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LAMPIRAN

Lampiran 1. Sertifikat kalibrasi temperature logger

	PT. POLARITAS MULTITRANS TECHNOLOGY Laboratorium Kalibrasi Izin Operasional Institusi Pengujian Alat Kesehatan KEMENKES DIRJENYANKES NO. HK.02.02/II/4316/2019		
Lingkup Kalibrasi : Instrumen Medis, Suhu dan Kelembaban, Massa, Volumetrik, Tekanan, Gaya, Aliran, Akustik, Waktu dan Frekuensi, Fotometri, Instrumen Analitik Scope of Calibration : Medical Instruments, Temperature and Humidity, Mass, Volumetric, Pressure, Force, Flow, Acoustics, Time and Frequency, Photometry, Analytical Instruments			
SERTIFIKAT KALIBRASI CALIBRATION CERTIFICATE Nomor / Number : C.231101003 Order / Order : SO.2311002			
IDENTITAS ALAT <i>INSTRUMENT DETAIL</i>			
Nama Alat <i>Instrument</i>	: Temperature Data Logger Type k (10 CH)		
Merek Pabrik <i>Manufacturer</i>	: HIOKI		
Model/Tipe <i>Model/Type</i>	: Memory Hi Logger / LR8400-20		
Nomor Seri <i>Serial Number</i>	: 171045825		
Resolusi <i>Resolution</i>	: 0,05 °C		
Rentang Ukur <i>Measure Range</i>	: (-200 ~ 1260) °C		
Nomor Inventaris <i>Inventory Number</i>	: -		
IDENTITAS PEMILIK <i>OWNER IDENTIFICATION</i>			
Nama Pelanggan <i>Customer</i>	: PT. Fukuda Technology		
Alamat <i>Address</i>	: Jl. Raya Cikarang Cibusah, Komp. Cikarang Square B-22, Cikarang Selatan, Bekasi 17750		
Tanggal Terbit <i>Date of Issue</i>	: 09 November 2023		
Jumlah Halaman Sertifikat : - 3 - Number of Pages of The Certificate Hal/Page 1 Dari/From 3 Penanggung Jawab Laboratorium Responsible Person for Laboratory  Agus Kurniawan, S.Si Manajer Teknik			
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INFORMASI KALIBRASI

CALIBRATION INFORMATION

Tempat Kalibrasi : In - House
Calibration Place
Tanggal Terima : 02 November 2023
Date of Acceptance
Tanggal Kalibrasi : 02 November 2023
Date of Calibration
Prosedur : IK.T-K-LAB.I.21-TD.S03.1
Procedure
Acuan : DKD-R 5-1 09 : 2018
Reference

Rentang Kalibrasi : (-20 ~ 150) °C

Calibration Range

Dikalibrasi oleh : Vannesse Edwar Altarice Gea
Calibrated by
Diperiksa oleh : Moh. Fahmi Haifan, S.T
Checked by

KONDISI LINGKUNGAN

ENVIRONMENTAL CONDITIONS

Termohigrometer : SMT026
Thermohygrometer

Suhu : (21.4 ± 0.3) °C
Temperature

Kelembapan : (54.9 ± 2.2) %RH
Relative Humidity

Semua pengukuran dilakukan di Laboratorium Suhu dan Kelembaban - PMT
All measurements were carried out at the Laboratory of Temperature & Humidity - PMT.

PERALATAN PENGUKURAN/MEASURING EQUIPMENT

Standar Referensi <i>Reference Standards</i>	No. ID <i>ID-No</i>	No. Seri <i>Serial-No.</i>	Ketertelusuran <i>Traceability</i>
Thermohygro Digital	SMT026	40375148	LK-160-IDN
IPRT	SMT036	1620875	LK-070-IDN
Multifunction Temperature Calibrator (LI)	SMT005	1705063	LK-160-IDN
Precision Temperature Scanner	SMT035	50985108	NVLAP 105016-0

METODE KALIBRASI/METHOD OF CALIBRATION

Termometer digital ini dikalibrasi dengan IPRT PT-100 di dalam bak cairan. Hasil kalibrasi yang dilaporkan dapat ditelusuri ke satuan SI melalui Institut Nasional Metrologi / Internasional Metrologi dan/atau laboratorium kalibrasi yang terakreditasi. / The digital thermometer was calibrated by a IPRT PT-100 in an liquid bath. The reported calibration results can be traced to SI units through the Institute Recognized National / International Metrology and/or accredited calibration laboratory.

KONDISI PENGUKURAN/MEASURING CONDITIONS

Probe dan termometer referensi dicelupkan ke dalam bak cairan selama kalibrasi. Kedalaman pencelupan adalah 200 mm. / The probe and reference thermometer are immersed in the liquid bath during calibration. The immersion depth is 200 mm. $\neq$

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HASIL KALIBRASI/ CALIBRATION RESULT

TK CP	Penunjukan Alat/ Device Reading									
	Koreksi/ Correction									
(°C)	CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	CH 9	CH 10
-20	-18.60	-18.65	-18.50	-18.65	-18.60	-18.65	-18.65	-18.70	-18.65	-18.45
Koreksi	-1.75	-1.70	0.00	-1.70	-1.75	-1.70	-1.70	-1.65	-1.70	-1.90
-10	-8.80	-8.85	-8.75	-8.90	-8.85	-8.90	-8.90	-8.90	-8.90	-8.75
Koreksi	-1.25	-1.20	-1.30	-1.15	-1.20	-1.15	-1.15	-1.15	-1.15	-1.30
0	0.85	0.75	0.85	0.75	0.80	0.75	0.75	0.70	0.70	0.80
Koreksi	-0.88	-0.78	-0.88	-0.78	-0.83	-0.78	-0.78	-0.73	-0.73	-0.83
50	49.15	49.20	49.25	49.25	49.30	49.25	49.90	49.55	49.30	49.20
Koreksi	0.92	0.87	0.82	0.82	0.77	0.82	0.17	0.52	0.77	0.87
100	99.25	99.15	99.20	99.20	99.20	99.20	98.95	83.40	99.45	98.45
Koreksi	0.85	0.95	0.90	0.90	0.90	0.90	1.15	16.70	0.65	1.65
150	150.40	150.40	150.30	150.35	150.35	150.30	150.10	150.20	150.70	149.90
Koreksi	-0.30	-0.30	-0.20	-0.25	-0.25	-0.20	0.00	-0.10	-0.60	0.20
Ketidakpastian (Uncertainty), U_{95} (°C)										± 0.12

Catatan / notes :

- TK = Titik Kalibrasi / CP = Calibration Point
- Penunjukan nilai sebenarnya ditentukan dari pembacaan instrumen ditambah dengan koreksinya. (The true value is determined from the instrument reading added by it's correction).
- Ketidakpastian kalibrasi ini merupakan ketidakpastian bentangan yang diperoleh dari sumber-sumber kesalahan tipe A dan tipe B sesuai EA-4/02 M: 2022, "Evaluation of the Uncertainty of Measurement in calibration" yang dinyatakan pada tingkat kepercayaan 95% dengan faktor cakupan $k = 2$. (This calibration uncertainty is the spread uncertainty obtained from sources of type A and type B errors according to EA-4/02 M: 2022, "Evaluation of the Uncertainty of Measurement in calibration" which is expressed at a 95% confidence level with a factor of coverage $k = 2$).

=====Akhir dari Sertifikat / End of Certificate=====

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Lampiran 2. Program mikrokontroler arduino

```

#include <Wire.h>
#include <LiquidCrystal_I2C.h>
#include <Adafruit_MAX31865.h>
#include <PID_v1.h>

// Inisialisasi LCD I2C
LiquidCrystal_I2C lcd(0x27, 16, 2);

// Inisialisasi MAX31865 (PT100)
#define MAX31865_CS 22
#define MAX31865_MOSI 24
#define MAX31865_MISO 26
#define MAX31865_CLK 28

Adafruit_MAX31865 max = Adafruit_MAX31865(MAX31865_CS, MAX31865_MOSI,
MAX31865_MISO, MAX31865_CLK);

// Konfigurasi MAX31865
#define RREF 430.0 // Referensi resistor (ohm)
#define RNOMINAL 100.0 // Resistansi nominal PT100

// Pin untuk tombol
const int button1 = 6;
const int button2 = 7;
const int button3 = 8;

// Pin untuk dimmer
const int dimmerPin = 5;

// Pin Zero Crossing
const int zeroCrossPin = 2; // Pin input zero crossing

// Variabel setpoint suhu
double setpoint = 35.0;

// Variabel PID
double input, output;
const double Kp = 3.5, Ki = 0.0, Kd = 0.0;
PID myPID(&input, &output, &setpoint, Kp, Ki, Kd, DIRECT);

// Variabel untuk zero-crossing
volatile bool zeroCrossDetected = false;
unsigned long lastZeroCrossTime = 0;

```

```

// Fungsi untuk deteksi zero-crossing
void zeroCrossInterrupt() {
    zeroCrossDetected = true;
}

// Fungsi setup
void setup() {
    // Inisialisasi LCD
    lcd.begin();
    lcd.backlight();
    lcd.setCursor(0, 0);
    lcd.print("Sistem PID");
    // Inisialisasi MAX31865
    max.begin(MAX31865_3WIRE);
    // Inisialisasi tombol
    pinMode(button1, INPUT_PULLUP);
    pinMode(button2, INPUT_PULLUP);
    pinMode(button3, INPUT_PULLUP);
    // Inisialisasi dimmer
    pinMode(dimmerPin, OUTPUT);
    // Inisialisasi pin Zero Crossing
    pinMode(zeroCrossPin, INPUT);
    attachInterrupt(digitalPinToInterrupt(zeroCrossPin), zeroCrossInterrupt, FALLING); //
    Menunggu tepi jatuh
    // Inisialisasi PID
    myPID.SetMode(AUTOMATIC);
    myPID.SetOutputLimits(0, 180); // Sesuai dengan nilai PWM (0-255)
}

// Fungsi loop utama
void loop() {
    // Membaca tombol
    if (digitalRead(button1) == LOW) {
        setpoint = 35.0;
    } else if (digitalRead(button2) == LOW) {

```

```

    setpoint = 37.0;
} else if (digitalRead(button3) == LOW) {
    setpoint = 41.0;
}
// Membaca suhu dari MAX31865
input = max.temperature(RNOMINAL, RREF);
// Update PID
myPID.Compute();
// Jika zero-crossing terdeteksi, atur output dimmer
if (zeroCrossDetected) {
    zeroCrossDetected = false; // Reset deteksi zero-crossing
    // Kendalikan dimmer dengan output PID (PWM)
    analogWrite(dimmerPin, (int)output);
}
// Tampilkan data pada LCD
lcd.setCursor(0, 0);
lcd.print(" SV: ");
lcd.print(setpoint);
lcd.print("C ");
lcd.setCursor(0, 1);
lcd.print(" PV: ");
lcd.print(input);
lcd.print("C ");
delay(2500);
}

```


Lampiran 3. Surat Keterangan SKCP

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SURAT KETERANGAN

668/SKCP/PERPUS-ITI/2025

Yang bertanda tangan di bawah ini menerangkan bahwa:

Nama Pemohon : **Sammy Jonathan**
Status Pemohon : **Mahasiswa**
Nomor Identitas : **3671082009670001**

Telah menyerahkan dokumen uji plagiasi dengan judul sebagai berikut:

Rancang Bangun Alat Kalibrasi Termometer Inframerah Blackbody Berbasis Mikrokontroler

Hasil pengecekan uji kemiripan dokumen diatas adalah sebesar **28 %**.

Demikian kami sampaikan untuk dapat dipergunakan sebagaimana mestinya.

Tangerang Selatan, 09 Februari 2025
Staf Perpustakaan,

(Dwima Trisna Wulandari, S.IP)