32-bit Microcontroller Collateral and Solutions Reference Guide

Abstract

This document provides references to the technical material that helps in developing applications on Microchip's 32-bit microcontroller units (MCUs).

Table of Contents

1. Cortex M0+ Family of Devices

1.1 SAM D21/SAM D20/SAM D11/SAM D10 [1]

Note:

1. Most of the collaterals listed below cover the SAM D21 family of devices. They can be extended and easily ported to any of the SAM D20/SAM D11/SAM D10 devices.

Click on the following links to view the various collaterals:

1. Videos.
2. Training Modules.
3. Virtual/ On-Demand Training.
4. Technical Briefs.
5. Application Notes.
6. Application Demonstrations.
7. Reference Designs/ Solutions.

1.1.1 SAM D2x/D1x: Videos

Table 1-1. SAM D2x/D1x: Videos

Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
1	Getting Started with Tools	N/A	A step-by-step guide explaining the following: • How to Install MPLAB® X IDE • How to Install MPLAB XC32 Compiler • How to install the Configurator • How to Download the Harmony Framework from MPLAB Harmony v3 repositories on GitHub MPLAB Harmony v3 is configurable through the MCC. Refer to items 6 and 7 for specific instructions to use the MCC.	How to Set-up the Tools Required to Get Started with MPLAB Harmony v3
2	Getting Started with Device/Kit	SAM D21 Xplained Pro Evaluation Kit (ATSAMD21-XPRO)	Explains how to create a simple application on the SAM D21 using MPLAB Harmony v3. The application sends a "Hello World!" string to the PC terminal. MPLAB Harmony v3 is configurable through the MCC. Refer to items 6 and 7 for specific instructions to use the MCC.	Create Your First Project with SAMD21 using Using MPLAB Harmony v3
3	Getting Started with Device/Kit	SAM D21 Curiosity Nano Evaluation Kit (DM320119)	Explains how to create a simple application on the SAM D21 using MPLAB Harmony v3. The application toggles an LED periodically and prints the LED toggling rate on a serial terminal. MPLAB Harmony v3 is configurable through the MCC. Refer to items 6 and 7 for specific instructions to use the MCC.	Getting Started with the SAM D21 Curiosity Nano
4	Getting Started with IoT	SAM-IoT WG Board (EV75S95A)	Explains the steps to get started with the SAM-IoT Board and the supported features.	Getting Started with the SAM IoT WG Board
5	IoT	SAM-IoT WG Board (EV75S95A)	Explains the steps to create an IoT-based heart rate monitoring application on the SAM-IoT WG Development Board.	How to Create an IoT Based Heart Rate Monitoring Application
6	Getting Started with Software Tools	N/A	Explains how to use the MCC Content Manager	MPLAB® Code Configurator Content Manager

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Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
7	Getting Started with Software Tools	Though the video covers DM320209 and EV76S68A, the same content can be replicated for SAM D21 Xplained Pro Evaluation Kit (ATSAMD21-XPRO) or SAM D21 Curiosity Nano Evaluation Kit (DM320119)	Explains how to create a new MPLAB Harmony v3 project using the MCC and shows how to migrate an MHC-based project to an MCC- based project.	Getting Started with Harmony v3 Using Code Configurator
8	Getting started with Docs	N/A	Introduces the Quick Docs package to help develop applications using Microchip's 32-bit products using the MPLAB Harmony v3 software framework.	Harmony Quick Docs Package
9	Getting started with Solutions	N/A	Introduces the MPLAB Harmony Reference Apps package and describes its typical application types and download methods.	Harmony Reference Applications Package
10	AWS IoT Core Application with SAM IoT Wx v2 Development Board	SAM IoT Wx v2 Development Board (EV62V87A)	The SAM-IoT Wx v2 Development Board, based on the SAM D21 microcontroller, serves as a compact Wi-Fi-based IoT Node development platform for the AWS IoT Core. The application showcases MQTT data transfer from onboard light and temperature sensors to AWS IoT Core.	Demonstrating AWS IoT Core Application with SAM IoT Wx v2 Development Board
11	SAM-IoT Wx v2 Development Board Overview	SAM IoT Wx v2 Development Board (EV62V87A)	This video explains how scalable SAM-IoT Wx v2 Development Board combines an easy to use, yet powerful ATSAMD21 low power MCU, a pre-provisioned ATECC608B Trust Flex secure element and the fully certified ATWINC1510 Wi-Fi® network controller.	SAM-IoT Wx v2 Development Board Overview
12	Creating Your First Project with SAM D21	SAM D21 Xplained Pro evaluation kit (ATSAMD21-XPRO)	The video explains how the application reads the current room temperature from the temperature sensor on the I/O1 Xplained Pro Extension. The temperature read is displayed on a serial console periodically every 500 milliseconds. The periodicity of the temperature values displayed on the serial console is changed to 1 second, 2 seconds, 4 seconds and back to 500 milliseconds every time you press the switch SW0 on the SAM D21 Xplained Pro Evaluation Kit. Also, an LED is toggled every time the temperature is displayed on the serial console.	Create Your First Project with SAMD21 Using MPLAB® Harmony v3 and MCC

1.1.2 SAM D2x/D1x Training Modules

Table 1-2. SAM D2x/D1x Training Modules

Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
1	Getting Started with Device/Kit	SAM D21 Xplained Pro Evaluation Kit (ATSAMD21-XPRO	Shows how to create an application to get started with the SAM D21 using the MPLAB Harmony v3 software framework. The training module is based on the MHC. Similar steps and flow can be used to create a project using the MCC.	Getting Started with Harmony v3 Peripheral Libraries on SAM D21
2	Getting Started with Device/Kit	The SAM D21 Xplained Pro Evaluation Kit (ATSAMD21-XPRO)	Shows how to create an application to get started with the SAM D21 using the MPLAB Harmony v3 software framework with FreeRTOS. The training module is based on the MHC. Similar steps and flow can be used to create a project using the MCC.	Getting Started with Harmony v3 Drivers on SAM D21 Using FreeRTOS

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Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
3	Getting started with tools	N/A	Shows how to create a new MPLAB Code Configurator (MCC) Harmony v3 project from scratch.	Create a new MPLAB Harmony v3 project using MCC
4	Getting started with tools	N/A	Shows how to open an existing project and use with MCC.	MCC - Open an Existing MPLAB® Harmony v3 Project
5	Getting started with tools	N/A	Shows how to install the MPLAB® Code Configurator (MCC) plugin, and how to download the MPLAB Harmony v3 framework.	MPLAB® Code Configurator Overview with MPLAB Harmony Content
6	Getting started with tools	Though this training uses the SAM D5x/E5x, the same training can be used as a reference for other MCUs.	Shows how to create a new MPLAB Harmony v3 project using MCC.	Create a new MPLAB Harmony v3 project using MCC
7	Application Specific	SAM D21 Xplained Pro Evaluation Kit (ATSAMD21-XPRO)	Shows how to create a low-power application on the SAM D21 by showcasing the current measurement on Idle and Standby sleep modes. The current consumption data is displayed on the data visualizer.	Low Power Application on SAM D21
8	Migration	Though this training uses the PIC32MZ EF, the same training can be used as a reference for other MCUs.	Shows how to update and configure an existing MPLAB Harmony Configurator (MHC)-based MPLAB Harmony v3 project to MPLAB Code Configurator (MCC)-based project.	Update and Configure an Existing MHC-based MPLAB Harmony v3 Project to MCC-based Project
9	IoT	PIC32CM MC00 Curiosity Nano Evaluation Kit (EV10N93A) Or SAM D21 Curiosity Nano Evaluation Kit (DM320119)	Shows how to develop an application prototype from a concept without designing a Printed Circuit Board (PCB) using 32-bit MCU-based Curiosity Nano Evaluation Kits and Nano baseboard. This training uses the PIC32CM MC00 Curiosity Nano. The same training can be used for other MCUs that are supported in the Curiosity Nano platform.	Rapid prototyping with 32-bit MCU-based Curiosity Nano

1.1.3 SAM D2x/D1x Virtual/On-Demand Training

Though some of the following virtual trainings are developed using other MCUs, the same training can be easily ported to the SAM D21 MCU.

Table 1-3. SAM D2x/D1x Virtual/On-Demand Training

Sl. No	Event	Description	Link
1	Design Week 2022 - Rapid Prototyping	Discusses how to rapidly develop IoT-centered smart appliance control application prototypes from a concept. Refer to items 2, 3, and 4 in the following table for details.	Link
2	Rapid Prototyping with Curiosity Nano: Part I Webinar	Discusses how to rapidly develop an IoT-centered smart appliance control application prototype from a concept. In the first part, The concept of creating a system to capture sensor data and control actuators through an I^2C interface is explained. This demonstration, though it was developed on the PIC32CM MC00 Curiosity Nano Evaluation Kit, can be easily ported to the SAM D21 Curiosity Nano Evaluation Kit (DM320119).	Link
3	Rapid Prototyping with Curiosity Nano: Part II Webinar	Discusses how to rapidly develop an IoT-centered smart appliance control application prototype from a concept. In the second part, the concept of creating a system to capture and display sensor data through the UART and SPI interfaces is explained. This demonstration, though it was developed on the PIC32CM MC00 Curiosity Nano Evaluation Kit, can be easily ported to the SAM D21 Curiosity Nano Evaluation Kit (DM320119).	Link

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Sl. No	Event	Description	Link
4	Rapid Prototyping with Curiosity Nano: Part III Webinar	Discusses how to rapidly develop an IoT-centered smart appliance control application prototype from a concept. In the third part, the concepts to add more functionality to the project created in the first part of this webinar series is explained: • Extending the project to display the data captured by sensors through the SPI • Extending the project to add wireless capability through the UART This demonstration, though it was developed on the PIC32CM MC00 Curiosity Nano Evaluation Kit, can be easily ported to the SAM D21 Curiosity Nano Evaluation Kit (DM320119).	Link
5	Develop 32-bit MCU Applications Using MPLAB® Harmony v3	Discusses the fundamentals of MPLAB Harmony v3, the middleware, and other design tools available for application development. It also showcases a weather station demonstration using the SAM D21 32-bit microcontroller using the SAM D21 Curiosity Nano Evaluation Kit (DM320119).	Link
6	Tech Insights Asia 2022 - Rapid Prototyping Connected Applications With 32-Bit Microcontrollers	This training gives an insight into how rapid prototyping can be done with 32 bit Curiosity Pro and Curiosity Nano boards to create applications.	Link

More virtual trainings are available at Microchip University. Click on the following links for more details:

1. Introduction To MPLAB® X IDE
2. MPLAB® X Tips and Tricks
3. Overview of the Microchip Code Configurator (MCC) Content Manager (CM)
4. MPLAB® Code Configurator (MCC) For Simplified Embedded Software Development
5. ARM® Cortex®-M Architecture Overview
6. Getting Started with Writing Code for the Microchip ARM® Cortex® Microcontrollers
7. MPLAB® Harmony v3 Fundamentals
8. Simple Applications Using the MPLAB® Harmony v3 Peripheral Libraries
9. Creating Advanced Embedded Applications with 32-bit MCUs/MPUs using the MPLAB® Harmony v3 Software Framework
10. FreeRTOS Simplified: A Beginner's Guide to Develop and Debug FreeRTOS Applications
11. Class B Diagnostic Libraries For Functional Safety

1.1.4 SAM D2x/D1x Technical Briefs

Table 1-4. SAM D2x/D1x Technical Briefs

Sl. No	Type/ Focus Area	Description	Link
1	Getting Started	TB3231: Explains how to create a simple application on a SAM MCU using the MPLAB Harmony v3 modules. This application sends a "Hello World!" string to a console running on a computer. This document explains one MCU; however, it can be ported to other MCUs. **Note:** MPLAB Harmony v3 is configurable through MCC. Refer to items 6 and 7 in SAM D2x/ D1x: Videos for specific instructions to use the MCC.	Link
2	Getting Started	TB3232: Explains how to set up the tools required to get started with MPLAB Harmony v3 software development framework.	Link
3	Getting Started	TB3304: *How to Add a New Configuration to an Existing MPLAB Harmony v3 Project*	Link
4	Getting Started	TB3305: *How to Use the MPLAB Harmony v3 Project Manifest Feature*	Link
5	Getting Started	TB3290: *MPLAB Harmony v3 Synchronous Drivers and their Usage in FreeRTOS Based Applications*	Link

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Sl. No	Type/ Focus Area	Description	Link
6	Getting Started	TB3269: *The Differences Between MPLAB Harmony v3 Synchronous and Asynchronous Drivers and When to Use Them*	Link
7	Getting Started	TB3291: *The Difference Between MPLAB Harmony v3 PLIBs and Drivers, and When to Use Them*	Link
8	Getting Started	Build MPLAB Harmony v3 project with Arm GCC toolchain in MPLAB X IDE.	Link
9	Migration	Application migration from 8-bit PIC18F (MCC) to 32-bit SAM D21 (MHC).	Link
10	Migration	Application migration from 8-bit AVR (MCC) to 32-bit SAM D21 (MHC).	Link
11	Getting Started	TB3253: *How to Build an Application by Adding a New PLIB, Driver, or Middleware to an Existing MPLAB Harmony v3 Project*	Link
12	Getting Started	TB3246: *How to Use the MPLAB Harmony v3 Debug System Service*	Link
13	Peripheral Feature	TB3243: *How to Wake-up Fast from an External Event on Cortex M0+ Based MCUs*	Link
14	Peripheral Feature	TB3230: *Various Timers on SAM Devices*	Link
15	Peripheral Feature	TB3222: *EEPROM Emulation for Flash-Only Devices*	Link
16	MCU Feature	TB3183: *What is Sleepwalking? How it helps to reduce the power consumption?*	Link
17	Peripheral Feature	TB3170: *How the Event System Helps to Lower CPU Load and Power Consumption in Cortex™-M0+ Microcontrollers*	Link
18	Getting Started	TB3355: How to Use the MPLAB® Data Visualizer with 32-bit MCU based Curiosity Nano Evaluation Kits	Link

1.1.5 SAM D2x/D1x Application Notes

Table 1-5. SAM D2x/D1x Application Notes

Sl. No	Type/ Focus Area	Description	Link
1	Getting Started	AN3563: *SAM D21 Curiosity Nano: MPLAB Harmony v3 PLIBs Setup and Evaluation*	Link
2	Migration	AN4495: MPLAB Harmony v3 Project Migration application note discusses the migration of an existing MPLAB Harmony v3-based project developed on a particular hardware (microcontroller or development board) platform to another one of Microchip's 32-bit hardware platforms of the user's choice.	Link
3	Feature specific	AN4383: *32-bit Microcontroller Wafer-Level Chip-Scale Package (WLCSP)*	Link
4	Migration	*PIC18F to PIC24F to SAM D2x Migration and Performance Enhancement Guide*	Link
5	Migration	AN3346: *Introduction to MPLAB and Harmony v3 for Atmel Studio and ASF users*	Link

1.1.6 SAM D2x/D1x Application Demonstrations

Table 1-6. SAM D2x/D1x Application Demonstrations

Sl. No	Type	Hardware Board/ Kit Used	Description	Link
1	Getting Started	SAM D21 Curiosity Nano (DM320119)	Getting Started Application on the SAM D21 Curiosity Nano Evaluation Kit	Link
2	Getting Started	SAM D21 Xplained Pro Evaluation Kit (ATSAMD21-XPRO)	Getting Started Application on the SAM D21 Xplained Pro Evaluation Kit	Link
3	IoT, Connectivity	SAM D21 Curiosity Nano (DM320119)	Amazon Alexa Connect Kit (ACK) SDK port, Smart Applications and Over the Air (OTA) firmware upgrade on the SAM D21 Curiosity Nano	Link
4	Tracking	SAM D21 Curiosity Nano (DM320119)	Location Tagged SOS Application on the SAM D21 Curiosity Nano and Nano Base for Click boards	Link
5	IoT, Healthcare	SAM D21 Curiosity Nano (DM320119)	Fitness Tracker Application on the SAM D21 Curiosity Nano Evaluation Kit and Nano Base for Click boards	Link
6	IoT, Automation	SAM D21 Curiosity Nano (DM320119)	BLE based Weather Station and Motion Sensor Application on the SAM D21 Curiosity Nano and Nano Base for Click boards	Link
7	Low Power	SAM D21 Xplained Pro Evaluation Kit (ATSAMD21-XPRO)	Low-Power Application on the SAM D21 Xplained Pro Evaluation Kit	Link
8	Data Logger	SAM D21 Xplained Pro Evaluation Kit (ATSAMD21-XPRO)	SD Card USB Data Logger Application on the SAM D21 Xplained Pro Evaluation Kit	Link

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Sl. No	Type	Hardware Board/ Kit Used	Description	Link
9	Low Power	SAM D21 Xplained Pro Evaluation Kit (ATSAMD21-XPRO)	AC Sleepwalking Application built with GCC Toolchain on the SAM D21 Xplained Pro Kit	Link
10	Azure	SAM-IoT Wx v2 Development Board (EV62V87A)	This specific development board can be provisioned for Azure IoT Core; The application demonstrates MQTT data transfer of onboard light and temperature sensor data to Microsoft Azure IoT core	Link
11	AWS Cloud	SAM-IoT Wx v2 Development Board (EV62V87A)	This specific development board can be pre-provisioned for AWS IoT Core; The application demonstrates MQTT data transfer of onboard light and temperature sensor data to AWS IoT core	Link

More application demonstrations are available at Microchip's MPLAB Harmony GitHub repositories. Refer to the following links:

- More application demonstrations on SAM D21 Curiosity Nano Evaluation Kit and other Development Boards/Kits having the same part number (ATSAMD21G17D)
- More application demonstrations on SAM D21 Xplained Pro Evaluation Kit and other Development Boards/Kits having the same part number (ATSAMD21J18A)

1.1.7 SAM D2x/D1x Reference Designs/Solutions

Table 1-7. SAM D2x/D1x Reference Designs/Solutions

Sl. No	Type	Description	Link
1	Automation, Tracking	Location-Tagged SOS, Asset Tracking or Vehicle Tracking Application: This solution can be used during an emergency to send a distress signal through a location-tagged SOS SMS text message.	Link
2	IoT, Medical	Fitness Tracker Wearables Application: This solution displays heart rate readings measured in beats per minute (bpm) on a low-power E ink display.	Link
3	IoT, Automation	Bluetooth® Low Energy-Based Weather Station This solution showcases a Bluetooth Low Energy-based solution for environmental or weather monitoring applications. It demonstrates the logging of weather and motion sensor data collected from various sensors to an Android™ mobile application through Bluetooth Low Energy.	Link
4	Battery Charger	The USB PD Demonstration Board is a USB power delivery battery charger demonstration board featuring the ATSAMD21J18A microcontroller. The battery charger's SEPIC power supply can support the full 20V/5A 100W USB PD specification.	Link
5	Automation	SD™ Card USB Data Logger Demonstration Application: This solution demonstrates an example of using the MPLAB® Harmony v3 File System to access and modify the contents of an SD card using the SDSPI driver, the SPI PLIB, and MPLAB Harmony USB Device Stack to simultaneously enumerate an SD card as a USB Mass Storage Device (MSD).	Link

1.1.8 SAM D2x/D1x Key Links

- SAM D21 Curiosity Nano Evaluation Kit (DM320119)
- SAM-IoT WG Development Board (EV75S95A)
- SAM D21 Xplained Pro Evaluation Kit (ATSAMD21-XPRO)
- MPLAB Harmony Landing Page
- MPLAB Harmony v3 GitHub Reference Application Repository
- MPLAB Harmony v3 GitHub Quick Docs Repository
- Microchip Reference Designs Page
- Rapid Prototyping with 32-bit MCUs

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1.2 SAM C21/SAM C20/PIC32CM MC/PIC32CM JH [(1)]

Note:

1. Most of the collaterals listed below are covering the SAM C21 and PIC32CM MC family of devices. They can be easily extended and ported to the SAM C20/PIC32CM JH devices.

Click on the following links to view the various collaterals:

1. Videos.
2. Training Modules.
3. Virtual / On-Demand Training.
4. Technical Briefs.
5. Application Notes.
6. Application Demonstrations.
7. Reference Designs/ Solutions.

1.2.1 SAM C2x/PIC32CM MC/PIC32CM JH Videos

Table 1-8. SAM C2x/PIC32CM MC/PIC32CM JH Videos

Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
1	Getting Started with Tools	N/A	A step-by-step guide explaining: • How to Install MPLAB® X IDE • How to Install MPLAB XC32 Compiler • How to install the Configurator • How to Download Harmony Framework from MPLAB Harmony v3 repository MPLAB Harmony v3 is configurable through the MCC. Refer to items 6 and 7 for specific instructions to use the MCC.	How to Set-up the Tools Required to Get Started with Harmony v3
2	Getting Started with Device/Kit	SAM C21 Xplained Pro Evaluation Kit (ATSAMC21-XPRO)	Explains how to create a simple application on the SAMC21 using Harmony v3. This application sends a "Hello World!" string to the PC terminal. MPLAB Harmony v3 is configurable through the MCC. Refer to items 6 and 7 for specific instructions to use the MCC.	Create Your First Project with SAMC21
3	Getting Started with Device/Kit	PIC32CM MC00 Curiosity Nano Evaluation Kit (EV10N93A)	Explains how to create a simple application on the PIC32CM MC00 using Harmony v3. This application toggles an LED toggling periodically and prints the LED toggling rate on a serial terminal. MPLAB Harmony v3 is configurable through the MCC. Refer to items 6 and 7 for specific instructions to use the MCC.	Getting Started with the PIC32CM MC00 Curiosity Nano
4	IoT	PIC32CM MC00 Curiosity Nano Evaluation Kit (EV10N93A)	Explains the implementation of an IoT sensor node on the Google cloud platform. The demonstration is developed on the PIC32CM MC00 Curiosity Nano. Since Google Cloud's IoT Core Service is being discontinued on August 2023, this video will be updated in the future with an alternative cloud service.	Create a Smart Asset Monitor With a PIC32CM MC00 Curiosity Nano Eval Kit and Google Cloud IoT Core
5	Getting Started with S/W Tools	N/A	Explains how to use the MCC Content Manager.	MPLAB® Code Configurator Content Manager

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Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
6	Getting Started with S/W Tools	The video covers DM320209 and EV76S68A. The video content can be replicated for the SAM C21 Xplained Pro Evaluation Kit (ATSAMC21-XPRO) or the PIC32CM MC00 Curiosity Nano Evaluation Kit (EV10N93A).	Explains how to create a new MPLAB Harmony v3 project using the MCC, and shows how to migrate an MHC-based project to an MCC based project.	Getting Started with Harmony v3 Using Code Configurator
7	Getting started with Docs	N/A	Introduces the Quick Docs package to help develop applications using Microchip's 32-bit products using the MPLAB Harmony v3 software framework.	Harmony Quick Docs Package
8	Getting started with Solutions	N/A	Introduces the MPLAB Harmony v3 Reference Apps package and describes its typical application types and download methods.	Harmony Reference Applications Package
9	Creating Applications using MCC on PIC32CM JH Family MCUs	PIC32CM JH01 Curiosity Pro Evaluation Kit (EV81X90A) and PIC32CM JH01 Curiosity Nano+ Touch Evaluation Kit (EV29G58A)	This video provides instructions and pointers to develop applications for Automation, Touch, FuSa and 5v applications using Arm Cortex M0+ based 32-bit MCUs (PIC32CM JH Family).	32-bit MCU Digest | Build Smarter with PIC32CM JH (Cortex M0+) using Harmony and MCC: Automation, Touch, FuSa and 5V Apps
10	Creating Applications using MCC on PIC32CM JH Family MCUs	SAMC21N Xplained Pro evaluation kit (ATSAMC21N18A)	This video introduces and explains how to get started with SAM C21N Xplained Pro Evaluation Kit using MPLAB Harmony and MCC, the application reads the current room temperature from the temperature sensor on the I/O1 Xplained Pro Extension.	Create Your First Project with SAMC21N Using MPLAB® Harmony v3 and MCC
11	Creating Applications using MCC on PIC32CM MC Family MCUs	PIC32CM MC00 Curiosity Pro Evaluation Kit (ev15n46a), PIC32CM MC00 Curiosity Nano Evaluation Kit (ev10n93a), PIC32CM MC00 Motor Control Plug-In-Module (ev94f66a)	This video provides instructions and pointers to develop applications for Home appliances, Motor/Industrial control, and 5v applications using Arm Cortex M0+ based 32-bit MCUs (PIC32CM MC Family).	Create Your First Project with SAMC21N Using MPLAB® Harmony v3 and MCC

1.2.2 SAM C2x/PIC32CM MC/PIC32CM JH Training Modules

Table 1-9. SAM C2x/PIC32CM MC/PIC32CM JH Training Modules

Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
1	Getting Started with Device/Kit	SAM C21N Xplained Pro Evaluation Kit (ATSAMC21N-XPRO)	Shows how to create an application to get started with the SAM C21 using the MPLAB Harmony v3 software framework. The training module is based on the MHC. Similar steps and flow can be used to create a project using the MCC.	Getting Started with Harmony v3 Peripheral Libraries on SAMC2x MCUs
2	Getting Started with Device/Kit	SAM C21 Xplained Pro Evaluation Kit (ATSAMC21-XPRO)	Shows how to create an application to get started with the SAM C21 using the MPLAB Harmony v3 software framework with FreeRTOS. The training module is based on the MHC. Similar steps and flow can be used to create a project using the MCC.	Getting Started with Harmony v3 Drivers on SAM C21 MCUs Using FreeRTOS
3	Getting started with tools	N/A	Shows how to create a new MPLAB® Code Configurator (MCC) MPLAB Harmony v3 project from scratch.	Create a New MPLAB Harmony v3 Project Using MCC

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Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
4	Getting started with tools	N/A	Shows how to open an existing project and use it with the MCC.	MCC - Open an Existing MPLAB® Harmony v3 Project
5	Getting started with tools	N/A	Shows how to install the MPLAB Code Configurator (MCC) plugin and how to download the MPLAB Harmony v3 framework.	MPLAB® Code Configurator Overview with MPLAB Harmony Content
6	Getting started with tools	This training uses the SAM D5x/E5x device. The same training can be used as a reference for other MCUs.	This tutorial shows how to create a new MPLAB Harmony v3 project using the MCC.	Create a New MPLAB Harmony v3 project Using MCC
7	Migration	PIC32CM MC00 Curiosity Nano Evaluation Kit (EV10N93A)	This tutorial shows how to migrate an application from Advanced Software Framework (ASF) to the MPLAB Harmony v3 software framework using a 32-bit Arm® Cortex®-based M0+ PIC32CM MC microcontroller.	Migrating ASF SAM C21 Application to MPLAB Harmony v3 PIC32CM MC
8	Application Specific	SAM C21 Xplained Pro Evaluation Kit (ATSAMC21-XPRO)	Shows how to create a low-power application on a SAM D21, showcasing the current measurement on Idle and Standby Sleep modes. The current consumption data is shown on the data visualizer.	Low Power Application on SAMC2x
9	Migration	This training uses the SAM D5x/E5x. The same training can be used as a reference for other MCUs.	Shows how to update and configure an existing MPLAB Harmony Configurator (MHC) based MPLAB Harmony v3 project to a MPLAB Code Configurator (MCC) based project.	Update and Configure an Existing MHC-based MPLAB Harmony v3 Project to MCC-based Project
10	IoT	PIC32CM MC00 Curiosity Nano Evaluation Kit (EV10N93A)	Shows how to develop an application prototype from a concept,without designing a Printed Circuit Board (PCB) using the 32-bit MCU-based Curiosity Nano Evaluation Kits and Nano baseboard.	Rapid prototyping with 32-bit MCU-based Curiosity Nano

1.2.3 SAM C2x/PIC32CM MC/PIC32CM JH Virtual/On-Demand Training

Table 1-10. SAM C2x/PIC32CM MC/PIC32CM JH Virtual/On-Demand Training

Sl. No	Event	Description	Link
1	Design Week 2022 - Rapid Prototyping	This session discusses how to rapidly develop IoT-centered smart appliance control application prototypes from a concept. Refer to items 2, 3, and 4 in this table for details.	Link
2	Rapid Prototyping with Curiosity Nano: Part I webinar	Discusses how to rapidly develop IoT-centered smart appliance control application prototypes from a concept. In the first part, The concept of creating a system to capture sensor data and control actuators through an I^2C interface is explained. This demonstration, though it was developed on the PIC32CM MC00 Curiosity Nano Evaluation Kit (EV10N93A), can be easily ported to the SAM D21 Curiosity Nano Evaluation Kit (DM320119).	Link
3	Rapid Prototyping with Curiosity Nano: Part II webinar	Discusses how to rapidly develop IoT-centered smart appliance control application prototypes from a concept. In the second part, the concept of creating a system to capture and display sensor data via the UART and SPI interfaces is explained. This demonstration, though it was developed on the PIC32CM MC00 Curiosity Nano Evaluation Kit (EV10N93A), can be easily ported to the SAM D21 Curiosity Nano Evaluation Kit (DM320119).	Link
4	Rapid Prototyping with Curiosity Nano: Part III webinar	Discusses how to rapidly develop IoT-centered smart appliance control application prototypes from a concept. In the third part, the concepts to add more functionality to the project created in the first part of this webinar series is explained: • Extending the project to display the data captured by sensors through the SPI. • Extending the project to add wireless capability through the UART. This demonstration, though it was developed on the PIC32CM MC00 Curiosity Nano Evaluation Kit (EV10N93A), can be easily ported to the SAM D21 Curiosity Nano Evaluation Kit (DM320119).	Link

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Sl. No	Event	Description	Link
5	Develop 32-bit MCU applications using MPLAB Harmony v3	Discusses the fundamentals of MPLAB Harmony v3, the middleware, and other design tools available for application development. It also showcases a weather station demonstration using the SAM D21 32-bit microcontroller and the SAM D21 Curiosity Nano Evaluation Kit (DM320119). The same demonstration can be ported for PIC32CM MC00 Curiosity Nano Evaluation Kit (EV10N93A).	Link
6	Tech Insights Asia 2022 - Rapid Prototyping Connected Applications With 32-Bit Microcontrollers	Tech Insights Asia 2022 - Rapid Prototyping Connected Applications With 32-Bit Microcontrollers.	Link

More virtual trainings are available at Microchip University. Click on the following links for more details:

- Introduction To MPLAB® X IDE
- MPLAB® X Tips and Tricks
- Overview of the Microchip Code Configurator (MCC) Content Manager (CM)
- MPLAB® Code Configurator (MCC) For Simplified Embedded Software Development
- ARM® Cortex®-M Architecture Overview
- Getting Started with Writing Code for the Microchip ARM® Cortex® Microcontrollers
- MPLAB® Harmony v3 Fundamentals
- Simple Applications Using the MPLAB® Harmony v3 Peripheral Libraries
- Creating Advanced Embedded Applications with 32-bit MCUs/MPUs using the MPLAB® Harmony v3 Software Framework
- FreeRTOS Simplified: A Beginner's Guide to Develop and Debug FreeRTOS Applications
- Introduction to Functional Safety
- Class B Diagnostic Libraries For Functional Safety

1.2.4   SAM C2x/PIC32CM MC/PIC32CM JH Technical Briefs

Table 1-11. SAM C2x/PIC32CM MC/PIC32CM JH Technical Briefs

Sl. No	Type/ Focus Area	Description	Link
1	Getting Started	TB3231: This document explains how to create a simple application on a SAM MCU using the MPLAB Harmony v3 modules. This application sends a "Hello World!" string to a console running on a computer. Though this document is explained on one MCU, it can be ported to other MCUs. **Note:** MPLAB Harmony v3 is configurable through MCC. Refer to items 6 and 7 in SAM C2x/ PIC32CM MC/ PIC32CM JH Videos for specific instructions to use the MCC.	Link
2	Getting Started	TB3232: This document explains how to set up the tools required to get started with the MPLAB Harmony v3 software development framework.	Link
3	Getting Started	TB3304: *How to Add a New Configuration to an Existing MPLAB Harmony v3 Project*	Link
4	Getting Started	TB3305: *How to Use the MPLAB Harmony v3 Project Manifest Feature*	Link
5	Getting Started	TB3290: *MPLAB Harmony v3 Synchronous Drivers and Their Usage in FreeRTOS Based Applications*	Link
6	Getting Started	TB3269: *The Differences Between MPLAB Harmony v3 Synchronous and Asynchronous Drivers and When to Use Them*	Link
7	Getting Started	TB3291: *The Difference Between MPLAB Harmony v3 PLIBs and Drivers, and When to Use Them*	Link
8	Getting Started	TB3227: *Clock System Configuration and Usage on SAM C2x (Cortex M0+) Devices*	Link
9	Getting Started	TB3253: *How to Build an Application by Adding a New PLIB, Driver, or Middleware to an Existing MPLAB Harmony v3 Project*	Link

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Sl. No	Type/ Focus Area	Description	Link
10	Getting Started	TB3246: *How to Use the MPLAB Harmony v3 Debug System Service*	Link
11	Peripheral Feature	TB3243: *How to Wake-up Fast from an External Event on Cortex M0+ Based MCUs*	Link
12	Peripheral Feature	TB3230: *Various Timers on SAM Devices*	Link
13	Peripheral Feature	TB3222: *EEPROM Emulation for Flash-Only Devices*	Link
14	MCU Feature	TB3183: *What is Sleepwalking? How it helps to reduce the power consumption?*	Link
15	Peripheral Feature	TB3170: *How the Event System Helps to Lower CPU Load and Power Consumption in Cortex™-M0+ Microcontrollers*	Link
16	Creating First Application on JH01	This document explains how to create a simple application on a Cortex-M0+ based PIC32CM JH01 Microcontroller using the MCC with MPLAB Harmony v3 modules. The objective of this application is to toggle an LED on a timeout basis and print the LED toggling rate	Link
17	Getting Started	TB3355: How to Use the MPLAB® Data Visualizer with 32-bit MCU based Curiosity Nano Evaluation Kits	Link

1.2.5 SAM C2x/PIC32CM MC/PIC32CM JH Application Notes

Table 1-12. SAM C2x/PIC32CM MC/PIC32CM JH Application Notes

Sl. No	Type/ Focus Area	Description	Link
1	ADC	AN3589: *Using Sigma-Delta Analog-to-Digital Converter (SDADC) on a SAMC MCU*	Link
2	Migration	AN4495: MPLAB Harmony v3 Project Migration application note discusses the migration of an existing MPLAB Harmony v3-based project developed on a particular hardware (microcontroller or development board) platform to another one of Microchip's 32-bit hardware platforms of the user's choice.	Link
3	Feature specific	AN4383: *32-bit Microcontroller Wafer-Level Chip-Scale Package (WLCSP)*	Link
4	Migration	AN3346: *Introduction to MPLAB and Harmony v3 for Atmel Studio and ASF users*	Link

1.2.6 SAM C2x/PIC32CM MC/PIC32CM JH Application Demonstrations

Table 1-13. SAM C2x/PIC32CM MC/PIC32CM JH Application Demonstrations

Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
1	Getting Started	PIC32CM MC00 Curiosity Nano Evaluation Kit (EV10N93A)	Getting Started Application Demonstration on the PIC32CM MC00 Curiosity Nano Evaluation Kit using MPLAB Harmony v3.	Link
2	Getting Started	PIC32CM MC00 Curiosity Pro Evaluation Kit (EV15N46A)	Getting Started Application on the PIC32CM MC00 Curiosity Pro Development Board.	Link
3	IoT, Automation	PIC32CM MC00 Curiosity Nano Evaluation Kit (EV10N93A)	Smart Appliance Control Application Demonstration on a PIC32CM MC00 Curiosity Nano Evaluation kit.	Link
4	IoT, Automation	PIC32CM MC00 Curiosity Nano Evaluation Kit (EV10N93A)	Temperature-based Fan Speed Control with OLED C click display on a PIC32CM MC00 Curiosity Nano Evaluation kit + Base Board using MPLAB Harmony v3.	Link
5	IoT, Automation	PIC32CM MC00 Curiosity Nano Evaluation Kit (EV10N93A)	Smart Tag Google Cloud IoT Core Application on a PIC32CM MC00 Curiosity Nano Evaluation Kit.	Link
6	Getting Started	SAM C21N Xplained Pro Evaluation Kit (ATSAMC21N-XPRO)	Getting Started Application on a SAMC21N Xplained Pro Evaluation Kit.	Link
7	Getting Started	SAM C21N Xplained Pro Evaluation Kit (ATSAMC21N-XPRO)	SDADC Conversion Interrupt Mode Application on a SAMC21N Xplained Pro Evaluation Kit.	Link
8	Getting Started	SAM C21N Xplained Pro Evaluation Kit (ATSAMC21N-XPRO)	SDADC Conversion Polling Mode Application on a SAMC21N Xplained Pro Evaluation Kit.	Link
9	Getting Started	SAM C21 Xplained Pro Evaluation Kit (ATSAMC21-XPRO)	Getting Started with Harmony v3 Drivers on a SAM C21 MCU Using FreeRTOS.	Link
10	Low Power	SAM C21 Xplained Pro Evaluation Kit (ATSAMC21-XPRO)	Low-Power Application on a SAM C21 Xplained Pro Evaluation Kit.	Link

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Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
11	Getting Started	PIC32CM JH01 Curiosity Nano+ Touch Evaluation Kit (EV29G58A)	The Getting Started Application Demonstration on PIC32CM JH01 Curiosity Nano+ Touch Evaluation Kit using MPLAB Harmony v3.	Link
12	Smart Appliance Control	PIC32CM JH01 Curiosity Nano+ Touch Evaluation Kit (EV29G58A)	This application demonstrates a smart fan control system that operates in two distinct modes: Temperature control mode and BLE control mode.	Link

More application demonstrations are available at Microchip's MPLAB Harmony GitHub repositories. Refer to the following links:

- More Application demonstrations on PIC32CM MC00 Curiosity Nano Evaluation Kit and other Development Boards/Kits having the same part number (PIC32CM1216MC00032)
- More application demonstrations on PIC32CM MC00 Curiosity Pro Development Board and other Development Boards/Kits having the same part number (PIC32CM1216MC00048)
- More application demonstrations on SAM C21 Xplained Pro evaluation kit and other Development Boards/Kits having the same part number (ATSAMC21J18A)
- More application demonstrations on SAM C21N Xplained Pro Evaluation Kit and other Development Boards/Kits having the same part number (ATSAMC21N18A)

1.2.7 SAM C2x/PIC32CM MC/PIC32CM JH Reference Designs/Solutions

Table 1-14. SAM C2x/PIC32CM MC/PIC32CM JH Reference Designs/Solutions

Sl. No	Type	Hardware Board/ Kit Used	Description	Link
1	IoT, Automation	PIC32CM MC00 Curiosity Nano Evaluation Kit (EV10N93A)	IoT Smart Asset Monitor Demonstration Application	Link
2	IoT, Automation	PIC32CM MC00 Curiosity Nano Evaluation Kit (EV10N93A)	IoT Smart Appliance Control Demonstration Application	Link
3	Graphics	SAM C21 Xplained Pro Evaluation Kit (ATSAMC21-XPRO)	Graphical User Interface Demonstrations: MPLAB Harmony v3 has various demonstration examples for creating an intuitive and reliable GUI in applications.	Link Link
4	Wireless Charging	-	Powermat Wireless Charging for Automotive Applications	Link
5	Motor Control	High-Voltage Development Board (DM330023-3) Low-Voltage Development Board (DM330021-2) PIC32CM MC00 Motor Control Plug-In Module (EV94F66A) SAM C21 Motor Control Plug-In Module (MA320206)	Motor Control for Appliances: Multiple demonstration examples are pre-configured to run on various motor control development boards to make it easy to prototype motor drive applications.	Link Link

1.2.8 SAM C2x/PIC32CM MC/PIC32CM JH Key Links

- PIC32CM JH01 Curiosity Nano+ Touch Evaluation Kit (EV29G58A)
- PIC32CM JH Family of Microcontrollers (MCUs)
- SAM C21N Xplained Pro Evaluation Kit (ATSAMC21N-XPRO)
- SAM C21 Xplained Pro Evaluation Kit (ATSAMC21-XPRO)
- PIC32CM MC00 Curiosity Nano Evaluation Kit (EV10N93A)
- PIC32CM MC00 Curiosity Pro Evaluation Kit (EV15N46A)
- MPLAB Harmony Landing Page.
- MPLAB Harmony v3 GitHub Reference Application Repository
- MPLAB Harmony v3 GitHub Quick Docs Repository

- Microchip Reference Designs Page
- Rapid Prototyping with 32-bit MCUs

1.3 SAM L21/SAM L22

Click on the following links to check various collaterals:

1. Videos.
2. Training Modules.
3. Virtual/On-Demand Training.
4. Technical Briefs.
5. Application Notes.
6. Application Demonstrations.
7. Reference Designs/Solutions.

1.3.1 SAM L2x Videos

Table 1-15. SAM L2x Videos

Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
1	Getting Started with Tools	N/A	A step-by-step guide explaining: • How to Install MPLAB® X IDE • How to Install MPLAB XC32 Compiler • How to install the Configurator • How to Download the Harmony Framework from the MPLAB Harmony v3 repository MPLAB Harmony v3 is configurable through the MCC. Refer to items 3 and 4 for specific instructions to use the MCC.	How to Set-up the Tools Required to Get Started with Harmony v3
2	Getting Started with Device/ Kit	SAM L21 Xplained Pro Evaluation Kit (ATSAML21-XPRO-B) OR SAM L22 Xplained Pro Evaluation Kit (ATSAML22-XPRO-B)	Explains how to create a simple application on the SAMD21 using MPLAB Harmony v3. This application sends a "Hello World!" string to the PC terminal. MPLAB Harmony v3 is configurable through the MCC. Refer to items 3 and 4 for specific instructions to use the MCC. The same example can be ported to the SAML2x following the same steps.	Create Your First Project with SAMD21
3	Getting Started with Software Tools	N/A	This video explains how to use the MCC Content Manager.	MPLAB® Code Configurator Content Manager
4	Getting Started with Software Tools	The video covers DM320209 and EV76S68A. The same content can be replicated for SAM L21 Xplained Pro Evaluation Kit (ATSAML21-XPRO-B).	Explains how to create a new MPLAB Harmony v3 project using the MCC and shows how to migrate an MHC-based project to an MCC-based project.	Getting Started with Harmony v3 Using Code Configurator
5	Getting started with Docs	N/A	This video introduces the Quick Docs package to help develop applications on Microchip's 32-bit products using the MPLAB Harmony v3 software framework.	Harmony Quick Docs Package
6	Getting started with Solutions	N/A	This video introduces the MPLAB Harmony v3 Reference Apps package and describes its typical application types and download methods.	Harmony Reference Applications Package

1.3.2 SAM L2x Training Modules

Table 1-16. SAM L2x Training Modules

Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
1	Low Power	SAM L21 Xplained Pro Evaluation Kit (ATSAML21-XPRO-B)	Shows how to create a low-power application on a SAM L21 showcasing the current measurement on different low-power modes. Though the training module is based on the MHC, similar steps and flow can be used to create a project using the MCC.	Low Power Application on SAM L21
2	Getting Started with Device/ Kit	SAM L21 Xplained Pro Evaluation Kit (ATSAML21-XPRO-B)	Shows how to create an application to get started with the SAM D21 using the MPLAB Harmony v3 software framework. This training module content can be easily ported for the SAM L21. Though the training module is based on the MHC, similar steps and flow can be used to create a project using the MCC.	Getting Started with Harmony v3 Peripheral Libraries on SAM D21
3	Getting started with tools	N/A	Shows how to create a new MPLAB® Code Configurator (MCC) Harmony v3 project from scratch.	Create a new MPLAB Harmony v3 project using MCC
4	Getting started with tools	N/A	Shows how to open an existing project and use it with the MCC.	MCC - Open an Existing MPLAB® Harmony v3 Project
5	Getting started with tools	N/A	Shows how to install the MPLAB® Code Configurator (MCC) plugin and how to download the MPLAB Harmony v3 framework.	MPLAB® Code Configurator Overview with MPLAB Harmony Content
6	Getting started with tools	While this training is using the SAM D5x/E5x, the same training can be used as a reference for other MCUs.	Shows how to create a new MPLAB Harmony v3 project using MCC.	Create a new MPLAB Harmony v3 project using MCC
7	Migration	While this training is using the PIC32MZ EF, the same training can be used for other MCUs.	Shows how to update and configure an existing MPLAB Harmony Configurator (MHC)-based MPLAB Harmony v3 project to an MPLAB Code Configurator (MCC)-based project.	Update and Configure an Existing MHC-based MPLAB Harmony v3 Project to MCC-based Project

1.3.3 SAM L2x Virtual/On-Demand Training

More virtual trainings are available at Microchip University. Click on the following links for more details:

- Introduction To MPLAB® X IDE
- MPLAB® X Tips and Tricks
- Overview of the Microchip Code Configurator (MCC) Content Manager (CM)
- MPLAB® Code Configurator (MCC) For Simplified Embedded Software Development
- ARM® Cortex®-M Architecture Overview
- Getting Started with Writing Code for the Microchip ARM® Cortex® Microcontrollers
- MPLAB® Harmony v3 Fundamentals
- Simple Applications Using the MPLAB® Harmony v3 Peripheral Libraries
- Creating Advanced Embedded Applications with 32-bit MCUs/MPUs using the MPLAB® Harmony
- FreeRTOS Simplified: A Beginner's Guide to Develop and Debug FreeRTOS Applications
- Class B Diagnostic Libraries For Functional Safety

1.3.4 SAM L2x Technical Briefs

Table 1-17. SAM L2x Technical Briefs

Sl. No	Type/ Focus Area	Description	Link
1	Getting Started	TB3231: This document explains how to create a simple application on a SAM MCU using the MPLAB Harmony v3 modules. This application sends a "Hello World!" string to a console running on a computer. This document is explained on one MCU, it can be ported for other MCUs. **Note:** MPLAB Harmony v3 is configurable through the MCC. Refer to items 3 and 4 in SAM L2x Videos for specific instructions to use the MCC.	Link
2	Getting Started	TB3232: This document explains how to set up the tools required to get started with the MPLAB Harmony v3 software development framework.	Link
3	Getting Started	TB3304: *How to Add a New Configuration to an Existing MPLAB Harmony v3 Project*	Link
4	Getting Started	TB3305: *How to Use the MPLAB Harmony v3 Project Manifest Feature*	Link
5	Getting Started	TB3290: *MPLAB Harmony v3 Synchronous Drivers and Their Usage in FreeRTOS Based Applications*	Link
6	Getting Started	TB3269: *The Differences Between MPLAB Harmony v3 Synchronous and Asynchronous Drivers and When to Use Them*	Link
7	Getting Started	TB3291: *The Difference Between MPLAB Harmony v3 PLIBs and Drivers, and When to Use Them*	Link
8	Getting Started	TB3253: *How to Build an Application by Adding a New PLIB, Driver, or Middleware to an Existing MPLAB Harmony v3 Project*	Link
9	Getting Started	TB3246: *How to Use the MPLAB Harmony v3 Debug System Service*	Link
10	Peripheral Feature	TB3243: *How to Wake-up Fast from an External Event on Cortex M0+ Based MCUs*	Link
11	Peripheral Feature	TB3230: *Various Timers on SAM Devices*	Link
12	Peripheral Feature	TB3222: *EEPROM Emulation for Flash-Only Devices*	Link
13	MCU Feature	TB3183: *What is Sleepwalking? How it helps to reduce the power consumption?*	Link
14	Peripheral Feature	TB3170: *How the Event System Helps to Lower CPU Load and Power Consumption in Cortex™-M0+ Microcontrollers*	Link

1.3.5 SAM L2x Application Notes

Table 1-18. SAM L2x Application Notes

Sl. No	Type/ Focus Area	Description	Link
1	Migration	AN4495: MPLAB Harmony v3 Project Migration application note discusses the migration of an existing MPLAB Harmony v3-based project developed on a particular hardware (microcontroller or development board) platform to another one of Microchip's 32-bit hardware platforms of the user's choice.	Link
2	Feature specific	AN4383: 3*2-bit Microcontroller Wafer-Level Chip-Scale Package (WLCSP)*	Link
3	Migration	AN3346: *Introduction to MPLAB and Harmony v3 for Atmel Studio and ASF Users*	Link

1.3.6 SAM L2x Application Demonstrations

Table 1-19. SAM L2x Application Demonstrations

Sl. No	Type	Hardware Board/ Kit Used	Demonstration Description	Link
1	Low Power	SAM L21 Xplained Pro Evaluation Kit (ATSAML21-XPRO-B)	Low-Power Application on SAM L21 Xplained Pro Evaluation Kit.	Link
2	IoT	SAM L21 Xplained Pro Evaluation Kit (ATSAML21-XPRO-B)	BLE Fitness Tracker Application on SAM L21 Xplained Pro Evaluation Kit.	Link
3	Automation	SAM L22 Xplained Pro Evaluation Kit (ATSAML22-XPRO-B)	SD Card USB Data Logger Application on SAM L22 Xplained Pro Evaluation Kit using MPLAB Harmony v3.	Link
4	Graphics	SAM L22 Xplained Pro Evaluation Kit (ATSAML22-XPRO-B)	Graphical User Interface Demonstrations: MPLAB Harmony v3 has various demonstration examples for creating an intuitive and reliable GUI in applications.	Reference design Link and Graphics demonstration link

More application demonstrations are available at Microchip's MPLAB Harmony GitHub repositories. Refer to the following links:

- More application demonstrations on SAM L21 Xplained Pro Evaluation Kit and other Development Boards/Kits having the same part number (ATSAML21J18B)
- More application demonstrations on SAM L22 Xplained Pro Evaluation Kit and other Development Boards/Kits having the same part number (ATSAML22N18A)

1.3.7 SAM L2x Reference Designs/ Solutions

Table 1-20. SAM L2x Reference Designs/ Solutions

Sl. No	Type	Hardware Board/ Kit Used	Description	Link
1	IoT, Automation	SAM L21 Xplained Pro Evaluation Kit (ATSAML21-XPRO-B)	Bluetooth® Low Energy-Based Weather Station Demonstration	Link

1.3.8 SAM L2x Key Links

- SAM L21 Xplained Pro Evaluation Kit (ATSAML21-XPRO-B)
- SAM L22 Xplained Pro Evaluation (ATSAML22-XPRO-B)
- MPLAB Harmony Landing Page
- MPLAB Harmony v3 GitHub Reference Application Repository
- MPLAB Harmony v3 GitHub Quick Docs Repository
- Microchip Reference Designs Page

2. Cortex M23 Family of Devices

2.1 PIC32CM LE00/LS00/LS60

Click on the following links to check various collaterals:

1. Videos.
2. Training Modules.
3. Virtual / On-Demand Training.
4. Technical Briefs.
5. Application Notes.
6. Application Demonstrations.
7. Reference Designs/ Solutions.

2.1.1 PIC32CM Lx Videos

Table 2-1. PIC32CM Lx Videos

Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
1	Getting Started with Tools	N/A	A step-by-step guide explaining: • How to Install MPLAB® X IDE • How to Install MPLAB XC32 Compiler • How to install the Configurator • How to Download Harmony Framework from MPLAB Harmony v3 repository MPLAB Harmony v3 is configurable through the MCC. Refer to items 6 and 7 for specific instructions to use the MCC.	How to Set-up the Tools Required to Get Started with Harmony v3
2	Getting Started with Tools	PIC32CM LE00 Curiosity Pro Evaluation Kit (EV80P12A)	Introduces the PIC32CM LE00 Curiosity Pro Evaluation Kit and explains the key features of the board.	PIC32CM LE00 Curiosity Pro Evaluation Kit Overview
3	Getting Started with application	PIC32CM LE00 Curiosity Pro Evaluation Kit (EV80P12A)	Explains how to create a simple application on the PIC32CM LE00 using the MCC. This application demonstrates how to toggle an LED by pressing the switch on a timeout basis and viewing the LED toggling rate on the serial terminal.	Getting Started with PIC32CM LE00 Curiosity Pro Evaluation Kit
4	Getting Started with Device/ Kit	PIC32CM LS60 Curiosity Pro Evaluation Kit (EV76R77A) or PIC32CM LS00 Curiosity Pro Evaluation Kit (EV12U44A)	Introduces TrustZone®-based security on the PIC32CM LSx Microcontrollers and shows how to create a simple TrustZone®-based application using the MCC. The application has two projects pertaining to Secure and Non-Secure modes of the PIC32CM LS60/LS00 that work together on the same MCU. It offers security isolation between the trusted and the non-trusted resources in the device.	Getting Started With the TrustZone®-based Security on PIC32CM LSx
5	Getting Started with Software Tools	N/A	Explains how to use the MCC Content Manager	MPLAB® Code Configurator Content Manager
6	Getting started with Docs	N/A	Introduces the Quick Docs package to help develop applications using Microchip's 32-bit products using the MPLAB Harmony v3 software framework.	Harmony Quick Docs Package
7	Getting started with Solutions	N/A	Introduces the MPLAB Harmony Reference Apps package and describes its typical application types and download methods.	Harmony Reference Applications Package

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Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
8	Overview of the PIC32CM LS00 Curiosity Pro Evaluation kit	PIC32CM LS00 Curiosity Pro Evaluation kit (EV12U44A)	The video explains robust security features like secure boot, Crypto accelerator & Arm® TrustZone® Technology, paired with enhanced peripherals like PTC, Op Amps, ADC, DAC, and Analog comparators. With an Arduino® Uno connector, microBUS socket, and expansion headers, this kit offers limitless development possibilities.	PIC32CM LS00 Curiosity Pro Evaluation Kit Overview
9	Overview of the PIC32CM LS60 Curiosity Pro Evaluation kit	PIC32CM LS60 Curiosity Pro Evaluation kit (EV76R77A)	The video says industry's first ultra-low power microcontroller that brings together a JIL 'High' rated secure subsystem and Arm® TrustZone in one package. The MCU integrates TrustFLEX ECC608 secure subsystem & Arm® TrustZone® Technology in one package.	PIC32CM LS60 Curiosity Pro Evaluation Kit

2.1.2 PIC32CM Lx Training Modules

Table 2-2. PIC32CM Lx Training Modules

Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
1	Getting Started with Device/ Kit	PIC32CM LE00 Curiosity Pro Evaluation Kit (EV80P12A) or PIC32CM LS60 Curiosity Pro Evaluation Kit (EV76R77A) or PIC32CM LS00 Curiosity Pro Evaluation Kit (EV12U44A)	This training module shows how to create an application to get started with the SAM L10 using the MPLAB Harmony v3 software framework. This training module content can be easily ported for the PIC32CM LE00/ LS00/ LS60. Though the training module is based on the MHC, similar steps and flow can be used to create a project using the MCC.	Getting Started with Harmony v3 Peripheral Libraries on SAM L10
2	Getting started with tools	N/A	Shows how to create a new MPLAB® Code Configurator (MCC) Harmony v3 project from scratch.	Create a new MPLAB Harmony v3 project using MCC
3	Getting started with tools	N/A	Shows how to open an existing project and use it with the MCC.	MCC - Open an Existing MPLAB® Harmony v3 Project
4	Getting started with tools	N/A	Shows how to install the MPLAB® Code Configurator (MCC) plugin and how to download the MPLAB Harmony v3 framework..	MPLAB® Code Configurator Overview with MPLAB Harmony Content
5	Getting started with tools	This training uses the SAM D5x/E5x. The same training can be used as a reference for other MCUs.	Shows how to create a new MPLAB Harmony v3 project using the MCC.	Create a new MPLAB Harmony v3 project using MCC
6	Application Specific	PIC32CM LE00 Curiosity Pro Evaluation Kit (EV80P12A) or PIC32CM LS60 Curiosity Pro Evaluation Kit (EV76R77A) or PIC32CM LS00 Curiosity Pro Evaluation Kit (EV12U44A)	Shows how to create a low-power application on a SAM L1x, showcasing the current measurement on Idle and Standby Sleep modes. The current consumption data is shown on the data visualizer. The same training module methodology can be ported to the PIC32CM Lx MCU.	Low Power Application on SAM L10

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Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
7	Product Feature	PIC32CM LE00 Curiosity Pro Evaluation Kit (EV80P12A) or PIC32CM LS60 Curiosity Pro Evaluation Kit(EV76R77A) or PIC32CM LS00 Curiosity Pro Evaluation Kit (EV12U44A)	Shows how to create an Arm® TrustZone® feature application on the SAM L11 microcontroller (MCU) using the MPLAB Harmony v3 software framework.	Arm® TrustZone® Getting Started Application on SAM L11 MCUs
8	Secure Boot on PIC32CM LS60 Curiosity Pro Evaluation Kit	PIC32CM LS60 Curiosity Pro Evaluation Kit (EV76R77A)	This tutorial shows how to use the Secure Boot feature on the PIC32CM LS60 microcontroller (MCU) using ATECC608B to create a Secure Bootloader and an application that is loaded using the Secure Bootloader. This tutorial helps you get started in developing secure applications on PIC32CM LS60 MCUs using Microchip's Trust Platform Design Suite (TPDS) and MPLAB Harmony v3 software framework.	Secure Boot on PIC32CM LS60 Curiosity Pro Evaluation Kit using MPLAB® Harmony v3 Software Framework
9	Low Power Application on a PIC32CM LE00 MCU	PIC32CM LE00 Evaluation Kit (EV80P12A)	This tutorial shows how to create a low power application on a PIC32CM LE00 MCU using the MPLAB® Harmony v3 software framework.	Low Power Application on PIC32CM LE00 (Cortex M23) MCUs Using MPLAB® Harmony v3 Peripheral Libraries
10	Arm® TrustZone® Getting Started	PIC32CM LS60 Curiosity Pro Evaluation Kit (EV76R77A)	This tutorial shows how to create an Arm® TrustZone® technology feature application on a PIC32CM LS60 microcontroller (MCU) using MPLAB® Harmony v3 software framework.	Arm® TrustZone® Getting Started Application on PIC32CM LS60 (Arm Cortex®-M23) MCUs

2.1.3 PIC32CM Lx Virtual/On-Demand Training

More virtual trainings are available at Microchip University. Click on the following links for more details:

- Introduction To MPLAB® X IDE
- MPLAB® X Tips and Tricks
- Overview of the Microchip Code Configurator (MCC) Content Manager (CM)
- MPLAB® Code Configurator (MCC) For Simplified Embedded Software Development
- ARM® Cortex®-M Architecture Overview
- Getting Started with Writing Code for the Microchip ARM® Cortex® Microcontrollers
- MPLAB® Harmony v3 Fundamentals
- Simple Applications Using the MPLAB® Harmony v3 Peripheral Libraries
- Creating Advanced Embedded Applications with 32-bit MCUs/MPUs using the MPLAB® Harmony v3 Software Framework
- FreeRTOS Simplified: A Beginner's Guide to Develop and Debug FreeRTOS Applications

2.1.4 PIC32CM Lx Technical Briefs

Table 2-3. PIC32CM Lx Technical Briefs

Sl. No	Type/ Focus Area	Description	Link
1	Getting Started	TB3231: This document explains how to create a simple application on SAM MCU using the MPLAB Harmony v3 modules. This application sends a "Hello World!" string to a console running on a computer. Though this document is explained on one MCU, it can be ported for other MCUs. **Note:** MPLAB Harmony v3 is configurable through the MCC. Refer to items 3 and 4 in PIC32CM Lx Videos for specific instructions to use the MCC.	Link
2	Getting Started	TB3232: This document explains how to set up the tools required to get started with the MPLAB Harmony v3 software development framework.	Link
3	Getting Started	TB3304: *How to Add a New Configuration to an Existing MPLAB Harmony v3 Project*	Link
4	Getting Started	TB3305: *How to Use the MPLAB Harmony v3 Project Manifest Feature*	Link
5	Getting Started	TB3290: *MPLAB Harmony v3 Synchronous Drivers and Their Usage in FreeRTOS Based Applications*	Link
6	Getting Started	TB3269: *The Differences Between MPLAB Harmony v3 Synchronous and Asynchronous Drivers and When to Use Them*	Link
7	Getting Started	TB3291: *The Difference Between MPLAB Harmony v3 PLIBs and Drivers, and When to Use Them*	Link
8	Getting Started	TB3253: *How to Build an Application by Adding a New PLIB, Driver, or Middleware to an Existing MPLAB Harmony v3 Project*	Link
9	Getting Started	TB3246: *How to Use the MPLAB Harmony v3 Debug System Service*	Link
10	Peripheral Feature	TB3306: *Dual Developer Application Development Use Case with TrustZone on SAM L11 Using MPLAB Harmony v3*	Link
11	Low Power	TB3318: *Peripheral Power Consumption in Standby Mode for SAM L10/L11 Family of Devices*	Link
12	Peripheral Feature	TB3222: *EEPROM Emulation for Flash-Only Devices*	Link
13	MCU Feature	TB3183: *What is Sleepwalking? How it Helps to Reduce Power Consumption?*	Link
14	Getting Started	TB3342: *Creating the First Application on PIC32CM LSx Microcontrollers Using MPLAB Harmony v3 with MPLAB Code Configurator (MCC)*	Link
15	Getting Started	TB3355: *How to Use the MPLAB® Data Visualizer with 32-bit MCU based Curiosity Nano Evaluation Kits*	Link

2.1.5 PIC32CM Lx Application Notes

Table 2-4. PIC32CM Lx Application Notes

Sl. No	Type/ Focus Area	Description	Link
1	Getting Started	AN4511: *Getting Started with the PIC32CM LE00/LS00/LS60 Curiosity Pro Board*	Link
2	IoT, Connectivity	AN4152 - *PIC32CM LS00/LS60 Ultra Low-Power Secure LoRa Demonstration*	Link
3	Migration	AN4495: MPLAB Harmony v3 Project Migration application note discusses the migration of an existing MPLAB Harmony v3 based project developed on a particular hardware (microcontroller or development board) platform to another one of Microchip's 32-bit hardware platforms of the user's choice.	Link
4	Migration	AN3346: *Introduction to MPLAB and Harmony v3 for Atmel Studio and ASF Users*	Link

2.1.6 PIC32CM Lx Application Demonstrations

Table 2-5. PIC32CM Lx Application Demonstrations

Sl. No	Type	Hardware Board/ Kit Used	Description	Link
1	Getting started	PIC32CM LE00 Curiosity Pro	*Getting Started Extended Application on PIC32CM LE00 Curiosity Pro Evaluation Kit*	Link
2	Getting started feature	PIC32CM LS00 Curiosity Pro	*TrustZone Getting Started on PIC32CM LS00 Curiosity Pro Evaluation Kit*	Link
3	Getting started feature	PIC32CM LS60 Curiosity Pro	*TrustZone Getting Started on PIC32CM LS60 Curiosity Pro Evaluation Kit*	Link

...........continued

Sl. No	Type	Hardware Board/ Kit Used	Description	Link
4	AWS Secure Cloud Connect	PIC32CM LS60 Curiosity Pro Evaluation Kit (EV76R77A)	This specific development board can be pre-provisioned for AWS IoT Core; The application demonstrates MQTT data transfer of light and temperature sensor data from IO1Xpro to AWS IoT core.	Link
5	Secure IoT Gateway	PIC32CM LS60 Curiosity Pro Evaluation Kit (EV76R77A)	This application demonstrates the anti-cloning feature on the PIC32CM LS60 microcontroller (MCU) using ATECC608B secure element. The application has three projects pertaining to Secure and Non-Secure modes of PIC32CM LS60 that work between the Host and Client devices (PIC32CM LS60/LE00) and offers security isolation between the trusted and the non-trusted resources in the device.	Link
6	Smart Lock	PIC32CM LS60 Curiosity Pro Evaluation Kit (EV76R77A)	The application showcases key-less secure access control and monitoring of a deadbolt through multiple methods.	Link

More application demonstrations are available at Microchip's MPLAB Harmony GitHub repositories. Refer to the following links:

- More application demonstrations on PIC32CM LS60 Curiosity Pro Evaluation Kit and other Development Boards/Kits having the same part number (PIC32CM5164LS60100)
- More application demonstrations on PIC32CM LS00 Curiosity Pro Evaluation Kit and other Development Boards/Kits having the same part number (PIC32CM5164LS00100)
- More application demonstrations on PIC32CM LE00 Curiosity Pro Evaluation Kit and other Development Boards/Kits having the same part number (PIC32CM5164LE00100)

2.1.7 PIC32CM Lx Reference Designs/ Solutions

Table 2-6. PIC32CM Lx Reference Designs/ Solutions

Sl. No	Type	Hardware Board/ Kit Used	Description	Link
1	PTC, MCU feature	PIC32CM LE00 ULP Water-Tolerant Touch Reference Design (EV55S83A)	Water Tolerant Demonstration Application	Link
2	MCU Feature	Smart Home Lock Reference Design Kit (BN33J40A)	Showcases keyless secure access control and monitoring of a mechanical lock through capacitive touch keypad or a smartphone app.	Link
3	MCU Feature	Secure IoT Gateway	The Secure IoT Gateway application provides a secure, pre-configured, compact and managed solution for Internet of Things (IoT) applications. It is designed to provide robust security and connectivity for devices operating on the edge of the network.	Link

2.1.8 PIC32CM Lx Key Links

- PIC32CM LS60 Curiosity Pro Evaluation Kit (EV76R77A)
- PIC32CM LS00 Curiosity Pro Evaluation Kit (EV12U44A)
- PIC32CM LE00 Curiosity Pro Evaluation Kit (EV80P12A)
- PIC32CM LE00 ULP Water-Tolerant Touch Reference Design (EV55S83A)
- PIC32CM Lx Family of Microcontrollers (MCUs)
- PIC32CM LS00 Curiosity Nano+ Touch Evaluation Kit (EV41C56A)
- MPLAB Harmony Landing Page
- MPLAB Harmony v3 GitHub Reference Application Repository
- MPLAB Harmony v3 GitHub Quick Docs Repository
- Microchip Reference Designs Page

2.2 SAM L10/SAM L11

Click on the below links to check various collaterals.

MICROCHIP

1. Videos.
2. Training Modules.
3. Virtual/On-Demand Training.
4. Technical Briefs.
5. Application Notes.
6. Application Demonstrations.

2.2.1 SAM L1x Videos

Table 2-7. SAM L1x Videos

Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
1	Getting Started with Tools	N/A	A step-by-step guide explaining: • How to Install MPLAB® X IDE • How to Install MPLAB XC32 Compiler • How to install the Configurator • How to Download the Harmony Framework from the MPLAB Harmony v3 repository MPLAB Harmony v3 is configurable through the MCC. Refer to items 3 and 4 for specific instructions to use the MCC.	How to Set-up the Tools Required to Get Started with Harmony v3
2	Getting Started with Device/ Kit	SAM L11 Xplained Pro Evaluation Kit (DM320205) or SAM L10 Xplained Pro Evaluation Kit (DM320204)	Explains how to create a simple application on the SAM L11 using Harmony v3. This application sends a "Hello World!" string to the PC terminal. MPLAB Harmony v3 is configurable through the MCC. Refer to items 3 and 4 for specific instructions to use the MCC.	Create Your First Project with SAML11
3	Getting Started with Software Tools	N/A	Explains how to use the MCC Content Manager.	MPLAB® Code Configurator Content Manager
4	Getting Started with Software Tools	The video covers DM320209 and EV76S68A. The same content can be replicated for SAM L10/L11 Xplained Pro Evaluation Kits (DM320205/DM320204).	This video explains how to create a new MPLAB Harmony v3 project using the MCC and shows how to migrate an MHC-based project to an MCC-based project.	Getting Started with Harmony v3 Using Code Configurator
5	Getting started with Docs	N/A	Introduces the Quick Docs package to help develop applications using Microchip's 32-bit products using the MPLAB Harmony v3 software framework.	Harmony Quick Docs Package
6	Getting started with Solutions	N/A	Introduces the MPLAB Harmony Reference Apps package and describes its typical application types and download methods.	Harmony Reference Applications Package

2.2.2 SAM L1x Training Modules

Table 2-8. SAM L1x Training Modules

Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
1	Getting Started with Device/Kit	SAM L11 Xplained Pro Evaluation Kit (DM320205) or SAM L10 Xplained Pro Evaluation Kit (DM320204)	Shows how to create an application to get started with the SAM L10 using the MPLAB Harmony v3 software framework. This training module content can be easily ported for the PIC32CM LE00/ LS00/ LS60.	Getting Started with Harmony v3 Peripheral Libraries on SAM L10
2	Getting started with tools	N/A	Shows how to create a new MPLAB Code Configurator (MCC) Harmony project from scratch.	Create a new MPLAB Harmony v3 project using MCC
3	Getting started with tools	N/A	Shows how to open an existing project and use it with the MCC.	MCC - Open an Existing MPLAB® Harmony v3 Project
4	Getting started with tools	N/A	Shows how to install the MPLAB Code Configurator (MCC) plugin and how to download the MPLAB Harmony v3 framework.	MPLAB® Code Configurator Overview with MPLAB Harmony Content
5	Getting started with tools	This training uses the SAM D5x/E5x. The same training can be used as a reference for other MCUs.	Shows how to create a new MPLAB Harmony v3 project using the MCC.	Create a new MPLAB Harmony v3 project using MCC
6	Application Specific	SAM L11 Xplained Pro Evaluation Kit (DM320205) or SAM L10 Xplained Pro Evaluation Kit (DM320204)	Shows how to create a low-power application on a SAM L1x showcasing the current measurement on Idle and Standby Sleep modes. The current consumption data is shown on the data visualizer. The same training module methodology can be ported to the SAM L1x MCU.	Low Power Application on SAM L10
7	Product Feature	SAM L11 Xplained Pro Evaluation Kit (DM320205)	Shows how to create an Arm® TrustZone® feature application on the SAM L11 microcontroller (MCU) using the MPLAB Harmony v3 software framework.	Arm® TrustZone® Getting Started Application on SAM L11 MCUs

2.2.3 SAML1x Virtual/On-Demand Training

More virtual trainings are available at Microchip University. Click on the following links for more details:

- Introduction To MPLAB® X IDE
- MPLAB® X Tips and Tricks
- Overview of the Microchip Code Configurator (MCC) Content Manager (CM)
- MPLAB® Code Configurator (MCC) For Simplified Embedded Software Development
- ARM® Cortex®-M Architecture Overview
- Getting Started with Writing Code for the Microchip ARM® Cortex® Microcontrollers
- MPLAB® Harmony v3 Fundamentals
- Simple Applications Using the MPLAB® Harmony v3 Peripheral Libraries
- Creating Advanced Embedded Applications with 32-bit MCUs/MPUs using the MPLAB® Harmony v3 Software Framework
- FreeRTOS Simplified: A Beginner's Guide to Develop and Debug FreeRTOS Applications

2.2.4 SAM L1x Technical Briefs

Table 2-9. SAM L1x Technical Briefs

Sl. No	Type/ Focus Area	Description	Link
1	Getting Started	TB3231: This document explains how to create a simple application on a SAM MCU using the MPLAB Harmony v3 modules. This application sends a "Hello World!" string to a console running on a computer. Though this document is explained on one MCU, it can be ported for other MCUs. **Note:** MPLAB Harmony v3 is configurable through the MCC. Refer to items 3 and 4 in SAM L1x Videos for specific instructions to use the MCC.	Link
2	Getting Started	TB3232: This document explains how to set up the tools required to get started with the MPLAB Harmony v3 software development framework.	Link
3	Getting Started	TB3304: *How to Add a New Configuration to an Existing MPLAB Harmony v3 Project*	Link
4	Getting Started	TB3305: *How to Use the MPLAB Harmony v3 Project Manifest Feature*	Link
5	Getting Started	TB3290: *MPLAB Harmony v3 Synchronous Drivers and Their Usage in FreeRTOS Based Applications*	Link
6	Getting Started	TB3269: *The Differences Between MPLAB Harmony v3 Synchronous and Asynchronous Drivers and When to Use Them*	Link
7	Getting Started	TB3291: *The Difference Between MPLAB Harmony v3 PLIBs and Drivers, and When to Use Them*	Link
8	Getting Started	TB3253: *How to Build an Application by Adding a New PLIB, Driver, or Middleware to an Existing MPLAB Harmony v3 Project*	Link
9	Getting Started	TB3246: *How to Use the MPLAB Harmony v3 Debug System Service*	Link
10	Peripheral Feature	TB3306: *Dual Developer Application Development Use Case with TrustZone on SAM L11 Using MPLAB Harmony v3*	Link
11	Low Power	TB3318: *Peripheral Power Consumption in Standby Mode for SAM L10/L11 Family of Devices*	Link
12	Peripheral Feature	TB3222: *EEPROM Emulation for Flash-Only Devices*	Link
13	MCU Feature	TB3183: *What is Sleepwalking? How it Helps to Reduce the Power Consumption?*	Link

2.2.5 SAM L1x Application Notes

Table 2-10. SAM L1x Application Notes

Sl. No	Type/ Focus Area	Description	Link
1	Migration	AN4495: *MPLAB Harmony v3 Project Migration* application note discusses the migration of an existing MPLAB Harmony v3 based project developed on a particular hardware (microcontroller or development board) platform to another one of Microchip's 32-bit hardware platforms of the user's choice.	Link
2	Feature specific	AN4383: *32-bit Microcontroller Wafer-Level Chip-Scale Package (WLCSP).*	Link
3	Migration	AN3346: *Introduction to MPLAB and Harmony v3 for Atmel Studio and ASF Users.*	Link
4	Op Amp, ADC	AN2794: *SAM L10/ L11: OPAMP as ADC Gain Amplifier.* This document introduces the configuration and usage of the op amp module, different built-in modes, and presents an application example. In the application example, one of the operational amplifiers is configured as a non-inverting gain amplifier with the output internally connected to the ADC. With this setup, the op amp operates as a gain amplifier stage for ADC sampling.	Link
5	MCU Feature	AN2775: *CPU Usage Demonstration Using DMAC for SAM L10/ L11*: This document demonstrates the CPU usage when an application is executed with or without the DMA.	Link
6	Bootloader	AN2699: *UART Bootloader SAM L10 and L11*: This document describes the design and operation of a UART Bootloader for the SAM L10 and SAM L11 devices.	Link
7	IOT, Security	AN2835: *SAML11 Ultra Low-Power Secure LoRa* Application Note.	Link
8	Bootloader, Security	AN2698: *Secure Bootloader SAML11.*	Link

2.2.6 SAM L1x Application Demonstrations

Table 2-11. SAM L1x Application Demonstrations

Sl. No	Type	Hardware Board/ Kit Used	Description	Link
1	Getting Started	SAM L10 Xplained Pro Evaluation Kit (DM320204)	Getting Started Application on SAM L10 Xplained Pro Evaluation Kit	Link
2	Security	SAM L11 Xplained Pro Evaluation Kit (DM320205)	TrustZone Getting Started Application on the SAM L11 Xplained Pro Evaluation Kit	Link
3	Low Power	SAM L10 Xplained Pro Evaluation Kit (DM320204)	Low-Power Application on the SAM L10 Xplained Pro Evaluation Kit	Link

More application demonstrations are available at Microchip's MPLAB Harmony GitHub repositories. Refer to the following links:

- More application demonstrations on SAM L10 Xplained Pro Evaluation Kit and other Development Boards/Kits having the same part number (ATSAML10E16A)
- More application demonstrations on SAM L11 Xplained Pro Evaluation Kit and other Development Boards/Kits having the same part number (ATSAML11E16A)

2.2.7 SAM L1x Key Links

- SAML11 Xplained Pro Evaluation kit (DM320205)
- SAM L10 Xplained Pro Evaluation kit (DM320204)
- MPLAB Harmony Landing Page
- MPLAB Harmony v3 GitHub Reference Application Repository
- MPLAB Harmony v3 GitHub Quick Docs Repository
- Microchip Reference Designs Page

3. Cortex M33 Family of Devices

3.1 PIC32CK SG/GC

Click on the following links to view the various collaterals:

1. Videos.
2. Training Modules.
3. Virtual/On-Demand Training.
4. Technical Briefs.
5. Application Notes.
6. Application Demonstrations.

3.1.1 PIC32CK SG/GC Videos

Table 3-1. PIC32CK SG/GC Videos

Sl.No	Type / Focus Area	Hardware Board / Kit Used	Description	Link
1	Getting Started with Tools	N/A	A step-by-step guide explaining the following: • How to Install MPLAB® X IDE • How to Install MPLAB XC32 Compiler • How to install the Configurator • How to Download the Harmony Framework from MPLAB Harmony v3 repositories on GitHub MPLAB Harmony v3 is configurable through the MCC Refer to items 6 and 7 for specific instructions to use the MCC.	How to Set-up the Tools Required to Get Started with MPLAB Harmony v3
2	Getting Started with Software Tools	N/A	Explains how to use the MCC Content Manager.	MPLAB® Code Configurator Content Manager
3	Getting Started with Software Tools	Though the video covers DM320209 and EV76S68A, the same content can be replicated for PIC32CK SG Curiosity Ultra Development Board	Explains how to create a new MPLAB Harmony v3 project using the MCC and shows how to migrate an MHC-based project to an MCC- based project.	Getting Started with Harmony v3 Using Code Configurator
4	Getting started with Docs	N/A	Introduces the Quick Docs package to help develop applications using Microchip's 32-bit products using the MPLAB Harmony v3 software framework.	Harmony Quick Docs Package
5	Getting started with Solutions	N/A	Introduces the MPLAB Harmony Reference Apps package and describes its typical application types and download methods.	Harmony Reference Applications Package
6	TrustZone Getting started with PIC32CK SG	PIC32CK SG Curiosity Ultra development board (EV33A17A)	This video introduces the PIC32CK SG01 Curiosity Ultra Development Board using MPLAB Harmony and MCC. The project demonstrates TrustZone by separating Secure and Non-Secure applications.	Getting Started with TrustZone using PIC32CK SG01

3.1.2 PIC32CK SG/GC Training Modules

Table 3-2. PIC32CK SG/GC Training Modules

SL.No	Type / Focus Area	Hardware Board / Kit Used	Description	Link
1	Getting Started with Tools	N/A	Shows how to create a new MPLAB Code Configurator (MCC) Harmony v3 project from scratch.	Create a new MPLAB Harmony v3 project using MCC
2	Getting Started with Tools	N/A	Shows how to open an existing project and use it with the MCC.	MCC - Open an Existing MPLAB® Harmony v3 Project
3	Getting Started with Tools	N/A	Shows how to install the MPLAB Code Configurator (MCC) plugin, and how to download the MPLAB Harmony v3 framework.	MPLAB® Code Configurator Overview with MPLAB Harmony Content
4	Getting Started with Tools	This training uses the SAMD5x/E5x. The same training can be used as a reference for other MCUs.	Shows how to create a new MPLAB Harmony v3project using the MCC.	Create a new MPLAB Harmony v3 project using MCC
5	Migration	This training uses the PIC32MZ EF. The same training can be used for other MCUs.	Shows how to update and configure an existing MPLAB Harmony Configurator (MHC)-based MPLAB Harmony v3 project to a MPLAB Code Configurator(MCC) - based project.	Update and Configure an Existing MHC-based MPLAB Harmony v3 Project to MCC based Project
6	Getting Started	PIC32CK SG01 Curiosity Ultra Development Board (EV33A17A)	This application demonstrates the TrustZone feature on the PIC32CK SG01 microcontroller (MCU). The application has two projects pertaining to Secure and Non-Secure modes of PIC32CK SG01 that work together on the same MCU and offers security isolation between the trusted and the non-trusted resources in the device.	Arm® TrustZone® Technology Getting Started Application on PIC32CK SG01 (Cortex®-M33) MCUs

3.1.3 PIC32CK SG/GC Virtual / On - Demand Training

More virtual trainings are available at Microchip University. Click on the following links for more details:

1. Introduction To MPLAB®XIDE
2. MPLAB®X Tips and Tricks
3. Overview of the Microchip Code Configurator (MCC) Content Manager (CM)
4. MPLAB®Code Configurator (MCC) For Simplified Embedded Software Development
5. ARM®Cortex®-M Architecture Overview
6. Getting Started with Writing Code for the Microchip ARM®Cortex® Microcontrollers
7. MPLAB®Harmonyv3 Fundamentals
8. Simple Applications Using the MPLAB® Harmony v3 Peripheral Libraries
9. Creating Advanced Embedded Applications with 32-bit MCUs/MPUs using the MPLAB®Harmony v3 Software Framework
10. FreeRTOS Simplified: A Beginner's Guide to Develop and Debug FreeRTOS Applications
11. Class B Diagnostic Libraries For Functional Safety

3.1.4 PIC32CK SG/GC Technical Briefs

Table 3-3. PIC32CK SG/GC Technical Briefs

Sl. No	Type / Focus Area	Description	Link
1	Getting Started	TB3231: This document explains how to create a simple application on a SAM MCU using the MPLAB Harmony v3 modules. This application sends a "Hello World!" string to a console running on a computer. Though this document is explained on one MCU, it can be ported to other MCUs.	Link
2	Getting Started	TB3232: This document explains how to set up the tools required to get started with the MPLAB Harmony v3 software development framework.	Link
3	Getting Started	TB3304: *How to Add a New Configuration to an Existing MPLAB Harmony v3 Project*	Link
4	Getting Started	TB3305: *How to Use the MPLAB Harmony v3 Project Manifest Feature*	Link
5	Getting Started	TB3290: *MPLAB Harmony v3 Synchronous Drivers and Their Usage in FreeRTOS Based Applications*	Link
6	Getting Started	TB3269: *The Differences Between MPLAB Harmony v3 Synchronous and Asynchronous Drivers and When to Use Them*	Link
7	Getting Started	TB3291: *The Difference Between MPLAB Harmony v3 PLIBs and Drivers, and When to Use Them*	Link
8	Getting Started	TB3227: *Clock System Configuration and Usage on SAM C2x (Cortex M0+) Devices*	Link
9	Getting Started	TB3253: *How to Build an Application by Adding a New PLIB, Driver, or Middleware to an Existing MPLAB Harmony v3 Project*	Link
10	Getting Started	TB3246: *How to Use the MPLAB Harmony v3 Debug System Service*	Link
11	Peripheral Feature	TB3243: *How to Wake-up Fast from an External Event on Cortex M0+ Based MCUs*	Link
12	Peripheral Feature	TB3230: *Various Timers on SAM Devices*	Link
13	Peripheral Feature	TB3222: *EEPROM Emulation for Flash-Only Devices*	Link
14	MCU Feature	TB3183: *What is Sleepwalking? How it helps to reduce the power consumption?*	Link
15	Peripheral Feature	TB3170: *How the Event System Helps to Lower CPU Load and Power Consumption in Cortex™-M0+ Microcontrollers*	Link
16	Getting Started	TB3358: *Creating the First Application on PIC32CK GC Microcontrollers Using MPLAB Harmony v3 with MPLAB Code Configurator (MCC)*	Link

3.1.5 PIC32CK SG/GC Application Notes

Table 3-4. PIC32CK SG/GC Application Notes

Sl. No	Type/ Focus Area	Description	Link
1	Migration	AN4495: MPLAB Harmony v3 Project Migration application note discusses the migration of an existing MPLAB Harmony v3-based project developed on a particular hardware (microcontroller or development board)platform to another one of Microchip's 32-bit hardware platforms of the user's choice.	Link
2	Feature specific	AN4383: *32-bit Microcontroller Wafer-Level Chip-Scale Package(WLCSP)*	Link
3	Migration	AN3346: *Introduction to MPLAB and Harmony v3 for Atmel Studio and ASF Users*	Link

3.1.6 PIC32CK SG/GC Application Demonstrations

Table 3-5. PIC32CK SG/GC Application Demonstrations

Sl. No	Type/ Focus Area	Hardware Kit Used	Description	Link
1	Getting Started	PIC32CK SG Curiosity Ultra Development Board	This application demonstrates the TrustZone feature on the PIC32CK SG01 microcontroller (MCU). The application has two projects pertaining to Secure and Non-Secure modes of PIC32CK SG01 that work together on the same MCU and offers security isolation between the trusted and the non-trusted resources in the device.	Link

3.1.7 PIC32CK SG/GC Key Links

- PIC32CK SG/GC Family of Microcontrollers (MCUs)
- PIC32CK SG Curiosity Ultra development board (EV33A17A)

- PIC32CK GC Curiosity Ultra development board (EV44P93A)
- MPLAB Harmony Landing Page
- MPLAB Harmony v3 GitHub Reference Application Repository
- MPLAB Harmony v3 GitHub Quick Docs Repository
- Microchip Reference Designs Page
- Rapid Prototyping with 32-bit MCUs

4. Cortex M4F Family of Devices

4.1 SAM D5x/E5x

Click on the following links to check various collaterals:

1. Videos.
2. Training Modules.
3. Virtual/On-Demand Training.
4. Technical Briefs.
5. Application Notes.
6. Application Demonstrations.
7. Reference Designs/ Solutions.

4.1.1 SAM D5x/E5x Videos

Table 4-1. SAM D5x/E5x Videos

Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
1	Getting Started with Tools	N/A	A step-by-step guide explaining: • How to Install MPLAB® X IDE • How to Install MPLAB XC32 Compiler • How to install the Configurator • How to Download the Harmony Framework from the MPLAB Harmony v3 repository MPLAB Harmony v3 is configurable through the MCC. Refer to items 6 and 7 for specific instructions to use the MCC.	How to Set-up the Tools Required to Get Started with Harmony v3
2	Getting Started with Device/Kit	SAM E54 Xplained Pro Evaluation Kit (ATSAME54-XPRO)	Explains how to create a simple application for the SAM E54 using MPLAB Harmony v3. This application sends a "Hello World!" string to the PC terminal. Microchip is moving from the MHC to the MCC. Refer to items 6 and 7 in the table.	Create Your First Project with SAME54
3	Getting Started with Device/Kit	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	Explains how to create a simple application for the SAM E51 using MPLAB Harmony v3. This application toggles an LED periodically and prints the LED toggling rate on a serial terminal. Microchip is moving from the MHC to the MCC. Refer to items 6 and 7 in the table.	Getting Started with SAM E51 Curiosity Nano
4	IoT	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	Explains the steps to Create an IoT-Based Heart Rate Monitoring Application. The application displays heart rate readings (in beats per minute (bpm)) on a very low-power consuming display and posts this Heart Rate data to the Microchip Bluetooth Data (MBD) Android mobile application through Bluetooth Low Energy.	How to Create a BLE Fitness Tracker Application on SAM E51 Curiosity Nano
5	Getting Started with Device/ Kit	SAM E54 Curiosity Ultra Development Board (DM320210)	Explains how to create a simple application for the SAM E51 using MPLAB Harmony v3. This application toggles an LED periodically and prints the LED toggling rate on a serial terminal. The demonstration application has additional functionality to print the current room temperature using an on board temperature sensor.	Getting Started with the SAM E54 Curiosity Ultra

..........continued

Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
6	Getting Started with Software Tools	N/A	Explains how to use the MCC Content Manager.	MPLAB® Code Configurator Content Manager
7	Getting Started with Software Tools	Video covers Curiosity PIC32MZ EF 2.0 Development Board (DM320209) and SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	Explains how to create a new MPLAB Harmony v3 project using the MCC and shows how to migrate an MHC-based project to an MCC based project.	Getting Started with Harmony v3 Using Code Configurator
8	Getting started with Docs	N/A	Introduces the Quick Docs package to help develop applications using Microchip's 32-bit products using the MPLAB Harmony v3 software framework.	Harmony Quick Docs Package
9	Getting started with Solutions	N/A	Introduces the MPLAB Harmony v3 Reference Apps package and describes its typical application types and download methods.	Harmony Reference Applications Package
10	CAN USB bridge & CAN-based Host/Bootloader Application using SAM E54 Xplained Pro Evaluation Kit	SAM E54 Xplained Pro Evaluation Kit (ATSAME54-XPRO)	This application acts as a CAN-USB bridge and a CAN-based NVM (Non-Volatile Memory) bootloader host application. With CAN-USB bridge functionality, it reads the data transmitted on a CAN network via the CAN peripheral and displays it on the PC serial terminal window using the USB CDC virtual COM port. With CAN NVM bootloader host functionality, it sends the binary image from the Python script to the target over the CAN bus for programming.	CAN USB bridge & CAN-based Host/Bootloader Application using SAM E54 Xplained Pro Eval Kit

4.1.2   SAM D5x/E5x Training Modules

Table 4-2. SAM D5x/E5x Training Modules

Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
1	Getting Started with Device/ Kit	SAM E54 Xplained Pro Evaluation Kit (ATSAME54-XPRO)	Shows how to create an application to get started with the SAM D5x/ E5x using the MPLAB Harmony v3 software framework. This training module is based on the MHC. The same flow can be used to create a project for the MCC.	Getting Started with Harmony v3 Peripheral Libraries on SAM D5x/E5x
2	Getting Started with Device/ Kit	SAM E54 Xplained Pro Evaluation Kit (ATSAME54-XPRO)	Shows how to create an application to get started with the SAM E5x using the MPLAB Harmony v3 software framework with FreeRTOS. This training module is based on the MHC. The same flow can be used to create a project for the MCC.	Getting Started with Harmony v3 Drivers on SAM E54 MCUs Using FreeRTOS
3	Getting started with tools	N/A	Shows how to create a new MPLAB® Code Configurator (MCC) Harmony v3 project from scratch.	Create a new MPLAB Harmony v3 project using MCC
4	Getting started with tools	N/A	Shows how to open an existing project and use it with the MCC.	MCC - Open an Existing MPLAB® Harmony v3 Project
5	Getting started with tools	N/A	Shows how to install the MPLAB® Code Configurator (MCC) plugin and how to download the MPLAB Harmony v3 framework.	MPLAB® Code Configurator Overview with MPLAB Harmony Content
6	Getting started with tools	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	Shows how to create a new MPLAB Harmony v3 project using the MCC.	Create a new MPLAB Harmony v3 project using MCC

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Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
7	Application Specific	SAM E54 Xplained Pro Evaluation Kit (ATSAME54-XPRO)	Shows how to create a low-power application on a SAM E54 showcasing the current measurement on Idle and Standby Sleep modes. The current consumption data is shown on a data visualizer.	Low Power Application on SAM E54
8	Migration	Though this training is using PIC32MZ EF, the same training can be used for other MCUs	Shows how to update and configure an existing MPLAB Harmony Configurator (MHC)-based MPLAB Harmony v3 project to a MPLAB Code Configurator (MCC)-based project.	Update and Configure an Existing MHC-based MPLAB Harmony v3 Project to MCC-based Project
9	AI/ ML	Integrated Graphics and Touch (IGaT) Curiosity Evaluation Kit (EV14C17A)	Shows how to create an Artificial Intelligence/Machine Learning (AI/ML) application using TensorFlow Lite for Microcontrollers (TFLM) to recognize handwritten digits on a SAM E51 Integrated Graphics and Touch (IGAT) Curiosity Evaluation Kit.	Digit Recognition AI/ML Application on SAM E51 IGAT
10	Motor control	dsPICDEM MCLV-2 Development Board Low Voltage (DM330021-2) and ATSAME54 Motor Control Plugin Module (MA320207)	Shows how to create a motor control application Brushless DC (BLDC) block commutation using a hall sensor on a SAM E54 microcontroller. This training module is based on the MHC. The same flow can be used to create a project for the MCC.	Create your first Motor Control Application
11	IoT	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	Shows how to develop an application prototype from a concept without designing a Printed Circuit Board (PCB) using the 32-bit MCU-based Curiosity Nano Evaluation Kits and Nano baseboard. This training uses the PIC32CM MC00 Curiosity Nano. The same training can be used for other MCUs that are supported on the Curiosity Nano platform.	Rapid prototyping with 32-bit MCU-based Curiosity Nano

4.1.3   SAM D5x/E5x Virtual/On-Demand Training

Some of the following virtual trainings were developed using other MCUs. The same trainings can be ported to the SAM E51 Curiosity Nano Evaluation Kit.

Table 4-3. SAM D5x/E5x Virtual/On-Demand Training

Sl. No	Event	Description	Link
1	Design Week 2022 - Rapid Prototyping Connected Applications With 32-bit Microcontrollers	Discusses how to rapidly develop an IoT-centered smart appliance control application prototype from a concept. Refer to items 2, 3, and 4 in this table for details.	Link
2	Rapid Prototyping with Curiosity Nano: Part I webinar	Discusses how to rapidly develop an IoT-centered smart appliance control application prototype from a concept. In the first part, The concept of creating a system to capture sensor data and control actuators through an I^2C interface is explained. This demonstration was developed on the PIC32CM MC00 Curiosity Nano Evaluation Kit. It can be easily ported to the SAM E51 Curiosity Nano Evaluation Kit (EV76S68A).	Link
3	Rapid Prototyping with Curiosity Nano: Part II webinar	Discusses how to rapidly develop an IoT-centered smart appliance control application prototype from a concept. In the second part, the concept of creating a system to capture and display sensor data through the UART and SPI interfaces is explained. This demonstration was developed on the PIC32CM MC00 Curiosity Nano Evaluation Kit. It can be easily ported to the SAM E51 Curiosity Nano Evaluation Kit (EV76S68A).	Link

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Sl. No	Event	Description	Link
4	Rapid Prototyping with Curiosity Nano: Part III webinar	Discusses how to rapidly develop an IoT-centered smart appliance control application prototype from a concept. In the third part, the concepts needed to add more functionality to the project created in the first part of this webinar series is explained: • Extending the project to display the data captured by sensors through the SPI. • Extending the project to add wireless capability through the UART. This demonstration was developed on the PIC32CM MC00 Curiosity Nano Evaluation Kit. It can be easily ported to the SAM E51 Curiosity Nano Evaluation Kit (EV76S68A).	Link
5	Develop 32-bit MCU applications using MPLAB® Harmony v3	Discusses the fundamentals of MPLAB Harmony v3, the middleware, and other design tools available for application development. It showcases a weather station demonstration using the SAM D21 32-bit microcontroller using the SAM D21 Curiosity Nano (DM320119). The same can be ported for the SAM E51 Curiosity Nano Evaluation Kit (EV76S68A).	Link

More virtual trainings are available at Microchip University. Click on the following links for more details:

- Introduction To MPLAB® X IDE
- MPLAB® X Tips and Tricks
- Overview of the Microchip Code Configurator (MCC) Content Manager (CM)
- MPLAB® Code Configurator (MCC) For Simplified Embedded Software Development
- ARM® Cortex®-M Architecture Overview
- Getting Started with Writing Code for the Microchip ARM® Cortex® Microcontrollers
- MPLAB® Harmony v3 Fundamentals
- Simple Applications Using the MPLAB® Harmony v3 Peripheral Libraries
- Creating Advanced Embedded Applications with 32-bit MCUs/MPUs using the MPLAB® Harmony v3 Software Framework
- FreeRTOS Simplified: A Beginner's Guide to Develop and Debug FreeRTOS Applications
- Introduction to Functional Safety
- Class B Diagnostic Libraries For Functional Safety
- Get Started Simplifying Your IoT Design with Azure RTOS
- Build and manage an IoT device with the Microsoft Azure IoT service and the Microchip SAME54 Xplained Pro evaluation kit

4.1.4 SAM D5x/E5x Technical Briefs

Table 4-4. SAM D5x/E5x Technical Briefs

Sl. No	Type/ Focus Area	Description	Link
1	Getting Started	TB3231: This document explains how to create a simple application on a SAM MCU using the MPLAB Harmony v3 modules. This application sends a "Hello World!" string to a console running on a computer. This document is explained on one MCU, it can be ported for other MCUs. **Note:** Microchip is moving from the MHC to the MCC. Refer to items 6 and 7 in the Videos table.	Link
2	Getting Started	TB3232: This document explains how to set up the tools required to get started with the MPLAB Harmony v3 software development framework.	Link
3	Getting Started	TB3304: *How to Add a New Configuration to an Existing MPLAB Harmony v3 Project*	Link
4	Getting Started	TB3305: *How to Use the MPLAB Harmony v3 Project Manifest Feature*	Link
5	Getting Started	TB3290: *MPLAB Harmony v3 Synchronous Drivers and Their Usage in FreeRTOS Based Applications*	Link

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Sl. No	Type/ Focus Area	Description	Link
6	Getting Started	TB3269: *The Differences Between MPLAB Harmony v3 Synchronous and Asynchronous Drivers and When to Use Them*	Link
7	Getting Started	TB3291: *The Difference Between MPLAB Harmony v3 PLIBs and Drivers, and When to Use Them*	Link
8	Getting Started	TB3226: *Clock System Configuration and Usage on SAM E5x (Cortex M4) Devices*	Link
9	Migration	TB3298: *How to Move an Application into a Desired Flash Memory Location with the Help of Linker Script on SAM E54*	Link
10	Getting Started	TB3253: *How to Build an Application by Adding a New PLIB, Driver, or Middleware to an Existing MPLAB Harmony v3 Project*	Link
11	Getting Started	TB3246: *How to Use the MPLAB Harmony v3 Debug System Service*	Link
12	Peripheral Feature	TB3230: *Various Timers on SAM Devices*	Link
13	Peripheral Feature	TB3222: *EEPROM Emulation for Flash-Only Devices*	Link
14	MCU Feature	TB3183: *What is Sleepwalking? How it helps to reduce the power consumption?*	Link
15	Getting Started	TB3355: *How to Use the MPLAB® Data Visualizer with 32-bit MCU based Curiosity Nano Evaluation Kits*	Link

4.1.5   SAM D5x/E5x Application Notes

Table 4-5. SAM D5x/E5x Application Notes

Sl. No	Type/ Focus Area	Description	Note Link
1	Migration	AN4495: MPLAB Harmony v3 Project Migration application note discusses the migration of an existing MPLAB Harmony v3 based project developed on a particular hardware (microcontroller or development board) platform to another one of Microchip's 32-bit hardware platforms of the user's choice.	Link
2	TCP/IP	AN4833: *File Transfer Protocol Using MPLAB Harmony v3 TCP/IP Stack for SAM E54 MCU*	Link
3	Security	AN3923: *AES Cipher Modes Using MPLAB Harmony v3 for the SAM E54*	Link
4	Bootloader	AN3767: *Live Update Application on SAM E54 MCU Using MPLAB Harmony v3*	Link
5	Bootloader	AN3508: *Dual Bank Bootloader on SAM E54 Microcontroller (MCU) Using MPLAB Harmony v3*	Link
6	Low Power	AN3342: *SleepWalking with Event System Using the SAM E54*	Link
7	Feature specific	AN4383: *32-bit Microcontroller Wafer-Level Chip-Scale Package (WLCSP)*	Link
8	Migration	AN3346: *Introduction to MPLAB and Harmony v3 for Atmel Studio and ASF Users*	Link

4.1.6   SAM D5x/E5x Application Demonstrations

Table 4-6. SAM D5x/E5x Application Demonstrations

Sl. No	Type	Hardware Board/ Kit Used	Description	Link
1	Getting started	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	Getting Started Application on the SAM E51 Curiosity Nano Evaluation Kit.	Link
2	Getting started	SAM E54 Xplained Pro Evaluation Kit (ATSAME54-XPRO)	Getting Started Application on the SAM E54 Xplained Pro Evaluation Kit.	Link
3	Getting started	SAM E54 Curiosity Ultra Development Board (DM320210)	Getting Started Application with the SAM E54 Curiosity Ultra Development Board.	Link
4	IoT	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	BLE Fitness Tracker Application on the SAM E51 Curiosity Nano Evaluation Kit and Nano Base for Click boards.	Link
5	IoT	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	Google Cloud IoT Core Application on the SAM E51 Curiosity Nano Evaluation Kit.	Link
6	Low Power	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	Low-Power Application Demonstration on the SAM E51 Curiosity Nano Evaluation Kit with OLED C.	Link
7	IoT, Automation	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	Weather Click Example	Link
8	HMI	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	Eink Display Bundle Click example	Link

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Sl. No	Type	Hardware Board/ Kit Used	Description	Link
9	IoT, Medical	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	Heart Rate 9 Click Example	Link
10	IoT, Automation	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	IR Thermo 2 Click Example	Link
11	IoT, Automation	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	10DOF Click Example	Link
12	Display	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	LED Driver 3 Click Example	Link
13	Storage	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	EEPROM 4 Click Example	Link
14	Gaming	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	Thumbstick Click Example	Link
15	Click Extension	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	XPRO Adapter Click Example	Link
16	IoT, Automation	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	Fan Click Example	Link
17	IoT, Automation	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	GSM GPS Click Example	Link
18	IoT, Automation	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	PIR Click Example	Link
19	Connectivity	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	USB UART Click Example	Link
20	Display	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	OLED C Click Example	Link
21	IoT, Automation	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	WIFI 7 Click Example	Link
22	IoT, Automation	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	RFID Click Example	Link
23	Connectivity	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	USB I2C Click Example	Link
24	IoT, Automation	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	BLE 2 Click Example	Link
25	Automation	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	GRID EYE Click Example	Link
26	Wireless Connectivity	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	LR Click Example	Link
27	Connectivity	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	USB SPI Click Example	Link
28	Automotive	SAM E54 Xplained Pro Evaluation Kit (ATSAME54-XPRO)	CAN to USB bridge Application using SAM E54 Xplained Pro Evaluation Kit.	Link
29	Consumer	SAM E54 Xplained Pro Evaluation Kit (ATSAME54-XPRO)	Vending Machine Application Demonstration on the SAM E54 Xplained Pro Evaluation Kit using MP.	Link
30	Low Power	SAM E54 Xplained Pro Evaluation Kit (ATSAME54-XPRO)	Low-Power Application on the SAM E54 Xplained Pro Evaluation Kit.	Link
31	Low Power	SAM E54 Xplained Pro Evaluation Kit (ATSAME54-XPRO)	SleepWalking Application on the SAM E54 Xplained Pro Evaluation Kit.	Link
32	Automation	SAM E54 Xplained Pro Evaluation Kit (ATSAME54-XPRO)	EEPROM Temperature Logger Application on the SAM E54 Xplained Pro Evaluation Kit using FreeRTOS.	Link
33	Automation	SAM E54 Curiosity Ultra Development Board (DM320210)	Motion Surveillance Application on the SAM E54 Curiosity Ultra Development Board.	Link
34	Bootloader	SAM E54 Curiosity Ultra Development Board (DM320210)	Live Update Application on the SAM E54 Curiosity Ultra Development Board.	Link

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Sl. No	Type	Hardware Board/ Kit Used	Description	Link
35	Audio, Consumer	SAM E54 Curiosity Ultra Development Board (DM320210)	SD Card USB Audio Player on the SAM E54 Curiosity Ultra Development Board + maXTouch® Curiosity Pro Board using Legato Graphics.	Link
36	microSD	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	This application showcases the capabilities of the microSD Click module. It demonstrates various file operations that can be performed on an SD card.	Link
37	13DOF	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	This application demonstrates the reading of weather parameters (Temperature, Pressure , Humidity and Gas Resistance) from BME680 sensor, Motion parameters (Gyroscope, Accelerometer) in X , Y and Z axes from BMI088 sensor,Geomagnetic data in X , Y and Z axes from BMM150 sensor.	Link
38	Eink E-Paper display 2,9" 296x128 dots display	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	This example demonstrates the display capability of Eink E-Paper display 2,9" 296x128 dots display board on SAM E51 Curiosity Nano Evaluation Kit.	Link
39	MCP25625	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	This example demonstrates the transmitting and receiving of CAN data using the MCP25625 CAN click board and displays the transmit/receive CAN message on a serial terminal on SAM E51 Curiosity Nano Evaluation Kit using the MCP25625 Click board.	Link
40	Barcode Scanner	Integrated Graphics and Touch (IGaT) Curiosity Evaluation Kit (EV14C17A)	This application detects the EAN-13 barcode and decodes it with the help of the ArduCAM Mega camera module. The ArduCAM Mega captures an image with a resolution of 1920x1080 and stores the image in an internal memory. The decoded barcode is then displayed on the serial console and graphical display.	Link

More application demonstrations are available at Microchip's MPLAB Harmony GitHub repositories. Refer to the following links:

- More application demonstrations on SAM E51 Curiosity Nano Evaluation Kit and other Development Boards/Kits having the same part number (ATSAME51J20A)
- More application demonstrations on SAM E54 Xplained Pro Evaluation Kit and other Development Boards/Kits having the same part number (ATSAME54P20A)
- More application demonstrations on SAM E54 Curiosity Ultra Development Board and other Development Boards/Kits having the same part number (ATSAME54P20A)
- More application demonstrations on IGAT Kit and other Development Boards/Kits having the same part number (ATSAME51J20A)

4.1.7   SAM D5x/E5x Reference Designs/Solutions

Table 4-7. SAM D5x/E5x Reference Designs/ Solutions

Sl. No	Type	Hardware Board/ Kit Used	Description	Link
1	HMI	Integrated Graphics and Touch (IGaT) Curiosity Evaluation Kit (EV14C17A)	Low-Cost GUI With Graphics and Touchscreen Demonstration.	Link
2	HMI	Integrated Graphics and Touch (IGaT) Curiosity Evaluation Kit (EV14C17A) or SAM E54 Curiosity Ultra Development Board (DM320210)	Graphical User Interface Demonstrations: MPLAB Harmony v3 has various demonstration examples for creating an intuitive and reliable GUI in applications.	Ref design Link and Graphics demonstration link

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SI. No	Type	Hardware Board/ Kit Used	Description	Link
3	Motor Control	dsPICDEM MCLV-3 Development Board High Voltage (DM330023-3) dsPICDEM MCLV-2 Development Board Low Voltage (DM330021-2) and ATSAME54 Motor Control Plugin Module (MA320207)	Motor Control for Appliances: There are multiple demonstration examples, which are pre-configured to run on Microchip's various motor control development boards for easy prototyping of motor drive applications.	Ref Design Link and Motor Control examples
4	Connectivity	SAM E54 Xplained Pro Evaluation Kit (ATSAME54-XPRO)	Vending Machine Demonstration: This solution demonstrates an embedded network application to update and track the status of the drinks being offered in a vending machine.	Link
5	IoT	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	IoT Smart Appliance Control Demonstration: This solution showcases smart control of a fan through an Android™-based smartphone using a Bluetooth® Low Energy (BLE) connection. This solution is done for the PIC32CM MC00 Curiosity Nano. It can be ported for the SAM E51 Curiosity Nano (EV76S68A).	Link
6	IoT	SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)	Fitness Tracker Wearables Demonstration: This fitness tracker demonstration displays the heart rate readings measured in beats per minute (bpm) on a low-power E ink display, and optionally posts this data to the Microchip Bluetooth® Data mobile application for Android™ through Bluetooth Low-Energy technology.	Link
7	CAN, USB	SAM E54 Xplained Pro Evaluation Kit (ATSAME54-XPRO)	This reference design acts as a CAN-USB bridge along with CAN based NVM bootloader host application. With CAN-USB bridge functionality, it reads the data transmitted on a CAN network via the CAN peripheral and displays it on the PC serial terminal window using the USB CDC virtual COM port. With CAN NVM bootloader host functionality, it sends the binary image from the Python script to the target over the CAN bus for programming.	Link

4.1.8 SAM D5x/E5x Key Links

- SAM E51 Curiosity Nano Evaluation Kit (EV76S68A)
- SAM E54 Xplained Pro Evaluation Kit (ATSAME54-XPRO)
- Integrated Graphics and Touch (IGaT) (EV14C17A)
- SAM E54 Curiosity Ultra Development Board (DM320210)
- MPLAB Harmony Landing Page.
- MPLAB Harmony v3 GitHub Reference Application Repository
- MPLAB Harmony v3 GitHub Quick Docs Repository
- Microchip Reference Designs Page
- 32-bit MCUs Rapid Prototyping page

4.2 SAM G5x

Click on the following links to check the various collaterals:

1. Videos.
2. Training Modules.
3. Virtual/On-Demand Training.
4. Technical Briefs.
5. Application Notes.

6. Application Demonstrations.

7. Reference Designs/Solutions.

4.2.1   SAM G5x Videos

Table 4-8. SAM G5x Videos

Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
1	Getting Started with Tools	N/A	A step-by-step guide explaining: • How to Install MPLAB® X IDE • How to Install MPLAB XC32 Compiler • How to install the Configurator • How to Download the Harmony Framework from the MPLAB Harmony v3 repository MPLAB Harmony v3 is configurable through the MCC. Refer to items 3 and 4 for specific instructions for using the MCC.	How to Set-up the Tools Required to Get Started with Harmony v3
2	Getting Started with Device/ Kit	SAM G55 Xplained Pro Evaluation kit (ATSAMG55-XPRO)	Explains how to create a simple application on the SAM E54 using MPLAB Harmony v3. This application sends a "Hello World!" string to the PC terminal. MPLAB Harmony v3 is configurable through the MCC. Refer to items 3 and 4 for specific instructions for using the MCC. The same example can be ported to the SAM G55 Xplained Pro Evaluation Kit (ATSAMG55-XPRO) following the same steps.	Create Your First Project with SAME54
3	Getting Started with Software Tools	N/A	Explains how to use the MCC Content Manager.	MPLAB® Code Configurator Content Manager
4	Getting Started with Software Tools	The video covers DM320209 and EV76S68A. The same content can be replicated for the SAM G55 Xplained Pro Evaluation kit (ATSAMG55-XPRO).	Explains how to create a new MPLAB Harmony v3 project using the MCC, and shows how to migrate an MHC-based project to an MCC-based project.	Getting Started with Harmony v3 Using Code Configurator
5	Getting started with Docs	N/A	Introduces the Quick Docs package to help develop applications using Microchip's 32-bit products with the MPLAB Harmony v3 software framework.	Harmony Quick Docs Package
6	Getting started with Solutions	N/A	Introduces the MPLAB Harmony v3 Reference Apps package and describes its typical application types and download methods.	Harmony Reference Applications Package

4.2.2   SAM G5x Training Modules

Table 4-9. SAM G5x Training Modules

Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
1	Getting Started with Device/Kit	SAM G55 Xplained Pro Evaluation kit (ATSAMG55-XPRO)	Shows how to create an application to get started with the SAM D5x/ E5x using the MPLAB Harmony v3 software framework. The training module is based on the MHC, similar steps and flow can be used to create a project using the MCC. The same example can be ported to the SAM G5x following the same steps.	Getting Started with Harmony v3 Peripheral Libraries on SAM D5x/E5x

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Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
2	Getting started with tools	N/A	Shows how to create a new MPLAB® Code Configurator (MCC) Harmony v3 project from scratch.	Create a new MPLAB Harmony v3 project using MCC
3	Getting started with tools	N/A	Shows how to open an existing project and use it with the MCC.	MCC - Open an Existing MPLAB® Harmony v3 Project
4	Getting started with tools	N/A	Shows how to install the MPLAB® Code Configurator (MCC) plugin and how to download the MPLAB Harmony v3 framework.	MPLAB® Code Configurator Overview with MPLAB Harmony Content
5	Getting started with tools	This training uses the SAM D5x/E5x. The same training can be used as a reference for other MCUs.	Shows how to create a new MPLAB Harmony v3 project using the MCC.	Create a new MPLAB Harmony v3 project using MCC
6	Migration	This training uses the PIC32MZ EF. The same training can be used for other MCUs.	Shows how to update and configure an existing MPLAB Harmony Configurator (MHC)-based MPLAB Harmony v3 project to a MPLAB Code Configurator (MCC)-based project.	Update and Configure an Existing MHC-based MPLAB Harmony v3 Project to MCC-based Project

4.2.3 SAM G5x Virtual/On-Demand Training

More virtual trainings are available at Microchip University. Click on the following links for more details:

- Introduction To MPLAB® X IDE
- MPLAB® X Tips and Tricks
- Overview of the Microchip Code Configurator (MCC) Content Manager (CM)
- MPLAB® Code Configurator (MCC) For Simplified Embedded Software Development
- ARM® Cortex®-M Architecture Overview
- Getting Started with Writing Code for the Microchip ARM® Cortex® Microcontrollers
- MPLAB® Harmony v3 Fundamentals
- Simple Applications Using the MPLAB® Harmony v3 Peripheral Libraries
- Creating Advanced Embedded Applications with 32-bit MCUs/MPUs using the MPLAB® Harmony v3 Software Framework
- FreeRTOS Simplified: A Beginner's Guide to Develop and Debug FreeRTOS Applications

4.2.4 SAM G5x Technical Briefs

Table 4-10. SAM G5x Technical Briefs

Sl. No	Type/ Focus Area	Description	Link
1	Getting Started	TB3231: This document explains how to create a simple application on a SAM MCU using the MPLAB Harmony v3 modules. This application sends a "Hello World!" string to a console running on a computer. Though this document is explained on one MCU, it can be ported to other MCUs. **Note:** Microchip is moving from the MHC to the MCC. Refer to items 3 and 4 in the Videos table.	Link
2	Getting Started	TB3232: This document explains how to set up the tools required to get started with the MPLAB Harmony v3 software development framework.	Link
3	Getting Started	TB3304: *How to Add a New Configuration to an Existing MPLAB Harmony v3 Project*	Link
4	Getting Started	TB3305: *How to Use the MPLAB Harmony v3 Project Manifest Feature*	Link
5	Getting Started	TB3290: *MPLAB Harmony v3 Synchronous Drivers and Their Usage in FreeRTOS Based Applications*	Link
6	Getting Started	TB3269: *The Differences Between MPLAB Harmony v3 Synchronous and Asynchronous Drivers and When to Use Them*	Link

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Sl. No	Type/ Focus Area	Description	Link
7	Getting Started	TB3291: *The Difference Between MPLAB Harmony v3 PLIBs and Drivers, and When to Use Them*	Link
8	Getting Started	TB3253: *How to Build an Application by Adding a New PLIB, Driver, or Middleware to an Existing MPLAB Harmony v3 Project*	Link
9	Getting Started	TB3246: *How to Use the MPLAB Harmony v3 Debug System Service*	Link
10	Peripheral Feature	TB3230: *Various Timers on SAM Devices*	Link
11	Peripheral Feature	TB3222: *EEPROM Emulation for Flash-Only Devices*	Link
12	MCU Feature	TB3183: *What is Sleepwalking? How it helps to reduce the power consumption?*	Link
13	Peripheral	TB3181: *What is TWI? How to configure the TWI for I^{2}C Communication*	Link

4.2.5 SAM G5x Application Notes

Table 4-11. SAM G5x Application Notes

Sl. No	Type/ Focus Area	Description	Link
1	Migration	AN4495: MPLAB Harmony v3 Project Migration application note discusses the migration of an existing MPLAB Harmony v3 based project developed on a particular hardware (microcontroller or development board) platform to another one of Microchip's 32-bit hardware platforms of the user's choice.	Link
2	Feature specific	AN4383: *32-bit Microcontroller Wafer-Level Chip-Scale Package (WLCSP)*	Link
3	Migration	AN3346: *Introduction to MPLAB and Harmony v3 for Atmel Studio and ASF Users*	Link

4.2.6 SAM G5x Application Demonstrations

More application demonstrations are available at Microchip's MPLAB Harmony v3 GitHub repositories. Refer to the following link:

- Examples for SAMG55

4.2.7 SAM G5x Reference Designs/Solutions

Table 4-12. SAM G5x Reference Designs/Solutions

Sl. No	Type	Hardware Board/ Kit Used	Description	Link
1	Audio	SAM G55 Audio Curiosity Development Board (EV78Y10A)	SAM G55 Audio Curiosity Development Board.	Link

4.2.8 SAM G5x Key Links

- SAM G55 Xplained Pro Evaluation Kit (ATSAMG55-XPRO)
- MPLAB Harmony Landing Page
- MPLAB Harmony v3 GitHub Reference Application Repository
- MPLAB Harmony v3 GitHub Quick Docs Repository
- Microchip Reference Designs Page

4.3 PIC32CX SG41/SG60/SG61

Click on the following links to check various collaterals:

1. Videos.
2. Training Modules.
3. Virtual / On-Demand Training.
4. Technical Briefs.
5. Application Notes.
6. Application Demonstrations.
7. Reference Designs / Solutions.

![Microchip logo]

4.3.1   PIC32CX SG41/SG60/SG61 Videos

Table 4-13. PIC32CX SG41/SG60/SG61 Videos

Sl.No	Type/Focus Area	Hardware Board/ Kit Used	Description	Link
1	Getting Started with Tools	N/A	A step-by-step guide explaining the following: • How to Install MPLAB® X IDE • How to Install MPLAB XC32 Compiler • How to install the Configurator • How to Download the Harmony Framework from MPLAB Harmony v3 repositories on GitHub. MPLAB Harmony v3 is configurable through the MCC. Refer to items 6 and 7 for specific instructions to use the MCC.	How to Set-up the Tools Required to Get Started with MPLAB Harmony v3
2	Getting Started with Software Tools	N/A	Explains how to use the MCC Content Manager.	MPLAB® Code Configurator Content Manager
3	Getting Started with Software Tools	Though the video covers DM320209 and EV76S68A, the same content can be replicated for PIC32CX SG61 Curiosity Ultra Evaluation Board (**EV09H35A**) and other MCUs of the family.	Explains how to create a new MPLAB Harmony v3 project using the MCC and shows how to migrate an MHC-based project to an MCC- based project.	Getting Started with Harmony v3 Using Code Configurator
4	Getting started with Docs	N/A	Introduces the Quick Docs package to help develop applications using Microchip's 32-bit products using the MPLAB Harmony v3 software framework.	Harmony Quick Docs Package
5	Getting started with Solutions	N/A	Introduces the MPLAB Harmony Reference Apps package and describes its typical application types and download methods.	Harmony Reference Applications Package
6	Getting Started application	PIC32CX SG61 Curiosity Ultra Evaluation Board (**EV09H35A**)	This application demonstrates how to toggle LED by pressing switch SW on a timeout basis and viewing the LED toggling rate on the serial terminal.	Demonstrating Application Development with PIC32CX SG61 Curiosity Ultra Evaluation Board

4.3.2   PIC32CX SG41/SG60/SG61 Training Modules

Table 4-14. PIC32CX SG41/SG60/SG61 Training Modules

SL.No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
1	Getting started with tools	N/A	Shows how to create a new MPLAB Code Configurator (MCC) Harmony v3 project from scratch.	Create a new MPLAB Harmonyv3 project using MCC
2	Getting started with tools	N/A	Shows how to open an existing project and use it with the MCC.	MCC - Open an Existing MPLAB® Harmony v3 Project
3	Getting started with tools	N/A	Shows how to install the MPLAB Code Configurator (MCC) plugin, and how to download the MPLAB Harmony v3 framework.	MPLAB® Code Configurator Overview with MPLAB Harmony Content Manager
4	Getting started with tools	This training uses the SAM D5x/E5x. The same training can be used as a reference for other MCUs.	Shows how to create a new MPLAB Harmony v3 project using the MCC.	Create a new MPLAB Harmony v3 project using MCC
5	Migration	This training uses the PIC32MZ EF. The same training can be used for other MCUs.	Shows how to update and configure an existing MPLAB Harmony Configurator (MHC)-based MPLAB Harmony v3 project to a MPLAB Code Configurator (MCC)-based project.	Update and Configure an Existing MHC-based MPLAB Harmony v3 Project to MCC based Project

4.3.3 PIC32CX SG41/SG60/SG61 Virtual / On-Demand Training

More virtual trainings are available at Microchip University. Click on the following links for more details:

1. IntroductionTo MPLAB®XIDE.
2. MPLAB®XTips and Tricks.
3. Overviewof the Microchip Code Configurator (MCC) Content Manager (CM).
4. MPLAB®CodeConfigurator (MCC) For Simplified Embedded Software Development.
5. ARM®Cortex®-MArchitecture Overview.
6. GettingStarted with Writing Code for the Microchip ARM®Cortex®Microcontrollers.
7. MPLAB®Harmonyv3 Fundamentals.
8. Simple Applications Using the MPLAB® Harmony v3 Peripheral Libraries.
9. CreatingAdvanced Embedded Applications with 32-bit MCUs/MPUs using the MPLAB®Harmony v3 Software Framework.
10. FreeRTOSSimplified: A Beginner's Guide to Develop and Debug FreeRTOS Applications.
11. ClassB Diagnostic Libraries For Functional Safety.

4.3.4 PIC32CX SG41/SG60/SG61 Technical Briefs

Table 4-15. PIC32CX SG41/SG60/SG61 Technical Briefs

Sl. No	Type/ Focus Area	Description	Link
1	Getting Started	TB3231: This document explains how to create a simple application on a SAM MCU using the MPLAB Harmony v3 modules. This application sends a "Hello World!" string to a console running on a computer. Though this document is explained on one MCU, it can be ported to other MCUs.	Link
2	Getting Started	TB3232: This document explains how to set up the tools required to get started with the MPLAB Harmony v3 software development framework.	Link
3	Getting Started	TB3304: *How to Add a New Configuration to an Existing MPLAB Harmony v3 Project*	Link
4	Getting Started	TB3305: *How to Use the MPLAB Harmony v3 Project Manifest Feature*	Link
5	Getting Started	TB3290: *MPLAB Harmony v3 Synchronous Drivers and Their Usage in FreeRTOS Based Applications*	Link
6	Getting Started	TB3269: *The Differences Between MPLAB Harmony v3 Synchronous and Asynchronous Drivers and When to Use Them*	Link
7	Getting Started	TB3291: *The Difference Between MPLAB Harmony v3 PLIBs and Drivers, and When to Use Them*	Link
8	Getting Started	TB3227: *Clock System Configuration and Usage on SAM C2x (Cortex M0+) Devices*	Link
9	Getting Started	TB3253: *How to Build an Application by Adding a New PLIB, Driver, or Middleware to an Existing MPLAB Harmony v3 Project*	Link
10	Getting Started	TB3246: *How to Use the MPLAB Harmony v3 Debug System Service*	Link
11	Peripheral Feature	TB3243: *How to Wake-up Fast from an External Event on Cortex M0+ Based MCUs*	Link
12	Peripheral Feature	TB3230: *Various Timers on SAM Devices*	Link
13	Peripheral Feature	TB3222: *EEPROM Emulation for Flash-Only Devices*	Link
14	MCU Feature	TB3183: *What is Sleepwalking? How it helps to reduce the power consumption?*	Link
15	Peripheral Feature	TB3170: *How the Event System Helps to Lower CPU Load and Power Consumption in Cortex™-M0+ Microcontrollers*	Link
16	Getting Started	TB3345: Creating the First Application on PIC32CX SG Microcontrollers Using MPLAB Harmony v3 with MPLAB Code Configurator (MCC)	Link
17	MCU Feature	TB3359: Immutable Boot on PIC32CX SG41 MCU	Link

4.3.5 PIC32CX SG41/SG60/SG61 Application Notes

Table 4-16. PIC32CX SG41/SG60/SG61 Application Notes

Sl. No	Type/ Focus Area	Description	Link
1	Migration	AN4495: MPLAB Harmony v3 Project Migration application note discusses the migration of an existing MPLAB Harmony v3-based project developed on a particular hardware (microcontroller or development board) platform to another one of Microchip's 32-bit hardware platforms of the user's choice.	Link
2	Feature specific	AN4383: *32-bit Microcontroller Wafer-Level Chip-Scale Package (WLCSP)*	Link
3	Migration	AN3346: *Introduction to MPLAB and Harmony v3 for Atmel Studio and ASF Users*	Link

4.3.6 PIC32CX SG41/SG60/SG61 Application Demonstrations

Table 4-17. PIC32CX SG41/SG60/SG61 Application Demonstrations

Sl. No	Type/ Focus Area	Hardware Kit Used	Description	Link
1	Getting Started	PIC32CX SG41 Curiosity Ultra Evaluation Board (**EV06X38A**)	This application demonstrates how to toggle LED by pressing switch SW on a timeout basis and viewing the LED toggling rate on the serial terminal.	Link
2	Getting Started	PIC32CX SG61 Curiosity Ultra Evaluation Board (**EV09H35A**)	This application demonstrates how to toggle LED by pressing switch on a timeout basis and viewing the LED toggling rate on the serial terminal.	Link
3	Barcode Scanner	PIC32CX SG61 Curiosity Ultra Evaluation Board (**EV09H35A**)	This application detects the EAN-13 barcode and decodes it with the help of the ArduCAM Mega camera module. The ArduCAM Mega captures an image with a resolution of 1920x1080 and stores the image in an internal memory. The decoded barcode is then displayed on the serial console and graphical display.	Link
4	Secure CAN Bootloader	PIC32CX SG61 Curiosity Ultra Evaluation Board (**EV09H35A**)	This application demonstrates usage of the internal Hardware Security Module (HSM) of the PIC32CX SG61 for securely transferring application firmware between Host and Client over a CAN bus.	Link

4.3.7 PIC32CX SG41/SG60/SG61 Reference Designs

Table 4-18. PIC32CX SG41/SG60/SG61 Reference Designs

Sl. No	Type	Hardware Board/ Kit Used	Description	Link
1	MCU Feature	PIC32CX SG61 Curiosity Ultra Evaluation Board (EV09H35A)	This solution recognizes a valid barcode image and then analyzes and decodes the image using an Arm Cortex-M4F-based MCU from Microchip. This application detects the EAN-13 barcode and decodes it with the help of the Arducam Mega camera module. The Arducam Mega captures an image with a resolution of 1920 × 1080 and stores the image in an internal memory. The decoded barcode is then displayed on the serial console and graphical display.	Link

4.3.8 PIC32CX SG41/SG60/SG61 Key Links

- PIC32CX SG41 Curiosity Ultra Evaluation Board(EV06X38A)
- PIC32CX SG61 Curiosity Ultra Evaluation Board(EV09H35A)
- PIC32CX SG Family of Microcontrollers
- MPLABHarmony Landing Page
- MPLABHarmony v3 GitHub Reference Application Repository
- MPLABHarmony v3 GitHub Quick Docs Repository
- MicrochipReference Designs Page

5. Cortex M7 Family of Devices

5.1 SAM E70/S70/V70/V71

Click on the following links to check the various collaterals:

1. Videos.
2. Training Modules.
3. Virtual/On-Demand Training.
4. Technical Briefs.
5. Application Notes.
6. Application Demonstrations.
7. Reference Designs/Solutions.

5.1.1 SAM E70/S70/V70/V71 Videos

Table 5-1. SAM E70/S70/V70/V71 Videos

Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
1	Getting Started with Tools	N/A	A step-by-step guide explaining: • How to Install MPLAB® X IDE • How to Install MPLAB XC32 Compiler • How to install the Configurator • How to Download the Harmony Framework from the MPLAB Harmony v3 repository MPLAB Harmony v3 is configurable through the MCC. Refer to items 6 and 7 for specific instructions to use the MCC.	How to Set-up the Tools Required to Get Started with Harmony v3
2	Getting Started with Device/ Kit	SAM E70 Xplained Ultra Evaluation Kit (DM320113)	Explains how to create a simple application on the SAME70 using MPLAB Harmony v3. This application sends a "Hello World!" string to the PC terminal. MPLAB Harmony v3 is configurable through the MCC. Refer to items 6 and 7 for specific instructions to use the MCC.	Create Your First Project with SAM E70
3	Getting Started with Software Tools	N/A	Explains how to use the MCC Content Manager.	MPLAB® Code Configurator Content Manager
4	Getting Started with Software Tools	The video covers DM320209 and EV76S68A. The same content can be replicated for the SAM E70/SAM V71 Evaluation Kits.	Explains how to create a new MPLAB Harmony v3 project using the MCC and shows how to migrate an MHC-based project to an MCC based project.	Getting Started with Harmony v3 Using Code Configurator
5	Getting started with Docs	N/A	Introduces the Quick Docs package to help develop applications using Microchip's 32-bit products using the MPLAB Harmony v3 software framework.	Harmony Quick Docs Package
6	Getting started with Solutions	N/A	Introduces the MPLAB Harmony v3 Reference Apps package and describes its typical application types and download methods.	Harmony Reference Applications Package

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5.1.2   SAM E70/S70/V70/V71 Training Modules

Table 5-2. SAM E70/S70/V70/V71 Training Modules

Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
1	Getting Started with Device/Kit	SAM E70 Xplained Ultra Evaluation Kit (DM320113) or SAM V71 Xplained Ultra Evaluation Kit (ATSAMV71-XULT)	Shows how to create an application to get started with the SAM E70/S70/V70/V71 using the MPLAB Harmony v3 software framework. The training module is based on the MHC. Similar steps and flow can be used to create a project using the MCC.	Getting Started with Harmony v3 Peripheral Libraries on SAM E70/S70/V70/V71 MCUs
2	Getting Started with Device/Kit	SAM E70 Xplained Ultra Evaluation Kit (DM320113) or SAM V71 Xplained Ultra Evaluation Kit (ATSAMV71-XULT)	Shows how to create an application to get started with Drivers and System Services on the SAM E70/S70/V70/V71 using the MPLAB Harmony v3 software framework. The training module is based on the MHC. Similar steps and flow can be used to create a project using the MCC.	Getting Started with Harmony v3 Drivers and System Services on SAM E70/S70/V70/V71 MCUs
3	Getting started with tools	N/A	Shows how to create a new MPLAB Code Configurator (MCC) Harmony v3 project from scratch.	Create a new MPLAB Harmony v3 project using MCC
4	Getting started with tools	N/A	Shows how to open an existing project and use it with the MCC.	MCC - Open an Existing MPLAB® Harmony v3 Project
5	Getting started with tools	N/A	Shows how to install the MPLAB Code Configurator (MCC) plugin, and how to download MPLAB Harmony v3 framework.	MPLAB® Code Configurator Overview with MPLAB Harmony Content
6	Getting started with tools	This training uses the SAM D5x/E5x. The same training can be used as a reference for other MCUs.	Shows how to create a new MPLAB Harmony v3 project using the MCC.	Create a new MPLAB Harmony v3 project using MCC
7	Migration	This training uses the PIC32MZ EF. The same training can be used for other MCUs.	Shows how to update and configure an existing MPLAB Harmony Configurator (MHC)-based MPLAB Harmony v3 project to a MPLAB Code Configurator (MCC)-based project.	Update and Configure an Existing MHC-based MPLAB Harmony v3 Project to MCC-based Project
8	USB	SAM E70 Xplained Ultra Evaluation Kit (DM320113)	Shows how to create a simple USB CDC class serial terminal menu application and will help with getting started on developing a USB-based application for SAM MCUs using the MPLAB Harmony v3 software framework.	Getting Started with USB on SAM MCUs Using MPLAB® Harmony v3

5.1.3   SAM E70/S70/V70/V71 On-Demand Training

More virtual trainings are available at Microchip University. Click on the following links for more details:

- Introduction To MPLAB® X IDE
- MPLAB® X Tips and Tricks
- Overview of the Microchip Code Configurator (MCC) Content Manager (CM)
- MPLAB® Code Configurator (MCC) For Simplified Embedded Software Development
- ARM® Cortex®-M Architecture Overview
- Getting Started with Writing Code for the Microchip ARM® Cortex® Microcontrollers
- MPLAB® Harmony v3 Fundamentals
- Simple Applications Using the MPLAB® Harmony v3 Peripheral Libraries
- Creating Advanced Embedded Applications with 32-bit MCUs/MPUs using the MPLAB® Harmony v3 Software Framework

- FreeRTOS Simplified: A Beginner's Guide to Develop and Debug FreeRTOS Applications
- Introduction to Functional Safety
- Class B Diagnostic Libraries For Functional Safety

5.1.4 SAM E70/S70/V70/V71 Technical Briefs

Table 5-3. SAM E70/S70/V70/V71 Technical Briefs

Sl. No	Type/ Focus Area	Description	Link
1	Getting Started	TB3231: This document explains how to create a simple application on a SAM MCU using the MPLAB Harmony v3 modules. This application sends a "Hello World!" string to a console running on a computer. This document is explained on one MCU. However, it can be ported for other MCUs. **Note:** Microchip is moving from the MHC to the MCC. Refer to items 6 and 7 in the Videos table.	Link
2	Getting Started	TB3232: This document explains how to set up the tools required to get started with the MPLAB Harmony v3 software development framework.	Link
3	Getting Started	TB3304: *How to Add a New Configuration to an Existing MPLAB Harmony v3 Project*	Link
4	Getting Started	TB3305: *How to Use the MPLAB Harmony v3 Project Manifest Feature*	Link
5	Getting Started	TB3290: *MPLAB Harmony v3 Synchronous Drivers and Their Usage in FreeRTOS Based Applications*	Link
6	Getting Started	TB3269: *The Differences Between MPLAB Harmony v3 Synchronous and Asynchronous Drivers and When to Use Them*	Link
7	Getting Started	TB3291: *The Difference Between MPLAB Harmony v3 PLIBs and Drivers, and When to Use Them*	Link
8	Getting Started	TB3253: *How to Build an Application by Adding a New PLIB, Driver, or Middleware to an Existing MPLAB Harmony v3 Project*	Link
9	Getting Started	TB3246: *How to Use the MPLAB Harmony v3 Debug System Service*	Link
10	Peripheral	TB3181: *What is TWI? How to configure the TWI for I^{2}C Communication*	Link
11	Peripheral Feature	TB3221: *External Memory on SAM E70/S70/V70/V71 MCUs*	Link
12	MCU Feature	TB3195: *Managing Cache Coherency on CortexM7 Based SAM Devices*	Link
13	MCU Feature	TB3260: *How to Create Non-Cacheable Memory Region on CortexM7 (SAM S70/ E70/ V70/ V71) MCUs Using MPLAB Harmony v3*	Link
14	MCU Feature	TB3295: *Handling Cache Coherency Issues at Runtime Using Cache Maintenance Operations on Cortex-M7 MCUs Using MPLAB Harmony v3*	Link
15	MCU Feature	TB3240: *How to Use the TCM on A Cortex-M7 Based MCU with the XC32 Compiler*	Link
16	MCU Feature	TB3182: *How to use Differential ADC on SAM V7x/E7x/S7x MCUs*	Link

5.1.5 SAM E70/S70/V70/V71 Application Notes

Table 5-4. SAM E70/S70/V70/V71 Application Notes

Sl. No	Type/ Focus Area	Description	Link
1	Migration	AN4495: MPLAB Harmony v3 Project Migration application note discusses the migration of an existing MPLAB Harmony v3 based project developed on a particular hardware (microcontroller or development board) platform to another one of Microchip's 32-bit hardware platforms of the user's choice.	Link
2	Migration	AN3346: *Introduction to MPLAB and Harmony v3 for Atmel Studio and ASF Users*	Link
3	Peripheral Feature	AN4686: *Watchdog Timer (WDT) on ATSAM E70/S70/V70/V71 Devices Using MPLAB Harmony v3*	Link
4	Peripheral Feature	AN3443: *Execute-In-Place (XIP) with QSPI on Cortex-M7 MCUs Using MPLAB Harmony v3*	Link
5	Peripheral Feature	AN3466: *Using XDMAC with QSPI on Arm Cortex-M7 MCUs Using MPLAB Harmony v3*	Link
6	TCP/ IP	AN3475: *File Transfer Protocol Using MPLAB Harmony v3 TCP/IP Stack*	Link

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5.1.6   SAM E70/S70/V70/V71 Application Demonstrations

Table 5-5. SAM E70/S70/V70/V71 Application Demonstrations

Sl. No	Type	Hardware Board/ Kit Used	Description	Link
1	Getting started	SAM E70 Xplained Ultra Evaluation Kit (DM320113)	Getting Started Application on the SAM E70 Xplained Ultra Evaluation Kit.	Link
2	Getting started	SAM E70 Xplained Ultra Evaluation Kit (DM320113)	Getting Started Application using MPLAB Harmony v3 Drivers on a SAM E70 Xplained Ultra Evaluation Kit.	Link
3	Getting started	SAM E70 Xplained Ultra Evaluation Kit (DM320113)	Getting Started Application using MPLAB Harmony v3 Drivers and FreeRTOS on a SAM E70 Xplained Ultra Evaluation Kit.	Link
4	DMA, QSPI	SAM E70 Xplained Ultra Evaluation Kit (DM320113)	XDMAC with QSPI Application on a SAM E70 Xplained Ultra Evaluation Kit.	Link
5	TCP/ IP	SAM E70 Xplained Ultra Evaluation Kit (DM320113)	File Transfer Protocol Application on a SAM E70 Xplained Ultra Evaluation Kit.	Link

More application demonstrations are available at Microchip's MPLAB Harmony GitHub repositories. Refer to the following link:

- More application demonstrations on SAM E70 Xplained Ultra Evaluation Kit and other Development Boards/Kits having the same part number (ATSAME70Q21B)

5.1.7   SAM E70/S70/V70/V71 Reference Designs/Solutions

Table 5-6. SAM E70/S70/V70/V71 Reference Designs/Solutions

Sl. No	Type	Hardware Board/ Kit Used	Description	Link
1	HMI Graphics	SAM E70 Xplained Ultra Evaluation Kit (DM320113)	Graphical User Interface Demonstrations: MPLAB Harmony v3 has various demonstration examples for creating an intuitive and reliable GUI in applications.	Reference design Link and Graphics demonstration link
2	Motor Control	dsPICDEM MCLV-3 Development Board High Voltage (DM330023-3) dsPICDEM MCLV-2 Development Board Low Voltage (DM330021-2) and ATSAME54 Motor Control Plugin Module (MA320207)	Motor Control for Appliances: There are multiple demonstration examples which are pre-configured to run on Microchip's various motor control development boards to make it easy to prototype a motor drive application.	Reference Design Link Motor Control examples

5.1.8   SAM E70/S70/V70/V71 Key Links

- SAM E70 Xplained Ultra Evaluation Kit (DM320113)
- SAM V71 Xplained Ultra evaluation Kit (ATSAMV71-XULT)
- MPLAB Harmony Landing Page.
- MPLAB Harmony v3 GitHub Reference Application Repository
- MPLAB Harmony v3 GitHub Quick Docs Repository
- Microchip Reference Designs Page

5.2   PIC32CZ CA80/CA9x

Click on the following links to check the various collaterals:

1. Videos.
2. Training Modules.
3. Virtual / On-Demand Training.
4. Technical Briefs.

5. Application Notes.

6. Application Demonstrations.

5.2.1 PIC32CZ CA80/CA9x Videos

Table 5-7. PIC32CZ CA80/CA9x Videos

Sl.No	Type/Focus Area	Hardware Board/ Kit Used	Description	Link
1	Getting Started with Tools	N/A	A step-by-step guide explaining the following: • How to Install MPLAB® X IDE • How to Install MPLAB XC32 Compiler • How to install the Configurator • How to Download the Harmony Framework from MPLAB Harmony v3 repositories on GitHub MPLAB Harmony v3 is configurable through the MCC. Refer to items 6 and 7 for specific instructions to use the MCC.	How to Set-up the Tools Required to Get Started with MPLAB Harmony v3
2	Getting Started with Software Tools	N/A	Explains how to use the MCC Content Manager.	MPLAB® Code Configurator Content Manager
3	Getting Started with Software Tools	Though the video covers DM320209 and EV76S68A, the same content can be replicated for PIC32CZ CA80/90 (PIC32CZ8110CA90208)	Explains how to create a new MPLAB Harmony v3 project using the MCC and shows how to migrate an MHC-based project to an MCC- based project.	Getting Started with Harmony v3 Using Code Configurator
4	Getting started with Docs	N/A	Introduces the Quick Docs package to help develop applications using Microchip's 32-bit products using the MPLAB Harmony v3 software framework.	Harmony Quick Docs Package
5	Getting started with Solutions	N/A	Introduces the MPLAB Harmony Reference Apps package and describes its typical application types and download methods.	Harmony Reference Applications Package
6	Getting Started application	PIC32CZ CA90 Curiosity Ultra Development Board (PIC32CZ8110CA90208)	This application demonstrates how to toggle LED0 by pressing switch SW-0 on a timeout basis and viewing the LED toggling rate on the serial terminal.	Getting Started with PIC32CZ CA Family MCUs

5.2.2 PIC32CZ CA80/CA9x Training Modules

Table 5-8. PIC32CZ CA80/CA9x Training Modules

SL.No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
1	Getting started with tools	N/A	Shows how to create a new MPLAB Code Configurator (MCC) Harmony v3 project from scratch.	Create a new MPLAB Harmony v3 project using MCC
2	Getting started with tools	N/A	Shows how to open an existing project and use it with the MCC.	MCC - Open an Existing MPLAB® Harmony v3 Project
3	Getting started with tools	N/A	Shows how to install the MPLAB Code Configurator (MCC) plugin, and how to download the MPLAB Harmony v3 framework.	MPLAB® Code Configurator Overview with MPLAB Harmony Content
4	Getting started with tools	This training uses the SAM D5x/E5x. The same training can be used as a reference for other MCUs.	Shows how to create a new MPLAB Harmony v3 project Using the MCC.	Create a new MPLAB Harmony v3 Project Using MCC
5	Migration	This training uses the PIC32MZ EF. The same training can be used for other MCUs.	Shows how to update and configure an existing MPLAB Harmony Configurator (MHC)-based MPLAB Harmony v3 project to a MPLAB Code Configurator(MCC)-based project.	Update and Configure an Existing MHC-based MPLAB Harmony v3 Project to MCC based Project

5.2.3 PIC32CZ CA80/CA9x Virtual / On-Demand Training

More virtual trainings are available at Microchip University. Click on the following links for more details:

1. Introduction To MPLAB®XIDE.
2. MPLAB®X Tips and Tricks.
3. Overview of the Microchip Code Configurator (MCC) Content Manager (CM).
4. MPLAB®Code Configurator (MCC) For Simplified Embedded Software Development.
5. ARM®Cortex®-M Architecture Overview.
6. Getting Started with Writing Code for the Microchip ARM®Cortex® Microcontrollers.
7. MPLAB®Harmonyv3 Fundamentals.
8. Simple Applications Using the MPLAB® Harmony v3 Peripheral Libraries.
9. Creating Advanced Embedded Applications with 32-bit MCUs/MPUs using the MPLAB®Harmony v3 Software Framework.
10. FreeRTOS Simplified: A Beginner's Guide to Develop and Debug FreeRTOS Applications.
11. Class B Diagnostic Libraries For Functional Safety.

5.2.4 PIC32CZ CA80/CA9x Technical Briefs

Table 5-9. PIC32CZ CA80/CA9x Technical Briefs

SL.No	Type / Focus Area	Description	Link
1	Getting Started	TB3231: This document explains how to create a simple application on a SAM MCU using the MPLAB Harmony v3 modules. This application sends a "Hello World!" string to a console running on a computer. Though this document is explained on one MCU, it can be ported to other MCUs.	Link
2	Getting Started	TB3232: This document explains how to set up the tools required to get started with the MPLAB Harmony v3 software development framework.	Link
3	Getting Started	TB3304: *How to Add a New Configuration to an Existing MPLAB Harmony v3 Project*	Link
4	Getting Started	TB3305: *How to Use the MPLAB Harmony v3 Project Manifest Feature*	Link
5	Getting Started	TB3290: *MPLAB Harmony v3 Synchronous Drivers and Their Usage in FreeRTOS Based Applications*	Link
6	Getting Started	TB3269: *The Differences Between MPLAB Harmony v3 Synchronous and Asynchronous Drivers and When to Use Them*	Link
7	Getting Started	TB3291: *The Difference Between MPLAB Harmony v3 PLIBs and Drivers, and When to Use Them*	Link
8	Getting Started	TB3227: *Clock System Configuration and Usage on SAM C2x (Cortex M0+) Devices*	Link
9	Getting Started	TB3253: *How to Build an Application by Adding a New PLIB, Driver, or Middleware to an Existing MPLAB Harmony v3 Project*	Link
10	Getting Started	TB3246: *How to Use the MPLAB Harmony v3 Debug System Service*	Link
11	Peripheral Feature	TB3243: *How to Wake-up Fast from an External Event on Cortex M0+ Based MCUs*	Link
12	Peripheral Feature	TB3230: *Various Timers on SAM Devices*	Link
13	Peripheral Feature	TB3222: *EEPROM Emulation for Flash-Only Devices*	Link
14	MCU Feature	TB3183: *What is Sleepwalking? How it helps to reduce the power consumption?*	Link
15	Peripheral Feature	TB3170: *How the Event System Helps to Lower CPU Load and Power Consumption in Cortex™-M0+ Microcontrollers*	Link
16	Getting Started	TB3348: Creating the First Application on PIC32CZ CAx Microcontrollers Using MPLAB Harmony v3 with MPLAB Code Configurator (MCC)	Link

5.2.5 PIC32CZ CA80/CA9x Application Notes

Table 5-10. PIC32CZ CA80/CA9x Application Notes

Sl. No	Type/ Focus Area	Description	Link
1	Migration	AN4495: MPLAB Harmony v3 Project Migration application note discusses the migration of an existing MPLAB Harmony v3 based project developed on a particular hardware (microcontroller or development board) platform to another one of Microchip's 32-bit hardware platforms of the user's choice.	Link
2	Feature specific	AN4383: *32-bit Microcontroller Wafer-Level Chip-Scale Package (WLCSP)*	Link
3	Migration	AN3346: *Introduction to MPLAB and Harmony v3 for Atmel Studio and ASF Users*	Link

5.2.6 PIC32CZ CA80/CA9x Application Demonstrations

Table 5-11. PIC32CZ CA80/CA9x Application Demonstrations

Sl. No	Type/Focus Area	Hardware Kit Used	Description	Link
1	Getting Started	PIC32CZ CA90 Curiosity Ultra Development Board (PIC32CZ8110CA90208)	This application demonstrates how to toggle LED0 by pressing switch SW0 on a timeout basis and viewing the LED toggling rate on the serial terminal.	Link
2	Getting Started	PIC32CZ CA80 Curiosity Ultra Development Board (PIC32CZ8110CA80208)	This application demonstrates how to toggle LED0 by pressing switch SW0 on a timeout basis and viewing the LED toggling rate on the serial terminal.	Link

5.2.7 PIC32CZ CA80/CA9x Key Links

- PIC32CZ CA Family Landing Page
- PIC32CZ CA80 Curiosity Ultra Development Board (EV51S73A)
- PIC32CZ CA90 Curiosity Ultra Development Board (EV16W43A)
- MPLAB Harmony Landing Page
- MPLAB Harmony v3 GitHub Reference Application Repository
- MPLAB Harmony v3 GitHub Quick Docs Repository
- Microchip Reference Designs Page

6. MIPS Family of Devices

6.1 PIC32MZ EF

Click on the following links to check the various collaterals:

1. Videos.
2. Training Modules.
3. Virtual/On-Demand Training.
4. Technical Briefs.
5. Application Notes.
6. Application Demonstrations.
7. Reference Designs/Solutions.

6.1.1 PIC32MZ EF Videos

Table 6-1. PIC32MZ EF Videos

Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
1	Getting Started with Tools	N/A	A step-by-step guide explaining: • How to Install MPLAB® X IDE • How to Install MPLAB XC32 Compiler • How to install the Configurator • How to Download the Harmony Framework from the MPLAB Harmony v3 repository MPLAB Harmony v3 is configurable through the MCC. Refer to items 4 and 5 for specific instructions using the MCC.	How to Set-up the Tools Required to Get Started with Harmony v3
2	Getting Started with Device/Kit	Curiosity PIC32MZ EF 2.0 Development Board (DM320209)	Explains how to create a simple application with the PIC32MZ EF using MPLAB Harmony v3. This application sends a "Hello World!" string to the PC terminal. MPLAB Harmony v3 is configurable through the MCC. Refer to items 4 and 5 for specific instructions using the MCC.	Create The First Project with PIC32MZ EF using MPLAB® Harmony v3
3	Consumer	Curiosity PIC32MZ EF 2.0 Development Board (DM320209)	Shows how to create a thermal camera heatmap application on the Curiosity PIC32MZ EF 2.0 Development board using the MCC.	Create a Thermal Camera Heatmap Application on the Curiosity PIC32MZ EF 2.0 Development Board
4	Getting Started with Software Tools	N/A	Explains how to use the MCC Content Manager.	MPLAB® Code Configurator Content Manager
5	Getting Started with Software Tools	Curiosity PIC32MZ EF 2.0 Development Board (DM320209)	Explains how to create a new MPLAB Harmony v3 project using the MCC and shows how to migrate an MHC-based project to an MCC based project.	Getting Started with Harmony v3 Using Code Configurator
6	Getting started with Docs	N/A	Introduces the Quick Docs package to help develop applications using Microchip's 32-bit products using the MPLAB Harmony v3 software framework.	Harmony Quick Docs Package
7	Getting started with Solutions	N/A	Introduces the MPLAB Harmony Reference Apps package and describes its typical application types and download methods.	Harmony Reference Applications Package

6.1.2   PIC32MZ EF Training Modules

Table 6-2. PIC32MZ EF Training Modules

Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
1	Getting Started with Device/Kit	Curiosity PIC32MZ EF 2.0 Development Board (DM320209)	Shows how to create an application to get started with the PIC32MZ EF using the MPLAB Harmony v3 software framework. The training module is based on the MHC. Similar steps and flow can be used to create a project using the MCC.	Getting Started with Harmony v3 Peripheral Libraries on PIC32MZ EF MCUs
2	Getting Started with Device/Kit	Curiosity PIC32MZ EF 2.0 Development Board (DM320209)	Shows how to create an application to get started with the PIC32MZ EF using the MPLAB Harmony v3 software framework drivers and middleware with FreeRTOS. The training module is based on the MHC. Similar steps and flow can be used to create a project using the MCC.	Getting Started with Harmony v3 Drivers and Middleware on PIC32MZ EF MCUs using FreeRTOS
3	Getting started with tools	This training is using the SAM D5x/E5x. The same training can be used as a reference for other MCUs.	Shows how to create a new MPLAB Harmony v3 project using the MCC.	Create a new MPLAB Harmony v3 project using MCC
4	Migration	Curiosity PIC32MZ EF 2.0 Development Board (DM320209)	Shows how to update and configure an existing MPLAB Harmony Configurator (MHC)-based MPLAB Harmony v3 project to a MPLAB Code Configurator (MCC)-based project.	Update and Configure an Existing MHC-based MPLAB Harmony v3 Project to MCC-based Project
5	Getting started with tools	N/A	Shows how to create a new MPLAB® Code Configurator (MCC) Harmony v3 project from scratch.	Create a new MPLAB Harmony v3 project using MCC
6	Getting started with tools	N/A	Shows how to open an existing project, and use it with the MCC.	MCC - Open an Existing MPLAB® Harmony v3 Project
7	Getting started with tools	N/A	Shows how to install the MPLAB® Code Configurator (MCC) plugin, and how to download the MPLAB Harmony v3 framework.	MPLAB® Code Configurator Overview with MPLAB Harmony Content
8	Web-Enabled Digital Photo Frame using MPLAB® Harmony v3	Curiosity PIC32MZ EF2.0 Development Board (DM320209)	This tutorial is intended to show users how to create a web-enabled digital photo frame from scratch using MPLAB Harmony v3 and MPLAB Code Configurator (MCC) with Harmony 3.	Getting Started with MPLAB® Harmony v3 to Create a Web-Enabled Digital Photo Frame

6.1.3   PIC32MZ EF Virtual/On-Demand Training

More virtual trainings are available at Microchip University. Click on the following links for more details:

- Introduction To MPLAB® X IDE
- MPLAB® X Tips and Tricks
- Overview of the Microchip Code Configurator (MCC) Content Manager (CM)
- MPLAB® Code Configurator (MCC) For Simplified Embedded Software Development
- MPLAB® Harmony v3 Fundamentals
- Simple Applications Using the MPLAB® Harmony v3 Peripheral Libraries
- Creating Advanced Embedded Applications with 32-bit MCUs/MPUs using the MPLAB® Harmony v3 Software Framework
- FreeRTOS Simplified: A Beginner's Guide to Develop and Debug FreeRTOS Applications
- Class B Diagnostic Libraries For Functional Safety

6.1.4 PIC32MZ EF Technical Briefs

Table 6-3. PIC32MZ EF Technical Briefs

Sl. No	Type/ Focus Area	Description	Link
1	Getting Started	TB3259: This document explains how to create a simple application on PIC32 MCU using the MPLAB Harmony v3 modules. This application sends a "Hello World!" string to a console running on a computer. This document is explained on one MCU. It can be ported for other MCUs. **Note:** Microchip is moving from the MHC to the MCC. Refer to items 4 and 5 in the Videos table.	Link
2	Getting Started	TB3232: This document explains how to set up the tools required to get started with the MPLAB Harmony v3 software development framework.	Link
3	Getting Started	TB3304: *How to Add a New Configuration to an Existing MPLAB Harmony v3 Project*	Link
4	Getting Started	TB3305: *How to Use the MPLAB Harmony v3 Project Manifest Feature*	Link
5	Getting Started	TB3290: *MPLAB Harmony v3 Synchronous Drivers and Their Usage in FreeRTOS Based Applications*	Link
6	Getting Started	TB3269: *The Differences Between MPLAB Harmony v3 Synchronous and Asynchronous Drivers and When to Use Them*	Link
7	Getting Started	TB3291: *The Difference Between MPLAB Harmony v3 PLIBs and Drivers, and When to Use Them*	Link
8	Cache	TB3308: *Handling Cache Coherency Issues at Runtime Using Cache Maintenance Operations on the PIC32MZ MCUs Using MPLAB Harmony v3*	Link
9	DMA CRC	TB3196: *How to Use the DMA CRC Generator on PIC32 Devices*	Link
10	Getting Started	TB3296: *Multiplexed and Remappable Functionalities on I/O pins on PIC32M Devices Using MPLAB Harmony v3*	Link
11	Getting Started	TB3253: *How to Build an Application by Adding a New PLIB, Driver, or Middleware to an Existing MPLAB Harmony v3 Project*	Link

6.1.5 PIC32MZ EF Application Notes

Table 6-4. PIC32MZ EF Application Notes

Sl. No	Type/ Focus Area	Description	Link
1	Migration	AN4495: MPLAB Harmony v3 Project Migration application note discusses the migration of an existing MPLAB Harmony v3 based project developed on a particular hardware (microcontroller or development board) platform to another one of Microchip's 32-bit hardware platforms of the user's choice.	Link
2	Migration	AN3388: *MPLAB Harmony v3 Application Development Guide for MPLAB Harmony v2 Users*	Link
3	Bootloader	AN3703: *Live Update Application on PIC32MZ MCUs Using MPLAB Harmony v3*	Link

6.1.6 PIC32MZ EF Application Demonstrations

Table 6-5. PIC32MZ EF Application Demonstrations

Sl. No	Type	Hardware Board/ Kit Used	Description	Link
1	Getting started	Curiosity PIC32MZ EF 2.0 Development Board (DM320209)	Getting Started Extended Application on a Curiosity PIC32MZ EF 2.0 Development Board.	Link
2	Datalogger, Automation	Curiosity PIC32MZ EF 2.0 Development Board (DM320209)	Thermal Camera based Heat Map Application on a Curiosity PIC32MZ EF 2.0 Development Board + OLED C click + Grid-EYE click.	Link
3	Consumer, Graphics	Curiosity PIC32MZ EF 2.0 Development Board (DM320209)	Snake Game Application on a Curiosity PIC32MZ EF 2.0 Development Board + High-Performance WVGA LCD Display Module with maXTouch Technology using Legato Graphics.	Link
4	IoT, Automation	Curiosity PIC32MZ EF 2.0 Development Board (DM320209)	Wi-Fi®-based RGB LED Control Application on a Curiosity PIC32MZ EF 2.0 Development Board.	Link
5	Consumer, Audio	Curiosity PIC32MZ EF 2.0 Development Board (DM320209)	SD Card Audio Player Application on a Curiosity PIC32MZ EF 2.0 Development Board.	Link
6	Automation	Curiosity PIC32MZ EF 2.0 Development Board (DM320209)	EEPROM/Thumb drive Temperature Logger Application on a Curiosity PIC32MZ EF 2.0 Development Board.	Link

...........continued

Sl. No	Type	Hardware Board/ Kit Used	Description	Link
7	Motion Surveillance Camera	Curiosity PIC32MZ EF 2.0 Development Board (DM320209)	The Motion Surveillance application detects a motion in front of the Arducam Mega (camera module) using the PIR Click (motion sensor) board. ArduCAM captures an image with resolution 320x240 and stores the image in an external storage device (microSD Card). Additionally, the application demonstrates a live preview of captured images.	Link

More application demonstrations are available at Microchip's MPLAB Harmony GitHub repositories. Refer to the following link:

- More Application demonstrations on Curiosity PIC32MZ EF 2.0 Development Board and other Development Boards/Kits having the same part number (PIC32MZ2048EFM144)

6.1.7 PIC32MZ EF Reference Designs/Solutions

Table 6-6. PIC32MZ EF Reference Designs/Solutions

Sl. No	Type	Hardware Board/ Kit Used	Description	Link
1	HMI, Graphics	Curiosity PIC32MZ EF 2.0 Development Board (DM320209)	Graphical User Interface Demonstrations: MPLAB Harmony v3 has various demonstration examples for creating an intuitive and reliable GUI in applications.	Reference design Link and Graphics demonstration link
2	Datalogger, Automation	Curiosity PIC32MZ EF 2.0 Development Board (DM320209)	Thermal Camera Heat Map Demonstration Application	Link
3	IoT	Curiosity PIC32MZ EF 2.0 Development Board (DM320209)	Wi-Fi® Remote Control for Lighting or Appliances Demonstration Application	Link
4	Consumer, Graphics	Curiosity PIC32MZ EF 2.0 Development Board (DM320209)	Snake Game with Graphics Demonstration Application	Link
5	USB	Curiosity PIC32MZ EF 2.0 Development Board (DM320209)	USB Mass Storage Device for Multiple Drives Demonstration Application	Link
6	Consumer, Audio	Curiosity PIC32MZ EF 2.0 Development Board (DM320209)	SD Card/USB Audio Player Demonstration Application	Link
7	Consumer, Graphics	Curiosity PIC32MZ EF 2.0 Development Board (DM320209)	Audio Player/Recorder Demonstration Application	Link
8	Web Photo Frame	Curiosity PIC32MZ EF 2.0 Development Board (DM320209)	A web photo frame is a device that displays digital photos. We provide solutions for web photo frames, including microcontrollers (MCUs), memory, power management and connectivity components. Our solution, which is based on the Curiosity PIC32MZ EF 2.0 development board, helps to connect to the web to download and display photos.	Link

6.1.8 PIC32MZ EF Key Links

- Curiosity PIC32MZ EF 2.0 Development Board (DM320209)
- MPLAB Harmony Landing Page
- MPLAB Harmony v3 GitHub Reference Application Repository
- MPLAB Harmony v3 GitHub Quick Docs Repository
- Microchip Reference Designs Page

6.2 PIC32MZ DA

Click on the following links to check the various collaterals:

1. Videos.

2. Training Modules.

3. Virtual/On-Demand Training.

4. Technical Briefs.

5. Application Notes.

6. Application Demonstrations.

7. Reference Designs/Solutions.

6.2.1   PIC32MZ DA Videos

Table 6-7. PIC32MZ DA Videos

Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
1	Getting Started with Tools	N/A	A step-by-step guide explaining: • How to Install MPLAB® X IDE • How to Install MPLAB XC32 Compiler • How to install the Configurator • How to Download the Harmony Framework from the MPLAB Harmony v3 repository MPLAB Harmony v3 is configurable through the MCC. Refer to items 3 and 4 for specific instructions for using the MCC.	How to Set-up the Tools Required to Get Started with Harmony v3
2	Getting Started with device/kit	PIC32MZ DA Curiosity Development Board (EV87D54A)	Introduces the PIC32MZ DA Curiosity Development Kit and explains how to create a simple application on Microchip's PIC32MZ DA, that is based on a MIPS Core 32-bit microcontroller using the MPLAB Harmony v3 MHC. Introduces the PIC32MZ DA Curiosity Development Kit and explains how to create a simple application on Microchip's PIC32MZ DA, that is based on a MIPS™ Core 32-bit microcontroller using the MPLAB Harmony v3 MHC. MPLAB Harmony v3 is configurable through the MCC. Refer to items 3 and 4 for specific instructions for using the MCC.	Getting Started with the PIC32MZ DA Curiosity Development Kit
3	Getting Started with S/W Tools	N/A	Explains how to use the MCC Content Manager.	MPLAB® Code Configurator Content Manager
4	Getting Started with S/W Tools	The video covers DM320209 and EV76S68A, the same content can be replicated for the PIC32MZ DA Curiosity Development Board (EV87D54A)	Explains how to create a new MPLAB Harmony v3 project using the MCC and shows how to migrate an MHC-based project to a MCC based project.	Getting Started with Harmony v3 Using Code Configurator
5	Getting started with Docs	N/A	Introduces the Quick Docs package to help develop applications using Microchip's 32-bit products using the MPLAB Harmony v3 software framework.	Harmony Quick Docs Package
6	Getting started with Solutions	N/A	Introduces the MPLAB Harmony Reference Apps package and describes its typical application types and download methods.	Harmony Reference Applications Package

6.2.2   PIC32MZ DA Training Modules

Table 6-8. PIC32MZ DA Training Modules

Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
1	Getting Started with Device/ Kit	PIC32MZ DA Curiosity Development Board (EV87D54A)	Shows how to create an application to get started with PIC32MZ EF using the MPLAB Harmony v3 software framework. The training module is based on the MHC. Similar steps and flow can be used to create a project using the MCC. The same training module example/ flow can be ported to the PIC32MZ DA following the same steps.	Getting Started with Harmony v3 Peripheral Libraries on PIC32MZ EF MCUs
2	Getting Started with Device/ Kit	PIC32MZ DA Curiosity Development Board (EV87D54A)	This training module shows how to create an application to get started with the PIC32MZ EF using the MPLAB Harmony v3 software framework drivers and middleware with FreeRTOS. The training module is based on the MHC, similar steps and flow can be used to create a project using the MCC. The same training module example or flow can be ported to the PIC32MZ DA following the same steps.	Getting Started with Harmony v3 Drivers and Middleware on PIC32MZ EF MCUs using FreeRTOS
3	Getting started with tools	N/A	This training module shows how to create a new MPLAB® Code Configurator (MCC) Harmony v3 project from scratch.	Create a new MPLAB Harmony v3 project using MCC
4	Getting started with tools	N/A	This training module shows how to open an existing project and use it with the MCC.	MCC - Open an Existing MPLAB® Harmony v3 Project
5	Getting started with tools	N/A	This page will show how to install the MPLAB® Code Configurator (MCC) plugin, and how to download MPLAB Harmony v3 framework.	MPLAB® Code Configurator Overview with MPLAB Harmony Content
6	Getting started with tools	This training is uses the SAM D5x/E5x. The same training can be used as a reference for other MCUs.	This tutorial shows how to create a new MPLAB Harmony v3 project using the MCC.	Create a new MPLAB Harmony v3 project using MCC
7	Migration	This training is uses the PIC32MZ EF. The same training can be used for other MCUs.	This tutorial shows how to update and configure an existing MPLAB Harmony Configurator (MHC)-based MPLAB Harmony v3 project to a MPLAB Code Configurator (MCC)-based project.	Update and Configure an Existing MHC-based MPLAB Harmony v3 Project to MCC-based Project

6.2.3   PIC32MZ DA Virtual/On-Demand Training

More virtual trainings are available at Microchip University. Click on the following links for more details:

- Introduction To MPLAB® X IDE
- MPLAB® X Tips and Tricks
- Overview of the Microchip Code Configurator (MCC) Content Manager (CM)
- MPLAB® Code Configurator (MCC) For Simplified Embedded Software Development
- MPLAB® Harmony v3 Fundamentals
- Simple Applications Using the MPLAB® Harmony v3 Peripheral Libraries
- Creating Advanced Embedded Applications with 32-bit MCUs/MPUs using the MPLAB® Harmony v3 Software Framework
- FreeRTOS Simplified: A Beginner's Guide to Develop and Debug FreeRTOS Applications

6.2.4　PIC32MZ DA Technical Briefs

Table 6-9. PIC32MZ DA Technical Briefs

Sl. No	Type/ Focus Area	Description	Link
1	Getting Started	TB3259: This document explains how to create a simple application on a PIC32 MCU using the MPLAB Harmony v3 modules. This application sends a "Hello World!" string to a console running on a computer. This document is explained on one MCU, it can be ported for other MCUs. **Note:** Microchip is moving from the MHC to the MCC. Refer to items 3 and 4 in the Videos table.	Link
2	Getting Started	TB3232: This document explains how to set up the tools required to get started with the MPLAB Harmony v3 software development framework.	Link
3	Getting Started	TB3304: *How to Add a New Configuration to an Existing MPLAB Harmony v3 Project*	Link
4	Getting Started	TB3305: *How to Use the MPLAB Harmony v3 Project Manifest Feature*	Link
5	Getting Started	TB3290: *MPLAB Harmony v3 Synchronous Drivers and Their Usage in FreeRTOS bBsed Applications*	Link
6	Getting Started	TB3269: *The Differences Between MPLAB Harmony v3 Synchronous and Asynchronous Drivers and When to Use Them*	Link
7	Getting Started	TB3291: *The Difference Between MPLAB Harmony v3 PLIBs and Drivers, and When to Use Them*	Link
8	Cache	TB3308: *Handling Cache Coherency Issues at Runtime Using Cache Maintenance Operations on PIC32MZ MCUs Using MPLAB Harmony v3*	Link
9	DMA CRC	TB3196: *How to Use the DMA CRC Generator on PIC32 Devices*	Link
10	Getting Started	TB3296: Multiplexed and Remappable Functionalities on I/O pins on PIC32M Devices Using MPLAB Harmony v3	Link
11	Getting Started	TB3253: *How to Build an Application by Adding a New PLIB, Driver, or Middleware to an Existing MPLAB Harmony v3 Project*	Link

6.2.5　PIC32MZ DA Application Notes

Table 6-10. PIC32MZ DA Application Notes

Sl. No	Type/ Focus Area	Description	Link
1	Migration	AN4495: MPLAB Harmony v3 Project Migration application note discusses the migration of an existing MPLAB Harmony v3 based project developed on a particular hardware (microcontroller or development board) platform to another one of Microchip's 32-bit hardware platforms of the user's choice.	Link
2	Migration	AN3388: *MPLAB Harmony v3 Application Development Guide for MPLAB Harmony v2 Users*	Link
3	Bootloader	AN3703: *Live Update Application on PIC32MZ MCUs Using MPLAB Harmony v3*	Link

6.2.6　PIC32MZ DA Application Demonstrations

Table 6-11. PIC32MZ DA Application Demonstrations

Sl. No	Type	Hardware Board/ Kit Used	Description	Link
1	Getting Started	PIC32MZ DA Curiosity Development Board (EV87D54A)	Getting Started Application with the PIC32MZ DA Curiosity Development Kit.	Link
2	Audio, Graphics	PIC32MZ DA Curiosity Development Board (EV87D54A)	SD Card USB Audio Player on a PIC32MZ DA Curiosity Development Kit + High-Performance 4.3" WQVGA Display Module with maXTouch® Technology using Legato Graphics.	Link

More application demonstrations are available at Microchip's MPLAB Harmony GitHub repositories. Refer to the following link:

- More application demonstrations on PIC32MZ DA Curiosity Development Kit and other Development Boards/Kits having the same part number (PIC32MZ2064DAR176)

6.2.7 PIC32MZ DA Reference Designs/Solutions

Table 6-12. PIC32MZ DA Reference Designs/Solutions

Sl. No	Type	Hardware Board/ Kit Used	Description	Link
1	HMI, Graphics	PIC32MZ DA Curiosity Development Board (EV87D54A)	Graphical User Interface Demonstrations: MPLAB Harmony v3 has various demonstration examples for creating an intuitive and reliable GUI in applications.	Ref design Link and Graphics demonstration link
2	Graphics, IoT	PIC32MZ DA Curiosity Development Board (EV87D54A) PIC32MZ Embedded Graphics with External DRAM (DA) Starter Kit (DM320008) PIC32MZ Embedded Graphics with External DRAM (DA) Starter Kit (Crypto)(DM320008-C)	This reference design demonstrates a round display user interface that is more attractive for users and differentiates it from a rectangular display. Integrating a MiWi protocol module on the board combines an attractive user interface with broad IoT communication capability in a small package.	Link

6.2.8 PIC32MZ DA Key Links

- PIC32MZ DA Curiosity Development Board (EV87D54A)
- MPLAB Harmony Landing Page
- MPLAB Harmony v3 GitHub Reference Application Repository
- MPLAB Harmony v3 GitHub Quick Docs Repository
- Microchip Reference Designs Page

6.3 PIC32MK

Click on the following links to check the various collaterals:

1. Videos.
2. Training Modules.
3. Virtual/On-Demand Training.
4. Technical Briefs.
5. Application Notes.
6. Application Demonstrations.
7. Reference Designs/Solutions.

6.3.1 PIC32MK Videos

Table 6-13. PIC32MK Videos

Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
1	Getting Started with Tools	N/A	A step-by-step guide explaining: • How to Install MPLAB® X IDE • How to Install MPLAB XC32 Compiler • How to install the Configurator • How to Download the Harmony Framework from the MPLAB Harmony v3 repository MPLAB Harmony v3 is configurable through the MCC. Refer to items 3 and 4 for specific instructions to use the MCC.	How to Set-up the Tools Required to Get Started with Harmony v3

..........continued

Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
2	Getting Started with device/ kit	PIC32MK MCM Curiosity Pro Development Board (EV31E34A)	Introduces the PIC32 MK MCM Curiosity Pro Development Board and explains how to create a simple application on Microchip's PIC32 MK MCM 32-bit microcontroller using the MPLAB Code Configurator.	Getting Started on the PIC32MK MCM Curiosity Pro
3	Getting Started with Software Tools	N/A	Explains how to use the MCC Content Manager.	MPLAB® Code Configurator Content Manager
4	Getting Started with Software Tools	The video covers DM320209 and EV76S68A. The same content can be replicated for the PIC32MK MCM Curiosity Pro Development Board (EV31E34A).	Explains how to create a new MPLAB Harmony v3 project using the MCC and shows how to migrate an MHC-based project to a MCC based project.	Getting Started with Harmony v3 Using Code Configurator
5	Getting started with Docs	N/A	Introduces the Quick Docs package to help develop applications using Microchip's 32-bit products using the MPLAB Harmony v3 software framework.	Harmony Quick Docs Package

6.3.2 PIC32MK Training Modules

Table 6-14. PIC32MK Training Modules

Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
1	Getting Started with Device/ Kit	PIC32MK MCM Curiosity Pro Development Board (EV31E34A)	Shows how to create an application to get started with PIC32MK GP MCUs using the MPLAB Harmony v3 software framework. The training module is based on the MHC. Similar steps and flow can be used to create a project using the MCC. This training module is developed for PIC32MK GP Development Kit. The same flow can be reused for the PIC32MK MCM Curiosity Pro Development Board (EV31E34A).	Getting Started with Harmony v3 Peripheral Libraries on PIC32MK GP MCUs
2	Getting started with tools	N/A	Shows how to create a new MPLAB® Code Configurator (MCC) Harmony v3 project from scratch.	Create a new MPLAB Harmony v3 project using MCC
3	Getting started with tools	N/A	Shows how to open an existing project and use it with the MCC.	MCC - Open an Existing MPLAB® Harmony v3 Project
4	Getting started with tools	N/A	Shows how to install the MPLAB® Code Configurator (MCC) plugin and how to download the MPLAB Harmony v3 framework.	MPLAB® Code Configurator Overview with MPLAB Harmony Content
5	Getting started with tools	This training uses the SAM D5x/E5x. The same training can be used as a reference for other MCUs.	Shows how to create a new MPLAB Harmony v3 project using the MCC.	Create a new MPLAB Harmony v3 project using MCC
6	Migration	This training uses the PIC32MZ EF. The same training can be used for other MCUs.	Shows how to update and configure an existing MPLAB Harmony Configurator (MHC)-based MPLAB Harmony v3 project to a MPLAB Code Configurator (MCC)-based project.	Update and Configure an Existing MHC-based MPLAB Harmony v3 Project to MCC-based Project

6.3.3 PIC32MK Virtual/On-Demand Training

More virtual trainings are available at Microchip University. Click on the following links for more details:

- Introduction To MPLAB® X IDE

- MPLAB® X Tips and Tricks
- Overview of the Microchip Code Configurator (MCC) Content Manager (CM)
- MPLAB® Code Configurator (MCC) For Simplified Embedded Software Development
- MPLAB® Harmony v3 Fundamentals
- Simple Applications Using the MPLAB® Harmony v3 Peripheral Libraries
- Creating Advanced Embedded Applications with 32-bit MCUs/MPUs using the MPLAB® Harmony v3 Software Framework
- FreeRTOS Simplified: A Beginner's Guide to Develop and Debug FreeRTOS Applications
- Class B Diagnostic Libraries For Functional Safety

6.3.4 PIC32MK Technical Briefs

Table 6-15. PIC32MK Technical Briefs

Sl. No	Type/ Focus Area	Description	Link
1	Getting Started	TB3259: This document explains how to create a simple application on a PIC32 MCU using the MPLAB Harmony v3 modules. This application sends a "Hello World!" string to a console running on a computer. This document explains one MCU, it can be ported for other MCUs. **Note:** Microchip is moving from the MHC to the MCC. Refer to items 3 and 4 in the Videos table.	Link
2	Getting Started	TB3232: This document explains how to set up the tools required to get started with the MPLAB Harmony v3 software development framework.	Link
3	Getting Started	TB3304: *How to Add a New Configuration to an Existing MPLAB Harmony v3 Project*	Link
4	Getting Started	TB3305: *How to Use the MPLAB Harmony v3 Project Manifest Feature*	Link
5	Getting Started	TB3290: *MPLAB Harmony v3 Synchronous Drivers and Their Usage in FreeRTOS Based Applications*	Link
6	Getting Started	TB3269: *The Differences Between MPLAB Harmony v3 Synchronous and Asynchronous Drivers and When to Use Them*	Link
7	Getting Started	TB3291: *The Difference Between MPLAB Harmony v3 PLIBs and Drivers, and When to Use Them*	Link
8	ADC	TB3319: *How to Perform ADC Conversions with DMA Data Transfers on PIC32MK Devices Using MPLAB Harmony v3*	Link
9	DMA CRC	TB3196: *How to Use the DMA CRC Generator on PIC32 Devices*	Link
10	Getting Started	TB3296: *Multiplexed and Remappable Functionalities on I/O pins on PIC32M Devices Using MPLAB Harmony v3*	Link
11	Getting Started	TB3253: *How to Build an Application by Adding a New PLIB, Driver, or Middleware to an Existing MPLAB Harmony v3 Project*	Link

6.3.5 PIC32MK Application Notes

Table 6-16. PIC32MK Application Notes

Sl. No	Type/ Focus Area	Description	Link
1	Migration	AN4495: MPLAB Harmony v3 Project Migration application note discusses the migration of an existing MPLAB Harmony v3 based project developed on a particular hardware (microcontroller or development board) platform to another one of Microchip's 32-bit hardware platforms of the user's choice.	Link
2	Migration	AN3388: *MPLAB Harmony v3 Application Development Guide for MPLAB Harmony v2 Users*	Link

6.3.6 PIC32MK Application Demonstrations

Table 6-17. PIC32MK Application Demonstrations

Sl. No	Type	Hardware Board/ Kit Used	Description	Link
1	Getting started	PIC32MK GP Development Kit (DM320106)	Getting Started Application Demonstration on a PIC32MK General Purpose (GP) Development Board using MPLAB Harmony v3.	Link

More application demonstrations are available at Microchip's MPLAB Harmony GitHub repositories. Refer to the following link:

- More application demonstrations on PIC32MZ MCM Curiosity Pro Development Board and other Development Boards/Kits having the same part number

6.3.7　PIC32MK Reference Designs/Solutions

Table 6-18. PIC32MK Reference Designs/ Solutions

Sl. No	Type	Hardware Board/ Kit Used	Description	Link
1	Motor Control	dsPICDEM MCLV-3 Development Board High Voltage (DM330023-3) dsPICDEM MCLV-2 Development Board Low Voltage (DM330021-2) and PIC32MK MCM Motor Control Plug In Module (MA320211) or PIC32MK1024 Motor Control Plug In Module (MA320024)	Motor Control for Appliances: There are multiple demonstration examples, which are pre-configured to run on the various motor control development boards, which makes it easy for prototyping motor drive applications.	Ref Design Link Motor Control examples
2	Motor Control	PIC32MK MCA Curiosity Pro Development Board (EV15D86A) PIC32MK MCJ Curiosity Pro Development Board (DT100113) PIC32MK MCM Curiosity Pro Dual-USB Development Kit (EV31E34A)	The PIC32MK MCM multi-motor control solution demonstrates how to use a PIC32MK MCM to drive up to three motors.	Link

6.3.8　PIC32MK Key Links

- PIC32MK MCM Curiosity Pro Development Board (EV31E34A)
- PIC32MK MCA Curiosity Pro Development Board (EV15D86A)
- MPLAB Harmony Landing Page
- MPLAB Harmony v3 GitHub Reference Application Repository
- MPLAB Harmony v3 GitHub Quick Docs repository
- Microchip Reference Designs Page

6.4　PIC32MX

Click on the following links to check the various collaterals:

1. Videos.
2. Training Modules.
3. Virtual/On-Demand Training.
4. Technical Briefs.
5. Application Notes.
6. Application Demonstrations.

6.4.1   PIC32MX Videos

Table 6-19. PIC32MX Videos

Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
1	Getting Started with Tools	N/A	A step-by-step guide explaining: • How to Install MPLAB® X IDE • How to Install MPLAB XC32 Compiler • How to install the Configurator • How to Download the Harmony Framework from the MPLAB Harmony v3 repository MPLAB Harmony v3 is configurable through the MCC. Refer to items 3 and 4 for specific instructions for using the MCC.	How to Set-up the Tools Required to Get Started with Harmony v3
2	Getting Started with Software Tools	N/A	Explains how to use the MCC Content Manager.	MPLAB® Code Configurator Content Manager
3	Getting Started with Software Tools	The video covers DM320209 and EV76S68A. The same content can be replicated for PIC32MX devices.	Explains how to create a new MPLAB Harmony v3 project using the MCC and shows how to migrate an MHC-based project to a MCC based project.	Getting Started with Harmony v3 Using Code Configurator
4	Getting started with Docs	N/A	Introduces the Quick Docs package to help develop applications using Microchip's 32-bit products using the MPLAB Harmony v3 software framework.	Harmony Quick Docs Package

6.4.2   PIC32MX Training Modules

Table 6-20. PIC32MX Training Modules

Sl. No	Type/ Focus Area	Hardware Board/ Kit Used	Description	Link
1	Getting Started with Device/ Kit	Curiosity PIC32MX470 Development Board (DM320103)	Shows how to create an application to get started with the PIC32MX MCUs using the MPLAB Harmony v3 software framework. The training module is based on MHC. Similar steps and flow can be used to create a project using the MCC.	Getting Started with Harmony v3 Peripheral Libraries on PIC32MX 470 MCUs
2	Getting started with tools	N/A	Shows how to create a new MPLAB® Code Configurator (MCC) Harmony v3 project from scratch.	Create a new MPLAB Harmony v3 project using MCC
3	Getting started with tools	N/A	Shows how to open an existing project and use it with the MCC.	MCC - Open an Existing MPLAB® Harmony v3 Project
4	Getting started with tools	N/A	Shows how to install the MPLAB Code Configurator (MCC) plugin, and how to download the MPLAB Harmony v3 framework.	MPLAB® Code Configurator Overview with MPLAB Harmony Content
5	Getting started with tools	This training uses the SAM D5x/E5x. The same training can be used as a reference for other MCUs.	Shows how to create a new MPLAB Harmony v3 project using the MCC.	Create a new MPLAB Harmony v3 project using MCC
6	Migration	This training uses the PIC32MZ EF. The same training can be used for other MCUs.	Shows how to update and configure an existing MPLAB Harmony Configurator (MHC)-based MPLAB Harmony v3 project to a MPLAB Code Configurator (MCC)-based project.	Update and Configure an Existing MHC-based MPLAB Harmony v3 Project to MCC-based Project

6.4.3   PIC32MX Virtual/On-Demand Training

More virtual trainings are available at Microchip University. Click on the following links for more details:

Microchip

- Introduction To MPLAB® X IDE
- MPLAB® X Tips and Tricks
- Overview of the Microchip Code Configurator (MCC) Content Manager (CM)
- MPLAB® Code Configurator (MCC) For Simplified Embedded Software Development
- MPLAB® Harmony v3 Fundamentals
- Simple Applications Using the MPLAB® Harmony v3 Peripheral Libraries
- Creating Advanced Embedded Applications with 32-bit MCUs/MPUs using the MPLAB® Harmony v3 Software Framework
- FreeRTOS Simplified: A Beginner's Guide to Develop and Debug FreeRTOS Applications

6.4.4   PIC32MX Technical Briefs

Table 6-21. PIC32MX Technical Briefs

Sl. No	Type/ Focus Area	Description	Link
1	Getting Started	TB3259: This document explains how to create a simple application on a PIC32 MCU using the MPLAB Harmony v3 modules. This application sends a "Hello World!" string to a console running on a computer. This document is explained on one MCU. It can be ported for other MCUs. **Note:** Microchip is moving from the MHC to the MCC. Refer to items 3 and 4 in the Videos table.	Link
2	Getting Started	TB3232: This document explains how to set up the tools required to get started with the MPLAB Harmony v3 software development framework.	Link
3	Getting Started	TB3304: *How to Add a New Configuration to an Existing MPLAB Harmony v3 Project*	Link
4	Getting Started	TB3305: *How to Use the MPLAB Harmony v3 Project Manifest Feature*	Link
5	Getting Started	TB3290: *MPLAB Harmony v3 Synchronous Drivers and Their Usage in FreeRTOS Based Applications*	Link
6	Getting Started	TB3269: *The Differences Between MPLAB Harmony v3 Synchronous and Asynchronous Drivers and When to Use Them*	Link
7	Getting Started	TB3291: *The Difference Between MPLAB Harmony v3 PLIBs and Drivers, and When to Use Them*	Link
8	DMA CRC	TB3196: *How to Use the DMA CRC Generator on PIC32 Devices*	Link
9	Getting Started	TB3296: *Multiplexed and Remappable Functionalities on I/O pins on PIC32M Devices Using MPLAB Harmony v3*	Link
10	Getting Started	TB3253: *How to Build an Application by Adding a New PLIB, Driver, or Middleware to an Existing MPLAB Harmony v3 Project*	Link

6.4.5   PIC32MX Application Notes

Table 6-22. PIC32MX Application Notes

Sl. No	Type/ Focus Area	Description	Link
1	Migration	AN4495: MPLAB Harmony v3 Project Migration application note discusses the migration of an existing MPLAB Harmony v3 based project developed on a particular hardware (microcontroller or development board) platform to another one of Microchip's 32-bit hardware platforms of the user's choice.	Link
2	Migration	AN3388: *MPLAB Harmony v3 Application Development Guide for MPLAB Harmony v2 Users*.	Link

6.4.6   PIC32MX: Application Demonstrations

Table 6-23. PIC32MX: Application Demonstrations

Sl. No	Type	Hardware Board/ Kit Used	Description	Link
1	Getting started	Curiosity PIC32MX470 Development Board (DM320103)	Getting Started Application on a Curiosity PIC32MX470 Development Board	Link

More application demonstrations are available at Microchip's MPLAB Harmony GitHub repositories. Refer to the following link:

- More application demonstrations on Curiosity PIC32MX470 Development Board and other Development Boards/Kits having the same part number (PIC32MX470F512H)

6.4.7   PIC32MX Key Links

- Curiosity PIC32 MX470 Development Board
- MPLAB Harmony Landing Page
- MPLAB Harmony v3 GitHub Reference Application Repository
- MPLAB Harmony v3 Quick Docs GitHub Repository
- Microchip Reference Designs Page

7. Revision History

Revision B - December 2024

The following updates were performed for this revision:

- Updated links and tables in the following sections to reflect new collaterals:
  - SAM D21/SAM D20/SAM D11/SAM D10
  - SAM C21/SAM C20/PIC32CM MC/PIC32CM JH
  - SAM L21/SAM L22
  - PIC32CM LE00/LS00/LS60
  - SAM L10/SAM L11
  - SAM D5x/E5x
  - SAM G5x
  - SAM E70/S70/V70/V71
  - PIC32MZ EF
  - PIC32MZ DA
  - PIC32MK
  - PIC32MX
- The following new sections were added:
  - Cortex M33 Family of Devices
  - PIC32CK GC01
  - PIC32CX SG41/SG60/SG61
  - PIC32CZ CA80/CA9x

Revision A - June 2023

This is the initial public release of this document.

For access to previous non-public releases and other information regarding MPLAB Harmony v3, please contact a local Microchip sales representative.

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