

A L A N G O

Technologies and solutions

VOICE COMMUNICATION PACKAGE (VCP) 8TH Generation “VCP8”

DATASHEET

Document revision 1.8 (November 13, 2019)

1. Voice Communication Package – general description

Voice Communication Package (VCP) is a suit of digital signal processing technologies enabling high quality, full duplex, noise free voice communication for a variety of applications including automotive hands-free, mobile phones, Bluetooth headsets, hearables and wearables, audio and video conferencing systems, intercom systems and others. VCP was designed to enable the highest possible voice quality in various acoustic environments while consuming relatively low MIPS and memory resources.

VCP generation 8 “VCP8” accumulates many years of practical Alango experience providing a scalable, highly optimized solution for voice communication applications. In addition to the software DSP technologies Alango has developed a unique set of auxiliary software and hardware tools facilitating development, debugging, testing, acoustic tuning, problem identification and reporting.

The standard VCP8 package is a complete voice enhancement solution that addresses all required processing such as Acoustic Echo Cancellation, Noise Suppression, and Gains management. Additionally, VCP8 includes optional add-ons to further enhance the user experience.

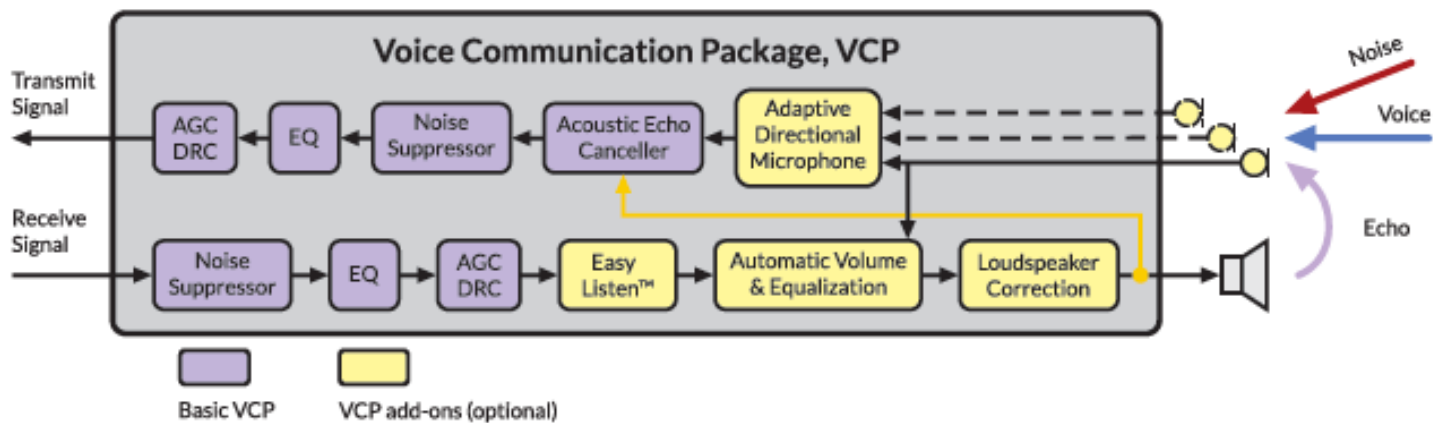


Figure 1. Alango Voice Communication Package (VCP) block diagram

Adaptive Directional Microphone (ADM)

Two or more microphones in the device are positioned to adaptively discriminate between speech and noise utilizing Alango's beamforming algorithms. The algorithm supports multiple types of beam-forming including end-fire, close-talk, blind source localization and broad-side.

Acoustic Echo Canceller (AEC)

Eliminates acoustic echo with multi-band residual echo suppressor ensuring full-duplex communication with minimal voice distortions. Mono and Stereo AEC are supported.

Noise Suppressor (NS)

Detects and attenuates stationary and transient noises (traffic, pub, passing cars, etc.) in transmitted and received signals.

Automatic Gain Control (AGC) and Dynamic Range Compressor (DRC)	Equalizes voice levels in the microphone and loudspeaker signals ensuring clear intelligibility. Alango AGC technology is robust to ambient noises and allows fast signal equalization without increasing ambient noises.
Frequency Equalizer (EQ)	Allows fine frequency adjustment of microphone and loudspeaker frequency responses with high frequency resolution.
EasyListen™	Slows down incoming speech in real time improving intelligibility of fast talkers, foreign language, mailbox and numbers.
Automatic Volume & Equalization (AVQ)	Modifies the loudspeaker signal according to the ambient noise level and spectrum providing perceptually equal loudness and intelligibility in dynamically changing conditions (street, bus, train, etc.).

2. Technical Details

2.1. Performance

- Echo canceller
 - Echo suppression with high frequency resolution (up to 31.5 Hz per band)
 - Fast convergence (< 300ms) with no initial echo
 - Convergence in double talk, high noise and changing acoustic echo path
 - Robustness to speaker signal distortions
 - Support for long echo tails, up to 1000ms
 - Residual echo level < -60dB
- Noise suppression
 - Noise suppression with high frequency resolution (up to 31.5 Hz per band)
 - Up to 30dB noise reduction with low distortions
 - Fast noise adaptation (as low as 100ms for transient noises)
 - Single-channel and multi-microphone wind noise reduction
- Maximal AGC gain of 24dB
- Processing delay 24ms
- Flexible processing frame size (including standard Bluetooth 7.5ms frame, 10ms for VoIP, etc.)
- Supported sampling rates: 8kHz, 16kHz, 24kHz, 32kHz
- Fully compliant with ITU/VDA/CarPlay and eCall/ERA-GLONASS automotive specifications

2.2. Availability

VCP is available¹ on the following platforms:

- All types of ARM cores including ARM M4 and M4F
- Cadence (Tensilica) HiFi2, HiFi3/4/5
- Qualcomm CSR BC5MM, 8670/8675, QCC512x Kalimba-based processors family²
- CEVA TeakLite III, IV
- Renesas SuperH family
- Synopsys ARC cores

Porting to other platforms can be done upon request.

2.3. VCP variants: Full, Light, Headset

VCP generation 8 is available in three variants: VCP8-Full, VCP8-Light and VCP8-Headset. The Light and the Headset versions implement all the same algorithms and DSP blocks as the “Full” version, but operate at reduced frequency resolution to save computational resources.

The Headset version is suitable for wearable types of devices having moderate echo levels with short acoustic echo tail.

The Full and the Light versions are suitable for automotive, speakerphones and intercoms demonstrating significant echo levels and long echo tail.

A table presented below lists differences between these three variants.

	Typical applications	Supported sampling rates (Fs), kHz	Frequency resolution, bands @Fs=8 KHz / @Fs=16 KHz			TX processing delay, ms	Frame size, ms
			AEC	NR	EQ		
VCP8-F	Automotive, speakerphones, intercoms, etc.	8,16,24,32	128 / 256	128 (256)	Flexible, up to 128 (256)	24	8, flexible
VCP8-L	Automotive, speakerphones, intercoms, etc.	8,16,24,32	64 / 128	64 (128) [*]	Flexible, up to 64 (128)	32	Strictly 8 or 7.5 [**]
VCP8-H	Headsets, wearables, hearables	8,16	64 / 128 [***]	64 (128) [*]	Flexible, up to 64 (128)	16	8, flexible [**]

[*] Optionally, frequency resolution of the NR block can be increased to correspond to the “Full” version.

[**] 7.5 ms frame (Bluetooth standard frame) is supported

[***] 7.5 ms frame (Bluetooth standard frame) is supported; AEC performance is limited in the VCP8-Headset version, maximal echo tail is 30ms

¹ Implementation and availability of specific VCP blocks may differ between platforms. Please, contact Alango technical support for specific information. Porting on other platforms can be performed quickly.

² VCP for Qualcomm (CSR) SOCs represents a separate, highly optimized implementation specifically designed for this platform, based on VCP generation 7

2.4. Resources

The numbers below are based on ARM Cortex A9 with Neon instructions and correspond to “typical” automotive acoustic settings with AEC echo tail of 100 ms.

Library type	Processing type	Sampling rate, KHz	Data RAM, Kb	MHz
VCP Full	With RX processing	8	44	28
VCP Full	Without RX processing	8	37	23
VCP Light	With RX processing	8	30	17
VCP Light	Without RX processing	8	24	13
VCP Full	With RX processing	16	79	54
VCP Full	Without RX processing	16	68	44
VCP Light	With RX processing	16	54	31
VCP Light	Without RX processing	16	43	26
VCP Full	With RX processing	24	116	87
VCP Full	Without RX processing	24	101	71
VCP Light	With RX processing	24	81	47
VCP Light	Without RX processing	24	67	36

The numbers below are based on ARM M4F and correspond to a “typical” dual-microphone headset device:

Library type	Processing type	Sampling rate, KHz	Data RAM, Kb	MHz
VCP Headset	With RX processing	16	40	50

Total program (instructions) memory: VCP Full: 100 Kb, VCP Light/Headset: 105 Kb

3. VCP Advantages

VCP integrates a significant number of front-end voice processing technologies scalable for different applications. Overall, VCP component technologies provide multiple advantages:

Basic package advantages

1. Low computational and memory resources. This is achieved by:
 - a. Tight integration of processing blocks sharing computations and memory.
 - b. Special Assembly language optimization for particular DSP cores.
2. Highly efficient echo canceller
 - a. Sub-band scheme with a large number of frequency sub-bands (33Hz sub-band width) reducing the computational complexity of adaptive filters. This makes VCP very efficient for wideband voice with long adaptive filters.
 - b. Proprietary, complex LMS adaptive filtering with very fast adaptation time, robust convergence in double talk and special dis-convergence protection mechanism.
 - c. Sub-band echo suppressor blocking only those spectral parts of the uplink signal where echo is distorted and cannot be completely cancelled by adaptive filters.
 - d. Configurable band closing/opening times; configurable suppression gains
3. Noise suppressor with fast noise adaptation time.
 - a. Utilization of a proprietary, very reliable voice activity detector reducing the adaptation time on “noise only” sections (voice is not detected).
 - b. Suppression of fast changing, transient noises (e.g. noises of passing cars). A proprietary detector of transient noises further reduces noise adaptation time when transient noise is detected.
 - c. A special “Click removal” feature attenuating sudden signal bursts such as clicks and pops
 - d. Single channel wind noise reduction
4. Automatic Gain Control with almost instantaneous amplification of low level voice signals without being confused by ambient noises. Such noise robustness is enabled by the voice activity detector.
5. Narrow band equalizers with 33Hz (Rx) and (Tx) bandwidth allow precise compensation of loudspeaker or microphone frequency response irregularities
6. Sub-band limiter on RX for accurate speaker correction

Advanced blocks advantages

1. ADM -- Sub-band adaptive multi-microphone array with:
 - a. Very fast adaptation time allowing efficient cancellation of noises in changing environments.
 - b. Support for different configurations (end-fire, broad-side, close talk, echo cancellation)
2. AVQ -- Automatic, ambient noise dependent speaker volume and frequency equalization technology with minimal computation requirements (borrowing noise estimation from uplink noise suppressor)
3. EasyListen™ -- highly efficient, real time slowing down of incoming speech for better intelligibility of “fast talkers”.

4. VCP Development Tools

4.1. VCP configurator

VCP Configurator is a PC Windows graphical application allowing control of VCP functionality. The configurator screen shot is depicted below. VCP blocks and their parameters are shown according to their real position in the signal processing chains. Parameters are provided with short prompts as well as detailed help. VCP configurator generates an acoustic profile structure that can be uploaded into a device under tuning in real time via UART or other available interface.

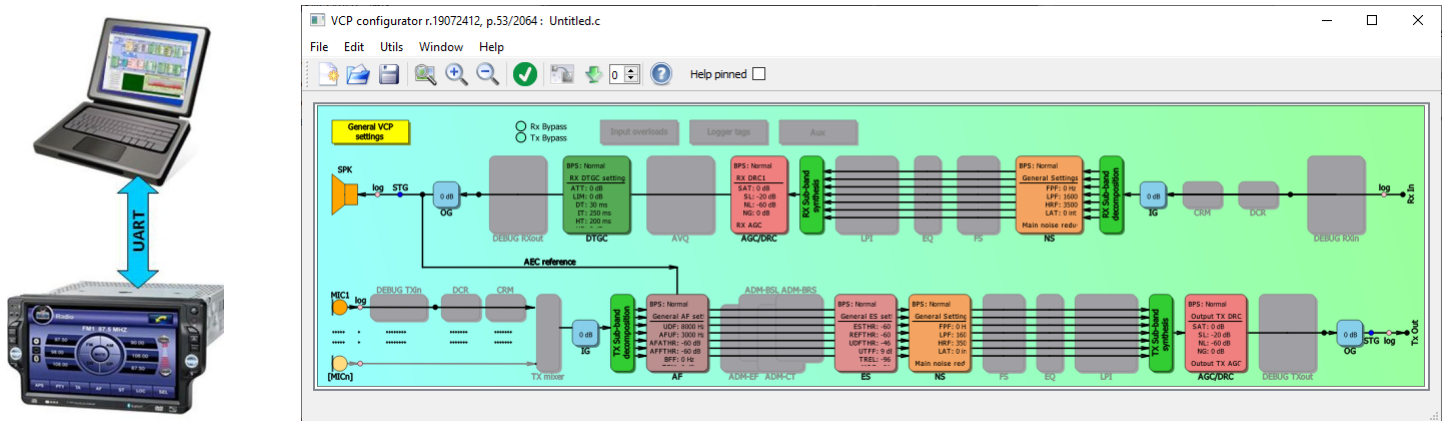


Figure 2. VCP Configurator software tool

4.2. Signal and data logger

Alango Logger and the corresponding PC Windows application allows real time monitoring and storing of VCP input/output signals. Logger functionality helps during the device development stage, accelerates acoustic tuning and simplifies problem identification and reporting. The Logger screenshot is illustrated below.

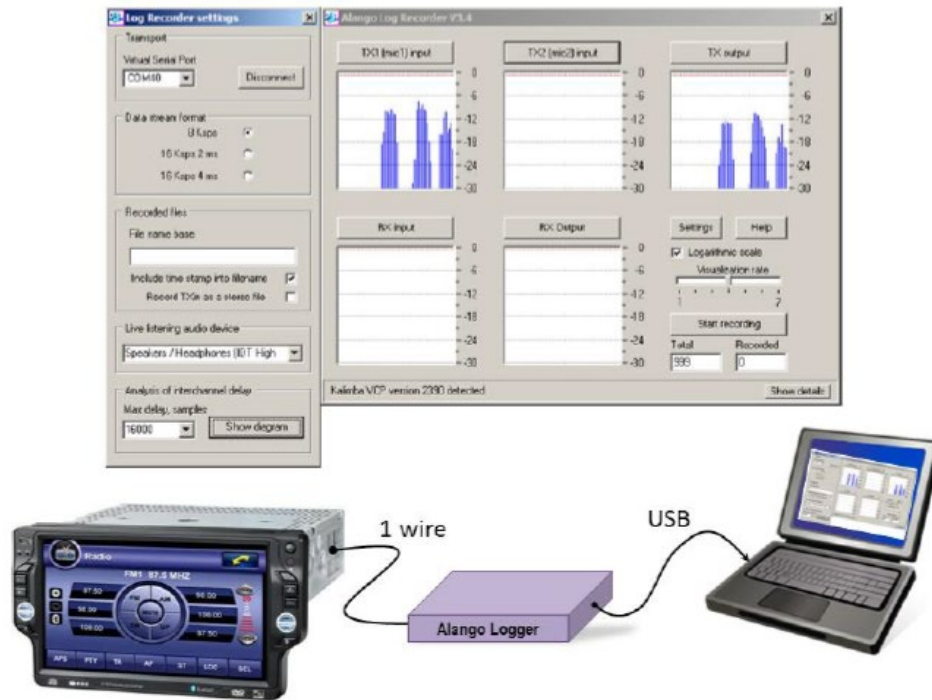


Figure 3 Alango Logger software tool

The device under development/testing/tuning is connected via 1 wire interface to the Alango Logger that is transferring accumulated data into a Windows computer via USB. Logger PC application parses the incoming stream separating input/output signals and auxiliary data. The input/output signal levels are shown in real time. It is possible to store the signals as well as to listen to one of the signals via headphones.

5. Features added in VCP profile 53 (vs. profile 52)

- improved precision and reduced noise floor at analysis/synthesis (by means of better precision and optional integrator/differentiator filtering)
- TX input (mic) sub-band mixer with per-input gains and delays
- RX AVQ block with mono and stereo RX
- Limited stereo RX support (with EQ and AVQ)
- AEC block: new "Elementary AF"
- ADM block: selectable beam-forming type (end-fire, blind source localization, close-talk , broad-side)
- ADM block: calibration feature
- ES block: controllable BCT/GCT time smoothing
- ES block: controllable attenuation on bands closure
- ES block: changing echo path detection
- LPA (Lost Packets Attenuation) block and parameters
- "Click Removal" feature on RX and TX
- API: new vcp_get_data() interface with various internal estimations
- API: multi-framed calls supported as standard
- file-to-file tool: AEC reference can be taken from file
- file-to-file tool: virtual volume signal can be taken from file
- RX limiter, RX phase inverter
- flexible frame length including support of 7.5ms (Bluetooth), 8ms and 10ms.

6. Contact information

Alango Technologies Ltd.
Etgar 2, Tirat-Carmel, 39100, Israel
Phone: +972 4 8580743
www.alango.com

7. Document revisions

Revision	Date	Description
1.0	Jan 23, 2017	Initial Release
1.1	Jul 1, 2017	Revision
1.2	March 23, 2018	Revision
1.3	April 22, 2018	Revision
1.31	May 1, 2018	Revision
1.5	May 12, 2019	Update
1.6/1.7	September 16, 2019	Update related to VCP8 profile53
1.8	November 13	Revision