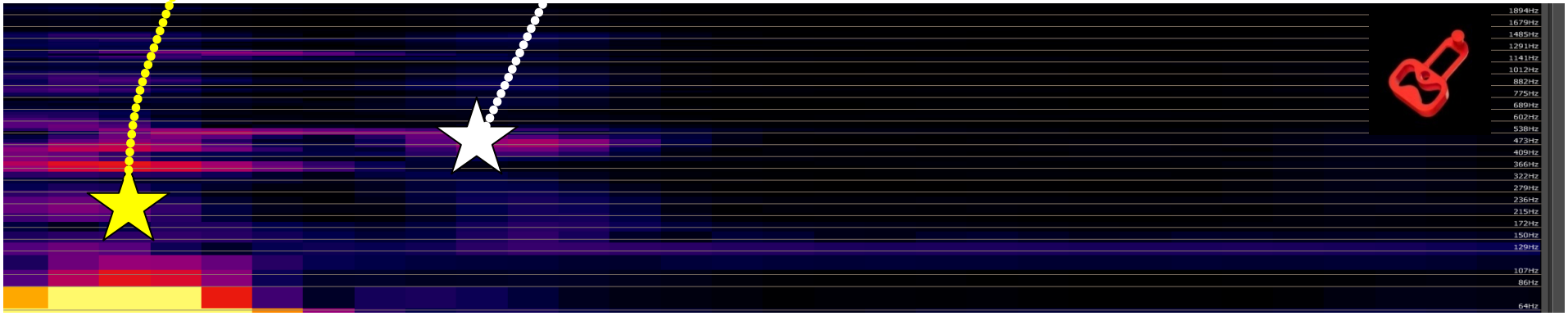
100-200Hz



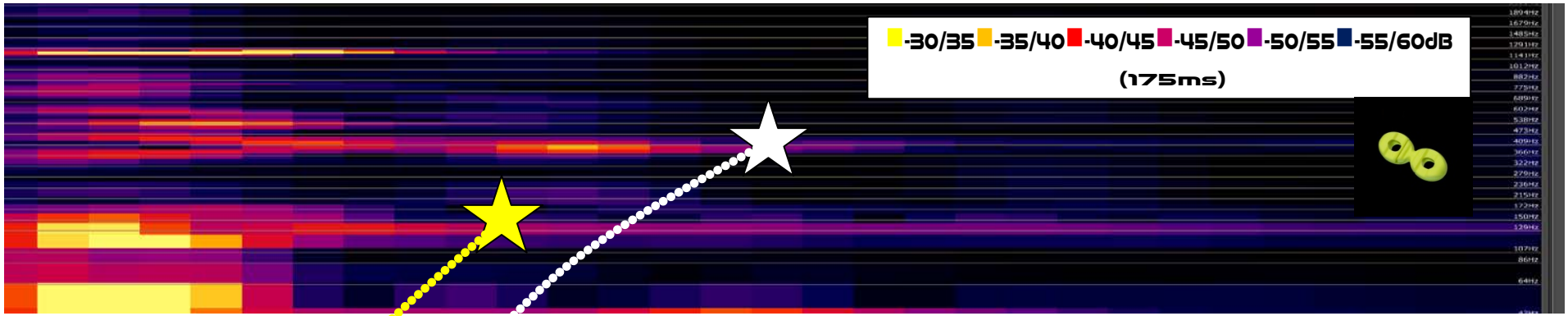
naked racket - impact test



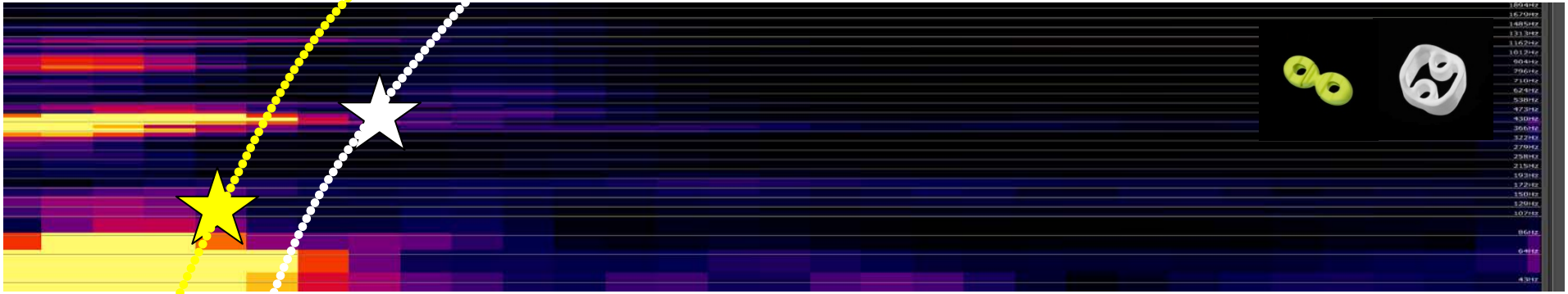
FLUENDO 5g - impact test



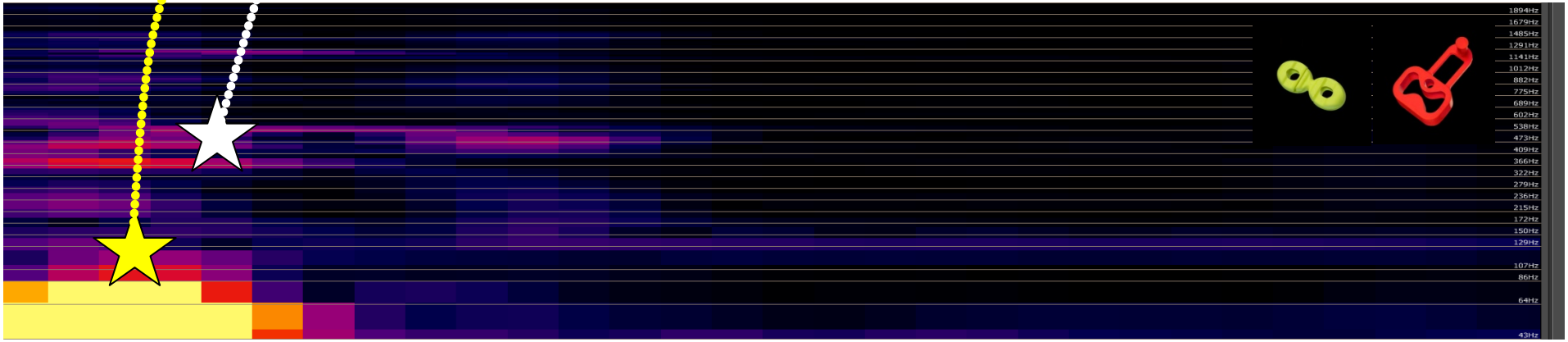
FLUENDO DOCTOR - impact test



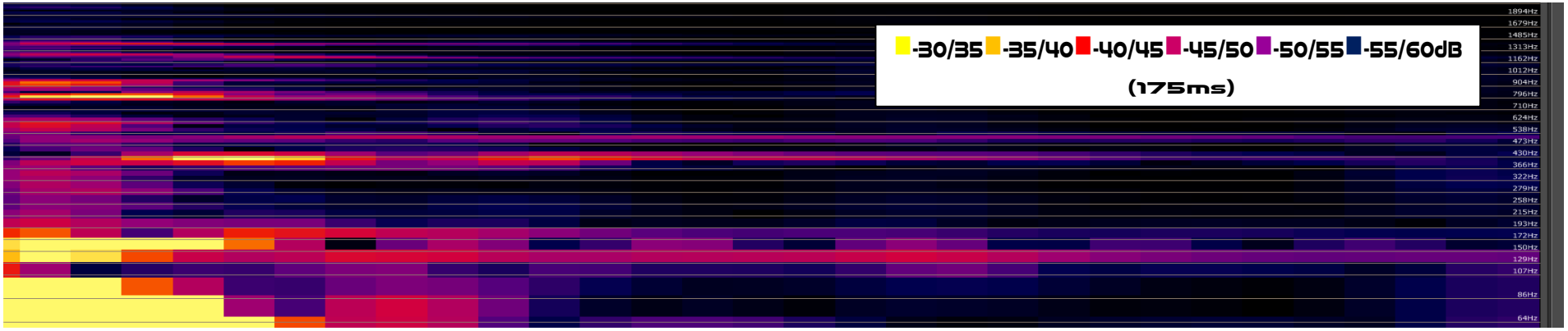
FLUENDO LOOP - impact test



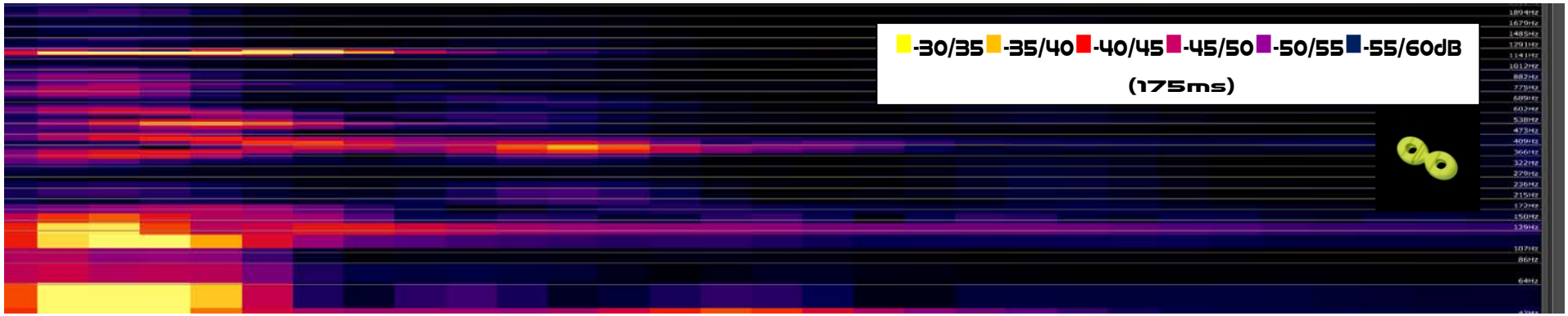
FLUENDO 5g + LOOP - impact test



FLUENDO DOCTOR + LOOP - impact test



naked racket



FLUENDO LOOP (TFFT analisys)

The use of the LOOP device guarantees, in view of the elastic-resilient capacities on the string plane, an effective damping of frequencies between 400 and 600Hz.

The damping function takes place both in terms of magnitude of the signal and in terms of damping time of the vibrating wave.

Tennis dB values - resume data

	test 1 racchetta		test 3 racchetta + 5G		test 5 racchetta + doctor	
1	-18	dB	-20	dB	-19	dB
2	-18	dB	-19	dB	-20	dB
3	-15	dB	-16	dB	-19	dB
4	-15	dB	-21	dB	-22	dB
5	-21	dB	-15	dB	-19	dB
6	-15	dB	-14	dB	-18	dB
7	-15	dB	-14	dB	-17	dB
media segnale	-16,7	dB	-17,0	dB	-19,1	dB
scarto	0,0	dB	-0,3	dB	-2,4	dB
perdita potenza	0%		-5%		-75%	
	0%		-10%		-80%	

	test 2 racchetta fluendo loop		test 4 racchetta + 5G fluendo loop		test 6 racchetta + doctor fluendo loop	
1	-16	dB	-19	dB	-18	dB
2	-16	dB	-20	dB	-19	dB
3	-17	dB	-14	dB	-18	dB
4	-19	dB	-15	dB	-18	dB
5	-19	dB	-19	dB	-20	dB
6	-18	dB	-17	dB	-21	dB
7	-16	dB	-19	dB	-21	dB
media segnale	-17,3	dB	-17,6	dB	-19,3	dB
scarto	-0,6	dB	-0,9	dB	-2,6	dB
perdita potenza	-10%		-20%		-80%	
	-15%		-25%		-85%	

valori di perdita di potenza in relazione al calo di segnale dB	
100%	0,0 dB
105%	0,2 dB
110%	0,4 dB
115%	0,6 dB
120%	0,8 dB
125%	1,0 dB
130%	1,1 dB
135%	1,3 dB
140%	1,5 dB
145%	1,6 dB
150%	1,8 dB
155%	1,9 dB
160%	2,0 dB
165%	2,2 dB
170%	2,3 dB
175%	2,4 dB
180%	2,6 dB
185%	2,7 dB
190%	2,8 dB
195%	2,9 dB
200%	3,0 dB

CONCLUSIONS

From the analysis of the data obtained from the sampling it is possible to obtain useful indications on the functioning and effectiveness of the devices according to their type and technical characteristics.

The device FLUENDO LOOP, is to all intents and purposes an antivibration dumper with an operation substantially concentrated in the typical vibration frequencies of the strings and therefore included between 400-450 and 550-600Hz.

The effect is appreciable in terms of damping and lowering of the overall energy transmitted to the frame. From the data obtained it is possible to obtain a reduction of the transmitted power of 10-15%.

The FLUENDO 5G device is an OFF-NODE type device as it works as a dynamic damper due to the mass out of the node, coupled with the elastic-resilient characteristics of the material used. It is interesting to highlight that this type of element has absorption function both on frequencies close to 500Hz and on those typical of the fundamentals of the frame that are between 125 and 200Hz.

In these terms the detectable absorption on all frequency ranges is quantifiable in a 5-10% in single use and in a 20-25% in combination with the LOOP device.

The FLUENDO DOCTOR device is a device of the same type of the 5G but with higher mass. The operation is of the same type in terms of frequency response but with a top class performance in terms of vibration absorbtion.

The detectable absorption on the whole frequency spectrum, affecting both frames and strings, is 75-80% in single use and 80-85% in combination with the LOOP device.

--- TENNIS ---

-10%/-15%

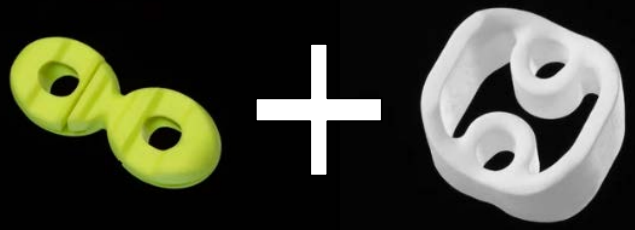
strings

-5%/-10%

frame + strings

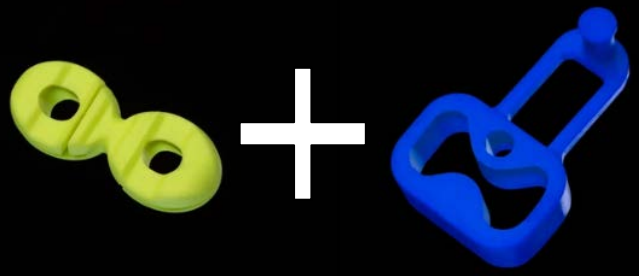
-75%/-80%

frame+strings



-20%/-25%

frame + strings



-80%/-85%

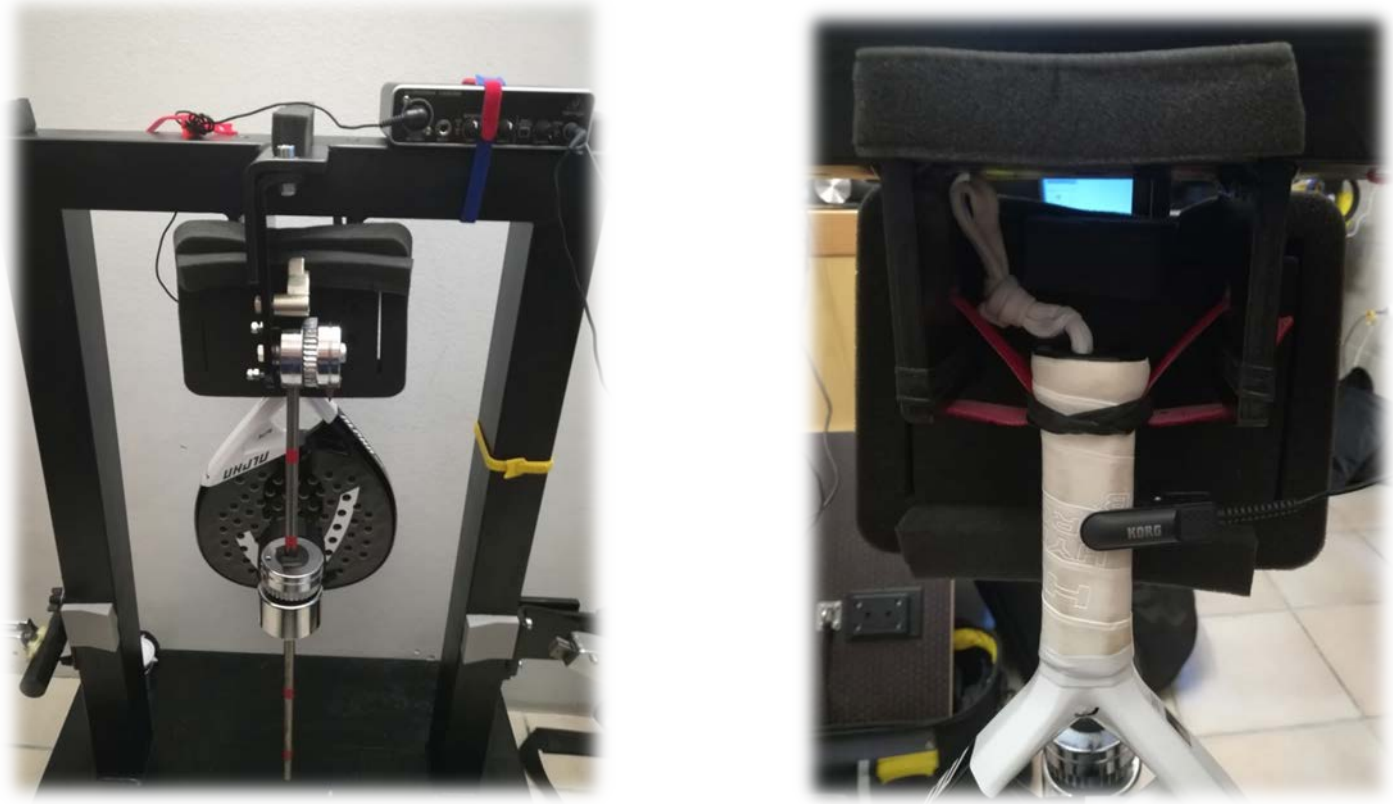
frame + strings

--- PADEL ---

PADEL test procedure

The testing mode for padel is quite similar to that used for tennis testing.

The variations are limited to the mass used and the lever arm, which is shorter due to the need to impact the racket in the center of the plate with the right distance. Due to the lower drop height, the mass was increased, bringing it, with an addition of 500g to a total weight of 1750-1800g



pro-t-one MARTELL-ONE - dynamic impact test

The hanging mass with a total weight of 1750-1800g impacts on the racquet stringbed in a central position with a lever arm of 26-27cm.

In the impact schematization, losses in the order of 10-15% have been considered, which appear entirely credible given the quality and nature of the elements used.

ENERGIA TRASMESSA IN FASE DI IMPATTO CON LA PALLA

padel

peso del maglio	1750	g	=	1,75	kg	
altezza di caduta	26	cm	=	0,26	m	
energia potenziale	**4,55**	**J**	**dovuta alla caduta del maglio**			
velocità	2,28	m/sec	=	8,21	km/h	
velocità reale max	2,05	m/sec	=	7,39	km/h	
velocità reale min	1,94	m/sec	=	6,98	km/h	
energia cinetica max	**4,10**	J	**perdite**	10%		
energia cinetica min	**3,87**	J	**perdite**	15%		
quantità di moto max	3,59	con un maglio da		1750	g	
quantità di moto min	3,39	con un maglio da		1750	g	
velocità eq. palla	**61,92**	**m/sec**	**=**	**222,92**	**km/h**	
velocità eq. palla	**58,48**	**m/sec**	**=**	**210,54**	**km/h**	

The system has been dimensioned to schematize the impact of a tennis ball impacted on the string plate at an overall speed between 210 and 220 km/h (racket speed + incoming ball speed).

It is fundamental to underline, as premised, that the racket is fixed on the gantry by means of a suspension system capable of guaranteeing a behavior similar in dynamic terms to the real biomechanical one, with the formation of a hinge of spherical type in correspondence of the wrist during the impact of the racket.

To obtain such a result, the handle is suspended by means of a pair of elastic bands that hold the grip at the cap and a pair of Velcro bands that support the rings, connecting the frame, indirectly, to the steel portal.

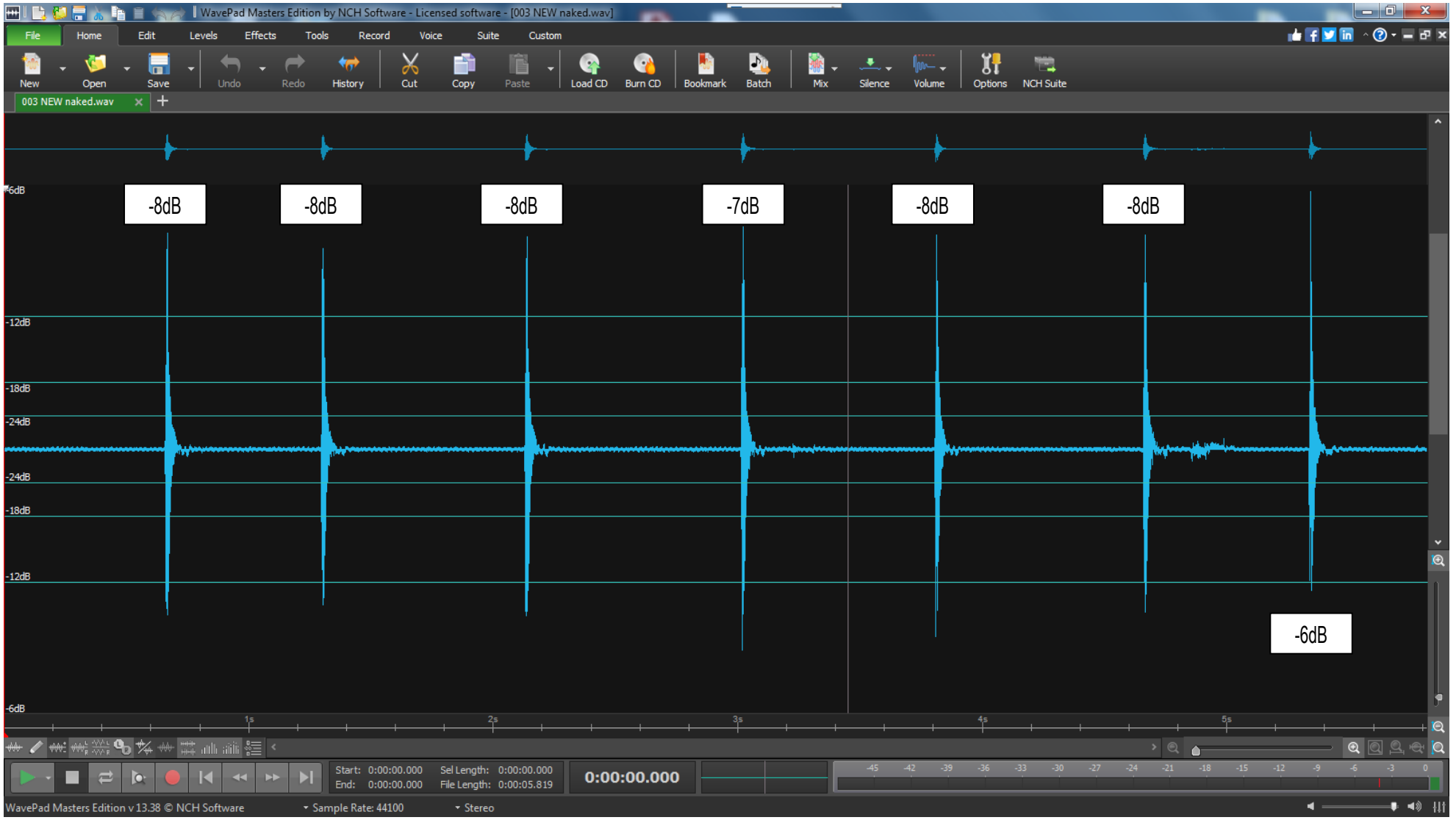
The operating scheme of the entire system is as follows:

- Mechanical instrumentation for impact tests pro-t-one MARTELL-ONE - hitting mass 1750g (padel)
- Suspended racket HEAD ALPHA ELITE 2021 - 370g
- KORG piezo detector (piezo microphone) on handle KORG piezo - contact microphone
- Behringer Uphoria UMC22 signal preamplifier
- Portable computer HP Pro-Book - microprocessor Intel I5
- Recording-sampling program WAVEPAD Master Edition 2021 - sampling frequency 44kHz
- Frequency analysis program TFFT (Temporal Fourier Fast Transformation) WAVEPAD Master Edition 2021

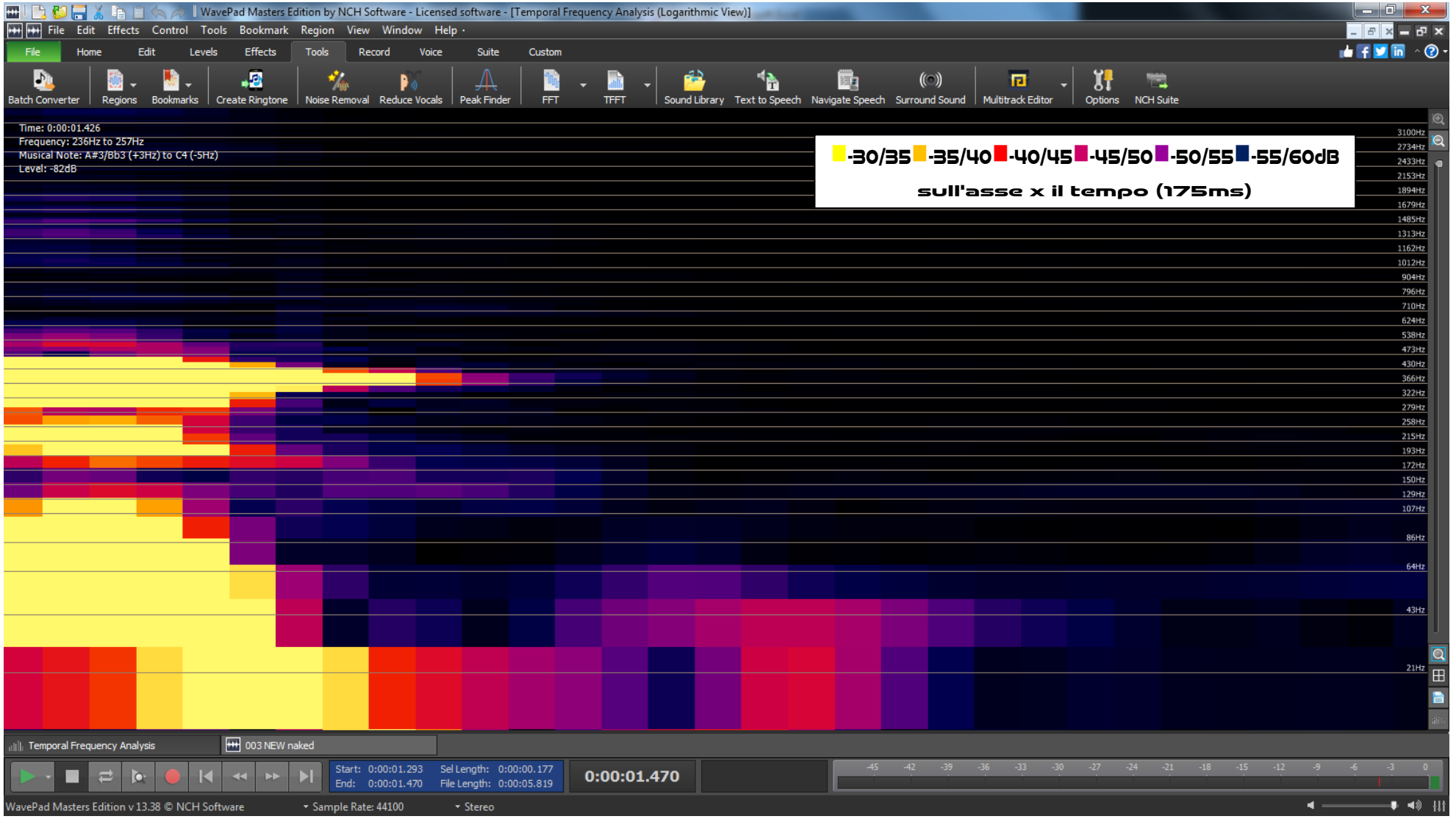
The scheme can be schematized as follows:

Microphone Preamplifier → Computer → Digital recorder → Frequency analyzer

test n°1 - impact test - naked pala



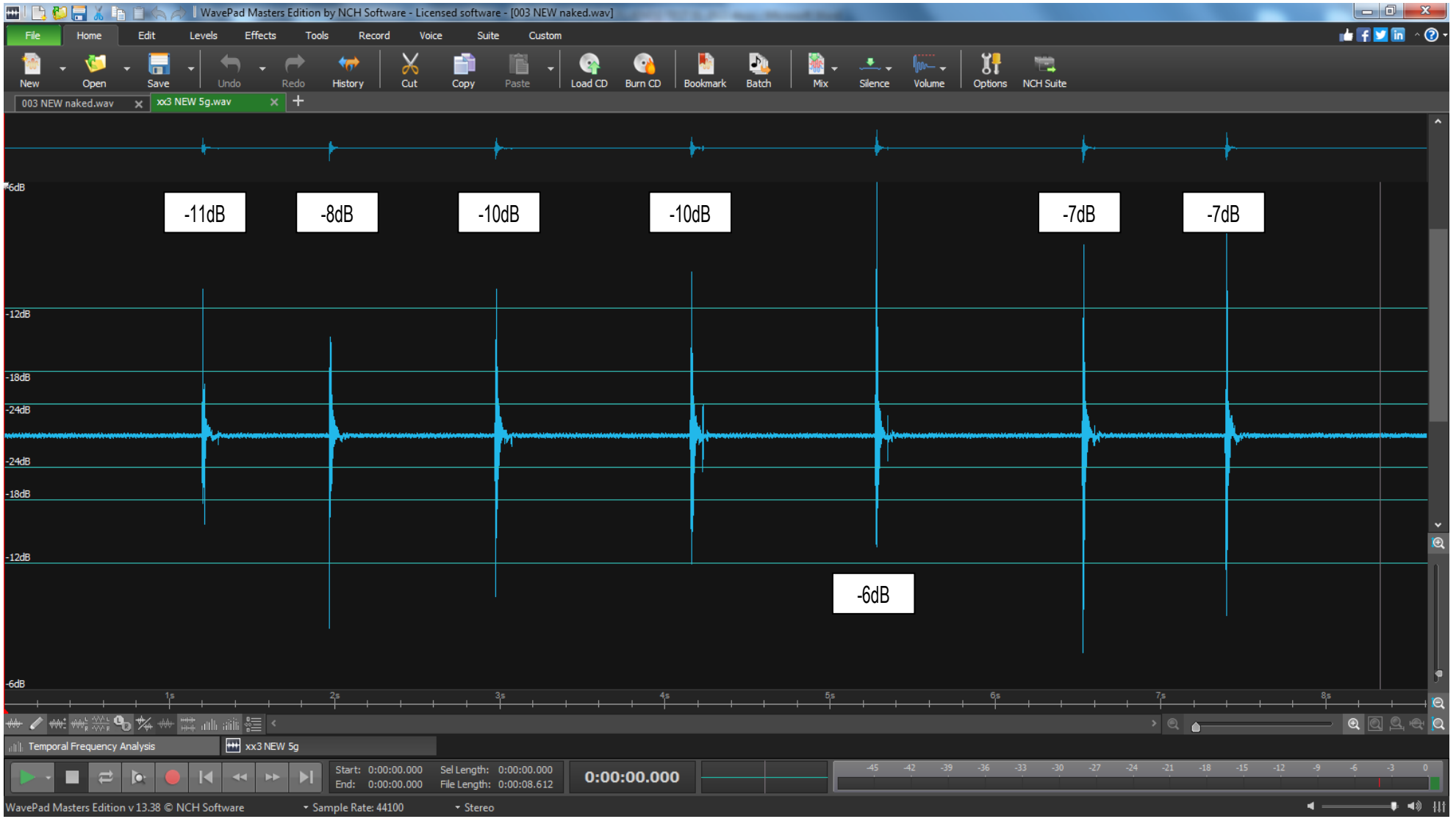
peaks reconding - racket



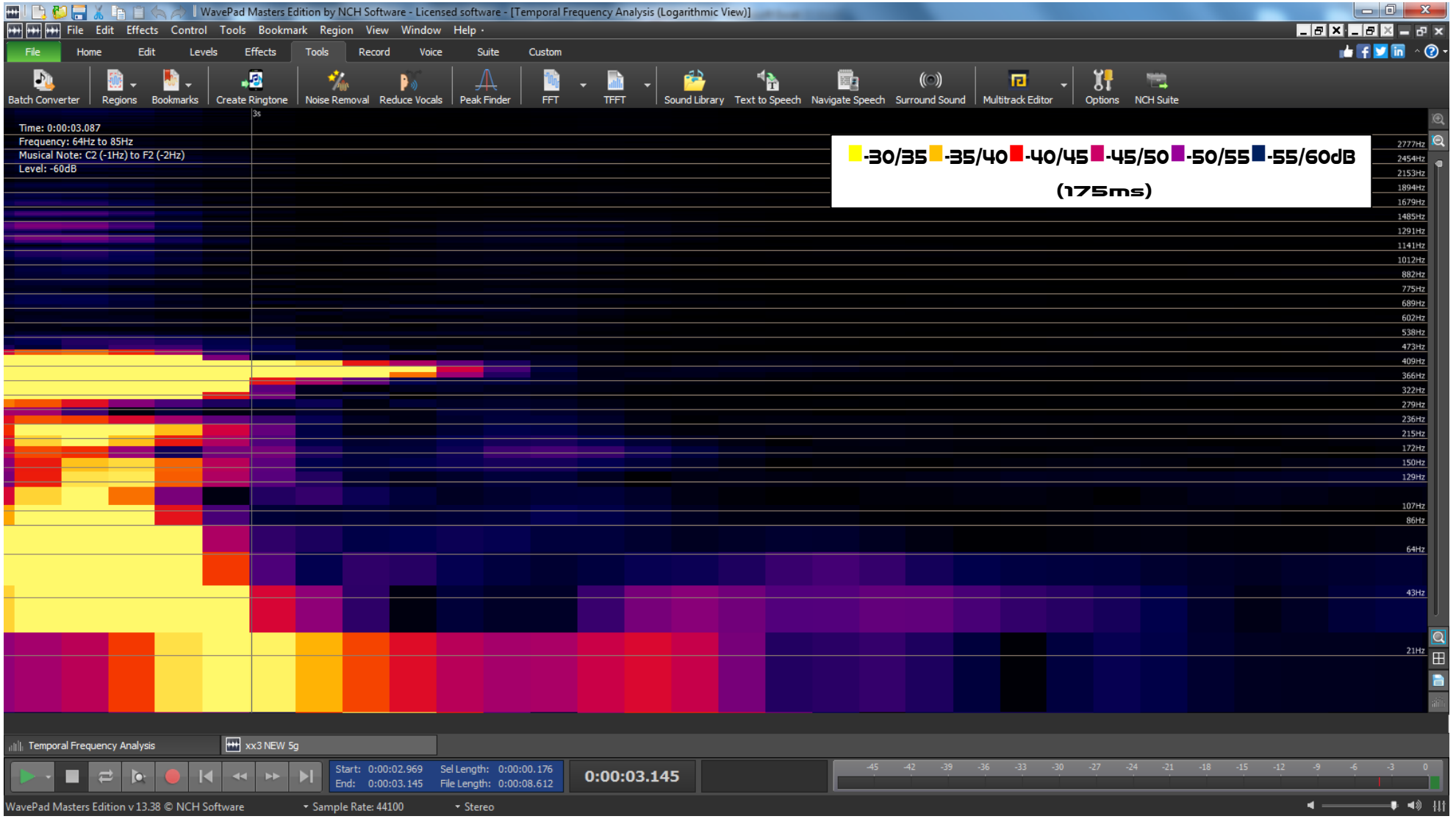
Frequency analisys TFFT - time interval 175ms

naked pala

test n°2 - impact test - pala + FLUENDO 5G



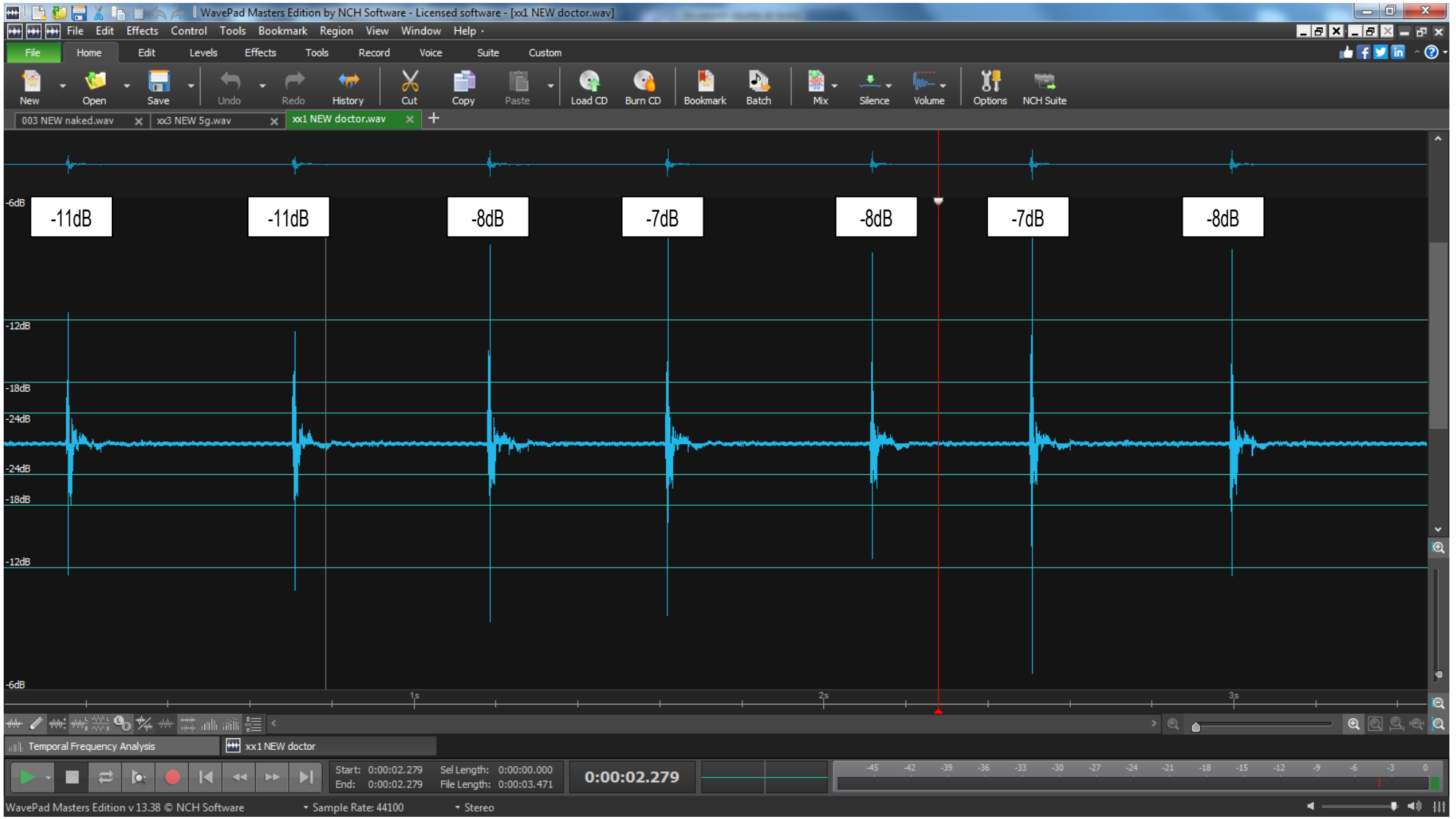
peaks recording - pala + 5G



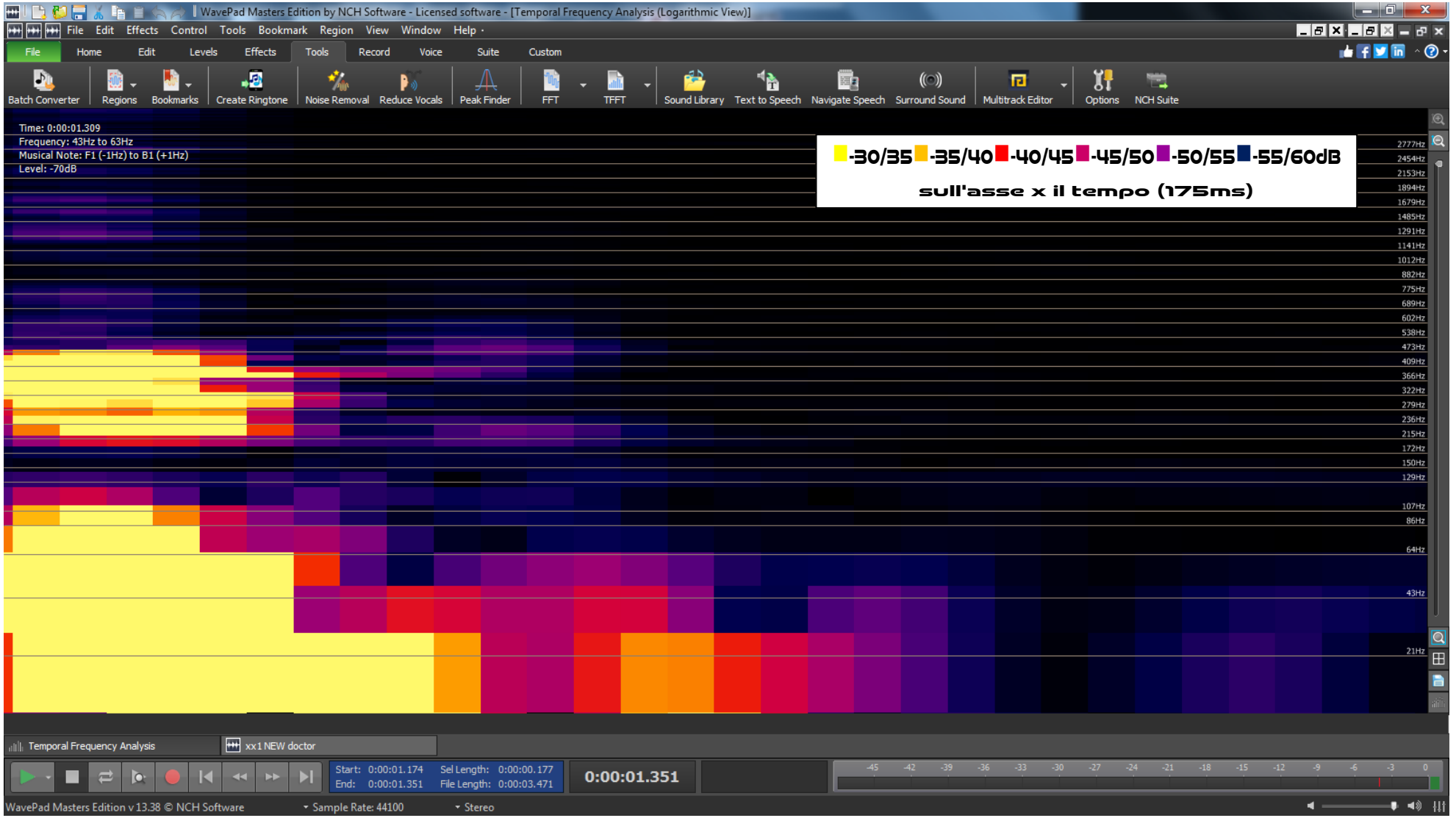
Frequency analisys TFFT - time interval 175ms

pala + FLUENDO 5g

test n°3 - impact test - pala + FLUENDO DOCTOR

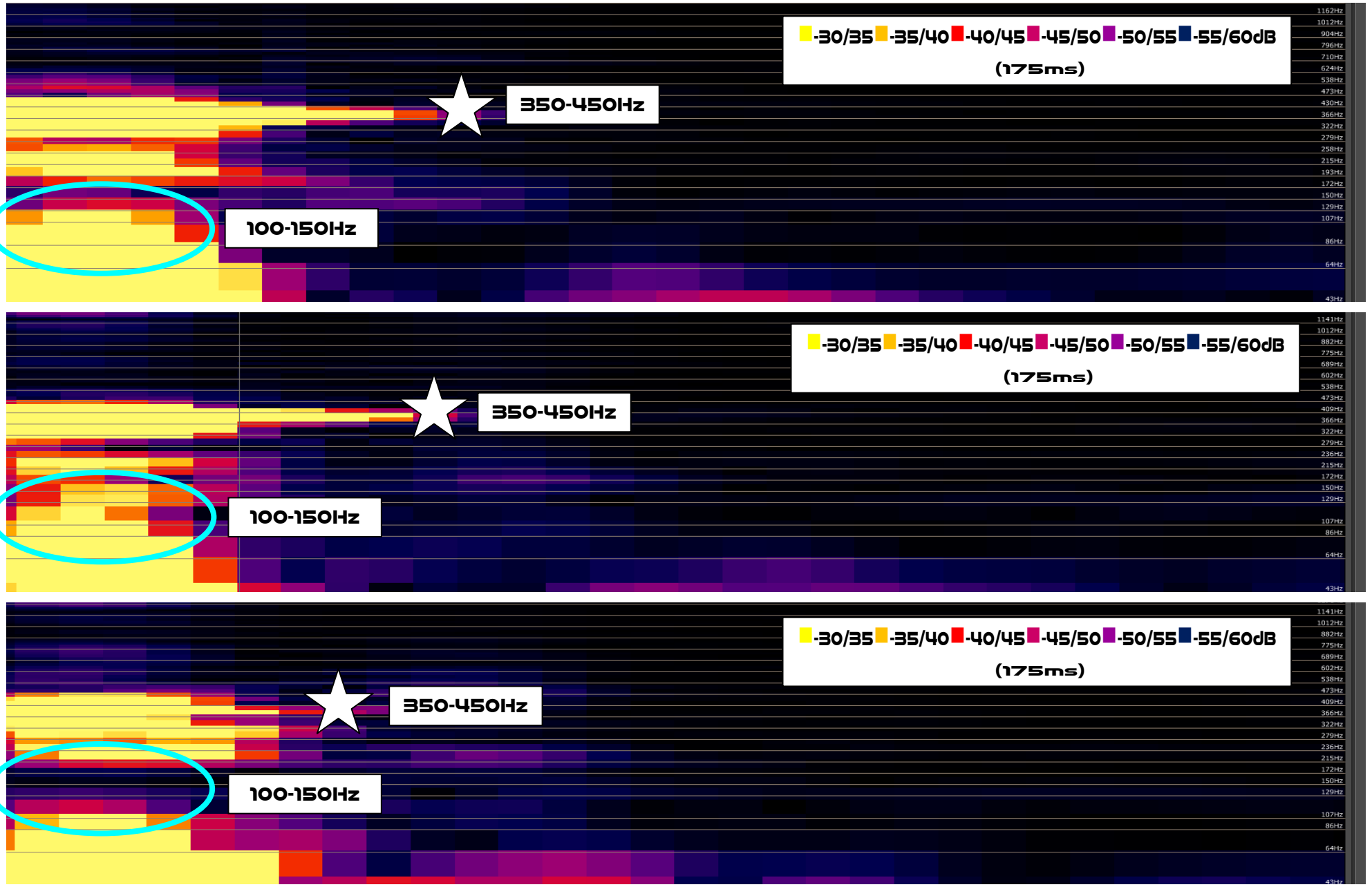


PALA + FLUENDO DOCTOR



Frequency analisys TFFT - time interval 175ms

peaks recording - pala + FLUENDO doctor


-30/35 -35/40 -40/45 -45/50 -50/55 -55/60dB
(175ms)
350-450Hz
100-150Hz
-30/35 -35/40 -40/45 -45/50 -50/55 -55/60dB
(175ms)
350-450Hz
100-150Hz
-30/35 -35/40 -40/45 -45/50 -50/55 -55/60dB
(175ms)
350-450Hz
100-150Hz

PADEL - RESUME DATA dB

	test 1 racchetta PADEL		test 3 racchetta + 5G PADEL		test 5 racchetta + doctor PADEL	
1	-8	dB	-11	dB	-11	dB
2	-8	dB	-8	dB	-11	dB
3	-8	dB	-10	dB	-8	dB
4	-7	dB	-10	dB	-7	dB
5	-8	dB	-6	dB	-8	dB
6	-8	dB	-7	dB	-7	dB
7	-6	dB	-7	dB	-8	dB
media segnale	-7,6	dB	-8,4	dB	-8,6	dB
scarto	0,0	dB	-0,9	dB	-1,0	dB
perdita potenza	0%		-20%		-25%	
	0%		-25%		-30%	

1	0	dB	0	dB	0	dB
2	0	dB	0	dB	0	dB
3	0	dB	0	dB	0	dB
4	0	dB	0	dB	0	dB
5	0	dB	0	dB	0	dB
6	0	dB	0	dB	0	dB
7	0	dB	0	dB	0	dB
media segnale	0,0	dB	0,0	dB	0,0	dB
scarto	7,6	dB	7,6	dB	7,6	dB
perdita potenza	0%		0%		0%	
	0%		0%		0%	

valori di perdita di potenza in relazione al calo di segnale dB	
100%	0,0 dB
105%	0,2 dB
110%	0,4 dB
115%	0,6 dB
120%	0,8 dB
125%	1,0 dB
130%	1,1 dB
135%	1,3 dB
140%	1,5 dB
145%	1,6 dB
150%	1,8 dB
155%	1,9 dB
160%	2,0 dB
165%	2,2 dB
170%	2,3 dB
175%	2,4 dB
180%	2,6 dB
185%	2,7 dB
190%	2,8 dB
195%	2,9 dB
200%	3,0 dB

CONCLUSIONS

From the data analysis obtained from the sampling it is possible to get useful indications on the functioning and effectiveness of the devices due to their shape, mass and technical characteristics on PADEL rackets.

The FLUENDO 5G device is an OFF-NODE type device as it works as a dynamic damper due to the effect of the mass outside the node, coupled with the elastic-resilient characteristics of the material used. It is interesting to highlight that this element has absorption function both on frequencies close to 350Hz and on those typical low frequencies frame fundamentals around 150Hz.

In these terms the absorption detectable on all frequency ranges is quantifiable in a 20-25%.

The FLUENDO DOCTOR device is a device of the same type of the 5G but with greater mass. The operation is of the same type in terms of frequency response.

The detectable absorption over the entire frequency spectrum, affecting the frames is higher and around 25-30%.

note: it is interesting to note how the behavior of the PADEL RACKET, although different from that of a TENNIS RACKET, (which follows the principles of dynamic deflection of an excised shaft/bar), undergoes positive dynamic effects in terms of vibration absorption.

THE PADEL RACKET WORKS LIKE A TABLE SUBJECT TO VIBRATION-SHOCK FROM IMPACT WHERE THE HARMONIC FLEXIONAL EFFECTS (see what has been said for the tennis racket) ARE TRANSCURRENT OR LESS EXTENSIVE THAN THOSE OF A TENNIS RACKET BUT ALSO IN THIS PHISICAL DIFFERENT SITUATION FLUENDO DEVICES PLAY AN INTERESTING AND APPRECIABLE ROLE IN TERMS OF VIBRATION ABSORPTION .

--- PADEL ---

-20%/-25%

-25%/-30%

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