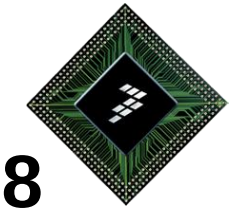
June 2012

CW for Microcontrollers v10.2 and MQX 3.8



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Contents

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- Build MQX libraries
- Import and Debug MXQ Hello World Project
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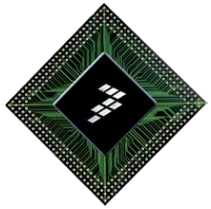
- Debugging with Jlink
- Eclipse Working Set
- CW10.2, MQX 3.8 and Processor Expert
- CW10.2, MQX 3.8 and PE : New LDD driver

Import MQX Libraries



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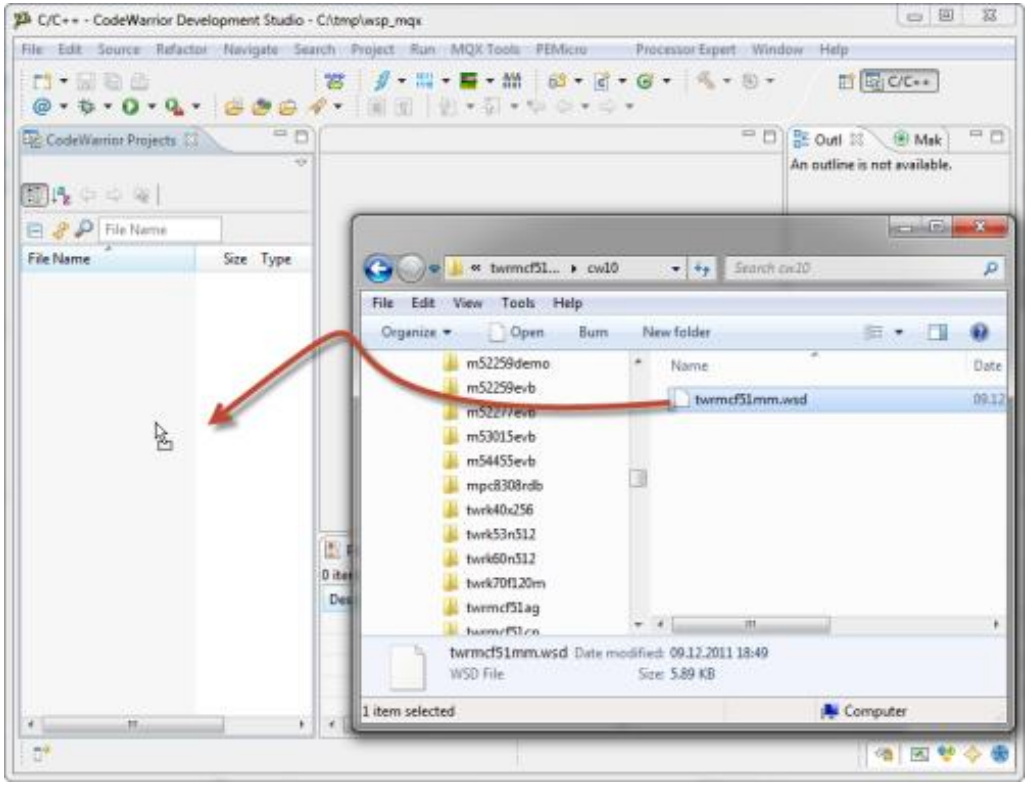
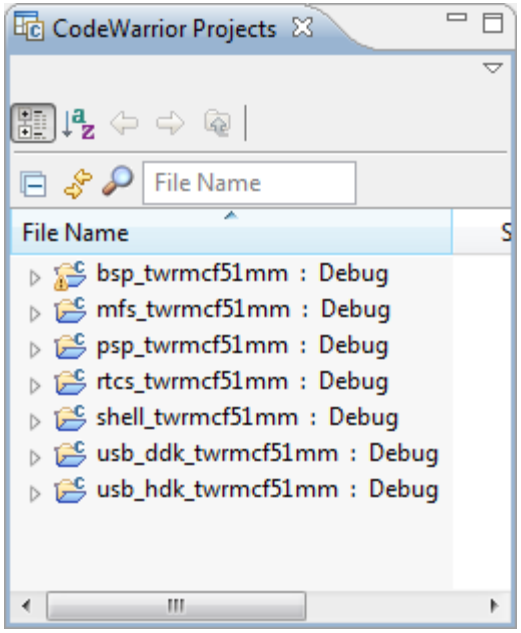
Importing MQX Library projects

- Navigate to `C:\Freescale\Freescale MQX 3.8\config\<board_name>` and drag <board>.wsd to the CodeWarrior



- All BSP libraries will be loaded to your environment automatically



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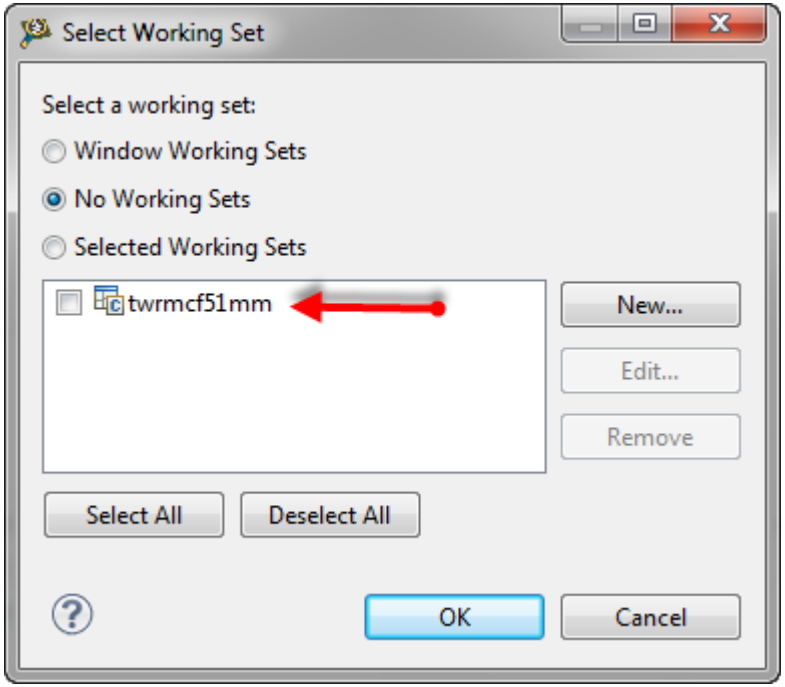
Importing MQX Library projects

- Beside of the projects, it has imported as well the Working Set:



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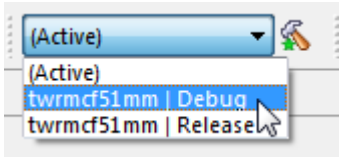
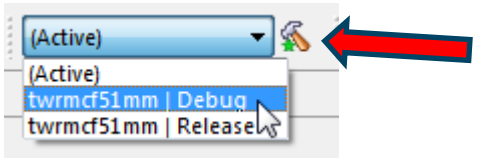
Building MQX Libraries

- Use MQX toolbar to select desired configuration to build



- and push hammer icon to build all MQX libraries for selected working set



Note:
Debug configuration of MQX libraries (workingset) have compiler optimization set to lowest level for all imported projects, while **Release** configuration uses the highes possible compiler optimizaton setting

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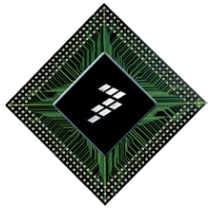
Import and Debug MQX Hello World Project



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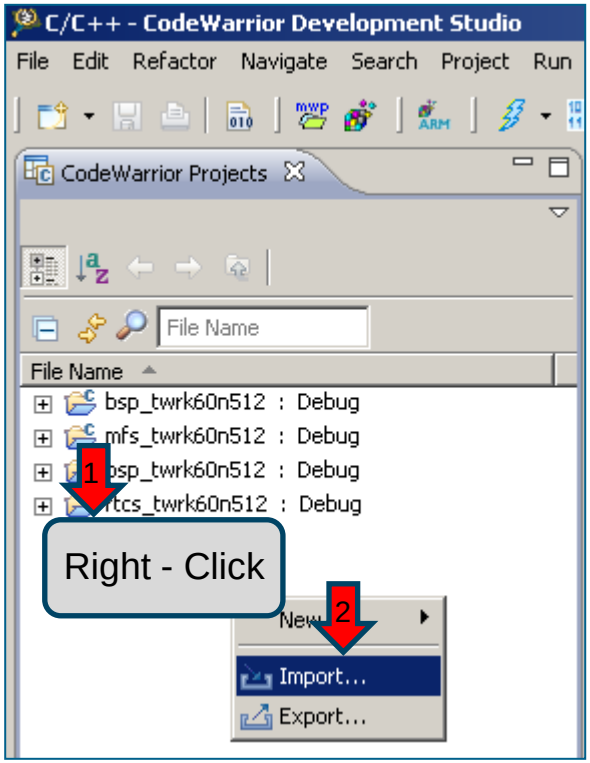
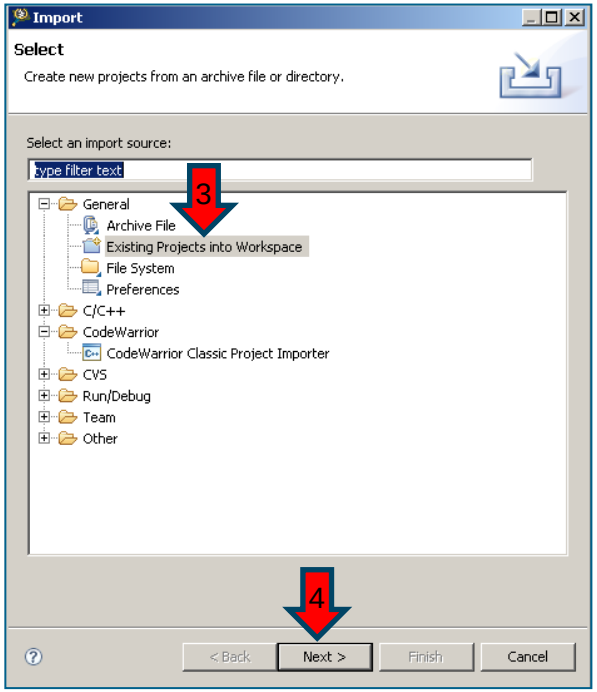
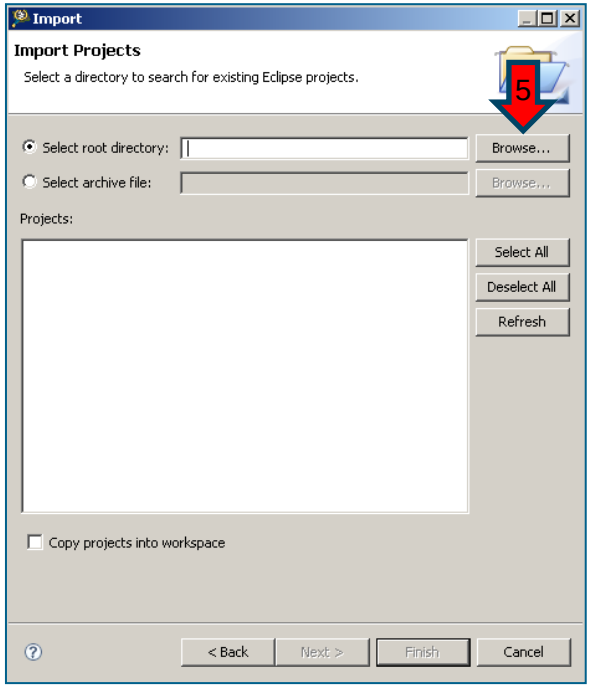
Import ‘Hello World’ MQX example

- Right-Click on Project Explorer and Import
- Select Existing Projects into Workspace and Browse







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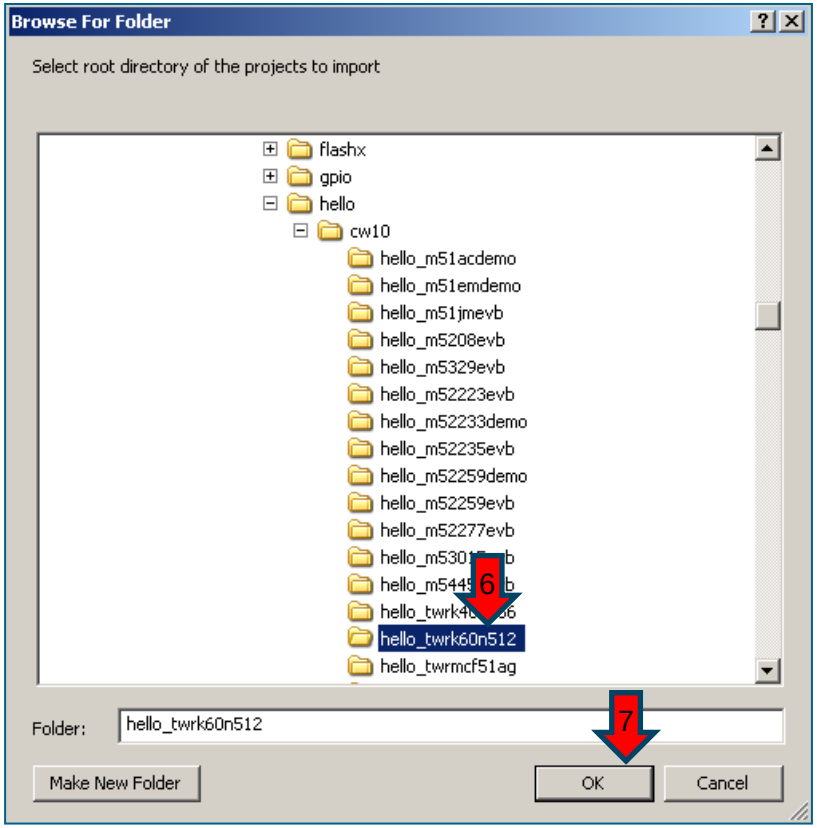
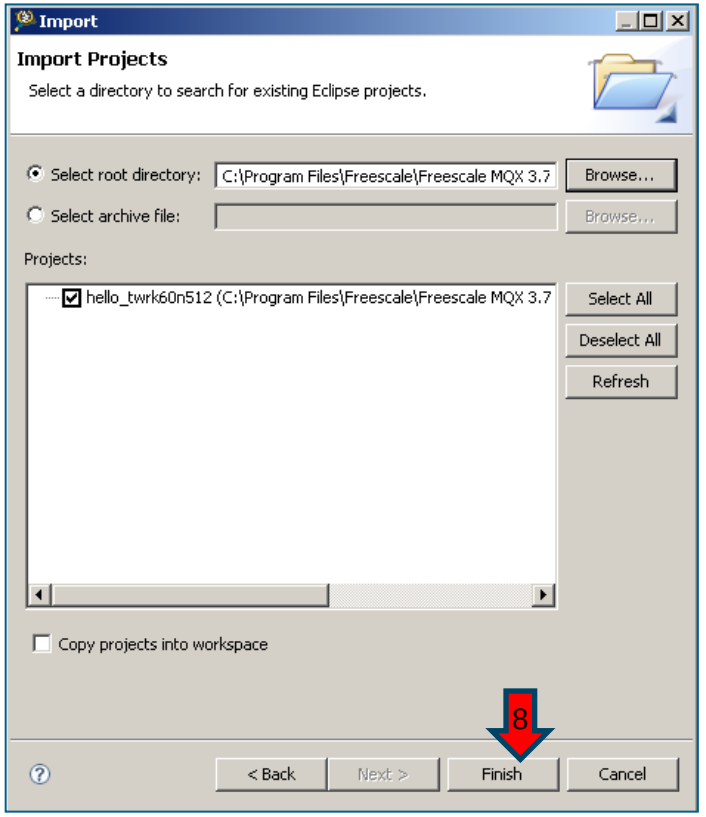
Import ‘Hello World’ MQX example

- Select *<install mqx folder>\mqx\examples\hello\CW10*\hello_twrk60n512





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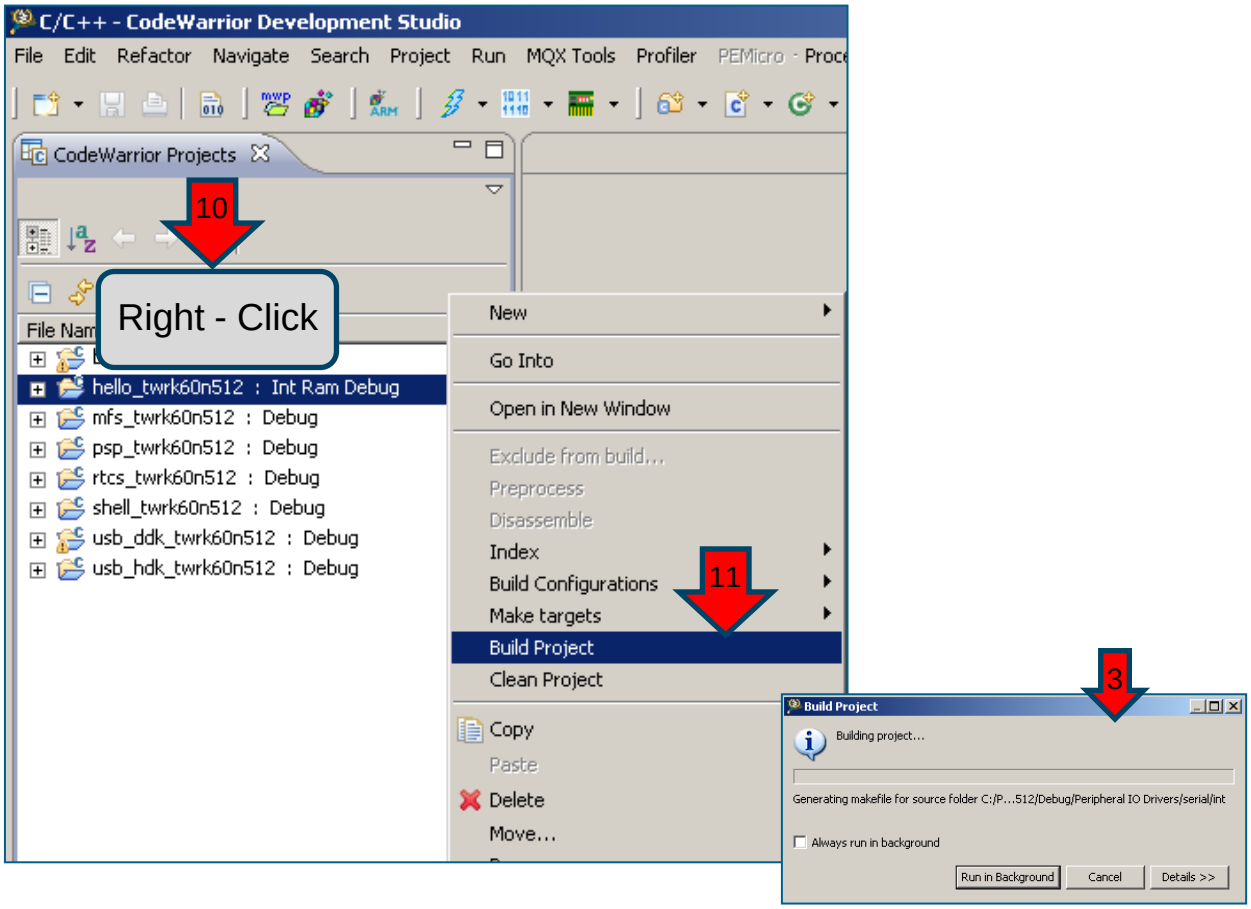
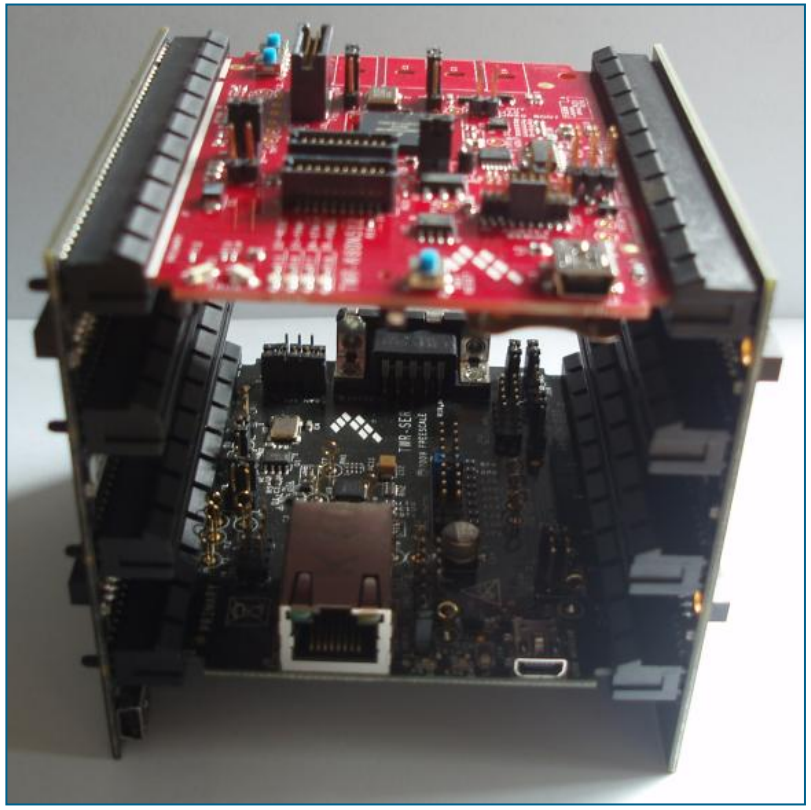
Build ‘Hello World’ MQX example

- Right-Click on Project Explorer **hello_twrk60n512** and Build Project



Prepare your hardware (example for K60 TWR Kit)

- Prepare your Tower System:
  - Connect **TWR-SER** and **TWR-K60N512** to **TWR-ELEV** (Primary and Secondary)



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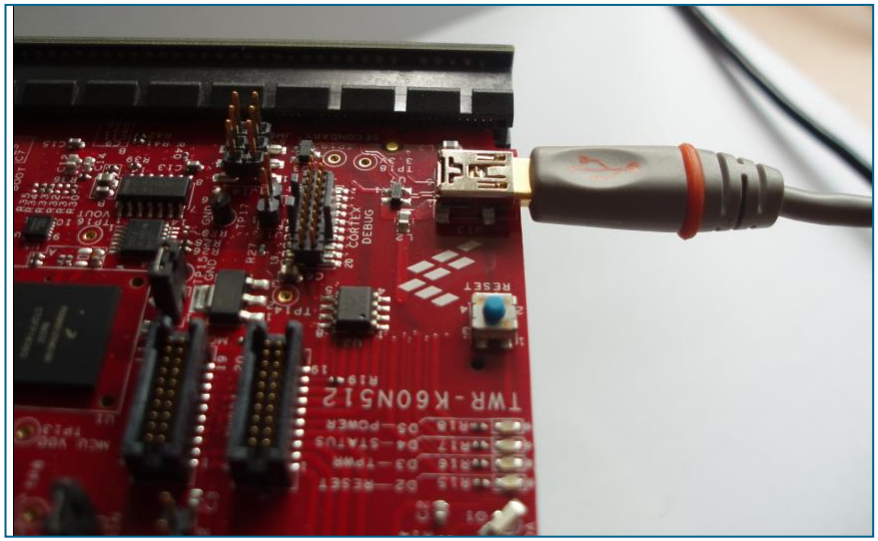
Prepare your hardware

- Connect USB Cable to **TWR-K60N512** (J13) and laptop



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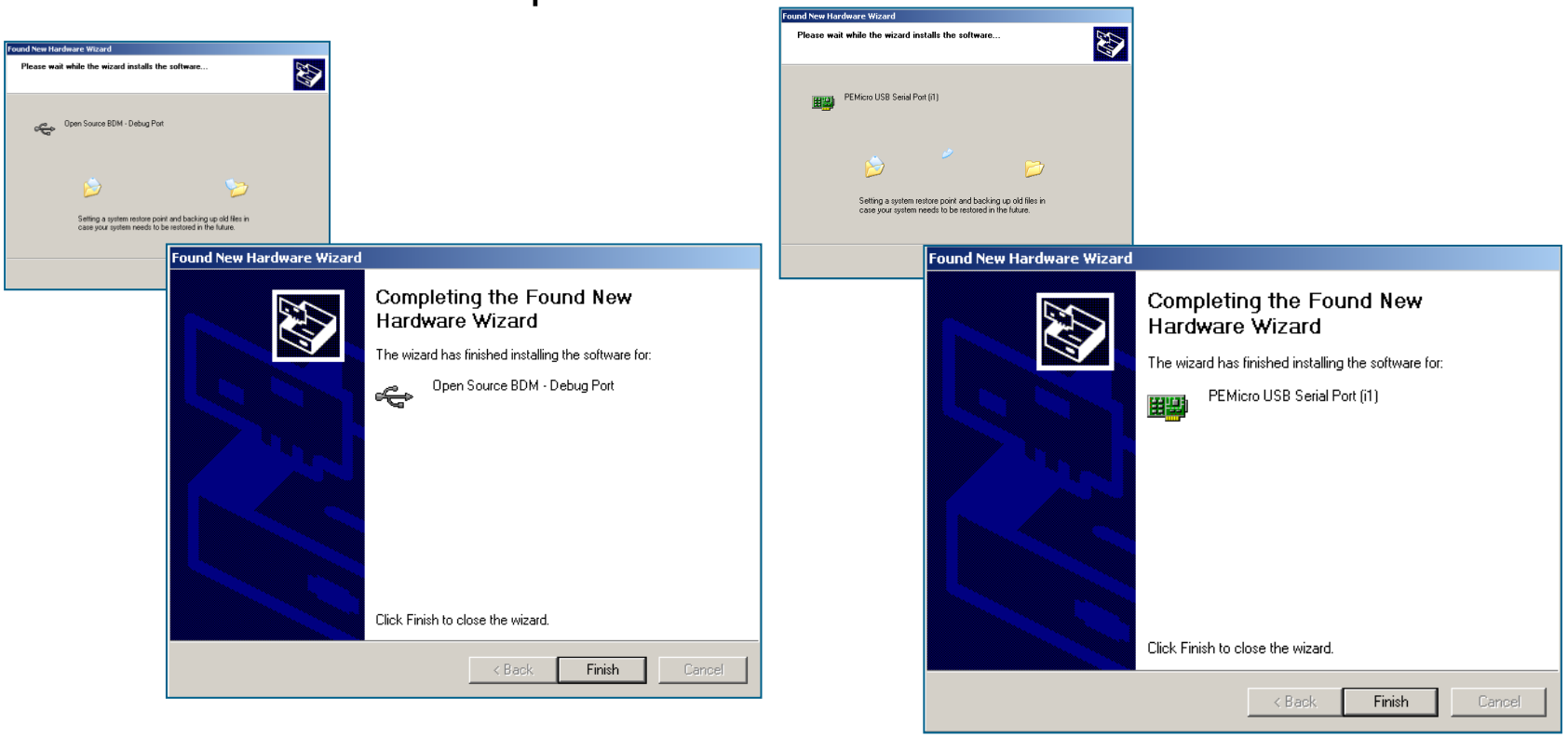
Install OSJTAG Drivers

- Windows will detect the new USB device. Follow the installation wizards for BDM and virtual Serial port drivers.



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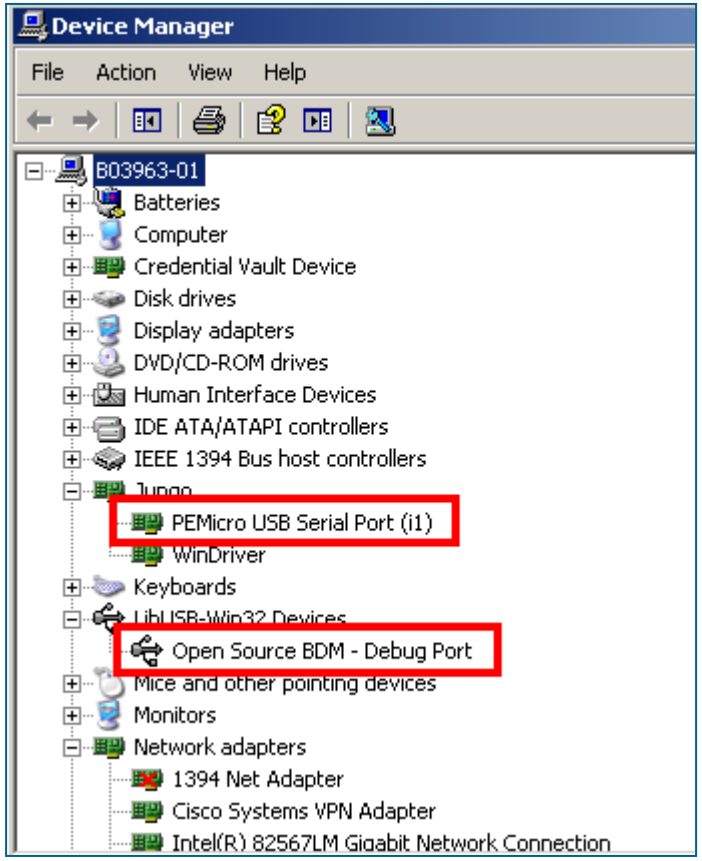
Install OSJTAG Drivers

- You can see in Device Manager the two new USB devices installed



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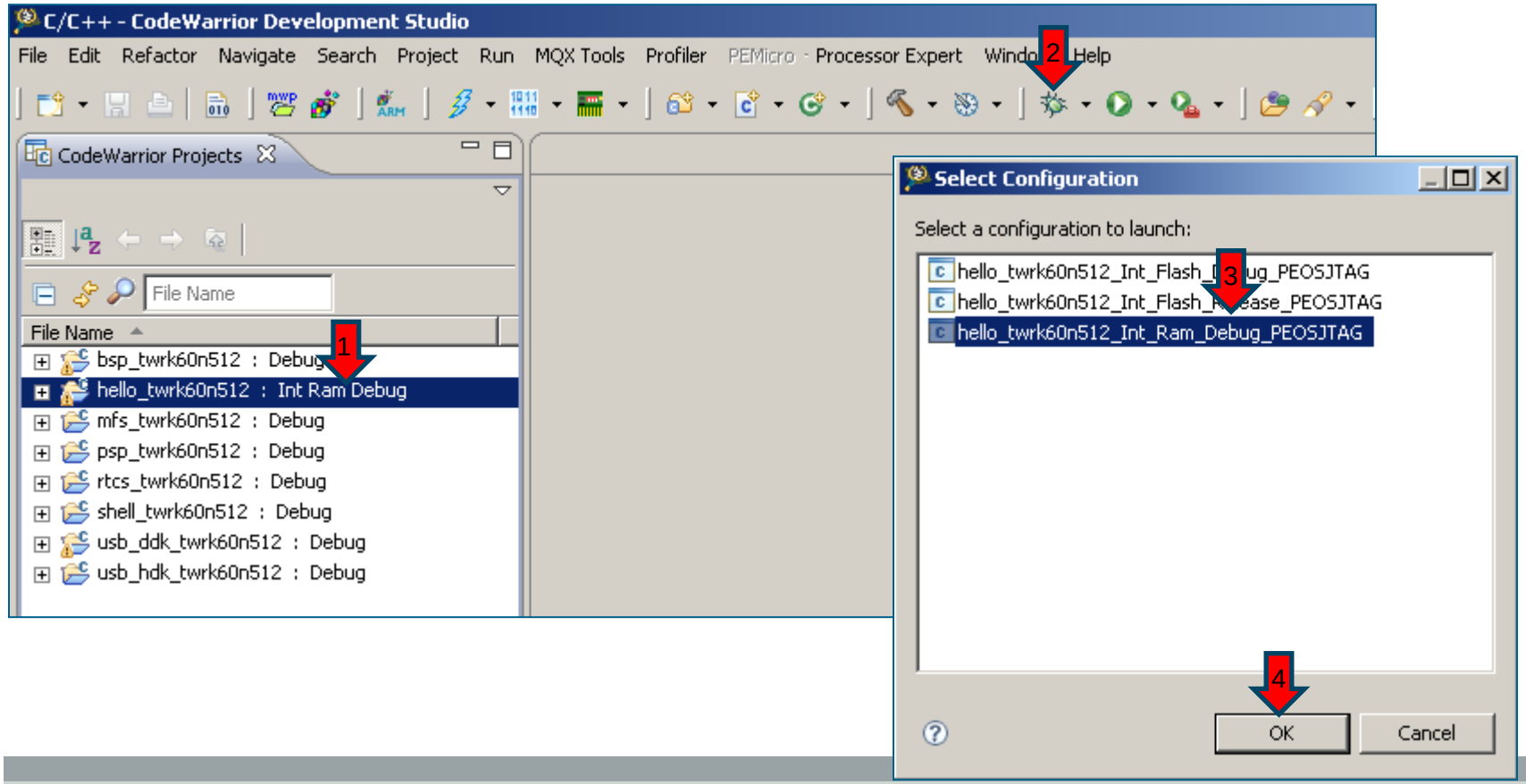
Debug MQX ‘Hello World’ example

- Select **hello_twrk60n512** project and Click ‘Debug icon’
- Select **hello_twrk60n512_Int_Ram_Debug_PEOSJTAG** Connection



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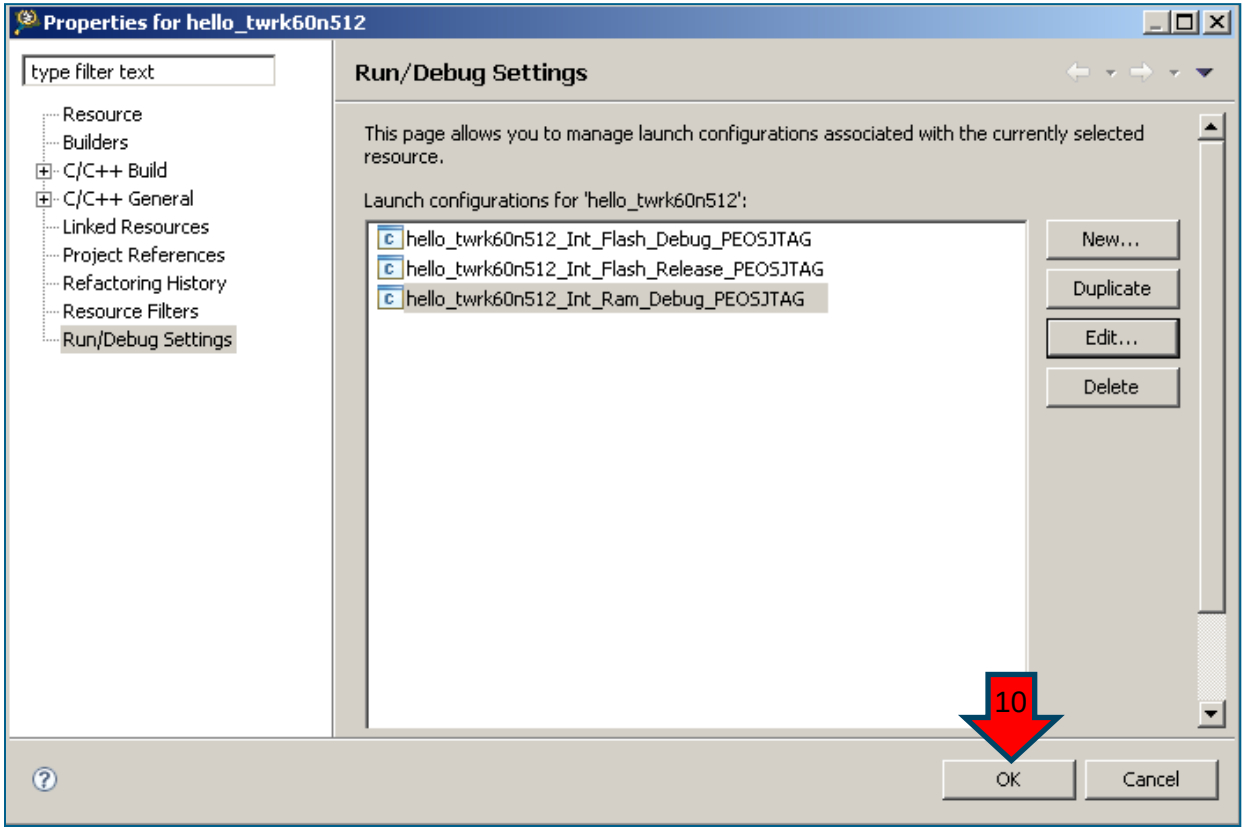
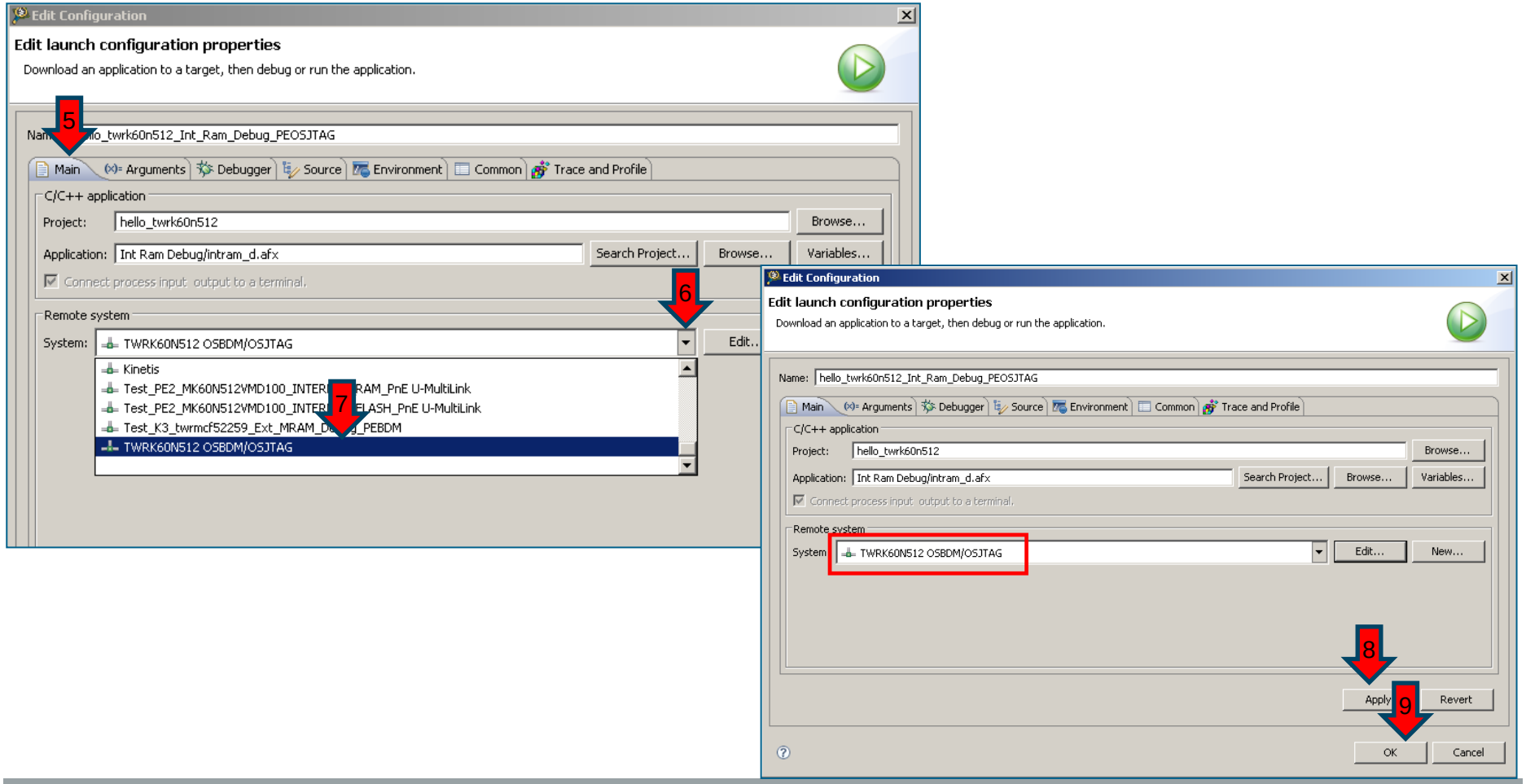
Change Connection Settings

- Click OK



Change Connection Settings

- Select **TWRK60N512 OSBDM/OSJTAG** Remote System



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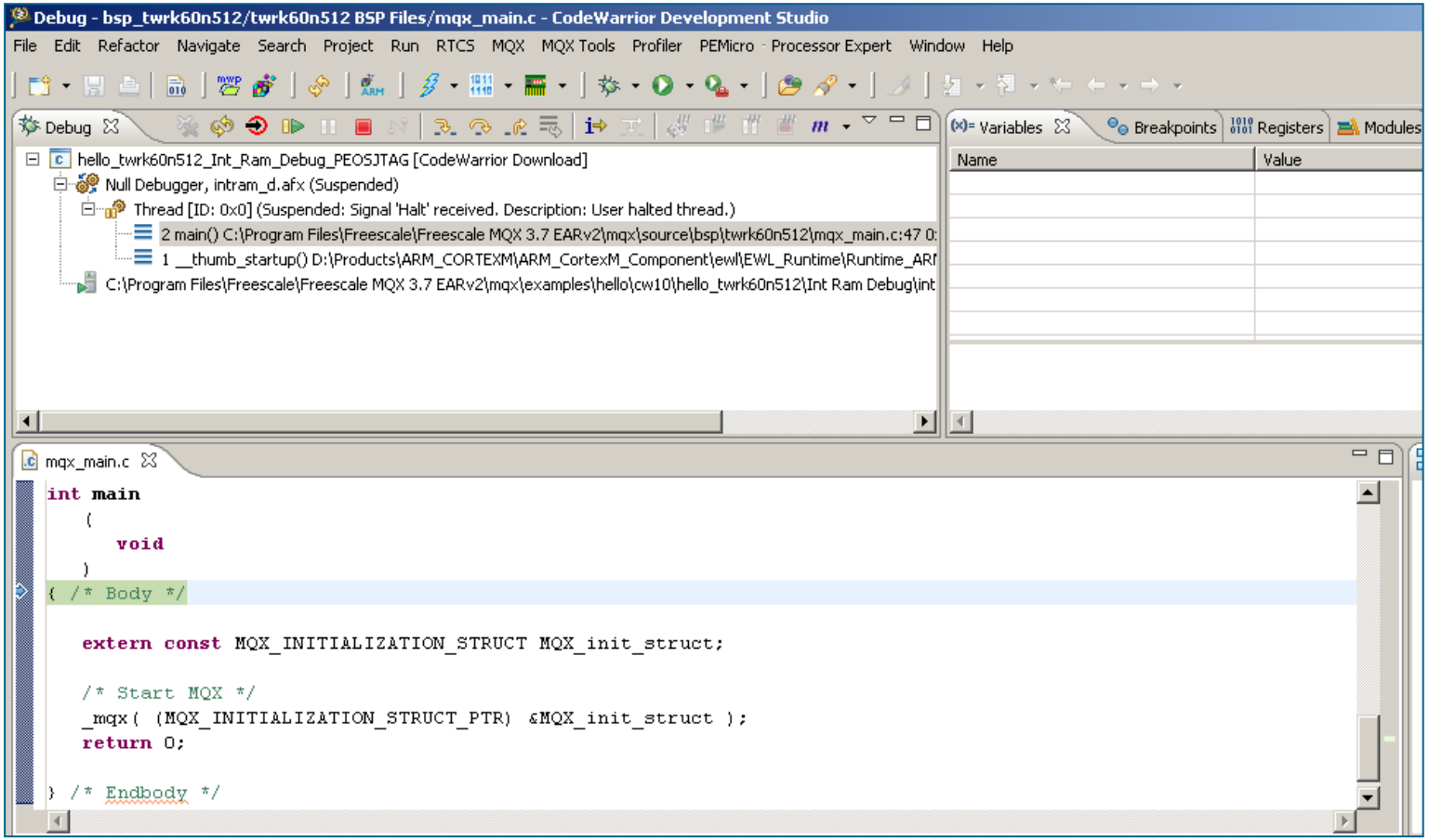
Update OSJTAG firmware

- You are ready to Run and Debug the project



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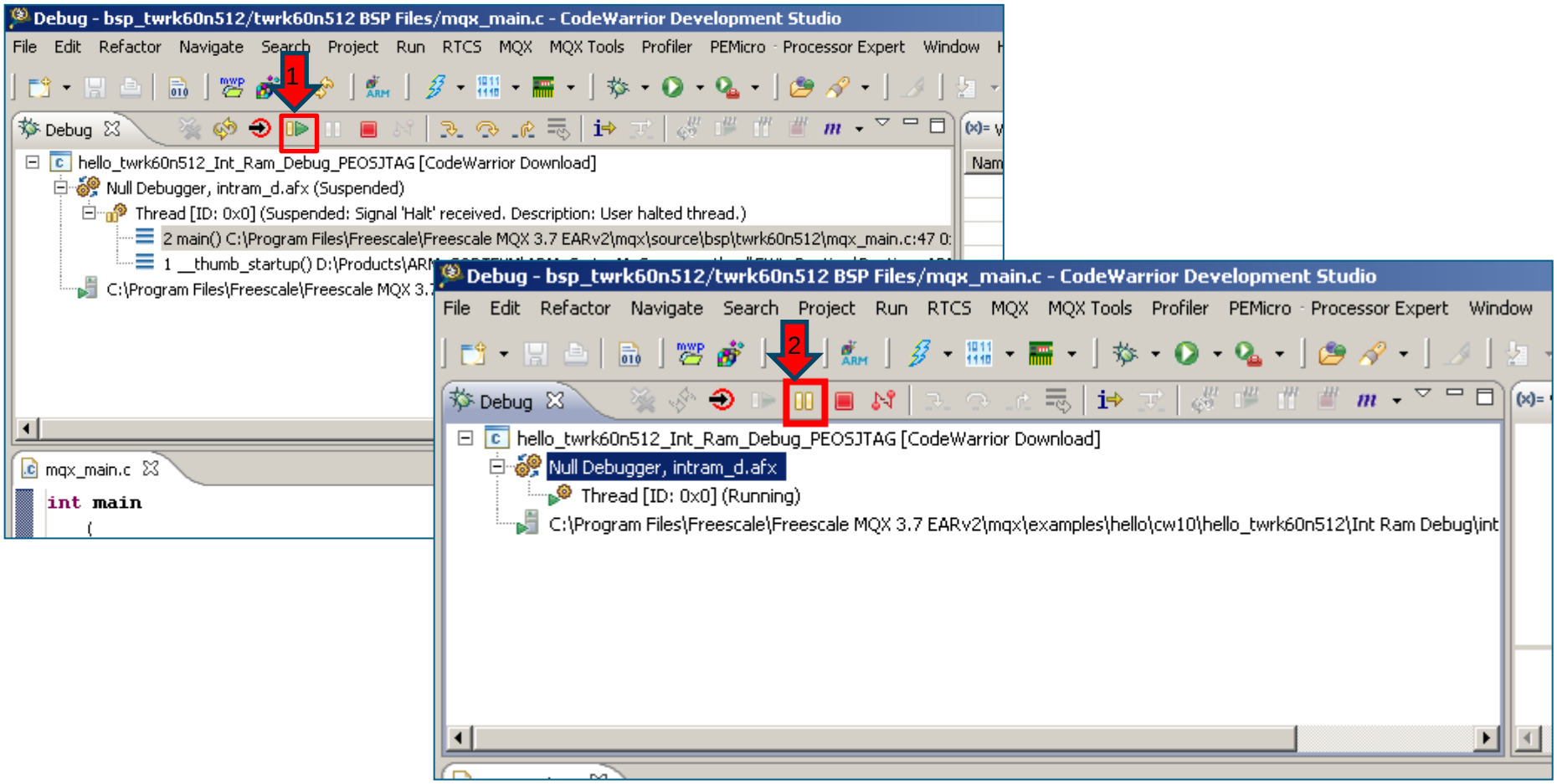
Run MQX ‘Hello World’ example

- Execute the code ‘Resume’ icon and ‘Pause’ execution



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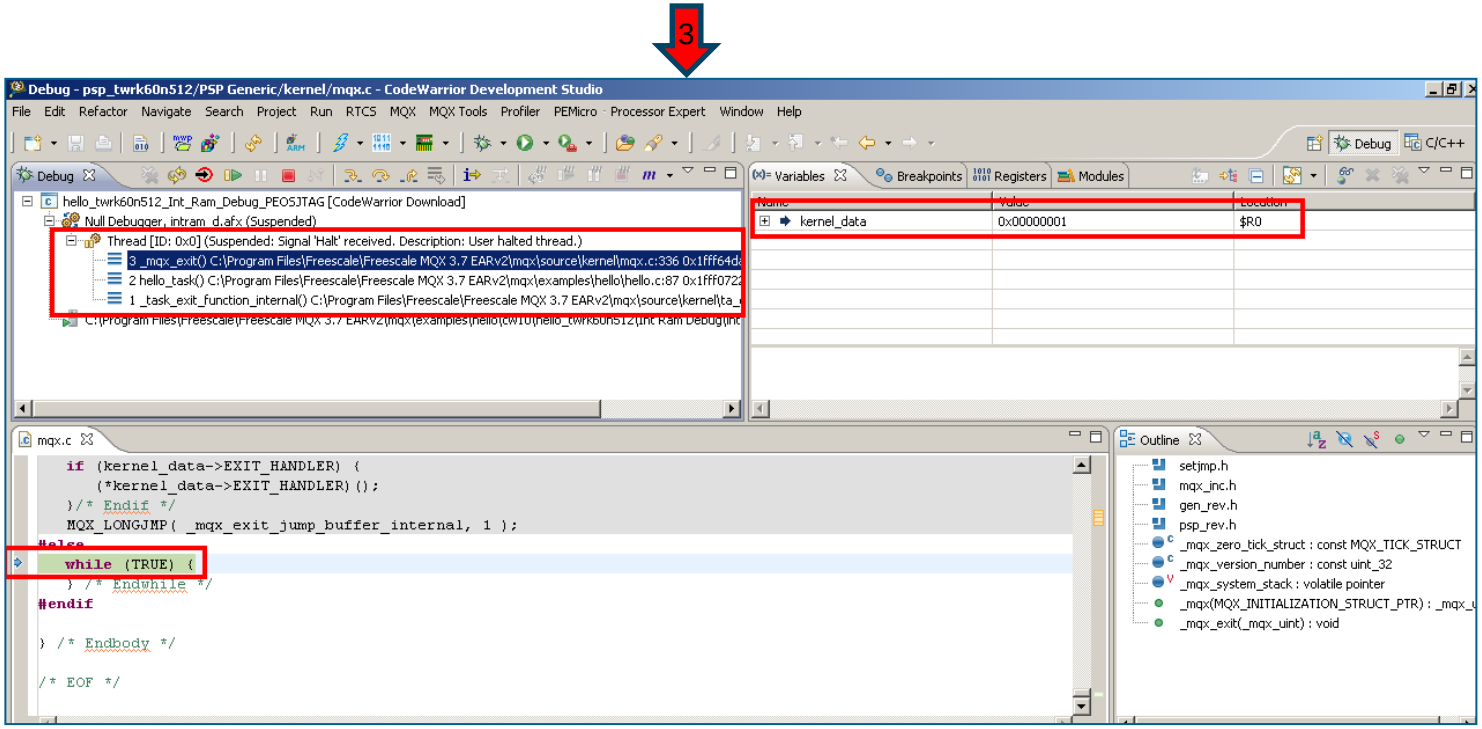
Run MQX 'Hello World' example

- You can explore the Debugging Eclipse perspective



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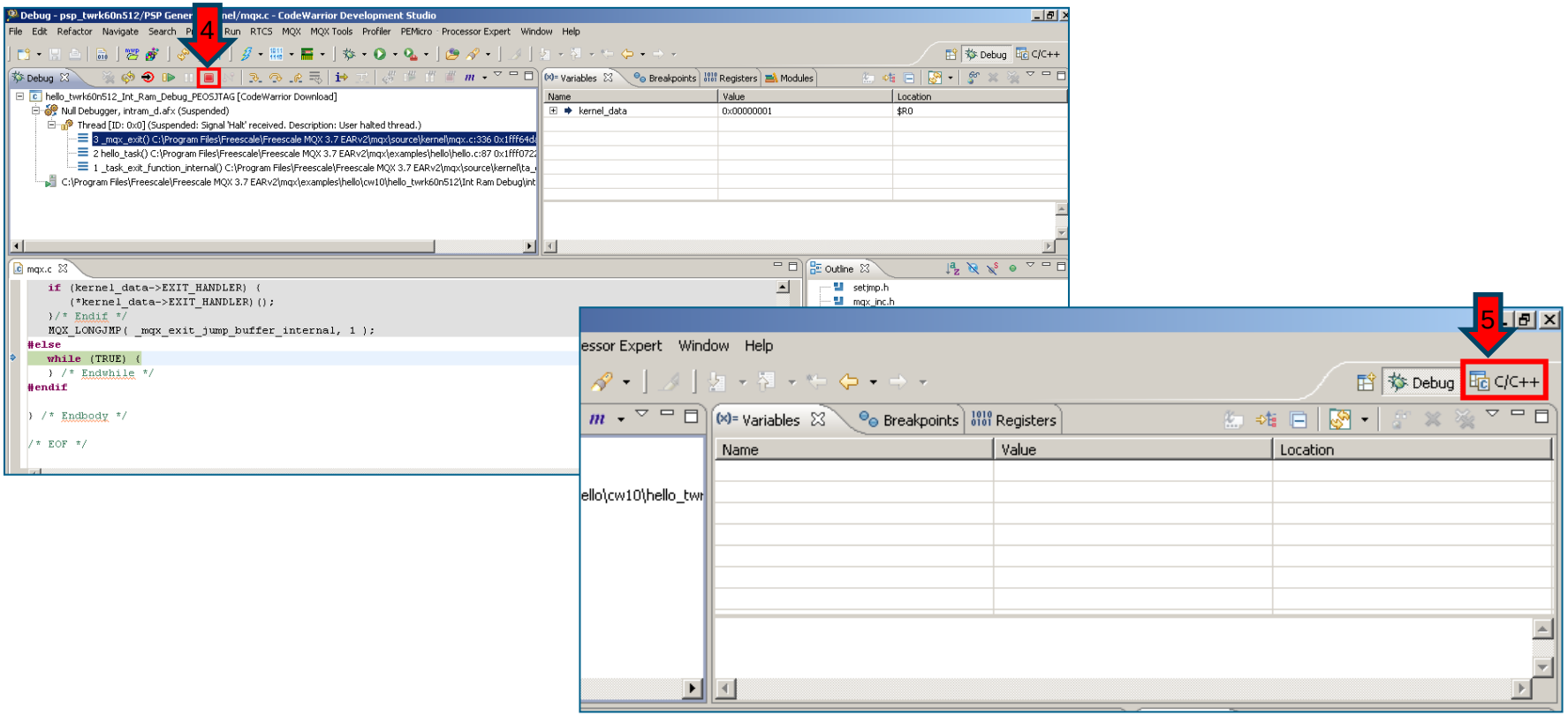
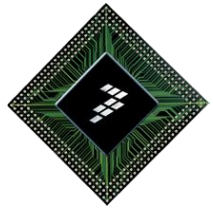
Run MQX 'Hello World' example

- Terminate the Debugging session and change Eclipse perspective
- You have Run and Debug your first MQX CW10 project



New MQX project



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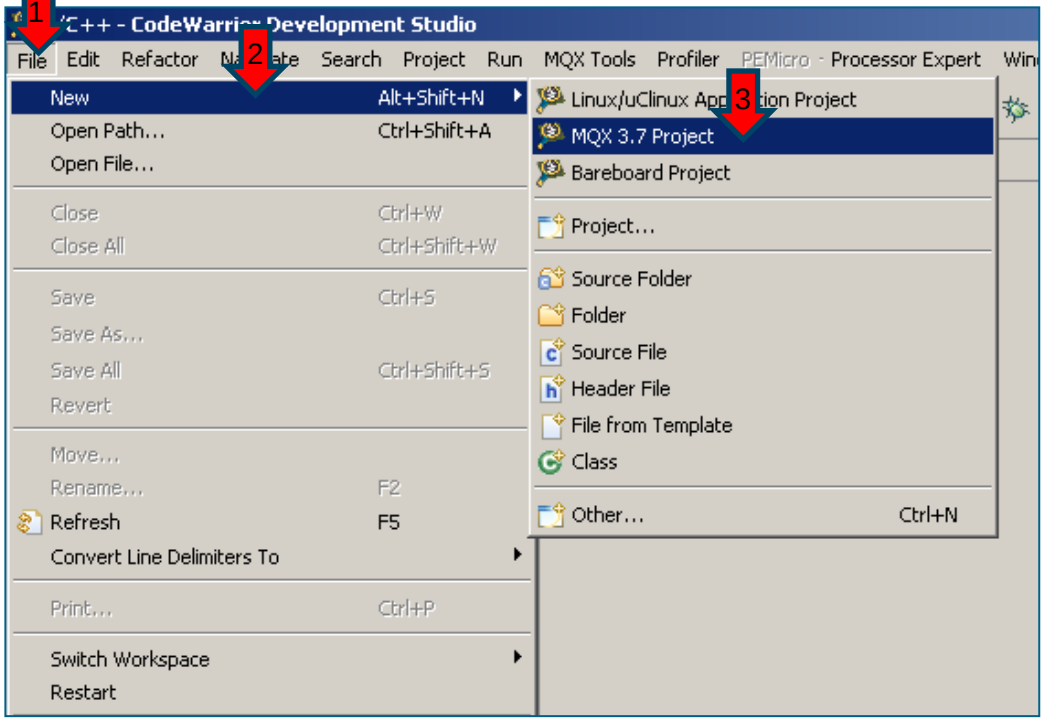
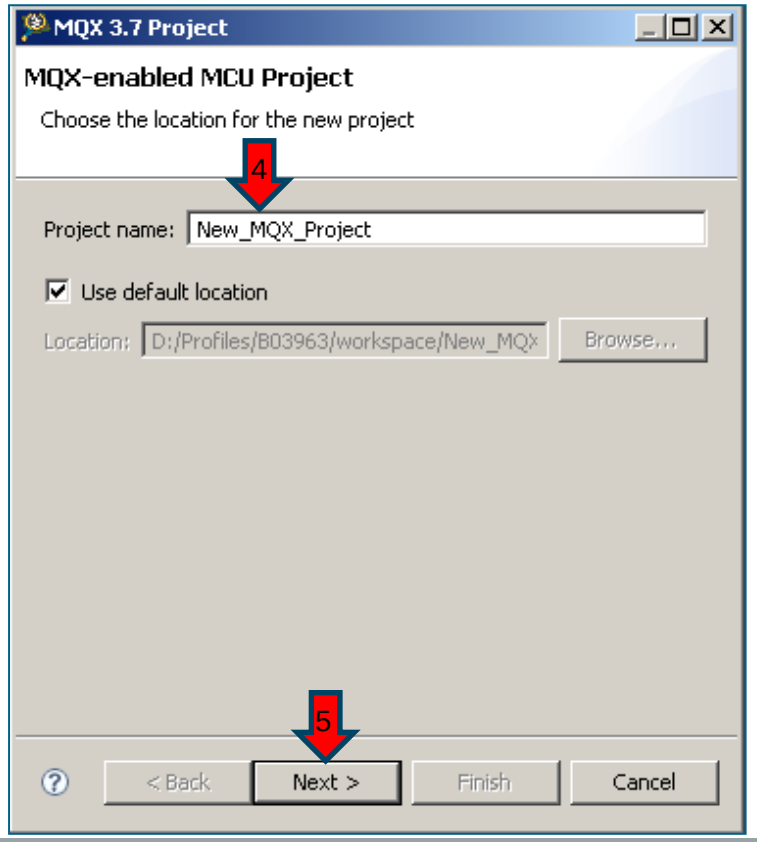
New MQX Project

- File -> New -> MQX 3.8 Project
- Give a name and click Next





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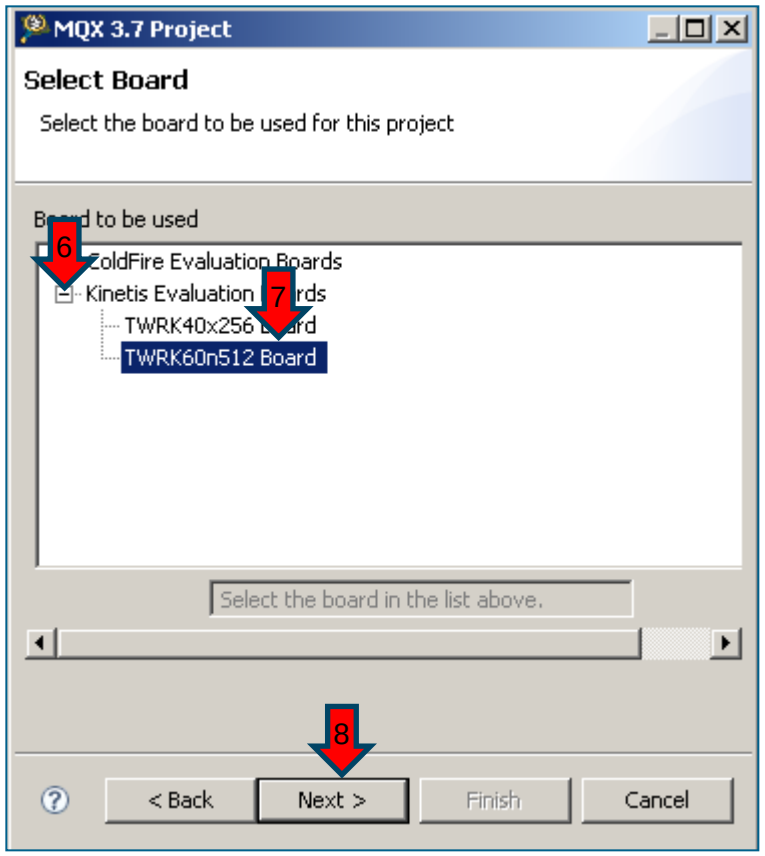
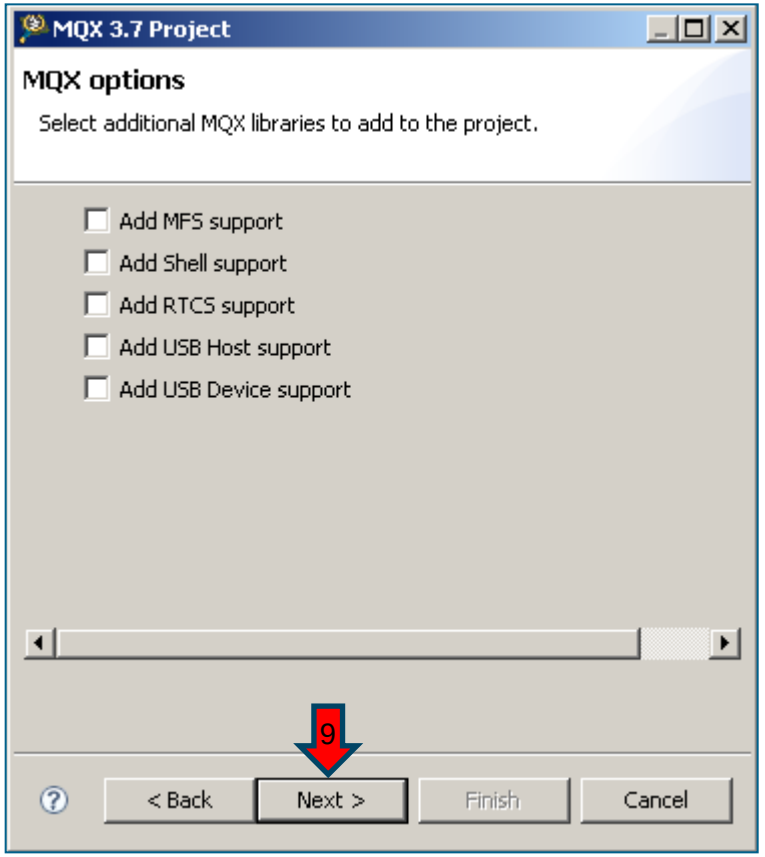
New MQX Project

- Select **TWRK60n512** Board





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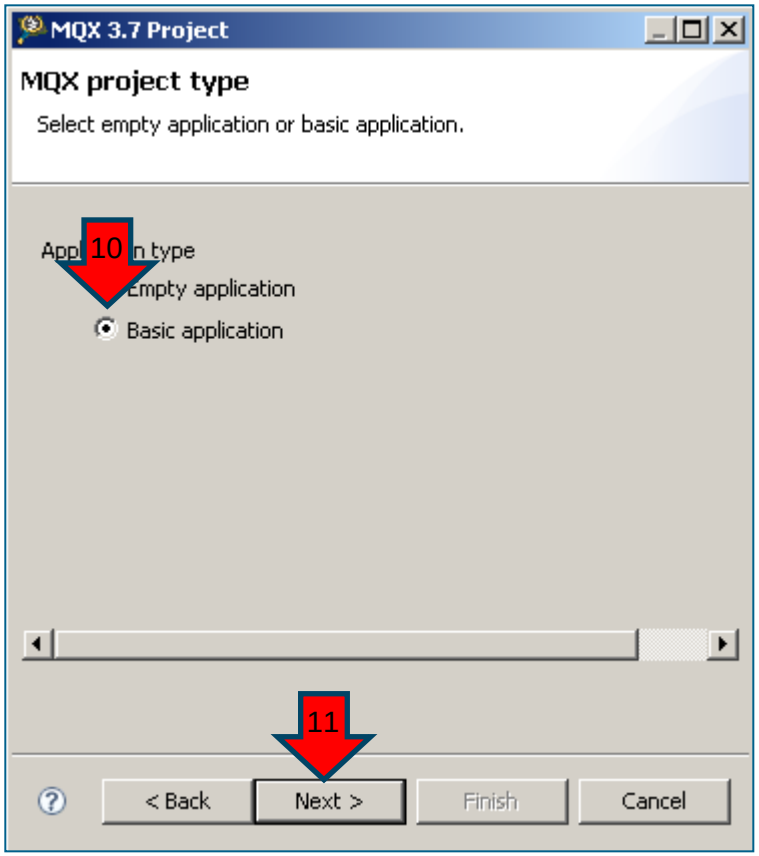
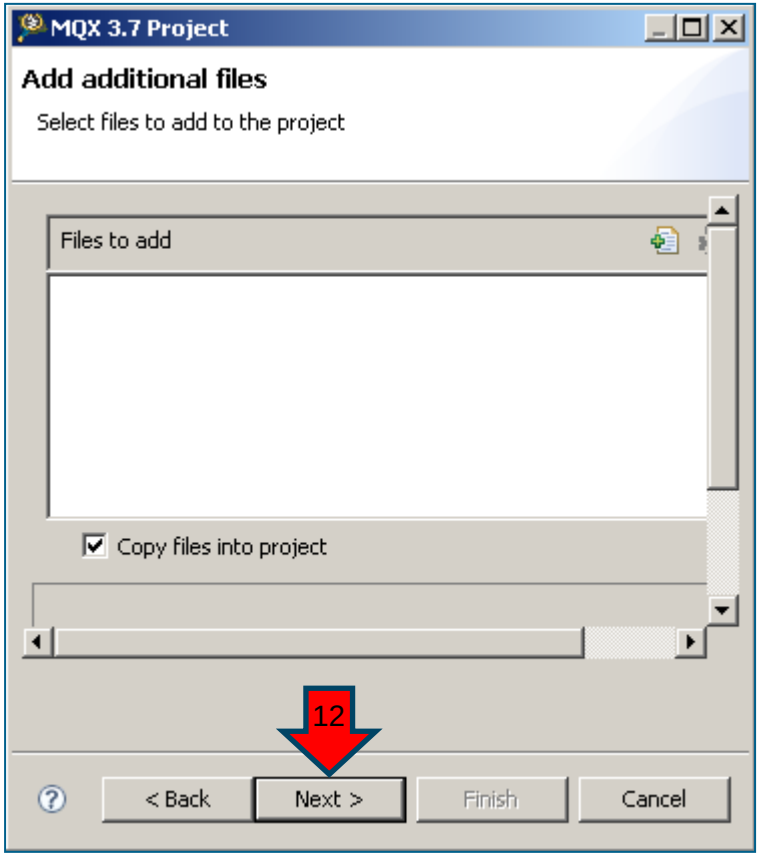
New MQX Project

- Select Basic application





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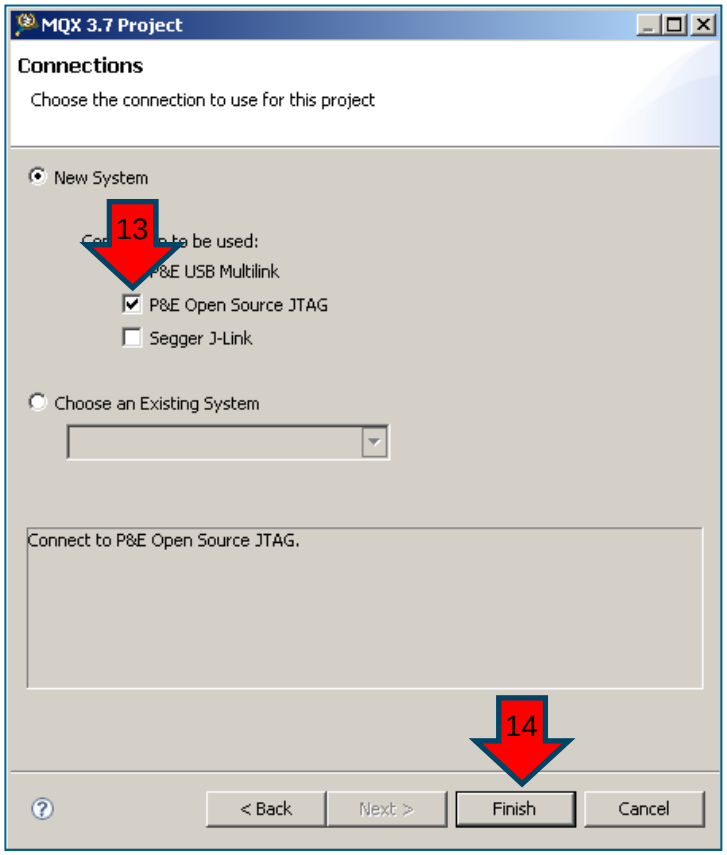
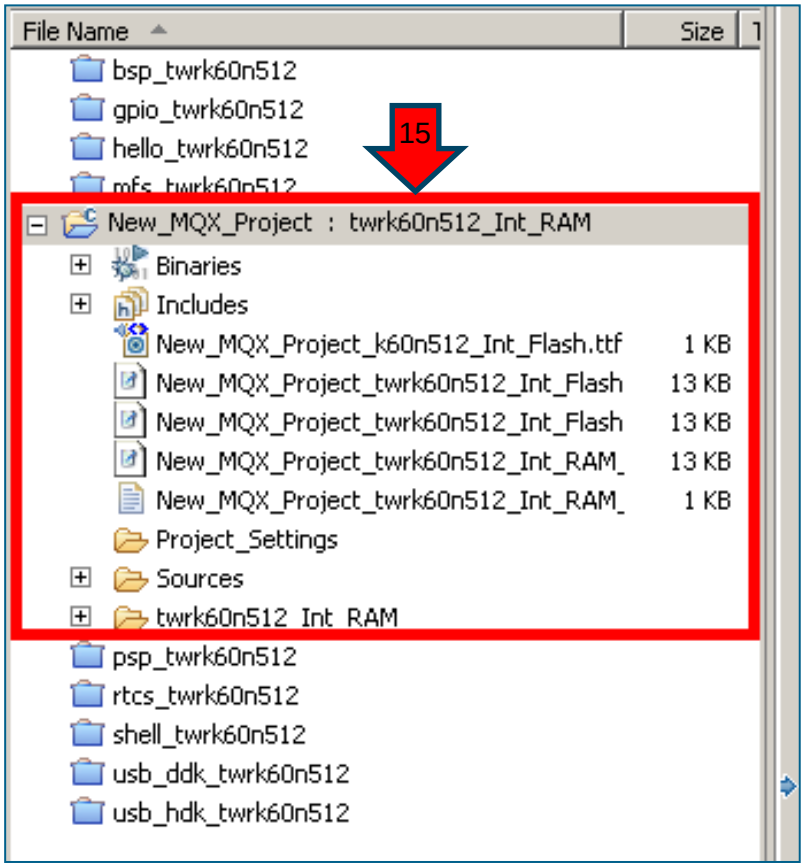
New MQX Project

- Select P&E Open Source JTAG
- Project is created





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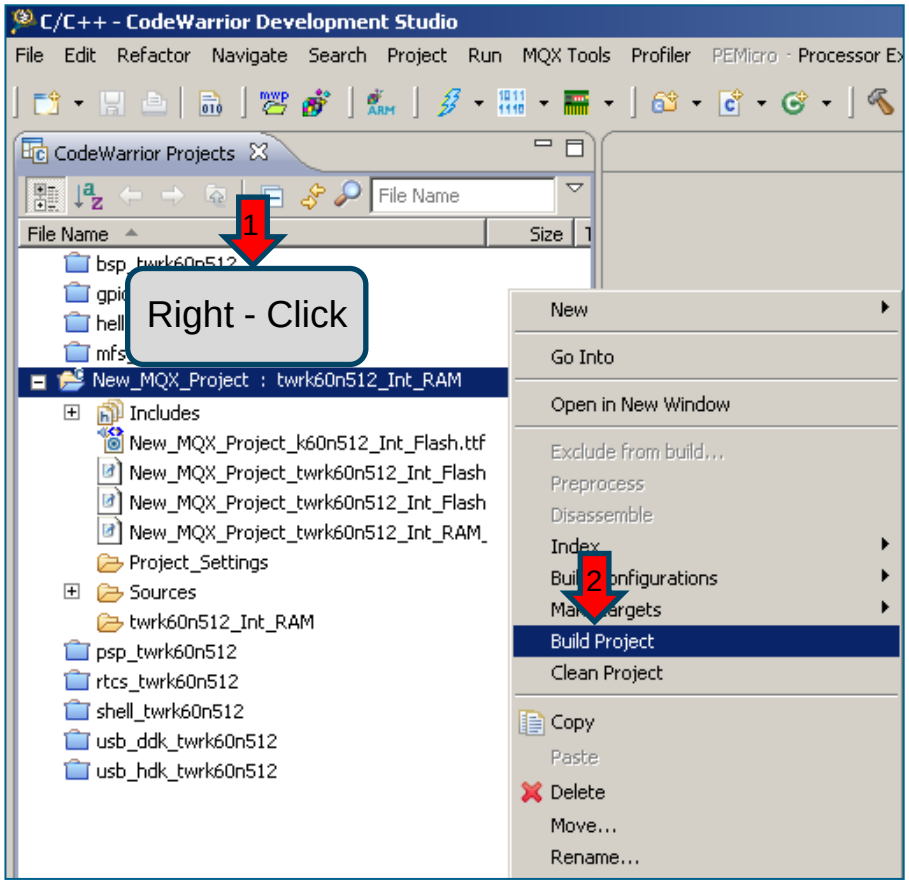
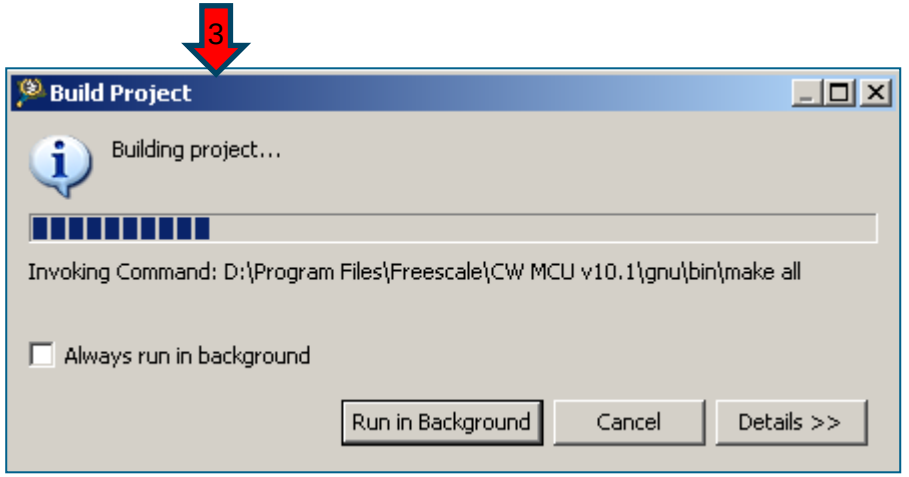
Build New MQX Project

- Right-Click on Project Explorer **New_MQX_Project** and Build Project





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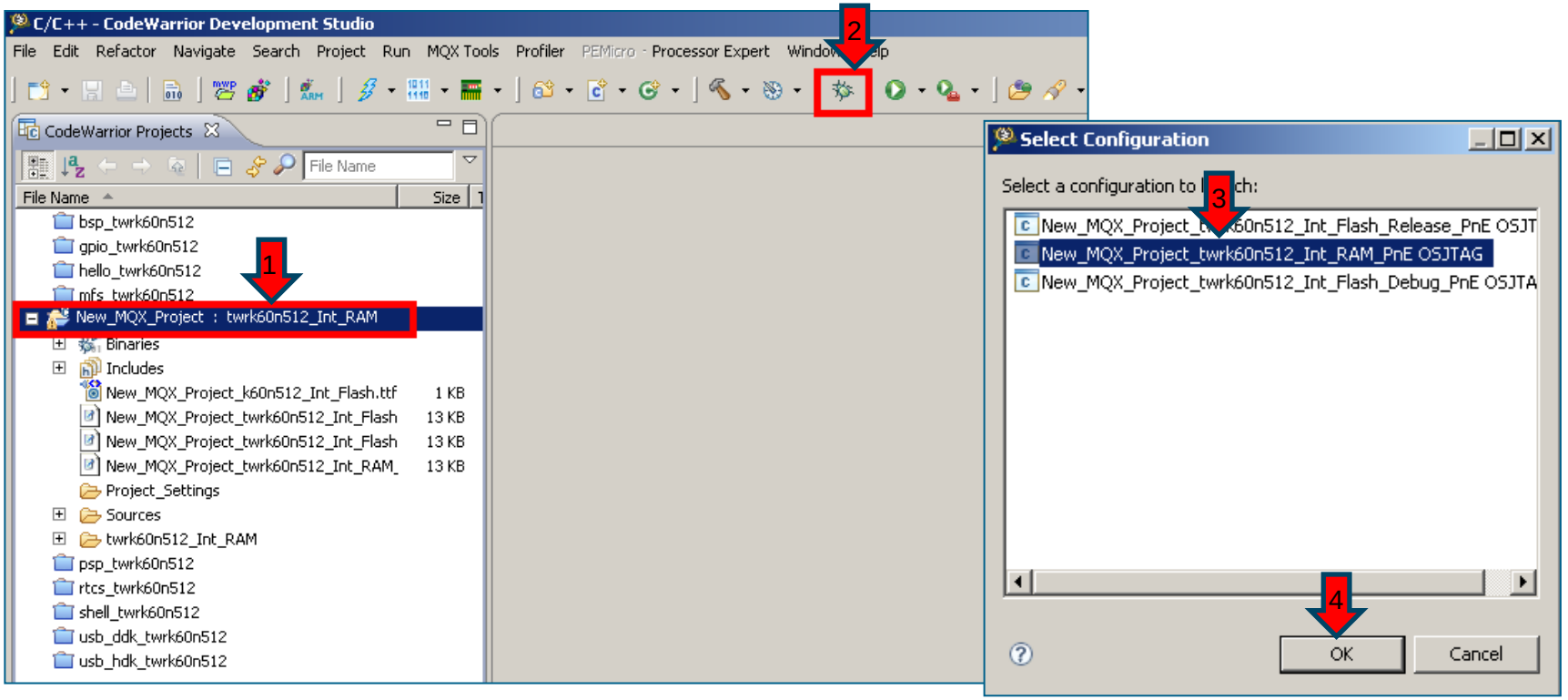
Debug New MQX Project

- Select **New_MQX_Project : twrk60n512_Int_RAM**
- Select **New_MQX_Project_twrk60n512_Int_Ram_PnE OSJTAG**



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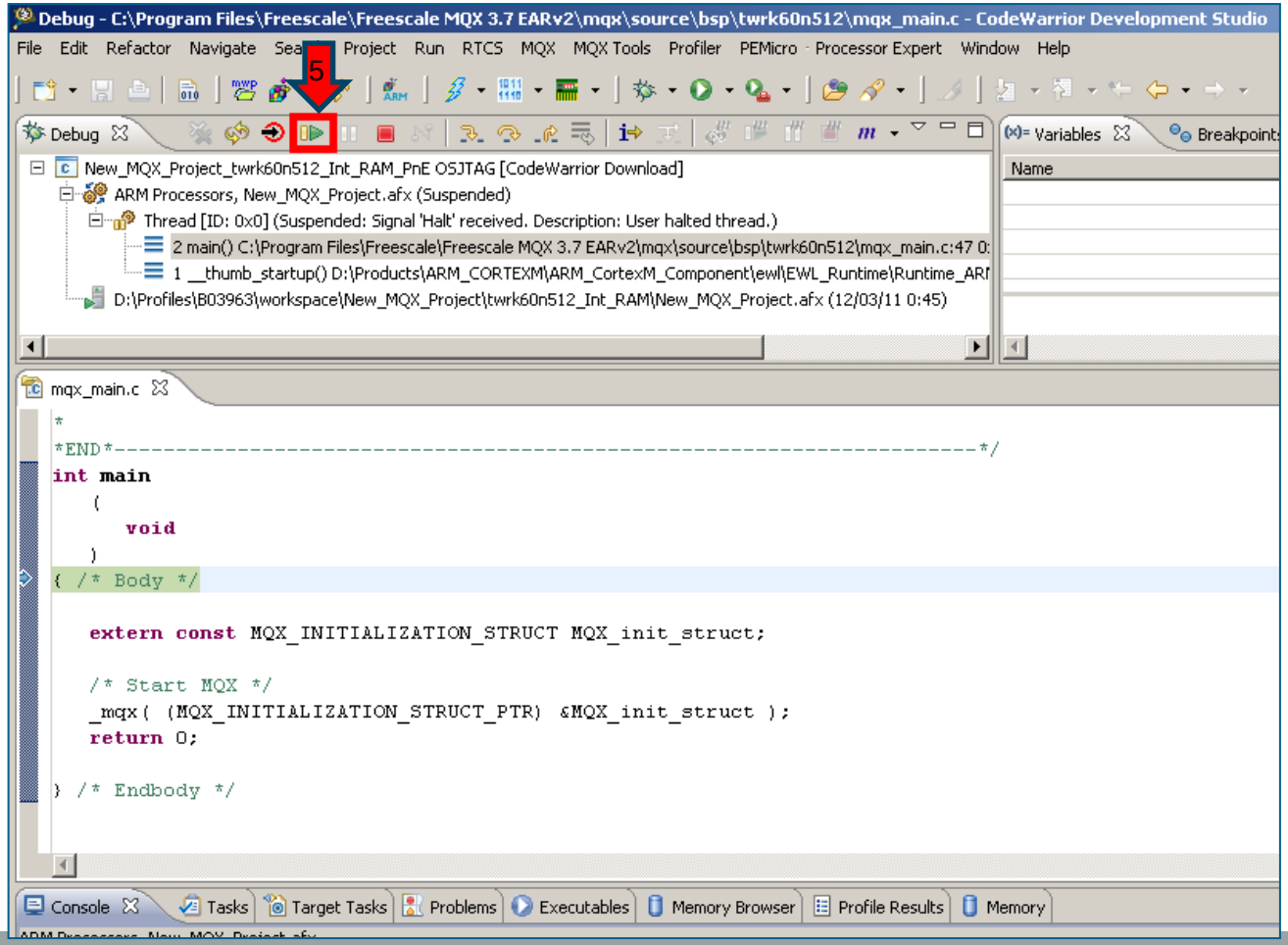
Run New MQX Project

- Execute the code '**Run**' icon



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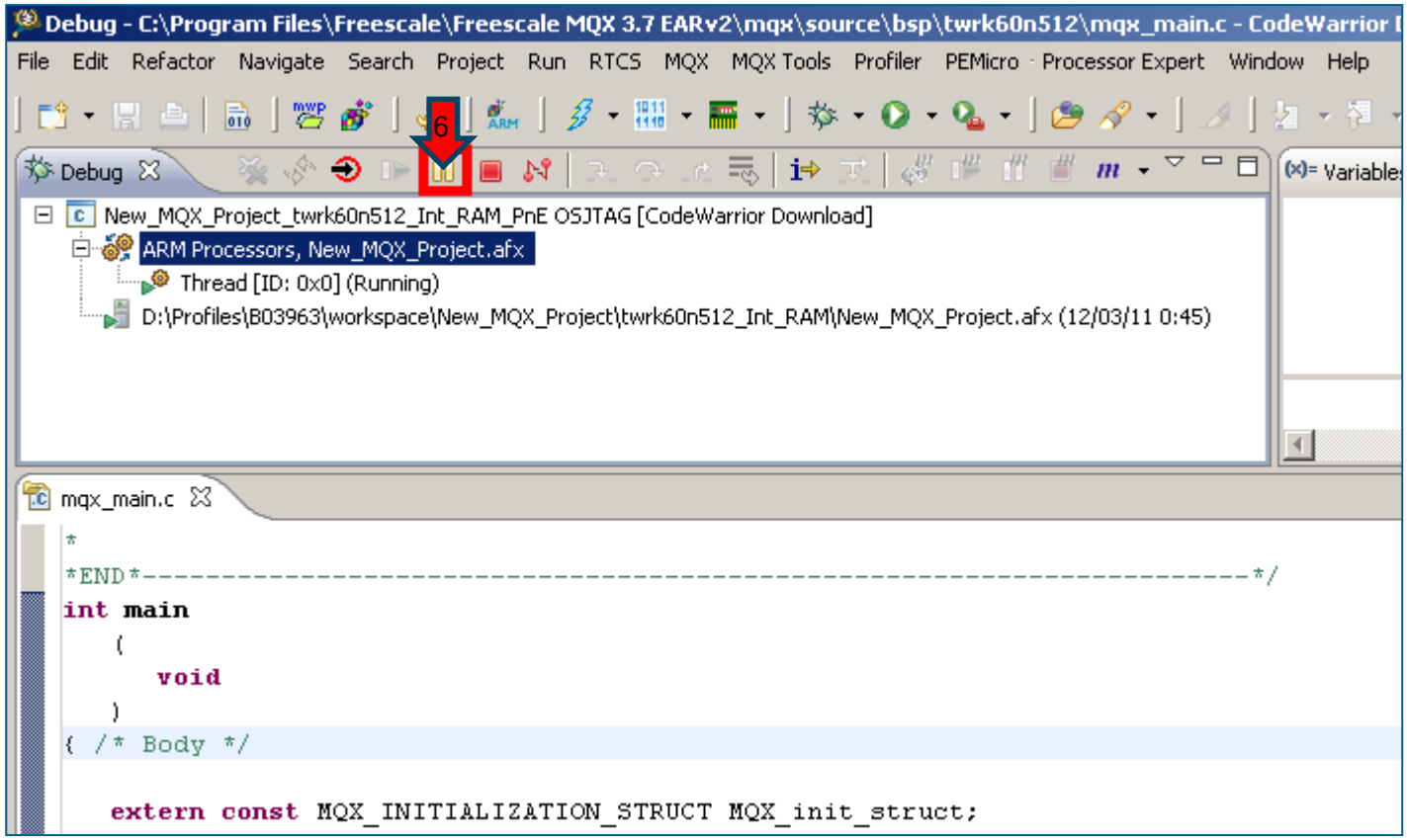
Run New MQX Project

- Pause execution



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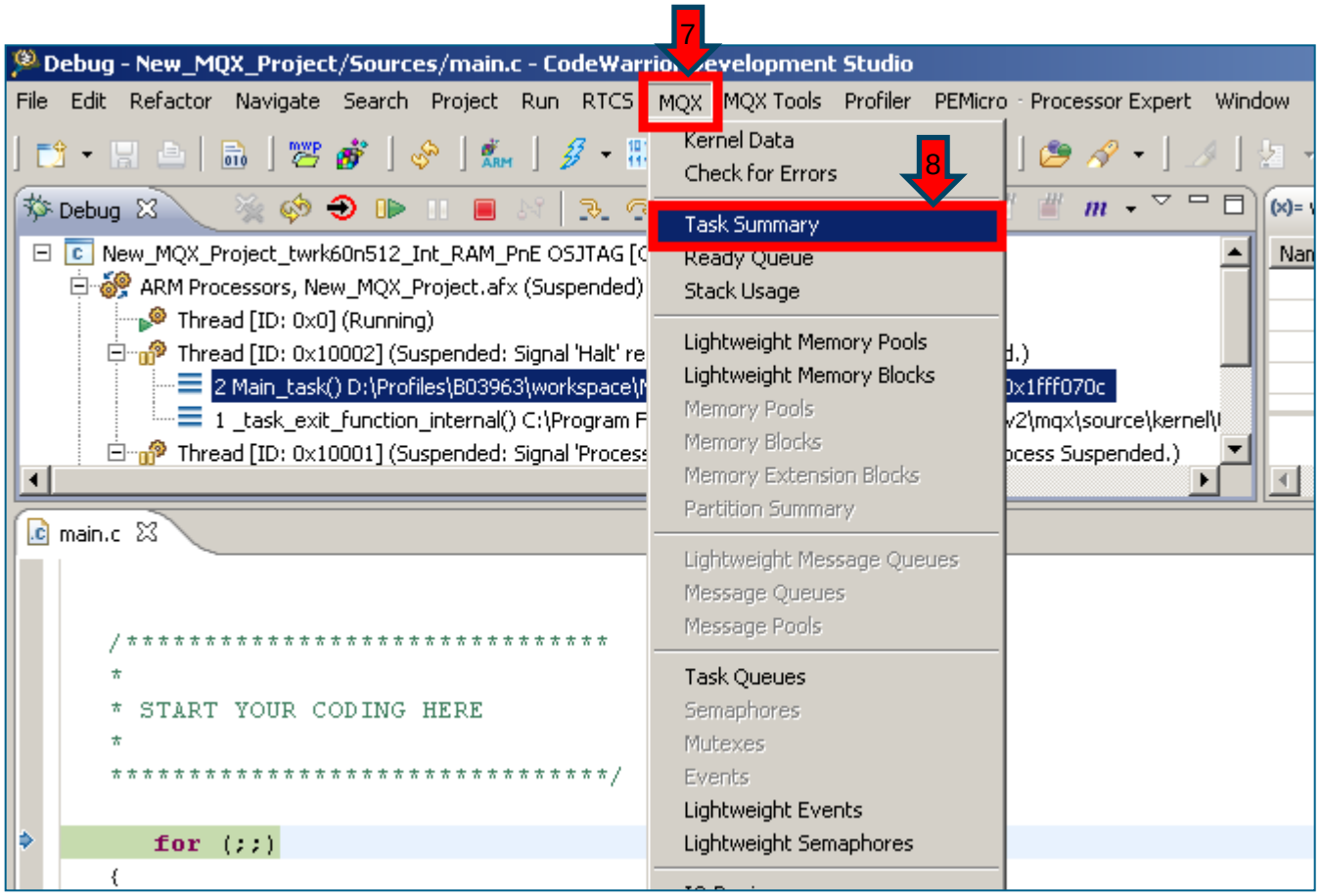
TAD: Task Summary

- MQX -> Task Summary



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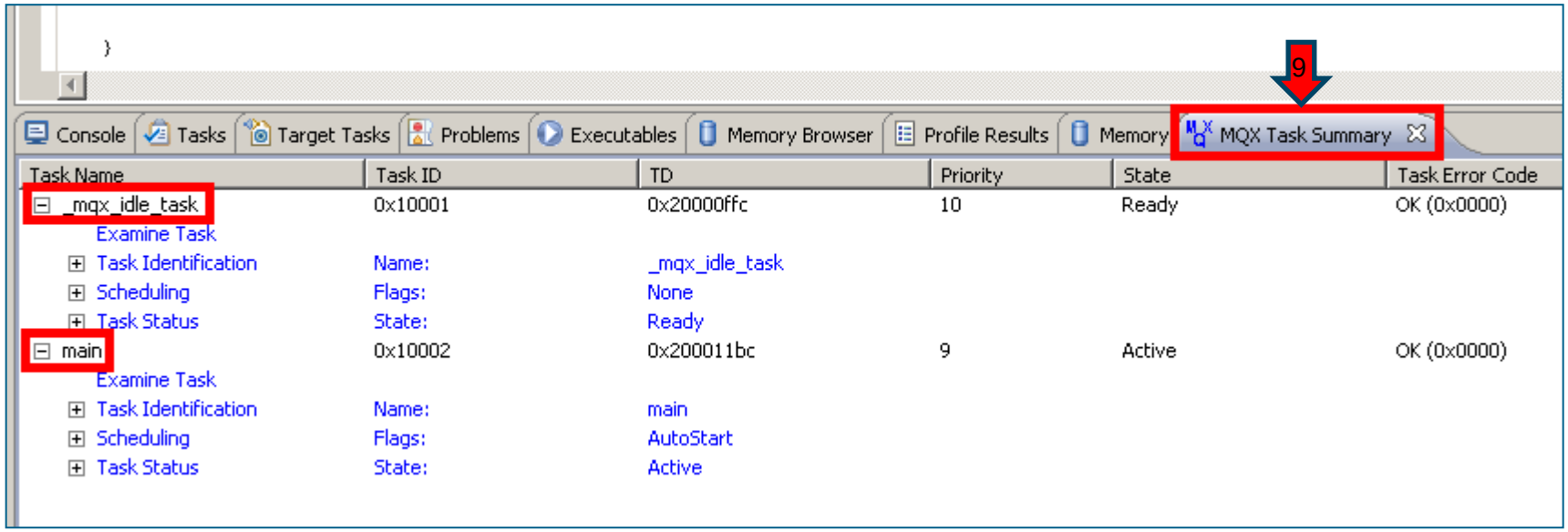
TAD: Task Summary

- Observe Tasks in your Application



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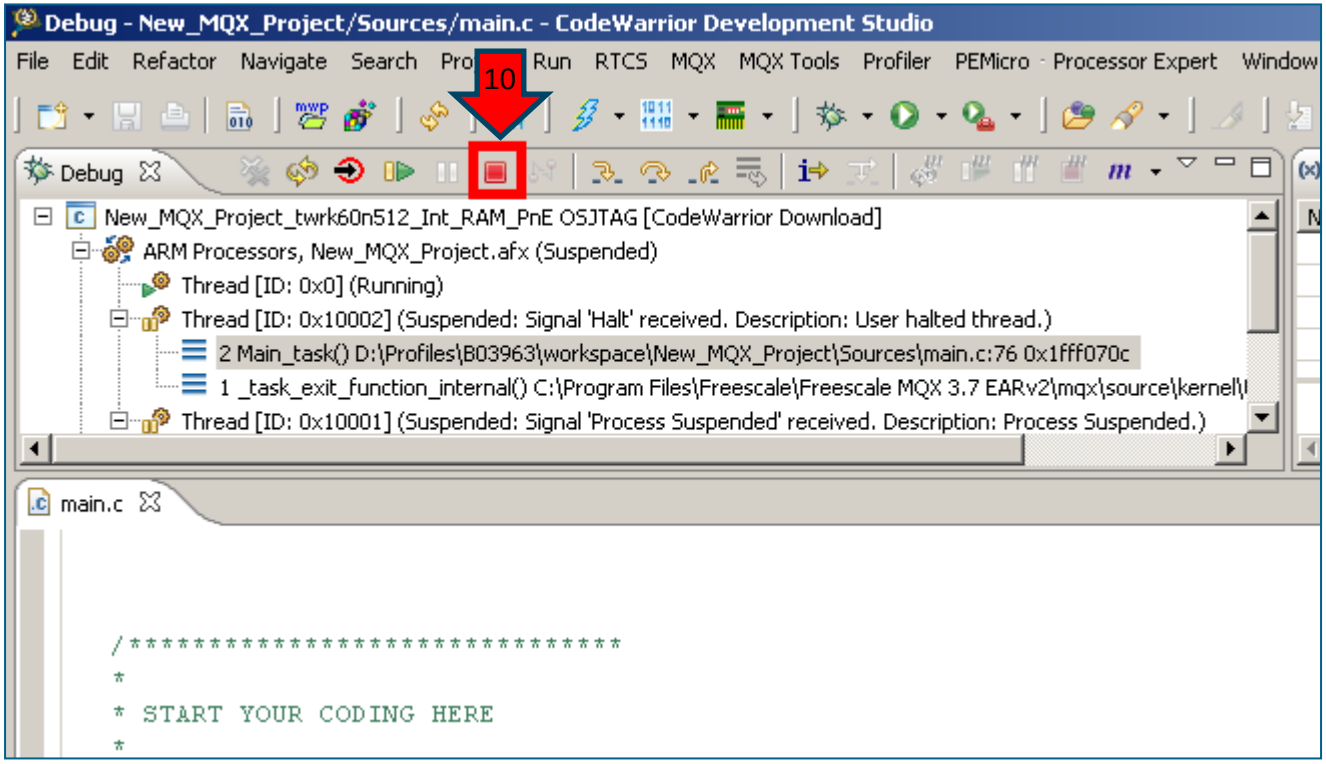
Run New MQX Project

- Terminate execution



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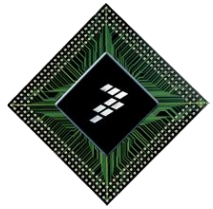
Debugging with JLink



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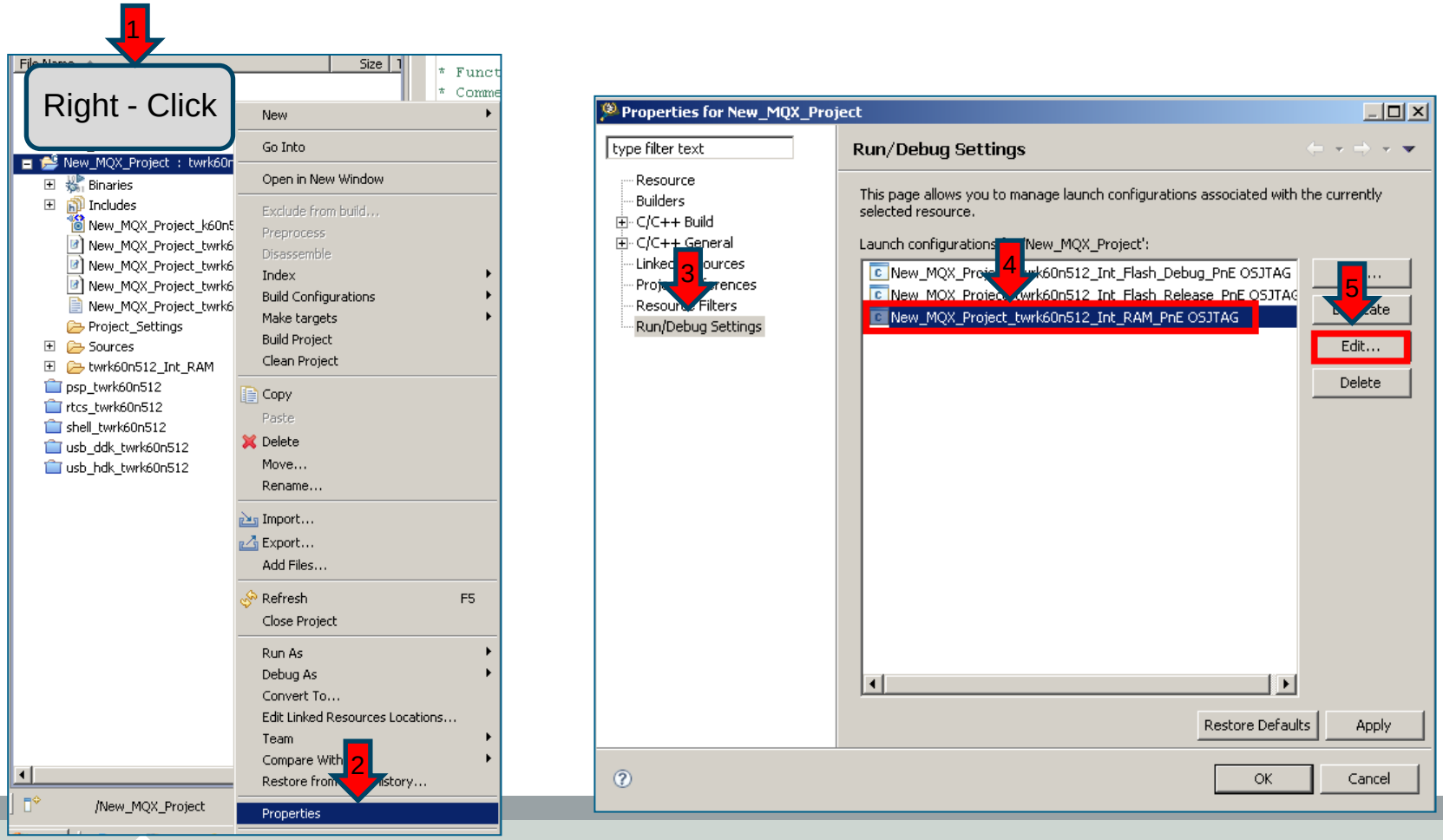
Debugging with JLINK - Change Connection Type

- Edit Connection Settings of the project



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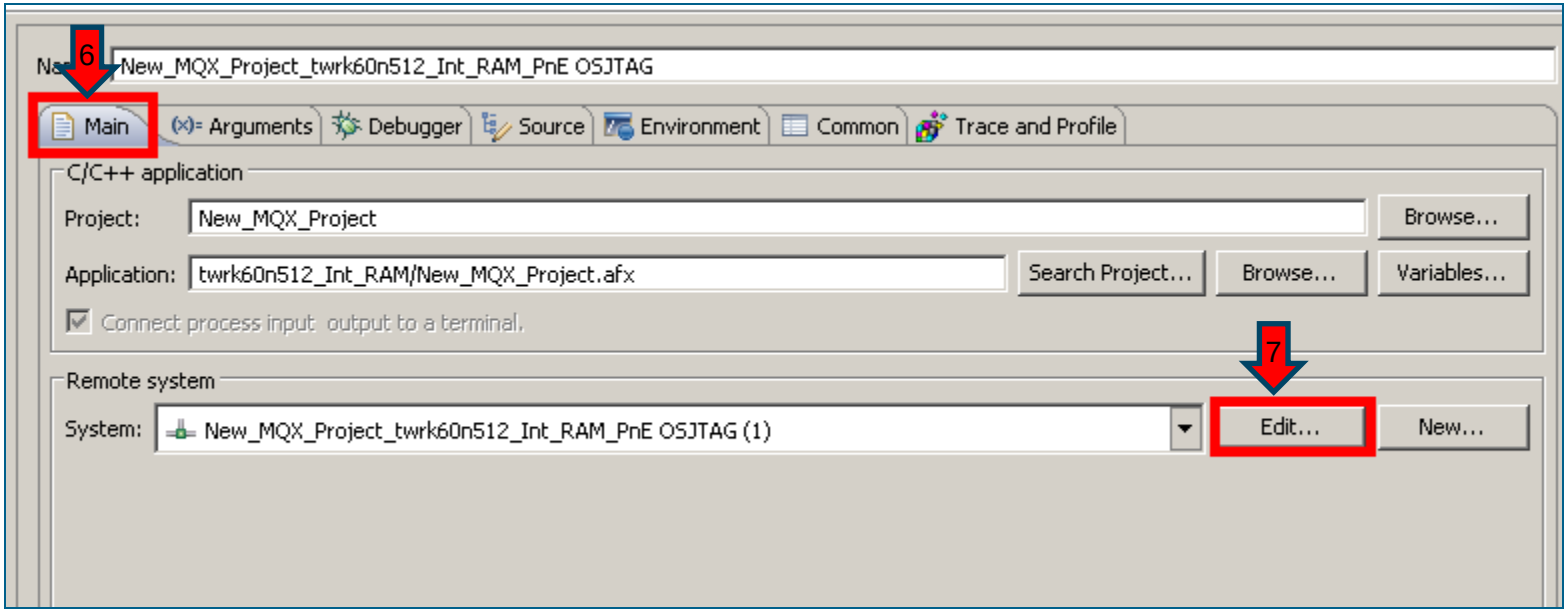
Change Connection Type

- Edit Remote System



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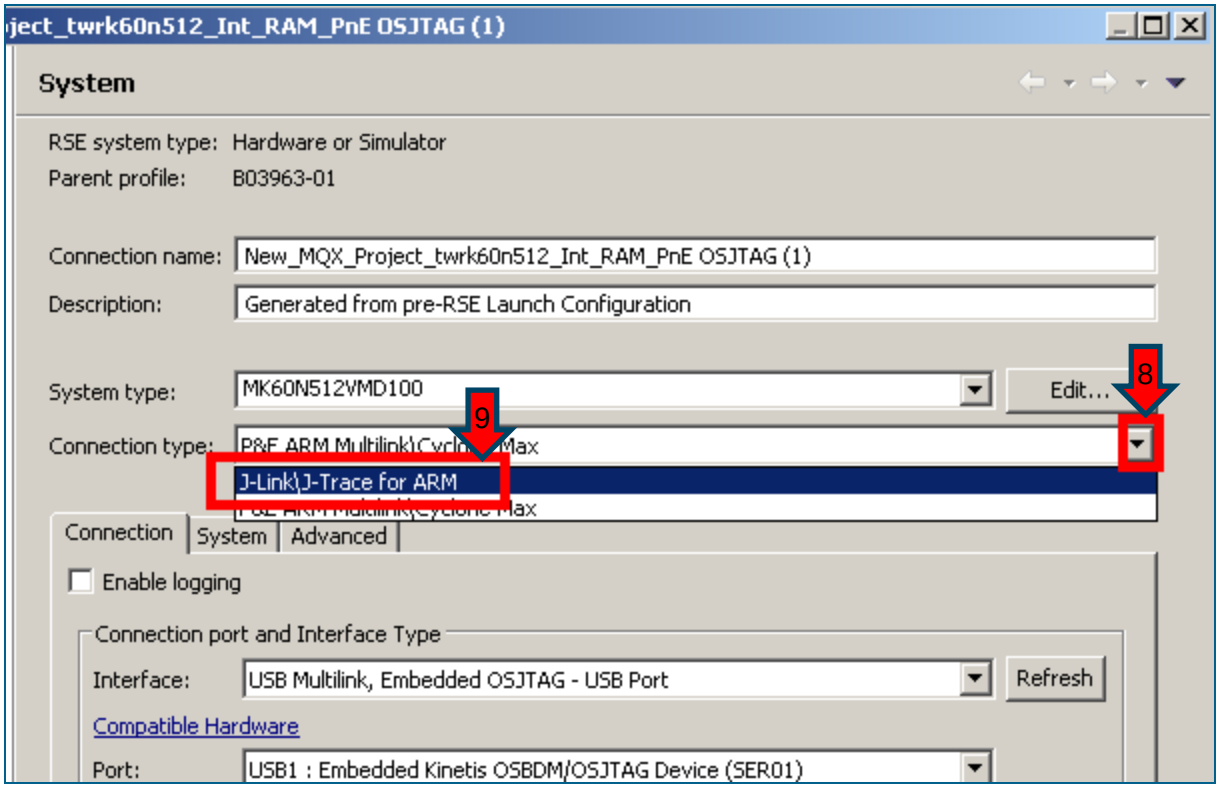
Change Connection Type

- Select **J-Link\J-Trace for ARM**



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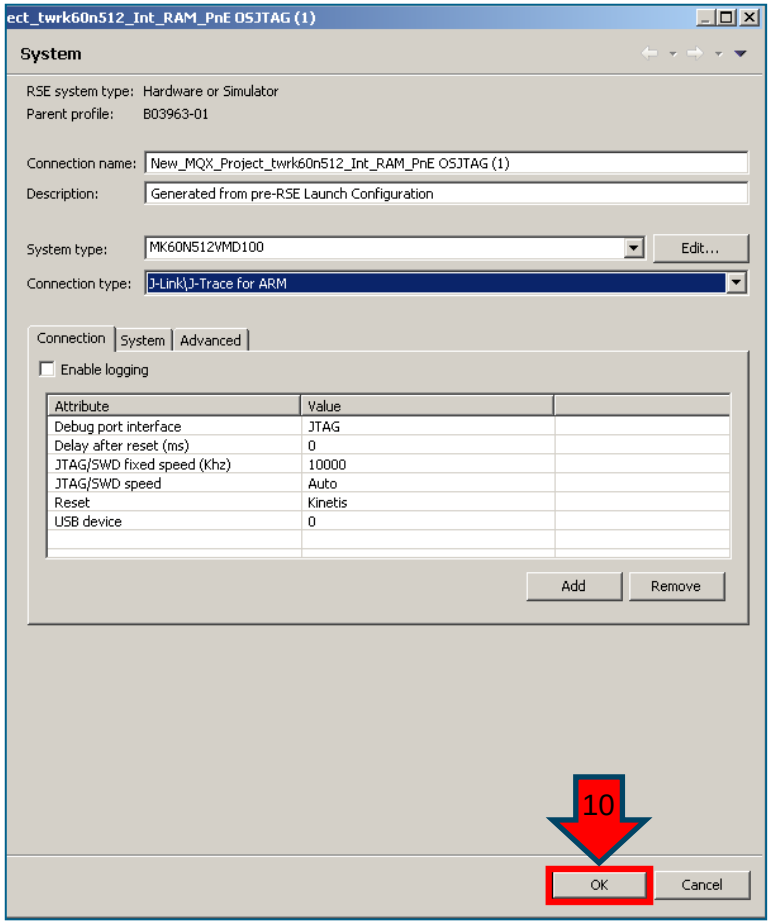
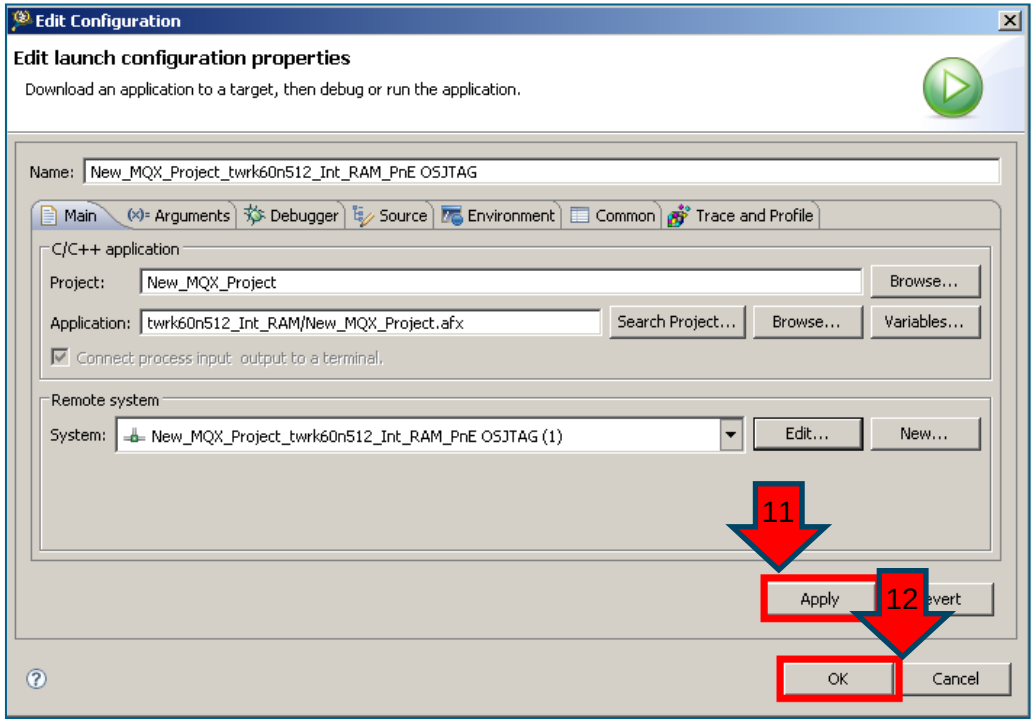
Change Connection Type

- Confirm changes





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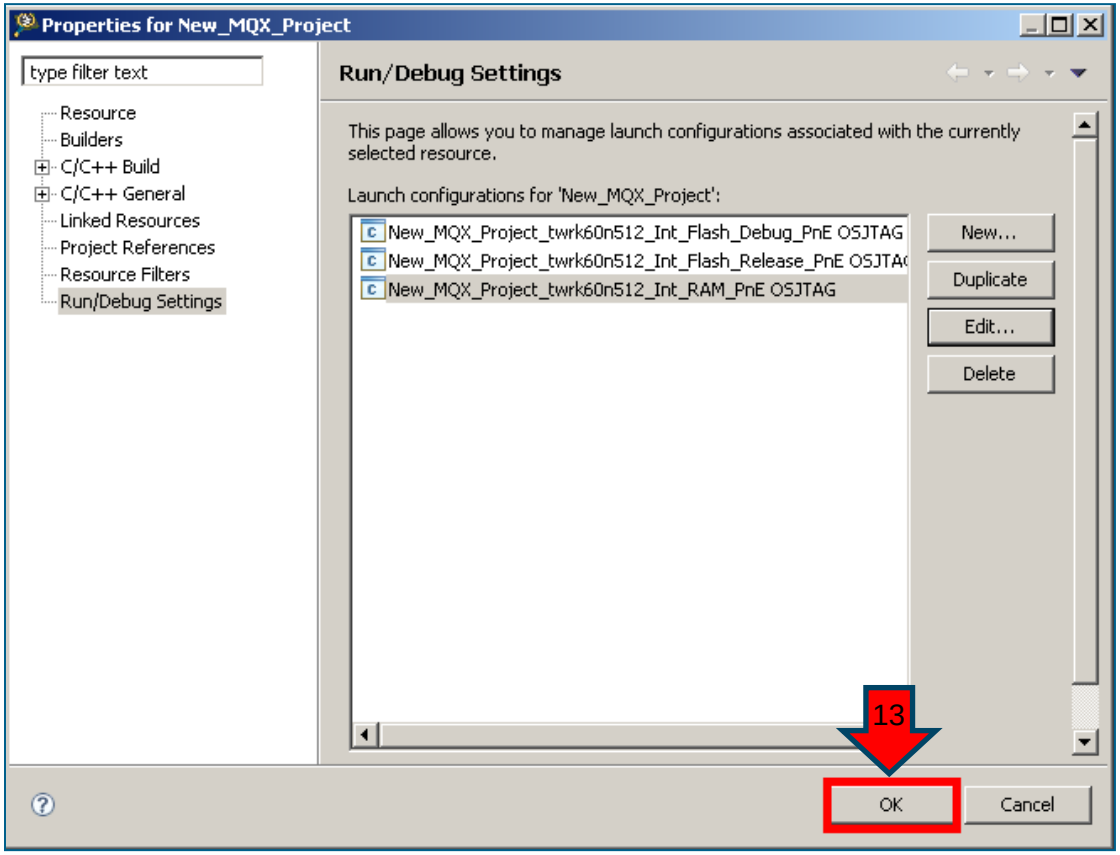
Change Connection Type

- Click OK



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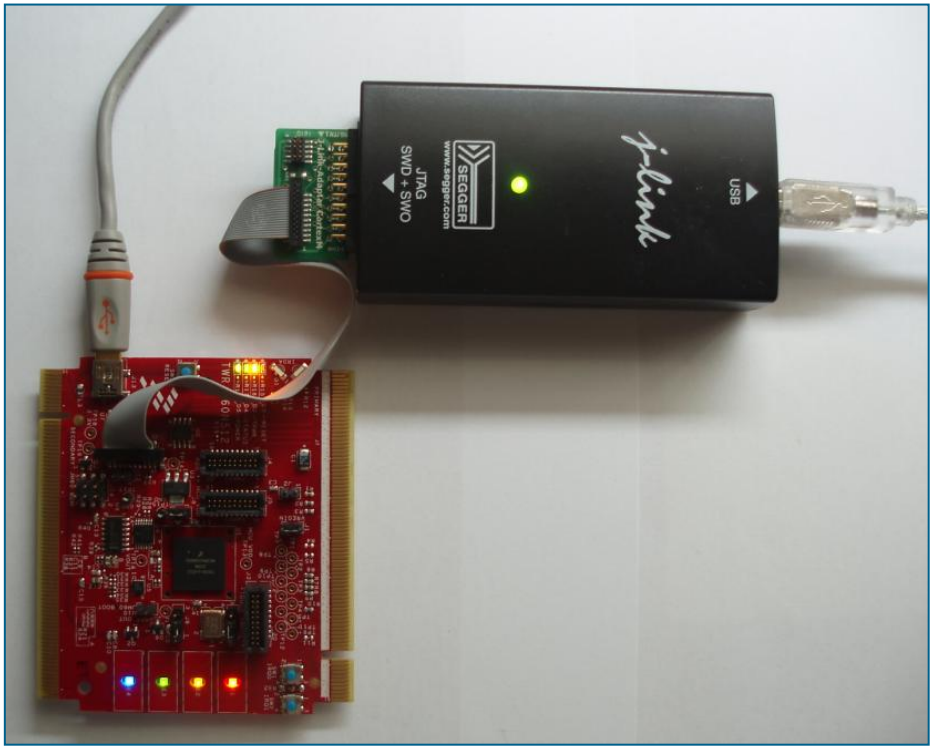
Debug with JLink

- Connect J-Link target cable to TWR-K60N512 (J11)
- Connect USB J-Link cable to laptop
- Connect USB Cable to TWR-K60N512 (J13) and laptop



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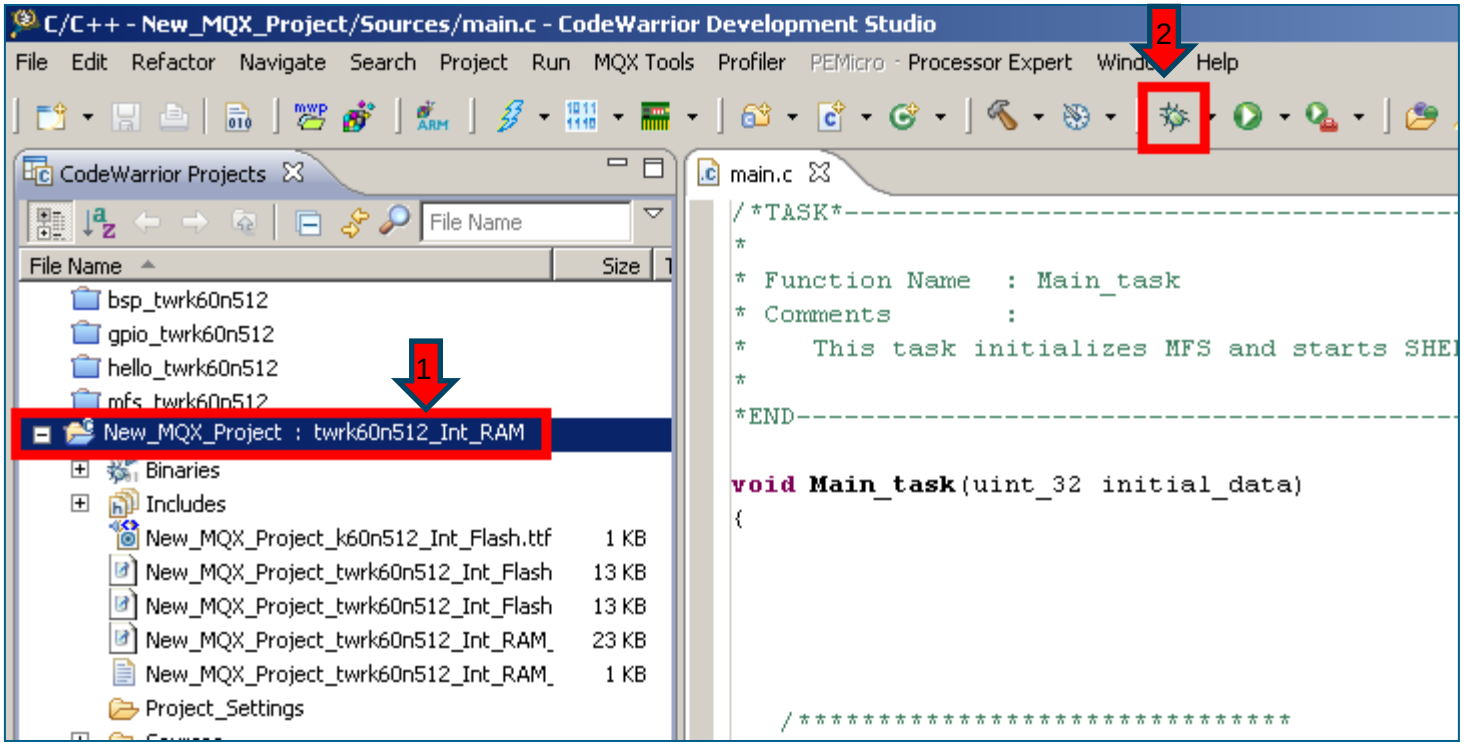
Change Connection Type

- Select **New_MQX_Project : twrk60n512_Int_RAM**
- Click Debug



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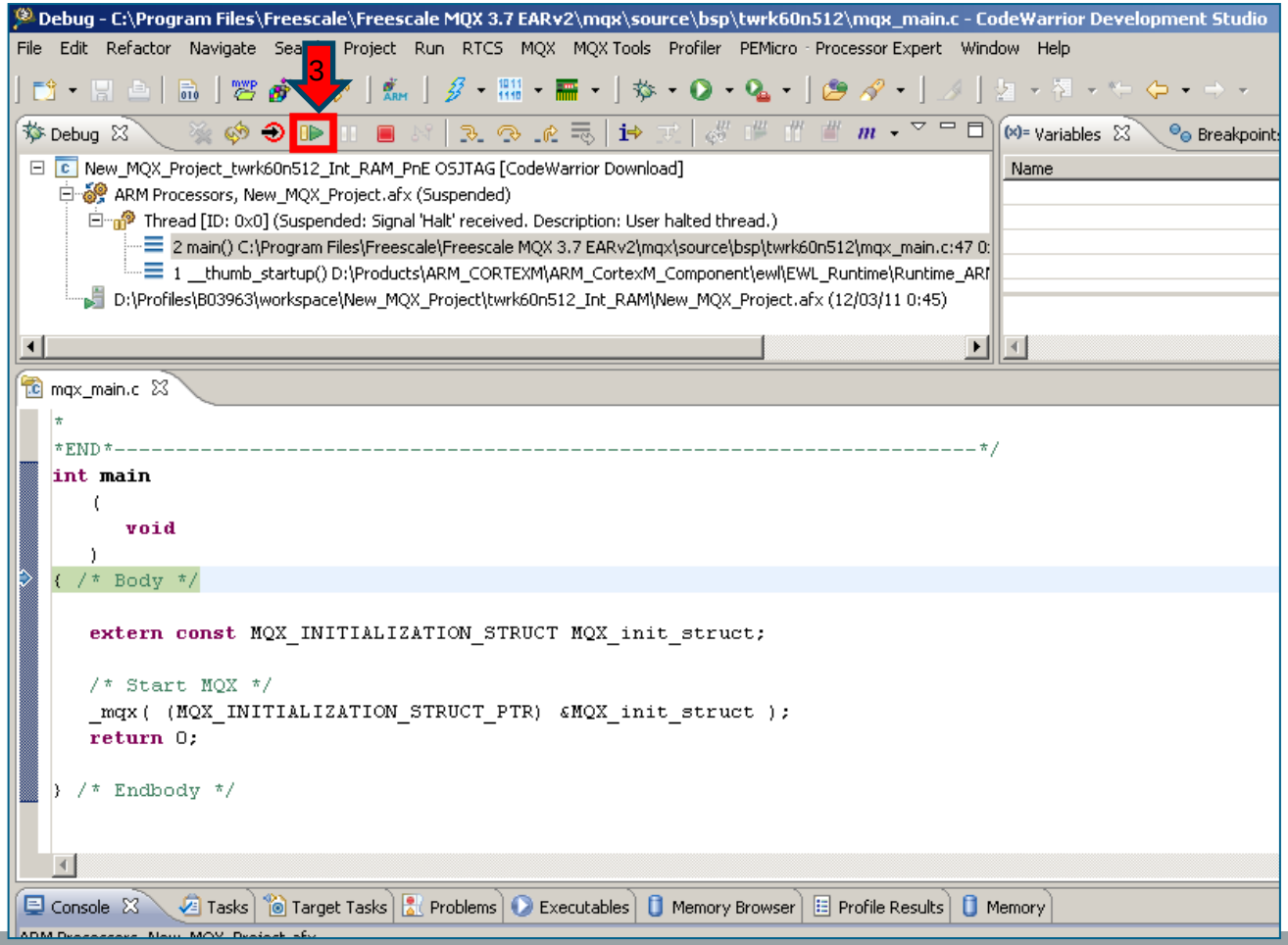
Run New MQX Project

- Execute the code '**Resume**' icon



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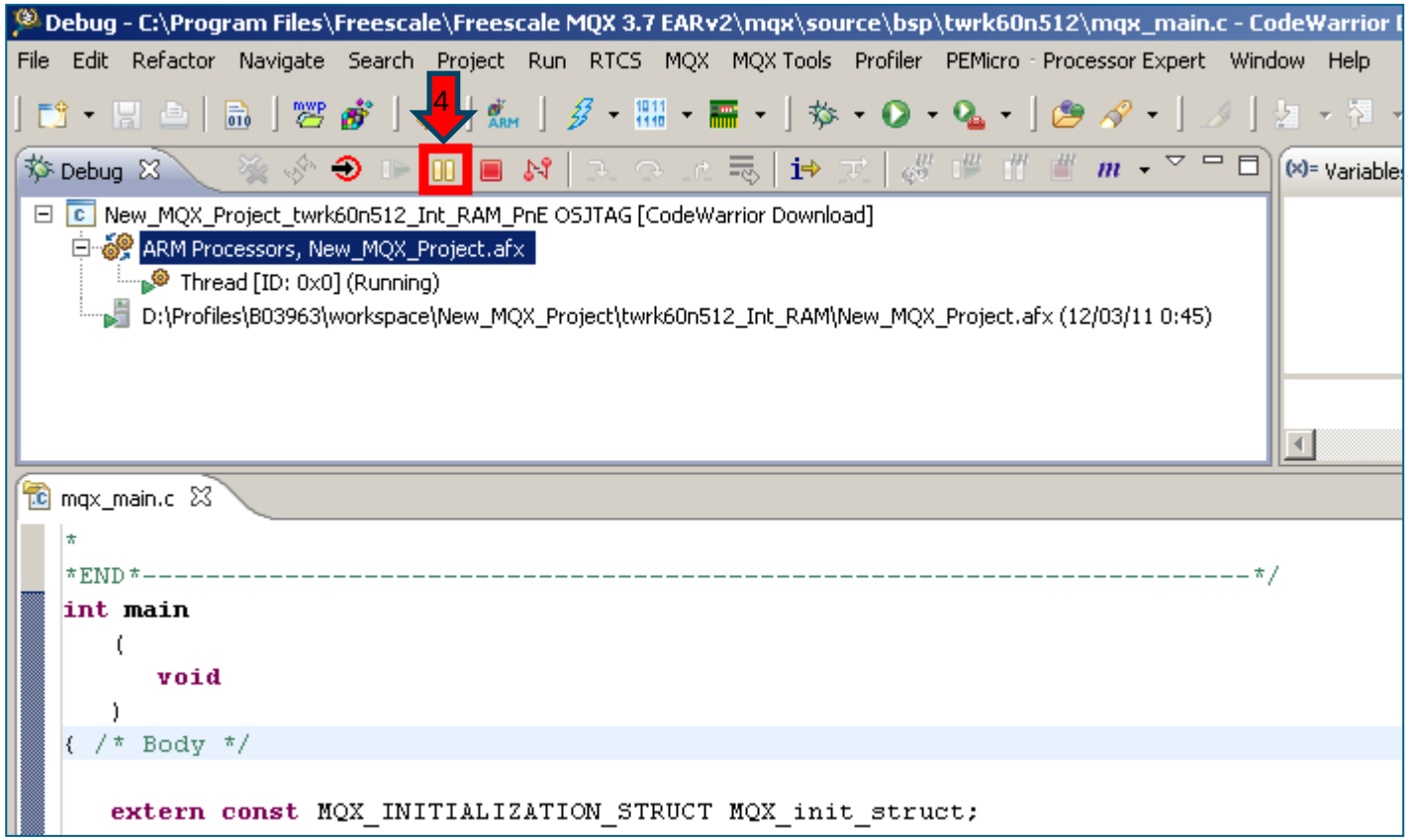
Run New MQX Project

- Pause execution



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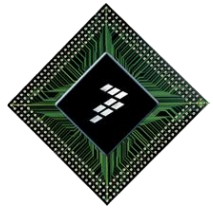
CW10.2, MQX 3.8 and Processor Expert



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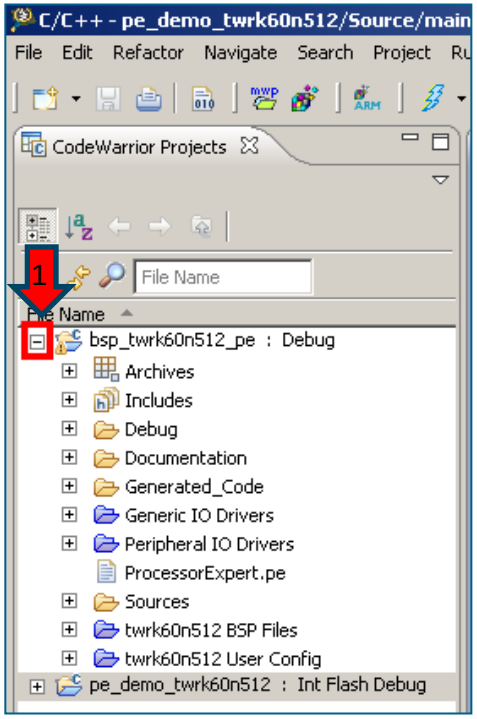
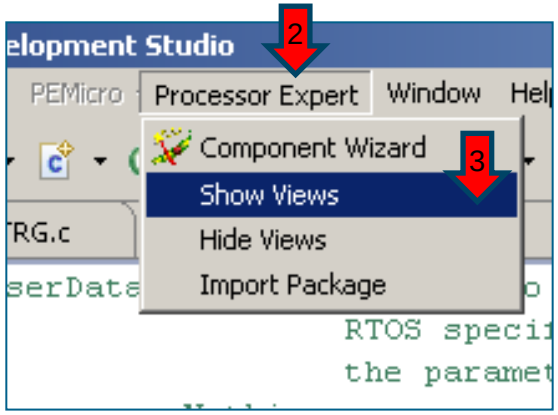
MQX and Processor Expert

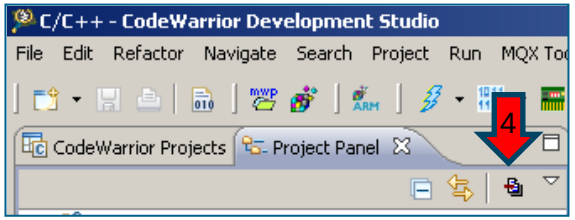
- All Kinetis BSP projects are Processor Expert Ready and Processor Expert drivers are enabled in MQX RTOS environment

New LLD Driver

- Expand **bsp_twrk60n512** project view
- Show Processor Expert View
- Generate code







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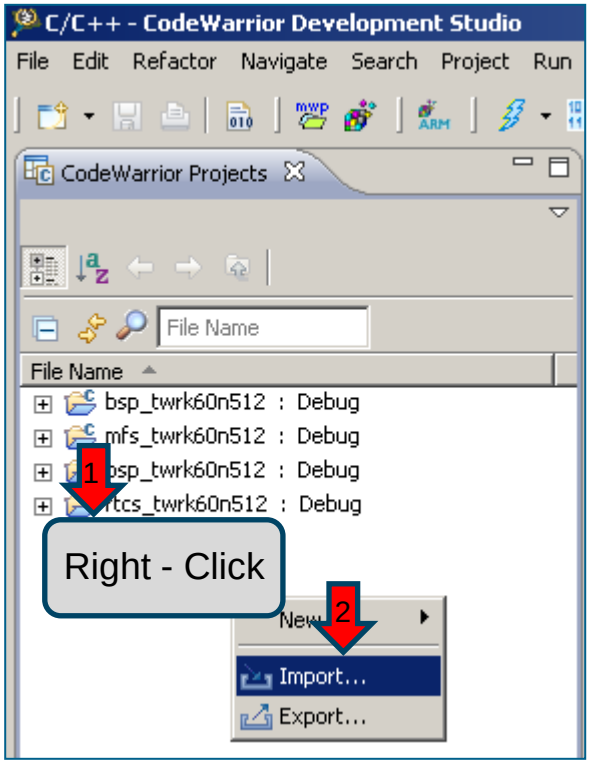
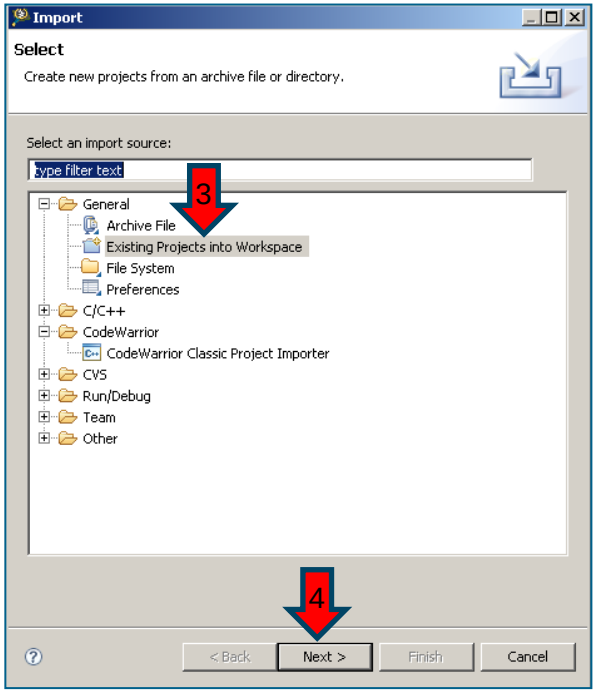
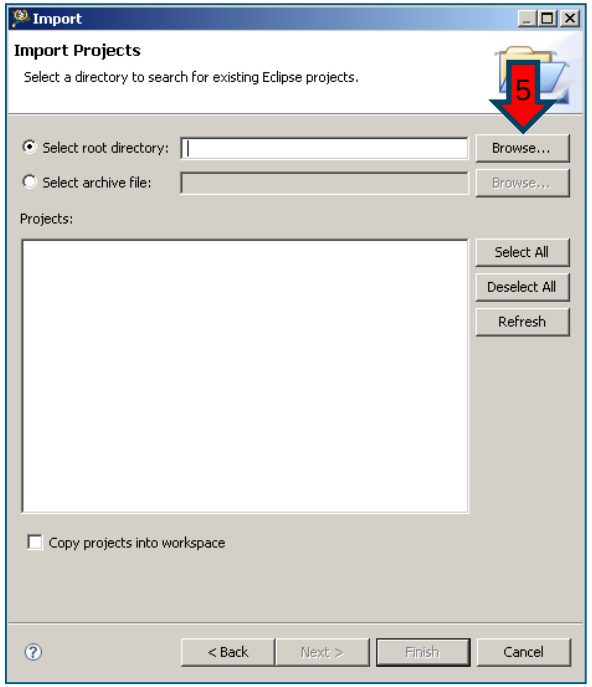
Import MQX PE Demo

- Right-Click on Project Explorer and Import
- Select Existing Projects into Workspace and Browse







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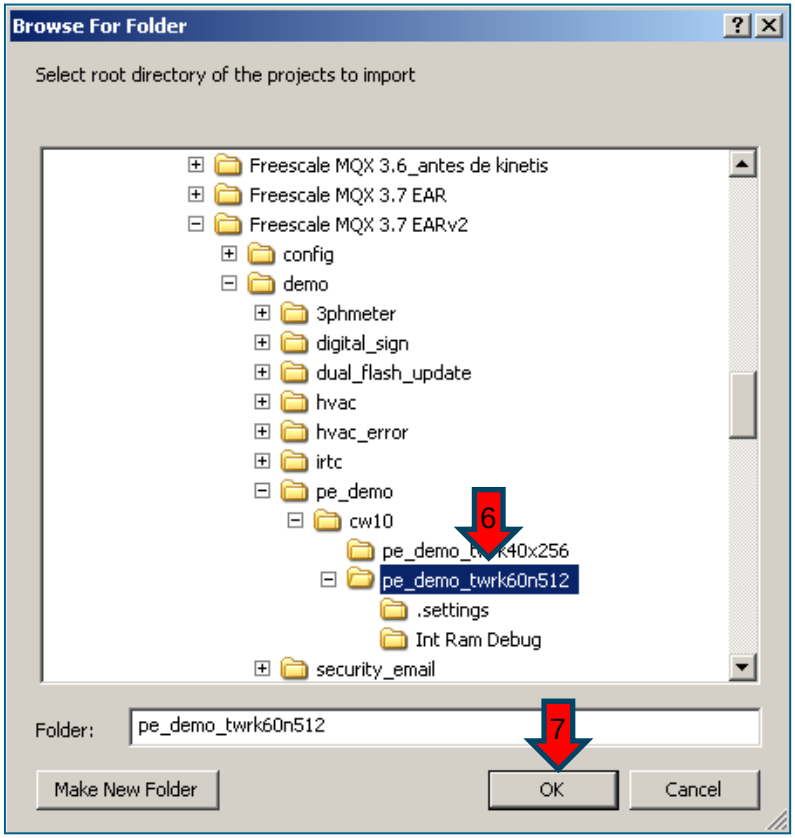
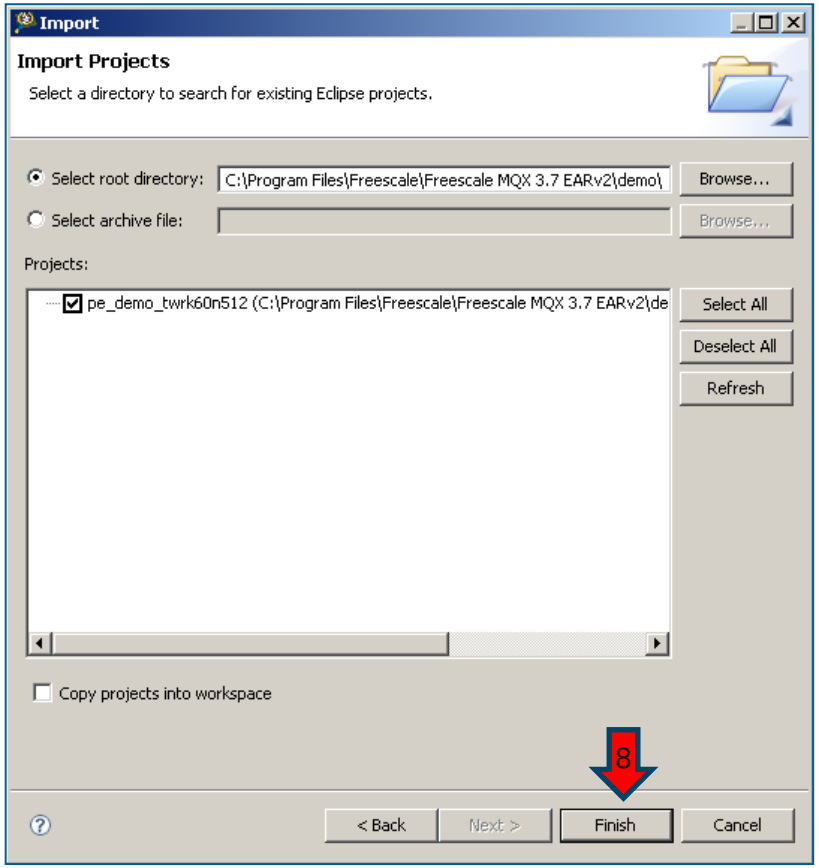
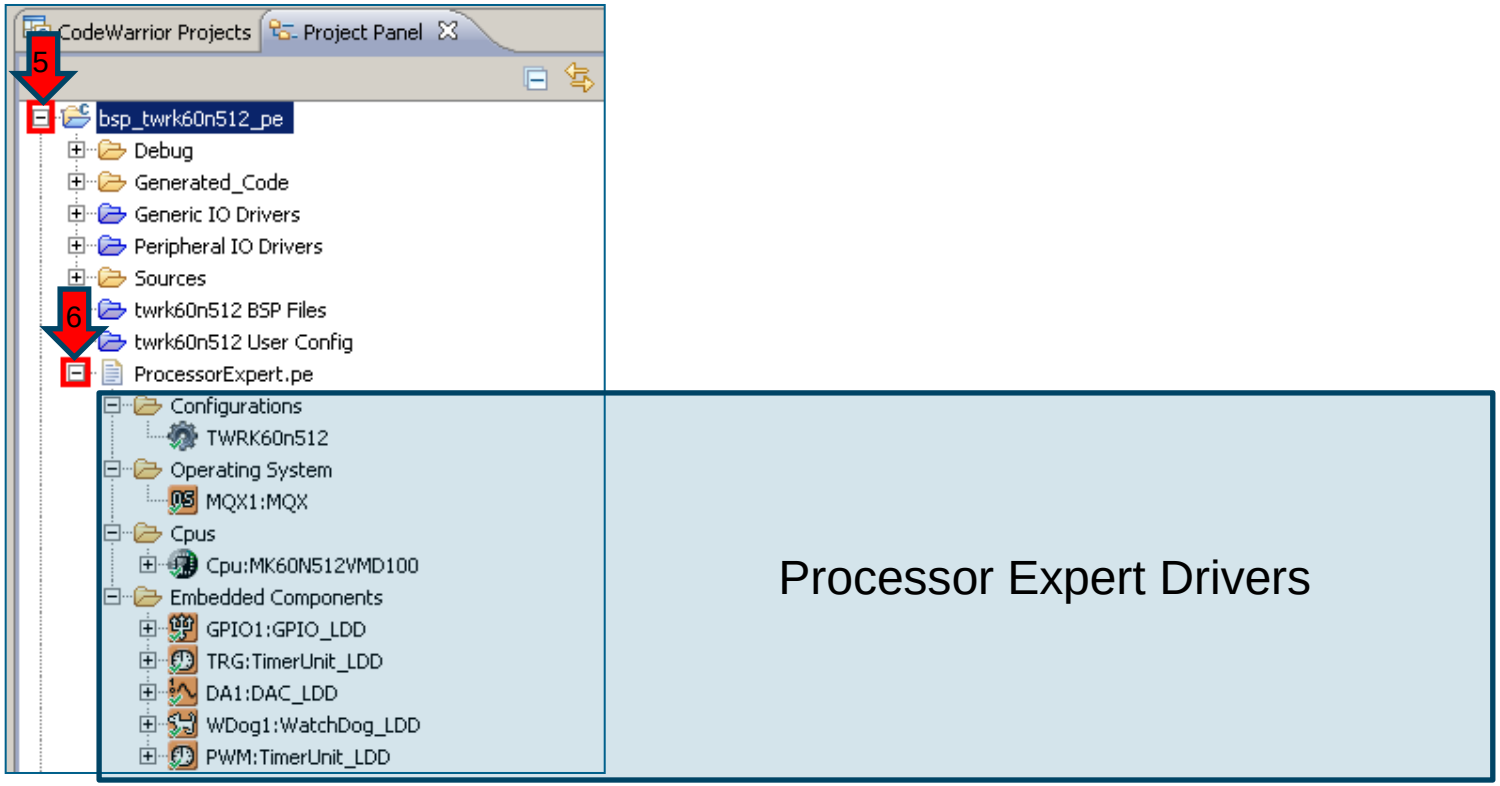
Import MQX PE Demo

- Select *<install mqx folder>\mqx\pe_demo\pe_demo_twrk60n512*



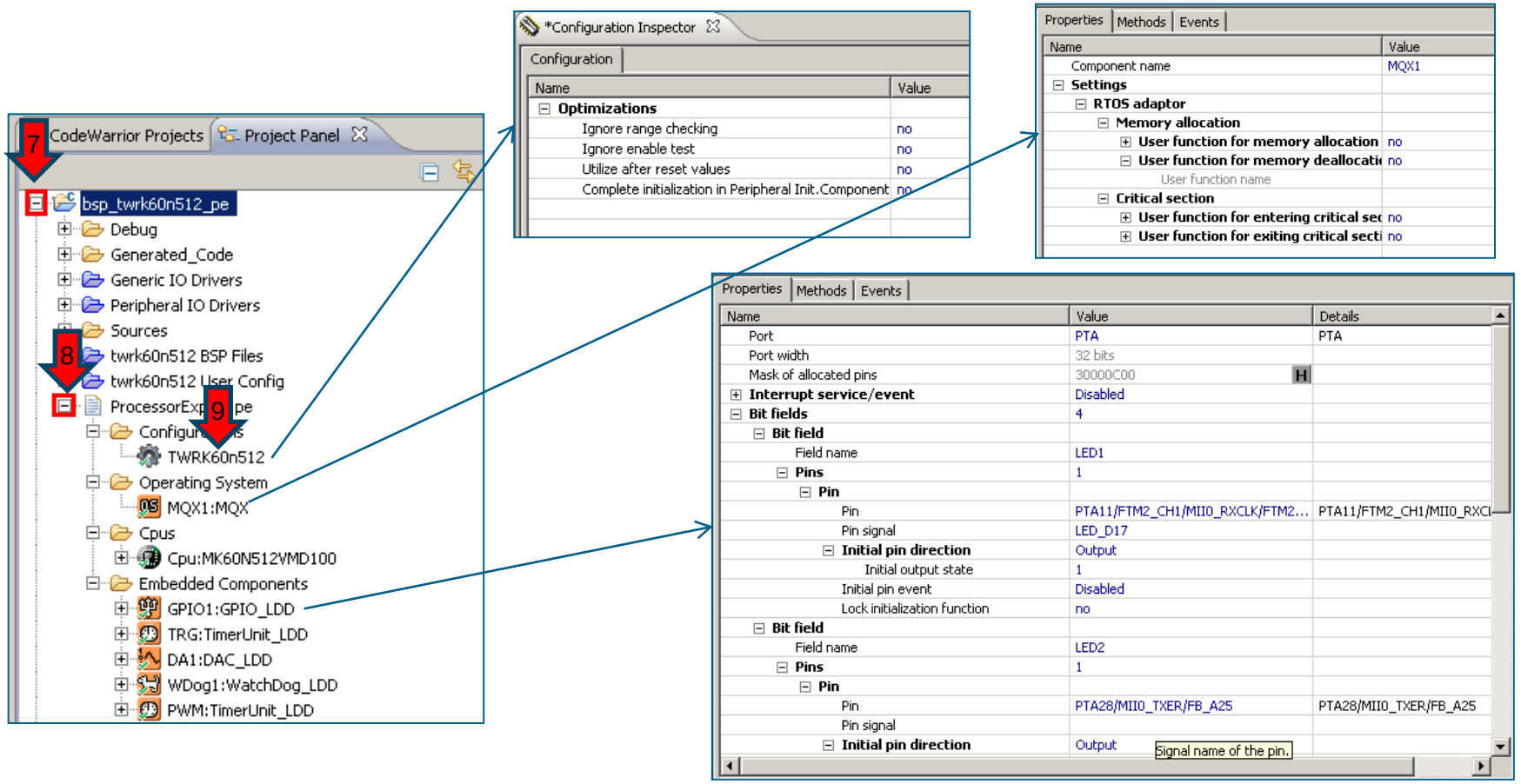


- Expand **bsp_twrk60n512** project view



MQX PE Demo

- Click on PE components to watch the properties



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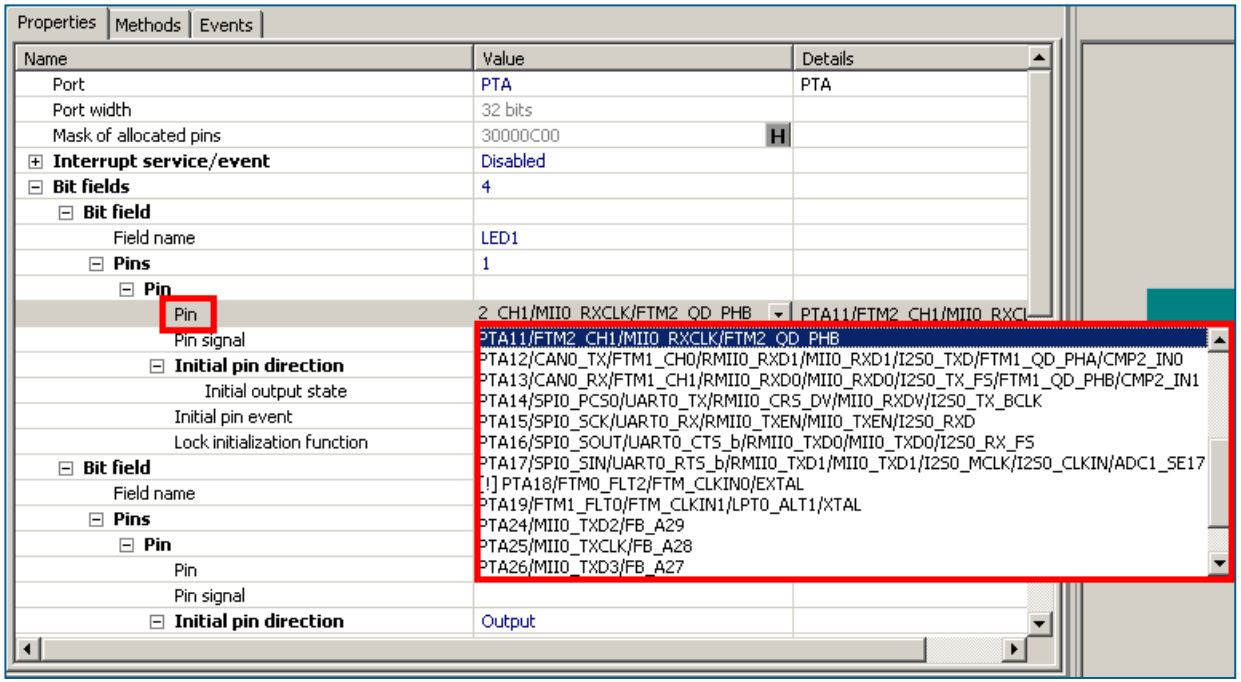
MQX PE Demo

- Processor Expert gives you a easy way to add device drivers to MQX BSP.
- In BSP example two Timers GPIO are included
- Properties of component can be changed easily, for example GPIO pin



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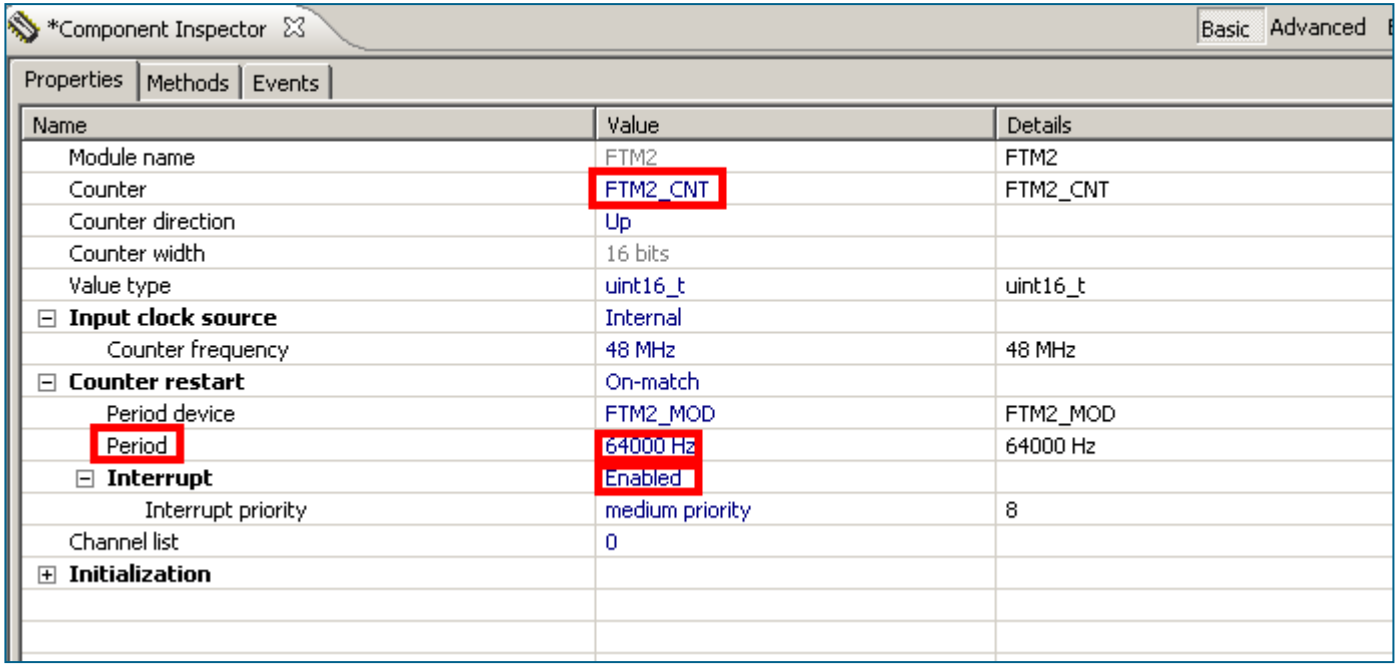
- **GPIO1** component in BSP is driving LED's in Tower board
- **TRG** Timer will generate a 64KHz interrupt



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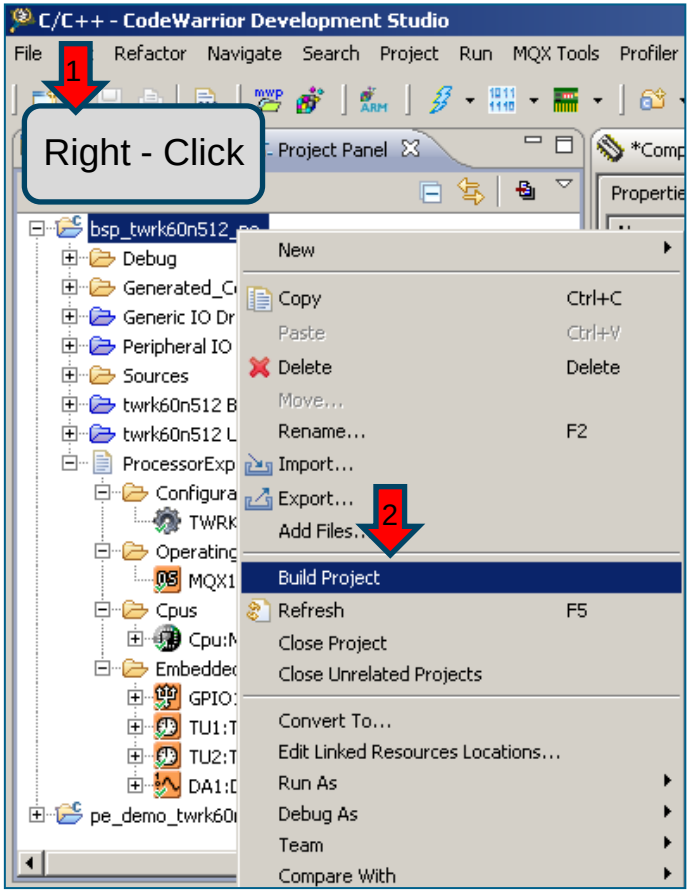
- **PWM** configures Channel 0 in Flex Timer 0 a PWM of 4096 timer-ticks

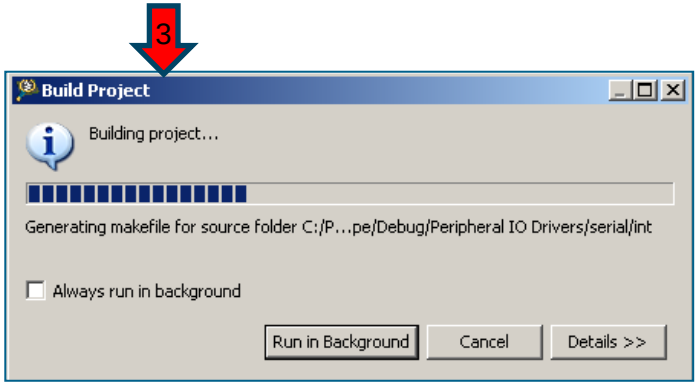
Properties | Methods | Events

Name	Value	Details
Module name	FTM0	FTM0
Counter	FTM0_CNT	FTM0_CNT
Counter direction	Up	
Counter width	16 bits	
Value type	uint16_t	uint16_t
Input clock source	Internal	
Counter frequency	48 MHz	48 MHz
Counter restart	On-match	
Period device	FTM0_MOD	FTM0_MOD
Period	4096 timer-ticks	4096 timer-ticks
Interrupt	Enabled	
Interrupt priority	medium priority	8
Channel list	1	
Channel 0		
Mode	Compare	
Compare	FTM0_C0V	FTM0_C0V
Offset	1 timer-ticks	1 timer-ticks
Output on compare	Set	
Output on overrun	Clear	
Initial state	Low	
Output pin	PTC1/SPI0_PCS3/UART1_RTS_b/FTM...	PTC1/SPI0_PCS3/UART1_RTS_b/FTM...
Interrupt	Disabled	
Initialization		
Enabled in init. code	no	
Event mask		

Build PE BSP

- Right-Click on Project Explorer **bsp_twrk60n512** and Build Project





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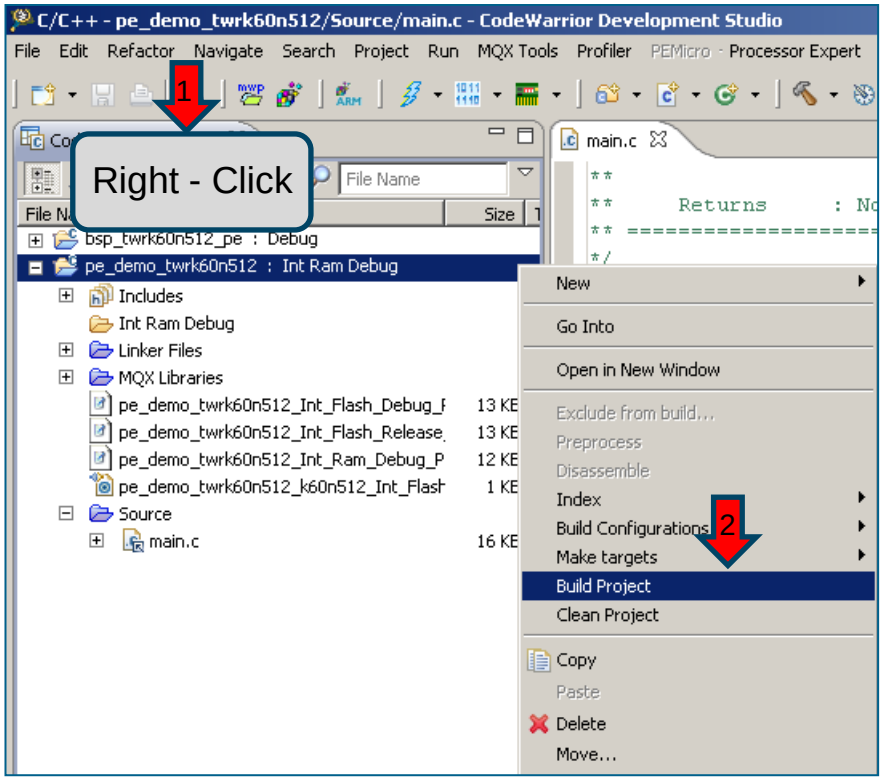
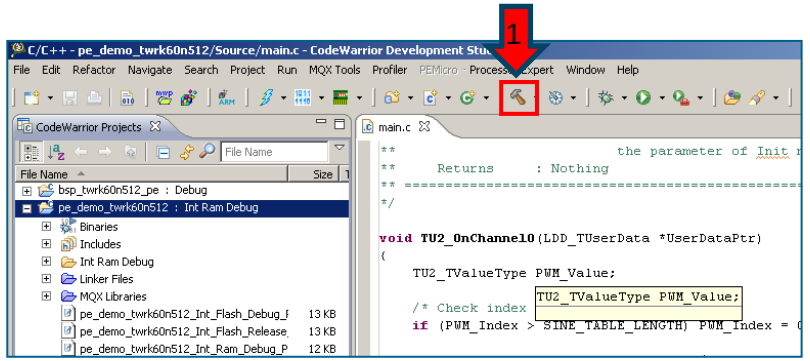
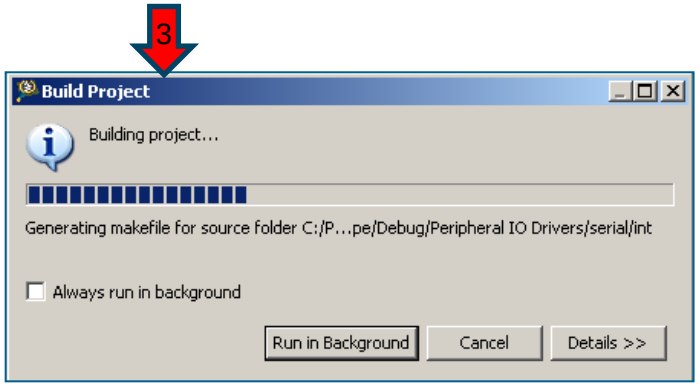
Build PE Demo

- Right-Click on Project Explorer **pe_demo_twrk60n512** and Build Project or click on icon 







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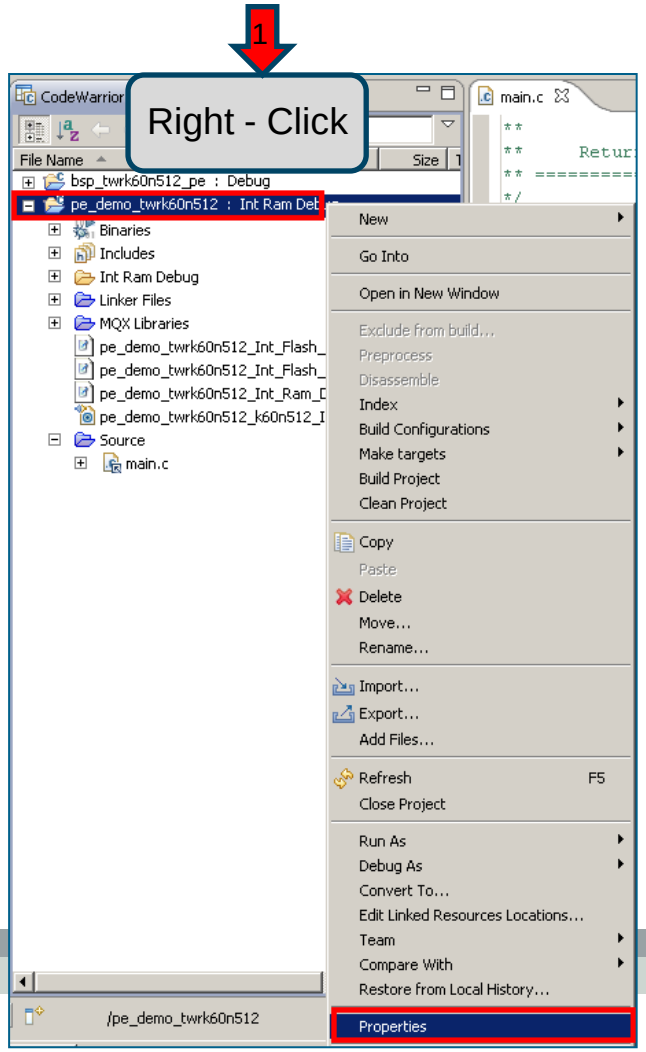
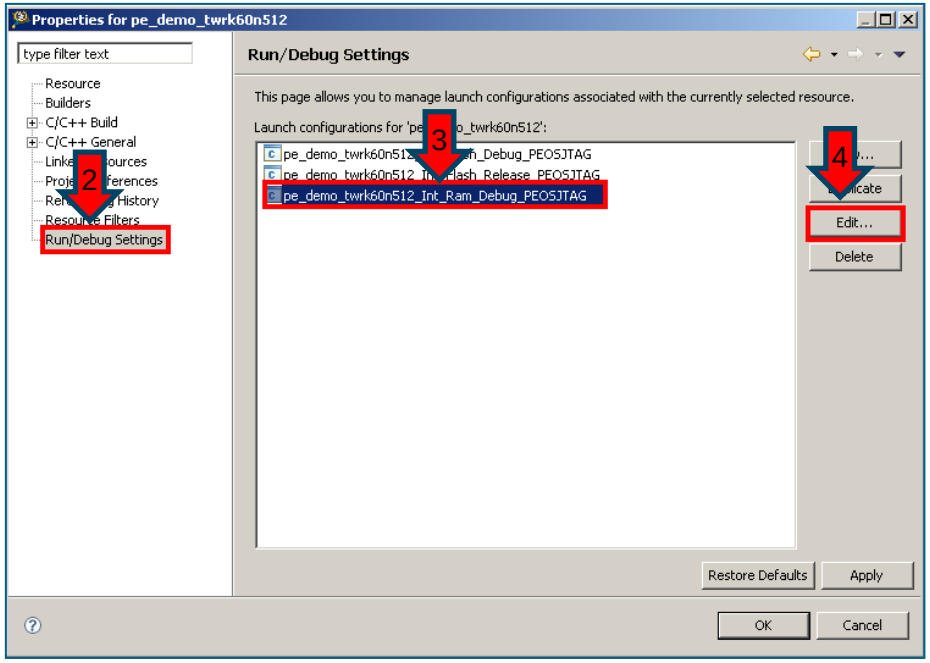
Debug Connection MQX PE Demo

- Right-Click on Project Explorer **pe_demo_twrk60n512** and Build Project
- Edit **pe_demo_twrk60n512_Int_Ram_Debug_PEOSJTAG**





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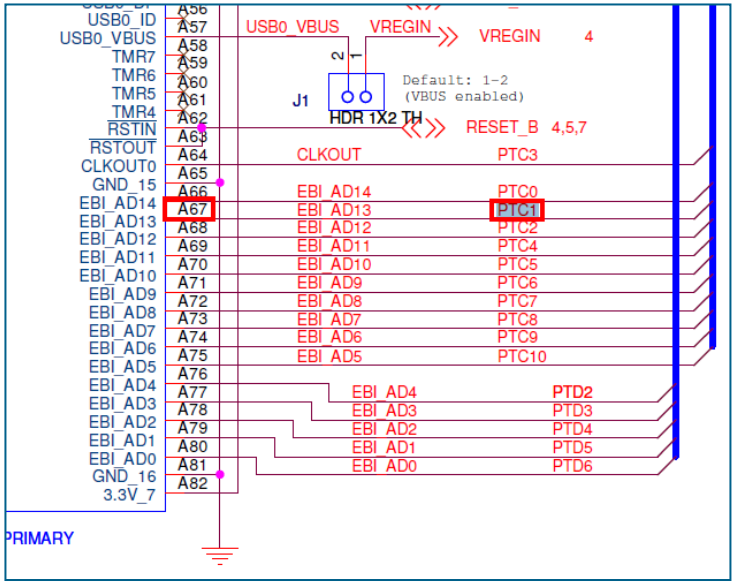
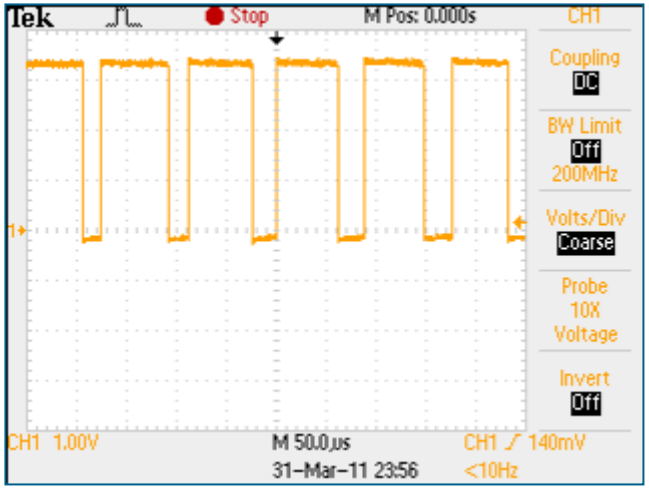
Run MQX PE Demo

- Check PWM output on A67



Properties | Methods | Events

Name	Value	Details
Module name	FTM0	FTM0
Counter	FTM0_CNT	FTM0_CNT
Counter direction	Up	
Counter width	16 bits	
Value type	uint16_t	uint16_t
Input clock source	Internal	
Counter frequency	48 MHz	48 MHz
Counter restart	On-match	
Period device	FTM0_MOD	FTM0_MOD
Period	4096 timer-ticks	4096 timer-ticks
Interrupt	Enabled	
Interrupt priority	medium priority	8
Channel list	1	
Channel 0		
Mode	Compare	
Compare	FTM0_C0V	FTM0_C0V
Offset	1 timer-ticks	1 timer-ticks
Output on compare	Set	
Output on overrun	Clear	
Initial state	Low	
Output pin	PTC1/SPI0_PCS3/UART1_RTS_b/FTM...	PTC1/SPI0_PCS3/UART1_RTS_b/FTM...
Interrupt	Disabled	
Initialization		
Enabled in init. code	no	



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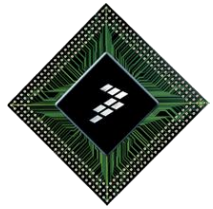
CW10.2, MQX 3.8 and PE : New LDD driver



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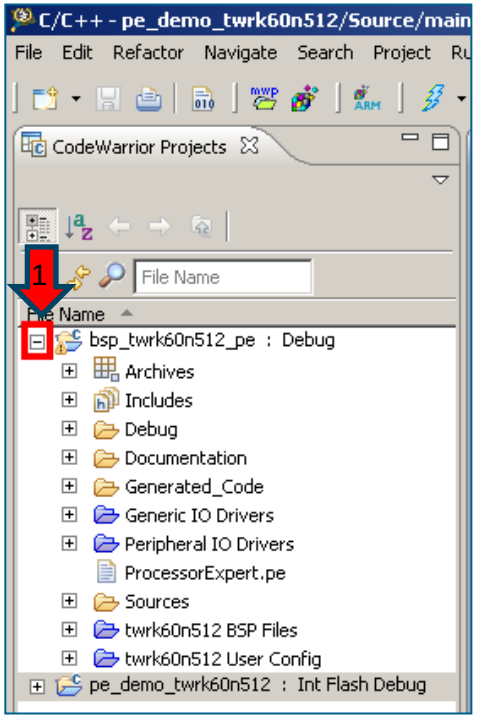
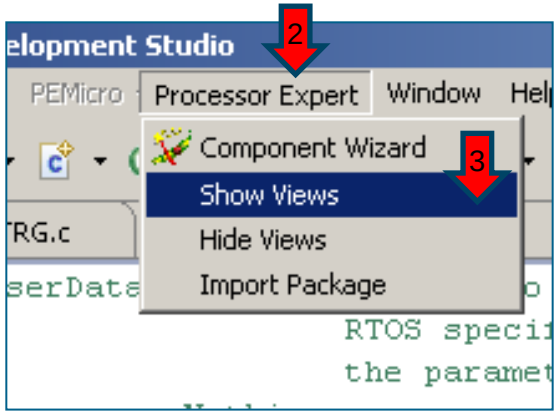
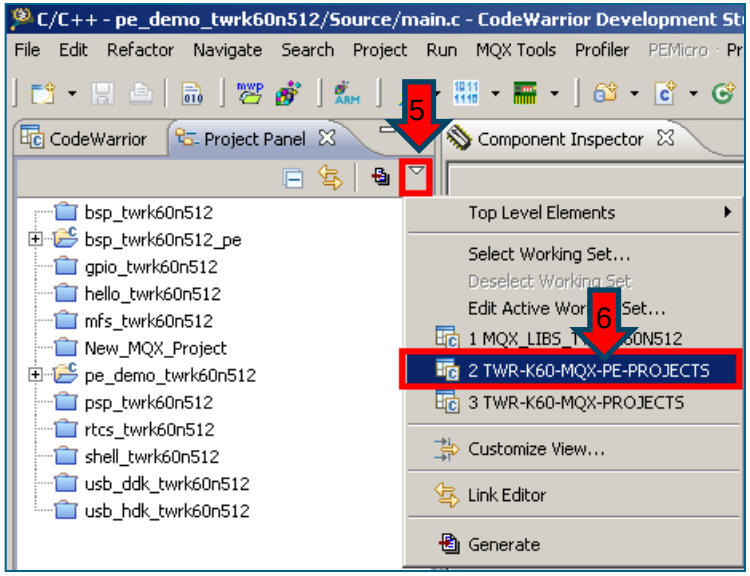
New LLD Driver

- Expand **bsp_twrk60n512** project view
- Show Processor Expert View
- Select PE Projects Working Set







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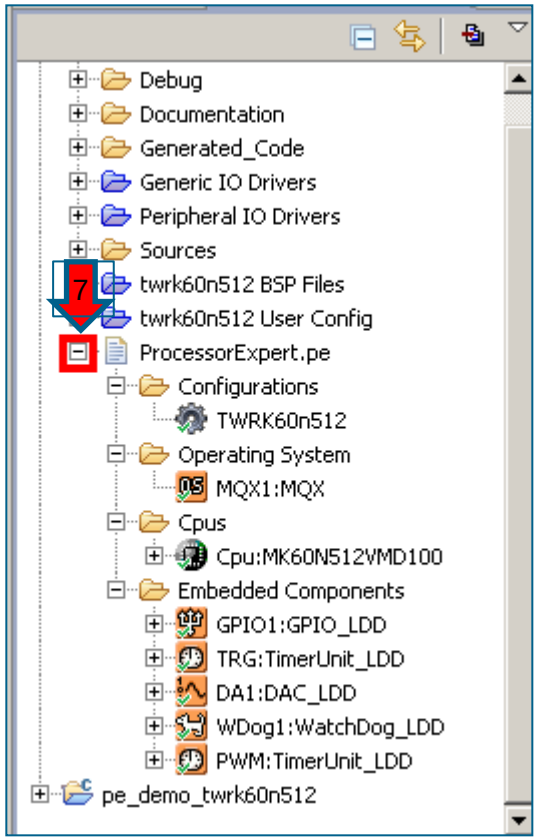
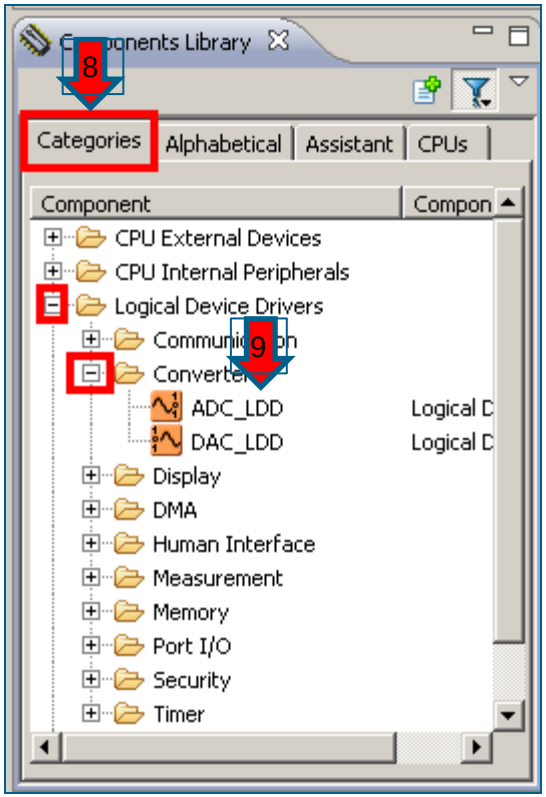
New LLD Driver

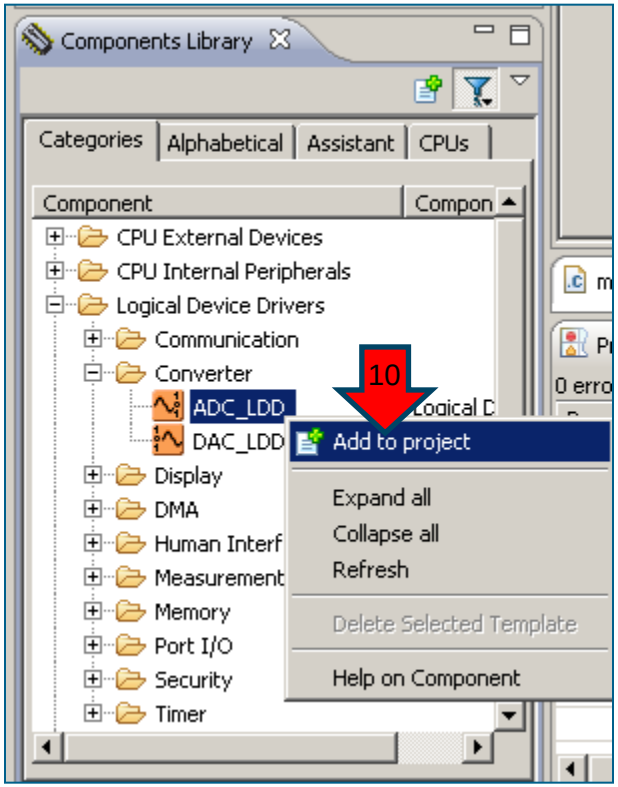
- Expand Processor Expert Project View
- Search ADC_LDD in Components Library window

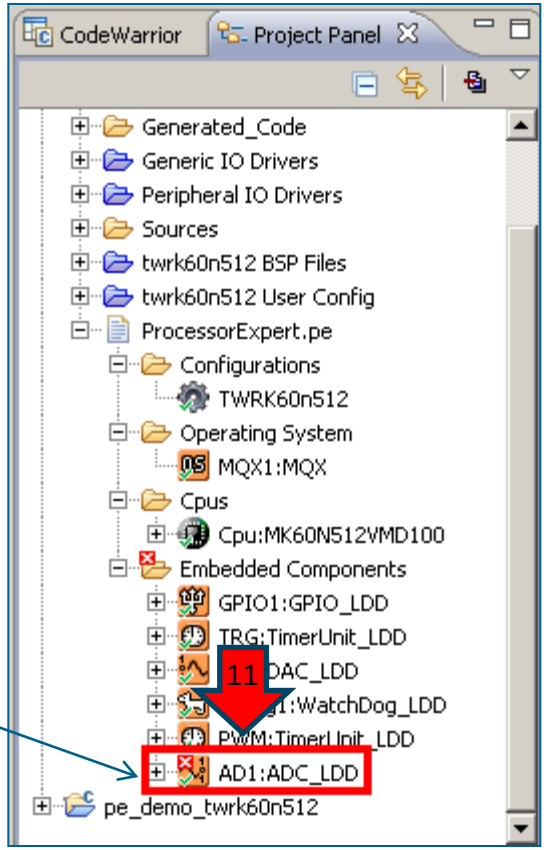




New LLD Driver

- Right click on the component
- Select Add to project





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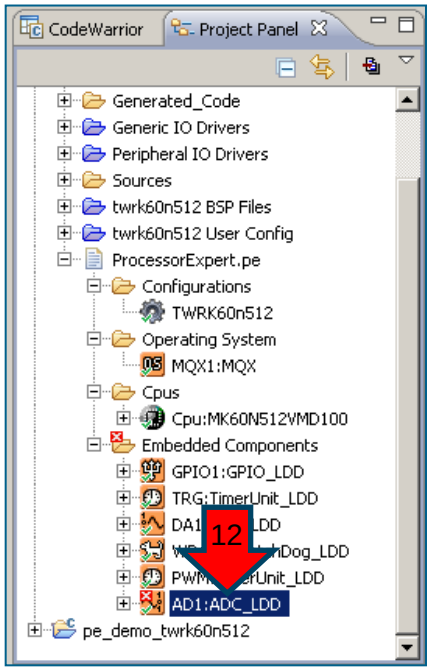
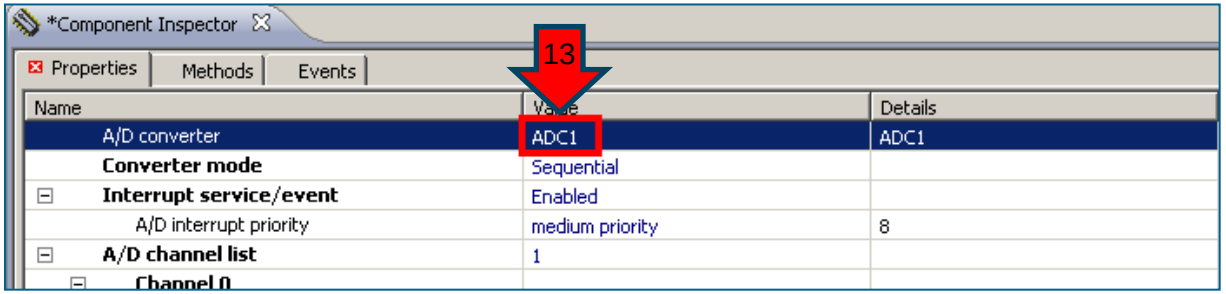
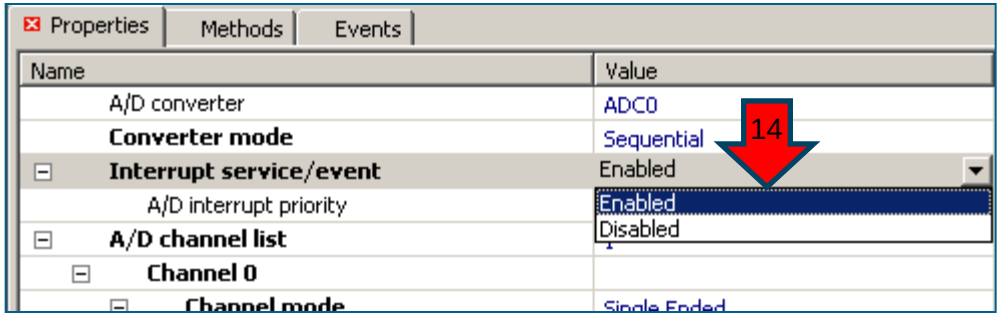
New LLD Driver

- Double click on ADC_LDD
- Select ADC1
- Enable Interrupt service







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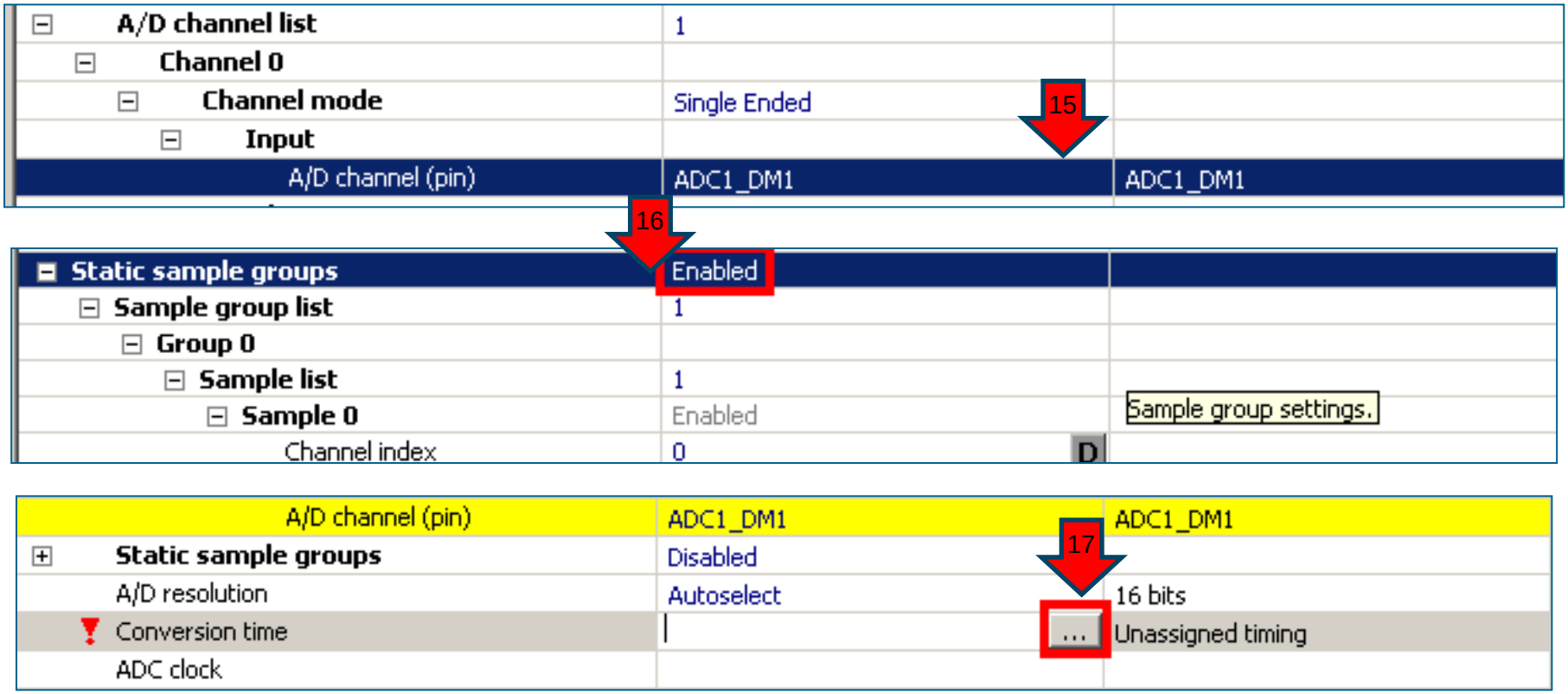
New LLD Driver

- Select **ADC1_DM1** Channel
- Enable Static sample groups
- Open Conversion Time Window



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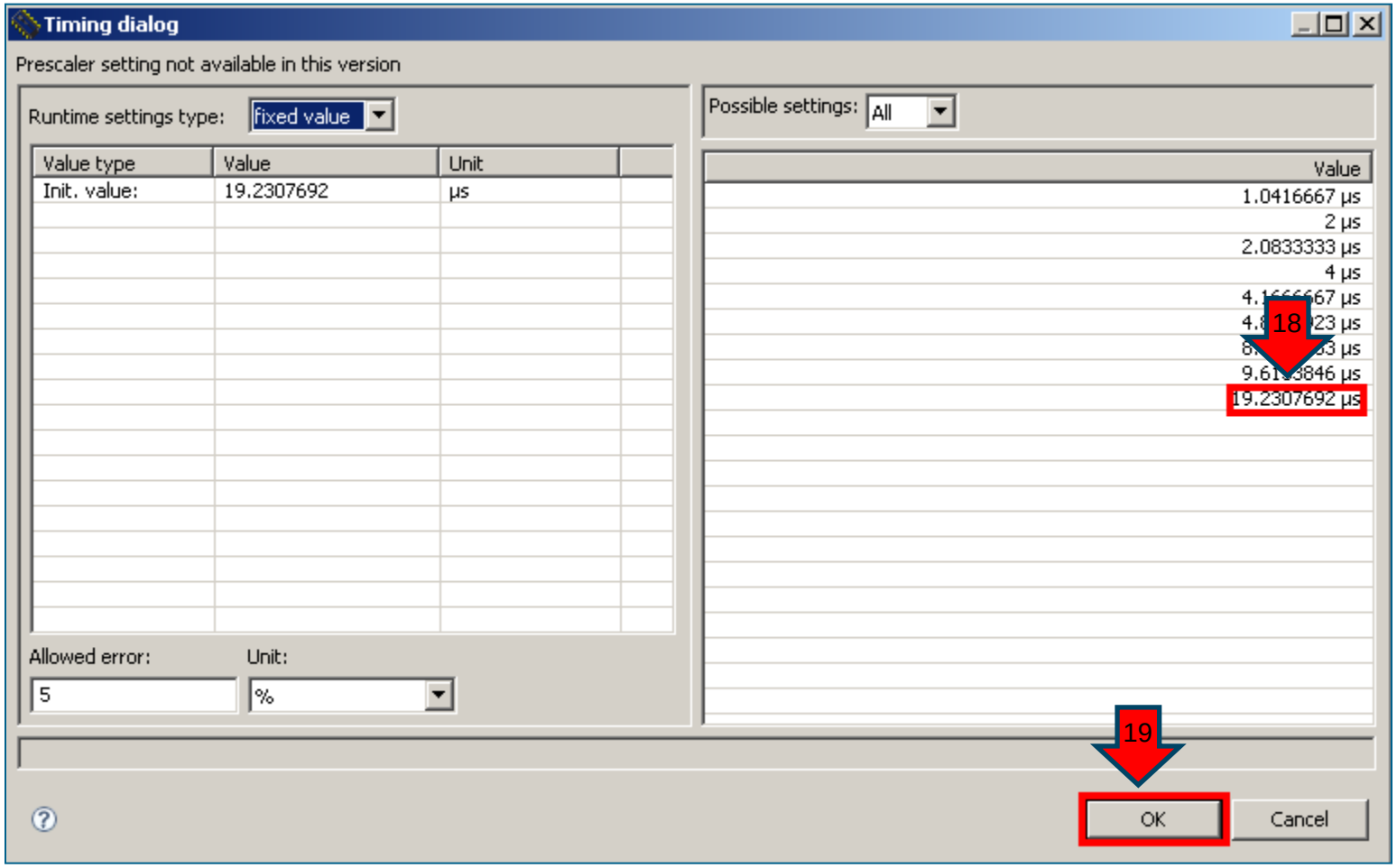
- Select **19.23** us



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- ADC LLD Driver is configured

Properties | Methods | Events

Name	Value	Details
A/D converter	ADC1	ADC1
Converter mode	Sequential	
Interrupt service/event	Enabled	
A/D interrupt priority	medium priority	8
A/D channel list	1	
Channel 0		
Channel mode	Single Ended	
Input		
A/D channel (pin)	ADC1_DM1	ADC1_DM1
Static sample groups	Enabled	
Sample group list	1	
Group 0		
Sample list	1	
Sample 0	Enabled	
Channel index	0 D	
A/D resolution	Autoselect	16 bits
Conversion time	4µs	4.167 µs
ADC clock	5.999 MHz (166.667 ns)	Clock conf. 0: 5.999 MHz (166.667 ns)
Single conversion time - Single-ended	10.104 us	Clock conf. 0: 10.104 us
Single conversion time - Differential	11.604 us	Clock conf. 0: 11.604 us
Additional conversion time - Single-ended	4.166 us	Clock conf. 0: 4.166 us
Additional conversion time - Differential	5.666 us	Clock conf. 0: 5.666 us
Result type	unsigned 16 bits, right justified	
Initialization		This property allows to select one of result
Enabled in init. code	yes	*Description for the current value* (unsigned
Event mask		
OnMeasurementComplete	Enabled	

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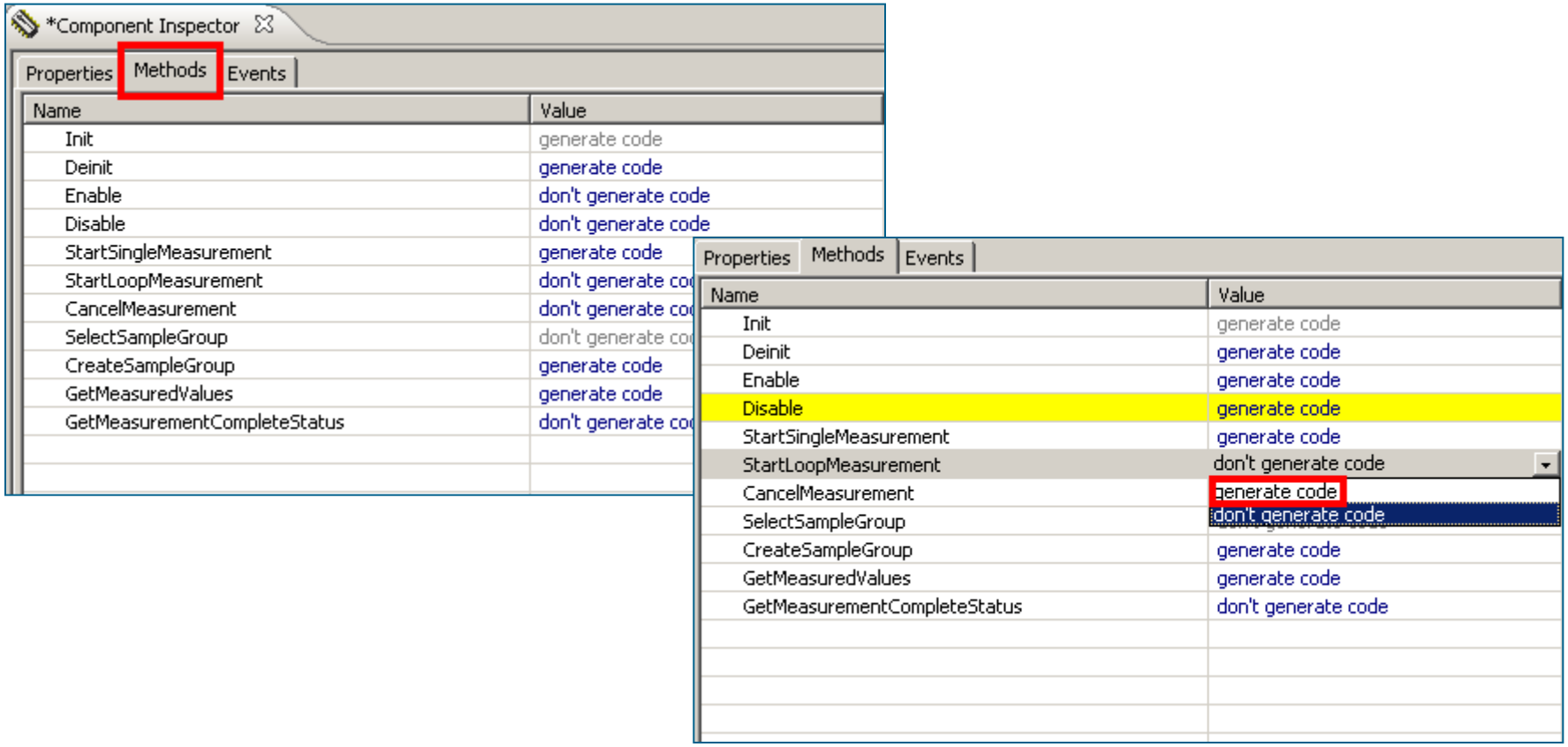
New LLD Driver

- Click Methods Tab
- Click to generate code for methods



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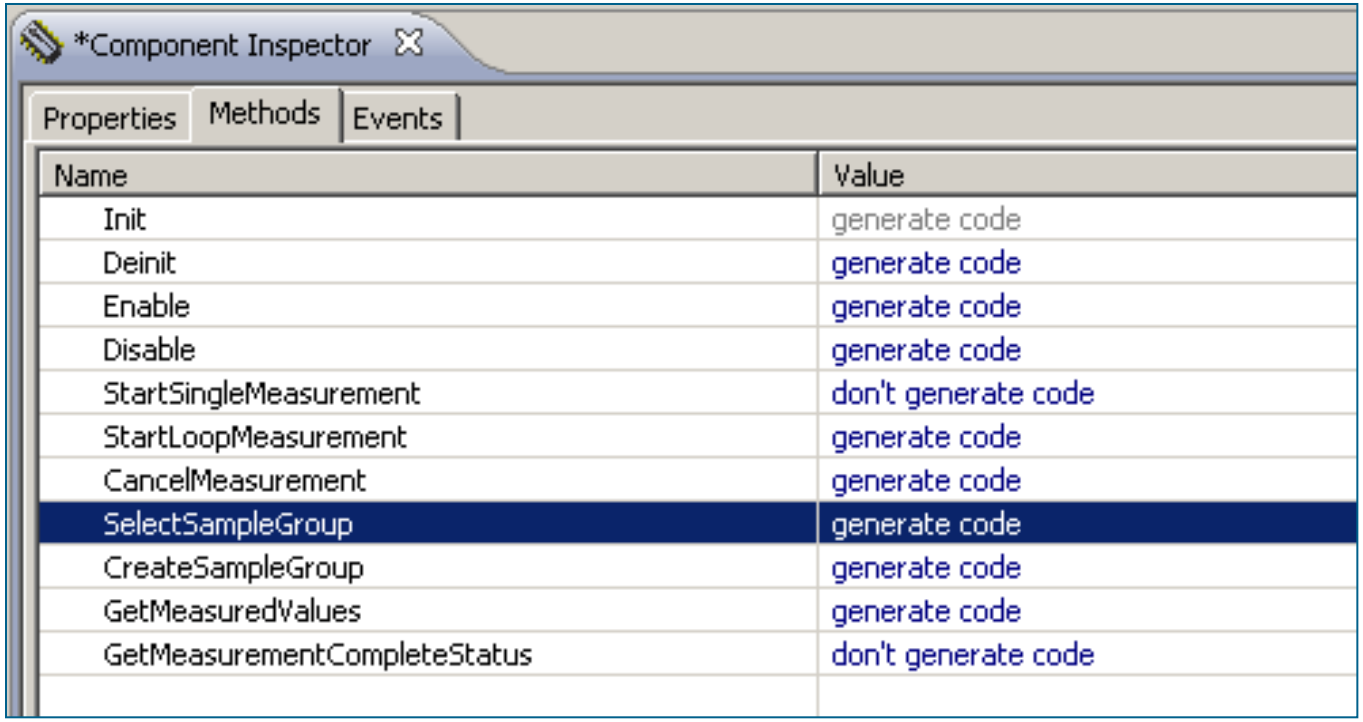
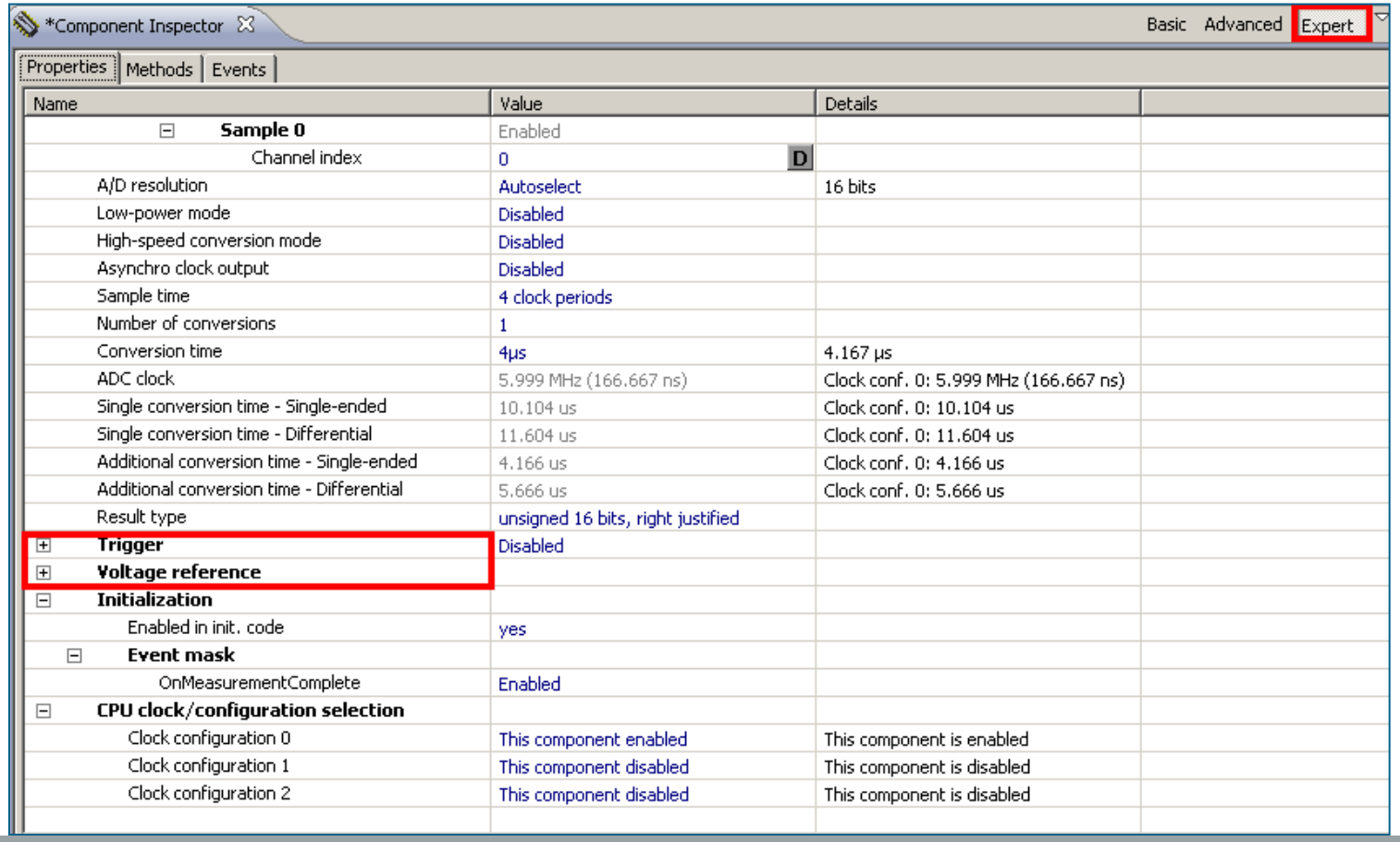
- Set ‘generate code’ for the next Methods:



New LLD Driver

- You can configure more parameters of the components selecting Expert View



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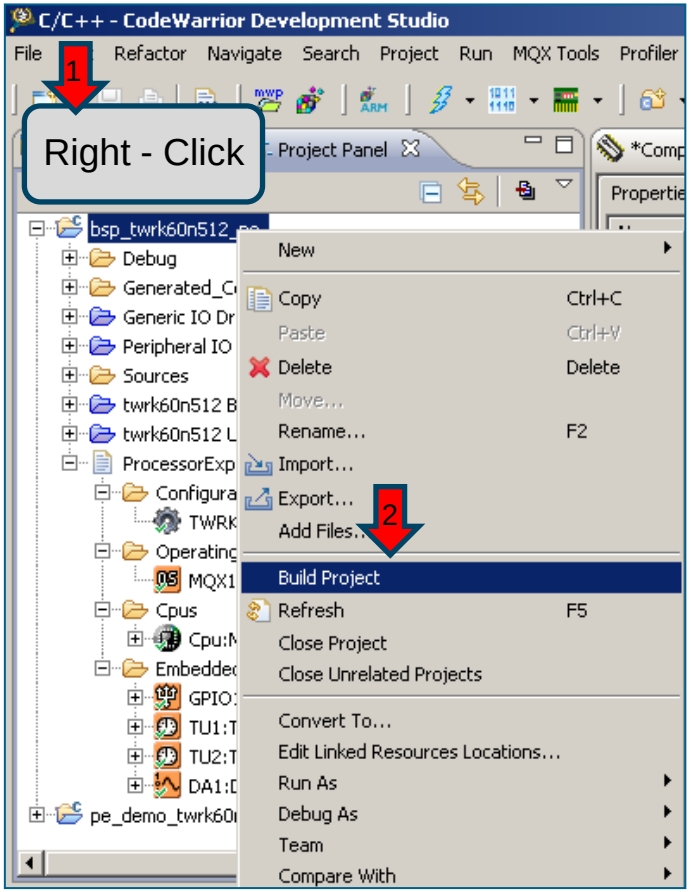
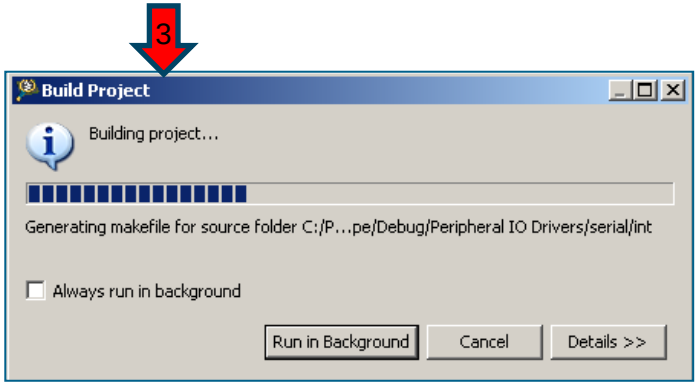
Build BSP project

- Right-Click on Project Explorer **bsp_twrk60n512** and Build Project





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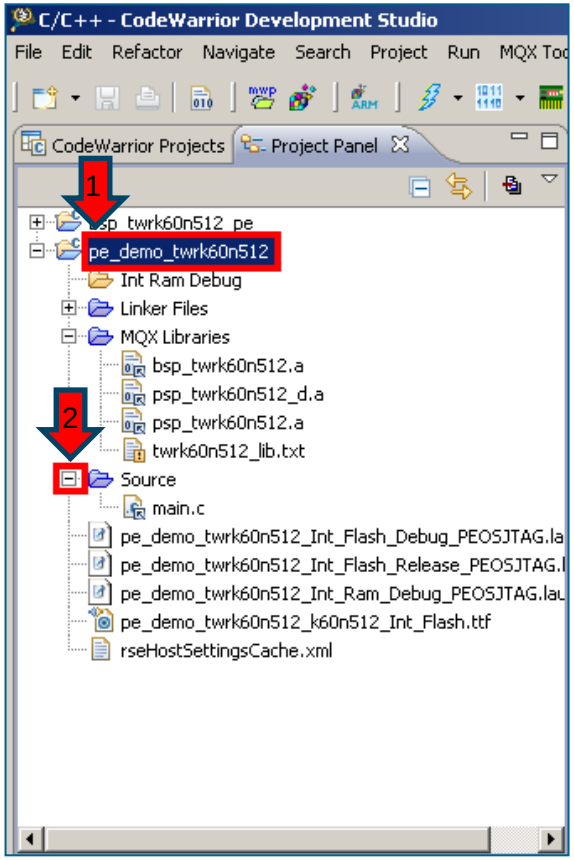
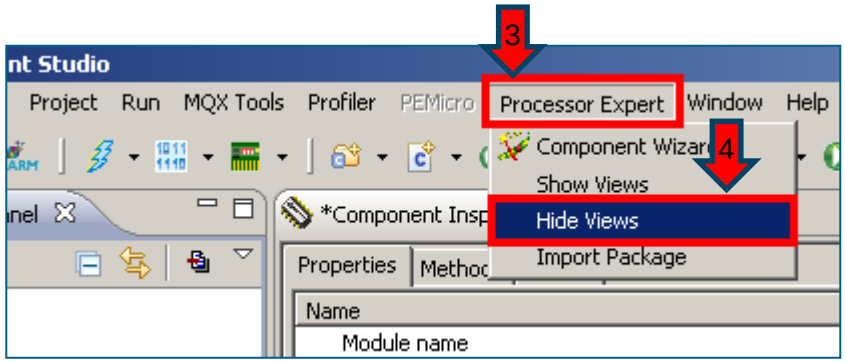
New LDD driver

- Expand **pe_demo_twrk60n512** project view
- Hide Processor Expert View





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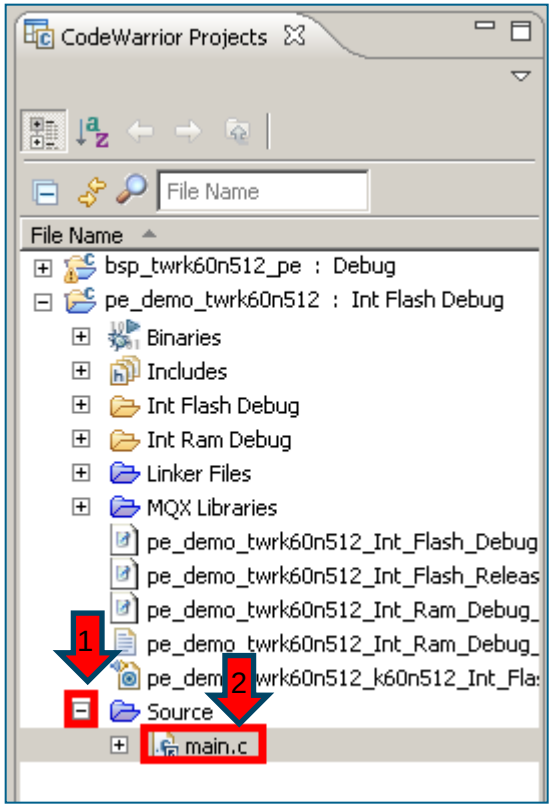
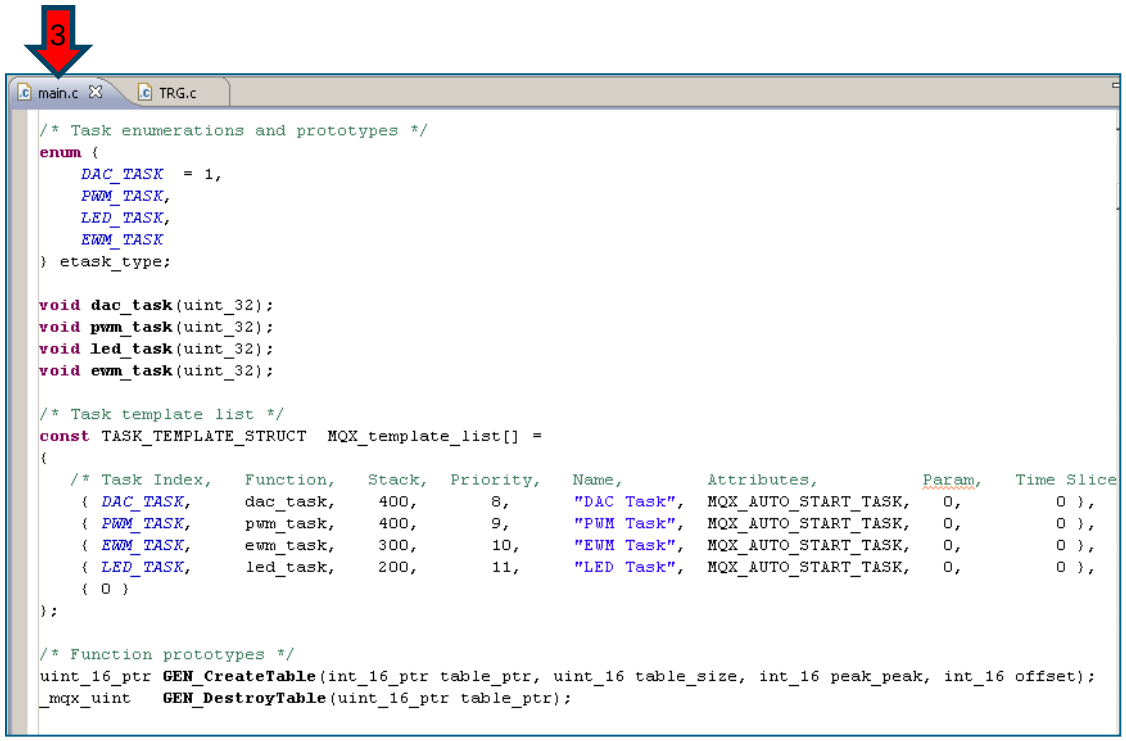
- Double click in **main.c** to view code






```
/* Task enumerations and prototypes */
enum {
    DAC_TASK  = 1,
    PWM_TASK,
    LED_TASK,
    EWM_TASK
} etask_type;

void dac_task(uint_32);
void pwm_task(uint_32);
void led_task(uint_32);
void ewm_task(uint_32);

/* Task template list */
const TASK_TEMPLATE_STRUCT  MQX_template_list[] =
{
   /* Task Index,   Function,   Stack,  Priority,   Name,        Attributes,          Param,   Time Slice
    { DAC_TASK,     dac_task,    400,       8,       "DAC Task", MQX_AUTO_START_TASK,  0,          0 },
    { PWM_TASK,     pwm_task,    400,       9,       "PWM Task", MQX_AUTO_START_TASK,  0,          0 },
    { EWM_TASK,     ewm_task,    300,       10,      "EWM Task", MQX_AUTO_START_TASK,  0,          0 },
    { LED_TASK,     led_task,    200,       11,      "LED Task", MQX_AUTO_START_TASK,  0,          0 },
    { 0 }
};

/* Function prototypes */
uint_16_ptr GEN_CreateTable(int_16_ptr table_ptr, uint_16 table_size, int_16 peak_peak, int_16 offset);
_mqx_uint   GEN_DestroyTable(uint_16_ptr table_ptr);
```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- Add new task : ADC

```
/* Task enumerations and prototypes */
enum {
    DAC_TASK  = 1,
    PWM_TASK,
    LED_TASK,
    EWM_TASK,
    ADC_TASK
} etask_type;

void dac_task(uint_32);
void pwm_task(uint_32);
void led_task(uint_32);
void ewm_task(uint_32);
void adc_task(uint_32);

/* Task template list */
const TASK_TEMPLATE_STRUCT  MQX_template_list[] =
{
   /* Task Index,   Function,   Stack,  Priority,   Name,         Attributes,           Param,   Time Slice
    { DAC_TASK,     dac_task,    400,       8,      "DAC Task",  MQX_AUTO_START_TASK,   0,          0 },
    { PWM_TASK,     pwm_task,    400,       9,      "PWM Task",  MQX_AUTO_START_TASK,   0,          0 },
    { EWM_TASK,     ewm_task,    300,      10,      "EWM Task",  MQX_AUTO_START_TASK,   0,          0 },
    { LED_TASK,     led_task,    200,      11,      "LED Task",  MQX_AUTO_START_TASK,   0,          0 },
    { ADC_TASK,     adc_task,    200,      12,      "ADC Task",  MQX_AUTO_START_TASK,   0,          0 },
    { 0 }
};
```

- Add Task function and code

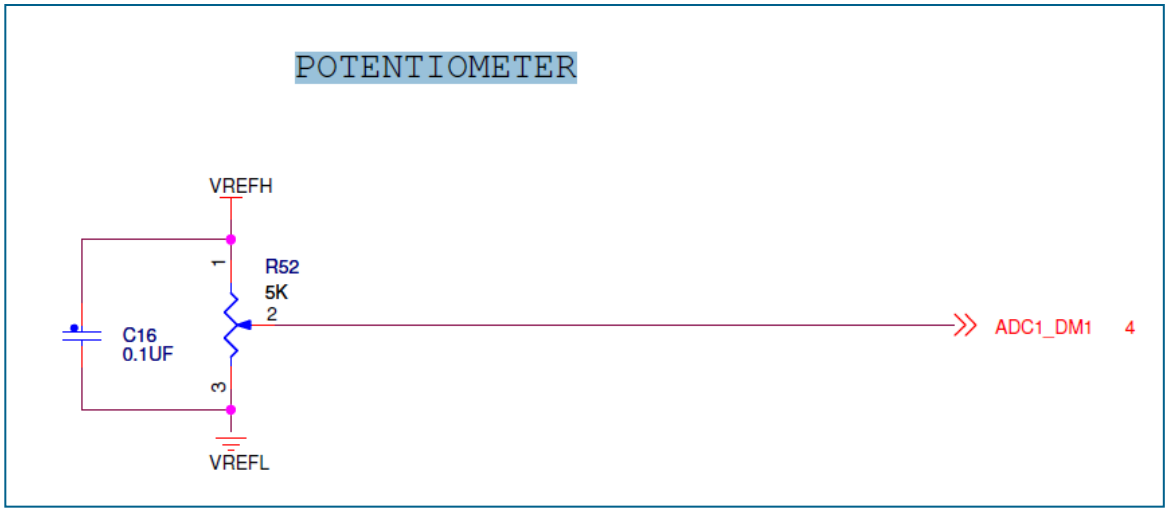
```
#define SAMPLE_GROUP_SIZE 1U
volatile AD1_TResultData MeasuredValues[SAMPLE_GROUP_SIZE];
LDD_TDeviceData *MyADCPtr;
LDD_TError Error;

void adc_task
    (
       uint_32 initial_data
    )
{
     MyADCPtr = AD1_Init((LDD_TUserData *)NULL);          /* Initialize the device */
     Error = AD1_SelectSampleGroup(MyADCPtr, 0U);         /* Select sample group 0 */
     Error = AD1_StartLoopMeasurement(MyADCPtr);          /* Start continuous measurement */
     Error = AD1_Enable(MyADCPtr);
     while(1)
     {
     /* Suspend task for 100ms */

          if(MeasuredValues[0]>2000)GPIO1_ToggleFieldBits(LED_DeviceData, LED4, 1);
          _time_delay(200);

     }
}
```

- Add **ADC1** Event function code

8

```
void AD1_OnMeasurementComplete(LDD_TUserData *UserDataPtr)
{
  Error = AD1_GetMeasuredValues(MyADCPtr, (LDD_TData *)&MeasuredValues);  /* Read measured values */
}
/* EOF */
```

- ADC1 channel is connected to TWR-K60N512 Potentiometer



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New LLD Driver

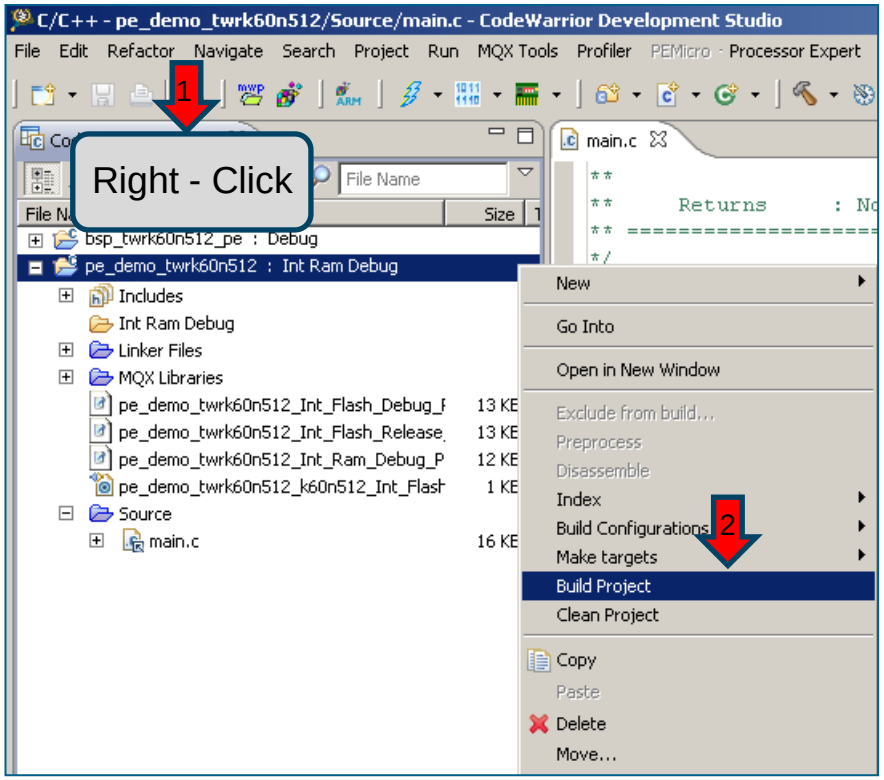
- When ADC value is greater than 20000, LED4 (Blue) toggles

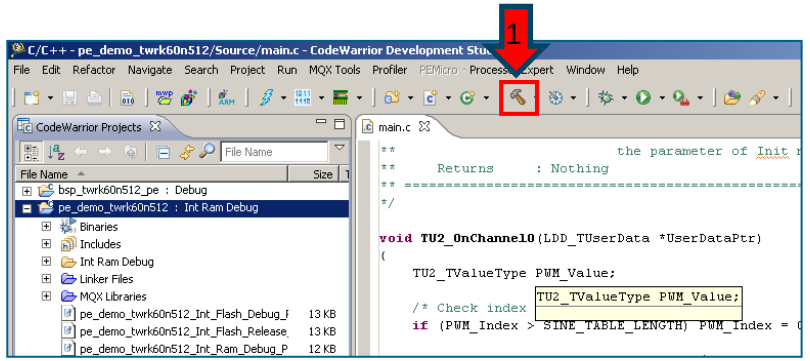
```
while(1)
{
/* Suspend task for 100ms */

    if(MeasuredValues[0]>2000)GPIO1_ToggleFieldBits(LED_DeviceData, LED4, 1);
     _time_delay(200);

}
```

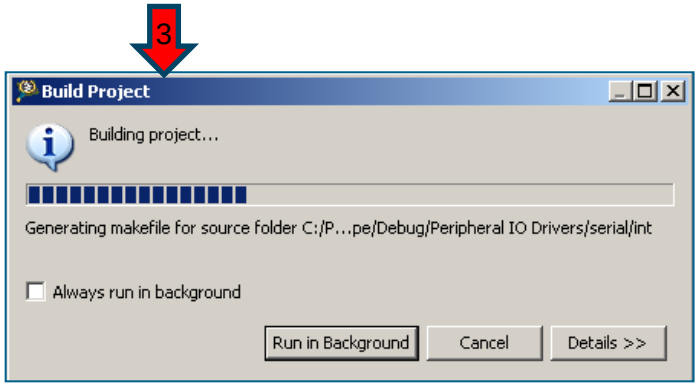
- Moving potentiometer R52 can start/stop LED4 toggle

Build PE Demo

- Right-Click on Project Explorer **pe_demo_twrk60n512** and Build Project or click on icon 







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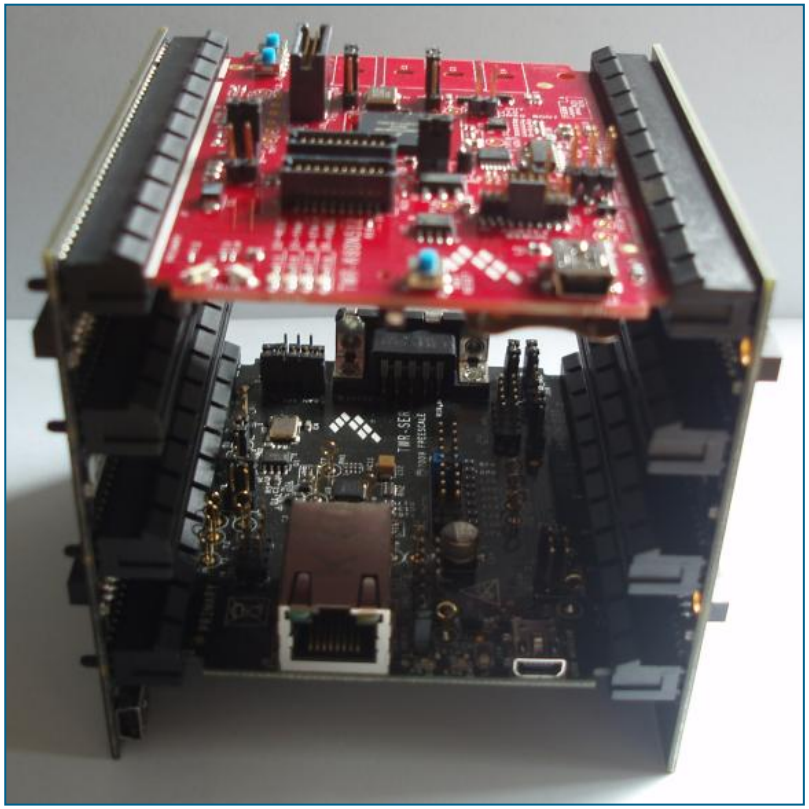
New LLD Driver

- Test the new functionality in the application and the new LDD driver



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