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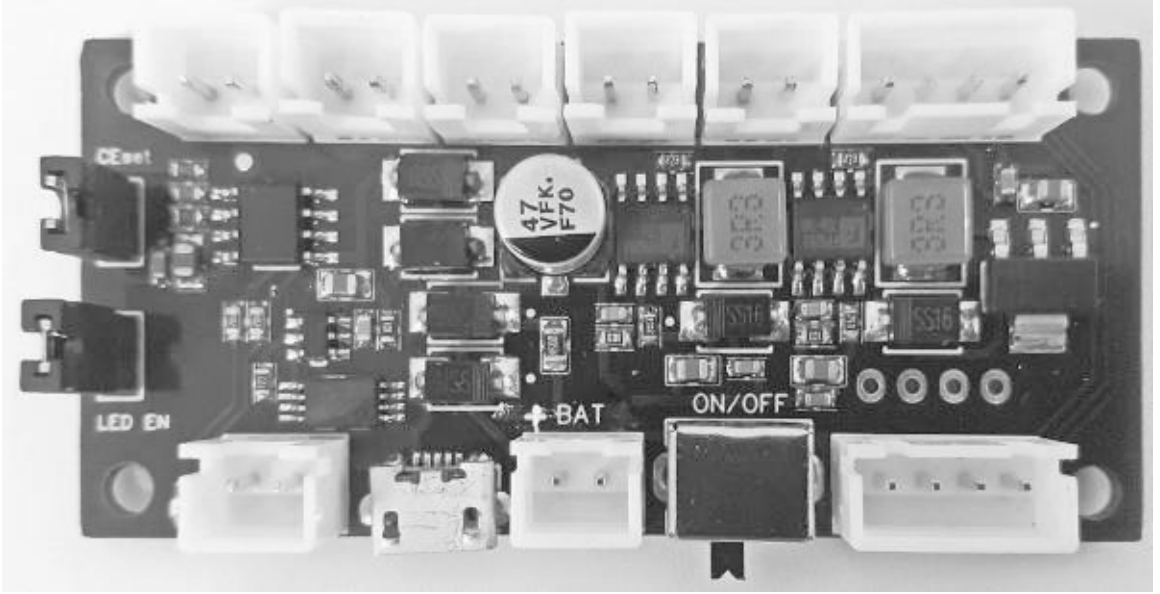


PS4IoT_V1

A Smart Power Supply Unit Module
For DIY, Smart Devices and IoT

Quick Facts Sheet

Document Revision History

- 26/11/2021 - Initial Document

Contents

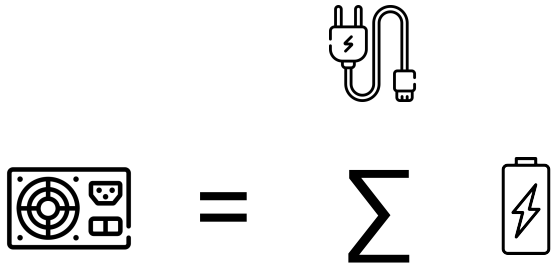
PS4IoT - a smart Power Supply Unit module formula

An online uninterruptible power supply module

- With automatic charger and power path selection
- Intelligent and connected
- With power sources redundancy layout
- Fully autonomous or sufficiently managed

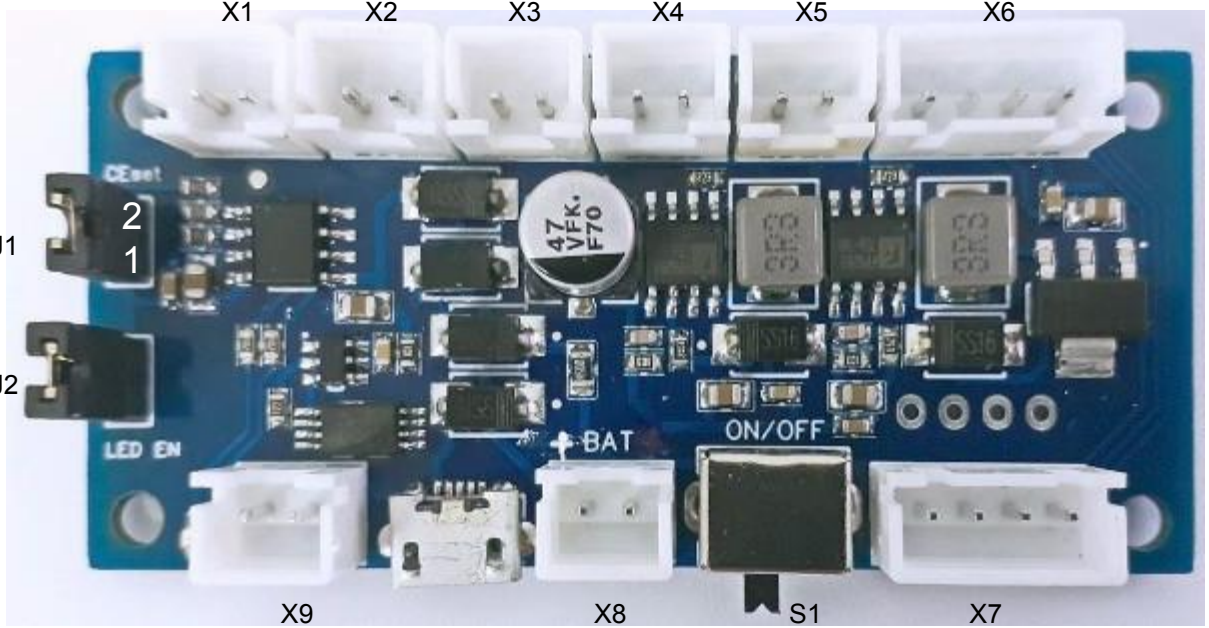
- With or without a battery
- For pockets or stationary
- With simultaneous charging and power supply of loadings
- Indoor or outdoor
- In inexpensive and miniature design

- Best suited for smart devices and IoT



Any other DC
power supply source
(3.0 - 6.0 V)
is allowed

PS4IoT_V1
Smart Power Supply Unit module for IoT.
Port Description



Note. The PS2 input (X1 port) allows the use of any DC source, including but not limited to both a conventional battery and a rechargeable battery.

Caution! Use only rechargeable 3.7V Lithium Battery as PS3 input (X8 port)!

Legend:
CP - Charge in Progress
CC - Charge Complete

- Inputs
- Outputs
- Controls

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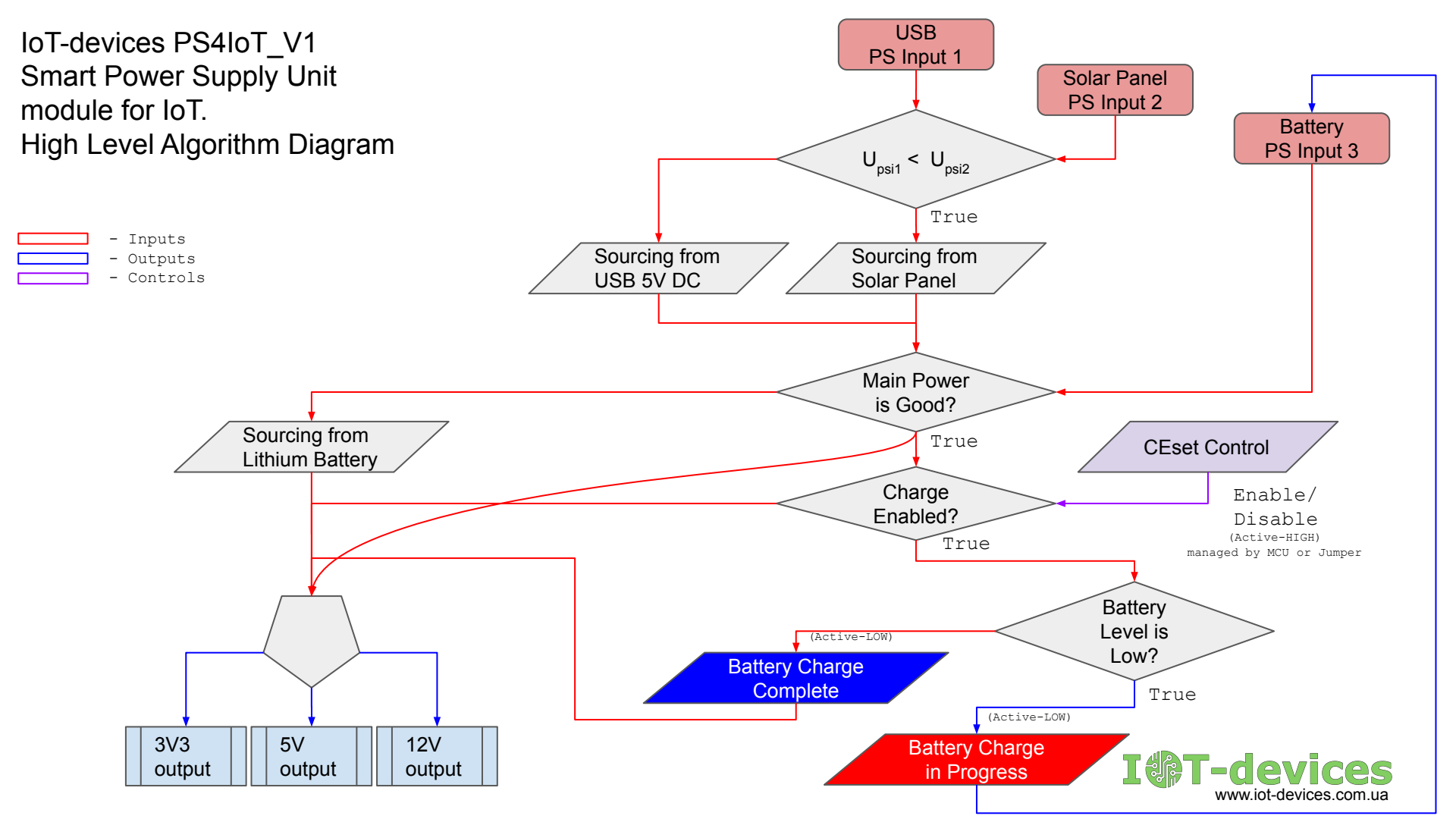
PS4IoT_V1
Smart Power Supply Unit module for IoT.
Detailed Port Table

Type	Symbol	Alias	Logic	Name	Comment
Input	-	PS1	-	USB Micro-B 5V PS Input 1	PS1 and PS2 are also known as an external power sources
Input	X1	PS2	-	Solar Panel PS Input 2	Note. The PS2 input (X1 port) allows the use of any DC source, including but not limited to both a conventional battery and a rechargeable battery.
Input	X8	BAT / PS3	-	Battery PS Input 3	Caution! Use rechargeable 3.7V Lithium Battery as PS3 input (X8 port) Only PS3 is considered as an internal power source
Control	S1	-	Mechanical	Manual Main Power Switch	Completely turns on/off the entire device
Control input	J1.2	CEset.2	Active-HIGH	Charge Enable Control Input	Set J1.[2-1] jumper in automatic mode. Or use only J1.2 pin as CE input in managed by MCU mode
Output	J1.1	CEset.1	Active-HIGH	External Power Supply Blackout Detector - 5V output.	Caution! 5V logic. In managed mode, use the right logic level converter on the MCU side. In automatic mode, set jumper J1.[2-1].
Control	J2	LED_EN	-	CP & CC LEDs Enable Jumper.	Caution! Must be switched off in managed by MCU mode. Can be set in automatic mode. Use only as a jumper
Outputs	X4	3V3	-	3V3 Load Output	Caution! The total maximum load is 5 watts, including the load on the lithium-ion battery charger
Outputs	X3	5V	-	5V Load Output	
Outputs	X2	12V	-	12V Load Output	
Outputs	X9.1	CP	Active-LOW	Charge in Progress status output	Use 10K Ohm Pull-Up externally to 3V3 at the MCU side when in managed mode
Outputs	X9.2	CC	Active-LOW	Charge Complete status output	Use 10K Ohm Pull-Up externally to 3V3 at the MCU side when in managed mode
Indicator	-	CP Red LED	Active-LOW	Charge in Progress status Red LED	Usefull when in automatic (autonomous) mode
Indicator	-	CC Blue LED	Active-LOW	Charge Complete status Blue LED	Usefull when in automatic (autonomous) mode
Outputs	X5.1		-	Battery Voltage Level Output (0-4.2V)	Always detect a battery presence with CEset=disabled
Spare	X6	AUX	-	AUX Spare 4-pin Passthrough Interface	May be used for I2C or other tasks
Spare	X7	AUX	-	AUX Spare 4-pin Passthrough Interface	May be used for I2C or other tasks

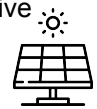
Legend:
CP - Charge in Progress
CC - Charge Complete
CE - Charge Enable
PS - Power Supply
AUX - Auxiliary
MCU - Main Computing Unit
LED - Light Emitting Diode
I2C - Inter-Integrated Circuit Bus
BAT - Li-Ion Rechargeable Battery
EN - Enable

- Inputs
- Outputs
- Controls

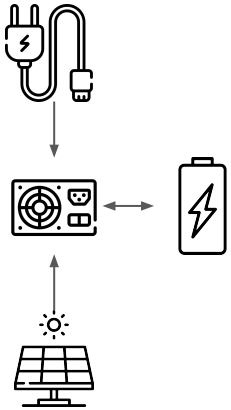
IoT-devices PS4IoT_V1
Smart Power Supply Unit module for IoT.
High Level Algorithm Diagram



Possible PS4IoT_V1 Setup Variations

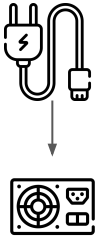
	AC-DC Adapter Power Supply 1 	Solar Panel (or alternative DC power source) Power Supply 2 	Lithium Battery Power Supply 3 
1 Full power sources redundancy	+	+	+
2 Batteryless device	+	+	
3 Generic indoor stationary device	+		
4 Generic pocket device on charger stand	+		+
5 Outdoor standalone solar powered device with battery backup and automatic charging		+	+
6 Solar powered daylight device		+	
7 Generic pocket device on the go			+

Possible PS4IoT_V1 Setup Variations (continued)

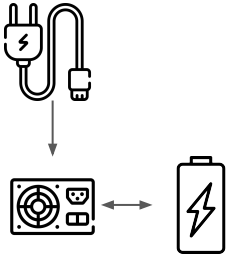


#1 Full power sources redundancy

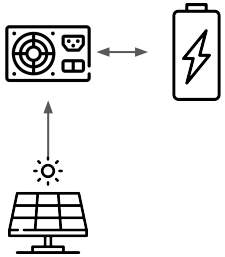
#2 Batteryless device



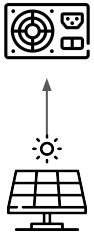
#3 Generic indoor stationary device



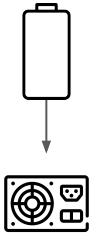
#4 Generic pocket device



#5 Outdoor standalone solar powered device

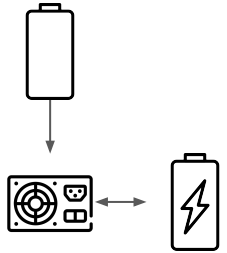


#6 Solar powered daylight device

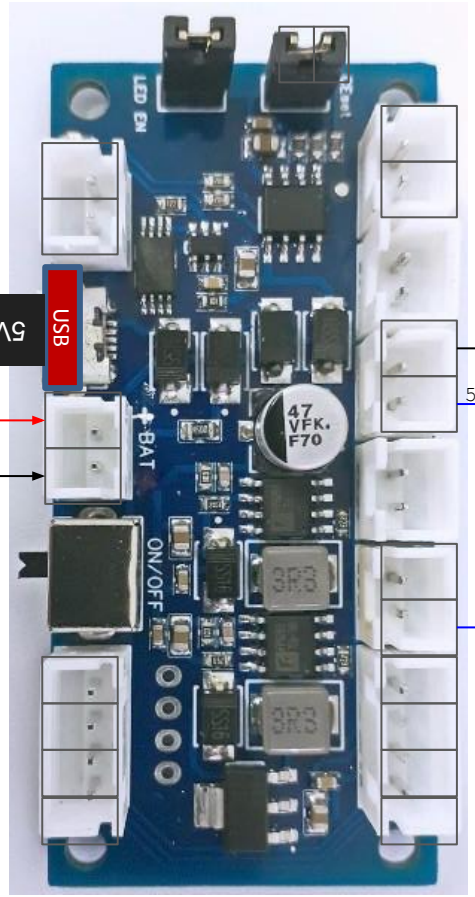


#7 Non-chargeable battery device

Other use-specific setups...



Typical PS4IoT_V1 Setup Example: #4 Generic pocket device on charger stand (automatic mode)



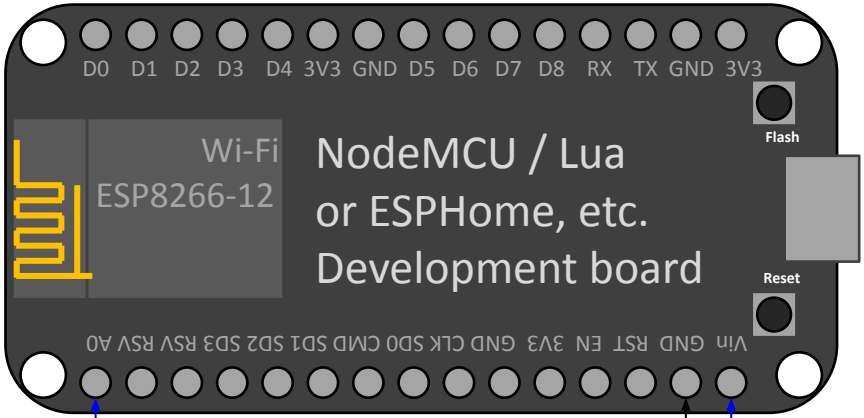
AC-DC Adapter [3-6V] PS1

Lithium Battery [3.0-4.2V] PS3

Caution! Rechargeable Battery Only!

5V

Note. ESP8266 was taken as an example only. It can be any MCU, such as Arduino, ESP32, STM32, etc. Or it can also be any other electronic load - a device or component, of course, in the automatic mode of PS4IoT.



Divider

0..1V

5V Power Input

- Inputs
- Outputs
- Controls

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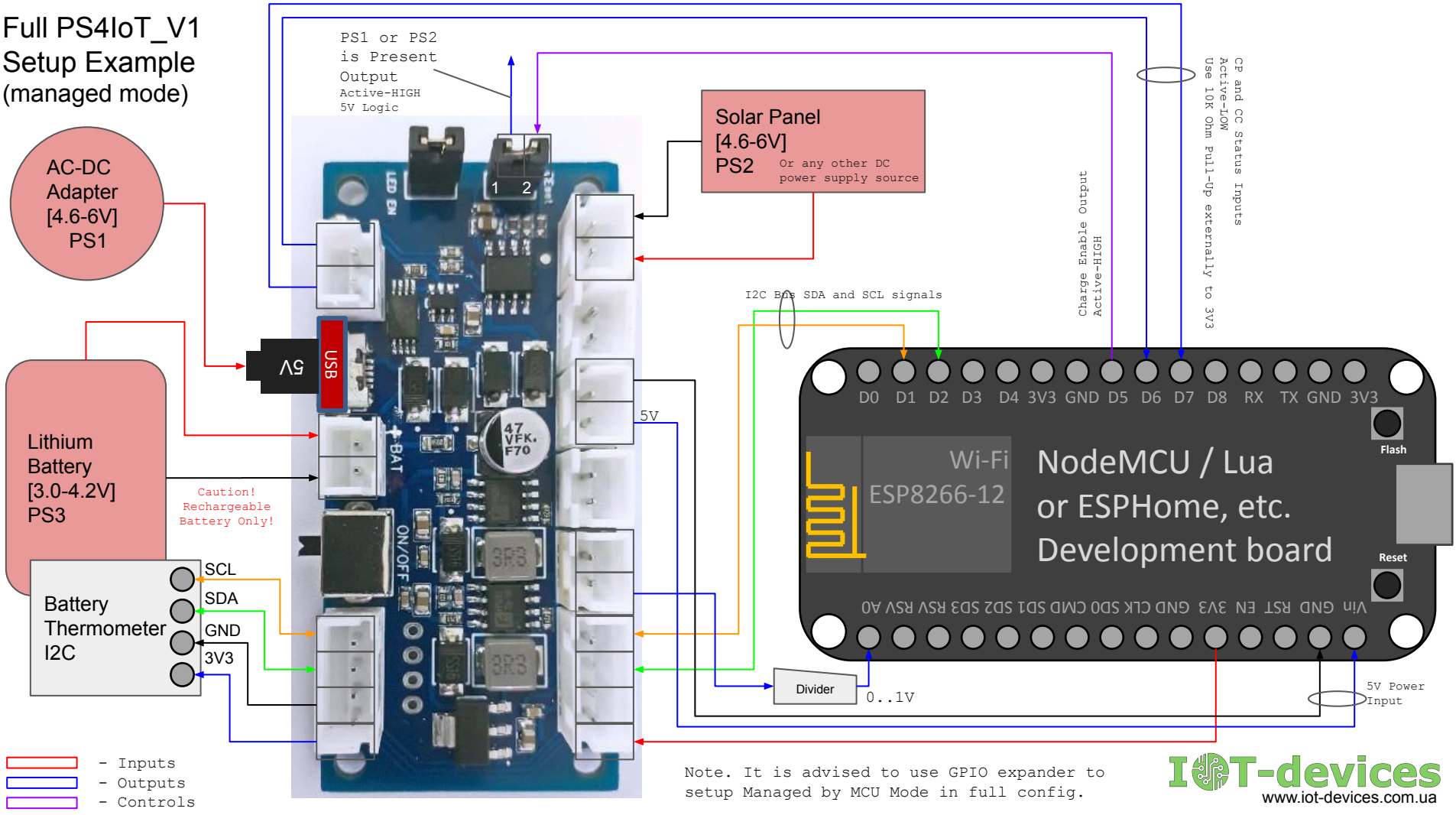
Full PS4IoT_V1 Setup Example (managed mode)



General PS4IoT_V1 Functionality

	Automatic (Autonomous) Mode	Managed by MCU Mode
Battery-free operation	Yes, auto	Yes, auto
Deeply discharged battery start	Yes, auto	Yes, auto
Simultaneous power supply of loads and battery charging	Yes, auto	Yes, auto
Automatic battery recharge	Yes, auto	Yes, auto. Or managed by MCU via CEset pin
Power source selection	Yes, auto	Yes, auto
Manual Charge Enable control	Yes, via jumper	Yes, managed by MCU via CEset pin
Built-in module status LEDs switch-off	Yes, via jumper	No, LEDs MUST be switched off via a jumper in the MCU - managed mode
Electronic main power switch	Mechanical, manual only	Mechanical, manual only
Power input blackout detection	Yes, via built-in LEDs manually	Yes, by MCU via CC, CP, CEset.1 signals

PS4IoT_V1 Battery Safety Functionality

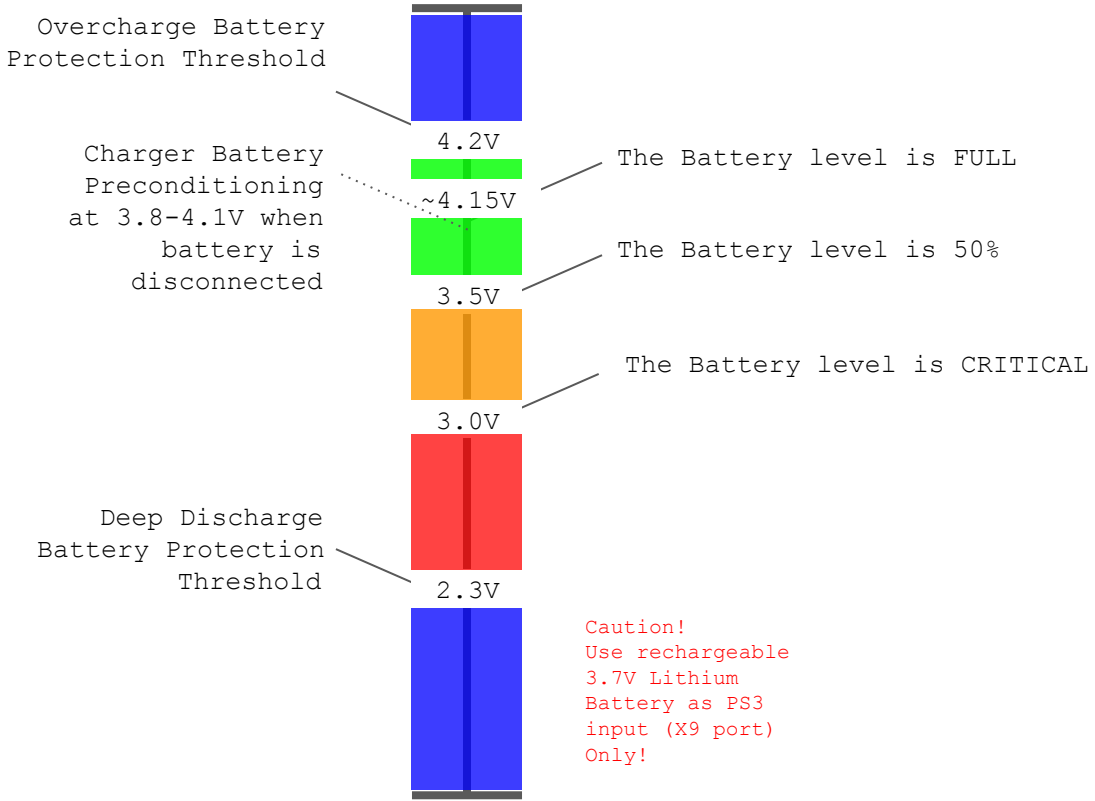
	Automatic (Autonomous) Mode	Managed by MCU Mode
Battery over temperature protection	No	Possible, managed by MCU via additional I2C or 1-Wire, etc. thermometer using spare 4-pin AUX passthrough interface connector
Battery deep discharge protection	Yes, auto with a decrease below 2.3V	Possible, managed by MCU with battery voltage level monitoring on ADC and triggering a deep sleep mode
Battery overcharge protection	Yes, auto in case of exceeding 4.2V	Yes, auto or managed by MCU
Battery charging termination	Yes, auto	Yes, auto or managed by MCU
Thermal feedback charge current regulator	Yes, auto	Yes, auto

PS4IoT_V1 Test Conditions and Truth Matrix

PS4IoT_V1 Module Side	Main Power Switch	External Power Supplied	Battery Power Supplied	Charge Enable	Charge in Progress	Charge Complete	External Power Supply Detector	Battery Voltage Level	3V3 Load Output	5V Load Output	12V Load Output
	Control	Input	Input	Control	Output	Output	Output ! 5V Logic	Output	Output	Output	Output
Switched OFF	OFF	TRUE	TRUE	TRUE	FALSE	FALSE	FALSE	0-4.2V +-1.5%	0V	0V	0V
Powering from PS1 or PS2; Battery is disconnected; CEset disabled at startup;	ON	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	0V	3V3	5V	12V
Powering from PS3 (battery); Battery is discharging; CEset disabled at startup; PS1 and PS2 disconnected;	ON	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	2.3-4.2V +-1.5%	3V3	5V	12V
Powering from PS1 or PS2; CEset enabled; Battery is charging;	ON	TRUE	TRUE	TRUE	TRUE	FALSE	TRUE	2.3-4.2V +-1.5%	3V3	5V	12V
Powering from PS1 or PS2; CEset enabled; Battery charge is completed;	ON	TRUE	TRUE	TRUE	FALSE	TRUE	TRUE	4.2V +-1.5%	3V3	5V	12V
Powering from PS1 or PS2; CEset disabled; Battery is floating;	ON	TRUE	TRUE	FALSE	FALSE	FALSE	TRUE	2.3-4.2V +-1.5%	3V3	5V	12V
Powering from PS1 or PS2; Battery is disconnected; CEset is enabled;	ON	TRUE	FALSE	TRUE	BLINKING Bat Preconditioning	BLINKING Bat Preconditioning	TRUE	near 4.1V	3V3	5V	12V
Managing MCU Side	-	-	-	**Output** Active-HIGH	**Input** Active-LOW use 10K Ohm Pull-Up	**Input** Active-LOW use 10K Ohm Pull-Up	**Input** Active-HIGH use right level convertor	**Input, Voltage** use right divider	-	**Power Input**	-
	-	-	-	GPIO	GPIO	GPIO	GPIO	ADC	-	Vin	-

Legend:
External Sources:
 PS1 - USB Power Supply Input 1
 PS2 - Solar Panel (or alternative) Power Supply Input 2
Internal Source:
 PS3 - Lithium Battery

PS4IoT_V1 PS Input 3 Battery Voltage Levels Diagram



PS4IoT_V1 Managed by MCU mode. Recommended software scripting

	Managed by MCU Mode Scripting
Step 1. Disable Charger	Set “Charge Enable” to “disabled” state (CEset in Active-HIGH logic) on MCU boot by default
Step 2. Battery Check	Check if the battery is present via the ADC input level measurement. Note, that if you measure the battery level with the charger enabled, you will get an erroneous value that will make it impossible to determine the presence of the battery.
Step 3. Control the Charger	If the battery is present, you then may: - enable “Charge Enable output” (via CEset pin); OR - enable it only when the battery level is almost empty. Doing so you may save charge cycles and prolong your battery life. If the battery is not connected, you should not set the "Charge Enable output" to "Enable". This way you can avoid a huge number of state changes on the CP and CC pins (charger battery preconditioning) and unload and extend the service life of your local or cloud server database accordingly. Also note, that the charger is being enabled, works fully automatically. So in most cases you do not need to control it at all.

ESPHome and Home Assistant deployment using ESP8266 / ESP32.
ESPHome configuration YAML-script ‘nodemcu-ps4iot-v1.yaml’ components

```
switch:
  - platform: gpio
    pin: D5
    name: "NodeMCU PS4IoT Bat Charge Enable"
    restore_mode: RESTORE_DEFAULT_ON

  - platform: shutdown
    name: "NodeMCU PS4IoT Node Infinite Shutdown"
  - platform: restart
    name: "NodeMCU PS4IoT Node Software Restart"

sensor:
  - platform: adc
    pin: A0
    name: "NodeMCU Battery Voltage Level"
    icon: "mdi:sine-wave"
    unit_of_measurement: "V"
    update_interval: 30s
    filters:
      - multiply: 5.0
```

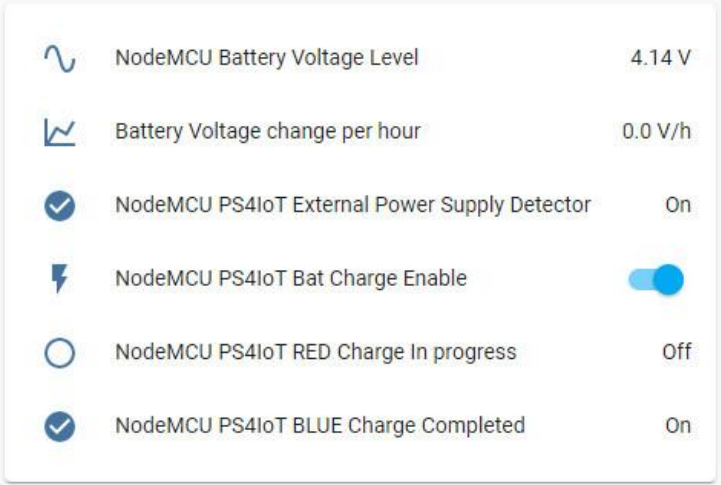
```
binary_sensor:
  - platform: gpio
    name: "NodeMCU PS4IoT RED Charge In progress"
    pin:
      number: D1
      inverted: true

  - platform: gpio
    name: "NodeMCU PS4IoT BLUE Charge Completed"
    pin:
      number: D2
      inverted: true

  - platform: gpio
    name: "NodeMCU PS4IoT External Power Supply Detector"
    pin:
      number: D6

  - platform: status
    name: "NodeMCU PS4IoT Node Status"
```

ESPHome and Home Assistant deployment using ESP8266 / ESP32 (continued)

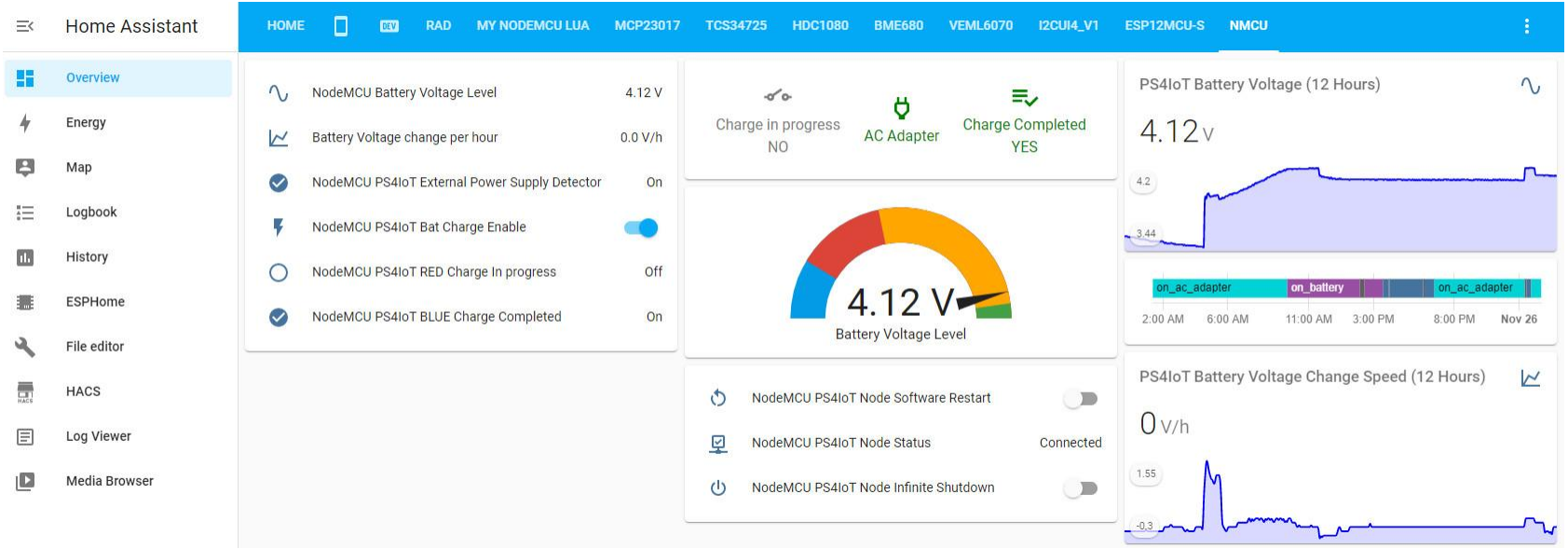


ESPHome Device Entities in Home Assistant Server:
sensor.nodemcu_battery_voltage_level
sensor.battery_voltage_change_per_hour
binary_sensor.nodemcu_ps4iot_external_power_supply_detector
switch.nodemcu_ps4iot_bat_charge_enable
binary_sensor.nodemcu_ps4iot_red_charge_in_progress
binary_sensor.nodemcu_ps4iot_blue_charge_completed

Home Assistant ‘configuration.yaml’ synthetic sensor entity script:

```
sensor:
  - platform: derivative
    source: sensor.nodemcu_battery_voltage_level
    name: Battery Voltage change per hour
    round: 1
    unit_time: h # the resulting "unit_of_measurement" will be °C/h if the
sensor.temperate has set °C as it's unit
    time_window: "00:30:00"  # we look at the change over the last half hour
```

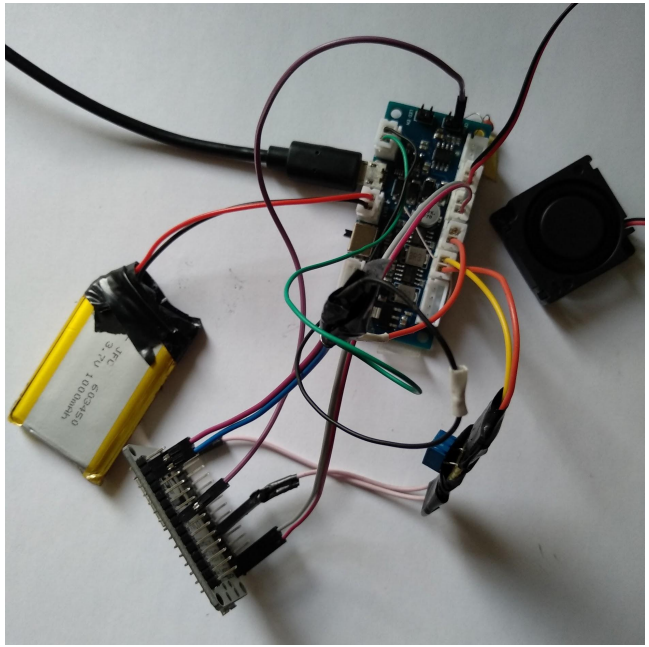
ESPHome and Home Assistant deployment using ESP8266 / ESP32 (continued)
PS4IoT HA Test Environment



ESPHome and Home Assistant deployment using ESP8266 / ESP32 (continued)
Our PS4IoT + NodeMCU/ESP8266 Test Environment

PS4IoT_V1
Module

PS1 Input



PS3 Input

12V Output
Load

NodeMCU Board
at 5V Output

In this Setup:

- MCU is powered by PS4IoT at 5V output
- Battery Voltage is measured by MCU
- CP & CC states are monitored by MCU
- CE is controlled by MCU
- Additional Load is powered by PS4IoT at 12V output

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Email	info@iot-devices.com.ua

About IoT-devices, LLC

IoT-devices is a Ukrainian private company founded in 2020 in Kyiv, which develops and manufactures its own ecosystem of electronic modules for building smart devices in the sphere of the Internet of things.

The company's B2C business is focused on the needs of customers who deal with the consumer and embedded electronics, home automation, smart home and the connected home. The company's products allow users to learn, conduct laboratory work and experiments, make their own smart devices in the best traditions of DIY.

The IoT-devices project was born thanks to customer support, as well as the team's experience and love for Electronics. All IoT-devices products are designed and manufactured with freedom and wisdom in Ukraine.

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