

## Ethernet-APL Field Switch Without Auxiliary Power

# Ethernet-APL Field Switch Without Auxiliary Power

## User Manual

### Product Model: SW-APL08



## Ethernet-APL Field Switch Without Auxiliary Power

---

### Overview:

Single-Pair Ethernet (SPE) is a single-pair Ethernet technology based on the IEEE 802.3cg-2019 standard. It represents a new trend in industrial automation data transmission applications and serves as the foundation for the development of the Industrial Internet of Things (IIoT). SPE technology overcomes the limitations of high space requirements and high transmission costs associated with Ethernet, enabling Ethernet to meet communication needs from remote networks to field devices for the first time with reduced space requirements and lower costs. SPE transmits Ethernet data using only a single pair of twisted-pair copper wires (single pair) and simultaneously utilizes Power over Data Line (PoDL) technology—where twisted-pair cables transmit both data and power—to supply power to end devices such as various sensors, actuators, instruments, and cameras. SPE opens up more, even limitless, possibilities for industrial Ethernet and IoT data transmission.

Although the SPE physical layer uses a single pair of twisted-pair copper wires for transmission, the protocol layer retains the various upper-layer protocols of the original IEEE 802.3 standard, particularly the 10BASE-T1 standard, which is specifically tailored for industrial automation and building automation (This standard has two variants: 10BASE-T1S for short-distance multipoint connections and 10BASE-T1L for long-distance point-to-point connections; the two are not interoperable.) It provides enhanced support for all types of upper-layer industrial Ethernet protocols, such as PROFINET, MODBUS TCP/IP, Ethernet/IP, CC-Link IE, POWERLINK, and others.

Ethernet-APL (Ethernet Advanced Physical Layer) is a physical layer based on the 10BASE-T1L standard defined in IEEE 802.3cg-2019, developed specifically for process automation. It functions similarly to Single-Pair Ethernet (SPE) but establishes its own industry standards in certain areas, particularly regarding power over Ethernet (PoE), such as:

IEC TS 63444-2023 Industrial Networks—Ethernet-APL Port Profile Specification; IEEE Std 802.3-2022 IEEE

Standard for Ethernet

## Ethernet-APL Field Switch Without Auxiliary Power

---

The 8-port Ethernet-APL field switch SW-APL08, which does not require auxiliary power, enables bidirectional, transparent data transmission between the APL power switch and the field switch. The product's two trunk interfaces support cascading expansion; they function as power-receiving interfaces that accept the 48–54 VDC (typical 50 VDC) PoDL voltage and signals output by the power switch. The trunks support APL power levels 3 and 4 (3 : 50 V/57.5 W, 4: 50 V/92 W) The six spur interfaces serve as power supply interfaces, connecting to APL terminal devices to provide power and transmit Ethernet data; the data line voltage output by the spur interfaces is 12 VDC. The APL trunk interface receives the DATA+ power signal and power output from a power switch operating at power levels 3 or 4, while the APL spur interfaces output power levels A and C

(A: 12V/0.54W, C: 12V/1.11W) The maximum transmission distance for the trunk is 1,000 meters, and the maximum transmission distance for the spur is 200 meters.

This product's Power over Data Line (PoDL) feature does not include PD detection or power classification (SCCP) processes. Instead, it uses DIP switches to enable or disable PoDL for each spur interface. Once the upstream switch is powered on, the SW-APL08 switch's spurs begin supplying power to the end-user devices via twisted-pair cables (PDs) via the twisted-pair cable. Therefore, users must verify that the powered devices comply with the Ethernet-APL standard, as the PoDL voltage specification is 9–15 VDC. If PoDL is not enabled, these issues.

### Applications

- Industrial Automation
- Building Automation
- Process Automation
- Transportation Control Systems
- Industrial Internet of Things

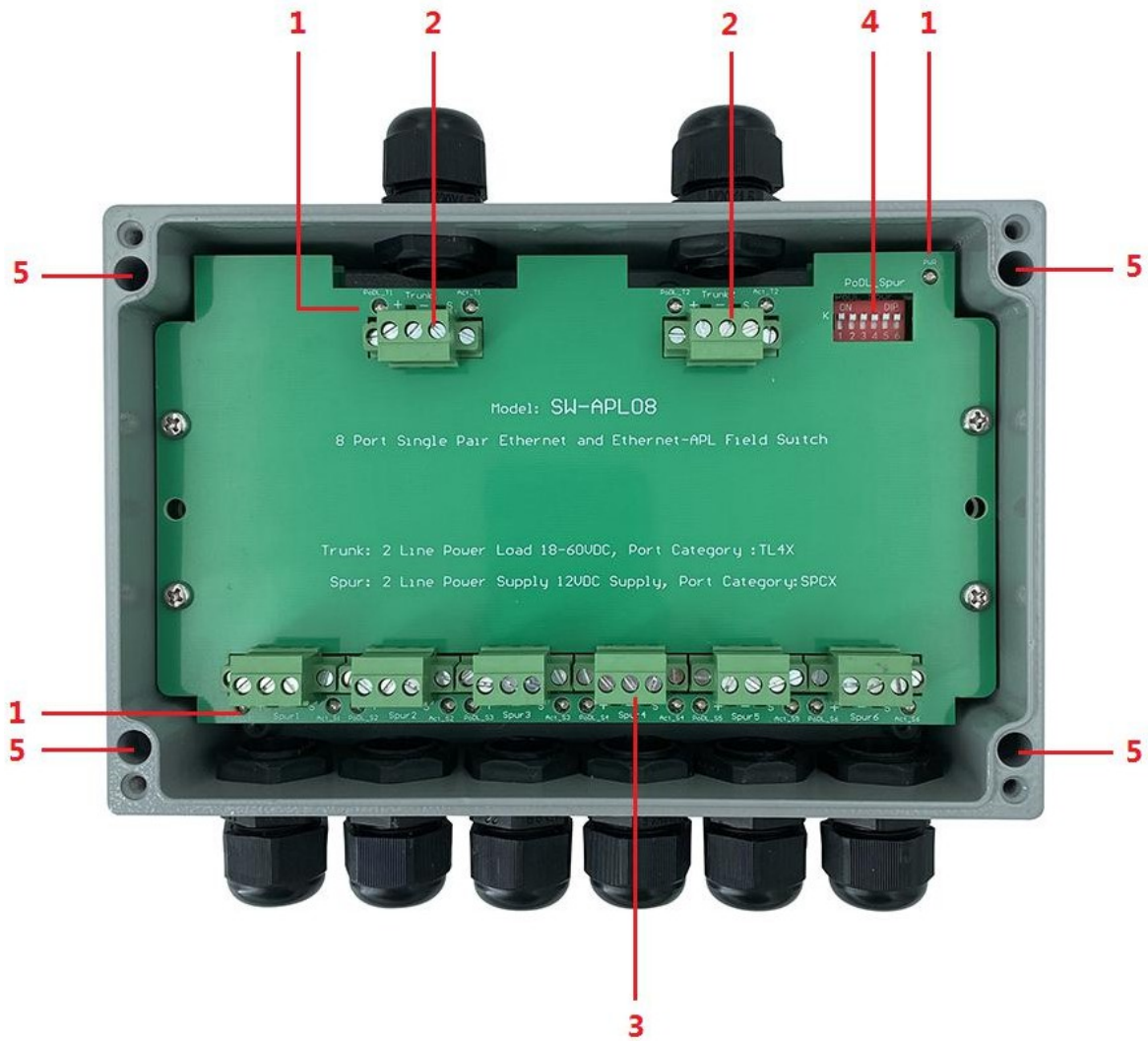
## Ethernet-APL Field Switch Without Auxiliary Power

### Key Technical Specifications:

Parameter Category	Item	Refers to Specification
Ethernet-APL Interface Parameters	Interface Type	5.08-3-pin pluggable terminal block.
	Data Rate	10 Mbit/s full-duplex, compliant with the 10BASE-T1L standard, IEEE 802.3cg-2019.
	Output Signal Peak-to-Peak	The factory default peak-to-peak signal voltage (V <sub>pp</sub> ) is 2.4 V. If V <sub>pp</sub> = 1.0 V is required, this must be specified at the time of ordering.
	Transmission Medium	Single-pair twisted-pair cable, characteristic impedance 100–120 ohms, inter-wire capacitance <60 pF/m. Trunk: 16 AWG (1.5 mm <sup>2</sup> ) to 14 AWG (2.5 mm <sup>2</sup> ) Spur: 20 AWG (0.5 mm <sup>2</sup> ) to 18 AWG (0.75 mm <sup>2</sup> ).
	Output signal peak-to-peak voltage	Trunk: V <sub>pp</sub> = 2.4 V; Spur: V <sub>pp</sub> = 1.0 V.
	Maximum transmission distance	The total length of the trunk line is up to 1,000 meters, and the spur line is up to 200 meters. If PoDL is used for power supply, the distance is limited by power and cable cross-sectional area.
	Connection Indicators	APL port communication status indicator and PoDL power supply indicator.
	PoDL Power Levels	The Trunk port receives signals and power from the upstream power-supply switch and supports receiving Ethernet-APL Power Levels 3 and 4. Level 3: 50 V/57.5 W; Level 4: 50 V/92 W. The spur output voltage is 12 VDC, and the maximum PoDL output power for each APL branch interface is 2 W. Supports Ethernet-APL power levels A and C. A: 12 V/0.54 W, C: 12 V/1.11 W.
	Number of Interfaces	2 trunk interfaces, 6 spur interfaces.
Supported Communication Protocols	IEEE 802.3cg-2019, 10Base-T1L, transparent data transmission, supports all Ethernet upper-layer protocols, such as PROFINET, MODBUS TCP/IP, Ethernet/IP, CC-Link IE, POWERLINK, etc.	
General Parameters	Input Trunk PoDL Voltage	Any voltage between 48 and 54 VDC (typical value: 50 VDC), with reverse polarity protection and surge protection.
	Output Spur PoDL Voltage and Power	The PoDL voltage for the spur output is 12 VDC, and the maximum PoDL output power for each APL branch interface is 2 W.
	Power	When the spur ports of this switch are not powered via PoDL, the power consumption is approximately 5 W. When the spur ports are powered via PoDL, the power consumption depends on the trunk input power and the power consumption of the connected terminal equipment
	Port Isolation	There is no electrical isolation between the individual APL ports (shared PoDL voltage).
	Protection Rating	IP66
	Operating Temperature	-20°C to +75°C.
	Dimensions	200 mm × 130 mm × 80 mm (L × W × H), cast aluminum waterproof housing, cable entry cable entry diameter: 6–12 mm.
	Height	1.2kg
Installation method	Secured with screws on the back plate.	

## Ethernet-APL Field Switch Without Auxiliary Power

### Product Dimensions and Component Descriptions:



## Ethernet-APL Field Switch Without Auxiliary Power

1. Indicator Lights: Names and functions of the LED indicator lights on the front panel.

Indicator Name	Indicator Status		
	On	On	Flashing Flashing
PWR	Power supply is operating normally	Fault	Power not connected or hardware failure
Act_T1	Trunk 1 is connected normally	Trunk 1 is transmitting data	Trunk 1 is not connected or connection error
Act_T2	Trunk 2 is connected normally	Trunk 2 is transmitting data	Trunk 2 is not connected or connection error
PoDL_T1	Trunk1 data line is supplying Power	Trunk1 data cable power supply Abnormal	Trunk1 has no data cable Power
PoDL_T2	Trunk 2 Data Cable Power Supply	Trunk 2 data cable power supply Abnormal	Trunk 2 has no data cable Power
Act_S1-Act_S6	Spurs Spur1-Spur6 Connected Connection is normal	Spurs Spur1-Spur6 are transmitting data	Spurs 1-6 are not or connection error
PoDL_S1-PoDL_S6	Spurs Spur1-Spur6 are Data line power is enabled	Spurs 1-6: Data Data Line Power Supply Overload Protection Triggered	Spurs 1-6: Data Line Power Off data line power supply

2. The two APL trunk interfaces, Trunk1 and Trunk2, use 5.08-3-pin pluggable terminal blocks. The signal definitions are as follows:

Terminal Name	APL, 10BASE-T1L	Type
+	D+, APL positive signal (Rx/Tx+)	Input/Output
-	D-, APL Negative Signal (Rx/Tx-)	Input/Output
S	Shield terminal; connect to the APL cable shield.	-

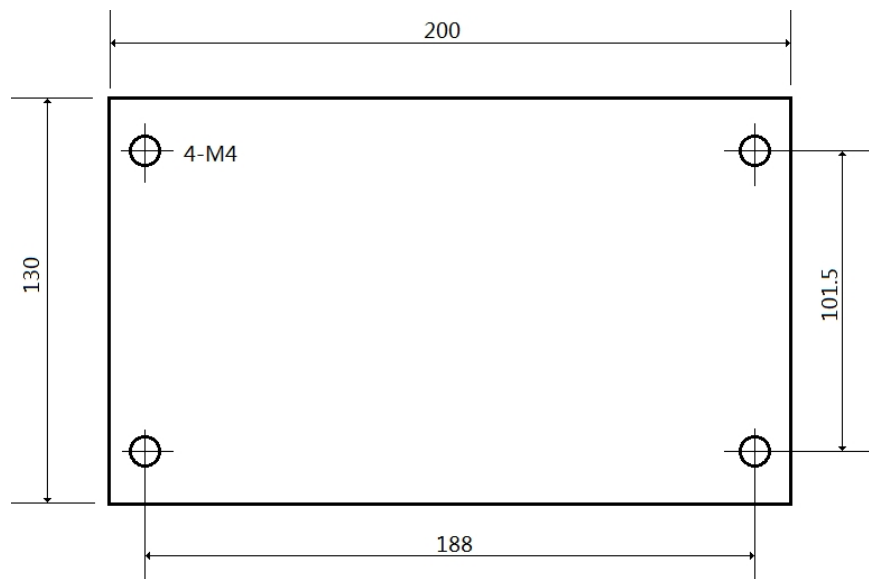
3. Six APL spur interfaces (Spur1-Spur6) use 5.08-3-pin pluggable terminals; the signal definitions are as follows:

Terminal Name	APL, 10BASE-T1L	Type
+	D+, APL Positive Signal (Rx/Tx+)	Input/Output
-	D-, APL Negative Signal (Rx/Tx-)	Input/Output
S	Shield terminal; connect to the APL cable shield.	-

4. PoDL\_Spur DIP switches for the 6 spur interfaces (Spur1–Spur6). These DIP switches enable or disable PoDL power supply. The 6-position DIP switch controls the power supply to the data lines of the corresponding 6 APL spur ports. When a DIP switch is set to ON, the corresponding spur port enables PoDL power supply, and the corresponding PoDL indicator light illuminates. At this time, the corresponding spur port transmits both data and power, with an output voltage of 12 VDC. When the DIP switch is set to OFF, PoDL power supply is disabled for the corresponding Spur port, and the corresponding PoDL indicator turns off. At this time, the corresponding Spur port transmits data only and does not supply power.

This product's PoDL power supply does not include PD detection or power classification (SCCP) processes. When the DIP switch is set to ON, power supply to the powered device (PD) via the APL cable begins immediately after power-up. Therefore, users must confirm that their powered device supports PoDL power supply **and that the PD's acceptable PoDL voltage range is 9–15 VDC**. If PoDL power supply is not enabled, these considerations do not apply.

5. Mounting holes: Secure with M4 screws. Installation dimensions are as follows:



The SW-APL08 is an APL field switch that does not require auxiliary power:

➤ As an Ethernet-APL field switch:

When the SW-APL08 functions as an Ethernet-APL field switch, the PoDL voltage output on the spur line is 12 VDC, while on the trunk line

(Trunk1 or Trunk2) connects to the upstream APL power switch as a power-receiving interface; the PoDL voltage output from the upstream APL power switch must be within the range of 48–54 VDC (typical value: 50 VDC). The trunk supports APL power levels 3 and 4 (3: 50 V/57.5 W; 4: 50 V/92 W). The six spur (Spur1–Spur6) interfaces on the SW-APL08 serve as power output interfaces, connecting to APL terminal devices to provide them with PoDL power. The PoDL voltage output is 12 VDC, and the spurs support APL power levels A and C (A: 12 V/0.54 W, C: 12 V/1.11 W)

➤ Power Estimation:

The maximum PoDL power output from a port on the upstream APL power switch (outputting 50 VDC PoDL voltage) must exceed the sum of the power consumed by the terminal devices connected to all spurs (including all cascaded spurs, Spur1 through SpurN) to the connected terminal devices, plus the line losses of the trunk and all spurs, and the approximately 5W power consumption of each cascaded SW-APL08 unit itself.

### Installation and Usage Guide

#### 1. Connection topology for the SW-APL08 Ethernet-APL field switch without auxiliary power:

As an Ethernet-APL field switch without auxiliary power supply, the PoDL voltage output on the spur lines is 12 VDC.

Connect the Trunk1 or Trunk2 interface to the upstream APL power switch; the PoDL power voltage output by the upstream power switch is typically 50 VDC. The six APL branch (Spur1–Spur6) interfaces connect to various APL devices in the field (such as instruments, sensors, and actuators). Set the PoDL\_Spur DIP switch to ON to enable PoDL power supply for the branch. The PoDL voltage output from the branch is 12 VDC, supporting PoDL power levels A and C. The maximum PoDL output power for each APL branch interface is 2 W.

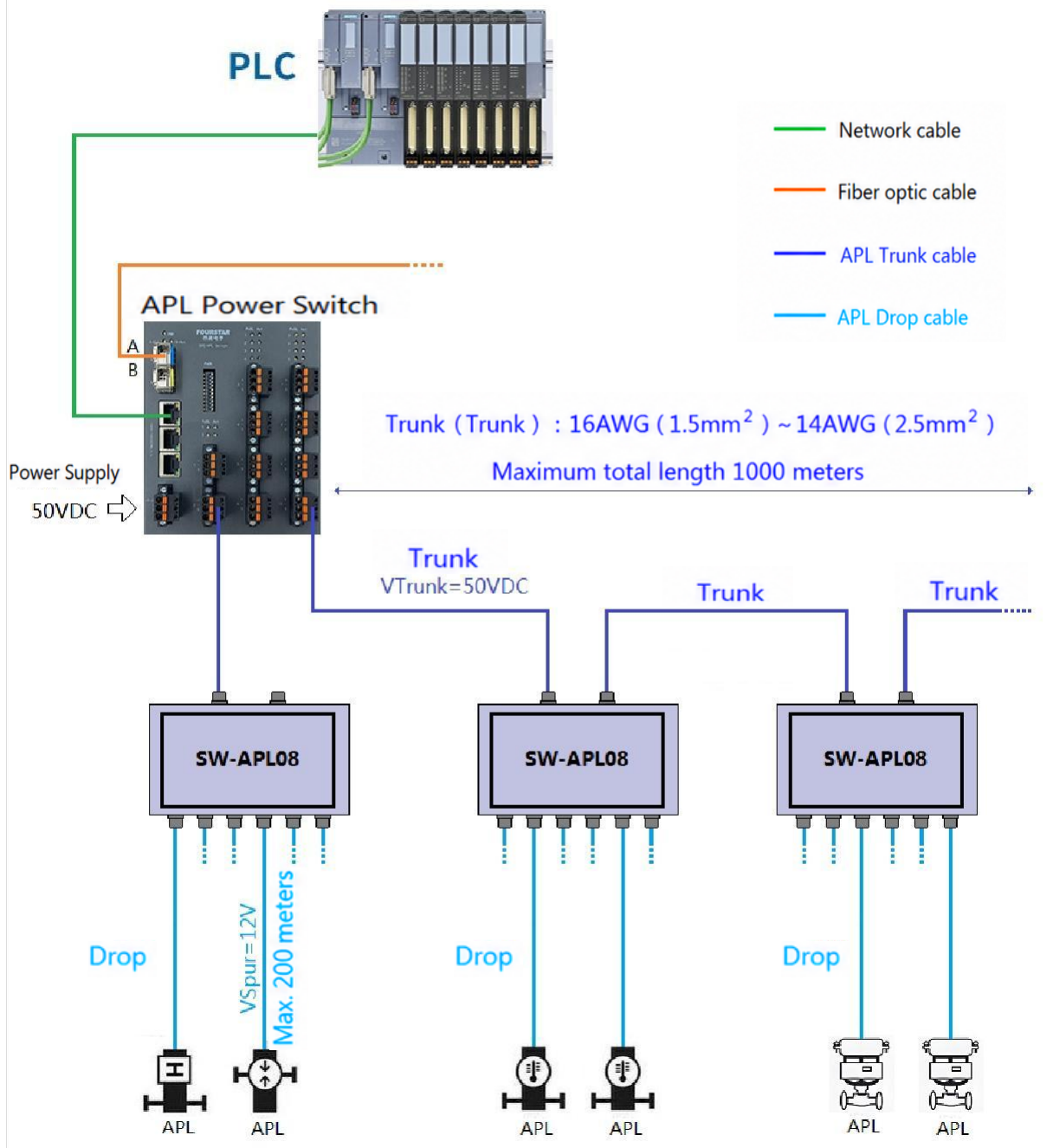
When the SW-APL08 functions as an Ethernet-APL field switch, the port types are as follows:

Trunk: TL4X (T: APL trunk; L: power-consuming device; 4: 50 VDC/92 W; X: non-hazardous area/non-intrinsically safe hazardous area.)

Branch: SPCX (S: APL branch; P: power supply port; 4: 15 V DC/1.11 W; X: non-hazardous area/non-intrinsically safe hazardous area).

The connection topology of the SW-APL08 when used as an APL field switch is shown below:

## Ethernet-APL Field Switch Without Auxiliary



Connection Topology of the APL Field Switch SW-APL08

### Power Calculation Example:

Assuming that one port on the upstream power switch has a power rating of 3, i.e., 50V/57.5W, and one SW-APL08 has six APL terminals connected to its branch, with each terminal having a power rating of C, i.e., 12V/1.11W, and the SW-APL08 itself consumes approximately 5W. Therefore, the total power consumption of one SW-APL08 is:  $1.11\text{ W} \times 6 + 5 = 11.66\text{ W} \approx 12\text{ W}$ . One APL port on the power switch (57.5 W) can cascade  $57.5 / 12 = 4.79 \approx$

---

## Ethernet-APL Field Switch Without Auxiliary Power

---

5 SW-APL08 field switches. For other power ratings, apply this principle accordingly. Generally, a 30% margin is required to account for line loss; therefore, the number of SW-APL08 units cascaded on each trunk line should not exceed 4.

The maximum allowable length of 1,000 meters for a trunk refers to the total length after multiple SW-APL08 units are cascaded, as shown in the figure above. It does not mean that the maximum allowable length between adjacent SW-APL08 units is 1,000 meters; this is primarily limited by power supply capacity and line loss.

Regarding twisted-pair cables for trunks, line loss becomes a significant issue due to the need to transmit high power and cover long distances. Therefore, cables with larger cross-sectional areas must be used, typically ranging from 16 AWG (1.5 mm<sup>2</sup>) to 14 AWG (2.5 mm<sup>2</sup>). Pay close attention to the three key specifications for trunk cables:

★ The characteristic impedance of the twisted-pair cable should be 100–120 ohms.

★ The cross-sectional area must be at least 1.5 mm<sup>2</sup>, and the conductor material must be low-resistance oxygen-free copper.

This can be verified using the resistance formula:  $R = \rho L / S$

$\rho$ : resistivity of copper (0.017  $\Omega \cdot \text{mm}^2/\text{m}$ ), L: cable length (meters), S: cable cross-sectional area (square millimeters), R: cable resistance (ohms)

For example, for a twisted-pair cable that is 100 meters long with a cross-sectional area of 1.5 square millimeters, the resistance of the loop (two wires) is:

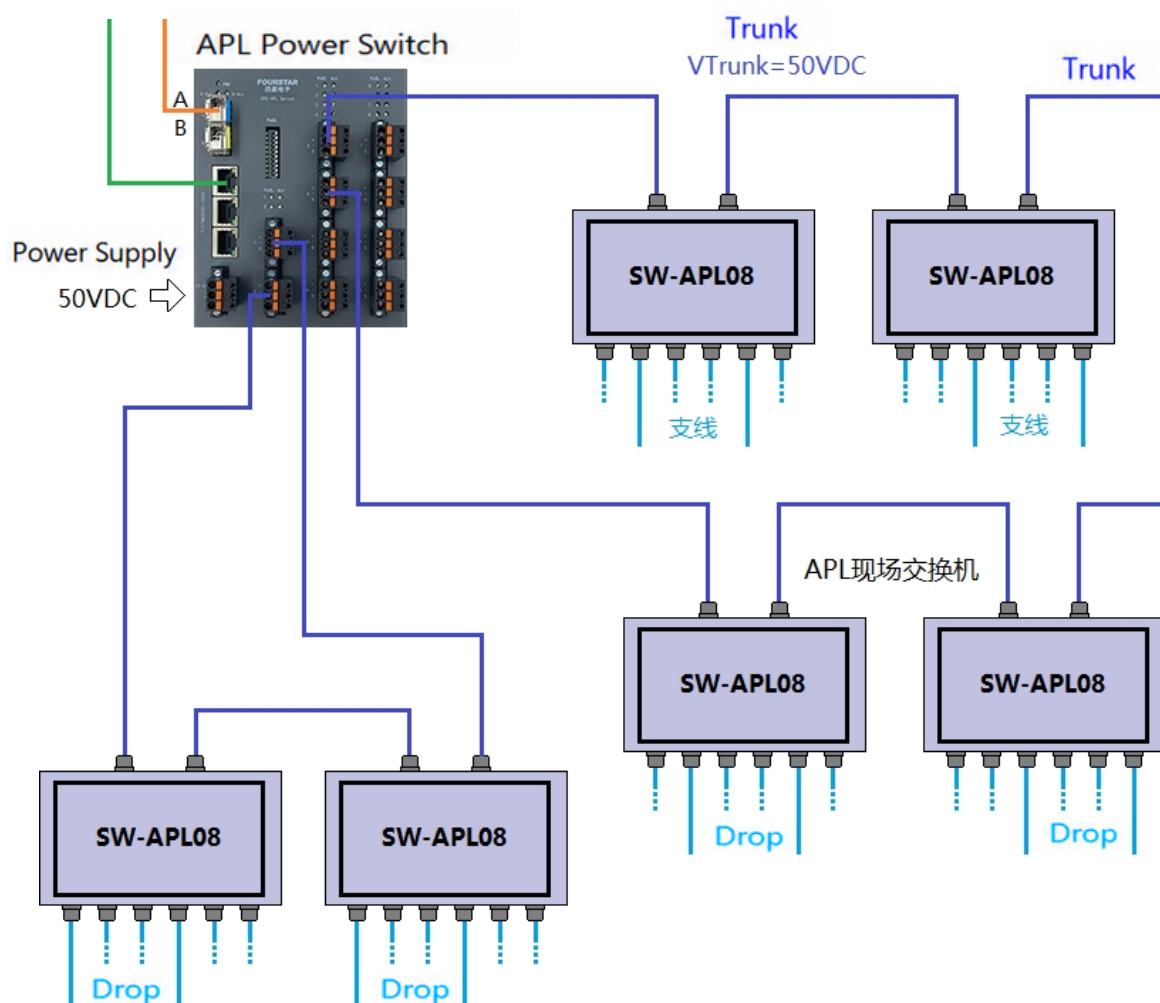
$$R = \rho L / S = 0.017 \times 2 \times 100 / 1.5 = 2.27 \text{ ohms}$$

If the resistance exceeds this value, it indicates that some inexpensive metals have been added to the copper, meaning it is not pure copper.

★ The inter-wire capacitance of twisted-pair cable must be less than 60 pF/meter; this is also an important indicator and can be measured with a multimeter.

### 2. Trunk Lines Forming a Ring Network:

The APL power switch FO2G-IE3G-10T1L10 has 10 APL ports, of which only ports 1, 2, 3, and 4 support ring networks. When combined with the SW-APL08 field switch, it can form two trunk ring networks. If a trunk line breaks at any point in the ring network, it does not affect normal network communication. The connection topology is shown in the figure below.

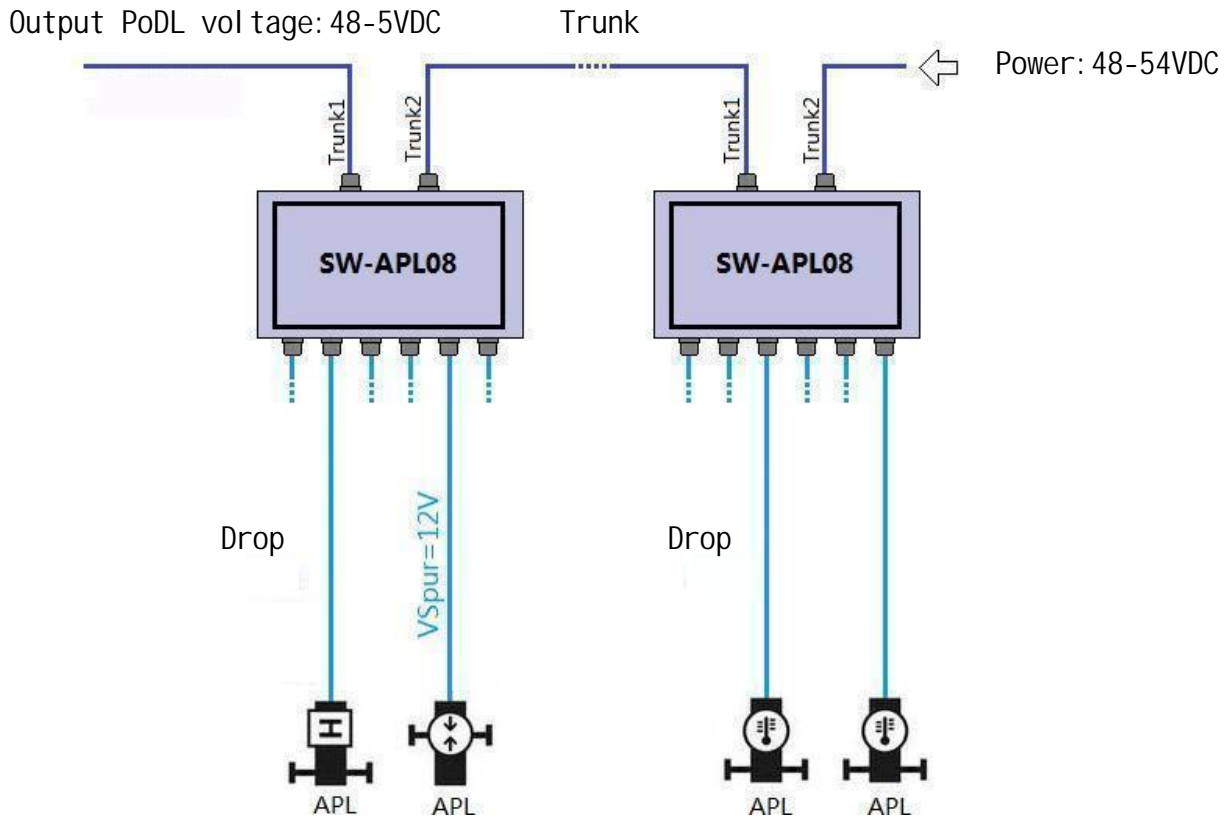


APL Field Switch SW-APL08 Ring Topology

### 3. Providing Auxiliary Power to the SW-APL08:

Sometimes, the power output from the upstream power switch is insufficient, or the trunk cable's cross-sectional area is too small, or the cable is too long. As a workaround, an external power source can be connected to the SW-APL08 switch, as shown in the figure below. Simply connect a 48–54 VDC power source directly to Trunk2 (or Trunk1). In this case, the Trunk1 port will output a PoDL voltage equal to that of the external power supply. This method requires that the power switch's output voltage match the external voltage to prevent reverse current flow.

**Ethernet-APL Field Switch Without Auxiliary Power**



## **Ethernet-APL Field Switch Without Auxiliary Power**

---

Disclaimer: This document provides guidance for users of the SW-APL08 Ethernet-APL field switch. Due to the rapid development of new technologies, actual product functionality is subject to change.