

LAMPIRAN

Lampiran 1. Program Rancang Bangun

```
#define BLYNK_TEMPLATE_ID "TMPL6op62-By9"
#define BLYNK_TEMPLATE_NAME "Regenerasi Silica Gel"
#define BLYNK_PRINT Serial

#include <WiFi.h>
#include <WiFiClient.h>
#include <WiFiClientSecure.h>
#include <HTTPClient.h>
#include <BlynkSimpleEsp32.h>
#include <max6675.h> // Library: "MAX6675" by Adafruit (install via Library
Manager)
#include <Wire.h>
#include <LiquidCrystal_I2C.h> // Library: "LiquidCrystal I2C" by Frank de
Brabander (install via Library Manager)

// --- KONFIGURASI BLYNK & WIFI ---
char auth[] = "8j7szxdVkd_LN2ImtYqPjwYuvb8dto8w";
char ssid[] = "amanda";
char pass[] = "amanda_123";

// --- KONFIGURASI GOOGLE SHEETS (Apps Script Web App) ---
const char* GSHEET_URL =
"https://script.google.com/macros/s/AKfycbyk3xDf50ItE9p8hMByrjUofFSWQvy
esxFZwGdi0f4ZFEQVoDjpp6lClnLjIzHje1Qh/exec";

// --- KONFIGURASI PIN ---
const int PIN_RELAY_HEATER = 18;
const int PIN_LAMPU_ON = 2;
const int PIN_LAMPU_OFF = 4;
const int PIN_LAMPU_AUTO = 5;
const int PIN_TOMBOL_ON = 33;
const int PIN_TOMBOL_OFF = 32;
const int PIN_TOMBOL_AUTO = 35;
const int PIN_TCS_S0 = 12;
const int PIN_TCS_S1 = 15;
const int PIN_TCS_S2 = 14;
const int PIN_TCS_S3 = 27;
const int PIN_TCS_OUT = 34;

// --- PIN MODUL MAX6675 (Thermocouple K-Type) ---
// SO = Serial Data Out (MISO)
// CS = Chip Select
```

```

// SCK = Serial Clock
const int PIN_MAX_SO = 22;
const int PIN_MAX_CS = 23;
const int PIN_MAX_SCK = 21;

MAX6675 thermocouple(PIN_MAX_SCK, PIN_MAX_CS, PIN_MAX_SO);

// --- KONFIGURASI LCD 20x4 (I2C) ---
// CATATAN: pin I2C default ESP32 (GPIO21/22) sudah dipakai oleh MAX6675
// (SCK/SO),
// sehingga jalur I2C untuk LCD dipindah ke GPIO25 (SDA) & GPIO26 (SCL)
// agar tidak bentrok.
const int PIN_LCD_SDA = 26;
const int PIN_LCD_SCL = 25;
LiquidCrystal_I2C lcd(0x27, 20, 4); // Jika layar tidak menyala/tidak terdeteksi,
coba alamat 0x3F

// --- VARIABEL GLOBAL ---
bool modeOtomatis = false, lastModeOtomatis;
int redFreq, greenFreq, blueFreq;
// Nilai RGB hasil konversi dari frekuensi mentah TCS3200 ke skala 0-255 (setara
PWM/8-bit)
int redColor, greenColor, blueColor;
float suhuTerakhir = 0;
String statusWarnaGel = "Membaca...", lastStatusWarnaGel = "";
bool lastHeater Status;
bool lastLampuON, lastLampuOFF, lastLampuOTO;

// Timeout untuk pulseIn (mikrodetik). PENTING untuk responsivitas tombol,
// lihat catatan analisis di bagian prosesInputTombol()/bacaSensor().
const unsigned long TCS_PULSE_TIMEOUT = 30000UL; // 30 ms per channel
warna

// Batas kalibrasi frekuensi mentah TCS3200 untuk dipetakan ke rentang 0-255.
// Sesuaikan TCS_FREQ_MIN/TCS_FREQ_MAX dengan hasil kalibrasi sensor
di lokasi
// pemasangan (frekuensi minimum & maksimum yang pernah terbaca oleh
pulseIn()).
const int TCS_FREQ_MIN = 0;
const int TCS_FREQ_MAX = 2000;

// Timer millis()
unsigned long prevSensorMillis = 0, prevBlynkTimer = 0, prevGSheetMillis = 0;
const long intervalSensor = 500; // MAX6675 butuh jeda min. ~220ms antar
pembacaan
const long intervalBlynk = 3000; // Kirim suhu/RGB setiap 3 detik

```

```
const long intervalGSheet = 1000; // Kirim data ke Google Sheets & update LCD
setiap 1 detik (realtime)
```

```
// --- PROTOTIPE FUNGSI ---
```

```
void bacaSensor();
void prosesInputTombol();
void deteksiStatus(float suhu);
void updateLampuIndikator();
void tampilkanStatus(float suhu);
void kirimKeBlynk();
void kirimKeGoogleSheets();
void lcdPrintLine(int baris, String teks);
void tampilkanLCD(float suhu);
```

```
void setup() {
  Serial.begin(115200);
  Blynk.begin(auth, ssid, pass);
```

```
  pinMode(PIN_RELAY_HEATER, OUTPUT);
  digitalWrite(PIN_RELAY_HEATER, HIGH);
```

```
  pinMode(PIN_LAMPU_ON, OUTPUT);
  pinMode(PIN_LAMPU_OFF, OUTPUT);
  pinMode(PIN_LAMPU_AUTO, OUTPUT);
```

```
  pinMode(PIN_TOMBOL_ON, INPUT_PULLUP);
  pinMode(PIN_TOMBOL_OFF, INPUT_PULLUP);
  pinMode(PIN_TOMBOL_AUTO, INPUT_PULLUP);
```

```
  pinMode(PIN_TCS_S0, OUTPUT);
  pinMode(PIN_TCS_S1, OUTPUT);
  pinMode(PIN_TCS_S2, OUTPUT);
  pinMode(PIN_TCS_S3, OUTPUT);
  pinMode(PIN_TCS_OUT, INPUT);
  digitalWrite(PIN_TCS_S0, HIGH); digitalWrite(PIN_TCS_S1, LOW);
```

```
  // Inisialisasi LCD 20x4 I2C
  Wire.begin(PIN_LCD_SDA, PIN_LCD_SCL);
  lcd.begin();
  lcd.backlight();
  lcd.setCursor(0, 0);
  lcd.print("Regenerasi Silica");
  lcd.setCursor(0, 1);
  lcd.print("Gel - Memulai...");
```

```
  // MAX6675 butuh waktu ~500ms untuk stabil setelah power-on
```

```

delay(500);

lcd.clear();
}

void loop() {
  // Cek tombol paling awal di setiap iterasi loop, SEBELUM operasi yang bisa
  // memblokir (Blynk.run(), pembacaan sensor warna, kirim HTTP ke Google
  Sheets).
  // Lihat catatan lengkap di komentar dalam prosesInputTombol().
  prosesInputTombol();

  Blynk.run();
  unsigned long currentMillis = millis();

  if (currentMillis - prevSensorMillis >= intervalSensor) {
    prevSensorMillis = currentMillis;
    bacaSensor();
    deteksiStatus(suhuTerakhir);
    tampilkanStatus(suhuTerakhir);

    // Kirim data status (Mode, Heater, Gel) HANYA JIKA ADA PERUBAHAN
    bool heater Status = digitalRead(PIN_RELAY_HEATER);
    bool lampuON = digitalRead(PIN_LAMPU_ON);
    bool lampuOFF = digitalRead(PIN_LAMPU_OFF);
    bool lampuAUTO = digitalRead(PIN_LAMPU_AUTO);

    if (modeOtomatis != lastModeOtomatis || heater Status != lastHeater Status ||
        statusWarnaGel != lastStatusWarnaGel || lampuON != lastLampuON ||
        lampuOFF != lastLampuOFF || lampuAUTO != lastLampuOTO) {

      Blynk.virtualWrite(V0, modeOtomatis ? "Otomatis" : "Manual");
      Blynk.virtualWrite(V1, heater Status ? "OFF" : "ON");
      Blynk.virtualWrite(V2, statusWarnaGel);

      // Kirim status lampu ke Blynk (V5, V6, V7)
      Blynk.virtualWrite(V7, lampuON ? 1 : 0);
      Blynk.virtualWrite(V8, lampuOFF ? 1 : 0);
      Blynk.virtualWrite(V9, lampuAUTO ? 1 : 0);

      // Update status terakhir
      lastModeOtomatis = modeOtomatis;
      lastHeater Status = heater Status;
      lastStatusWarnaGel = statusWarnaGel;
      lastLampuON = lampuON;
      lastLampuOFF = lampuOFF;
    }
  }
}

```

```

        lastLampuOTO = lampuAUTO;
    }
}

// Cek tombol lagi setelah blok pembacaan sensor (yang kini jauh lebih cepat
// berkat timeout pulseIn), untuk menambah "titik cek" tombol dalam satu loop.
prosesInputTombol();

// Kirim data berkala (Suhu & RGB) setiap 3 detik
if (currentMillis - prevBlynkTimer >= intervalBlynk) {
    prevBlynkTimer = currentMillis;
    Blynk.virtualWrite(V3, suhuTerakhir);
    Blynk.virtualWrite(V4, redColor);
    Blynk.virtualWrite(V5, greenColor);
    Blynk.virtualWrite(V6, blueColor);
}

// Kirim data realtime ke Google Sheets & update LCD setiap 1 detik
if (currentMillis - prevGSheetMillis >= intervalGSheet) {
    prevGSheetMillis = currentMillis;
    tampilkanLCD(suhuTerakhir);
    kirimKeGoogleSheets();
}

// Cek tombol sekali lagi setelah proses HTTP (yang paling lama memblokir),
// supaya penekanan tombol tidak "hilang" saat sedang mengirim ke Google
Sheets.
prosesInputTombol();

updateLampuIndikator();
}

void setRelayHeater (bool state) {
    // Jika state TRUE (ON), kirim LOW ke pin. Jika FALSE (OFF), kirim HIGH.
    digitalWrite(PIN_RELAY_HEATER, state ? LOW : HIGH);
}

// --- IMPLEMENTASI FUNGSI ---
void bacaSensor() {
    digitalWrite(PIN_TCS_S2, LOW); digitalWrite(PIN_TCS_S3, LOW);
    redFreq = pulseIn(PIN_TCS_OUT, LOW, TCS_PULSE_TIMEOUT);

    digitalWrite(PIN_TCS_S2, HIGH); digitalWrite(PIN_TCS_S3, HIGH);
    greenFreq = pulseIn(PIN_TCS_OUT, LOW, TCS_PULSE_TIMEOUT);

    digitalWrite(PIN_TCS_S2, LOW); digitalWrite(PIN_TCS_S3, HIGH);

```

```

blueFreq = pulseIn(PIN_TCS_OUT, LOW, TCS_PULSE_TIMEOUT);

redColor = constrain(map(redFreq, TCS_FREQ_MIN, TCS_FREQ_MAX, 0,
255), 0, 255);
greenColor = constrain(map(greenFreq, TCS_FREQ_MIN, TCS_FREQ_MAX,
0, 255), 0, 255);
blueColor = constrain(map(blueFreq, TCS_FREQ_MIN, TCS_FREQ_MAX, 0,
255), 0, 255);

// Baca suhu dari thermocouple K-type via modul MAX6675
float bacaan = thermocouple.readCelsius();

// MAX6675 mengembalikan NAN jika probe tidak terpasang/putus
if (!isnan(bacaan)) {
    suhuTerakhir = bacaan;
} else {
    Serial.println("[WARNING] Gagal membaca thermocouple (cek koneksi
MAX6675)");
}
}

void prosesInputTombol() {
    // Dipanggil beberapa kali per loop() (lihat loop()) agar penekanan tombol
    // langsung terdeteksi walau ada operasi lain yang memakan waktu (sensor
    // warna & pengiriman HTTP ke Google Sheets).
    if (digitalRead(PIN_TOMBOL_AUTO) == LOW) modeOtomatis = true;
    if (digitalRead(PIN_TOMBOL_ON) == LOW) { modeOtomatis = false;
setRelayHeater (true); }
    if (digitalRead(PIN_TOMBOL_OFF) == LOW) { modeOtomatis = false;
setRelayHeater (false); }
}

if ((redColor >= 75 && redColor <= 125) &&
    (greenColor >= 90 && greenColor <= 125) &&
    (blueColor >= 60 && blueColor <= 90)) {
    statusWarnaGel = "Ungu (Basah)";
}
else if ((redColor >= 130 && redColor <= 200) &&
    (greenColor >= 130 && greenColor <= 200) &&
    (blueColor >= 80 && blueColor <= 120)) {
    statusWarnaGel = "Biru (Kering)";
}
else {
    statusWarnaGel = "Tidak Terdeteksi";
}
}

```

```

    if (modeOtomatis) {
        if (statusWarnaGel == "Ungu (Basah)") setRelayHeater (true);
        else if (statusWarnaGel == "Biru (Kering)") setRelayHeater (false);
        if (suhu > 130.0) setRelayHeater (false);
    }
}

void tampilkanStatus(float suhu) {
    // Menentukan status apakah data dikirim ke Blynk (berdasarkan interval 3 detik)
    // Data dikirim jika sisa pembagian millis dengan 3000 mendekati 0
    bool isBlynkSending = (millis() % 3000 < 500);

    Serial.print("[STATUS] Mode: "); Serial.print(modeOtomatis ? "Otomatis" :
"Manual");
    Serial.print(" | Heater : "); Serial.print(digitalRead(PIN_RELAY_HEATER) ?
"OFF" : "ON");
    Serial.print(" | Gel: "); Serial.print(statusWarnaGel);
    Serial.print(" | Suhu: "); Serial.print(suhu); Serial.print(" C");
    Serial.print(" | RGB: "); Serial.print(redFreq); Serial.print(",");
Serial.print(greenFreq); Serial.print(","); Serial.print(blueFreq);
    Serial.print(" | Blynk: "); Serial.println(isBlynkSending ? "TERKIRIM" :
"Standby");
}

void updateLampuIndikator() {
    digitalWrite(PIN_LAMPU_AUTO, modeOtomatis);
    digitalWrite(PIN_LAMPU_ON, !digitalRead(PIN_RELAY_HEATER));
    digitalWrite(PIN_LAMPU_OFF, digitalRead(PIN_RELAY_HEATER));
}

// Cetak satu baris ke LCD 20x4, dipotong/ditambah spasi agar selalu genap 20
karakter
// (mencegah sisa karakter lama menempel di layar saat teks baru lebih pendek).
void lcdPrintLine(int baris, String teks) {
    while (teks.length() < 20) teks += " ";
    if (teks.length() > 20) teks = teks.substring(0, 20);
    lcd.setCursor(0, baris);
    lcd.print(teks);
}

void tampilkanLCD(float suhu) {
    bool heater Status = digitalRead(PIN_RELAY_HEATER); // HIGH = OFF
(relay aktif LOW)

    // Baris 1: Mode + status heater
    // -> Manual Heater ON / Manual Heater OFF / Otomatis Heater ON /

```

```

Otomatis Heater OFF
String baris1 = String(modeOtomatis ? "Otomatis" : "Manual");
baris1 += " Heater ";
baris1 += heater Status ? "OFF" : "ON";
lcdPrintLine(0, baris1);

// Baris 2: Suhu terbaca
lcdPrintLine(1, "Suhu: " + String(suhu, 2) + " C");

// Baris 3: Nilai R, G, B (skala 0-255)
lcdPrintLine(2, "R:" + String(redColor) + " G:" + String(greenColor) + " B:" +
String(blueColor));

// Baris 4: Status warna gel
lcdPrintLine(3, statusWarnaGel);
}

void kirimKeGoogleSheets() {
  if (WiFi.status() != WL_CONNECTED) {
    Serial.println("[GSHEET] WiFi tidak terhubung, lewati pengiriman");
    return;
  }

  WiFiClientSecure client;
  client.setInsecure(); // Google Apps Script pakai sertifikat publik, verifikasi di-
skip agar ringan di ESP32

  HTTPClient http;
  http.begin(client, GSHEET_URL);
  http.addHeader("Content-Type", "application/json");
  http.setFollowRedirects(HTTPC_FORCE_FOLLOW_REDIRECTS); // wajib,
karena Apps Script me-redirect ke googleusercontent.com

  bool heater Status = digitalRead(PIN_RELAY_HEATER);

  String payload = "{}";
  payload += "\"mode\": \"" + String(modeOtomatis ? "Otomatis" : "Manual") +
  "\"";
  payload += "\"heater\": \"" + String(heater Status ? "OFF" : "ON") + "\"";
  payload += "\"gel\": " + statusWarnaGel + "\"";
  payload += "\"suhu\": " + String(suhuTerakhir, 2) + "\"";
  payload += "\"red\": " + String(redColor) + "\"";
  payload += "\"green\": " + String(greenColor) + "\"";
  payload += "\"blue\": " + String(blueColor) + "\"";
  payload += "}";

```

```

int httpCode = http.POST(payload);

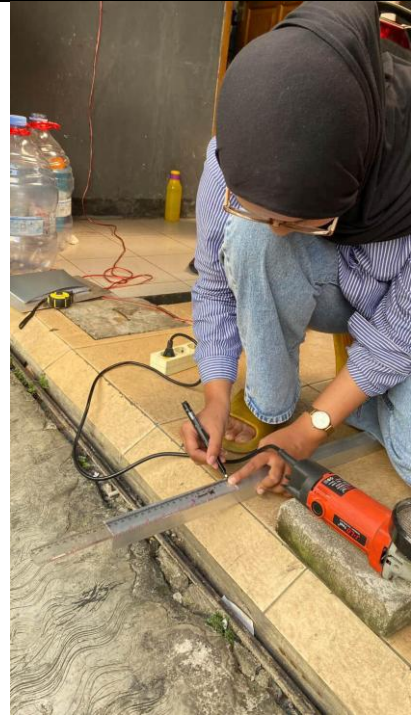
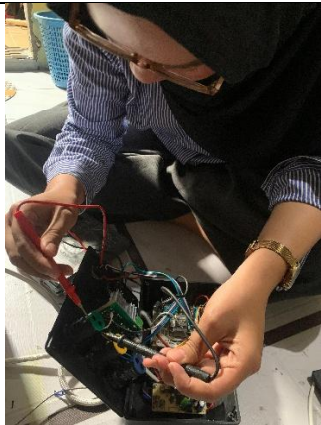
if (httpCode > 0) {
  Serial.print("[GSHEET] Terkirim, kode HTTP: ");
  Serial.println(httpCode);
} else {
  Serial.print("[GSHEET] Gagal kirim, error: ");
  Serial.println(http.errorToString(httpCode));
}

http.end();
}

```

Lampiran 2. Foto Pembuatan Alat dan Pengujian Alat





Google Spreadsheet Regenearasi Silica Gel

Log Monitoring Silica Gel ☆ 📎 Saving...
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K7 | fx

	A	B	C	D	E	F	G	H	
1	Timestamp	Mode	Heater	Status Gel	Suhu	Red	Green	Blue	
2	15/09/2026 17:56:00	Otomatis	ON	Ungu (Basah)	28	101	114	88	
3	15/09/2026 17:56:05	Otomatis	ON	Ungu (Basah)	28,75	101	113	88	
4	15/09/2026 17:56:10	Otomatis	ON	Ungu (Basah)	29	101	113	89	
5	15/09/2026 17:56:16	Otomatis	ON	Ungu (Basah)	28,75	102	113	89,5	
6	15/09/2026 17:56:20	Otomatis	ON	Ungu (Basah)	28,5	102	113,5	89	
7	15/09/2026 17:56:26	Otomatis	ON	Ungu (Basah)	29	102	113	90	
8	15/09/2026 17:56:30	Otomatis	ON	Ungu (Basah)	28,5	102	114	87	
9	15/09/2026 17:56:36	Otomatis	ON	Ungu (Basah)	29	102,5	114	88	
10	15/09/2026 17:56:41	Otomatis	ON	Ungu (Basah)	29	102,5	114,5	87	
11	15/09/2026 17:56:46	Otomatis	ON	Ungu (Basah)	28,75	103	145	87	
12	15/09/2026 17:56:50	Otomatis	ON	Ungu (Basah)	28,75	103	145	89	
13	15/09/2026 17:56:54	Otomatis	ON	Ungu (Basah)	28,5	102,5	146	89	
14	15/09/2026 17:56:58	Otomatis	ON	Ungu (Basah)	28,5	102	146	89	
15	15/09/2026 17:57:02	Otomatis	ON	Ungu (Basah)	29	103	145	90	
16	15/09/2026 17:57:06	Otomatis	ON	Ungu (Basah)	28,75	103	146	90,5	
17	15/09/2026 17:57:10	Otomatis	ON	Ungu (Basah)	28,75	104	147	90	
18	15/09/2026 17:57:14	Otomatis	ON	Ungu (Basah)	28,75	104	146	90	

Log Monitoring Silica Gel ☆ 📎
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	A	B	C	D	E	F	G	H	
987	15/09/2026 19:13:48	Otomatis	ON	Tidak Terdeteksi	124	126	134	101	
988	15/09/2026 19:13:51	Otomatis	ON	Tidak Terdeteksi	124,5	126	134	101	
989	15/09/2026 19:13:56	Otomatis	ON	Tidak Terdeteksi	124,5	126	134	101,5	
990	15/09/2026 19:14:00	Otomatis	ON	Tidak Terdeteksi	124,5	127	134	101	
991	15/09/2026 19:14:03	Otomatis	ON	Tidak Terdeteksi	124	127	135	101	
992	15/09/2026 19:14:08	Otomatis	ON	Tidak Terdeteksi	124	126,5	135	102	
993	15/09/2026 19:14:12	Otomatis	ON	Tidak Terdeteksi	124	127	135	101,5	
994	15/09/2026 19:14:16	Otomatis	ON	Tidak Terdeteksi	124	127	136	102	
995	15/09/2026 19:14:20	Otomatis	ON	Tidak Terdeteksi	126	127	136	102	
996	15/09/2026 19:14:26	Otomatis	OFF	Biru (Kering)	126	130	137	103	
997	15/09/2026 19:14:31	Otomatis	OFF	Biru (Kering)	126	130	136	102	
998	15/09/2026 19:14:35	Otomatis	OFF	Biru (Kering)	125,5	129	137	102	
999	15/09/2026 19:14:38	Otomatis	OFF	Biru (Kering)	126	128	137	103	
1000	15/09/2026 19:14:43	Otomatis	OFF	Biru (Kering)	126	129	138	103	
1001	15/09/2026 19:14:48	Otomatis	OFF	Biru (Kering)	125	128	139	104	
1002	15/09/2026 19:14:52	Otomatis	OFF	Biru (Kering)	125	130	138	104	
1003	15/09/2026 19:14:58	Otomatis	OFF	Biru (Kering)	126	130	138	104	
1004	15/09/2026 19:15:02	Otomatis	OFF	Biru (Kering)	126	130	138	104	

Lampiran 3. Datasheet

Thermocouple Type – k

Thermocouple type K



Thermocouple type K

Order nr.: 803910 1211

Thermocouples have a simple structure. The two thermocouple wires are welded at the tip and remain without a protection sleeve. Therefore, thermocouples are characterized by particularly fast response times and a wide range of applications. The thermocouples can be used in a temperature range from -40 °C to +350 °C. You will find thermocouples of type J (Fe-CuNi) and type K (NiCr-Ni), we will be pleased to offer you others on request.



General information	
Measuring range	-40 °C to +350 °C
Perm. °C range cable	-50 °C to +350 °C
Accuracy	-40 °C to +375 °C: ±1,5 °C according to DIN IEC 60584 Class 1
Response time	t63 / t99: information is available on request
Pull-out force	≥ 30 N
Supply and output	
Measuring element	Thermocouple Type K
Measuring point	Welding point not insulated
Measurement signal	Thermovoltage
Ambient conditions	
Protection class	IP20 according to DIN 60529
Humidity and moisture condensation resistance	according to application-specific qualification
Certificates and Standards	
Standards	DIN EN 61326-1:2013 DIN EN IEC 63000:2019-05
Directive	RoHS 2011/65/EU 2014/30/EU
Certificates	Certificate of suitability (on request)



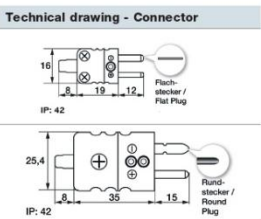
Customizable options
E - Material connection cable
F - Length connection cable
G - Connector

E - Cable material and configuration connection cable											
Code	Type	Color	IP	From (°C) ¹⁾	To (°C) ²⁾	Outside material	Isol. Leads	Sheath (mm) ³⁾	Q (mm ²)	Color Leads	Ω / m ⁴⁾
E8321	Thermocouple cable	Type K ³⁾	IP20	-50	+350	Glass fibre	Glass fibre	2,0 x 1,2	0,2	gn, wt	2,00

Insulation resistance: ≥ 100 MOhm at min. 100 VDC | ¹⁾Perm. range °C | ²⁾Tolerance ± 0,2 mm | ³⁾Color according to IEC 584 | ⁴⁾per thermocouple

F - Length								
Code	F010	F020	F030	F040	F050	F100	F150	F200
m	1	2	3	4	5	10	15	20

Your order code			
Order nr.	Material connection cable	Length connection cable	Connector
803910 1211	E_____	F_____	G_____



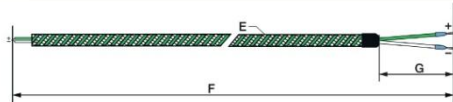
RL / KS / 17.03.2022

G - Connector					
Picture	Code	Feature	Bild	Code	Merkmal
	G01 ¹⁾	Insulated end ferrules (50 mm)			
	G12	Mini-TE-Stecker Typ K gn		G19	Mini-TC connector Type K ye
	G321 ¹⁾	TE-Stecker Typ K gn		G391 ¹⁾	TC connector Type K ye

1) auf Anfrage | Weitere Stecker auf Anfrage erhältlich

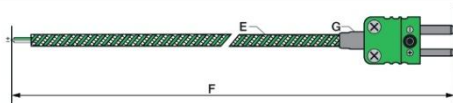
Technical drawing

Version with insulated end ferrules

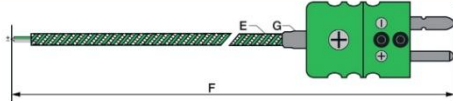


Konfigurierbare Optionen
E - Material Anschlussleitung
F - Länge Anschlussleitung
G - Stecker
All dimensions in mm

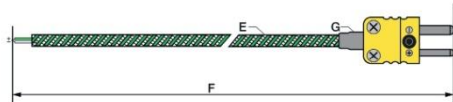
Variante mit Mini-TE-Stecker



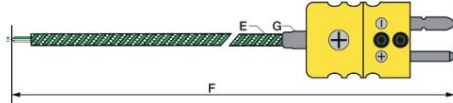
Variante mit TE-Stecker



Version with mini TE connector



Version with TE connector



RL / KS / 17.03.2022

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TCS3200



TCS3200, TCS3210 PROGRAMMABLE COLOR LIGHT-TO-FREQUENCY CONVERTER

TAOS099A – AUGUST 2011

Terminal Functions

TERMINAL NAME	NO.	I/O	DESCRIPTION
GND	4		Power supply ground. All voltages are referenced to GND.
OE	3	I	Enable for f_0 (active low).
OUT	6	O	Output frequency (f_0).
S0, S1	1, 2	I	Output frequency scaling selection inputs.
S2, S3	7, 8	I	Photodiode type selection inputs.
V _{DD}	5		Supply voltage

Table 1. Selectable Options

S0	S1	OUTPUT FREQUENCY SCALING (f_0)	S2	S3	PHOTODIODE TYPE
L	L	Power down	L	L	Red
L	H	2%	L	H	Blue
H	L	20%	H	L	Clear (no filter)
H	H	100%	H	H	Green

Available Options

DEVICE	T _A	PACKAGE – LEADS	PACKAGE DESIGNATOR	ORDERING NUMBER
TCS3200	–40°C to 85°C	SOIC–8	D	TCS3200D
TCS3210	–40°C to 85°C	SOIC–8	D	TCS3210D

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The LUMENOLGY® Company

TCS3200, TCS3210
PROGRAMMABLE
COLOR LIGHT-TO-FREQUENCY CONVERTER
TAOS099A – AUGUST 2011

Terminal Functions

TERMINAL NAME	NO.	I/O	DESCRIPTION
GND	4		Power supply ground. All voltages are referenced to GND.
OE	3	I	Enable for f_o (active low).
OUT	6	O	Output frequency (f_o).
S0, S1	1, 2	I	Output frequency scaling selection inputs.
S2, S3	7, 8	I	Photodiode type selection inputs.
V _{DD}	5		Supply voltage

Table 1. Selectable Options

S0	S1	OUTPUT FREQUENCY SCALING (f_o)	S2	S3	PHOTODIODE TYPE
L	L	Power down	L	L	Red
L	H	2%	L	H	Blue
H	L	20%	H	L	Clear (no filter)
H	H	100%	H	H	Green

Available Options

DEVICE	T _A	PACKAGE – LEADS	PACKAGE DESIGNATOR	ORDERING NUMBER
TCS3200	–40°C to 85°C	SOIC–8	D	TCS3200D
TCS3210	–40°C to 85°C	SOIC–8	D	TCS3210D

TCS3200, TCS3210
PROGRAMMABLE
COLOR LIGHT-TO-FREQUENCY CONVERTER
TAOS099A – AUGUST 2011

Absolute Maximum Ratings over operating free-air temperature range (unless otherwise noted)[†]

Supply voltage, V_{DD} (see Note 1)	6 V
Input voltage range, all inputs, V_I	-0.3 V to $V_{DD} + 0.3$ V
Operating free-air temperature range, T_A (see Note 2)	-40°C to 85°C
Storage temperature range (see Note 2)	-40°C to 85°C
Solder conditions in accordance with JEDEC J-STD-020A, maximum temperature (see Note 3)	260°C

[†] Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES: 1. All voltage values are with respect to GND.
2. Long-term storage or operation above 70°C could cause package yellowing that will lower the sensitivity to wavelengths < 500nm.
3. The device may be hand soldered provided that heat is applied only to the solder pad and no contact is made between the tip of the solder iron and the device lead. The maximum time heat should be applied to the device is 5 seconds.

Recommended Operating Conditions

		MIN	NOM	MAX	UNIT
Supply voltage, V_{DD}		2.7	5	5.5	V
High-level input voltage, V_{IH}	$V_{DD} = 2.7$ V to 5.5 V	2		V_{DD}	V
Low-level input voltage, V_{IL}	$V_{DD} = 2.7$ V to 5.5 V	0		0.8	V
Operating free-air temperature range, T_A		-40		70	°C

Electrical Characteristics at $T_A = 25^\circ\text{C}$, $V_{DD} = 5$ V (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{OH} High-level output voltage	$I_{OH} = -2$ mA	4	4.5		V
V_{OL} Low-level output voltage	$I_{OL} = 2$ mA		0.25	0.40	V
I_{IH} High-level input current				5	μA
I_{IL} Low-level input current				5	μA
I_{DD} Supply current	Power-on mode		1.4	2	mA
	Power-down mode			0.1	μA
Full-scale frequency (See Note 4)	$S0 = H$, $S1 = H$	500	600		kHz
	$S0 = H$, $S1 = L$	100	120		kHz
	$S0 = L$, $S1 = H$	10	12		kHz
Temperature coefficient of responsivity	$\lambda \leq 700$ nm, $-25^\circ\text{C} \leq T_A \leq 70^\circ\text{C}$		±200		ppm/°C
k_{SVS} Supply voltage sensitivity	$V_{DD} = 5$ V ±10%		±0.5		%/V

NOTE 4: Full-scale frequency is the maximum operating frequency of the device without saturation.

Relay

SONGLE RELAY

	RELAY ISO9002	SRD
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1. MAIN FEATURES

- Switching capacity available by 10A in spite of small size design for highdensity P.C. board mounting technique.
- UL,CUL,TUV recognized.
- Selection of plastic material for high temperature and better chemical solution performance.
- Sealed types available.
- Simple relay magnetic circuit to meet low cost of mass production.

2. APPLICATIONS

- Domestic appliance, office machine, audio, equipment, automobile, etc.
(Remote control TV receiver, monitor display, audio equipment high rushing current use application.)

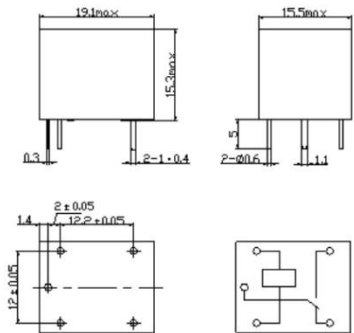
3. ORDERING INFORMATION

SRD	XX VDC	S	L	C
Model of relay	Nominal coil voltage	Structure	Coil sensitivity	Contact form
SRD	03、05、06、09、12、24、48VDC	S:Sealed type	L:0.36W	A:1 form A
		F:Flux free type	D:0.45W	B:1 form B
				C:1 form C

4. RATING

CCC FILE NUMBER: CQC03001003731 10A/250VDC
UL/CUL FILE NUMBER: E167996 10A/125VAC 28VDC
TUV FILE NUMBER: R50056114 10A/250VAC 30VDC

5. DIMENSION(unit:mm) DRILLING(unit:mm) WIRING DIAGRAM



6. COIL DATA CHART (AT20°C)

Coil Sensitivity	Coil Voltage Code	Nominal Voltage (VDC)	Nominal Current (mA)	Coil Resistance (Ω) $\pm 10\%$	Power Consumption (W)	Pull-In Voltage (VDC)	Drop-Out Voltage (VDC)	Max-Allowable Voltage (VDC)
SRD (High Sensitivity)	03	03	120	25	abt. 0.36W	75%Max.	10% Min.	120%
	05	05	71.4	70				
	06	06	60	100				
	09	09	40	225				
	12	12	30	400				
	24	24	15	1600				
SRD (Standard)	48	48	7.5	6400	abt. 0.45W	75% Max.	10% Min.	110%
	03	03	150	20				
	05	05	89.3	55				
	06	06	75	80				
	09	09	50	180				
	12	12	37.5	320				
	24	24	18.7	1280	abt. 0.51W			
	48	48	10	4500				

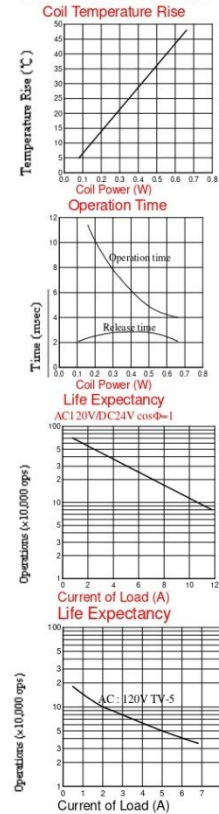
7. CONTACT RATING

Item	Type	SRD
	FORM C	FORM A
Contact Capacity		
Resistive Load ($\cos\phi=1$)	10A 125VAC	10A 30VDC 10A 250VAC
Inductive Load ($\cos\phi=0.4$ L/R=7msec)	3A 120VAC 3A 28VDC	5A 120VAC 5A 28VDC
Max. Allowable Voltage	250VAC/110VDC	250VAC/110VDC
Max. Allowable Power Force	800VAC/240W	1200VA/300W
Contact Material	AgCdO	AgCdO

8. PERFORMANCE (at initial value)

Item	Type	SRD
Contact Resistance		100m Ω Max.
Operation Time		10msec Max.
Release Time		5msec Max.
Dielectric Strength		
Between coil & contact		1500VAC 50/60HZ (1 minute)
Between contacts		1000VAC 50/60HZ (1 minute)
Insulation Resistance		100 M Ω Min. (500VDC)
Max. ON/OFF Switching		
Mechanically		300 operation/min
Electrically		30 operation/min
Ambient Temperature		-40°C to +85°C
Operating Humidity		45 to 85% RH
Vibration		
Endurance		10 to 55Hz Double Amplitude 1.5mm
Error Operation		10 to 55Hz Double Amplitude 1.5mm
Shock		
Endurance		100G Min.
Error Operation		10G Min.
Life Expectancy		
Mechanically		10 ⁷ operations. Min. (no load)
Electrically		10 ⁵ operations. Min. (at rated coil voltage)
Weight		abt. 10grs.

9. REFERENCE DATA



I2C SERIAL 20X4 LCD MODULE

SBC-LCD20x4



This 20x4 character LCD suits perfectly for your project. It works with a PCF8574 adapter chip and a blue backlight. Moreover, it is conforming to the HD44780 industrial standard.



MAIN FEATURES

Model	Serial I2C 20x4 2004 LCD module
Characters	20 x 4 characters (4 rows with 20 columns)
Adapterchip	PCF8574
Compatible with	Raspberry Pi
Special feature	Soldered I2C-communication-adapter: Only 4 I/O lines are needed (power supply + 2 data-lines)
Dimensions	9,8 x 6 x 2 cm
Scope of delivery	Serial I2C 20x4 2004 LCD module

FURTHER SPECIFICATIONS

Address range	0 x 20 - 0 x 27
Industrial standard	HD44780
Backlight	Blue
Logic level	3.3 V & 5 V (by a power supply of 5V)

FURTHER DETAILS

Article No.	SBC-LCD20x4
EAN	4250236813226
Customs tariff No.	8473302000

Published: 19.03.2020

www.joy-it.net
SIMAC Electronics GmbH,
Pascalstr. 8, 47506 Neukirchen-Vluyn

Modul MP1584



MP1584 3A, 1.5MHz, 28V Step-Down Converter

DESCRIPTION

The MP1584 is a high frequency step-down switching regulator with an integrated internal high-side high voltage power MOSFET. It provides 3A output with current mode control for fast loop response and easy compensation.

The wide 4.5V to 28V input range accommodates a variety of step-down applications, including those in an automotive input environment. A 100 μ A operational quiescent current allows use in battery-powered applications.

High power conversion efficiency over a wide load range is achieved by scaling down the switching frequency at light load condition to reduce the switching and gate driving losses.

The frequency foldback helps prevent inductor current runaway during startup and thermal shutdown provides reliable, fault tolerant operation.

By switching at 1.5MHz, the MP1584 is able to prevent EMI (Electromagnetic Interference) noise problems, such as those found in AM radio and ADSL applications.

The MP1584 is available in a thermally enhanced SOIC8E package.

FEATURES

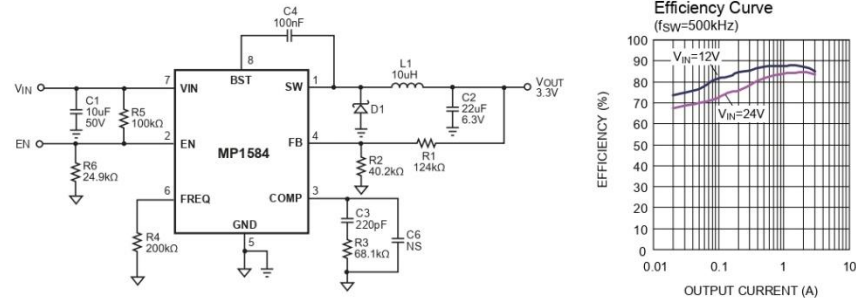
- Wide 4.5V to 28V Operating Input Range
- Programmable Switching Frequency from 100kHz to 1.5MHz
- High-Efficiency Pulse Skipping Mode for Light Load
- Ceramic Capacitor Stable
- Internal Soft-Start
- Internally Set Current Limit without a Current Sensing Resistor
- Available in SOIC8E Package.

APPLICATIONS

- High Voltage Power Conversion
- Automotive Systems
- Industrial Power Systems
- Distributed Power Systems
- Battery Powered Systems

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TYPICAL APPLICATION

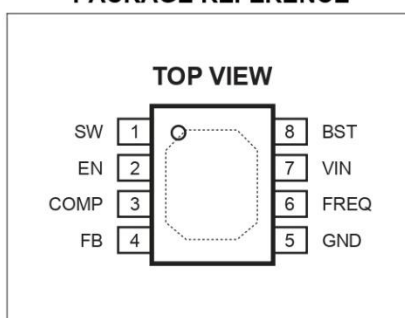


ORDERING INFORMATION

Part Number*	Package	Top Marking	Free Air Temperature (T _A)
MP1584EN	SOIC8E	MP1584EN	–20°C to +85°C

* For Tape & Reel, add suffix –Z (e.g. MP1584EN–Z);
For RoHS Compliant Packaging, add suffix –LF. (e.g. MP1584EN–LF–Z)

PACKAGE REFERENCE

**ABSOLUTE MAXIMUM RATINGS** ⁽¹⁾

Supply Voltage (V_{IN}).....–0.3V to +30V
 Switch Voltage (V_{SW}).....–0.3V to V_{IN} + 0.3V
 BST to SW–0.3V to +6V
 All Other Pins–0.3V to +6V
 Continuous Power Dissipation (T_A = +25°C)⁽²⁾ 2.5W
 Junction Temperature 150°C
 Lead Temperature 260°C
 Storage Temperature..... –65°C to +150°C

Recommended Operating Conditions ⁽³⁾

Supply Voltage V_{IN}..... 4.5V to 28V
 Output Voltage V_{OUT}..... 0.8V to 25V

Operating Junct. Temp (T_J)–20°C to +125°C

Thermal Resistance ⁽⁴⁾

SOIC8E 50 10... °C/W

Notes:

- Exceeding these ratings may damage the device.
- The maximum allowable power dissipation is a function of the maximum junction temperature T_J(MAX), the junction-to-ambient thermal resistance θ_{JA}, and the ambient temperature T_A. The maximum allowable continuous power dissipation at any ambient temperature is calculated by P_D(MAX)=(T_J(MAX)–T_A)/ θ_{JA}. Exceeding the maximum allowable power dissipation will cause excessive die temperature, and the regulator will go into thermal shutdown. Internal thermal shutdown circuitry protects the device from permanent damage.
- The device is not guaranteed to function outside of its operating conditions.
- Measured on JE51-7, 4-layer PCB.

ELECTRICAL CHARACTERISTICS

$V_{IN} = 12V$, $V_{EN} = 2.5V$, $V_{COMP} = 1.4V$, $T_A = +25^{\circ}C$, unless otherwise noted.

Parameter	Symbol	Condition	Min	Typ	Max	Units
Feedback Voltage	V_{FB}	$4.5V < V_{IN} < 28V$	0.776	0.8	0.824	V
Upper Switch On Resistance	$R_{DS(ON)}$	$V_{BST} - V_{SW} = 5V$		150		m Ω
Upper Switch Leakage		$V_{EN} = 0V$, $V_{SW} = 0V$, $V_{IN} = 28V$		1		μA
Current Limit			4.0	4.7		A
COMP to Current Sense Transconductance	G_{CS}			9		A/V
Error Amp Voltage Gain ⁽²⁾				200		V/V
Error Amp Transconductance		$I_{COMP} = \pm 3\mu A$	40	60	80	$\mu A/V$
Error Amp Min Source current		$V_{FB} = 0.7V$		5		μA
Error Amp Min Sink current		$V_{FB} = 0.9V$		-5		μA
VIN UVLO Threshold			2.7	3.0	3.3	V
VIN UVLO Hysteresis				0.35		V
Soft-Start Time ⁽²⁾		$0V < V_{FB} < 0.8V$		1.5		ms
Oscillator Frequency		$R_{FREQ} = 100k\Omega$		900		kHz
Shutdown Supply Current		$V_{EN} = 0V$		12	20	μA
Quiescent Supply Current		No load, $V_{FB} = 0.9V$		100	125	μA
Thermal Shutdown				150		$^{\circ}C$
Thermal Shutdown Hysteresis				15		$^{\circ}C$
Minimum Off Time ⁽²⁾				100		ns
Minimum On Time ⁽²⁾				100		ns
EN Up Threshold			1.35	1.5	1.65	V
EN Hysteresis				300		mV

Note:

5) Guaranteed by design.

PIN FUNCTIONS

SOIC Pin #	Name	Description
1	SW	Switch Node. This is the output from the high-side switch. A low forward drop Schottky diode to ground is required. The diode must be close to the SW pins to reduce switching spikes.
2	EN	Enable Input. Pulling this pin below the specified threshold shuts the chip down. Pulling it up above the specified threshold or leaving it floating enables the chip.
3	COMP	Compensation. This node is the output of the error amplifier. Control loop frequency compensation is applied to this pin.
4	FB	Feedback. This is the input to the error amplifier. The output voltage is set by a resistive divider connected between the output and GND which scales down V_{OUT} equal to the internal +0.8V reference.
5	GND Exposed Pad	Ground. It should be connected as close as possible to the output capacitor to shorten the high current switch paths. Connect exposed pad to GND plane for optimal thermal performance.
6	FREQ	Switching Frequency Program Input. Connect a resistor from this pin to ground to set the switching frequency.
7	VIN	Input Supply. This supplies power to all the internal control circuitry, both BS regulators and the high-side switch. A decoupling capacitor to ground must be placed close to this pin to minimize switching spikes.
8	BST	Bootstrap. This is the positive power supply for the internal floating high-side MOSFET driver. Connect a bypass capacitor between this pin and SW pin.

Modul MAX6675

EVALUATION KIT AVAILABLE

Click [here](#) to ask about the production status of specific part numbers.

MAX6675

Cold-Junction-Compensated K-Thermocouple-to-Digital Converter (0°C to +1024°C)

General Description

The MAX6675 performs cold-junction compensation and digitizes the signal from a type-K thermocouple. The data is output in a 12-bit resolution, SPI-compatible, read-only format.

This converter resolves temperatures to 0.25°C, allows readings as high as +1024°C, and exhibits thermocouple accuracy of 8 LSBs for temperatures ranging from 0°C to +700°C.

The MAX6675 is available in a small, 8-pin SO package.

Applications

- Industrial
- Appliances
- HVAC

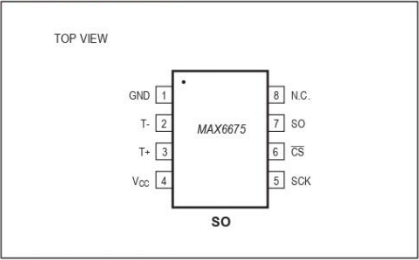
Features

- Direct Digital Conversion of Type -K Thermocouple Output
- Cold-Junction Compensation
- Simple SPI-Compatible Serial Interface
- 12-Bit, 0.25°C Resolution
- Open Thermocouple Detection

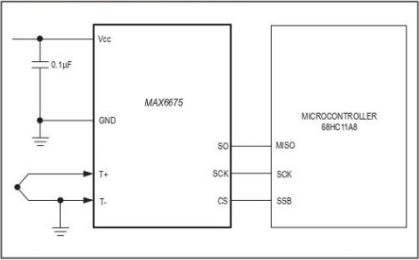
Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
MAX6675ISA	-20°C to +85°C	8 SO

Pin Configuration



Typical Application Circuit



MAX6675

Cold-Junction-Compensated K-Thermocouple-to-Digital Converter (0°C to +1024°C)

Absolute Maximum Ratings

Supply Voltage (V_{CC} to GND) -0.3V to +6V
 SO, SCK, CS, T-, T+ to GND -0.3V to $V_{CC} + 0.3V$
 SO Current 50mA
 ESD Protection (Human Body Model) $\pm 2000V$
 Continuous Power Dissipation ($T_A = +70^\circ C$) 471mW
 8-Pin SO (derate 5.88mW/ $^\circ C$ above $+70^\circ C$) 471mW
 Operating Temperature Range $-20^\circ C$ to $+85^\circ C$

Storage Temperature Range $-65^\circ C$ to $+150^\circ C$
 Junction Temperature $+150^\circ C$
 SO Package
 Vapor Phase (60s) $+215^\circ C$
 Infrared (15s) $+220^\circ C$
 Lead Temperature (soldering, 10s) $+300^\circ C$

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Electrical Characteristics

($V_{CC} = +3.0V$ to $+5.5V$, $T_A = -20^\circ C$ to $+85^\circ C$, unless otherwise noted. Typical values specified at $+25^\circ C$.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Temperature Error		$T_{THERMOCOUPLE} = +700^\circ C$, $T_A = +25^\circ C$ (Note 2)	$V_{CC} = +3.3V$	-5	+5	LSB
			$V_{CC} = +5V$	-6	+6	
		$T_{THERMOCOUPLE} = 0^\circ C$ to $+700^\circ C$, $T_A = +25^\circ C$ (Note 2)	$V_{CC} = +3.3V$	-8	+8	
			$V_{CC} = +5V$	-9	+9	
		$T_{THERMOCOUPLE} = +700^\circ C$ to $+1000^\circ C$, $T_A = +25^\circ C$ (Note 2)	$V_{CC} = +3.3V$	-17	+17	
			$V_{CC} = +5V$	-19	+19	
Thermocouple Conversion Constant				10.25		$\mu V/LSB$
Cold-Junction Compensation Error		$T_A = -20^\circ C$ to $+85^\circ C$ (Note 2)	$V_{CC} = +3.3V$	-3.0	+3.0	$^\circ C$
			$V_{CC} = +5V$	-3.0	+3.0	
Resolution				0.25		$^\circ C$
Thermocouple Input Impedance				60		$k\Omega$
Supply Voltage	V_{CC}			3.0	5.5	V
Supply Current	I_{CC}			0.7	1.5	mA
Power-On Reset Threshold		V_{CC} rising		1	2	2.5
Power-On Reset Hysteresis				50		mV
Conversion Time		(Note 2)		0.17	0.22	s
SERIAL INTERFACE						
Input Low Voltage	V_{IL}				$0.3 \times V_{CC}$	V
Input High Voltage	V_{IH}			$0.7 \times V_{CC}$		V
Input Leakage Current	I_{LEAK}	$V_{IN} = GND$ or V_{CC}			± 5	μA
Input Capacitance	C_{IN}			5		pF

Pin Description

PIN	NAME	FUNCTION
1	GND	Ground
2	T-	Alumel Lead of Type-K Thermocouple. Should be connected to ground externally.
3	T+	Chromel Lead of Type-K Thermocouple
4	V _{CC}	Positive Supply. Bypass with a 0.1µF capacitor to GND.
5	SCK	Serial Clock Input
6	$\overline{\text{CS}}$	Chip Select. Set CS low to enable the serial interface.
7	SO	Serial Data Output
8	N.C.	No Connection

Detailed Description

The MAX6675 is a sophisticated thermocouple-to-digital converter with a built-in 12-bit analog-to-digital converter (ADC). The MAX6675 also contains cold-junction compensation sensing and correction, a digital controller, an SPI-compatible interface, and associated control logic.

The MAX6675 is designed to work in conjunction with an external microcontroller (µC) or other intelligence in thermodynamic, process-control, or monitoring applications.

Temperature Conversion

The MAX6675 includes signal-conditioning hardware to convert the thermocouple's signal into a voltage compatible with the input channels of the ADC. The T+ and T- inputs connect to internal circuitry that reduces the introduction of noise errors from the thermocouple wires.

Before converting the thermoelectric voltages into equivalent temperature values, it is necessary to compensate for the difference between the thermocouple cold-junction side (MAX6675 ambient temperature) and a 0°C virtual reference. For a type-K thermocouple, the voltage changes by 41µV/°C, which approximates the thermocouple characteristic with the following linear equation:

$$V_{\text{OUT}} = (41\mu\text{V} / ^\circ\text{C}) \times (T_R - T_{\text{AMB}})$$

Where:

V_{OUT} is the thermocouple output voltage (µV).

T_R is the temperature of the remote thermocouple junction (°C).

T_{AMB} is the ambient temperature (°C).

Cold-Junction Compensation

The function of the thermocouple is to sense a difference in temperature between two ends of the thermocouple wires. The thermocouple's hot junction can be read from 0°C to +1023.75°C. The cold end (ambient temperature of the board on which the MAX6675 is mounted) can only range from -20°C to +85°C. While the temperature at the cold end fluctuates, the MAX6675 continues to accurately sense the temperature difference at the opposite end.

The MAX6675 senses and corrects for the changes in the ambient temperature with cold-junction compensation. The device converts the ambient temperature reading into a voltage using a temperature-sensing diode. To make the actual thermocouple temperature measurement, the MAX6675 measures the voltage from the thermocouple's output and from the sensing diode. The device's internal circuitry passes the diode's voltage (sensing ambient temperature) and thermocouple voltage (sensing remote temperature minus ambient temperature) to the conversion function stored in the ADC to calculate the thermocouple's hot-junction temperature.

Optimal performance from the MAX6675 is achieved when the thermocouple cold junction and the MAX6675 are at the same temperature. Avoid placing heat-generating devices or components near the MAX6675 because this may produce cold-junction-related errors.

Digitization

The ADC adds the cold-junction diode measurement with the amplified thermocouple voltage and reads out the 12-bit result onto the SO pin. A sequence of all zeros means the thermocouple reading is 0°C. A sequence of all ones means the thermocouple reading is +1023.75°C.

ESP32

Table 1: ESP32-WROOM-32 Specifications

Categories	Items	Specifications
Certification	RF certification	FCC/CE-RED/IC/TELEC/KCC/SRRC/NCC
	Wi-Fi certification	Wi-Fi Alliance
	Bluetooth certification	BQB
	Green certification	RoHS/REACH
Test	Reliability	HTOL/HTSL/uHAST/TCT/ESD
Wi-Fi	Protocols	802.11 b/g/n (802.11n up to 150 Mbps) A-MPDU and A-MSDU aggregation and 0.4 μ s guard interval support
	Frequency range	2.4 GHz ~ 2.5 GHz
Bluetooth	Protocols	Bluetooth v4.2 BR/EDR and BLE specification
	Radio	NZIF receiver with -97 dBm sensitivity
		Class-1, class-2 and class-3 transmitter
		AFH

Espressif Systems

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1. Overview

Categories	Items	Specifications
	Audio	CVSD and SBC
Hardware	Module interfaces	SD card, UART, SPI, SDIO, I ² C, LED PWM, Motor PWM, I ² S, IR, pulse counter, GPIO, capacitive touch sensor, ADC, DAC
	On-chip sensor	Hall sensor
	Integrated crystal	40 MHz crystal
	Integrated SPI flash	4 MB
	Operating voltage/Power supply	3.0 V ~ 3.6 V
	Operating current	Average: 80 mA
	Minimum current delivered by power supply	500 mA
	Recommended operating temperature range	-40 °C ~ +85 °C
	Package size	(18.00±0.10) mm × (25.50±0.10) mm × (3.10±0.10) mm
	Moisture sensitivity level (MSL)	Level 3