#### S32K144 EVB QUICK START GUDE

#### REV4.1 APPLIES FOR: S32K144 EVB (SCH-29248 REV B)





SECURE CONNECTIONS FOR A SMARTER WORLD

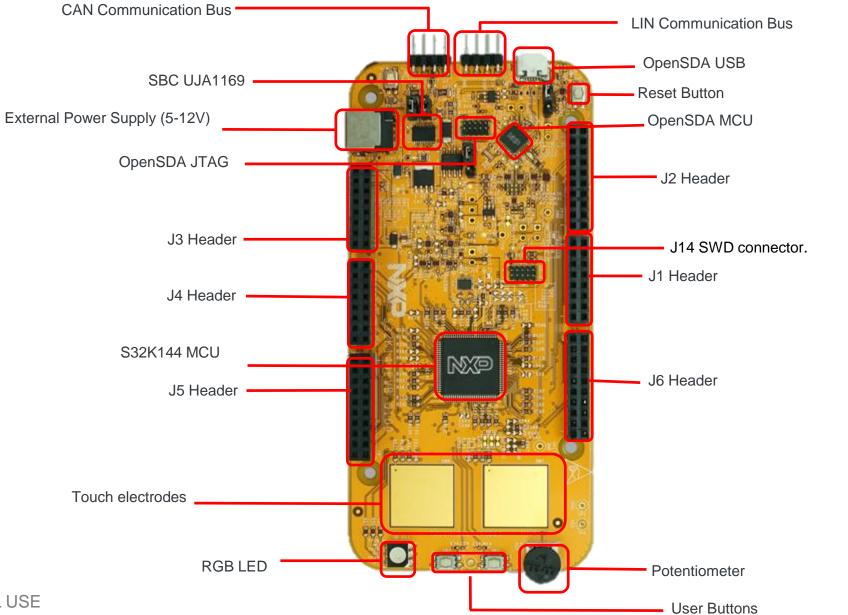
EXTERNAL USE

#### **Contents:**

- Get to Know S32K144 EVB
- Out of the Box Setup
- Introduction to OpenSDA
- Creating a new S32DS project for S32K144
- S32DS Debug basics
- Create a P&E debug configuration



#### Get to know S32K144-EVB





## S32K144 EVB Features:

- Supports S32K144 100LQFP
- Small form factor size supports up to 6" x 4"
- Arduino<sup>™</sup> UNO footprint-compatible with expansion "shield" support
- Integrated open-standard serial and debug adapter (OpenSDA) with support for several industry-standard debug interfaces
- Easy access to the MCU I/O header pins for prototyping
- On-chip connectivity for CAN, LIN, UART/SCI.
- SBC UJA1169 and LIN phy TJA1027
- Potentiometer for precise voltage and analog measurement
- RGB LED
- Two push-button switches (SW2 and SW3) and two touch electrodes
- Flexible power supply options
  - microUSB or
  - external 12V power supply





#### Header/Pinout Mapping for S32K144

PIN	PORT	FUNCTION	J3	PIN	PORT	FUNCTION
J3-02	PTB6*	GPIO		J3-01		VIN
J3-04	PTB7*	GPIO		J3-03		IOREF
J3-06	PTE0	GPIO		J3-05	PTA5	RESET
J3-08	PTE9	GPIO		J3-07		3V3
J3-10	PTC5	GPIO		J3-09		5V
J3-12	PTC4	GPIO		J3-11		GND
J3-14	PTA10	GPIO		J3-13		GND
J3-16	PTA4	GPIO		J3-15		VIN

PIN	PORT	FUNCTION	J4	PIN	PORT	FUNCTION	
J4-02	PTC7	GPIO		J4-01	PTD4	ADC0	
J4-04	PTC6	GPIO		J4-03	PTB12	ADC1	
J4-06	PTB17	GPIO		J4-05	PTB0	ADC2	
J4-08	PTB14	GPIO		J4-07	PTB1	ADC3	
J4-10	PTB15	GPIO		J4-09	PTA6/PTE11/PTA2	ADC4	
J4-12	PTB16	GPIO		J4-11	PTC0/PTE10/PTA3	ADC5	
J4-14	PTC14	GPIO		J4-13	PTE2	ADC6	
J4-16	PTC3	GPIO		J4-15	PTE6	ADC7	

FUNCTION	PORT	PIN	J5	FUNCTION	PORT	PIN
ADC8	PTA15/PTD11	J5-01		GPIO	PTE16	J5-02
ADC9	PTA16/PTD10	J5-03		GPIO	PTE15	J5-04
ADC10	PTA1	J5-05		GPIO	PTE14	J5-06
ADC11	PTA0	J5-07	HH:	GPIO	PTE13	J5-08
ADC12	PTA7	J5-09	14124	VDD		J5-10
ADC13	PTB13	J5-11		GND		J5-12
ADC14	PTC1	J5-13	100	GPIO	PTE1	J5-14
ADC15	PTC2	J5-15		GPIO	PTD7	J5-16
GPIO	NC	J5-17	<b>1</b>	GPIO	PTD6	J5-18
N/A	NC	J5-19		GPIO	PTC15	J5-20

		F J J J J J J J J
JЗ		J2 <sup>J</sup> J2
J4		נ נ נ ן ן ן ן ן ן ן ן ן ן ן ן ן ן ן ן ן
J5		J6 <sup>1</sup>
	Arduino compatible pins	

NXP pins

PIN	PORT	FUNCTION	J2	PIN	PORT	FUNCTION
J2-19	PTE10/PTA3	D15/I2C_SDA		J2-20	NC	GPIO
J2-17	PTE11/PTA2	D14/I2C_CLK		J2-18	NC	GPIO
J2-15		ANALOGUE REF		J2-16	PTA14	GPIO
J2-13		GND		J2-14	PTE7	GPIO
J2-11	PTB2	D13/SPI_SCK		J2-12	PTC13	GPIO
J2-09	PTB3	D12/SPI_SIN		J2-10	PTC12	GPIO
J2-07	PTB4	D11/SPI_SOUT		J2-08	PTE8	GPIO
J2-05	PTB5	D10/SPI_CS		J2-06	PTD0	GPIO
J2-03	PTD14	D9/PWM		J2-04	PTD16	GPIO
J2-01	PTD13	D8/PWM		J2-02	PTD15	GPIO

	PIN	PORT	FUNCTION	J1	PIN	PORT	FUNCTION
	J1-15	PTC11/PTE8	D7		J1-16	PTE3	GPIO
14	J1-13	PTC10/PTC3	D6		J1-14	PTD3	GPIO
JI	J1-11	PTB11	D5		J1-12	PTD5	GPIO
	J1-09	PTB10	D4		J1-10	PTD12	GPIO
	J1-07	PTB9	D3		J1-08	PTD11	GPIO
	J1-05	PTB8	D2		J1-06	PTD10	GPIO
	J1-03	PTA3	D1		J1-04	PTA17	GPIO
16	J1-01	PTA2	D0		J1-02	PTA11	GPIO
JD	)						

PIN	PORT	FUNCTION	J6	PIN	PORT	FUNCTION
J6-19	PTA9	D14		J6-20	PTE4	GPIO
J6-17	PTA8	D15		J6-18	PTE5	GPIO
J6-15	PTE12	D16		J6-16	PTA12	GPIO
J6-13	PTD17	D17		J6-14	PTA13	GPIO
J6-11	PTC9	D18		J6-12		GND
J6-09	PTC8	D19		J6-10		VDD
J6-07	PTD8	D20		J6-08	PTC16	GPIO
J6-05	PTD9	D21		J6-06	PTC17	GPIO
J6-03	PTD2	GPIO		J6-04	PTD3	GPIO
J6-01	PTD0	GPIO		J6-02	PTD1	GPIO

\*0ohm resistor is not connected

### **Jumper Settings**

Jumper	Configuration	Description
J104	1-2	Reset signal to OpenSDA, use to enter into OpenSDA Bootloader mode
	2-3 (Default)	Reset signal direct to the MCU, use to reset S32K144.
J107	1-2	S32K144 powered by 12V power source.
	2-3 (Default)	S32K144 powered by USB micro connector.
J109/J108	1-2 (Default)	Removes CAN termination resistor



#### **HMI** mapping

Component	S32K144
Red LED	PTD15 (FTM0 CH0)
Blue LED	PTD0(FTM0 CH2)
Green LED	PTD16(FTM0 CH1)
Potentiometer	PTC14 (ADC0_SE12)
SW2	PTC12
SW3	PTC13
OpenSDA UART TX	PTC7(LPUART1_TX)
OpenSDA UART RX	PTC6(LPUART1_RX)
CAN TX	PTE5(CAN0_TX)
CAN RX	PTE4 (CAN0_RX)
LIN TX	PTD7(LPUART2_TX)
LIN RX	PTD6 (LPUART2_RX)
SBC_SCK	PTB14 (LPSPI1_SCK)
SBC_MISO	PTB15(LPSPI1_SIN)
SBC_MOSI	PTB16(LPSPI1_SOUT)
SBC_CS	PTB17(LPSPI1_PCS3)



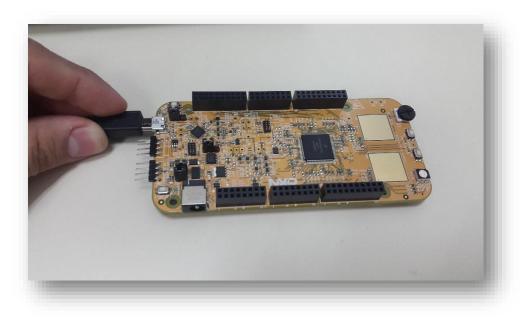
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## S32K144 EVB OUT OF THE BOX



#### **Step 1: Power up the Board – EVB Power Supplies**

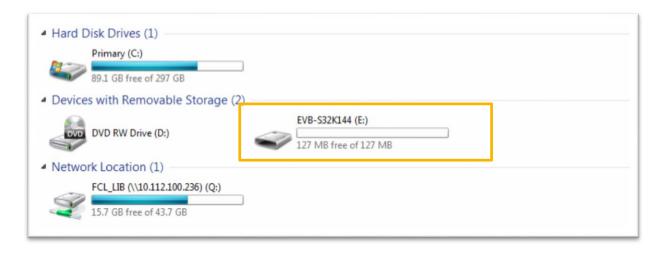
- The S32K144-EVB evaluation board powers from a USB or external 12V power supply. By default USB power is enabled with J107 (check slide 5)
- Connect the USB cable to a PC using supplied USB cable .
- Connect other end of USB cable (microUSB) to mini-B port on FRDM-KEA at J7
- Allow the PC to automatically configure the USB drivers if needed
- Debug is done using OpenSDA through J7





#### Step 1: Power up the Board – Is it powered on correctly?

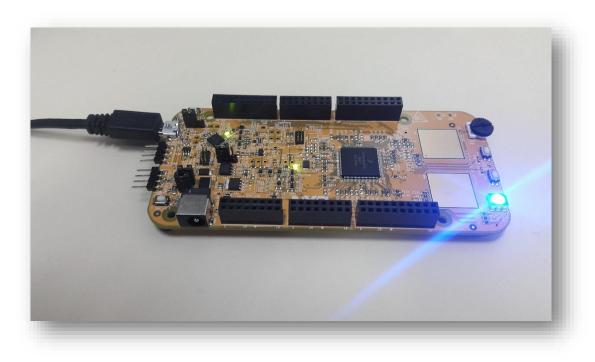
- When powered through USB, LEDs D2 and D3 should light green
- Once the board is recognized, it should appear as a mass storage device in your PC with the name EVB-S32K144.





#### **Step 1: Power up the Board – Is it powered on correctly?**

 Board is preloaded with a software, in which the red, blue and green leds will toggle at different rates.





## INTRODUCTION TO OPENSDA



#### **Introduction to OpenSDA: 1 of 2**

OpenSDA is an open-standard serial and debug adapter. It bridges serial and debug communications between a USB host and an embedded target processor. OpenSDA software includes a flash-resident USB mass-storage device (MSD) bootloader and a collection of OpenSDA Applications. S32K144 EVB comes with the MSD Flash Programmer OpenSDA Application preinstalled. Follow these instructions to run the OpenSDA Bootloader and update or change the installed OpenSDA Application.

#### Enter OpenSDA Bootloader Mode

- 1. Unplug the USB cable if attached
- 2. Set J104 on position 1-2.
- 3. Press and hold the Reset button (SW5)
- 4. Plug in a USB cable (not included) between a USB host and the OpenSDA USB connector (labeled "SDA")
- 5. Release the Reset button

A removable drive should now be visible in the host file system with a volume label of BOOTLOADER. You are now in OpenSDA Bootloader mode.

**IMPORTANT NOTE:** Follow the "Load an OpenSDA Application" instructions to update the MSD Flash Programmer on your S32K144 EVB to the latest version.

#### Load an OpenSDA Application

- 1. While in OpenSDA Bootloader mode, double-click **SDA\_INFO.HTML** in the **BOOTLOADER** drive. A web browser will open the OpenSDA homepage containing the name and version of the installed Application. This information can also be read as text directly from **SDA\_INFO.HTML**
- 2. Locate the OpenSDA Applications
- 3. Copy & paste or drag & drop the MSD Flash Programmer Application *to the BOOTLOADER drive*
- Unplug the USB cable and plug it in again. The new OpenSDA Application should now be running and a S32K144 EVB drive should be visible in the host file system

You are now running the latest version of the MSD Flash Programmer. Use this same procedure to load other OpenSDA Applications.



### Introduction to OpenSDA: 2 of 2

The MSD Flash Programmer is a composite USB application that provides a virtual serial port and an easy and convenient way to program applications into the KEA MCU. It emulates a FAT16 file system, appearing as a removable drive in the host file system with a volume label of EVB-S32K144. Raw binary and Motorola S-record files that are copied to the drive are programmed directly into the flash of the KEA and executed automatically. The virtual serial port enumerates as a standard serial port device that can be opened with standard serial terminal applications.

#### **Using the MSD Flash Programmer**

- 1. Locate the .srec file of your project , file is under the Debug folder of the S32DS project.
- 2. Copy & paste or drag & drop one of the .srec files to the EVB-S32K144 drive

The new application should now be running on the S32K144 EVB. Starting with v1.03 of the MSD Flash Programmer, you can program repeatedly without the need to unplug and reattach the USB cable before reprogramming.

Drag one of the .srec code for the S32K144 the S32K144 EVB board over USB to reprogram the preloaded code example to another example.

**NOTE:** Flash programming with the MSD Flash Programmer is currently only supported on Windows operating systems. However, the virtual serial port has been successfully tested on Windows, Linux and Mac operating systems.

#### **Using the Virtual Serial Port**

- Determine the symbolic name assigned to the EVB-S32K144 virtual serial port. In Windows open Device Manager and look for the COM port named "PEMicro/Freescale – CDC Serial Port".
- 2. Open the serial terminal emulation program of your choice. Examples for Windows include <u>Tera Term</u>, <u>PuTTY</u>, and <u>HyperTerminal</u>
- 3. Press and release the Reset button (SW0) at anytime to restart the example application. Resetting the embedded application will not affect the connection of the virtual serial port to the terminal program.
- 4. It is possible to debug and communicate with the serial port at the same time, no need to stop the debug.

**NOTE:** Refer to the OpenSDA User's Guide for a description of a known Windows issue when disconnecting a virtual serial port while the COM port is in use.



## **INSTALLING S32DS**



#### **Download S32DS**

Download S32DS from:

http://www.nxp.com/S32DS



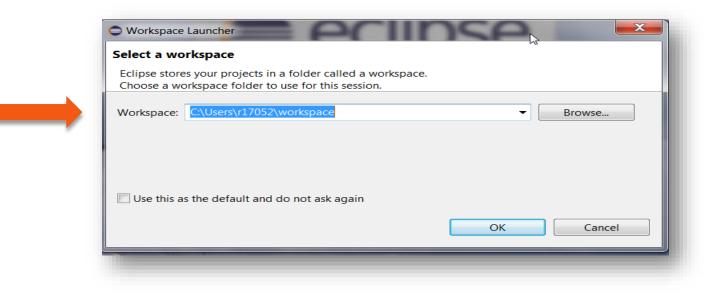
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# **CREATE A NEW PROJECT IN S32 DESIGN STUDIO**



#### **Create New Project: First Time – Select a Workspace**

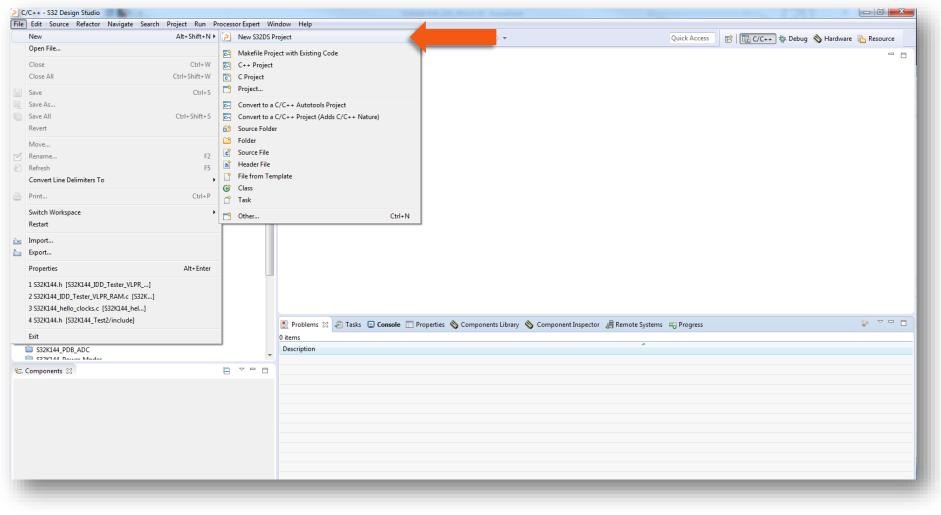
- Start program: Click on "S32 Design Studio for ARM v1.3" icon
- Select workspace:
  - Choose default (see below example) or specify new one
  - Suggestion: Uncheck the box "Use this as the default and do not ask again"
  - Click OK





#### **Create New Project: Top Menu Selection**

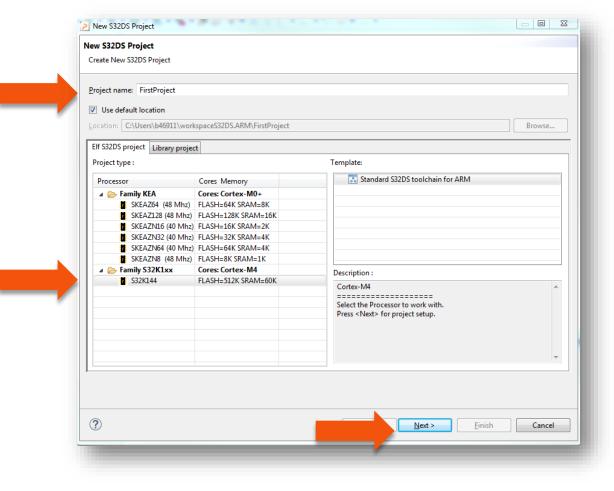
• File – New – Project





#### **Create New Project: S32DS Project**

- Project Name:
  - Example: FirstProject
- Project Type:
  - Select from inside executable or library folder
- Next





#### **Create New Project: S32DS Project**

- Select Debugger Support and Library Support
- Click Finish

Core	Debugger	Library _	I/O Support	FPU Support
Ortex-M4	PE Micro GDB server	✓ ewl ✓	No I/O 🗸	Toolchain Default
•				



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#### **OpenSDA Configuration**

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**EXTERNAL USE** 

- To Debug your project with OpenSDA, it is necessary to select the OpenSDA in the Debug Configuration.
- Select your project, and click on debug configuration

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Project Explorer	□ 😫 😜 🗢 🗆	© 532 Debug As	- 8
S32K144_EVB         S32K144_EVB         S32K144_EVB         S32K144_EVB         S32K144_EVB         S32K144_Flash         S32K144_F		Debug Configurations       M4_100         Organize Favorites       M4_100         Compilers:       GNU C Compiler for ARM         Reference manual:       S32K144_0N77P_RN Rev. 0 DraftA, 06/2015         Version:       rev. 1.4, 2015-08-10         Build:       bi50811         Abstract:       Peripheral Access Layer for S32K144         Copyright (c) 1997 - 2015 Freescale Semiconductor, Inc.       All rights reserved.         Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:       o         O Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.       o         O Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.       o         O Neither the name of Freescale Semiconductor, Inc. nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.	
. Components - S32K144_EVB 🔀		THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS "AS IS" AND ANY EXPRESS OF IMPLIED MARANTIES, TILUDING, BUT NOT LIMITED TO, THE IMPLIED WARANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT HOLDER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITIS; OR BUSINESS INTERRUPTION) HOMEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING MEDIAGENCE OR OTHEMIZES) ANSISS INTERRUPTION HOMEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING MEDIAGENCE OR OTHEMIZES) ANSISS INTERRUPTION HOMEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING MEDIAGENCE OR OTHEMIZES) ANSISS INTERRUPTION HOMEVER CAUSED AND ON ANY THEORY OF LABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING MEDIAGENCE OR OTHEMIZES) ANSISS INTERNATION HOMEVER CAUSED AND ON THE (INCLUDING MEDIAGENCE ON CONTENEDS) THE PROSIBILITY OF SUCH DAMAGE. (INCLUDING MEDIAGENCE ON CONSEL OF THE POSSIBILITY OF SUCH DAMAGE. (INCLUDING MEDIAGENCE ON CONSEL OF THE POSSIBILITY OF SUCH DAMAGE. (INCLUDING MEDIAGENCE ON CONSEL OF THE POSSIBILITY OF SUCH DAMAGE. (INCLUDING MEDIAGENCE ON CONSEL OF THE POSSIBILITY OF SUCH DAMAGE. (INCLUDING MEDIAGENCE ON CONSEL OF THE POSSIBILITY OF SUCH DAMAGE. (INCLUDING MEDIAGENCE ON CONSEL OF THE POSSIBILITY OF SUCH DAMAGE. (INCLUDING MEDIAGENCE ON CONSEL OF THE POSSIBILITY OF SUCH DAMAGE. (INCLUDING MEDIAGENCE ON CONSEL OF THE POSSIBILITY OF SUCH DAMAGE. (INCLUDING MEDIAGENCE ON CONSEL OF THE POSSIBILITY OF SUCH DAMAGE. (INCLUDING MEDIAGENCE ON CONSEL OF THE POSSIBILITY OF SUCH DAMAGE. (INCLUDING MEDIAGENCE ON CONSEL OF THE POSSIBILITY OF SUCH DAMAGE. (INCLUDING MEDIAGENCE ON CONSEL OF THE POSSIBLE OF THE POSSIBILITY OF	, , ,

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#### **OpenSDA Configuration**

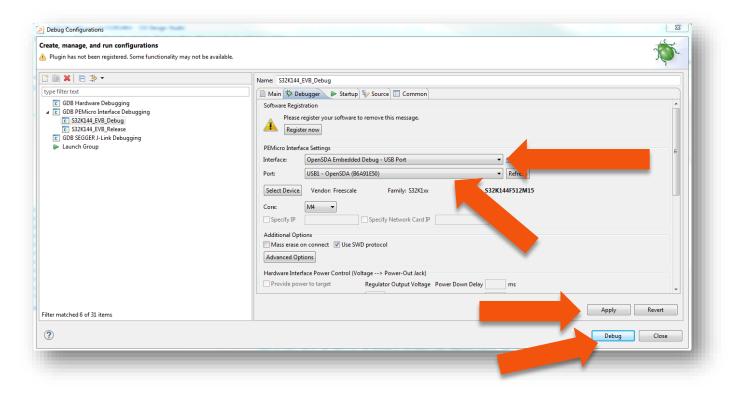
- Select the Debug configuration under GDB PEMicro Interface Debugging
- Click on Debugger tab

Create, manage, and run configurations	E Contraction of the second
□ ■ ¥   □ ≱ -	Name: S32K144_EVB_Debug
type filter text © GDB PEMicro Interface Debugging © GDB PEMicro Interface Debugging © 332K144_FVR_Pelexe © GDB SEGGER J-Link Debugging ► Launch Group	Main      Second Project:     S22(141_EVB     Brows     Specify the number of additional EIF Files you wish to program:     Generate EIF Fields     C/C++ Application:     Debug/S32X144_EVB.eIF     Variables Search Project Brows     Build (if required) before launching     Build configuration:     Use Active     Enable auto build     O Disable auto build     O Use workspace settings     Configure Workspace Settings
Filter matched 6 of 31 items	Apply
?	Debug



#### **OpenSDA Configuration**

- Select OpenSDA as the interface, if your board is plugged should appear in the Port field.
- Click Apply and debug to finish.



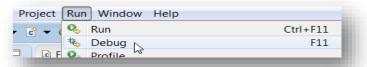


## **DEBUG BASICS**



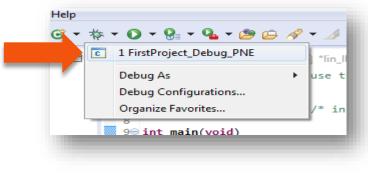
#### **Debug Basics: Starting the Debugger**

- Debug configuration is only required once. Subsequent starting of debugger does not require those steps.
- Three options to start debugger:
  - If the "Debug Configuration" has not been closed, click on "Debug" button on bottom right
  - Select Run Debug (or hit F11)



*Note*: This method currently selects the desktop target (*project.elf*) and gives an error. Do not use until this is changed.

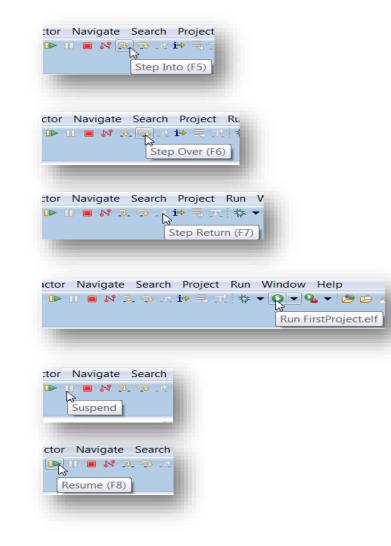
 <u>Recommended Method</u>: Click on pull down arrow for bug icon and select ...\_debug.elf target





### Debug Basics: Step, Run, Suspend, Resume

- Step Into (F5)
- Step Over (F6)
- Step Return (F7)
- Run
- Suspend
- Resume (F8)





#### **Debug Basics: View & Alter Variables**

- View variables in "Variables" tab.
- Click on a value to allow typing in a different value.

Name	Туре	Value
(×)= counter	int	8
		L'a



#### **Debug Basics: View & Alter Registers**

- View CPU registers in the "Registers" tab
- Click on a value to allow typing in a different value
- View peripheral registers in the EmbSys Registers tab

N	lame		Value
	🖬 🛗 Genera	al Registers	
	1818 rO		3
	1818 r1		5
	1919 r2		536866944
	1818 r3		8
	1010 -4		0

Arch: cortex-m0 Vendor: Freescale C	hip: SKEAZ1284	Board: none				
egister	Hex	Bin	Reset	Access	Address	Description
🔺 🗁 IRQ						Interrupt
🔺 💦 SC	0x00	0000000	0x00	RW	0x40031000	Interrupt Pin Request Status and Co
IRQMOD (bit 0)	0x0	0				O: IRQ event is detected only on f
IRQIE (bit 1)	0x0	0				O: Interrupt request when IRQF se
IRQACK (bit 2)	0x0	0				IRQ Acknowledge
IRQF (bit 3)	0x0	0				🙆 0: No IRQ request
IRQPE (bit 4)	0x0	0				🕲 0: IRQ pin function is disabled.
IRQEDG (bit 5)	0x0	0				🕲 0: IRQ is falling-edge or falling-e
IRQPDD (bit 6)	0x0	0				O: IRQ pull device enabled if IRQI
RESERVED (bit 7)	0x0	0				no description available
A CBC						Could Build and Charles

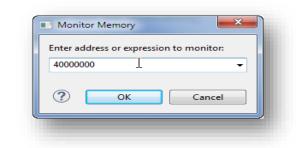


#### **Debug Basics: View & Alter Memory**

Add Memory Monitor



Select Base Address
 to Start at : 40000000



View Memory

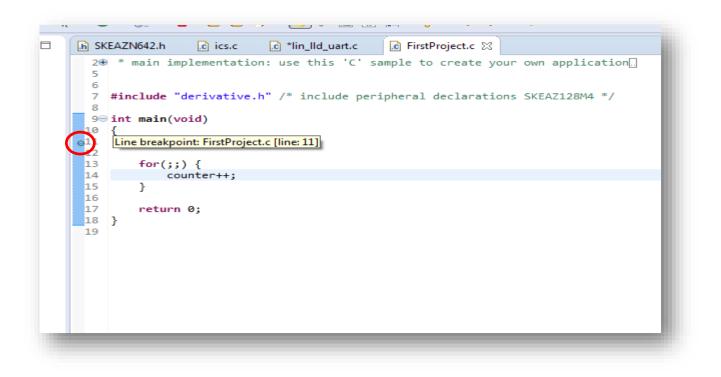
4000000		Address	0 - 3	4 - 7	8 - B	C - F
		02625A00	00000000	00000000	00000000	00000000
		02625A10	00000000	00000000	00000000	00000000
	02625A20	00000000	00000000	00000000	00000000	
		02625A30	00000000	00000000	00000000	00000000
		02625A40	00000000	00000000	00000000	00000000
		02625A50	00000000	00000000	00000000	00000000
	02625A60	00000000	00000000	00000000	00000000	



#### **Debug Basics: Breakpoints**

Add Breakpoint: Point and Click

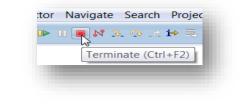
light blue dot represents debugger breakpoint





#### **Debug Basics: Reset & Terminate Debug Session**

- Reset program counter
- Terminate Ctl+F2()





# CREATE A P&E DEBUG CONFIGURATION (OPTIONAL)



#### **New P&E debug configuration**

Click in debug configurations

Edit Source Refactor Navigate Search Project Run Processor Exp	•	
	$\bullet \stackrel{\bullet}{\leftrightarrow} \bullet \bigcirc \bullet \stackrel{\bullet}{\circ} \stackrel{\bullet}{\bullet} \bullet \stackrel{\bullet}{\circ} \stackrel{\bullet}{\bullet} \stackrel{\bullet}{\circ} \stackrel{\bullet}{\bullet} \stackrel{\bullet}{\circ} \bullet \stackrel{\bullet}{\bullet} \stackrel{\bullet}{\bullet} \bullet \stackrel{\bullet}{\bullet} \bullet \stackrel{\bullet}{\bullet} \bullet \bullet$	🖹 📴 C/C++ 🔅 Debug
Project Explorer     Image: Second Seco	<pre>(no launch history) Debug As Peripherals_init()</pre>	
Components - S32K144_SDK_hello ☆ Generator_Configurations RAM Generator_Configurations Constant of the second of the seco	<pre>} /**** End of main routine. DO NOT MODIFY THIS TEXT!!! ***/ /* END main */ @**1 *** @} */ @/* ** This file was created by Processor Expert 10.1 [05.21] *** This file was created by Processor Expert 10.1 [05.21] *** *** *** *** *** *** *** *** *** *</pre>	
	🧝 Problems 🛱 🧔 Tasks 📮 Console 🔲 Properties 🗞 Components Library 📎 Component Inspector - pin_mux 🚑 Remote Systems 🔫 Progress	
	0 errors, 6 warnings, 0 others Description	
	▷ ▲ Warnings (6 items)	
	•	
S32K144_SDK_hello		



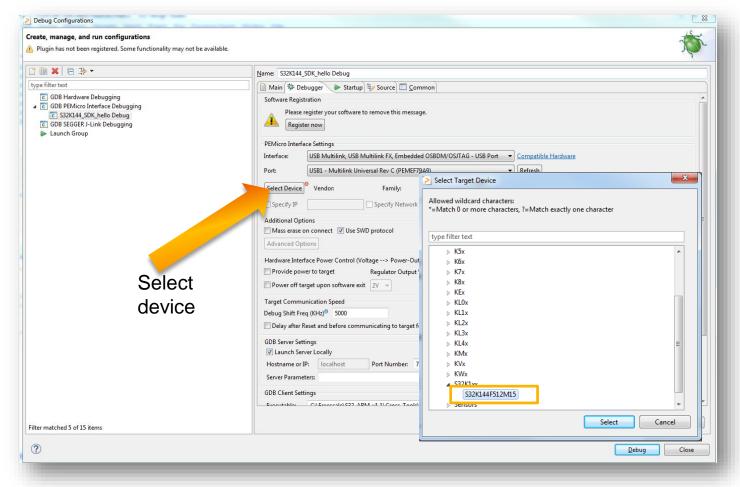
#### **New P&E debug configuration**

	Debug Configurations			
	Create, manage, and run configurations			
		Name: S32K144_SDK_h ug		
	type filter text	📄 Main 🕸 Debugger 🕨 Startup 🧤 Source 🔲 🤇	Common	
	GDB Hardware Debugging	Project:		
	GDB PEMicro Interface Debugging     S32K144_SDK_hello Debug	S32K144_SDK_hello		
ick to create a new	GDB SEGGER J-Link Debugging	C/C++ Application:		
	Launch Group	Debug\S32K144_SDK_hello.elf		
		Build (if required) before launching	Variables Search Project	
unch		Build configuration: Select Automatically		
		Enable auto build	O Disable auto build	
		Use workspace settings	Configure Workspace Settings	
	Filter matched 5 of 15 items		Apply Debug	



#### **New P&E debug configuration**

Select S32K144 device



Click Apply and debug your application



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### SECURE CONNECTIONS FOR A SMARTER WORLD