AXM0F343 SDK Getting Started Guide

October, 2021 – Rev. 1.4b

Contents

Introduction

The AXM0F343 combines the industry-leading AX5043 sub-GHz transceiver with a low-power Arm® Cortex-M0+ processor useful for various wireless applications. The AXM0F343 SDK includes the necessary firmware, software, example projects, documentation, and development tools to begin building end applications on the platform. This SDK is built on the Eclipse-based ON Semiconductor Integrated Development Environment (IDE), which is available as a free download from the AXM0F343 product page.

All example applications, device drivers, and application configuration files are delivered in a CMSIS pack format. This enables a modular approach that simplifies the set-up, compilation, and programming of reference example code on the AXM0F343 Development Kit boards. The following sections will describe the process of installing and using the SDK. Please refer to the readme files included with the example projects for additional descriptions of the applications and their configuration and use.

Hardware Setup

System Overview

The AXM0F343-X-X-1-GEVB are a series of evaluation boards intended for use in conjunction with the AXM0F343-SDK. The first -X represents the memory configuration, while the second represents the frequency.

For example, AXM0F343-256-915-1-GEVB has the IC variant with 256 kB of FLASH and the RF matching network is tuned for 915 MHz operation.

The board can be powered via USB, CR2032 battery, or an external 3.3V DC source via the Arduino-compatible header. Both SWD and Serial interfaces are provided via the J-Link On-Board. The AXM0F343 can be configured to output the RF signal via a differential load network, which supports both TX and RX, or a power-efficient single-ended network, which only supports TX. The block diagram of the system is shown below:

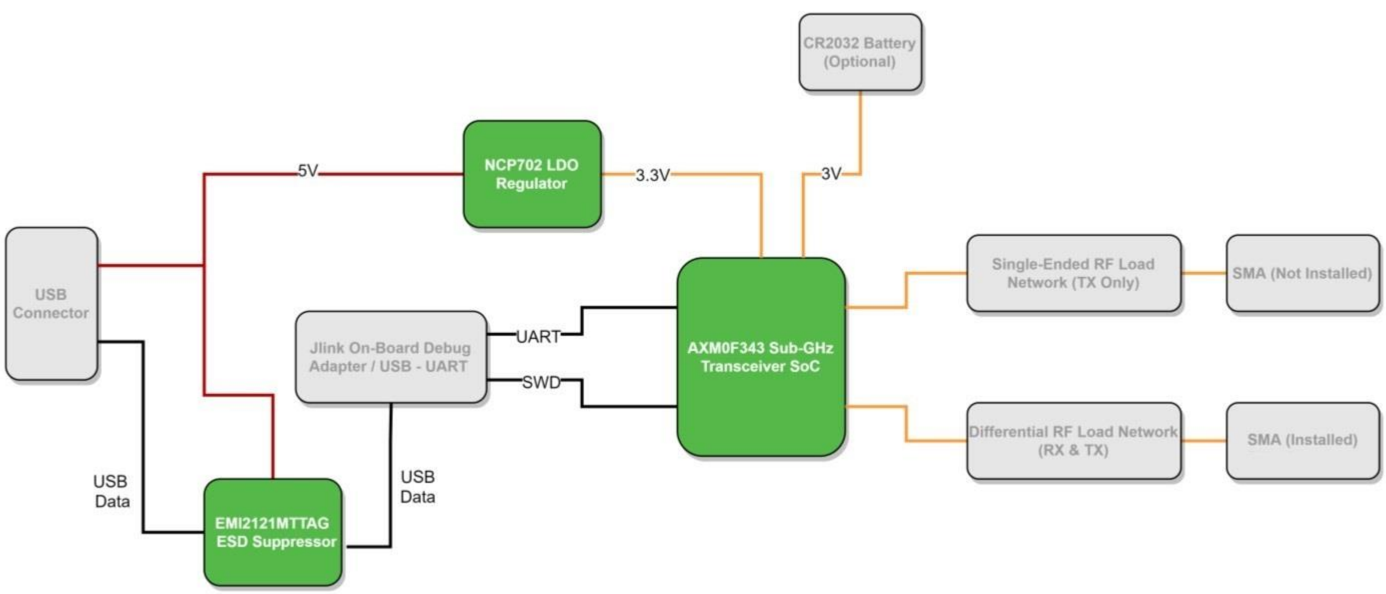


Figure 1 - AXM0F343-x-x-1-GEVB block diagram

NOTE: By default, the boards do not have the single-ended SMA installed. This is because the example software is designed to use the differential interface. Software configuration must be done to switch between single-ended and differential output networks.

Evaluation Kit Content

The AXM0F343-X-X-1-GEVK evaluation kit includes all what is needed to start testing and developing RF applications:

- 2x AXM0F343-X-X-1-GEVB boards pre-loaded with AX-Radio-TX and AX-Radio-RX examples;
- 2x Micro-USB cables;
- 2x whip antennas;
- Components bag with PCB mounting feet, extra headers, and an SMA connector that can be mounted when needed as shown in the figure below.

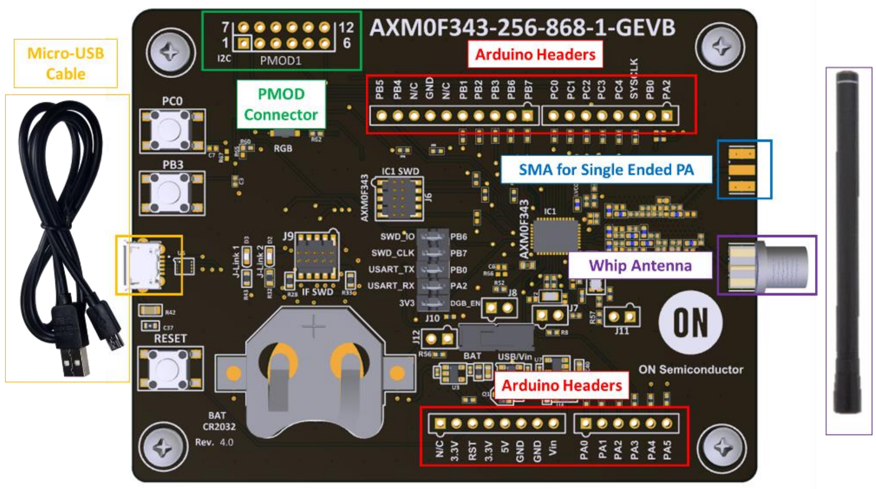


Figure 2: AXM0F343-x-x-1-GEVK content.

Headers Configuration

Figure 3 highlights several power headers available on the AXM0F343-X-X-1-GEVB that allow to connect/disconnect power domains and to monitor the currents:

- **Supply:** the yellow "Supply" arrow shows the main power selector. With this selector the power source can be toggled between battery operation (BATT) and USB or external voltage (USB/VIN).
- **J10:** this 10 pin header is the interface between the On-Board J-Link programmer and the AXM0F343 IC. The top four pairs connect the UART and SWD ports, while the bottom pair pulls the DBG_EN to VDD. In order to perform low power measurements with this PCB we recommend to disconnect these headers in order to avoid any leakage current.
- **J12:** by removing the parallel resistor R56, this header allows monitoring the current flowing from the battery.
- **J8:** by removing the parallel resistor R52, this header allows monitoring the current flowing to the MCU.
- **J7:** by removing the parallel resistor R58, this header allows monitoring the current flowing to the RADIO.
- **J11:** by removing the parallel resistor R57, this header allows monitoring the current flowing to the TCXO.

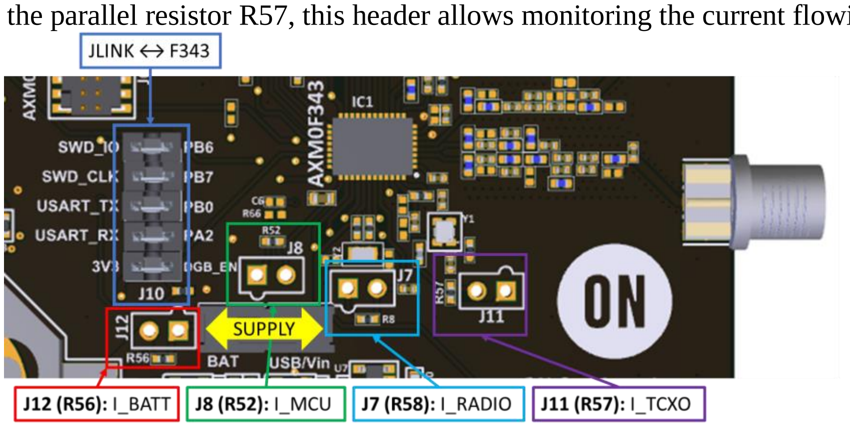


Figure 3 - AXM0F343-x-x-1-GEVB headers.

AXM0F343 IC Pinout and DVK connections

The AXM0F343 IC pinout and position on the AXM0F343-x-x-1-GEVB is shown in Figure 4. The available GPIOs are listed in Table 1, while the different connections to external peripherals and headers are explained in Table 2.

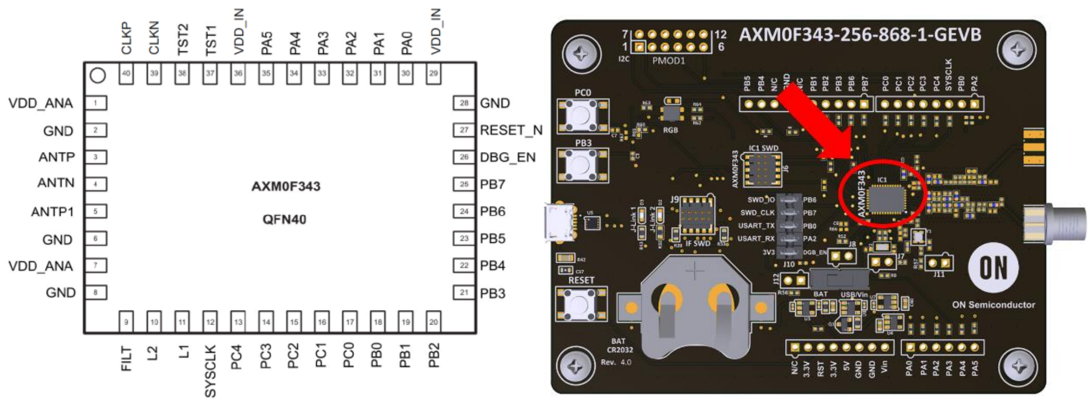


Figure 4 - AXM0F343 pinout and chip position on the DVK

Name	GPIO	Pin	DVK	ADC	Comparator	Timer	USART	PWM	I2C	SPI	CLK & XOSC	MISC
PA0	GPIO0	30	J4-1	ANA_CH0	CMP0/1_MI	TIM0OUT		PWM2H		SPI_SEL1	HSXOSC_P	CAPT1
PA1	GPIO1	31	J4-2	ANA_CH1	CMP0/1_PL	TIM0/1/2OUT TIM0CLK	USART1_CLK	PWM0L PWM1H			HSXOSC_N	TSTART
PA2	GPIO2	32	USART1_RX J4-3, J2-1	ANA_CH2	CMP0/1_MI		USART1_RX	PWM0H	SDA	SPI_SCK SPI_SEL_IN		TSTOP CAPT2
PA3	GPIO3	33	LPXOSC J4-4	ANA_CH3	CMP0/1_PL	TIM1OUT			SCL	SPI_SEL0 SPI_SCK_IN	LPXOSC_P EXTCLK_IN	
PA4	GPIO4	34	LPXOSC J4-5	ANA_CH4	CMP0/1_MI ACOMP0	TIM1CLK				SPI_DOUT	LPXOSC_N EXTCLK_OUT	EXT_INT
PA5	GPIO5	35	LED_B J4-6	ANA_CH5	CMP0/1_PL		USART1_TX	PWM1L PWM3H		SPI_SEL2		CAPT0
PB0	GPIO8	18	USART1_TX J2-2	ADCTRIG	ACMPO0		USART1_TX	PWM0L		SPI_DIN	EXTCLK_OUT	CAPT1
PB1	GPIO9	19	LED_G J1-5			TIM0CLK	USART1_RX USART0_CLK	PWM1/2H	SDA	SPI_DOUT		
PB2	GPIO10	20	TCXO_EN J1-4			TIM0/1/2OUT		PWM3H	SCL	SPI_SCK SPI_SEL_IN		CAPT0
PB3	GPIO11	21	Button J1-3			TIM1OUT TIM2CLK		PWM0H		SPI_SEL0 SPI_SCK_IN		WAKEUP
PB4	GPIO12	22	SDA J1-9			TIM1CLK	USART0_TX	PWM2H	SDA	SPI_DIN		PC4 TSTART
PB5	GPIO13	23	SCL J1-10			TIM1OUT	USART0_RX	PWM3H	SCL	SPI_SCK SPI_SEL_IN		TSTOP
PB6	GPIO14	24	SWDIO J1-2					PWM1H		SPI_SEL0/1 SPI_SCK_IN		
PB7	GPIO15	25	SWCLK J1-1			TIM0/1/2OUT	USART0/1_CLK	PWM1L		SPI_DOUT SPI_SEL2		EXT_INT
PC0	GPIO16	17	Button J2-8	ADCTRIG		TIM0OUT		PWM3L		SPI_SEL0 SPI_CSK_IN	EXTCLK_OUT	CAPT3 TSTART, TSTOP
PC1	GPIO17	16	J2-7		ACMPO1	TIM2OUT TIM0CLK		PWM0L		SPI_SCK SPI_SEL_IN	EXTCLK_IN	EXTCLK_IN
PC2	GPIO18	15	J2-6			TIM2CLK	USART0_TX	PWM1L		SPI_DOUT SPI_SEL1		CAPT2 EXT_INT
PC3	GPIO19	14	J2-5		ACMPO0		USART0_RX	PWM2L		SPI_SEL2 SPI_DIN		
PC4	GPIO20	13	LED_R J2-4	ADCTRIG	ACMPO1	TIM0/1/2OUT TIM1CLK	USART1_CLK	PWM2H				PB4

Table 1 - List of GPIOs and crossbar configuration table

Pin Number	Pin Name	Connection on AXM0F343-x-x-1-GEVB
1	VDD_ANA	Connected to ground (GND) via a decoupling capacitor
2	GND	Ground connection
3	ANTP	Connected to the matching network and differential (TX/RX) SMA connector
4	ANTN	Connected to the matching network and differential (TX/RX) SMA connector
5	ANTP1	Connected to the matching network and single-ended (TX) SMA connector (not-fitted)
6	GND	Ground connection
7	VDD_ANA	Connected to ground (GND) via a decoupling capacitor
8	GND	Ground connection
9	FILT	CAL line, connected to Pin 37 - TST1
10	L2	Shorted to L1 via a 0Ω Resistor
11	L1	Shorted to L2 via a 0Ω Resistor
12	SYSCLK	Connected to J2-3
13	PC4	Connected to J2-4
14	PC3	Connected to J2-5. Could be used for a RGB LED (not-fitted)
15	PC2	Connected to J2-6. Could be used for a RGB LED (not-fitted)
16	PC1	Connected to J2-7. Could be used for a RGB LED (not-fitted)
17	PC0	Connected to J2-8
18	PB0	Used by the debugger for UART TX and connected to J2-1
19	PB1	D4 - Green LED
20	PB2	Supply for the 48MHz TCXO (RF reference oscillator)
21	PB3	Pushbutton and connected to J1-1
22	PB4	Connected to J1-9 and PMOD1-8 using pull-up resistors for I2C_SDA
23	PB5	Connected to J1-10 and PMOD1-7 using pull-up resistors for I2C_SCL
24	PB6	Connected to J6-2 and used by the debugger for SWDIO
25	PB7	Connected to J6-4 and used by the debugger for SWCLK
26	DBG_EN	Connected to J10 to enable debugging mode
27	RESET_N	Pushbutton and connected to J3-3
28	GND	Ground connection
29	VDD_IN	Power supply input
30	PA0	Connected to J4-1
31	PA1	Connected to J4-2
32	PA2	Used by the debugger for UART RX and connected to J4-3
33	PA3	32.768kHz crystal input/output (Microcontroller external reference oscillator)
34	PA4	32.768kHz crystal input/output (Microcontroller external reference oscillator)
35	PA5	Connected to J4-4
36	VDD_IN	Power supply input
37	TST1	CAL line, connected to Pin 9 - FILT
38	TST2	Used for ground connection
39	CLKN	TCXO input/output (RF reference oscillator)
40	CLKP	TCXO input/output (RF reference oscillator)

Table 2 - AXM0F343-x-x-1-GEVB connections

IDE and SDK Setup

Prerequisites

To begin, the following tools must be downloaded from the AXM0F343 product page at https://www.onsemi.com/design/resources/design-resources/software?rpn=AXM0F343:

- **ON Semiconductor IDE** – This package includes the Eclipse-based IDE, the ARM GNU toolchain (compiler, linker, GDB debugger), and the J-Link software required program and debug the board.
- **AXM0F343 CMSIS Pack** – This includes all example code, middleware, and device drivers for the radio and MCU peripherals.
- **ARM CMSIS Pack** – This can either be downloaded automatically from inside of the IDE or installed manually. To install manually, first download the **.pack** file from the latest release at https://github.com/ARM- software/CMSIS_5/releases.
- **AX-ConfigurationUtility** – optional GUI to generate custom radio projects compatible with the ON Semiconductor IDE.

IDE Installation

Install your new ON Semiconductor IDE by running *ON_Semiconductor_IDE.msi*. The ON Semiconductor IDE is installed in this location by default: *C:\Program Files (x86)\ON Semiconductor\IDE_V*<**version**>.

You are prompted to install SEGGER J-Link. You need the J-Link software to download and debug applications on the Evaluation and Development Board. The **J-Link Installation Check** screen will guide you through the process of installing J-Link if no valid J-Link installation is found.

NOTE: If using a separately installed J-Link toolchain, version 6.71c or greater is required to support the AXM0F343 device family.

The release version and build number are stored in the *REVISION* text file at the root of the installed ON Semiconductor IDE.

AXM0F343 SDK Installation

To install the AXM0F343 CMSIS Pack:

1. Open the ON Semiconductor IDE.
2. From the launch screen create and / or select a directory to contain a workspace. The workspace contains all active projects and user IDE settings such as UI theming.
3. In the top right corner of the workbench perspective, click on the *Open Perspective* icon, select *CMSIS Pack Manager*, then click *Open*. (See Figure 3).

NOTE: If you cannot see the *CMSIS Pack Manager* item, re-install the IDE in your user folder (i.e., C:\Users\<user_name>)

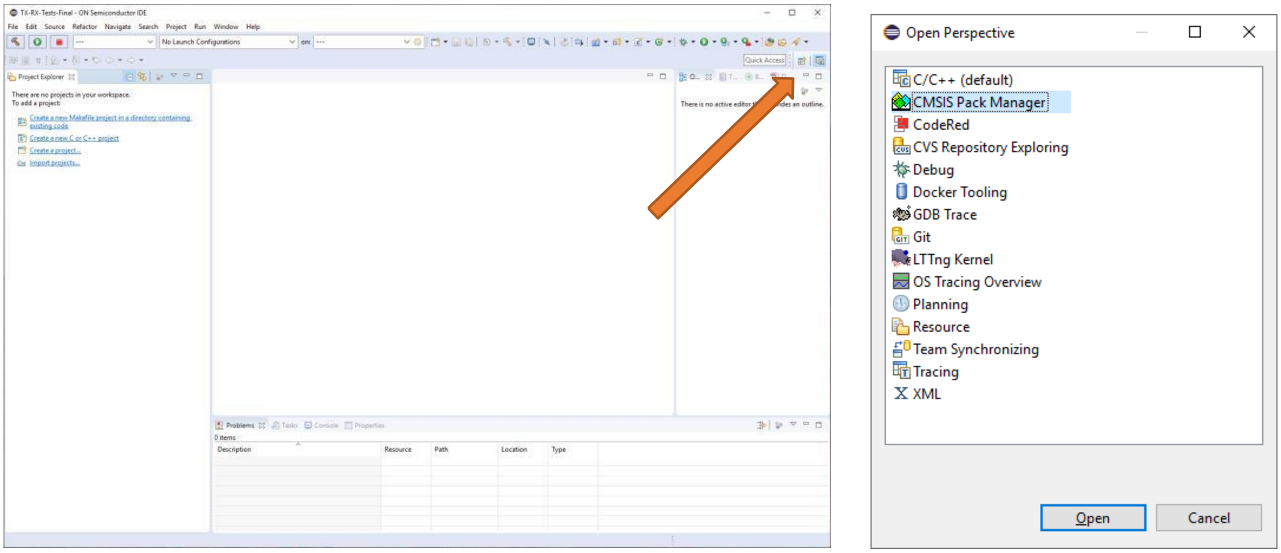


Figure 3: Open CMSIS Pack Manager perspective

4. Click on the *Import Existing Packs* icon, then select the pack file – *ONSemiconductor.AXM0F343*.<version>*.pack*. (pack versions are formatted with three numbers such as 1.2.0).

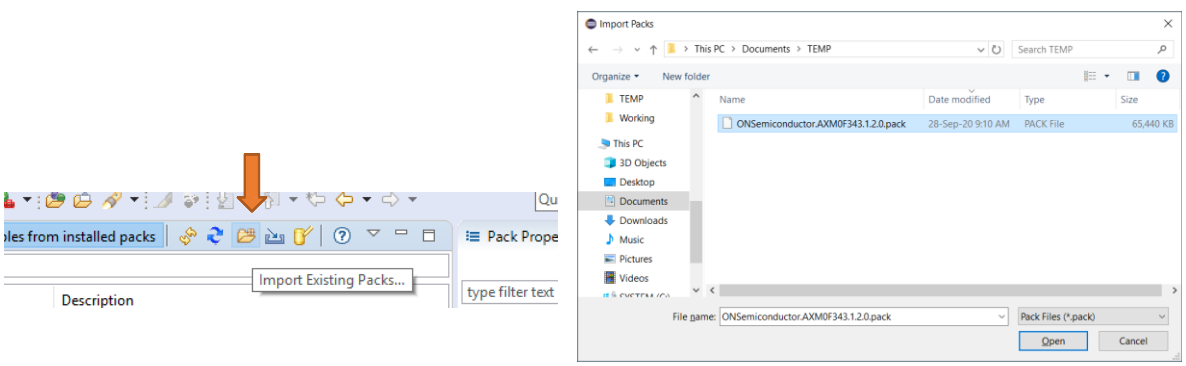


Figure 4: Import CMSIS Pack

5. You will be prompted with a license agreement.

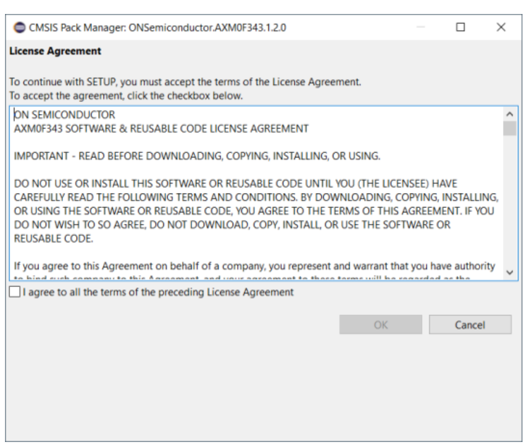


Figure 5 - License Agreement

6. After the IDE is finished importing the pack, the available example applications can be viewed. Note that there is an example for each variant of flash memory (64K and 256K).

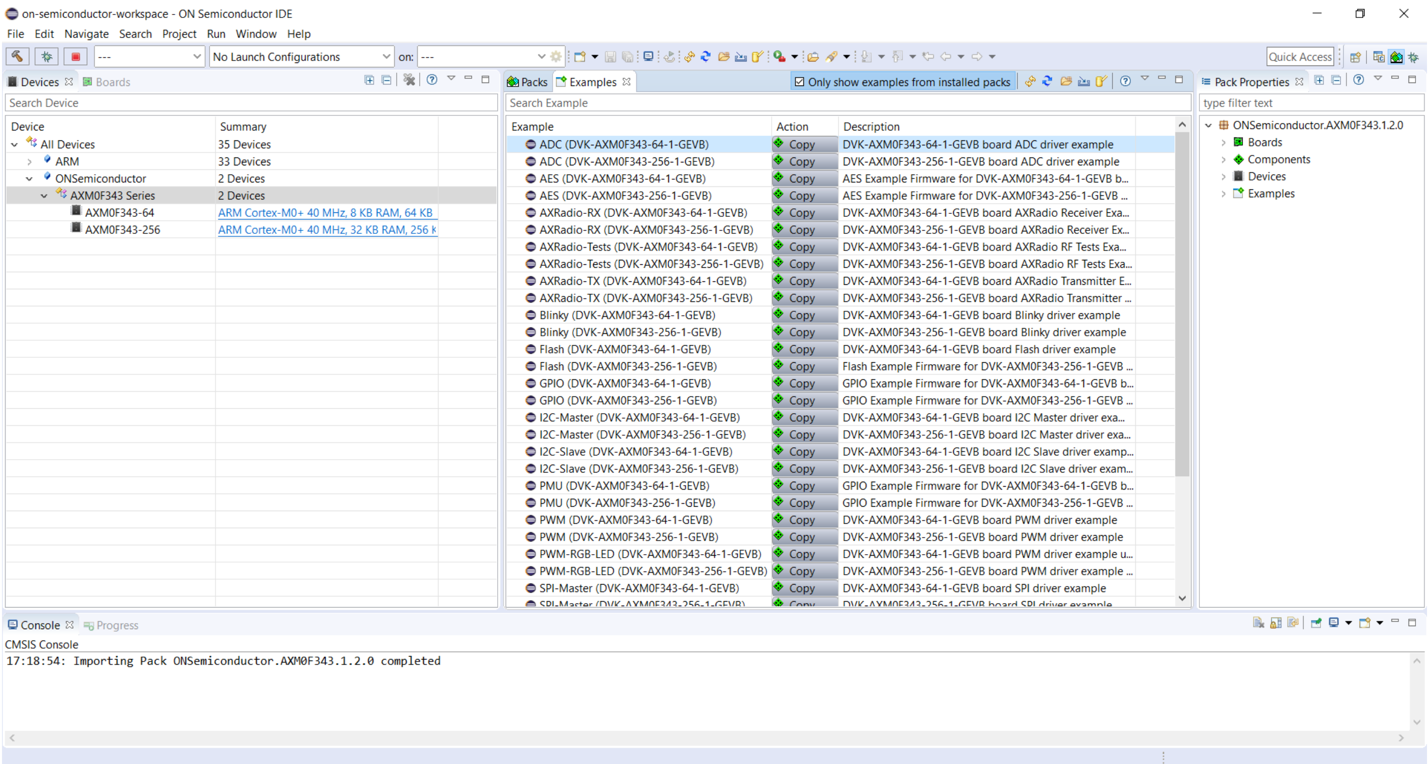


Figure 6 - Available Applications shown after pack import

7. To install the Arm CMSIS pack, repeat the process in step 4 to unpack the *ARM.CMSIS.*<version>*.pack* file. If it is desired to install this pack directly from the CMSIS pack manager, select the blue *Check for Updates on Web* icon, and let the manager download the index to all available CMSIS packs. Once complete, select the ARM.CMSIS pack and click *Install*.

NOTE: If using the AX Configuration Utility to generate code for custom radio examples, then version 5.8.0 of the ARM.CMSIS pack should be installed. The pack can be downloaded at https://github.com/ARM-software/CMSIS_5/releases/tag/5.8.0

Working with Example Applications

Importing and Building Applications

To import an application:

1. From the *CMSIS Pack Manger* perspective, select the *Boards* tab and enter “AXM0F343” into the search field.
2. Select the development board corresponding to the part that is being used – either AXM0F343-64… or AXM0F343-256…
3. Select the *Examples* tab to the right to view all the available applications for the selected board. (See Figure 8)
4. Select *Copy* next to the desired application to copy the application into the IDE Workspace. If the perspective does not automatically change from the CMSIS Pack Manager, select the *C/C++* perspective icon in the upper right corner of the IDE.

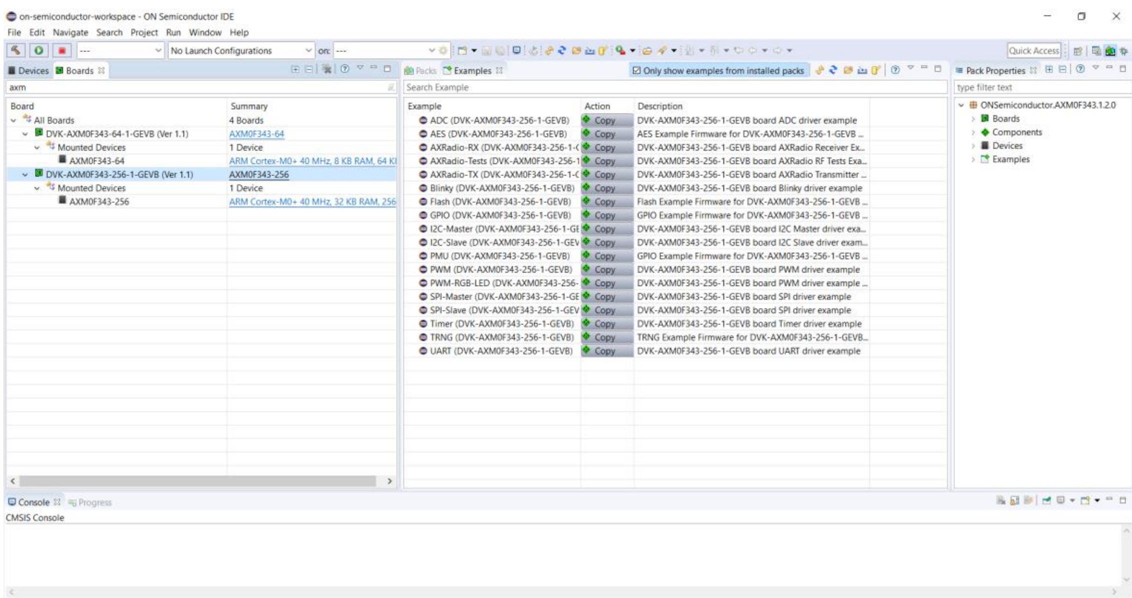


Figure 7 - Available applications for the selected 256K FLASH memory size.

5. To build a project, as shown in Figure 8:
   a. Select the configuration corresponding to the desired project (Debug / Release);
   b. Select either Run or Debug;
   c. Select “Build” to build the configuration or “Debug” to build, flash, and enter Debug mode.

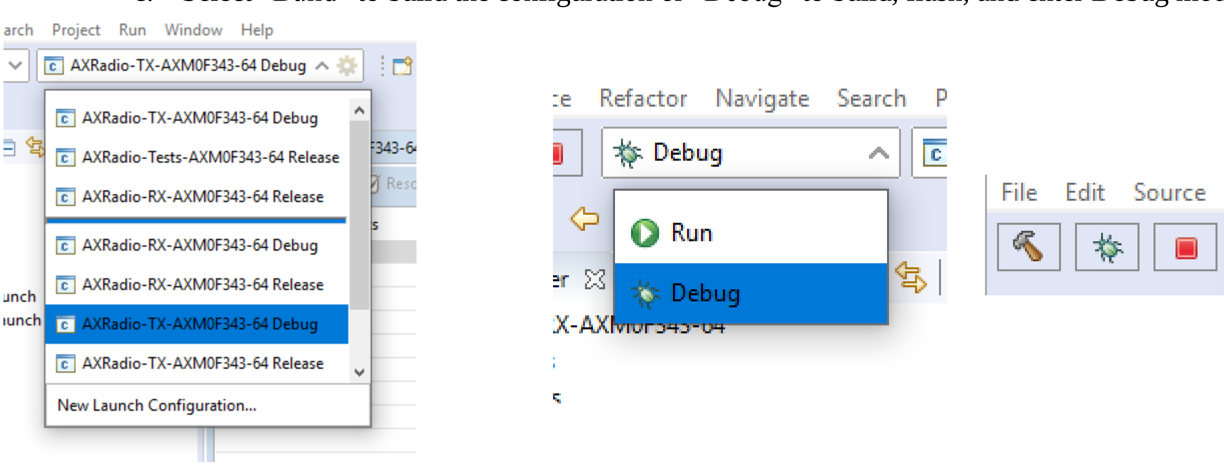


Figure 8 - Select Configuration and Build Project.

6. After the build is completed, the results are displayed in the console:

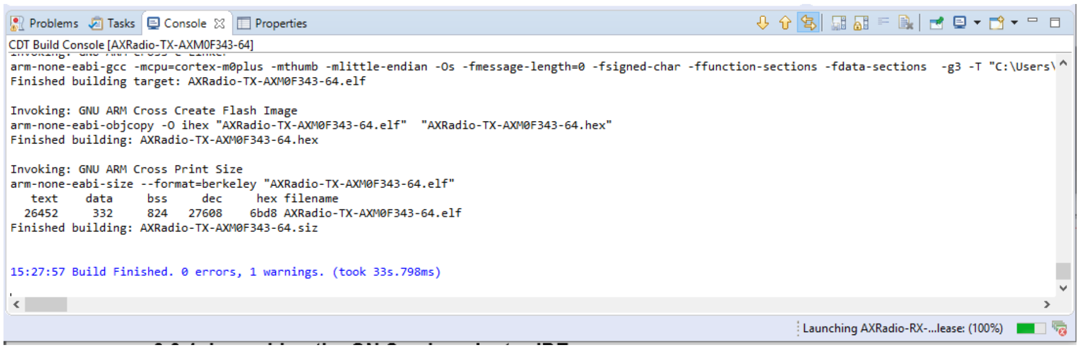


Figure 9: Build Results.

NOTE: For each project copied, a Debug and Release configuration are generated:

- Debug – includes debugging symbols so that single-step debugging can occur using the GDB server in the Debug Perspective of the IDE.
- Release – is optimized for production builds where debugging symbols are excluded from the compiled application code to reduce flash and RAM usage.

NOTE: There are two configurations for flashing the chip:

- Debug – launches GDB server and automatically halts at MAIN, ready for single step debugging.
- Run – uses the GDB server to download the image to the device, but starts the application and terminates the GDB server. This is useful for quick testing where single-step debugging is not required.

Once the application is running, either via Debug or Run, (and if *printf* is enabled in the *.rteconfig* file) the serial output can be observed in the IDE built-in terminal or any other serial monitor application. To enable the *Terminal Panel* search though the menu bar *Window / Show View / Terminal*.
Once the terminal window opens, select the terminal icon as shown in Figure 10, then select *Serial Terminal* from the drop down menu. Configure the serial port settings as shown, selecting COM[X] that corresponds to the Serial COM port assigned to the board by the PC.

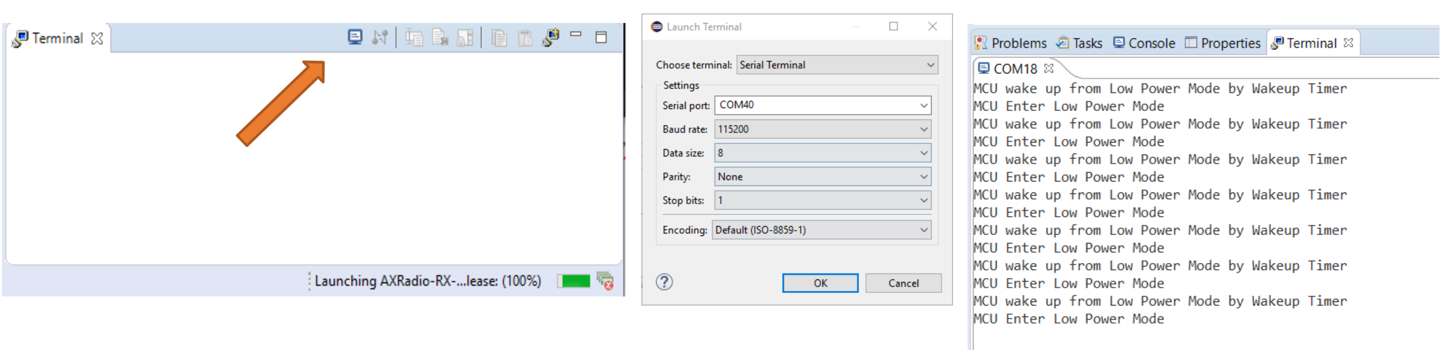


Figure 10: Open *New Terminal* icon, COM port selection, and Serial Terminal output.

Advanced Configuration and Debugging

CMSIS Configuration Wizard

Several applications in the AXM0F343 SDK, such as the peripheral examples and AXRadio examples, include application parameters that can be modified within the IDE using the *CMSIS Configuration Wizard*. As shown in Figure 11, the *CMSIS Configuration Wizard* is a GUI tool that allows users to select from a list of available options and change key parameters used by the application.

To open the *CMSIS Configuration Wizard*, right-click the *user_config_wizard.h* file from the <Example>/RTE/Application folder, and select *Open With* -> *CMSIS Configuration Wizard* as shown in Figure 12.

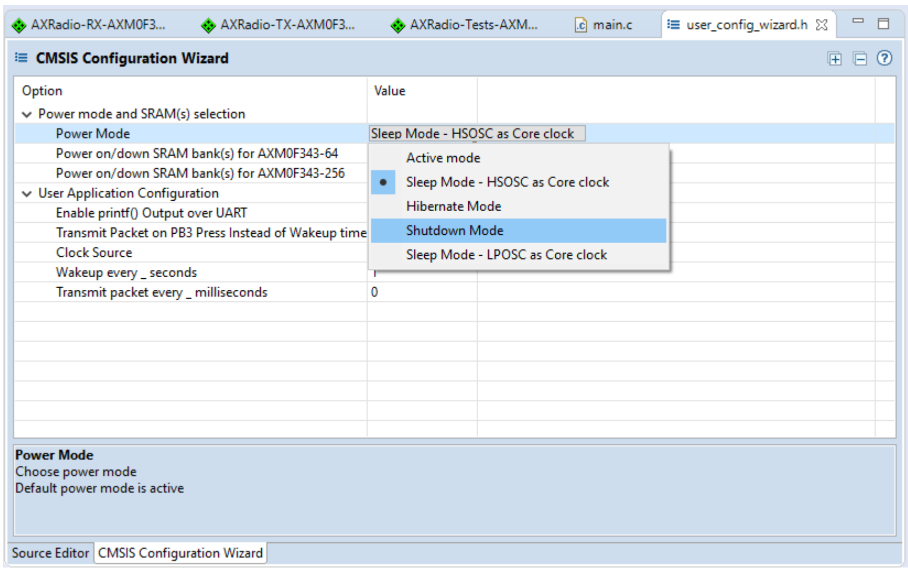


Figure 11 - CMSIS Configuration Wizard.

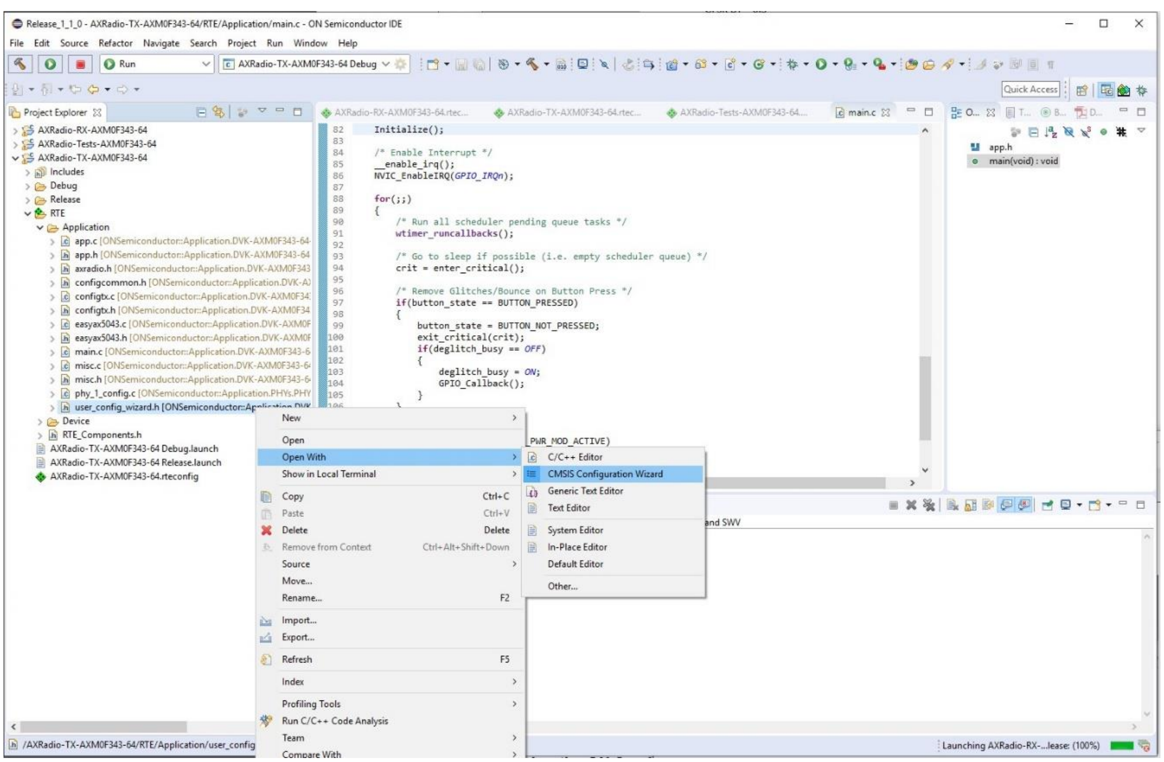
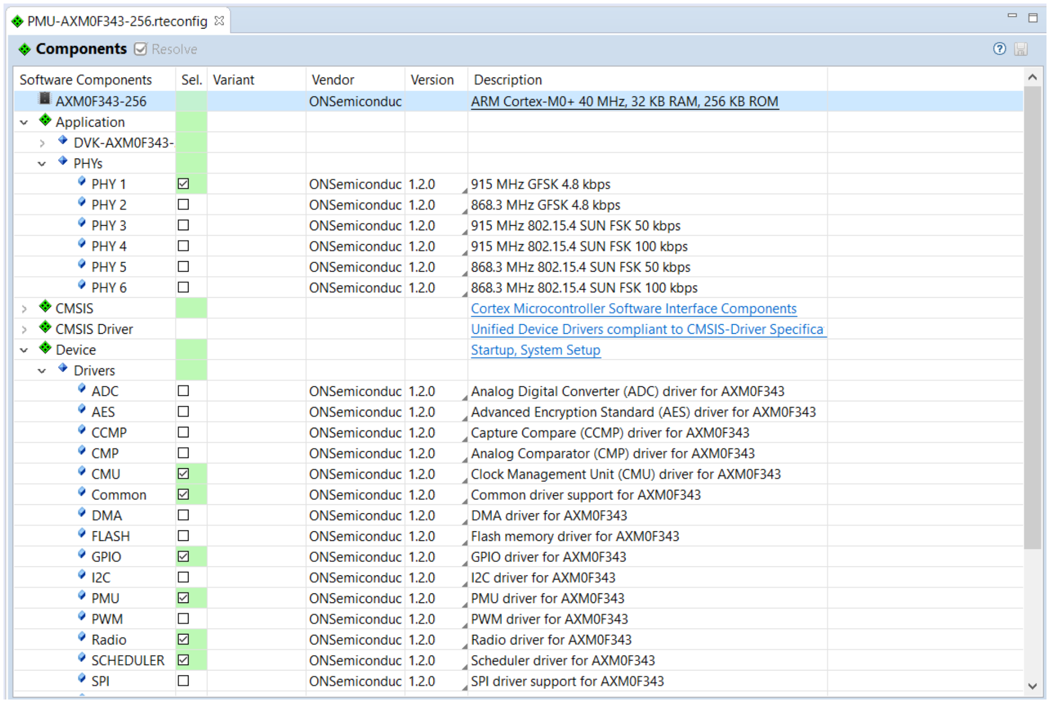


Figure 12 - Open user_config_wizard.h in CMSIS Configuration Wizard.

RTE Configuration

Each CMSIS Pack example project includes an *.rteconfig* file. The purpose of this file is to configure which libraries are made available to the application at build time. This tool can be used to actively modify files that are either linked during build process or actually copied into the project directory. Examples of this include selecting which physical layer configuration file (PHY) is used by a radio application or which device drivers are linked in to the project.



Software Components	Sel.	Variant	Vendor	Version	Description
AXM0F343-256			ONSemiconduc		ARM Cortex-M0+ 40 MHz, 32 KB RAM, 256 KB ROM
Application					
DVK-AXM0F343-					
PHYs					
PHY 1	☑		ONSemiconduc	1.2.0	915 MHz GFSK 4.8 kbps
PHY 2	☐		ONSemiconduc	1.2.0	868.3 MHz GFSK 4.8 kbps
PHY 3	☐		ONSemiconduc	1.2.0	915 MHz 802.15.4 SUN FSK 50 kbps
PHY 4	☐		ONSemiconduc	1.2.0	915 MHz 802.15.4 SUN FSK 100 kbps
PHY 5	☐		ONSemiconduc	1.2.0	868.3 MHz 802.15.4 SUN FSK 50 kbps
PHY 6	☐		ONSemiconduc	1.2.0	868.3 MHz 802.15.4 SUN FSK 100 kbps
CMSIS					Cortex Microcontroller Software Interface Components
CMSIS Driver					Unified Device Drivers compliant to CMSIS-Driver Specifica
Device					Startup, System Setup
Drivers					
ADC	☐		ONSemiconduc	1.2.0	Analog Digital Converter (ADC) driver for AXM0F343
AES	☐		ONSemiconduc	1.2.0	Advanced Encryption Standard (AES) driver for AXM0F343
CCMP	☐		ONSemiconduc	1.2.0	Capture Compare (CCMP) driver for AXM0F343
CMP	☐		ONSemiconduc	1.2.0	Analog Comparator (CMP) driver for AXM0F343
CMU	☑		ONSemiconduc	1.2.0	Clock Management Unit (CMU) driver for AXM0F343
Common	☑		ONSemiconduc	1.2.0	Common driver support for AXM0F343
DMA	☐		ONSemiconduc	1.2.0	DMA driver for AXM0F343
FLASH	☐		ONSemiconduc	1.2.0	Flash memory driver for AXM0F343
GPIO	☑		ONSemiconduc	1.2.0	GPIO driver for AXM0F343
I2C	☐		ONSemiconduc	1.2.0	I2C driver for AXM0F343
PMU	☑		ONSemiconduc	1.2.0	PMU driver for AXM0F343
PWM	☐		ONSemiconduc	1.2.0	PWM driver for AXM0F343
Radio	☑		ONSemiconduc	1.2.0	Radio driver for AXM0F343
SCHEDULER	☑		ONSemiconduc	1.2.0	Scheduler driver for AXM0F343
SPI	☐		ONSemiconduc	1.2.0	SPI driver support for AXM0F343

Figure 13 - RTE Configuration Wizard.

Register Viewer

In debug mode, the IDE offers several advanced features, including a register viewer. This is based on a .svd file, which provides a description of the register mapping on the chip. For AXM0F343, all peripheral registers, including those for AX5043, are made available in the peripheral register viewer. To open this,

1. Select the Peripherals tab on the right panel of the Debug perspective.
2. Check the box next to the peripheral of interest.
3. Select the Memory tab in the bottom panel of the Debug Perspective to view the selected registers.
4. Halt the processor or place a breakpoint at a section of interest in the code. When the processor stops, the register contents are displayed. Entering a number into the *Value* field will manually overwrite the register content on the device.

NOTE: By default, the console tab in the bottom panel is configured to return itself to focus whenever there is an output from the debugger. To disable this, right-click on the *Console* while in debug mode, and select *Preferences*. Then uncheck *"Show when program writes to standard out"* and select *"Apply and Close"*. Now the Memory tab can remain in focus while debugging.

NOTE: To search for a specific register, right-click in the register list in the Memory tab, and select *"Add Filter"*. Enter a text string, and the list will filter to show only matching registers.

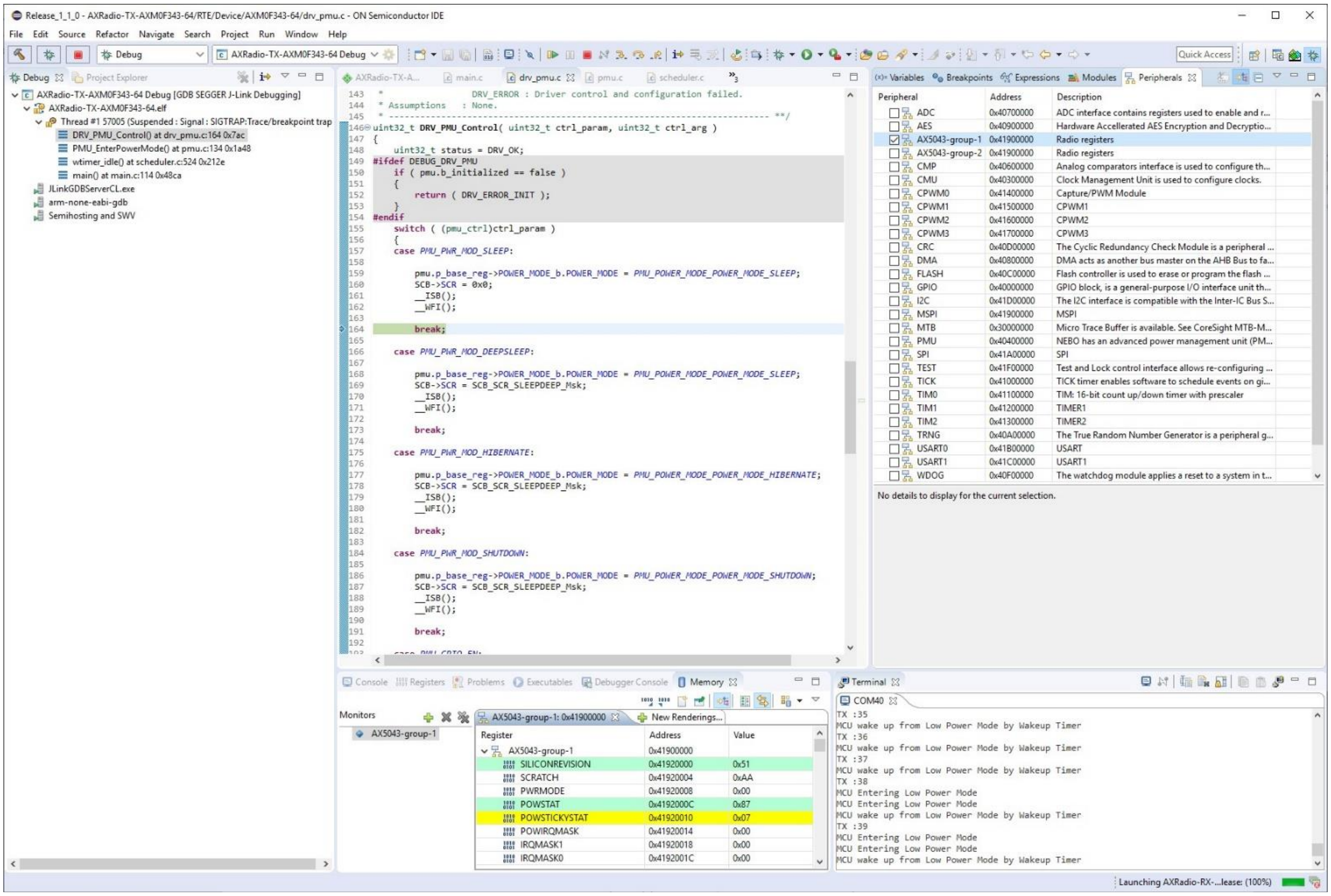


Figure 14 - Peripheral register view during debugging.

PUBLICATION ORDERING INFORMATION

LITERATURE FULLFILLMENT:
Literature Distribution Center for ON Semiconductor 19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA

Phone: 303−675−2175 or 800−344−3860 Toll Free USA/Canada
Fax: 303−675−2176 or 800−344−3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

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