XMC1000 / XMC4000
Motor Control Application Kit

Getting Started 01 v1.0

Induction Motor V/F Control App
(ACIM_FREQ_CTRL)

Induction Motor V/F Control App

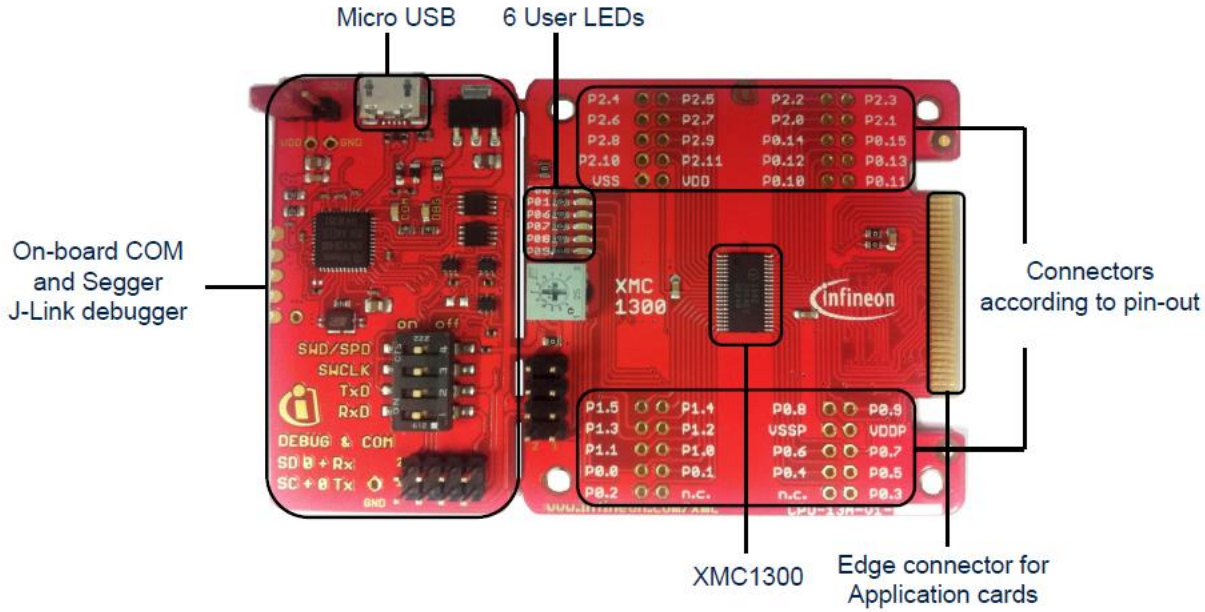
1. Motor Control Application Kit Composition
2. Development Tool: DAVE™ version 4
3. Example: PMSM Motor with fixed speed
4. Example: PMSM Motor with adjustable speed
5. Additional information

Induction Motor V/F Control App

1. Motor Control Application Kit Composition
2. Development Tool: DAVE™ version 4
3. Example: PMSM Motor with fixed speed
4. Example: PMSM Motor with adjustable speed
5. Additional information

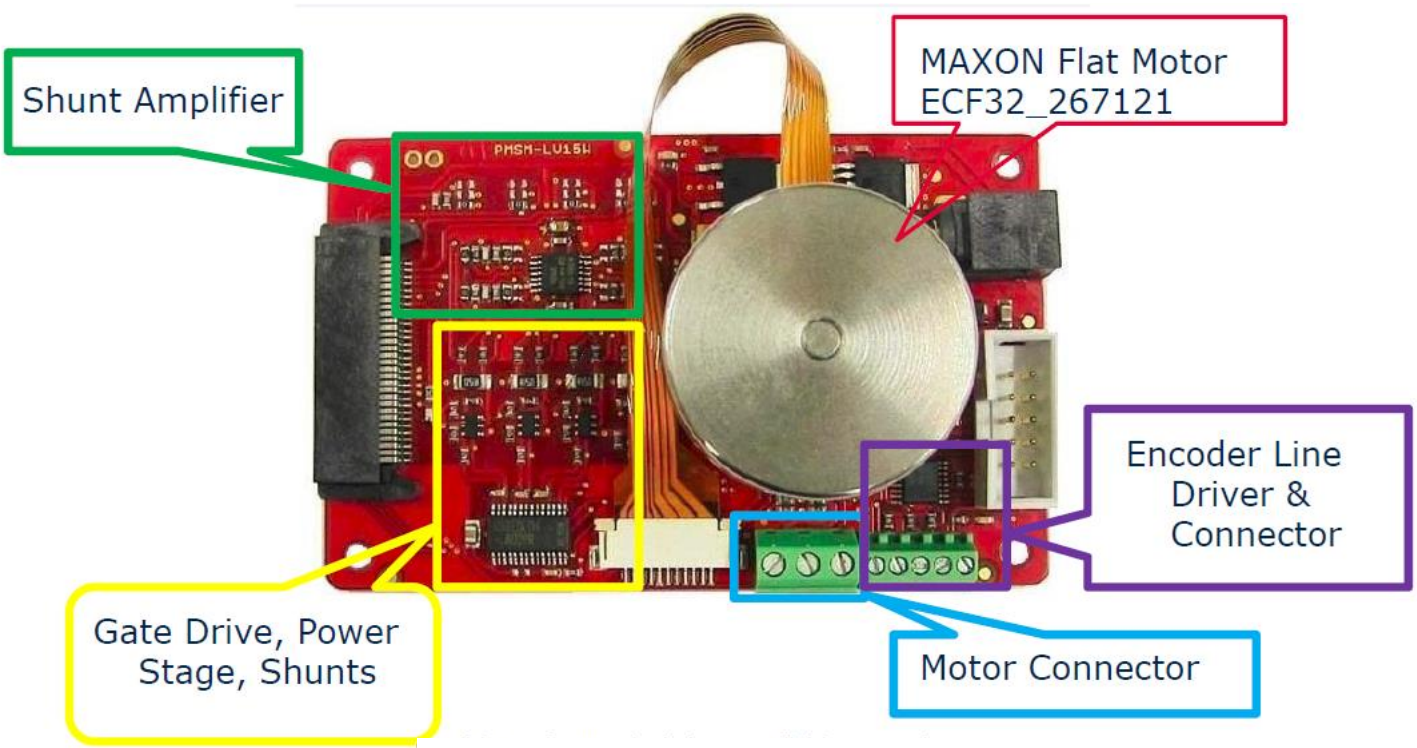
Kit composition – XMC 1300 Boot Kit

Included in KIT_XMC1X_AK_MOTOR_001



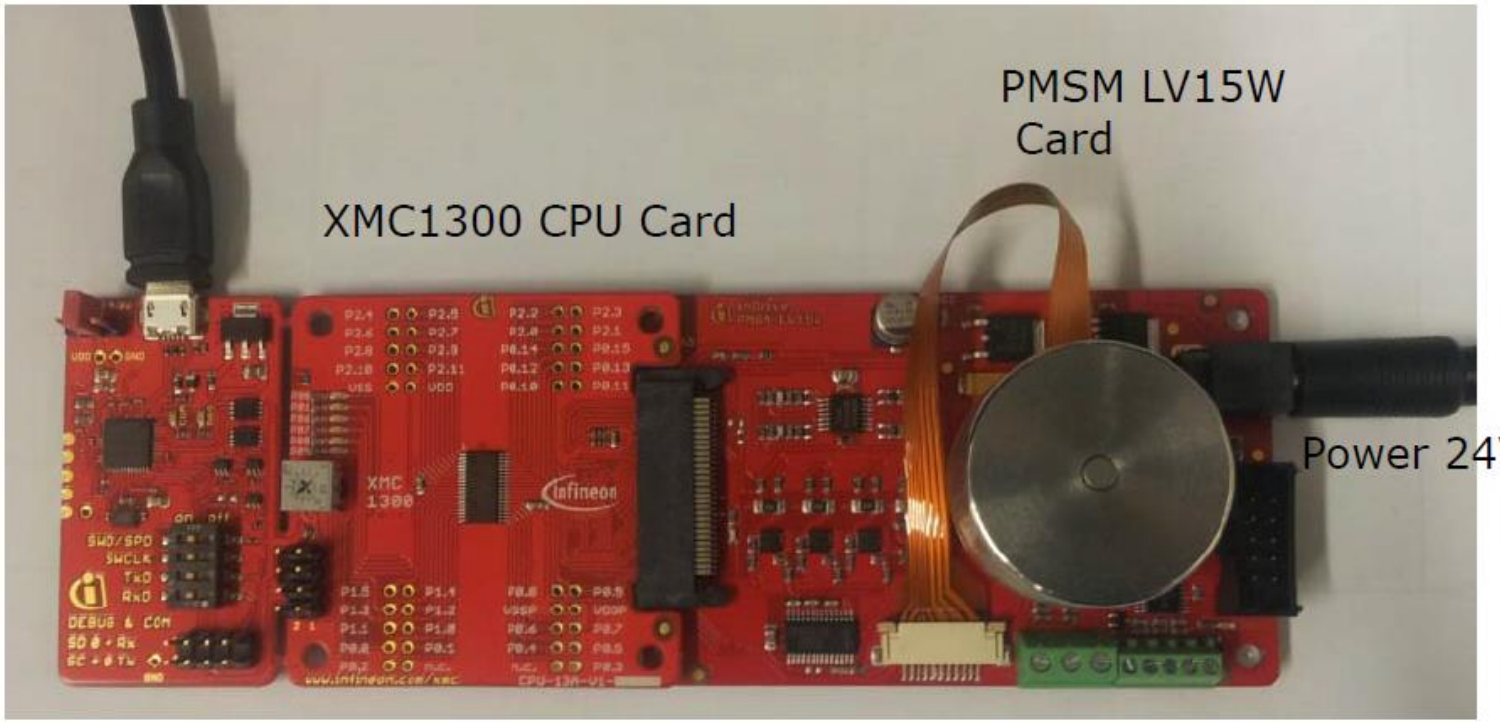
Kit composition – PMSM LV 15W Card

› Included in KIT_XMC1X_AK_MOTOR_001



Kit composition – connection XMC1300

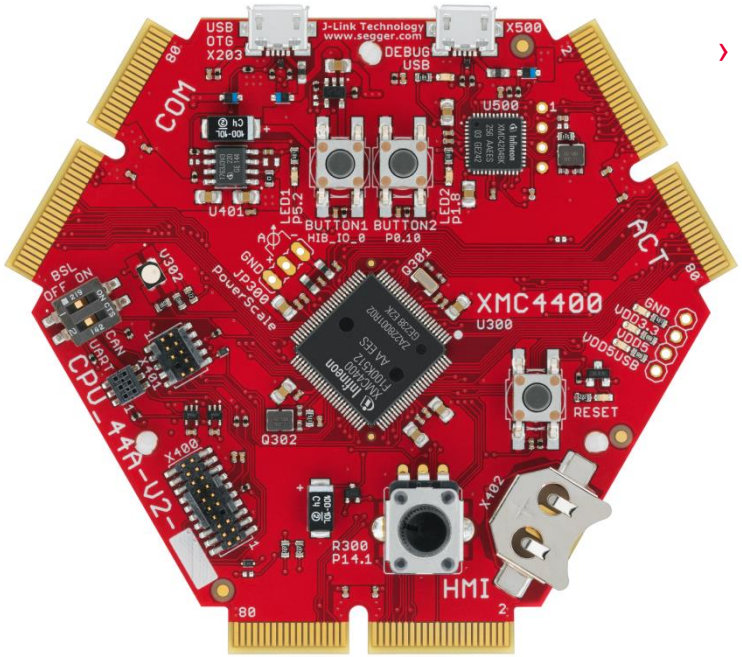
KIT_XMC1X_AK_MOTOR_001



Kit composition – XMC4400 Enterprise Kit

- Included in KIT_XMC44_AE3_001

- Micro USB for Debug



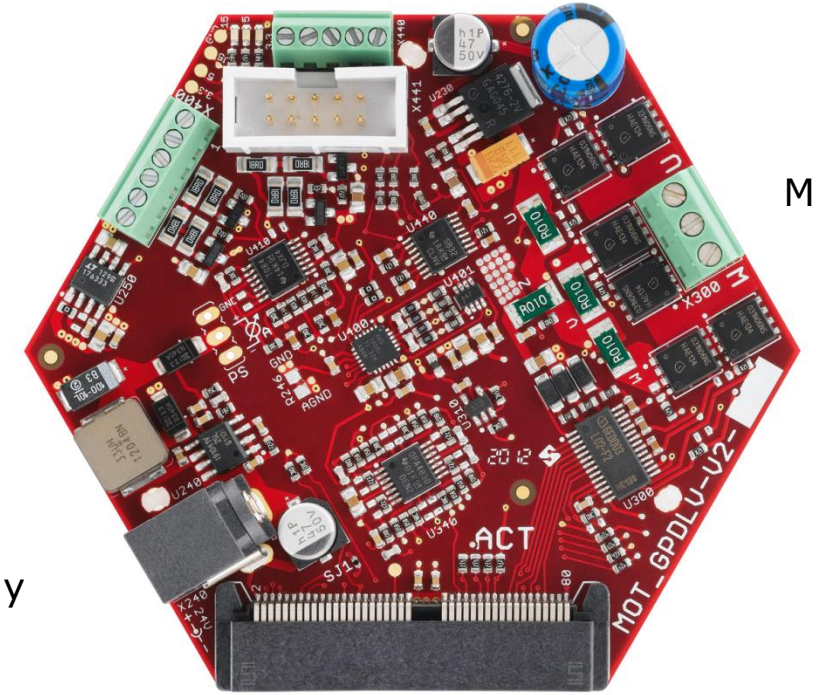
- ACT connector for MOT_GPDVL satellite

Kit composition – General Purpose Motor Drive

Included in KIT_XMC44_AE3_001

Encoder input (white)
Hall input (green)

Resolver input



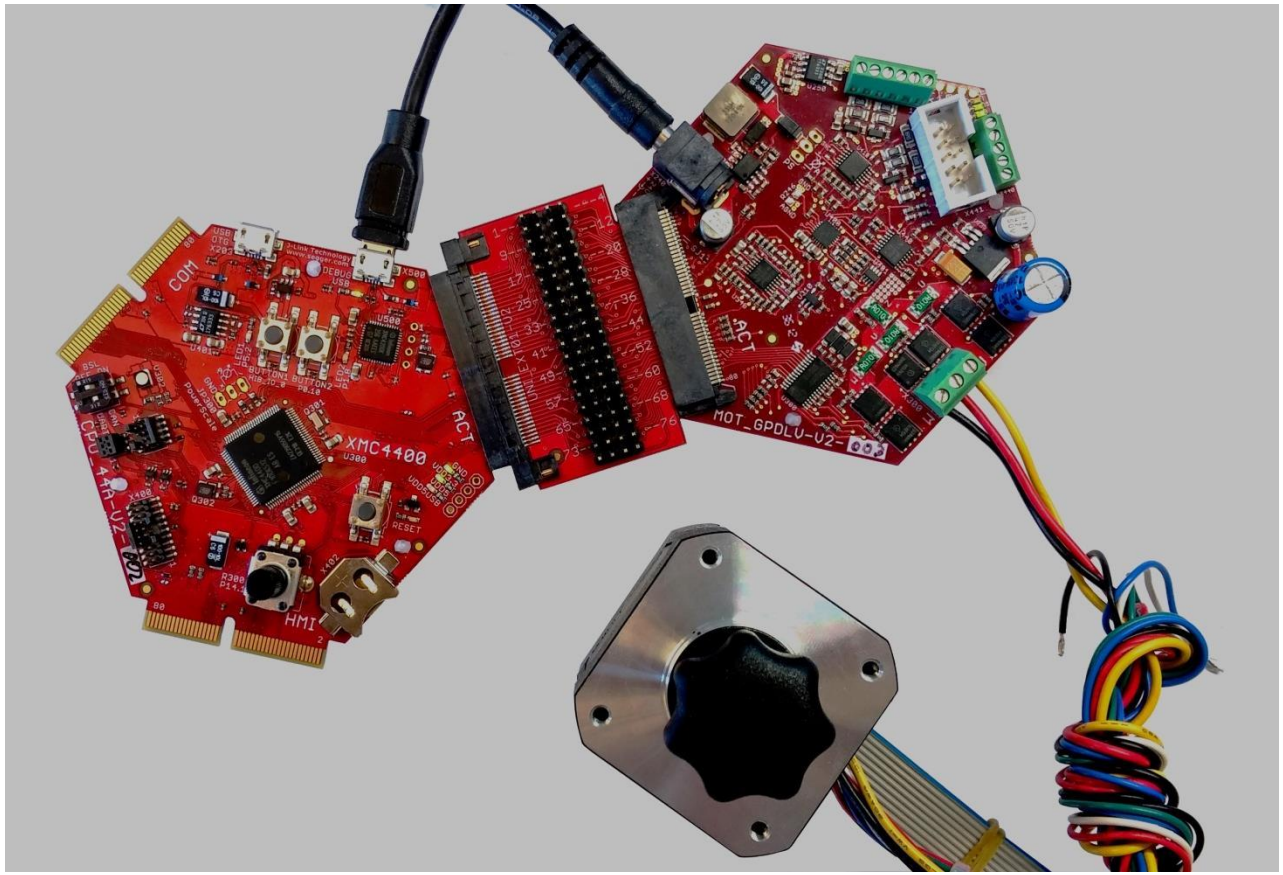
Motor connector

24V power supply

ACT connector to CPU Card
(e.g. CPU_44A)

Kit composition – connection XMC4400

KIT_XMC44_AE3_001



Induction Motor V/F Control App

1. Motor Control Application Kit Composition
2. Development Tool: DAVE™ version 4
3. Example: PMSM Motor with fixed speed
4. Example: PMSM Motor with adjustable speed
5. Additional information

Development Tool: DAVE™ version 4

- DAVE™ is a free development platform for code generation by Infineon
- The Software package: DAVE™ , Examples, Videos, Apps, XMCLib… can be downloaded from
- http://www.infineon.com/DAVE

- This Getting started is based on DAVE™ v. 4.1.2

Induction Motor V/F Control App

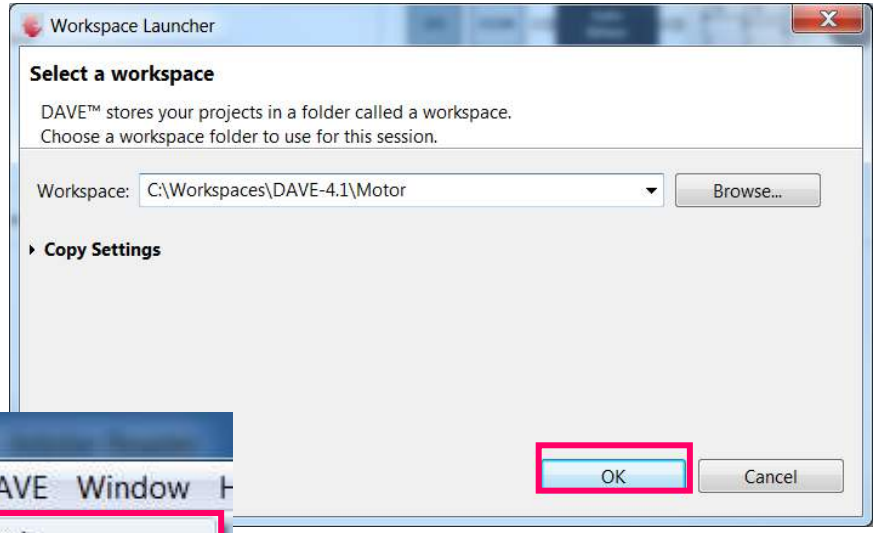
1. Motor Control Application Kit Composition
2. Development Tool: DAVE™ version 4
3. Example: PMSM Motor with fixed speed
4. Example: PMSM Motor with adjustable speed
5. Additional information

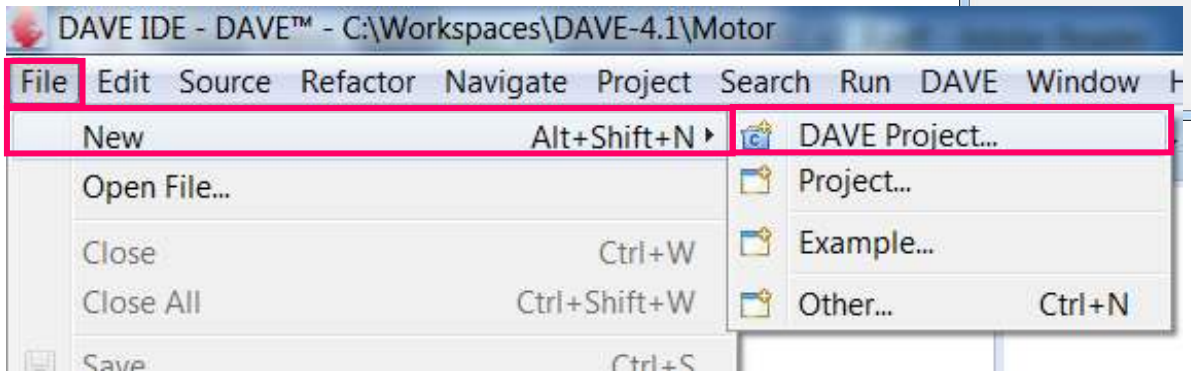
Getting started limitations

- The following example shows the default usage of the App.
- This Getting Started shows how to create an example with the default settings. Only the used App configurations are described. More information about the spectrum of the App can be found in the Help or an Application Note.
- The creation is described in steps. If a step is specific to XMC1300 or XMC4400 it is mentioned in the title and a sub-step e.g. 2.a, 2.b. Variation of the example (e.g. with adjustable speed) based on the main example.
- The following examples based on ACIM_FREQ_CTRL/ACIM_FREQ_CTRL APP v. 4.0.5 **beta**

Step 1: create new project

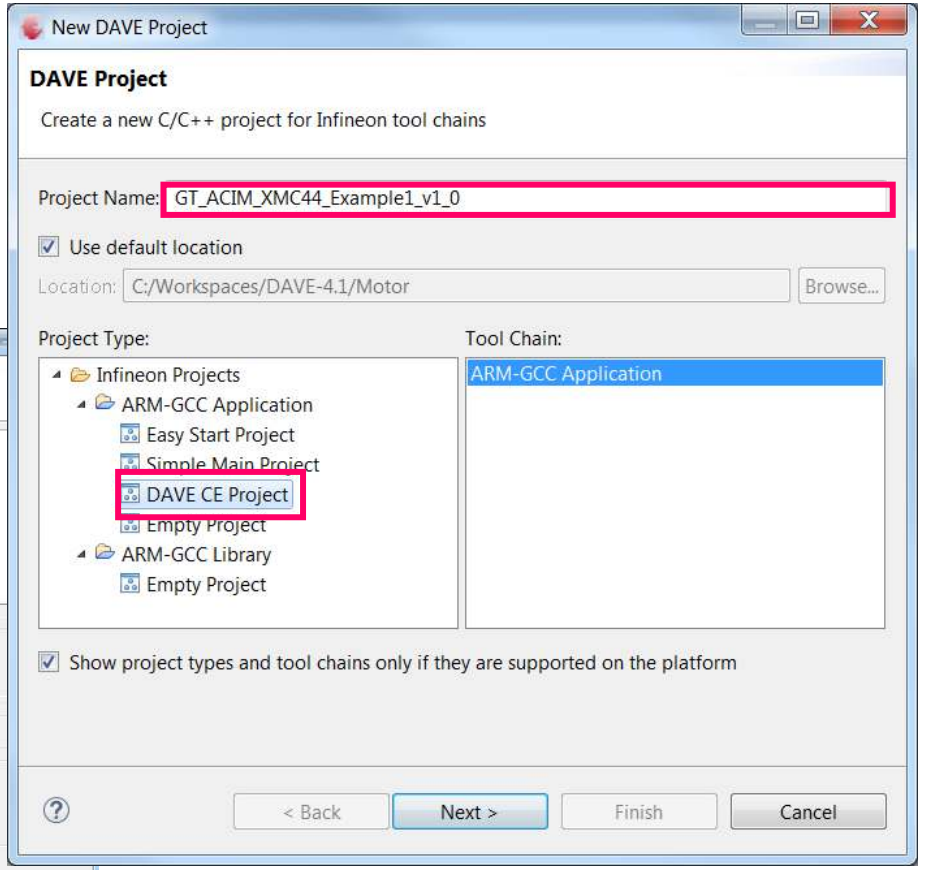
- Open Dave
- Select a workspace or use the default workspace
- Click "OK"
- File → New → DAVE Project…

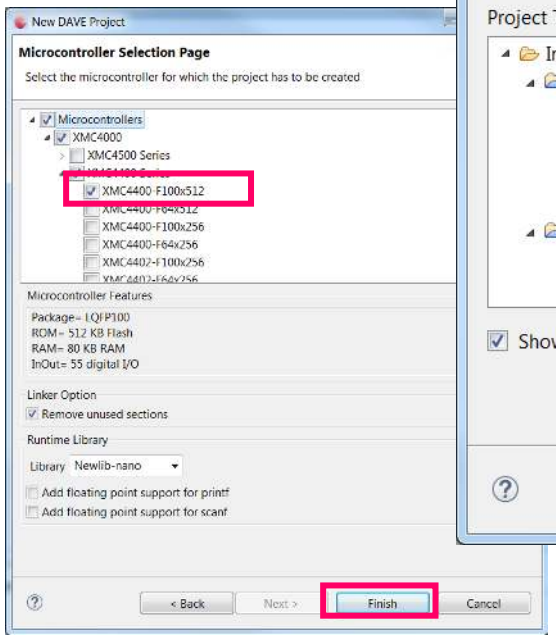




Step 1: create new project

- Enter project name: e.g. GT_ACIM_XMC44_Example1_v1_0
- Select "DAVE CE Project" for Project Type
- Click "Next >"
- Select your microcontroller:
  - **XMC1300**: XMC1302-TO38X0200
  - **XMC4400**: XMC4400-F100x512
- Click "Finish"

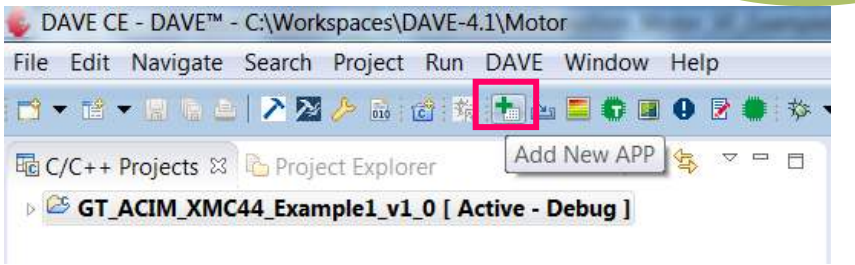


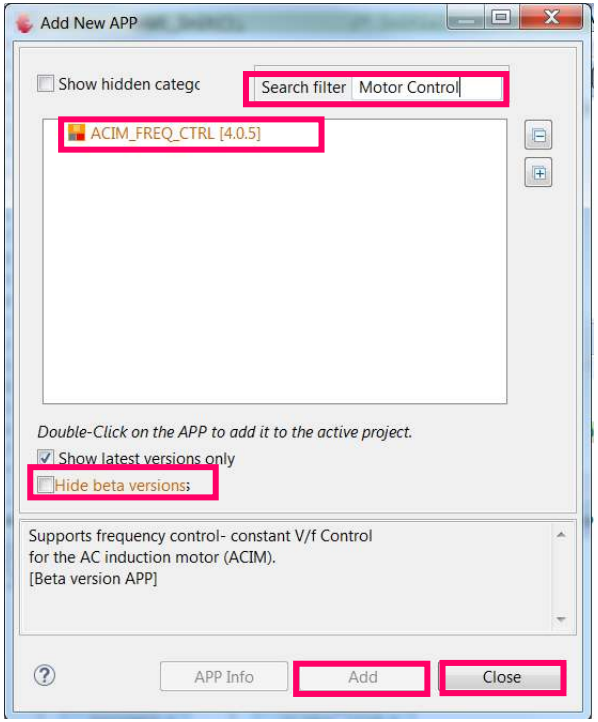


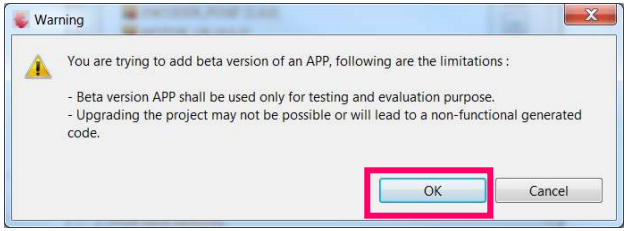
Step 2: add APP

Step 2

- Click "Add New App" 
- Deactivate "Hide beta versions"
- Enter in search filter "Motor Control"
- Select "ACIM_FREQ_CTRL"
- Click "Add"
- Read the warning regarding beta versions and Click "OK" to confirm.
- ➢ Add in a new APP takes a few seconds
- Click "Close" to hide the "Add new APP" window



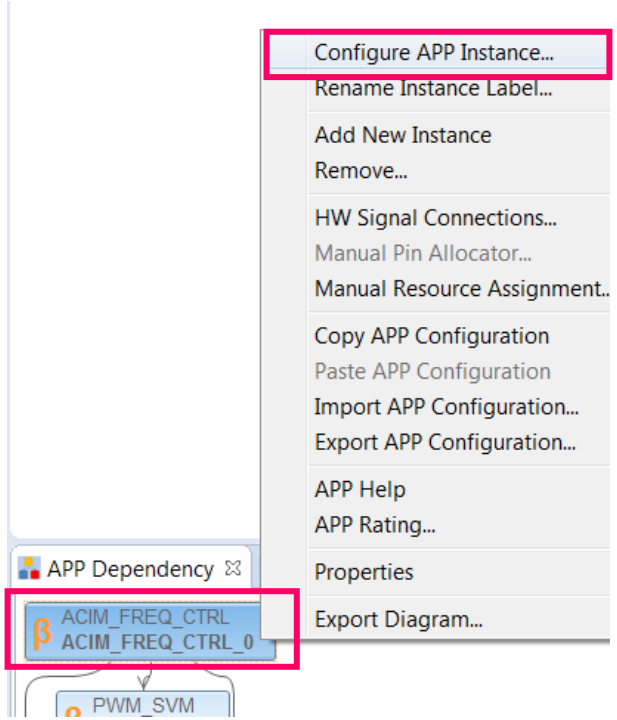


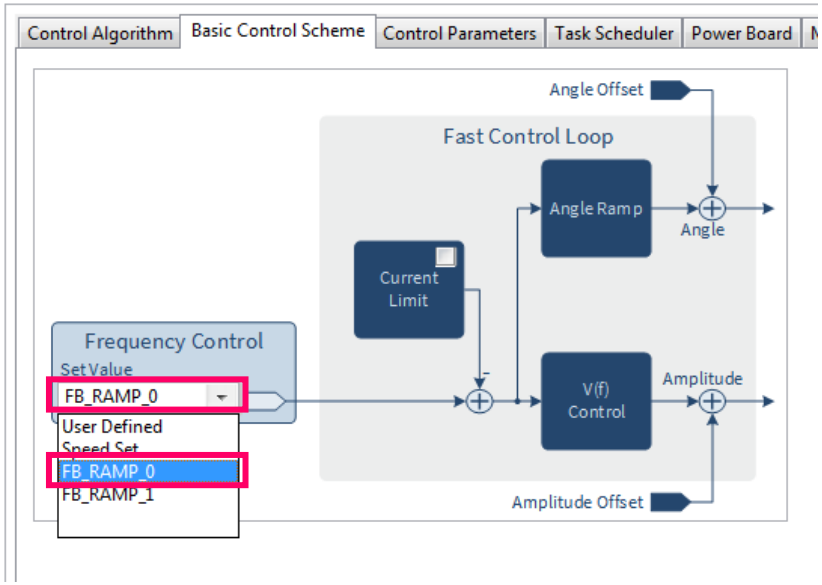


Step 3: APP configuration

Step 3

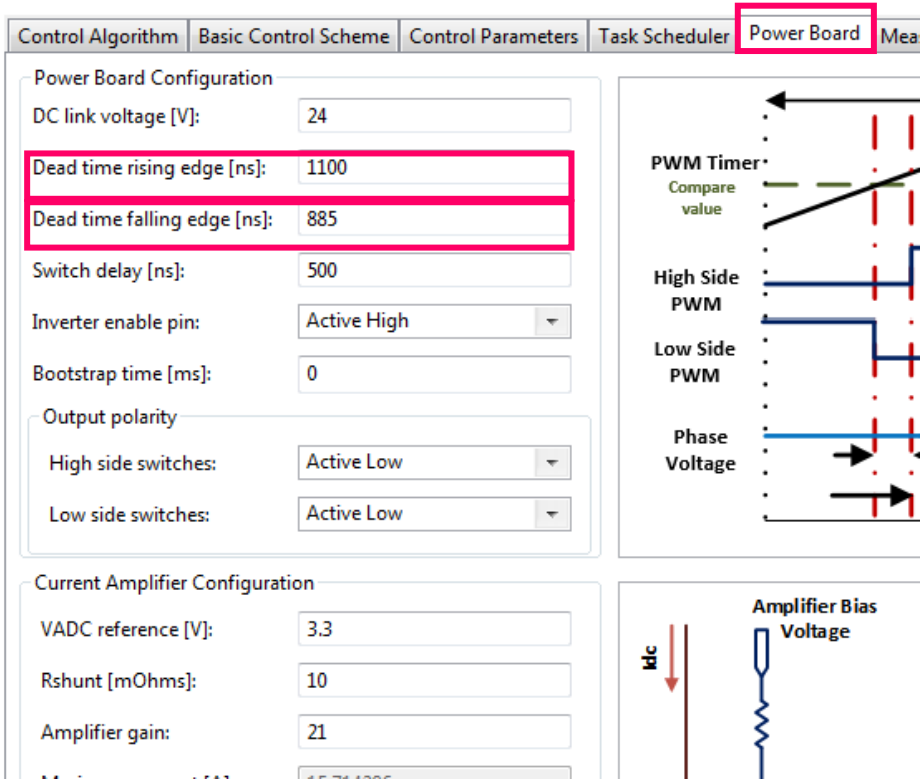
- Open "ACIM_FREQ_CTRL" by double click or right click → "Configure App instance"
- Open "Basic Control Scheme" **tab**
- Select "FB_RAMP_0"
- This will add the AUTOMATION APP. This can take a few seconds.



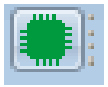


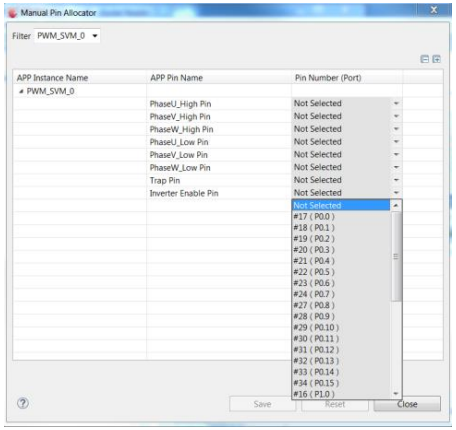
Step 3: APP configuration

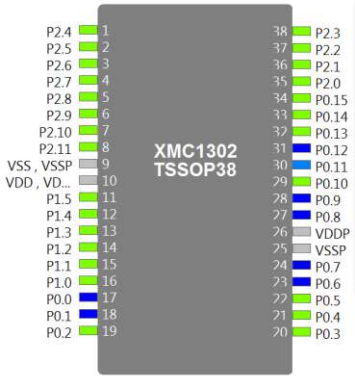
- Open "Power Board" **tab**
- Set "Dead time rising edge[ns]" to 1100
- Set "Dead time falling edge[ns]" to 885



Step 4: Pin assignment

- The pin allocation can be done in two ways:
  - 1) table view 
  - 2) graphical view 

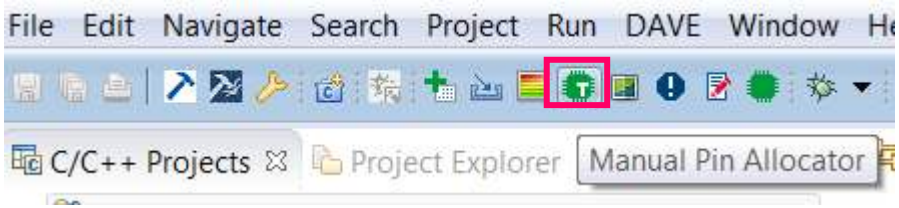


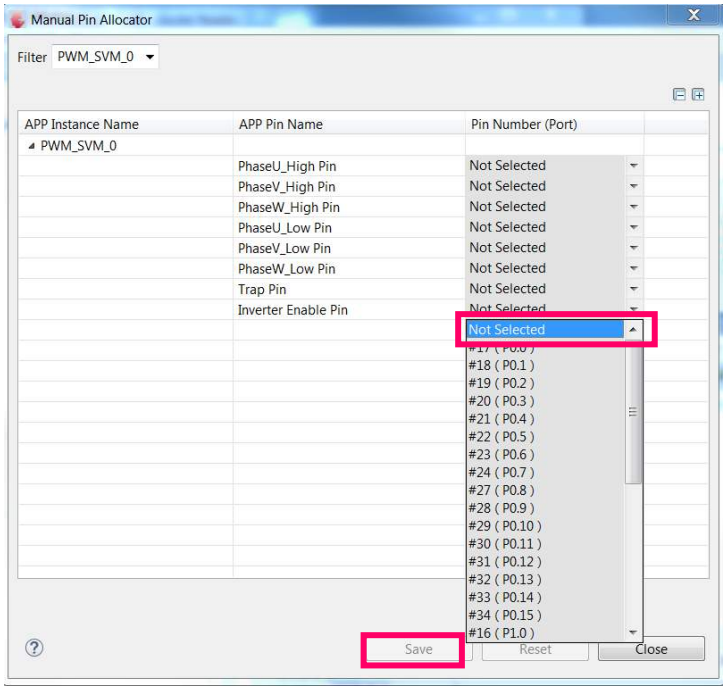


Step 4: Pin assignment– table view

The Pin Allocation can be done in two ways:

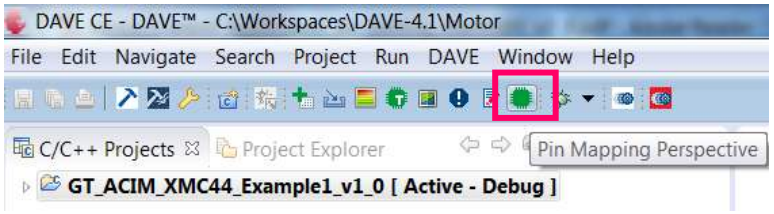
- Table view:
  - Click "Manual Pin Allocator" 
  - Table: select the corresponding pin for each pin
  - Click "Save"

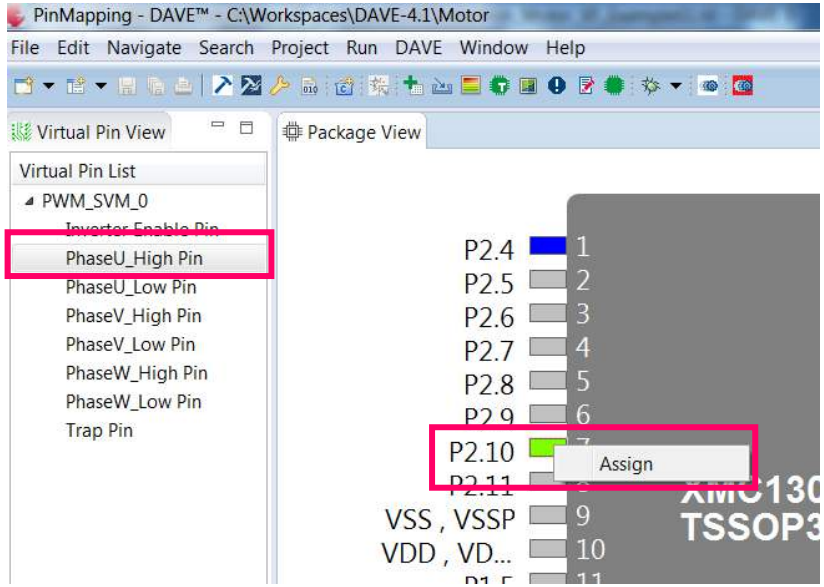




Step 4: Pin assignment– graphical view

- Graphical view:
  - Click "Pin Mapping Perspective"
  - Select pin in the left table
  - Right click on a colored pin
  - Click "Assign"





Note: See legend color code for additional information

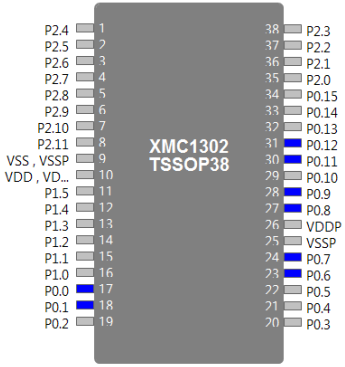
Step 4a: Pin assignment - XMC1300

Manual Pin Allocator

Filter ALL

APP Instance Name	APP Pin Name	Pin Number (Port)
PWM_SVM_0		
	PhaseU_High Pin	#17 (P0.0)
	PhaseV_High Pin	#24 (P0.7)
	PhaseW_High Pin	#27 (P0.8)
	PhaseU_Low Pin	#18 (P0.1)
	PhaseV_Low Pin	#23 (P0.6)
	PhaseW_Low Pin	#28 (P0.9)
	Trap Pin	#31 (P0.12)
	Inverter Enable Pin	#30 (P0.11)

Save Reset Close



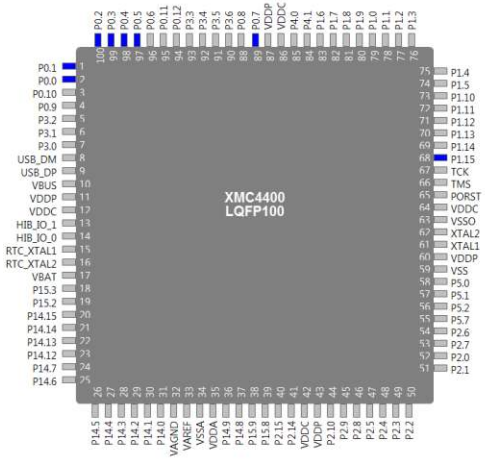
Step 4b: Pin assignment– XMC4400

Manual Pin Allocator

Filter ALL

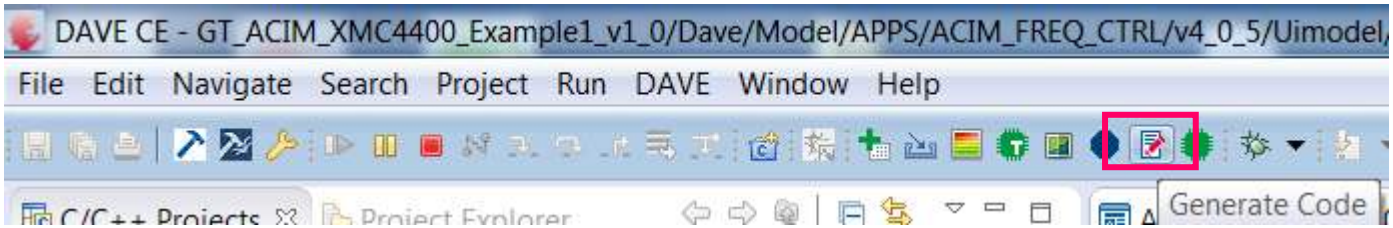
APP Instance Name	APP Pin Name	Pin Number (Port)
PWM_SVM_0		
	PhaseU_High Pin	#97 (P0.5)
	PhaseV_High Pin	#98 (P0.4)
	PhaseW_High Pin	#99 (P0.3)
	PhaseU_Low Pin	#100 (P0.2)
	PhaseV_Low Pin	#1 (P0.1)
	PhaseW_Low Pin	#2 (P0.0)
	Trap Pin	#89 (P0.7)
	Inverter Enable Pin	#68 (P1.15)

Save Reset Close



Step 5: Generate code

- Click “Generate Code” 
- Code Generation can take a few seconds.



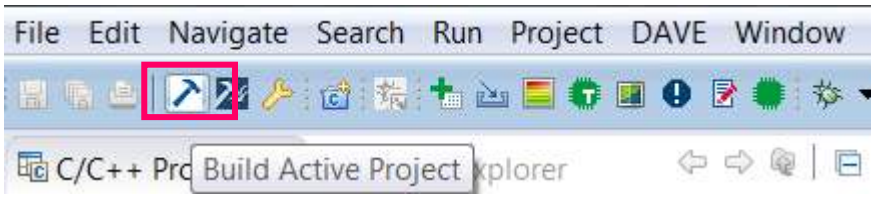
Step 6: Add function

› Edit main.c by adding the following function call: ACIM_FREQ_CTRL_MotorStart(&ACIM_FREQ_CTRL_0);

```
23 int main(void)
24 {
25   DAVE_STATUS_t status;
26
27   status = DAVE_Init();           /* Initialization of DAVE APPs  */
28
29   if(status == DAVE_STATUS_FAILURE)
30   {
31     /* Placeholder for error handler code. The while loop below can be replaced with an user error handler. */
32     XMC_DEBUG("DAVE APPs initialization failed\n");
33
34     while(1U)
35     {
36
37     }
38   }
39
40   ACIM_FREQ_CTRL_MotorStart(&ACIM_FREQ_CTRL_0);
41   /* Placeholder for user application code. The while loop below can be replaced with user application code. */
42   while(1U)
43   {
44
45   }
46 }
```

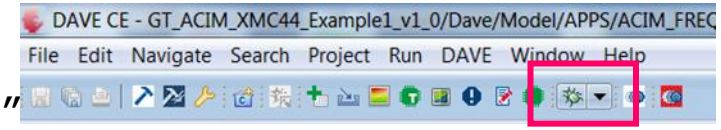
Step 7: Build project

› Build Project 



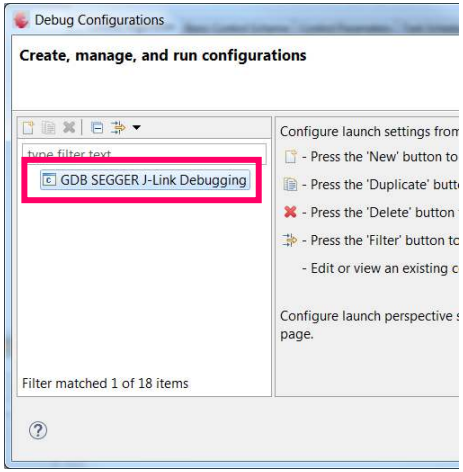
Step 8: Debug – create debug session

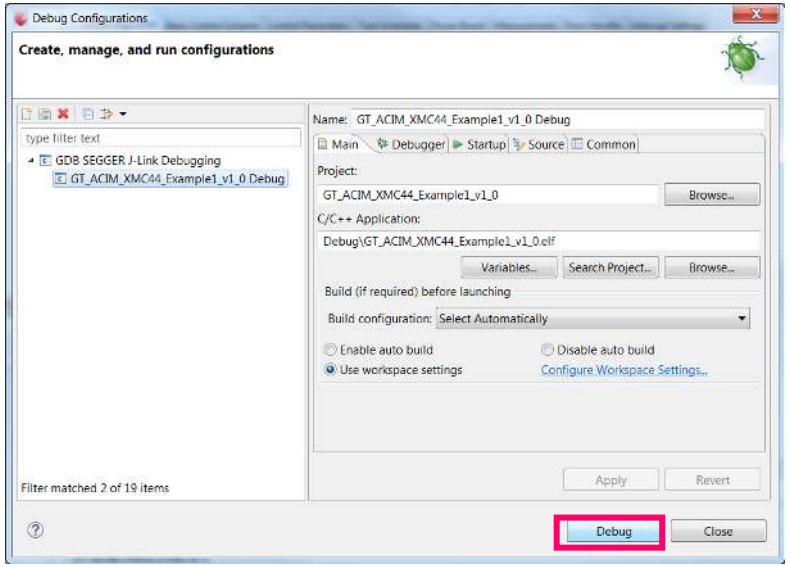
- Click "Debug": 
- Double click "GDB SEGGER J-Link Debugging"

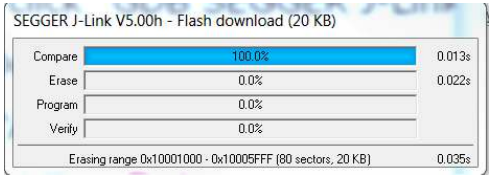


- Click "Debug"
- ➢ The debugger is downloading the program

(See next slide)

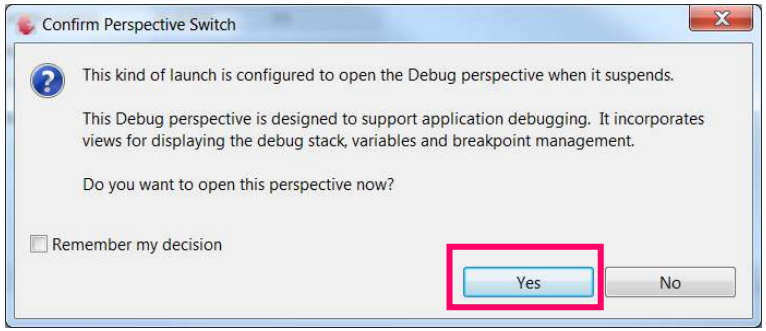


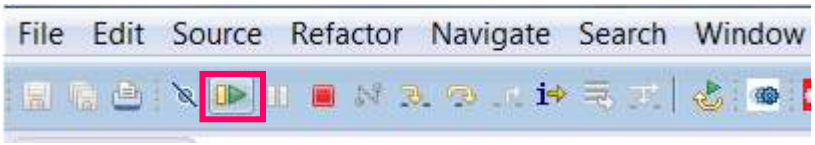




Step 8: Debug – start program

- Switch to debug perspective. Confirm with "YES"
- To start the program click "Resume (F8)"





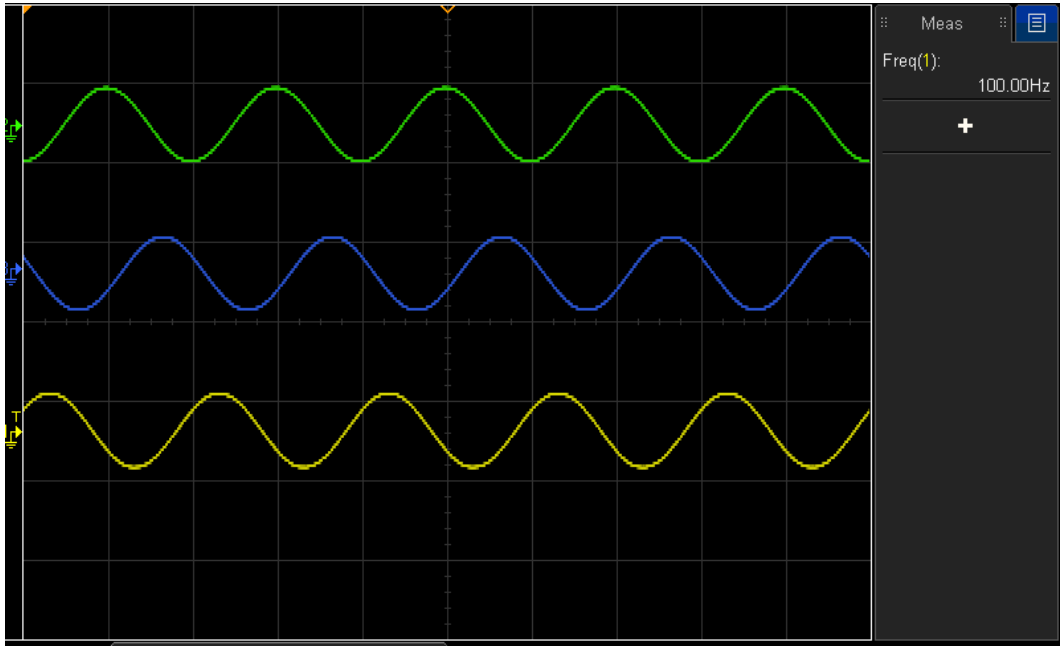
Behavior

› The Motor slowly ramps up to 1500rpm

$N_s = \frac{60 \times f}{p}$

N_s=speed; f= frequency in Hz; p= No. of pole pair

$N_s = \frac{60 \times 100}{4}$ = 1500rpm



Induction Motor V/F Control App

1. Motor Control Application Kit Composition
2. Development Tool: DAVE™ version 4
3. Example: PMSM Motor with fixed speed
4. Example: PMSM Motor with adjustable speed
5. Additional information

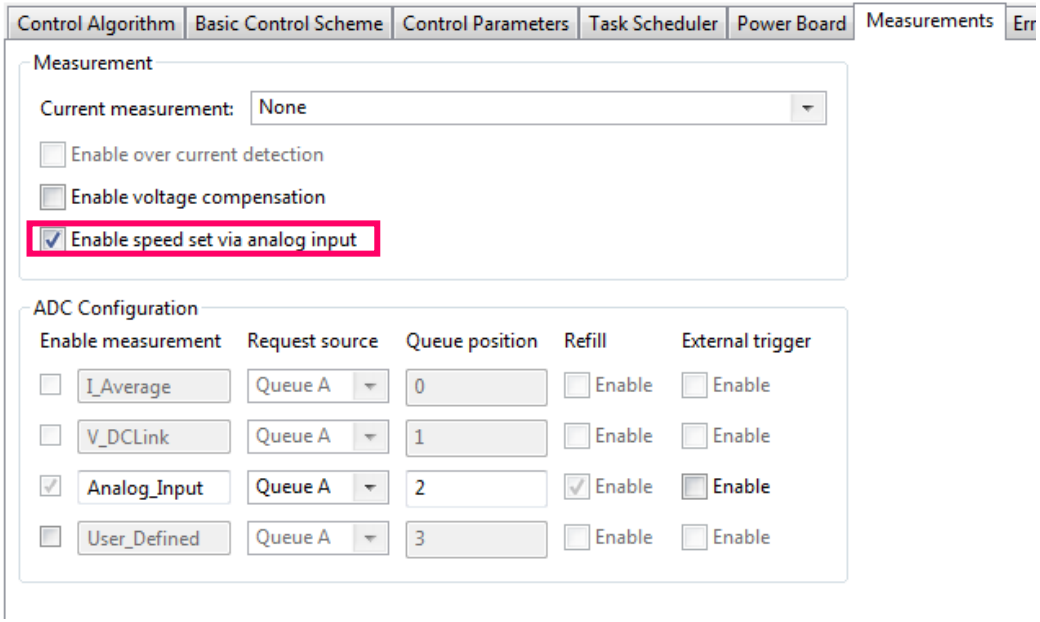
Getting started limitations

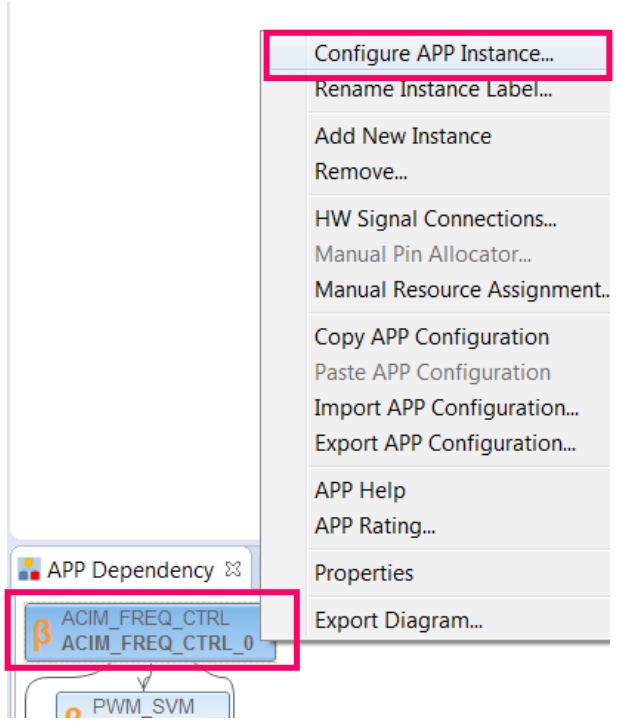
- The following example shows the default usage of the App.
- This Getting Started shows how to create an example with the default settings. Only the used App configurations are described. More information about the spectrum of the App can be found in the Help or an Application Note.
- The creation is described in steps. If a step is specific to XMC1300 or XMC4400 it is mentioned in the title and a sub-step e.g. 2.a, 2.b. Variation of the example (e.g. with adjustable speed) based on the main example.
- The following examples based on ACIM_FREQ_CTRL/ACIM_FREQ_CTRL APP v. 4.0.5 **beta**
- Example 2 with adjustable speed based on example 1. Only the delta is discribed in this cheptar. The target speed is selected by adjusting the potentiometer.

Step 1: APP configuration

Step 1

- open "ACIM_FREQ_CTRL" by double click or right click → "Configure App instance"
- Open the "Measurements" **tab**
- Click "Enable speed set via analog input"
- This will add the ADC APP. This can take a few seconds.

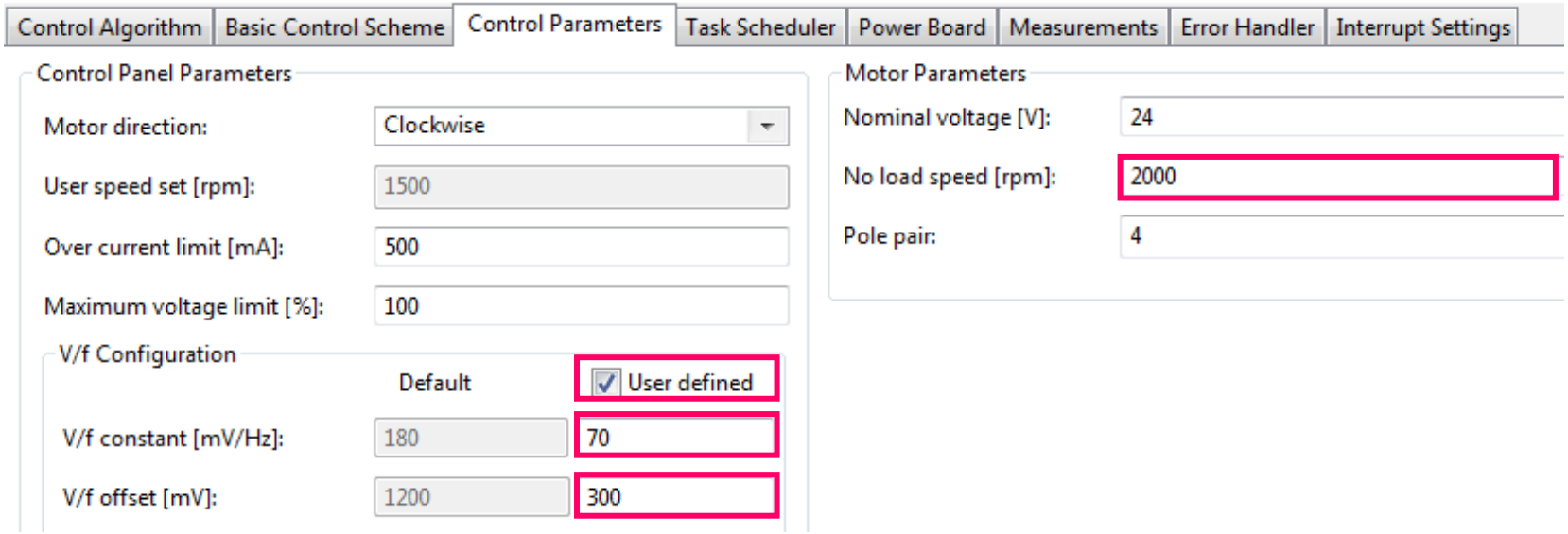




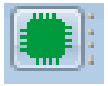
Step 1: APP configuration – XMC4400

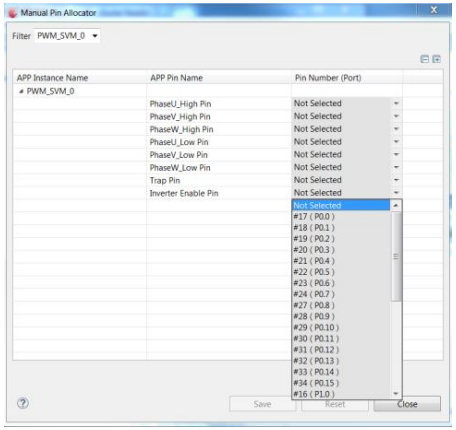
The V/f control is less efficient than FOC control. To reduce the maximum power consumption the default values is be changed. This only applies to **XMC4400** kits.

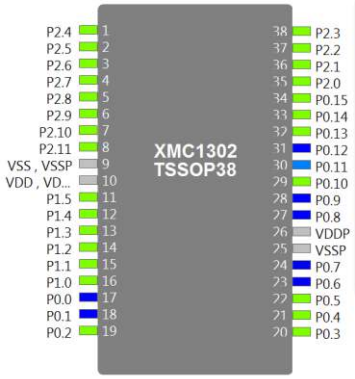
- Open the "Control Parameters" **tab**
- Reduce "No load speed [rpm]" to 2000
- Enable "User defined"
- Set "V/f constant" to 70
- Set "V/f offset" to 300



Step 2: Pin assignment

- Assign the ADC pin in table or graphical view:
  - 1) table view 
  - 2) graphical view 





Note: Pin assignment is explained in example1 step 4

Step 2a: Pin assignment - XMC1300

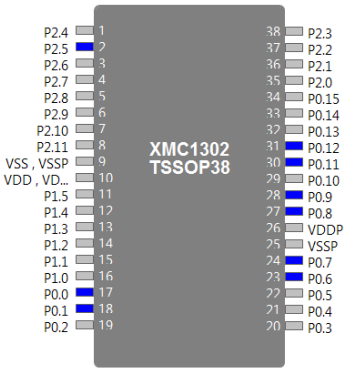
› Allocate the "Analog_Input pin" to the potentiometer input pin

Manual Pin Allocator

Filter ALL

APP Instance Name	APP Pin Name	Pin Number (Port)
ACIM_FREQ_CTRL_0		
	Analog_Input pin	#2 (P2.5)
PWM_SVM_0		
	PhaseU_High Pin	#17 (P0.0)
	PhaseV_High Pin	#24 (P0.7)
	PhaseW_High Pin	#27 (P0.8)
	PhaseU_Low Pin	#18 (P0.1)
	PhaseV_Low Pin	#23 (P0.6)
	PhaseW_Low Pin	#28 (P0.9)
	Trap Pin	#31 (P0.12)
	Inverter Enable Pin	#30 (P0.11)

Save Reset Close



Step 2b: Pin assignment– XMC4400

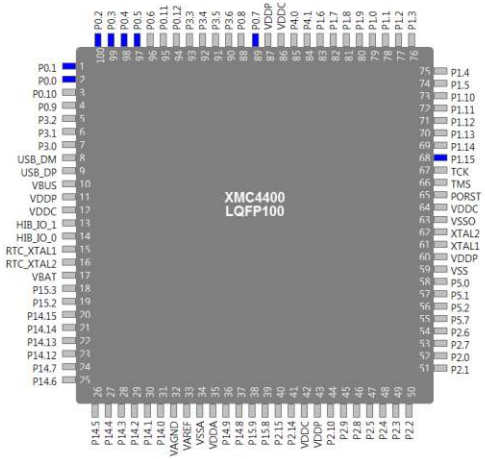
› Allocate the "Analog_Input pin" to the potentiometer input pin

Manual Pin Allocator

Filter ALL

APP Instance Name	APP Pin Name	Pin Number (Port)
◢ PWM_SVM_0		
	PhaseU_High Pin	#97 (P0.5)
	PhaseV_High Pin	#98 (P0.4)
	PhaseW_High Pin	#99 (P0.3)
	PhaseU_Low Pin	#100 (P0.2)
	PhaseV_Low Pin	#1 (P0.1)
	PhaseW_Low Pin	#2 (P0.0)
	Trap Pin	#89 (P0.7)
	Inverter Enable Pin	#68 (P1.15)

Save Reset Close



Step 3: Generate, build, debug

- Repeat following steps from example 1:
  - Step 5: Generate code 
  - Step 7: Build code 
  - Step 8: Debug 

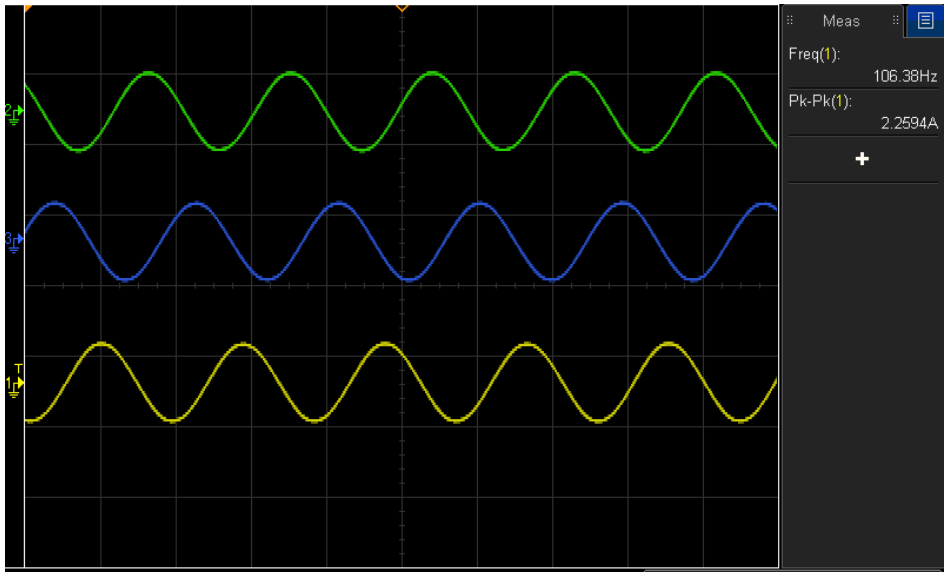
Behavior

- The target speed is selected by potentiometer
- The target speed can vary from 0rpm to “No load speed”
- Motor slowly ramps up or down to the target speed

$N_s = \frac{60 \times f}{p}$

N_s=speed; f= frequency in Hz; p= No. of pole pair

$N_s = \frac{60 \times 106}{4}$ = 1590rpm



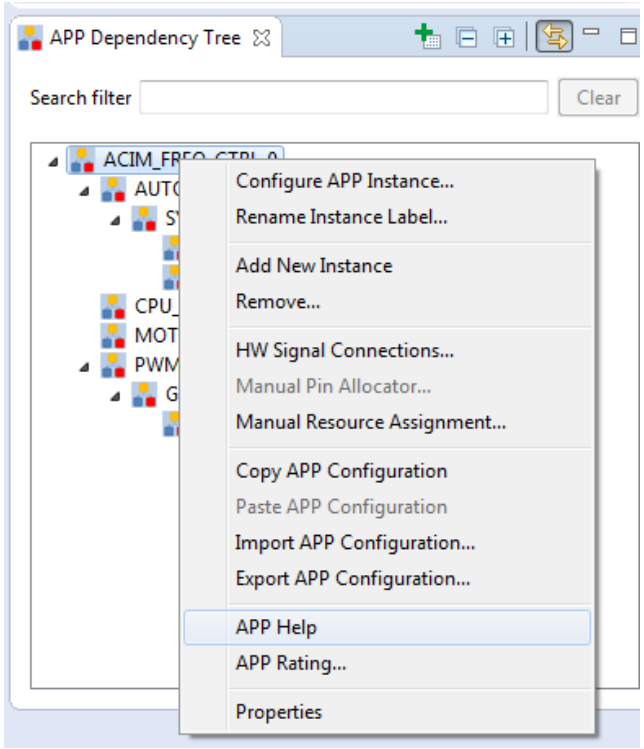
Induction Motor V/F Control App

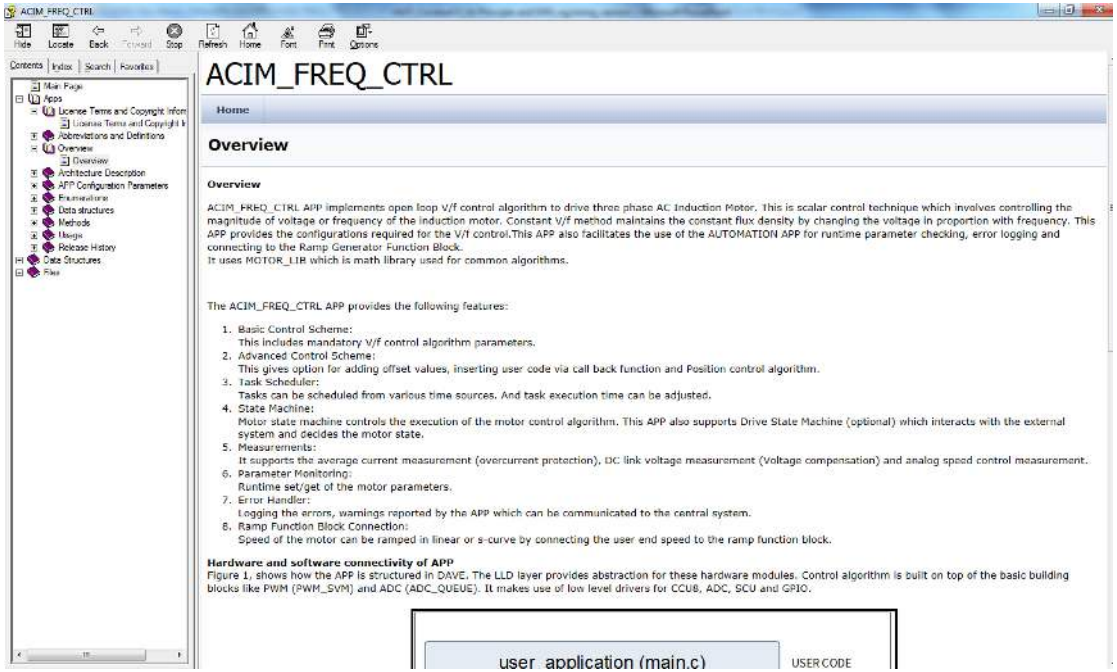
1. Motor Control Application Kit Composition
2. Development Tool: DAVE™ version 4
3. Example: PMSM Motor with fixed speed
4. Example: PMSM Motor with adjustable speed
5. Additional information

App help

This will show helpful information regarding to the APP:

- Right click on **ACIM_FREQ_CTRL_0**
- Select **"App Help"**
- This will show the help contents this App

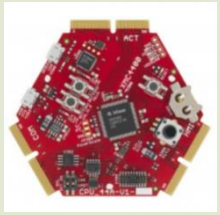
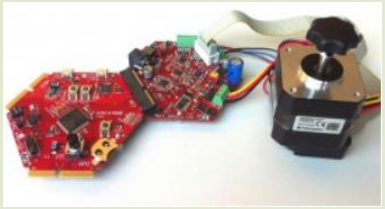




Where to buy - XMC1300

Development Boards		Order Number
XMC1300 Boot Kit		KIT_XMC13_BOOT_001
XMC1000 Motor Control Application Kit		KIT_XMC1x_AK_Motor_001

Where to buy – XMC4400

Development Boards		Order Number
XMC4400 Enterprise Kit		KIT_XMC44_EE1_001
General Purpose Motor Drive Kit		KIT_XMC4x_MOT_GPDLV_001
XMC4400 Motor Control Application Kit		KIT_XMC44_AE3_001

General information

- Information about all available XMC Motor Control Application Kits:

  LINK

- For latest updates, please refer to:

  http://www.infineon.com/xmc1000

  http://www.infineon.com/xmc4000

- DAVE™ development platform:

  http://www.infineon.com/DAVE

- For support:

  http://www.infineonforums.com/forums/8-XMC-Forum

Part of your life. Part of tomorrow.

Infineon