

DIGITAL LOGOPEDIC SET: SUPPORT TOOL IN SPEECH AND LANGUAGE THERAPY

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Complex acoustic processing of speech sound can be useful in therapy of some speech and language disorders. Improving the signal-to-noise ratio, filtering and amplification of some speech frequencies and elimination of other redundant sounds can be used to enhance the reception of speech signals and thus provide a better learning platform for persons with auditory processing disorders (APD), stuttering, language and learning disabilities, dyslexia, attention deficit disorder (ADD), attention deficit/hyperactivity disorder (ADHD), etc. Very fast dynamic processing of speech sound (e.g. compression or limiting) in combination with filtering can help hearing impaired children to improve speech intelligibility in speech/hearing therapy.



Digital logopedic set (DLS) is "ALL-IN-ONE" device designed to provide a technical support for therapy in variety of speech/language disorders and hearing impairments. DLS allows for an adjustment of speech signal by filtering and acoustic dynamic processing of sounds for better clarity and intelligibility of speech by auditory, visual and/or vibro-tactile perception. This tool includes six (seven with vibrotactile board) modes of auditory feedback that can apply simultaneously in any combination.

DLS contains one or two cardioid condenser (vocal) microphone (also wireless version), omni-directional condenser measurement microphone, double vacuum-tube microphone preamplifier, digital sound processor and 4-way headphone amplifier with headphones. Optional, it is possible to connect any sound source device (on input) and variety output devices (wireless headphones or FM-wireless hearing/cochlear aids, vibro-acoustic coupler, vibro-tactile board etc.).

The main central unit of DLS is digital sound processor (Ultra-Curve Pro DEQ2496, Behringer, Germany) which extremely high audio performance makes it ideal for speech and hearing purposes. The Ultra-Curve Pro DEQ2496 is an ultra high-precision digital 24-bit/96 kHz mastering sound processor with resolution of 112 dB dynamic range, frequency range 20 Hz - 20 kHz and with maximum filter attenuation of selected frequencies to ± 30 dB (max. range 60 dB).

Therapy applications:

	FTAF	FFT	DAF	DAP	SPL	MAF	VTF
Voices		✓	✓		✓	✓	
Articulation, phonology	✓	✓					
Stuttering	✓		✓		✓	✓	
Dysarthria, Parkinson's	✓	✓	✓		✓	✓	
Hearing impairment	✓	✓		✓	✓		✓
Cochlear implant	✓	✓		✓	✓		
Auditory processing disorder	✓			✓			
ADHD/ADD	✓			✓			
Dyslexia	✓			✓			
Learning disabilities	✓			✓			
Language disorders	✓			✓			



DLS contains 50 various presets for therapy of phonological/articulation disorders, auditory training, speech intelligibility training and fluency and voice disorders therapy, auditory processing disorders, language disorders, learning disabilities, ADD and ADHD. It also contains seven different feedback systems:

Frequency transformed auditory feedback (FTAF) will be helpful for phonological and articulation disorders. Much of the speech therapy focus was given to practice in filtered hearing and production of the correct sound. This feedback use three devices: 31-band graphic Equalizer, 10-band parametric Equalizer and 3 Dynamic Equalizers. FTAF facilitate better clarity and intelligibility of speech in any speech-language or hearing problems.

Masking auditory feedback (MAF) can be useful in patients with stuttering, functional and psychogenic aphonia and dysarthria (aphasic patients). Some of these patients produce faulty voices because of poor auditory feedback but they are often able to produce better or normal phonation under masking.

Delayed auditory feedback (DAF) can be useful for slowing down speech rate in motor speech difficulties and Parkinson's disease. Voice clinicians occasionally use DAF with patients with functional dysphonia (DAF will sometimes result in a marked improvement of vocal quality).

Dynamic Amplifying and processing feedback (DAP) increases intelligibility of speech by providing digital audio processing customizable based on characteristics of hearing difficulties. The DAP enables a dynamic volume control (limiter or compressor) and automatic frequency control. It improves the auditory signal by filtering and acoustic dynamic processing of sounds for better clarity and intelligibility of speech.

Visual Feedback - SPL The Sound Pressure Level Meter - SPL (or Voice Level Meter) displays the input from a calibrated measurement electrocondenser microphone (ECM8000) in range from 40 to 120 dB SPL. Results of measurement are displayed with graphic bar and numerical. The highest level (peak) is also displayed until reset. Device provides three modes of measurements: A or C weighting and off. The SPL meter will continuously in real time monitor the input from the microphone. The main contribution to speech volume is the vowel sounds. An A-weighted measurement is the best for speech and vowel sounds.

Visual feedback (FFT) can be used as a 61-band spectrum analyzer and a visual feedback tool as well as an interactive visualization of speech/voice. Visual Feedback can be used to see the pitch and timbre of voice. It helps to improve resonance by monitoring harmonics and formants. Visual feedback training can accelerate the learning of specific vocal techniques in speech therapy (voice, phonological and articulation disorders and speech therapy in hearing impairment).

Vibrotactile feedback (VTF) can facilitate speech perception (rhythm, pitch, Loudness) in hearing impaired persons. With optional external device (Vibrotactile board) DLS can transform audio signal in vibrotactile perception. The best results in therapy are achieved with the frequencies from 40 to 500Hz (the best enhancement of vibrotactile perception is human fingertip because of highest innervation's density).



Device included Feedback effect

31-band graphic Equalizer 10-band parametric Equalizer 3 Dynamic Equalizers per stereo channel	Frequency transformed auditory Feedback (FTAF)
61-band real-time FFT Spectrum Analyzer	Visual feedback (FFT)
Stereo Delay 0 - 300 ms	Delayed auditory feedback (DAF)
Fast Dynamic Compressor, Expander and Limiter (zero attack time: 0-200ms)	Dynamic amplifying and processing (DAP)
Calibrated Sound Pressure Level Meter - SPL level meter (with dBA and DBC weighting) with measurement microphone	Visual feedback (SPL)
Pink noise generator	Masking auditory feedback (MAF)
Vibrotactile board (Optional)	Vibrotactile feedback (VTF)

Operating

Operating DLS is very simple: just by pressing few buttons mounted on the front of the device, user can load these presets from memory. DSL is currently in use by more than 150 therapists in Croatia and neighboring countries. This application was developed by dr. sc. Mladen Hedjever, speech pathologist with 25 years of clinical and scientific Experience. The DSL is the "all-in-one" useful device for therapy in variety of speech/language disorders and hearing impairments with seven different feedback systems which can be applied to a wide variety of communication disorders. combination of variety feedback, modes can be used simultaneously.

