HIWIN® MIKROSYSTEM

APM

Absolute Position Measurement System

User Manual

www.hiwinmikro.tw
ME06UE01-2405_V1.1

Related Documents

Through related documents, users can quickly understand the positioning of this manual and the correlation between manuals and products. Go to HIWIN MIKROSYSTEM's official website → Download → Manual Overview for details (https://www.hiwinmikro.tw/Downloads/ManualOverview_EN.htm).

Approvals

Approvals		
Integration Standards	EU Directives	
	Emissions	EN-61000-6-4:2007/A1:2011
	Immunity	EN 6100-6-2:2005
Absolute Position Measurement System Model	EU Directives	
	CE	RoHS Directive
APM-□□-□□-□□-T-10	✓	✓

Note:

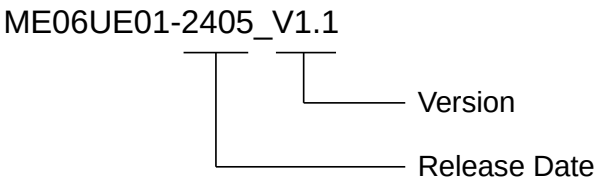
EN: Europäische Norm = European standard

Table of Contents

1. General information

1.1 Revision history

The version of the manual is also indicated on the bottom of the front cover.



Release Date	Version	Applicable Product	Revision Contents
May 24th, 2024	1.1	Absolute position measurement system	1. Update section 3.2.2.1 **BiSS-C communication**. 2. Add section 3.2.2.3 **Relationship between cable length, communication frequency and voltage**. 3. Update section 5.1.2 **Absolute position measurement installation**. 4. Update section 5.2.1.1 **Port type**. 5. Update section 5.2.3 **Cable length description**. 6. Update chapter 10's name: **Declaration**.
Jan. 31st, 2024	1.0	Absolute position measurement system	First edition.

1.2 About this manual

This manual aims to assist users to operate absolute position measurement system. The content of this manual contains introduction, sizing, installation, troubleshooting, maintenance, waste disposal and appendix. Before using the product, please carefully read through this manual, and follow the general precautions and safety instruction to ensure normal operation of the product.

1.3 General precautions

Before using the product, please carefully read through this manual. HIWIN MIKROSYSTEM is not responsible for any damage, accident or injury caused by failure in following the installation instructions and operating instructions stated in this manual.

- Before installing or using the product, ensure there is no damage on its appearance. If any damage is found after inspection, please contact HIWIN MIKROSYSTEM or local dealers.
- Carefully read through the specification noted on the product label or technical document, and check if the product is used with the power supply specified in the product requirement. Install the product in accordance with the specification and instructions stated in this manual. HIWIN MIKROSYSTEM is not responsible for any damage, accident or injury caused by the usage of incorrect power supply.
- Do not subject the product to shock or place it in risky locations. HIWIN MIKROSYSTEM is not responsible for any damage, accident or injury caused by improper usage.
- Do not disassemble or modify the product on your own. The design of the product has been verified by structural calculation, simulation analysis and actual testing. HIWIN MIKROSYSTEM is not responsible for any damage, accident or injury caused by disassembly or modification done by users without authorization.
- Avoid using magnetic tools, screws, magnetic storage devices, or precision instruments to contact the position scale. HIWIN MIKROSYSTEM is not responsible for any damage, accident or injury caused by this.
- If an error or any abnormal conditions occur in the product, please refer to chapter 9 and follow the instructions for troubleshooting. The product can only be repaired by qualified technician from HIWIN MIKROSYSTEM. HIWIN MIKROSYSTEM is not responsible for any damage, accident or injury caused by human factors.
- If the information of registration does not match with your purchasing or if there are any questions related to the product, please contact the sales representatives of HIWIN MIKROSYSTEM or agents or dealers.

HIWIN MIKROSYSTEM offers 1-year warranty for the product. The warranty does not cover damage caused by improper usage (refer to the precautions and instructions stated in this manual) or natural disaster.

1.4 Safety instruction

- Carefully read through this manual before installation, transportation, maintenance, and examination. Ensure the product is correctly used.
- Carefully read through electromagnetic (EM) information, safety information, and related precautions.
- Safety precautions in this manual are classified into “DANGER,” “WARNING,” and “CAUTION.”

⚠DANGER

Imminent danger!

Indicates that death or severe personal injury will result if proper precautions are not taken.

⚠WARNING

Potentially dangerous situation!

Indicates that death or severe personal injury may result if proper precautions are not taken.

⚠CAUTION

Potentially dangerous situation!

Indicates that property damage or environmental pollution can result if proper precautions are not taken.

Warning Signs			
	Warning!		Electrostatic-sensitive device.
	Do not scratch the position scale with sharp objects.		Keep magnetic objects away from the position scale.
	Do not band the position scale.		When storing the position scale, the radius should not be smaller than 140 mm.
	Dangerous voltage!		Environmentally hazardous substance.

Mandatory Signs			
	Refer to user manual!		Disconnect before carrying out maintenance or repair.
	Wear protective gloves!		Wear safety footwear!

DANGER

- Do not use the product in explosive zones.

WARNING

- During operation, do not touch any movable parts (e.g., position measurement) to avoid bruising, rubbing, abrasing, and seizing of limbs or clothes.
- Since the position measurement is sensitive to static electricity, please be careful. Without proper ESD protection, do not touch the cables or the pins of connectors. The level of ESD protection is only 8 kV.
- Do not perform wiring work or disconnect electrical connections when power on.
- Perform wiring work in power off state only.
- Check all the cables and plug connections before switching on the device.

CAUTION




- Do not scratch the position scale with sharp objects.
- Keep magnetic objects away from the position scale.
- Do not band the position scale.
- When storing the position scale, the radius should not be smaller than 140 mm.
- Before installation, check if the position measurement has transport damages. Do not install damaged position measurement.
- Do not apply excessive force to the product.
- Do not drop the product.
- Magnetic objects (e.g., screwdriver) cannot be in contact with the scale.
- Since the position scale consists of magnetic substance, keep it away from strong magnetic materials and strong magnetic fields during usage and installation to prevent malfunction.
- Stay at least 5 cm away from the magnetic field strength of 5000 gauss to prevent the position measurement system from disruption.

1.5 Copyright

Note:
HIWIN MIKROSYSTEM reserves the right to change the contents of this manual or product specifications without prior notice.

1.6 Manufacturer information

Table 1.6.1 Manufacturer's details

Corp.	HIWIN MIKROSYSTEM CORP.
Address	No.6, Jingke Central Rd., Taichung Precision Machinery Park, Taichung 40852, Taiwan
Tel.	+886-4-23550110
Fax	+886-4-23550123
Sales E-mail	business@hiwinmikro.tw
Customer Service E-mail	service@hiwinmikro.tw
Website	http://www.hiwinmikro.tw

1.7 Product monitoring

Please inform HIWIN MIKROSYSTEM about the following contents:

- Accidental risk assessment.
- Potential source of danger involving person and property.
- Anything in this user manual which is difficult to understand.

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2. Basic safety information

2.1 Overview

Position measurement system is a magnetic distance measuring system for positioning tasks with linear movement within an automated system. It is mainly used in linear motors. Position measurement system may only be used as described for the intended purpose, and it must not be used outdoors or in hazardous areas where there is a risk of explosions.

⚠WARNING

Danger due to strong magnetic fields!

- This chapter is for the safety of everyone who works with, assembles, installs, operates, maintains or disassembles position measurement system. Failure to comply with the following information could be dangerous!

2.2 Basic safety notices

- Stay vigilant for safety when using the product. Immediately report if there is an emergency.
- Users need to maintain a good mental state. Do not use the product without clear consciousness.
- Do not run or play in the workspace.
- It is necessary to understand chemical related to the product such as alcohol and lubricants. Mark them on the bottles to prevent accidental ingestion.
- Be sure to configure fire extinguishers and install automatic sprinklers in the operating environment to avoid fire that causes casualties and property loss.
- It is strictly forbidden to store flammable substances in the working area, smoking is prohibited in the place.

2.3 Reasonably foreseeable misuse

2.3.1 Environment factors

- The product is in contact with magnetic objects.

⚠WARNING

Danger of serious or fatal injuries!

- Before and during all assembly, disassembly or repair work, the position measurement system or the higher-level system must be de-energized and it must be ensured that the mains connection cannot be re-established by other persons!
- Position measurement system must not be used in potentially explosive atmospheres.
- Position measurement system may only be used and operated indoors.

2.3.2 Personal factors

- Operation performed by untrained or unauthorized personnel.
- Persons who have not fully read and understood this user manual.
- Not follow the instructions in this user manual intentionally or carelessly while using the product.
- Operate the product without clear consciousness or under the influence of drugs or alcohol.

2.4 Conversions and modifications

- Do not disassemble the product on your own without authorization. If there are any special requests, please contact HIWIN MIKROSYSTEM.
- Do not tear the product label.

2.5 Residual risks

If users operate the product with instructions in the user manual, risks can be effectively controlled and reduced. Please refer to the relevant chapters for risks and warnings of the management and operation.

If users still have doubts about the product after reading the manual, please contact the sales representatives of HIWIN MIKROSYSTEM, there will be professionals to assist you.

2.6 Personnel requirements

Users must read the product manual carefully, be authorized or have knowledge of the product, and must be familiar with safety equipment and regulations.
Untrained personnel can cause personal injury, serious damage to the machine or to the product.

- Configuration, adjustment, installation, and maintenance can only be performed by trained staff.
- These professionals must be able to identify the hazards that may be caused by mechanical, electrical, or electronic equipment.

Professionals are those who are familiar with the safety guidelines of electrical and automation technology when carrying out configuration tasks, who are able to adjust, ground, and label circuits and equipment/systems according to safety standards.

2.7 Protective equipment

2.7.1 Personal protective equipment

Table 2.7.1.1

Operation Phase	Personal Protective Equipment	Description
Transport, maintenance and cleaning		Wear safety shoes to prevent the risk of the injury caused by the falling product.
		Wear latex gloves when wiping the product with alcohol.

2.8 Labels on absolute position measurement system

The label affixed on the product and package provides detailed information on product specification.

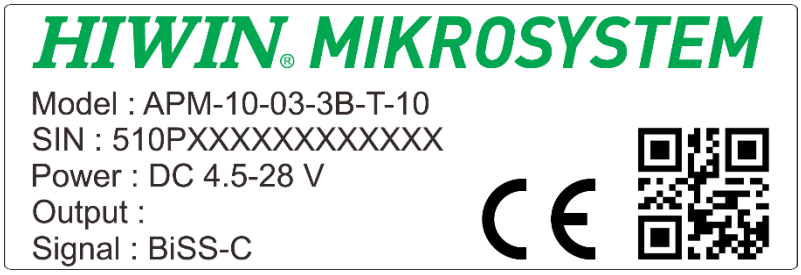

Figure 2.8.1 Shipping label of absolute position measurement

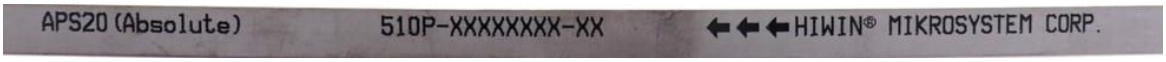

Figure 2.8.2 Shipping label of absolute position scale

Note:

1. Before using the product, check if the label matches the specification.
2. The Output on the shipping label of absolute position measurement will vary according to the selected specification.
3. The shipping label of absolute position scale will be directly printed on the scale.

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3. Product description

3.1 Absolute position measurement system description

Absolute position measurement system is optimized for measuring the distances travelled in linear movements and particularly on linear motor axes. It is particularly well-suited for use in harsh environments and is insensitive to oil, dirt, vibration and shock. It is mainly applicable to automation equipment, with the following advantages:

- Immediately display absolute position when power on, no need to perform homing
  - ✓ Save time
  - ✓ Improve product safety
  - ✓ No need to perform homing during troubleshooting
- Additional Hall sensors are not required to perform phase initialization for electrical angle
  - ✓ No need to set installation wiring setting
  - ✓ Increase effective travel distance
  - ✓ Reduce machine size
- No jitter when power on
  - ✓ Avoid damage to the workpiece
  - ✓ Improve user experience
- High reliability
  - ✓ It will not burn even if the polarity of the power supply is reversed
  - ✓ Applicable to most of the electrical controls, with voltages of 5 V, 12 V, and 24 V
  - ✓ Auxiliary installation of LED light

3.2 Main components of absolute position measurement system

This product consists of absolute position scale and absolute position measurement. The information of technical specifications is as follows.

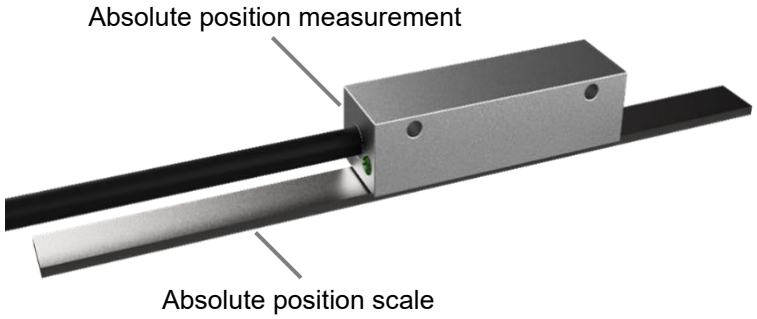


Figure 3.2.1

3.2.1 Technical specifications of absolute position scale

■ System specification

Table 3.2.1.1

Feature	Technical Data	Additional Information
Pole pitch	2 mm	-
Accuracy	±20 μm/m	20°C
Maximum length of scale	16.3 m	-

■ Mechanical specification

Table 3.2.1.2

Feature	Technical Data	Additional Information
Position scale width	10 mm	-
Position scale thickness	1.83 mm	With cover strip
Mass	60 g/m	-

■ Environmental specification

Table 3.2.1.3

Feature	Technical Data	Additional Information
Operating temperature	-25°C~80°C	-
Storage temperature	-25°C~80°C	-
Relative humidity	0~100%	Condensation allowed

Feature	Technical Data	Additional Information
Expansion coefficient	$(11\pm1)\times10^{-6}$/K	-

3.2.2 Technical specifications of absolute position measurement

■ System specification

Table 3.2.2.1

Feature	Technical Data	Additional Information
Resolution	1 μm	-
Repeatability	±1 μm	Unidirectional
Hysteresis	±2 μm	-
Maximum velocity (speed)	7 m/s	BiSS-C@7 m/s H-code@6 m/s
Installation gap	0.5±0.3 mm	-

■ Mechanical specification

Table 3.2.2.2

Feature	Technical Data	Additional Information
Size	54×16×14 mm	-
Mass	20 g	-

■ Environmental specification

Table 3.2.2.3

Feature	Technical Data	Additional Information
Operating temperature	-20°C~60°C	-
Storage temperature	-20°C~70°C	-
Relative humidity	0~100%	Condensation allowed
International protection marking	IP68	IEC60529
Vibration resistance	145 m/s^2 (50 Hz~2000 Hz)	IEC60068-2-6
Shock resistance	1000 m/s^2 (6 ms)	IEC60068-2-27
Maximum external magnetic field	±5 mT	-
EMC protection	EN61000-6-2	
	EN61000-6-4	-

■ Electrical specification

Table 3.2.2.4

Feature	Technical Data	Additional Information
Power supply	4.5~28 V	DC voltage
Set-up time after switch-on	20 ms	Only read head
Current consumption	< 200 mA	When voltage input is 5 V
Voltage drops	25 mV/m	-
Communication interface	BiSS-C/H-code	BiSS-C contains analog synchronous output
RoHS certified	Qualified	-

3.2.2.1 BiSS-C communication

BiSS-C communication provides both serial output and analog output.

- **BiSS-C one-way interface**

Table 3.2.2.1.1 BiSS-C communication parameters

Packet	Bit	Time
Busy	-	12 μs
Start	1	-
CDS	1	-
Position Data	27	-
Error	1	-
Warn	1	-
CRC	6	-
Time out	-	2 μs
Clock frequency		
5 MHz		
E1 series servo drive and the allowed communication rate		
1.25/2.5/5 Mbps		

- **Timing diagram**

The position (up to 27-bit natural binary code) and the status of absolute position measurement can be obtained via BiSS-C protocol.

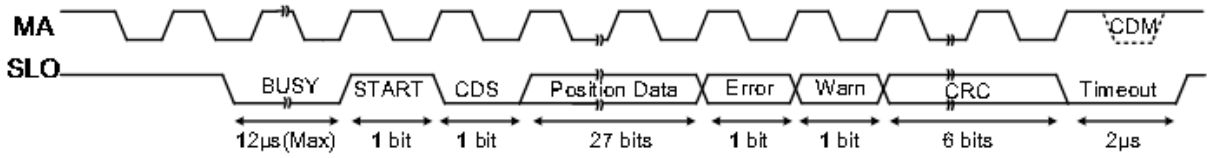


Figure 3.2.2.1.1 BiSS-C communication timing diagram

- **Communication state table**

Table 3.2.2.1.2 BiSS-C communication state table

Bit	Type	High (1)	Low (0)	Possible cause of error
Error	Alarm	Normal	Abnormal	Abnormal reading position
Warn	Alarm	Normal	Abnormal	Abnormal temperature warning

3.2.2.2 H-code communication

H-code communication belongs to serial output and needs to be used with E1 series servo drive.

- **H-code interface**

Table 3.2.2.2.1 H-code communication parameters

Packet	Bit	Time
CF	10	2 μs
SF	10	2 μs
DF0~DF7	10	2 μs
CRC	10	2 μs
Clock frequency		
5 MHz		
E1 series servo drive and the allowed communication rate		
5 MHz		

- **Timing diagram**

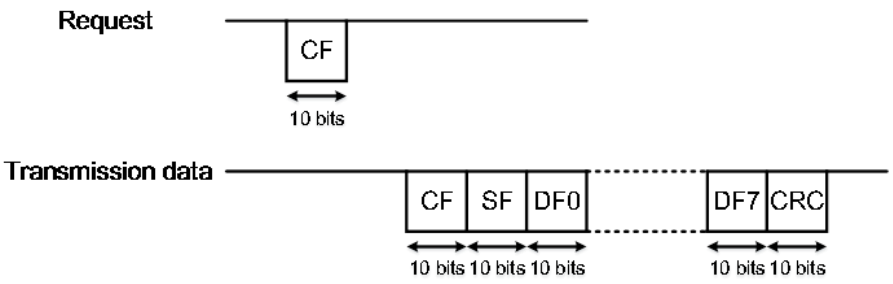


Figure 3.2.2.2.1 H-code communication timing diagram

- **Communication state table**

Table 3.2.2.2.2 H-code communication state table

Byte	Type	0x00	0x10, 0x20, 0x30	Possible cause of error
SF field	Alarm	Normal	Abnormal	0x10: abnormal reading position 0x20: abnormal temperature, signal error, abnormal counting, abnormal hardware 0x30: including the errors of 0x10 and 0x20

3.2.2.3 Relationship between cable length, communication frequency and voltage

⚠CAUTION

- The external power supply of all products must be safely grounded.
- When the flying load or external power supply is used, provide insulation protection for unused pins to prevent short circuits from damaging the encoder.

Cable length within 16 m can use the input voltage of 5 V. To use the cable length longer than 16 m, please connect an external power supply. Refer to the following instructions:

■ The comparison diagram of the required power supply voltage and the cable length for one-conductor mains cable, two-conductor mains cable and three-conductor mains cable

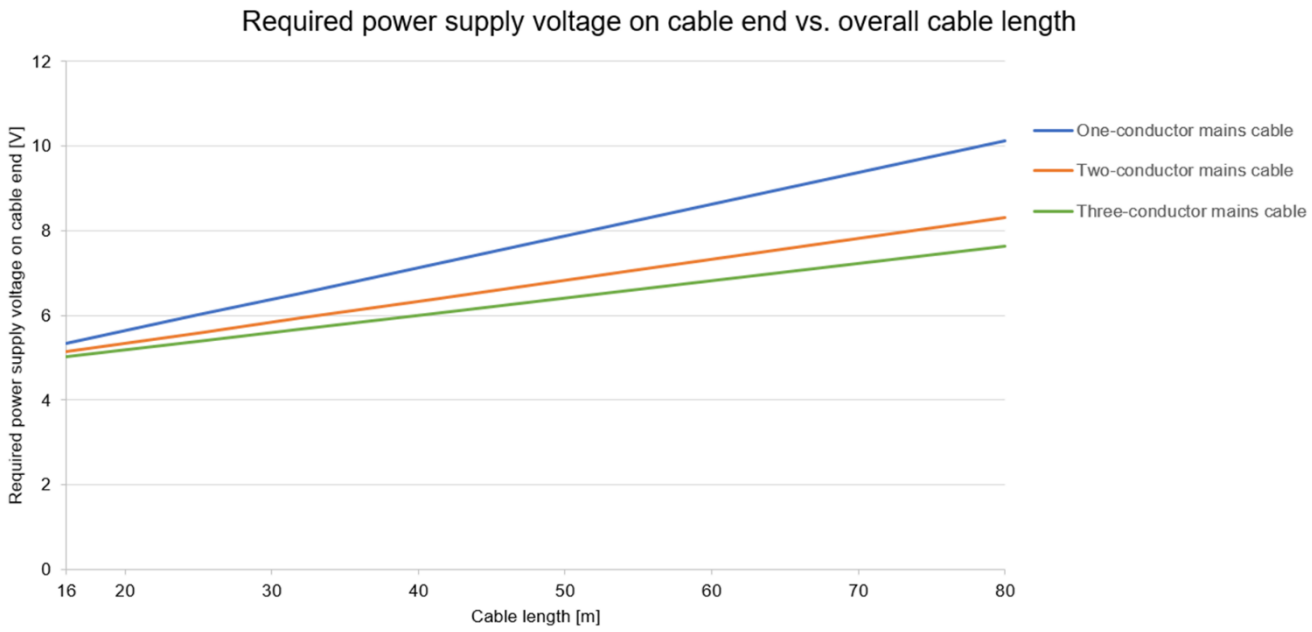


Figure 3.2.2.3.1

Table 3.2.2.3.1

Cable definition	Cable color for +Vcc	Cable color for GND
One-conductor mains cable	Brown	White
Two-conductor mains cable	Brown / Green	White / Yellow
Three-conductor mains cable	Brown / Green / Gray	White / Yellow / Pink

■ The relationship between the communication frequency and the cable length

Table 3.2.2.3.2

Cable length (m)	Maximum clock frequency (MHz)
< 25	5
25~50	2.5
50~80	1.25

3.3 Order code

Select suitable absolute position measurement system based on requirement.

3.3.1 Absolute position scale

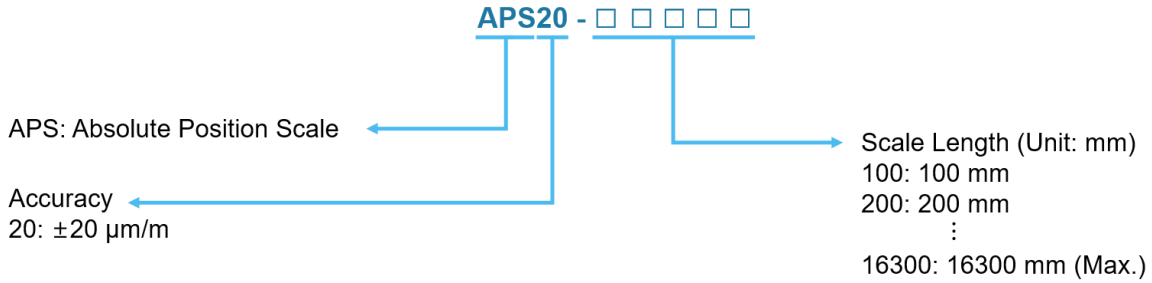


Figure 3.3.1.1 Model description of absolute position scale

3.3.2 Absolute position measurement

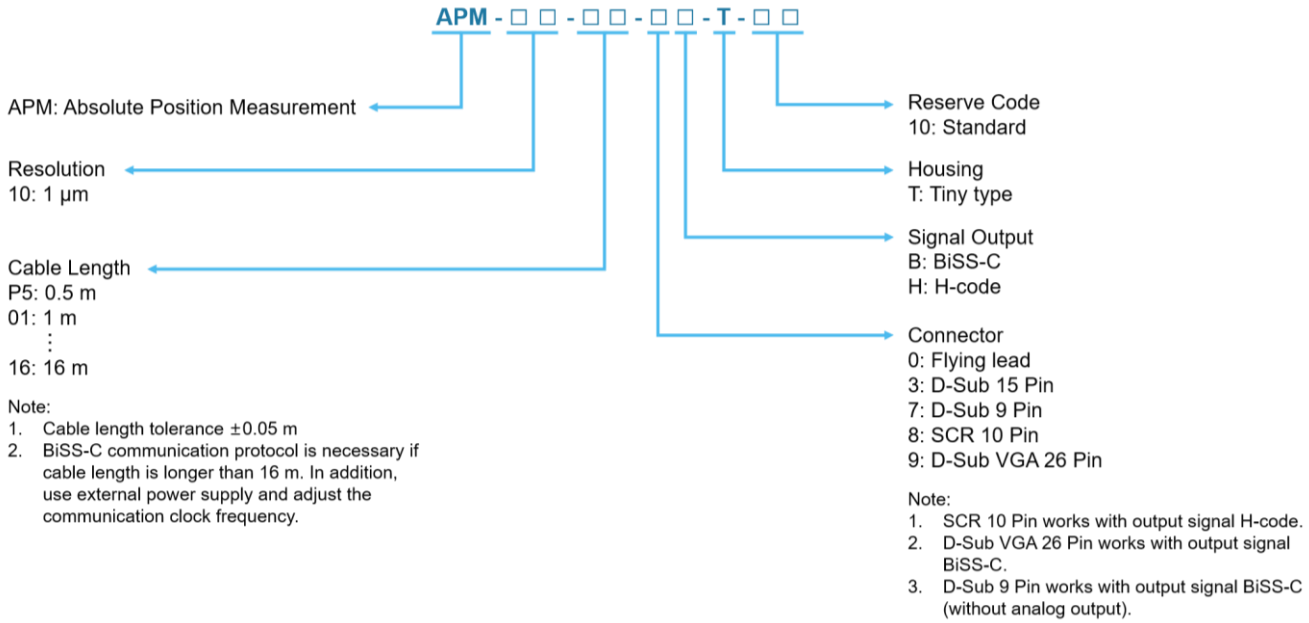


Figure 3.3.2.1 Model description of absolute position measurement

4. Transport and setup

4.1 Delivery

Transport the product in the original unopened packaging.

4.2 Transport to the installation site

Keep the product away from strong magnetic materials and strong magnetic fields, or the scale and the accuracy will be affected.

⚠CAUTION
◆ Do not apply excessive force to the product.
◆ Do not drop the product.
◆ Magnetic objects (e.g., screwdriver) cannot be in contact with the scale.
◆ The position measurement systems are delivered in suitable packaging. The systems must be left in these until they are installed.
◆ The position measurement systems must be stored in dry areas protected from impacts.
◆ No heavy objects may be placed on the products during storage and transport.

Note:

1. The position scale of the position measurement system must not be exposed to strong magnetic fields (keep a distance to permanent magnets of linear motor axes!).
2. Strong vibrations (e.g., a blow with a hammer) can also damage the magnetization of the position scale.

4.3 Requirements at the installation site

This section explains the installation interface and dimension definitions of absolute position measurement system.

⚠CAUTION
◆ Before installation, check if the position measurement has transport damages. Do not install damaged position measurement.

4.3.1 Recommended accuracy for installation surface

The sectional view of the base of the installation platform and the recommended tolerances are shown as follows.

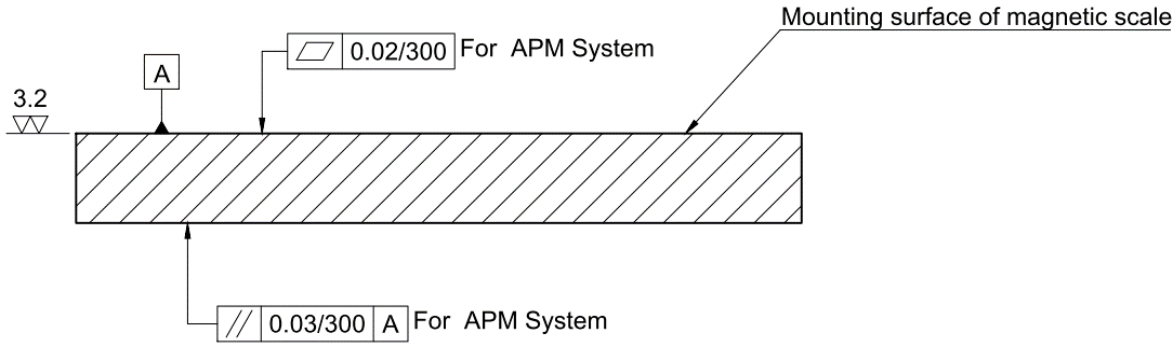


Figure 4.3.1.1

4.3.2 Dimensions of absolute position measurement system

4.3.2.1 Dimensions of absolute position scale

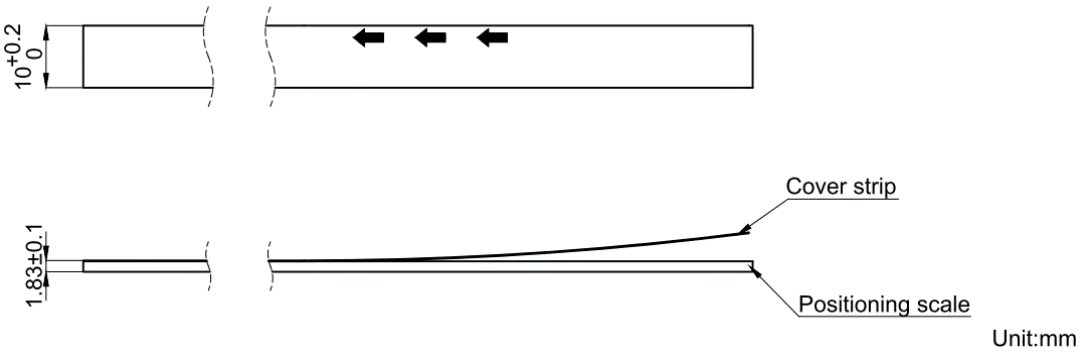


Figure 4.3.2.1.1

4.3.2.2 Dimensions of absolute position measurement

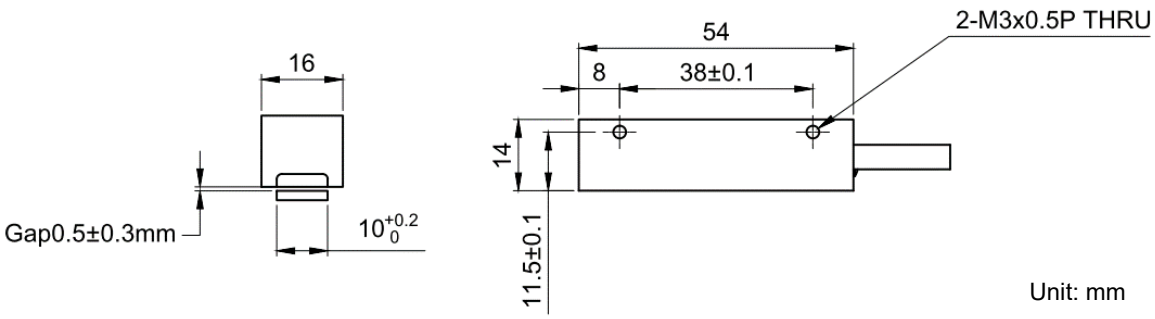
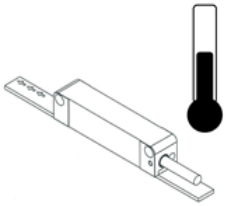


Figure 4.3.2.2.1

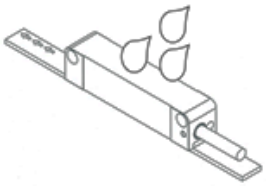
4.4 Storage

Store and keep the position measurement with caution. Please note the following:

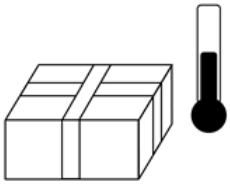
- Store the position measurement in the original unopened packaging.
- Prevent the position measurement from physically harmful influences, including dust, heat, and humidity.
- Do not damage the connection via mechanical or thermal shock.



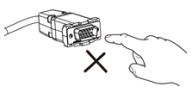
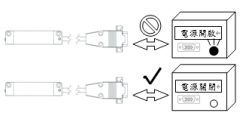
Operating temperature
-20°C~60°C



Relative humidity
up to 100%



Storage temperature
-20°C~70°C

⚠CAUTION		
	◆ Do not scratch the position scale with sharp objects.	
	◆ Keep magnetic objects away from the position scale.	
	◆ Do not band the position scale.	
	◆ When storing the position scale, the radius should not be smaller than 140 mm.	
		Hydrochloric acid, Alcohol, Seawater, Antifreeze, Brake oil, Engine oil
		Carbon tetrachloride, Heptane, Vapor, Turpentine, Trichloroethylene, Kerosene, Toluene
	◆ Do not directly touch the connector, or the generated static electricity may affect the function.	
	◆ Do not plug or unplug the connector when the power is on.	

4.5 Unpacking and setup

Keep away from magnetic objects when unpacking the product. The unpack procedure of the product is as follows:

Step1. Ensure the quantity and the specification on the label are correct.

Step2. Carefully unpack the carton and keep the product away from magnetic objects.

Step3. Preserve the carton after unpacking, send it back if there are any problems. If there are no questions, deal with the packaging environmentally friendly.

Step4. Wear an electrostatic wristband first. Carefully take out the product and inspect if the product inside is correct without any damage on the surface. Users can take a photo to record. During the process, avoid the direct contact with the adapters or bare wires.

Step5. Carefully transport the product and avoid heavy drops and dents.

5. Assembly and connection

5.1 Mechanical installation

This section explains the installation of absolute position measurement system. Refer to chapter 4 for the installation dimensions and specifications.

⚠WARNING

Danger due to electrical voltage!

Dangerous currents may flow before and during assembly, disassembly and repair work.

- Before and during all assembly, disassembly or repair work, the position measurement system or the higher-level system must be de-energized and it must be ensured that the mains connection cannot be re-established by other persons!
- Observe the assembly instructions of the other system components (e.g., linear motor, servo drive)!

⚠CAUTION

Possible damage to position measurement system!

Position scale must not be exposed to strong magnetic fields. Magnetic dust can falsify the measuring signal or damage the position measurement system.

- Keep the distance between the position measurement systems and the permanent magnets of linear motor axes!
- Be cautious when using dial gauge holders (e.g., to align the profile rails)!
- Avoid strong shocks (e.g., use of a hammer)!
- Do not use the system in environments with magnetic dust (e.g., graphite dust)!

⚠CAUTION

Possible damage to position measurement system!

Magnetic chips or other foreign objects may stick to the position scale. This can destroy the mechanics of the encoder.

- Check the air gap between the scanning unit and the position scale regularly and keep it free!

5.1.1 Absolute position scale installation

⚠CAUTION

- When installing the position scale, ensure there is no strong magnetic field or magnetic objects around it to prevent degaussing.
- Stay at least 5 cm away from the magnetic field strength of 5000 gauss to prevent the position measurement system from disruption.

To prevent the scale from skew, use the installation fixture and follow the steps below for installation.

The position scale can be mounted on a suitable flat surface chosen by the customer parallel to the direction of movement on the fixed part of the system. The following criteria must be met:

- Average roughness value Ra ≤ 3.2 μm
- Height deviation (parallelism) to the direction of travel of the encoder: ≤ 0.1 mm
- Lateral parallelism deviation to the direction of travel of the encoder: ≤ 0.2 mm (ideally use a reference edge)
- The position scale and the cover strip are provided with an adhesive film covered by a protective scale.

Step 1: Thoroughly clean the installation surface on which the position scale is to be mounted with alcohol or isopropanol.

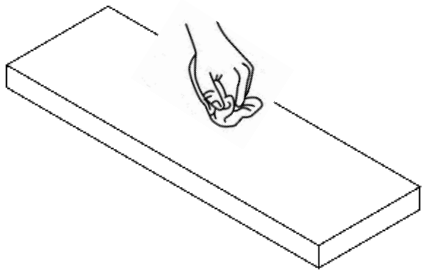


Figure 5.1.1.1

Note:
The mounting surface for the position scale must be absolutely clean, dry and free of grease! This is the only way to ensure a reliable adhesive bond!

Step 2: Tear off the double-sided tape of the position scale.

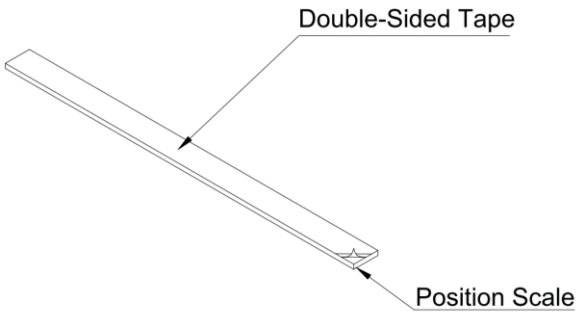


Figure 5.1.1.2

Step 3: Use the installation fixture to paste the position scale on the installation surface.

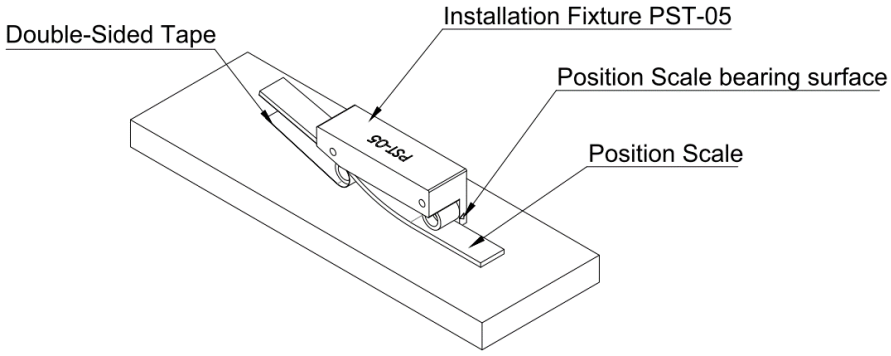


Figure 5.1.1.3

Step 4: Clean the surface of the position scale.

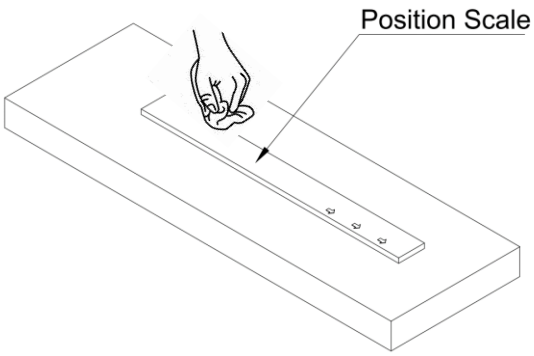


Figure 5.1.1.4

Step 5: Tear off the double-sided tape of the cover strip.

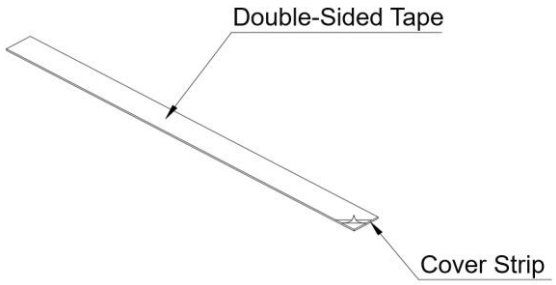


Figure 5.1.1.5

Step 6: Paste the cover strip on the position scale.

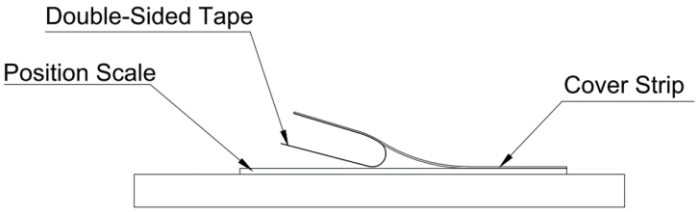


Figure 5.1.1.6

5.1.2 Absolute position measurement installation

The standard installation gap of absolute position measurement is 0.5±0.3 mm, and the specifications of the offset angle are shown in the following figure.

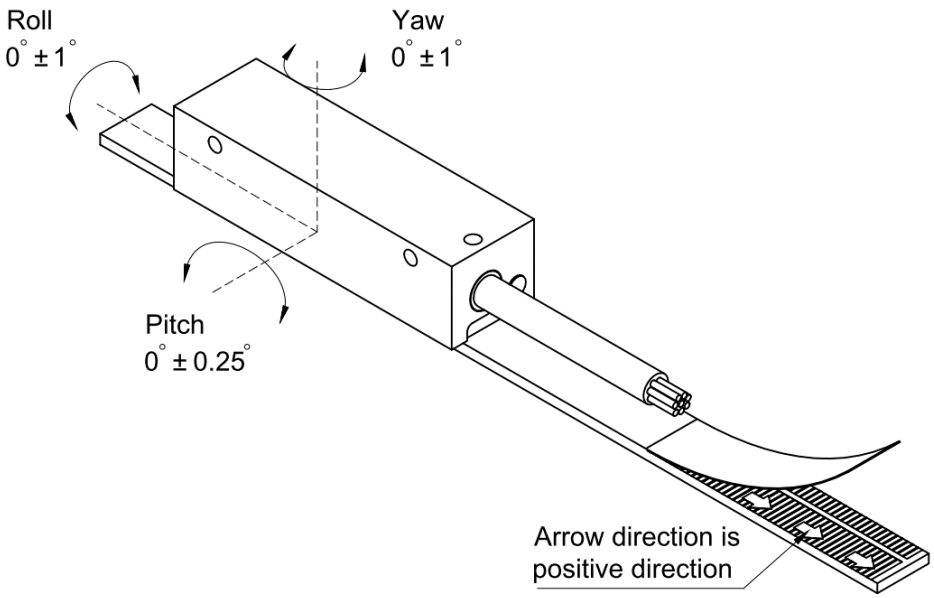


Figure 5.1.2.1 Reference data for installing position measurement

Note:

When installing the absolute position measurement, the outlet of the position measurement must be in the same direction as the printed arrow direction on the position scale.

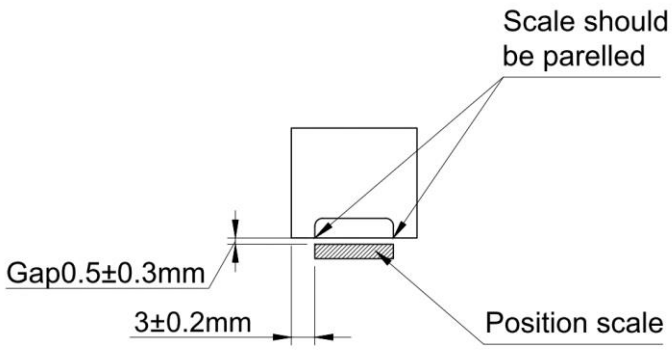


Figure 5.1.2.2 Side specifications for installing position measurement

Note:

The read head must be aligned with the position scale according to the figure above, and the direction of the LED light must be the same as the printed arrow direction on the position scale.

Do not bend the signal cable when the outlet is smaller than 30 mm, and the minimum bending radius is 40 mm.

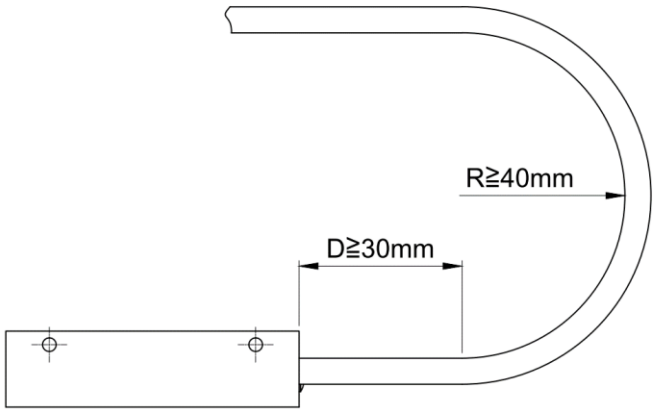


Figure 5.1.2.3 Specifications of outlet and bending radius for absolute position measurement

Note:

The static limit radius of the signal cable is 25 mm.

5.2 Electrical installation

This section explains the wiring method and the pin definition of connectors.

⚠WARNING

- Since the position measurement is sensitive to static electricity, please be careful. Without proper ESD protection, do not touch the cables or the pins of connectors. The level of ESD protection is only 8 kV.
- Do not perform wiring work or disconnect electrical connections when power on.
- Perform wiring work in power off state only.
- Check all the cables and plug connections before switching on the device.

⚠WARNING

Danger due to electrical voltage!

Dangerous currents may flow before and during assembly, disassembly and repair work.

- Ensure the system (e.g., linear motor axis) is properly earthed via the PE rail in the switch cabinet before connecting the electrical power supply!
- Electrical currents can also flow when the motor is not moving. Never disconnect electrical connections while they are live. In unfavorable cases, electric arcs can occur and injure persons and damage contacts!
- Observe the assembly instructions of the other system components (e.g., linear motor, servo drive)!

Note:

1. Do not operate the sensor with a voltage other than the specified voltage, otherwise it may be destroyed!
2. Keeping the sensor cable as short as possible is also recommended when using the sensor near an EMC interference source, e.g., a linear motor. Generally, the shorter the line, the lower the sensitivity to interference.
3. Up to a cable length of 500 mm and use of the described plug and the prescribed extension cable, test severity level 4 is also achieved with insulation of the encoder housing to machine ground with an insulation thickness greater than 4 kV in accordance with EN61000-4-4.
4. To avoid EMC interference in the encoder signal, the encoder cable extension must be shielded, and the shielding must be contacted over a wide area via the plugs. High-quality, fully shielded plugs must be used.

5.2.1 Communication port

5.2.1.1 Port type

There are five types of outlets for this product, flying lead, D-Sub 15 Pin, D-Sub VGA 26 Pin, SCR 10 Pin and D-Sub VGA 9 Pin.

Note:

For the communication quality, it is recommended to use male and female connectors of the same brand.

5.2.1.2 BiSS-C communication port

Table 5.2.1.2.1 Pin assignment for BiSS-C communication

Function	Signal	Wire Color	Connector			
			D-Sub 15 Pin	D-Sub VGA 26 Pin	D-Sub 9 Pin	Flying Lead
Power supply	+VCC	Brown	7	4	4	Brown
		Green	8	5	5	Green
		Gray				Gray
Signal grounding	GND	White	2	13	8	White
		Yellow	15	14	9	Yellow
		Pink				Pink
Output signal	SIN+	Dashed line Yellow and Brown	5	1	-	Dashed line Yellow and Brown
	SIN-	Dashed line Yellow and White	10	10	-	Dashed line Yellow and White
	COS+	Dashed line Green and Brown	6	2	-	Dashed line Green and Brown
	COS-	Dashed line Green and White	11	11	-	Dashed line Green and White
	MA+	Blue	3	7	2	Blue
	MA-	Red	4	17	3	Red
	SLO+	Violet	13	23	6	Violet
	SLO-	Black	14	24	7	Black
Shield	Inner shield	Inner shield	1	15	Case	Inner shield
	Outer shield	Outer shield	Case	Case		Outer shield

Note:

D-Sub VGA 26 Pin must be used with HIWIN Excellent Smart Cube (ESC).

5.2.1.3 H-code communication port

Table 5.2.1.3.1 Pin assignment for H-code communication

Function	Signal	Wire Color	Connector		
			D-Sub 15 Pin	SCR 10 Pin (used with E1 series servo drive)	Flying Lead
Power supply	+VCC	Brown	7	1	Brown
		Green	8		Green
		Gray			Gray
Signal grounding	GND	White	2	2	White
		Yellow	15		Yellow
		Pink			Pink
Output signal	PS+	Blue	3	3	Blue
	PS-	Red	4	4	Red
Shield	Inner shield	Inner shield	Case	Case	Shield
	Outer shield	Outer shield			

5.2.2 Configuration of signal receiver

For absolute position measurement, there are two kinds of signal outputs, analog signal and serial signal. The configurations of signal receiver are shown in the following figure.

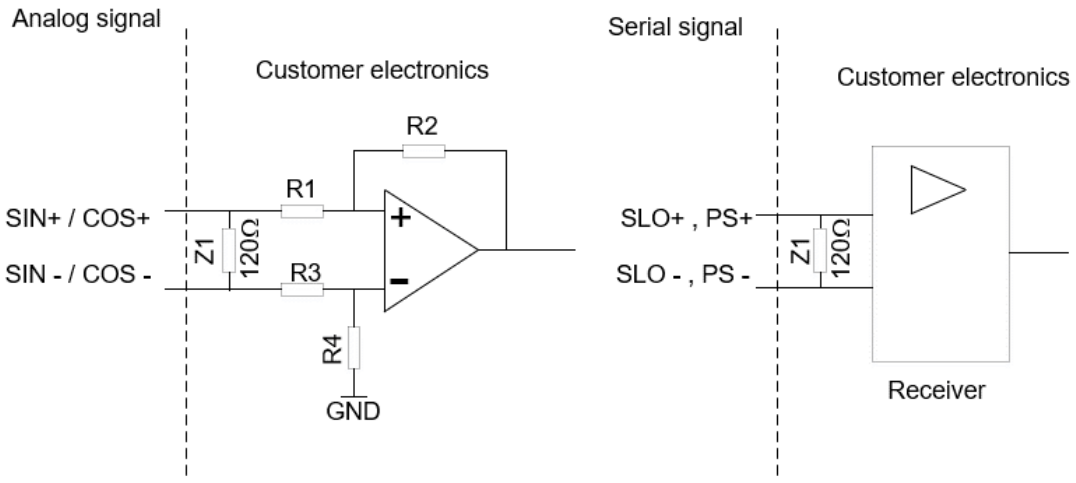


Figure 5.2.2.1

Table 5.2.2.1

Signal	Description
SIN+ / COS+	Analog signal, sender, + output
SIN- / COS-	Analog signal, sender, - output
SLO+	Serial signal, sender, + output
SLO-	Serial signal, sender, - output
PS+	Serial signal, sender, + output
PS-	Serial signal, sender, - output

5.2.3 Cable length description

The cable length of absolute position measurement is defined as follows (the following types can only be used when the input voltage is 5 V):

Type I (Only for H-code communication): One cable to the end, cable length A ≤ 16 m (including connectors).

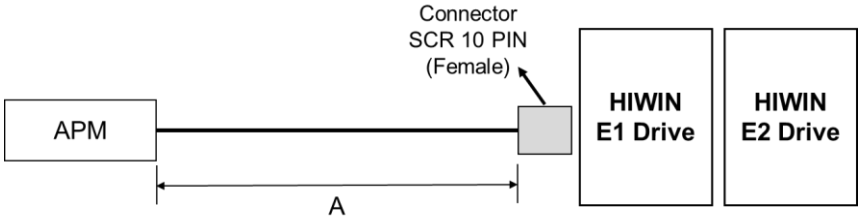


Figure 5.2.3.1

Type II: Connect Excellent Smart Cube (ESC) to servo drive, cable length A+B ≤ 16 m (including connectors).

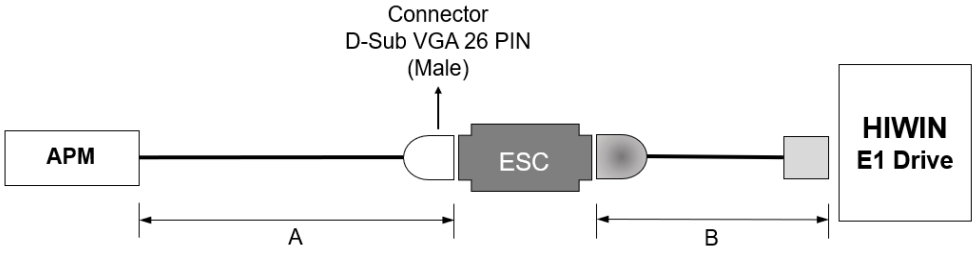


Figure 5.2.3.2

Note:

1. For the specifications of Excellent Smart Cube (ESC), refer to chapter 3 **Excellent Smart Cube (ESC)** in “E1 Series Servo Drive User Manual”.
2. For the cable length specifications of cable B, refer to chapter 16 **Appendix** in “E1 Series Servo Drive User Manual”.

Type III (Only for H-code communication): Connect extension cable to servo drive, cable length A+C ≤ 16 m (including connectors).

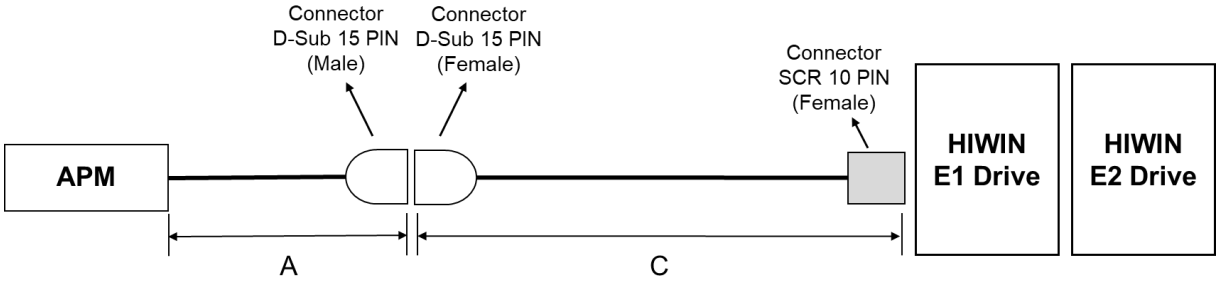


Figure 5.2.3.3

Note:

The figure here is for demonstration only. Perform the configuration according to the actual specifications.

6. Commissioning

6.1 Commissioning

After proper installation and wiring, users can make the absolute position measurement system operate normally by switching on the operating voltage. Besides, observe the assembly instructions of the other system components (e.g., linear motor, servo drive)!

The following sequence must be observed when commissioning position measurement system:

- Connect encoder.
- Apply supply voltage.
- Do not exceed the operating voltage, otherwise the encoder may be destroyed!
- Check output signal (e.g., with an oscilloscope).

6.1.1 LED light status

Table 6.1.1.1 LED light status of absolute position measurement

LED	Description
Green light	The absolute position measurement is ready.
Flashing green light	The absolute position measurement is ready, but there is no communication between servo drive (controller) and position measurement.
Orange light	The absolute position measurement has internal warning.
Flashing orange light	The absolute position measurement has internal warning, and there is no communication between servo drive (controller) and position measurement.
Red light	The absolute position measurement has rational error or the internal power malfunctions.
Flashing red light	The absolute position measurement has rational error or the internal power malfunctions, and there is no communication between servo drive (controller) and position measurement.
No light	No power input or general failure.

7. Maintenance and cleaning

7.1 Maintenance

Position measurement system works without making contact and thus in principle maintenance-free. However, it must be regularly checked for dirt and, if necessary, cleaned with a suitable cleaning agent (e.g., alcohol). Dirt particles between the encoder and the position scale can destroy position measurement system.

⚠WARNING

Danger due to electrical voltage!

Dangerous currents may flow before and during assembly, disassembly and repair work.

- Ensure the system (e.g., linear motor axis) is properly earthed via the PE rail in the switch cabinet before connecting the electrical power supply!
- Electrical currents can also flow when the motor is not moving. Never disconnect electrical connections while they are live. In unfavorable cases, electric arcs can occur and injure persons and damage contacts!
- Observe the assembly instructions of the other system components (e.g., linear motor, servo drive)!

Note:

After maintenance work, re-grease steel parts to avoid corrosion!

7.2 Cleaning

If the surface of the position scale is dirty, gently wipe it with a soft cloth and alcohol to avoid excessive cleaning of the position scale. Besides, regularly check the air gap.

⚠CAUTION

- Obstacle removal and maintenance can only be performed by HIWIN MIKROSYSTEM technicians or authorized dealers, and with appropriate protective equipment.
- Do not perform any maintenance actions while the motor is running. The controller must stop the motor first.
- Turn off the power and the main switch of the machine (refer to the machine manufacturer’s instructions for operation).

8. Disposal

8.1 Waste disposal

⚠CAUTION

Environmentally hazardous substances!

- The risk posed to the environment depends on the type of materials used.
- Always clean contaminated components before disposal!
- Clarify proper disposal with disposal companies and, if necessary, with the responsible authorities!

The electronic components of absolute position measurement contain materials which are environmentally harmful but also recyclable. Therefore, when the position measurement has reached end-of-life or is out of service, please recycle it according to the environmental protection guidelines of the country/region. Do not discard it at will.

Follow Table 8.1.1 to dispose of waste.

Table 8.1.1

Disposal Type	Subdivision	Description
Liquids	Lubricants	Dispose of as hazardous waste in an environmentally safe manner
	Soiled cleaning cloths	Dispose of as hazardous waste in an environmentally safe manner
Block	Steel components	Sort by type before disposal
	Plastic components	Dispose of as residual waste
Position measurement system	Cabling, electrical components	Dispose of as electrical waste
Profile rails	Steel components	Sort by type before disposal
	Plastic cover caps	Dispose of as residual waste

9. Troubleshooting

9.1 Troubleshooting

Absolute position measurement has error judging function; it can detect and transmit the internal error messages as well as the errors that occur during installation to the drive control system.

9.1.1 LED troubleshooting

The followings are some typical errors that may occur during installation and operation, and they can be judged by the display of LED light:

Table 9.1.1.1 LED troubleshooting

LED		Com.	Possible Cause	Corrective Action
Green light	Green light	O	N/A	N/A
	Flashing green light	X	Communication is abnormal	Confirm the wiring of position measurement and the setting of servo drive.
Orange light	Orange light	O	Encoder operating temperature warning	Confirm the operating temperature.
			The installation gap exceeds or is smaller than the specification of manual	Check the installation gap between absolute position measurement and position scale.
	Flashing orange light	X	Communication is abnormal and the abnormalities related to orange light are included	Confirm the wiring of position measurement and the setting of servo drive, and confirm the corrective actions related to orange light.
Red light	Red light	O	Abnormal operating temperature for position measurement	Confirm the operating temperature.
			Installation error of position scale or position measurement	Check the installation position and orientation of position scale or position measurement.
			Abnormal voltage for encoder Absolute position measurement connection error	Check if the input voltage meets the specification. If the input voltage is correct, check if the grounding cable of motor and servo drive is properly locked. If the encoder is damaged, get it repaired.
	Flashing red light	X	Communication is abnormal and the abnormalities related to red light are included	Confirm the wiring of position measurement and the setting of servo drive, and confirm the corrective actions related to red light.
No light		X	The absolute position measurement is not connected to the servo drive or the wiring is wrong	Check if the position measurement is correctly connected to the servo drive. If it is correctly connected but the problem is still not solved, send the position measurement back to the factory for repairs by yourselves or through the dealers.

10. Declaration

10.1 Declaration

HIWIN MIKROSYSTEM

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ISO 9001 FM57748 ISO 14001 EMS61827 OHSAS 18001 OHS568853 TAIWAN EXCELLENCE

Declaration of Conformity

according to EMC directive 2014/30/EU

Name and address of the manufacturer:
HIWIN MIKROSYSTEM CORP., No.6, Jingke Central Rd., Taichung Precision Machinery Park, Taichung 408226, Taiwan

Description and identification of the product:

Product	Position Measurement Systems MAGIC
Identification	Series: PM-A、PM-B、PM-C、APM

The object of the declaration described above is in conformity with the relevant Union harmonization legislation Directives.

2011/65/EU	RoHS directive

References to the relevant harmonized standards used or references to the other technical specifications in relation to which conformity is declared

EN 61000-6-2:2005 EN 61000-6-2:2005/AC:2005	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
EN 61000-6-4:2007 EN 61000-6-4:2007/A1:2011	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments

This declaration of conformity is issued under the sole responsibility of the manufacturer.

Taichung 408226, Taiwan		
02.01.2024	**Szu, Kou-I, General manager**	
(Place, Date)	(Surname, first name, and function of signatory)	(Signature)

11. Appendix

11.1 Glossary

- **Absolute**
  The position is determined immediately after starting; it is not affected by any other position or value.

- **Accuracy**
  It is the closeness of the actual value to the measured position.

- **Resolution**
  It is the minimum measurement of step output for absolute position measurement system. This is the shortest distance of which the position measurement moves for the output to change by one count.

- **Repeatability**
  It is the ability to report the same position each time when the position measurement reaches a specific point on the axis. Sometimes it is also called reproducibility, scatter, or precision.

- **Hysteresis**
  It is the time delay in response to a change via input.

- **International Protection Marking**
  Also known as Ingress Protection Rating or IP code, it is defined in the international standard IEC60529. This defines the tightness of the electrical enclosure.
  International Protection Marking has two numbers: the first number represents the dustproof level (0~6), and the second number represents the waterproof level (0~9). For example, IP68 means that the dustproof level is 6, and the waterproof level is 8.

- **Terminal resistor**
  The terminal resistor is a resistor connected in parallel to a pair of communication cables at both ends of the line network, which can absorb the reflected waves on the network and effectively increase the signal strength. It is used to shield signal reflections, stabilize and adjust signals. The terminal matching resistance value is related to the impedance characteristics of the cable, and it has nothing to do with the cable length. The terminal resistance is generally between 100~140 ohm, and the typical value is 120 ohm.

11.2 Unit conversion

To convert the unit in column B to the unit in column A, multiply by the corresponding figure in the table.

- Mass

		B			
		g	kg	lb	oz
A	g	1	0.001	0.0022	0.03527
	kg	1000	1	2.205	35.273
	lb	453.59	0.45359	1	16
	oz	28.35	0.02835	0.0625	1

- Linear velocity

		B				
		m/s	cm/s	mm/s	ft/s	in/s
A	m/s	1	100	1000	3.281	39.37
	cm/s	0.01	1	10	3.281×10^{-2}	0.3937
	mm/s	0.001	0.1	1	3.281×10^{-3}	3.937×10^{-2}
	ft/s	0.3048	30.48	304.8	1	12
	in/s	0.0254	2.54	25.4	8.333×10^{-2}	1

- Force

		B		
		N	lb	oz
A	N	1	0.2248	3.5969
	lb	4.4482	1	16
	oz	0.2780	0.0625	1

■ Length

		B					
		m	cm	mm	μm	ft	in
A	m	1	100	1000	1000000	3.281	39.37
	cm	0.01	1	10	10000	3.281×10^{-2}	0.3937
	mm	0.001	0.1	1	1000	3.281×10^{-3}	3.937×10^{-2}
	μm	1×10^{-6}	1×10^{-4}	0.001	1	3.281×10^{-6}	3.937×10^{-5}
	ft	0.3048	30.48	304.8	304800	1	12
	in	0.0254	2.54	25.4	25400	8.333×10^{-2}	1

■ Temperature

		B	
		°C	°F
A	°C	1	(°F - 32) x 5 / 9
	°F	(°C x 9 / 5) + 32	1

■ Magnetic field

		B		
		T	mT	G
A	T	1	1000	10000
	mT	1×10^{-3}	1	10
	G	1×10^{-4}	0.1	1

■ Voltage

		B	
		V	mV
A	V	1	1000
	mV	0.001	1

■ Current

		B	
		A	mA
A	A	1	1000
	mA	0.001	1

11.3 Tolerances and hypotheses

11.3.1 Dimensional tolerances

The dimensional tolerances for the product drawing are shown in the following table.

Table 11.3.1.1 Dimensional tolerances table (Unit: mm)

<6	6~30	30~120	120~300	300~600	600~1200	1200~2400	>2400
±0.1	±0.2	±0.3	±0.4	±0.5	±0.8	±1.0	±1.5

11.3.2 Geometric tolerances

The geometric tolerances are excerpted from JIS B 0021 (1998), as the following table shows.

Table 11.3.2.1 Geometric tolerances table

Type of Tolerance		Symbol	Definition
Form tolerance	Straightness tolerance	—	It refers to the range value of the line body that deviates from the geometric line.
	Flatness tolerance	▱	It refers to the range value of the plane body that deviates from the geometric plane.
Orientation tolerance	Parallelism tolerance	//	It refers to the range value of a geometric line or geometric plane that should remain perpendicular and deviate from a geometric line or geometric plane, which is perpendicular to the datum line or datum plane.
	Perpendicularity tolerance	⊥	It refers to the range value of a line or plane that should have a theoretically correct angle, a geometric line or geometric plane that deviates from a theoretically correct angle relative to a reference line or plane.

11.4 Optional accessories

This product can be equipped with the accessories based on requirement.

- **Installation fixture**

  This facilitates the installation and ensures the parallelism of position scale's installation.

  Product model: PST-05

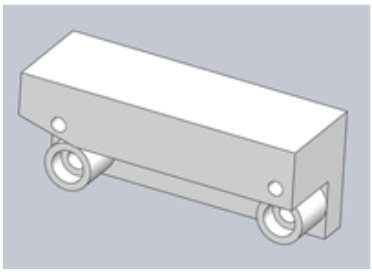

Figure 11.4.1 Installation fixture

- **End clamp**

  This ensures that the position scale can be used in harsh environments.

  Product model: PSF-01

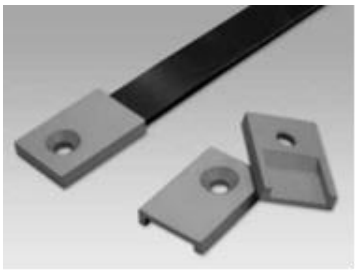

Figure 11.4.2 End clamp

- **Magnetic analysis card**

  With this, the incremental track and absolute track of position scale can be easily determined.

  Product model: MVF-03

Figure 11.4.3 Magnetic analysis card