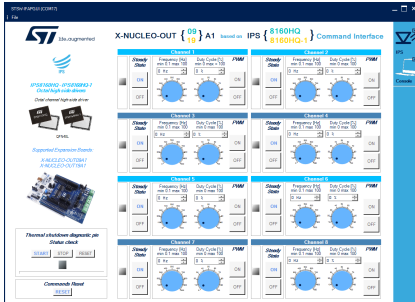# Demonstration firmware for NUCLEO-F401RE enabling STSW-IFAPGUI on X-NUCLEO-OUT09A1 and X-NUCLEO-OUT19A1 expansion boards

Features

- Full control of the X-NUCLEO-OUT09A1 and X-NUCLEO-OUT19A1 expansion boards via the STSW-IFAPGUI graphical user interface
- Control of:
  - output channel switching frequency and duty cycle configuration
  - visualization of diagnostic signal (overtemperature diagnostic)

Description

The STSW-OUT9F4 firmware runs on the NUCLEO-F401RE development board and allows controlling the X-NUCLEO-OUT09A1 or X-NUCLEO-OUT19A1 expansion boards using the STSW-IFAPGUI graphical user interface.

The STSW-OUT9F4 contains the software routines that enable the USB-based communication between the NUCLEO-F401RE and the system where the STSW-IFAPGUI runs, and the control of the X-NUCLEO-OUT09A1 or X-NUCLEO-OUT19A1.

The firmware can control a single expansion board (X-NUCLEO-OUT09A1 or X-NUCLEO-OUT19A1).

The STSW-IFAPGUI is based on a common engine and several plug-ins designed to communicate through the USB connection with the application layer running on the NUCLEO-F401RE development board stacked with the expansion board.

Product summary	
Demonstration firmware for NUCLEO-F401RE enabling STSW-IFAPGUI on X-NUCLEO-OUT09A1 and X-NUCLEO-OUT19A1 expansion boards	STSW-OUT9F4
Industrial digital output expansion board based on IPS8160HQ for STM32 Nucleo	X-NUCLEO-OUT09A1
Industrial digital output expansion board based on IPS8160HQ-1 for STM32 Nucleo	X-NUCLEO-OUT19A1
STM32 Nucleo-64 development board with STM32F401RE MCU, supports Arduino and ST morpho connectivity	NUCLEO-F401RE
Graphical user interface for the industrial IPS evaluation boards based on STM32 Nucleo	STSW-IFAPGUI
Applications	Industrial Safety
	Industrial Tools

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For further information contact your local STMicroelectronics sales office.

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1 How to control a single expansion board with IFAPGUI

This application scenario is based on the default on-board switches and resistors configuration of the X-NUCLEO-OUT09A1 (or X-NUCLEO-OUT19A1).

Step 1. Stack the X-NUCLEO-OUT09A1 (or X-NUCLEO-OUT19A1) on the NUCLEO-F401RE board flashed with the STSW-OUT9F4 firmware through the Arduino connectors.

Step 2. Connect the two stacked boards to your PC or laptop USB port through a mini-USB cable.
The STM32 is supplied via USB (3.3 V) and the flashed firmware starts running.
Press the black button on the NUCLEO-F401RE board to reset the firmware.

Step 3. Launch the STSW-IFAPGUI.

When the application starts, the firmware running on the STM32 is automatically detected and a COM port is opened for communication.

Figure 1. STSW-IFAPGUI COM port opened

Step 4. Click on the GUI STM32 Nucleo icon after it turns blue (it remains green until the firmware identification is complete).

The STSW-IFAPGUI appears on the screen.

Figure 2. STSW-IFAPGUI main control panel
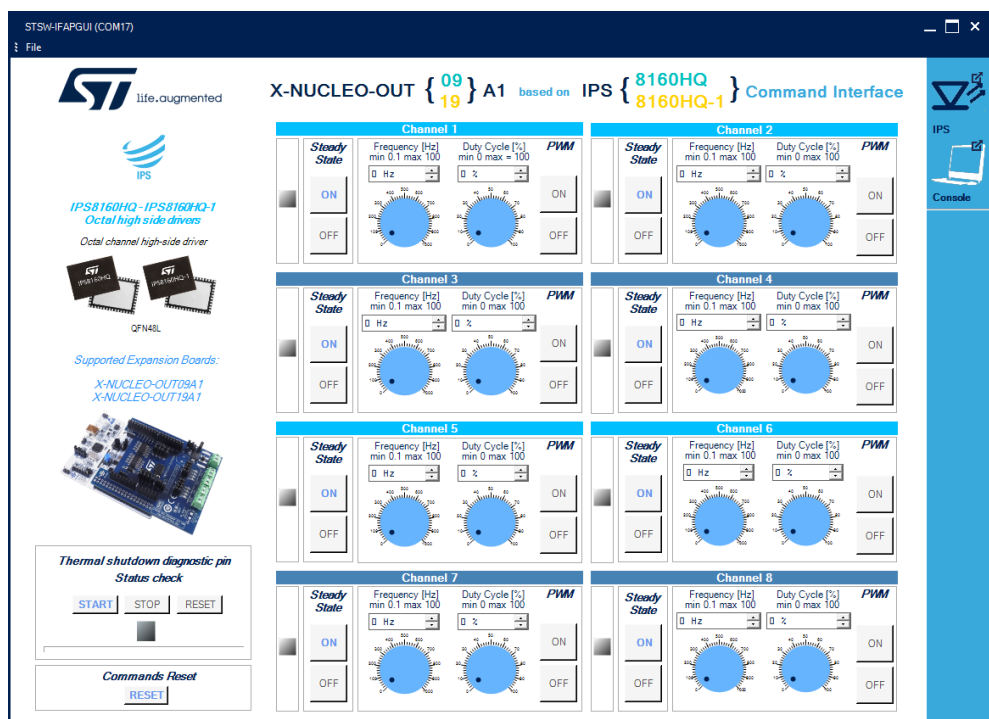
Step 5.

- Use the dedicated section of the GUI for the desired channel of IPS8160HQ (or IPS8160HQ-1)
- In each channel section use the left part to manage channel Steady State
- In each channel section use the right part to manage channel PWM settings
- [**Commands Reset**] button, available in bottom left side of the GUI, can be used to reset any channel setting and also the diagnostic pin status check

Step 6. Connect the load and supply the power stage of the X-NUCLEO-OUT09A1 (or X-NUCLEO-OUT19A1) with a 24 V rail via the CN1 connector.

Step 7. Select the desired switching frequency and duty cycle of the desired output channel through the [**Frequency**] and [**Duty Cycle**] input controls on the PWM part of desired channel section and then pressing the [**ON**] button to enable PWM feature for the current channel (or press the [**OFF**] button to turn off the PWM feature for the current channel).

Step 8. The desired output channel steady state can be activated/deactivated by clicking on the [**ON**] / [**OFF**] buttons on the left part of the desired channel section in the [**Steady State**] part.

Step 9. Click on the [**START**] button on the left side of the GUI to monitor the on/off status on the STATUS pin on IPS8160HQ (or IPS8160HQ-1).

You can stop monitoring the fault status by clicking on the [**STOP**] button.
Press the [**RESET**] button to reset the fault status.

Figure 3. STSW-IFAPGUI in action
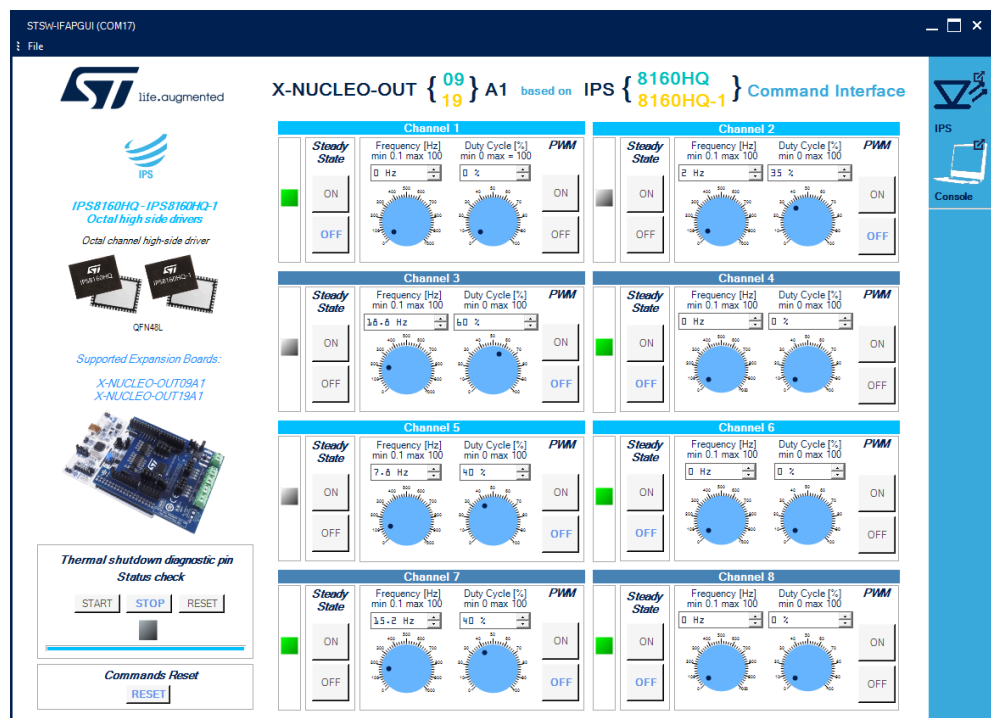
2 How to control a single expansion board with command-line interface

This application scenario is based on the default on-board switches and resistors configuration of X-NUCLEO-OUT09A1 (or X-NUCLEO-OUT19A1).

Step 1. Plug the X-NUCLEO-OUT09A1 or the X-NUCLEO-OUT19A1 expansion board on top of the NUCLEO-F401RE board, flashed with the STSW-OUT9F4 firmware, through the Arduino connectors.

Step 2. Connect the two stacked boards to your PC or laptop USB port through a mini-USB cable. The STM32 is supplied via USB (3.3 V) and the flashed firmware starts running. Press the black button on the NUCLEO-F401RE board to reset the firmware.

Step 3. Launch the serial communication terminal application (Tera Term). When the application starts, the serial communication must be configured as follows:

Figure 4. Tera Term: select serial communication method
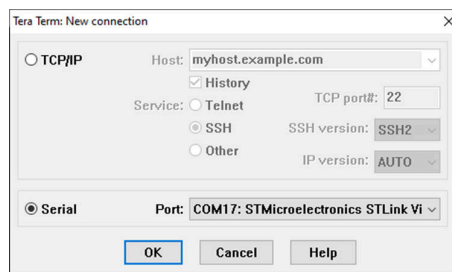
Figure 5. Tera Term: Setup/Terminal
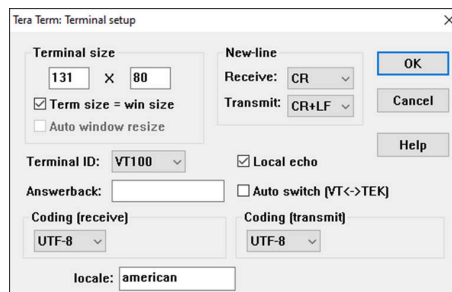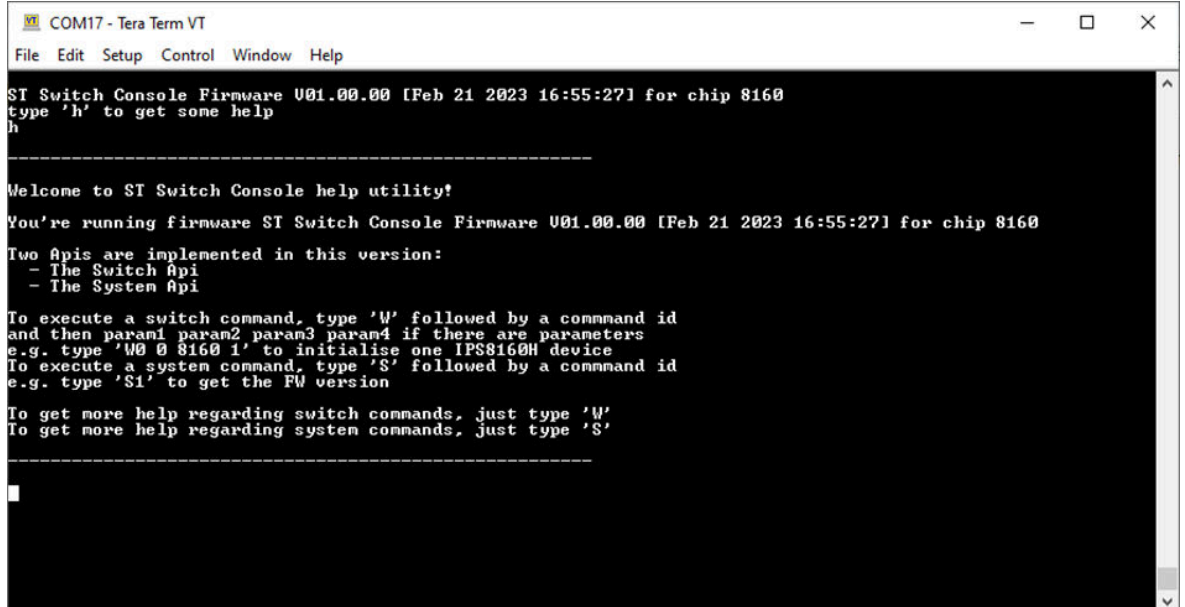
Figure 6. Tera Term: Setup/Serial port
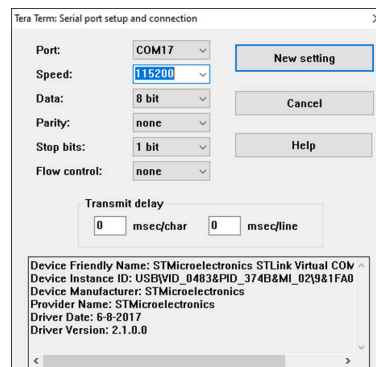
Step 4. Press [**Enter**] and type [**h**] for help:

Figure 7. CLI help

Step 5. Type [**w?**] for a list of available commands:

Figure 8. Command list

Step 6. Initialize the device using [**w0**] command:

Figure 9. Device initialization

Step 7. Continue to interact with the device using commands from the available command list (see above).

Revision history

Table 1. Document revision history

Date	Revision	Changes
23-May-2023	1	Initial release.

IMPORTANT NOTICE – READ CAREFULLY