GPIO

GPIO (general-purpose input/output) is a series of digital interfaces that can be used to connect relays, LEDs, sensors, and other components.

> ⚠ **Warning**
>
> - Before using GPIO on **PiKVM v3 HAT**, carefully study the purpose of its ports.
> - Using GPIO on a PiKVM was designed as a feature for advanced users, so please familiarize yourself with the topic to make sure you understand how to use use it before setting it up.
> - **Careless usage of GPIO can damage your Raspberry Pi or components.**

When talking about PiKVM and GPIO it refers not solely to the physical interface of the Raspberry Pi, but also to various plugins (for example, for USB relays) that can also be used transparently by emulating an abstract GPIO API.

Basics

Setting up GPIO is considerably complex. The interface is divided into several layers for flexibility. Any configuration is performed using a file `/etc/kvmd/override.yaml` which uses the YAML syntax. We will look at each part of the configuration individually with an example for each. Sections should be combined under shared keys.

- **Wrong:**

```yaml
kvmd:
    gpio:
        drivers: ...
kvmd:
    gpio:
        scheme: ...
```

- **Correct:**

```yaml
kvmd:
    gpio:
        drivers: ...
        scheme: ...
```

Drivers

The first part of the configuration refers to the hardware layer, which defines which IO channels are used (standard GPIO pins of the Raspberry Pi, an USB relay, and so on). If you just want to use GPIO with the default settings you can skip to the next section Scheme.

Each hardware input/output requires a individual driver configuration entry. Each driver has a type (which refers to the plugin that handles the communication between PiKVM and the hardware) and a unique name. This allows you to either can add multiple drivers of the same type with different settings or connect multiple USB HID relays.

> **Note**
>
> Each driver requires a unique name. Names surrounded by double underscore are system reserved and should not be used.

The only exception to this is the default GPIO driver with the name `__gpio__`, representing the physical GPIO interface of the Raspberry Pi. The configuration section for `__gpio__` is only required in your `/etc/kvmd/override.yaml` if you want to change the default settings. It can be omitted if you are fine with the defaults.

```
kvmd:
    gpio:
        drivers:
            # This example shows how the default __gpio__ driver settings can be changed. It can be omitted if you are fine with the defaults.
            __gpio__:  # Names surrounded by double underscore are system reserved
                type: gpio  # Refers to the plugin name handling the communication

            # You can define another gpio driver for some reason
            my_gpio:
                type: gpio

            # Example for a USB HID relay connected to PiKVM
            relay:
                type: hidrelay
                device: /dev/hidraw0  # The path to the linux device
```

Scheme

The second part defines how the various driver channels are configured. Each channel has a unique name, a mode (`input` or `output`), a pin number, and a reference to the driver configured in the previous part.

Note

Names that starts and ends with two underscores (like `__magic__`) are reserved.

Two interaction modes are available for outputs: `pulse` and `switch`. In pulse mode, the output quickly switches its state to logical 1 and back (just like pressing a button). In switch mode, it saves (toggles) the state that the user set. When PiKVM is started/rebooted (any time the KVMD daemon is started or stopped) all output channels are reset to 0. This can be changed using the `initial` parameter. For example, `initial=true` for logic 1 on startup.

If you don't specify a driver for the channel in the scheme the default driver, `__gpio__` will be used.

Parameter	Type	Allowed values	Default	Description
`led1`, `button1`, `relay1`, etc.	`string`	`a-Z`, numbers, `_`, `-`		A section for the named channel
`pin`	`integer`	`X >= 0`		Refers to a GPIO pin or driver's pin/port
`mode`	`enum`	`input` or `output`		Defines if a channel is used for input or output, may be limited by driver plugin
Input only				
`debounce`	`float`	`x >= 0`	`0.1`	Debounce time in seconds. `0` for disable debounce

Parameter	Type	Allowed values	Default	Description
Output only				
`switch`	`bool`	`true` or `false`	`true`	Enables or disables the switch mode on the channel (enabled by default).
`initial`	`nullable bool`	`true` , `false` or `null`	`false`	Defines the initial state of the switch upon boot, `null` for don't make changes (the last one does not supported by generic GPIO)
`inverted`	`bool`	`true` or `false`	`false`	Inverts the active logical level
`pulse`				A section header to define switch pulse configuration
`delay`	`float`	`X >= 0`	`0.1`	Defines the pulse time in seconds, `0` for disable pulsing
`min_delay`	`float`	`X >= 0.1`	`0.1`	
`max_delay`	`float`	`X >= 0.1`	`0.1`	

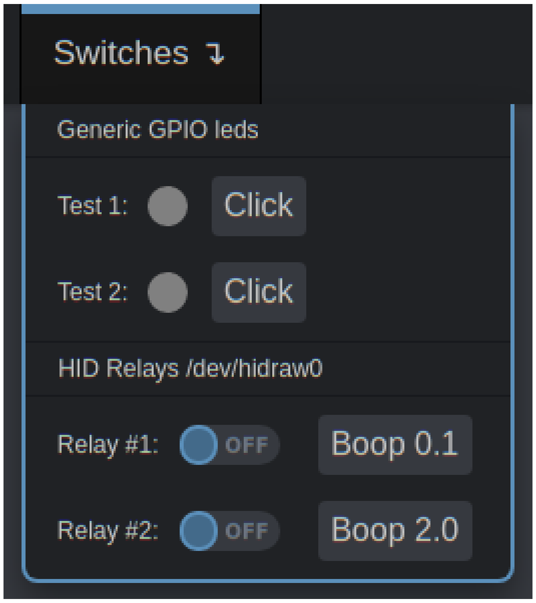
```
kvmd:
    gpio:
        scheme:
            # A certain device sends signals to the RPi and we want the PiKVM to display
this as an led
            led1:
                pin: 19 # GPIO pin number on the RPi
                mode: input
            led2:
                pin: 16
                mode: input


            # Two outputs of RPi's GPIO
            button1:
                pin: 26 # GPIO pin number on the RPi
                mode: output
                switch: false  # Disable switching, only pulse available
            button2:
                pin: 20
                mode: output
                switch: false

            relay1:  # Channel 1 of the relay /dev/hidraw0
                pin: 0  # Numerating starts from 0
                mode: output  # Relays can't be inputs
                initial: null  # Don't reset the state to 0 when initializing and
terminating KVMD
            relay2:  # Channel 2
                pin: 1
                mode: output
                initial: null
                pulse:
                    delay: 2  # Default pulse value
                    max_delay: 2  # The pulse interval can be between min_delay=0.1 (by
default) and max_delay=2
```

View

This is the last part of the required configuration. It defines how the previous driver and channel configuration is rendered on the Web interface. Here's an example for the example configuration above:

```
kvmd:
    gpio:
        view:
            header:
                title: Switches  # The menu title
            table:  # The menu items are rendered in the form of a table of text labels
and controls
                - ["#Generic GPIO leds"]  # Text starting with the sharp symbol will be a
label
                - []  # creates a horizontal separator and starts a new table
                - ["#Test 1:", led1, button1]  # Text label, one input, one button with
text "Click"
                - ["#Test 2:", led2, button2]
                - []
                - ["#HID Relays /dev/hidraw0"]
                - []
                - ["#Relay #1:", "relay1|Boop 0.1"]  # Text label and button with
alternative text
                - ["#Relay #2:", "relay2|Boop 2.0"]
```

This will be rendered as:



Some rules and customization options:

- Text starting with the `#` symbol will be a label.
- To place a channel in a cell, use the name you defined in the scheme.
- Inputs are displayed as round LEDs.
- Outputs are displayed as a switch AND a button.
- If the switch mode is disabled, only a button will be displayed. If pulse is disabled, only a switch will be shown.
- To change the LED's color specify it after the channel name like `"led1|red"`. Available: `green`, `yellow` and `red`.
- To change title of the button, write some its name like `"relay1|My cool relay"`.
- Buttons and switches can request confirmation on acting. To do this write its name like `"relay1|confirm|My cool relay"`. The third argument with a title is required in this case.

Hardware modules and pseudo-drivers

Raspberry's GPIO

Raspberry's GPIO

Click to view

The driver `gpio` provides access to regular GPIO pins with input and output modes. It uses `/dev/gpiochip0` and the libgpiod library to communicate with the hardware. Does not support saving state between KVMD restarts (meaning `initial=null`).

You can use the interactive scheme when selecting the pins to use. Please note that when selecting a pin for a channel, you need to use a logical number instead of a physical number. That is, if you want to use a physical pin with the number 40, the channel must have the number 21 corresponding to the logical GPIO21.

Channels should not use duplicate pins. You can also not use already used pins. To see which pins are currently used, run the command `gpioinfo`.

USB HID Relay

Click to view

The driver `hidrelay` provides access to cheap managed USB HID relays that can be found on AliExpress. This driver does not support input mode, only output. To use it, you need to specify the path to the device file (like `/dev/hidraw0`) using the `device` parameter.

Additionally, we recommend to configure access rights and static device name using UDEV rules. For example, create `/etc/udev/rules.d/99-kvmd-extra.rules`:

```
KERNEL=="hidraw[0-9]*", SUBSYSTEMS=="usb", ATTRS{idVendor}=="16c0",
ATTRS{idProduct}=="05df", GROUP="kvmd"
```

Channels should not use duplicate physical numbers. The driver supports saving state between KVMD restarts (meaning `initial=null`).

ezCoo KVM switch

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You can use GPIO to control KVM port switching. This usually requires the use of relays and buttons, but for the ezCoo switch there is a special `ezcoo` driver that simulates GPIO by sending commands to the switch via serial port. So you can make a menu in PiKVM to control the multiport switch.

IPMI

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The driver `ipmi` provides the ability to send IPMI commands (on, off, reset) and show the power status of the remote host. In fact, this is not a hardware driver, but something like a pseudo-GPIO. Each "pin" is actually responsible for a specific IPMI operation of `ipmitool`:

Pin	Type	Command
`0`	`input`	`ipmitool ... power status`, can be used to draw the LED in the menu
`1`	`output`	`ipmitool ... power on`, sends the `on` command (and only this), so like all other outputs it should be a button
`2`	`output`	`ipmitool ... power off`
`3`	`output`	`ipmitool ... power cycle`
`4`	`output`	`ipmitool ... power reset`
`5`	`output`	`ipmitool ... power diag`
`6`	`output`	`ipmitool ... power soft`

You are supposed to define one driver per host:

```
kvmd:
    gpio:
        drivers:
            my_server:
                type: ipmi
                host: myserver.local
                user: admin
                passwd: admin
        scheme:
            my_server_status:
                driver: my_server
                pin: 0
                mode: input
            my_server_on:
                driver: my_server
                pin: 1
                mode: output
                switch: false

            my_server_off:
                driver: my_server
                pin: 2
                mode: output
                switch: false
        view:
            table:
                - [my_server_status, "my_server_on|On", "my_server_off|Off"]
```

Wake-on-LAN

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The driver `wol` provides a simple generator of Wake-on-LAN packages. One driver and one output are generated for one host if a simplified configuration method is used. However, you can define multiple drivers if you want to manage different hosts. One driver controls one host, and can only be used as an output. Pin numbers are ignored.

```
kvmd:
    gpio:
        drivers:
            wol_server1:
                type: wol
                mac: ff:ff:ff:ff:ff:f1
            wol_server2:
                type: wol
                mac: ff:ff:ff:ff:ff:f2
                ip: 192.168.0.100
                port: 9
        scheme:
            wol_server1:
                driver: wol_server1
                pin: 0
                mode: output
                switch: false
            wol_server2:
                driver: wol_server2
                pin: 0
                mode: output
                switch: false
        view:
            table:
                - ["#Server 1", "wol_server1|Send Wake-on-LAN"]
                - ["#Server 2", "wol_server2|Send Wake-on-LAN"]
```

CMD

Click to view

The `cmd` driver allows you to run custom command on PiKVM OS.

> **Note**
>
> This driver does not support bash operators, that is, it is a direct call to commands with arguments. For more complex cases, write your own shell scripts.

Commands are executed from the user `kvmd`. If you want to run the command as root, then you need to configure `sudo`. Example of the `/etc/sudoers.d/custom_commands`:

```
kvmd ALL=(ALL) NOPASSWD: /usr/bin/reboot
```

Example of the `/etc/kvmd/override.yaml`:

```
kvmd:
    gpio:
        drivers:
            reboot:
                type: cmd
                cmd: [/usr/bin/sudo, reboot]
        scheme:
            reboot_button:
                driver: reboot
                pin: 0
                mode: output
                switch: false
        view:
            table:
                - ["reboot_button|confirm|Reboot PiKVM"]
```

PWM

Click to view

The `pwm` driver allows you to use some GPIO pins on the Raspberry Pi for PWM.

Here the small example with servo control:

1. Add to `/boot/config.txt`:

   ```
   dtoverlay=pwm
   ```

2. Create `/etc/udev/rules.d/99-kvmd-pwm.rules`:

   ```
   SUBSYSTEM=="pwm*", ACTION=="add", RUN+="/bin/chgrp -R kvmd /sys%p", RUN+="/bin/chmod -R g=u /sys%p"
   SUBSYSTEM=="pwm*", ACTION=="change", ENV{TRIGGER}!="none", RUN+="/bin/chgrp -R kvmd /sys%p", RUN+="/bin/chmod -R g=u /sys%p"
   ```

3. Connect Servo motor like SG90 PWM connection to RPi GPIO18, +5V and GND to a 5V and GND pin on header:

4. Add to /etc/kvmd/override.yaml

   ```
   kvmd:
       gpio:
           drivers:
               servo1:
                   type: pwm
                   chip: 0                        # PWM Chip Number
                   period: 20000000               # Servo Motor SG90 Period in nano-seconds
                   duty_cycle_push: 1500000       # Servo Motor SG90 duty_cycle for pushing button
                   duty_cycle_release: 1000000   # Servo Motor SG90 duty_cycle for releasing button
           scheme:
               short_press:
                   driver: servo1
                   pin: 0   # Pin number is the PWM channel number on the PWM Chip
                   mode: output
                   switch: false
                   pulse:
                       delay: 0.5
                       max_delay: 2
               long_press:
                   driver: servo1
                   pin: 0
                   mode: output
                   switch: false
                   pulse:
                       delay: 2
                       max_delay: 2
   ```

> ```
>             extra_long_press:
> 
>                 driver: servo1
>                 pin: 0
>                 mode: output
>                 switch: false
>                 pulse:
>                     delay: 10
>                     max_delay: 20
>         view:
>             header:
>                 title: Controls
>             table:
>                 - ["#Servo - Short Press", "short_press|Press"]
>                 - ["#Servo - Long Press", "long_press|Press"]
>                 - ["#Servo - Extra Long Press", "extra_long_press|Press"]
> ```

Servo

Click to view

The `servo` module is built on top of the `pwm` module and allows user to define angles instead of `duty_cyles` to control a PWM enabled servo motor like SG90. When the button is pressed the servo motor moves to an angle defined by `angle_push` and when button is released it moves back to `angle_release`. In the example configuration for a cheap 5V SG90 Servo, the motor moves to an angle of 45 degrees when button is pressed and moves back to 20 degress when released.

To use Servo motors in PiKVM you need to follow steps 1-3 for PWM Module and then use the following configuration.

Add to `/etc/kvmd/override.yaml`:

```
kvmd:
    gpio:
        drivers:
            servo1:
                type: servo
                chip: 0                  # PWM Chip Number
                period: 20000000         # Servo Motor SG90 Period in nano-seconds
                duty_cycle_min: 350000   # Servo Motor SG90 duty_cycle for -90 degrees
                duty_cycle_max: 2350000  # Servo Motor SG90 duty_cycle for +90 degrees
                angle_max: 90            # Servo Motor SG90 angle at duty_cycle_max
                angle_min: -90           # Servo Motor SG90 angle at duty_cycle_min
                angle_push: 45           # Servo Motor SG90 angle to push button
                angle_release: 20        # Servo Motor SG90 angle to release button
        scheme:
            short_press:
                driver: servo1
                pin: 0  # Pin number is the PWM channel number on the PWM Chip
                mode: output
                switch: false
                pulse:
                    delay: 0.5
                    max_delay: 2
            long_press:
                driver: servo1
                pin: 0
                mode: output
                switch: false
                pulse:
                    delay: 2
                    max_delay: 2
            extra_long_press:
                driver: servo1
                pin: 0
                mode: output
                switch: false
                pulse:
                    delay: 10
                    max_delay: 20
        view:

            header:
                title: Controls
            table:
                - ["#Servo - Short Press", "short_press|Press"]
                - ["#Servo - Long Press", "long_press|Press"]
                - ["#Servo - Extra Long Press", "extra_long_press|Press"]
```

Philips Hue

Click to view

The `hue` module can control smartplugs and lamps over Philips Hue Bridge API. In general the plugin can switch any device on/off which is connected to the bridge. To use it you will need API token aka username:

1. Open `http://bridge/debug/clip.html`.
2. In the URL: Field type `/api/`.
3. In the Message Body: Field type: `{"devicetype": "pikvm"}`.
4. Hit the Get Button.
5. As the Response you become the Username: `{"success": {"username": "apiusername"}`.

Example:

```
kvmd:
    gpio:
        drivers:
            hue:
               type: hue
               url: http://bridge
               token: YG-xxxxxxxxxxxx
        scheme:
            plug_button:
                driver: hue
                pin: 32
                mode: output
                initial: null
                switch: true
                pulse:
                    delay: 0
            plug_led:
                driver: hue
                pin: 32
                mode: input
        view:
            table:
                - ["plug_led", "plug_button"]
```