PP/983/9 May 2016

CMX983
Analogue Front End (AFE) for Digital Radio
Including Two Fractional-N Synthesisers

Introduction

High performance digital radio systems are migrating towards the Software Defined Radio model, where a common hardware platform can be used across a number of radio systems. System-specific operation and functions are fully software based within the DSP/microcontroller.

The world of the DSP and the microcontroller is a digital one, yet the real world, including RF, is analogue. Therefore, the important functions sitting in front of the DSP are the analogue to digital converters and other auxiliary functions allowing the analogue world to interact with the digital one.

The CMX983 AFE for Digital Radio bridges this gap between the DSP a digital radio's RF section. Being flexible and high performance, this device can form the basis of a digital radio platform. It provides direct connection to and support of the RF section along with a host of auxiliary functions, effectively reducing the overall system size, cost and power consumption.

Applications

- Software Defined Radio (SDR)
- Satellite Communication
- Wireless Data Terminals
- Digital PMR/LMR Radio
- TETRA, DMR, APCO P-25, PDT

CMX983 Brief Description

The CMX983 is an Analogue Front End (AFE) IC that bridges the gap between a digital radio's RF section and DSP/FPGA.

Specifically designed to meet the needs of a Software Defined Radio (SDR), the CMX983 performs critical DSP-intensive functions, provides dual channel analogue to digital and digital to analogue conversion , includes two RF fractional-N synthesisers, and embeds a host of auxiliary ADCs and DACs for use within the radio system.

Suitable for radio systems employing modulation bandwidths up to 50kHz in wideband mode and up to 25kHz in narrowband mode.

The CMX983 is highly configurable, supporting numerous sample rates and filtering characteristics. This configurability enables a high level of functionality, integration and connectivity with RF building block ICs. The CMX983 connects seamlessly with CML's CMX994 Direct Conversion Receiver and the CMX998 Cartesian Feedback Loop Transmitter, to provide a complete small form factor, RF-to-digitised baseband solution.

The device is widely used in high performance wireless data systems including: military and satellite communication, professional two-way radio and wireless telemetry applications.

Features

- Rx channel
  Two 16-bit Σ-Δ A/D Converters
  Programmable Channel Filter
- Tx Channel
  Two 14-bit Σ-Δ D/A Converters
  Programmable Channel Filter
- RF Support
  Two 2.1GHz Fractional-N Synths
- Auxiliary Functions
  10-bit A/D Converter (8 inputs)
  Five Analogue Comparators
  Nine 10-bit D/A Converters
- Duplex and Half Duplex operation
- Fast Serial Interface
  DSP Interface for Rx/Tx Data
  C-BUS Control and Configuration Port
- Low power 1.8V/3.3V supply
- 3V-5.25V Charge Pump supply
- Small 64-lead VQFN Package
- Supports Direct Connection to:
  CMX998 Cartesian Loop Transmitter
  CMX994 Direct Conversion Receiver
  CMX972 Quadrature Demodulator with IF PLL VCO
  CMX973 Quadrature Modulator/Demodulator

Small 64-lead VQFN Package
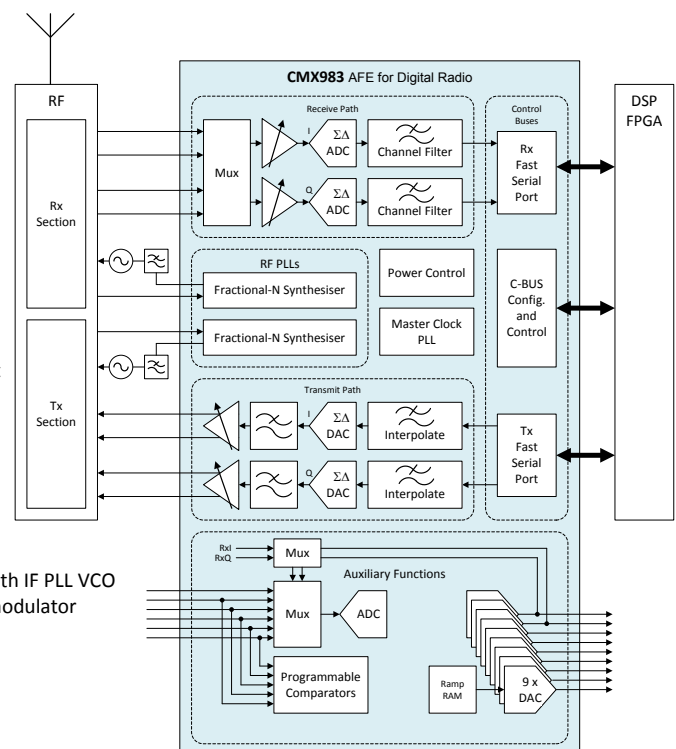
Key Feature Descriptions

- **Main Signal Paths to and from RF Section**
  - Programmable analogue gain to optimise dynamic range
  - Wideband (50kHz) and narrowband (25kHz) operating modes
  - Fully differential matched I/Q high dynamic range receive ADCs
    - User programmable digital channel filtering
    - Facility to trim ADC phase
  - Matched I/Q high dynamic range transmit DACs
    - User programmable interpolation filters
    - Transmit outputs support gain programmability
    - Differential outputs

- **Auxiliary Converters**
  - 10-bit low power SAR ADC with 8 inputs
    - Interrupt generating programmable thresholds
    - Single shot or continuous conversion modes
    - Five channels of programmable low power analogue comparators
  - Nine 10-bit DACs, one with ramp RAM for PA power control

- **Frequency Generation Circuits**
  - Two 2.1GHz Fractional N phase locked loops
  - Integrated PLL generates all system clocks from the master clock input
  - Low phase noise/low jitter design
  - 24-bit fractional divider
  - Fast lock mechanism
  - Indication of lock detection
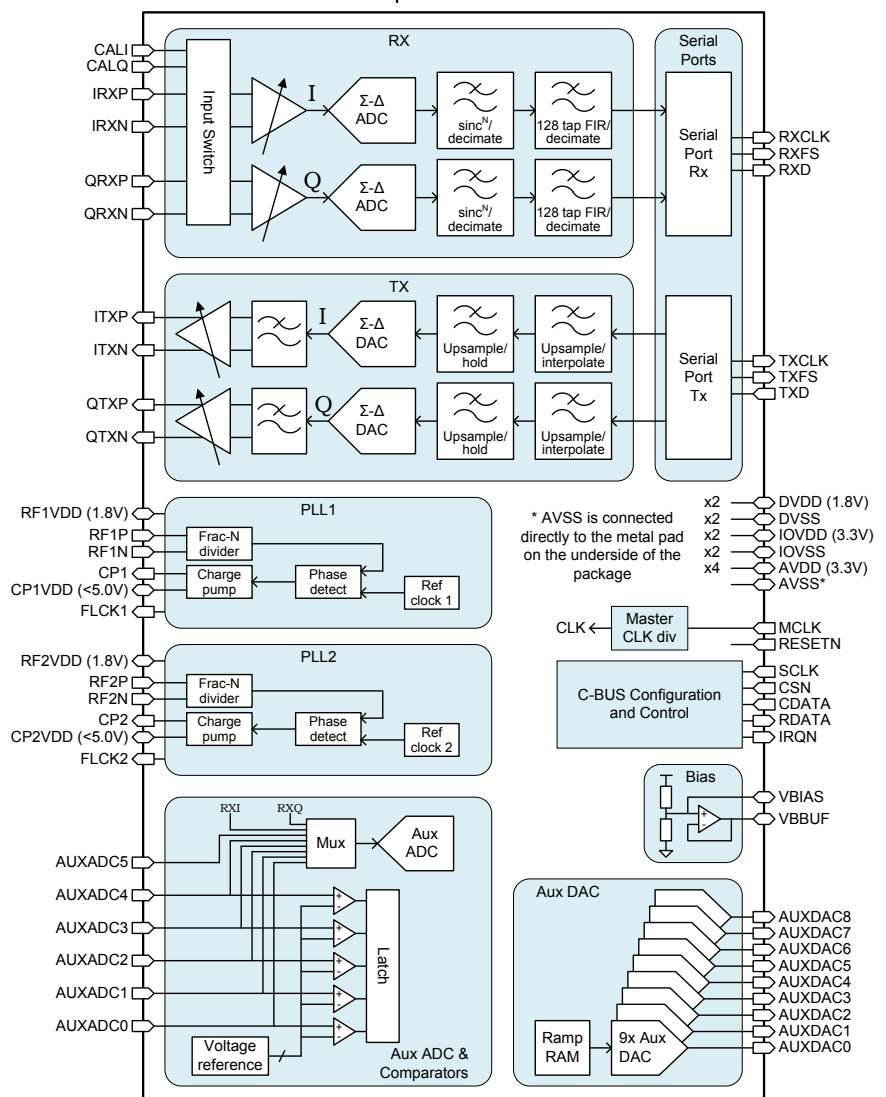 - 4.75V capable charge pump drive

- **Serial Interfaces**
  - Separate RX/TX data and control interfaces
  - PCM ports for RF data
  - C-BUS for device control

- **Power Management**
  - Power control for individual blocks

- **Small 64 VQFN package**

System Overview

The CMX983 provides a versatile interface to support a variety of transceiver architectures. The flexible nature of the main signal ADCs and DACs makes the device suitable for a wide range of wideband and narrowband radio systems, supporting modulation bandwidths from 6kHz up to 50kHz.

Integrated auxiliary functions reduce PCB area with an ADC handling measurement of PA power and temperature, RSSI, battery and other parameters whilst controlling trimming of TCXOs and other functions via low power DACs.

When coupled with other CML RF devices a highly integrated radio solution is possible, capable of supporting linear and constant envelope modulations.

All devices are compatible with a 3.3V digital I/O and are supported by a common C-BUS serial control channel simplifying radio design.
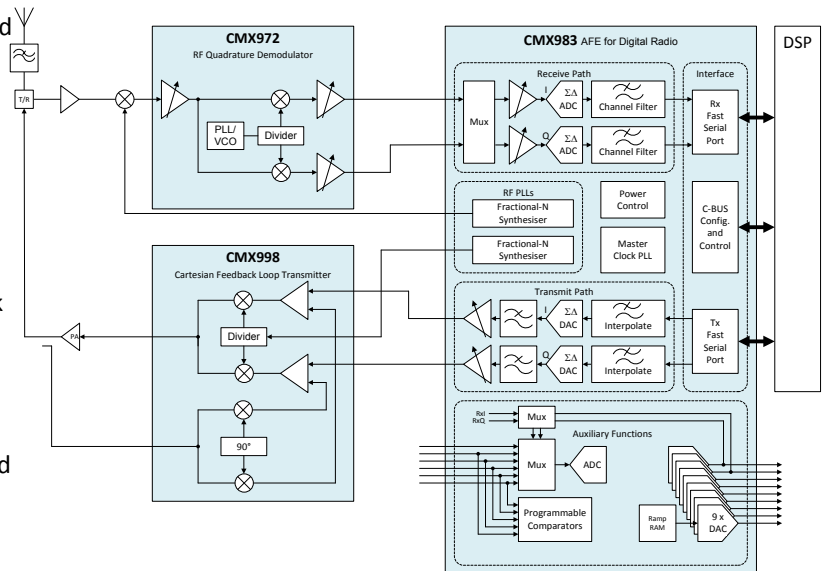
The diagrams show three typical device combinations:

1. Direct conversion receiver with Cartesian feedback transmitter

2. I/Q superhet receiver with Cartesian feedback transmitter
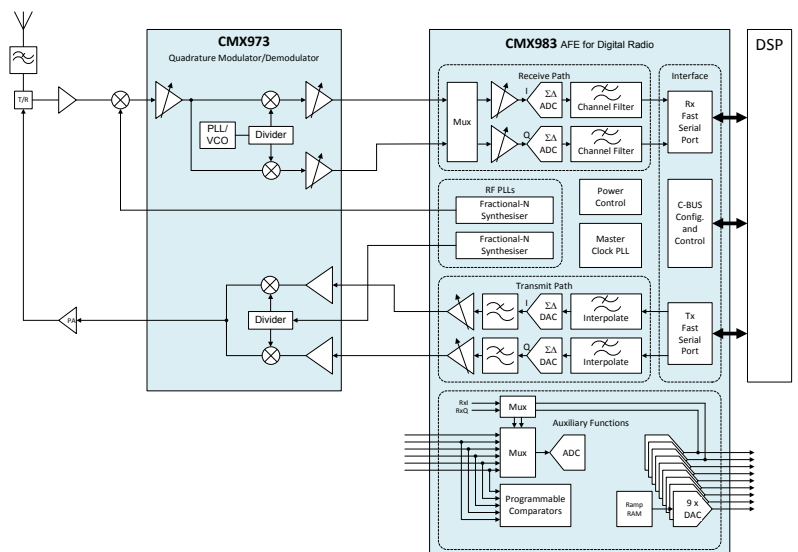
3. I/Q superhet receiver with direct modulator

The CMX983 is also suitable for use with conventional Limiter Discriminator (LD) receivers and two point VCO modulation transmitters.
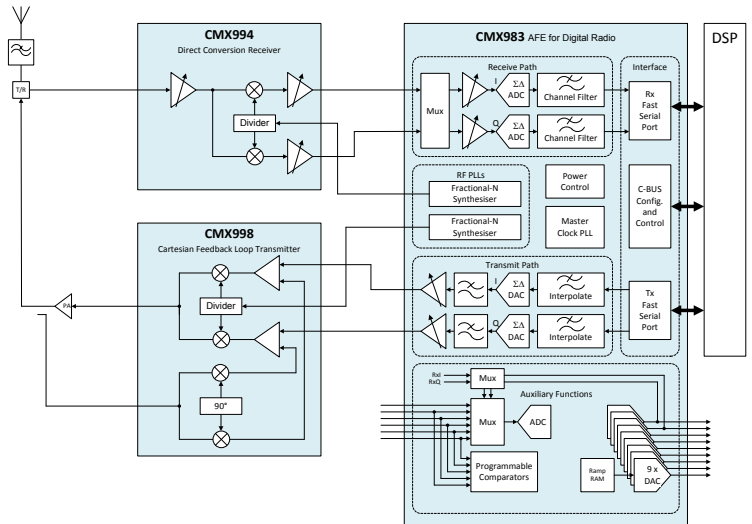
1. Direct conversion receiver with Cartesian feedback transmitter

2. I/Q superhet receiver with Cartesian feedback transmitter

3. I/Q superhet receiver with direct modulator

CMX983 Electrical Specification Summary

Operating Limits	Min	Typ	Max	Unit
Supply Voltage:				
$IOV_{DD} - IOV_{SS}$	3.0	3.3	3.6	V
$DV_{DD} - DV_{SS}$	1.7	1.8	1.9	V
$AV_{DD} - AV_{SS}$	3.0	3.3	3.6	V
CP1/CP2 $V_{DD} - AV_{SS}$	3.0	5.0	5.25	V
RF1/RF2 $V_{DD} - AV_{SS}$	1.7	1.8	1.9	V
Operating Temperature	-40	-	+85	°C
Internal Clock Frequency	5.0	-	50	MHz
Master Clock Frequency	5.0	-	30	MHz

Receive Chain	Min	Typ	Max	Unit
SINAD		88		dB
Differential input signal range		4		V_{pk-pk}
Gain control range (1dB steps)	-12		+12	dB

Transmit Chain	Min	Typ	Max	Unit
SINAD		76		dB
Gain control range (0.5dB steps)	-11.0		+11.0	dB

Fractional-N Synthesisers	Min	Typ	Max	Unit
Frequency range	100		2100	MHz
Fast lock time		1.675		ms
RF input sensitivity	50		500	mV pk-pk
RF slew rate	150			V/µs

Auxiliary Converters	Min	Typ	Max	Unit
ADC resolution		10		bits
INL			+/- 2	LSB
DNL			+/- 1	LSB
DAC resolution		10		bits
INL			+/- 4	LSB
DNL			+/- 1	LSB
Settling time			10	µs

Evaluation Support

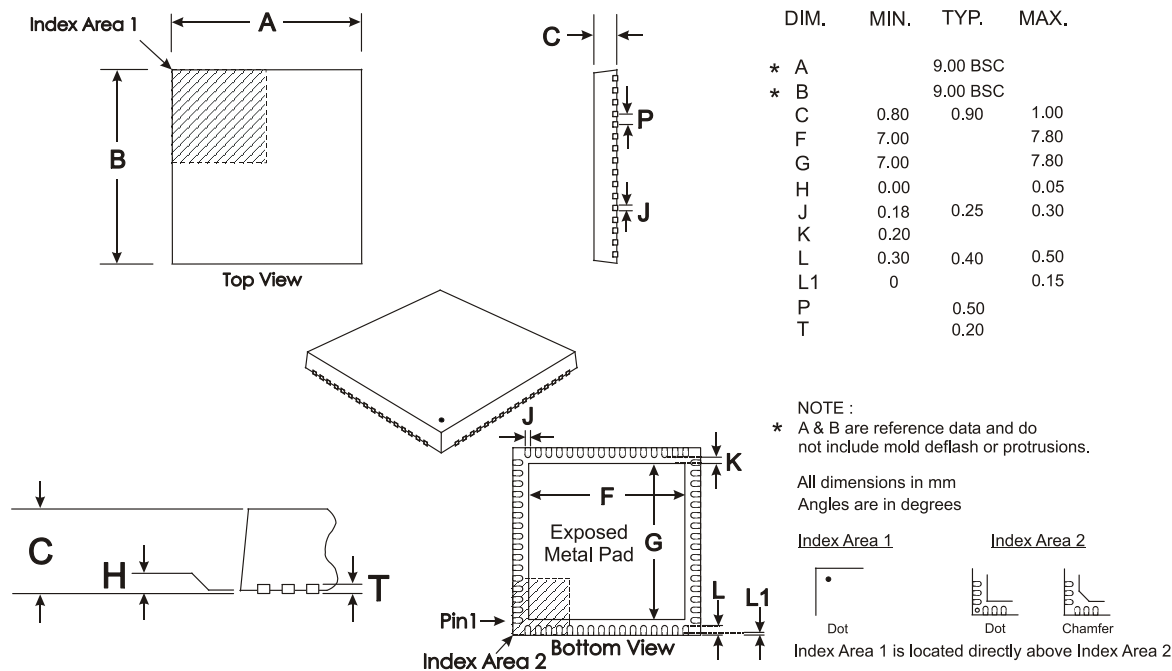The EV9830 Evaluation Kit enables a fast and efficient evaluation of the CMX983 AFE for Digital Radio.

The board is fitted with easy access point and can be controlled via the PE0002 Universal Interface card or a user's own microcontroller/DSP

CMX983 Package

DIM.	MIN.	TYP.	MAX.
* A		9.00 BSC	
* B		9.00 BSC	
C	0.80	0.90	1.00
F	7.00		7.80
G	7.00		7.80
H	0.00		0.05
J	0.18	0.25	0.30
K	0.20		
L	0.30	0.40	0.50
L1	0		0.15
P		0.50	
T		0.20	

Index Area 1

A

C

B

P

J

Top View

NOTE :
* A & B are reference data and do not include mold deflash or protrusions.

All dimensions in mm
Angles are in degrees

Index Area 1   Index Area 2

Dot   Dot   Chamfer

Index Area 1 is located directly above Index Area 2

J

K

F

Exposed
Metal Pad   G

C   H   T

Pin1

Index Area 2   Bottom View

L   L1

64 VQFN Mechanical Outline (Q1)
Order as part no. **CMX983Q1**

For further information visit www.cmlmicro.com or search for: CMX983

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