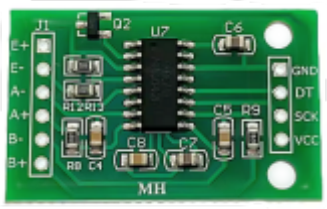
LamaPLC: HX711 24-bit analog-to-digital converter (ADC)

The HX711 is a widely used, low-cost 24-bit analogue-to-digital converter (ADC) integrated circuit with an internal amplifier, specifically designed to interface directly with bridge sensors such as load cells and strain gauges.



It is a popular component for DIY and commercial weighing-scale projects using microcontrollers such as Arduino and Raspberry Pi.

Key Features

- **High Resolution:** It provides 24-bit resolution, enabling precise measurement of small voltage changes.
- **Integrated Amplifier (PGA):** Features an on-chip, low-noise Programmable Gain Amplifier (PGA) with selectable gains of 32, 64, or 128 to amplify very small signals from load cells.
- **Dual Input Channels:** Two selectable differential input channels (Channel A and Channel B). Channel A is programmable to 128 or 64, while Channel B has a fixed gain of 32.
- **Simple Interface:** Uses a simple two-wire serial interface (clock and data lines) that is easy to use with most microcontrollers and does not require complex programming of internal registers.
- **Integrated Components:** Includes an on-chip power supply regulator for the load cell and ADC's analogue supply, an internal oscillator, and a power-on-reset circuit, minimising the need for external components.
- **Selectable Data Rate:** The output data rate can be set to either 10 samples per second (SPS) or 80 SPS.
- **Power Efficiency:** Operates over a wide supply voltage range (2.6V to 5.5V) and has low power consumption, including a power-down mode of less than 1µA.
- **Communication:** The HX711 does not use a standard, named communication protocol such as I²C or SPI. Instead, it uses a custom 2-wire serial interface consisting of a Data line (DT) and a Clock line (SCK).

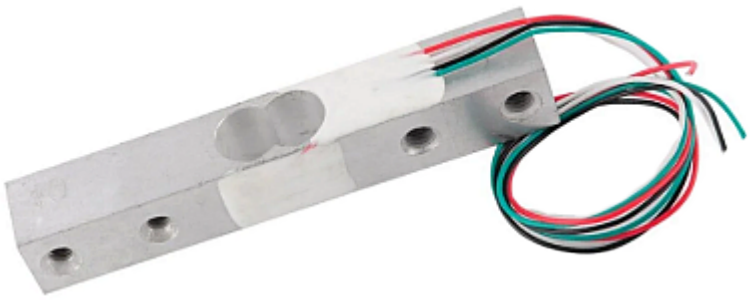
Applications

The primary application of the HX711 is to build precise weight and force measurement systems.

- **Weighing Scales:** Used in commercial and kitchen scales to provide accurate weight readings.
- **Industrial Control:** Integrated into automation systems to monitor and control the weight of objects in manufacturing processes.
- **IoT Projects:** Serves as a sensor node in smart home or environmental monitoring systems (e.g., smart pet feeders, beehive monitoring).

HX711 with a load cell

Using the HX711 with a load cell is a common method for building digital scales or force measurement systems due to its simplicity, low cost, and high precision. The process involves correctly wiring the load cell's four wires to the HX711 board, connecting the board to a microcontroller, using a library, and performing a simple calibration.

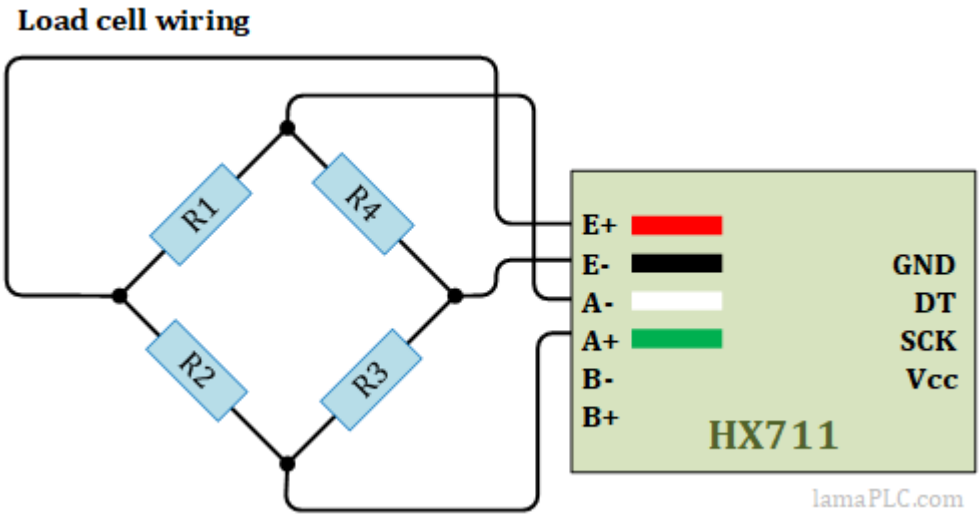


The HX711 is purpose-built to interface with **Wheatstone bridge**s, which are the internal circuits of load cells and strain gauges. It provides the necessary excitation voltage to power the bridge and precisely measures the resulting minute differential voltage changes.

Wiring the Components

A standard four-wire load cell uses a color-coded system to identify the wires for excitation voltage and the output signal.

Load Cell to HX711 Connections



Connect the load cell wires to the corresponding terminals on the HX711 board:

- **Red Wire (E+):** Connect to HX711's E+ terminal (Excitation Positive).
- **Black Wire (E-):** Connect to HX711's E- terminal (Excitation Negative).
- **Green Wire (A+):** Connect to HX711's A+ terminal (Signal Positive).
- **White Wire (A-):** Connect to HX711's A- terminal (Signal Negative).

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HX711 module board pinout

The HX711 module is a 24-bit ADC meant for weight scales, serving as an interface between a load cell (bridge sensor) and a microcontroller. It usually features two pin sets: one for connecting the load cell (input) and another for the microcontroller (output).

Pin Label	Name	Description	Typical Wire Colour
E+	Excitation Positive	Positive supply to the load cell.	Red
E-	Excitation Negative	Ground/Negative supply to the load cell.	Black
A-	Channel A Negative	Negative differential signal input from the load cell.	White
A+	Channel A Positive	Positive differential signal input from the load cell.	Green
B-	Channel B Negative	Secondary input channel (lower priority/gain).	—
B+	Channel B Positive	Secondary input channel (lower priority/gain).	—
Vcc	Supply Voltage	Power supply for the module (**2.7V to 5.5V**).	—
GND	Ground	Common circuit ground.	—
DT / DAT	Data Out	Serial data output to the microcontroller.	—
SCK / CLK	Serial Clock	Clock signal input from the microcontroller.	—

Key Connection Notes

- **Microcontroller Pins:** The DT and SCK pins can be connected to any digital GPIO pins on your Arduino or ESP32; they do not require specific hardware SPI pins.
- **Channel A vs. B:** Channel A is the primary input and supports a gain of 128 or 64. Channel B is for a second load cell and has a fixed gain of 32.
- **Voltage Logic:** If you are using a 3.3V microcontroller (like an ESP32), ensure the module is powered appropriately. While many modules work at 3.3V, some “green” boards require a 5V supply to properly excite the load cell.
- **Drift Prevention:** For the best accuracy, keep the load cell wires short and use a stable power source, as the HX711 is extremely sensitive to voltage fluctuations.

Arduino & HX711

To get started, you'll need the HX711 Arduino Library by bogde, which is the community standard. You can install it directly via the Arduino Library Manager.

Software Setup and Calibration

You will need a library to easily communicate with the HX711 using your microcontroller. The **HX711 library** by Bogdan Necula is a popular, well-maintained option available in the Arduino Library Manager.

- **Upload Calibration Code:** Use example code from the library to get the raw readings. With the load cell unloaded, record the “tare” value.
- **Apply Known Weight:** Place an object of a known weight (e.g., a 100g calibration weight) on the load cell and record the new raw reading.
- **Calculate the Calibration Factor:** The calibration factor is calculated using the formula: *Calibration Factor = (Raw Reading with Weight - Tare) / Known Weight.*
- **Update Code:** Update your main program with this calibration factor using the

scale.set_scale(calibration_factor) function in the library. The scale is now ready to provide accurate weight measurements.

Wiring Diagram

HX711 Pin	Arduino Pin
VCC	5V (or 3.3V)
GND	GND
DT (Data)	D3
SCK (Clock)	D2

Basic Reading & Calibration Code

This script initialises the scale, “tares” it (sets it to zero), and reads the weight.

```
#include "HX711.h"

// Pin definitions
const int LOADCELL_DOUT_PIN = 3;
const int LOADCELL_SCK_PIN = 2;

HX711 scale;

void setup() {
  Serial.begin(57600);
  Serial.println("Initializing the scale...");

  scale.begin(LOADCELL_DOUT_PIN, LOADCELL_SCK_PIN);

  // --- CALIBRATION ---
  // 1. Upload this code with scale.set_scale() empty or set to 1.
  // 2. Put a known weight (e.g. 100g) on the scale.
  // 3. Divide the raw reading by the known weight to find this factor.
  scale.set_scale(2280.f);     // Replace 2280.f with your calculated
calibration factor
  scale.tare();               // Reset the scale to 0

  Serial.println("Scale ready!");
}

void loop() {
  if (scale.is_ready()) {
    long reading = scale.get_units(10); // Average of 10 readings
    Serial.print("Weight: ");
    Serial.print(reading);
    Serial.println(" g");
  } else {
    Serial.println("HX711 not found.");
  }
```

```
  delay(1000);
}
```

Critical Tips

- **The Calibration Factor:** Every load cell is physically different. If your readings are off by a lot, use the Calibration Tutorials to find your specific value.
- **Baud Rate:** Many HX711 examples use 57600 baud. Ensure your Serial Monitor matches the *Serial.begin()* value, or you will see gibberish.
- **Drift:** Cheap load cells drift with temperature. If accuracy degrades over time, consider the ADS1220 we discussed earlier; it includes an internal temperature sensor to help you compensate.

Sensor topics on lamaPLC

Page	Date	Tags
• lamaPLC project: Arduino - OLED SH1106 with AHT20/BMP280 Sensor	2026/04/23 21:51	bmp280, aht20, temperature, humidity, pressure, sensor, arduino, oled, sh1106, arduino code
• lamaPLC project: Arduino - Vibration sensors	2026/04/15 17:21	vibration, sensor, piezoelectric, mems, eddy-current, electrodynamic, gxfm0459, ldtm-028k, arduino, arduino code
• lamaPLC project: Digitales Potentiometer Board Moduls	2026/04/11 18:29	sensor, module, arduino code, renesas, x9c series, x9c102, x9c103, x9c104, x9c503, xdcp, digitally controlled potentiometer
• lamaPLC project: Sension SCD CO² measurement module	2026/04/15 19:34	scd30, scd40, scd41, iaq, ndir, sensor, i2c, arduino code
• lamaPLC: A0221AU / A02YYUW Waterproof Ultrasonic Distance Sensor with UART communication	2026/04/23 21:52	a0221au, a02yyuw, waterproof, ultrasonic, distance, sensor, uart, ip67, serial, sen0311, dfrobot
• LamaPLC: AHT10 Modul	2026/03/22 03:14	communication, i2c, temperature, humidity, sensor, aht, aht 10, modul
• LamaPLC: AHT20 / BMP280 Modul	2026/04/23 21:52	bmp280, aht20, adafruit, temperature, humidity, pressure, sensor, arduino, code, i2c
• LamaPLC: Allegro ACS758 Hall-effect linear current sensors	2026/04/23 21:52	cjmcu, cjmcu-758, acs758, acs758lcb-050b, acs758lcb-100b, acs758kcb-150b, acs758ecb-200b, hall-effect, current, sensor, analog, arduino, code
• LamaPLC: APDS - Avago ALS and proximity detection sensors with I²C communication	2026/04/23 21:52	avago, apds-9900, apds-9930, apds-9960, als, proximity, detection, gesture recognition, gesture, i2c, communication, sensor, arduino, code
• lamaPLC: Arduino Modul: BME680	2026/05/12 18:40	code, c, 2026, arduino, bme680, sensor, i2c, comunication
• lamaPLC: AS5600 Magnetic Induction Angle Measurement Sensor Module	2026/05/13 00:06	communication, i2c, as5600, as-5600, magnetic, induction, angle, sensor

• LamaPLC: BMP/BME Bosch Temperature/Humidity/Pressure sensors with I²C communication	2026/04/23 21:52	bme280, bme680, bme688, bmp180, bmp280, hw-611, hw611, bosch, temperature, humidity, pressure, sensor, arduino, i2c, communication, ai, cjmcu, volatile organic compounds, vocs, volatile sulfur compounds, vscs, iaq
• LamaPLC: BQ25570 / CJMCU-2557 - Texas Instruments nano-power management IC and module	2026/04/23 21:52	bq25570, sensor, texas instruments, nano-power management, dc-dc boost charger, mppt, solar, thermoelectric, piezoelectric, energy harvesting, eh
• LamaPLC: CJMCU-219/INA-219 breakout board/IC with I²C communication	2026/04/23 21:52	cjmcu-219, ina-219, ina219, breakout board, i2c, communication, sensor, voltage, current, arduino, code, cjmcu
• LamaPLC: CJMCU-3216 / AP-3216 integrated digital ambient light and proximity sensor module/IC with I²C communication	2026/04/23 21:52	cjmcu-3216, cjmcu, ap-3216, ap3216, ambient light, proximity, sensor, arduino, code, i2c, communication
• LamaPLC: CJMCU-3901/PMW-3901 compact optical flow sensor module/IC by PixArt with SPI communication	2026/04/23 21:52	cjmcu-3901, cjmcu, pmw3901, pmw-3901, optical flow, sensor, pixart, spi, communication, arduino, code, pmw3901mb-txqt
• LamaPLC: CJMCU-6701: Biosensor for measuring Galvanic Skin Response (GSR) with SPI communication	2026/04/23 21:52	cjmcu, cjmcu-6701, acs758, acs-758, galvanic skin response, gsr, electrodermal activity, eda, spi, communication, arduino, code, sensor, healthcare
• LamaPLC: CJMCU-6814 combined gas sensor module for CO, NO_2, NH_3	2026/04/23 21:52	analog, cjmcu, cjmcu-6814, mics6814, mics-6814, sensor, arduino, code, carbon monoxide, co, ammonia, nh_3, nitrogen dioxide, no_2
• lamaPLC: CJMCU-811 CCS811 Gas Sensor (VOCs TVOC CO2)	2026/04/23 21:52	cjmcu-811, ccs811, gas, sensor, vocs, tvoc, eco2, co2, arduino, air quality metal oxide, mox, i2c, micropython, rp2040-eth
• LamaPLC: CJMCU-8221 Analog Devices Precision instrumentation amplifier module	2026/04/23 21:52	cjmcu-8221, ad8221ar, analog devices, amplifier, sensor, cjmcu
• LamaPLC: D6T Omron Non-Contact Thermal Sensors with I²C communication	2026/04/23 21:52	d6t, d6t-32l, d6t-44l, d6t-8l, d6t-1a, omron, non-contact, thermal, sensor, i2c, arduino, code
• LamaPLC: DHT Temperature /Humidity sensors with 1-wire / I²C communication	2026/04/23 21:52	dht11, dht20, dht22, temperature, humidity, pressure, sensor, 1-wire, arduino, code
• LamaPLC: DPS Infineon Temperature/Pressure sensors with I2C communication	2026/04/23 21:52	dps310, infineon, temperature, pressure, sensor, arduino, i2c, communication, code
• lamaPLC: DS18B20 1-Wire Digital Thermometer	2026/04/23 21:52	ds18b20, sensor, 1-wire, communication, arduino, thermometer, parasitic mode
• lamaPLC: Energy, power, current, and voltage	2025/05/31 23:32	i2c, i c, communication, arduino, energy, power, current, sensor, ina226

• LamaPLC: ENS ScioSense Multi-gas sensors with I²C communication	2026/04/23 21:52	ens160, sciosense, gas-quality, i2c, communication, sensor, arduino, code, eco₂, tvoc, aqi, indoor air quality, iaq, co₂, voc
• lamaPLC: ENS160 + AHT21 Air Quality Sensor - CO, ECO, TVOC, Temp & Humidity Module	2026/04/23 21:52	arduino, ens160, aht21, air quality, sensor, co, eco, tvoc, module, aqi
• LamaPLC: Gas sensors	2023/07/01 17:29	gas, sensor, i2c, onewire, communication, mq-3, mq-4, mq-5, mq-6, mq-7, mq-8, mq-9, mq-135, gm-102b, gm-302b, gm-502b, gm-702b, alcohol, ch4, natural gas, smoke, lng, co, co2, lpg, h2, iso-butane, nox, nh3, benzene, town gas, formaldehyde, propane, humidity, temperature, voc, grv gas sens v2
• LamaPLC: GM MEMS Gas-sensors	2026/04/23 21:52	gm-102b, gm-302b, gm-502b, gm-702b, mems, gas-quality, sensor, arduino, code, nitrogen dioxide, no₂, volatile organic compounds, voc, carbon monoxide, co, ethyl alcohol, c₂h₅ch, formaldehyde, ch₂o, alcohol, c₂h₅oh
• lamaPLC: GY-511 6DOF sensor module	2026/04/23 21:52	stmicroelectronics, lsm303dlhc, i2c, lsm303, sensor, gy-511, 6dof, pololu, module, arduino
• LamaPLC: HC-SR04 Ultrasonic Sensor Module	2026/04/23 21:52	hc-sr04, ultrasonic, sensor, arduino, code
• LamaPLC: HDC Texas Instruments Temperature/humidity sensors with I²C communication	2026/04/23 21:52	sht21, htu21, si7021, gy-21, gy-213v, hdc1080, gy-213v-hdc1080, cjmcu, cjmcu-1080, texas instruments, temperature, humidity, sensor, i2c, communication, arduino, code
• LamaPLC: HTU TE Connectivity temperature/humidity sensors with I²C communication	2026/04/23 21:52	htu, htu31d, htu21d, htu20d, sht20, htu20, sht21, htu21, si7021, gy-21, gy-213v, hdc1080, si702, gy-20, sht31, htu31, si7031, gy-31, te connectivity, temperature, humidity, i2c, communication, sensor, arduino, code
• LamaPLC: HX711 24-bit analog-to-digital converter (ADC)	2026/04/11 18:28	hx711, hx-711, analog-to-digital, adc, converter, load cell, wheatstone bridge, weight, sensor, communication, arduino, code
• lamaPLC: INA modules with Arduino libraries	2026/04/23 21:52	i2c, i c, communication, arduino, energy, power, current, monitor, sensor, ina219, gy-219, ina226, gy-216, ina228, gy-228, ina237, ina238, ina260, ina3221, ina
• lamaPLC: INA226 - current/voltage/power monitor with I²C communication	2026/04/23 21:52	i2c, i c, communication, arduino, energy, power, current, monitor, sensor, ina226, ina219, ina
• lamaPLC: LTC3588 - Nanopower energy harvesting power supply IC	2026/04/23 21:52	communication, arduino, sensor, energy harvesting, eh, energy, ambient power

• LamaPLC: M01 - V0.4 Laser ranging sensor with UART communication	2026/04/23 21:52	distance measurement, laser, distance, sensor, m01
• LamaPLC: MAX30100/MAX30102 Heart Rate Click Sensor Module	2026/04/23 21:52	max30102, max30100, heart rate click, sensor, communication, i2c, arduino, code
• lamaPLC: Max31865 RTD to Digital Converter - PT100/PT1000 Platine	2026/04/23 21:52	max31865, rtd, pt 100, pt 1000, temperature, spi, platinum, arduino, code, sensor, adafruit
• LamaPLC: MAX4466/MAX9814: Low-noise Microphone Preamplifiers	2026/04/23 21:52	audio, microphone, analogue audio, max4466, max9814, max 4466, max 9814, agc, preamplifiers, sensor, arduino, code
• LamaPLC: MH-Z19 series of NDIR CO_2 sensors	2026/04/23 21:52	mh-z19, mh-z19d, mh-z19c, mh-z19b, mh-z19e, ndir, co_2, sensor, winsen, uart, pwm, communication, non-dispersive infrared, infrared, ir, temperature, arduino, code, tasmota
• lamaPLC: MPU-6050 (HW-123, GY-521) 6-axis MotionTracking device	2026/04/23 21:52	mpu-6050, hw-123, gy-521, 6-axis motiontracking, dmp, temperature, sensor, mems, arduino code, arduino, accelerometer, gyroscope, tilt
• LamaPLC: MQ Winsen Gas-sensors	2026/04/23 21:52	mq, mq-2, mq-3, mq-4, mq-5, mq-6, mq-7, mq-8, mq-9, mq-131, mq-135, mq-137, winsen, gas-sensor, sensor, arduino, code, alcohol, c_2h_5oh, benzine gas, smoke, lpg, propane, c_3h_8, hydrogen, h_2, methane, ch_4, iso-butane, town gas, ammonia, nh_3
• LamaPLC: PIR sensors	2026/04/23 21:52	hc-sr501, hc-sr505, am-312, ekmb ekmc, pir, motion, sensor, arduino, code
• LamaPLC: Pixart PAJ7620U2 Gesture recognition sensors/module with I^2C communication	2026/04/23 21:52	paj7620u2, gy-paj7620, pixart, gesture recognition, i2c, communication, sensor, arduino, code
• lamaPLC: PT100 / PT1000	2025/09/23 18:59	pt100, pt1000, temperature, sensor, platine, rtd
• lamaPLC: PTA8C04 4-channel PT100 Modbus Modul	2026/02/14 18:42	pta8c04, sensor, modbus, rtu, rs-485, communication, platine, um72
• LamaPLC: RCWL - Microwave radar sensor	2026/04/23 21:52	rcwl-0516, rcwl, microwave, radar, sensor, arduino, code
• lamaPLC: RD-xx - Ai-Thinker Radar Module with UART communication	2026/04/23 21:52	radar, s3km1110, fmcw, rd-01, rd-03, rd-03d, ai-thinker, k-band, 24 ghz, sensor, distance, micro-movements
• lamaPLC: RP2040_ETH_Modul: Read BME 680/688 sensor data	2026/05/12 21:06	code, micropython, 2026, rp2040 eth, bme680, i2c, sensor, communication
• lamaPLC: RP2040_ETH_Modul: Read BME 680/688 sensor data and store in Modbus input registers	2026/05/12 18:58	code, micropython, 2026, rp2040 eth, bme680, i2c, sensor, communication
• LamaPLC: Sensors	2026/04/15 19:42	sensor

• LamaPLC: SGP Sensirion TVOC/VOC sensors with I²C communication	2026/04/15 19:41	sgp30, sgp40, sgp41, sensirion, gas-sensor, i2c, communication, sensor, arduino, code, eco₂, voc, tvoc, indoor air quality, iaq, nox, hydrogen
• LamaPLC: SHT Sensirion Temperature/humidity sensor with I²C communication	2026/04/23 21:52	sht20, sht21, sht25, sht30, sht31, sht35, sht40, gy21, temperature, humidity, i2c, communication, sensor, arduino, code
• LamaPLC: Texas Instruments ADCs: Delta-sigma multi-channel Analog Converters with SPI communication	2026/04/23 21:52	ads111x, ads12xx, delta-sigma, converter, texas instruments, adc, spi, communication, sensor, arduino, code, ads1110, ads1112, ads1113, ads1114, ads1115, ads1118, ads1119, ads1220, ads1232, ads1234, ads1256, ads1261, ads1263, multi channel
• LamaPLC: TOFnnnC STMicroelectronics Time-of-Flight (ToF) sensors with I²C communication	2026/04/23 21:52	tof050c, vl6180, tof200c, vl53l0x, tof400c, vl53l1x, stmicroelectronics, time-of-flight, tof, i2c, communication, sensor, arduino, code
• LamaPLC: UICPAL Temp.humi.sensor	2023/06/25 00:43	simatic, s7, modbus, communication, temperature, humidity, sensor
• LamaPLC: VL53Lnn STMicroelectronics time-of-flight (ToF) laser-ranging sensors with I²C communication	2026/04/23 21:52	vl53l0x, vl53l1x, vl53l0 1xv2, gy-530, time-of-flight, tof, laser-ranging, i2c, communication, sensor, arduino, code
• LamaPLC: VL6180X STMicroelectronics Time-of-Flight (ToF) sensor with I²C communication	2026/04/23 21:52	vl6180x, stmicroelectronics, time-of-flight, tof, i2c, communication, sensor, arduino, code
• LamaPLC: Waveshare TOF Laser Range Sensor with UART / I²C communication	2026/04/23 21:52	distance measurement, laser, range, sensor, tof, waveshare
• lamaPLC: XGZP68xx: Silicon Pressure Sensors/Module	2026/05/15 15:17	communication, i2c, sensor, modul, pressure, cfsensor, xgzp68xx, xgzp6810d, xgzp6857d, xgzp6859d, xgzp6887d, xgzp6897d, xgzp6899a, piezoresistive, capacitive
• lamaPLC: YR-3180 - Weight sensor module with UART or Modbus communication	2026/02/15 00:00	communication, modbus, rtu, sensor, weight, yr-3180, hx710b, arduino, ttl, rs-485
• LM393: Dual differential comparator (flame, light, sound sensors)	2026/05/12 22:18	communication, analog, lm393, lm-393, flame, ir, sound, hall, sensor, ky-026, hw-484, ky-037, ky-038, fc-03, hc-89, ky-024, modul
• Magnetic angle sensors	2026/04/23 21:52	magnetic angle sensor, magnetic flux, sensor, spi, i2c, pwm, communication, modul, as5047p, as5600, mt6701, mt6816, mt6835, tle5012b, amr, gmr, tmr, anisotropic magnetoresistive
• NT18B07: 7 Kanal RS485 Temperatur Sensor with Modbus RTU	2026/02/14 18:49	nt18b07, sensor, modbus, rtu, rs-485, communication, platine
• PT100 / PT1000 sensors	2026/04/23 21:52	rtd, pt100, pt1000, sensor, temperature

• Radar Module RD-xx	2026/04/23 21:52	radar, s3km1110, fmcw, rd-03, k-band, 24 ghz, sensor, distance, micro-movements

HX711, HX-711, analog-to-digital, ADC, converter, load cell, Wheatstone bridge, weight, sensor, communication, arduino, code

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