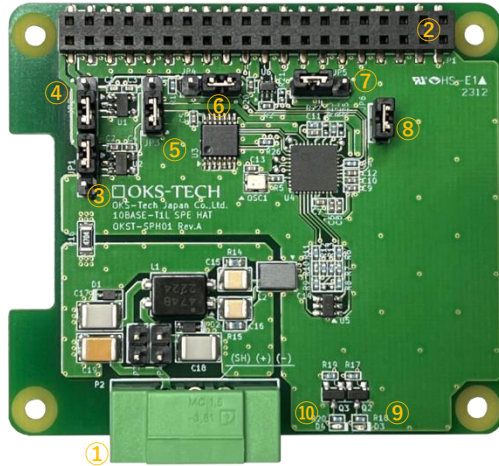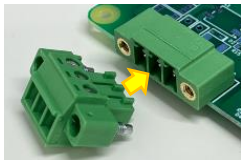# SPE HAT
User's Manual
☐ OKS-TECH

Part names and functions

1. Single pair Ethernet cable and shield wire connection terminal

   By attaching the included terminal block to the receptacles on the substrate, it becomes possible to connect twisted pair cables.

   Insert the terminal block firmly into the back of the receptacle and secure it by tightening the two screws on each side to prevent it from coming loose. Connect the twisted pair cable to the (+) and (-) positions and the shield to the (SH) position on the board, referring to the silk on the board.

   The model number for the receptacle is Phoenix Contact 1827871 , and the accompanying terminal block's model number is 1827716. In addition to screw-type terminal blocks, there are also push-in type terminal blocks that are compatible with this receptacle. Please refer to the datasheet for 1827871 for more details.

2. 40-pin penetration connector for Raspberry Pi

   This is a connection terminal for Raspberry Pi. To connect, first connect the pin socket to the Raspberry Pi side. Next, attach the spacer for fixing the SPE HAT and slowly insert this product from the top of the pin socket. There is a risk of peeling off the through-type connector if excessive force is applied.

1. Attach pin socket to Raspberry Pi

Red circles are spacer mounting points
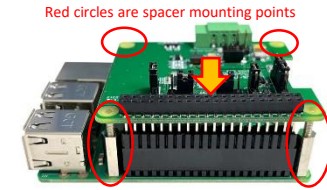
2. Attach spacers for fixing in four places, Insert the SPE HAT all the way over the pin socket

This product does not come with spacers for fixing. When the SPE HAT is attached with the included pin socket, the distance from the Raspberry Pi is 16mm. When using a 15mm spacer, use a washer or the like to adjust the height.

3. 3.3V power enable/disable jumper pin (JP1)

   Jumper settings:
   Jumper 1-2: Enable 3.3V power
   Jumper 2-3: Disable 3.3V power

   When selecting 1.8V using the 3.3V/1.8V power switching jumper pin (5), it is fine to enable the 3.3V power. However, if 3.3V is selected with (5) and this jumper is in the disabled position, power will not be supplied to the board.

4. 1.8V power enable/disable jumper pin (JP2)
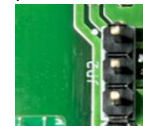
   Jumper settings:
   Jumper 1-2: Enable 1.8V power
   Jumper 2-3: Disable 1.8V power

   When selecting 3.3V with the power switch jumper pin (5), it is okay to enable the 1.8V power. However, if 1.8V is selected with (5) and this jumper pin is in the disable position, power will not be supplied to the substrate.

5. 3.3V / 1.8V Power Switch Jumper Pin (JP3)

   This is a jumper pin for switching the power supply to the devices on the substrate.
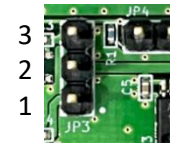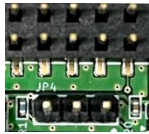

   Jumper settings:
   Jumper 1-2: 3.3V power supply
   Jumper 2-3: 1.8V power supply

   When the amplitude setting is 2.4Vp-p, be sure to use a 3.3V power supply.

6. SPI INT Switch Jumper Pin (JP4)

This pin switches the INT pin of SPI. It is used to change the pin to GPIO24 if there is a conflict with the INT pin (GPIO25) in other stacked boards and this product. If you change it to GPIO24, you need to modify the description of the driver's DeviceTree file and rebuild it. Please use the setting of GPIO25 unless there is a reason to use GPIO24.

Jumper settings:
Jumper 1-2 : SPI-INT GPIO25
Jumper 2-3 : SPI-INT GPIO24

3 2 1

7. SPI CE switch jumper pin (JP5)

This pin switches the CE pin of the SPI. It is used to change the CE pin (CE0) to another pin (CE1) when there is a conflict between the CE pin of this product and that of other stacked boards. Note that if you switch to CE1, you need to change the description in the driver's DeviceTree file and rebuild it. Please use the CE0 setting unless there is a reason to use CE1.

Jumper settings:
Jumper 1-2 : SPI-CE1
Jumper 2-3 : SPI-CE0

3 2 1

8. Amplitude Setting 2.4Vp-p / 1.0Vp-p Switch Jumper Pin (JP4)

The jumper pin for switching the output amplitude setting of 10BASE-T1L. Unless there is a special reason, set it to 2.4Vp-p. Also, when using a twisted-pair cable of 200m or more, set it to 2.4Vp-p.

Jumper settings:
Jumper on 1-2: Amplitude 2.4Vp-p
No jumper on 1-2: Amplitude 1.0Vp-p

When the amplitude setting is 2.4Vp-p, be sure to use a 3.3V power supply.

9. Link up/access LED (Red)

Lights up when connection is established. Blinks when communication is in progress between the devices.

10. Amplitude mode LED (Green)

Lights up when the amplitude mode is set to 2.4Vp-p, and turns off when set to 1.0Vp-p. Even if the amplitude mode jumper is set to 2.4Vp-p, the amplitude mode may be set to 1.0Vp-p depending on the result of auto-negotiation with the communication partner. If both devices are set to 2.4Vp-p amplitude mode, it will operate in the 2.4Vp-p mode. However, if one of the devices is set to 1.0Vp-p amplitude mode, both devices will operate in the 1.0Vp-p mode after auto-negotiation.

Setup

1. Jumper pin settings

Set jumper pins JP1 to JP6 according to the conditions for which they will be used. The initial jumper settings for this product are as follows:

- JP1: Jumper 1-2 (3.3V power supply enabled)
- JP2: Jumper 2-3 (1.8V power supply disabled)
- JP3: Jumper 1-2 (Selecting 3.3V power supply)
- JP4: Jumper 1-2 (SPI-INT GPIO25)
- JP5: Jumper 2-3 (SPI-CE0)
- JP6: Jumper (Amplitude set to 2.4Vp-p)

2. Make sure the Raspberry Pi to be connected is powered off

Please confirm that the power to the device to be connected is turned off. If you unplug and replug the product while the power is on, it may malfunction.

3. Mounting on Raspberry Pi

Attach the necessary length of pin socket to the 40-pin GPIO terminal of the Raspberry Pi, and then plug this product into the pin socket. Also, fix the Raspberry Pi and this product with spacers or similar. Please be careful not to apply excessive force during installation, as this may cause the connector to peel off.

4. Turn on the power to the Raspberry Pi

After confirming that the 40-pin connector is securely plugged in, turn on the power to the Raspberry Pi. Even if the OS starts up after the power is turned on, the red and green LEDs will not light up until the driver is installed and linked.

5. Building and installing the driver
The method for building and installing the driver varies depending on Linux distribution. The following GitHub page explains how to build and install the driver for the Raspberry Pi OS.
https://github.com/OKS-Tech-Japan/spehat_driver

6. Connecting the twisted-pair cable
Connect the 10BASE-T1L devices with a twisted-pair cable. After the devices are connected, auto-negotiation is automatically performed between the devices and the red LED lights up. The green LED only lights up when the amplitude is set to 2.4Vp-p.

Note that if the red LED does not light up and the green LED flashes irregularly, the signal quality flowing through the twisted-pair cable may be poor, and auto-negotiation may fail or the link may not be established. Please shorten the cable length or replace it with a cable with good transmission quality.

About twisted pair cables

The 10BASE-T1L standard claims a transmission distance of 1000m, but the actual distance that can be transmitted depends on the characteristics and quality of the twisted pair cable used, as well as the environment in which the cable and equipment are placed. Therefore, our company does not select or guarantee any specific cable. Please select the cable yourself and evaluate the entire system, including the equipment, before use.

Specifications

Compliance Standards	10BASE-T1L(IEEE 802.3cg-2019)
Transmission Speed	10Mbps (standard)
Transmission Distance	1000m (standard)
Termination Resistance	100 Ohms
Amplitude Mode	2.4Vp-p / 1.0Vp-p
Power Voltage	3.3V / 1.8V
Power Supply	Supply from Raspberry Pi
Power Consumption	0.5W max
Insulation Resistance	1500VDC (design value)
Operating Temperature	-20 to 70 Celsius
Operating Humidity	10 to 85%RH (no condensation)
Dimensions	W: 65mm D: 56.7mm H: 12mm
Weight	15g
Penetration type connector insertion/removal guaranteed number of times	10 times
Accessories	Phoenix Contact 1827716, 40-pin socket (Long pin type)

Notices

- This product has been developed and manufactured for general electronic use. It is not intended for use in systems that require extremely high reliability and safety, such as medical equipment that supports life, aerospace equipment, trunk communication equipment, atomic energy control equipment, etc. Please do not use this product for these purposes.
- This product is not designed for explosion-proof applications. Please do not use it in locations where explosion-proof structures are required.
- Do not modify or repair this product.
- This product is a precision electronic device. Do not bend it, apply excessive force, or subject it to strong impacts.
- When installing or removing this product, be sure to turn off the power of the target equipment to be installed, and remove the static electricity of the installer before performing the work.
- When installing and using this product, please follow the instructions and precautions of the user manual of the target equipment to be installed.
- Do not use this product in humid or dusty environments. Also, please be careful not to touch the terminal parts of this product with dirt or foreign objects.
- If you notice any abnormalities, please stop using the product immediately and contact us.

Precautions for storage

Please do not store this product in the following locations as there is a risk of product degradation:

- Locations exposed to direct sunlight
- Dusty areas
- Areas where there is a possibility of water exposure
- Areas with open flames or high heat (above 70 Celsius) or high humidity (above 85%), areas where condensation occurs, or areas with rapid temperature changes
- Locations where strong magnetic fields or static electricity are generated.

Product Warranty Policy

Please refer to the Terms and Conditions of Sale on our website.
https://www.okstech.co.jp/en/products/terms_and_cond.html

Disclaimer

- Our liability for breach of duty and tort liability shall be limited to the purchase price of this product, regardless of our intention or negligence.
- We shall not be liable for any consequential, incidental, indirect, or emotional damages, or for any loss of profits or earnings arising from the failure of this product.
- We do not guarantee the data damage or inconsistency between related data caused by the use of this product.

- The transfer speed and transmission distance of this product are standard values and are not guaranteed to perform at that level.

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