Getting Started - XMC™ LED Current Control Explorer Kit

XMC Microcontrollers

Apr 2016

Agenda

1. Kit Overview
2. Hardware Overview
3. Tooling Overview
4. Getting Started
5. Resource Listing
6. Support Material

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Kit Overview (1/7)

Easy entry into smart LED lighting with XMC™ MCUs

- Low cost, flicker-free, smart and connected single channel LED driver concept demonstrator
- 15W Single Channel CCM DC/DC Buck converter in peak-current control mode
- Software-based automatic adaptation to different input DC voltages and LED forward voltages
- Isolated DALI Interface card
  - DALI Software Stack available

Recommended LED System Overview

MAX DC Supply V_{IN}(Max)	I_{LED} Peak	$I_{AVERAGE}$	$V_{FORWARD}$ LED
30V	1A	<800mA	≤V_{IN}

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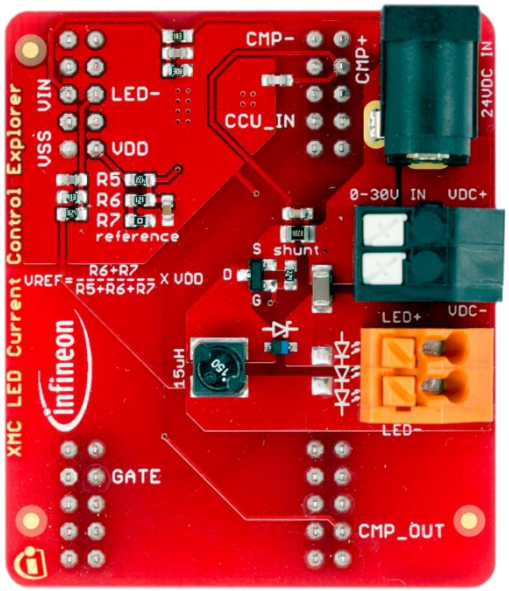
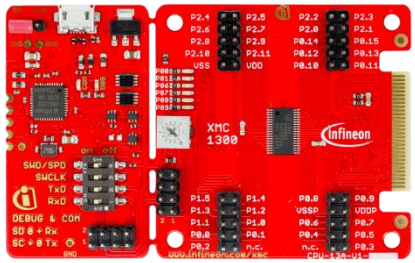
Kit Overview (2/7)

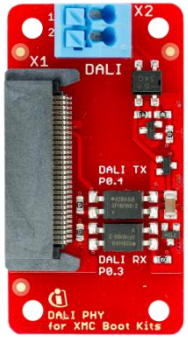
- XMC™ LED Current Control Explorer Kit
  - XMC™ LED Current Control Explorer Card
  - XMC1300 Boot Kit (XMC1302-AB)
  - DALI PHY for XMC™ Boot Kits



XMC™ LED Current Control Explorer Card



XMC1300 Boot Kit



DALI PHY for XMC™ Boot Kits

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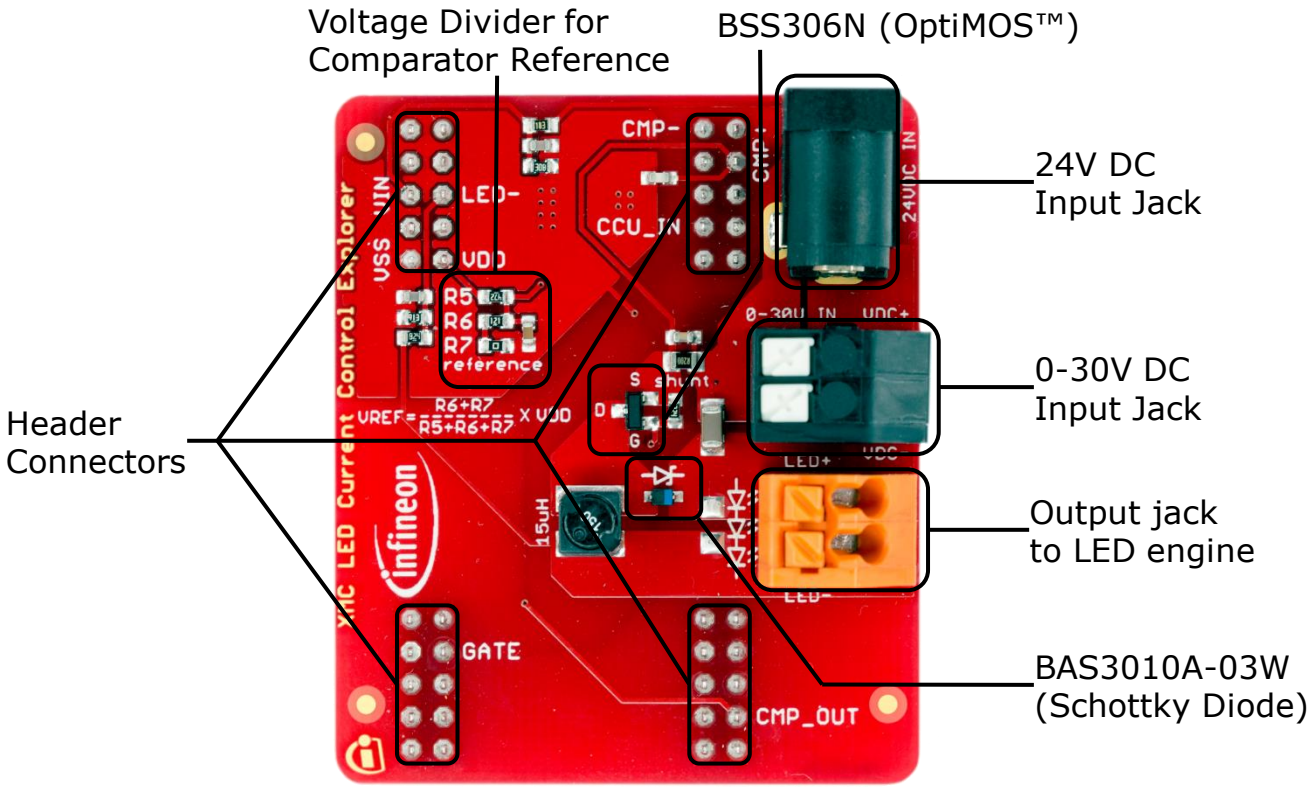
Kit Overview (3/7)

› XMC™ LED Current Control Explorer Card



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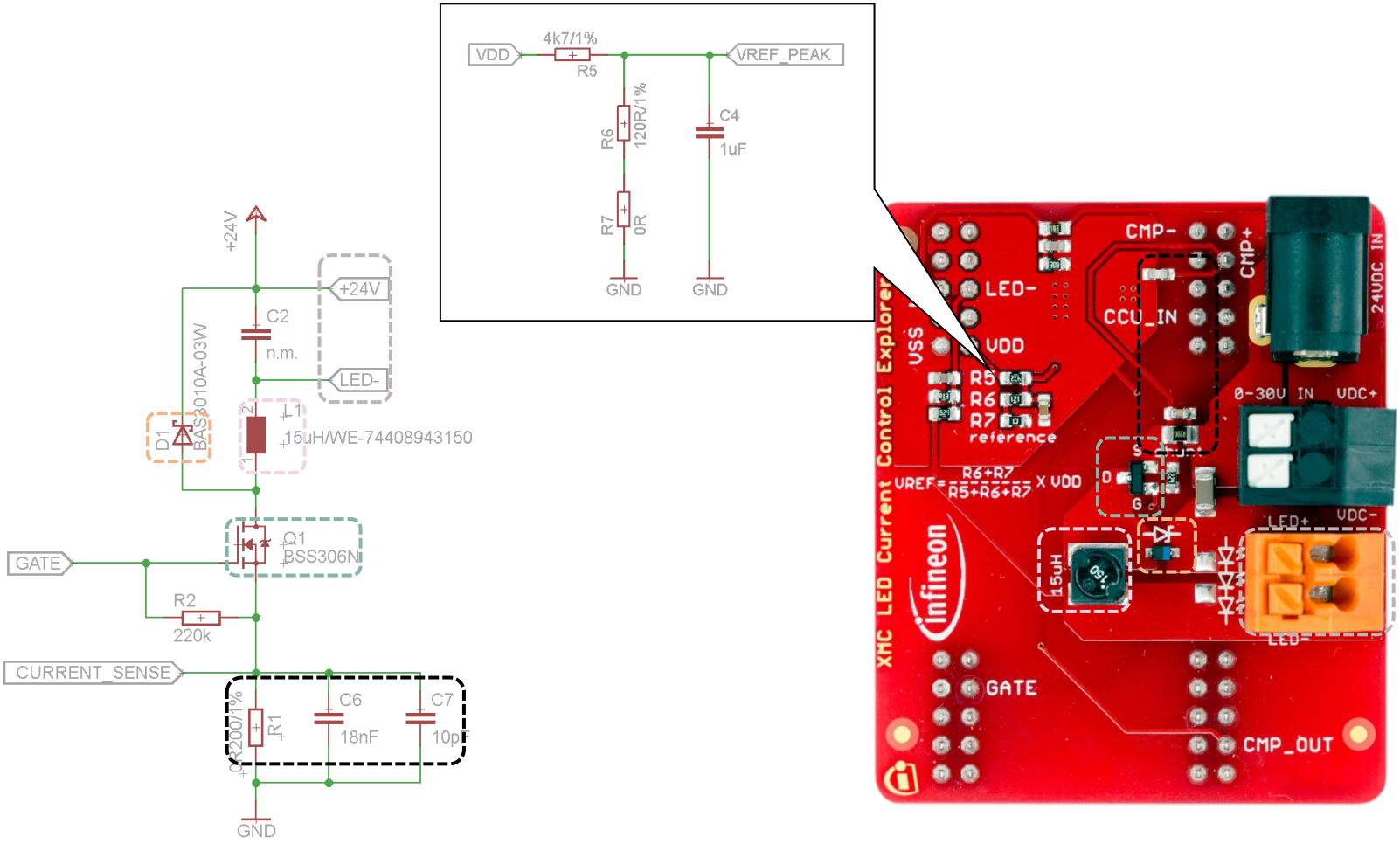
Kit Overview (4/7)



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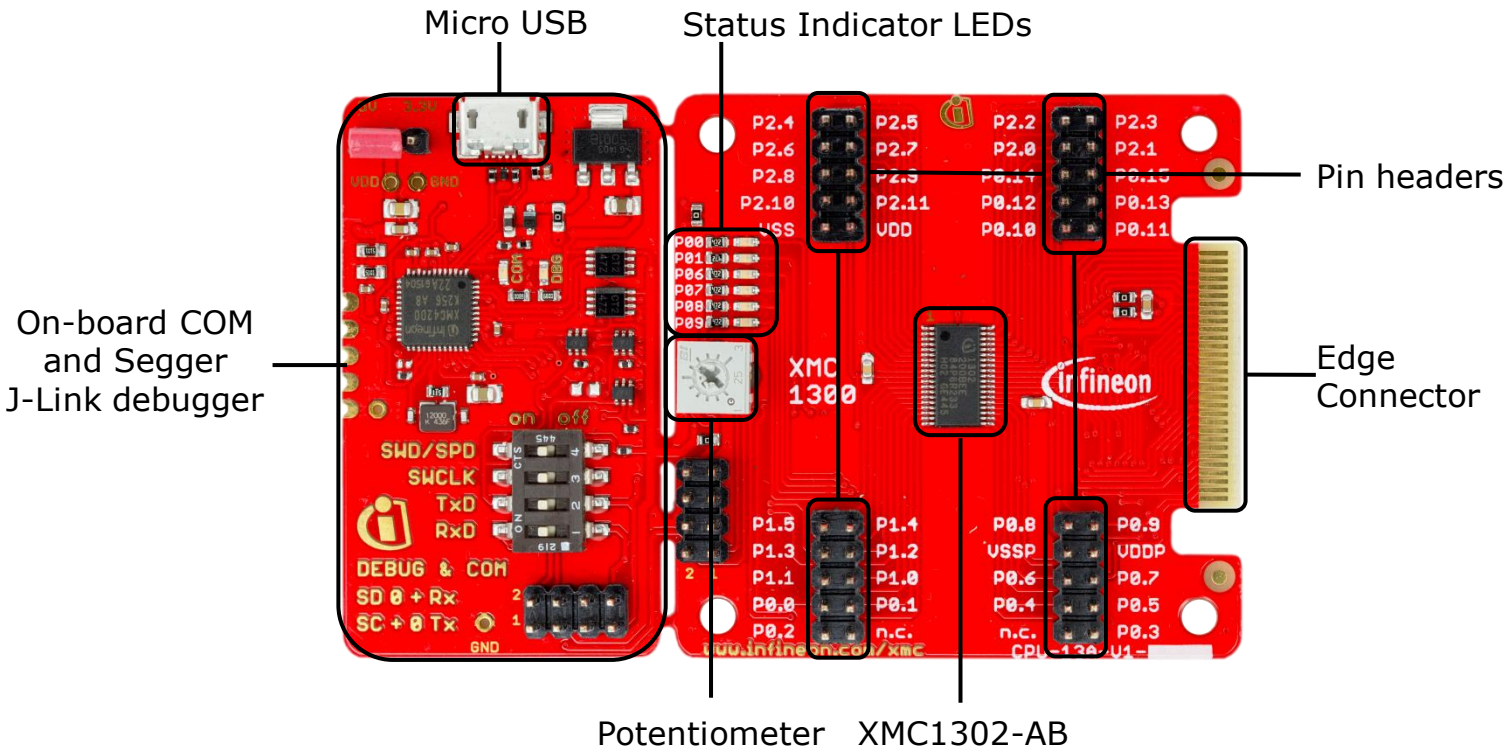
Kit Overview (5/7)

- XMC1300 Boot Kit



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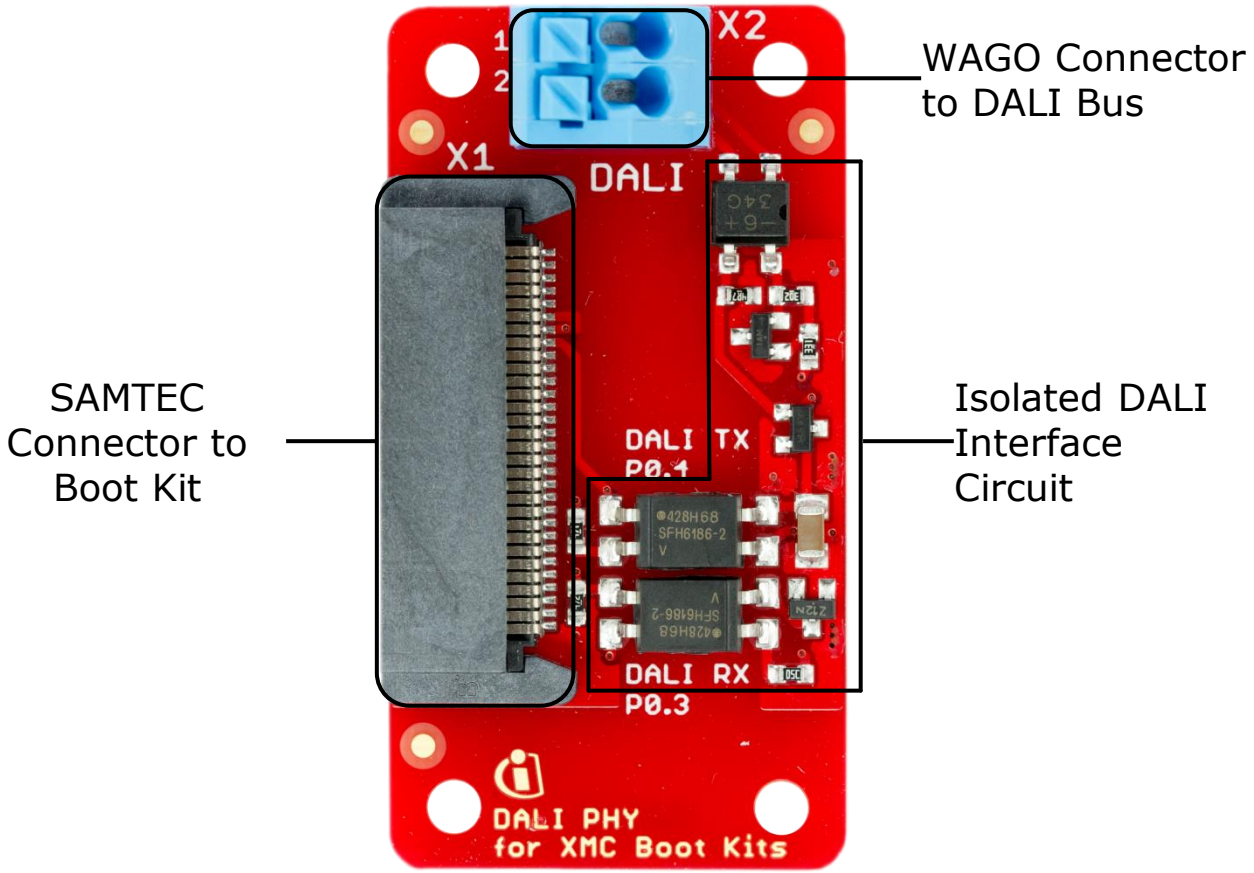
Kit Overview (6/7)

› DALI PHY for XMC™ Boot Kits



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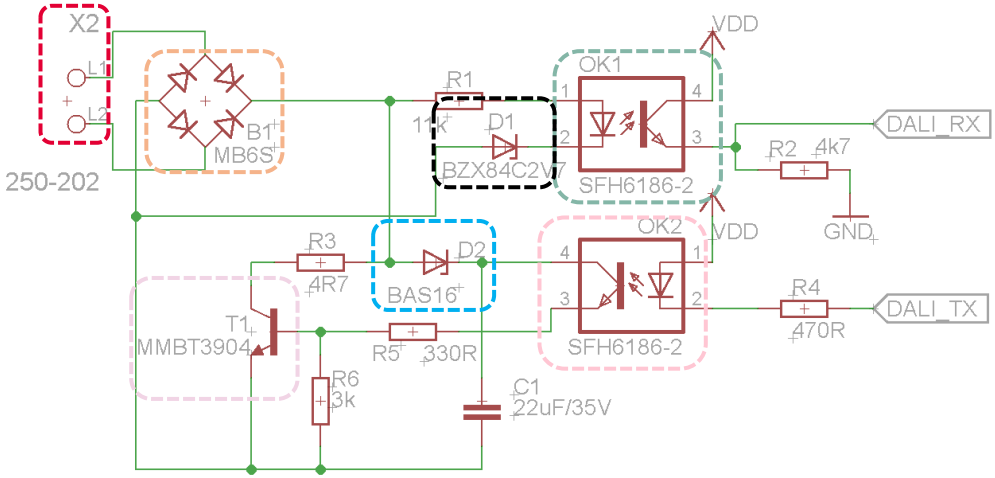
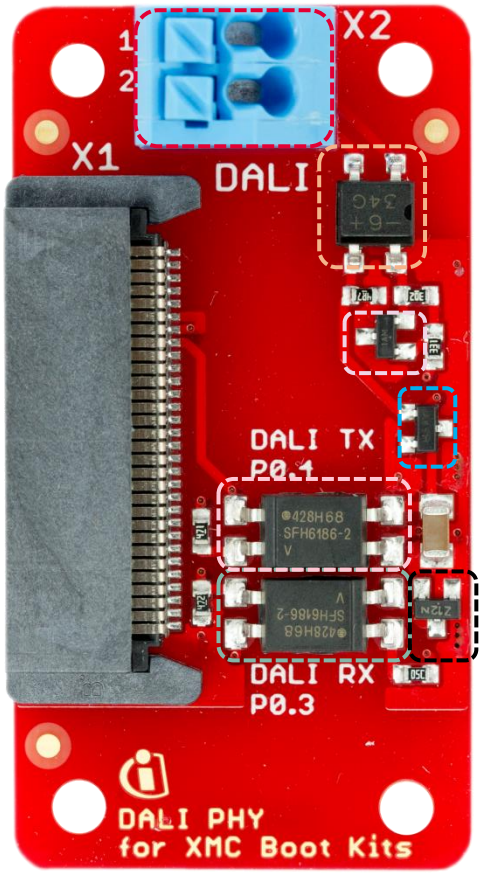
Kit Overview (7/7)





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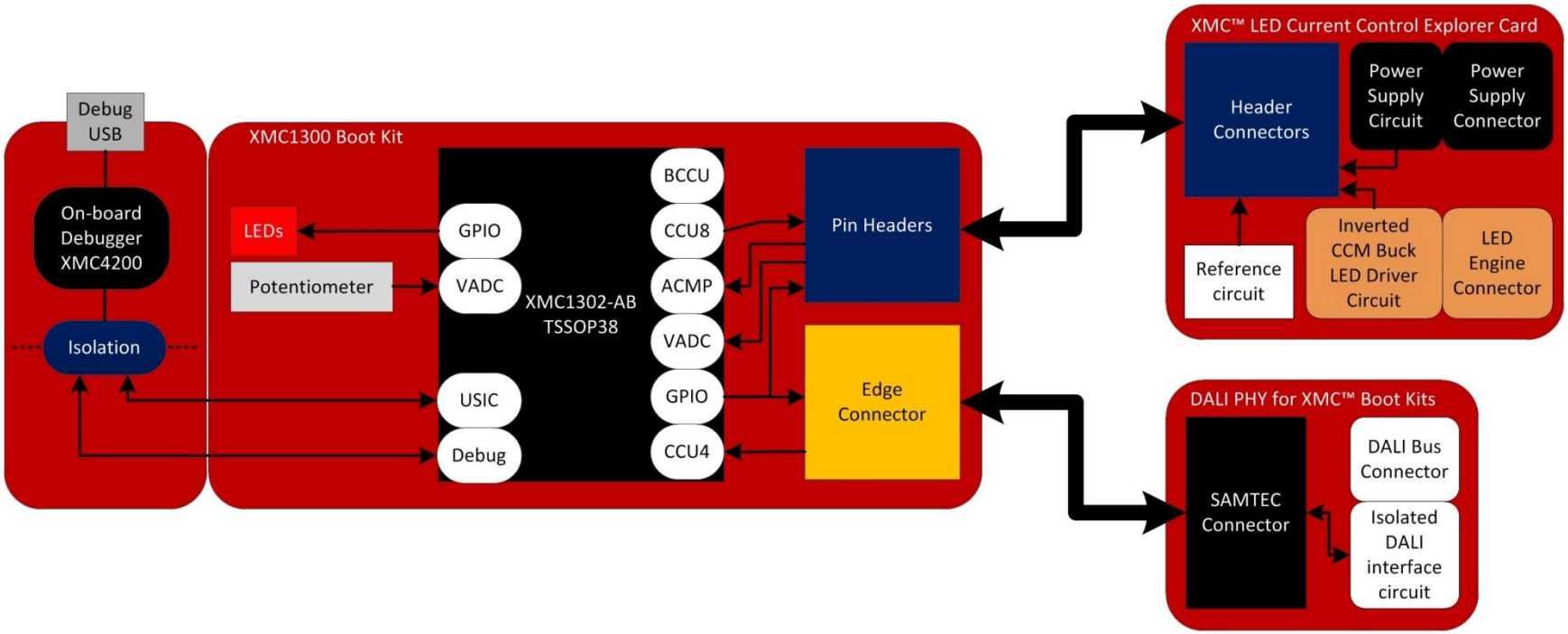
Hardware Overview (1/2)

› Hardware block diagram of kit



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Hardware Overview (2/2)

- Kit information

Nr.	Kit Name	Kit Description	Order Number
1	KIT_XMC1_LED_CC_EXP_001	XMC™ LED Current Control Explorer Kit	KIT_XMC1_LED_CC_EXP_001

- Infineon parts utilized on Kit Nr. 1:

Infineon Parts	Order Number
XMC1302 Microcontroller	XMC1302T038X0200ABXUMA1
Schottky Diode BAS3010A-03W	BAS3010A03WE6327HTSA1
Transistor BSS306N	BSS306NH6327XTSA1

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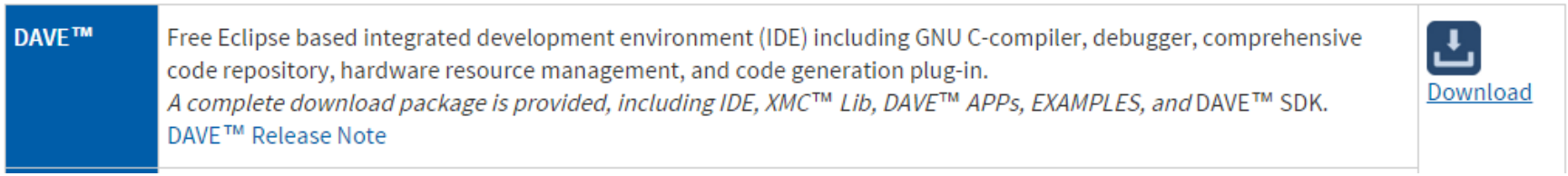
Tooling Overview – DAVE™ (1/5)

- 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.

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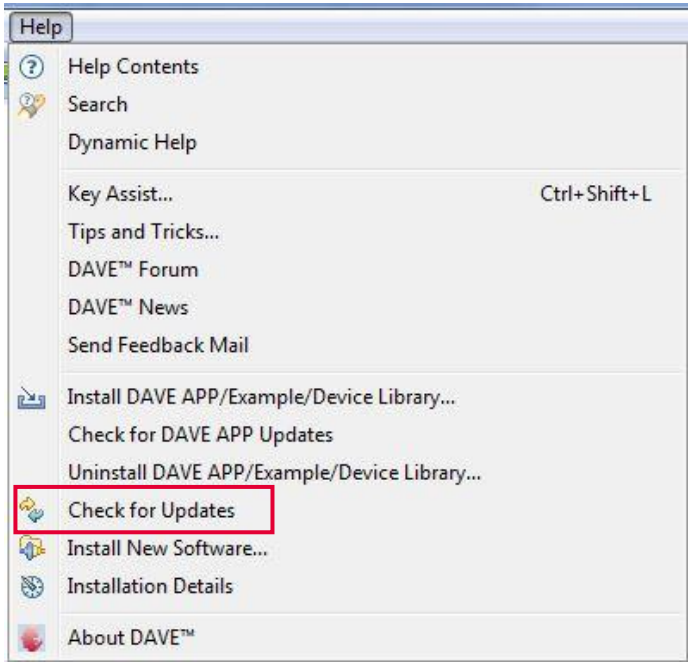
Tooling Overview – DAVE™ (2/5)

- Check for DAVE™ updates

  Help → Check for Updates



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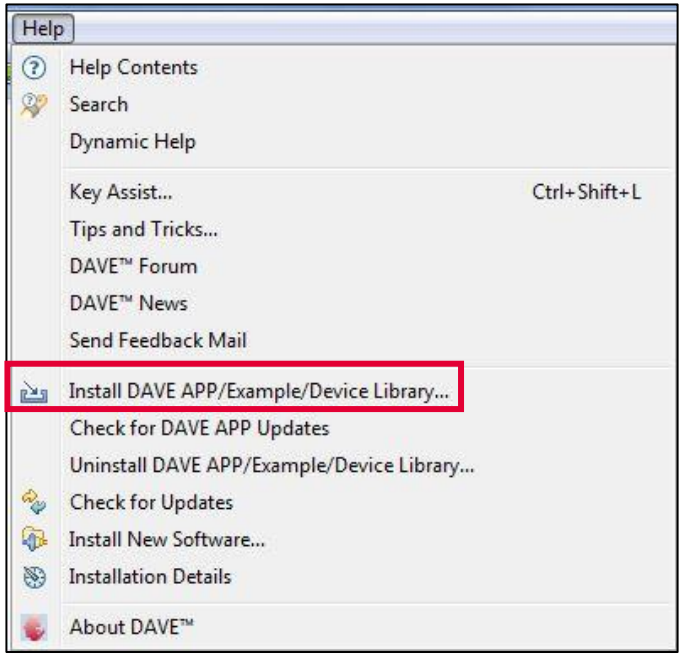
Tooling Overview – DAVE™ (3/5)

- 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

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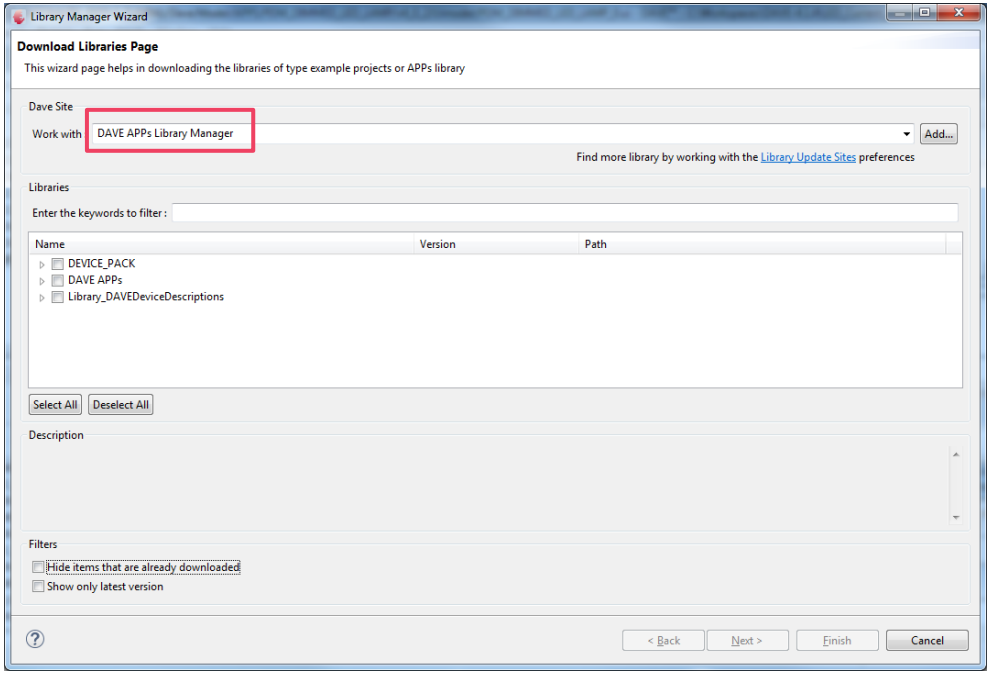
Tooling Overview – DAVE™ (4/5)

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



› Select Library_DAVEApps and Library_DAVEDeviceDescriptions (for XMC1300 Device) and click Next

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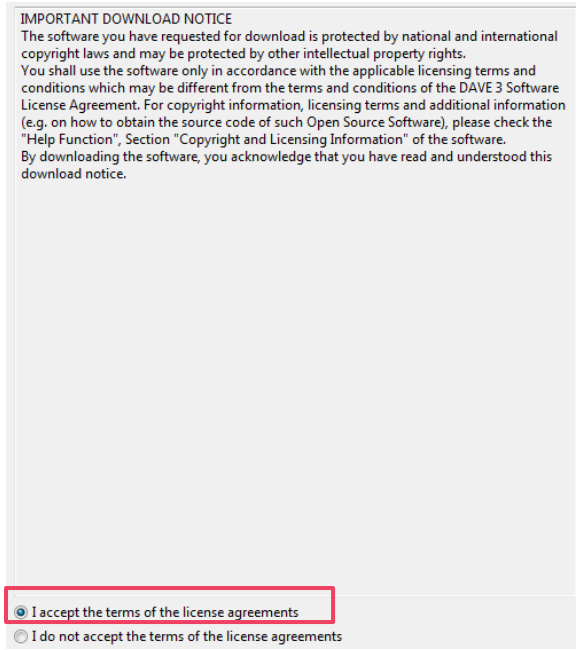
Tooling Overview – DAVE™ (5/5)

- Accept terms of the license agreements and click Finish



- DAVE™ APPs and DAVE™ device descriptions are installed

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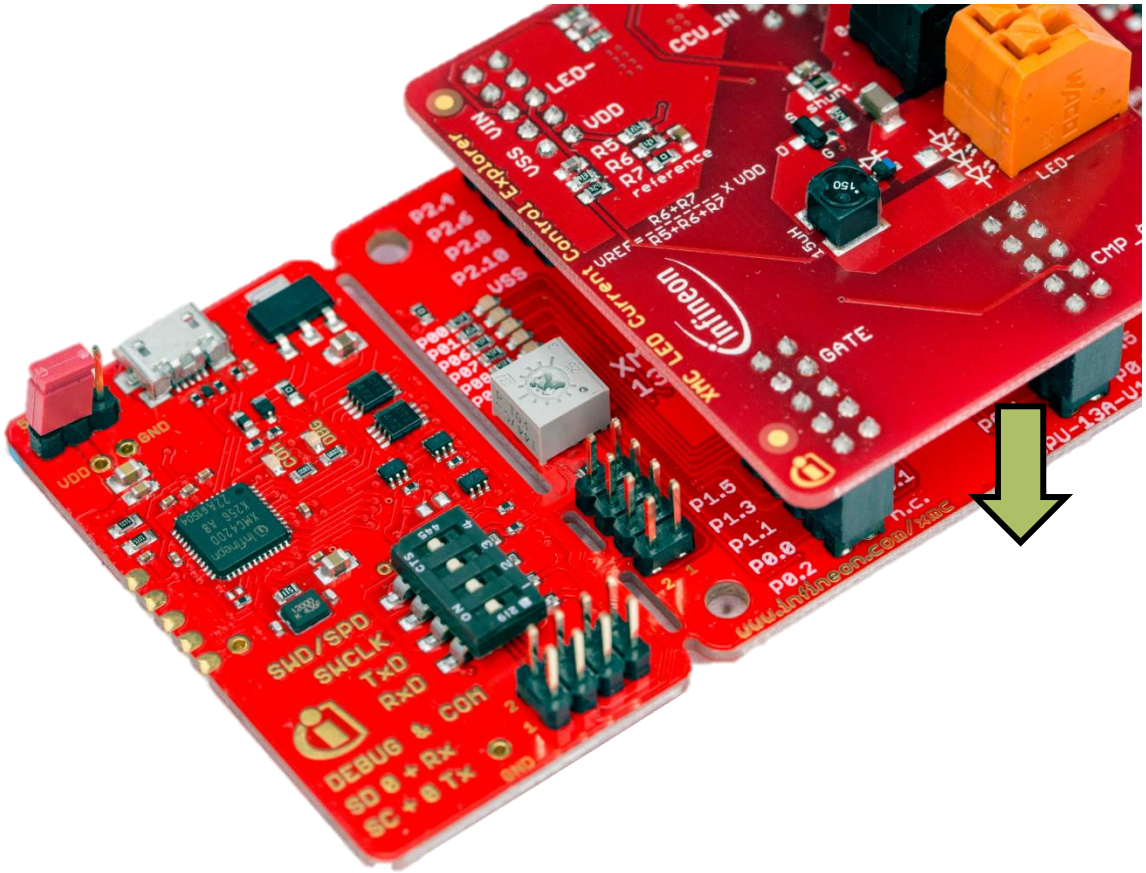
Getting Started
Setting up the Kit (1/4)

1. Plug the XMC™ LED Current Control Explorer Card onto the XMC1300 Boot Kit



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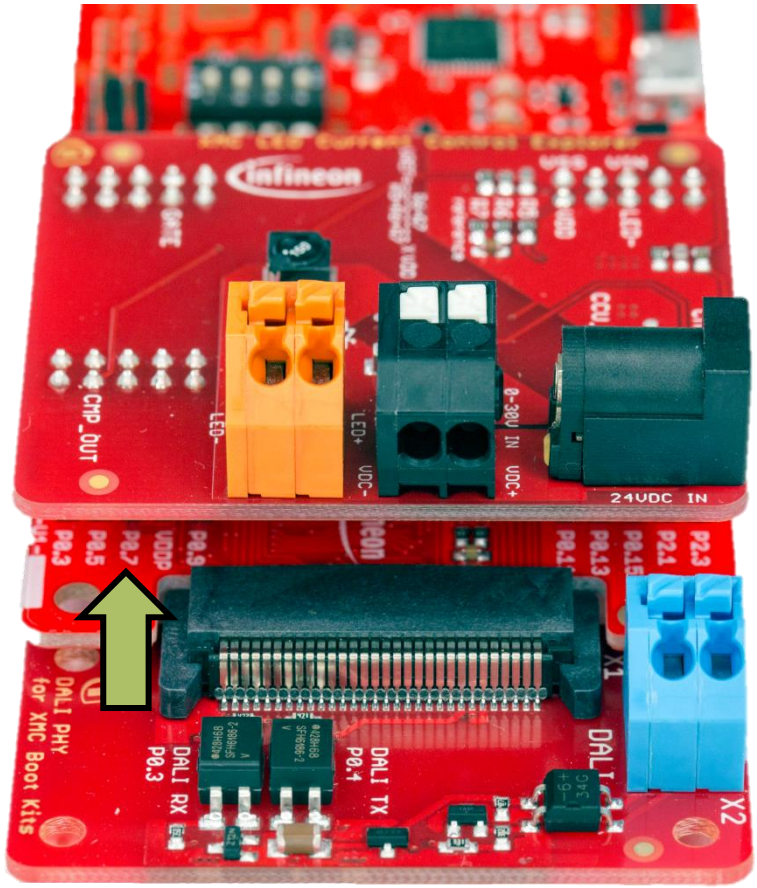
Getting Started
Setting up the Kit (2/4)

2. Connect the DALI PHY for XMC™ Boot Kits card to the XMC1300 Boot Kit



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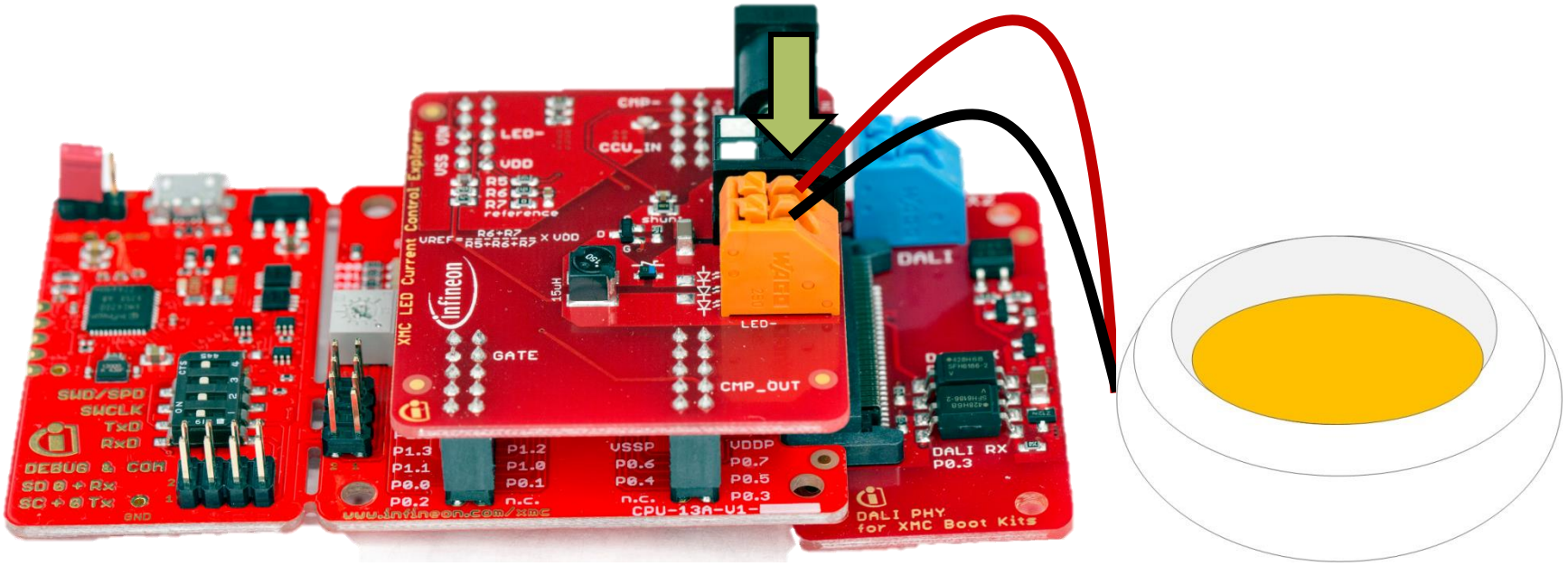
Getting Started
Setting up the Kit (3/4)

3. Connect the LED light engine to the XMC™ LED Current Control Explorer card via the orange connectors



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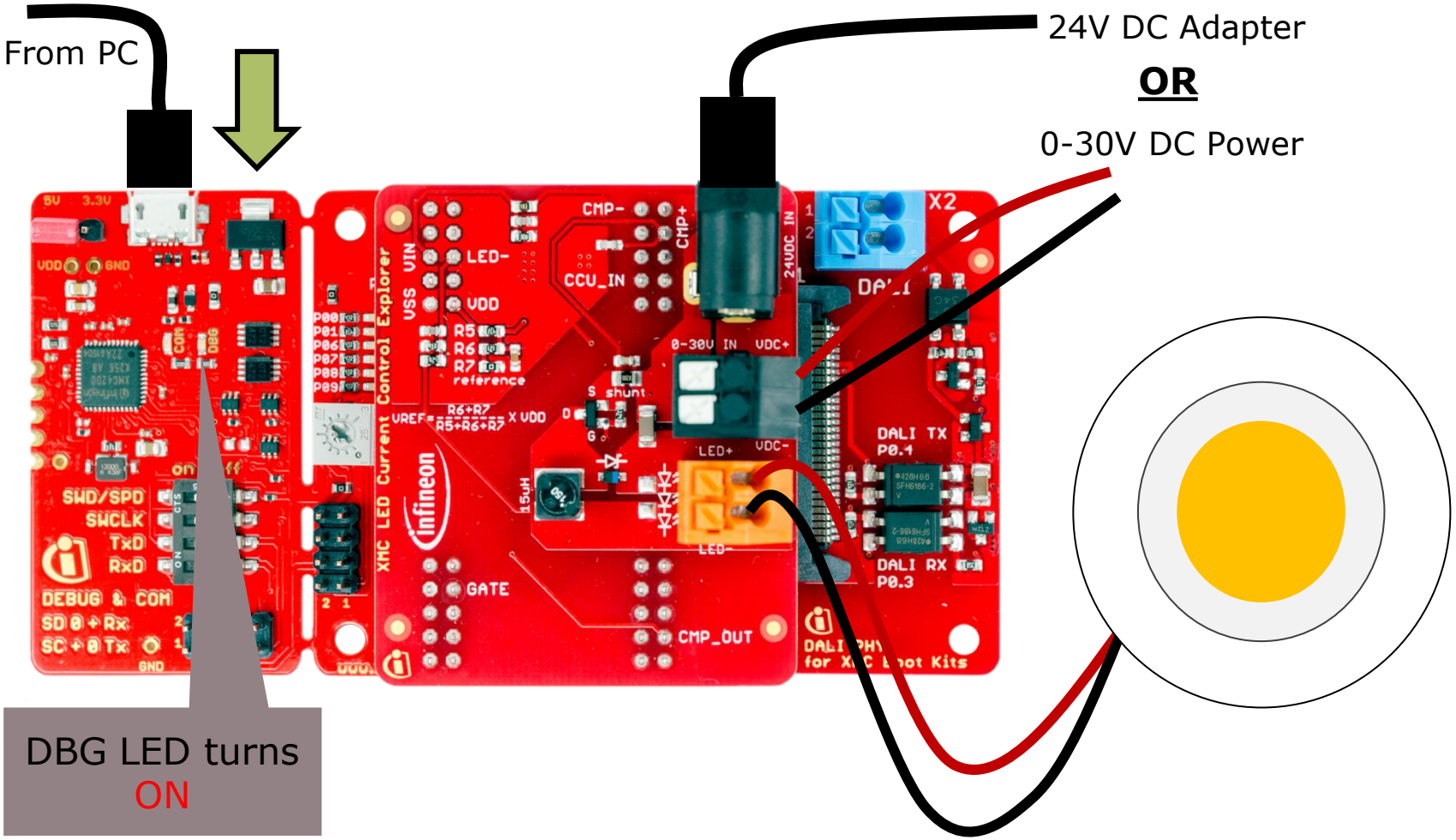
Getting Started
Setting up the Kit (4/4)

4. Connect the kit to PC and power supply



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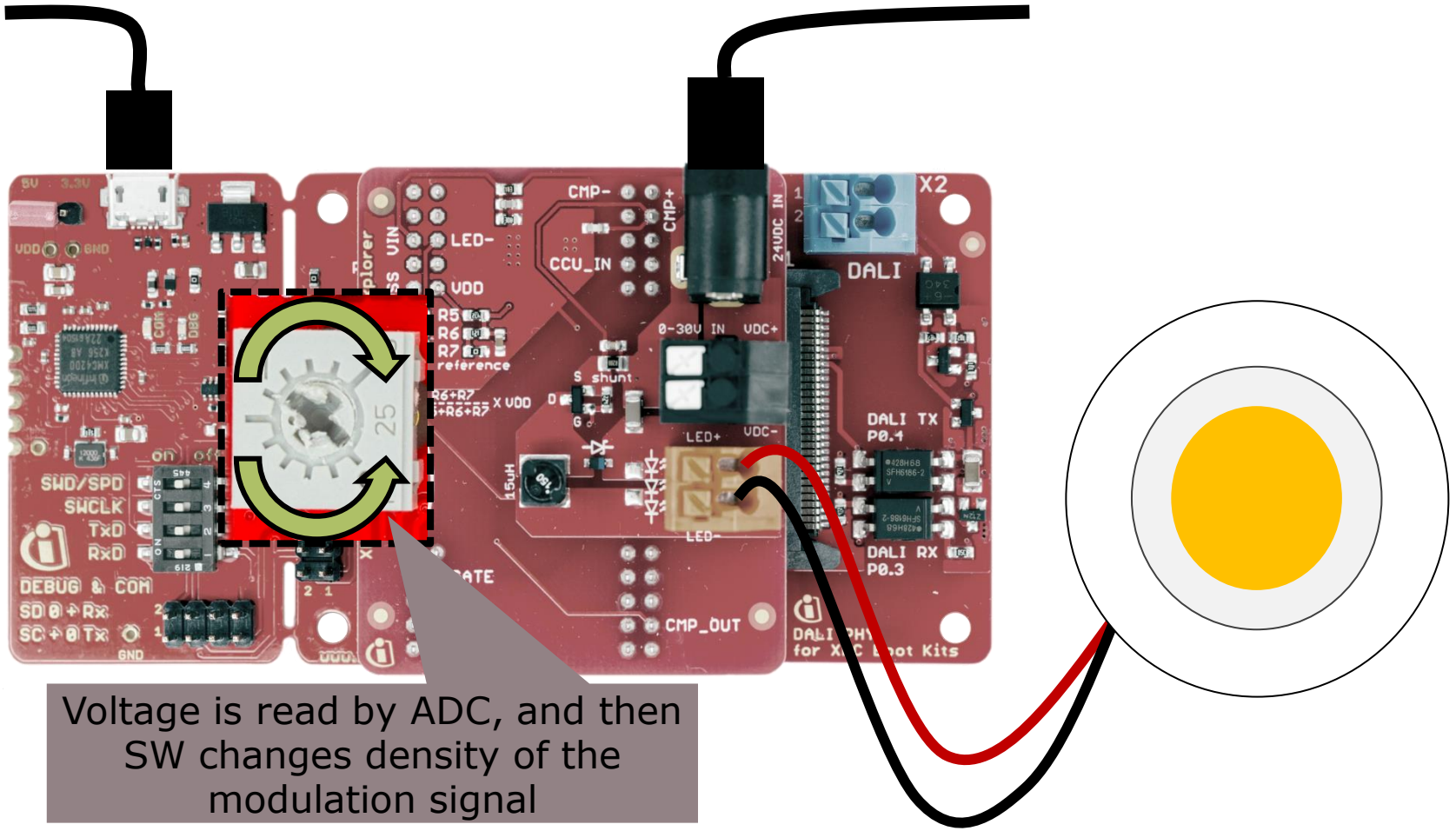
Getting Started
Adjusting LED Brightness (1/3)

› Option 1: Via potentiometer with a screwdriver



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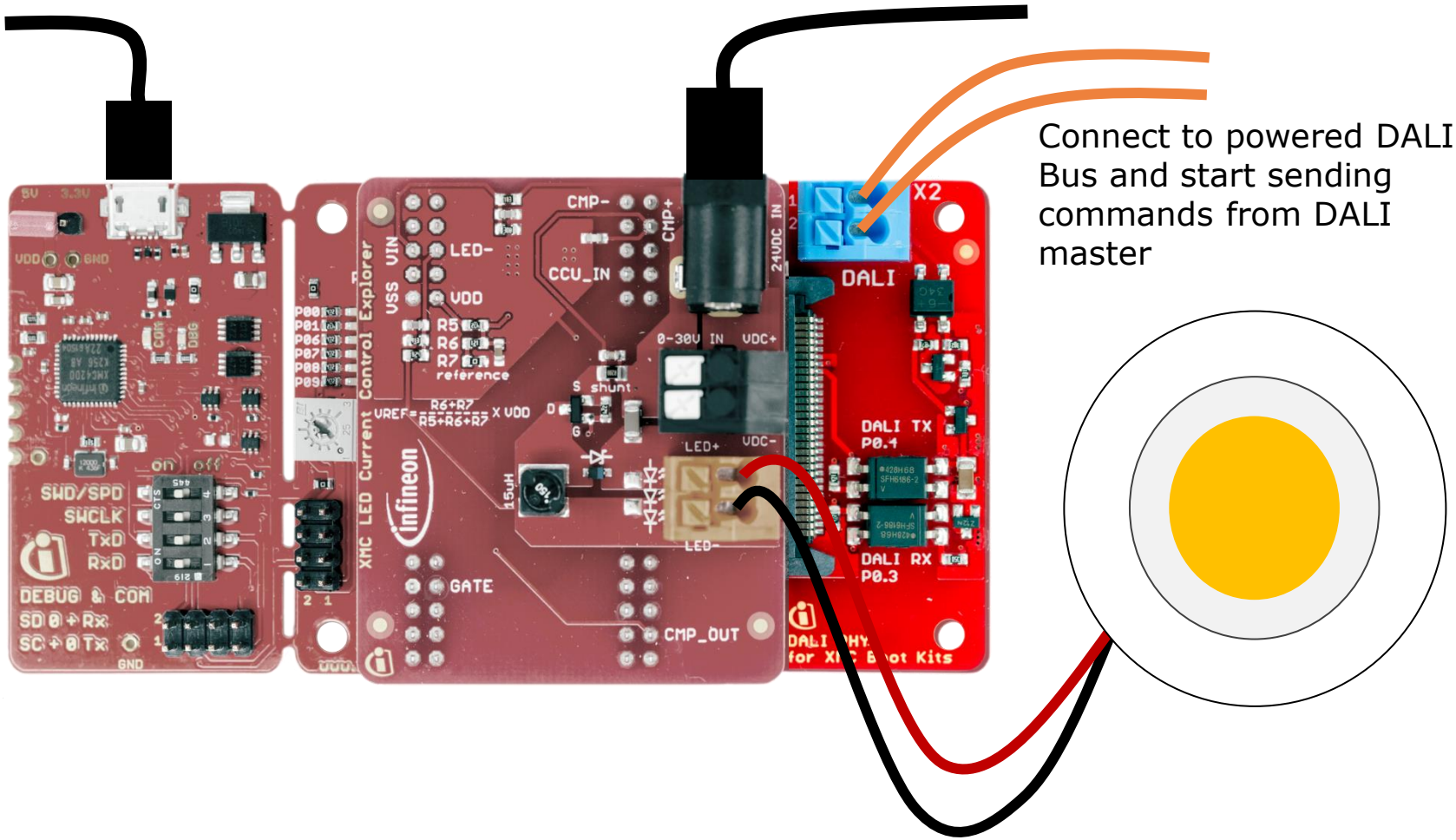
Getting Started
Adjusting LED Brightness (2/3)

› Option 2: Via DALI communication



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Getting Started
Adjusting LED Brightness (3/3)

- DALI commands supported based on 62386-102:2009
  - Direct arc power command
  - Indirect arc power control commands e.g. OFF, UP, DOWN etc.
  - Query commands e.g. QUERY STATUS, QUERY ACTUAL LEVEL etc.
  - Special commands e.g. INITIALISE, RANDOMISE etc.

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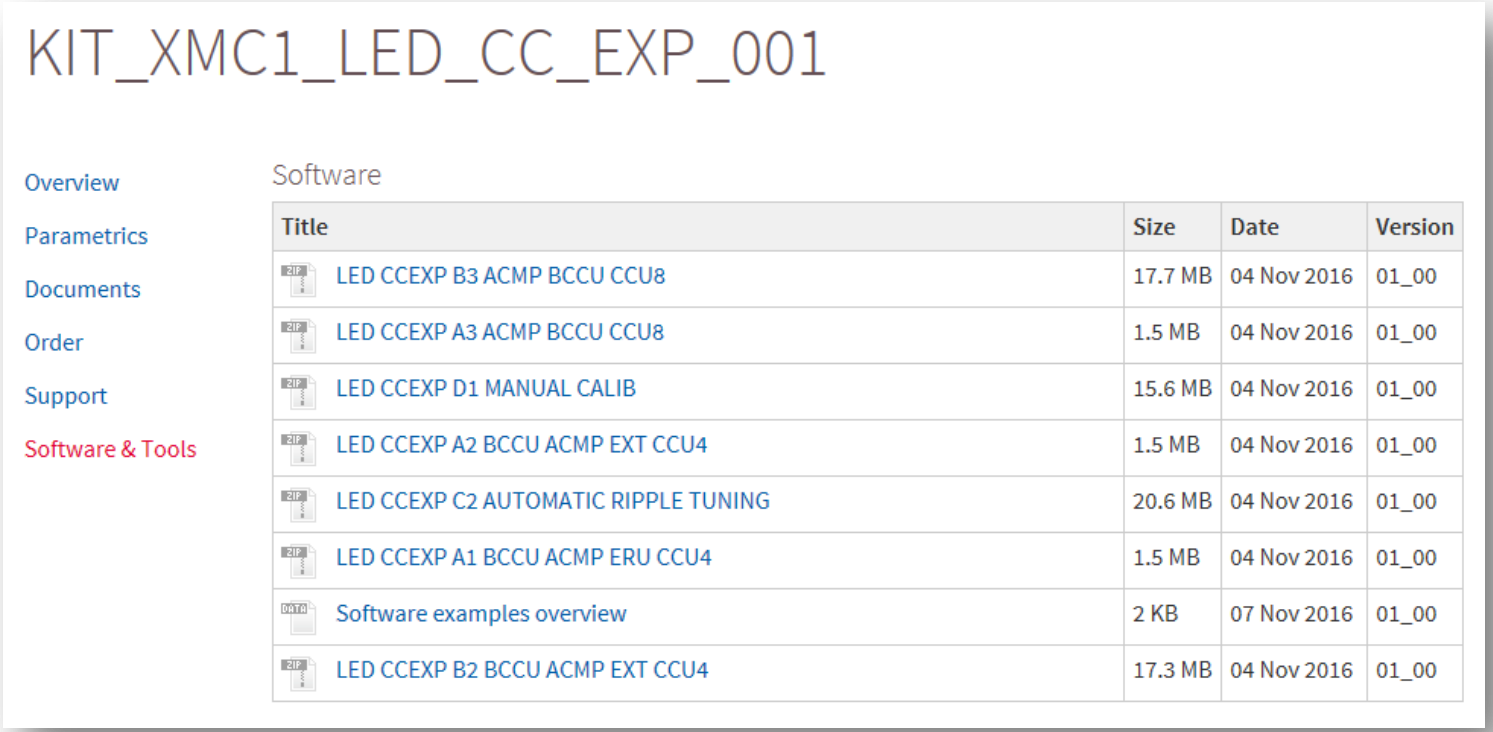
Getting Started
Downloading the Kit Software (1/3)

- http://www.infineon.com/xmc-led-ccexp
- Click on the 'Software & Tools' tab
- Download the example project(s)



Title	Size	Date	Version
LED CCEXP B3 ACMP BCCU CCU8	17.7 MB	04 Nov 2016	01_00
LED CCEXP A3 ACMP BCCU CCU8	1.5 MB	04 Nov 2016	01_00
LED CCEXP D1 MANUAL CALIB	15.6 MB	04 Nov 2016	01_00
LED CCEXP A2 BCCU ACMP EXT CCU4	1.5 MB	04 Nov 2016	01_00
LED CCEXP C2 AUTOMATIC RIPPLE TUNING	20.6 MB	04 Nov 2016	01_00
LED CCEXP A1 BCCU ACMP ERU CCU4	1.5 MB	04 Nov 2016	01_00
Software examples overview	2 KB	07 Nov 2016	01_00
LED CCEXP B2 BCCU ACMP EXT CCU4	17.3 MB	04 Nov 2016	01_00

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Getting Started
Downloading the Kit Software (2/3)

- List of available projects

1. Basic-level: Introduction to possible implementations of control loop for CCM Buck, with dimming via potentiometer

   - XMCLib-based
     - LED_CCEXP_A1_BCCU_ACMP_ERU_CCU4
     - LED_CCEXP_A2_BCCU_ACMP_EXT_CCU4
     - LED_CCEXP_A3_ACMP_BCCU_CCU8
   - APP-based
     - LED_CCEXP_B1_BCCU_ACMP_ERU_CCU4
     - LED_CCEXP_B2_BCCU_ACMP_EXT_CCU4
     - LED_CCEXP_B3_ACMP_BCCU_CCU8

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Getting Started
Downloading the Kit Software (3/3)

- List of available projects (continued)
  2. Application-level: Fastest control loop for CCM Buck implementation with dimming via potentiometer or DALI
     - APP-based
       - LED_CCEXP_C1_ACMP_BCCU_CCU8_DALICG (will be available soon)
       - LED_CCEXP_C2_AUTOMATIC_RIPPLE_TUNING: with automatic current ripple tuning according to input voltage and LED load to maintain LED average current (Default pre-loaded code)
  3. Customization: Basic project without dimming, for user to adopt kit to their own LED engine (more instructions from here)
     - APP-based
       - LED_CCEXP_D1_MANUAL_CALIB

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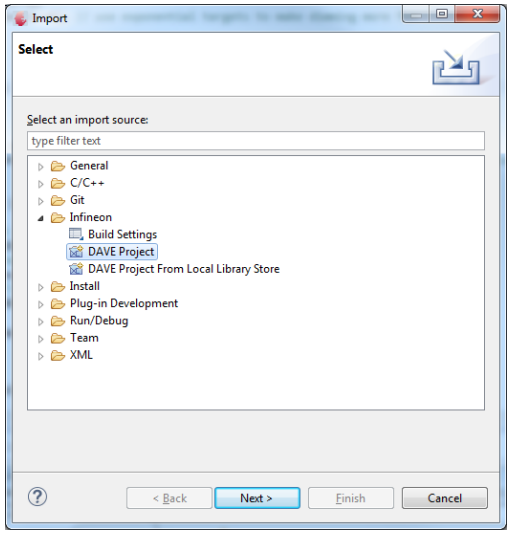
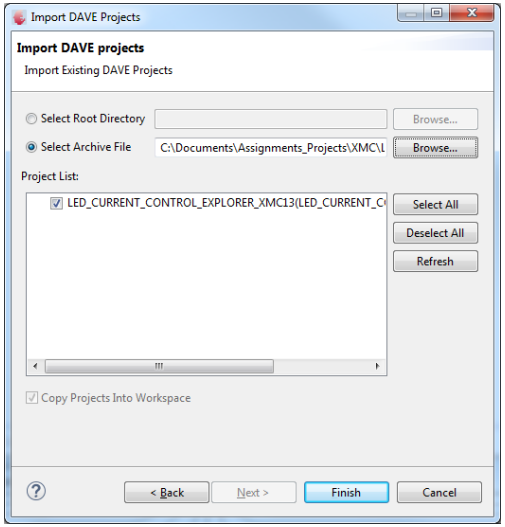
Getting Started
Programming the kit (1/3)

1. Open DAVE™ 

2. In DAVE™ workspace, import the downloaded project:
   - File → Import → Infineon → DAVE Project
   - Click Next
   - Check "Select Archive File"
   - Browse to the downloaded project zip file
   - Click Open
     - ➢ Project name will appear under Project List
   - Click Finish





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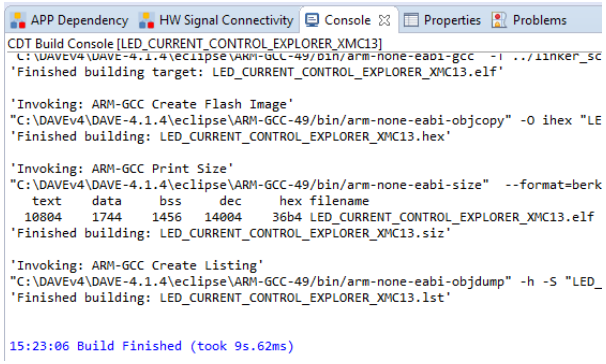
Getting Started
Programming the kit (2/3)

- Build project
  1. Click 
  2. Wait for Build to finish



- Download code
  1. Ensure that the power to the XMC™ LED Current Control Explorer card is turned OFF
  2. Click 
  3. Switch to TASKING Debug view

  4. Click  to run code
- Turn ON the power to the XMC™ LED Current Control Explorer card
- Adjust LED brightness

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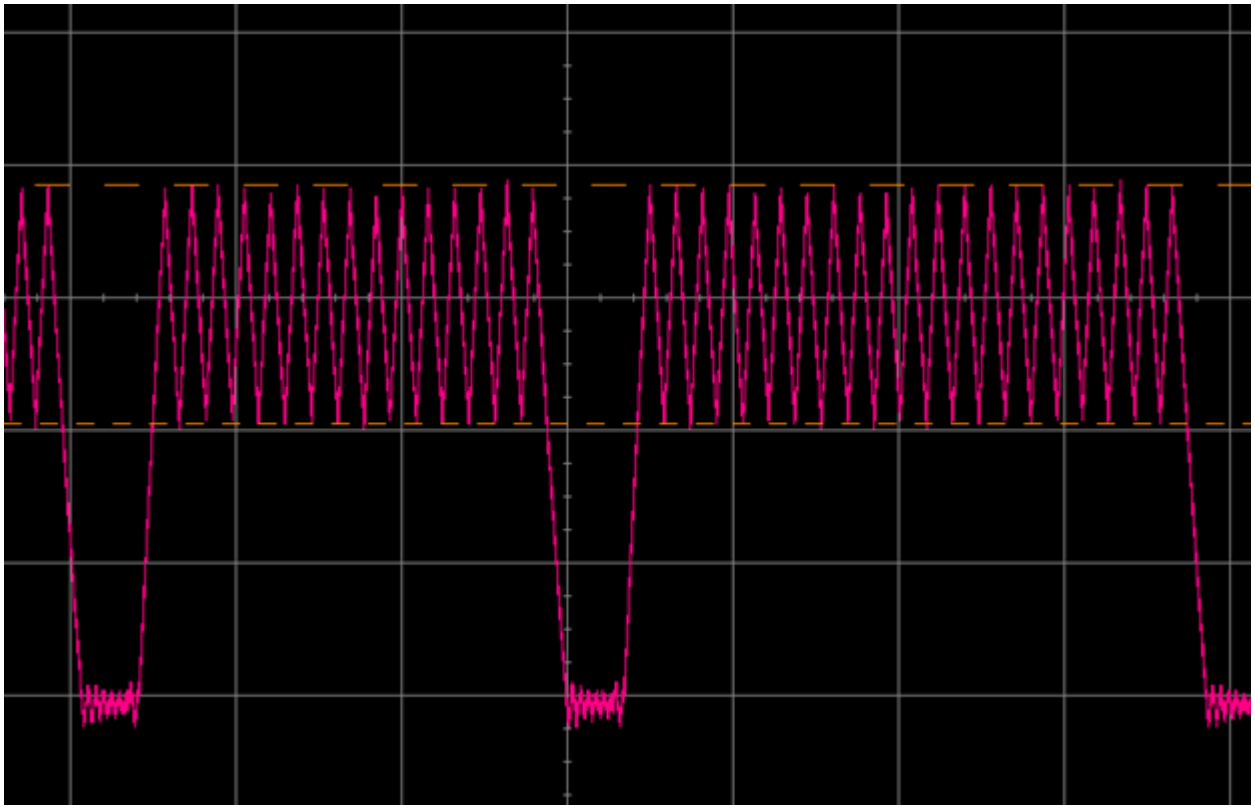
Getting Started
Programming the kit (3/3)

- Observe the LED current waveform on an oscilloscope via a current probe



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Getting Started
Software Information

- XMC™ LED Current Control Explorer Kit is preloaded with **LED_CCEXP_C2_AUTOMATIC_RIPPLE_TUNING**
- Features of this software
  - Safe to use with a wide range of LED engines and input voltage supply
  - Automatically tunes current ripple to adopt to input voltage and LED load
  - Not the best dimming performance and efficiency as the code serves to cater to a wide range of LED engines and input voltage. Fine tuning of software parameters and hardware may be required to achieve best dimming performance and efficiency
  - Average LED current ≈ 620mA
- All other software provided in the package are developed with MOLEX 180081-4250
  - Average LED current = 700mA
  - Forward voltage = 12.3V
- To manually adopt software to your LED engine, follow the instructions on next slides

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Getting Started
Adopting SW to Your LED Engine (1/6)

1. Import **LED_CCEXP_D1_MANUAL_CALIB** code onto DAVE™
2. Compile  and program the kit 
3. Connect your LED engine to the kit
4. Power up the kit

Note: Ensure that the voltage supplied is the maximum expected input voltage and sufficient to power the LED

5. Observe the LED current waveform on oscilloscope
   a. Measure the LED current rise time
   b. Measure the LED current fall time
   c. Measure the time required for LED current to fall from peak to reference value (620mA). We shall call this parameter the Required OFF-time

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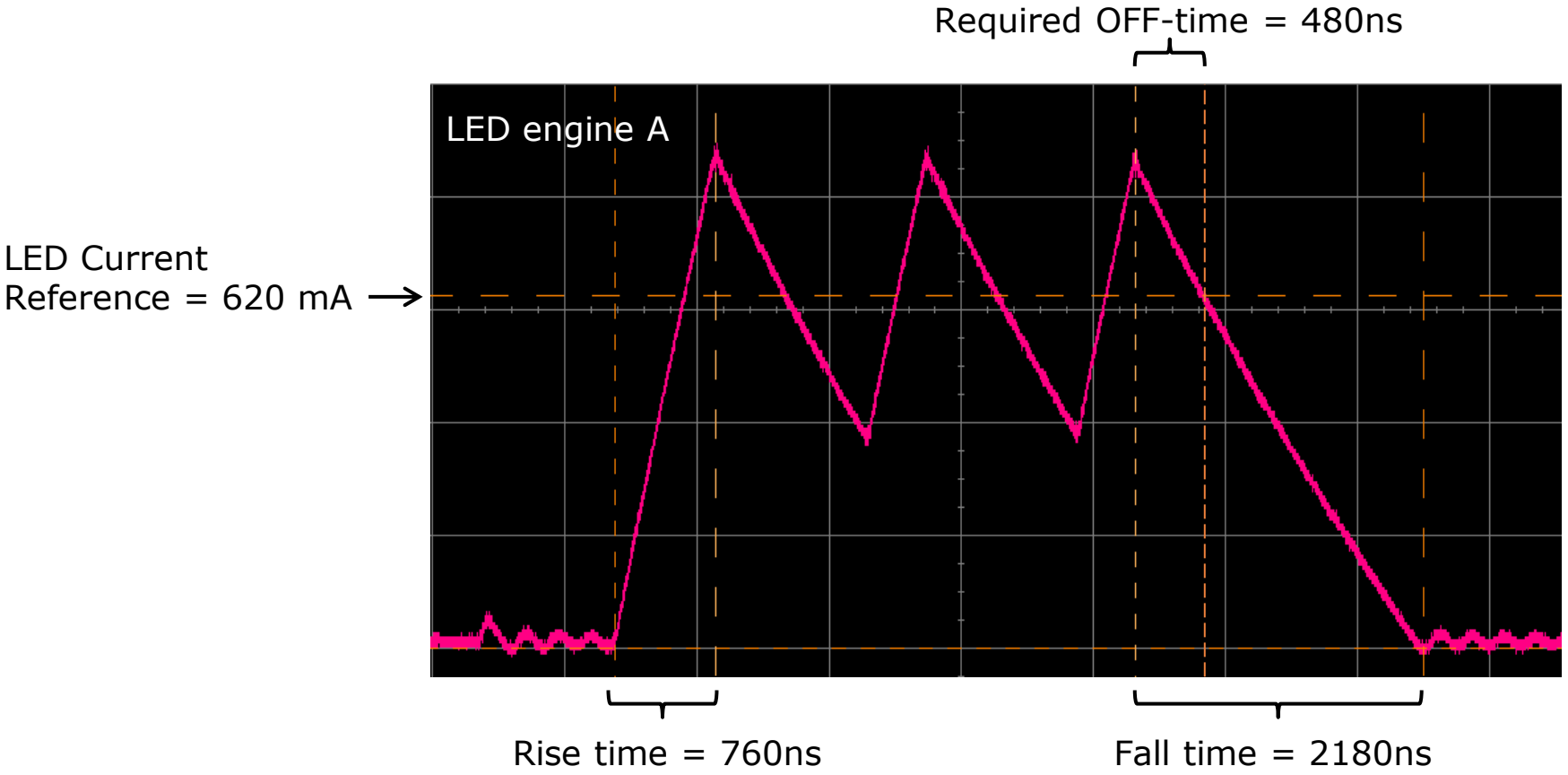
Getting Started
Adopting SW to Your LED Engine (2/6)

› Lets take for example, LED engine A:



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Getting Started
Adopting SW to Your LED Engine (3/6)

6. Open the UI of **GLOBAL_BCCU** APP
7. Change the frequency of FCLK such that the bit-time is the same as the LED current rise time or fall time, whichever is longer
   - This is to ensure the following criteria are met:
     a. During an ON bit, there is enough time for the LED current to reach the desired peak level
     b. During an OFF bit, there is enough time for the LED current to reach zero

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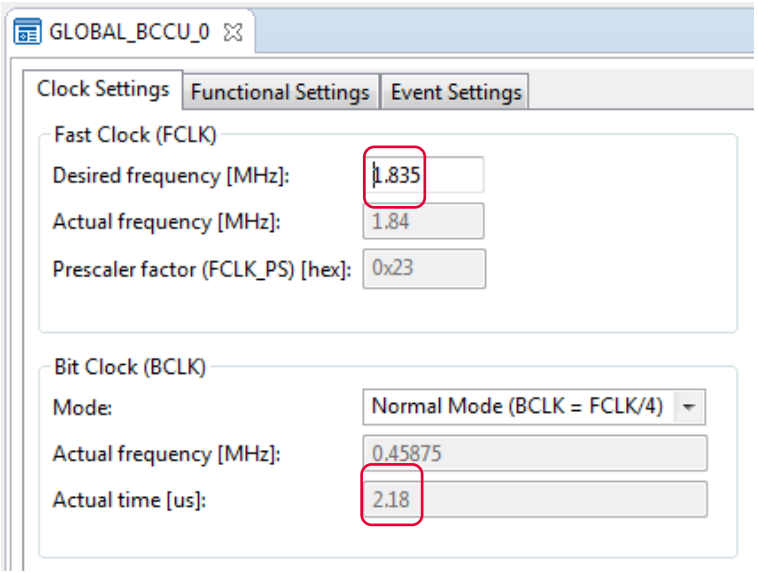
Getting Started
Adopting SW to Your LED Engine (4/6)

- In the example of LED engine A, the fall time is longer
- Set FCLK such that Actual bit-time = 2180ns
- Can be calculated:

$$FCLK = \frac{1}{bit\ time} \times 4$$

$$e.g.\ FCLK = \frac{1}{2180 \times 10^{-9}} \times 4$$

$$\approx 1.835MHz$$



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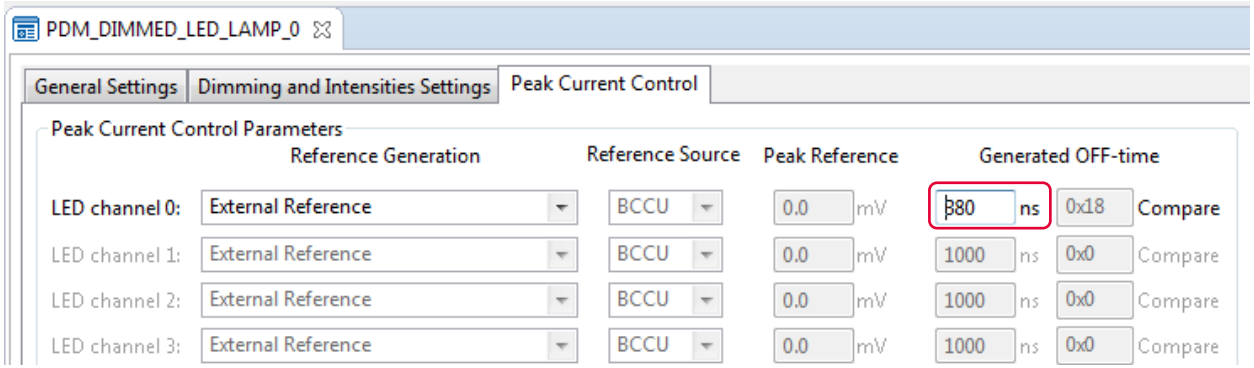
Getting Started
Adopting SW to Your LED Engine (5/6)

8. Open the UI of **PDM_DIMMED_LED_LAMP** APP
9. Change the Generated OFF-time based on the value measured previously
   - This is to ensure just enough time for the LED current to drop to just below the reference level i.e. minimum ripple size
   - In the example of LED engine A, this is 480ns
   - Considering a propagation delay of 100ns, we shall set the OFF-time to (480-100 = 380ns)



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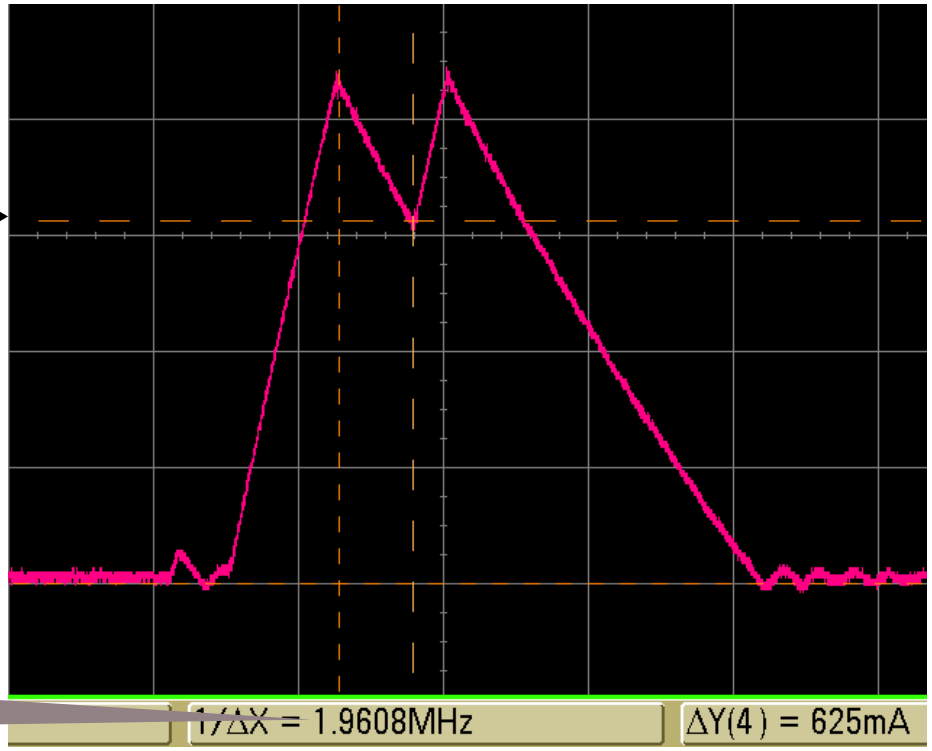
Getting Started
Adopting SW to Your LED Engine (6/6)

10. Re-generate code  , compile  and program the kit 
11. Observe LED current waveform

You now have the optimized parameters to use your LED engine with the kit!

LED Current
Reference = 620 mA



MOSFET switching frequency

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Resource Listing

- http://www.infineon.com/xmc-led-ccexp
- Documents
  - Board User Manuals
  - Product Brief
  - Application Note
- Application examples (SW)
- Videos

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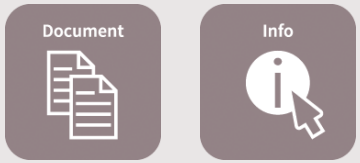
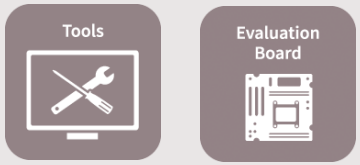
Support Material

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
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Glossary of Abbreviations

ACMP	Analog Comparator
BCCU	Brightness and Color Control Unit
CCU4/8	Capture/Compare Unit 4/8
DALI	Digital Addressable Lighting Interface
DAVE™	Free development IDE for XMC
ERU	Event Request Unit
GPIO	General Purpose Input/Output
LED	Light-emitting Diode
PC	Personal Computer
PDM	Pulse Density Modulation
PHY	Physical Layer
PWM	Pulse Width Modulation
USIC	Universal Serial Interface Channel
VADC	Versatile Analog Digital Converter

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