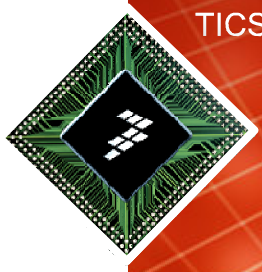
Freescale MQX MQX Basics S4 Drivers

TICS - Technical Information & Commercial Support



Jan 2014

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Module Agenda

- Drivers

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What is a driver?

- What is a device driver?
  - A software layer that interacts with the hardware
  - Contain specific routines to handle the hardware

- Advantages offered by a driver:
  - Portable application
  - Faster development
  - Reusable code
  - Simplify the application

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MQX Drivers

- MQX provides several device drivers that your application can use:
  - I2C
  - UART
  - SPI
  - RTC
  - Flash
  - SD card
  - and much more!
- These drivers are included on the Board Support Package (BSP)
- BSP is a software layer with all the initialization code, drivers, configuration needed to bring up a MCU/MPU

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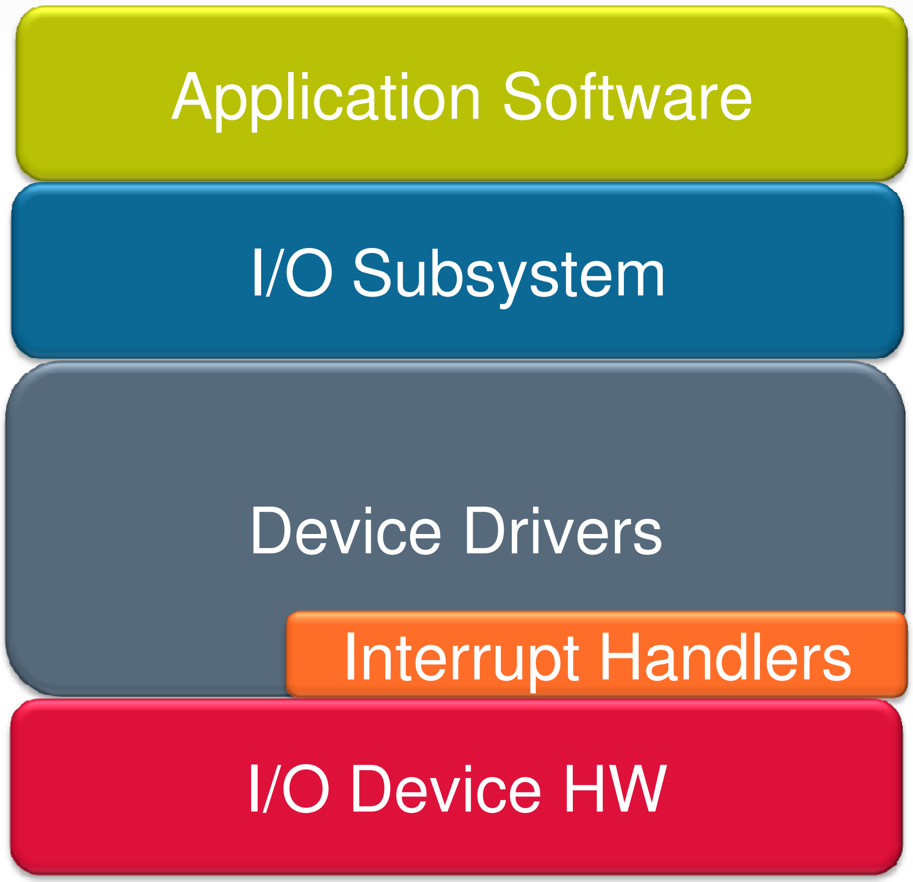
I/O Subsystem

- Uniform method to communicate with I/O device drivers
- Hide specific driver functions
- Easy API



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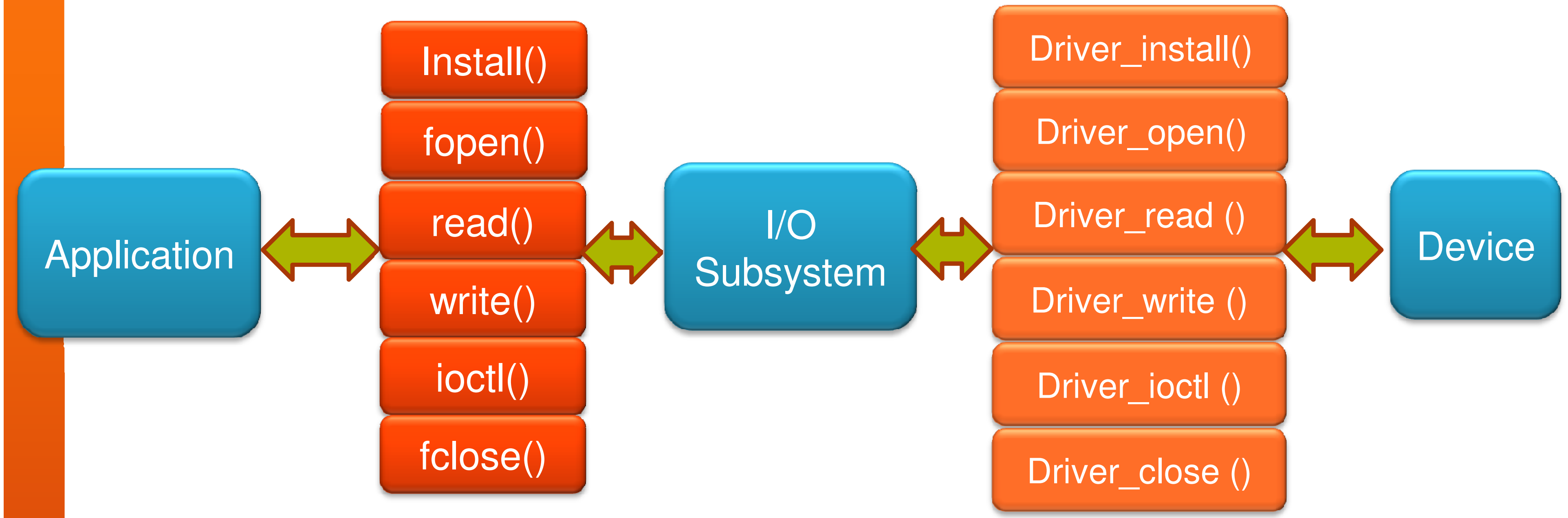
I/O Subsystem API

- POSIX standard I/O
- What does the I/O subsystem API look like?



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Using a MQX driver

- Install the driver using the *user_config.h* file if not installed
  - Recompile the MQX libraries
- Open the driver with *fopen*
  - Use the same driver name used on install
  - For standard MQX drivers the names are available on the IO Driver User guide
- Use the *read* or *write* functions as you need
  - The FD provided by fopen is used to specify the driver to be called
- Use *ioctl* function when needed
  - Commands for standard MQX drivers are available on IO Driver User Guide

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MQX Driver API

- MQX I/O device driver provides different services to interact with the application
- Some of these services are optional
- Depends on the driver how these services are implemented

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MQX Driver API

- The MQX device drive is installed by:
  - _io_*device*_install
- All MQX device drives should contain the following services:
  - _io_*device*_open
  - _io_*device*_close
  - _io_*device*_read
  - _io_*device*_write
  - _io_*device*_ioctl
- Note that "***device***" should be replaced with the name of the device family such as:
  - _io_*null*_xxx
  - _io_*rng*_xxx
  - _io_*ttya*_xxx

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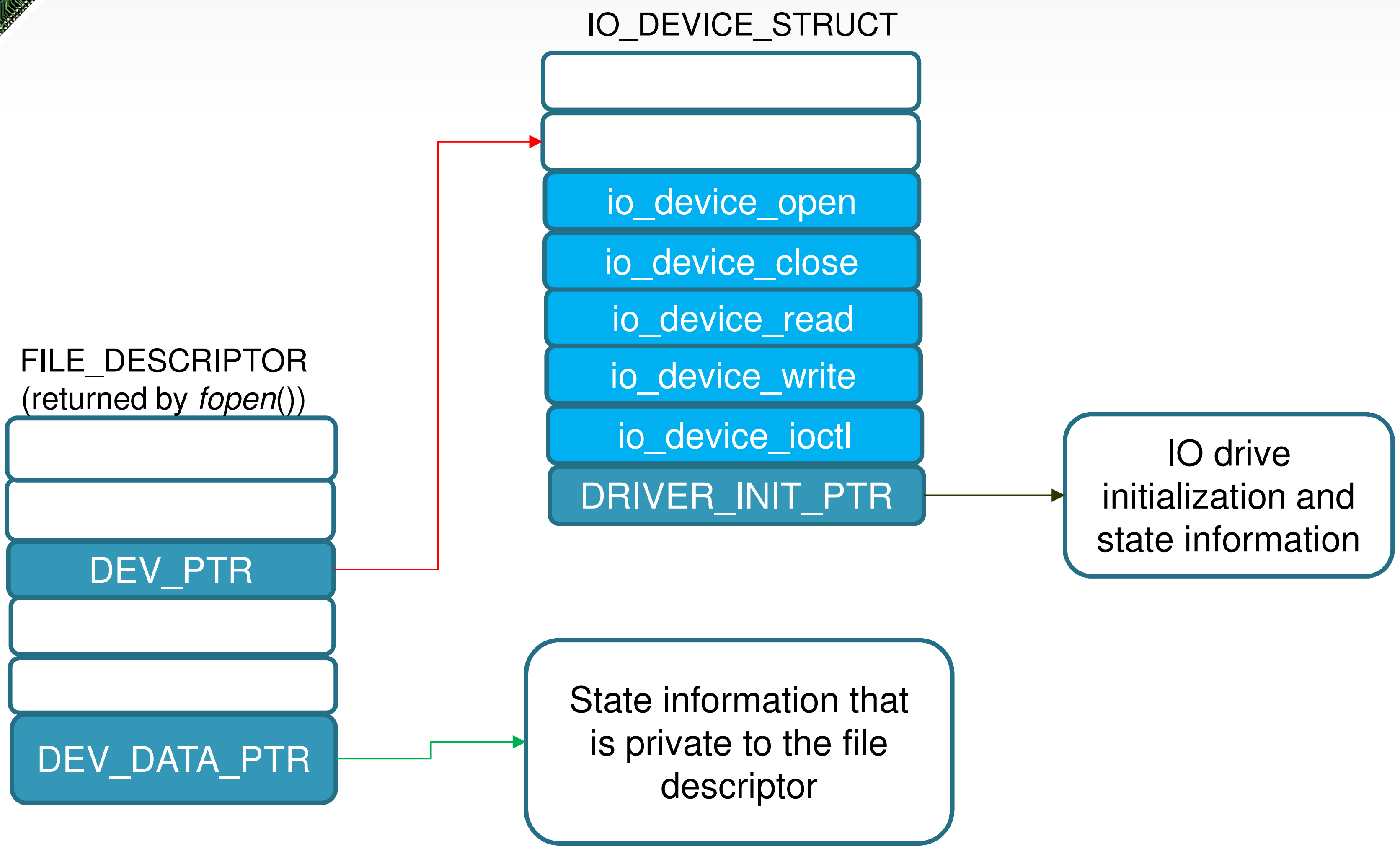
MQX Driver API



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MQX API driver description

Install (Required):

- Parameters:
  - Identifier: The driver name
  - Specific driver initialization
- Usually called on BSP initialization
- Set up the driver to MQX

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What Does Each Function Need?

Open (Required):

- Parameters:
  - File handler
  - Open name
  - Flags

- Allocate memory for driver buffers

- Configure the specific device

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What Does Each Function Need?

Close (Required):

- Parameters:
  - File handler

- Free the memory allocated

- Close other drivers used

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What Does Each Function Need?

Read (Optional):

- Parameters
  - File handler
  - Pointer to the buffer
  - Amount of data to be read (on bytes)

- Perform the actions needed to retrieve data from the device

- Can call other drivers

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What Does Each Function Need?

Write (Optional):

- Parameters
  - File handler
  - Pointer to the data buffer
  - Amount of data to be written (in bytes)
- Perform action needed to send the data to the device
- Can use other drivers

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What Does Each Function Need?

IOCTL (Optional):

- Parameters:
  - File handler
  - Command to be executed
  - Pointer to command parameters
- Usually implement “get” and “set” commands
- Provides different configuration settings for the driver
- Specific actions for the driver

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MQX Driver API

- Once the driver is written test it before use it on your application
  - Create a test project and add it directly to it

- Once is tested and working:
  - Add it to the BSP
  - Create a macro to install it from the *user_config.h* file
  - Install it either from the BSP or directly from application
  - Enjoy your new driver!!!

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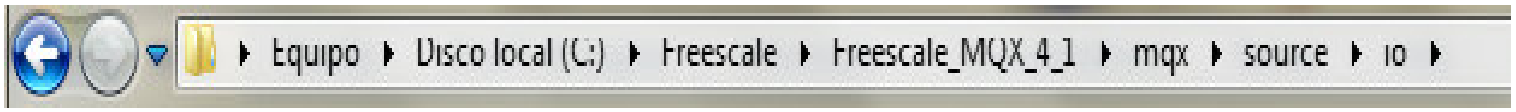
How to make a driver?

Go to io folder at:



Equipo ▸ Disco local (C:) ▸ Freescale ▸ Freescale_MQX_4_1 ▸ mqx ▸ source ▸ io ▸

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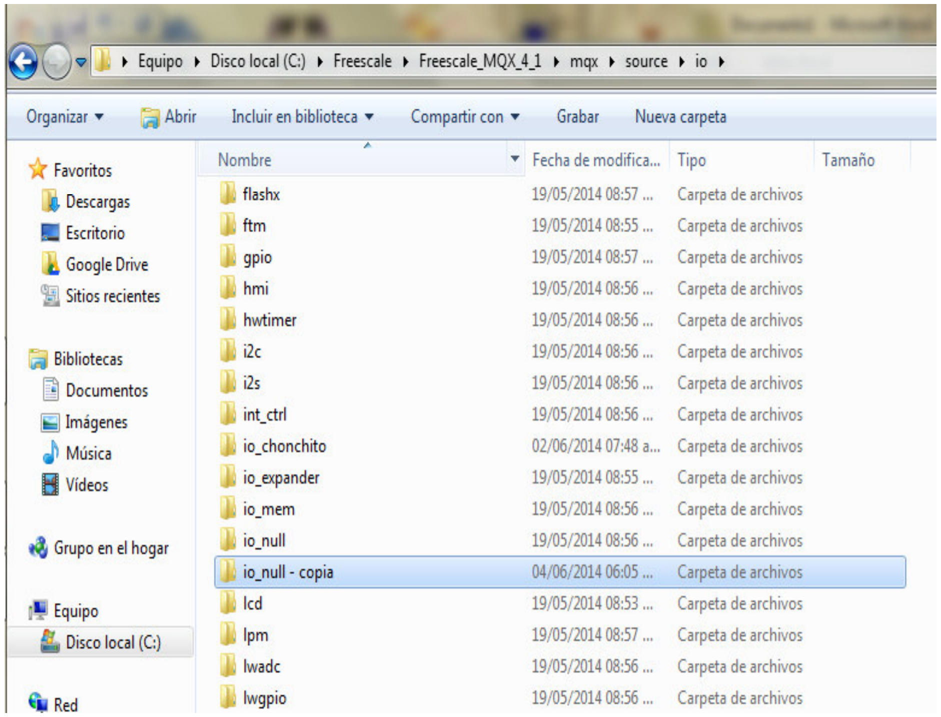
How to make a driver?

Copy and paste the io_null folder, a folder called io_null will appear - copy, which is the folder where the new driver will be created:



Equipo ▸ Disco local (C:) ▸ Freescale ▸ Freescale_MQX_4_1 ▸ mqx ▸ source ▸ io ▸

Nombre	Fecha de modifica...	Tipo	Tamaño
flashx	19/05/2014 08:57 ...	Carpeta de archivos	
ftm	19/05/2014 08:55 ...	Carpeta de archivos	
gpio	19/05/2014 08:57 ...	Carpeta de archivos	
hmi	19/05/2014 08:56 ...	Carpeta de archivos	
hwtimer	19/05/2014 08:56 ...	Carpeta de archivos	
i2c	19/05/2014 08:56 ...	Carpeta de archivos	
i2s	19/05/2014 08:56 ...	Carpeta de archivos	
int_ctrl	19/05/2014 08:56 ...	Carpeta de archivos	
io_chonchito	02/06/2014 07:48 a...	Carpeta de archivos	
io_expander	19/05/2014 08:55 ...	Carpeta de archivos	
io_mem	19/05/2014 08:56 ...	Carpeta de archivos	
io_null	19/05/2014 08:56 ...	Carpeta de archivos	
io_null - copia	04/06/2014 06:05 ...	Carpeta de archivos	
lcd	19/05/2014 08:53 ...	Carpeta de archivos	
lpm	19/05/2014 08:57 ...	Carpeta de archivos	
lwadc	19/05/2014 08:56 ...	Carpeta de archivos	
lwgpio	19/05/2014 08:56 ...	Carpeta de archivos	

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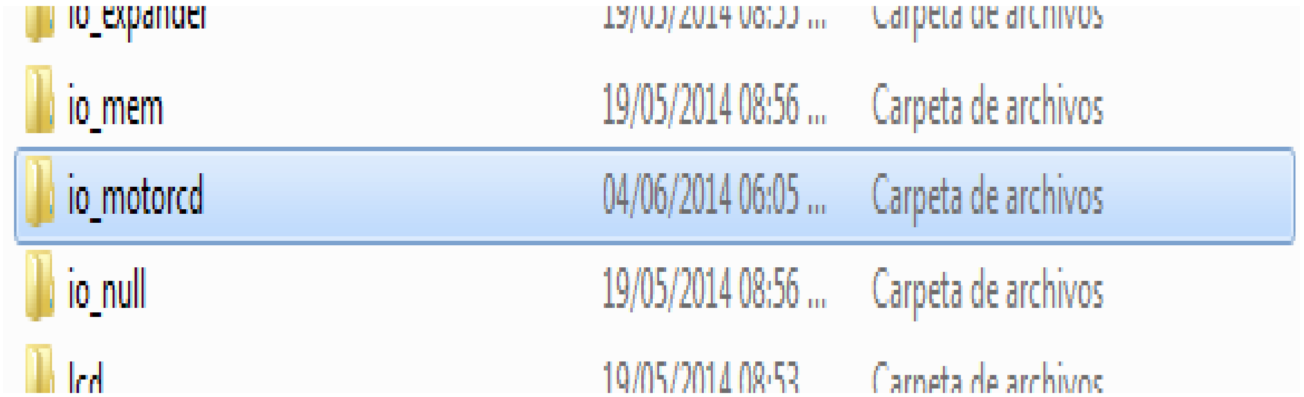
How to make a driver?

Rename the folder io_null – copia



```
io_expander    19/05/2014 08:55 ...   Carpeta de archivos
io_mem         19/05/2014 08:56 ...   Carpeta de archivos
io_motorcd     04/06/2014 06:05 ...   Carpeta de archivos
io_null        19/05/2014 08:56 ...   Carpeta de archivos
lcd            19/05/2014 08:53       Carpeta de archivos
```

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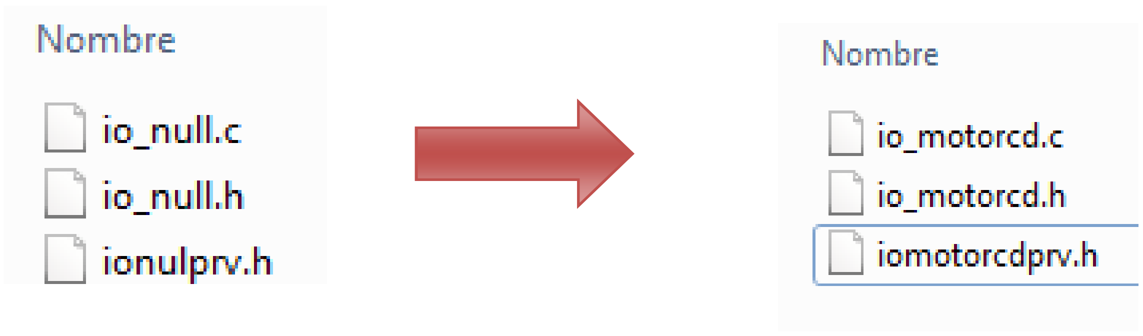
How to make a driver?

Inside the folder 3 files are located, to which they should change the name, removing “null” and renaming with the desired name:



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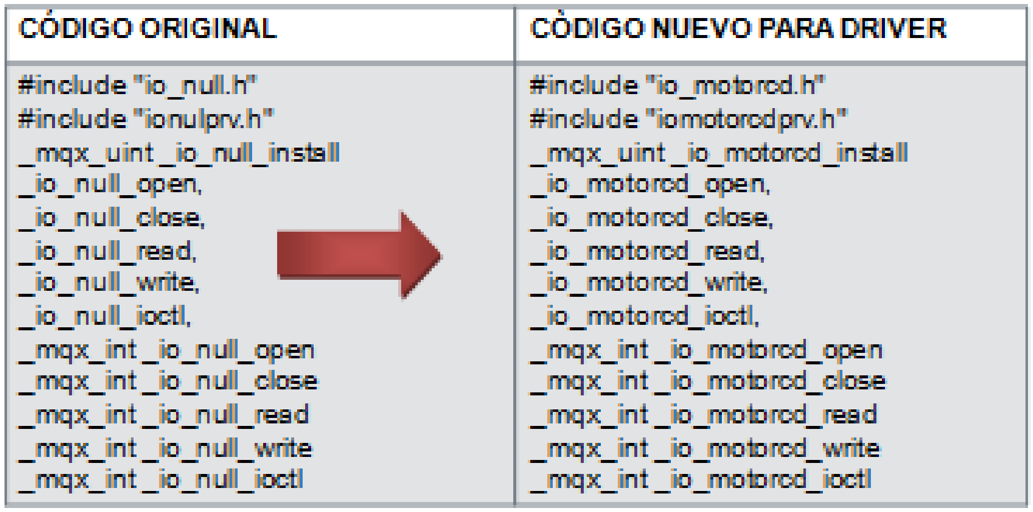
How to make a driver?

The file io_motorcd.c must be modified from a text editor, where the word “null” is replaced by motorcd, lines to change are:



CÓDIGO ORIGINAL	CÒDIGO NUEVO PARA DRIVER
#include "io_null.h"	#include "io_motorcd.h"
#include "ionulprv.h"	#include "iomotorcdprv.h"
_mqx_uint _io_null_install	_mqx_uint _io_motorcd_install
_io_null_open,	_io_motorcd_open,
_io_null_close,	_io_motorcd_close,
_io_null_read,	_io_motorcd_read,
_io_null_write,	_io_motorcd_write,
_io_null_ioctl,	_io_motorcd_ioctl,
_mqx_int _io_null_open	_mqx_int _io_motorcd_open
_mqx_int _io_null_close	_mqx_int _io_motorcd_close
_mqx_int _io_null_read	_mqx_int _io_motorcd_read
_mqx_int _io_null_write	_mqx_int _io_motorcd_write
_mqx_int _io_null_ioctl	_mqx_int _io_motorcd_ioctl

Be careful, in the file is the" NULL" function, which is a reserved word and should not be modified.

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How to make a driver?

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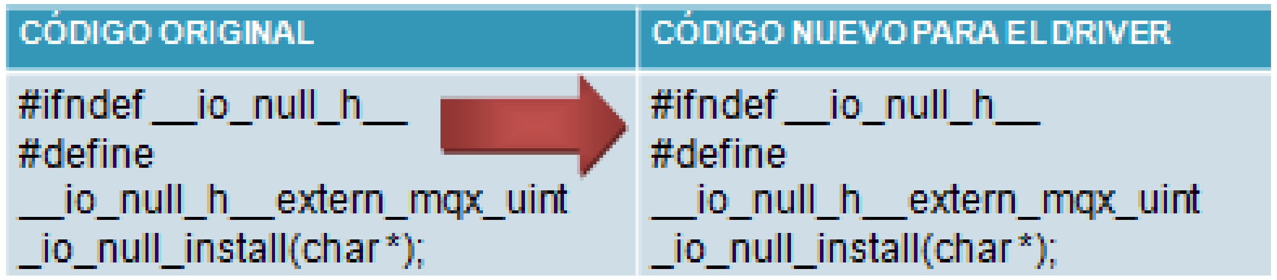

CÓDIGO ORIGINAL	CÓDIGO NUEVO PARA EL DRIVER
#ifndef __io_null_h__ #define __io_null_h__extern_mqx_uint _io_null_install(char *);	#ifndef __io_null_h__ #define __io_null_h__extern_mqx_uint _io_null_install(char *);

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How to make a driver?

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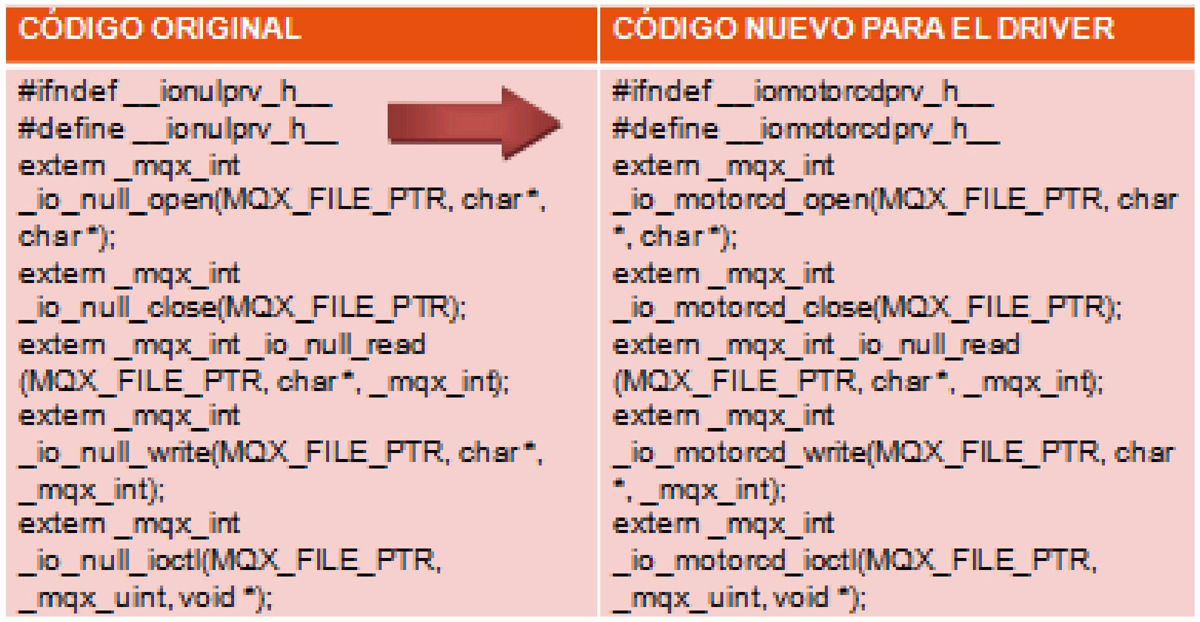

CÓDIGO ORIGINAL	CÓDIGO NUEVO PARA EL DRIVER
#ifndef __ionulprv_h__	#ifndef __iomotorcdprv_h__
#define __ionulprv_h__	#define __iomotorcdprv_h__
extern _mqx_int _io_null_open(MQX_FILE_PTR, char *, char *);	extern _mqx_int _io_motorcd_open(MQX_FILE_PTR, char *, char *);
extern _mqx_int _io_null_close(MQX_FILE_PTR);	extern _mqx_int _io_motorcd_close(MQX_FILE_PTR);
extern _mqx_int _io_null_read (MQX_FILE_PTR, char *, _mqx_int);	extern _mqx_int _io_null_read (MQX_FILE_PTR, char *, _mqx_int);
extern _mqx_int _io_null_write(MQX_FILE_PTR, char *, _mqx_int);	extern _mqx_int _io_motorcd_write(MQX_FILE_PTR, char *, _mqx_int);
extern _mqx_int _io_null_ioctl(MQX_FILE_PTR, _mqx_uint, void *);	extern _mqx_int _io_motorcd_ioctl(MQX_FILE_PTR, _mqx_uint, void *);

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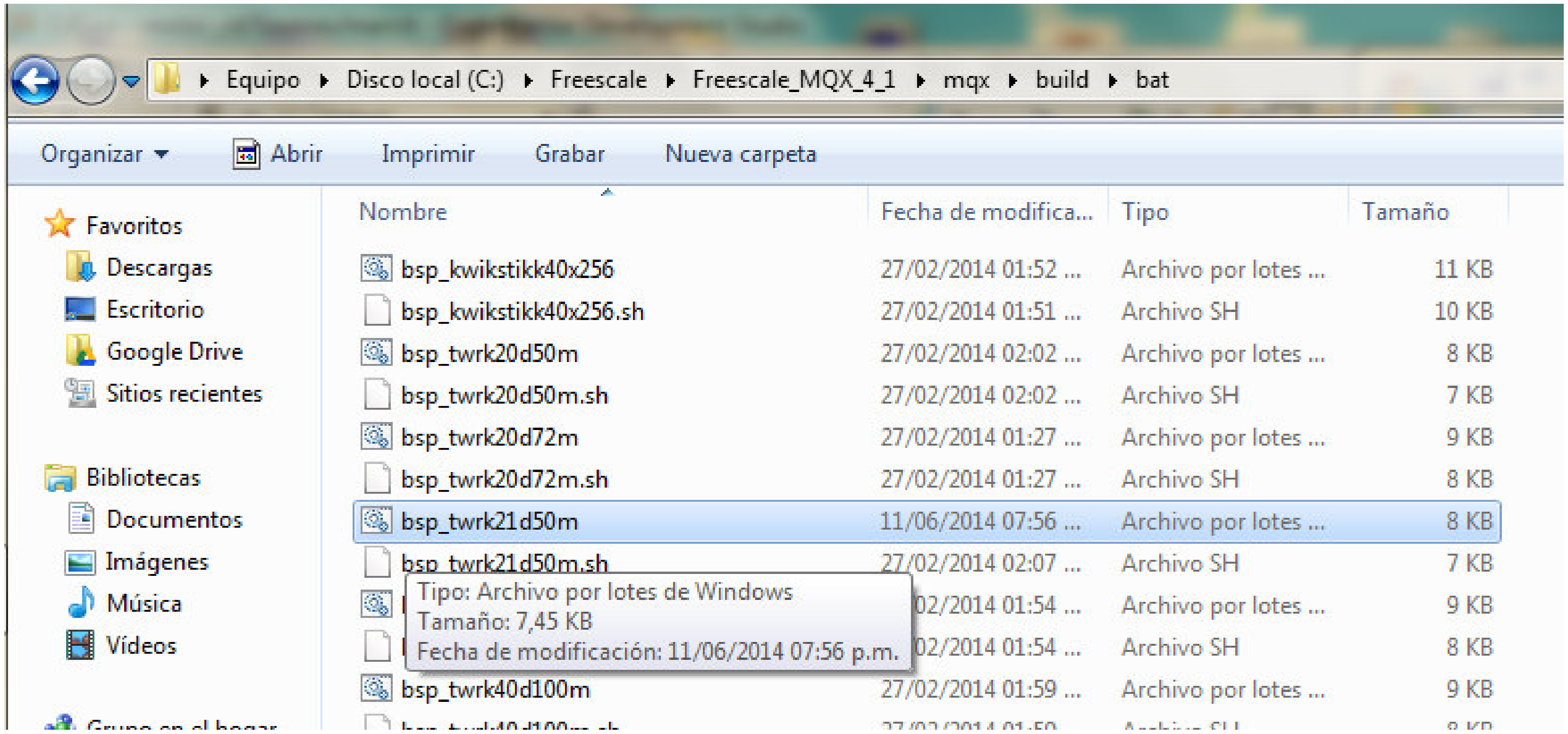
How to make a driver?

Modify the file .bat using a text editor. This file is located at the following address:



Equipo ▸ Disco local (C:) ▸ Freescale ▸ Freescale_MQX_4_1 ▸ mqx ▸ build ▸ bat

Nombre	Fecha de modifica...	Tipo	Tamaño
bsp_kwikstikk40x256	27/02/2014 01:52 ...	Archivo por lotes ...	11 KB
bsp_kwikstikk40x256.sh	27/02/2014 01:51 ...	Archivo SH	10 KB
bsp_twrk20d50m	27/02/2014 02:02 ...	Archivo por lotes ...	8 KB
bsp_twrk20d50m.sh	27/02/2014 02:02 ...	Archivo SH	7 KB
bsp_twrk20d72m	27/02/2014 01:27 ...	Archivo por lotes ...	9 KB
bsp_twrk20d72m.sh	27/02/2014 01:27 ...	Archivo SH	8 KB
bsp_twrk21d50m	11/06/2014 07:56 ...	Archivo por lotes ...	8 KB
bsp_twrk21d50m.sh	27/02/2014 02:07 ...	Archivo SH	7 KB
[illegible]	02/2014 01:54 ...	Archivo por lotes ...	9 KB
[illegible]	02/2014 01:54 ...	Archivo SH	8 KB
bsp_twrk40d100m	27/02/2014 01:59 ...	Archivo por lotes ...	9 KB
bsp_twrk40d100m.sh	27/02/2014 01:59 ...	Archivo SH	8 KB

Tipo: Archivo por lotes de Windows
Tamaño: 7,45 KB
Fecha de modificación: 11/06/2014 07:56 p.m.

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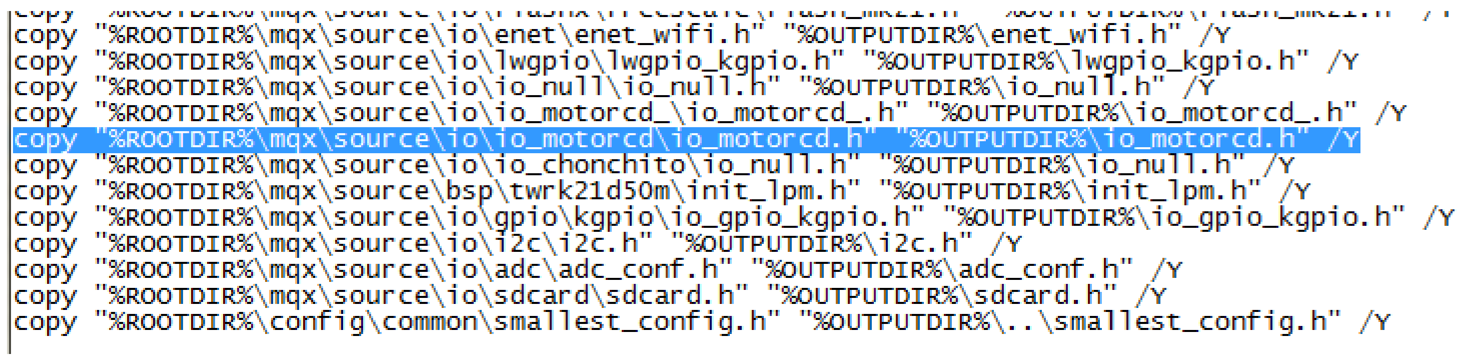
How to make a driver?

Inside archive .bat, add the following line:

copy"%ROOTDIR%\mqx\source\io\io_motorcd\io_motorcd.h""%OUTPUTDIR%\io_motorcd.h“:



```
copy "%ROOTDIR%\mqx\source\io\enet\enet_wifi.h" "%OUTPUTDIR%\enet_wifi.h" /Y
copy "%ROOTDIR%\mqx\source\io\lwgpio\lwgpio_kgpio.h" "%OUTPUTDIR%\lwgpio_kgpio.h" /Y
copy "%ROOTDIR%\mqx\source\io\io_null\io_null.h" "%OUTPUTDIR%\io_null.h" /Y
copy "%ROOTDIR%\mqx\source\io\io_motorcd_\io_motorcd_.h" "%OUTPUTDIR%\io_motorcd_.h" /Y
copy "%ROOTDIR%\mqx\source\io\io_motorcd\io_motorcd.h" "%OUTPUTDIR%\io_motorcd.h" /Y
copy "%ROOTDIR%\mqx\source\io\io_chonchito\io_null.h" "%OUTPUTDIR%\io_null.h" /Y
copy "%ROOTDIR%\mqx\source\bsp\twrk21d50m\init_lpm.h" "%OUTPUTDIR%\init_lpm.h" /Y
copy "%ROOTDIR%\mqx\source\io\gpio\kgpio\io_gpio_kgpio.h" "%OUTPUTDIR%\io_gpio_kgpio.h" /Y
copy "%ROOTDIR%\mqx\source\io\i2c\i2c.h" "%OUTPUTDIR%\i2c.h" /Y
copy "%ROOTDIR%\mqx\source\io\adc\adc_conf.h" "%OUTPUTDIR%\adc_conf.h" /Y
copy "%ROOTDIR%\mqx\source\io\sdcard\sdcard.h" "%OUTPUTDIR%\sdcard.h" /Y
copy "%ROOTDIR%\config\common\smallest_config.h" "%OUTPUTDIR%\..\smallest_config.h" /Y
```

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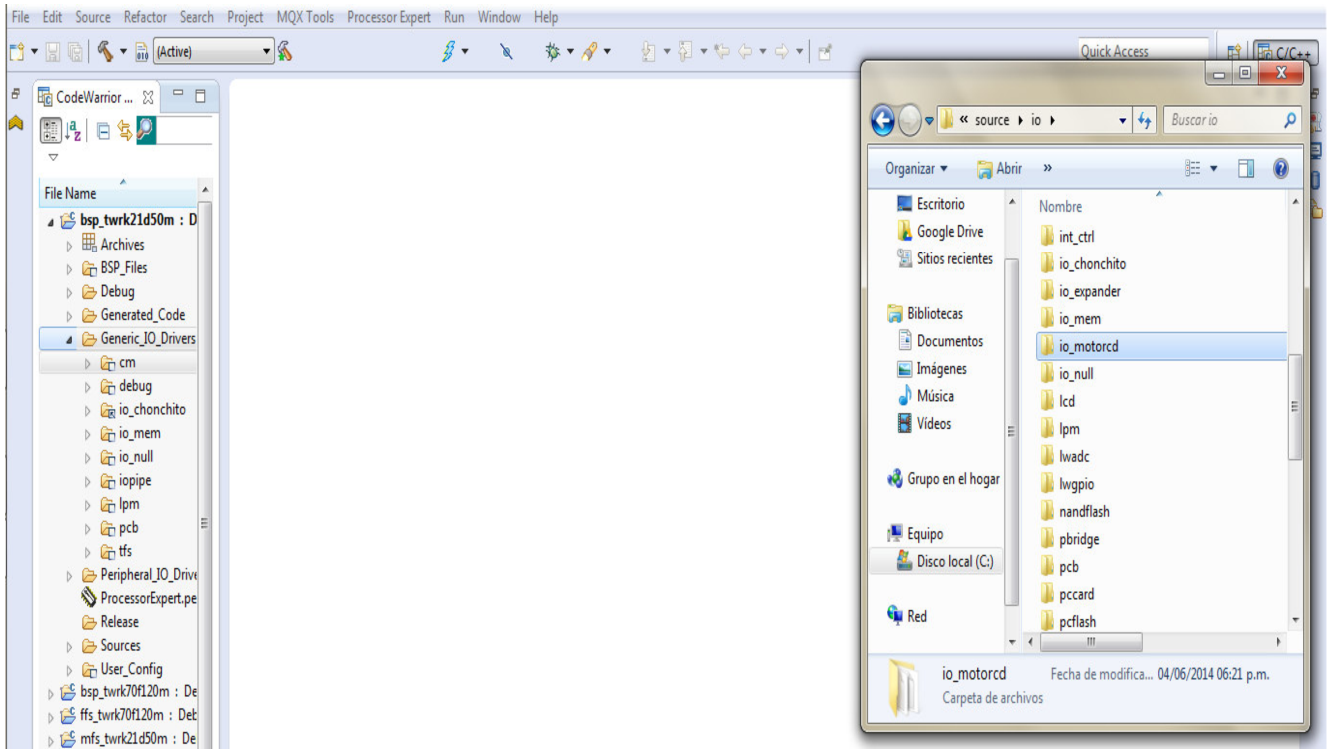
How to make a driver?

Open CodeWarrior Generic_IO_Drivers and drag the folder io_motorcd inside the bsp card folder to use:



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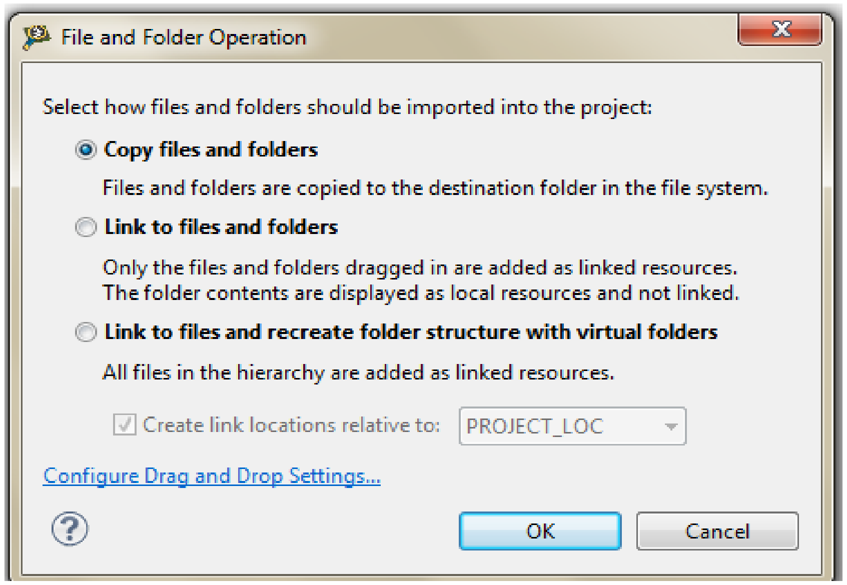
How to make a driver?

Dragging the folder, a window will appear where you will select “copy files and folders”:


File and Folder Operation

Select how files and folders should be imported into the project:

[✓ Copy files and folders]

Files and folders are copied to the destination folder in the file system.

Link to files and folders

Only the files and folders dragged in are added as linked resources. The folder contents are displayed as local resources and not linked.

Link to files and recreate folder structure with virtual folders

All files in the hierarchy are added as linked resources.

[✓] Create link locations relative to: PROJECT_LOC

Configure Drag and Drop Settings...

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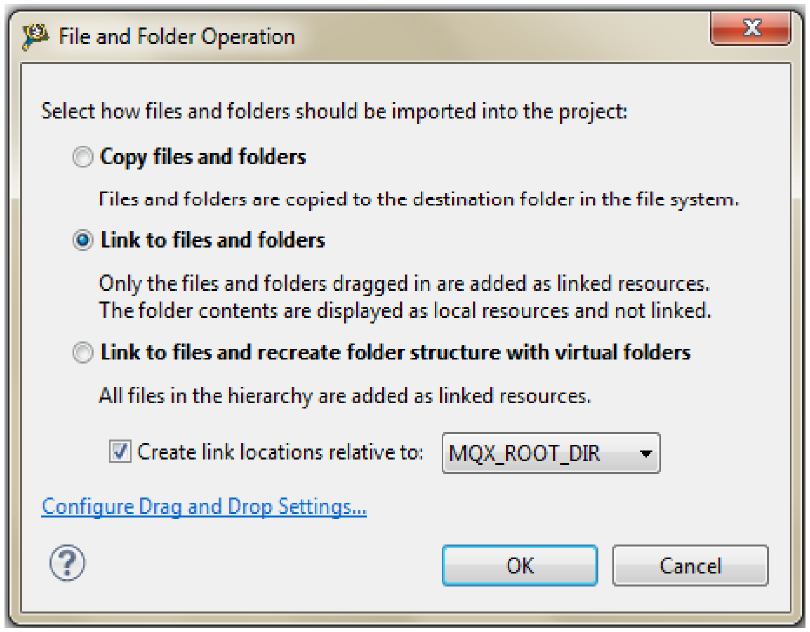
How to make a driver?

Remove the above folder and paste it again, this time select " Link to files and folders" and “MQX_ROOT_DIR”


File and Folder Operation

Select how files and folders should be imported into the project:

( ) Copy files and folders

Files and folders are copied to the destination folder in the file system.

(●) Link to files and folders

Only the files and folders dragged in are added as linked resources.
The folder contents are displayed as local resources and not linked.

( ) Link to files and recreate folder structure with virtual folders

All files in the hierarchy are added as linked resources.

[✓] Create link locations relative to: MQX_ROOT_DIR

Configure Drag and Drop Settings...

OK Cancel

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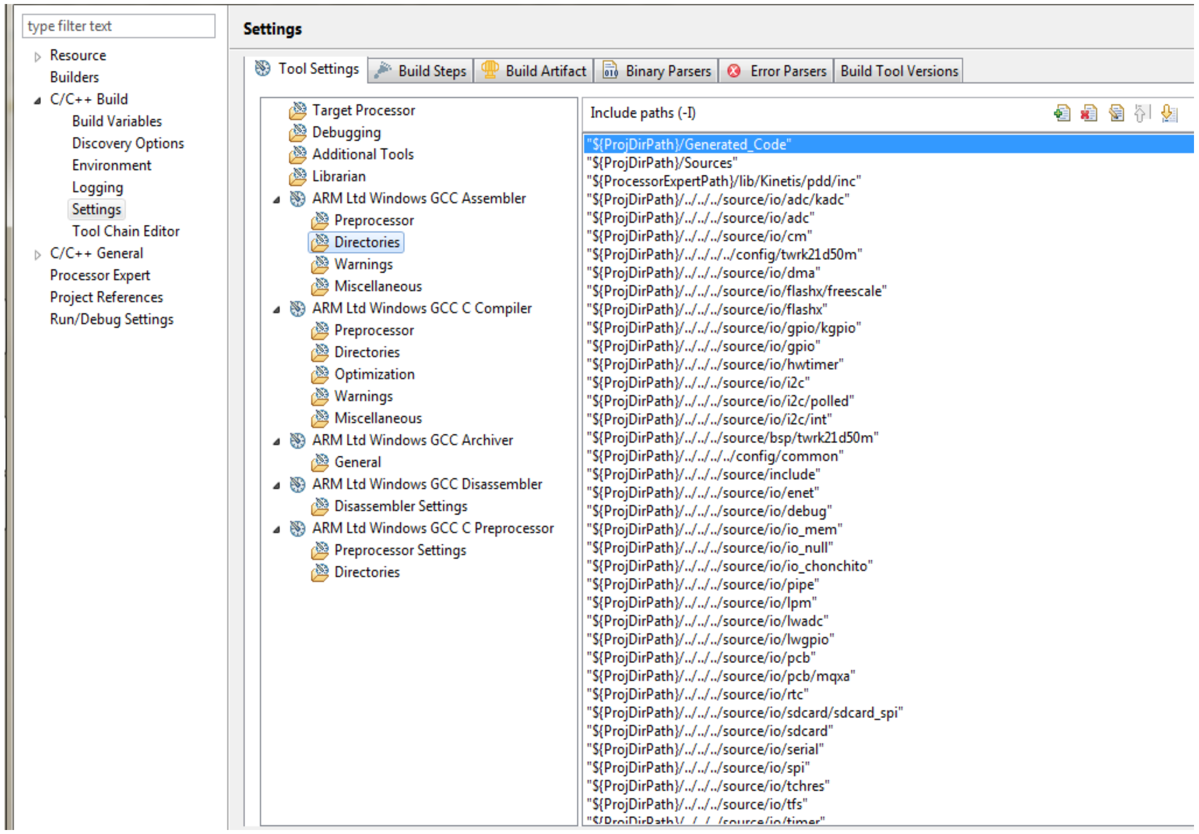
How to make a driver?

Right click on bsp folder and select properties → C/C++ build → Settings → Arm Ltd Windows GCC Assembler → Directories:



Include paths (-I)

```
"${ProjDirPath}/Generated_Code"
"${ProjDirPath}/Sources"
"${ProcessorExpertPath}/lib/Kinetis/pdd/inc"
"${ProjDirPath}/../../../source/io/adc/kadc"
"${ProjDirPath}/../../../source/io/adc"
"${ProjDirPath}/../../../source/io/cm"
"${ProjDirPath}/../../../../config/twrk21d50m"
"${ProjDirPath}/../../../source/io/dma"
"${ProjDirPath}/../../../source/io/flashx/freescale"
"${ProjDirPath}/../../../source/io/flashx"
"${ProjDirPath}/../../../source/io/gpio/kgpio"
"${ProjDirPath}/../../../source/io/gpio"
"${ProjDirPath}/../../../source/io/hwtimer"
"${ProjDirPath}/../../../source/io/i2c"
"${ProjDirPath}/../../../source/io/i2c/polled"
"${ProjDirPath}/../../../source/io/i2c/int"
"${ProjDirPath}/../../../source/bsp/twrk21d50m"
"${ProjDirPath}/../../../../config/common"
"${ProjDirPath}/../../../source/include"
"${ProjDirPath}/../../../source/io/enet"
"${ProjDirPath}/../../../source/io/debug"
"${ProjDirPath}/../../../source/io/io_mem"
"${ProjDirPath}/../../../source/io/io_null"
"${ProjDirPath}/../../../source/io/io_chonchito"
"${ProjDirPath}/../../../source/io/pipe"
"${ProjDirPath}/../../../source/io/lpm"
"${ProjDirPath}/../../../source/io/lwadc"
"${ProjDirPath}/../../../source/io/lwgpio"
"${ProjDirPath}/../../../source/io/pcb"
"${ProjDirPath}/../../../source/io/pcb/mqxa"
"${ProjDirPath}/../../../source/io/rtc"
"${ProjDirPath}/../../../source/io/sdcard/sdcard_spi"
"${ProjDirPath}/../../../source/io/sdcard"
"${ProjDirPath}/../../../source/io/serial"
"${ProjDirPath}/../../../source/io/spi"
"${ProjDirPath}/../../../source/io/tchres"
"${ProjDirPath}/../../../source/io/tfs"
"${ProjDirPath}/../../../source/io/timer"
```

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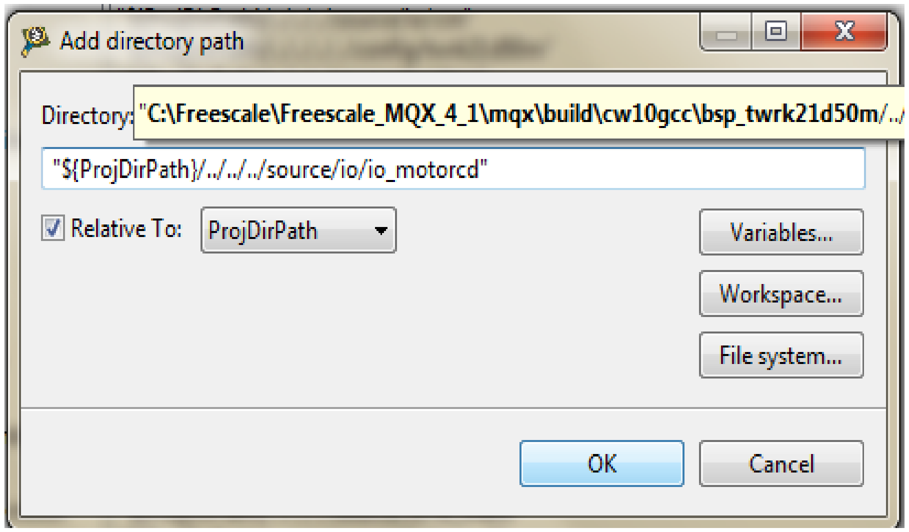
How to make a driver?

Add the driver clicking new and typing "motorcd":


Add directory path
Directory:
"C:\Freescale\Freescale_MQX_4_1\mqx\build\cw10gcc\bsp_twrk21d50m/../
"${ProjDirPath}/../../../source/io/io_motorcd"
Relative To:
ProjDirPath
Variables...
Workspace...
File system...
OK
Cancel

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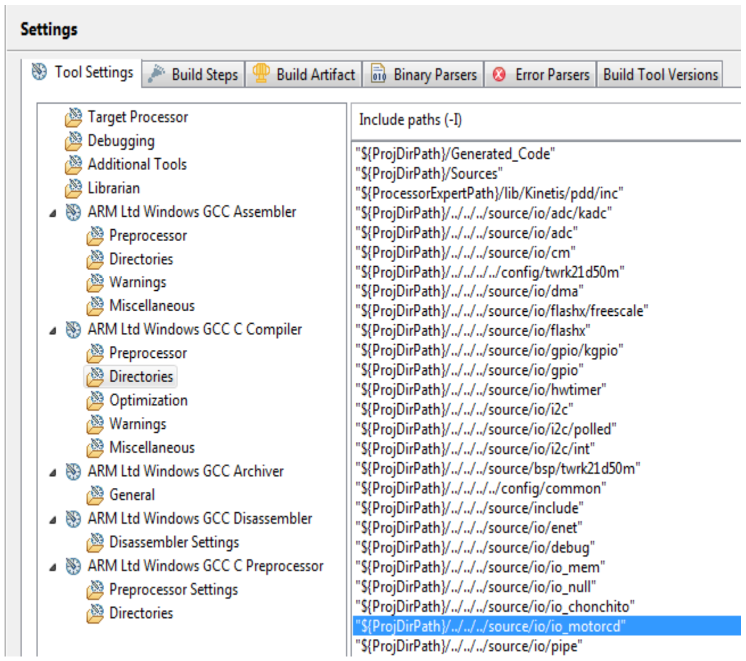
How to make a driver?

Do the same in Windows GCC Compiler Arm Ltd:



Settings

Tool Settings | Build Steps | Build Artifact | Binary Parsers | Error Parsers | Build Tool Versions

- Target Processor
- Debugging
- Additional Tools
- Librarian
- ARM Ltd Windows GCC Assembler
  - Preprocessor
  - Directories
  - Warnings
  - Miscellaneous
- ARM Ltd Windows GCC C Compiler
  - Preprocessor
  - Directories
  - Optimization
  - Warnings
  - Miscellaneous
- ARM Ltd Windows GCC Archiver
  - General
- ARM Ltd Windows GCC Disassembler
  - Disassembler Settings
- ARM Ltd Windows GCC C Preprocessor
  - Preprocessor Settings
  - Directories

Include paths (-I)

```
"${ProjDirPath}/Generated_Code"
"${ProjDirPath}/Sources"
"${ProcessorExpertPath}/lib/Kinetis/pdd/inc"
"${ProjDirPath}/../../../source/io/adc/kadc"
"${ProjDirPath}/../../../source/io/adc"
"${ProjDirPath}/../../../source/io/cm"
"${ProjDirPath}/../../../../config/twrk21d50m"
"${ProjDirPath}/../../../source/io/dma"
"${ProjDirPath}/../../../source/io/flashx/freescale"
"${ProjDirPath}/../../../source/io/flashx"
"${ProjDirPath}/../../../source/io/gpio/kgpio"
"${ProjDirPath}/../../../source/io/gpio"
"${ProjDirPath}/../../../source/io/hwtimer"
"${ProjDirPath}/../../../source/io/i2c"
"${ProjDirPath}/../../../source/io/i2c/polled"
"${ProjDirPath}/../../../source/io/i2c/int"
"${ProjDirPath}/../../../source/bsp/twrk21d50m"
"${ProjDirPath}/../../../../config/common"
"${ProjDirPath}/../../../source/include"
"${ProjDirPath}/../../../source/io/enet"
"${ProjDirPath}/../../../source/io/debug"
"${ProjDirPath}/../../../source/io/io_mem"
"${ProjDirPath}/../../../source/io/io_null"
"${ProjDirPath}/../../../source/io/io_chonchito"
"${ProjDirPath}/../../../source/io/io_motorcd"
"${ProjDirPath}/../../../source/io/pipe"
```

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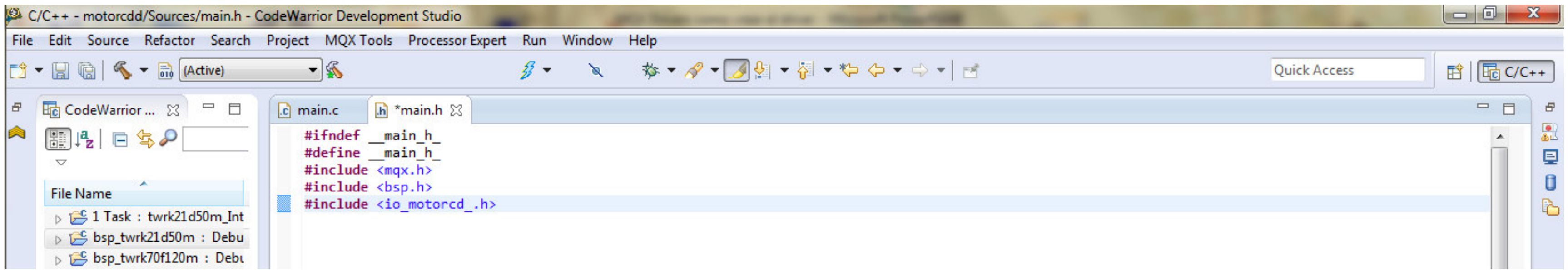
How to prove that our driver work?

1. Create a new MQX project.
2. Open main.c and main.h files.
3 . Add the library "motorcd_.h" in the main.h file:


C/C++ - motorcdd/Sources/main.h - CodeWarrior Development Studio
File Edit Source Refactor Search Project MQX Tools Processor Expert Run Window Help
(Active)
Quick Access
C/C++
CodeWarrior ...
File Name
1 Task : twrk21d50m_Int
bsp_twrk21d50m : Debu
bsp_twrk70f120m : Debu
main.c
*main.h

```
#ifndef __main_h_
#define __main_h_
#include <mqx.h>
#include <bsp.h>
#include <io_motorcd_.h>
```

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Add the following code in main.c

```
#include "main.h"
void Main_task(uint32_t initial_data)
{
FILE_PTR motorcd__file;    /* pointer to a file device structure*/
uint8_t data[10];
if (IO_OK != _io_motorcd__install("motorcd_:"))
{
printf("Error opening motorcd_ driver\n");
 }
if (NULL == (motorcd__file = fopen("motorcd_:", NULL )))
{
printf("Opening motorcd_ device driver failed.\n");
_mqx_exit(-1);
}
if (write(motorcd__file, data, 4 ) != 4)
{
printf("Writing to motorcd_ driver failed.\n");
_mqx_exit(-1);
}
else
{
printf("Writing to motorcd_ driver success.\n");
}
fclose(motorcd__file);
printf ("motorcd_ driver working\n");
mqx_exit(0);
}
```

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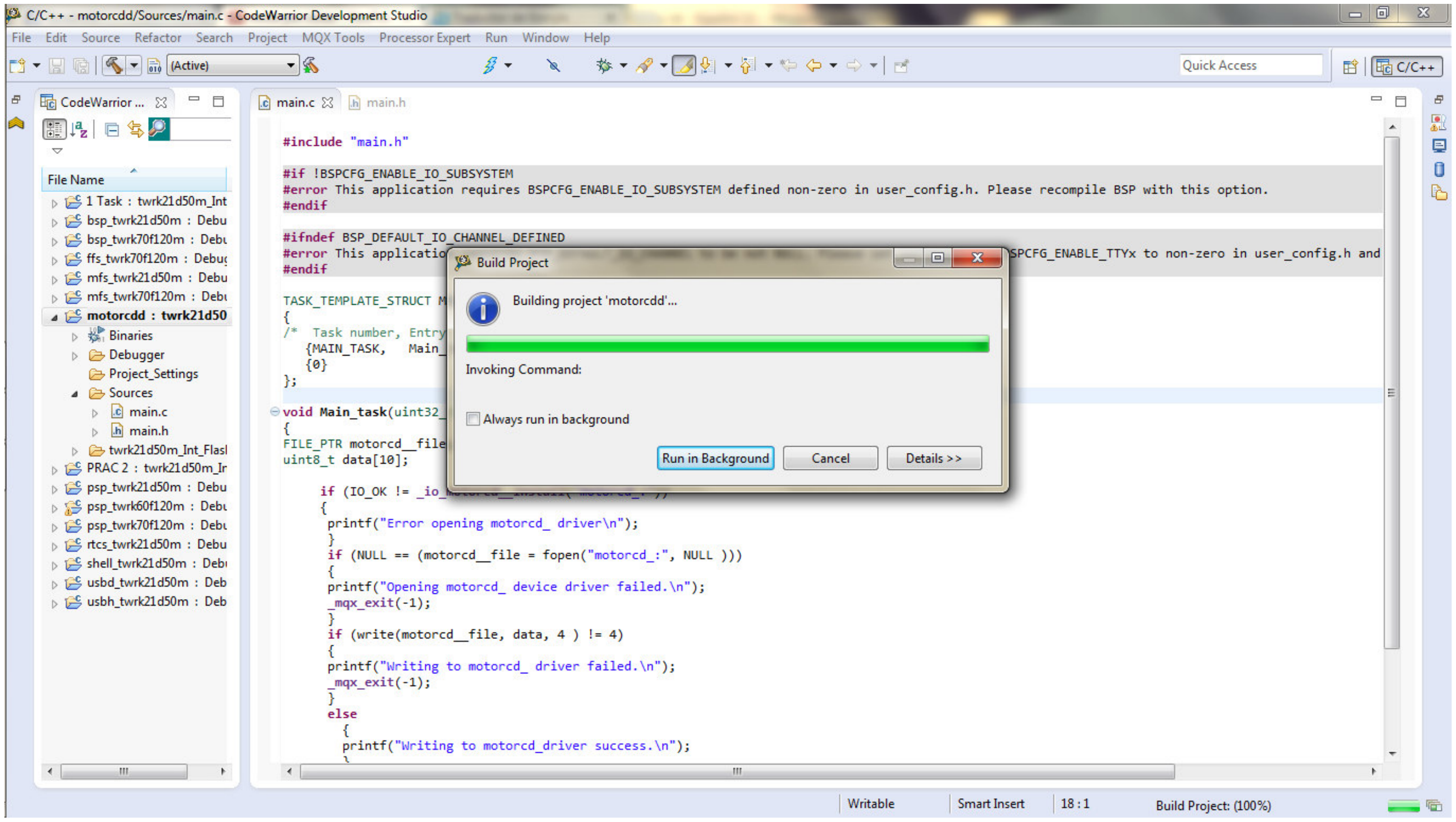
How to prove that our driver work?

Compile the code, if no exist error, our driver works perfectly.



```
#include "main.h"

#if !BSPCFG_ENABLE_IO_SUBSYSTEM
#error This application requires BSPCFG_ENABLE_IO_SUBSYSTEM defined non-zero in user_config.h. Please recompile BSP with this option.
#endif

#ifndef BSP_DEFAULT_IO_CHANNEL_DEFINED
#error This applicatio                                                  SPCFG_ENABLE_TTYx to non-zero in user_config.h and
#endif

TASK_TEMPLATE_STRUCT M
{
/*  Task number, Entry
   {MAIN_TASK,   Main_
   {0}
};

void Main_task(uint32_
{
FILE_PTR motorcd__file
uint8_t data[10];

     if (IO_OK != _io_
     {
      printf("Error opening motorcd_ driver\n");
      }
      if (NULL == (motorcd__file = fopen("motorcd_:", NULL )))
      {
      printf("Opening motorcd_ device driver failed.\n");
      _mqx_exit(-1);
      }
      if (write(motorcd__file, data, 4 ) != 4)
      {
      printf("Writing to motorcd_ driver failed.\n");
      _mqx_exit(-1);
      }
      else
        {
        printf("Writing to motorcd_driver success.\n");
```

Building project 'motorcdd'...

Invoking Command:

Build Project: (100%)

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