Programming in C and Interrupts (Code in PSRAM)

SUMMARY

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- 1. Compile the Software using KEIL MDK ARM and generate code.hex file
- 2. Download code.hex onto PSRAM
- 3. Open FPGA project under Vivado and implement the design
- 4. Use Vivado hardware manager to download the .bit file
- 5. Communicate with the board using HyperTerminal (or any other serial terminal)

SOFTWARE COMPILATION

- 1. Open the software project lab/software/code.uvproj
- 2. Right click on Target and press "Build Target"





- 3. Check code.hex get generated inside software folder
- 4. The code binary is now ready to be downloaded onto the board

DOWNLOADING CODE.HEX ONTO ONBOARD PSRAM USING SERIAL COMMUNICATION

- 1. Go to the tools directory and open HyperTerminal.exe
- 2. Set the serial terminal with the following setting

COM19 Properties	? <mark>X</mark>
Port Settings	
Bits per second: 19200	•
Data bits: 8	•
Parity: None	-
Stop bits: 1	•
Flow control: Hardware	•
<u>R</u> estore	e Defaults
OK Cancel	Apply

3. Now click FILE \rightarrow Properties and change the ASCII setting,

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Nav nei Clic	Nexys4 Properties 2 52 Connect To Settings Function, arrow, and ctrl keys act as Terminal keys Windows keys Backspace key sends Backspace key sends Quit+H Del Quit+H, Space, Quit+H 	ASCII Setup
	Emulation: Auto detect Terminal Setup Telnet terminal ID: ANSI Backscroll buffer lines: 500 Play sound when connecting or disconnecting ASCII Setup OK Cancel	Line delay: 0 milliseconds Character delay: 0 milliseconds ASCII Receiving ASCII Receivi
Connected 00:05:17 Auto detect Auto	detect SCROLL CAPS NUM Capture Print echo	

4. Now open a new Vivado window

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5. Open Flow \rightarrow Hardware Manager as show below

0 11000 E01511		Address - Manual Real of State	_ 1
File Flow Tools Window Help			Q _* Search commands
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	Getting Started	Documentation	
	Create New Project New Project Waard will guide you through the of selecting leagn sources and a target device a new project.	process e for Documentation and Tutorials Invaluable for first time users or to try new features.	
	Open one of the most recently used projects on any previously created project.	or User Guide More testaled info on Vivado commanda, daloga, and buttora.	
	Open Example Project Open one of the lutorial projects.	Quick Take Videos We a series of fort videos on various topics from design flows overview to recommended methodology.	
	Manage: IP Open the IP Catalog and view available IP. Create and customize IP to be used in a new y or spen previous quantimed IP to make char or spen previous quantimed IP to make char	roject first and the second se	
	4		
Tcl Console			



6. Click on "Open Recent Target" and choose the connection you established in the previous

lab



7. Right click on the device and choose "Program device"



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Name Image: Image of the second se	/Digile	Status Connected ient/210274533378A (1) Open 0 (n) (active) Brogrammed Hardware Device Properties Ctrl+E Assign Programming File	
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	ø	Refresh Device	
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xc7a100t_0			
Name: Part: ID code: IR length: IR programmable Programming file: General Propertie	x0 x0 13 6 e	xc7a100t_0 xc7a100t 13631093 5	•
Messages	; [Hide All	

- 8. Choose "download_19200.bit" present in the tools directory
- 9. This will load the download program which will transfer binary file into PSRAM
- 10. Open HyperTerminal and you should see below message,

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Nexys4 - HyperTerminal		
<u>File Edit View Call Transfer Help</u>		
		(1)
ram Hit Esc Key after ser Waiting for data to co	nding the data ome via serial port	
Connected 00:07:15 Auto detect 19	9200 8-N-1 SCROLL CAPS NUM Capture Print echo	.đ

11. Send the code.hex file using "Send Text File" wizard in HyperTerminal

The cure view can	Transfer Help			
D 🖻 🛯 🕈 💕	Send File			
	Receive File			
ram _	Capture Text			
Hit Esc Key	Send Text File	data		
warting for	Capture to Printer	al port		
		_ .		

12. Choose code.hex file generated in lab/software directory

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13. At the end of the transfer hit <ESC> key to complete the transfer. You should see the below message



Nexys4 - HyperTerminal	x
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47704800	
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00020026	
00004770	
00000238	
00000238	
00000868	
000000.4	
Reading and displaying first 16 butes from the external memory	
FC FF 0 0 D 1 0 0 0 0 0 0 0 0 0	
Exiting main()	
	=
Connected 00:00:49 Auto detect 19200 8-N-1 SCROLL CAPS NUM Capture Print ecno	đ

14. This complete the binary transfer and loads the PSRAM with code.hex binary data





SYNTHESIZE THE IMPLEMENT THE HARDWARE DESIGN

- 1. Open the Vivado project given in lab/FPGA/Nexys4/Nexys4.xpr
- 2. Analyze the top level of the design AHBLITE_SYS.v
- 3. Implement the design and generate bit stream
- 4. Once the bit stream is generated download the bit stream onto FPGA using hardware

manager

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- 5. Once the hardware is loaded onto FPGA, the CMO in the design starts to execute the program loaded onto PSRAM
- Send characters through the UART terminal and see the LED behavior onboard.
 Below I have sent these characters "Welcome to AUP-XUP Joint Workshop"



Nexys4 - HyperTerminal	J
<u>File Edit View Call Iransfer H</u> elp	
C5C0C5C0 C5C0C5C0 C5C0C5C0 C5C0C5C0 00493040 4770468D 46C04604 462046C0 FF77F7FF 47704800 00000238 20184901 E7FEBEAB 00000238 00000238 00000238 00000024 Reading and displaying first 16 bytes from the external memory FC FF 0 0 D 1 0 0 0 0 0 0 0 0 0 - Exiting main() Welcome to AUP-XUP Joint Workship!	
	1
Connected 00:06:35 Auto detect 19200 8-N-1 SCROLL CAPS NUM Capture Print echo	

7. If everything is working fine you should see something like below,



LEDs change pattern when you send UART Characters.

SLEEPING SIGNAL

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