ePrebe 5.3.4

Analysis User guide

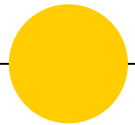
ScienceBeam Co

eProbe

Version 5.3.4

Acquisition and analysis software
June 2016

Analysis

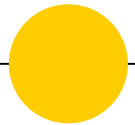


Analysis

- **eTrace :** It designed for offline analysis of data collected through eTrace Experiments (**local field potentials**) such as evoked fEPSP and PS, EEG, EMG, ….
- It analyzing all basic properties of synaptic potentials (Slope, Peak Amplitude, Latency, Area, PopSpike Amplitude, …) and also EEG, EMG, phase and frequency of signals.

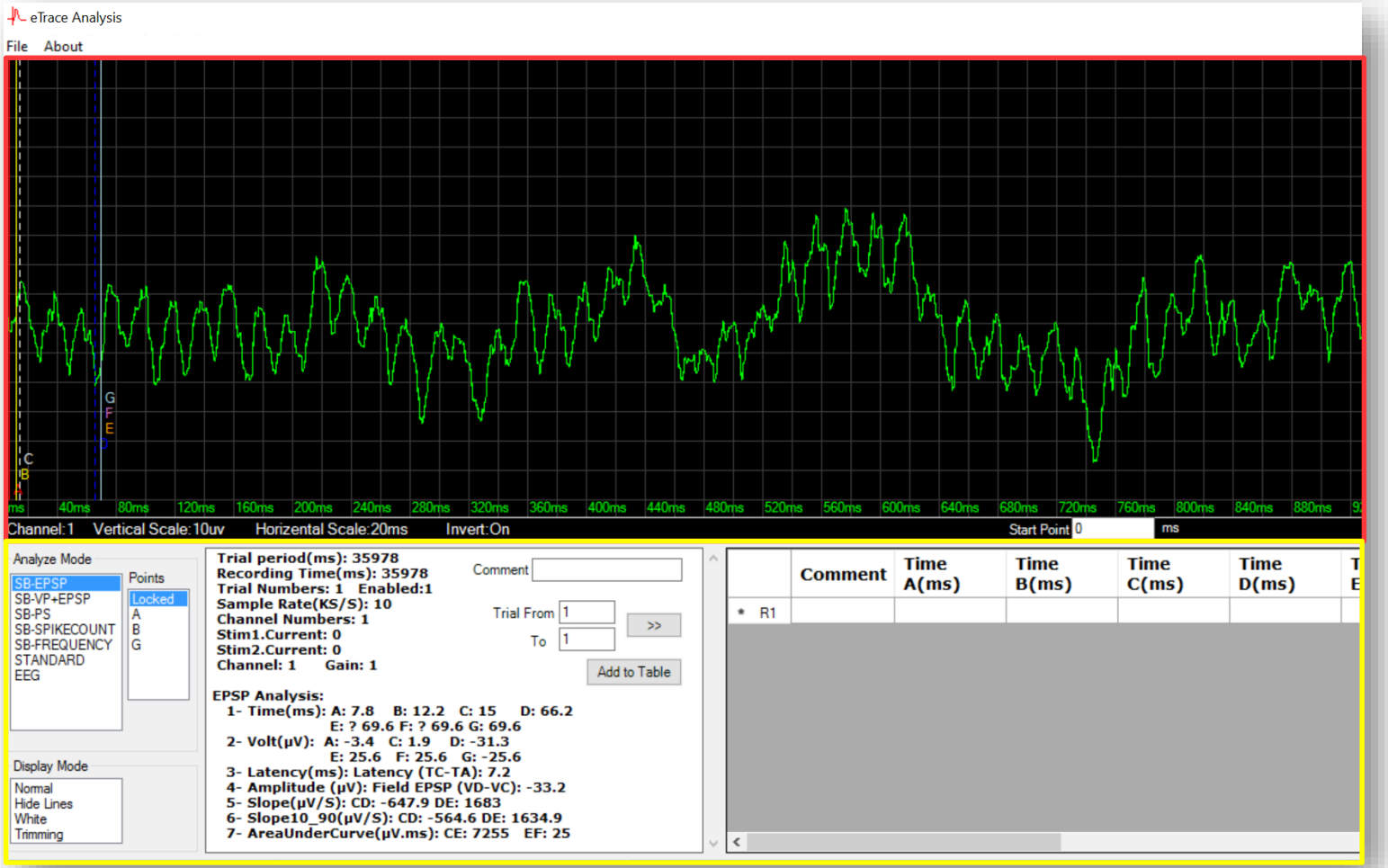
- **eSpike:** It developed as an offline analyzing program for collected data through eSpike Experiments (**neuronal unit activity**) such as single or multi unit activity .

eTrace

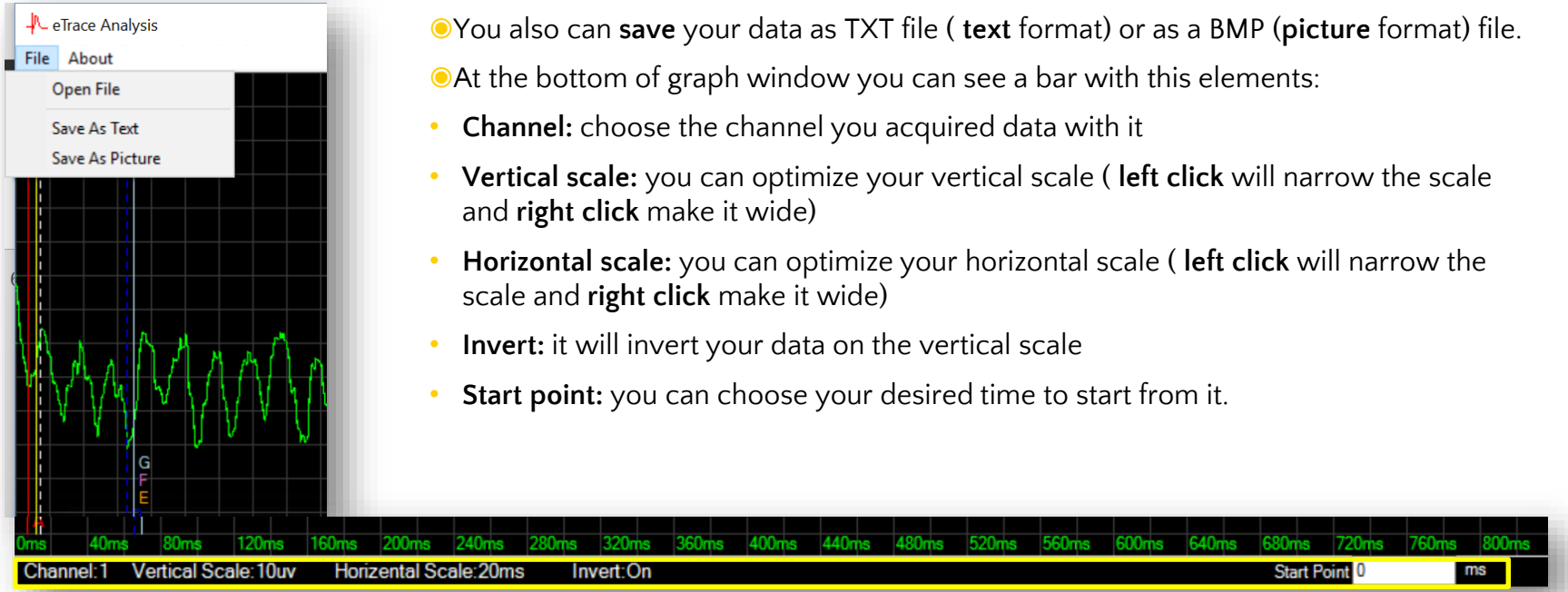


Graph window

Data window



eTrace – graph window



- You can **open** the data you need to analyze by **Analysis** -> **eTrace** -> **File** -> **Open File**
- You also can **save** your data as TXT file (**text** format) or as a BMP (**picture** format) file.
- At the bottom of graph window you can see a bar with this elements:
  - **Channel:** choose the channel you acquired data with it
  - **Vertical scale:** you can optimize your vertical scale (**left click** will narrow the scale and **right click** make it wide)
  - **Horizontal scale:** you can optimize your horizontal scale (**left click** will narrow the scale and **right click** make it wide)
  - **Invert:** it will invert your data on the vertical scale
  - **Start point:** you can choose your desired time to start from it.

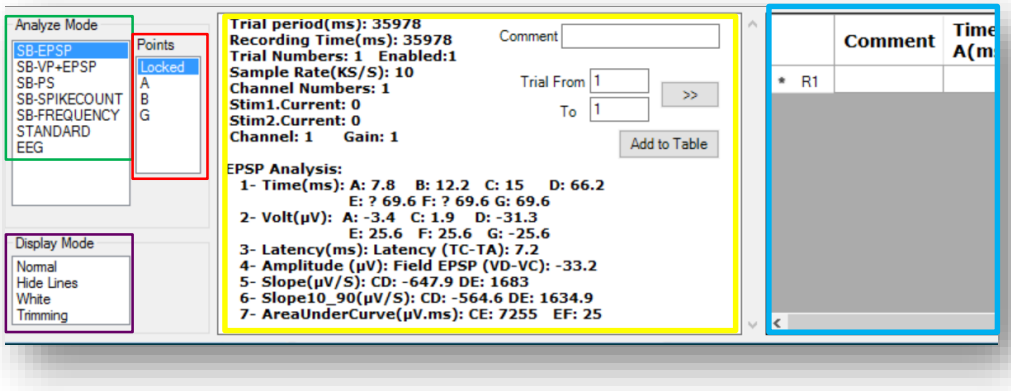
Note:

◉**Note:** When you start a recording with *eTrace experiments* the software will save two separated file: a file with *.Trace* and a file with *.Event*. Event files (*.Event)* are text files. *eTrace analysis*, just able to open files with *.Trace*.

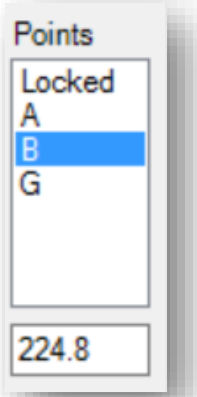
eTrace- data windows

◉At the data window below the graph window, you can see these boxes:

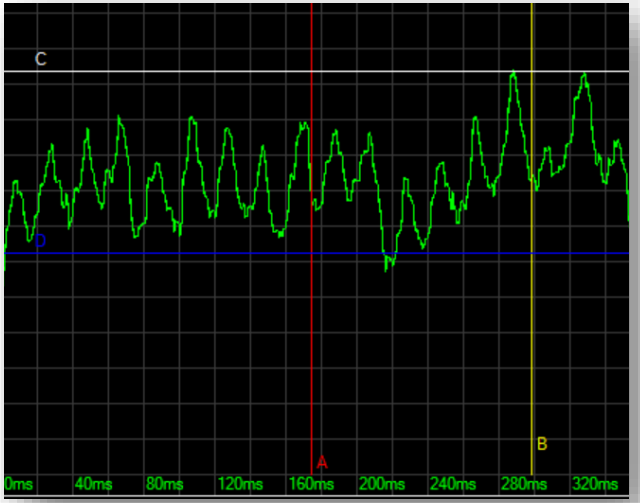
- Analyze Mode
- Display Mode
- Points
- Results
- Table



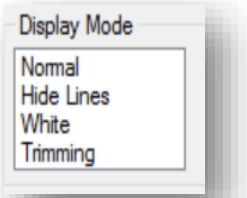
eTrace – points



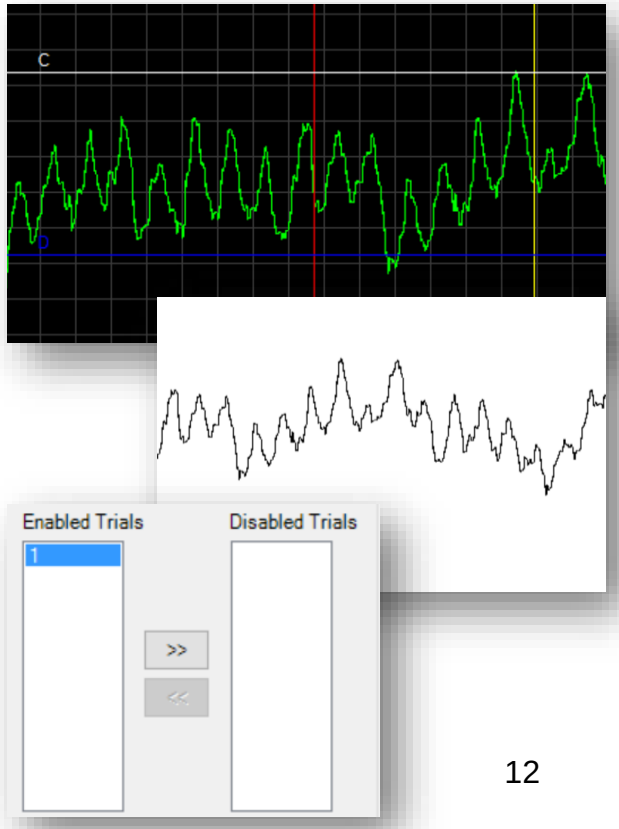
- You can place the point bars by choosing them from points box and moving your mouse cursor on the graph to put the point bar on appropriate place or by entering a value in value box under the points box.
- If you choose **Locked** in points box, you are not able to move points bar in the graph window.
- There is a file named **eTraceTemplate.txt** in the **eProbe folder** that you can change it's content to add or remove points and other templates available in eTrace analysis.
- **You can find the instruction for changing the template in the ScienceBeam company website!**



eTrace – Display Mode

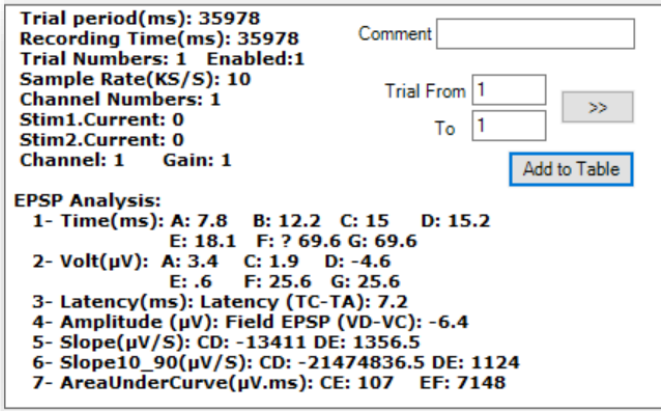


- it has four options:
  - **Normal:** you will see the whole graph in a dark background with shown points
  - **Hide Lines:** points will be hidden
  - **White:** the whole graph will be shown in a white background
  - **Trimming:** you can trim your data here by moving trials between enabled or disabled trials.



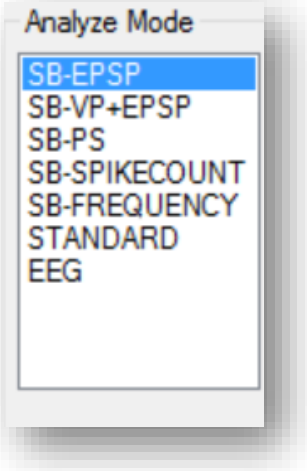
eTrace – Results

- In advance to the specific analysis information, you can see these information's in results box too:
- **trial period**
- **Recording time**
- **Trial number**
- **Sample rate**
- **Channel number**
- **Stimulation current**
- **Gain**
- You can write comment in **comment** box and also move between trials in **Trial From – To** boxes
- You can move results to the Table by clicking on **Add to Table**



eTrace – Analyze Mode

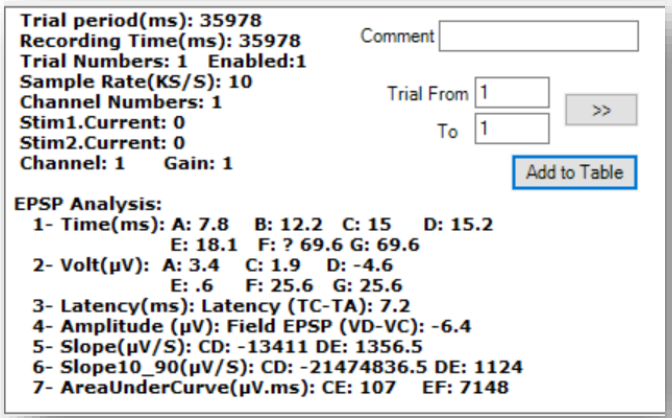
- It has many mode to analyze your data:
  - **SB-EPSP:** Science Beam defined EPSP (Excitatory Post Synaptic Potential)
  - **SB-VP+EPSP:** Science Beam defined VP+EPSP (Volley Potential+ EPSP)
    - (Volley is an indication of the presynaptic action potential arriving at the recording site and the EPSP itself)
  - **SB-PS:** Science Beam defined Population Spike
  - **SB-SPIKECOUNT:** Science Beam defined spikes counting
  - **SB-FREQUENCY:** Science Beam defined frequency measurement
  - **STANDARD**
  - **EEG**



SB-EPSP

It can analyze these measures between you defined points:

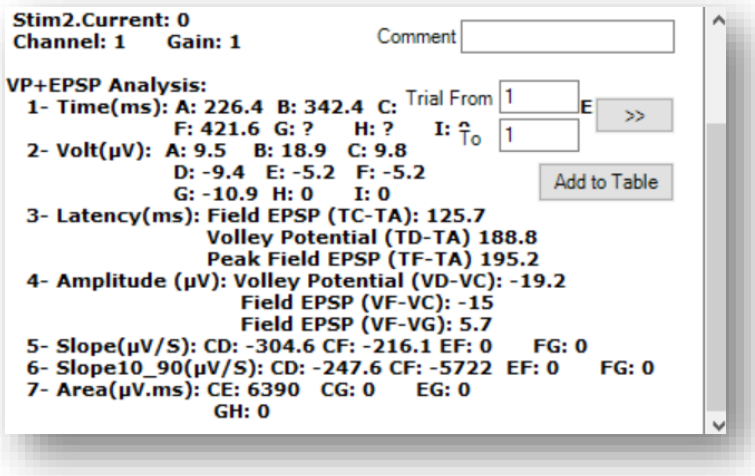
- **Time**
- **Volt**
- **Latency**
- **Amplitude (Field EPSP)**
- **Slope**
- **Slope10-90**
- **Area under curve**



SB-VP+EPSP

It can analyze these measures between you defined points:

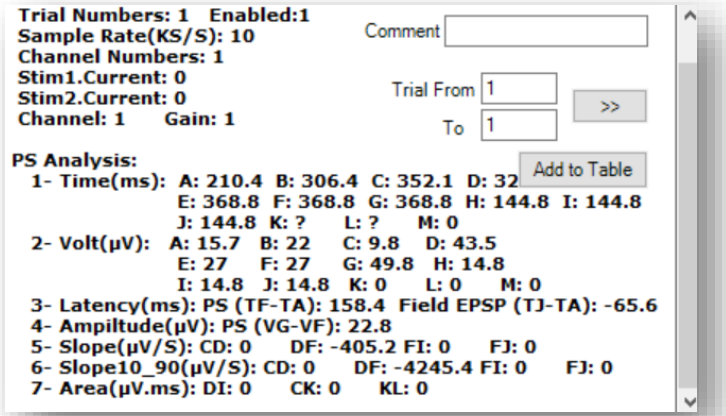
- **Time**
- **Volt**
- **Latency (Field EPSP, Volley potential, Peak Field EPSP)**
- **Amplitude (Field EPSP, Volley potential)**
- **Slope**
- **Slope10-90**
- **Area under curve**



SB-PS

◉It can analyze these measures between you defined points:

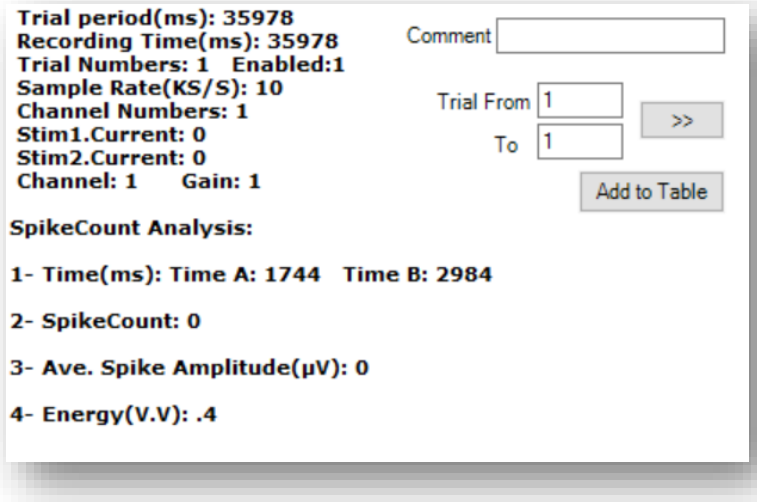
- **Time**
- **Volt**
- **Latency (PS, Field EPSP)**
- **Amplitude (PS)**
- **Slope**
- **Slope10-90**
- **Area under curve**



SB-SPIKECOUNT

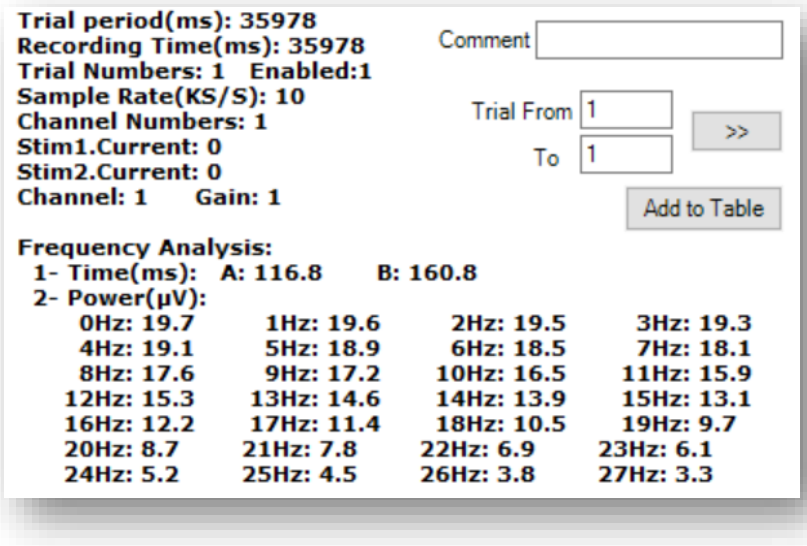
It can analyze these measures between you defined points:

- **Time**
- **SpikeCount**
- **Ave.Spike Amplitude**
- **Energy**



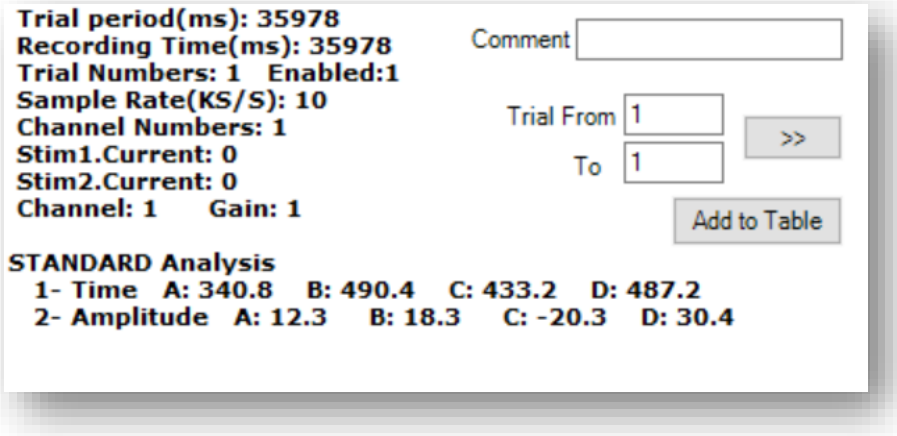
SB-FREQUENCY

- It can analyze these measures between you defined points:
  - **Time**
  - **Power**



STANDARD

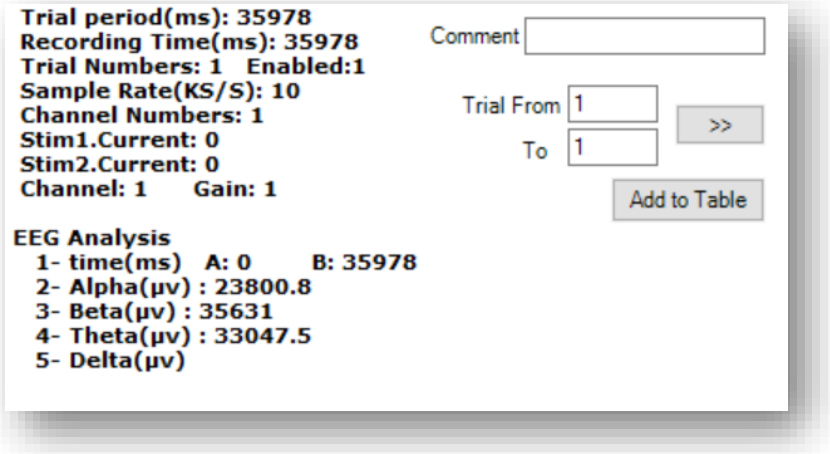
- It can analyze these measures between you defined points:
  - **Time**
  - **Amplitude**



EEG

- It can analyze these measures:
  - **Time**
  - **Alpha band**
  - **Beta band**
  - **Theta band**
  - **Delta band**

- Points are locked in EEG mode

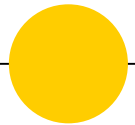


eTrace – Table

- By clicking on Add to Table in result box, data will be added to the table next beside the result box.
- You can **copy Data** or **Data/Header** of this table by **right clicking** on the table and then paste it in Excel for more analysis.
- You also can remove the table by **right click** on the table -> **Remove**

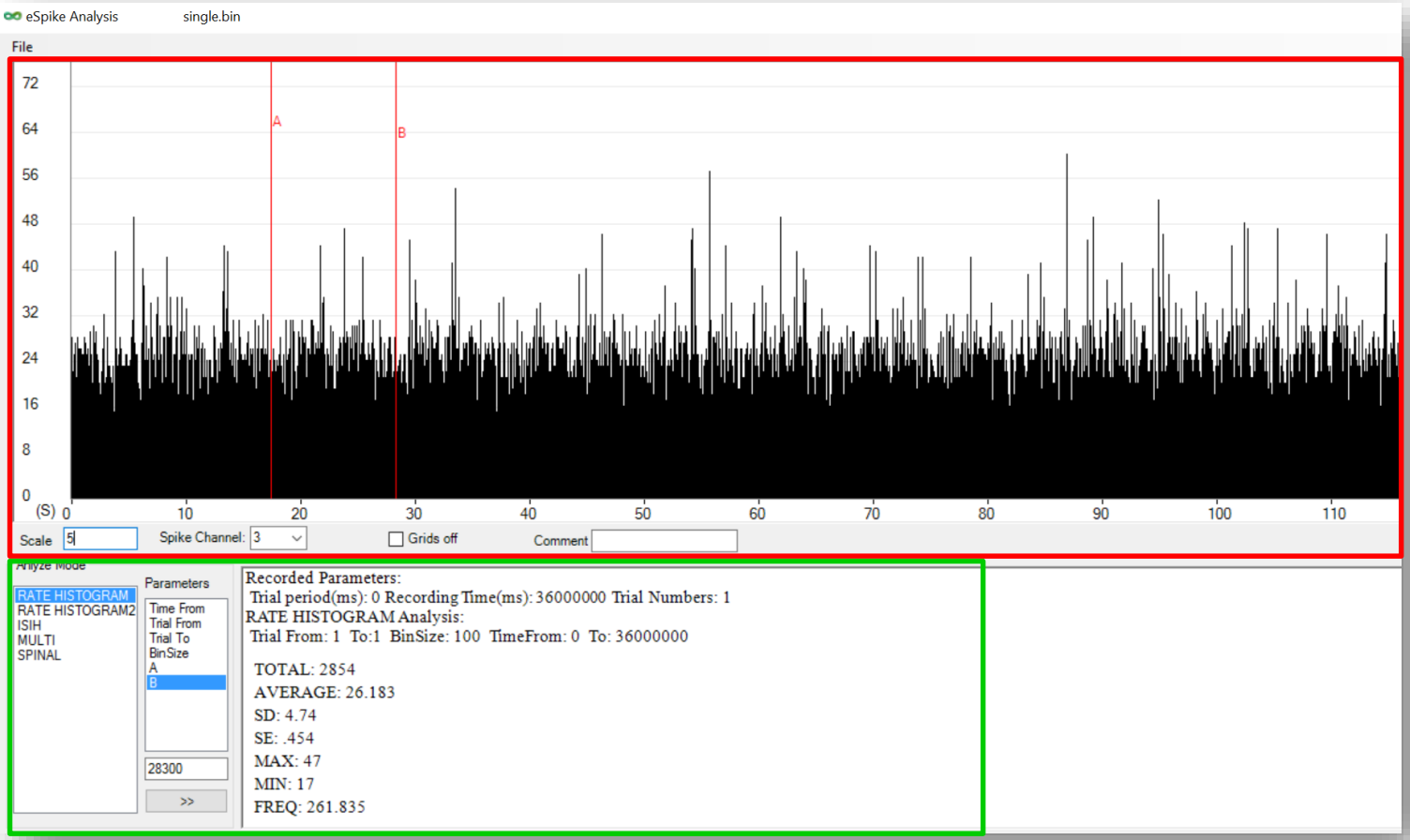
	Comment	Time A(ms)	Time B(ms)	Time C(ms)	Time D(ms)	Time E(ms)
R1	-Tr.1-Ch.1-	7.8	12.2	15	15.2	18.1
R2	-Tr.1-Ch.1-	1472	4696	0	0	.9
R3	-Tr.1-Ch.1-	226.4	342.4	352.1	415.2	421.6
R4	-Tr.1-Ch.1-	226.4	342.4	352.1	415.2	421.6
R5	-Tr.1-Ch.1-	226.4	342.4	352.1	415.2	421.6
R6						

eSpike

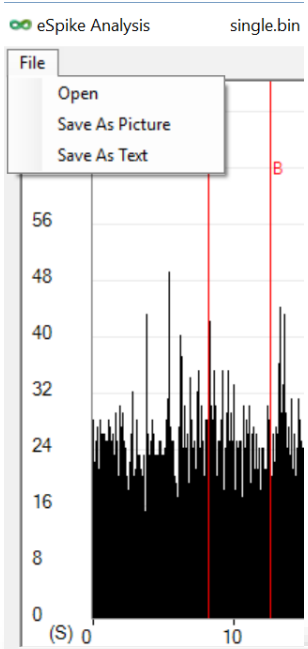


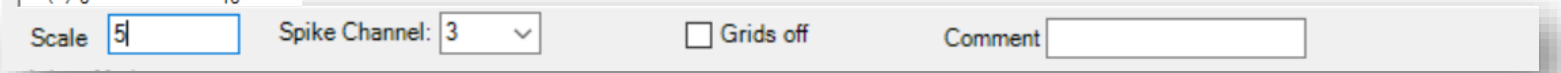
Graph window

Data window



eSpike - graph window



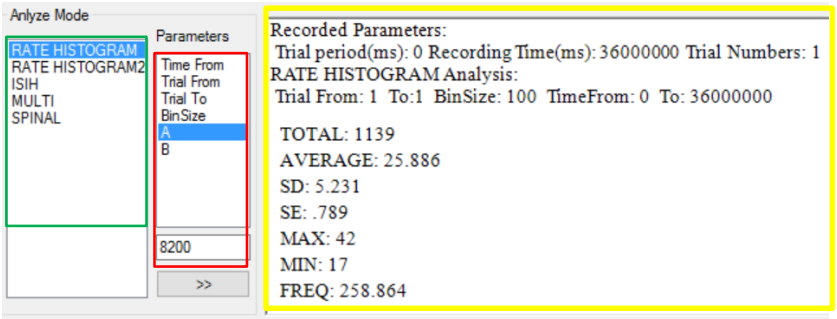


- You can **open** the data you need to analyze by **Analysis** -> **eSpike** -> **File** -> **Open File**
- You also can **save** your data as TXT file (**text** format) or as a BMP (**picture** format) file.
- At the bottom of graph window you can see a bar with this elements:
  - **Scale:** you can change the scale number to optimize the graph view
  - **Spike Channel:** choose which channel you want to analyze
  - **Grid off:** If you check the box, grids will be hidden
  - **Comment:** You can write any comment here

eSpike - data windows

◉At the data window below the graph window, you can see these boxes:

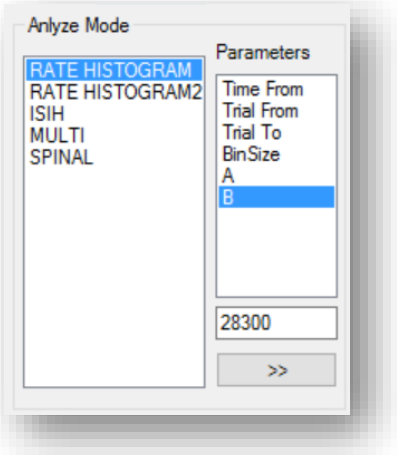
- Analyze Mode
- Parameters
- Results



◉ You can see the trial period, recording time, trial numbers in result window despite which analyze mode you choose.

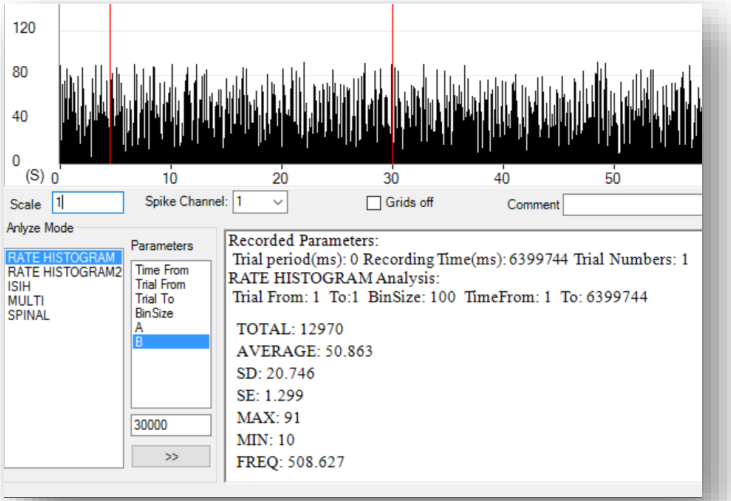
Analyze Mode

- **Rate Histogram:** Use this mode for continuous recording without electrical stimulation (for example to investigate the effect of drug X)
- **ISIH:** It gives you an Inter Spike interval Histogram
- **Multi:** Use this mode to check the response number of neurons
- **Spinal:** you can evaluate the impact of every neuronal fiber specially in the pain research



Rate histogram

- In the parameters box, set appropriate value for Bin size
- Choose from which trial, it begun to analyze and to which trial, it ends by locating desired trial number
- Set the appropriate value for point A and B to limit the analyze between A and B
- Recorded parameters for this analyze mode are:
  - **TOTAL:** total number of spikes
  - **AVERAGE**
  - **SD** (Standard Deviation)
  - **SE** (Standard Error)
  - **MAX** (Maximum)
  - **MIN** (Minimum)
  - **FREQ** (Frequency)



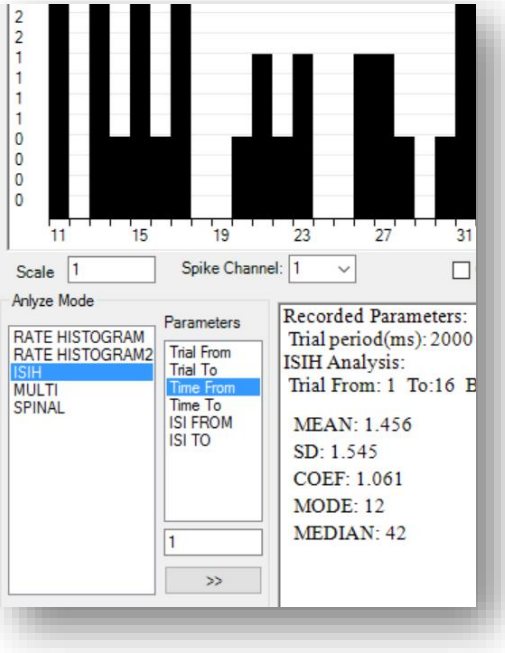
ISIH

◉Choose from which trial **(Trial from)**, it begun to analyze and to which trial **(Trial to)**, it ends by locating desired trial number

◉Set the appropriate value for **ISI FROM-TO** to limit the ISI Histogram between those values.

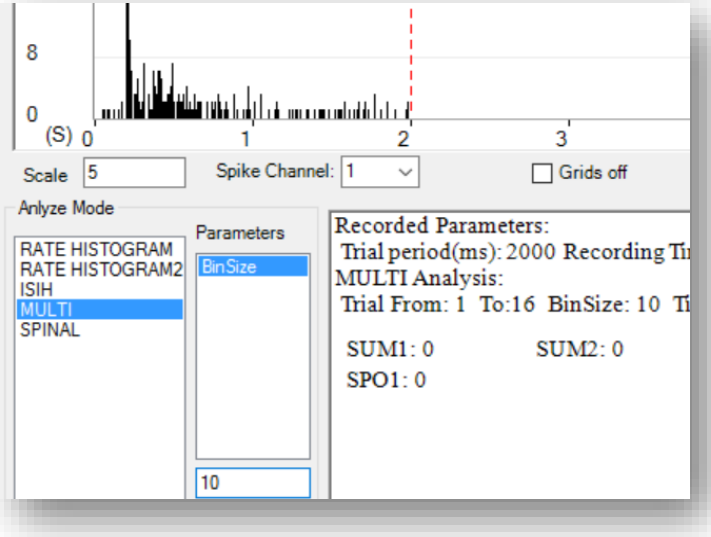
◉Recorded parameters for this analyze mode are:

- **MEAN**
- **SD** (Standard Deviation)
- **COEF** (Coefficient)
- **MODE**
- **MEDIA**



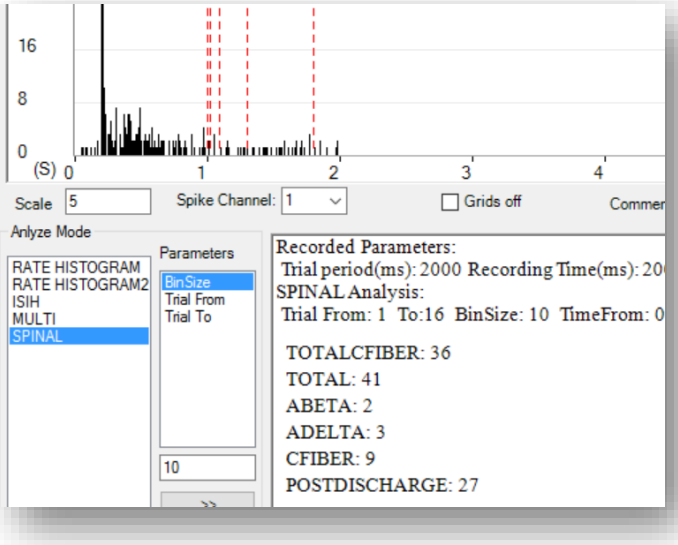
MULTI

- In the parameters box, set appropriate value for Bin size
- You get the result which is SUM of neuronal responses in result box



SPINAL

- In the parameters box, set appropriate value for Bin size
- Choose from which trial, it begun to analyze and to which trial, it ends by locating desired trial number
- You get the result which is Total neuronal fibers and also the number of every fiber type (C Fiber) and also Post Discharge in the result box.

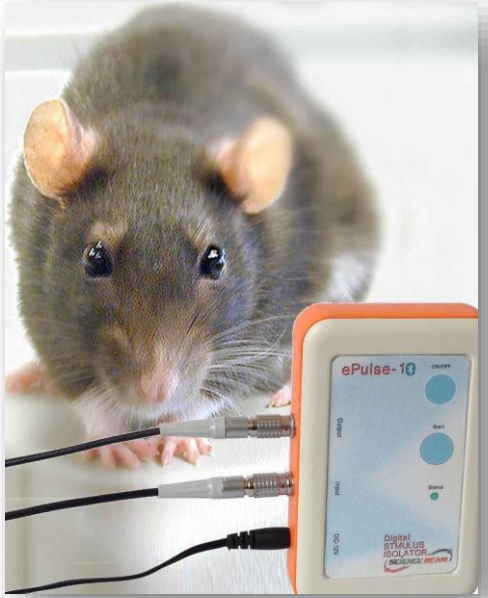


ePulse

ePulse

◉ePulse is a Wireless Stimulus Isolator which is used for deep brain stimulation

- 4 channel Pulse generator
- Professional mixer in designing stimulus pattern



Specification

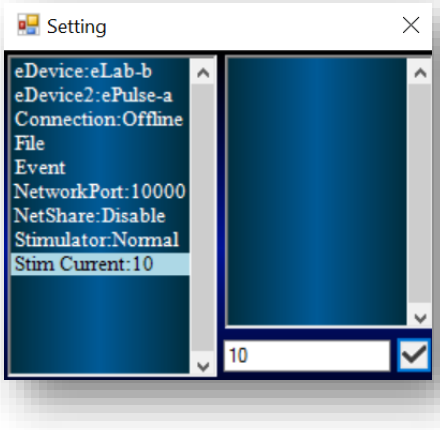
Electrical stimulator	Mode	Constant current, unipolar, isolated
	Number of channel	Optional, 1 or 2
	Current range	0–4 mA or 0–20 mA (optional)
	Current resolution	1 μA or 5 μA (optional)
	Output waveform	DC or current pulse
	Current control	Yes, software control by 12 bit DAC
	Current amplitude error	3 LSB (maximum)
	Polarity inversion	Yes, software control by relay
	Output switch	Yes, software control by relay
	Output voltage compliance	150 V
	Current rise time and delay	5 μs, typical (1KΩ load)
	Current fall time and delay	5 μs, typical (1KΩ load)
	Isolation type	Optical
	Isolation voltage	2500 V
	Isolation resistance	10^{12} Ω

Specification

Pulse generator	Experiment protocols	Single trial, multi trial, single protocol, multi protocol
	Stimulation timing pattern	4
	Pattern parameters	Delay, pulse duration, pulse cycle, pulse numbers, trial period, trial number
	Timing pattern resolution	10 μs
	Mixers	2Ch internal stimulator, 2Ch mechanical stimulator, 2Ch digital outs
	Mixer inputs	Pattern1, pattern2, pattern3, pattern4, digital input1, digital input2

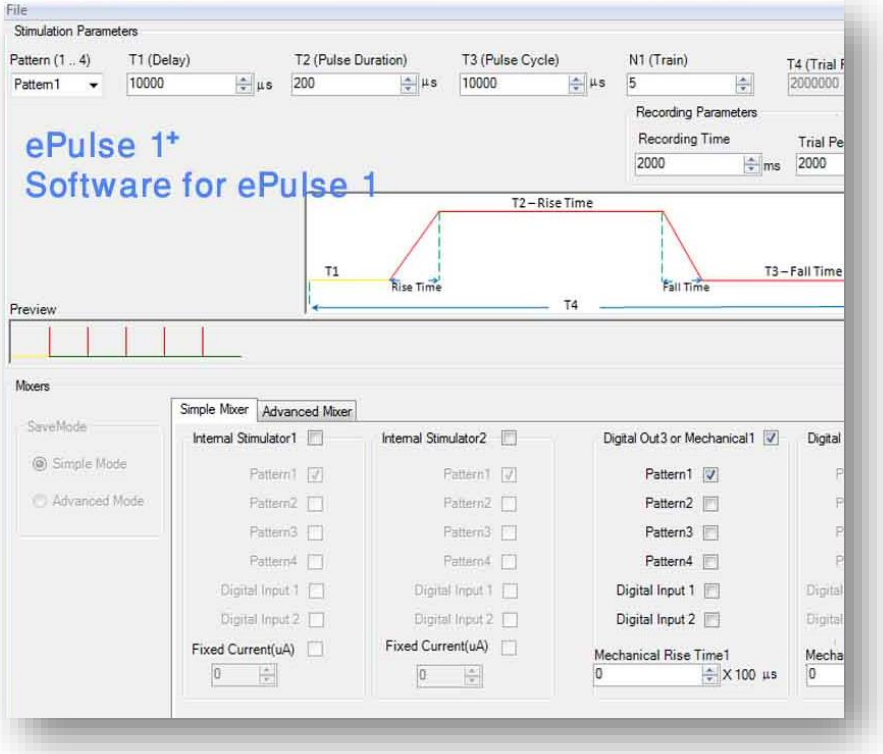
Connection

- To use this device, it needs to be connected to eLab via a cable and eLab connect to the computer. In **eProbe** software -> **Setting menu** -> set these parameters -> **eDevice: eLab** and **eDevice2: ePulse**.
- Then, you only need to create your stimulation protocol. Go to the **Setting** -> **File** -> **Make Stim Protocol**.
- You can change stimulator situation to **off, normal** or **inverted** from **Setting menu** -> **Stimulator**
- You can define current in **Setting menu** -> **Stim Current ->** set the value in the box

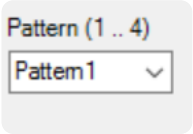


Make Stimulation Protocol

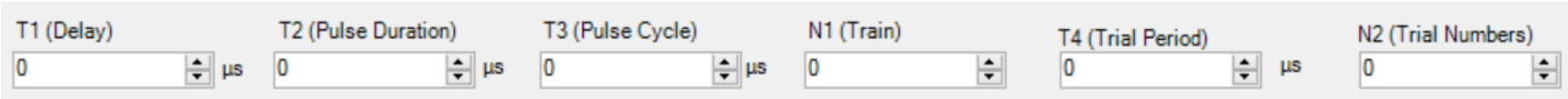
- Stimulation Parameters
- Recording Parameters
- Preview
- Mixers



Stimulation Parameters

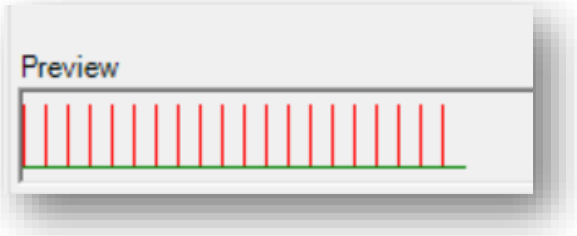


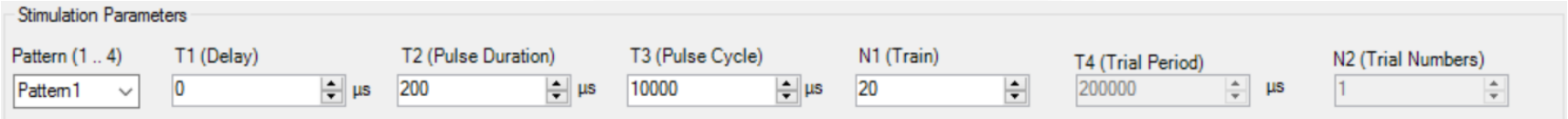
- **Pattern (1 .. 4):** make four different patterns of stimulation. you can mix these patterns to produce a complex protocol by using **Mixers**.
- **T1 (Delay):** Latency between starting the recording time and applying the **first** stimulation pulse of each train
- **T2 (Pulse Duration):** Duration of a single stimulation pulse.
- **T3 (Pulse Cycle):** Duration from starting a single pulse to starting the next single pulse.
- **N1 (Train):** Number of pulses in a *trial period.*
- **T4 (Trial Period):** Duration from starting a trial period to starting the next one.
- **N2 (Trial Numbers):** Number of repeating a desired trial.



Example

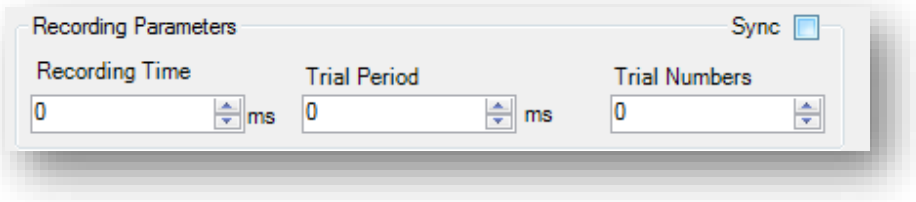
- A train of **20 single pulses at 100 Hz**, each single pulse has **200µs duration**.
- stimulation pattern in 100 Hz (100 pulses/second): **pulse cycle** must be 10ms (1000ms/100pulse).
  - Through the pulse cycle you could establish frequency of a train and vice versa.
- N1 will explain how many pulses you want to have in a train.
- According to T1, T3 and N1 you must write a value for T4.





Recording Parameters

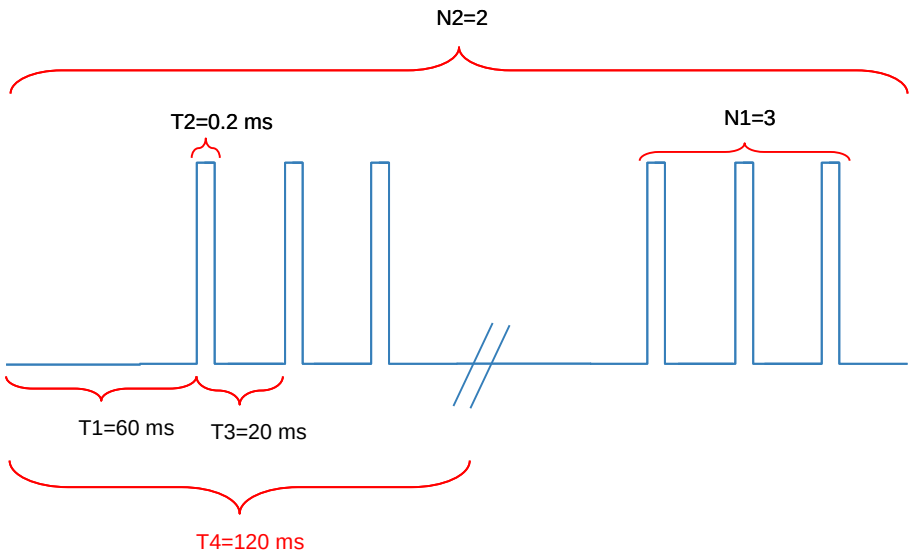
- Usually, following the stimulation, you have an electrophysiological response and you want to save it. Record your data using the below menu:



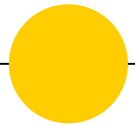
- **Recording time:** It is part of trial period, which you wish to save it on the computer.
- **Trial period** and **Trial Numbers** are the same as described in stimulation parameters.
- **Recording time must not be longer than the trial period (could be lesser or equal).**
- check the sync box to equalize the values of Trial period and Trial Numbers in both stimulation and recording parameters.

Preview of Stimulation Protocol

- According to T1, T3 and N1 you must write a value for T4!



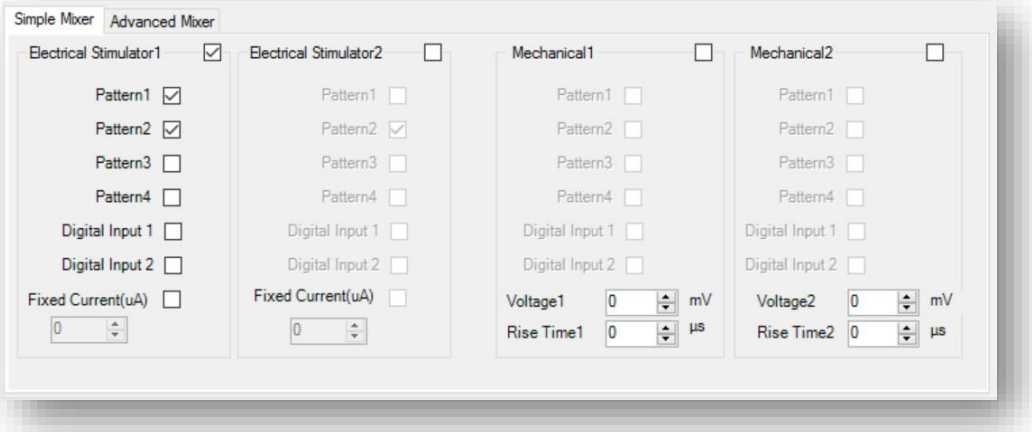
Mixers



Simple mixer

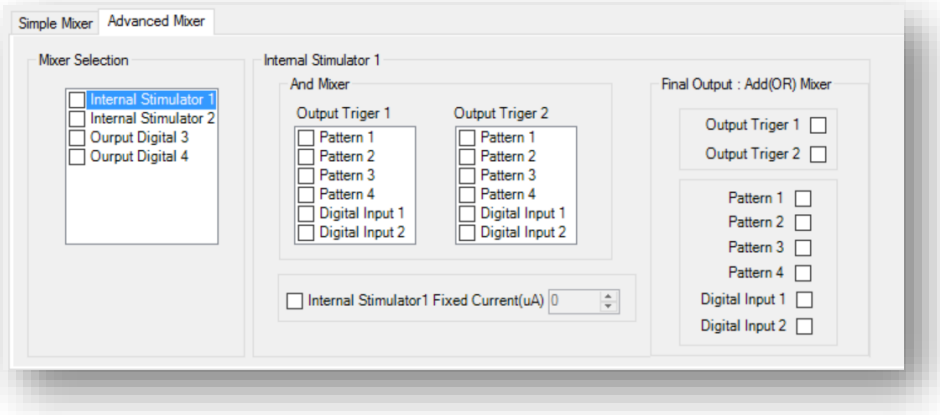
- You can mix your stimulation protocol here.
- **Electrical Stimulator:** mix your defined electrical pattern here by choosing **patterns** and **inputs** and also **fixed current**.

- **Mechanical:** it is mechanical mixer that you can choose **patterns** and **inputs** and also **Voltage** and **Rise time**



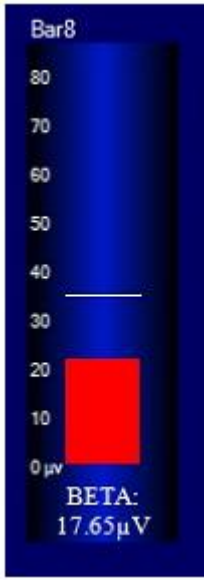
Advanced mixer

- You have access to more advanced settings for mixer here
- You have access to **AND/ OR** feature to apply it on your stimulus design.

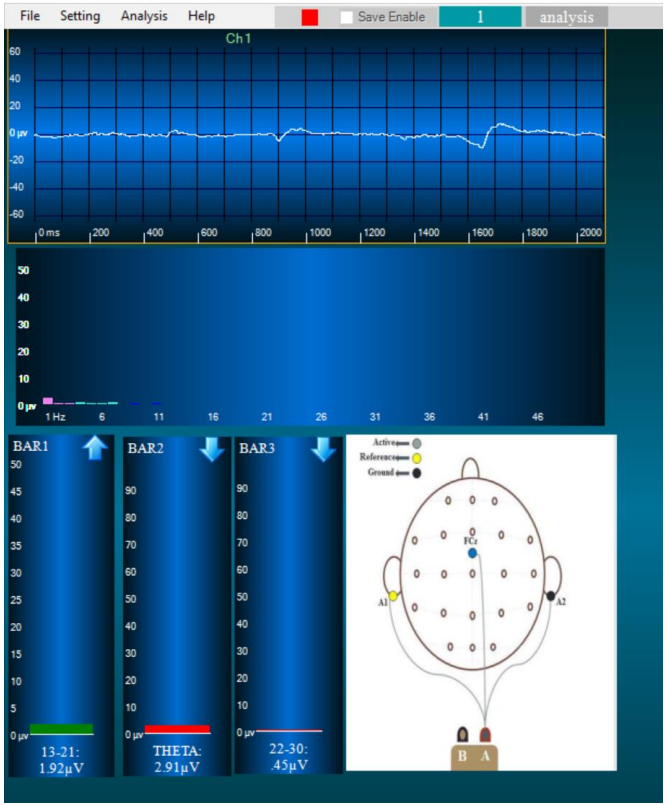


- deep brain stimulation
- Brain stimulator

Bar



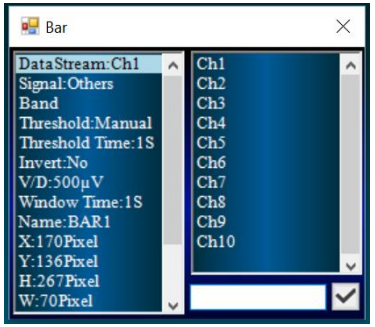
It shows weather the square of the instantaneous FFT(Fast Fourier Transform) power of a specific band (δ,θ, α,β,γ) is **beyond or less (direction)** than the **threshold** and considers it as a **logic** for the Game panel.

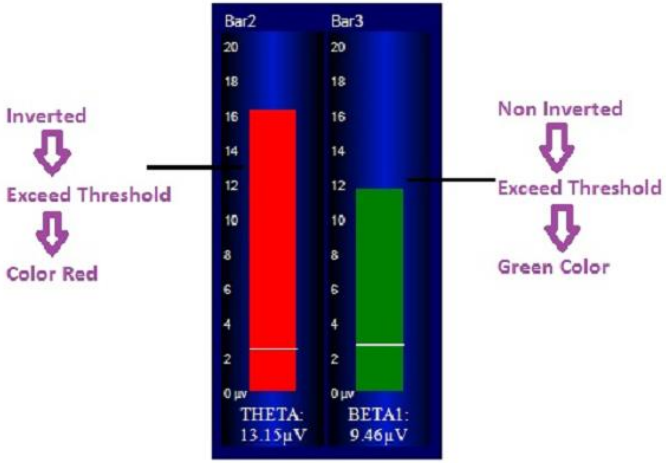


Bar setting

- **Data Stream:** channels or ports which stream data
- **Signal:** type of signal(ECG/EEG/EMG/RRI/BVP/IBP/Spike/Field)
- **Band:** brainwaves spectrum, Low/High Artifact
- **Threshold:** manual or percent
- **Threshold Time**
- **Invert:** Objective direction of frequency band in Bar
- **V/D:** Amplitude scaling to optimize view
- **Window Time:** change the window size
- **Name:** Change the name of Bar
- **X/Y/H/W:** Change the size and coordination of Bar
- **Script**

Delta: $1-4Hz$
Theta: $4-8Hz$
Thalpha: $6-10Hz$
Alpha: $8-12Hz$
LowAlpha: $8-10Hz$
HighAlpha: $10-12Hz$
Mu: $8-13Hz$
SMR: $12-15Hz$
Beta: $12-35Hz$
Beta1: $15-18Hz$
Beta2: $18-22Hz$
Beta3: $22-26Hz$
Beta4: $26-30Hz$
Beta5: $30-35Hz$
Gama: $35-100Hz$
LowArtifact: $43-59Hz$
HighArtifact: $1-2Hz$



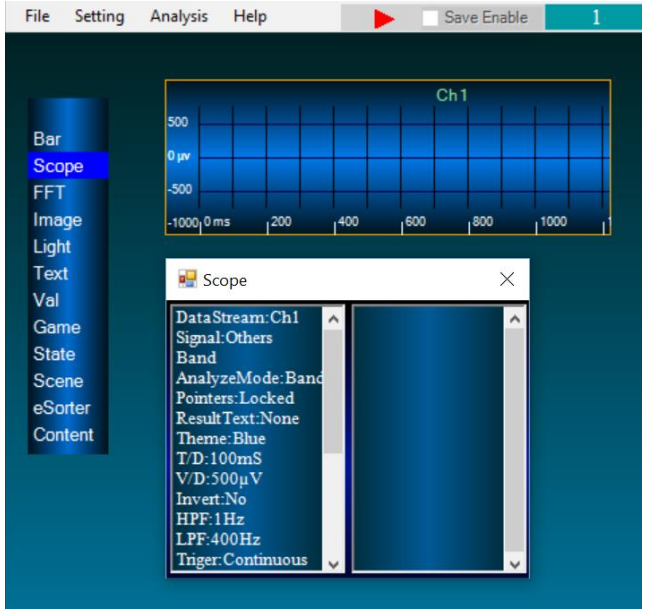


Scope

- It displays the signal both in time and frequency domain

Scope setting

- **Data Stream:** Channels or ports which stream data
- **Signal:** type of signal(ECG/EEG/EMG/RRI/RatRRI/BVP/IBP)
- **Band:** Brainwaves spectrum, Low/High Artifact
- **Analyze Mode:** Bands
- **Pointers:** Lock pointer lines
- **ResultsText:** showing a result text beside scope
- **Theme:** Change the color of waves inside scope
- **T/D:** Time scaling to optimize view
- **V/D:** Amplitude scaling to optimize view
- **Invert:** invert waves in scope
- **HPF:** eliminate the high frequency signals or noises
- **LPF:** eliminate the low frequency signals or noises
- **Triger:** to trigger continuously or not



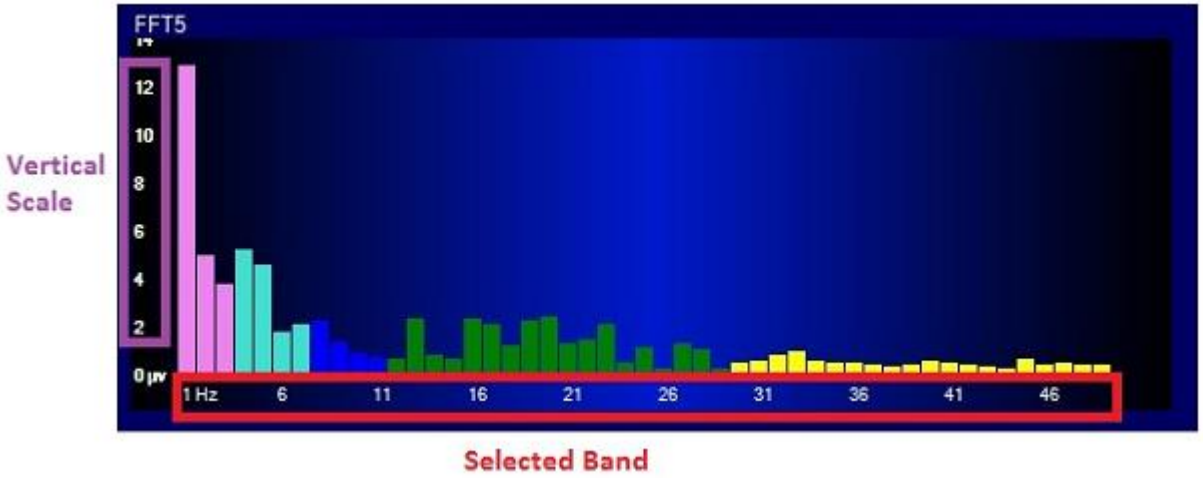
eWave devices

Product name	eWave8D	eWave16D	eWave32-64-128D	eWave4s
Amplifier Channel numbers	8	16	32/64/128	3
Amplifier Type	Differential, DC	Differential, DC	Differential, DC	Differential, DC
ADC resolution	24bit	24bit	24bit	24bit
Sample rate/ per channel	1Ks/s	1Ks/s	500s/s	5Ks/s
Processor	32bit, 128MHz	32bit, 128MHz	32bit, 153MHz	32bit, 72MHz
Data Interface	WI-FI/USB2 Bluetooth wireless	WI-FI/USB2	WI-FI/USB2	USB2 Bluetoothwireless
Current Stimulator	No	No	No	Yes (100mA, 350V)
Gain	6	6	6	6

Product name	eWave8b	eWave16b	eWave32b	ePulse
Digital inputs	2	2	2	2
Digital output	2	2	2	2
Analog input	1	0	0	0
Analog output	1	0	0	0
Dimensions (L/H/W) mm	120x28x60	120x28x60	155x33x95	155x33x95
inputs resistance	10^{12} Ω	10^{12} Ω	10^{12} Ω	10^{12} Ω
Battery life Re-chargeable	24 Hours	12 Hours	12Hours	24 Hours
Filter band	DC -500Hz	DC -500Hz	DC -250Hz	DC -2KHz
Application EEG/ ECoG /ECG/EMG/ EOG	Yes	Yes	Yes	Yes
ERP	Yes-8ch	Yes -16ch	Yes -32/64/128ch	No
Sensors EEG,EMG,ECG,BVP, Temp, Skin Resistance	Yes	No	yes	No
LFP	No	No	No	No
Single unit	No	No	No	No
Intracellular recording Patch ,Voltag ,Curent Clamp	No	No	No	No
Spike Sorter	No	No	No	No

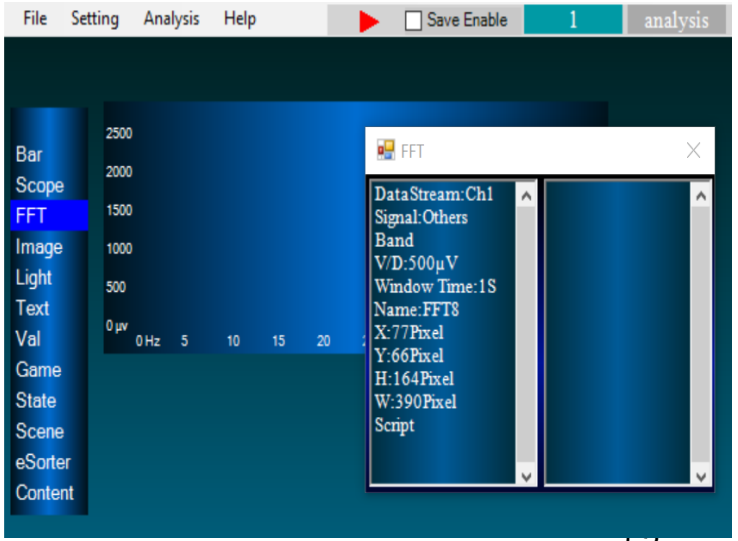
FFT

- In FFT panel, you can see the square of the instantaneous FFT power of your desired band

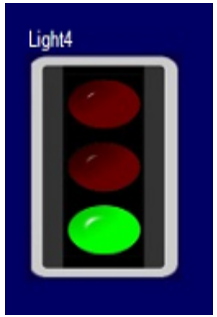


FFT setting

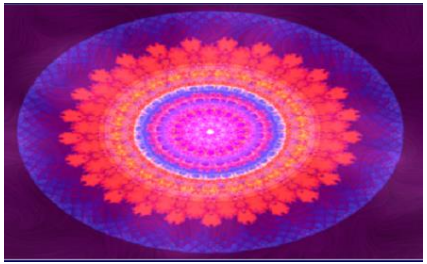
- **Data Stream:** Channels or ports which stream data
- **Signal:** Type of signal(ECG/EEG/EMG/RRI/BVP/IBP/Spike/Field)
- **Band:** Brainwaves spectrum, Low/High Artifact
- **V/D:** Amplitude scaling to optimize view
- **Window Time:** change the window size of FFT calculation



Image, Text, Light



- **Image panel** shows image. You can select the image file you want to display.
- **Text panel** add some information as text to your protocol or show the result of the analyze panel.
- **Light panel** calculates the square of the FFT power of the selected band and compares it with two thresholds. If the value is more than both thresholds the light shows green color. If it is less than both thresholds the color is red and if it is in the middle, the color is orange.



Image, Text, Light setting

◉Image

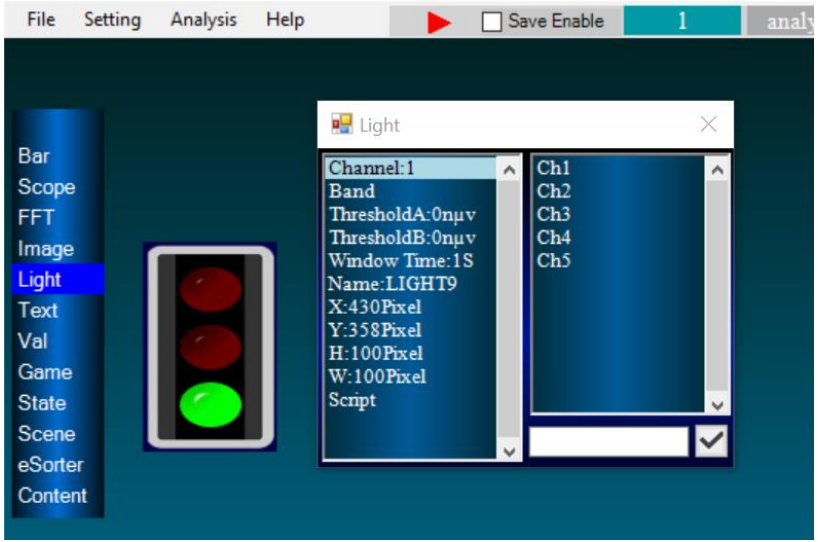
- **File:** Choose the image from here (first you must add the image in image folder)

◉Text

- **Content:** Type the text here

◉Light

- **Channel**
- **Band**
- **ThresholdA**
- **ThresholdB**
- **WindowTime**



Val

- Val panel displays the square of the FFT power of the band that you have selected.
- You can see the output of only one channel at a time in each Val panel.

Please, write your comments on the PDF for later edition

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