

SCENAR: the secrets of effectiveness

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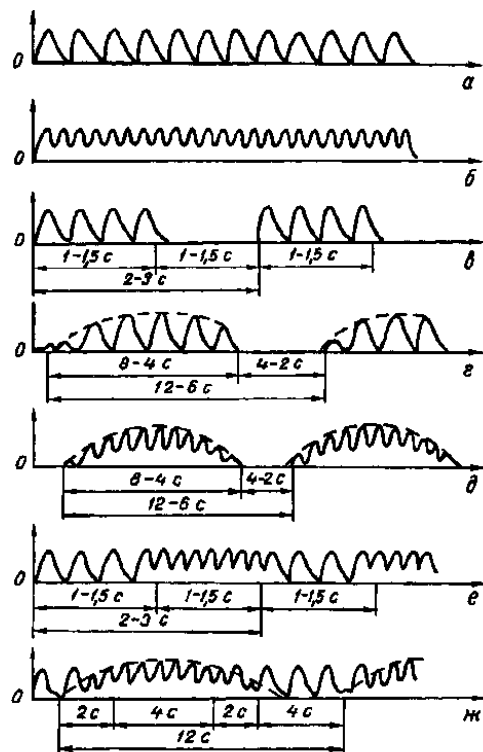


A few words about electrotherapy

Galvanization is low-power (under 50mA) and low-voltage (30-80V) direct current. Galvanization exists for 200 years.



A few words about electrotherapy



In the 1950s P. Bernard offered the treatment with alternating current (**diadynamic currents therapy**).

In 1963 it was offered to use sinusoidal currents with frequency 5000 Hz, modulated with frequency from 10 up to 150 Hz (**amplipulse therapy**).

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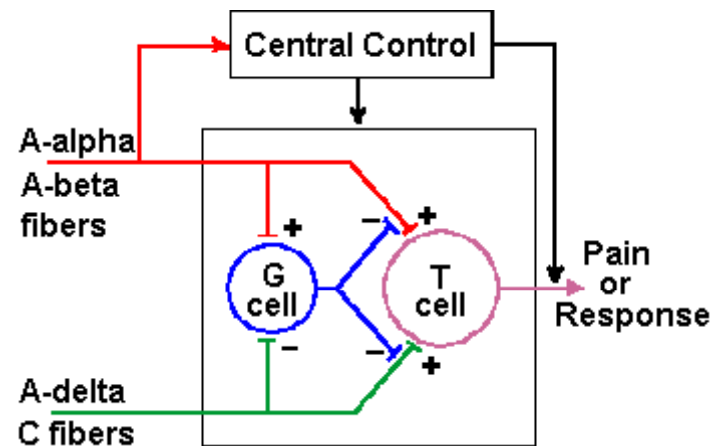
A few words about electrotherapy

Electropulse therapy was developed basing on 'The gate control theory' by Melzack R., Canada, and Wall P., England, 1965.

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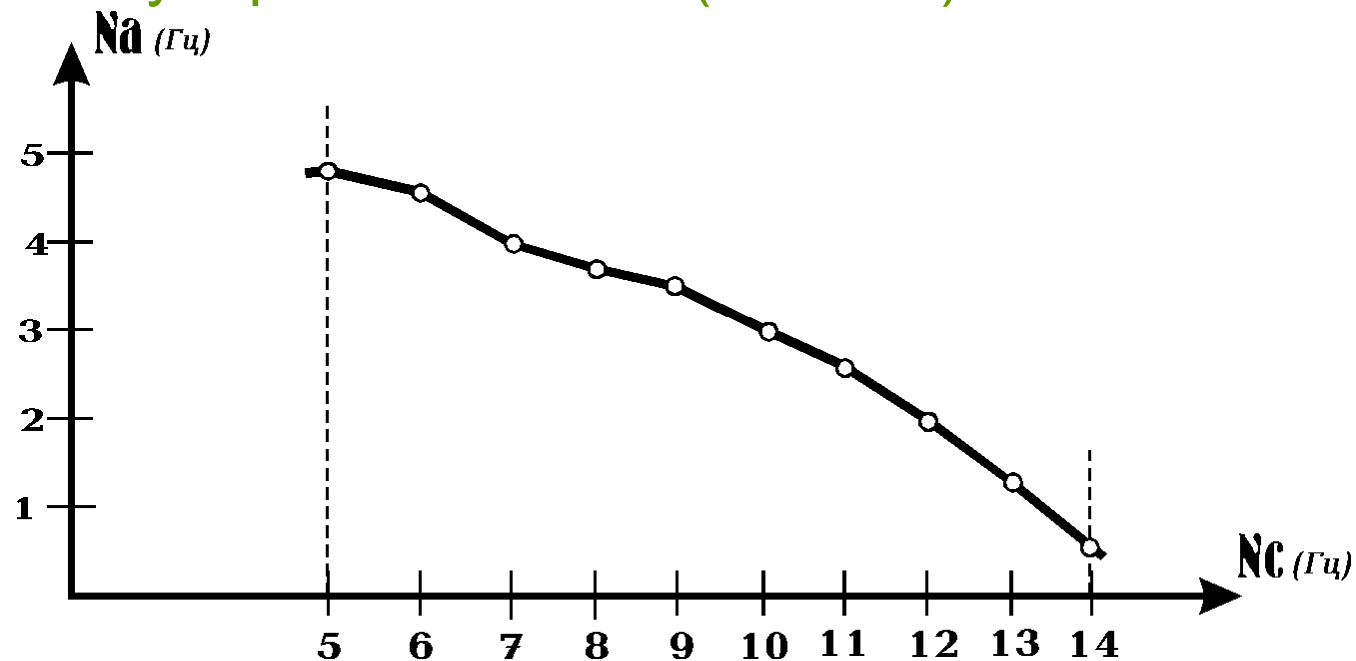
Photo credit: The Canadian Medical Hall of Fame



'Addiction' and coping with it

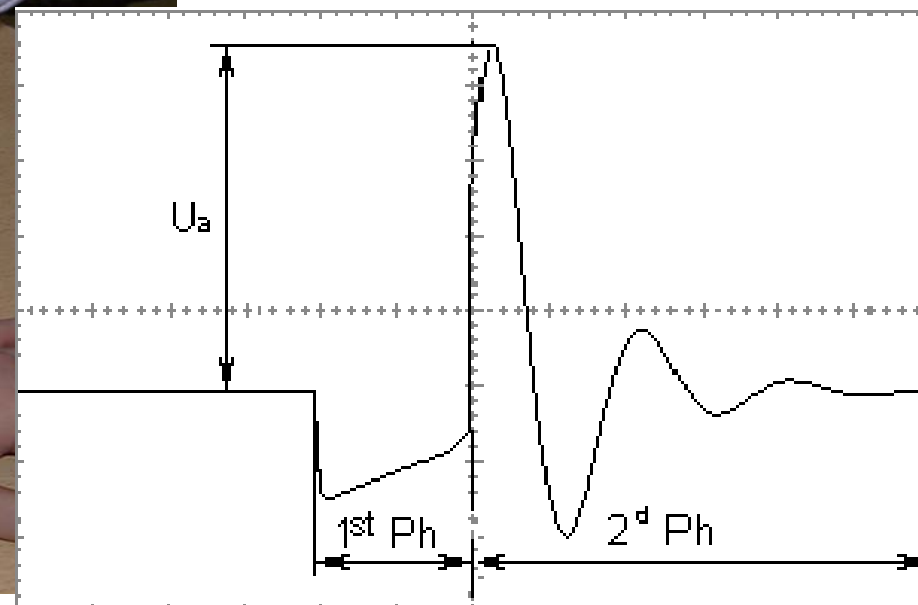
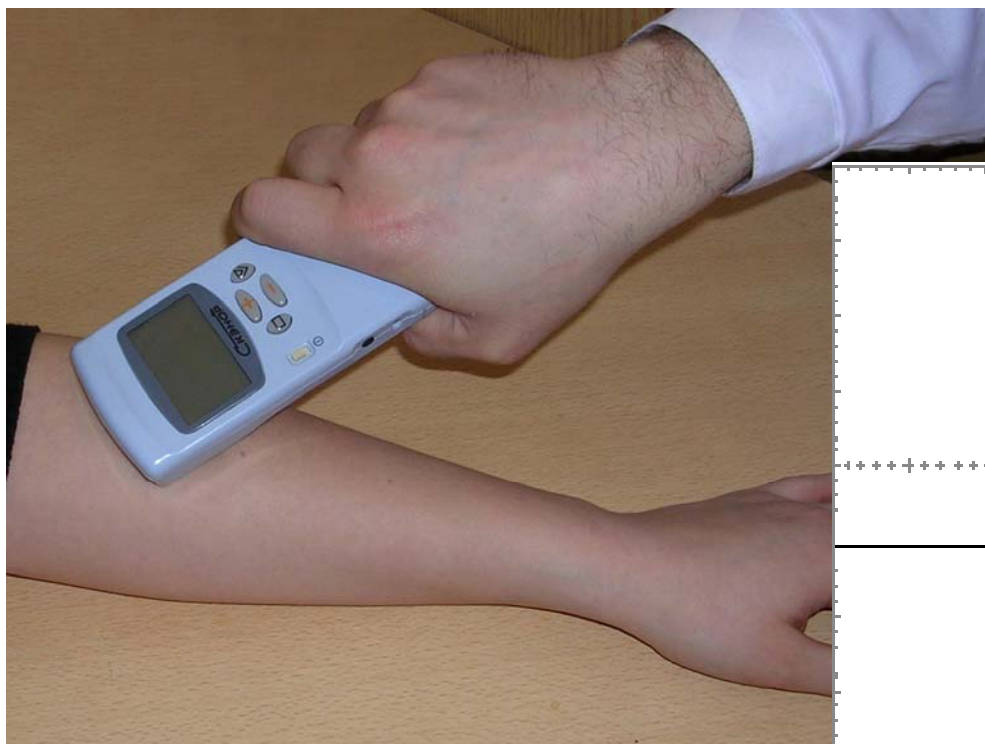
There is a problem of 'addiction' (or tolerance) to electric influence - the effect diminishes with time. SCENAR copes with this problem successfully.

The frequency of caused pulse activity vs the frequency of neuron synaptic stimulation (irritation).



SCENAR impulse features

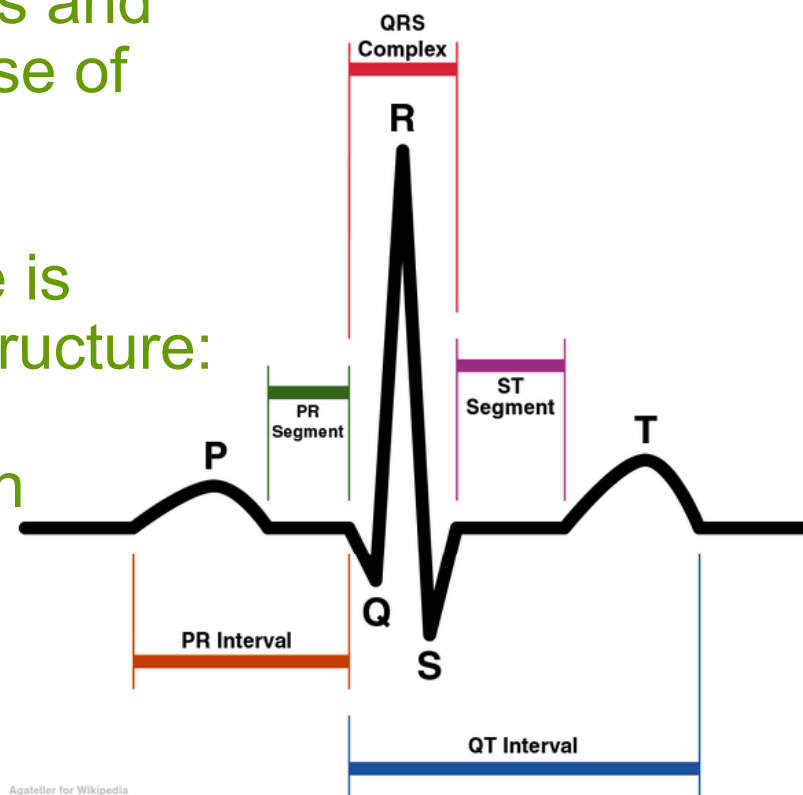
SCENAR generates two-phase bipolar pulses with insignificant constant (DC) component.



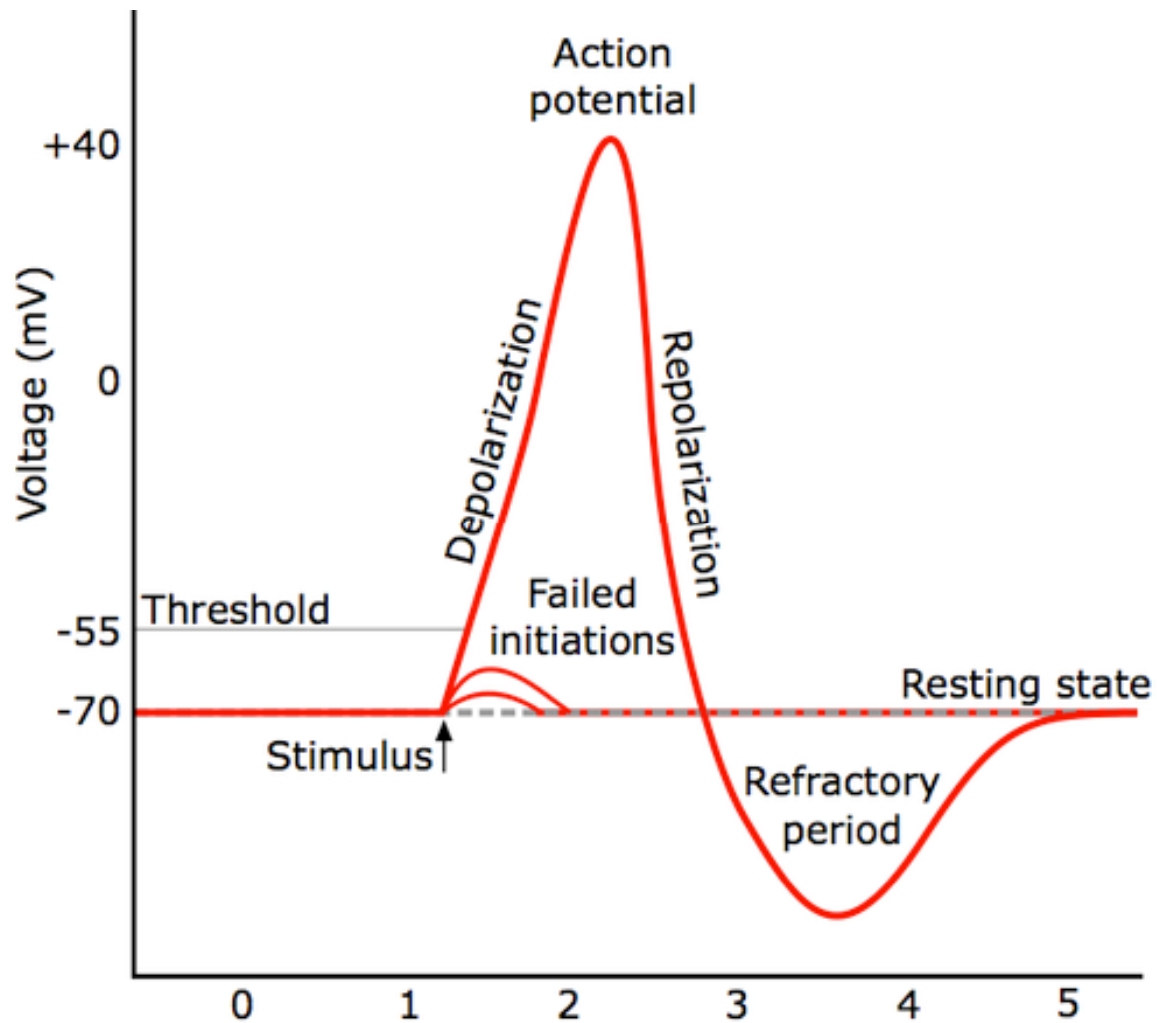
SCENAR impulse features

Such shape is called 'neural-like', as it is similar to myopulses and cardiopulses (particular case of myopulses).

Their characteristic feature is Precisely the two-phase structure:
I-st phase – depolarization
II-nd phase – repolarization

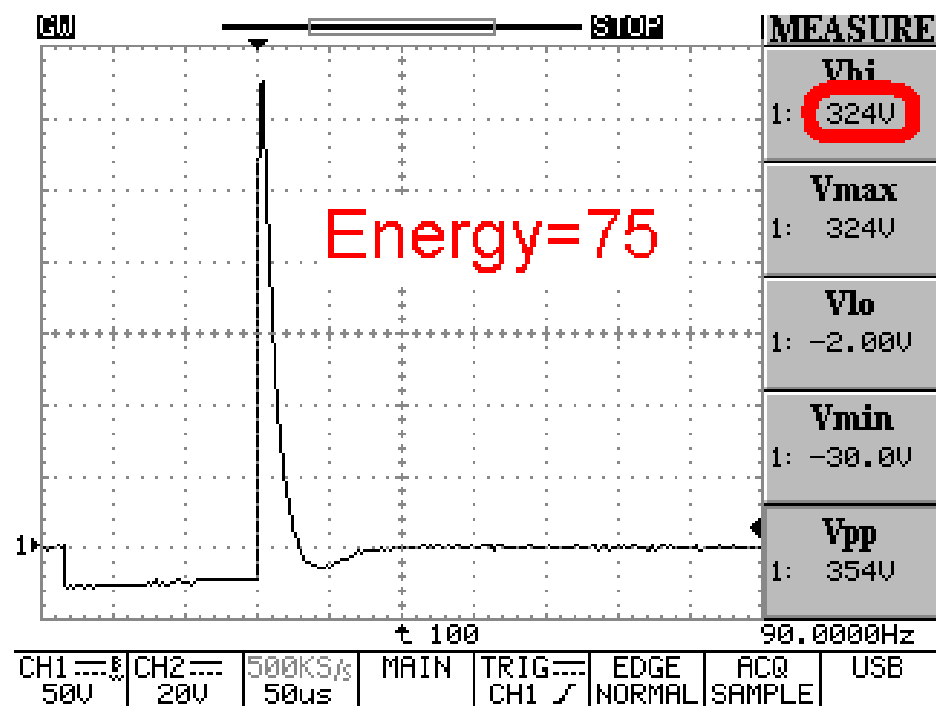


SCENAR impulse features



SCENAR impulse features

High-amplitude



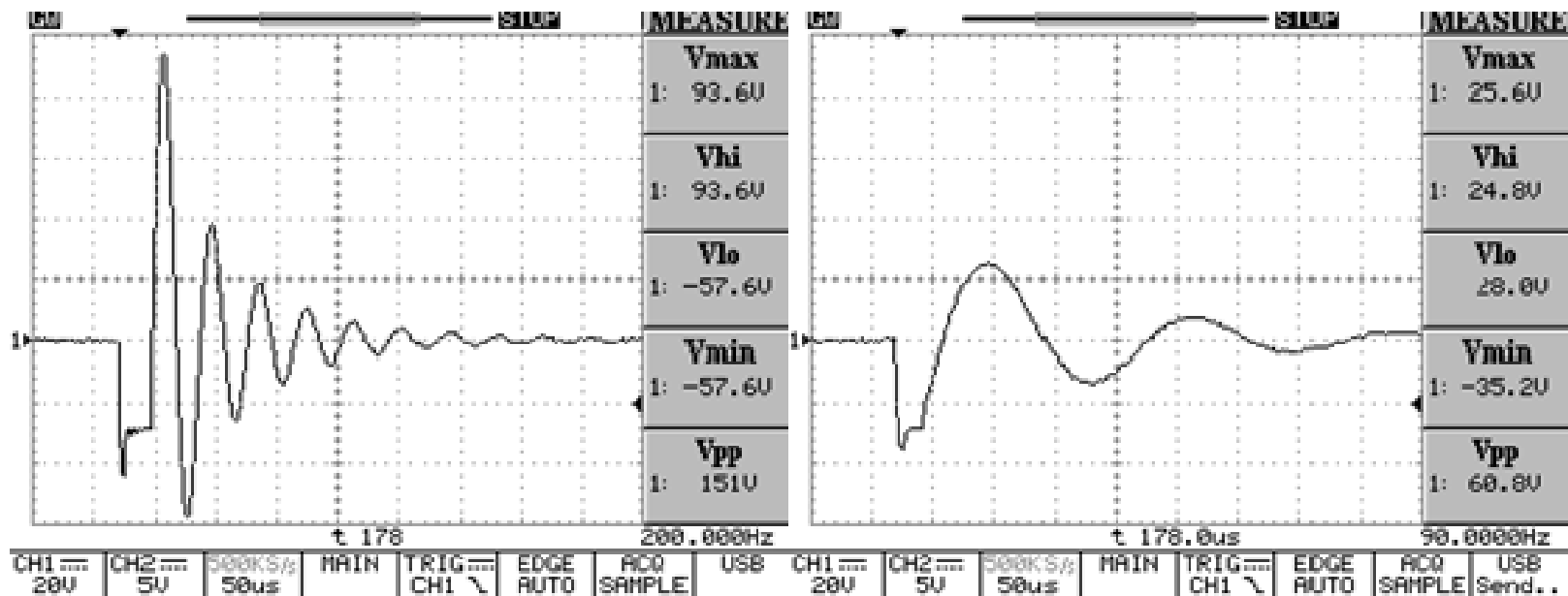
SCENAR impulse features

With limited energy (undamaging)

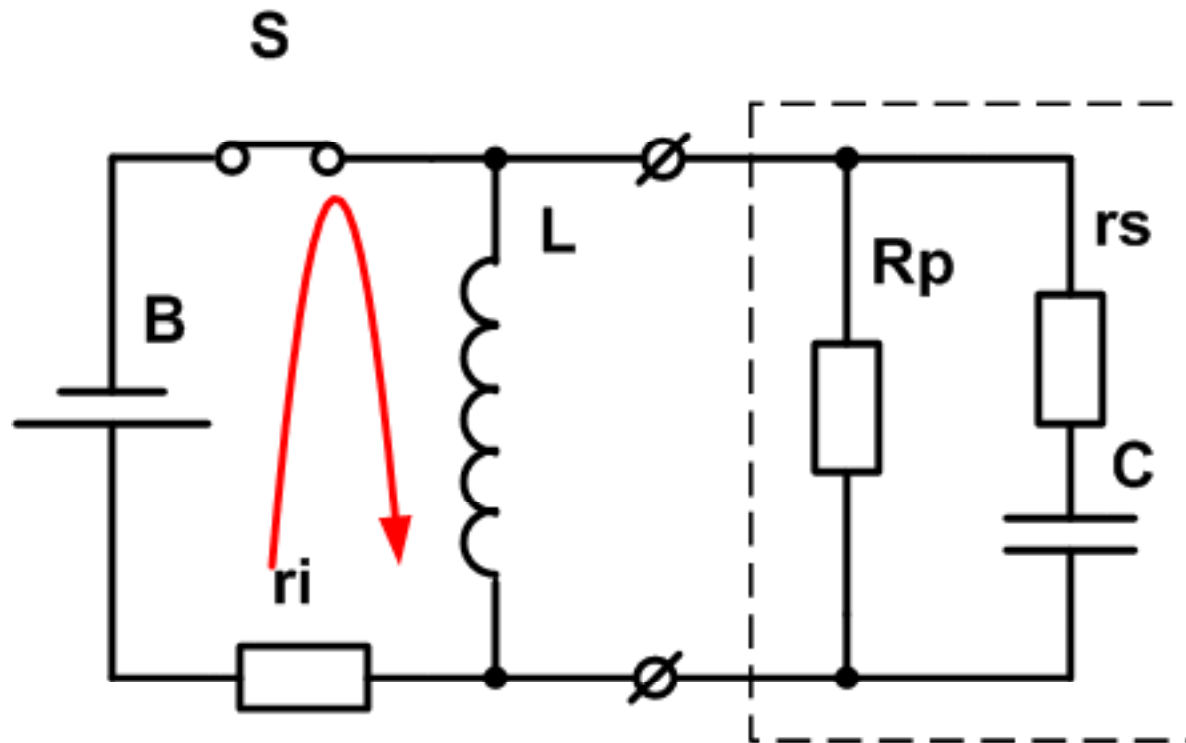
	500 Ω		2k Ω		10k Ω	
	Measured U_{rms}, V	Average power, W	Measured U_{rms}, V	Average power, W	Measured U_{rms}, V	Average power, W
SCENAR-1-NT	10.3	0.212	14.3	0.102	12.5	0.016
CHANS-01- SCENAR	11.4	0.260	13.9	0.097	12.6	0.016
InterX5000	9.8	0.192	13.5	0.091	13.8	0.019

SCENAR impulse features

High-variative (Energy=20, 1st and 30nd sec)



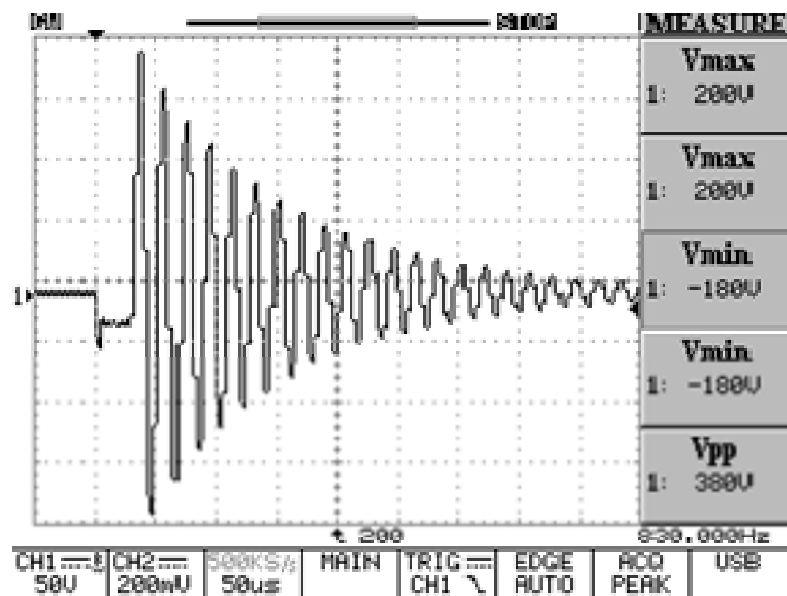
How is the SCENAR impulse formed?



1st phase

SCENAR impulse vs load

No load

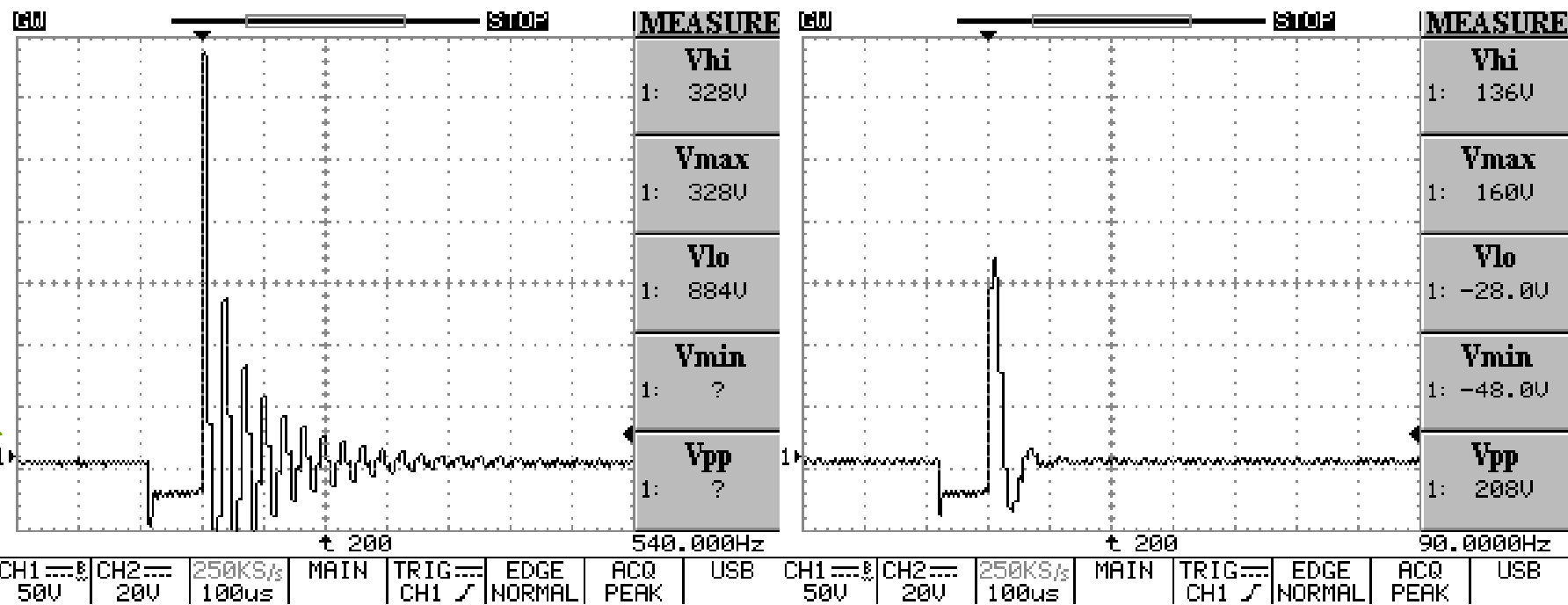


SCENAR impulse vs load

Back of the hand

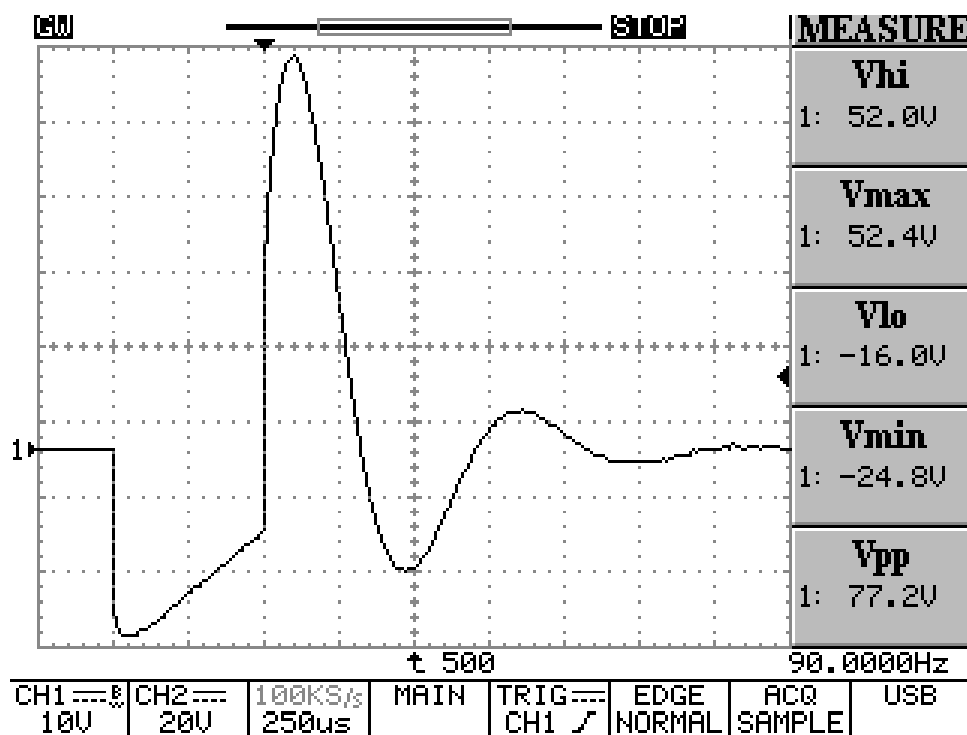
Palm

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SCENAR impulse vs load

Self-adhesive electrodes, Energy=250



SCENAR impulse vs load

$$\omega = \frac{1}{\sqrt{LC}}$$

$$T = \sqrt{LC}$$

$$IR = Const \cdot \sqrt{C}$$

$$C = \frac{(IR)^2}{K}; K \sim 1$$

C_{sim}	IR	C_{calc}
	10	140
300	15	320
	20	570
	30	1 300
	50	3 600
10000	75	8 000
220000	400	230 000
	600	510 000
	800	910 000



SCENAR impulse features

Summary:

- two-phase bipolar (neural-like);
- high-amplitude, but undamaging;
- highly variable (dynamic) (no addiction).



SCENAR impulse features

Questions?
Break...



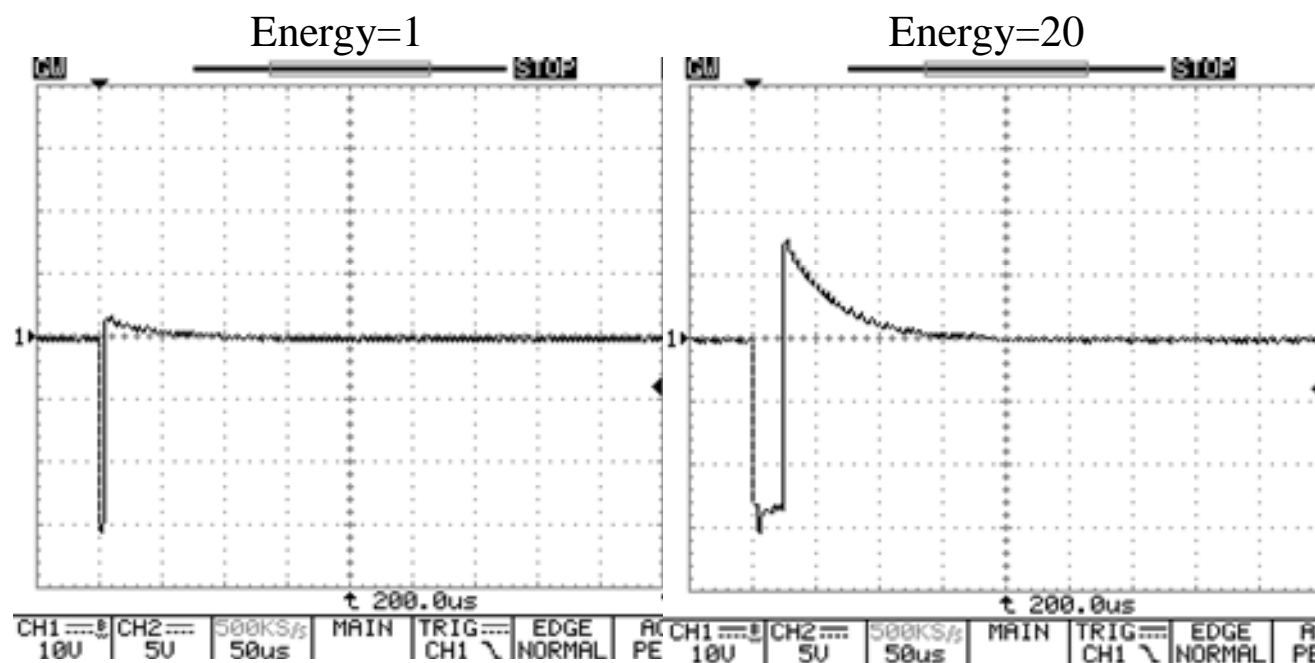


Available settings



Available settings: 'Energy'

Basic parameter, its regulation is available in all devices and in the same limits. Max/min amplitude rate is from 50 to 100 times. For energy it corresponds to more than 2500 times.

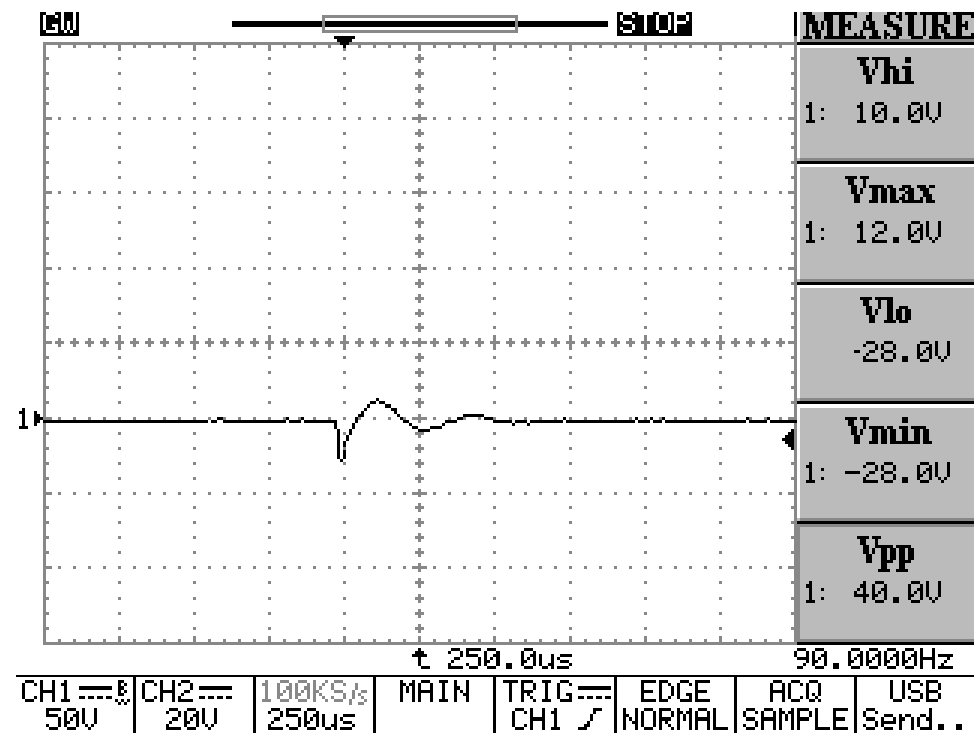


a

b

Available settings: 'Energy'

Energy changes from 20 to 250.



Available settings: 'Energy'

While increasing the energy the sensations are changing from their absence to painful ones. At the comfortable level of electric influence it is felt as pulsation, pricking, vibration.

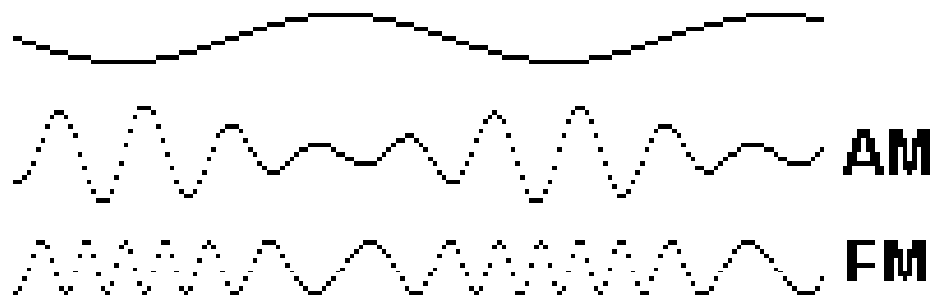


Consequently, there is a scale of influence:
subthreshold level,
threshold level,
comfortable level,
uncomfortable level,
painful level.

Even at the subthreshold level the influence is still present. The result is not always proportional to the strength of sensations.

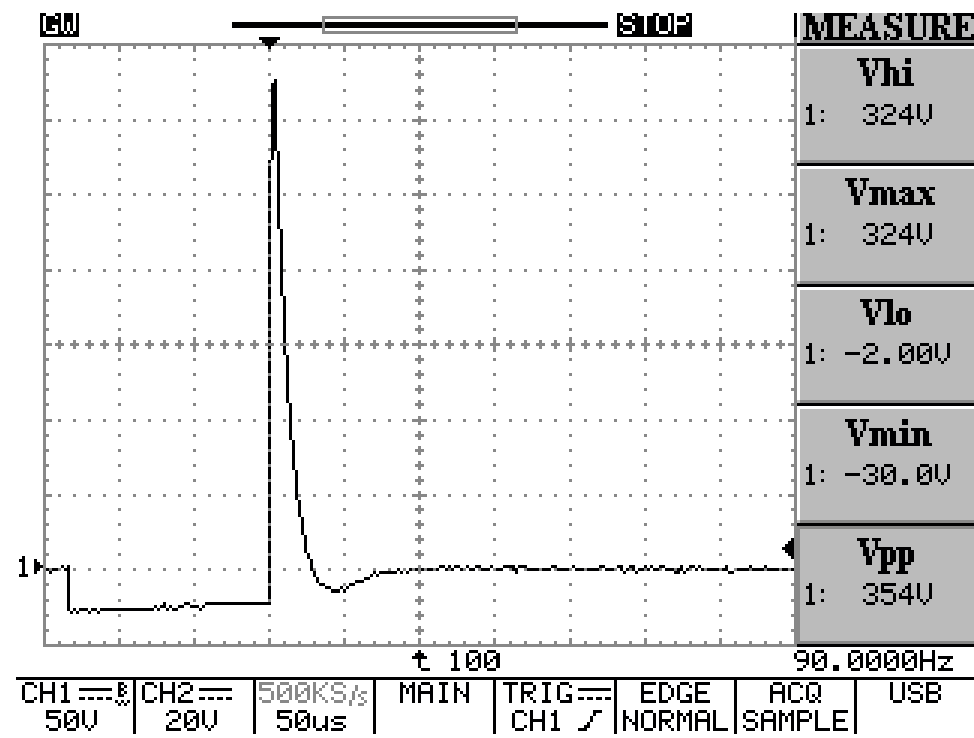
Available settings: 'AM'

Amplitude modulation (AM) is the change in the impulse amplitude in time according to a certain rule. It is available in all devices, completely or partially.



Available settings: 'AM'

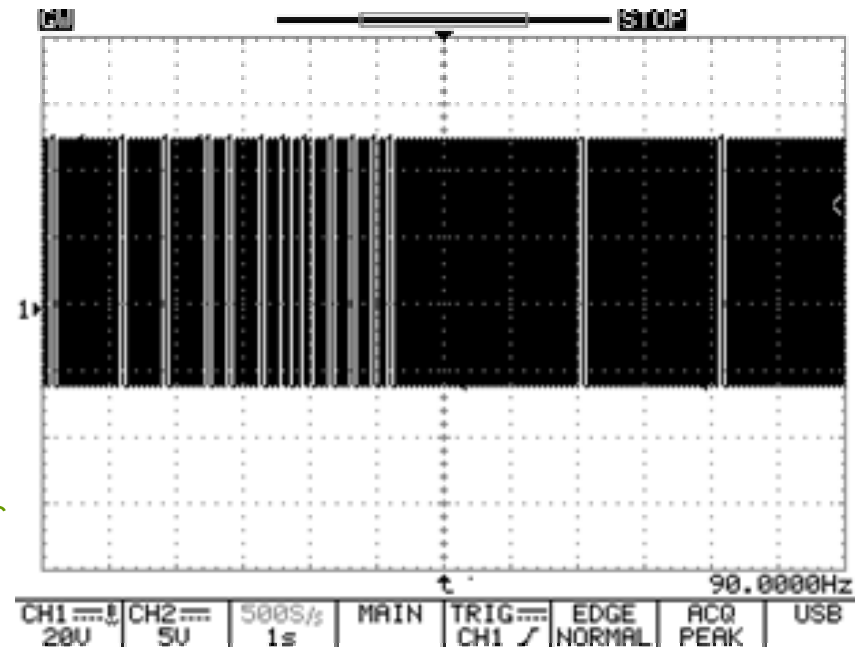
AM: single impulse



Available settings: 'AM'

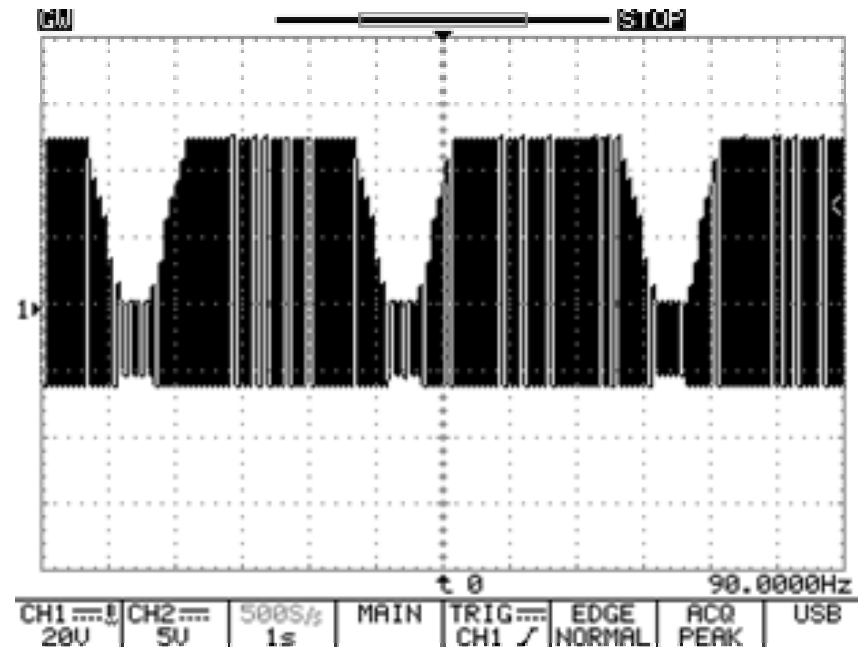
AM: bursts (batches) of impulses

AM=Off



a

AM=3:1



b

Available settings: 'AM'

When AM is on it is felt as increasing and decreasing of the strength of influence.



Available settings: 'Bee'

'Bee' is one of the 'AM' modes. The device at the minimal energy level is waiting for the skin contact. Right after the contact it gives 1 or more pulses with the maximal energy.

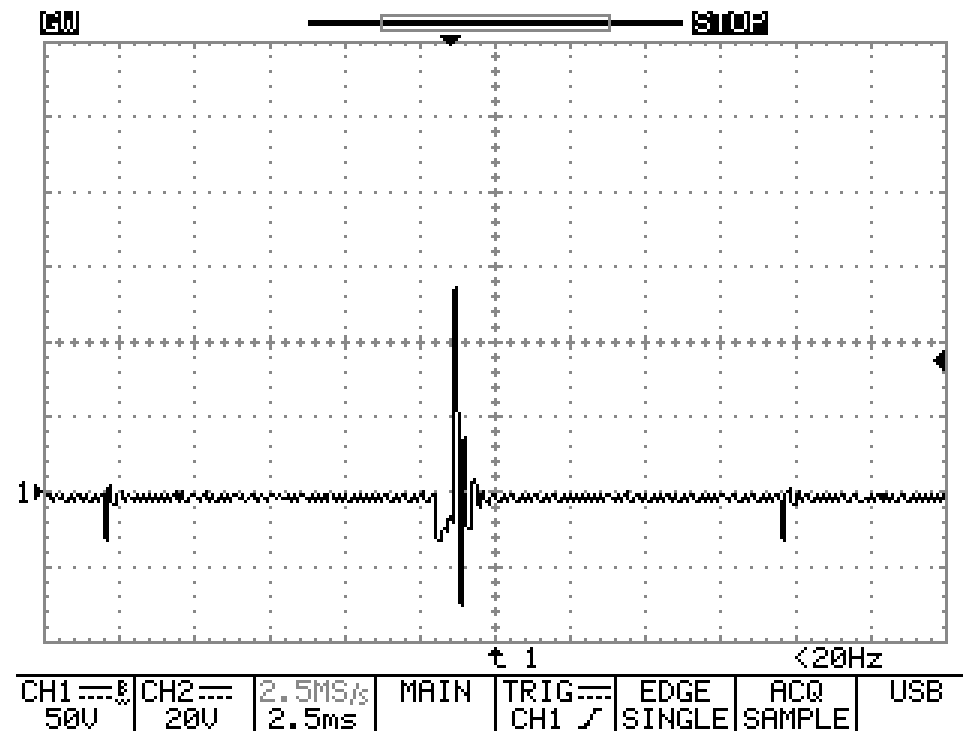
The setting is available only in the most advanced models of SCENAR devices.





Available settings: 'Bee'

'Bee' mode with 'Int=1'



Available settings: 'Bee'



When 'Bee' is on, right after the skin contact it is felt as a short strong influence, like the real bee sting.

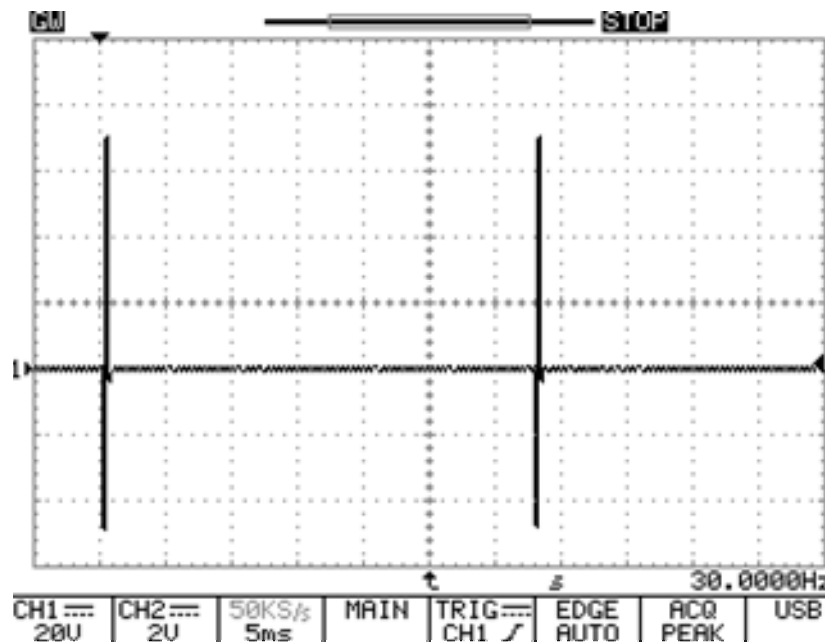
'Energy' settings does NOT affect 'Bee' strength. It can be regulated only with the 'Intensity' settings.



Available settings: 'Frequency'

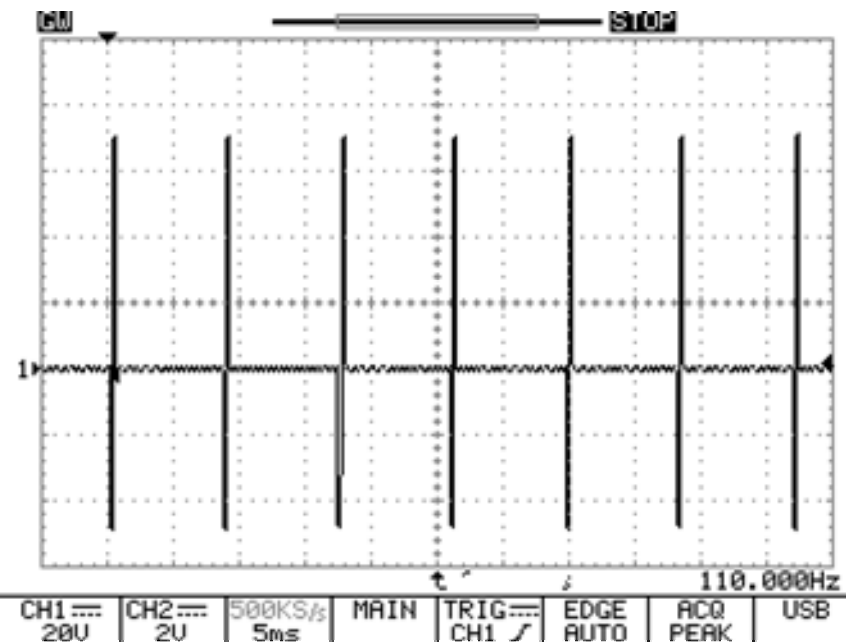
Frequency is quantity of pulses per second.
Is available in all devices completely or partially.

F=30Hz



a

F=120Hz



b



Available settings: 'Frequency'

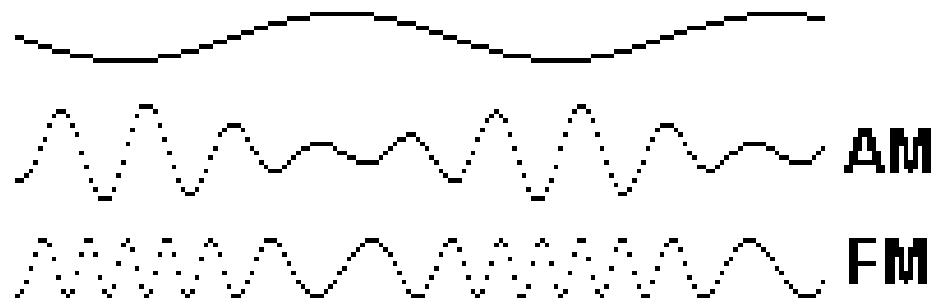
While changing the frequency the changes of both the strength and the 'volume' of influence are felt.



Available settings: 'FM'

Frequency modulation (FM) is the influencing impulse frequency change during the time according to a certain rule.

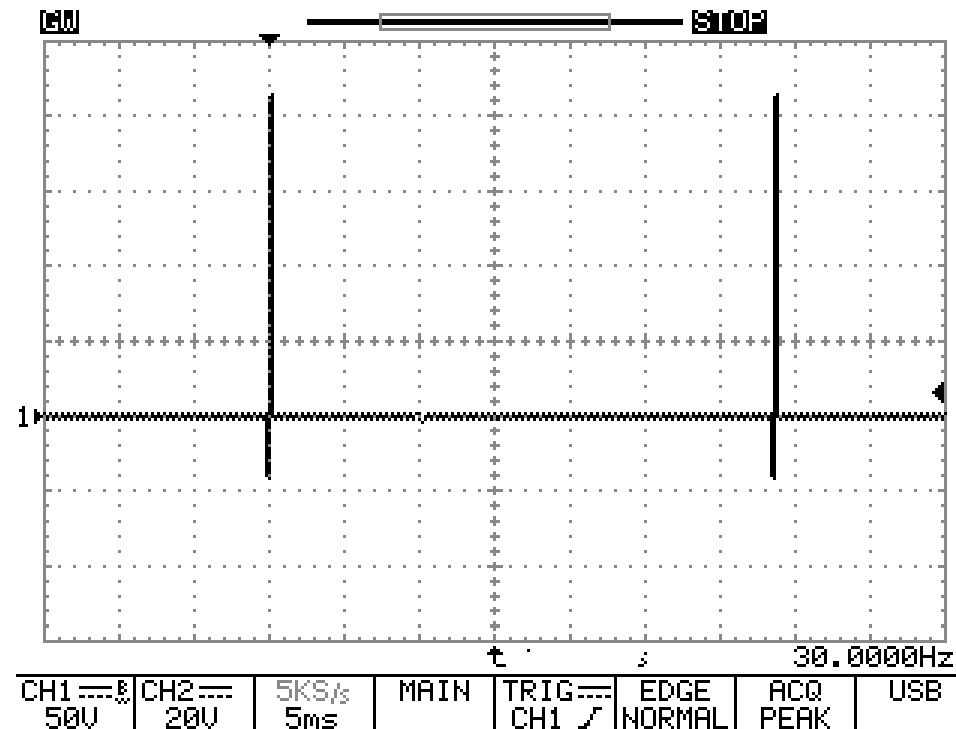
It is available in all devices except for the lowest CHANCE device.





Available settings: 'FM'

Just as well as with changing the frequency manually, the changes of both the strength and the 'volume' of influence are felt.

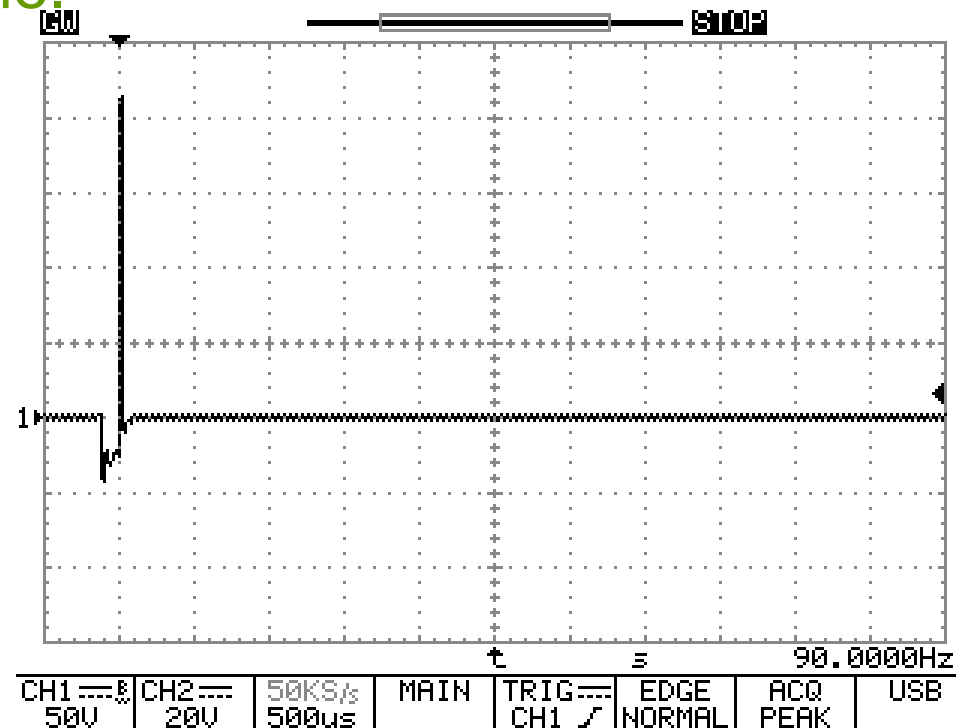




Available settings: 'Intensity'

The quantity of impulses in a batch. The space between impulses in the batch (gap) is smaller than the space between batches.

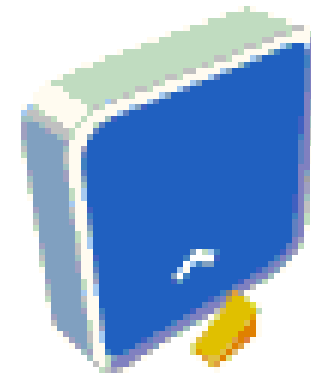
It is available in all SCENAR devices except for the lowest one.





Available settings: 'Intensity'

While changing the intensity the changes of both the strength and the 'depth' of influence are felt. That's why there is another name for intensity – 'depth'.

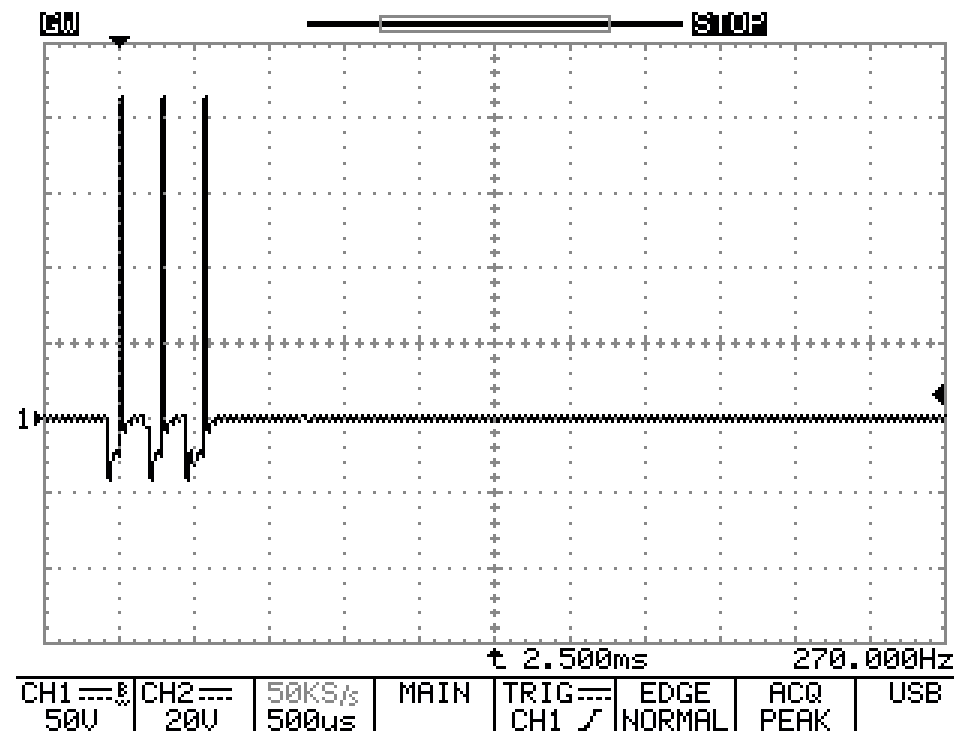




Available settings: 'Gap'

The gap is a space between impulses in a batch. It makes sense only for intensity 2 and more.

It is available in all SCENAR devices except for the lowest one.



Available settings: 'Gap'

While changing the gap the changes of the 'depth' of influence are felt as well as a kind of impulses 'rotation'.





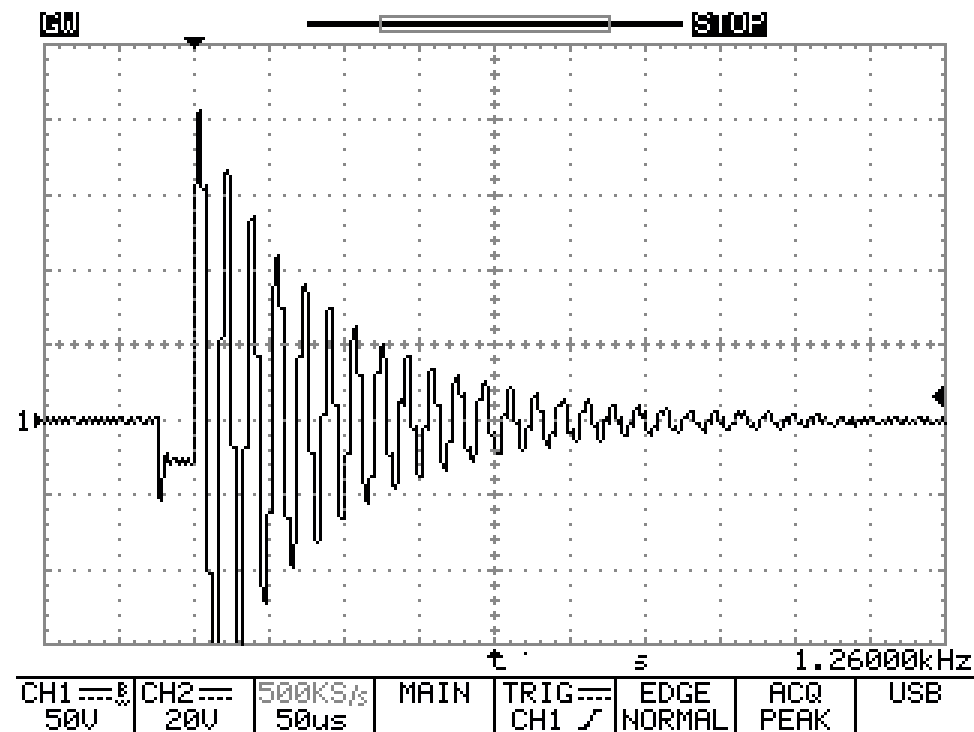
Available settings: 'Damping'

It means changes in the initial shape of impulses, and the law of their changing depends on the load.

It is available in all SCENAR devices except for the lowest one.

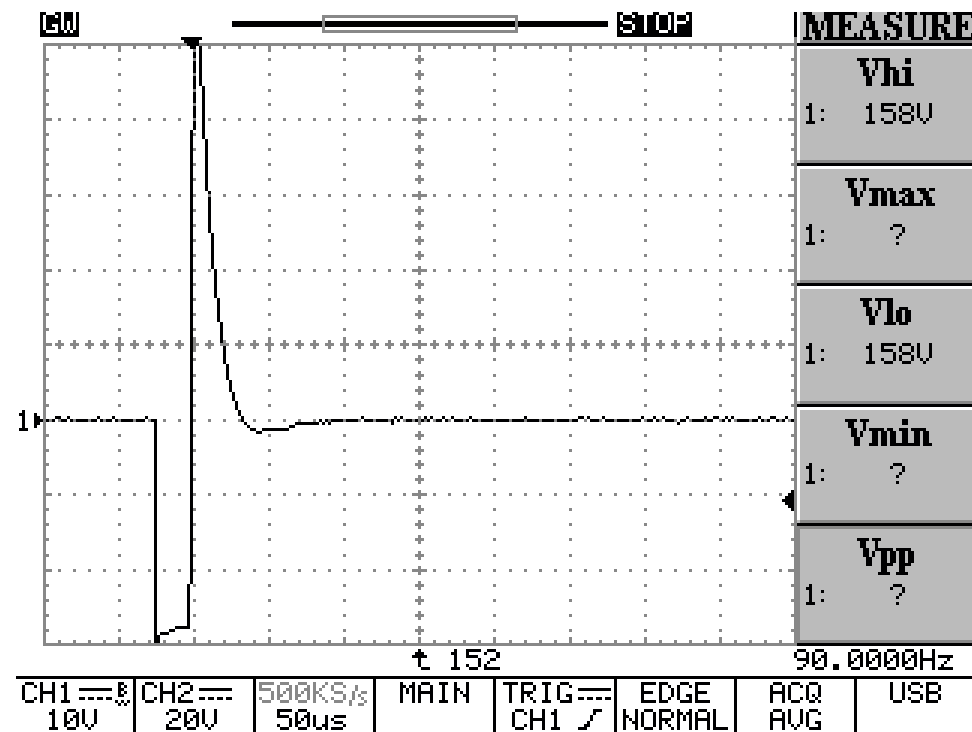
Available settings: 'Damping'

Without load



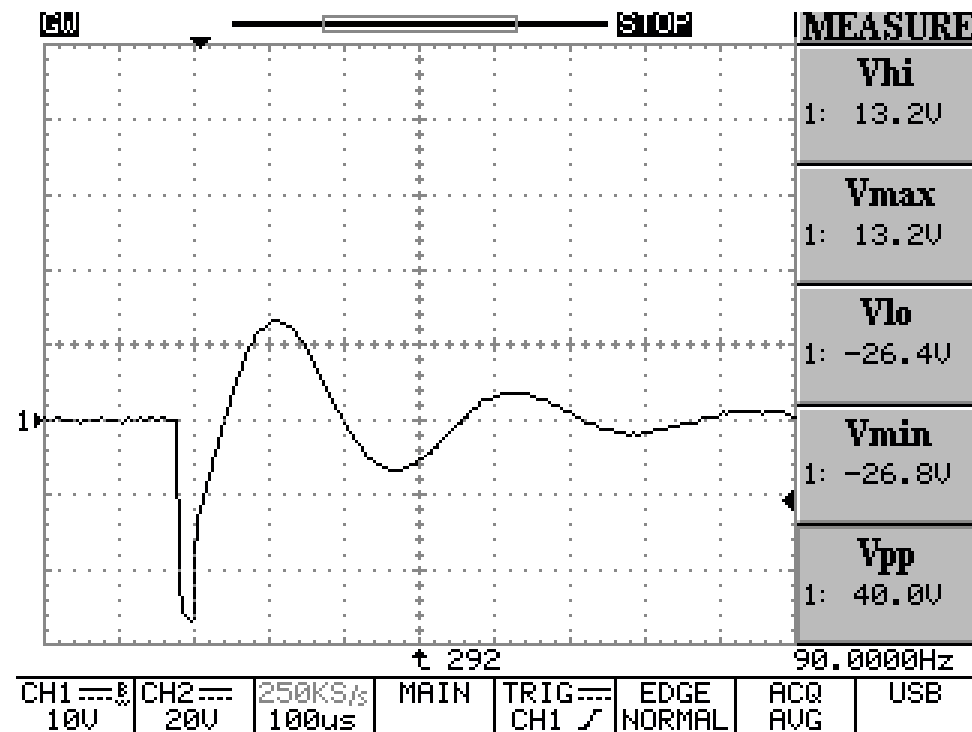
Available settings: 'Damping'

High resistance with the load



Available settings: 'Damping'

Load with high capacity



Available settings: 'Damping'

While changing the Damping the changes of the 'softness' or the 'sharpness' of influence are felt.





Available settings: 'Swings'

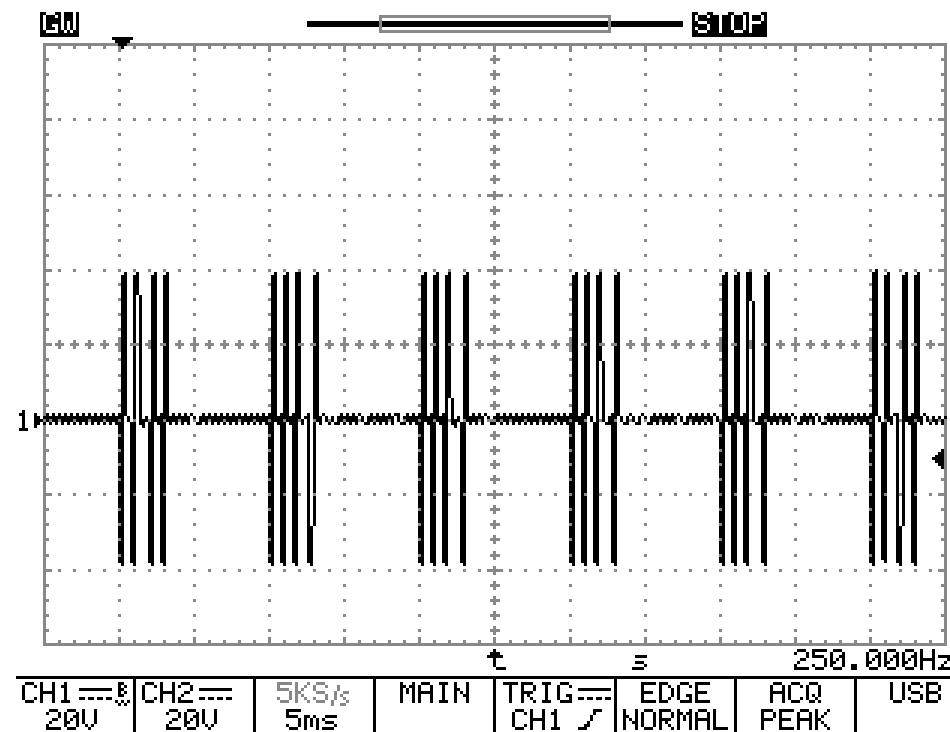
Swings are combined modulations. They are simultaneous autochanges of frequency (FM), gap, damping.

In Sw4 mode the Intensity is changing too.

They are available in all SCENAR devices except for the lowest one.

Available settings: 'Swings'

Example of Sw4





Available settings: 'Swings'

When any Swing is on, the simultaneous changing of 'softness', 'depth' and 'volume' of influence are felt.



Available settings

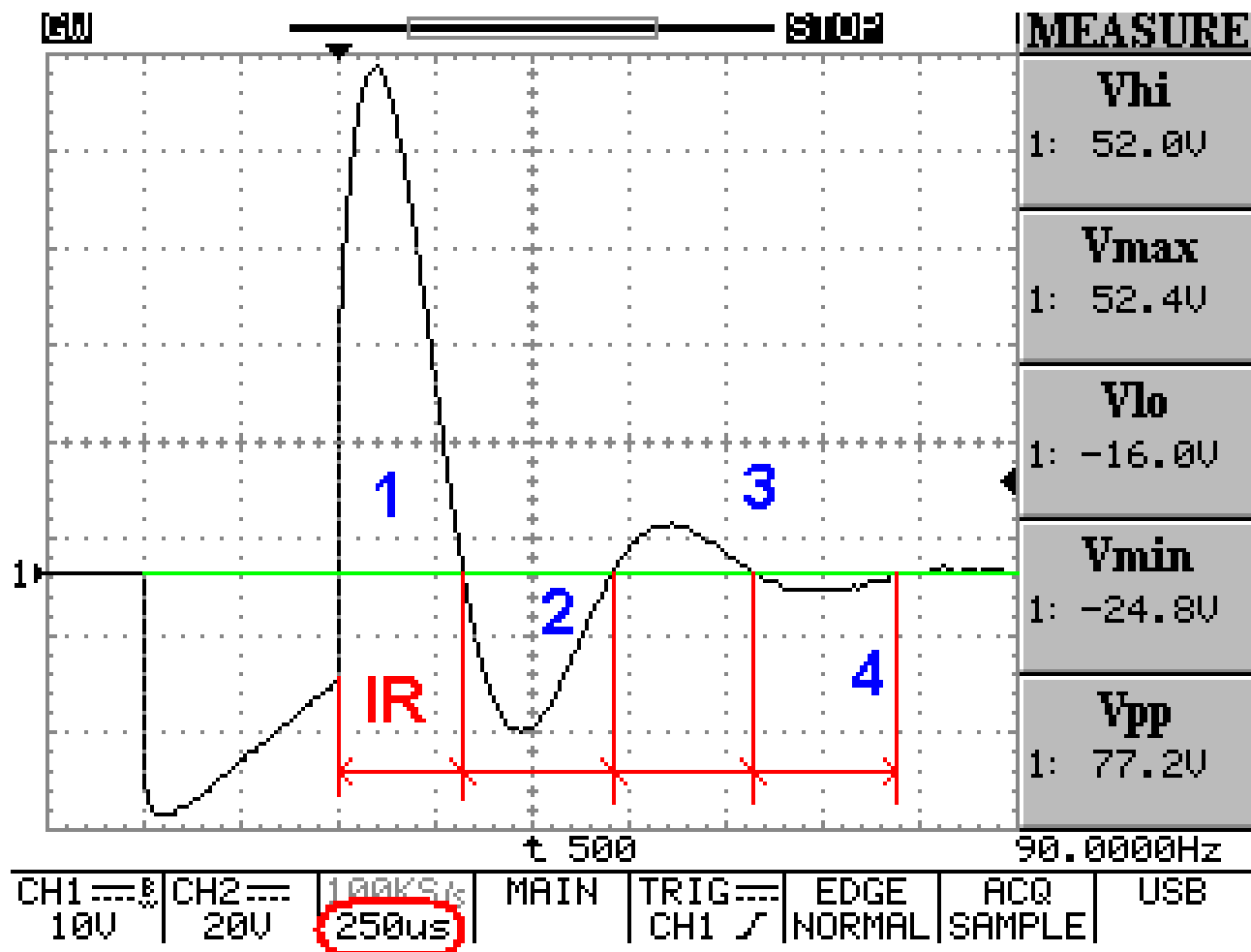
Questions?
Break...



Dose, Zero, Rate...



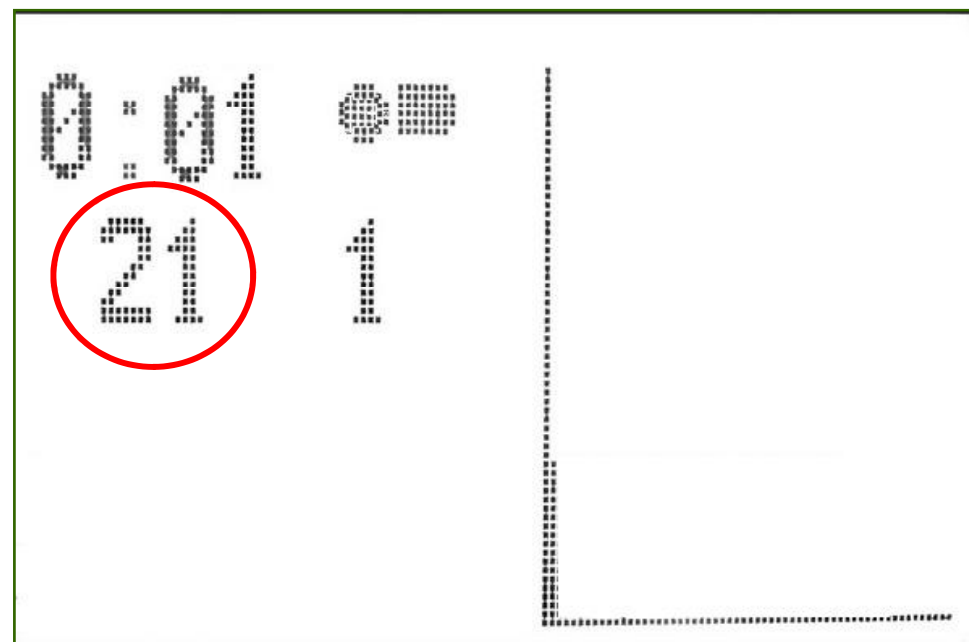
Dose, Zero, Rate...



Dose, Zero, Rate...

Initial Reaction (IR) is length of the 2d phase of the first impulse.

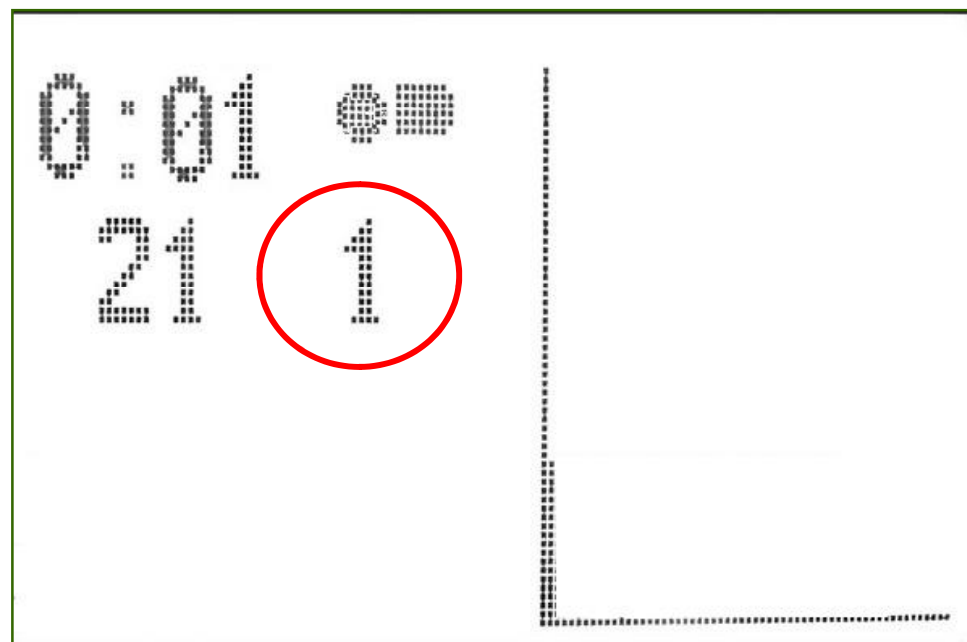
The difference between **IR** and **current (ongoing) reaction (CR)** is that **IR** is the average parameter in 1st second and **CR** is the average parameter in current second.



Dose, Zero, Rate...

Shape coefficient (SC) is quantity of oscillation half-phases (or zero crossing) during Phase 2.

Initial Shape coefficient (IS) is average **SC** in first second and **Current Shape coefficient (CS)** is average **SC** one in current second.





Dose, Zero, Rate...

Speed is relative speed of current reaction changing in percentage per second.

$$V = \frac{100\% \cdot (R_t - R_0)}{R_0 \cdot t}$$

R_0 – initial reaction,
 R_t – current reaction,
 t – time of the point treating,
 V – reaction speed.

Exact formula for the speed is

$$V = \frac{128\% \cdot (R_t - R_0)}{R_0 \cdot t}$$

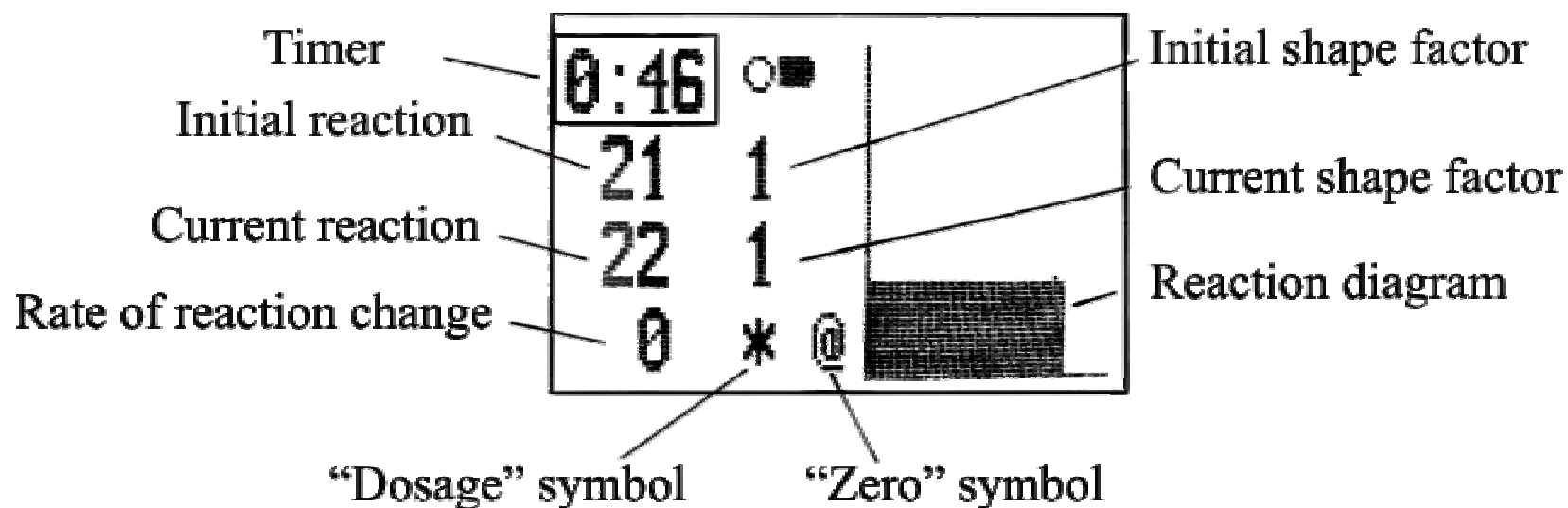
This way is easier to calculate for microcontroller.

Dose 1

Dose 1 – adaptive dose + integrated zero.

Dose (*) means that over the full time the zone was stimulated, the reaction has changed ENOUGH (according to our criterion).

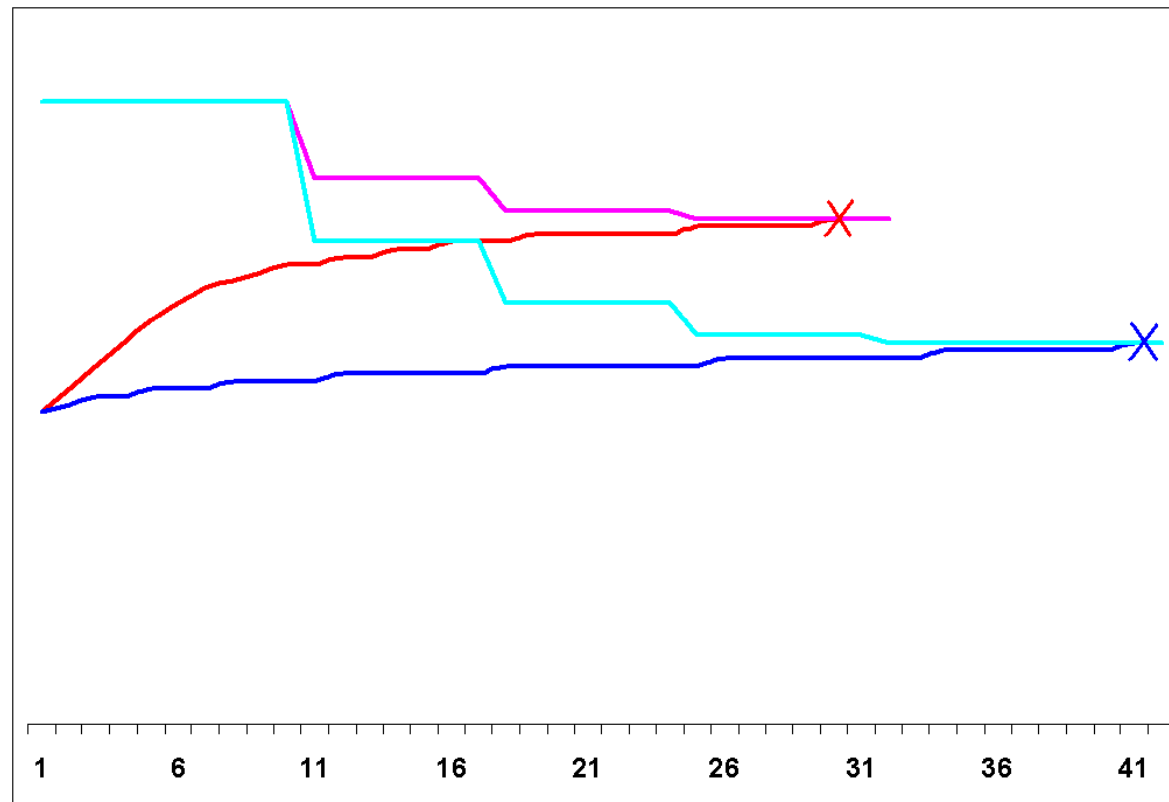
Zero (@) means the speed became less than 1%/sec.





Dose 1

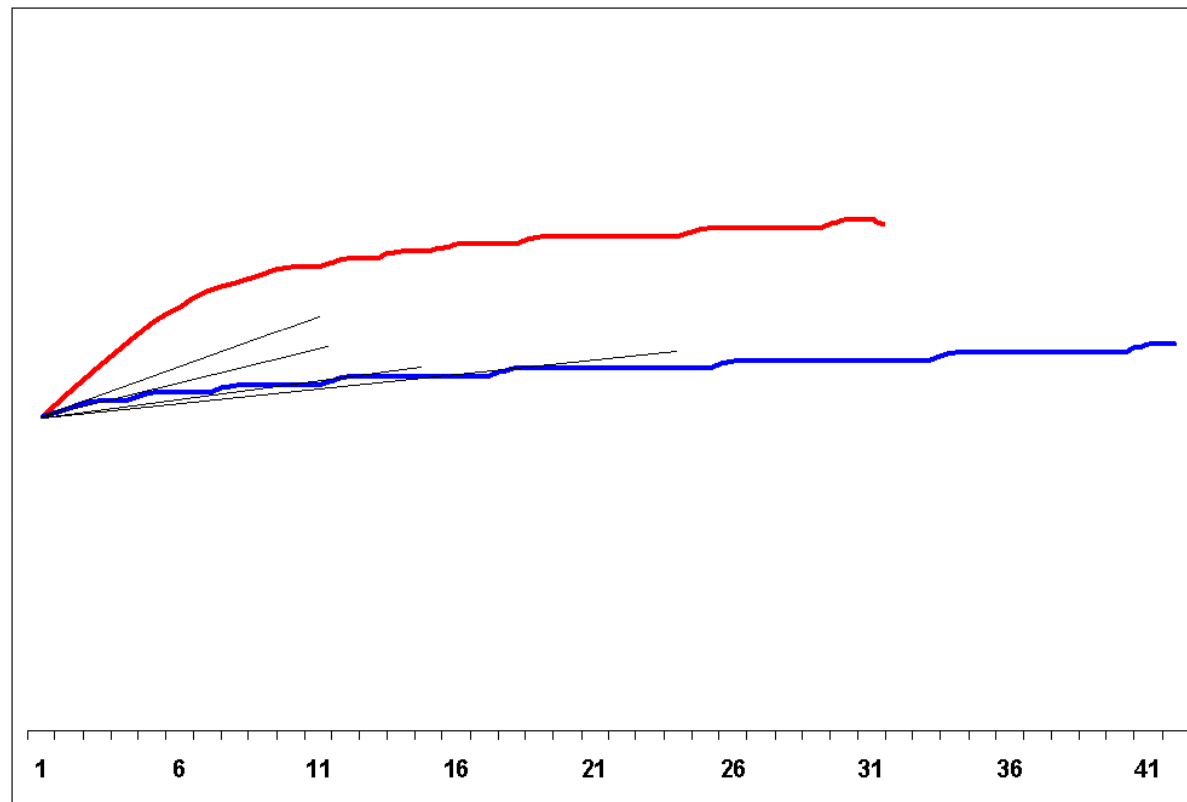
Low dynamics – long dose





Speed and Zero

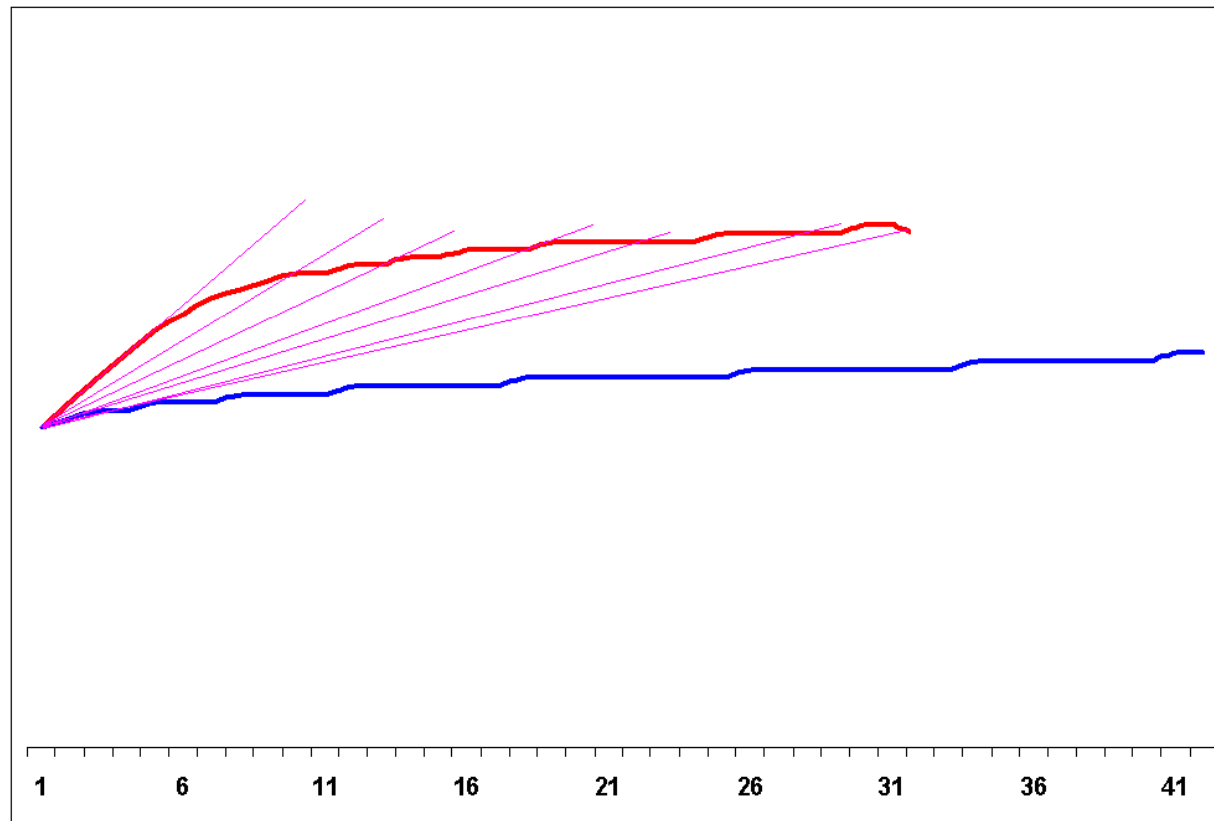
Low speed – quick Zero





Speed and Zero

High speed – long Zero





Dose 2

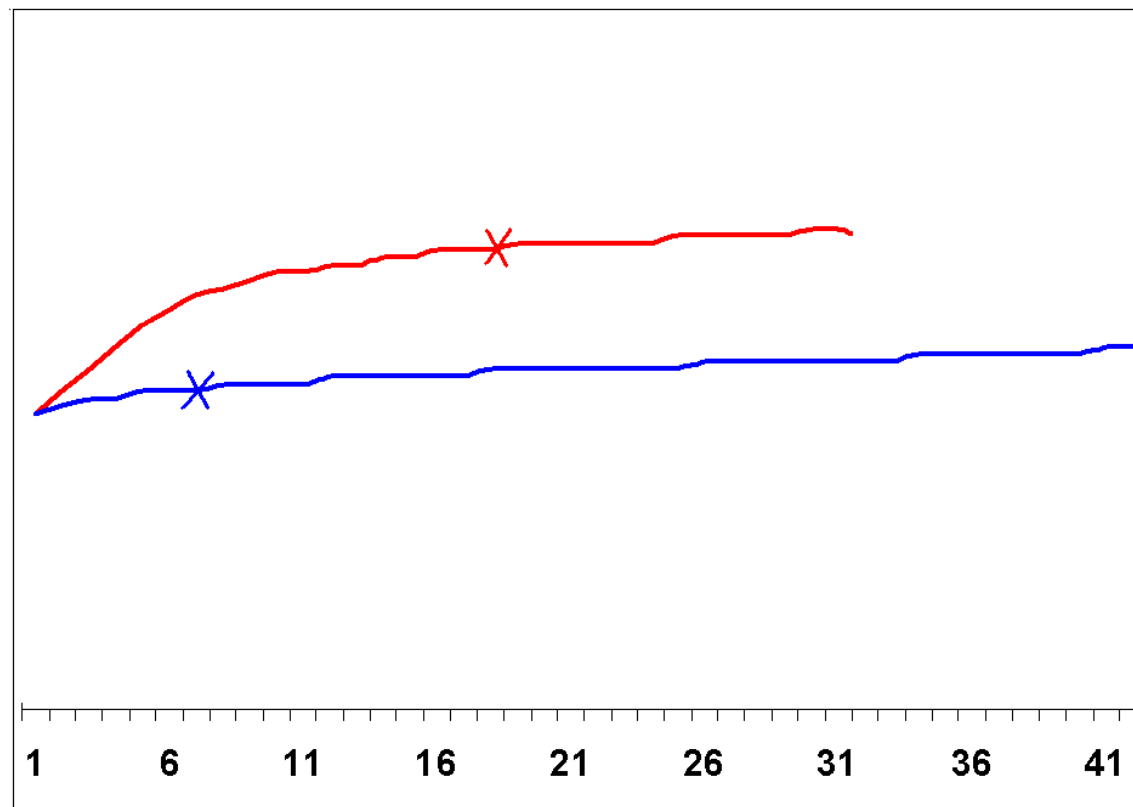
Dose 2 – zero and dose together, differential dose/zero.
That is for Dose 2 the speed is counted relatively to the reaction on previous second.

Dose appears after 3 seconds of non-positive speed/
dynamic (zero or negative).



Dose 2

Low dynamics – quick dose





Dose, Zero, Rate...

Questions?



The secrets of effectiveness

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The secrets of effectiveness

We consider SCENAR efficiency is provided with its pulses' features and with additional regulations of its parameters.

There are physical and (bio)chemical effects approved to different degree.

Approved local effects:

- collateral circulation increasing,
- anti-inflammatory,
- analgetic,
- antiedematous,
- genetic...

Energy influence concentration



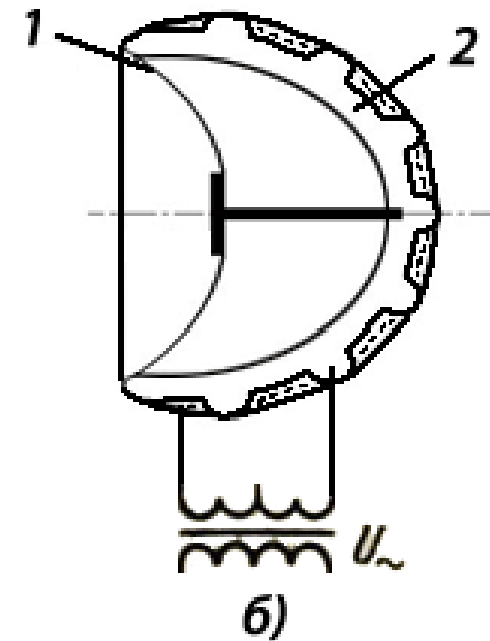
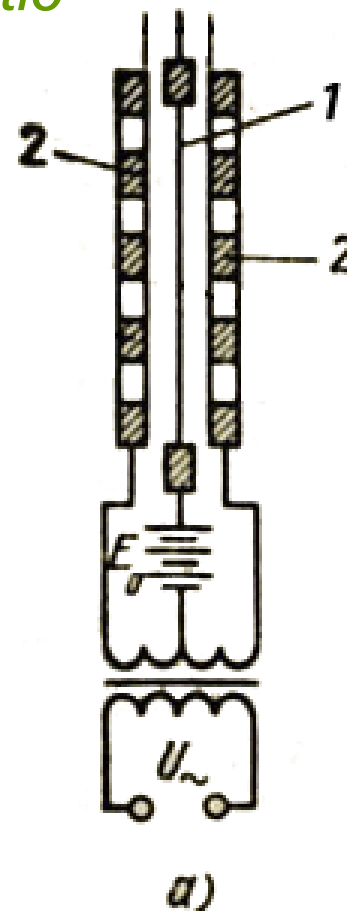
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Right hand: palm – back of the hand.
Left hand: palm – back of the hand.
Right hand, palm – left hand, back of the hand.
Left hand, palm – right hand, back of the hand.

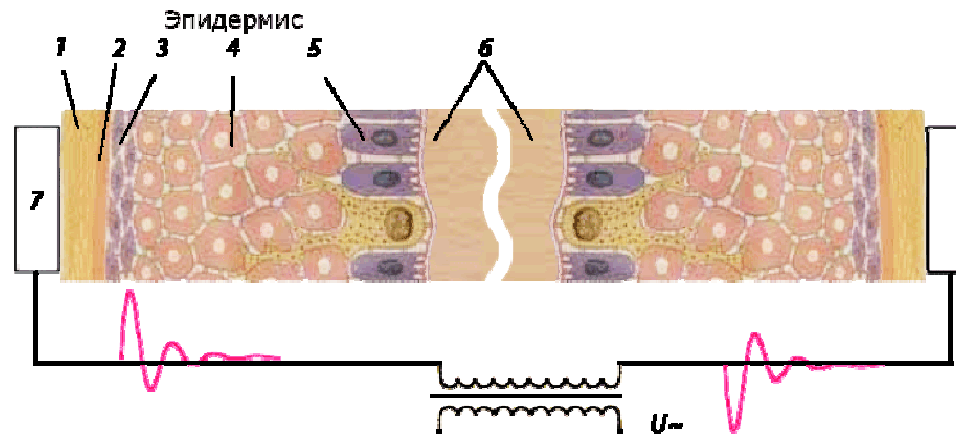
High-frequency massage

Construction of electrostatic loudspeakers

- 1 – flexible electrode,
- 2 – fixed electrode



High-frequency massage

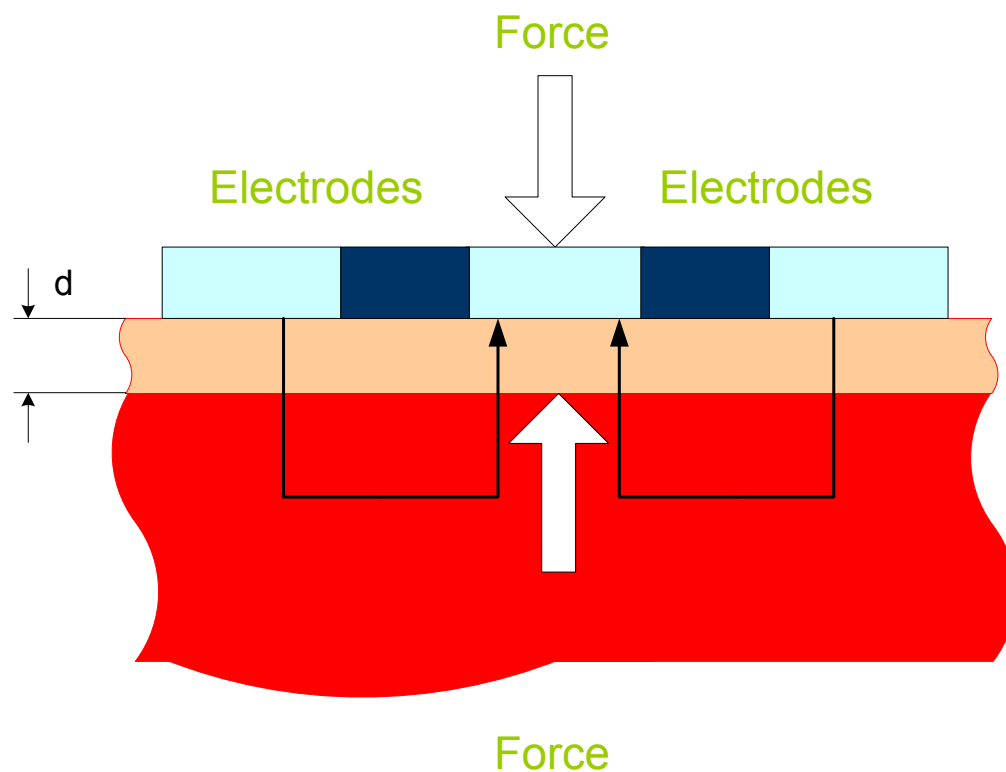


Voltage-to-sound skin conversion

- 1 – horny layer (corneal layer);
- 2 – clear layer (lucid layer);
- 3 – granular layer;
- 4 – prickly layer;
- 5 – basal layer;
- 6 – dermis, hypodermis;
subcutaneous tissues;
- 7 – device electrodes.

High-frequency massage

Influence force estimation

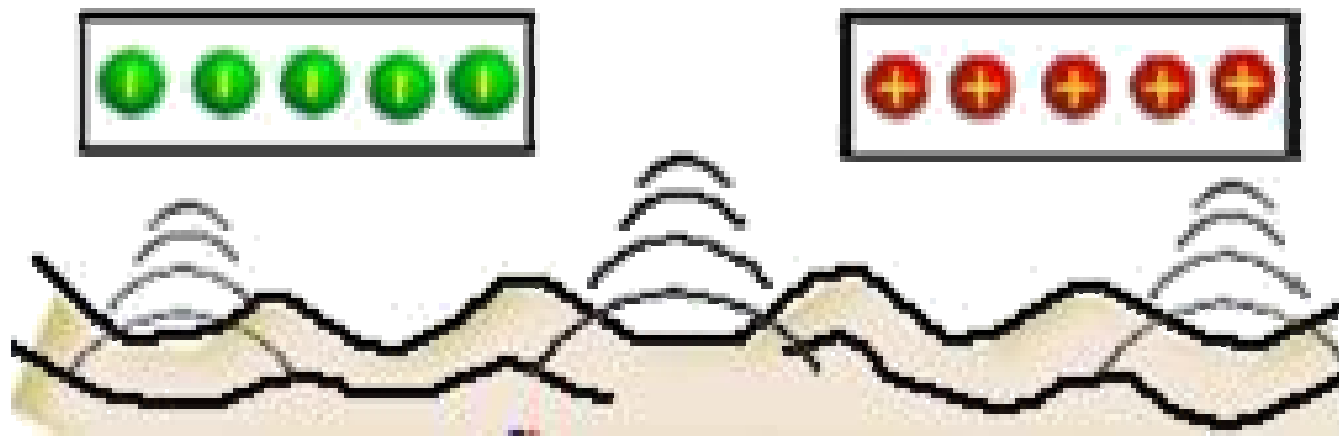


$$F = \frac{U^2 \cdot C}{2d}$$

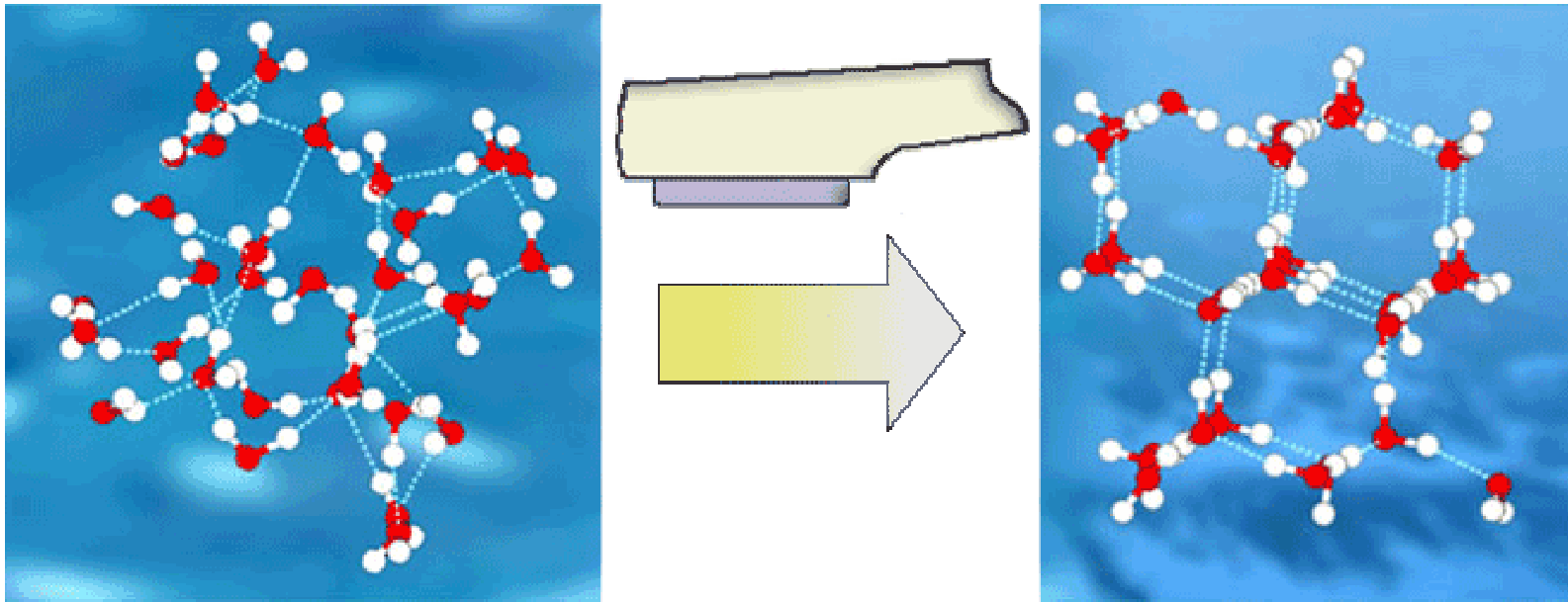
$$F = \frac{50^2 \cdot 0.22 \cdot 10^{-6}}{2 \cdot 5 \cdot 10^{-5}} = 5(N)$$

Skin vibration

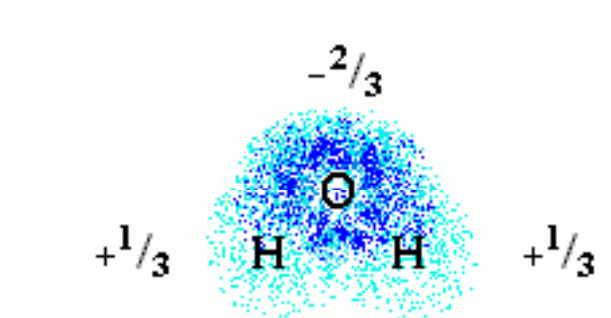
Electric pulses enable the substances to penetrate inside, while vibrations stimulate certain receptors. While preparing competent cells, shaking is ordinary procedure. Therefore, we expect electroporation effect increasing.



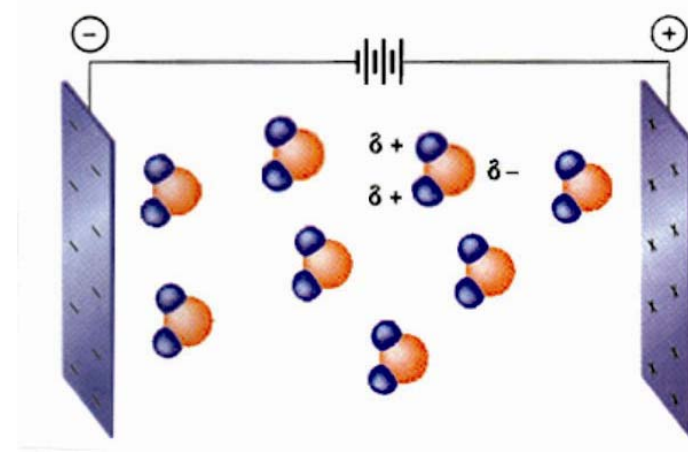
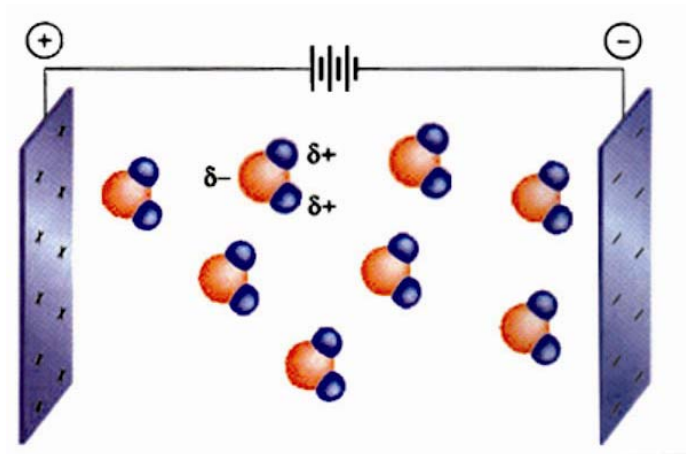
Fluid structuring



Fluid structuring

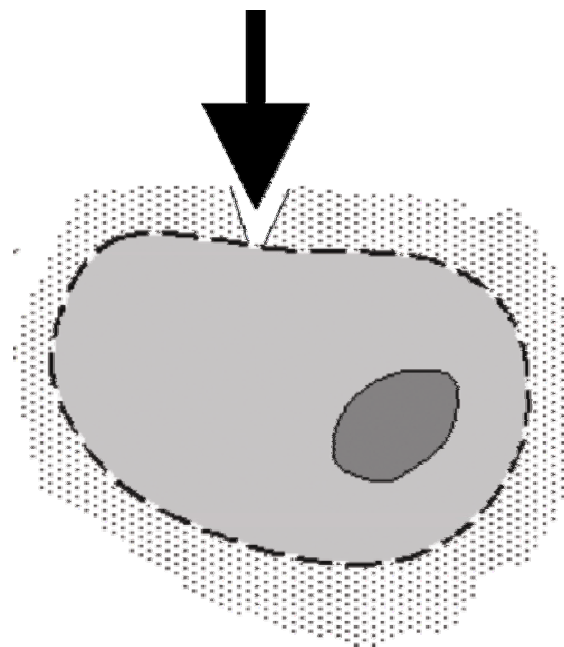


Charge distribution in water atoms



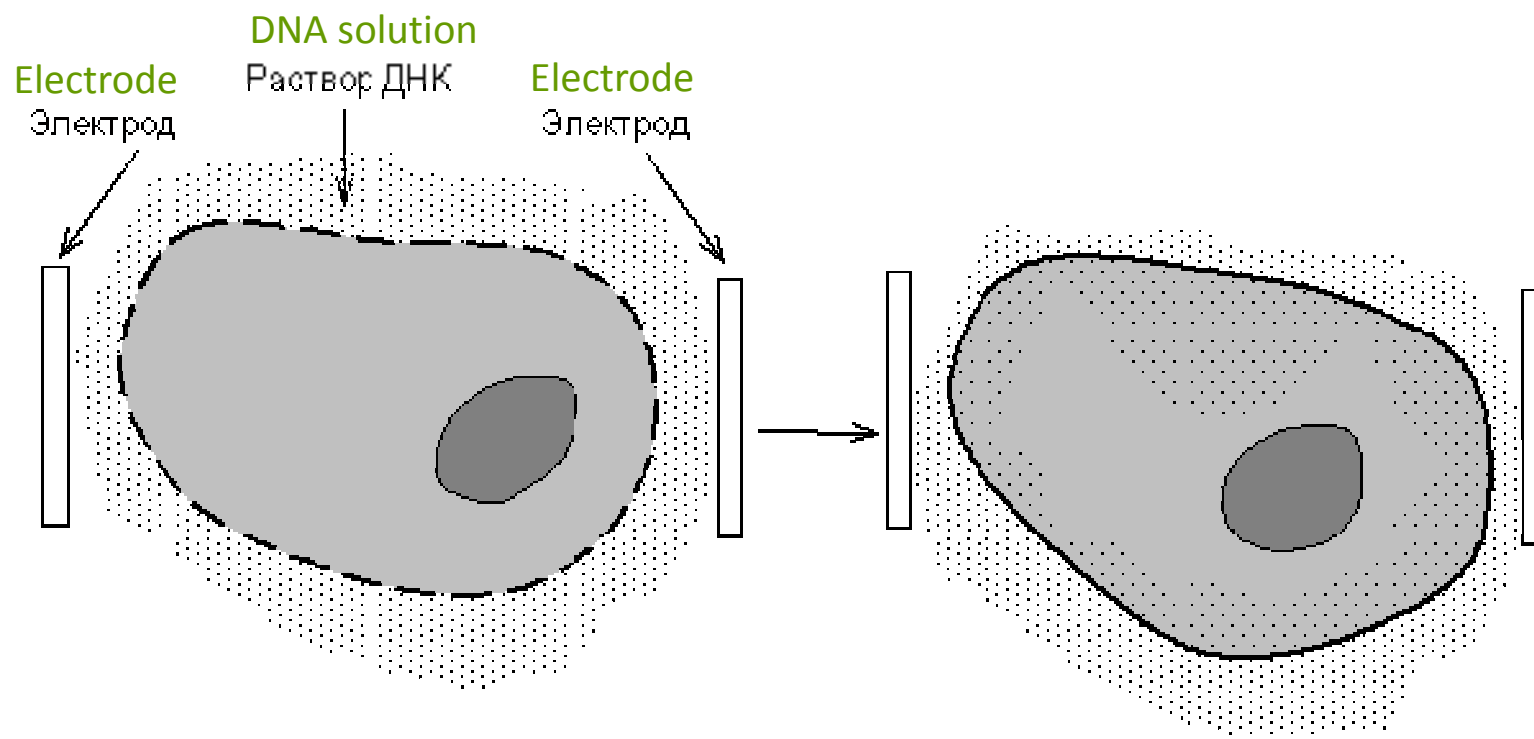
Water molecule arrangement after the voltage sign changed

Electroporation



Electroporation is a significant increase of the cell membrane permeability caused by externally applied electric field of high intensity.

Electroporation



As a result of electroporation the DNA fragments penetrate from tissue liquid into cells.



Electroporation

Physiological effects in 'soft' reversible electroporation on cellular level:

cell metabolism acceleration,
cells activation,
increase in production and acceleration of proliferation.

on tissue level

- improves functionality of microvasculature,
- increases the perfusion of tissue fluid,
- accelerates the immune reaction,
- increases the level of antioxidative enzymes,
- decreases the inflammatory process,
- inhibits oxidative stress.



Electroporation

Intensity and duration of electric field for each system of cells is selected empirically, while great variety of SCENAR stimulation modes enables the user to apply this empirical mechanism.



The secrets of efficiency

The **SCENAR** efficiency sources:

- electroporation and its effects,
- energy influence concentration,
- high-frequency massage,
- skin vibrations...



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Bibliography

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Good luck!

