XMC1000 LED lighting application kit

XMC™ microcontrollers

July 2016

Agenda

1. Kit overview
2. Hardware overview
3. Tooling overview – boot modes
4. Tooling overview – DAVE™
5. Getting started - examples
6. General information
7. References

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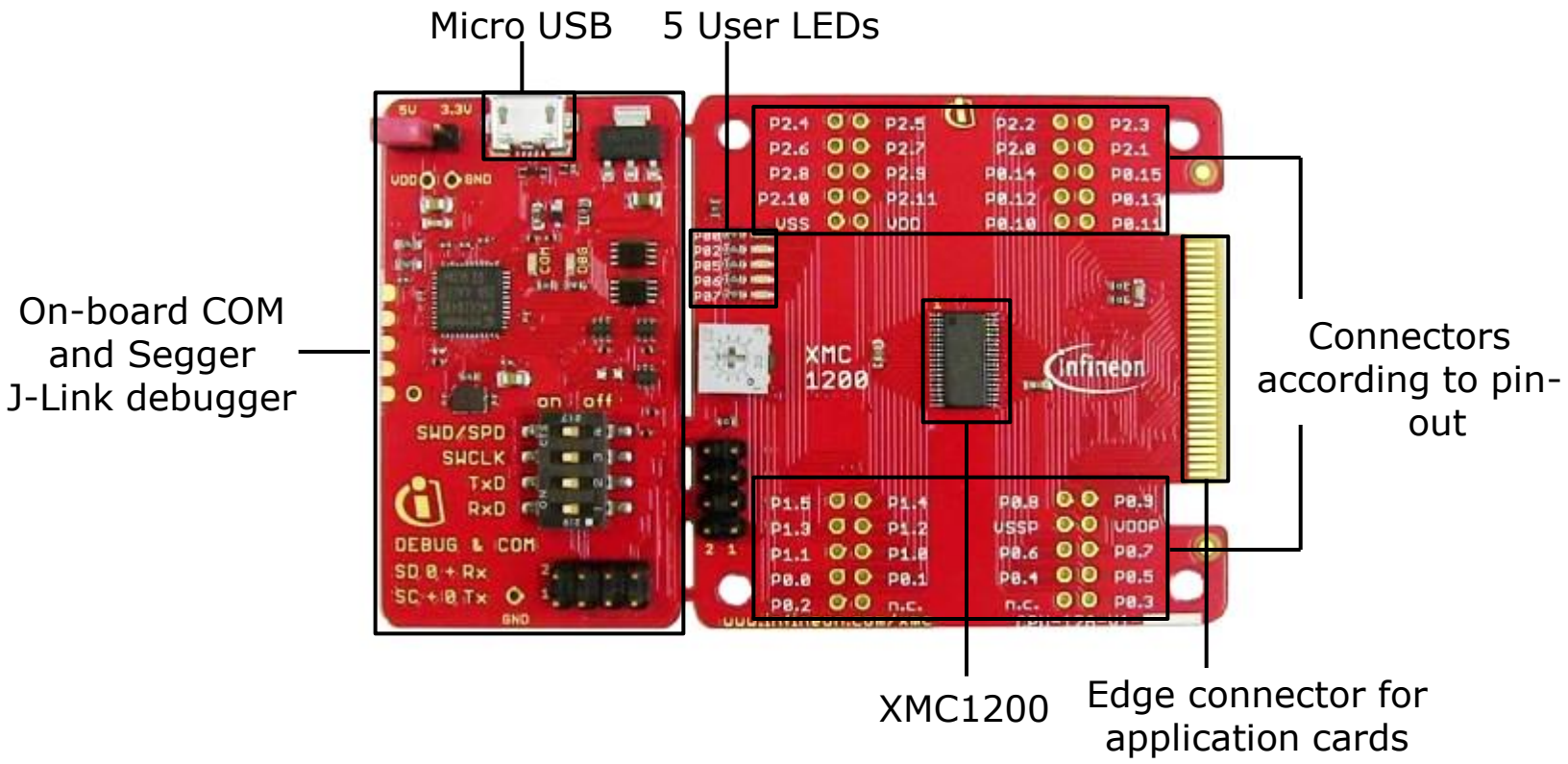
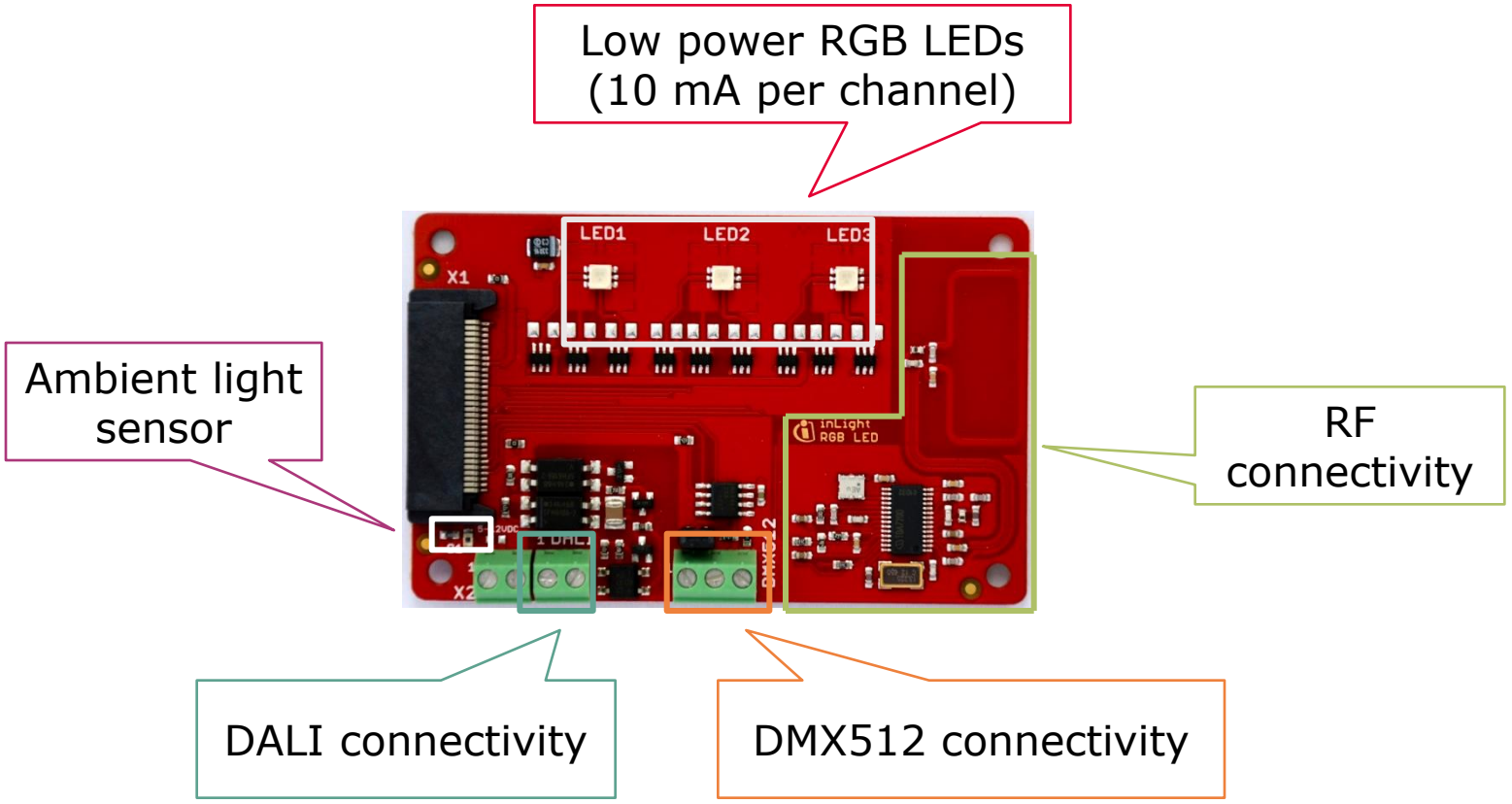
Kit overview (1/3)

- XMC1200 CPU Card



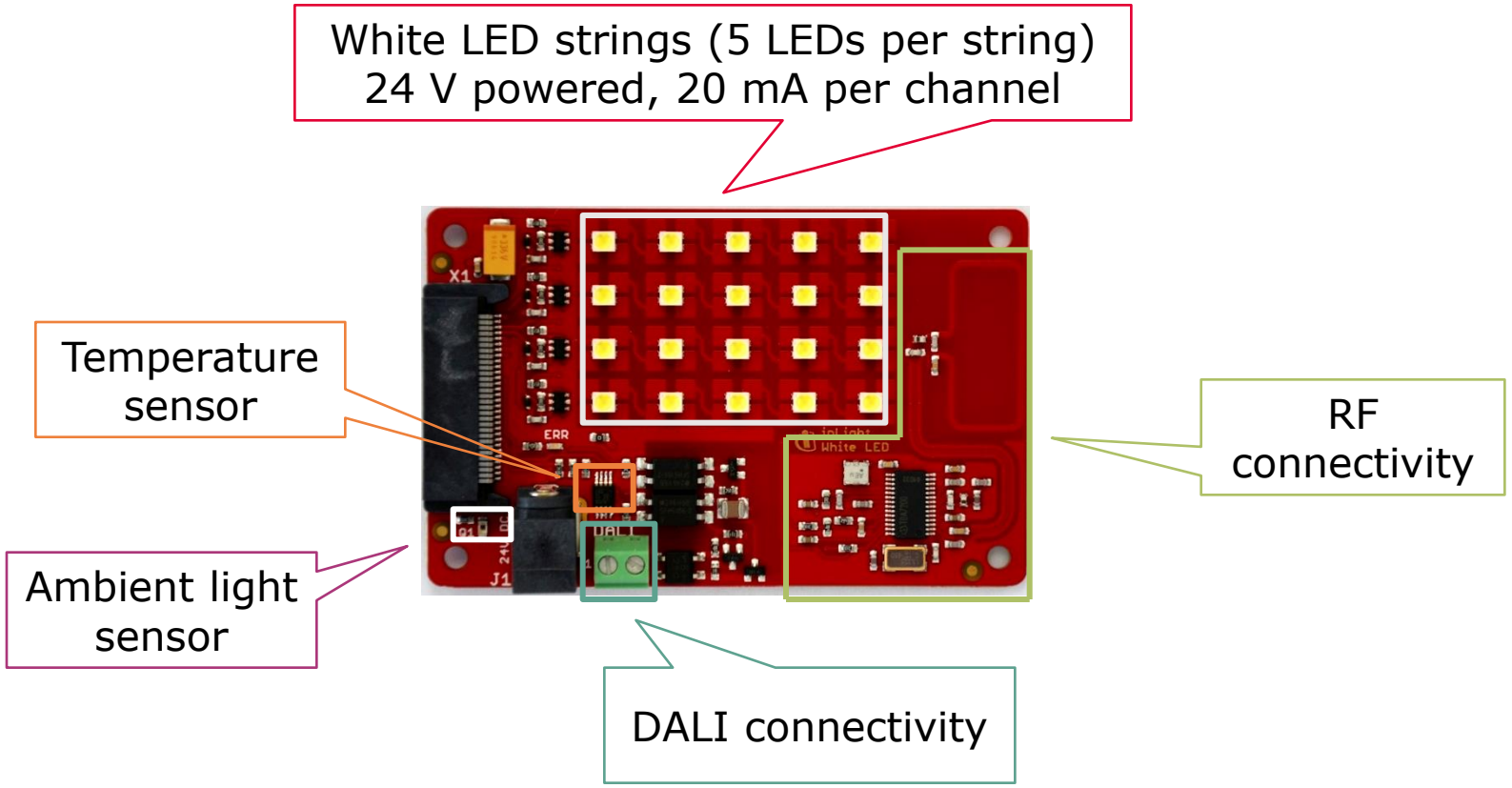
Kit overview (2/3)

- Color LED card
  - Showcases color control



Kit overview (3/3)

- White LED card
  - Showcases brightness control



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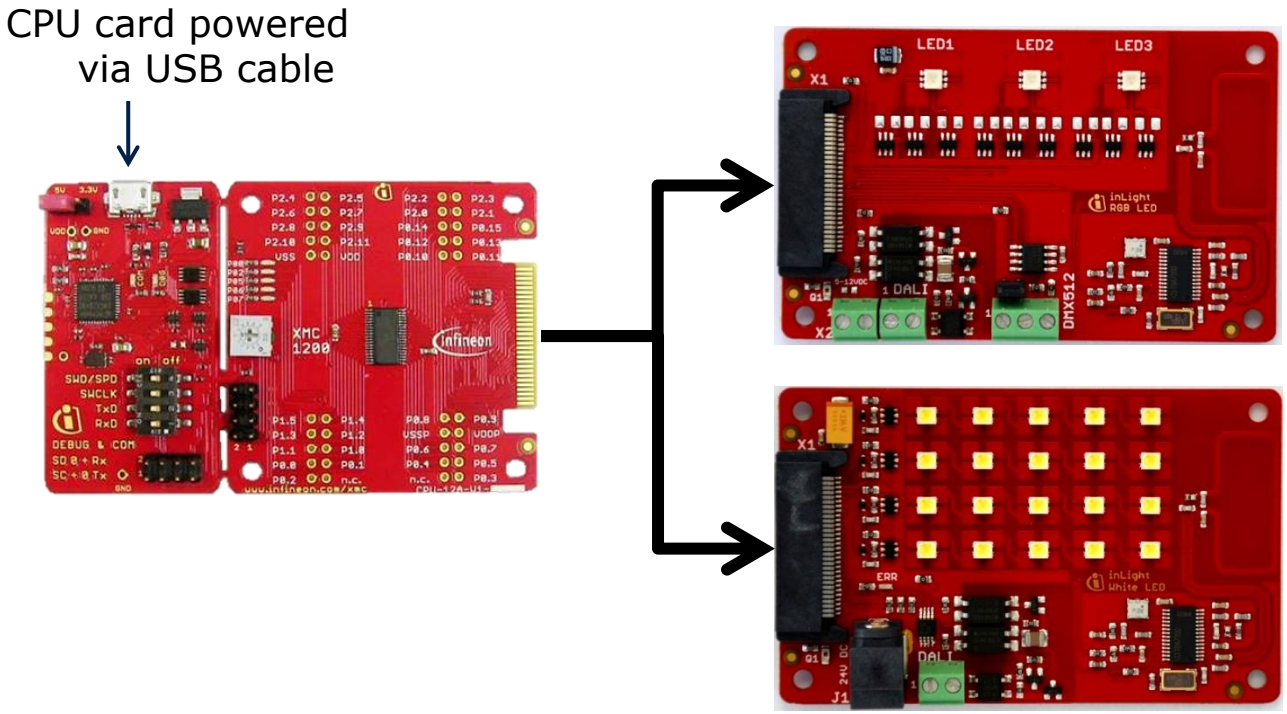
Hardware overview

- Attach color LED or white LED card to XMC1200 CPU card
- Connect XMC1200 CPU card to PC via USB cable
- CPU card is powered up (as indicated by LED on the card)



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Tooling overview
Boot modes

- Boot modes available
  - UART bootstrap-loader mode
  - User mode (Halt after reset)
  - User mode (Debug) **Default mode of device on boot kit**
  - User mode (Productive)

- Boot modes can be configured via:
  - DAVE™
    - Download DAVE™

    http://www.infineon.com/dave/v4
  - MemTool
    - Download MemTool

    http://www.infineon.com/cms/en/product/channel.html?channel=ff80808112ab681d0112ab6b50fe07c9

- For more information on how to configure the BMI value, please refer to the XMC1000 tooling guide

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Tooling overview
DAVE™

- DAVE™ is a free development platform for code generation by Infineon
- It can be downloaded from:
  - http://www.infineon.com/dave/v4
- For a guide on setting up DAVE™, please refer to XMC1x00 boot kit getting started

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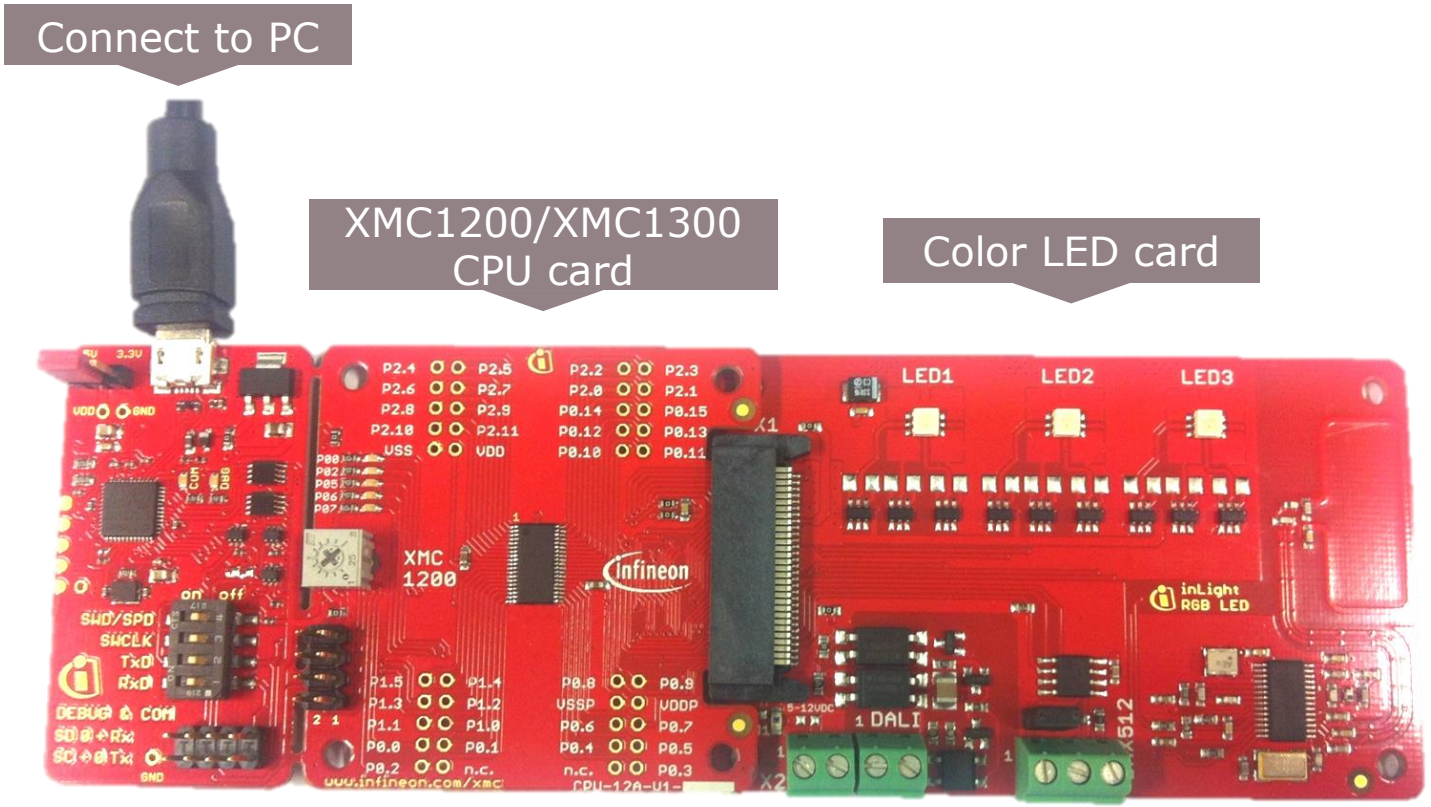
Getting started – Example 1
RGB lamp using LED_LAMP APP (1/20)

Example 1: RGB lamp using LED_LAMP APP



Getting started – Example 1
RGB lamp using LED_LAMP APP (2/20)

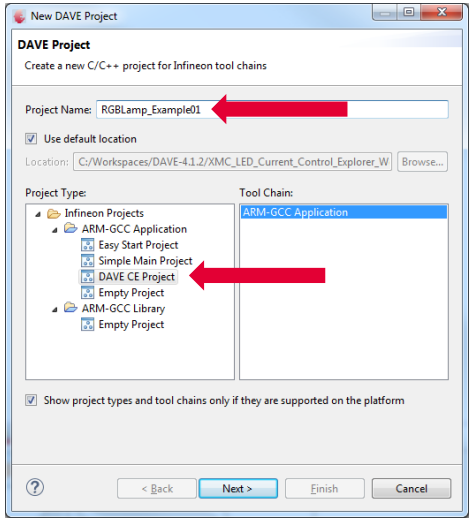
1. Open DAVE™

2. In DAVE™ workspace, create a new "DAVE™ CE" project:

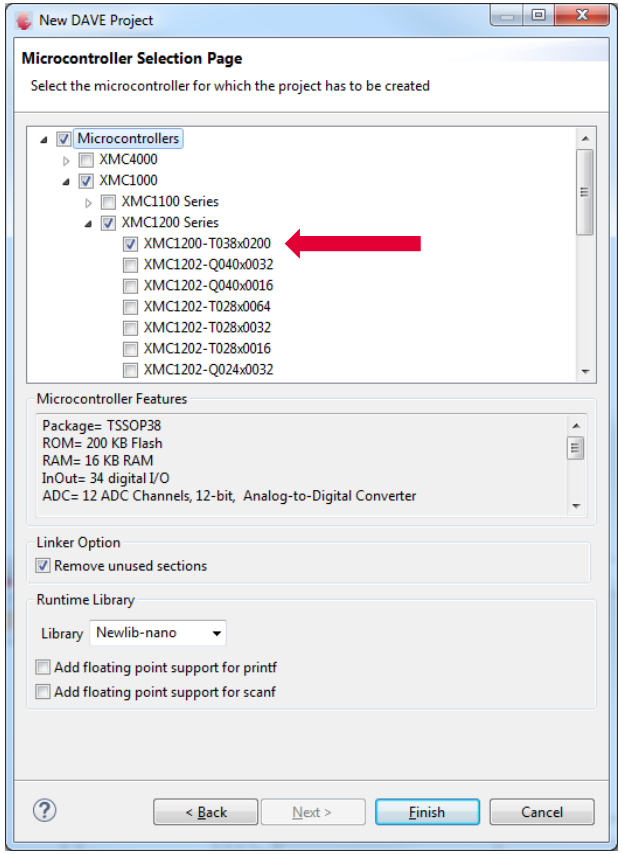
› File->New->DAVE™ Project

› Give the project a name e.g. "RGB_LAMP_EXAMPLE"

› Select "DAVE™ CE Project" as project type



3. Select the device accordingly



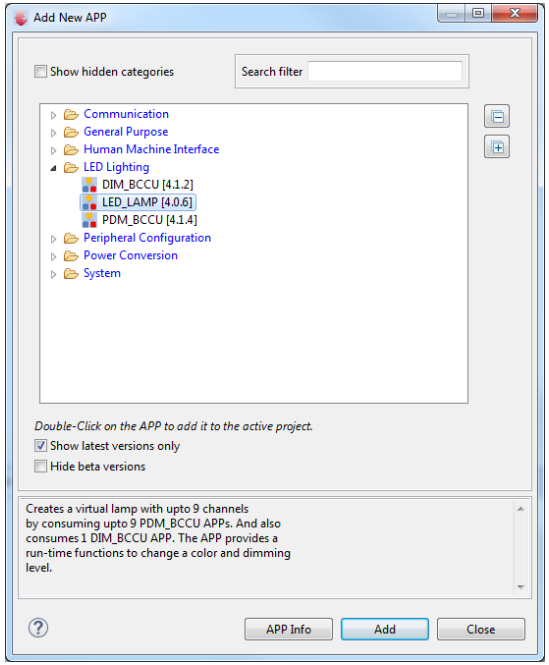
Getting started – Example 1
RGB lamp using LED_LAMP APP (3/20)

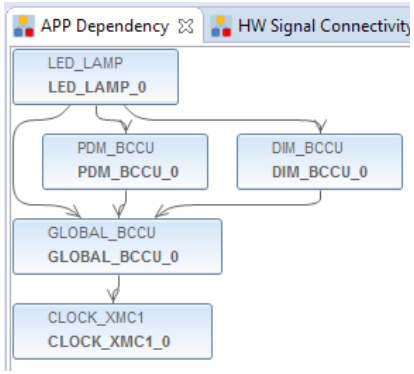
- This example demonstrates RGB lamp functionality using LED_LAMP APP
- We will use the system timer (SysTick) as the time base for the interrupt
  - Time base of 1 s
  - In the interrupt, a new target dimming level or target color is regularly set with a 7 s transition time
- Next, we will show you the steps to creating this project:

1. Instantiate LED_LAMP APP
2. Configure LED_LAMP APP
3. Configure BCCU Channels
4. Assign PDM_BCCU APPs to the right channels
5. Configure Brightness and Color Control Unit (BCCU) global settings
6. Configure Port Pins
7. Configure SysTick
8. Define the SYSTIMER callback function

Getting started – Example 1
RGB lamp using LED_LAMP APP (4/20)

1. Instantiate LED_LAMP APP
   - Click  to add new APP
   - Select the **LED_LAMP** APP
   - LED_LAMP APP automatically aggregates a BCCU channel app (**PDM_BCCU**), a BCCU dimming engine app (**DIM_BCCU**) and a BCCU global app (**GLOBAL_BCCU**)





Getting started – Example 1
RGB lamp using LED_LAMP APP (5/20)

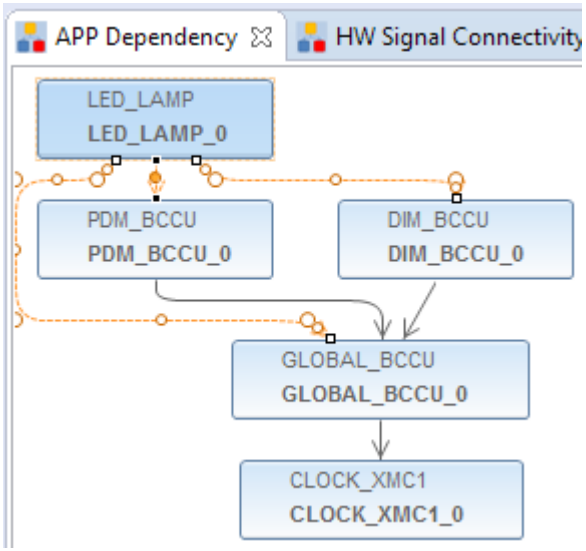
2. Configure LED_LAMP APP

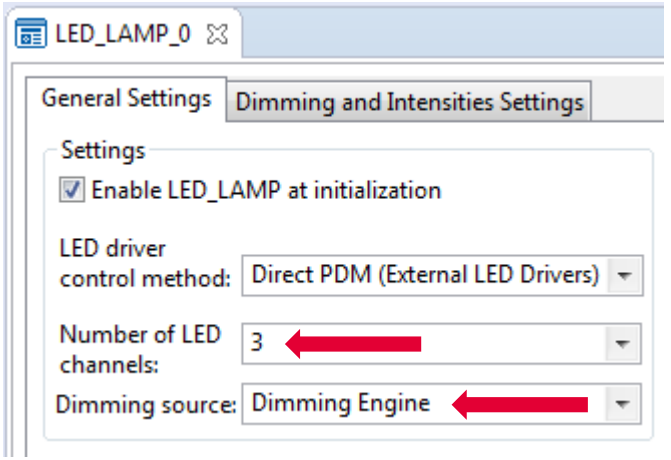
› Double-click **LED_LAMP_0** to open UI

› Under **General Settings** tab,

– set **Number of LED channels** to **3**

– select **Dimming Engine** as **Dimming Source**

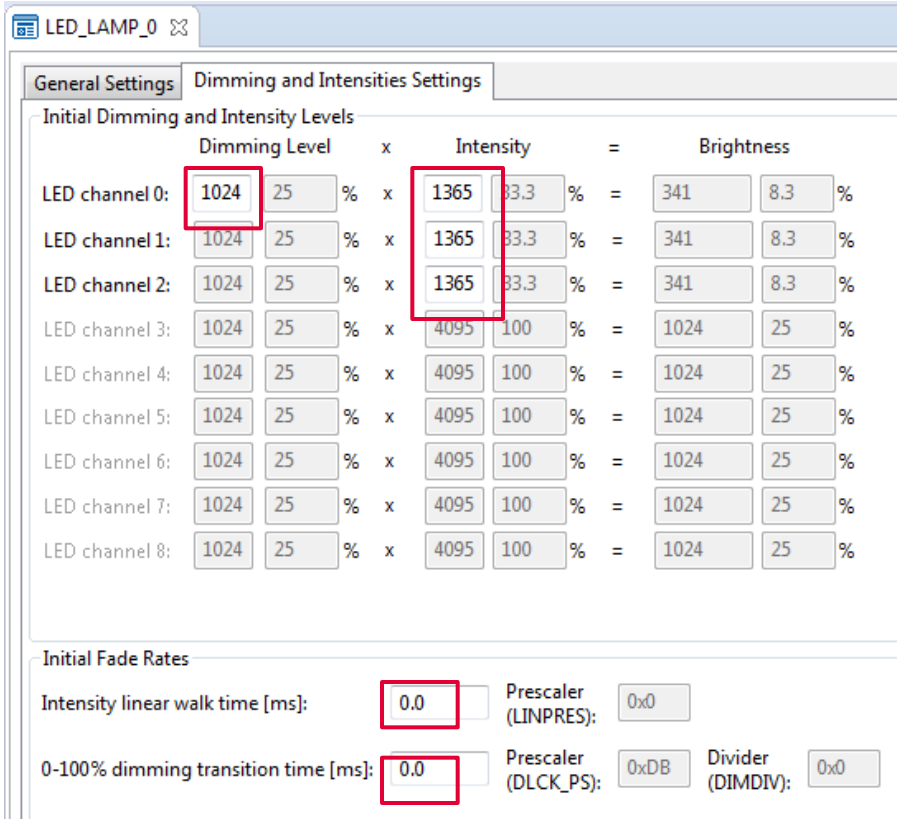




Getting started – Example 1
RGB lamp using LED_LAMP APP (6/20)

2. Configure LED_LAMP APP (continued)

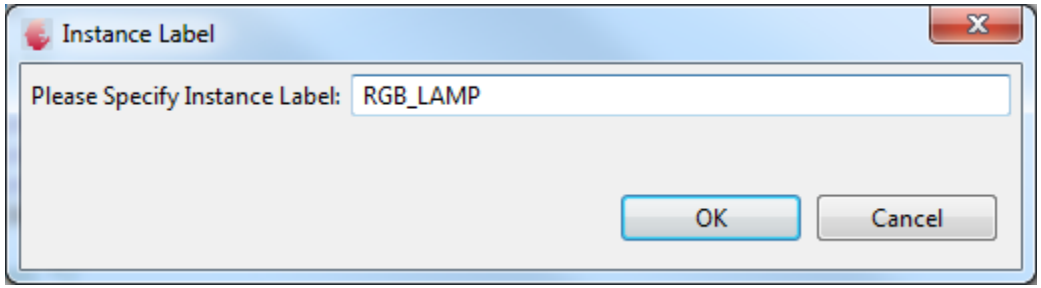
- Under **Dimming and Intensities Settings** tab
  - set initial **Dimming Level** to **1024**
  - set initial **Channel Intensities** to **1365**
  - set initial **Intensity linear walk time** to **0 ms**
  - Set initial **0-100% dimming transition time** to **0 ms**



Getting started – Example 1
RGB lamp using LED_LAMP APP (7/20)

2. Configure LED_LAMP APP (continued)

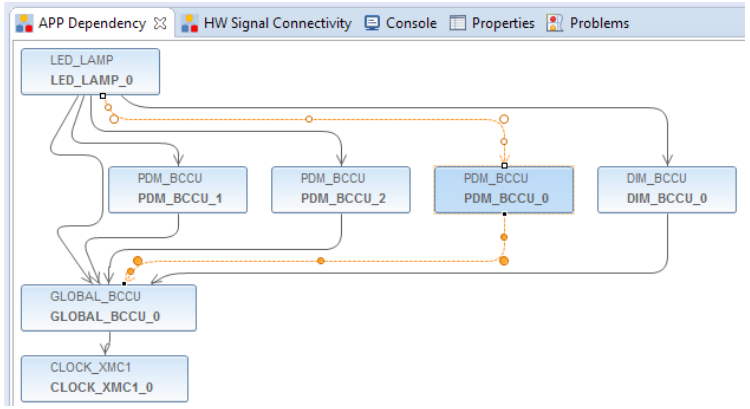
› Rename Instance Label
  - **Right-click** LED_LAMP APP
  - Select **Rename Instance Label…**
  - Rename as **RGB_LAMP**



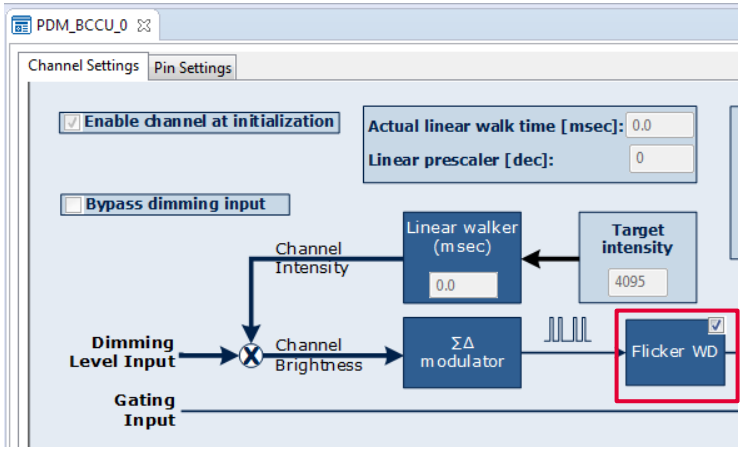
Getting started – Example 1
RGB lamp using LED_LAMP APP (8/20)

3. Configure BCCU Channels

› Double-click a **PDM_BCCU APP**



› Select **Flicker Watchdog (WD)** to enable



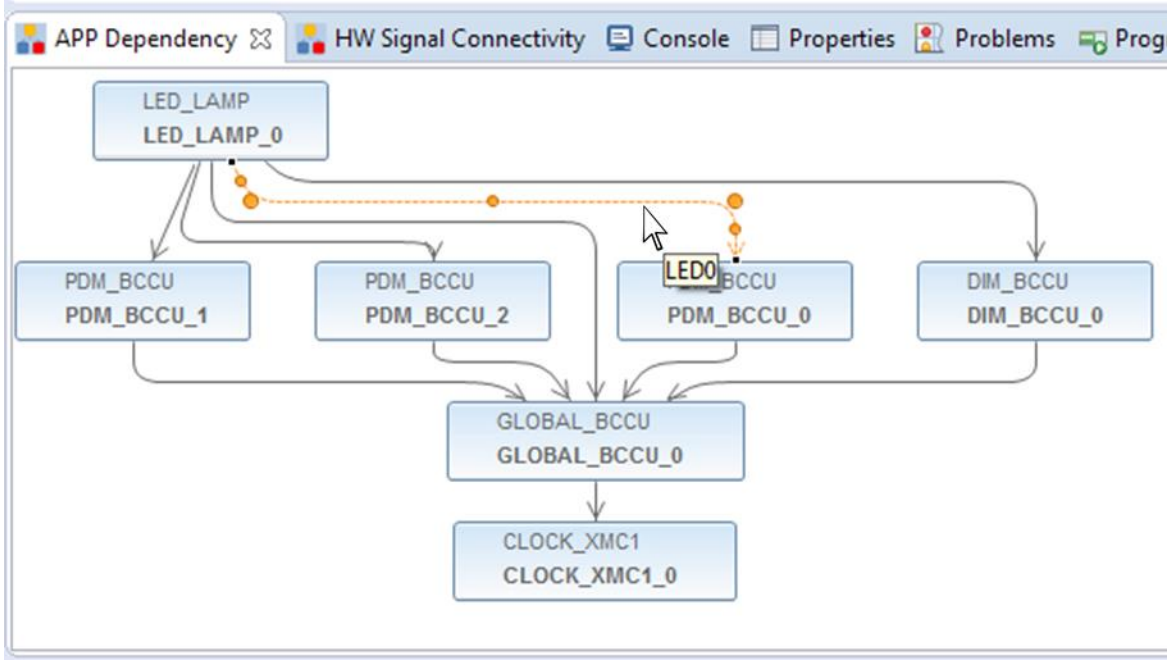
› Repeat for the other 2 PDM_BCCU APP instances

Getting started – Example 1
RGB lamp using LED_LAMP APP (9/20)

4. Assign PDM_BCCU APPs to the right channels

› Hover mouse cursor over the connecting arrow to a PDM_BCCU APP

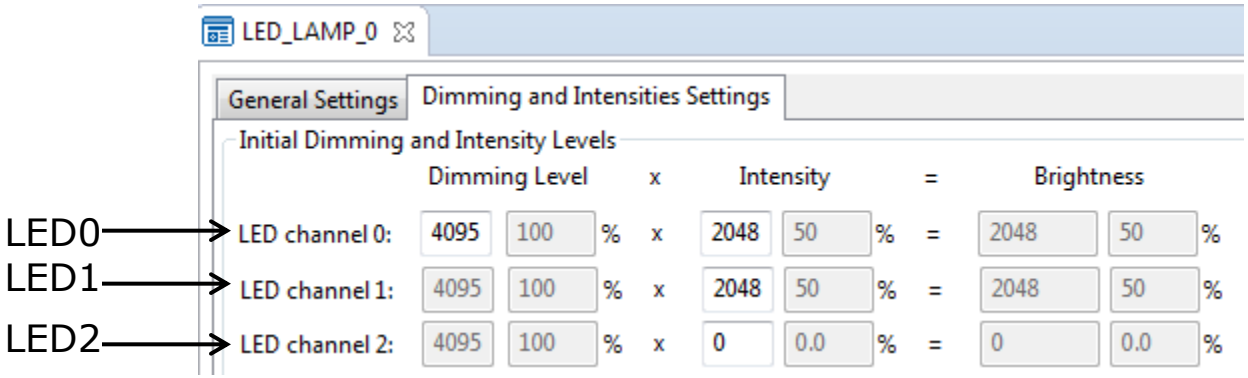
› A label will appear momentarily e.g. LED0/LED1/LED2



Getting started – Example 1
RGB lamp using LED_LAMP APP (10/20)

4. Assign PDM_BCCU APPs to the right channels (continued)

› The labels correspond to the LED channels in the UI



› Rename the PDM_BCCU instance label according to the table below

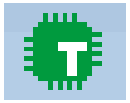
- Right-click PDM_BCCU APP
- Select "Rename Instance Label"

Label	New Label
LED0	R_LED1
LED1	G_LED1
LED2	B_LED1

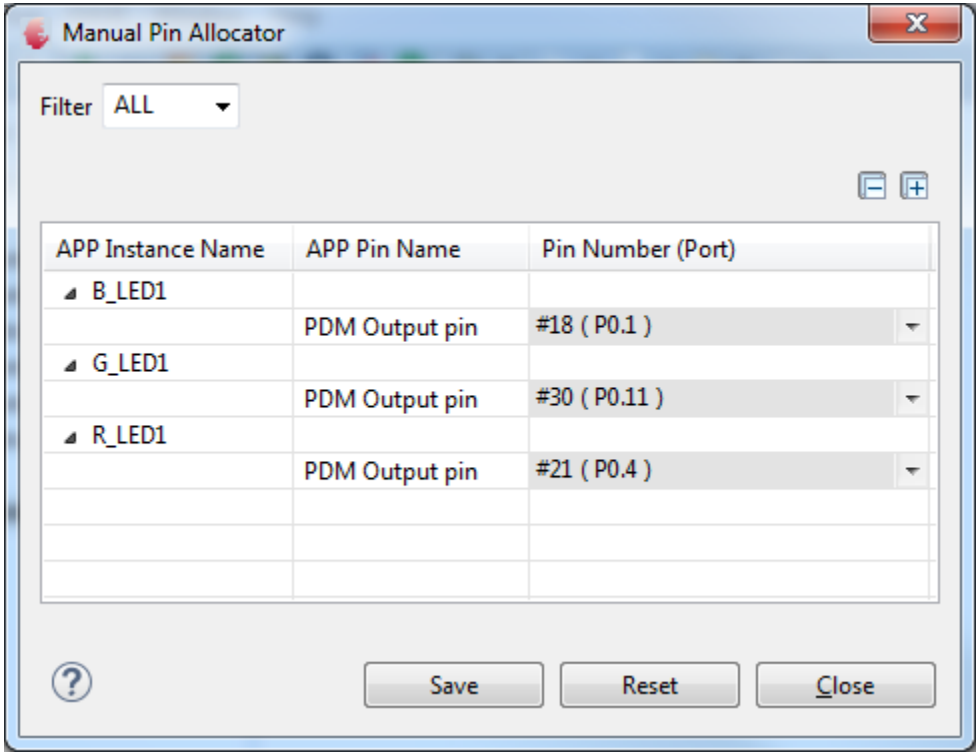
- Repeat the above steps with the other 2 PDM_BCCU APP instances

Getting started – Example 1
RGB lamp using LED_LAMP APP (11/20)

4. Assign PDM_BCCU APPs to the right channels (continued)

› Click  to assign pins to PDM_BCCU APPs

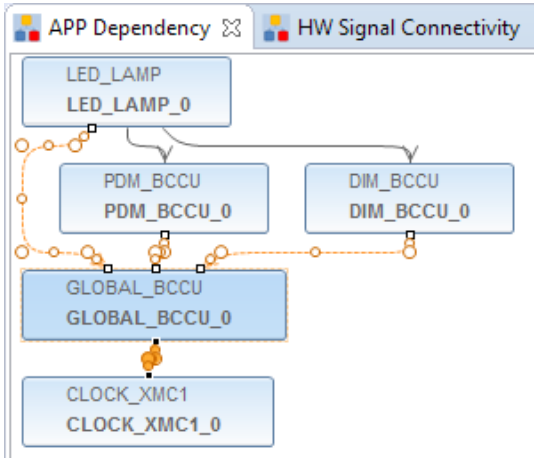
› Assign pins as shown:



Getting started – Example 1
RGB lamp using LED_LAMP APP (12/20)

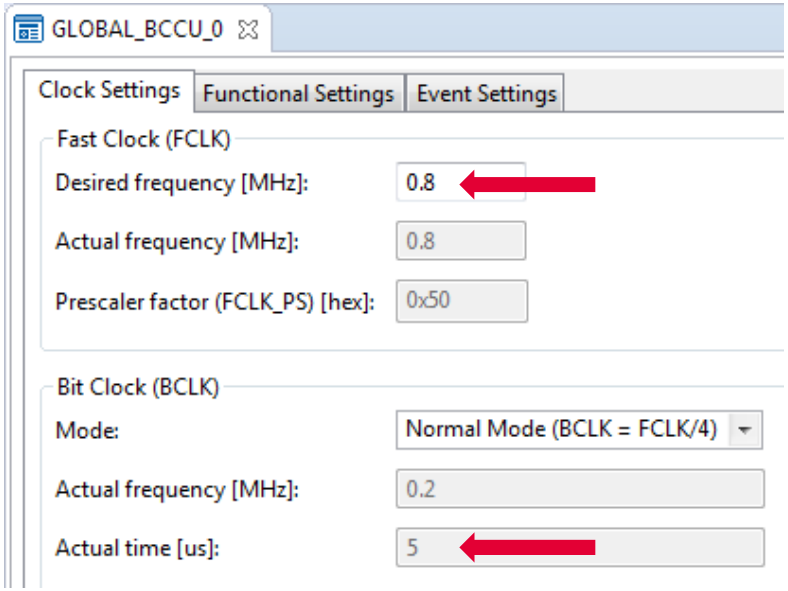
5. Configure BCCU global settings

› Double-click **GLOBAL_BCCU_0** in **APP Dependency tab**



› Under **Clock Settings** tab,

- to get a bit time of 5 us
- change the **Desired Fast Clock Frequency** to **0.8 MHz**



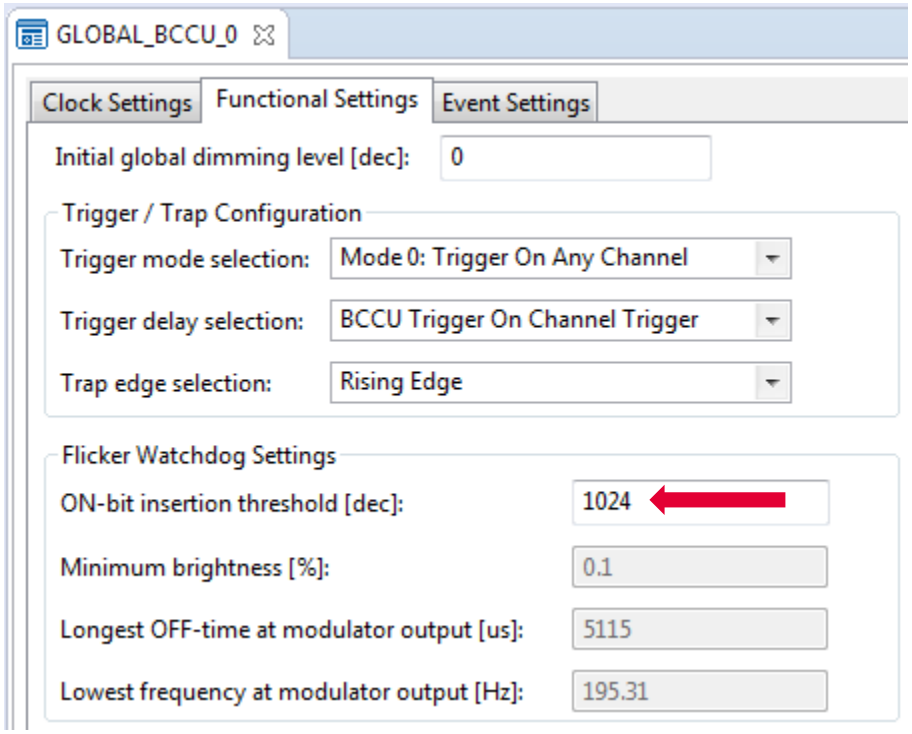
Getting started – Example 1
RGB lamp using LED_LAMP APP (13/20)

5. Configure BCCU global settings (continued)

› Under **Functional Settings** tab,

– limit the maximum possible off time to approx. 5ms (no flicker)

– change **ON-bit insertion threshold** to **1024**

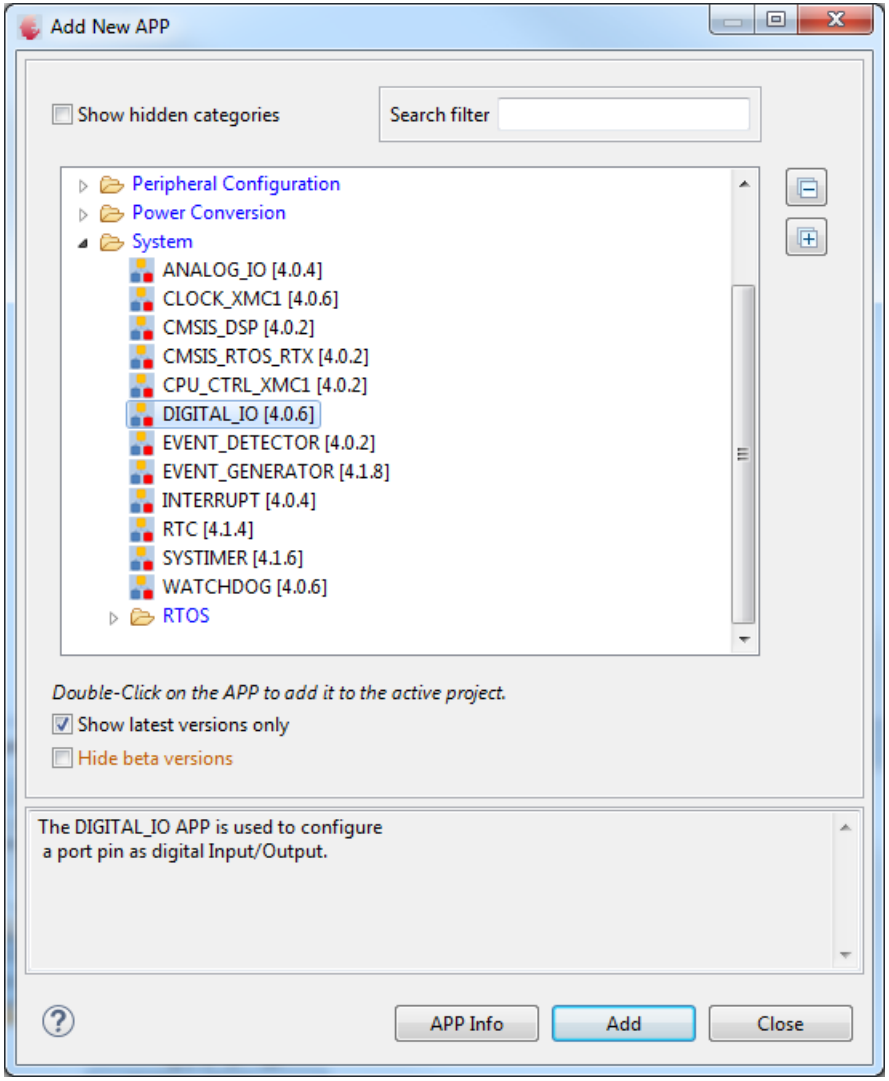


Getting started – Example 1
RGB lamp using LED_LAMP APP (14/20)

6. Configure PORT Pins

- The intention of this step is to ensure that the unused pins (to the LED2 and LED3) are not left in a floating state

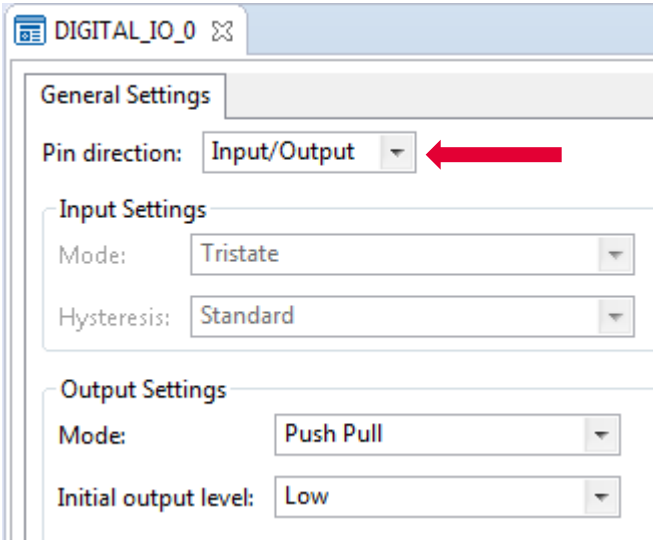
- Add **6** instances of **DIGITAL_IO** APP to the project



Getting started – Example 1
RGB lamp using LED_LAMP APP (15/20)

6. Configure PORT Pins (continued)

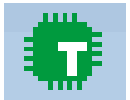
- Double-click a **DIGITAL_IO** APP to open UI
- Set **Pin Direction** to **Input/Output**



- Repeat for other 5 instances of DIGITAL_IO APP

Getting started – Example 1
RGB lamp using LED_LAMP APP (16/20)

6. Configure PORT Pins (continued)

› Click  to assign pins to DIGITAL_IO APPs

› Assign pins as shown:

◢ DIGITAL_IO_0		
	pin	#22 (P0.5)
◢ DIGITAL_IO_1		
	pin	#23 (P0.6)
◢ DIGITAL_IO_2		
	pin	#24 (P0.7)
◢ DIGITAL_IO_3		
	pin	#27 (P0.8)
◢ DIGITAL_IO_4		
	pin	#28 (P0.9)
◢ DIGITAL_IO_5		
	pin	#29 (P0.10)

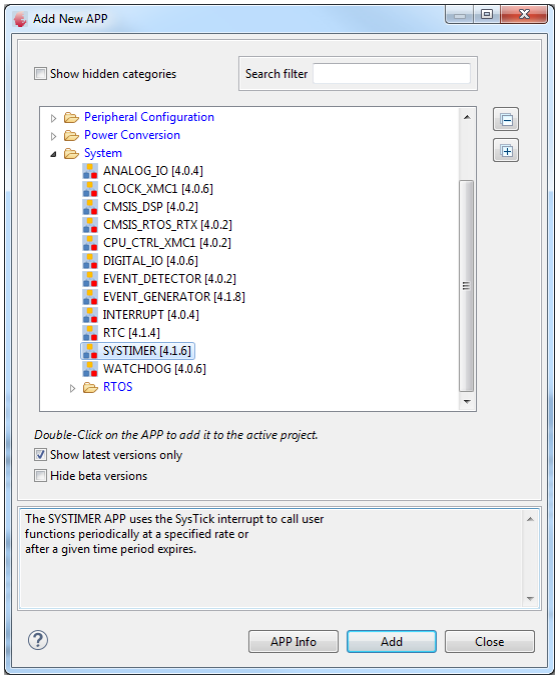
Getting started – Example 1
RGB lamp using LED_LAMP APP (17/20)

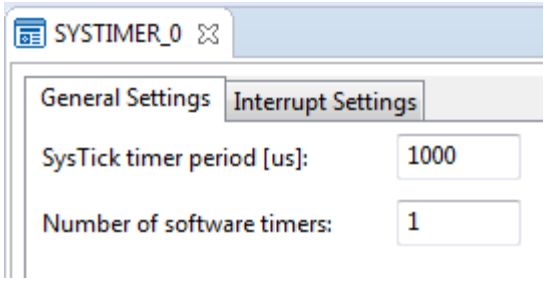
7. Configure SysTick

- Add **SYSTIMER** to the project

- Double-click **SYSTIMER** APP to open UI
  - Set **SysTick timer period** to **1000 us**
  - Set **Number of software timers** to **1**

- Click  to generate code





Getting started – Example 1
RGB lamp using LED_LAMP APP (18/20)

8. Define SYSTIMER callback function

- Purpose of callback function is to change the colour and brightness of LED every 7 seconds
- Initialize callback function

```
void OneSecTick(void);
```

- Create software timer and start timer

```
uint32_t timer_id;
TimerId = SYSTIMER_CreateTimer(1000000,SYSTIMER_MODE_PERIODIC,OneSecTick,NULL);
SYSTIMER_StartTimer(TimerId);
```

Getting started – Example 1
RGB lamp using LED_LAMP APP (19/20)

8. Define SYSTIMER callback function (continued)

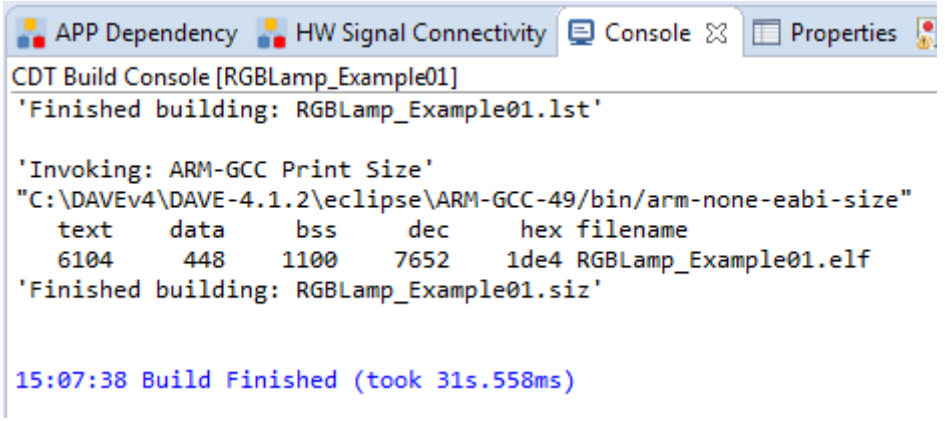
```
void OneSecTick(void)
{
  static uint8_t step = 0;
  if (++step==1) {// change color to red
    RGB_LAMP_config.led_intensity[0] = 4095;
    RGB_LAMP_config.led_intensity[1] = 0;
    RGB_LAMP_config.led_intensity[2] = 0;
    LED_LAMP_SetColorAdv(&RGB_LAMP, 0x2AC);
  }
  else if (step==9) {// change color to green
    RGB_LAMP_config.led_intensity[0] = 0;
    RGB_LAMP_config.led_intensity[1] = 4095;
    RGB_LAMP_config.led_intensity[2] = 0;
    LED_LAMP_SetColorAdv(&RGB_LAMP, 0x2AC);
  }
  else if (step==17) {// change color to blue
    RGB_LAMP_config.led_intensity[0] = 0;
    RGB_LAMP_config.led_intensity[1] = 0;
    RGB_LAMP_config.led_intensity[2] = 4095;
    LED_LAMP_SetColorAdv(&RGB_LAMP, 0x2AC);
  }
  else if (step==25) {// change color to white
    RGB_LAMP_config.led_intensity[0] = 1365;
    RGB_LAMP_config.led_intensity[1] = 1365;
    RGB_LAMP_config.led_intensity[2] = 1365;
    LED_LAMP_SetColorAdv(&RGB_LAMP, 0x2AC);
  }
  else if (step==33) {// dim down slowly to 0%
    RGB_LAMP_config.dim_level = 0;
    LED_LAMP_SetDimLevelExponentialAdv(&RGB_LAMP,0x64,0xDB);
  }
  else if (step==40) {// dim up slowly to 25%
    RGB_LAMP_config.dim_level = 1024;
    LED_LAMP_SetDimLevelExponentialAdv(&RGB_LAMP,0x64,0xDB);
  }
  else if (step==47) {
    step = 0;
  }
}
```

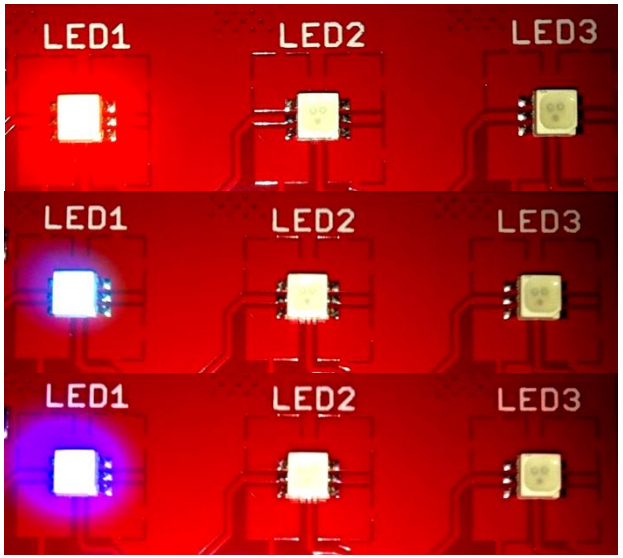
Getting started – Example 1
RGB lamp using LED_LAMP APP (20/20)

- Build project
  1. Click 
  2. Wait for Build to finish
- Download code
  1. Click 
  2. Switch to Debug view

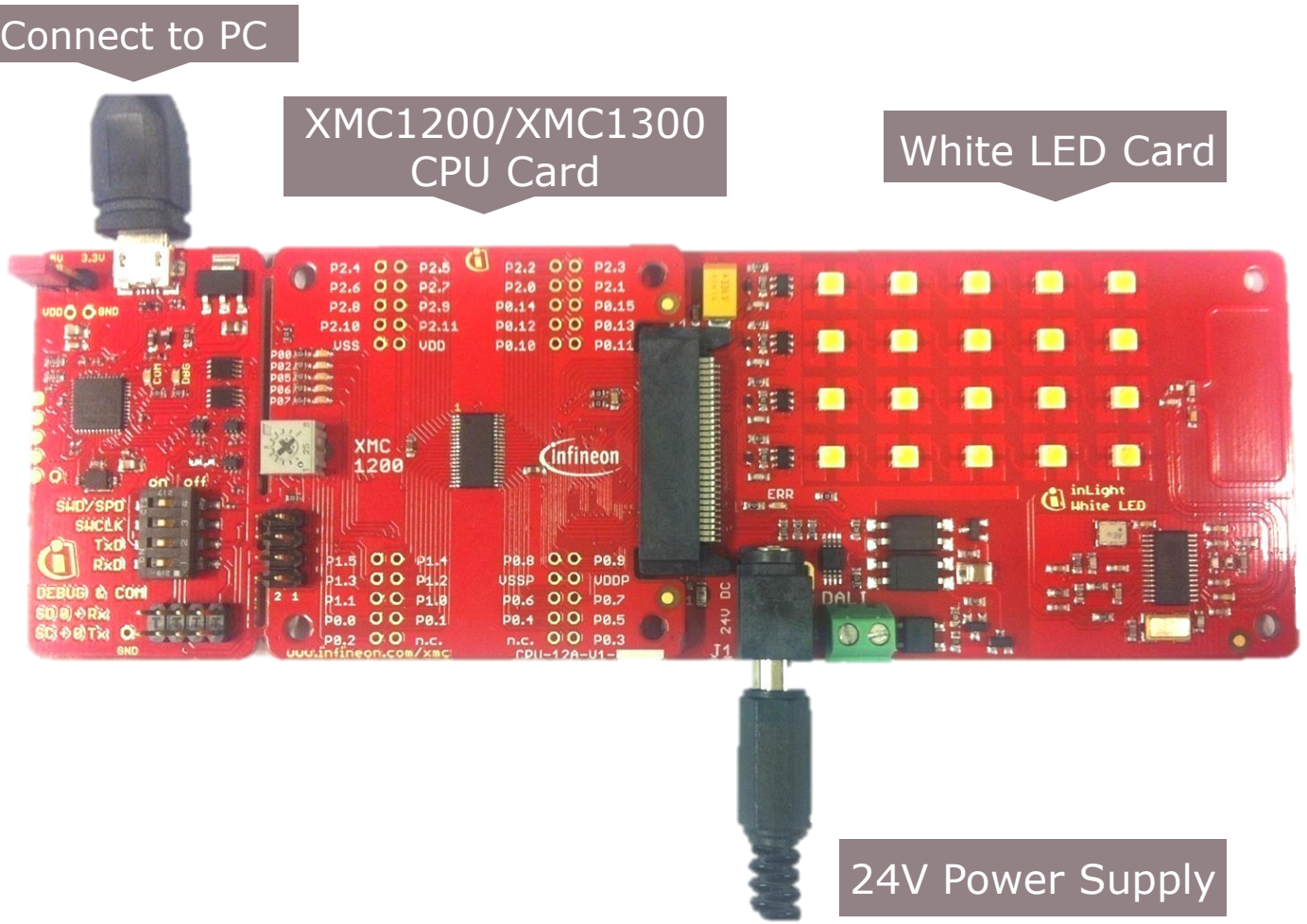
  3. Click  to run code
- LED1 regularly changes color and brightness





Getting started – Example 2
White lamp using LED_LAMP APP (1/19)

Example 2: White Lamp using LED_LAMP APP



Getting started – Example 2
White lamp using LED_LAMP APP (2/19)

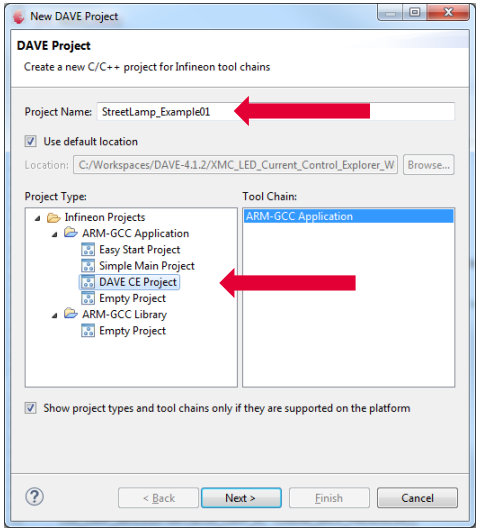
1. Open DAVE™

2. In DAVE™ workspace, create a new "DAVE™ CE" project:

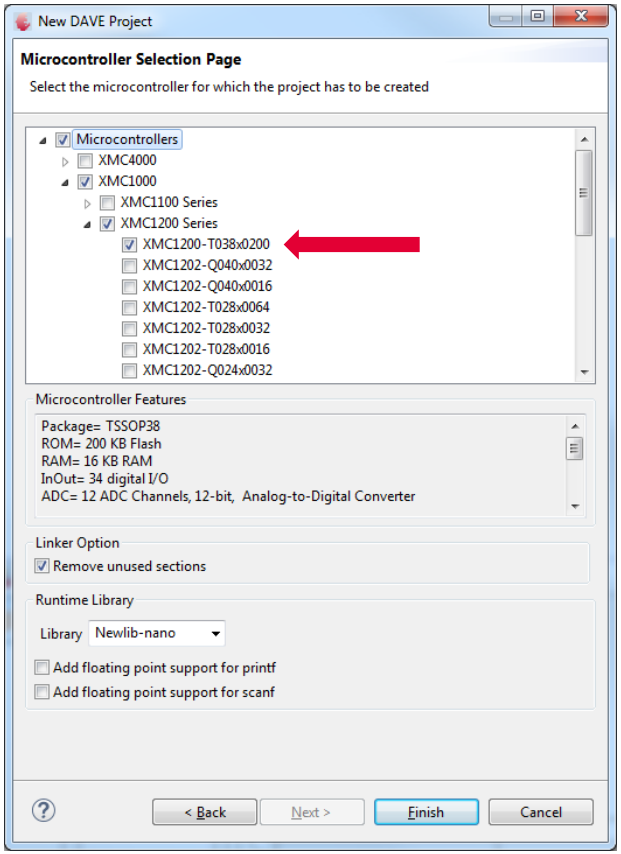
› File->New->DAVE™ Project

› Give the project a name e.g. "WHITE_LAMP_EXAMPLE"

› Select "DAVE™ CE Project" as Project Type



3. Select the device accordingly



Getting started – Example 2
White lamp using LED_LAMP APP (3/19)

- This example demonstrates White Lamp functionality using LED_LAMP APP
- We will use the System Timer (SysTick) as the time base for the interrupt
  - Time base of 1 s
  - In the interrupt, a new target dimming level is set and the dimming process is started
- Next, we will show you the steps to creating this project:
  1. Instantiate LED_LAMP APP
  2. Configure LED_LAMP APP
  3. Assign PDM_BCCU APPs to the right channels
  4. Configure BCCU Channels
  5. Configure Brightness and Color Control Unit (BCCU) global settings
  6. Configure SysTick
  7. Define the SYSTIMER callback function

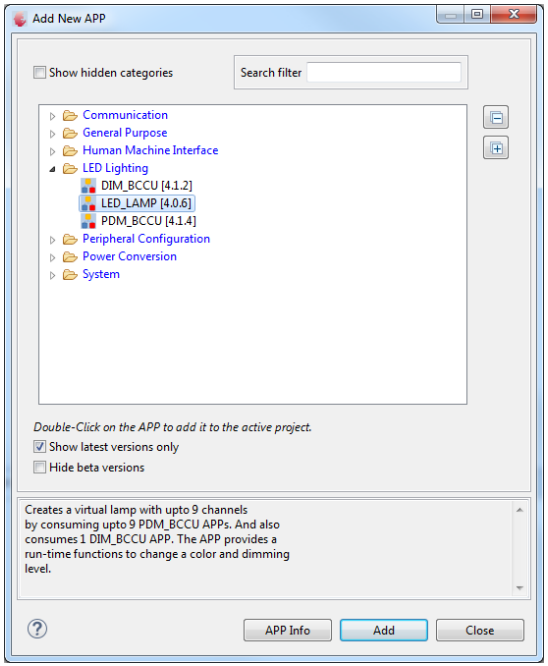
Getting started – Example – White lamp using LED_LAMP APP (4/19)

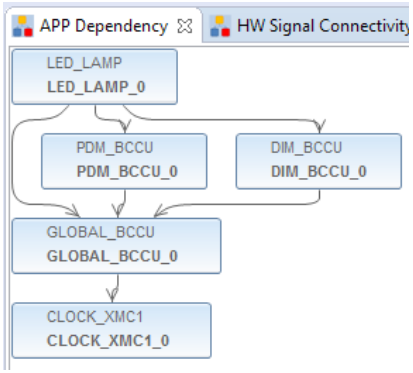
1. Instantiate LED_LAMP APP

   › Click  to add new APP

   › Select the **LED_LAMP** APP

   › LED_LAMP APP automatically aggregates a BCCU channel app (**PDM_BCCU**), a BCCU dimming engine app (**DIM_BCCU**) and a BCCU global app (**GLOBAL_BCCU**)

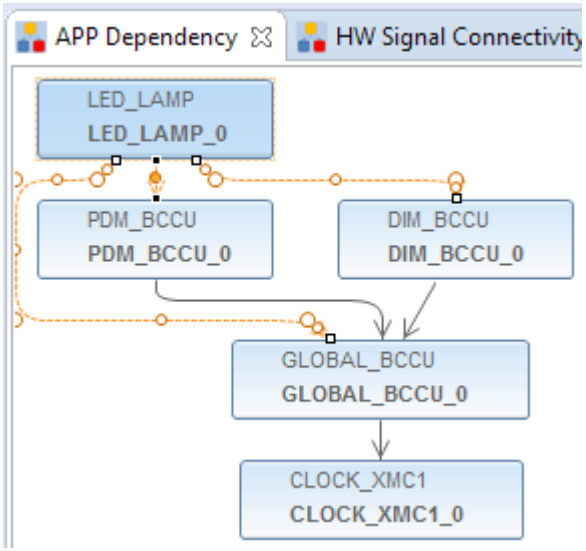




Getting started – Example 2
White lamp using LED_LAMP APP (5/19)

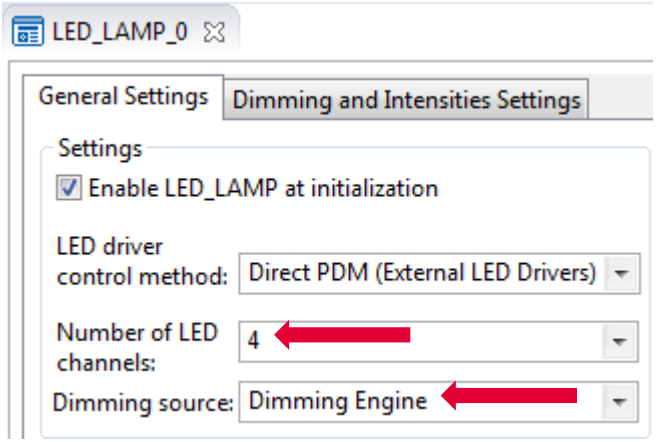
2. Configure LED_LAMP APP

› Double-click **LED_LAMP_0** to open UI



› Under **General Settings** tab,

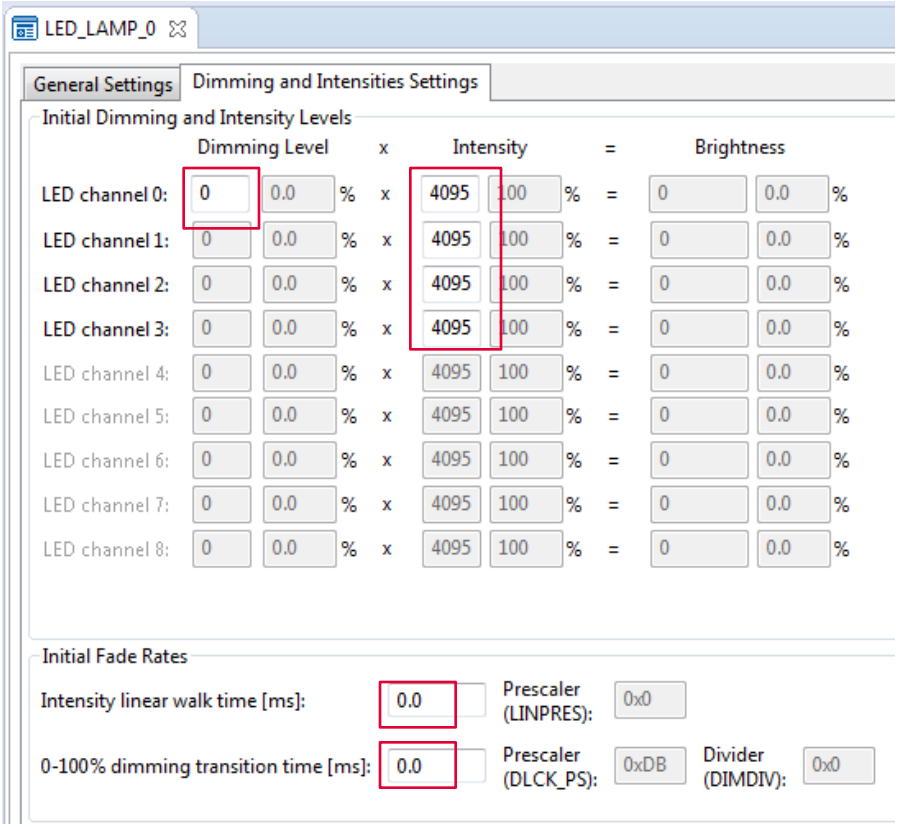
- set **Number of LED channels** to **4**
- select **Dimming Engine** as **Dimming Source**



Getting started – Example 2
White lamp using LED_LAMP APP (6/19)

2. Configure LED_LAMP APP (continued)

- Under **Dimming and Intensities Settings** tab
  - set initial **Dimming Level** to **0**
  - set initial **Channel Intensities** to **4095**
  - set initial **Intensity linear walk time** to **0 ms**
  - Set initial **0-100% dimming transition time** to **0 ms**

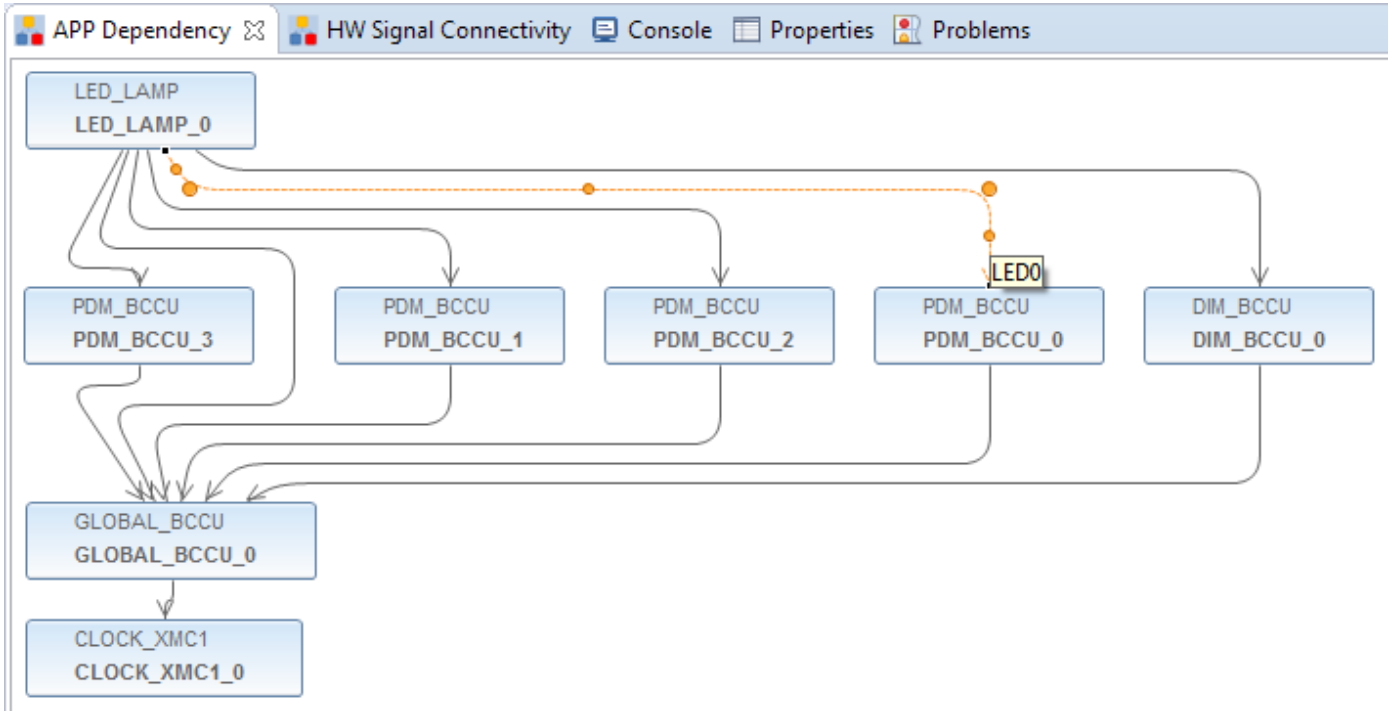


Getting started – Example 2
White lamp using LED_LAMP APP (7/19)

3. Assign PDM_BCCU APPs to the right channels

› Hover mouse cursor over the connecting arrow to a PDM_BCCU APP

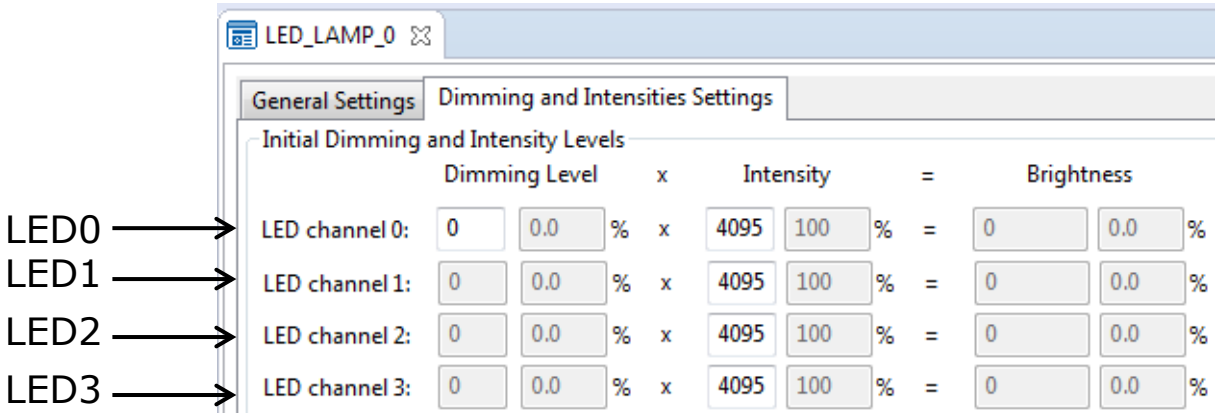
› A label will appear momentarily e.g. LED0/LED1/LED2/LED3



Getting started – Example 2
White lamp using LED_LAMP APP (8/19)

3. Assign PDM_BCCU APPs to the right channels (continued)

› The labels correspond to the LED channels in the UI



› Rename the PDM_BCCU instance label according to the table below

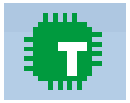
- Right-click PDM_BCCU APP
- Select "Rename Instance Label"

Label	New Label
LED0	D_LED1
LED1	D_LED2
LED2	D_LED3
LED3	D_LED4

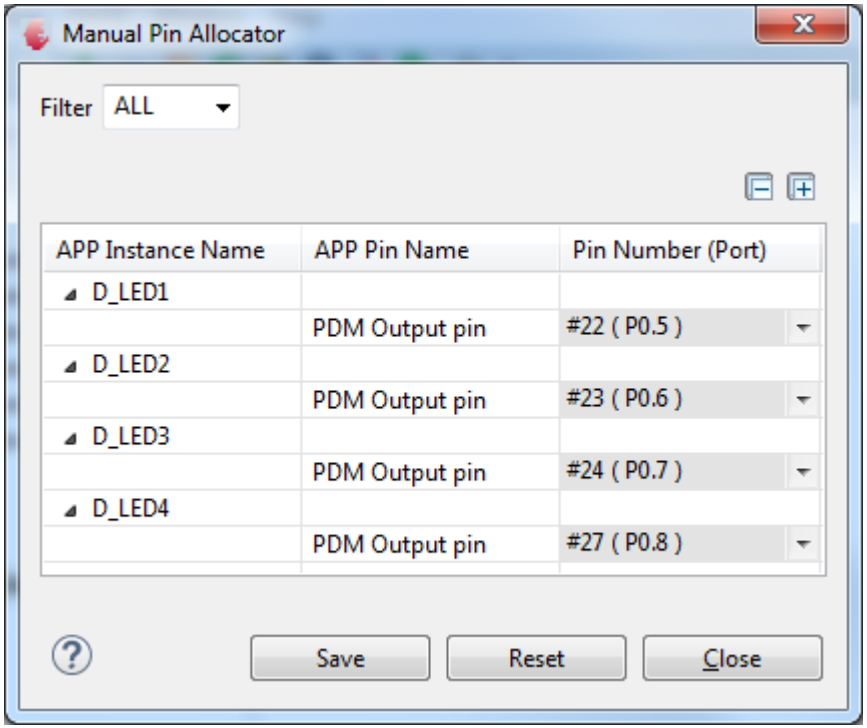
- Repeat the above steps with the other 2 PDM_BCCU APP instances

Getting started – Example 2
White Lamp using LED_LAMP APP (9/19)

3. Assign PDM_BCCU APPs to the right channels (continued)

› Click  to assign pins to PDM_BCCU APPs

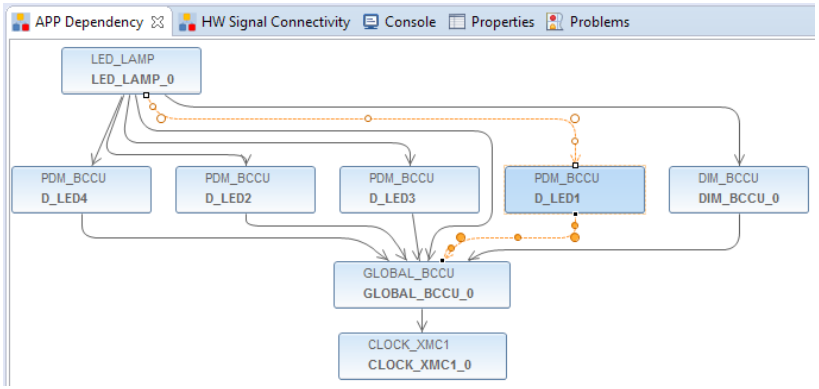
› Assign pins as shown:

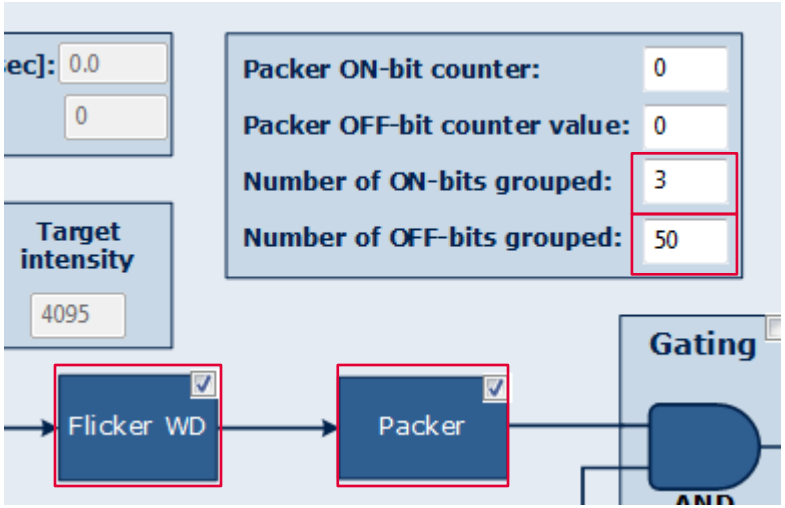


Getting started – Example 2
White Lamp using LED_LAMP APP (10/19)

4. Configure BCCU Channels

- Double-click PDM_BCCU instance **D_LED1**
- Select **Flicker Watchdog (WD)** to enable
- Select **Packer** to enable
- Set **Number of ON-bits grouped** to **3**
- Set **Number of OFF-bits grouped** to **50**

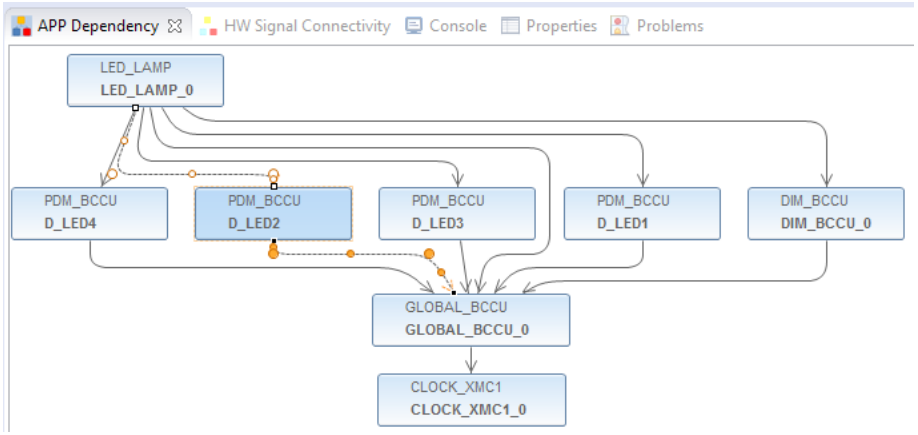


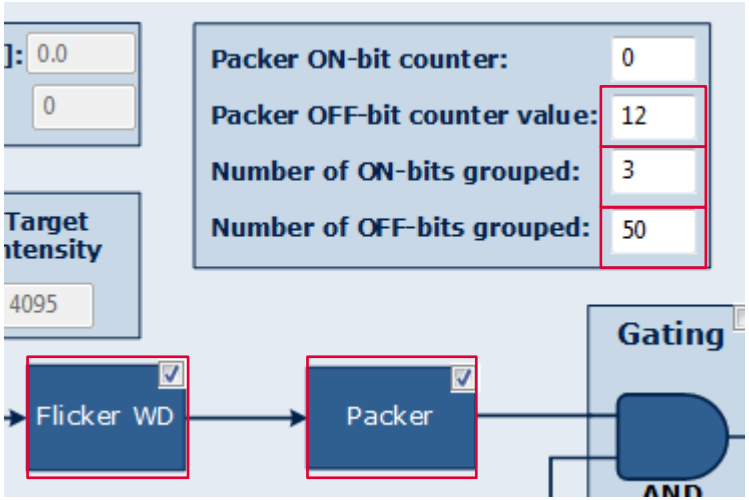


Getting started – Example 2
White lamp using LED_LAMP APP (11/19)

4. Configure BCCU Channels (continued)

- Double-click PDM_BCCU instance **D_LED2**
- Select **Flicker Watchdog (WD)** to enable
- Select **Packer** to enable
- Set **Packer OFF-bit counter value** to **12**
- Set **Number of ON-bits grouped** to **3**
- Set **Number of OFF-bits grouped** to **50**

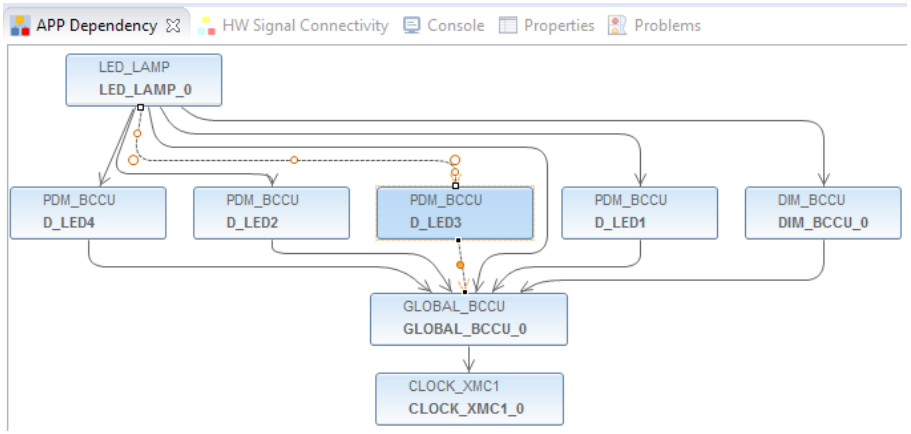


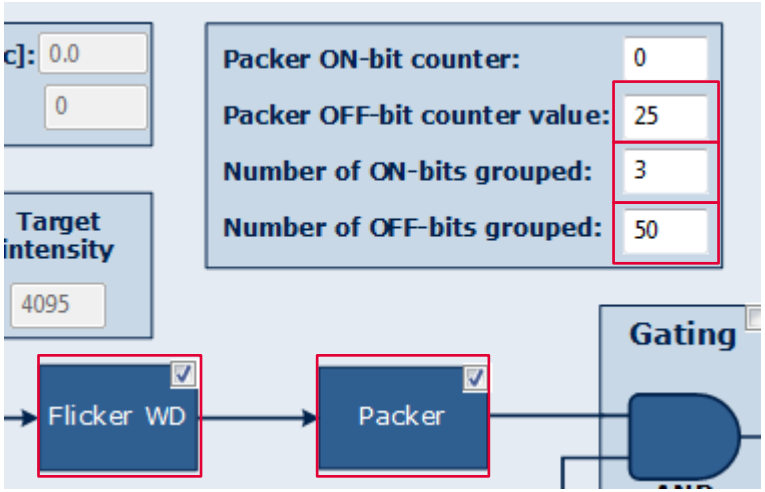


Getting started – Example 2
White lamp using LED_LAMP APP (12/19)

4. Configure BCCU Channels (continued)

- Double-click PDM_BCCU instance **D_LED3**
- Select **Flicker Watchdog (WD)** to enable
- Select **Packer** to enable
- Set **Packer OFF-bit counter value** to **25**
- Set **Number of ON-bits grouped** to **3**
- Set **Number of OFF-bits grouped** to **50**

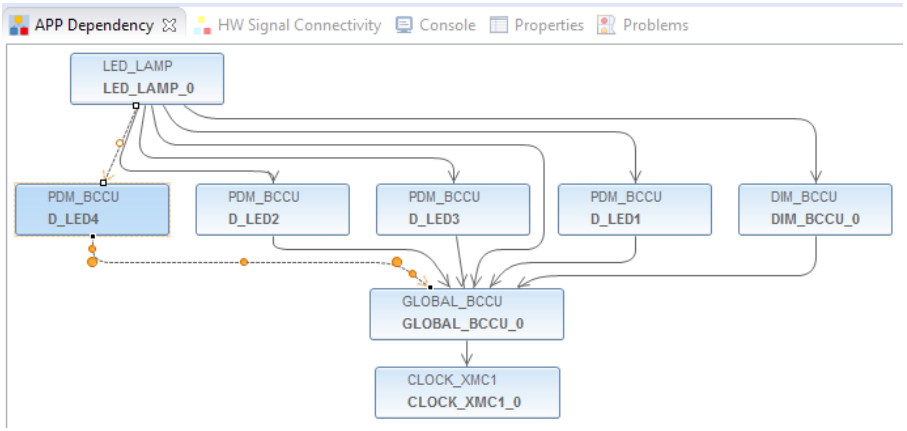


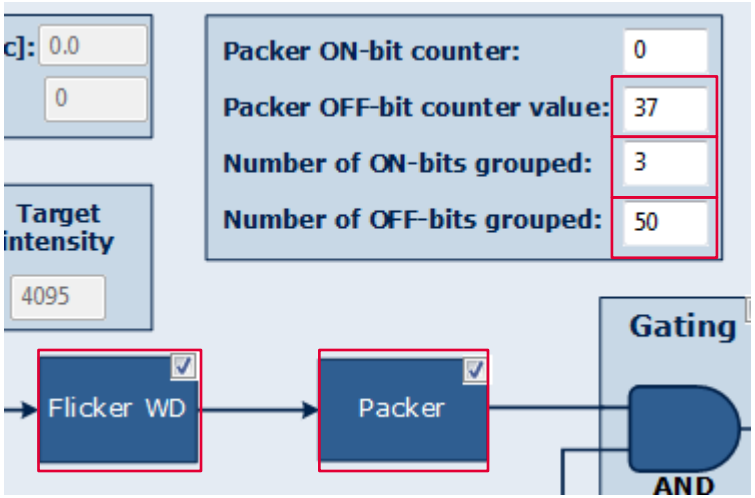


Getting started – Example 2
White lamp using LED_LAMP APP (13/19)

4. Configure BCCU Channels (continued)

- Double-click PDM_BCCU instance **D_LED4**
- Select **Flicker Watchdog (WD)** to enable
- Select **Packer** to enable
- Set **Packer OFF-bit counter value** to **37**
- Set **Number of ON-bits grouped** to **3**
- Set **Number of OFF-bits grouped** to **50**

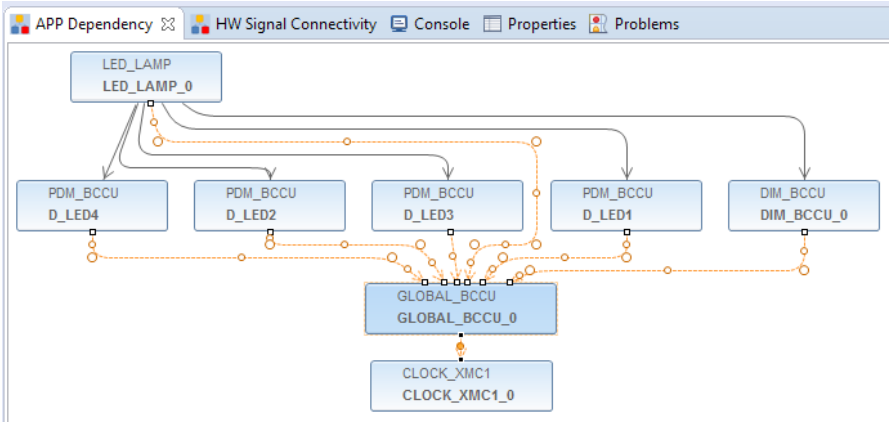




Getting started – Example 2
White lamp using LED_LAMP APP (14/19)

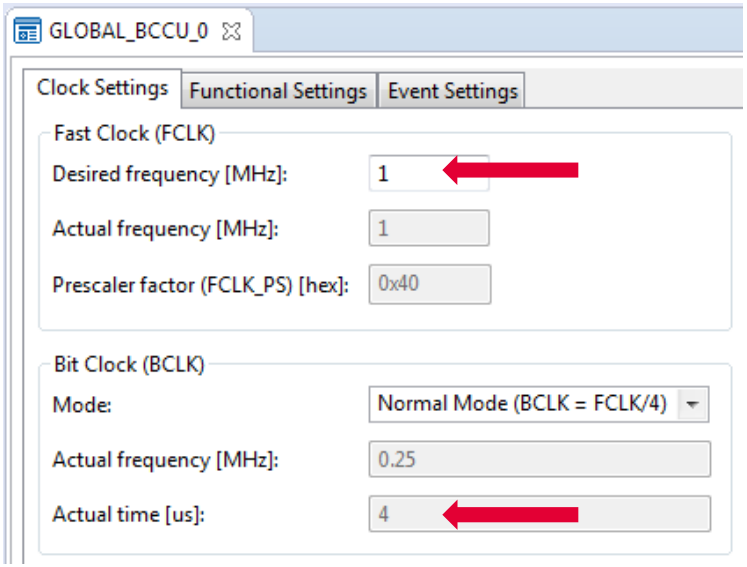
5. Configure BCCU global settings

› Double-click **GLOBAL_BCCU_0** in **APP Dependency tab**



› Under **Clock Settings** tab,

- to get a bit time of 4 us
- change the **Desired Fast Clock Frequency** to **1 MHz**



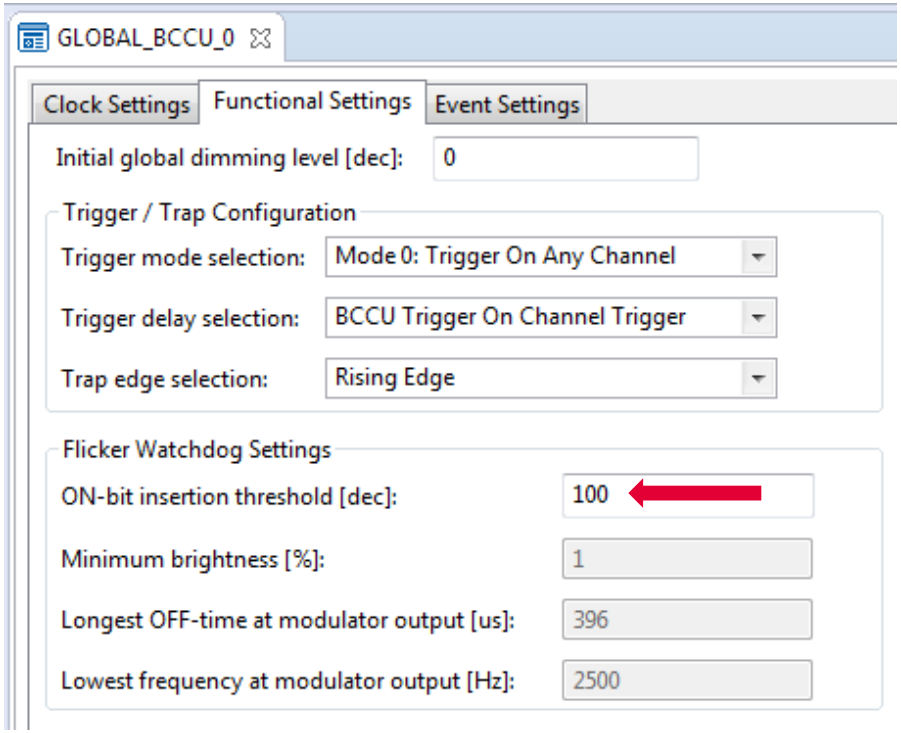
Getting started – Example 2
White lamp using LED_LAMP APP (15/19)

5. Configure BCCU global settings (continued)

› Under **Functional Settings** tab,

  – limit the minimum brightness to 1%

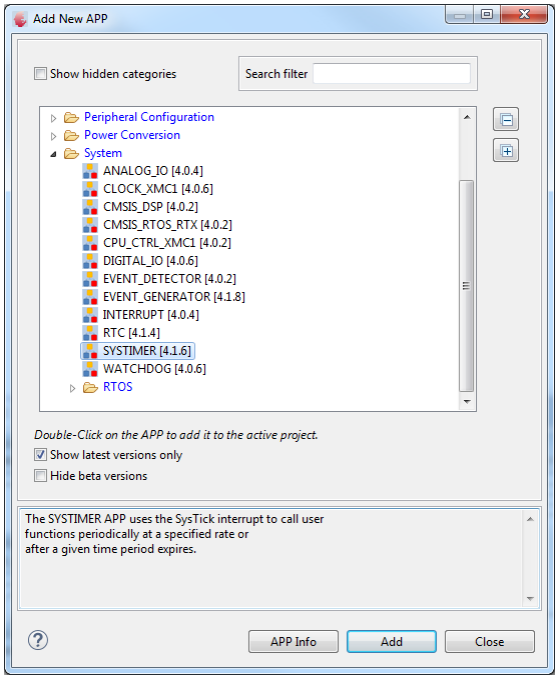
    – change **ON-bit insertion threshold** to **100**



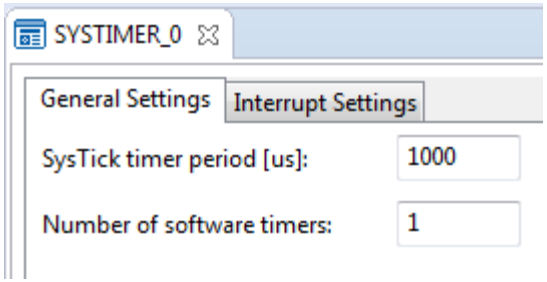
Getting started – Example 2
White lamp using LED_LAMP APP (16/19)

6. Configure SysTick

- Add **SYSTIMER** to the project



- Double-click **SYSTIMER** APP to open UI
  - Set **SysTick timer period** to **1000 us**
  - Set **Number of software timers** to **1**



- Click  to generate code

Getting started – Example 2
White lamp using LED_LAMP APP (17/19)

7. Define SYSTIMER callback function

› Purpose of callback function is to change the brightness of lamp every 10 seconds

› Initialize callback function

```
void OneSecTick(void);
```

› Create software timer and start timer

```
uint32_t timer_id;
TimerId = SYSTIMER_CreateTimer(1000000,SYSTIMER_MODE_PERIODIC,OneSecTick,NULL);
SYSTIMER_StartTimer(TimerId);
```

Getting started – Example 2
White lamp using LED_LAMP APP (18/19)

7. Define SYSTIMER callback function (continued)

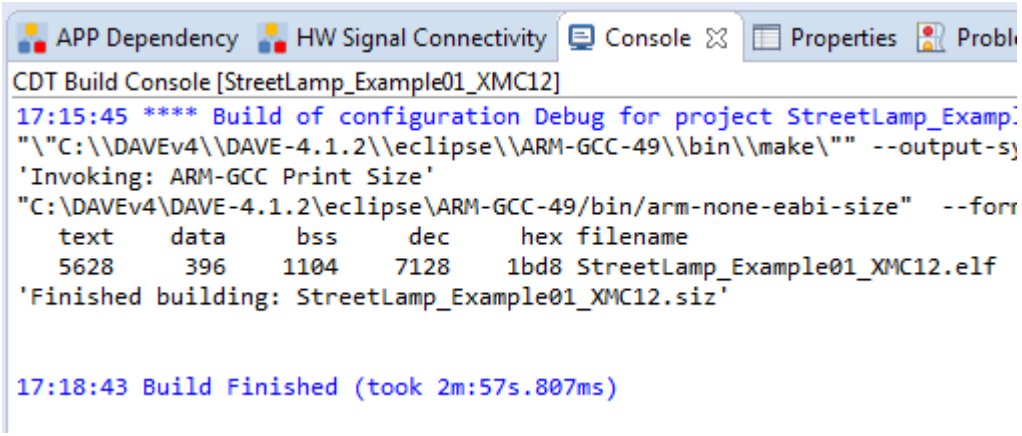
```
void OneSecTick(void)
{
  static uint8_t step = 0;

  if (++step==1) {
    /* Dim up to 10% slowly */
    LED_LAMP_0_config.dim_level = 410;
    LED_LAMP_SetDimLevelExponentialAdv(&LED_LAMP_0, 0x64, 0xDB);
  }
  else if (step==10) {
    /* Dim up to 100% slowly */
    LED_LAMP_0_config.dim_level = 4095;
    LED_LAMP_SetDimLevelExponentialAdv(&LED_LAMP_0, 0x64, 0xDB);
  }
  else if (step==20) {
    /* Dim down to 0% slowly */
    LED_LAMP_0_config.dim_level = 0;
    LED_LAMP_SetDimLevelExponentialAdv(&LED_LAMP_0, 0x64, 0xDB);
  }
  else if (step==30) {
    step = 0;
  }
}
```

Getting started – Example 2
White lamp using LED_LAMP APP (19/19)

- Build project
  1. Click 
  2. Wait for Build to finish
- Download code
  1. Click 
  2. Switch to Debug view

  3. Click  to run code
- LEDs regularly change brightness



Agenda

1. Kit overview
2. Hardware overview
3. Tooling overview – boot modes
4. Tooling overview – DAVE™
5. Getting started - examples
6. General information
7. References

General information (1/2)

- Where to buy kit:
  - http://ehitex.com/starter-kits/for-xmc1000
  - Order Number: KIT_XMC1x_AK_LED_001

- Infineon parts utilized on kit:

Infineon parts	Order number
XMC1200 Microcontroller	XMC1200-T038F0200
XMC4200 Microcontroller	XMC4200-Q48F256
5 V regulator	IFX25001TFV50
3V3 regulator	IFX25001MEV33
BCR421/SC74 LED Driver	BCR421UE6327HTSA1
BCR450 LED Driver	BCR450E6327HTSA1
TDA7200 RF Receiver	TDA7200XUMA1

General information (2/2)

- Kit documentation:
  - LED Lighting Application Kit

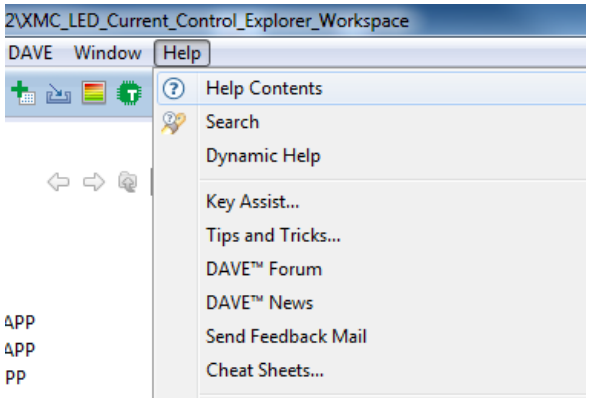
- Video series: XMC1000 boot kit getting started
  - Introduction
  - DAVE™ (Version 4) - Project Management
  - Boot Mode Index Configuration via DAVE™ or MemTool
  - Example Projects Download

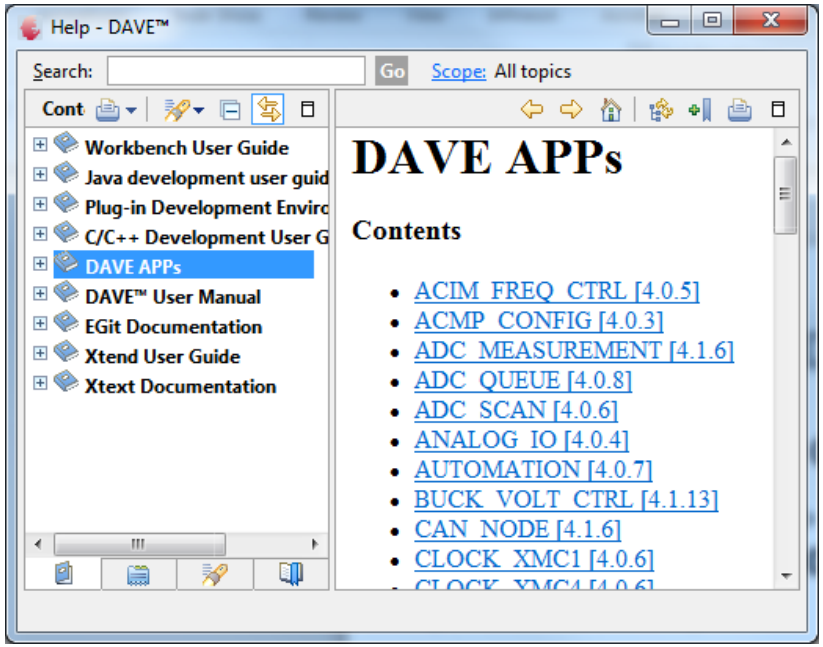
Agenda

1. Kit overview
2. Hardware overview
3. Tooling overview – boot modes
4. Tooling overview – DAVE™
5. Getting started - examples
6. General information
7. References

References
Where to find APP documentation? (1/2)

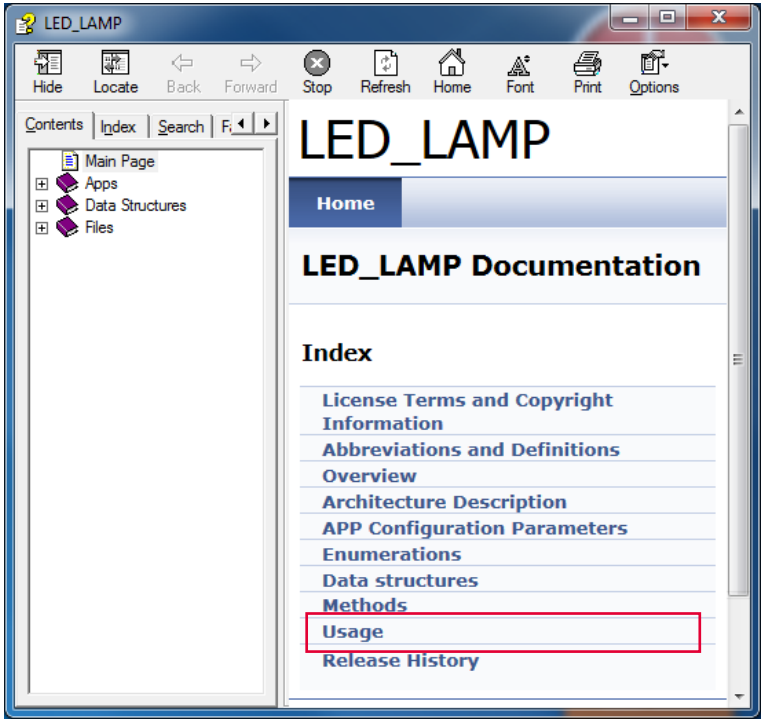
- Go to **Help → Help Contents**
- Click **DAVE™ APPs**
- Click APP_Name (e.g. **LED_LAMP**)

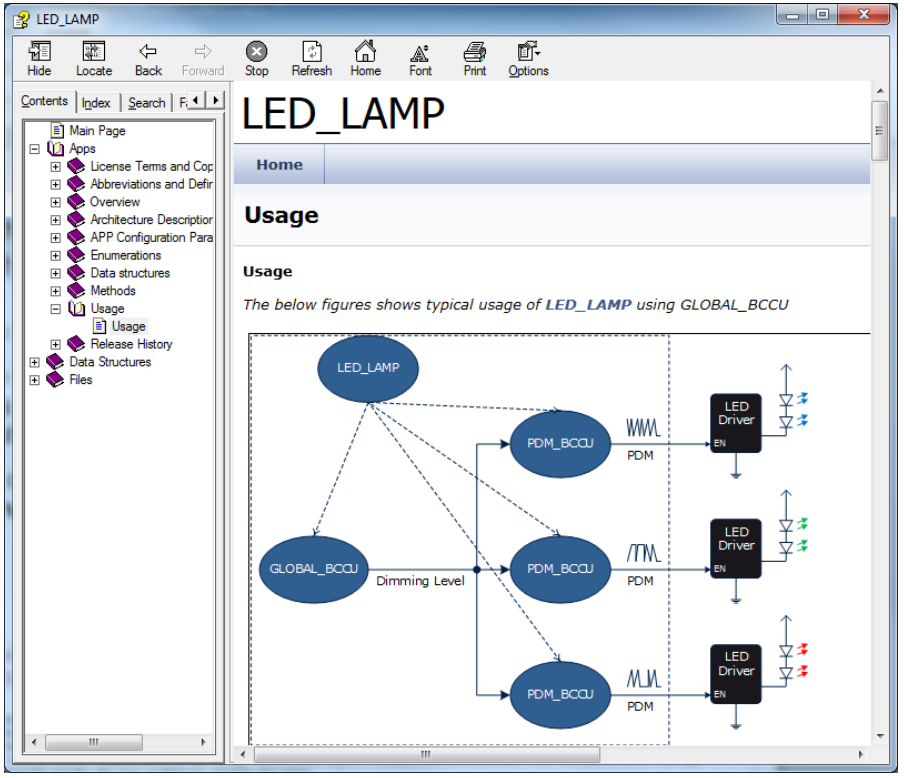




References
Where to find APP documentation? (2/2)

- Usage information can be found under **Usage** section





References
Where to download example projects?

- Two sets of example projects available
  - Additional application examples
    - Can be downloaded directly from the web
  - DAVE™ project library examples
    - Can be downloaded from library in DAVE™
    - Can also be downloaded directly from the web

References
Where to download example projects?

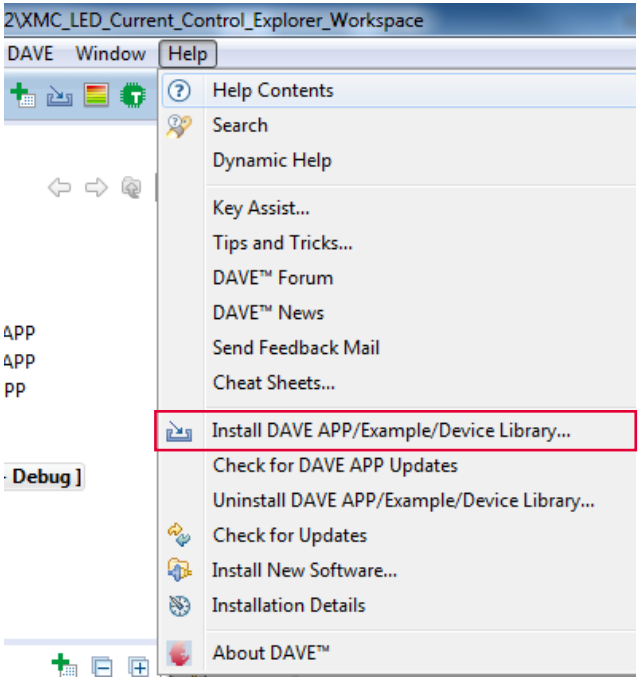
- Additional application examples available
  - RGB Lamps Example with Apps (LED_LAMP_3RGB_EXAMPLE_XMC12.zip)
    - Demonstrates 3 RGB Lamps functionality using 3 LED_LAMP APPs (9 Channels, 3 Dimming Engines)
  - RGB Lamp Example (BCCU_RGB_LAMP_EXAMPLE.zip)
    - Demonstrates 1 RGB Lamp functionality using XMC™ Lib

References
Where to download example projects?

- Additional application examples available
  - White Lamp Example (BCCU_WHITE_LAMP_EXAMPLE.zip)
    - Demonstrates white lamp functionality using XMC™ Lib
- Can be downloaded from the web HERE

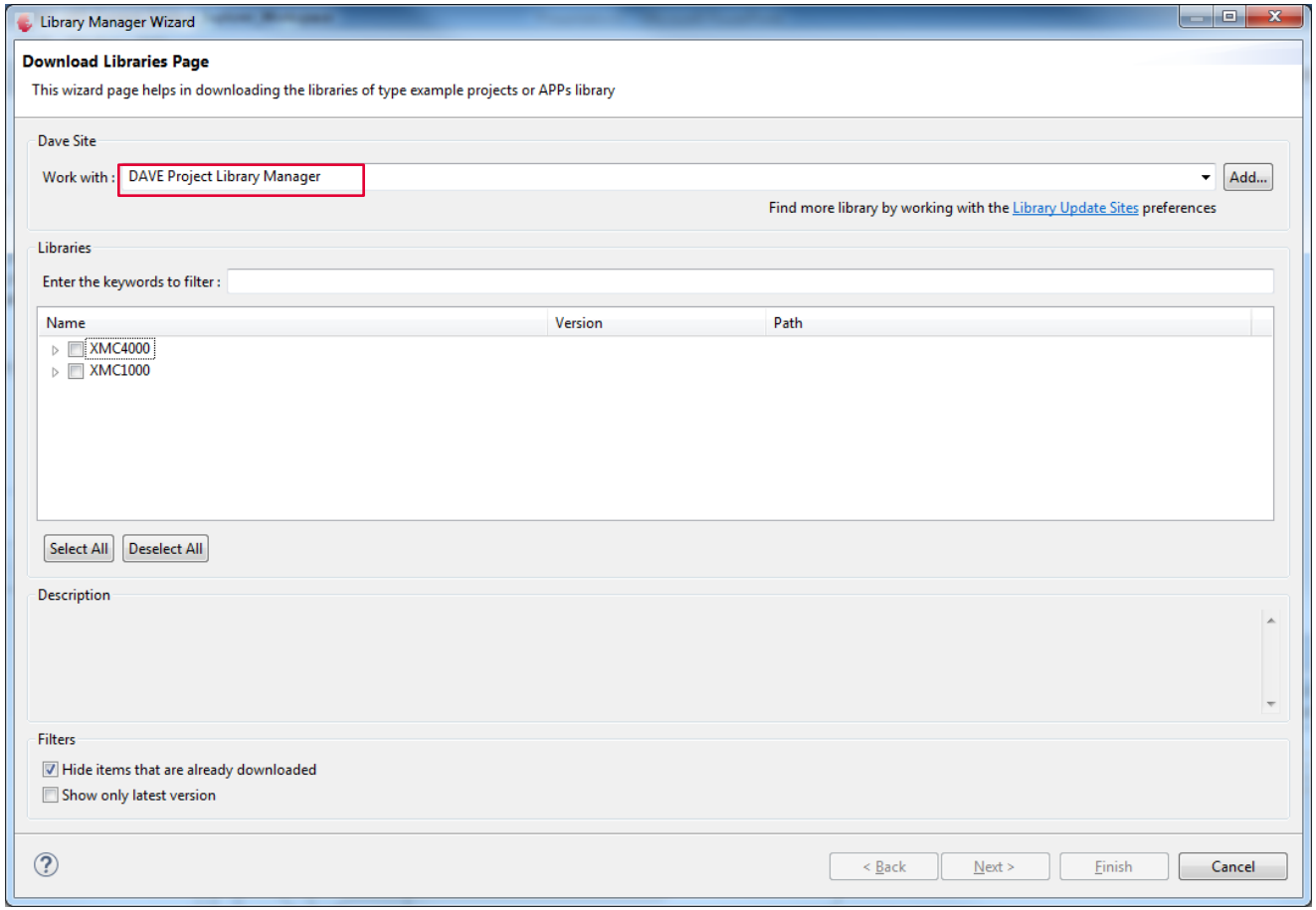
References
How to load example project in DAVE™? (1/5)

- Download example projects via DAVE™ library store
  - **Help → Install DAVE™ APP/Example/Device Library…**



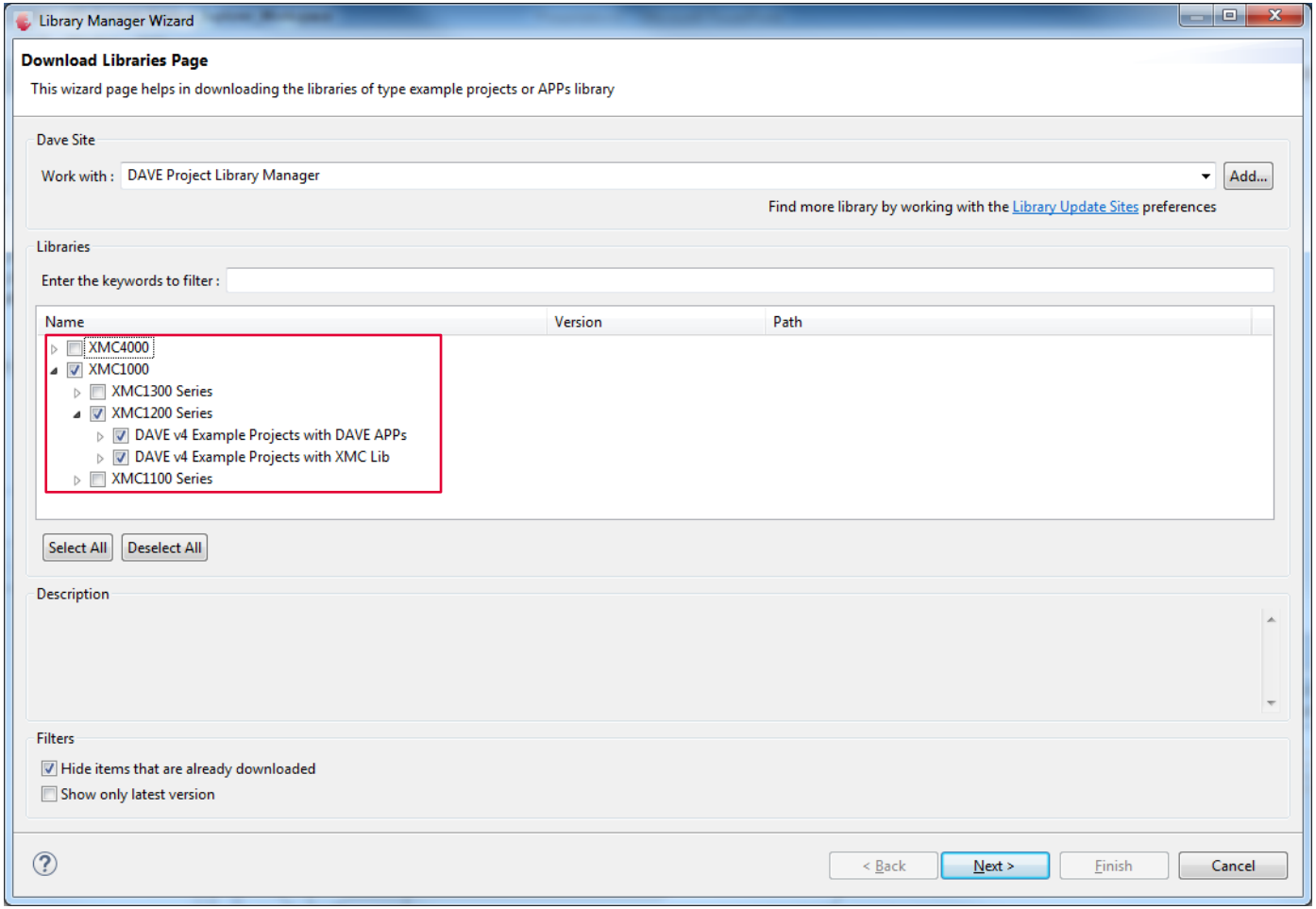
References
How to load example project in DAVE™? (2/5)

› Select **DAVE™ Project Library Manager** in the drop-down menu



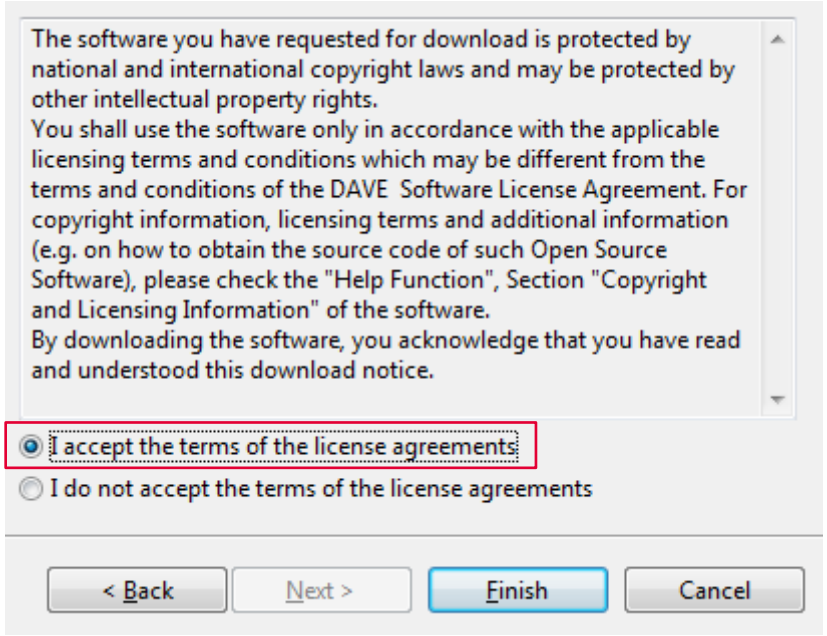
References
How to load example project in DAVE™? (3/5)

› Select examples in the **Libraries** window and click Next



References
How to load example project in DAVE™? (4/5)

- Accept terms of the license agreement and click Finish

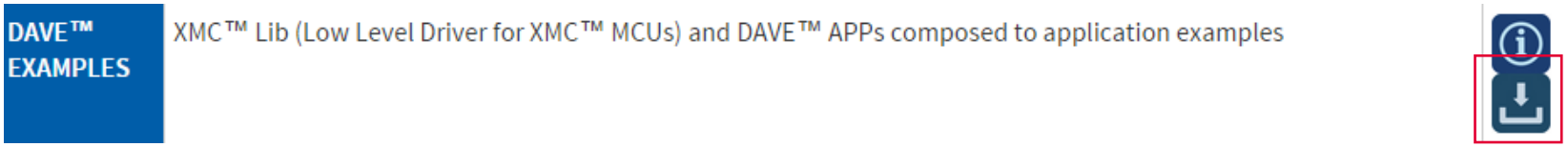


- DAVE™ example projects are installed

References
How to load example project in DAVE™? (5/5)

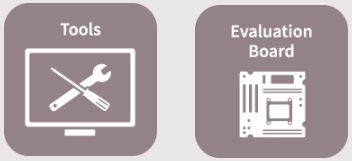
- Download Example Projects from the web

  http://www.infineon.com/dave/v4



  - Download the project zip file and unzip to a known location
  - Open **DAVE™** and go to **File → Import → Infineon → DAVE™ Project**
  - Select **Select Archive File**
  - Browse to the downloaded DAVE™ project zip file
  - Click **Open**
  - Click **Finish**

Support material

Collaterals and Brochures 	› Product Briefs › Selection Guides › Application Brochures › Presentations › Press Releases, Ads	› www.infineon.com/XMC
Technical Material 	› Application Notes › Technical Articles › Simulation Models › Datasheets, MCDS Files › PCB Design Data	› www.infineon.com/XMC › Kits and Boards › DAVE™ › Software and Tool Ecosystem
Videos 	› Technical Videos › Product Information Videos	› Infineon Media Center › XMC Mediathek
Contact 	› Forums › Product Support	› Infineon Forums › Technical Assistance Center (TAC)

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