CML Microcircuits
COMMUNICATION SEMICONDUCTORS

**Product Preview**
RALCWI Vocoder
CMX608/CMX618

CMX608 RALCWI Low Bit Rate Vocoder
CMX618 RALCWI Low Bit Rate Vocoder with integrated Voice Codec

Features

- Near toll quality RALCWI coding algorithm
- Half-duplex operation
- Multiple bit rate modes:
    - 2400 or 2750 bps
    - 3600 bps with FEC enabled
- CMX618 Only:
    - Integrated audio codec
    - Integrated input and output filters
- 4-bit Viterbi soft decision decoding
- 20ms Vocoder frame length
- 60ms and 80ms FEC frames
- No licensing or royalty payments
- Ancillary audio functions:
    - Voice Activity Detector
    - Comfort noise generator
    - DTMF transport
    - Single tone regeneration
- 1.8V Low power operation, 3.3V tolerant I/O
- Small 48-pin LQFP and VQFN packages

Applications

- Digital professional PMR/LMR (DMR)
- Digital leisure PMR (dPMR)
- Digital trunking
- Voice scramblers / voice encryption
- Lift systems
- Military field radios
- Secure telephone
- Voice storage / playback:
- Voice annunciation
- Answering machines
- Alarm systems
- VoIP
- WLL
- Voice pagers
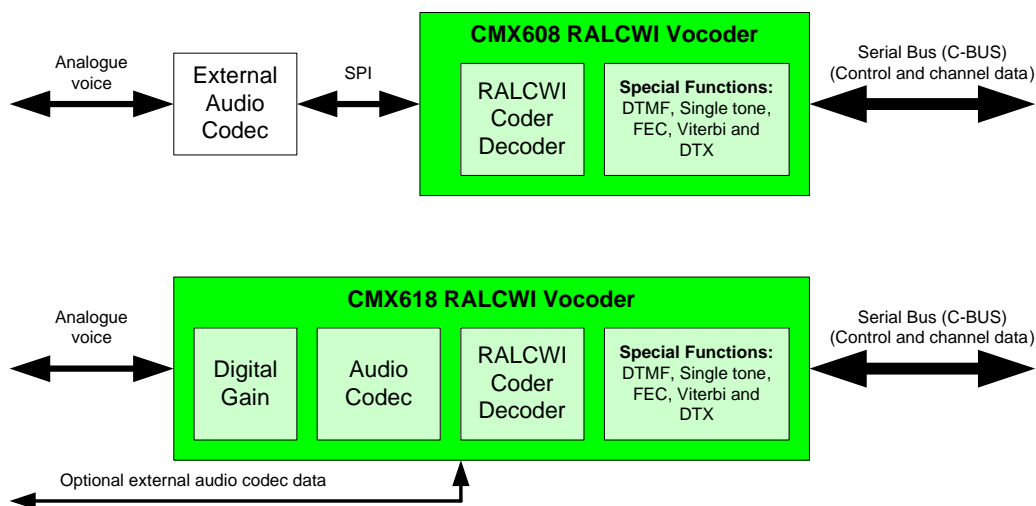
System Overview Diagram

Brief Description

The CMX608 and CMX618 are flexible, high integration, high performance, RALCWI (Robust Advanced Low Complexity Waveform Interpolation) Vocoder ICs, offering near toll quality voice at very low bit rates. There are 2 programmable Vocoding bit rates: 2400bps or 2750bps, which when combined with the embedded FEC, provides an overall bit rate of 3600bps. FEC packet lengths of 60ms and 80ms are supported providing maximum protection to channel errors. The CMX618 includes an integrated voice codec, offering a complete analogue voice-to-low-bit-rate vocoded data function. The CMX608 and CMX618 are free from any licence and royalty costs, fully meet the requirement of high performance low bit rate digital voice applications and are available in very small 48pin VQFN and LQFP packages.

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Block Diagram
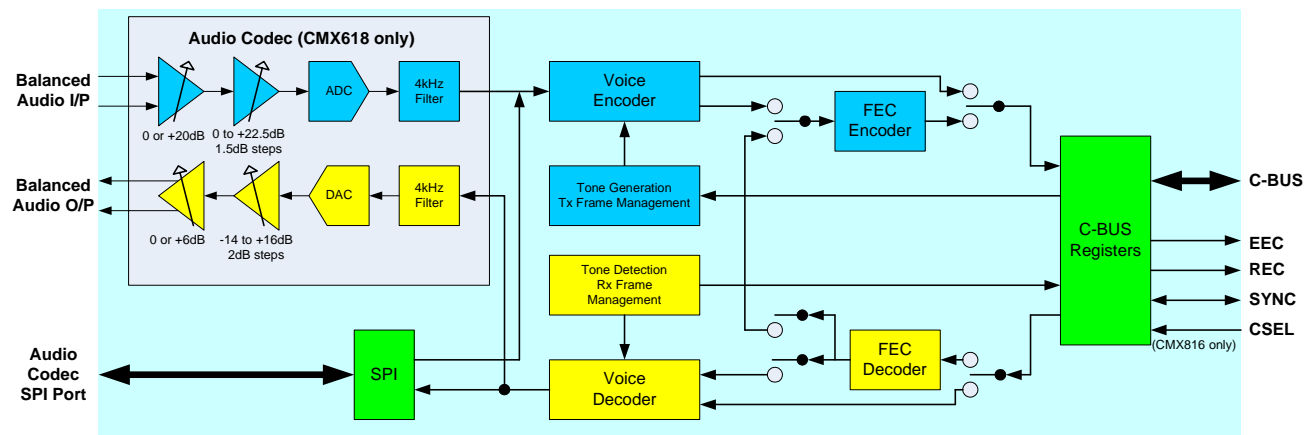
General Description

The CMX608 and CMX618 are near toll quality half duplex Vocoders. The voice encoding/decoding is performed by a new, low bit-rate algorithm technology called RALCWI (Robust Advanced Low Complexity Waveform Interpolation). The data rate is selectable between 2400bps or 2750bps all without FEC or 3600bps with FEC. The frame length is selectable from 20ms, 40ms, 60ms or 80ms all without FEC and 60ms or 80ms with FEC protected frames. The integral Viterbi decoder can optionally use "soft decision" metrics to improve its decoding ability if the data signal is applied in a 4-bit digital representation of the received/demodulated analogue signal. The FEC function can also be used separately, so that data can be decoded/error-corrected then re-encoded and forwarded on. This is particularly useful in voice repeaters, providing optimum voice performance on the overall up/down link and the maximum range.

RALCWI technology uses unique proprietary signal decomposition and parameter encoding methods, ensuring high speech quality at high compression ratios. The speech quality of RALCWI, as estimated by independent listeners, is similar to that provided by standard codecs running at bit rates above 4000 bps. The Mean Opinion Score (MOS) of speech quality for this vocoder is around 3.5-3.6. This value was determined by a paired comparison method, performing listening tests of developed and standard speech coders.

The RALCWI Speech Encoder/Decoder operates on a "frame-by-frame" basis. The source speech frame consists of 160 samples of linear 16-bit PCM sampled at 8 kHz. The Speech Encoder performs speech analysis at a high time resolution (8 times per frame) and forms a set of estimated parameters for each speech segment. All of the estimated parameters are quantized to produce 41-, 48- or 55-bit frames, using Vector Quantisation (VQ) of different types. All the vector quantisers were trained on a mixed multi-language speech base, which contains speech samples in both Eastern and Western languages.

All speech parameters are coded with high efficiency by the Speech Encoder. Sensitivity to errors is estimated for each output bit and a bit frame is split into two parts: "more sensitive to errors" and "less sensitive to errors". To protect the speech parameters against channel errors without reducing speech quality, the "more sensitive" bits are protected. Such protection is provided by the FEC Encoder/Decoder engine. The Speech Decoder de-quantises the parameters and re-synthesises the speech. Reconstructed speech is filtered and presented to the output gain block.

General Description (Continued)

The CMX618 includes a microphone input connected to an ADC, and a DAC driving an earpiece output; a variable gain stage is associated with each converter. The differential input stage includes 20dB of switchable gain, for use as a microphone pre-amplifier, whilst the differential output stage includes 6dB of switchable gain. By using the DAC output stage in a differential configuration, a further 6dB of gain can be achieved. The CMX618 is a self contained RALCWI Vocoder only requiring control from a host microcontroller, therefore offering a very small footprint.

Control of the CMX608 and CMX618 is via a serial port (C-BUS), from the host µC. The CSEL pin allows the selection of an internal or external CODEC.

DTMF and single tones can be successfully transported through the Vocoder by special control codes. The CMX608/CMX618 also feature a DTX (Discontinuous Transmission) mode, where an integral Voice Activity Detector will send SID (Silence Insertion Description) data to the decoder, which will perform Comfort Noise Generation.
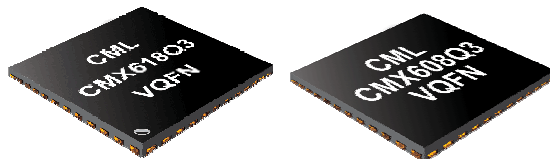
The CMX608/CMX618 flexibility extends to the selection of a Xtal or external clock source. A number of Xtal/Clock frequencies in the range from 9.6MHz through to 24MHz can be pin-selected.

Package options

### CMX618L4 and CMX608L4 (48pin LQFP package)
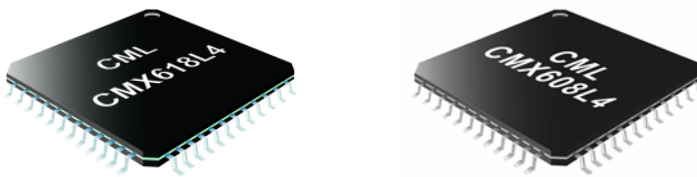
CMX618Q3 and CMX608Q3 (48pin VQFN package)

Product Support

EV6180 Evaluation Kit

The EV6180 evaluation kit enables quick and easy evaluation of the CMX608 and CMX618 RALCWI
Vocoders. Providing connections for audio input and output, power supply and a serial bus (C-BUS)
header for the connection to a host microcontroller.
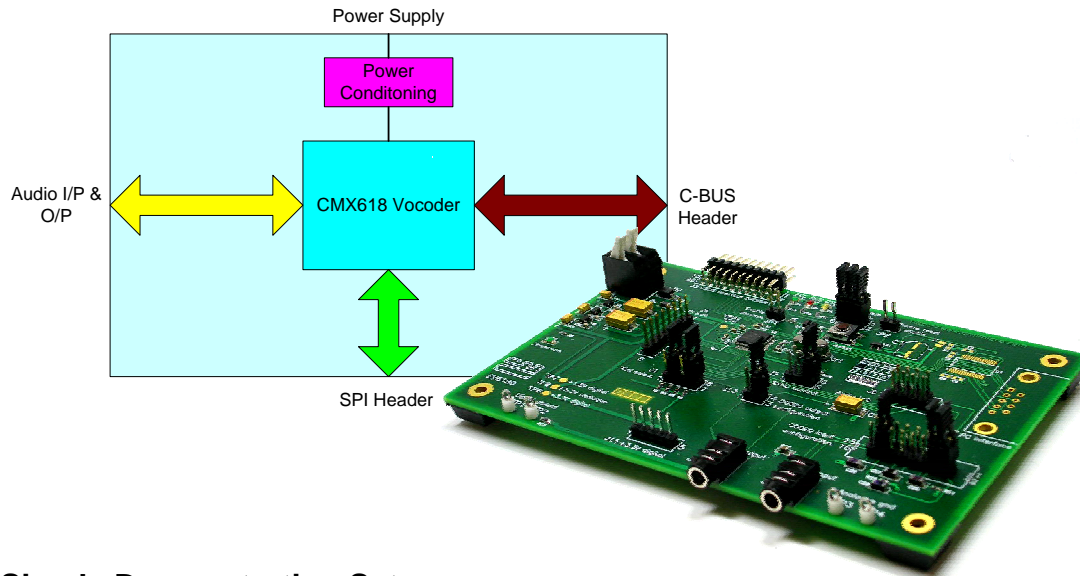
Simple Demonstration Setup

Utilising the PE0001 Evaluation kit interface card and basic GUI program running on a PC, a simple
loop-through Vocoder demonstration can be performed. The PC based GUI enables different
Vocoding bit rates to be selected and enables a special encode/decode loop-through mode. Audio
files can be played through the Vocoder via the PC's sound card and a suitable audio editing program.
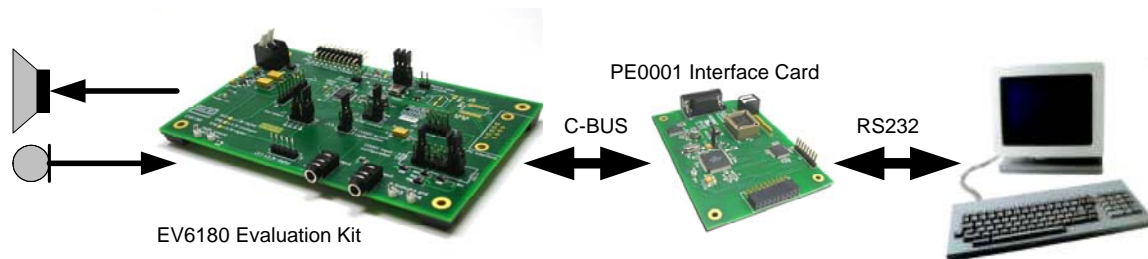

Evaluation Setup

Full evaluation of the CMX608 and CMX618 can be realised utilising the EV6180 evaluation kit and a
microcontroller evaluation/emulator kit.
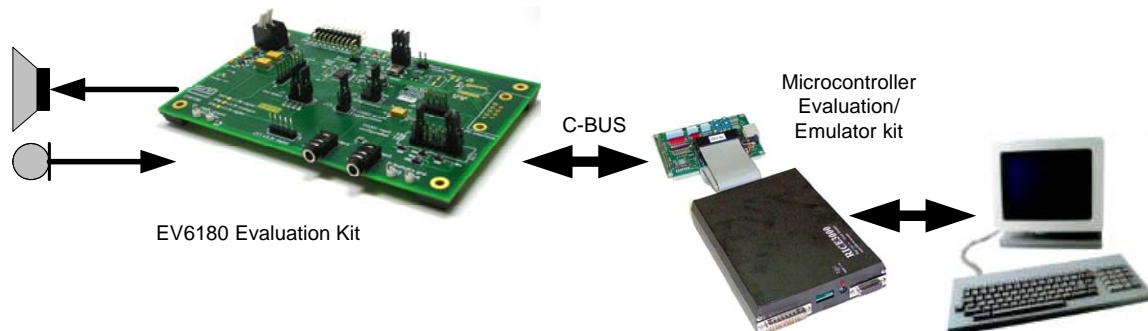
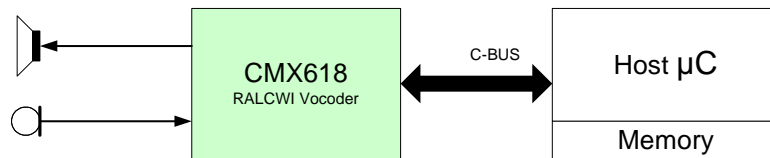## Digital Radio / Digital Scrambler Application

Combining the CMX618 RALCWI Vocoder with the CMX7141 Digital Two-Way Radio Processor, a digital voice over radio application can be realised. Examples of use include digital PMR/LMR, digital voice scrambling on PMR/LMR, digital Wireless Local Loop (WLL) and military field radios.

The 4-level FSK modem running at 4800bps could carry the coded voice data at 3600bps leaving 1200bps of data for channel coding. A suitable air interface would need to be conceived to manage this.
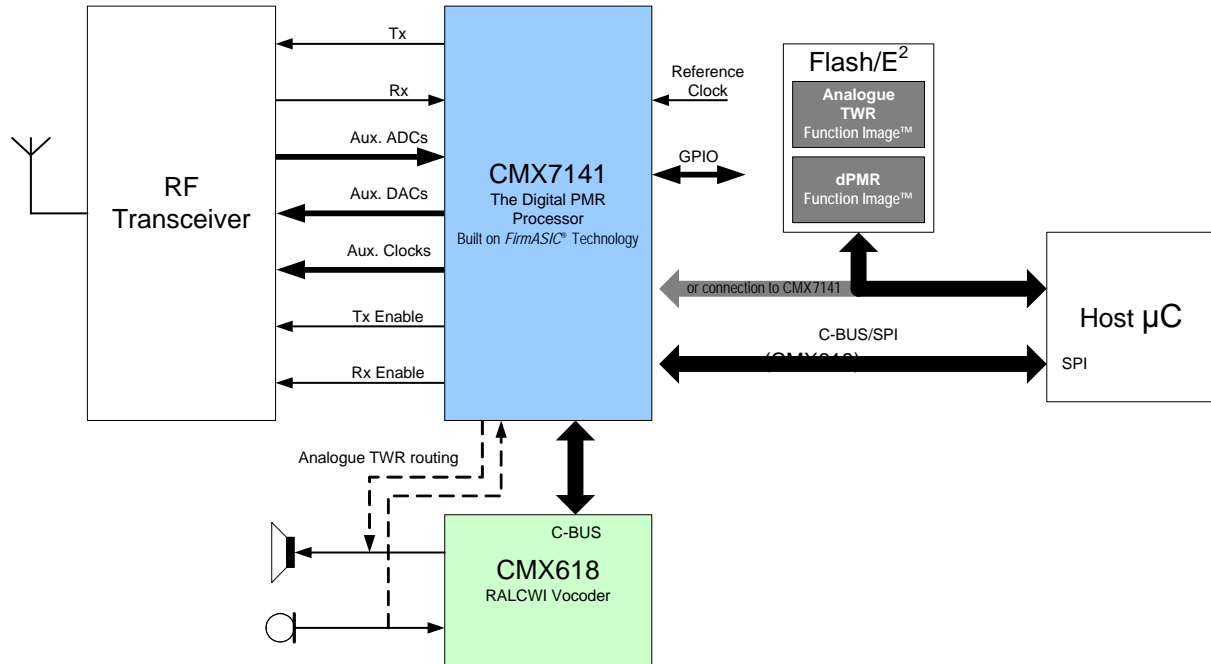
Digital Voice Storage / Voice Encryption Application
Combining the CMX618 RALCWI Vocoder with a microcontroller, voice storage and voice encryption systems can be easily implemented.