User’s Manual

Richard Ojo

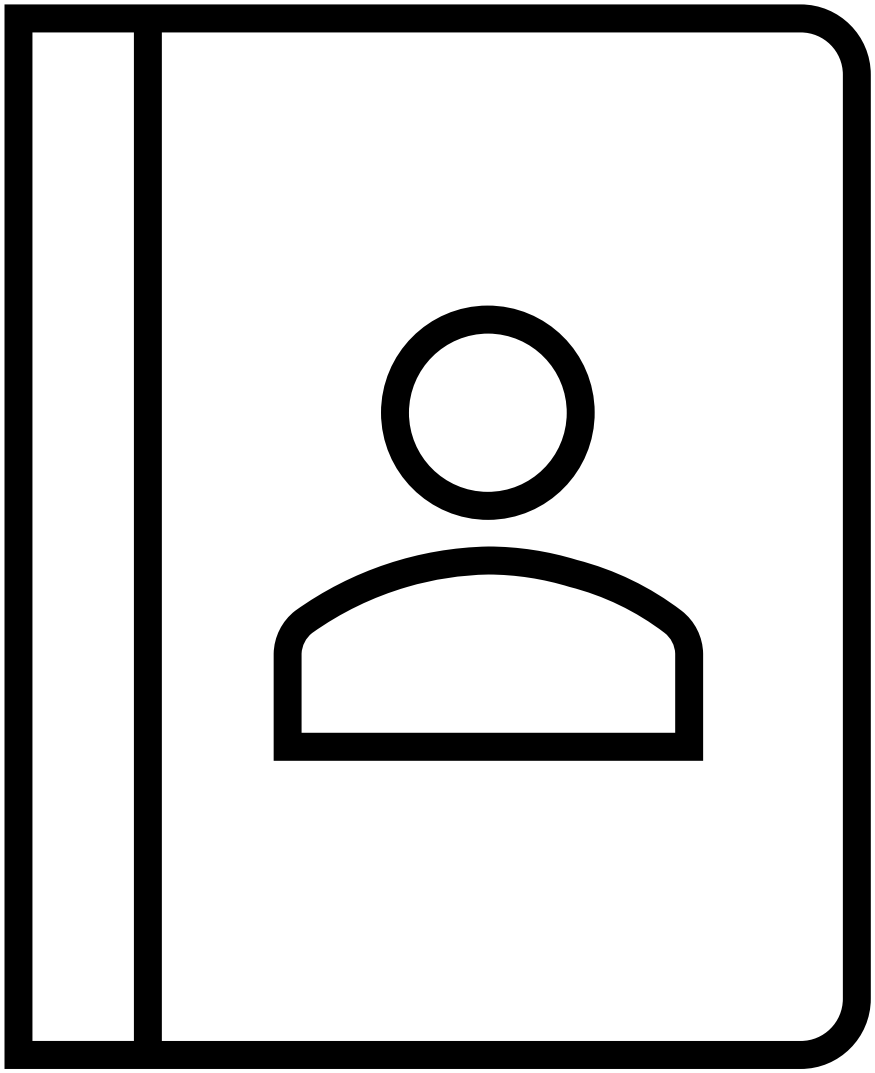
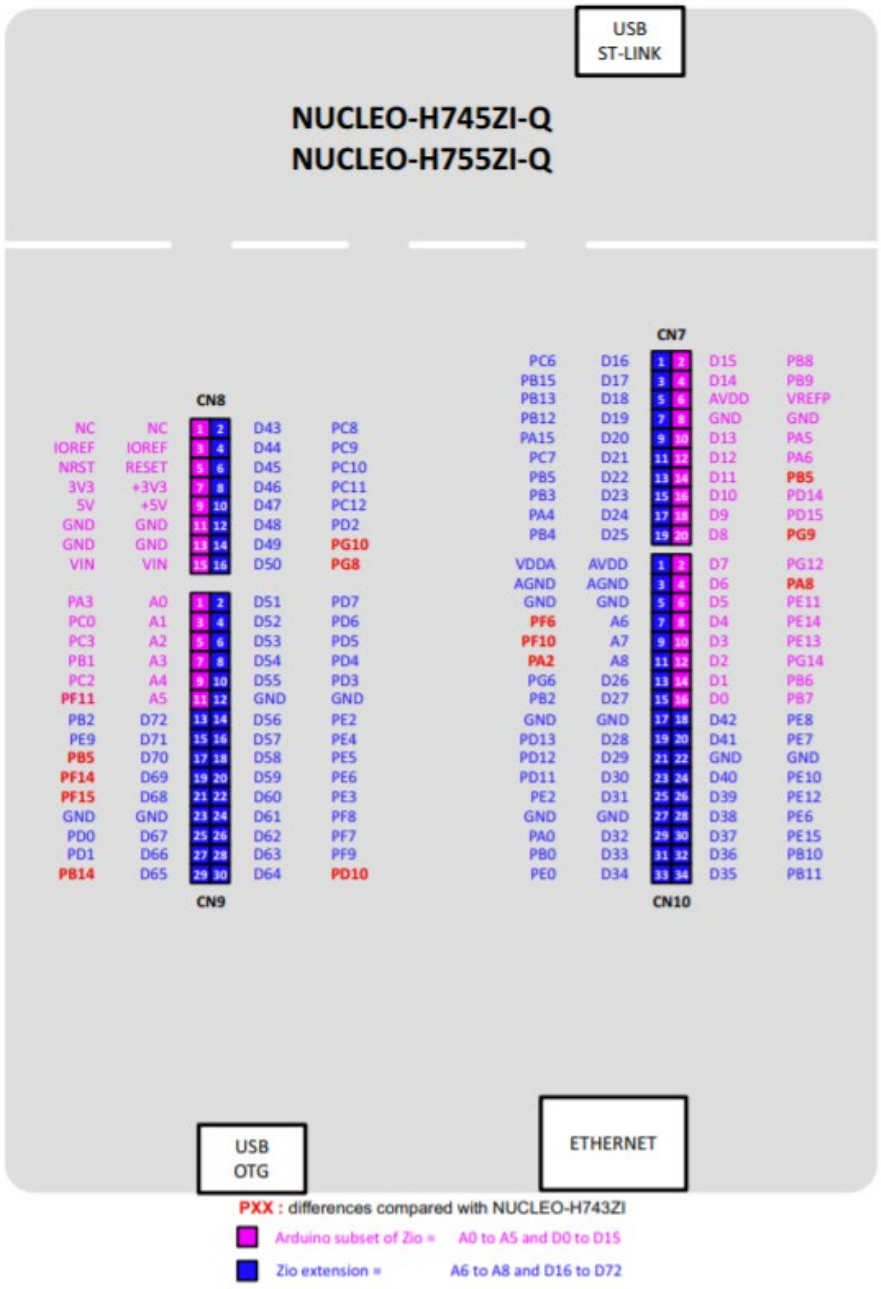


Table of Contents

STM32H745ZI-Q Pin Layout



General Use - Startup

This .zip contains multiple files and directories:

- 05c_testy_ws is a directory that contains the project's build directory and code.
- maintainer document contains information on how to modify or service the program's different features.
- user's manual contains information on how to effectively use all features provided by the project contained in 05c_testy_ws.
- acceptance test script contains commands that will be run to demonstrate the H745's different features and I/Os (TIM, GPIO, SPI)

To use:

1. Download and install "System Workbench for stm32" along with stm32 st-link drivers
2. Open the 05c_testy_ws project in "System Workbench for stm32" by double clicking "Your directory/05c_testy_ws/testy/.project" file
3. Connect the stm32h745zi-q board to the computer
4. Build the Project in the Workspace
5. Run the program in debug mode
6. Run both CM4 and CM7
7. You should see the Yellow LED start to blink
8. Make a note of the COM port number for the STM
9. Navigate to “Your directory/05c_testy_ws/PC_code/testtermv04”
10. Create a new testy script or modify testy script (“testy_script3”) with commands that the H745 will execute
11. Double click “_mingw-w64-_work”
12. Type appropriate command. For example, “testterm COMx testy_script3.txt”
13. Press enter to execute commands

Reference "_readme_testterm.pdf" for more information about terstterm and how to use it.

General Use - Commands

Commands sent to the testy device can be different sizes, but they all follow certain rules; or in other words they have a similar pattern.

Form 1: No Reload/ Count/ Arguments

:	2 hex Device Number/ ID	2 hex Command Number	2 hex Checksum Value

Form 2: With Reload/ Count/ Arguments

:	2 hex Device Number/ ID	2 hex Command Number	8 hex Arguments	2 hex Checksum Value

Every command begins with a colon / :

Device Number: 0xYY, where YY is a number in hexadecimal. Specifies that device you want to interact with.

Command Number: 0xYY, where YY is a number in hexadecimal. Specifies the command that you want to run for that device.

<u>Optional</u>*

Arguments: 0xYYYYYYYY, where Y is a number in hexadecimal. Commands may or may not require arguments. (32 bits)

Checksum Value: Checksum = 0x100 – (Device # - Command # - Arguments)

*For all commands, a message will be printed on the screen.

General Use – hex2testy

Use hex2testy to generate MoT commands along with correct Checksum value.

Navigate to "Your directory/05c_testy_ws/PC_code".

Run "_mingw-w64-_.bat" work by double clicking it.

Type in parameters for command you would like to generate.

Ex. device: 01, command: 02, Argument value: 00000001

Type: h2t 01 02 00000001

Output: cmd string: **:010201000000FC**

01 02 01 00 00 00

*Reference "Your directory/05c_testy_ws/PC_code/readme_hex2Testy.txt" for more information

*Reference "Your directory/05c_testy_ws/PC_code/testy_script2.txt" for more information

Zero Device and Nth Device

Device 0/ Nth

The Zero Device is always the device linked list's head.

The Nth Device is always the device linked list's tail.

***For more information, refer to maintainer document.**

Green LED

Device 1

The greenLED device utilizes the stm32h745zi-q's greenLED. Corresponding structures, commands, and variables is contained in the "MoTdevice_greenLED.S" section file.

The greenLED device has 4 commands: initGPIOBbit0, start_ONtask, start_OFFtask, reportGPIOBbit0.

The stm32h745zi-q's greenLED is connected to GPIO PB0.

Commands

:0100FF initGPIOBbit0 - Configures greenLED (GPIO Output)

:0101FE start_ONtask – Turns greenLED On

:0102FD start_OFFtask – Turns greenLED Off

:0103FC reportGPIOBbit0 – Report whether greenLED is On or Off

:010400000000FB start_Disabletask - Turn off and Disable greenLED

To use the greenLED device:

1. Initialize the greenLED
2. Execute either the start_ONtask, start_OFFtask, or reportGPIOBbit0 task

***For more information, refer to maintainer document.**

Red LED

Device 2

The redLED device utilizes the stm32h745zi-q's redLED. Corresponding structures, commands, and variables is contained in the "MoTdevice_redLED.c" C file and "MoTdevice_redLED.S" section file.

The redLED device has 3 commands: init_redLED, start_ONtask, start_OFFtask.

The stm32h745zi-q's redLED is connected to GPIO PB14.

Commands

:0200FE init_redLED - Configures redLED (GPIO Output)

:0201XXXXXXXX YY start_ONtask – Repeatedly Turns redLED On then Off

:0202XXXXXXXX YY start_OFFtask – Repeatedly Turns redLED Off then On

XXXXXXXX – Count value

To use the redLED device:

3. Initialize the redLED
4. Execute either the start_ONtask or start_OFFtask

***For more information, refer to maintainer document.**

Blue Button

Device 3

The Blue Button device utilizes the stm32h745zi-q's Blue/User Button. Corresponding structures, commands, and variables is contained in the "MoTdevice_blueBUTTON.S" section file.

The blueButton device has 4 commands: initGPIOCpin13, start_ONtask, start_OFFtask, reportGPIOCpin13.

The stm32h745zi-q's greenLED is connected to GPIO PC13.

Commands

:0300FF initGPIOCpin13 - Initialize hardware and install blueBUTTON blink task on task list

:0301XXXXXXXXYY start_ONtask – Set blink rate and start device_blueBUTTON_ONtask

:0302XXXXXXXXYY start_OFFtask – Set blink rate and start device_blueBUTTON_OFFtask

:0303FC reportGPIOCpin13– Report blueBUTTON state ('ON' or 'OFF')

YY - Checksum

XXXXXXXX – Count value or delay in milliseconds

***For more information, refer to maintainer document.**

TIM

Device 4

The TIM device utilizes the STM32H745ZI-Q Nucleo-144 board's TIM3 and associated peripherals.

Commands

Pulse width modulation

:0400FC	TIM3_PWM - Initialize TIM3 to 50% duty cycle, ms resolution, 1s period
:0401FB	TIM3_PWM_Increase - increase duty cycle by 10%
:0402FA	TIM3_PWM_Decrease - decrease duty cycle by 10%

Pulse frequency modulation

:0403F9	TIM3_PFM - Initialize TIM3 to 50% duty cycle, ms resolution, 1s period
:0404F8	TIM3_PFM_Increase - increase freq by 10%
:0405F7	TIM3_PFM_Decrease - decrease freq by 10%

greenLED

:0406F6	TIM3_greenLED_PWM_PFM - TIM3 PWM/PFM is input to greenLED
:0407F5	start_TIM3_Disabletask – Disable TIM device and greenLED

*Must initialize TIM3_PWM or TIM3_PFM before using the corresponding increase and decrease tasks.

*Must initialize TIM3_PWM or TIM3_PFM before using the corresponding greenLED tasks.

Recommended order/ To use the TIM device:

1. Initialize TIM3_PWM or TIM3_PFM
2. Execute TIM3_greenLED_PWM_PFM
3. Execute Corresponding function(s)

***For more information, refer to maintainer document.**

GPIO

Device 5

The GPIO device utilizes the STM32H745ZI-Q Nucleo-144 board's GPIOs and associated peripherals.

The SPI device's commands, functions, and variables are contained in the files "MoTdevice_GPIO_LL.S" and "MoTdevice_GPIO.c".

Input GPIO: PB1

Output GPIO: PC2

Commands

:0500FB	init_GPIO_Input - Initialize PB1 as GPIO input
:0501FA	init_GPIO_Output - Initialize PC2 as GPIO output
:0502F9	GPIO_output_set - Set PC2 to 1
:0503F8	GPIO_output_reset - Set PC2 to 0
:0504F7	GPIO_input_read - Read value from PB1 IDR
:0505XXXXXXXXYY	GPIO_Input_repetitive - Read value from PB1 IDR continuously

Argument is time between concurrent tasks calls.

:0506XXXXXXXXYY	GPIO_Output_repetitive - Output 1 and 0 on PC2 continuously

Argument is time between concurrent tasks calls.

:0507XXXXXXXXYY	GPIO_Input_scheduled - Read Input PB1 after x milliseconds
:0508XXXXXXXXYY	GPIO_Output_scheduled - Output 1 on output PC2 after x milliseconds
:0509F2	GPIO_Off_task - Disable both GPIO input and GPIO output

YY - Checksum

XXXXXXXX – Count value or delay in milliseconds

*Use jumper/Dupont wires to read GPIO output or to send input to GPIO input.

<u>Polling loop</u>

Establishing a connection between GPIO Input (PB1) and GPIO Output (PC2) can be done with a jumper/Dupont wire to test GPIO functionality.

1. Read from GPIO input
2. Set GPIO output
3. Read from GPIO input
4. Reset GPIO output
5. Repeat

***For more information, refer to maintainer document.**

SPI

Device 6

The SPI device utilizes the STM32H745ZI-Q Nucleo-144 board's SPI1 (Master), SPI3(slave) and associated peripherals.

The SPI device's commands, functions, and variables are contained in the files "MoTdevice_SPI_LL.S", "MoTdevice_SPI_M_LL.S", "MoTdevice_SPI_S_LL.S", and "MoTdevice_SPI.c".

MoTdevice_SPI_M_LL.S

Contains functions and information for initializing, sending data, and receiving data for the SPI master.

MoTdevice_SPI_S_LL.S

Contains functions and information for initializing, sending data, and receiving data for the SPI slave.

<u>SPI ports/pins</u>

SPI Master - SPI1

SPI1_NSS - PA4

SPI1_SCK - PA5

SPI1_MISO - PA6

SPI1_MOSI - PB5

SPI Slave – SPI3

SPI3_NSS - PA15

SPI3_SCK - PC10

SPI3_MISO - PC11

SPI3_MOSI - PC12

*Reference **Pin layout** for locating GPIO pins.

Commands

:0600FA Full Duplex 32bit transfers	init_SPItask	initializes SPI1 as master, SPI3 as slave,
:0601XXXXXXXXYY MOSI	MasterTxtask	Send word from Master MOSI to Slave
:0602F8	MasterRxtask	Receive word on MISO
:0603XXXXXXXXYY MISO	SlaveTxtask	Send word from Slave MISO to Master
:0604F6	SlaveRxtask	Receive word on MOSI
:0605XXXXXXXXYY Slave MOSI every 10s	MasterTxtask_polled	Continuous Send word from Master MOSI to
:0606F4 10s	MasterRxtask_polled	Continuous Receive word on MISO every
:0607XXXXXXXXYY Master MISO every 10s	SlaveTxtask_polled	Continuous Send word from Slave MISO to
:0608F2	SlaveRxtask_polled	Continuous Receive word on MOSI every 10s
:0609F1	Disable_SPI	Disable SPI Master and Slave

YY - Checksum

XXXXXXXX – 32-bit Data value

To initialize the SPI master, four GPIOs must be configured appropriately for that SPI. The GPIOs should be in the appropriate alternate function mode.

To initialize the SPI slave, four GPIOs must be configured appropriately for that SPI. The GPIOs should be in the appropriate alternate function mode.

***For more information, refer to maintainer document.**