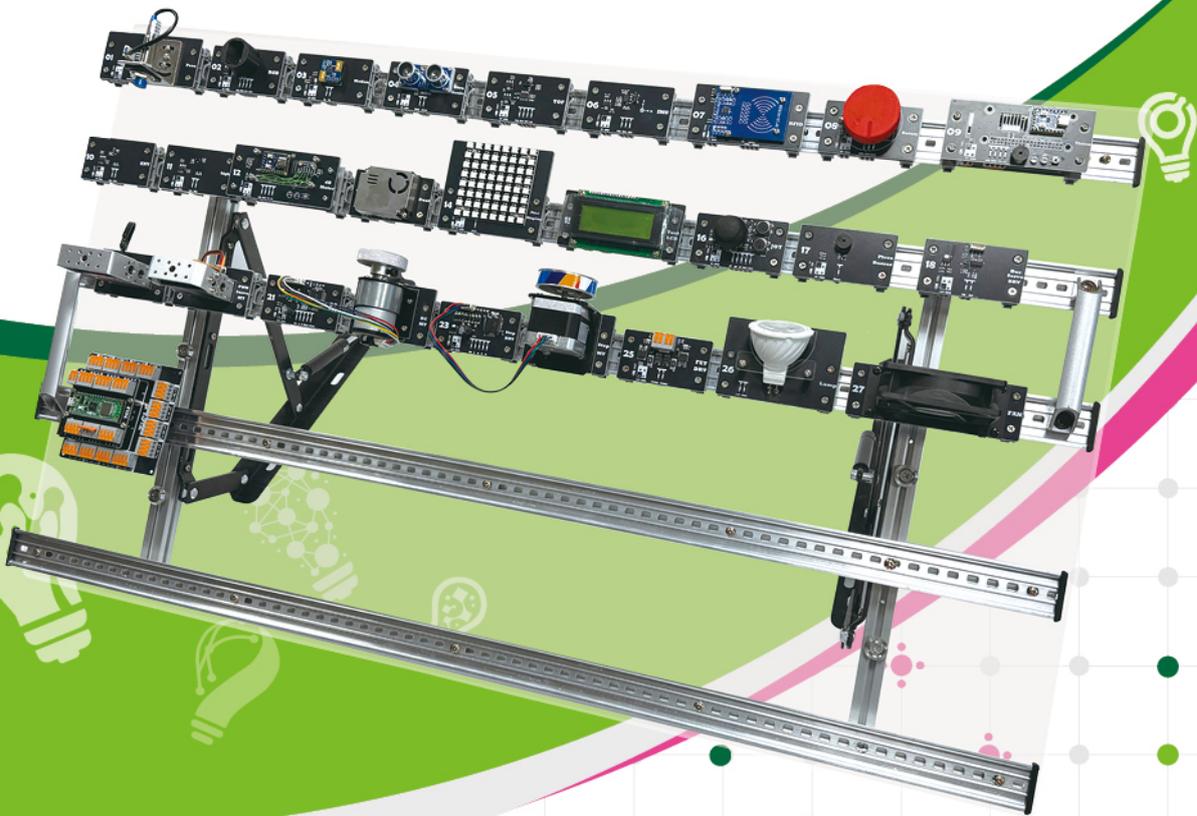


# Modular Physical Computing Training Equipment

Immediately Implementing Logistics  
and Manufacturing Sensing Scenarios

# TICLE Sensor



- Modular Physical Computing Training Equipment that immediately implements logistics and manufacturing sensing scenario without soldering or breadboard
- Support real-time and non-real-time job separation through Dual-Core ARM Cortex-M33 Main Processor
- Rapidly replace sensor/actuator and optimize PBL repetitive experiment through lever connector-based free wiring
- Freely place/rearrange module with clip bracket + layout board of DIN Rail structure for industrial equipment, Resistant to collision/vibration and Quickly configure Line Tracing, Conveyor and Sorting Layout
- Provide object identification/distance/position/posture/speed/recognition sensor and drive/feedback actuator to implement advanced PBL project
- Power module corresponds to various devices (ex: DC motor 12 V, servo 5 V, logic 3.3 V)
- Pop Plus library makes it possible to pipeline Sensing → Control → Actuator with a few lines in MicroPython, extending to physical AI creation
- Provide open-source MQTT broker that supports SSL/TLS encryption/authentication, QoS/topic-specific ACL
- Provide Python/MicroPython integrated development environment including real-time log/serial console-firmware transfer-package management
- Configure no-code Android/IOS remote control GUI with Blynk example
- Provide physical AI application example based on PySide6-Vision perception-AI STT

## Software Specifications

### Embedded Runtime Environment for MCU

- MicroPython Version 1.26 or higher
- Supports PIO 0 - 3 (12 state machines)

### Pop plus Library for MCU

- upaho, ublynk, ufilter, utools, Din, Dout, Adc, Pwm, I<sup>2</sup>C, ReplSerial
- Multiple control components (Button, Relay, Servo, Ultrasonic etc)

### Integrated Development Environment for PC

- replx with VSCode
- Real-time log/serial console, firmware transfer, package management work-flow

## Hardware Specifications

### WorkCell Base

<b>Size</b> : 920 x 550 mm
<b>For module layout and cabling</b>
• 5ea DIN Rail Block

### Core

<b>Size</b> : 65 x 85 mm
<b>Dual Core ARM Cortex-M33</b>
• Equipped with DSP, single-precision FPU
• providing a simplified double-precision (F64) calculation coprocessor
<b>Connectivity</b> : Wi-Fi, Bluetooth, UART, USB
<b>Interface</b>
• 26 GPIOs based on lever connector. +5V Tolerant

### Power

<b>Size</b> : 150 x 70 mm
<b>Interface</b>
• +12V DC In
• +12V Lever Connector 4 ea
• +5V Lever Connector 20 ea
• +3.3V Lever Connector 4 ea
• GND Lever Connector 24 ea

### Object Detection Block

<b>Proximity Inductive Sensor</b>
• GPIO interface
• Detects the presence of metallic objects
<b>Color Sensor</b>
• I <sup>2</sup> C Interface
• Red, Green, Blue (RGB), and White Light Sensing with IR Blocking Filter
<b>Motion Sensor</b>
• Asynchronous serial communication
• Detection Distance : 900 cm
• Beam Angle : 100° x 40°
• Eye Safe : Class 1 laser device compliant

### Distance Measurement Block

<b>Ultrasonic Sensor</b>
• GPIO interface
• Effectual angle : <15°
• Ranging distance : 3 - 200 cm
<b>TOF Sensor</b>
• I <sup>2</sup> C Interface
• Emitter : 940 nm invisible Class 1 VCSEL (vertical cavity surface-emitting laser)
• Resolution : 1 mm depth, 4x4 or 8x8 sensor zones
• Ranging distance : 3 - 300 cm

### Positioning Block

<b>9 Axis IMU Sensor</b>
• I <sup>2</sup> C Interface
• 16bit gyroscope, 14bit accelerometer and a full performance geomagnetic
• Outputs : Quaternion, Euler angles, Rotation vector, Linear acceleration, Gravity, Heading

### Identification Block

<b>RFID Reader &amp; Tag</b>
• SPI Interface
• Operation Frequency : 13.56MHz
• Supported card : mifare1 S50, mifare1 S70, mifare UltraLight, mifare Pro, mifare Desfire

### Positioning & Speed Measurement Block

<b>Magnetic Rotary Encoders</b>
• I <sup>2</sup> C Interface
• 360° contact-less angle position sensor
• Angle accuracy 0.05° after system linearization and averaging

### Object Detection & Identification Block

<b>Vision Sensor</b>
• GPIO(Trigger IO), UART, Wi-Fi Interface
• 1080p30 / 720p60 / VGA 90 fps
• 1D(EAN-13 / EAN-8, UPC-A / UPC-E, Code 128, Code 39, Interleaved 2 of 5 (ITF)), 2D(QR Code)
• Color Detection, Object Detection
• CMOS 5M Image Sensor (default)
• CMOS 12M Image Sensor (option)

### Environmental stability Block

<b>Environment Sensor</b>
• I <sup>2</sup> C Interface
• Relative humidity : 0% - 100%, ±0.008%RH
• Temperature : -40°C - +85 °C, 0.01°C
• Pressure : 300hPa - 1100hPa, 0.18PA, highest over-sampling
• Gas : IAQ, bVOC & CO2 equivalents (ppm), Gas scan result (%) & Intensity level

<b>Acoustic Sensor</b>
• GPIO(Trigger IO), UART, Wi-Fi Interface
• MEMS with a range of about 60Hz - 20KHz
• SPL Measurement: Fast (125 ms) / Slow (1 s) / Impulse (35 ms)
• FFT/Spectrum : N=512/1024/2048
• Smoothing : Number Weighted (EMA), Moving Average
• Voice/environmental sound sensing

<b>Dust Sensor</b>
• I <sup>2</sup> C Interface
• Particle size range : 0.3µm~ 10µm
• Resolution : 1 µg/m

<b>Light Sensor</b>
• I <sup>2</sup> C Interface
• range : 1 - 65535 lux

### Actuators for Sensor Test

<b>RGB LEDs</b>
• One wire digital control Interface
• RGB LED 64ea

<b>Text LCD</b>
• I <sup>2</sup> C Interface
• 20 characters x 4 Lines

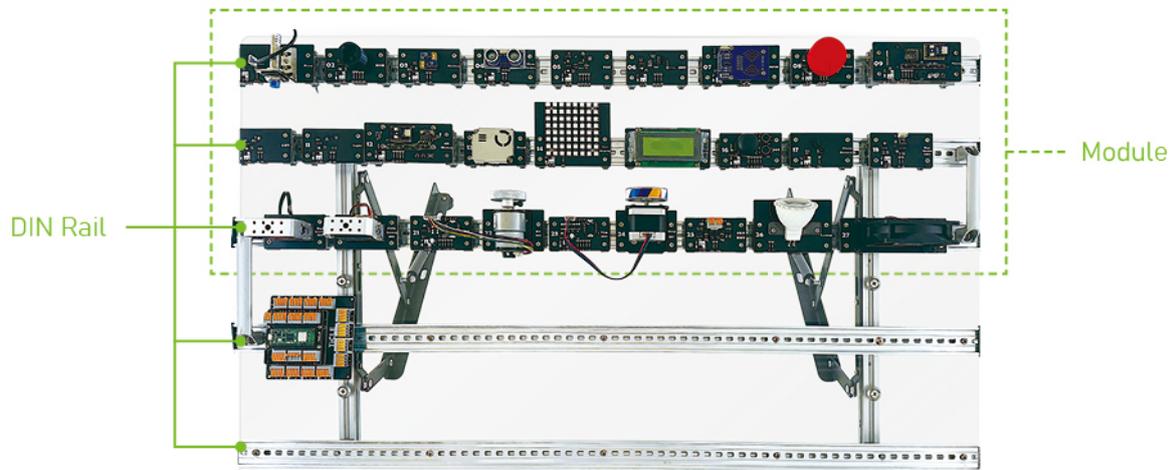
<b>Joystick with Button</b>
• ADC / GPIO Interface
• Joystick X / Y
• Button Switch 2ea

<b>Lamp : 12V DC LED</b>
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<b>Motors</b>
• 5V Serial Bus Servo Motor
• 5V PWM Servo Motor
• 12V DC Motor with encoder
• 12V DC Fan
• 12V Step Motor

<b>Sound : Piezo Buzzer</b>
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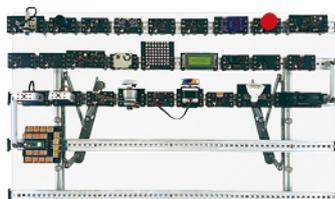
## Layout



## Training Contents

- Digital/Analog IO, Switch/Indicator
- DC Motor + Encoder – Speed Control
- Bus Serial Servo – Position/Gate Operation
- Logistics Identification I
  - Proximity Inductive, Color, PIR
- Distance Sensing – Ultrasonic vs ToF
- Inertial sensing – 9-axis IMU and filtering
- ID tracking – RFID
- Camera-based vision – marker/color tracking
- Environmental sensing – temperature/humidity  
gas/barometric pressure/illumination
- RT/NRT separation and scheduling

## Components



**TICLE-Sensor**



Micro B Type Magnetic  
USB Cable



DC 5V 4A  
Adaptor



Male to Male Jumper  
Cable 1set

\* The above information is subject to change or modification due to product upgrades or other reasons.

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Subject to Change