CML Microcircuits
COMMUNICATION SEMICONDUCTORS

Product Preview

PP/71317141/4 March 2014

CMX7131/CMX7141

FDMA Digital/Analogue PMR Processors

Multi-standard Digital and Conventional Analogue PMR Systems Supported

NXDN™ · dPMR™ · dPMR446 · ARIB STD-T98 · ARIB STD-T102 · Analogue

Small VQFN /LQFP Packages

Introduction

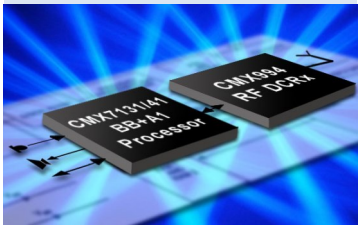
Conventional analogue PMR is gradually going digital. The word 'Digital' is seen in the market place as meaning advanced and better than analogue, which is questionable, however digital does present a number of advantages for the user, operator and in the area of spectrum management.

Data capability is a major benefit to the end user, opening up completely new application areas more synonymous with the mobile phone market, such as texting and gaming. Operators benefit by potentially doubling their user capability and therefore revenue chain, with the same channel allocation. Spectrally, digital PMR is at least twice as efficient as analogue, offering 6.25kHz channel bandwidth per communication, as opposed to 12.5kHz or even 25kHz in the legacy analogue systems.

There is a clear requirement for multi-mode digital radios with analogue backward compatibility to be developed. This simplifies the introduction of new digital radios into a predominantly analogue market place by providing users with digital benefits such as data capability on digital systems and for legacy analogue systems, full backward compatibility.

The multi-mode (analogue/digital) radio approach has benefits for the radio manufacturer: a single radio platform design capable of supplying both analogue and digital PMR market needs.

Two distinct methodologies exist to enable the narrowband PMR market to go digital: Time Division Multiple Access (TDMA) and Frequency Division Multiple Access (FDMA). The CMX7131/7141 focus on the FDMA route as FDMA is generally considered to have cost benefits over the more complex TDMA route.



Brief Description

The CMX7131/CMX7141 digital PMR processors are ideally placed to meet the specific requirements of both new and emerging FDMA digital PMR radio systems and dual-mode digital/analogue two-way radio platforms.

The CMX7131/CMX7141 are enablers for the radio platform concept, allowing a single radio platform to encompass multiple digital PMR standards all with backward compatibility to conventional analogue PMR.

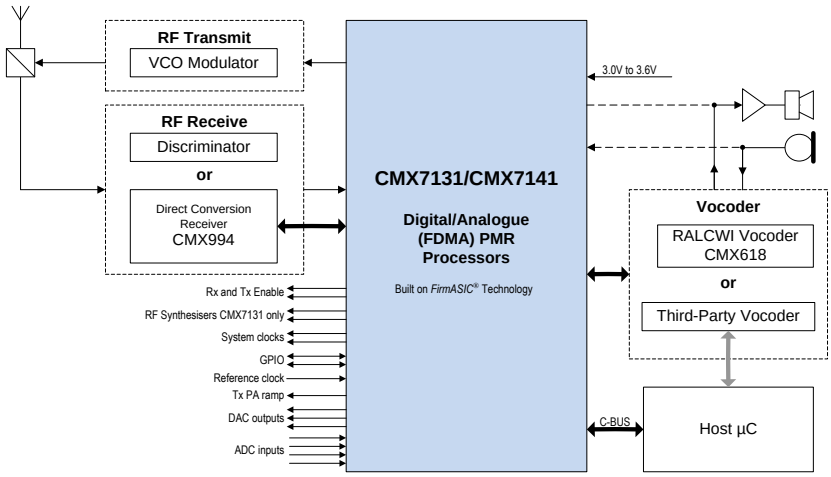
The Ultimate FDMA Digital Radio Chipset

The combination of the CMX7131/7141 and CMX994 enables the highest integration, multi-standard FDMA digital/analogue PMR radio, to be realised. The CMX7131/7141 and CMX994 together address the market requirements for: Low power operation, small size, low cost, flexibility and high performance.

Built on CML's proprietary *FirmASIC*® technology, the CMX7131/CMX7141 encompass the elements required for the implementation of a digital radio's air interface physical and data link layers. Third-party Vocoders are supported and in the case of CML's RALCWI vocoder, this can be completely managed and controlled by the CMX7131/CMX7141 enabling a small, low-power host microcontroller to be used for overall radio operation.

Systems Supported via Function Image™

Function Image	System	Standard	Direct Connection to CMX994 DCRx
7131/7141FI-1.x	dPMR446 (Mode 1/2)	TS 102 490	-
7131/7141FI-2.x	Digital Convenience Radio (DCR)	ARIB STD-T98	Yes
7131/7141FI-3.x	NXDN (Air Interface)	NXDN-TS 1/2	Yes
7131/7141FI-5.x	dPMR (Mode 1/2) Analogue PMR (Audio + Sub Audio Signalling)	TS 102 490 EN 300 086/TIA 603	-
7131/7141FI-6.x	ARIB STD-T102 (Part 2)	ARIB STD-T102	Yes
7131/7141FI-7.x	dPMR (Mode 1/2/3)	TS 102 658	Yes
7131/7141FI-8.x	Analogue PMR (Multi-function)	EN 300 086/TIA 603	Yes
7031/7041FI-1.x	Multi-function Analogue PMR (Operation as defined in the CMX7031/7041 Datasheet)	EN 300 086/TIA 603	-



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Vocoder management and control

The CMX7131/CMX7141 can completely manage and control an external vocoder function providing the most efficient data routing through the digital PMR/LMR Air Interfaced Layers, keeping the overall system power consumption to an absolute minimum. The vocoder connectivity by default is designed to work with CML's low bit rate RALCWI vocoder IC CMX618.

The CMX7131/CMX7141 can also be configured to work with third-party Vocoders such as the AMBE2020 and AMBE3000 ICs (AMBE2020 and AMBE3000 are trademarks of Digital Voice Systems, Inc).

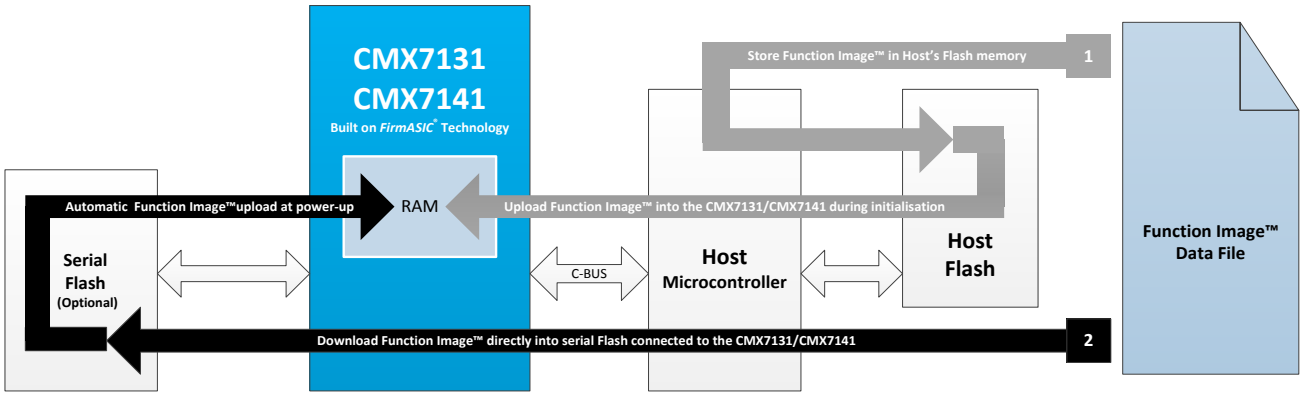
Function Image™ is the key to flexibility

The Function Image™ concept is the key to a multi-mode radio platform. A Function Image™ is a small data file that is uploaded to the CMX7141 during power-up. The Function Image™ configures on-chip sub-systems to provide the operation and functionality for a specific application.

Two methods of uploading the Function Image™ into the CMX7141 are available, as depicted below.

Method 1 - The Function Image™ is loaded into and retained within the host's Flash memory.
During CMX7131/CMX7141 initialisation, the Function Image™ is uploaded into the device via the host and C-BUS.

Method 2 - The Function Image™ is loaded directly into the optional serial Flash attached to the CMX7131/CMX7141. The Function Image™ is then automatically uploaded into the CMX7131/CMX7141 during power-up, without host intervention.



Software Defined Radio (SDR)

The CMX7131/CMX7141 multi-mode digital PMR processors are perfectly positioned to fulfil the needs of an SDR platform. A single radio hardware design can to be reconfigured to meet the needs of a conventional analogue two-way radio, currently defined digital PMR/LMR systems and adapt to meet the requirements of the emerging digital specifications.

The combination of the CMX7131/7141 Multi-mode FDMA Digital/Analogue PMR Processor and CMX994 Direct Conversion Receiver enables the highest integration, multi-standard digital/analogue PMR radio, to be realised.

This is all achievable due to the flexibility of the Function Image™ concept. Uploading a different CMX7131/CMX7141 Function Image™ completely changes the device's operation and function. Function images are available to support both analogue and digital PMR/LMR systems with an evolving roadmap to support new emerging digital PMR/LMR systems. Please visit the CMX7131/CMX7141 on the CML website for the latest information. If you are interested in more information concerning support for a digital PMR/LMR system mentioned, please contact your local CML representative.

Maximum Support

CML is keen to work with radio manufacturers to support new/emerging digital PMR/LMR systems with the development of a specific Function Image™. Standard, semi-custom and full custom Function Image™ possibilities exist.

Further details concerning the availability of function images for the CMX7131/CMX7141 can be found at the 'Technical Portal' on CML's website www.cmlmicro.com. If you would like to discuss your specific digital PMR/LMR requirements in more detail, please contact your local CML representative or use the CML 'Ask a Question' .

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Function Image Library

Common to all function images and operating modes for the CMX7131/CMX7141

- Low power 3V – 3.6V operation
- Small footprint LQFP and VQFN packaging
- Auxiliary ADCs (4 mux inputs)
- Auxiliary DACs (4 outputs)
- Two auxiliary system clock outputs
- Optional serial Flash memory
- Progressive powersave operating modes
- Two RF synthesisers (CMX7131 only)

Function Images with RF support for:
Rx - Limiter-discriminator (LD)
Tx - Two-point modulation or I/Q

7131/7141FI-1.x - dPMR446 conforming to TS 102 490
- Air Interface Physical Layer (layer 1)
- Air Interface Data Link Layer (layer 2)
- 4FSK Modem
- Soft decision decoding
- Automatic Frame Sync Detection (AFSD)
- Vocoder connectivity
- Management and control
- Data transport

7131/7141FI-5.x - dPMR446 (TS 102 490) + Analogue PMR
- Digital PMR
  - Air Interface Physical Layer (layer 1)
  - Air Interface Data Link Layer (layer 2)
  - 4FSK Modem
  - Soft decision decoding
  - Automatic Frame Sync Detection (AFSD)
  - Vocoder connectivity
- Analogue PMR
  - 300Hz HPF
  - 12.5/25 kHz channel filter
  - Pre-emphasis, De-emphasis, Limiter
  - Selectable Compander and Scrambler
  - CTCSS and DCS

7031/7041FI-1.x - Analogue two-way radio
(Emulation of the CMX7031/CMX7041)
- Concurrent audio, signalling and data operations
- Complete audio processing including scrambler option
- Sub-audio signalling – CTCSS, DCS and XTCSS
- Audio-band signalling – Selcall, DTMF
- FFSK/MSK data modem with packet and free-format modes
- Marine VHF operations – DSC, NOAA WAT and SAME
- Three analogue signal inputs
- Single and two-point modulation drivers

Function Images with RF support for:
Rx - Limiter-discriminator (LD) or
CMX994 Direct Conversion Receiver
Tx - Two-point modulation or I/Q

7131/7141FI-2.x - DCR ARIB STD-T98 compliant
- Air Interface Physical Layer (layer 1)
- Air Interface Data Link Layer (layer 2)
- 4FSK Modem
- Soft decision decoding
- Automatic Frame Sync Detection (AFSD)
- Vocoder connectivity
- Management and control
- Data transport to RALCWI and AMBE300
- Direct connection to CMX994 DCRx

7131/7141FI-3.x - NXDN-TS 1/2 compliant
- Air Interface Physical Layer (layer 1)
- Air Interface Data Link Layer (layer 2)
- 4FSK advanced data modem
- Raw mode data pump
- 4.8 and 9.6 kbps data rates
- Frame synchronised data output
- Soft decision data output
- Automatic Frame Sync Detection (AFSD)
- Vocoder connectivity—AMBE3000
- Direct connection to CMX994 DCRx

7131/7141FI-6.x - ARIB STD-T102 (part 2) compliant
- Air Interface Physical Layer (layer 1)
- Air Interface Data Link Layer (layer 2)
- 4FSK Modem
- Soft decision decoding
- Automatic Frame Sync Detection (AFSD)
- Vocoder connectivity
- Management and control
- Data transport to RALCWI and AMBE3000
- Direct connection to CMX994 DCRx

7131/7141FI-7.x - dPMR mode 1/2/3 TS 102 658 compliant
- Air Interface Physical Layer (layer 1)
- Air Interface Data Link Layer (layer 2)
- Voice and data supported in mode 1, 2 and 3 operation
- 4FSK Modem
- Soft decision decoding
- Automatic Frame Sync Detection (AFSD)
- Tx sequencer
- Management and control
- Supports similar functionality to I^2S mode
- Vocoder connectivity—RALCWI, TWELP, AMBE3000
- Direct connection to CMX994 DCRx

7131/7141FI-8.x - Analogue PMR (I/Q operation)
- Voice processing conforming to: EN 300 086 / TIA 603
- Voice compander
- 1200bps FFSK modem (MPT1327 compatible)
- Selcall encoder/decoder
- CTCSS / DCS encoder/decoder
- Audio tone generator
- Frequency inversion voice scrambler
- Direct connection to CMX994 DCRx

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Evaluation / Demonstration

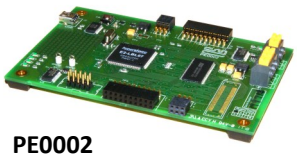
Microcontroller Emulator

DE6181
CMX7141/CMX618 Demonstration Kit Evaluation Kit

OR

OR

PE0402
CMX714x Evaluation Kit



PE0002
Universal Interface board

OR

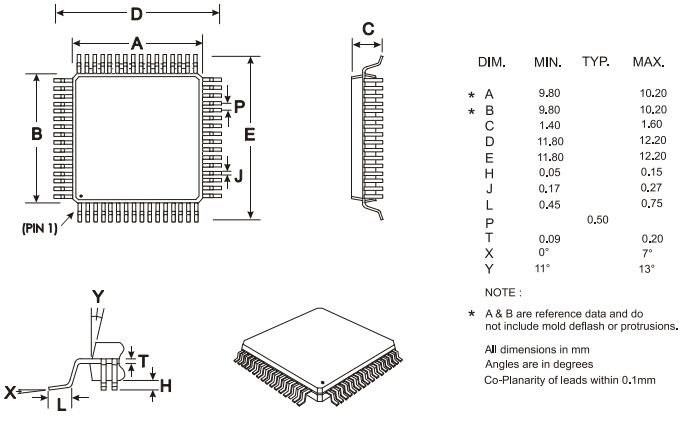
PE0201
CMX713x Evaluation Kit

DE9944
SDR Demonstrator for FDMA PMR
Out of the box PMR demonstrator for peer-to-peer FDMA digital and analogue radio.

CMX7131/CMX7141 Electrical Specification Summary

Operating Limits	Min	Typ	Max	Unit
Supply Voltage:				
$V_{DD} - V_{SS}$	3.0	3.3	3.6	V
$AV_{DD} - AV_{SS}$	3.0	3.3	3.6	V
Operating Temperature	-40	-	+85	°C
Xtal Frequency	3.0	-	12.288	MHz
External Clock Frequency	3.0	-	24.576	MHz
Supply Current				
All Powersaved				
DI_{DD}	-	8	-	µA
AI_{DD}	-	4	-	µA
Rx Mode				
$DI_{DD\ (4800bps\ Search\ for\ FS)}$	-	4.7	-	mA
$DI_{DD\ (4800bps\ FS\ Found)}$	-	2.8	-	mA
Tx Mode				
$DI_{DD\ (4800bps—2\text{-}point)}$	-	4.3	-	mA

CMX7131 Package Options



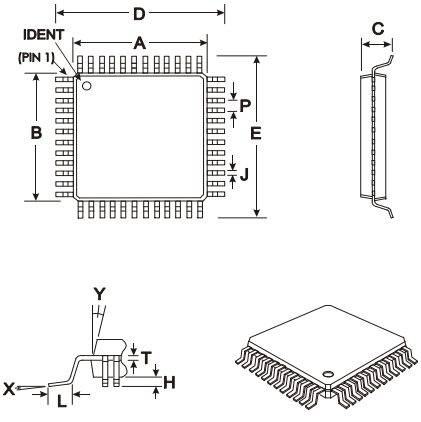
DIM.	MIN.	TYP.	MAX.
* A	9.80		10.20
* B	9.80		10.20
C	1.40		1.60
D	11.80		12.20
E	11.80		12.20
H	0.05		0.15
J	0.17		0.27
L	0.45		0.75
P		0.50	
T	0.09		0.20
X	0°		7°
Y	11°		13°

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

All dimensions in mm
Angles are in degrees
Co-Planarity of leads within 0.1mm

64-pin LQFP Mechanical Outline (L9)

CMX7141 Package Options

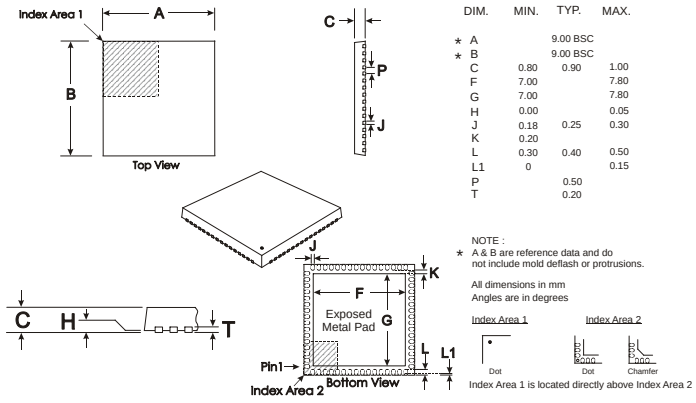


DIM.	MIN.	TYP.	MAX.
* A	6.91		7.11
* B	6.91		7.11
C	1.40		1.60
D	8.74		9.25
E	8.74		9.25
H	0.05		0.15
J	0.10		0.28
L	0.35		0.76
P		0.50	
T		0.13	
X	0°		7°
Y	11°		13°

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

All dimensions in mm
Angles are in degrees
Co-Planarity of leads within 0.1mm

48-pin LQFP Mechanical Outline (L4)



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	

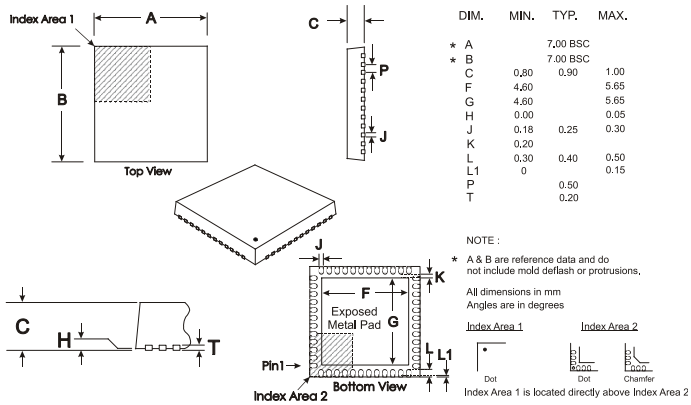
NOTE :
* A & B are reference data and do not include mold deflash or protrusions.

All dimensions in mm
Angles are in degrees

Index Area 1 is located directly above Index Area 2

Depending on the method of lead termination at the edge of the package, pull back (L1) may be present.
L minus L1 to be equal to, or greater than 0.3mm
The underside of the package has an exposed metal pad which should ideally be soldered to the pcb to enhance the thermal conductivity and mechanical strength of the package fixing. Where advised, an electrical connection to this metal pad may also be required

64-pin VQFN Mechanical Outline (Q1)



DIM.	MIN.	TYP.	MAX.
* A		7.00 BSC	
* B		7.00 BSC	
C	0.80	0.90	1.00
F	4.60		5.65
G	4.60		5.65
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	

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 is located directly above Index Area 2

Depending on the method of lead termination at the edge of the package, pull back (L1) may be present.
L minus L1 to be equal to, or greater than 0.3mm
The underside of the package has an exposed metal pad which should ideally be soldered to the pcb to enhance the thermal conductivity and mechanical strength of the package fixing. Where advised, an electrical connection to this metal pad may also be required

48-pin VQFN Mechanical Outline (Q3)

FirmASIC , *FirmCODEC* , RALCWI, Function Image and *DuraTALK* are trademarks of CML Microsystems Plc.
dPMR is a trademark of the dPMR MoU Association · TWELP is a trademark of DSP Innovations Inc
NXDN is a trademark of JVC Kenwood Corporation and ICOM Incorporated · AMBE3000 is a trademark of DVSI Inc.

RALCWI™ Vocoder

CML's proprietary RALCWI™ vocoder technology is supplied under CML's RALCWI user license agreement. A copy of the CML RALCWI™ end user license agreement is available on request from CML Microcircuits.

The CMX618 Vocoder product includes embedded RALCWI™ vocoder technology which is provided free of royalties in this device.

Infinite Capabilities . . . FirmASIC® . . . Maximum Flexibility

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. Specific functions of a *FirmASIC*® device are determined by uploading its Function Image™ during device initialization. New Function Images™ may be later provided to supplement and enhance device functions, expanding or modifying end-product features without the need for expensive and time-consuming design changes. *FirmASIC*® devices provide significant time to market and commercial benefits over Custom ASIC, Structured ASIC, FPGA and DSP solutions. They may also be exclusively customised where security or intellectual property issues prevent the use of Application Specific Standard Products (ASSP's).

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