

TLL-90S

双轴数显倾角仪

Dual-Axis Digital Incliner

使用说明书

User Guide



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1. 产品概述

TLL-90S 是一款基于 MEMS 传感技术与高精度温度补偿算法的工业级双轴数显倾角仪。仪器静态测量精度可达 $\pm 0.005^\circ$ ，分辨率达 0.001° 。设备集成静态倾角测量（基于重力方向）、动态旋转角测量（基于陀螺仪）、激光标线以及多种工业通信接口，适用于工程测量、设备安装、自动化检测、结构监测及科研实验等应用场景。



2. 产品特点



- **高精度双轴测量：**倾角测量精度最高 $\pm 0.005^\circ$ ，分辨率 0.001° ，测量范围支持单轴 $4 \times 90^\circ$ 及双轴 $\pm 40^\circ$ 。
- **动态旋转角测量：**陀螺仪测量精度 $\pm 0.5^\circ$ ，显示范围 $\pm 999.9^\circ$ ，适用于动态姿态变化监测。
- **多种测量模式：**支持单轴、双轴及陀螺仪旋转角测量。
- **多单位显示：**支持切换角度 ($^\circ$)、高度 (mm/m)、坡度 (%)、度分秒 ($^\circ''$) 显示。
- **360°自动翻转：**单轴测量时屏幕随仪器方向自动翻转。
- **角度蜂鸣提示：**支持自定义设定提示的角度阈值，实现异常角度的声响预警。
- **激光辅助定位：**内置红色地线激光，用于辅助安装与定位。
- **磁性底座设计：**底部与背部均配置强磁吸附结构并带V型槽，适配管道与金属表面。
- **多种通信方式：**支持无线 (BT) 通信、Type-C 虚拟串口及RS485 Modbus通信。

3.规格参数

重力倾角 (测量方式1)		陀螺仪旋转角 (测量方式2)	
测量精度: *校正之后的精度 精度 正角度范围 负角度范围 ±0.005° 0° ~ 15°, 0° ~ -15° ±0.01° 15° ~ 30°, -15° ~ -30° ±0.05° 30° ~ 90°, -30° ~ -90° 测量分辨率: 0.001° 测量范围: 单轴: 4x90° 双轴: ±40° 应用场景: 设备调平/安装校准/平台角度测量		测量精度: ±0.5° 屏幕显示分辨率: 0.1° 通讯输出分辨率: 0.01° 屏幕显示范围: ±999.9° 旋转速度: <90°/s 应用场景: 转台旋转监测/机械运动监测/动态角度跟踪	
零点温度系数	0.002°/°C	产品功耗	待机时: 18 μA
蜂鸣音量	75dB@10cm		使用时: 50 mA
响应时间	<0.3 s	电池续航	待机时: 3600 h
使用温度	0 ~ 50°C		使用时: 13 h
储存温度	-10 ~ 60°C	充电器接口	Type-C(DC 5V 1A)
激光功率	CLASS 2	磁力座	底部和背部
激光波长	650 nm	通讯接口	BT/Type-C/RS485
用户界面	单色背光 LCD	尺寸	94 x 68 x 29 mm
供电电源	3.7V充电锂电池	重量	约213 g (7.5 oz)




4.按键功能

按键	功能
	短按: 开机 / 开启或关闭激光 退出陀螺仪/设置界面 长按: 关机
	短按: 倾角模式下为切换相对/绝对模式 陀螺仪模式下为清零当前测量值 长按: 开启或关闭蜂鸣提示音

	短按：锁定当前测量数值 长按：循环切换倾角测量单位（° / mm/m / % / °'″）
	短按：进入或退出陀螺仪模式/确认菜单选项 长按：进入系统设置菜单

5.核心功能

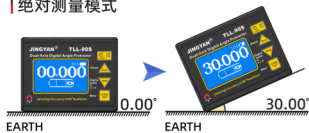
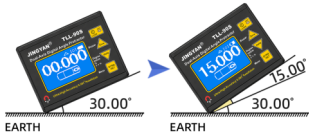
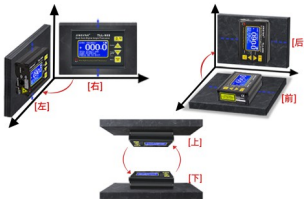
5.1 倾角仪支持单轴、双轴和陀螺仪三种测量方式

分类	静态重力倾角		动态旋转角
方式	单轴	双轴	陀螺仪
定义	测量单一方向在重力水平面上的倾斜偏差	同步测量正交 X、Y 轴在重力水平面上的倾斜偏差	测量物体绕旋转轴产生的动态旋转角变化
基准面	 <p>以仪器底部基准面进行测量</p>	 <p>以仪器背部基准面进行测量</p>	 <p>绕仪器旋转轴进行动态旋转角测量</p>
模式	绝对模式/相对模式		累计旋转角模式
切换方式	自动切换： 当双轴模式下任一轴倾角 $> \pm 40^\circ$ 时自动切换到单轴		手动切换： 短按GYRO按键进入/退出
显示界面			

5.2 图标说明

标识图标	状态描述与功能定义
①电池电量	实时显示剩余电量（馈电、低电、满电）。
②测量单位	长按 Hold 键循环切换测量单位： [°] 角度：基于重力方向的倾斜角度。 [mm] 高度：每1米（1000mm）水平长度倾斜对应的垂直高度差。 [%] 坡度：倾斜平面的百分比斜率（垂直高度/水平距离）。 [°'"] 度分秒：基于重力方向的倾斜角度，按（度、分、秒）形式显示。
③测量模式	无△符号：绝对模式（参考地球水平面） 显示△符号：相对模式(参考自定义水平零位)
④蜂鸣开关	显示图标时蜂鸣提示音开启。开启后，若角度满足设定范围，将发出提示声。
⑤单轴电子水泡	指示仪器本体当前放置方向的姿态， 屏幕横向显示时，对应仪器底边方向； 屏幕翻转成竖向显示时，对应仪器侧边方向。
⑥双轴电子水泡	指示仪器本体正交 X/Y 轴的实时倾斜状态。 上下移动指示Y轴倾斜，左右移动指示X轴倾斜。
⑦单轴测量数值	以仪器底座为基准的倾斜数值。
⑧双轴测量数值	以仪器背面为基准的 X 轴与 Y 轴倾斜数值。
⑨陀螺仪数值	反映仪器绕虚拟旋转轴旋转得到的动态旋转。

5.3 模式说明

	测量模式	图示
倾角 测量	绝对模式(无△符号): 以地球水平面为恒定零位, 测量物体相对于真实地平线的 倾斜状态。	绝对测量模式 
	相对模式(显示△符号): 短按Zero键, 将当前位置定 义为逻辑零位00.000°, 测 量被测面相对于该位置的倾 斜偏差。	相对测量模式 
陀螺 仪功 能	该模式下测量值为累计动态 旋转角。 陀螺仪清零: 短按Zero键将测量值清零, 重置为运动起始参考零点。	

6. 其他功能

6.1 数值锁定功能

应用模式: 单/双轴测量

激活锁定: 短按 Hold 键锁定当前测量数值, 此时屏幕上的单位图标将持续闪烁。

取消锁定: 再次短按 Hold 键解除锁定。

6.2 角度蜂鸣提示功能

应用模式: 单/双轴模式下以角度单位为设置基准

打开蜂鸣提示音: 长按 Zero 键, 屏幕显示图标

关闭蜂鸣提示音: 再长按 Zero 键, 无图标显示

蜂鸣角度设置方法：

1.长按 SET 进入菜单；2.短按 Zero/Hold 定位在 ALARM 选项；3.短按 SET 选择；4.通过按 Zero 键上调/ Hold 键下调设定值（长按可快速滚动数值）；5.短按 SET 进入下一步。

仪器界面内容	说明
SINGLE AXIS	单轴测量时触发蜂鸣提示的角度基准值
DUAL AXIS X	双轴测量时触发蜂鸣提示的X轴角度基准值
DUAL AXIS Y	双轴测量时触发蜂鸣提示的Y轴角度基准值
RANGE	设置相对于角度基准值的偏移范围
TRIGGER AREA	内（角度在计算范围内触发）或外（角度超出计算范围触发）

设置示例：单轴设置为 20.00，范围设置为 01.00，触发区域设置为内，则当单轴倾角值处于 $+19.00^{\circ}\sim+21.00^{\circ}$ 或 $-19.00^{\circ}\sim-21.00^{\circ}$ 区间内时，仪器将触发蜂鸣提示。

6.3 电池/自动关机

电池：采用3.7V充电锂电池供电，请使用合规的DC 5V 1A Type-C充电设备充电。

充电：充电时电源按键的红色灯亮；开机充电时，屏幕上的电池图标闪烁。

自动关机：仪器支持30分钟自动关机或关闭自动关机功能。

自动关机的设置方法：

1.长按 SET 进入菜单；2.短按 Zero/Hold 定位在 POWER 选项；3.短按 SET 选择；4.通过按 Zero 键上调/ Hold 键下调选择自动关机时间为 Never 或30Min；5.短按SET确认。

6.4 恢复出厂设置

当倾角仪出现异常时，可以使用恢复出厂设置对倾角仪进行重置。所有校准设置将全部恢复到出厂时的状态。在恢复出厂设置后，请重新校准以保证精度正常。

*正常状态时，不建议恢复出厂设置。若出现精度漂移，请校准倾角仪。

恢复出厂设置方法:

1.长按SET进入菜单；2.短按 Zero/Hold 定位在FACTORY选项；3.短按SET选择；4.通过按 Zero 键上调/ Hold 键下调选择 YES 或 NO；5.短按SET确认

7. 精度检验和校准

*重要提示：设备开机后，需先预热并稳定1分钟，再进行操作。

7.1 倾角精度检验

步骤1：选取平整的大理石基准台面，确保环境温度稳定无明显波动；将倾角仪平稳放置于台面，待数值稳定后记录当前读数 X_1, Y_1 。

步骤2：保持倾角仪底部基准面贴合台面，旋转 180° 后放回原位置。

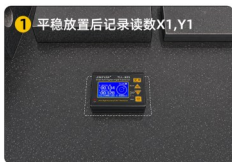
步骤3：待读数稳定，记录读数 X_2, Y_2 。

则零位误差 $E_x=(X_1+X_2)/2$, $E_y=(Y_1+Y_2)/2$,

若 $|E| \leq$ 标定精度范围，精度合格。

若 $|E| >$ 标定精度范围，则需进行倾角精度校准。

*多次测量平均误差可消除偶然误差；出现精度误差可能由测量表面不平整、较大的温度变化或者仪器基准面磨损不平等导致。



7.2 倾角精度校准

步骤1: 长按SET按键进入菜单模式。通过Zero和Hold按键选择LEVEL CAL.选项，按SET按键，进入倾角校准。

步骤2: 将倾角仪平面放置（背部基准面贴合水平台面，显示屏朝上），按SET按键，等待蜂鸣声停止。

步骤3: 保持倾角仪背部基准面贴合台面，水平旋转180°。

步骤4: 旋转后回到步骤2相同的位置，再次按SET按键，等待蜂鸣声停止。

步骤5: 将倾角仪正面立式放置（底部基准面贴合水平台面，显示屏面向操作员）。

步骤6: 按下SET按键，等待蜂鸣声停止。

步骤7: 保持倾角仪底部基准面贴合台面，水平旋转180°。

步骤8: 旋转后回到步骤5相同的位置，再次按SET按键，等待蜂鸣声停止。

步骤9: 将倾角仪立式旋转90°贴合垂直侧面（底部基准面贴合垂直侧面，GYRO按键最靠近垂直侧面）。

步骤10: 按下SET按键，等待蜂鸣声停止。

步骤11: 保持倾角仪底部基准面贴合垂直侧面，水平旋转180°（保持仪器显示屏位于按键上方）

步骤12: 旋转后回到步骤9相同的位置（此时Power按键最靠近垂直侧面），再次按SET按键，等待蜂鸣声停止。LCD屏幕回到菜单页面，表示校准程序完成。

注: *请选择平整稳定的台面进行校准，以保证校准精度。

*当倾角仪屏幕显示CAUTION时，表示触发了位置防错功能，需将倾角仪正确放置。

*蜂鸣提示声停止前，请勿移动倾角仪。



7.3 陀螺仪精度校准

步骤1：长按SET按键进入菜单。通过Zero和Hold按键选择GYRO CAL.选项，按SET按键，进入陀螺仪校准。

步骤2：将倾角仪竖直放置于一个较平的水平台面上，按下SET按键确认。

步骤3：保持倾角仪的旋转轴心不偏移，将倾角仪逆时针缓慢旋转360°。

步骤4：旋转完成回到原位置，再按下SET键确认。

步骤5：保持倾角仪的旋转轴心不偏移，将倾角仪顺时针缓慢旋转360°。

步骤6：旋转完成回到原位置，再按下SET按键，跳回菜单页即陀螺仪校准完成。



8. 数据传输

仪器支持三种通信接口：无线通信 (BT)、Type-C虚拟串口、RS485 MODBUS 工业总线。

- 有线通道支持切换SCPI与MODBUS双协议。
- 兼容移动设备、PC上位机及工业控制系统。
- SCPI模式支持主动推送数据流，降低主机轮询负载。

8.1 通信接口

- **无线通信BT (无线)**：仪器内置无线模组，适用于短距离无线监测与移动控制。该通道独立运行，默认SCPI指令集，支持即连即用的数据通信。
- **Type-C虚拟串口 (有线)**：仪器采用通用USB Type-C物理接口，支持数据传输及5V供电。适用于上位机高频数据采集与参数配置。
- **RS485 MODBUS (有线)**：工业级差分总线接口，具备

较强抗干扰能力，支持远距离稳定传输与一主多从组网，适配工业现场多设备集中采集场景。

RS485 (RJ11 6P6C) 引脚定义

引脚	定义	说明
1/2	VBUS	电源正极 (DC 6-12V)
3	A	RS485信号正 (+)
4	B	RS485信号负 (-)
5/6	GND	接地

8.2 参数配置

Type-C/RS485的运行逻辑由菜单参数决定。

进入设置：MENU→COMMUNICATION

根据测试环境配置以下参数：

参数名称	可选项	参数说明	生效通道
PORT	USB/RS485	设置激活的物理端口	USB/RS485
FORMAT	ASCII/ MODBUS	选择通讯协议格式 ASCII: 激活SCPI协议 MODBUS: 激活MODBUS RTU协议	USB/RS485
ADDRESS	1-255	设备唯一地址 (RS485组网时)	RS485
BAUD RATE	9600- 115200	通讯传输速率，有线传输 时，上位机波特率必须与 仪器设置一致	USB/RS485

9. 资料获取

为满足系统集成、自动化控制及二次开发需求，TLL-90S提供完整的通信协议与开发支持资料，如需获取相关资料，请通过以下方式联系：

官方网站：www.jingyan-tech.com

技术支持邮箱：support@jingyan.tech

10. 使用注意事项

- 为保证最佳测量精度，建议仪器开机预热1~3分钟后再进行测量。
- 环境温度快速变化可能影响测量精度。
- 如仪器经过较大的环境温度变化，建议重新进行精度校准。
- 请保持测量基准面清洁，避免附着异物影响测量精度。
- 请避免仪器受到强烈冲击、跌落或剧烈振动。

11. 常见问题

Q: 测量数值跳动较大?

A: 请确认测量表面稳定，并避免强震动和大温差环境。

Q: 测量值存在明显偏差?

A: 请确认仪器基准面与被测台面的清洁，并重新进行正确的精度校准。

Q: 无法连接通信接口?

A: 请检查仪器的通信参数与上位机是否保持一致。

Q: 陀螺仪测量值出现漂移?

A: 请重新进行陀螺仪精度校准。

12. 激光安全警示

本产品属于 2类 (Class 2) 激光产品。为了您的安全，请务必遵守以下规定：

- 禁止直视激光束或通过光学设备直接观察。
- 严禁将激光照射到他人眼睛。
- 请将设备放置在儿童无法触及的位置。
- 禁止自行拆卸或改装设备。



1. Product Overview

TLL-90S is an industrial-grade dual-axis digital inclinometer based on MEMS sensing technology and a high-precision temperature compensation algorithm.

The static measurement accuracy of the instrument can reach $\pm 0.005^\circ$, and the resolution reaches 0.001° . The device integrates static inclination measurement (based on the direction of gravity), dynamic rotation angle measurement (based on gyroscope), laser marking line, and multiple industrial communication interfaces, and is suitable for application scenarios such as engineering measurement, equipment installation, automated detection, structural monitoring, and scientific research experiments.

2. Product Features

- **High-precision dual-axis measurement:** the inclination measurement accuracy is up to $\pm 0.005^\circ$, the resolution is 0.001° , and the measurement range supports single-axis $4 \times 90^\circ$ and dual-axis $\pm 40^\circ$.
- **Dynamic rotation angle measurement:** Gyroscope measurement accuracy $\pm 0.5^\circ$, display range $\pm 999.9^\circ$, suitable for dynamic attitude change monitoring.
- **Multiple measurement modes:** supports single-axis, dual-axis, and gyroscope rotation angle measurement.
- **Multi-unit display:** supports switching among angle ($^\circ$), height (mm/m), slope (%), and degrees-minutes-seconds ($^\circ$ "'") display.
- **360° auto flip:** The screen automatically flips with the instrument orientation in single-axis measurement mode.
- **Angle buzzer alarm:** supports user-defined alarm angle threshold settings to realize audible warning for abnormal angles.
- **Laser-assisted positioning:** Built-in red ground laser for

auxiliary installation and positioning.





- **Magnetic base design:** both the bottom and the back are equipped with strong magnetic adsorption structures and V-grooves, suitable for pipes and metal surfaces.
- **Multiple communication methods:** supports wireless (BT) communication, Type-C virtual serial port, and RS485 Modbus communication.

3. Specifications

Gravity inclination (Method 1)	Gyro rotation angle (Method 2)
<p>Accuracy: *Accuracy is calibrated Accuracy Positive Negative ±0.005° 0° ~ 15°, 0° ~ -15° ±0.01° 15° ~ 30°, -15° ~ -30° ±0.05° 30° ~ 90°, -30° ~ -90°</p> <p>Resolution: 0.001°</p> <p>Range: Single-axis: 4x90° Dual-axis: ±40°</p> <p>Application: Leveling / Installation calibration / Platform angle detection</p>	<p>Accuracy: ±0.5°</p> <p>Display Resolution: 0.1°</p> <p>Output Resolution: 0.01°</p> <p>Display Range: ±999.9°</p> <p>Rotation Speed: <90°/s</p> <p>Application: Turntable rotation / Mechanical motion / Dynamic angle tracking</p>
Zero-point temperature co-efficient	0.002°/°C
Buzzer volume	75dB@10cm
Response time	<0.3 s
Operating temperature	0 ~ 50°C
Storage temperature	-10 ~ 60°C
Laser power	CLASS 2
Laser wavelength	650 nm
User Display	Backlit monochrome dot-matrix LCD


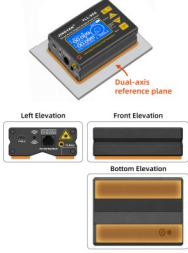

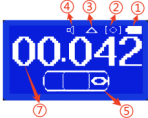


Power supply	3.7V rechargeable lithium battery
Power Consumption	Standby: 18 μ A, Operating: 50 mA
Battery life	Standby: 3600 h, Operating: 13 h
Charger interface	Type-C(DC 5V 1A)
Magnetic base	bottom and back
Communication Interface	BT/Type-C/RS485
Dimensions	94 x 68 x 29 mm
Weight	Approx. 213 g (7.5 oz)

4. Button Functions

Button	Function
	<p>Short press: power on / turn laser on or off. exit gyroscope / setting interface</p> <p>Long press: power off.</p>
	<p>Short press: Inclination Mode: switch between Relative / Absolute Mode. Gyroscope Mode: clear the current measured value to zero.</p> <p>Long press: turn the buzzer prompt sound on or off.</p>
	<p>Short press: lock the current measurement value.</p> <p>Long press: cyclically switch the inclination measurement unit ($^{\circ}$ / mm/m / % / $^{\circ}$ ' ").</p>
	<p>Short press: enter or exit gyroscope mode / confirm menu option.</p> <p>Long press: enter the system setting menu.</p>

5. Core Functions

5.1 The inclinometer supports three measurement methods: single-axis, dual-axis, and gyroscope

Category	Static Gravity Inclination		Dynamic Rotation Angle
Method	Single-axis	Dual-axis	Gyroscope
Definition	 <p>Measures the inclination deviation of a single direction on the gravity horizontal plane.</p>	 <p>Simultaneously measures the inclination deviations of the orthogonal X and Y axes on the gravity horizontal plane.</p>	 <p>Measures the dynamic rotation angle change generated by the object around the rotation axis.</p>
Reference Surface	<p>Measurement is performed using the instrument bottom reference surface.</p>	<p>Measurement is performed using the instrument back reference surface.</p>	<p>Dynamic rotation angle measurement is performed around the instrument rotation axis.</p>
Mode	<p>Absolute mode / relative mode</p>		<p>Cumulative rotation angle mode</p>
Switching Method	<p>Automatic switching: when any axis inclination in dual-axis mode is $> \pm 40^\circ$, it automatically switches to single-axis.</p>		<p>Manual switching: short press the GYRO button to enter / exit.</p>
Display Interface			

5.2 Icon Descriptions

① Battery Level

Shows remaining battery: low / medium / full.

② Unit of Measurement

Long-press Hold button to switch units:

[°] Angle: inclination angle based on the direction of gravity.

[mm] Height: the vertical height difference corresponding to the inclination over every 1 meter (1000 mm) of horizontal length.

[%] Slope: percentage slope of the inclined plane (vertical height / horizontal distance).

[°'"] DMS: Display the angle value in Degrees-Minutes-Seconds. .

③ Measurement mode

No \triangle Icon: absolute mode (reference to the earth's horizontal plane).

\triangle Icon displayed: relative mode (reference to a user-defined horizontal zero plane).

④ Buzzer switch

Icon displayed: buzzer is on. It beeps when angle enters the set range.

⑤ Single-axis electronic bubble

Indicates the instrument posture in its current placement direction.

When the screen is displayed horizontally, it corresponds to the bottom-edge direction of the instrument.

When the screen rotates to a vertical display, it corresponds to the side-edge direction of the instrument.

⑥ Dual-axis electronic bubble

Indicates real-time tilt along the instrument's orthogonal X/Y axes. Vertical movement indicates Y-axis tilt; horizontal movement indicates X-axis tilt.

⑦ Single-axis measurement value

Tilt value based on the bottom of the instrument.

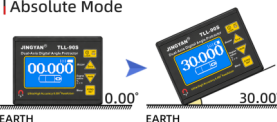
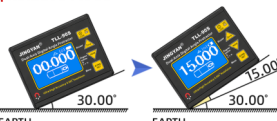
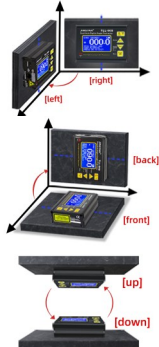
⑧ Dual-axis measurement value

X & Y tilt values based on the back of the instrument.

⑨ Gyroscope measurement value

Dynamic rotation angle around the virtual rotation axis.

5.3 Mode Descriptions

Measurement Mode	Description	Illustration
Inclination measurement -	<p>Absolute mode (no Δ symbol)</p> <p>With the earth's horizontal plane as the constant zero position, measures the inclination state of the object relative to the true horizon.</p>	<p>Absolute Mode</p> 
	<p>Relative mode (Δ symbol displayed)</p> <p>Short press the Zero button to define the current position as the logical zero plane (00.000°), and measure the inclination deviation of the measured surface relative to this plane.</p>	<p>Relative Mode</p> 
Gyroscope function	<p>In this mode, the measurement value is the cumulative dynamic rotation angle.</p> <p>Gyroscope zeroing: Short press the Zero button to clear the measurement value to zero and reset to the starting reference zero point of motion.</p>	

6. Other Functions

6.1 Value Hold Function

Application mode: single-axis / dual-axis measurement.

Activate hold: short press the Hold button to lock the current measurement value. At this time, the unit icon on the screen will keep flashing.

Cancel hold: short press the Hold button again to release the hold.

6.2 Angle Buzzer Alarm

Application mode: In single/dual-axis mode, angle is used as the setting reference.

Turn on the buzzer prompt sound: long press the Zero button, and the icon is displayed on the screen.

Turn off the buzzer prompt sound: long press the Zero button again, and no icon is displayed.

Buzzer angle setting method:

1.Long press SET to enter the menu.

2.Short press Zero / Hold to locate the ALARM option.

3.Short press SET to select.

4.Press the Zero button to increase / press the Hold button to decrease the set value (long press to scroll the value quickly).

5.Short press SET to enter the next step.

Interface terms	Description
SINGLE AXIS	The angle reference value that triggers the buzzer prompt during single-axis measurement.
DUAL AXIS X	The X-axis angle reference value that triggers the buzzer prompt during dual-axis measurement.
DUAL AXIS Y	The Y-axis angle reference value that triggers the buzzer prompt during dual-axis measurement.

RANGE	Sets the offset range relative to the angle reference value.
TRIGGER AREA	Inside: triggered when the angle is within the calculated range. Outside: triggered when the angle exceeds the calculated range.

Setting example: if the single-axis setting is 20.00, the range is set to 01.00, and the trigger area is set to inside, then when the single-axis inclination value is within $+19.00^{\circ}\sim+21.00^{\circ}$ or $-19.00^{\circ}\sim-21.00^{\circ}$, the instrument will trigger the buzzer prompt.

6.3 Battery / Auto Power-Off

Battery: powered by a 3.7V rechargeable lithium battery. Please use a compliant DC 5V 1A Type-C charging device for charging.

Charging: when charging, the red light of the power button is on. When charging while powered on, the battery icon on the screen flashes.

Auto power-off: the instrument supports 30-minute automatic power-off or turning off the automatic power-off function.

Auto power-off setting method:

- 1.Long press SET to enter the menu.
- 2.Short press Zero / Hold to locate the POWER option.
- 3.Short press SET to select.
- 4.Press the Zero button to increase / press the Hold button to decrease, and select the automatic power-off time as Never or 30Min.
- 5.Short press SET to confirm.

6.4 Restore Factory Settings

When the inclinometer is abnormal, the restore factory settings function can be used to reset the inclinometer. All calibration settings will be restored to the factory state. After restoring factory settings, please recalibrate to ensure normal accuracy.

In normal condition, restoring factory settings is not recommended. If accuracy drift occurs, please calibrate the inclinometer.

Restore factory settings method:

- 1.Long press SET to enter the menu.
- 2.Short press Zero / Hold to locate the FACTORY option.
- 3.Short press SET to select.
- 4.Press the Zero button to increase / press the Hold button to decrease, and select YES or NO.
- 5.Short press SET to confirm.

7. Accuracy Verification and Calibration

***Important Notice: After the device is powered on, please pre-heat and stabilize it for 1-3 minutes before operation.**

7.1 Inclination Accuracy Verification

Step 1: Select a flat marble reference surface and ensure the ambient temperature is stable without significant fluctuation. Place the inclinometer steadily on the surface. After the readings stabilize, record the current readings as X1 and Y1.

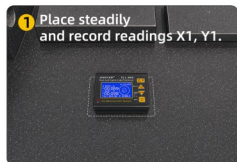
Step 2: Keep the bottom reference surface of the inclinometer in contact with the table, rotate the instrument by 180°, and place it back in the same position.

Step 3: After the readings stabilize, record the readings as X2 and Y2. The zero offset errors are calculated as:

$$E_x = (X1 + X2) / 2 \quad E_y = (Y1 + Y2) / 2$$

If $|E| \leq$ the calibrated accuracy range, the accuracy is acceptable. If $|E| >$ the calibrated accuracy range, inclination accuracy calibration is required.

* Taking the average error from multiple measurements can reduce random errors. Accuracy errors may be caused by an uneven measurement surface, significant temperature variations, or wear/unevenness of the instrument reference base.



7.2 Inclination Accuracy Calibration

Step 1: Long press the SET button to enter menu mode. Use the Zero and Hold buttons to select the LEVEL CAL. option, then press the SET button to enter inclination calibration.

Step 2: Place the inclinometer flat with its rear reference surface closely attached to the horizontal platform and the display facing upward. Press the SET button and wait until the buzzer stops.

Step 3: Keep the rear reference surface attached to the platform, then rotate the inclinometer 180° horizontally.

Step 4: Return to the same position as Step 2 after rotation, press the SET button again and wait until the buzzer stops.

Step 5: Place the inclinometer upright with its bottom reference surface attached to the horizontal platform and the display facing the operator.

Step 6: Press the SET button and wait until the buzzer stops.

Step 7: Keep the bottom reference surface attached to the platform, then rotate the inclinometer 180° horizontally.

Step 8: Return to the same position as Step 5 after rotation, press the SET button again and wait until the buzzer stops.

Step 9: Rotate the inclinometer upright by 90° and attach it to a vertical side face, with the bottom reference surface closely fitted to the vertical surface and the GYRO button is closest to the vertical side.

Step 10: Press the SET button and wait until the buzzer stops.

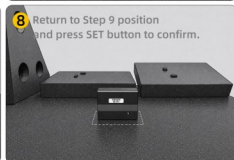
Step 11: Keep the bottom reference surface attached to the vertical side face, rotate 180° horizontally while keeping the display above the buttons.

Step 12: Return to the same position as Step 9 after rotation, the Power button is closest to the vertical side at this time. Press the SET button again and wait until the buzzer stops. The LCD returns to the menu page, indicating the calibration is completed.

Notes: *Please calibrate on a flat and stable platform to ensure calibration accuracy.

*When CAUTION appears on the screen, the position error prevention function is triggered. Please place the inclinometer correctly.

*Do not move the inclinometer until the buzzer stops.



7.3 Gyroscope Accuracy Calibration

Step 1: Long press the SET button to enter the menu. Use the Zero and Hold buttons to select the GYRO CAL. option, then press the SET button to enter gyroscope calibration.

Step 2: Place the inclinometer vertically on a flat horizontal

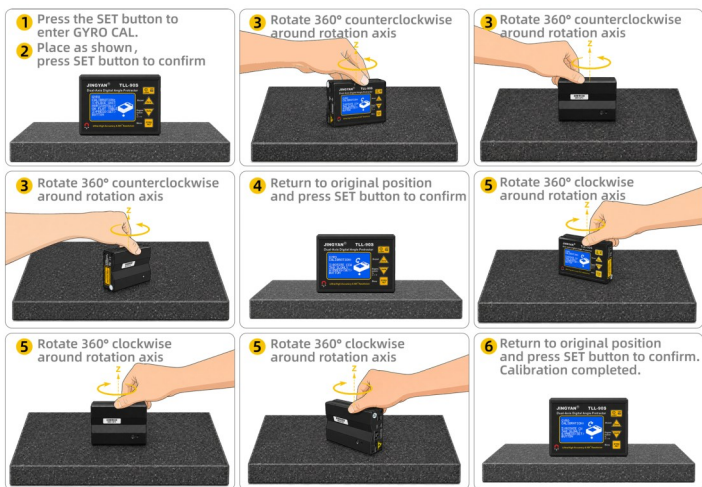
tabletop, then press the SET button to confirm.

Step 3: Keep the rotation axis of the inclinometer without offset, slowly rotate the inclinometer counterclockwise by 360°.

Step 4: Return to the original position after rotation, then press the SET button to confirm.

Step 5: Keep the rotation axis of the inclinometer without offset, slowly rotate the inclinometer clockwise by 360°.

Step 6: Return to the original position after rotation, then press the SET button. The system returns to the menu page, indicating the completion of gyroscope calibration.



8. Data Transmission

The instrument supports three communication interfaces: wireless communication (BT), Type-C virtual serial port, and RS485 MODBUS industrial bus.

- The wired channel supports switching between SCPI and MODBUS dual protocols.

- Compatible with mobile devices, PC host computers, and industrial control systems.
- In SCPI mode, active data stream pushing is supported, reducing the polling communication load of the host.

8.1 Communication Interfaces

- **Wireless communication BT (wireless):** the instrument has a built-in wireless module, suitable for short-distance wireless monitoring and mobile control. This channel operates independently, defaults to the SCPI command set, and supports plug-and-play data communication.
- **Type-C virtual serial port (wired):** the instrument uses a universal USB Type-C physical interface and supports data transmission and 5V power supply. It is suitable for high-frequency data acquisition and parameter configuration by a host computer.
- **RS485 MODBUS (wired):** an industrial-grade differential bus interface, with strong anti-interference capability, supporting long-distance stable transmission and one-master-multiple-slave networking, suitable for centralized acquisition scenarios of multiple devices in industrial sites.

RS485 (RJ11 6P6C) Pin Definition

Pin	Definition	Description
1/2	VBUS	Power positive pole (DC 6-12V)
3	A	RS485 signal positive (+)
4	B	RS485 signal negative (-)
5/6	GND	Ground

8.2 Parameter Configuration

The operating logic of Type-C / RS485 is determined by menu parameters. **Enter Settings:** MENU → COMMUNICATION. Configure the following parameters according to the test environment:

Parameter Name	Optional Items	Parameter Description	Effective Channel
PORT	USB / RS485	Sets the active physical port.	USB / RS485
FORMAT	ASCII / MODBUS	Selects the communication protocol format. ASCII: activates SCPI protocol. MODBUS: activates MODBUS RTU protocol.	USB / RS485
ADDRESS	1-255	The unique device address during RS485 networking.	RS485
BAUD RATE	9600-115200	Communication transmission rate. During wired transmission, the baud rate of the host computer must be consistent with the instrument setting.	USB / RS485

9. Obtaining Materials

To meet the needs of system integration, automation control, and secondary development, the TLL-90S provides a complete communication protocol and development support documentation. To obtain the relevant materials, please contact us via:

Official website: www.jingyan-tech.com

Technical support email: support@jingyan.tech

10. Precautions for Use

- To ensure the best measurement accuracy, it is recommended to warm up the instrument for 1-3 minutes after power-on before measurement.
- Rapid changes in ambient temperature may affect measurement accuracy.
- If the instrument has undergone a large change in ambient temperature, it is recommended to recalibrate the accuracy.

- Please keep the measurement reference surface clean and avoid attached foreign objects affecting measurement accuracy.
- Please avoid strong impact, dropping, or severe vibration of the instrument.

11. Frequently Asked Questions

Q: The measurement value fluctuates greatly?

A: Please confirm that the measurement surface is stable, and avoid strong vibration and environments with large temperature differences.

Q: The measurement value has an obvious deviation?

A: Please confirm that the instrument reference surface and the measured table surface are clean, and perform correct accuracy calibration again.

Q: Unable to connect to the communication interface?

A: Please check whether the communication parameters of the instrument and the host computer remain consistent.

Q: The gyroscope measurement value drifts?

A: Please perform gyroscope accuracy calibration again.

12. Laser Safety Warning

This product is a Class 2 laser product. For your safety, please be sure to comply with the following regulations:

- Do not stare directly into the laser beam or observe it directly through optical equipment.
- It is strictly forbidden to irradiate other people's eyes with the laser.
- Please place the device in a location that children cannot reach.
- Do not disassemble or modify the device by yourself.



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2. This device is an auxiliary precision measuring instrument, strictly calibrated before ex-factory. The manufacturer shall not be held liable for any and all consequences, losses or liabilities arising from construction, installation, machining, building works or any end-use decisions based on measurement output.

3. No responsibility will be accepted for accuracy drift, unit failure or consequential damages caused by accidental drop/impact, water ingress, unauthorized modification/disassembly, operation outside rated environmental limits, lack of user on-site recalibration, or improper handling.

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Website: www.jingyan-tech.com

E-mail: support@jingyan.tech

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