XMC Digital Power Explorer Kit

Getting Started

Agenda (1/2)

1. Kit Overview
2. – Hardware Overview
3. Tooling Overview
3a. – DAVE™
4. Getting Started
4a. – Example – XMC4200 Buck Converter in Voltage Control Mode
4b. – Example – XMC1300 Buck Converter in Voltage Control Mode

Agenda (2/2)

5 General Information

6 References

6a – Where to download Example Projects?

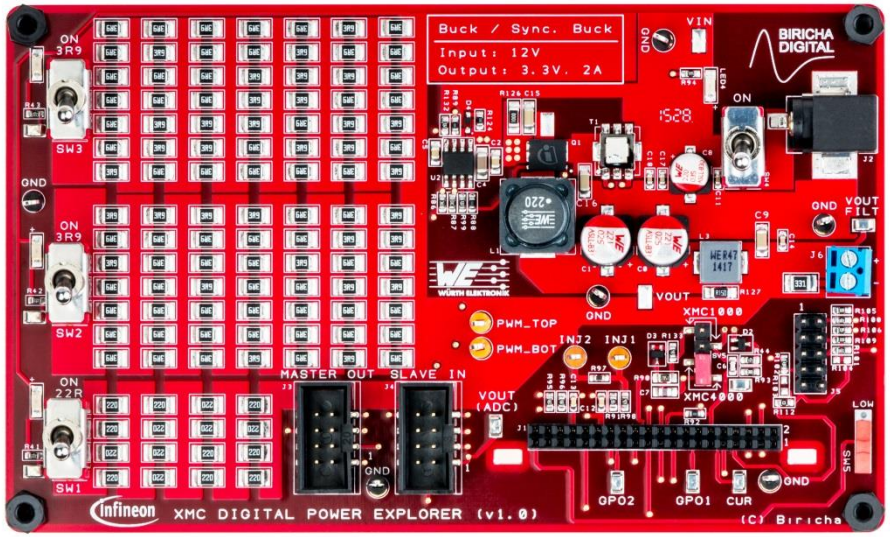
6b – How to load Example Project in DAVE™?

Agenda (1/2)

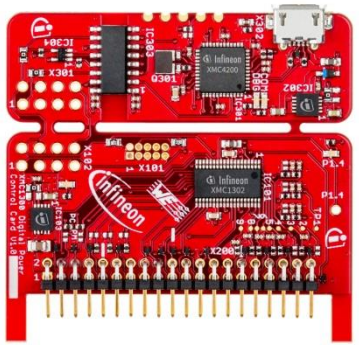
1. Kit Overview
2. Hardware Overview
3. Tooling Overview
   - 3a. DAVE™
4. Getting Started
   - 4a. Example – XMC4200 Buck Converter in Voltage Control Mode
   - 4b. Example – XMC1300 Buck Converter in Voltage Control Mode

Kit Overview (1/2)

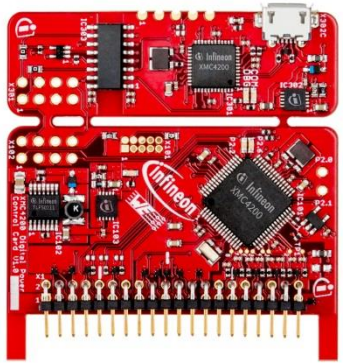
- XMC Digital Power Explorer Kit
  - XMC1300 Digital Power Control Card
  - XMC4200 Digital Power Control Card
  - XMC Digital Power Explorer Board



XMC Digital Power Explorer



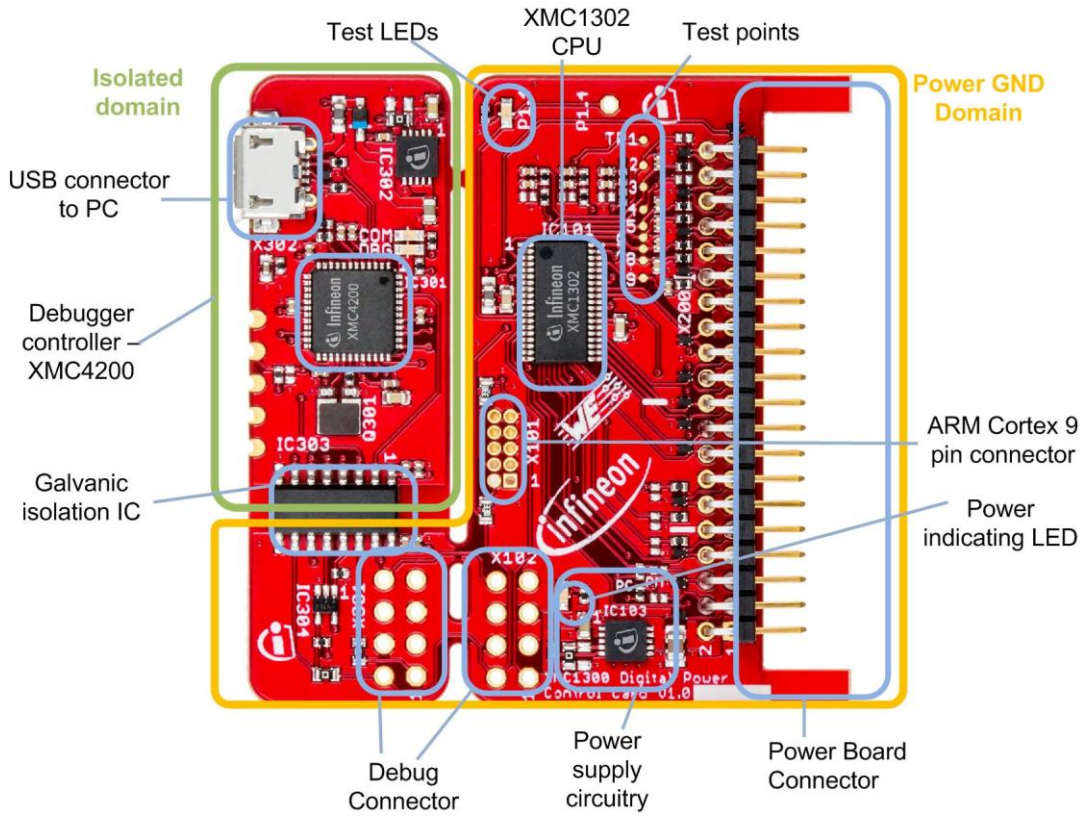
XMC1300 Digital Power Control Card



XMC4200 Digital Power Control Card

Kit Overview (2/2)

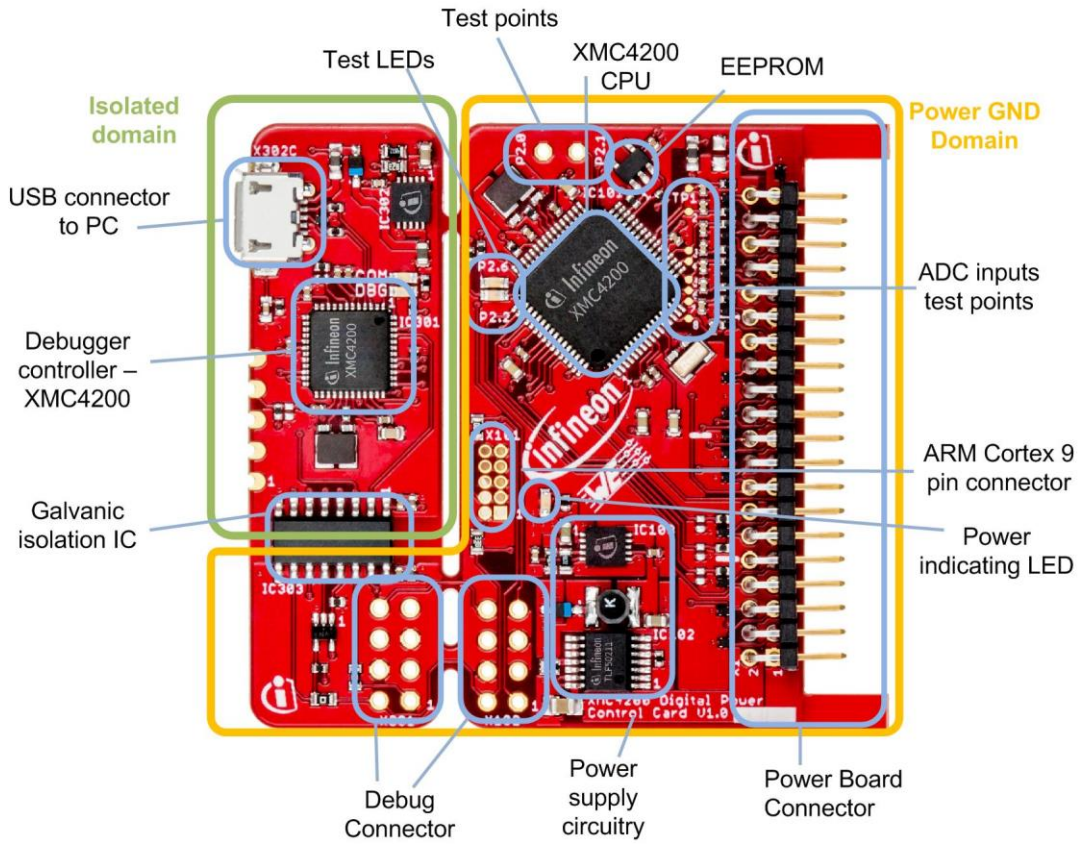
› XMC1300 Digital Power Control Card



Home

Kit Overview (2/2)

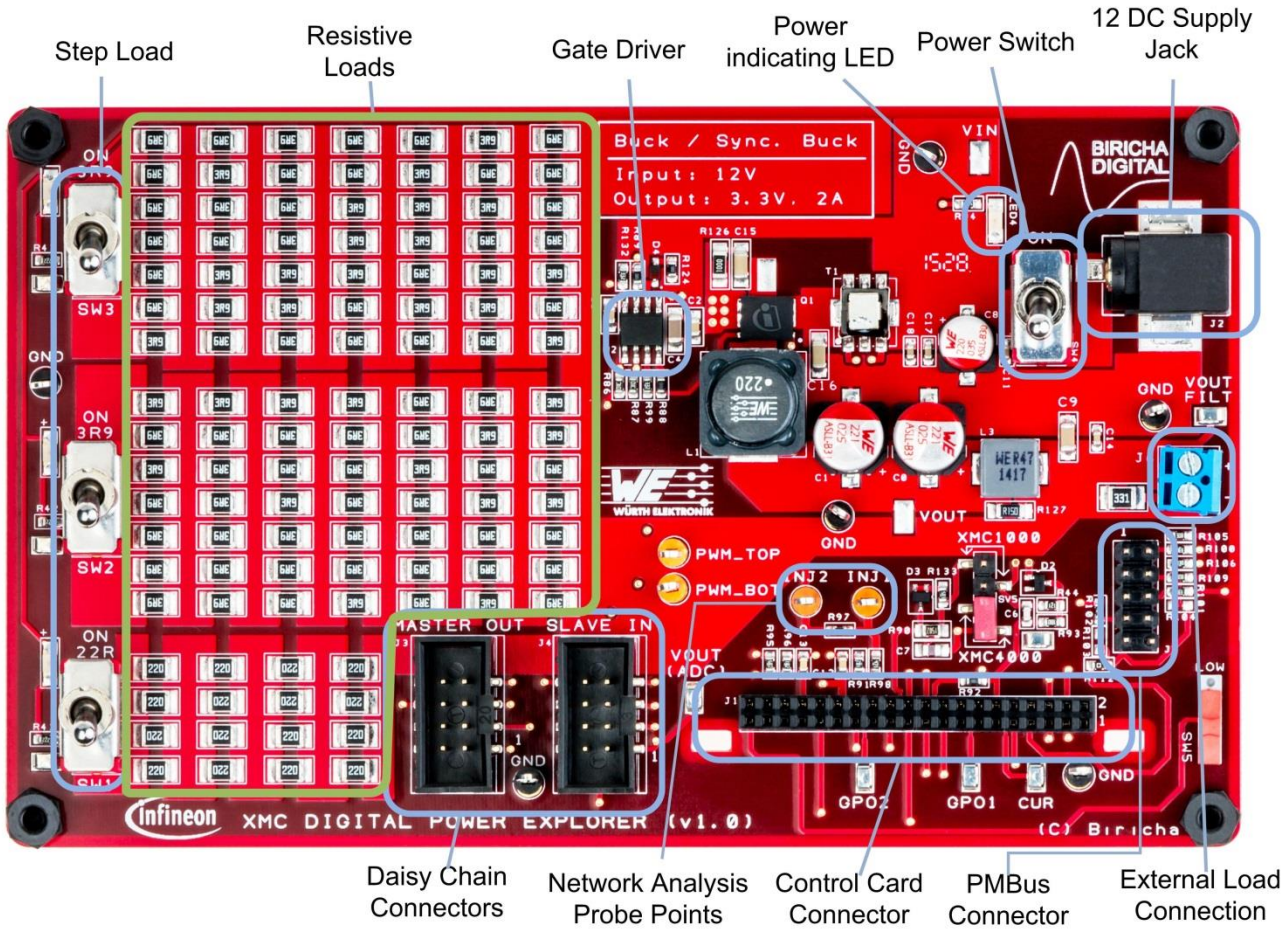
› XMC4200 Digital Power Control Card



Home

Kit Overview (2/2)

› XMC Digital Power Explorer



Home

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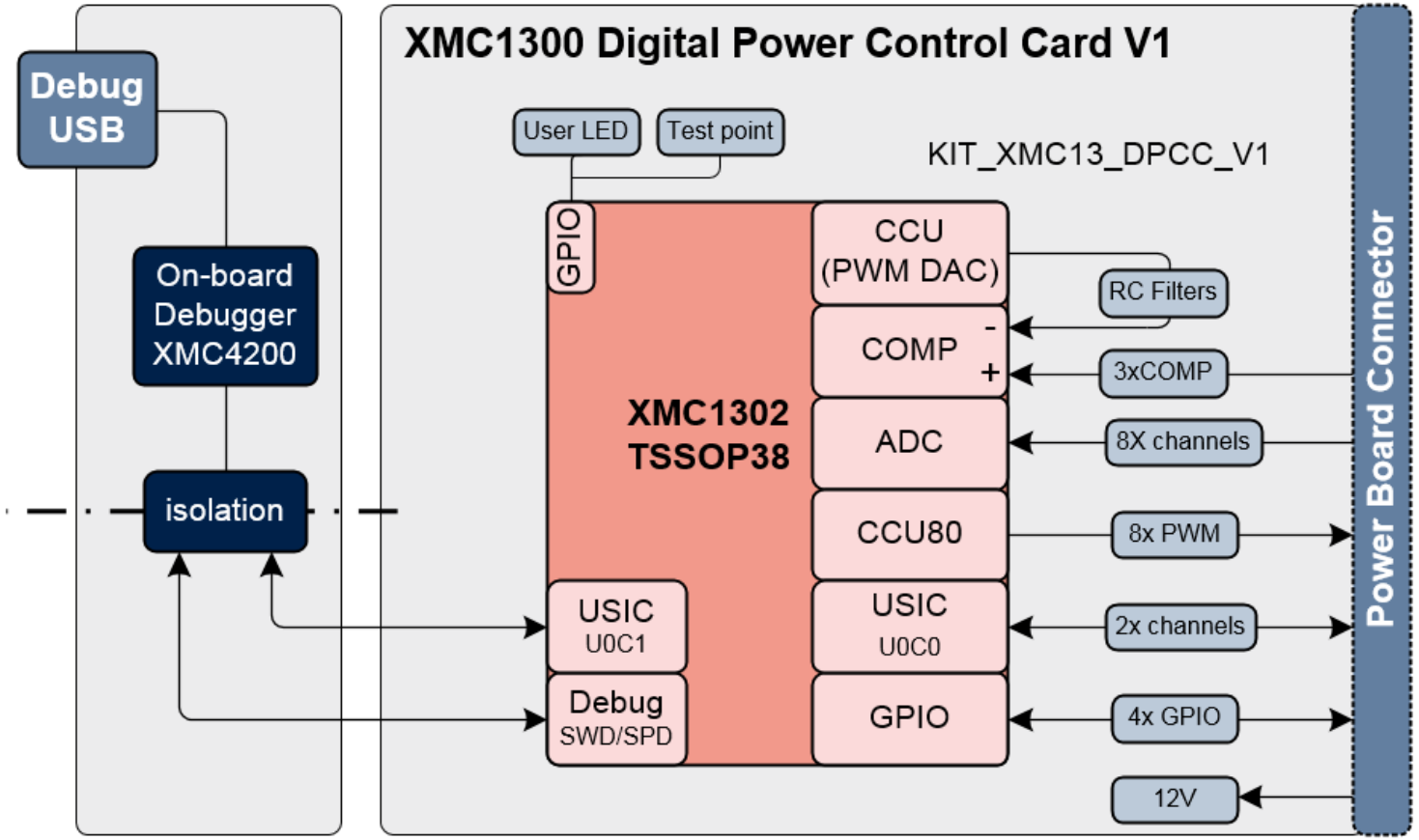
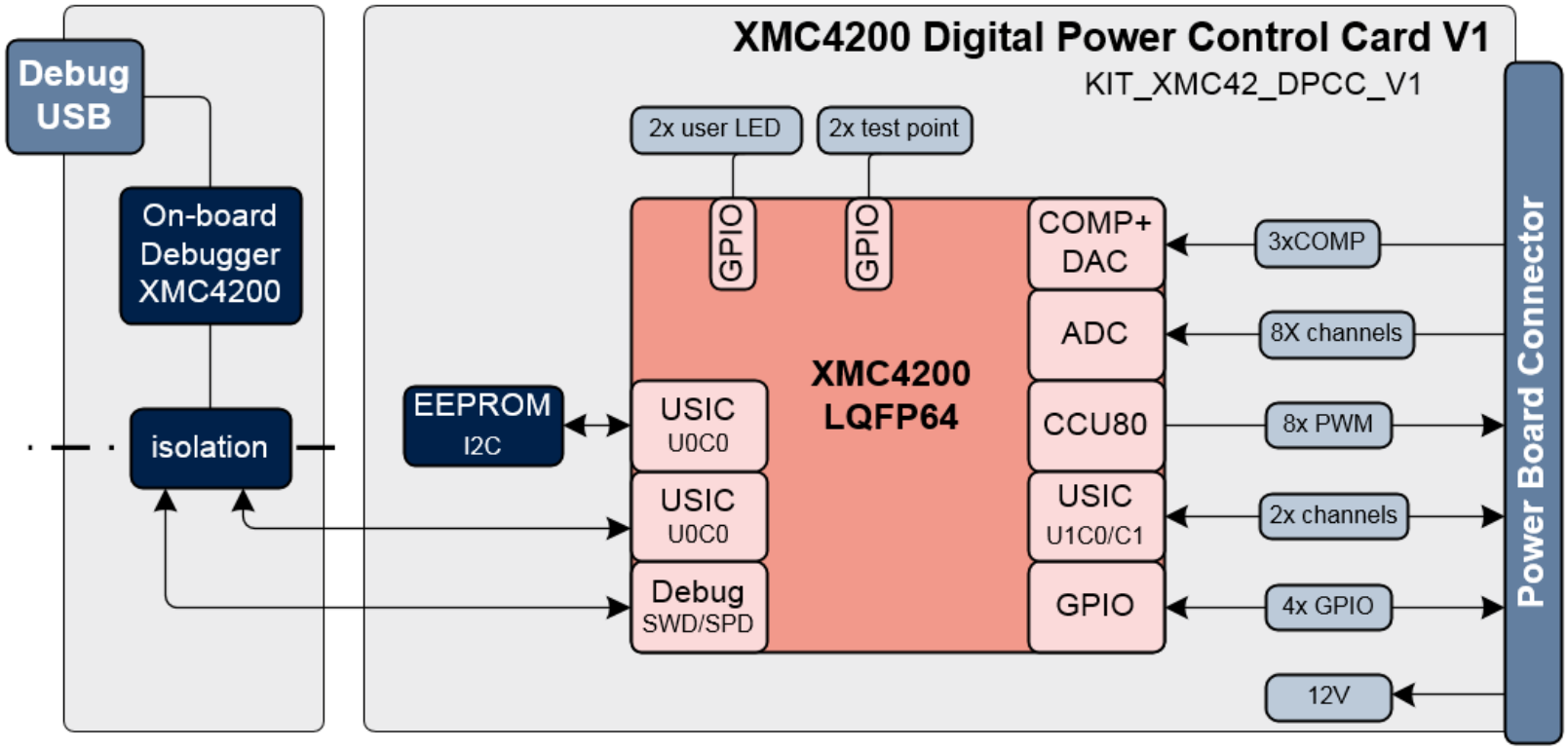
Hardware Overview

› Hardware Block Diagram of XMC1300 Control Card:



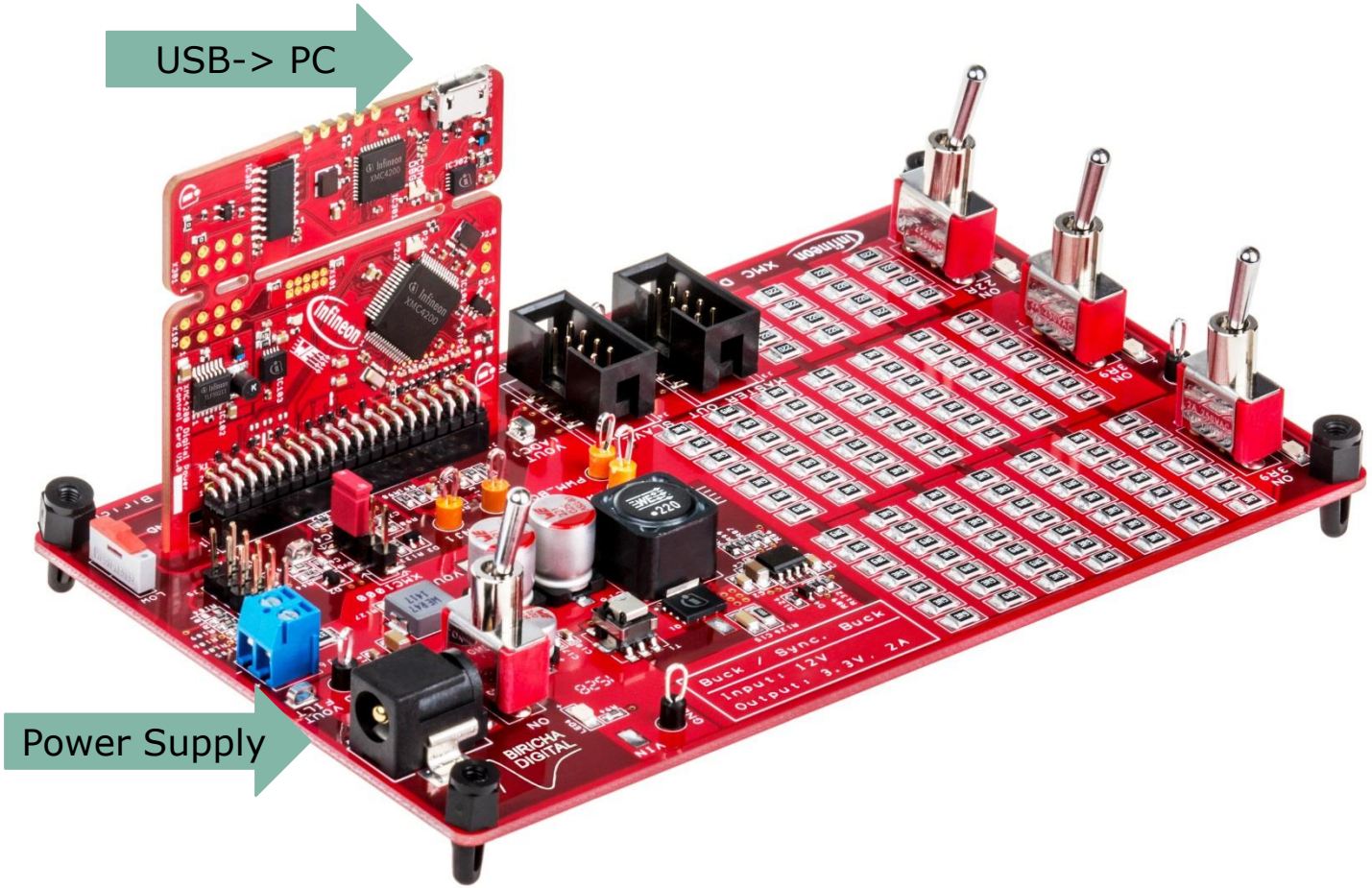
Hardware Overview

› Hardware Block Diagram of XMC4200 Control Card:



Hardware Overview

› Hardware connection is shown below:



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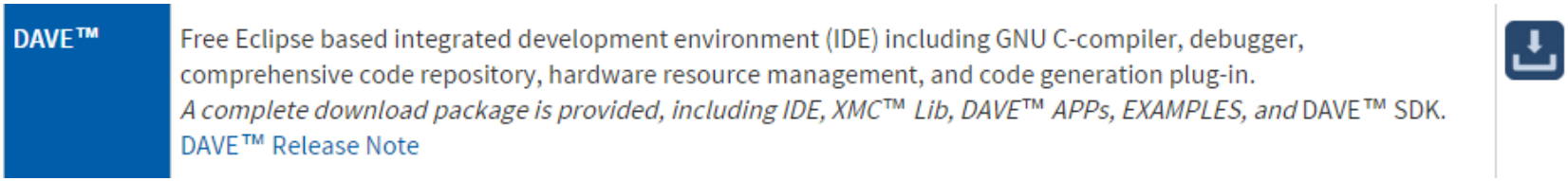
Tooling Overview – DAVE™ (1/5)

- Download DAVE™ installer package from:

  http://www.infineon.com/dave

- Download and unzip the installer package

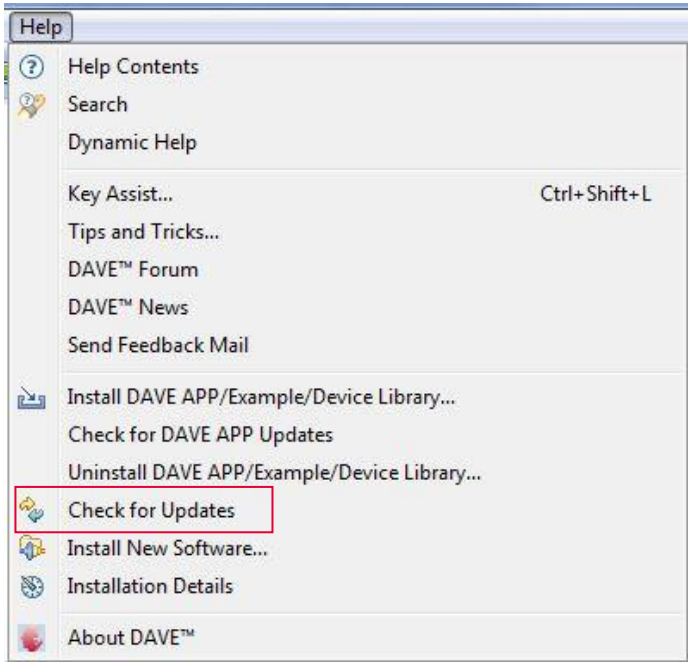


- Run *_Setup.exe file to install DAVE and Segger J-Link drivers
- After Installation, DAVE™ v4 can be started from desktop.

Tooling Overview – DAVE™ (2/5)

- Check for DAVE updates

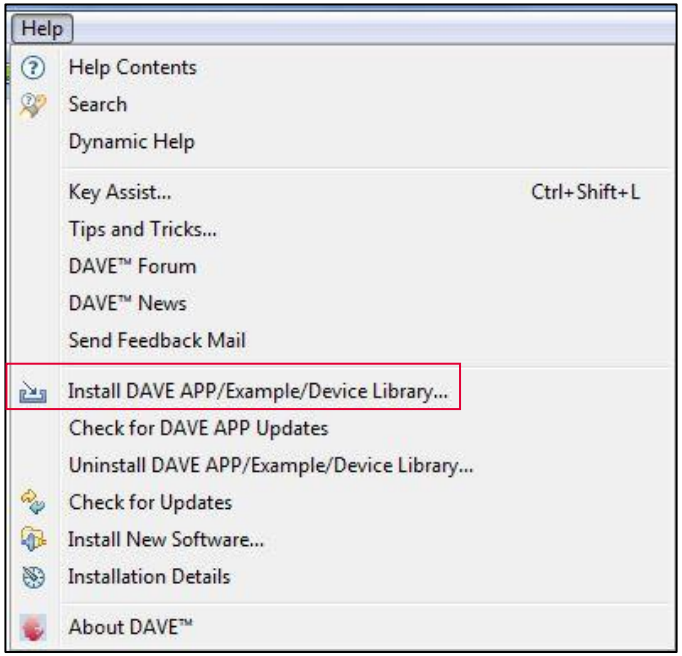
  Help → Check for Updates



Tooling Overview – DAVE™ (3/5)

- Install DAVE APPs and Device Descriptions

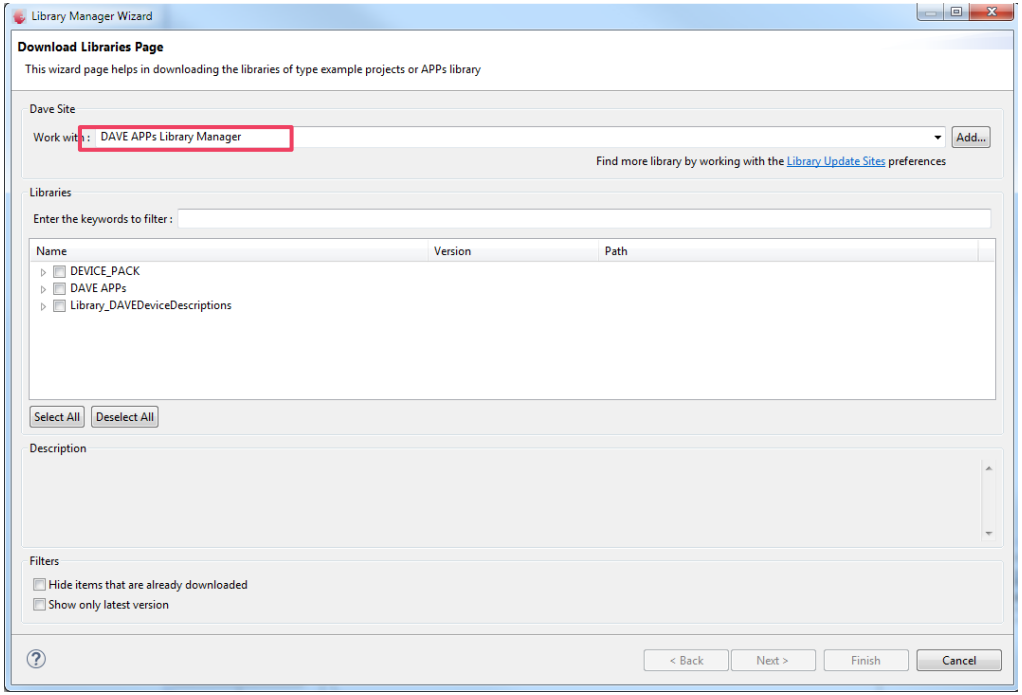
  Help → Install DAVE APP/Example/Device Library



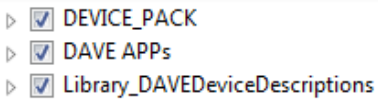
- Note: You may skip the above step if you are not using DAVE APPs

Tooling Overview – DAVE™ (4/5)

- Select DAVE Apps Library Manager in the drop-down menu

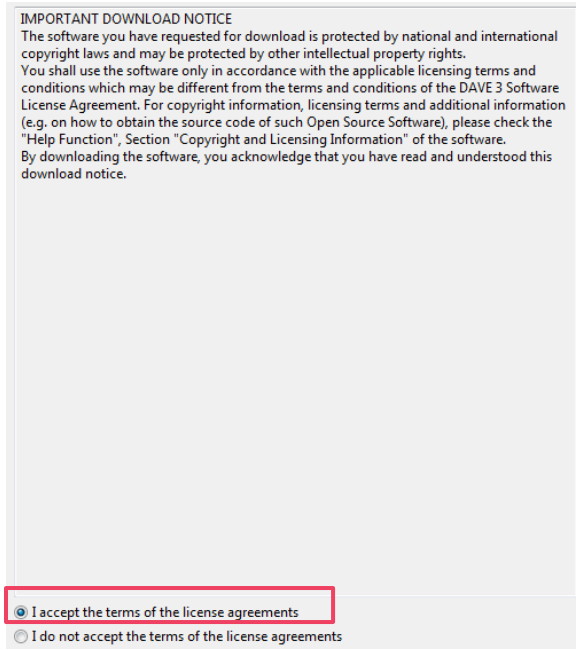


- Select all and click Next



Tooling Overview – DAVE™ (5/5)

- Accept terms of the license agreements and click Finish



- DEVICE_PACK, DAVE APPs and DAVE device descriptions are installed

Agenda (1/2)

1. Kit Overview
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   - 4a Example – XMC4200 Buck Converter in Voltage Control Mode
   - 4b Example – XMC1300 Buck Converter in Voltage Control Mode

Getting Started – Example – XMC4200 Buck Converter in Voltage Control Mode (1/16)

- For this project, we will use
  - Hardware: XMC Digital Power Explorer Power Board + XMC4200 Digital Power Control Card
  - Tools: DAVE™ version 4

- Next, we will show you
  1. How to create project in DAVE™.
  2. Select and configure the required DAVE APPs to control the switching of the buck converter.

Getting Started – Example – XMC4200 Buck Converter in Voltage Control Mode (2/16)

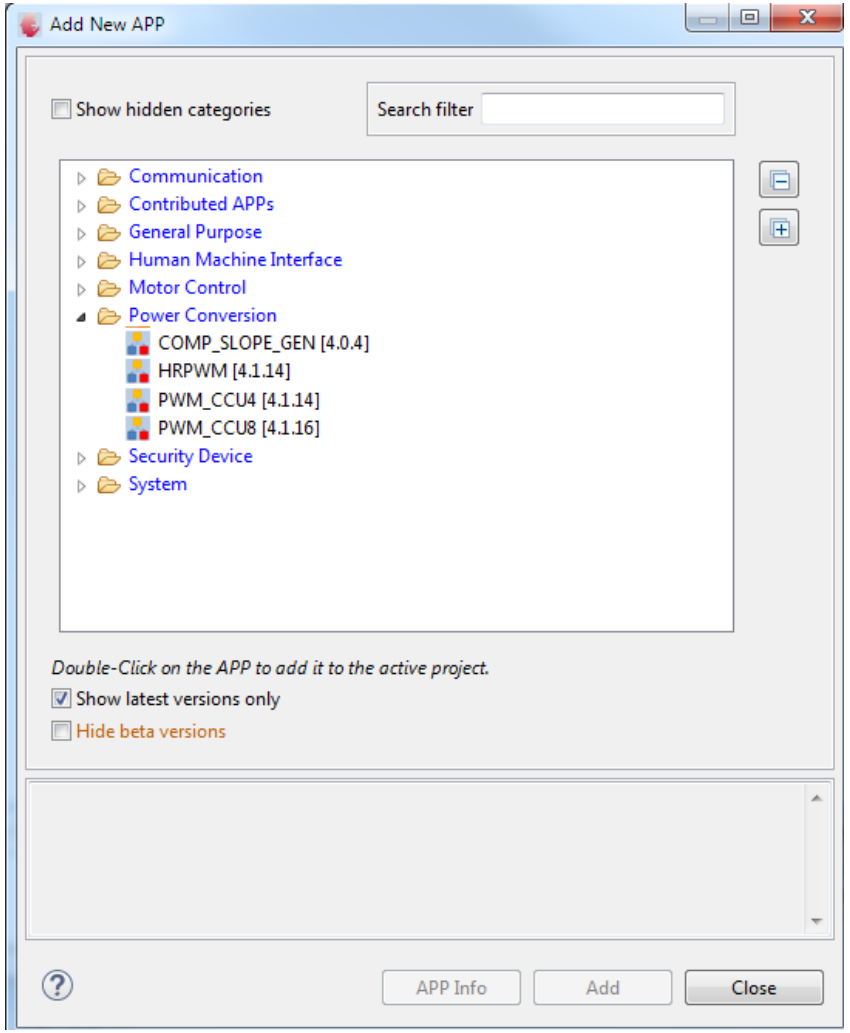
1. Open DAVE™ 

2. In DAVE™ workspace, create DAVE Code Engine (CE) project
   - Go to File -> New -> DAVE Project
   - Select DAVE CE Project
   - Click Next
   - Select the device accordingly
     - For XMC4200 Digital Power Control Card, select 'XMC4200-F64x256'

3. To change Compiler optimization level
   - Click to change active project setting.
   - Select C/C++ Build -> Settings.
   - Under Tool Settings, select ARM-GCC C Compiler -> Optimization.
   - Set Optimization level to 'Optimize most (-O3)'

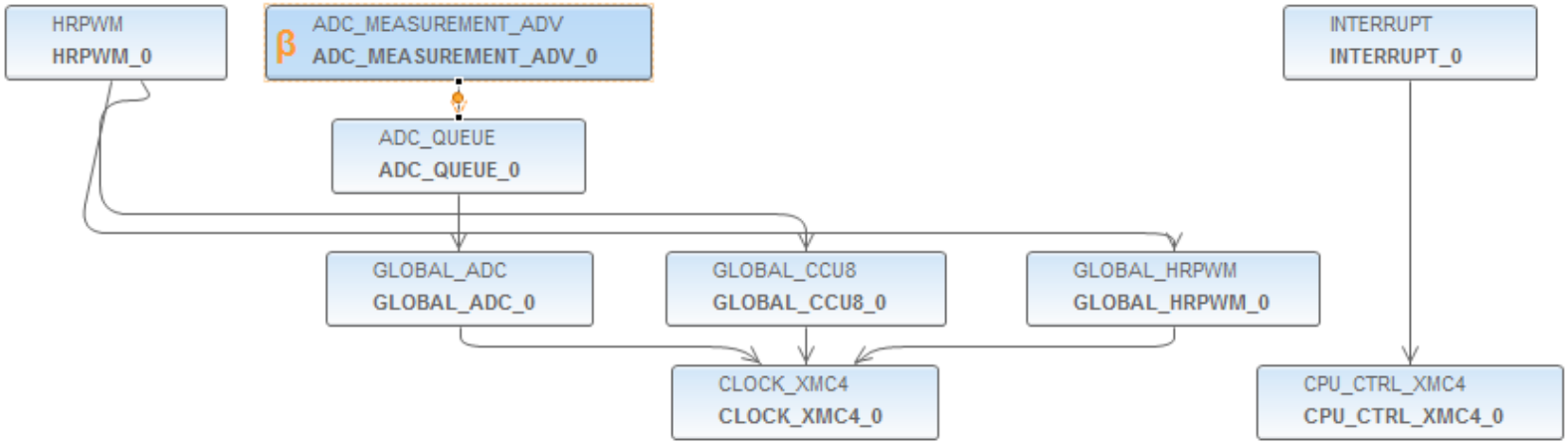
Getting Started – Example – XMC4200 Buck Converter in Voltage Control Mode (3/16)

4. Add the required APPs to Project:
   - Click  in Tool Panel
   - Double-click for including the following APPs:
     - HRPWM
     - ADC_MEASUREMENT_ADV
     - COMP_SLOPE_GEN
     - INTERRUPT



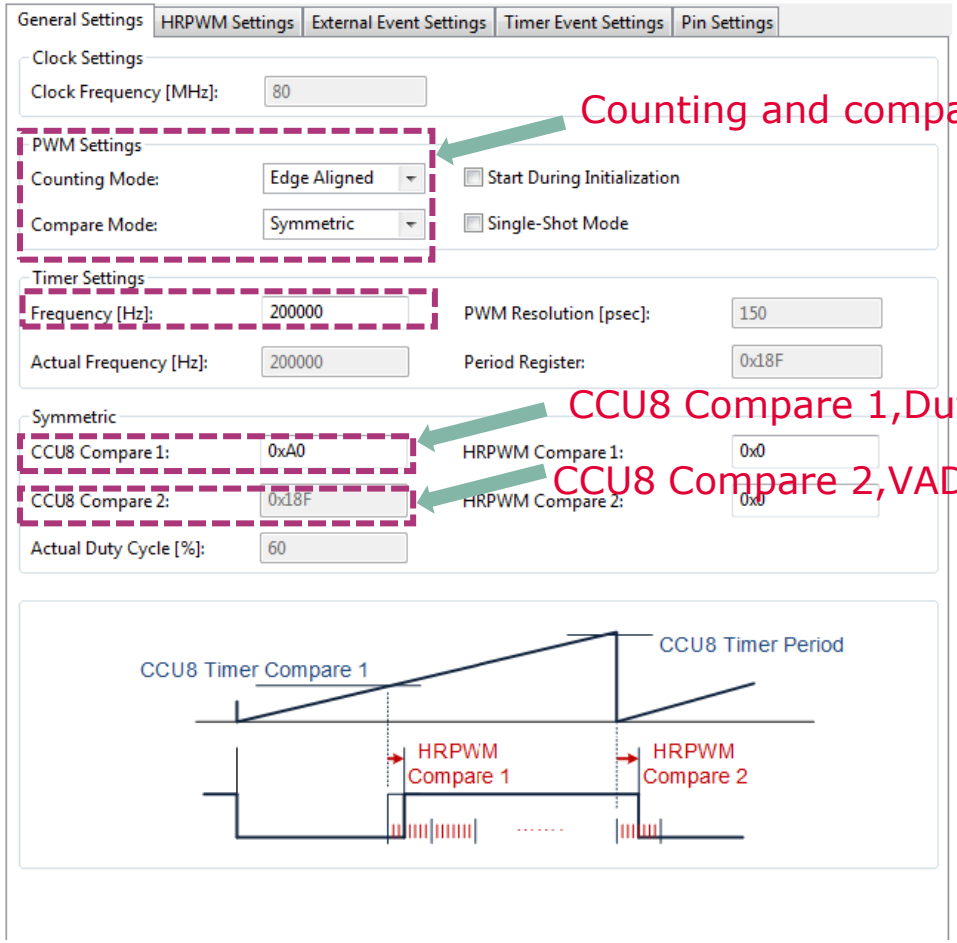
Getting Started – Example – XMC4200 Buck Converter in Voltage Control Mode (4/16)

- After including the APPs, the APP Dependency View of your project should look like this:



Getting Started – Example – XMC4200 Buck Converter in Voltage Control Mode (5/16)

5. Configure HRPWM APP – PWM and VADC trigger signal configuration



Counting and compare mode

PWM Frequency

CCU8 Compare 1,Duty cycle

CCU8 Compare 2,VADC trigger signal

Getting Started – Example – XMC4200 Buck Converter in Voltage Control Mode (6/16)

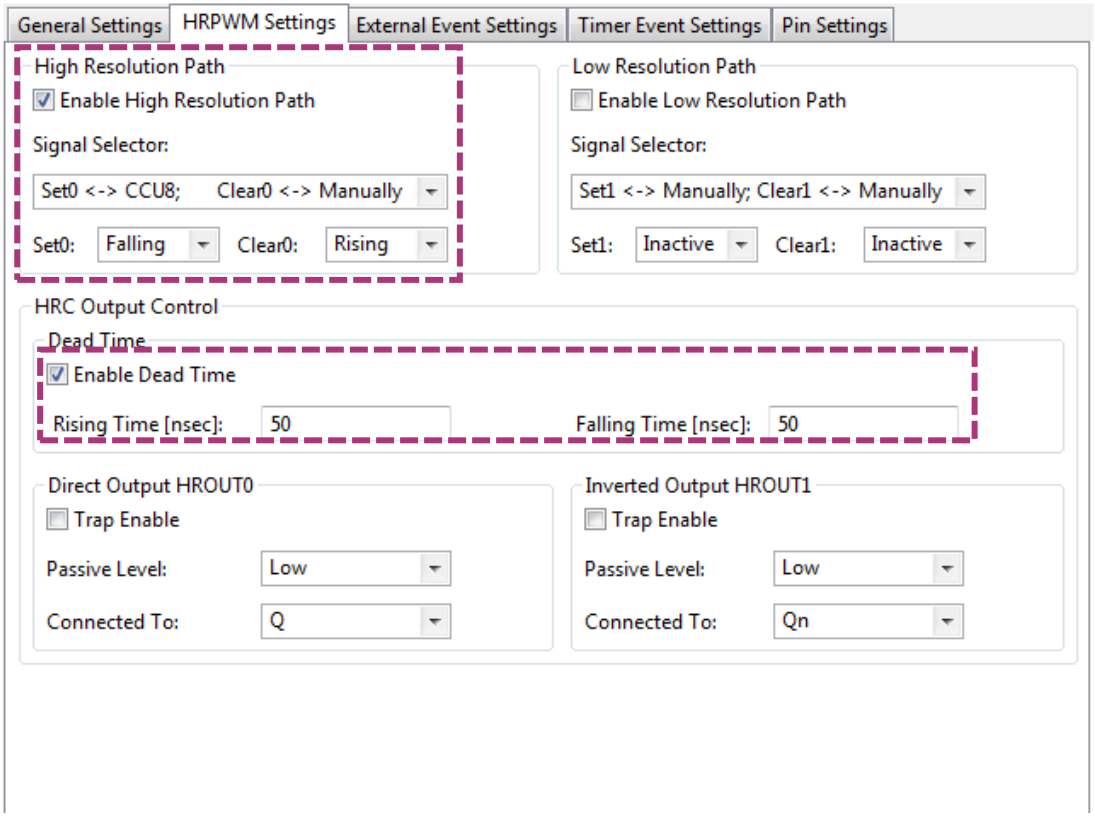
6. Configure HRPWM APP – PWM and VADC trigger signal configuration

Enabling HR path

Configuring set and clear signals

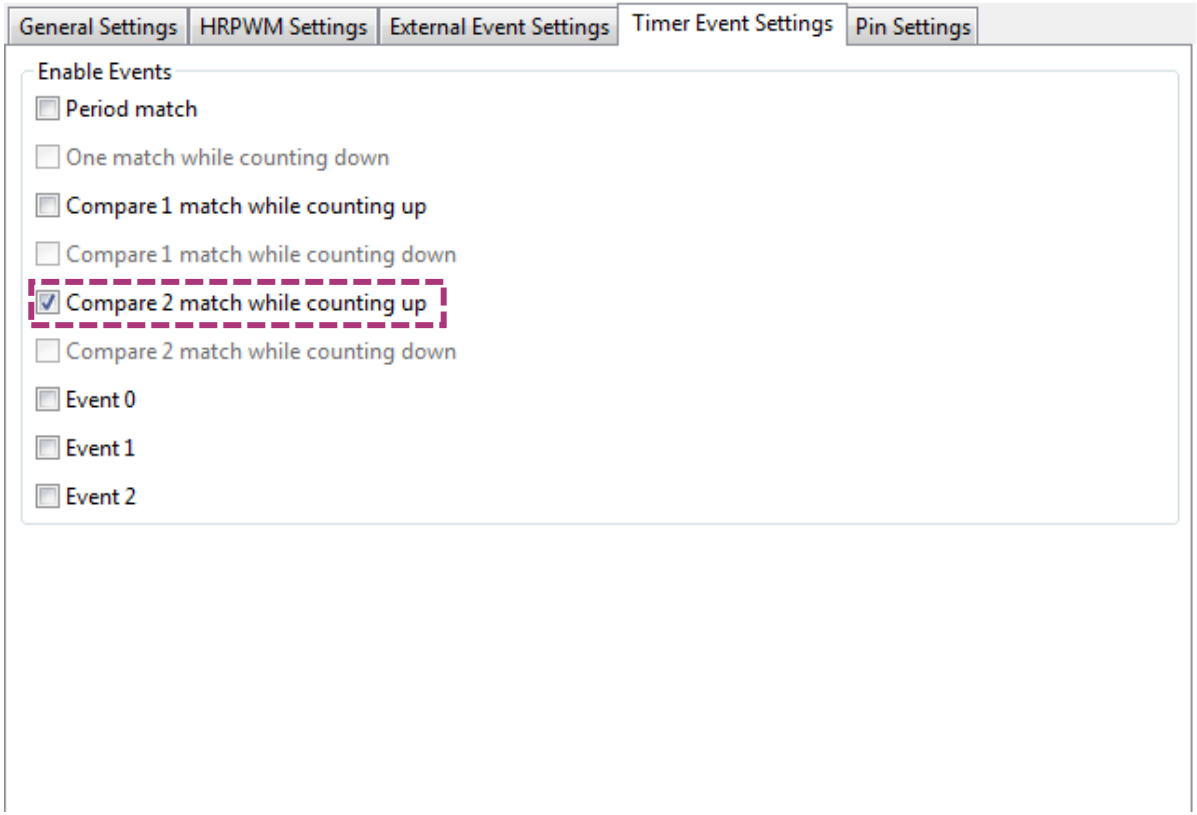
Enable Dead Time:

Rising and Falling time 50ns



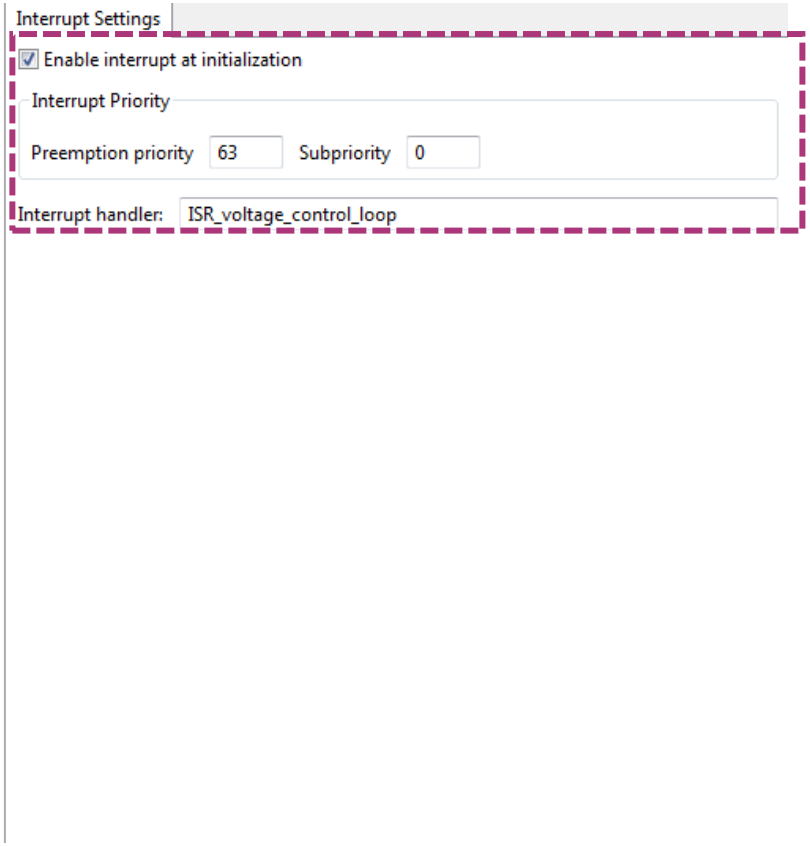
Getting Started – Example – XMC4200 Buck Converter in Voltage Control Mode (7/16)

7. Configure HRPWM APP – Enable Compare Match 2 while counting up (for VADC conversions triggering)



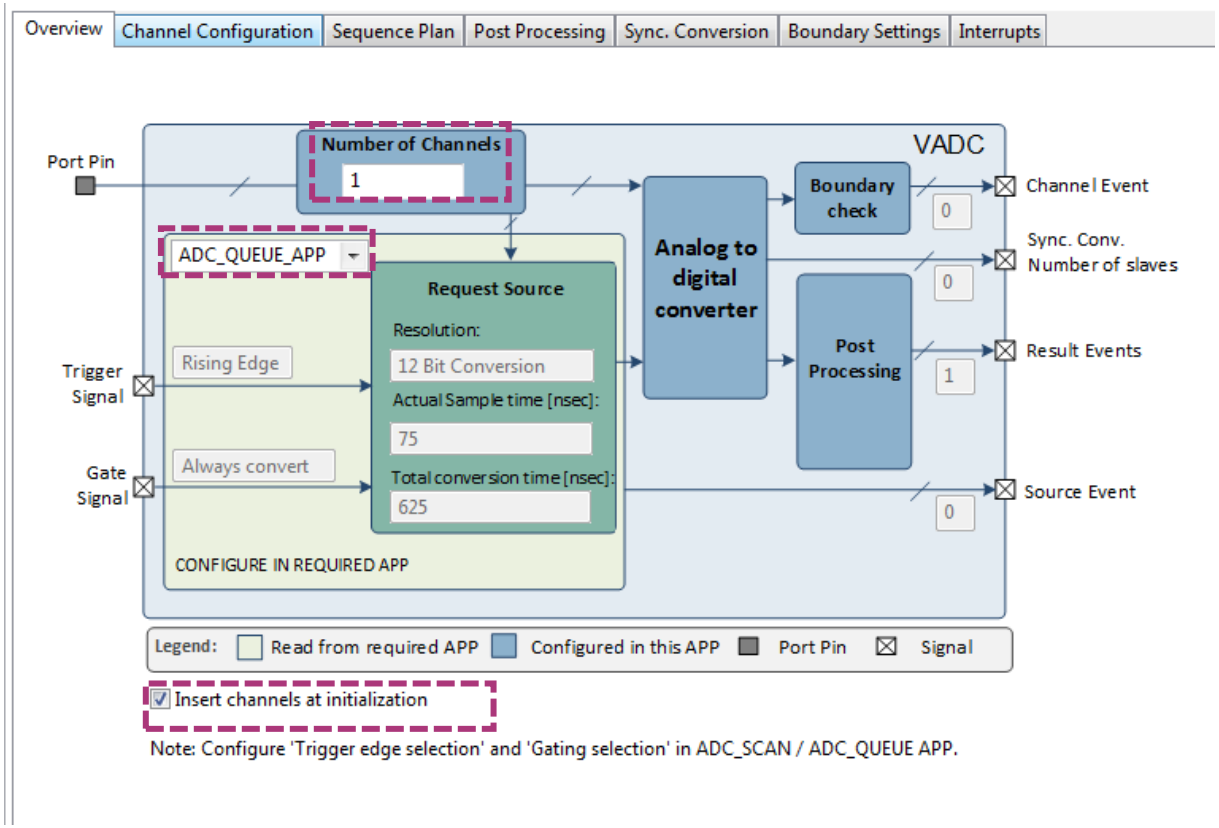
Getting Started – Example – XMC4200 Buck Converter in Voltage Control Mode (8/16)

8. Configure INTERRUPT APP – Interrupt Settings, Enable the interrupt at initialization and choose the name for the voltage control loop callback.



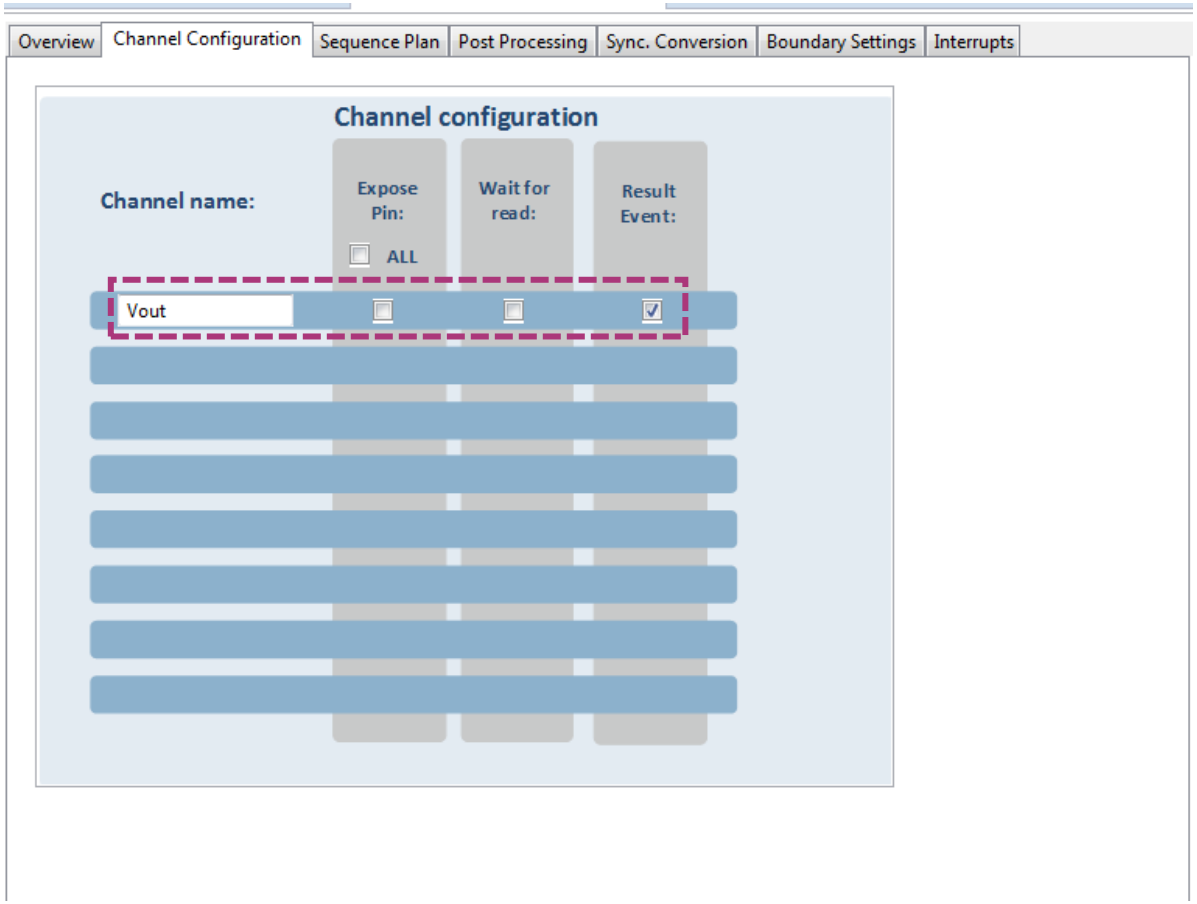
Getting Started – Example – XMC4200 Buck Converter in Voltage Control Mode (9/16)

9. Configure ADC_MEASUREMENT_ADV APP – Choose 1 channel, select the queue request source and insert the channel at initialization



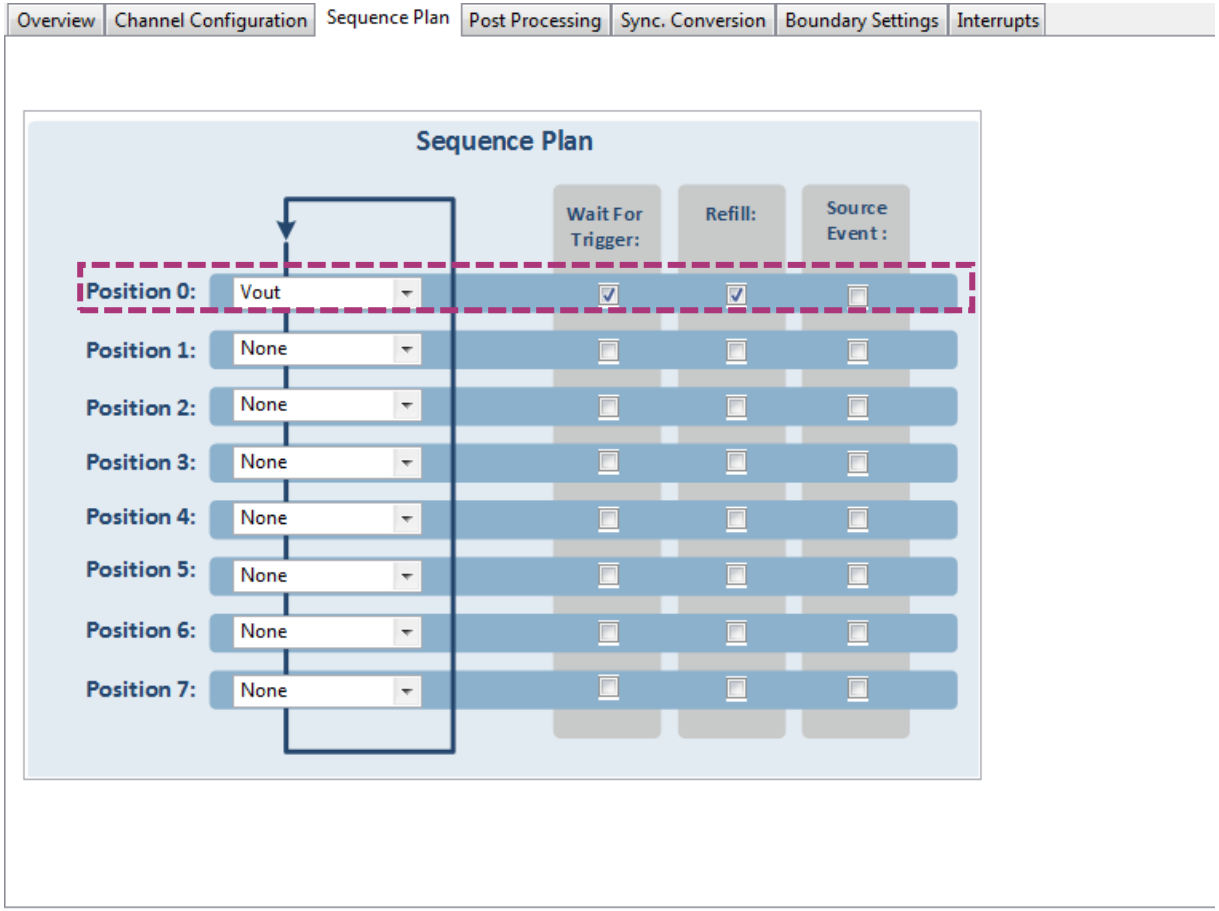
Getting Started – Example – XMC4200 Buck Converter in Voltage Control Mode (10/16)

10. Configure ADC_MEASUREMENT_ADV APP – Give a name to the measured channel (Vout) and enable the "Result Event"



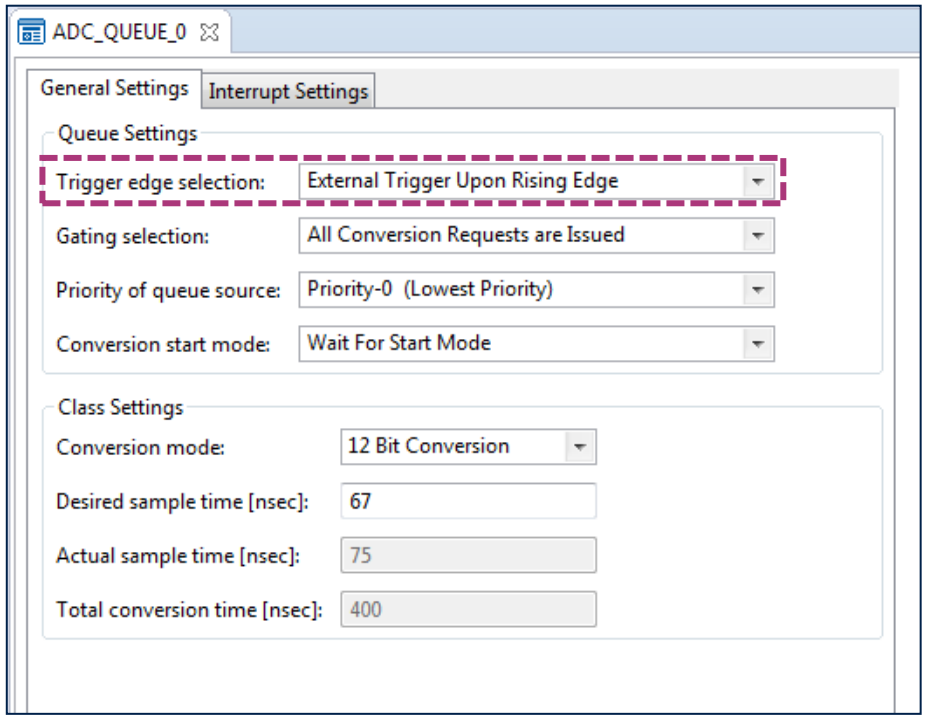
Getting Started – Example – XMC4200 Buck Converter in Voltage Control Mode (11/16)

11. Configure ADC_MEASUREMENT_ADV APP – Configure the sequence for the conversion and select “Wait For Trigger” and “Refill”.



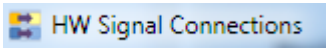
Getting Started – Example – XMC4200 Buck Converter in Voltage Control Mode (12/16)

12. Configure Trigger edge selection in the ADC_QUEUE APP



Getting Started – Example – XMC4200 Buck Converter in Voltage Control Mode (13/16)

13. Click  to open Manual Pin Allocator view
    - Allocate:
      - Vout pin to P14.6
      - HRPWM OUT0 to P0.5
      - HRPWM OUT1 to P0.2

14. Connect hardware signal by doing right-click in the APP and then select 

    - In HRPWM connect:
      - event_ch2_cmp_match→ ADC_QUEUE→trigger_input

    - In ADC_MEASUREMENT_ADV connect:
      - Event_res_Vout→ INTERRUPT→sr_irq

Getting Started – Example – XMC4200 Buck Converter in Voltage Control Mode (14/16)

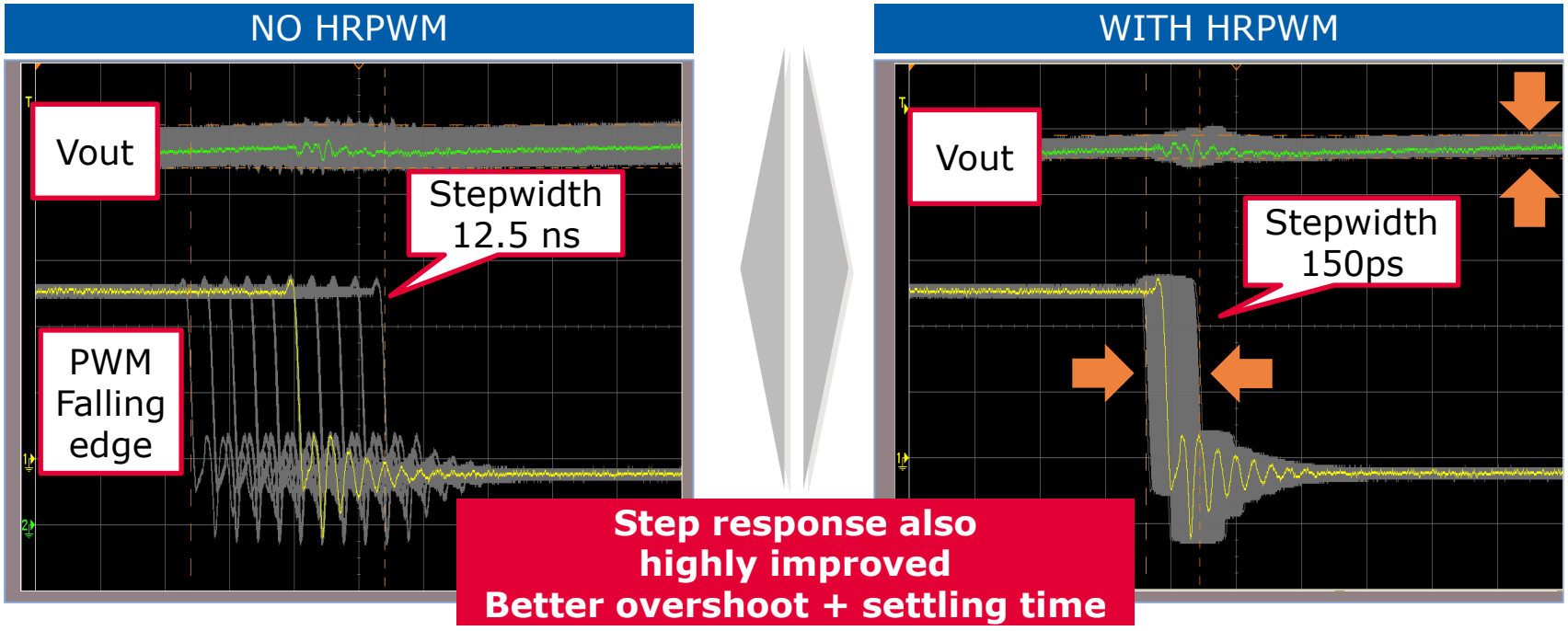
15. Make sure you have the source code for the voltage control loop implementation. The following files can be copied from the provide example project(go to section 6. References for more information):
    - xmc_3p3z_filter_float.h
    - main.c

16. Prepare board set up:
    - Connect XMC4200 Digital Power Control Card into XMC Digital Power Explorer and supply power with included power adapter to it.
    - Place the jumper is in the “XMC4000” position.
    - Make sure power on switch is in the "on" position.

Getting Started – XMC4200 Example Buck Converter in Voltage Control Mode (15/16)

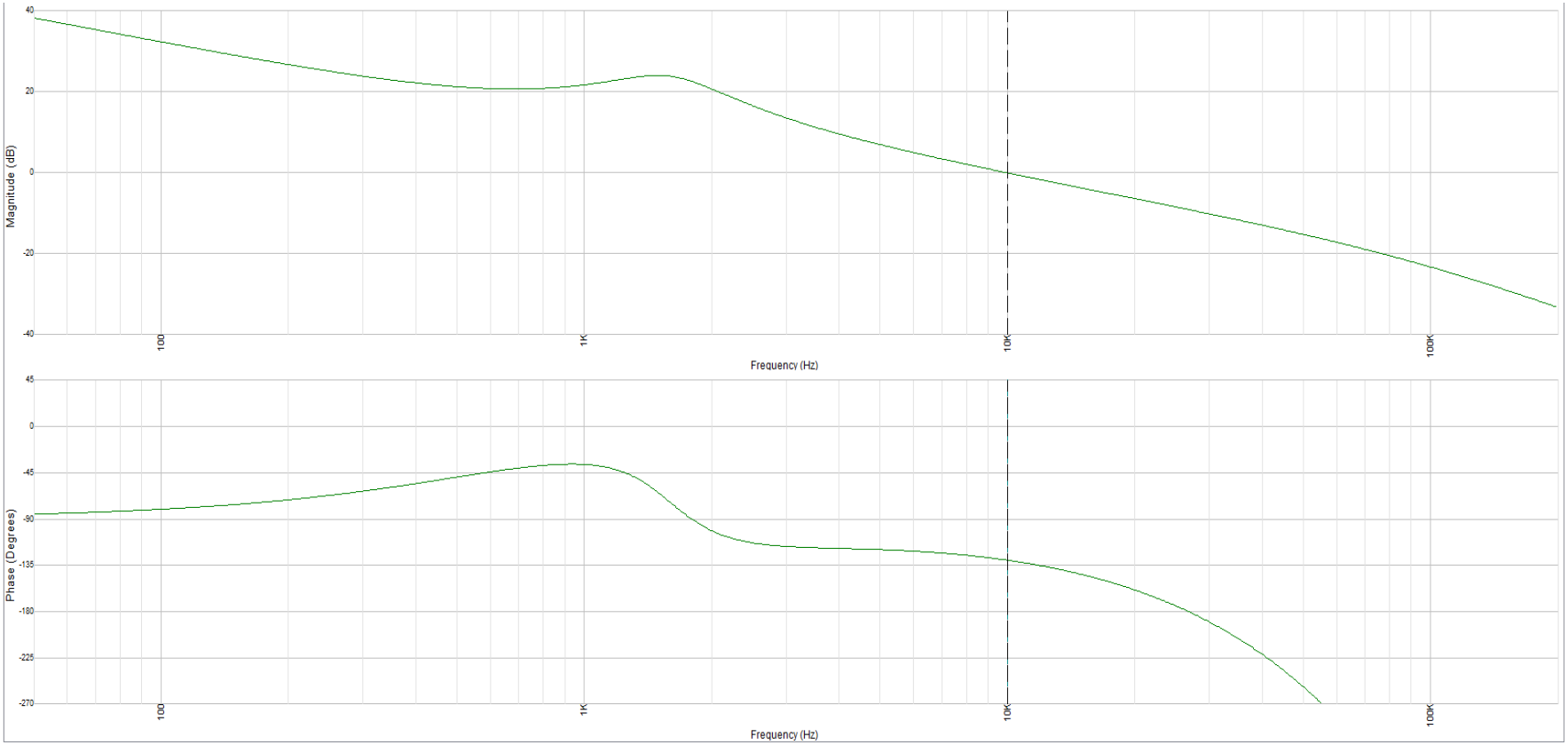
17. Click  to generate code
18. Click  to build project
19. Download code and debug
    - Click 
    - Click  to run code

› With finer adjustment of the duty cycle, the output voltage is regulated more accurately and this reduce the ripple significantly



Getting Started – XMC4200 Example Buck Converter in Voltage Control Mode (16/16)

- Expected Frequency Response of the control loop: crossover frequency 10kHz, phase margin 50°, gain margin 10dB



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Getting Started – Example – XMC1300 Buck Converter in Voltage Control Mode (1/16)

- For this project, we will use
  - Hardware: XMC Digital Power Explorer Power Board + XMC1300 Digital Power Control Card
  - Tools: DAVE™ version 4

- Next, we will show you
  1. How to create project in DAVE™.
  2. Configure the required DAVE APPs to control the switching of the buck converter.

Getting Started – Example – XMC1300 Buck Converter in Voltage Control Mode (2/16)

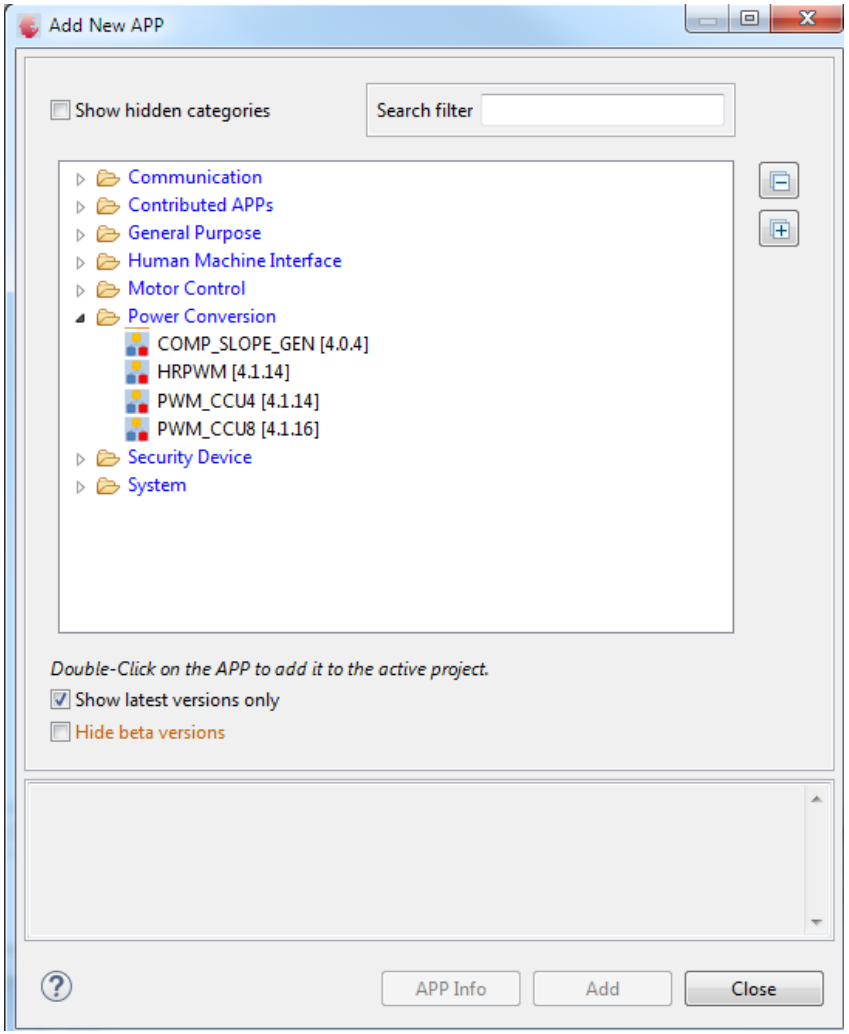
1. Open DAVE™ 

2. In DAVE™ workspace, create DAVE Code Engine (CE) project
   - Go to File -> New -> DAVE Project 
   - Select DAVE CE Project
   - Click Next
   - Select the device accordingly
     - For XMC1300 Digital Power Control Card, select 'XMC1302-T038x200'

3. To change Compiler optimization level
   - Click  to change active project setting.
   - Select C/C++ Build -> Settings.
   - Under Tool Settings, select ARM-GCC C Compiler -> Optimization.
   - Set Optimization level to 'Optimize most (-O3)'

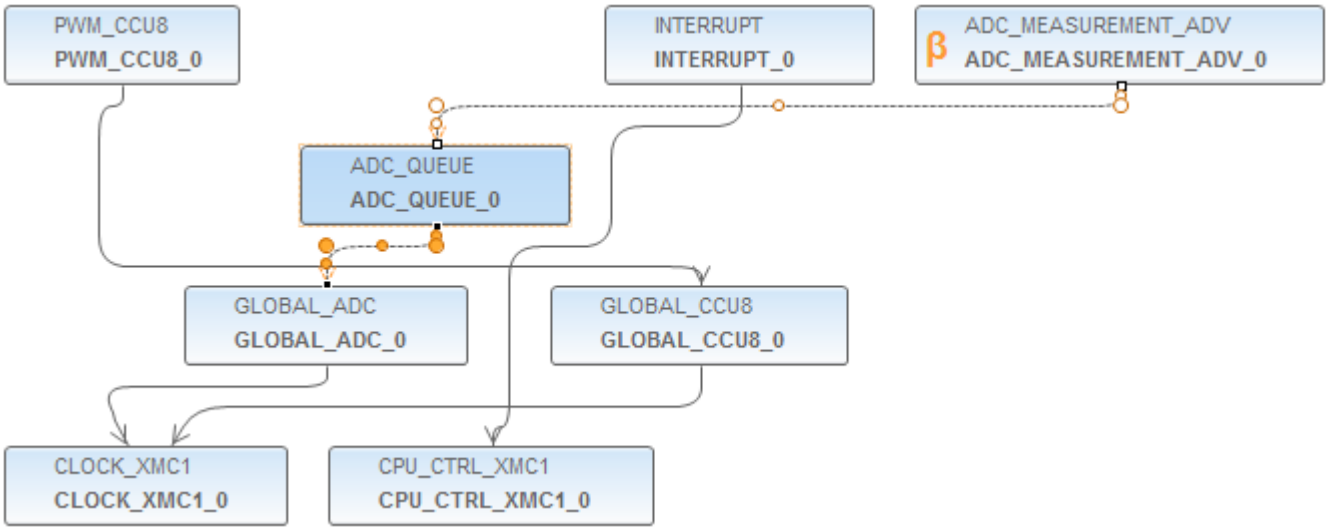
Getting Started – Example – XMC1300 Buck Converter in Voltage Control Mode (3/16)

4. Add the required APPs to Project:
   - Click  in Tool Panel
   - Double-click for including the following APPs:
     - PWM_CCU8
     - ADC_MEASUREMENT_ADV
     - INTERRUPT



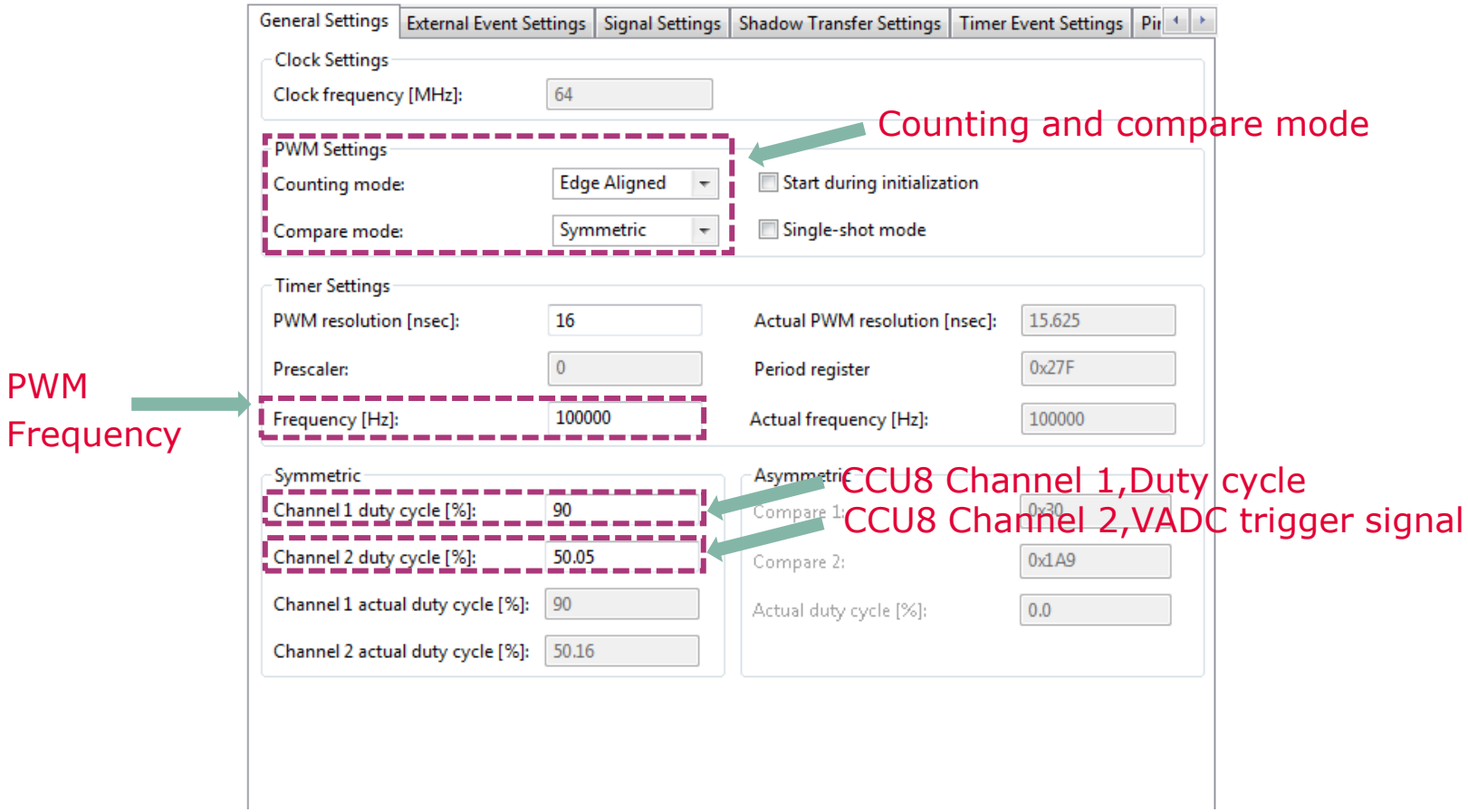
Getting Started – Example – XMC1300 Buck Converter in Voltage Control Mode (4/16)

- After including the APPs, the APP Dependency View of your project should look like this:



Getting Started – Example – XMC1300 Buck Converter in Voltage Control Mode (5/16)

5. Configure PWM_CCU8 APP – PWM and VADC trigger signal configuration



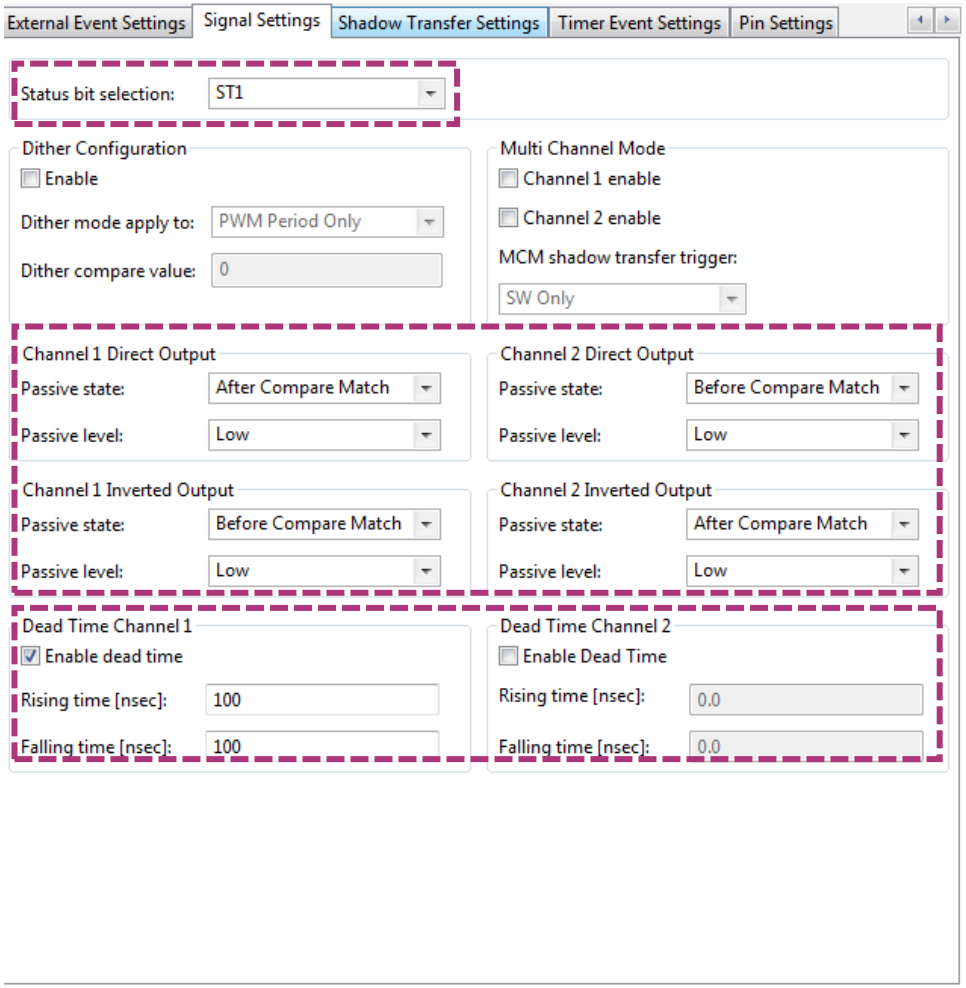
Getting Started – Example – XMC1300 Buck Converter in Voltage Control Mode (6/16)

6. Configure PWM_CCU8 APP – PWM and VADC trigger signal configuration

Status bit selection

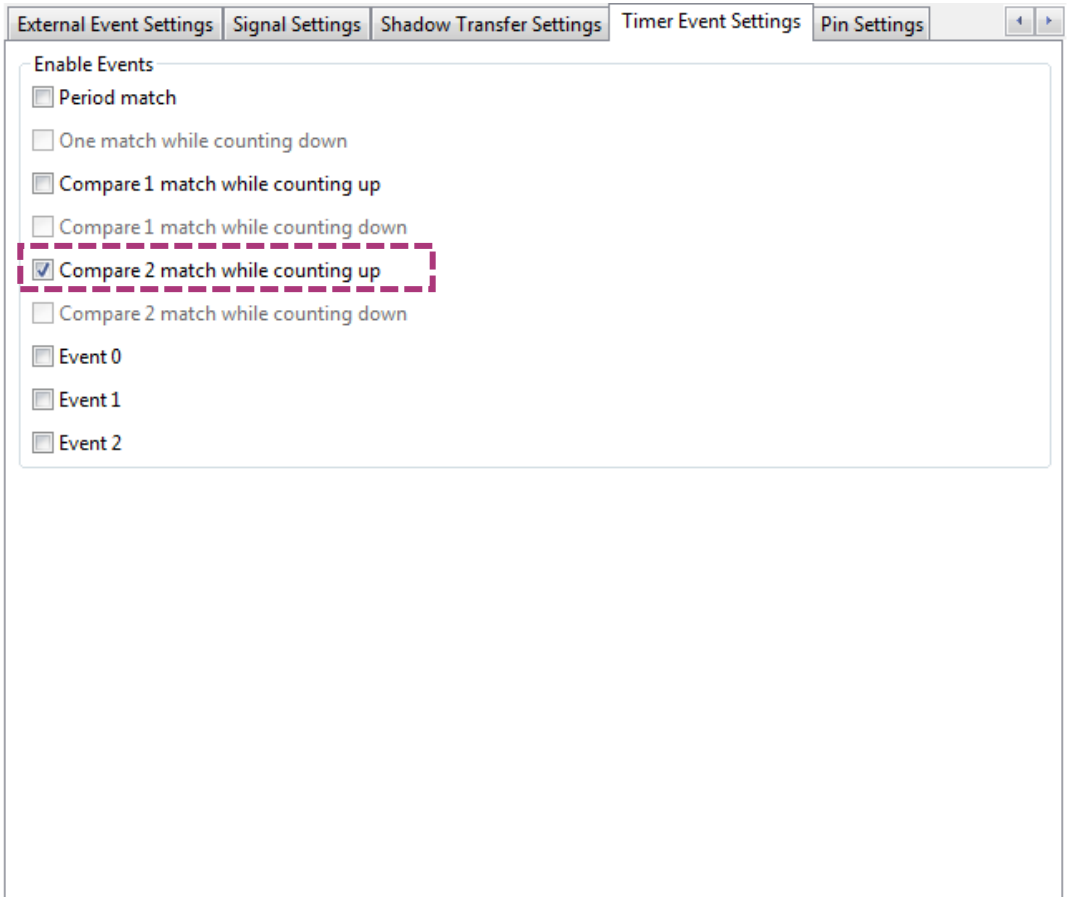
Channel 1 and Channel 2 Outputs configuration

Dead time selection



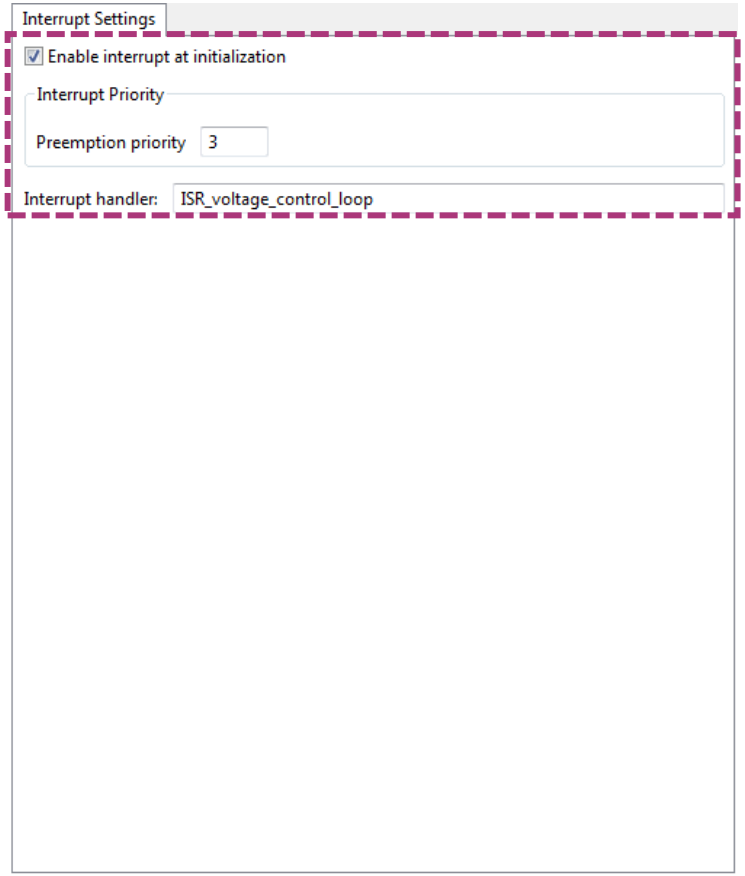
Getting Started – Example – XMC1300 Buck Converter in Voltage Control Mode (7/16)

7. Configure PWM_CCU8 APP – Enable Compare Match 2 while counting up (for VADC conversions triggering)



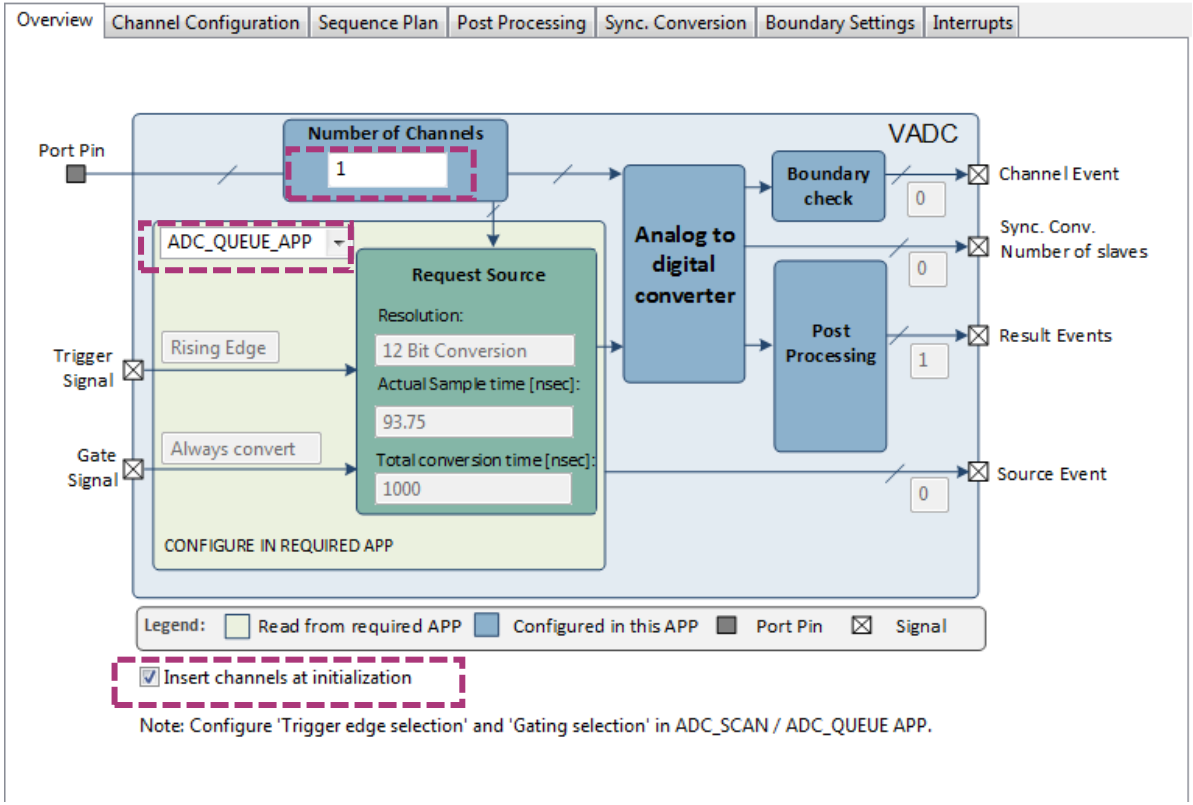
Getting Started – Example – XMC1300 Buck Converter in Voltage Control Mode (8/16)

8. Configure INTERRUPT APP – Interrupt Settings, Enable the interrupt at initialization and choose the name for the voltage control loop callback.



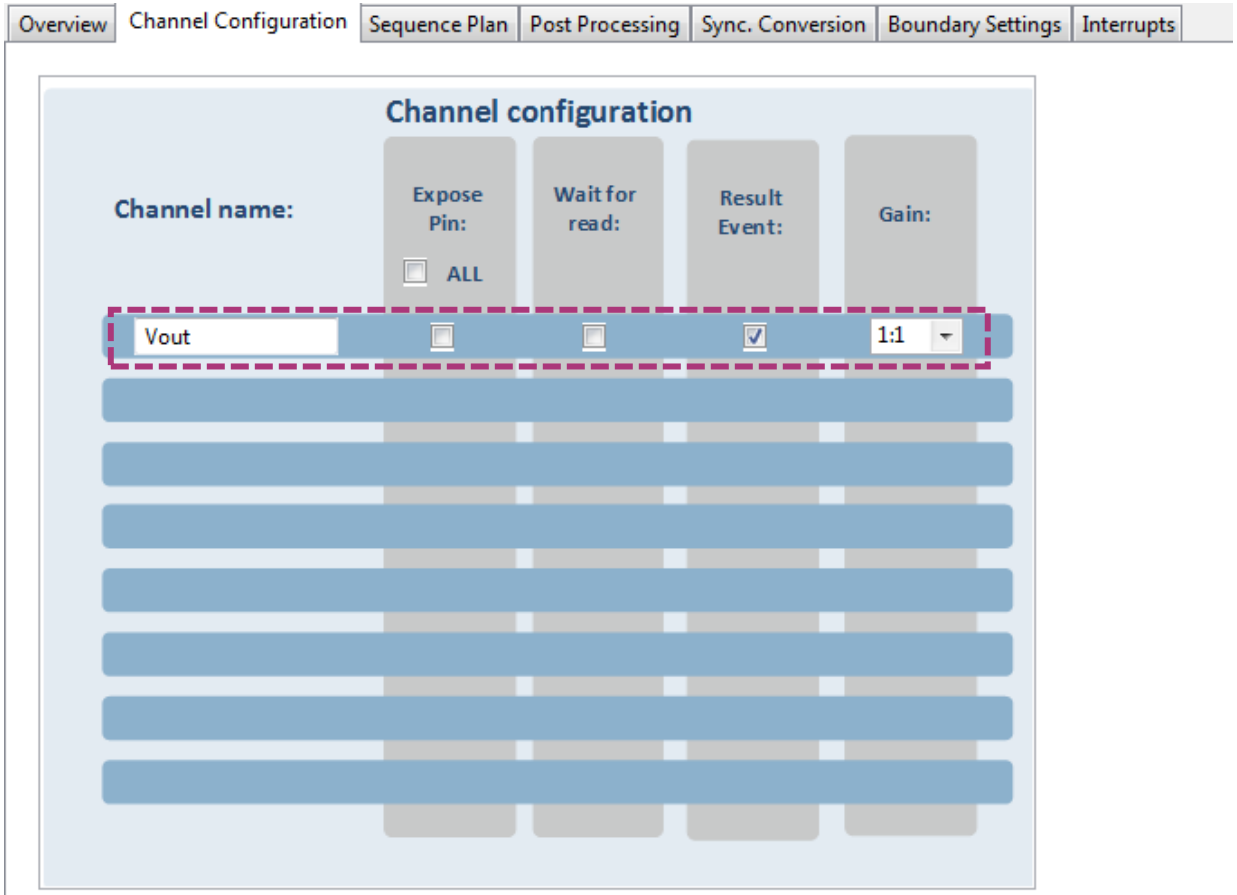
Getting Started – Example – XMC1300 Buck Converter in Voltage Control Mode (9/16)

9. Configure ADC_MEASUREMENT_ADV APP – Choose 1 channel, select the queue request source and insert the channel at initialization



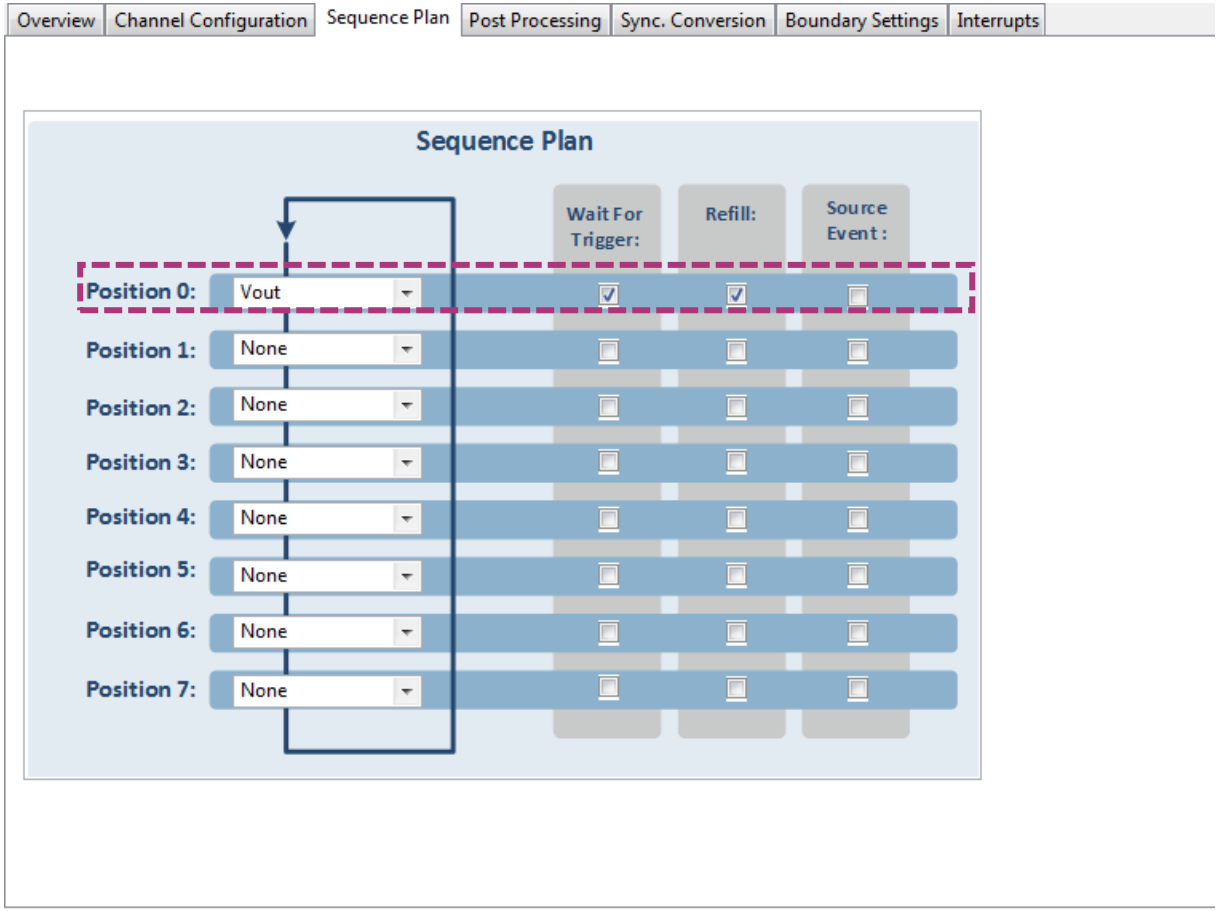
Getting Started – Example – XMC1300 Buck Converter in Voltage Control Mode (10/16)

10. Configure ADC_MEASUREMENT_ADV APP – Give a name to the measured channel (Vout) and enable the "Result Event"



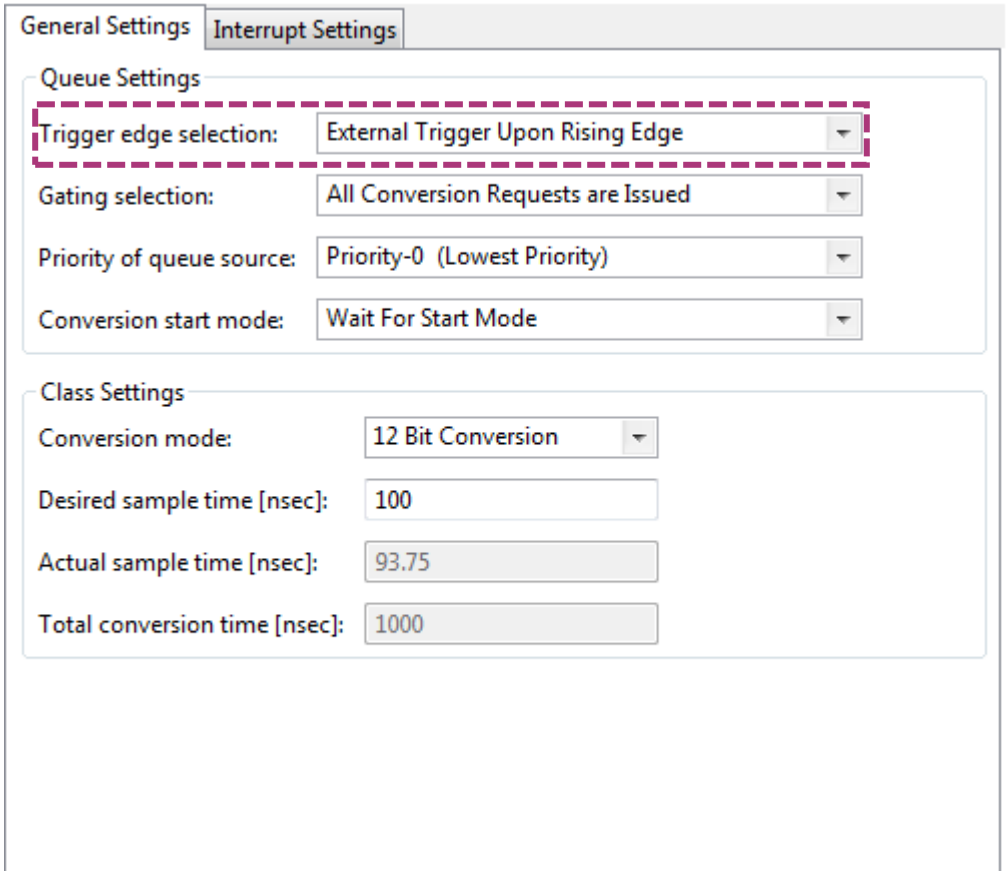
Getting Started – Example – XMC1300 Buck Converter in Voltage Control Mode (11/16)

11. Configure ADC_MEASUREMENT_ADV APP – Configure the sequence for the conversion and select “Wait For Trigger” and “Refill”.



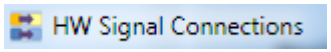
Getting Started – Example – XMC1300 Buck Converter in Voltage Control Mode (12/16)

12. Configure Trigger edge selection in the ADC_QUEUE APP



Getting Started – Example – XMC1300 Buck Converter in Voltage Control Mode (13/16)

13. Click  to open Manual Pin Allocator view
    - Allocate:
      - Vout pin to P2.3
      - PWM_CCU8 CH1 Direct Out to P0.0
      - PWM_CCU8 CH1 Invert Out to P0.5

14. Connect hardware signal by doing right-click in the APP and then select 

    - In HRPWM connect:
      - event_ch2_cmp_match→ ADC_QUEUE→trigger_input
    - In ADC_MEASUREMENT_ADV connect:
      - Event_res_Vout→ INTERRUPT→sr_irq

Getting Started – Example – XMC1300 Buck Converter in Voltage Control Mode (14/16)

15. Make sure you have the source code for the voltage control loop implementation. The following files can be copied from the provide example project(go to section 6. References for more information):
    - xmc_3p3z_filter_fixed.h
    - main.c

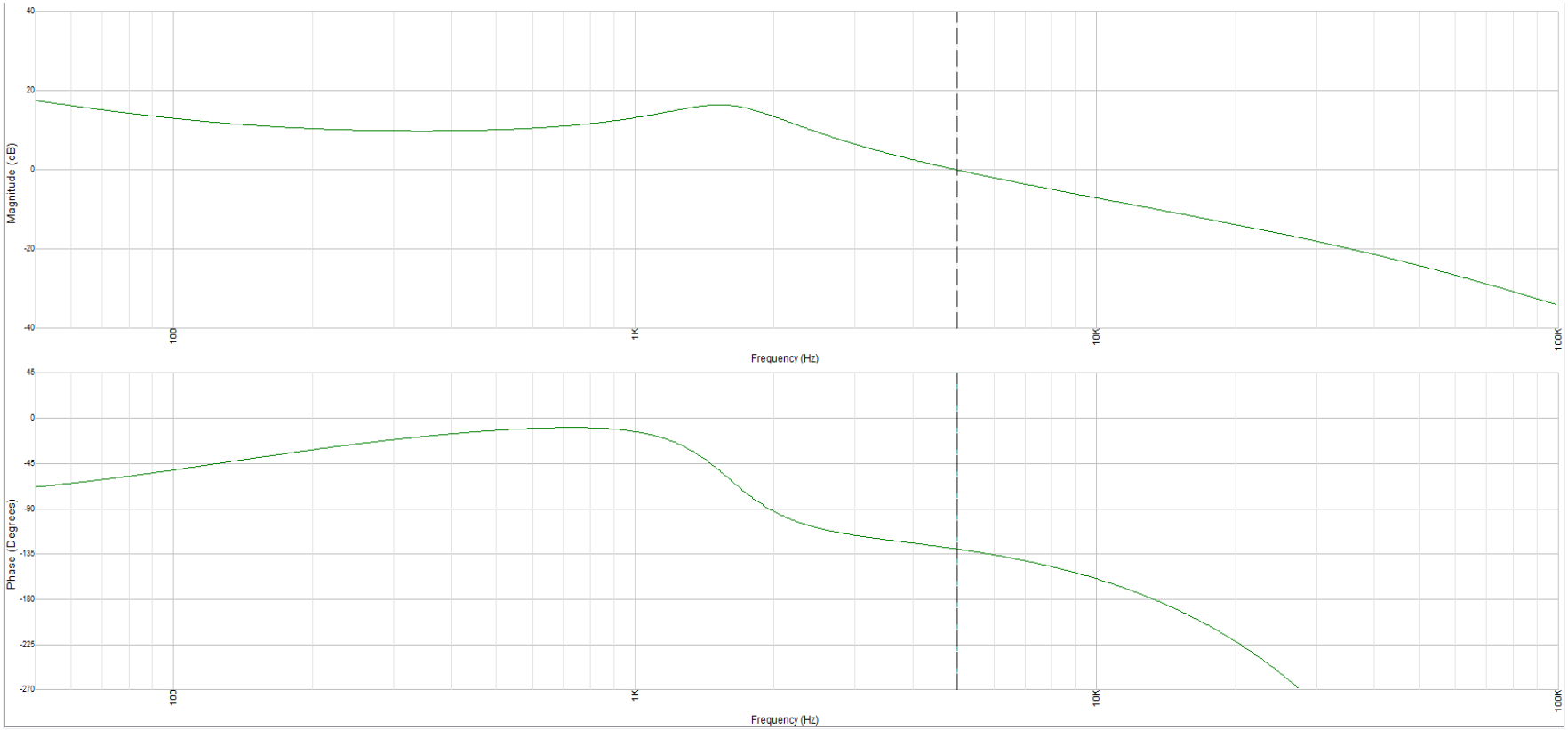
16. Prepare board set up:
    - Connect XMC1300 Digital Power Control Card into XMC Digital Power Explorer and supply power with included power adapter to it.
    - Place the jumper is in the “XMC4000” position(Voltage Control Mode position).
    - Make sure power on switch is in the "on" position.

Getting Started – Example – XMC1300 Buck Converter in Voltage Control Mode (15/16)

17. Click  to generate code
18. Click  to build project
19. Download code and debug
    - Click 
    - Switch to Debug view 
    - Click  to run code

Getting Started – Example – XMC1300 Buck Converter in Voltage Control Mode (16/16)

- Expected Frequency Response of the control loop: crossover frequency 5kHz, phase margin 50°, gain margin 10dB



Agenda (2/2)

5 General Information

6 References

6a – How to load Example Project in DAVE™?

6b – Where to download Example Projects?

General Information (1/2)

- Where to buy XMC Digital Power Explorer kit:
  - ISAR Order Name: KIT_XMC_DP_EXP_01

- Documentation:
  - XMC Digital Power Explorer Kit
  - XMC4100 / 4200 Reference Manual
  - XMC4100 / 4200 Datasheet
  - XMC1300 Reference Manual
  - XMC1300 Datasheet

- Video Series: XMC Digital Power Explorer Kit
  - XMC Digital Power Explorer Kit - Live Demo

General Information (2/2)

› Infineon parts utilized on kit:

Infineon Parts	Order Number
XMC1300 Microcontroller	XMC1302-T038X0200
XMC4200 Microcontroller	XMC4200-F64K256
XMC4200 Microcontroller	XMC4200-Q48K256
DC/DC Converter	IFX90121ELV50
Regulator	IFX54441LDV
Diode	BAS 16
Schottky Diode	BAT 54-05
Schottky Diode	BAS 3010B-03W
Dual N-Channel OptiMOS™ MOSFET	BSC0924NDI
High Side & low side gate driver	IRS2011SPBF

Agenda (2/2)

5 General Information

6 References

6a – How to load Example Project in DAVE™?

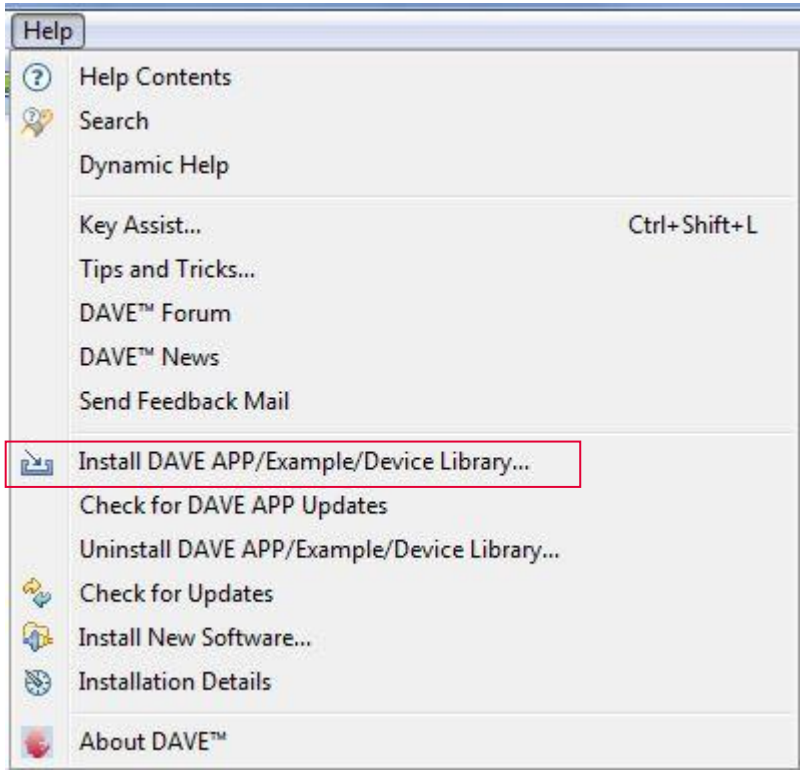
6b – Where to download Example Projects?

References –
Where to download Example Projects?

- DAVE™ Project Library Examples
  - Can be downloaded from library in DAVE™

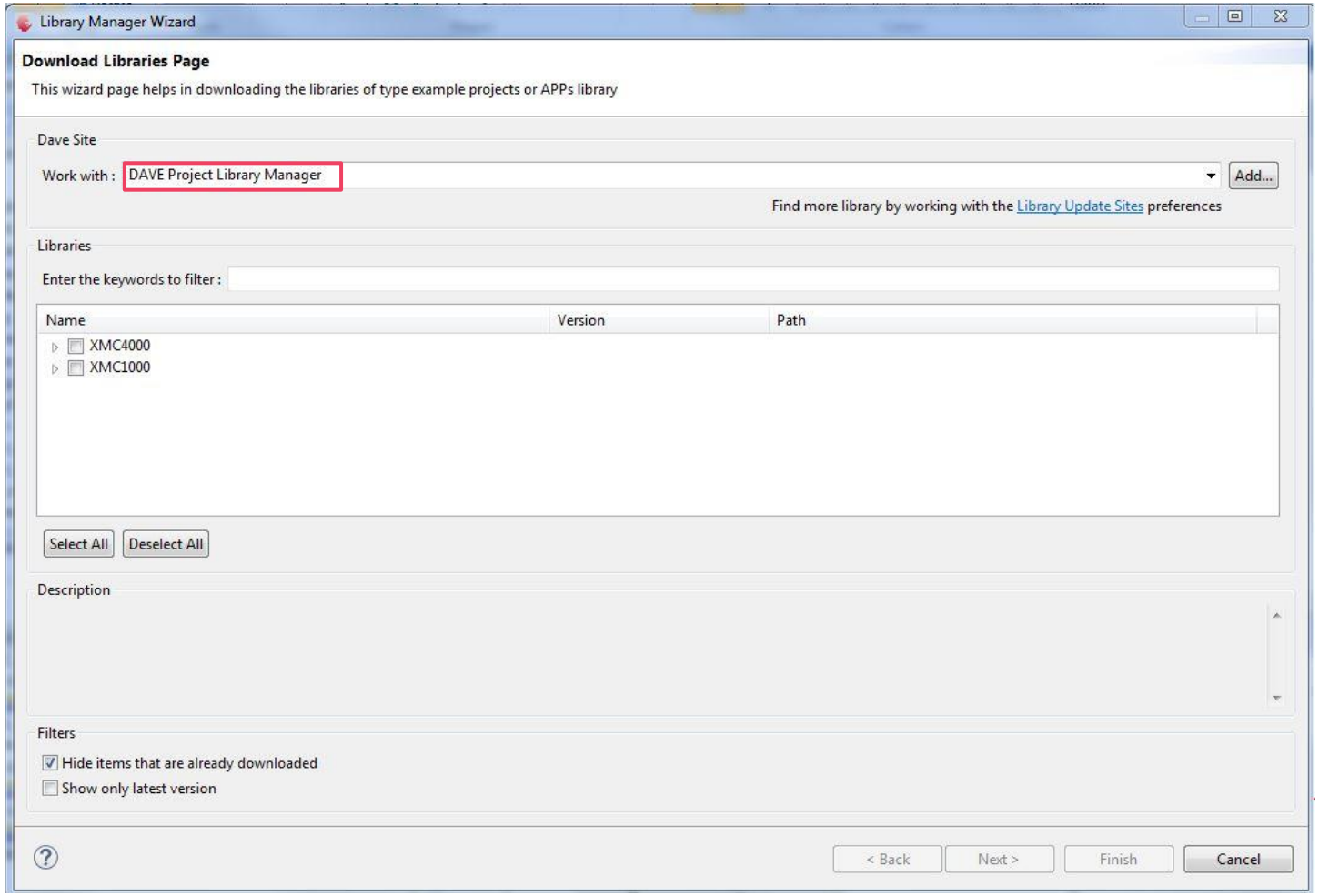
References – How to load Example Project in DAVE™? (1/3)

- Download Example Projects via DAVE™ library store
  - Help → Install DAVE APP/Example/Device Library



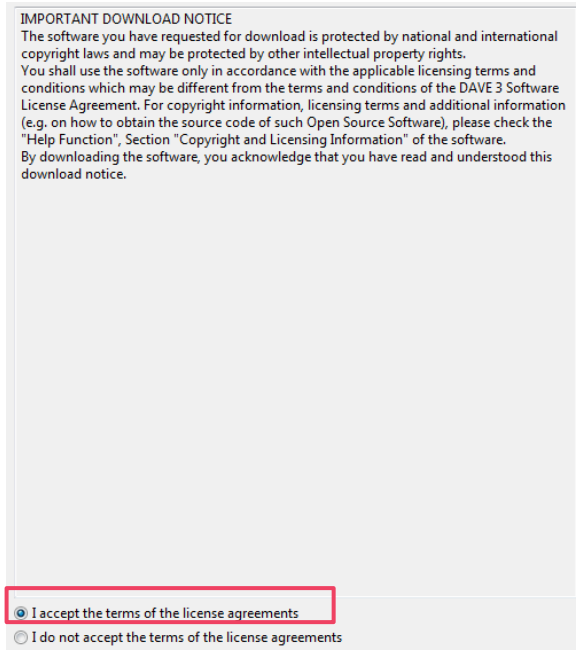
References – How to load Example Project in DAVE™? (2/3)

- Select DAVE Project Library Manager in the drop-down menu



References –
How to load Example Project in DAVE™? (3/3)

- Select Examples in the Libraries window and click Next
- Accept terms of the license agreements and click Finish



- DAVE Example Projects are installed

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