

G4XS_K64F_XSG_Measurement

Processor Expert Example Project

Date: 21. 11. 2016

Revision: 2.0

Requirements

Kinetis Design Studio 3.2.0 or newer

FRDM-K64F MCU board

FRDM-32XSG-EVB Gen4 eXtreme Switch board

channel load

USB cable

Overview

The purpose of this example project is to show how to configure feedback monitoring and how to get measured values. In this example monitored output is constantly changed and measured after synchronization occurs.

Setting up hardware

Target platform for this example is FRDM-K64F MCU board with FRDM-32XSG-EVB eSwitch board.

FRDM-32XSG-EVB eSwitch board has to be properly configured in such way that CSB0 pin is correctly routed to PTD0 on MCU. This can be achieved by switching number 0 on SW2 switch on the eSwitch board to ON position. The rest of CSB routes should remain in OFF position.

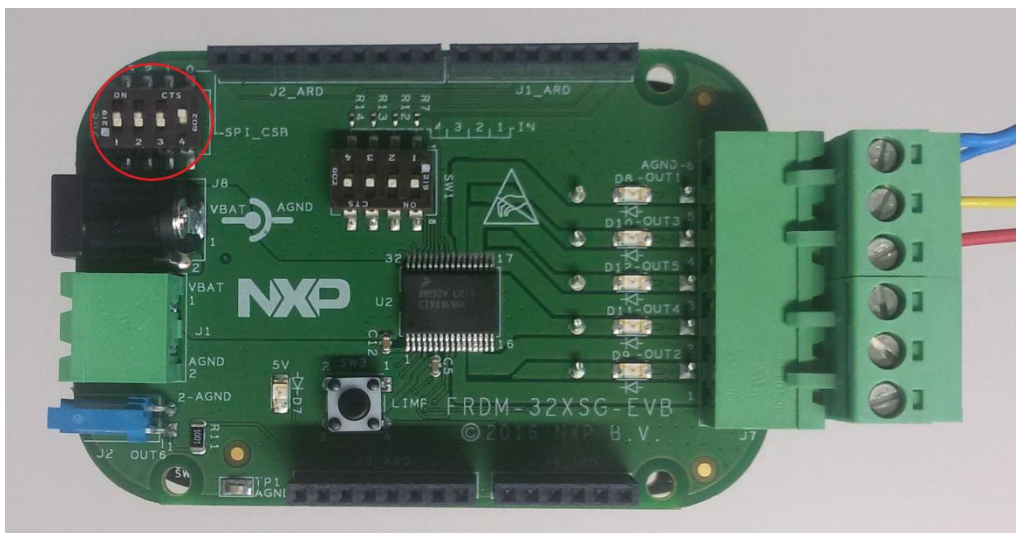


Figure 1 CSB Route Selection

In order to get the project successfully running you need to connect some load to channel 1 on your FRDM eSwitch board.

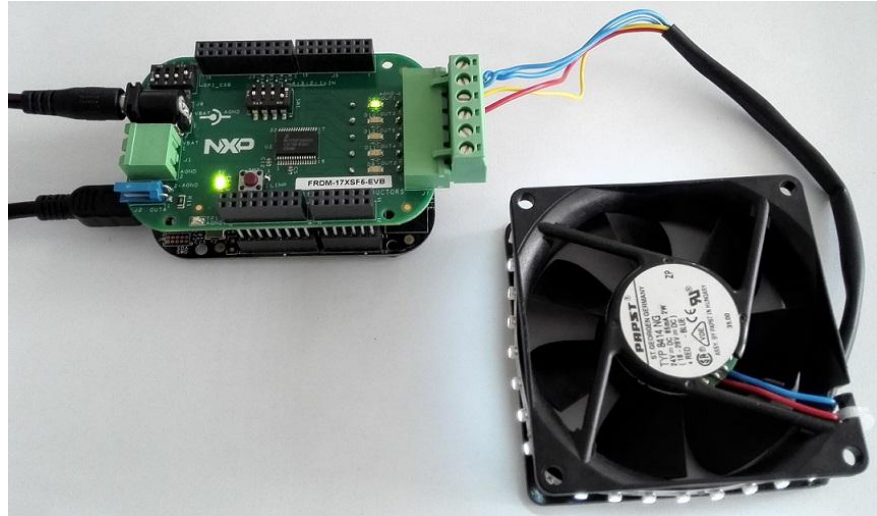


Figure 2 Channel Load

Set up connection between PC and MCU board. Connect USB cable to OpenSDA port on MCU side.

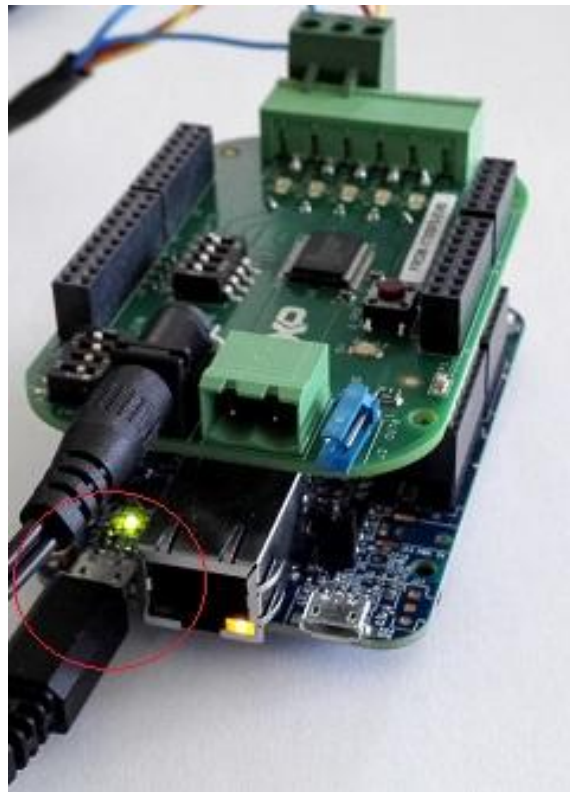


Figure 3 OpenSDA PC-MCU Debug Connection

Setting up software

Make sure you have installed KDS 3.2.0 or newer which comes with Processor Expert support.

Then components must be imported to the Processor Expert Component Library.

- **SPI_Device** component
- **Gen4eXtremeSwitch** component

Component	Description
Kinetis	
Legacy User Components	
My Components	
Software	
User Components	
BC_MC32BC3770	Processor Expert support for battery charger MC32BC3770.
FRDM_BC3770	Processor Expert support for MC32BC3770, Charger Freedom Board
Gen4eXtremeSwitch	Processor Expert support for 32V eXtremeSwitch devices.
LVHBridge	Low voltage H-Bridge supporting MC34933, MPC17529, MPC17C724, M...
SPI_Device	Communication with SPI device placed on SPI bus
ThreePhaseMotorC	Three-Phase BLDC Motor Control
ThreePhasePreDrive	Three Phase FET Pre-Driver GD3000/MC33937/MC34937

Figure 4 Processor Expert Component Library

Check that your OpenSDA connection has properly installed driver.

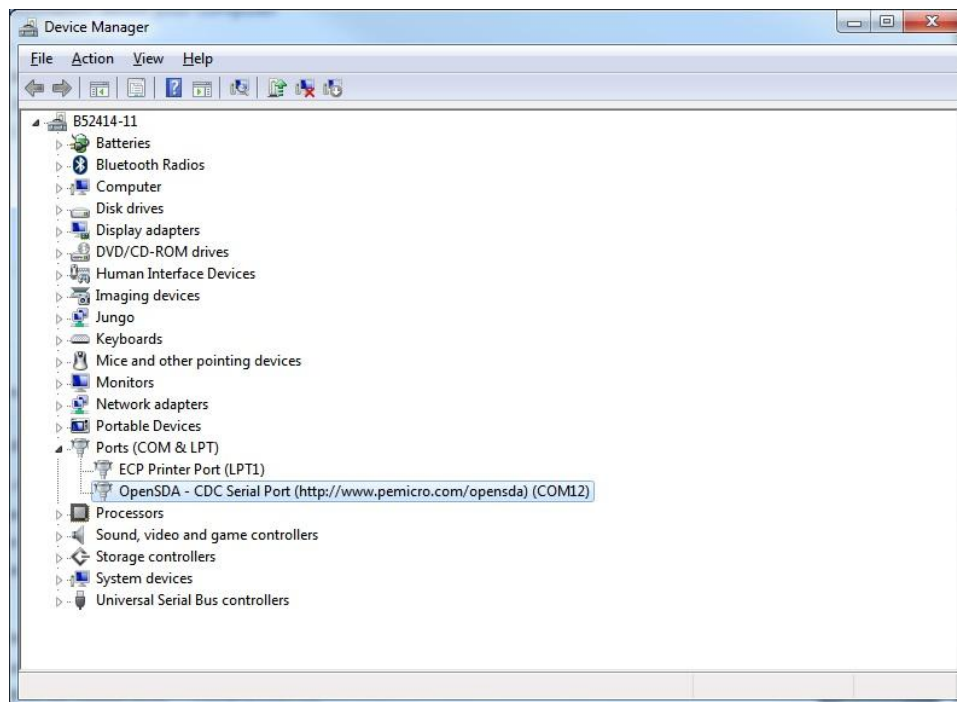


Figure 5 OpenSDA Virtual Port

Description

The example is preconfigured in the following way. ESwitch board is configured in **Gen4eXtremeSwitch** component, see Figure 7. SPI settings are configured separately in **SPIMaster_LDD** component, see Figure 8 and in inherited **CSpin1** component, see Figure 9. All components can be accessed in component tree, see Figure 6.

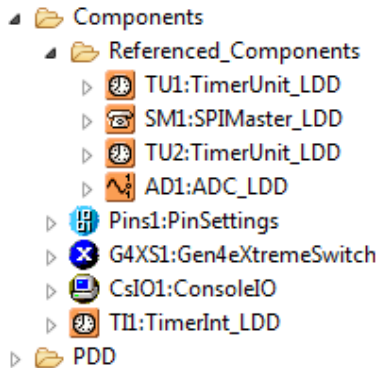


Figure 6 Component Tree

CSNS Function is set to Channel 1 current measurement, but will be changed in the code. OCLO Threshold is set to Low and Advanced Sensing Mode is enabled for more accurate measurement of low currents (25 % of Full Scale Range = Maximum Current), for higher currents set these properties to High and Disabled (100% FSR). Pay attention to Watchdog Timeout value, make sure that if you modify project, you still hold the period needed to feed watchdog.

Component Name	G4XS1	
SPI Configuration	Parallel SPI	
▲ Global Configuration		
RSTB Pin	PTE26/ENET_1588_CLKIN/UART4_...	
External Clock Frequency	50000	D
CLK Pin	ADC0_SE15/PTC1/LLWU_P6/SPI0_...	ADC0_SE15/PTC1/LLWU_P6/SPI0_...
Watchdog Timeout	128 ms	
▷ Direct Input Control	Disabled	
▲ Current, Voltage and Temperature	Enabled	
ADC Conversion Time	4.768372 μs	4.768 μs
CSNS Function	Channel 1	
CSNS Pin	ADC1_SE14/PTB10/SPI1_PCS0/UA...	
▲ CSNS Synchronization	Trigger 0	
CSNS SYNC Pin	PTB9/SPI1_PCS1/UART3_CTS_b/FB...	
▲ Devices	1	
▲ Device1		
Device Model	MC17XSF500	
SOA Mode	Single read	
Overtemperature Warning	115 °C	
HID Selection	Disabled	
OCHI Type	Default	
Global PWM Duty Cycle	0	D
▲ Channels	6	
▲ Output1	Enabled	Corresponds to channel with index...
▲ PWM Output Control		
Global PWM	Disabled	
Channel Duty Cycle	0	D
Phase Selection	0°	
Pulse Skipping	Disabled	
Slew Rate Prescaler	1	
Output Initial Slope	Off	
Direct Input Control	Disabled	
▲ Open Load		
Open Load LED	Disabled	
OLON Deglitch	64 us	
▲ Overcurrent		
OCLO Threshold	Low	
Advanced Current Limit	Disabled	
Short OCHI	Disabled	
No OCHI	Disabled	
▷ Output2	Disabled	Channel disabled.
▷ Output3	Disabled	Channel disabled.
▷ Output4	Disabled	Channel disabled.
▷ Output5	Disabled	Channel disabled.
▷ Output6	Disabled	Channel disabled.
Auto Initialization	yes	

Figure 7 G4XS Component Settings

SPI setting involves pin selection (MISO, MOSI, CLK and CSB). The first three pins are configured in SPIMaster_LDD, see Figure 8 and the last one is configured in CSPin component, see Figure 9, which is inherited by SPI_Device component.

Device	SPI0
Interrupt service/event	Enabled
▲ Settings	
▲ Input pin	Enabled
Pin	PTD3/SPI0_SIN/UART2_TX/FTM3_CH3/FB_AD3/I2C0_SDA
▲ Output pin	Enabled
Pin	PTD2/LLWU_P13/SPI0_SOUT/UART2_RX/FTM3_CH2/FB_AD4/I2C0_...
▲ Clock pin	
Pin	ADC0_SE5b/PTD1/SPI0_SCK/UART2_CTS_b/FTM3_CH1/FB_CS0_b
Chip select list	0
▲ Attribute set list	1
▲ Attribute set 0	
Width	8 bits
MSB first	yes
Clock polarity	Low
Clock phase	Change on leading edge
Parity	None
Chip select toggling	no
Clock rate index	0
Delay after transfer index	0
CS to CLK delay index	0
CLK to CS delay index	0
Clock rate	0.667572 μ s
Delay after transfer	0.190735 μ s
CS to CLK delay	0.190735 μ s
CLK to CS delay	0.190735 μ s
▲ Initialization	
Auto initialization	yes

Figure 8 SPI Master Component Settings

Pin for I/O	PTD0/LLWU_P12/SPI0_PCS0/UART2_RTS_b/FTM3_CH0/FB_ALE/FB_...
Direction	Output
▲ Initialization	
Init. direction	Output
Init. value	0
Auto initialization	yes

Figure 9 Chip Select Pin Settings

This demo project uses output 1 which is enabled in the Gen4eXtremeSwitch component. It is important to mention that index of this channel is 0. Please see the Detail column in Component Inspector to know indexes of available channels.

In main function *SetPWMDuty* method is called to set 88% duty cycle for output 1. After this method a *FeedWatchdog* method is periodically called in an infinite loop. Note that it is necessary to periodically feed the watchdog otherwise the device would get in fail-safe mode. In the infinite loop also the *IsInterrupt* flag is checked which is set by timer every 2 seconds (interrupt service routines are located in *Events.c* module). If the flag equals *TRUE*, measurement is started and the result is sent to console. Also with every timer interrupt the

measured quantity is changed. At first the current on channel 1 is measured, then the supply voltage and after that the die temperature. These values are sent to console in this order.

Two methods for measurement setting and reading data are provided by *Gen4eXtremeSwitch* component. The first one is *ConfigureMonitoring* which selects device, sets a quantity to be measured and a type of trigger. Method *GetSenseValue* starts ADC measurement and returns measured data. If the device is set for current measurement it is important to set some of available triggers to get precise data. The trigger sets an interrupt flag if the measurement is synchronized with PWM signal. This flag is checked in an infinite loop in *StartMeasurement* method and if it equals *TRUE*, measurement is started. The method *GetSenseValue* returns after the measurement has finished.

Import the example project

Pre-requisites such as needed components are assumed to be imported already. If that is correct, you can approach to importing of the example project.

1. In KDS click on the File / Import.
2. Choose General / Existing Projects into Workspace.
3. Click Browse to select root directory with your downloaded example projects.
4. Select project named *G4XS_K64F_XSG_Measurement* and click Finish to complete process.
5. Now the example project should be copied to your workspace and ready to run.

Build and Debug

In order to build and run the project you need to generate code at first. Then you can build the project usual way. If the build is successful, debug and run the project.