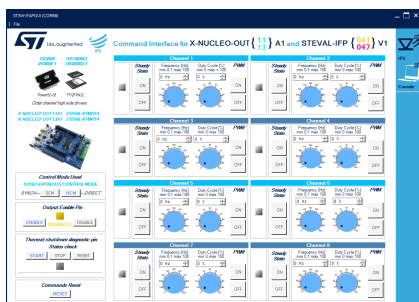


## Demonstration firmware for NUCLEO-F401RE enabling STSW-IFAPGUI on X-NUCLEO-OUT11A1 and X-NUCLEO-OUT13A1 expansion boards



### Features

- Full control of the X-NUCLEO-OUT11A1 and X-NUCLEO-OUT13A1 expansion boards via the STSW-IFAPGUI graphical user interface
- Control of:
  - output channel switching frequency and duty cycle configuration
  - visualization of diagnostic signal (common overtemperature/communication error)
  - both Direct Control Mode and Synchronous Control Mode management

### Description

The STSW-OUT11F4 firmware runs on the NUCLEO-F401RE development board and allows controlling the X-NUCLEO-OUT11A1 or X-NUCLEO-OUT13A1 expansion boards using the STSW-IFAPGUI graphical user interface.

The STSW-OUT11F4 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-OUT11A1 or X-NUCLEO-OUT13A1.

The firmware can control a single expansion board (X-NUCLEO-OUT11A1 or X-NUCLEO-OUT13A1).

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-OUT11A1 and X-NUCLEO-OUT13A1 expansion boards	STSW-OUT11F4
Industrial digital output expansion board based on ISO808 for STM32 Nucleo	X-NUCLEO-OUT11A1
Industrial digital output expansion board based on ISO808-1 for STM32 Nucleo	X-NUCLEO-OUT13A1
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

# 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-OUT11A1 (or X-NUCLEO-OUT13A1).

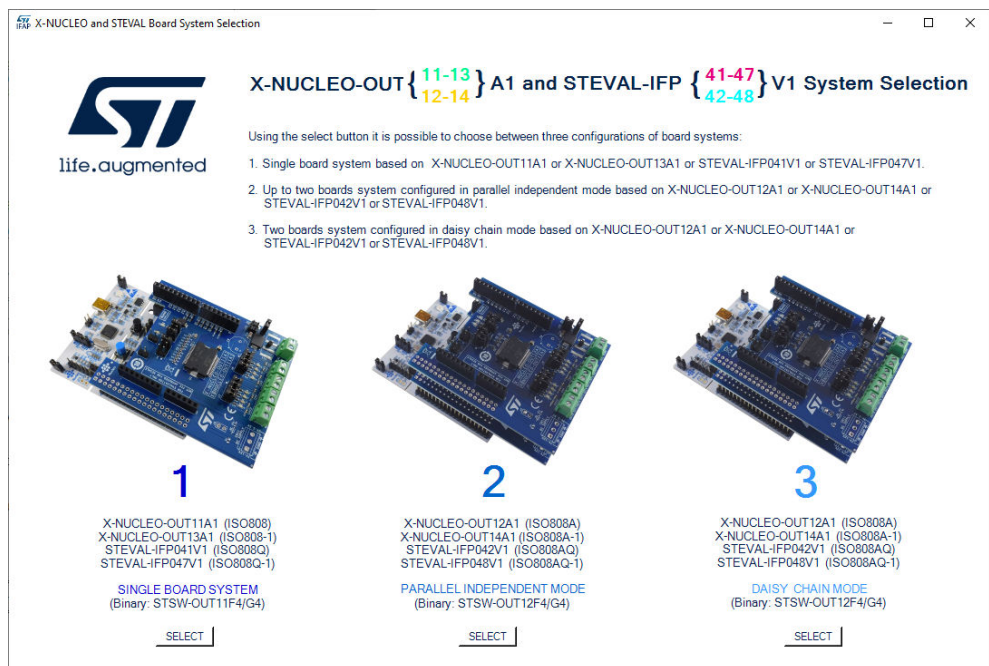
- Step 1.** Stack the X-NUCLEO-OUT11A1 (or X-NUCLEO-OUT13A1) on the NUCLEO-F401RE board flashed with the STSW-OUT11F4 firmware through the Arduino connectors.
- Step 2.** Connect the two stacked boards to your PC or laptop USB port through a mini-USB cable. The STM32 is supplied via USB (3.3 V) and the 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**



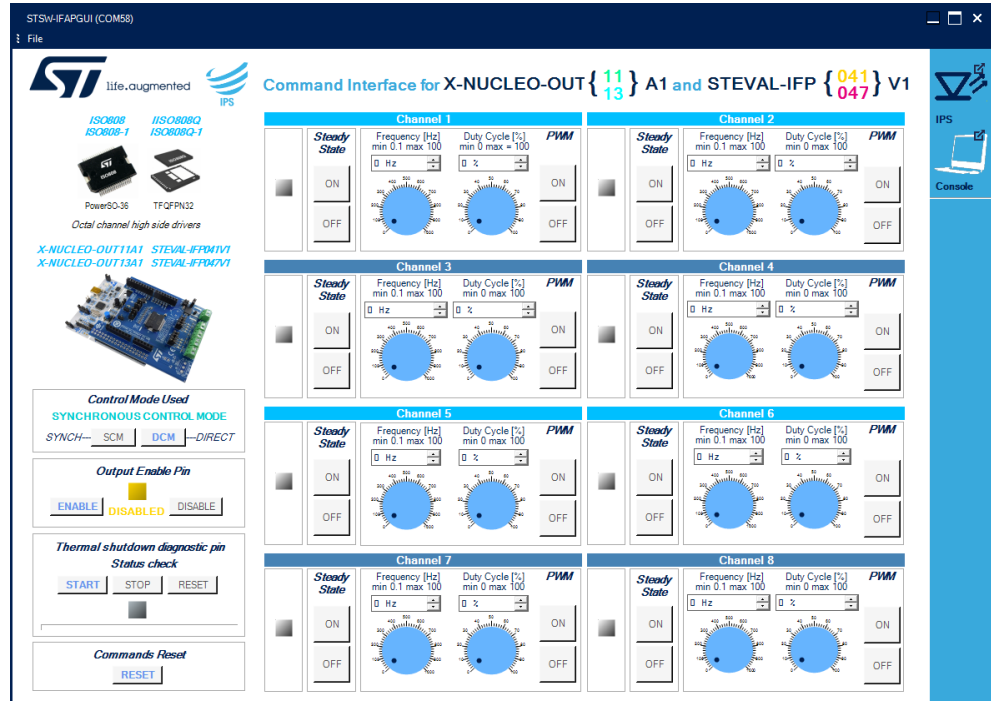
- Step 4.** Click on the GUI STM32 Nucleo icon after it turns blue (it remains green until the firmware identification is complete). A popup window appears to choose the proper system configuration.

**Figure 2. System configuration selection panel**



**Step 5.** Select [1] [SINGLE BOARD SYSTEM] and the STSW-IFAPGUI appears on the screen.

**Figure 3. STSW-IFAPGUI main control panel**



**Step 6.** Use the dedicated section of the GUI for the desired channel of ISO808 (or ISO808-1) to:

- Manage channel steady state (the left part in each channel section).
- Manage channel PWM settings (the right part in each channel section).

Use the bottom left side of the GUI to:

- Select the Control Mode to be used (DCM or SCM, last one is the default).
- Enable/disable outputs, properly setting the Output Enable pin.
- Enable/disable and reset diagnostic pin polling activity.
- Reset all channel features to OFF state.

**Step 7.** Connect the load and supply the power stage of the X-NUCLEO-OUT11A1 (or X-NUCLEO-OUT13A1) with a 24 V rail via the CN1 connector.

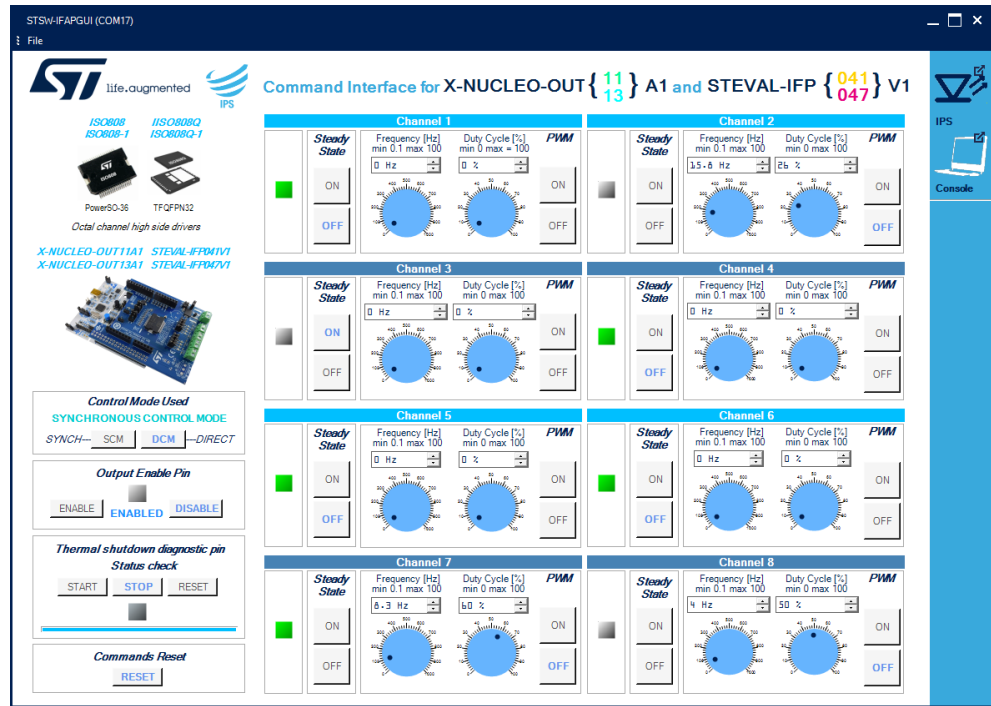
**Step 8.** Select the desired switching frequency and duty cycle of the desired output channel through the [Pulse Width Modulation] controls in the right part of desired channel section.

**Step 9.** The desired output channel steady state can be activated/deactivated by clicking on the [ON/OFF] buttons in the left part of the desired channel section in the [Steady State] sub-section.

**Step 10.** Click on the [START] button in the [Thermal shutdown diagnostic pin Status check] area on the bottom left side of the GUI to monitor the on/off status on the FAULT pin on ISO808 (or ISO808-1). You can stop monitoring the fault status by clicking on the [STOP] button in the same section. Press the [RESET] button to reset the fault status.

**Step 11.** Click on [Enable] button in [Output Enable Pin] section to drive the output pins. Click on [Disable] in the same section to turn off all output pins.

- Step 12.** Click on **[RESET]** button in **[Commands Reset]** section to reset any channel setting and also the diagnostic pin status monitoring.

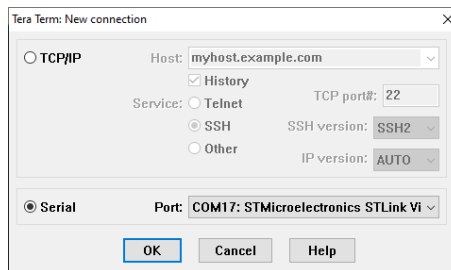
**Figure 4. STSW-IFAPGUI in action**


## 2 How to control a single expansion board with Command Line Interface

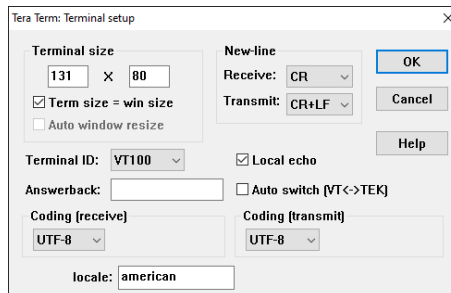
This application scenario is based on the default on-board switches and resistors configuration of X-NUCLEO-OUT11A1 (or X-NUCLEO-OUT13A1).

- Step 1.** Plug the X-NUCLEO-OUT11A1 or X-NUCLEO-OUT13A1 expansion board on top of the NUCLEO-F401RE board, flashed with the STSW-OUT11F4 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 (TeraTerm in our notes). When the application starts, the serial communication must be configured as follows:

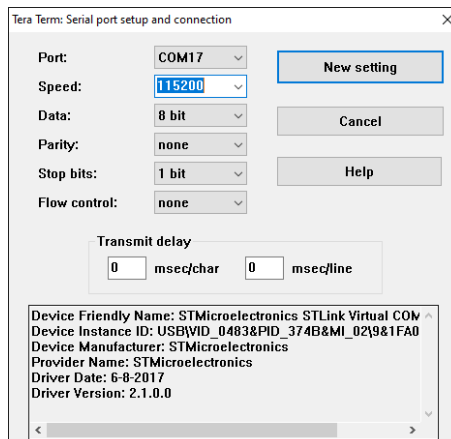
**Figure 5. Tera Term: select serial communication method**



**Figure 6. Tera Term: Setup / Terminal...**



**Figure 7. Tera Term: Setup / Serial port...**



**Step 4.** Press Enter and then type 'h' for help:

**Figure 8. CLI help**

```

COM17 - Tera Term VT
File Edit Setup Control Window Help

ST Switch Console Firmware U01.00.00 [Feb 23 2023 16:03:41] for chip 808
type 'h' to get some help
h

-----
Welcome to ST Switch Console help utility!
You're running firmware ST Switch Console Firmware U01.00.00 [Feb 23 2023 16:03:41] for chip 808

Two Apis are implemented in this version:
- The Switch Api
- The System Api

To execute a switch command, type 'W' followed by a command id
and then param1 param2 param3 param4 if there are parameters
e.g. type 'W0 0 808 1' to initialise one IPS808H device
To execute a system command, type 'S' followed by a command id
e.g. type 'S1' to get the FW version

To get more help regarding switch commands, just type 'W'
To get more help regarding system commands, just type 'S'

-----
    
```

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

**Figure 9. Command list**

```

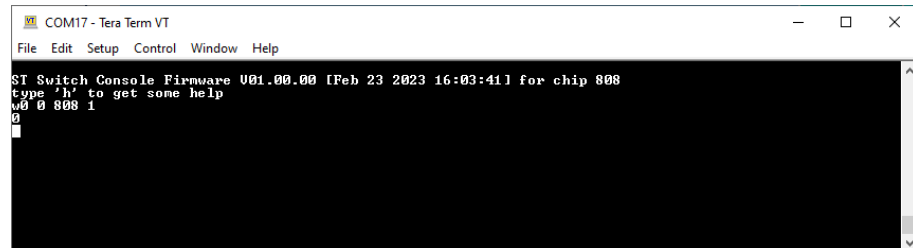
COM17 - Tera Term VT
File Edit Setup Control Window Help

ST Switch Console Firmware U01.00.00 [Feb 23 2023 16:03:41] for chip 808
type 'h' to get some help
w?

Switch API commands list:
Id: 0 IPS_SWITCH_API_INIT
w0 Instance(1B) ChipId(2B) NbDevices(1B) -> Output: status(4B)
Id: 1 IPS_SWITCH_API_DEINIT
w1 Instance(1B) -> Output: status(4B)
Id: 2 IPS_SWITCH_API_READ_ID
w2 Instance(1B) -> Output: status(6B)
Id: 3 IPS_SWITCH_API_GET_FW_VERSION
w3 Instance(1B) -> Output: status(8B)
Id: 4 IPS_SWITCH_API_GET_CAPABILITIES
w4 Instance(1B) -> Output: status(5B)
Id: 5 IPS_SWITCH_API_GET_FAULT_STATUS
w5 Instance(1B) -> Output: status(5B)
Id: 6 IPS_SWITCH_API_GET_CHANNEL_STATUS
w6 Instance(1B) ChanId(1B) -> Output: status(5B)
Id: 7 IPS_SWITCH_API_SET_CHANNEL_STATUS
w7 Instance(1B) ChanId(1B) ChanStatus(1B) -> Output: status(4B)
Id: 8 IPS_SWITCH_API_GET_ALL_CHANNEL_STATUS
w8 Instance(1B) -> Output: status(5B)
Id: 9 IPS_SWITCH_API_SET_ALL_CHANNEL_STATUS
w9 Instance(1B) ChanBitmap(1B) -> Output: status(4B)
Id: 10 IPS_SWITCH_API_GET_CHANNEL_FREQ
w10 Instance(1B) ChanId(1B) -> Output: status(6B)
Id: 11 IPS_SWITCH_API_SET_CHANNEL_FREQ
w11 Instance(1B) ChanId(1B) Freq(2B) -> Output: status(4B)
Id: 12 IPS_SWITCH_API_GET_CHANNEL_DC
w12 Instance(1B) ChanId(1B) -> Output: status(5B)
Id: 13 IPS_SWITCH_API_SET_CHANNEL_DC
w13 Instance(1B) ChanId(1B) DutyCycle(1B) -> Output: status(4B)
Id: 14 IPS_SWITCH_API_GET_PWM_ENABLE
w14 Instance(1B) ChanId(1B) -> Output: status(5B)
Id: 15 IPS_SWITCH_API_SET_PWM_ENABLE
w15 Instance(1B) ChanId(1B) PwmEnable(1B) -> Output: status(4B)
Id: 17 IPS_SWITCH_API_GET_CTRL_PIN_STATUS
w17 Instance(1B) CtrlPinId(1B) -> Output: status(5B)
Id: 18 IPS_SWITCH_API_SET_CTRL_PIN_STATUS
w18 Instance(1B) CtrlPinId(1B) CtrlPinStatus(1B) -> Output: status(4B)
Id: 19 IPS_SWITCH_API_SET_OPERATING_MODE
w19 Instance(1B) opMode(1B) -> Output: status(4B)
    
```

**Step 6.** Initialize the device as first action using **w0** command:

**Figure 10. Device init**



```
COM17 - Tera Term VT
File Edit Setup Control Window Help
ST Switch Console Firmware U01.00.00 [Feb 23 2023 16:03:41] for chip 808
Type 'h' to get some help
w0 0 808 1
```

**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.



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