Analogue Radio ICs
Two-Way Radio Baseband Processor ICs

CML Microcircuits
COMMUNICATION SEMICONDUCTORS

Function Image™ updates enhance voice, signalling and data performances

The CML Family of Analogue Radio ICs

- **CMX7031** — Two-Way Radio Processor/4-Level FSK Modem/C4FM Modem - with RF Support
- **CMX7041** — Two-Way Radio Processor/4-Level FSK Modem/C4FM Modem
- **CMX881** — Baseband Processor for PMR and Trunked Radios
- **CMX882** — Baseband Processor, with GPS Data Transport for FRS, MURS, PMR446 and GMRS 'Leisure' Radios
- **CMX838** — FRS/PMR446/GMRS 'Family Radio' Processor
- **CMX808A** — CTCSS 'Type 2' Encoder/Decoder

A versatile collection of audio, signalling and data ICs to cater to the needs of most analogue radio systems.

Ranging from the simple CTCSS codec to the highly integrated multi-function *FirmASIC®* based products, the CMX7031 and CMX7041, at least one of the products showcased in this document is suitable for your two-way radio design.

	CMX7031			CMX7041			CMX808A	CMX838	CMX881	CMX882
FirmASIC® Product		✔			✔					
Function Image™	FI-1.x	FI-2.x	FI-3.x	FI-1.x	FI-2.x	FI-3.x				
C-BUS Control	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Audio Processing	✔			✔				✔	✔	✔
Sub Audio . . .										
CTCSS	✔			✔			✔	✔	✔	✔
DCS	✔			✔					✔	✔
In-Band . . .										
DTMF	✔			✔					✔	
Selcall	✔								✔	
Audio Tones	✔			✔				✔	✔	✔
XTCSS	✔			✔						✔
Data . . .										
FFSK/MSK	✔			✔					✔	✔
Marine DSC FSK	✔			✔						
NWR SAME AFSK Rx	✔			✔						
4-Level FSK		✔			✔					
C4FM		✔			✔					
Aux Functions . . .										
DAC	✔	✔	✔	✔	✔	✔				
ADC	✔	✔	✔	✔	✔	✔			✔	✔
System Clocks	✔	✔	✔	✔	✔	✔				
RF Support . . .										
RF Synthesiser/s	✔	✔	✔					✔		

Two-Way Radio Processor ICs
- Professional and Semi-Professional PMR, LMR, P25 and Trunked Systems -
- Leisure: FRS, GMRS, MURS and PMR446 -
- Marine VHF, Aviation Comms, Amateur and Weather Radio -

The CML Advantage

- High Integration Supports Multiple On-chip Functions

- Baseband Audio, Signalling, Data and RF Functions

- Multiple Functions Reduce Final Component Count

- Integral C-BUS Instruction Set and On-chip Signal Manipulation Reduce Host µC Overhead

- C-BUS Serial Interface Compatible with Most Serial Port Systems

- *FirmASIC®* Component Technology

- Comprehensive Application Support
  - Evaluation and Demonstration Kits
  - CML Website: www.cmlmicro.com
  - Datasheets, User Manuals and Application Notes
  - Help Desk Support on Three Continents

- Low-power Requirements with Dynamic Powersave Features

- Compact Packages Reduce PCB Footprint

CONTENTS

www.cmlmicro.com

CML in Analogue Radio
Voice, Signalling and Data ICs for Two-Way Radio Equipment

- **The CMX7031:** A versatile IC based on *FirmASIC®* technology offering either full-feature baseband (voice, signalling and data) processing, 4-level FSK freeformat/packet data or C4FM data, depending on the choice of Function Image™. Auxiliary ADCs, DACs, RF synthesisers and system clocks are included.

- **The CMX7041:** A versatile IC based on *FirmASIC®* technology offering either full-feature baseband (voice, signalling and data) processing, 4-level FSK freeformat/packet data or C4FM data, depending on the choice of Function Image™. Auxiliary ADCs, DACs and system clocks are included.

- **The CMX881:** A baseband audio, signalling and data processor for PMR and trunked radios. Voice, sub-audio and inband signalling work alongside a 1200/2400 bps freeformat modem. The IC's operations are supported by an on-chip auxiliary ADC.

- **The CMX882:** A baseband audio, signalling and data processor for leisure-type radios. Voice, sub-audio and inband signalling are available, with a 1200/2400 bps packet and freeformat modem for system set-up, wireless data and GPS data transport. The IC's operations are supported by an on-chip auxiliary ADC.

- **The CMX838:** A wide-ranging CTCSS processor with full-feature audio processor, audio call-tone generator and RF synthesiser.

- **The CMX808A:** A CTCSS encoder/decoder with flexible sub-audio configurations, including Tone Clone™ capabilities. A voiceband filter is selectable to both Rx and Tx paths.

Infinite Capabilities . . .

*Firm*ASIC®

. . . Maximum Flexibility

FirmASIC®

CML's proprietary *FirmASIC®* component technology reduces cost, time to market and development risk, with increased flexibility for the designer and end application. *FirmASIC®* combines Analogue, Digital, Firmware and Memory technologies in a single silicon platform that can be focused to deliver the right feature mix, performance and price for a target application family.

CMX7031 and CMX7041 Two-Way Radio Processors (Function Image™ 1.x)

. . . the platform approach to saving cost, time and space in two-way radio designs
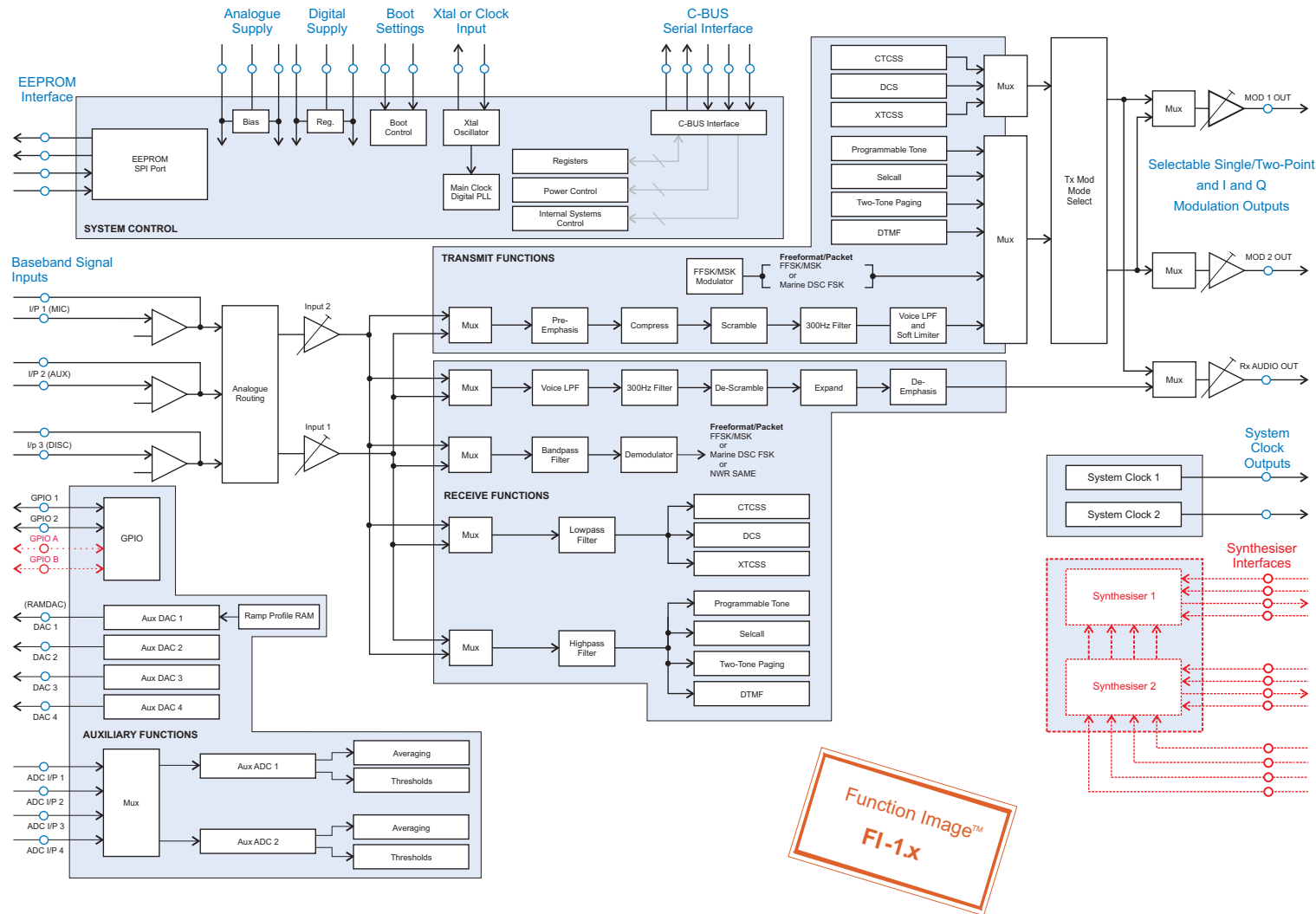
Features

- Built on *FirmASIC®* Technology
- Half-Duplex Operation
- Complete Audio Processing
- Selectable Audio Filter/Process Element Sequence Setting
- Concurrent Sub-audio and Inband Signalling
- Tone Squelch Signalling
- Inband Signalling
- XTCSS Combination Signalling
- 1200/2400 bps FFSK/MSK Data Modem
- Raw and Formatted (Marine) DSC Data Modes
- NWR SAME AFSK Demodulator
- NWR WAT Detector
- RF Synthesisers: 100MHz to 600MHz (CMX7031 only)
- Reference Clock PLL
- Auxiliary ADCs and DACs (with optional RAMDAC)
- Programmable System Clocks
- GPIO Port/s
- Flexible Single/Two-Point and I and Q Tx Modulation Outputs
- Function Upgrade Flexibility via *FirmASIC®* Technology
- C-BUS Serial Interface
- Customisation Options
- VQFN and LQFP Packaging
- Supply Requirement Range: 3.0 to 3.6 V

Series Variants

The block diagram illustrates the functions available from the CMX7031 and CMX7041 ICs with Function Image™ 1.x loaded. Functions in **black** are common to both products; dotted functions in **red** on the diagram are specific to products as detailed below:

Integer-N RF Synthesisers -
Two of these are available on the CMX7031 but are excluded from the CMX7041.

General Purpose Interfaces -
These GPIO interfaces (CMX7031 = 2 : CMX7041 = 4), which are currently unused, offer future customisation possibilities.
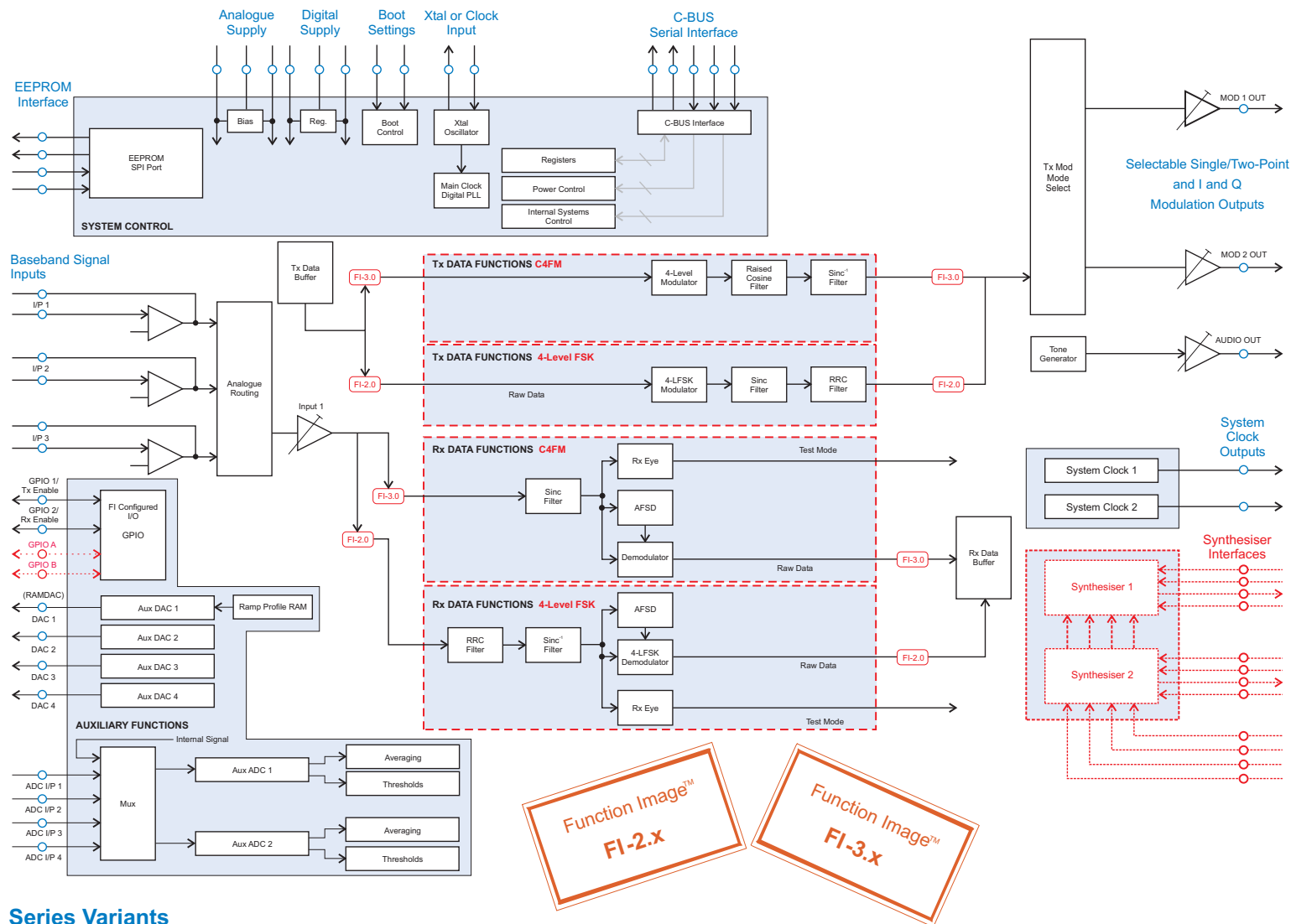
Package Styles	-40º to +85ºC
CMX7031L9	64-pin LQFP
CMX7031Q1	64-pin VQFN
CMX7041L4	48-pin LQFP
CMX7041Q3	48-pin VQFN

3

CMX7031 and CMX7041 Data Processing Functions

. . . flexible modems for data-over-radio operations

4-Level FSK Baseband Modem (Function Image™ 2.x)
C4FM Baseband Modem (Function Image™ 3.x)

Features

- Built on *FirmASIC*® Technology
- Half-Duplex 4-Level FSK Modem (FI-2.x)
- Half-Duplex C4FM Modem (FI-3.x)

- Selectable Data Rates of 4800 and 9600 bps
- Raw (Freeformat) Data Modes
- Selectable Automatic Preamble and Frame-Sync Operations
- RF Synthesisers: 100MHz to 600MHz (CMX7031 only)
- Three Selectable Analogue Inputs
- Flexible Single/Two-Point and I and Q Tx Modulation Outputs
- Programmable Comfort Tones via Audio Output
- GPIO Port/s
- Auxiliary ADCs and DACs (with optional RAMDAC)
- Reference Clock PLL
- Programmable System Clocks
- Function Upgrade Flexibility via *FirmASIC*® Technology
- C-BUS Serial Interface
- Customisation Options
- VQFN and LQFP Packaging
- Low-Power Operation
- Supply Requirement Range: 3.0 to 3.6 V

Block Diagram Labels

Analogue Supply · Digital Supply · Boot Settings · Xtal or Clock Input · C-BUS Serial Interface

EEPROM Interface · EEPROM SPI Port · Bias · Reg. · Boot Control · Xtal Oscillator · C-BUS Interface · Registers · Power Control · Internal Systems Control · Main Clock Digital PLL · **SYSTEM CONTROL**

Baseband Signal Inputs · I/P 1 · I/P 2 · I/P 3 · Analogue Routing · Input 1 · Tx Data Buffer

Tx Mod Mode Select · MOD 1 OUT · Selectable Single/Two-Point and I and Q Modulation Outputs · MOD 2 OUT · Tone Generator · AUDIO OUT

Tx DATA FUNCTIONS C4FM · 4-Level Modulator · Raised Cosine Filter · Sinc⁻¹ Filter · FI-3.0

Tx DATA FUNCTIONS 4-Level FSK · Raw Data · 4-LFSK Modulator · Sinc Filter · RRC Filter · FI-2.0

Rx DATA FUNCTIONS C4FM · Rx Eye · Test Mode · Sinc Filter · AFSD · Demodulator · Raw Data · FI-3.0

Rx DATA FUNCTIONS 4-Level FSK · AFSD · RRC Filter · Sinc⁺ Filter · 4-LFSK Demodulator · Raw Data · FI-2.0 · Rx Eye · Test Mode

Rx Data Buffer

System Clock Outputs · System Clock 1 · System Clock 2

Synthesiser Interfaces · Synthesiser 1 · Synthesiser 2

GPIO 1/ Tx Enable · GPIO 2/ Rx Enable · GPIO A · GPIO B · FI Configured I/O · GPIO

(RAMDAC) · DAC 1 · Aux DAC 1 · Ramp Profile RAM · DAC 2 · Aux DAC 2 · DAC 3 · Aux DAC 3 · DAC 4 · Aux DAC 4 · **AUXILIARY FUNCTIONS**

Internal Signal · Mux · ADC I/P 1 · ADC I/P 2 · ADC I/P 3 · ADC I/P 4 · Aux ADC 1 · Averaging · Thresholds · Aux ADC 2 · Averaging · Thresholds

Function Image™ **FI-2.x** · Function Image™ **FI-3.x**

Series Variants

The block diagram illustrates the functions available from the CMX7031 and CMX7041 ICs with Function Image™ 2.x or 3.x loaded. Functions in **black** are common to both products; dotted functions in **red** on the diagram are specific to products as detailed below:

Integer-N RF Synthesisers -
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General Purpose Interfaces -
These GPIO interfaces (CMX7031 = 2 : CMX7041 = 4), which offer FI configured operations.

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CMX7041Q3	48-pin VQFN

Audio Processing (Function Image™ 1.x)

Audio Functions

The audio signal can be processed in a multitude of ways, depending on the implementation/s required. When configured for operation, to minimise the operating power requirement, all unused functions can be disabled and powered-down.
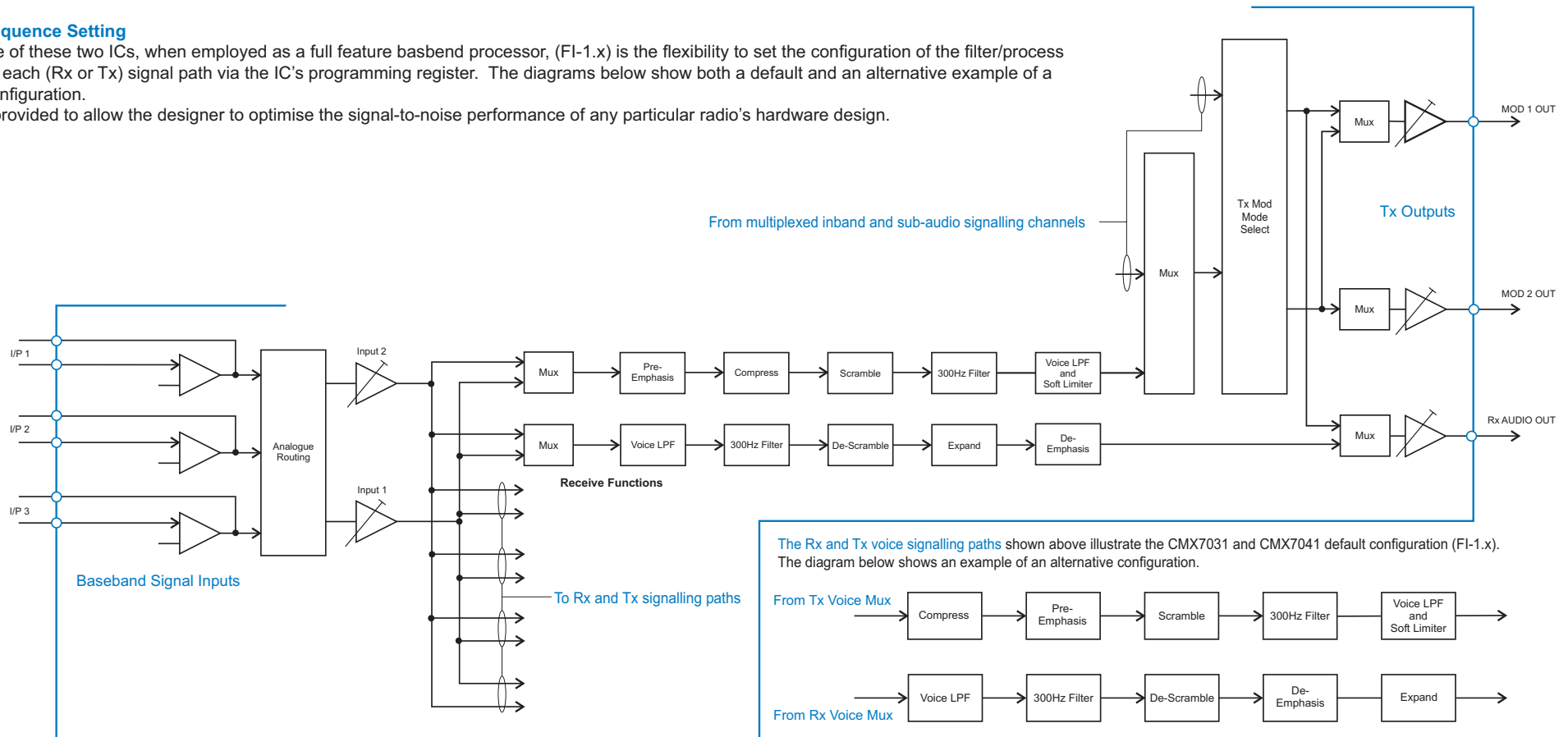
Voiceband Processing Operations

- Half duplex operation
- Flexible routing architecture permits concurrent signal processing
- Separate Rx and Tx channels
- Selectable audio filter/process sequence setting
- Selectable pre- and de-emphasis filter stages
- Host controlled VOGAD feature in microphone input stage
- Rx and Tx channel filtering selectable to 12.5kHz and 25kHz channels

- Programmable soft Tx voiceband limiter to reduce effects of over-modulation
- Rx and Tx channel filtering compliant with ETS-300-086 and TIA/EIA-603 specifications
- Selectable Rx voiceband filter with sub-audio rejection properties
- Selectable 'syllabic' compression and expansion
- Selectable, programmable-point frequency-inversion audio scrambler/descrambler
- Software 'volume' control

Function Image™
FI-1.x

Audio Filter Sequence Setting

A unique feature of these two ICs, when employed as a full feature basbend processor, (FI-1.x) is the flexibility to set the configuration of the filter/process elements within each (Rx or Tx) signal path via the IC's programming register. The diagrams below show both a default and an alternative example of a programmed configuration.
This feature is provided to allow the designer to optimise the signal-to-noise performance of any particular radio's hardware design.

The Rx and Tx voice signalling paths shown above illustrate the CMX7031 and CMX7041 default configuration (FI-1.x). The diagram below shows an example of an alternative configuration.

Signalling (Function Image™ 1.x)

In the case of both Rx and Tx signalling sections, when suitably configured by the relevant Function Image™, these products offer a complete and comprehensive suite of inband, sub-audio and combination signalling functions, all to run concurrently with voiceband audio operations.

Inband Signalling

These two ICs, when configured by FI-1.x, support Selcall, two-tone paging, DTMF and user-programmable inband tones in the range 288 to 3000 Hz.

The CMX7031 and CMX7041 implement QTC coding; by default, on-power-up, the IC will load the EEA Selcall tone-set, but, to remain compatible with all available tone systems in use, this may be overwritten, by the host, with any valid set of tones in the in-band range.

Adjustable decoder bandwidths and threshold levels are programmable to allow the user to trade-off decode performance against local environmental conditions.
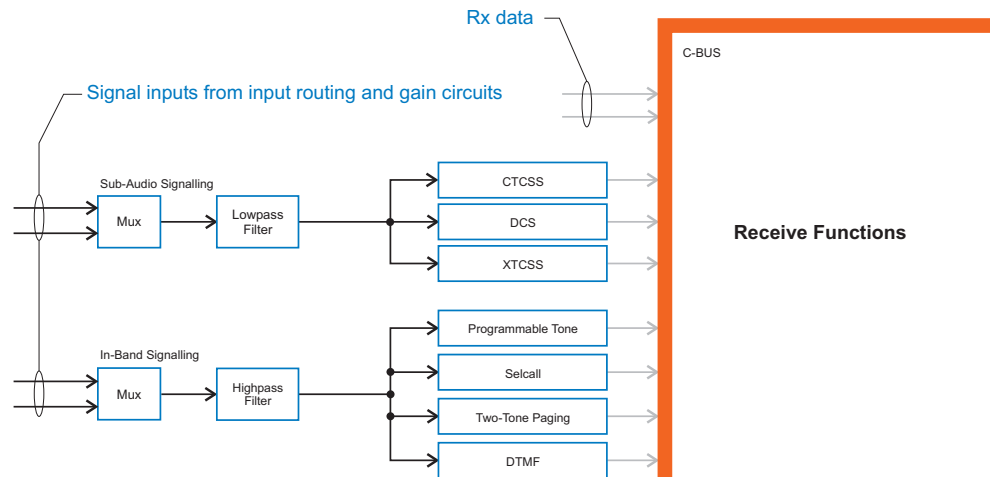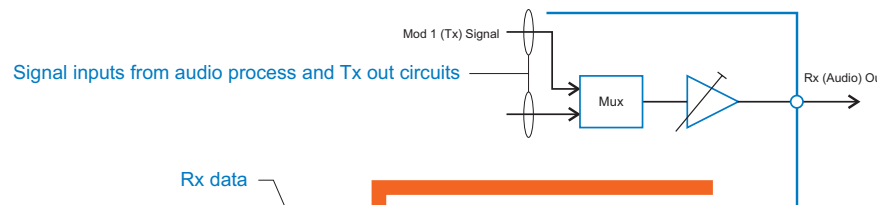
Inband Signalling
- DTMF
- Programmable Single or Dual Tones
- Selcall

Sub-audio Signalling
- CT CSS
- DCS

Combination Signalling
- XTCSS

Mod 1 (Tx) Signal

Signal inputs from audio process and Tx out circuits

Mux

Rx (Audio) Out

Rx data

C-BUS

Signal inputs from input routing and gain circuits

Sub-Audio Signalling

Mux — Lowpass Filter — CTCSS / DCS / XTCSS

In-Band Signalling

Mux — Highpass Filter — Programmable Tone / Selcall / Two-Tone Paging / DTMF

Receive Functions

Selectable Inband Signal Processing Modes
- Rx and Tx Dual-Tone Multi-Frequency (DTMF)
- Programmable encoder/decoders
  - Selcall (EEA tone-set default)
  - Single or dual tone audio (288Hz to 3000Hz)
- Pre-programmed XTCSS with 4-tone inband addressing
- **N**ational **W**eather **R**adio (NWR) 1050Hz Warning Alarm Tone (WAT) detection
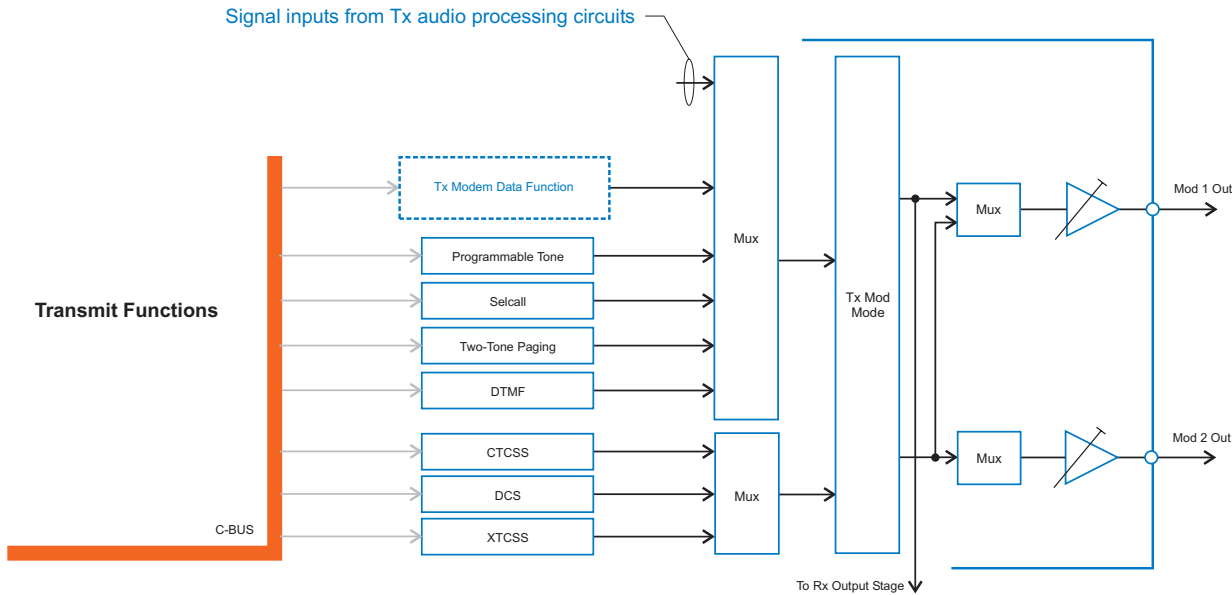
NWR Weather Radio Reception

Support is provided for the US National Oceanic and Atmospheric Administration (NOAA) weather radio systems, offering Warning Alarm Tone detection (WAT) via the inband signalling stages, and Specific Area Message Encoding (SAME) data demodulation and detection via a dedicated AFSK demodulator. NWR monitoring can be selected and performed in parallel with existing radio operations.

DTMF Encoding and Decoding

These ICs are pre-programmed with the standard DTMF tone set for Rx and Tx operation. The transmission of (a pair of) single tones can be enabled. In addition, twist parameters can be adjusted. Selcall and sub-audio or voice audio or data can be processed in parallel.
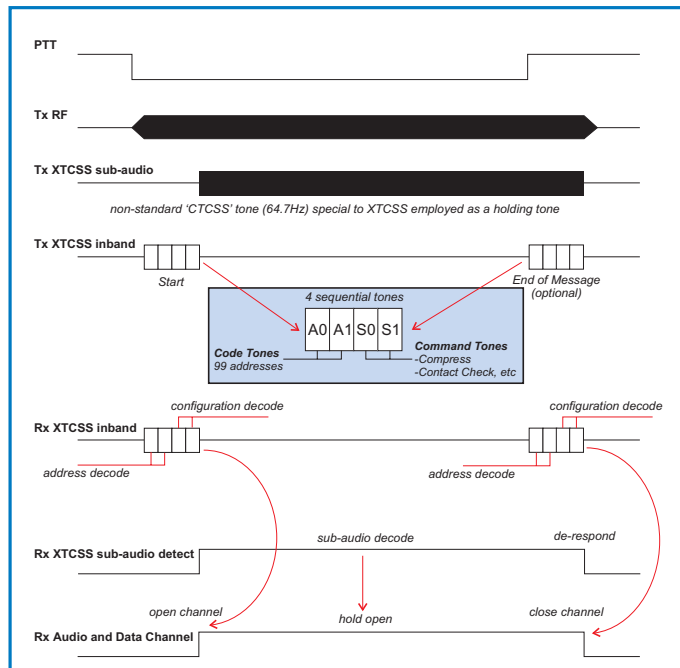
Function Image™
FI -1.x

Signal inputs from Tx audio processing circuits

Transmit Functions

- Tx Modem Data Function
- Programmable Tone
- Selcall
- Two-Tone Paging
- DTMF
- CTCSS
- DCS
- XTCSS

C-BUS

Mux

Mux

Tx Mod Mode

Tx Mod Mode

Mux → Mod 1 Out

Mux → Mod 2 Out

To Rx Output Stage

Sub-Audio Signal Processing

- 51 tone CTCSS codec
- 0°/120°/180° CTCSS phase-shift generation (Tx)
- 0°/120°/180° CTCSS phase-shift detection (Rx)
- Tone Clone™ compatibility
- Programmable 23/24 bit DCS codec with 'true' and inverse modulation formats
- DCS end-of-transmission 'off' 134Hz tone-burst feature
- XTCSS sub-audio component encoding and decoding

CTCSS Tone Clone™

Tone Cloning™ is a process of automating the configuration of Family Radio type radios, especially when using radios from different vendors.
A radio that supports Tone Cloning™ can copy over-air (clone) the CTCSS tone/s used by another radio. The CMX7031 and CMX7041 (FI-1.x), CMX882, CMX838 and CMX808A can be configured to support Tone Cloning™ operations.

PTT

Tx RF

Tx XTCSS sub-audio

non-standard 'CTCSS' tone (64.7Hz) special to XTCSS employed as a holding tone

Tx XTCSS inband

Start

End of Message (optional)

4 sequential tones

A0 A1 S0 S1

Code Tones 99 addresses

Command Tones -Compress -Contact Check, etc

configuration decode

configuration decode

Rx XTCSS inband

address decode

address decode

sub-audio decode

de-respond

Rx XTCSS sub-audio detect

open channel

hold open

close channel

Rx Audio and Data Channel

XTCSS Combination Signalling

Many CTCSS channels can be employed in a single RF channel. Within the 'leisure radio' environment there is always the possiblity that other in-range users will use the same, standard sub-audio tone, therefore causing interference and loss of privacy.
The implementation of XTCSS, an in-band tone and sub-audio signalling combination, provides, currently, up to 99 additional private channels within the single RF channel. The use of XTCSS signalling prevents 'squelch breakthrough' caused by other common-channel users.

XTCSS

- Provides secure and private voice communications
- Pre-programmed XTCSS and inband tone codec
- Over-air configuration and addressing via 4-tone (inband) signalling
- XTCSS (64.7Hz) Holding Tone available in CTCSS cache
- Provides up to 99 additional 'private' channels

Operation . . .

At the start of an 'over', the initial in-band bits (tones) (A0, A1, S0, S1) select the address and set up the chosen operational configuration
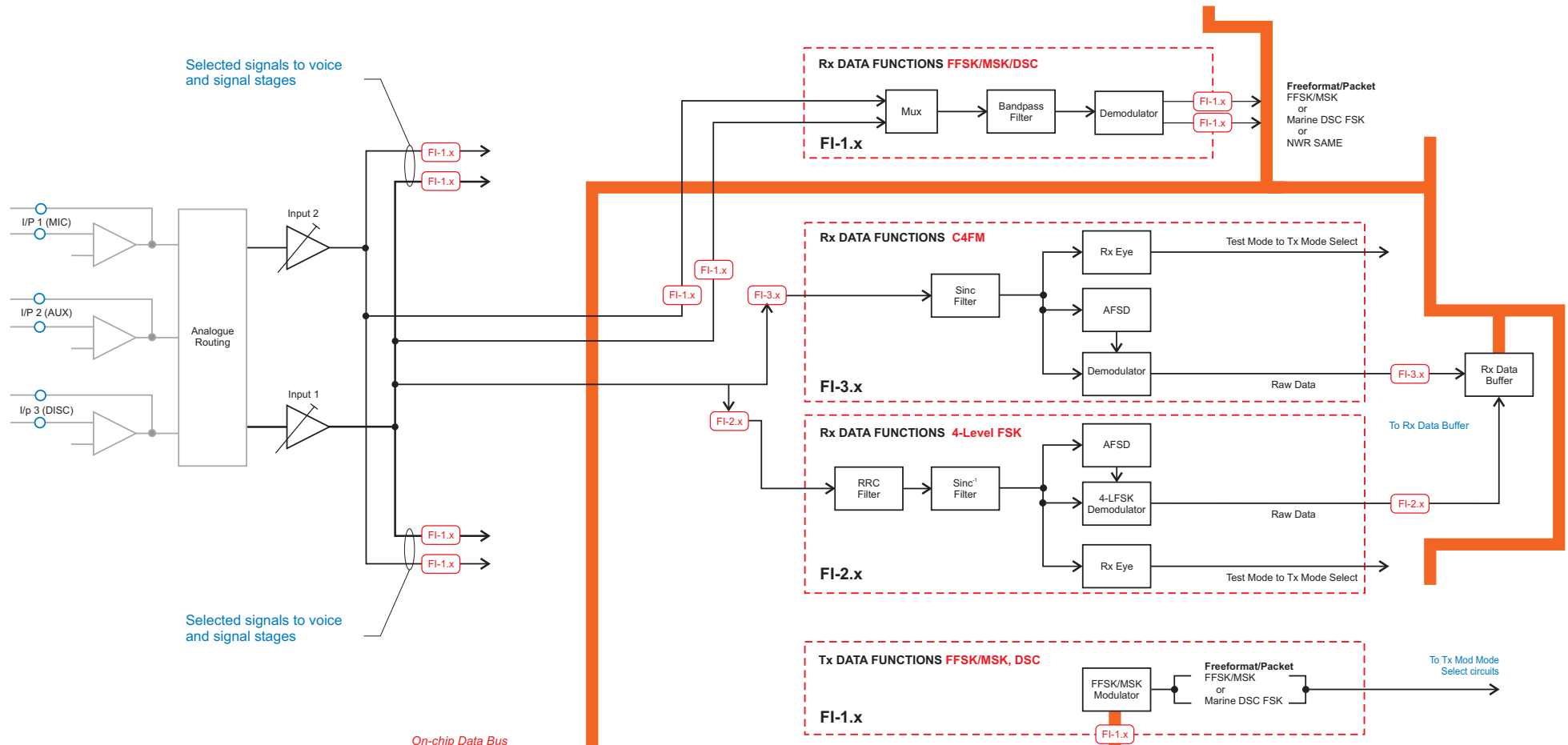
During the 'over', a non-standard (64.7Hz) sub-audio tone holds the channel open

At the end of the 'over', the sub-audio holding tone is dropped and, if required, the channel re-configured to a new or default mode.

XTCSS parameters and operating functions are controlled by on-chip registers

Data Functions

Selected signals to voice and signal stages

I/P 1 (MIC)

I/P 2 (AUX)

I/p 3 (DISC)

Analogue Routing

Input 2

Input 1

FI-1.x
FI-1.x

FI-1.x
FI-1.x

FI-1.x

FI-1.x

FI-3.x

FI-2.x

Selected signals to voice and signal stages

On-chip Data Bus

Rx DATA FUNCTIONS FFSK/MSK/DSC

Mux

Bandpass Filter

Demodulator

FI-1.x

FI-1.x

FI-1.x

Freeformat/Packet
FFSK/MSK
or
Marine DSC FSK
or
NWR SAME

Rx DATA FUNCTIONS C4FM

Sinc Filter

Rx Eye

AFSD

Demodulator

Test Mode to Tx Mode Select

Raw Data

FI-3.x

FI-3.x

Rx DATA FUNCTIONS 4-Level FSK

RRC Filter

Sinc⁻¹ Filter

AFSD

4-LFSK Demodulator

Rx Eye

Raw Data

FI-2.x

Test Mode to Tx Mode Select

FI-2.x

Rx Data Buffer

To Rx Data Buffer

Tx DATA FUNCTIONS FFSK/MSK, DSC

FFSK/MSK Modulator

Freeformat/Packet
FFSK/MSK
or
Marine DSC FSK

To Tx Mod Mode Select circuits

FI-1.x

FI-1.x

Tx Data Buffer

Tx DATA FUNCTIONS C4FM

4-Level Modulator

Raised Cosine Filter

Sinc⁻¹ Filter

FI-3.x

FI-3.x

To Tx Mod Mode Select circuits

FI-3.x

Tx DATA FUNCTIONS 4-Level FSK

4-LFSK Modulator

Sinc Filter

RRC Filter

Raw Data

FI-2.x

FI-2.x

FI-2.x

Wireless Data Modes	
Function Image™ 1.x	**FFSK/MSK** and **DSC** Mod/Demod and **SAME AFSK** *Demod*
Function Image™ 2.x	4-Level FSK
Function Image™ 3.x	C4FM

CMX7031 and CMX7041 Data Functions by Function Image™

The CMX7031 and the CMX7041 ICs, operating under the currently available Function Image™ standards FI-1.x, FI-2.x and FI-3.x, each offer an on-chip wireless data function.

As part of the complete radio processor, for general system setup and wireless data operations, the FI-1.x standard configures a half-duplex 1200/2400 bps FFSK/MSK modem with both freeformat and full feature packet-data options.
In addition, this product offers, as part of its NOAA system compatibility, an NWR 1050Hz Warning Alarm Tone (WAT) detector and Specific Message Area Encoding (SAME) 520.83bps Audio Frequency Shift Keying (AFSK) demodulator.

Function Image™
FI-1.x

FFSK/MSK Data Processing (FI-1.x)
- Freeformat and packet capabilities
- 16-bit frame sync detector, error correction, data scrambling/descrambling and interleaving
- Frame head decoding
- 1200/2400 bps FFSK/MSK data modem with auto-bauding
- On-chip clock recovery
- Flexible packet data facility suitable for:
  - Text messaging
  - Calling line ID
  - Caller location
  - Digital poll of remote systems
  - GPS information in NMEA 0183 format
  - Data transfer
  - MPT 1327 systems
- Packet data assembly/dis-assembly

Marine DSC Data Operations (FI-1.x)
In place of the standard FFSK/MSK modem, this product, with FI-1.x loaded, can implement a 1200bps Digital selective Call (DSC) modem conforming to the requirements of ITU-R M.493-11 for use in Marine VHF band radio systems. This function uses tones of 1300Hz and 2100Hz to represent binary 1s and 0s respectively.

- Raw and formatted (Rx and Tx) FSK data modes
- Rx Raw: Modem passes all received data to the host
- Tx Raw: Host passes all data to modem in correctly formatted form
- Rx Formatted: Incoming data checked for valid phasing; passes decoded 'characters' to host
- Tx Formatted: Dotting pattern programmed; data coded; checksum appended

NWS Specific Area Message Encoding (SAME) Reception
- NWR SAME AFSK (520.83bps) demodulation
- Selectable raw or formatted output

Function Image™
FI-2.x

4-Level FSK Data Processing (FI-2.x)
- Half-duplex 4-Level FSK modem
- Programmable 4800bps and 9600bps data rates
- Selectable 'raw' and packet data formatting/coding modes
- Soft and Hard decision payload data output
- Selectable automatic preamble and frame-sync insertion
- Selectable automatic frame-sync detection
- Automatic frame handling
- Root Raised Cosine (RRC) filtering
- Rx EYE monitor output for test and alignment

Function Image™
FI-3.x

C4FM Data Processing (FI-3.x)
- Half-duplex 4-Level FSK modem
- Programmable 4800bps and 9600bps data rates
- Selectable 'raw' and packet data formatting/coding modes
- Soft and Hard decision payload data output
- Selectable automatic preamble and frame-sync insertion
- Selectable automatic frame-sync detection
- Automatic frame handling
- Root Raised Cosine (RRC) filtering
- Rx EYE monitor output for test and alignment

Signal Interfacing

Signal Interfacing and Routing

These products offer a very flexible on-chip routing architecture with three selectable signal inputs, and where configured by a Function Image™, two separate, multiplexed signal processing paths.

The output interface offers a selection of two modulator drive outputs selectable to single, two-point and I and Q modulation schemes. A single audio (Rx or Tx voice or tone output) channel is selectable.

To reduce transients when switching to the Tx mode, the MOD output signals can be programmed to 'ramp-up' and 'ramp-down' at a pre-programmed rate.
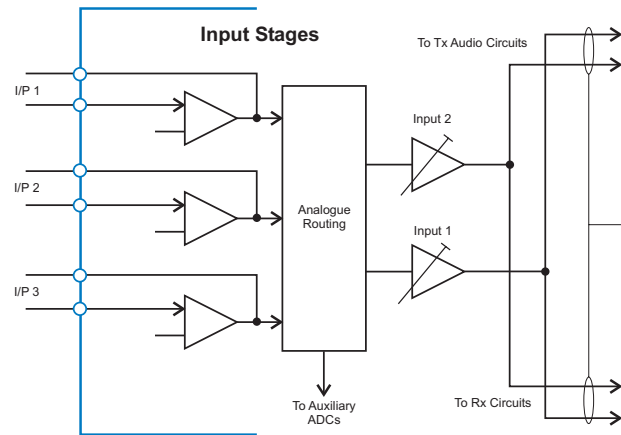
Three possible signal inputs with flexible routing and gain facilities

Input Stages

- Three flexible input stages with component adjustable matching and level
- Individually programmable input amplifiers with coarse and fine level adjustment
- Selectable voice, signalling and data signal multiplexing for concurrent operations

Multiplexed signals for transmission

Selectable Single/Two Point and I and Q Modulation Outputs
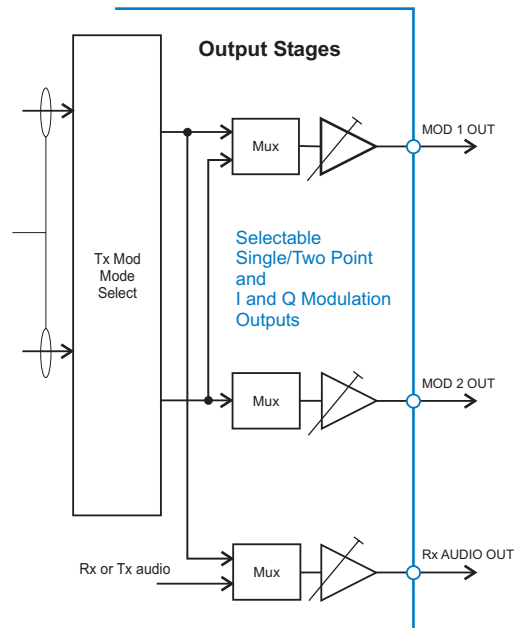
Tx and Rx output stages with flexible routing and gain facilities

Output Stages

- Selectable single, two-point and I and Q modulation outputs with independently programmable level adjustment
- Programmble Tx output ramp-up and ramp-down rates, via AuxDAC 1, reduce spurious outputs
- Output path offset compensation setting
- Individual output signal inversion settings
- Selectable voice, signalling and data signal multiplexing
- Rx and Tx 'audio volume control' and output
- MOD 1 and MOD 2 output levels can be ramped-up under control during Rx to Tx changeover. Ramp-down is available for the reverse function

Input/Output Level Setting Ranges		
Input 1 and 2 Gain	Course	0dB to 22.4dB
	Fine	0dB to -3.5dB
MOD 1 and MOD 2 Attenuation	Course	0dB to >40dB
	Fine	0dB to -3.5dB
Audio Output Attenuation		0dB to >60dB

Auxiliary Functions and Synthesisers
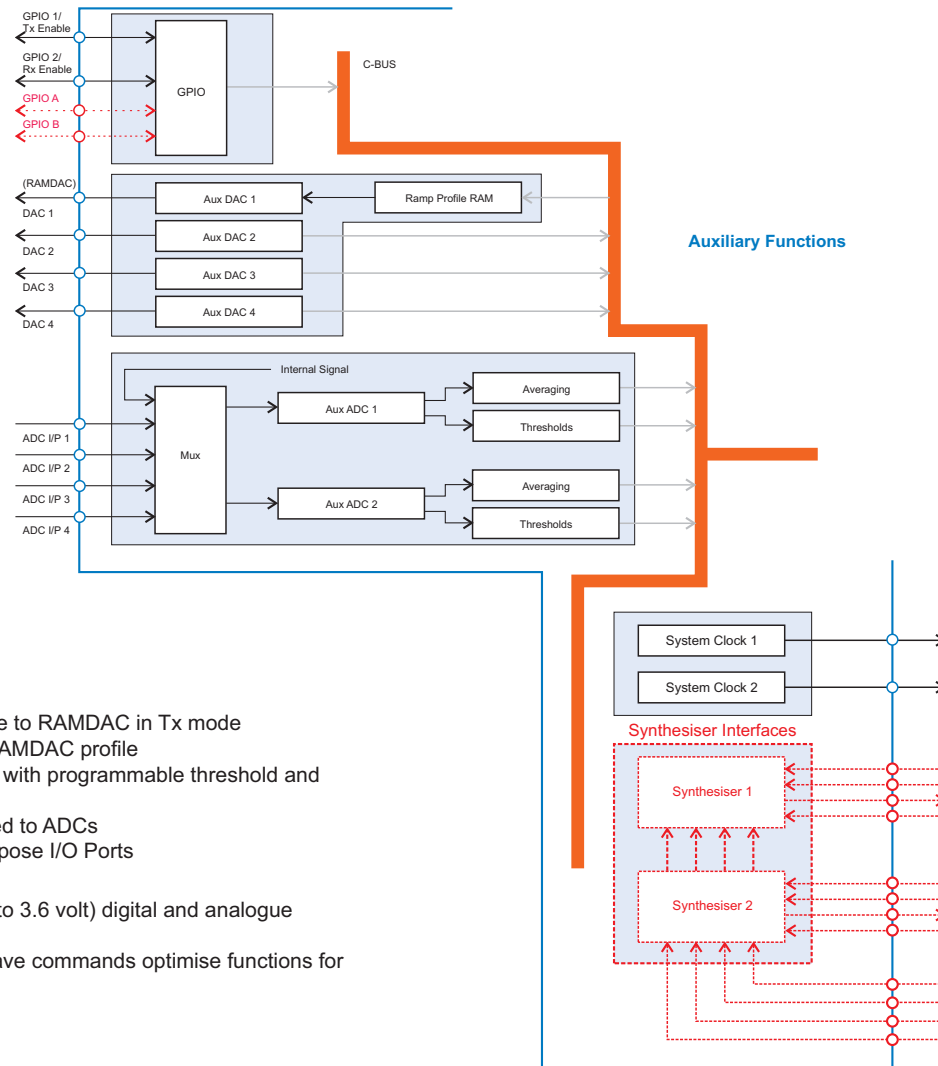
Synthesisers (CMX7031)
- Two 'Integer-N' synthesisers
- Frequency range: 100MHz to 600MHz

C-BUS Interfacing and Control
- Serial interface, command/control, status and data via C-BUS command set
- On-chip 'data' handling reduces host processor overhead

Auxiliary System Clocks
- Two programmable system clocks for external operations

Auxiliary Functions
- 4 Auxiliary DACS
- Channel 1 DAC selectable to RAMDAC in Tx mode
  Pre-set or user-defined RAMDAC profile
- 4-input multiplexed ADCs with programmable threshold and 'average-timing' settings
- Input signals can be routed to ADCs
- Uncommitted general purpose I/O Ports

Power Requirements
- Separate low-power (3.0 to 3.6 volt) digital and analogue supplies
- Flexible dynamic powersave commands optimise functions for power economy

Versatile Power Systems

With a very low-power requirement in a voltage range of 3.0 to 3.6 V, the majority of the on-chip functions of either IC can be separately powersaved under host control. This enables minimum, controlled power consumption at all times.

As half-duplex products, the non-operating mode functions (Rx/Tx) can be powered-down until required. Separate function powersaving is also operationally advantageous, for instance, in allowing the power-up of the required Rx functions prior to the end of a Tx operation.

Function Images™ and System Control

Configuration via the Function Image™

The specific functions of these *FirmASIC®* devices are determined by the uploading of the relevant Function Image™ file during device initialisation.

- Function Image™: a data file for IC function configuration
- Atmel EEPROM and serial Flash memory interface
- Versatile loading methods:
  [1] via C-BUS after power-up
  [2] automatically from an on-board EEPROM
- Requires a maximum of 46kbytes of memory
- Fast turn-around (hot-swop) for Function Image™ changeover
- Available from 'My CML' Technical Portal

Function Image™ Library

Function Image™ File Handling Arrangements
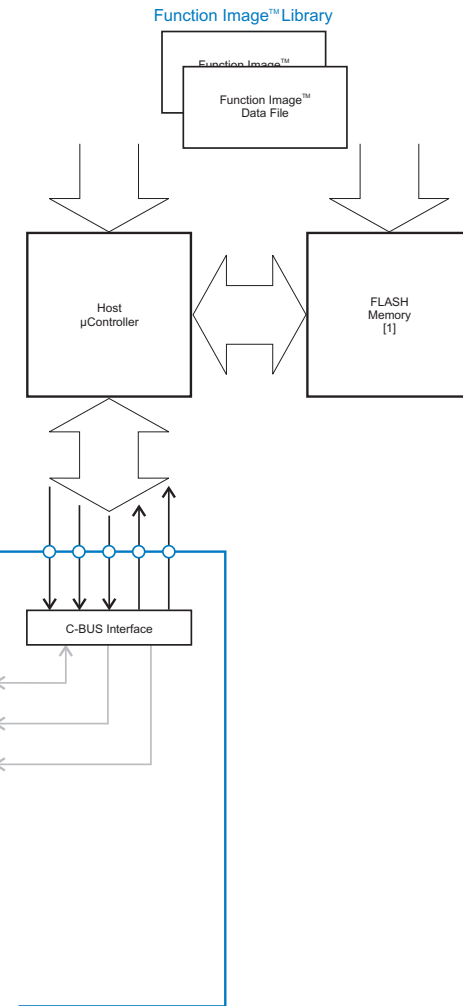
System Configuration and Control via C-BUS

All of the activated on-chip functions are controlled, by the host µC, via the C-BUS serial data interface.

- C-BUS Serial Data Interface

- Compatible with Microwire and SPI type interfaces

- Command, status and data transfers

- Facilitates Function Image™ operations

- Comprehensive on-chip C-BUS instruction set

- On-chip register structure reduces host overhead

- Maskable interrupts

CMX881 and CMX882 Baseband Processors

. . . baseband processors for PMR, Trunked and Leisure radios

Individual IC differences are indicated by outlines as shown:

CMX881 only =
CMX882 only =
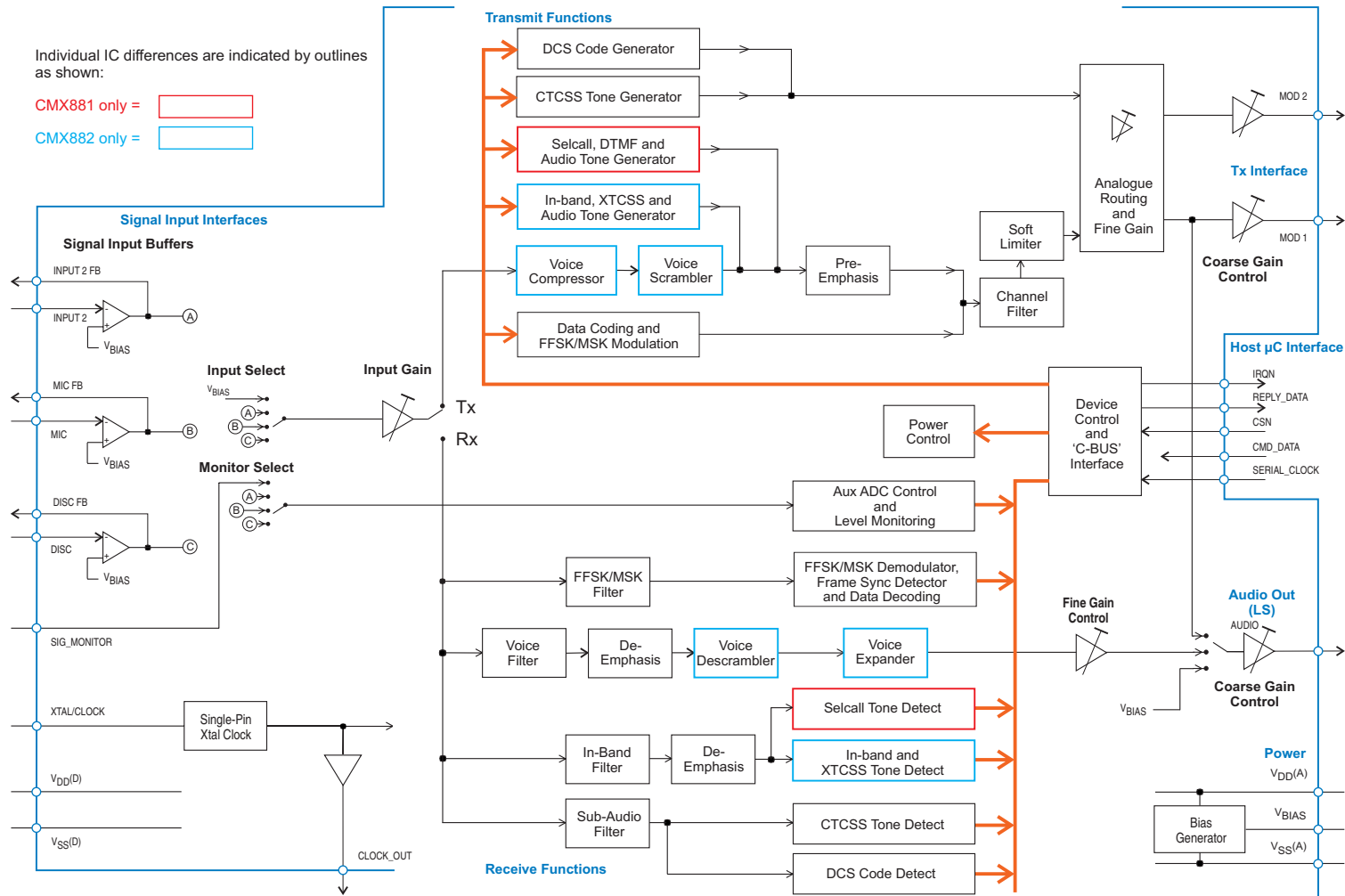
Features

- Automatic Signal Scanning, with IRQ, on Detection of Valid Signals
- Voice Processing Facilities
  - Rx and Tx Path Gain Setting
  - Voiceband and Sub-Audio Filtering
  - Programmable Soft Limiter
- Programmable Signal Detection Thresholds
- Simultaneous Selcall and CTCSS/DCS Decoding
- CTCSS Tone Clone™ Compatibility
- CTCSS and (23/24-bit) DCS Codecs
- DTMF Transmitter
- Tone Generation for Caller-Recognition Tunes
- Programmable Selcall Codec
- 1200/2400 bps MSK/FFSK Freeformat Modem with Rx Sync. Detect
- XTCSS Channel and Data Signalling (see page 7)
- Robust Automatic Packet-Data Protocol with: Error Correction and Detection, Interleaving and Data Scrambling/Privacy
- Auxiliary ADC Available to Monitor Inputs
- C-BUS Serial Interface
- Tx Interface for Single or Two-Point Modulation
- Meets ETS 300 086, MPT1327, PAA1382 and ETS 300 230 specs
- Supply Requirement Range: 2.7 to 5.5 V

CMX881 and CMX882

Two full-function half-duplex audio and signalling processor ICs for either PMR (CMX881) or FRS and PMR446 (CMX882) type facilities suitable for both complex and simple end-designs. Under the control of the host µC, all voiceband requirements, as relevant, are catered for. These include, voiceband and sub-audio filtering, pre/de-emphasis, compression/expansion and audio routing and global level setting with single or two-point modulation functions in the transmit path.

Additionally, on the CMX882, CTCSS and In-band tone functions are integrated with the new XTCSS (page 7) code implementation. XTCSS provides additional and improved squelch-centred privacy codes with the added advantage of 'silent operation'; no annoying interference from other sub-audio users. XTCSS fitted radios enjoy more privacy and flexibility of operation.

Both ICs offer FFSK/MSK 1200/2400 bps freeformat data functions, while the CMX882 provides an advanced 1200/2400 bps free-format and packet data FFSK/MSK modem for text messaging/paging, GPS location data transport (compatible with NMEA 0183) and other data applications.

With ultra low power requirements and graduated powersave, this product only requires a smaller, lower power µC than many existing FRS/PMR446 solutions.

Package Styles	-40º to +85ºC
CMX881D6	28-pin SSOP
CMX881E1	28-pin TSSOP
CMX882D6	28-pin SSOP
CMX882E1	28-pin TSSOP

CMX838 FRS/PMR446/GMRS 'Family Radio' Processor

. . . FRS, PMR 446 and GMRS 'Family Radio' Processor
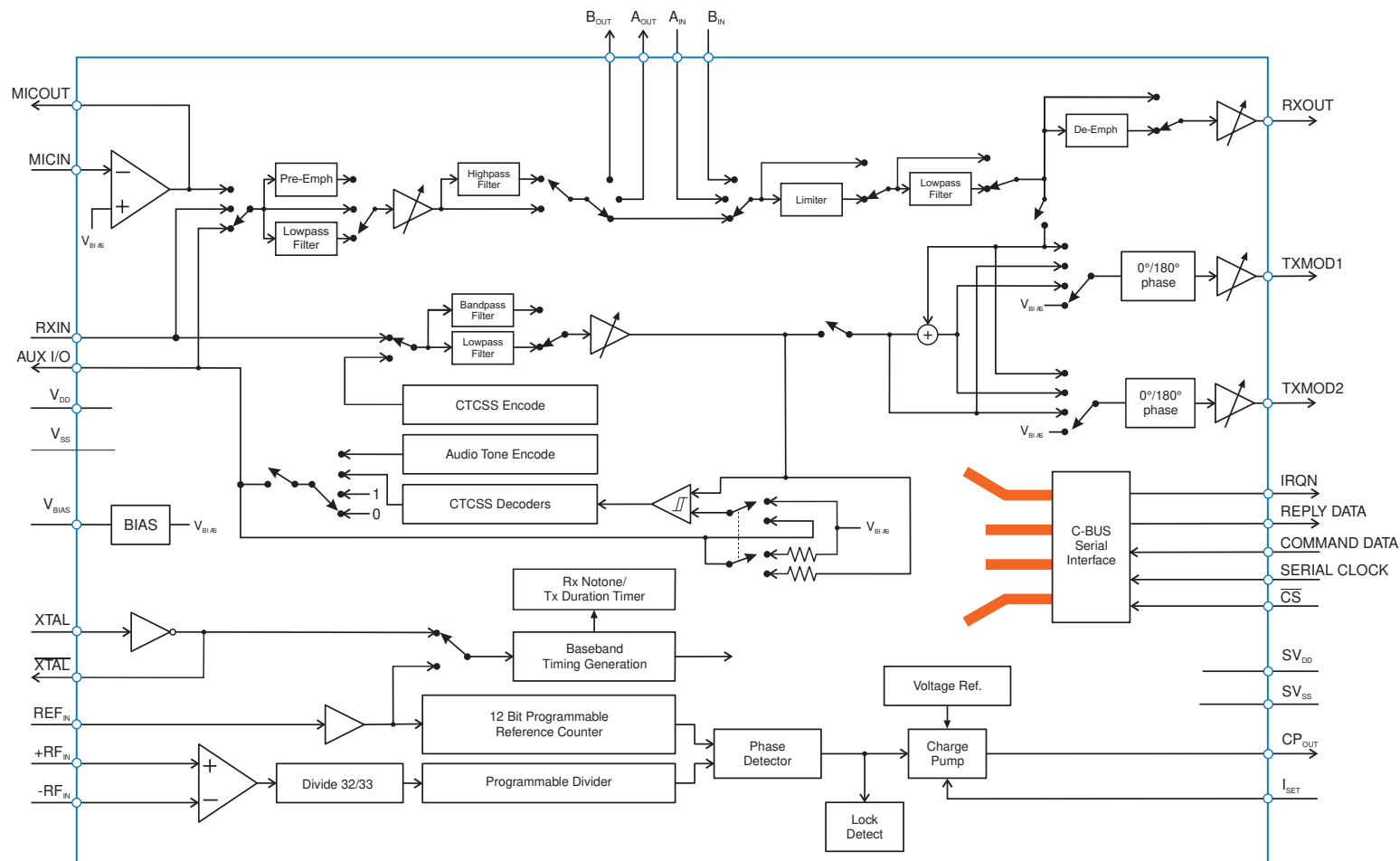
Features

- Advanced 'Any-One-of-Any' 50-Tone CTCSS Processor
  - Fast Decode Time
  - IRQ on Any/All Valid Tones
  - Fast Scan
  - Group Calling
  - Auto-Response Tone Select
  - Tone Cloning™
- RF Synthesiser
  - FRS, PMR and GMRS RF Channels
  - Configurable Charge-Pump
- Audio Call-Tone Generator
- Audio Processing
  - Mic. Amplifier
  - Pre/De-Emphasis
  - Limiter
  - Post Limiter Filtering
  - Mic., Rx and Tx Digital Gain
  - Single and Dual Tx Outputs
- C-BUS Serial Control Interface
- Signal Source and External Function Selection
- Supply Requirement Range: 2.7 to 5.5 V

CMX838

The highly integrated CMX838 Family Radio Processor includes sub-audio, audio, and synthesiser functions to serve as the core engine for low cost, high performance FRS, PMR446 and GMRS radio designs. Its flexibility supports both simple and advanced multi-channel radios without cost penalties.

Integrated Tx voltage reference and baseband clock generation circuits eliminate the need for external components. The CMX838's features directly support advanced end-product functions such as: group calling, scanning, automatic scanner response, tone setup, and 'Tone Cloning™'. By using the CMX838 one global radio design can support multiple standards and markets. Controlled via a C-BUS serial interface this Family Radio Processor operates from a low-power supply in the range 2.7 to 5 V.

Package Styles	-40º to +85ºC
CMX838D1	28-pin SOIC
CMX838E1	28-pin TSSOP

CMX808A CTCSS 'Type 2' Encoder/Decoder

. . . individual-code CTCSS programming for FRS and PMR 446
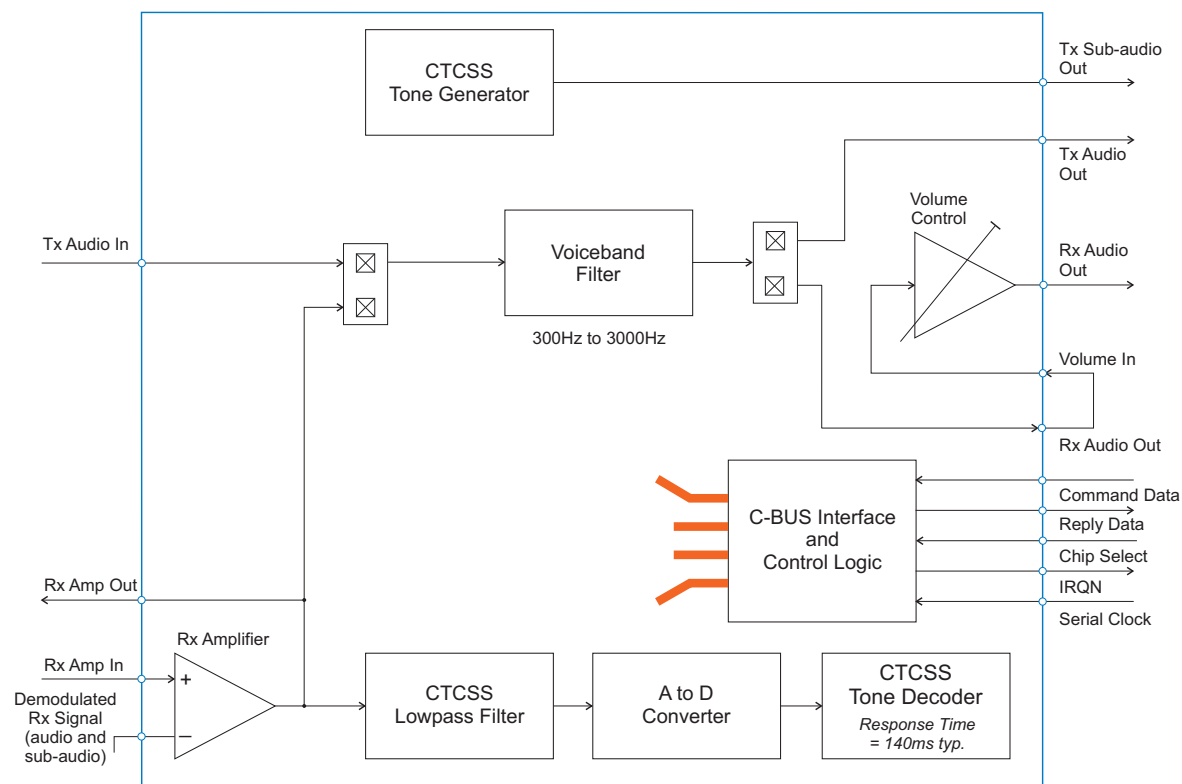
Features

- Full CTCSS 'Type 2' Compatibility
- Up to 7 Tones in 'Active Receive'
- Single Tone Encode; Multi-tone (7) Decode with Selectable Rx Bandwidth
- 48 Programmable Tones Available (62.5Hz to 251Hz)
- Fast (140ms) Tone Decode
- Tone-set Cloning (Tone Clone™) Capability
- Voiceband Filtering Function Switchable to Rx and Tx Paths
- Low Power Operation with Powersave
- Supply Requirement Range: 3.0 to 5.5 V

Block diagram labels:

- CTCSS Tone Generator
- Tx Sub-audio Out
- Tx Audio In
- Voiceband Filter
- 300Hz to 3000Hz
- Tx Audio Out
- Volume Control
- Rx Audio Out
- Volume In
- Rx Audio Out
- C-BUS Interface and Control Logic
- Command Data
- Reply Data
- Chip Select
- IRQN
- Serial Clock
- Rx Amp Out
- Rx Amplifier
- Rx Amp In
- Demodulated Rx Signal (audio and sub-audio)
- CTCSS Lowpass Filter
- A to D Converter
- CTCSS Tone Decoder
- *Response Time = 140ms typ.*

CMX808A

This device is a unique product for the designer of family radio transceivers. A full range of 48 sub-audio tones can be generated and detected by the device. The decode time is vastly superior to that offered by other solutions. Fast response and de-response times give the user of a Family Radio transceiver faster switching times and a reduction in the annoying squelch tail interference often found in CTCSS based systems.

A unique feature of the device is its ability to look for 7 different CTCSS codes simultaneously.
This allows FRS designers to offer equipment which can look for personal, family or open channel codes at the same time.
For example: *A soccer team coach can call each of the 11 players individually or the team as a group.* Codes can be used as Paging codes, open chat mode codes as well as personal and family codes.

The device is simple to interface to the host of µController via the C-BUS serial programming interface.

These features allow FRS designers to differentiate their products from that of the competition and, in unique ways, to gain market share in this highly competitive market.

Package Styles	-40º to +85ºC
CMX808AE3	20-pin TSSOP
CMX808AP4	24-pin PDIP

Other Recent CML Two-Way Radio IC Products

CMX981 Advanced Digital Radio Baseband Processor: a combination codec/processor that interfaces analogue and digital sections of a digital radio system and performs the majority of the critical DSP-intensive functions of either portable, mobile or base systems. Evaluation kit available.

CMX649 Adaptive Delta Modulation (ADM) Codec: a full-duplex ADM, A-law, µ-law and linear PCM codec and transcoder for low power voice applications. Demonstration kit available.

CMX998 Cartesian Feed-Back Loop (CFBL) Transmitter: Transmitter linearisation for high-speed data systems.

Visit the CML website for a detailed and comprehensive overview of CML's wireless and wireline voice, signalling and data products.

www.cmlmicro.com

Product Evaluation, Demonstration and Support

PE0401

PE0201

PE0001

EV8810

- PC Windows-based universal GUI to enable efficient evaluation of the product
- RS232 connection to and from a PC
- PE0001: Evaluation kit interface card translates commands to the IC's C-BUS serial bus
- PE0201: CMX7031 evaluation kit
- PE0401: CMX7041 evaluation kit
- EV8810: CMX881 and CMX882 evaluation kit

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Design Resources

Design and application support available:

- CML website: www.cmlmicro.com/
- Technical datasheets and user manuals
- MyCML technical support portal
- Function Image™ downloads
- Application notes
- Frequently Asked Questions
- Application information via local support desks
- NOAA National Weather Service: www.nws.noaa.gov/nwr/

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