LAMPIRAN

Lampiran 1. Program Arduino

```
#include <WiFi.h>  // Library wifi esp32
#include <Wire.h>
#include <DFRobot_SHT20.h> // Library sensor SHT20
#include <ESP32-HUB75-MatrixPanel-I2S-DMA.h> // Library PAnel P5
#include "time.h"
#include <Firebase_ESP_Client.h>
#include "addons/RTDBHelper.h"
#include "addons/TokenHelper.h"

// --- WiFi ---
const char* ssid = "xxxx";
const char* password = "xxxx";

#define API_KEY "AIzaSyAXQ5KprTtoQrYof_7CL8A5sY6_lgB78zQ"
#define DATABASE_URL "fir-iot-12265-default-rtdb.firebaseio.com"

FirebaseData fbdo;
FirebaseAuth auth;
FirebaseConfig config;

// --- NTP Server dan Timezone ---
const char* ntpServer = "pool.ntp.org";
const long gmtOffset_sec = 25200; // GMT+7 untuk Jakarta,
Indonesia (7 * 3600 detik)
const int daylightOffset_sec = 0; // Tidak ada daylight saving

// --- Sensor Suhu & Kelembaban ---
DFRobot_SHT20 sht20(&Wire, SHT20_I2C_ADDR);

// --- MQ7 ---
#define MQ7_SENSOR_PIN 33    // Konfigurai pin analog MQ-7
#define  MQ7_PWM_PIN 32      // pin PWM untuk memanaskan MQ-7
const int MQ7_PWM_CHANNEL = 0;    // Channel PWM yang digunakan
untuk MQ-7
const int MQ7_PWM_FREQ = 5000;    // Frequensi PWM
const int MQ7_PWM_RES = 8;        // Resolusi PWM (8 bit = 0-255)
const int MQ7_HIGH_DUTY = 255;    // Nilai PWM untuk high phase
const int MQ7_LOW_DUTY = 72;      // Nilai PWM untuk low phase
const float MQ7_RL = 10.0;        // Nilai res. beban (khm)
const float MQ7_VCC = 5.0;        // Teg. referensi MQ-7 (karena
sensor bekerja di 5V)
const float MQ7_Ro = 22.61;       // Nilai RO hasil kalibrasi
const float MQ7_a = -0.45;      // Kemiringan kurva logaritmik
pada kadar CO
const float MQ7_b = 0.9;       // Intersep kurva logarirmik pada
kadar CO
const unsigned long MQ7_PREHEAT_TIME = 120000;  // Durasi
pemanasan awal 2 menit
const unsigned long MQ7_HIGH_TIME = 60000;      // Durasi siklus
highphase 1 mneit
const unsigned long MQ7_LOW_TIME = 60000;       // Durasi siklus
lowphase 1 menit
const int MQ7_SAMPLES = 10;             // rata" sampling
```

```
unsigned long mq7_previousMillis = 0;   // Variabel untuk
menyimpan waktu sebelumnya
bool mq7_isHighPhase = true;            // Siklus pemanasan tinggi
bool mq7_isPreheating = true;           // Siklus pemanasan awal
float mq7_last_ppm = 0;                 // membaca data hasil
terakhir

// --- MQ135 ---
#define MQ135_PIN 34              // Konfigurasi pin analog MQ-135
#define MQ135_RL 10000.0          // Nilai res. beban
#define VREF 3.3                  // Teg. referensi ADC esp32
#define ADC_RES 4095.0            // Resolusi ADC esp32 12-bit (0-
4095)
float MQ135_Ro = 157.77;          // Nilai RO pada kalibrasi
const float MQ135_a = 2010.2743;  // Nilai regresi dari kurva
datasheet pada kadar CO2
const float MQ135_b = -1.139187;  // Nilai regresi dari kurva
datasheet pada kadar CO2
float mq135_last_ppm = 0;         // Variabel untuk hasil ppm dari
MQ-135
#define MQ135_PREHEAT_TIME 60000  // Durasi pemanasan awal 1 menit
bool mq135_ready = false;         //
unsigned long mq135_start_time = 0; //

// --- MQ2 ---
#define MQ2_PIN 35                          // Konfigurasi pin
analog MQ-2
#define MQ2_RL 10000.0                      // Res. beban pada MQ-
2
const float MQ2_R0_CALIBRATED = 124475.73;  // Nilai RO dari
kalibrasi
const float MQ2_lpgSlope = -0.50;           // Nilai default slope
dari kalibrasi
const float MQ2_lpgIntercept = 1.45;        // Nilai default
intercept dari kalibrasi
float mq2_last_ppm = 0;                     // Variabel untuk
hasil ppm dari MQ-2
#define MQ2_PREHEAT_TIME 60000              // Durasi pemanasan
awal 1 menit
bool mq2_preheating = true;
unsigned long mq2_start_time = 0;

//tombol ganti wifi/tanpa wifi
#define tombol  25                                  // Pin input
saklar (pakai 3.3V jangan 5V)
// --- Relay ---
#define RELAY_PIN 23      // Konfigurasi pin relay

// --- LED Matrix Panel ---
#define R1_PIN 19     // Merah baris atas
#define G1_PIN 13     // Hijau baris atas
#define B1_PIN 18     // Biru baris atas
#define R2_PIN 5      // Merah baris bawah
#define G2_PIN 12     // Hijau baris bawah
#define B2_PIN 17     // Biru baris bawah
#define A_PIN 16      // Alamat bit baris 0
```

```
#define B_PIN 14      // Alamat bit baris 1
#define C_PIN 4       // Alamat bit baris 2
#define D_PIN 27      // Alamat bit baris 3
#define E_PIN -1      // Alamat bit baris 4, untuk panel tertentu,
jika tidak dipakai diisi -1
#define LAT_PIN 26    // Latch
#define OE_PIN 15     // Output Enable
#define CLK_PIN 2     // Clock
#define PANEL_RES_X 64  // Resolusi panel X
#define PANEL_RES_Y 32  // Resolusi panel Y
#define PANEL_CHAIN 2   // Jumlah panel yang dirangkai

unsigned long lastGoogleSend = 0;                //
const unsigned long googleSendInterval = 60000;

MatrixPanel_I2S_DMA *dma_display = nullptr;     // Pointer objek
panel LED
unsigned long lastSwitch = 0;                    // Waktu terakhir
ganti tampilan
bool ganti = true;                               // Status tampilan
berganti
const int switchInterval = 10000;                // interval
pergantian tampilan 10 detik
int xrelay;
int relay;

int displayMode = 0; // 0: data sensor, 1: tulisan, 2: jam

// --- Fungsi untuk tampilan di panel LED ---
void tulisan() {
  dma_display->setTextColor(dma_display->color565(255, 255,
0));  // Set Warna kuning
  dma_display->setCursor(10, 1);                 // set koordinat
  dma_display->print("TEKNIK ELEKTRONIKA");     // Menampilkan
Teks
  dma_display->setCursor(2, 8);
  dma_display->print("----------------------");  // Menampilkan
garis pemisah
  dma_display->setCursor(34, 14);
  dma_display->print("UNIVERSITAS");
  dma_display->setCursor(28, 23);
  dma_display->print("HARKAT NEGERI");
}

// --- Fungsi untuk menampilkan jam di panel LED ---
void displayClock() {
  struct tm timeinfo;
  if (!getLocalTime(&timeinfo)) {
    Serial.println("Gagal mendapatkan waktu");
    return;
  }

  // Format waktu menjadi string "HH:MM:SS"
  char timeStr[9];
  strftime(timeStr, sizeof(timeStr), "%H:%M:%S", &timeinfo);
```

```
  dma_display->fillScreen(0);
  dma_display->setTextSize(1);
  dma_display->setTextColor(dma_display->color565(255, 255, 0));
// Warna kuning
  dma_display->setCursor(35, 1); // Atur posisi tampilan tengah
  dma_display->print("PEMANTAUAN"); // Tampilkan NAMA ALAT
  dma_display->setCursor(23, 10);
  dma_display->print("KUALITAS UDARA"); // Tampilkan NAMA ALAT
  dma_display->setCursor(2, 17);
  dma_display->print("---------------------");
  dma_display->setCursor(37, 23);
  dma_display->print(timeStr);

}

// --- Fungsi untuk membaca semua sensor ---
void datautama(){
  unsigned long now = millis();

  float temp = sht20.readTemperature();
  float hum = sht20.readHumidity();

  if (!mq135_ready && now - mq135_start_time >=
MQ135_PREHEAT_TIME) {
    MQ135_Ro = getMQ135Resistance() / 2.29;
    mq135_ready = true;
    Serial.println("Kalibrasi MQ135 selesai.");
  }

  if (mq7_isPreheating && now - mq7_previousMillis >=
MQ7_PREHEAT_TIME) {
    mq7_isPreheating = false;
    mq7_previousMillis = now;
    ledcWrite(MQ7_PWM_CHANNEL, MQ7_HIGH_DUTY);
  }

  if (!mq7_isPreheating) {
    if (mq7_isHighPhase && now - mq7_previousMillis >=
MQ7_HIGH_TIME) {
      mq7_isHighPhase = false; mq7_previousMillis = now;
      ledcWrite(MQ7_PWM_CHANNEL, MQ7_LOW_DUTY);
    } else if (!mq7_isHighPhase && now - mq7_previousMillis >=
MQ7_LOW_TIME) {
      mq7_isHighPhase = true; mq7_previousMillis = now;
      ledcWrite(MQ7_PWM_CHANNEL, MQ7_HIGH_DUTY);
    }
    if (!mq7_isHighPhase) bacaMQ7();
  }

  if (mq135_ready && mq7_isHighPhase) bacaMQ135();

  if (now - mq2_start_time >= MQ2_PREHEAT_TIME) {
    if (mq2_preheating) {
      Serial.println("MQ2 preheat selesai.");
      mq2_preheating = false;
    }
```

```
    bacaMQ2();
  } else {
    Serial.println("MQ2 sedang preheat...");
  }

  Serial.printf("CO: %.2f ppm | CO2: %.2f ppm | LPG: %.2f ppm\n",
mq7_last_ppm, mq135_last_ppm, mq2_last_ppm);
  Serial.printf("Temp: %.2f C | Humidity: %.2f %%\n", temp, hum);

if (Firebase.ready()) {
    if (Firebase.RTDB.setFloat(&fbdo, "PPM/HK", mq2_last_ppm)) {
      Serial.print("HK: ");
      Serial.println(mq2_last_ppm);
    } else {
      Serial.println("FAILED HK");
    }
    if (Firebase.RTDB.setFloat(&fbdo, "PPM/CO2", mq135_last_ppm))
{
      Serial.print("CO2: ");
      Serial.println(mq135_last_ppm);
    } else {
      Serial.println("FAILED CO2");
    }
    if (Firebase.RTDB.setFloat(&fbdo, "PPM/CO", mq7_last_ppm)) {
      Serial.print("CO: ");
      Serial.println(mq7_last_ppm);
    } else {
      Serial.println("FAILED CO");
    }
    if (Firebase.RTDB.setFloat(&fbdo, "PPM/Temp", temp)) {
      Serial.print("Temp: ");
      Serial.println(temp);
    } else {
      Serial.println("FAILED Temp");
    }
    if (Firebase.RTDB.setFloat(&fbdo, "PPM/Hum", hum)) {
      Serial.print("Hum: ");
      Serial.println(hum);
    } else {
      Serial.println("FAILED Hum");
    }

  if (Firebase.ready()) {
  if (Firebase.RTDB.getInt(&fbdo, "PPM/relay", &relay)) {
    Serial.printf("Get int ref... %s\n", String(relay).c_str());

    if (relay == 1) {
      digitalWrite(RELAY_PIN, HIGH); // pastikan ini pakai huruf
besar
      Serial.println("Relay MENYALA");
    } else {
      digitalWrite(RELAY_PIN, LOW);
      Serial.println("Relay MATI");
    }

    xrelay = relay;
```

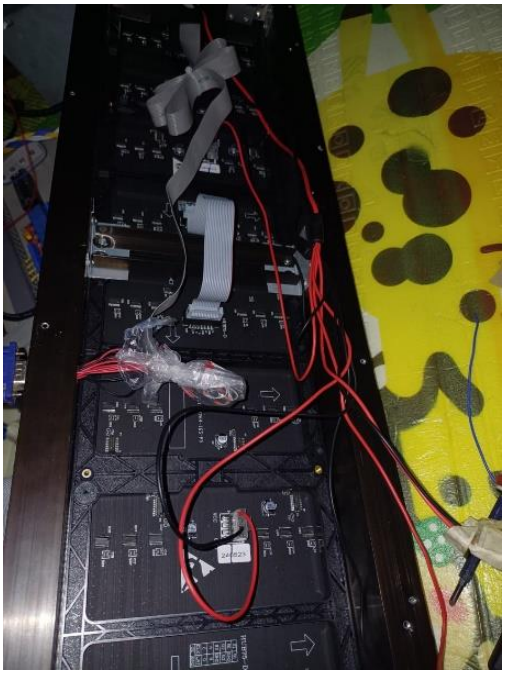
```
  } else {
    Serial.print("Firebase error: ");
    Serial.println(fbdo.errorReason());
  }
} else {
  Serial.println("Firebase not ready.");
}

  sendToDisplay(temp, hum, mq7_last_ppm, mq2_last_ppm,
mq135_last_ppm);
}
}

// --- Display Function (Gabungan) ---
void sendToDisplay(float temp, float hum, float last_ppm7, float
last_ppm2, float last_ppm135) {
 unsigned long now = millis();

  if (now - lastSwitch < switchInterval) {
    // Perbarui tampilan jam setiap detik, jika mode tampilan
adalah jam.
  if (displayMode == 2) {
      displayClock();
    }
    return;
  }
 lastSwitch = now;

 dma_display->fillScreen(0);
 dma_display->setTextSize(1);

 displayMode = (displayMode + 1) % 3;

  if (displayMode == 0) {
    // Tampilan 1: Data Sensor
    dma_display->setTextColor(dma_display->color565(255, 0, 255));
    dma_display->setCursor(2, 0);    dma_display->print("CO :");
dma_display->print(last_ppm7);
    dma_display->setCursor(78, 0);   dma_display->print("ppm");
    dma_display->setCursor(2, 8);    dma_display->print("HC :");
dma_display->print(last_ppm2);
    dma_display->setCursor(78, 8);   dma_display->print("ppm");
    dma_display->setCursor(2, 16);   dma_display->print("CO2:");
dma_display->print(last_ppm135);
    dma_display->setCursor(78, 16);  dma_display->print("ppm");
    dma_display->setTextColor(dma_display->color565(255, 0, 0));
    dma_display->setCursor(10, 24);  dma_display->print("T");
    dma_display->setTextColor(dma_display->color565(255, 0, 255));
    dma_display->setCursor(8, 24);   dma_display->print("  :");
dma_display->print(temp, 1);
    dma_display->setCursor(52, 24);  dma_display->print("C");
    dma_display->setTextColor(dma_display->color565(0, 0, 255));
    dma_display->setCursor(68, 24);  dma_display->print("H");
    dma_display->setTextColor(dma_display->color565(255, 0, 255));
    dma_display->setCursor(61, 24);  dma_display->print("  :");
```

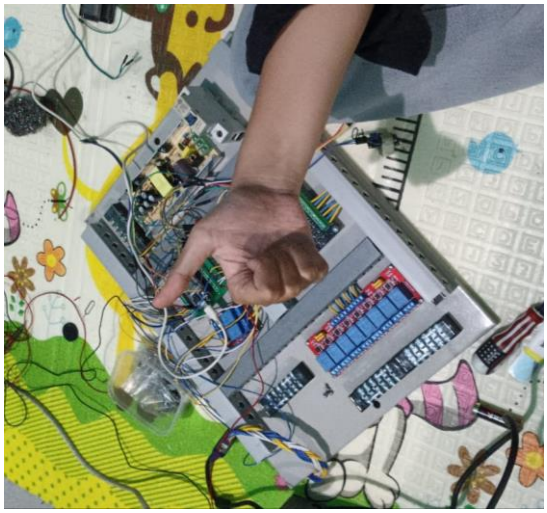
```
    dma_display->setCursor(78, 24); dma_display->print(hum, 1);
    dma_display->setCursor(103, 24); dma_display->print("%");
  } else if (displayMode == 1) {
    // Tampilan 2: Tulisan
    tulisan();
  } else if (displayMode == 2) {
    // Tampilan 3: Jam
    displayClock();
  }
}

// --- Sensor Functions ---
void bacaMQ7() {
 float total = 0;
 for (int i = 0; i < MQ7_SAMPLES; i++) {
  total += analogRead(MQ7_SENSOR_PIN);
  delay(50);
 }
 float adc = total / MQ7_SAMPLES;
 float Vout = (adc / ADC_RES) * MQ7_VCC;
 float Rs = (MQ7_VCC - Vout) * MQ7_RL / Vout;
 float rs_ro = Rs / MQ7_Ro;
 mq7_last_ppm = pow(10, MQ7_a * log10(rs_ro) + MQ7_b);
}

float getMQ135Resistance() {
 int adc = analogRead(MQ135_PIN);
 float volt = (adc / ADC_RES) * VREF;
 return (VREF - volt) * MQ135_RL / volt;
}

void bacaMQ135() {
 float rs = getMQ135Resistance();
 float rs_ro = rs / MQ135_Ro;
 mq135_last_ppm = pow(rs_ro / MQ135_a, 1.0 / MQ135_b);
}

float readFilteredADC(int pin) {
 const int samples = 10;
 float total = 0;
 for (int i = 0; i < samples; i++) {
  total += analogRead(pin);
  delay(10);
 }
 return total / samples;
}

void bacaMQ2() {
 float adc = readFilteredADC(MQ2_PIN);
 float volt = (adc / ADC_RES) * VREF;
 float Rs = (VREF - volt) * MQ2_RL / volt;
 float rs_ro = Rs / MQ2_R0_CALIBRATED;
 mq2_last_ppm = pow(10, MQ2_lpgSlope * log10(rs_ro) +
MQ2_lpgIntercept);
}
```

```
// --- Setup ---
void setup() {
 Serial.begin(115200);
 Wire.begin();
 sht20.initSHT20();
 delay(100);
 Serial.println("Sensor init finish!");
 pinMode(RELAY_PIN, OUTPUT);
 pinMode(tombol,INPUT);
 digitalWrite(RELAY_PIN, HIGH);

 int datatombol = digitalRead(tombol);
  if(datatombol == 1){
    WiFi.begin(ssid, password);
    Serial.print("Menghubungkan ke WiFi");
    while (WiFi.status() != WL_CONNECTED) {
      delay(500); Serial.print(".");
    }
    Serial.println("\nWiFi connected!");

    config.api_key = API_KEY;
    config.database_url = DATABASE_URL;
    if (Firebase.signUp(&config, &auth, "", "")) {
      Serial.println("Firebase OK\nFree Palestine");
    } else {
      Serial.printf("%s\n",
config.signer.signupError.message.c_str());
    }
    config.token_status_callback = tokenStatusCallback;
    // Koneksi Firebase
    Firebase.begin(&config, &auth);
    Firebase.reconnectWiFi(true);

    // Konfigurasi NTP untuk sinkronisasi waktu
    configTime(gmtOffset_sec, daylightOffset_sec, ntpServer);
    Serial.println("Waktu disinkronkan dari NTP server.");
  } else {
    Serial.println("Running tanpa WiFi & layanan eksternal.");
  }

 ledcSetup(MQ7_PWM_CHANNEL, MQ7_PWM_FREQ, MQ7_PWM_RES);
 ledcAttachPin(MQ7_PWM_PIN, MQ7_PWM_CHANNEL);
 ledcWrite(MQ7_PWM_CHANNEL, MQ7_HIGH_DUTY);
 mq7_previousMillis = millis();

 mq2_start_time = millis();
 mq135_start_time = millis();

 HUB75_I2S_CFG::i2s_pins _pins =
{R1_PIN,G1_PIN,B1_PIN,R2_PIN,G2_PIN,B2_PIN,A_PIN,B_PIN,C_PIN,D_PIN
,E_PIN,LAT_PIN,OE_PIN,CLK_PIN};
 HUB75_I2S_CFG mxcfg(PANEL_RES_X, PANEL_RES_Y, PANEL_CHAIN,
_pins);
 mxcfg.i2sspeed = HUB75_I2S_CFG::HZ_10M;

 dma_display = new MatrixPanel_I2S_DMA(mxcfg);
```

```
 dma_display->begin();
 dma_display->setBrightness8(65);
}

// --- Loop ---
void loop() {
  datautama();
  delay(1000);
}
```

Lampiran 2. Dokumentasi Perancangan





Lampiran 3. Datasheet Komponen

1. Datasheet MQ-2

MQ-2 Semiconductor Sensor for Combustible Gas

Sensitive material of MQ-2 gas sensor is SnO_2, which with lower conductivity in clean air. When the target combustible gas exist, The sensor's conductivity is more higher along with the gas concentration rising. Please use simple electrocircuit, Convert change of conductivity to correspond output signal of gas concentration.

MQ-2 gas sensor has high sensitity to LPG, Propane and Hydrogen, also could be used to Methane and other combustible steam, it is with low cost and suitable for different application.

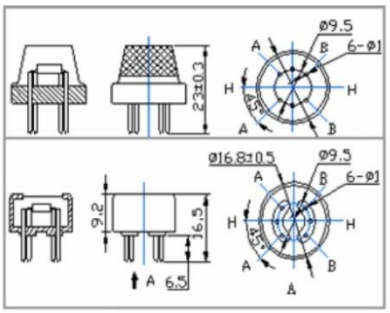
Character

*Good sensitivity to Combustible gas in wide range
* High sensitivity to LPG, Propane and Hydrogen
* Long life and low cost
* Simple drive circuit

Application

* Domestic gas leakage detector
* Industrial Combustible gas detector
* Portable gas detector

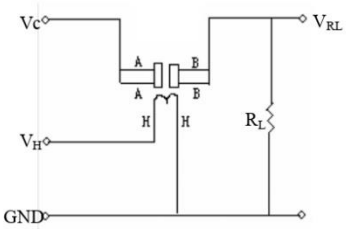
Configuration



Technical Data

Model No.			MQ-2
Sensor Type			Semiconductor
Standard Encapsulation			Bakelite (Black Bakelite)
Detection Gas			Combustible gas and smoke
Concentration			300-10000ppm (Combustible gas)
Circuit	Loop Voltage	V_c	≤24V DC
	Heater Voltage	V_H	5.0V±0.2V ACorDC
	Load Resistance	R_L	Adjustable
Character	Heater Resistance	R_H	31Ω±3Ω（Room Tem.）
	Heater consumption	P_H	≤900mW
	Sensing Resistance	R_s	2KΩ-20KΩ(in 2000ppm C_3H_8)
	Sensitivity	S	Rs(in air)/Rs(1000ppm isobutane)≥5
	Slope	α	≤0.6($R_{5000ppm}/R_{3000ppm}$ CH_4)
Condition	Tem. Humidity		20℃±2℃；65%±5%RH
	Standard test circuit		Vc:5.0V±0.1V; V_H: 5.0V±0.1V
	Preheat time		Over 48 hours

Basic test loop



The above is basic test circuit of the sensor. The sensor need to be put 2 voltage, heater voltage（VH） and test voltage（VC）. VH used to supply certified working temperature to the sensor, while VC used to detect voltage (VRL) on load resistance （RL） whom is in series with sensor. The sensor has light polarity, Vc need DC power. VC and VH could use same power circuit with precondition to assure performance of sensor. In order to make the sensor with better performance, suitable RL value is needed:
Power of Sensitivity body(Ps):
$Ps=Vc^2\times Rs/(Rs+RL)^2$

Resistance of sensor(Rs): Rs=(Vc/VRL-1)×RL

Sensitivity Characteristics

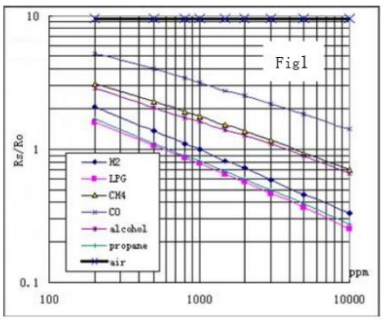


Fig.1 shows the typical sensitivity characteristics of the MQ-2, ordinate means resistance ratio of the sensor (Rs/Ro), abscissa is concentration of gases. Rs means resistance in different gases, Ro means resistance of sensor in 1000ppm Hyrogen. All test are under standard test conditions.

Influence of Temperature/Humidity

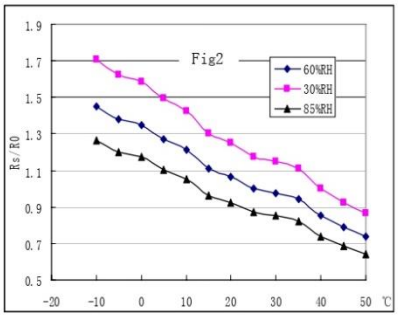
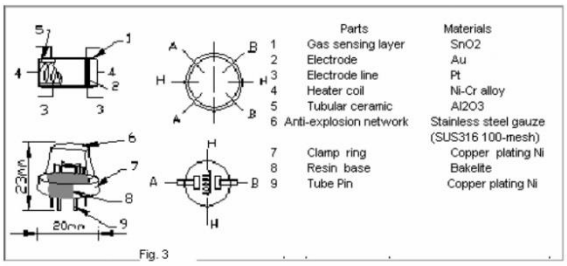


Fig.2 shows the typical temperature and humidity characteristics. Ordinate means resistance ratio of the sensor (Rs/Ro), Rs means resistance of sensor in 1000ppm Butane under different tem. and humidity. Ro means resistance of the sensor in environment of 1000ppm Methane, 20℃/65%RH

Structure and configuration



Structure and configuration of MQ-2 gas sensor is shown as Fig. 3, sensor composed by micro AL2O3 ceramic tube, Tin Dioxide (SnO2) sensitive layer, measuring electrode and heater are fixed into a crust made by plastic and stainless steel net. The heater provides necessary work conditions for work of sensitive components. The enveloped MQ-2 have 6 pin, 4 of them are used to fetch signals, and other 2 are used for providing heating current.

Notification

1 Following conditions must be prohibited

1.1 Exposed to organic silicon steam

Organic silicon steam cause sensors invalid, sensors must be avoid exposing to silicon bond, fixature, silicon latex, putty or plastic contain silicon environment

1.2 High Corrosive gas

If the sensors exposed to high concentration corrosive gas (such as H_2Sz, SO_X, Cl_2, HCl etc), it will not only result in corrosion of sensors structure, also it cause sincere sensitivity attenuation.

1.3 Alkali, Alkali metals salt, halogen pollution

The sensors performance will be changed badly if sensors be sprayed polluted by alkali metals salt especially brine, or be exposed to halogen such as fluorin.

1.4 Touch water

Sensitivity of the sensors will be reduced when spattered or dipped in water.

1.5 Freezing

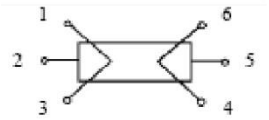
Do avoid icing on sensor'surface, otherwise sensor would lose sensitivity.

1.6 Applied voltage higher

Applied voltage on sensor should not be higher than stipulated value, otherwise it cause down-line or heater damaged, and bring on sensors' sensitivity characteristic changed badly.

1.7 Voltage on wrong pins

For 6 pins sensor, if apply voltage on 1、3 pins or 4、6 pins, it will make lead broken, and without signal when apply on 2、4 pins



2 Following conditions must be avoided

2.1 Water Condensation

Indoor conditions, slight water condensation will effect sensors performance lightly. However, if water condensation on sensors surface and keep a certain period, sensor' sensitivity will be decreased.

2.2 Used in high gas concentration

No matter the sensor is electrified or not, if long time placed in high gas concentration, if will affect sensors characteristic.

2.3 Long time storage

The sensors resistance produce reversible drift if it's stored for long time without electrify, this drift is related with storage conditions. Sensors should be stored in airproof without silicon gel bag with clean air. For the sensors with long time storage but no electrify, they need long aging time for stbility before using.

2.4 Long time exposed to adverse environment

No matter the sensors electrified or not, if exposed to adverse environment for long time, such as high humidity, high temperature, or high pollution etc, it will effect the sensors performance badly.

2.5 Vibration

Continual vibration will result in sensors down-lead response then repture. In transportation or assembling line, pneumatic screwdriver/ultrasonic welding machine can lead this vibration.

2.6 Concussion

If sensors meet strong concussion, it may lead its lead wire disconnected.

2.7 Usage

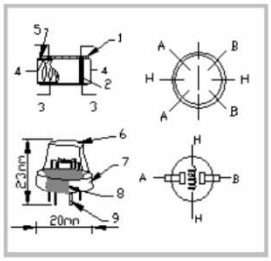
For sensor, handmade welding is optimal way. If use wave crest welding should meet the following conditions:

2.7.1 Soldering flux: Rosin soldering flux contains least chlorine
2.7.2 Speed: 1-2 Meter/ Minute
2.7.3 Warm-up temperature：100±20℃
2.7.4 Welding temperature：250±10℃
2.7.5 1 time pass wave crest welding machine

If disobey the above using terms, sensors sensitivity will be reduced.

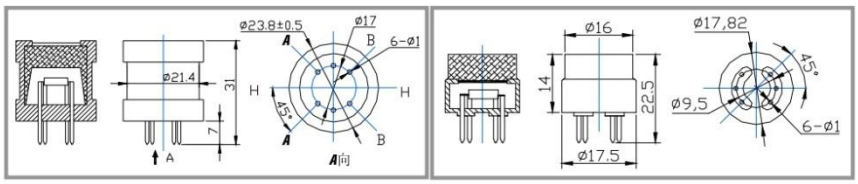
2. Datasheet MQ-7

6 pin ,4 of them are used to fetch signals, and other 2 are used for providing heating current.



	Parts	Materials
1	Gas sensing layer	SnO_2
2	Electrode	Au
3	Electrode line	Pt
4	Heater coil	Ni-Cr alloy
5	Tubular ceramic	Al_2O_3
6	Anti-explosion network	Stainless steel gauze (SUS316 100-mesh)
7	Clamp ring	Copper plating Ni
8	Resin base	Bakelite
9	Tube Pin	Copper plating Ni

Fig.1



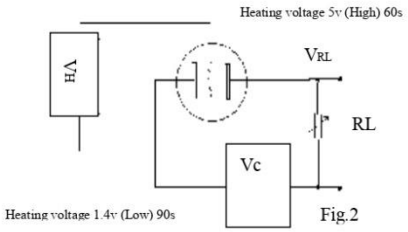


Fig.2

Standard circuit:

As shown in Fig 2, standard measuring circuit of MQ-7 sensitive components consists of 2 parts. one is heating circuit having time control function (the high voltage and the low voltage work circularly). The second is the signal output circuit, it can accurately respond changes of surface resistance of the sensor.

Electric parameter measurement circuit is shown as Fig.2

E. Sensitivity characteristic curve

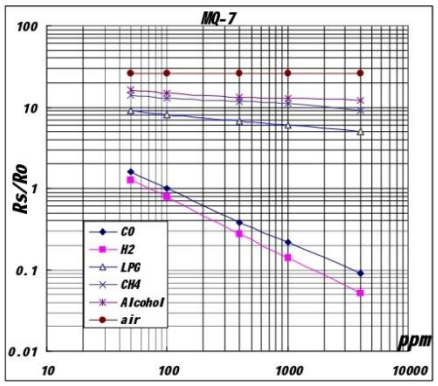


Fig.3 is shows the typical sensitivity characteristics of the MQ-7 for several gases.
in their: Temp: 20℃、
Humidity: 65%、
O_2 concentration 21%
RL=10kΩ
Ro: sensor resistance at 100ppm CO in the clean air.
Rs: sensor resistance at various concentrations of gases.

Fig.3 sensitivity characteristics of the MQ-7

TECHNICAL DATA MQ-7 GAS SENSOR

FEATURES

* High sensitivity to carbon monoxide
* Stable and long life

APPLICATION

They are used in gas detecting equipment for carbon monoxide(CO) in family and industry or car.

SPECIFICATIONS

A. Standard work condition

Symbol	Parameter name	Technical condition	Remark
Vc	circuit voltage	5V±0.1	Ac or Dc
V_H (H)	Heating voltage (high)	5V±0.1	Ac or Dc
V_H (L)	Heating voltage (low)	1.4V±0.1	Ac or Dc
R_L	Load resistance	Can adjust	
R_H	Heating resistance	33Ω ±5%	Room temperature
$T_{H(H)}$	Heating time (high)	60±1 seconds	
$T_{H(L)}$	Heating time (low)	90±1 seconds	
PH	Heating consumption	About 350mW	

b. Environment conditions

Symbol	Parameters	Technical conditions	Remark
Tao	Using temperature	-20℃-50℃	
Tas	Storage temperature	-20℃-50℃	Advice using scope
RH	Relative humidity	Less than 95%RH	
O_2	Oxygen concentration	21%(stand condition) the oxygen concentration can affect the sensitivity characteristic	Minimum value is over 2%

c. Sensitivity characteristic

symbol	Parameters	Technical parameters	Remark
Rs	Surface resistance Of sensitive body	2-20k	In 100ppm Carbon Monoxide
a (300/100ppm)	Concentration slope rate	Less than 0.5	Rs (300ppm)/Rs(100ppm)
Standard working condition	Temperature -20℃±2℃ relative humidity 65%±5% RL:10KΩ ±5%		
	Vc:5V±0.1V VH:5V±0.1V VH:1.4V±0.1V		
Preheat time	No less than 48 hours	Detecting range: 20ppm-2000ppm carbon monoxide	

D. Structure and configuration, basic measuring circuit

Structure and configuration of MQ-7 gas sensor is shown as Fig. 1 (Configuration A or B), sensor composed by micro AL_2O_3 ceramic tube, Tin Dioxide (SnO_2) sensitive layer, measuring electrode and heater are fixed into a crust made by plastic and stainless steel net. The heater provides necessary work conditions for work of sensitive components. The enveloped MQ-7 have

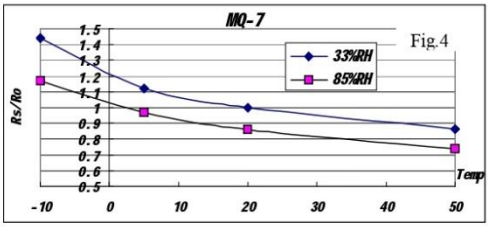


Fig.4

Fig.4 is shows the typical dependence of the MQ-7 on temperature and humidity.
Ro: sensor resistance at 100ppm CO in air at 33%RH and 20degree.
Rs: sensor resistance at 100ppm CO at different temperatures and humidities.

OPERATION PRINCIPLE

. The surface resistance of the sensor Rs is obtained through effected voltage signal output of the load resistance RL which series-wound. The relationship between them is described:

Rs\RL = (Vc-VRL) / VRL

Fig. 5 shows alterable situation of RL signal output measured by using Fig. 2 circuit output

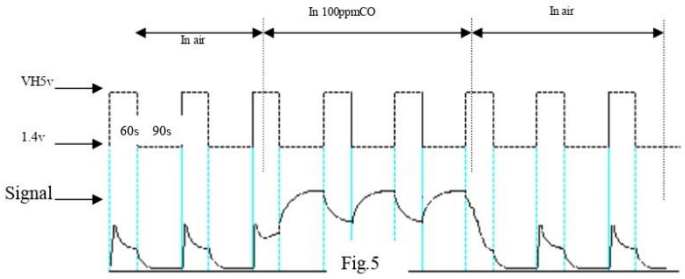


Fig.5

signal when the sensor is shifted from clean air to carbon monoxide (CO) , output signal measurement is made within one or two complete heating period (2.5 minute from high voltage to low voltage).

Sensitive layer of MQ-7 gas sensitive components is made of SnO_2 with stability, So, it has excellent long term stability. Its service life can reach 5 years under using condition.

SENSITVITY ADJUSTMENT

Resistance value of MQ-7 is difference to various kinds and various concentration gases. So, When using this components, sensitivity adjustment is very necessary. we recommend that you calibrate the detector for 200ppm CO in air and use value of Load resistance that(R_L) about 10 KΩ (5KΩ to 47 KΩ).

When accurately measuring, the proper alarm point for the gas detector should be determined after considering the temperature and humidity influence. The sensitivity adjusting program:

a. Connect the sensor to the application circuit.
b. Turn on the power, keep preheating through electricity over 48 hours.
c. Adjust the load resistance RL until you get a signal value which is respond to a certain carbon monoxide concentration at the end point of 90 seconds.
d. Adjust the another load resistance RL until you get a signal value which is respond to a CO concentration at the end point of 60 seconds .

3. Datasheet MQ-135

TECHNICAL DATA MQ-135 GAS SENSOR

FEATURES

Wide detecting scope — Fast response and High sensitivity
Stable and long life — Simple drive circuit

APPLICATION

They are used in air quality control equipments for buildings/offices, are suitable for detecting of NH3,NOx, alcohol, Benzene, smoke,CO_2 ,etc.

SPECIFICATIONS

A. Standard work condition

Symbol	Parameter name	Technical condition	Remarks
Vc	Circuit voltage	5V±0.1	AC OR DC
V_H	Heating voltage	5V±0.1	ACOR DC
R_L	Load resistance	can adjust	
R_H	Heater resistance	33Ω±5%	Room Tem
P_H	Heating consumption	less than 800mw	

B. Environment condition

Symbol	Parameter name	Technical condition	Remarks
Tao	Using Tem	-10□-45□	
Tas	Storage Tem	-20□-70□	
R_H	Related humidity	less than 95%Rh	
O_2	Oxygen concentration	21%(standard condition)Oxygen concentration can affect sensitivity	minimum value is over 2%

C. Sensitivity characteristic

Symbol	Parameter name	Technical parameter	Ramark 2
Rs	Sensing Resistance	30KΩ-200KΩ (100ppm NH_3)	Detecting concentration scopeⅡ 10ppm-300ppm NH_3 10ppm-1000ppm Benzene 10ppm-300ppm Alcohol
α (200/50) NH_3	Concentration Slope rate	≤0.65	
Standard Detecting Condition	Temp: 20□±2□ Humidity: 65%±5%	Vc:5V±0.1 Vh: 5V±0.1	
Preheat time	Over 24 hour		

D. Structure and configuration, basic measuring circuit

	Parts	Materials
1	Gas sensing layer	SnO_2
2	Electrode	Au
3	Electrode line	Pt
4	Heater coil	Ni-Cr alloy
5	Tubular ceramic	Al_2O_3
6	Anti-explosion network	Stainless steel gauze (SUS316 100-mesh)
7	Clamp ring	Copper plating Ni
8	Resin base	Bakelite
9	Tube Pin	Copper plating Ni

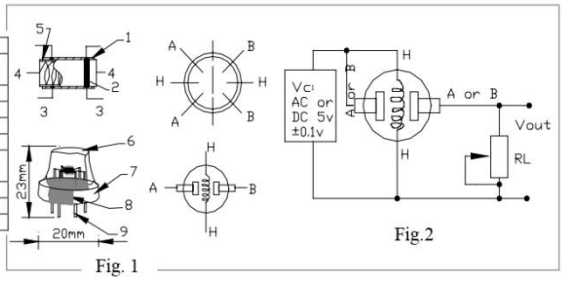
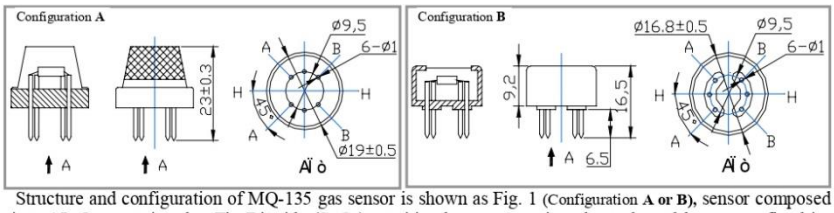


Fig. 1 Fig.2



Structure and configuration of MQ-135 gas sensor is shown as Fig. 1 (Configuration **A or B**), sensor composed by micro AL_2O_3 ceramic tube, Tin Dioxide (SnO_2) sensitive layer, measuring electrode and heater are fixed into a crust made by plastic and stainless steel net. The heater provides necessary work conditions for work of sensitive

components. The enveloped MQ-135 have 6 pin ,4 of them are used to fetch signals, and other 2 are used for providing heating current.

Electric parameter measurement circuit is shown as Fig.2

E. Sensitivity characteristic curve

Fig.2 sensitivity characteristics of the MQ-135

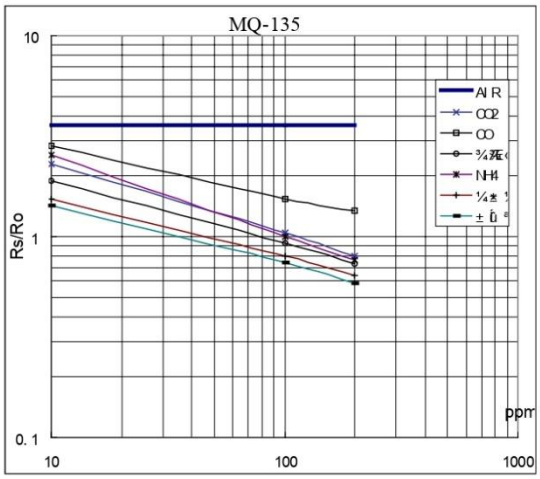


Fig.3 is shows the typical sensitivity characteristics of the MQ-135 for several gases.
in their: Temp: 20
Humidity: 65%
O_2 concentration 21%
RL=20kΩ
Ro: sensor resistance at 100ppm of NH_3 in the clean air.
Rs:sensor resistance at various concentrations of gases.

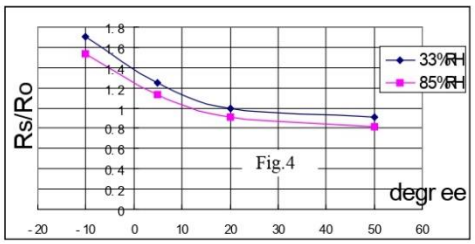


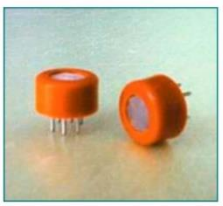
Fig.4

Fig.4 is shows the typical dependence of the MQ-135 on temperature and humidity.
Ro: sensor resistance at 100ppm of NH_3 in air at 33%RH and 20 degree.
Rs: sensor resistance at 100ppm of NH_3 at different temperatures and humidities.

SENSITVITY ADJUSTMENT

Resistance value of MQ-135 is difference to various kinds and various concentration gases. So,When using this components, sensitivity adjustment is very necessary. we recommend that you calibrate the detector for 100ppm NH_3 or 50ppm Alcohol concentration in air and use value of Load resistancethat(R_L) about 20 KΩ(10KΩ to 47 KΩ).

When accurately measuring, the proper alarm point for the gas detector should be determined after considering the temperature and humidity influence.



4. SHT 20

SHT20 Digital Temperature and Humidity Sensor Module I2C Communication

Terjual 70+ • ★ 5 (8 rating)

Rp40.000

Detail | Spesifikasi | Info Penting

Kondisi: Baru

Min. Pemesanan: 1 Buah

Etalase: **Sensor**

SKU : A14004

1. Humidity measurement range: 0~100% RH
2. Humidity measurement accuracy: ± 3% RH
3. Temperature measurement range: -40 ~ 125°C
4. Temperature measurement accuracy: ± 0.3°C
5. Operating voltage: 2.1 ~ 3.6VDC (Please note: Do not use 5V power supply !!!)...

Lihat Selengkapnya

5. P5

lines, rectangles, circles and text. You'll get your color blasting within the hour! On most Arduino-compatible boards, you'll need 12 digital pins, and about 800 bytes of RAM to hold the 12-bit color image (double that for the 32x32 matrix, double again for smooth double-buffered animation).

The library works with a LIMITED NUMBER of boards. Please see the COMPATIBLE HARDWARE lists above.

Power

Although LEDs are very efficient light sources, get enough of them in one place and the current really adds up.

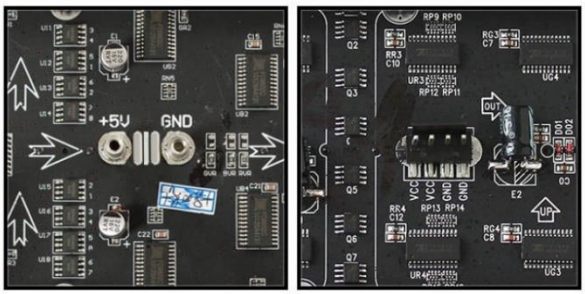
A single **32x16** or **32x32** RGB matrix, running full tilt (all pixels set white), can require nearly **4 Amps** of current! Double that figure for a **64x32** matrix.

On average though, displaying typical graphics and animation, these panels will use less...a **2A** supply is usually sufficient for a single 32x16 or 32x32 panel, or 4A for a 64x32 panel. There's no harm in using a larger power supply rated for more Amps (e.g. a 10A supply), but never use one with a higher Voltage (use **5V, period**)!

On these panels, the power connection is separate from the data connection. Let's begin by connecting a 5V supply...

Our parts suppliers occasionally make revisions to designs. As a result, the connections have changed over time. We'll walk through the different wiring combinations here...pick the explanation that matches the panel(s) you received.

Two different types of power connectors have made an appearance:



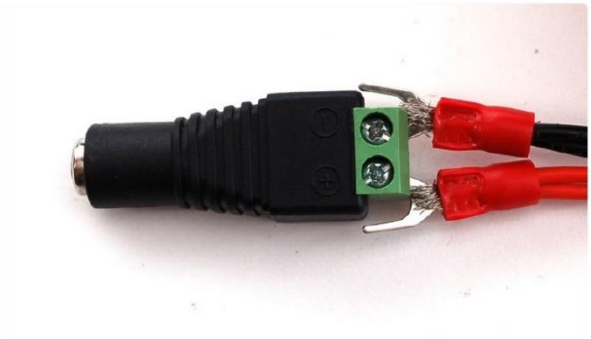
On the left is a screw post power connector (with adjacent pads for soldering wires directly). On the right, a Molex-style header. Some panels will have two headers...the power cable included with these panels has connectors for both headers.

With the posts-and-pads connector, you can either screw down the spades from the power cable, or another approach is to cut a 2.1mm jack from this extension cord (http://adafru.it/327) and solder it to the pads on the panel back. This way you can plug the 5V from a wall adapter (http://adafru.it/276) right in (the one we have in the shop is suggested). Simply cut the other half of the cable off, and strip the wiring so you can solder the red wire to +5 and the black wire to ground.

Solder both pins correctly to the power port. Make sure you get this right because there is no protection diode!

If your panel has the Molex-style header, just plug in the included power cable, observing the correct polarity.

If your power cable came with spades at the opposite end of this power cable, they can be screwed into a 2.1mm terminal block adapter. Works nicely! Don't allow the exposed connectors to contact metal though...you should probably cover this with heat-shrink tube or electrical tape.



You may receive power cables with different endings, e.g. round instead of spade ends, or maybe with another Molex connector. Just strip the cables and wire directly to the power plug

Lampiran 4. Form Bimbingan Tugas Akhir

1. Pembimbing 1

FORMULIR BIMBINGAN TUGAS AKHIR

NAMA : **PUTRI IZZA AMALIA**

NIM : **22010008**

JUDUL : IMPLEMENTASI SISTEM MONITORING KUALITAS UDARA MENGGUNAKAN SENSOR MQ-SERIES PADA LAMPU HIAS IKONIK KOTA TEGAL.

PEMBIMBING I

NO	HARI/TANGGAL	URAIAN	TANDA TANGAN
1.	Senin, 14-04-2025.	Penyesuaian Judul	
2	Senin, 21/04 2025	- Batasan masalah - Latar belakang - Tujuan - manfaat	
3.	Senin 28/4/2025	- Bab 2 - Revisi Gambar - keterangan Gambar.	
4.	Jum'at 16-05-2025	- Bab 3 - lengkapi keterangan gambar	
5.	Senin 07-07-2025	- Revisi Flowchart sistem.	
6.	Kamis 17-07-2025	- Revisi Bab 4 dan 5	
7.	Jum'at 18-07-2025	Acc Pbb	

2. Pembimbing 2

FORMULIR BIMBINGAN TUGAS AKHIR

NAMA : **PUTRI IZZA AMALIA**

NIM : **22010008**

JUDUL : IMPLEMENTASI SISTEM MONITORING KUALITAS UDARA MENGGUNAKAN SENSOR MQ-SERIES PADA LAMPU HIAS IKONIK KOTA TEGAL

PEMBIMBING 2

NO	HARI/TANGGAL	URAIAN	TANDA TANGAN
1	Rabu, 19-3-25	- Perbaikan Judul TA	
2	Rabu, 16-3-2025	- Bab I - Latar belakang sesuaikan judul - Tujuan disesuaikan. - Manfaat, fokus ke judul TA ACC Bab I	
3	Senin 28-4-2025	Bab II - kategori Gambar - Perbesar gambar / Rangkaian	
4.	Jumat 16-5-2025	Bab III - Gambar Desain - Program	

FORMULIR BIMBINGAN TUGAS AKHIR

NAMA : PUTRI IZZA AMALIA

NIM : 22010008

JUDUL : IMPLEMENTASI SISTEM MONITORING KUALITAS UDARA MENGGUNAKAN SENSOR MQ SERIES PADA LAMPU HIAS IKONIK KOTA TEGAL

PEMBIMBING 2

NO	HARI/TANGGAL	URAIAN	TANDA TANGAN
	Selasa 8-7-2025	Bab II - Gambar relay - flowchart revisi	
	Rabu 16-7-2025	Bab IV - Tambahkan Waktu	
	Jumat 18-7-2025	Laporan Ace.	

Lampiran 5. Penilaian Bimbingan Tugas Akhir Individu

PENILAIAN BIMBINGAN TUGAS AKHIR INDIVIDU

Judul : Implementasi Sistem Monitoring Kualitas Udara Menggunakan Sensor MQ Series Pada Lampu Hias Ikonik Kota Tegal

Nama : Putri Izza Amalia

NIM : 22010008

Kelas : 6A / D3 Teknik Elektronika

I. Nilai Bimbingan Tugas Akhir (Pembimbing I)

No	Unsur Yang Dinilai	Nilai
1	Kedisiplinan dalam bimbingan	90
2	Kreativitas pemecahan dalam bimbingan	85
3	Penguasaan materi tugas akhir	90
4	Kelengkapan dan referensi tugas akhir	85
Total Nilai = (Jumlah Nilai / 4)		87,5

II. Nilai Bimbingan Tugas Akhir (Pembimbing II)

No	Unsur Yang Dinilai	Nilai
1	Kedisiplinan dalam bimbingan	90
2	Kreativitas pemecahan dalam bimbingan	85
3	Penguasaan materi tugas akhir	85
4	Kelengkapan dan referensi tugas akhir	90
Total Nilai = (Jumlah Nilai / 4)		87.5

Nilai Bimbingan $= \frac{TotalNilaiPembimbing1 + TotalNilaiPembibing2}{2}$

$= \frac{87,5 + 87,5}{2} = 87,5$

Tegal, 18 Juli 2025

Mengetahui,

Pembimbing 1	Pembimbing 2
Rony Darpono M.T	Bahrun Niam M.T

Lampiran 6. Surat Kesediaan Membimbing TA

SURAT KESEDIAAN MEMBIMBING TUGAS AKHIR

Yang bertanda tangan di bawah ini :

Nama	: Rony Darpono, M.T
NIPY	: 09.012.264
Jabatan Fungsional	: Dosen Tetap Prodi DIII Teknik Elektronika

Dengan ini menyatakan bersedia menjadi Pembimbing 1 pada Tugas Akhir Mahasiswa berikut :

Nama	: Putri Izza Amalia
NIM	: 22010008
Program Studi	: DIII Teknik Elektronika
Judul Laporan Tugas	: **RANCANG BANGUN PEMANTAUAN KUALITAS UDARA MENGGUNAKAN SENSOR MQ SERIES PADA LAMPU HIAS IKONIK KOTA TEGAL**

Demikian Pernyataan ini dibuat agar dilaksanakan sebagaimana mestinya.

Tegal, 6 Maret 2025

Mengetahui,
Ka. Prodi DIII Teknik Elektronika

Rony Darpono, M.T
NIPY. 09.015.282

Calon Dosen Pembimbing 1,

Rony Darpono, M.T
NIPY. 09.015.282

SURAT KESEDIAAN MEMBIMBING TUGAS AKHIR

Yang bertanda tangan di bawah ini :

Nama	: Bahrun Niam, M.T
NIPY	: 09.012.277
Jabatan Fungsional	: Dosen Tetap Prodi DIII Teknik Elektronika

Dengan ini menyatakan bersedia menjadi Pembimbing 1 pada Tugas Akhir Mahasiswa berikut :

Nama	: Putri Izza Amalia
NIM	: 22010008
Program Studi	: DIII Teknik Elektronika
Judul Laporan Tugas	: **RANCANG BANGUN PEMANTAUAN KUALITAS UDARA MENGGUNAKAN SENSOR MQ SERIES PADA LAMPU HIAS IKONIK KOTA TEGAL**

Demikian Pernyataan ini dibuat agar dilaksanakan sebagaimana mestinya.

Tegal, 6 Maret 2025

Mengetahui,

Ka. Prodi DIII Teknik Elektronika

Rony Darpono, M.T
NIPY. 09.015.282

Calon Dosen Pembimbing 2,

Bahrun Niam, M.T
NIPY. 09.015.277

Lampiran 7 Form Revisi Ujian Tugas Akhir

1. Ketua Penguji

FORMULIR REVISI

UJIAN TUGAS AKHIR

NAMA : PUTRI IZZA AMALIA

NIM : 22010008

JUDUL : RANCANG BANGUN PEMANTAUAN KUALITAS UDARA MENGGUNAKAN SENSOR MQ SERIES PADA LAMPU HIAS IKONIK KOTA TEGAL

KETUA PENGUJI

No	Hari/Tanggal	Uraian	Tanda Tangan
	20/8 '24	Acc	

Ketua Penguji

Qirom S.Pd., M.T

2. Penguji 1

FORMULIR REVISI

UJIAN TUGAS AKHIR

NAMA : PUTRI IZZA AMALIA

NIM : 22010008

JUDUL : RANCANG BANGUN PEMANTAUAN KUALITAS UDARA MENGGUNAKAN SENSOR MQ SERIES PADA LAMPU HIAS IKONIK KOTA TEGAL

PENGUJI 1

No	Hari/Tanggal	Uraian	Tanda Tangan
1.	8 Agustus 2025	Acc Laporan TA & projek	

Penguji 1

Ulil Albab M.T

3. Penguji 2

FORMULIR REVISI

UJIAN TUGAS AKHIR

NAMA : PUTRI IZZA AMALIA

NIM : 22010008

JUDUL : RANCANG BANGUN PEMANTAUAN KUALITAS UDARA MENGGUNAKAN SENSOR MQ SERIES PADA LAMPU HIAS IKONIK KOTA TEGAL

PENGUJI 2

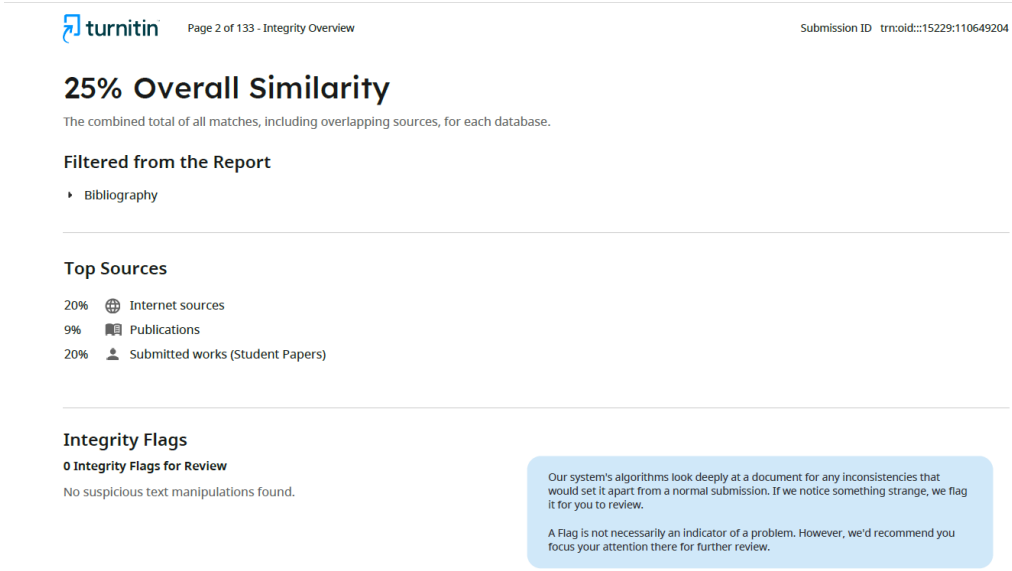
No	Hari/Tanggal	Uraian	Tanda Tangan
1	Senin 4/8 2025	Revisi penambahan Tabs_ pemantauan. dan jam & kalibrasi	
2.	Rabu 6/8 2025	Final Revisi	
3.	Kamis 7/8 2025	Acc Revisi	

Penguji 2

Dany Sucipto M.T

09-015-278

Lampiran 8 *Originality Report By Turnitin*



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