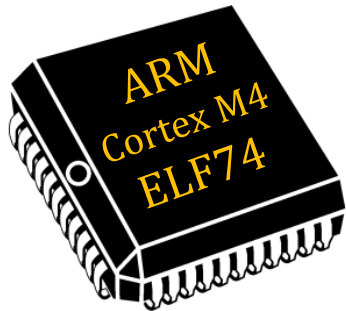


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- Projeto

Sistemas Embarcados: (ELF74)

Prof: DaLuz



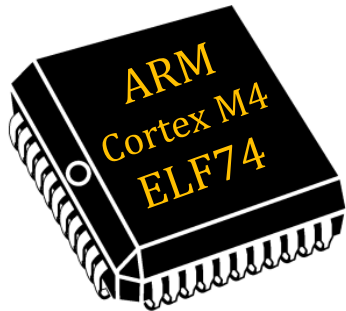
Keil MDK-ARM



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- 📖 Ambiente de desenvolvimento de *software* completo para as famílias **Cortex-M**.
- 📖 *Disponível apenas para Windows.*
- 📖 Grátis até **32 kB** de código.

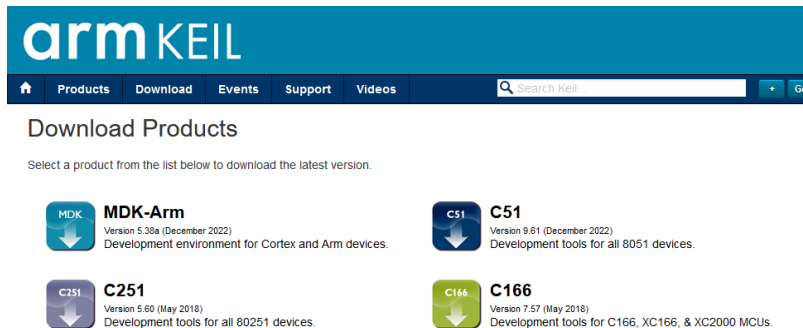




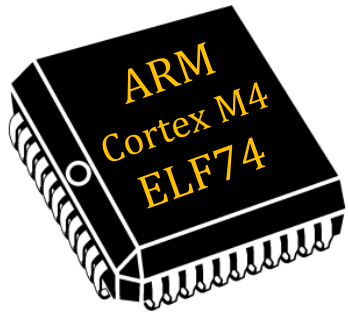
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Keil MDK-ARM

IDE: KEIL – MDK-Arm



<https://www.keil.com/download/product/>



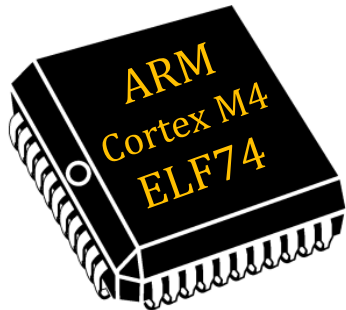
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📖 Entrar no **site** e clicar na seção:



MDK-Arm

<https://www.keil.com/download/product/>



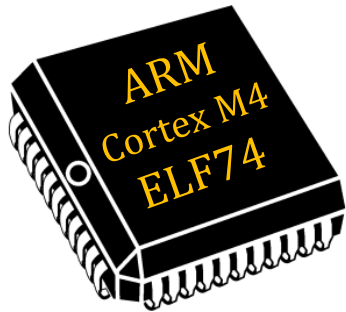
Keil MDK-ARM

- ☐ Preencher seus **dados de contato** em todos os campos do formulário.
- ☐ Este procedimento **não custa** nada.
- ☐ Lembrando que este ambiente é **pago** para códigos maiores que **32 KB**.



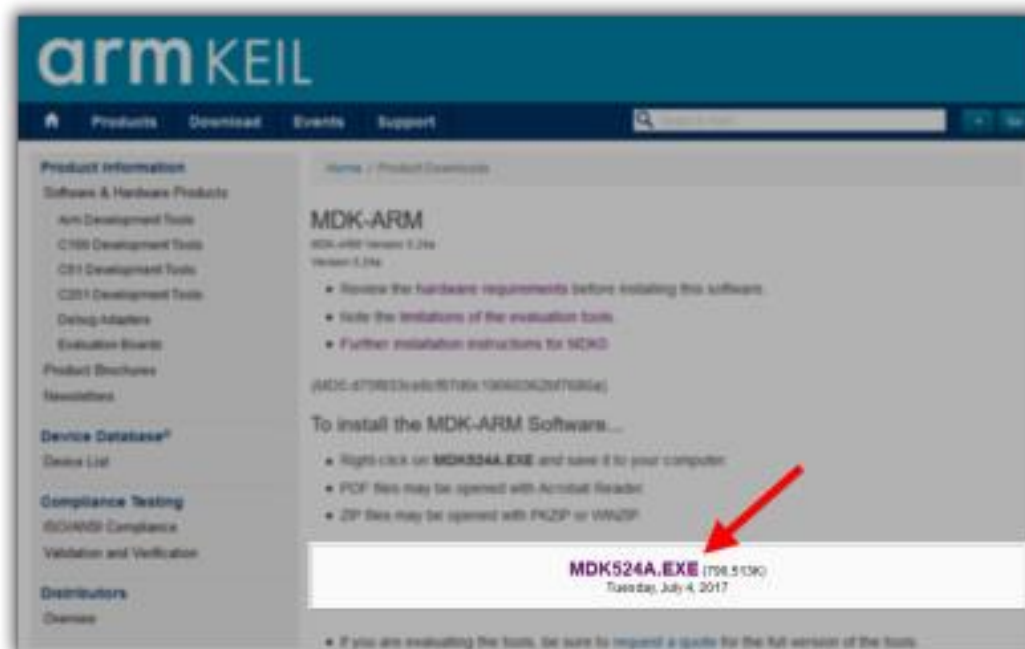
- Keil
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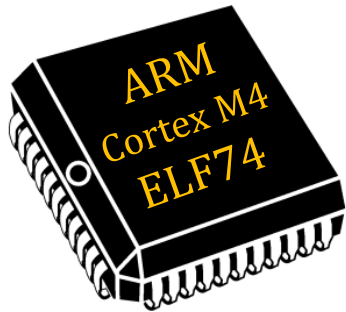
The screenshot shows the ARM KEIL website's download page for MDK-ARM. The page has a blue header with the 'armKEIL' logo and navigation links: Home, Products, Download, Events, Support. A search bar is also present. The main content area is titled 'MDK-ARM' and 'MDK-ARM Version 5.24a'. It instructs users to 'Complete the following form to download the Keil software development tools.' Below this is a section titled 'Enter Your Contact Information Below' with a form containing the following fields: First Name, Last Name, E-mail, Company, Address (multiple lines), City, State/Province (dropdown menu), Zip/Postal Code, Country (dropdown menu), and Phone. There is a checkbox for 'Send me e-mail when there is a new update.' with a 'NOTICE' text below it. At the bottom, there is a field for 'Which device are you using? (eg. STM32)'.



Keil MDK-ARM

- 📖 Clicar no botão ***“submit”*** na parte inferior da página. Aparecerá um *link* para realizar o ***download*** do **MDKxxx.EXE**.



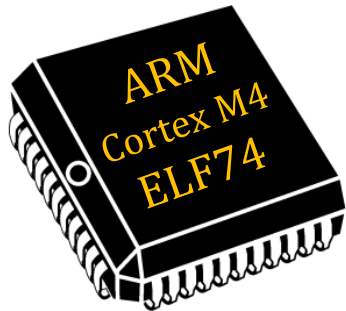


Keil MDK-ARM

- ❏ Executar o arquivo de *download*. Seguir as instruções para instalar o MDK-Core no computador. A instalação irá adicionar os pacotes de *software* para **ARM CMSIS**, compilador **ARM** e o *Middleware* **MDK-Professional**.
- ❏ Quando encerrada a instalação, pode-se ativar uma licença ou pular este passo para utilizar a versão grátis (*lite*) de até **32 KB** de código.



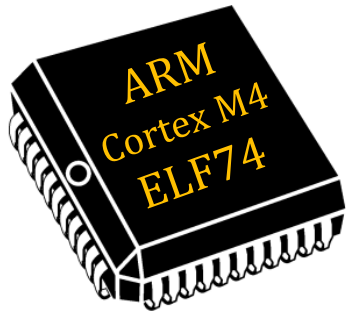
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Keil MDK-ARM

- Para versões do MDK superiores a **5.29**, foi removido o **Stellaris** como opção para fazer o **debug**. Assim, é necessária a instalação do **Add-on**;
- Baixar o arquivo disponível no site da disciplina na área de **“Recursos”** e executá-lo.


http://www.elf52.daeln.com.br/Recursos/MDK_Stellaris_ICDI_AddOn.exe

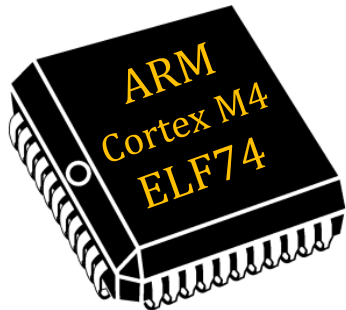


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- Depois da instalação do **MDK Core**, o **Pack Installer** é iniciado automaticamente, que permite adicionar pacotes de *software* complementares.
- O **Pack Installer** pode ser iniciado por meio do IDE Keil MDK-ARM clicando no botão **Pack Installer**.
- Ícone: 



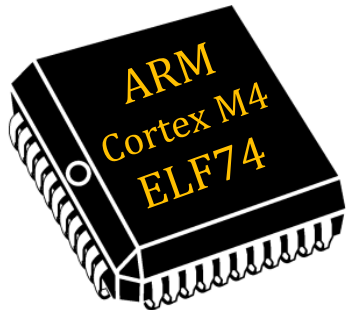
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📖 No Tab **Devices**, expandir o **Texas Instruments** e selecionar **Tiva C Series**. Depois instalar os pacotes de família de dispositivos (DFP) na aba **Packs**. Instalar os seguintes pacotes:

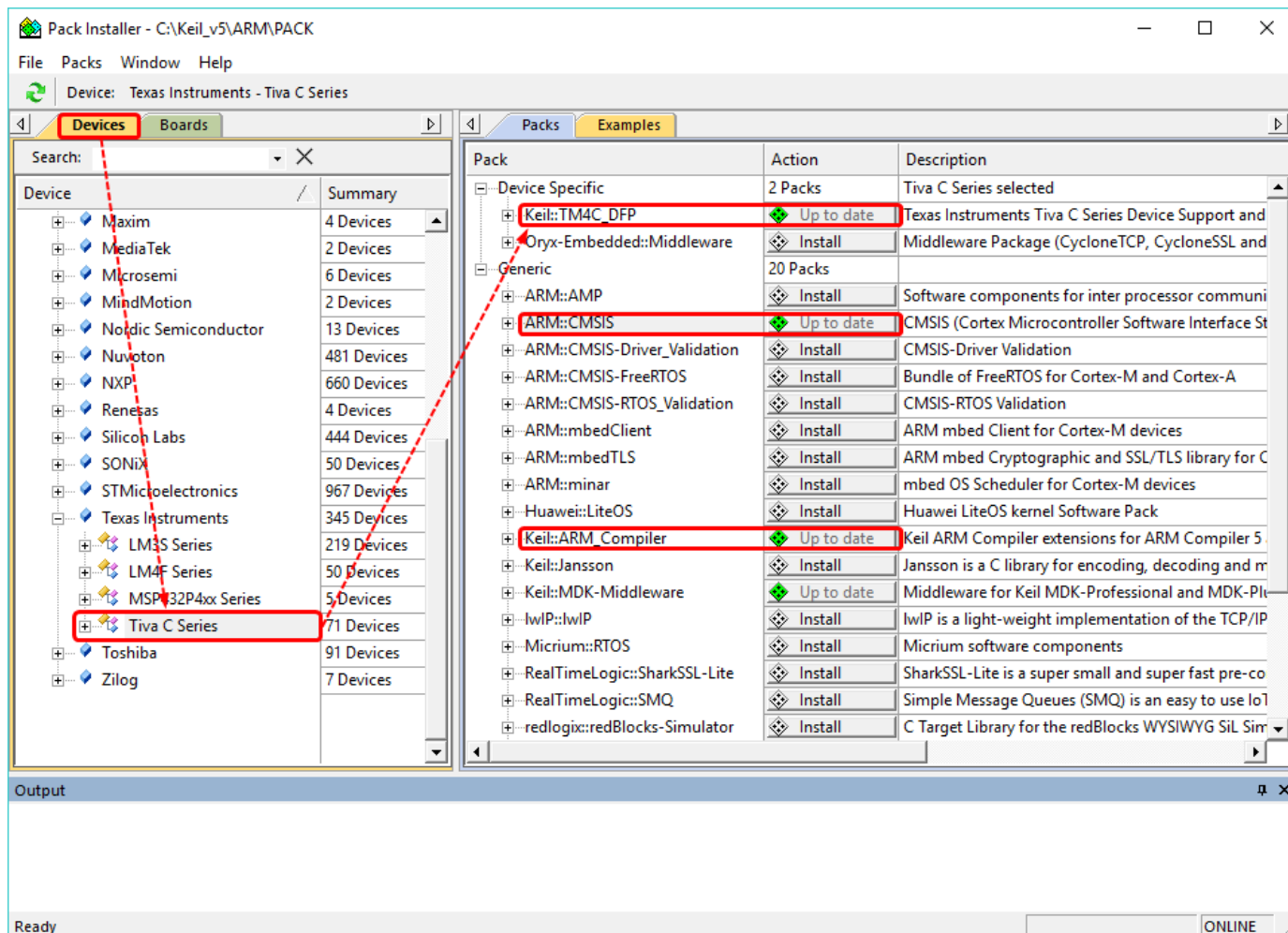
- 📖 Device Specific ➤ **Keil::TM4C_DFP**
- 📖 Generic ➤ **ARM::CMSIS**
- 📖 Generic ➤ **Keil::ARM_Compiler**

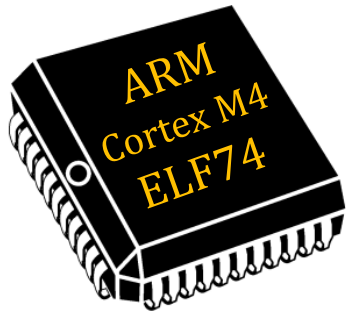


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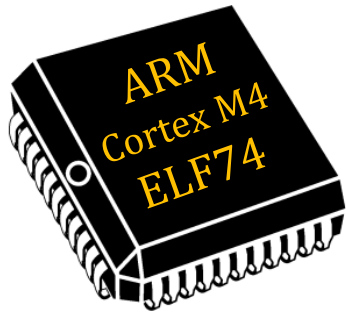
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- ❏ Cada placa **Tiva** tem uma interface de depuração, chamada **In-Circuit Debug Interface** (ICDI) que permite programar e depurar o microcontrolador. Para controlar esta interface, os **drivers** devem ser instalados.
- ❏ Baixar o arquivo disponível no site da disciplina na área de “**Recursos**” e executá-lo.

http://www.elf52.daeln.com.br/Recursos/Stellaris_ICDI_Drivers.zip



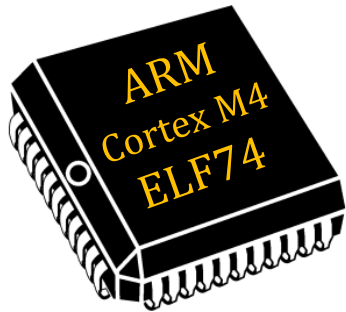
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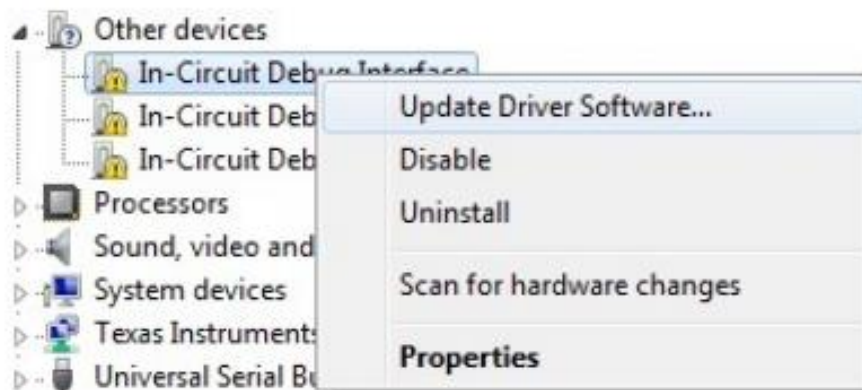
- ❏ Conectar a placa na interface **USB** do PC.
- ❏ Executar o **Gerenciador de Dispositivos** no **Painel de Controle** do Windows.
- ❏ Verificar na seção Outros Dispositivos há alguns dispositivos que necessita de **drivers**.



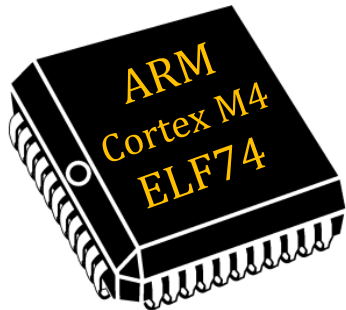


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- ❏ Clicar com o direito em uma das entradas e selecionar **Atualizar Driver**:



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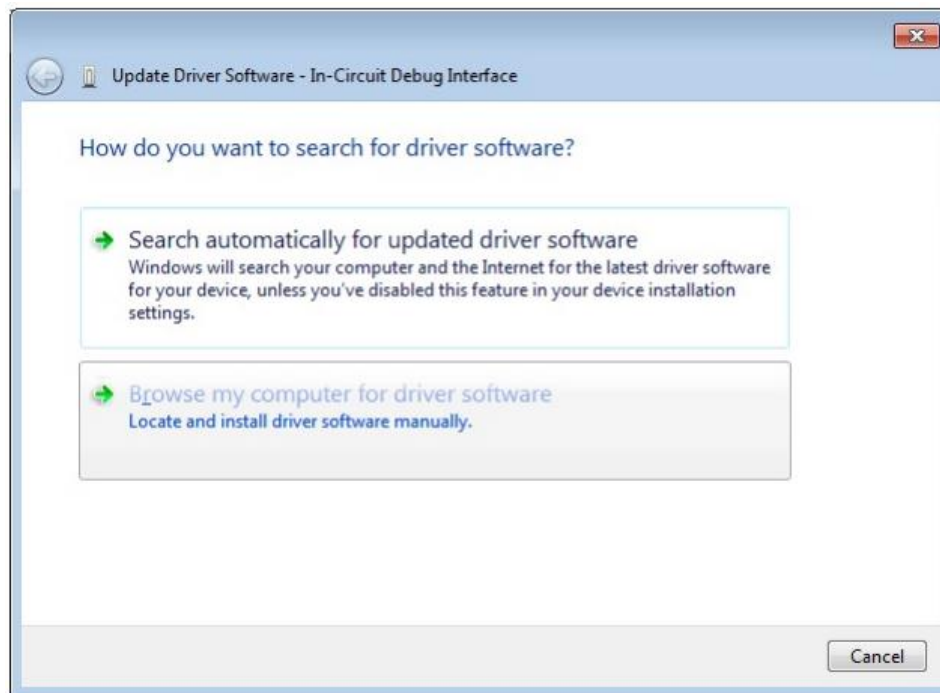


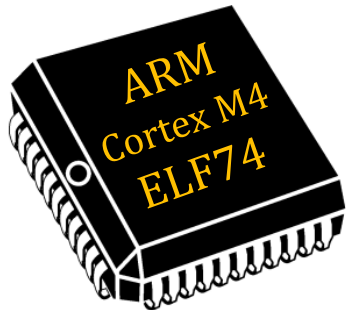
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- Uma janela irá aparecer perguntando se deseja procurar automaticamente ou procurar no computador. Selecione: **procurar no computador**



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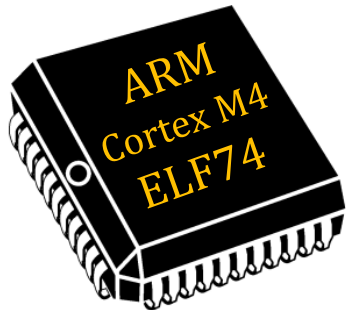
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- Escolher a pasta temporária onde **descompactou** os **drivers** e clique em Avançar.



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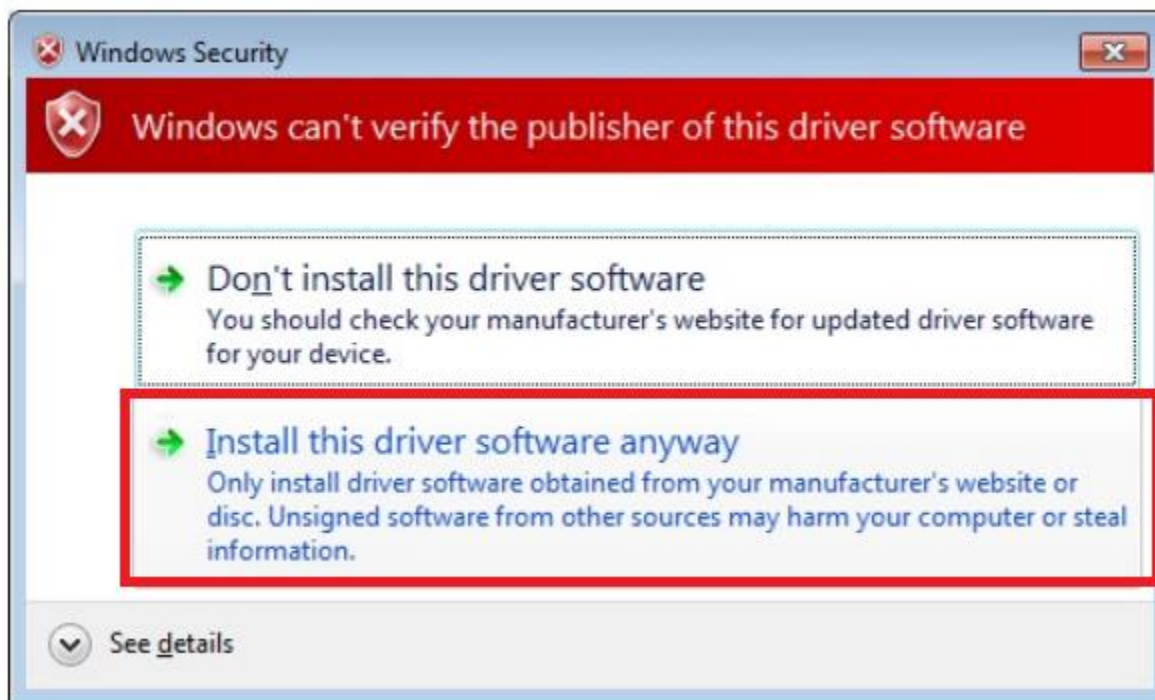


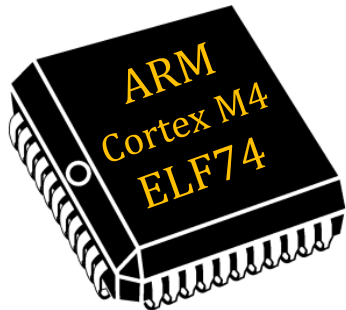
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- ❏ Pode aparecer uma janela avisando que o Windows não pode verificar o *software* instalado. Clicar em Instalar o **driver**.



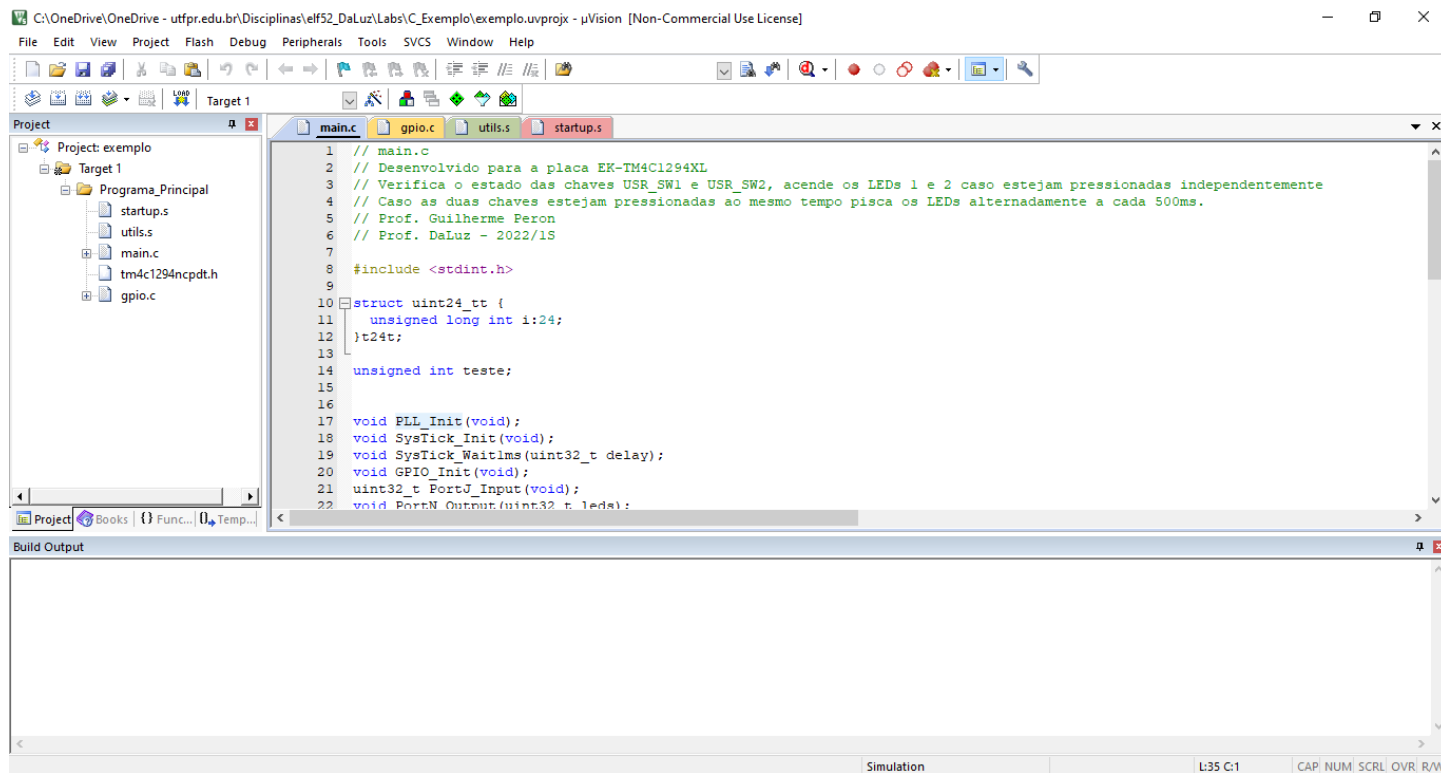
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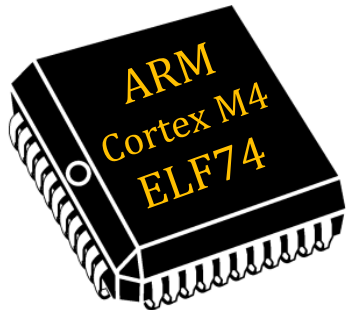




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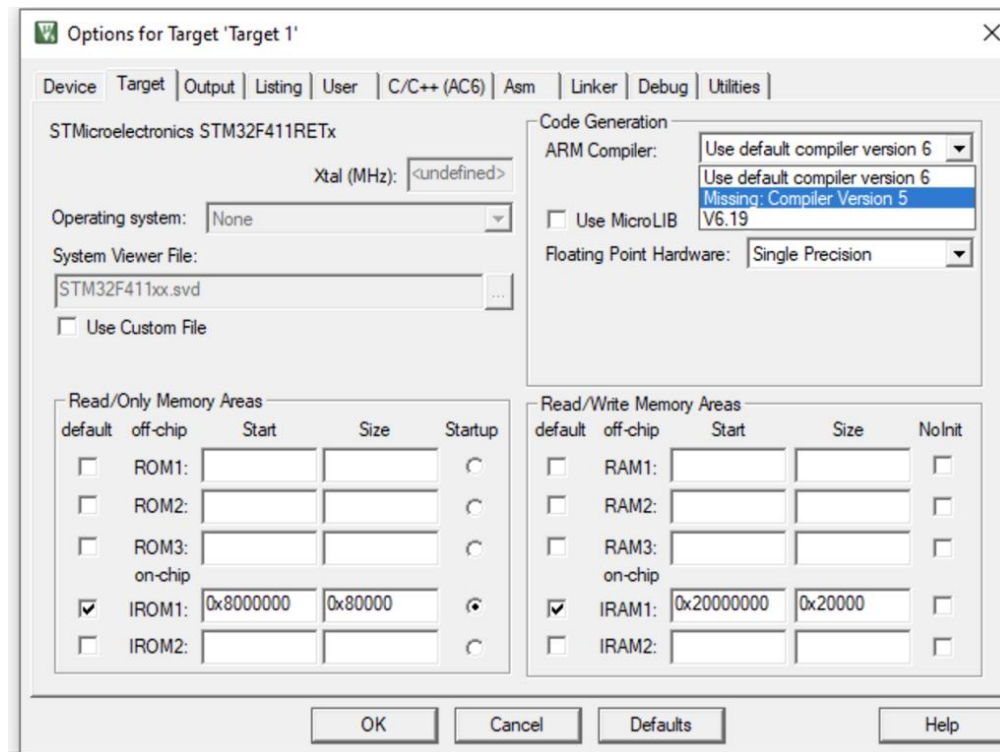
Depois do **driver** ser instalado, as vezes é necessário repetir o último processo para os outros **drivers**.

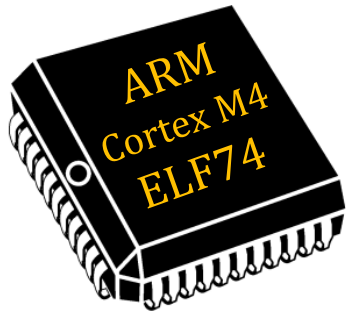




Keil Compiler V5

- Também temos que instalar o **Compiler V5** de forma manual.



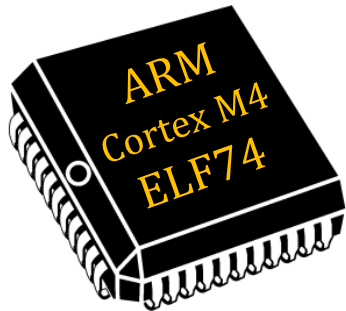


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📖 Também temos que instalar o **Compiler V5** de forma manual.

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	Arm Compiler 6.9	ACOMPE	r6p9-00rel0 25 Oct 2017
	Arm Compiler 5.06 update 7 (build 960)	ACOMP5	r5p6-07rel1 14 Sep 2020
	Arm Compiler 5.06 update 6 (build 750)	ACOMP5	r5p6-06rel1 28 Sep 2017
	Arm Compiler 5.06 update 5 (build 528)	ACOMP5	r5p6-05rel1 3 Feb 2017
	Arm Compiler 5.06 update 4 (build 422)	ACOMP5	r5p6-04rel1 30 Sep 2016

<https://developer.arm.com/downloads/view/ACOMP5>



Keil Compiler V5

Após executar o **LogIN** no site (**WIN32**/LIN32):

arm Developer

Developing on Arm ▾ Architecture and Processors ▾ Tools and Software ▾

Releases

Sort releases by:

☒ Available date ☐ Revision

Select Revision to Download

r5p6-07rel1 ▾

Release Name: ACOMP5-r5p6-07rel1
Release Quality: REL
Available Date: 25 de jan. de 2021

Arm Compiler 5.06 update 7 (build 960) Lin32

Name: DS500-PA-00003-r5p0-26rel0
Filename: ARMCompiler_506_Linux_x86_b960.tar.gz
MD5: fd5943a097e272aef23491600c222981

97.9 MB

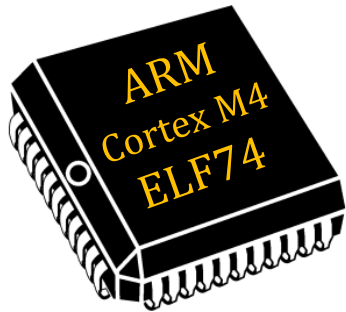
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Arm Compiler 5.06 update 7 (build 960) Win32

Name: DS500-PA-00002-r5p0-26rel0
Filename: ARMCompiler_506_Windows_x86_b960.zip
MD5: 56a3c52585e7ce4d95fc75ae6ff6b9df

80.9 MB

+ Add to queue Download Now



Keil Compiler V5

- Após o Download ver esses dois vídeos: (criar a pasta destino dentro da pasta de instalação do Keil)

https://youtu.be/_EYGFfCI93Y?si=CtqHbSdbUOZ8KW9S

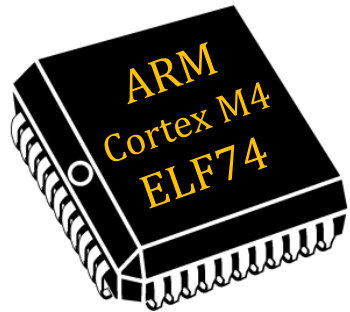
<https://youtu.be/Gh8mqKIYOW4?si=kMclJ3bjqj8ePji9>

- Seguir estes passos em caso ainda tenha problemas:

<https://developer.arm.com/documentation/101407/0538/Creating-Applications/Tips-and-Tricks/Manage-Arm-Compiler-Versions>



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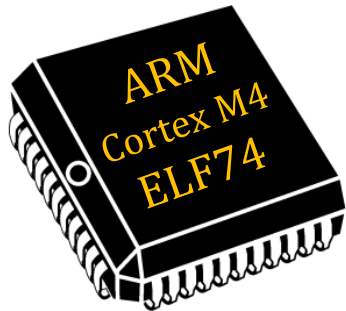
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TivaWare SDK

TivaWare™ for C Series

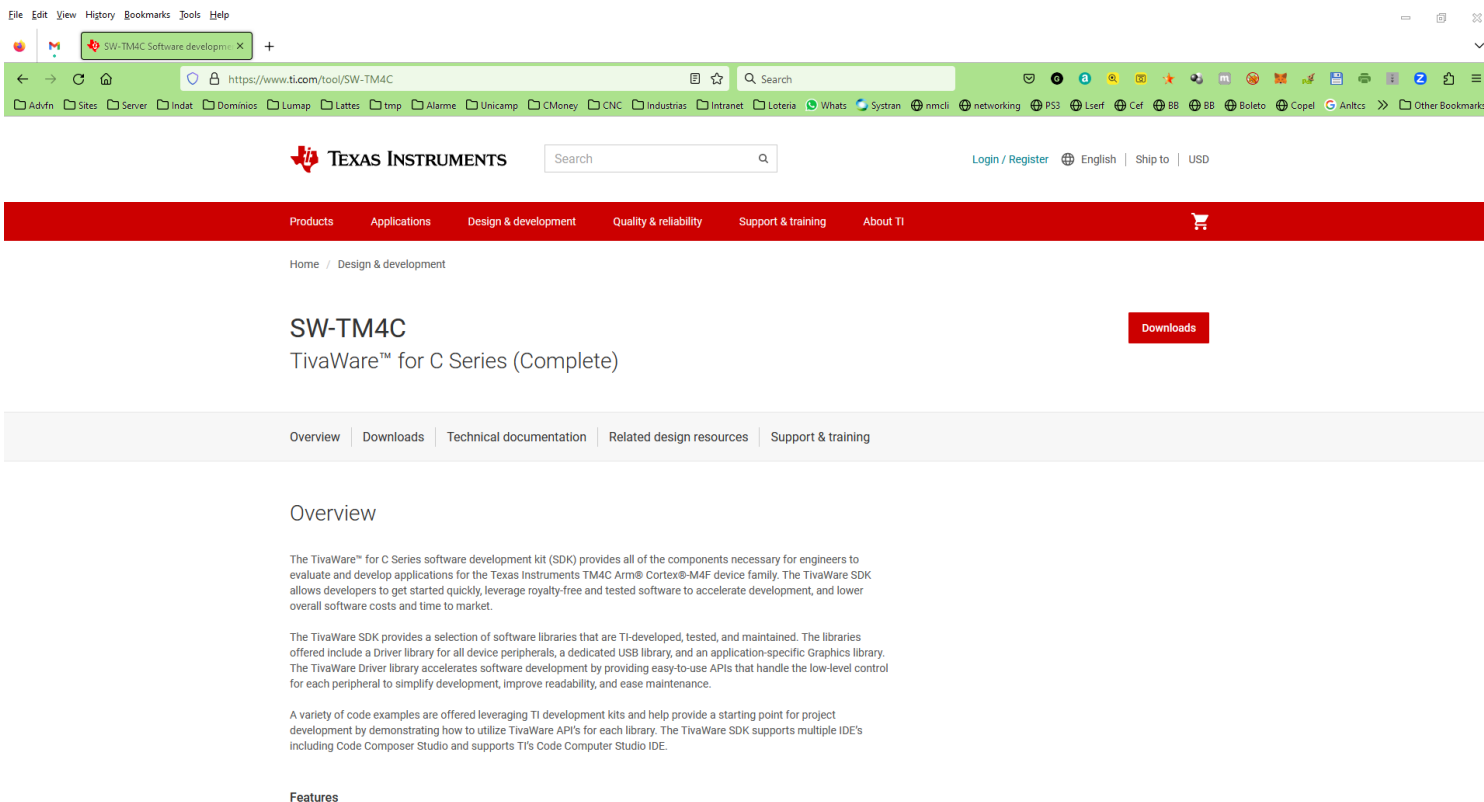


<https://www.ti.com/tool/SW-TM4C>



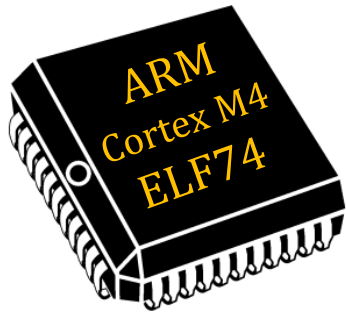
TivaWare SDK

 Acessar o site e clicar em **Download**.



The screenshot shows the Texas Instruments website. The browser address bar displays <https://www.ti.com/tool/SW-TM4C>. The page title is "SW-TM4C TivaWare™ for C Series (Complete)". A red "Downloads" button is visible. The page content includes an "Overview" section with text describing the TivaWare™ for C Series software development kit (SDK) and its features.

<https://www.ti.com/tool/SW-TM4C#downloads>



TivaWare SDK

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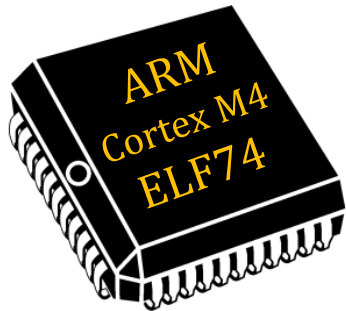
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User guide	TivaWare™ Sensor Library for C Series User's Guide (Rev. E)	14 May 2020
User guide	TivaWare™ USB Library for C Series User's Guide (Rev. E)	14 May 2020
User guide	TivaWare™ Graphics Library for C Series User's Guide (Rev. E)	14 May 2020



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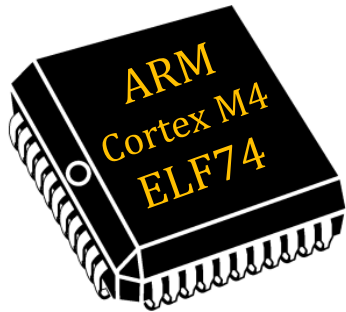
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Type	Title	Date
All	Filter title by keyword	
User guide	Getting Started with TivaWare™ for C Series (Rev. A)	25 Aug 2022
User guide	TivaWare™ Sensor Library for C Series User's Guide (Rev. E)	14 May 2020
User guide	TivaWare™ USB Library for C Series User's Guide (Rev. E)	14 May 2020
User guide	TivaWare™ Graphics Library for C Series User's Guide (Rev. E)	14 May 2020



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TivaWare SDK



Agora Selecionar:



SW-TM4C-2.2.0.295.exe – 145877 K

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https://www.ti.com/tool/SW-TM4C#downloads

SW-TM4C

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SW-TM4C — TivaWare for C Series Software (Complete)

Latest version Version: 2.2.0.295 Release date: 22 Apr 2020

Release notes View all versions Browse

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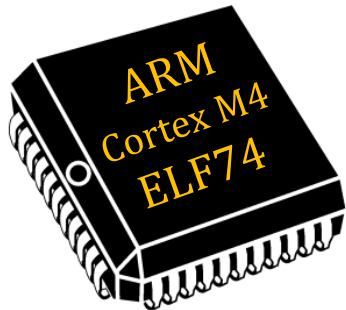
SW-TM4C-2.2.0.295.exe – 145877 K	TivaWare for TM4C Series MD5 checksum 119027d0b6f6041e8b7aff9962a48221
SW-EK-TM4C123GXL-2.2.0.295.exe – 29855 K	EK-TM4C123GXL Kit Software MD5 checksum 9dead6606e7457274bb3f4528b7ea53a
SW-EK-TM4C1294XL-2.2.0.295.exe – 76363 K	EK-TM4C1294XL Kit Software MD5 checksum 630832652fc423a4af613ff625204ab6
SW-EK-TM4C129EXL-2.2.0.295.exe – 75111 K	EK-TM4C129EXL Kit Software MD5 checksum 2516c1c4f1f1446a4142864135



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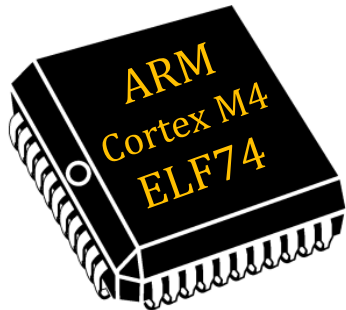
TivaWare SDK

- Após logar com sua conta **TI** e terminar o **download**:



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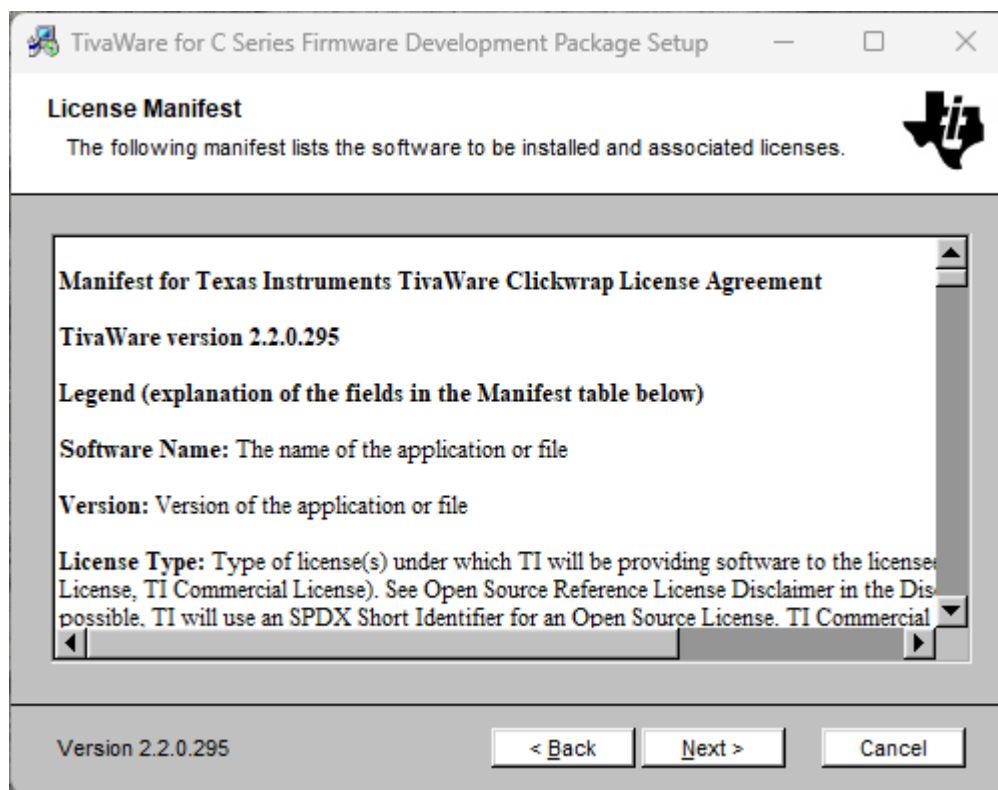


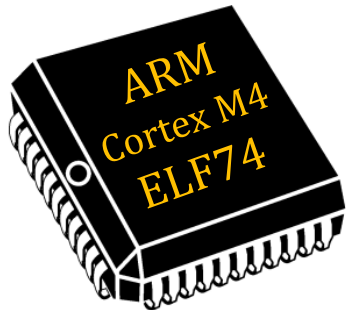
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■ Telas de Instalação ...



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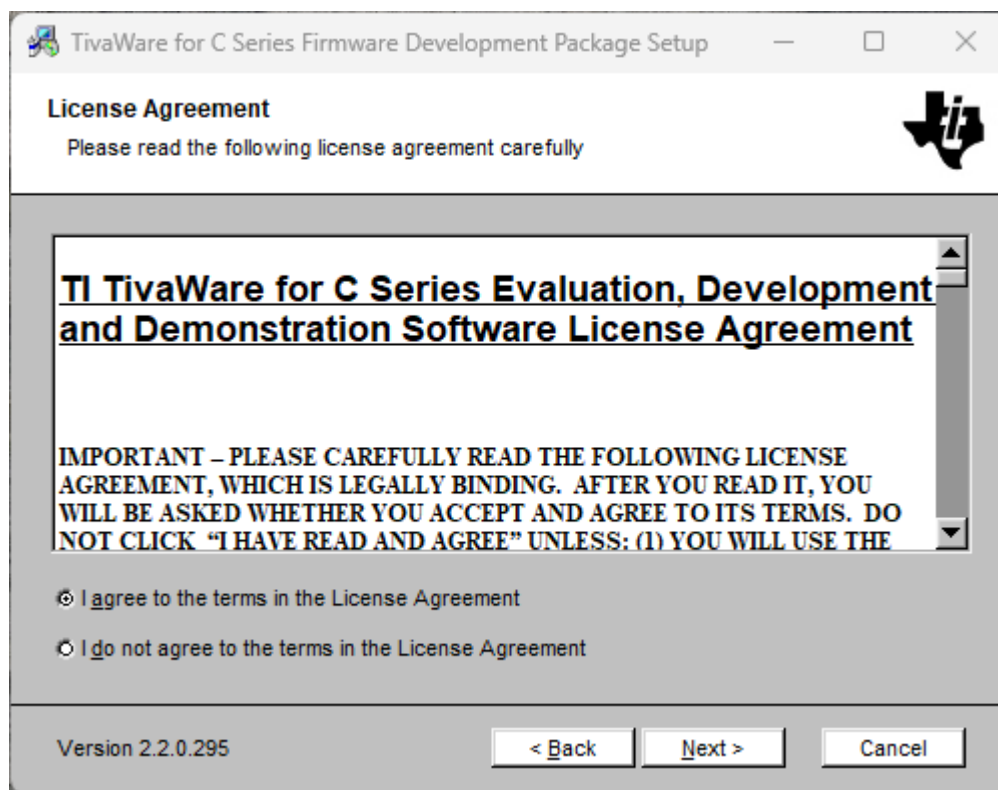


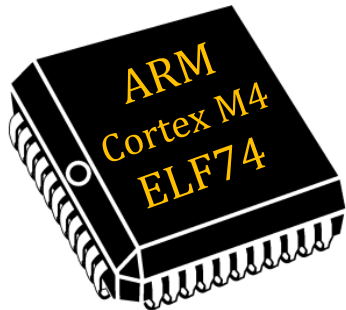
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■ Telas de Instalação ...



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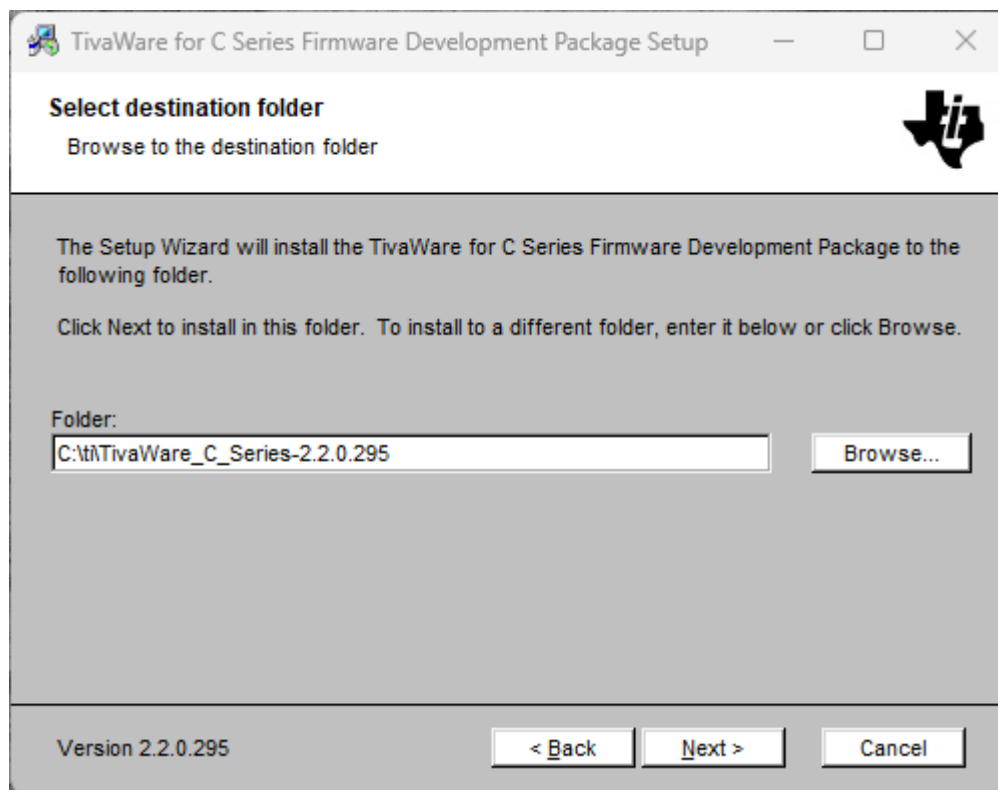


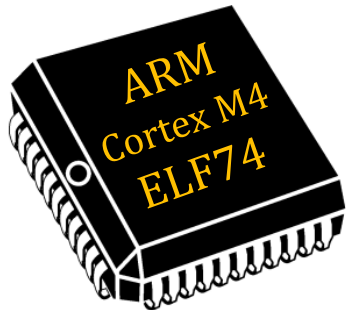
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📖 Telas de Instalação ... (Pasta da disciplina ex.: **..\ELF74**)



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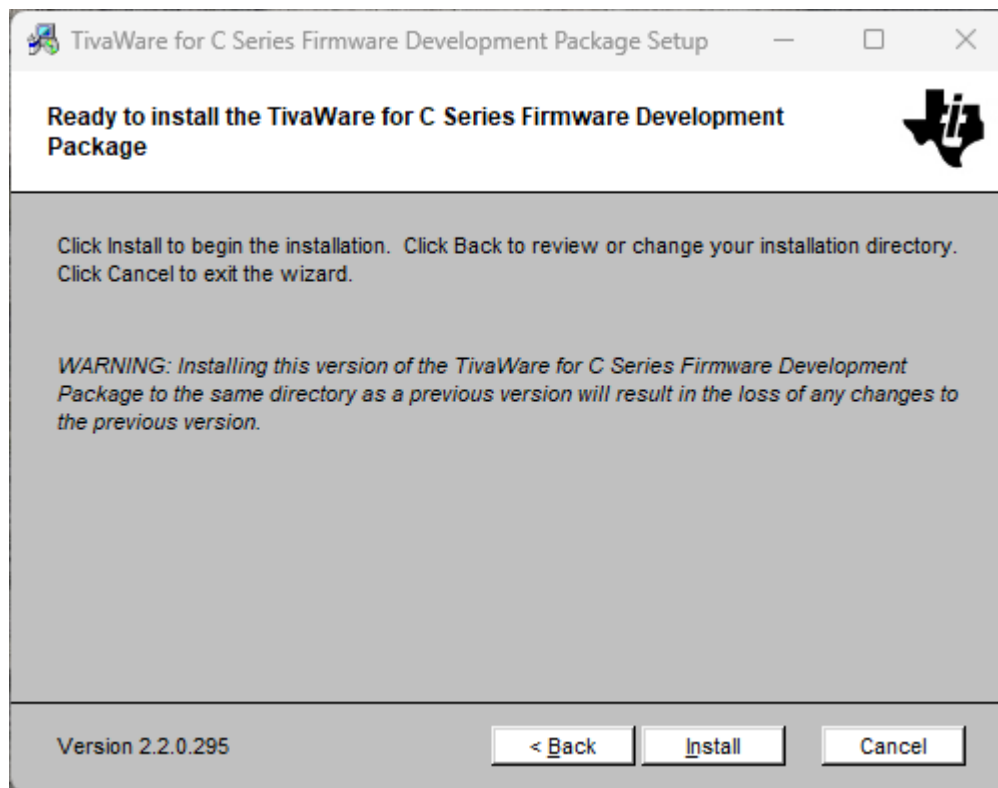


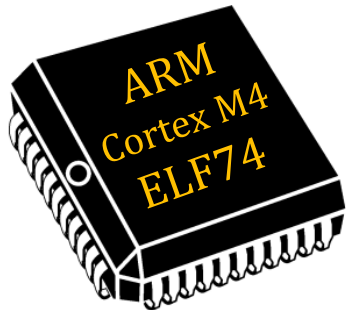
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📁 Telas de Instalação ... (Pasta da disciplina ex.: **..\ELF74**)



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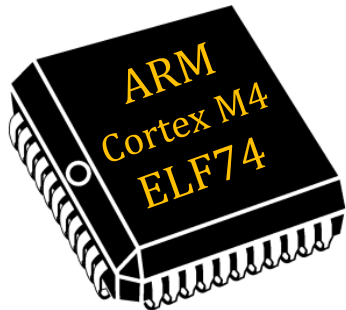
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📁 Telas de Instalação ... (Pasta da disciplina ex.: **..\ELF74**)



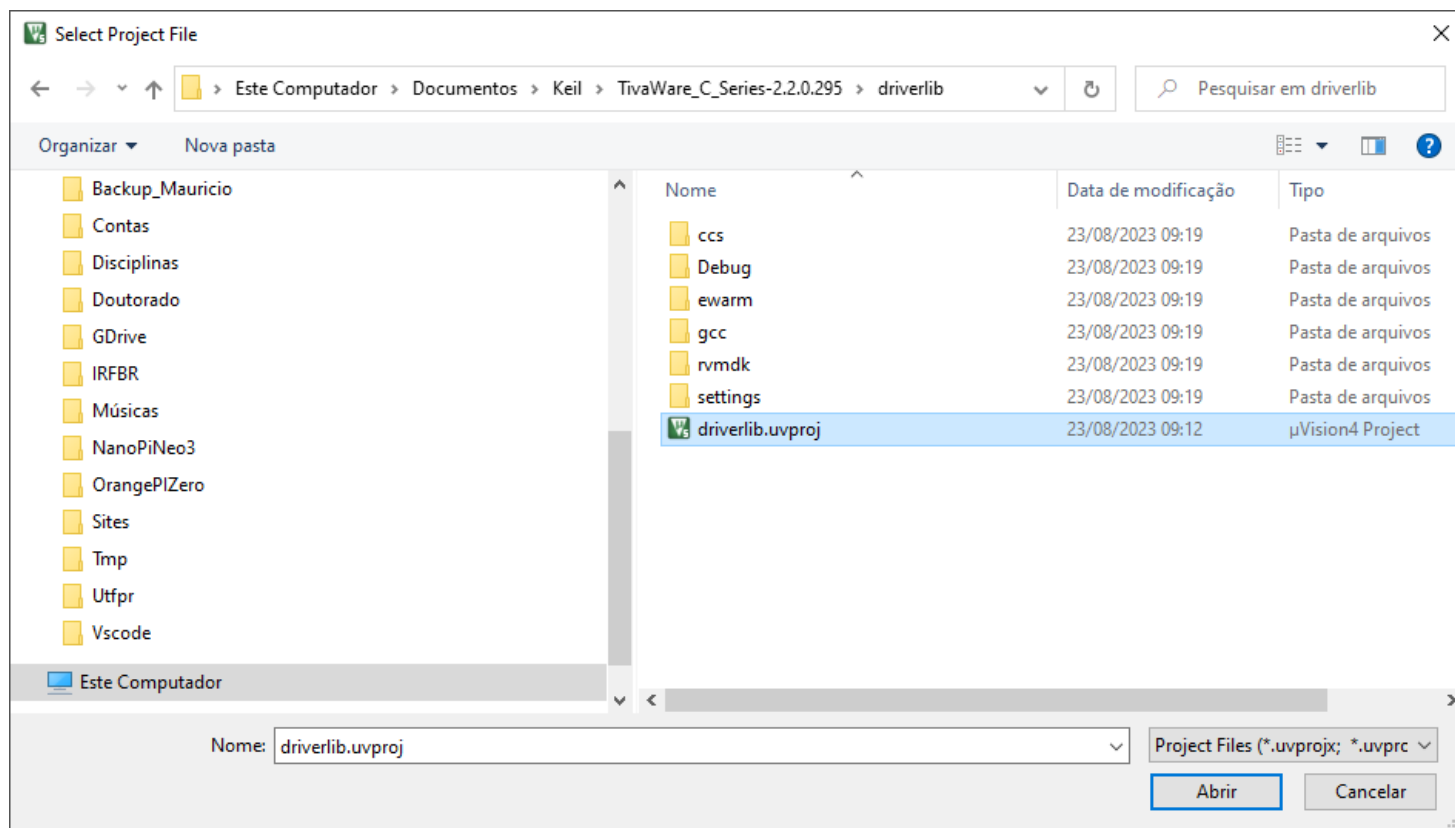
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- TivaWare
- Projeto



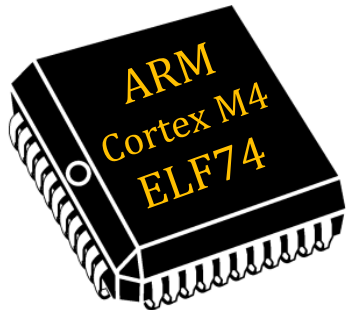


Compilar o TivaWare SDK

 Abrir o Keil, depois escolher: ***Project -> Open Project***

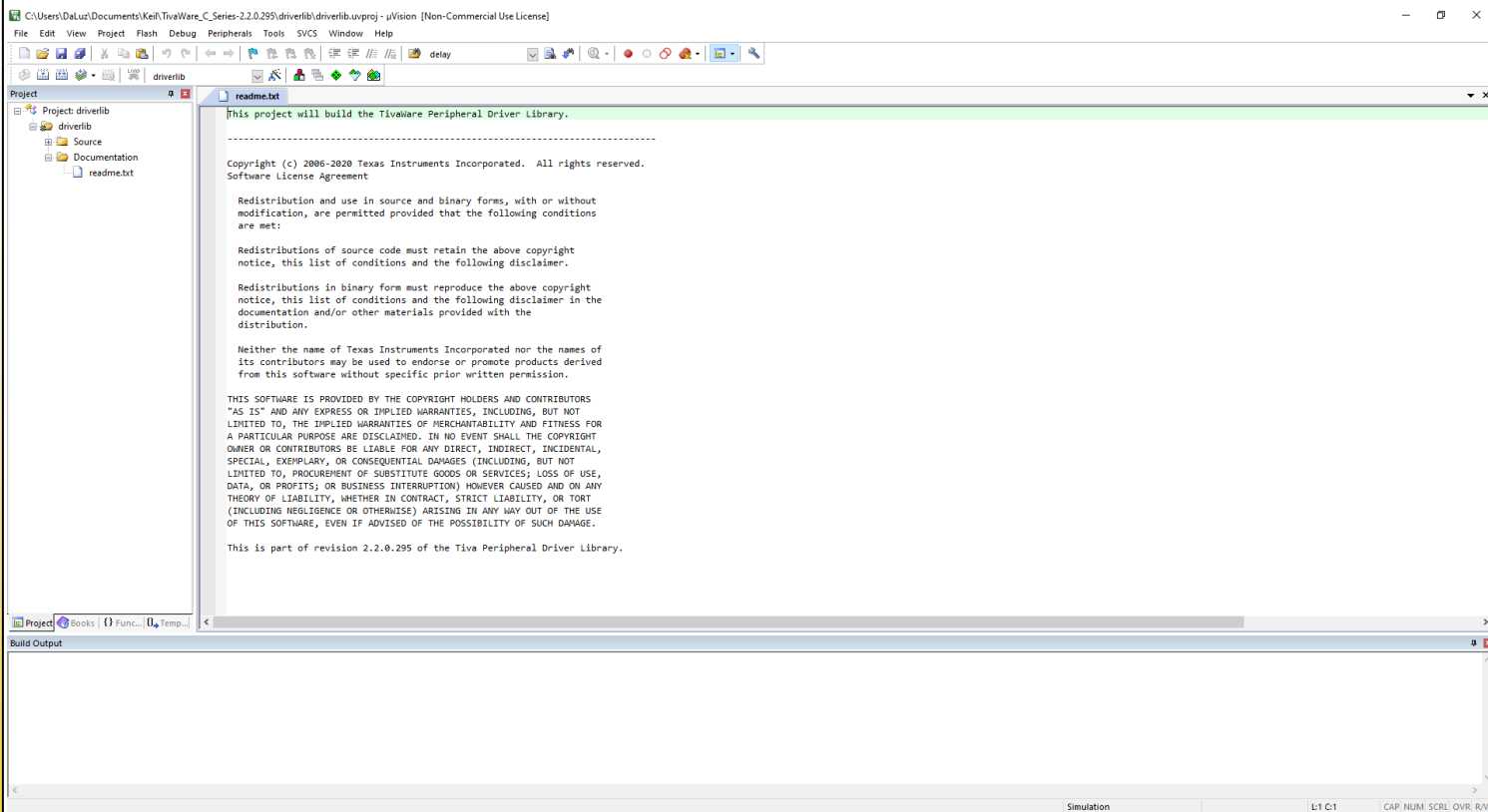


- Keil
- TivaWare
- Projeto



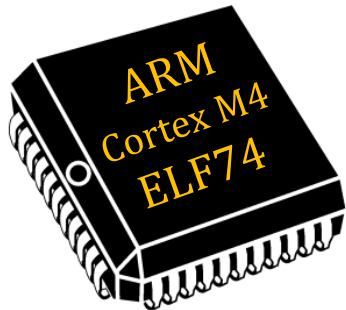
Compilar o TivaWare SDK

 Projeto Aberto, Clicar em **ReBuild** ...



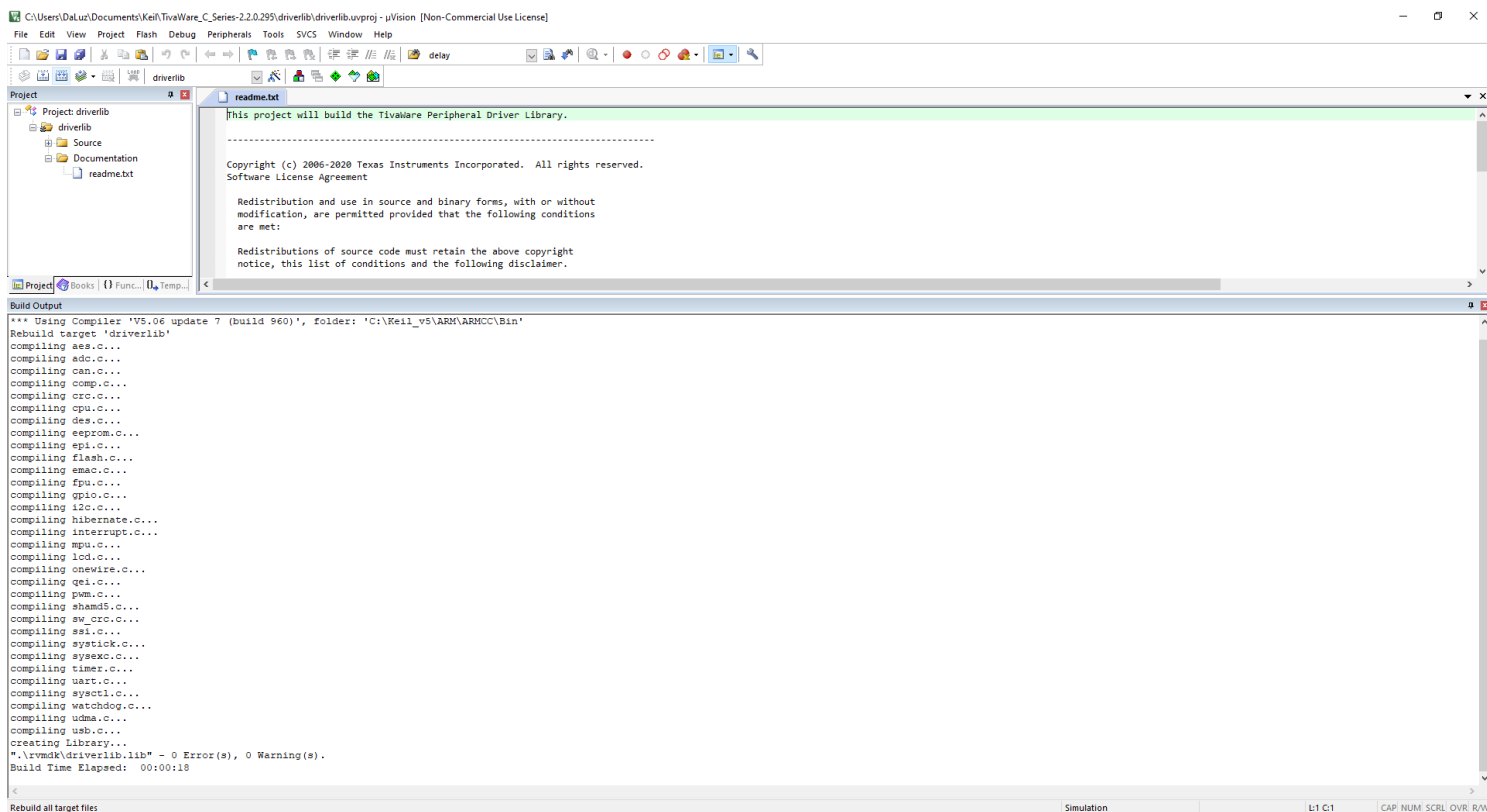


- Keil
- TivaWare
- Projeto



Compilar o TivaWare SDK

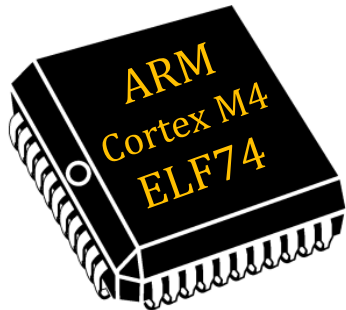
 Projeto Aberto, Clicar em **ReBuild** ...



- Keil

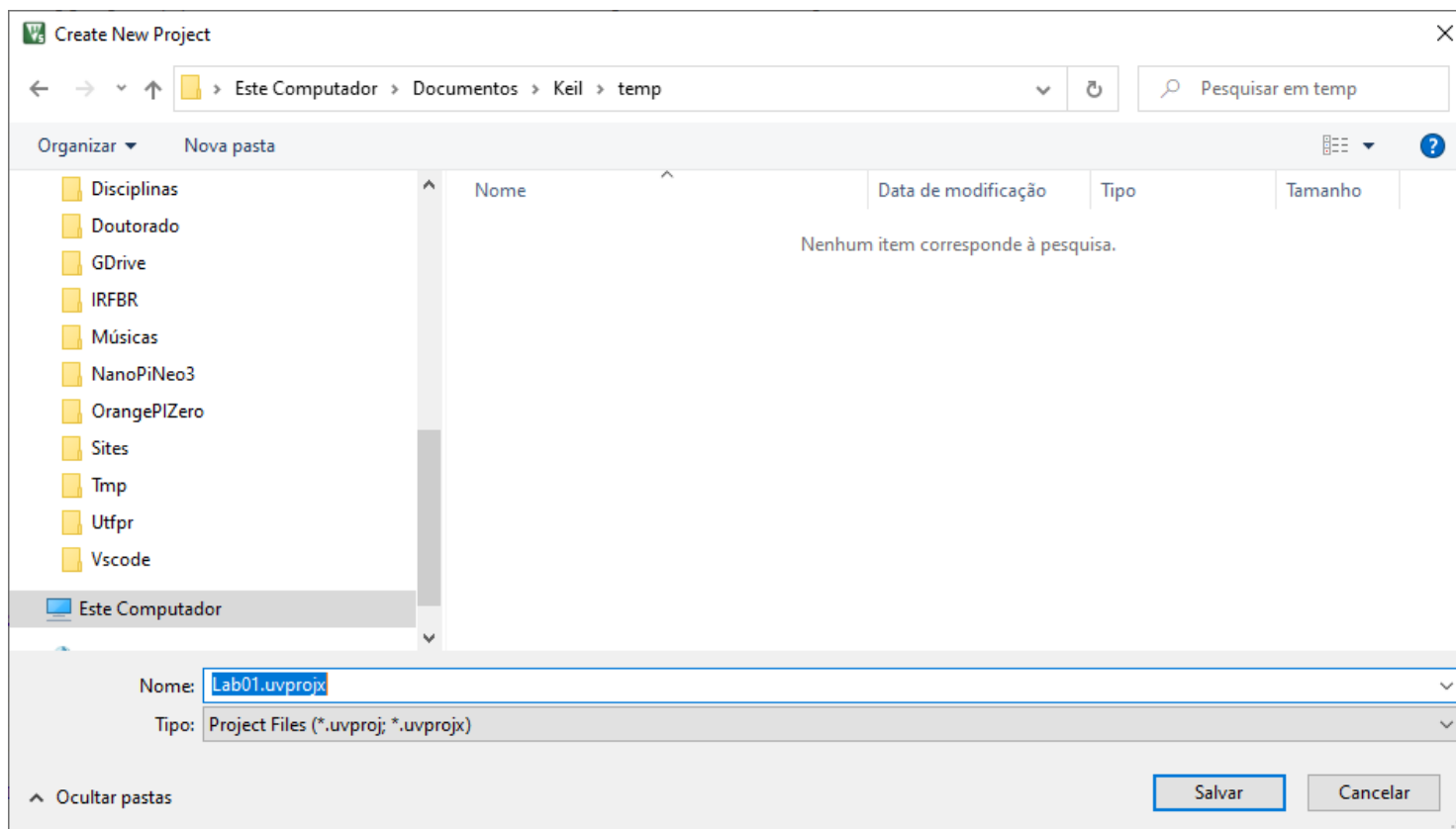
- TivaWare

- Projeto

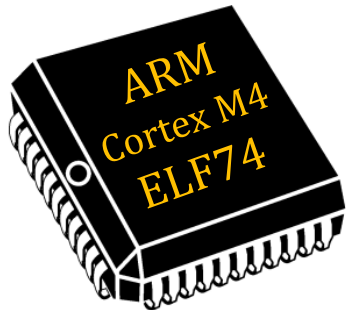


Criar Projeto com TivaWare

Com o Keil aberto clicar em: **Project -> New uVision Project**



- Keil
- TivaWare
- Projeto

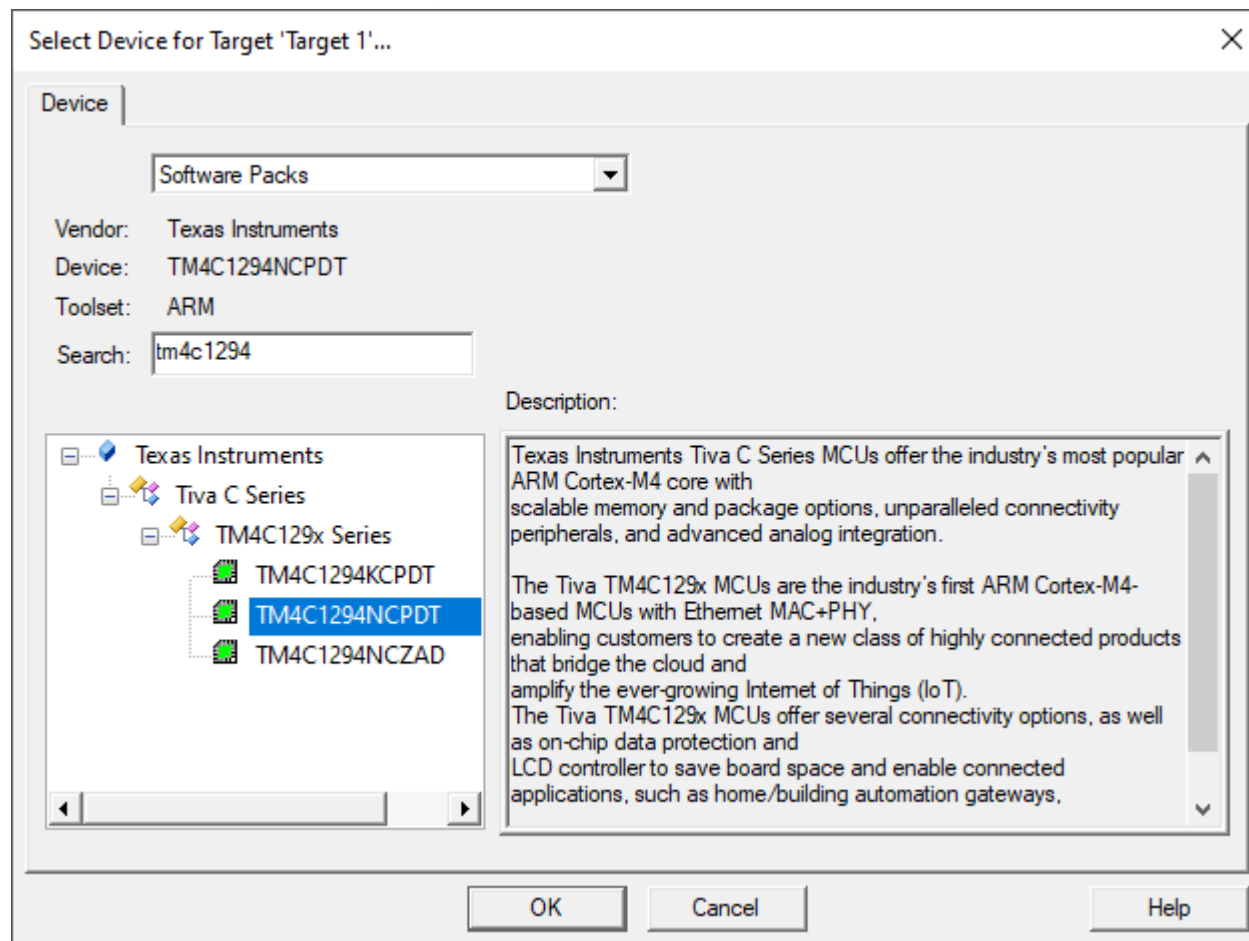


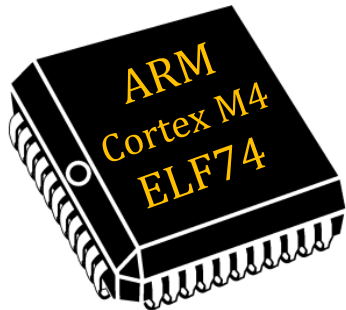
Criar Projeto com TivaWare

Após nomear o Projeto, escolher o microcontrolador.



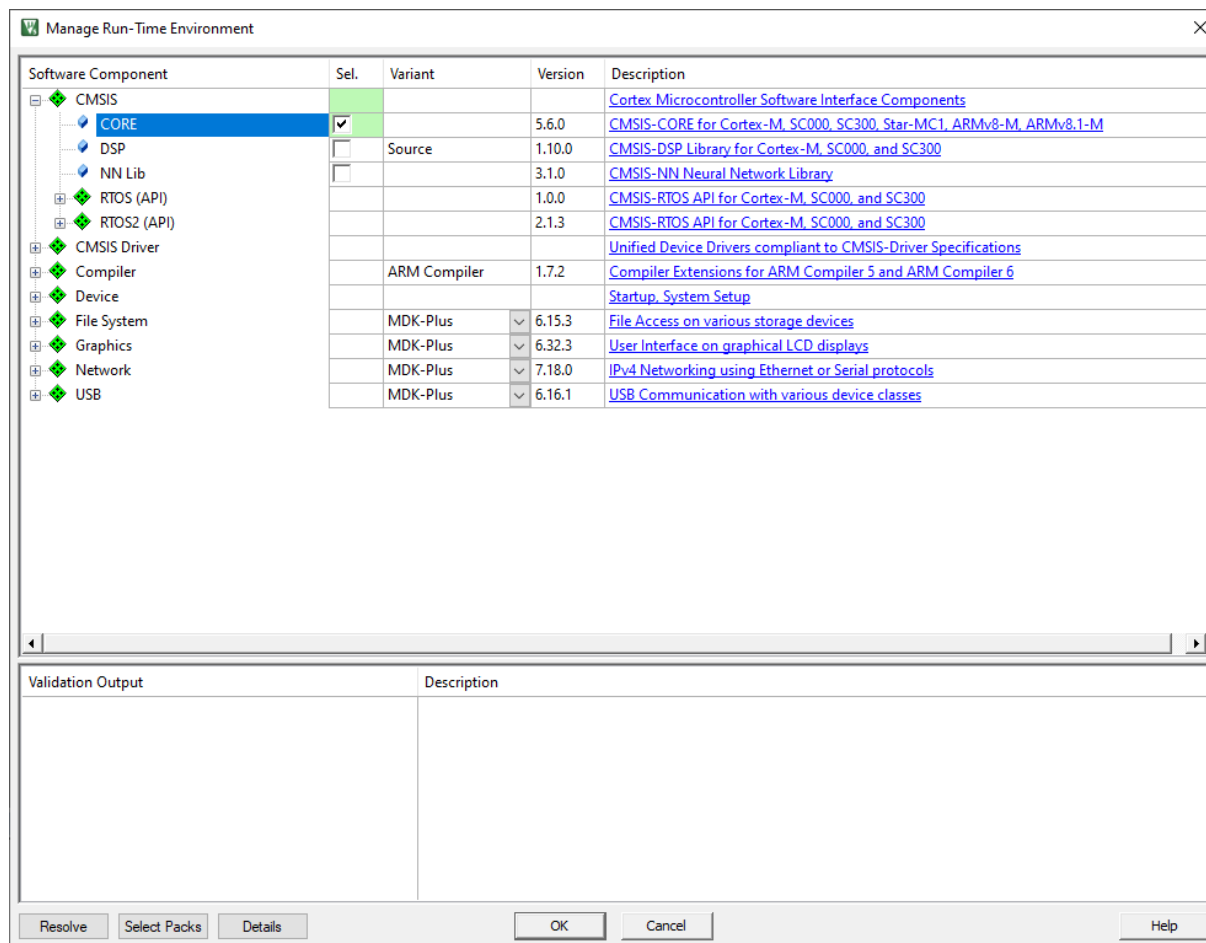
- Keil
- TivaWare
- Projeto



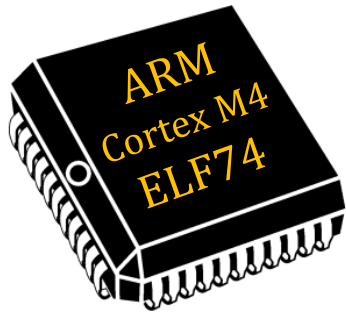


Criar Projeto com TivaWare

Após escolher o **Device**, selecionar:



- Keil
- TivaWare
- Projeto

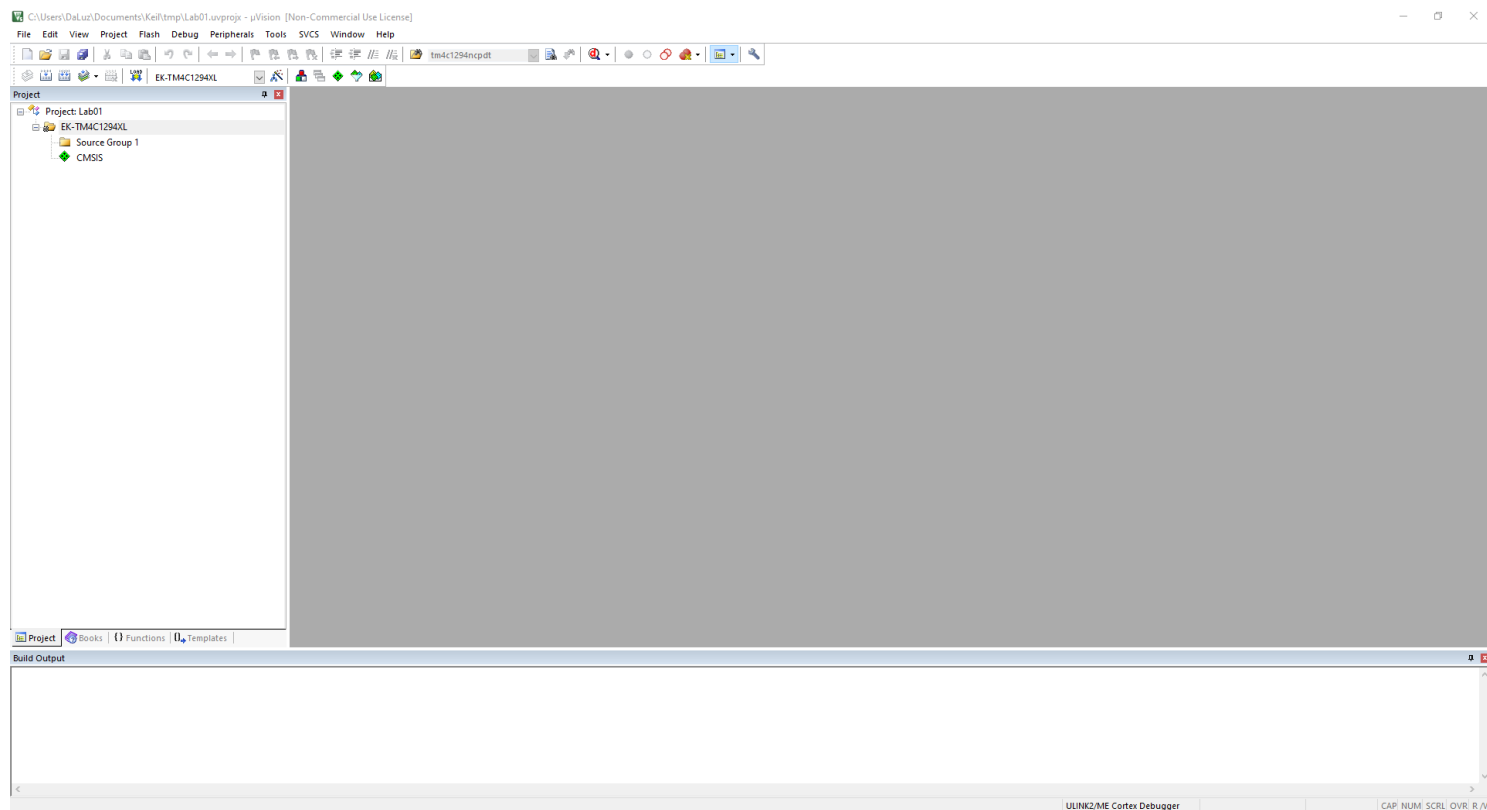


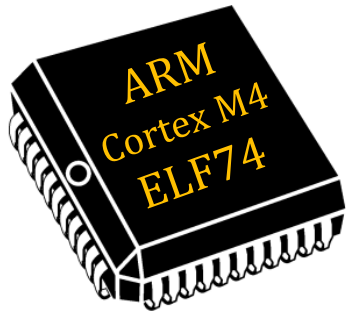
Criar Projeto com TivaWare

- 📁 Projeto a ser configurado tela inicial:
- 📁 *Alterar Target 1 -> EK-TM4C1294XL*



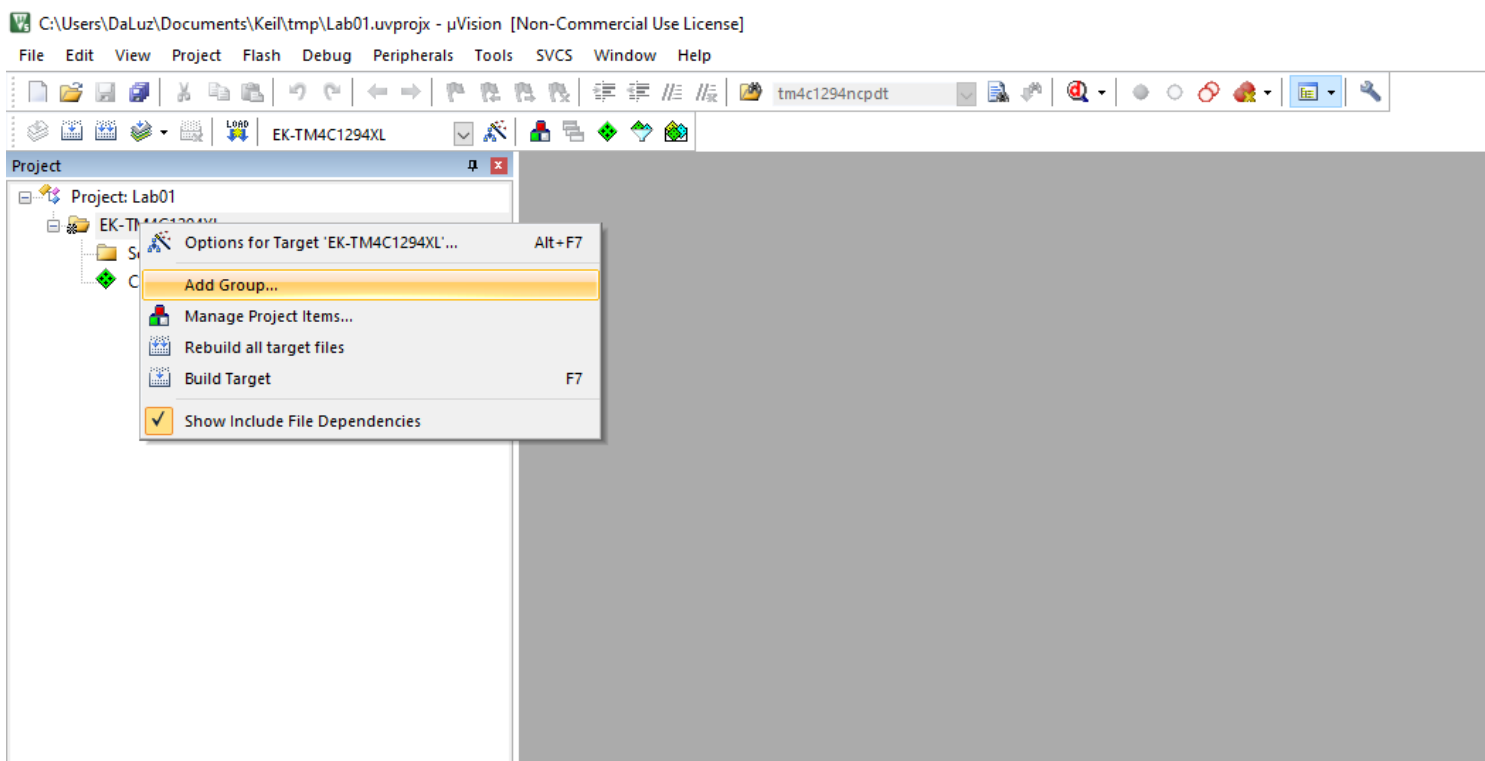
- Keil
- TivaWare
- Projeto



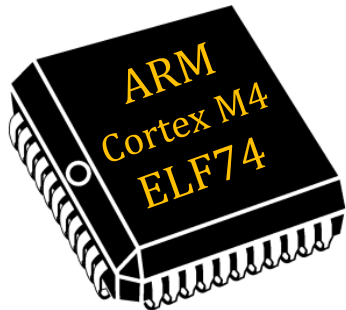


Criar Projeto com TivaWare

Após alterar o **Target 1**, inserir 2 novos Grupos:



- Keil
- TivaWare
- Projeto



Criar Projeto com TivaWare

📁 Nomear eles: **Documentation** e **Libraries**:

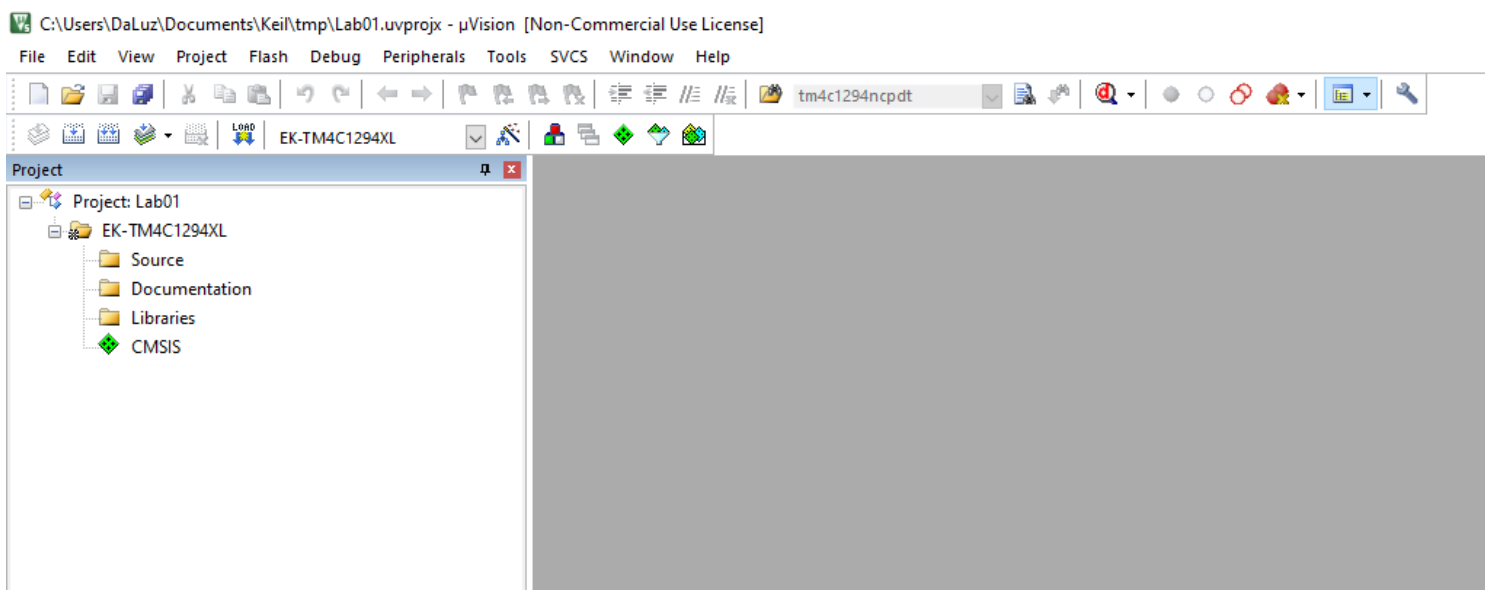
📁 *Source Group 1 -> Source*

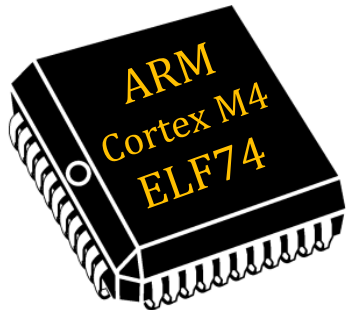
📁 *New Group -> Documentation*

📁 *New Group -> Libraries*



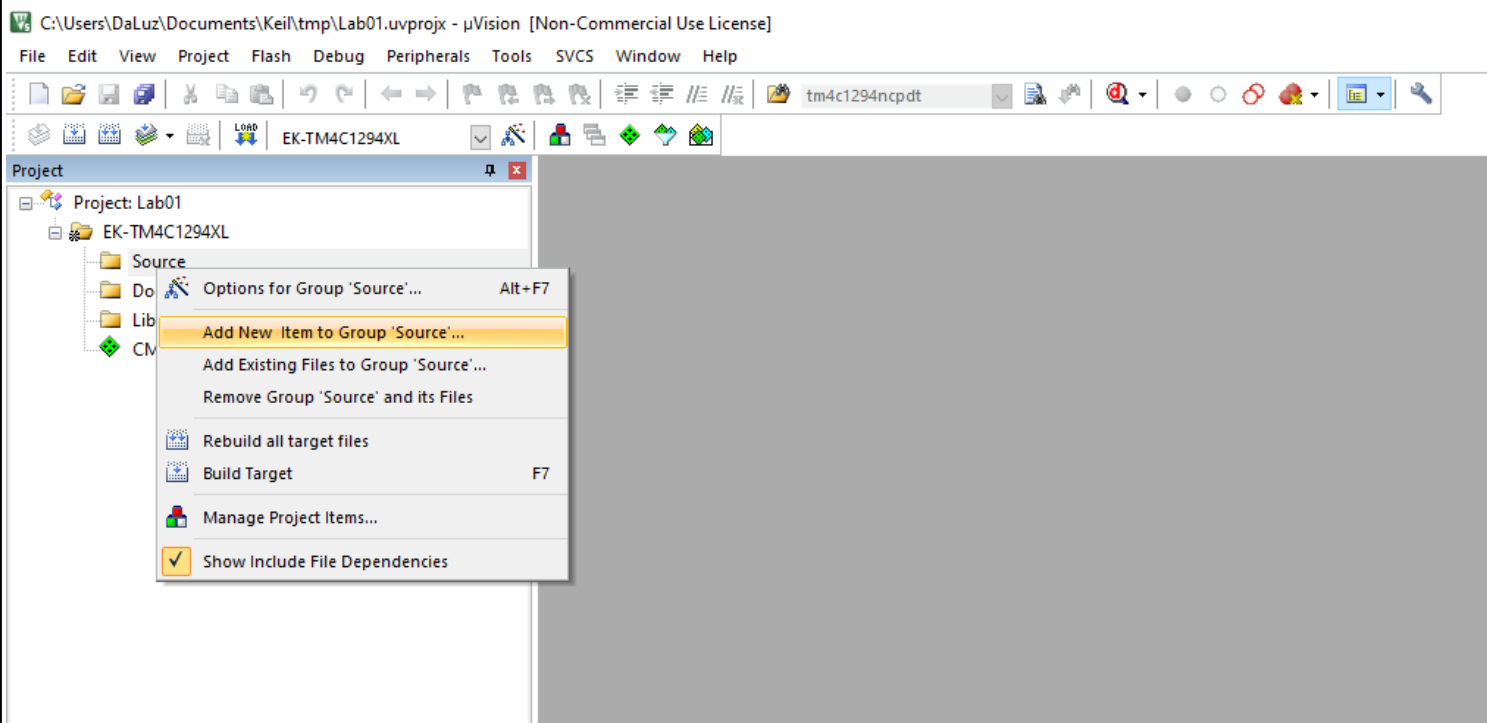
- Keil
- TivaWare
- Projeto



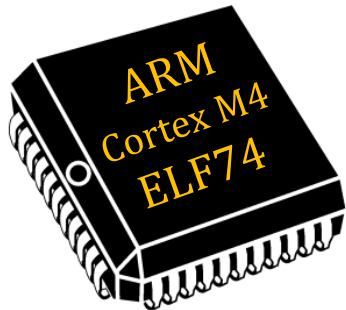


Criar Projeto com TivaWare

📁 Inserir o **main.c** no grupo **Source**:

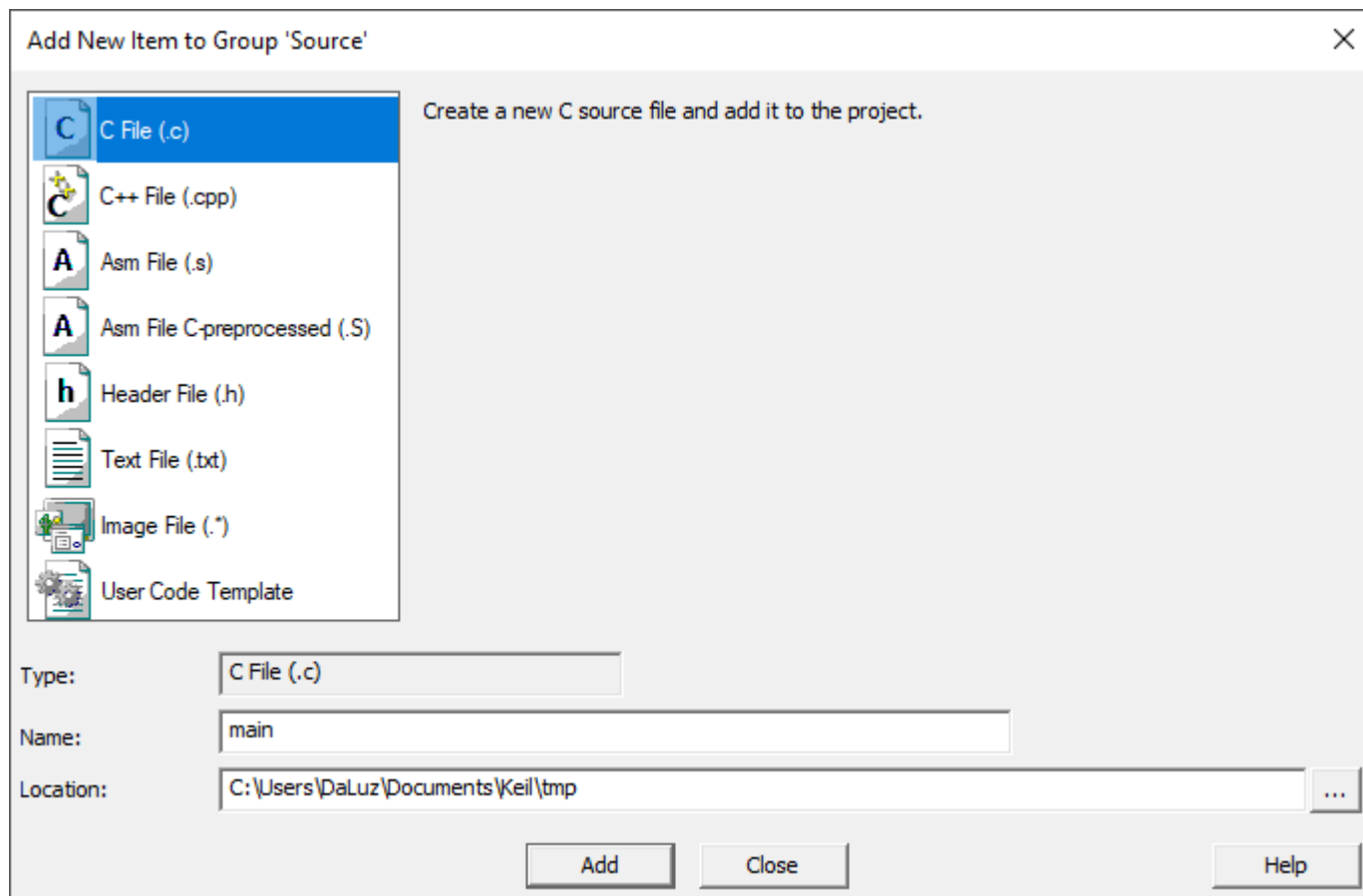


- Keil
- TivaWare
- Projeto

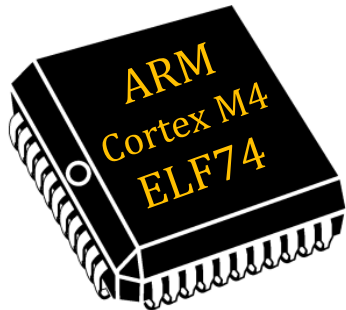


Criar Projeto com TivaWare

📁 Inserir o **main.c** no grupo **Source**:

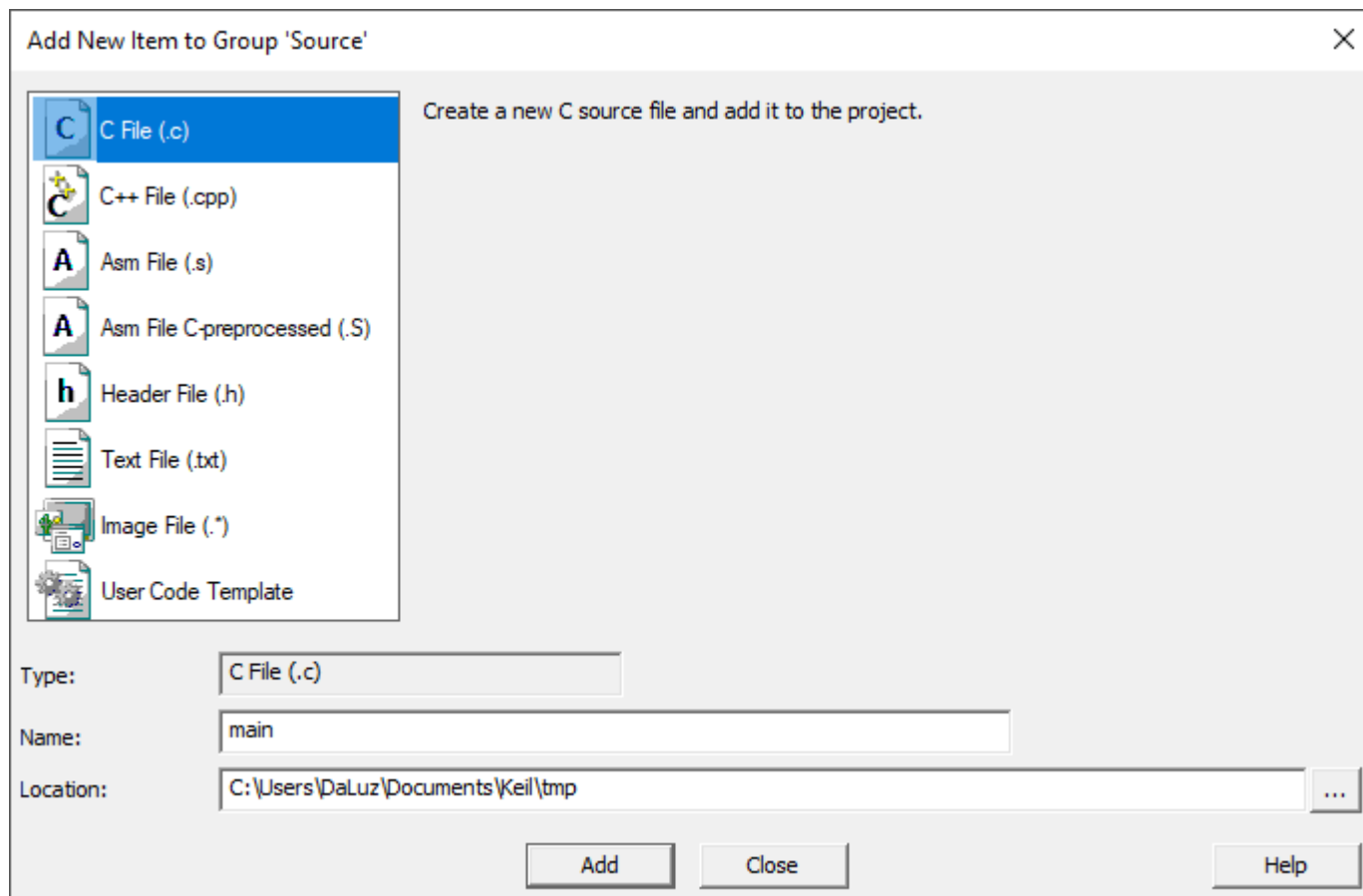


- Keil
- TivaWare
- Projeto

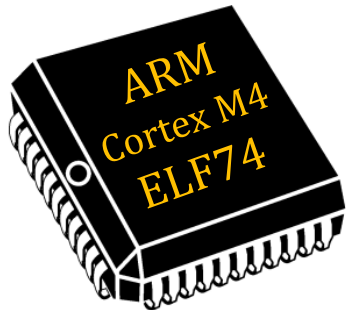


Criar Projeto com TivaWare

📁 Inserir o **main.c** no grupo **Source**:



- Keil
- TivaWare
- Projeto



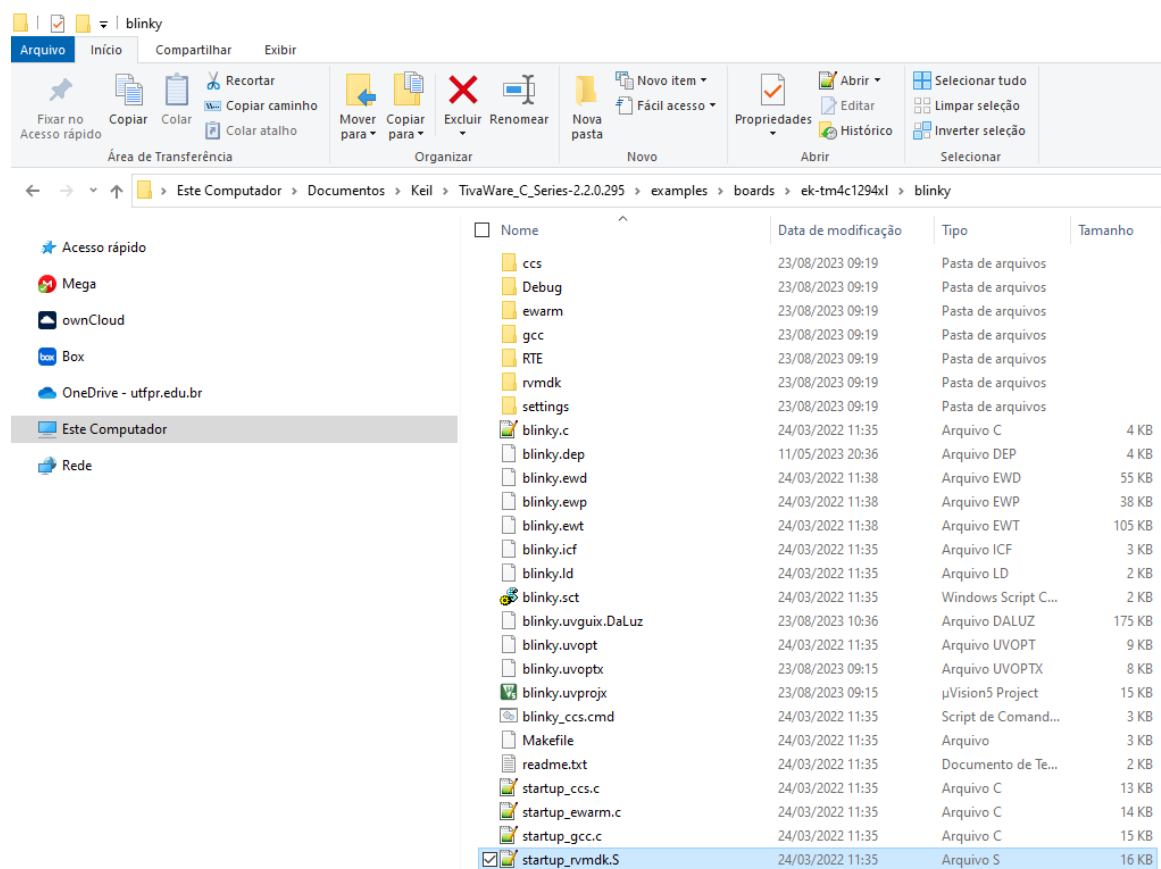
Criar Projeto com TivaWare

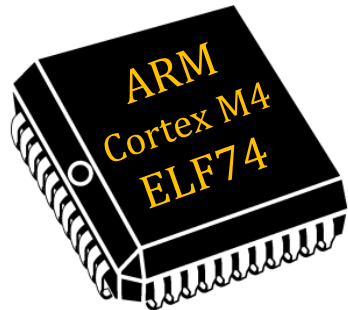


- Keil
- TivaWare
- Projeto

1. Inserir o **startup_rvmdk.S** (copiar para a pasta do projeto) no grupo **Source**:

2. Localizar a pasta: `\TivaWare_C_Series-2.2.0.295\examples\boards\ek-tm4c1294xl\blinky`





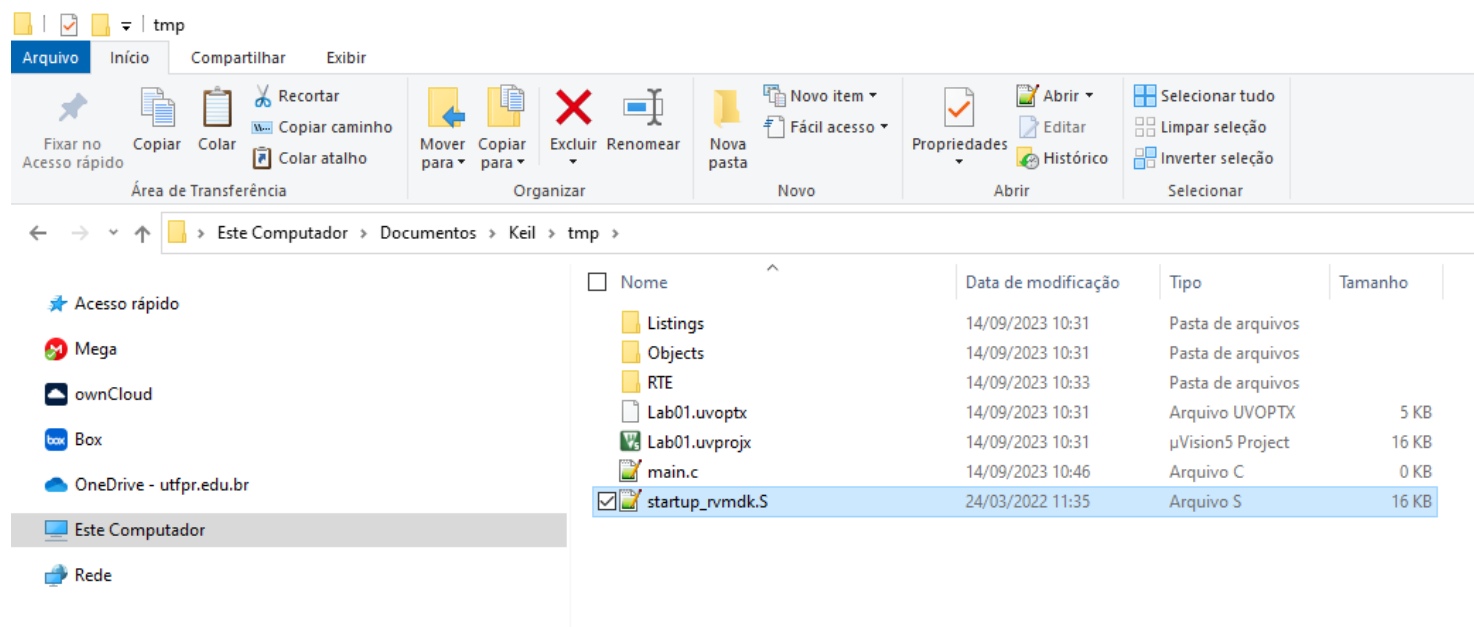
Criar Projeto com TivaWare

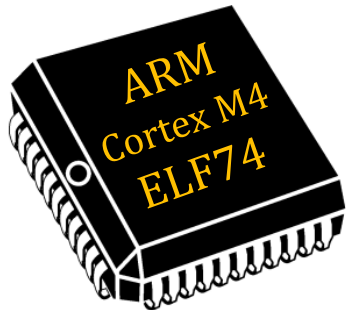


- Keil
- TivaWare
- Projeto

📁 Inserir o **startup_rvmdk.S** (copiar para a pasta do projeto) no grupo **Source**:

📁 Localizar a pasta: `\TivaWare_C_Series-2.2.0.295\examples\boards\ek-tm4c1294xl\blinky`





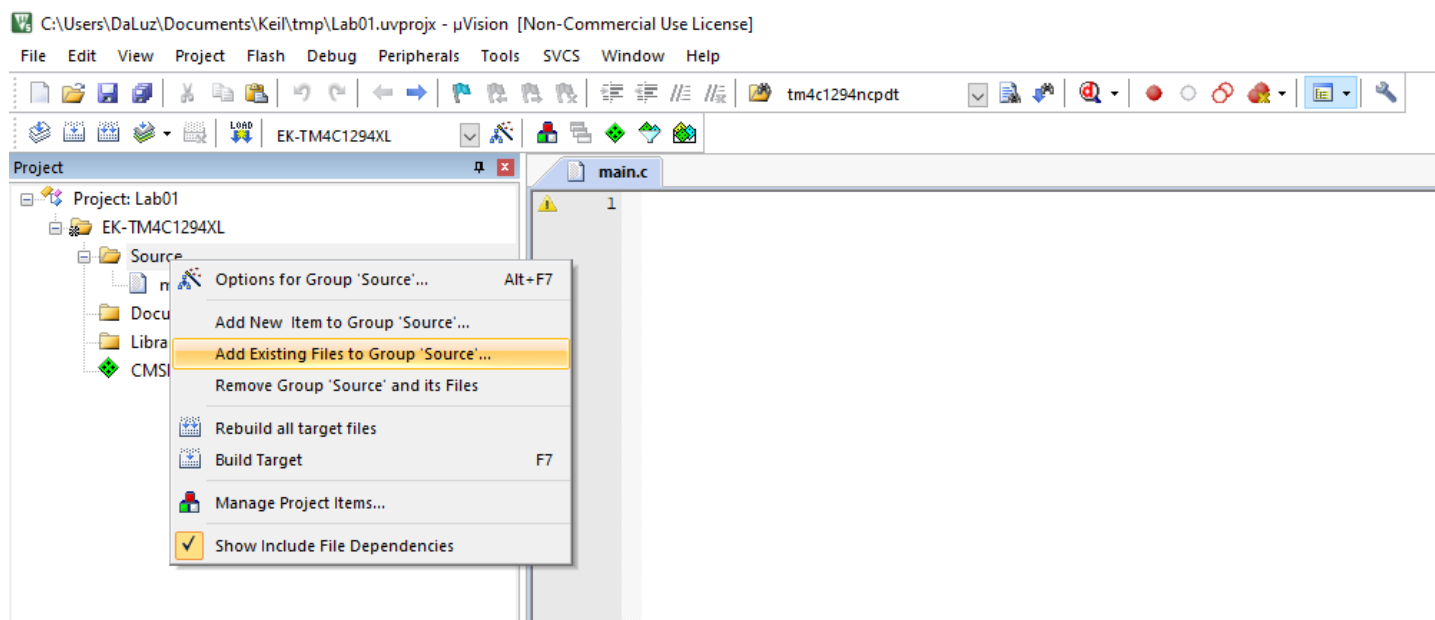
Criar Projeto com TivaWare

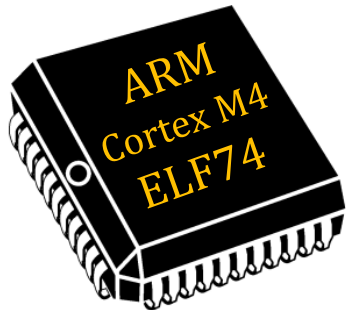


- Keil
- TivaWare
- Projeto

📁 Inserir o **startup_rvmdk.S** (copiar para a pasta do projeto) no grupo **Source**:

📁 Localizar a pasta: `\TivaWare_C_Series-2.2.0.295\examples\boards\ek-tm4c1294xl\blinky`





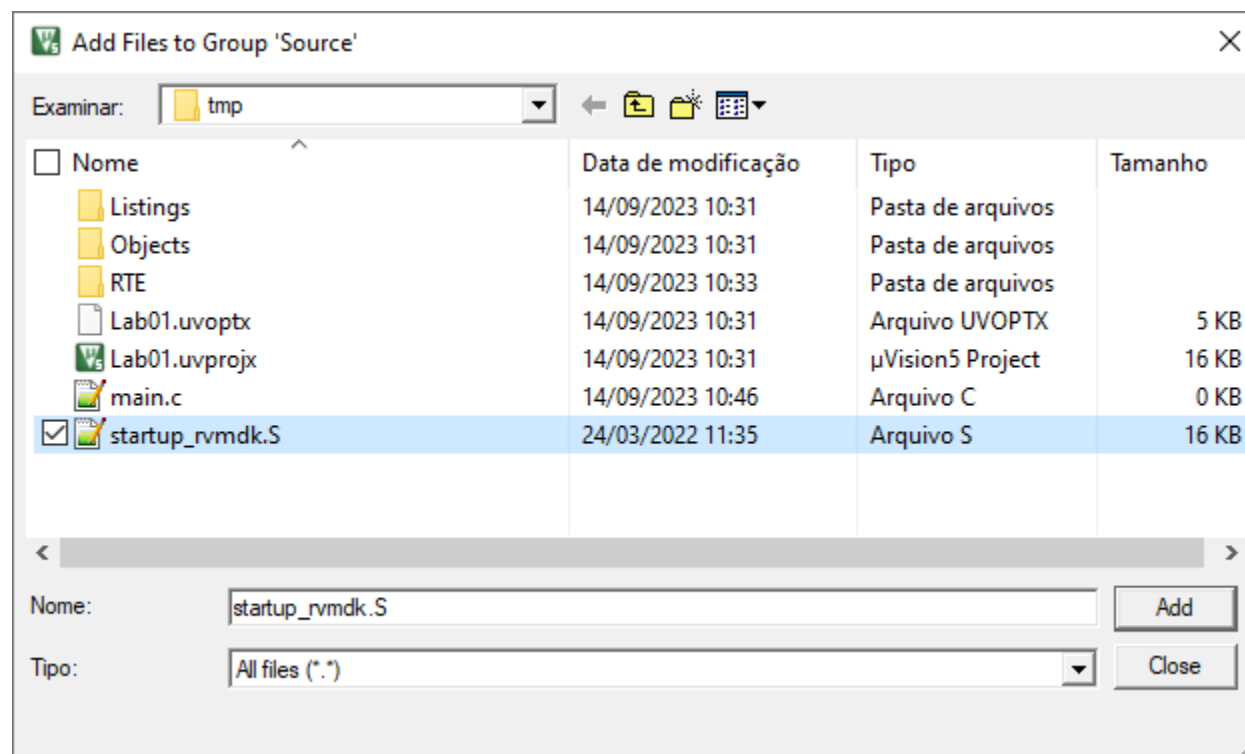
Criar Projeto com TivaWare

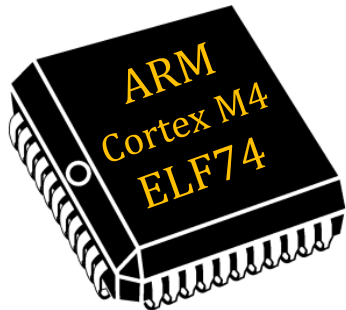


- Keil
- TivaWare
- Projeto

📁 Inserir o **startup_rvmdk.S** (copiar para a pasta do projeto) no grupo **Source**:

📁 Localizar a pasta: `\TivaWare_C_Series-2.2.0.295\examples\boards\ek-tm4c1294xl\blinky`





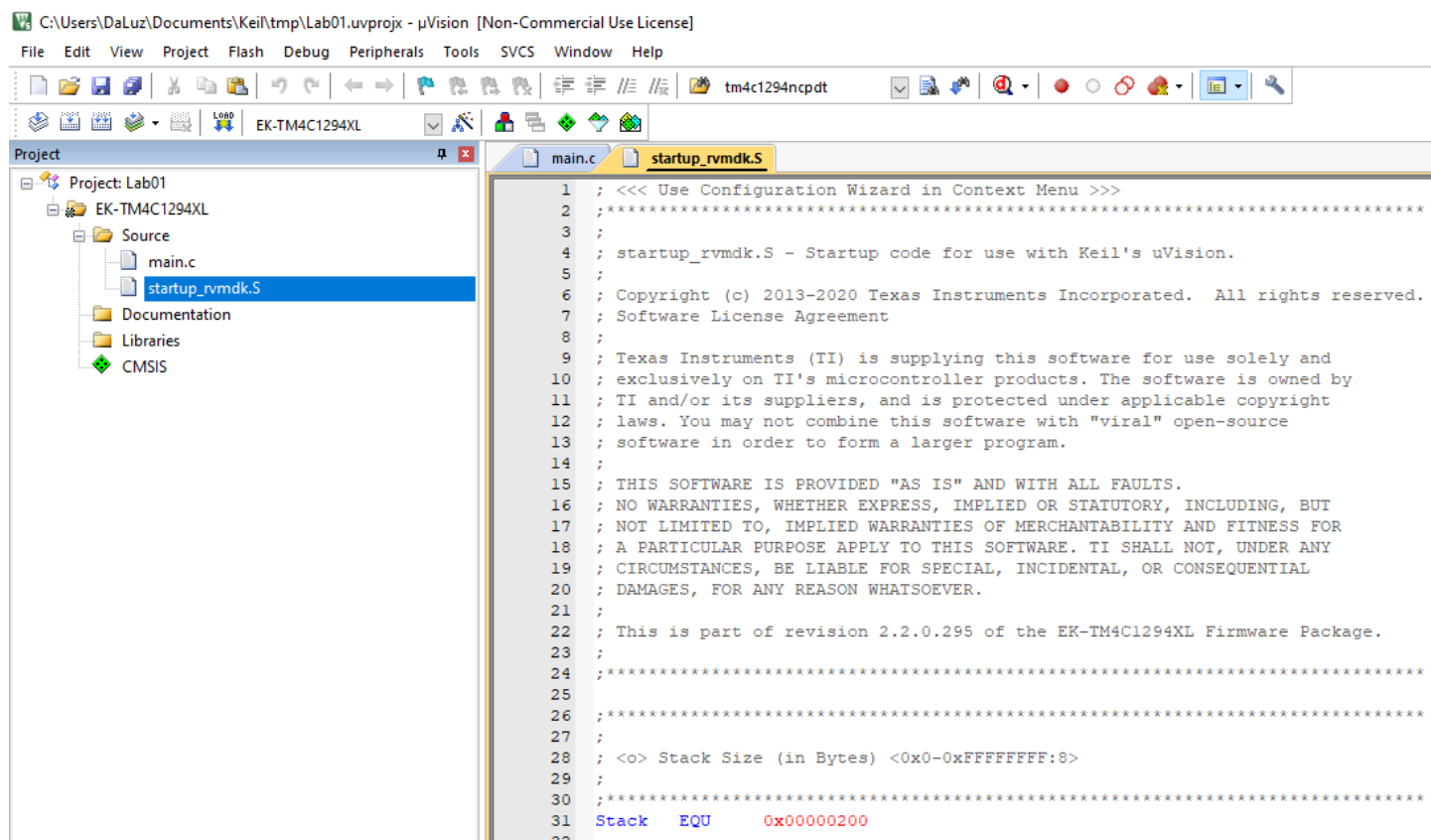
Criar Projeto com TivaWare

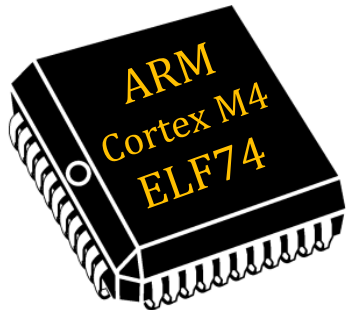


- Keil
- TivaWare
- Projeto

📁 Inserir o **startup_rvmdk.S** (copiar para a pasta do projeto) no grupo **Source**:

📁 Localizar a pasta: `\TivaWare_C_Series-2.2.0.295\examples\boards\ek-tm4c1294xl\blinky`



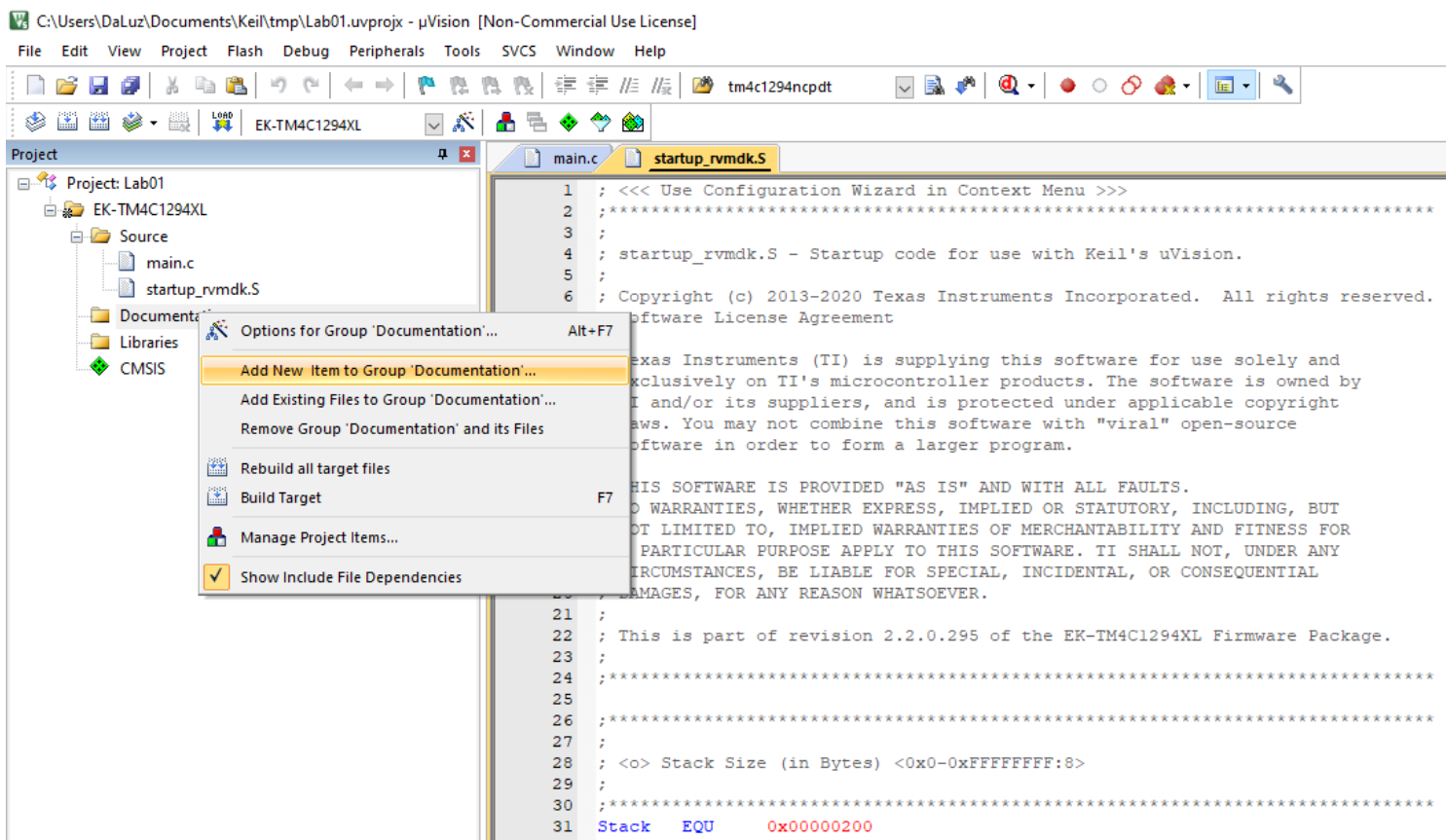


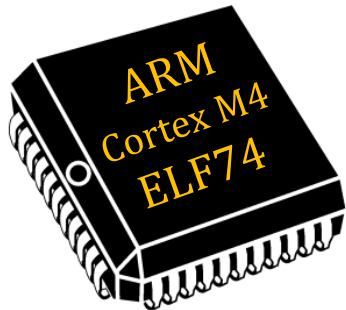
Criar Projeto com TivaWare



- Keil
- TivaWare
- Projeto

📄 Inserir o **readme.txt** no grupo **Documentation**:



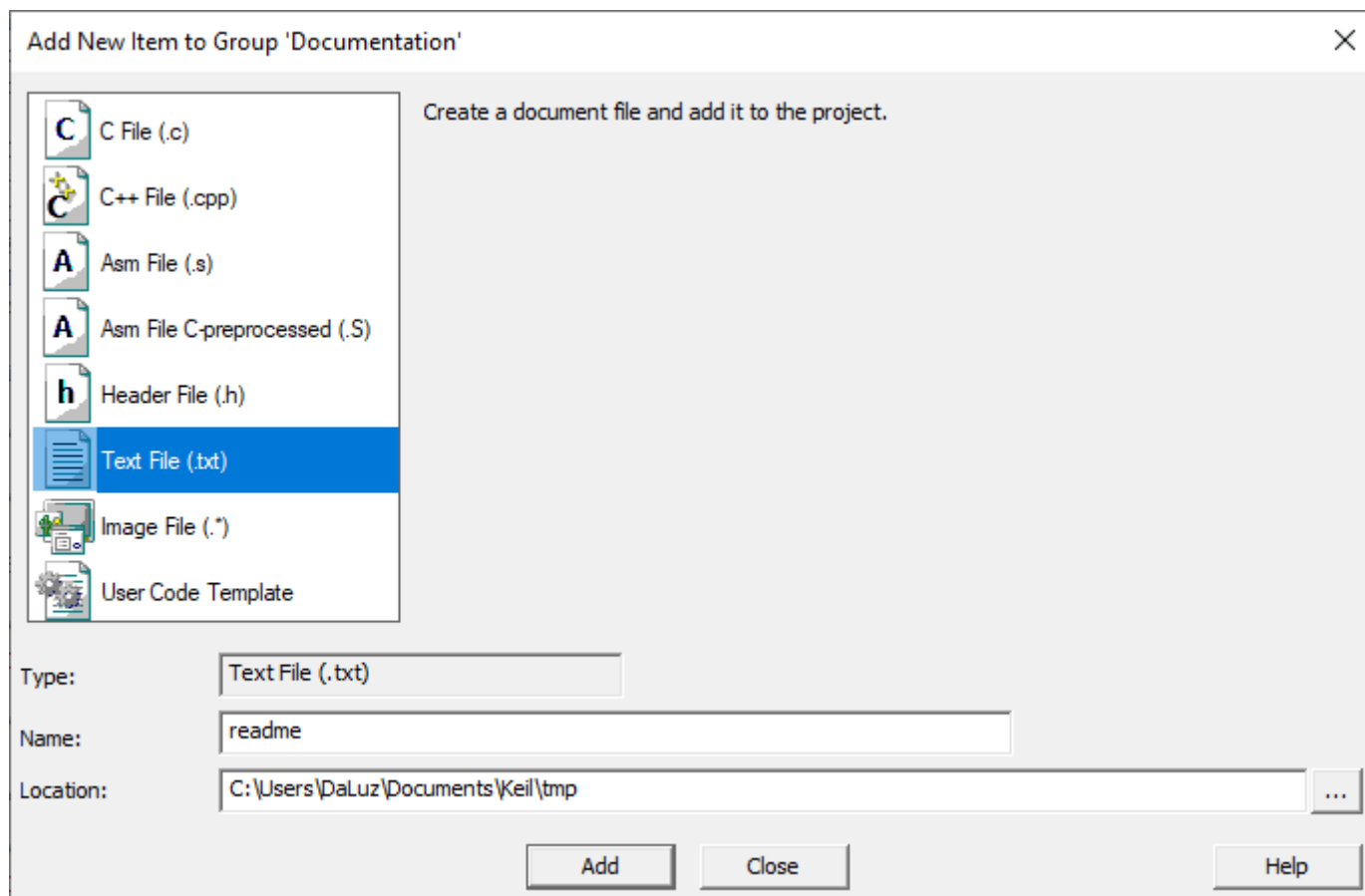


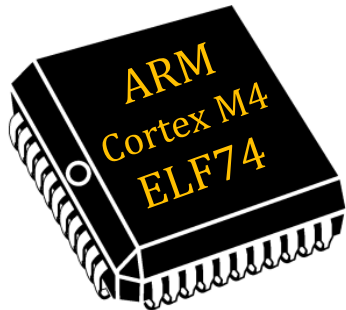
Criar Projeto com TivaWare



- Keil
- TivaWare
- Projeto

📄 Inserir o **readme.txt** no grupo **Documentation**:



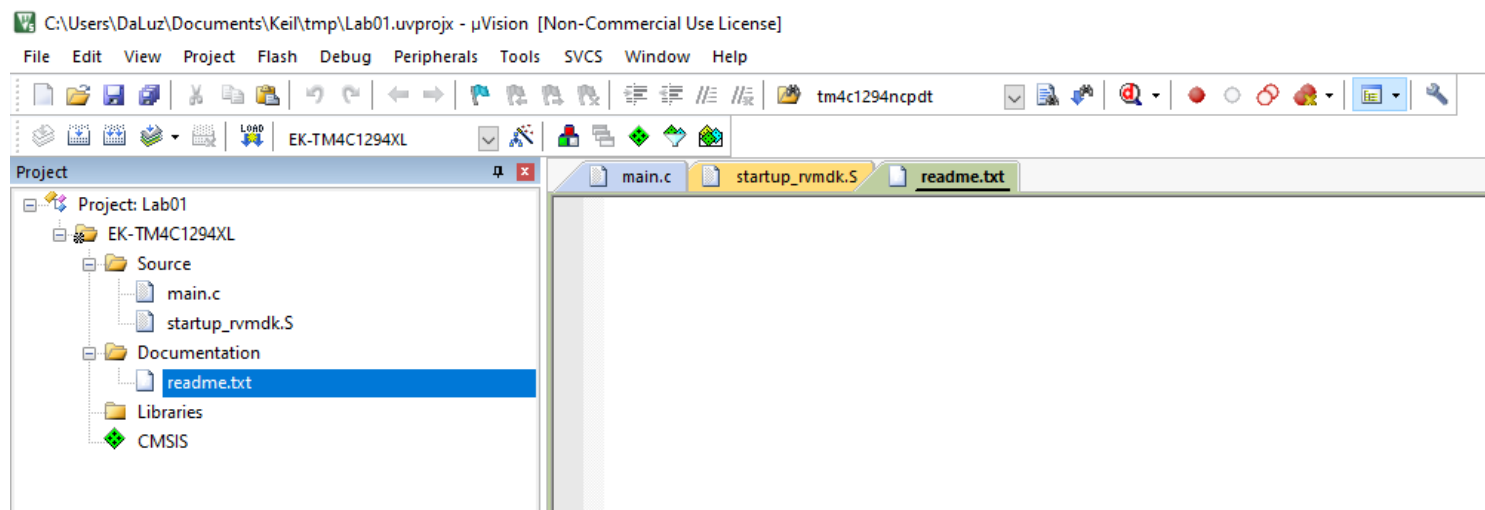


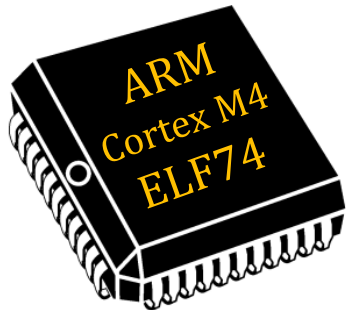
Criar Projeto com TivaWare



- Keil
- TivaWare
- Projeto

📄 Inserir o **readme.txt** no grupo **Documentation**:



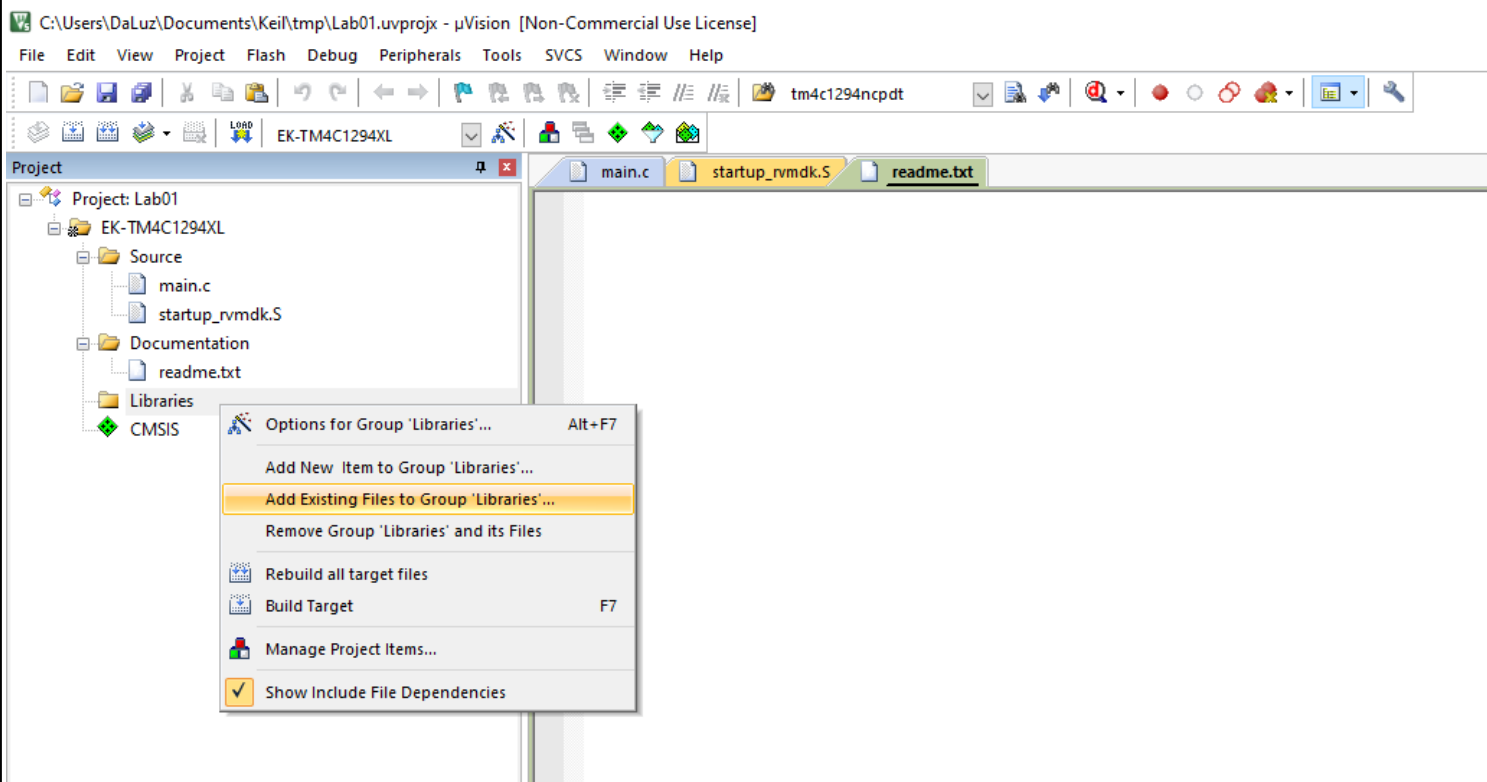


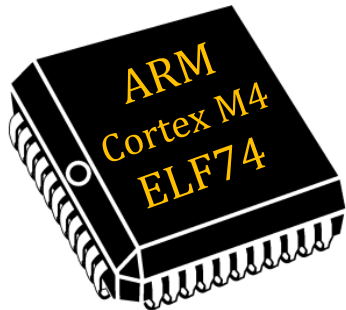
Criar Projeto com TivaWare



- Keil
- TivaWare
- Projeto

📁 Inserir o **driverlib.lib** (TivaWare) no grupo **Libraries**:





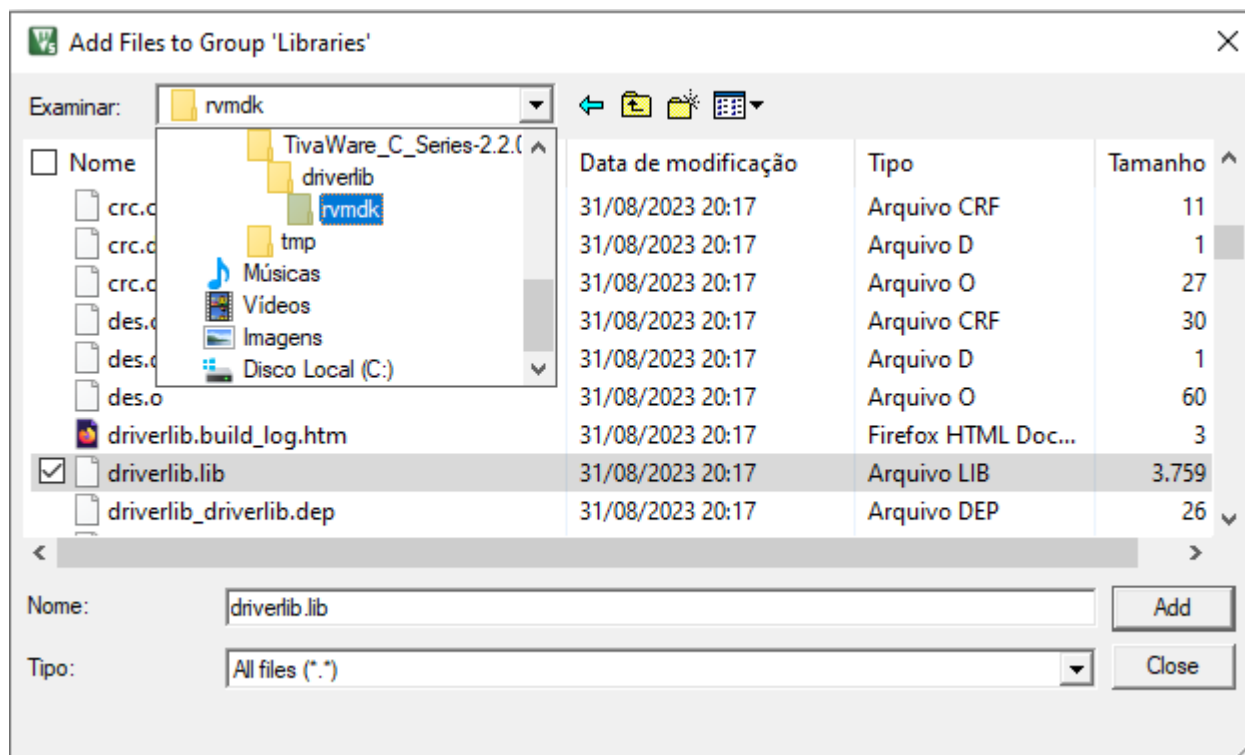
Criar Projeto com TivaWare

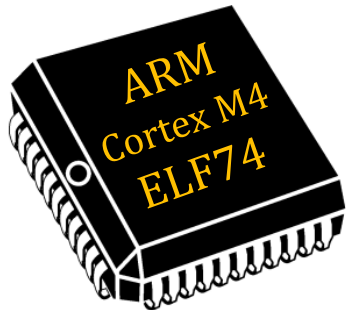


- Keil
- TivaWare
- Projeto

📁 Inserir o **driverlib.lib** (TivaWare) no grupo **Libraries**:

📁 Localizar a pasta: `\TivaWare_C_Series-2.2.0.295\driverlib\rvmdk`



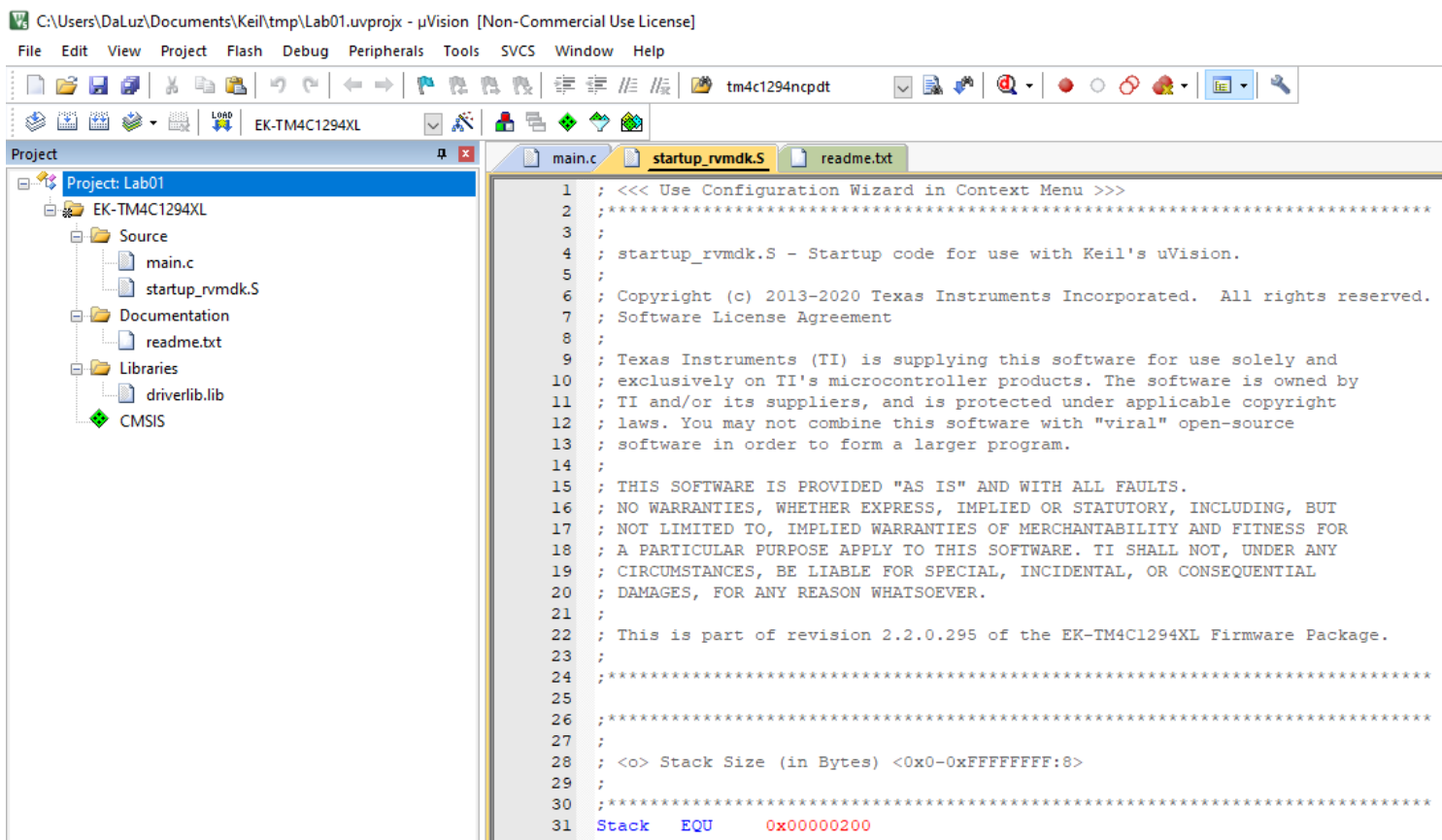


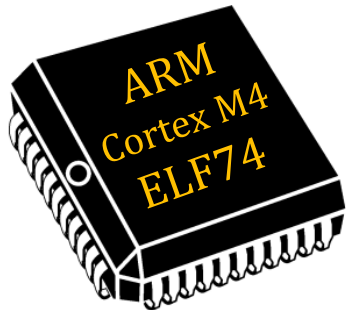
Criar Projeto com TivaWare



- Keil
- TivaWare
- Projeto

📁 Árvore completa do Projeto:



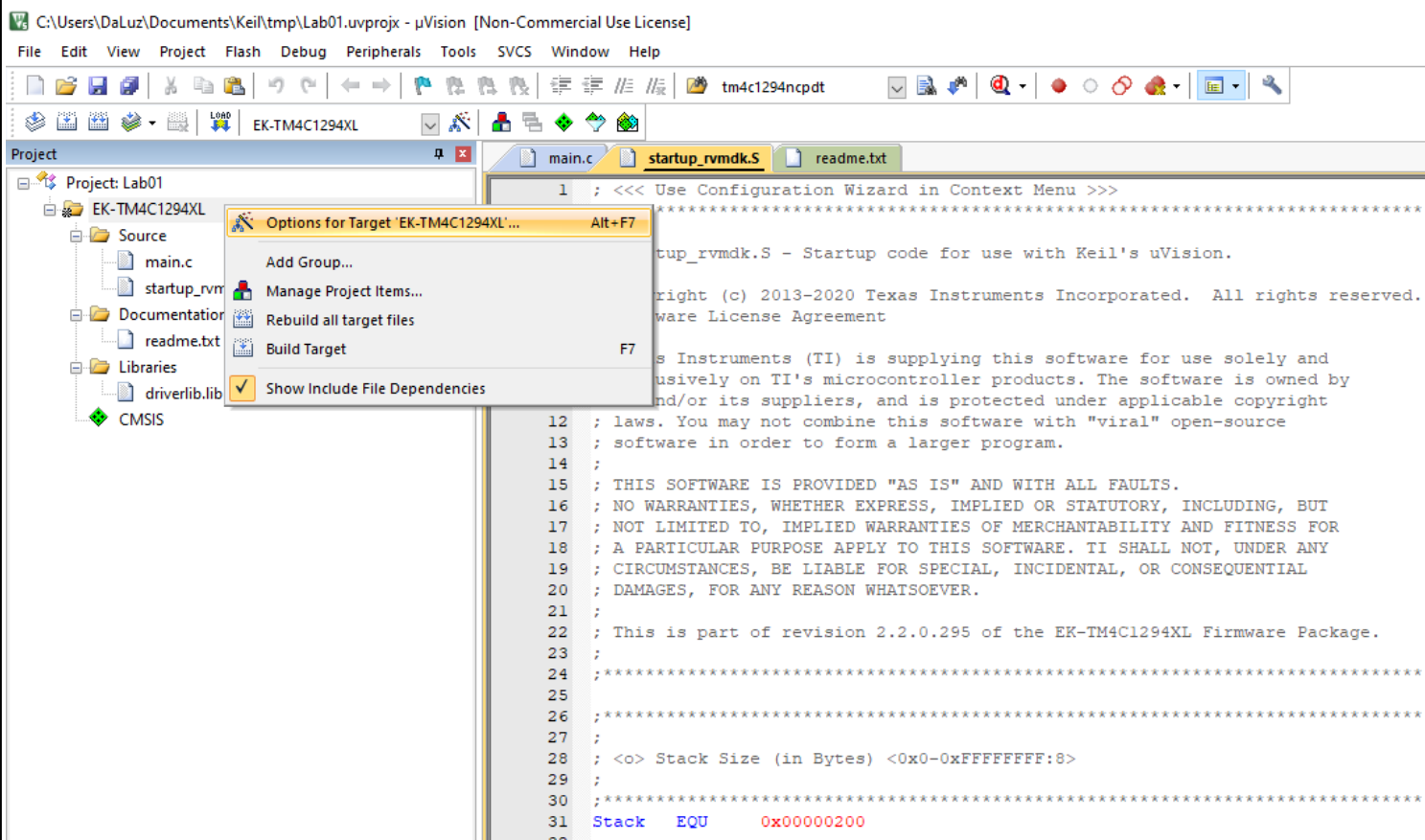


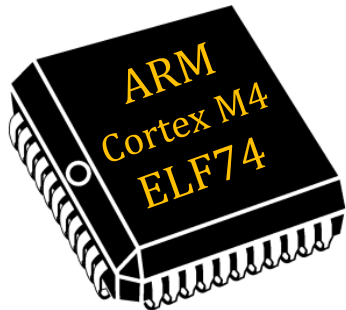
Criar Projeto com TivaWare



- Keil
- TivaWare
- Projeto

Configurar Propriedades do Projeto:



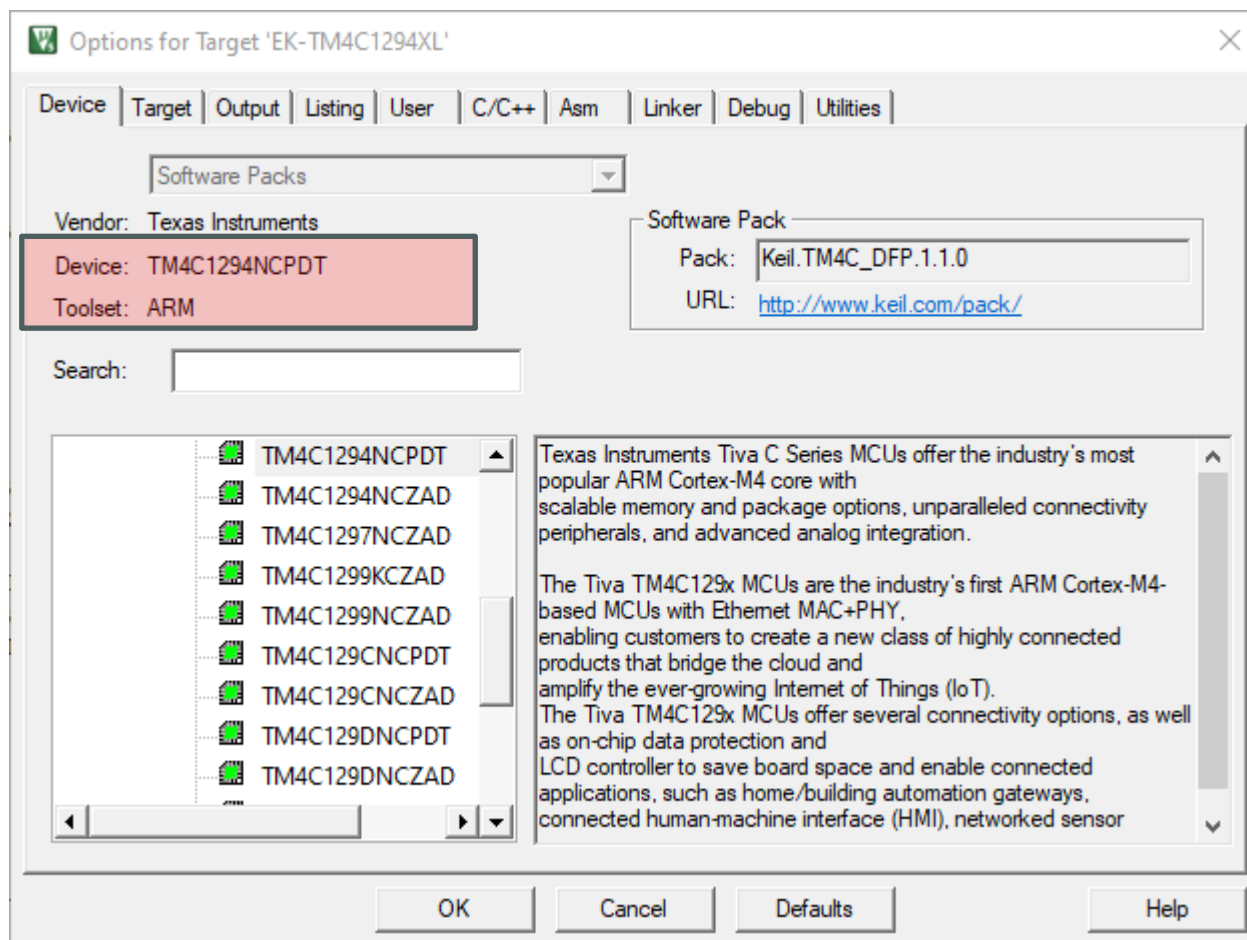


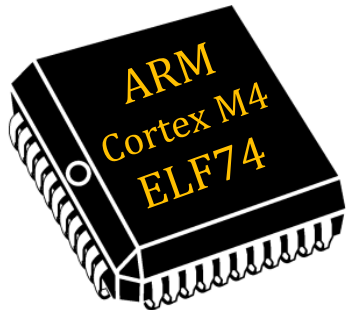
Criar Projeto com TivaWare



- Keil
- TivaWare
- Projeto

Configurar Propriedades do Projeto: **(TM4C1294NCPDT)**



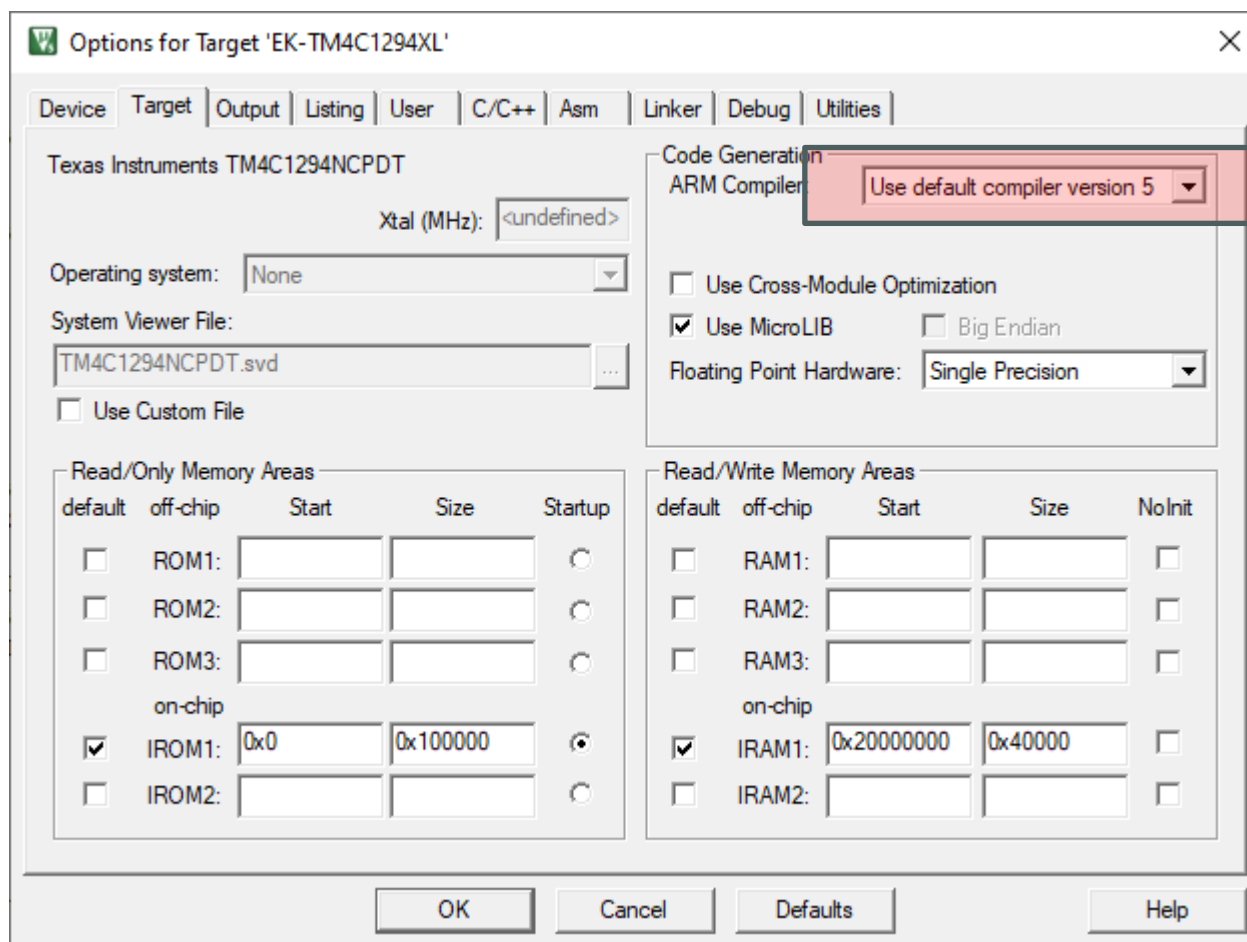


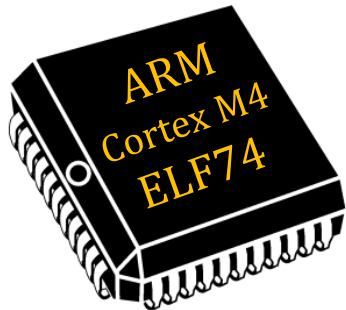
Criar Projeto com TivaWare



- Keil
- TivaWare
- Projeto

- Configurar Propriedades do Projeto: **(Use default compiler version 5)**



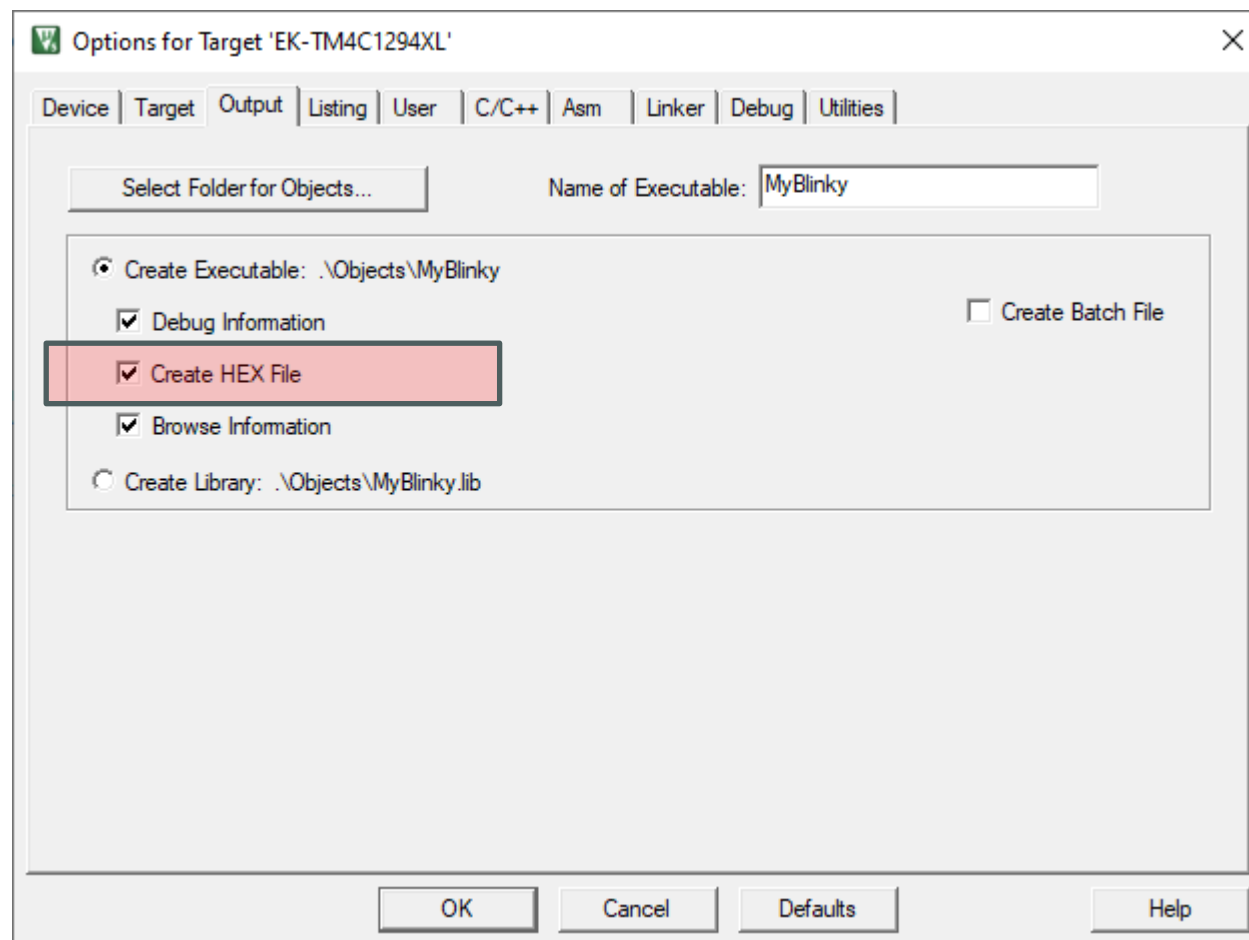


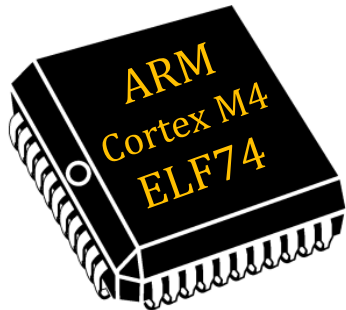
Criar Projeto com TivaWare



- Keil
- TivaWare
- Projeto

Configurar Propriedades do Projeto: **(Output)**



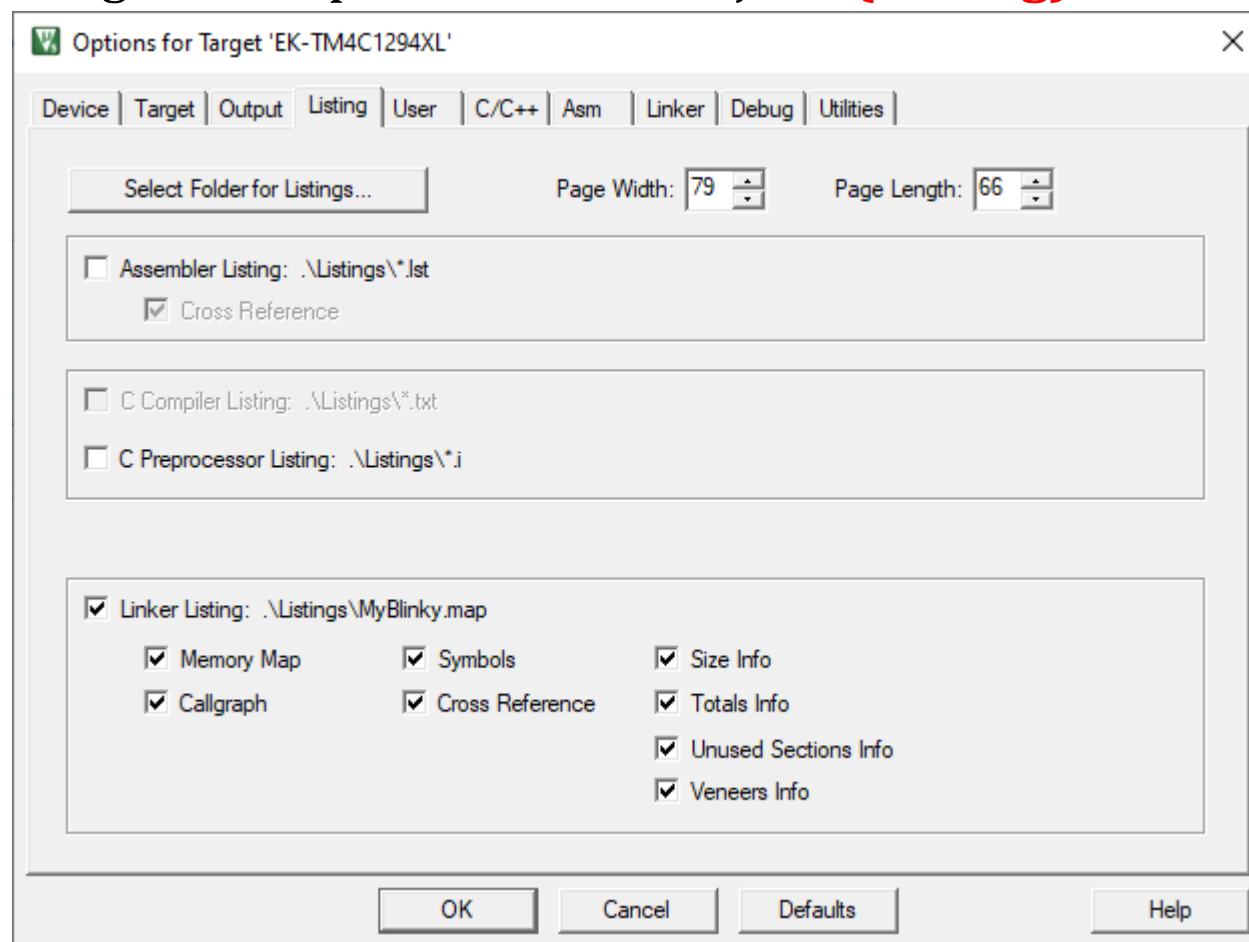


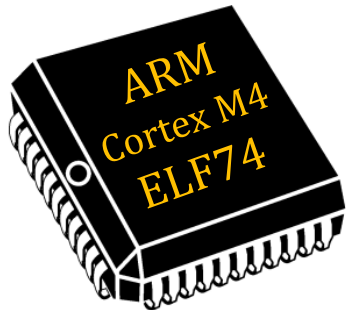
Criar Projeto com TivaWare



- Keil
- TivaWare
- Projeto

Configurar Propriedades do Projeto: **(Listing)**



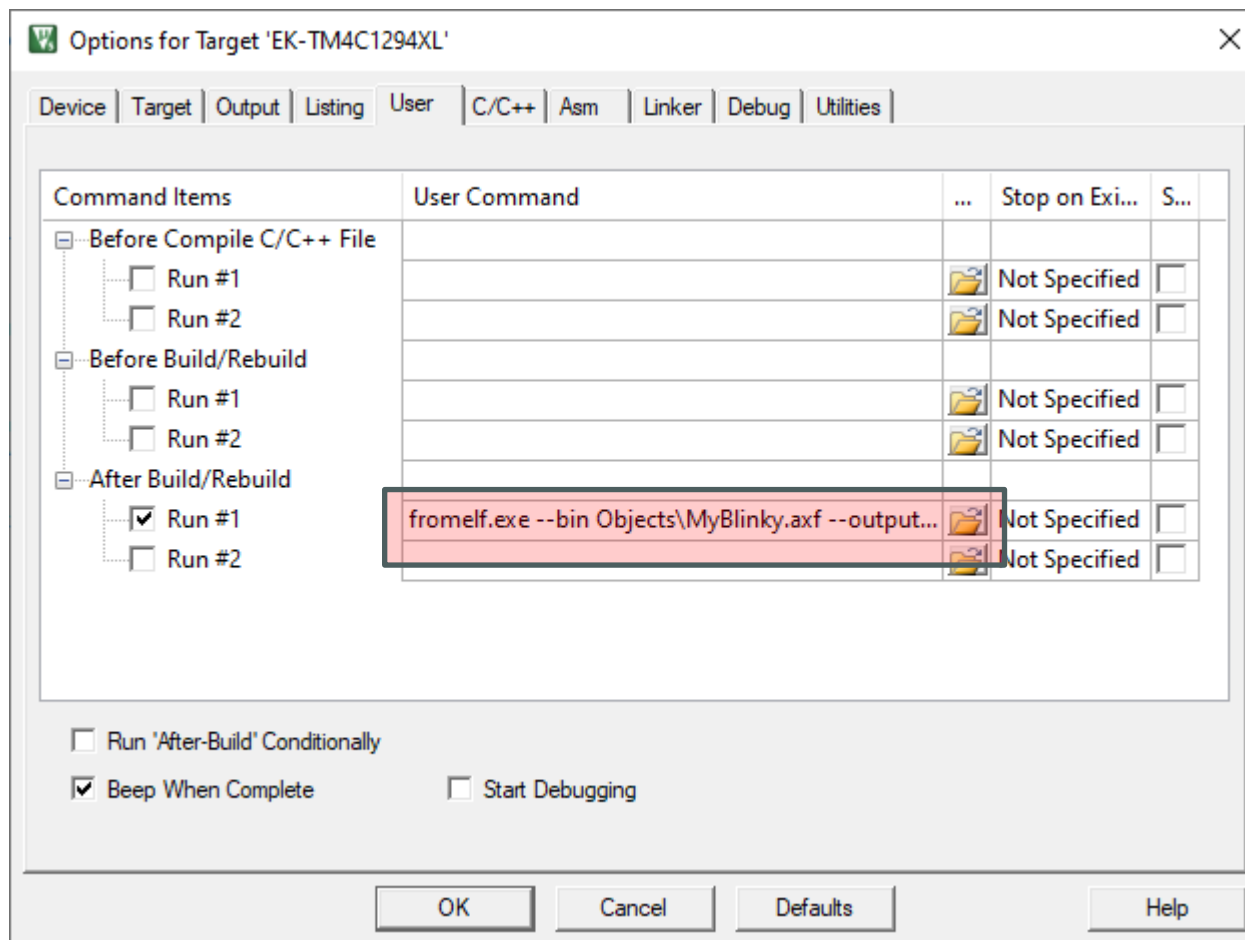


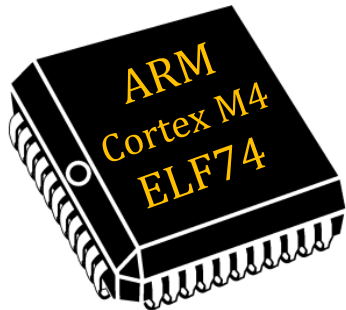
Criar Projeto com TivaWare

- Configurar Propriedades do Projeto: **(Run #1: fromelf.exe --bin Objects\MyBlinky.axf --output Objects\MyBlinky.bin)**



- Keil
- TivaWare
- Projeto



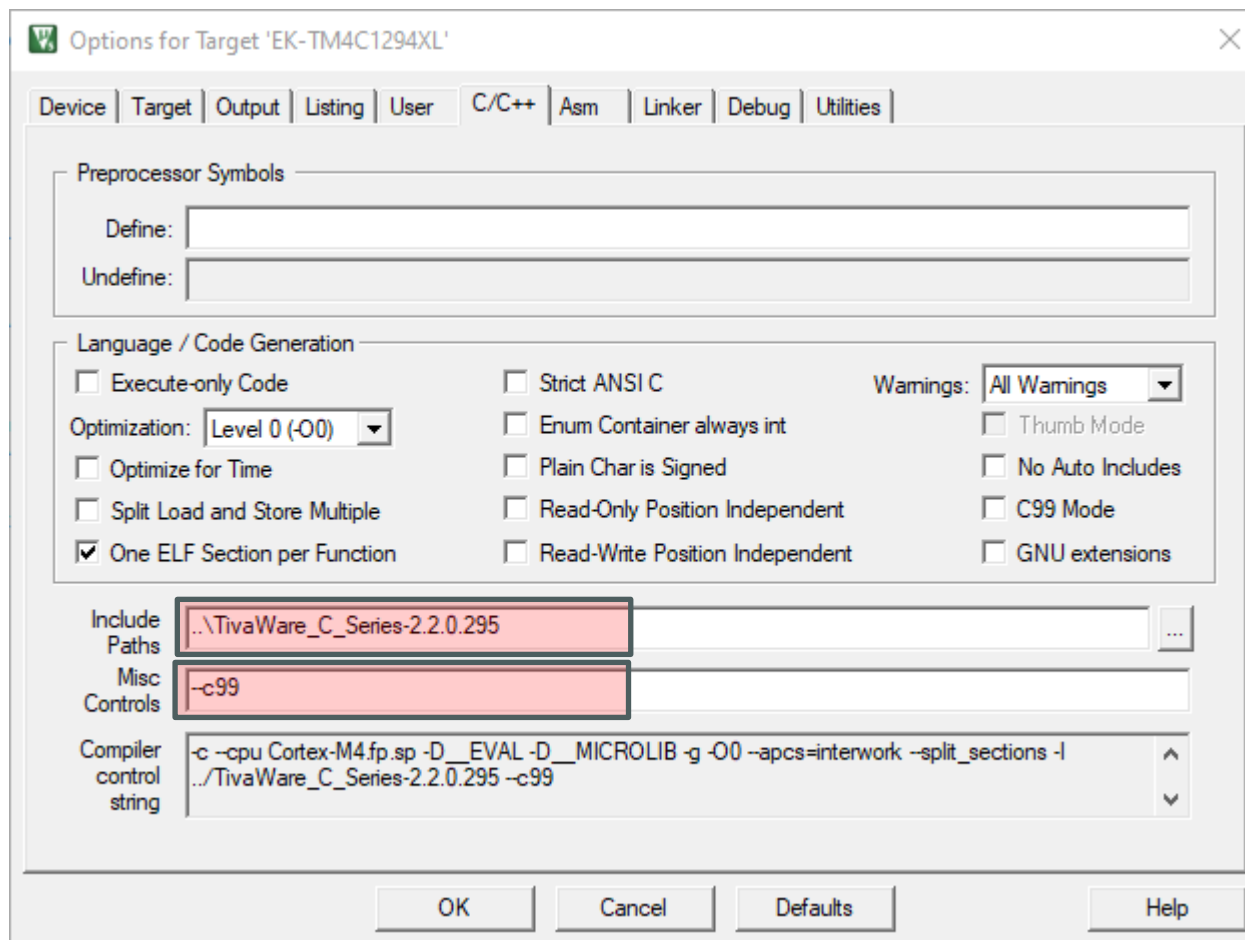


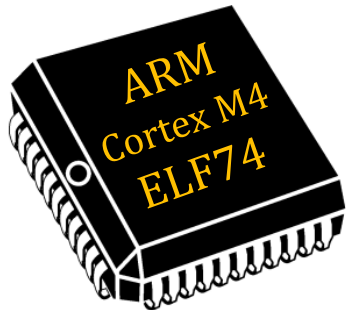
Criar Projeto com TivaWare



- Keil
- TivaWare
- Projeto

Configurar Propriedades do Projeto: ([..\TivaWare_C_Series-2.2.0.295 | --c99](#))



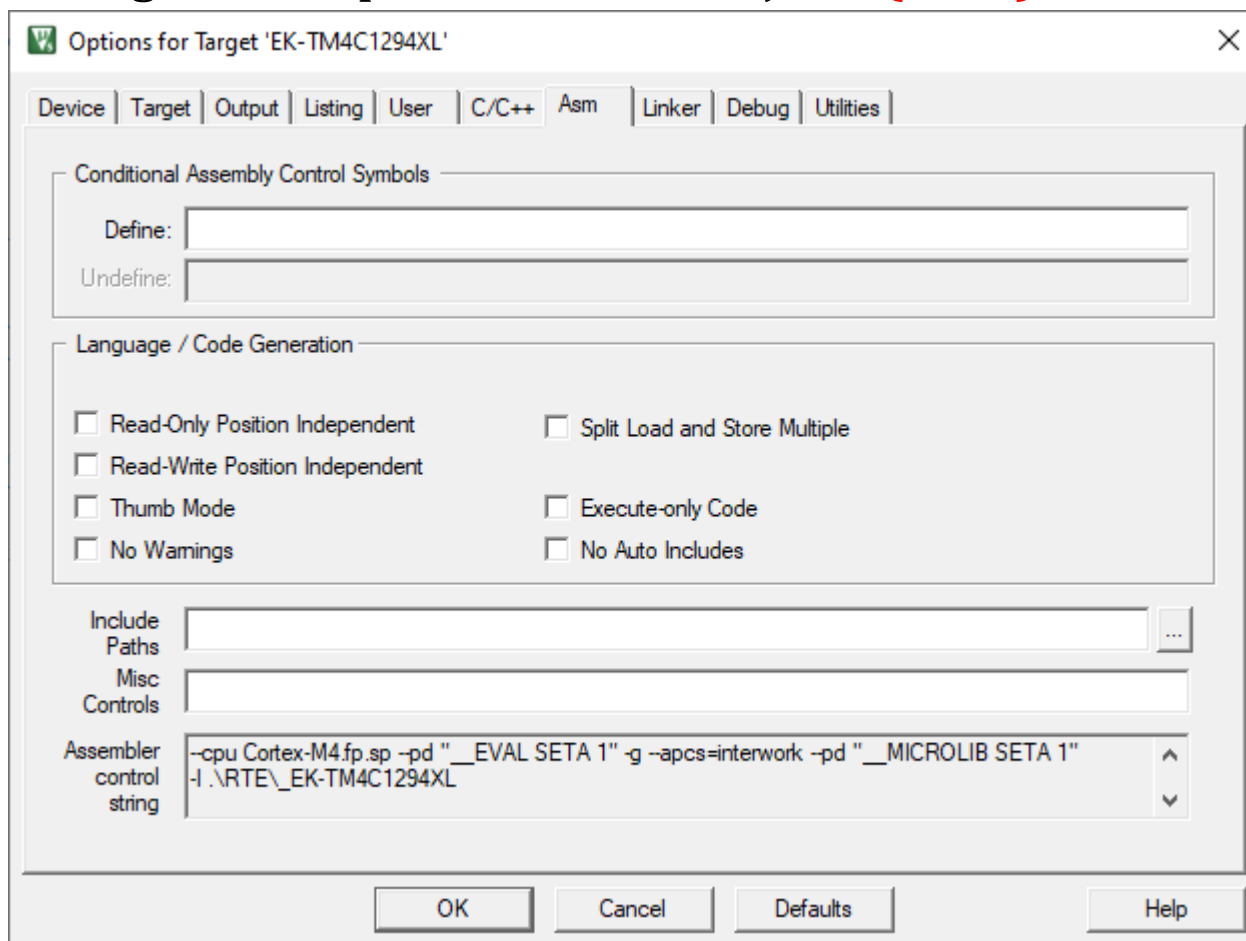


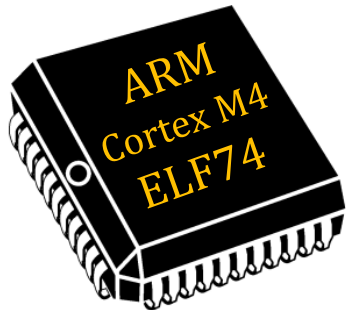
Criar Projeto com TivaWare



- Keil
- TivaWare
- Projeto

Configurar Propriedades do Projeto: (Asm)



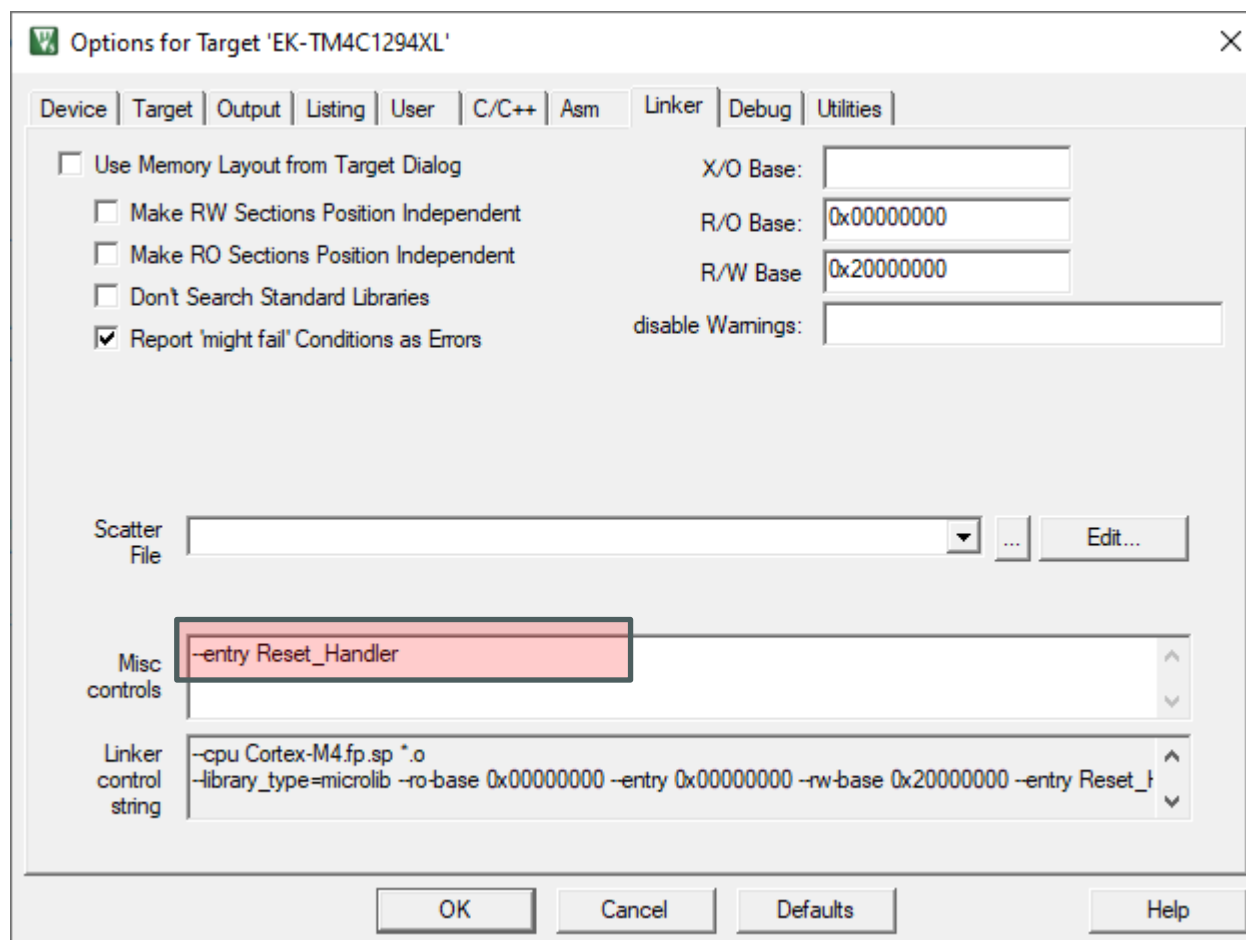


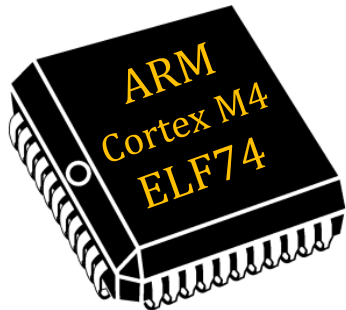
Criar Projeto com TivaWare



- Keil
- TivaWare
- Projeto

Configurar Propriedades do Projeto: (**--entry Reset_Handler**)



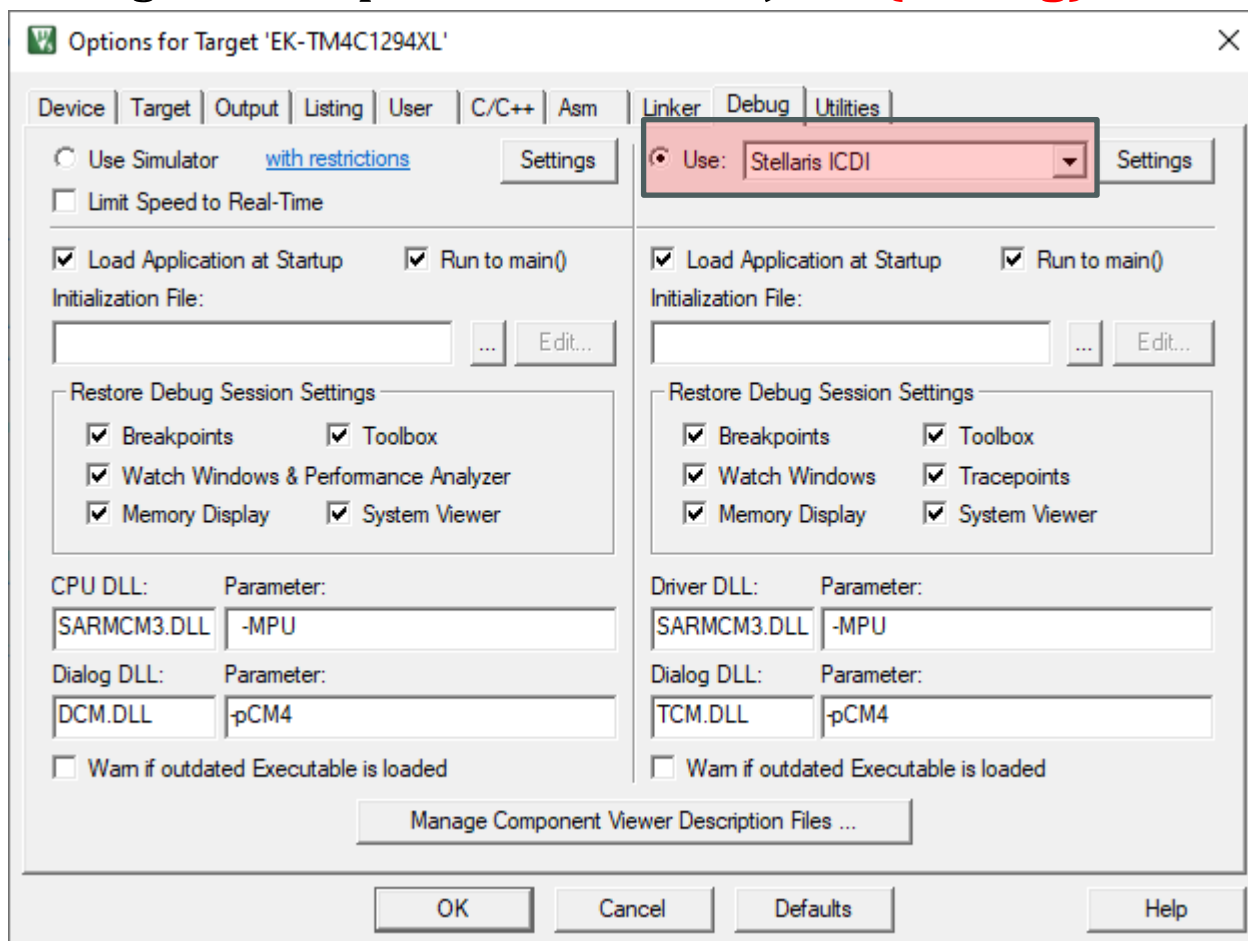


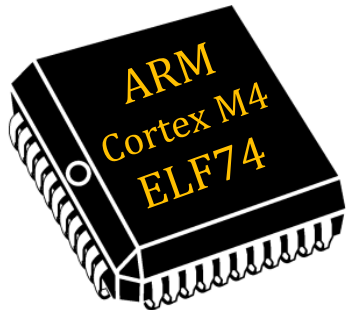
Criar Projeto com TivaWare



- Keil
- TivaWare
- Projeto

Configurar Propriedades do Projeto: **(Debug)**



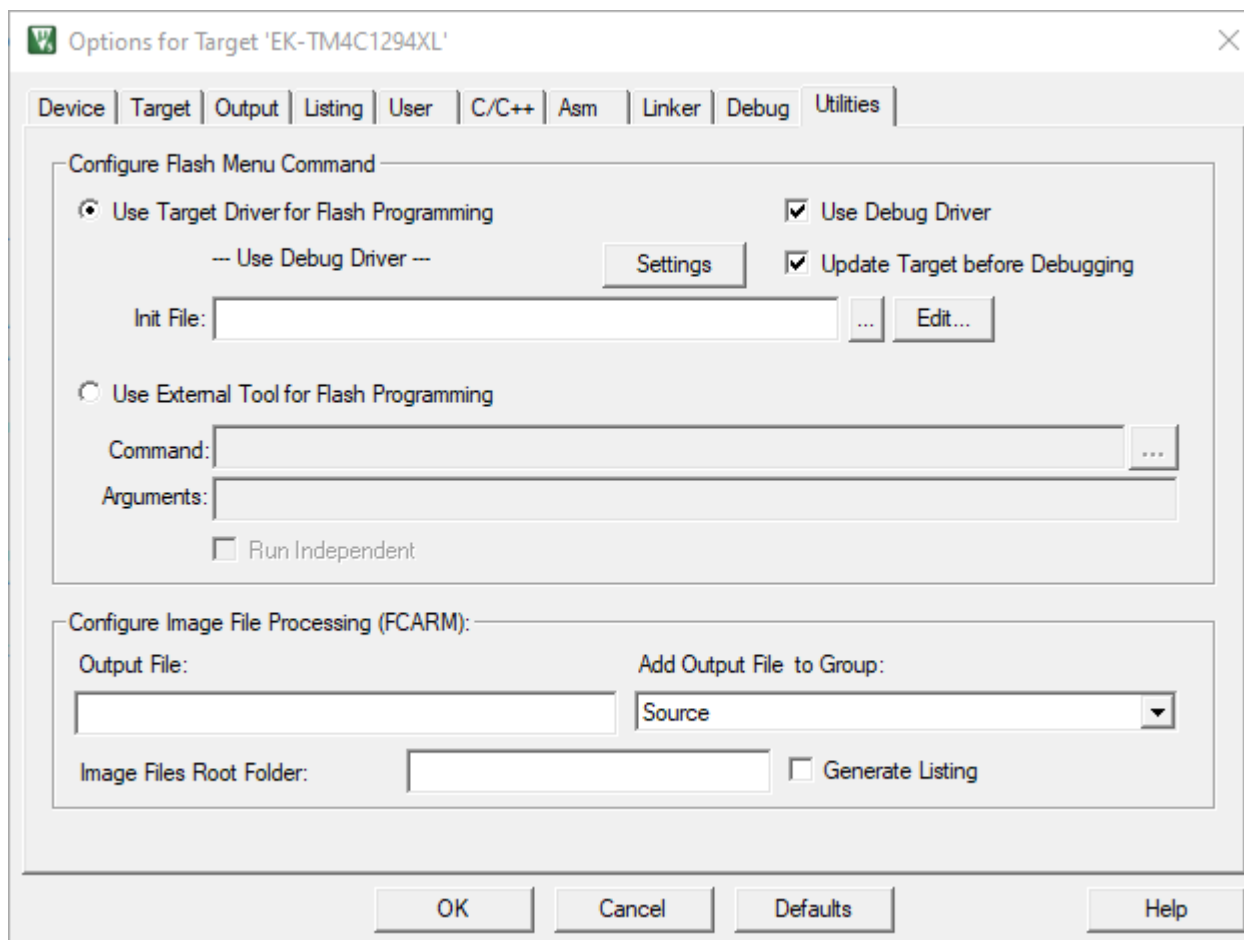


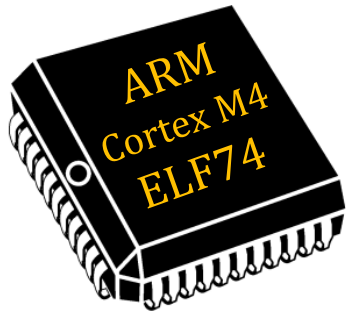
Criar Projeto com TivaWare



- Keil
- TivaWare
- Projeto

Configurar Propriedades do Projeto: **(Utilities)**





Criar Projeto com TivaWare



- Keil
- TivaWare
- Projeto

📁 Projeto completo:

```
1 //*****
2 Prof. Paulo Denis Garcez da Luz - 2023/23
3 Desenvolvido para a placa EK-TM4C1294XL utilizando o SDK TivaWare no KEIL
4 Programa exemplo de blink(is) usando apenas 1 led e Periférico SysTick.
5 *****/
6 #include <stdint.h>
7 #include <stdbool.h>
8 #include "inc/hw_memmap.h"
9 #include "driverlib/debug.h"
10 #include "driverlib/gpio.h"
11 #include "driverlib/sysctl.h"
12 #include "driverlib/systick.h"
13
14 //variável que conta os ticks(lms) - Volatile não permite o compilador otimizar o código
15 static volatile unsigned int SysTicks;
16
17 //Protótipos de funções criadas no programa, código depois do main
18 void SetupSysTick(void);
19 void SysTickIntHandler(void);
20
21 int main(void)
22 {
23     //estado do led
24     bool led=false;
25     //Configura o Clock para utilizar o xtal interno de 16MHz com FLL para 40MHz
26     SysCtlClockFreqSet(SYSCTL_OSC_INT | SYSCTL_USE_FLL | SYSCTL_CFG_VCO_320, 40000000);
27     //habilitar gpio port W
28     SysCtlPeripheralEnable(SYSCTL_PERIPH_GPIOW);
29     //aguardar o periférico ficar pronto para uso
30     while(!SysCtlPeripheralReady(SYSCTL_PERIPH_GPIOW)) { /*espera habilitar o port*/ }
31     //configura o pin 0 como saída
32     GPIOPinTypeGPIOOutput(GPIO_PORTW_BASE, GPIO_PIN_0);
33     //executa configuração e inicialização do SysTick
34     SetupSysTick();
35     //loop infinito
36     while (1)
37     {
38         //se já passou 1000ms = 1s, alterar o estado do led
39         if (SysTicks==1000)
40         {
41             led=!led;
42             SysTicks=0;
43         }
44     }
45 }
```

Build Output

```
Rebuild started: Project: MyBlinky
*** Using Compiler 'V5.06 update 7' (build 960), folder: 'C:\Keil_v5\ARM\ARMCC\Bin'
Rebuild target 'EK-TM4C1294XL'
assembling startup_rvmdk.S...
compiling main.c...
linking...
Program Size: Code=2252 RO-data=628 RW-data=1644 ZI-data=516
FromELF: creating hex file...
After Build - User command #1: fromelf.exe --bin Objects\MyBlinky.axf --output Objects\MyBlinky.bin
Objects\MyBlinky.axf - 0 Error(s), 0 Warning(s).
Build Time Elapsed: 00:00:01
```