



SWR14X / SWR14D Precision (Relay-Type)

Level Control Switch

Product Manual

V1.3-20250401

✔ Product Introduction

The SWR14X/SWR14D is a digital tilt switch specifically developed for safety-critical leveling and platform-stabilization applications. It features an integrated relay output, offering flexible and convenient operation. Users can define custom alarm thresholds; when the tilt angle exceeds the preset safety limit, the device triggers a passive relay contact (with a 1A drive current). This can directly actuate solenoid valves to control hydraulic leveling jacks, making it an ideal solution for equipment such as construction vehicles and aerial work platforms.

The device undergoes dual-stage compensation for temperature characteristics and linearity, ensuring superior measurement accuracy. It is equipped with comprehensive protection circuitry—safeguarding against short circuits, high-voltage transients, reverse polarity, and surge impacts—to effectively resist various electrical disturbances encountered in the field. Built with industrial-grade components, including a high-performance MCU, a ruggedized (conformal-coated) PCB, premium imported cabling, and a durable metal housing designed for a wide temperature range, the unit is engineered for long-term, reliable operation in harsh industrial environments characterized by high humidity, vibration, and significant temperature fluctuations.

✔ Key Features

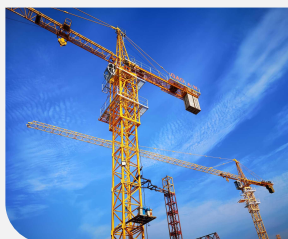
- ❖ 0.01° resolution
- ❖ Dual-axis tilt measurement
- ❖ RS232 serial output
- ❖ Zero-setting function
- ❖ IP67 protection rating
- ❖ Relay output (selectable NO/NC)
- ❖ User-configurable alarm angle thresholds

✔ Application Scope

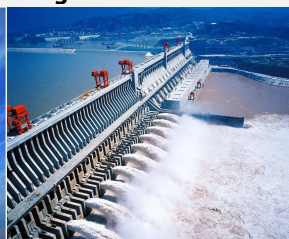
With their high-precision inertial measurement capabilities, this product series offers mature solutions for industrial-grade applications:

- ❖ Agricultural Machinery & Equipment
- ❖ Construction Lifting Equipment
- ❖ Aerial Work Platforms
- ❖ Suspended Access Platforms (Cradles)
- ❖ Woodworking Machinery
- ❖ Construction Tower Cranes
- ❖ Leveling for Medical Equipment
- ❖ Electric Vehicle Control Systems

Measurement and Control for Construction Machinery and Equipment



Safety Monitoring of Bridges and Dams



Excavator Angle Measurement and Control



High-precision large-scale jig



Performance Parameters

SWR14X/SWR14D	Condition	Parameters	
Measurement Range		±15	°
Measurement Axis		X Axis Y Axis	Axis
Resolution		0.01	°
Measurement Accuracy (RMS)		0.05	°
Long-term Stability		0.05	°
Temperature Coefficient of Zero Point	-40 ~ 85℃	±0.006	°/℃
Temperature Coefficient of Sensitivity	-40 ~ 85℃	≤100	ppm/℃
Startup Time		0.1	S
Response Time		0.2	s
Electromagnetic Compatibility (EMC)	In accordance with EN 61000 and GB/T 17626		
Mean Time Between Failures (MTBF)	≥98,000 hours/cycles		
Insulation Resistance	≥100 MΩ		
Shock Resistance	100g @ 11ms, three axes (half-sine wave)		
Vibration Resistance	10grms, 10 ~ 1000Hz		
Waterproof Rating	Direct-wired version: IP67; Aviation connector version: IP65		
Cable	Standard 1-meter cable: wear-resistant, oil-resistant, wide-temperature-range, shielded (4 × 0.4 mm²)		
Weight	164 g (excluding cable)		
Resolution: Refers to the smallest change in the measured quantity that a sensor can detect and distinguish within its measurement range.			
Measurement Accuracy: Refers to the combined error of a sensor—under room temperature conditions—encompassing linearity, repeatability, hysteresis, zero-point deviation, and cross-axis error.			
Long-term Stability: Refers to the deviation between the maximum and minimum output values of a sensor after one year of continuous operation under room temperature conditions.			
Response Time: Refers to the time required for a sensor's output to reach a specified value following a change in the measured angle.			

Electrical Parameters

Parameters	Condition	Minimum Value	Typical Value		Maximum Value	Unit
Supply voltage	Standard	9	12	24	36	V
Alarm output current					500	mA
Operating current	No load		40			mA
Operating temperature		-40			+85	℃
Storage temperature		-40			+85	℃

Ordering and Selection

Model	Measurement Axis	Output Type	Output Orientation	Angle Threshold
SWR14	X: X Axis	1: Single output	NO: Relay normally open output	Setting the output angle threshold:
	Y: Y Axis	-	-	Any value within the 0–30° range can be entered. Examples: 005 = 0.5° (triggers alarm); 135 = 13.5° (triggers alarm).
	D: Dual Axis	2: Dual output	NC: Relay normally closed output	

Example: SWR14X1-NO-005: X-axis, single-channel output, normally open (NO) relay output, 0.5° alarm threshold.

Notes: 1) Wire color-to-function assignments vary by model; please refer to the model descriptions in the ordering information before placing an order.

2) Default factory alarm threshold: $\pm 2^\circ$ (customizable upon request).

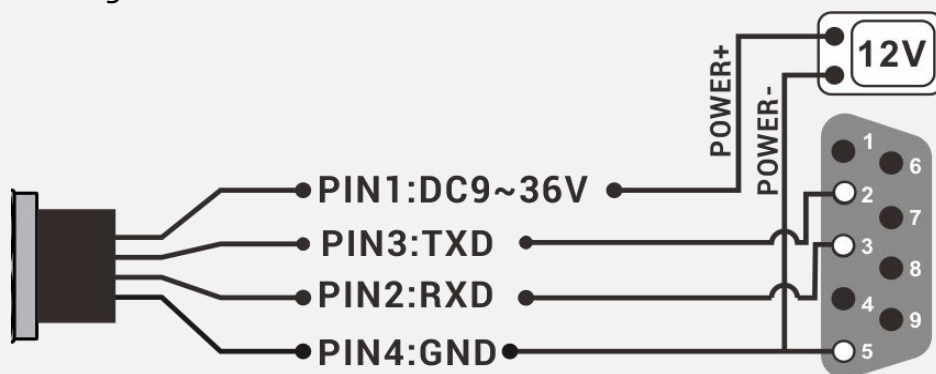
3) Explanation of Normally Closed (NC) and Normally Open (NO): NC (normally closed output) is closed by default and opens when the alarm threshold is exceeded; NO (normally open output) is open by default and closes when the alarm threshold is exceeded.

Interface Definition

Color Definition	Single-Axis Single-Channel	Single-Axis Dual-Channel	Dual-Axis Single-Channel	Dual-Axis Dual-Channel
Red	Positive power terminal	Positive power terminal	Positive power terminal	Positive power terminal
Black	GND	GND	GND	GND
Green	Reset to zero	RXD	Reset to zero	RXD
Brown	Common terminal	+X Common terminal	Common terminal	X Common terminal
Orange	RXD	-X Signal Output	RXD	Y Signal Output
Black	TXD	-X Common terminal	TXD	Y Common terminal
Yellow	X-axis normally open	+X Signal Output	XY-axis normally open	X Signal Output
Blue	X-axis normally closed	TXD	XY-axis normally closed	TXD

Notes: 1) The RXD and TXD lines can be connected to a computer, allowing alarm thresholds to be configured via software. Separate thresholds can be set for each direction (-X, +X, -Y, +Y).

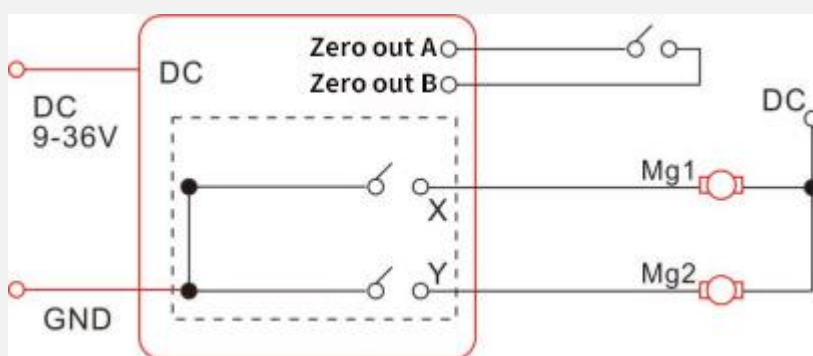
- Please refer to the diagram below for the RXD and TXD connection method used to set alarm thresholds via a computer:
- For units where the wires do not support RXD/TXD functionality, the alarm thresholds are fixed at the factory settings and cannot be modified by the user.
- Debugging via a laptop requires an RS232-to-USB adapter, whereas a desktop computer can be connected directly to a COM port. (If an adapter is used, the corresponding driver must be installed for it to function.)



Instructions for Use

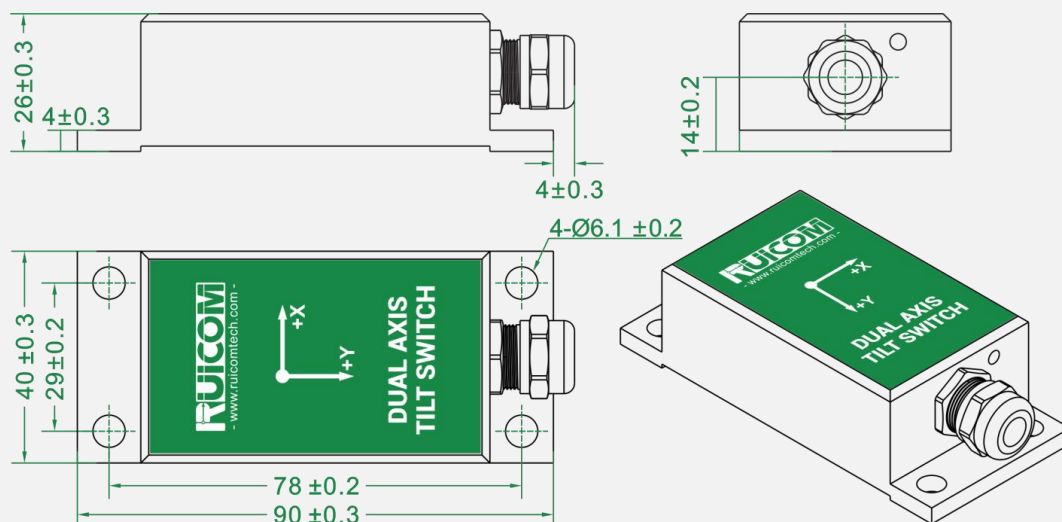
The image above illustrates the operating principle of a dual-axis tilt switch. The output signals are relay-style switch signals; each output terminal corresponds to an internal switch (indicated within the dashed box), with one side of each switch connected internally to ground. In versions equipped with a common (COM) terminal, the internal switches are connected to this COM terminal, which the user can then connect to either the power supply or ground, depending on their specific requirements.

In this diagram, MG1 is triggered when the tilt reaches a preset threshold along the X-axis, while MG2 is triggered when the tilt reaches a preset threshold along the Y-axis.



To set a relative angle (zeroing), short-circuit the "Clear A" and "Clear B" lines for 2 seconds.

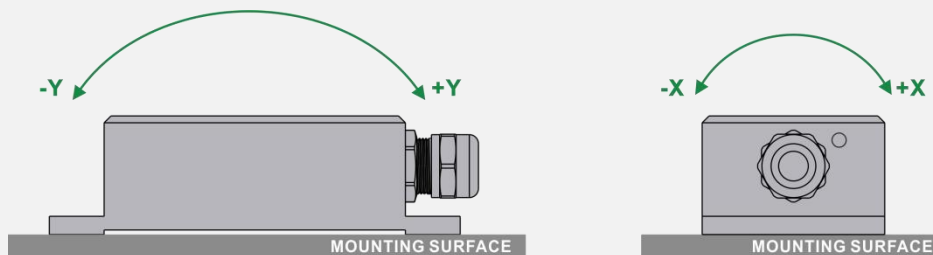
Product Dimensions



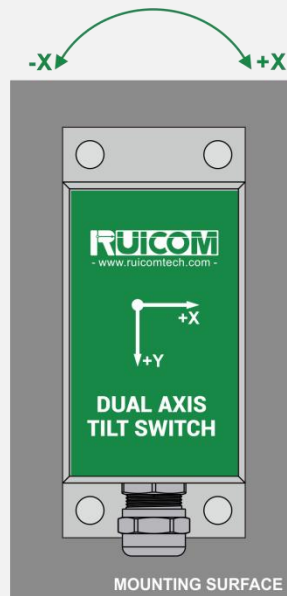
Enclosure dimensions: L90 × W40 × H26 mm	Mounting dimensions: L78 × W29 × H4.5 mm	Mounting screws: 4 × M6 screws
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✓ Installation Orientation

Note: During installation, ensure that the sensor's mounting surface remains parallel to the surface of the target being measured; also, minimize the impact of dynamic forces and acceleration on the sensor. This product can be installed either horizontally or vertically; please refer to the diagrams below for mounting configurations.



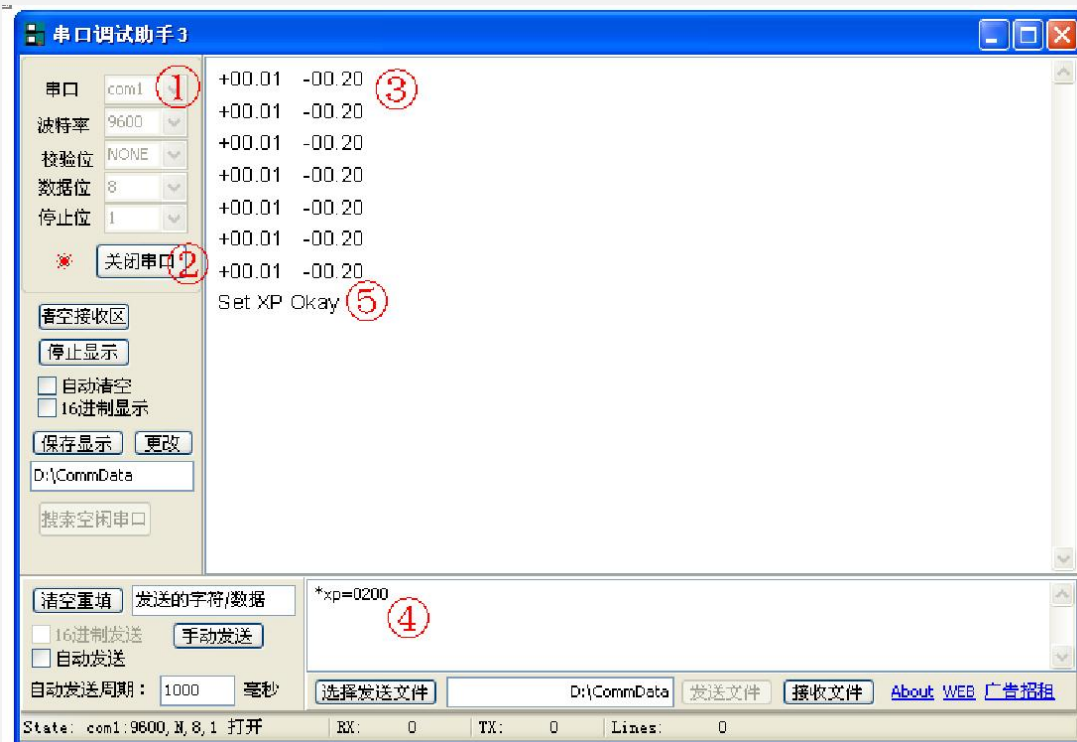
Horizontal installation



Vertical installation

✓ Debugging software

If a customer wishes to modify the alarm threshold, this can be done by connecting the device to a computer and using serial debugging software. You may use a standard, widely available serial debugging tool downloaded from the internet. Alternatively, the dedicated debugging software provided with Ruicom products can be used to connect to the inclinometer on your computer, allowing for the display of angle data.



Debugging Steps:

- 1) Open the software.
- 2) Select the appropriate COM port (refer to section "2").
- 3) Keep all other settings at their default values; no further configuration is required.
- 4) Click the button to open the serial port (refer to section "2").
- 5) Data will then appear in the returned data area (refer to section "3").
- 6) To set an alarm threshold, enter the corresponding command into the input area (refer to section "4"). (Please consult the communication protocol section of this specification for the specific command.)
- 7) If "Command + Okay" appears in the returned data area, the setting has been applied successfully (refer to section "5").

Analysis of Common Connection Issues:

- a) Check the power supply: Verify the positive and negative terminals, and ensure it is a DC power source.
- b) Swap the RXD and TXD data lines and test again.
- c) The COM port may be in use; close any other applications or devices currently accessing that COM port.
- d) Ensure the black wire is connected to pin 5 of the COM port.
- e) If an RS232 converter is being used, verify that it is functioning correctly and that the necessary drivers are installed.
- f) Use a multimeter to measure the sensor's current; if the reading is below 20 mA or above 60 mA, the sensor is likely damaged.



Communication Protocol

1: Data frame format: (8 data bits, 1 stop bit, no parity, default baud rate 9600)

Angle output format (ASCII code)

Each set of output data consists of 18 bytes:

Byte1: X	Byte 10: Y
Byte2: +/-	Byte 11: +/-
Byte3: X	Tens digit of the axis angle value
Byte4: X	Units digit of the axis angle value
Byte 5: Decimal point "."	Byte 14: Decimal point "."
Byte6: X	Tenths digit of the axis angle value
Byte7: X	Hundredths digit of the axis angle value
Byte 8: Space (0x20)	Byte 17: Carriage return (0x0D)
Byte 9: Space (0x20)	Byte 18: Line feed (0x0A)

The format is as follows:

ITEM	SIGNED	DATA	SPACE	SPACE	ITEM	SIGNED	DATA	ENTER	NEWLINE
X	+/-	**.**	Space	Space	Y	+/-	**.**	Enter	Line break

For example: If the current X-axis angle is +01.50 degrees and the Y-axis angle is -01.00 degrees, the display will show X+01.50; Y-01.00.

Note: If the user set a relative zero point during the previous session, the system will display "relative angle measure!" upon startup.

2: Relevant Configuration Commands(The following commands are case-sensitive)

Command	Description
&Z	Taking the current position as relative zero, the relevant data is stored in EEPROM. And perform relative angle output. After accepting the command, output: "set relative zero".
&R	Output in absolute angle. After accepting the command, output: "absolute zero".
*xp=????	Set the X-axis positive half-axis alarm point, "?????" is the angle value, and the possible values are "0001-1000". The default value is 0150. After accepting the command, output: "SetxP OK!"
*xn=????	*xn=????—Set the X-axis negative half-axis alarm point, "?????" is the angle value, and the possible values are "0001-1000". The default value is 0150. After accepting the command, output: "SetxN OK!"
*yp=????	*yp=????—Set the Y-axis positive half-axis alarm point, "?????" is the angle value, and the possible values are "0001-1000". The default value is 0150. After accepting the command, output: "SetyP OK!"
*yn=????	*yn=????—Set the Y-axis negative half-axis alarm point, "?????" is the angle value, and the possible values are "0001-1000". The default value is 0150. After accepting the command, output: "SetyN OK!"

When the green wire functions as a zero-reset line, short-circuiting it with the black wire for 2 seconds and then releasing it will set the current angle as a relative zero point. This function is equivalent to the "&Z" command; however, unlike the "&Z" command, this method triggers an alarm signal for approximately 1 second upon successfully setting the zero point. (When this function is not in use, please ensure the green wire is properly secured or insulated to prevent it from short-circuiting with any other wires.)