CML Microcircuits

Product Preview

CMX7241/CMX7341

PMR/LMR Common Platform Processors— Supporting Digital/Analogue FDMA and Digital 2-slot TDMA PMR/LMR Systems

DMR, dPMR™· NXDN™ · ARIB STD-T98 · ARIB STD-T102 · APCO P25 · PDT

Introduction

The Two-way Radio market (TWR), commonly referred to as business critical radio, Professional/Private Mobile Radio (PMR) or Land Mobile Radio (LMR), has become fragmented in its migration to digital.

A number of digital FDMA and TDMA PMR/LMR systems have emerged along with the ongoing requirement for a radio platform to support legacy analogue. With each system potentially having different requirements and specification down to radio architecture level, the radio manufacturer's goal of a single, cost effective radio platform to fit all has become complex.

The CMX7241/CMX7341 PMR Common Platform Processor addresses this challenge.

The CMX7241/CMX7341 provides a common platform that can deliver FDMA digital, TDMA digital and legacy analogue PMR/LMR with direct connection to an I/Q based RF receiver. The chip-set comprising CMX7341 (PMR Common Platform Processor) + CMX994A/E (Direct Conversion Receiver) enables the highest integration and cost-effective radio platform to be realised.

The CMX7241/CMX7341 provides a common platform to support digital and analogue FDMA and 2-slot TDMA PMR/LMR.

Based on CML's proprietary *FirmASIC®* component technology, a Function Image™ (FI) upload determines the CMX7241/CMX7341 overall function and operating characteristics.

- CMX7241 is pin compatible with the CMX7141 enabling a smooth forward evolution with power saving features and enhancements.

- CMX7341 has a differential I/Q Rx interface for optimum performance and direct connection to I/Q based RF circuits such as CML's CMX994A low power Direct Conversion Receiver IC.

Function Images available:

1. dPMR and Analogue PMR - Function Image™ 7241/7341FI-1.x
Implements the dPMR Air Interface Protocol termaninals using 4FSK modulation at 4.8kbps suitable for 6.25kHz channels and analogue PMR operations.

2. DMR and Analogue PMR - Function Image™ 7241/7341FI-2.x
Implements the DMR Air Interface Protocol for terminal equipment using 4FSK modulation at 9.6kbps in a 12.5kHz RF channels and professional Analogue PMR operations.

3. NXDN/ARIB STD-T98/T102 and Analogue PMR - Function Image™ 7241/7341FI-3.x
Implements the NXDN Air Interface Protocol for digital terminal equipment using 4FSK modulation at 4.8kbps in a 6.25kHz RF channels and professional Analogue PMR operations.

4. APCO P25 MR and Analogue PMR - Function Image™ 7241/7341FI-2.x
Implements the Conventional APCO P25 Air Interface Physical Layer 1 for terminal equipment using C4FM at 9.6kbps 12.5kHz RF channels and professional Analogue PMR operations.

dPMR and Analogue PMR Processing

Function Image™ 7241/7341FI-1.x.x.x

Function Image™ 7241/7341FI-1.x embeds the dPMR™ ETSI TS 102 490 and TS 102 658 standard Air Interface protocol and provides full audio/voice processing to suit the requirements of EN 300 086, EN 300 296, TIA-603-D and includes a comprehensive signalling suite.

Automatic Digital and Analogue detection is included and the following digital operating modes:

Mode 1 - Peer-to-peer direct communication using a single frequency channel

Mode 2 - Centralised repeater network where communication between devices is via a repeater/base station

Mode 3 - Managed centralised repeater network with multi-channel and multi-site trunked networks

Digital Features

- Air Interface Physical Layer 1

  - 4FSK modulation and demodulation

  - Bit and symbol definition

  - Frequency and symbol synchronisation

  - Transmission burst building and splitting

- Air Interface Data Link Layer 2

  - Channel coding (FEC, CRC)

  - Interleaving, de-interleaving and bit ordering

  - Frame and superframe building and synchronising

  - Burst and parameter definition

  - Link addressing (source and destination)

  - Interface of voice applications (voice data) with the Physical Layer

  - Data bearer services

  - Exchanging signalling and/or user data with the Call Control Layer

  - Automatic Own-ID and Group-ID detection

- Status, Type 1, Type 2 packet data

- Mode 1/2/3 operation

- Tx sequencer

Analogue Features

- Complete voice, signalling and data processing

- Selectable pre-emphasis and de-emphasis

- Selectable audio equaliser in mic and speaker paths

- Selectable voice compandor

- Selectable frequency inversion scrambler

- Tx limiter and splatter filter

- Mic AGC

- Selectable sub-audio rejection filter

- CTCSS and DCS generator and decoder

- Support for external CTCSS/DCS generation and decoding with selectable filters (low speed data)

- 1200 bps FFSK/MSK modem for MPT1327

- ADSW and CCSW reporting in MPT1327 mode

- 16-tone Selcall generator and decoder

- DTMF generator and decoder

- Tone generator

System Block Diagram
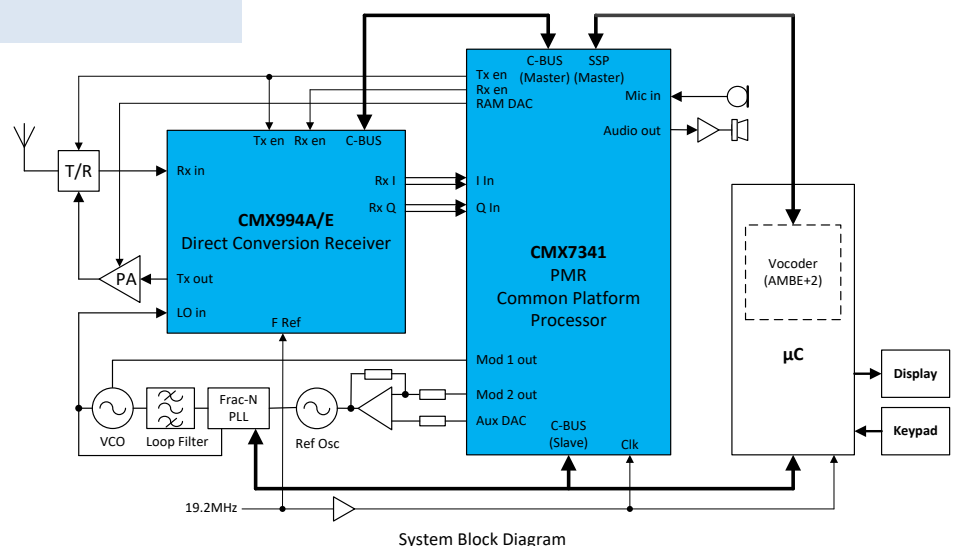
dPMR and Analogue PMR Processing

Function Image™ 7241/7341FI-1.x.x.x *Continued*

Auxiliary Functions

- Automatic Tx sequencer simplifies host control

- RAMDAC operation

- TXENA and RXENA hardware signals

- Two-point or I/Q modulation outputs

- Hard or soft decision Rx data output options

- Two programmable system clock outputs

- Two auxiliary ADCs with four selectable external input paths

- Four auxiliary DACs, one with built-in programmable RAMDAC

Evaluation Support

The PE0403 kit supports evaluation for the CMX724x and CMX734x series of products. The board allows fast and
efficient evaluation of the target product. The board schematics are also available to assist the designer with an end product development.

Interface

- C-BUS - high-speed synchronous serial command/ data
  interface to host for control and data transfer

- Auxiliary SPI/C-BUS interface to CMX6x8/CMX7262 or CMX994A with pass-through mode from host

- SPI bus interface for PCM speech codec to support third-party vocoders, e.g. AMBE+2

- Two GPIO pins

- Flexible power control facility enables optimum powersave mode when not actively processing signals

- The device includes a crystal clock generator, with buffered output, to provide a common system clock if required

- LD and I/Q receiver connectivity

Micro/DSP Emulator

Serial BUS

OR

USB

C-BUS

PE0003

PE0403

RF
Section
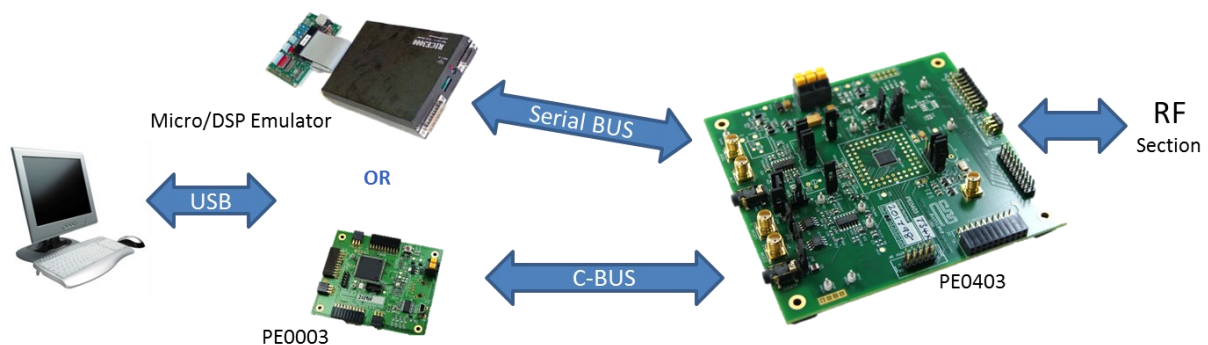
DMR and Analogue PMR Processor

Function Image™ 7241/7341FI-2.x.x.x

The 7241/7341FI-2.3.x.x Function Image™ (FI) implements a half-duplex 4FSK modem and a large proportion of the DMR Air Interface physical layer and data link layer. In conjunction with a suitable host and an RF transceiver function, a compact, low-cost, low-power digital PMR radio conforming to ETSI's DMR standard TS 102 361-1 can be realised.

Comprehensive DMR operation is supported for the following Tiers:

Tier 1 - Unlicensed peer-to-peer direct communication network (without repeaters or infrastructure), using a single frequency channel, unlicensed (limited RF power).

Tier 2 - Licensed operation (allowing higher RF powers) using either Direct mode (peer-to-peer) or Conventional repeater mode (note that this FI is designed for implementation in terminal devices only).

Tier 3 - Trunked operation, using multiple channels and/or repeaters .

Digital Features

- DMR ETSI TS 102 361 - compliant

- Air Interface Physical Layer 1
  - 4FSK modulation and demodulation
  - Bit and symbol definition
  - Frequency and symbol synchronisation
  - Sync detection (MS/BS/Direct/Voice/Data)
  - Slot timing
  - Transmission burst building and splitting
  - Burst timing/scheduling

- Air Interface Data Link Layer
  - Channel coding and decoding (FEC, CRC)
  - Interleaving, de-interleaving and bit ordering
  - Frame and superframe building and synchronising
  - Burst and parameter definition
  - Interface of voice applications (voice data) with the Physical Layer
  - Data bearer services
  - Exchanging signalling and/or user data with the Call Control Layer

  - Tier 1, 2 and 3 support

  - Status and data modes

  - Tx sequencer simplifies host control

  - Voice Codec supports external vocoders (SPI/PCM/I^2S) compatible e.g. AMBE+2

Analogue Features

- Complete voice, signalling and data processing

- Selectable pre-emphasis and de-emphasis

- Selectable audio equaliser in mic and speaker paths

- Selectable voice compandor

- Selectable frequency inversion scrambler

- Tx limiter and splatter filter

- Mic AGC

- Selectable sub-audio rejection filter

- CTCSS and DCS generator and decoder

- Support for external CTCSS/DCS generation and decoding with selectable filters (low speed data)

- 1200 bps FFSK/MSK modem for MPT1327

- ADSW and CCSW reporting in MPT1327 mode

- 16-tone Selcall generator and decoder

- DTMF generator and decoder

- Tone generator

DMR and Analogue PMR Processor

Function Image™ 7241/7341FI-2.x.x.x *Continued*

Auxiliary Functions

- RAMDAC operation

- TXENA and RXENA hardware signals

- Two-point or I/Q modulation outputs

- Hard or soft decision Rx data output options

- Two programmable system clock outputs

- Two auxiliary ADCs with four selectable external input paths

- Four auxiliary DACs, one with built-in programmable RAMDAC

Interface

- Optimised C-BUS (4-wire, high-speed synchronous serial command/data bus) interface to host for control and FIFOs for data transfer

- Open drain IRQ to host

- Auxiliary SPI/C-BUS for direct control of CMX994A I/Q Receiver (CMX7341 only)

- Auxiliary SPI-Codec interface for PCM speech codec to support third-party vocoders, e.g. AMBE+2

- Fast, streaming C-BUS (host) boot mode

- LD and I/Q receiver connectivity

Demonstrator

The DE9945 is a demonstration kit utilising the CMX994A/E (Direct Conversion Receiver IC) and CMX7341 (PMR Common Platform Processor IC)

running the DMR Function Image™. The board provides an out-of-the-box DMR demonstrator and can also be used throughout the evaluation of the devices. The boards schematics are also available to assist the designer with an end product development.

DE9945/DE9945E - DMR Demonstrator Board

NXDN, ARIB STD-T98/T102 and Analogue PMR

Function Image™ 7241/7341FI-3.x.x.x

The 7241/7341FI-4.x Function Image™ (FI) implements a half-duplex C4FM modem and a large proportion of the C4FM Air Interface physical layer. In addition, the FI also supports Analogue FM voice modes with flexible signalling options. In conjunction with a suitable host and an RF transceiver, a compact, low-cost, low-power digital PMR radio conforming to C4FM digital radio standards and Analogue EN 300 086 / TIA 603D can be realised. The FI analyses incoming traffic, detects the modulation type and switches to the associated operating mode. This ensures that dual mode, analogue/digital PMR operation can be achieved on a single radio platform without the need to re-configure hardware or software by loading alternative FIs.

Features

Auto detect of Digital and Analogue Receive

- Digital PMR Functions: APCO P25 conventional:

    - Air Interface Physical Layer (layer 1)

    - C4FM modulation / demodulation

    - Bit and symbol definition

    - Frequency and symbol synchronisation

    - Transmission burst building and splitting

- Tx Sequencer

- Analogue PMR EN 300 086 / TIA 603D:

    - Voice processing

    - De-emphasis / pre-emphasis

    - Tx Limiter and splatter filter

    - Voice scrambler Voice compander

    - CTCSS and DCS generation and detection

    - Selcall generation and detection

    - DTMF generation and detection

    - 1200/2400 bps FFSK modem (MPT1327 compatible)

Features Continued

- 2 Auxiliary ADCs (4 Multiplexed Inputs)

- 4 Auxiliary DACs

- 2 Auxiliary System Clock Outputs

- Tx Outputs for Two-point or I/Q Modulation

- Rx Inputs for Limiter/Discriminator or CMX994 Direct Conversion (I/Q) Receiver

- C-BUS serial interface to CMX994/A/E Direct Conversion Receiver

- Voice Codec supports external vocoders (SPI/PCM/I2S compatible - e.g. IMBE)

- C-BUS Serial Interface to Host micro

- Flexible Powersave Modes

- Low-power (3.3V) Operation

- Dedicated hardware reset pin

- Single-ended inputs (CMX7241)

- Differential inputs (CMX7341)

- Available in LQFP or VQFN Packages (CMX7341 – VQFN only)

APCO P25 and Analogue PMR Processor

Function Image™ 7241/7341FI-4.x.x.x

The 7241/7341FI-4.x Function Image™ (FI) implements a half-duplex C4FM modem and a large proportion of the C4FM Air Interface physical layer. In addition, the FI also supports Analogue FM voice modes with flexible signalling options. In conjunction with a suitable host and an RF transceiver, a compact, low-cost, low-power digital PMR radio conforming to C4FM digital radio standards and Analogue EN 300 086 / TIA 603D can be realised. The FI analyses incoming traffic, detects the modulation type and switches to the associated operating mode. This ensures that dual mode, analogue/digital PMR operation can be achieved on a single radio platform without the need to re-configure hardware or software by loading alternative FIs.

Features

- Auto detect of Digital and Analogue Receive
- Digital PMR Functions: APCO P25 conventional:
  - Air Interface Physical Layer (layer 1)
  - C4FM modulation / demodulation
  - Bit and symbol definition
  - Frequency and symbol synchronisation
  - Transmission burst building and splitting
- Tx Sequencer
- Analogue PMR EN 300 086 / TIA 603D:
  - Voice processing
  - De-emphasis / pre-emphasis
  - Tx Limiter and splatter filter
  - Voice scrambler Voice compander
  - CTCSS and DCS generation and detection
  - Selcall generation and detection
  - DTMF generation and detection
  - 1200/2400 bps FFSK modem (MPT1327 compatible)

Features

- 2 Auxiliary ADCs (4 Multiplexed Inputs)
- 4 Auxiliary DACs
- 2 Auxiliary System Clock Outputs
- Tx Outputs for Two-point or I/Q Modulation
- Rx Inputs for Limiter/Discriminator or CMX994 Direct Conversion (I/Q) Receiver
- C-BUS serial interface to CMX994/A/E Direct Conversion Receiver
- Voice Codec supports external vocoders (SPI/PCM/I2S compatible - e.g. IMBE)
- C-BUS Serial Interface to Host micro
- Flexible Powersave Modes
- Low-power (3.3V) Operation
- Dedicated hardware reset pin
- Single-ended inputs (CMX7241)
- Differential inputs (CMX7341)
- Available in LQFP or VQFN Packages (CMX7341 – VQFN only)

Block Diagram

The simplified diagram below shows the basic function blocks within the CMX7241 and CMX7341.
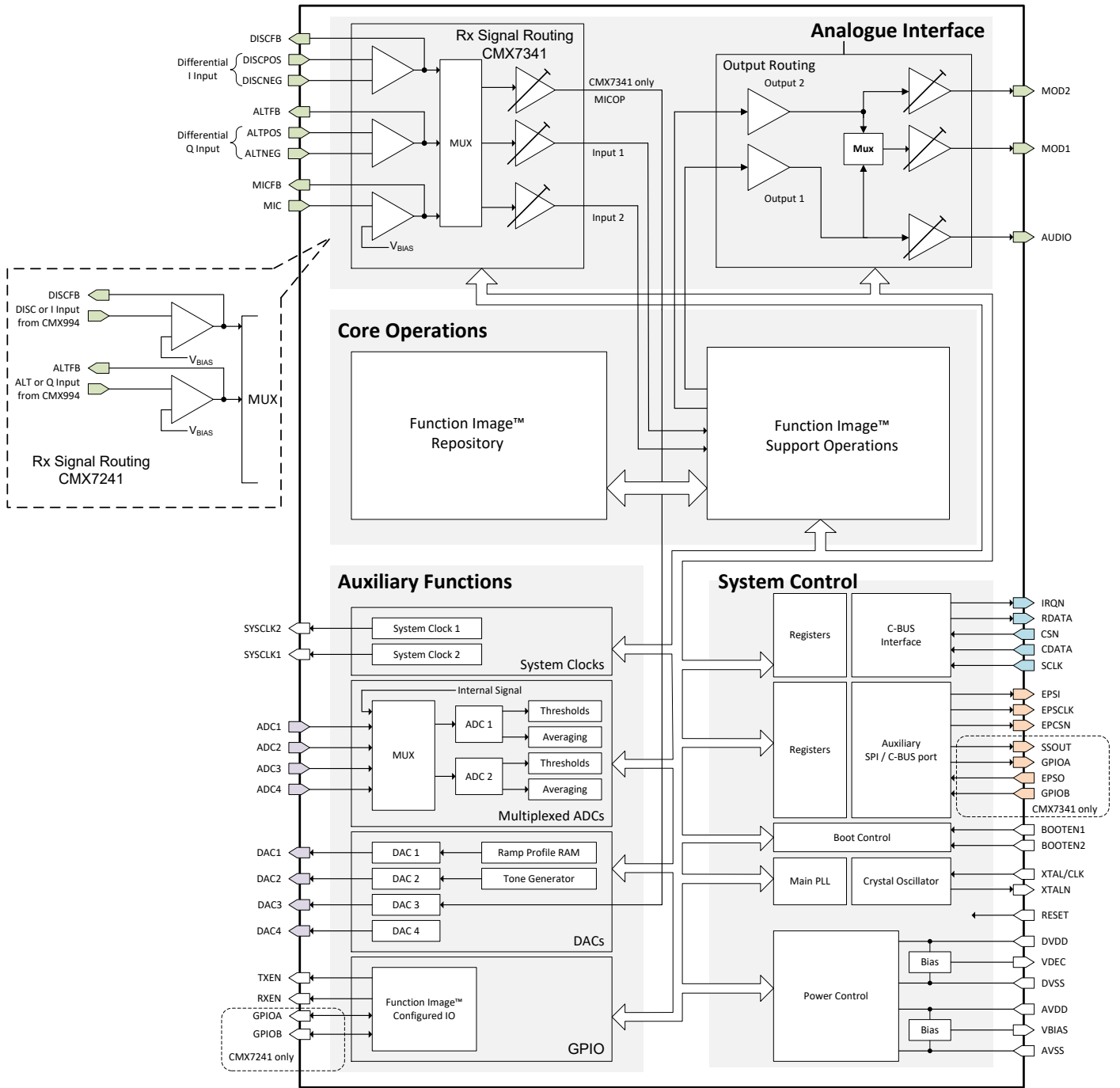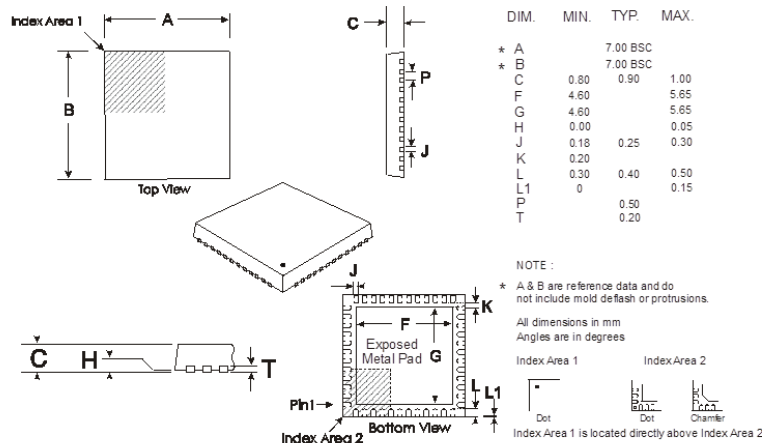
Electrical Specification Summary

	Min	Typ	Max	Unit
Supply Voltage				
$DV_{DD} - DV_{SS}$	3.0	3.3	3.6	V
$AV_{DD} - AV_{SS}$	3.0	3.3	3.6	V
Operating Temperature	-40		+85	°C
XTAL/CLK (External Clock)	3.0		24.576	MHz
7241/7341FI-1.x dPMR™ + Analogue				
All Powersaved				
DI_{DD}		8		µA
AI_{DD}		4		uA
Rx Mode (LD)				
DI_{DD} (4.8kbps - search for FS)		4.7		mA
DI_{DD} (4.8kbps - FS found)		2.8		mA
AI_{DD}		1.6		mA
Tx Mode				
DI_{DD} (4.8kbps - 2-point)		4.3		mA
AI_{DD}		1.5		mA

Package Options

CMX7241Q3/CMX7341Q3 48-pin VQFN Mechanical Outline (Q3)

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

CMX7241L4 48-pin LQFP Mechanical Outline (L4)

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

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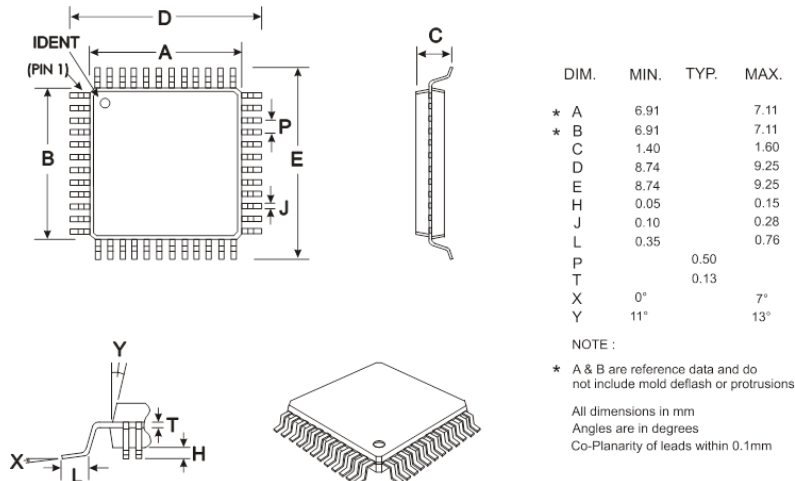
CML's proprietary *FirmASIC®* component technology reduces cost, time to market and development risk, with increased flexibility for the designer and end application. *FirmASIC®* combines Analogue, Digital, Firmware and Memory technologies in a single silicon platform that can be focused to deliver the 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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Faster time to market
Developing proven high performance and field tested ASSP ICs, CML is helping engineers to cope with increasing
pressure in delivering shorter project design cycles.

Design flexibility
CML's *FirmASIC®* reconfigurable technology with the use of a Function Image upload enables a single hardware platform to be used for multiple communications systems.

High Quality
With 100% of products being tested before shipping, customers are assured of the highest reliability.

Product Longevity
Designing with CML products, manufacturers are rewarded with longer product life cycles and a stable BOM, ensuring minimum engineering costs and maximum profit.

Low Power
Being at the forefront of low power chip technology, manufacturers can develop smaller equipment with extended battery life.

Superior Support
Internal and field based applications teams worldwide
provide focused customer support to ease the development process.

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