CML’s Digital Voice Coding ICs
Products from CML’s unique range of flexible voice-data ICs are used globally in wireline, wireless and general purpose audio applications.

As well as use in such active applications as radio and telephone systems, these products, with their highly versatile and efficient data-rate formats and bandwidth requirements, are ideal for voice storage environments like: answering machines, announciators, voice-repeaters, voice-command and voice scramblers.

CML’s voice data products are currently available in two ranges:

- Low Bit-rate (RALCWI) Vocoder
- Continuously Variable Slope Delta (CVSD) modulation type codecs

This document, whilst focusing on the RALCWI Vocoder products, also details the major points of the CML CVSD Codec range of ICs.

- CMX608 RALCWI Vocoder
- CMX618 RALCWI Vocoder with Integral Audio Codec
- CMX639 CVSD Voice Codec
- CMX649 Adaptive Delta Modulation (ADM) Voice Codec
- FX/MX619 and MX629 Military Delta Modulation Codecs

Vocoder Digital Communications Applications
CMX608 and CMX618 Flexible Low Bit-Rate RALCWI Vocoder ICs

**CMX608** Low Bit-rate RALCWI Vocoder IC

**CMX618** Low Bit-rate RALCWI Vocoder IC with Integral Audio Codec

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**Features**
- Near Toll-quality RALCWI Coding Algorithm
- Half-duplex Operation
- Multiple Bit-rate Modes
  - 2050, 2400 or 2750 bps
  - 3600 bps with FEC Enabled
- 20ms Voice Frames
  - 20, 40, 60 and 80 ms Packet Lengths
  - 60 or 80 ms (with FEC) Packet Lengths
- Compatible with DMR and dPMR Frame (Slot) Parameters
- CMX618 Only
  - Integrated Audio Codec
  - Integrated Input and Output Digital Channel Filters
- Compatible with Many Industry Standard Audio Codecs
- Flexible FEC Operations
- Handles 4-bit Viterbi ‘Soft-Decision’ Decoding
- FEC ‘Loop-through’ Mode Supports Digital Repeater Operations
- Ancillary Audio Functions
  - Voice Activity Detector
  - Comfort Noise Generator
  - DTMF and Single-Tone Transport
- Licence and Royalty Free
- Supported by EV6180 EvKit
- Good PESQ MOS Performance Test Results
- Low Pin Count with Small PCB Footprint
- Small Profile 48-pin (L4) LQFP and (Q3) VQFN Packages
- Supply Requirement Range:
  - 1.8V with 3.3V I/O Tolerance

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Two flexible, high performance half-duplex RALCWI Vocoder ICs for use in many wireless and wireline voice applications. With selectable bit rate modes and an FEC function, both ICs offer near-toll-quality voice (Mean Opinion Score (MOS) is 3.5 - 3.6) at extremely low bit rates.

RALCWI technology uses proprietary signal decomposition and parameter encoding methods which ensure optimum recovered speech quality at high compression and low bit rates.

Both products, with their low-power requirements, offer versatile encode and decode facilities with the ability to operate to externally generated ‘soft-decision’ FEC inputs. Added to this is a range of auxiliary functions: Voice Activity Detection, Comfort Noise Generation and DTMF and single-tone detect and regeneration. Provision is made for operation in digital radio repeaters by using the extracted Rx FEC at the repeater to correct any errors in the voice-data before retransmitting (repeating) with a new FEC.

The CMX618’s integral audio codec removes the need for an external voice codec whilst providing variable gain earphone and loudspeaker interfaces, ADC and DAC voice-data and data-voice converters with high-order 4kHz channel input and output digital filters.

Both the CMX608 and the CMX618 are free from any licence and royalty costs and both ICs comfortably meet the requirements of many high-performance audio applications.
... for Wireless and Wireline Voice Applications

RALCWI

Robust Advanced Low Complexity Waveform Interpolation
The Encoder
The encoder deals with a basic frame size of 20ms: 160 samples of audio. One, two, three or four frames may be collected together and supplied to the host or modulator, via C-BUS, as a single packet. In the case of the three and four frame packets, error protection may be added via the FEC option.

Forward Error Correction (FEC)
Voice parameters are initially coded by the encoder. Sensitivity to errors has been categorised for each output bit as either ‘less sensitive’ or ‘more sensitive’. To protect voice parameters against channel errors without reducing voice quality, the ‘more sensitive’ bits are protected. This protection is provided by the FEC system. Three and four frame (60ms and 80ms) packets only may be protected in this way.

FEC Support for Radio Repeaters
In applications such as radio repeaters, FEC Rx data can be extracted, the voice data error-corrected, protected and retransmitted.

The Decoder
The decoder deals with a basic frame size of 20ms: 160 samples of audio. One, two, three or four frames may be collected together and supplied by the host as a single packet. In the case of data from the encoder (via a transmission medium), the frame configuration loaded to the FEC decoder/voice decoder will be the configuration as output from the encoding system.

Features
- Basic Individual Frame Size 20ms
- One, Two, Three or Four Frame Packets
- Error Protection via FEC and Interleaving Options
- Audio (Single or Dual) Tone Handling
- Special DTMF and Tone Frames Generated for Encoding
- Special FEC Configuration for Radio Repeater Operations
- Integral Audio Codec (CMX618)
- System Control via C-BUS Serial Interface
- Synchronous Serial Port (SSP) for External Audio Codec
- Flexible Host/Vocoder Synchronisation
- Efficient Power Usage
Audio Codecs
Samples of audio for encoding are required from an audio codec source. Likewise, an audio codec is required to convert the decoded data back into (analogue) voice audio. The CMX608 has no audio codec and therefore needs to work with an external codec; the CMX618 has an integral codec but can be set to operate with an external codec.

External Audio Codec Support
An external codec can be supported, on either product, using the chip’s 4-wire Synchronous Serial Port (SSP). The SSP is flexible enough to drive a range of codec devices, and both ICs are pre-configured with parameters for both a general purpose configuration and the Burr-Brown (TI) PCM3500 single channel codec.

The CMX618’s Integral Audio Codec
The encode stage of the integral audio codec consists of a microphone input through variable gain stages to an analogue-to-digital converter (ADC). The decode section operates in reverse. Both input and output analogue interfaces can be used in single or differential configuration with both sections including a high order (4kHz) digital channel filter.

Auxiliary Functions
- DTMF Transmit and Receive Coding
- Single Tone Transmit and Receive Coding
- Discontinuous Transmission (DTX) Features
  - Voice Activity Detector
  - Comfort Noise Generation
  - Silence Insertion Description

Power Requirements and Optimisation
Both vocoder ICs operate from a very low current (1.8 volts) power supply with 3.3 volt tolerance I/O requirement.

Codec encoder and decoder sections (CMX618) can be individually set to powersave when not operating, and as an added powersaving facility, the vocoder internal clock may be ‘throttled’ to a quarter of its normal speed.

C-BUS Data Streaming

Synchronous Serial Port (SSP)
As a control, command and data transfer feature for use in support of an external audio codec source, the product offers a Synchronous Serial Port (SSP).

Synchronisation
The vocoder/host synchronisation is available via either a logic (pin) input or by a C-BUS command. Likewise, the vocoder can produce sync pulses for external devices.
CVSD and ADM IC Products

FX/MX619  ‘Eurocom’ Delta Codec
MX629   ‘Military’ Delta Modulation Codec
CMX639   CVSD Voice Codec

Features
- Full Duplex CVSD Codecs
- Separate Rx and Tx Paths
- 3 or 4-bit Compand Algorithm
- Programmable Sample Rates
  - FX/MX619: 8 to 64 kbps
  - MX629: 8 to 64 kbps
  - CMX639: 8 to 128 kbps
- Encoder and Decoder Force Idle
- Anti-alias Voice Filters
- Data Clock Recovery
- Supply Requirement Ranges:
  - FX/MX619 and MX629: 4.5 to 5.5 V
  - CMX639: 2.7 to 5.5 V

Package Styles
- FX619J  22-pin cerdip DIL
- MX619J  22-pin cerdip DIL
- FX619L1 24-pin PLCC
- FX619L2 24-lead PLCC
- MX619LH 24-pin PLCC
- FX619M1 28-lead CCLC
- MX619P  22-pin plastic DIL
- MX629J  22-pin cerdip DIL
- MX629LH 24-pin PLCC
- MX629P  22-pin plastic DIL
- CMX639E2 24-plastic TSSOP
- CMX639D4 16-pin plastic SOIC
- CMX639P6 22-pin plastic DIL

FX/MX619, MX629 and CMX639
CML’s full duplex CVSD ICs serve a variety of application fields including DECT, Eurocom and many military and general-purpose voice applications.

With separate Rx and Tx paths, encode and decode output filters are incorporated on-chip. Sampling clocks, working with a 3- or 4-bit compand algorithm, can operate at internally or externally generated rates of between 8kbps and 64kbps (with the CMX639 increasing the range up to 128kbps). The sampling clock frequency is also available as an output for the synchronisation of external circuits.

With simple pin-selected control functions, the IC provides: CVSD encoder and decoder both with force idle facilities, and a data-enable selector at the encode output to allow the use of the codec IC in multiplex and time domain environments.
CMX649 Adaptive Delta Modulation (ADM) Voice Codec
As an advance on CML’s full duplex CVSD ICs this ADM voice codec offers full duplex ADM, μ-law, A-law and linear PCM codec and transcoder functions for wireless, wireline telephony and general purpose ‘voice’ applications. Control, communications and data setting is via CML’s C-BUS serial interface.

CMX649 Features
- Multiple Codec Modes: 16 to 128 kbps
  - ADM and CVSD
  - PCM: μ-law, A-law and 13-bit Linear
- Flexible Data Interfaces
  - 8 and 16-bit Burst Data with Sync Strobe
  - 1-bit Serial Data with Clock
  - Host Serial Control and Data
- Dual Channel Transcode/Decode Functions
- Versatile Programmable Functions:
  - Input and Output Gains
  - Anti-alias Voice Filters
  - Digital Scrambling
  - Rx and Tx Voice Activity Detectors (VAD)
- Data Clock Recovery
- Control and Communications via C-BUS Serial Interface
- Supported by DE6491 DemoKit
- Supply Requirement Range: 2.7 to 5.5 V

Package Styles
- CMX649D3 20-pin plastic SOIC
- CMX649E3 20-pin plastic TSSOP

CVS and ADM
The EV6180 IC Evaluation Platform

- For CMX608 and CMX618 Evaluation, Demonstration and Investigation
- Operation with Integral (CMX618) or External Audio Codec
- End-to-End Audio Vocoding Demonstration Mode
- Header Connections to SSP and C-BUS Interfaces
- Test Points and Jumpers Provide Access to Signals and Levels
- Single-ended or Differential Audio Codec Input Configuration
- PC Software Available for Performance Demonstration
- Works with PE0001 EvKit Evaluation Card (or Custom Interface) for PC-Based Demonstration
- Circuit Schematics and Board Layouts Available
- Interfaces to PE0001 Evaluation Card Interface
- Mic. and Speaker Jack-sockets On-board
- Single, External DC Power Requirement: On-board Regulators Provide Analogue and Digital Supplies

The EV6180 provides the means to demonstrate and evaluate the operation of a CMX608 or a CMX618 half-duplex RALCW1 vocoder IC.

The EvKit allows the operation/evaluation of both the CMX608 and the CMX618 at all specified data rates and frame lengths via an external (3rd party) audio codec, or the CMX618 using its integral audio codec.

A PC software application is available which demonstrates the kit running in a special 'end-to-end' audio-loopback mode. Signal, supply and control monitor points are available, via headers, connectors and test-points, providing access to all of the CMX IC's interfaces and operations.

The DE6491 Wireless Voice Link Demonstration Kit

- For CMX649 Demonstration
- Operates in the 863 - 865 MHz European Licence Free Band
- 20m Range - Line of Sight
- Privacy via CMX649 Digital Scrambler
- On/Off, Volume and RF Channel Pushbutton Controls
- Phone Quality Voice Transmission using TDD Airlink Protocol
- Selectable RF Power

A CMX649-based wireless voice link demonstration kit that demonstrates CMX649 ADM Codec IC operation in a low-power, cordless headset application.

Design Resources
- Design and application support available:
  - CML website: www.cmlmicro.com/

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