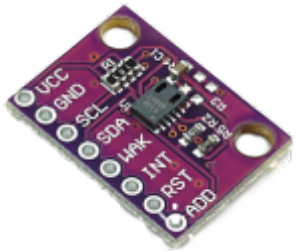
lamaPLC: CJMCU-811 CCS811 Gas Sensor (VOCs TVOC CO2)

The CJMCU-811 is a small, ultra-low-power digital gas sensor module designed to monitor indoor air quality. It is built around the CCS811 sensor from AMS, which uses a metal oxide (MOX) multi-gas sensor to detect a broad range of Volatile Organic Compounds (VOCs).



- This type of digital sensor is used to measure changes in volatile organic compounds, especially carbon dioxide (CO^2). The module features a CJMCU-811 CCS811 CO^2 Air Quality Metal Oxide Gas Sensor.
- The sensor is known for its low power consumption, making it suitable for use in battery-powered devices.
- This device is primarily used to monitor indoor air quality and can be read by microcontrollers through the I^2C interface.
- Because of its complex design, the module is highly sensitive and can accurately measure the share of eCO^2.

- **ETVOC** measurement range: 0 ~ 32768 ppb
- **ECO2** measurement range: 400 ~ 32768 ppm

Key Capabilities

The sensor measures atmospheric conditions and outputs digitized values via an I^2C interface:

- **eCO^2 (Equivalent CO^2):** Calculates carbon dioxide levels based on volatile organic compounds, usually ranging from 400 to 8,192 ppm.
- **TVOC (Total Volatile Organic Compounds):** Detects a wide array of gases, including alcohols, aldehydes, ketones, organic acids, and amines.
- **On-board Processing:** Incorporates an integrated 8-bit microcontroller that runs intelligent algorithms to turn raw sensor data into air quality readings, decreasing the processing load on your main controller.

eCO2 (Equivalent Carbon Dioxide) Levels

The CCS811 does not measure actual CO_2. Instead, it estimates it based on hydrogen gas levels. This ppm (parts per million) value accurately reflects how stuffy or occupied a room is.

eCO2 Value (ppm)	Air Quality	Meaning & Recommended Action
400 – 600	♦ Excellent	Clean outdoor air level. Ideal baseline.
600 – 1000	♦ Good	Standard indoor level. Safe with no health effects.
1000 – 1500	♦ Fair	Stale air. May cause slight drowsiness. Open a window.
1500 – 2000	♦ Poor	Headaches and fatigue can start. Ventilation required.
2000 – 5000	X Severe	Heavy lethargy, loss of focus. Immediate fresh air is needed.

TVOC (Total Volatile Organic Compounds) Levels

TVOC measures airborne chemicals, gases, and toxins (e.g., from cleaning sprays, perfumes, paints, adhesives, or new furniture) in ppb (parts per billion).

TVOC Value (ppm)	Air Quality	Potential Effects & Actions
0 – 50	♦ Excellent	Clean, chemical-free air.
50 – 220	♦ Good	Normal indoor environment. Low risk of irritation.
220 – 660	♦ Moderate	Sensitive individuals may feel eye or throat irritation.
660 – 2200	♦ Poor	Headaches, nausea, or chemical odors. Locate source and ventilate.
Over 2200	X Unhealthy	Intense irritation and discomfort. Toxic for long-term exposure.

Technical Specifications

Feature	Details
Operating Voltage	1.8V to **3.3V** DC (Note: *Some modules include a regulator for 5V compatibility*)
Power Consumption	~30mA average; extremely low power in idle modes (< 6µW)
Interface	I2C (standard address is often 0x5A or 0x5B)
Dimensions	Roughly 15mm x 21mm
Environment	Operating temperature from -40°C to 125°C

Usage Considerations

- **“Equivalent” Readings:** It's important to understand that this isn't a genuine CO2 sensor. Instead, it estimates eCO2 levels from VOC concentrations, which can sometimes lead to inaccuracies compared to industrial-grade NDIR (non-dispersive infrared) sensors.
- **Burn-in & Run-in:** New sensors need a 48-hour burn-in period to achieve stability. Moreover, after turning on the device, the sensor typically requires about 20 minutes of run-in time to produce accurate readings.
- **Baseline Calibration:** The sensor automatically adjusts its *“clean air”* baseline gradually. However, for optimal performance, it should regularly be exposed to fresh outdoor air.

Pin Descriptions

The CJMCU-811 (featuring the CCS811 sensor) is typically an 8-pin breakout board. For basic operation, you must connect VCC, GND, SDA, SCL, and WAKE.

Pin Name	Function	
VCC	Power Supply	**1.8V to 3.6V** (*Some boards include a 5V regulator*).
GND	Ground	Common ground for power and logic.
SCL	I²C Clock	Serial clock line for communication.
SDA	I²C Data	Serial data line for communication.
WAKE	Wake (Active Low)	Crucial: Must be pulled to GND to enable I²C communication.
INT	Interrupt (Active Low)	Optional; indicates when new data is ready, or thresholds are crossed.
RST	Reset (Active Low)	Optional; pulling this low resets the sensor.

Pin Name	Function	
ADDR	I²C Address Select	Connect to GND for 0x5A (default) or VCC for 0x5B.

Connection Tips

- **WAKE Pin:** On many CJMCU-811 modules, the sensor will not respond to I2C commands if the WAKE pin is left floating. Connect it directly to a GND pin for continuous operation.
- **Voltage Logic:** While the sensor chip runs at 3.3V, many breakout boards, such as those from Adafruit or standard CJMCU versions, include level shifters, making them safe for use with 5V microcontrollers like the Arduino Uno.
- **I²C Speed:** If using a Raspberry Pi, you may need to lower the I²C baud rate to 10kHz because the Pi's hardware sometimes struggles with the *"clock stretching"* required by the CCS811.

Arduino example code

To use the CJMCU-811 with an Arduino, the most common approach is to use the **Adafruit CCS811** Library.

Arduino Wiring

Connect your CJMCU-811 breakout to the Arduino as follows:

- **VCC → 3.3V** (or 5V if your board has a regulator)
- **GND → GND**
- **SDA → A4** (on Uno/Nano) or Pin 20 (Mega)
- **SCL → A5** (on Uno/Nano) or Pin 21 (Mega)
- **WAKE → GND** (Required to keep the sensor active)

This basic sketch initializes the sensor and prints eCO2 and TVOC levels to the Serial Monitor.

```
#include "Adafruit_CCS811.h"

Adafruit_CCS811 ccs;

void setup() {
  Serial.begin(115200); // Set Serial Monitor to 115200 baud
  Serial.println("CCS811 test");

  // Initialize the sensor
  if(!ccs.begin()){
    Serial.println("Failed to start sensor! Check wiring and WAKE pin.");
    while(1);
  }

  // Wait for the sensor to be ready
  while(!ccs.available());
}

void loop() {
  if(ccs.available()){
```

```
    // readData returns false if there is no error
    if(!ccs.readData()){
      Serial.print("CO2: ");
      Serial.print(ccs.geteCO2());
      Serial.print("ppm, TVOC: ");
      Serial.print(ccs.getTVOC());
      Serial.println("ppb");
    } else {
      Serial.println("ERROR reading sensor!");
      while(1);
    }
  }
  delay(1000); // Wait 1 second between readings
}
```

Common Troubleshooting

- **I²C Address:** If the code fails to start, your board might use address 0x5B instead of the default 0x5A. You can try *ccs.begin(0x5B)*; in the setup.
- **Serial Monitor Speed:** Ensure the baud rate in your Serial Monitor matches *Serial.begin(115200)*;.
- **Accuracy:** Remember that this sensor requires a 20-minute warm-up for stable readings and a 48-hour burn-in period when first used.

RP2040-ETH Micropython example code

I²C settings: i2c = I2C(0, sda=Pin(4), scl=Pin(5), freq=100000)

```
from machine import UART, Pin, I2C
import machine
import time

# I2C konfiguráció az RP2040-ETH szabadon használható pinjein
# Gyári alapértelmezett I2C cím a CCS811-nél: 0x5A (ha az ADDR pin GND-n van)
CCS811_ADDR = 0x5A

# Regiszter címek a CCS811 adatlap szerint
REG_STATUS = 0x00
REG_MEAS_MODE = 0x01
REG_ALG_DATA = 0x02
REG_HW_ID = 0x20
REG_APP_START = 0xF4
REG_SW_RESET = 0xFF

# I2C busz inicializálása
i2c = I2C(0, sda=Pin(4), scl=Pin(5), freq=100000)
```

```
def init_ccs811():
    print("CCS811 inicializálása...")

    # 1. Eszköz keresése az I2C buszon
    devices = i2c.scan()
    if CCS811_ADDR not in devices:
        raise RuntimeError("A CCS811 szenzor nem található! Ellenőrizd a
WAKE -> GND bekötést.")

    # 2. Hardver ID ellenőrzése (kötelezően 0x81)
    hw_id = i2c.readfrom_mem(CCS811_ADDR, REG_HW_ID, 1)[0]
    if hw_id != 0x81:
        raise RuntimeError(f"Hibás Hardver ID: {hex(hw_id)} (0x81 helyett)")

    # 3. Szoftveres indítás (Átváltás Bootloaderből Alkalmazás módba)
    # Üres adatot kell írni az APP_START regiszterbe
    i2c.writeto_mem(CCS811_ADDR, REG_APP_START, b'')
    time.sleep_ms(100)

    # 4. Mérési mód beállítása (Mód 1: Mérés másodpercenként egyszer)
    # A 0x10 érték beírja az 1-es módot (Drive Mode 1) és letiltja az
megszakításokat
    i2c.writeto_mem(CCS811_ADDR, REG_MEAS_MODE, b'\x10')
    time.sleep_ms(100)
    print("Szenzor sikeresen elindítva Mód 1-ben (1 mp mintavétel).")

def read_air_quality():
    # Állapotregiszter ellenőrzése
    status = i2c.readfrom_mem(CCS811_ADDR, REG_STATUS, 1)[0]

    # A 3-as bit (0x08) jelzi, ha van új adat (DATA_READY)
    if status & 0x08:
        # Az ALG_DATA regiszterből 4 byte-ot olvasunk be:
        # Byte 0-1: eCO2 (ppm)
        # Byte 2-3: TVOC (ppb)
        data = i2c.readfrom_mem(CCS811_ADDR, REG_ALG_DATA, 4)

        eco2 = (data[0] << 8) | data[1]
        tvoc = (data[2] << 8) | data[3]

        return eco2, tvoc
    return None, None

# Főprogram futtatása
try:
    init_ccs811()
    print("Mérés indítása... (Az első értékek beállásához idő kell)\n")

    while True:
        eco2, tvoc = read_air_quality()
```

```
        if eco2 is not None:
            print(f"[{time.ticks_ms() // 1000}s] eCO2: {eco2} ppm | TVOC:
{tvoc} ppb")
        else:
            # Ha még nem frissült az adatregiszter, várunk
            pass

        time.sleep(1)

except Exception as e:
    print(f"Hiba történt: {e}")
```

Output

```
[2788s] eCO2: 717 ppm | TVOC: 48 ppb
[2789s] eCO2: 665 ppm | TVOC: 40 ppb
[2790s] eCO2: 634 ppm | TVOC: 35 ppb
[2791s] eCO2: 634 ppm | TVOC: 35 ppb
[2792s] eCO2: 634 ppm | TVOC: 35 ppb
[2793s] eCO2: 641 ppm | TVOC: 36 ppb
[2794s] eCO2: 641 ppm | TVOC: 36 ppb
[2795s] eCO2: 657 ppm | TVOC: 39 ppb
[2796s] eCO2: 649 ppm | TVOC: 37 ppb
[2797s] eCO2: 649 ppm | TVOC: 37 ppb
```

I²C topics on lamaPLC

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• lamaPLC Communication: 1-Wire	2026/04/23 21:51	1-wire, communication, bus, microlan, i2c, uart, usart, ds18b20
• lamaPLC Communication: I²C	2025/09/23 21:25	i2c, i c, smbus, philips, bus, communication, arduino
• lamaPLC project: Sension SCD CO² measurement module	2026/04/15 19:34	scd30, scd40, scd41, iaq, ndir, sensor, i2c, arduino code
• 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: 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: Bi-Directional Logic Level Converter 3.3V ↔ 5V	2026/04/12 00:34	bi-directional, logic level converter, i2c, uart, spi
• 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: 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-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: 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: DPS Infineon Temperature/Pressure sensors with I2C communication	2026/04/23 21:52	dps310, infineon, temperature, pressure, sensor, arduino, i2c, communication, code
• 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: ESP32 / ESP8266	2025/11/22 00:07	esp8266, esp32, esp32-c2, esp32-c3, esp32-c5, esp32-c6, esp32-c61, esp32-h2, esp32-s2, esp32-s3, esp32-p4, espressif systems, communication, ethernet, ip, wi-fi, thread, zigbee, matter, homekit, bluetooth, mqtt, adc, spi, uart, i2c, i2s, rmt, pwm, usb, usb otg, twai
• 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: GY-511 6DOF sensor module	2026/04/23 21:52	stmicroelectronics, lsm303dlhc, i2c, lsm303, sensor, gy-511, 6dof, pololu, module, arduino

• LamaPLC: GY-9250 MPU-9250/6500 9-axis Attitude Sensor Board	2026/04/23 21:52	ak8963, gy-9250, mpu-9250, 9-axis, motion detection, magnetometer, communication, i c, i2c, spi
• 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
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• 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: 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: LCD 1602/2004 with I²C communication	2026/02/14 18:27	communication, i2c, display, lcd, 1602, 2004, hd44780, pcf8574, pcf8574t, pcf8574at, arduino
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• lamaPLC: MCP23017 / MCP23S17 16-Bit I/O Expander with Serial Interface I²C / SPI	2026/04/23 21:52	communication, i2c, mcp23017, mcp23s17, spi, i o expander, serial, cjmcu-2317, cjmcu
• lamaPLC: MLX90614 (GY-906) infrared non-contact thermometer	2026/05/08 00:03	communication, i2c, temperature, mlx90614, gy-906, modul, infrared, non-contact thermometer, dsp, pwm, smbus, hailege
• lamaPLC: PCF857x I/O Expander chip/modul with I²C communication	2026/05/15 01:03	communication, i2c, pcf857x, pcf8574, pcf8574a, pcf8575, i o expander, i o extension, nxp, texas instruments
• LamaPLC: Pixart PAJ7620U2 Gesture recognition sensors/module with I²C communication	2026/04/23 21:52	paj7620u2, gy-paj7620, pixart, gesture recognition, i2c, communication, sensor, arduino, code
• lamaPLC: RP2040_ETH_Modul: I²C scanner	2026/05/12 16:20	code, micropython, 2026, rp2040 eth, i2c, comunication
• lamaPLC: RP2040_ETH_Modul: MLX90614 simple	2026/05/12 17:06	code, micropython, 2026, rp2040 eth, i2c, communication, mlx90614
• 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: SC16IS750 / SC16IS752: One or two serial (UART) ports from microcontroller via I²C or SPI communication	2026/04/23 21:52	cjmcu-750, cjmcu-752, cjmcu, nxp, sc16is750, sc16is752, uart, serial, i2c, spi, modul, converter, arduino, code
• 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: Signal level converters	2026/02/14 23:47	pca9306, i2c, voltage, level, converter
• lamaPLC: st756x display drivers	2026/05/20 16:17	display, driver, i2c, spi, lcd, cog, oled, st7565, st7567, gm12864, gm12864-59n, gm12864-03a, gm12864-01a, gme12864-41
• lamaPLC: TCA9548A (HW617); Low-Voltage 8-Channel I²C Switch Module	2026/02/14 23:51	tca9548a, hw617, i2c, switch, communication, expansion board, arduino
• lamaPLC: TM1637 7-segment display	2026/02/14 18:26	i2c, 7-segment display, display, tm1637, arduino
• 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: 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: 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
• 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
• SSH1106/SSD1306 OLED Display with I²C communication	2026/02/14 18:27	i2c, oled, display, ssd1306, sh1106, ssh1106, arduino, cmos

CJMCU-811, CCS811, Gas, Sensor, VOCs, TVOC, eCO2, CO2, Arduino, Air Quality Metal Oxide, MOX, I2C, micropython, RP2040-ETH

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