Developer Day

Live session with DAVE
Hands-on: Get DAVE up and running

Basic Principles of DAVE

- example with how to…
  - Create first project
  - Handle DAVE surface
  - Configure Apps
  - Allocate Pins
  - Find the generated Code
  - Debug
  - Create more complex projects
  - Connect Apps with each other
  - Create Hardware Connections
  - Create Interrupt Service Routines
  - Use GPIO & API
  - Write own code into the projects

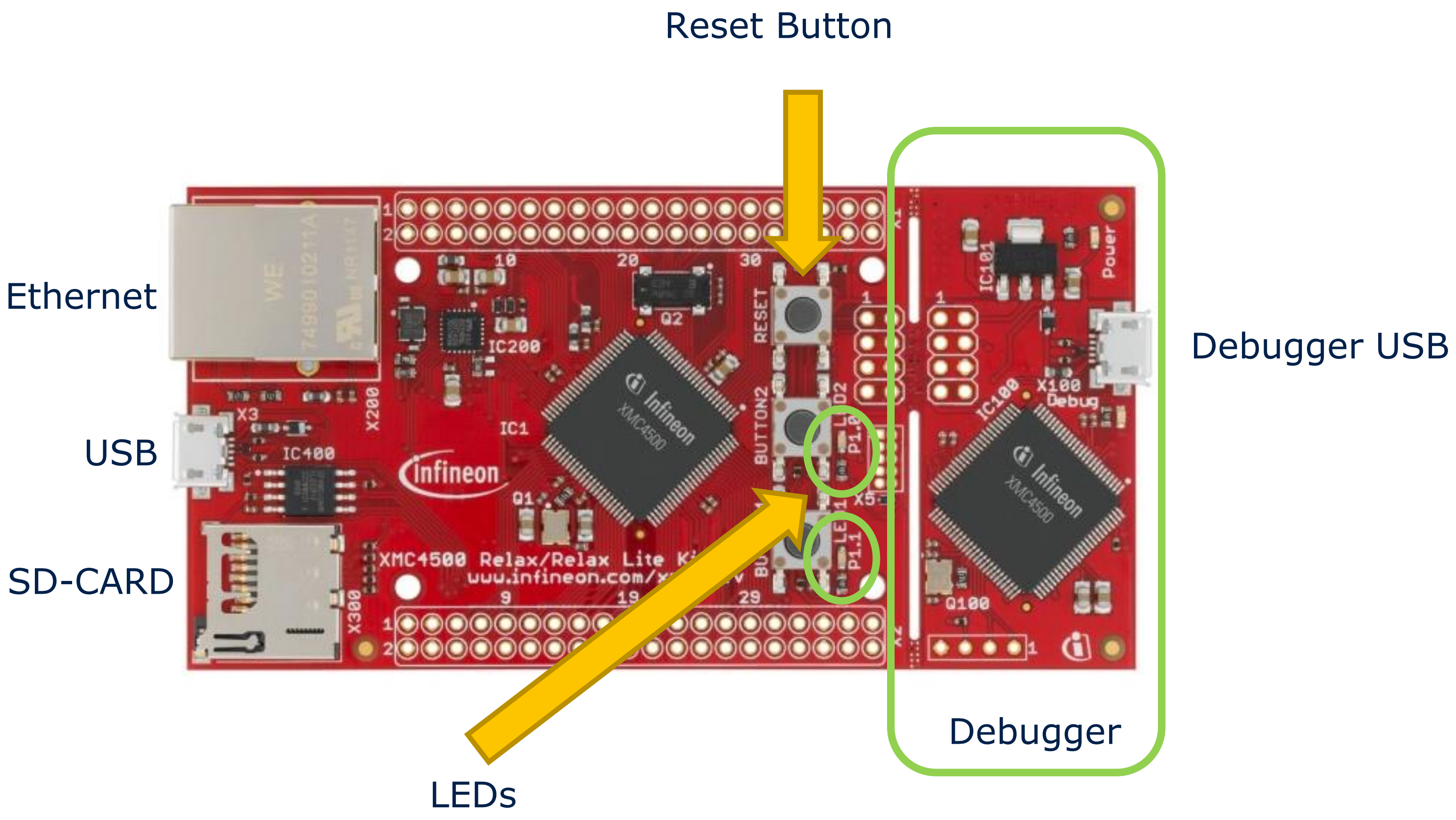
First Task

- Typically the first „Hello World"-like example for microcontrollers is blinking an LED:

- 1) Create a PWM signal with frequency 10 Hz
- 2) Output the PWM signal on a LED connected to P1.1 on the Relax Kit

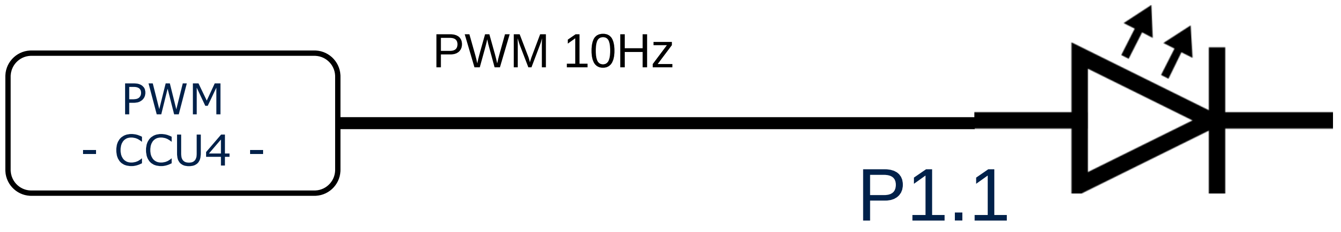
Relax Kit intro

- Relax-kit shoud be connected to your PC via Debugger USB



PWM to Blink an LED

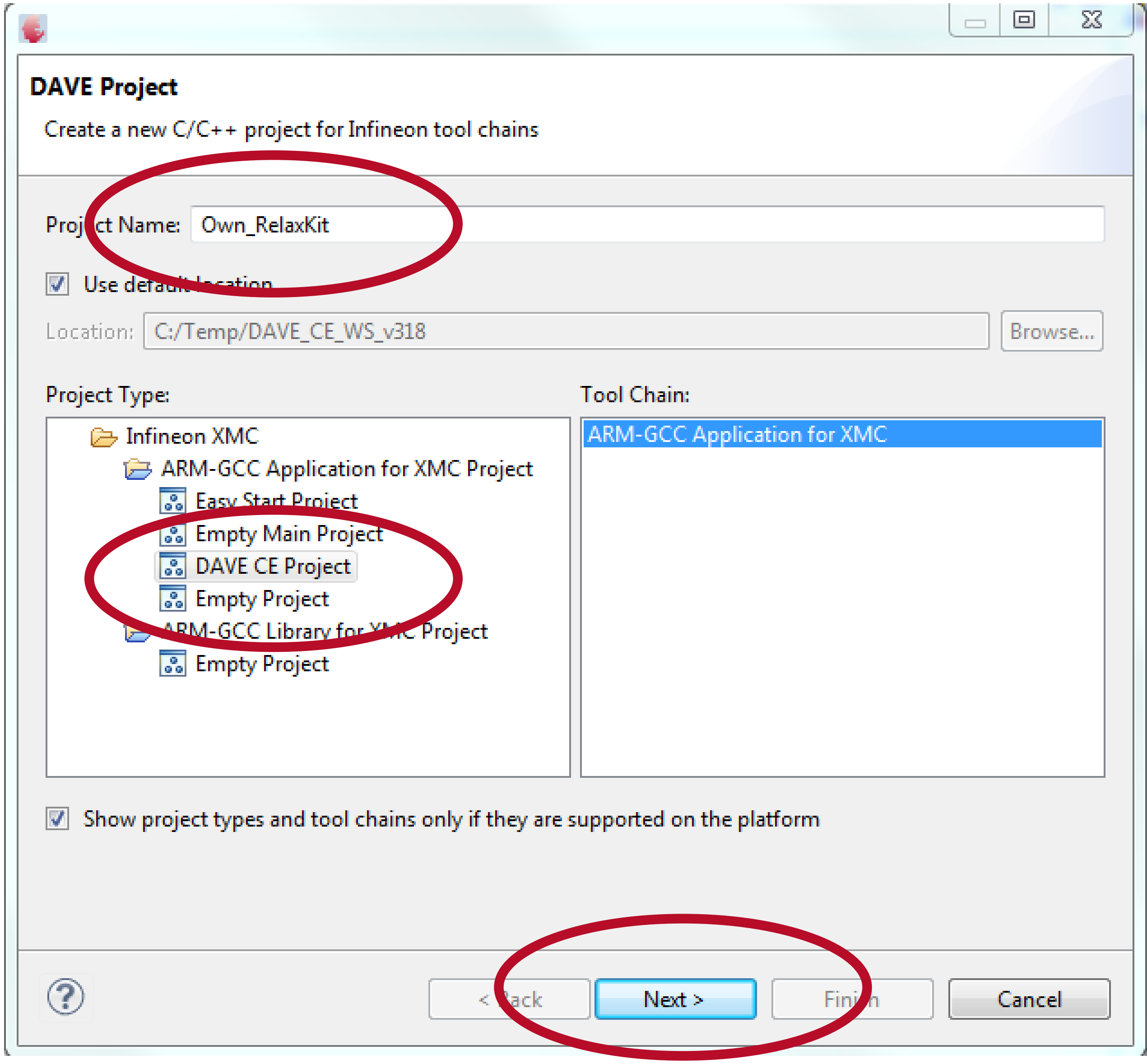
- Creation of a PWM signal that control a LED



Create a new project

- Click "File"
- "New"
- "DAVE CE Project"

- Click "Next"



DAVE Project

Create a new C/C++ project for Infineon tool chains

Project Name: Own_RelaxKit

☑ Use default location

Location: C:/Temp/DAVE_CE_WS_v318

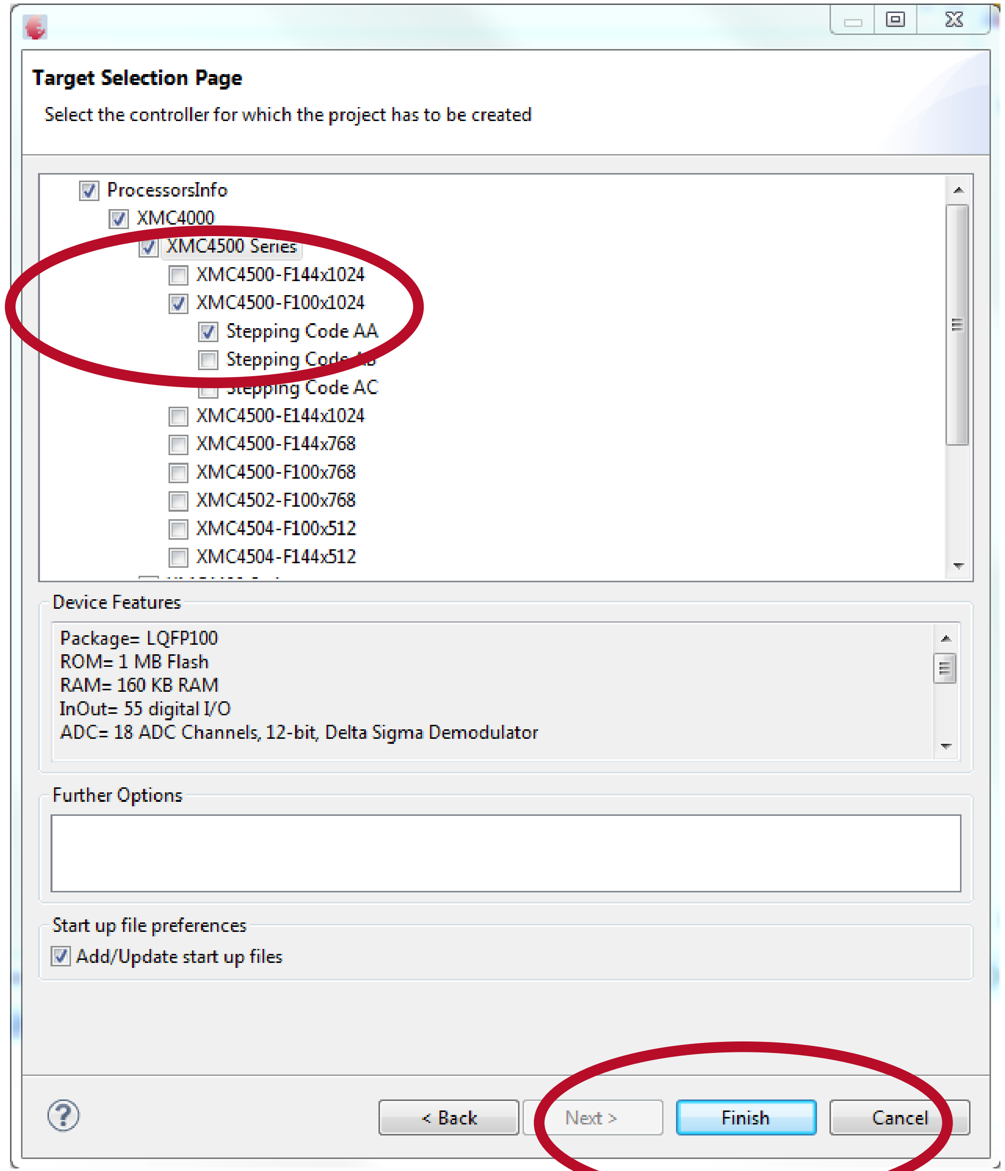
Project Type:
- Infineon XMC
  - ARM-GCC Application for XMC Project
    - Easy Start Project
    - Empty Main Project
    - DAVE CE Project
    - Empty Project
  - ARM-GCC Library for XMC Project
    - Empty Project

Tool Chain: ARM-GCC Application for XMC

☑ Show project types and tool chains only if they are supported on the platform

Select Microcontroller

- Select the appropriate microcontroller
- In this case
  - XMC4500_F100x1024



Target Selection Page

Select the controller for which the project has to be created

- [✓] ProcessorsInfo
  - [✓] XMC4000
    - [✓] XMC4500 Series
      - [ ] XMC4500-F144x1024
      - [✓] XMC4500-F100x1024
        - [✓] Stepping Code AA
        - [ ] Stepping Code AB
        - [ ] Stepping Code AC
      - [ ] XMC4500-E144x1024
      - [ ] XMC4500-F144x768
      - [ ] XMC4500-F100x768
      - [ ] XMC4502-F100x768
      - [ ] XMC4504-F100x512
      - [ ] XMC4504-F144x512

Device Features

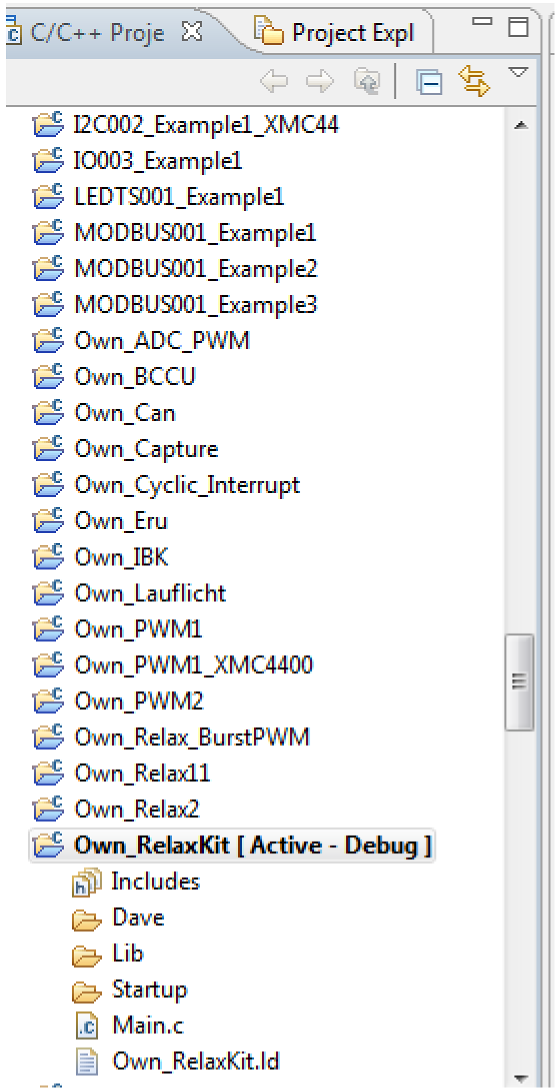
Package= LQFP100
ROM= 1 MB Flash
RAM= 160 KB RAM
InOut= 55 digital I/O
ADC= 18 ADC Channels, 12-bit, Delta Sigma Demodulator

Further Options

Start up file preferences

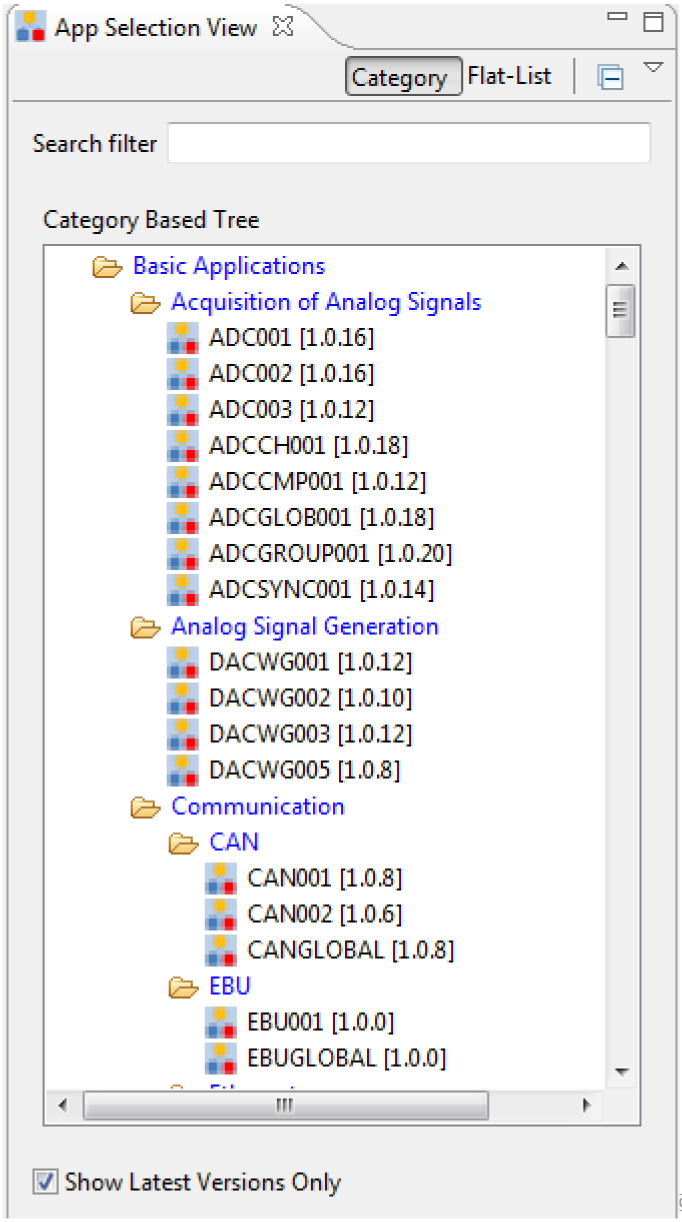
[✓] Add/Update start up files

Project View


C/C++ Proje
Project Expl

- I2C002_Example1_XMC44
- IO003_Example1
- LEDTS001_Example1
- MODBUS001_Example1
- MODBUS001_Example2
- MODBUS001_Example3
- Own_ADC_PWM
- Own_BCCU
- Own_Can
- Own_Capture
- Own_Cyclic_Interrupt
- Own_Eru
- Own_IBK
- Own_Lauflicht
- Own_PWM1
- Own_PWM1_XMC4400
- Own_PWM2
- Own_Relax_BurstPWM
- Own_Relax11
- Own_Relax2
- **Own_RelaxKit [Active - Debug]**
  - Includes
  - Dave
  - Lib
  - Startup
  - Main.c
  - Own_RelaxKit.ld

Adding an App



App Selection View

Category | Flat-List

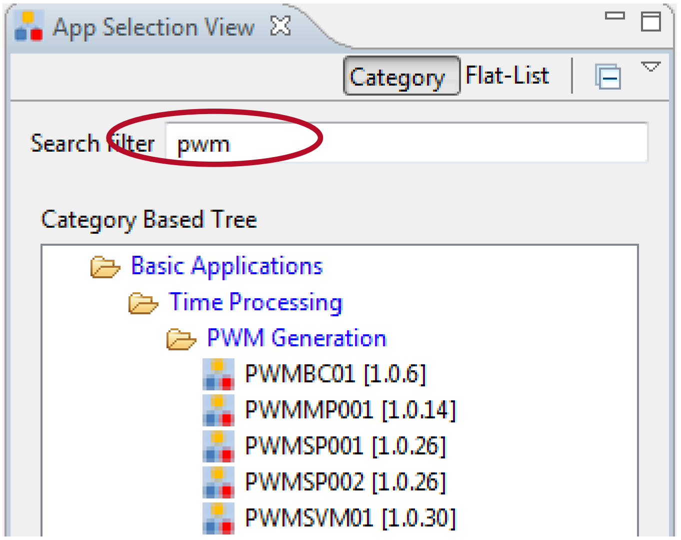
Search filter

Category Based Tree

- Basic Applications
  - Acquisition of Analog Signals
    - ADC001 [1.0.16]
    - ADC002 [1.0.16]
    - ADC003 [1.0.12]
    - ADCCH001 [1.0.18]
    - ADCCMP001 [1.0.12]
    - ADCGLOB001 [1.0.18]
    - ADCGROUP001 [1.0.20]
    - ADCSYNC001 [1.0.14]
  - Analog Signal Generation
    - DACWG001 [1.0.12]
    - DACWG002 [1.0.10]
    - DACWG003 [1.0.12]
    - DACWG005 [1.0.8]
  - Communication
    - CAN
      - CAN001 [1.0.8]
      - CAN002 [1.0.6]
      - CANGLOBAL [1.0.8]
    - EBU
      - EBU001 [1.0.0]
      - EBUGLOBAL [1.0.0]

☑ Show Latest Versions Only

- Type „pwm“ in the search filter field
- Double-click on PWMSP001



App Selection View

Category | Flat-List

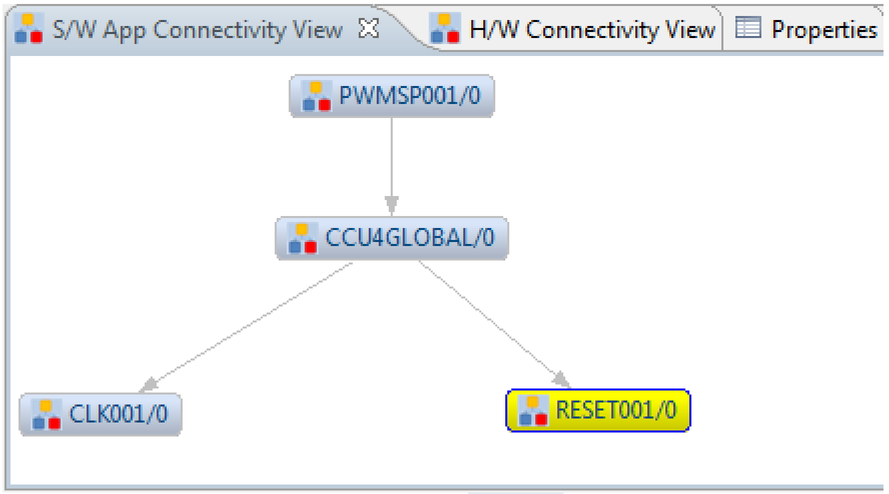
Search filter: pwm

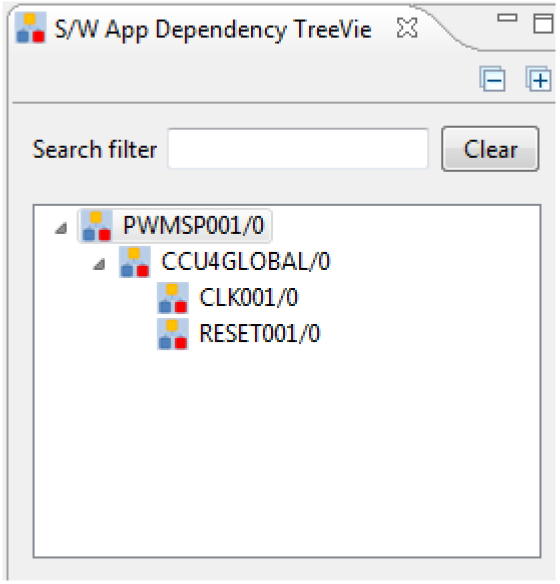
Category Based Tree

- Basic Applications
  - Time Processing
    - PWM Generation
      - PWMBC01 [1.0.6]
      - PWMMP001 [1.0.14]
      - PWMSP001 [1.0.26]
      - PWMSP002 [1.0.26]
      - PWMSVM01 [1.0.30]

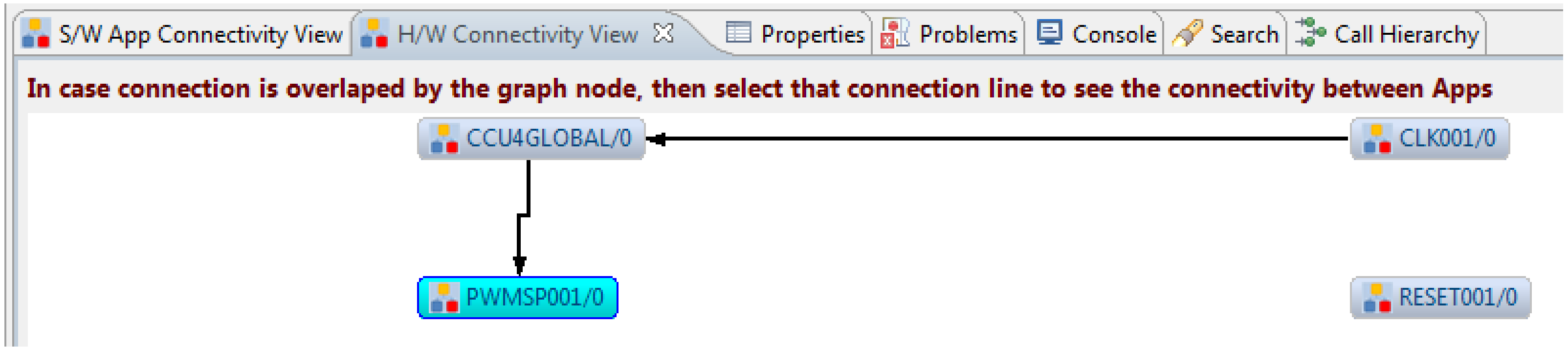
More Project Views

- All Apps in included into one Project are displayed in different Views:





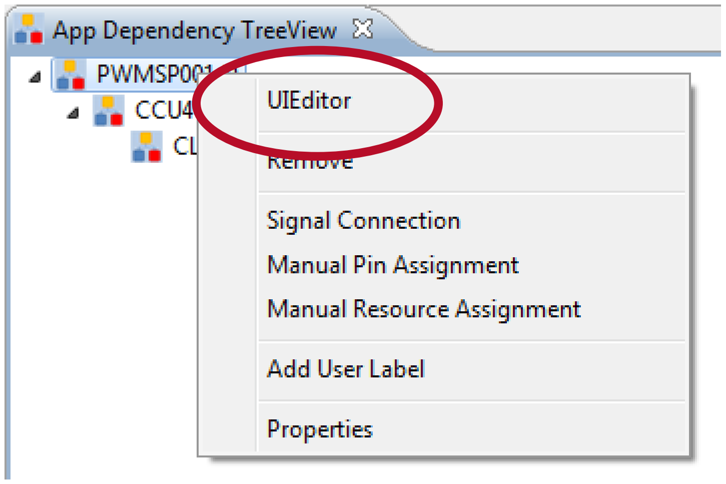
- The number behind the „/“ identifies the instance of an App



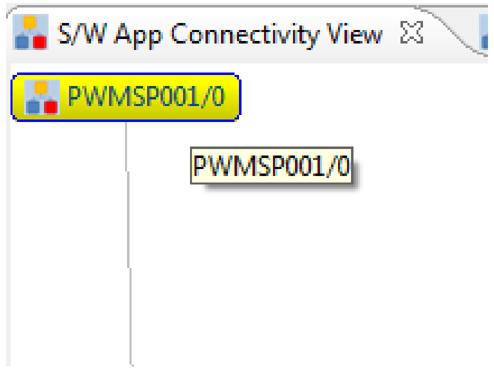
In case connection is overlaped by the graph node, then select that connection line to see the connectivity between Apps

Configuring Apps

- Perform right-click on App name in the App Depency TreeView
- Select UIEditor

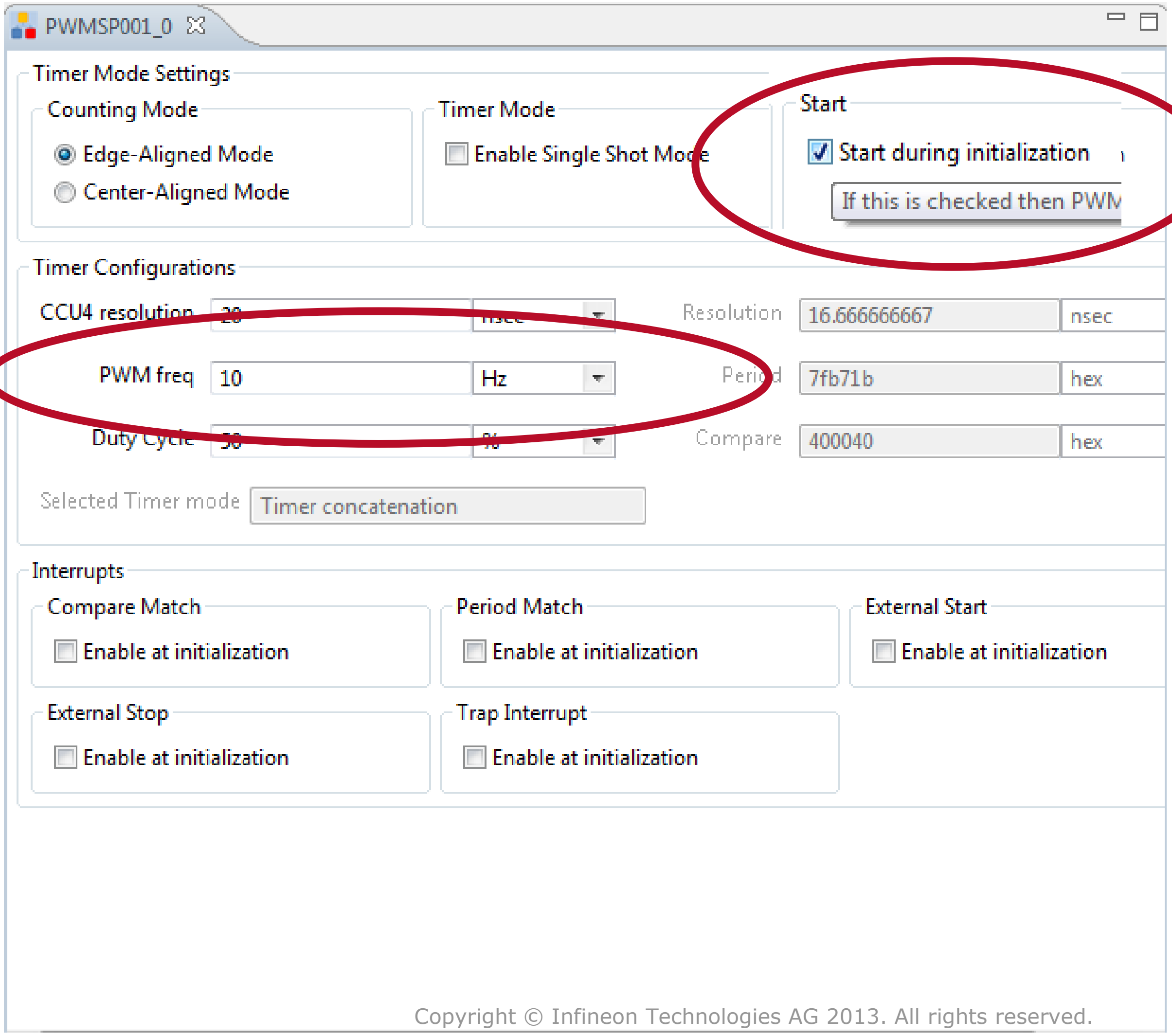


- Second Possibility:
- Double-click on App Name in S/W App Connectivity View



Configure PWMSP001 App for a 10 Hz signal

- Open the UIEditor of PWMSP001 and configure:



PWMSP001_0

Timer Mode Settings

Counting Mode
- [✓ Edge-Aligned Mode]
- Center-Aligned Mode

Timer Mode
- ☐ Enable Single Shot Mode

Start
- ☑ Start during initialization
- If this is checked then PWM

Timer Configurations

CCU4 resolution	20	nsec	Resolution	16.666666667	nsec
PWM freq	10	Hz	Period	7fb71b	hex
Duty Cycle	50	%	Compare	400040	hex

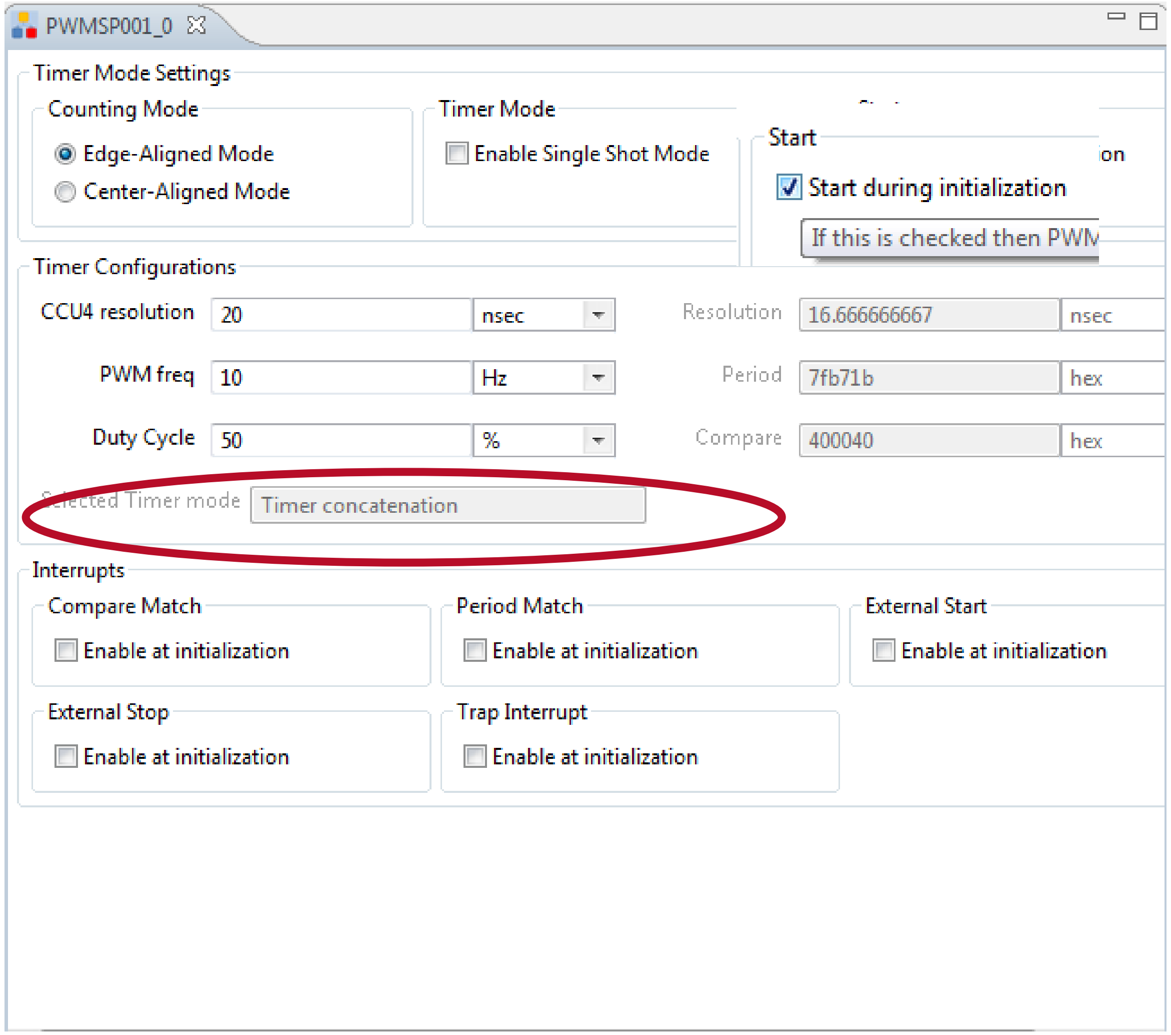
Selected Timer mode: Timer concatenation

Interrupts

- Compare Match: ☐ Enable at initialization
- Period Match: ☐ Enable at initialization
- External Start: ☐ Enable at initialization
- External Stop: ☐ Enable at initialization
- Trap Interrupt: ☐ Enable at initialization

Hint

- Please note that the Tool automatically concatenates timers



PWMSP001_0

Timer Mode Settings

Counting Mode: [✓ Edge-Aligned Mode] Center-Aligned Mode

Timer Mode: ☐ Enable Single Shot Mode

Start: ☑ Start during initialization

If this is checked then PWM

Timer Configurations

CCU4 resolution	20	nsec	Resolution	16.666666667	nsec
PWM freq	10	Hz	Period	7fb71b	hex
Duty Cycle	50	%	Compare	400040	hex

Selected Timer mode: Timer concatenation

Interrupts

Compare Match: ☐ Enable at initialization

Period Match: ☐ Enable at initialization

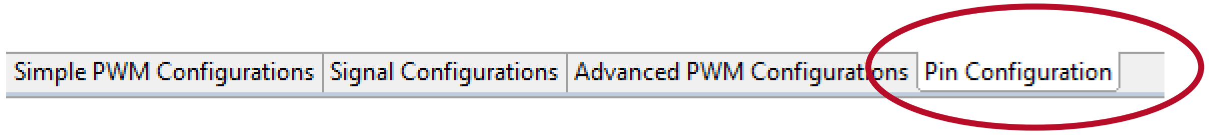
External Start: ☐ Enable at initialization

External Stop: ☐ Enable at initialization

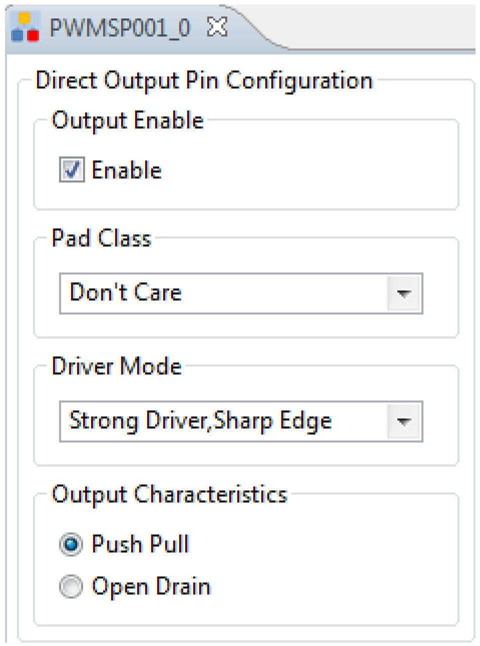
Trap Interrupt: ☐ Enable at initialization

Output Settings

- From the selection of the subviews of the UIEditor select „Pin Configuration“



- Check „Output Enable“



Direct Output Pin Configuration

Output Enable

[✓] Enable

Pad Class: Don't Care

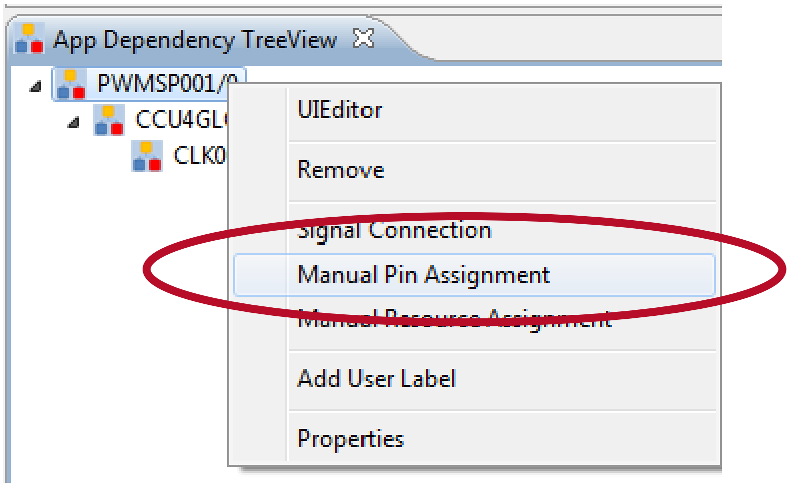
Driver Mode: Strong Driver,Sharp Edge

Output Characteristics

[✓ Push Pull] Open Drain

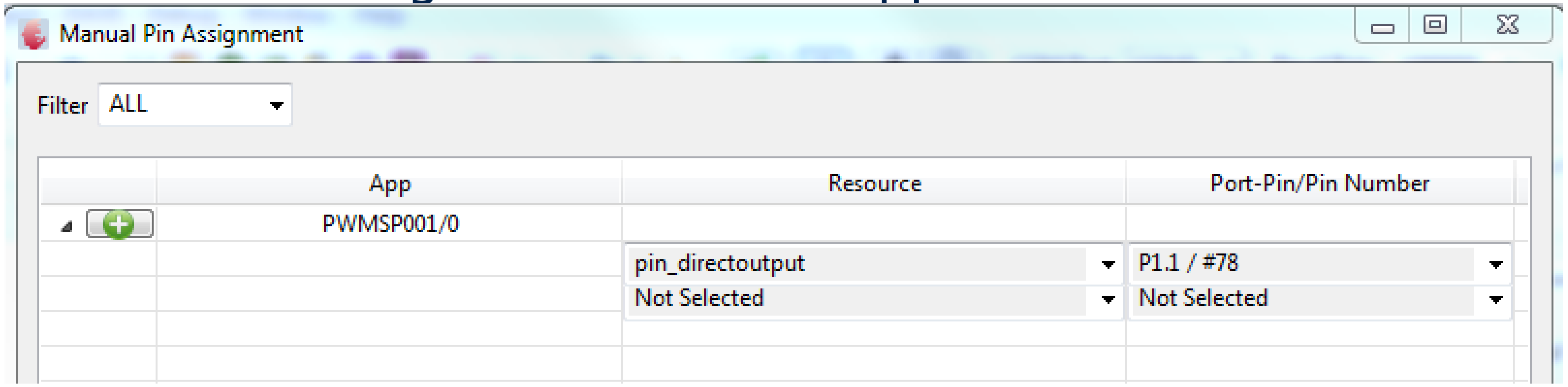
Pin Configuration

- Now to direct the PWM signal we just configured out of the P1.2 we have to assign this pin to the PWM signal output
- Right-click on PWMSP001/0
- Select „Manual Pin Assignment"



Pin Configuration

- Manual Pin Assignment Window appears:

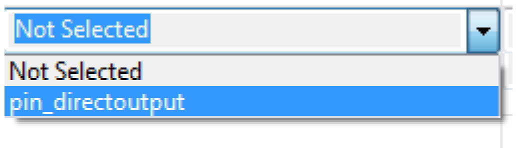


Manual Pin Assignment

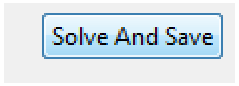
Filter: ALL

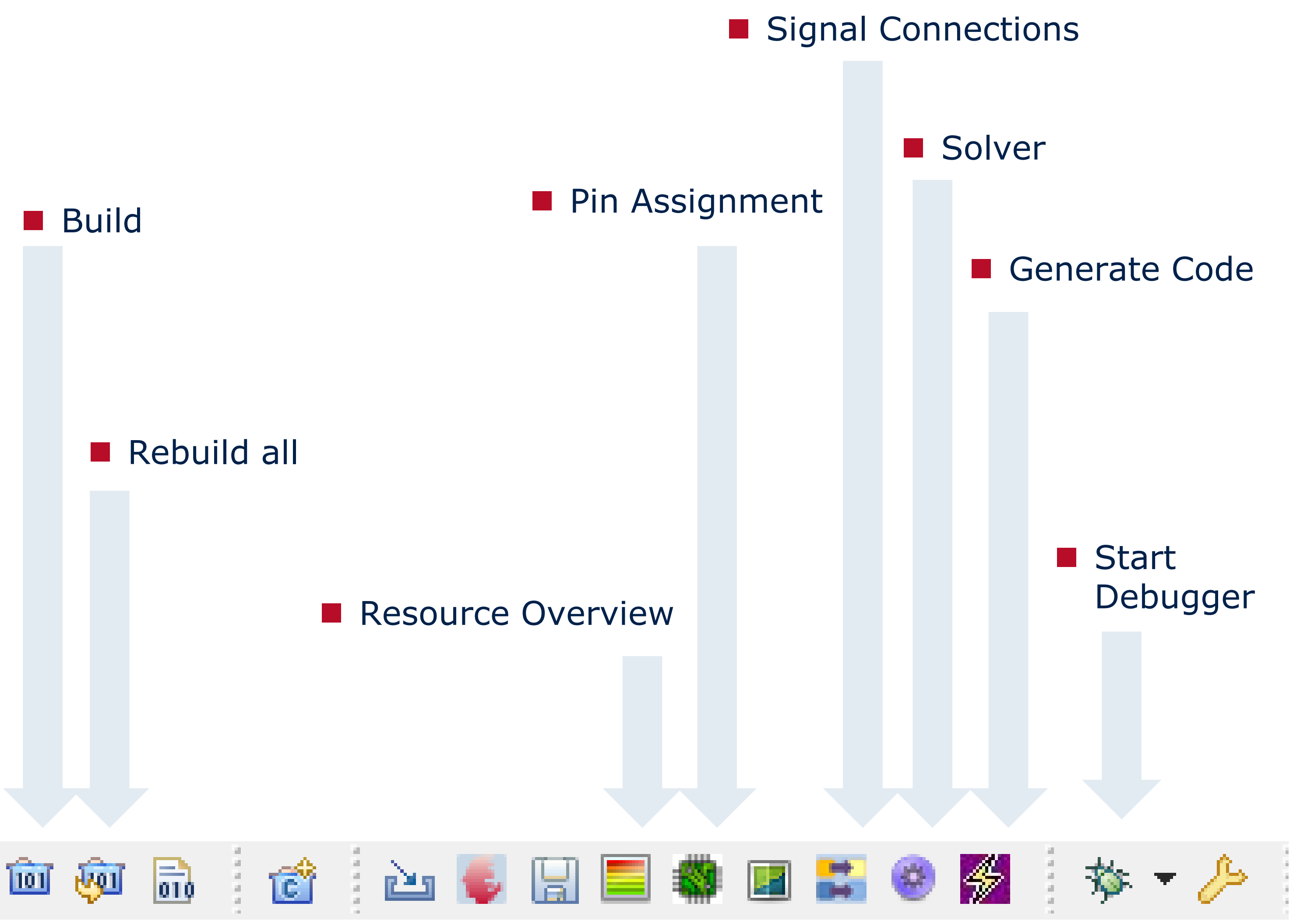
	App	Resource	Port-Pin/Pin Number
	PWMSP001/0		
		pin_directoutput	P1.1 / #78
		Not Selected	Not Selected

- From the Drop-down menu select „pin_directoutput“



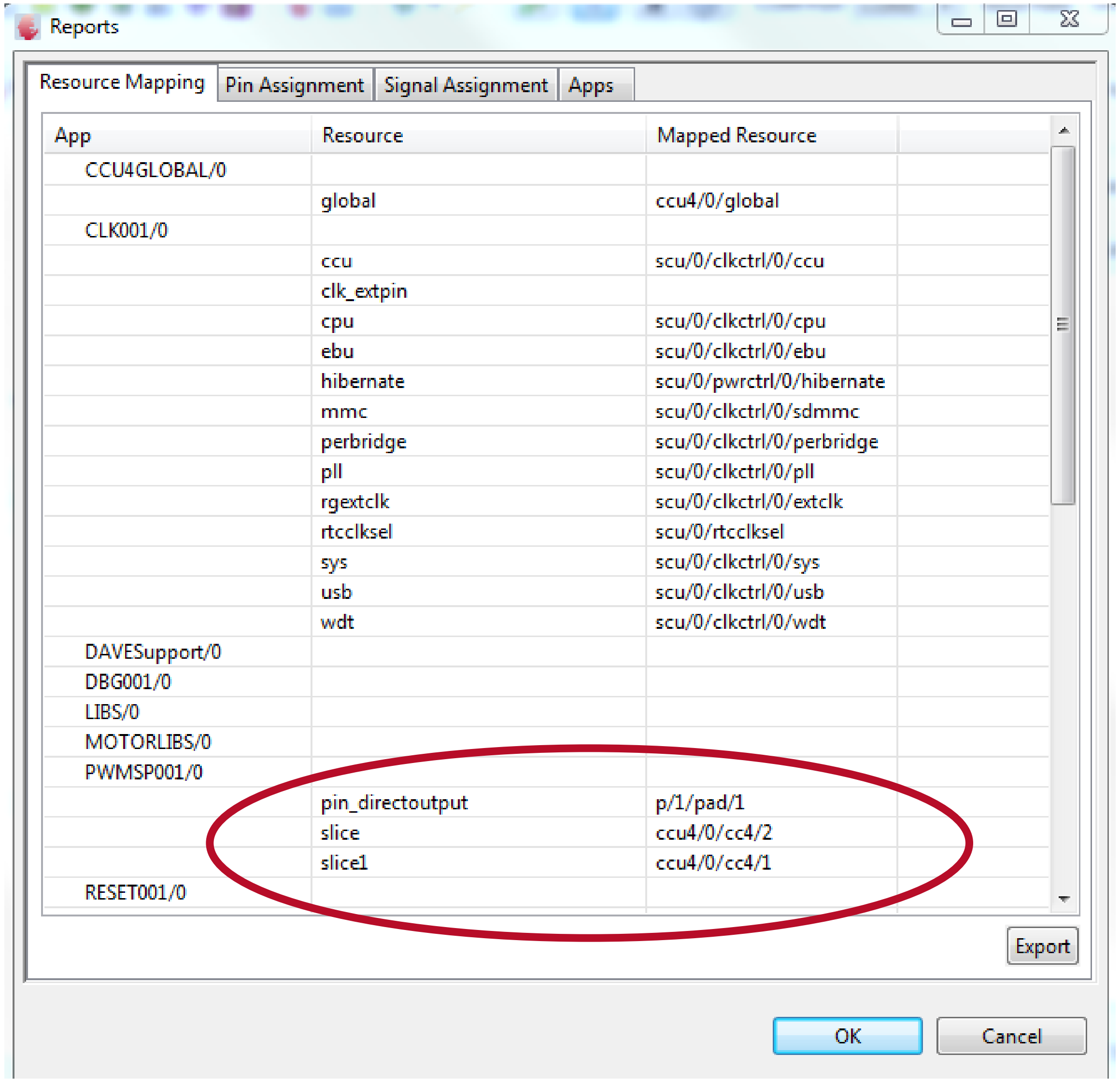
- From the second Drop-down menu select „P1.1 / #78“
- Click „Solve and Save“




Signal Connections
Solver
Pin Assignment
Build
Generate Code
Rebuild all
Start Debugger
Resource Overview

Check Correct function of the Timer Module

- Open the Resource Overview in DAVE CE perspective



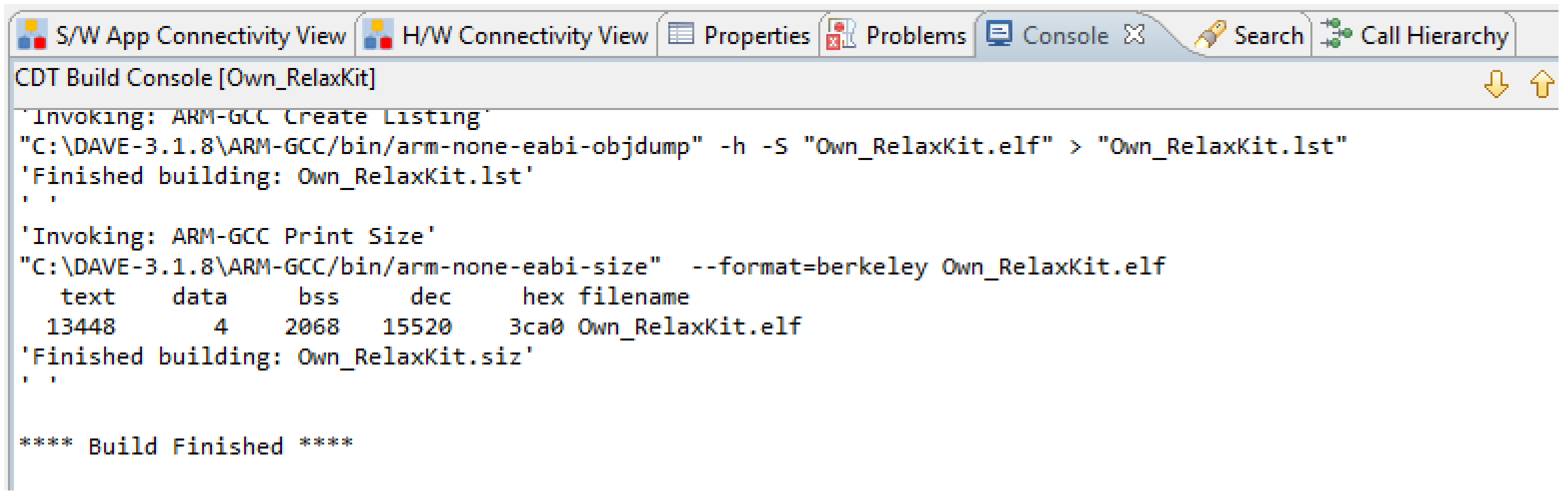
App	Resource	Mapped Resource
CCU4GLOBAL/0		
	global	ccu4/0/global
CLK001/0		
	ccu	scu/0/clkctrl/0/ccu
	clk_extpin	
	cpu	scu/0/clkctrl/0/cpu
	ebu	scu/0/clkctrl/0/ebu
	hibernate	scu/0/pwrctrl/0/hibernate
	mmc	scu/0/clkctrl/0/sdmmc
	perbridge	scu/0/clkctrl/0/perbridge
	pll	scu/0/clkctrl/0/pll
	rgextclk	scu/0/clkctrl/0/extclk
	rtcclksel	scu/0/rtcclksel
	sys	scu/0/clkctrl/0/sys
	usb	scu/0/clkctrl/0/usb
	wdt	scu/0/clkctrl/0/wdt
DAVESupport/0		
DBG001/0		
LIBS/0		
MOTORLIBS/0		
PWMSP001/0		
	pin_directoutput	p/1/pad/1
	slice	ccu4/0/cc4/2
	slice1	ccu4/0/cc4/1
RESET001/0		

Generate & Compile Code

- Start the Solver by clicking „the disc" in the tool panel
- If the solver does not show an error, there is none and everything that is configured it possible
- Start the Code generator by clicking the „Lightning" in the tool panel
- Start the compiler by clicking the „build" symbol in the tool panel

Check Compiler Results

- Ensure that Compiler finished regularly in Console window



```
'Invoking: ARM-GCC Create Listing'
"C:\DAVE-3.1.8\ARM-GCC/bin/arm-none-eabi-objdump" -h -S "Own_RelaxKit.elf" > "Own_RelaxKit.lst"
'Finished building: Own_RelaxKit.lst'
' '
'Invoking: ARM-GCC Print Size'
"C:\DAVE-3.1.8\ARM-GCC/bin/arm-none-eabi-size"  --format=berkeley Own_RelaxKit.elf
   text    data     bss     dec     hex filename
  13448       4    2068   15520    3ca0 Own_RelaxKit.elf
'Finished building: Own_RelaxKit.siz'
' '


**** Build Finished ****
```

The Project Folder

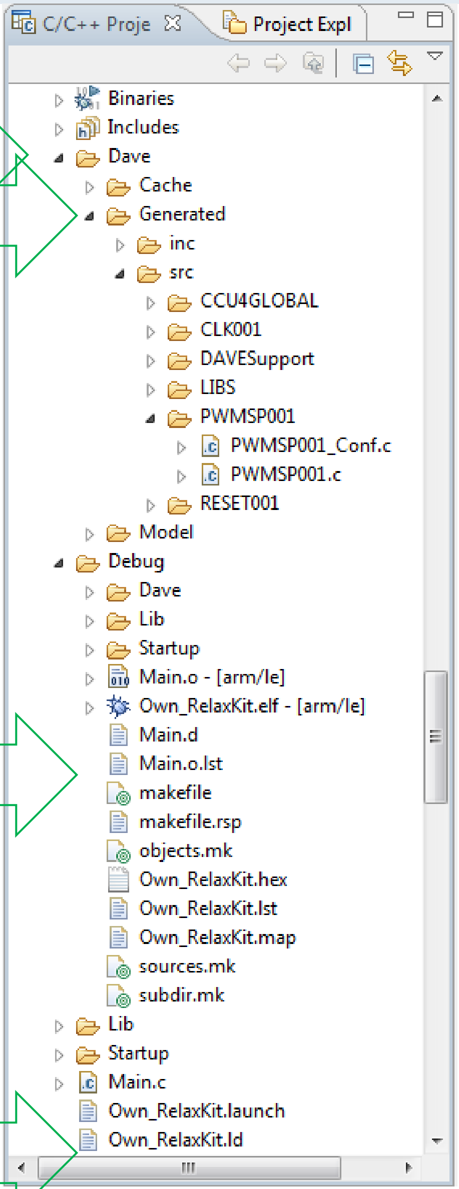
Folder which is used exclusively by DAVE

Generated code goes in here

Code Templates can be found in here

Compiler output files

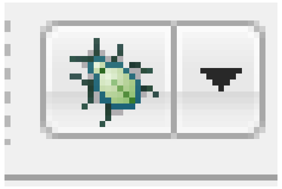
Linker Script file



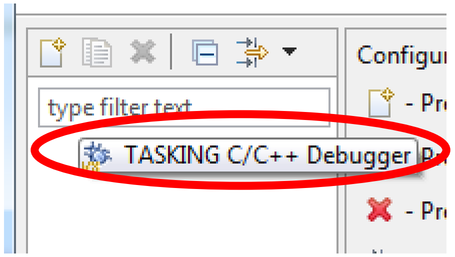
```
Binaries
Includes
Dave
    Cache
    Generated
        inc
        src
            CCU4GLOBAL
            CLK001
            DAVESupport
            LIBS
            PWMSP001
                PWMSP001_Conf.c
                PWMSP001.c
            RESET001
    Model
Debug
    Dave
    Lib
    Startup
    Main.o - [arm/le]
    Own_RelaxKit.elf - [arm/le]
    Main.d
    Main.o.lst
    makefile
    makefile.rsp
    objects.mk
    Own_RelaxKit.hex
    Own_RelaxKit.lst
    Own_RelaxKit.map
    sources.mk
    subdir.mk
Lib
Startup
Main.c
Own_RelaxKit.launch
Own_RelaxKit.ld
```

Flash and Debug

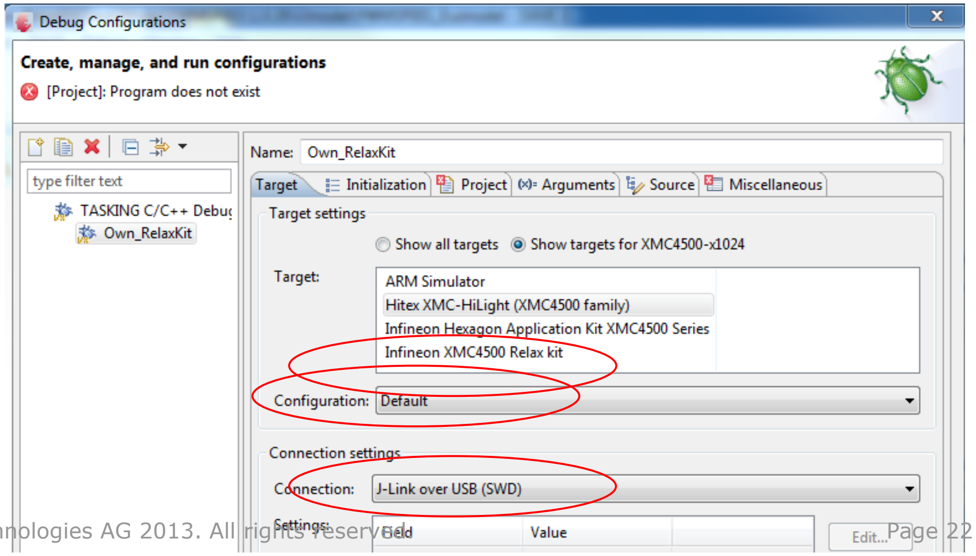
- Start the Debug Session by clicking on „the bug" in the tool panel



- Create a new Debug Configuration by double-clicking on „Tasking C/C++ Debugger"



- Select „Infineon XMC4500 Relax kit"
  Configuration: Default
  Connection: J-Link over USB (SWD)



Debug Configurations

Create, manage, and run configurations

[Project]: Program does not exist

type filter text
TASKING C/C++ Debug
Own_RelaxKit

Name: Own_RelaxKit

Target | Initialization | Project | Arguments | Source | Miscellaneous

Target settings

○ Show all targets ● Show targets for XMC4500-x1024

Target:
ARM Simulator
Hitex XMC-HiLight (XMC4500 family)
Infineon Hexagon Application Kit XMC4500 Series
Infineon XMC4500 Relax kit

Configuration: Default

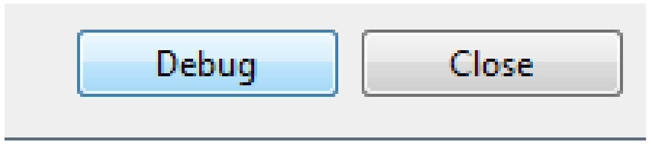
Connection settings

Connection: J-Link over USB (SWD)

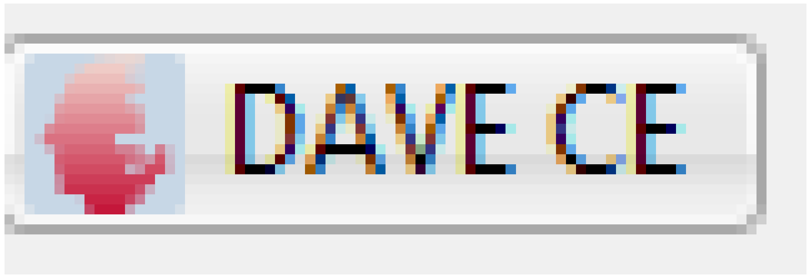
Settings: Field | Value | Edit...

Flash and Debug

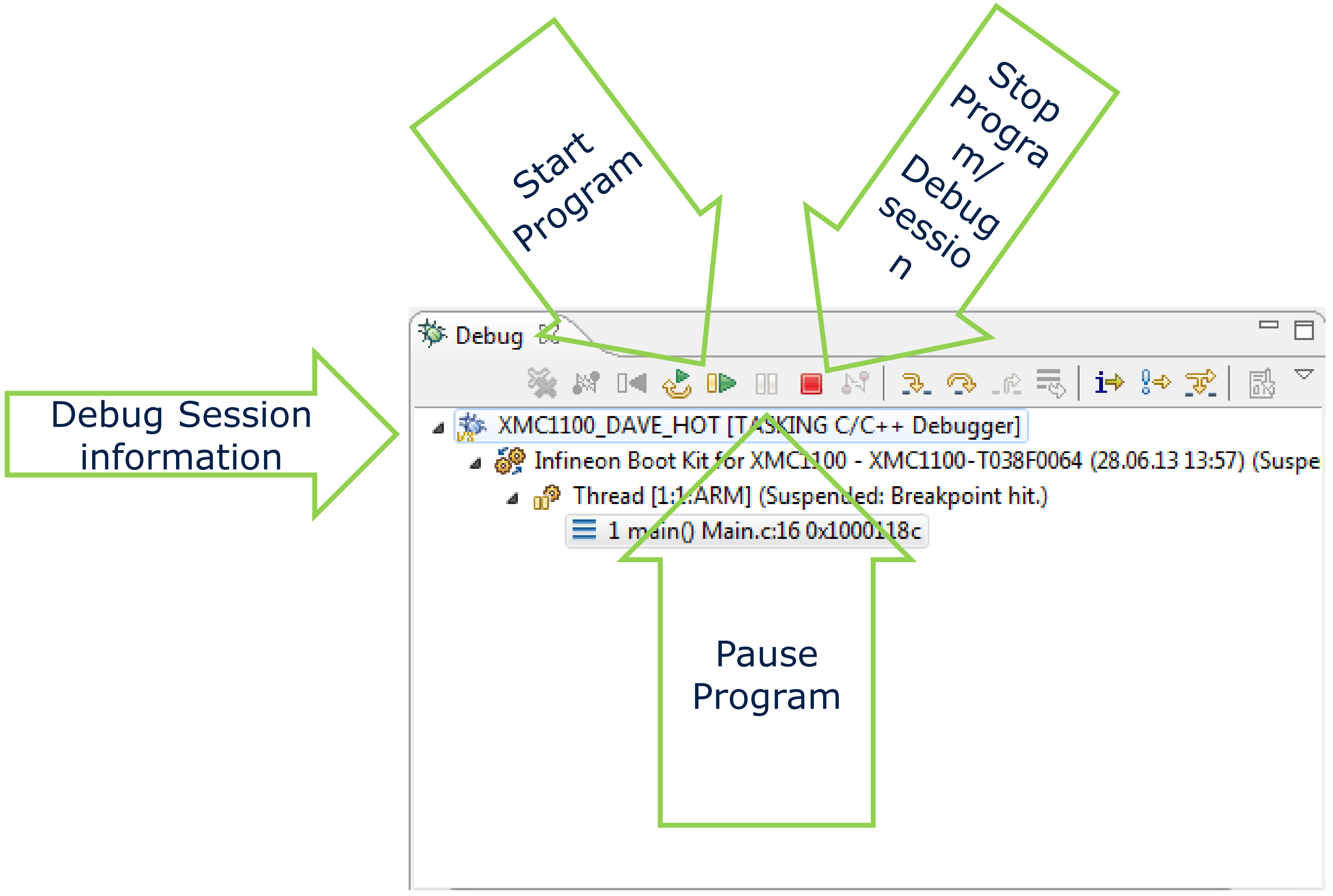
- Click on „Debug“



- The flashing process is started automatically and DAVE automatically switches to the Debug Perspective
- You can switch back to the Project Workspace Perspective using this button in the upper right corner of your window:



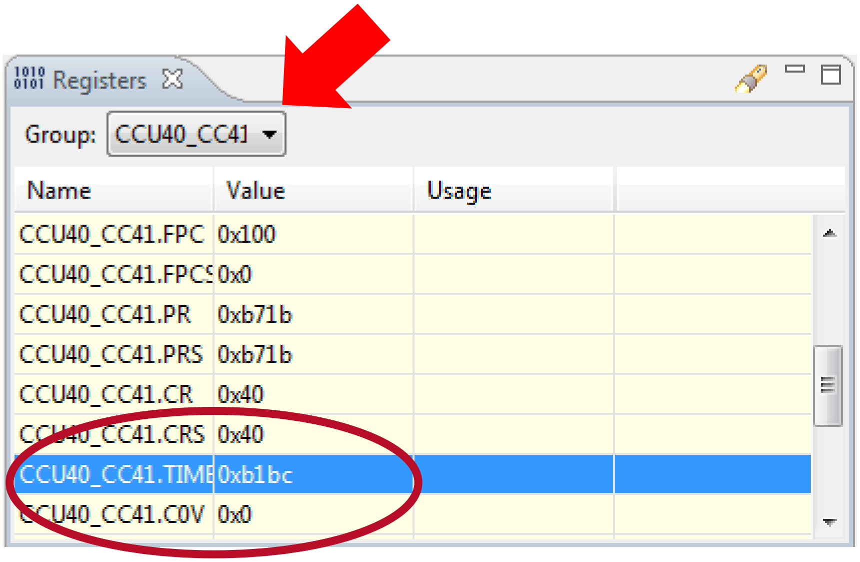
The Debug Perspective - Debug Window



XMC1100_DAVE_HOT [TASKING C/C++ Debugger]
Infineon Boot Kit for XMC1100 - XMC1100-T038F0064 (28.06.13 13:57) (Suspe
Thread [1:1:ARM] (Suspended: Breakpoint hit.)
1 main() Main.c:16 0x1000118c

The Debug Perspective – Register Views

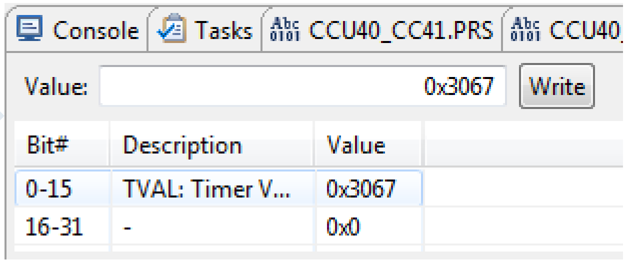
- Registers
- Drop-down list with modules
- For detailed register view right-click on the register name and select „Symbolic Representation“



Registers

Group: CCU40_CC41

Name	Value	Usage
CCU40_CC41.FPC	0x100	
CCU40_CC41.FPCS	0x0	
CCU40_CC41.PR	0xb71b	
CCU40_CC41.PRS	0xb71b	
CCU40_CC41.CR	0x40	
CCU40_CC41.CRS	0x40	
CCU40_CC41.TIME	0xb1bc	
CCU40_CC41.C0V	0x0	



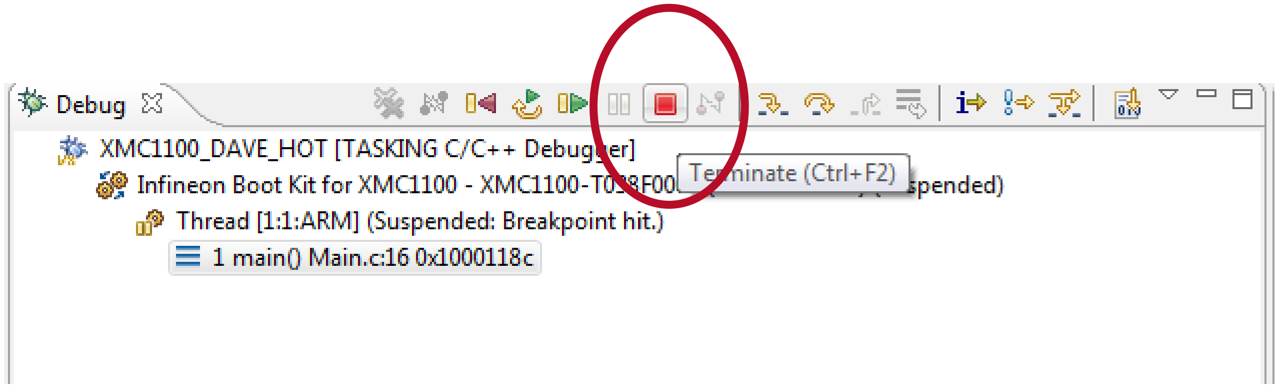
Console | Tasks | CCU40_CC41.PRS | CCU40

Value: 0x3067 Write

Bit#	Description	Value
0-15	TVAL: Timer V...	0x3067
16-31	-	0x0

The Debug Perspective – End Debug Session

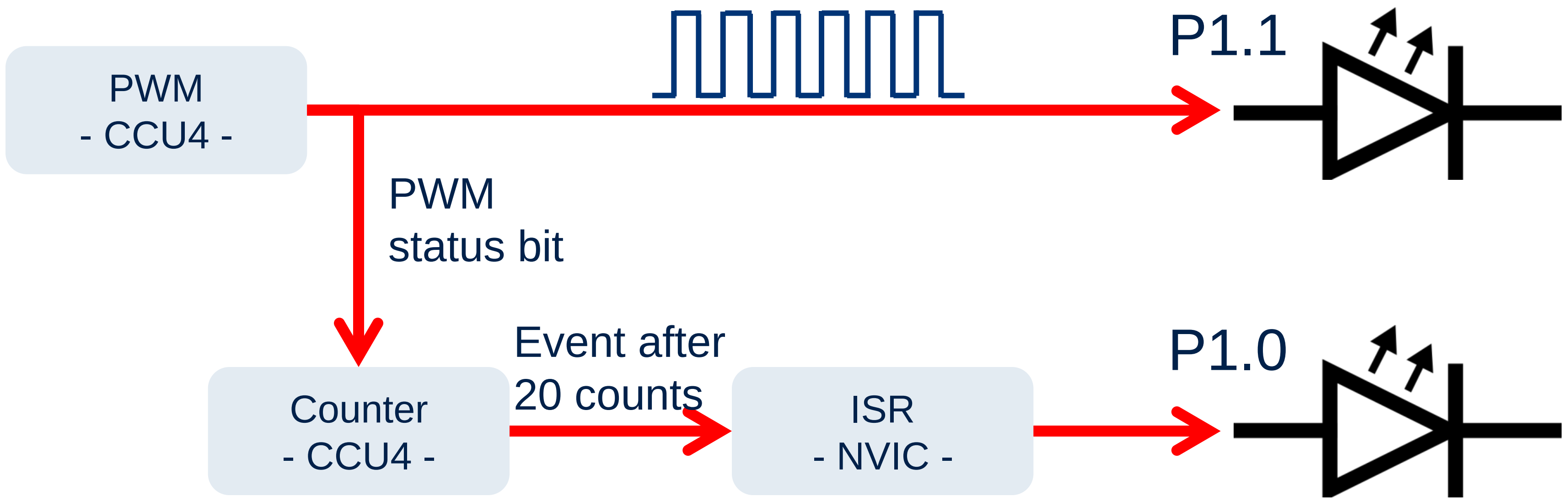
- Always end a debug session by clicking the „Stop“ Button



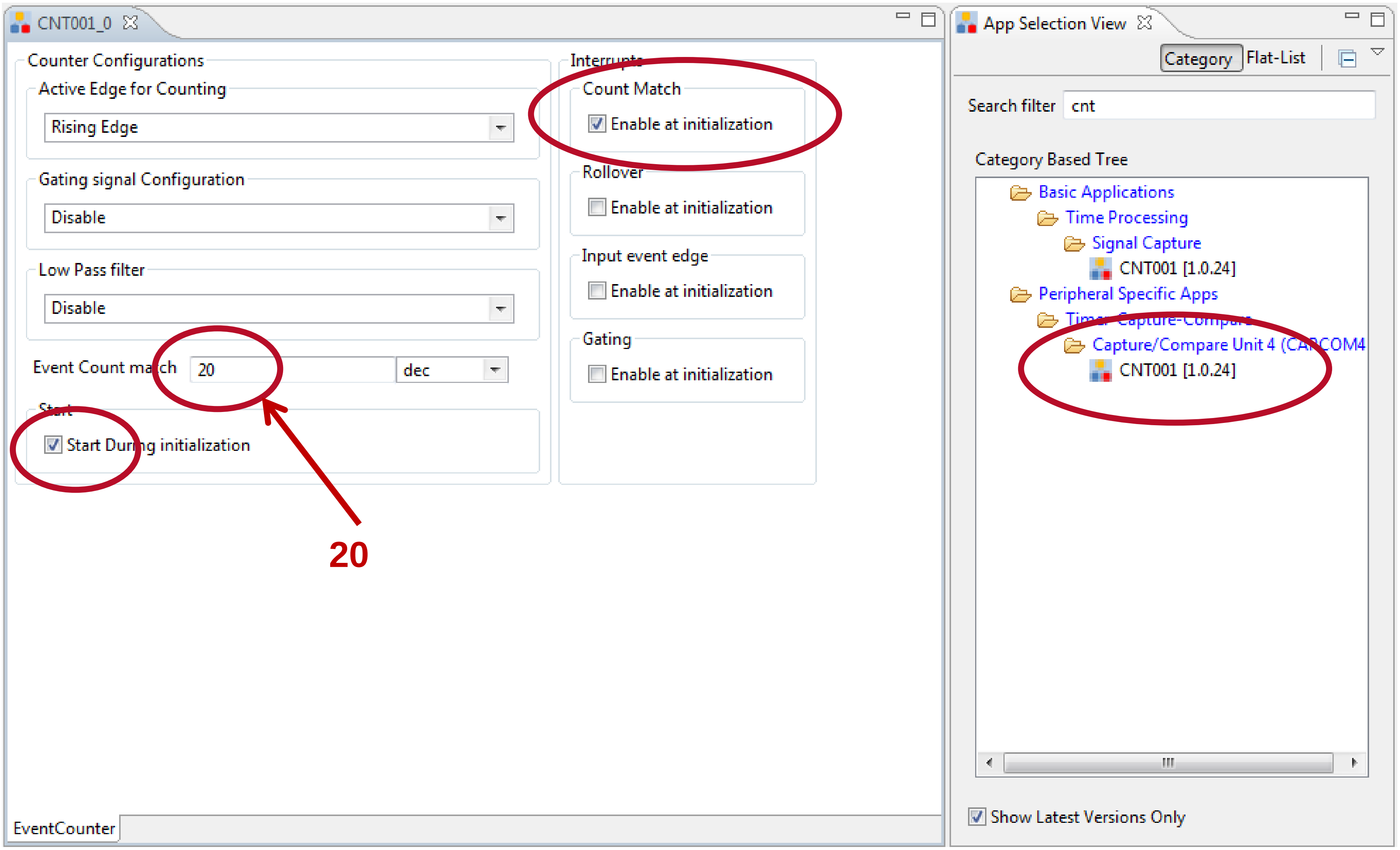
XMC1100_DAVE_HOT [TASKING C/C++ Debugger]
Infineon Boot Kit for XMC1100 - XMC1100-T038F00 ... (Suspended)
Thread [1:1:ARM] (Suspended: Breakpoint hit.)
1 main() Main.c:16 0x1000118c

Connecting Apps

- Task: Additional PWM with 5Hz shall be output on P1.0
- Generated by Counter Event = 20
- Counter incremented by PWM
- ISR: Resetting Counter and Toggling P1.0



Add and configure a Counter App



CNT001_0

Counter Configurations

Active Edge for Counting: Rising Edge

Gating signal Configuration: Disable

Low Pass filter: Disable

Event Count match: 20 dec

Start

[✓] Start During initialization

Interrupts

Count Match: [✓] Enable at initialization

Rollover: [ ] Enable at initialization

Input event edge: [ ] Enable at initialization

Gating: [ ] Enable at initialization

EventCounter

App Selection View

Category | Flat-List

Search filter: cnt

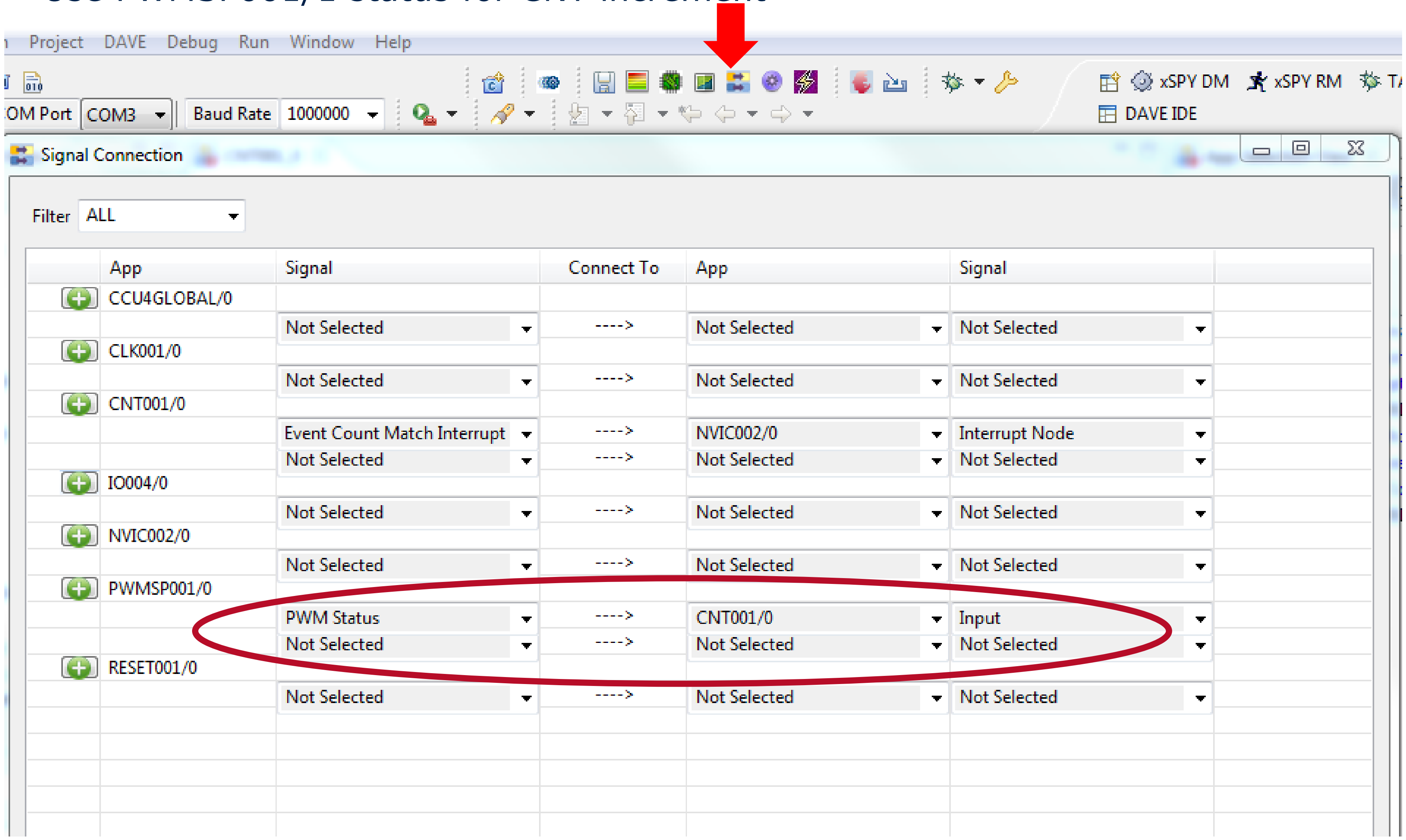
Category Based Tree

- Basic Applications
  - Time Processing
    - Signal Capture
      - CNT001 [1.0.24]
- Peripheral Specific Apps
  - Timer-Capture-Compare
    - Capture/Compare Unit 4 (CAPCOM4
      - CNT001 [1.0.24]

[✓] Show Latest Versions Only

Connect PWM App with CNT App

- Use PWMSP001/1 status for CNT increment


Project DAVE Debug Run Window Help

OM Port COM3 Baud Rate 1000000

xSPY DM xSPY RM DAVE IDE

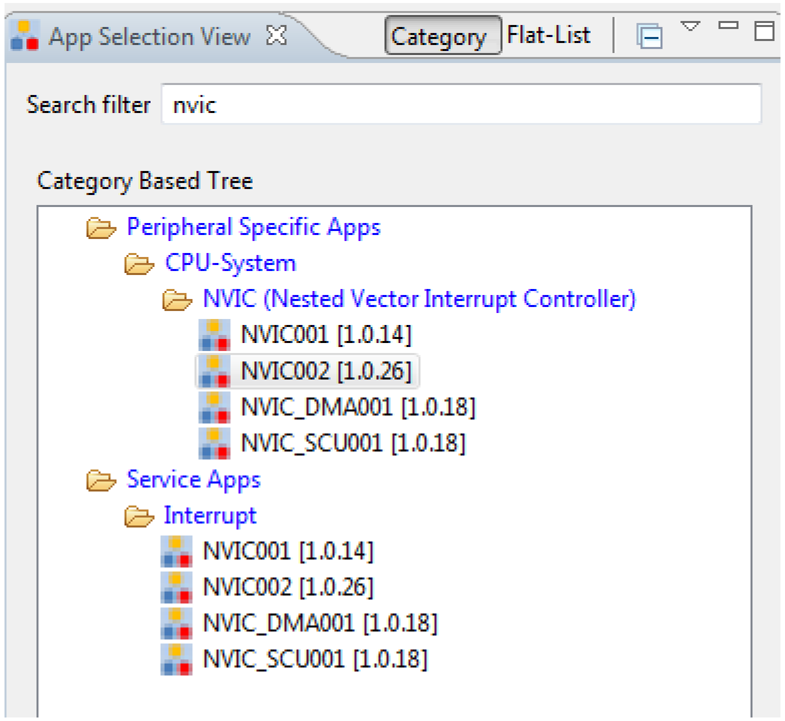
Signal Connection

Filter ALL

App	Signal	Connect To	App	Signal
CCU4GLOBAL/0				
	Not Selected	---->	Not Selected	Not Selected
CLK001/0				
	Not Selected	---->	Not Selected	Not Selected
CNT001/0				
	Event Count Match Interrupt	---->	NVIC002/0	Interrupt Node
	Not Selected	---->	Not Selected	Not Selected
IO004/0				
	Not Selected	---->	Not Selected	Not Selected
NVIC002/0				
	Not Selected	---->	Not Selected	Not Selected
PWMSP001/0				
	PWM Status	---->	CNT001/0	Input
	Not Selected	---->	Not Selected	Not Selected
RESET001/0				
	Not Selected	---->	Not Selected	Not Selected

Add a Nested Vector Interrupt App - Solution

- Select the NVIC002 app which allows to configure an interrupt node
- Add this app to the project



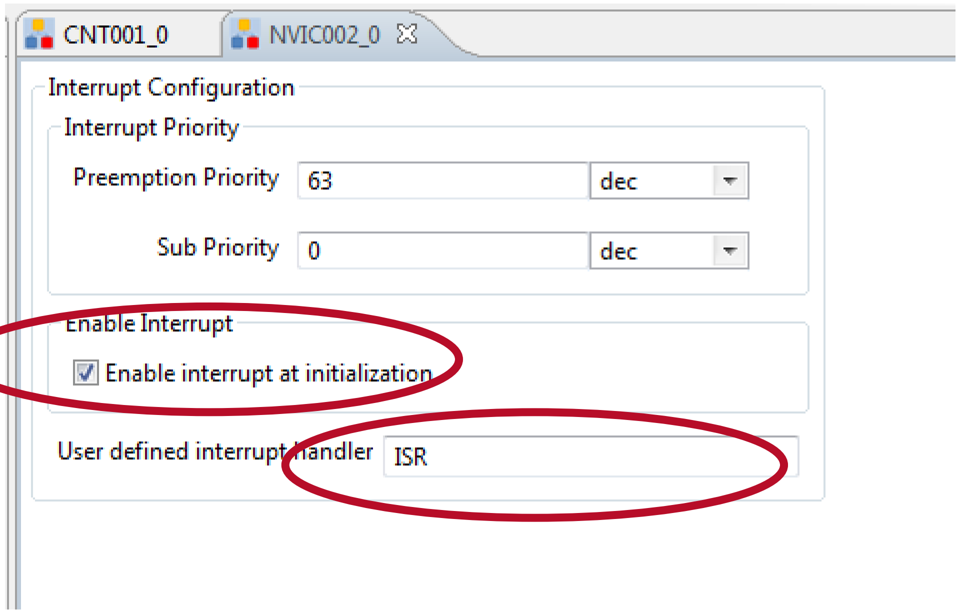
Search filter nvic

Category Based Tree

- Peripheral Specific Apps
  - CPU-System
    - NVIC (Nested Vector Interrupt Controller)
      - NVIC001 [1.0.14]
      - NVIC002 [1.0.26]
      - NVIC_DMA001 [1.0.18]
      - NVIC_SCU001 [1.0.18]
- Service Apps
  - Interrupt
    - NVIC001 [1.0.14]
    - NVIC002 [1.0.26]
    - NVIC_DMA001 [1.0.18]
    - NVIC_SCU001 [1.0.18]

Configure Interrupt Node

- Open the UIEditor of the added NVIC002 App
- Check „Enable interrupt at initialization"
- Type a name for the User defined interrupt handler
  - Note that this is the C function name used in the code



Interrupt Configuration

Interrupt Priority

Preemption Priority: 63 dec

Sub Priority: 0 dec

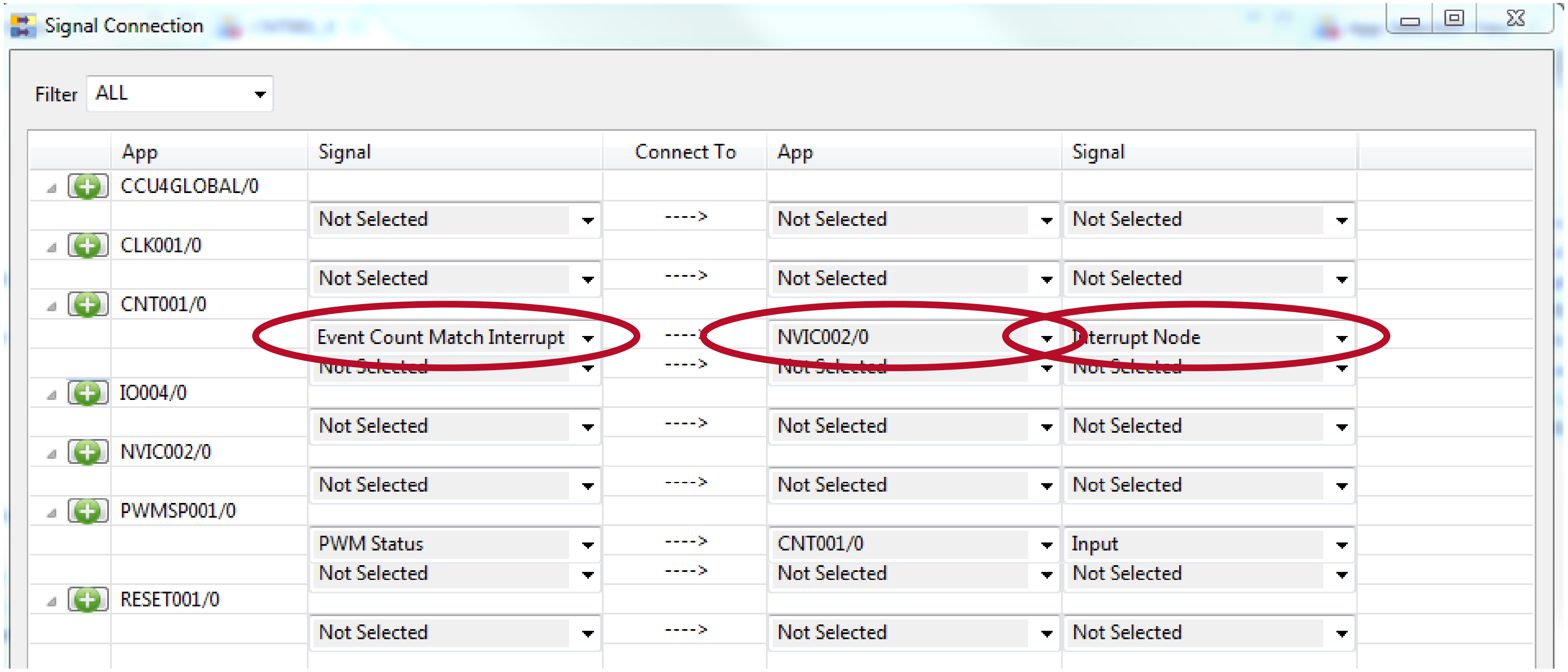
Enable Interrupt

[✓] Enable interrupt at initialization

User defined interrupt handler: ISR

Signal Connection

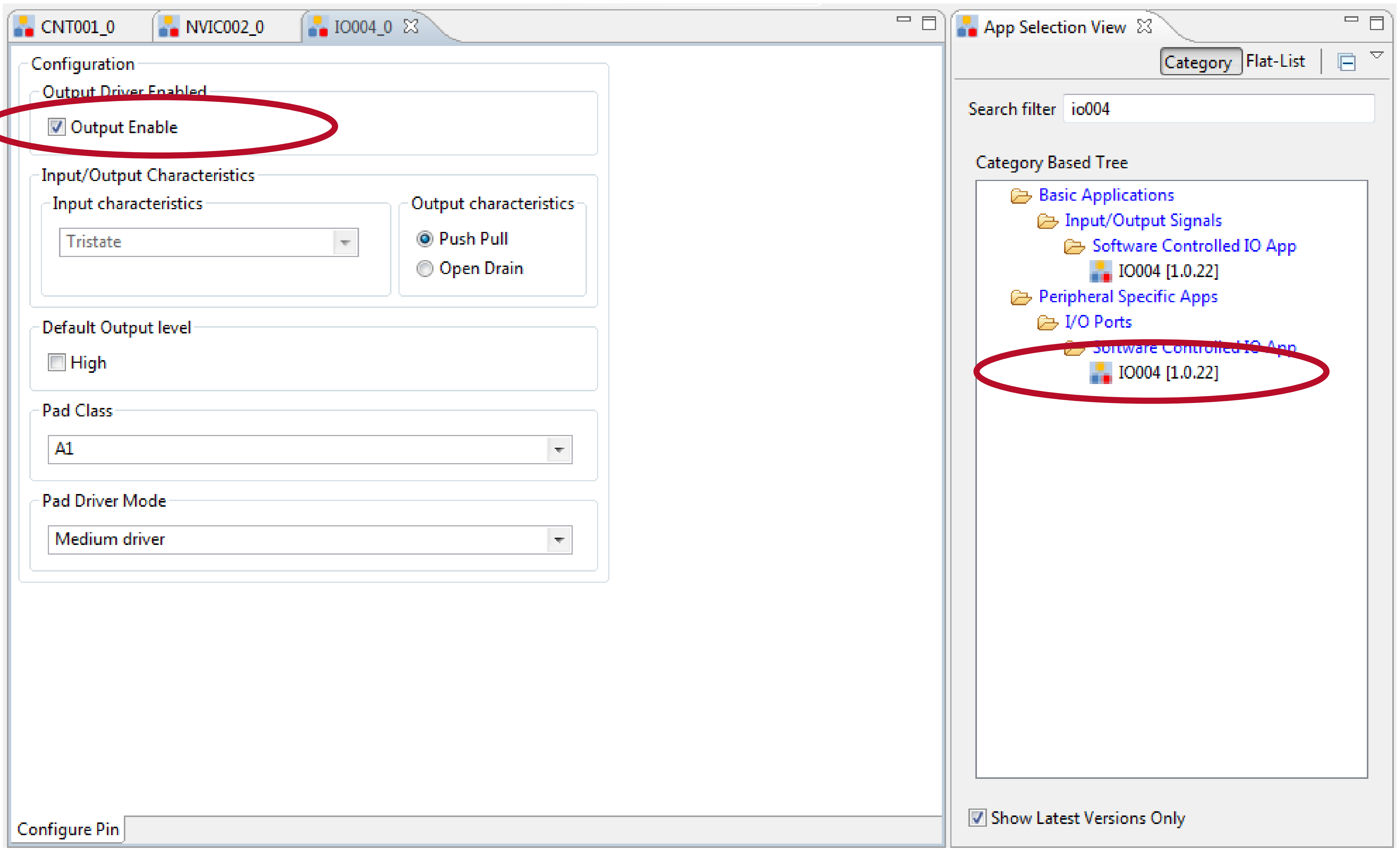
- Select the signal „Event Count Match Interrupt"
- Route the signal to NVIC002/0
- Click „Solve and Save" and „Close"


Signal Connection

Filter: ALL

App	Signal	Connect To	App	Signal
CCU4GLOBAL/0				
	Not Selected	---->	Not Selected	Not Selected
CLK001/0				
	Not Selected	---->	Not Selected	Not Selected
CNT001/0				
	Event Count Match Interrupt	---->	NVIC002/0	Interrupt Node
	Not Selected	---->	Not Selected	Not Selected
IO004/0				
	Not Selected	---->	Not Selected	Not Selected
NVIC002/0				
	Not Selected	---->	Not Selected	Not Selected
PWMSP001/0				
	PWM Status	---->	CNT001/0	Input
	Not Selected	---->	Not Selected	Not Selected
RESET001/0				
	Not Selected	---->	Not Selected	Not Selected

Add and configure IO App



CNT001_0 | NVIC002_0 | IO004_0

Configuration

Output Driver Enabled

- [✓] Output Enable

Input/Output Characteristics

Input characteristics: Tristate

Output characteristics: (●) Push Pull ( ) Open Drain

Default Output level

- [ ] High

Pad Class: A1

Pad Driver Mode: Medium driver

Configure Pin

App Selection View

Category | Flat-List

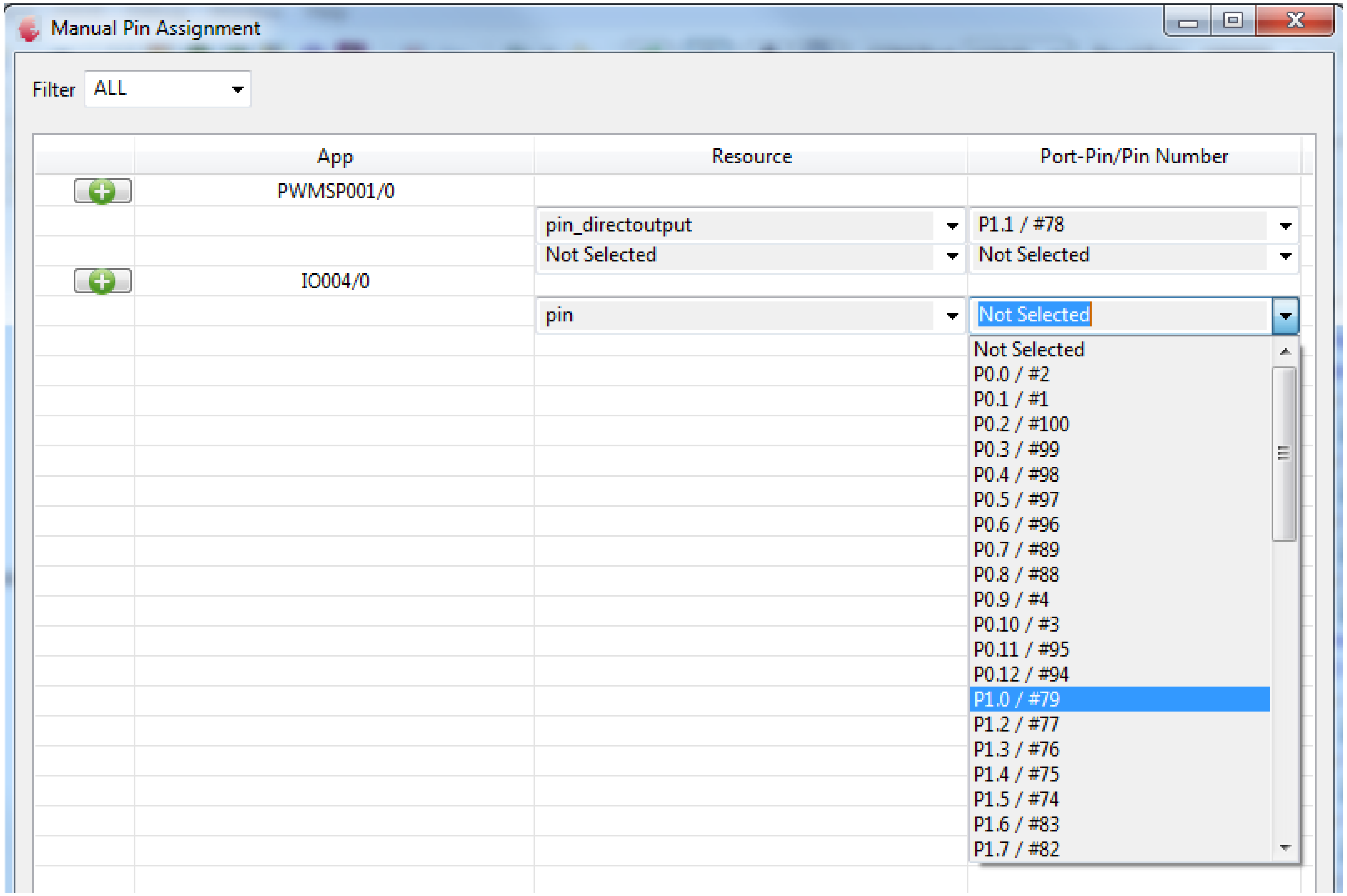
Search filter: io004

Category Based Tree

- Basic Applications
  - Input/Output Signals
    - Software Controlled IO App
      - IO004 [1.0.22]
- Peripheral Specific Apps
  - I/O Ports
    - Software Controlled IO App
      - IO004 [1.0.22]

- [✓] Show Latest Versions Only

Assign the P1.0 - Solution


Manual Pin Assignment

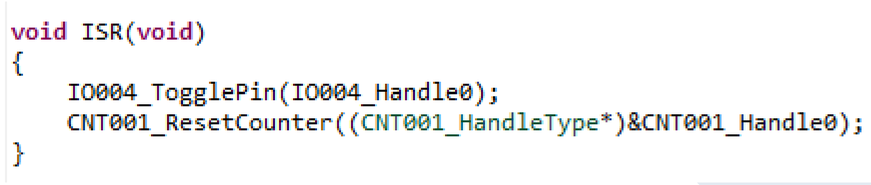
Filter: ALL

	App	Resource	Port-Pin/Pin Number
+	PWMSP001/0		
		pin_directoutput	P1.1 / #78
		Not Selected	Not Selected
+	IO004/0		
		pin	Not Selected

Not Selected
P0.0 / #2
P0.1 / #1
P0.2 / #100
P0.3 / #99
P0.4 / #98
P0.5 / #97
P0.6 / #96
P0.7 / #89
P0.8 / #88
P0.9 / #4
P0.10 / #3
P0.11 / #95
P0.12 / #94
P1.0 / #79
P1.2 / #77
P1.3 / #76
P1.4 / #75
P1.5 / #74
P1.6 / #83
P1.7 / #82

Include the Interrupt Service Routine

- The interrupt service routine has to be written by the user because DAVE has no access to the user code parts of the project workspace.
- Therefore one has to write this:



```
void ISR(void)
{
    IO004_TogglePin(IO004_Handle0);
    CNT001_ResetCounter((CNT001_HandleType*)&CNT001_Handle0);
}
```

- Use App Help Functionality (see next slide)

- Make sure that the name of the function matches the one that is configured in the NVIC-App!

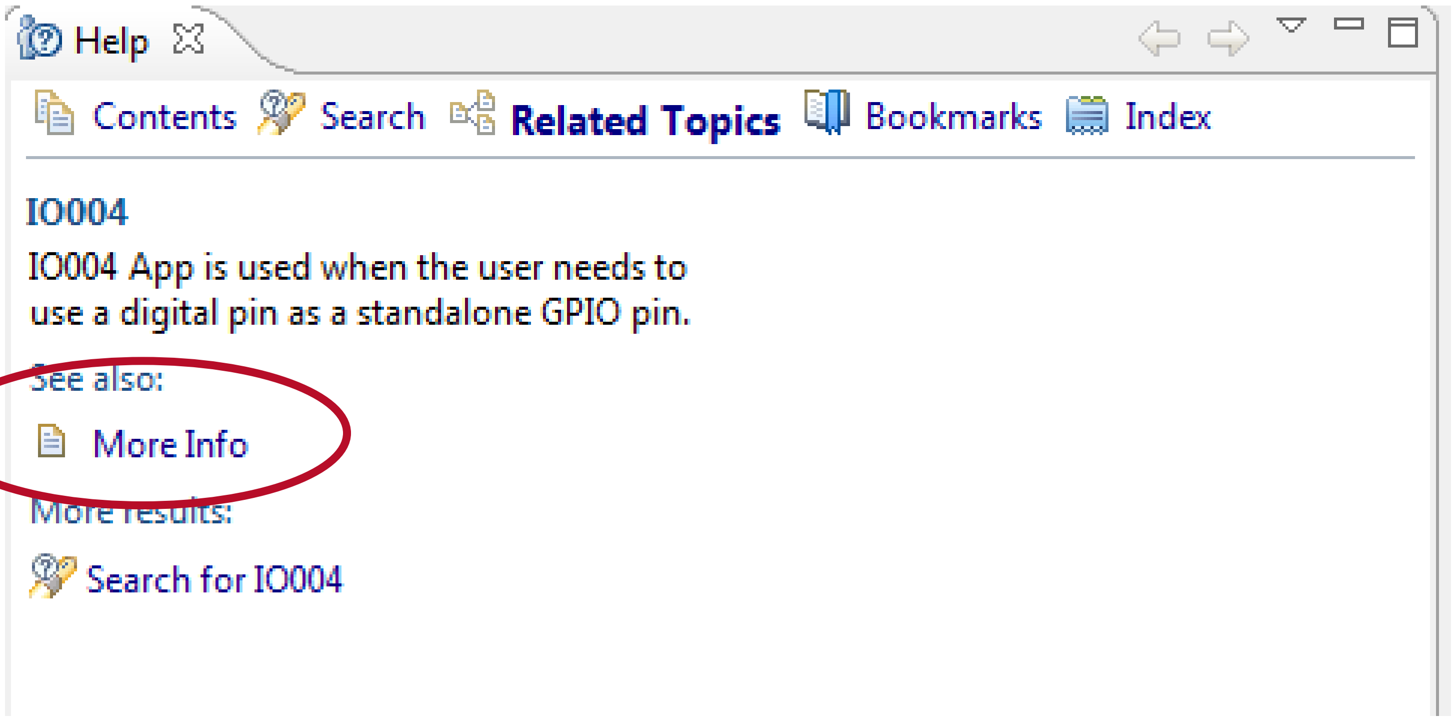
How to use App HELP function

- Each App has a dedicated help file which includes
  - Description
  - Parameter description
  - Variables
  - API description

- Press „F1“ on your keyboard and left-click the IO004 App in your project view

The Help

- Click „More Info“



IO004

IO004 App is used when the user needs to use a digital pin as a standalone GPIO pin.

See also:

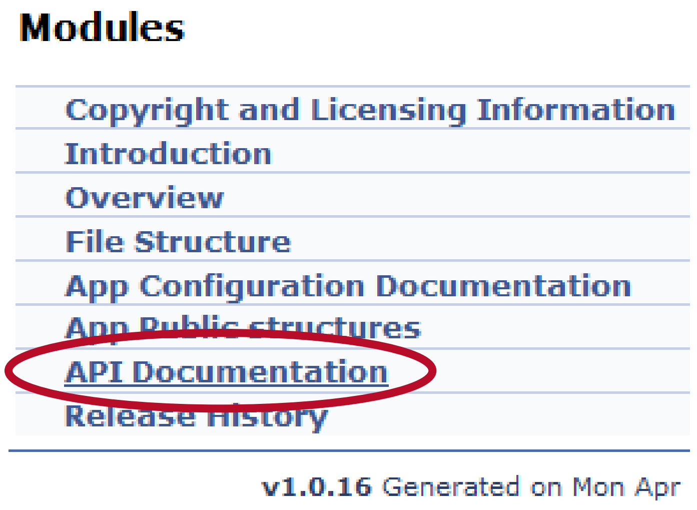
More Info

More results:

Search for IO004

Find the function you search for

- Select „API Documentation“

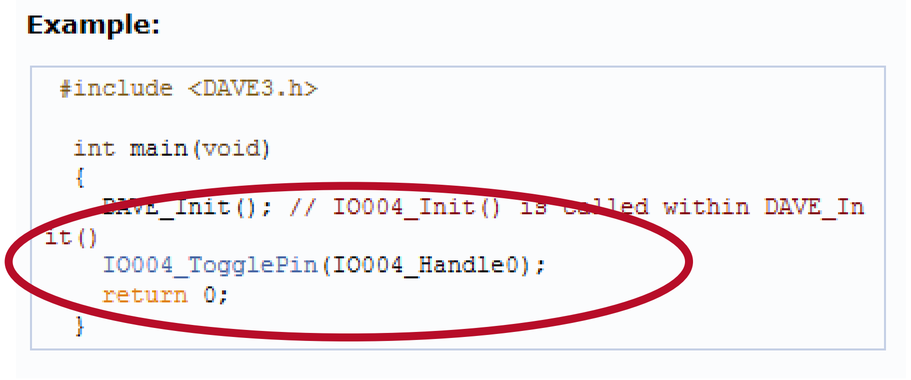


Modules

- Copyright and Licensing Information
- Introduction
- Overview
- File Structure
- App Configuration Documentation
- App Public structures
- API Documentation
- Release History

v1.0.16 Generated on Mon Apr

- Select „IO004_TogglePin“; copy & paste into main.c



Example:

```
#include <DAVE3.h>

 int main(void)
 {
   DAVE_Init(); // IO004_Init() is called within DAVE_In
it()
   IO004_TogglePin(IO004_Handle0);
   return 0;
 }
```

Main.c

```c
// global variable to be used for debugger demo
PWMSP001_TimerRegsType TimerVal;
//  global variable to be used for debugger demo
uint32_t CountVal;
```

```c
while(1)
{
PWMSP001_GetTimerRegsVal(&PWMSP001_Handle0, &TimerVal); // writing to global variable
CNT001_GetEvtCountValue(&CNT001_Handle0, &CountVal);    // writing to global variable
}
```

```c
// ISR Handler for  Count match interrupt to toggle the LED and reset the  counter
void ISR (void){
IO004_TogglePin(IO004_Handle0);
CNT001_ResetCounter(&CNT001_Handle0);
}
```

Main.c

Compile

Task:

Save everything

Generate Code

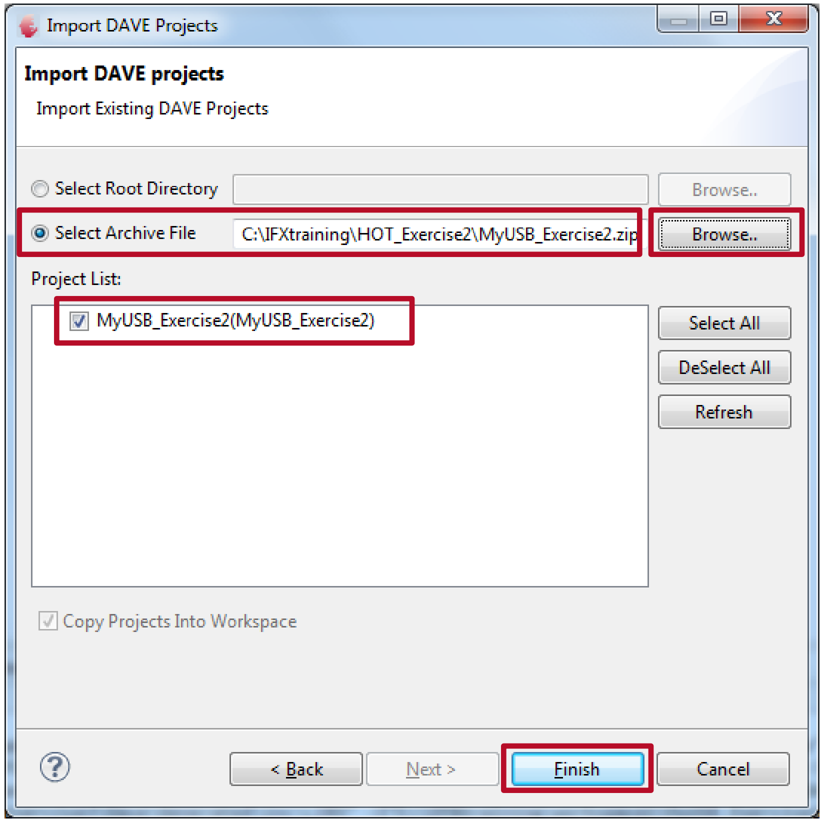
Build

Start Debug

Pause the program in the interrupt service routine

DAVE™ Project Management

- **Import** a project (RelaxKit_XMC_DevDay):
  - File > Import > Infineon > DAVE Project
  - Click "Next >"
  - Select "Select Archive File"
  - Browse to ..\RelaxKit_XMC_DevDay.zip
  - Check the project Project RelaxKit_XMC_DevDay
  - Click "Finish"


Import DAVE Projects

Import DAVE projects

Import Existing DAVE Projects

( ) Select Root Directory [Browse..]

(●) Select Archive File C:\IFXtraining\HOT_Exercise2\MyUSB_Exercise2.zip [Browse..]

Project List:

☑ MyUSB_Exercise2(MyUSB_Exercise2)

[Select All] [DeSelect All] [Refresh]

☑ Copy Projects Into Workspace

ENERGY EFFICIENCY
MOBILITY
SECURITY

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