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

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## 5. Additional information
Kit composition – XMC 1300 Boot Kit

Included in KIT_XMC1X_AK_MOTOR_001
Kit composition – PMSM LV 15W Card

- Shunt Amplifier
- Gate Drive, Power Stage, Shunts
- MAXON Flat Motor ECF32_267121
- Encoder Line Driver & Connector
- Motor Connector

Included in KIT_XMC1X_AK_MOTOR_001
Kit composition – connection **XMC1300**

![Kit composition diagram](image)

- **XMC1300 CPU Card**
- **PMSM LV15W Card**
- **Power 24V**

*KIT_XMC1X_AK_MOTOR_001*
Kit composition – XMC4400 Enterprise Kit

- Micro USB for Debug
- ACT connector for MOT_GPDVL satellite

Included in KIT_XMC44_AE3_001
Kit composition – General Purpose Motor Drive

- Encoder input (white)
- Hall input (green)
- Resolver input
- Motor connector
- ACT connector to CPU Card (e.g. CPU_44A)
- 24V power supply

Included in KIT_XMC44_AE3_001
Kit composition – connection **XMC4400**

KIT_XMC44_AE3_001
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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
<p>| | |</p>
<table>
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<tr>
<th></th>
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<tbody>
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<td>Motor Control Application Kit Composition</td>
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<td>2</td>
<td>Development Tool: DAVE™ version 4</td>
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<td>3</td>
<td>Example: PMSM Motor with fixed speed</td>
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<td>Example: PMSM Motor with adjustable speed</td>
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<tr>
<td>5</td>
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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

› 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

- 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

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

![XMC1300 Pinout Diagram]
Step 4b: Pin assignment– XMC4400

![Manual Pin Allocator]

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<td>#97 (P0.5)</td>
</tr>
<tr>
<td></td>
<td>PhaseV_High Pin</td>
<td>#98 (P0.4)</td>
</tr>
<tr>
<td></td>
<td>PhaseW_High Pin</td>
<td>#99 (P0.3)</td>
</tr>
<tr>
<td></td>
<td>PhaseU_Low Pin</td>
<td>#100 (P0.2)</td>
</tr>
<tr>
<td></td>
<td>PhaseV_Low Pin</td>
<td>#1 (P0.1)</td>
</tr>
<tr>
<td></td>
<td>PhaseW_Low Pin</td>
<td>#2 (P0.0)</td>
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<tr>
<td></td>
<td>Trap Pin</td>
<td>#89 (P0.7)</td>
</tr>
<tr>
<td></td>
<td>Inverter Enable Pin</td>
<td>#68 (P1.15)</td>
</tr>
</tbody>
</table>

[Diagram of XMC4400]

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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);

```c
int main(void)
{
    DAVE_STATUS_t status;
    status = DAVE_Init();  /* Initialization of DAVE APPs */
    if(status == DAVE_STATUS_FAILURE)
    {
        /* Placeholder for error handler code. The while loop below can be replaced with an user error handler. */
        XMC_DEBUG("DAVE APPs initialization failed\n");
        while(1U)
        {
        }
    }
    ACIM_FREQ_CTRL_MotorStart(&ACIM_FREQ_CTRL_0);
    /* Placeholder for user application code. The while loop below can be replaced with user application code. */
    while(1U)
    {
    }
} 
```
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)”
The Motor slowly ramps up to 1500rpm

\[ N_s = \frac{60 \times f}{p} \]

\[ N_s = \text{speed}; \quad f = \text{frequency in Hz}; \quad p = \text{No. of pole pair} \]

\[ N_s = \frac{60 \times 100}{4} = 1500 \text{rpm} \]
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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 described in this chapter. The target speed is selected by adjusting the potentiometer.
Step 1: APP configuration

- 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
Step 2b: Pin assignment – XMC4400

Allocate the “Analog(Input pin” to the potentiometer input pin
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

\[
N_s = \frac{60 \times 10^6}{4} = 1590 \text{rpm}
\]
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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

<table>
<thead>
<tr>
<th>Development Boards</th>
<th>Order Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>XMC1300 Boot Kit</td>
<td>KIT_XMC13_BOOT_001</td>
</tr>
<tr>
<td>XMC1000 Motor Control Application Kit</td>
<td>KIT_XMC1x_AK_Motor_001</td>
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## Where to buy – XMC4400

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</tr>
<tr>
<td>General Purpose Motor Drive Kit</td>
<td>KIT_XMC4x_MOT_GPDLV_001</td>
</tr>
<tr>
<td>XMC4400 Motor Control Application Kit</td>
<td>KIT_XMC44_AE3_001</td>
</tr>
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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.