

Teaching online electronics, microcontrollers and programming in Higher Education

Programing of embedded systems

1. Introduction

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1. Introduction

Declaration

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1. Introduction

I. LPC804 features

1. The LPC804 are an Arm Cortex-M0+ based, low-cost 32-bit MCU family operating at CPU frequencies of up to 15 MHz. The LPC804 supports 32 KB of flash memory and 4 KB of SRAM. The peripheral complement of the LPC804 includes a CRC engine, two I2C-bus interfaces, up to two USARTs, one SPI interface, Capacitive Touch Interface (Cap Touch), one multi-rate timer, self-wake-up timer, one general purpose 32-bit counter/timer, one 12-bit ADC, one 10-bit DAC, one analog comparator, function-configurable I/O ports through a switch matrix, an input pattern match engine, Programmable Logic Unit (PLU), and up to 30 general-purpose I/O pins [1].



Source: NXP

2. Development board and Shields:







Source: NXP

1. Introduction

II. MCUXpresso Integrated Development Environment (IDE)

1. Go to the website: <u>https://www.nxp.com/design/software/development-software/mcuxpresso-software-and-tools-/mcuxpresso-integrated-development-environment-ide:MCUXpresso-IDE</u>, register and download the MCUXpresso IDE installer. The installer is available for Windows, MacOS and Linux:

Product Download

MOUV presses IDE

		O Download Help
		3 Files
🗘 File Size 🌲	File Name	\$
928.6 MB	mcuxpressoide-11.4.1_6260.x86_64.deb.bin	
885.1 MB	MCUXpressoIDE_11.4.1_6260.pkg	
833.3 MB	MCUXpressoIDE_11.4.1_6260.exe	
	File Size ↓ 928.6 MB 885.1 MB 833.3 MB	File Size File Name 928.6 MB <u>↓</u> mcuxpressoide-11.4.1_6260.x86_64.deb.bin 885.1 MB <u>↓</u> MCUXpressoIDE_11.4.1_6260.pkg 833.3 MB <u>↓</u> MCUXpressoIDE_11.4.1_6260.exe

2. Install MCUXpresso environment on your computer:



3. Then go to the website: https://mcuxpresso.nxp.com/en/welcome



4. Click *Select Development Board* and then select the prototype board with the LPC804 microcontroller, and then click *Build MCUXPresso SDK* (actual version):

MCUXpresso	SDK Builder	· · · · · · · · · · · · · · · · · · ·	•		
SDK Dashboard	Select Development Board Search for your board or kit to get started.	Selection Details			
Select Board / Processor Middleware (0) Sector Examples (0)	Search for Hardware	LPCXpresso804			
Y Toolchain (Off)	8	Q. LPCXpresso Development Board for LF	PC804		
(Off)	Select a Board, Kit, or Processor				
Notifications	LPCXpresso55S06 (LPC55S06)	Build WCOApresso SDK V2: 10:0 * Additional Details			
Preferences	LPCXpresso55S16 (LPC55S16)	Matched Hardware Platforms			
INLOADS	LPCXpresso55S28 (LPC55S28)	Found (593) HW solutions that match your criteria.			
MCUXpresso IDE	LPCXpresso55S69 (LPC55S69)	(Boards: 121), Kits: 77), Processors: (395))			
MCUXpresso	LPCXpresso802 (LPC802)				
Config Tools	LPCXpresso804 (LPC804)	Filtering Criteria - Reset all			
Offline data	LPCXpresso812MAX (LPC812)	Regulared Middleware			
ICUXpresso Secure Provisioning Tool	LPCXpresso824MAX (LPC824)	Middleware filtering not applied	Middleware filtering not applied		
locale rionauring toor	LPCXpresso845MAX (LPC845)	Required Example Projects			
	► MW	Example Project filtering not applied			
	→ QN	Required Toolchains			
	▶ dsc	Toolchains filtering not applied			
	► LMX	Processor Deservation Planates			
	 Kits 	Processor Parametric Filtering not applied			
	 Processors 				
	 Deprecated 				

5. Select the operating system you are using and select *Toolchain / IDE: MCUXpresso. Select All* available components:

NXP MCUXpresso S	SDK Builde	er			0 • E + 1
SDK Dashboard BUILD SDK Select Board / Processor III Middeware (0) C Examples (0) C Toolchain (Off) III Processor Parametrics	Build Generate Developer Selections he	A downloadable SDK archive for use with des Environment Sattinge we will impact files and examples projects included in the SDK Host OS	ktop MCUXpresso Tools. K and Generated Projects Toolchain / ID	e 🔝 🎯 🕑 orm 🖊	SDK Version: 2.10.0 (released 2021-07-15)
(Off) ADMINISTRATION	Filter by N	Name, Category, or Description		Select All	Unselect All
Preferences		Name CMSIS DSP Library	Category CMSIS DSP Lib	Description CMSIS DSP Software Library	Dependencies
MCUXpresso IDE				Download SDK	
Config Tools Coffline data					«
MCUXpresso Secure Provisioning Tool					

- 6. After a while, the ready SDK will appear in your Dashboard. Click *Download SDK* and in the next window select *Download SDK Archive*:
- 7. Open *MCUXpresso IDE* and move (Drag and Drop) Archive SDK to *Installed SDKs* tab:

<pre>Class 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</pre>			
Control Control Control <th>🖆 • 🖩 🕲 • 💁 🕼 🖉 🖓 🔛 🖉 🖉 🖉 👘 🖷 🖉</th> <th>: 🗅 🛈 🖷 3. 🗢 3. (건 🔞 🛛 🖉 🎜 🖉 👗 🕸 💺 🕸 4 • 0 • 9. • 🖗 🖉 🖉 🗇 1 🕅 1 🔛 - 취 • 1 🐨 4 • • • - 📷</th> <th>🔍 🔡 🔀 🗰 🗤 🕴 🗘</th>	🖆 • 🖩 🕲 • 💁 🕼 🖉 🖓 🔛 🖉 🖉 🖉 👘 🖷 🖉	: 🗅 🛈 🖷 3. 🗢 3. (건 🔞 🛛 🖉 🎜 🖉 👗 🕸 💺 🕸 4 • 0 • 9. • 🖗 🖉 🖉 🗇 1 🕅 1 🔛 - 취 • 1 🐨 4 • • • - 📷	🔍 🔡 🔀 🗰 🗤 🕴 🗘
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8. Go to Import SDK examples (picture above) and select Ipcxpresso804:



9. Select demo_apps and then *led_blinky*. Click Finish:

• 0 •	SDK Import Wizard					SDK Import Wizard			
A The source from the SDK will be copied into the workspace. If you want to use link	ed files, please unzip the 'SDK_2 x_LPCXpresso804' SDK.	NP						N	P 👝
Import projects			Advanced Settin	gs					
Project name prefix: pcxpresso804	Project name suffix:		* C/C++ Library Settings						
Use default location			Set library type (and hosti	ng varient) Declib (sobset	ef)				
Location: /Jsers/danie//Documents/MCUXpressolDE_11.4.1_6260/workspace_LPC	804,Fpcspresso804	Browse	~~~~						
Project Type	Project Options		Redit: Use heating poin	t version of print! ther than string based printf		Net Net	viloNano: Use floating (viloNano: Use floating)	ioint version of print? ioint version of scarf	
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0	< Back Next >	Cancel Finish	0				< Back	Next> Cancel	Firish

1. Introduction

10. Build the project by clicking *Build*:



11. Connect the *LPCXpresso804* board with the USB interface labeled *Emulator* to the computer:



12. Program the microcontroller by pressing GUI Flash Tool:



13. Leaving the default settings in the following programmer windows and click Run:

• • •	Probes discovered		• • •	GUI Flash Tool	
Connect to target: LPC804 1 probe found. Select the probe to use:	:		GUI Flash Tool for MCUXpresso IDE L Program file into f	: .inkServer (inc. CMSIS–DAP) probes flash: lpcxpresso804_led_blinky.axf	
Available attached probes			Million.		
Name	Serial number / ID / Nickna Type	Manufacturer	Target: LPC804		
LS LPC11U3x CMSIS-DAP v1.0.4	02014020 LinkSe	rver NXP Semiconductors	Probe Options		
			Probe specific options		
			Connect script		Workspace File System
			Default Flash Driver		Workspace File System
			Reset Handling	Default	8
Commente d Dankara (tink (untink to another)	disables.		Flash Reset Handling	Default	0
MCUXpresso IDE LinkServer (inc. CMS	disable) SIS-DAP) probes		Boot ROM Stall		
P&E Micro probes SEGGER J-Link probes			Wire Speed		
			Reset the target on connection	Disable use of preconnect script	
Probe search options			Target Operations		
Rearch again			Select the target flash operation to p	perform	
Search again			Program Erase		
			Actions		
(?)	Canor	el OK	Select the action to perform		
			Program	 Program (mass erase first) 	
			O Verify only	Check file areas blank	
			Options		
			Select the options to apply		
			File to program	pace_loc)/lpcxpresso804_led_blinky/Debug/lpcxpresso804_led_blinky.ax	Workspace File System
			Format to use for programming	o axf ⊖ bin	
			Base address		
			Reset target on completion		
			General Options		
			Flash programming tool options		
			Additional options		
			Repeat on completion Enabl	le flash hashing UPreview command	
			Ciear console		
					Cancel Run

14. The LED on the evaluation board should flash.

15. Start Debug mode:

• • •	e workspace_LPC804 - Ipcxpresso804_led_blinky/source/led_blinky.c - MCUXpresso IDE		
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🖕 Project Explorer 🐹 🐰 Registers 🎋 Faults 🧏 Peripherals+ 👘 🗇	🖻 led_blinky.c 😫 🔤	Se Outline 💱 👀 Global Variables	□ 北 マ 🕯 • ₩ 🕴 🗆 !
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 Build your project 	🕅 Installed SDKs 🔲 Properties 🕑 Problems 🗈 Console 😒 📾 Image Info 🐼 Debugger Console 😓 Offline Peripherals 👘 🗖 🚺 Memory 😒 🕬 Head	p and Stack Usage	📑 🛃 💷 🕵 💷 8 📼
Clean	CDT Build Console (Ipczpresso804_Jed_blinky)	K %	
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D Export project(s) to archive (zip)			

16. By pressing Step Over (F6) you can execute the program in steps. Pressing *Instruction Stepping Mode* opens the *Disassembly* window where you can see the generated assembly instructions. Go to the *Peripherals* tab and find the GPIO and then the B0_13 registry:

mare Name	Faults 🔀 Peripherals+ S	3 🧠 🤹 🔫	2. (1) (1) (1) (1) (1) (1) (1) (1) (1) (1)		Q 🛛 😰 🔜 🗤 🕴 🔿 🖩
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Debug your project Sebug Terminate, Build and Debu Miscellaneous Miscellaneous Did project settings Multikaps> Quick Settings> Discret project(s) to archive (rb)	a 	15 • 🔛 • 🔛			

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- 17. Check how the value of the B0_13 register changes when the LED is on and off.
- 18. You can change value of B0_13 register directly in *Peripherals* tab, by write 0 or 1.

III. Exercises

1. Check the operation of other *Debugger* functions in the *Run* menu:

Run	RTOS	Analysis	Window	Help
∎► Re	esume			F8
Su	spend			
📕 Te	rminate		H	GF2
💦 Di	sconnect	t		
🜏 St	ep Into			F5
🔁 St	ep Over			F6
_n St	ep Retur	n		F7
⇒] Rı	in to Line	÷	Я	8 R
T	se Step F	ilters		
Step I	nto Seleo	ction	æ	\$ F5

2. Check out the other examples provided with the SDK.

References

- 1. LPC804 Data Sheet, https://www.nxp.com/
- 2. LPC804 User manual, https://www.nxp.com/
- 3. User Manual for LPCXpresso804 Board, https://www.nxp.com/