Infineon Designer – SPICE & XMC™ MCU co-simulation using ModusToolbox™

https://www.infineon.com/ifxdesigner

Getting Started June 2021
Agenda

1. Infineon: the link between the real and the digital world
2. Infineon Designer introduction
3. Infineon Designer – SPICE & XMC™ MCU co-simulation using ModusToolbox™
4. Summary
## Agenda

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Infineon Vision: We are the link between the real and the digital world

Our vision
We are the link between the real and the digital world.

Part of your life. Part of tomorrow.

Our values
We commit
We partner
We innovate
We perform

Our mission
We make life easier, safer and greener.
Infineon offers a unique portfolio linking the real and the digital world

https://www.infineon.com

Real-world applications

- Battery-powered devices
- Coin cell-powered devices
- Power supplies
- Industrial IoT
- Drives
- Smart Home
- Consumer IoT
- 5G
- Automotive

Digital world

- Information and data about the real world
- Value addition and optimized use of resources

Software Ecosystem

- Sense
- Compute
- Actuate

- Security solutions

- Connectivity: Wi-Fi, Bluetooth, USB

Sense: sensors
Compute: microcontrollers, memories
Actuate: power semiconductors
Security Solutions

2021-06-23
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Software & Tools help developers to shorten design-in-time

https://softwaretools.infineon.com

Selection Tools

Solution Finder

Infineon Toolbox (Developer Center)

Simulation Tools

Online

Aspects

Infineon Toolbox (Developer Center)

Selection Tools

Solution Finder

Infineon Toolbox (Developer Center)

Simulation Tools

Online

Aspects

› Does the sensor switch at the right position?
› What is the overall efficiency?
› Does my design not overheat?
› Is my design stable?
› Does my software run w/o errors?

Sense

Actuate

Compute

Secure & Safeguard

Connect

Magnetic design

Thermal design

Electrical design

Software design

Sensor Tools

(3D, Angle & Hall sensors)

IPOSIM (IGBT, Bipolar, SiC)

Motor Simulator (IGBT, IPM)

OPTIREG™ (PMIC)

PowerEsim (SMPS)

Infineon Designer (MOSFET, IGBT, Gate Driver, Voltage Regulator, Audio Class D, MCU)

PowerDesk (DC-DC PoL)

TINA Spice, PSpice, SIMetrix, [Ltspace1]

EasyAPE PRO (ATV Body Power)

TINA

1 switches & diodes only
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Infineon Designer - Online SPICE Engine

https://www.infineon.com/ifxdesigner

- 650+ application circuits (lighting, power supplies, motor control, computing DC-DC PoL, Audio etc.)
- Accurate transient and system efficiency simulation powered by TINA SPICE engine
- Full-featured circuit editor with Infineon SPICE library for free
- Export to Altium PCB design and export of the BoM (Bill of Materials)
- Fast parameter configuration with design tool for better evaluation experience
- Digital/analog co-simulation (e.g. Microcontroller code debugging)
Infineon Designer Server Infrastructure

Infineon servers

www.infineon.com/ifxdesigner

DesignSoft servers

www.tinacloud.com

PC, Mac, Tablet, Smartphone
Available in 22 languages

TINA Industrial version

Start here

Online

Offline

Compatible

Upgrade
Infineon Designer Features

- **Efficiency simulation**: Component losses, Component junction temperature, Steady-state system efficiency
- **Export to Altium**: Infineon product footprints, Passive component footprints, Altium PCB project with schematic
- **Export BoM**: Detailed BoM including type, value, footprint, part number, description, manufacturer and more
- **Design tool**: Fast configuration of circuit variables and global parameters, Individual function programming
- **MCU-SPICE co-simulation**: Support of XMC1000, (PSoC® 4/6 under evaluation), Instruction Cycle accurate co-simulation, DAVE™ support, New: available for XMC1400: ModusToolbox™ support

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Infineon Designer Features

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1. Open circuit and login with myInfineon account

2. Check & set the power types of components

3. Set transient analysis and run simulation

Thermal & System Efficiency Simulation
24V Automotive Battery Switch Demonstrator

Set U3 as power loss

Set Battery as power source

Clear power type
Set as power source
Set as power sink
Set as power loss

Run Transient Analysis

Diagram

Efficiency: 98.72% Total Input: 37.2kW Total Output: 35.98kW

<table>
<thead>
<tr>
<th>Component</th>
<th>Power type</th>
<th>Power dissipation</th>
<th>Percentag...</th>
<th>Pass/Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery</td>
<td>Source</td>
<td>37.2k</td>
<td>100</td>
<td>Pass</td>
</tr>
<tr>
<td>Road</td>
<td>Sink</td>
<td>35.98k</td>
<td>96.72</td>
<td>Pass</td>
</tr>
<tr>
<td>U3</td>
<td>Loss</td>
<td>201.45</td>
<td>0.54</td>
<td>Pass</td>
</tr>
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Export to Altium PCB
1.0V 6A Single Output Integrated PoL Solution IR38060

1. Open circuit and login with myInfineon account

2. Download as Altium archive and check
Export to Altium PCB

1.0V 6A Single Output Integrated PoL Solution IR38060

1. Open circuit and login with myInfineon account
2. Download as Altium archive and check
3. Open project in Altium and start PCB design
Infineon Designer Features

- Efficiency simulation
- Export to Altium
- Export BoM
- Design tool
- MCU-SPICE co-simulation

- Component losses
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Export the Bill of Materials

1.0V 6A Single Output Integrated PoL Solution IR38060

1. Open circuit and login with myInfineon account
2. Open the Bill of Materials, check details
3. Save to Excel .csv
Infineon Designer Features

- Component losses
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- DAVE™ support
- Coming soon: ModusToolbox™ support
Use Design Tool - Parameter Setting & Calculation

1.0V 6A Single Output Integrated PoL Solution IR38060

1. Open circuit and login with myInfineon account
2. Open design tool, set parameters and Run
3. Simulate again

Design Tool (advanced mode see appendix)
- Easier parameter setting
- Faster value calculation for all circuit components set by defined formulas & scripts

1. Wanna try it out? Click on analysis
   2. Double click on green window to design
   3. If you like what you see, buy online
   4. Enjoy other circuits

1. Open design tool, set parameters and Run

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1. Open Menu >> Tools >> Design Tool…

2. Create parameters for user interpreter window

3. Assign values, create formulas and scripts

Design Tool – Setup & Programming
1.0V 6A Single Output Integrated PoL Solution IR38060

Design tool parameters

1.0V 6A Single Output Integrated PoL Solution IR38060

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Assign values

1. Assign parameter value to component

Vin := V_in

Vin → component label

:= → value assignment

V_in → design tool parameter

2. Assign parameter value to local variable

Vout := V_out

Vout → local variable used in calculations

V_out → design tool parameter

3. Assign parameter value to circuit global parameter

Iout := I_out

Iout → global variable

I_out → design tool parameter
Create formulas and scripts

1. Formulas

- Support math. operators: + - * / () etc...
- Support math. functions: e.g. sqrt(), Round(), etc...
- := → value assignment
- = → display value (e.g. calculated results)
- {} → comment

2. Assign parameter value to local variable

- Support Pascal scripting
- Support math. operators: + - * / () etc...
- Support math. functions: e.g. sqrt(), Round(), etc...
- := → value assignment
- = → display value (e.g. calculated results)
- {} → comment
Design Tool – Setup & Programming
1.0V 6A Single Output Integrated PoL Solution IR38060

Insert Design Text (Interpreter Window) for quick access

[Please double click here to enter design criteria]

(V_in = 12;
V_out = 1;
L_out = 6;
F_sw = 306k;
C_out = 17.5µ;
C_out_N = 16;
Vout_ripple = 10m;
C8_Cc = 2.2n;
L_ripple_percentage = 38;
I_step = 1.8;)

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All MCU Circuits


- Video Getting Started Infineon Designer MCU


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Infineon Designer – Online SPICE Simulator

Infineon Designer is the first online prototyping engine combining analog and digital simulation functionalities in an internet application. Requiring a web browser only, it is a perfect match for supporting customers in selecting the right product for a defined application. Infineon Designer works intuitively in a very short time, and neither installation nor licenses are needed. Please start with one of the following application circuits.

Infineon Designer is powered by TINAcloud the online circuit analyzer of DesignSoft. You can upgrade to the full version of TINAcloud or its offline version TINA here: [https://www.tina.com/tinaupgrade](https://www.tina.com/tinaupgrade)

<table>
<thead>
<tr>
<th>Circuit</th>
<th>Application</th>
<th>Product Category</th>
<th>Product Configuration</th>
<th>Description</th>
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</table>
| 24V smart High Side Switch shield with PROFET™ BTI6030-2ERA and BTI6020-1ERA for Arduino | Automotive power | Smart Switch Microcontroller | • BTI6030-2ERA  
• BTI6020-1ERA  
• XMC1100-T038X0064 AB  
• 24V_SHIELD_BTI6030 | Read more |
| Stepper Motor Control Shield with IFX9201 & XMC1300 using Fullstep, Halfstep or Microstepping modes | Motor control | Motor Driver Microcontroller | • IFX9201SG  
• XMC1300-T038X0200AB  
• KIT_XMC1300_IFX9201 | Read more |
| 12V DC Motor Control with BTN8982TA and XMC1100 for one uni-directional DC brushed motor | Motor control | Motor Driver Microcontroller | • XMC1100-T038F0064 AB  
• BTN8982TA | Read more |
| 12V DC Motor Control Shield with BTN8982TA and XMC1100 for two uni-directional or one bi-directional DC brushed motor | Motor control | Motor Driver Microcontroller | • XMC1100-T038F0064 AB  
• BTN8982TA  
• DC_MOTORCONTR_BTN8982 | Read more |
| 48V inverse buck LED driver for RGB color controlling with IRS606N and XMC1200 | LED lighting | Power MOSFET Microcontroller | • XMC1200-T038F0200AB  
• IRS606N  
• KIT_LED_XMC1202_AS_01 | Read more |
# Agenda

1. Infineon: the link between the real and the digital world
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3. Infineon Designer – SPICE & XMC™ MCU co-simulation using ModusToolbox™
4. Summary
Solution: Digital Twin Circuit Simulation simulate first on virtual system before building the real hardware

1. build application code project in ModusToolbox™

2. upload .elf .hex to simulator

3. co-simulate XMC™ w/ SPICE

Value Proposition MCU co-simulation
- **Time-to-market**: start developing before you have the hardware kit
- **Safety**: test on virtual system will not harm engineer or destroy hardware
- **Cost**: exploration of design space cheaper than building hardware many times
- **Security**: CCS controller lack a debug interface so code debugging can be only

4. run on real hardware kit

New Software Ecosystem: ModusToolbox™
Supporting XMC1400

https://softwaretools.infineon.com/tools?q=modus

Value Proposition
- **Flexible**: You can use any IDE in your own workflow (Eclipse, GNU Make, IAR Embedded Workbench, KEIL µVision; Visual Studio Code)
- **Cross platform**: Linux, macOS, Windows
- **GitHub software ecosystem driven by manifests**: Create a project with the latest version using Project Creator independent of any IDE and export to any IDE
- **Library Manager**: Add, update, or remove libraries with the Library Manager
- **Kit & Board Support**: Includes board support packages (BSPs). Every release of every library is readily available
- **Tools & Configurators**: to set things up Device, CapSense, QSPI, Smart I/O, USB, Bluetooth, Segment LCD

2021-06-23
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ModusToolbox™ Design Flow

1. Create new XMC1400 Application
2. Write & build application code
3. Start online simulator (Infineon Designer)
4. Upload .elf .hex to simulator
5. Co-simulate XMC™ w/ SPICE
Demo 1: ModusToolbox™ IoT/Binky XMC1400

Start circuit design

Digital Twin of XMC1400 Boot Kit co-simulating Embedded Application Code generated by ModusToolbox™ Development Ecosystem with analog SPICE

Good news: ModusToolbox™ is now supporting code generation for our XMC1400 microcontrollers bringing together the ARM® Cortex™-M core and advanced post-processing for power control, power supplies and filtering. Freely simulate your application code and benchmark the performance virtually before getting the real hardware.

ModusToolbox™ is all about making life easier for developers. From project creation to product deployment, ModusToolbox™ has taken away tools and utilities that form a complete development environment which can be integrated into established development flows or used as an isolated alternative.

Download Development platform: ModusToolbox™ v2.3
Product info: XMC1400-Q66A-MX02-00 AA
Reference manual: XMC1400 AB Step
Evaluation board: XMC1400 Boot Kit
Simulation Code Example Binky XMC1400 Boot Kit
GitHub Code Examples XMC1400 Boot Kit
Other circuits
Buy online
Demo 2: DAVE™ Motor Control/FOC XMC1300

Start circuit design

Inverter (B6 Bridge) based on ideal switches

Motor: Maxon EC 32 BLDC, 15 Watt

Brushless DC (BLDC) Motor Maxon EC 32 controlled by Sensorless Field-Oriented Control (FOC) using XMC1302 (Ideal Inverter)

This simulation example shows how to control the brushless DC motor (BLDC) Maxon EC 32 by sensorless Field-oriented Control (FOC) algorithm using XMC1302 32-bit ARM Cortex®-M8 microcontroller with focus on low-cost embedded control applications. Our XMC1300 family is best suited to integrate all the control and analog interface functions required for sensorless Field-oriented Control (FOC), brushless (BLDC), brushed DC and PMIM motors achieving highest cost-performance ratios.

How to start:
1) adapt the motor parameters to your needs
2) set your speed profile [rpm]
3) run the simulation and check the performance of the motor control algorithm
4) update the control algorithm source code using DAVE™ IDE
5) flash the updated code to the simulator

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Demo 3: DAVE™ Power Supply/PFC XMC1300

Start circuit design

1. Wanna try it out? Click on simulate
2. Click on circuit components to change
3. If you like what you see, buy online
4. Enjoy other circuits

How to program the microcontroller:
1. Build project in DJAVE
2. Export project into a .zip
3. Click on the microcontroller symbol
4. Click on the "MCU-code" details
5. Select "Upload"
6. Drag and drop the .zip file created earlier
7. Click "Upload", then click "OK"
8. (optional) Launch debugger by clicking on the "TR" button on the top right

XMC1000: 230V Boost PFC - Quasi-Resonant Conduction Mode

This example demonstrates active digital power factor correction performed by an XMC1302, based on the DAVE project "PFC_XMC1302_QR"

Only the power factor corrector current loop is closed, by employing constant on-time, zero-crossing detection, and valley delay. The voltage loop that controls the output voltage is left open (not implemented). The constant on-time is fixed at a value that results in 410V output over the fixed 4kohm load.
Simulation: 32-bit XMC1000™ Industrial MCU Arm® Cortex®-M


ARM® Cortex®-M0
› Core up to 48 MHz
› Peripherals up to 96 MHz
› Wide supply voltage range 2–5 V
› 12-bit ADC
› -40…+105°C temperature
› And more…

Motor Control, SMPS DAVE™ (ModusToolbox™ coming soon)

XMC1200
ARM® Cortex®-M0
CPU at 32 MHz
Flash: 8–200 kB
Package: 16–40 pins

Main features
› 9 ch LED control
› 3x analog comparators
› BCCU LED unit

XMC1300
Cortex®-M0
CPU at 32 MHz
Flash: 8–200 kB
Package: 16–40 pins

Main features
› Math co-processor
› CCU8 PWM timer
› POSIF encoder
› Motor control SW

XMC1400
ARM® Cortex®-M0
CPU at 48 MHz
Flash: 8–200 kB
Package: 40–64 pins

Main features
› 70% more performance
› 2x CAN
› 2x CCU8
› Up to 4 serial channel
› 4x analog comparators

Lighting DAVE™ (ModusToolbox™ coming soon)

Universal DAVE™ (ModusToolbox™ coming soon)
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Use Infineon Designer SPICE simulator to check the electrical & thermal performance of your products & solutions

Use ModusToolbox™ ecosystem to enable rapid development of Infineon MCUs, covering connected IoT applications like motor control, power supply and cloud-connected solutions

Combine both to co-simulate & debug MCU software together with hardware by using Infineon Designer – online SPICE simulator integrated into ModusToolbox™

More to come in December 2021, New integrated webpage release with all software & tools as one interface to customers (Infineon Toolbox/Developer Center)
Resource List & Support

https://www.infineon.com/tools

Finder Tools

› Infineon Solution Finder
› Infineon Evaluation Board Finder
› Infineon Product Finder
› Infineon Simulation Models

Hardware Simulation Tools

Thermal design
› Infineon IPOSIM Power Simulation for Power Modules and Disk Devices
› Infineon Power Simulation for Integrated Power Modules (IPM) powered by PLECS
› Infineon Power Simulation for discrete IGBTs powered by PLECS

Electrical & software design
› Infineon Designer powered by TINACloud
› PowerEsim Simulation for Switched-Mode Power Supply (SMPS)

Magnetic design
› Infineon Magnetic Sensor Design Tools

Software & Tools

› Infineon Toolbox (future: Infineon Developer Center)

Software Development Tools

› ModusToolbox™ Software and Tools
› TriCore™ Development Tools for AURIX™ 32-bit Automotive Microcontroller based on TriCore™
› DAVE™ Development Platform for XMC™ 32-bit Industrial Microcontroller based on ARM® Cortex®-M

Infineon Support & Distribution Partners

› Technical Support Center
› Forums Cypress Developer Community
› Newsletter for Engineers
› Orderable Part Number (OPN) Finder
› Where to Buy your Products
Part of your life. Part of tomorrow.
## Tips & Tricks

| Enlarge the editor area | Menu >> View >> Full-screen (full-screen & remove banner)  
|                         | F11 (Browser full-screen)  
|                         | Component view |
| Edit circuit            | Zoom-in/out: mouse scroll, or key [Shift ↑] + drag for zoom-in  
|                         | Wire connection: see demonstration  
|                         | Multi-selection: see demonstration  
|                         | Circuit view shifting: see demonstration |
| Search text             | Key combination [Ctrl] + [F]  
|                         | • Search components in circuit editor  
|                         | • Search variable in design tool editor |
| Solve artifacts         | browser and server caching issues  
|                         | • revert to original (Menu >> File >> Revert to original)  
|                         | • change language (Menu >> View >> Language) |
| Import additional SPICE models | First menu bar + – >> Upload macros…  
|                          | Then menu bar + – >> Insert macros… |
| More features offline   | Menu >> Help >> Order or Upgrade…  
|                         | Upgrade to TINA Industrial offline version: [www.tina.com](http://www.tina.com) |
How To Import A SPICE Model (Part 1/2)

1. Login with your myInfineon account
2. Select File -> New, create a new circuit
3. Click menu bar symbol and click “Upload macro…”
4. Name your model, select “from file”, and browse to your SPICE model in .SUBCKT format
5. Click on “Upload”

Example Model OrCAD Capture for IR2110

```
.SUBCKT IR2110 VDD HIN SD LIN VSS HO VB VS VCC COM LO
+PARAMS:
T1=-40 T2=25 T3=125
...
.ENDS IR2110
```
How To Import a SPICE Model (Part 2/2)

6. Edit symbol pin layout
7. Optional: Replace “?” with new pin name in symbol
   Example: VDD/? -> VDD/VDD
8. Optional: place pins on top, left, right, bottom
9. Click on OK to upload macro
10. Click menu bar symbol and click “Insert macro…”
11. Select IR2110 macro and place it on your schematic
12. Finalize your circuit and Save it with “Save -> Save as”
13. Test your circuit