SEOUL ROBOTICS.

LPU-101

User Manual

Edition 1

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SEOUL ROBOTICS.

Limited Product Warranty

Seoul Robotics provides a one-year product warranty. Should this product, in Seoul Robotics' opinion, fail to be in the good working order during the warranty period, Seoul Robotics will, at its option, repair or replace it at no charge, provided that the product has not been subjected to abuse, misuse, accident, disaster, or non-Seoul Robotics authorized modification or repair.

You may obtain the warranty service by delivering this product to an authorized Seoul Robotics business partner or to Seoul Robotics along with the proof of purchase. Products returned to Seoul Robotics must be pre-authorized by Seoul Robotics with an RMA (Return Material Authorization) number marked on the outside of the package and sent prepaid, insured, and packaged for the safe shipment. Seoul Robotics will return the product by prepaid shipment service.

It is not recommended to disassemble the box PC, which will impact the warranty. The limited product warranty is only valid over the serviceable life of the product. This is defined as the period during which all components are available. Should the product prove to be irreparable, Seoul Robotics reserves the right to substitute an equivalent product if available or to retract the product warranty if no replacement is available.

The above product warranty is the only warranty authorized by Seoul Robotics. Under no circumstances will Seoul Robotics be liable in any way for any damages, including any lost profits, lost savings, or other incidental or consequential damages arising out of the use of, or inability to use, such product.

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ESD Warning

Electronic components and circuits are sensitive to Electrostatic Discharge (ESD). When handling any circuit board assemblies including, it is highly recommended that ESD safety precautions can be observed. ESD safe best practices can include, but are not limited to the following ones.

1. Leave the circuit board in the antistatic package until it is ready to be installed.
2. Use a grounded wrist strap when handling the circuit board. At a minimum, you need to touch a grounded metal object to dissipate any static charge, which may be present on you.
3. Avoid handling the circuit board in the carpeted areas.
4. Handle the board by the edges and avoid the contact with the components.
5. Only handle the circuit boards in ESD safe areas, which may include ESD floor and/or table mats, wrist strap stations, and ESD safe lab coats.

Safety Precautions

1. Pay attention to all labels and warnings on the device.
2. Only qualified service personnel should open the device to ensure safety.
3. Place the device on a sturdy surface during installation to prevent falls.
4. Keep the device away from humid environments.
5. Store the device within its temperature limits to prevent damage.
6. Only use Seoul Robotics' supplied adaptors and cables to prevent malfunctions or fires.
7. Ensure the power source matches the device's power rating.
8. Keep the power cord away from foot traffic and avoid placing objects on it.
9. Always disconnect power when the device is not in use for an extended period.
10. Disconnect from AC supply before cleaning; use a damp cloth, not liquid.
11. Install the device near an accessible power outlet.
12. Do not cover openings for proper heat dissipation.
13. Be cautious around heatsinks when the device is running.
14. Never pour liquids into device openings to prevent fire or shock.
15. Ground yourself while installing internal components; use wrist straps and static-shielded containers.
16. Contact service if the device is dropped, damaged, exposed to moisture, or not functioning properly.

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Table of Contents

1. Introduction

The LPU-101 embeds NVIDIA® Jetson AGX Orin 32G module. The LPU-101 provides multiple I/O including one HDMI video output, two USB 3.2 ports, one OUTPUT port, one SENSORS port, 40-pin expansion.

Operating with the NVIDIA® Jetson AGX Orin 32G module and rich I/O functions, the LPU-101 is the perfect choice for high performance LiDAR perception in an outdoor environment.

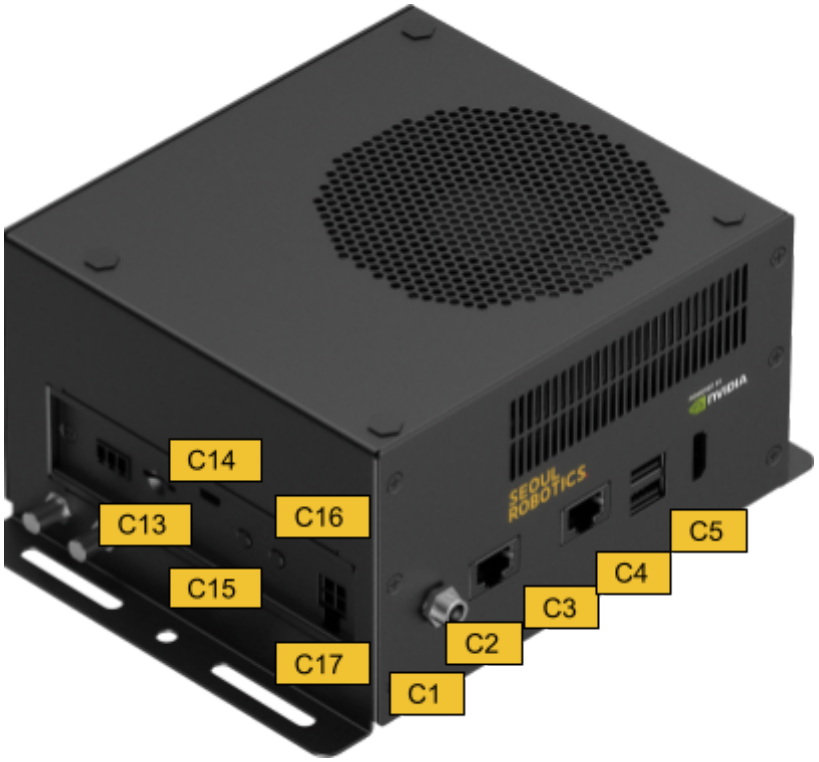
1.1. Product specifications

Type	System requirements
GPU	NVIDIA Orin AGX
RAM	32GB
Network	1x RJ-45 Port for SENSORS 1x RJ-45 Port for OUTPUT Data
Display output	1x HDMI 2.0 (3840x2160 at 60Hz)
Temperature	Operating temperature -25°C~65°C (TBD) Storage temperature -40°C ~ 85°C Relative humidity 40 °C @ 95%, Non-Condensing
USB	2x USB 2.0 Type-A 2x USB 3.2 Type-A
Storage	256Gb
Input Power	Max Consumption: 60W DC Range: 12~54V (7~1.95A) ATX 4-pin: 12~54V (10.8~2.4A)
Expansion Header	40-pin (UART, SPI, CAN, I2C, I2S, GPIOs)
Buttons	Power and Recovery
Dimensions	181.5mm (W) x 137mm (L) x 88mm (H) (with mounting hole)
Weight	1.5kg
Cooling	Heatsink + Fan
Certifications	CE, FCC, KC

1.2. Product Overview

Connector	Description
C1	DC power Jack with Lock
C2	SENSORS LAN port
C3	OUTPUT LAN port
C4	USB 3.2 Gen2 Dual Port Type A Connector
C5	HDMI output Type-A Vertical Side Connector (Female)
C6	40-pin Expansion
C7	Micro SIM card socket (Push-Push)
C8	USB 2.0 Gen1 Dual Port Type A Connector
C9	Micro SD Card Socket (Push-Push)
C10	-
C11	-
C12	-
C13	Micro SD Card Socket (Push-Push)
C14	USB 2.0 Micro B Connector
C15	Recovery Button
C16	Power Button
C17	Input Power – 4.2mm Pitch 90° ATX Power 4P

1.3. Connectors Location

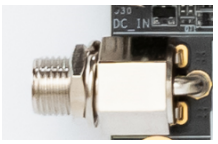


Connector	Description
C1	DC power Jack with Lock
C2	SENSORS LAN port
C3	OUTPUT LAN port
C4	USB 3.2 Gen2 Dual Port Type A Connector
C5	HDMI output Type-A Vertical Side Connector (Female)
C13	Micro SD Card Socket (Push-Push)
C14	USB 2.0 Micro B Connector
C15	Recovery Button
C16	Power Button
C17	Input Power – 4.2mm Pitch 90° ATX Power 4P

Connector	Description
C6	40-pin Expansion
C7	Micro SIM card socket (Push-Push)
C8	USB 2.0 Gen1 Dual Port Type A Connector

2. Connectors description

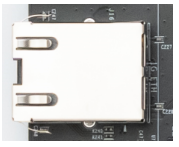
2.1. DC Power Jack

<table>
<tr><td>Function</td><td>DC Power input with lock</td><td rowspan="2"> 
  </td></tr>
<tr><td>Location</td><td>C1</td></tr>
<tr><td>Type Description</td><td>JACK_DC POWER_D2.5mm_90°_DIP include nut and washer</td><td></td></tr>
<tr><td>Mating Connector</td><td>SMCTS OD 5.5*2.5 mm DC 10mm</td><td></td></tr>
<tr><td>Pinout</td><td><table><tr><th>Pin Number</th><th>Description</th></tr><tr><td>Center</td><td>Power</td></tr><tr><td>Outer ring</td><td>GND</td></tr></table></td><td></td></tr>
<tr><td>Remarks</td><td colspan="2">-</td></tr>
</table>

2.2. SENSORS LAN port

<table>
<tr><td>Function</td><td>10 Gb single-port Ethernet connector, used to connect LiDARs.</td><td rowspan="4">  </td></tr>
<tr><td>Location</td><td>C2</td></tr>
<tr><td>Type Description</td><td>RJ45 with integrated magnetics</td></tr>
<tr><td>Mating Connector</td><td>Any standard 10Gb Ethernet connector.</td></tr>
<tr><td>Pinout</td><td>Ethernet standard.</td><td></td></tr>
<tr><td>Remarks</td><td colspan="2">-</td></tr>
</table>

2.3. OUTPUT LAN port

<table>
<tr><td>Function</td><td>1Gb single-port Ethernet connector, used to connect to external systems.</td><td rowspan="4">  </td></tr>
<tr><td>Location</td><td>C3</td></tr>
<tr><td>Type Description</td><td>RJ45 with integrated magnetics</td></tr>
<tr><td>Mating Connector</td><td>Any standard 1Gb Ethernet connector.</td></tr>
<tr><td>Pinout</td><td>Ethernet standard.</td><td></td></tr>
<tr><td>Remarks</td><td colspan="2">-</td></tr>
</table>

2.4. USB 3.2 Gen 2 Type-A

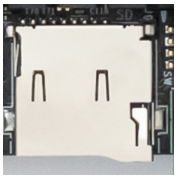
Function	USB 3.2 Gen 2 Type-A connector #1 #2
Location	C4
Type Description	Dual-port USB 3.2 Gen 2 Type-A female connector
Mating Connector	Any USB 3.2 Gen 2 standard Type-A interface cable or device.
Pinout	USB 3.2 Gen 2 standard.
Remarks	-

2.5. HDMI OUTPUT

Function	HDMI output connector
Location	C5
Type Description	HDMI Type-A female connector
Mating Connector	Any HDMI standard Type-A interface cable or device.
Pinout	HDMI standard.
Remarks	-

2.6. Micro SD Card Slot

Function	Micro SD Card
Location	C13
Type Description	SOCKET_MICRO SD CARD_9PIN_90°_SMD
Pinout	MicroSD card standard
Remark	Push-Push



2.7. ATX 4Pin

<table>
<tr><td>Function</td><td>ATX 4P</td><td rowspan="5"> 
  </td></tr>
<tr><td>Location</td><td>C17</td></tr>
<tr><td>Type Description</td><td>WAFER_2*2PIN_4.2㎜_90°_DIP</td></tr>
<tr><td>Mating Connector</td><td>ATX 4pin power standard</td></tr>
<tr><td>Pinout</td><td><table>
<tr><th>Pin Number</th><th>Description</th></tr>
<tr><td>1</td><td>GND</td></tr>
<tr><td>2</td><td>GND</td></tr>
<tr><td>3</td><td>12-54V Power</td></tr>
<tr><td>4</td><td>12-54V Power</td></tr>
</table></td></tr>
<tr><td>Remarks</td><td colspan="2">-</td></tr>
</table>

2.8. 40-Pin expansion header

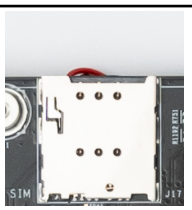
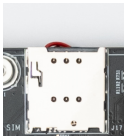
Function	General-purpose input/output
Location	C6
Type Description	HEADER_BOX_2*20PIN_2.54㎜_90°_SMD
Mating Connector	Any 2.54mm pitch standard interface female

Pinout

Sysfs GPIO	Connector Label	Pin	Pin	Connector Label	Sysfs GPIO
	3.3 VDC	1	2	5.0 VDC	
/dev/i2c-7	I2C_GP8_DAT	3	4	5.0 VDC	
	I2C_GP8_CLK	5	6	GND	
gpio454	MCLK05	7	8	UART1_TX	/dev/ttyTHS0
	GND	9	10	UART1_RX	
SFIO (gpio460)	UART1_RTS	11	12	I2S2_CLK	gpio398
SFIO (gpio456)	PWM01	13	14	GND	
gpio433	GPIO27_PWM2	15	16	GPIO8_AO_DMIC_IN_DAT	gpio325
	3.3 VDC	17	18	GPIO35_PWM3	gpio391
gpio483	SPI1_MOSI	19	20	GND	
gpio482	SPI1_MISO	21	22	GPIO17_40HEADER	gpio444
gpio481	SPI1_SCK	23	24	SPI1_CS0	gpio484
	GND	25	26	SPI1_CS1	gpio485
/dev/i2c-1	I2C_GP2_DAT	27	28	I2C_GP2_CLK	/dev/i2c-1
CAN0	CAN0_RX	29	30	GND	
	CAN0_TX	31	32	GPIO9_CAN1_GPIO0	gpio324
gpio318	CAN1_DOUT	33	34	GND	
gpio401	I2S2_FS	35	36	UART1_CTS	SFIO (gpio461)
gpio319	CAN1_DIN	37	38	I2S2_SDIN	gpio400
	GND	39	40	I2S2_SDOUT	gpio399

Note	-

2.9. Micro SIM Card Socket

Function	Micro SIM Card	
Location	C7	
Type Description	SOCKET_MICRO SIM_8PIN_90°_SMD	
Pinout	Micro SIM card standard	
Remark	*Push Push type *Inserting directing as below  	

2.10. USB 2.0 Gen 1 Type-A

Function	USB 2.0 Gen 1 Type-A connector #1 #2	 
Location	C8	
Type Description	Dual-port USB 2.0 Gen 1 Type-A female connector	
Mating Connector	USB 2.0 Type-A standard.	
Pinout	Please refer to USB 2.0 Gen 1 standard.	
Remarks	-	

3. Technical accesses

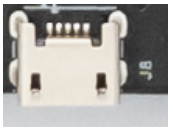
3.1. DIP Switch

<table>
<tr><td>Function</td><td>Switch Button</td><td rowspan="5">  </td></tr>
<tr><td>Location</td><td>SW1</td></tr>
<tr><td>Type
Description</td><td>4 SPST DIP switch</td></tr>
<tr><td>Pinout</td><td><table><tr><th>Pin #</th><th>Description</th></tr><tr><td>1</td><td>OFF=>Auto Power
ON=>Button Power</td></tr><tr><td>2</td><td>OFF=>FAN PWM
ON=>FAN Always</td></tr><tr><td>3</td><td>NC</td></tr><tr><td>4</td><td>OFF=>CAN W/O Terminal ON=>CAN W/ Terminal</td></tr></table></td></tr>
<tr><td>Remarks</td><td>The Switch can be used to select the computer behavior at startup, it can be accessed by opening the case.</td></tr>
</table>

3.2. Power & Recovery Button

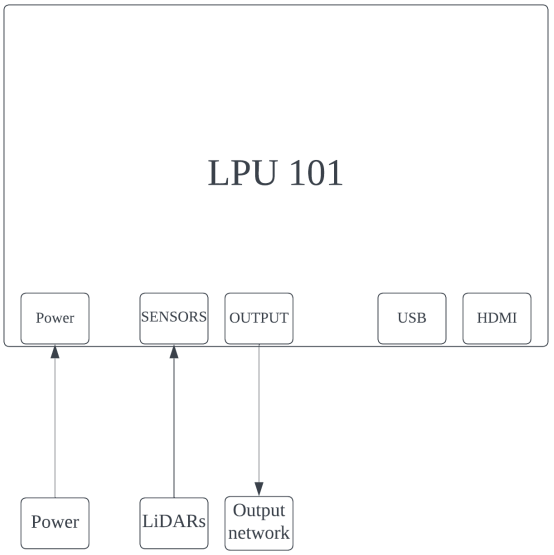
Function	Power & Recovery control button	
Location	C15 & C16	
Type Description	Button	
Pinout	N/A	
Remark	-	

3.3. USB 2.0 Micro B Connector

Function	BSP Installation in recovery mode	
Location	C14	
Type Description	USB micro-type B female connector	
Mating Connector	Any USB standard Micro-type interface cable or device.	
Pinout	USB Micro-type standard.	
Remarks	-	

4. Installation

4.1. Connections



This section details how to connect your devices to the LPU-101

- Connect the LiDARs to the **SENSORS LAN port**
- Connect your external systems / internet access to the **OUTPUT LAN port**
- Connect your monitor using the **HDMI port**
- Connect your Mouse and Keyboard using the **USB connectors**
- Power the device using either the **DC Jack** or **ATX 4pins** connectors

4.2. Powering the device

- Check and ensure all the external system power supplies are turned off.
- Connect the power cord to DC in jack or ATX 4pin
- Press the Power button
- Plug in AC power

4.3. Connecting to the device

The default Login/Password for the LPU-101 is:

- Login: discovery
- Password: seoulrobotics

5. Recovery instructions

The procedure below describes how to Flash a BSP (Board Support Package) on the LPU-101.

Important Note: Flashing the BSP on the device will erase all files stored in the machine. Before going through the steps below, please backup your files.

Necessary items

- BSP file: D315AO-R2.*.*.*.*.tar.gz (please request the BSP package at support@seoulrobotics.org)
- Ubuntu 20.04 Vanilla PC
- MicroUSB standard cable

Instructions

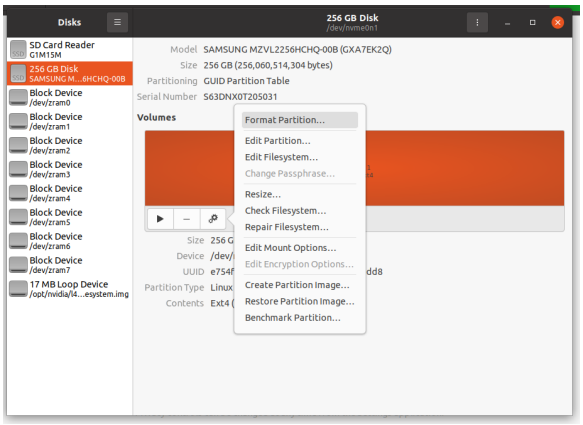
1. Set the LPU-101 into recovery mode.
   - Power the machine off
   - Connect the LPU-101 and PC using a MicroUSB cable (port **C14**)
   - Press both the **Recovery** button and the **Power on** button
2. Verify the LPU-101 is properly connected to the PC
   - In a terminal, enter *dmesg*
   - Verify that a message similar to the one below is displayed
     [24685.229129] usb 1-7: Product: APX
     [24685.229132] usb 1-7: Manufacturer: NVIDIA Corp

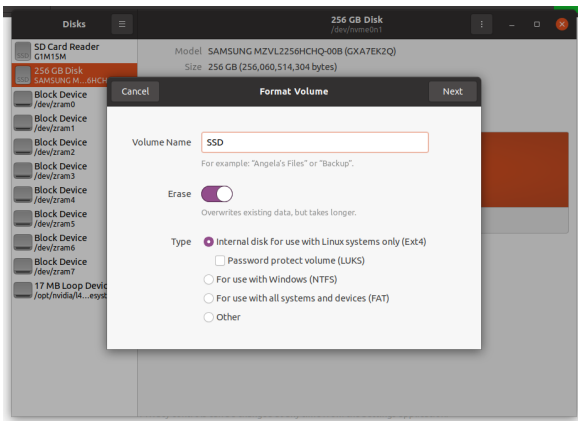
3. Download and extract the BSP on the PC:
   $ sudo tar zxvf D315AO-R2..*.*.*.tar.gz*
   *$ cd JetPack_*.**/Linux_for_Tegra*

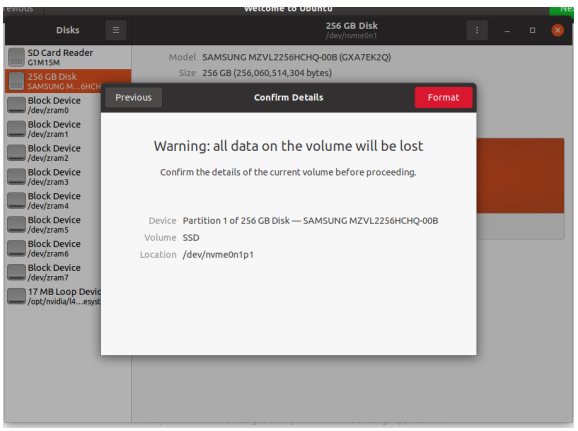
4. Flash the BSP on the target LPU-101
   ./install.sh --create_default_account
   discovery
   seoulrobotics

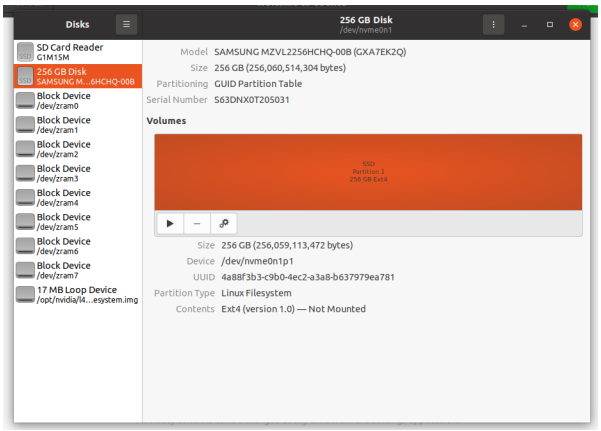
Note: If not specified, the default login username/password of the BSP is nvidia/nvidia.

5. Transfer operation on the 250Gb storage drive









6. Transfer the OS from the 60Gb to the 250Gb drive:

- clone the github repo for transfering
  git clone http://github.com/jetsonhacks/rootOnNVMe
- copy rootfs on the SSD
  cd rootOnNVMe
  ./copy-rootfs-ssd.sh
- Setup the SSD booting service
  ./setup-service.sh
- Reboot the device
  reboot
- Check the storage
  df –h

6. Force Recovery Mode

The procedure below describes how to Flash the LPU-101 by connecting its MicroUSB port of LPU-101 can be used to re-program NVIDIA® Jetson AGX Orin by using the other host system running NVIDIA Jetpack, as the procedure described below.

1. Before you start
   - Please make sure to use a Linux host PC with Ubuntu 18.04 or 20.04 operating system.
   - Please use a native setup (no virtual machine) installation file in the following steps.
   - You will also need a high-quality standard USB. Type A to micro-USB cable
   - Download installation file from Seoul Robotics.
2. Connect carrier board to host PC
3. Connect the system to the Linux host PC. Please use a USB cable (micro-USB on the carrier board).
4. After connecting to the host PC powering up the system. The system will detect the host PC and automatically enter the flashing state (also called force recovery mode).
5. Check that the connection is established with the lsusb command. You should find one entry with Nvidia Corp. as highlighted below.
6. Flashing of system
   - Use the flash cmd script in the extracted bootloader folder to transfer the software into the Jetson compute module and flash it.
   - Please connect a monitor to the system. After the flashing process has completed the should automatically boot and show the Ubuntu desktop.
   - You now have a functioning system ready for your needs.

7. Power Consumption

Item Description	Power Consumption
Theoretical Max System Power Consumption	Power Consumption of LPU-101: 11.5W(*1) to 64W (*2) *1: The condition is Normal Mode and connected to USB3*2/ USB2*2/ Ethernet*1/ SD Card*1 *2: The condition is Full Loading Mode and connected USB3*2/ USB2*2)/ Ethernet*1(1G)/ Micro SD Card*1 / SSD*1
Typical System Power Consumption	The power consumption under the normal operating mode is depending on the application software running with NVIDIA® Jetson Orin

8. GPIO activation commands

The LPU-101 GPIOs can be used to control various devices, the commands below show how to enable and activate the GPIOs. Feel free to contact Seoul Robotics' FAEs for more information.

(1) **Output**: (e.g. gpio483)

```
$ sudo su
$ gpio_id=483
$ echo $gpio_id > /sys/class/gpio/export
$ cat /sys/kerne/debug/gpio | grep 483
gpio-483 (PZ.05          )

$ gpio_index=PZ.05
$ echo out > /sys/class/gpio/$gpio_index/direction
$ echo 1 > /sys/class/gpio/$gpio_index /value   # HIGH
$ echo 0 > /sys/class/gpio/$gpio_index /value   # LOW
```

(2) **Input**

```
$ sudo su
$ gpio_id=483
$ echo $gpio_id > /sys/class/gpio/export
$ cat /sys/kerne/debug/gpio | grep 483
gpio-483 (PZ.05          )

$ gpio_index=PZ.05
$ echo in > /sys/class/gpio/$gpio_index /direction
$ cat /sys/class/gpio/$gpio_index /value     # 1: HIGH,  0: LOW
```

(3) **Disable**

```
$ sudo su
$ gpio_id=483
$ echo $gpio_id >/sys/class/gpio/unexport
```

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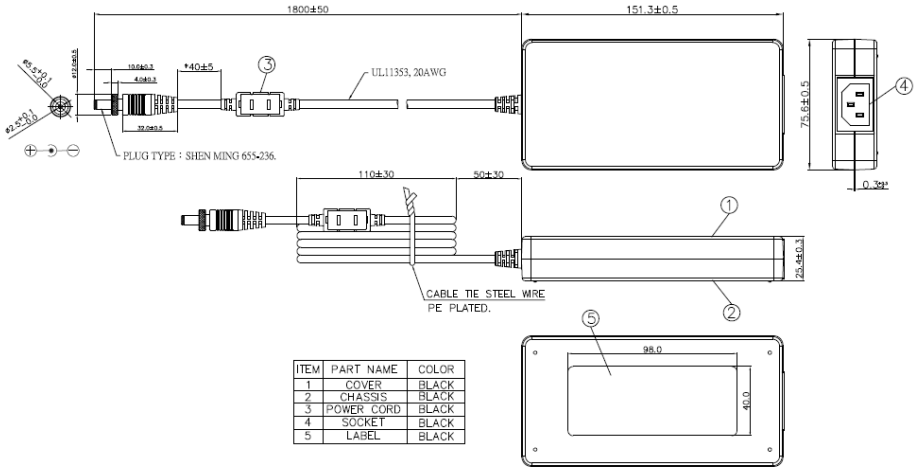
9. Accessory Drawings

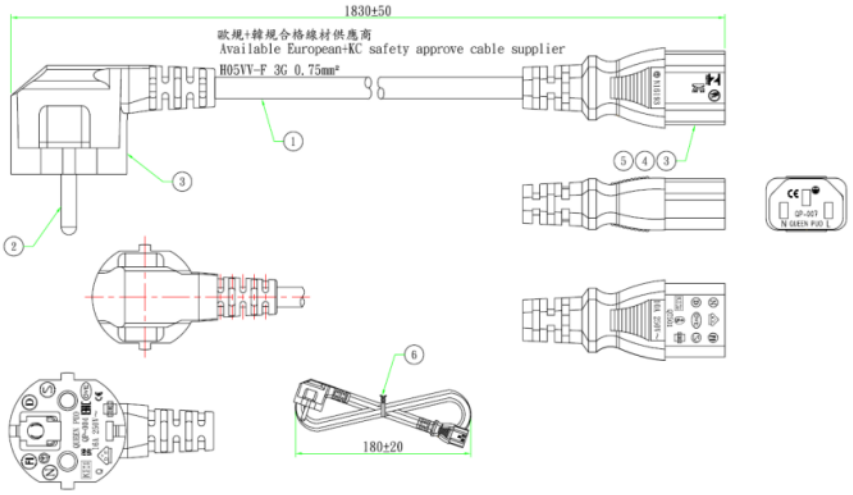
9.0. Power Adapter



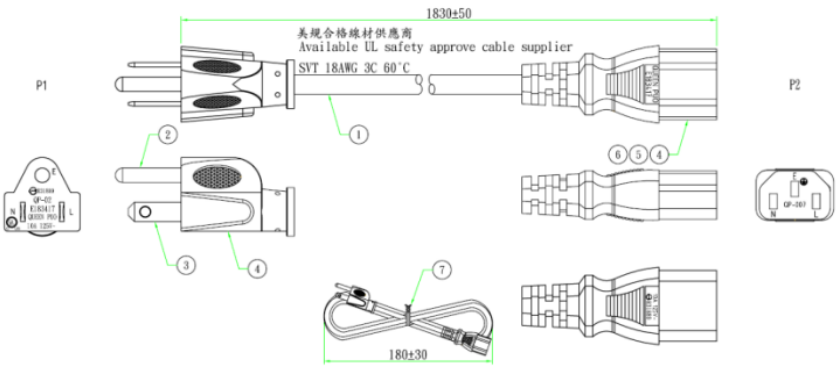
ITEM	PART NAME	COLOR
1	COVER	BLACK
2	CHASSIS	BLACK
3	POWER CORD	BLACK
4	SOCKET	BLACK
5	LABEL	BLACK

9.1. Power Adapter

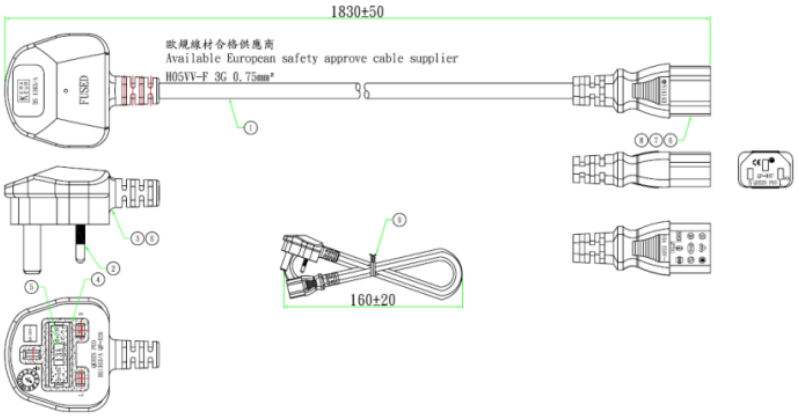
Korea / EU



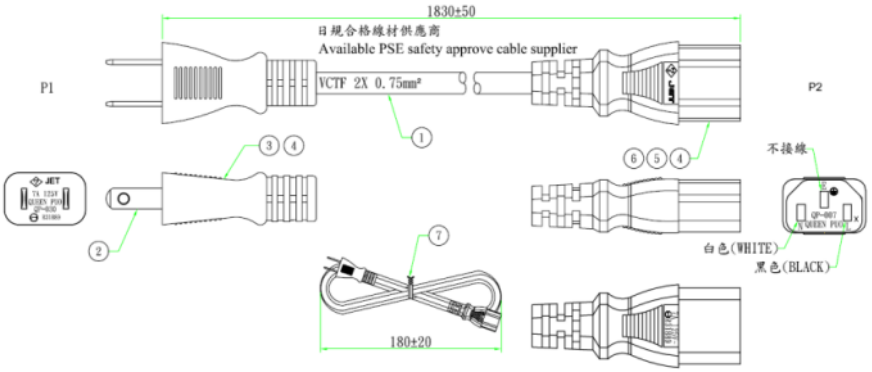
US



UK


1830±50
歐規線材合格供應商
Available European safety approve cable supplier
H05VV-F 3G 0.75mm²
160±20

Japan


1830±50
日規合格線材供應商
Available PSE safety approve cable supplier
P1
VCTF 2X 0.75mm²
P2
不接線
白色(WHITE)
黑色(BLACK)
180±20